



**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 2023**

#### **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 twenty-second meeting of the FAO Working Group on the Assessment of Small Pelagic Fish off Northwest Africa, from 19–28 July 2023 in Tenerife, Spain. Scientists from the Gambia, Mauritania, Morocco, Senegal, and Spain (for the Canary Islands) attended the meeting. Members from the European Commission (DG MARE) and the Russian Federation also attended the meeting. 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.

During the meeting, the Working Group members discussed the submitted data by species chapter, and performed the stock assessments, along with using exploratory approaches, and formulated the final management recommendations. Support to the Tenerife meeting was provided by the EAF-Nansen programme, and meeting venue facilities were provided by the Spanish Institute of Oceanography (IEO).

The meeting was preceded by a working group on acoustic surveys and planning, where results from the 2022 R/V *Dr Fridtjof Nansen* were presented and included in the final assessments, along with results from the Moroccan research vessels, and the recruitment surveys from the Russian R/V *Atlantida*. 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.

The Working Group was chaired by Mr Cheikh-Baye Braham (IMROP, Mauritania).

## KEY FINDINGS AND RECENT DEVELOPMENTS IN THE FISHERIES

Six out of eight stocks were determined to be within biologically sustainable limits (status of fully or not fully exploited), while three stocks were considered overexploited. The assessments for the two sardinella species show action is needed to rebuild stocks of round sardinella and bonga, which are both overexploited.

