GENERAL FISHERIES COMMISSION FOR THE MEDITERRANEAN

COMMISSION GÉNÉRALE DES PÊCHES POUR LA MÉDITERRANÉE

SCIENTIFIC ADVISORY COMMITTEE (SAC)

Fourteenth Session

Sofia, Bulgaria, 20-24 February 2012

Report of the Workshop on Stock Assessment of selected species of Elasmobranchs in the GFCM area DG-MARE, Brussels, Belgium, 12-16 December 2011

OPENING, ARRANGEMENT OF THE MEETING AND ADOPTION OF THE AGENDA

1. The meeting of the Workshop on Stock Assessment of Selected Species of Elasmobranchs in the GFCM area was held in Brussels, Belgium, from 12 to 16 December 2011 in the premises of the Directorate General for Maritime Affairs and Fisheries (DG MARE) of the European Commission. It was attended by 25 experts from Algeria, Bulgaria, Croatia, France, Ireland, Italy, Morocco, Romania, Syria, Tunisia, Turkey as well as representatives of the European Union (EU), the Mediterranean Action Plan for the United Nations Environment Programme – Regional Activity Centre for Specially Protected Areas (UNEP-MAP RAC/SPA), and the GFCM Secretariat. The list of participants in available in Appendix A.

2. Mr Fabrizio Donatella, Head of Unit for conservation and control in the Mediterranean and the Black Sea, DG-MARE of the EU, welcomed the participants to Brussels and to the workshop on Elasmobranchs, introducing the topic as a priority for the EU which committed to organize the meeting, as a follow-up to the first held in Tunisia in 2010. He informed the present experts on the necessity to provide the most reliable and best available scientific information, so to allow managers to take the correct decisions. Finally, he recalled that the GFCM represents one of the very complete examples of the possibility to interact and thus needs to be given the means, through such technical meetings, to promote management measures and scientific knowledge. He concluded wishing the participants a very fruitful meeting. Mr Franco Biagi represented the European Union for the duration of the meeting.

3. Ms Pilar Hernàndez, from the GFCM Secretariat, welcomed the participants and thanked the EU for their support in the organization of the meeting. She then mentioned the framework within which the workshop was carried out and recalled its objectives, stressing the need to provide the GFCM Scientific Advisory Committee with sound advice emanating in particular from the practical sessions to take place during the meeting.

4. Mr Graham Johnston, from the Marine Institute of Ireland, and representing the International Council for the Exploration of the Sea (ICES), illustrated the points in common between the ICES and the GFCM and the importance of sharing experiences, not only because of the shared stocks but

especially as both organisations experience the same problems related to lack of data and target species.

5. Mr Johnston was unanimously selected as chair of the meeting, together with Mr Alvaro Abella, moderator. Mr Francesco Ferretti, from the Hopkins Marine Station of Stanford University, together with Ms Margherita Sessa, from the GFCM Secretariat, acted as Rapporteurs.

6. The Agenda was introduced and adopted with some minor changes (Appendix B).

OVERVIEW OF THE CHARACTERISTICS OF CHONDRICTHYANS IN TERMS OF BIOLOGICAL FEATURES AND DATA AVAILABILITY

7. Several presentations were made by the experts with the objective to describe the current situation of stock assessment of selected species together with analyses carried out in this domain.

- **Review of the available data on four Elasmobranchs species caught by the French fleets on the Mediterranean coast (Gulf of Lions and Corsica)** (Poisson F.)

The presentation illustrated the temporal evolution of the abundance status of the population of thornback ray (*Raja clavata*), the Mediterranean starry ray (*Raja asterias*), the Brown ray (*Raja miraletus*), and the small-spotted catshark (*Scyliorhinus canicula*) in the French fisheries starting from the 1970's, according to (1) information and analyses published in three key scientific documents published in the 90s' (Campillo A., 1992; Aldebert, 1997; Bertrand et al, 1998), (2) from data collected more recently during MEDITS surveys (Souplet, 2010), (3) from the national fishery statistics and (4) yearly national fisheries bulletin (IFREMER-SIH). The choice of the species was justified by the availability and a greater reliability of the statistics.

8. Some questions were posed to clarify the sampling methods used, and underlined the issue of the lack of a real record of fishing operations since most information came from Catch Assessment surveys and interviews, and also the MEDITS protocol. Mr Poisson added that a Spanish fleet operating in the area was not considered in the study.

- **Age Determination of Spiny Dogfish (*Squalus acanthias* L. 1758) in the Black Sea Waters** (Polat N.)

Mr Polat showed the results of an analysis regarding the spiny dogfish aimed at the finding of the most reliable ageing method for such species using hard anatomical structures. A total of 165 individuals inhabiting the Black Sea were collected in Black Sea waters between December 1991 and April 1993. The second dorsal spine and first ten vertebrae were removed from the specimens and processed with different preparation techniques prior to age interpretation. Ageing by the second dorsal spine was done by using the annuli on the surface of the mantle and the spine base diameter. No age interpretation could be done on the vertebrae due to a lack of sufficiently well defined ring formation. Consequently, it was concluded that the second dorsal spine was the more suitable anatomical structure for ageing in this species.

- ***Squalus acanthias* L. and *Raja clavata* L., Length-Weight composition from scientific surveys in Bulgarian Black Sea waters** (Raykov V.)

Mr Raykov presented the results of a study on growth of some elasmobranchs. He showed that Picked dogfish (*Squalus acanthias* L.) and Thornback ray (*Raja clavata* L.) had been identified as the most widespread species in the Black Sea. Common stingray (*Dasyatis pastinaca* L.) was considered less abundant in the Black Sea. The mean TL, (cm) previously estimated for *Squalus acanthias* L. was 125cm (TL_{min}-TL_{max} = 112-144 cm ± SE = 0.68) and mean weight, kg (MW =

10.35kg; W_{min}-W_{max} = 6.2-14.2). The parameters of L-W relationship were as follows: a=0.001 and b=3.153; r2 =0.81; ± SE (b) = 0.81, P = 0.1. Examined specimen of *Raja clavata* L.have MTL = 68.81cm; ±SE = 1.38; TL_{min}-TL_{max} = 56-79 cm; MW (kg) = 2.89; ±SE = 0.24 and W_{min}-W_{max} = 1.2-5.5. The parameters of L-W relationship were: a = 0.001 and b =2.302; r2 =0.86 ; SE(b) = 0.16; p =0.11.

9. Following this presentation, questions were raised about the most likely causes of decreasing trends in catch rates in the case of some selected species of relevance to the Black Sea and it was argued that overfishing and related by-catch were the main reasons for such evolutions. Moreover, the importance of comparative studies with neighboring countries was pointed out, in order to obtain more complete information, and as a result Mr Raykov insisted on the necessity to have a clearer overview of all Black Sea countries, given the considerable differences in fishing effort and removals.

- **Research on the status of dogfish (*Squalus acanthias*) populations in the Romanian marine area. Summary data on dogfish at Black Sea level** (Radu G.)

The contents of the presentation concerned data on species biology and behavior; distribution area, migration routes; distribution and migration routes at Romanian littoral; distribution and migration routes at Black Sea level, landings; biological parameters; stock biomass; size structure; yearly distribution of fishing distribution; indices of abundance by length classes, biomass by length classes; historical catch in number; stock weights at age; proportion mature at age; age-length key.

10. The EU representative, in relation to the information presented by the expert on the decrease of overall catches in the area – trend attributed to overfishing activities – raised the issue of the mismatch and clear gap between description of the situation and identification of the causes and insisted that the role of the scientific community was to indicate a direct relationship. It was confirmed by the floor that evidences for supporting such hypothesis should be shown.

- **Stock biomass, species composition, depth and seasonal distribution of elasmobranches in the Iskenderun Bay, Northeastern Mediterranean coast of Turkey** (Turan C.)

Total biomass, species composition, depth distribution, seasonal distribution and abundance of elasmobranchs were examined for two years between 2009 and 2010 from the Iskenderun Bay, Northeastern Mediterranean coast of Turkey. In regard to total stock biomass estimates, elasmobranchs constituted 23 percent (190,06 kg/km^2) of total fish biomass (650,715 kg/km^2) in the Iskenderun Bay. The composition of the 23 percent of elasmobranchs species in the area were *Raja clavata*, *Dasyatis pastinaca* and *Gymnura altavela* showed high occurrence and represented 34%, 26% and 20% of the whole biomass of the elasmobranchs respectively. Shark species, *Squatina squatina, Mustelus mustelus, Scyliorhinus stellaris, Scyliorhinus canicula, Galeus melastomus*, represented 1.2, 1.2, 0.4, 0.4, 0.4 percent of the whole biomass of the elasmobranchs respectively. The other species, *Raja oxyrinchus*, *Rhinobatos rhinobatos*, *Raja miraletus*, *Torpedo marmorata*, *Torpedo torpedo* comprised 7.6, 7.5, 0.4, 0.2, 0.1 percent of total biomass of the elasmobranchs respectively. When seasonal distribution was examined in the Iskenderun Bay, total catch of fish were 843, 605, 279, 876 kg/km^2, of which elasmobranchs species constituted 183, 259, 155, 162 kg/km^2 in autumn, winter, spring and summer respectively. Single or sporadic captures were also recorded for *Isurus oxyrinchus*, *Carcharhinus plumbeus*, *Carcharhinus altimus*, *Oxynotus centrina* and *Raja radula*. Depth and seasonal distribution of each elasmobranch were also discussed.

- **CPUE time series and fishery trends of pelagic elasmobranchs species in Italian waters** (Garibaldi F.)

Mr Garibaldi analysed catch data of *Prionace glauca* as by-catch in swordfish fisheries. He stated that total incidental catches and CPUE of *P. glauca* in the Ligurian Sea had decreased since the

entry in force of the new law regarding Italian and Mediterranean swordfish fishery. During the last 3-4 years fishers had moved from surface longlines (1-25 m) to new mesopelagic longlines, set in a depth range 100-600 m; other deeper waters sharks species (i.e. little sleeper shark, *Somniosus rostratus*) had on the other hand increased as by-catch in the swordfish fishery.

- **Defining the stocks: Preliminary data about the presence of *Squalus megalops* in Central-western Mediterranean** (Mulas A.)

Mr Mulas described a study aimed at verifying the presence of *Squalus megalops* in the seas surrounding Sardinia. A first morphological comparison among 118 individuals belonging to *Squalus* was provided. Samples were collected at depths between 100 and 300m, during scientific surveys (MEDITS) and commercial landings, since 2010 to 2011. Specimens were divided into two groups on the basis of the number of chondrocranial processes, following Munoz-Chàpuli & Ramos (1989). 16 specimens with 1 chondrocranial process and 102 with 2 processes were obtained. No statistical differences were noticed from the analysis of the morphometric parameters neither for the body or the chondrocranium. The multivariate analysis did not find any useful parameter to establish the membership of the samples to one of the two groups. The description of the specimens corresponded with that given in bibliography for *S. blainvillei* (Compagno, 1984). The preliminary results lead to exclude the presence of *Squalus megalops* in the Sardinian waters. It was finally argued that such preliminary statement could be confirmed by the first molecular analysis.

11. Following the presentation, the experts from Tunisia informed that the presence of *S. megalop*s was confirmed in their country and that the related publication will be printed out soon by *Scientia Marina*. They wondered about the numeric consistency of the *S. megalops* stock because up to now it was not possible to be estimated since they have not been able to clearly distinguish between the two species. Some comments were made about the statistical procedures for the analysis of allometric parameters.

