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Scientific Advisory Committee (SAC)

Sixteenth Session

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Report of the SCSA Working Group on Stock Assessment of Demersal species (WGSAD)

Bar, Montenegro, 28 January – 1 February 2014

DRAFT BEFORE PARTICIPANTS'COMMENTS

OPENING OF THE WORKING GROUPS ON STOCK ASSESSMENT (WGSAs)

1. The meetings of the SCSA Working Groups on Stock Assessment of Demersal (WGSAD) and Small Pelagic Species (WGSASP) were held in Bar, Montenegro from 28 January to 1 February 2014. The first day was dedicated to a joint Workshop on the definition and estimation of reference points for Mediterranean and Black Sea fisheries.

2. Ms. Pilar Hernandez and Mr. Miguel Bernal, GFCM Secretariat, welcomed participants. They thanked the Ministry of Agriculture and Rural Development of Montenegro, together with the Institute of Marine Biology of Kotor, for their warm welcome and for the hosting and organization of the meetings. They then provided background information to the WGSAs and explained the new structure of the Stock Assessment forms, informing on how to upload them online and inviting participants to use SharePoint for this purpose.

WORKSHOP ON THE DEFINITION AND ESTIMATION OF REFERENCE POINTS FOR MEDITERRANEAN AND BLACK SEA FISHERIES (joint session for the two WGSAS)

3. Mr. Miguel Bernal opened the Workshop on the definition and estimation of reference points for Mediterranean and Black Sea fisheries and gave the floor for three presentations, as follows:

- Reference points and advice in the SAC and in other relevant organizations *(Miguel Bernal*)

An introductory presentation describing the current framework of reference points in use in the GFCM and comparisons with other frameworks was delivered. Mr Bernal highlighted that reference points are crucial elements for the provision of advice for fisheries management, and that their role was defined in the GFCM Guidelines for management plans, approved at the 36th session of the Commission. He pointed out however, that some inconsistencies in the definition of reference points regularly used in the GFCM existed, and that there was room for harmonization on how the Working Groups provided advice to the SAC. He also introduced some the approaches being used by the EU

and UNEP on the definition of Good Environmental Status by highlighting that indicators based on the status of stocks were the most developed. He stressed the importance to increase the number of stocks assessed in the Mediterranean and Black Sea, and therefore to extend the assessment methods to fisheries for which information is limited.

4. Participants agreed on the relevance of reference points and the need to better define and harmonize their use in the different stocks, as well as the importance to try to incorporate biological and ecological considerations on the definition and estimation of reference points. Also, the importance of incorporating appropriate Stock-Recruitment relationships (when apparent from the information on specific stocks) and incorporate uncertainty into the reference point framework was stressed.

- Review of reference points for demersal stocks in the Mediterranean and Black Sea (*Francesco Colloca*)

An overview of the demersal stocks assessed by GFCM and STECF since 2007 and the reference points more commonly used to produce an advice on the status of the stocks. Mr Colloca highlighted that under the UN Fish Stock Agreement, F_{msy} should be the Limit Reference point. He also underlined the great variability observed on the values obtained for F0.1 in the different GSAs and pointed out to the different values of biological parameters used as the possible cause and ask for an effort to standardized these values. The need i) to find ways to assess also data poor stocks (e.g. catch-MSY model, by Martell and Froese, 2013), to have reference levels based on biomass and ii) to define priority lists of stocks to be assessed in the next years was stressed.

5. Some participants suggested that stock units' identification, migration rates and stock boundaries should be among priorities for the SAC. The group was informed that StockMed Project was trying to address this issue in the Mediterranean using different sources of standardised information.

6. The use of catch or landings as well as the different ways of calculating biological parameters were pinpointed as possible causes of the observed differences in estimated reference points for neighbor stocks of the same species, and a general request to standardize the estimators and to improve documentation of the basic information used in the analysis was highlighted.

- Review of reference points for small pelagics in the Mediterranean and Black Sea *(Piera Carpi)*

The presentation reviewed the management strategies developed for small pelagics stocks worldwide, e.g. empirical reference points, reference points from stock assessment and reference points based on the potential biological removal principles. The more common reference points used inside the ICES framework and in the Mediterranean and Black sea were presented.

7. Some doubts were expressed about the applicability of approaches designed in upwelling ecosystems to the estuarine-type (input runoff) ecosystems predominant in the Mediterranean and the Black Sea, and participants agreed on the need to use approaches suitable for non-upwelling ecosystems. Also, participants agreed that for the Mediterranean, the use of simulations (e.g. as in some of the approaches done at ICES), could be a complimentary option to the exclusively use of analytical models or empirical analysis to estimate reference points.

8. Participants stressed the need to account for the biological characteristics of small pelagic fisheries that fluctuate not only due to the fishing activity but also on the base of natural causes. In this regard, the analysis of time series was considered crucial to understand the dynamics of small pelagics in the ecosystem, and management should take into consideration that different phases (e.g. regime shifts) that show different productivity are common for these species.

9. The general conclusions and recommendations of the Workshop on the definition and estimation of reference points for Mediterranean and Black Sea as agreed among the two WGSAs are included in Appendix D.

OPENING AND ARRANGEMENTS OF THE WORKING GROUP ON STOCK ASSESSMENT OF SMALL PELAGIC SPECIES

10. The meeting of the SCSA Working Group on Demersal species (WGSAD) was held in Bar, Montenegro, from 29 of January to 1 February 2014. It was attended by 21 participants from nine GFCM Member Countries, FAO Regional Projects as well as representatives of the GFCM Secretariat (see list of participants in Appendix B).

11. Ms Pilar Hernández welcomed participants and thanked them for attending and providing contributions to this meeting.

12. She introduced the new format of the Stock assessment forms according to recommendations of the previous year and encouraged participants to use SharePoint for uploading the three components of the new Stock assessment forms, stressing the importance of providing the requested metadata for the elaboration of the SharePoint libraries that will conform databases with the assessments of each year.

13. The agenda was adopted with minor amendments and is included as Appendix A.

14. Ms Beatriz Guijarro was unanimously elected as Coordinator of the WGSAD among participants. Ms Angélique Jadaud and Mr Tristan Rouyer were elected as rapporteurs for the fish species sessions, while Ms Isabella Bitteto and Mr J. Luis Pérez were designated rapporteurs for the crustaceans sessions supported by Ms Pilar Hernández.

15. Ms Pilar Hernández introduced the main conclusions and recommendations from the previous year with the aim to review the progress done in their regard by national experts and by the GFCM Secretariat. Some advances were welcomed by participants, such as the modifications on the stock assessment forms and the online SharePoint platform as well as the considerations by most of participants of the agreed reference points.

OVERVIEW OF ASSESSMENT PERFORMED AND STOCK STATUS

16. Overall, 26 assessments were presented of which 18 referred to stocks of six fish species and eight to stocks of three crustacean species. Of the 18 assessments on fish stocks, six referred to *Merluccius merluccius*, six to *Mullus barbatus*, three to *Mullus surmuletus* and three to one stock of the following species *Solea solea, Spicara smaris* and *Saurida undosquamis*, one alien species of Egypt. From the eight assessments on crustacean six stocks referred to *Parapenaeus longirostris*, one to *Aristaeus antennatus* and one to *Nephrops norvegicus*.

17. With respect to assessments by GFCM geographical sub-area, 22 assessments were confined within one subarea (1 assessment referred to GSA01, 2 to GSA03, 5 to GSA 05, 2 to GSA06, 2 to GSA07, 1 to GSA10, 2 to GSA17, 2 to GSA18, 2 to GSA19, 1 to GSA25 and 2 to GSA26 and 4 assessments spanned more than one GSA (2 for GSAs 11-16 and 2 for GSAs 15-16).

18. Regarding methodologies, different models were used for the assessments (i.e. VPA, LCA, XSA, Y/R, production models, SS3, and predictive models) in relation to the different characteristics of the stocks assessed and the availability of data.

19. All the assessments were carried out by participants before the WGSAD meeting. 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 were thoroughly revised. Only for one of the assessments (M. merluccius in GSA03) new analysis were performed during the WGSAD. 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 E.

20. Overall, 21 stocks were validated by the group as in overfishing status, three were validated as fully exploited and two were considered as qualitative assessments, and for those no final advice was 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: 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., Sabatini L., Franceschini G., Mion M., Piras C., Fortibuoni T., Vrgoc N., Isajlovic I., Despalatovic M., Cvitković N., Pengal P. and Marceta B.

Fishery: The Italian fleets exploit common sole with *rapido* trawl and set 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% of catches come from the Italian side. Landings fluctuated between 1,000 and 2,300 t in the period 1996-2012 (data source: FAO-FishStat and 2013 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 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) 1970-2005 database and in the framework of Italian and Slovenian Official Data Collection submitted in the data call 2013, 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 *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, and Statistical Catch at Age (SCAA) using SS3 assessments 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. Considering the longer data series employed and the possibility to model the selectivity of fleets and survey, has been decided that the SCAA using SS3 provides more accurate results on the status of the stock, thus such analysis have been used to draft the scientific advices. Moreover, due to the different approach used to estimate the fishing mortality it was decided to use the 2012 value of F, instead of the mean of the last 3 years (0.94)

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

Results:

$F_{current}$ (2012, ages 0-4)	0.93
$F_{0.1}$ (estimated in 2012)	0.31
Biomass current (tons)	4570
Biomass (33^{rd}, tons)	8926
Biomass (66^{th}, tons)	21536
Current Recruitment (Thousands)	44,255
$F_{current}/F_{0.1}$	3

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 (2012) estimated with SCAA model equal to 0.93 (SCAA) and higher than the proposed reference point ($F_{0.1SCAA}$ = 0.31 as a proxy of F_{MSY}).

Advices and recommendation: A reduction fishing mortality is advised towards the proposed reference point FMSY. Considering the overexploited situation and the low values of SSB and biomass of the sole stock in GSA 17 a reduction of fishing effort and an improvement in exploitation pattern is advisable, especially of Italian rapido trawlers and gillnetters, which mainly exploit juveniles. The best option to reduce effort and improve the exploitation pattern for sole in GSA 17, would be to introduce a closure for rapido trawling within 17 km (9 nm) of the Italian coast during the summer-fall period (June- December) as observed in the spatial simulation presented in the stock assessment form. Moreover, it was noted that in the last years some Italian artisanal fleets fish with gill net in the main spawning area during periods when trawling is prohibited. Additional measures to restrict exploitation of sole in the spawning area are desirable, to afford further protection to the Adriatic sole stock.

Discussion: The group considered the use of the SS3 method as a good initiative. The WG appreciated the comparison between the two models provided, as requested by last year's WG.

2. Stock: European hake, *Merluccius merluccius*

GSA: 01

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

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 2009-2012).
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 a stabilization in catches (around 300 tons) during the period 2005-2008. Catches increase from 2009 to 2011 reaching 614 tons (the highest in the series) and decreasing to 418 tons in 2012.

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 2003-2012 and performed from 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. Length-weight relationship and maturity ogive comes from Spanish DCF and the vector of natural mortality by age was calculated from Caddy´s formula, using the PROBIOM Excel spreadsheet (Abella et al., 1997).

Assessment method: VPA tunned 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: Sensitivity and retrospective analyses were applied in the XSA model in order to check the robustness of the assessment. Results showed no particular retrospective bias in spawning biomass (SSB), fishing mortality (F) or recruitment (R).

Results: The results show a decreasing trend in the two 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.

$F_{current}$ (mean 6 last years, ages 2-4)	1.64
F 33rd percentile (ages 1-3)	1.3
F 66th percentile (ages 1-3)	1.6
$F_{0.1}$	0.22
$F_{current}/F_{0.1}$	7.4
$B_{current}$ (mean 6 last years)	1090 (t)
B 33rd percentile	890 (t)
B 66th percentile	1226(t)

Diagnosis of stock status:

- High overfishing ($F_{current}/F_{0.1}$ =7.4)
- Relative intermediate biomass ; $B_{current}$ = 1090(t), Biomass at 33rd percentile = 890(t)

Advices and recommendation: A reduction of the current fishing mortality is recommended by reducing the fishing effort and improving the selection pattern of the fishery

Discussion: It was suggested that comparison of current biomass and historical trends coming from the model could be compared with trends on biomass from survey.

3. Stock: European hake, *Merluccius merluccius*

GSA: 03

Author(s): Benchoucha S. & El Ouamari N.

Fishery: European hake**,** *Merluccius merluccius* is one of the most important demersal target species of the commercial fisheries in the GSA 03. In this area, the white hake is exploited mainly by the coastal trawlers. Around 115 boats are involved in this fishery. According to the Moroccan national official statistics (MAIA system), total annual landings for the period 2003-2012 oscillated between 132 and 547 tons. The effort targeting european hake oscillated between 7200 and 11100 fishing days and the CPUE ranged from 14,5 and 75 kg/fishing day. The number of these trawlers operating in the GSA 03 oscillated for the last five years between 110 and 115. Most fleets are based in Nador, Al Hoceima and M'diq ports respectively. The mean power of the trawlers ranged from 200 to 357 depending the port. The mean GT ranged from 28 to 55 and the mean length from 16 to 20 meters. 73% of the trawlers are based in Nador port, 25% in Al Hoceima port and 17% only are linked to the M'diq port. The trawlers of Nador and Al Hoceima have the biggest power, GT and length. The landing sampling length frequencies are available for 2007 and 2008. From 2009 to 2012, the length sizes composition is based on the sampling on board the research boat "Charif Al Idrissi" during the Moroccan surveys. The length composition ranged between 2007 and 2012 from 7 to 66 cm total length. The trawlers fisher is multispecific and exploits a highly diversified species: the deep water pink shrimp (*Parapenaeus longirostris*), the common octopus (*Octopus vulgaris*), the axillary sea-bream (*Pagellus acarne*), the bogue (*Boops boops*), the red mullet (*Mullus barbatus*), the striped mullet (*Mullus surmuletus*), the European conger (*Conger conger*) and others fishes, Crustaceans and Cephalopods species.

Data and parameters: The information used for the assessment of the European hake stock consisted of annual size composition of catches and surveys (estimated from monthly sampling in the main landing ports and from the INRH surveys), official Moroccan landings, growth parameters estimated by (Mellou et al, 2009) and L-W relationship, sex-ratio and maturity ogive estimated by IFREMER for the DCF. The vector of natural mortality by age (used for the software VIT) was calculated from Caddy´s formula, using the PROBIOM Excel spreadsheet (Abella et al., 1997). For the Pedro LCA and Yield per Recruit Model, 2 values of M were used: 0.2 and 0.5. The official catches, Commercial CPUE and the surveys abundance indexes were used for running the production model. For this model, the value of the CPUE for 2006 were reestimated by the average of 2005 and 2007 values since this value seems to be an error due to the statistic data collection system.

Assessment method: For the period of the study (2003-2012), 4 models were applied for the assessment of the status of the white hake stock. The 4 methodologies applied were VPA and Yield per Recruit using the software VIT, the LCA and Yield per recruit using Pedro De Baros Excel sheet, the Yield per Recruit using the Hajo excel sheet and the Production Model

using Pedro De Baros Excel sheet. For the 4 models, an assessment and an analysis were performed and the results were discussed.

Results:

	VIT-2007	VIT-2008	ExcelSheet-2007	ExcelSheet-2008	Production Model 2003-2012
$F_{0.1}$	0.427	0.334	0.209	0.20	
F_{curr}	1.96	1.67	1.9	1.67	
F_{max}	0.56	0.47	0.323	0.33	
$F_{curr}/F_{0.1}$	4.59	5	9.09	8.35	95%
$B_{curr}/B_{0.1}$					136%

	LCA Y/R M=0.2 2007-2012	LCA Y/R M=0.5 2007-2012	LCA Y/R M Vector
$F_{0.1}$	0.111	0.246	0.121
F_{curr}	0.926	0.724	0.806
F_{max}	0.120	0.391	0.339
$F_{curr}/F_{0.1}$	8.33	2.94	6.67
$B_{curr}/B_{0.1}$			

Advices and recommendation: No management advice could be derived from the results. The assessment was not endorsed.