**Table 1:** Summary of assessment results.

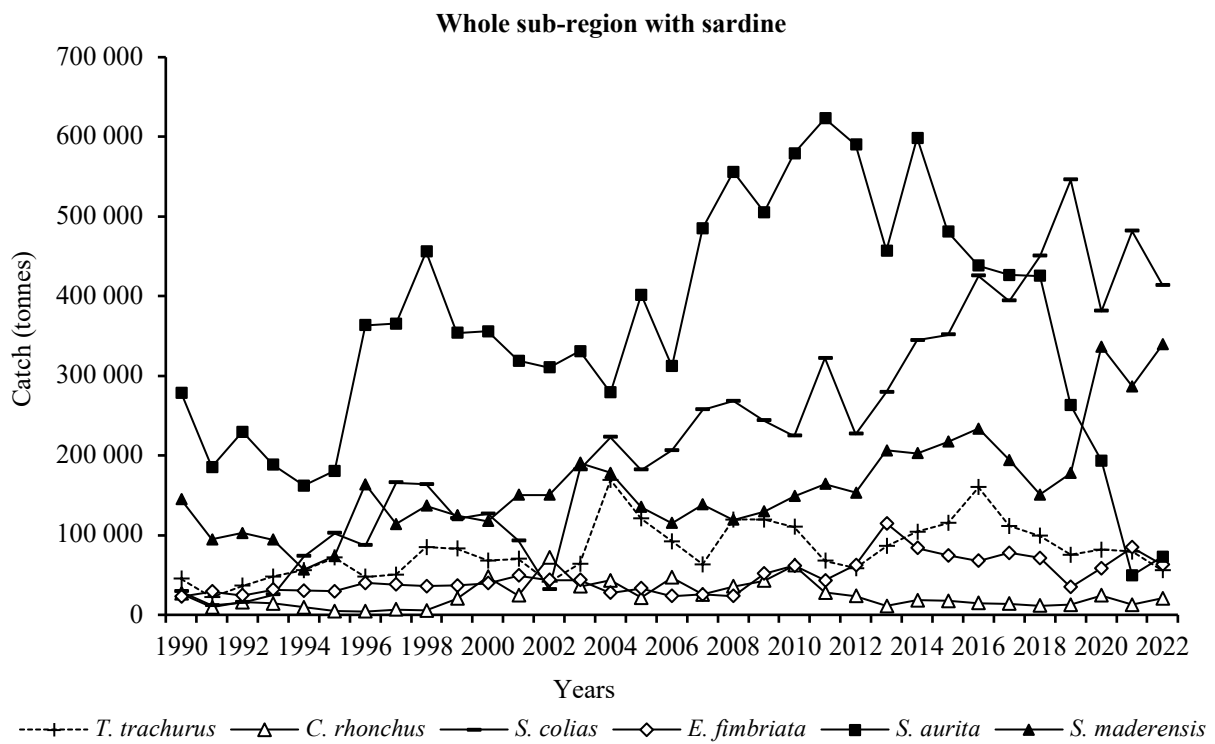
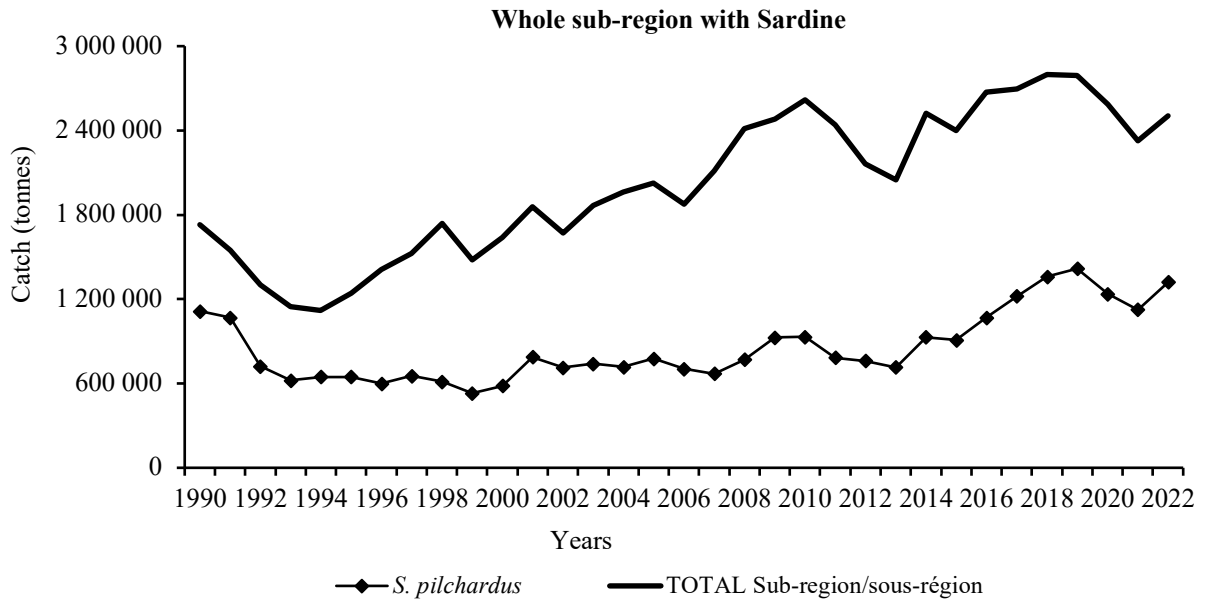
Species	Area	Not fully exploited	Fully exploited	Overexploited
<b>Sardine (<i>Sardina pilchardus</i>)</b>	Zone A+B	√		
	Zone C	√		
<b>Sardinella (<i>Sardinella aurita</i>, <i>S. maderensis</i>, <i>Sardinella</i> spp.)</b>	Whole subregion (three stocks)			√
<b>European horse mackerel (<i>Trachurus trachurus</i>)</b>	Whole subregion		√	
<b>Cunene horse mackerel (<i>Trachurus trecae</i>)</b>	Whole subregion		√	
<b>Chub mackerel (<i>Scomber colias</i>)</b>	Whole subregion		√	
<b>Anchovy (<i>Engraulis encrasicolus</i>)</b>	Zone N & Zone A+B		√	
<b>Bonga (<i>Ethmalosa fimbriata</i>)</b>	Maur./Sen./Gam			√

No assessments for *Caranx rhonchus*. Assessments do not include data from the Canary Islands.

