Food and Agriculture Organization of the United Nations

FISHERY COMMITTEE FOR THE EASTERN CENTRAL ATLANTIC

SUMMARY REPORT

FAO WORKING GROUP ON THE ASSESSMENT OF SMALL PELAGIC FISH OFF NORTHWEST AFRICA 2021

INTRODUCTION

This summary provides the **preliminary results, not yet validated** by the Scientific Sub-Committee (SSC) of the Fishery Committee for the Eastern Central Atlantic (CECAF), of the twentieth meeting of the FAO Working Group on the Assessment of Small Pelagic Fish off Northwest Africa held virtually from 21–25 June 2021 with scientists and participants from The Gambia, the European Commission (DG MARE), the European Union (the Netherlands), Mauritania, Morocco, Russian Federation, Senegal, and Spain (also for the Canary Islands) and FAO. 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.

Due to the extraordinary circumstances caused by the COVID-19 pandemic, the 2021 Working Group meeting was divided into two meetings: the first meeting took place virtually from 22–26 February 2021 and focused on presenting species and other necessary data by country to standardize and prepare the data for the assessments. The second meeting took place virtually from 21–25 June 2021 where the stock assessments were conducted, management recommendations formulated, and the Working Group report updated. Support to both meetings were provided by the FAO Regional Office for Africa and the EAF-Nansen Programme.

In the period between the two meetings, another virtual meeting took place from 9–11 June 2021 with the EAF-Nansen programme to present results from the 2019 R/V *Dr Fridtjof Nansen* survey carried out in Morocco, Mauritania and Senegal. It is to be noted that no acoustic survey took place in 2020 due to COVID-19 restrictive measures. However, the Nansen programme is planning to carry out coordinated regional surveys with national research vessels at the end of 2021 and/or early 2022.

The species assessed by the Group were: 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. The Canary Islands fisheries are also considered by the group.

Altogether, 17 scientists from five countries and FAO participated in the two meetings, both Chaired by Mr Cheikh-Baye Braham (IMROP), Mauritania.

KEY FINDINGS AND RECENT DEVELOPMENTS IN THE FISHERIES

Six of the eight stocks assessed are within biologically sustainable limits, while two stocks were considered overexploited - although no formal assessment could be carried out for the two sardinella species due to lack of data. For the round sardinella, it is overexploited as indicated by the applied analytical model and other indicators which show a strong overexploitation. Urgent action is needed to rebuild stocks of round sardinella and bonga which are both overexploited.

Table 1: Summary of assessment results.

Species	Area	Not fully exploited	Fully exploited	Overexploited
Sardine *(Sardina pilchardus)*	Zone A+B	V (2019)		
	Zone C	V (2019)		
Sardinella *(Sardinella aurita* and *S. maderensis)*	Whole subregion			V
Cunene horse mackerel *(Trachurus trecae)*	Whole subregion		V	
European horse mackerel *(Trachurus trachurus)*	Whole subregion		V	
Chub mackerel *(Scomber colias)*	Whole subregion		V	
Anchovy *(Engraulis encrasicolus)*	Zone N & Zone A+B		V	
Bonga *(Ethmalosa fimbriata)*	Maur./Sen./Gam.			V

No assessments for *Caranx rhonchus*.

Highlights of recent developments that impact the fisheries in the subregion:

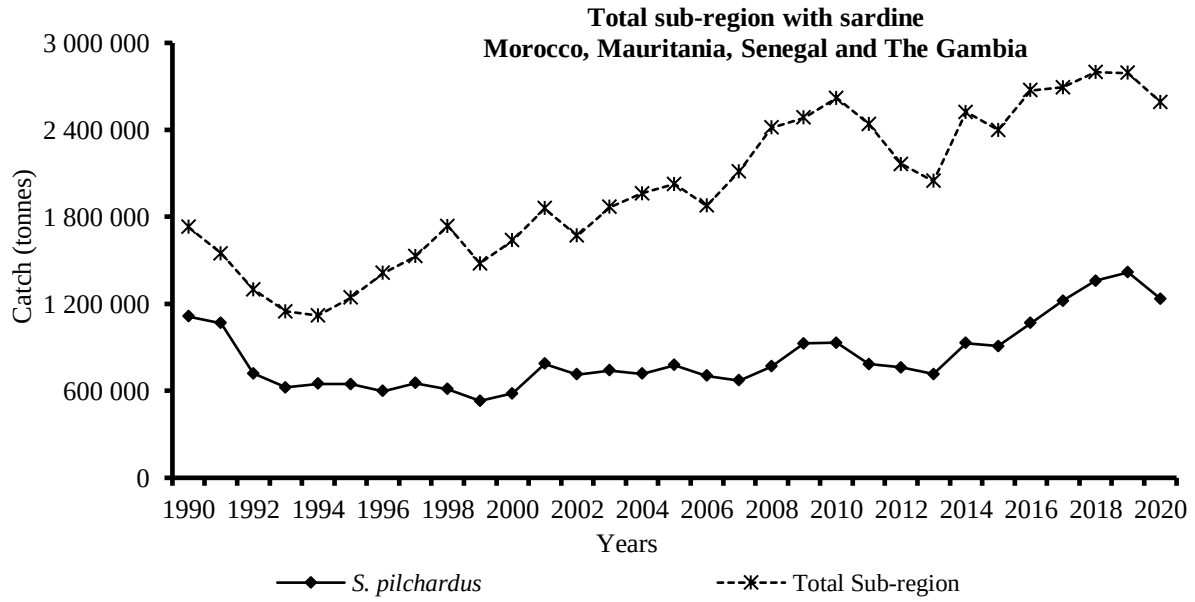
- The COVID-19 pandemic significantly impacted fishing activities throughout the region, despite some countries determining the fishing sector as an essential business to remain open during quarantine and lockdown protocols.
- There has been an expansion of the fishmeal industry in some countries in the sub-region, with artisanal and costal fleets providing fish for fish meal factories. This has led to a strong increase in fishing effort and a depletion of the stocks of sardinella and bonga, and also other small pelagic species.
- The depletion of the stocks of coastal small pelagics poses a serious threat to food security in the subregion.
- Rapid changes in fleet composition have been observed, in particular in Mauritania, where a coastal fleet segment has developed in recent years. In The Gambia, more people have engaged in the marine artisanal fisheries sector recently, moving from inland regions.
- New management measures have been put in place in several of the countries in the region, which includes the setting of total allowable catches (TACs) and zoning measures. In Mauritania, aimed at reducing the amount of round sardinella used for fishmeal. The application of this measure is still hampered by enforcement problems, due to the mixed nature of the catches.

OVERALL REGIONAL TRENDS

CATCH

The decreasing trend in total catch observed from 2010 to 2013 was reversed in 2014 and since then a general increasing trend was observed until 2017, from around 2.5 million in 2014 to around 2.7 million tonnes in 2017. In 2018, the total catch of small pelagic fish could not be estimated with precision because the 2018 data from Senegal was not available to the Working Group due to a problem in the database. The total catch for 2019, recalculated to include Senegal (who did not participate in the 2019 meeting) was around 2.8 million tonnes. This total decreased slightly by 7 percent to reach around 2.6 million tonnes in 2020. The average total catch for the period 1990–2020 has been fluctuating with an average of around 2 million tonnes, while the average for the last five years (2016–2020) was 2.7 million tonnes (Figures 1 and 2).

It should be noted that the general trend is upwards despite the decrease recorded between 2019 and 2020. This development is mainly due to the increase in sardine catches in the sub-region.



