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

SUMMARY

The FAO Working Group on the Assessment of Small Pelagic Fish off Northwest Africa meets annually to update stock assessments and provide advice for management for the main small pelagic species and stocks in the region. Three meetings have been held from 2016-2018 since the last meeting of the Scientific Sub-Committee in 2015.

The species analysed and assessed by the Group are: sardine (*Sardina pilchardus*), sardinella (*Sardinella aurita* and *Sardinella maderensis*), horse mackerel (*Trachurus trecae*, *Trachurus trachurus* and *Caranx rhonchus*, *Trachurus* spp.), chub mackerel (*Scomber colias*), bonga (*Ethmalosa fimbriata*) and anchovy (*Engraulis encrasicolus*) in the region between the southern border of Senegal and the northern Atlantic border of Morocco and including the Canary Islands.

This summary report describes the main trends in catches of the main pelagic fish, recent changes in the fisheries, addresses data quality issues with respect to sampling and provide an update on the most recent assessment results for the small pelagic species and stocks and presents the management recommendations formulated by the working group. The report focuses on the results of the assessment from the 2018 Working Group, whereas the readers are invited to consult all of the earlier working group reports from 2016-2018 that have been provided as reference documents. Of the stocks assessed, sardine Stock A+B and Stock C were found not-fully exploited, chub-mackerel and anchovy were considered fully exploited, whereas sardinella, bonga, Atlantic horse mackerel and Cunene horse mackerel were found to be overexploited.

INTRODUCTION

1. This report provides a summary of the results of the work of the FAO Working Group on the Assessment of Small Pelagic Fish off Northwest Africa which has met three times since the last meeting of the Scientific Sub-committee in September 2015:

    - 2016: Sixteenth meeting of the FAO Report of the FAO Working Group on the Assessment of Small Pelagic Fish off Northwest Africa. 23 – 28 May 2016. (CECAF/SSCVIII/2018/Ref.12).
    - 2017: Seventeen meeting of the FAO Report of the FAO Working Group on the Assessment of Small Pelagic Fish off Northwest Africa. 22 – 27 May 2017. (CECAF/SSCVIII/2018/Ref.13)
    - 2018: Eighteen meeting of the FAO Working Group on the Assessment of Small Pelagic Fish off Northwest Africa. 26 June–01 July 2018. Banjul, The Gambia (CECAF/SSCVIII/2018/Ref.14).

2. The Working Group Reports are provided as reference documents on the meeting website: http://www.fao.org/fi/static-media/MeetingDocuments/CECAF/CECAF-SSC8/default.htm

3. The overall objective of the Working Group is to assess the state of the small pelagic resources in Northwest Africa and make recommendations on fisheries management and exploitation options aimed at ensuring optimal and sustainable use of small pelagic fish resources for the benefit of coastal countries.

4. The 26th of June was dedicated to reviewing a working document that had been prepared at a two-day meeting to analyse the 2017 survey data from the R/V *Dr Fridtjof Nansen* and to discuss how the information can be used by the Working Group. Mr Erling Kaare Stenevik (IMR, Norway) presented the working document and led the discussions with the Working Group.

5. From 27 June–01 July, the Working Group analysed and assessed the following species: sardine (*Sardina pilchardus*), sardinella (*Sardinella aurita* and *Sardinella maderensis*), horse mackerel (*Trachurus trecae*, *Trachurus trachurus* and *Caranx rhonchus*), chub mackerel (*Scomber colias*), bonga (*Ethmalosa fimbriata*) and anchovy (*Engraulis encrasicolus*) in the region between the southern border of Senegal and the northern Atlantic border of Morocco and including Sardinella (*Sardinella* spp.) and horse mackerel (*Trachurus* spp.) from the Canary Islands.

6. The Working Group included participants from eight countries (Morocco, Mauritania, Senegal, The Gambia, Spain, The Russian Federation, Norway, and The Netherlands), and FAO. At the 2015 meeting of the Working Group, Ms Aziza Lakhnigue from INRH, Morocco was voted the Chairperson by the Working Group members for the next three meetings. In 2018, the Chairperson of the Working Group was extra-ordinarily substituted by Hamid Chfiri, INRH, Morocco, due to the absence of Ms Lakhnigue.

