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STATUS SUMMARY FOR SMALL PELAGIC STOCKS IN THE SOUTHERN AREA OF THE EASTERN CENTRAL ATLANTIC - CECAF

SUMMARY

The fourth meeting of the FAO/CECAF Working Group on the Assessment of Small Pelagic Fish – Subgroup South (WGASP-S) was held in Accra, Ghana, from 12-20 September 2018. The Group assessed the status of the Small Pelagic resources in Southwest Africa and advises on future effort and catch levels.

The species assessed by the Group were: sardinella (Sardinella aurita, Sardinella maderensis and *Sardinella* spp.), bonga (*Ethmalosa fimbriata*), anchovy (*Engraulis encrasicolus*), horse mackerel (*Trachurus trecae* and *Decapterus rhonchus*), and other Carangidae, in the region between the northern border of Guinea-Bissau and the southern border of Angola.

Of the 16 stocks analyzed, four were found to be overexploited: round and flat sardinella (*S. aurita* and *S. maderensis*) western stock; Cunene horse mackerel (*Trachurus trecae*) northern and southern stock. For these stocks, the recommendation was not to increase catch levels above the average of the last five years, this in order to allow the stock to rebuild. Two stocks were found to be fully exploited: *Sardinella* spp. southern stock and *Decapterus* spp. northern stock. For these stocks, as a precautionary measure, the recommendation was that the catch level should not exceed the average catch of the last five years. Four stocks, were considered not fully exploited: *Sardinella* spp. northern stock; *E. fimbriata* southern stock; and *Engraulis encrasicolus* central and southern stocks the Working Group recommended that the catch level should not exceed the average catches of the five last years. For two of the stocks, the data did not provide reliable results, and for four stocks the data available were not sufficient to apply any assessment model. For these stocks, as a precautionary measure, the Working Group recommended that the catch level should not exceed the average of the last five or three years or, in some cases, the previous year's (2016) catch. Very few data were provided to the Working Group this year, leading to weak assessments for the stocks.

INTRODUCTION

1. The fourth meeting of the FAO/CECAF Working Group on the Assessment of Small Pelagic Fish – Subgroup South was held in Accra, Ghana from 12-20 September 2018.

2. The overall objective of the Working Group is to contribute to the improved management of small pelagic resources in West Africa through the assessment of the state of the stocks and fisheries in order to ensure sustainable use of these resources for the benefit of coastal countries.

3. The 2018 Working Group was preceded by a two-day workshop where participants reviewed the 2017 survey data from the R/V *Dr Fridtjof Nansen* for the southern region of CECAF. The workshop produced a working document that summarizes the description of the surveys, the abundance and biology results, the oceanographic conditions by country, and provides maps on the species distribution and length-frequency by species from the R/V *Dr Fridtjof Nansen*.

4. The species assessed by the Group were: sardinella (*Sardinella aurita, Sardinella maderensis* and *Sardinella* spp.), bonga (*Ethmalosa fimbriata*), anchovy (*Engraulis encrasicolus*) and horse mackerel (*Trachurus trecae* and *Decapterus rhonchus*) and other *Carangidae.*

5. Altogether, 18 researchers from Angola, Benin, Cameroon, Côte D'Ivoire, Democratic Republic of Congo, Congo, Gabon, Ghana, Guinea, Guinea Bissau, Spain, S. Tomé and Principe, Togo, Norway, and FAO participated in this Working Group.

6. The working area for the Working Group is defined as the waters between the southern border of Senegal and southern border of Angola, including Cape Verde and S. Tome and Principe Iles.

Methodology

7. After reviewing the available data, the Working Group concluded that the only class of methods that could be applied to all stock units was the dynamic production model. Remaining consistent with the methods used for earlier assessments, the dynamic version of the Schaefer (1954) model, through an Excel spreadsheet implementation of the dynamic version of this model, with an observation error estimator (Haddon, 2001), was used to assess the current state of the stocks and estimate the model parameters. The model was fitted to the data using the non-linear optimizer built into the Excel solver.

8. The three assessment categories adopted by the CECAF scientific working groups include:

    - **Non-fully exploited:** The stock is in good condition and fishing pressure can be increased without affecting the sustainability. All increases must be seen in the context of the general environmental situation.

    - **Fully Exploited:** The fishery operates within the limits of sustainability. Current fishing pressure seems sustainable and can be maintained.

    - **Overexploited:** The fishery is in an undesired state both in terms of biomass and fishing mortality. Fishing pressure should be reduced to allow the stock to grow.

Management advice

9. The advices for the stocks are given in relation to the agreed reference points (FAO, 2006):

    - Target Reference Points: **$F_{0.1}$ and $B_{0.1}$.**

- Limit Reference points: **B_{MSY} and F_{MSY}.**

Results

10. A total of 7 species or species groups and 16 stocks were analyzed by the Group when the data was available.

11. The results of the assessments show that: (Table 2).

    - Two stocks were found to be fully exploited: *Sardinella* spp. Southern stock and *Decapterus* spp. Northern stock.
    - Four stocks, were considered not fully exploited: *Sardinella* spp. Northern stock; *E. fimbriata* Southern stock; and *Engraulis encrasicolus* central and Southern stocks
    - For two of the stocks, the data did not provide reliable results from the assessments.
    - Four stocks the data available were not sufficient to apply any assessment model and they were analyzed by others parameters.

