GENERAL FISHERIES COMMISSION FOR THE MEDITERRANEAN

COMMISSION GÉNÉRALE DES PÊCHES POUR LA MÉDITERRANÉE

GFCM Working Group on the Black Sea (WGBS)

Report of the second meeting of the Subregional Group on Stock Assessment in the Black Sea (SGSABS)

Constanta, Romania, 10–12 November 2014

EXECUTIVE SUMMARY

The second meeting of the Subregional Group on Stock Assessment in the Black Sea (SGSABS) was held in Constanta, Romania from 10-12 November 2014.The key objectives of this meeting were to: i) revise the status of the main fish stocks in the Black Sea (with a special focus on turbot [*Psetta maxima*] and small pelagic species stocks); and ii) review the existing data and assessment methods for the main stocks in the area. The SGSABS reviewed a total of seven Black Sea fish stocks/populations and provided recommendations on the data required in order to improve the advice provided on managing the stock.

This meeting reported the status of the turbot population in the Black Sea as both "overexploited" and "in overexploitation". Similarly, the Black Sea anchovy (*Engraulis encrasicolus ponticus*) population was found to be "in overexploitation". The Black Sea horse mackerel (*Trachurus mediterraneus ponticus)* stock was reported as "overexploited" whereas the piked dogfish (*Squalus acanthia*) population was considered to be depleted at the Black Sea scale. In contrast, the Black Sea stocks of sprat (*Sprattus sprattus*) were deemed to be sustainably exploited. The SGSABS advises the implementation of a recovery plan for both turbot and piked dogfish and the reduction of fishing mortality for both anchovy and horse mackerel. Additional comments on the status of each stock are provided in this report.

In addition, the meeting conducted practical exercises to: i) evaluate the influence of using various estimates of the level of IUU fishing on the assessment of turbot, and ii) testing different time series and different assessment models for the case of Black Sea anchovy. As part of the meeting, a specific session was held on Black Sea scientific surveys at sea. In addition to an in-depth analysis of the surveys, this session identified potential options for extending the area covered by the surveys. Participants in this session voiced their desire to prioritize at-sea scientific surveys in the Black Sea and agreed on a number of steps to take in order to work towards harmonizing existing surveys. The session on scientific surveys culminated in the updating of the list of surveys currently being carried out by GFCM Black Sea riparian states.

The second meeting of the SGSABS recognized the importance of its role in providing the Working Group on the Black Sea (WGBS) and other relevant GFCM fora with sound technical advice for consideration in issuing recommendations. Subsequently, the SGSABS updated its terms of reference and added ad-hoc objectives for 2015.

OPENING OF THE MEETING AND OVERVIEW OF THE WGBS AND SAC ADVICE

1. The second meeting of the Subregional Group on Stock Assessment in the Black Sea (SGSABS) was held at the "Grigore Antipa" National Institute for Marine Research Development *in* Constanta, Romania, from 10 to 12 November 2014. The meeting was attended by 22 fisheries experts from the Black Sea riparian states (Bulgaria, Georgia, Romania, Turkey and Ukraine), as well as by representatives of the GFCM Secretariat. The full list of participants is provided in Appendix B of this report.

2. Mr Violin Raykov, vice-coordinator of the Working Group on the Black Sea (WGBS) and meeting chair, opened the meeting by thanking the hosting institution for the hospitality and emphasizing the importance of the continuation of the work of the SGSABS.

3. Mr Simion Nicolaev, coordinator of the WGBS and director of the hosting institution, expressed his satisfaction with the positive outcomes of the first SGSABS meeting vis-à-vis supporting the assessment of Black Sea stock status. He welcomed the second meeting and backed its important objectives. In his opening remarks, Mr Nicolaev alluded to the crucial role of the SGSABS in bridging the gap between Black Sea riparian states in collecting data and carrying out scientific surveys. He suggested that this gap could be bridged by formulating appropriate recommendations.

4. Mr Miguel Bernal, GFCM Fishery Resources Officer, welcomed the participation of fisheries experts from all Black Sea riparian states (except for the Russian Federation, who was unable to be present due to logistical difficulties) and expressed his eager anticipation of the usual fruitful collaboration during the meeting. He then went on to introduce the objectives of the meeting, which were based on the terms of reference for the SGSABS, as well as the objectives for the session on surveys, which were approved by the sixteenth session of the GFCM Scientific Advisory Committee (March 2014) and the objectives for the advice on turbot (*Psetta maxima*) fisheries which were provided by the thirty-eighth session of the GFCM (May 2014).

OVERVIEW AND ASSESSMENTS OF THE STATUS OF BLACK SEA STOCKS

5. The GFCM Secretariat presented the SAC advice on the status of exploited populations in both the Mediterranean and Black Sea, recalling the problems of lack of information for some stocks and of overall high fishing pressure in the area. The presentation then recapped the findings of the first SGSABS meeting where turbot and piked dogfish (*Squalus acanthias*) were determined to be depleted at the Black Sea scale. The first meeting had assessed stocks of sprat (*Sprattus sprattus*) and Azov Sea anchovy (*Engraulis encrasicolus maeticus*) as sustainably exploited, whereas the status of anchovy (*Engraulis encrasicolus ponticus*) was considered uncertain. The presentation ended by listing the recently formulated conclusions of the European Union's Scientific, Technical and Economic Committee for Fisheries (STECF) on the status of nine Black Sea fish stocks.

6. The following new information on seven Black Sea fish stocks/populations was reviewed by the group:

i. five full stock assessments, all at the Black Sea scale, except for Azov Sea anchovy
    - two distinct stocks of both anchovy subspecies (Black Sea anchovy assessment from Ukraine and Turkey together, and Azov Sea anchovy);
    - horse mackerel (*Trachurus mediterraneus ponticus*);
    - piked dogfish;
    - sprat ; and
    - turbot

ii. catch data on bonito (*Sarda Sarda*) and rapa whelk (*Rapana venosa*) fisheries.

7. Abstracts of the presentations by experts are reproduced in Appendix G. The completed stock assessment forms (SAFs) for the stocks assessed by the group are available in Appendix I of this report.

8. Mr George Komakhidze (Georgia) presented an overview of his country's fisheries monitoring activities and internal capacities for carrying out research and assessments. This presentation also described Georgia's primary commercially-important fisheries and the fisheries on this country's red list for endangered species. Mr Komakhidze informed the group about Georgia's existing practices for assigning fishing quotas and issuing licenses, and provided available catch data.

9. Participants welcome the presentation from Mr Komakhidze and highlighted that it was important to incorporate information from all Black Sea riparian States, including Georgia, Russian Federation and Ukraine. Experts from Ukraine and Georgia concurred on the importance to collect and share information on their fisheries, and the GFCM Secretariat mentioned the important role that the GFCM Data Collection Reference Framework (GFCM-DCRF) should have in this context.

10. In the ensuing discussions, the group shared views on the contents of the presentations and on the information provided by experts. The group then commented on the assessments presented. The final advice and comments by the SGSABS are found in Appendix C, while a summary on the discussion by species is included below.

European anchovy

A full stock assessment for anchovy in the Black Sea was presented for the first time, using catch data from Turkey and Georgia, and survey data from Turkey and Ukraine. Two different stock assessment models were used (XSA and Aspic) and the results were considered consistent and robust to some issues in the underlying data and assumptions (see the section on the hands-on data session for more information). The anchovy stock was considered to be "in overexploitation"'. Meeting participants highlighted a number of issues relevant to this stock:

- In Ukraine, a relationship was observed between *Mnemiopsis leidyi* (ctenophore) blooms and anchovy catch. The collapse of the anchovy stock in the area was related to a combination of both fishing pressure and increased fish mortality caused by these blooms. However, the potential effects of generally deteriorating environmental conditions in the area were also pointed out. An association was also observed between the blooms of *M. leidyi* and the blooms of another ctenophore, *Beroe ovata*, which preys on the former. Participants agreed on the pressing need to improve understanding of the ecological links between these species in the Black Sea pelagic ecosystem in order to gain a comprehensive picture of anchovy stock fluctuations. In so doing, the future management of the anchovy fishery would be improved.
- The status of the anchovy fishery before and after the collapse that occurred in 1989 seemed to show different patterns in the various areas/countries of the Black Sea. Although catch levels in Turkey recovered to values similar to those recorded before the collapse, catch levels in the rest of the Black Sea countries remained lower than before the collapse. This pattern could be partially explained by the differences in the specifications of the fishing fleets involved. However, anchovy biomass levels at the Black Sea scale does not seem to have recovered to the levels recorded before the collapse.
- Participants highlighted a number of concerns regarding the data used for the assessment, including potential inconsistencies in the methods used to determine fish age. In addition, participants pointed out that, in recent years, all countries except Turkey have stopped

direct surveys at sea for anchovy which has undoubtedly affected the quality of the assessment. The section on the hands-on data session in this report includes details on an exercise in testing the biomass and XSA models for anchovy with a reduced time series and checking the use of average age structure in the assessment models.

Horse mackerel

New tuning information collected by a commercial catch per unit effort (CPUE) study in Turkey (2005–2013) was used to tune an XSA model for horse mackerel. The stock assessment was considered to be an improvement on that from the previous year (when the stock assessment was considered preliminary due to uncertainties and lack of reliable tuning information). The stock was considered to be "in overexploitation", and in the absence of a reference point for biomass, the biomass level was considered to be uncertain. Participants highlighted the need to continue harmonizing the various methods used to estimate fish age between institutes. Participants also pointed out the limitations of using CPUE as a tuning index in general, but in particular given that the species is not the main target of most of the fishing fleets involved. Participants proposed obtaining acoustic-based estimates of horse mackerel biomass as a solution (see the section of this report on surveys).

Piked dogfish

The only information on dogfish catches provided to the group was that which was collected by Romania. Based on this data, a number of assessment models were used (VIT and XSA), which lead to an $F_{current}$ estimate of 0.112. Two different reference points for this stock were available, a VIT-based F_{MSY} (0.5) and an estimate of F_{MSY} for dogfish populations in the North Atlantic (0.03). Despite the uncertainty related to an appropriate reference point for F, trends in the catches clearly showed a large decline (more than 75 times lower than that of the previous record), and estimates of biomass and recruitment were more than 20 times lower than the previous estimates. Therefore, the Black Sea dogfish population was considered to be depleted. In line with this, participants agreed to recommend the development of a recovery plan for this species. Participants discussed the lack of available information on catches, bycatch and IUU catches in the various Black Sea riparian states. Discard data (on dogfish and other species) from Romania were available from trawl fisheries of sprat, while no information on discards or bycatch was available for any other country or fleet in the area. Participants alluded to the fact that the presence of dogfish in the market and the current level of catches of dogfish were very low. In addition, individuals of captured dogfish appeared to be much smaller in average length than in the previous decade.

Sprat

An updated assessment model (ICA with new data from the most recent year but with the same configuration as the assessment from the previous year) was used to assess sprat. The sprat stock in the Black Sea was considered to be fished sustainably. Participants discussed several issues related to acoustic surveys of sprat, such as the fact that estimates of abundance from Turkish acoustic surveys could in principle be used as tuning or recruitment indices. However, sprat is often found at the outer limits of the survey, and as such, the survey does not cover the entire area of distribution (see the section on surveys for more information). In addition, participants discussed several market-related issues for sprat, such as the fact that market demand and consumption was moderate. It was also mentioned that Bulgaria had stopped using sprat to produce fishmeal, and that the catch level of sprat was inversely related to the catch level of anchovy.

Turbot

An updated assessment model (SAM with new data from the most recent year but with the same configuration as the assessment from the previous year) was used to assess turbot. The turbot stock in the Black Sea was considered to be "overexploited" and "in overexploitation", i.e., the same status as the previous assessment. Due to the low abundance and to the fact that the stock has been classified as overexploited and in overexploitation in the last years, participants highlighted that management measures allowing for the stock to recover would be needed. A number of tests (including the estimation of alternative mortality estimates and the effect of IUU fishing on the stock assessment model) were carried out during the meeting. For more information on these tests, see the section of this report on the hands-on data session. Participants highlighted a number of issues relevant to this stock, including:

i. The amount of IUU catches continues to be perceived as very high (up to four times the declared catches). However, reliable estimates of IUU catches were not available. Moreover, different ad-hoc approaches had been used for the purposes of stock assessment in the past (for more information, refer to the report of the first meeting of the SGSABS). The estimation of reliable values for IUU catches and the reduction of IUU fishing were both considered priorities for the turbot stock;

ii. Some uncertainties in stock units and spatial dynamics for this stock remain. The trends in landings and survey results from the various parts of the turbot distribution range are different which may indicate the existence of spatial dynamics not accommodated in the stock assessment model. No new information on stock identification and stock limits was presented to the group, and participants highlighted the need to increase research in this area. Participants also highlighted the need to incorporate spatial dynamics into the stock assessment model, with a view to providing advice at spatial scales conducive to the adoption of effective management measures; and

iii. Participants underlined the need to improve and harmonize age-reading between researchers and institutes. Additionally, participants called for the improvement of catch statistics at the Black Sea level (including data from Georgia and the Russian Federation).

Bonito

A tentative stock assessment of bonito based on a biomass model (ASPIC) was attempted. The assessment was not considered reliable due to the short time series available and the high fluctuation exhibited by the indices. Participants discussed additional sources of information that could be useful for the assessment of this stock, such as information on egg and larvae distribution/abundance from an ichthyoplankton survey, and information on catches in the Marmara Sea and the eastern Mediterranean.

Rapa whelk

Some information on the distribution and density of *Rapana venosa* off the Turkish coast was presented to the group. Participants highlighted the lack of relevant information for a regional-scale assessment. The meeting simultaneously discussed the potentially harmful effects of the presence of this species in the ecosystem, as well as its increasing economic importance due to its price and the increasing level of catches dedicated to export. The meeting was informed about the various methods and gear used to collect whelk, which include SCUBA diving and the use of beam trawlers. Participants discussed the potential ecosystem effects of using beam trawlers, e.g., bycatch of other species such as juvenile turbot. Participants agreed on the importance to perform both ecological and socio-economic studies on this species, as well as the importance of attempting to estimate at least local abundance, either through direct surveys or by using dedicated stock assessment methods.

HANDS-ON DATA SESSION ON THE ANALYSIS OF THE STATUS OF SELECTED STOCKS

11. The SGSABS dedicated a session on data analysis to address specific issues related to turbot and anchovy assessment (listed in Appendix D), namely: i) analyzing the influence of various

estimates of IUU fishing on turbot assessments; ii) estimating natural mortality of turbot; iii) testing the biomass and XSA models for anchovy with reduced time series; and iv) checking the effects/implications of using of average age structure.

12. The main discussions and conclusions emanating from these exercises are included in Appendix D. In the case of turbot, the most noteworthy conclusion was that the perception of stock status is robust to the various assumptions of the estimates of IUU fishing used. A simple exercise simulating the elimination of IUU fishing demonstrated that reducing IUU fishing while keeping current fishing effort constant would generate a proportional reduction in the fishing mortality rates.

13. For anchovy, the results of the tests carried out showed that the current assessment model is robust to a number of uncertainties with the input data, and that the perspective on current stock levels is consistent between the various assessment methods. However, given the diversity in the historical perspectives, estimating biomass reference points can be difficult.

SESSION ON USEFUL SURVEYS FOR THE ASSESSMENT OF STOCKS IN THE BLACK SEA

14. In line with the terms of reference provided by both the WGBS and the SAC, the SGSABS dedicated a session in the meeting to surveys-at-sea. The aim of this session was to improve existing knowledge on: i) the spatial and temporal dimensions of the area currently covered by surveys; ii) the methodologies and objectives of existing surveys; and iii) potential avenues to pursue the harmonization of current surveys at the Black Sea scale. On the basis of the table compiled during the first meeting of the SGSABS, information on surveys carried out by Bulgaria, Romania and Turkey was updated. This table can be found in Appendix H. It was confirmed at the meeting that Georgia and Ukraine had not carried out any surveys in recent years.

15. Based on the list of existing surveys and on the need for direct surveys for stock assessments, the group discussed priority surveys for assessing the main stocks in the Black Sea. The group also discussed the follow-up steps needed to harmonize information and direct data from surveys and between all Black Sea riparian states.

16. The meeting considered having two hydro-acoustic surveys – one in autumn-winter and one in spring-summer – as the main priority. These surveys would provide indices of stock abundance and distribution for anchovy, sprat, horse mackerel and whiting. The meeting also prioritized having two trawl surveys – one in the autumn and one in the spring – in order to provide an indices of the abundance and the distribution of demersal species (see full description in Appendix E/a).

17. In terms of harmonization, a roadmap of steps with suggested deadlines and contact persons was prepared by the meeting. This is included in Appendix E/b. The roadmap includes follow-up steps to harmonize the estimation of biological parameters, to assess and/or calibrate the differences in sampling gear between countries/surveys, and to describe in detail the estimation methods used by the different scientific institutes.

GENERAL CONCLUSIONS AND RECOMMENDATIONS

18. On the basis of the discussions held and with the objective of bolstering the process of stock assessment in the Black Sea, the SGSABS reached the following conclusions:

- Stock assessments were carried out and stock advice was provided for four stocks in the Black Sea: turbot, anchovy (*E. encrasicolus ponticus*), horse mackerel and piked dogfish. Information on stock status was analyzed for two other stocks (Atlantic bonito and rapa whelk) but no stock status or advice was provided due to lack of relevant information. The status of the stocks reviewed are available in Appendix C of this report;

- Analysis of the input data and assumptions for the assessment of turbot and anchovy stocks were conducted during the meeting. The main conclusions and recommendations to improve the input data for these stocks are included in Appendix D of this report.
- The SGSABS agreed on the need to create a database of information required to carry out stock assessments for those species analyzed in the group. The meeting also agreed that all participants should make the input data available for the assessment of the stocks presented to the group, if possible two weeks in advance of the meeting. Input data for all assessments will be incorporated in the database which will be used only for the purpose of the work carried out by the SGSABS.
- In order to meet all the requirements for stock assessments, it should be ensured that the following minimum set of fishery- independent surveys, with the maximum range of area covered, are carried out: two pelagic hydro-acoustic surveys (one spring-summer targeting sprat and whiting; one autumn-winter targeting anchovy and horse mackerel), and one demersal trawl survey providing information for turbot, whiting, piked dogfish and red mullet.
- Based on a compilation of existing surveys at sea (Appendix H) and previously identified needs for the assessment of main commercial species in the Black Sea, the SGSABS agreed on priority surveys that should be maintained in the Black Sea, as included in Appendix E/a. The SGSABS also highlighted main priorities for expanding the area currently covered by existing surveys (also included in Appendix H).
- In order to improve the harmonization of existing surveys with each other, the SGSABS agreed to undertake the following steps:
    - Compile detailed information on the sampling and estimation methodologies used in the various surveys before the next session of the SGSABS, based on a common template to be distributed by the GFCM Secretariat;
    - Exchange samples for different biological parameters as detailed in Appendix E/b and carry out a comparative analysis of results;
    - Present and discuss the results of the activities above in a dedicated meeting of experts.
- The SGSABS agreed that in addition to the harmonization and improvement of existing surveys, the possibility to organize coordinated international surveys covering all the Black Sea would be beneficial to address specific questions related to stock assessment, including providing information on spawning grounds and stock identification.
- The group agreed to meet in November of the following year (2015), and propose to focus on the Terms of Reference as updated in Appendix F. The conclusions and work plan of the SGSABS would be submitted for consideration by the GFCM-SAC subcommittees, the WGBS annual meeting and consequently the annual sessions of the SAC and the GFCM.

OTHER MATTERS

19. SGSABS experts committed to continue collaborating during the intersession on the issues outlined in Appendix E/b and on the agreed priorities. The GFCM Secretariat would facilitate communication through interactive online tools and regular updates.

20. Mr Nicolaev, in his capacity of WGBS Coordinator, praised the work of the experts during the second meeting, which in his opinion demonstrated that the establishment of the SGSABS was a successful initiative - particularly in light of the sound technical advice provided to the WGBS for it to rely on in formulating appropriate recommendations for the consideration of the Commission. He

encouraged strengthening cooperation with the Black Sea Commission Advisory Group on Environmental Aspects of Management of Fisheries and Other Marine Living Resources (BSAGFOMLR) in order to avoid overlap, with regards to the Black Sea Integrated Monitoring and Assessment Programme (BSIMAP) in particular.

21. Mr Constantin Stroie, Romanian National Agency for Fisheries and Aquaculture, recognized the efforts deployed by GFCM Black Sea Members through the work of their experts in promoting and supporting the development of an instrument dedicated to Black Sea fisheries issues such as the SGSABS. He also welcomed the productive involvement of Georgia and Ukraine. He referred to the conclusions and recommendations of the group as “a useful basis in support to managing authorities”.

22. Joining the SGSABS chair in thanking experts for their active participation, the GFCM Secretariat expressed satisfaction in the positive outcomes of the meeting, and highlighted that the group outcome allow the WGBS and the SAC to provide the GFCM with a solid advice on the status of Black Sea stocks, and therefore anticipated the continuity of the Group.

DATE AND VENUE OF NEXT SESSION

23. All participants and the GFCM Secretariat thanked the hosting country and in particular the “Grigore Antipa”, National Institute for Marine Research Development its Director and staff for the impeccable organization and working conditions for the meeting, alongside their warm hospitality in Constanta.

24. The group strongly encouraged holding the third meeting of the SGSABS during the first two weeks of November 2015. The scheduling of both the STECF and BSC regular meetings during that period should be taken into consideration when finalizing the work plan.

25. On behalf of the Bulgarian National Agency for Fisheries and Aquaculture, Mr Sergei Kostadinov announced that the next meeting of the SGSABS would be hosted in Burgas, Bulgaria. The generous offer was highly appreciated by the group.

ADOPTION OF THE REPORT

26. The meeting formally adopted the SGSABS conclusions, recommendations and appendices on Wednesday 12 November 2014. The full report was adopted by e-mail on 24 January 2015.

Appendix A

Agenda

1. **Opening, arrangements of the meeting and adoption of the agenda**
2. **Overview of the WGBS and SAC advice on the status of stocks and priority issues for stock assessment in the Black Sea**
3. **Presentation and discussion of assessments on the status of stocks**
4. **Hands-on data session on the analysis of the status of selected stocks**
5. **Direct scientific surveys useful for the assessment of stocks in the Black Sea**
   - Summary of existing surveys
   - Summary of main requirements for fisheries surveys in the Black Sea based on SAC and WGBS advice
   - Discussion on possible adaptations to current survey plans to cover the requirements expressed by WGBS and SAC
   - Discussion on the roadmap to improve scientific surveys at sea
6. **Formulation of conclusions, recommendations and management advice to be submitted to the SCSA, the WGBS and the SAC for their consideration.**
7. **Closing session**

Appendix B

List of participants

BULGARIA

Marina PANAYOTOVA
Institute of Oceanology – BAS
"Parvi May"40 Str., 9000
P.O. Box 152
Varna
Tel.: +359 52370486
E-mail: mpanayotova@io-bas.bg

Violin RAYKOV
Institute of Oceanology – BAS
"Parvi May"40 Str., 9000
P.O. Box 152
Varna
Tel.: +359 887 958 939
E-mail: vio_raykov@abv.bg

Maria YANKOVA
Institute of Oceanology – BAS
"Parvi May"40 Str., 9000
P.O. Box 152
Varna
E-mail: maria_y@abv.bg

GEORGIA

George KOMAKHIDZE
Head
Fisheries and Black Sea
MonitoringDepartment
National Environmental Agency
Tbilisi
E-mail: g.komakhidze@gmail.com

ROMANIA

Simion NICOLAEV
Director
National Institute for Marine Research and
Development "Grigore Antipa"
Blv. Mamaia 300
900581 Constanta
Tel.: +40 241 543288
Fax: +40 241 831274
E-mail: nicolaev@alpha.rmri.ro

Constantin STROIE
NAFA Romania
2 Transilvaniei Street, Sector 1
Bucharest
Tel.: 0374.466.140 , 0374.466.139
Fax: 0374.466.138
E-mail: constantin.stroie@anpa.ro

Eugen ANTON
National Institute for Marine Research and
Development "Grigore Antipa"
Blv. Mamaia 300
900581 Constanta

Madalina GALATCHI
Research Assistant
National Institute for Marine Research and
Development "Grigore Antipa"
Blv. Mamaia 300
900581 Constanta
E-mail: madalina.galatchi@gmail.com

Valodia MAXIMOV
National Institute for Marine Research and
Development "Grigore Antipa"
Blv. Mamaia 300
900581 Constanta
E-mail: vmaximov@alpha.rmri.ro

Magda NENCIU
Technology Transfer and Dissemination
Department NIRDEP
National Institute for Marine Research and
Development "Grigore Antipa"
Blv. Mamaia 300
900581 Constanta
E-mail: mnenciu@alpha.rmri.ro

Gheorghe RADU
Senior Fisheries Scientist
National Institute for Marine Research and
Development "Grigore Antipa"
Blv. Mamaia 300
900581 Constanta
E-mail: gpr@alpha.rmri.ro

George TIGANOV
Research Assistant
National Institute for Marine Research and Development "Grigore Antipa"
Blv. Mamaia 300
900581 Constanta
E-mail: gtiganov@alpha.rmri.ro

TURKEY

Murat DAĞTEKİN
Head
Agricultural Economy Department
Central Fisheries Research Institute
Vali Adil Yazar Cad., 14 Kaşüstü, Yomra
Trabzon
Tel.: +90 462 341 10 53
Fax: +90 462 341 11 52
E-mail: muratdagtekin998@gmail.com

Esra Fatma DENIZCI
Fisheries Engineer
General Directorate of Fisheries and Aquaculture
Ministry of Food, Agriculture and Livestock
Eskişehir Yolu 9.km Lodumlu, Çankaya, Ankara
E-mail: esrafatma.denizci@tarim.gov.tr

Ali Cemal GÜCÜ
Associate Professor
Middle East Technical University
Institute of Marine Science
E-mail: gucu@ims.metu.edu.tr

İlkay ÖZCAN AKPINAR
Aquaculture Engineer
Central Fisheries Research Institute
Vali Adil Yazar Cad., 14 Kaşüstü, Yomra
Trabzon
Tel.: +90 462 341 10 53
Fax: +90 462 341 11 52
E-mail: iakpinar@sumae.gov.tr

UKRAINE

Oleksandr CHASHCHYN
Lead Scientist
Odessa Centre, Research Institute of Marine Fisheries and Oceanography (YugNIRO)
132 Mechnikova str.
65007 Odessa
E-mail: alchashchin@yandex.ru

Kostiantyn DEMIANENKO
Deputy Director
Research Institute of the Azov Sea
State Agency of Fisheries of Ukraine
Tel.: +380 6153 36604
Mob.: +380 50 3227888
E-mail: s_erinaco@i.ua

GFCM Secretariat

Miguel BERNAL
Fishery Resources Officer
Food and Agriculture Organization of the United Nations (FAO)
Fisheries and Aquaculture Department
Palazzo Blumenstihl,
Via Vittoria Colonna, 1
00193, Rome, Italy
Tel.: +39 06 57056537
E-mail: miguel.bernal@fao.org

Constantina KARLOU-RIGA
Expert
Tel: +306945874145
E-mail: constakarlou@gmail.com

Margherita SESSA
Consultant
Food and Agriculture Organization of the United Nations (FAO)
Fisheries and Aquaculture Department
Via Vittoria Colonna 1
00193 Rome, Italy
Tel.: +39 06 57052827
E-mail: margherita.sessa@fao.org

Appendix C

Assessments for Black Sea species, with recommendations by the GFCM Sub-regional Group on the Black Sea

GSA	Species	Data type	Time series	Methodology used	Stock status	F_{curr} /F_{lim}	B_{curr} /B_{lim}	Advice	SGSABS comments
29	**Turbot** ***(Psetta maxima)***	Total landings; catch-at-age; weight-at-age; natural mortality; maturity ogive; tuning indices	1950-2013	SAM	Overexploited and in overexploitation	5.12		Implement a recovery plan	The level of IUU fishing is considered to be high. The current estimate of IUU fishing used in assessments is only considered to be an approximation that may not be representative of the real level of IUU fishing. Further analyses of natural mortality are desirable. The model used is considered to be robust to assumptions (including IUU fishing)
29	**Anchovy** ***(E. encrasicolus ponticus)***	Total landings; catch-at-age; weight-at-age; natural mortality; maturity ogive; tuning indices	1988-2013	XSA	In overexploitation	1.40	--	Reduce fishing mortality	There is some discrepancy between the tuning indices which could be related to the check ring in otolith readings. For catches in Georgia, age structure is needed to improve the input data of the XSA model. Mixing of Black Sea and Azov Sea anchovy subspecies in the area off Georgia coast should be taken into account. The average biomass level and fishing mortality rate generated by the XSA model were confirmed by an ASPIC model. However, there are some differences in the historical perspective and in the current F to F_{lim} ratio between the two models. The XSA model is robust to tests with input data. There are doubts with regards to the historical perspective on biomass; therefore it is only possible to use an F reference point. Future tests with two-stage biomass models are recommended.

GSA	Species	Data type	Time series	Methodology used	Stock status	F_{curr} /F_{lim}	B_{curr} /B_{lim}	Advice	SGSABS comments
29	**Horse mackerel** ***(Trachurus mediterra-neus ponticus)***	Total landings; catch-at-age; weight-at-age; natural mortality; maturity ogive; tuning indices (only Turkish data)	2005-2013	XSA	In overexploitation	1.95	--	Reduce fishing mortality	Needs further improvements on the tuning information. Tuning information for other Black Sea countries desirable. Fishery-independent information from hydro-acoustic surveys particularly desirable.
29	**Piked dogfish** ***(Squalus acanthias)***	Catch-at-age; weight-at-age; natural mortality; maturity ogive; tuning indices (Romanian CPUE)	1989-2013	VIT4Win, YPR-LEN, and XSA	Depleted	3.73	--	Implement a recovery plan.	Despite the absence of formal biomass reference points, the population is considered depleted due to very low presence in the catches and a large decrease in estimated biomass.
29	**Sprat** ***(Sprattus sprattus)***	Catch-at-age; weight-at-age; natural mortality; maturity ogive; tuning indexes (Bulgaria, Ukraine and Romania)	1994-2013	ICA	Sustainable	0.70	--	Do not increase fishing mortality	Hydro-acoustic survey covering at least western and north-western part of the Black Sea desirable. Egg and larvae survey could also be included.

GSA	Species	Data type	Time series	Methodology used	Stock status	F_{curr} /F_{lim}	B_{curr} /B_{lim}	Advice	SGSABS comments
29	**Atlantic bonito** ***(Sarda sarda)***	--	--	--	Unknown	--		No advice	Exploratory analysis with ASPIC model is inconclusive due to pulses in the input data. Further information on bonito catches and age/length structure from the Black, Marmara and Aegean Seas is desirable. There is a need to identify bonito spawning areas. This could be achieved through an egg and larvae survey.
29	**Rapa whelk** ***(Rapana venosa)***	--	--	--	Unknown	--		No advice	Currently only assessed at the local scale in select areas. A socioeconomic assessment should be conducted. Further methodological development will be required.

Appendix D

Exercise on stock assessment input data for Black Sea stocks

Stock	Question	Discussion and conclusions
Turbot (*Psetta maxima*)	Check current estimates of natural mortality Check the influence of using various estimates of IUU fishing on the assessment model Check the influence of using various estimates of IUU fishing on fishing mortality	- Natural mortality estimates from PRODBIOM are very different than those from Gislasson. PRODBIOM is considered to be more appropriate for this species. However, further studies on natural mortality will be beneficial, including studies to understand the implications of pathogen-induced large-scale natural mortality events. - Perception of stock status is robust to assumptions on IUU fishing. - Reduction of IUU fishing will lead to a reduction in fishing mortality. For a given biomass level, fishing mortality is a function of the catches, therefore if IUU catches were reduced to zero and official catches remain at its current levels, then fishing mortality will be reduced proportionally to the rate between IUU catches and official catches (reduction of F by about 4 times)
Anchovy (*Engraulis encrasicolus*)	Check the use of reduced time series in the biomass model (1988 – 2013) Check the use of reduced time series in the XSA model (2005 – 2013) Check the use of average age structure in the (1998 – 2004) period	- The assessment model is robust to the various tests carried out. - Any biomass reference point from the biomass model will be dependent on the perception of the biomass level at the beginning of the series, no biomass reference point could be established at this point - Some inconsistencies in the tuning indices were found; the effect of differences in otolith readings between different institutes should be further investigated

Appendix E/a

Priority surveys for stock assessment

Priority	Period	Type of survey	Target species	Current area covered[1]	Potential expansion
High	Autumn-winter	Hydro-acoustic[2]	Anchovy, sprat, horse mackerel	Turkey, Bulgaria	Turkey to cover Georgia
High	Spring-summer	Hydro-acoustic[1]	Anchovy, sprat, whiting	Turkey	Turkey to cover Georgia Bulgaria Romania Romania to cover Ukraine
High	Autumn	Trawl	Demersal species[3]	Turkey, Bulgaria, Romania, Georgia	Romania to cover Ukraine
High	Spring	Trawl	Demersal species[2]	Turkey, Bulgaria, Romania, Georgia	Romania to cover Ukraine
Medium	Summer	Daily Egg Production Method (DEPM)	Anchovy	Turkey, Romania (2000-2008)	Turkey to cover Georgia Romania to continue and add horse mackerel
Low	Autumn	Juveniles (trawl)	Anchovy, horse mackerel	Romania (2000 – 2008)	Romania to continue and Bulgaria to start
Low	Spring	Juveniles (trawl)	Sprat	Romania (2000 – 2008)	Romania to continue, Bulgaria to start

For Rapa whelk: local/national surveys with SCUBA diving and/or dredge

[1] Current coverage of surveys carried out by Russian Federation is not known to the Group
[2] Include ichthyoplankton samples in hydro-acoustic surveys (This is possible in Turkey and could be possible with new R/V in Romania).

[3] Demersal species: turbot, whiting, dogfish, red mullet

Appendix E/b

Steps to improve the harmonization of surveys-at-sea in the Black Sea

THEMATICS	STEPS	CONTACT PERSON	DEADLINE
BIOLOGICAL PARAMETERS	**1.** Identify national experts (by species and topic; ageing and maturity)	Secretariat	by 30 November 2014
	2. Exchange of sampled material to do cross-checking		
	2.1 Turbot (all countries interested)		
	- exchange of otoliths (with info)	Bulgaria: Marina Panayotova Georgia: George Komakhidze Romania: Madalina Galatchi Turkey: Aysun Gumus Ukraine: Oleksandr Chashchyn	January 2015
	- exchange of maturity scale key	Bulgaria: Marina Panayotova Georgia: George Komakhidze Romania: Aurelia Totoiu Turkey: Ilkay Özcan Akpinar Ukraine: Oleksandr Chashchyn	December 2014
	- exchange of genetic samples (Ukraine, Romania and Georgia could provide samples to a joint project between Turkey and Bulgaria)	Bulgaria: Petya Ivanova Georgia: George Komakhidze Romania: George Tiganov Turkey: Cemal Turan Ukraine: Oleksandr Chashchyn	Secretariat to contact Petya May 2015
	2.2 Anchovy		
	- Age reading (exchange of otoliths – Ukraine, Georgia, Turkey)	Georgia: Archil Guchmanidze Turkey: Ali Cemal Gucu Ukraine: Oleksandr Chashchyn	February 2015 June 2015
	- Subspecies identification (otolith exchange – Ukraine, Georgia, Turkey)	Georgia: Archil Guchmanidze Turkey: Ali Cemal Gucu Ukraine: Oleksandr Chashchyn	February 2015 June 2015
	2.3 Dogfish		
	- Exchange of pikes/photographic material between Ukraine and Georgia to Romania (pending minimal funds)	Georgia: George Komakhidze Romania: Georghe Radu Ukraine: Oleksandr Chashchyn	May 2015

THEMATICS	STEPS	CONTACT PERSON	DEADLINE
SAMPLING GEAR	**1.** Exchange characteristics of survey gear (intersession)	Bulgaria: Violin Raykov / Marina Panayotova Georgia: Archil Guchmanidze Romania: George Tiganov / Eugen Anton Turkey: Ali Cemal Gucu / Murat Dagtekin Ukraine: Oleksandr Chashchyn	February 2015
	2. Calibration of sampling gears already used at country level, including hydro-acoustics and trawl nets (start by exchange of data in the proximate areas – full calibration will require funding)	Ali Cemal Gucu and Violin Raykov	February 2015
ESTIMATION METHODS	**1.** Protocols for acoustic surveys		
	- Detailed description of estimation methods	Bulgaria: Violin Raykov Georgia: Archil Guchmanidze Romania: George Tiganov Turkey: Ali Cemal Gucu Ukraine: Oleksandr Chashchyn	February 2015
	2. Protocols for trawl surveys		
	- Detailed description of estimation methods	Bulgaria: Marina Panayotova Georgia: Archil Guchmanidze Romania: Eugen Anton Turkey: Murat Dagtekin Ukraine: Oleksandr Chashchyn	February 2015

Appendix F

Proposed Terms of reference for the Subregional Group on Stock Assessment in the Black Sea (SGSABS) in 2015

- Revise the status of the main commercial stocks in the Black Sea, with focus on turbot and small pelagic stocks;
- Review existing data and stock assessment methods for main stocks in the area, with special focus on the estimation of IUU fishing and discards which are required to conduct stock assessments;
- Review updated information on stock identification; and
- Provide advice to the GFCM and other relevant organizations on stock status and research priorities to improve the knowledge on the status of stocks.

Specific mandate for 2015:

- Revise input data and attempt analytical assessment for red mullet, whiting and bonito.

Appendix G

List of abstracts

Stock assessment of turbot (*Psetta maxima/Scophthalmus maximus*) *(M. Panayotova)*

Turbot is one of the most commercially important fish species in the Black Sea. The stock has historically been fished by all coastal states, using both stationary and mobile fishing gears, but also often caught as a by-catch of otter trawls, long lines and purse seiners' fishery. Total annual landings in the Black Sea present a decreasing trend since 2007 and are believed to be underestimated due to the occurrence of illegal, unregulated and unreported (IUU) fishing.

Turbot stock in the Black Sea was assessed by a state-space assessment model (SAM) in FLR environment (STECF – Black Sea Assessments (STECF-14-14), 2014.). The present assessment is based on the analysis of the best available information and considering the stock as representing a single unit in the entire Black Sea. In the assessment, turbot spawning biomass was estimated at the 1st of January 2013.

The data set for the period 1950-2013 was compiled using the historical data sources and new data for 2013. Available data of total landings, catch-at-ages, weights and maturity-at-age are considered appropriate for assessing the stock by SAM model. Five tuning series - 4 surveys and 1 commercial CPUE series were compiled and used in the assessment. Estimates of IUU catches during the period 2002-2013 were based on the assumption that the sudden drop after 2001 in the annual landings by Turkish vessels operating in the western portion of the Black Sea was replaced by unreported catches of turbot by Bulgarian, Romanian and Ukrainian fishers. The IUU catches in 2002-2013 were estimated by raising the cumulative landings of Ukraine, Romania and Bulgaria by a proportion given by the following expression: (mean Turkish landings in 1993-2001 - mean Turkish landings in 2002-2010) divided by the mean cumulative landings by Ukraine, Romania and Bulgaria in 2002-2010. The estimated ratio is 4.7, which implies that IUU catches in Ukrainian, Romanian and Bulgarian waters since 2002 were about 5 times larger than the reported official landings.

The SAM-estimated recruitment has four peaks in 1965 – 1968, 1974 – 1978, 1991 – 1994 and 2004 – 2007 and three troughs in 1982-85, 1996 – 1997 and after 2009. Correspondingly, the level of SSB attained higher values up to 12 689 tonnes in 1977 – 1982 and very low values after 2009. Fishing mortality F4-8 has peaks of F~1.24 in 2000-2001 and F~1.33 during the recent years (2012 – 2013). The assessment indicates that the spawning stock biomass continues to be at a very low level (around 1634 tonnes) and it is estimated to be around half of B_{lim} (3535 t). F in 2013 (1.33) is more than five times higher than F_{MSY} (0.26). Recruitment peaked during the period 2004 - 2007 and decreased thereafter. The STECF EWG 14 14 classifies the stock of turbot in the Black Sea as being exploited unsustainably and at risk of collapse. On the basis of precautionary considerations there should be no directed fisheries for turbot in 2015 and by-catch should be minimized.

Short-term prediction of stock size and catch was conducted based on SAM results. Fishing at the current level of F (1.33) from 2014 to 2015 generates a reduction of the catches of 0.08 % and a decrease of the spawning stock biomass of 0.04% from 2015 to 2016. Fishing at F_{MSY} (0.26) from 2014 to 2015 generates a decrease of the catch of 70.55% and a spawning stock biomass increase of 39.16 % from 2015 to 2016. Catches of turbot in 2015 consistent with F_{MSY} (0.26) should not exceed 213 tonnes. In case of zero catches in 2015, the SSB is expected to increase 47.6 % in 2016.

Stock assessment of piked dogfish (*Squalus Acanthias*) *(G. Radu)*

Piked dogfish are long-lived, late maturing, and have low fecundity, which means that the stock has very limited capability to rebound quickly once it becomes depleted. During the 25 years for which landings data are available the largest annual catches of piked dogfish occurred during the early years of the series, with the peak landings of 6,159 tonnes in the first year of the series (1989). Although the cumulative landings were taken primarily by Turkey and Ukraine, piked dogfish has lost its commercial importance in these countries. In the last three years, 2011- 2013, about 40% of the landings were produced by Bulgaria. The landings of piked dogfish have dropped steadily and dramatically since the start of the reported landings series, from more than 6,000 tonnes in 1989 to only 80 tonnes in 2013. The fishing mortality rate during 2013 is estimated to be F = 0.112, which is more than 3.5 times greater than the F_{MSY}. Recent catches of this long-lived and low fecundity species are very low compared to the past and the stock appears to be severely depleted. Comparing the obtained results in a period of 25 years, the stock biomass has decreased dramatically. In the last 15 years alone, the biomass decreased about 20 times.

Results from any assessment of dogfish in the Black Sea will remain highly uncertain unless there are concerted and coordinated efforts to collect representative biological samples of dogfish from all fisheries that catch dogfish (including dogfish discarded by fisheries that do not target dogfish). It is imperative to improve the catch statistics regarding *Squalus acanthias* in the Black Sea area. Catch information is vital for the successful management of this species. Additionally, age reading of dogfish needs to be calibrated between different national laboratories to avoid discrepancy between national catch-at-age data. Joint surveys (6 Black Sea countries) are necessary to follow the distribution patterns, spawning areas, CPUE series, biomass estimations, diet, maturity indices etc. As a general conclusion, continuing to operate in the same manner, in the competitive system without management at the regional level will result in the collapse of the dogfish stock.

Stock assessment of horse mackerel *(Trachurus mediterraneus ponticus)* *(M. Yankova)*

The horse mackerel is a migratory species distributed in the whole Black Sea (Ivanov and Beverton, 1985). In the spring, it migrates to the north for reproduction and feeding. In the summer, the horse mackerel is distributed preferentially in the shelf waters above the seasonal thermocline. In the autumn, it migrates towards the wintering grounds along the Anatolian and Caucasian coasts migration (Ivanov and Beverton, 1985). The horse mackerel population in the Black Sea mainly winters along the Crimean, Caucasian and Anatolian coasts and warm sections of the Marmara Sea. The horse mackerel (*Trachurus mediterraneus*) fishery operates mainly on the wintering grounds in the southern Black Sea using purse seine and mid-water trawls. The catches of Black Sea horse mackerel were realized by active (pelagic trawls and purse seine) and passive fishing gears (gill nets, trawl nets, trap nets, etc.). Horse mackerel stocks in the Black Sea are usually caught by Turkish fishermen using active (bottom trawler, pelagic trawler and large purse seine) and passive (extension and longline) nets. Almost the entire horse mackerel catch (98.2%) is caught by large purse seine. A large part of the catch (80%) in Turkish waters is caught in the autumn and the first part of winter (September-December).

The data set of landings was compiled for the period 1950 – 2013. During the period 1956–1965, catches have continued to grow and their mean values reached 19007. 95 tonnes. During the period 1966 – 1975, the total average catch increased to 21041.98 tonnes. The next decade (1976 – 1985), horse mackerel catches also increased from 20576.3 to 141077.8 tonnes, respectively. The period 1986 – 1995 was characteristic with abrupt decline in the catches of the fish from 977408 to 15906 tonnes. The next 7 years (1996 – 2002) represented a period of prolonged decreasing of the mean horse mackerel catch- (mean values reached-12343.64 tonnes). In 1992, catch was 21065 tonnes. In 1994, the amount of catch decreased, in particular between 1998 and 1999. In 2013, a decrease in catches of horse mackerel was reported, at the level of 20213.51tonnes.

A new tuning series from a commercial CPUE study in Turkey has been used to tune an XSA model. Given the availability of a tuning fleet of commercial CPUE data from Turkey for years 2005-2013 an XSA(in FLR) was attempted. Based on the residual patterns and the retrospective analysis, the best assessment was deemed the hma.xsa5, which has a 3 years of shrinkage on 2 ages and a standard error of 2. There are however two limitations with this CPUE: first, the CPUE is an index of biomass split with the age structure of the catch matrix from Turkey; second, the yearly biomass index is derived by adding the monthly CPUE estimates together rather than averaging across months. Finally a commercial CPUE estimate derived from purse-seine and standardized to kg/vessel/day is a very raw index since it does not account for search time, number of sets, boat size etc. A much better index should be derived from fisheries-independent surveys. Thus an international hydro-acoustic survey should be established to monitor trends in the horse mackerel age-structure and stock biomass across all national waters of the Black Sea. State of the spawning stock size:

Assessment formulations indicate that the SSB in 2013 is decreasing from the previous year, but is fluctuating since 2005. In the absence of total stock size estimates and biological reference points, it is not possible to fully assess the current stock size.

Recruitment is indicated to have decreased in the mid-part of the series and is now in a high period. Using the current assessment of horse mackerel in the Black Sea, F_{2013}= 1.42310, since horse mackerel is a pelagic species, the Patterson Exploitation E=0.4 reference point was selected to be consistent with long-term exploitation of the stock.E_{2013}= 0.7805936 is almost two times higher than the reference point, thus the stock is in a state of overexploitation in 2013 and since 2005.

The lack of a fishery independent hydro-acoustic scientific survey to monitor horse mackerel across the entire Black Sea to indicate trends in total mortality and recruitment appears to be the major data deficiency in the assessment and there is a growing need to establish such a survey.

Stock assessment of anchovy (*Engraulis encrasicolus)* *(O. Chashchyn)*

European anchovy is the most abundant fish in the Azov and Black Sea basin and forms the basis of an important fishery. There are two subspecies of the European anchovy in the Black Sea: the Black Sea anchovy *Engraulis encrasicolus ponticus Aleksandrov* and the Azov anchovy *Engraulis encrasicolus maeoticus Pusanov*. Wintering areas of both subspecies (stocks) are located in the Black Sea. Based on the more than 30 years research of anchovy, this review summarizes data on catches, spatial distribution patterns, abundance, and scientific survey results separately for two stocks. Direct methods of stock assessment have been applied, based on trawl, lampara and hydro-acoustic survey data. Authors recommend to the Black Sea countries authorities to base their anchovy fishery-regulating decisions mainly on the hydro-acoustic surveys' results. A major impact of invasive Atlantic ctenophores *Mnemiopsis leidyi* and *Beroe ovata* on anchovy populations is revealed.

Stock assessment of Black Sea anchovy (*Engraulis encrasicolus*) *(A. Gucu)*

The Black Sea anchovy is one of the two stocks of the species inhabiting the Black Sea and fished by five of the six Black Sea countries. The fleet of the Russian Federation exclusively targets Azov Sea anchovy (*Engraulis encrasicolus maeoticus*), which is assumed to form an isolated stock. Only a negligible quantity of the Black Sea anchovy (*Engraulis encrasicolus ponticus*) exists in Russian waters.

Apart from year-to-year fluctuations, a significant drop in the landings has been experienced in 1989. Following the three years after the collapse, the Black Sea anchovy stock seemed to recover, as can be seen from the increase in the Turkish landing. However, the catch of the countries near to the spawning and nursery grounds or on the migration route of the species has never been increased, yet, reduced since then. This situation is explained by the drastic drop in the number of fishing vessels and pond net in these countries; however it may also be an indication of habitat shift and/or change in the migration route.

The anchovy fleet is characterized by purse-seiners usually coupled with a carrier boat. The largest fleet targeting Black Sea anchovy belongs to Turkey. In accordance with a bilateral agreement, since 2003, a small part of the Turkish purse seiners move to Georgian waters as soon as the Black Sea anchovy season is over on the Turkish coast.

Although only less than 10% of the fishing boats moved to Georgia in 2013 and took part in the anchovy fishery, the quantity of the fish landed in Georgia is almost half the Turkish anchovy landed in Turkey. Apparently the CPUE is much higher in the Georgian waters. This is most probably a consequence of the different minimum size regulations applied in the countries (7 cm TL in Georgia and 9 cm TL in Turkey.

The only country applying a catch quota to Black Sea anchovy is Georgia, where the quota has been increased from 60 000 to 85 000 tonnes in 2013. As no information is provided by the Georgian authorities concerning the methodology applied to estimate TAC, it is not clear whether or not the increased quota is in line with the stock status. On the other hand the lowest minimum landing size among the Black Sea countries is in Georgia (7 cm, TL). In the rest of the countries (Bulgaria, Romania, and Turkey) minimum landing size is around 9 cm total length). Turkey, in an attempt to reduce fishing mortality, has enforced various measures such as restricting the fisheries to night hours (16:00-08:00) and to winter months (15 Sep-Mar), as well as narrowing the fishing ground by banning the purse seining in the coastal zone ranging from 0 to 24 m and reducing the number of licensed boats through a vessel buy-back campaign launched first in 2012 and later repeated in 2013 (more than 900 industrial class fishing vessel were removed from the fleet). Consequently, the annual catch of Turkey slightly increased compared to 2012; however still well below the average of the last 10 years. In contrary, Georgia raised the TAC in 2013 and the anchovy caught on the Georgian waters increased 2.1 times in 2011 and further increased by 1.3 times in 2013. A noticeable increase in the Romanian catch was also noted in 2013.

The stock of Black Sea anchovy was assessed by two different methods; XSA was based on landings (1989-2013) of all countries assuming that the age/length compositions are identical in every country. It should be noted that a significant violation of the assumption of uniform age/length composition is the differences in the minimum landing size in two main exploiters (Turkey and Georgia). The acoustic biomass estimations conducted by Ukraine (1989-2001) and Turkey (2011-2013) were used to tune the model. The same index data were used in ASPIC which was run for Turkish + Georgian catch and number of Turkish purse seiners being indicative of the effort.

The results of the XSA displayed a very strong year class entry in 2012, which, lead to an increase in the SSB in the following year. The cyclic pattern in recruitment which peaked in 1994, 1999, 2006, 2012 seems to be an environmentally driven feature of the stock which usually followed by a drop within the last 25 years. The F, which had been dropped noticeably in 2012, increased slightly in 2013. General trend in the last ten years, however, indicates a slight decrease in the fisheries mortality. The absolute values varies with the model settings for shrinkage. According to the worst scenario (highest F estimate), the current F(1:3) for 2013 is estimated as 1.2, which is higher than the FMSY (0.56) estimated based on precautionary exploitation rate (the current exploitation rate of 0.59 exceeds the precautionary threshold 0.4 recommended for small pelagic fish. The average of the last 5 years' F estimate is 1.37 (± 0.36) and the high variance of estimate hampers to make meaningful short term predictions.

The F estimated by the ASPIC model is slightly lower than those of XSA however despite some differences in the absolute values, displayed a quite similar pattern of fluctuation. One of the noticeable deviances was in the estimate of last year. The average biomass estimated by ASPIC and the spawning stock biomass resulted by XSA represented a very similar pattern of fluctuation with synchronous peaks and troughs over the years. According to the results of ASPIC the F, which had remained well above the F_{MSY} dropped gradually and displayed a very sharp decline in the last two year. The drop in the F is reflected on the average biomass.

Stock assessment of sprat *(V. Raykov)*

Sprat represents a unit stock shared among the Black Sea countries. Its key role is determined by the importance from both commercial and ecological point of view. The sprat fishery takes place in the Black Sea (GFCM Fishing Sub-area 37.4 (Division 37.4.2) and Geographical Sub-area (GSA) 29). The sprat landings highly varied as for 2000-2013 the average catch accounted to 62097.69 tonnes. In 2012 the catch dropped significantly from 120708 tonnes to 35025 tonnes and continue to decrease at 27268.48 tonnes in 2013. Discards of sprat are evidently very low. Most of the reported landings of sprat since 2004 were taken by Turkey (47%). The stock was exploited unsustainably during 2010, 2011 and 2012 (but not during 2013). The catch forecast for 2014 based on the accepted proxy for FMSY (exploitation ≤ 40%) is 48 775 tonnes, which is more than the catch forecast under status quo fishing.

There is concern that the fishery for sprat produces significant quantities of bycatch and discard of other fish species, such as whiting. State of the spawning stock size: According to the present assessment in recent years the SSB is at medium levels (180 000-300 000 tonnes) with a decreasing trend since 2010. In 2013, the SSB has dropped to 179 464 tonnes. Under a constant recruitment scenario and status quo F = 0.446, in 2014 the SSB is expected to increase to 198 189 and to decrease to 185 093 tonnes by 2016.Management measures applicable for the sprat stock concern the TAC and quota (for 2012-2013: 11 475 tonnes) in EU waters (Bulgaria and Romania). Ukraine and the Russian Federation have TAC = 70 000 tonnes .No TACs and quotas in Georgian and Turkish Black Sea waters exist.

Information on stock assessment of bonito *(Sarda Sarda)* *(M. Dagtekin)*

Atlantic bonito plays a major role as top predator in the Black Sea ecosystem and has high commercial importance, especially for the Turkish fishery since 1950. Atlantic bonito is caught only by Turkey and Bulgaria. Reports of last 25 years have shown that a dominant part of the Atlantic bonito catches in the Black Sea are obtained in Turkish waters. The common stock assessments should be done in Black Sea, Marmara and Aegean Sea.

Ichthyoplankton samples from oceanographic surveys and other potential data sources should be explored for evidence that bonito spawn in the Black Sea and to identify spawning seasons and locations.

The very rapid growth of bonito implies that age-length keys will need to be developed for very short time intervals (e.g., monthly) if they are to be used to generate reliable estimates of age composition. Age and length data that are aggregated over longer time-intervals will blend adjacent cohorts and produce biased estimates of age-composition.

Information on rapa whelk fisheries *(Rapana venosa)* in the Black Sea *(M. Dagtekin)*

The invasion of ecosystems by non-indigenous species is one of the greatest threats to biodiversity and community structure (Vitousek et al. 1996; Mack et al. 2000). *Rapana venosa* are large predatory marine gastropods that, to date, are the progenitors of four known successful invasions into estuarine habitats around the World (Harding and Mann, 2005). *R.venosa*, known to be of indo-pacific origin, was introduced to the Black Sea in the 1940s. The ecological impacts in the Black Sea have been severe. *R. venosa* predation was identified as the key reason for the decline of bivalve species.

An *R. venosa* fishery has developed in the Black Sea since 1980s. Catches of rapa whelk are made using dredges, scuba diving or beam trawls. According to some studies the use of some gear for fishing *R. venosa* damages benthic habitats, destroying native mussel reefs that are important high biodiversity areas (Janssen et al., 2014).

It is required to have socio-economic studies related to the rapa whelk fisheries in order to determine whether it is accepted as a part of the habitat in Black sea and continue catching of this species more. There is a need for experimental studies on the abundance of rapa whelk. Age determination of rapa whelk is an important technical problem and region-wide harmonization of methods for ageing would be very beneficial for comparative studies of *Rapana* spp.

Appendix H

Ongoing or recent surveys related to fisheries assessment for Black Sea stocks

Country	Species	Dates	Region covered	Main sampler	Alternative sampler	Objectives	Time series	Type of data available
Bulgaria	Sprat *Sprattus sprattus*	May -June	Bulgarian marine area up to 100 m isobath	PTS[4], R/v"Prof. Valkanov and F/V RK3	-	Biomass	2007-2009	CPUE, CPUA, biological data/age/length/sex ratio/weight/, SST, zooplankton
Bulgaria	Sprat *Sprattus sprattus*	June	Bulgarian marine area up to 100 m isobath	PTS, R/V Steaua de MareI, NIMRD	-	Biomass	2010	CPUE, CPUA, biological data/age/length/sex ratio/weight/, SST, zooplankton
Romania	Sprat *Sprattus sprattus*	Spring (June-July)	Romanian marine area up to the 60 m isobath	Pelagic trawl (50/35-74) R/V Steaua de Mare	-	Stock assessment	2000-2009	CPUE, biomass, biological data, growth and length-weight parameters, maturity, sex ratio
Romania & Bulgaria	Sprat *Sprattus sprattus*	Spring (June-July)	Romanian marine area up to the 60 m isobath	Pelagic trawl (36/26-59) R/V Steaua de Mare	-	Stock assessment	2010	CPUE, biomass, biological data, growth and length-weight parameters, maturity, sex ratio
Romania	Sprat *Sprattus sprattus*	Autumn (October-November)	Romanian marine area up to the 60 m isobath	Pelagic trawl (50/35-74) R/V Steaua de Mare	-	Stock assessment	2000-2009	CPUE, biomass, biological data, growth and length-weight parameters, maturity, sex ratio
Romania	Sprat *Sprattus*	Autumn (December)	Romanian marine	Pelagic trawl (36/26-59)	-	Stock assessment	2012 (cont'd)	CPUE biomass, biological data, growth and

[4] **(PTS = pelagic trawl survey)**

Country	Species	Dates	Region covered	Main sampler	Alternative sampler	Objectives	Time series	Type of data available
	sprattus		area up to the 60 m isobath	R/V Steaua de Mare				length-weight parameters
Bulgaria	Sprat *Sprattus sprattus*	November - December	Part of Bulgarian EEZ (2010); Bulgarian EEZ (2011)	EK60, OTM	-	Abundance and biomass indices	2010-2011 (cont'd with interruption in 2012, 2013	NASC m2.nm-2, biomass, biological data, hydro-chemical parameters
Romania & Bulgaria	Sprat *Sprattus sprattus*	Autumn (December)	Romanian marine area up to the 100 m isobath	EK60 hydro acoustic R/V Akademic	-	Hydro-acoustic survey Stock assessment	2010	CPUE, biomass biological data growth and length-weight parameters maturity, sex ratio
Romania & Bulgaria	Sprat *Sprattus sprattus*	Autumn (November-December)	Romanian marine area up to the 100 m isobath	EK60 hydro acoustic R/V Akademic	-	Hydro-acoustic survey Stock assessment	2011	CPUE, biomass biological data growth and length-weight parameters maturity, sex ratio

Country	Species	Dates	Region covered	Main sampler	Alternative sampler	Objectives	Time series	Type of data available
Bulgaria	Turbot *Psetta maxima*	April-May	Bulgarian marine area up to 100 m isobaths	Demersal trawl	-	Abundance and biomass indices	2006-2009	CPUE, CPUA, biological data/age/length/sex ratio/weight/
Bulgaria	Turbot *Psetta maxima*	April-May	Bulgarian marine area up to 100 m isobath	Demersal trawl (22/27 -34) (R/V "Steaua de Mare I",NIMRD) (2010-2012)	-	Abundance and biomass indices	2010-2012 (cont'd with interruptions in 2013, 2014)	CPUE, CPUA, biological data/age/length/sex ratio/weight
Romania	Turbot *Psetta maxima*	Spring (May-June)	Romanian marine area up to the 75 m isobath	Demersal trawl (57/63-62) R/V Steaua de Mare	-	Stock assessment	2003-2009 annually (cont'd)	CPUE, biomass biological data growth and length-weight parameters maturity, sex ratio
Romania & Bulgaria	Turbot *Psetta maxima*	Spring (May-June)	Romanian marine area up to the 75 m isobath	Demersal trawl (22/27-34) R/V Steaua de Mare	-	Stock assessment	2010-2012 annually	CPUE, biomass biological data growth and length-weight parameters maturity, sex ratio
Bulgaria	Turbot *Psetta maxima*	October-November	Bulgarian marine area up to 100 m isobaths	Demersal trawl	-	Abundance and biomass indices	2006-2009	CPUE, CPUA, biological data/age/length/sex ratio/weight
Bulgaria	Turbot *Psetta maxima*	October-November	Bulgarian marine area up to 100 m isobath	Demersal trawl (22/27 -34) (R/V "Steaua de Mare I", NIMRD) (2010-2012)	-	Abundance and biomass indices	2010-2012	CPUE, CPUA, biological data/age/length/sex ratio/weight
Romania	Turbot *Psetta maxima*	Autumn (October-November)	Romanian marine area up to the 75 m isobath	Demersal trawl (57/63-62) R/V Steaua de Mare	-	Stock assessment	2003-2009 annually (cont'd)	CPUE, biomass biological data growth and length-weight parameters maturity, sex ratio

Country	Species	Dates	Region covered	Main sampler	Alternative sampler	Objectives	Time series	Type of data available
Romania & Bulgaria	Turbot *Psetta maxima*	Autumn (October-November)	Romanian marine area up to the 75 m isobath	Demersal trawl (22/27-34) R/V Steaua de Mare	-	Stock assessment	2010-2012 annually	CPUE, biomass biological data growth and length-weight parameters maturity, sex ratio

Country	Species	Dates	Region covered	Main sampler	Alternative sampler	Objectives	Time series	Type of data available
Romania	Whiting *Merlangius merlangus*	Spring (May-June)	Romanian marine area up to the 75 m isobath	Demersal trawl (22/27-34) R/V Steaua de Mare	-	Stock assessment	2007-2012 annually (cont’d)	CPUE, biomass biological data growth and length-weight parameters maturity, sex ratio
Romania	Whiting *Merlangius merlangus*	Autumn (October-November)	Romanian marine area up to the 75 m isobath	Demersal trawl (22/27-34) R/V Steaua de Mare	-	Stock assessment	2007-2012 annually (cont’d)	CPUE, biomass biological data growth and length-weight parameters maturity, sex ratio

Country	Species	Dates	Region covered	Main sampler	Alternative sampler	Objectives	Time series	Type of data available
Romania	Dogfish *Squalus acanthias*	Spring (May-June)	Romanian marine area up to the 75 m isobath	Demersal trawl (22/27-34) R/V Steaua de Mare	-	Stock assessment	2010-2012 annually (cont'd)	CPUE, biomass biological data growth and length-weight parameters maturity, sex ratio
Romania	Dogfish *Squalus acanthias*	Autumn (October-November)	Romanian marine area up to the 75 m isobath	Demersal trawl (22/27-34) R/V Steaua de Mare	-	Stock assessment	2010-2012 annually (cont'd)	CPUE, biomass biological data growth and length-weight parameters maturity, sex ratio

Country	Species	Dates	Region covered	Main sampler	Alternative sampler	Objectives	Time series	Type of data available
Turkey	Anchovy	Nov 2011-Nov 2013	All All All All Eastern Eastern All East	Hydro-acoustic	Pelagic trawl	Overwintering ground determination	Nov-Dec 2011 Jan-Feb 2012 Nov 2012 Dec 2012 Jan 2013 Feb 2013 July 2013 Nov-Dec 2013 (cont'd)	Biomass, length –frequency, age distribution, sex ratio
Turkey	Anchovy	June 1992-July 2013	All All All All All East East	Hansen egg net	Hydro-acoustic, pelagic trawl	Spawning area	June 1991 July 1992 August 1993 June-July-1996 July 2013 Jan-Dec 2011 Jan-Dec 2013 (cont'd)	Abundance and distributions

Country	Species	Dates	Region covered	Main sampler	Alternative sampler	Objectives	Time series	Type of data available
Turkey	Demersal commercial species	1991-1996	Eastern Eastern Eastern Eastern Eastern	Bottom trawl	Bottom trawl		1991-1992 1992-1993 1993-1994 1994-1995 1995-1996	Bio mass Length -frequency Age distribution Sex ratio
Turkey	Demersal commercial species	2009-2012	Middle Middle Middle	Bottom trawl	-	CPUE	2009-2010 2010-2011 2011-2012	Bio mass Length -frequency Age distribution Sex ratio
Turkey	Demersal commercial species	2009-2013	Western Western Western	Commercial trawl	-	CPUE Discard	2009-2010 2010-2011 2011-2012	Bio mass Length -frequency Age distribution Sex ratio
Turkey	Demersal commercial species	2010-2013	Western Western Western	Demersal	Bottom trawl	CPUE	2009-2010 2010-2011 2011-2012	Bio mass Length -frequency Age distribution Sex ratio

Appendix I

Stock assessment forms for main stocks in the Black Sea

Stock Assessment Form Small Pelagics

Reference Year: 2013

Reporting Year: 2014

[A brief abstract may be added here]

1 Basic Identification Data

Scientific name:	Common name:	ISCAAP Group:
Engraulis encrasicolus ponticus	[Black Sea anchovy]	[ISCAAP Group]
1st Geographical sub-area:	**2nd Geographical sub-area:**	**3rd Geographical sub-area:**
[GSA_29]		
1st Country	**2nd Country**	**3rd Country**
Turkey	Georgia	Ukraine
4th Country	**5th Country**	**6th Country**
Romania	Bulgaria	
Stock assessment method: (direct, indirect, combined, none)		
indirect		
Authors:		
[Ali Cemal Gucu]		
Affiliation:		

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

Direct methods (you can choose more than one):

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

Indirect method (you can choose more than one):

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

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

2 Stock identification and biological information

2.1 Stock unit

The anchovy, *Engraulis encrasicolus* is distributed all over the Black Sea (Figure 1) and represented by at least two different stocks in the Black Sea: the Black Sea and the Azov Sea stocks (Ivanov and Beverton 1985). The later reproduces and feeds in the Azov Sea and hibernates along the northern Caucasian and Crimean coast of the Black Sea. In addition to these two distinct stocks, there are strong evidences for the existence of a resident stock, spawning within the Turkish EEZ and overwintering on the Anatolian coast. An alternative view to existence of more than two stocks is displacement in the spawning areas (Niermann et al. 1994). The degradation of ecological status of the spawning area was believed to lead anchovy to replace its spawning areas (**Error! Reference source not found.**).