METHODOLOGY

7. The main model used by the Working Group is the dynamic version of the Schaefer (1954) model. This model has traditionally been applied to sardine, sardinella, horse mackerel, chub mackerel and bonga but the Working Group has not been in a position to apply it to sardinella in recent years due to the lack of a consistent time series of abundance. When possible, ssimple medium-term projections of future yields and stock development were made using the Schaefer model fitted to the historical data with a time horizon of five years. All projections took as their departure point the

estimated stock status in the last year of data available. Future management strategies were defined as changes in fishing mortality and/or catch relative to those estimated for the last year of data available.

8. For anchovy, a Length Cohort Analysis (Jones, 1984) has been applied to estimate the current F-level and the relative exploitation pattern on the fishery over the last few years. A length-based Yield per Recruit Analysis (Thomson and Bell 1934) was then run on these estimates, to assess the status of the stock in relation to the biological reference points F_{max} and $F_{0.1}$. This model has also been applied to bonga and sardinella in recent years.

9. For the mackerel stock, catch-at-age data from the Russian fleet are available, and age-based methods such as XSA (Shepherd, 1999) and ICA (Patterson and Melvin, 1995) have been used as the basis for scientific advice, together with the Schaefer model, if the results of analysis of correlation within cohorts was considered adequate by the working group.

10. The 2018 working group meeting applied the following assessment models:

Species	**Stock**	**Model**
Sardine	A+B	Production model
Sardine	C	Production model
Round sardinella	Whole sub region	Data Analyses
Atlantic Horse mackerel	Whole sub region	Production model
Cunene horse mackerel	Whole sub region	Production model
Chub mackerel	Whole sub region	Production model; XSA; ICA
Anchovy	Whole sub region	LCA and Y/R
Bonga	Whole sub region	LCA and Y/R

11. In addition, a special focus was given to exploring possible options for alternative assessment methods for the different species, following up on recommendations from a technical review, the CECAF Expert Group meeting on assessment methods (FAO, 2015), and the seventh session of the CECAF Scientific Sub-Committee in 2015.

PRINCIPLES AND APPROACH TAKEN BY THE WORKING GROUP

12. The Working Group strives to be consistent, which means to use the same type of method and abundance indices for the different stocks while being open to explore alternative options.

13. Adopted agreed assessment categories and reference points are as indicated below.

Stock status categories

14. 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.

Reference points for management recommendations

15. The Working group has adopted the following Biological Reference Points (BRPs):

- **Target Reference Points**: $B_{0.1}$ and $F_{0.1}$
- **Limit Reference points:** B_{MSY} and F_{MSY}

The Group will present for each stock estimates of:

F_{cur}/F_{MSY}: Ratio between the observed fishing mortality coefficient for the last year of the series and that which would give a maximum sustainable yield over the long term.
F_{cur}/F_{SYCur}: Ratio between the observed fishing mortality coefficient for the last year of the series and that which would produce a sustainable catch at the current biomass level.
B_{cur}/B_{MSY}: Ratio between the estimated biomass for the last year of the series and the biomass corresponding to F_{MSY}.
$F_{cur}/F_{0.1}$: Ratio between the fishing mortality coefficient observed for the last year of the series and $F_{0.1}$.
$B_{cur}/B_{0.1}$: Ratio between the estimated biomass for the last year of the series and the biomass corresponding to $F_{0.1}$.

Where:

$F_{0.1}$ - level of fishing mortality at which the slope of the Y/R curve is 10% of the slope at the origin

F_{MSY}- value of F (and of other characteristics of the stock) where the long term total yield is maximum

$B_{0.1}$ – is the value of B corresponding to $F_{0.1}$

B_{MSY} – is the value of B corresponding to F_{MSY}

16. The target reference points indicate the ideal situation for the stocks whereas the limit indicate that the situation that we do not want to surpass.

17. Management advice for the stocks is given in relation to the reference points and on the basis of the projections, if available. The advice is intended to provide guidance to management on how to make the different stocks develop in a direction where each stock is exploited at an optimum level.

OVERALL REGIONAL TRENDS

Catch

18. Figures 1a and Figure 1b show the catch of the main small pelagic species studied in the FAO Working Group on the Assessment of Small Pelagic Fish off Northwest Africa from 1990 to 2017. The decreasing trend in total catch observed from 2010 to 2013 was reversed in 2014. A slight decrease in total catch of the main small pelagic fish in the subregion was observed from 2014 to 2015, from around 2.5 million tonnes in 2014 to around 2.4 million tonnes in 2015. In 2016, an increase of 13 percent in relation to 2015 was observed. However, catch trends between 2016 and 2017 remained stable at around 2.7 million tonnes. Total catch of small pelagic fish for the period 1990–2017 has been fluctuating with an average of around 1.9 million tonnes, while the average for the five last years was 2.5 million tonnes.