Management Recommendations

12. For all stocks, as a precautionary measure, the Working Group recommended that the catch level should not exceed the average of the last five or three years or, in some cases, the previous year's (2016) catch. Very few data were provided to the Working Group this year, leading to weak management mesures for almost all the stocks.

Conclusions

10. Since most of the stocks are shared by two or more countries in the region, the Working Group strongly recommends the strengthening of regional cooperation in research and management. The members of the Working Group should discuss with fisheries managers of their countries their expectations in relation to management advice from scientists and develop strategies to improve the advice provided. For two of the stocks, the data did not provide reliable results from the assessment models applied, and for four stocks the data available were not sufficient to apply any assessment model. For all stocks, a precautionary measure was advised, the Working Group recommended that the catch level should not exceed the average of the last five or three years or, in some cases, the previous year's (2016) catch.

OVERALL REGIONAL TRENDS

Catch

11. There was an increase of 31 percent in total catches of the main small pelagic fish studied at this meeting, from 444 000 tonnes in 2011 to 581 000 tonnes in 2012. However, the trend observed since 1999 is rather stable, with few years showing catches either higher (1996 and 2003) or lower than the average. Total catches of small pelagic fish for the period 1990– 2012 fluctuated about 514 000 tonnes (Table 1, Figure 1).

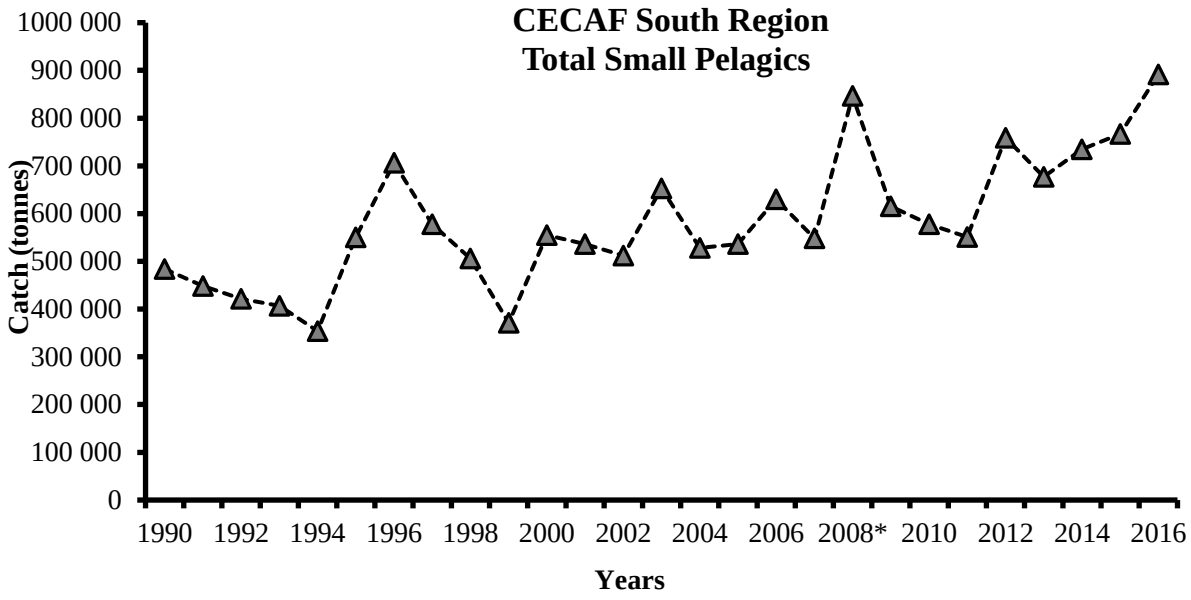

Figure. 1. Total Catch of Demersal South studied by the Small Pelagic South Working Group.

Table 1. Catch contribution in 2015-2016, percentage change and average in the period studied.

	2015 Catch (t)	2016 Catch (t)	Catch contribution 2015%	Catch contribution 2016%	Percentage Change %	AVERAGE (1990-2016)
***Sardinella* spp.**	201 604	309 677	26%	35%	35%	100 301
S. maderensis	178 958	223 577	23%	25%	20%	69 861
T. trecae	125 240	101 670	16%	11%	-23%	107 796
S. aurita	42 455	59 453	6%	7%	29%	55 305
Other Carangidae	32 312	55 871	4%	6%	42%	46
***Trachurus* sp.**	89 721	47 313	12%	5%	-90%	6 292
E.fimbriata	52 475	42 318	7%	5%	-24%	35 641
E.encrasicolus	16 160	26 900	2%	3%	40%	13 091
Caranx	13 902	16 058	2%	2%	13%	60 104
***Decapterus* spp.**	9 525	9 053	1%	1%	-5%	96 181
***C. rhonchus* (or *D. rhonchus*)**	-	-	-	-	-	3 399
S. colias	-	-	-	-	-	7 818
Ilisha africana	-	-	-	-	-	21 475
Others	4 256	-	1%	-	-	8 958
Total	**766 608**	**891 890**	**100%**	**100%**	**14%**	**583 145**

12. The round sardinella (*S. aurita*) constituted almost 7 percent of total catches of small pelagic fish, in 2016, thus ranking as one of the most important small pelagic fish in the region. Total catches of round sardinella fluctuated between 35 000 and 237 000 tonnes in the period 1990–2016 with an average of about 55 000 tonnes. The overall trend has been a steady decrease (with fluctuations) in catches for this species since 1999, with a total landing of about 60 000 tonnes in 2016 (Figure 2).