- **Effects of changes in mesh size for *S. canicula* in western Algerian basin** (Hemida F.)

Mr Hemida presented the results of a length frequency analysis study as an example of a feasible method for the definition of growth rates. shown the results of a Yield per recruit analysis including the proposal of using F_{max} as a limit Reference Point.

12. The issue of ageing elasmobranchs was put forward. Some participants stated that in the case of sharks exhibiting long period of spawning, length frequency approach is not the most suitable for assignation of reliable age because modes representing age classes are difficult to discriminate. The discussion followed also regarded the convenience of choosing F_{max} as reference value, since it is considered unsafe for assessing the current exploitation status of a stock. The recommendation of the SAC on the Reference Point ($F_{0.1}$) considered a proxy of F_{MSY} was recalled to the group.

- **Age, growth and maturity of *Raja Clavata* of the Gulf of Gabès: Tunisia, Central Mediterranean Sea** (Kadri H., Marouani S., Saidi B. and M.N. Bradai)

Life history parameters were estimated for *Raja clavata* from the Gulf of Gabès, where the species is a common component of the elasmobranchs landed by bottom trawls. The age and growth parameters were estimated by counting of vertebral growth rings of 160 females and 125 males, ranging in size from 16.5 to 104 cm total length (TL). Marginal increment and edge analysis supported the hypothesis of annual deposition of growth bands. The oldest female was 15 years (104 cm TL), whereas the oldest male was 12 years (89 cm TL). The von Bertalanffy growth parameters were L_∞=111.46 cm, k=0.11 year^{-1} and t_0 = -1.23 years for females and L_∞=100.8 cm, k=0.14 year^{-1} and t_0= -1.13 years for males. Males were found to mature between 55 and 75 cm

TL whereas females matured between 72.4 and 85 cm TL. The $L_{50\%}$ were 65 and 79 cm for males and females, respectively. Males and females thornback ray mature respectively at approximately 5.3 and 7 years old. The yearly estimate of egg cases production for an adult *R. clavata* was 97.

- **Age, growth and maturity of *Raja Miraletus* of the Gulf of Gabès: Tunisia, Central Mediterranean Sea** (Kadri H., Marouani S., Saidi B. and M.N. Bradai)

Age and growth of the brown ray, *Raja miraletus*, was estimated from ring countings on vertebral sections from 95 females (13.5-56.0 cm total length (TL)) and 85 males (13.5-58.0 cm TL) collected from the Gulf of Gabès during 2007. Marginal increment and edge analyses suggest annual band pair formation. The oldest female and male brown rays were 9 and 7 years, respectively. Von Bertalanffy growth parameters are $L\infty = 69.20$ cm TL, $k = 0.18$ year^{-1} and $t_0 = -0.11$ year for females, and $L\infty = 67$ cm TL, $k = 0.22$ year^{-1} and $t_0 = -1.01$ year for males.
Longevity estimates were 19.25 and 15.75 years respectively for females and males. Using empirical equations based on life history parameters, the estimated natural mortality "M" rates were in the range 0.37-0.47 for females and 0.60-0.61 for males.
Males were found to mature between 28 and 43 cm TL and reached $L_{50\%}$ at 34.31 cm (21.91 cm DW). Females were found to mature between 33 and 48 cm TL and reached $L_{50\%}$ at 41.8 cm (27.10 cm DW). Age at maturity was estimated at 2.7 years for males and 4.41 years for females. The yearly estimate of egg cases production for an adult *R. miraletus* was 147.

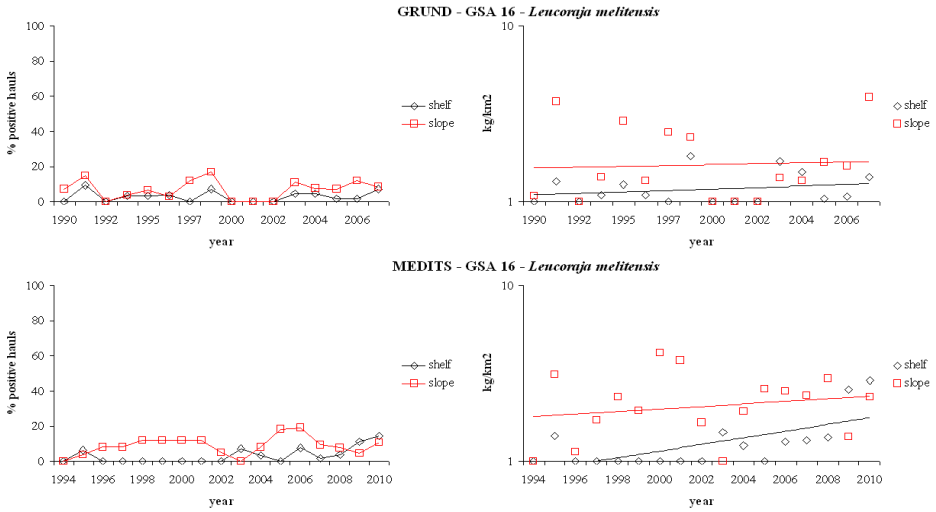
- **A preliminary assessment of the Thornback ray stock in the GSA 15 and 16 based on trawl survey data** (Fiorentino F., Knittweis L., Gangitano V., Midsuf R. and S. Vitale)

The importance of thornback ray (*Raja clavata* Linnaeus, 1758) to fisheries varies between regions, but amongst rays it is the most economically valuable species. Thornback ray is frequently caught as by catch by otter trawls and bottom longlines with relatively high rates of discard. Fishery independent information regarding the state of thornback ray stock status in GSA 15 and 16 was derived from the international trawl survey MEDITS and the Italian trawl survey GRUND. Trends in standing stock biomass indices derived from MEDITS/GRUND data (1990-2010) were analyzed using a quartile approach, and a catch curve analysis based on 3 year averages of MEDITS survey data from both GSAs 15 and 16 (2002-2004, 2005-2007, 2008-2010) was carried out. In addition, potential yield and F based biological reference points (BRP) were estimated using the "Yield" Package according to a Beverton & Holt type model (Y and SSB per recruit). Biomass indices derived from scientific surveys carried out in spring-summer (MEDITS) in GSA 15 and 16, show that the BI have been increasing steadily since 2003. The analysis of Beverton & Holt Type model combined with the estimation of mean current fishing mortality by trawl surveys data, however, suggests that the fishing mortality *R. clavata* is exposed to in GSA 15/GSA 16 exceed the reference value of $F_{0.1}$ and hence the stock is likely in overfishing status. However the assessment is considered preliminary and should be supported by the analyses of commercial data in order to give effective management advice.

- **On the abundance of the Maltese skate in the GSA 16** (Fiorentino F., Gancitano V. and S. Vitale)

The Maltese skate, *Leucoraja melitensis* (Clark, 1926) is a Mediterranean endemic batoid species (Serena 2005). In recent papers from the north Mediterranean coastline (Baino *et al*. 2001; Bertrand *et al*. 2000) and off the Malta and Tunisia waters (Bradai 2000; Schembri et al. 2003; Stehmann and Burkel 1984) this species was reported "rare", even if it's occurrence was previously moderately common. In the regional IUCN Red List "status of all assessed Mediterranean elasmobranch species" (Cavanagh and Gibson, 2007) the Maltese skate is reported Critically Endangered (A2bcd+3bcd+4bcd) as well as the SAC on elasmobranchs (FAO 2011) highlighted as the Maltese skate currently listed in Annex III (list of species whose exploitation is

regulated) might be uplisted into Annex II (list of endangered or threatened species) pending further scientific information. In contrast to what is reported in some areas of the Mediterranean Sea, in the GSA 16 data collected within the framework of the GRUND (1990 -2008) and MEDITS (1994 – 2010) scientific trawl surveys showed performance trends in abundance and biomass quite constant or even slightly increasing both in shelf and slope. Similar conclusion can be obtained considering the percent of the hauls in which the species was found in both scientific trawl surveys, suggesting that the species is not to be considered as endangered or threatened. Anyway, as suggested by Ungaro et al. (2006) the lack of information on the exploitation and the scarcity of knowledge on distribution, biology and ecology of this species, as well as trends in abundance, suggest the need to improve scientific investigation.



Data collected for the Maltese skate (*Leucoraja melitensis*)
during the GRUND and MEDITS surveys in GSA 16 (South of Sicily).

13. There was a general discussion about the choice of input parameters and stock identity and interpretations on the status of the stocks and on the reference points to be used to assess the status of a stock. Many of the input parameters were assumed or calculated from equations derived from elsewhere (i.e. Cannizzaro *et al.*). It was remarked that it is necessary to have more validation in the age estimation of the species, possibly using historical data preserved in the institution (old samples in their laboratory with carbon estimation). It was also stressed the importance to take into account the pattern of fishing exploitation operated by the fishing fleet in Mazara del Vallo which might have influenced the patterns observed and some discrepancy of the results obtained from different analyses performed on the same stock. It emerged that the fishing fleet in Mazara historically was fishing closer to the home port and now more recently switched to far distant fishing grounds giving relief to the inshore stock.

14. The presentation stimulated some discussion on the seasonality of the catches observed and whether these have some biological nature and its linkage with the behaviour of the Tunisian trawl fisheries in landing or discarding skates. In general the Tunisian bottom trawl fishery increase fishing effort in periods when skates are more abundant. This is possibly due to the fact that fishers knows when resources are more available. However Tunisian fishers does not tend to land all elasmobranchs, the amount discarded depend on the size, commercial demand and the availability of other more valuable fish (teleosts). Big skate species (e.g. *Raja clavata*, *Dipturus oxyrhincus*) and small skates such as *R. miraletus* or *R. asterias* (which according to the representative of INSTM is rare in the area) would be discarded.

GENERAL REVIEW ON THE AVAILABLE METHODS FOR STOCK ASSESSMENT, ESPECIALLY IN DATA SHORTAGE SITUATIONS

15. Mr Abella recalled that, according to the Johannesburg UN Conference, the recommendation to the scientific community was to maintain the stocks at levels of Maximum Sustainable Yields, and for the countries that have already signed this agreement imply that the levels of Biomass or fishing mortality rates which correspond with MSY should be their reference points. He presented some alternatives for reference points that can be considered as proxies of F_{MSY} such as $F_{0.1}$ derived from Yield per recruit analyses and F_{MBP} (Caddy and Csirke, 1983) based in surplus production methods, using Z (instantaneous total mortality rate) as a direct index of effort instead of f (fishing effort). He did a general overview of advantages and disadvantages of several types of models and he concluded that the choice depends on the data we have, and stressing that the more complex, the model, the more data demanding it is. A summary table with the different options and the data requirements is presented in Appendix C.

16. The EU representative enquired about the availability of data in the Mediterranean which is the first step and conditions the choice of the model, and reminded to the participants to thoroughly document the results they present by providing the data, the input parameters and the estimation methods they used so as to allow reproducibility of the analysis for any other scientist that may want to do it.

17. The moderator highlighted the fact that in SAC/GFCM working group we are already using tools, i.e. Stock Assessment Forms, to gather this information and to allow reproducibility of analyses, and that is the usual way of working, for the finfish and invertebrate stocks assessed every year. This should be also the case when dealing with elasmobranchs.