The common belief is that the Black Sea anchovy migrates to the wintering grounds along the Anatolian and Caucasian coasts in southern Black Sea in October-November. In these areas they form dense hibernating concentrations until March. During this period they are subjected to intensive fishery. In the rest of the year they occupy spawning and feeding habitats across the sea with some preference to the shelf areas characterized by high productivity (Faschuk et al. 1995).

On the other hand in the view of new findings, to what extent the different forms of anchovies are mixed and discriminated in the landings and as to whether they subjected to the same nutritious conditions for growth and reproduction and to the same level of natural and fisheries mortality, are matter of assessment concerns. It is crucial to address unit stock question for anchovy in the Black Sea. Here in this assessment it was assumed that i) there are only two stocks of anchovy in the Black Sea; ii) the Azov Sea anchovy inhabits a rather small region confined to Sea of Azov, east of Kerch, Caucasian coast and to a minor extent Georgia; iii) Azov stock is almost exclusively fished and hence regulated by Ukraine and Russian Federation. Therefore the assessment is populated with the data pertaining only to the Black Sea anchovy.

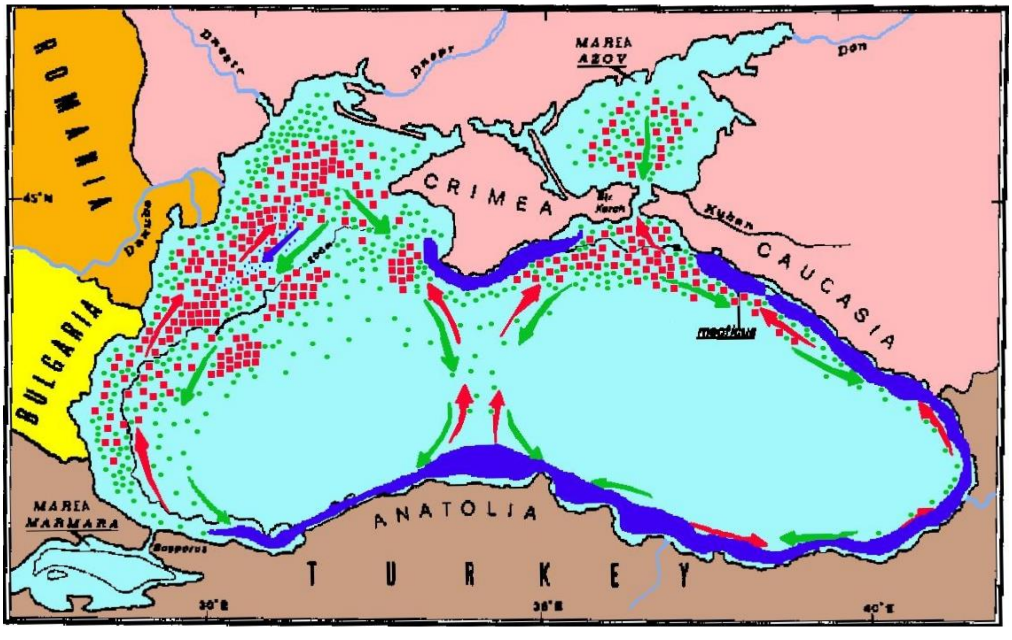


Figure 1.Distribution of the anchovy at the Romanian littoral and in the whole Black Sea.

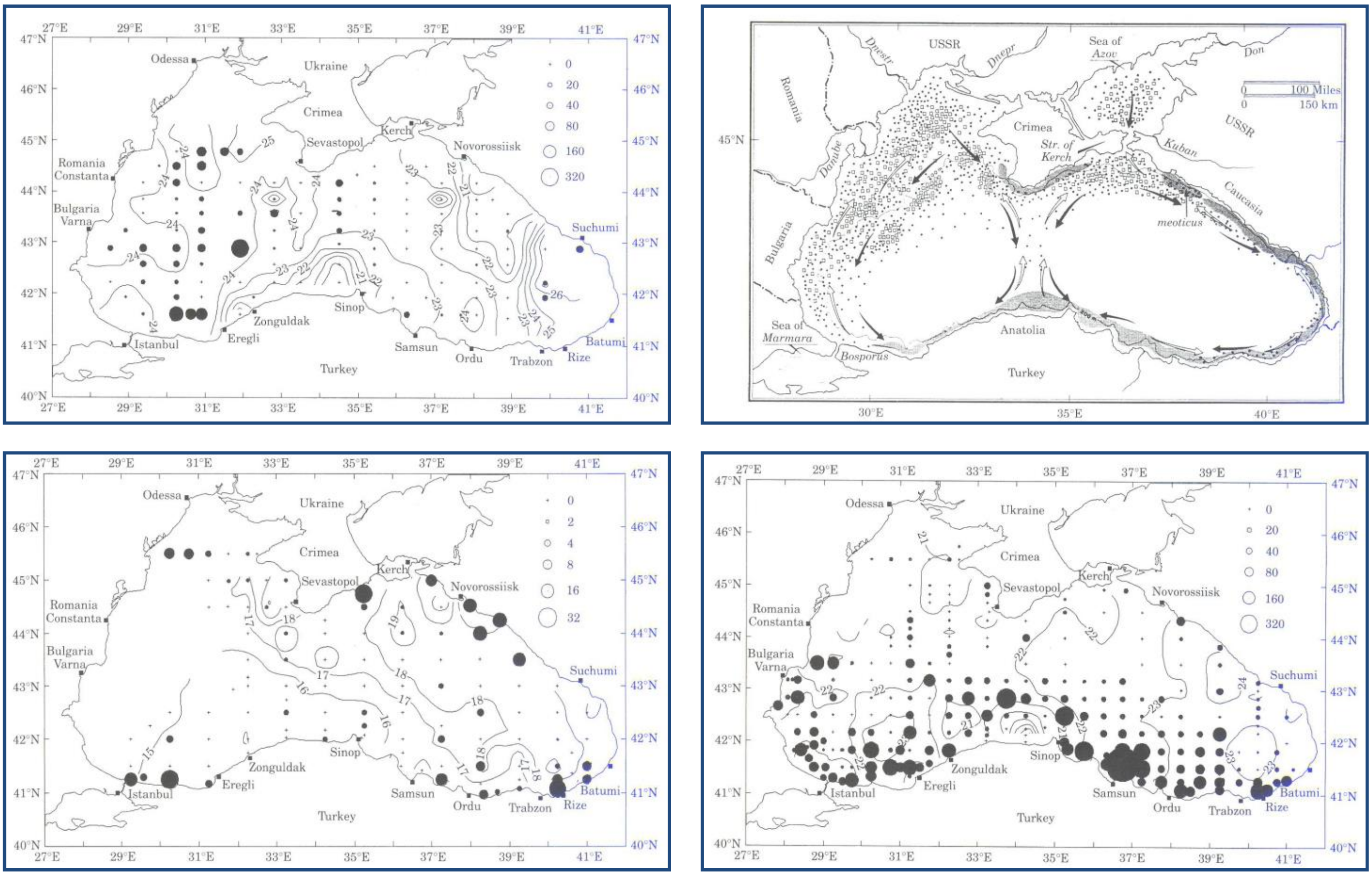


Figure 2.Egg distribution of anchovy in 1950s (upper left; Einarson and Gürtürk 1960); in 1970s (upper right, Ivanov and Beverton, 1985), and in 1990s (lower, Niermann et al. 1994).

2.2 Growth and maturity

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

Somatic magnitude measured (LT, LC, etc)			LT	Units	cm
Sex	**Fem**	**Mal**	**Combined**	**Reproduction season**	May-August
Maximum size observed			14.5	**Recruitment season**	
Size at first maturity				**Spawning area**	
Recruitment size to the fishery				**Nursery area**	

Table 2-2.2: M vector and proportion of matures by size or age

Age	Natural mortality	Proportion of matures
0	*1.32*	*0*
1	*0.81*	*1*
2	*0.56*	*1*
3	*0.48*	*1*
4	*0.48*	*1*

Table 2-3: Growth and length weight model parameters

			Sex			
		Units	**female**	**male**	**Combined**	**Years**
Growth model	**L_∞**					
	K					
	t_0					
	Data source					
Length weight relationship	**a**					
	b					
	M (scalar)				0.82	
	sex ratio (% females/total)					

3 Fisheries information

3.1 Description of the fleet

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

	Country	GSA	Fleet Segment	Fishing Gear Class	Group of Target Species	Species
Operational Unit 1*	[Turkey]	[GSA29]	H	[Purse seine]	[ISCAAP Group]	
Operational Unit 2	[Georgia]	[GSA29]	H	[Purse seine]	[ISCAAP Group]	

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

Operational Units*	Fleet (n° of boats)*	Catch (T of the species assessed)	Other species caught (names and weight)	Discards (species assessed)	Discards (other species caught)	Effort (units)
[Turkish Purse Seiner]	218	153555				No of vessel
[Purse seiners in Georgia]	21	70700				No of vessel
[Bulgaria]	na	9.5				
[Romania]	na	111				
[Ukraine]	na	1686				
Total	239	226 062				

TUBITAK-KAMAG 110G124 – Turkish Ministry of Food, Agriculture and Live stocks

3.2 Historical trends

The anchovy landings during the period 1970 – 2013 by countries are presented on Figure 1. The data presented under Ukraine belong exclusively to the Black Sea anchovy (Azov anchovy excluded). In1997-2006, the Ukrainian fleet fished the Black Sea anchovy, not only in their own waters, but also in waters of Georgia. It was assumed that Russian Federations targets only Azov anchovy and the Black Sea anchovy catch of this country is negligibly low.

The stock has experienced a collapse in late 1980s and recovered, as can be seen from the landings of Turkey. The very high level of anchovy catch of former USSR has never been reached after the disintegration. The fate of the stock is not known.

The landings figures suggests that the annual catch of Turkey slightly increased compared to 2012; however still well below the average of the last 10 years. In contrary, Georgia raised the TAC in 2013 and the anchovy caught on the Georgian waters increased 2.1 times in 2011 and further increased by 1.3 times in 2013. A noticeable increase in the Romanian catch was also noted in 2013.

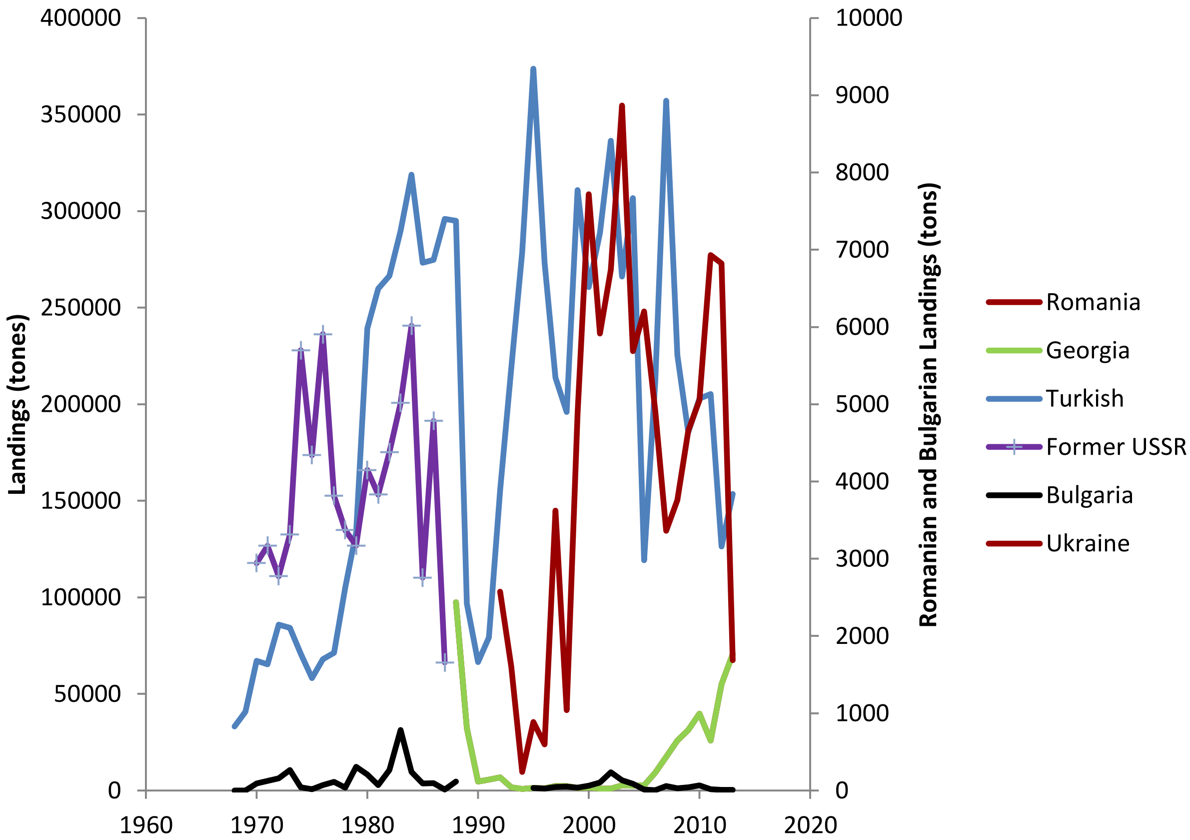


Figure 3. Annual anchovy landings of the Black Sea countries

3.3 Management regulations

In the Black Sea countries, anchovy fishing are generally regulated by i) closed seasons (May April to October/November for Bulgaria and Romania, April to September for Turkey, and no closed season for Ukraine), ii) closed areas, iii) mesh size regulations, iv) minimum landing size (9 cm total length (or equal) in general and 7 cm TL for Georgia). The Black Sea and Azov anchovy are treated as two different stocks in Ukraine and in the Russian Federation and the fishery is managed separately for each stock.

The only country applying a catch quota to Black Sea anchovy is Georgia, where the quota has been increased from 60 000 to 85 000 tones in 2013. As no information is provided by the Georgian authorities concerning the methodology applied to estimate TAC, it is not clear whether or not the increased quota is in line with the stock status

Turkey as the owner of the main fleet fishing the Black Sea anchovy enforced additional measured to control the size of the fishing fleet. These includes;

a) The fishing capacity of the fleet had been develop over the years and finally overcapitalized beyond the profitability within the last 3 decades. The issue and its consequences on the fish stocks have been recognized in mid-1990s when a significant reduction in the stocks hit the fishery sector. However a comprehensive measure has been enforced only at the beginning of 2000's. As the first step, licensing new fishing boats has been stopped in 2002 with the aim of reducing the fishing pressure on the stocks and to maintain sustainable fisheries. Despite interruptions during 2004 and 2005, the applied policy had positive effects on control of increasing fleet capacity. Since then, new entries to the fleet are only allowed when a vessel of same size is exiting from the fleet. In summary the size of the main anchovy fishing fleet in the Black Sea is stable since 2005.

b) Another very substantial and promising remedy is the fishing boat buyback program launched in 2012 and repeated in 2013. Given that by far greater part of the catch is landed by the industrial boats, the first phase of the program targets fishing vessels larger than 12 meters in 2012. Although the ultimate goal is to reach greater percentages in time, with the available funds allocated for the buyback program only 407 boats (156 boats of them were registered to the port on the Black Sea coast) has been removed from the fleet at this first phase in 2013. In the second phase launched in 2014 another 529 boats have been decommissioned within this campaign.

c) A series of new regulations and methodological reforms have been enforced within the last 2 years to enhance accuracy of the landing statistics, such as transportation permits for anchovy issued at the landing site

d) As of 18.08.2012 the minimum depth limit allowed for purse seine and for pelagic trawls has been increased from 18 to 24 meters. Considering that the anchovy overwintering on the Anatolian coast are confined to 0 to 100 meters, the regulation has noticeable positive effect on the reduction of fishing pressure on the anchovy stocks.

e) Another practice to reduce the fishing pressure on the anchovy stock is that the anchovy fishery is restricted to night hours (16:00-08:00)

Reference points

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

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

4 Fisheries independent information

4.1 Hydroacoustic survey

4.1.1 Brief description of the chosen method and assumptions used

Direct methods: DEPM

Table 4.1-1: Egg production cruise information.

Date					
Cruise				**R/V**	
Total area (km^2)		Positive		**Negative**	
Egg sampler					
Adult sampler					

Table 4.1-2: Parameters of the egg mortality curve

Parameters (exponential decay model)	**Value**	**CV**
P_0 (# of eggs /0.05 m^2)		

Z (days^{-1})				
Temperature range	ºC	ºC		

Table 4.1-3: DEPM Model parameters

Model parameters	**value**	**CV**
P_0 (# of eggs/0.05 m^2 per day)		
A (surface of region 0.05 m^2)		
W (average female weight in gr)		
F (batch fecundity: eggs / batch per mature female)		
S (spawning fraction: # spawning female per mature female)		
R (sex ratio: females/total)		

Table 4.1-4: DEPM based estimates

Result	value	CV
Biomass (t)		

Direct methods: acoustics

- Specify if numbers are per km^2 or raised to the area, assuming the same catchability .
- Specify the ageing method or the age slicing procedure applied, specify the maturity scale used.
- In case maturity ogive has not been estimated by year, report information for groups of years.

Table 4.1-5: Acoustic cruise information.

Date			
Cruise		**R/V**	RV Bilim 2
Target species	Anchovy		
Sampling strategy			
Sampling season	July and November		
Investigated depth range (m)	No depth range		
Echo-sounder	SIMRAD EK-60		

Fish sampler	
Cod –end mesh size as opening (mm)	7 mm
ESDU (i.e. 1 nautical mile)	1 nm
TS (Target Strength)/species	B20 = -70.2
Software used in the post-processing	EchoView
Samples (gear used)	Pelagic trawl with depth sensors attached to bottom and head line
Biological data obtained	Length-frequency, W/L, species composition, age composition
Age slicing method	
Maturity ogive used	

Table 4.1-6: Acoustic results, if available by age or length class

	Biomass in metric tons	**fish numbers**	**Nautical Area Scattering Coefficient**	**Indicator …**	**Indicator …**

4.1.2 Spatial distribution of the resources

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

4.1.3 Historical trends

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

5 Ecological information

5.1 Protected species potentially affected by the fisheries

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

5.2 Environmental indexes

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

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

6 Stock Assessment

The stock of Black Sea anchovy was assessed based on the assessment preformed in the 2014 experts meeting of STECF. The shortcomings and the recommendations provided by the STECF expert group was used to improve the assessment. In order to be in line with the STECF assessment, the same models were used; The XSA was based on landings (1989-2013) of all countries assuming that the age/length compositions are identical in every country. The acoustic biomass estimations conducted by Ukraine (1989-2001) and Turkey (2011-2013) were used to tune the model. The same index data were used in ASPIC which was run for Turkish + Georgian catch and number of Turkish purse seiners being indicative of the effort.

6.1 XSA

6.1.1 Model assumptions

XSA was based on landings (1989-2013) of all countries assuming that the age/length compositions are identical in every country. It should be noted that a significant violation of the assumption of uniform age/length composition is the differences in the minimum landing size in two main exploiters (Turkey and Georgia), particularly when the different minimum landing size regulations applied in two countries are considered.

6.1.2 Scripts

Provided in the sharepoint

6.1.3 Input data and Parameters

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

	Year												
Age Class	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**

0	3.3E-3	3.3E-3	2.8E-3	3.0E-3	3.1E-3	3.0E-3	2.7E-3	3.2E-3	3.5E-3	3.8E-3	4.6E-3	4.0E-3	2.0E-3
1	6.2E-3	6.2E-3	6.6E-3	6.8E-3	6.8E-3	6.9E-3	6.8E-3	6.6E-3	7.2E-3	7.9E-3	1.1E-2	1.0E-2	6.7E-3
2	1.1E-2	1.1E-2	1.3E-2	1.1E-2	1.0E-2	1.1E-2	1.0E-2	1.1E-2	1.1E-2	1.2E-2	1.4E-2	1.2E-2	1.3E-2
3	1.5E-2	1.5E-2	1.6E-2	1.5E-2	1.4E-2	1.4E-2	1.4E-2	1.4E-2	1.4E-2	1.4E-2	1.7E-2	1.3E-2	1.7E-2
4+	2.2E-2	2.2E-2	2.2E-2	2.2E-2	2.2E-2	2.2E-2	2.2E-2	2.2E-2	2.2E-2	2.2E-2	2.2E-2	2.2E-2	2.2E-2
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
0	5.1E-3	4.3E-3	5.8E-3	4.6E-3	4.4E-3	3.9E-3	4.1E-3	3.2E-3	4.0E-3	3.8E-3	3.7E-3	4.5E-3	3.4E-3
1	9.9E-3	7.9E-3	7.0E-3	8.7E-3	8.1E-3	8.1E-3	7.4E-3	8.6E-3	8.0E-3	9.3E-3	8.5E-3	8.8E-3	7.1E-3
2	1.3E-2	1.2E-2	1.4E-2	1.0E-2	1.2E-2	1.0E-2	9.9E-3	1.1E-2	1.1E-2	1.1E-2	1.3E-2	1.0E-2	9.0E-3
3	1.4E-2	1.6E-2	1.8E-2	1.3E-2	1.4E-2	1.5E-2	1.3E-2	1.4E-2	1.3E-2	1.4E-2	1.5E-2	1.1E-2	1.1E-2
4+	2.2E-2	2.2E-2	2.2E-2	2.2E-2	2.2E-2	2.2E-2	2.2E-2	2.2E-2	2.2E-2	2.2E-2	2.2E-2	2.2E-2	2.2E-2

6.1.4 Tuning data

	Year												
Age Class	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
0	8.8E+3	6.3E+4	6.0E+4	3.7E+4	8.3E+4	6.7E+4	7.9E+4	1.6E+5	2.8E+4	2.4E+4	2.6E+4	4.4E+4	2.8E+4
1	6.1E+4	2.0E+4	4.4E+3	1.6E+4	7.4E+4	5.4E+4	6.4E+4	6.1E+4	4.7E+4	5.5E+4	6.0E+4	1.0E+5	6.6E+4
2	5.4E+4	9.6E+2	1.4E+3	3.0E+3	7.2E+3	9.2E+3	1.1E+4	1.1E+4	3.6E+4	2.5E+4	2.7E+4	4.5E+4	2.9E+4
3	2.3E+3	3.1E+2	4.5E+2	1.6E+2	1.6E+2	5.1E+2	6.1E+2	9.3E+1	4.0E+3	3.1E+3	3.4E+3	5.6E+3	3.6E+3
4	1.0E+0	1.0E+0	1.0E+0	1.0E+0	1.0E+0	1.0E+0	1.0E+0	1.0E+0	1.0E+0	1.0E+0	5.3E-1	3.4E-1	8.7E-1
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
0	5.5E+3	4.3E+3	3.3E+3	2.1E+4	1.2E+4	3.4E+4	8.5E+4	2.2E+4	3.2E+4	2.7E+4	3.6E+4	1.1E+5	6.2E+3
1	4.1E+4	3.5E+4	2.5E+4	4.3E+4	7.4E+3	2.7E+4	7.2E+4	3.2E+4	3.0E+4	3.7E+4	5.3E+4	4.8E+4	2.4E+4
2	4.0E+4	3.3E+4	2.3E+4	2.3E+4	9.3E+3	1.1E+4	2.7E+4	2.3E+4	1.6E+4	3.6E+4	2.4E+4	9.7E+3	6.7E+3
3	7.7E+3	6.4E+3	4.5E+3	1.9E+3	6.5E+2	3.8E+2	8.1E+2	8.4E+2	6.2E+2	1.6E+3	1.3E+3	9.7E+2	4.5E+2
4+	1.0E+0	1.0E+0	1.0E+0	1.0E+0	1.0E+0	1.0E+0	1.0E+0	1.0E+0	1.0E+0	1.0E+0	2.6E+2	6.6E+2	1.0E+0

6.2. ASPIC

The Turkish purse seine CPUE was expanded until 1970 and two new fleet data were added. The first is the CPUE for the former USSR for the same period concerned and the second is the Turkish purse seiners fishing in the Georgian water. In addition to the CPUE data overwintering (Chashchin, 2007) and spawning stock biomass estimates (Chashchin, 1998) were also added to the model. However, a very significant inconsistency was found between the tuning indexes, therefore the data was cropped to 1989-2013.

6.1.5 Results

The results of the XSA displayed a very strong year class entry in 2012, which, lead to an increase in the SSB in the following year. The cyclic pattern in recruitment which peaked in 1994, 1999, 2006, 2012 seems to be an environmentally driven feature of the stock which usually followed by a drop within the last 25 years. The F, which had been dropped noticeably in 2012, increased slightly in 2013. General trend in the last ten years, however, indicates a slight decrease in the fisheries mortality. The absolute values varies with the model settings for shrinkage. According to the worst scenario (highest F estimate), the current $F_{(1:3)}$ for 2013 is estimated as 1.2, which is higher than the F_{MSY} (0.56) estimated based on precautionary exploitation rate (the current exploitation rate of 0.59 exceeds the precautionary threshold 0.4 recommended for small pelagic fish. The average of the last 5 years' F estimate is 1.36 (± 0.36) and the high variance of estimate hampers to make meaningful short term predictions.

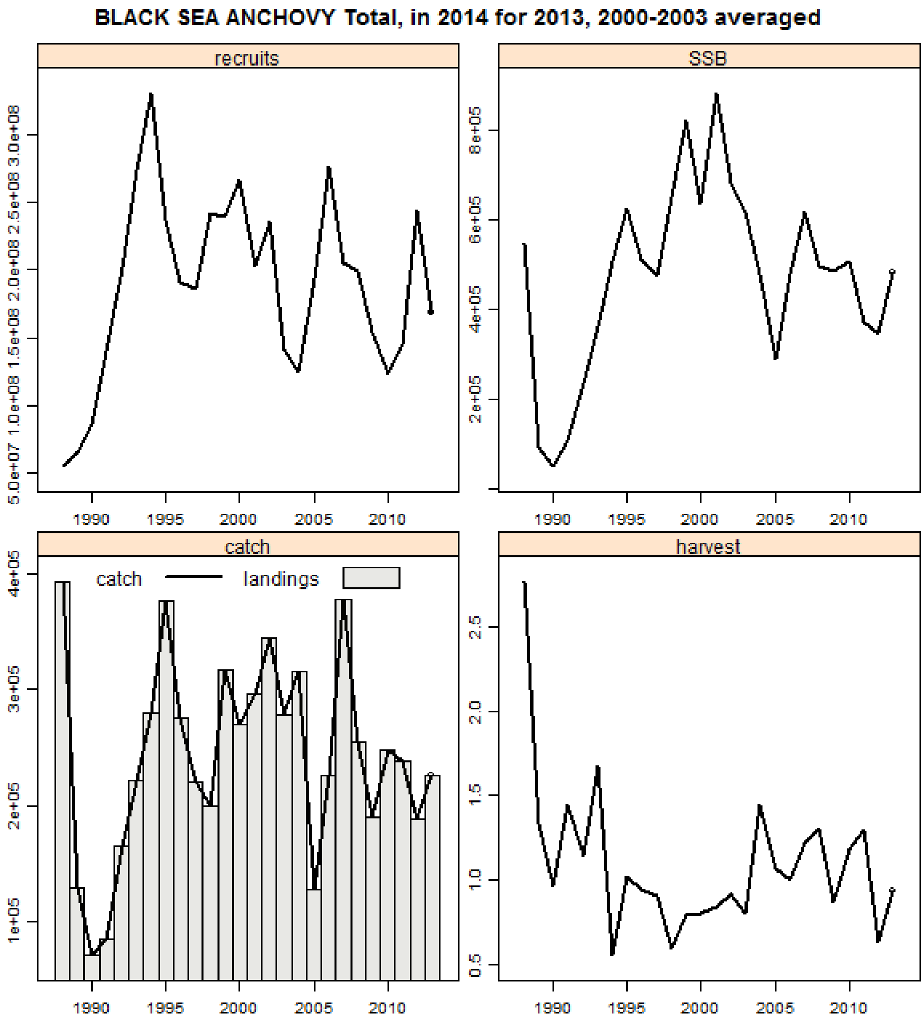


Figure 4. XSA results

The F estimated by the ASPIC model is slightly lower than those of XSA however despite some differences in the absolute values, displayed a quite similar pattern of fluctuation. One of the noticeable deviances was in the estimate of last year .

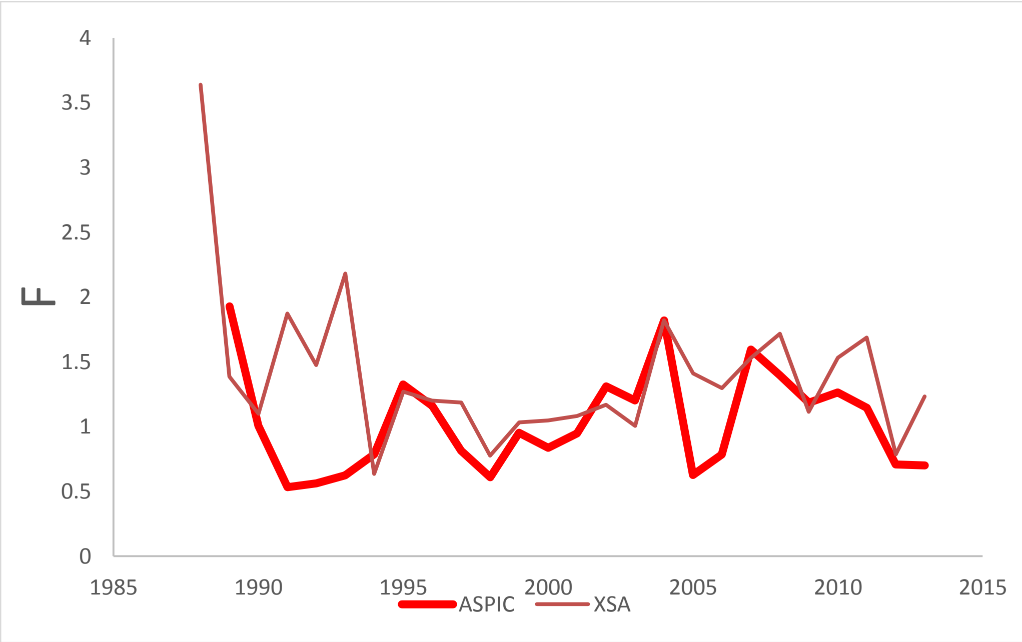


Figure 5. F estimates over the years

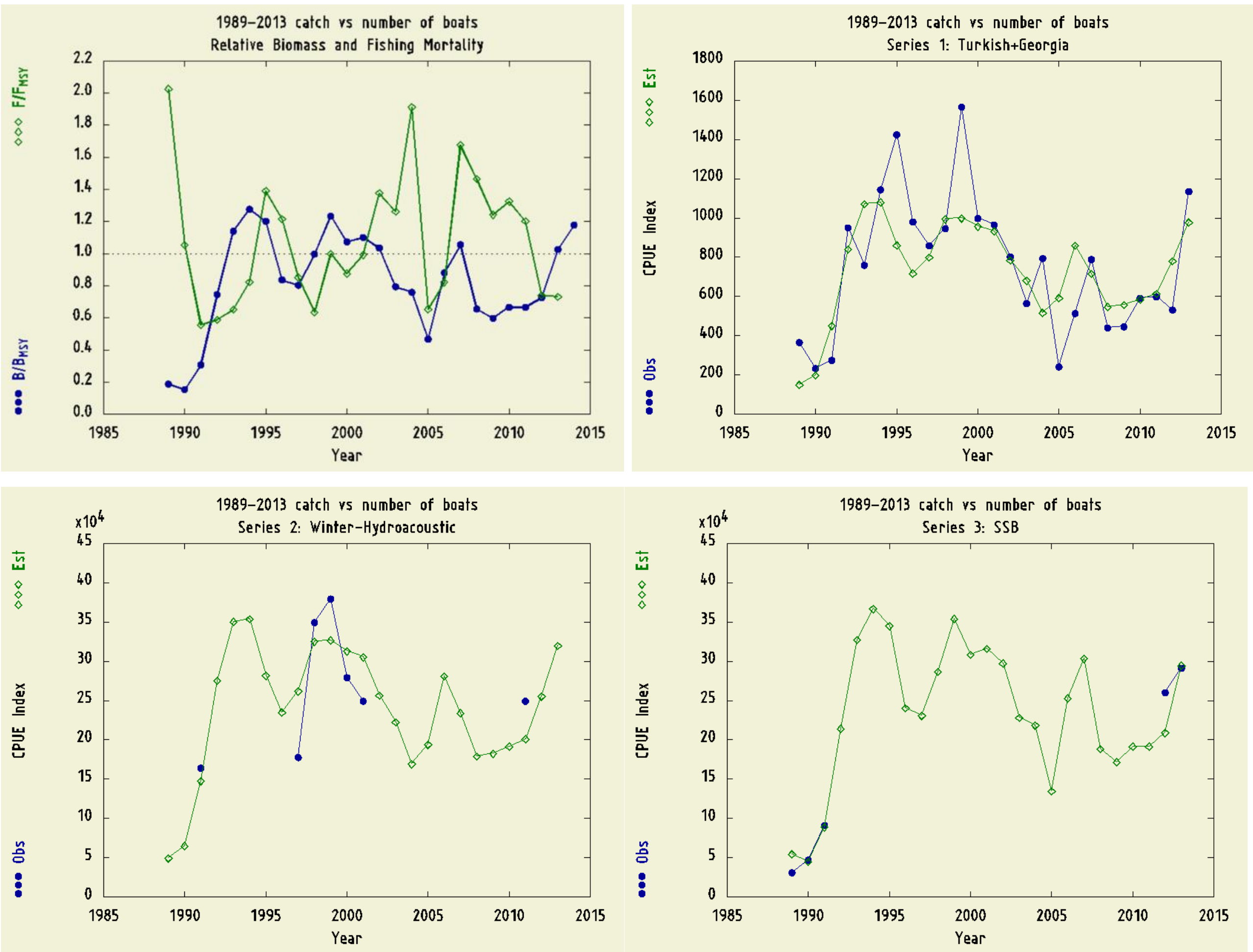


Figure 6. Variations of F and Biomass (average) with respect to F_{MSY} and B_{MSY} over the years

6.1.6 Robustness analysis

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

The XSA model was tested for its sensitivity for the shrinkage used and 4 different values, 0, 0.5, 1.5 and 2.05 were tested. The results are presented below. The group decided to use 1.5 shrinkage which produced lower and randomly distributed residuals (Figure 11) and better restrospective analysis results (Figure 10)

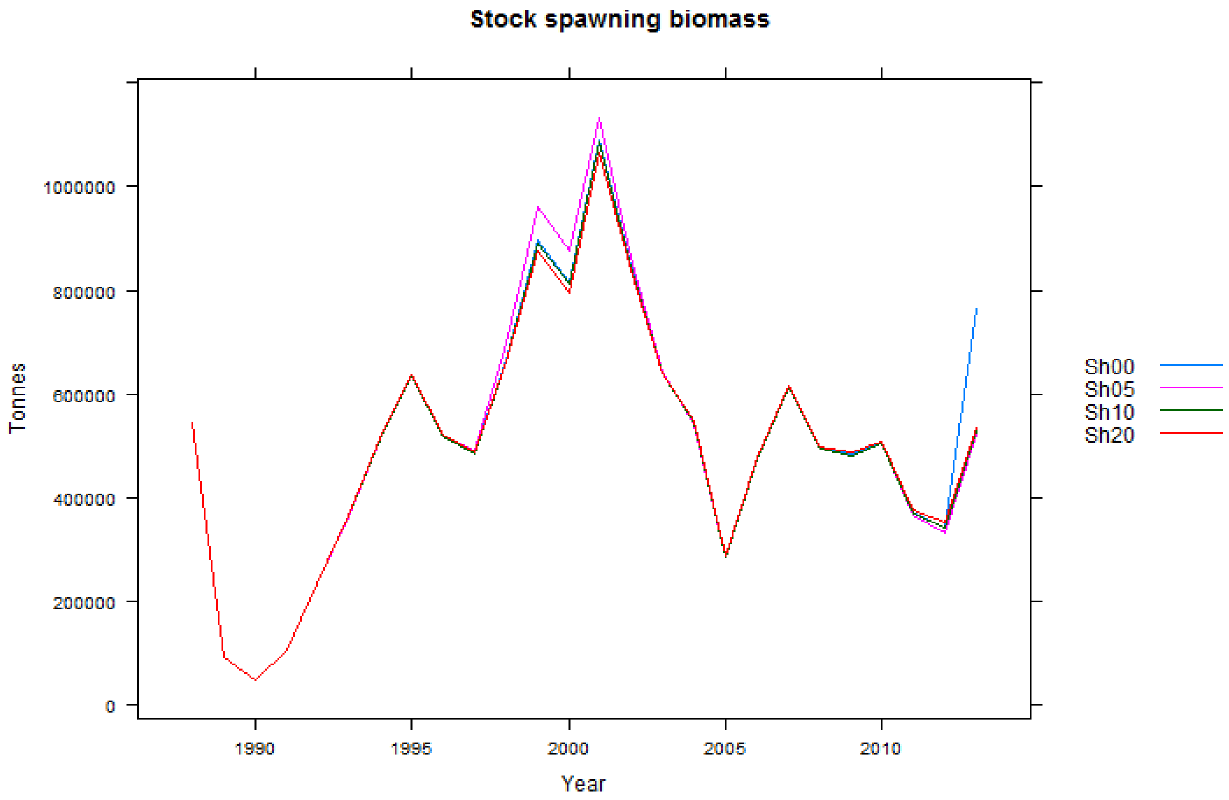


Figure 7. XSA results: Spawning stock biomass estimates by 0, 0.5, 1.5 and 2.5 shrinkage.

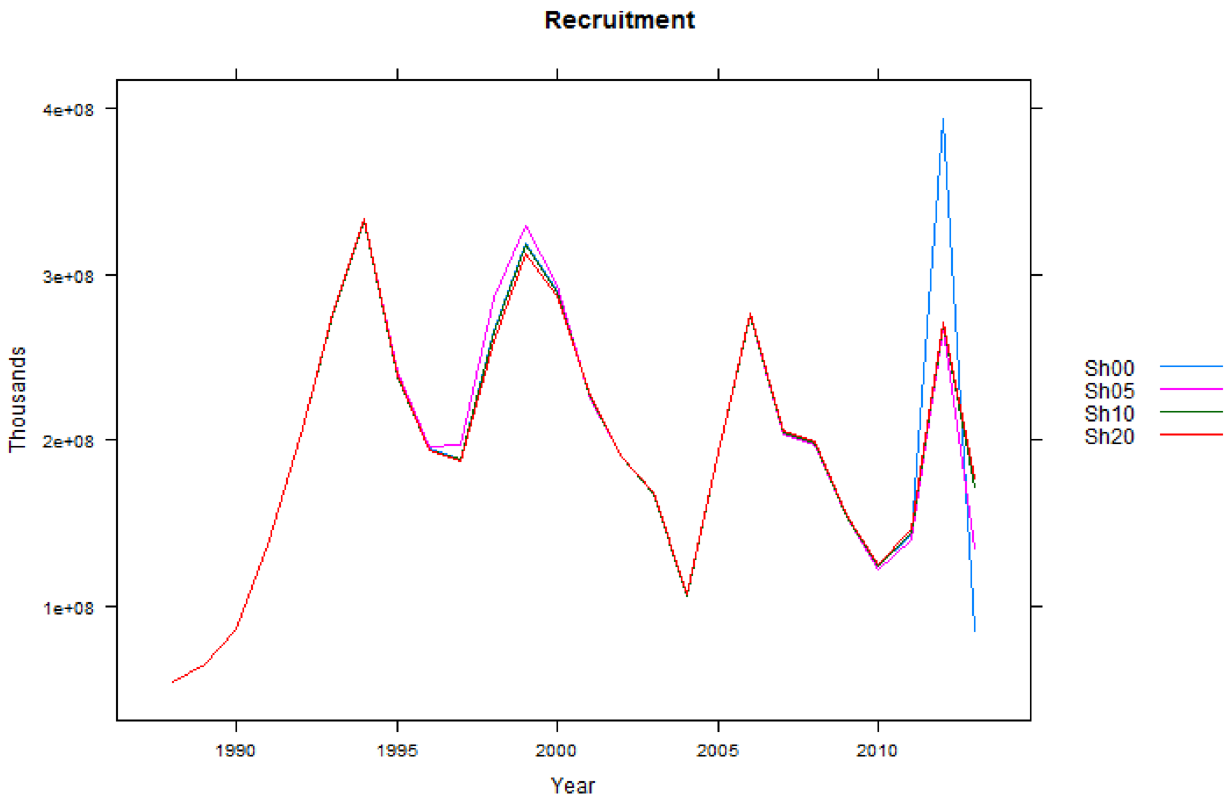


Figure 8. XSA results: Recruitment estimates by 0, 0.5, 1.5 and 2.5 shrinkage.

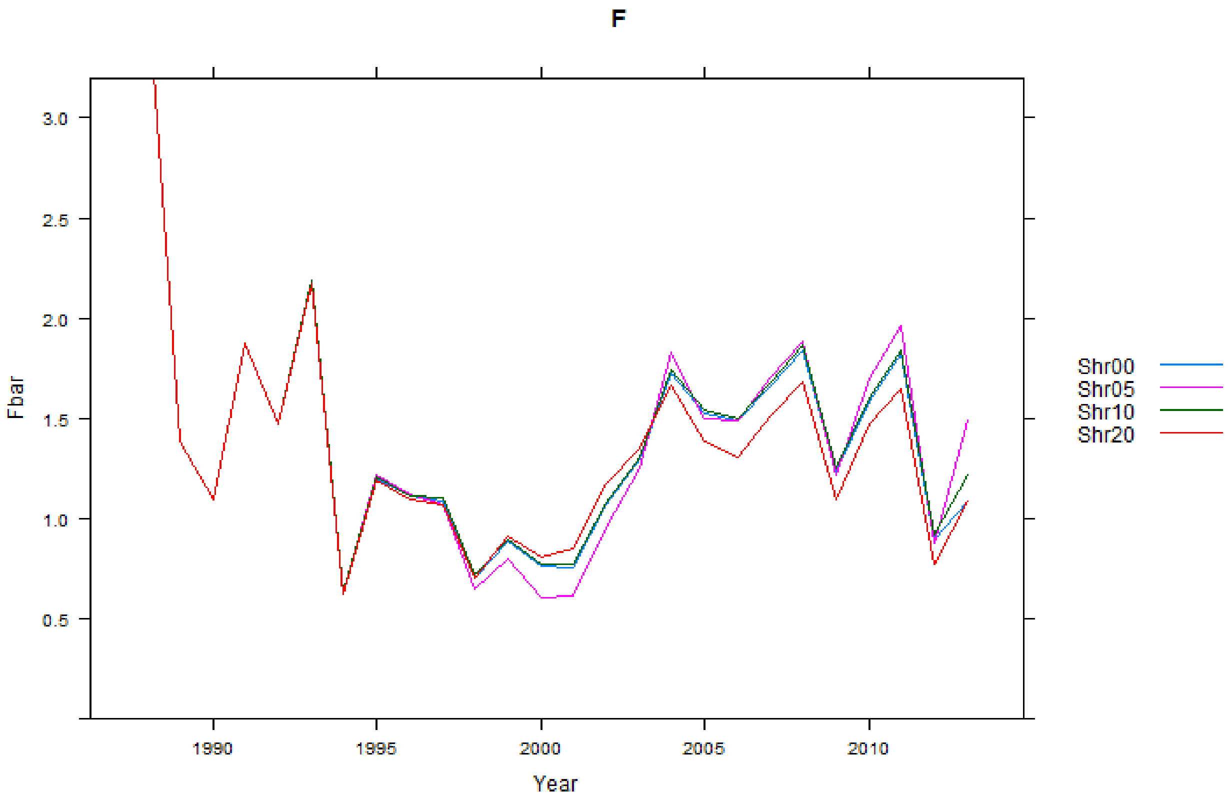


Figure 9. XSA results: Fishing mortality estimates by 0, 0.5, 1.5 and 2.5 shrinkage.

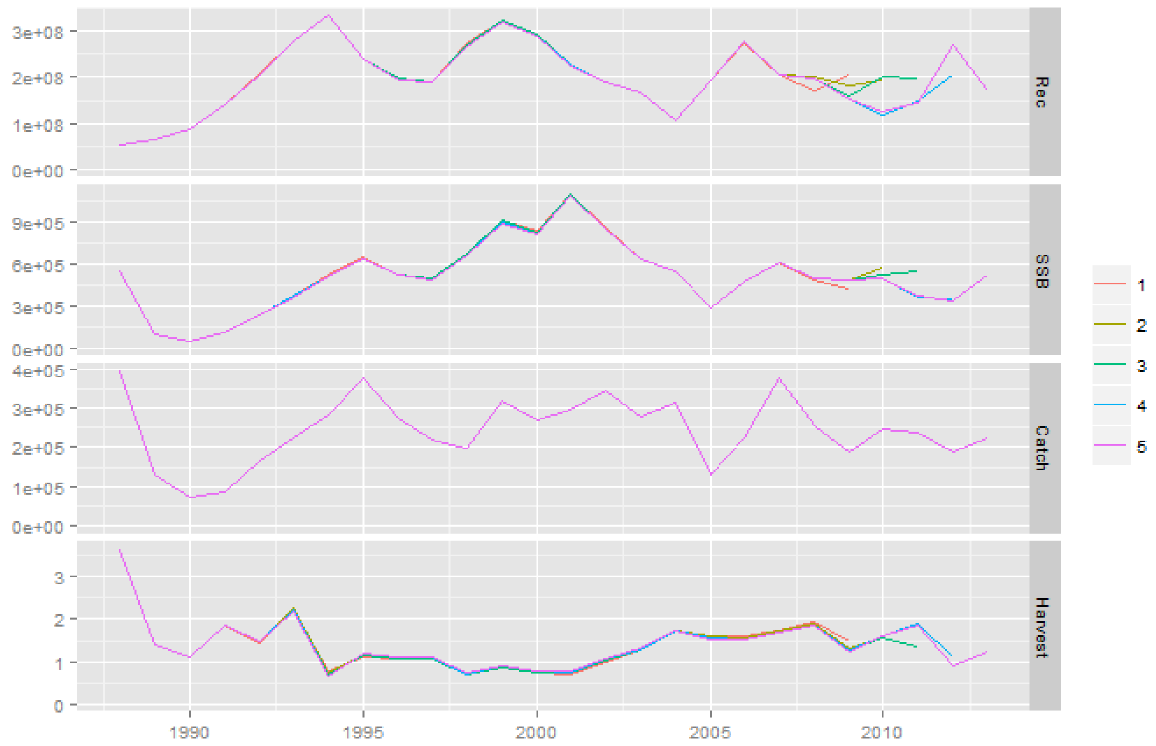


Figure 10. Retrospective analysis results of the XSA for 1.5 shrinkage (5 years @ last 2 ages)

The results of the analysis display a very strong year class entry in 2012, which, as all assessment results agrees, increased the SSB in the following year. The F, however, which had been dropped noticeably, increased again in 2013. The current exploitation rate (E=0.59) exceeds the precautionary threshold 0.4 recommended for small pelagic fish. On the other hand, the high variance of the F estimates averaged over the last 5 years hampers to make meaningful short term predictions.

In all model runs recruitment displayed a cyclic pattern with peaking values observed in 1994, 1999, 2006, 2012 (Figure 8), which usually followed by a drop within the last 25 years. The pulse of a strong year class usually effects the next years SSB. This is what happened in 2013; the strong recruitment gave rise to the number of spawners next year. F estimated for the last year is very much dependent on the level and type of shrinkage used in the XSA assessment (Figure 9). General trend in the last ten years, however, indicates a slight decrease in the fisheries mortality.

6.1.8 Assessment quality

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

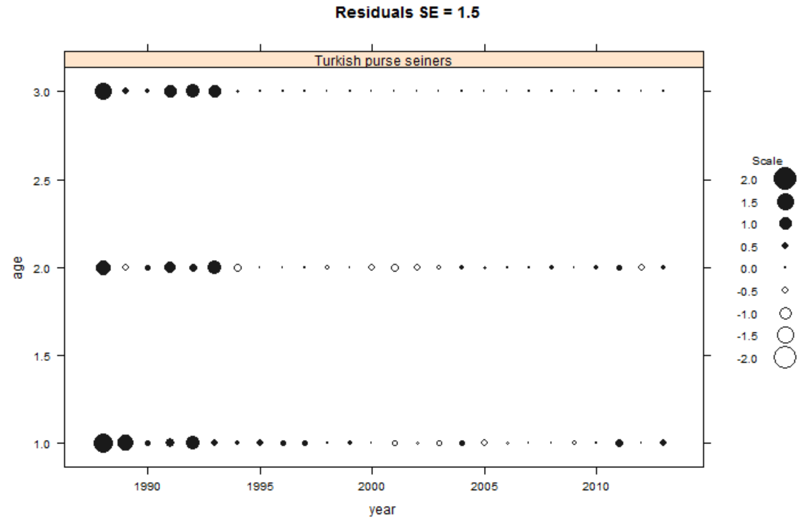


Figure 11. Residual distribution of the XSA applied with 1.5 shrinkage

The case of ASPIC, the residuals distributed randomly (Figure 12). The estimated CPUE captured the general fluctuation pattern in the Turkish+Georgian CPUE with appreciable success (Figure 6); however the deviance in USSR CPUE is very high (Figure 6) and this is reflected in the contrast index, which is slightly higher that the acceptable level (0.68; Table 7). The consistency between two independent biomass estimates and the model is at least within the same order of magnitude (**Error! Reference source not found.Error! Reference source not found.**)

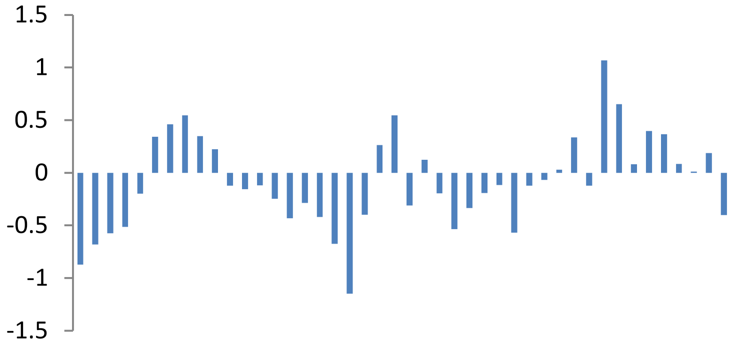


Figure 12. Log residual distribution of the ASPIC model

Table 7. Correlation among input series expressed as CPUE and degrees of freedom

1	Turkish+Georgian	1.000 (44)	
2	USSR	0.567	1.000

	(31)	(31)		
3 Winter-Hydroacoustics	0.415	0.366	1.000	
	(15)	(12)	(15)	
4 SSB	0.434	0.534	0.665	1.000
	(15)	(12)	(9)	(15)
	1	2	3	4

The average biomass estimated by ASPIC and the spawning stock biomass resulted by XSA represented a very similar pattern of fluctuation with synchronous peaks and troughs over the years.

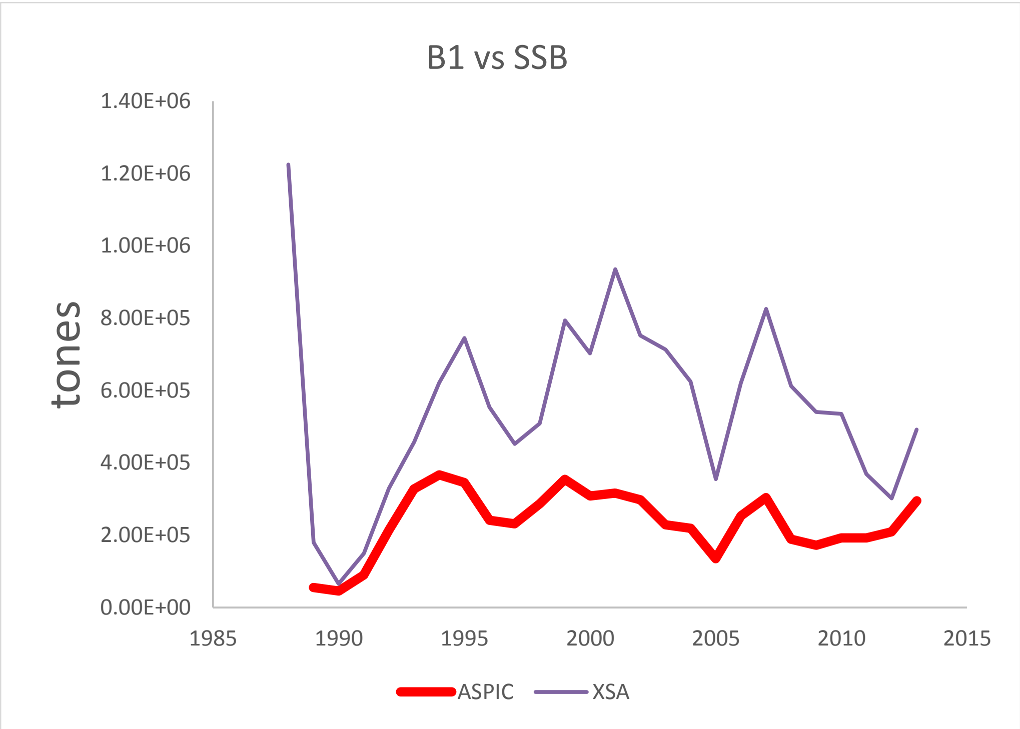


Figure 13. Spawning Stock Biomass (XSA) and average biomass (ASPIC) estimates

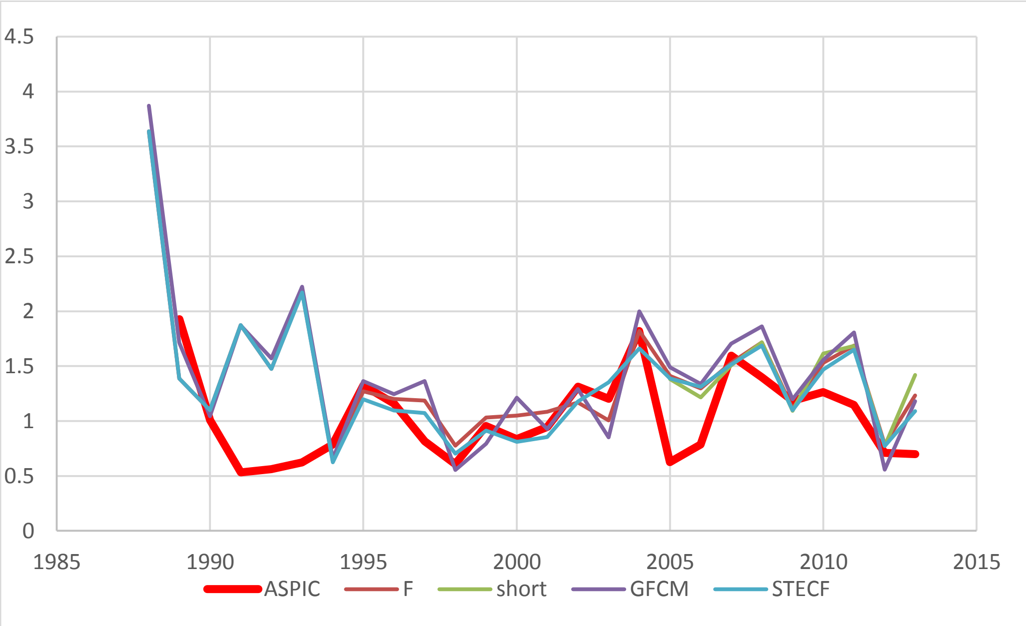


Figure 14. Comparison of F estimates

According to the results of ASPIC the F, which had remained well above the F_{MSY} dropped gradually and displayed a very sharp decline in the last two year. The drop in the F is reflected on the average biomass.

7 Stock predictions

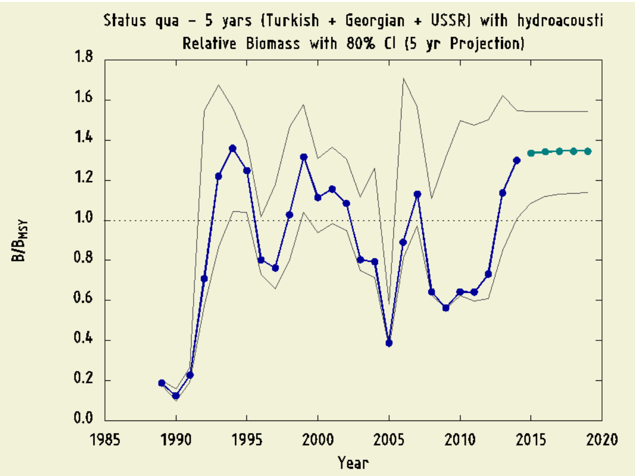
7.1 Short term predictions

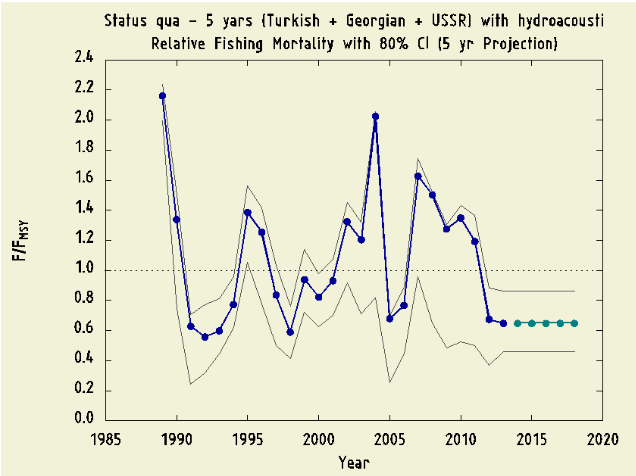
The average of the last 5 years' F estimate is 1.36 (± 0.36) and the high variance of estimate undermined the reliability of short term predictions.