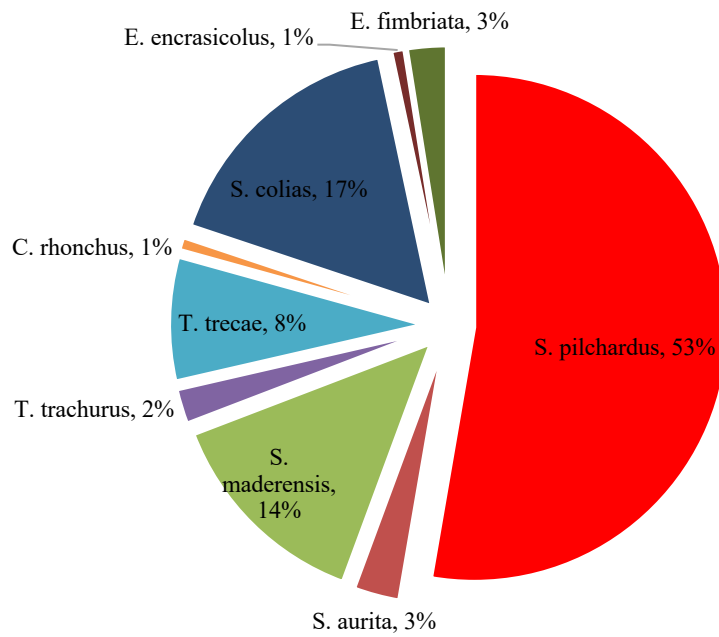
## OVERALL REGIONAL TRENDS

### CATCH

The total catch of small pelagics has been fluctuating since the beginning of the time series in 1990 (Figure 1 and 2, Table 1). There was a moderately increasing trend from 2013 to 2019, followed by a sharp decrease that began to reverse in 2022. Sardines make up most of the total catch of small pelagics in the sub-region at 53 percent of the total catch, followed by Chub mackerel (*Scomber colias*) at 17 percent of the total and flat sardinella (*Sardinella maderensis*) at 14 percent of the total. The total catch for the sub-region reached 2.6 million tonnes in 2022, which represents an 8 percent increase from the total catch in 2021 (total of 2.3 million tonnes). The 2022 total catch is similar to the average of the whole time series (1990–2022) at 2.6 million tonnes, and higher than the five-year average of 2 million tonnes. The moderate increase in catches from 2021 to 2022 is due to the increase in total catch for sardine, sardinella, and horse mackerel (except *T. trachurus*). All other species experienced a decrease in total catch from 2021 to 2022.



**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 2022.

**Table 2:** Comparative catches between 2018 and 2022 in tonnes.

Species	Catch 2018	Catch 2019	Catch 2020	Catch 2021	Catch 2022	% of total catch in 2022	Average (2018-2022)	Average (1990-2022)
<i>S. pilchardus</i>	1 360 328	1 416 934	1 235 572	1 125 092	1 320 108	53%	1 291 607	859 854
<i>S. aurita</i>	425 561	263 205	193 408	49 550	73 078	3%	200 961	358 107
<i>S. maderensis</i>	150 887	177 962	336 480	286 826	339 223	14%	258 276	161 921
<i>T. trachurus</i>	99 273	75 509	81 709	79 558	55 800	2%	78 370	81 237
<i>T. trecae</i>	204 883	245 224	226 459	155 861	197 669	8%	206 019	188 137
<i>C. rhonchus</i>	11 653	12 526	24 273	12 824	20 638	1%	16 383	23 722
<i>S. colias</i>	450 405	545 746	381 215	481 508	413 875	17%	454 550	225 792
<i>E. encrasicolus</i>	24 071	19 797	50 629	49 410	20 746	1%	32 931	75 085
<i>E. fimbriata</i>	71 226	34 889	58 454	84 601	63 013	3%	62 436	47 804
<b>Total</b>	<b>2 798 287</b>	<b>2 791 791</b>	<b>2 588 199</b>	<b>2 325 230</b>	<b>2 504 150</b>	-	<b>2 601 532</b>	<b>2 021 658</b>