13. The catches of flat sardinella (*S. maderensis*) in 2016 were 224 000 tonnes, with a contribution to the total catches of the main small pelagic fish in the region of about 25 percent in 2016. Since 2012 the catch trend of sardinella maderensis increased substantially The average for the period 1990–2016 for this species is around 70 000 tonnes. Some countries report catches for *Sardinella* spp. as a whole, without separating the species which represents in 2016 about 35 percent of the total catch of the main small pelagics CECAF South and it was the most important species group in the Region 2016 (Figure 2).

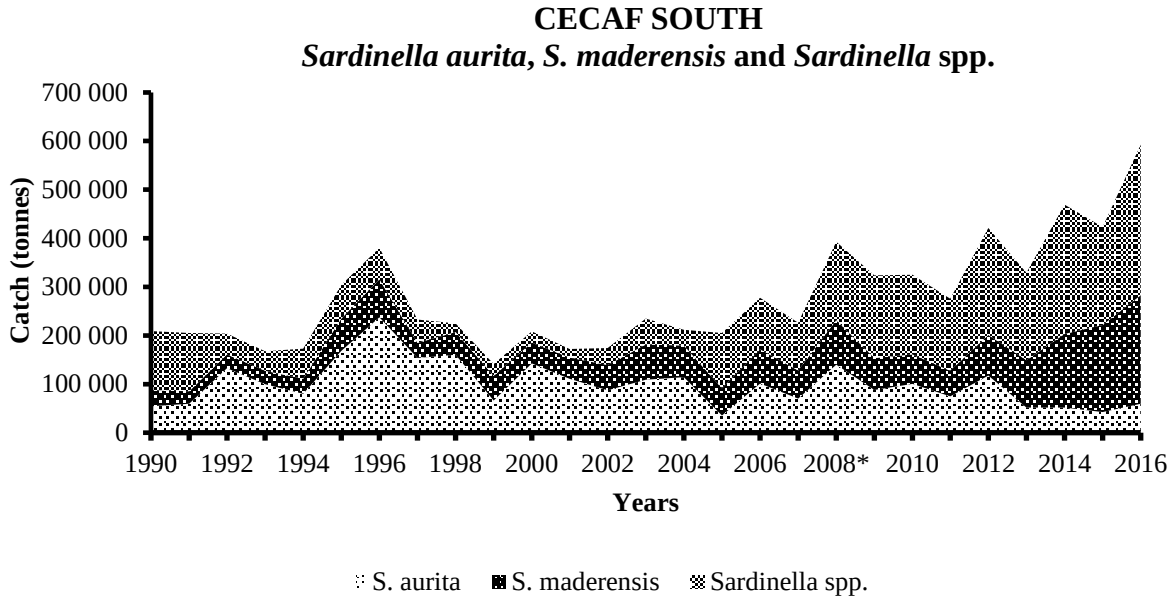

Figure. 2. Total Catch of sardinellas studied by the Small Pelagic South Working Group.

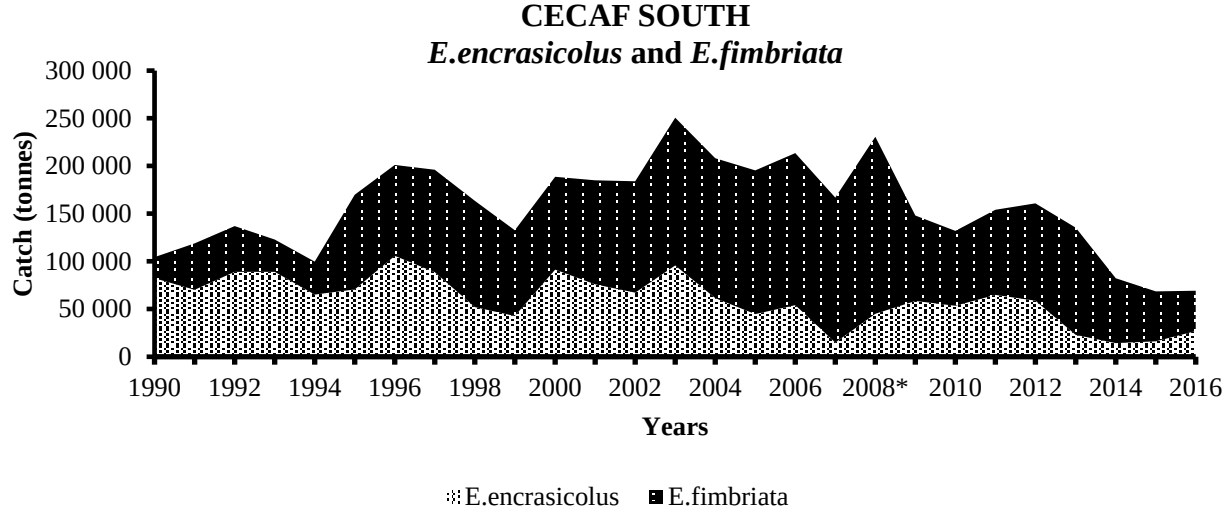

Figure. 3. Total Catch of Anchovy and Bonga studied by the Small Pelagic South Working Group.