Discussion: The original models (VPA in an Excel sheet and production model) presented showed some problems: the VPA joined information from the fleet and from the survey, M was used as a scalar not as a vector and the production model was done using a short data series, without clear contrasts reflecting substantial changes in fishing effort, as recommended last year. For all these reasons, the assessment could not be endorsed as it was. The assessment was re-run using VIT for the 2 years in which commercial data was available (2007-2008), but the results were not used for providing management advice as they were considered too old. A trial comparing trends from commercial CPUEs and survey data was carried out, trying to produce qualitative assessment, but there was not a clear correspondence between both series of data. It was recommended to use SURBA in the following years, although the lack of information for some years would imply big assumptions. The collection of data of size composition from catches will allow to perform an analysis of recent years. The assessment was considered qualitative and could not be endorsed.

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

GSA: 05

Author(s): Guijarro B., 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 *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 tons 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 (1980-2012), CPUE data from bottom trawl surveys (2001-2012) and from commercial fleet (2000-2012). Growth parameters from Mellon-Duval *et al*. (2010), maturity ogive from from Spanish National Data Collection Programme, M vector from PRODBIOM.

Assessment method: Extended Survivor Analysis (XSA), Yield per recruit analysis and short-term forecast.

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.

$F_{current}$ (mean 2010-2012, ages 0-2)	1.52
$F_{0.1}$	0.18
$F_{current}/F_{0.1}$	8.44
Current survey biomass index (kg/km^2)	28.4
33th percentile survey biomass index (kg/km^2)	19.6
66th percentile survey biomass index (kg/km^2)	24.9

Diagnosis of stock status: The stock is in high overfishing status with relative high biomass.

Advices and recommendation: To reduce fishing mortality

Discussion: Although an updated of growth parameters is recommended after certain years, the growth parameters used here are the most reliabale considering that otholiths reading for this species has stopped in Spain, following an agreement in the ICES area, due to the problems in otolith reading. The same applies to GSA1 and GSA 7. This was considered an issue to be taken into consideration.

5. Stock: European hake, *Merluccius merluccius*

GSA: 07

Author(s): Jadaud A., Guijarro B., Rouyer T., 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 240 boats are involved in this fishery and, according to official statistics; the total annual landings for the period 1998-2012 have oscillated around an average value of 2030 tons (1123 tons in 2012). The French trawler fleet is the largest in number of boats and catch (42 and 72%, respectively). The length of hake in the trawler catches ranges between 3 and 92 cm total length (TL), with an average size of 21 cm TL. The second largest fleet is the French gillnetters (~41 and 14% respectively, range 13-86 cm TL and average size 39 cm TL), followed by the Spanish trawlers (~11 and 8%, respectively, range 5-88 cm TL, and average size 24 cm TL), and the Spanish long-liners (~6 and 6%, respectively, range 22-96 cm TL and average size 52 cm TL).
In 2009, because of the large decline of small pelagic fish species in the area, the trawlers fishing small pelagic have diverted their effort on demersal species.
Since the beginning of the assessment period (1998), the number of French trawlers in GSA 07 has decreased by around 40%, and by 20% since 2010 due to management measures based on the destruction of boats in 2011, 2012. This measure has been maintained in 2013. The other management measure taken is a temporary closure of 1 month by year for the french trawlers in 2011, 2012, during the periods of higher recruitement (end of winter, beginning of spring).
The hake trawlers exploit 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 assessment of the stock 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 in the GSA 7 (2003-2010) by IFREMER for the DCF. These parameters were length-weight relationship, sex-ratio and maturity ogive and were computed using inbio (R scripts developed by IEO). The growth parameters come 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 (1998-2012), 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 2012, the reference point $F_{0.1}$ was not re-estimated since 2011, because of no rationale for that. The reference point of 2011, was estimated using the yield per recruit (Y/R) analysis.

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

Results:

$F_{current}$ (mean last 3 years, ages 0-3)	1.83
$F_{0.1}$ (estimated in 2011)	0.15
Biomass current (tons)	3133
Biomass (33th, tons)	3874
Biomass (66th, tons)	5173
Current Recruitment (Thousands)	27757
$F_{current}/F_{0.1}$	12.2

Diagnosis of stock status: The stock is in a high overfishing status with a relative low abundance with periodically higher recruitments (1998, 2001-2002 and 2007) which ensured the sustainability of the stock at the lower level of abundance of the series. Since 2007, the recruitment has reached the lowest level of the historical series 1998-2012.

Advices and recommendation:

- Improve the fishing pattern of the trawlers so that the minimum length of catches is consistent with the minimum legal landing size
- reduce the effort of trawlers, longliners and gillnetters.
- Freezing of the effort in the Fishery Restricted Area

It is important to notice that some management measures have been taken since 2011 (reduction from 2010 to 2012 by 20% of the number of trawlers). This measure was enforced in 2013. Also, temporary closures for the trawlers (1 month per year) are enforced since 2011.

Discussion: $F_{0.1}$ used came from last year's assessment. This issue was further discussed during the WG (see CONCLUSIONS AND RECOMMENDATIONS).

6. Stock: European hake, *Merluccius merluccius*

GSA: 12-13-14-15-16

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

Fishery: Hake, *Merluccius merluccius*, is one of the most important demersal target species of the commercial fisheries in the south-central Mediterranean Sea (GFCM-GSAs12-16). 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 2010-2012 is about 2000 tones. Trawlers targeting hake 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 frequency distribution of hake catches range between 8 and 66 cm total length (TL), with an average size of 20 cm TL.

Data and parameters:

- The information used for the assessment of the stock were: i) annual size composition of catches (estimated from monthly or quarterly sampling in the main landing ports), and total catch official landings from Tunisia, Italy and Malta; and ii) biological parameters (sex combined) estimated by experts from Tunisia, Italy and Malta such as: $L\infty = 100.0$, $k = 0.116$, $t0 = -0.6$, $a = 0.004$, $b = 3.15$. The natural mortality was estimated by Prodbiom (Abella et al., 1998).
- General comment - The definition of the most appropriate growth parameters for this species is still a matter of active debate (Bouhlal, 1975; Aldebert 1981; Aldebert and Carries, 1988; Relini Orsi 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).

Assessment method: The assessment was performed using length cohort analysis (LCA) and Yield per Recruit as implemented in VIT4Win (Lleonart and Salat 1992, 1997) and ANALEN. Current mean F and exploitation pattern were assessed using the steady state LCA by length on LFD of 2010, 2011 and 2012 and by mean data 2010-2012. In the following table the result obtained in the latest year of the time series (2012) as agreed by the WG to describe the status of the stock.

Results:

Current Y/R	21.4
$Y/R_{0.1}$	48.5
Fcurrent	0.65
$F_{0.1}$	0.16
Current B/R	28.9
Maximum B/R	326.3
$B/R_{0.1}$	444.6
$F_{curr}/F_{0.1}$	4.06

Diagnosis of stock status: Current values of F showed a progressive increase in the study period (2010-2012). The results of the assessment revealed an high (growth) overfishing status and low abundance of the stock.

Advices and recommendation: Considering the estimated values of F, to reach $F_{0.1}$ the current level of fishing mortality should be reduced by about 70%.
According to the stock assessment performed, the fisheries is essentially oriented to juveniles, resulting in growth overfishing An improvement of the fishing pattern of trawlers would result in an reduction of pressure on juveniles, increase of minimum length of catch and reduction of growth overfishing. Reduce the impact of trawlers targeting especially the juvenile fraction of the stock, by reducing time at sea, number of fishing boats, engine power could improve the stock status. Also, it is not excluded that the stock is shared with fisheries from adjacent subareas so it is recommended to proceed to joint assessment integrating data from adjacent GSAs.

Discussion: LCA has been run by year, for the last three years and for a mean of them three, showing similar results. The WG agreed to consider the results of the last year (2012) as reference for advice.

7. Stock: European hake, *Merluccius merluccius*

GSA: 18

Author(s): Bitetto I., Carbonara P., Casciaro L., Ceriola L., Đurovič M., Facchini M. T., Hoxha A., Ikica Z., Joksimovič A., Kolitari J., Kroqi G., Lembo G., Markovič O., Milone N., M. T. Spedicato

Fishery: *Merluccius merluccius* is one of the most important species in the Geographical Sub Area 18 representing more than 20% of landings from trawlers.
In this area, hake is exploited by trawlers, especially of demersal métier, from Italy, Albania and Montenegro. Italian longliners also exploit this stock. Around 700 boats are potentially involved in this fishery. Total annual landings obtained by DCF for Italy and by National Statistics for Albania and Montenegro for the years 2007-2012 are in the range 4639 (2008) to 3406 (2012), which is the lower value in the time series. The fishing effort in terms of nominal effort (kW*days) (DCF data for Italy) is decreasing. The bulk of the catches is from age 0 and 1 in each year of the time series with average numbers of 31879 and 26877 individuals (in thousands) respectively.
Fishing grounds are located on the soft bottoms of continental shelves and the upper part of continental slope along the coasts of the whole GSA. Catches from trawlers are from a depth range between 50-60 and 500 m and hake occurs with other important commercial species as *Illex coindetii, M. barbatus, P. longirostris, Eledone spp., Todaropsis eblanae, Lophius spp., Pagellus spp., P. blennoides, N. norvegicus*

Data and parameters: The information used for the assessment of the stock consisted of annual size composition of catches (estimated from quarterly sampling in the main landing ports), official landings, and biological parameters estimated from data collected in the GSA18 (2007-2012) by COISPA for the DCF. These parameters were: number of individuals per length class, growth parameters and number of individuals by age class, L-W relationship, sex-ratio and maturity ogive. These metrics were estimated and computed using different IT systems: FAO tools, R scripts and the software ISYCAMPBIOL (developed by COISPA). The growth parameters used in the assessment come from length frequency distribution analysis. 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 (2007-2012), the methodology applied was a tuned VPA, applying the XSA method considering as tuning fleet MEDITS campaign indices of the GSA. The software used was FLR. The FLR script for estimating reference points was also used. Simulation analysis to predict the effects of possible management options were accomplished using ALADYM model that was parameterized using the outputs from XSA as regards mortality and recruitment, while growth, natural mortality, length weight relationships were the same inputs as XSA. Fishing mortality was shaped by selectivity models. Three scenarios were simulated: one with a gradual decrease of the fishing mortality to reach $F_{0.1}$ in 2020, a second scenario with the increase of mesh size to 60 mm in 2014 and a third one with a fishing ban of one month for all the fleets (additional for the Italy trawlers).

Model performance: The residuals and retrospective analysis did not show any trend and the results obtained by XSA were consistent, in terms of pattern, with those from MEDITS as regards recruits and biomass. In ALADYM the fitting of the observed vs. simulated catches

was satisfactory, with average differences around 3%. Model outputs evidenced improvement in productivity and increase in mean length of captured individuals for the mesh increase scenario under the assumption of total survival of the individuals escaped by the net.

Results: High level of overfishing ($Fc/F_{0.1}$=5.56 (XSA)) and high abundance according to the trawl survey (MEDITS) time series.

Fcurrent	1
$F_{0.1}$	0.18
Biomass MEDITS	28.2 kg/km^2
Biomass 33rd percentile MEDITS	20.4
Biomass 66th percentile MEDITS	33

Diagnosis of stock status: Stock is in overfishing status and intermediate biomass (estimates on the MEDITS time series). The stock is characterized by fluctuations of recruitment and abundance, which contribute to sustain the catches.
The stock is in overfishing as current fishing mortality exceed the $F_{0.1}$ levels (1 vr. 0.18) and thus it is necessary to consider a considerable reduction of the fishing mortality to allow the achievement of $F_{0.1}$.

Advices and recommendation: Objectives of a more sustainable harvest strategy could be achieved with a multiannual plan that foresees a reduction of fishing mortality through fishing limitations. As observed in 2012, the production of hake in GSA 18 is split in 17% caught by Italian longlines, 74% by Italian trawlers, about 1% by Montenegrin trawlers and about 8% by Albania trawlers.

Discussion: No stock recruitment relationship was used to perform the forecasts in ALADyM, but instead a constant recruitment from the past 3 years. It was suggested to bootstrap the recruitment instead of using a constant value to provide an idea of the uncertainty in the data. The retrospective analysis indicates some trends in parameters, and therefore the XSA results may not be very robust, probably to the short time series available.

8. Stock: red mullet, *Mullus barbatus*

GSA: 05

Author(s): Beatriz Guijarro, Vanessa Rubio, Francesc Ordines and Antoni Quetglas

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 red mullet (*Mullus barbatus*) is a

by-catch species in the shelf and deep shelf, with annual landings oscillating between 10 and 30 tons during the last years.

Data and parameters: Size composition of commercial trawl catches and official landings (2000-2012) and CPUE data from bottom trawl surveys (2001-2012). Growth parameters agreed during SGMED-08-03 and length-weight relationship and maturity ogive from from Spanish National Data Collection Programme, M vector from PRODBIOM.

Assessment method: Extended Survivor Analysis (XSA), Yield per recruit analysis and short-term forecast.

Model performance: XSA residuals did not show any trend.

Results: Stock abundance, stock biomass, recruitment and spawning stock biomass did not show any clear trend, with some oscillations along the data series.

$F_{current}$ (mean 2010-2012, ages 1-2)	0.93
$F_{0.1}$	0.14
$F_{current}/F_{0.1}$	6.64
Current survey biomass index (kg/km^2)	5.4
33th percentile survey biomass index (kg/km^2)	15.1
66th percentile survey biomass index (kg/km^2)	20.2

Diagnosis of stock status: The stock is in high overfishing status with relative low biomass.

Advices and recommendation: To reduce fishing mortality

Discussion: No particular discussion on this stock.

9. Stock: Red mullet, *Mullus barbatus*

GSA: 06

Author(s): Fernández, A. M; A. Esteban, A & Pérez Gil, J. L.

Fishery: Both species of red mullet, *Mullus surmuletus* and *M. barbatus*, are exploited by trawl and artisanal fleets in GSA 06, although small gears (trammel nets and gillnets) account only for 5% of the total landings of these species (Demestre et al., 1997). Trawl fisheries developed along the continental shelf and upper slope are multi-specific. Small vessels (12-16m length) operate mainly on the shallow shelf targeting on red mullets, octopus, cuttlefish and sea breams. Medium and large vessels usually operates on deep continental shelf and slope areas targeting on hake and crustaceans, but some of these units can also operate on the shallow shelf depending on weather conditions or market prices. Red mullet is more intensively exploited from September to November coinciding with the recruitment period of this species (Martín et al., 1999). The total trawl fleet in the GSA 06 has declined from 810 boats in 1998 to 478 boats in 2012; around 30% of these boats regularly operate in sallow shelf.
According to official statistics, the fishery developed quickly during the seventies reaching a maximum of 1984 tons in the year 1984. Since then landings have widely oscillated around a

mean value of 1134 tons (1995-2012) although a decreasing trend is observed. Catches in the period 1995-2010 were composed mainly by individuals of age groups 0 and 1. After the enforcement of the new mesh type in 2010 (40mm square or alternatively 50mm diamond) catches in 2011 and 2012 are composed mainly by individuals of age groups 1 and 2.

Data and parameters: The information used for the assessment are the total annual landings from official statistics, the annual catch in number by size class estimated by monthly port sampling and on board observers and the abundance index from commercial fleet and MEDITS surveys. Growth parameters are those used in previous assessments by STECF and GFCM for GSA 06 (Demestre et al, 1997). Length-weight relationship and maturity ogive comes from Spanish DCF and the vector of natural mortality by age was calculated from Caddy´s formula, using the PROBIOM Excel spreadsheet (Abella et al., 1997). Selectivity experiences carried out by the IEO with 40 mm diamond and square mesh in the cod-end were also used.

Assessment method: Tuned VPA applying the XSA method (Darby & Flatman, 1994) and Yield per recruit (YPR software, NOOA Fisheries Tools) for the estimation of reference points.

Model performance: Log catchability residuals and Retrospective analysis suggest that the model is consistent.

Results: Because of the change in fishing pattern the mean $F_{current}$ for ages 1-2 and the mean $B_{current}$ for the years 2011-2012 were retained as references to establish the diagnosis of stock status.

