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2023 Med QSR Harvest of Commercially Exploited Fish and Shellfish (EO3) assessment

UNEP/MAP
Athens, 2023

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Report prepared by:

General Fisheries Commission for the Mediterranean – GFCM

Note by the Secretariat

The 2023 MED QSR Roadmap and Needs Assessment was endorsed by COP 21 (Naples, Italy, December 2019) with Decision IG.24/4. It defines the vision for the successful delivery of the 2023 MED QSR, and outlines key IMAP-related processes, milestones and outputs to be undertaken, with their timelines.

The main assessment chapters of the 2023 MED QSR are based on assessments of Common Indicators (CI) and some Candidate Common Indicators (CCI) within Ecological Objectives (EO) for biodiversity and fisheries, pollution and marine litter and cost and hydrography clusters. Where feasible, and where the data allow, CIs are integrated within and across EOs.

As a contribution to the 2023 MED QSR Biodiversity and fisheries chapter, General Fisheries Commission for the Mediterranean GFCM has prepared the Ecological Objective 3 sub chapter related to Harvest of Commercially Exploited Fish and Shellfish.

The present proposal of the 2023 MED QSR EO3 chapter is submitted for review and discussion by the Integrated CORMONs on 27 and 28 June 2023 with a view to its finalization for consideration by the 10th Meeting of the EcAp Coordination Group to be held in September 2023.

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Background

1. The indicators of Good Environmental Status of Commercially Exploited fish are quantitative proxies to describe the status of a specific fish stock (i.e. the fish population from which catches are taken in a given fishery) as well as the anthropogenic pressure imposed on it through fishing activities. These indicators are regularly used in fisheries management to assess the sustainability of fisheries, as well as the performance of management measures (Miethe et al., 2016), by monitoring how far the indicator is from previously agreed targets (i.e. reference points).
2. The assessment of the size and state of exploited fish stocks is one of the pillars of fisheries management. Generally, stock status is determined by estimating both current levels of fishing mortality (EO3CI7) and spawning-stock biomass (see EO3CI9), and comparing these with reference points, which are typically associated with maximum sustainable yield (MSY - Brooks et al., 2010).
3. Total catch refers to the total amount of fish of a commercially exploited fish and shellfish species taken by any fishing gear, while total landings (EO3CI8) are the total amount of fish and shellfish landed and officially registered. Total catch is composed of total landings plus discards and unreported catches. As information on the latter quantities is fragmented, total landing is often used as a proxy indicator of fisheries production as well as of the removal of organisms from the ecosystem, although for areas where the latter are important a sizeable shift from real values may occur.
4. The GFCM provides regular reports on main indicators of relevance for fisheries management, and in 2016 it launched its flagship publication "The state of Mediterranean and Black Sea fisheries – SoMFi" that includes a comprehensive analysis of salient issues of relevance in the area. The assessment on the status of commercially exploited fish, included in relation to the indicators of fishing mortality (GES indicator EO3CI7), Total landings (GES indicator EO3CI8) and spawning stock biomass (GES indicator EO3CI9), emanates from the information published in SoMFi 2022 (FAO, 2022).

1. Key Messages

<u>Fishing mortality</u>

5. The overexploitation of stocks has decreased over the past decade, with an accelerated reduction of fishing pressure in the last two years, particularly for key species under management plans. However, most commercial species are still overexploited, and fishing pressure is still double what is considered sustainable.
6. Most stocks for which validated assessments are available continue to be fished outside biologically sustainable limits, and average fishing pressure is still twice the level considered sustainable (average F/FMSY = 2.25). Nevertheless, there has been a 10 percent decrease in the percentage of stocks in overexploitation since 2012 and a continuous gradual decrease in fishing pressure since 2012 (a 21 percent decrease since 2012, double what was reported in 2020).
7. For some priority species under management plans, fishing pressure has declined by considerably more over the past decade, including European hake (-39 percent) and common sole (-75 percent). However, fishing pressure continues to increase on certain other stocks, notably commercially important blue and red shrimp in the central and eastern Mediterranean.

Spawning stock biomass

8. While the biomass of some species under management plans is already increasing as a result of decreased fishing pressure, others have yet to show any improvement. Across the region, 44 percent of the stocks were found to have low relative biomass levels, with 19 percent intermediate and 37 percent high.