- **The WGEF approach to dealing with data-poor elasmobranch stocks** (Johnston G.)

  Mr Johnston informed the participants that the ICES Working Group on Elasmobranch Fishes (WGEF) provides advice on several elasmobranch stocks in the NE Atlantic. He indicated that many of these are data-poor, while assessment is complicated by the catch of several of these species in mixed fisheries. He then outlined the approach taken by WGEF in assessing and drafting advice for these stocks, showing that that the only full assessment was related to *S. Acanthias* with MSY approach through production models and that very limited assessment without updated reference points was implemented for *Lamna nasus*.

18. The floor asked for information on the minimum and maximum sizes historically allowed for *S. Acanthias* and on the fact that they are included among the pelagic species as well as on the explanation for the fluctuations on the abundance curve of skates other than effort. It was explained that the WGEF was basing the *S. acanthias* analysis on direct surveys data although more assessments based on commercial data would be considered in the future. Assessments of skates and rays use a combination of commercial and survey trends.

- **Searching forward a conceptual framework for the statistical analysis of occurrence data for large elasmobranch species: case study of porbeagle shark *Lamna nasus*** (Scacco U.)

  Mr Scacco showed that, since a large amount of information for Mediterranean large elasmobranch species is often represented by single records of occurrences and sightings, the validation of a species' presence in a given area often depends on the quality and accuracy of data reported in occurrence descriptions. He then proposed a statistical method to assess the quality and strength of occurrence data from literature aiming at a standardization of such information. The case study of porbeagle shark *Lamna nasus* was discussed as an example, based on the recent by-catch of two specimens of this species in the central Adriatic sea and on review of information

provided by the latest and historical occurrence data for the mentioned species. He continued explaining that the porbeagle shark, a large elasmobranch globally classified as vulnerable on the IUCN red list, seemed to have virtually disappeared from the Mediterranean sea. Its findings in the Adriatic sea suggested a likely correlation between density of species occurrences and the presence of a biologically significant environment, namely the Jabuka-Pomo pit. Mr Scacco argued the methodological framework proposed, that gives different weight to the information related to qualitative characteristics of the information to be useful to get a quantitative evaluation of the quality of occurrence information, as a prerequisite to identify marine areas ecologically significant for large and highly migratory elasmobranch species.

19. Subsequently, questions were raised about the subjectivity of the scale used for scoring the records and about the reliability of the records when it is not supported by pictures and real proofs of the sighting. It was proposed to provide data of recent records in central Adriatic for validating the method. Some concern was expressed on the fact that the number of criteria used to score the records was quite high and the model very sensitive; it was hence advised to use less criteria. Some participants expressed doubts about the use of sighting data, since elasmobranchs are fishes that do not need to surface to breathe as cetaceans do. As a consequence, sightings are probably more abundant in certain areas and for certain species.

- **Considerations on the EU project - Fish/2004/03-41: Status of ray populations in the Mediterranean Sea and advice for sustainable exploitation of the stocks** (Serena F.)

The presentation described the main results as regards stock assessment of an EU Project. It was highlighted that yield per recruit methods were used for three species of *Raja*: *R. miraletus*, *R. asterias* and *R. clavata*, and showed a growth overfishing status in most of the GSA assessed. Composite models assuming Shaeffer models were also applied to MEDITS and Grund Trawl survey data for *Raja asterias* and *R. clavata*. Values of the reference point F_{MBP} = 0.3 and 0.39 respectively were obtained and compared with the current F values in the different areas. It was stressed that the conclusions of the MEDITS Coordination meeting (Data Collection Programme) produced by the meeting held in Nantes were to build up a Protocol for using MEDITS raw data on elasmobranchs. It was stated that the steps to follow are: Create an archive for raw data, analyze them with a variety of statistical methods (e.g. Generalized Linear Models, hierarchical Bayes methods, meta-analytic methods, delta-gamma models and others) and modeling aspects related to the management of fish stocks comparing different scenarios.

- **Use of Leslie matrix for the assessment of the exploitation status of *Raja asterias*, *Raja clavata*, *Scyliorhinus canicula* and *Galeues melastomus*** (Abella A., Mancusi C. and F. Serena)

A demographic analysis was used for the definition of the status of the stock regarding its capacity of self-renewal (Caswell, 1989). The model rely primarily on life history parameters. Such analysis is expected to provide some useful information for management. The approaches based on life history traits as fecundity and survival rates are widely used for modelling population dynamics in elasmobranchs. The model allows simulations of replacement at different fishing mortality rates. The approach was used for the assessment of *Galeus melastomus, Scyliorhinus canicula, Raja clavata* and *Raja asterias*. The model allows the definition of a reference point based on fishing mortality related to the ability of the stock to self-renewal.

20. The presentation stimulated some discussion on the applicability of the model to other species and on the possibility to adopt an ecosystem approach with such modelling exercises (i.e. the application to several species in a time). It was remarked that in general adopting an ecosystem approach in these situation would add complexity to the models and their data requirements. Given the general status of data shortage of the Mediterranean this could be a hard thing to accomplish in the area. The moderator underlined the possibility to give advice for some species despite their non-

commercial relevance. The audience raised the question of the suitability of the use of this method also with plancental viviparous species, which was immediately confirmed by the moderator. With regard to the presentation of the moderator on the Productivity and Susceptibility Analysis some of the experts remarked the need of a lot of data for such assessment and asked to extend the method to a whole spectrum of fishery species besides the elasmobranchs. Some on the experts re-marked the issue of the subjectivity of the method to the classification scheme (choice of indicators and relative weight).

DATA QUALITY AND FORMATS STANDARDIZATION

21. The floor was opened to allow participants to share information about their available data, in order to determine which data to work on during the practical sessions. It was decided to analyze 3 sets of data under different models; *Rhinobatos cemiculus* from Tunisia (see Appendix E), *Scyliorhinus canicula* from Algeria (see Appendix F), *Squalus acanthias* from the Black Sea area (information from Ukraine jointly provided by the Bulgarian and Romanian experts) (see Appendix G) and Raja clavata from Malta and South of Sicily (see Appendix H).

REPORT OF THE PRACTICAL SESSION

22. The Moderator showed to the conveners the NOAA (http://nft.nefsc.noaa.gov/) toolbox for stock assessment accessible at http://nft.nefsc.noaa.gov/. Firstly an index model (http://nft.nefsc.noaa.gov/AIM.html) was explored, together with PSA, Length Based Y/R, and Surplus production models. Also the excel add in poptool (http://www.poptools.org/) was explored . There was a general interest from the audience on the applications and platforms to be used to run the models. After a general overview on the models there was a call for data to be used in the workshop; 3 species were selected coming from 5 areas: *Squalus acanthias* in the Black Sea, *Scyliorhinus canicula* in Algeria, *Glaucostegus cemiculus* in The Gulf of Gabes, Tunisia and *Raja clavata* in Malta and South of Sicily. The results are shown in Appendix E, F, G and H.

23. The practical session proceeded in groups composed of researchers involved in the analyses of their own data. The groups started working on PSA, Y/R and Surplus production models. Resources in R http://www.ncfaculty.net/dogle/fishR/packages/packages.html.

24. http://cran.r-project.org/web/packages/fishmethods/fishmethods.pdf shows length based year per recruit. Beverthon and Holt equation. PSA model, surplus production models with catch rates from surveys and fishery landings.

25. Under the guidance of the moderator, participants analyzed the provided sets of data with downloaded software in their personal laptops. Software used was Length Based Yield per Recruit (YPRLEN), a module of the ToolBox from NOAA which allows obtaining Yield per Recruit curves is an implementation of the basic Thompson-Bell model for estimating the expected lifetime yield and biomass from a cohort subjected to varying levels of fishing mortality.

26. The process and the results were showed in the screen and discussed. Several trials were performed with changing values of some parameters. For *R. cemiculus* in Tunisian waters it was possible to estimate F fishing mortality rates with a length cohort analysis. The current F, with an average of 0.102, is mainly due to the gillnet fishery removals. Such value was compared with the value estimated by YPRLEN for $F_{0.1}$= 0.19. The results lead to the conclusion that the stock exploited by gillnet fishery in southeastern Tunisia is in an under-exploitation status. Landings reported by trawlers are negligible and mainly caught as by-catch. The results should be analysed with caution due to the fact that VPA doesn't perform very well when F is much lower than M.

27. The analysis for Algerian data for *Scyliorhinus canicula* showed that the obtained value of current F= 1.38 (with a length converted catch curve) is much higher than $F_{0.1}$= 0.51, and F_{max} =1.051. As the results is so much influenced by parameters such as the M value, it is necessary to use the appropriate parameters and is also possible to use different approaches and get a set of values and chose those that can be considered more reliable. It is also possible to compare used parameters with those already published for the species elsewhere.

28. In the case of the stock of *S. acanthias* in the Black sea, the results were thoroughly discussed. Due to the erratic fluctuations of the Mortality rates obtained through the catch curve method, it is not possible to derive a mean reliable current F, these fluctuations are occurring synchronic to the specific ecological events occurred in the Black sea such as the blooms of gelatinous species due to eutrophication processes that may have had strong impact on the natural mortality of the fished resources even stronger that the this caused by the fishery.

29. The group was requested to draw up Assessment Reports following the template of the Demersals and small pelagic Working Groups with the information available and the results of the assessment done at the sessions. These sheets are provided as Appendixes (E, F, G, H) to this report together with a table summarizing the assessments of the elasmobranchs species presented and/or performed during the Workshop (Appendix D).

MANAGEMENT AND CONSERVATION

- **Biology and ecology of sharks in NE Atlantic and Mediterranean. Study of acoustic deterrents to limit sharks incidental catches** (Bitòn S.)

He presented his project of Doctoral thesis financed by the Spanish Ministry of Environment, rural and Marine affairs. He studies the ecology and biology of sharks populations affected by the surface longlines in NE Atlantic and Mediterranean. In a second phase, he will analyze the effectiveness of different repellers to reduce sharks by-catch. Results are not yet obtained, only some records of landings in the port of Vigo.

30. Mr Bitón was asked about technical characteristics of the device they are going to use and he replied that those are going to be magnetic wave devices that are going to be tested for the first time. He was advised to consider also the effect of these devices in the long term.

- **Elasmobranches listed in the Annexes to the SPA/BD Protocol of the Barcelona Convention** (Cebrián D.)

RAC/SPA recently prepared Protocol annexes lists reviews, adding several new elasmobranch species. RAC/SPA engaged elasmobranches experts to verify for 2009 and 2011 SPA Focal Points meetings the status of cartilaginous fish species found in the Mediterranean, worthy to figure in the Annexes II or III to the SPA/BD Protocol of the Barcelona Convention. It further undertook on the same years consultations with regional experts. Four species already listed since 1995 where considered in 2009 worthy to be kept in their actual listing; other six ones were proposed for uplisting to Annex II and other 23 new ones were proposed to be added to the annexes (UNEP(DEPI)/MED WG.331/6). Amendments to the annexes II and III to the SPA/BD Protocol were finally adopted on 2010 by the Barcelona Convention Parties, including most of the elasmobranches proposals. Certain Parties requested then to update the scientific assessment and to further evaluate the status of shark species listed in Annex III, with a view to consider at the 2012 Meeting of the Contracting Parties the possible amendment of the SPA/BD Protocol for further inclusions in Annex II. Species to be considered at the 2012 Meeting of the Contracting Parties for uplisting to Annex II include: species newly listed in Annex III on 2010 for which direct listing in Annex II had been proposed: *Sphyrna lewini, Sphyrna mokarran, Sphyrna*

zygaena, Leucoraja melitensis, Leucoraja circularis, Rhinobatos rhinobatos and Rhinobatos cemiculus (UNEP(DEPI)/MED WG.359/7); species for which uplisting from Annex III to II is been requested but not yet adopted: *lsurus oxyrinchus, Lamna nasus* and *Galeorhinus galeus* (UNEP(DEPI)/MED WG.359/7). Contributions on elasmobranchs status & scientific assessment gaps by the participants to GFCM meetings may assist the Parties to the SPA/BD Protocol to undertake future annexes reviews on these species.