$F_{current}$ (mean last 2 years, ages 1-2)	0.90
$F_{0.1}$ (present assessment)	0.51
Bcurrent (mean last 2 years, tons)	3074
Biomass (33^{rd}, tons)	2918
Biomass (66^{th}, tons)	3165
$F_{current}/F_{0.1}$	1.76

Diagnosis of stock status:

- High overfishing ($F_{current}/F_{0.1}$ = 1.76)
- Relative intermediate biomass ($B_{current}$=3074; Biomass at 33^{rd} percentile = 2918)

Advices and recommendation:

- Reduce $F_{current}$ towards $F_{0.1}$
- Progressive reduction of the fishing effort

Discussion: It was very remarkable the effect of the application of the mesh size regulation with a clear change on the size structure of catches, with a practical absence of individuals of age 0 in the catches.

10. Stock: red mullet *Mullus barbatus*

GSA: 7

Author(s): Jadaud A., Guijarro B., Rouyer T., 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 for 2011, but although it is suspected that they have been fishing red mullet in the past, no data is available to quantify their catches. Between 2004 and 2012, around 100 boats have been involved in the fishery. According to official statistics, during this period the total annual landings have oscillated around an average value of 190 tons and the french trawlers have been dominating the fishery, as they represented 76% of the boats (103 boats) and 83% of the landings (158 tons). Between 2010 and 2012 the number of trawlers decreased by 20% and it decreased by 40% over the 2004-2012 period. This follows management measures to reduce the number of boats. A temporary closure of 1 month by year for the trawlers has been enforced since 2011. The mean modal lengths in the catches of the french and spanish trawlers were 13 and 15cm, respectively and the length at first capture is about 7 cm. Catch is mainly composed by individuals of age 0, 1 and 2, while the oldest age class (5+ group) is poorly represented. In GSA 7, 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: From 2004 until 2011, size compositions were converted from number at length to number at age by knife edge slicing (deriving the growth from DCF data), whereas in 2012 age-length key from otolith readings was used. This marks a change in the biological parameters used as it depicts a slower-growing stock compared to the previous years, for which growth parameters were borrowed from GSA 09 (Ligurian and North Tyrrhenian Sea). The length/weight parameters used came from the french National DCF programme and natural mortality was estimated using PROBIOM (Abella et al., 1997).

Assessment method: The assessment was carried out by means of Extended Survivor Analysis (XSA) over the period 2004-2012, and calibrated with indices from the scientific survey MEDITS, and yield-per-recruit (Y/R) for the period 2010-2012. These methods were applied using the FLR libraries in the statistical software R.

Model performance: No concern was raised about that issue.

Results:

$F_{current}$ (average last 3 years, ages 0-3)	0.56
$F_{0.1}$ (estimated in 2012)	0.14
Biomass current (tons) 2010-2012	734
Biomass (33^{rd} percentile, tons)	628
Biomass (66^{th}, percentile, tons)	664
Current Recruitment (Thousands) 2010-2012	17341
$F_{current}/F_{0.1}$	4

Diagnosis of stock status: The stock is in a high overfishing status with a relative high biomass and punctually higher recruitments (2005, 2006, 2007 and 2011). However, the fishing mortality is the lowest of the series and the spawning stock biomass currently follows an upward trend. The current biomass (2010-2012) is above the 66th percentile.

Advices and recommendation
Investigate potential changes in catchability.
Management advice and recommendations:

- Improve the fishing pattern of trawlers so that the minimum length of catches is consistent with the minimum legal landing size
- Reduce the effort of trawlers
- Freezing of the effort in the Fishery Restricted Area

It has to be noticed that management measures are currently enforced since 2011 to reduce the number of trawlers.

Discussion: Three trials with different growth parameters (fast, slow and slow with age-length key for the last year) were presented. The general conclusions of them three were the same, but the levels of biomass estimated using fast growth were half of those obtained with slow growth.

11. Stock: Red mullet, *Mullus barbatus*

GSA: 10

Author(s): Bitetto I., Carbonara P., Casciaro L., Facchini M. T., Lembo G. and Spedicato M. T.

Fishery: In the central-southern Tyrrhenian Sea (GSA 10) the main demersal resources on the continental shelf are European hake (*Merluccius merluccius*), red mullet (*Mullus barbatus*), pandora (particularly *Pagellus erythrinus*) and, among cephalopods, squids (e.g. *Todarodes sagittatus*, *IIlex coindetii*) and octopus (*Octopus vulgaris*). Red mullet is an important species in the area, targeted by trawlers and small scale fisheries using mainly gillnet and trammel nets. Fishing grounds are located along the coasts of the whole GSA within the continental shelves. During late summer-early autumn (September-October), the species is intensely fished. About three-four months after settlement, red mullet has spread up to depths of about 100 m.

Data and parameters: The commercial landing time series (2006-2012) and the LFDs by fleet segment from DCF has been used for the assessment. MEDITS trawl survey data from 1994 to 2012 have been used in the analysis. The biological parameters estimated within DFC for the area have been also used (growth parameters, length-weight relationship, sex ratio and maturity. The vector of natural mortality by age was calculated from Caddy´s formula, using the PROBIOM Excel spreadsheet (Abella et al., 1997).

Assessment method: Given that the time series covers the total number of age classes in landing (0 to 3+) at least one time was possible to make an attempt of assessment using XSA (Extended Survivors Analysis) on the times series 2006-2012.

Model performance: The log-catchability residuals and the retrospective analysis did not show any trend.

Results:

$F_{current}$	0.44
$F_{0.1}$	0.55
MEDITS biomass index 33rd percentile (kg/km^2)	22.5
MEDITS biomass index 66th percentile(kg/ km^2)	29
Current MEDITS biomass index (2012) (kg/ km^2)	29

Diagnosis of stock status: Given the results of the present analysis, the stock seems sustainably exploited, being exploited at level of F (0.44) lower than the reference point (0.55). The level of biomass is intermediate according to MEDITS survey data.

Advices and recommendation: It is recommended to not increase the relevant fleets' effort and/or catches to maintain fishing mortality in line with the agreed reference point. It is recommended to continue monitoring the stock next year.

Discussion: No particular discussion on this stock.

12. Stock: Red mullet, *Mullus barbatus*

GSA: 17

Authors: Scarcella G., Fabi G., Grati F., Polidori P., Bolognini L., Pellini G., Pengal P., Marceta B., Piccinetti C., Manfredi C., Giovanardi O., Raicevich S., Fortibuoni T., Isajlović I., Vrgoc N.

Fishery: In the Adriatic, red mullet is one of the main target species of the trawler fleets. The species is mainly fished by otter bottom trawl nets and smaller quantities are also caught with set nets and rapido trawl. Different management regulation are applied in Italian and in Croatian waters. Fishing closure for Italian trawlers for 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. Minimum landing sizes: EC regulation 1967/2006 defined 11 cm TL as minimum legal landing size for red mullet.
Along 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. Minimum landing size for red mullet is the same like in the EC regulation.
Mannini and Massa (2000) analyzed trends of the red mullet landings in the Adriatic from 1972 to 1997. In that period, the landings showed an overall increase. This positive trend was constant in the Western Adriatic, while in the Eastern Adriatic landings decreased during the second half of the 1990s. Estimations of total mortality and analyses of trawl survey data were carried out during the 80's showing respectively an overfishing situation for the stock and higher abundances in the eastern side of the sub-basing (Arneri and Jukic, 1985)
Landings data for the Italian and Slovenia fleet were reported through the Data Collection Framework, while Croatian data comes from official statistics of Fisheries Department and data were collected through logbooks. The Italian catches remained above the 3000 t from

2006 to 2009 and then started to decrease, reaching the minimum in 2012 with less than 2000 t.The Croatian catches remain lower than 1000 tons for all the time series except in 2011, in which the increase to a value around 1000 tons.

Data and parameters: The information used for the assessment of the stock consisted of red mullet landings estimated in the framework of Italian and Slovenian Official Data Collection submitted in the data call 2013, with Croatian data provided in the Croatian Primo Project and biological parameters estimated from data collected in the GSA 17. Abundance and biomass indexes from *MEDITS* trawl survey were computed using ATrIS software. The natural mortality has been assumed as a vector using the Probiom approach.

Assessment method: XSA methods 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 MEDITS survey.

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

Results:

Fcurrent (Mean 2010-2012, ages 0-5)	1.06
$F_{0.1}$ (estimated in 2012)	0.20
Biomass current (2012 MEDITS – kg/km^2)	47.6
Biomass (33rd - MEDITS – kg/km^2)	20.3
Biomass (66th - MEDITS – kg/km^2)	23.6
Current Recruitment (Thousands)	1238500
Fcurrent/$F_{0.1}$	5.3

Diagnosis of stock status: Considering the results of the analyses conducted the red mullet stock in GSA 17 is **subjected to overfishing**, being the current F estimated higher than the proposed reference point ($F_{0.1XSA}$ = 0.20 as a proxy of F_{MSY}).

Advices and recommendation: A reduction fishing mortality towards the proposed reference point is advised. Considering the overfishing situation of the red mullet stock in GSA 17 a reduction of fishing pressure and an improvement in exploitation pattern, especially of Italian trawlers exploiting a larger amount of Age 0+ group than Croatian and Slovenian trawlers, is advisable. However, from the analysis of the relative biomass observed in 2012 from MEDITS and from the SSB and total biomass estimated for the same year from XSA is possible to conclude that the abundance of the stock is high and there is not risk of stock depletion.

Discussion: Two different methods were used to calculate M (PRODBIOM and Gislasson), showing different results. As there is not a robust scientific evidence for selecting one in front of the other, the one that produced the most conservative results (PRODBIOM) was selected. It was also recommended to be consistent year after year in the methodology used for the input parameters. The percentile approach for the biomass is not very appropriate for short time series. In these cases, it is better to consider independent biomass indices (such as survey indices) if available.

13. Stock: Red mullet, *Mullus barbatus*

GSA: 19

Author(s): Carlucci R., Scarcella G., Sion L., Maiorano P., Tursi A., D'Onghia G. and Riga C.

Fishery: Red mullet, *Mullus barbatus*, is one of the most important commercially valuable species in the North-western Ionian Sea (GFCM-GSA19) and is an important component in the demersal assemblage mostly targeted by the bottom trawling fleets operating near shore. The highest trawl fishing pressure occurs along the Calabrian coast while the presence of rocky bottoms on the shelf along the Apulian coast prevents the fishing by trawling in this sector. National official statistics (IREPA, 2009), showed as the trawling fleet along the Calabrian and Apulian coasts counted 225 vessels for a total amount of 4000 GT and 30000 kW. During the 2004-2011 the monthly fishing effort in GSA19 fluctuated around a mean value of 482470±217862 GT*days. Similarly, the monthly engine power fluctuated around a mean value of 1481187±497910 kW*days. During spring and summer a higher number of working days were recorded for trawling in GSA19, whilst during autumn and winter the bad sea-weather conditions could influence the displacement of the fishing effort on very coastal areas rather than on deep water grounds. The mean annual values fluctuated between 63167±21505 GT*days (2004) and 582576±198435 GT*days (2006) and between 476270±163906 kW*days (2004) and 1892829±305992 kW*days (2005), without indicating any temporal trend.
Generally, the majority of the sampled specimens in both the experimental surveys as well in landing catches monitored by the Data Collection Framework (DCF) in GSA19, belonged to the 0 and 1 age classes showing sizes < 15.0 cm TL, providing thus elements to consider the current assessment of a certain concern (Sion et al., 2012). In the contest of DCF 2006-2012, the landings and discards of the red mullet from the otter bottom trawl (OTB) and on lesser extent gillnet (GNS) and trammel net (GTR) showed abundance fluctuations from a minimum of 446 t (2008) to a maximum of 872 t (2006). However, the observed decreasing trend not resulted statistical significant. Generally, the discard was almost negligible.

Data and parameters: Data used for the analyses of red mullet in GSA19 were catch (landings and discards) at age data per gear in numbers by DCF from 2006 to 2012. The vector of natural mortality M was estimated using ProdBiom model (Abella et al., 1998) assuming values equal to M in age 0=0.92, M in age 1=0. 40, M in age 2=0.30, M in age 3=0.26, M in age 4=0.23. The F terminal (0.23) was set equal to M at age 4. Due to the length at maturity equal to 11.7 cm TL and the adopted growth parameters for sex combined (L_{∞} = 27.0 cm TL, k = 0.697 and t_0 = -0.39) (Voliani et al., 1998), the proportion of mature was set as equal to 0.5 in age 0 and 1 in the other age classes.

Assessment method: The methodology was a VPA applied year by year, using the VIT model on DCF data (2006-2012). The software used was VIT4win. A Y/R analysis was performed. In addition, the biomass and density index values derived from trawl surveys (Medits time series 1994-2012) were also observed throughout indicating an empirical relative condition in the stock biomass.

Model performance: 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 methods were applied testing different sets of growth parameters and consequent natural

mortality values, as estimated by the Prodbiom model. Consistency between the life history parameters adopted as inputs in the VIT and Y/R models was checked comparing the reconstructing total catches and the landings recorded in the framework of the DCF. The stability in fishing pattern was also tested in order to test the equilibrium condition.

Results:

Current Y/R	17.973
$Y/R_{0.1}$	20.470
Fcurrent	1.17
$F_{0.1}$	0.38
$Biomass_{curr}$ (kg/km^2)	33.87
$Biomass_{33th}$ (kg/km^2)	20.58
$Biomass_{66th}$ (kg/km^2)	35.45

The Y/R analysis in 2012 for the complex of the different gears indicated a current level of fishing mortality equal to 1.17 corresponding to a yield of about 18 g/recruit. The limit reference point $F_{0.1}$ was estimated to be 0.38. According to the $F_{curr}/F_{0.1}$ ratio equal to 3.13 the stock of red mullet in GSA19 is considered to be in high overexploitation (O_H). Moreover, the analysis on biomass index by trawl survey throughout the time series indicated that B_{curr} is falling within the 33th and 66th percentile showing an empirical relative intermediate condition in the stock biomass (O_I).

Diagnosis of stock status: Stock is in high overfishing status (O_H) and relative intermediate condition in the stock abundance (O_I).

Advices and recommendation: Considering the results of the analyses, the objectives of a more sustainable harvest strategy could be achieved with a multiannual plan based on a reduction of the fishing mortality through fishing activity limitations and possibly fishing capacity decreasing, mostly focused on trawling.

Discussion: No particular discussion on this stock.

14. Stock: striped red mullet, *Mullus surmuletus*

GSA: 05

Author(s): Quetglas A., Guijarro B., Rubio V., Ordines F. and Massutí E.

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 (2000-2012), CPUE data from bottom trawl surveys (2001-2012) and from commercial fleet (2000-2012). 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), Yield per recruit analysis and short-term forecast.

Model performance: XSA residuals did not show any trend.

Results: Stock abundance, stock biomass, recruitment and spawning stock biomass showed a clear decreasing trend for the last years, although they cannot explained by changes in F as it has oscillated around 0.5 along the data series, without a clear trend.

$F_{current}$ (mean 2010-2012, ages 0-2)	0.54
$F_{0.1}$	0.18
$F_{current}/F_{0.1}$	3.00
Current survey biomass index (kg/km^2)	36.8
33th percentile survey biomass index (kg/km^2)	40.6
66th percentile survey biomass index (kg/km^2)	77.7

Diagnosis of stock status: The stock is in high overfishing status with relative low biomass.

Advices and recommendation: To reduce fishing mortality

Discussion: The decrease in biomass and recruitment in the last two years is not connected with the dynamics of effort that is constant. This apparent contradiction is difficult to understand and could be related to changes in the fishing exploitation pattern related to market demands (it is a multispecific fishery), changes in selectivity or in the ecosystem.

15. Stock: striped red mullet, *Mullus surmuletus*

GSA: 15-16

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

Fishery: Striped red mullet (*Mullus surmuletus*) is an important demersal target species in the Strait of Sicily (GSA 15 and 16). On average 73% of total striped red mullet landings in GSA 15 came from trawlers in 2007-2012. In GSA 16 the proportion of landings coming from bottom otter trawlers was 88% in 2004-2012, the remaining catches coming from fixed nets fisheries. Total striped red mullet landings for Italian and Maltese fleets combined in the period 2002-2012 decreased from 2616 tonnes in 2002 to 753 tonnes in 2012. The Maltese landings have increased in 2005-2012, from 7.4 tons in 2005 to 75 tons in 2012. With regards to fishing effort, data submitted by Italy and Malta in response to the annual EU fisheries Data Collection Framework (DCF) data-call in 2013 revealed a 40% decrease in fishing

effort for Italian bottom otter trawl vessels larger than 24 m in the period 2004-2012. Maltese vessels were only responsible for 3.5% of total trawling effort in GSAs 15 and 16 in 2012, however the total nominal effort of Maltese trawlers increased by 78% in 2005-2012.