15. Anchovy (*E.encrasicolus*) and bonga (*E.fimbriata*) are very important species in the southern region of CECAF. The total catches of anchovy in 2016 were about 27 000 tonnes, increasing by about 40 percent compared with 2015 (Figure 3). An average of 13 000 tonnes of anchovy was recorded for the period analysed. Catches of bonga in 2016 constituted about 5 percent of total catches of small pelagic fish in the subregion (42 000 tonnes). Bonga, an estuarine species, is mainly targeted by artisanal fishers operating in the whole subregion with an average of 36 000 tonnes in the period 1990-2016.

Surveys

16. The 2018 Working Group was preceded by a two-day workshop where participants reviewed the 2017 survey data from the R/V Dr Fridtjof Nansen for the southern region of CECAF. The workshop produced a working document that summarizes the description of the surveys, the results, the oceanographic conditions by country, and provides maps on the species distribution and length-frequency by species from the R/V Dr Fridtjof Nansen.
17. No regional coverage of the small pelagic stocks has been carried out in recent years by National research vessels.
18. Several pelagic surveys have been carried out in the region since the 1980s, all of them by the Norwegian research vessel R/V Dr. Fridtjof Nansen. The Senegalese R/V Itaf Deme also carried out pelagic surveys in Sierra Leone in 2008 and 2009.
19. The longest survey series is that of Angola, where R/V Dr. Fridtjof Nansen has carried out acoustic surveys since 1985. From 1995[1] to 2017, a series of annual acoustic surveys were carried out in the same season (August–September).

Environment

20. These stocks are influenced by a tropical hydro climate characterized by three current systems (the Guinea current, the Canary current and the Equatorial counter current) which affects the oceanographic conditions and the pelagic species. The dominant current system is the Guinea current and the offshoot of the Canary current (blowing from February to April) which flows eastward along the coast to join the westward flowing South Equatorial current (May–July) off the coast of Liberia.

State of stocks and management recommendations

21. A summary sheet with the complete results of the assessments and management recommendations is given in Table 3.
22. The FAO/CECAF Working Group has agreed on the existence of various stocks for the species studied in the Southern CECAF Area (Table 2; Figure 3).

Table 2. Stocks and species considered by the Group

Sub-group/Species/Group of species/stocks	**Zone**
***Sardinella maderensis, S. aurita and Sardinella* spp.**	
Stock North	Guinea Bissau, Guinea , Sierra Leone & Liberia
Stock West	Côte d´Ivoire, Ghana, Togo & Benin
Stock Central	Nigeria & Cameroon
Stock South	Gabon, Congo, Democratic Republic of the Congo & Angola
Ethmalosa fimbriata	
Stock North	Guinea Bissau, Guinea , Sierra Leone & Liberia
Stock West	Côte d´Ivoire, Ghana, Togo & Benin
Stock Central	Nigeria & Cameroon
Stock South	Gabon, Congo, Democratic Republic of

[1] In 1995 and 1996, two acoustic surveys were carried out, one in February–March and one in July–August.

	the Congo &Angola
Engraulis encrasicolus	
Stock West	Cote d'Ivoire, Ghana, Togo & Benin
Stock South	Congo
Horse mackerel and other *Carangidae*	
Trachurus trecae	
Stock North	Guinea Bissau, Guinea, Sierra Leone & Liberia
Stock West	Côte d'Ivoire, Ghana, Togo & Benin
Stock South	Gabon, Congo, DR Congo & Angola
***Decapterus* spp.**	
Stock North	Guinea

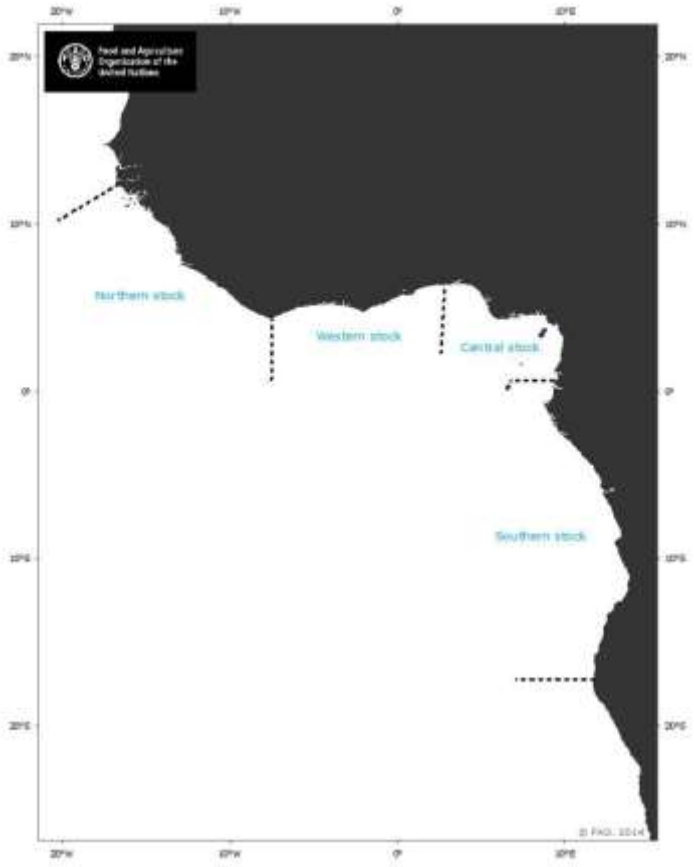

Figure 3. Stocks for the species studied in the Southern CECAF Area

Sardinella spp.