Table 8. Short term predictions based on XSA results

Fscenario	Fmult	Catch_2012	Catch_2013	Catch_2014	SSB_2012	SSB_2013	SSB_2014	ChangeSSB_2012_2014	ChangeCatch_2013_2011
0.55	0.387178	245768.3	112988.9	146547.8	442616.4	414430.1	502069.1	13.43211	-50.0186
0	0	245768.3	0	0	442616.4	414430.1	598693.1	35.26228	-100
0.142054	0.1	245768.3	33901.54	53004.06	442616.4	414430.1	569190.9	28.59688	-85.0034
0.284107	0.2	245768.3	64207.07	93563.85	442616.4	414430.1	543168.6	22.71768	-71.5976
0.426161	0.3	245768.3	91431.7	124897.1	442616.4	414430.1	520103.7	17.50666	-59.5546
0.568215	0.4	245768.3	116004.7	149367.7	442616.4	414430.1	499563.2	12.86595	-48.6846
0.71026	0.5	245768.3	138285	168714.7	442616.4	414430.1	481186.6	8.714134	-38.8287

8									
0.852322	0.6	245768.3	158573.9	184219.2	442616.4	414430.1	464673	4.983225	-29.8538
0.994376	0.7	245768.3	177125.2	196826.6	442616.4	414430.1	449770.3	1.616271	-21.6475
1.13643	0.8	245768.3	194153.3	207236	442616.4	414430.1	436266.5	-1.43463	-14.115
1.278483	0.9	245768.3	209840.6	215965.8	442616.4	414430.1	423982.7	-4.2099	-7.17562
1.420537	1	245768.3	224342.4	223401.1	442616.4	414430.1	412767.1	-6.74384	-0.76066
1.562591	1.1	245768.3	237791.8	229829.6	442616.4	414430.1	402490.6	-9.0656	5.188748
1.704644	1.2	245768.3	250303.1	235466.4	442616.4	414430.1	393042.7	-11.2001	10.72321
1.846698	1.3	245768.3	261975.2	240473.6	442616.4	414430.1	384328.8	-13.1689	15.88644
1.988752	1.4	245768.3	272893.8	244973.9	442616.4	414430.1	376267.2	-14.9902	20.71637
2.130805	1.5	245768.3	283133.7	249060.6	442616.4	414430.1	368787.2	-16.6802	25.24604
2.272859	1.6	245768.3	292760.1	252805.3	442616.4	414430.1	361827.3	-18.2526	29.50435
2.414913	1.7	245768.3	301830.6	256263.5	442616.4	414430.1	355333.9	-19.7197	33.51672
2.556967	1.8	245768.3	310395.6	259478.3	442616.4	414430.1	349260.1	-21.0919	37.30552
2.69902	1.9	245768.3	318500.1	262483.8	442616.4	414430.1	343564.5	-22.3787	40.8906
2.841074	2	245768.3	326183.9	265307.3	442616.4	414430.1	338210.6	-23.5883	44.28958





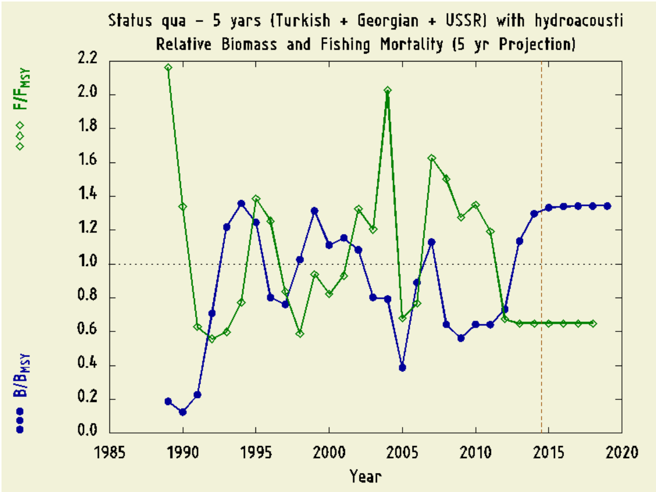


Figure 15.Short-medium term (5 years) prediction for status qua based on ASPIC results

8 Draft scientific advice

Based on	Indicator	Analytic al reference point (name and value)	Current value from the analysis (name and value)	Empirical reference value (name and value)	Trend (time period)	Status
Fishing mortality	Fishing mortality	F_{msy}= 0.56	F(1:3) = 1.2		D	IO
	Fishing effort				D	
	Catch				C	
Stock abundance	Biomass					
	SSB				C	
Recruitment					C	
Final Diagnosis		In overexploitation				

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

8.1 Explanation of codes

Trend categories

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

Stock Status

Based on Fishing mortality related indicators

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

   Range of Overfishing levels based on fishery reference points

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

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

   *Fc is current level of F

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

Based on Stock related indicators

1) **N - Not known or uncertain:** Not much information is available to make a judgment
2) **S - Sustainably exploited:** Standing stock above an agreed biomass based Reference Point;
3) **O - Overexploited**: Standing stock below the value of the agreed biomass based Reference Point. An agreed range of overexploited status is provided;

   Empirical Reference framework for the relative level of stock biomass index

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

4) **D – Depleted**: Standing stock is at lowest historical levels, irrespective of the amount of fishing effort exerted;
5) **R –Recovering:** Biomass are increasing after having been depleted from a previous period;

Agreed definitions as per SAC Glossary

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

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

Stock Assessment Form Demersal species

Reference year: 2013

Reporting year: 2014

Turbot stock in the Black Sea was assessed by state-space assessment model (SAM) in FLR environment. The present assessment is based on the analysis of the best available information and assuming the stock as representing a single unit in the entire Black Sea. The data set for the period 1950-2013 was compiled using the historical data sources and new data for 2013. Five tuning series - 4 surveys and 1 commercial CPUE series were compiled and used in the assessment. Estimates of IUU catches during the period 2002-2013 were made and added to the officially reported landings. The assessment indicates that the spawning stock biomass continues to be at very low level (around 1634 t) and it is estimated to be around half of B_{lim} (3535 t). F in 2013 (1.33) is more than five times higher than F_{msy} (0.26). Recruitment peaked during the period 2004 - 2007 and decreased thereafter. The STECF EWG 14 14 classifies the stock of turbot in the Black Sea as being exploited unsustainably and at risk of collapse. On the basis of precautionary considerations there should be no directed fisheries for turbot in 2015 and by-catch should be minimized.

1 Basic Identification Data

Scientific name:	Common name:	ISCAAP Group:
Psetta maxima/Scophthalmus maximus	Black Sea Turbot	31
1st Geographical sub-area:	**2nd Geographical sub-area:**	**3rd Geographical sub-area:**
29		
4th Geographical sub-area:	**5th Geographical sub-area:**	**6th Geographical sub-area:**
1st Country	**2nd Country**	**3rd Country**
Bulgaria	Romania	Ukraine
4th Country	**5th Country**	**6th Country**
Turkey	Russian Federation	Georgia
Stock assessment method: (direct, indirect, combined, none)		
Combined method **Indirect: State-Space Assessment Model (SAM) in FLR environment.** **Direct: Trawl surveys used for tuning**		
Authors:		
STECF members: Casey, J., Abella, J. A., Andersen, J., Bailey, N., Bertignac, M., Cardinale, M., Curtis, H., Daskalov, G., Delaney, A., Döring, R., Garcia Rodriguez, M., Gascuel, D., Graham, N., Gustavsson, T., Jennings, S., Kenny, A., Kraak, S., Kuikka, S., Malvarosa, L., Martin, P., Murua, H., Nord, J., Nowakowski, P., Prellezo, R., Sala, A., Scarcella, G., Somarakis, S., Stransky, C., Theret, F., Ulrich, C., Vanhee, W. & Van Oostenbrugge, H. EWG-14-14 members: Sampson, D. (chair), Ak, O., Cardinale, M., Chashchyn, O., Damalas, D., Dagtekin, M., Daskalov, G., Duzgunes, E., Genç, Y., Gucu, A.C., Gumus, A., Maximov, V., Osio, G. C., Panayotova, M., Radu, G., Raykov, V., Yankova, M. and Zengin, M.		
Affiliation:		

European Commission

EUR XXXX EN – Joint Research Centre – Institute for the Protection and Security of the Citizen
Title: Scientific, Technical and Economic Committee for Fisheries Black Sea Assessments (STECF-14-XX).
Luxembourg: Publications Office of the European Union
2014 – XX pp. – 21 x 29.7 cm
EUR – Scientific and Technical Research series – ISSN 1831-9424 (online), ISSN 1018-5593 (print)
ISBN XXXXXXX
doi:XXXXXXXXXXXXXX

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

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

Direct methods (you can choose more than one):

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

Indirect method (you can choose more than one):

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

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

2 Stock identification and biological information

Turbot in the Black Sea is represented by several local populations, which migrate and mix in the adjacent zones. Local populations are independent units of the stock, and have to be covered in order to ensure an accurate assessment of the stock at regional level.

The taxonomic status of Black Sea turbot as a subspecies has not been clarified yet. It is still being argued whether this fish distributing in different locations of Black Sea is the same species or there is a subspecies. Popova (1954) and Karpetkova (1964) recorded that the turbot forms mixed local populations in nearby zones which is proved by tagging experiments. However, the suggestion for the presence of local varieties of turbot (ecotypes) currently exists. The analysis of the haplotype sequences data did not provide clear indications on the existence of phylogeographic differentiation among the studied turbot populations inhabiting the west coast of the Black Sea. At the same time the haplotype phylogenetic analysis provided further support to the earlier proposed existence of two distinct turbot mitochondrial lineages, 'western Mediterranean' and 'eastern secluded Mediterranean basins'. The present study offers an essential background for long term monitoring of the changes of the Black Sea turbot populations (Atanassov, et al. 2011). Turbot is represented by several local populations mixing in the adjacent zones in the Black Sea. It is also to be found in the Black Sea, where (sub) species Psetta maxima maeotica has been described (Suzuki et al. 2004). Local populations are independent units of the stock, and it is especially important to cover them all in order to provide an accurate assessment of the stock (Daskalov et al., 2010).

The present assessment is based on the analysis of the best available information, obtained from combined data of all Black Sea countries and assuming the stock as representing a single unit in the entire Black Sea.

2.1 Stock unit

The stock assessment assumed that all turbot in the Black Sea are part of a single stock.

2.2 Growth and maturity

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

Somatic magnitude measured (LT, LC, etc)				**Units**	cm
Sex	**Fem**	**Mal**	**Combined**	**Reproduction season**	**April - June**
Maximum size observed			85	**Recruitment season**	
Size at first maturity			41	**Spawning area**	Black Sea Shelf area
Recruitment size to the fishery			45 (TL)	**Nursery area**	Black Sea coastal zone

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

Size/Age	Natural mortality	Proportion of matures
2	0.114	0
3	0.11	0.4316667
4	0.108	0.6783333
5	0.107	1
6	0.106	1
7	0.106	1
8	0.105	1
9	0.105	1
10	0.105	1

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

Size/Age	Natural mortality	Proportion of matures
…	…	…

Table 2-3: Growth and length weight model parameters in 2013

COUNTRY	AREA	YEAR_PERIOD	SPECIES	SEX	L_INF	K	t_0	a	b
BG	29	2013	TUR	C	97.21	0.14	-0.61	0.00	2.58
TR	29	2013	TUR	C	85.96	0.14	-1.15	0.01	3.07
RO	29	2013	TUR	C	76.84	0.39	-0.48	0.01	3.15

Table 2-3: Growth and length weight model parameters

			Sex			
		Units	female	male	Combined	Years
Growth model	L_∞					
	K					
	t_0					
	Data source					
Length weight relationship	a					
	b					

3 Fisheries information

3.1 Description of the fleet

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

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

	Country	GSA	Fleet Segment	Fishing Gear Class	Group of Target Species	Species
Operational Unit 1*	Bulgaria	29	LOA > 0 < 6 LOA => 6<12 LOA => 12<18 LOA => 18<24 LOA => 24<40 LOA => 12<18 LOA => 18<24 LOA => 24<40	GNS OTM	Demersal Pelagic	Turbot
Operational Unit 2	Romania	29	LOA > 0 < 6 LOA => 6<12 LOA => 12<18 LOA => 18<24 LOA => 24<40	GNS	Demersal	Turbot
Operational Unit 3	Turkey	29	4 – 23 m 12 – 28 m	GNS Trawl vessels	Demersal Demersal	Turbot Turbot
Operational Unit 4	Ukraine	29	Not reported	Not reported	Demersal	Turbot
Operational Unit 5	Russian Federation	29	Not reported	Not reported	Demersal	Turbot
Operational Unit 6	Georgia	29	Not reported	Not reported	Demersal	Turbot

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

Operational Units*	Fleet (n° of boats)*	Catch (T or kg of the species assessed)	Other species caught (names and weight)	Discards (species assessed)	Discards (other species caught)	Effort (units)
Bulgaria	124	39.58	Not reported	Not reported	Not reported	CPUE, kW days at sea
Romania	76	43.2	Not reported	Not reported	Not reported	CPUE, kW days at sea
Turkey	486	193.6	Not reported	Not reported	Not reported	CPUE (kg/h/vessel)
Ukraine		193.37	Not reported	Not reported	Not reported	-
Russia		30	Not reported	Not reported	Not reported	-
Georgia		0	Not reported	Not reported	Not reported	-
Total		499.76				

3.2 Historical trends

Table 2-1: time series of catches used in the assessment

Year	Landings	Landings + IUU
1950	3932	3932
1951	4741	4741
1952	5217	5217
1953	4985	4985
1954	4505	4505
1955	3678	3678
1956	3623	3623
1957	3017	3017
1958	4289	4289
1959	4653	4653
1960	2680	2680
1961	3058	3058
1962	2904	2904
1963	3812	3812
1964	3666	3666
1965	3063	3063
1966	3093	3093
1967	2709	2709
1968	2931	2931
1969	3076	3076
1970	5273	5273
1971	3052	3052
1972	3049	3049
1973	3705	3705
1974	1696	1696
1975	1273	1273
1976	1584	1584
1977	2012	2012
1978	2160	2160
1979	5447	5447
1980	2843	2843
1981	3276	3276
1982	4662	4662
1983	5307	5307
1984	2852	2852
1985	527	527
1986	428	428
1987	849	849
1988	1116	1116

1989	1460	1460
1990	1393	1393
1991	935	935
1992	439	439
1993	1603	1603
1994	2144	2144
1995	2943	2943
1996	2048	2048
1997	1025	1025
1998	1588	1588
1999	1953	1953
2000	2789	2789
2001	2557	2557
2002	618	1567
2003	424	1122
2004	434	1142
2005	741	1400
2006	967	1751
2007	1035	2259
2008	816	2122
2009	731	2078
2010	622	1738
2011	486	1659
2012	528	1714
2013	500	1522

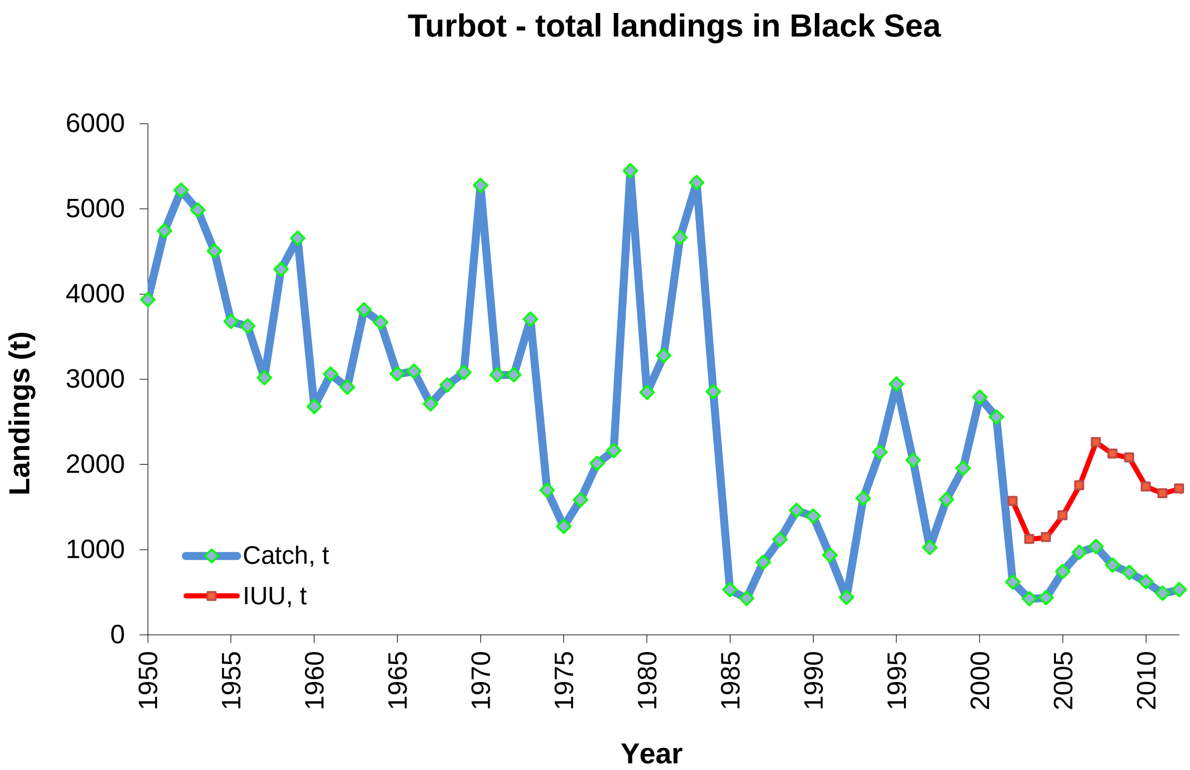


Figure 3.2-1. Landings and IUU estimates of turbot in the Black Sea during the period 1950 – 2013. The IUU estimated refers to the total estimated catches including unreported landings.

3.3 Management regulations

Turbot fisheries in Black Sea EU waters are being managed through the annual establishment of fishing opportunities (EU quotas) since 2008, by the adoption of Council Regulations. During the last four years, the EU turbot quota has been fixed at 86.4 t and allocated to Bulgaria and Romania (50 % each). The same Council Regulations set up every year the prohibition of fishing activities during reproduction period for turbot. The ban has been in force from 15 April to 15 June in European Community waters of the Black Sea. The same period of prohibition is fixed by Turkish National Legislation.

During the 37 Session of the General Fisheries Commission for the Mediterranean (GFCM), a recommendation to establish a set of minimum standards for Turbot fisheries in the Black Sea was adopted. This recommendation, set up minimum conservation size (45 cm) for turbot and minimum mesh size (400 mm) for gillnets. Proposed measures were already in place in Turkey and the EU.

In Turkey, turbot fisheries have been traditionally conducted by bottom set gill nets with minimum mesh size of 320-400 mm (Tonay, Öztürk, 2003) and by bottom trawls - with minimum mesh size 40 mm. However the above mentioned GFCM recommendation establishes gillnets as the only gear allowed to fish turbot in the Black Sea.

Though some violations, turbot fishery is conducted along offshore waters starting from 3 miles from coast to 9.7 miles. Fishing depth ranges between 25 m and 100 m. The catches are highest within depths of 50-60 m. The basic management criteria for turbot fisheries in 2012-2014 announced by Commercial Fishery Advice of General Directorate of Fishery in Turkey are summarized below (Anonim, 2012):

- Area closures: Bottom trawling is prohibited in the areas between 1) Sinop city, İnceburun (42° 05.959’ N-34° 56.695’E and Samsun city Çayağzı cape (41° 41.040’ N-35° 25.193’ E), 2) Ordu city; Ünye, Taşkana cape (41° 08.725’ N-37° 17.531’ 4) and Georgia border. Furthermore, it is also banned within 2 miles from land between Zonguldak city; Ereğli, Baba cape (41° 17.342’ N-31° 23.937’E) and Bartın city; Amasra, Tekke cape (41° 43.485' N-32° 19.258' E) (Fig.3.3-1). In the rest of the areas, the waters open for trawling are 3 miles from the coast.

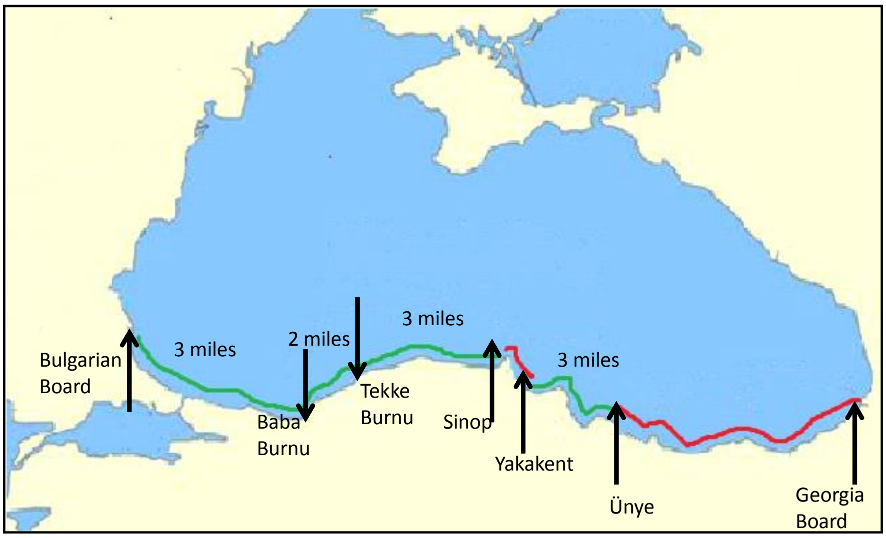


Fig. 3.3-1. Area closures and distance limitations for bottom trawling along theTurkish coast (Green lines: open areas, red lines: area closures).

Time closures: In open areas, bottom trawling for turbot is banned between 15 April and 15 September. Turbot fishery by gillnet is allowed except during the period 15 April – 15 June.

Mesh size limitations: a) Mesh size of the codend should not be lower than 40 mm for bottom trawl nets. b) Mesh size of gillnets should not be lower than 400 mm. c) Long lines and trammel gillnets are forbidden for turbot fishery.

Minimum legal catch size: Minimum legal size (total length) is determined as 45 cm for all fishing gears.

In Ukraine turbot fisheries are conducted with bottom (turbot) gill nets with mesh size 360 - 400 mm. The use of bottom trawls has been prohibited. Turbot exploitation in Ukraine has been regulated by TACs since 1996.The Ukranian TAC for turbot in 2012 was 430 tons.

The Regulations of Fisheries in Ukraine determine the following standards regulating the fisheries of the Black Sea turbot:

- minimum commercial fishing size – 35 cm (SL);
- allowable by-catch of its juveniles – during the non-target fisheries not more than 2% of total catch weight, during the target fisheries with nets (with mesh size 360 mm) not more 5% by counting;
- during target long-lining of picked dogfish and Rajiformes by-catch of turbots is allowed, at the amount of not more than 20% of its juveniles by counting;
- turbot by-catch is allowed in trawl catches of sprat not more than 4 individuals a commercial fishing length per one ton of catch;
- in the period of abundant spawning of turbot in the coastal 12-mile zone a temporal prohibition for 15 – 30 days is implemented for harvesting of fish with trawls, net and long-lines (such prohibition applies to different zones at different periods depending on the maturity of fish).

There is a full ban on the use of bottom trawls in Ukraine and fishery ban on the use of gillnets for turbot during the period from 1 November to 31 January. Additionally, in the economic zone beyond the territorial waters a ban on the use of gillnets and by-catch in other gears applied during the spawning period from 1 to 30 May. In the same month, a ban on the fishing of turbot in the territorial waters of Ukraine, which has a duration of 15 days is implemented. The initial term of this period is set according to the recommendations of the scientific institute that monitors the state of maturity of the fish.

The fishing effort on turbot is limited to 7,700 gillnets (100 m each). For small vessels the minimum number of gillnets is 20. For registered vessels are 100 units.

3.4 Reference points

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

Indicator	Limit Reference point/empirical reference value	Value	Target Reference point/empirical reference value	Value	Comments
B	Bpa Blim	4949 3535			
SSB					
F	Fmsy	0.26			
Y					
CPUE					
Index of Biomass at sea					

4 Fisheries independent information

4.1 Bottom trawl survey in EU waters (Romania)

4.1.1 Brief description of the direct method used

Two demersal trawl surveys in EU waters (Romania) were executed under the national Data collection program of Romania in 2013. No surveys were executed in Bulgarian Black Sea area. Surveys were aimed to assess the turbot abundance and biomass indices during the spring and autumn seasons in 2013.

Standard methodology for stratified random sampling (Sparre, Venema, 1998) and swept area method were applied. The method is based on bottom trawling across the seafloor (area swept) and is widely used as a direct method for demersal fish stock assessment when only an index of abundance is required.

Direct methods: trawl based abundance indices

Table 4.1-1: Trawl survey basic information

Survey	Bottom trawl survey in EU waters (Romania)	**Trawler/RV**	RV “Steaua di Mare I”
Sampling season	Spring, Autumn		
Sampling design	Stratified sampling (0 – 30 m, 30 – 50m, 50-70m, 70-100m)		
Sampler (gear used)	Demersal trawl (22/27 -34)		
Cod –end mesh size as opening in mm	10 mm		
Investigated depth range (m)	0 – 100 m		

Table 4.1-2: Trawl survey sampling area and number of hauls – Romania, Spring 2013

Stratum	**Total surface (km^2)**	**Trawlable surface (km^2)**	**Swept area (km^2)**	**Number of hauls**
0 – 30 m	2230.15			9
30 – 50 m	4202.975			12
50 – 70 m	4631.85			18
70 – 100 m	171.55			2

Total (0 – 100 m)	11322.3			41

Table 4.1-3: Trawl survey sampling area and number of hauls – Romania, Autumn 2013

Stratum	**Total surface (km²)**	**Trawlable surface (km²)**	**Swept area (km²)**	**Number of hauls**
0 – 30 m	2144.375			8
30 – 50 m	3688.325			19
50 – 70 m	1543.95			13
Total (0 – 100 m)	7376.65			40

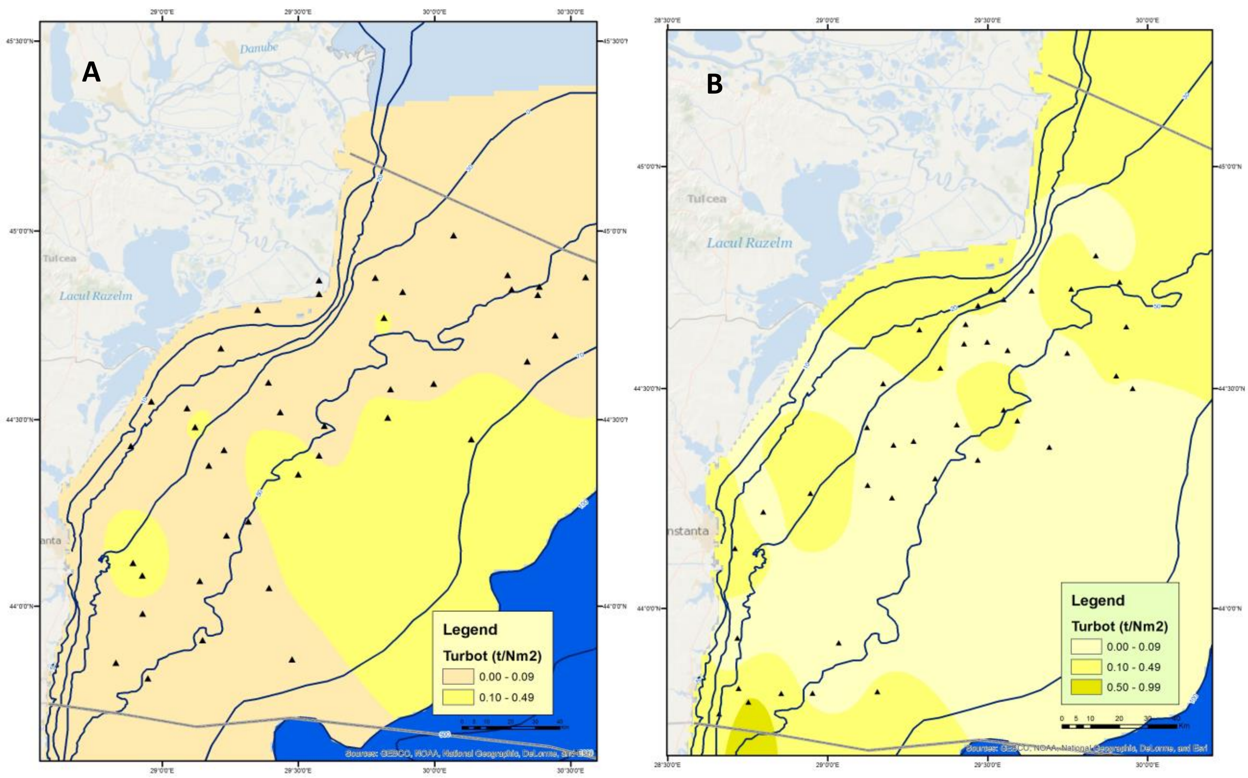


Figure 4.1-1. Distribution of turbot CPUA (kg.Nm^{-2}) from surveys along the Romanian Black Sea coast in spring (A) and autumn (B) seasons of 2013.

Table 4.1-4: Trawl survey abundance and biomass results, Spring 2013

Depth Stratum	Years	kg per km^2	CV or other	N per km^2	CV or other
0 – 30 m	2013	6.606432			
30 – 50 m	2013	7.658927			
50 – 70 m	2013	12.22514			
70 – 100 m	2013	48.04004			
Total (0 – 100 m)	2013	18.632634			

*

k

Table 4.1-5: Trawl survey abundance and biomass results, Autumn 2013

Depth Stratum	Years	kg per km^2	CV or other	N per km^2	CV or other
0 – 30 m	2013	44.73914			
30 – 50 m	2013	25.89624			
50 – 70 m	2013	35.99534			
Total (0 – 70 m)	2013	35.54357			

*

Comments

- Specify CV or other index of variability of mean
- Specify sampling design (for example random stratified with number of haul by stratum proportional to stratum surface; or systematic on transect;…)
- Specify if catchability coefficient is assumed =1 or other

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

Slicing method

Report the maturity scale and age slicing method used

Table 4.1-3: Trawl survey results by length or age class - Romania

N (Total or sex combined) by Length or Age class	Year		
	2013	**....**	**.....**
1	5660		
2	14547		
3	61297		
4	68302		
5	42032		
6	27146		
7	13135		
Total	**232119**		

Sex ratio by Length or Age class	Year		
	....	**....**	**.....**
Total			

Comments

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

Direct methods: trawl based Recruitment analysis

Table 4.1-4: Trawl surveys; recruitment analysis summary

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

Table 4.1-5: Trawl surveys; recruitment analysis results

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

Comments

- Specify type of recruitment:
  - continuous and diffuse
  - discrete and diffuse
  - discrete and localised
  - continuous and localised.

- Specify the method used to estimate recruit indices
- Specify if the area is the total or the swept one
- Possibility to insert graphs and trends

Direct methods: trawl based Spawner analysis

Table 4.1-6: Trawl surveys; spawners analysis summary

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

Table 4.1-7: Trawl surveys; spawners analysis results

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

Comments

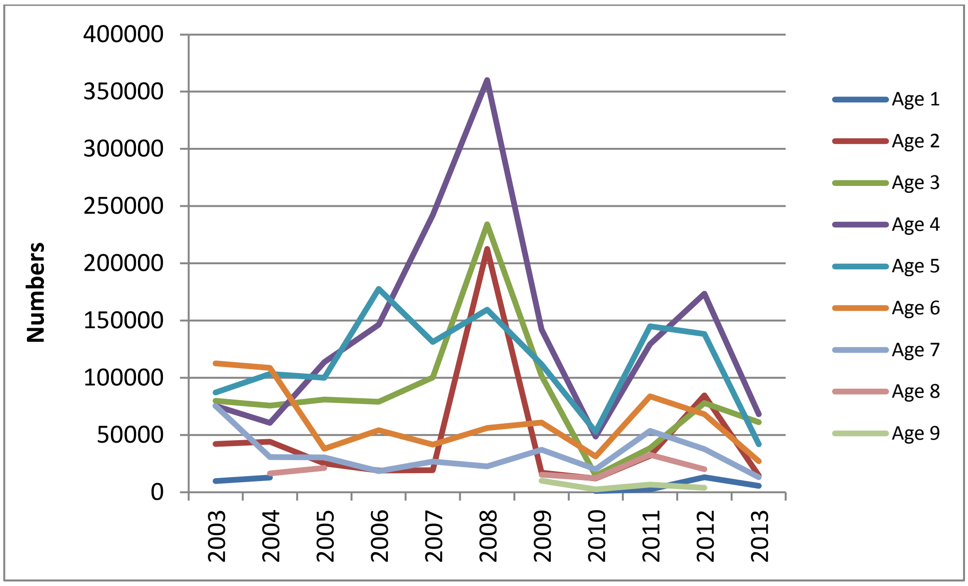
- Specify type of spawner:
  - total spawner
  - sequential spawner
  - presence of spawner aggregations
- Specify if the area is the total or the swept one
- Possibility to insert graphs e trends

4.1.2 Spatial distribution of the resources

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

4.1.3 Historical trends

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



4.1.3-1. Observed trends in abundance by age class during demersal surveys in front of Romanian Black Sea coast, 2003 – 2013.

5 Ecological information

5.1 Protected species potentially affected by the fisheries

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

<u>Marine mammals</u>

Delphinus delphis

Phocoena phocoena

Tursiops truncatus

The by-catch of other non-target species (R. clavata, S. acanthias, Acipenser spp., cetaceans) in turbot fishing gear could be significant. Along the Turkish Black Sea coast, about 3000 P. phocoena and 1500 T. truncatus were by-caught annually (TUDAV, 1999; Birkun, 2002). In 2010-2011 during the most intense turbot fishing season (April-July) direct recording of cetacean bycatches in bottom set gillnets was conducted in the central Bulgarian area. (GFCM, 2011). The bycatch index of P. phocoena was estimated at 22 per 100 km net set and that of T. truncatus – 2 per 100 km net set or overall 24 cetaceans per 100 km net set. (GFCM, 2011). However, there are no enough studies on the by-catch and discards rates of species in fishing gears, dedicated to turbot fisheries in the Black Sea.

5.2 Environmental indexes

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

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

6 Stock Assessment

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

6.1 SAM

6.1.1 Model assumptions

The data set for the period 1950-2013 was compiled using the historical data sources (Ivanov, Beverton, 1985; Ivanov, Karapetkova, 1979; Prodanov et. al, 1997, Daskalov et.al, 2012; Sampson et.al, 2013) and new data for 2013. Available data of total landings, catch at ages, weights and maturity at age are considered appropriate for assessment the stock using the state-space assessment model (SAM) (Nielsen et al., 2012) in FLR environment. The SAM environment is encapsulated into the Fisheries Library in R (FLR) (Kell et al., 2007) in the form of the package “FLSAM”. The state-space assessment model (SAM) is an assessment model which is used for several assessments within ICES and it has been used for the assessment of Black Sea turbot since 2012. The model allows selectivity to evolve gradually over time. It has fewer model parameters than full parametric statistical assessment models, with quantities such as recruitment and fishing mortality modelled as random effects. All assessments are performed with version 0.99-3 of FLSAM, together with version 2.5 of the FLR library (FLCore). Five tuning series (4 surveys and 1 commercial CPUE series were compiled from previous assessments (Daskalov et al., 2012) and recent data. In 2013, only 2 surveys were updated – Romanian research surveys and Turkish CPUE survey.

6.1.2 Scripts

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

6.1.3 Input data and Parameters

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

Table 6.1.3-1. Catch-at-age data (10^3 individuals) including estimated IUU catches, but not discards.

age/year	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
2	16.397	19.748	23.692	25.119	21.002	18.31	18.04	14.862	21.169	33.373
3	112.918	135.972	164.901	176.873	146.621	128.763	126.874	130.048	259.27	355.666
4	216.681	260.864	321.152	349.953	286.75	254.327	250.607	293.781	383.447	567.8
5	280.36	337.472	420.244	463.324	376.404	336.296	331.387	387.218	486.748	402.023
6	226.152	272.659	302.097	291.305	261.462	214.675	211.467	220.132	309.756	293.197
7	180.133	217.37	224.295	195.543	189.597	145.942	143.719	77.563	138.655	157.728
8	115.062	138.899	138.981	115.318	116.204	86.64	85.307	41.332	57.23	64.621
9	41.986	50.659	52.827	46.801	44.818	34.857	34.327	12.084	18.122	17.733
10	25.562	30.857	30.872	25.611	25.811	19.242	18.946	6.269	8.541	11.175
age/year	**1960**	**1961**	**1962**	**1963**	**1964**	**1965**	**1966**	**1967**	**1968**	**1969**
2	27.762	8.915	14.186	43.495	25.964	11.486	21.708	61.68	35.427	30.656
3	138.435	131.955	135.825	235.771	372.001	169.355	132.49	251.327	306.856	334.071
4	231.44	278.865	281.284	235.009	312.064	320.28	206.362	235.719	319.099	362.644
5	205.908	229.911	172.624	262.933	271.244	265.077	267.176	175.771	204.389	262.83
6	182.972	209.673	216.155	290.267	227.835	172.629	236.643	192.666	178.719	186.969
7	109.8	112.386	121.817	181.621	136.976	112.799	131.96	93.375	113.986	98.328
8	58.186	75.748	72.532	94.435	82.583	69.137	70.776	54.007	49.266	40.67
9	13.454	20.071	17.249	15.62	18.076	17.422	13.6	13.28	9.798	8.641
10	9.369	11.085	5.081	6.805	6.018	9.17	8.142	7.644	4.943	5.437
age/year	**1970**	**1971**	**1972**	**1973**	**1974**	**1975**	**1976**	**1977**	**1978**	**1979**
2	72.647	1.814	1.875	3.4	2.089	0.211	27.663	20.331	22.42	3.575
3	353.927	47.933	72.838	47.204	5.576	11.202	86.728	47.836	64.459	148.2
4	171.982	434.073	49.816	62.156	8.826	30.674	35.072	22.505	50.179	106.001
5	540.574	200.784	202.466	276.994	44.395	145.872	103.805	73.658	195.913	406.363
6	310.77	188.526	209.334	237.515	102.688	99.776	93.079	93.499	134.19	331.837
7	234.828	142.951	175.418	208.852	101.49	63.921	64.781	89.041	99.558	252.491
8	83.85	42.138	72.451	77.682	36.091	19.512	19.124	29.572	30.561	77.947
9	38.218	16.895	28.245	34.258	22.168	7.251	12.702	24.734	19.218	51.679
10	41.594	15.546	32.019	49.547	39.956	9.98	34.436	64.526	32.096	107.789
age/year	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**
2	12.814	18.143	0.064	0.067	0.061	0.055	0.056	0.059	0.057	11.804
3	75.89	75.342	115.985	158.094	53.836	0.776	0.056	1.185	0.057	33.052
4	41.273	24.159	69.497	98.656	49.529	2.251	0.224	8.296	0.226	41.147
5	162.346	75.826	201.974	375.707	45.761	4.347	4.938	12.593	19.53	59.359
6	193.383	136.36	171.426	212.477	75.37	8.461	5.78	47.704	29.559	68.128
7	147.618	166.726	172.368	192.419	80.754	15.215	11.783	13.926	24.457	34.739
8	49.345	91.002	76.879	77.62	66.218	7.22	0.225	13.63	38.181	16.863
9	25.463	51.087	70.832	70.771	45.761	12.188	2.581	8.593	8.622	15.852
10	52.008	83.458	157.448	150.266	121.131	27.169	30.806	42.222	55.599	52.614

age/year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
2	55.811	70.661	42.675	436.461	122.823	67.184	38.396	0.01	0.01	0.01
3	68.144	120.758	29.139	366.249	283.93	47.037	40.687	62.311	8.951	69.841
4	104.67	87.588	29.625	150.765	224.63	311.408	130.189	48.751	25.789	114.285
5	94.524	60.376	17.215	63.55	204.966	486.222	168.863	43.585	73.551	76.19
6	37.011	47.027	13.473	25.902	62.968	246.691	210.143	50.365	176.184	184.125
7	29.226	36.382	15.199	14.71	44.668	87.013	97.104	68.768	97.091	146.031
8	20.721	8.41	9.901	14.699	39.514	18.741	42.477	32.285	54.775	25.397
9	12.93	6.112	2.271	11.461	33.673	2.444	9.999	13.56	11.2	12.698
10	35.602	6.112	2.453	3.249	10.323	2.444	0.011	3.229	0.01	6.349

age/year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
2	110.151	28.426	84.166	24.442	20.082	51.322	94.06	117.382	128.957	83.862
3	98.406	42.512	163.214	42.607	51.124	153.999	125.794	220.447	139.244	224.049
4	132.503	133.008	123.606	39.716	62.95	157.707	170.44	418.457	312.066	251.296
5	107.75	247.27	145.575	66.472	77.473	109.903	125.757	201.385	197.272	162.742
6	78.666	322.937	101.483	94.014	85.809	52.807	76.834	103.231	132.293	93.987
7	197.593	103.839	72.104	100.788	58.606	43.57	65.849	37.013	69.431	117.221
8	110.854	22.142	5.964	16.856	31.719	28.872	12.568	4.862	24.002	19.222
9	56.976	2.584	1.296	0.947	3.56	2.512	16.305	4.737	3.987	2.761
10	17.343	7.753	1.556	0.568	0.028	0.809	0.018	0.508	1.524	0.029

age/year	2010	2011	2012	2013
2	9.311	294.674	58.215	135.845
3	29.855	92.415	94.85	57.522
4	103.768	83.081	156.768	207.847
5	183.663	107.532	131.293	212.49
6	153.727	46.091	46.144	85.401
7	86.314	56.057	71.553	37.768
8	40.255	63.96	43.978	18.225
9	13.489	28.782	21.683	10.578
10	3.321	8.611	5.676	1.111

Table 6.1.3-2. Weight-at-age in catch and in the stock (kg).

age/year	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
2	0.869	0.869	0.869	0.869	0.869	0.869	0.869	0.869	0.869	0.869	0.869
3	1.265	1.265	1.265	1.265	1.265	1.265	1.265	1.265	1.265	1.265	1.265
4	1.765	1.765	1.765	1.765	1.765	1.765	1.765	1.765	1.765	1.765	1.765
5	2.243	2.243	2.243	2.243	2.243	2.243	2.243	2.243	2.243	2.243	2.243
6	3.289	3.289	3.289	3.289	3.289	3.289	3.289	3.289	3.289	3.289	3.289
7	4.377	4.377	4.377	4.377	4.377	4.377	4.377	4.377	4.377	4.377	4.377
8	5.667	5.667	5.667	5.667	5.667	5.667	5.667	5.667	5.667	5.667	5.667
9	7.368	7.368	7.368	7.368	7.368	7.368	7.368	7.368	7.368	7.368	7.368

10	10.568	10.568	10.568	10.568	10.568	10.568	10.568	10.568	10.568	10.568	10.568
age/year	**1961**	**1962**	**1963**	**1964**	**1965**	**1966**	**1967**	**1968**	**1969**	**1970**	**1971**
2	0.869	0.869	0.869	0.869	0.869	0.869	0.869	0.869	0.869	0.869	0.869
3	1.265	1.265	1.265	1.265	1.265	1.265	1.265	1.265	1.265	1.265	1.265
4	1.765	1.765	1.765	1.765	1.765	1.765	1.765	1.765	1.765	1.765	1.765
5	2.243	2.243	2.243	2.243	2.243	2.243	2.243	2.243	2.243	2.243	2.243
6	3.289	3.289	3.289	3.289	3.289	3.289	3.289	3.289	3.289	3.289	3.289
7	4.377	4.377	4.377	4.377	4.377	4.377	4.377	4.377	4.377	4.377	4.377
8	5.667	5.667	5.667	5.667	5.667	5.667	5.667	5.667	5.667	5.667	5.667
9	7.368	7.368	7.368	7.368	7.368	7.368	7.368	7.368	7.368	7.368	7.368
10	10.568	10.568	10.568	10.568	10.568	10.568	10.568	10.568	10.568	10.568	10.568
age/year	**1972**	**1973**	**1974**	**1975**	**1976**	**1977**	**1978**	**1979**	**1980**	**1981**	**1982**
2	0.869	0.869	0.869	0.869	0.869	0.869	0.869	0.869	0.869	0.869	0.869
3	1.265	1.265	1.265	1.265	1.265	1.265	1.265	1.265	1.265	1.265	1.265
4	1.765	1.765	1.765	1.765	1.765	1.765	1.765	1.765	1.765	1.765	1.765
5	2.243	2.243	2.243	2.243	2.243	2.243	2.243	2.243	2.243	2.243	2.243
6	3.289	3.289	3.289	3.289	3.289	3.289	3.289	3.289	3.289	3.289	3.289
7	4.377	4.377	4.377	4.377	4.377	4.377	4.377	4.377	4.377	4.377	4.377
8	5.667	5.667	5.667	5.667	5.667	5.667	5.667	5.667	5.667	5.667	5.667
9	7.368	7.368	7.368	7.368	7.368	7.368	7.368	7.368	7.368	7.368	7.368
10	10.568	10.568	10.568	10.568	10.568	10.568	10.568	10.568	10.568	10.568	10.568
year											
age/year	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**
2	0.869	0.869	0.869	0.869	0.869	0.869	1	0.73	0.777	0.947	0.893
3	1.265	1.265	1.265	1.265	1.265	1.265	1.4	1.247	1.153	1.427	1.1
4	1.765	1.765	1.765	1.765	1.765	1.765	1.8	1.777	1.71	1.997	1.543
5	2.243	2.243	2.243	2.243	2.243	2.243	2.2	2.16	2.12	2.647	2.087
6	3.289	3.289	3.289	3.289	3.289	3.289	3.3	3.243	3.03	3.907	2.963
7	4.377	4.377	4.377	4.377	4.377	4.377	4	3.9	4.257	5.283	4.443
8	5.667	5.667	5.667	5.667	5.667	5.667	5.3	5.447	5.467	6.3	5.82
9	7.368	7.368	7.368	7.368	7.368	7.368	6.6	6.5	6.6	8.8	8.34
10	10.568	10.568	10.568	10.568	10.568	10.568	12.117	12.278	9.537	9.537	9.369
age/year	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
2	0.76	0.72	1.083	1.083	1.083	1.083	1.083	1.083	0.852	0.793	0.973
3	1.07	0.953	1	1	1.3	1.3	1.227	1.3	1.283	1.292	1.429
4	1.593	1.57	1.6	1.6	1.7	1.7	1.567	1.7	1.938	1.975	1.953
5	2.083	2.22	2.1	2.1	2.2	2.2	2.223	2.3	2.532	2.4	2.517
6	2.597	2.993	2.8	2.8	3.1	3.1	2.87	3.1	3.197	3.116	3.183
7	4.2	4.423	4.3	4.3	4.3	4.3	3.913	4.1	4.117	4.078	4.238
8	5.9	6	6	6	6	6	5.233	5.7	5.4	5.4	5.796
9	8.3	8.5	9.5	9.5	7	7	6.62	9.5	6.6	6.6	6.8
10	9.473	9.5	10	10.5	10.314	9.5	8.321	12.667	10.25	10	9.921

age/year	2005	2006	2007	2008	2009	2010	2011	2012	2013
2	0.843	0.999	0.794	0.571	0.66	0.683	0.604	0.594	0.454
3	1.321	1.507	1.4	1.356	1.155	1.188	1.129	1.39	1.227
4	1.938	2.114	1.891	1.791	1.749	1.726	1.658	1.956	1.592
5	2.545	2.68	2.441	2.42	2.423	2.511	2.363	2.64	2.257
6	3.436	3.501	3.119	3.001	3.415	2.622	3.192	3.364	3.087
7	4.388	4.467	4.706	4.015	4.197	3.846	3.708	4.272	3.93
8	5.78	5.828	6.06	4.694	5.192	5.177	4.962	5.645	4.662
9	7.5	7.4	7.5	5.697	6.323	5.999	5.627	6.552	5.946
10	9.842	9.421	9	6.643	7.109	7.575	7	6.894	7

Table 6.1.3-3. Natural mortality.

Age	M
2	0.114
3	0.11
4	0.108
5	0.107
6	0.106
7	0.106
8	0.105
9	0.105
10	0.105

Table 6.1.3-4. Proportion of mature fish.

Age	Proportion of mature fish
2	0
3	0.4316667
4	0.6783333
5	1
6	1
7	1
8	1
9	1
10	1

6.1.4 **Tuning data.**

RO Trawl	survey	-	Configuration

age/year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
4	71.57	63.16	113.18	145.08	244.96	228.11	136.44	126.53	173.48	129.46	68.302
5	64.24	77.36	79.23	145.09	105.58	101.16	107.2	98.98	138.42	145.06	42.032
6	70.08	68.31	24.52	36.69	26.94	35.23	58.24	47.97	68.15	83.71	27.146
7	39.42	16.75	16.98	11.02	13.48	14.03	35.74	26.23	37.8	53.55	13.135
8	0.01	16.43	21.28	0.01	0.01	0.01	15.23	12.28	32.75	20.07	0.01
9	0.01	0.01	0.01	0.01	0.01	0.01	10.12	2.53	6.76	3.77	0.01
UKR	Trawl	survey	West	-		Configuration					
BLACK SEA	TURBOT	Total	2013	COMBSEX	TUNING	DATA(effort	nos at age).	Imported	from	VPA	file.
min	max	plusgroup	minyear	maxyear	startf	endf					
4	10	10	1989	2007	0.75	0.83					
Index	type	:	number								
UKR	Trawl	survey	West	-	Index	Values					
Units	:	NA									
age/year	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	
4	24.77	13.12	41.04	37.77	29.37	28.2	NA	NA	NA	19.36	
5	35.74	13.83	29.7	33.15	53.37	51.25	NA	NA	NA	55.5	
6	41.02	18.13	28.8	38.03	34.73	33.35	NA	NA	NA	122.93	
7	20.92	19.68	21.6	28.01	33.2	31.88	NA	NA	NA	70.34	
8	10.15	11.69	4.68	6.42	29.37	28.2	NA	NA	NA	37.11	
9	9.54	8.71	4.14	5.4	25.03	24.03	NA	NA	NA	10.97	
10	8.94	5.84	0.9	1.03	5.62	5.4	NA	NA	NA	0.01	
age/year	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**		
4	NA	NA	60.94	50.2	23.53	45.97	20.99	176.46	153.74		
5	NA	NA	77.7	89.77	60.51	60.23	45.17	114.86	121.44		
6	NA	NA	22.85	64.96	95.99	89.02	49.18	71.32	56.85		
7	NA	NA	4.57	53.15	139.68	104.56	95.17	50.48	39.62		
8	NA	NA	0.65	6.79	33.24	40.84	70.17	7.87	9.04		
9	NA	NA	0.65	1.48	1.87	12.85	13.61	10.19	12.06		
10	NA	NA	0.65	0.89	1.12	0.01	3.23	0.01	1.29		
BG	**Trawl**	**survey**	**-**		**Configuration**						
BLACK SEA	TURBOT	Total 2013	COMBSEX	TUNING	DATA (effort	nos at age).	Imported	from VPA	file.		
min	max	plusgroup	minyear	maxyear	startf	endf					
2	7	NA	2006	2012	0.5	0.5					
Index	type	:	number								
BG	Trawl	survey	-	Index	Values						

Units	:	NA							
age/ year	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**		
2	222.36	124.13	171.01	19.95	5.1	38.33	9.85		
3	259.03	233.08	118.97	139.66	7.66	38.33	19.71		
4	108.8	328.24	215.63	136.59	24.24	26.35	26.28		
5	41.4	204.12	270.15	155.01	57.42	16.77	13.14		
6	24.84	86.89	161.1	102.83	37	26.35	9.85		
7	10.65	13.79	19.83	30.7	17.86	21.56	6.57		
TR CPUE	**-**	**Configuration**							
BLACK SEA	TURBOT	Total 2013	COMBSEX	TUNING	DATA(effort	nos at age).	Imported	from VPA	file.
min	max	plusgroup	minyear	maxyear	startf	endf			
2	10	10	1987	2013	0.45	0.55			
Index	type	:	number						
TR	CPUE	-	Index	Values					
Units	:	NA							
age/ year	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**
2	0.92	1.13	138.23	342.49	649.47	223.13	648.31	922.43	516.78
3	18.53	1.13	387.05	418.17	1109.94	152.35	544.02	2132.38	361.81
4	129.7	4.54	481.83	642.33	805.06	154.9	223.94	1687.02	2395.4
5	196.9	391.07	695.1	580.06	554.94	90.01	94.4	1539.34	3740.0
6	745.8	591.9	797.79	227.12	432.24	70.45	38.47	472.9	1897.6
7	217.7	489.73	406.79	179.35	334.4	79.47	21.85	335.47	669.31
8	213.1	764.53	197.47	127.16	77.3	51.77	21.83	296.76	144.16
9	134.3	172.64	185.62	79.35	56.18	11.87	17.02	252.89	18.8
10	660.1	1113.3	616.11	218.48	56.18	12.82	4.83	77.53	18.8
age/ year	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
2	78.02	0.02	0.03	0.02	383.21	38.6	50.26	45.01	34.73
3	82.68	139.88	30.41	133.81	342.35	57.72	97.46	78.46	88.41
4	264.6	109.44	87.61	218.96	460.97	180.6	73.81	73.14	108.86
5	343.2	97.85	249.87	145.97	374.86	335.75	86.93	122.41	133.97
6	427.0	113.07	598.53	352.77	273.67	438.5	60.6	173.12	148.39
7	197.3	154.38	329.84	279.78	687.42	141	43.06	185.6	101.34
8	86.32	72.48	186.08	48.66	385.66	30.07	3.56	31.04	54.85
9	20.32	30.44	38.05	24.33	198.22	3.51	0.77	1.74	6.16
10	0.02	7.25	0.03	12.16	60.33	10.53	0.93	1.05	0.05
age/	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**

year											
2	95.16	192.51	174.81	96.98	60.94	10.74	64.23	19.91	37.79		
3	285.6	257.46	328.31	104.71	162.82	34.42	20.14	32.45	15.615		
4	292.4	348.84	623.2	234.67	182.62	119.65	18.11	53.63	56.66		
5	203.8	257.39	299.92	148.35	118.27	211.77	23.44	44.91	53.68		
6	97.92	157.26	153.74	99.48	68.3	177.26	10.05	15.78	21.42		
7	80.79	134.77	55.12	52.21	85.19	99.52	12.22	24.48	9.73		
8	53.54	25.72	7.24	18.05	13.97	46.42	13.94	15.04	5.07		
9	4.66	33.37	7.06	3	2.01	15.55	6.27	7.42	2.94		
10	1.5	0.04	0.76	1.15	0.02	3.83	1.88	1.94	0.3		
UKR	**Trawl**	**survey**	**East -**	**Configuration**							
BLACK	SEA	TURBOT	Total	2013	COMBSEX	TUNING	DATA(effort	nos at age).	Imported	from	VPA file.
min	max	plusgroup	minyear	maxyear	startf	endf					
2	10	10	1989	2006	0.75	0.83					
Index	type	:	number								
UKR	Trawl	survey	East	-	Index	Values					
Units	:	NA									
age/ year	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**		
2	2.22	0.94	6.01	11.43	4.45	7.06	NA	NA	NA		
3	6.21	1.69	2.8	14.95	8.74	13.87	NA	NA	NA		
4	7.73	4.32	10.42	11.75	9.31	14.77	NA	NA	NA		
5	11.15	4.55	13.21	10.31	16.92	26.85	NA	NA	NA		
6	12.8	5.97	12.56	11.83	11.01	17.47	NA	NA	NA		
7	6.53	6.48	6.96	8.71	10.53	16.7	NA	NA	NA		
8	3.17	3.85	1.73	2	9.31	14.77	NA	NA	NA		
9	2.98	2.87	1.79	1.68	7.93	12.59	NA	NA	NA		
10	2.79	1.92	0.36	0.32	1.78	2.83	NA	NA	NA		
year											
age/ year	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**		
2	0.01	NA	NA	0.01	0.01	0.25	0.75	0.46	0.21		
3	0.44	NA	NA	0.36	0.74	0.48	3.38	0.46	0.34		
4	1.12	NA	NA	1.45	1.38	0.98	5.8	2.09	1.33		
5	3.13	NA	NA	1.09	2.46	2.52	4.69	1.62	1.19		
6	9.38	NA	NA	2.91	1.78	4	4.36	1.39	0.75		
7	4.68	NA	NA	2.55	1.46	5.82	3.82	0.23	0.75		
8	3.13	NA	NA	0.73	0.19	1.39	2.99	0.01	0.13		
9	0.01	NA	NA	0.01	0.04	0.08	0.01	0.01	0.2		
10	0.01	NA	NA	0.01	0.02	0.05	0.01	0.01	0.01		

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

Add a table with input parameters and model settings

6.1.5 Results

STECF EWG 14-14 evaluated the Black Sea Turbot stock applying the state-space assessment model (SAM) (Nielsen et al., 2012). Version details and model configuration are listed below and are similar to those, used for the assessment for the period 1950 - 2012. In the new assessment, turbot spawning biomass was estimated at 1st of January.

SAM outputs and model diagnostics are listed in the tables below.

Table 6.1.5-1. Summary table of the final SAM model.