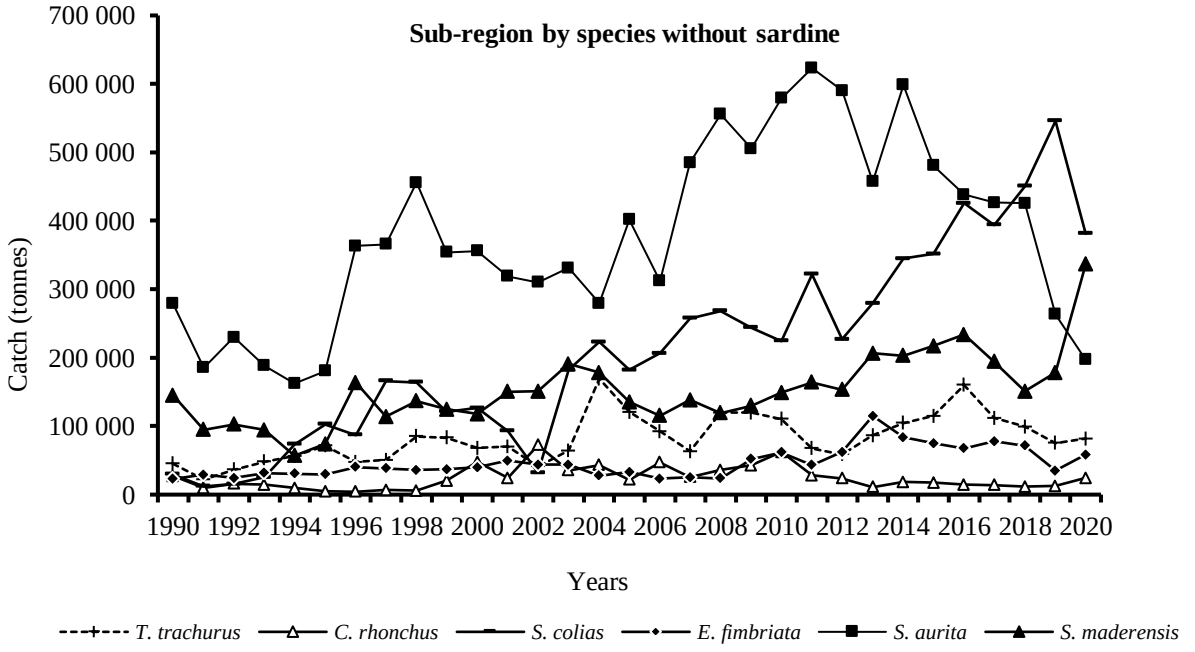


Figure 1: Total small pelagic species and sardine catches in the subregion by species and year with and without Sardine catches.

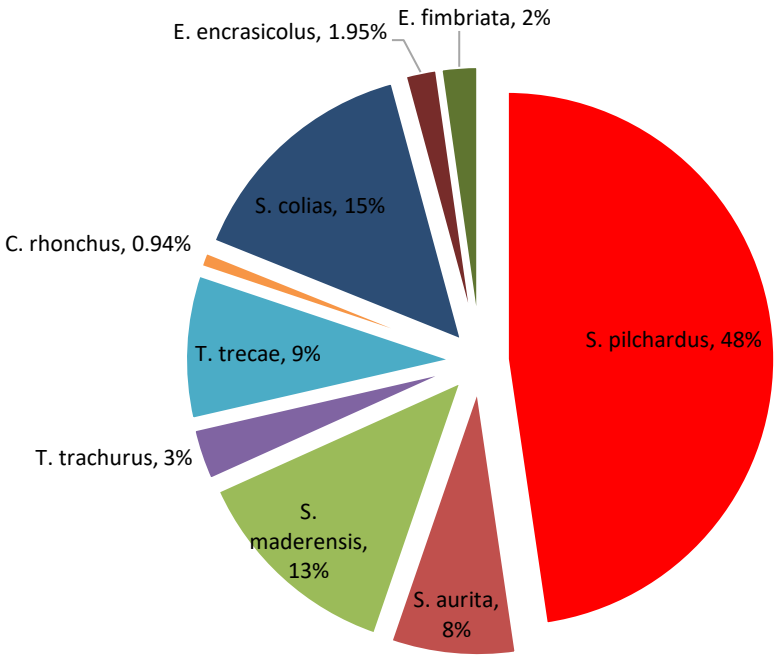


Figure 2: Percentage of each species in catches in Northwest Africa region in 2020.

Sardine *(Sardina pilchardus*) remains the dominant species, constituting about 48 percent of overall catch of the main small pelagic species in 2020. After a period of increased catch recorded since 2013, catches of this species decreased about 13 percent from 2019 to 2020, from around 1.4 million tonnes in 2019 to 1.2 million tonnes in 2020. Sardine is followed by *Sardinella* spp. (21 percent), chub mackerel (16 percent), Cunene horse mackerel (9 percent), European horse mackerel (3 percent), Bonga (2 percent), Anchovy (2 percent) and false scad (1 percent).