Data and parameters: The annual size distributions (LFDs) of the catch as well as of the surveys (MEDITS) were converted in numbers at ages classes 1-5+ using the slicing statistical approach developed during STECF-EWG 11-12 (Scott et al., 2011). LFDs were sliced according to two different set of growth parameters corresponding to a slow growth (Linf=36.00, k=0.22, to=-0.7) and fast growth pattern (Linf=38.00, k=0.31, to=-0.4) respectively. The pattern produced by the fast growth parameters appeared more consistent and was therefore adopted to compile the catch-at age matrix as well as to split the MEDITS length frequency distributions from 2002 to 2012. These were used as tuning data.
The natural mortality was estimated by Prodbiom (Abella *et al.,* 1998), whereas length-weight parameters and proportion of maturity by age were obtained for landings data available since 2002.

Assessment method: The assessment was performed by XSA run with three shrinkage at 0.5, 1.0 and 2.0, Rage: 2; Qage: 2; shk.yrs: 3; shk.ages: 3. A yield per recruits model (YPR) under the equilibrium assumption was run using FLR. YPR was run using the XSA input values for ages 1 to 5+ and XSA estimates of F at age, recruitment and SSB.

Model performance: XSA run with shrinkage at 2.0 diverged from runs with the other two settings in particular for SSB and recruitment and was adopted as final model based on both residuals and retrospective analysis and more consistent estimates of MEDITS recruitment indices for the last years. It however important to highlight that the XSA assessment would benefit by the inclusion of time series of CPUE data from artisanal vessels exploiting the stock with fixed nets (gillnets, trammel nets) to better reconstruct the dynamics of oldest age classes.

Results: In 2002-2012, the SSB ranged between about 1043 and 2462 t. In the same period recruitment at age 1 fluctuated widely between 19.4 and 77.6 million. $Fbar_{1-4+}$ showed a declining temporal trend from 3.0 in 2002 to 0.78 in 2012. Fishing mortality was generally higher for age classes 3-4.
A short term projection assuming a status-quo F of Fstq=0.78 in 2013 and a recruitment of 41944 thousand individuals shows that:
- Fishing at Fstq from 2012 to 2014 would produce an increase in catches of 156.4% and a decrease in SSB of 4.5% between 2014 and 2015.
- Fishing at $F_{0.1}$ (0.19) from 2012 to 2014 would generate a decrease of 8.1% of the catches and an increase of 46.2% in SSB.

$Y/R_{0.1}$	0.03
Fcurrent	0.78
$F_{0.1}$	0.19
$B/R_{0.1}$	0.21
$F_{curr}/F_{0.1}$	4.1

Diagnosis of stock status: $F_{0.1} \leq 0.19$ is proposed as a limit management reference point consistent with high long term yields (FMSY proxy). Given the results of the present analysis (mean Fcur (2012) = 0.78; Fcur (2010-2012) = 1.0), the stock is considered to be exploited

unsustainably in the last three years (O_H). Biomass indices from MEDITS survey indicate an intermediate level of biomass in 2012.

Advices and recommendation: Based on the F_{cur} estimated by XSA the stock was exploited unsustainably in the period 2002-2012. WGSAD recommends to reduce the current F toward the proposed F_{MSY}, in order to avoid future loss in stock productivity and landings. This should be achieved by means of a multi-annual management plans, considering also reduction in the relevant fleets' effort and / or catches.

Discussion: The decrease in catches observed is similar to the previous case, apparently not connected with the fishing effort. The limitations of the survey index were also discussed, as the survey is not suitable for all the species and ages, so the inclusion of the survey index as tuning fleet in the XSA should be done carefully. This is also limited by the fact that it is not possible to incorporate selectivity into the model. It was suggested to repeat this assessment next year with the inclusion of Tunisian data catches in the data set and also to investigate better approaches to the analysis (such as statistical catch-at-age).

16. Stock: striped red mullet, *Mullus surmuletus*

GSA: 26

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

Fishery: The striped red mullet *Mullus surmuletus* is one of the most important commercial species in the eastern Mediterranean coast of Egypt (GSA 26). Its landings were 2268 tons during 2011 and 1443 tons during 2012. Four species *(Mullus surmuletus, Mullus barbatus, Upeneus moluccensis* and *Upeneus asymmetricus)* of Mullidae were recorded in the catch of eastern Mediterranean (GSA 26). Samples were collected monthly for two consecutive years; the bulk of the landed catch of red mullet came from the trawl vessels while there is a minor percentage of the landed catch comes from the artisanal so it was negligible. *Mullus surmuletus* constituted about 55% of red mullets in GSA 26.

Data and parameters: Length structure of the landings was collected monthly during the period from January 2011 till December 2012 within a pilot study in the framework of EastMed project. The length frequency was analyzed by Bhattacharya method in order to estimate the growth parameters by Ford & Walford method for sex combined. Length-weight relationship, maturity ogive with Lm50%, sex ratio were estimated. The vector of natural mortality by age was calculated from Caddy's formula, using the PROBIOM Excel spreadsheet, LFDA was used for age slice. Yield per recruit, biomass per recruit and biological reference points were estimated.

Assessment method: VIT software was used for pseudo cohort analysis. In addition, the Y/R analysis implemented in the VIT was applied for the calculation of the reference point $F_{0.1}$.

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: Sex ratio (% females / total) was 0.555 during study period. The stock of each year was assessed separately for result comparing. Age composition analysis indicates that, the majority of the catch of this species represented by the young ages especially in 2012. The Y/R analysis indicates a current level of fishing mortality of 0.395 during 2011 and 0.464 during 2012 while the target reference point $F_{0.1}$ is 0.217 and 0.223 during 2011 and 2012 respectively. Length at first capture is smaller than length at first maturity in both years.

$F_{current}$	0.46
$F_{0.1}$	0.22
$F_{current}/F_{0.1}$	2.1

Diagnose of Stock status: according to GFCM recommendation (Split, 2012), the ratio between F_{cur} and $F_{0.1}$ indicates that, the stock of *Mullus surmuletus* is in high overfishing during 2011 and 2012.

Advices and recommendations: The objectives of a more sustainable harvest strategy could be achieved by reduction of fishing mortality through fishing activity limitations. Improve the selection pattern of the trawl fishery and enforcement of the application of the closed season will help in protecting the SSB.

Discussion: The lack of enforcement of the existing regulations, specifically the closed season during the last three years, can have a strong effect in this species.

17. Stock: picarel, *Spicara smaris*

GSA: 25

Authors: Josephides M., Scarcella G., Riga K.

Fishery: Picarel (*Spicara smaris*) is the most important demersal fish targeted by bottom trawl fisheries in GSA 25, covering ~ 64% of the total catch. It is exploited in depths ranging from 50-100 meters mainly along the southern coast of Cyprus, and mostly distributed in depths less than 100 m. It inhabits sandy and muddy bottoms. The species in GSA 25 is considered as a single stock, though this has not been evidenced by studies on population structure. Landings fluctuated between 78 and 1030 t in the period 1970-2012 (data source: DCF, FAO-FishStat, DFMR reports).

Data and parameters: Catch at age matrix, total landings, maturity ogive, natural mortality and LPUE as abundance index data series for picarel caught by commercial trawlers in GSA25, were used for the period 2005-2012. The data were collected in the Data Collection Framework (DCF) of the EU Regulation 199/2008. Growth parameters were obtained through the Von-Bertalanffy growth equation and the length-weight relationship in order to calculate natural mortality vector at age (Ma), using Caddy's method (1991) (PROBIOM Excel spreadsheet; Caddy and Abella, 1999; Abella et al. 1997, 1998).

Assessment method: Considering the variability observed in the catches and effort, the assessment is based on non-equilibrium method. Fisheries Library in R statistical language was used to implement Extended Survivor Analysis (XSA) as an assessment method. For the

XSA model, a shrinkage coefficient of variation (CV) was supplied in order to weight the fishing mortality (F) shrinkage by testing three values of 0.5, 1 and 2. The best model was chosen according to the diagnostics of the residuals. A plus age group was set in the assessment. Biological reference points of $F_{0.1}$ and F_{max} were estimated from the FLBRP library in R using the Yield per Recruit analysis. Also the biomass reference points $B_{0.33}$ and $B_{0.66}$ from the 33rd and 66th percentile were calculated to observe the status of current biomass.

Model performance: Diagnostic plots of XSA show an adequate fitting of the models and did not show any trends in the residuals that were observed, excluding the age group of 0. The reason is that the available data for the particular age group does not give representative abundance indices of CPUE because the trawl fishery starts on November, a month later when the recruitment occurs (Demetropoulos 1985). Also, the Mediterranean Trawl Survey takes place only in June, so the abundance indices do not cover adequately the age 0 group of the species.
Retrospective analysis showed a good agreement in the trend of spawning stock biomass (ssb) and harvest, indicating that the assessment was consistent. A slight inconsistency for the recruitment was appeared in the year 2010.

Results: Exploitation showed an increase from 2006 to 2009 with values of 0.38 to 0.8 respectively, while in the period 2009 to 2012 harvest has decreased rapidly from 2009 to 2012, with values 0.8 to 0.1 respectively. The current estimate of fishing mortality (F_{0-4}) is 0.09.
Recruitment varied with a decreasing trend in the years 2005-2012, reaching a minimum in 2010. The SSB fluctuated reaching a maximum in 2007 and a minimum in 2009.
Yield per Recruit analysis showed that reference points of $F_{0.1}$ and F_{max} have values of 0.14 and 0.25 respectively, while biomass of 33rd and 66th percentile have values of 477.89 and 688.78 tones respectively. The current biomass B_{cur} estimated to be 564.33 tones.

$F_{current}$	0.09
$F_{0.1}$	0.14
$F_{current}/F_{0.1}$	0.6
Biomass	564.3
Biomass 33rd percentile (t)	477.9
Biomass 66th percentile (t)	688.9

Diagnosis of Stock status: Considering the results, it can be concluded that the resource is in sustainable exploitation (S) with a relative intermediate biomass (**O_I**).

Advices and recommendation: The adoption of larger mesh size of the codend (50mm diamond) in May of 2010 as well as the decrease of the number of vessels from 4 to 2 in 2011, most likely contributed to the recovery of the stock. The 5 month closure of the fisheries (June-October), is important for the recovery of the stock as well as for the success of recruitment. Therefore, it is recommended that fishing mortality should not be increased. It should be considered that the exploitation is not orientated towards juveniles. Hence, in the case of increasing fishing mortality and yearly bad recruitment, there could be a high risk of stock depletion.

Discussion: No particular discussion on this stock.

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

GSA: 26

Authors: Mahmoud H.H., El-Haweet A.A.K., Scarcella G., 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 one of the most important demersal target species of the commercial fishery in Egypt. It represented about 70% (912 tons) of the total landing of the family Synodontidae during 2012, which is nearly equal to 2% of the total Egyptian Mediterranean landed catch. The bulk of the landed catch of *Saurida undosquamis* came from the trawl vessels while there is a minor percentage of the landed catch comes from the artisanal so it was negligible. The demersal fishes of Egypt are exploited by 1098 fishing trawlers vessels (GAFRD, 2013). The size of the fish samples ranged between 9 and 36 cm and the mean length was 19.8 cm.

Data and parameters: The information used for the assessment of the stock consisted of catch length structure, length weight relationship, total length at the end of each year of life, Von Bertalanffy growth parameters, Sex ratio, length at first sexual maturity, the values of total (Z) and fishing mortalities (F). 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 (2012), the methodology applied indirect methods: Length cohort analysis and Beverton & Holt Yield per recruit analysis were performed in order to estimate the limit and target reference points. (FiSAT, LFDA, Vit 4 win & ProdBiom, 2009).

Results: Length at first capture is smaller than length at first maturity in both years (2011 & 2012). The reference points from Yield per Recruit analysis (2012) are summarized in the following table.

Current Y/R	10.361
Maximum Y/R	10.82
$Y/R_{0.1}$	10.399
$F_{current}$	0.537
F_{max}	0.365
$F_{0.1}$	0.247
Current B/R	17.395
Maximum B/R	25.693
$B/R_{0.1}$	35.98
$F_{current}$ / $F_{0.1}$	2.17

The Y/R analysis indicates a current level of fishing mortality of 0.588 during 2011 and 0.537 during 2012 while the target reference point $F_{0.1}$ is 0.29 and 0.247 during 2011 and 2012 respectively.

Diagnosis of stock status: According to the results obtained of both years (2011 & 2012) the current fishing level of the lizard fish is higher than the biological reference points ($F_{0.1}$ &

F_{max}) and the ratio between F_{cur} and $F_{0.1}$ (2.02 & 2.17 during 2011 and 2012 respectively) shows that the lizard fish (*Saurida undosquamis*) resources in GSA 26 is in a state of high overfishing (according to GFCM recommendations 2012).
Based on the fact that the length at first capture (L_c= 14.12 cm) is almost equal with the length at first maturity (L_{50}= 15 cm), it seems that fishery is focused on spawners.

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

Discussion: No particular discussion on this stock.

19. Stock: Blue and 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). *A. antennatus* is a target species with a high economic importance.

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 (Carbonell *et al.*, 1999).

Assessment method: Length cohort analysis (VPA and Y/R) for a pseudocohort 2007-2012 and Separable VPA and Extended Survivor Analysis (XSA) for 1992-2012. Analysis were performed by sex, combining the results, and for both sexes.

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:

$F_{current}$ (mean 2010-2012, ages 0-4)	0.58
$F_{0.1}$	0.10
$F_{current}/F_{0.1}$	4.35
Biomass at sea (tons)	313.9
33^{th} percentile biomass at sea (tons)	330.3
66^{th} percentile biomass at sea (tons)	379.2

Diagnosis of stock status: The stock is in high overfishing status with relative low biomass.

Advices and recommendation: To reduce fishing mortality

Discussion: No particular discussion on this stock.

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

GSA: 03

Author(s): Benchoucha S. & El Ouamari N.

Fishery: Deep water pink shrimp**,** *Parapenaeus longirostris* is one of the most important demersal target species of the commercial fisheries in the GSA 03. In this area, the Deep water pink shrimp is exploited only by the coastal trawlers. Around 115 boats are involved in this fishery. According to the Moroccan national official statistics (MAIA system), total annual landings for the period 2003-2012 oscillated between 183 and 684 tons. The effort targeting *P. longirostris* oscillated between 8671 and 11554 fishing days for the same period and the CPUE ranged from 20 and 62 kg/fishing day. The number of these trawlers operating in the GSA 03 oscillated for the last five years between 110 and 115. Most of this fleet is based in Nador, Al Hoceima and M'diq ports respectively. The mean power of these trawlers ranged from 200 to 357 depending the port. The mean GT ranged from 28 to 55 and the mean length from 16 to 20 meters. 73% of the trawlers are based in Nador port, 25% in Al Hoceima port and 17% only in M'diq port. The trawlers of Nador and Al Hoceima have the biggest power, GT and length. The landing sampling length frequencies are available for 2009 from landings sampling and from 2010 to 2012 from the surveys. The length composition ranged between 2009 and 2012 from 9 to 42 mm carapace length. The main species landed with *P. longirostris* are: the white kake (*Merluccius merluccius*), the common octopus (*Octopus vulgaris*), the axillary sea-bream (*Pagellus acarne*), the bogue (*Boops boops*), the red mullet (*Mullus barbatus*), the striped mullet (*Mullus surmuletus*), the European conger (*Conger conger*) and others fishes, Crustaceans and Cephalopods species.

Data and parameters: The information used for the assessment of the stock consisted of the total annual catches, effort, CPUE and surveys abundance indexes. Official landings and CPUEs and informations about the fishery were used for the production model.

Assessment method: For the period of the study (2003-2012), the Production Model (Biodyn, Pedro De Baros) was applied for the assessment of the state of the stock of *Parapenaeus longirostris*. Analysis was performed and the results were discussed.
An analysis was also performed by comparing the trend of the catches and CPUEs and by comparing the current abundance to its 33th and 66^{th} percile.