Northern stock

23. The input data for the model used in the assessment were total catch data of *Sardinella* spp. from the artisanal and industrial fisheries of Guinea,Guinea Bissau, Sierra Leone and Liberia for the period 1990–2017. The artisanal fisheries data from Guinea-Bissau were not available to the Working Group, and artisanal catches for the recent period for Sierra Leone were not available either since 2008. The CPUE of Guinea-Bissau's industrial fishery was used in the assessment.

24. The model fitted reasonably well to the data The results from the assessment indicate that the current biomass of Sardinella spp. is 29 percent above B0.1. The relationship between the current fishing mortality at F0.1 is 49 percent, and is lower than the fishing mortality coefficient that will provide a sustainable yield in the long term. The results of the model showed that the stock is not fully exploited.

25. Although the model shows that the stock is not fully exploited, other knowledge available on these fisheries from the region indicate that Sardinella spp. may not be in a good state. Considering the many uncertainties in the data made available to the working group and the lack of information on the fishery from Sierra Leone and the artisanal fisheries in Guinea-Bissau, the Working Group decided to be cautious with respect to the advice provided As a precautionary measure, the recommendation is not to exceed the current fishing level which is 60 000 tonnes.

Southern stock

26. The input data for the model used in the assessment were the total catch data for Sardinella spp. from the artisanal and industrial fisheries of all countries.The CPUE used in the assessment was the abundance index of acoustic surveys estimated by R/V Dr. Fridtjof Nansen in Angola (Winter surveys, 1990–2017).

27. The results of the assessment show that Sardinella spp. is fully exploited, the current biomass is 13 percent above B0.1 and the current fishing mortality is 55 percent above F0.1..As the current fishing mortality is more than that which can be maintained at the current biomass level, the biomass is expected to decrease in future years if the current fishing mortality is maintained. As a precautionary approach, the recommendation is not to exceed the catch recommended for the last assessment in 2014 (80 000 tonnes).

Sardinella aurita and *Sardinella maderensis*

Western Stock

28. The input data were the total catch data on round sardinella (S. aurita) and flat sardinella (S. maderensis) from the artisanal, semi–industrial and industrial fisheries for the period 1990–2017 from Côte d´Ivoire, Ghana, Togo and Benin. The CPUE of Ghana's artisanal fishery was used in the assessment for round sardinella (1990–2017).

29. The model applied fitted reasonably well the data. The results of the assessment model show that the stocks of round and flat sardinella are overexploited and near collapse in terms of biomass and the fishing mortality levels. This implies that if the fishing effort remains at the current level, the stock may collapse; hence, as a precautionary measure, the fishery should be closed in order to allow the stock to recover also considering the results from the R/V Dr. Fridtjof Nansen survey for 2017 in the region.

Central stock

30. No assessment was done for the central stock for round and flat sardinella as no CPUE series were available. Catches show increasing trends. An analysis of catches in Nigeria shows a general increase in round sardinella catches since 2007, whereas catches of flat sardinella have been stable in recent years. As a precautionary measure, catches should not exceed the average of the last five years (14 000 tonnes).

Ethmalosa fimbriata

Northern stock

31. Bonga has been intensively fished for a long time in the subregion. As a coastal and estuarine species, bonga is mainly fished by the artisanal fisheries. The data from Guinea-Bissau, Guinea and Liberia were analysed and input in the assessment model. No reliable result was obtained from the model. The assessment was considered unsatisfactory and therefore rejected. The CPUE of Guinea shows a relatively same trend over the period analysed but catches increased in a little in the last three years. This means that caution has to be applied in the management of this stock. Therefore the Working Group advise, do not increase catches above the average of the last five years (46 000 tonnes).

Western stock

32. The CPUE from Ghana's artisanal fleet (1990–2017) was chosen to fit the model because the series made available to the Group were believed to better reflect the variations in the stock. The estimate of the total catches for Côte d'Ivoire, Ghana and Benin from 1990 to 2017 was used. For the western stock, Togo has no catch data for the entire period concerned. Benin, for its part, has no data on the first seven years (1990–96). The Côte d'Ivoire series begins in 1999 with data unavailable in 2007 and 2008. However, the Ghana artisanal fishery series is complete (1990–2017) and that of the coastal fishery is sporadic. For the western stock, the model results do not make it possible to draw a conclusion on the status of the stock. Moreover, the catches show annual fluctuations. No specific recommendation was made owing to the uncertainties in the data. Close monitoring of the stock is recommended.

Central stock

33. No assessment made, but catches have been stable in the last few years. As a precautionary measure, the average of the last five years (24 000 tonnes) should not be exceeded.

Southern stock

34. The CPUE from the artisanal fleet of the Congo (1998–2017) was chosen to fit the model. The total catches for the time series of all the countries (the Congo, Gabon and the Democratic Republic of Congo) in the southern stock from 1998 to 2017 was analyzed and input to the assessment model. Angola provided no catch data for the species. The Working Group stresses the need to provide the necessary information to allow the assessment of the total stock in the future.

35. This stock is considered not fully exploited, as a precautionary measure, and due to uncertainty in the data catches of this species should not be increased above the average of the last five years (5 000 tonnes). This was quite low when compared to the previous assessment (14 000 tonnes) from last meeting.

Engraulis encrasicolus

Northern stock

36. No assessment was made for the northern stock owing to the fact that the Working Group has not had any data from Guinea Bissau, Guinea, and Liberia, on the CPUEs since the last assessment in 2009. No management measures were advised.