Total landings

9. Capture fisheries production in the region has been stalled since the mid-1990s, with a decrease in 2020 likely exacerbated by the COVID 19 pandemic. Landings for the Mediterranean and the Black Sea (2018–2020 average) amount to 1 189 200 tonnes (excluding tuna-like species), very similar to the landings reported in The State of Mediterranean and Black Sea Fisheries 2020 (2016–2018 average). However, landings in 2020 show a 16 percent decline in comparison with 2019, likely related to some extent to the impacts of the COVID-19 pandemic on fleet dynamics, demand and trade. The total production for the Mediterranean Sea alone was 743 100 tonnes (62 percent of the total capture fish production in the region).

2. Background Information and Methodology

10. The General Fisheries Commission for the Mediterranean (GFCM) of the Food and Agriculture Organization of the United Nations (FAO) is the regional fisheries management organization for the Mediterranean and the Black Sea and is, inter alia, a knowledge-based organization committed to improving both the quantity and quality of data and information used to formulate sound scientific advice underpinning the adoption of binding decisions for the sustainable management of fisheries and the development of aquaculture in the region .

11. The biennial Flagship publication of GFCM "The state of Mediterranean and Black Sea fisheries – SoMFi" sets a comprehensive analysis of salient issues of relevance in the area. The SOMFI 2022 (FAO, 2022) is the fourth edition of the SoMFi series. The series was established to serve as a reference for the GFCM's membership and partners on the status of marine resources, ecosystems and fisheries in the Mediterranean Sea. It provides an essential information on the main issues surrounding the fisheries sector in the region, as well as a key tool to monitor progress towards the main goals and objectives set by the GFCM and consequently to support strategic decision-making. SoMFi also complements the FAO global reference series The State of World Fisheries and Aquaculture, holding a magnifying glass over fisheries in the Mediterranean and the Black Sea, or FAO major fishing area 37.

12. The assessment of the status of commercially exploited fish and shellfish, presented below in relation to the indicators of fishing mortality (GES indicator EO3CI7) and spawning stock biomass (SSB; GES indicator EO3CI9), emanates from the information published in Chapter 5 SoMFi 2022, while information related to total landings (GES indicator EO3CI8), comes from Chapter 2 of SoMFi 2022.

13. Since the adoption of the GFCM Data Collection Reference Framework (DCRF – GFCM, 2017a) by Mediterranean and Black Sea countries, the data collection, reporting and analysis within the context of GFCM have substantially improved. The DCRF is the instrument governing the collection and submission of fisheries-related data in the GFCM area of application by GFCM contracting parties and cooperating non-contracting parties (CPCs), in line with binding recommendations adopted by the GFCM. As such, it aims to better integrate data and management measures, underpinning the formulation of sound scientific advice by the GFCM Scientific Advisory Committee on Fisheries, which in turn informs the activities of the GFCM Compliance Committee and ultimately supports GFCM decision-making processes.

14. The DCRF encompasses all the necessary indications for the collection of fisheries data (i.e., national fisheries catch; incidental catch of vulnerable species; fleet; effort; socio-economics; biological information) by GFCM CPCs in a standardized way, in order to provide the minimum set of data needed to support fisheries management decision-making processes, including through technical working groups.

15. The assessment of the size and state of exploited fish stocks is one of the pillars of fisheries management. In the context of the assessment of commercial priority species and key fisheries, in the Mediterranean the GFCM works through its permanent Working Groups on Stock Assessment (WGSAs) – on demersal (WGSAD) and small pelagic (WGSASP) species - where fisheries scientists perform stock assessments and provide the scientific basis for advice on stock status to better manage fisheries. Several analytical methods, based on the population dynamics of different stocks of demersal and small pelagic species are applied within the GFCM WGSAs.

16. Data for the assessment of stocks are collected through DCRF stock assessment form (SAFs) input data calls and the outcomes of the assessments are detailed in the stock assessment forms (SAFs) and Stock Assessment Results (STAR) files which contain information on reference points and the outcomes of the assessment (e.g., fishing mortality, exploitation rate, spawning stock biomass, recruitment etc.).

17. Following the decision of the GFCM to work on indicators of Good Environmental Status (GES) of Mediterranean Sea species, habitats, and ecosystems, so further embracing the FAO Ecosystem Approach to Fisheries (EAF) and within the ongoing collaboration between GFCM and UNEP/MAP several activities have been undertaken in the framework of the GFCM Scientific Advisory Committee on Fisheries (SAC) in recent years.