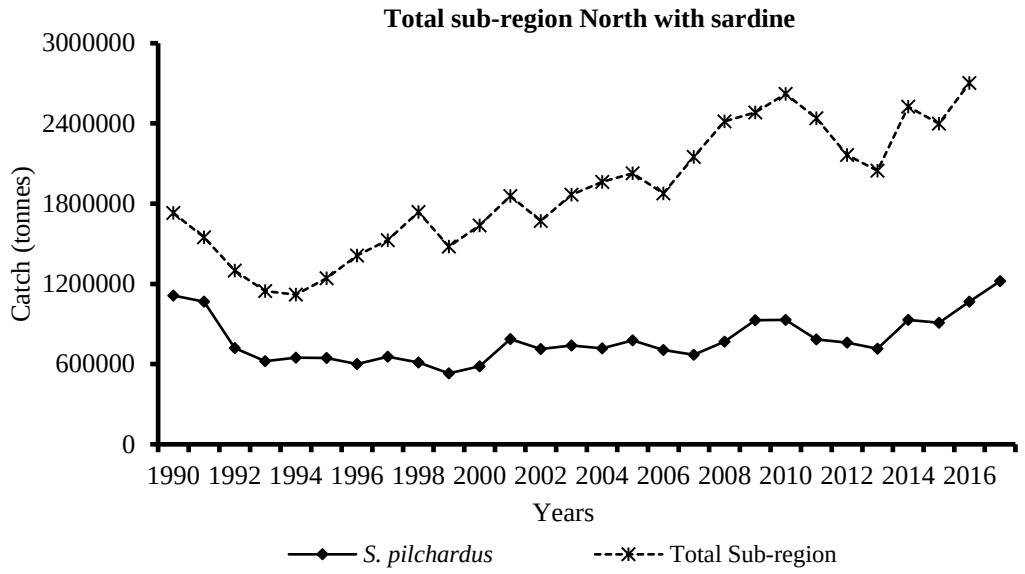

Figure 1a: Catches (1990–2017) in the sub-region with sardine (weight in tonnes)

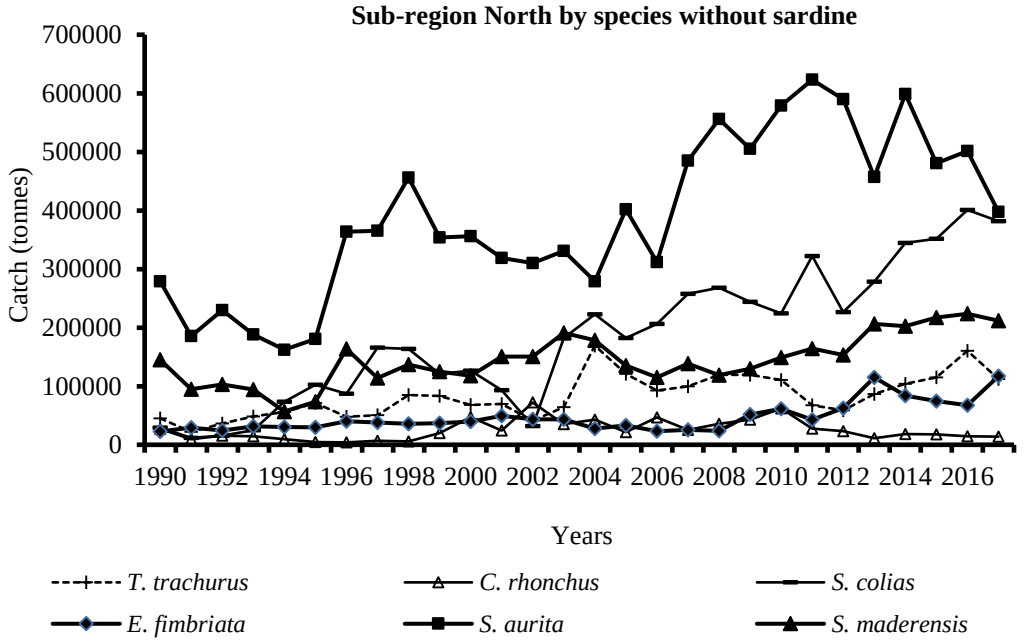

Figure 1b: Catches (1990–2017) in the sub-region without sardine (weight in tonnes)

19. Sardine (*Sardina pilchardus*) remains the dominant species, constituting about 45 percent of overall catch of the main small pelagic species in 2017. Catches have been increasing about 14 percent from 2016 to 2017 with catches of around 1 068 200 tonnes in 2016 and around 1 220 500 tonnes in 2017.