Table 2: Comparative catches between 2016 and 2020 in thousand tonnes.

Species	Catch 2016	Catch 2017	Catch 2018	Catch 2019	Catch 2020	% 2020 related to total catch	Average (2016-2020)	Average (1990-2020)
S. pilchardus	1 068	1 220	1 360	1 417	1 236	48%	1 260	836
S. aurita	438	427	426	263	197	8%	350	377
S. maderensis	234	194	151	178	336	13%	219	152
T. trachurus	160	112	99	76	82	3%	106	82
T. trecae	236	235	205	245	226	9%	229	189
C. rhonchus	15	14	12	13	24	1%	15	24
S. colias	426	394	450	546	381	15%	439	211
E. encrasicolus	29	20	24	20	51	2%	29	78
E. fimbriata	68	78	71	35	58	2%	62	46
Total	**2 672**	**2 693**	**2 798**	**2 792**	**2 592**	**-**	**2 710**	**1 996**

Comparative catches between 2016 and 2020 for the Canary Islands (in tonnes)

Species	Catch 2016	Catch 2017	Catch 2018	Catch 2019	Catch 2020	% 2020 related to total catch	Average (2016-2020)	Average (1990-2020)
S. pilchardus	523	338	230	079	042	3%	242	285
S. colias	706	987	1 105	1 149	710	49%	931	869
***Sardinella* spp.**	326	397	118	110	055	4%	201	289
***Trachurus* spp.**	713	710	408	495	628	44%	591	571
Total	**2 268**	**2 432**	**1 861**	**1 832**	**1 435**	**-**	**1 966**	**2 015**

REGIONAL SURVEYS

Regional and national surveys for the area did not take place during 2020 due to the COVID-19 pandemic.

The 2019 survey of the R/V *Dr Fridtjof Nansen* survey of the pelagic resources in Northwest Africa included Leg 1.1 of the western Africa coverage for 2017 encompassed Morocco to Cape Blanc. The second leg, (Leg 1.2), conducted an experimental survey of the mesopelagic resources of the region, and the third and fourth legs (1.3 and 1.4) conducted pelagic surveys for Mauritania and Senegal, respectively.

ASSESSMENT RESULTS AND MANAGEMENT ADVICE

Sardine (*Sardina pilchardus*)

The results of the assessment show that the stock in Zone A+B is considered not fully exploited. The Working Group was unable to assess the status of the stock for the year 2020 due to the absence of an appropriate abundance index. However, there are slight decreases in CPUE and average sizes of sardines caught in the central zone. This observation prompts vigilance regarding the exploitation of this stock, whose biomass levels fluctuate. Projections show that the stock could support an increase in catches. However, the variability of the resource vis-à-vis hydro-climatic changes requires the adoption of a precautionary approach. The Working Group maintains the recommendation to limit catches of sardines in this area to a level not exceeding 550 000 tonnes (recommended catch limit in 2016, 2017, 2018 and 2019).

Sardine in Zone C is also considered not fully exploited. Due to the lack of an appropriate abundance index, the group was not able to assess the state of the stock for the year 2020. There is a 13 percent decrease in the catch in 2020 compared to 2019. However, significant catches have been recorded in recent years (2016–2019), while the biomass has remained stable. The average size of the sardine caught has shown a decreasing trend in recent years. Hence the need to be vigilant in the exploitation of this stock. This stock is strongly influenced by environmental factors and exhibits fluctuations in biomass independent of fishing. For this reason, the maximum total catch to be caught must be adapted to the natural modifications of the stock. The structure and abundance of the stock should also be closely monitored by methods independent of fishing, such as coordinated acoustic surveys covering the entire range of the species.

Sardinella (*Sardinella. aurita, S. maderensis* and *Sardinella* spp.)