Year	Recruitment	Low	High	TSB	Low	High	SSB	Low	High	Fbar	Low	High	Landings	La SOP
1950	1975	1344	2903	16757	13935	20152	12666	10342	15513	0.4778	0.3494	0.6535	3932	1
1951	1907	1339	2717	16518	13951	19557	12664	10577	15163	0.5199	0.3992	0.677	4741	1
1952	1741	1217	2491	15639	13197	18532	12102	10116	14478	0.5725	0.4471	0.733	5217	1
1953	1908	1352	2693	14501	12215	17216	10970	9157	13141	0.6098	0.4807	0.7735	4985	1
1954	2054	1460	2891	13520	11384	16057	9831	8211	11771	0.6583	0.5221	0.83	4505	1
1955	1983	1398	2813	12729	10690	15156	8924	7464	10669	0.6883	0.5487	0.8634	3678	1
1956	1875	1319	2664	12215	10219	14601	8485	7092	10150	0.7288	0.5741	0.9251	3623	1
1957	1852	1308	2621	11919	9949	14279	8317	6928	9986	0.6293	0.4948	0.8004	3017	1
1958	1915	1365	2687	12047	10104	14365	8456	7064	10122	0.681	0.5441	0.8524	4289	1
1959	1776	1263	2498	11702	9857	13892	8204	6893	9764	0.7122	0.5651	0.8977	4653	1
1960	1684	1192	2378	11181	9427	13262	7838	6595	9314	0.6407	0.5054	0.8123	2680	1
1961	1641	1160	2322	11086	9366	13121	7901	6662	9369	0.6435	0.5067	0.8173	3058	1
1962	1625	1142	2311	11048	9340	13068	7931	6693	9398	0.6405	0.5036	0.8146	2904	1
1963	1730	1226	2441	11051	9338	13079	7871	6637	9334	0.6965	0.5532	0.8769	3812	1
1964	1632	1160	2295	10619	8958	12588	7480	6301	8880	0.6982	0.5529	0.8817	3666	1
1965	1922	1381	2675	10547	8903	12495	7184	6042	8542	0.6765	0.5304	0.8628	3063	1
1966	1980	1421	2758	10835	9146	12835	7260	6105	8633	0.677	0.5198	0.8816	3093	1
1967	2029	1455	2830	11302	9505	13437	7514	6293	8972	0.5822	0.4303	0.7877	2709	1
1968	1753	1259	2441	11851	9925	14151	8271	6884	9938	0.4952	0.3601	0.6811	2931	1
1969	1392	993	1952	12210	10152	14685	9096	7485	11053	0.427	0.3118	0.5847	3076	1
1970	1046	744	1470	12145	9971	14794	9670	7827	11948	0.499	0.3598	0.6921	5273	1
1971	847	602	1191	11035	8840	13774	9102	7149	11590	0.4114	0.2905	0.5827	3052	1
1972	914	657	1271	10434	8088	13461	8691	6546	11538	0.4181	0.2882	0.6064	3049	1
1973	995	722	1372	9790	7282	13161	7993	5683	11241	0.4497	0.2947	0.6863	3705	1
1974	1340	978	1836	9414	6758	13116	7230	4810	10868	0.3292	0.2058	0.5265	1696	1
1975	1498	1097	2045	10211	7311	14261	7623	4990	11644	0.2543	0.1612	0.4014	1273	1
1976	1614	1184	2201	11702	8532	16050	8746	5860	13054	0.228	0.1477	0.3519	1584	1
1977	1434	1058	1942	13178	9796	17728	10251	7124	14749	0.2292	0.1526	0.3443	2012	1
1978	1212	886	1658	14326	10815	18976	11671	8381	16253	0.2437	0.1689	0.3518	2160	1
1979	794	560	1124	14753	11178	19471	12689	9292	17328	0.3235	0.2336	0.448	5447	1
1980	442	295	662	13597	10254	18030	12195	8977	16567	0.2804	0.2037	0.3861	2843	1
1981	276	195	391	12455	9211	16843	11609	8442	15963	0.2961	0.218	0.402	3276	1

1982	209	151	289	10867	7801	15138	10340	7317	14612	0.3712	0.2822	0.4882	4662	1
1983	217	161	291	8691	5975	12640	8262	5577	12240	0.5132	0.374	0.7043	5307	1
1984	211	159	280	6343	4089	9839	5935	3716	9480	0.466	0.3218	0.6746	2852	1
1985	222	167	295	5025	3084	8187	4604	2705	7835	0.2307	0.1501	0.3545	527	1
1986	248	187	329	4725	2935	7609	4275	2529	7228	0.145	0.0906	0.2321	428	1
1987	279	208	374	4691	3033	7257	4191	2578	6813	0.2015	0.1466	0.2769	849	1
1988	321	235	439	4293	2948	6252	3724	2425	5719	0.2923	0.2247	0.3801	1116	1
1989	466	344	630	4055	2998	5484	3234	2237	4675	0.4401	0.3418	0.5668	1460	1
1990	728	542	978	3519	2830	4375	2560	1952	3358	0.533	0.4158	0.6833	1393	1
1991	1122	824	1527	3668	3105	4334	2208	1845	2643	0.5219	0.3983	0.684	935	1
1992	1351	972	1878	5505	4636	6537	3127	2657	3680	0.3541	0.2614	0.4796	439	1
1993	1325	939	1870	5762	4824	6883	3458	2929	4082	0.3622	0.2744	0.4781	1603	1
1994	1123	826	1525	6316	5326	7491	4380	3674	5222	0.593	0.4667	0.7536	2144	1
1995	926	688	1248	6606	5625	7758	5057	4247	6021	0.745	0.5874	0.9447	2943	1
1996	665	491	901	6292	5424	7299	4755	4033	5605	0.7715	0.6201	0.9599	2048	1
1997	693	504	955	5861	5070	6774	4453	3788	5235	0.6921	0.5504	0.8702	1025	1
1998	800	589	1087	6241	5411	7198	4664	4005	5432	0.589	0.4648	0.7464	1588	1
1999	756	560	1021	6156	5297	7154	4521	3851	5308	0.6208	0.4942	0.7798	1953	1
2000	653	481	887	5413	4608	6359	3929	3290	4691	1.036	0.8575	1.2516	2789	1
2001	592	441	795	4782	4097	5581	3450	2923	4072	1.2436	1.0468	1.4775	2557	1
2002	657	484	892	4315	3721	5004	3150	2698	3676	0.8351	0.6914	1.0086	1567	1
2003	871	651	1165	4189	3622	4844	2901	2504	3360	0.7505	0.619	0.9098	1122	1
2004	1225	908	1654	4940	4218	5787	2920	2520	3385	0.7922	0.6511	0.9639	1142	1
2005	1384	1004	1908	5507	4650	6522	3212	2758	3741	0.7588	0.6212	0.927	1400	1
2006	1359	974	1895	6957	5790	8360	4063	3446	4790	0.8573	0.711	1.0336	1751	1
2007	1112	791	1562	6657	5531	8012	4363	3672	5184	0.7466	0.6047	0.9218	2259	1
2008	882	620	1254	6088	5089	7282	4452	3743	5295	0.8291	0.6738	1.0203	2122	1
2009	722	499	1044	5515	4676	6505	4262	3616	5023	0.7124	0.5804	0.8745	2078	1
2010	590	403	864	4428	3718	5274	3390	2863	4013	0.7493	0.6124	0.9169	1738	1
2011	567	358	897	3595	2953	4377	2716	2252	3276	0.7911	0.6464	0.9681	1659	1
2012	496	265	928	3298	2598	4186	2493	1993	3119	1.0519	0.8533	1.2967	1714	1
2013	504	226	1128	2238	1576	3178	1634	1217	2194	1.3301	0.9247	1.9133	1522	1

The SAM estimated recruitment has four peaks in 1965 – 1968, 1974 – 1978, 1991 – 1994 and 2004 – 2007 and three lows in 1982-85, 1996 – 1997 and after 2009. Correspondingly, SSB attained higher values up to 12 689 t in 1977 – 1982 and very low values after 2009. For the period after 2002, STECF EWG 14 14 is aware that misreporting of actual catches might be larger than assumed in the assessment (around 4.7 the official catches of Bulgaria, Romania and Ukraine. Fishing mortality F4-8 has a peaks of F~1.24 in 2000-2001 and F~1.33 during the recent years (2012 – 2013) (Fig. 6.1.5-1).

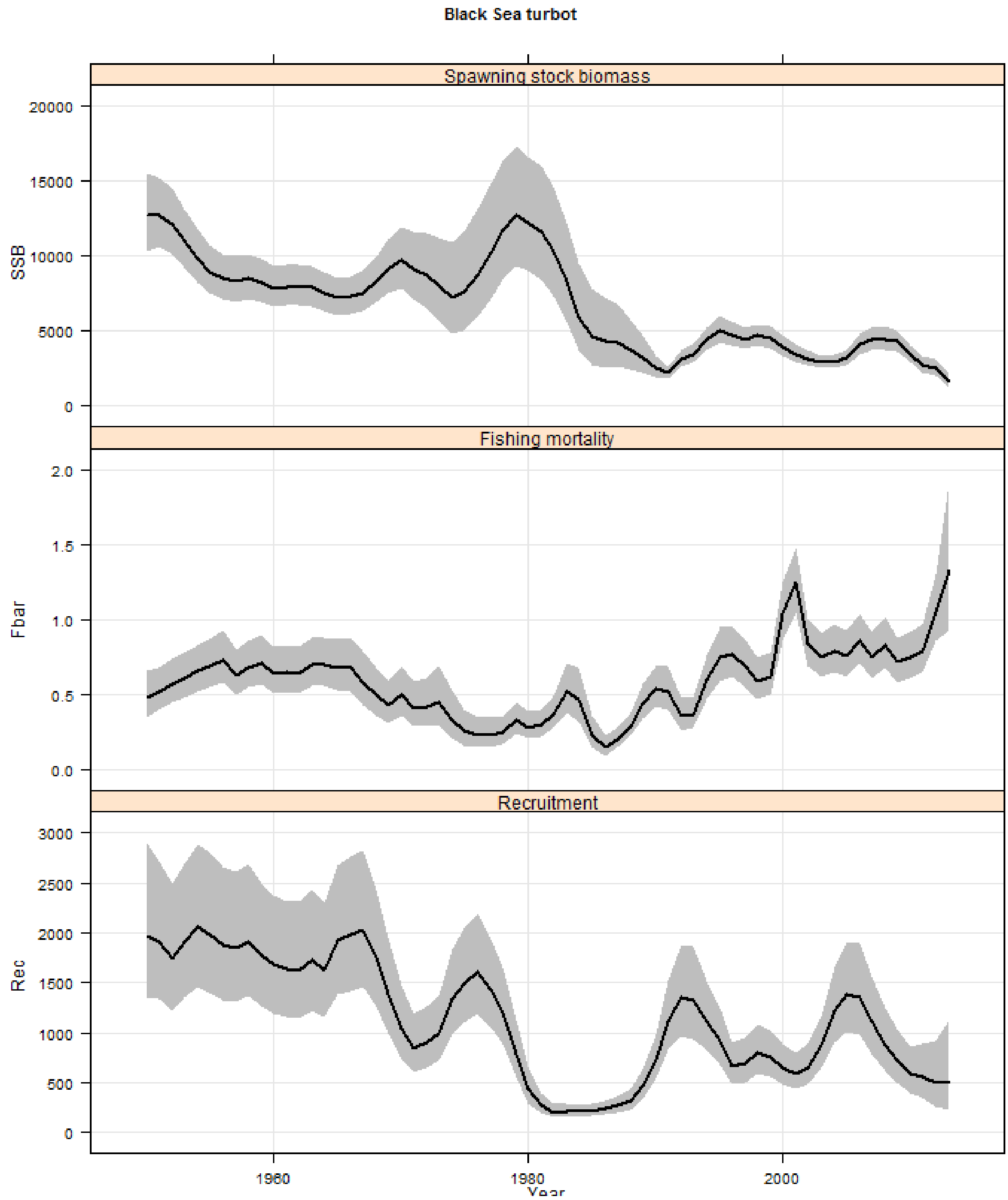


Figure 6.1.5-1. Time-series of population estimates of Black Sea turbot: SSB, F (ages 4–8) and recruitment with estimate of uncertainty.

6.1.6 Robustness analysis

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

The retrospective runs consistently overestimate F, underestimte recruitment but has no particular trend on SSB.

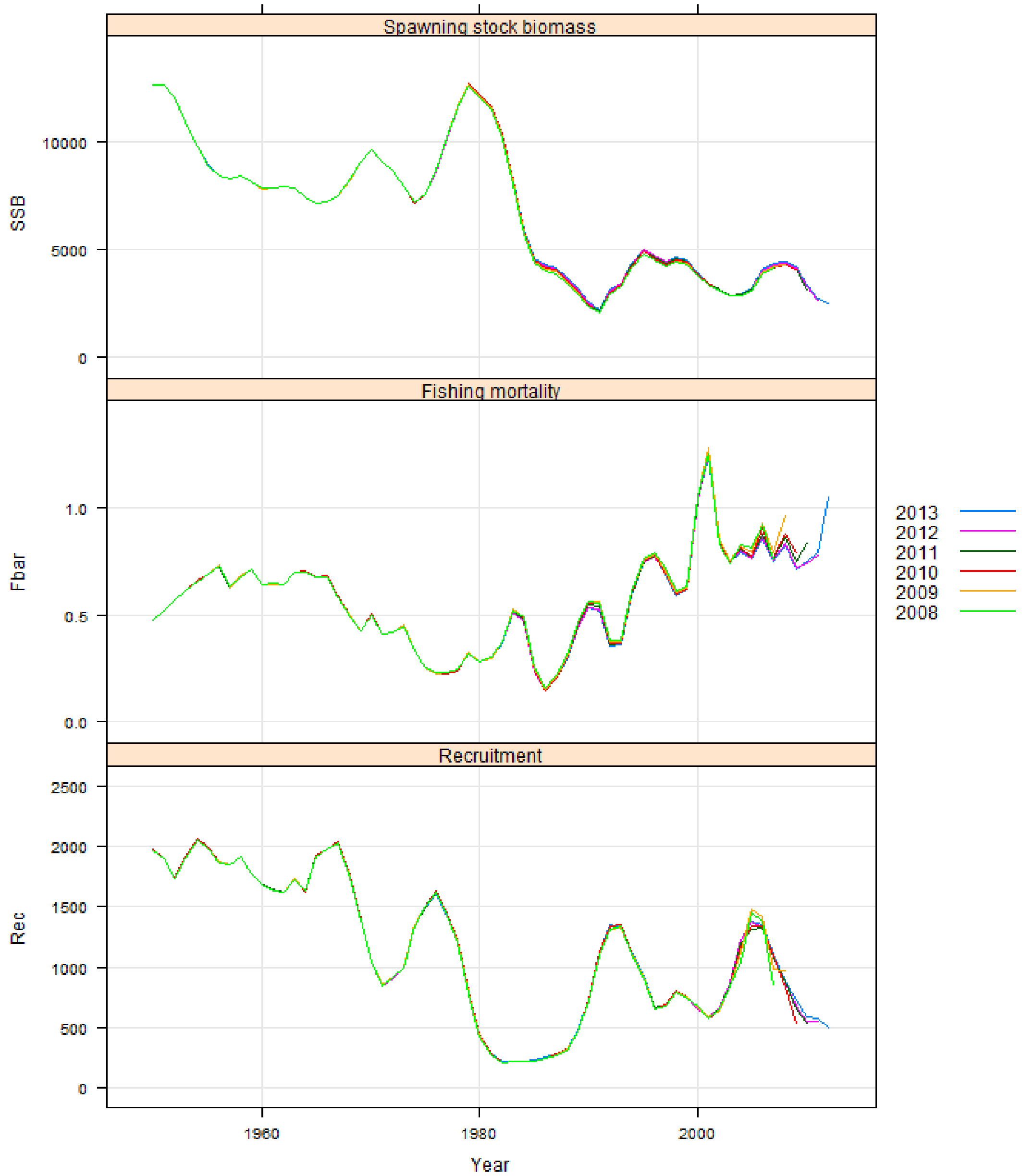


Fig.6.1.7-1. Analytical retrospective pattern over years in the assessment for spawning stock biomass, recruitment and mean fishing mortality in the ages 4-8 ringer.

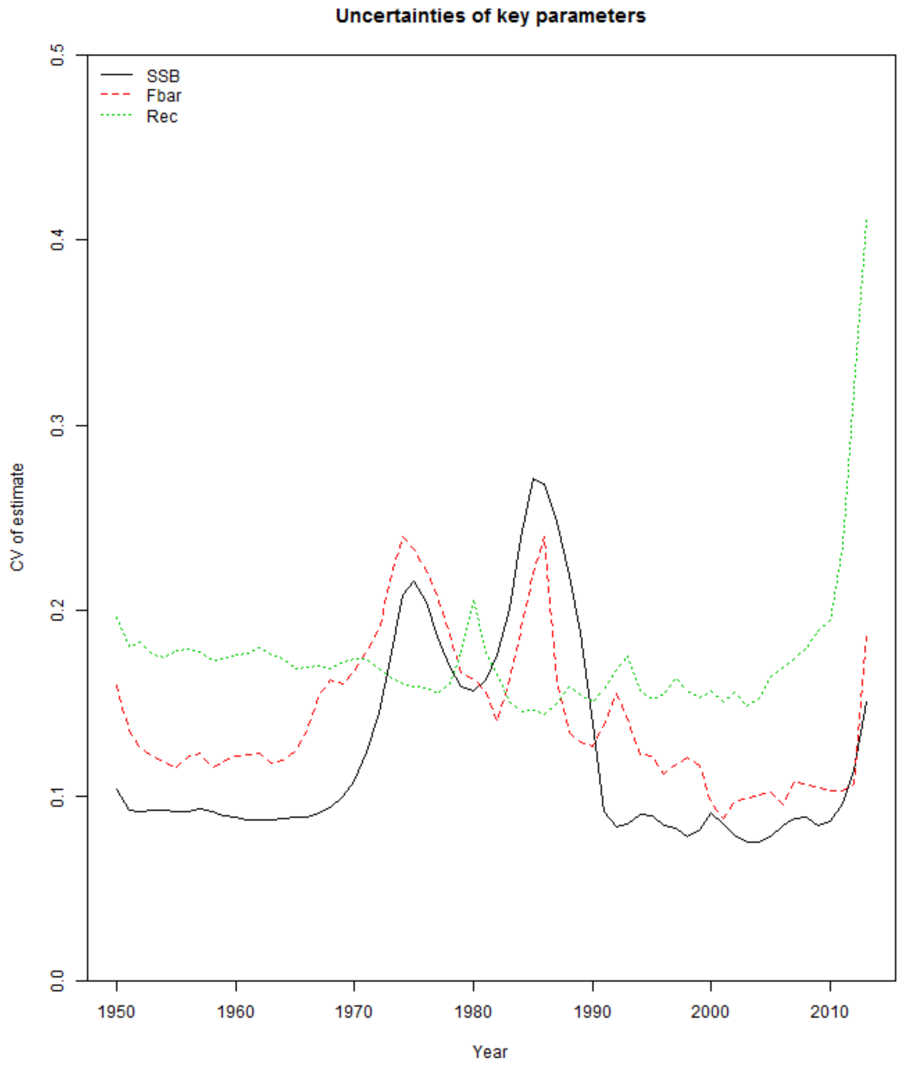


Figure 6.1.7-2. Coefficient of variation (CV) of the main stock parameters.

6.1.8 Assessment quality

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

The available data for turbot stock assessment in 2013 is considered good enough in order to perform a reliable assessment of the stock. The share of IUU fisheries by countries was not reported but it was estimated and included in the catches. No data were provided by countries regarding the discards.

7 Stock predictions

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

7.1 Short term predictions

Short term prediction of stock size and catch was conducted based on SAM results and given on the table below.

Table 6.2.5.3.1. Turbot in Black Sea. Short term prediction.

Fscenario	Fmult	Catch_2014	Catch_2015	Catch_2016	Landings_2014	Landings_2015	Landings_2016	SSB_2014	SSB_2015	SSB_2016	Change SSB_2014_2016	ChangeCatch_2015_2013
0.26	**0.25**	**724.50**	**213.38**	**306.23**	**724.50**	**213.38**	**306.23**	**1310.12**	**1211.86**	**1686.49**	**28.73**	**-85.87**
0.00	**0.00**	**724.50**	**0.00**	**0.00**	**724.50**	**0.00**	**0.00**	**1310.12**	**1211.86**	**1933.56**	**47.59**	**-100.00**
0.11	0.10	724.50	92.07	147.27	724.50	92.07	147.27	1310.12	1211.86	1826.75	39.43	-93.90
0.21	0.20	724.50	176.79	262.15	724.50	176.79	262.15	1310.12	1211.86	1728.73	31.95	-88.30
0.32	0.30	724.50	254.99	352.57	724.50	254.99	352.57	1310.12	1211.86	1638.52	25.07	-83.12
0.42	0.40	724.50	327.39	424.28	724.50	327.39	424.28	1310.12	1211.86	1555.23	18.71	-78.32
0.53	0.50	724.50	394.61	481.46	724.50	394.61	481.46	1310.12	1211.86	1478.15	12.83	-73.87
0.63	0.60	724.50	457.19	527.25	724.50	457.19	527.25	1310.12	1211.86	1406.63	7.37	-69.73
0.74	0.70	724.50	515.58	563.98	724.50	515.58	563.98	1310.12	1211.86	1340.10	2.29	-65.87
0.85	0.80	724.50	570.19	593.42	724.50	570.19	593.42	1310.12	1211.86	1278.10	-2.44	-62.25
0.95	0.90	724.50	621.37	616.96	724.50	621.37	616.96	1310.12	1211.86	1220.20	-6.86	-58.86
1.06	1.00	724.50	669.43	635.66	724.50	669.43	635.66	1310.12	1211.86	1166.03	-11.00	-55.68
1.16	1.10	724.50	714.64	650.37	724.50	714.64	650.37	1310.12	1211.86	1115.25	-14.87	-52.69
1.27	1.20	724.50	757.24	661.78	724.50	757.24	661.78	1310.12	1211.86	1067.58	-18.51	-49.87
1.38	1.30	724.50	797.44	670.42	724.50	797.44	670.42	1310.12	1211.86	1022.76	-21.93	-47.20
1.48	1.40	724.50	835.44	676.76	724.50	835.44	676.76	1310.12	1211.86	980.56	-25.15	-44.69
1.59	1.50	724.50	871.40	681.15	724.50	871.40	681.15	1310.12	1211.86	940.78	-28.19	-42.31
1.69	1.60	724.50	905.49	683.90	724.50	905.49	683.90	1310.12	1211.86	903.22	-31.06	-40.05
1.80	1.70	724.50	937.83	685.28	724.50	937.83	685.28	1310.12	1211.86	867.72	-33.77	-37.91
1.90	1.80	724.50	968.55	685.48	724.50	968.55	685.48	1310.12	1211.86	834.14	-36.33	-35.88
2.01	1.90	724.50	997.76	684.70	724.50	997.76	684.70	1310.12	1211.86	802.32	-38.76	-33.94
2.12	2.00	724.50	1025.57	683.09	724.50	1025.57	683.09	1310.12	1211.86	772.16	-41.06	-32.10

Fishing at the Fstq generates a decrease of the catch of 56 % from 2013 to 2015 and a decrease of the spawning stock biomass of 11% from 2015 to 2016.

Fishing at FMSY (0.26) generates a decrease of the catch of about 86 % from 2013 to 2015 and an increase of the spawning stock biomass of 29 % in the same period.

Catches of turbot in 2015 consistent with FMSY would not exceed 213 tonnes.

In case of closed turbot fishery (zero catches) in 2015, the SSB increases of about 48 % in 2016.

7.2 Medium term predictions

Medium term projections were not undertaken

7.3 Long term predictions

Long term projections were not undertaken.

8 Draft scientific advice

(Examples in blue)

Based on	Indicator	Analytic al reference point (name and value)	Current value from the analysis (name and value)	Empirical reference value (name and value)	Trend (time period)	Stock Status
Fishing mortality	Fishing mortality	(F_{msy} = 0.26m)			I	IO_H
	Fishing effort				No data	
	Catch				D	
Stock abundance	Biomass				D	
	SSB	B_{pa} = 4949 B_{lim} = 3535			D	
Recruitment					D	
Final Diagnosis		Example: In high level of overfishing and overexploited with low level of biomass				

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

8.1 Explanation of codes

Trend categories

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

Stock Status

Based on Fishing mortality related indicators

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

Range of Overfishing levels based on fishery reference points

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

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

*Fc is current level of F

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

Based on Stock related indicators

1) **N - Not known or uncertain:** Not much information is available to make a judgment
2) **S - Sustainably exploited:** Standing stock above an agreed biomass based Reference Point;
3) **O - Overexploited**: Standing stock below the value of the agreed biomass based Reference Point. An agreed range of overexploited status is provided;

Empirical Reference framework for the relative level of stock biomass index

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

4) **D – Depleted**: Standing stock is at lowest historical levels, irrespective of the amount of fishing effort exerted;
5) **R –Recovering:** Biomass are increasing after having been depleted from a previous period;

Agreed definitions as per SAC Glossary

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

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

Stock Assessment Form

Demersal species

Reference year: 2013

Reporting year:2014

[Dogfish: The fishing mortality rate during 2013 is estimated to be F = 0.112, which is more than 3.5 times greater than the FMSY. Recent catches of this long-lived and relatively unproductive species are very low compared to the past and the stock appears to be severely depleted. Results from any assessment of dogfish in the Black Sea will remain highly uncertain unless there are concerted and coordinated efforts to collect representative biological samples of dogfish from all fisheries that catch dogfish, including dogfish discarded by fisheries that do not target dogfish.]

1 Basic Identification Data

Scientific name:	Common name:	ISCAAP Group:
Squalus acanthias Linnaeus, 1758	Piked dogfish	38
1st Geographical sub-area:	**2nd Geographical sub-area:**	**3rd Geographical sub-area:**
[GSA_29]		
1st Country	**2nd Country**	**3rd Country**
Bulgaria	Georgia	Romania
4th Country	**5th Country**	**6th Country**
Russia	Ukraine	Turkey
Stock assessment method: (direct, indirect, combined, none)		
VIT4Win, YPR-LEN, and XSA		
Authors:		
[Authors: Gheorghe RADU[1], David SAMSON[2], Massimiliano CARDINALE[3]]		
Affiliation:		
1-National Institute for Marine Research and Development "Grigore Antipa", Constanta, Romania; 2- Oregon State University, USA; 3- Swedish University, Sweden		

2 Stock identification and biological information

Piked dogfish inhabits the whole Black Sea shelf at the water temperatures 6 – 15º C. It undertakes extensive migrations. In autumn feeding migrations are aimed at the grounds of the formation of the wintering concentrations of anchovy and horse mackerel in the vicinity of the Crimean Caucasus and Anatolian coasts. With their disintegration piked dogfish disperses all over the shelf. Reproductive migrations of viviparous piked dogfish take place towards the coastal shallows with two peaks of intensity – in spring and autumn. The autumn migration for reproduction covers more individuals usually. The major grounds for reproduction of piked dogfish in the Ukrainian waters are located in Karkinitsky Bay, in front of Kerch Strait and in Feodosia Bay.

Piked dogfish belongs to long-living and viviparous fish; therefore reproduction process includes copulation and birth of fries. Near the coasts of Bulgaria, Georgia, Romania, Russian Federation and Ukraine the intense spawning season is in March-May. Two peaks of birth of juveniles can be distinguished – spring period (April-May) and summer-autumn (August-September, Serobaba et al.. 1988). To give birth of juveniles the females approach the coastal zone in depth 10 – 30 m (Maklakova, Taranenko, 1974). At this time males keep separately from females in depth 30 – 50 m. The birth of piked dogfish juveniles takes place at the temperature of water 12 – 18°C.

In autumn piked 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 piked dogfish are observed, where piked dogfish feeds intensively. They are associated, above all, with major wintering areas of anchovy in the waters of Georgia and Turkey. In the North-western Black Sea in the waters of Ukraine and Romania in depth from 70-80 m down to 100-120 m abundant wintering concentrations of piked dogfish are also observed, where they are located on the grounds of whiting and sprat concentrations (Kirnosova, Lushnicova., 1990).

2.1 Stock unit

According to the previous research belonging to the USSR period, existence of existence of single population is indicated for the Black Sea (Svetovidov, 1964; Maklakova, Taranenko, 1974). All regional stock assessment piked dogfish made assuming / confidence in the existence of a single population (Prodanov et al, 1997; Daskalov et al, 2012; Sampson et al, 2013, Shlyakhov, 2014).

2.2 Growth and maturity

Piked dogfish is a major demersal predator, reaching the Black Sea the length of about 1.50 m. According to investigations conducted in former USSR waters. Kirnosova. (1993) found that the piked dogfish maximum age is 20 years. The parameters in VBGF and natural mortality parameters are:

<u>Males:</u> K=0.029 t_0=-3.84; L_∞=272 cm; W_∞=47 kg; M=0.20÷0.23

<u>Females:</u> K=0.026 t_0=-3.32; L_∞=303 cm; W_∞=196 kg; M=0.15÷0.20

Age and length, at which 50% of individuals are mature, are 10.49 years and 87.57 cm for males and 11.99 years and 102.97 cm for females, respectively. Mean biennial fecundity is 19.4 eggs and

12.9 pups. The linear relationship between fecundity and length is: F_e = 0.09 x TLp + 2.12 (r = 0.5) for pups and F_o = 0.27 x T Lp - 21.59 (r = 0.7) for eggs (Demirhan and Seyhan. 2007).

Ukrainian data for the period 1971-2001 are: L_∞=282; t_0 = -3.6684 (year); a = 0.00000677; b =2.9593. For period 2002 – 2012 a= 0.00000640; b= 3.0000

Romanian data for the last three years are:

Main parameters used in assessment for 2011 data

Linf= 136	a= 0.0117
k= 0.191	b= 2.7694
t0= -1.31	M= 0.15 (0.258)

Main parameters used in assessment for 2012 data

Linf= 157	a= 0.0169769
k= 0.153	b= 2.696436
t0= -1.13684	M= 0.15

Main parameters used in assessment for 2013 data

Linf= 156	a= 0.061086
k= 0.134	b= 2.41368
t0= -0.9304	M= 0.15 (0.22)

Life-history parameters and food diet of piked dogfish (Squalus acanthias) from the SE Black Sea were studied (Demirhan and Seyhan, 2007). Piked dogfish at age 1 to 14 years old were observed, with dominance of 8 years old individuals for both sexes. The length–weight relationship was W=0.0040*L2·95and the mean annual linear and somatic growth rates were 7.2 cm and 540.1 g, respectively. The estimated parameters in VBGF were: W∞=12021 (g), L∞=157 (cm), K=0.12 (year−1) and t0=−1.30 (year). The size at first maturity was 82 cm for males and 88 cm for females. Mean biennial fecundity was also found to be 8 pups per female. The relationships fecundity–length, fecundity–weight and fecundity–age were found to be:

F=−17.0842+0.2369*L (r=0.93)

F=0.3780+0.0018*W (r=0.89)

F =−0.7859+1.1609*A (r=0.94), respectively.

In conformity with Ukrainian data, the maturity ogive for last years is the following:

Year/ Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
2011	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.25	0.45	0.55	0.75	0.95	1.0	1.0	1.0	1.0	1.0

Maturity ogive from Romanian data

Year/ Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
2011	0.0	0.0	0.45	0.7	0.95	1.0	1.0	1.0	1.0	1.00	1.0	1.0	1.	1.0	1.0	1.0	1.0	1.0	1.0

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

Somatic magnitude measured (LT, LC, etc)			Lt	**Units**	cm
Sex	**Fem**	**Mal**	**Combined**	**Reproduction season**	April-May (copulation and birth of juvenile); August-September (birth of juvenile)
Maximum size observed			148	**Recruitment season**	April –May and September-October
Size at first maturity			80	**Spawning area**	Mainly in the Western part of the Black Sea
Recruitment size to the fishery			100	**Nursery area**	Mainly in the Western part of the Black Sea

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

Size/Age	Natural mortality	Proportion of matures
1	*0.2*	*0.0*
2	*0.2*	*0.0*
3	*0.2*	*0.0*
4	*0.2*	*0.45*
5	*0.2*	*0.75*
6	*0.2*	*0.95*
7	*0.2*	*1.0*
8	*0.2*	*1.0*
9	*0.2*	*1.0*
…..	….	…..
19	*0.2*	*1.0*

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

Size/Age	Natural mortality	Proportion of matures
…	…	…

Table 2-3: Growth and length weight model parameters

			Sex			
		Units	**female**	**male**	**Combined**	**Years**
Growth model	**L_∞**				155.789	2013
	K				0.134	2013
	t_0				-0.934	2013

	Data source	Romanian National Data Collection Program				
Length weight relationship	**a**				0.061086	2013
	b				2.41368	2013
	M (scalar)				0.2	
	sex ratio (% females/total)	0%				

3 Fisheries information

In the Black Sea, the largest catches of piked 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 piked 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 piked 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 piked dogfish is harvested mainly as by-catch, annual catches are usually lower than the Ukraine. The maximum annual catches of piked 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).

In Turkey piked 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,)

In the last three years increased the importance of the catches in Bulgaria, these being around 40% from total Black sea catches.

3.1 Description of the fleet

Only Romania and Ukraine give data on fleet and gears used for dogfish.

In 2011, 2012 and 2013 Romania provided data regarding the number of gillnets by vessel length class. The number of fishing gillnets for dogfish dropped from 265 in 2011 to 160 in 2012 and 25 in 2013.

Number of fishing gillnets for dogfish in the Romanian area (2011-2013)

Vessel length (m)	Number of gillnets for dogfish in 2011	Number of gillnets for dogfish in 2012	Number of gillnets for dogfish in 2013
< 6m	10	-	-
6-12 m	205	110	-
18-24 m	50	50	-
24-40 m	-	-	25
Total	**265**	**160**	**25**

Romania gives also data regarding commercial CPUE for 2009-2012 period and CPUE in at sea surveys for 2010, 2011, 2012 and 2013

Romanian CPUE in commercial fishing, 2009-2013 periods

YEAR	Fishing gear	CPUE
2009		
LOA 6-12 m	gillnets	0.24 kg/gear/day
LOA 18-24 m	gillnets	0.40 kg/gear/day
LOA 24-40 m	gillnets	0.89 kg/gear/day
2010		
LOA 6-12 m	gillnets	0.18 kg/gear/day
2011		
LOA 6-12 m	gillnets	0.248kg/gear/day
LOA 18-24 m	gillnets	0.91 kg/gear/day
2012		
LOA 6-12 m	gillnets	8.8 kg/gear/day
LOA 12-18 m	gillnets	8.5 kg/gear/day
18-24	gillnets	6.0 kg/gear/day
2013		
LOA 6-12 m	long lines	20.65 kg/gear/day /
LOA 24-40 m	pelagic trawl	123.45 kg/gear/day
LOA 24-40 m	gillnets	8.91 kg/gear/day

In Ukraine, for harvesting of piked dogfish in the Black Sea are used types of gears: gill nets (target fishery and by-catch), hook gears (target fishery), trawls (by-catch),. Information on their actual dislocations and the actually used amount of gear to get very difficult as it is officially reported missing. Piked dogfish is an object of both industrial, and small-scale (artisanal) gill nets fishery. A common classification of fisheries in the Black Sea fishing vessels imply its division into small-size vessels (bot, bajda, boat, yawl, etc.), small-tonnage vessels (SCHS, MRST, MRTK, PTR, RS, etc.) (Commercial fisheries description, 1988; Shlyakhov et al, 2006).

Small- size vessels, i.e. vessels without stationary engine or with a low-power engine, not part of Classification Association. They are used for operations of fixed and passive fishing gear. That is, they usually work in the narrow coastal zone, which is not available or not easily accessible for the other two categories of fishing vessels.

Small-tonnage vessels come in Classification Association. Small-tonnage vessels are multipurpose - they are used for the application of active fishing gear (trawl, purse seine) and passive fishing gear (gillnets, long-line). Some of the small-tonnage vessels were constructively not meant for fishing (e.g. VRD, PTS), but after the conversion were used.

Ukrainian piked dogfish landings by fishing gears in 2010-2012, tonnes

Year	Fishing gears			
	Turbot gillnets	Long-lines, hand-lines	Bottom gillnets for dogfish and skates	Trawls
2010	2.7	5.3	15.9	2.7
2011	3.1	6.1	18.3	3.1
2012	-	1.9	5.4	1.2

Table 3.1 -1: Description of operational units in the stocks of the Black Sea turbot

	Country	GSA	Fleet Segment	Fishing Gear Class	Group of Target Species	Species
Operational Unit 1	Ukraine	29	MULTIPURPUSE (small size boats)	Dogfish&Skates gillnets, Hand-lines	38	*Squalus acanthias*
Operational Unit 2	Ukraine	29	MULTIPURPUSE (small tonnage boats)	Dogfish&Skates gillnets, Long-lines	38	*S. acanthias*
Operational Unit 4	Ukraine	29	GILLNETTERS (small tonnage boats)	Dogfish&Skates gillnets	38	*S. acanthias*

Table 3.1-1: Catch, bycatch, discards and effort by operational unit in the reference year, Romania

Operational Units*	Fleet (n° of boats)*	Catch (T or kg of the species assessed)	Other species caught (names and weight)	Discards (species assessed)	Discards (other species caught)	Effort (units)
Trawlers	4	659		5300		47 fishing days
Gillneters	2	2074				9
Poundneters	22	35				1060
longlinners	1	413				6
Total		3181		5300		

3.2 Historical trends

Piked dogfish landings by countries (FAO Fisheries Statistics, GFCM Capture Production 2006 – 2008, BSC data, input from experts).

Year	Bulgaria	Georgia	Romania	Russian Federation	Turkey	Ukraine	TOTAL
1989	28	217.000	30	135.000	4558	1191.000	**6159.000**
1990	16	128.000	45	183.000	1059	1330.000	**2761.000**
1991	21	18.000	26	67.000	2017	775.000	**2924.000**
1992	15	14.000	52	15.000	2220	595.000	**2911.000**
1993	12	131.000	6	5.000	1055	409.000	**1618.000**
1994	12	45.000	2	11.000	2432	148.000	**2650.000**
1995	80	31.000	7	90.000	1562	67.000	**1837.000**
1996	64	71.000	5	19.000	1748	44.000	**1951.000**
1997	40	1.000	5	9.000	1510	20.000	**1585.000**
1998	28	550.000	5	6.000	855	38.000	**1482.000**
1999	25	18.000	5	9.000	1478	94.000	**1629.000**

2000	102	21.000	5	12.000	2390	71.000	**2601.000**
2001	126	27.000	5	27.000	576	134.000	**895.000**
2002	100	65.000	5	19.000	316	97.000	**602.000**
2003	51.3	40.000	5	29.000	184	172.000	**481.300**
2004	47.2	31.000	5	34.000	211	93.000	**421.200**
2005	14.5	35.000	5	19.000	102	75.000	**250.500**
2006	6.226	10.000	9	17.000	193	67.000	**302.226**
2007	23.98	2.000	17	32.000	91	45.000	**210.980**
2008	22.75	0.400	10	59.000	35	79.000	**206.150**
2009	9.46	1.500	4	14.000	159	47.000	**234.960**
2010	42	1.500	3	8.540	16	27.000	**98.040**
2011	38.06	1.500	4	3.610	26.5	30.537	**104.207**
2012	28.67	1.50	2.14	4.00	25.00	9.00	**70.310**
2013	30.95	1.5	8.681	4	25	13.241	**83.372**

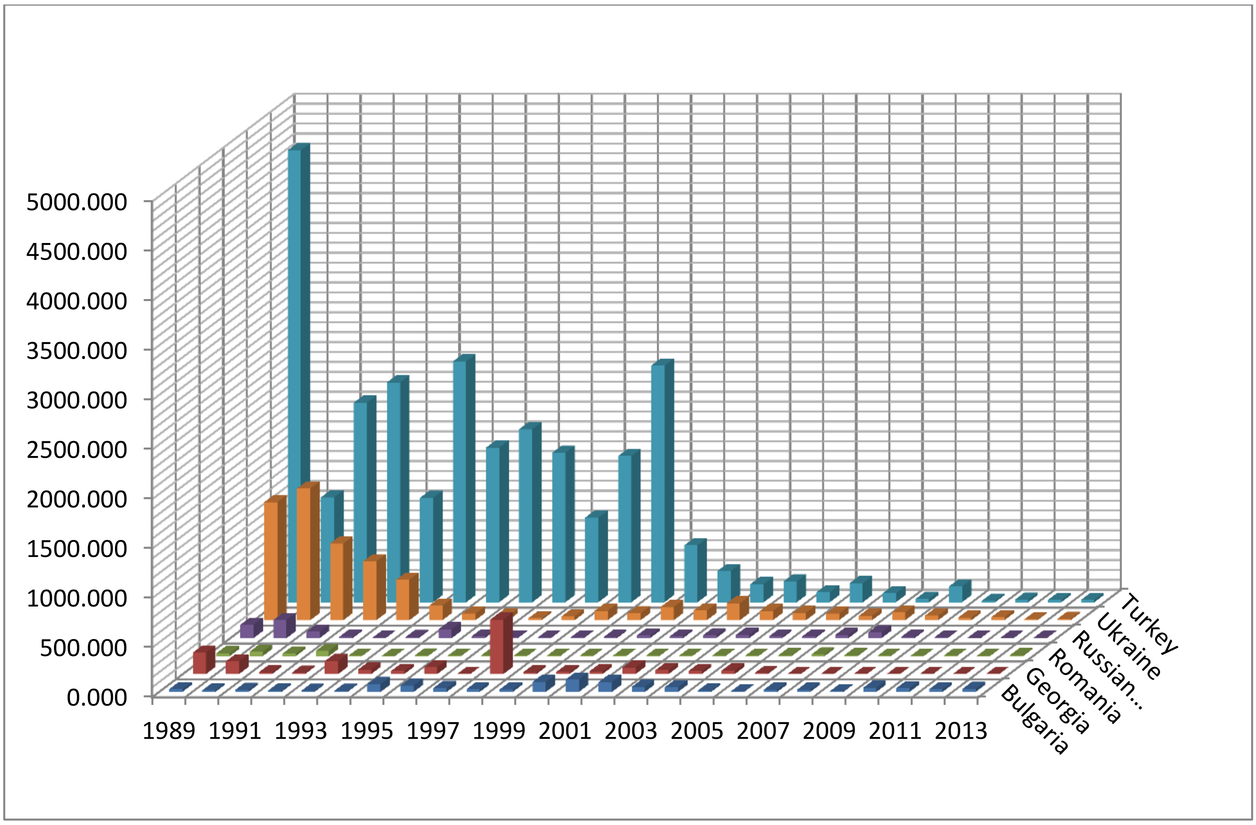


Fig: Spiny dogfish landings in the Black Sea area (t)

The number of fishing gears and Ukrainian total landing of piked dogfish, based on official statistics and fisherman's report (table 3.2.1) are hardly useful for stock assessment, because they are not based neither on the real catch, nor the real number of fishing gears used (Shlyakhov, 2013).

Fishing gears number and Ukrainian landings of piked dogfish in 1997-2012 (Shlyakhov, 2013)

Year	Fishing gears number and official landing		
	Bottom gillnets for dogfish and skates lines number	Long-lines, hand-lines*	Landing, tonnes
1997	31440	516	20,0
1998	4900	860	38,0
1999	8000	3055	94,0
2000	8000	1500	71,0
2001	7500	1792	134,0
2002	30000	1736	97,4
2003	45485	3675	172,2
2004	63000	2500	93,4
2005	65250	4818	74,5
2006	95050	4177	67,3
2007	95000	4000	45,3
2008	95000	4000	79,1
2009	95630	5350	46,5
2010	30000	4000	26,6
2011	25000	3000	30,5
2012	7800	3000	8,5

* - total number of hooks

3.3 Management regulations

Romanian fisheries regulatory framework includes between others the following laws:

- Law on Fishing Fund. Fishery and Aquaculture No. 23 /2008;
- Annual Order on the Fishing Prohibition;
- Order no. 342/2008 on minimal size of the aquatic living resources;
- Order nr. 449/2008 on technical characteristics and practice conditions for fishing gears used in the commercial fishing.

Regarding Spiny dogfish. for protecting the reproduction and rehabilitation of the stock were adopted the following measures (Radu G. and Nicolaev S.. 2010):

- in period April - June. 60 days. the fishing is prohibited;
- it is banned to use the trawl in marine zone under the 20 m depths;

- mesh size for dogfish gillnets: a = 100mm. 2a = 200 mm;
- minimum admissible length in catches is 120cm (TL)

Fishing effort

In compliance with Ukrainian legislation the use of natural resources is exercised within the limits of allowed volumes (Ukrainian Law “On Protection of Natural Environment”, No. 1264-XII of 1991, Art. 41). In particular, it refers also to aquatic biologic resources (Ukrainian Law “On Fish Industry, Commercial Fisheries and Fish Resources Protection”, No. 3677-VI of 2011). According to this law limits are established for all species (groups of species) of the living aquatic resources subjected to commercial fishing, except those, which stocks are formed by means of artificial reproduction (Art. 29).

The legislation of Ukraine provides the possibility of fishing effort regulation. Types, sizes and number of fishing vessels, fishing gears and their number can be regulated by the rules of commercial fishing (Art. 31).

Area and time restrictions

The following activities are forbidden by the rules of commercial fishing in the Black Sea in the course of all year: any fishing in the area of the sea in front of the mouth of the Danube River (from Starostambulsky arm to Belgorod canal inclusive and 10 kilometers into the sea) in the areas one kilometer wide on both sides of each arm, starting from the middle of fairway and 5 kilometers into the sea (“The Rules of Special Commercial Fishing in the Black Sea Basin”, par. 10.1).

During the spawning period prohibition of the fishing of turbot in 2013, the fishing of piked dogfish and ray and stingray with gillnets and long-lines is forbidden as well (“The Regime of Special Commercial Fishing in the Black Sea Basin in 2013”, par. 9).

Closing of certain areas for the fishing as a regulation measure is provided by the rules of commercial fishing (Ukrainian Law “On Fish Industry, Commercial Fisheries and Fish Resources Protection”, No. 3677-VI of 2011, Art. 31).

Ukrainian legislation provides the possibility of implementing restrictions on the economic activity in certain areas as nature conservation measure. The respective territories and natural objects are called the territories and the objects of nature conservation fund. Their creation and activity are regulated by Ukrainian Law “On Nature Conservation Fund of Ukraine (No. 2456-XII of 1992). It should be taken into account that the declaration of any area to be the territory of nature conservation fund does not always call forth fishing prohibition in respective area.

The Botanical Sanctuary “The Phyllophora Field of Zernov” is created in the Black Sea according to the decree of the President of Ukraine No. 1064 of 2008. It covers the marine area of 4025 km² bounded by the lines crossing the points with the following coordinates:

1) 45 ° 18'25'' north latitude and 30 ° 42'26'' east longitude;
2) 45 ° 54'42'' north latitude and 30 ° 55'05'' east longitude;
3) 46 ° 01'53'' north latitude and 31 ° 10'40'' east longitude;
4) 45 ° 31'05'' north latitude and 31 ° 42'56'' east longitude;
5) 45 ° 17'41'' north latitude and 31 ° 23'20'' east longitude.

The sanctuary is created for phyllophora protection and recovery of the flora and fauna of coastal waters of the Black Sea.

The other reserves are not entirely marine ones.

The most important are two reserves created mainly for the protection of waterfowl:

1. Danube Biosphere Reserve is created according to the decree of the President of Ukraine No. 861 of 1998. This reserve covers the two-kilometer marine coastal zone contiguous to the Ukrainian sector of the Danube delta; additional restrictions (to those prescribed by fishing rules) are not provided for exercising of fishing in this zone.

A reserve is created on the Romanian side of the Danube delta as well.

2. Black Sea Biosphere Reserve got its current legal status according to the decree of the President of Ukraine No. 563 of 1993, and this reserve exists since 1927 (Decree of the Council of People's Commissars of the USSR, № 172 of 1927). This reserve covers the water area and the small islands in Tendrivsky and Yahorlytsky Bays of the Black Sea.

In addition, the following reserves and natural parks covering small coastal marine areas are created on the coast of the Black Sea:

1) Karadag Nature Reserve (covers 809 hectares of the Black Sea water area);
2) Dzharylhatsky National Park (covers 2469 hectares of marine water area);
3) Sanctuary “Serpent Island” (covers 232 hectares of marine water area);
4) State landscape reserve "Cape Aya" (covers 208 hectares of marine water area);
5) Opuksky Nature Reserve (covers 62 hectares of marine water area);
6) Nature reserve "Cape Martian" (covers 20 hectares of marine water area).

Fishing is prohibited within the following protected areas:

- Karadag Nature Reserve;
- State landscape reserve "Cape Aya";
- Opuksky Nature Reserve;

- Nature reserve "Cape Martian".

The fishing may be restricted in addition to the restrictions prescribed by fishing rules within the Botanical Sanctuary “The Phyllophora Field of Zernov”, Black Sea Biosphere Reserve, Dzharylhatsky National Park and Sanctuary “Serpent Island”.

In the marine part of Danube Biosphere Reserve additional fishing restrictions are

currently absent (essential restrictions of fisheries in this area are provided by fishing rules).

Ukraine is a party to Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention). In compliance with this Convention Tendrivska, Karkinitska and Dzharylgatska Bays in the Black Sea are considered to be such areas (“The List of Wetlands of International Importance especially as Waterfowl Habitat”, approved by the Cabinet of Ministers of Ukraine Decree No. 935 of 1995).

These areas are subject to protection, and commercial fishing can be limited there; though additional restrictions (conditioned by the mentioned Convention) are currently absent.

Fishing Gears and Methods

Fishing gears allowed for the use in fishing activity, and their characteristics are defined by fishing rules; annually these rules can be specified (Ukrainian Law “On Fish Industry, Commercial Fisheries and Fish Resources Protection”, No. 3677-VI of 2011, Art. 31).

- gillnets - for the fishing of gobies, turbot, European flounder, piked dogfish and ray and stingray, so-iuy mullet, Black Sea shad;
- longlines - for the fishing of piked dogfish and ray and stingray
- gillnets for the fishing of piked dogfish – 100 (and not more than 120 in 2013 “The Regime of Special Commercial Fishing in the Black Sea Basin in 2013”, , par. 11);
- gillnets for the fishing of ray and stingray in 2013 – 180 (“The Regime of Special Commercial Fishing in the Black Sea Basin in 2013”, par.11).

The sizes of hooks: a gap is 26 mm with permissible deviation ±2 mm (“The Rules of Special Commercial Fishing in the Black Sea Basin”, par. 19).

It is prohibited (“The Rules of Special Commercial Fishing in the Black Sea Basin”, par. 16):

- to place set fishing gears in staggered order;
- to carry out trawling with a midwater trawl without netsounders, and with otter boards touching ground;
- to use the net inset between a bag and a wing (privod) with length more than a half of the length of respective wing in beach seines (the characteristic feature of a privod is that its size of half mesh is intermediate between size of half mesh in wings and size of half mesh in a bag);
- to use funnel-shaped entrances with rings in pound nets with size of half mesh less than 20 mm;

- to use double walled nets and trammel nets when executing directed fishing of Black Sea shad, turbot, piked dogfish, ray and stingray with gillnets.

All fishing methods with the use of fishing gears prohibited by fishing rules are not allowed.

In addition, it is prohibited to product, to sale, to use and to keep thrust fishing gears, electric fishing systems (electric fishing rods), explosives and monofilament gillnets (except those meant for commercial fishing) in the whole territory of Ukraine (Ukrainian Law “On Animal World”, No. 2894-III of 2001, Art. 521).

Since fishermen can use only the fishing gears allowed by fishing rules, they cannot start to use any other fishing gears on their own initiative. Currently the following order of implementing the new for the Black Sea basin fishing gears exists (it is not formalized legally). Scientific organizations on their own initiative or initiative of users for several years carry out scientific researches aimed at the assessment of suitability of the use of appropriate fishing gears (this assessment includes the assessment of influence of these fishing gears on environment). The execution of these researches is possible only after the discussion of their plans and their approval by the Scientific Fishing Council. If preliminary results of these researches are favorable, these researches are expanded for 1-2 years according the decision of the Scientific Fishing Council. If final results of these researches are favorable as well, the scientific organization carrying the researches prepares the Biological substantiation for the inclusion of the relevant type of fisheries in fishing rules. These substantiations are considered by the Scientific Fishing Council. In case of its approval of this substantiation the central executive body authorized to set the rules of fishing sets the appropriate norms of fishing rules.

The requirement that the rules of commercial fishing should be set on the basis of scientific substantiations is approved by Ukrainian Law “On Fish Industry, Commercial Fisheries and Fish Resources Protection” (No. 3677-VI of 2011, Art. 31).

Minimum sizes

Commercial fishing is forbidden, if by-catch of fish or other aquatic organisms smaller than established value exceeds the established norms. For these purposes, the following minimal sizes of fish or other aquatic organisms are established in the Black Sea (cm):

- piked dogfish 85

The length of fish body is measured from the top of a snout to the beginning of middle rays of a caudal fin. The size of a mussel is defined by a measurement of the maximal length of a shell; the size of a shrimp is measured from the centre of an eye to the end of a tail.

It is allowed to carry out undirected (un-target) fishing when the by-catch of individuals of non-fishing size does not exceed:

- with the fishing gears with size of half mesh 20 mm and more – 20% of a total catch amount;

- with the fishing gears with size of half mesh less than 20 mm: for Azov anchovy, whiting – 20%, for gobies, red mullet, horse mackerel, sprat – 8%, for other fish – 2% of a total catch mass.

It is allowed to carry out directed (target) fishing of objects when the number of by-catch of individuals of non-fishing size does not exceed:

- for piked dogfish – 15%.

In 2013 the by-catch of individuals of non-fishing size (except sturgeons) is allowed according to the norms established for undirected fishing when carrying out directed fishing ("The Regime of Special Commercial Fishing in the Black Sea Basin in 2013", par. 17).

If a by-catch of individuals of non-fishing size in a catch exceeds the established norms, the fishermen must release all the catch into the water and change the place of fishing by not less than:

- 2 miles – for trawls;
- 1 mile – for purse seines and ring nets, beach seines, gillnets, long-lines, dredges;

("The Rules of Special Commercial Fishing in the Black Sea Basin", par. 17 and 18).

When the by-catch of individuals of non-fishing size is heightened in any area, the fish protection authorities by consent with scientific organizations make decision on the prohibition of fishing or replacement of the fishing gears by other ones with bigger mesh in this area.

The prohibition of fishing in this area is established in case of heightened by-catch of individuals of non-fishing size, which is defined as average not less than:

- when fishing with trawls, purse seines, ring nets, cast nets, beach seines in the different areas of shore, dredges – after 5 hauls (trawlings);
- when fishing with beach seines in the same place, gillnets, long-lines, pound nets, stationary covered traps and fyke nets – as average of daily catches of not less than 4 gears in given area (if less than 4 gears are available, as average of their daily catches for not less than 4 hauls).

("The Rules of Special Commercial Fishing in the Black Sea Basin", par. 18).

By-catch

When carrying out directed (target) fishing of any objects, the by-catch of other objects should be less than 50%.

The following cases are exceptions:

- when fishing sprat and whiting with midwater trawls the by-catch of piked dogfish is allowed to 200 kg per trawling, and when the amount of by-catch is great, it should not exceed 50% of total catch;
- when fishing horse mackerel with lift nets, the amount of by-catch of piked dogfish is not regulated;

- the amount of by-catch of objects, for which the minimum size is not established, is not limited when carrying out directed fishing in the Black Sea in 2013 ("The Regime of Special Commercial Fishing in the Black Sea Basin in 2013", par. 8).

It is allowed to exercise fishing, if by-catch of sturgeon with body-length less than 110 cm and stellate sturgeon with body-length less than 110 cm does not exceed (by-catch of sturgeons should be released):

- when fishing with the fishing gears with size of half mesh 12 mm or more, except gillnets and trawls, - 4 specimens per 100 kg of catch;
- when fishing with the fishing gears with size of half mesh less than 12 mm, except gillnets and trawls, - 2 specimens per 100 kg of catch;
- when fishing with gillnets, - 2 specimens per 100 kg of catch;
- when fishing with trawls and long-lines, - 2 specimens per 1 ton of catch.

The fishing with long-lines is allowed having by-catch of sturgeon with body-length 110 cm or more and stellate sturgeon with body-length 100 cm or more – to 2 specimens per 1 ton of catch (by-catch of sturgeons should be released).

The state fish protection authorities should be informed of excess of allowed by-catch, and catch may be taken (exception for the living aquatic resources prohibited for fishing), than the place of fishing should be changed not less than by:

- 2 miles – for trawls;
- 1 mile – for purse seines and ring nets, beach seines, gillnets, long-lines, dredges.

("The Rules of Special Commercial Fishing in the Black Sea Basin", par. 14, 15 and 18).

In the case of heightened by-catch of the same objects during directed fishing of the other objects, the state fish protection authorities by the agreement with scientific organizations make decisions on fishing prohibition or replacement of the fishing gears by other ones with bigger mesh in this area.

The prohibition of fishing is established by the average amount of by-catch, determined after not less than:

- when fishing with trawls, purse seines, ring nets, cast nets, beach seines in the different areas of shore, dredges – after 5 hauls (trawlings);
- when fishing with beach seines in the same place, gillnets, long-lines, pound nets, stationary covered traps and fyke nets – as average of daily catches of not less than 4 gears in given area (if less than 4 gears are available, as average of their daily catches for not less than 4 hauls).

("The Rules of Special Commercial Fishing in the Black Sea Basin", par.15).

It is forbidden for fishermen to throw a catch or its part overboard, if these living aquatic resources are not prohibited for fishing.

("The Rules of Special Commercial Fishing in the Black Sea Basin", par. 9.9.8).

3.4 Reference points

Table 3.2-1: List of reference points and empirical reference values previously agreed (if any)

Indicator	Limit Reference point/empirical reference value	Value	Target Reference point/empirical reference value	Value	Comments
B					
SSB					
F	0.03			0.112	F_{MSY} = F ≤ 0.03, based on North East Atlantic dogfish.
Y					
CPUE					
Index of Biomass at sea					

The fishing mortality rate during 2013 is estimated to be F = 0.112, which is more than 3.5 times greater than the FMSY. Recent catches of this long-lived and relatively unproductive species are very low compared to the past and the stock appears to be severely depleted. The reported landings of piked dogfish have dropped steadily and dramatically since the start of the landings series, from more than 6 000 t in 1989 to only 83 t in 2013.

ICES estimates that F_{MSY} for piked dogfish in the North East Atlantic is equal to 0.029, expressed as the proportion of the total catches over the total biomass, which corresponds approximately to an F=0.03. Given (a) the uncertainty in the VIT and YPR-LEN analyses, linked to the assumption of constant recruitment, (b) the preliminary nature of the XSA analysis, and (c) the absence of more reliable information, the EWG 14-14 considers it precautionary to use the F_{MSY} value estimated by ICES for piked dogfish in the North East Atlantic as an appropriate proxy for FMSY for piked dogfish in the Black Sea.

4 Fisheries independent information

4.1 Trawl surveys

In 2013, only Romania presented data on demersal trawl surveys for dogfish. The scheduled survey has been realized in 2nd and 4th Quarter 2013.

4.1.1 Brief description of the direct method used

It was used the bottom trawl 22/27-34 with horizontal opening of 13m. The average speed of the vessel was of 2.4 knots in the spring survey and 2.5 knots in autumn survey, the trawling time was standardized at 60 minutes. Was realized 41 hauling in the Romanian area in 2nd Ouarter survey and 40 hauling in the 4th Quarter survey, being registered the following elements: geographical coordinates for trawling points, water depth (m), the average trawling speed (knots), time of trawling, total catch and structure on species. For every trawling operation was taken one random sample for small size species and for big species, like turbot and dog-fish, each specimens were registered and measured.

Having data regarding horizontal opening of the trawl, trawling speed and time have been calculated the surveyed area, catch per surveyed area, extrapolated catch per square Nm for each species and biomass.

Direct methods: trawl based abundance indices

Table 4.1-1: Trawl survey basic information

Survey	Demersal trawl surveys	**Trawler/RV**	RV Steaua de Mare
Sampling season	spring and autumn		
Sampling design	From Sulina (Northern part) to Vama Veche (Southern part)		
Sampler (gear used)	demersal trawl 22/27-3422/27-34		
Cod –end mesh size as opening in mm	2a=14mm		
Investigated depth range (m)	from 15 to 80m depth		

4.1.2 Spatial distribution of the resources

Assessment of dogfish agglomerations in the period May –June 2013, demersal trawl survey , Romanian area

Depth range (m)	0 - 30m	30 – 50m	50-70 m	70-100m	Total
Investigated area (Nm^2)	650	1225	1350	50	3300
Variation of the catches (t/ Nm^2)	0.325-2.264	0.00-4.272	0.00-6.878	0.013-0.019	0.00-6.878
Average catch (t/ Nm^2)	1.19033	0.530778	0.607833	0.015583	0.63622
Biomass of the fishing agglomerations (t)	773.7167	650.2028	820.575	1.16875	2099.53

Biomass extrapolated the Romanian shelf (t)		3181.119

Assessment of dogfish agglomerations in October 2013, demersal trawl survey, Romanian area

Depth range (m)	0 - 30m	30 – 50m	50-70 m	Total
Investigated area (Nm^2)	625	1075	450	2150
Variation of the catches (t/ Nm^2)	0.00-0.308	0.00-11.404	0.00-1.32	0.00-11.40
Average catch (t/ Nm^2)	0.060333	1.5042	0.386714	0.896522
Biomass of the fishing agglomerations (t)	37.70833	1617.015	174.0214	1927.522
Biomass extrapolated the Romanian shelf (t)				4482.609

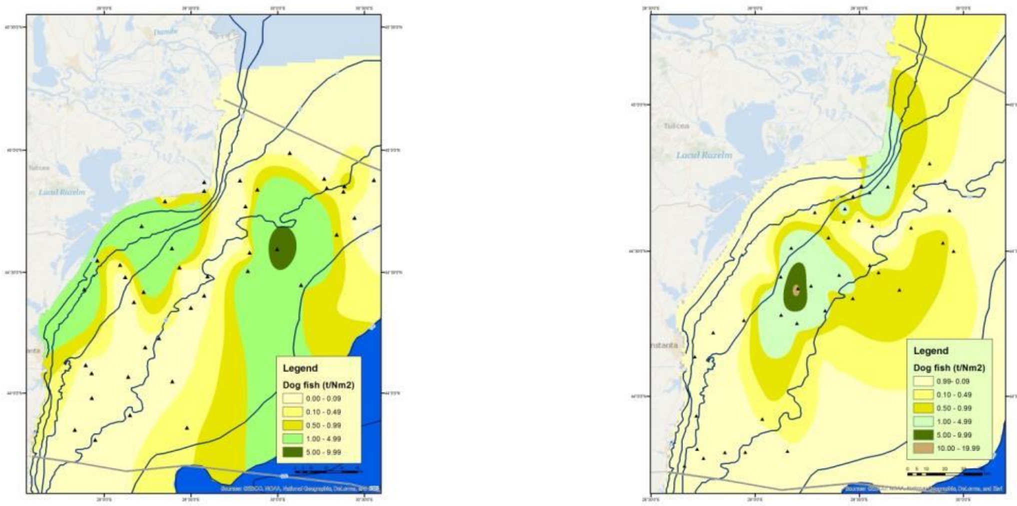


Fig: The distribution of the dogfish agglomerations in demersal trawl survey, in May and October 2013, Romanian area

4.1.3 Historical trends

Table CPUE in the at sea surveys for Romanian Black Sea areas

YEAR	2010		2011		2012		2013	
Period	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn
Range (kg/hour)	3.6 – 98.63	4.5 – 106.22	5.8 – 24.9	5.0 - 24.83	1.1-19.2	1.5-134	5.5-115.8	0.95-200

Table Indices of abundance at length of the piked dogfish over the Romanian littoral

Year	Biomass (t)		Indice of abundance in number of individuals per length classes									
			2009		2010		2011		2012		2013	
2008	883											
2009	2509											
2010	13051											
2011	1690											
2012	1436											
2013	4483											
Year	**Abundance (No.ind.)**	**class (cm)**	**%**	**Abundance (thousands)**	**%**	**Abundance (thousands)**	**%**	**Abundance (thousands)**	**%**	**Abundance (thousands)**	**%**	**Abundance (thousands)**
2008	126068	35.5									0.78	127.846
2009	393840	38.5									1.57	200.901
2010	1748855	41.5									0.00	0
2011	266064	44.5									1.57	132.358
2012	226651	47.5									0.00	0
2013	1283342	50.5									0.00	0
		53.5									1.57	68.600
		56.5									0.00	0
		59.5									1.57	46.260
		62.5									0.00	0
		65.5									0.00	0
		68.5									0.00	0
		71.5									0.00	0
		74.5									0.00	0
		77.5									0.00	0
		80.5									0.00	0
		83.5									0.00	0

		86.5									0.00	0
		89.5			1.00	17.621					0.00	0
		92.5			0.00	0					0.00	0
		95.5			2.00	35.241					0.00	0
		98.5			2.99	52.862					0.00	0
		101.5			0.00	0	6.78	18.038	0.93	2.955	0.39	4.185
		104.5	1.93	7.601	0.50	8.810	8.48	22.548	0.0	0.0	1.57	15.801
		107.5	8.21	32.334	7.98	140.966	16.95	45.096	2.78	7.540	6.27	56.592
		110.5	14.98	58.997	16.46	290.742	28.81	76.663	10.19	26.583	10.20	86.733
		113.5	19.81	78.020	23.44	414.087	25.42	67.643	34.26	80.033	26.67	209.946
		116.5	27.05	106.534	17.71	312.768	8.48	22.548	27.78	61.020	20.78	155.348
		119.5	16.43	64.708	9.73	171.802	3.39	9.019	8.33	17.464	16.47	116.092
		122.5	7.24	28.514	4.49	79.293	0.00	0	14.81	29.453	8.24	52.704
		125.5	1.93	7.601	2.99	52.862	1.70	4.510	0.93	1.602	0.39	2.388
		128.5	0	0	8.73	154.181					0.00	0
		131.5	1.45	5.711	2.00	35.241					0.39	1.870
		134.5									0.39	1.749
		137.5	0.97	3.820							0.00	0
		140.5									0.39	1.450
		143.5									0.00	0
		146.5									0.78	2515
		Total	**100.0**	**393.840**	**100.0**	**1748.855**	**100.0**	**266.064**	**100.0**	**226651**	**100**	1283.342

Table The biomass at length of the piked dogfish over the Romanian littoral.