31. Some questions were addressed on the criteria they use for the allocation of the species in the lists (Annex II is fully protected and annex III is properly managed) and also about the collaboration between RAC/SPA and IUCN. The IUCN members described the work done by the IUCN and explained the process in which double revision by experts is undertaken following certain criteria that are published by the IUCN. EU stressed that scientists must provide a sufficient basis for this evaluation, and also suggested that GFCM considers the species in the lists for further assessments. Some experts mentioned that a duplication of efforts could be avoided when IUCN and RAC/SPA could collaborate since the expert are the same all over the Mediterranean and should share the information with the GFCM. The working group asked to some of the participants who take part of the process for IUCN and RAC/SPA to show to the table with the criteria they use and an example of one of the species included in the protection/conservation lists of both organizations. It was raised the issue doubling effort for assessing the conservation status of species, mainly on the objection that some species are endangered for the IUCN but yet not listed in the Annexes of the Barcelona convention. IUCN assessments are taken into consideration for the listing of the species. However it is not automatic that a species is listed either in app. III or II on the basis of the IUCN classification. RAC/SPA classification does independent assessments sometime requesting advice by the same scientist involved in IUCN and sometimes not, they also take into account management and political consideration. The choice seems subjective with unclear criteria. It was also acknowledged that there are reasons to justify the non-automatic listing of a species on the basis of the IUCN, but there should be clear specification of these reasons to ensure the process is clear, transparent and replicable. It was proposed a greater collaboration between GFCM, IUCN and RAC/SPA to avoid doubling of effort in some phases of the decision-making. It was suggested that the RAC/SPA adopted a more clear and objective set of rules for the classification of species. Concerns are on the species with high commercial interest or on those whose management actions would have profound implication for the fishery for which they are by-catch. It was feared that these would have less chances to be included in Appendix II. In fact, it was suggested that species such as blue (*Prionace glauca*) and mako (*Isurus oxyrinchus*) sharks would hardly be inserted into Appendix II because their inclusion would imply heavy restrictions on the swordfish and tuna long-line fisheries. The DG-MARE representative warned that RAC/SPA should not take IUCN advice automatically because too many species of great commercial value would be included in Appendix II. However in the end it was recognized that for the scientific phase it is best to co-ordinate the efforts.

- **Elasmobranch management in Croatia** (Soldo A.)

Mr Soldo explained that the number of sharks and rays caught in the Adriatic, as well as in the whole Mediterranean area, has been poorly reported. Main reason for such situation is that national or international regulations for reporting catch and by-catch are not existing, not enforced, or ineffective. Thus, deficiency of such information, including specific biological and ecological data, limits the stock assessments of these species and, consequently, their management and protection.
Hence, in most cases, when some kind of management of elasmobranch species in Mediterranean exists, the used techniques and enforcement measures are insufficient to ensure the long-term good status of those species and populations. Moreover, it has to be noted that assessment models, that are usually applied, are based on teleost fisheries, but such models are inadequate to elasmobranch populations. Unfortunately, for the most of elasmobranch species, absence of usually required and conventional stock assessment data results with absence and/or postponing of applying measures for their conservation. However, such data deficiency can not be used as a reason for lack of action. Therefore, Croatia chose to applied precautionary approach to elasmobranchs management, based on existing available data. As a result, since 2009 Croatia have granted strictly protected status to

23 elasmobranch species, which is highest level of protection, according to croatian regulations. Within those species 16 are large sharks, mainly highly migratory species. Such measures have positioned Croatia as the leading European country in elasmobranchs conservation, so methodology of that process is described in this presentation.

32. The Croatian expert was asked about the distribution of basking sharks in Croatian waters and on the process that lead to the legislation adopted for the protection of the species.

- **Elasmobranches Exploitation and Conservation in Syria** (Saad A.)

Mr Saad, explained that the Laboratory of Marine Sciences at Tishreen University had been conducting since 2005 a research program on elasmobranchs' monitoring, distribution and exploitation off the Syrian coast through data collection programs, permitting and reporting requirements, identification of essential fish habitat, by-catch reduction of sharks in all fisheries, and promoting safety at sea for shark fishermen. As a result, it was explained that 41 cartilaginous fish species including 23 shark species had been recorded in Mediterranean Syrian water, some of these species are commercially important and have been exploited over the ages as target species (*C. plumbeus, Squatina spp., Shinobatos spp.*, and *Raja spp.*) or by-catch of the gillnet and longline fishery, since trawling is banned in Syrian waters since 2005. Others are rare or very rare, and therefore have not been recorded on a regular basis. A decline of some shark populations has been observed.

- **Sustainability of by-catch of sharks and finfish in the Norway lobster fishery** (Abella A.)

An assessment of the sustainability of by-catch species in the Norway lobster fishery was performed. The analysis was done using the software PSA (Productivity and Susceptibility Analysis) aimed at examining the impact of the above mentioned fishery on the fishery's by-catch with particular reference to some cartilaginous fishes species. *Galeus melastomus* and *Dipturus oxyrhinchus*, the only two elasmobranchs that were included in the analysed list of species resulted to be the more vulnerable species according with this approach.

- **Long-term ecological change in the elasmobranch community of the Adriatic Sea** (Ferretti F.)

The presentation touched upon elasmobranchs diversity and abundance which can drop considerably after short period of fishing although community changes are complex and may involve species-specific intrinsic vulnerability, differential exposure to fishing, and varying biological interactions. Mr Ferretti presented an analysis of a demersal community of elasmobranchs in the Adriatic Sea, a large continental shelf of the Mediterranean where marine ecosystems have been exploited for hundreds of years. He explained that in that highly exploited ecosystem, top-predators have been reduced to very low levels, and fishing developed with higher impact on the western side. Utilizing gradients of perturbation, we combined data from five research trawl surveys between 1948 and 2005. We applied generalized linear models and a multi-model information theoretic approach to standardize catches controlling for technological and environmental covariates. Long- and short-term abundance trends were estimated, and used life histories, fish-market and effort data, and historical information to explain community changes. The results revealed an elasmobranch community in an advanced state of depletion. Since 1948, catches have declined by >92% and 11 species disappeared. The long exploitation history and strong spatial gradient of fishing intensity from west to east explained most patterns in abundance and diversity. Few compensatory increases were detected, mostly in less-exploited areas and in older surveys. Historical data suggested stronger compensatory changes in previous centuries. He finally argued that the results highlighted ecological corridors and large-scale protected areas as promising management options for elasmobranchs' recovery, which, despite their slow population dynamics, can show rapid increases through migration from less exploited areas.

GENERAL CONCLUSIONS AND RECOMMENDATIONS

- The following general conclusions were drawn from the workshop:

a) Data Deficiencies

Assessments, in the main, have been hampered by a lack of reliable data. While survey data are available, both at a national level, and from co-ordinated surveys such as MEDITS, commercial data is not available in the same quantities and detail. The lack of length data from the commercial catch composition limits the types of stock assessment that can be carried out. There are three main data issues, two related to official landings statistics, the other to commercial data.

b) Official statistics

While the availability of official landings statistics is improving, there appears to be an underreporting of landings, as compared to data available from individuals at the meeting. This can be for a number of reasons:

i) Fishermen may not take care when completing landings data records, for a variety of reasons;

ii) Administrations may not consider that it is important to collect accurate data for these species, or do not have adequate data collection systems in place;

iii) Some species could be underreported to avoid highlighting the level of by-catch;

iv) Some small inshore vessels may target (or have a by-catch of) certain elasmobranch species and the landings of such inshore vessels may not always be included in official statistics.

c) The use of generic landings categories

Where landings data are supplied, they are rarely available at species level. Catches are frequently supplied to the GFCM in generic categories such as "dogfish sharks nei", "*Raja*, rays nei" or even just as "Sharks, rays, skates etc. nei". The problems associated with this approach have been documented in other regions (ICES 2006, Johnston *et al*. 2005). The use of generic categories means that accurate species assessments are not possible, as the proportion of individual species within these categories cannot be calculated. Trends in landings or CPUE cannot be seen when landings are declared to these levels.

d) Port sampling data

Stock assessment models require data on the age or length composition of the commercial catches. Port sampling programmes are required to collect these data. These programmes would have the added benefit of proving additional data that would help separate the generic catches outlined above into their constituent species.

- Need to improve correct species identification, both for full specimens and for uncompleted carcasses landed at port after finning or trunking.

- Difficulties on ageing elasmobranchs – Standardized methods (spines, vertebrae, length frequency methods) and protocols should be agreed.

- Need to establish biological reference points for most species.

- Need to harmonize values of Biological Parameters and be well aware of the influence these parameters have on the final results of the assessment. The GFCM Biological Parameters database is a good tool towards this process.

- The importance of comparative studies among neighboring countries, such as the cases of Black Sea, Adriatic Sea and Alboran Sea, and to combine information in order to obtain more complete picture of the stocks situation.

33. The workshop agreed on the following recommendations:

A. Commercial data collection programmes for both targeted and by-catch species and by-products, should be developed in a standardized way at regional level with harmonized protocols based on the existing FAO and other guidelines already published.

B. Elaboration of field practical guides for identification of the species and dissemination of the existing ones.

C. Enhance capacity building through training workshops to improve knowledge on assessing the age such as the one being organized by the GFCM within the framework of the "medium term research program to improve the knowledge on elasmobranchs" currently in force and that will be held from 12 to 16 March 2012 in Antalya, Turkey. Identification training workshops as well as on quantitative analysis are also advisable.

D. Make use of the existing experience on the work in other areas, to use available methodologies to assess the status in cases of data shortage as for the specific cases of long lived species.

E. To create a multi-choice table to facilitate the selection of methods to be used, adapted to the data available and to the Mediterranean context (data shortage).

F. The research institutions from neighboring countries sharing stocks should strengthen their collaboration.

G. Collaboration needs to be granted among the organizations dealing with conservation issues (e.g. IUCN, RAC/SPA) so as not to duplicate efforts, base their evaluations on the most sound scientific knowledge, and also improve the consultation process with the GFCM.

ANY OTHER MATTERS

34. The participants unanimously thanked the EU for providing support in the organization of the meeting. The participants also thanked the Chairs and the Rapporteurs for their work.

ADOPTION OF THE REPORT/RECOMMENDATIONS

35. The Conclusions and Recommendations were adopted by the Workshop on Friday 16th December 2011. The whole report was adopted after revisions and amendments by electronic correspondence within the next two weeks.