20. The other dominant species group is the *Sardinella* spp. (*S. aurita* and *S. maderensis*) that constituted 15 percent of total catch of the main small pelagic fish species in 2017, decreasing 16 percent in relation to 2016. There was a 21 percent decrease for round sardinella (*Sardinella aurita*) and a 5 percent decrease for flat sardinella (*Sardinella maderensis*). The round sardinella is the second most important species in terms of catch. The catch levels have been generally decreasing since 2014, with around 500 000 tonnes in 2016 and just under 400 000 tonnes in 2017, a decrease

of 21%. The average catch over the last five years of round sardinella was around 490 000 tonnes, as compared to 387 000 tonnes when looking at the time period 1990-2017. The catch of flat sardinella (*Sardinella maderensis*), making up 8% of the overall catch, showed a slight decrease in 2017 (at 212 000 tonnes) as compared to 2016 when catches were 224 000 tonnes, representing a decrease of 5 percent. The average over the last five years for this species being 212 000 tonnes as compared to a long-term average (1990-2017) of 145 000 tonnes.

21. Cunene horse mackerel (*Trachurus trecae*) is the most important species of horse mackerel reported in the catches, constituting about 9 percent (approximately 235 000 tonnes) of the total catch of the main small pelagic fish in 2017. This is a slight decrease from 2016 levels at around 236 000 tonnes. Catches have been more or less stable since 2013, after a large decrease between 2010 and 2012. The average annual catch of the Cunene horse mackerel over the last five years was estimated at about 208 000 tonnes, as compared to a long-term average of 185 000 tonnes (1990-2017). Catches of Atlantic horse mackerel (*Trachurus trachurus*) showed a large decrease of 30 percent between 2016 and 2017, from 160 000 tonnes to 112 000 tonnes, respectively. However, the average catch over the last five years is high (116 000 tonnes) compared to the long-term average for 1990-2017 (83 000 tonnes). The third species in this group, the false scad (*Caranx rhonchus*), also showed a decrease of 5 percent in catch from 2016 to 2017, from around 15 000 tonnes to around 14 000 tonnes. The Working Group also decided (according a recommendation of CECAF Committee, 2015) to include data from the Canary Islands (29°-27°N, 19°-13°O) for *Trachurus* spp. that included *T. picturatus* and *T. trachurus* together.

22. Chub mackerel, (*Scomber colias*), continues to make up a large portion of the overall catch for the sub-region, constituting 14 percent of overall catches in 2017. The species has shown a generally increasing trend since 1990, with a peak in catches in 2016 at 400 000 tonnes. There was a 5 percent decrease in catch levels for 2017, to 382 000 tonnes. The average catch for the period 1990-2017 was estimated around 184 000 tonnes, and the average for the last five years was 351 000 tonnes.

23. The total catch of anchovy (*Engraulis encrasicolus*) in 2017 was around 20 000 tonnes, showing a continued decrease since 2011 (150 000 tonnes). This constituted a 29 percent decrease from 2016 (28 000 tonnes). Catches of this species have been fluctuating with an average of about 26 000 tonnes for the last five years (2013–2017), as compared to the long-term average of around 83 000 tonnes (1990-2017).

24. The catch of bonga (*Ethmalosa fimbriata*) in 2017 constitutes around 4% of the total catch of the main small pelagic fish in the subregion. This is an increase as compared to 2016, when the species constituted 2 percent of the total small pelagic catch. Total catch of bonga was around 83 000 tonnes in 2014, decreasing to 74 000 tonnes in 2015 (12 percent) and in 2016 a catch of 68 000 tonnes showing a decreasing of 9 percent. Bonga then increase 73 percent to 117 000 tonnes in 2017. The average over the last five years has been around 92 000 tonnes, as compared to the long-term average of around 47 000 tonnes (1990-2017).