BIOMASS (t)										
	2009		2010		2011		2012		2013	
class (cm)	%	Biomass (t)	%	Biomass (t)	%	Biomass (t)	%	Biomass (t)	%	Biomass (t)
35.5									0.78	35.158
38.5									1.57	70.315
41.5									0.00	0
44.5									1.57	70.315
47.5									0.00	0
50.5									0.00	0
53.5									1.57	70.315
56.5									0.00	0
59.5									1.57	70.315
62.5									0.00	0
65.5									0.00	0
68.5									0.00	0
71.5									0.00	0
74.5									0.00	0
77.5									0.00	0
80.5									0.00	0
83.5									0.00	0
86.5									0.00	0
89.5			0.41	52.86					0.00	0
92.5			0.00	0.00					0.00	0
95.5			0.91	118.50					0.00	0
98.5			1.54	201.36					0.00	0

101.5			0.00	0.00	6.48	109.833851	0.93	13.296296	0.39	17.579
104.5	1.27	31.86	0.30	38.59	7.65	129.816526	0.0	0.0	1.57	70.315
107.5	6.74	169.08	5.32	693.93	15.37	260.719579	2.78	39.888889	6.27	281.262
110.5	13.80	346.17	12.82	1673.05	28.31	480.198320	10.19	146.259259	10.20	457.050
113.5	19.07	478.47	19.98	2607.85	26.83	454.971965	34.26	491.962963	26.67	1195.362
116.5	27.13	680.81	16.97	2214.86	9.27	157.145078	27.78	398.888889	20.78	931.680
119.5	17.27	433.30	10.52	1372.70	4.00	67.884406	8.33	119.666667	16.47	738.312
122.5	8.43	211.57	6.18	806.90	0.00	0.000000	14.81	212.740741	8.24	369.156
125.5	2.28	57.19	5.02	655.49	2.09	35.430275	0.93	13.296296	0.39	17.579
128.5	0.00	0.00	15.99	2087.18					0.00	0
131.5	1.90	47.57	4.04	527.74					0.39	17.579
134.5	0.00	0.00	0.00	0.00					0.39	17.579
137.5	2.11	52.94	0.00	0.00					0.00	0
140.5									0.39	17.579
143.5									0.00	0
146.5									0.78	35.158
Total	**100**	**2508.97**	**100**	**13051.0**	**100**	**1690.000**	**100**	**1436.000**	**100**	**4482.609**

Results for estimated piked dogfish biomasses in May and November of 2009- 2013 in Romanian waters

Species	2009	2010	2011	2012	2013
Piked dogfish	967-2,541	5,635-13,051	1,173-1,619	1,436-1,159	3,181-4,482

The calculated biomasses in the Romanian littoral zone ranged between 967 t and13,051t.

5 Ecological information

5.1 Protected species potentially affected by the fisheries

Fish

Acipenser gueldenstaedtii
Acipenser stellatus
Huso huso

Cetaceans

Tursiops truncatus
Delphinus delphis
Phocoena phocoena

5.2 Environmental indices

Drastic reduction of the stock of shark is mainly due to three factors:

- Overfishing of the species;
- Overfishing of the food resources of this species;
- pollution, the causes of reduction of piked dogfish stock should also be related to the changes in the Black Sea ecosystem due to pollution and subsequent progressive deterioration of reproductive ability of females (Shlyakhov and Charova, 2003).

6 Stock Assessment

EWG14-14 used for 2013 two methods, VIT4Win like in previous years and for the first time, XSA

6.1.1 Model assumptions

VIT program has been used for estimation of abundance and fishing mortality and YPR-LEN (NOAA Fisheries Toolbox Version 3.1) for obtaining the reference points for dogfish in the Black Sea. The program VIT is conceived for the analysis of fisheries where the available information is limited. VIT is designed for the analysis of marine populations, exploited by one or several gears, based on single species' catch data (structured by age or size). The main assumption underlying the model is that of steady state, because the program works with pseudo-cohorts and it is therefore not suitable for historical data series.

To compare results, have been used also XSA. For the sake of consistency, the piked dogfish stock was first assessed quantitatively by XSA. The model was tuned with the CPUE at age derived from the Romanian scientific demersal surveys realized in the last three years (2011-2013).

6.1.2 Scripts

6.1.3 Input data and Parameters

For VIT and YPR-LEN have been used :
Linf =156 cm; k = 0.134; to = -0.9304; a = 0.061086; b= 2.41368
Ft =0.5 and Ft =0.15;
Number of classes = 9;
Lower limit of first class = 11;
Class interval = 1;
Fecundity = 1;
M= 0.15;

In the calculation we used two variants, the average catch of the past 25 years (1989-2013) and catch value from 2013. Also, have been compared results with two values for Ft, o.5 and 0.15.

Results will be presented in the following.
For reference points, using YPR-LEN have been used the following parameters:
Length at start = 95 cm;
Maximum relative age = 19 cm;
Age step size = 1;
Linf =156 cm; k = 0.134; to = -0.9304; a = 0.061086; b= 2.41368
Maturity: Alpha = 106; Beta = 0.5
Linf =156 cm; k = 0.134; to = -0.9304; a = 0.061086; b= 2.41368
Ft =0.5 and Ft =0.15;
Number of classes = 9;
Lower limit of first class = 11;
Class interval = 1;
Fecundity = 1;
M= 0.15;

In the calculation we used two variants, the average catch of the past 25 years (1989-2013) and catch value from 2013. Also, have been compared results with two values for Ft, o.5 and 0.15.
Results will be presented in the following.
For reference points, using YPR-LEN have been used the following parameters:
Length at start = 95 cm;
Maximum relative age = 19 cm;
Age step size = 1;
Linf =156 cm; k = 0.134; to = -0.9304; a = 0.061086; b= 2.41368
Maturity: Alpha = 106; Beta = 0.5

For XSA, have been used the following input parameters:
Tuning BLACK SEA SPURDOG, 2013, COMBSEX

101

Commercial CPUE Romania

2009 2013

1   1   0.75   0.83

10   19

1	0.01	0.01	7.60	32.33	137.02	171.24	28.51	7.60	5.71	3.82
1	17.62	88.10	8.81	140.97	704.83	484.57	79.29	207.04	35.24	0.01
1	0.01	0.01	40.59	45.10	144.31	31.57	0.01	4.51	0.01	0.01
1	0.01	0.01	2.96	7.54	106.62	78.48	29.45	1.60	0.01	0.01
1	0.01	0.01	19.99	56.59	296.68	271.44	52.70	2.39	3.62	3.97

BLACK SEA Piked Dogfish, 2013,COMBSEX,PLUSGROUP,CATCH NOS

1 2

1989 2013

7 19

1

5.77	24.32	26.85	73.69	101.44	89.64	121.37	101.13	107.77	139.63	80.70	30.45	7.75
2.55	10.76	11.88	32.61	44.89	40.06	54.22	47.42	49.68	62.01	35.81	13.48	3.43
2.72	11.47	12.66	34.75	47.84	42.49	57.52	49.17	51.92	65.96	38.11	14.36	3.65
2.69	11.34	12.51	34.35	47.29	42.22	57.15	50.16	52.48	65.33	37.72	14.19	3.61
1.51	6.38	7.04	19.33	26.60	23.54	31.87	26.73	28.42	36.63	21.17	7.99	2.03
2.49	10.51	11.60	31.84	43.83	38.61	52.28	42.86	45.94	60.26	34.84	13.16	3.35
1.65	6.98	7.70	21.14	29.10	26.48	35.82	34.32	34.87	40.47	23.33	8.73	2.22
1.78	7.50	8.28	22.73	31.29	28.21	38.17	35.05	36.12	43.38	25.03	9.39	2.39
1.46	6.14	6.78	18.60	25.61	22.96	31.07	27.82	28.91	35.43	20.45	7.69	1.96
1.37	5.78	6.38	17.50	24.09	21.50	29.10	25.47	26.68	33.28	19.22	7.23	1.84
1.51	6.38	7.04	19.31	26.59	23.66	32.02	27.62	29.08	36.68	21.19	7.98	2.03
2.36	9.94	10.97	30.13	41.47	37.56	50.81	47.63	48.74	57.58	33.21	12.45	3.17
0.72	3.05	3.36	9.23	12.70	12.58	16.97	22.00	20.46	18.23	10.44	3.81	0.97
0.67	4.02	10.36	17.13	21.48	22.44	19.79	12.44	4.27	1.32	0.27	0.01	0.01
0.01	0.01	0.01	0.24	0.54	4.66	11.05	12.18	12.96	5.61	6.99	4.96	0.54
0.71	2.12	2.20	0.46	0.01	0.01	0.12	0.79	3.16	5.57	8.72	11.76	5.94
1.03	3.11	1.03	0.01	0.01	0.01	1.03	4.14	9.30	8.28	3.14	1.03	0.01
0.01	2.41	2.48	4.89	19.56	14.67	12.19	2.48	0.01	2.41	2.41	0.01	0.01
0.01	0.01	0.73	1.46	1.46	2.92	5.84	5.11	2.92	5.11	2.19	1.46	0.01
0.01	0.01	0.01	0.01	0.01	0.96	2.92	1.94	2.92	5.82	4.84	1.94	0.96
0.01	0.01	2.60	13.83	10.06	5.89	5.59	5.25	2.89	2.01	0.93	0.01	0.01
0.09	0.39	0.43	1.18	1.63	1.43	1.94	1.56	1.68	2.24	1.29	0.49	0.12
0.10	0.42	0.46	1.26	1.73	1.52	2.06	1.65	1.79	2.38	1.38	0.52	0.13

0.04	0.16	0.17	0.48	0.66	0.62	0.91	2.77	2.42	1.62	0.57	0.20	0.05
0.01	0.01	0.01	0.01	0.53	1.07	1.60	2.14	2.67	1.07	0.53	0.53	0.53

BLACK SEA Piked Dogfish, 2013,COMBSEX,PLUSGROUP,CATCH WEIGHT

1 3

1989 2013

7 19

1

1.48	1.90	2.40	3.00	3.73	4.58	5.72	7.01	8.28	9.77	11.01	12.33	13.71
1.48	1.90	2.40	3.00	3.73	4.59	5.72	6.94	8.21	9.76	11.00	12.33	13.71
1.48	1.90	2.40	3.00	3.73	4.58	5.72	6.97	8.24	9.77	11.01	12.33	13.71
1.48	1.90	2.40	3.00	3.73	4.59	5.72	6.94	8.20	9.76	11.00	12.33	13.71
1.48	1.90	2.40	3.00	3.73	4.58	5.72	7.00	8.27	9.77	11.01	12.33	13.71
1.48	1.90	2.40	3.00	3.73	4.57	5.72	7.03	8.31	9.78	11.02	12.33	13.71
1.48	1.90	2.40	3.00	3.73	4.60	5.72	6.82	8.07	9.74	10.99	12.33	13.71
1.48	1.90	2.40	3.00	3.73	4.59	5.72	6.88	8.13	9.75	10.99	12.33	13.71
1.48	1.90	2.40	3.00	3.73	4.59	5.72	6.91	8.17	9.76	11.00	12.33	13.71
1.48	1.90	2.40	3.00	3.73	4.59	5.72	6.94	8.21	9.76	11.00	12.33	13.71
1.48	1.90	2.40	3.00	3.73	4.58	5.72	6.96	8.23	9.76	11.01	12.33	13.71
1.48	1.90	2.40	3.00	3.73	4.60	5.72	6.85	8.10	9.75	10.99	12.33	13.71
1.48	1.90	2.40	3.00	3.73	4.67	5.71	6.51	7.64	9.64	10.90	12.33	13.71
1.71	2.20	2.77	3.47	4.32	5.28	6.61	8.16	9.64	11.31	12.74	11.95	13.29
1.60	2.05	2.59	2.82	3.50	4.29	5.37	6.63	7.83	9.18	10.35	11.58	12.87
1.48	1.90	2.40	3.00	3.62	4.43	5.72	7.06	8.34	9.78	11.02	12.33	13.71
1.48	1.90	2.40	3.00	3.73	4.56	5.71	7.05	8.33	9.77	11.01	12.32	13.70
1.41	1.90	2.40	3.00	3.73	4.56	5.71	7.05	8.33	9.77	11.01	12.32	13.70
1.35	1.77	2.40	3.00	3.73	4.57	5.72	7.06	8.34	9.78	11.02	12.33	13.70
1.35	1.65	2.40	3.00	3.73	4.57	5.71	7.05	8.33	9.77	11.01	12.32	13.70

1.35	1.65	2.40	3.00	3.73	4.56	5.71	7.05	8.33	9.77	11.01	10.76	11.95
1.35	1.65	2.01	2.45	2.98	3.59	4.42	5.39	6.32	7.36	8.26	9.21	10.21
1.48	1.90	2.40	3.00	3.73	4.57	5.72	7.06	8.34	9.78	11.02	12.33	13.71
1.48	1.90	2.40	3.00	1.89	6.92	4.63	7.65	7.74	6.85	10.30	18.92	13.75
1.48	1.90	2.40	3.00	4.00	4.60	5.80	7.00	8.00	10.00	11.00	12.50	13.80

BLACK SEA Piked Dogfish, 2013,COMBSEX,PLUSGROUP,LANDINGS

1 1

1989 2013

7 19

5

6159

2761

2924

2911

1618

2650

1837

1951

1585

1482

1629

2601

895

602

452

421

251

302

211

206

235

75

104

70

83

BLACK SEA Piked Dogfish, 2013,COMBSEX,PLUSGROUP,MAT.PROPORTION

1 6

1989 2013

7 19

1

0.5	0.5	0.625	0.625	0.725	0.775	0.875	0.975	1	1	1	1	1
0.5	0.5	0.625	0.625	0.725	0.775	0.875	0.975	1	1	1	1	1
0.5	0.5	0.625	0.625	0.725	0.775	0.875	0.975	1	1	1	1	1
0.5	0.5	0.625	0.625	0.725	0.775	0.875	0.975	1	1	1	1	1
0.5	0.5	0.625	0.625	0.725	0.775	0.875	0.975	1	1	1	1	1
0.5	0.5	0.625	0.625	0.725	0.775	0.875	0.975	1	1	1	1	1
0.5	0.5	0.625	0.625	0.725	0.775	0.875	0.975	1	1	1	1	1
0.5	0.5	0.625	0.625	0.725	0.775	0.875	0.975	1	1	1	1	1
0.5	0.5	0.625	0.625	0.725	0.775	0.875	0.975	1	1	1	1	1
0.5	0.5	0.625	0.625	0.725	0.775	0.875	0.975	1	1	1	1	1
0.5	0.5	0.625	0.625	0.725	0.775	0.875	0.975	1	1	1	1	1
0.5	0.5	0.625	0.625	0.725	0.775	0.875	0.975	1	1	1	1	1
0.5	0.5	0.625	0.625	0.725	0.775	0.875	0.975	1	1	1	1	1
0.5	0.5	0.625	0.625	0.725	0.775	0.875	0.975	1	1	1	1	1
0.5	0.5	0.625	0.625	0.725	0.775	0.875	0.975	1	1	1	1	1
0.5	0.5	0.625	0.625	0.725	0.775	0.875	0.975	1	1	1	1	1

0.5	0.5	0.625	0.625	0.725	0.775	0.875	0.975	1	1	1	1	1
0.5	0.5	0.625	0.625	0.725	0.775	0.875	0.975	1	1	1	1	1
0.5	0.5	0.625	0.625	0.725	0.775	0.875	0.975	1	1	1	1	1
0.5	0.5	0.625	0.625	0.725	0.775	0.875	0.975	1	1	1	1	1
0.5	0.5	0.625	0.625	0.725	0.775	0.875	0.975	1	1	1	1	1
0.5	0.5	0.625	0.625	0.725	0.775	0.875	0.975	1	1	1	1	1
0.5	0.5	0.625	0.625	0.725	0.775	0.875	0.975	1	1	1	1	1
0.5	0.5	0.625	0.625	0.725	0.775	0.875	0.975	1	1	1	1	1
0.5	0.5	0.625	0.625	0.725	0.775	0.875	0.975	1	1	1	1	1

BLACK SEA Piked Dogfish, 2013,COMBSEX,PLUSGROUP,NAT. MORTALITY

1 5

1989 2013

7 19

1

0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15

0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15

BLACK SEA Dogfish,2013,COMBSEX,PLUSGROUP,STOCK WEIGHT

1 4

1989 2013

7 19

1

1.48	1.90	2.40	3.00	3.73	4.58	5.72	7.01	8.28	9.77	11.01	12.33	13.71
1.48	1.90	2.40	3.00	3.73	4.59	5.72	6.94	8.21	9.76	11.00	12.33	13.71
1.48	1.90	2.40	3.00	3.73	4.58	5.72	6.97	8.24	9.77	11.01	12.33	13.71
1.48	1.90	2.40	3.00	3.73	4.59	5.72	6.94	8.20	9.76	11.00	12.33	13.71
1.48	1.90	2.40	3.00	3.73	4.58	5.72	7.00	8.27	9.77	11.01	12.33	13.71
1.48	1.90	2.40	3.00	3.73	4.57	5.72	7.03	8.31	9.78	11.02	12.33	13.71
1.48	1.90	2.40	3.00	3.73	4.60	5.72	6.82	8.07	9.74	10.99	12.33	13.71
1.48	1.90	2.40	3.00	3.73	4.59	5.72	6.88	8.13	9.75	10.99	12.33	13.71
1.48	1.90	2.40	3.00	3.73	4.59	5.72	6.91	8.17	9.76	11.00	12.33	13.71

1.48	1.90	2.40	3.00	3.73	4.59	5.72	6.94	8.21	9.76	11.00	12.33	13.71
1.48	1.90	2.40	3.00	3.73	4.58	5.72	6.96	8.23	9.76	11.01	12.33	13.71
1.48	1.90	2.40	3.00	3.73	4.60	5.72	6.85	8.10	9.75	10.99	12.33	13.71
1.48	1.90	2.40	3.00	3.73	4.67	5.71	6.51	7.64	9.64	10.90	12.33	13.71
1.71	2.20	2.77	3.47	4.32	5.28	6.61	8.16	9.64	11.31	12.74	11.95	13.29
1.60	2.05	2.59	2.82	3.50	4.29	5.37	6.63	7.83	9.18	10.35	11.58	12.87
1.48	1.90	2.40	3.00	3.62	4.43	5.72	7.06	8.34	9.78	11.02	12.33	13.71
1.48	1.90	2.40	3.00	3.73	4.56	5.71	7.05	8.33	9.77	11.01	12.32	13.70
1.41	1.90	2.40	3.00	3.73	4.56	5.71	7.05	8.33	9.77	11.01	12.32	13.70
1.35	1.77	2.40	3.00	3.73	4.57	5.72	7.06	8.34	9.78	11.02	12.33	13.70
1.35	1.65	2.40	3.00	3.73	4.57	5.71	7.05	8.33	9.77	11.01	12.32	13.70
1.35	1.65	2.40	3.00	3.73	4.56	5.71	7.05	8.33	9.77	11.01	10.76	11.95
1.35	1.65	2.01	2.45	2.98	3.59	4.42	5.39	6.32	7.36	8.26	9.21	10.21
1.48	1.90	2.40	3.00	3.73	4.57	5.72	7.06	8.34	9.78	11.02	12.33	13.71
1.48	1.90	2.40	3.00	1.89	6.92	4.63	7.65	7.74	6.85	10.30	18.92	13.75
1.48	1.90	2.40	3.00	4.00	4.60	5.80	7.00	8.00	10.00	11.00	12.50	13.80

6.1.4 Results

The VIT software was applied to assess population parameters based on pseudocohort analyses for the 1989-2013 data. In analyse have been used three groups of years: 1989, 1990, 1991; 2001, 2002, 2003 and 2010, 2011, 2012 and 2013. For these years were run two scenarios using Fterminal = 0.5 and Fterminal = 0.15. The two scenarios were run with M=0.15, and, M = 0.2.

For Fterminal = 0.5, the results are the following:

Table – Total F obtained using Fterminal =0.5

Year	Total F	Bg	Ge	Ro	Ru	Tk	Uk
1989	0.277	0	0.001	0	0	0.259	0.018
1990	0.277	0	0.002	0	0.003	0.106	0.167
1991	0.277	0	0	0	0	0.241	0.036
2001	0.282	0.008	0.001	0	0.001	0.258	0.014
2002	0.347	0.028	0.012	0	0.001	0.279	0.026
2003	0.370	0.014	0.009	0	0.005	0.183	0.16

2010	0.278	0.173	0	0.001	0.007	0.025	0.072
2011	0.277	0.129	0	0.001	0.001	0.063	0.083
2012	0.344	0.117	0.001	0.001	0.005	0.195	0.025
2013	0.231	0.119	0	0.009	0.002	0.078	0.022

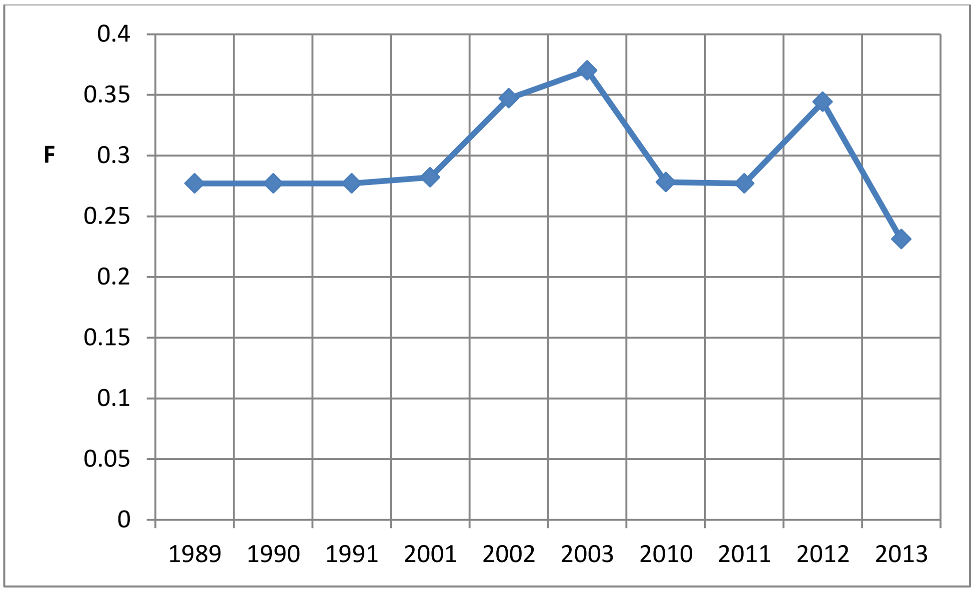


Fig. Total F in the case of using the Fterminal = 0.5

Table - The biomasses obtained using Fterminal =0.5

	1989	1990	1991	2001	2002	2003	2010	2011	2012	2013
Mean biomass (kg)	6304800095.48	1857414441.97	2786875948.00	712688989.40	383858170.00	151897288.60	50473168.00	52200571.00	42477497	17257926.5
SSB (kg)	6304800095.48	1857414441.97	2786875948.00	712688989.40	322328546.70	151897288.60	50473168.00	52200571.00	42477497	17257926.5
Recruitment biomass (kg)	953922314.34	281026915.60	421657303.50	107805121.30	32524541.38	33812017.94	7637430.00	7898374.00	6296022	4337220.71
Growth biomass (kg)	550529775.96	162192667.19	243350126.30	62355718.60	56642985.09	8674145.15	4407944.00	4558087.00	3750589	756331.77
Natural death biomas (kg)	945720014.32	278612166.30	418031392.20	106903348.40	51844261.05	22784593.29	7570975.00	7830086.00	6371625	2588688.97

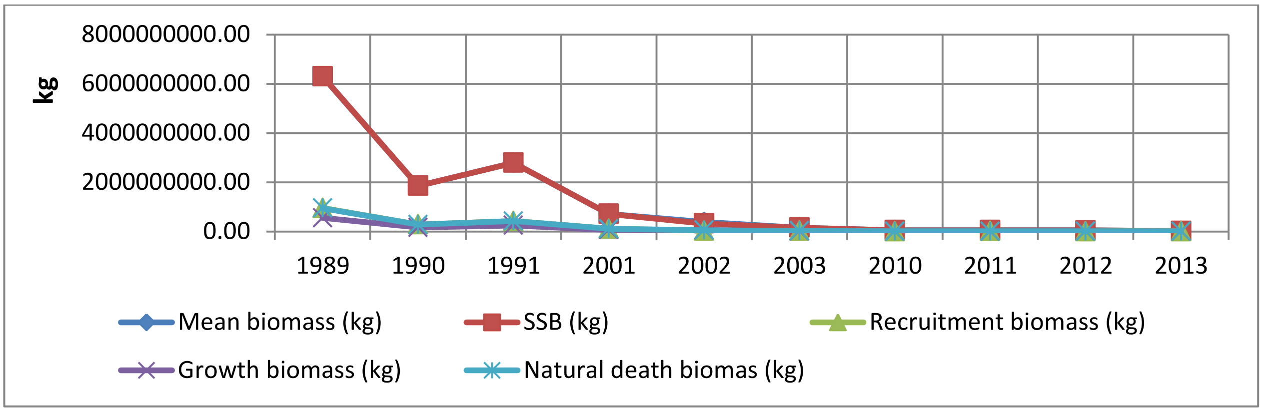


Fig. The biomasses obtained using Fterminal = 0.5

Table Total F obtained using Fterminal = 0.15

	Total F	Bg	Ge	Ro	Ru	Tk	Uk
2001	0.180	0.007	0	0	0	0.164	0.009
2002	0.249	0.02	0.008	0	0.001	0.201	0.019
2003	0.238	0.009	0.006	0	0.003	0.118	0.103
2010	0.177	0.11	0	0.001	0.005	0.016	0.046
2011	0.176	0.082	0	0.001	0.001	0.04	0.053
2012	0.239	0.103	0	0.001	0.003	0.117	0.015
2013	0.112	0.058	0	0.005	0.001	0.038	0.011

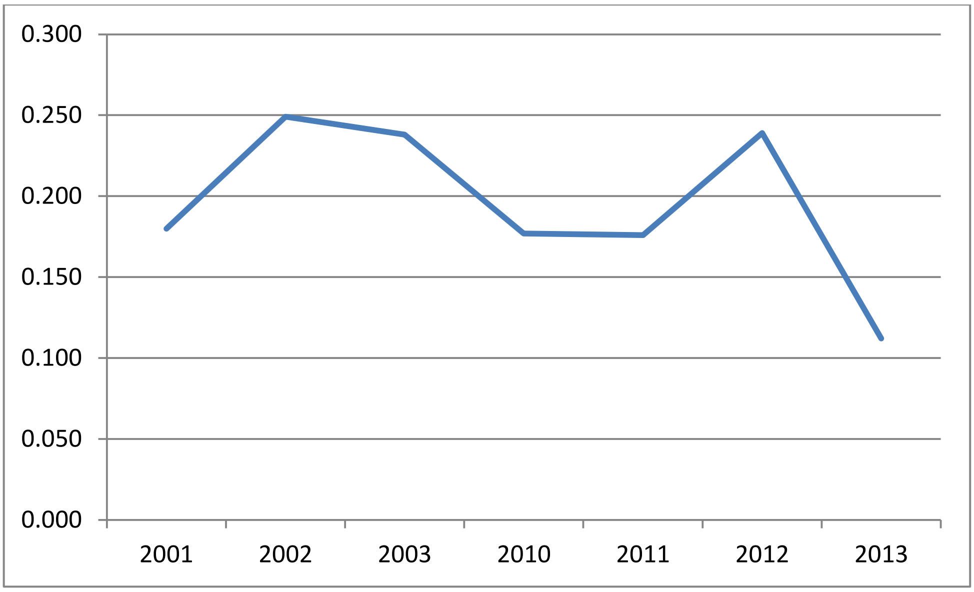


Fig. Total F in the case of using the Fterminal = 0.15

Table- The biomasses obtained using Fterminal =0.15

	2001	2002	2003	2010	2011	2012	2013
Mean biomass (kg)	789668568	397286126.1	168847423.2	56201852	58172429	44522958	27278589
SSB (kg)	789668568	397286126.1	168847423.2	56201852	58172429	44522958	27278589
Recruitment biomass (kg)	116340957	33323505.33	36393208.91	8272674	8560596	6522407	5998871
Growth biomass (kg)	65391347.1	57731304.41	8643811.89	4633754	4793457	3832396	608806
Natural death biomas (kg)	118450285	53717561.99	25327113.48	8430278	8725864	6678444	4091788

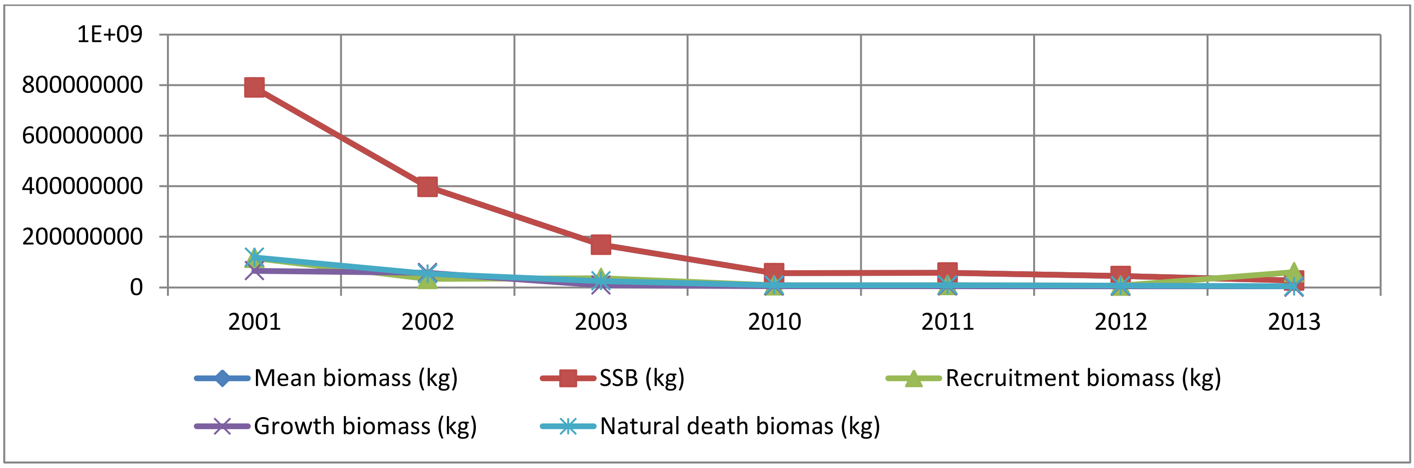


Fig. The biomasses obtained using Fterminal = 0.15

Comparing the obtained results in a period of 25 years the stock biomass has decreased dramatically. Only in the last 15 years the biomass decreased about 20 times.

The XSA assessment was conducted in an exploratory fashion, with tuning provided by the Romanian scientific demersal surveys conducted during 2011 to 2013. The results indicated a steady and major reduction in the spawning stock biomass since 1989. The estimates of current rates of fishing mortality are high (~0.3) and estimates of F for past years were erratic, exceeding 0.7 four times during 1999 to 2009 (STECF EWG 14-14).

<u>Results of XSA for Piked dogfish</u>

Year ssb fbar rec catch landings
1989 21327.5 0.403137 888.4916 6159.066 6159
1990 16900.89 0.220227 838.2069 2761.342 2761
1991 15790.01 0.250921 757.7806 2924.171 2924
1992 14337.04 0.281868 672.4678 2911.124 2911
1993 12852.6 0.167502 658.0868 1618.019 1618
1994 12425.23 0.293459 448.0273 2650.528 2650
1995 10720.23 0.227698 356.8775 1836.96 1837
1996 9810.904 0.261933 335.432 1950.854 1951
1997 8636.504 0.235532 247.0885 1585.398 1585
1998 7655.869 0.243234 151.8017 1482.224 1482

1999 6639.956 0.307669 108.0694 1628.968 1629
2000 5446.358 0.805687 273.7462 2601.601 2601
2001 3054.804 0.919883 91.54777 894.9765 895
2002 2921.907 0.280892 95.72033 601.5113 602
2003 2177.697 0.283799 55.57748 452.4222 452
2004 2028.456 0.360405 52.37006 421.4447 421
2005 1480.491 0.687951 65.97022 250.8492 251
2006 1449.457 0.274379 82.64084 302.5813 302
2007 1363.506 0.262536 43.85416 211.036 211
2008 1270.912 0.77065 63.19147 206.3849 206
2009 1171.017 0.374735 70.48022 235.2514 235
2010 847.8346 0.200707 67.3138 74.9921 75
2011 1188.978 0.368972 59.26857 104.268 104
2012 692.9493 0.302269 60.90922 77.8236 70
2013 755.7072 0.269752 66.35939 83.2188 83

6.1.5 Robustness analysis

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

6.1.7 Assessment quality

The lack of a fishery independent scientific survey to monitor dogfish all over the Black Sea to indicate trends in total mortality and recruitment appears the major data deficiency in the assessment.

Also age reading of dogfish needs to be calibrated between different national laboratories to avoid discrepancy between national catch-at-data.

It is very important the improvement of catch statistics regarding Squalus acanthias in the Black Sea area.

Catch information is vital for the successful management of this species. Also, the joint surveys (6 Black Sea countries) are necessary to follow the distribution patterns, spawning areas, CPUE series, biomass estimations, diet, maturity indices etc.

7 Stock predictions

7.1 Short term predictions

Taking into account that the current F fluctuates between 0.112 (VIT) and <0.1 (XSA) the results can be viewed as being uncertain but indicative of the status of piked dogfish. The stock can be considered to be overexploited or even severely depleted, if the precautionary FMSY value is to be taken into account (ICES F_{MSY}-0.03). Nevertheless, XSA results indicated a steady and major reduction in the spawning stock biomass since 1989 and linked to the poor recruitment during the past couple of years there seems to be no indication of a stock recovery.

7.2 Medium term predictions

Continuing to operate in the same manner, in the competitive system without management at the regional level will result in the collapse of the dogfish stock.

7.3 Long term predictions

No long term predictions were undertaken.

8. Scientific advice

Current stock status of piked dogfish on classification GFCM (Table 8.1) can be defined as «**Depleted**».

Based on	Indicator	Analytic al reference point (name and value)	Current value from the analysis (name and value)	Empirical reference value (name and value)	Trend (time period)	Stock Status
Fishing mortality	Fishing mortality	($F_{0.1}$, = 0.03	Fc= 0.112		D	C
	Fishing effort				D	
	Catch				D	
Stock abundance	Biomass			33_{th} percentile	D	D
	SSB					
Recruitment					D	
Final Diagnosis		Example: In intermediate level of overfishing and overexploited with low level of biomass				

Trend categories

D – Decreasing

Stock Status

Based on fishing mortality-related indicators

C- Collapsed- no or very few catches;

Based on stock-related indicators

D – Depleted: Standing stock is at lowest historical levels, irrespective of the amount of fishing effort exerted;

References

- Abella A., Caddy J.F., Serena F., 1997. Do natural mortality and availability decline with age? An alternative yield paradigm for juvenile fisheries, illustrated by the hake *Merluccius merluccius* fishery in the Mediterranean. IFREMER Aquatic Living Resources. 10: 257-269.

- Abella A., Caddy J.F., Serena F., 1998. Estimation of the parameters of the Caddy reciprocal M-at-age model for the construction of natural mortality vectors. DYNPOP. Genova 2-5.10.96 Cahiers Options Medit 35:191-200.

- Acara A., 1985 – The Black Sea turbot. State Planning Organization, Ankara, Turkey, 19

Babayan V.K., Bulgakova T.I., Borodin R.G., Efimov Yu.N. Methodic recommendations. The use of mathematical methods and models to assess of fish stocks. Moscow: VNIRO, 1984, 154. (in Russian).

- Bingel F., Gügü A. C., Stepnovski A., Niermann U., Mutlu E., Avşar D., Kideyş A. E., Uysal Z., İşmen A., Genç Y., Okur H., Zengin M., 1995 – Stock assessment study for Turkish Black Sea cost. METU IMS Erdemli and FRI Trabzon, TÜBİTAK, Final Report, 159.

- Caddy J. F., 1984 – Method of solving for natural mortality rate for stock components with different schedules of growth and mortality. Can.J.Fish.Aquat.Sci, 41:1226-1230.

- Caddy J.F., 2006 – The potential use of indicators, reference points and the traffic lights convention for managing Black Sea fisheries. In: Selected papers presented at the Workshop on biological reference points , 20-21 April 2004. G. Lembo (Ed.). Studies and Reviews. GFCM. 83: 1-24.

- Commercial fisheries description of the Black Sea. Reference manual / Eds. Dubinets G. A., Gubanov E. P. GU navigation and cartography Mos Publ., USSR, Moscow 1988. – 140 (in Russian).

- Daskalov G., Gümüş A., Maximov V., Panayotova M., Radu G., Raykov V., Shlyakhov V., Zengin M., Rätz H.-J., Scott R., Druon J.-N 2010. Scientific, Technical and Economic Committee for Fisheries. Review of scientific advice for 2010 - part 3b. Advice on Stocks of Interest to the European Community in the Black Sea. EUR – Scientific and Technical Research series. Joint Research Centre – ISSN 1831-9424. 167 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. Technical and Economic Committee for Fisheries. Assessment of Black Sea Stocks (STECF-11-06). EUR – Scientific and Technical Research series – ISSN 1831-9424 (online), ISSN 1018-5593 Luxembourg: Publications Office of the European Union 2011 – 213 pp.

- Daskalov, G., Cardinale, M., Charef, A., Duzgunes, E., Genç, Y., Gümüş, A., Maximov, V., Mikhaylyuk, A., Nikolaev, S., Osio, G. C., Panayotova, M., Radu, G., Raykov, V., Shlyakhov, V., Yankova, M. and Zengin, M. Scientific, Technical and Economic Committee for Fisheries. Assessment of Black Sea Stocks (STECF-12-15). Luxembourg: Publications Office of the European Union. 2012. – ISSN 1831-9424 (online), ISSN 1018-5593 (print) 277 pp. http://stecf.jrc.ec.europa.eu

- David Sampson, Dimitrios Damalas and Giacomo Chato Osio, 2014- Scientific, Technical and Economic Committee for Fisheries (STECF) Black Sea assessments (STECF-14-14). JRC Scientific and Policy Reports.

- Efimov Yu.N., Revina N.I., Shlyakhov V.A., Vinarik T.V. Status of stocks turbot in the Black Sea. – Scientific. Proc. / VNIRO "Biological basis of population dynamics and forecasting fish catch," Moscow: VNIRO, 1989, p.179-199. (in Russian).

- Eremeev V. N., Zuev G.V., 2006 – Commercial fishery impact on the modern Black Sea ecosystem: a review. 1st Bilateral Scientific Conference "Black Sea Ecosystem 2005 and Beyond" 8-10 May 2006, Istanbul, Turkey.

-. Gasyukov P. S., 1979. – Methodical recommendations for processing results from trawl surveys – Kaliningrad, AtlantNIRO: 27 pp.

- Jones R. The use of length composition data in fish stock assessments. FAO Fish Circ., 1981, No 734, 55 p.

- Karapetkova M., 1964 – On the distribution and migration of turbot along the Bulgarian Black Sea coast. Proc. Inst. Oceanology BAN, Vol.16, 61-85. (in Bulgarian)

- Maximov V., Nicolaev S., Staicu I., Radu G.,Anton E., Radu E., 2006 – Contributions a la connaissance des caraceristiques certaines especes de poisons demersaux de la zone marine roumane de la mer Noire.Cercetari marine I.N.C.D.M. 36 : 271-297.

- Maximov V., G. Radu, I. Staicu, 2006. Contributios to the knowledge of the biological caracteristics of the some demersal fish from the Romanian marine area. Cercetari Marine (Recherches Marines), v. 36, p. 153-172.

- Maximov V., S. Nicolaev, G. Radu, I. Staicu, 2008. Estimation of growing parameters for main demersal fish species in the Romanian Marine Area. Cercetări marine, (Recherches Marines), 37:p. 289-304.

- Maximov V.,, I. Staicu, 2008. Evolution of Demersal Fish Species catches from the Romanian Marine Area between 2000 and 2007; Cercetări marine (Recherches Marines), v. 37:305-323.

- Maximov V., Nicolaev S., Raykov V., 2014 - State of small-scale fisheries practiced in the romanian and bulgarian sectors of the Black sea, during the past decade, GFCM (in press);

- Öztürk B., Keskin Ç. And Ergin. Some remarks on the cathes of anchovy Engraulis encrasicolus (Linnaeus, 1758), in Georgian Waters by Turkish Fleet Between 2003 and 2009 // The state of the Turkish Fisheries/ Tokaç A., Gücü A. C., Öztürk B. (Eds.)– Publication Number: 34, Published by Turkish Marine Research Foundation, Istanbul, Turkey. – 2012. – P. 372 – 381.

- Panayotova M., Todorova V., Konsulova Ts., Raykov V. Yankova, M, Stoykov S. 2006 – Species composition, distribution and stocks of demersal fishes along the Bulgarian Black Sea coast in 2006. Technical report.

- Polonskiy A. B.., Popov Yu, I. Conditions of formation of the cold intermediate layer of the Black Sea / / Marine Hydrophysical Institute NASU. – Sevastopol, 2011. – 54 (in Russian).

- Popova V. P., 1954 – On the distribution of turbot in the Black Sea. Proc. VNIRO, v. 28, M: VNIRO 151 – 159 (in Russian).

- Prodanov K, 2003. Status of demersal fish along the Bulgarian Black Sea costs. In: Workshop on Demersal Resources in the Black & Azov Sea. Published by Turkish Marine Research Foundation, Istanbul, TURKEY, B. Öztűk and S. Karakulak (Eds.), 49 – 64.

- Prodanov K., Mikhailov K. 2003. Possibilities for applying Jones' methods for turbot stock assessment and catch projection in the Black Sea. In: Workshop on Demersal Resources in the Black & Azov Sea. Published by Turkish Marine Research Foundation, Istanbul, TURKEY, B. Öztűk and S. Karakulak (Eds.), 35-48.

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

- Radu G., 2003 – Management of Fisheries and Other Living Marine Resources, National Report and Data Sheets in Romania. Workshop on Responsible Fisheries in the Black Sea and the Azov Sea, and Case of Demersal Fish Resources, April 15-17 2003, Şile, İstanbul, BSEP Programme, Country Report, TÜDAV/BSEP/ UNDP/GEF.

- Radu, Gh. & Radu, E. 2008. Determinator al principalelor specii de pesti din Marea Neagra. Editura VIROM, Constanta, 558 p. (In Romanian).

- Radu, Gh. & Radu, E. 2008. Determinator al principalelor specii de pesti din Marea Neagra. Editura VIROM, Constanta, 558 p. (In Romanian).

- Radu G., E. Anton, Mariana Golumbeanu, 2010 - State of the Romanian Black Sea Fisheries in the Last Decade. International Conference on Fishery and Aquaculture - A View Point Upon the Sustainable Management of the Water Resources in the Balkan Area. 26-28 May, 2010, Galati – ROMANIA ISSN: 1311-5065.

- Radu G., E. Anton, Mariana Golumbeanu, V. Raykov, Maria Yankova, Marina Panayotova, V. Shlyahov, M. Zengin, 2010 - Evolution and state of the main Black Sea commercial fish species correlated with ecological conditions and fishing effort. Journal of Ecology and Environmental Protection – JEPE, Vol. 12, No. 2 pp. 549-557 ISSN 1311-5065.

- Radu G., S. Nicolaev, 2010 - The regulation of Black Sea fish stocks. International Association for Danube Research- IAD Danube News 22-5. Editor DANUBE NEWS Alumnus: Swiss Federal Institute of Aquatic Science and Technology (Eawag), Ueberlandstrasse 133; CH-8600 Dübendorf, Switzerland (in press).

- Radu G., V. Maximov, 2011 - Dynamics of Fisheries and Fish Population Status of the Main Species of Economic Interest in the Romanian Black Sea Area in the Last Decade. FAO/GFCM, GFCM Scientific Advisory Committee (SAC)- Working Group on stock assessment of Demersal Species. Chania, Crete (Greece), 24-29 October 2011.

- Radu G., S. Nicolaev, V. Maximov, E. Anton, 2011 - The Dynamics of Marine Fisheries at the Romanian Coast During 1950-2009. The joint 3rd biannual Black Sea Scientific Conference and up-grade BS-Scene Project Joint Conference. "Black Sea Outlook" Conference 31 October – 4 November 2011.

- Radu G., V. Maximov, E. Anton, 2011 - Research on the status of the dogfish (Squalus acanthias) population in the Romanian marine area. Summary data on dogfish at Black Sea level. FAO/GFCM Workshop on Stock Assessment of Selected Species of Elasmobranchs in the GFCM Area. Brussels, Belgium, 12-16 December 2011;

- Radu G., 2012 - Piked Dogfish in the Black Sea. STECF EWG 11-16 on Black Sea, Italia, Ispra 7 – 13 octombrie 2012.

- Radu Gh., Maximov V.,Anton E., 2012 – Distribution of the main fishing agglomerations in the Romanian narine area in the period 2009-2010, Cercetari Marine / Recherches Marines, nr. 42: 159-172, ISSN: 0250-3069;

- Radu Gh., Nicolaev S., Anton E., Maximov V., 2013 – Evolution of Romanian marine fisheries following EU accession; Cercetari Marine / Recherches Marines, nr. 43: 249-267, ISSN: 0250-3069;

- Radu Gh., Maximov V., Anton E., Cristea M., Tiganov G., Ţoţoiu A., Spanu A.D., 2013 – State of the fishery resources in the romanian marine area ; Cercetari Marine / Recherches Marines, nr. 43: 268-295, ISSN: 0250-3069;

- Raykov V., Shlyakhov Vl., Maximov,V., Radu, Gh., Staicu, I., Panayotova, M, Yankova, M, Bikarska I. Limit and target reference points for rational exploitation of the turbot (*Psetta maxima* L.) and whiting (*Merlangius merlangus euxinus* Nordm.) in the western part of the Black Sea // VI Anniversary Conference of the Institute of zoology. Acta Zoologica Bulgarica, Suppl.2, 2008. – pp. 305-316.

- Sampson, D., Ak, O., Daskalov, G., Cardinale, M., Charef, A., Duzgunes, E., Genc, Y., Gucu, A.C., Maximov, V., Mikhaylyuk, A., Orio, A., Osio, G. C., Panayotova, M., Radu, G., Raykov, V.,Shlyakhov, V., Yankova, M. and Zengin, M. Scientific, Technical and Economic Committee for Fisheries (STECF) – 2013 Assessment of Black Sea stocks (STECF 13-20). 2013. Publications Office of the European Union, Luxembourg, EUR 25309 EN, JRC 85367, 429 pp.

- Shlyakhov et al. 2006. Recommend number of fishing gears and vessels required for the realization of limits of anchovies, sprat, horse mackerel, tyulka, Azov-Don shad, Black Sea turbot, dogfish, skates and soiuy mullet in the Azov and Black Sea for 2007. YugNIRO, Kerch, 26 p. / Funds of Sc.Technical Library of YugNIRO. (Unpublished).

- Shlyakhov, V., Charova, I., 2006 – Scientific data on the state of the fisheries resources of Ukraine in the Black Sea in 1992 – 2005. 1 st Bilateral Scientific Conference “Black Sea Ecosystem 2005 and Beyond” 8-10 May 2006, Istanbul, Turkey, 131-134.

- Shlyakhov V. A., Daskalov G. M. 2008. 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, - 3, 321-364.

- Shlyakhov V. A. About stocks and fishing turbot in the Black Sea. – V. 48. – Kerch YugNIRO 2010. – 40-51.

- Shlyakhov, V.,2014 - Stock assessment form for Piked dogfish. GFCM meeting on BS stock assessment. Bucharest.

- Svetovidov A. N. (1964) The Black Sea fish. Moscow-Leningrad: USSR, Moscow:Nauka, 546 pp (in Russian)

- Suziki, N., Nishidas, K., Yoseda, C., Üstündağ, C., Amoka, K., 2004. Phylogeographic Relationships with the Mediterranean Turbot Inferred by Mitocondrial DNA Haplotype Variation. Journal of Fish Biology, 65; 1-6.

- Volovik S. P., Agapov S. A., 2003 – Composition, state and stocks of the demersal fish community of the Azov-Black Seas relating to the development of Russian sustainable fisheries. In: Workshop on Demersal Resources in the Black & Azov Sea. Published by Turkish Marine Research Foundation, Istanbul, TURKEY, B. Öztűk and S. Karakulak (Eds.), 82-92.

- Zengın M., 2000 – Türkiye'nin Doğu Karadeniz Kıyılarındaki Kalkan (*Scopthalmus maeoticus*) Balığının Biyoekolojik Özelikleri ve Populasyon Parametleri, Doktora Tezi, KTÜ Fen Bilimleri Estitüsü, Balıkçılık Teknolojisi Mühendisliği Anabilim Dalı, 225.

- Zengin, M., 2003. The Current Status of Turkey's Black Sea Fisheries and Suggestions on the Use of Those Fisheries, Workshop on Responsible Fisheries in the Black Sea and the Azov Sea, and Case of Demersal Fish Resources, April 15-17 2003, Şile, Istanbul, BSEP Black Sea Environmental Programme Country Report, 34.

Stock Assessment Form

Small Pelagics

Reference Year: 2013

Reporting Year: 2014

Three fish species from the Black Sea pelagic community are recognized as the most important commercially and ecologically: Black Sea sprat, anchovy, and horse mackerel (Raykov and Yankova, 2008). Horse mackerel, *Trachurus mediterraneus ponticus* (Aleev, 1956), is a major commercial fishery for the waters of the Black Sea and belongs to the family Carangidae. This family is represented by 200 species that are widely distributed in tropical, subtropical, and moderate areas of all oceans and adjoining seas. The catches of Black Sea horse mackerel were realized by active (pelagic trawls and purse seine) and passive fishing gears (gill netting, trawl net, trap nets). Horse mackerel stocks in the Black Sea are usually caught by Turkish fishermen by using active (bottom trawler, pelagic trawler and large purse seine) and passive (extension and longline) nets. Almost the whole horse mackerel catch (98.2%) in Turkish waters is caught by large purse seine.

1 Basic Identification Data

Scientific name:	Common name:	ISCAAP Group:
Trachurus mediterraneus ponticus	Horse mackerel	37.4
1st Geographical sub-area:	2nd Geographical sub-area:	3rd Geographical sub-area:
29	29	29
4th Geographical sub-area:	5th Geographical sub-area:	6th Geographical sub-area:
29	29	29
1st Country	2nd Country	3rd Country
Bulgaria	Georgia	Romania
4th Country	5th Country	6th Country
Russian Federation	Turkey	Ukraine
Stock assessment method: (direct, indirect, combined, none)		
XSA		
Authors:		
STECF members: Abella, J. A., Andersen, J., Bailey, N., Bertignac,M., Cardinale, M., Curtis, H., Daskalov, G., Delaney, A., Döring, R., Garcia Rodriguez, M., Gascuel, D., Graham, N., Gustavsson, T., Jennings, S., Kenny, A., Kraak, S., Kuikka, S., Malvarosa, L., Martin, P., Murua, H., Nord, J., Nowakowski, P., Prellezo, R., Sala, A., Scarcella, G., Somarakis, S., Stransky, C., Theret, F., Ulrich, C., Vanhee, W. & Van Oostenbrugge, H. EWG-14-14 members: Sampson, D. (chair), Ak, O., Cardinale, M., Chashchyn, O., Damalas, D., Dagtekin, M., Daskalov, G., Duzgunes, E., Genç, Y., Gucu, A.C., Gumus, A., Maximov, V., Osio, G. C., Panayotova, M., Radu, G., Raykov, V., Yankova, M. and Zengin, M.		
Affiliation:		

Practically, the horse mackerel (*Trachurus mediterraneus ponticus*), one of the intensively exploited pelagic species off the Black Sea Coast stock assessment is possible when the whole area of distribution of the species is included into examination.

Therefore, collection of samples in the waters of all Black Sea states (Bulgaria, Georgia, Romania, Russia, Turkey, Ukraine) and producing data for this pelagic species should take place.

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

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

Direct methods (you can choose more than one):

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

Indirect method (you can choose more than one):

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

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

2 Stock identification and biological information

The Black sea horse mackerel is a subspecies of the Mediterranean horse mackerel *Trachurus mediterraneus*. Although in the past the Black sea horse mackerel has been attributed to various subpopulations, in a more recent study Prodanov *et al*. (1997) brought evidence that the horse mackerel rather exists as a single population in the Black sea, and thus all Black sea horse mackerel fished across the region should be treated as a unit stock. The genetic analysis demonstrated that two scad shoal groups migrate in the Bulgarian adulatory sector of the Black Sea (Dobrovolov, 2000).
The horse mackerel is a migratory species distributed in the whole Black Sea (Ivanov and Beverton, 1985). In the spring it migrates to the north for reproduction and feeding. In summer the horse mackerel is distributed preferably in the shelf waters above the seasonal thermocline. In the autumn it migrates towards the withering grounds along the Anatolian and Caucasian coasts migration (Ivanov and Beverton, 1985). The horse mackerel population in the Black Sea mainly winters along the Crimean, Caucasian and Anatolian coasts and warm sections of the Marmara Sea. They winter at a depth ranging between 20 and 90 meters off Crimea and between 20 and 60 meters off the Caucasian coasts. The horse mackerel population continuously remains in the eastern Black Sea winters in an area north-east of Trabzon. The population migrating between Marmara and the eastern Black Sea spend the winter in the Bosphorus area and off the Marmara Sea at optimal depths ranging between 30 and 50 meters. Depending on water temperature, feeding migration starts in mid-April or towards the end of that month (Demir, 1958). Horse mackerel groups migrate from the Bosphorus to the Bulgarian and Romanian coasts in the north. They are also believed to migrate from Crimea to the north-west and from the Caucasian and north-eastern Anatolian coasts to the Crimean coasts. Autumn migration starts in September and reaches a peak in October and November (Ivanov and Beverton, 1985).

2.1 Stock unit

2.2 Growth and maturity

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

Somatic magnitude measured (LT, LC, etc)			LT	**Units**	cm
Sex	**Fem**	**Mal**	**Combined**	**Reproduction season**	Summer (June-August)
Maximum size observed	24.5	24.2		**Recruitment season**	
Size at first maturity	12.4			**Spawning area**	Southern Black Sea
Recruitment size to the fishery				**Nursery area**	Southern Black Sea

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

Size/Age	Natural mortality	Proportion of matures
…	…	…

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

Size/Age	Natural mortality	Proportion of matures
0		*0*
1		*0.8*
2		*1*
3		*1*
4		*1*
5		*1*
6		*1*

Table 2-3: Growth and length weight model parameters

COUNTRY	YEAR_PERIOD	SPECIES	SEX	L_INF	K	t_0	a	b
Bulgaria	2007-2008	HMM	C	19.75	0.3020	-0.830	0.0035	3.3046
Bulgaria	2007-2008	HMM	M	18.785	0.3373	-0.825	0.0034	3.3123
Bulgaria	2007-2008	HMM	F	19.661	0.3075	-0.836	0.0038	3.3029
Bulgaria	2013	HMM	C	20.98	0.2839	-0.71	-	-
Romania	2000	HMM	C	18.6	0.224	-1.430	0.0380	2.3552
Romania	2001	HMM	C	18.95	0.268	-0.630	0.0470	2.3501
Romania	2009	HMM	C	18.42	0.42	-0.410	0.0450	2.3469
Romania	2010	HMM	C	20.03	0.302	-0.467	0.0111	2.9065
Romania	2011	HMM	C	17.37	0.371	-0.445	0.0101	2.9101
Romania	2012	HMM	C	16.84	0.2686	-1.811	0.01075	2.883
Romania	2013	HMM	C	16.842	0.47	-1.1078	0.017884	2.6774
Turkey	1991 – 1992	HMM	M	19.9	0.396	-1.020	0.0110	3.18
Turkey	1991 – 1992	HMM	F	20.6	0.356	-1.110	0.0080	2.993
Turkey *	2005	HMM	C	20.237	0.3181	-1.603	0.0081	2.9983
Turkey *	2006	HMM	C	22.394	0.241	-1.932	0.0064	3.0986

Turkey *	2007	HMM	C	22.232	0.2554	-1.828	0.0085	2.984
Turkey *	2008	HMM	C	22.244	0.2538	-1.80	0.0069	3.1018
Turkey *	2009	HMM	C	24.023	0.2082	-2.075	0.0062	3.1024
Turkey *	2010	HMM	C	25.002	0.187	-2.11	0.0052	3.1654
Turkey *	2011	HMM	C	24.44	0.235	-1.767	0.0056	3.1402
Turkey *	2012	HMM	C	21.36	0.287	-1.84	0.0059	2.8831
Turkey *	2013	HMM	C	19.804	0.4516	-0.8235	0.0050	3.1862
Ukraine	2008	HMM	C	18.5	0.343	-0.66	-	-

*data according "Purse seine fisheries monitoring project by Trabzon Central Fisheries Institute"

3 Fisheries information

The horse mackerel (*Trachurus mediterraneus*) fishery operates mainly on the wintering grounds in the southern Black Sea using purse seine and mid-water trawls. The horse mackerel of age 1-3 years generally prevails in the commercial catches, but strong year classes (for example, the 1969-year class) may enter into exploitation at age of 0.5 year and may prevail up to age 5-6 years. Over the last 40 years, highest horse mackerel catches were reported in the years preceding *M. leidyi* outbreak (1988-1990) (Prodanov *et al.*, 1997; FAO, 2007). The maximum catch of 141 thousand tons was recorded in 1985, from which ~100 thousand tons were caught by Turkey (Prodanov *et al.*, 1997). In the next four years catches remained at the level of 97-105 thousand tons. In the period 1971-1989, the stock increased, although years of high abundance alternated with years of low abundance due to year class's fluctuations, typical of this fish. VPA estimates showed that the stock was highest in 1984-1988 (Prodanov *et a*l., 1997). Scientists (Chashchin, 1998) believed that the intensive fishing in Turkish waters in 1985-1989 has led to overfishing of horse mackerel population and reduction of the stock and catches in the next years. A drastic decline in stock abundance occurred after 1990 when the stock diminished by 56%. In 1991 the horse mackerel stock dropped to a minimum of 75 thousand tons and the catch dropped to 4.7 thousand tons that is a twenty fold reduction compared to the average annual catch in 1985-1989. In 1992 was achieved a catch of 21065 t. Upon 1994 the amounts of catches decreased especially in 1998-1999 period. In 2013 decrease in catches of horse mackerel was reported, at the level of 20213.51t. The catches of Black Sea horse mackerel were realized by active (pelagic trawls and purse seine) and passive fishing gears (gill netting, trawl net, trap nets). Horse mackerel stocks in the Black Sea are usually caught by Turkish fishermen by using active (bottom trawler, pelagic trawler and large purse seine) and passive (extension and longline) nets. Almost the whole horse mackerel catch (98.2%) in Turkish waters is caught by large purse seine.