Western stock

37. The data of anchovy (Engraulis encrasicolus) presented to the Working Group was analyzed for Côte d'Ivoire, Ghana, Benin and Togo from 1990 to 2017. The abundance indices used to adjust the model are the CPUEs from the artisanal fisheries in Ghana and Togo. As the results obtained are similar to the two CPUEs, the Working Group decided to maintain the results estimated with the CPUE from Togo for continuity in the 2009 assessment, and as a precautionary measure. The

results show that the current biomass is 137 percent of the corresponding biomass at B0.1, and the fishing mortality observed in 2017 is 49 percent of the fishing mortality F0.1. From this assessment, it appears that the stock is not fully exploited, but the catches of the artisanal fishery in Côte d'Ivoire are not available. The lack of data from this country affects the assessment of the western stock and consequently, the results of the model must be accepted with caution. For the western stock (Benin, Ghana and Togo), catches should not exceed the average of the last year (50 000 tonnes).

Southern stock

38. Only the R. Congo has a series of anchovy (Engraulis encrasicolus) data for the southern stock (Angola, the Congo, the Democratic Republic of the Congo, and Gabon) from 1998 to 2017. The other countries have sporadic data. The abundance indices used to adjust the model are the CPUEs from the Congo artisanal fisheries. The model results show that the current biomass is 22 percent higher than the biomass corresponding to B0.1, and the fishing mortality observed in 2017 represents 26 percent of the fishing mortality F0.1. From this assessment, it appears that the stock is not fully exploited.

39. Because Angola did not provide catch data, as a precautionary measure the catch level should not exceed the catch limit recommendation from 2014 (800 tonnes).

Decapterus spp.

Northern stock

40. This species is not targeted by the fishery in Guinea, and is mainly caught as a bycatch in the industrial fishery. The dynamic version of the Schaefer model (1954) was applied to the total catch (Guinea, Sierra Leone & Liberia) of Decapterus spp. with data from the CPUEs of the industrial pelagic trawlers of Guinea (period 1995–2017). The results of the model applied to the data for the Decapterus spp. species in the northern stock indicate that the current biomass is 92 percent of the biomass at B0.1. The relationship between the current fishing mortality and F0.1 is 95 percent. These results indicate that the stock is fully exploited. As a precautionary measure, catches should be decreased. The Working Group maintains the 2009 recommendation that catches should not exceed 3 000 tonnes.

41. As a precautionary measure, the catch levels for the northern stock should not increase more than the average of the last 5 years (6 000 tonnes).

Trachurus trecae and other Carangidae

Northern stock

42. The input data of Cunene horse mackerel from Guinea-Bissau, Guinea and Liberia were used in the assessment models for the period 1997–2012. Catches for Guinea-Bissau for the period 1998–1999 were not available. Catches for Liberia for the period 2014-2017 were not available. Data for Sierra Leone were not available. The CPUE as proxies to the abundance indices for the stock analyzed by the model was from demersal trawlers in Guinea.

43. The results of the analysis show that current biomass (Bcur) represents 75 percent of the target biomass B0.1. The current fishing mortality (Fcur) is 125 percent of the target fishing mortality (F0.1) and is currently above the fishing mortality that would provide a sustainable yield at the current biomass level. The results show that the Trachurus trecae northern stock is overexploited. If the fishing effort remains at this level with the same environmental conditions, a decrease in the biomass can be expected next year.

44. As a precautionary measure, do not increase catches of this species above the 2014 level (13 000

tonnes), and reduce effort in order to allow the stock to grow. The 2014 assessment and 2018 assessment both say the stock is overexploited (even after setting a low catch limit of 10 000 tonnes in 2014), but maintaining the stock at 2017 levels is too high (31 487 tonnes), so it was proposed to keep the lower limit and use the 2014 catch level.

Western stock

45. No reliable results from the assessments because there was no reliable data. Catches from Côte d'Ivoire, Ghana, Togo and Benin have decreased over the last five years. As a precautionary measure, do not increase catches of this species from the average of the 5 last years (14 900 tonnes).

Southern stock

46. The data of Trachurus trecae were analyzed in the period 1990–2017 for the four countries Angola, Congo, Democratic Republic of the Congo, and Gabon. The following data were used to estimate the total catch: the artisanal fisheries in Gabon (2007–17), the Democratic Republic of the Congo (2007–2012), as well as artisanal (2007, 08,12 & 17), purse seiners with the exception of 2016 (2007-17), pelagic trawlers (2015 & 17) and demersal trawlers (1998–2016) with an exception of 2012 for Angola. The indice of biomass used was the acoustic surveys' abundance index estimated by R/V Dr. Fridtjof Nansen (2007–2017) in Angola (Winter surveys).

47. The model provides an acceptable fit to the data available. The results of the assessment indicate that the current biomass level Bcur of the stock is 78 percent of the biomass at B0.1, and the current fishing mortality is 35 percent above the F0.1 is 135 t. The stock is overexploited. The model shows that the stock is overexploited. However, the total catches of this species are not available, Survey data show a general decreasing trend over the time series until 2011, followed by an increase in biomass for 2012 and 2013, and a decreasing trend for the reminder years with the exception of 2015. Currently, the fishing mortality is higher than that would produce a sustainable yield at the current biomass level.