**Table 2 (continued):** Comparative catches between 2018 and 2022 for the Canary Islands (in tonnes).

Species	Catch 2018	Catch 2019	Catch 2020	Catch 2021	Catch 2022	% of total catch in 2022	Average (2018-2022)	Average (1990-2022)
<i>S. pilchardus</i>	230	79	42	37	23	2%	82	234
<i>S. colias</i>	118	110	55	207	233	25%	145	275
<i>Sardinella</i> spp.	408	495	628	275	-	-	361	485
<i>Trachurus</i> spp.	1 105	1 149	710	693	694	73%	870	834
<b>Total</b>	<b>1 861</b>	<b>1 832</b>	<b>1 435</b>	<b>1 212</b>	<b>950</b>	-	<b>1 458</b>	<b>1 828</b>

## REGIONAL SURVEYS

The latest acoustic survey in the region with the R/V *Dr Fridtjof Nansen* was carried out in 2022, as part of a synoptic coverage of the pelagic resources and ecosystems off West Africa. The survey was conducted in the last quarter of the year, between October and December, continuing the historical series used in the assessments. This survey included Leg 5.1, which encompassed Senegal and the Gambia, leg 5.2 which covered the area between St. Louis and Cape Blanc, and leg 5.3 conducted the survey from Cape Blanc northward to Cape Spartel. Leg 5.1 started in Dakar (Senegal) on 4 October, proceeded southwards to the border of Guinea-Bissau, and covered from there evenly space transect northwards until the border to Mauritania.

The Russian R/V *Atlantida* conducted recruitment surveys from October-November 2022 for sardine and mackerels, between Cap Cantin and Cap Blanc, resulting in data from 143 trawls.

Morocco also conducted several acoustic surveys in Moroccan waters for small pelagic species in 2022 with the two research vessels *Al Amir Moulay Abdellah* and *Al Hassan Al Marrakchi*.

## 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. Sardine catches in the sub-region in 2022 increased by 17 percent compared to 2021, increasing from around 1.1 million tonnes in 2021 to more than 1.3 million tonnes in 2022. Catches in Zone North and Zone A+B increased: they went from 21 023 tonnes in 2021 to 23 230 tonnes in 2022 (an increase of around 10 percent) in Zone North. For Zone A+B, sardine catches increased from 344 261 tonnes in 2021 to 611 463 tonnes in 2022 (an increase of 78 percent).

Sardine in Zone C is also considered not fully exploited. Although the catch in Zone C represents more than 52 percent of the total catch of small pelagics for the subregion, this still represents a 10 percent decrease from 759 770 tonnes in 2021 to 685 391 tonnes in 2022. This decrease mainly concerns the area north of Cap Blanc where landings fell by 17 percent. South of Cap Blanc, catch levels remained stable. Concerning the Senegalese zone, the landed weight has improved significantly from 164 tonnes in 2021 to 1 331 tonnes in 2022.

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

The assessment and historical series on sardinella show that the sardinella stock is still overexploited. Round sardinella (*Sardinella aurita*) and flat sardinella (*Sardinella maderensis*) are often caught together. Sardinella catches of the two species combined increased by 23 percent between 2021 and 2022. This increase is due to an increase in recorded landings of flat sardinella by 18 percent and 48 percent of round sardinella compared to 2021. Regional round sardinella catches showed a continuous decline from 2014 to 2021. However, catches in all fleet segments (artisanal, coastal, and offshore) showed an increase in 2022. Regional flat sardinella catches have shown a strong increase since 2020 compared to other years in the series. Catch levels averaged around 200 000 tonnes over the 2013–2019 period. In 2020, the catch level was 336 000 tonnes; in 2021 the catch was 286 000 tonnes and in 2022 around 340 000 tonnes. In the Canary Islands, data for *S. aurita* and *S. maderensis* are combined due to problems identifying the species at landing sites. Recorded landings of *Sardinella* spp. of the Canary Islands fell from a level of 553 tonnes in 2013 to 233 tonnes in 2022.