Appendix A

List of Participants

Saidi **BÉCHIR**
Institut National des Sciences et Technologies de la Mer (I.N.S.T.M)
28 rue du 2 mars 1934 - 2025
Salammbô, Tunisia
Tel : +216 71 730420
Fax : +216 71 732622
Email: saidi-b@lycos.com

Sadia **BELCAID**
Institut National de Recherche Halieutique
BP 5268 Dradeb Tanger, Morocco
Tel: 0021239325139
Fax: 0021239325139
Email: s.belcaid@menara.ma
sadiabelcaid@hotmail.com

Franco **BIAGI**
Directorate General for Maritime Affairs and Fisheries. Unit A-2: "Fisheries Conservation, Mediterranean, Black Sea, Environmental Issues"
Rue Joseph II, 99
B-1049 Brussels, Belgium
Tel: +32 2 2994104
E-mail: franco.biagi@ec.europa.eu

Sebastian **BITON PORSMOGUER**
Université AIX-MARSEILLE II
Campus du Luminy
163 Av. du Luminy
13288 Marseille, France
Tel.: +04 91 82 93 00
Email: medio.marino@chelonia.es

Mohamed Nejmeddine **BRADAI**
Institut National des Sciences et Technologies de la Mer (I.N.S.T.M)
28 rue du 2 mars 1934 - 2025
Salammbô, Tunisia
Tel : +216 71 730420
Fax : +216 71 732622
Email : Mednejmeddine.bradai@instm.tn

Daniel **CEBRIAN-MENCHERO**
RAC/SPA-UNEP/MAP
Bd. Du Leaser Yasser Arafat-B.P 337 – 1080
Tunis Cedex, Tunisia
Email: Daniel.cebrian@rac-spa.org

Simona **CLÓ**
CTS
Via Albalonga 3
00166 Rome, Italy
Email: Simona@medsharks.org

Francesco **FERRETTI**
Hopkins Marine Station of
Stanford University
120 Oceanview Blvd., Pacific Grove
CA 93950, USA
Tel: +1 831 655 6251
Fax: +1 831 375 0793
Email: ferretti@stanford.edu

Abderrahmen **GANNOUN**
Director RAC/SPA-UNEP/MAP
Bd. Du Leaser Yasser Arafat-B.P 337 – 1080
Tunis Cedex, Tunisia
Email: gannoun.abderrahmen@rac-spa.org
car-asp@rac-spa.org

Fulvio **GARIBALDI**
DIP.TE.RIS
University of Genoa
C. so Europa, 26
16132 Genova Italy
Tel.: +39 010 3533018
E-mail: garibaldi.f@libero.it
largepel@unige.it

Farid **HEMIDA**
ENSSMAL
Campus universitaire
BP 19 16320 Dely
Ibrahim, Algiers, Algeria
Email: faridhemida@gmail.com

Graham **JOHNSTON**
Marine Institute
Rinville, Oranmore, Galway, Ireland
Tel: +353 (87) 2075963
Email: graham.johnston@marine.ie

Antonello **MULAS**
University of Cagliari
Department of Sciences of Life and Environment
Section of Animal Biology and Ecology
Via Ing. T. Fiorelli 1
09126 Cagliari Italy

E-mail: amulas@unica.it

Francois **POISSON**
IFREMER - Centre de Recherche Halieutique
Méditerranéenne et Tropicale,
B.P. 171 Avenue Jean Monnet,
34203 Sète, France
Email: francois.poisson@ifremer.fr

Nazmi **POLAT**
19 May University Science Faculty
Faculty Atakum Samsun
Turkey
Tel: 050 55890684
Email: npolat@omu.edu.tr

Gheorghe **RADU**
National Institute for Marine Research and
Development "Grigore Antipa"
B-dul Mamaia 300
Constanta, Romania
Tel: +40 0724 173294
Email: gpr@alpha.rmri.ro

Violin **RAYKOV**
Institute of Oceanology
Bulgarian academy of Sciences
Parvi Mai str. 40,
P.O.Box 152, Bulgaria
Email: vraykov@io-bas.bg
vio_raykov@abv.bg

Umberto **SCACCO**
I.S.P.R.A
Via di Casalotti 300
00166 Rome, Italy
E-mail: umbertoscacco@hotmail.com

Adib **SAAD**
Tishreen University
P.O.Box 1408
Lattakia, Syria
Tel: +96 393 347 7752
Email: adibsaad@scs-net.org
adibsaad@gmail.com

Fabrizio **SERENA**
A.R.P.A.T.
Via Marradi 114
57100 Livorno, Italy
Tel: +39 055 3206996
Email: f.serena@arpat.toscana.it

Alen **SOLDO**
Center for Marine Studies
University of Split
Livanjska 5, 21000
Split, Croatia
Tel: +385 21 558260
Fax: +385 21 558257
Email: soldo@unist.hr

Cemal **TURAN**
Mustafa Kemal University
Fisheries Faculty
Meydan Cad., 12
Iskenderun/Hatay, Turkey
Email: turancemal@yahoo.com

Sergio **VITALE**
Consiglio Nazionale delle Ricerche
Istituto per l'Ambiente Marino Costiero
U.O. di Mazara del Vallo
Italy
Email: sergio.vitale@iamc.cnr.it

Moderator

Alvaro **ABELLA**
ARPAT
Via Marradi 114
57100 Livorno, Italy
Tel: +39 0586 263456
Fax: +39 0586 263477
E-mail: aa00477@arpat.toscana.it
a.abella@arpat.toscana.it

GFCM Secretariat

Pilar **HERNANDEZ**
Information Management Officer
GFCM at Palazzo Blumenstihl,
Via Vittoria Colonna 1,
00193 Rome, Italy
Tel.: +39 06 57054617
E-mail: pilar.hernandez@fao.org

Margherita **SESSA**
GFCM at Palazzo Blumenstihl,
Via Vittoria Colonna 1,
00193 Rome, Italy
Tel.: + 39 06 570 52827
E-mail: margherita.sessa@fao.org

Appendix B

Adopted Agenda

1. **Opening session**

2. **Overview the characteristics of Chondricthyans in terms of biological features and data availability:**
   - Identification of technical constraints posed by their bio-ecological characteristics and data collection when compared to Ostheichthyans
   - Difficulties regarding the definition of reliable biological parameters

3. **General Review on the available methods for stock assessment, especially in data shortage situations, including:**

4. **Identification/setting of biological reference points (BRPs) and maximum sustainable yield (MSY) proxies**

5. **Data quality and formats standardization**
   - Analysis of the data sets provided by the participants (e.g. length frequencies, time series of abundance, structure by age, commercial *vs* surveys data)

6. **Practical session:**
   - Review of the available stock assessments
   - Stock assessment analysis, including diagnosis and formulation of management advice; illustration of some potentially useful software

7. **Management and conservation**

8. **General conclusions and recommendations including:**
   - Suggestions to improve data collection and assessment methods used
   - Advice for the consideration of the Scientific Advisory Committee (SAC)

9. **Any other matters**

10. **Adoption of the report and closure of the meeting**

Appendix C

Data Requirements Summary Table

METHOD	*DATA sources*	*Parameters for input*	*Parameters in output*	*Reference Point*	*Software (free shared)*	*Complexity*
VPA, Statistical catch-at-age	Commercial data	Total catch by age, M, terminal F	F vector, Numbers at age, Recruitment	Trends	XSA(Lowestoft) VPA (NOAA), others	High
Surplus Production Models	Commercial data	Catch and effort or Catch and Biomass	r, K, q, F per year, etc	f_{MSY}, F_{MSY}, B_{MSY}	ASPIC (NOAA), Spreadsheet (GFCM) CEDA (FAO)	Medium
Yield per Recruit, S/R	Parameters derived from biological sampling studies	L_∞; K, to, L/W a and b, M; Lc or selectivity, Lm or maturity ogive	Y/R vs F SSB/R vs F	$F_{0.1,}$ Fmax, Fx%SSB	FISAT (FAO), YIELD (FAO), YPR length(NOAA), YPR age(NOAA)	Low
Life tables and Leslie matrices	Biological sampling	Fecundity at age, Survival at age, M	r, net reproductive rate, generation time, etc	Frepl (r=0)	PopTools http://www.cse.csiro.au/poptools/	Low
Surplus ProductionModels using fishery independent data	Trawl surveys size structure by year and catch per unit of area	M, Z and index of abundance	r, B' (index of Carrying capacity)	F_{MSY}	Excel spreadsheets files	Low
Mortality estimates using trawl surveys	Trawl surveys size distribution by year	Size distributions, M, catchability at age	Z, tm, F, Recruitment per year, SSB per year	Trends	SURBA Coby L. Needle FRS Marine Laboratory Aberdeen	Low
LCA	Commercial catch	Size distribution of commercial catch, M, growth parameters	Vector of F, Numbers at sea, recruitment	Trends	VIT (Lleonart) FISAT (FAO) LFDA (CEFAS)	Low
Collie-Sissenwineme thod	Commercial catch and surveys data	Catch by age and abundance indices of trawl surveys separated by recruits and older inds.	Abundance and mortality rates	Trends	CSA (NOAA)	Medium

Some indicators potentially useful included in the NOAA stock assessment toolbox

An Index Method (AIM) allows the user to fit a relationship between time series of relative stock abundance indices and catch data. Underlying the methodology is a linear model of population growth, which characterizes the population response to varying levels of fishing mortality. If the underlying model is valid, **AIM** can be used to estimate the level of relative fishing mortality at which the population is likely to be stable. The index methodology can used to construct reference points based on relative abundance indices and catches and to perform deterministic or stochastic projections to achieve a target stock size.

AIM was developed by Dr. Paul Rago at the NMFS Northeast Fisheries Science Center.

The Depletion-Corrected Average Catch
Unlike the classic fishery problem of estimating MSY, data-poor fishery analysis must be content simply to estimate a yield that is likely to be sustainable. While absurdly low yield estimates would have this property, they are of little practical use. Here, the problem is to identify a moderately high yield that is sustainable, while having a low chance that the estimated yield level greatly exceeds MSY and therefore is a dangerous overestimate that could inadvertently cause overfishing and potentially lead to resource depletion before the error can be detected in the course of fishery monitoring and management.
Perhaps the most direct evidence for a sustainable yield would be a prolonged period over which that yield has been taken without indication of a reduction in resource abundance.
The estimate of sustainable yield would be nothing more than the long-term average annual catch over that period. However, it is rare that a resource is exploited without some change in underlying abundance. If the resource declines in abundance (which is necessarily the case for newly-developed fisheries), a portion of the associated catch stream is derived from that one-time decline, and does not represent potential future yield supported by sustainable production. If that non-sustainable portion is mistakenly included in the averaging procedure, the average will tend to overestimate the sustainable yield. This error has been frequently made in fishery management.

DCAC was developed by Alec MacCall, NMFS/SWFSC/FED (draft 9/6/07)

Other indicators

Trends in abundance, F, Z, C/B, as well as mean size, mean tm, etc can be potentially used for checking any trend. The existence of a statistically significant trend can be interpreted as a enhancement or worsening of the exploitation status, but they will be only useful for detecting such changes if no reference level (limit or target) is defined.