48. The Working Group recommends that the catch levels of this species should decrease.

Management recommendations

49. The results of the assessments show that many of the stocks analyzed are fully to overexploited, and the Working Group thus recommended that fishing effort should be reduced for the overexploited stocks or not increased for the other stocks, to avoid further depletion. When possible, recommendations on catch levels are also indicated for each stock. Given that most fisheries in the region are multi-specific, an overall reduction in fishing effort is necessary.

GENERAL CONCLUSIONS

50. As a basis for providing scientific advice for fisheries management, there is generally a need for information on the status and development of the various fish stocks. To manage fisheries in a sustainable way, there is also a need for knowledge of the status and development of the fishing pressure on the different fish stocks. In many regions of the world, all this information is not readily available. For some fish stocks, a lot of information exists, both on stock status and on fishing pressure, while for many stocks such information is limited. To compile all kinds of information on the fish resources, and turn it into useful information for managers, poses a challenge and especially so if the quality of the basic information is poor. Sometimes, the basic data are so limited and inadequate that there is hardly any relevant information that can be used as a basis for management.

51. To assess fish stocks and the fishery in a reliable way, there is generally a need to have a reliable stock definition and to have a time series of data for the defined stocks. This occurs because it is

the trends, or the lasting changes in the specific fish stocks that are of interest and that may be changed by managing the fisheries. Therefore, it is important to establish a reliable time series of abundance indices and catch statistics for each stock. For small pelagic fishes a time series needs to be at least five years long before it can be used as reliable information on any trends, and therefore, it takes time to establish sound basic information to be used in fish stock assessments.

52. In the area assessed by this Working Group, there are major challenges in obtaining reliable information from the available data. Similar to the previous Working Group in 2014, emphasis was this year put on the development of the database for the different fish stocks. Nevertheless, a number of assessments were made for some of the main stocks using a dynamic production model. For some of the species/stocks, the model did not produce reliable results owing to insufficient and inconsistent input data. The results of the dynamic production model depend strongly on the quality of the data, a quality of data that the Working Group does not have at its disposal. These data limitations must be kept in mind when interpreting the results of the assessments. For some stocks, only catch trends could be analysed owing to the lack of effort information.

53. Fishery-dependent information is based on catch statistics, effort data and the biological samples that are taken in the various fisheries, such as length measurements, etc. From these data, it is possible to obtain information relevant for fish stock assessments such as total catch, length groups harvested (and quantity thereof), CPUE, etc. The Working Group appreciates the effort made to obtain all these data, which are of the utmost importance for fish stock assessment and management; however, some deficiencies were noted. These deficiencies relate to, among others, incomplete (e.g. owing to incomplete sampling or under-reporting) or, in the case of some countries, lack of catch and effort data for some species/stocks of importance to the region. Inconsistencies between different data sets were still observed, and low sampling intensity and coverage was reported for several countries, especially in artisanal fisheries. Attention should be given to the aforementioned issues and, in particular, efforts should be made to verify and update existing catch and effort series, and to bring about one reliable series of total catch and effort data for stock assessments. An effort should also be made to ensure that catch and effort data are reported from all fleet segments. A more in-depth analysis of the CPUE series is also encouraged in order to facilitate the application of the assessment models.

54. In general, biological sampling of landings from the region is almost non-existent. For some species and stocks, length information from catches exists, but usually only for one or a limited number of years. Length data and other biological data are available from research surveys for species such as the two Sardinella species and Trachurus trecae. Before future meetings, all length data should be analysed in more detail to see if it would be possible to apply structural models to those stocks.

55. The advice for the stocks is given in relation to reference points. For the sake of comparability and consistency, the reference points chosen were the same as those used in the FAO Working Group for the Assessment of Small Pelagic Fish off Northwest Africa. The advice for each stock gives guidelines for managers in the management of the pelagic stocks in a way to make them develop in a direction where each stock is fished at an optimum level. The advice for each stock is given in terms of catch levels. It was noted that for shared stocks, such as many of the pelagic stocks, formal agreements on sharing arrangements would have to be made and management put into place. Moreover, many countries apply effort measures instead of catch measures, and it was noted that the catch advice can also be addressed through effort measures depending on the exigencies of the different countries.

56. Finally, the Working Group noted that for some species/stocks in the southern CECAF area, observed data deficiencies in catch and effort data for some countries were related to the relatively lower importance of these species to the countries concerned. The Working Group should therefore carefully review the species/stocks adopted at the first meeting in 2006 (FAO, unpublished report) to better focus future assessments.

FUTURE RESEARCH

57. Several recommendations were made by the previous Working Group sessions with respect to research to be pursued. The Working Group noted that work has been started to improve the statistical and biological sampling systems in the countries of the sub-region. Studies on biological aspects of certain species analyzed within the framework of the Working Group had also been initiated. Some recommendations, for various reasons, were not taken into consideration. Biological information is almost inexistent and sampling for biological purposes is not carried out on a regular basis in the sub-region. For most recommendations follow up activities had been initiated, although many of them require continuation to be useful for the assessments.

58. Some of the main recommendations on areas of work that require attention are summarized below:

- All data for the next Working Group must be prepared and sent to the chairman of each species group and FAO by the national focal points at the latest one week before starting the first part of the next meeting.
- Intensify sampling for length frequencies and species composition of catches including bycatch in all the main fisheries and present to the next Working Group meeting. Priority should be given to the main species, so as to obtain a complete catalogue of the basic biological parameters.
- Continue developing CPUE series from surveys and commercial fisheries. Continue to improve sampling by increasing the number of samples and sample size of each sample covering all size ranges. All fleet segments and all quarters of the year.
- Scientific surveys should be continued and abundance indices independent of the commercial fisheries should be integrated into the assessment models.
- Continue the collection of data from the artisanal fishery including effort and catch by species and gear.