The assessment and historical series on sardinella show that the sardinella stock is still overexploited. Regarding management, the Working Group repeats the recommendations of previous years: a substantial reduction in fishing effort is recommended as soon as possible. The Working Group cannot precisely quantify the necessary reduction in fishing effort but believes that this reduction should be at least in the order of 50 percent to achieve a substantial level of exploitation. Despite the recommendations in previous years, effort has continued to increase. In order to improve the state of the combined stocks of sardinella, it is recommended to also prohibit the use of flat sardinella for fishmeal. Another recommendation is that national governments assume their responsibilities for the sustainable management of sardinella and initiate mutual consultations on the joint management of this important resource.

Horse mackerel (*T. trecae* and *T. trachurus*)

The status of the two stocks of horse mackerel (*T. trecae* and *T. trachurus)* has improved, and these stocks are now considered fully exploited. This improvement is likely due to a decrease in fishing mortality in 2016 and 2017 as well as an improvement in the recruitment index for the Atlantic horse mackerel. There is no information of improved recruitment for the Cunene horse mackerel. Given the multi-specific nature of these fisheries and the results of the projections, the Working Group recommends not to exceed the estimated 2020 catch level for the two species (around 300 000 tonnes).

Chub mackerel (*Scomber colias*)

For mackerel (*Scomber colias*), the Working Group concluded, based on the results of both of the models applied, that the chub-mackerel stock is fully exploited. The Working Group concluded, based on the results of the production model and other analytical models and methods, that the stock is "fully exploited". The projection results obtained by the global and analytical models indicate similar trends indicating that the current level of catch is not sustainable and would induce a decrease in spawning and target biomass. To this end, the Working Group considers it important to limit the general upward trend in catches and recommends, as a precautionary approach, to renew the recommendation made in previous years, i.e., a maximum catch of 340 000 tonnes, which corresponds to a 12 percent reduction compared to catches recorded throughout the sub-region in 2020. In addition, the group notes a significant fishing of juveniles, which have not yet reached their first maturity, and recommends the implementation of measures to reduce the fishing mortality exerted on this vulnerable fraction of the stock to improve its biological productivity.

Anchovy (*Engraulis encrasicolus*)

Anchovy assessment was based on information from North Zone A+B. The results of the model show that the anchovy stock is fully exploited. The increase in biomass observed in 2018 is continuous in 2019. Strong catches were recorded in 2020, representing the largest in the series. All this did not change the final diagnosis for this stock because there was no biomass data for 2020. Since the availability of anchovy depends strongly on environmental factors, that it is exploited in an opportunistic way and that catches vary considerably from year to year, the Working Group recommends adjusting the fishing effort to the natural fluctuations of this stock.

Bonga (*Ethmalosa fimbriata*)

The Working Group considers that the bonga is overexploited in both Mauritania and Senegal. The Working Group recommended that effort and catches be reduced below 2020 levels to allow a level of biomass that can ensure sustainability.

The Canary Islands

For the Canary Islands, although the sampling coverage in the archipelago is greater than that observed in other areas for small pelagic species monitored by the Working Group, the current data series are not considered sufficient to assess the state of these stocks. The time series of catches are only available from 2013, when a monitoring program for the artisanal purse seine fishery entered into force as part of the European Union Data Collection Framework project. In addition, the data still have limitations, including the misidentification and incorrect registering of some species at the time of landings, leading to the recording of catches as horse mackerel and/or blue jack mackerel (*Trachurus* spp.) and sardinellas (*Sardinella* spp.) grouped at the genus level for scientific purposes. This issue should be addressed by the Canary Islands Regional Managers as soon as possible to facilitate the assessments of these species.

Table 2: Summary of the assessments and management recommendations by the 2019 Working Group. All advice is based on the results of the production model, unless otherwise indicated.

Stock	2020 catch in 1 000 tonnes (2016–2020) avg.)	*$B_{cur}/B_{0.1}$	*$F_{cur}/F_{0.1}$	Assessment	Management recommendations
Sardine *S. pilchardus* Zone A+B	389 (439)	141% (2019)	54% (2019)	Not fully exploited (2019)	The stock is considered **not fully exploited** by the 2019 deadline. The group was unable to assess the status of the stock for the year 2020 in the absence of an appropriate abundance index. However, there are slight decreases in CPUEs and average sizes of sardines caught in the central zone. This observation prompts vigilance regarding the exploitation of this stock, whose biomass levels fluctuate. Projections show that the stock could support an increase in catches. However, the variability of the resource vis-à-vis hydro-climatic changes requires the adoption of a precautionary approach. The Working Group maintains the recommendation to limit catches of sardines in this area to a level not exceeding 550 000 tonnes (recommended catch limit in 2016, 2017, 2018 and 2019).