Appendix D

Summary of the assessments presented and/or performed during the Workshop

Stock	GSA	Data	Method & Software	Reference Point	Stock Status	Advice & Recommendation
Raja asterias◦	**9** *Ligurian and North Tyrrhenian Sea*	Abundance indices from 28 years trawl surveys and 20 years of commercial catch. Age structure of commercial catch 2 yrs. Biological parameters. Growth, natural mortality, fecundity at age	$F_{rm=0}$ with Leslie matrix, Z with catch curve,and $F_{0.1}$ with Y/R Software: poptools and YPR NOAA	F_{rm}=0 $F_{30\%SSB}$ and $F_{0.1}$	in overfishing status	Reduction of F
Raja clavata◦	**9** *Ligurian and North Tyrrhenian Sea*	Size composition from trawl surveys and 20 years of abundance index commercial catch. Biological parameters. Growth, natural mortality, fecundity at age	Frm=0 with Leslie matrix, Z with SEINE and $F_{0.1}$ with Y/R Software: poptools and YPR NOAA	F_{rm}=0 $F_{30\%SSB}$ and $F_{0.1}$	in overfishing status	Reduction of F
Scyliorhinus canicula◦	**9** *Ligurian and North Tyrrhenian Sea*	Size composition from trawl surveys and 2 years of commercial catch. Biological parameters. Growth, natural mortality, fecundity at age	Frm=0 with Leslie matrix, Z with SEINE and $F_{0.1}$ with Y/R Software: poptools and YPR NOAA	F_{rm}=0 $F_{30\%SSB}$ and $F_{0.1}$	in overfishing status	Reduction of F
Galeus melastomus◦	**9** *Ligurian and North Tyrrhenian Sea*	Size composition from trawl surveys and 2 years of commercial catch. Biological parameters. Growth, natural mortality, fecundity at age	Frm=0 with Leslie matrix, Z with SEINE and $F_{0.1}$ with Y/R Software: poptools and YPR NOAA	F_{rm}=0 $F_{30\%SSB}$ and $F_{0.1}$	in overfishing status	Reduction of F
Raja clavata◦	**15,16** *Malta Island and South of Sicily*	Size distribution and abundance from trawl surveys. Biological parameters. Growth curve, L/W, M	Catch curve and Y/R analysis Software: LFDA and Yield of CEFAS-FAO	F_{max}, $F_{0.1}$, $F_{30\%SSB}$	in overfishing status	Reduction of F

* Assessments performed during the practical session of the Workshop
◦ Assessments presented during the Workshop

Scyliorhinus canicula*	**4** *Algeria*	Size distribution and abundance from trawl surveys. Biological parameters. Growth curve, L/W, M	Catch curve and Y/R analysis Software: LFDA and YPR NOAA	F_{max}, $F_{0.1}$, $F_{30\%SSB}$	in overfishing status	Reduction of F
Glaucostegus cemiculus*	**14** *Gulf of Gabes*	Size/Age distribution commercial catches, trawl surveys, Biological parameters. Growth curve, L/W, M, fecundity	Catch curve and Y/R analysis Software: VIT and YPR NOAA	F_{max}, $F_{0.1}$, $F_{30\%SSB}$	underexploitation status	no recommendations
Squalus acanthias*	**29** *Black Sea*	Size/Age distribution commercial catches, trawl surveys, Biological parameters. Growth curve, L/W, M	Catch curve and Y/R analysis Software: VIT and YPR NOAA	F_{max}, $F_{0.1}$, $F_{30\%SSB}$	uncertain considering the highly variable natural mortality along time series	Enhance the knowledge on influence of environment and species interactions on abundance and survival

* Assessments performed during the practical session of the Workshop
◦ Assessments presented during the Workshop

Appendix E

Glaucostegus cemiculus

GSA: 14 (Gulf of Gabes)

Authors: Enajjar S., Saidi B. and M.N. Bradai

Fishery: In Tunisia, elasmobranchs constitute about 2% (2000 Tones/an) of national fish production. They are captured mainly by the bottom trawl, gillnets and longlines. The most abundant fishing zone is the Gulf of Gabès from which about 70% of Tunisian production is landed.
In the Gulf of Gabes, the blackchin guitarfish, *Glaucostegus cemiculus* is targeted by a little traditional fleet, attached to Zarzis port, using special gillnets from April to August and landed as by-catch along the year (except July to September) in trawl fisheries (Bradai et al., 2005). Annual gillnets landings of this species are about 200 tons in Zarzis port. 20 metric tons were estimated to be landed as by-catch by trawlers working in the entire of Gulf of Gabès.

Data and parameters: Age, growth and sexual maturity parameters of the lackchin guitarfish *Glaucostegus cemiculus* are reported from the Gulf of Gabès (Central Mediterranean Sea). Age was estimated by counting the growth rings of thin sections of vertebrae from 110 fish (43-198 cm total length). Marginal increment analysis supported the hypothesis of annual deposition of growth rings, which form during the end of summer. The oldest females and males were 14 and 10 years respectively. Von Bertalanffy parameters based on length at age data were $TL\infty$= 179 cm, k= 0.272 y^{-1} and t_0=-0.71 for males and $TL\infty$= 198.7 cm, k= 0.202 y^{-1} and t_0= -0.81 for females (Combined sexes: $TL\infty$= 195.5±3.16 cm, k= 0.218 y^{-1} and t_0= -0.77). The combined total length-mass relationship was $Mp= 0.004\ LT^{2.95}$. Males were mature at 111.8 cm and females at 138.1 cm total length (TL). The age at which 50% of males and females matured was respectively 2.89 and 5.09 years.

Assessment method: VIT model fitted well with the data (CV=0.16)/Virtual Population Analysis Model (VPA/ADAPT) Length Based Yield Per Recruit (for the two gears, trawler and gillnets).

References

Bradai M.N., Saidi B., Enajjar S. & Bouain A. 2005. The Gulf of Gabès: A spot for the Mediterranean Elasmobranchs. In: *Proceeding of the international workshop on Mediterranean cartilaginous fish with emphasis on south eastern Mediterranean*. Istanbul-Turkey, pp. 107-117.

Enajjar S. Bradai M.N. & Bouain A. 2012. Age, growth and sexual maturity of the blackchin guitarfish *Rhinobatos cemiculus* in the Gulf of Gabès (southern Tunisia, central Mediterranean). Cah. Biol. Mar. (2012) 53.

Enajjar S. 2009. Diversité des Rajiformes et étude écobiologique de *Rhinobatos rhinobatos* et *Glaucostegus cemiculus* (Famille des Rhinobatidae) du Golfe de Gabès (Tunisie). *Thesis, university Sfax, Tunisie*. 173 p.

Results: The fishing mortality rate F for trawlers based on the small amount of catches concentrate on individuals lower than 100 cm. The estimated values by size are negligible (max F of 0.003). Gillnets catches represent more than 90% of the total catch and target larger specimens; F is much higher in the range 120–200 cm. F increases with size up to a maximum of 0.176 at around 145cm and then decreases.

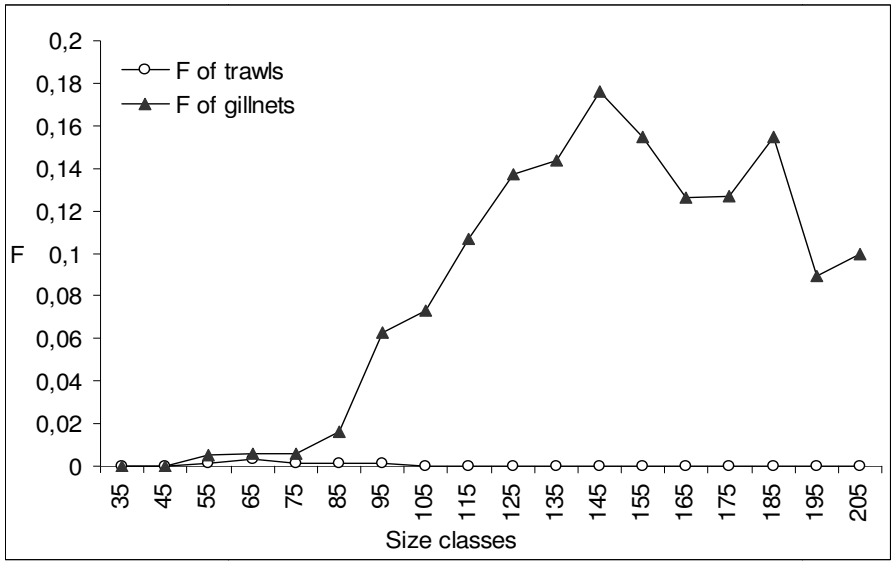


Fig.1. fishing mortality of *G. cemiculus* by gear

Results of Y/R analysis

The Y/R analysis was done for sexes combined, and allowed the estimation of Reference Points F0.1, Fmax and F30%MSP (Table.1, Fig.2).

Reference Point Summary Table 1

Reference Point	F	Yield per Recruit	SSB per Recruit	Total Biomass per Recruit
F Zero	0.00000	0.00000	3043223.90725	4756880.43299
F-01	0.19100	317860.85984	897204.65497	2136350.93163
F-Max	0.30700	336647.43065	460318.46116	1499310.97599

Fig.2. Yield per recruit of *G. cemiculus*.

Diagnosis of Stock status: The stock is in underfishing status, considering that the current F is lower than the chosen reference point F0.1 that is considered to produce good and sustainable yields. Landings show stability during 2001 to 2007 (Fig. 3). The abundance of this species increase from

North to the south of Tunisian coasts; the main fishery (gillnet) occurs only during April to August when gravid adults move to the shallow waters to lay.

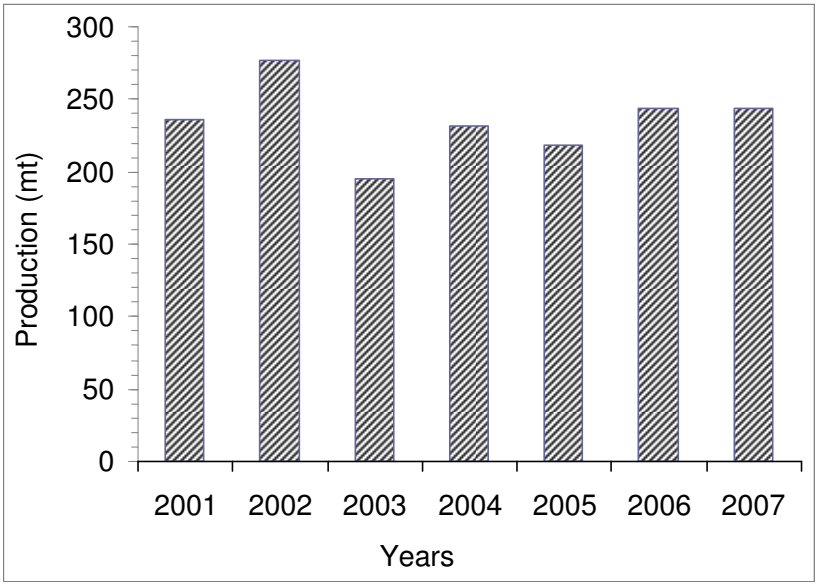


Fig.3. Yearly landing of *G. cemiculus* by gillnets in the gulf of Gabès.

Advice and recommendation:

The species appears in good exploitation status with a current fishing mortality rate which is lower than F0.1, which is considered a proxy of F_{MSY} (Fig.2).

Catches does not show any negative trend, which is useful for checking for stability in abundance considering that the fishing effort remained almost constant during the analysed period.