Description of the fleet

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

	Country	GSA	Fleet Segment	Fishing Gear Class	Group of Target Species	Species
Operational Unit 1*	Turkey	29	<12 m	Purse Seine	Small Pelagics	Anchovy Horse Mackerel

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

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

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

3.1 Historical trends

Year	Bulgaria	Georgia	Romania	Russian Federation	Turkey	Ukraine	Total
1950	644.4	-	217.0	-	1200.0	-	8291.4
1951	736.2	-	293.0	-	2500.0	-	5399.2
1952	564.9	-	260.0	-	2600.0	-	6474.9
1953	294.7	-	140.6	-	9200.0	-	22094.7
1954	593.2	-	617.8	-	12200.0	-	25511.2
1955	662.4	-	297.4	-	7200.0	-	19950.4
1956	131.5	-	63.5	-	14200.0	-	29734.5
1957	69.4	-	119.7	-	14000.0	-	26919.4
1958	233.0	-	587.4	-	4900.0	-	17370.0
1959	687.4	-	839.8	-	700.0	-	12687.4
1960	1017.7	-	674.6	-	4800.0	-	17691.7
1961	1240.6	-	2200.0	-	3600.0	-	16345.6
1962	805.2	-	1166.0	-	13500.0	-	29271.2
1963	231.4	-	532.0	-	3500.0	-	18163.4
1964	242.0	-	248.4	-	3100.0	-	13790.0
1965	301.6	-	1364.7	-	1200.0	-	8106.3
1966	556.7	-	1770.0	-	600.0	-	5276.7
1967	245.7	-	762.0	-	24615.0	-	32111.7
1968	37.4	-	175.0	-	4750.0	-	20124.4
1969	95.9	-	156.0	-	16762.0	-	18293.9
1970	689.1	-	1342.0	-	19380.0	-	22041.1
1971	630.9	-	1218.0	-	8722.0	-	14920.9
1972	534.0	-	500.0	-	10855.2	-	33709.2
1973	849.0	-	606.0	-	16593.7	-	28828.7
1974	2168.8	-	608.0	-	10244.8	-	15904.6
1975	1972.8	-	1003.0	-	11897.8	-	19208.6
1976	1808.7	-	1514.0	-	14077.9	-	35745.6
1977	791.0	-	404.0	-	14674.3	-	20576.3
1978	565.0	-	729.0	-	23529.0	-	25508.0
1979	934.5	-	1179.0	-	59772.0	-	62619.5
1980	813.0	-	1536.0	-	42339.0	-	45297.0
1981	476.2	-	588.0	-	40543.0	-	41951.2
1982	366.8	-	291.0	-	48918.0	-	51450.8
1983	496.7	-	1510.0	-	54548.0	-	63711.7
1984	1015.8	-	872.0	-	69980.0	-	77369.8
1985	755.8	-	1035.0	-	100417.0	-	141077.8
1986	850.9	-	945.0	-	100943.0	-	105108.9
1987	826.4	-	997.0	-	90850.0	-	93216.4
1988	1676.8	-	2660.0	-	93006.0	-	977408
1989	1100.9	-	1459.0	-	94023.0	-	96887.9
1990	164.1	-	165.0	-	65163.0	-	65548.1
1991	122.9	48.0	0	-	19781.0	-	19954.9
1992	54	0	22	0	20989	0	21065
1993	31	0	30	0	23945	0	24006
1994	80	0	35	1	25275	1	25392
1995	70	0	24	1	15809	2	15906
1996	68	0	10	0	16093	0	16171
1997	36	18	1	0	11097	5	11157
1998	40	13	15	2	8246	0	8316
1999	30	0	3	2	8331	1	8367.2
2000	111	35	8	2	16181	0	16336.8
2001	130	7	17	6	16750	1	16911
2002	141.5	19	21	28	8903	34	9146.5

2003	141.6	70	10	77	9213	745	10256,6
2004	73.9	56	14	105	9113	272	9633.9
2005	29.4	60	12	169	17003	329	17602.4
2006	62.834	55	19	200.5	12812	476	13625.33
2007	115.88	53	14	63.2	17429	211	17886.08
2008	179.607	8	11	154.24	20124	366	20842.85
2009	176.91	6*	17	124.04	15905	260	16489.06
2010	165.27	5*	7	108.86	12929	190	13405.50
2011	394.84	44**	22.820	87.21	17746	264	18558.87
2012	381.37	44	20.005	69.50	23911.2	539.713	24931.36
2013	271.38	0	26.325	89	18979.4	847.405	20113.51

Fig. 4.2-1: Trends in horse mackerel landings by countries, years 1950-2013.

3.2 Management regulations

Horse mackerel fishery in Turkey was firstly promoted by the Commercial Fishery Advice of General Directorate of Fishery (dated 14.08.1997, No: 23080 regarding the years 1997-1998, Section 2. Article 15). This arrangement was followed by new management criteria brought into force for horse mackerel fishery (Ak and Dağtekin, 2014). These measures cover:

Minimum catch size: 13 cm total length.

Fishing area: There are no restrictions for fishing areas.

Fishing gear: Fishing is allowed for purse seiners, trawlers, gillnet and long liners.

Time periods (Turkey): Though pelagic fishing period starts in 1 September and lasts to 15 April bottom trawling ends in 15 April. There is no limitation in distance from the coast for pelagic trawling. Horse mackerel fishing can be done all day.

Depth (Turkey: The pelagic fishery is banned in waters shallower than 24 m in all seasons.

Others: Small pelagic have to be carried in cases or boxes with net weight of 12 kg (± 10%). Certificate of origin and transportation is essential. Fisheries cooperatives are authorized for the issuing of this document

3.3 Reference points

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

Indicator	Limit Reference point/empirical reference value	Value	Target Reference point/empirical reference value	Value	Comments
B					
SSB					
F					

Y					
CPUE					
Index of Biomass at sea					

4 Fisheries independent information

4.1 {NAME OF THE DIRECT METHOD}

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

4.1.1 Brief description of the chosen method and assumptions used

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

Direct methods: DEPM

Table 4.1-1: Egg production cruise information.

Date					
Cruise				**R/V**	
Total area (km^2)		Positive		**Negative**	
Egg sampler					
Adult sampler					

Table 4.1-2: Parameters of the egg mortality curve

Parameters (exponential decay model)			**value**	**CV**
P_0 (# of eggs /0.05 m^2)				
Z ($days^{-1}$)				
Temperature range	ºC	ºC		

Table 4.1-3: DEPM Model parameters

Model parameters	value	CV
P_0 (# of eggs/0.05 m^2 per day)		
A (surface of region 0.05 m^2)		
W (average female weight in gr)		
F (batch fecundity: eggs / batch per mature female)		
S (spawning fraction: # spawning female per mature female)		
R (sex ratio: females/total)		

Table 4.1-4: DEPM based estimates

Result	value	CV
Biomass (t)		

Direct methods: acoustics

- Specify if numbers are per km^2 or raised to the area, assuming the same catchability .
- Specify the ageing method or the age slicing procedure applied, specify the maturity scale used.
- In case maturity ogive has not been estimated by year, report information for groups of years.

Table 4.1-5: Acoustic cruise information.

Date			
Cruise		**R/V**	
Target species			
Sampling strategy			
Sampling season			
Investigated depth range (m)			
Echo-sounder			
Fish sampler			
Cod –end mesh size as opening (mm)			

ESDU (i.e. 1 nautical mile)	
TS (Target Strength)/species	
Software used in the post-processing	
Samples (gear used)	
Biological data obtained	
Age slicing method	
Maturity ogive used	

Table 4.1-6: Acoustic results, if available by age or length class

	Biomass in metric tons	**fish numbers**	**Nautical Area Scattering Coefficient**	**Indicator …**	**Indicator …**

4.1.2 Spatial distribution of the resources

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

4.1.3 Historical trends

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

5 Ecological information

5.1 Protected species potentially affected by the fisheries

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

5.2 Environmental indexes

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

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

6 Stock Assessment

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

6.1 EXTENDED SURVIVORS ANALYSIS (XSA)

6.1.1 Model assumptions

6.1.2 Scripts

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

6.1.3 Input data and Parameters

Table 6.1.3.1 Aggregated catch at age in number 10^{-3} of Bulgaria, Georgia, Romania, Russia, Turkey and Ukraine during the period 2005-2013.

	Catch-at-age (thousands)								
Age class	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
0+	24623.8	7149.7177	596.92757	6678.3366	3910.7335	28029.157	29325.467	20740.433	380709.3
1+	446026.448	289385.028	633607.85	189996.56	395249.709	300248.161	715934.213	692427.992	961880.3
2+	510230.8371	381781.7543	364748.1832	556876.1004	421199.273	334444.5576	272264.7989	633694.9337	326623.8
3+	117165.337	68877.6232	61099.7537	232242.597	92146.0061	128585.373	134564.125	55724.1519	36617.1
4+	15977.07681	19612.52778	5731.807176	27287.16785	37179.53485	55875.03503	23781.84854	6778.735012	2768.8
5+	2078.610163	2295.03876	2740.416069	2573.869748	6013.341588	18165.18663	7464.849154	1088.402902	1399.8
6+	54.25073633	554.5081117	0	26.647332	998.3546439	6057.42282	3072.334567	87.96761201	44.8

Table 6.1.3.2 Tuning fleet data from Turkish commercial CPUE.

	Tuning fleet data from Turkish commercial CPUE								
Age class	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
0+	5.8	9.5	3.8	0.1	3.4	2.4	14.1	14.0	4.9
1+	16.7	526.5	402.2	1337.1	264.5	711.8	351.1	913.6	1268.2
2+	56.7	932.5	896.5	1054.3	1428.8	1200.6	848.6	662.3	1811.3
3+	1571.7	305.1	199.8	233.3	795.6	340.9	417.4	497.8	199.5
4+	0.0	50.3	91.0	24.9	115.9	187.1	181.9	116.3	13.3
5+	0.0	8.2	12.7	7.1	12.1	33.3	65.9	48.6	5.4
6+	0.0	8.2	3.5	0.0	0.0	9.0	45.0	22.5	0.0
Total	1832.22	1609.548	2656.86	2620.313	2485.156	1923.958	2275.128	3302.652	2408.553

Table 6.1.3.3 Weight at age in the catch (in g).

	Weight at age in the catch								
Age class	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
0+	4.24	4.94	9.66	4.79	5.19	4.37	5.43	6.52	3.50
1+	13.23	13.77	14.70	12.66	13.01	10.05	13.01	14.39	11.89
2+	20.62	21.19	20.10	23.07	20.69	21.85	24.79	23.18	23.60
3+	29.72	29.34	29.19	30.28	30.22	28.46	37.89	33.49	32.45
4+	38.62	42.06	36.97	39.00	42.54	31.43	51.42	34.62	33.21
5+	45.84	51.82	42.72	50.90	50.12	36.81	65.63	49.41	43.95
6+	43.56	57.20		41.25	67.44	63.36	73.17	39.88	62.97

Table 6.1.3.4 Horse mackerel maturity at age.

	Maturity at age								
Age class	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
0+	0	0	0	0	0	0	0	0	0
1+	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
2+	1	1	1	1	1	1	1	1	1
3+	1	1	1	1	1	1	1	1	1
4+	1	1	1	1	1	1	1	1	1
5+	1	1	1	1	1	1	1	1	1
6+	1	1	1	1	1	1	1	1	1

Table 6.1.3.5 Natural mortality matrix for Horse mackerel in Black Sea.

	Natural mortality matrix								
Age class	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
0+	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.8
1+	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.8
2+	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.8
3+	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.8
4+	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.8
5+	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.8
6+	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.8

6.1.4 Results

Accomplished analysis of residuals of Turkish tuning series for different shrinkage settings, results are presented in Figs. 6.1.4.1 - 6.1.4.6.

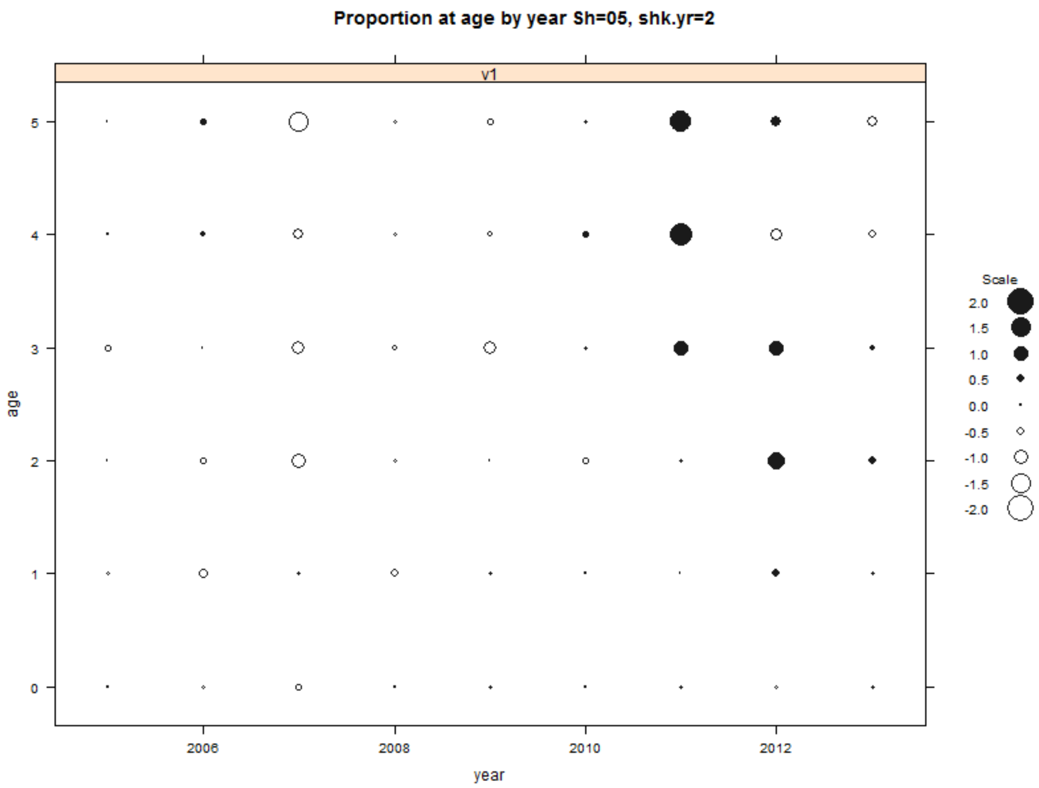


Figure 6.1.4.1 Residuals of tuning series applying a shrinkage of 0.5.

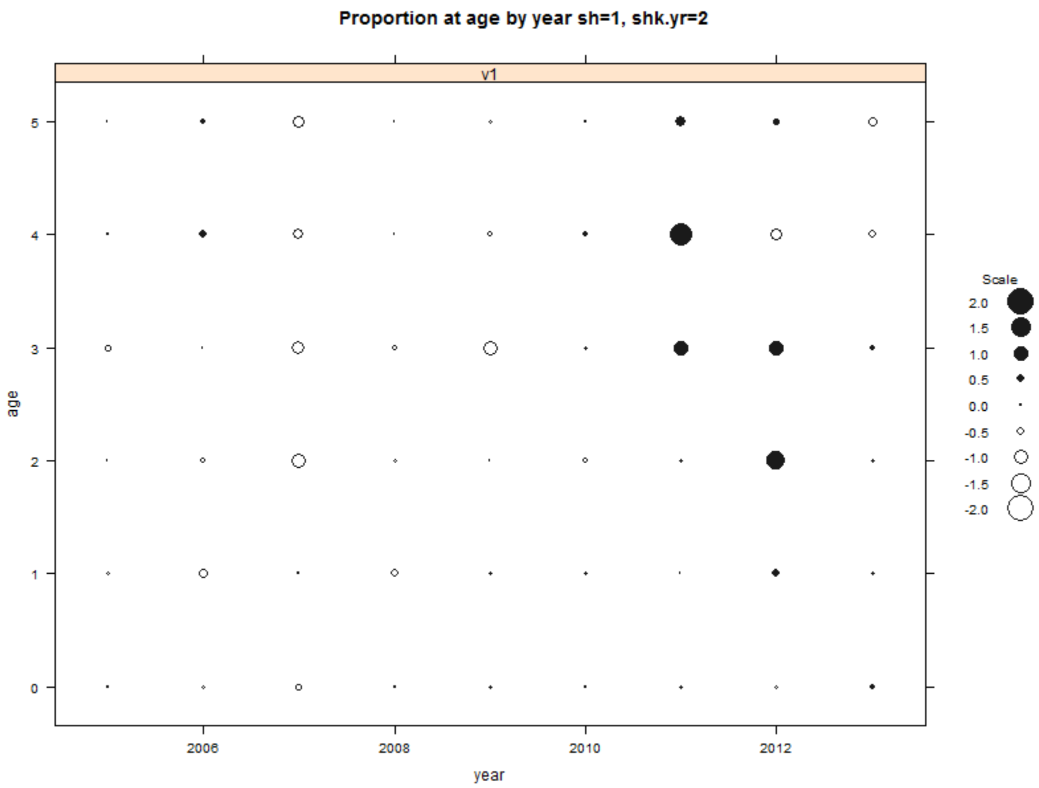


Figure 6.1.4.2 Residuals of tuning series applying a shrinkage of 1.0.

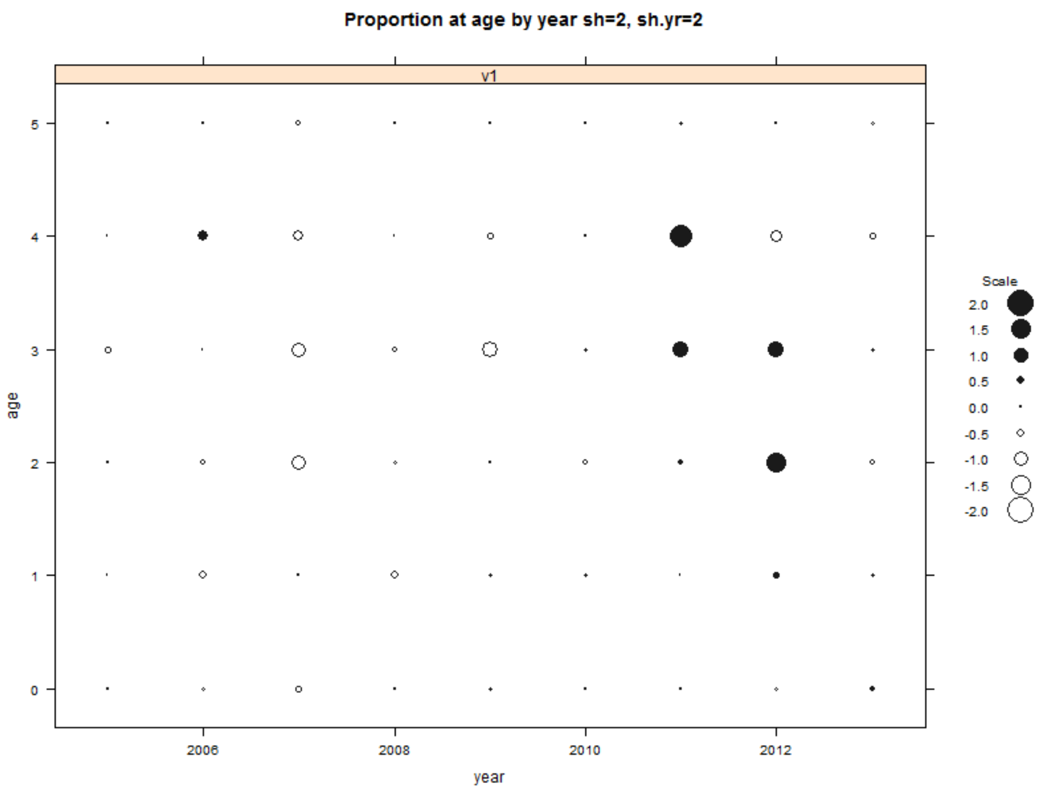


Figure 6.1.4.3 Residuals of tuning series applying a shrinkage of 2.0.

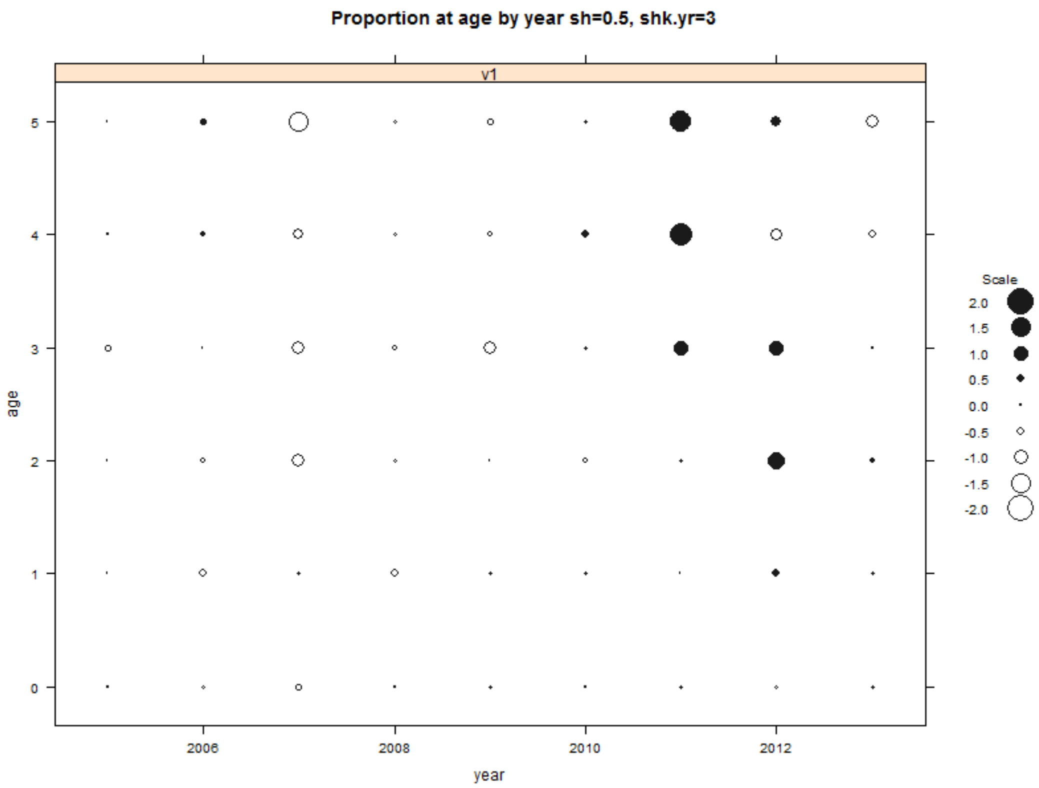


Fig. 6.1.4.4 Residuals of tuning series applying a shrinkage of 0.5.

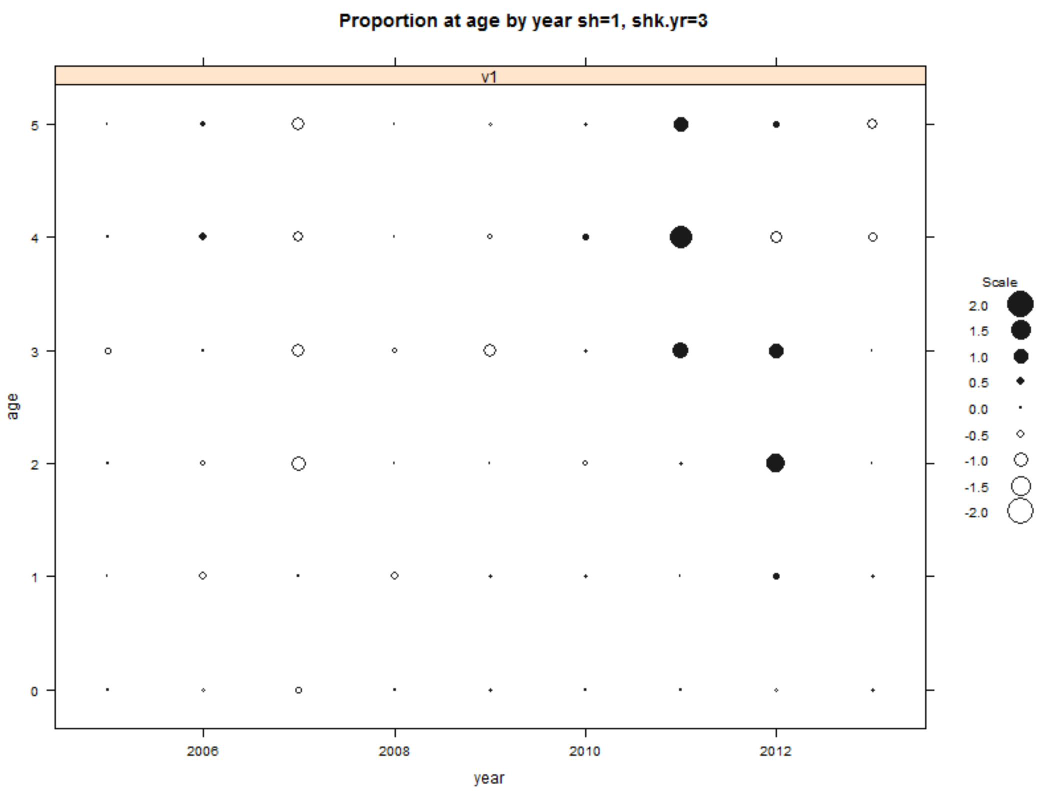


Fig. 6.1.4.5 Residuals of tuning series applying a shrinkage of 1.

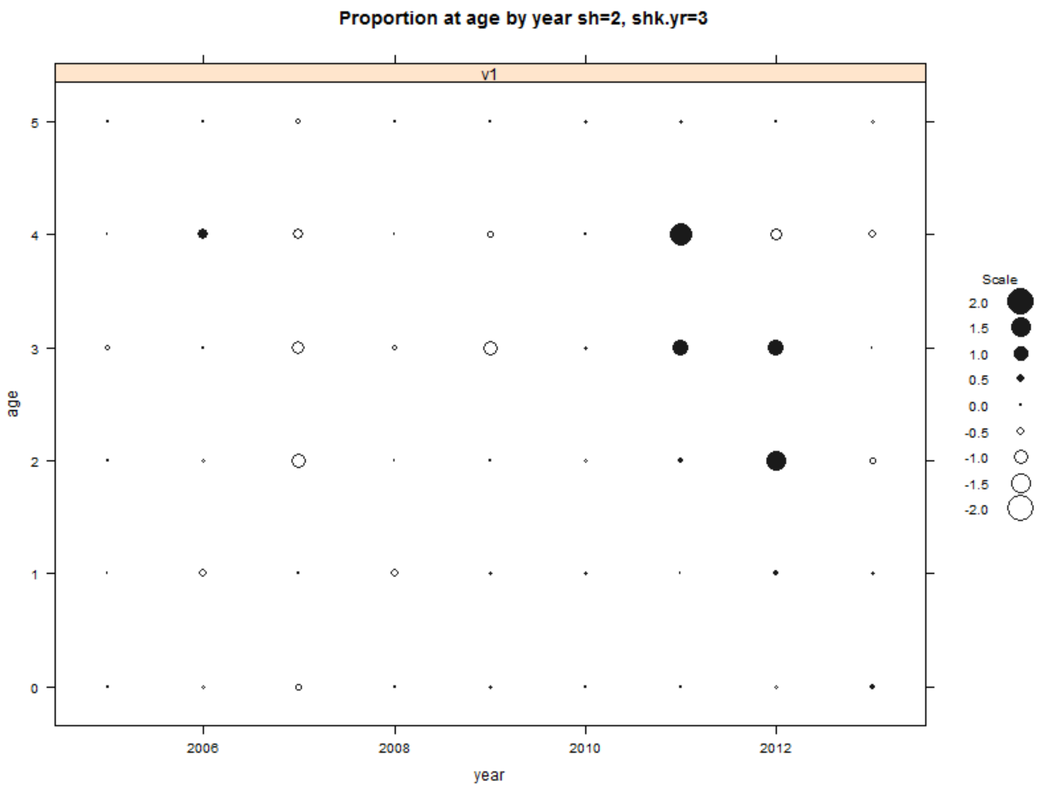


Fig. 6.1.4.6 Residuals of tuning series applying shrinkage of 2.0

Performed a sensitivity analysis for different shrinkage settings, results are presented in figures 6.1.4.7-6.1.4.9.

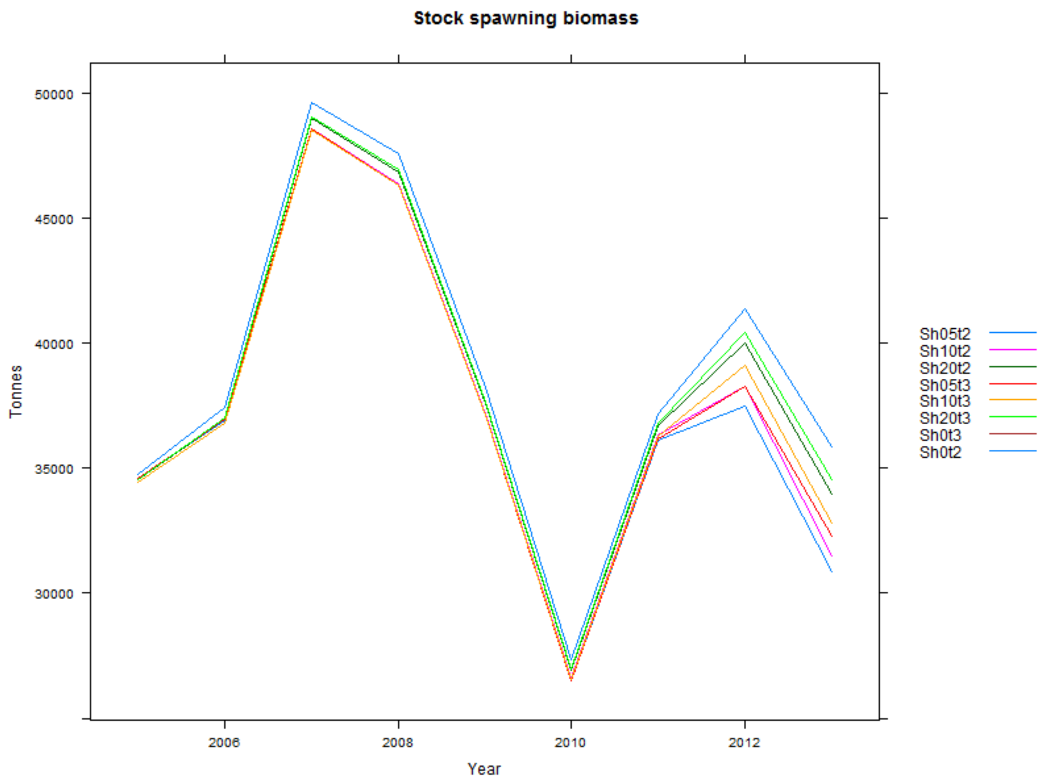


Figure 6.1.4.7 Sensitivity analysis on Stock spawning biomass for different levels of shrinkage.

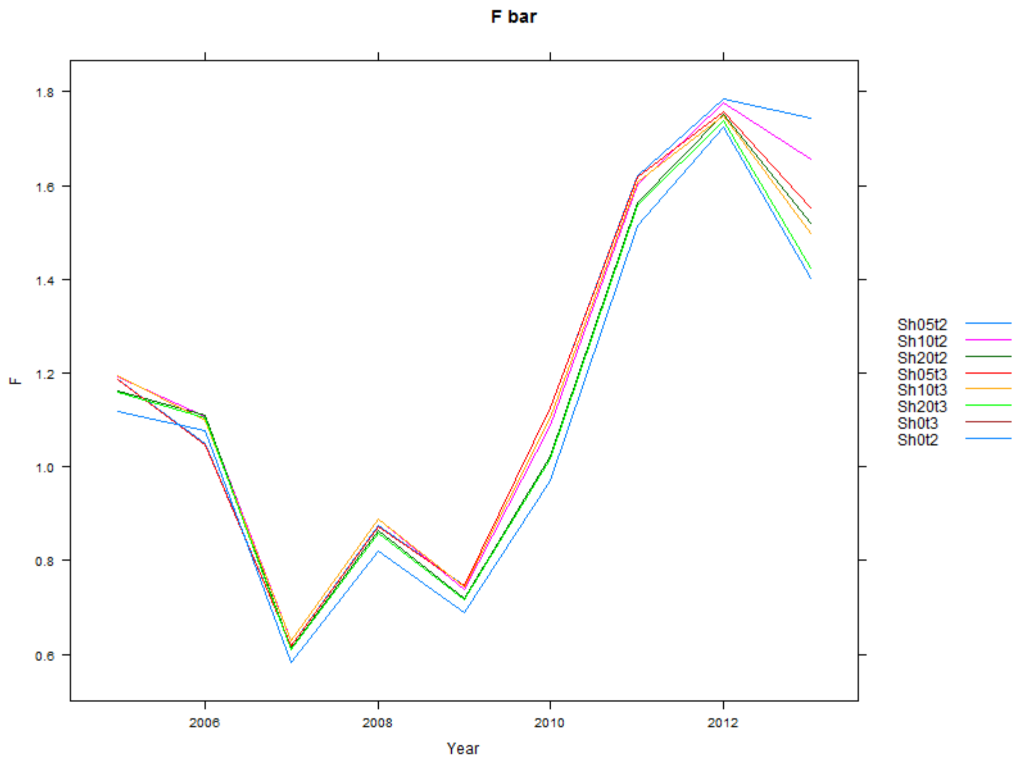


Figure 6.1.4.8 Sensitivity analysis on F_{bar} (Ages 1-3) for different levels of shrinkage.

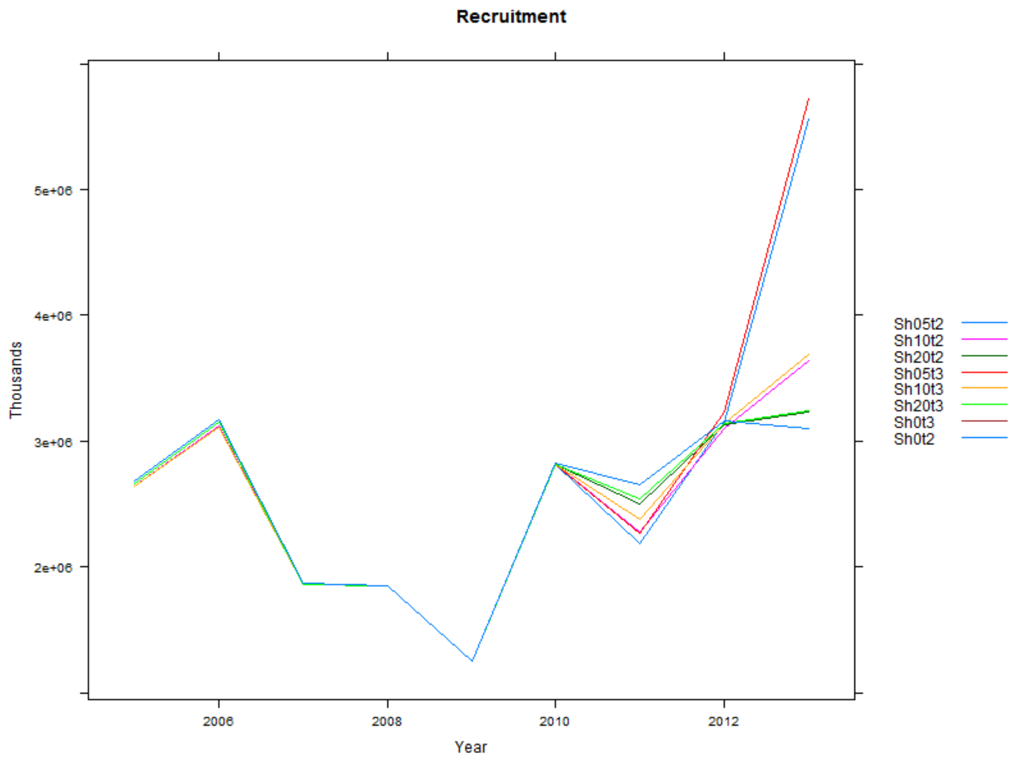


Figure 6.1.4.9 Sensitivity analysis on Recruitment for different levels of shrinkage.

6.1.5 Robustness analysis

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

Extended Survivors Analysis (XSA) in FLR and the technique "shrinkage to the mean" for assessing the stock of Horse mackerel over the period 2005-2013 was applied. The tuning of XSA is defined according to the default settings of the program, results are presented in figures 6.1.6.1-6.1.6.8.

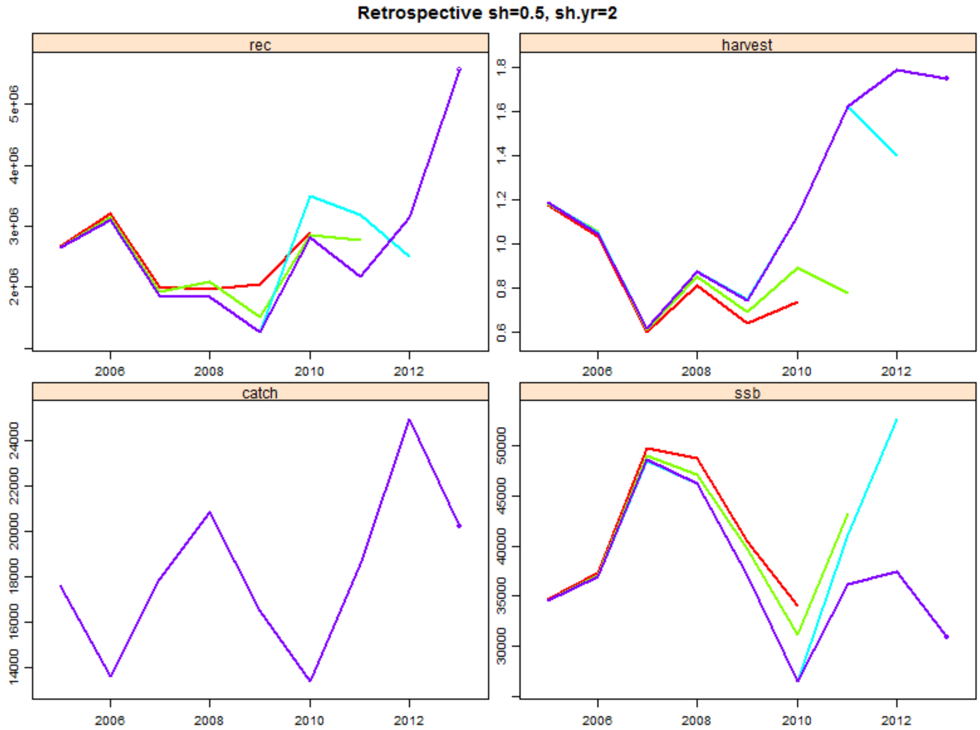


Figure 6.1.6.1 Retrospective trends of the assessment parameters (average over ages 1-3), recruitment, SSB, catch and harvest for shrinkage 0.5.

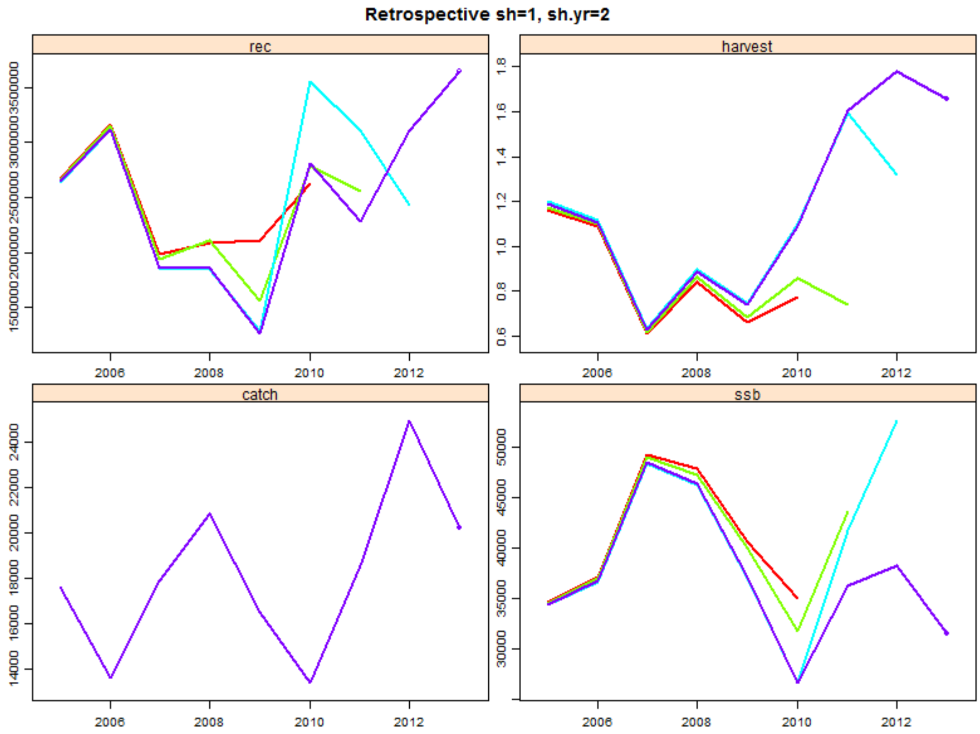


Figure 6.1.6.2 Retrospective trends of the assessment parameters (average over ages 1-3), recruitment, SSB, catch and harvest for shrinkage 1.

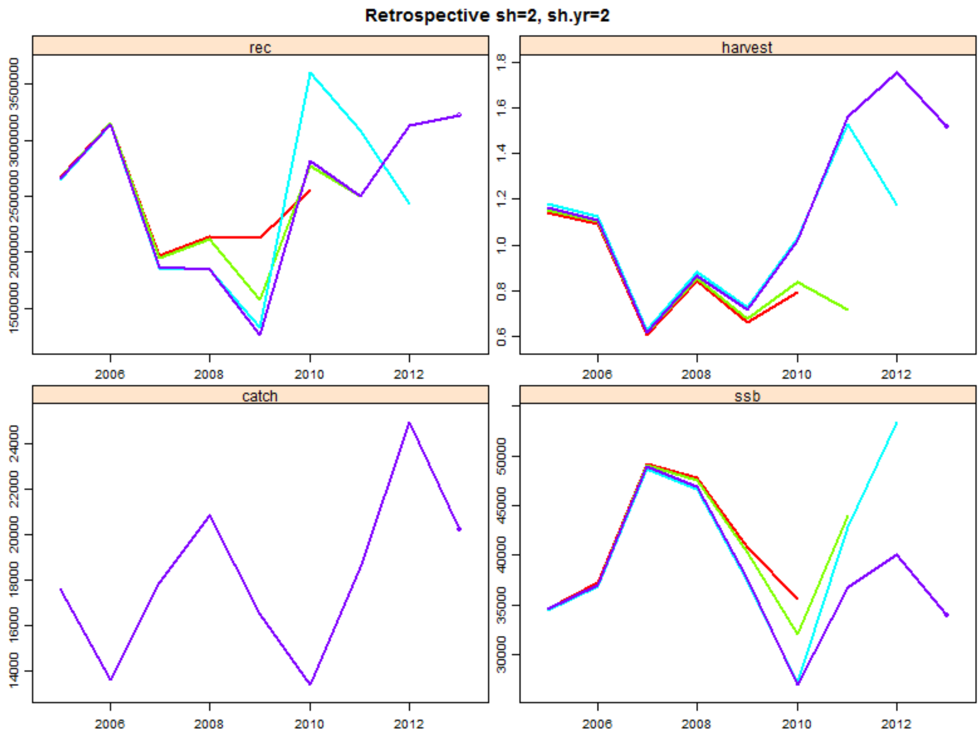


Figure 6.1.6.3 Retrospective trends of the assessment parameters (average over ages 1-3), recruitment, SSB, catch and harvest for shrinkage 2.

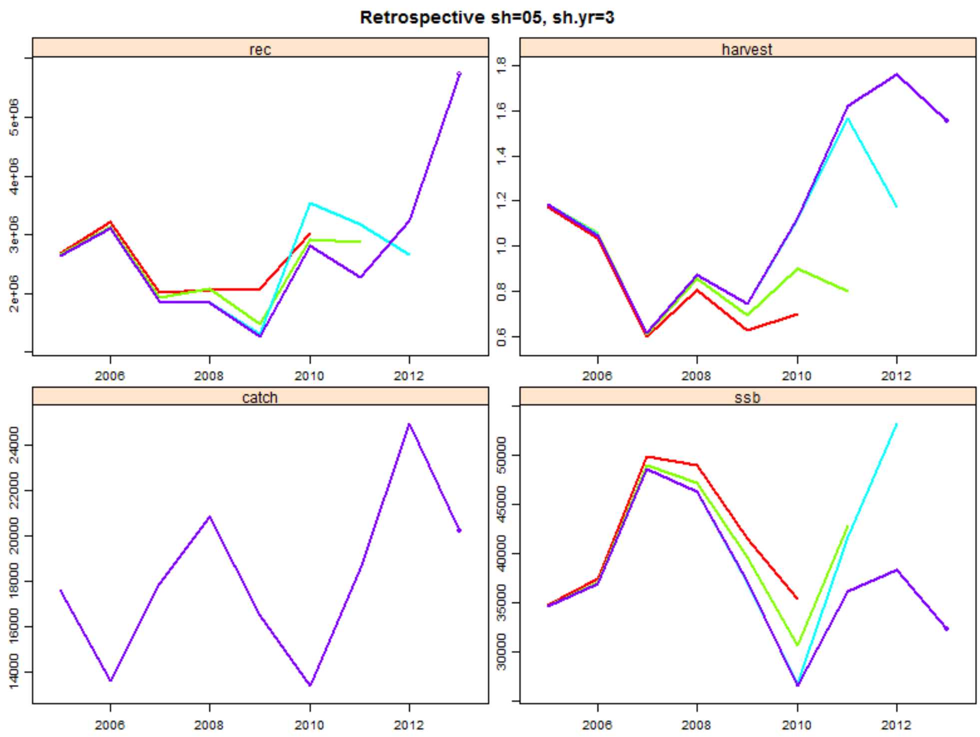


Figure 6.1.6.4 Retrospective trends of the assessment parameters (average over ages 1-3), recruitment, SSB, catch and harvest for shrinkage 0.5.

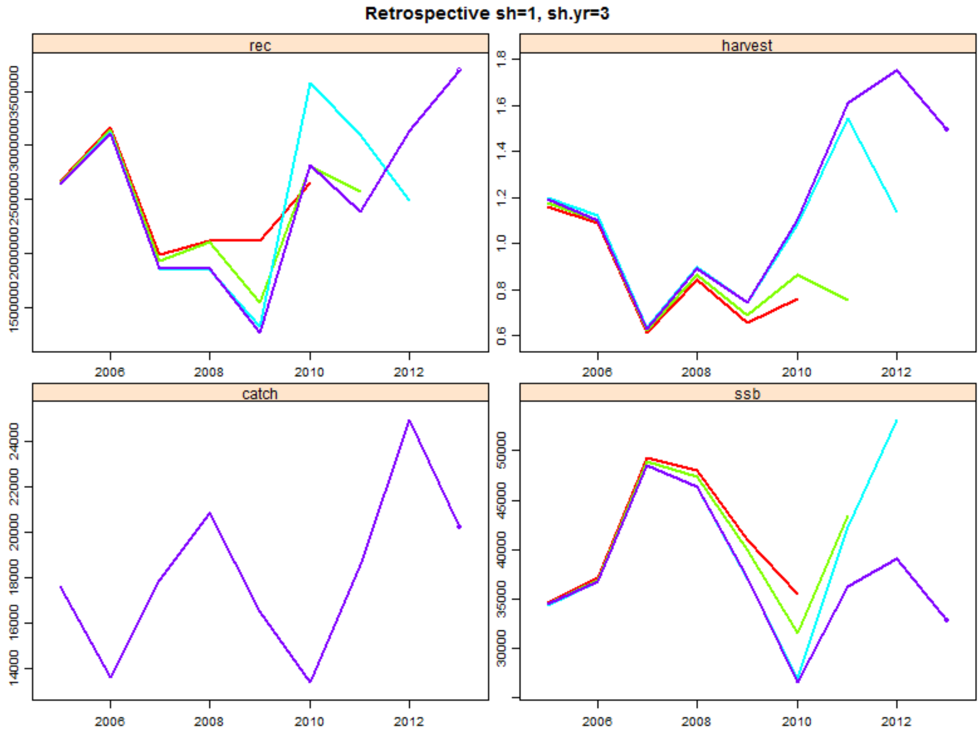


Figure 6.1.6.5 Retrospective trends of the assessment parameters (average over ages 1-3), recruitment, SSB, catch and harvest for shrinkage 0.5.

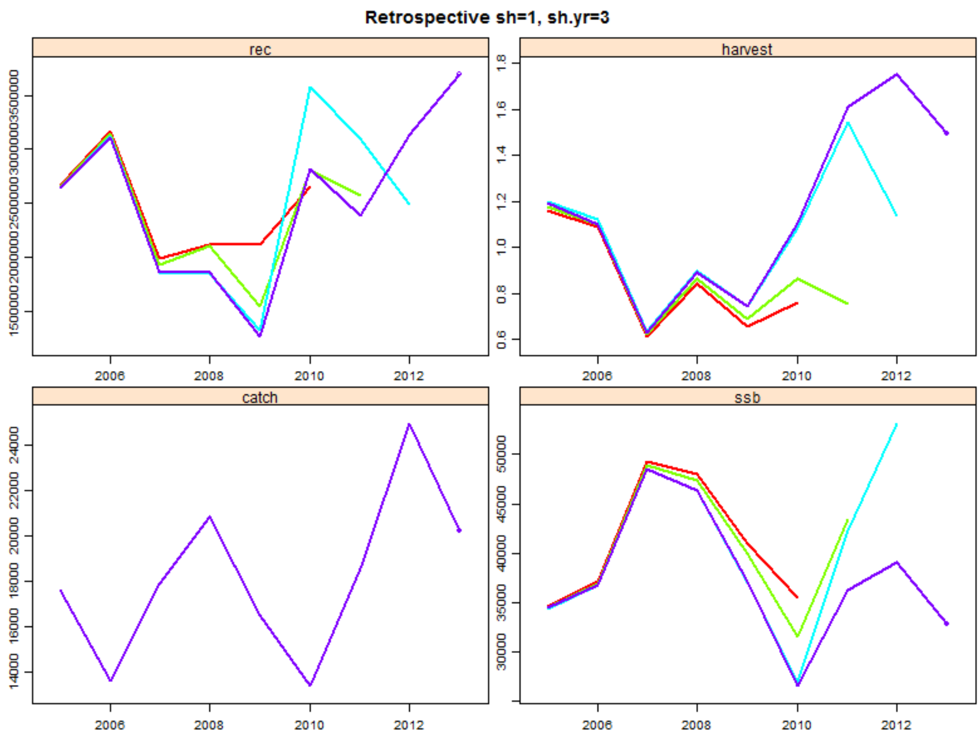


Figure 6.1.6.6 Retrospective trends of the assessment parameters (average over ages 1-3), recruitment, SSB, catch and harvest for shrinkage 1.

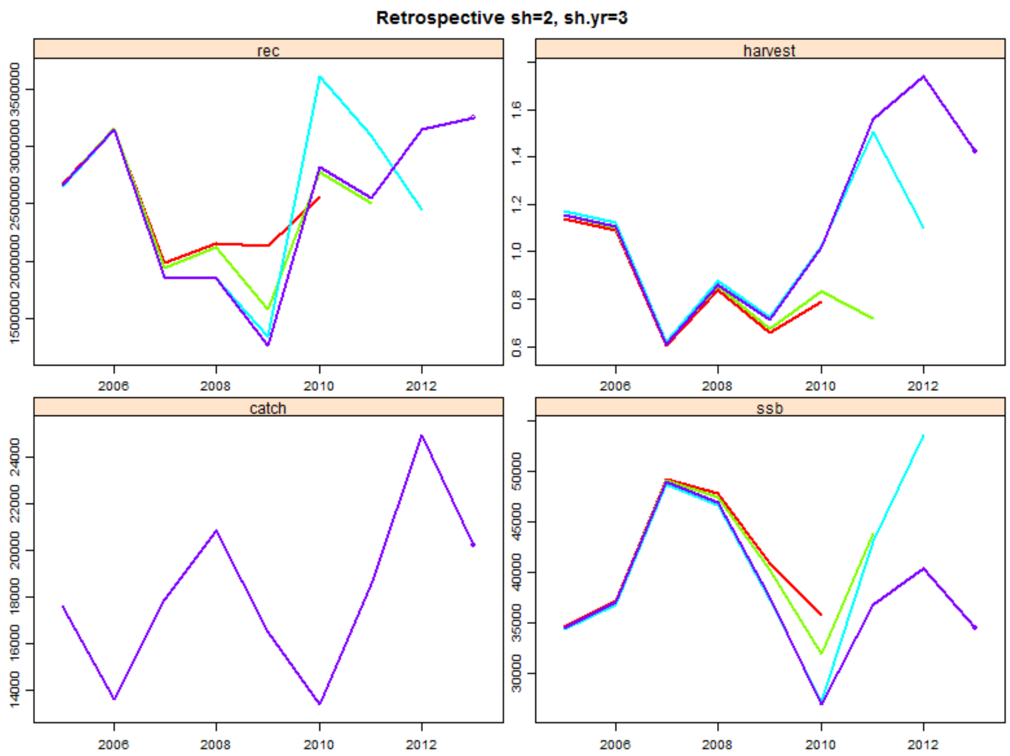


Figure 6.1.6.7 Retrospective trends of the assessment parameters (average over ages 1-3), recruitment, SSB, catch and harvest for shrinkage 2.

Based on the residual patterns and the retrospective analysis the best assessment was deemed the hma.xsa5, which has a 3 years of shrinkage on 2 ages and a standard error of 2 (Figure 6.1.6.8).

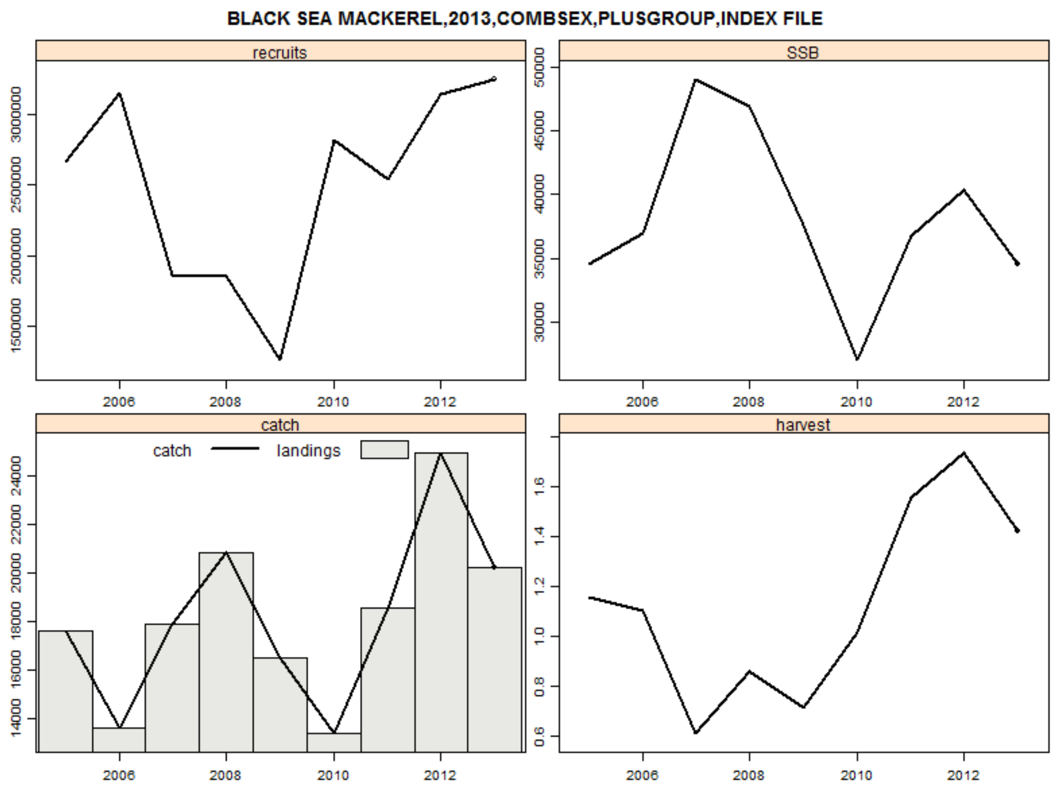


Figure 6.1.6.8 Final assessments for Horse Mackerel in the Black Sea according to the XSA best model run (hma.stk5).

Assessment results are reported in Table 6.1.6.1

Table 6.1.6.1 Results of the best assessments Spawning Stock Biomass (SSB), F over age 1-4 (F_{bar}), Recruitment (REC), catch and landings.

	SSB	F_{bar}	REC	CATCH	LANDINGS
2005	34538.37	1.1577857	2661622	17602.40	17602.40
2006	37022.25	1.1054564	3149912	13625.33	13625.33
2007	49013.28	0.6102013	1863902	17886.08	17886.08
2008	46907.62	0.8597044	1851759	20842.85	20842.85
2009	37647.47	0.7154386	1255322	16489.06	16489.06
2010	26970.41	1.0172681	2820623	13405.50	13405.50
2011	36771.91	1.5578679	2543753	18558.87	18558.87
2012	40405.69	1.7370362	3142292	24931.36	24931.36
2013	34530.60	1.4231011	3244748	20213.51	20213.51

Assessment formulations indicate that the SSB in 2013 is decreasing from previous year, but is fluctuating since 2005. In the absence of total stock size estimates and biological reference points, it is impossible to fully evaluate the stock size with regard to the precautionary approach.

Given the current assessment of horse mackerel in the Black Sea, F_{2013}= 1.42310. Since the stock is pelagic as reference point the Patterson Exploitation E=0.4 was selected to be consistent with long term exploitation of the stock. The E_{2013}= 0.7805936 is almost two times higher than the reference point, thus the stock is in state of overexploitation in 2013 and since 2005.

6.1.7 Assessment quality

The stock assessment for horse mackerel given the improvement over previous year's assessments. The main reason for accepting the current XSA assessments is the availability this year of a tuning fleet from commercial CPUE from Turkey that is considered reliable and is deemed appropriate for tuning the bulk of the catches coming from the Turkish series. There are however two limitations with this CPUE: first, the CPUE is an index of biomass split with the age structure of the catch matrix from Turkey; second, the yearly biomass index is derived by summing the monthly CPUEs rather than averaging across months. Finally a commercial CPUE derived from purse-seine and standardized to kg/vessel/day is a very raw index since it does not account of search time, number of sets, boat size etc. A much better index should be derived from fisheries independent surveys. Thus an international hydro-acoustic survey should be established to monitor trends in the horse mackerel age-structure and stock biomass across all national waters of the Black Sea.

7 Stock predictions

Assessment formulations indicate that the SSB in 2013 is decreasing from previous year, but is fluctuating since 2005. In the absence of total stock size estimates and biological reference points, it is impossible to fully evaluate the stock size with regard to the precautionary approach.

7.1 Short term predictions

Given the limitations, described above, with the Turkish CPUE used to tune the assessment, it is unable to provide a short term prediction of stock size and biomass under various management scenarios.

7.2 Medium term predictions

Given the limitations, described above, with the Turkish CPUE used to tune the assessment it is unable to provide a medium term prediction of stock size and biomass under various management scenarios.

7.3 Long term predictions

Given the limitations, described above, with the Turkish CPUE used to tune the assessment, it is unable to provide a long term prediction of stock size and biomass under various management scenarios.