Stock	2020 catch in 1 000 tonnes (2016–2020) avg.)	*$B_{cur}/B_{0.1}$	*$F_{cur}/F_{0.1}$	Assessment	Management recommendations
Sardine *S. pilchardus* Zone C	824 (795)	130% (2019)	70% (2019)	Not fully exploited (2019)	The stock is considered **not fully exploited** by 2019. Due to the lack of an appropriate abundance index, the group was not able to assess the state of the stock for the year 2020. There is a 13 percent decrease in the catch in 2020 compared to 2019. However, significant catches have been recorded in recent years (2016-2019), while the biomass has remained stable. The average size of the sardine caught has shown a decreasing trend in recent years. Hence the need to be vigilant in the exploitation of this stock. This stock is strongly influenced by environmental factors and exhibits fluctuations in biomass independent of fishing. For this reason, the maximum total catch to be caught must be adapted to the natural modifications of the stock. The structure and abundance of the stock should also be closely monitored by methods independent of fishing, such as coordinated acoustic surveys covering the entire range of the species.
Sardinella[1] *S. aurita* *S. maderensis* *Sardinella* spp. Whole subregion.	197 (350) 336 (219) 533 (577)	- - -	147% - -	Overexploited	The assessment and historical series on sardinella show that the sardinella stock is still **overexploited**. Regarding management, the group is simply repeating the recommendation of previous years: a substantial reduction in fishing effort as soon as possible. The group cannot exactly quantify the necessary reduction in fishing effort but believes that this reduction should be at least in the order of 50 percent to achieve a sustainable level of exploitation. In order to improve the state of the combined stocks of sardinella, it is recommended to prohibit the use of flat sardinella for fishmeal. Another recommendation from the group is that national governments assume their responsibilities for the sustainable management of sardinella and initiate mutual consultations on the joint management of this important resource.

[1] not including the Canary Islands

Stock	2020 catch in 1 000 tonnes (2016–2020) avg.)	*$B_{cur}/B_{0.1}$	*$F_{cur}/F_{0.1}$	Assessment	Management recommendations
Horse mackerel[2] *T.trachurus* *T. trecae* Whole subregion	 82 (106) 226 (229)	 128% 118%	 61% 65%	Fully exploited	The results of the model is **fully exploited** for *T. trecae* and *T. trachurus* stocks. This indicates an improvement in the state of the stocks of the two horse mackerel species. This improvement is likely due to a decrease in fishing mortality in 2016 and 2017 as well as an improvement in the recruitment index for the Atlantic horse mackerel. There is no information of improved recruitment for the Cunene horse mackerel. Given the multi-specific nature of these fisheries and the results of the projections, the Working Group recommends not to exceed the estimated 2020 catch level for the two species (around 300 000 tonnes).

[2] Not including the Canary Islands

Stock	2020 catch in 1 000 tonnes (2016–2020) avg.)	*$B_{cur}/B_{0.1}$	*$F_{cur}/F_{0.1}$	Assessment	Management recommendations
Chub mackerel[3] *Scomber colias* Whole subregion	381 (439)	109% (Global) 111% (XSA) 102% (ICA)	102% (Global) 82% (XSA) 77% (ICA)	Fully exploited	The Working Group concluded, based on the results of the production model and other analytical models and methods, that the stock is **fully exploited**. The projection results obtained by the global and analytical models indicate similar trends indicating that the current level of catch is not sustainable and would induce a decrease in spawning and target biomass. To this end, the group considers it important to limit the general upward trend in catches and recommends, as a precautionary approach, to renew the recommendation made in previous years, i.e., a maximum catch of 340 000 tonnes, which corresponds to a 12 percent reduction compared to catches recorded throughout the sub-region in 2020. In addition, the group notes a significant fishing of juveniles, which have not yet reached their first maturity, and recommends the implementation of measures to reduce the fishing mortality exerted on this vulnerable fraction of the stock to improve its biological productivity.
Anchovy *Engraulis encrasicolus* Zone North, A+B	50 (29)	N/A	76% (LCA-Y/R)	Fully exploited	Anchovy assessment was based on information from North Zone and Zone A+B. The results of the model show that the anchovy stock is **fully exploited**. The increase in biomass observed in 2018 is continuous in 2019. Strong catches were recorded in 2020, representing the largest in the series. As the biomass index for 2020 was not available, the assessment for this stock could not be updated. Since the availability of anchovy depends strongly on environmental factors, that it is exploited in an opportunistic way and that catches vary considerably from year to year, the Working Group recommends adjusting the fishing effort to the natural fluctuations of this stock.