Table 1: Catch contribution in 2016 (7) and change since last year (percent)

Species	Catch contribution 2017 (%)	Catch 2015 (tonnes)	Catch 2016 (tonnes)	Change (%)
Sardina pilchardus	45	908 216	1 068 189	15
S. aurita	15	480 731	501 630	4
Scomber colias	14	351 637	223 607	3
Trachurus trecae	9	217 182	160 229	28
S. maderensis	8	207 394	235 865	12
Ethmalosa fimbriata	4	114 970	14 649	-20
Trachurus trachurus	4	74 603	400 921	12
Engraulis encrasicolus	1	26 339	28 566	8
Caranx rhonchus	1	17 522	67 544	-10
TOTAL	**100**	**2 398 594**	**2 701 200**	**11**

Acoustic surveys

25. In advance of the 18th session of the Working Group in Banjul, The Gambia (26 June to 1 July), a two-day preparatory workshop was held to discuss the regional survey data from the R/V *Dr Fridtjof Nansen*, and a working document with information in support of the assessments was prepared that was later discussed at the Working Group.

26. Since 2011, no regional coverage of the small pelagic stocks has been carried out by national research vessels due to financial and technical reasons. Morocco continued its annual surveys regularly, Mauritania conducted two surveys in 2013 and 2014, and Senegal carried out one acoustic survey in 2015. The R/V *Dr Fridtjof Nansen* carried out two surveys targeting small pelagic fishes along the Northwest African region: autumn 2015 and spring 2017. Biomass estimates from the R/V *Dr Fridtjof Nansen* were made available to the Working Group.

27. The 2018 Working Group observed increases in abundance of some of the main species the northern part of the area (*Sardine pilchardus* and *Trachurus trachurus*) by the 2017 R/V *Dr Fridtjof Nansen* acoustic surveys.

Environment

28. In January 2017, the northern border of the Senegalo-Mauritanian thermal front was located close to Cap Vert. During the same time period in 2016 the front was located more to the north, and consequently positive anomalies in Mauritania were staying high until March, after which they became negative. During the last quarter of the years, such anomalies remained with an average 0.5°C in 2016 as compared to more than 2°C in 2017.

KEY RECENT DEVELOPMENTS – SMALL PELAGIC FISHERIES

29. The most important development at the sub-regional level is the continued expansion of the fishmeal industry. This development is occurring in Mauritania, Senegal and the Gambia. The fishmeal factories can absorb much larger quantities than the consumption market, and so they have stimulated artisanal fishermen to increase their fishing effort. In Mauritania a whole new fleet of purse seiners has been brought in from abroad to catch fish for the fishmeal plants. The main species used for fishmeal are the round and flat sardinellas, as well as bonga. The introduction of the fishmeal industry has thus led to a region-wide increase in fishing effort on sardinella. The development of the fishmeal industry has also led to problems in collecting accurate catch data. In Mauritania the government has imposed restrictions on the amount of round sardinella that can be transformed into fishmeal. As a result, factory owners sometimes report sardinella as bonga in order to avoid the restrictions. In Senegal, the research institute CRODT does not received any

information from the fishmeal factories. As a consequence, the catch data reported by CRODT do not contain the catches processed by the fishmeal plants. Hence the catch figures reported for Senegal will be underestimates.

30. Some other recent developments and management actions that impact the fisheries in the subregion include:
    - Measures implemented by Morocco to strengthen the management of small pelagic stocks:
        - Introduction of a measure in 2018 for annual catch for coastal seiners operating in the Central zone (Agadir-Laayoune).
        - The renewal of a 15 nm reserve area between 24-25°N, for five year periods, and the establishment of an additional closure zone between 22°N and 23°N over 15 nm during the May-June period of each year to protect the main spawning areas and the recruitment of small pelagics in Morocco.
    - As part of the eco-labelling of its sardine fisheries in Zones B and C, Morocco is working towards achieving certification according to Marine Stewardship Council (MSC) standards.
    - In 2017, there was no fisheries agreement between Mauritania and Senegal.
    - As in 2016, the small Dakar seiners called "sardine" which constitute the industrial fleet did not operate in 2017.
    - Regional markets for the export of sardinella to Mali from Saint Louis and to Guinea and Burkina Faso from Mbour and Joal influence the catches. The catches in Saint-Louis, Senegal and along the Petite Côte (Mbour and Joal) are influenced by the existence of a sub-regional market as well as the activities of the fish meal factories. In 2014, a high concentration of pirogues using encircling gillnets was observed between June and December in this area. These pirogues came from other fishing zones in Senegal. Thus the catches of round sardinella from the « petite côte » saw a big increase (121 percent in Joal and 50 percent in Mbour).
    - Local co-management committees exist at some landing sites such as Kayar and on the ”Petite Côte” (Ngaparou et Pointe Sarène).
    - In Senegal, measures relative to the banning of landings of juveniles of small pelagics during certain periods are still in effect at different landing sites. Violations of measures can be subject to sanction at local level, which may vary from site to site. Sanctions relate to confiscation of gear, catch, payment of fines etc.