Model performance: The Production Model gave a very good fit and adjustment with the total catches and the CPUE of the commercial trawlers (correlation about 96%).
The increasing trend of the catches, the CPUE and the surveys abundance indexes observed the last 3 years show the same result obtained by the Production Model.

Results:

	Production Model (Pedro De Baros), 2003-2012
Fcurr/F0,1	35%
Fcurr/FMSY	31%
Fcurr/Fsycurr	59%
Bcurr/B0,1	134%
Bcurr/BMSY	147%
Current abundance indexe (kg/h)	3.6
Abundance indexe at 66th percile (kg/h)	1.217
Abundance indexe at 33th percile (kg/h)	0.644

Diagnosis of stock status: The stock status is uncertain although with a relatively high level of biomass. Not to take any management decision based on this assessment.

Advices and recommendation:

- Do not take any management decision until the next assessment of the stock ;
- To perform other models (SURBA) using the surveys data ;
- To restart collecting commercial sizes data from the landings sampling in the main landing ports in the GSA 03.

Discussion: The working group considered the stock status uncertain although with a relatively high level of biomass. The production model was not considered appropriate due to the shortness of the data series, as it is not long enough and does not display fluctuations reflecting substantial changes in fishing effort. Nevertheless, biomass indexes from the commercial fleet and the surveys showed similar and homogeneous trends. The assessment was considered qualitative and could not be endorsed.

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

GSA: 05

Author(s): Guijarro B., Rubio V., Ordines F. and Quetglas A.

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 deep-water rose shrimp (*P. longirostris*) is a by-catch species mainly exploited on the and upper slope.

Data and parameters: Size composition of commercial trawl catches and official landings (2002-2012) and CPUE data from bottom trawl surveys (2001-2012). Biological parameters

obtained from studies carried out in the area (Guijarro *et al.*, 2009), M vector from PRODBIOM.

Assessment method: Extended Survivor Analysis (XSA), Yield per recruit analysis and short-term forecast.

Model performance: XSA residuals did not show any trend.

Results: Population values showed a very clear decreasing trend at the beginning of the assessed period, with a certain increasing trend in the last years.

$F_{current}$ (mean 2010-2012, ages 1-3)	0.77
$F_{0.1}$	0.62
$F_{current}/F_{0.1}$	1.24
Current survey biomass index (g/km^2)	626.4
33th percentile survey biomass index (g/km^2)	260.5
66th percentile survey biomass index (g/km^2)	639.7

Diagnosis of stock status: The stock is in low overfishing status with relative intermediate biomass level.

Advices and recommendation: To reduce fishing mortality

Discussion: Last time the assessment of this stock was performed (2010), the stock status was selected with some uncertainty and no management advice could be provided. The SCSA in 2010 decided that the assessment should be considered as a rough estimation of the stock status to be verified. Now, with a longer available series, the assessment has been shown to be robust enough. This species experiences important fluctuations apparently driven by changes in environmental conditions, especially temperature and salinity.

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

GSA: 06

Author(s): Pérez Gil, J. L; Quintanilla, L. F; Fernández, A. M, 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 2005-2012, fluctuating between 102 and 141 t, and decreased in 2011 reaching up 92 t that are the lowest in the last seven years. Yeld increased slightly to 99 t in 2012.

Data and parameters: The assessment was carried out using official landings and data on the size composition of trawl catches for the years 2001-2012. Catch-at-length data were converted into catch-at-age data by cohort slicing procedures. Length-weight relationship and

maturity ogive comes from Spanish DCF and the vector of natural mortality by age was calculated from Caddy´s formula, using the PROBIOM Excel spreadsheet (Abella et al., 1997).

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 (Y/R) and Spawning-per-Recruit (SSB/R) analyses 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. Stochastic short term projections assuming equilibrium conditions were also produced.

Model performance: Sensitivity and retrospective analyses were applied in the XSA model in order to check the robustness of the assessment. Results showed no particular retrospective bias in spawning biomass (SSB), fishing mortality (F) or recruitment (R).

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 8 years (2005-2012). Fishing mortality (F_{2-4}) also shows a decreasing trend from 2001 to 2004 (2.2 and 0.7 respectively) and stabilizes during the 2005-2012 period with slight variations that ranges between 0.9 and 1.47. 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 30% (Y), 52% (SSB) and 63% (B) of the values observed ten years ago. Y/R analysis shows that the $F_{ref} = F_{current}$ (1.48) exceeds the Y/R $F_{0.1}$ reference point (0.27).

$F_{current}$ (mean 6 last years, ages 2-4)	1.48
F 33rd percentile (ages 2-4)	1.34
F 66th percentile (ages 2-4)	1.64
$F_{0.1}$	0.27
$F_{current}/F_{0.1}$	5.48
$B_{current}$ (mean 6 last years, t)	538
B 33rd percentile (t)	481
B 66th percentile (t)	540

Diagnosis of stock status:

- High overfishing; $F_{current}/F_{0.1}$ =5.48
- Relative intermediate biomass; $B_{current}$= 538 (t); Biomass at 33rd percentile = 481(t)

Advices and recommendation.
A reduction of the current fishing mortality is recommended by reducing the fishing effort.

Discussion: Fluctuations found in this stock are in agreement with those observed in other areas, probably related to environmental conditions. Although the WG considered that the growth rate was low, it was agreed that it is up to the experts to decide the most appropriate growth parameters for each stock.

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

GSA: 12-16

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

Fishery: *Parapenaeus longirostris*, is caught by bottom otter trawling in the Strait of Sicily together with Norway lobster (*Nephrops norvegicus*), giant red shrimp (*Aristaeomorpha foliacea*), hake (*Merluccius merluccius*), violet shrimp (*Aristeus antennatus*), scorpionfish (*Helicolenus dactylopterus*), grater forkbeard (*Phicys blennioides*), red Pandora (*Pagellus bogaraveo)* 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. Sicilian trawlers over 24 m in length have longer fishing trips, which may have a duration of up to 4 weeks (distant trawlers). These vessels operate offshore, in both Italian and international waters of the Central Mediterranean. 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. 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. data.

Data and parameters: Catch matrices from Italy (OTB 12-24 m and OTB >24), Malta and Tunisia for 2007, 2008, 2009, 2010, 2011 and 2012. The parameters used were an average of growth parameters and length-weight relationships from SAMED (2002) and Ben Meriem (unpublished). Females: $L\infty = 42.705$, $k = 0.67$, $t0 = -0.208$, $a = 0.0029$, $b = 2.48185$. 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) and Yield per Recruit 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, 2009, 2010, 2011 and 2012 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.

Model performance: Results of VIT on the mean pseudocohort (2007-2012), in terms of $F_{0.1}$ (1.18) are very consistent with those obtained assessing pseudocohort year by year (range= 1.08-1.34 with median value 1.10).

Results:

Current Y/R	2.67
$Y/R_{0.1}$	2.47
Fcurrent	1.80
$F_{0.1}$	1.0

Current B/R	1.89
$B/R_{0.1}$	2.58
Virgin Biomass	5.24
$F_{curr}/F_{0.1}$	1.8

Diagnosis of stock status: According to the recommendation of the Working Group of Demersals (November 2012) and Rätz et al. (2010)[1], the analysis has been carried out year by year. Further to this, taking into account that annual variation in estimated F are not relevant, the mean values for all years combined is described as well. The final judgment on the state of the stock is provided based on the values estimated for the last year of the time series, i.e. 2012.
Current values of F (mean overall size classes contributing to the 90% of catches) showed a progressive increase from 2007 (F=0.86) to 2012 (F= 1.8). The results of the assessment revealed an exploitation pattern catching an high fraction of juveniles. The WG proposed $F_{0.1}$ = 1.0 as proxy of FMSY and as the exploitation reference point consistent with high long term yields.

Advices and recommendation: Considering the current exploitation pattern, characterized by high values of F on undersized shrimps due to small trawlers targeting this fraction of the population, and considering F0.1 as target reference points, a reduction of about 40% of current F is recommended. The protection of juveniles is also recommended. This objective is attaint by improving the exploitation pattern of trawlers targeting juveniles, and the protection of nursery areas are suggested.

Discussion: The WG was informed that last year this assessment was performed with XSA, but the results were not considered consistent, probably due to the shortness of the data series.

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

GSA: 18

Author(s): Bitetto I., Carbonara P., Casciaro L., Ceriola L., Đuroviæ M., Facchini M. T., Hoxha A., Ikica Z., Joksimoviæ A., Kolitari J., Kroqi G., Lembo G., Markoviæ O., Milone N. and Spedicato M. T.

Fishery: The deep-water pink shrimp, is one of the target species of the central and southern Adriatic multispecies trawl catches and is an epibenthic short-lived species, inhabiting preferably muddy sediments (Karlovac, 1949). Pink shrimp is only targeted by trawlers and fishing grounds are located along the coasts of the whole GSA.
Catches are from a depth range between 50-60 and 500 m and the species may co-occurs with other important commercial species as *Merluccius merluccius, Illex coindetii, Eledone cirrhosa, Lophius* spp., *Lepidorhombus boscii, N. norvegicus*.

Data and parameters:

[1]Rätz H.J., Anna Cheilari A. and Lleonart J. (2010) On the performance of fish stock parameters derived from VIT pseudo-cohort analysis. Scientia Marina 74(1): 155-162.

Standardized LFD abundance indices (N/km2) for the whole GSA18 from MEDITS trawl survey data from 1996 to 2012 have been used for the analysis. The length structure of landings and production by fishing segment from DCF has been used for west side, while for the east side data collected within a pilot study in the framework of Adriamed project (Montenegro) and from National Statistics (Albania)
The biological parameters estimated within DFC for the area have been also used (growth parameters, length-weight relationship, sex ratio and maturity. The vector of natural mortality by age was calculated from Caddy´s formula, using the PROBIOM Excel spreadsheet (Abella et al., 1997).

Assessment method: Previous assessments were performed with VIT (from 2008 to 2011). This year an attempt with XSA has been made, given that the time series covers the total number of age classes in landing (0 to 3+) more than one time, taking into account the data of the western and eastern side of GSA. As comparison, also ALADYM simulation model, providing a multi-fleet approach, has been applied and used also to forecast effects of different management strategies. The scenarios that have been performed are:

- Status quo until 2021;
- Change in mesh size since 2014 for all the fleet segments;
- Fishing ban of one additional month since 2014 for all the fleet segments;
- Reduction of F towards $F_{0.1}$ in 2020.

Model performance: About XSA analysis, the log-catchability residuals and the retrospective analysis did not show any trend.
A satisfactory fit has been obtained with ALADYM simulation model for all the fleet segments between simulated and observed landing. The hind-casting approach used for this assessment was accomplished to supporting the validity of the combined assessment.

Results:

Fcurrent	1.36
$F_{0.1}$	0.75
MEDITS biomass index 33^{rd} percentile (kg/km^2)	4.96
MEDITS biomass index 66^{th} percentile(kg/km^2)	7.03
Current MEDITS biomass index (2012) (kg/km^2)	5.5

Diagnosis of stock status: The stock is in overfishing as current fishing mortality exceed $F_{0.1}$. levels (1.36 vr. 0.75) and thus it is necessary to consider a considerable reduction of the fishing mortality to allow the achievement of $F_{0.1}$.

Advices and recommendation (in terms of research and, when possible in terms of management).
The reference point $F_{0.1}$ can be gradually achieved by multiannual management plans that foresees a reduction of fishing mortality through fishing limitations. As observed in 2012, the contribute of each country to the total production of *P. longirostris* in the GSA18 is: Italy 60 %; Albania 38%; Montenegro 2%.

Discussion: No particular discussion on this stock.

25 Stock : Deep-water pink shrimp, *Parapenaeus longirostris*

GSA: 19

Author(s): Bitetto I., Recasens L., Carbonara P., Casciaro L., Facchini M.T., Lembo G., M.T.Spedicato

Fishery: Deep water pink shrimp *Parapenaeus longirostris*, is one of the most important demersal target species of the commercial fisheries in the Western Ionian sea (GFCM-GSA19) where it contributes to the total landings for about 7%. In this area, deep water pink shrimp is exploited by trawlers, especially of mixed demersal deep water species (40%). Around 225 boats are potentially involved in this fishery (European Fleet Register, 2012). According to DCF data, total annual landings for 2006-2012 are in the range 1245 (2006) to 488 (2012), which is the lower value in the time series. The fishing effort in terms of nominal effort (kW*days) of the GSA19 seems quite stable with the lower levels in 2005 and 2007, whilst the current levels are more similar to those of 2006, which were higher. The bulk of the catches is from age 0 and 1 in each year of the time series with average numbers of 81167 and 36479 individuals (in thousands) respectively. The most important demersal resources exploited by mixed demersal deep water metier are: red mullet (*Mullus barbatus*) on the continental shelf, hake (*Merluccius merluccius*), deep water pink shrimp (*Parapenaeus longirostris*) and Norway lobster (*Nephrops norvegicus*), over a wide bathymetric range, deep-water red shrimps (*Aristeus antennatus* and *Aristaeomorpha foliacea*) on the slope.

Data and parameters: The information used for the assessment of the stock consisted of annual size composition of catches (estimated from quarterly sampling in the main landing ports), official landings, and biological parameters estimated from data collected in the GSA19 (2007-2012) by COISPA for the DCF. These parameters were: number of individuals per length class, growth parameters and number of individuals by age class, L-W relationship, sex-ratio and maturity ogive. These metrics were estimated and computed using different IT systems: FAO tools, R scripts and the software ISYCAMPBIOL (developed by COISPA). The growth parameters used in the assessment come from length frequency distribution analysis. 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 (2006-2012), the methodology applied was a tuned VPA, applying the XSA method considering as tuning fleet MEDITS campaign indices of the GSA. The software used was FLR. The FLR script for estimating reference points was also used. Simulation analysis to predict the effects of possible management options were accomplished using ALADYM model that was parameterized using the outputs from XSA as regards mortality and recruitment, while growth, natural mortality, length weight relationships were the same inputs as XSA. Fishing mortality was shaped by selectivity models. Two scenarios were simulated: one with a gradual decrease of the fishing mortality to reach $F_{0.1}$ in 2020 and a second scenario with the increase of mesh size to 60 mm in 2014.

Model performance: The residuals and retrospective analysis did not show any trend and the results obtained by XSA were consistent, in terms of pattern, with those from MEDITS as regards recruits and biomass. In ALADYM the fitting of the observed vs. simulated catches was satisfactory, with average differences around 4%. Model outputs evidenced improvement

in productivity and increase in mean length of captured individuals for the mesh increase scenario under the assumption of total survival of the individuals escaped by the net.

Results:
High level of overfishing ($Fc/F_{0.1}$=2.38 (XSA))
High abundance according to the trawl survey (MEDITS) time series

Fcurrent	1.6
$F_{0.1}$	0.67
Others (percentiles on the MEDITS time series. Biomass33 percentile = 6.4; Biomass 66 percentile = 8.1)	8.8 kg
……	

Diagnosis of stock status: Stock is in overfishing status and high biomass (estimates on the MEDITS time series). The stock is characterized by fluctuations of recruitment and abundance likely driven by environmental factors, which contribute to sustain the catches by ensuring the stock productivity.

Advices and recommendation: Improving the fishing pattern of the trawl to increase the size at first capture, protect nursery areas, reduce the effort of the trawl reducing time at sea.

Discussion: No particular discussion on this stock.

26. Stock: Norway lobster, *Nephrops norvegicus*

GSA: 15-16

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

Fishery: Norway lobster is an important commercial species for trawlers exploiting fishing grounds on the upper slope to target mainly the deep water rose shrimp (*Parapenaeus longirostris*) and the giant red shrimp (*Aristaeomorpha foliacea*). Landings ranged between 428 and 797 t in 2004-2007 decreasing to 440 t in 2012. These landings are mostly produced by the two segments of the Sicilian trawl fleet. Vessels of 12 and 24 m exploiting *N. norvegicus* during short fishing trip (1-2 days at sea) and vessels over 24 m overall length exploiting off-shore areas during long-term fishing trips (up to 4 weeks).
The effort Italian otter trawl >24 m LOA decreased of 32% since 2004 In addition, a decreasing of the effort of the smallest trawlers (12-24 m LOA) was also observed in the last few years. The effort of Maltese trawlers of LOA>24 m showed an increasing trend.