[3] Not including the Canary Islands.

Stock	2020 catch in 1 000 tonnes (2016–2020) avg.)	*$B_{cur}/B_{0.1}$	*$F_{cur}/F_{0.1}$	Assessment	Management recommendations
Bonga *Ethmalosa fimbriata* Stock North Mauritania	10 (24)	N/A	130% (LCA-Y/R)	Overexploited	The Working Group considers that the bonga is **overexploited** in both Mauritania and Senegal. The Working Group recommended that effort and catches be reduced below 2020 levels to allow a level of biomass that can ensure sustainability.
Stock South Senegal	32 (20)	N/A	209%	Overexploited	

* XSA = extended survivor analysis
** LCA-Y/R = length cohort analysis – yield per recruit

OVERALL OBSERVATIONS AND RECOMMENDATIONS FOR DATA AND RESREACH

- The main deficiency of biological data is reliable length and age data for most of the stocks. The study of age and growth, therefore, is a priority for the Working Group. Despite efforts to improve data, there are still data deficiencies concerning length composition of the landings and discards of the industrial fleets in Mauritania, length distribution of catches in the Gambia and Senegal and age distribution of catches per species in all countries of the region.
- There are also still uncertainties with regards to fishery statistics in the Northwest Africa region. The current models applied for the assessments depend strongly on the estimated levels of past and present catch. Unreliable catch data will impact directly on the quality and reliability of the assessment and recommendations made by the Group. Therefore, these issues should be addressed with urgency and insistence.
- Fisheries independent surveys have been the backbone of many of the assessments since the start of the FAO Working Group, however, since 2010 the regional acoustic surveys series covering the whole sub-region have been interrupted for several reasons. The Working Group stresses the importance of restarting the regular regional acoustic surveys of the pelagic stocks by the regional research vessels covering the complete distribution area of all the stocks. Only the northern part of the distribution of stocks in the CECAF North region is regularly covered by the Moroccan R/V *Al Amir Moulay Abdellah*. It is recommended that the regional planning group for the coordination of acoustic surveys should reconvene. It was noted that no surveys took place in the region due to the COVID-19 pandemic.
- The recruitment surveys are also very important for management of small pelagic fisheries. The Working Group recommends the continuation of the recruitment surveys in the period November-January by the Russian research vessel and or national or other regional vessels.
- Given the marked variability of environmental conditions in this region, the Working Group again stressed the need to continue studies for the effect of hydrographical and/or ecological variability in the region and its effects on stock dynamics and to explore possibilities to further development of the production model used to better account for these factors.

METHODS AND APPROACH

METHODS

Consistent with previous years, the main model used by the Working Group was the dynamic version of the Schaefer (1954) model. This model was applied to sardine, horse mackerel and chub mackerel. Simple medium-term projections of future yields and stock development were made using this model fitted to the historical data with a projected time horizon of three/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. An Excel spreadsheet implementation of the dynamic version of these models, with an observation error estimator, was used. The model was fitted to the data using the non-linear optimizer built into Excel, Solver.

For round sardinella, bonga and anchovy, a length cohort analysis (LCA) was 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 was then run on these estimates, to estimate the status of the stock in relation to the biological reference points F_{MAX} and $F_{0.1}$. Both the LCA and the yield-per-recruit analysis (YR)were implemented as Excel spreadsheets with instructions, developed specially for this Working Group.