Appendix F

Scyliorhinus canicula

GSA: 4 (Algeria)

Authors: Hemida F. and R.S. Benabdallah Benarmas

Fishery: The smallspotted catshark (*Scyliorhinus canicula* Linnaeus, 1758) in the Algerian basin (GSA 4) is exploited mainly by the bottom trawlers (annex 1). The species is exploited with a number of other demersal species (*Pagellus acarne*, *Mullus barbatus*, *Parapenaeus longirostris*, *Merluccius merluccius*). Length frequency distribution were gathered for the assessment period (2000-2010) from the commercial landings of three region of Algerian coast. The most exploited length classe is the 42-51cm.

Data and parameters: Length frequency distribution of females and males of the western region of the Algerian basin were analyzed by ELEFAN I (Electronic Length Frequency Analysis) programm to calculate the growth parameters (L_{inf}, K). Z was estimated by Pauly's model (1984a) as M by Djabali's method (1993).

Ouest females : $\mathbf{LT = 61.43\ [1 - e^{-0.6*(t-0)}]}$

Ouest males : $\mathbf{LT = 58.28\ [1 - e^{-0.6*(t-0)}]}$

L-W relationship (females) : $\mathbf{WT =}\ 0.0013\ \mathbf{LT}^{3.2514}$
L-W relationship (males) : $\mathbf{WT =}\ 0.0042\ \mathbf{LT}^{2.9136}$
Z, M et F values

Parameters / Gender	L_∞	K	T_0	Z (Pauly, 1984)	M (Djabali *et al.*,1993)	F
Females	61.43	0.6	13	2.11	0.58	1.53
Males	58.28	0.6	13	2.1	0.59	1.51

Assessment method: VPA, and Thomson and Bell production model for females and males, for the period 2000-2010, using the mixed approach. The results (annex 4) have been compared to the yield per recruit performed (Y/R) by NOAA program with the females data (annex 2 and 3).

Model performance: The last model fitted well with the data, giving the F0.1, Fmax, Fat 30% of MSP

Results: for the period 2000-2010
Females Y/R (NOAA program)

F0.1: 0.38 Y/R: 61792 SSB per recruit : 116870 Total biomass per recruit : 184666
Fmax : 1.051 Y/R: 67675 SSB per recruit : 57463 Total biomass per recruit : 121086
F at 30% MSP: 0.637 Y/R : 64722 SSB per recruit : 97809 Total biomass per recruit : 164631

Females and males Y (VPA/Thomson & Bell production model, using the mixed approach)

F0.1
Fmax 1.5

Diagnosis of Stock status: *The stock is in overfishing state, considering that the current F (1.5) should be reduced by more than 50% (based on the assessment period)*

- **Advice and recommendation:**

Discussion:
Growth parameters calculated (values to be checked) influence the result of the analysis

References

Djabali F., Mehailia A., Koudil M. & Brahmi B., 1993. Empirical equation for the estimation of naturel mortality in Mediterraneen. Teleosts. *NAGA, the ICLARM Quartely*: 35-37.

Pauly D., 1984. Fish population dynamics in tropical waters: a manual for use with programmable calculators. *ICLARM Stud. Rev*. (8):325p.

Gayanilo JR. F. C., Sparre P. & Pauly D., 2002. The FAO - ICLARM Stock Assessment Tools (FISAT II Version 1.1.3) User's Guide. *FAO Computerize Information Series (Fisheries). N°8, Rome. FAO* : 126p.

Thompson W.F. & F.H. Bell, 1934. Biological statistics of the Pacific halibut fishery. 2. Effect of changes in intensity upon total yield and yield per unit of gear. *Rep. Int. Fish. (Pacific Halibut) Comm*., (8): 49p.

Appendix G

Squalus acanthias

GSA: 29 (Black Sea)

Authors: Radu G. and V. Raykov

Fishery: In the Black Sea the largest catches of spiny dogfish are along the coasts of Turkey, although this fish is not a target species of fisheries, being yielded as by-catch in trawl and purse seine operations mainly in the wintering period. In the 1989-1995 annual catches of Turkey are 1055-4558 t (Shlyakhov, Daskalov, 2008). In subsequent years, they have decreased about 2 times and did not exceed 2400 t. In the waters of Ukraine most of spiny dogfish is harvested in spring and autumn months by target fishing with gill-nets of 100 mm mesh-size, long-lines, and as by-catch of sprat trawl fisheries. As in Turkish waters, in the last 20 years the maximum annual catches of picked dogfish are observed in 1989-1995, reaching 1200-1300 t. After 1994 the catches went down being between 20 and 200 t. In the rest of countries spiny dogfish is harvested mainly as by-catch, annual catches are usually lower than the Ukraine. The maximum annual catches of picked dogfish in 1989-2005 were: Bulgaria - 126 t (2001), Georgia - 550 t (1998), Romania - 52 t (1992), Russian Federation - 183 t (1990). It should be noted that in the waters of Bulgaria, the highest catches were observed in the early 2000's. In Romania dogfish is caught mainly as by-catch of the sprat trawl fishery. The catches decreased very much because of decreasing of the trawling effort (Maximov *et al*., 2008b, 2010b; Radu *et al.,* 2009b, 2010a,b) (Table 1). In Turkey spiny dogfish lost its commercial importance in recent years. In the last 20 years, the decrease of dogfish landing may be may be due to over-fishing (Demirhan, *PhD thesis*, Daskalov *et al*., 2011).

Data and parameters: We use NOAA fishery toolbox – Length-based YPR analysis for *Squalus acanthias* in Black Sea.

1. General data used are:
   - Length at start: 75 cm;
   - Last age (relative) : 20 years;
   - Age step size : 1 year;
   - Maximum value of *F*: 2;
   - F increment in output report: 0.001;
   - F increment in *YPR* calculation: 0.0002;
   - Fraction of maximum spawning: 0.3;

   Next step was to perform Sensitivity analysis;

   2. Biological data used:

   VBGF: $L\infty$ = 157 cm (derived from scientific surveys);

   $K = 0.12\ y^{-1}$

   Natural mortality M = 0.2 (Demirhan and Seyhan, 2007)

   L-W parameters – a = 0.004; b = 2.95 (Demirhan and Seyhan, 2007)

   Natural mortality was considered as constant and fully mature length at 95 cm.

   3. Fishery selectivity

   We used "ascending ramp function"
   - Selectivity is below length of 75 cm;
   - Fully selected at minimum length of 106 cm;

   4. Sensitivity analysis

   We used Natural mortality with the following values:
   - Initial value = 0.01
   - Final value = 0.5
   - Increment = 0.02

   Then the analysis was run.

Catch number per age derived from commercial Ukrainian landings of trawls. In the Black Sea spiny dogfish represented in the landings as by-catch mainly.

Assessment method: YPR and catch curve analysis

Model performance: There were some uncertainties related to the gaps (quality of data for some years).

Bibliographic review. Spiny dogfish inhabits the whole Black Sea shelf at the water temperatures 6 – 15° C. It undertakes extensive migrations. In autumn Spiny dogfish aggregates into large schools, accompanying anchovy and horse mackerel, which migrate to wintering grounds along eastern and western coast. During wintering the densest concentrations of picked dogfish are observed, where picked dogfish feeds intensively. where they are located on the grounds of whiting and sprat concentrations (Kirnosova, Lushnicova, 1990). Catches, analysis of population parameters, distribution patterns, and biomass and population structure in Romanian and Bulgarian marine area have been performed by (Maximov *et al*., 2010; Radu *et al*., 2010; Raykov *et al*., 2010). Important growth parameters for Spiny dogfish from Black Sea have been published by Kirnosova, 1990; Demirhan & Seyhan, 2007; Daskalov *et al*., 2009; Daskalov *et al*., 2011;Yankova *et al*., 2011). For the whole population of picked dogfish stock assessments for 1972 – 1992 were produced by VPA method (Prodanov *et al*., 1997). Spiny dogfish and thornback rays are, according to Kutaygil and Bilecik (1976), very important among the Black Sea's demercal fish fauna, and constituted 18.1% and 5.7%, respectively, of the total demercal catch on the Turkish coasts of the Black Sea at this time (Kutaygil & Bilecik, 1977; Demirhan *et al*., 2007). In the Black Sea area several papers refer to the population dynamics, catches, biology etc.of spiny dogfish, which are gave us consistent picture regarding this species (BSC, 2008, BSC, 2010 Schlyahov & Daskalov, 2008).

Results: On table 1 and summary of reference points for *Squalus acanthias* is presented. F zero was zero for fishing mortality and for YPR, kg. An $F_{0.1}$ criterion equals 0.2326; the values for YPR, SSB per recruit and TotalB per recruit were as follows: 324466.1kg, 2553269 kg, 1421640 kg; F_{max} = 1.122 and corresponded values for YPR, SSB per recruit were higher than corresponding to $F_{0.1}$ with exception of TotalB per recruit, kg (1300059kg).Other reference point $F_{30\% \text{ from MSP}}$ is less restrictive than $F_{0.1}$ and equals to 0.2866.The corresponding levels of YPR and SSB-per-recruit were less than those of F_{max}, excluding TotalB-per-recruit, kg (Table 1).

Table 1. Reference points of *Squalus acanthias* from the Black Sea.

	F	Yield-per-Recruit, kg	SSB-per-Recruit,kg	TotalBio-per-recruit,kg
F_{zero}	0	0	4011297	5171470
$F_{0.1}$	0.2326	324466.1	1421640	2553269
F_{max}	1.122	382488.6	260967.6	1300059
$F_{30\% \text{ from MSP}}$	0.2866	341614.9	1203448	2328730

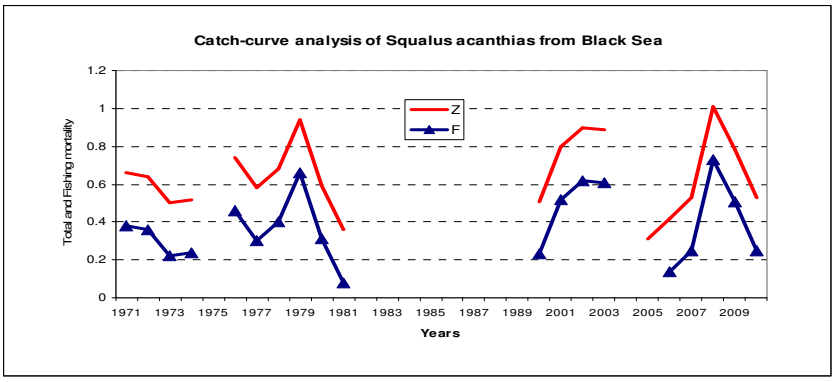


Figure 7. Catch curve analysis of spiny dogfish in the Black Sea for 1971-2010.

Diagnosis of exploitation: The stock $F_{curr} \approx 0.24 \approx F_{0.1}$. At the Black Sea level the stock of spiny dogfish can be considered as fully exploited. However, there were significant uncertainties regarding the fluctuating levels of natural mortality. Thus, we are unable to estimate the exact values of fishing mortality.

Advice and recommendation:

Data requirements The improvement of catch statistics regarding *Squalus acanthias* in the Black Sea is needed; Joint surveys (6 Black Sea countries) are recommended to follow the distribution patterns, spawning areas, CPUE series, biomass estimations, diet, maturity indices etc.