Data and parameters: Assessment was based on Italian and Maltese annual landings data of the GSAs 15-16 for the period 2002 to 2012 and calibrated with MEDITS survey data for the same period were used. The Maltese landings (GSA 15), corresponding to a proportion generally less than 0.25% of the Italian landings, were available for the period 2006-2012. An average proportion of 0.25% was added to the Italian landings for the period 2002-2006 to

reconstruct the whole landings for GSAs 15-16. As there is not an estimation of growth parameters in the area, the used ones where those estimated for the GSA 09, the adopted growth parameters for sexes combined are: L_{∞}=72.1, K=0.17, t0=0 and for LW relationship a = 0.000373, b = 3.1576. The annual size distributions of the catch as well as of the surveys (MEDITS) were converted in numbers at ages classes 1-8+ using the slicing statistical approach developed during STECF-EWG 11-12 (Scott et al., 2011). The natural mortality was estimated by Prodbiom (Abella *et al.*, 1998).

Assessment method: An SCA approaches (Millar et al., 2012) using the a4a assessment model was performed. Differently to VPA-XSA that assume that the observed catch-at-age data are exact, with the fishing selectivity pattern consequently varying from year to year, SCA approaches assume the selectivity pattern to be fixed in time and consider the differences between observed and (constant selectivity) model-predicted catch-at-age data to reflect errors associated with age reading and other source.

Model performance: The results obtained by SCA approaches showed SSB between about 860 and 1892 t with a large increases in 2012. Recruitment at age 1 showed large fluctuations from about 230 and 22 million with an abrupt decline in 2012. ($F_{bar\ 2\text{-}7}$) was generally lower than 0.5 with a declining trend from 0.65 in 2003 to 0.15 in 2012. F was generally higher for age classes 3-6. Reference F for the Yield per recruit (YPR) analysis was estimated using 1 to 8+ years age classes using the FLR routine based on the exploitation pattern estimated by the statistical catch at age. F_{01} was estimated to be 0.20

Results:

$F_{current}$	0.15
$F_{0.1}$	0.2
$F_{curr}/F_{0.1}$	0.75

Diagnosis of stock status: Taking into account that annual value of current F and considering $F_{0.1} \leq 0.15$ as proxy of F_{MSY} the stock is considered to be exploited sustainably in 2012.

Advices and recommendation: $F_{0.1} \leq 0.20$ as a limit management reference point consistent with high long term yields (F_{MSY} proxy) for the Norway lobster stock in GSas 15 and 16. Based on the F_{cur} estimated by the statistical catch at age (a4a assessment), the stock was exploited unsustainably in the period 2002-2011. The estimated F_{cur} was however below F_{MSY} in 2012 indicating that in this year the stock was exploited sustainably. WG recommends the relevant fleets' effort or catches are not increased to maintain fishing mortality below the proposed F_{MSY} level, in order to avoid future loss in stock productivity and landings.

Discussion: The group agreed that there is uncertainty on the use of the model and the settings, because the recruitment value of 2011 seems not consistent.

GENERAL COMMENTS AND REMARKS

21. The following general comments and remarks, applicable to all current and future assessments, were gathered during the discussions held after each stock presentation.

22. For some stocks, differences in the growth parameters among the different GSAs have been identified. Thus far, the selection of these parameters was made on the basis of the experts' knowledge but the WGSAD recommended to further investigate, possibly through a dedicated workshop, to standardize methodologies for the estimation of these parameters.

23. For some stock assessment softwares that had been recently used by participants of the group, the methodology behind was not very clear and the WGSAD would like to be informed about the way of computation of these softwares when presenting the results. When a software or package is used for the first time, it would be helpful to have a comparison of the results of the already adopted softwares or packages.

24. The WGSAD highlighted that most of the methodologies used did not consider variation in selectivity with age. There was a general agreement in the WGSAD that, for several stocks, the use of methods that could include selectivity patterns should be encouraged. The need of extra sources of information coming from spatial pattern of fishing effort is crucial in order to verify if the selectivity patterns employed are appropriate or not.

CONCLUSIONS AND RECOMMENDATIONS

25. Twenty-six stock assessments were revised by the WGSAD. Three of the stocks were considered being in sustainable exploitation status, 21 of them in overfishing status and two of them were considered as qualitative assessments and no final advice was provided. A Summary Table with stock status and management advice for each stock is available as Appendix E to this report.

26. A thorough revision of the Stock Assessment Forms was undertaken by the group and some amendments were proposed, gathered in the new version included as Appendix F to this report.

27. The utilization of the GFCM SharePoint for the second year proved to be a very useful tool to transmit information in both directions from the participants to the coordinator and vice-versa. All efforts should be put on the improvement of the quality of data that would become part of such new information portal.

28. <u>On the use of VIT combining years or on a yearly basis:</u> Concerning the use of pseudo-cohort approach in stock assessment (for example the VIT package), the group remarked what had been agreed the previous year, using yearly VIT estimates as an exploratory phase to check the steady state assumption, as supported by literature (Rätz et al. 2010) and by experiences gathered by WGSAD. This approach allows i) evaluating the stock status by considering the variability of parameters by year during the whole study period and ii) identifying anomalies or changes in recruitment or exploitation patterns.

29. <u>On the use of surplus production models</u>: It was agreed that if an available time series was long enough and displayed fluctuations reflecting substantial changes in fishing effort, the use of surplus production models could be an alternative way for the diagnosis when structured (length/age) data are not available, but also a complementary approach, even if age/length data are available.

30. <u>On stock unit identification</u>**:** The WGSAD recommended giving attention to stock unit aspect when assessing stock status. The need to improve the knowledge on the stock boundaries and the spatial extension of the fishery activities across GSAs was stressed.

31. On the computation of M: When the model used in the assessment makes it possible, the group recommended that M should be considered as a vector instead of a scalar. When a change from the previous years in the method to compute M is decided, it should be duly justified and, whatever method is used, the checking of the assumptions is required.

32. On the selection of growth parameters: Although the selection of growth parameters was left up to the experts, the WGSAD encouraged the use of appropriate methods to validate them. Although some validation methods require high investment (like tagging), other methodologies such as the analysis of length frequency distributions could be applied.

33. If there is no major change in the fishing exploitation pattern, neither in the input parameters (such as growth curve) nor in the method of computing the reference point, a reference point based on a validated estimate of $F_{0.1}$ for a given stock should be kept without revision for several years, (i.e. the reference point should not be estimated annually). After a certain number of years, this value should be re-calculated by the expert and revised by the WGSAD, especially when some of the above-mentioned changes take place.

34. On the calculation of $F_{current}$: The way to calculate $F_{current}$ could depend on the method used as well as on the stock itself. In general, as the results of XSA for the previous year were the less reliable data series, it was recommended to calculate $F_{current}$ as the previous three years average. For other methods, such as VIT or SCA, the previous year could be considered as $F_{current}$. Anyhow, it was deemed very important to indicate which was the period considered for calculating the value as well as the ages included. It was recommended to include the F-at-age matrix in the SAF.

35. In the case of different results obtained with different methodologies or input parameters (like growth parameters), the one to be chosen should be selected according to scientific evidence. When there is no clear scientific evidence, the most conservative option should be prioritized.

36. The WGBS recommended to improve the standardization on the methodologies to calculate the input of biological parameters of the stock assessment through a specific workshop.

1. The WGBS recommended to go further in the creation of a standard classification of the assessment of analyzed stocks. According to this, there will be no longer “preliminary assessment” but each assessment could be classified as “qualitative” or “quantitative”.

37. For the purpose of assisting the experts in the best selection of methods according with the data available, the WGSAD proposed a classification of stocks in different categories related to the kind of information available and the length of the data series, along with the proposal of the methods and software to be used. This table is included in Appendix G for the consideration and eventual adoption by the SCSA.

ADOPTION OF THE REPORT/RECOMMENDATIONS

38. All conclusions and recommendations were adopted by the WGSAD on the 1st of February 2014. The whole report was adopted after revisions and amendments by electronic correspondence.

Bibliography

Aldebert Y. and B. Morales-Nin. (1992) La croissance des juvenile de merlu dans le Golfe du Lion: nouvelles méthodes d'approche. Rapp. Comm. Int. Mer Mèdit. 33 :281.

Aldebert Y. and C. Carries (1989) L'exploitation du merlu dans le golfe du lion données complémentaires. Bull, Soc. Zool. France, 114(4) : 15-20.

Aldebert Y. (1981) Contribution a la biologie du merlu du Golfe du Lion: Premieres donnees sur la croissance. Rapp. Pv Réun. CIEM 27(5): 47-48.

Beverton R.J.H. and S.J. Holt (1957). On the dynamics of exploited fish populations. U. K. Ministry of Agriculture Fisheries and Food, Ish. Invest. 19: 533 pp.

Bouhlal M. (1975) Contribution a l'étude biologique et dynamique du merlu *Merluccius merluccius* mediterraneus (L. 1758) du Coife de Tunis. Université de Tunis, Facuité des sciences. 177 p. Thèse de 3ème cycle de biologie marine.

Caddy J. F. and Mahon R. (1995) Reference points for fisheries management (Vol. 374). Food and Agriculture Organization of the United Nations.

Caddy J.F. and Abella A.J. (1999) Reconstructing reciprocal M vectors from length cohort analysis (LCA) of commercial size frequencies of hake, and fine mesh trawl surveys over the same grounds. Fish. Res. 41: 169–175.

Caddy J.F. (2010) Biological indicators and their use in stock assessment to achieve sustainable levels of fishing. Part 1. Ciencia Pesquera 18,2: 87-124.

Courbin N., Fablet R., Mellon C. and de Pontual H. (2007) Are hake otolith macrostructures randomly deposited? Insights from an unsupervised statistical and quantitative approach applied to Mediterranean hake otoliths. ICES Journal of Marine Science, 64:1191–1201.

Darby C.D. and S. Flatman (1994) Virtual Population Análisis: version 3.1 (Windows/DOS) user guide. Info. Tech. Ser., MAFF Direct. Fish. Res., Lowestoft, nº 1: 85 pp.

Demestre M. and Lleonart J. (1993) Population dynamics of *Aristeus antennatus* (Decapoda: Dendrobranchiata) in the northwestern Mediterranean.

FAO, CECAFE Shaeffer production model, 1970. (Ad hoc excel sheet, Pedro de Barros, CECAF).

Fernández M.V., Heras S., Maltagliati F., Turco A. and Roldán M.I. (2011) Genetic structure in the blue and red shrimp *Aristeus antennatus* and the role played by hydrographical and oceanographical barriers. Mar Ecol Prog Ser 421: 163-171, 2011.

Guijarro B. and E. Massutí (2006) Selectivity of diamond- and square-mesh codends in the deepwater crustacean trawl fishery off the Balearic Islands (western Mediterranean). ICES J. Mar. Sci., 63: 52-67.

Lleonart J. and J. Salat (1997) VIT: Software for fishery analysis. User's manual. FAO Computerized Information Series (Fisheries). Nº 11. Rome, FAO, 105 pp.

Lleonart J. and Umbert J.S. (1992) VIT: Programa de análisis de pesquerías. Instituto de Ciencias del Mar (CSIC).

Le Quesne *et al*., 2013

Martell, S. and Froese, R. (2013), A simple method for estimating MSY from catch and resilience. Fish and Fisheries, 14: 504–514Mellon-Duval C., H. de Pontual, L. Métral

and L. Quemener (2010) Growth of European hake (Merluccius merluccius) in the Gulf of Lions based on conventional tagging. ICES J. Mar. Sys., 67: 62-70.

Morales-Nin B. and Moranta J. (2004) Recruitment and post-settlement growth of juvenile *Merluccius* merluccius on the western Mediterranean shelf. Sci. Marina 68 (3), 399–409.

Morales-Nin B., Tores G.J., Lombarte A. and Recasens L. (1998) Otolith growth and age estimation in the European hake. Journal of Fish Biology, 53(6), 1155-1168.

Morales-Nin, B. and Aldebert Y. (1997). Growth of juvenile *Merluccius merluccius* in the Gulf of Lions (NW Mediterranean) based on otolith microstructure and length-frequency analysis. Fisheries Research, 30(1), 77-85.

Ordines F., E. Massutí, B. Guijarro and Ramon Mas (2006) Diamond vs. *s*quare mesh codend in a multi-species trawl fishery of the western Mediterranean: effects on catch composition, yield, size selectivity and discards. Aquat. Living Resour., 19: 329-338.

Pauly D. (1980) On the interrelationships between natural mortality, growth parameters, and mean environmental temperature, in 175 fish stocks. J. Cons. CIEM, 39(2):175-192.

Rätz H.J., Anna Cheilari A. and Lleonart J. (2010) On the performance of fish stock parameters derived from VIT pseudo-cohort analysis. Scientia Marina 74(1): 155-162.

Recasens L. (1992) Dinàmica poblacional i pesqueria del lluç (*Merluccius merluccius*) al golf de Lleó i la mar Catalana. Tesis doctoral. Universitat de Barcelona.

Shepherd J G. (1999) Extended survivors analysis: an improved method for the analysis of catch-at-age data and abundance indices. ICES Journal of Marine Science, 56: 584-591.

Appendix A

Agenda

1. **Opening session (joint session for the two Working Groups on Demersal and Small Pelagic Species)**
2. **Workshop on the definition and estimation of reference points for Mediterranean and Black Sea fisheries (joint session for the two Working Groups on Demersal and Small Pelagic Species)**

   2.1. Introduction

   2.1.1. Reference points and advice in the SAC and in other relevant organization

   2.1.2. Review of reference points for small pelagics in the Mediterranean and Black Sea

   2.1.3. Review of reference points for demersal stocks in the Mediterranean and Black Sea

   2.2. Discussion on reference points for small pelagics and demersal stocks:

   - Discussion on conceptual reference points in agreement with GFCM guidelines for management plans
   - Discussion on already adopted or proposed reference points
   - Discussion on alternatives for data-poor stocks

2. **Conclusions and recommendations of the Workshop on reference points**
3. **Introductory session for the WGSAD**
4. **Presentation and discussion of draft assessments**
5. **Review and adoption of recommendations from the Workshop on Reference points.**
6. **Practical session to finalize individual reports and SAFs.**
7. **Discussion on the advice from the WGSAD**
   - Submission of information for the assessment of demersals
   - Summary sheets with stock advice
   - Stock Assessment forms
   - Review of the advice for the stocks assessed this year (elaboration of the table for the SCSA)
   - Criteria to classify stocks and methods according to data availability (proposal depending of availability of time)
8. **Formulation of conclusions, recommendations and management advice to be transmitted for the consideration by the SCSA and SAC**
9. **Closing Session**

Appendix B

List of participants

Sadok BEN MERIEM
National Institute of Marine Sciences and
Technologies (INSTM)
Centre de la Goulette
2060 La Goulette Port, Tunisia
E-mail: sadokbm@yahoo.fr

Isabella BITETTO
COISPA Tecnologia & Ricerca
Stazione Sperimentale per lo Studio delle Risorse del Mare
Via dei Trulli, 18/20
70126 Bari, Torre a Mare, Italy
E-mail: bitetto@coispa.it

Roberto CARLUCCI
Department of Biology
University of Bari
via Orabona 4
70125 Bari, Italy
E-mail: roberto.carlucci@uniba.it

Francesco COLLOCA
Istituto per l'Ambiente Marino Costiero
Consiglio Nazionale delle Ricerche (CNR)
Via Luigi Vaccara 61
91026 Mazara del Vallo (TP), Italy
Tel: +39 0923948966
E-mail: francesco.colloca@iamc.cnr.it

Angel FERNÁNDEZ
Instituto Español de Oceanografia
C.O. Murcia
c/ Varadero nº 1
30740 San Pedro del Pinatar
Murcia, Spain
E-mail: angel.fernandez@mu.ieo.es

Vita GANCITANO
Istituto per l'Ambiente Marino Costiero
Consiglio Nazionale delle Ricerche (CNR)
Via Luigi Vaccara 61
91026 Mazara del Vallo (TP), Italy
E-mail: vita.gancitano@iamc.cnr.it