### **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. In 2022, catches of horse mackerel reached 274 000 tonnes for the entire sub-region, an increase of 10 percent compared to 2021. This increase is due to the 27 percent increase in catches of Cunene horse mackerel (*Trachurus trecae*). For Atlantic horse mackerel (*Trachurus trachurus*), an overall decrease of 30 percent was recorded in 2022. Catches of *Trachurus* spp. in the Canary Islands fell 19 percent from 275 tonnes in 2021 to 231 tonnes in 2022.

### **Chub mackerel (*Scomber colias*)**

For chub mackerel (*Scomber colias*), the Working Group concluded, based on the results of both models applied, that the stock is fully exploited. In 2021, the various fleets operating in Zone C recorded increases in catches. The total catch in the zone increased by 39 percent in 2021 compared to 2020. However, in 2022, the catches from Zone C by the different fleets fell overall by 4 percent due to the decrease in catches in practically all fleets (except for purse seiners and Moroccan pelagic trawlers which showed an increase of 51 percent). This increase could be explained by the targeting of this species due to the low availability of sardine which is the main target of these two fleets. For the year 2022, catches in Mauritania's EEZ fell by 48 percent from 124 487 tonnes in 2021 to 64 154 tonnes in 2022. The drop affected all fleets operating in this area. Indeed, the management measures already undertaken seem to limit the activity of fleets targeting small pelagics in Mauritania. In the Canary Islands in 2022, catches reached 640 tonnes, which is a decrease of 8 percent compared to 2021.

### **Anchovy (*Engraulis encrasicolus*)**

Anchovy assessment was based on information from North Zone North, A+B. The results of the model show that the anchovy stock is fully exploited. Overall, catches decreased significantly between 2021 and 2022 (about 58 percent), falling from 49 410 tonnes in 2021 to 20 746 in 2022.

### **Bonga (*Ethmalosa fimbriata*)**

The Working Group considers that the bonga is overexploited in both Mauritania and Senegal. Globally, total bonga catches in the subregion in 2022 decreased by 26 percent from 84 601 tonnes in 2021 to 63 013 tonnes in 2022. From 2021 to 2022, decreased bonga catches were recorded in all countries: a decrease in catch of 53 percent from Mauritania (5 187 tonnes in 2022), a decrease of 25 percent from Senegal (43 746 tonnes in 2022), and a decrease of 6 percent in the Gambia (14 080 tonnes in 2022).

## **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 3:** Summary of the assessments and management recommendations by the 2022 Working Group. All recommendations are based on the results of the production model, and projections for the next five years.

Stock	2022 catch in 1 000 tonnes (2018–2022 avg.)	$B_{cur}/B_{0.1}$	$F_{cur}/F_{0.1}$	Assessment	Management recommendations
<b>Sardine</b> <i>S. pilchardus</i> Zone A+B	611 (444)	135%	71%	Not fully exploited	The stock is considered <b>not fully exploited</b> in 2022. However, significant catches were recorded in 2022 (an increase of 78% compared to 2021) with stable biomass levels. Furthermore, a general downward trend in the average size of sardines caught in the central zone has been recorded in recent years and calls for vigilance regarding the exploitation of this stock whose biomass and recruitment levels fluctuate. Projections show that the stock could sustain a slight increase in catches. However, the variability of the resource vis-à-vis hydroclimatic changes requires the adoption of a precautionary approach. The working group maintains the recommendation not to exceed a level of 550 000 tonnes, as in previous years.
<b>Sardine</b> <i>S. pilchardus</i> Zone C	685 (824)	140%	47%	Not fully exploited	The stock is considered <b>not fully exploited</b> in 2022. However, the acoustic biomass (of the Moroccan R/V) decreased in 2022 (29% compared to the year 2021). This decrease coincided with a drop in catches especially for vessels operating offshore. In addition, catches have continued to decline since 2019, a period that coincided with the implementation of several management measures at the regional level. It should be recalled that in recent years, the emergence of coastal fleets in Mauritania has contributed to significant sardine catches south of Cap Blanc. In this latter area, the abundance indices are not regularly assessed. The average size of the sardine caught showed an overall downward trend, hence the need to be vigilant in the exploitation of this stock. In addition, this stock is strongly influenced by environmental factors and exhibits fluctuations in biomass independent of fishing. For this reason, the total authorized catch must be adapted to variations in the stock. Stock structure and abundance should also be closely monitored through fishery-independent methods, such as coordinated acoustic surveys throughout the species' range.