Cautions for multigear fisheries Firstly, there are strong technical interactions, being exploited by different types of fishing boats and gears, and secondly biological features, connected with complex predator-prey interactions involving most of the exploited species;

Discussion: In the last period in the analysis using catch curves F current is almost the same as $F_{0.1}$ (0.2326). But, historical analysis show that the state of spiny dogfish stock has been influenced not only by fishing which was at quite high level due to the bigger number of trawlers and high levels of the spiny dogfish by-catch. The state of the species has also been influenced by ecological changes due to eutrophication and *Mnemiopsis leiydi* invasion and outburst in Black Sea. Comb jelly competes with small pelagic fish for the food. Simultaneously, the small pelagic fishes are important trophic base for the dogfish in the Black Sea. We assume the decrease of the small pelagic stocks due to overexploitation and eutrophication processes have a strong impact on the top predators including Elasmobranches in the Black Sea.

References

BSC, 2008. State of the Environment of the Black Sea (2001-2006/7). Edited by Temel Oguz. Publications of the Commission on the Protection of the Black Sea Against Pollution (BSC) 2008-3, Istanbul, Turkey, 448 pp.

BSC, 2010 Diagnostic Report' about improvements to the regular reporting process on the state of the Black Sea environment (Raykov.V – part "Fisheries") www.blacksea-commission.org.

Daskalov G., V. Raykov, M. Panayotova, G. Radu, V. Maximov, V. Shlyakhov, E. Duzgunez and H.-J.Rätz 2009. Scientific, Technical and Economic Committee for Fisheries. Report of the SGMED-09-01 working group on the review of advice on Black Sea Stocks for 2009. EUR – Scientific and Technical Research series. Joint Research Centre – ISSN 1018-5593. 158 pp http://stecf.jrc.ec.europa.eu.

Daskalov, G., Cardinale, M., Aysun Gümüş, Zengin, M., Panayotova, M., Duzgunes, E., Shlyakhov, V., Genç, Y., Radu, G., Yankova, M., Maximov, V., Mikhaylyuk, A., Raykov, V. and Rätz, H.-J.Scientific, Technical and Economic Committee for Fisheries (STECF) Opinion by written procedure Assessment of Black Sea Stocks(STECF-OWP-11-06) November 2011 Edited by Georgi Daskalov and Hans-Joachim Rätz ISBN 978-92-79-21872-9 ISSN 1831-9424 (online) ISSN 1018-5593 (print) doi: 10.2788/94711.

Demirhan, S., Seyhan, K, 2007- Maturity and Fecundity of Spiny Dogfish (*Squalus acanthias* L., 1758) in the Eastern Black Sea, Turk. J. Zool., 31, (2007), 301-308.

Kutaygil, N., and Bilecik, N. 1976. Observations sur les principaux produits démersaux qui sont pêchés sur les côtes Turques de la mer Noire. Rapp. Comm. Ýnt. Mer Médit., 23, 8:75-77.

Kutaygil, N., and Bilecik, N. 1977. Recherches sur le *Squalus acanthias* L. Du littoral anatolien de la mer Noire. Rapp. Comm. Ýnt. Mer Médit., 24, 5:81-83.

Kirnosova I. P., 1990 – Grows parameters and mortality of spiny dogfish from the Black Sea. In: Biological resources of the Black Sea. Collected papers. – USSR, Moscow: VNIRO, 113-123. *(in Russian).*

Kirnosova I. P., Lushnicova V. P., 1990 – Feeding and food requirements of spiny dogfish (Squalus acanthias L.). – Biological resources of the Black Sea. Collected papers. – USSR, Moscow: VNIRO, 45-57. *(in Russian).*

Maximov V., E. Patras, L. Oprea, G. Radu T. Zaharia, 2010. Contributions to the knowledge of the biological characteristcs of the main marketable fish species from the Black Sea Romanian area, between 2005-2009; International Conference on Fishery and Aquaculture, A view point upon the sustainable management of the water resources in the Balkan Area", Galati, Romania, 2010 (in print JEPE).

Prodanov, K., K. Mikhaylov, G. Daskalov, K. Maxim, E. Ozdamar, V. Shlyakhov, A. Chashchin, A. Arkhipov, 1997. Environmental management of fish resources in the Black Sea and their rational exploitation. Studies and Reviews. GFCM. 68. Rome, FAO . 178p.

Radu, Gh. Eugen, A. Golumbeanu, M. Raykov, V. Yankova, M. Panayotova, M. Shlyahov, Vl. Zengin, M. 2010. Evolution and state of the main Black Sea commercial fish species correlated with ecological conditions and fishing effort. JEPE (in prep).

Raykov. V, Staicu. I. Nicolaev. S., Maximov.V, Radu.G Specificity of the fishery and Common Fishery implementation: a case study of the western part of the Black Sea. NIMRD Certetari marine ISSN: 0250-3069 (2008).

Raykov, V., Bikarska, I Marine living resource management and fishing effort control in view of socio-economic reality – alternatives and measures. IGI Global DOI: 10.4018/978-1-60960-621-3 ISBN13: 978-1-60960-621-3 ISBN10: 1-60960-621-3 EISBN13: 978-1-60960-622-0.

Shlyakhov, V., 2006 – TDA TTT National Fishery Report (first) Ukraine. UNDP/GEF Black Sea Ecosystem Recovery Project Phase II, 6 p.

Shlyakhov V. A., Daskalov G. M. Chapter 9 The state of marine living resources// State of the Environment of the Black Sea (2001-2006/7)/ Edited by Temel Ogus. – Publication of the Commission on the Protection of the Black Sea Against Pollution (BSC). – Istanbul, Turkey, 2008.- 3.- pp. 321-364.

Yankova M., D. Pavlov, Raykov V., V. Mihneva, Gh. Radu Length-weight relationships of ten fish species from the Bulgarian Black Sea waters Turk J Zool,2011; 35(2): 265-270.

Appendix H

Raja clavata

GSA: 15, 16 (Malta Island, South of Sicily)

Authors: Fiorentino F., Gancitano V. and S. Vitale

Fishery: *R. clavata* is the most commonly landed species of ray in the Strait of Sicily, it is frequently caught as by catch by otter trawls targeting the deep-water rose shrimp and bottom longlines targeting large sized demersal bony fishes. Almost all of the fishing effort exerted in the two GSAs is performed by the Italian and Maltese fleets. The contribution made by the Maltese fleet to the fishing effort exerted in the northern sector of the Strait of Sicily (GSA 15 & 16) in 2004-2009 was 28% for longline and 1.1% for bottom otter trawlers.

Data and parameters: data was collected within the framework of the GRUND and MEDITS scientific trawl surveys between 2002-2009 for GSA 15 and between 1994-2010 for GSA 16. All data were assigned to strata based upon the shooting position and average depth (between shooting and hauling depth). The abundance and biomass indices by km^2 were subsequently calculated as stratified means. Standardized length frequency distributions (LFD) were standardised to 100 km^2. Biological parameters (L-W relationship, size at first maturity, age and growth parameters, etc.) were collected from literature.

Assessment method: three methods were used for the assessment of the Thornback ray. Method 1: Analysis of survey indices of standing stock, using a quartile approach in order to assess the status of the standing stock. Method 2: Yield and SSB per recruit analysis, using the Yield software (Branch *et al*., 2000) in order to asses the potential productivity of the stock in function of fishing mortality. Method 3: Catch curve analysis, using the software package LFDA 5 (Kirkwood *et al.,* 2001) in order to assess the current fishing mortality exerted on the stock.

Model performance: all the three models were suitable to highlight the present condition of the resource. In particular, even though an increase in standing stock biomass was recorded in GSA 16, an overfishing condition (with respect to the adopted technical target reference point ($F_{0.1}$)) still remains.

References

Camilleri, M., Dimech, M., Drago, A., Fiorentino, F., Fortibuoni, T., Garofalo, G., Gristina, M., Schembri, P.J., Massa, F., Coppola, S., Bahri, T., Giacalone, V. (2008). Spatial distribution of demersal fishery resources, environmental factors and fishing activities in GSA 15 (Malta Island). GCP/RER/010/ITA/MSM-TD-13. *MedSudMed Technical Documents,* 13: 97 pp.

Cannizzaro, L., Rizzo, P., Levi, D., Garofalo, G., Gancitano, S. (1995) *Raja clavata* (Linneo, 1758) nel Canale di Sicilia: crescita, distribuzione e abbondanza. *Biol. Mar. Medit*., 2(2): 257-262.

Holden, M.J. (1975) The fecundity of *Raja clavata* in British waters. J. Cons. Int. Explor. Mer., 36(2):110-118.

Ragonese S., Andreoli M.G., Bono G., Giusto G.B., Rizzo P., Sinacori G., 2004. Overview of the available biological information on demersal resources of the Strait of Sicily. MedSudMed Technical Documents 2: 67-74.

Serena, F. (2005) Field identification guide to the sharks and rays of the Mediterranean and Black Sea. FAO Species Identification Guide for Fishery Purpose. Rome, FAO. 95p. 11 colour plates+egg capsules.

Serena F., Abella A. (1999a) *Raja clavata*. In Relini G., J. A. Bertrand and A. Zamboni (eds), Synthesis of Knowledge on Bottom Fishery Resources in Central Mediterranean (Italy and Corsica). Biol. Mar. Medit. 6 (1): 87-93.

Results: In the GSA 16, while recruitment can be considered to have been quite constant between 1990-2000, an increasing trend was observed between 2001-2010. Probability distribution of $F_{0.1}$ (modal values: males=0.12; females=0.10; combined sex=0.10) and F_{max} (Modal values: males=0.18; females=0.16; combined sex=0.16) was estimated from Yield approach. The standardized LFD from MEDITS were used for age slicing. The resulting age structure were combined to produce mean age composition used for 2002-2004, 2005-2007, and 2008-2010. The total mortality Z estimation by catch curve analysis ranged between 0.32 (2002- 2004; 2005-2007) and 0.34 (2008-2010), with average M=0.2 for male and female . On the basis of the assessment, the current F (F_c) (0.12 – 0.14) was higher than the $F_{0.1}$ reference point (0.1), but smaller than F_{max} (0.16).

Diagnosis of exploitation status: The analysis of survey data suggests that the stock of *R. clavata* in GSA 15/GSA 16 is likely to be in a state of overfishing; in order to the higher value of the F_c than $F_{0.1}$ a reduction of F (about 30%) may be suggested.

Advice and recommendation:

- **Data requirements:** add data from commercial fisheries
- **Assumption**: trawl survey data allows to give a good picture of stock status.
- **Cautions:** due to the lack of data from commercial fisheries in the time series, this assessment of *R. clavata* in GSA 15/GSA 16 is being considered as "preliminary" and therefore only partially able to provide management advice.

Discussion:

At present there are no formal management objectives for thornback ray in the Strait of Sicily fisheries. As in other areas of the Mediterranean, the fishery management is based on control of fishing capacity (licenses), fishing effort (fishing activity), technical measures (mesh size and area/season closures). A compulsive fishing ban for 30 days was adopted by Sicilian Government (August –September).

In order to limit the over-capacity of fishing fleet a progressive reduction of the trawl fleet capacity is occurring for Italian fleet (about 18% from 2008 to 2013). Maltese fishing licenses for trawlers have been fixed at a total of 16 since 2000. However, Eight new licences were issued in 2008, a move made possible under EU law by the reduction of the capacities of other Maltese fishing fleets.

Anyway, future analysis will be considered in both GSAs using data from commercial fisheries collected in the last years with the aim to provide a more robust assessment for the management advice**.**