Beatriz GUIJARRO
Instituto Español de Oceanografia
C.O. Baleares
Moll de Ponent s/n
07015 Palma, Spain
E-mail: beatriz@ba.ieo.es

Jerina KOLITARI
Aquaculture and Fishery Laboratory
Rruga "Skenderbeg" lagjia 4
Durres, Albania
E-mail: j.kolitari@gmail.com

Angélique JADAUD
IFREMER
1, Avenue Jean Monnet
BP171, 34203 Sète Cedex, France
E-mail: ajadaud@ifremer.fr

Aleksandar JOKSIMOVIC
Institute of Marine Biology
Dobrota b.b, PO box 69,
Kotor, Montenegro
E-mail: acojo@ac.me

Marios JOSEPHIDES
Department of Fisheries and Marine Research (DFMR)
101 Vithleem str,
1416 Nicosia, Cyprus
E-mail: mjosephides@dfmr.moa.gov.cy

Zdravko IKICA
Institute of Marine Biology
Dobrota b.b, PO box 69,
Kotor, Montenegro
E-mail: zdikica@ac.me

Igor ISAJLOVIĆ
Institute of oceanography and fisheries
Set. I. Mestovica 63
Croatia
E-mail: igor@izor.hr

Hatem Hanafy MAHMOUD
Associate Professor
Arab academy for science and technology
49 Rassafa st. Moharram Bik
Alexandria, Egypt
E-mail: hatemhanafy@hotmail.com

Olivera MARKOVIC
Institute of Marine Biology
Dobrota b.b, PO box 69,
Kotor, Montenegro
E-mail: omarkovic@ac.me

Srdjan MUGOSA
Ministry of Agriculture and Rural Development
Rimski trg 46,
81 000 Podgorica, Montenegro
E-mail: srdjan.mugosa@mpr.gov.me

José Luis PEREZ GIL
Spanish Institute of Oceanography
C.O. de Malaga
Puerto Pesquero S/N
29640 Fuengirola, Spain
E-mail: joseluis.perez@ma.ieo.es

Tristan ROUYER
IFREMER
1, Avenue Jean Monnet
BP171, 34203 Sète Cedex, France
E-mail: tristan.rouyer@ifremer.fr

Giuseppe SCARCELLA
CNR - ISMAR
L.go Fiera della Pesca 2
60125 Ancona, Italy
Phone: 393387043071
Email: g.scarcella@ismar.cnr.it

Maria Teresa SPEDICATO
COISPA Tecnologia & Ricerca
Stazione Sperimentale per lo Studio delle Risorse del Mare
Via dei Trulli, 18/20
70126 Bari, Torre a Mare, Italy
E-mail: spedicato@coispa.it

Nedo VRGOČ
Institute of oceanography and fisheries
Set. I. Mestovica 63
Croatia
E-mail: vrgoc@izor.hr

FAO Regional Projects

Juan Antonio CAMIÑAS
FAO CopeMed II
Project Coordinator
Fisheries and Aquaculture Resources Use
and Conservation Division (FIRF)
Subdelegación del Gobierno en Malaga
Paseo de Sancha 64
29071 Malaga, Spain
Ph: +34 695797666
E-mail: juanantonio.caminas@fao.org

Matthieu BERNARDON
FAO CopeMed II
Fisheries and Aquaculture Resources Use and Conservation Division (FIRF)
Subdelegación del Gobierno en Malaga
Paseo de Sancha 64
29071 Malaga, Spain
E-mail: matthieu.bernardon@fao.org

Konstantina KARLOU-RIGA
FAO EastMed
Project Coordinator
Fisheries and Aquaculture Resources Use and
Conservation Division (FIRF)
Fisheries and Aquaculture Department
Androu 1, 112 57 Athens, Greece
Ph: +30 2108847960
E-mail: Konstantina.Riga@fao.org

Enrico ARNERI
FAO AdriaMed/MedSudMed
Project Coordinator
Fisheries and Aquaculture Resources Use and
Conservation Division (FIRF)
Fisheries and Aquaculture Department
Viale delle Terme di Caracalla
00153 Rome, Italy
Ph.: + 39 06 57056092
Fax: + 39 06 570 53020
E-mail: enrico.arneri@fao.org

Luca CERIOLA
FAO MedSudMed
Fisheries and Aquaculture Resources Use and
Conservation Division (FIRF)
Fisheries and Aquaculture Department
Viale delle Terme di Caracalla
00153 Rome, Italy
Ph.: +39 346229179
E-mail: luca.ceriola@fao.org

Nicoletta MILONE
FAO AdriaMed
Fisheries and Aquaculture Resources Use and
Conservation Division (FIRF)
Fisheries and Aquaculture Department
Viale delle Terme di Caracalla
00153 Rome, Italy
Ph.: +39 06 57055467
E-mail: nicoletta.milone@fao.org

GFCM-SAC vice chair

Othman JARBOUI
Directeur du laboratoire Ressources Marines Vivantes
Institut National des Sciences et Technologies
de la Mer (INSTM)
Centre de Sfax - BP 1035
3018 Sfax, Tunisia
E-mail: othman.jarboui@instm.rnrt.tn

GFCM Secretariat

Miguel BERNAL
Fisheries Officer
GFCM Secretariat
Food and Agriculture Organisation of the United Nations (FAO)
Via Vittoria Colonna 1
00193 Rome, Italy
Tel: +39 0657056437
E-mail: miguel.bernal@fao.org

Pilar HERNÁNDEZ
Information Management Officer
GFCM Secretariat
Food and Agriculture Organisation of the United Nations (FAO)
Via Vittoria Colonna 1
00193 Rome, Italy
Tel: +39 0657054617
E-mail: pilar.hernandez@fao.org

Appendix C

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. Analyse the data sets provided by the participants (Sampling frequency, time series, age structured, commercial vs surveys data, …)
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 13th SAC meeting, namely FMSY 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,…) of environmental stress.
7. Produce diagnoses on the status of the stocks.
8. Present and discuss assessment related woks.
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 D

General conclusions and recommendations of the *Workshop on the definition and estimation of reference points for Mediterranean and Black Sea fisheries* (WGREF)

Specific recommendations for reference points for stocks with analytical assessment	
Clarify the role of $F_{0.1}$ as a reference point	- $F_{0.1}$ is a proxy for F_{MSY} - $F_{0.1}$ is in principle lower than F_{pa} and F_{lim}. If not, estimation of reference points should be revised - If possible $F_{0.1}$ should be complemented with an additional estimate of F_{lim} (e.g. from an independent B_{lim} estimate) and F_{pa} should be defined in relation to F_{lim}. If that is achieved, then there is a full framework in place for fishing mortality and advice can be provided in relation to MSY and precautionary frameworks - If only $F_{0.1}$ is available, then F_{lim} should be defined in relation to $F_{0.1}$ (a percentage or identical) and advice should be provided based on these two points.
Requirements for advice in small pelagics	- A threshold for Biomass, based on reproductive capacity should be established to maximize probability of obtaining good recruitments. Advice should be based if possible on both Biomass (priority) and fishing mortality (or some proxy such as exploitation rate) reference points. - In the absence of a precise stock recruitment relationship, limit biomass reference points and associated precautionary should be obtained from analysis of temporal series of Biomass estimates. - Estimates of maximum observed biomass (as a proxy for B_{virgin}) or minimum observed biomass from which the stock recovered (as a proxy for B_{loss}) could be used as reference to estimate limit and threshold reference points. - Due to the fluctuating nature of small pelagics and the existence of regime shifts that alter the ecosystem productivity, the concept of B_{virgin} is not expected to represent the potential maximum biomass on a range of possible ecosystem status. - The combination of B_{loss} as a limit reference point and a precautionary threshold that minimizes the probability to reach it, is therefore considered the most appropriate option. - B_{lim} is defined as the lowest biomass from which a recovery has been confirmed. B_{lim} is estimated from an analysis of time series of biomass estimates. Time series should be sufficiently long and only if the analysis provides consistent perspective in the historical and the recent part of the time series this reference points is to be considered. Whenever similar minima that meet the required criteria (recovery) exist in the time series the upper value should be chosen as a precautionary approach. - B_{pa} is defined as a point at which the probability to be below B_{lim} is lower than 5%. In order to estimate it, a lognormal distribution of B_{lim} is assumed, with a coefficient of variation of 40%. This approximately results in $B_{pa} = 2 * B_{lim}$.

Specific recommendations for reference points for stocks with analytical assessment	

	- Advice for small pelagics:
	  o If only fishing mortality/explotaition rate reference points (e.g. Patterson) is used, then use the overexploitation ranking proposed in WG demersal.
	  o If you have both fishing mortality/exploitation rate and Biomass:
	  ▪ If $B > B_{pa}$ and $E <$ Patterson / $F < F_{MSY}$: sustainable
	  ▪ If $E >$ Patterson or $F > F_{MSY}$ and $B > B_{pa}$, increased risk of overexploitation
	  ▪ If $B_{lim} < B < B_{pa}$ and $F > F_{MSY}$ or $E >$ Patterson: overexploited and in overexploitation
	  ▪ If $B_{lim} < B < B_{pa}$ and $F < F_{MSY}$ or $E <$ Patterson: overexploited and/or ecologically unbalanced
	  ▪ $B < B_{lim}$: depleted / collapsed
	  o If you have only Biomass reference points, then:
	  ▪ $B > B_{pa}$: sustainable
	  ▪ $B_{lim} < B < B_{pa}$: overexploited / ecologically unbalanced
	  ▪ $B < B_{lim}$: depleted / collapsed

Clarify the term "in overexploitation" in relation to reference points	- The proposal from the Demersal WG last year should be revised taking into account the definition of $F_{0.1}$ and F_{lim} above:
	- If you have the three (Target, threshold, limit):
	  o $F_{target} < F < F_{pa}$: increased risk of overexploitation
	  o $F_{pa} < F < F_{lim}$: in overexploitation
	  o $F > F_{lim}$: Severe overexploitation
	- If you have only $F_{0.1}$ (and an associated F_{lim})
	  o $F > F_{0.1}$: Use the percentile proposal from WG (copy)

How should the advice be provided? (replace for the definitions on the status of stock defined above)	- $F_{target} < F < F_{pa}$ and $B > B_{pa}$. Do not increase fishing mortality and revise stock advice next year. - $F_{lim} > F > F_{pa}$: reduce F - F ~~>~~ < F_{lim}: Immediate measures to minimize risk of collapse - If both F_{target} and B_{pa} exist, then if $B > B_{pa}$ and $F <= F_{target}$ then keep fishing mortality - If $B_{lim} < B < B_{pa}$ then F has to be reduced - If $B < B_{lim}$: recovery plan - In case there are signs of stock unbalance or stock is not able to recover even if low fishing mortality, then a recovery plan could be suggested.
Incorporate these conclusions to the Individual stock summary	

Specific recommendations for data limited stocks	
SCSA should aim to extend the advice on the status of stocks to those Mediterranean and Black Sea stocks consider important and not yet being assessed. In order to do the following steps should be performed:	- Review existing information for the most important stocks which are not yet assessed - Define a set of methods to apply to all these stocks - Collate the data and perform a benchmark assessment of those stocks - Organize a dedicated Workshop to analyse the data with the countries and report back to the SCSA.
General recommendations	
Compare the estimates of $F_{0.1}$ for selected species across the different GSAs, making use of the incipient library of stocks assessments being developed at the GFCM.	- Evaluate ecosystem considerations and differences in parameter estimation that could led to these differences, and propose potential harmonization of methodologies/reference points.
Incorporate environmental issues in the reference points framework	- Environmental issues should be incorporated into the estimation of reference points (both target and threshold), especially for small pelagics

Appendix E

Advice on the status of the stocks analyzed, including WGSAD comments and recommendations

GSA	Species	Data type	Years data	Methodology used	Stock status	Fcurr/F0.1	Management advice	WGSAD comments
GSA 01	European hake *Merluccius merluccius*	Catch, effort Lfreq catch & trawl surveys	2003-2012	XSA tuned with CPUE from commercial fleet and MEDITS data.	High overfishing Relative intermediate biomass	7.4	A reduction of the current fishing mortality is recommended by reducing the fishing effort and improving the selection pattern of the fishery.	No specific comments on this stock.
GSA 03	European hake *Merluccius merluccius*	Catch, CPUE, trawl surveys, Lfreq (commercial and surveys)	2003-2012	a) VIT(LCA,VPA,Y/R) b) ExcelSheet1 (Y/R) c) ExcelSheet2 (LCA, Y/R) M=0,2 d) ExcelSheet2 (LCA, Y/R) M=0,5 e) ExcelSheet2 (LCA, Y/R, M vector) f) Biodyn (Production Model)	Uncertain	a) 4.5-5 (2007, 2008) b) 8.3-9.1 (2007, 2008) c) 8,33 (2007, 2008) d)6,7 (2007, 2008) e) 2,9 (2007, 2008) f) 1.0 (2003-2012)	No management advice could be derived from the results. The assessment was not endorsed.	The original VPA showed some problems: it merged information from the fleet and from the surveys, M was used as a scalar not as a vector and the production model used a short data series, without clear contrasts reflecting substantial changes in fishing effort, as recommended last year. The assessment was re-run using VIT for the 2 years in which commercial data was available (2007-2008), but the results were not used for providing management advice as they were considered too old. A trial comparing trends from commercial CPUEs and survey data was carried out, trying to produce qualitative assessment, but there was not a clear correspondence between both series of data. It was recommended to use SURBA in the following years.
GSA 05	European hake *Merluccius merluccius*	Catch, effort, Lfreq catch & trawl surveys	2000-2012	XSA and Y/R analysis	In high overfishing status with relative high biomass	8.4	To reduce fishing mortality.	No specific comments on this stock.
GSA 07	European hake *Merluccius merluccius*	Catch, effort, Lfreq catch (French and Spanish trawlers, French gillnetters and Spanish longliners), trawl surveys	1998-2012	XSA and Y/R analysis	In High overfishing status; relative low biomass	12.2	- Improve the fishing pattern of the trawlers so that the minimum length of catches is consistent with the minimum legal landing size - reduce the effort of trawlers, longliners and gillnetters. - Freezing of the effort in the Fishery Restricted Area	The WGSAD was informed that some management measures have been taken since 2011 (reduction from 2010 to 2012 by 20% of the number of trawlers). This measure was enforced in 2013. Also, temporary closure for the trawlers (1 month per year) is enforced since 2011.

GSA	Species	Data type	Years data	Methodology used	Stock status	Fcurr/F0.1	Management advice	WGSAD comments
GSA 12, 13, 14, 15, 16	European hake *Merluccius merluccius*	Catch & Lfreq catch	2010-2012	LCA, Y/R analysis	The stock is in high overfishing and low biomass level	5.8	F should be reduced and the fishing pattern improved by increasing the selectivity of gears	LCA run by year, and combining the last three years, showed similar results. The WGSAD agreed to consider the results of the last year (2012) as reference for advice. WGSAD agreed on assessment results and management advice provided.
GSA 18	European hake *Merluccius merluccius*	Catch, effort, Lfreq catch, trawl surveys	survey data: 1996-2012; catch data: 2007-2012	XSA; ALADYM	High overfishing	5.6	Stock is in overfishing status and intermediate biomass (estimates on the MEDITS time series). The stock is characterized by fluctuations of recruitment and abundance, which contribute to sustain the catches. The stock is in overfishing as current fishing mortality exceeds the $F_{0.1}$ levels (1 vs. 0.18) and thus a considerable reduction of the fishing mortality is necessary to allow the achievement of $F_{0.1}$. Objectives of a more sustainable harvest strategy could be achieved with a multiannual plan that foresees a reduction of fishing mortality through fishing limitations. As observed in 2012, the production of hake in GSA 18 is split in 17% caught by Italian longlines, 74% by Italian trawlers, about 1% by Montenegrin trawlers and about 8% by Albania trawlers.	No specific comments on this stock.
GSA 17	Common sole, *Solea solea*	Trawls surveys, catch, Lfreq catch & Lfreq catch	1970-2012 (SCAA); 2006-2012 (XSA)	XSA, SCAA with SS3	High overfishing with relative low biomass level.	3.0	A reduction of fishing mortality towards the proposed reference point is advised. Considering the overexploited situation and the low values of SSB and biomass of the sole stock in GSA 17 a reduction of fishing pressure and an improvement in exploitation pattern is advisable, especially of Italian rapido trawlers and gillnetters, which mainly exploit juveniles. The best option to reduce effort and improve the exploitation pattern for sole in GSA 17, would be to introduce a closure	The WGSAD appreciated the comparison between the two models provided, as requested by last year's WG.