Stock	2022 catch in 1 000 tonnes (2018–2022 avg.)	$B_{cur}/B_{0.1}$	$F_{cur}/F_{0.1}$	Assessment	Management recommendations
<b>Sardinella<sup>1</sup></b>					
<i>S. aurita</i>	72 (201)	-	192% (LCA)	Overexploited	<p>The different models show alarming round sardinella stock situations. An examination of the historical round sardinella series and abundances indices show that the stock is in a critical situation marked by very strong <b>overexploitation</b>. The working group reiterates the recommendations of previous years for the management of the stock and advocates a substantial and immediate reduction in fishing effort and mortality (around 60 percent of the current mortality exerted on this stock). As for the flat sardinella, the level of fishing mortality has been very high over the last three years. Indeed, the fishing effort on the two species is currently directed towards the flat sardinella. Therefore, the working group also recommends the reduction of fishing effort directed towards the flat. Furthermore, to improve the state of sardinella stocks, it is recommended to maintain the ban on their use for the manufacture of fishmeal in Mauritania and to extend it to the entire sub-region. The working group recommends the urgency of putting in place concerted management measures between the different countries and encourages the dynamics of the implementation of national development plans. Also, the working group reiterates the need to strengthen the collection of data on these species at the scale of their distribution.</p>
<i>S. maderensis</i>	339 (258)	-	-	Overexploited	
<i>Sardinella</i> spp.	411 (459)	-	-	Overexploited	
Whole subregion					

<sup>1</sup>Not including the Canary Islands.

Stock	2022 catch in 1 000 tonnes (2018–2022 avg.)	$B_{cur}/B_{0.1}$	$F_{cur}/F_{0.1}$	Assessment	Management recommendations
<b>Horse mackerel<sup>2</sup></b> <i>T. trachurus</i> <i>T. trecae</i> Whole subregion	56 (78) 198 (206)	100% 109%	55% 52%	Fully exploited ( <i>T. trachurus</i> ) Fully exploited ( <i>T. trecae</i> )	The results of the global model show that the stock of <i>Trachurus trachurus</i> and that of <i>T. trecae</i> are <b>fully exploited</b> . This indicates an improvement in the status of <i>Trachurus trecae</i> stocks which were overexploited in 2021. This is due to an improvement in biomass and recruitment indices in 2022, observed by the recruitment surveys. The working group recommends not to exceed 300 000 tonnes for both species during 2023, a maximum threshold for both species for three years. In addition, the working group has observed for several years a significant fishing of juveniles, which have not yet reached their first maturity, and recommends the implementation of urgent measures (e.g., spatio-temporal measures, etc.) aimed at reducing the fishing mortality exerted on this vulnerable fraction of the stock to improve its biological productivity.
<b>Chub mackerel<sup>3</sup></b> <i>Scomber colias</i> Whole subregion	413 (454)	115% (Biodyn/Global) 98% (XSA) - (ICA)	92% (Biodyn/Global) 85% (XSA) - (ICA)	Fully exploited	The working group concluded, based on the results of the production model and other analytical models, that the stock is <b>fully exploited</b> . Stock biomass has improved, catches have shown a downward trend since 2020. In addition, the level of recruitment for 2022 is above the historical average. Despite these positive indicators for the stock, the projections show different stock response trajectories depending on the models used. To this end, the working group was not able to adopt projections on the evolution of this stock, complicated by the interannual fluctuations in recruitment. To this end, the working group, as a precaution, recommends limiting the catch to 340,000 tonnes throughout the sub-region in 2023. In addition, the working group has observed for several years a significant fishing of juveniles, which have not yet reached their first maturity, and recommends the implementation of urgent measures (e.g., spatio-temporal measures, revision of the minimum catch size and landing tolerance thresholds, etc.), based on science, aimed at to reduce fishing mortality on this vulnerable part of the stock in order to improve its biological productivity.
<b>Anchovy</b> <i>Engraulis encrasicolus</i> Zone North, A and B	21 (33)	-	87% (LCA-Y/R)	Fully exploited	The anchovy assessment was based on information from the North+A+B area. The results show that the anchovy is considered <b>fully exploited</b> . Given that the availability of anchovy is highly dependent on environmental factors, that it is exploited opportunistically and that catches vary considerably from year to year, the working group recommends adjusting fishing effort to the natural fluctuations of this stock. To carry out an assessment of the distribution of this stock, it is necessary to strengthen the collection in zone C, and to initiate studies on the identity of the stock.