Draft scientific advice

Based on	Indicator	Analytic al reference point (name and value)	Current value from the analysis (name and value)	Empirical reference value (name and value)	Trend (time period)	Status
Fishing mortality	Fishing mortality		F_{2013}= 1.42310		I	
	Fishing effort					
	Catch				D	
Stock abundance	Biomass					
	SSB				D	
Recruitment					I	
Final Diagnosis		overexploited				

7.4 Explanation of codes

Trend categories

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

Stock Status

Based on Fishing mortality related indicators

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

Range of Overfishing levels based on fishery reference points

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

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

*Fc is current level of F

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

Based on Stock related indicators

1) **N - Not known or uncertain:** Not much information is available to make a judgment
2) **S - Sustainably exploited:** Standing stock above an agreed biomass based Reference Point;
3) **O - Overexploited**: Standing stock below the value of the agreed biomass based Reference Point. An agreed range of overexploited status is provided;

Empirical Reference framework for the relative level of stock biomass index

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

4) **D – Depleted**: Standing stock is at lowest historical levels, irrespective of the amount of fishing effort exerted;
5) **R –Recovering:** Biomass are increasing after having been depleted from a previous period;

Agreed definitions as per SAC Glossary

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

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

Stock Assessment Form

Small Pelagics

Reference year:2013

Reporting year:2014

* Sprat is a key species for the Black Sea ecosystem. Its key role is determined by the importance from both commercial and ecological point of view. The sprat fishery takes place in the Black Sea (GFCM Fishing Sub-area 37.4 (Division 37.4.2) and Geographical Sub-area (GSA) 29). The sprat landings highly varied as for 2000-2013 the average catch accounted to 62097.69 tons. In 2012 the catch dropped significantly from 120708 t to 35025 t and continúe to decaerse at 27268.48 t in 2013. Discards of sprat are evidently very low. Most of the reported landings of sprat since 2004 were taken by Turkey (47%). The stock was exploited unsustainably during 2010, 2011 and 2012 (but not during 2013). The catch forecast for 2014 based on the accepted proxy for F_{MSY} (exploitation ≤ 40%) is 48 775 t, which is more than the catch forecast under status quo fishing. There is concern that the fishery for sprat produces significant quantities of bycatch and discard of other fish species, such as whiting. State of the spawning stock size: According to the present assessment in recent years the SSB is at medium levels (180 000-300 000 t) with a decreasing trend since 2010. In 2013, the SSB has dropped to 179 464 t. Under a constant recruitment scenario and status quo F = 0.446, in 2014 the SSB is expected to increase to 198 189 and to decrease to 185 093 t by 2016.
*

1 Basic Identification Data

<table>
<tr><th colspan="2">Scientific name:</th><th colspan="2">Common name:</th><th colspan="2">ISCAAP Group:</th></tr>
<tr><td colspan="2">Sprattus sprattus L.</td><td colspan="2">Sprat</td><td colspan="2"></td></tr>
<tr><th colspan="2">1st Geographical sub-area:</th><th colspan="2">2nd Geographical sub-area:</th><th colspan="2">3rd Geographical sub-area:</th></tr>
<tr><td colspan="2">29</td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><th>Bulgaria</th><th>Romania</th><th>Ukraine</th><th>Russian Federation</th><th>Turkey</th><th>Georgia</th></tr>
<tr><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><th colspan="6">Stock assessment method: (direct, indirect, combined, none)</th></tr>
<tr><td colspan="6">Indirect for GSA29</td></tr>
<tr><th colspan="6">Authors:</th></tr>
<tr><td colspan="6"></td></tr>
<tr><th colspan="6">Affiliation:</th></tr>
<tr><td colspan="6">Abella, J. A., Andersen, J., Bailey, N., Bertignac, M., Cardinale, M., Curtis, H., Daskalov, G., Delaney, A., Döring, R., Garcia Rodriguez, M., Gascuel, D., Graham, N., Gustavsson, T., Jennings, S., Kenny, A., Kraak, S., Kuikka, S., Malvarosa, L., Martin, P., Murua, H., Nord, J., Nowakowski, P., Prellezo, R., Sala, A., Scarcella, G., Somarakis, S., Stransky, C., Theret, F., Ulrich, C., Vanhee, W. & Van Oostenbrugge, H. Sampson, D., Ak, O., Cardinale, M., Chashchyn, O., Damalas, D., Dagtekin, M., Daskalov, G., Duzgunes, E., Genç, Y., Gucu, A.C., Gumus, A., Maximov, V., Osio, G. C., Panayotova, M., Radu, G., Raykov, V., Yankova, M. and Zengin, M.</td></tr>
</table>

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

Direct methods (you can choose more than one):

- Acoustics survey x
- Egg production survey
- Trawl survey x

Indirect method (you can choose more than one):

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

2 Stock identification and biological information

The Black Sea sprat (*Sprattus sprattus L.*) is a key species in the Black Sea ecosystem. Sprat is a marine pelagic schooling species, sometimes entering in the estuaries (especially as juveniles) and the Azov Sea and tolerating salinities as low as 4‰. Sprat is one of the most important fish species, being fished and consumed traditionally in the Black Sea countries. It is most abundant small pelagic fish species in the region, together with anchovy and horse mackerel and accounts for most of the landings in the north-western part of the Black Sea. Whiting is also taken as a by-catch in the sprat fishery, although there is no targeted fishery beyond this (Raykov, 2006) except for Turkish waters. Sprat fishing takes place on the continental shelf on 15-110 m of depth (Shlyakhov, Shlyakhova, 2011). The harvesting of the Black Sea sprat is conducted during the day time when its aggregations become denser and are successfully fished with trawls. The main fishing gears are mid-water otter trawl, pelagic pair trawls and uncovered pound nets. The species is fast growing; age comprises 4-5 age groups. Sprat has lengths comprised between 50 and 120 mm, the highest frequency pertaining to the individuals of 70-100 mm lengths. The age corresponding to these lengths was 0+ - 4-4+, the ages 2-2+ - 3-3+ having a significant participation. By 1982, the age classes 4-4+ years had a share of 34% from the catch of this species, then the percentage continually decreased up to 1995 when this age was not signalled, meaning the increase of the pressure through fishing exerted on the populations. While the share of this age decreased, the prevalence of 0+ especially 1-1+ ages became increased. During last years the age structure show the presence of the specimens of $1\text{-}1^+$ and 3; 3^+ years, the catch base being the individuals of $1\text{-}1^+$ and $2\text{-}2^+$ years. The sprat fishery is taking place in the Black Sea (GFCM Fishing Sub-area 37.4 (Division 37.4.2) and Geographical Sub-area (GSA) 29). The opportunities of marine fishing are limited by the specific characteristics of the Black Sea. The exploitation of the fish recourses is limited in the shelf area. The water below 100-150 m is anoxic and contains hydrogen sulphide. In Bulgarian, Romanian, Russian and Ukrainian waters the most intensive fisheries of Black Sea sprat is conducted in April till October with mid-water trawls on vessels 15- 40 m long and a small number vessels >40m. Beyond the 12-mile zone a special permission is needed for fishing. Harvesting of Black Sea sprat is conducted during the day, when the sprat aggregations become denser and are successfully fished with mid-water trawls.

2.1 Stock unit

It is assumed that sprat represent a unit stock shared among the Black Sea countries

2.2 Growth and maturity

No specified research on maturity was performed in 2013. Peak of spawning activity take place in December-February.

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

Somatic magnitude measured (LH, LC, etc)*					Units*	
Sex	**Fem**	**Mal**	**Both**	**Unsexed**		
Maximum size observed			12.5		**Reproduction season**	Nov-March
Size at first maturity			5.5		**Reproduction areas**	North western Black Sea
Recruitment size					**Nursery areas**	North western Black Sea coastal zone and marginal habitats

Table 2.2-2: Growth and length weight model parameters

	L∞	k	t0	A	b
Bulgaria	12.03	0.66	-1.33	0.008	2.784
Romania	12.10	0.350	-1.67	0.0064	2.974
Ukraine	12.42	0.286	-1.504	0.0085	2.969
Turkey	13.04	0.445	-1.096	0.004	1.878

			Sex			
		Units	**female**	**male**	**both**	**unsexed**
Growth model	**L_∞**					
	K					
	t_0					
	Data source	Sampson et al., 2014				
Length weight relationship	**A**					
	B					

M (vector by length or age)	0.95				

sex ratio (% females/total)	F51:M49

3 Fisheries information

The sprat fishery is taking place in the Black Sea (GFCM Fishing Sub-area 37.4 (Division 37.4.2) and Geographical Sub-area (GSA) 29). The opportunities of marine fishing are limited by the specific characteristics of the Black Sea. The exploitation of the fish recourses is limited in the shelf area. The water below 100-150 m is anoxic and contains hydrogen sulphide. In Bulgarian, Romanian, Russian and Ukrainian waters the most intensive fisheries of Black Sea sprat is conducted in April till October with mid-water trawls on vessels 15- 40 m long and a small number vessels >40m. Beyond the 12-mile zone a special permission is needed for fishing. Harvesting of Black Sea sprat is conducted during the day, when the sprat aggregations become denser and are successfully fished with mid-water trawls. . Most of the reported landings of sprat since 2004 were taken by Turkey (47%).

For the period 1993 to 2012 catches of sprat in the Black Sea increased steadily from a low level of about 17 thousand tons in 1993 to a first peak level of about 72 thousand tons in 2002, and a subsequent peak of almost 121 thousand tons in 2011. Catch during 2013 was only 27 thousand tons.

3.1 Description of the fleet

Table 3.1-1: Description of operational units in the stock

	Country	GSA	Fleet Segment	Fishing Gear Class	Group of Target Species	Species
Operational Unit 1	Bulgaria	29	24<40 12<18 18<24 6<12	OTM	Sprat, horse mackerel,bluefish,anchovy	Alosa immaculata,Atherina pontica,Raja clavata, Dasyatis pastinavca,M.merlangius, Squalus acanthias etc
Operational Unit 2	Bulgaria	29	-	FPN GNS	Sprat, anchovy, horse mackerel	Alosa immaculata,Atherina pontica,Raja clavata, Dasyatis pastinavca,M.merlangius,Squalus acanthias etc
Operational Unit 3	Romania	29	24<40	OTM	Sprat, anchovy, horse mackerel	Alosa immaculate,Atherina pontica,Raja clavata, Dasyatis pastinavca,M.merlangius, Squalus acanthias etc
Operational Unit 4	Romania	29	-	FPN,GNS	Sprat, anchovy,horse mackerel	Alosa immaculata,Atherina pontica,Raja clavata, Dasyatis pastinavca,M.merlangius, Squalus acanthias etc
Operational	Ukraine	29	24<40		Sprat, anchovy,horse	Alosa immaculata,Atherina pontica,Raja clavata, Dasyatis

Unit 5			12<18 18<24 6<12		mackerel	pastinavca,M.merlangius, Squalus acanthias etc

Operational Unit 6	Turkey	29	24<40 12<18 18<24 6<12	OTM, Pair trawls, Purse seiners	Sprat, horse mackerel,bluefish,anchovy,bonito	Alosa immaculata,Atherina pontica,Raja clavata, Dasyatis pastinavca,M.merlangius, Squalus acanthias etc

Operational Unit 7	Russian Federation	29	24<40 12<18 18<24 6<12	OTM	Sprat, horse mackerel,bluefish,anchovy	Alosa immaculata,Atherina pontica,Raja clavata, Dasyatis pastinavca,M.merlangius, Squalus acanthias etc

Table 3.1-2: Catch, bycatch, discards and effort by operational unit

Operational Units*	Fleet (n° of boats)*	Kilos or Tons	Catch (species assessed)	Other species caught	Discards (species assessed)	Discards (other species caught)	Effort units
1 BG OTM	69	3784 tons	sprat	M.merlangius,D.pastinaca,Raja clavata,Sq.acanthias,Alosa immaculata, etc	no	-	Kw*days/GT*days
2BG FPO	32 stationary nets FPO	Not known t	sprat	M.merlangius,D.pastinaca,Raja clavata,Sq.acanthias,Alosa immaculata,Atherina pontica etc	no	-	Days deployed
3 RO OTM	4	99t	sprat	M.merlangius,D.pastinaca,Raja clavata,Sq.acanthias,Alosa immaculata,Atherina pontica etc	1%	-	Kw*days, GT*days
4 RO FPN	26	Not known t	sprat	M.merlangius,D.pastinaca,Raja clavata,Sq.acanthias,Alosa immaculata,Atherina pontica etc	-	-	Days, hours deployed
5 UKR OTM	23	24652 t	sprat	M.merlangius,D.pastinaca,Raja clavata,Sq.acanthias,Alosa immaculata,Atherina pontica etc	-	-	Kw*days, GT*days
6 TU Pair trawl,OTM	60	9764	sprat	M.merlangius,D.pastinaca,Raja clavata,Sq.acanthias,Alosa immaculata,Atherina pontica etc	-	-	Kw*days,GT*days
7 RU OTM	Not known	842	Sprat	M.merlangius,D.pastinaca,Raja	-	-	Kw*days,GT*days

				clavata,Sq.acanthias,Alosa immaculata,Atherina pontica etc			
Total		27269					

Table 3.1-3: Catches as used in the assessment

Classification	**Catch (tn)**
BG	3784.1918
RO	98.84
UKR	12866.052
TU	9677.4
RU	842
Total	27268.48

3.2 Historical trends

Table.3.2.1 DCF fishing effort in Bulgarian marine zone(number of vessels) as submitted to JRC through the DCF 2013 Med and Black Sea data call by major gear type 2008-2013 in Bulgaria (A) and Romania (B)

(A)

YEAR	VESSEL_LENGTH	GEAR	MESH_SIZE_RANGE	FISHERY	AREA	NOMINAL_EFFORT	GT_DAYS_AT_SEA	NO_VESSELS
2008	VL1824	OTM	14D16	MDPSP	SA 29	16560	5100	2
2008	VL1218	OTM	14D16	MDPSP	SA 29	2740	304	4
2008	VL0612	FPN	14D16	MDPSP	SA 29	72575	32256	13
2008	VL0006	FPN	14D16	MDPSP	SA 29	3198	410	4
2009	VL2440	OTM	14D16	SPF	SA 29	10592	4352	2
2009	VL0612	FPN	14D16	MDPSP	SA 29	113342	50377	17
2009	VL0006	FPN	14D16	MDPSP	SA 29	5429	714	7
2010	VL2440	OTM	14D16	SPF	SA 29	662	272	1
2010	VL0612	FPN	14D16	MDPSP	SA 29	102528	45546	14
2010	VL0006	FPN	14D16	MDPSP	SA 29	2624	100	3

Year	Vessel Length	Gear	Mesh Size Range	Fishery	Area	Nominal Effort	GT_Days_at_Sea	Num Vessels
2008	VL0006	SB	00D14	MDPSP	SA 29	86279	7201	45
2008	VL0612	FPO	00D14	MDPSP	SA 29	16388855	155008	192
2008	VL1218	OTM	00D14	SPF	SA 29	1068620	146035	9
2008	VL1824	OTM	00D14	SPF	SA 29	808959	204422	4
2008	VL2440	OTM	20D40	SPF	SA 29	4251250	2025889	11
2009	VL0006	SB	00D14	MDPSP	SA 29	35948	6960	38
2009	VL0612	FPO	00D14	MDPSP	SA 29	12075037	1178437	169
2009	VL1218	OTM	00D14	SPF	SA 29	2957668	434558	15
2009	VL1824	OTM	00D14	SPF	SA 29	1440379	376387	5
2009	VL2440	OTM	20D40	SPF	SA 29	5520149	2650975	12
2010	VL0006	SB	00D14	MDPSP	SA 29	249121	27299	64
2010	VL0612	FPO	00D14	MDPSP	SA 29	18617358	1710535	188
2010	VL1218	OTM	00D14	SPF	SA 29	3559407	449947	6
2010	VL1824	OTM	00D14	SPF	SA 29	1306384	351630	7
2010	VL2440	OTM	20D40	SPF	SA 29	6995010	3003786	13
2011	VL0006	SB	00D14	MDPSP	SA 29	34136	3493	39
2011	VL0612	FPO	00D14	MDPSP	SA 29	740804	64139	87
2011	VL0612	OTM	00D14	MDPSP	SA 29	180869	15660	4
2011	VL1218	OTM	00D14	SPF	SA 29	5833424	827010	23
2011	VL1824	OTM	00D14	MDPSP	SA 29	856319	246060	5
2011	VL2440	OTM	20D40	SPF	SA 29	6172300	2718507	11
2012	VL0006	SB	00D14	MDPSP	SA 29	1649473	156317	124
2012	VL0612	FPO	00D14	MDPSP	SA 29	4694659	389268	104
2012	VL0612	OTM	00D14	MDPSP	SA 29	26822	2224	8
2012	VL1218	OTM	00D14	SPF	SA 29	7499190	1001555	26
2012	VL1824	OTM	00D14	MDPSP	SA 29	2080654	543064	12
2012	VL2440	OTM	20D40	SPF	SA 29	5570111	2511970	10
2013	VL0006	FPO	00D14	SPF	SA 29	295.47	54.27	1
2013	VL0612	FPO	00D14	SPF	SA 29	22012.69	2297.76	31
2013	VL0612	OTM	00D14	MDPSP	SA 29	10819.3	1204.68	10
2013	VL1218	OTM	00D14	MDPSP	SA 29	193288.8	22383.5	35
2013	VL1824	OTM	00D14	MDPSP	SA 29	135303.2	38066.1	13
2013	VL2440	OTM	20D40	MDPSP	SA 29	430653.6	207801	11

2011	VL2440	OTM	14D16	SPF	SA 29	27158	8012	2
2011	VL2440	OTM	14D16	MDPSP	SA 29	4416	1290	1
2011	VL0612	FPN	14D16	MDPSP	SA 29	90236	26371	40
2011	VL0006	FPN	14D16	MDPSP	SA 29	1727	151	8
2012	VL2440	OTM	14D16	SPF	SA 29	23405	6837	1
2012	VL1218	FPN	14D16	DEMSP	SA 29	695	68	1
2012	VL0612	FPN	14D16	DEMSP	SA 29	195992	52100	27
2012	VL0006	FPN	14D16	DEMSP	SA 29	2394	199	4
2013	VL2440	OTM	14D16	SPF	SA 29	52245	11280	2
2013	VL1218	OTM	14D16	SPF	SA 29	3530	384	1
2013	VL0612	FPN	14D16	MDPSP	SA 29	195548	38434	22
2013	VL0612	OTM	14D16	SPF	SA 29	528	37	1
2013	VL0006	FPN	14D16	MDPSP	SA 29	3270	431	4

(B)

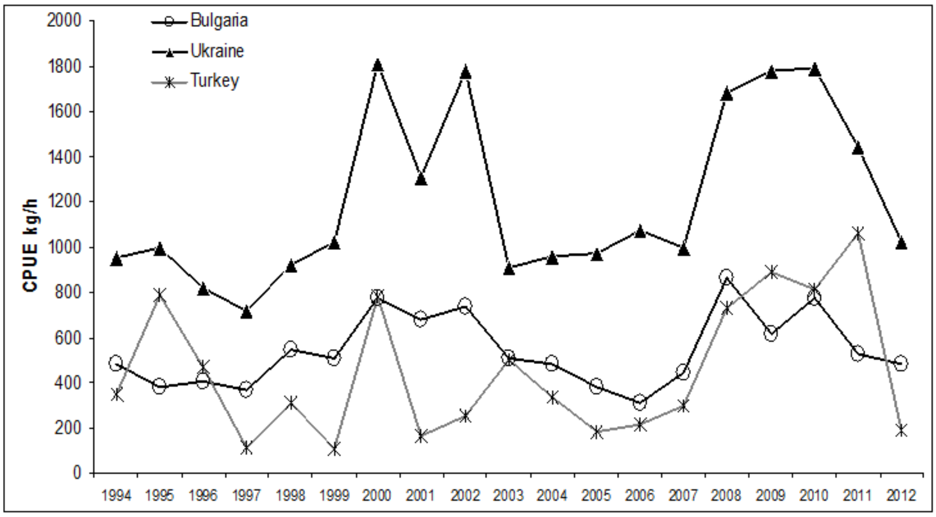


Fig.3.2.1. CPUE $kg*h^{-1}$ derived from commercial fishery in Bulgaria, Ukraine and Turkey.

3.3 Management regulations

A quota (Table) is allocated in EU waters of the Black Sea (Bulgaria and Romania). No fishery management agreement exists among other Black Sea countries. In the EU Black Sea waters a global (both Romania and Bulgaria) TAC 12 750 tons has been allocated in 2009 and 2010. In 2011 and in 2012 and 2013 allocated quota in Bulgarian waters was at the rate of 8 032.5 t sprat (Council Regulation 5/2012) and 3 442.49 t for Romanian waters .The decreasing trend in indices since 2008 was observed despite of quotas regime in force in community waters. From the catches of fish only the turbot species (*Psetta maxima*) and sprat (*Sprattus sprattus*) are subject to quotas and are included in the National data collection program (NDCP). The applied quotas are precautionary because it is not possible their biomass to be calculated for the whole water basin of the Black Sea.

Table 3.3.1. EC quota and recommended Total allowable catch of sprat in EU waters for 2008-2013.

Year	*2008*	*2009*				

National data			***2010***	***2011***	***2012***	***2013***
Spicies	***Sprat (SPR)***	***Sprat (SPR)***	***Sprat (SPR)***	***Sprat (SPR)***	***Sprat (SPR)***	***Sprat (SPR)***
Quota. T	15 000[2]	12 750[2]	12 750[2]	11 475[2] 8032.51	11 475[2] 8032.51	11 475[2] 8032.51
Total catch. t	4 300.0363(BG) 234 (RO)	4 541.35 (BG) 92(RO)	4 039. 966 (BG) 39(RO)	3 957.895 (BG) 131.3 (RO)	3 156.832 (BG) 87.458(RO)	3784.191 (BG) 98.84(RO)
Biomass. T	32 718.33 60 000[5]	41 761.398[3] 60 000[5]	75 080.20[4] 59 600[5]	48 201.7[4] -	- 688 865	- 56 428
Recommended TAC	Average 13 746.57	11 469.9[3]	12 500[4]	-	-	-

NB: 1 - quota according to Regulation (EU) № 1579/2007. Regulation (EU) № 1139/2008. Regulation (EU) № 1287/2009. Regulation (EU) № 1004/2010. Regulation (EU) № 1256/2010. Regulation (EU) № 5/2012

2 - EC's quota

3 - Source of data: Institute of Oceanology – BAS. Bulgaria

4 - Source of data: Institute of Oceanology – BAS. Bulgaria and NIMRD,Romania

5National Institute for Marine Research and Development. Romania

In Turkey:

Regulations about fishing area: Sprat fishery by pelagic trawls should be conducted only along Samsun shelf area. The coordinates of this area were specified. But except sprat. the fishery was allowed for anchovy. horse mackerel and bluefish along other trawling areas in Black Sea.

Regulations about fishing gear: In Turkey pelagic trawls operate as paired vessels. Vessels engaged in sprat fishery need to receive licence eligible only for one fishing period from Samsun City Directorate of Food. Agriculture and Livestock. The single vessel operation in pelagic fishery seems to be inconvenient for Turkey at least for now as the fisherman can quickly change the gear to bottom trawling during operation.

Regulations about time periods: Though pelagic fishing period starts in 15 September as same as bottom trawling. it lasts to 15 May. Bottom trawling ends with 15 April. There is no limitation in distance from land for pelagic trawling.

Regulations about depth: The pelagic fishery is banned in waters shallower than 18 m in fishing area between 15 September and 15 April. But between 15 April-15 May it is allowed in waters deeper than 36 m limited with offshore of Çayağzı Cape (Samsun-Yakakent) in west and Akçay estuary (Samsun - Ordu city border) in east (Anonymous. 2006). Sprat catch reaches a maximum in this one month-period and provide a great economic input for fishermen. Conversely with bottom trawling depth limitations are in force in pelagic fishery instead distance from land. But as mentioned above the depth limitation is increased to 36 m by 15 April in order to protect spawning adults and juveniles on coastal zone.

Table.3.3.1.Sprat TAC applied in Ukraine and Russian Federation in tons.

Year	Russian Federation	Ukraine
2005	42 000	60 000
2006		70 000
2007		40 000
2008	21 000	50 000
2009	21 000	50 000
2010	21 000	50 000
2011		60 000
2012		70 000
2013		70 000

Table 3.3.2. Minimum landing size of sprat in the Black sea region

	BG	**GE**	**RO**	**RU**	**TR**	**UA**
Sprattus sparttus	TL=7cm	SL=6cm	TL=7cm	SL= 6cm	NO	SL=6cm

Legend: TL-total length; SL-standard length;

3.4 Reference points

Table 3.4-1: List of reference points

Criterion	Current value	Units	Reference Point	Trend	Comments
B					
SSB	180000		300-400000	decreased	The SSB decreased after 2011
F	0.446		=F≤0.64	decreasing	The *status quo* fishing in 2014 would result in landings 35 678 t and SSB of 198 971 t. It is likely to occur since the 3 years olds individuals increased in the stock.
Y	27260		100000 t	decreasing	There are significant evidences that sprat landings increased last years. In 2012 and especially in 2013 the catches dropped
CPUE				decreasing	

4 Fisheries independent information

4.1.Pelagic survey in Romanian waters (PS)

Pelagic survey under DCF was conducted in spring 2013 only in Romanian waters. During the surveys the collected information included length (TL), weight, sex composition and maturity. Each survey includes 30-40 mid-water trawl hauls for 8-10 days. The pelagic trawl has the following dimensions: 57/63-62m, with horizontal opening of 22m. The average speed of the vessel was of 2.5 knots. The trawling time was standardized to 60 minutes, being realized 32 hauling.

In the Fig.4.1. are presented the distribution of the sprat in the June, 2013 in Romanian waters.

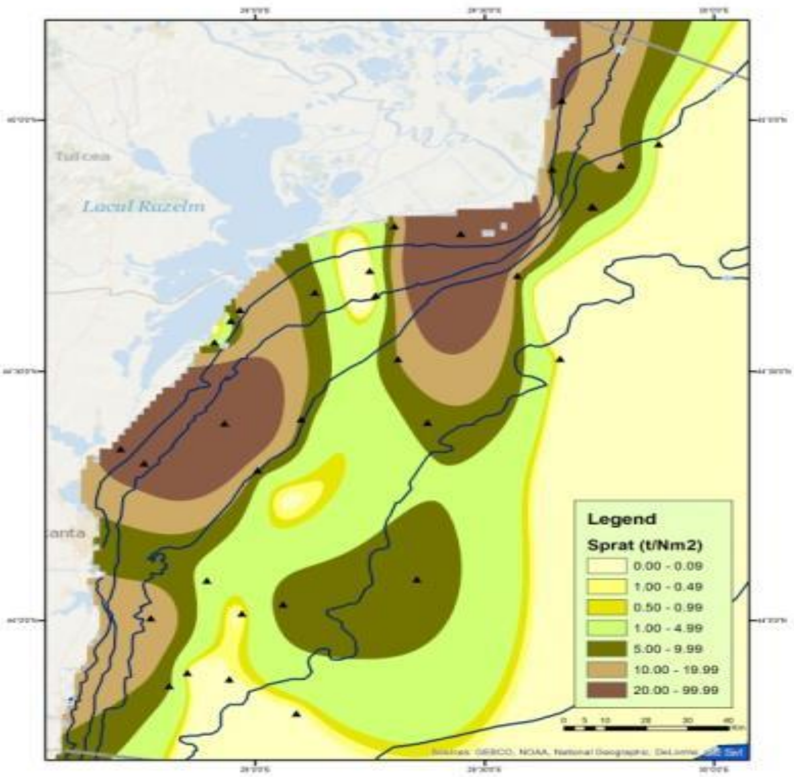


Figure 4.1.1.Distribution of the sprat agglomerations in 2nd Quarter 2013 in the Romanian marine waters

The Pelagic survey (PS) conducted in Romania in June 2013 covered Romanian waters from Sulina to Vama-Veche. Each hauling was with 30 min duration and was conducted according to “swept area” method (Sparre and Venema, 1992)..

Table 4.1.Assessment of sprat agglomerations in June 2013, pelagic trawl survey in Romanian area

Depth range (m)	0 - 30m	30 – 50m	50-70 m	Total
Investigated area (Nm2)	625	887.5	87.5	1600
Variation of the catches (t/ Nm2)	1.755-89.977	0.00 – 16.894	0.00 – 6.74	0.00 – 89.977
Average catch (t/ Nm2)	23.96618	4.943529	3.37	11.2857
Biomass of the fishing agglomerations (t)	14978.86	4387.382	294.875	18057.266
Biomass extrapolated the Romanian shelf (t)				56428.955

4.1.1 Brief description of the chosen method and assumptions used

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

Direct methods: DEPM

Table 3.4-1: Egg production cruise information.

Date					
Cruise				**R/V**	
Total area (km^2)		Positive		**Negative**	
Egg sampler					
Adult sampler					

Table 3.4-2: Parameters of the egg mortality curve

Parameters (exponential decay model)			**value**	**CV**
P_0 (# of eggs /0.05 m^2)				
Z ($days^{-1}$)				
Temperature range	ºC	ºC		

Table 3.4-3: DEPM Model parameters

Model parameters	**value**	**CV**
P_0 (# of eggs/0.05 m^2 per day)		
A (surface of region 0.05 m^2)		
W (average female weight in gr)		
F (batch fecundity: eggs / batch per mature female)		
S (spawning fraction: # spawning female per mature female)		
R (sex ratio: females/total)		

Table 3.4-4: DEPM based estimates

Result	value	CV
Biomass (t)		

*4.1.2.*Direct methods: acoustics

The acoustically detected distribution of sprat within the Turkish EEZ during summer 2013 is presented in the Figure 6.1.3.2.1.1. The biomass of the species is remarkably higher in the eastern part of the area surveys. The averaged biomass is estimated as 6.4 tons/na2 (423 552 tons within the Turkish EEZ). However this values should be treated with care.

Hydroacoustically estimated biomass is 6.4 tons/na2

The biomass extrapolated over the Turkish EEZ is 423 552 tons

Wmean = 0.58 g

Lmean = 4.9 cm

TSmean = - 57.4 (based on B20=-71.2)

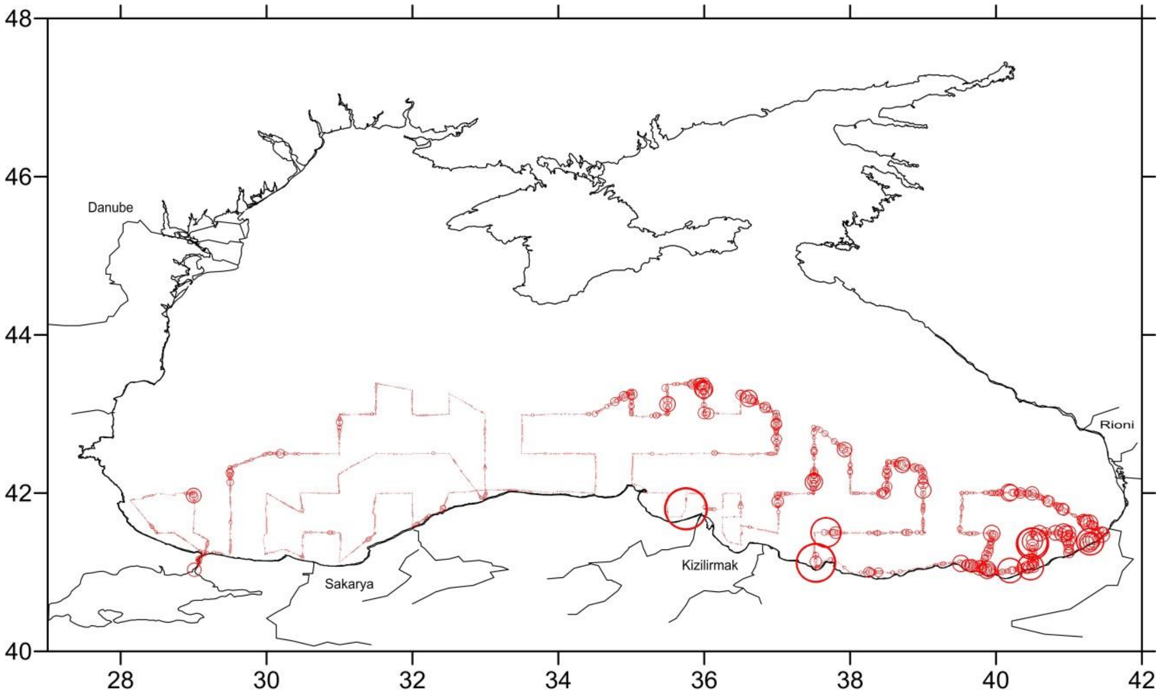


Figure 4.1.2.1Hydroacoustic survey in Turkish waters conducted in 2013 with corresponding sprat agglomerations

Table 3.4-5: Acoustic cruise information.

Date	December 2010		
Cruise		**R/V Bilim**	
Target species anchovy,sprat			
Sampling strategy	**Transects north-south parallel to the coast**		
Sampling season	**November**		

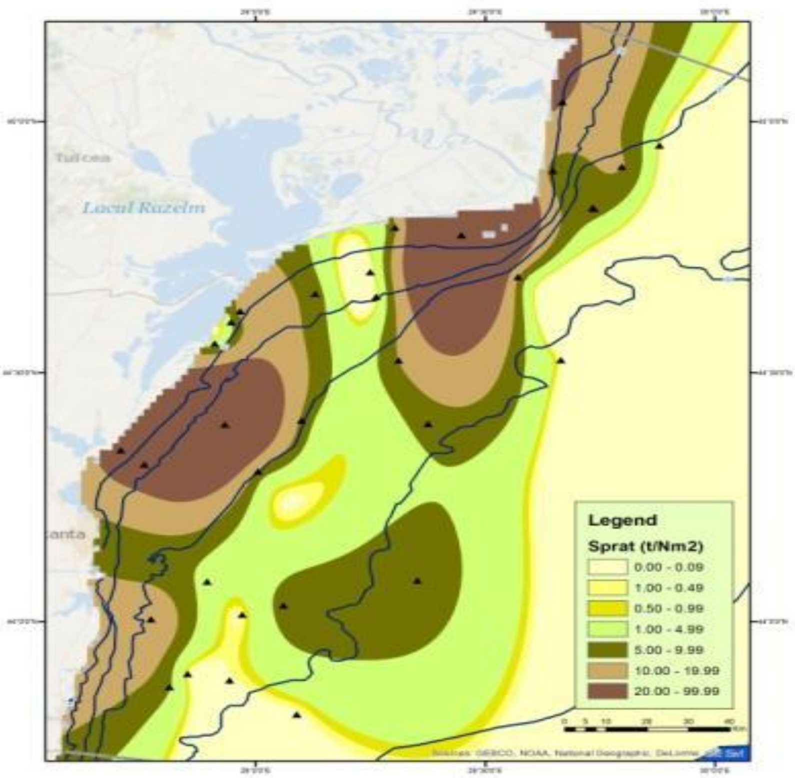
Investigated depth range (m) 40-110	
Echo-sounder SIMRAD EK60	
Fish sampler	
Cod –end mesh size as opening (mm) **6.5mm**	
ESDU (i.e. 1 nautical mile)	
TS (Target Strength)/species **Sprat** *TSmean = - 57.4 (based on B20=-71.2)*	
Software used in the post-processing	**EchoView**
Samples (gear used)	**OTM**
Biological data obtained	**Age, length, weight**
Age slicing method - Shepard	
Maturity ogive used	1

Table 3.4-6: Acoustic results, if available by age or length class

	Biomass in metric tons	fish numbers	Nautical Area Scattering Coefficient	Indicator …	Indicator …

4.1.2 Spatial distribution of the resources

Total number of hauling of PS in Romanian waters was 32 (strata: 0-35m (15 hauling); 35-50m (13 hauling) and 50-70m (4 hauling). The total amount of catch was 4530 kg. The estimated biomass in Romanian shelf was 56 428 tons



.

Figure 4.1.2.1.Distribution of the sprat agglomerations in 2nd Quarter 2013 in the Romanian marine waters

4.1.3 Historical trends

Trends in abundance at length or age

The fishing gear and method for stock assessment for sprat in 2013 used in Romanian pelagic survey was in line with previous pelagic surveys, so we were able to compare abundance indices (derived in pelagic trawl surveys) with the previous assessments.

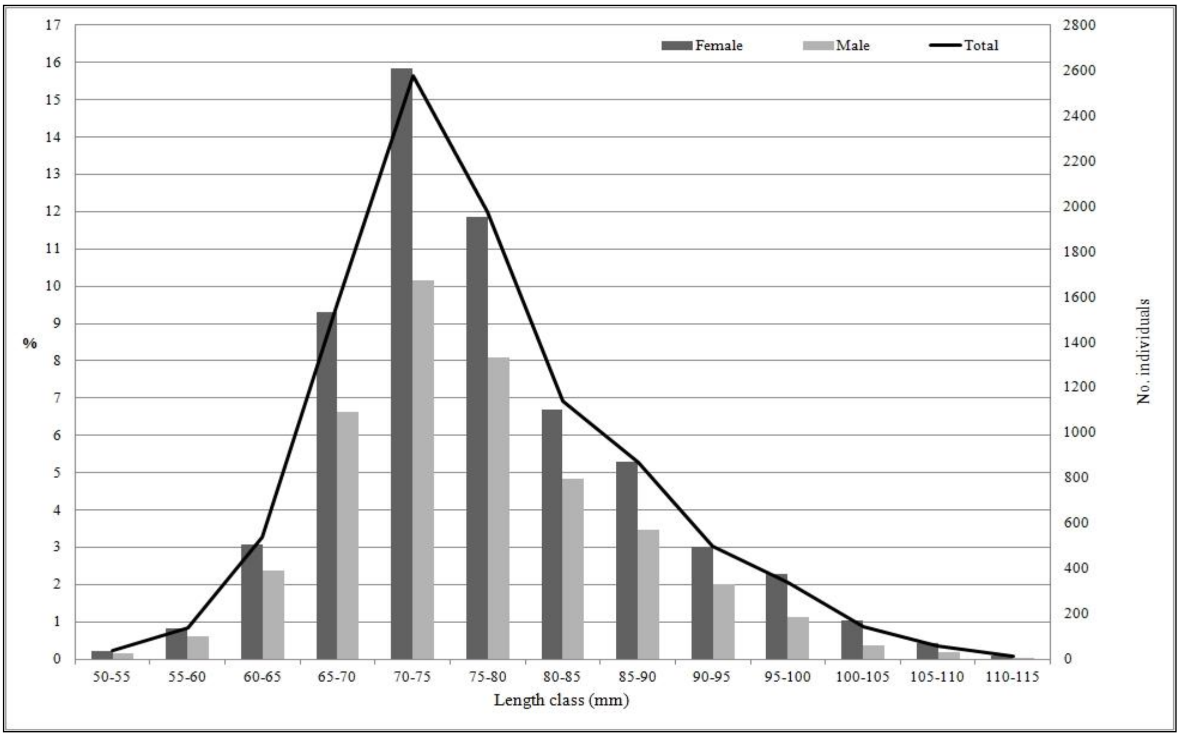


Figure 4.1.3.1. Length distribution of sprat from scientific survey in June, 2013.

Although sprat catches were low in 2013 (January - December), they were composed of mature specimens of 50 - 115 mm / 1.14 – 7.965 g, aged 1-3 years, the dominant classes are 65.5 - 90 mm / 1,87 - 3,98 g, 1 years (66.32%). Average body length was 76.88 mm and the average mass of 2.815 g. The sex ratio indicates a clear dominance of females (59.94%) than males (40.06%). The composition by age of sprat catches reveals the existence of specimens between 1 to 3 years. Most of the individuals are 1 years old (66.32%), followed closely by those of 2 years (29.19%) and of 3 years old (4.56%) Fig. 6.1.1.2.1. (Maximov, 2013).

Bulgarian catch length- frequency analyses show clear dominance of the 7.5 – 8.00 cm length classes, while the bigger fish were presented with lower percentage in the samples (Fig. 6.1.1.2.2.).

The age classes comprises 1 to 3+ years old individuals as 0+ while 4-5 age specimen are totally absent.

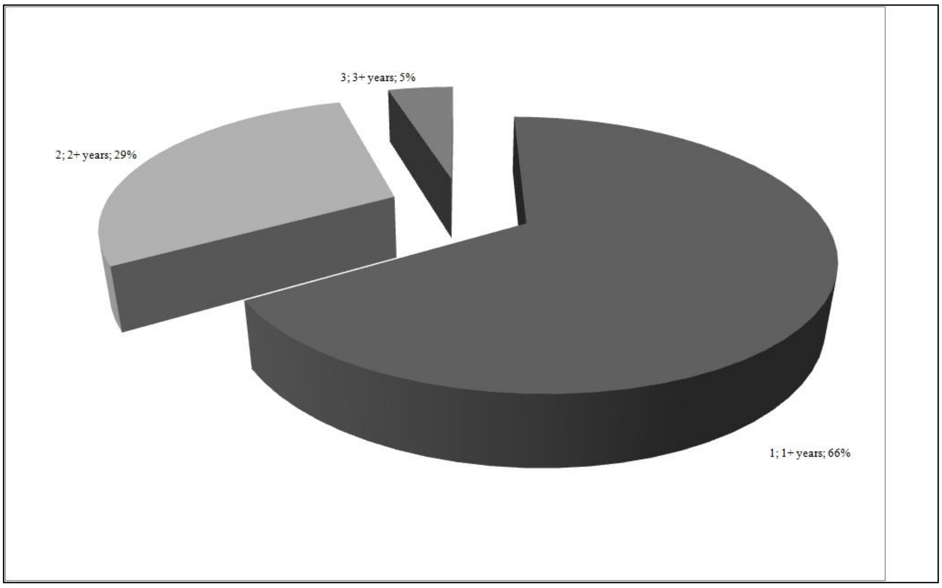


Figure 4.1.3.2. Age structure of sprat from June, 2013

1.1.1.1.1 Abundance and biomass

The mean catches per unit effort (CPUE) and abundance index (CPUA) in Turkish waters for 2013 are respectively 1508.4 kg/h and 1416,3 kg/km2 in trawl samplings conducted between 20 and 70 m (minimum 22.5 m, maximum 70.4 m) along the Samsun shelf area between first period of year (January-May) and last period of year (October-December) in 2013 (Table 6.1.3.2.5.1). Abundance indices were estimated by 'swept area method' (Sparre and Venema, 1992) for the same period by commercial vessels. Figure 6.1.3.2.5.1 show that distribution of biomass indices in SSA. The individual experience of fisherman and the quality of technical equipment of the vessel are determinative in the amount of daily catch. Sprat catch reaches its maximum especially in spring months; especially between March-May. But it showed that different decreasing CPUE and CPUA comprising in 2013. The monthly mean catches per unit effort (CPUE) is calculated for January 10650, February 8991, March 9044, April 7148, May 5000, October 6420, November 6908 and December 10668 respectively as kg/h/vessel (Figure 6.1.3.2.5.1).

Table 4.1.3.1 Descriptive data regarding catch effort (kg/h) and abundance indices (kg/km2) of sprat for 2013, in the Samsun shelf area (SSA)

Years	**No of hauls**	**Minimum**	**Maximum**	**Mean**	**Std. Error**
CPUE/2013	20	550	4000	**1508.4**	269.2
CPUA/2013	20	225	4090	**1416.3**	275.5

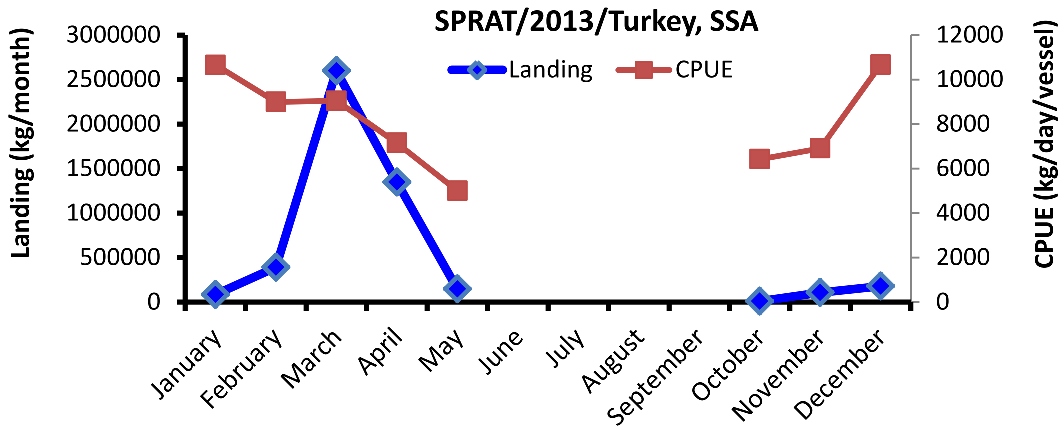


Figure 4.1.3.3 Monthly distribution of monthly and daily CPUE of sprat in Samsun Shelf Area, 2013

Biomass indices in the Samsun shelf area are presented on Figure 6.1.3.2.5.2

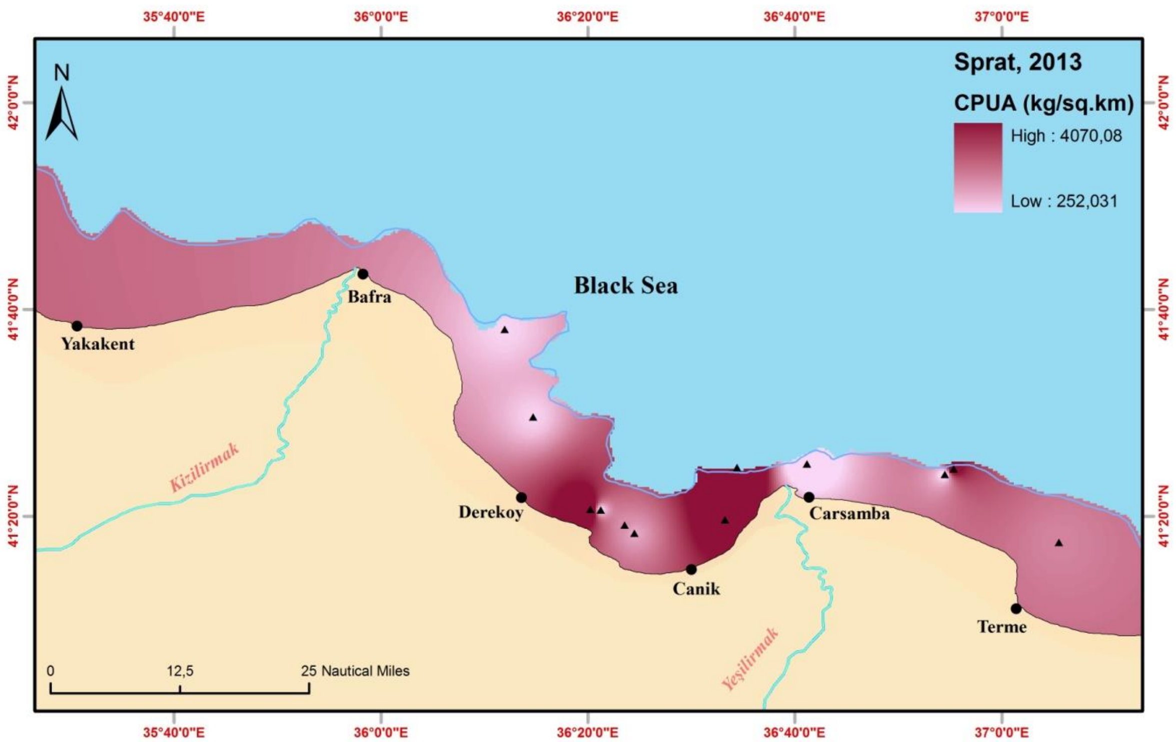


Figure 4.1.3.4. Map of the sprat biomass indices in the Samsun Shelf Area, 2013

5 Ecological information

5.1 Protected species potentially affected by the fisheries

No estimation exist.

5.2 Environmental indexes

No report

6 Stock Assessment

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

6.1 {Integrated catch analysis}

6.1.1 Model assumptions

We used Integrated Catch-at-age Analysis (ICA; Patterson and Melvin, 1996). ICA is a statistical catch-at-age method based on the Fournier and Deriso models (Deriso et al., 1985). It applies a statistical optimization procedure to calculate population numbers and fishing mortality coefficients-at-age from data of catch numbers-at-age and natural mortality. The dynamics of a cohort (generation) in the stock are expressed by two non-linear equations referred to as a survival equation (exponential decay) and a catch equation:

$N_{a+1,y+1} = N_{a,y} * exp(-F_{a,y} - M)$,

$C_{a,y} = N_{a,y} * [1 - exp(-F_{a,y} - M)] * F_{a,y} / (F_{a,y} + M)$,

where C, N, M, and F are catch, abundance, natural mortality, and fishing mortality, respectively, and a and y are subscript indices for age and year.

The algorithm initially estimates population numbers and fishing mortality fitting a separable model, when F is assumed to conform to a constant selection pattern (fishing mortality-at-age), but fishing mortality by year is allowed to vary. The F matrix is then modelled as a multiplication of the year-specific F and the specified selection pattern. This procedure substantially diminishes the number of parameters in the model.

In its second stage, the ICA algorithm minimizes the weighted Sum of Square Residuals (SSR) of observed and modelled catch and relative abundance indices (CPUE), assuming Gaussian distribution of the log residuals:

$min\ [\sum_{a,y} pc_{a,y} (log\ C_{a,y} - log\ \hat{C}_{a,y})^2 + \sum_{a,y,f} pi_{a,f} (log\ I_{a,y,f} - log\ \hat{I}_{a,y,f})^2$,

where C, Ĉ, I, and Î are observed and estimated catch and age-structured index, respectively, and a, y, and f are subscript indices for age, year, and fleet, respectively. Weights associated with catches and different indices (pc, pi) are ideally set equal to the inverse variances of catch and index data, and can be calculated based on the residuals between modelled and observed values. However, weights are usually set by the user on the basis of some information about the reliability of different indices and current experience with modelling the stock. Indices are defined as related to population numbers by the equations:

$\hat{I}_{a,y} = N_{a,y} * exp(-F_{a,y} - M)$

$\hat{I}_{a,y} = q_a * N_{a,y} * exp(-F_{a,y} - M)$

$\hat{I}_{a,y} = q_a * (N_{a,y} * exp(-F_{a,y} - M))^{k}{}_{a}$.

The two unknown parameters (qa, an age-specific catchability, and k, a constant) are estimated according to the assumed relationship between the population and the abundance index, which has to be specified as being one of the above – identity, linear, or power, respectively.

6.1.2 Scripts

SPRAT 2013

Catch in Number

AGE	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
0	115.	21.	108.	278.	236.	1009.	406.	809.	415.	1202.	445.	528.	1158.	3180.	1299.
1	2072.	1712.	2496.	2741.	2278.	3838.	4877.	10352.	6829.	5654.	6878.	6024.	5976.	5351.	7774.
2	2182.	2792.	2773.	2600.	2831.	3086.	3340.	6646.	7655.	5454.	3580.	4652.	2705.	1876.	3248.
3	442.	418.	579.	830.	1741.	1302.	1313.	1269.	3090.	3024.	2666.	1602.	785.	802.	1327.
4	13.	13.	17.	43.	82.	121.	110.	109.	182.	674.	278.	372.	92.	113.	168.
5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

x 10 ^ 6

Catch in Number

AGE	2009	2010	2011	2012	2013
0	1558.	2934.	2581.	3861.	1811.
1	12266.	7940.	10080.	4468.	5009.
2	7833.	7120.	12677.	2882.	3129.
3	3278.	4378.	8236.	1106.	588.
4	369.	316.	377.	97.	37.
5	0.	6.	14.	0.	1.

x 10 ^ 6

Predicted Catch in Number

AGE	2008	2009	2010	2011	2012	2013
0	1811.	2127.	1515.	3173.	3200.	1811.
1	5263.	12541.	8524.	8256.	7316.	5834.
2	3407.	8857.	11363.	9340.	3783.	3082.
3	1455.	2918.	3549.	4734.	1442.	696.
4	187.	318.	255.	336.	108.	46.

x 10 ^ 6

Weights at age in the catches (Kg)

AGE	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
0	.002300	.002500	.002500	.002300	.002400	.002800	.002300	.001700	.001800	.001700	.001900	.002100	.002000	.001700	.002300
1	.003400	.003800	.003800	.003300	.004000	.003200	.003500	.002500	.002700	.002800	.002900	.003500	.003300	.003300	.003400
2	.004000	.004600	.005200	.004900	.005100	.005000	.004500	.004000	.004100	.004000	.004400	.004700	.004300	.004900	.004300
3	.004700	.005400	.006000	.006300	.007600	.006500	.006000	.006300	.005800	.006100	.006000	.006200	.006000	.007200	.005200
4	.007700	.006900	.007400	.007200	.009400	.007300	.007800	.006900	.007700	.006800	.007300	.007700	.007300	.008700	.007000
5	.010000	.010000	.010000	.010000	.010000	.010000	.010000	.010000	.010000	.010000	.010000	.010000	.010000	.010000	.010000

Weights at age in the catches (Kg)

AGE	2009	2010	2011	2012	2013
0	.002400	.002100	.002100	.001600	.001800
1	.003100	.002900	.002700	.002200	.002100
2	.004000	.004400	.003700	.004200	.003300
3	.004900	.006500	.004600	.005500	.005000
4	.006000	.008000	.008700	.007100	.006800
5	.010000	.016000	.010000	.010000	.010000

Weights at age in the stock (Kg)

AGE	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
0	.001000	.001000	.001000	.001000	.001000	.001000	.001000	.001000	.001000	.001000	.001000	.001000	.001000	.001000	.001000
1	.003500	.003300	.002800	.002700	.003400	.002500	.003200	.003500	.003600	.003500	.003400	.003600	.003600	.003600	.003100
2	.004100	.004300	.004300	.004700	.004600	.004700	.004400	.004400	.004500	.004400	.004400	.004600	.004600	.004700	.004200
3	.004800	.004800	.004700	.005700	.006400	.005900	.005600	.005200	.006100	.005900	.006000	.006100	.005700	.006300	.005600
4	.006200	.005500	.005300	.006900	.008200	.007300	.007200	.006700	.007400	.007400	.007200	.007400	.007400	.007600	.007000
5	.010000	.010000	.010000	.010000	.010000	.010000	.010000	.010000	.010000	.010000	.010000	.010000	.010000	.010000	.010000

Weights at age in the stock (Kg)

AGE	2009	2010	2011	2012	2013
0	.001000	.001000	.001000	.001000	.001000
1	.003100	.002500	.003000	.002600	.001600
2	.004100	.003500	.004000	.003900	.004100
3	.004700	.004500	.004800	.005500	.004800
4	.005400	.007100	.007300	.007900	.008000
5	.010000	.016000	.010000	.010000	.010000

Natural Mortality (per year)

AGE	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
0	0.64000	0.64000	0.64000	0.64000	0.64000	0.64000	0.64000	0.64000	0.64000	0.64000	0.64000	0.64000	0.64000	0.64000	0.64000
1	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000
2	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000
3	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000
4	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000
5	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000	0.95000

Natural Mortality (per year)

AGE	2009	2010	2011	2012	2013
0	0.64000	0.64000	0.64000	0.64000	0.64000
1	0.95000	0.95000	0.95000	0.95000	0.95000
2	0.95000	0.95000	0.95000	0.95000	0.95000
3	0.95000	0.95000	0.95000	0.95000	0.95000
4	0.95000	0.95000	0.95000	0.95000	0.95000
5	0.95000	0.95000	0.95000	0.95000	0.95000

Proportion of fish spawning

AGE	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Proportion of fish spawning

AGE	2009	2010	2011	2012	2013
0	0.0000	0.0000	0.0000	0.0000	0.0000
1	1.0000	1.0000	1.0000	1.0000	1.0000
2	1.0000	1.0000	1.0000	1.0000	1.0000
3	1.0000	1.0000	1.0000	1.0000	1.0000
4	1.0000	1.0000	1.0000	1.0000	1.0000
5	1.0000	1.0000	1.0000	1.0000	1.0000

AGE-STRUCTURED INDICES

Bul

AGE	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1	9.78	19.59	41.06	53.32	52.36	101.06	106.86	103.05	74.39	56.86	65.51	42.09	40.59	57.25	79.25
2	57.49	48.77	38.16	28.37	58.52	30.60	76.34	71.10	71.11	49.82	44.34	27.74	21.64	32.98	71.84
3	16.27	7.36	9.45	6.21	5.28	4.54	6.95	4.03	23.08	14.35	15.94	9.36	4.21	10.17	51.88
4	0.25	0.23	0.59	0.61	0.54	0.30	0.67	0.23	1.25	2.57	3.93	0.94	1.30	1.73	5.16

x 10 ^ 3

Bul

AGE	2009	2010	2011	2012	2013
1	66.13	63.39	40.34	105.34	122.17
2	57.91	69.21	44.02	50.49	59.55
3	19.69	53.15	32.18	9.83	11.10
4	3.16	6.08	4.77	2.10	0.14

x 10 ^ 3

Ukr

AGE	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1	124.38	80.94	111.12	58.09	59.67	97.40	222.49	193.27	158.30	76.22	125.47	113.57	180.31	127.15	284.84
2	74.90	103.68	118.27	50.40	68.14	85.43	146.35	118.28	179.30	76.02	46.40	88.14	69.18	24.19	55.49
3	8.05	9.43	9.43	10.52	46.52	37.49	66.40	22.53	76.56	47.52	54.76	29.98	24.67	16.90	37.53
4	0.51	0.14	0.66	0.72	2.36	0.56	6.10	2.15	4.65	10.87	5.06	8.06	2.52	0.10	3.07

x 10 ^ 3

Ukr

AGE	2009	2010	2011	2012	2013
1	335.38	352.09	253.76	188.67	161.04
2	143.30	67.33	70.76	54.05	80.10
3	37.47	4.84	14.37	20.49	6.75
4	0.66	0.24	0.11	2.35	0.37

x 10 ^ 3

Rom survey

AGE	2007	2008	2009	2010	2011	2012	2013
1	20571.	72155.	53939.	999990.	999990.	79615.	45054.
2	26498.	40969.	72325.	999990.	999990.	39609.	19760.
3	14120.	11359.	14361.	999990.	999990.	11247.	311.

6.1.3 Results

ICA was run assuming a constant selection pattern in 2007-2013 (Fig..6.1.3.1 Table 6.1.3.1) with reference F at age 2 and Selection at the last 'real' age (S4) equal 1.

The results of the ICA show a reasonable agreement with tuning data The overall fit and partial SSR converged to unique minima (Fig.6.1.3.1.). Retrospective analyses show no systematic deviations (Fig.6.1.3.2.).

Analyses of the main population parameters (abundance, catch, fishing mortality, Fig. Table .) indicate that the sprat stock has recovered from the depression in the 1990s due to good recruitment in 1999-2001 and the biomass and catches have gradually increased over the 1990s and during the 2000s reached levels comparable to the previous periods of high abundance (Fig.). The stock estimates reveal the cyclic nature the sprat population dynamics. The years with strong recruitment were followed by years of low to medium recruitment which leads to corresponding changes in the Spawning Stock Biomass (SSB). High fishing mortalities ($F_{1\text{-}3}$) were observed during the stock collapse in the early 1990s in 2004-2005 and 2010-2012. In 2011 the highest ever total catch of 120 708t (Table 6.1.3.1.) was recorded due mainly to the intensive development of the Turkish sprat fishery. Over 2007-2010 years the levels of biomass and catches were comparable with the highest figures reported, but in 2009-2011 - a decreasing trend in recruitment becomes evident (Fig.). In the last couple of years catches dropped more than 3 times, and SSB is estimated at the level of about 180 000t. Due to lower catches average fishing mortality dropped from 1.24 in 2011 to 0.446 in 2013.

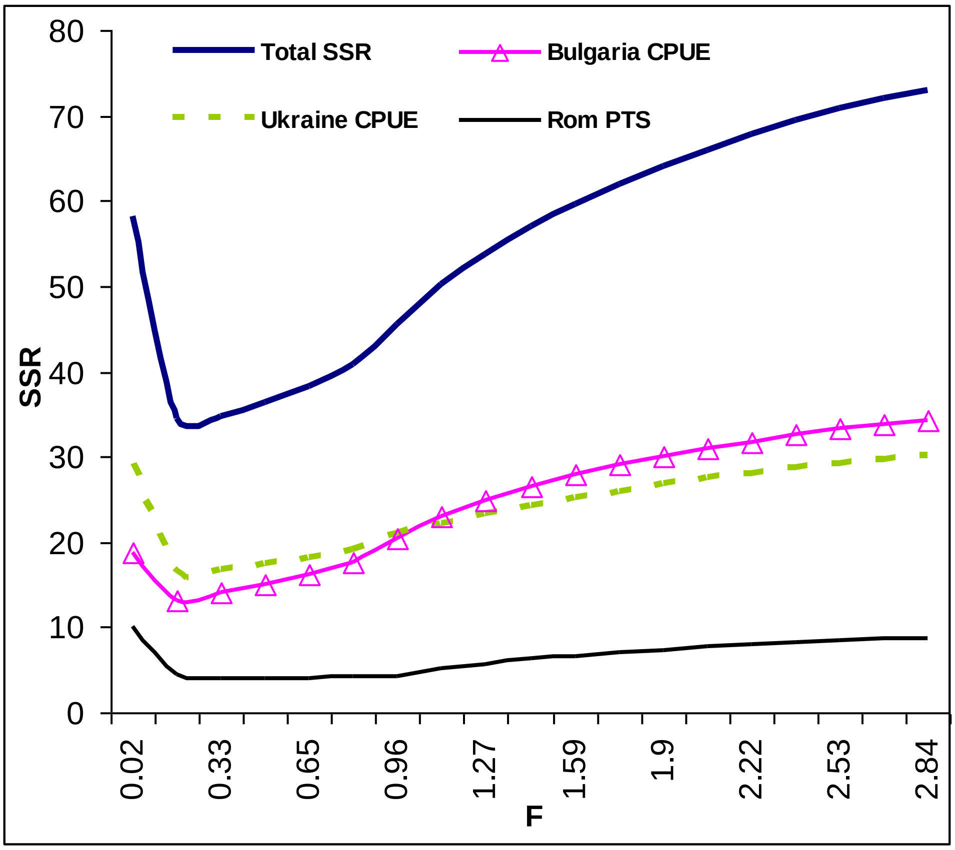


Fig. 6.1.3.1. Trajectories of the total Sum of Squared Residuals (SSR) and the partial SSRs of the two tuning fleets as functions of the reference F.

Fig.6.1.3.2. Selection pattern estimated by the separable model

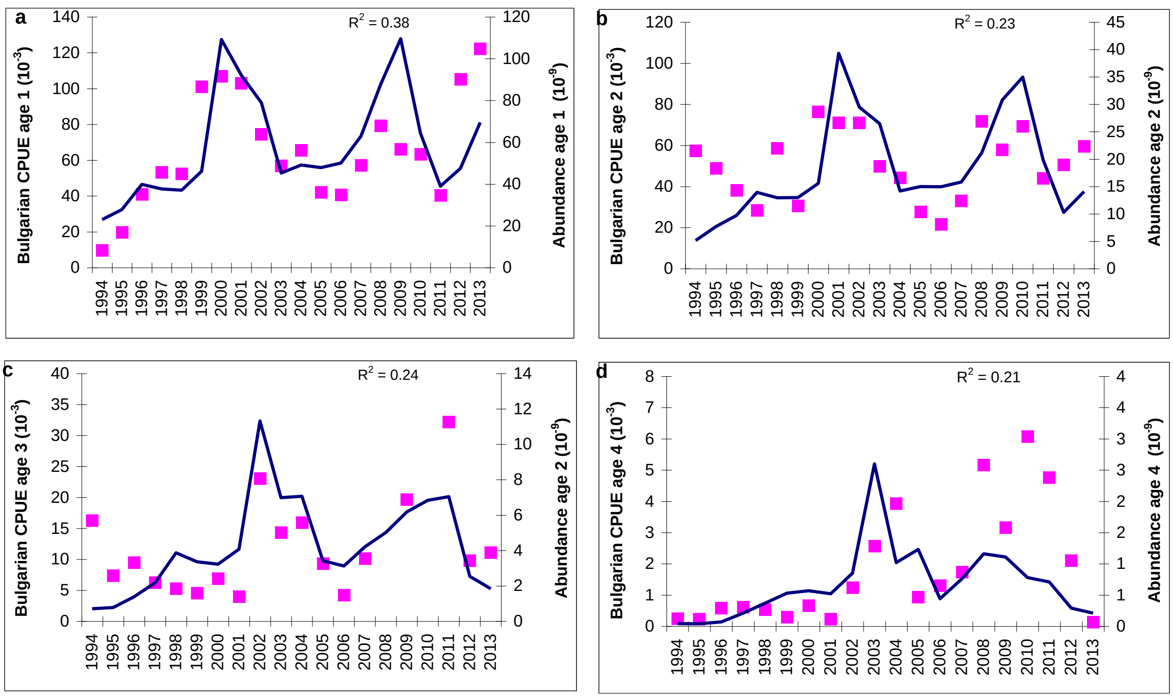


Fig..6.1.3.3. Adjustment of ICA: time-series of estimated abundance-at-age and age-structured Bulgarian CPUE (best fit is given by linear relationships and r^2 are displayed): (a) Age 1. (b) Age 2. (c) Age 3. (d) Age 4.