GSA	Species	Data type	Years data	Methodology used	Stock status	Fcurr/F0.1	Management advice	WGSAD comments
							for rapido trawling within 17 km of the Italian coast during the summer-fall period (June- December). Moreover, it was noted that in the last years some Italian artisanal fleets fish with gill net in the main spawning area during periods when trawling is prohibited. Additional measures to restrict exploitation of sole in the spawning area are desirable, to afford further protection of the Adriatic sole stock.	
GSA 05	Red mullet, *Mullus barbatus*	Catch, trawl surveys & Lfreq catch.	2000-2012	XSA and Y/R	High overfishing status with relative low biomass level.	6.6	To reduce fishing mortality.	No specific comments on this stock.
GSA 06	Red mullet, *Mullus barbatus*	Total annual landings, annual catch in number by size class, abundance index from commercial fleet an MEDITS surveys	1995-2012	XSA, Y/R	High overfishing and relative intermediate biomass level.	1.8	A reduction in fishing mortality towards the $F_{0.1}$ level is advised. A progressive reduction in fishing effort is recommended.	The use of 40mm square or 50mm diamond mesh has improved the exploitation pattern. Age groups 0-1 were predominant in catches until 2010. From 2011 onwards age groups 1-2 are predominant.
GSA 07	Red mullet, *Mullus barbatus*	Commercial and survey catch at age	2004-2012	XSA, Y/R	High Overfishing with relative high biomass level.	4.0	-Improve the fishing pattern of trawlers, so that the minimum length of catches is consistent with the minimum legal landing size -Reduce the effort of trawlers -Freezing the effort in the fishery Restricted Area	No specific comments on this stock.
GSA 10	Red mullet, *Mullus barbatus*	Trawl surveys, catch & Lfreq catch.	survey data: 1994-2012; catch data: 2006-2012	XSA	Sustainable exploited with relative intermediate biomass level.	0.8	It is recommended to not increase the relevant fleets' effort and/or catches to maintain fishing mortality in line with the agreed reference point and to avoid future loss in stock productivity and landings.	No specific comments on this stock.

GSA	Species	Data type	Years data	Methodology used	Stock status	Fcurr/F0.1	Management advice	WGSAD comments
GSA 17	Red mullet, *Mullus barbatus*	Trawls surveys, catch, Age freq catch	2006-2012	XSA, Y/R	High overfishing status with relatively intermediate high biomass level.	5.3	A reduction fishing mortality towards the proposed reference point is advised. Considering the overfishing situation of the red mullet stock in GSA 17 a reduction of fishing pressure and an improvement in exploitation pattern, especially of Italian trawlers exploiting a larger amount of Age 0+ group than Croatian and Slovenian trawlers, is advisable. However, from the analysis of the relative biomass observed in 2012 from MEDITS and from the SSB and total biomass estimated for the same year from XSA is possible to conclude that the abundance of the stock is high and there is not risk of stock depletion.	No specific comments on this stock.
GSA 19	Red mullet, *Mullus barbatus*	Catch, Lfreq catch, trawl surveys	2006-2012 (commercial) 1994-2012 (survey)	LCA, Y/R	High overfishing status with relative intermediate biomass level.	3.1	Considering the results of the analyses, the objectives of a more sustainable harvest strategy could be achieved with a multiannual plan based on a reduction of the fishing mortality through fishing activity limitations and possibly fishing capacity decreasing, mostly focused on trawling.	No specific comments on this stock.
GSA 05	Striped red mullet, *Mullus surmuletus*	Catch, trawl surveys & Lfreq catch.	2000-2012	XSA, Y/R and short term forecasts	High overfishing status with relative low biomass level.	3.0	To reduce fishing mortality.	The decrease in biomass and recruitment in the last two years is not connected with the dynamics of effort that is constant. This apparent contradiction is difficult to understand and could be related to changes in the fishing exploitation pattern related to market demands (it is a multispecific fishery), changes in selectivity or in the ecosystem.

GSA	Species	Data type	Years data	Methodology used	Stock status	Fcurr/F0.1	Management advice	WGSAD comments
GSA 15-16	Striped red mullet, *Mullus surmuletus*	Trawl surveys, catch & Lfreq catch	2002-2012	XSA, Y/R	High overfishing status with relative intermediate biomass level.	4.1	To reduce the current F toward the proposed FMSY, in order to avoid future loss in stock productivity and landings. This should be achieved by means of a multi-annual management plans, considering also reduction in the relevant fleets' effort and / or catches.	The reliability of MEDITS survey indices as tuning data was discussed. It is important to highlight that the XSA assessment would also benefit by the inclusion of time series of CPUE from gillnets and trammel nets to better reconstruct the dynamics of oldest age classes. It was suggested to repeat this assessment next year with the inclusion of Tunisian catch data if available.
GSA 26	Striped red mullet, *Mullus surmuletus*	Catch & Lfreq catch	2011-2012	LCA, Y/R	High overfishing status	2.1	The objectives of a more sustainable harvest strategy could be achieved by reduction of fishing mortality through fishing activity limitations. Improve the selection pattern of the trawl fishery and enforcement of the application of the closed season will help in protecting the SSB. The lack of enforcement of the existing regulations, specifically the closed season during the last three years, can have a strong effect in this stock.	No specific comments on this stock.
GSA 26	Brush tooth lizard fish, *Saurida undosquamis*	Catch & Lfreq catch	2011-2012	LCA, Y/R	In high overfishing status.	2.2	- Reduce the fishing mortality to $F_{0.1}$ by limitation of trawl fishing activities. - Improvement of the selection pattern of the trawl fishery	No specific comments on this stock.
GSA 25	Picarel, *Spicara smaris*	Catch, Age freq catch, CPUE as tuning index	2005-2012	XSA, Y/R	Sustainable exploitation with intermediate biomass	0.6	Do not increase the fishing mortality.	No specific comments on this stock.
GSA 05	Red shrimp, *Aristeus antennatus*	Catch, trawl surveys & Lfreq catch and commercial CPUE	1992-2012	LCA, XSA, VPA, Y/R	The stock is subject to high overfishing with relative low biomass level.	4.3	To reduce fishing mortality.	No specific comments on this stock.

GSA	Species	Data type	Years data	Methodology used	Stock status	Fcurr/F0.1	Management advice	WGSAD comments
GSA 03	Deep-water pink shrimp, *Parapenaeus longirostris*	Catch CPUE Surveys Abundance indexes	2003-2012	Biodyn (Production Model)	The stock status is uncertain although with a relatively high level of biomass.	NA	Not to take any management decision based on this assessment.	The production model was not considered appropriate due to the shortness of the data series. Nevertheless, biomass indexes from the commercial fleet and the surveys showed similar and homogeneous trends. For all these reasons, the assessment was considered qualitative and could not be endorsed.
GSA 05	Deep-water pink shrimp, *Parapenaeus longirostris*	Catch, trawl surveys & Lfreq catch.	2002-2012	XSA, Y/R and short term forecasts	Low overfishing status with relative intermediate biomass level.	1.2	To reduce fishing mortality.	No specific comments on this stock.
GSA 06	Deep-water pink shrimp, *Parapenaeus longirostris*	Catch, trawl surveys & Lfreq catch	2001-2012	XSA,Y/R	High overfishing. Relative intermediate biomass.	5.5	A reduction of the current fishing mortality is recommended by reducing the fishing effort.	Fluctuations found in this stock are in agreement with those observed in other areas, probably related to environmental variability. The WGSAD endorsed the assessment and recommendations.
GSA 12-16	Deep-water pink shrimp, *Parapenaeus longirostris*	Catch, trawl surveys & Lfreq catch	2007-2012	LCA, Y/R	High overfishing.	1.8	To reduce fishing mortality. The protection of juveniles is also recommended. This objective can be achieved by improving the exploitation pattern of trawlers, and the protection of nursery areas.	No specific comments on this stock.
GSA 18	Deep-water pink shrimp, *Parapenaeus longirostris*	Trawl surveys, catch & Lfreq catch	survey data: 1996-2007; catch data: 2007-2012	XSA, ALADYM	High overfishing.	1.8	It is necessary to consider a considerable reduction of the fishing mortality to allow the achievement of $F_{0.1}$. 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 2012, the contribution of each country to the total production of P. longirostris in the GSA18 is the following: Italy 60 %, Albania 38% and Montenegro 2%.	No specific comments on this stock.

GSA	Species	Data type	Years data	Methodology used	Stock status	Fcurr/F0.1	Management advice	WGSAD comments
GSA 19	Deep-water pink shrimp, *Parapenaeus longirostris*	Trawl surveys, catch & Lfreq catch	survey data: 1994-2007; catch data: 2006-2012	XSA, ALADYM	High overfishing with relative high biomass level.	2.4	It is necessary to consider a considerable reduction of the fishing mortality in order to achieve the estimated $F_{0.1}$ levels. Objectives of a more sustainable harvest strategy could be achieved with a multiannual plan that foresees a reduction of fishing mortality through fishing limitations and improving selectivity pattern	No specific comments on this stock.
GSA 15-16	Norway lobster, *Nephrops norvegicus*	Trawl surveys, catch & Lfreq catch	survey data: 2002-2012; catch data: 2002-2012	An SCA approach (Millar et al., 2012) using the a4a assessment model was performed on 2002-2012 catch data, tuned with Medits data	The estimated Fcur was below FMSY in 2012 indicating that in this year the stock was exploited sustainably	0.7	Not to increase relevant fleets' effort or catches to maintain fishing mortality below the proposed FMSY level, in order to avoid future loss in stock productivity and landings.	The WGSAD identified uncertainty on the way the model reconstructed recruitment with outliers values in 2011 and 2012. Assessment and recommendations were endorsed.

Appendix F

Stock Assessment Form (revised version)

Stock Assessment Form

Demersal species

Please specify Species and GSA

Reference Year:

Reporting Year:

Stock Assessment Form version 1.1 (February 2014)

Uploader: *Please include your name*

Stock assessment form

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1 Basic Identification Data

Scientific name:	Common name:	ISCAAP Group:
	[Species Common Name]	[ISCAAP Group]
1st Geographical sub-area:	2nd Geographical sub-area:	3rd Geographical sub-area:
[GSA_2]	[GSA_2]	[GSA_3]
4th Geographical sub-area:	5th Geographical sub-area:	6th Geographical sub-area:
[GSA_4]		
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

For Stock Assessment method, you first have to indicate if a direct, indirect or combined method is used, and then specify which method:

Direct methods (you can choose more than one):

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

Indirect method (you can choose more than one):

- *ICA*

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

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

2 Stock identification and biological information

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 names of spawning and nursery areas and maps 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 2.2-4: Growth and length weight model parameters

			Sex			
		Units	female	male	Combined	Years
Growth model	L_∞					
	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*

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

Table 3.1-1: 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]	
Operational Unit 2	[Country2]	[GSA2]	[Fleet Segment2]	[Fishing Gear Class2]	[ISCAAP Group]	
Operational Unit 3	[Country3]	[GSA3]	[Fleet Segment3]	[Fishing Gear Class3]	[ISCAAP Group]	
Operational Unit 4	[Country4]	[GSA4]	[Fleet Segment4]	[Fishing Gear Class4]	[ISCAAP Group]	
Operational Unit 5	[Country5]	[GSA5]	[Fleet Segment5]	[Fishing Gear Class5]	[ISCAAP Group]	
Operational Unit 6	[Country6]	[GSA6]	[Fleet Segment6]	[Fishing Gear Class6]	[ISCAAP Group]	

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

Operational Units*	Fleet (n° of boats)*	Catch (T or kg of the species assessed)	Other species caught (names and weight)	Discards (species assessed)	Discards (other species caught)	Effort (units)
[Operational Unit1]						
[Operational Unit2]						
[Operational Unit3]						
[Operational Unit4]						
[Operational Unit5]						
Total						

Historical trends

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

3.2 *Management regulations*

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

4 Fisheries independent information

4.1 *{The name of the section should reflect the type of survey – e.g. Trawl 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 the several tables provided in the template would have to be chosen: Egg Production Method, Acoustic survey, Trawl. Please also include a map with the stations/hauls when appropriate.

Direct methods: trawl based abundance indices

Table 4.1.1-1: 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 4.1.1-2: Trawl survey sampling area and number of hauls

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

Table 4.1.1-3: Trawl survey abundance and biomass results

YEAR	kg per km^2	CV or other	N per km^2	CV or other
2003				
2004				

Comments

- *Specify CV or 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;…)*
- *Specify if catchability coefficient is assumed =1 or other*

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

Slicing method

Report the maturity scale and age slicing method used

Table 4.1.1-4: 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 4.1.1-5: 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 4.1.1-6: Trawl surveys; recruitment analysis results

Year	**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 4.1.1-7: Trawl surveys; spawners analysis summary

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

Table 4.1.1-8: Trawl surveys; spawners analysis results

Year	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 T)

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. Chl a or other that may affect catchability, etc.) can be reported here.

6 Stock Assessment

*In this section there will be **one subsection (6.1, 6.2, etc.) for each different model** used (in case that more than one model has been run). In section 7 only the results of the model chosen as the most appropriate for the management advice must be included.*

6.1 *{The name of the section should reflect name of the model}*

6.1.1 Model assumptions

6.1.2 Input data and Parameters

Add a table with input parameters and model settings that are not in the excel file of input data.

6.1.3 Tuning data

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

7 Final stock assessment outcomes

Put a reference to the section describing in detail the final model used, add in this section the final Tables and graphs for: Total biomass, SSB, Recruitment, F or other outcomes of the stock assessment model with comments on trends in stock size, recruitment and exploitation.

7.1 *Data quality and gaps in knowledge*

Data issues (e.g. lack of discards data, stock parameters, etc.).

8 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.

8.1 *Short term predictions*

8.2 *Medium term predictions*

(i.e. effect of spatial measures…etc.)

8.3 *Long term predictions*

9 Draft scientific advice

*Examples in **blue**, please remove in the final version. Codes for the table are included in the Appendix I of the Stock Assessment Form. Please state the rationale behind that diagnoses, explaining if it is based on analytical or on empirical references*

Based on	Indicator	Analytical reference point (name and value)	Current value from the analysis (name and value)	Empirical reference value (name and value)	Trend (time period)	Stock Status
Fishing mortality	Fishing mortality	($F_{0.1}$, = value, F_{max}= value)			N	IO_I
	Fishing effort				D	
	Catch					
Stock abundance	Biomass			33_{th} percentile		O_L
	SSB					
Recruitment					D	
Final Diagnosis		Example: In intermediate level of overfishing and overexploited with low level of biomass				
Advice for management						

10 References

Appendix I: Codes for advice provided in the table included in Section 9

Trend categories

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

Stock Status

Based on Fishing mortality related indicators

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

Range of Overfishing levels based on fishery reference points

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

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

*Fc is current level of F

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

Based on Biomass related indicators

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

Classification of Relative levels of stock biomass

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

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)*

Appendix G

Stock categories

Category	Catch (discards)	CPUE Fleet	Size (Age)-composition	Survey data	Comments	Type of assessment	Examples of methods
1. Data rich and long time series	X	(X)	X	X	Time series as long as the lifespan	Age/length-based analytical assessment (quantitative assessment)	Separable VPA, XSA, SCA
2. Data moderate (short time series)	X	(X)	(X)	X	Short time series (shorter than lifespan)	Age/length-based analytical assessment in steady state (quantitative assessment)	Pseudocohort analysis (vit), catch curve
3. Data limited (moderate long time series)	X	X			The available time series is long enough to gather contrasts reflecting substantial changes in fishing effort	Production models (quantitative assessment), time series analysis	Global models/ASPIC, catch-MSY method, time series analysis
4. Data poor and short time series	X	X				Only trends (qualitative assessment)	Percentile approach
5. Only survey data				X		Indicators-based assessment (qualitative assessment)	SURBA, time series analysis, size-age indicators (e.g. mean length)