59. A summary of the assessments and management recommendations by the Working Group is presented in Table 3.

Table 3. Summary of assessments and management recommendations

		Model results			
Stock	**Last year catch in tonnes (5 year average)**	**$B_{cur}/B_{0.1}$ %**	**$F_{cur}/F_{0.1}$ %**	**Assessment**	**Management recommendations**
Sardinella					
S. aurita					
West (Côte d'Ivoire, Ghana, Togo and Benin)	58 180 (40 565)	19	564	Overexploited	Current catch of *S. aurita* are not sustainable. Catch will have to be reduced to avoid future depletion of the stock. The Working Group recommends the fishery should be closed, also considering the R/V *Dr Fridtjof Nansen* survey results for the region from 2017.
Central (Nigeria)	7 473 (6 308)*	-	-	No assessment made as no data was available.	As a precautionary measure, do not exceed the average of the 3 last years (15 000 tonnes)*.
S. maderensis					
West (Côte d'Ivoire, Ghana, Togo and Benin)	10 717 (10 929)	9	787	Overexploited	The Working Group considers the stock is in very bad condition, near collapse, and the fishery should be closed.
Central (Nigeria)	15 115 (14 616)*	-	-	No assessment made as there was incomplete data for the region.	As a precautionary measure, do not exceed the average of the 3 last years (14 616 tonnes)*.
***Sardinella* spp.**					
North (Guinea-Bissau, Guinea, Sierra Leone and Liberia)	60 047 (54 25)	129	49	Not fully exploited	As a precautionary measure, do not exceed current fishing level for 2017 (60 000 tonnes).
South (Gabon, Congo, DR Congo and Angola)	22 724 (121 862)**	113	155	Fully exploited	As a precautionary approach, it is recommended not to exceed catch level of the average of the last 5 years (121 862)**

* Data only available for Nigeria until 2015. Last year catch is from 2015, and the average is only three years from 2013-2015.

**Angola did not provide data for 2017

		Model Results			
Stock	**Last year catch[2] (tonnes) (5 year average)**	**$B_{cur}/B_{0.1}$ %**	**$F_{cur}/F_{0.1}$ %**	**Assessment**	**Management recommendations**
Bonga (*E. fimbriata*)					
North (Guinea)	53 757 (45 999)	-	-	No acceptable results from the models.	As a precautionary measure, do not increase catches from the average of the last 5 years (46 000 tonnes).
Central (Nigeria)	26 505 (24 776)*	-	-	No assessment made because there was incomplete data.	As a precautionary measure, do not exceed the average of the 3 last years (25 000 tonnes)[2].
West (Côte d'Ivoire, Ghana, Togo and Benin)	226 (713)	-	-	No acceptable results from models.	As a precautionary measure, the catch limit should not exceed the average of the last 5 years (7003 tonnes).
South (Gabon, Congo, DR Congo)	3 370 (4 734)[2]	134	18	Not fully exploited.	As a precautionary measure and due to uncertainty in the data, do not increase catches of this species from the average of the last 5years (5 000 tonnes)[3].
Anchovy (*E. encrasicolus*)					
West (Côte d'Ivoire, Ghana, Togo and Benin)	49 713 (24 722)	137	49	Not fully exploited	As a precautionary measure, catch levels should not exceed that of 2017 (50 000 tonnes).
South Congo	372 (489)	122	26	Not fully exploited	Because Angola did not provide catch data, as a precautionary measure the catch level should not exceed the catch limit recommendation from 2014 (800 tonnes).
Horse mackerel and other *Carangidae*					
Trachurus trecae					
North (Guinea Bissau, Guinea, and Liberia) (NO CATCH SL)	31 487 (22 032)	75	125	Overexploited	As a precautionary measure, do not increase catches of this species above the 2014 level (13 000 tonnes), and reduce effort[4]
West (Côte d'Ivoire, Ghana, Togo, Benin)	5 401 (14 938)	-	-	No reliable results from the model because there was no reliable data.	As a precautionary measure, do not increase catches of this species from the average of the 5 last years (14 900 tonnes).
South (Gabon, Congo, DR Congo and Angola)	48 006 (64 095)[5]	78	135	Overexploited	Catch levels should decrease.
***Decapterus* spp.**					
North (Guinea Bissau, Guinea, Sierra Leone, and Liberia)	4 796 (6 070)	92	95	Fully exploited	As a precautionary measure, the catch levels should not increase more than the average of the last 5 years (6 000 tonnes).

[2] Data only available for Nigeria until 2015. Last year catch is from 2015, and the average is only three years from 2013-2015.
[3] The 5-year average from the 2014 report was based on uncertain data (hence the high average during that assessment). The catch data for 2013-2017 is more certain, even though the 5-year average is much lower.
[4] The 2014 assessment and 2018 assessment both say the stock is overexploited (even after setting a low catch limit of 10 000 tonnes in 2014), but maintaining the stock at 2017 levels is too high (31 487 tonnes), so it was proposed to keep the lower limit and use the 2014 catch level (12 807 tonnes).
[5] No catch data for 2017, so the 2016 catch is used. Average is only 4 years from 2013-2016.