ASSESSMENT RESULTS AND MANAGEMENT ADVICE

Reference points and management advice

31. As for the previous years, the Working Group estimated the status of the stocks and fishery in relation to agreed reference points for management of the pelagic stocks in the sub-region. Projections of future yields and stock status under different scenarios for future management measures were made, when possible. The management advice for the stocks is given in relation to the reference points and on the basis of the projections, as outlined above. They are intended to provide guidance to management on how to make the different stock develop in a direction where each stock is exploited at an optimum level. As far as possible, advice for each stock is given both in terms of effort and catch levels. Since most of the stocks are shared by two or more countries in the region, the Working Group strongly recommends the reinforcement of regional cooperation in research and management.

State of stocks and fisheries

32. In general the status of the different stocks analysed and assessed is similar to the situation of 2017. Of the 7 stock analysed, both stocks of sardines are considered not fully exploited, stocks of

mackerel and anchovies are considered to be fully exploited, while stocks of sardinella, mackerel and ethmalosa are considered as overexploited.

33. Sardine in Zones A+B, show a slight decrease in the acoustic abundance index for 2017 as compared with the 2016 index. The results of the production model show that the state of this stock continues to improve, and the stock is now considered non-fully exploited. However, considering the instability of this resource vis-a-vis environmental changes call for the adoption of a precautionary approach and hence it is recommended setting a catch limit for sardine in this zone at the same level as for 2014, which is around 550 000 tonnes either the recommended catch in 2016 and 2017.

34. Sardine (*Sardina pilchardus*) in Zone C was still considered non-fully exploited. The results of the projections with a scenario of maintaining the effort at the current level (*Status quo*) for Zone C, would lead in 2018 to a slight decrease in catches and biomasses to stabilize in the year 2019 has a sustainable level of catch and abundance. The stock is influenced by environmental factors and shows fluctuations independent of fishing. Considering the observed fluctuations, total catch should be adjusted according to observed natural changes in the stock. The stock structure and abundance should be closely monitored by fishery independent methods covering the complete distribution area.

35. The assessment of sardinella (*S. aurita*, *S. maderensi*s and *Sardinella* spp.) continued to pose a challenge to the working group. Due to the absence of regional acoustic estimates for recent years and the deterioration of the available CPUE series, the production model traditionally applied can no longer be used. The Working Group also noted limitations in the sampling of size frequencies in Mauritania and Senegal, with low sampling intensity in both countries and a lack of sampling for several semesters and a large part of the catches. Despite these limitations, LCA and yields per recruit models were applied to the data of 2014-2017 for round sardinella as well as and the dynamic model, SPIFC, which can address several series of abundance. SPICT is a state-space model fitting a surplus production model in a statistical framework based on estimations of maximum likelihood (Petersen and Berg, 2017).

36. Due to the above issues with the available data, the Working Group was not able to adopt the results of these models directly due to the lack of information on other indicators (biomass, CPUE, evolution of length distributions, etc.). No models were applied for the flat sardinella. A survey carried out by the R/V *Dr Fridtjof Nansen* in May-July 2017 shows a very low biomass for sardinella. The prospective period does not coincide with the traditional series of regional surveys series (October-December), but the biomass was the lowest of the series compared with the surveys carried out in early 2000s.

37. The October-December 2015 survey also showed the lowest biomass of that series. Other analysis also showed signs of overexploitation (decrease in CPUE in Mauritania, reduction of catch mean length, etc.). Consequently, based on the analysis available to the group, the working group considered *S. aurita* to be overexploited. The state of *S. maderensis* remains unknown. Given the multi-specific nature of these fisheries, and as a precaution measure the working group recommends reduce the effort and catches for the two species in all regions and for all fleets. The Working Group hence maintains its recommendation of previous years to reduce fishing effort for all fleet segments. The Working Group could not make a catch recommendation as at present it does not dispose an adequate index of abundance and is unable to predict future recruitment.