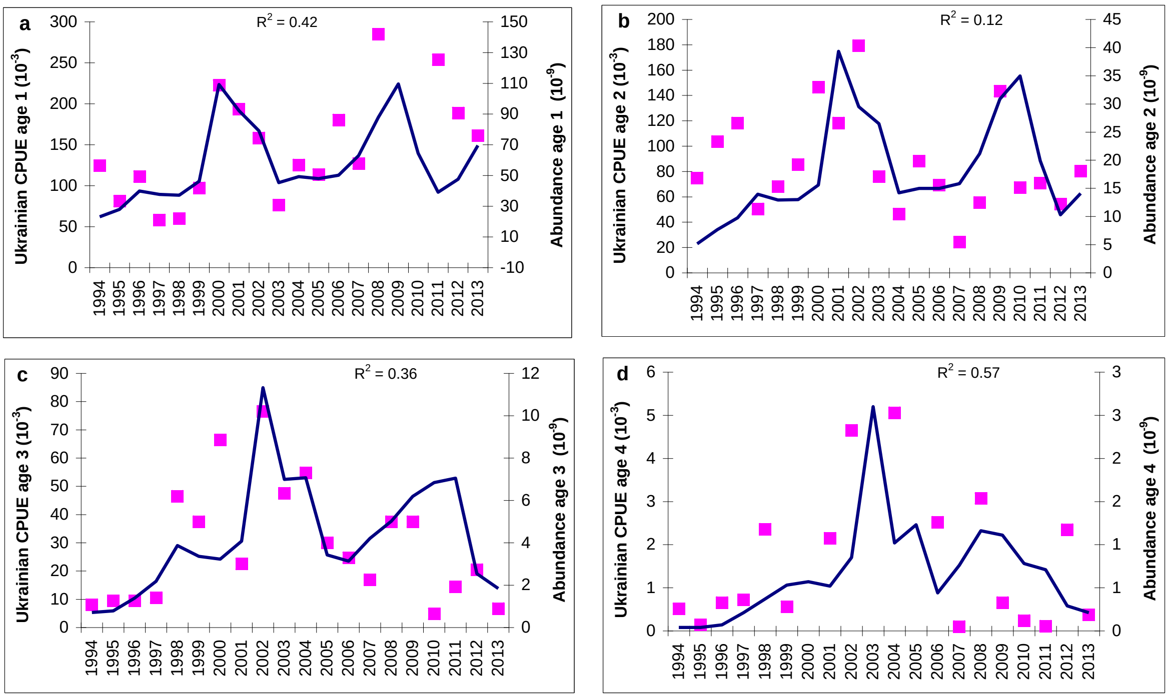


Figure 6.1.3.4. Adjustment of ICA: time-series of estimated abundance-at-age and age-structured Ukrainian CPUE (best fit is given by linear relationships and r^2 are displayed): (a) Age 1. (b) Age 2. (c) Age 3. (d) Age 4.

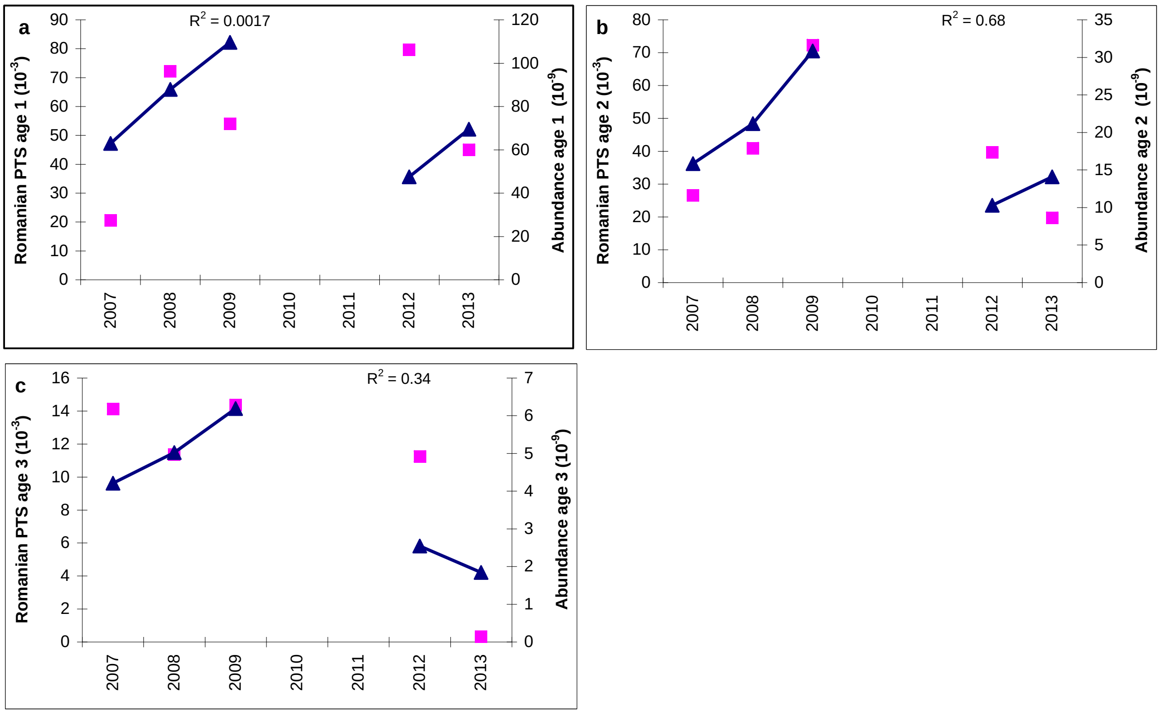


Figure.6.1.3.4. Adjustment of ICA: time-series of estimated abundance-at-age and age-structured Romanian PTS (best fit is given by linear relationships and r^2 are displayed): (a) Age 1. (b) Age 2. (c) Age 3.

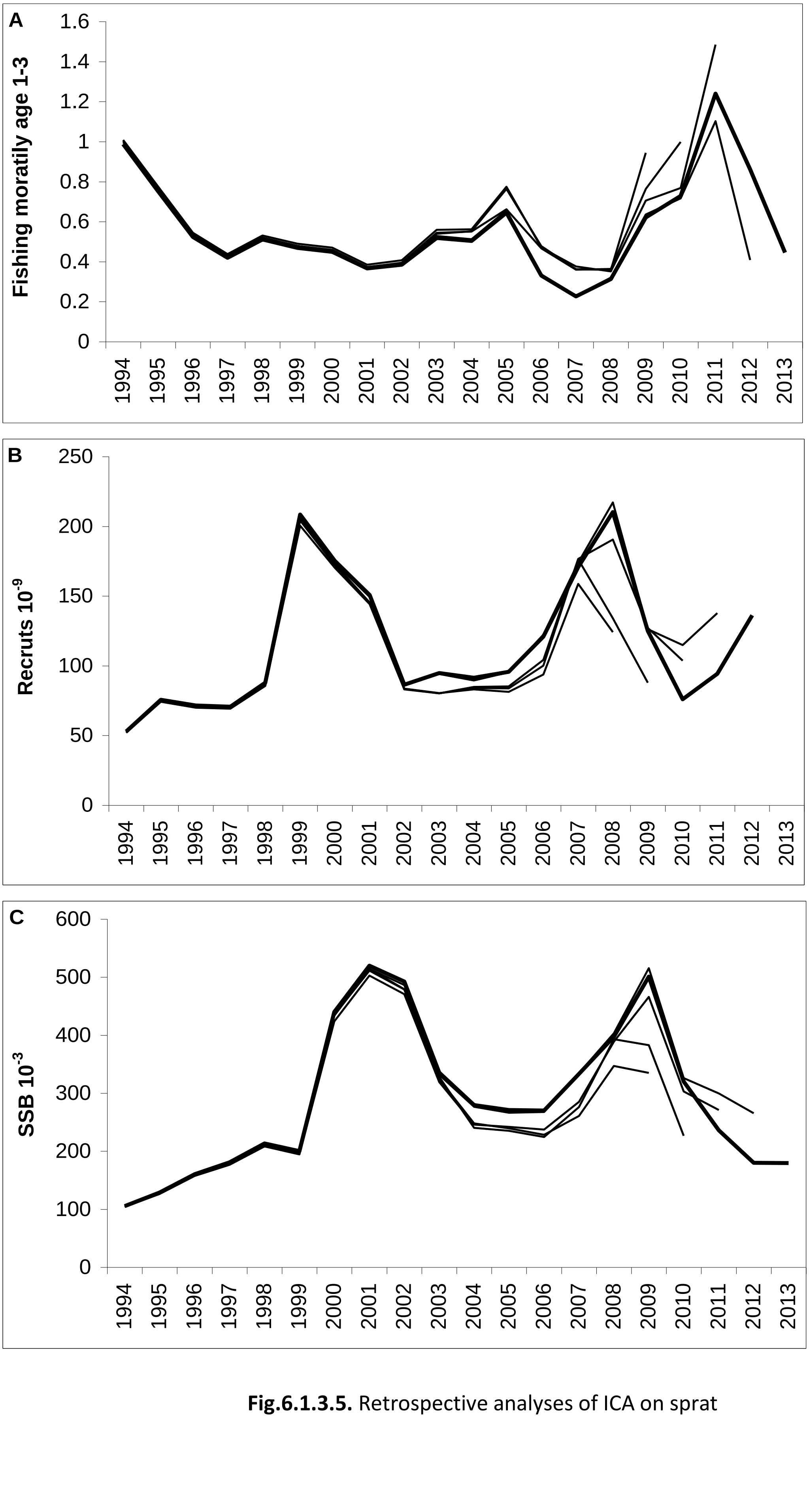


Fig.6.1.3.5. Retrospective analyses of ICA on sprat

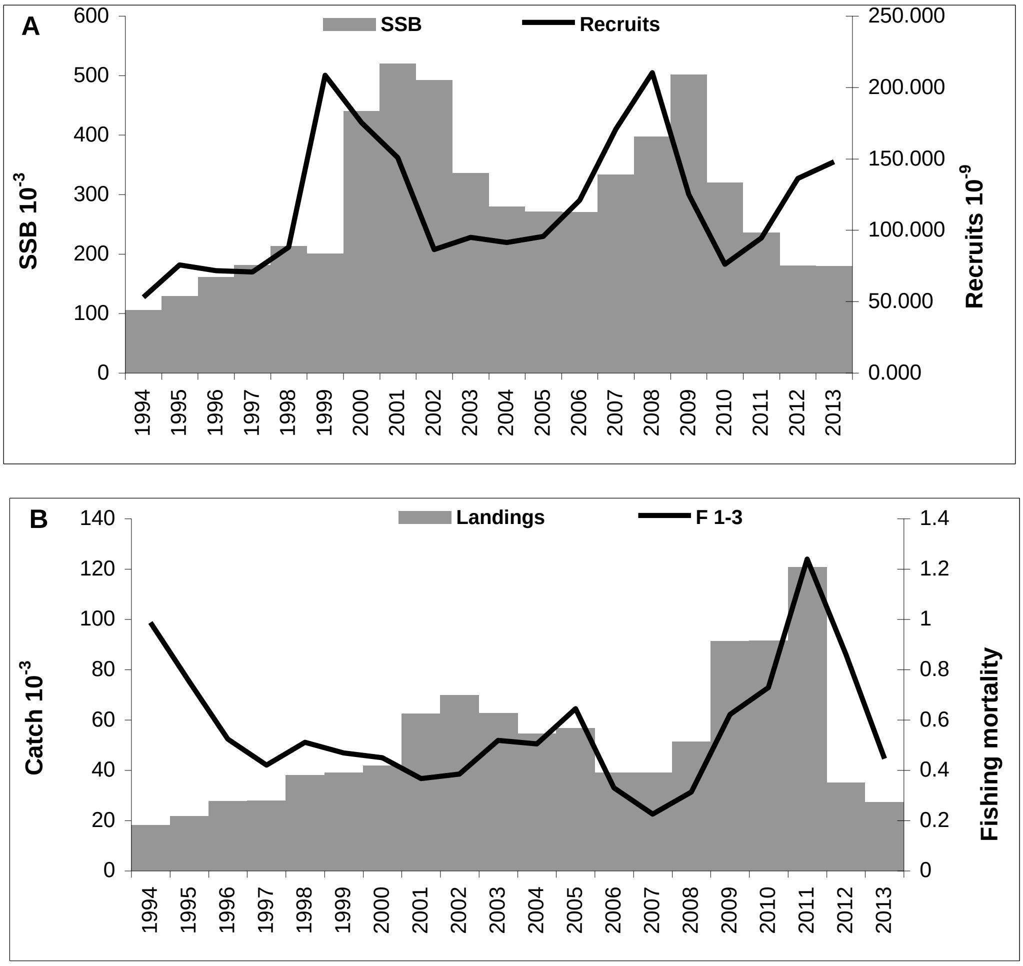


Fig.6.1.3.6. Time-series of sprat population estimates: A. recruitment (line) and SSB (grey); B. landings (grey) and average fishing mortality (ages 2–4. line).

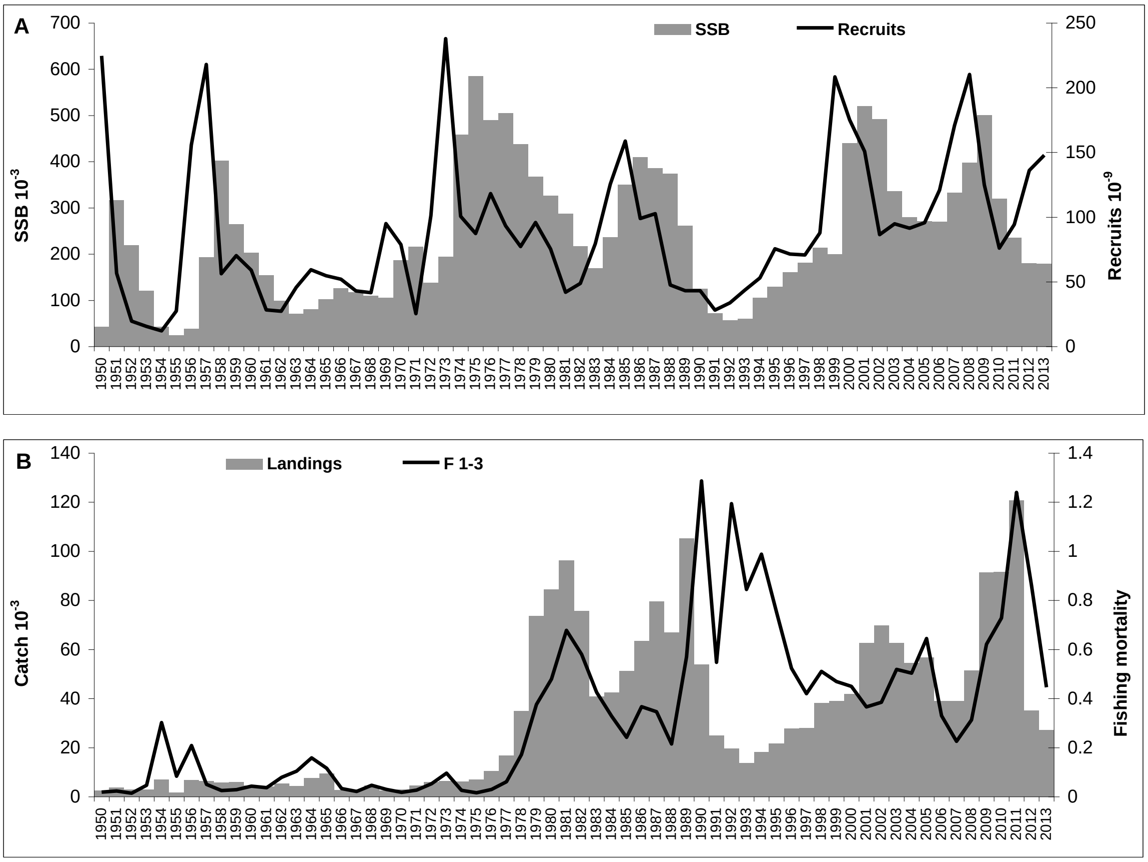


Fig.6.1.3.7. Time-series of sprat population estimates – present results combined with historical estimates from Daskalov 1998: A. recruitment (line) and SSB (grey); B. landings (grey) and average fishing mortality (ages 2–4. line).

Table 6.1.3.2. Sprat in the Black Sea: ICA results and diagnostics.

Fishing Mortality (per year)

AGE	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
0	0.0030	0.0004	0.0020	0.0053	0.0036	0.0066	0.0031	0.0073	0.0065	0.0173	0.0066	0.0075	0.0130	0.0255	0.0117
1	0.1483	0.0993	0.1012	0.1186	0.0992	0.1363	0.0713	0.1883	0.1422	0.2110	0.2392	0.2129	0.2009	0.1396	0.0967
2	0.9441	0.7586	0.5489	0.3310	0.3988	0.4399	0.3891	0.2956	0.4897	0.3712	0.4734	0.6148	0.3191	0.1991	0.2799
3	1.8709	1.3999	0.9206	0.8097	1.0352	0.8313	0.8874	0.6149	0.5215	0.9746	0.7989	1.1058	0.4698	0.3392	0.5620
4	0.7684	0.5811	0.4334	0.3592	0.4005	0.4162	0.3458	0.3823	0.3870	0.4892	0.5212	0.5940	0.3782	0.2574	0.2799
5	0.7684	0.5811	0.4334	0.3592	0.4005	0.4162	0.3458	0.3823	0.3870	0.4892	0.5212	0.5940	0.3782	0.2574	0.2799

Fishing Mortality (per year)

AGE	2009	2010	2011	2012	2013
0	0.0233	0.0273	0.0465	0.0323	0.0167
1	0.1920	0.2252	0.3831	0.2662	0.1377
2	0.5559	0.6519	1.1091	0.7708	0.3988
3	1.1163	1.3090	2.2272	1.5478	0.8008
4	0.5559	0.6519	1.1091	0.7708	0.3988
5	0.5559	0.6519	1.1091	0.7708	0.3988

Population Abundance (1 January)

AGE	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
0	52.95	75.62	71.52	70.69	87.87	208.45	175.17	150.80	86.44	94.87	91.37	95.70	120.87	170.84	210.23
1	23.03	27.84	39.86	37.64	37.08	46.16	109.19	92.08	78.94	45.28	49.17	47.86	50.08	62.91	87.81
2	5.15	7.68	9.75	13.93	12.93	12.98	15.58	39.32	29.50	26.48	14.18	14.97	14.96	15.84	21.16
3	0.71	0.78	1.39	2.18	3.87	3.36	3.23	4.08	11.32	6.99	7.07	3.42	3.13	4.21	5.02
4	0.04	0.04	0.07	0.21	0.37	0.53	0.57	0.52	0.85	2.60	1.02	1.23	0.44	0.76	1.16
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

x 10 ^ 9

Population Abundance (1 January)

AGE	2009	2010	2011	2012	2013	2014
0	124.95	76.04	94.37	136.11	147.84	150.54
1	109.56	64.37	39.02	47.50	69.49	76.66
2	30.83	34.97	19.87	10.29	14.08	23.42
3	6.19	6.84	7.05	2.54	1.84	3.65
4	1.11	0.78	0.71	0.29	0.21	0.32
5	0.00	0.02	0.03	0.00	0.01	0.06

x 10 ^ 9

Weighting factors for the catches in number

AGE	2008	2009	2010	2011	2012	2013
0	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Predicted Age-Structured Index Values

Bul Predicted

AGE	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1	24.70	30.60	43.77	40.98	40.76	49.82	121.73	96.81	84.93	47.08	50.40	49.71	52.33	67.77	96.66
2	12.26	20.06	28.28	45.06	40.42	39.77	48.94	129.47	88.13	83.95	42.72	42.01	48.68	54.74	70.21
3	1.55	2.15	4.91	8.12	12.90	12.38	11.61	16.79	48.77	24.02	26.51	10.99	13.84	19.85	21.21
4	0.07	0.10	0.18	0.55	0.94	1.32	1.45	1.30	2.15	6.22	2.41	2.79	1.11	2.04	3.08

x 10 ^ 3

Bul Predicted

AGE	2009	2010	2011	2012	2013
1	114.98	66.44	37.22	48.03	74.93
2	89.12	96.34	43.56	26.70	44.01
3	19.80	19.88	12.94	6.54	6.90
4	2.57	1.73	1.26	0.61	0.52

x 10 ^ 3

Ukr Predicted

AGE	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1	63.22	78.32	112.03	104.87	104.31	127.49	311.53	247.76	217.36	120.48	128.98	127.22	133.92	173.44	247.37
2	20.14	32.94	46.44	74.01	66.39	65.32	80.39	212.64	144.75	137.89	70.16	69.01	79.95	89.91	115.31
3	2.94	4.07	9.29	15.38	24.41	23.44	21.97	31.77	92.28	45.45	50.16	20.80	26.20	37.56	40.13
4	0.08	0.11	0.20	0.60	1.04	1.46	1.61	1.44	2.38	6.87	2.66	3.09	1.22	2.25	3.40

x 10 ^ 3

Ukr Predicted

AGE	2009	2010	2011	2012	2013
1	294.26	170.04	95.24	122.93	191.77
2	146.37	158.23	71.55	43.86	72.29
3	37.46	37.62	24.49	12.38	13.05
4	2.83	1.91	1.39	0.68	0.58

x 10 ^ 3

Rom survey Predicted

AGE	2007	2008	2009	2010	2011	2012	2013
1	43253.	61690.	73383.	999990.	999990.	30656.	47824.
2	37585.	48203.	61188.	999990.	999990.	18335.	30218.
3	9203.	9831.	9178.	999990.	999990.	3032.	3198.

Fitted Selection Pattern

AGE	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
0	0.0031	0.0005	0.0037	0.0162	0.0091	0.0149	0.0081	0.0247	0.0133	0.0466	0.0140	0.0122	0.0409	0.1280	0.0419

```
  1  | 0.1571 0.1309 0.1843 0.3581 0.2488 0.3099 0.1832 0.6371 0.2904 0.5686 0.5053 0.3463 0.6295 0.7013 0.3454
  2  | 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
  3  | 1.9817 1.8455 1.6770 2.4458 2.5955 1.8898 2.2807 2.0803 1.0649 2.6258 1.6878 1.7986 1.4722 1.7032 2.0081
  4  | 0.8139 0.7660 0.7896 1.0850 1.0043 0.9461 0.8888 1.2935 0.7903 1.3179 1.1011 0.9661 1.1852 1.2929 1.0000
  5  | 0.8139 0.7660 0.7896 1.0850 1.0043 0.9461 0.8888 1.2935 0.7903 1.3179 1.1011 0.9661 1.1852 1.2929 1.0000
------+------------------------------------------------------------------------------------------------------------------------



      Fitted Selection Pattern
      ------------------------
------+----------------------------------------
AGE  |   2009   2010   2011   2012   2013
------+----------------------------------------
  0  | 0.0419 0.0419 0.0419 0.0419 0.0419
  1  | 0.3454 0.3454 0.3454 0.3454 0.3454
  2  | 1.0000 1.0000 1.0000 1.0000 1.0000
  3  | 2.0081 2.0081 2.0081 2.0081 2.0081
  4  | 1.0000 1.0000 1.0000 1.0000 1.0000
  5  | 1.0000 1.0000 1.0000 1.0000 1.0000
------+----------------------------------------



              STOCK SUMMARY


 i Year i  Recruits  i  Total  i Spawningi Landings i Yield i Mean F i SoP i
```

i i Age 0 i Biomass i Biomass i i /SSB i Ages i i

i i thousands i tonnes i tonnes i tonnes i ratio i 2- 3 i (%) i

1994	52952770	158306	105354	18219	0.1729	1.4075	99
1995	75618970	204475	128856	21746	0.1688	1.0792	100
1996	71521830	231988	160466	27778	0.1731	0.7347	99
1997	70689180	251673	180984	27963	0.1545	0.5704	100
1998	87866660	301228	213361	38117	0.1786	0.7170	99
1999	208451090	408560	200109	39152	0.1957	0.6356	98
2000	175171320	615317	440145	41769	0.0949	0.6383	100
2001	150796860	670772	519975	62587	0.1204	0.4553	100
2002	86443290	578701	492258	69894	0.1420	0.5056	99
2003	94870920	430360	335489	62716	0.1869	0.6729	99
2004	91372270	370681	279309	54574	0.1954	0.6361	100
2005	95699350	366802	271103	56854	0.2097	0.8603	100
2006	120868310	391072	270203	39048	0.1445	0.3945	100
2007	170838100	504017	333179	39008	0.1171	0.2691	99
2008	210226210	607543	397317	51463	0.1295	0.4210	99
2009	124946880	626036	501089	91376	0.1824	0.8361	100
2010	76041620	395969	319928	91594	0.2863	0.9804	99
2011	94367690	330258	235890	120710	0.5117	1.6682	99
2012	136109560	315993	179883	35025	0.1947	1.1593	100
2013	147840780	327305	179464	27260	0.0152	0.5998	9

No of years for separable analysis : 6

Age range in the analysis : 0 . . . 5

Year range in the analysis : 1994 . . . 2013

Number of indices of SSB : 0

Number of age-structured indices : 3

Parameters to estimate : 30

Number of observations : 205

Conventional single selection vector model to be fitted.

PARAMETER ESTIMATES

iParm.i i Maximum i i i i i i Mean of i

i No. i i Likelh. i CV i Lower i Upper i -s.e. i +s.e. i Param. i

i i i Estimatei (%)i 95% CL i 95% CL i i i Distrib.i

Separable model : F by year

1	2008	0.2799	25	0.1702	0.4602	0.2172	0.3607	0.2890
2	2009	0.5559	21	0.3618	0.8541	0.4465	0.6921	0.5694
3	2010	0.6519	21	0.4318	0.9842	0.5283	0.8043	0.6664
4	2011	1.1091	18	0.7761	1.5852	0.9244	1.3308	1.1277
5	2012	0.7708	20	0.5121	1.1602	0.6257	0.9496	0.7878
6	2013	0.3988	31	0.2137	0.7442	0.2901	0.5483	0.4195

Separable Model: Selection (S) by age

7	0	0.0419	32	0.0220	0.0799	0.0301	0.0582	0.0442
8	1	0.3454	23	0.2161	0.5521	0.2719	0.4388	0.3554
	2	1.0000	Fixed : Reference Age					
9	3	2.0081	17	1.4162	2.8473	1.6804	2.3997	2.0402
	4	1.0000	Fixed : Last true age					

Separable model: Populations in year 2013

10	0	147840780	74	34062143	641677065	69908146	312651636	195703686
11	1	69488623	33	35695375	135274353	49466453	97615019	73620114
12	2	14076253	24	8643233	22924398	10975399	18053185	14518855
13	3	1840543	23	1167721	2901035	1459238	2321485	1890813
14	4	208558	30	114078	381287	153300	283735	218677

Separable model: Populations at age

15	2008	1158509	37	552691	2428380	794166	1690004	1244114
16	2009	1107031	26	655629	1869224	847399	1446212	1147284
17	2010	783382	26	470357	1304727	603865	1016266	810370
18	2011	714391	26	425541	1199309	548457	930528	739788
19	2012	293863	29	166416	518912	219862	392771	306494

Age-structured index catchabilities

Bul

Linear model fitted. Slopes at age :

20	1	Q	.1858E-02	19	.1545E-02	.3279E-02	.1858E-02	.2727E-02	.2293E-02
21	2	Q	.6137E-02	19	.5107E-02	.1082E-01	.6137E-02	.9001E-02	.7570E-02
22	3	Q	.8994E-02	19	.7476E-02	.1590E-01	.8994E-02	.1322E-01	.1111E-01
23	4	Q	.4920E-02	19	.4073E-02	.8806E-02	.4920E-02	.7291E-02	.6106E-02

Ukr

Linear model fitted. Slopes at age :

24	1	Q	.4754E-02	19	.3954E-02	.8393E-02	.4754E-02	.6980E-02	.5868E-02
25	2	Q	.1008E-01	19	.8387E-02	.1777E-01	.1008E-01	.1478E-01	.1243E-01

26 3 Q .1702E-01 19 .1415E-01 .3009E-01 .1702E-01 .2501E-01 .2102E-01

27 4 Q .5432E-02 19 .4497E-02 .9723E-02 .5432E-02 .8050E-02 .6742E-02

Rom survey

Linear model fitted. Slopes at age :

28 1 Q .1186E-02 34 .8488E-03 .3322E-02 .1186E-02 .2378E-02 .1784E-02

29 2 Q .4214E-02 34 .3032E-02 .1162E-01 .4214E-02 .8365E-02 .6296E-02

30 3 Q .4170E-02 34 .2985E-02 .1168E-01 .4170E-02 .8362E-02 .6273E-02

RESIDUALS ABOUT THE MODEL FIT

Separable Model Residuals

Age	2008	2009	2010	2011	2012	2013
0	-0.3325	-0.3113	0.6607	-0.2066	0.1877	0.0000
1	0.3900	-0.0221	-0.0710	0.1996	-0.4932	-0.1525
2	-0.0478	-0.1228	-0.4675	0.3055	-0.2723	0.0153
3	-0.0922	0.1163	0.2099	0.5538	-0.2652	-0.1685
4	-0.1028	0.1490	0.2170	0.1158	-0.1092	-0.2031

AGE-STRUCTURED INDEX RESIDUALS

Bul

Age	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1	-0.926	-0.446	-0.064	0.263	0.250	0.707	-0.130	0.062	-0.132	0.189	0.262	-0.166	-0.254	-0.169	-0.199
2	1.545	0.888	0.300	-0.463	0.370	-0.262	0.445	-0.599	-0.215	-0.522	0.037	-0.415	-0.811	-0.507	0.023
3	2.348	1.230	0.654	-0.269	-0.894	-1.003	-0.513	-1.426	-0.748	-0.515	-0.508	-0.161	-1.190	-0.669	0.895
4	1.202	0.886	1.169	0.103	-0.551	-1.492	-0.774	-1.729	-0.543	-0.886	0.492	-1.092	0.164	-0.162	0.515

Bul

Age	2009	2010	2011	2012	2013
1	-0.553	-0.047	0.081	0.785	0.489
2	-0.431	-0.331	0.010	0.637	0.302
3	-0.005	0.983	0.911	0.408	0.476
4	0.207	1.257	1.336	1.236	-1.332

Ukr

Age	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008

1	0.677	0.033	-0.008	-0.591	-0.559	-0.269	-0.337	-0.248	-0.317	-0.458	-0.028	-0.113	0.297	-0.310	0.141
2	1.313	1.147	0.935	-0.384	0.026	0.268	0.599	-0.587	0.214	-0.595	-0.414	0.245	-0.145	-1.313	-0.731
3	1.006	0.839	0.015	-0.379	0.645	0.470	1.106	-0.344	-0.187	0.044	0.088	0.366	-0.060	-0.799	-0.067
4	1.832	0.251	1.190	0.177	0.822	-0.964	1.335	0.405	0.671	0.458	0.645	0.960	0.722	-3.113	-0.103

Ukr

Age	2009	2010	2011	2012	2013
1	0.131	0.728	0.980	0.428	-0.175
2	-0.021	-0.854	-0.011	0.209	0.103
3	0.000	-2.051	-0.533	0.504	-0.659
4	-1.455	-2.066	-2.561	1.248	-0.450

Rom survey

Age	2007	2008	2009	2010	2011	2012	2013
1	-0.743	0.157	-0.308	*******	*******	0.954	-0.060
2	-0.350	-0.163	0.167	*******	*******	0.770	-0.425
3	0.428	0.145	0.448	*******	*******	1.311	-2.330

PARAMETERS OF THE DISTRIBUTION OF ln(CATCHES AT AGE)

Separable model fitted from 2008 to 2013

Variance	0.1679
Skewness test stat.	0.4197
Kurtosis test statistic	-0.3310
Partial chi-square	0.1237
Significance in fit	0.0000
Degrees of freedom	11

PARAMETERS OF THE DISTRIBUTION OF THE AGE-STRUCTURED INDICES

DISTRIBUTION STATISTICS FOR Bul

Linear catchability relationship assumed

Age	1	2	3	4
Variance	0.0417	0.0848	0.2315	0.2535
Skewness test stat.	-0.1115	1.7507	1.1324	-0.2981

Kurtosis test statisti	0.1376	0.5124	-0.1582	-1.1481
Partial chi-square	0.0741	0.1583	0.5111	0.7408
Significance in fit	0.0000	0.0000	0.0000	0.0000
Number of observations	20	20	20	20
Degrees of freedom	19	19	19	19
Weight in the analysis	0.2500	0.2500	0.2500	0.2500

DISTRIBUTION STATISTICS FOR Ukr

Linear catchability relationship assumed

Age	1	2	3	4
Variance	0.0476	0.1123	0.1295	0.4651
Skewness test stat.	1.3396	0.3398	-1.6301	-1.7528
Kurtosis test statisti	-0.2825	-0.3073	1.3567	-0.0873
Partial chi-square	0.0776	0.1952	0.2506	1.2813
Significance in fit	0.0000	0.0000	0.0000	0.0000
Number of observations	20	20	20	20
Degrees of freedom	19	19	19	19
Weight in the analysis	0.2500	0.2500	0.2500	0.2500

DISTRIBUTION STATISTICS FOR Rom survey

Linear catchability relationship assumed

Age	1	2	3
Variance	0.1322	0.0792	0.6295

Skewness test stat.	0.4427	0.7448	-1.0060
Kurtosis test statisti	-0.3312	-0.3560	-0.0686
Partial chi-square	0.0503	0.0315	0.3105
Significance in fit	0.0003	0.0001	0.0109
Number of observations	5	5	5
Degrees of freedom	4	4	4
Weight in the analysis	0.3333	0.3333	0.3333

ANALYSIS OF VARIANCE

Unweighted Statistics

Variance

	SSQ	Data	Parameters	d.f.	Variance
Total for model	116.1001	205	30	175	0.6634
Catches at age	2.2075	30	19	11	0.2007

Aged Indices

Bul	46.4635	80	4	76	0.6114
Ukr	57.3390	80	4	76	0.7545
Rom survey	10.0902	15	3	12	0.8408

Weighted Statistics

Variance

	SSQ	Data	Parameters	d.f.	Variance
Total for model	9.4553	205	30	175	0.0540
Catches at age	1.8465	30	19	11	0.1679
Aged Indices					
Bul	2.9040	80	4	76	0.0382
Ukr	3.5837	80	4	76	0.0472
Rom survey	1.1211	15	3	12	0.0934

6.2 Robustness analysis

Retrospective analysis, comparison between model runs, etc.

6.3 Assessment quality

ICA combines the power and accuracy of a statistical model with the flexibility of setting different options of the parameters (e.g. a separable model accounting for age effects) and for this raison is suitable for a short living species (age 5 at maximum) such as the Black Sea sprat. ICA has previously been applied to Black Sea sprat by Daskalov (1998), Pilling et al. 2009, and Daskalov et al. 2010.

7 Stock predictions

As the fishery for sprat in the Black Sea is not constrained by an international TAC the year 2014 was defined as a *status quo* effort year with unchanged fishing mortality.

7.1.Short term predictions

Table 7.1.1. Sprat in the Black Sea. Input to short term prediction.

2014

Age	stock size (000)	M	maturity	weight in stock (kg)	exploitation pattern	weight in catch (kg)
0	99217596	0.6400	0.0000	0.001	0.0167	0.0018
1	51449586	0.9500	1.0000	0.0016	0.1377	0.0021
2	23416807	0.9500	1.0000	0.0041	0.3988	0.0033
3	3654545	0.9500	1.0000	0.0048	0.8008	0.005

4	319492	0.9500	1.0000	0.008	0.3988	0.0068
5	54507	0.9500	1.0000	0.01	0.3988	0.01

2015

Age	stock size (000)	M	maturity	weight in stock (kg)	exploitation pattern	weight in catch (kg)
0	99217596	0.6400	0.0000	0.001	0.0167	0.0018
1		0.9500	1.0000	0.0016	0.1377	0.0021
2		0.9500	1.0000	0.0041	0.3988	0.0033
3		0.9500	1.0000	0.0048	0.8008	0.005
4		0.9500	1.0000	0.008	0.3988	0.0068
5		0.9500	1.0000	0.01	0.3988	0.01

2016

Age	stock size (000)	M	maturity	weight in stock (kg)	exploitation pattern	weight in catch (kg)
0	99217596	0.6400	0.0000	0.001	0.0167	0.0018
1		0.9500	1.0000	0.0016	0.1377	0.0021
2		0.9500	1.0000	0.0041	0.3988	0.0033
3		0.9500	1.0000	0.0048	0.8008	0.005
4		0.9500	1.0000	0.008	0.3988	0.0068
5		0.9500	1.0000	0.01	0.3988	0.01

8.Results

Table 8.1 Sprat in the Black Sea. Single option (status quo) short term prediction.

2014	F-factor:	1	reference F1-3	0.4458			1 January
Age	absolute F	catch in numbers (000)	catch in weight (t)	stock size (000)	stock biomass (t)	sp. stock size (000)	sp. stock biomass (t)
0	0.0167	1215668	2188	99217595.78	99218	0	0
1	0.1377	4319288	9071	51449585.54	82319	51449586	82319
2	0.3988	5126431	16917	23416806.6	96009	23416807	96009
3	0.8008	1381300	6907	3654545.255	17542	3654545	17542
4	0.3988	69944	476	319492.3709	2556	319492	2556
5	0.3988	11933	119	54506.7119	545	54507	545
		12124564	35678	178112532	298189	78894937	198971
2015	F-factor:	1	reference F1-3	0.4458			1 January
Age	absolute F	catch in numbers (000)	catch in weight (t)	stock size (000)	stock biomass (t)	sp. stock size (000)	sp. stock biomass (t)

0	0.0167	1215668	2188	99217596	99218	0	0
1	0.1377	4319288	9071	51449586	82319	51449586	82319
2	0.3988	3795549	12525	17337530	71084	17337530	71084
3	0.8008	2297275	11486	6077967	29174	6077967	29174
4	0.3988	138920	945	634565	5077	634565	5077
5	0.3988	18154	182	82926	829	82926	829
		11784854	36397	174800170	287701	75582574	188483
2016	F-factor:	1	reference F1-3	0.4458			1 January
Age	absolute F	catch in numbers (000)	catch in weight (t)	stock size (000)	stock biomass (t)	sp. stock size (000)	sp. stock biomass (t)
0	0.0167	1215668	2188	99217596	99218	0	0
1	0.1377	4319288	9071	51449586	82319	51449586	82319
2	0.3988	3795550	12525	17337531	71084	17337531	71084
3	0.8008	1700876	8504	4500056	21600	4500056	21600
4	0.3988	231041	1571	1055361	8443	1055361	8443
5	0.3988	36057	361	164705	1647	164705	1647
		11298480	34220	173724835	284311	74507239	185093

The *status quo* fishing in 2014 would result in landings 35 678 t and SSB of 198 971 t. At present levels of abundance and fishing mortality, the *status quo* model predicts some decrease in biomass in 2015 – 2016. Catches would slightly increase in 2015 (36 397 t) due to higher numbers of 3 years old fish (Table 6.1.5.3.1).

Recruitment estimates are rather imprecise due to the lack of survey data. Since 2011 there is an increasing trend in recruitment, which have not yet materialised in a biomass increase. In short-term forecast we used a geometric mean over 2010-2012 equal of 99 217 596.

Catches have been very high during 2009-2011 due to quickly expending Turkish fishery. In 2012 the catches dropped to 35 050 t and in 2013 - to 27 260t. The largest drop in catches is due to the lower catch by the Turkish fishery (Table 6.1.2.3.1.1). Under the status quo F assumption catches are expected to increase in 2014-2015.

Given that the state of the stock depends greatly on a variable recruitment, the dynamic nature of developing Turkish sprat fishery and the lack of quota constraints on the sprat fisheries, the status quo assumption must be taken with a caution when considered in management advice.

More management options through multiplications of the fishing mortality are given in Table 6.1.5.3.2. The Fmsy level of fishing mortality of 0.64 (corresponding to exploitation rate of 0.4. Patterson 1992, Daskalov et al. 2011) would reduce forecast catches from 48 755 t in 2015 to 42 558 t in 2016. On the other hand, keeping the *status quo* F, the catch is predicted to decrease from 36 397 t in 2015 to 34 220 t in 2016.

At present the sprat stock is experiencing a downward trend from historically high abundance peaking in 2008-2009. This trend, combined with the unprecedentedly high fishing pressure during the last years, prevents the SSB to recover, in spite of the indications of improving recruitment in 2011-2012.

Table 6.1.5.3.2. Sprat in the Black Sea. Management option table providing short term prediction.

2014						2015					2016		
F-factor	reference F	stock biomass	sp. stock biomass	catch in weight		F-factor	reference F	stock biomass	sp. stock bioma	catch in weight	stock biomass	sp. stock bioma	catch
1.0000	0.4458	298189	198971	35678		0.0000	0.0000	287842	188624	0	318325	219107	0
						0.1000	0.0446	287842	188624	4272	314255	215037	4872
						0.2000	0.0892	287842	188624	8384	310365	211147	9331
						0.3000	0.1337	287842	188624	12341	306646	207428	13417
						0.4000	0.1736	287842	188624	16155	303085	203867	17163
						0.5500	0.2387	287842	188624	21620	298024	198806	22228
						0.6000	0.2604	287842	188624	23377	296406	197188	23779
						0.7000	0.3120	287842	188624	26799	293268	194050	26703
						0.8000	0.3566	287842	188624	30107	290257	191039	29404
						0.9000	0.4012	287842	188624	33305	287364	188146	31904
					Fsq	**1.0000**	**0.4458**	**287701**	**188483**	**36397**	**284311**	**185093**	**34220**
						1.1000	0.4903	287842	188624	39390	281906	182688	36371
						1.2000	0.5349	287842	188624	42288	279328	180110	38371
						1.3000	0.5795	287842	188624	45097	276845	177627	40236
						1.4000	0.6241	287842	188624	47821	274450	175232	41976
						1.5000	0.6687	287842	188624	50463	272138	172920	43603
					Fmsy	**1.435**	**0.640**	**287842**	**188624**	**48755**	**273631**	**174413**	**42558**

9.Medium term prediction of stock biomass and catch

The EWG did not undertake medium term projections

10.Long term predictions

Fmax could not be estimated due to shape to the YpR curve, which has a maximum well outside of the reasonable range. The skewed shape of the YpR curve results from the high natural mortality and the short life span of sprat in the Black Sea. Due to such effects STECF EWG 14-14 on Black Sea does not consider $F_{0.1}$ as an appropriate management reference point and proposes a limit reference point of exploitation rate E≤0.4 which implies Fmsy = 0.64.

11.Draft scientific advice

State of the spawning stock size: According to the present assessment in recent years the SSB is at medium levels (180 000-300 000 t) with a decreasing trend since 2010. In 2013, SSB has dropped to 179 464 t. Under a constant recruitment scenario and status quo F = 0.446, in 2014 SSB is expected to increase to 198 189 and after to decrease again to 185 093 t by 2016.

State of recruitment: Recruitment reached a low in 2010-2011 and since then started to increase. Recruitment estimates are rather imprecise due to the lack of survey data. In short-term forecast we used a geometric mean over 2010-2012 average value of 99 217 596.

State of exploitation: Over the last few years the fishing mortality has peaked in 2010-2012 at a level of 0.7 - 1.24. Proposing a limit reference point of exploitation rate E≤0.4 that equals F = 0.64 (as suggested by Patterson 1992 for short living fish), the EWG considers that the catches where too high over the last years, that supported the decreasing trend in SSB. The current F=0.446 has resulted from an about 4 times drop in total catches since 2011 when the catches peaked at 120 710t. *Status quo* fishing implies catches in the range of 36 397 - 34 200 t over 2014 - 2016 which are bellow the recommended catch of 48 755 t, at Fmsy.

Table 6.3-1: Unidimensional stock status (choose one)

Unidimnsional	
	Not known or uncertain. Not much information is available to make a judgment; **Underexploited, undeveloped or new fishery**. Believed to have a significant potential for expansion in total production; **Moderately exploited**, exploited with a low level of fishing effort. Believed to have some limited potential for expansion in total production; **X Fully exploited**. The fishery is operating at or close to an optimal yield level, with no expected room for further expansion; **Overexploited**. The fishery is being exploited at above a level which is believed to be sustainable in the long term, with no potential room for further expansion and a higher risk of stock depletion/collapse; **Depleted**. Catches are well below historical levels, irrespective of the amount of fishing effort exerted; **Recovering**. Catches are again increasing after having been depleted or a collapse from a previous; **None** of the above.

Table 6.3-2: Bidimensional stock status

Bidimensional	Exploitation rate	Stock Abundance
	E≤0.4	180000

Please note the two new definitions provided by the SAC:

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

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

Stock Assessment Form

Small Pelagics (Atlantic Bonito)

Reference Year: 2013

Reporting Year:2014

Atlantic bonito plays a major role as top predator in the Black Sea ecosystem and has high commercial importance, especially for the Turkish fishery since 1950 (Prodanov et al., 1997; Cengiz, 2013; FAO, 2014). While total catches of Atlantic bonito from all Black Sea coastal states reached the maximum of 20.000 tons in 1969, thereafter have no Atlantic bonito catches recorded from these countries, except Turkey and Bulgaria. This was mainly due to pollution in northwest Black Sea, problems with migration routes (Changing of oceanographic conditions) and heavy fishing impact occurred in the Black Sea on Atlantic bonito stocks (Daskalov, 2002; Eremeev and Zuyev, 2007).

Reports of last 25 years have shown that a dominant part of the Atlantic bonito catches in the Black Sea, have are obtained in Turkish waters (TUIK, 2013). However, when considering the long-term statistics, Turkey's bonito catch from the Black Sea was also subjected to important fluctuations. There has been a decrease in catches since 2002. In 2005 an exceptional catch was landed - 70 797 t. In 2006, the catch decreased to 29 690 t. The 2005 catch was the highest in the last 35 years. It may be caused by some oceanographic factors and climate changes observed in the early 2000s such as:

While egg hatched, pre larva, post larva and juvenile periods getting to increase, which cause the decrease in natural mortality rate. The favourable water temperature and alterations in pelagic food web have positive effect on bonito population.

The spawning period may be prolonged compared to the period before 2000.

Migrating population into Black Sea spend more time than before and feed on small pelagic species as anchovy, horse mackerel and sprat.

1 Basic Identification Data

Scientific name:	Common name:	ISCAAP Group:
Sarda sarda	Atlantic Bonito	37
1st Geographical sub-area:	**2nd Geographical sub-area:**	**3rd Geographical sub-area:**
[GSA_2]	[GSA_2]	29
4th Geographical sub-area:	**5th Geographical sub-area:**	**6th Geographical sub-area:**
[GSA_4]		
1st Country	**2nd Country**	**3rd Country**
Turkey	[Country_2]	[Country_3]
4th Country	**5th Country**	**6th Country**
Stock assessment method: (direct, indirect, combined, none)		
Authors:		
[Authors]		
Affiliation:		

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

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

Direct methods (you can choose more than one):

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

Indirect method (you can choose more than one):

- ICA

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

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

2 Stock identification and biological information

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

Atlantic bonito (Sarda sarda Bloch, 1793), which is a member of Scombridae, exhibiting wide distribution in temperate and tropical coastal areas, coasts of the Atlantic Ocean, the Mediterranean, and the Black Sea (Collette and Chao,1975; Collette and Nauen, 1983; Sabatés and Recasens, 2001; Yoshida, 1980). It is an oceanodromous species which lives in schools along the neritic area and may enter in estuaries. It can be found from 80 to 200 meters depth (Collette and Nauen, 1983). Temperature is one of the most important environmental factors determining the distribution of tuna fish. This species can adapt to different temperatures 12°C to 27°C and salinities 14 to 39‰.

Atlantic bonito plays a major role as top predator in the Black Sea ecosystem and has high commercial importance, especially for the Turkish fishery since 1950 (Prodanov et al., 1997; Cengiz, 2013; FAO, 2014). While total catches of Atlantic bonito from all Black Sea coastal states reached the maximum of 20.000 tons in 1969, thereafter have no Atlantic bonito catches recorded from these countries, except Turkey and Bulgaria. This was mainly due to pollution in northwest Black Sea, problems with migration routes (Changing of oceanographic conditions) and heavy fishing impact occurred in the Black Sea on Atlantic bonito stocks (Daskalov, 2002; Eremeev and Zuyev, 2007).

- While egg hatched, pre larva, post larva and juvenile periods getting to increase, which cause the decrease in natural mortality rate? The favorable water temperature and alterations in pelagic food web have positive effect on bonito population.
- The spawning period may be prolonged compared to the period before 2000.
- Migrating population into Black Sea spend more time than before and feed on small pelagic species as anchovy, horse mackerel and sprat.

2.1 Stock unit

2.2 Growth and maturity

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

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

Somatic magnitude measured (LT, LC, etc)			Length	Units	(cm)
Sex	Fem	Mal	Combined	Reproduction season	May-August
Maximum size observed			71.2	Recruitment season	
Size at first maturity				Spawning area	
Recruitment size to the fishery				Nursery area	

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

Size/Age	Natural mortality	Proportion of matures
0+		2.259936
1+		0.954501
2+		0.743604
3+		0.679564

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

Size/Age	Natural mortality	Proportion of matures
0+		2.259936
1+		0.954501
2+		0.743604
3+		0.679564

Table 2-3: Growth and length weight model parameters

			Sex			
		Units	female	male	Combined	Years
Growth model	L_∞	69.24			C	2013
	K	1.08			C	2013
	t_0	-0.17			C	2013
	Data source					
Length weight relationship	a	0.0024			C	2013
	b	3.4115			C	2013
	M (scalar)	0.917			C	
	sex ratio (% females/total)					

3 Fisheries information

3.1 Description of the fleet

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

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

	Country	GSA	Fleet Segment	Fishing Gear Class	Group of Target Species	Species
Operational Unit 1*	Turkey	29	>12 m	Purse Seine	Small Pelagics	Anchovy Horse Mackerel Bonito
Operational Unit 2	[Country2]	[GSA2]	[Fleet Segment2]	[Fishing Gear Class2]	[ISCAAP Group]	
Operational Unit 3	[Country3]	[GSA3]	[Fleet Segment3]	[Fishing Gear Class3]	[ISCAAP Group]	
Operational	[Country4]	[GSA4]	[Fleet Segment4]	[Fishing Gear	[ISCAAP	

Unit 4				Class4]	Group]	
Operational Unit 5	[Country5]	[GSA5]	[Fleet Segment5]	[Fishing Gear Class5]	[ISCAAP Group]	
Operational Unit 6	[Country6]	[GSA6]	[Fleet Segment6]	[Fishing Gear Class6]	[ISCAAP Group]	

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

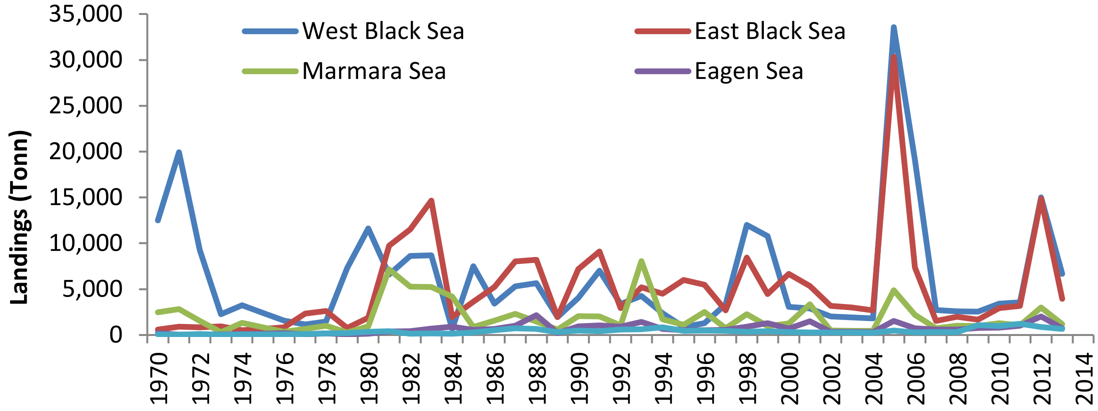
Operational Units*	**Fleet (n° of boats)***	**Catch (T or kg of the species assessed)**	**Other species caught (names and weight)**	**Discards (species assessed)**	**Discards (other species caught)**	**Effort (units)**
[Operational Unit1]						
[Operational Unit2]						
[Operational Unit3]						
[Operational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

3.2 Historical trends

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

Year	Turkish Seas (Tones)					Country (Tones)		
	West Black Sea	East Black Sea	Marmara Sea	Aegean Sea	Mediterranean Sea	Turkey	Greece	Bulgaria
1970	12.486	596	2.476	215	59	15.832	927	30
1971	19.935	900	2.829	35	16	23.716	611	41
1972	9.246	846	1.534	32	97	11.755	600	0
1973	2.269	939	327	73	45	3.654	500	28
1974	3.261	526	1.338	91	72	5.287	487	15
1975	2.399	674	847	149	72	4.140	658	0
1976	1.555	829	363	207	72	3.025	511	40
1977	1.162	2.332	664	78	104	4.339	550	44
1978	1.451	2.629	1.014	175	163	5.431	610	11
1979	7.294	782	283	82	198	8.639	712	1
1980	11.605	1.882	939	151	333	14.910	809	13
1981	6.604	9.733	7.165	367	432	24.300	1.251	0
1982	8.629	11.522	5.262	432	133	25.978	1.405	4
1983	8.701	14.668	5.237	695	184	29.485	1.367	24
1984	664	1.938	4.196	889	131	7.818	1.732	1
1985	7.486	3.640	871	547	265	12.809	1.321	1
1986	3.422	5.226	1.572	675	531	11.426	1.027	0
1987	5.287	8.026	2.288	1.018	714	17.333	1.848	13
1988	5.647	8.186	1.448	2.178	674	18.133	1.254	0
1989	1.936	1.936	592	219	325	5.008	2.534	0
1990	4.057	7.199	2.056	947	478	14.737	2.534	17
1991	7.030	9.114	2.037	1.057	407	19.645	2.690	15
1992	3.399	2.938	1.028	920	578	8.863	2.690	12
1993	4.248	5.213	8.054	1.419	614	19.548	2.690	8
1994	2.385	4.492	1.713	670	833	10.093	1.581	0
1995	861	6.005	1.125	508	445	8.944	2.116	25
1996	1.285	5.467	2.502	534	496	10.284	1.752	33
1997	3.362	2.682	738	565	463	7.810	1.559	16
1998	12.019	8.461	2.276	897	347	24.000	945	51
1999	10.775	4.458	961	1.303	403	17.900	2.135	20
2000	3.084	6.653	1.248	692	322	11.999	1.914	35
2001	2.905	5.332	3.345	1.491	287	13.360	1.550	49
2002	2.016	3.159	479	350	282	6.286	1.420	0
2003	1.924	3.015	457	335	269	6.000	1.538	23
2004	1.828	2.685	434	318	256	5.521	1.321	18
2005	33.572	30.324	4.878	1.536	487	70.797	1.390	56
2006	19.092	7.373	2.208	742	277	29.692	845	8
2007	2.707	1.539	731	590	298	5.865	1.123	1
2008	2.565	1.971	1.006	594	312	6.448	587	16
2009	2.535	1.681	983	754	1.083	7.036	476	5
2010	3.408	2.914	1.304	809	966	9.401	531	16
2011	3.555	3.171	1.054	1.004	1.235	10.019	277	8
2012	14.991	14.863	3.008	2.015	886	35.763	555	96
2013	6.671	3.930	1.180	732	645	13.158	615	0

In Turkey, the declared landings of Atlantic bonito in the last years are the following: 6322 tons in 2010; 6726 tons in 2011; 29854 tons in 2012; 10601 tons in 2013.



3.3 Management regulations

Regulations about fishing area: For purse seines, it is not allowed in the waters shallower under the 24 m (from the coastal).

Regulations about fishing gear: The depth of purse seine net cannot be more than 164 m. The use of gill nets for bonito is permitted between 15 and 31August in the all Black Sea.

Regulations about time periods: Fishing period of purse seine is from 1 September to 15 April. The use of fixed nets is prohibited in the Turkish territorial waters from 15 April to 31 August

Legal size: The minimum size for the Atlantic bonito is 25 cm in Turkey and 28 cm in the Bulgaria.

3.4 Reference points

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

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

sea					

4 Fisheries independent information

4.1 {NAME OF THE DIRECT METHOD}

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

4.1.1 Brief description of the chosen method and assumptions used

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

Direct methods: DEPM

Table 4.1-1: Egg production cruise information.

Date					
Cruise				**R/V**	
Total area (km^2)		Positive		**Negative**	
Egg sampler					
Adult sampler					

Table 4.1-2: Parameters of the egg mortality curve

Parameters (exponential decay model)			**value**	**CV**
P_0 (# of eggs /0.05 m^2)				
Z (days^{-1})				
Temperature range	ºC	ºC		

Table 4.1-3: DEPM Model parameters

Model parameters	**value**	**CV**
P_0 (# of eggs/0.05 m^2 per day)		
A (surface of region 0.05 m^2)		
W (average female weight in gr)		
F (batch fecundity: eggs / batch per mature female)		
S (spawning fraction: # spawning female per mature female)		
R (sex ratio: females/total)		

Table 4.1-4: DEPM based estimates

Result	value	CV
Biomass (t)		

Direct methods: acoustics

- Specify if numbers are per km^2 or raised to the area, assuming the same catchability .
- Specify the ageing method or the age slicing procedure applied, specify the maturity scale used.
- In case maturity ogive has not been estimated by year, report information for groups of years.

Table 4.1-5: Acoustic cruise information.

Date			
Cruise		**R/V**	
Target species			
Sampling strategy			
Sampling season			
Investigated depth range (m)			
Echo-sounder			
Fish sampler			
Cod –end mesh size as opening (mm)			
ESDU (i.e. 1 nautical mile)			
TS (Target Strength)/species			
Software used in the post-processing			
Samples (gear used)			
Biological data obtained			
Age slicing method			
Maturity ogive used			

Table 4.1-6: Acoustic results, if available by age or length class

	Biomass in metric tons	fish numbers	Nautical Area Scattering Coefficient	Indicator …	Indicator …

4.1.2 Spatial distribution of the resources

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

4.1.3 Historical trends

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

Year	Age-0+	Age-1	Age-2	Age-3
2000	7735.035	9551.772	1323.712	372.0833
2001	8513.704	10741.02	0	3183.519
2002				
2003				
2004				
2005	3364.883	94235.96	0	0
2006	28425.79	49498.43	0	0
2007	230.7439	1489.976	1493.865	374.3538
2008	11507.07	5513	0	0
2009	4044.66	3960.605	2276.431	465.6385
2010	6199.694	10633.11	0	0

2011	4665.997	10457.62	2866.445	497.8718
2012	9842.11	56652.81	1296.113	1382.787
2013	2420.415	8916.019	246.9811	197.5849

Aggregated catch at age in number 10^{-3} of Turkey.

Table 4.1.3.2. Weight at age in the catch (in g).

Year	**Age-0+**	**Age-1**	**Age-2**	**Age-3**
2000	371.581	612.7929	2632.6	3700
2001	205.7158	562.3243		5000
2002				
2003				
2004				
2005	226.2813	702.1296		
2006	210.3911	524.6252		
2007	275	887.8746	3306.429	5800
2008	218.2993	494.4091		
2009	206.3588	580.5513	2627.75	4300
2010	260.2305	506.4648		
2011	153.7717	544.0284	2594.667	3380
2012	178.7153	542.6042	3240	3456.667
2013	5748.035	12248.25	64449.73	82862.17

5 Ecological information

5.1 Protected species potentially affected by the fisheries

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

Sturgeon fisheries has banned.

5.2 Environmental indexes

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

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

6 Stock Assessment

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

6.1 {Name of the Model}

6.1.1 Model assumptions

6.1.2 Scripts

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

6.1.3 Input data and Parameters

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

6.1.4 Tuning data

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

Add a table with input parameters and model settings

6.1.5 Results

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

6.1.6 Robustness analysis

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

6.1.8 Assessment quality

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

7 Stock predictions

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

7.1 Short term predictions

7.2 Medium term predictions

7.3 Long term predictions

8 Draft scientific advice

(.)

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

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

8.1 Explanation of codes

Trend categories

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

Stock Status

Based on Fishing mortality related indicators

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

    Range of Overfishing levels based on fishery reference points

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

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

    *Fc is current level of F

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

Based on Stock related indicators

1) **N - Not known or uncertain:** Not much information is available to make a judgment
2) **S - Sustainably exploited:** Standing stock above an agreed biomass based Reference Point;
3) **O - Overexploited**: Standing stock below the value of the agreed biomass based Reference Point. An agreed range of overexploited status is provided;

Empirical Reference framework for the relative level of stock biomass index

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

4) **D – Depleted**: Standing stock is at lowest historical levels, irrespective of the amount of fishing effort exerted;
5) **R –Recovering:** Biomass are increasing after having been depleted from a previous period;

Agreed definitions as per SAC Glossary

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

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