<sup>2</sup> Not including the Canary Islands.

<sup>3</sup> Not including the Canary Islands.

Stock	2022 catch in 1 000 tonnes (2018–2022 avg.)	$B_{cur}/B_{0.1}$	$F_{cur}/F_{0.1}$	Assessment	Management recommendations
<b>Bonga</b> <i>Ethmalosa fimbriata</i>  Whole region (Mauritania+ Senegal+ Gambia)	63 (62)	-	179% (LCA-Y/R) (Mauritania+ Senegal)	Overexploited	The results of the size-based models (LCA and LBB), show that the bonga stock is <b>overexploited</b> in the sub-region. The working group maintains the recommendation to reduce fishing effort and catches below 2022 levels to allow a level of biomass that can ensure sustainability. In addition, it is necessary to strengthen the collection of data (e.g., statistical and biological) to allow a good assessment of this stock at the scale of this distribution.

\* XSA = extended survivor analysis

\*\* LCA-Y/R = length cohort analysis – yield per recruit

## OVERALL RECOMMENDATIONS FOR DATA AND RESEARCH

- Intensify biological sampling in the different countries of the sub-region, in particular the collection of data on size structures for sardinella, anchovy (southern zone) and bonga.
- Conduct exploration work to provide the working group with standard effort series for sardinella and bonga and explore other abundance indices to assess certain stocks such as mackerel.
- Revise historical horse mackerel data (size-age key reading) to allow the application of analytical models.
- Clarify stock boundaries and likely mixing with other populations in the sub-region.
- Strengthen scientific knowledge on the dynamics of juveniles and adults at the regional level in order to provide management advice aimed at their preservation, it is important to initiate thematic workshops on these aspects.
- The working group notes the need for a baseline workshop and the development of a framework for the identification and validation of all models used in assessments.
- Develop cooperation with other scientific groups (ICES, ICCAT, etc.) on stock assessment methods.
- The acoustic survey planning group should meet before the next working group session in 2024.
- Strengthen the capacities of the crews of national vessels (Mauritania and Senegal).

## 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: Just Another Bayesian Biomass Assessment (JABBA), the Monte Carlo-Catch Maximum Sustainable Yield (CMSY), catch curve analysis and length-based mortality estimates, and the Stochastic Surplus Production Model in Continuous Time (SPICT).

## 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<sub>0.1</sub>** - The fishing mortality rate at which the slope of the yield-per-recruit curve is only 1/10<sup>th</sup> the slope of the curve at its origin, or 90 percent of  $F_{MSY}$

**F<sub>MSY</sub>**-Value of F (and of other characteristics of the stock) where the long-term total yield is maximum

**F<sub>Max</sub>** - 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<sub>0.1</sub>** – is the value of Biomass corresponding to  $F_{0.1}$

**B<sub>MSY</sub>** – 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.