38. The results of the assessments showed no changes in the status of the Atlantic horse mackerel (*Trachurus trachurus*) as compared to the last assessment in 2017. The results of the 2018 assessment indicate that the current biomass is lower than the target biomass ($B_{0.1}$). Current fishing mortality is much higher than the target fishing mortality ($F_{0.1}$). The biomass level is not at the

optimum level and the fishing effort is at an unsustainable level. These results show that the stock is overexploited.

39. The Cunene horse mackerel (*Trachurus trecae*) remains overexploited as in the assessments from 2016 and 2017. It should be noted that this species is also taken as an important bycatch by demersal fleets operating in the Mauritanian EEZ.

40. Given the mixed nature of this horse mackerel fishery and the results of the projections for both species analysed in the Working Group, as a precautionary approach, recommends to reduce both effort and catch for the two species.

41. The assessment of Chub mackerel (*Scomber colias*), using both a dynamic production model and an age based approached, indicate that the Chub mackerel stock is fully exploited. The projection results obtained by the global and analytical models indicate different trends, to this end, the group recommends a catch of 340 000 tonnes at the level of the entire sub-region, that was the recommendation made during last year as a precautionary approach.

42. Anchovy (*Engraulis encrasicolus*) is fully exploited in the zone (A+B+North). The acoustic biomass in 2017 showed a sharp decrease compared to 2016, accompanied by a decrease in catches. Although there is a decrease in fishing mortality in 2017, showed by the analysis done, the working group recommends that the effort be adjusted to the natural fluctuations of this stock. The availability of this species is highly dependent on environmental factors and is fished opportunistically, thus the catches varies considerably from one year to another. Assessment was carried out using information from Zone North+A+B. The Working Group recommends that current effort should be reduced and on the long term be adjusted according to the natural fluctuations in this stock.

43. As previous years, the results from the assessment indicate that Bonga (*Ethmalosa fimbriata*) is overexploited at the subregional level. Catches and fishing effort of this species increased in 2017 compared with 2016, despite the status of overexploitation and the recommendation of 2016 that the effort be reduced compared to current levels. The Working Group recommends that effort should be decreased as compared to current levels for Bonga to regain a catch level that can ensure sustainability.

44. With respect to the Canary Islands, although the sampling coverage in the Archipelago is higher than what is observed in other areas for the small pelagic species followed by the Working Group, the current data series is not considered sufficient to assess the status of those stock yet. The time series of catches is considered reliable only from 2013, when a monitoring program of the artisanal purse seine fishery came into force through the EU project Data Collection Framework. Other considerations that were highlighted during the meeting included the misidentification of species at landing. For this reason, catches of *Trachurus* spp and *Sardinella* spp are grouped to genus level for scientific purposes. This issue needs to be addressed by the Canary Island's regional managers as soon as possible to facilitate the assessments of these species. Furthermore, although stable populations of small pelagic species are found in the Canary waters, there is a need to clarify the limits of the stocks and the probable mixing processes among them as a priority in the sub-region.

Table 2 below provides a summary of the assessments and management recommendations by the 2018 Working Group:

Stock	Last year– 2017– catch in 1 000 tonnes (2013–2017 avg.)	*$B_{cur}/B_{0.1}$	*$F_{cur}/F_{0.1}$	Assessment	Management recommendations
Sardine *S. pilchardus* Zone A+B	484 (444)	139%	56%	Non-fully exploited	The stock is considered non-fully exploited. The results of the projections were not conclusive. However, considering the instability of this resource vis-a-vis environmental changes call for the adoption of a precautionary approach requiring setting a catch limit for sardine in this zone at the same level as for 2016 and 2017 (550 000 tonnes).
Sardine ** *S. pilchardus* Zone C	699 (504)	147%	46%	Non fully exploited	The stock is influenced by environmental factors and shows fluctuations independent of fishing. Considering the observed fluctuations, total catch should be adjusted according to observed natural changes in the stock. The stock structure and abundance should be closely monitored by fishery independent methods covering the complete distribution area.
Sardinella** *S. aurita* *S. maderensis* *Sardinella* spp. Whole subregion	398 (487) 212 (212) 609 (697)	- - -	- - -	Overexploited	Based on the different indicators available, the Working Group found *S. aurita* to be overexploited. The state of *S. maderensis* remains unknown. Given the multi-specific nature of these fisheries, and as a precaution the Working Group recommends reducing both the effort and catches for the two species all zones and fleet.
Horse mackerel *T. trachurus* *T. trecae* Whole subregion	 112 (115) 235 (208)	 74% 53%	 142% 115%	*T. trachurus* and *T. trecae* are overexploited.	The two species *T. trecae* and *T. Trachurus* are overexploited, The Working Group recommends reducing both the effort and catches for the two species at the level of the different zones and fleets.
Chub mackerel *Scomber colias* Whole subregion	380 (350)	127% (Global model) 101% (XSA)	105% (Global model) 69 (XSA)	Fully exploited	The Working Group concluded, on the basis of the results of the dynamic production model and the analytical model, that the stock is fully exploited. In spite of the projection results obtained by the two models indicate different trends, the Working Group recommends as a precautionary approach to renew the recommendation made during last year (340 000 tonnes).
Anchovy *Engraulis encrasicolus* Whole subregion	20 (25)*	NA	84% (LCA-Y/R)	Fully exploited	The availability of this species is highly dependent on environmental factors and is fished opportunistically, thus the catches varies considerably from one year to another. Assessment was carried out on information from Zone North+A+B. In addition, the acoustic biomass in 2017 showed a sharp decrease compared to 2016 accompanied by a decrease in catches. Although there is a decrease in fishing mortality in 2017, the Working Group recommends that current effort should be reduced and on the long term be adjusted according to the natural fluctuations in this stock.

Stock	Last year– 2017– catch in 1 000 tonnes (2013–2017 avg.)	*$B_{cur}/B_{0.1}$	*$F_{cur}/F_{0.1}$	Assessment	Management recommendations
Bonga *Ethmalosa fimbriata* Whole sub-region	117 (92)[1]	NA -	145% (LCA-Y/R)	Overexploited	The Working Group considers that Bonga in the subregion remains overexploited. Despite the recommendation of 2017 to reduce the effort, the Working Group noted a very strong increase in catches and fishing effort in 2017 compared with 2016. The Working Group recommend that effort and catch be reduced relative to current levels, for bonga to regain a catch level that can ensure sustainability.

*All advice is based on the results of the production model, unless otherwise indicated.
See Chapter 6 for details.

FUTURE RESEARCH

The 2018 Working Group recommends that the following research areas and actions should be pursued in 2018/2019.

1. The Working Group notes with satisfaction the review of the assessments and the models applied by the group over the last 15 years and recommend that the Group members familiarize themselves with the new assessment tools.
2. In order to apply the LCA and Y/R models, the Group recommends an improvement of the quality of the length frequency data that serve as the basic entry data for these models.
3. The group recommends to organize training sessions for the scientists of the sub-region to get a good understanding of these assessment tools.
4. The assessment of small pelagics is critically dependent on the quality of the acoustic estimates. The absence of regional acoustic surveys has not made possible to update assessments by the dynamic global model on certain stocks, particularly those of sardinella. Acoustic surveys and related activities, such as coordination between countries and intercalibration, should be continued to maintain and improve the time series. It is, therefore, strongly recommended that the coordinated surveys conducted during the last quarter of each year should be resumed and that the Planning Group for the Coordination of Acoustic Surveys should meet.
5. The recurrent problems for the Senegalese vessel to participate in acoustic surveys were noted with great concern and the Working Group urges Senegal to find a solution to ensure complete coverage of the main shared small pelagic stocks in the future.
6. The group recommends the continuation of the recruitment surveys for horse mackerel, chub mackerel and sardine carried out by the Russians research vessels and that it should be extended to cover the whole subregion. It is also important that this work is carried out in collaboration with research vessels of the countries of the sub-region for all the species studied including sardinella.
7. It is essential to improve biological sampling by increasing the number and size of samples and to ensure that all size ranges and fleet segments are covered at all landing sites throughout the year. Each country and each subgroup must ensure that length composition of the catch and surveys is organised in a way exploitable by the Working Group before the next meeting.
8. Studies should be undertaken on stock identity and stock migration, by for example, tagging, learning from the experiences of other regions.
9. Work on age reading of sardine, sardinella, horse mackerel and chub mackerel needs to be strengthened through regular sampling and reading of all size classes throughout the year and through stimulation of regional exchanges of samples and results.
10. The development and improvement of assessment methods should be continued, including the integration of environmental aspects. The version of the production model used by the Working Group should be developed, including other versions of the production functions, multiple abundance indices and uncertainty estimates as well as other methods.