For the mackerel stock, catch-at-age data from the Russian fleet, that covered most of the reported catches, were available. The results of the analysis of correlation within cohorts was considered acceptable and the Working Group decided to proceed with applying the age-based methods, extended survivor analysis (XSA) and integrated catch analysis (ICA) as well as the dynamic production model.

Based on the recommendations from the technical review carried out in 2015, possible new assessment methods that could broaden the tools available to the Working Group have been tested since 2016.

As a result, several methods have been tested on different stocks. The models/approaches that have been tested include the Monte Carlo-Catch Maximum Sustainable Yield (CMSY), catch curve analysis and length-based mortality estimates and SPICT a state space model fitting a surplus production model in a statistical framework based on estimation by maximum likelihood.

ASSESSMENT CLASSIFICATION

The Working Group adopted three assessment categories:

- **Not-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 in terms of biomass or/and fishing mortality. Fishing pressure should be reduced to allow the stock to grow.

BIOLOGICAL REFERENCE POINTS

The Working group, consistent with CECAF, has adopted the following Biological Reference Points (BRPs):

Target Reference Points: $B_{cur}/B_{0.1}$ and $F_{cur}/F_{0.1}$

Limit Reference points: B_{cur}/B_{MSY} and F_{cur}/F_{MSY}

Where:

$F_{0.1}$ - The fishing mortality rate at which the slope of the yield-per-recruit curve is only $1/10^{th}$ the slope of the curve at its origin, or 90 percent of F_{MSY}
F_{MSY}-Value of F (and of other characteristics of the stock) where the long-term total yield is maximum
F_{Max} - Consider the long−term yield per recruit, Y/R, as a function of F, for a certain exploitation pattern. F_{Max} is the point of the curve, Y/R against F, where Y/R is maximum.
$B_{0.1}$ – is the value of Biomass corresponding to $F_{0.1}$
B_{MSY} – is the value of Biomass corresponding to F_{MSY}

The target reference points indicate what the current situation is like in terms of biomass and fishing mortality related to the ideal situation for the stocks whereas the limit indicate that the current situation related to what we want to avoid. The more conservative $F_{0.1}$ and $B_{0.1}$ have been selected as target reference points rather than the more traditional F_{MSY} and B_{MSY}, due to the inconsistencies of some data sets, and in line with the precautionary approach.

The Working Group estimates the status of the stocks and fisheries in relation to these agreed reference points adopted by CECAF. Whenever possible, the Group made projections of future yields and stock status under different scenarios for future management measures.

The management advice for the stocks is given in relation to the agreed reference points and on the basis of the projections. The advice is intended to provide guidance to management on how to make the different stocks can be maintained or develop in a direction where exploitation can be sustained at a level more conservative due to the inconsistencies of some data. As far as possible, advice for each stock is given both in terms of effort and/or 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.

DEFINITIONS

- **Effort-** The fishing activity can be measured in a given unit of time e.g. number of boats, number of days fishing, number of trips, number of hours trawled per day, number of hooks set per day, number of hauls per day, etc.
- **CPUE-** Catch per unit of effort is the catch of fish in numbers or weight taken by a defined period of effort.
- **Exploitation rate (E) –** Ratio between the number of individuals caught and the total number of individuals dead, over a certain period of time, that is, **E = C/D** or can be E=F/(F+M) and is $0<E<1$.
- **Exploitation pattern -** Fraction of the individuals of a given size, available to the gear, which is caught. Also designated by Selectivity or partial recruitment.
- **Fishing mortality (F) (fishing mortality coefficient)** – Relative instantaneous rate of the mortality of the number of individuals that die due to fishing.

- **Recruitment to the exploitable phase (R)** – Number of individuals of a stock that enter the fishery area for the first time each year.
- **Biomass –** Total weight of the stock in the ecosystem
- **Structural models** – Models that consider the structure of the stock by ages or sizes. These models allow one to analyze the effects on catches and biomasses, due to changes in the fishing level and exploitation pattern.
- **Global Models -** These models consider the stock globally, in particular the total abundance (in weight or in number) and study its evolution, the relation with the fishing effort, etc. They do not consider the structure of the stock by age or by size.