18. The indicators of Good Environmental Status of Commercially Exploited fish are quantitative proxies to describe the status of a specific fish stock (i.e., the fish population from which catches are taken in each fishery) as well as the anthropogenic pressure imposed on it through fishing activities. These indicators are regularly used in fisheries management to assess the sustainability of fisheries, as well as the performance of management measures (Miethe et al., 2016), by monitoring how far the indicator is from previously agreed targets (i.e., reference points). The two indicators used are fishing mortality (F) and spawning stock biomass (SSB; the combined weight of all individuals in a fish stock that are capable of reproducing). Generally, stock status is determined by estimating both current levels of fishing mortality and spawning-stock biomass and comparing these with reference points, which are typically associated with maximum Sustainable Yield - MSY (Brooks et al., 2010).

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19. The General Fisheries Commission for the Mediterranean (GFCM) of the Food and Agriculture Organization of the United Nations (FAO) is the regional fisheries management organization for the Mediterranean and the Black Sea and is, inter alia, a knowledge-based organization committed to improving both the quantity and quality of data and information used to formulate sound scientific advice underpinning the adoption of binding decisions for the sustainable management of fisheries and the development of aquaculture in the region .

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ii. Assessment methods

28. The complete set of main fishery indicators adopted to assess current status of Mediterranean stocks as well as their temporal trend is reported in the last SAC Report (FAO, 2021). Below is a list of the ones for which a common methodology has been already developed (GFCM, 2017b) and discussed during the meeting of the Correspondence Group on Monitoring (CORMON), Biodiversity and Fisheries (UNEP/MAP, 2017a) as well as the 6th meeting of the Ecosystem Approach Coordination Group (UNEP/MAP, 2017b):

i. Fishing mortality (F) and/or Exploitation rate (E) (Indicator assessment factsheet code EO3CI7).

ii. Total Landings (TL) (Indicator assessment factsheet code EO3CI8).

iii. Spawning Stock Biomass (SSB) (Indicator assessment factsheet code EO3CI9).

iii. Description of current indicators

Fishing mortality (F) (EO3CI7)

29. Fishing mortality (F) is considered an essential component of fishery stock status and a fundamental variable in stock assessment, representing fishing pressure. Generally, fishing mortality is defined as the instantaneous mortality rate (i.e. the individuals that die) due to fishing, and can be defined in terms either of numbers of fish or in terms of biomass of fish. It is usually expressed as a rate ranging from 0 (for no fishing) to high values (1.0 or more). Fishing mortality (F) and natural mortality (M) together make up the total mortality rate (Z). This indicator is intrinsically linked to the optimum catch that can be harvested from a stock in a sustainably way; a sustainable yield is one that will leave enough fish in the water to keep on breeding, so new generations of fish are created (i.e. where inputs to the fishery do not exceed what is coming out of the fishery). The Maximum Sustainable Yield (MSY) is the maximum yield that can be obtained from a species in a sustainable way, and it is associated with a maximum sustainable fishing mortality (FMSY)

Total landings (EO3CI8)

30. The most obvious impact that fishing has on the ecosystem is the removal (i.e. catch) of organisms from the environment. Catch (i.e. retained fraction + bycatch) represents the amount of marine biological resource, taken by the fishing gear, that reaches the deck of the fishing vessel. This should ideally include landings by commercial fleets, national landings in foreign ports, and foreign landings in domestic ports, bycatch, recreational fishing and illegal, unreported and unregulated (IUU) fishing estimates. However, most current statistics do not take into account those organisms that are caught but not landed (i.e. bycatch), thus causing the total catch of fishing vessels and the impact on the ecosystem to be underestimated. For this reason, when catch data are not available, landings data could be used as a proxy for catch. For the purpose of this indicator, and as reported in the DCRF (GFCM, 2017a) the following definitions are used:

- Catch: amount of marine biological resource taken by the fishing gear which reaches the deck of the fishing vessel. This includes catches of individuals of the target species, which are usually kept on board and retained, and bycatch, which refers to catches of species that are not targeted by the fishery, with or without commercial value.

- Landings: Part of the catch retained on board and brought ashore

• Bycatch: Bycatch is the part of the catch that is unintentionally captured during a fishing operation in addition to target species. It may refer to the catch of other commercial species that are landed, commercial species that cannot be landed (e.g. undersized, damaged individuals), non-commercial species, as well as to incidental catch of endangered, vulnerable or rare species (e.g. turtles, sharks, marine mammals etc.).

• Discards: Part of the catch not retained on board and discarded at sea. It may include the catch of target species or any other species (both commercial and non commercial) discarded at sea.

31. Data analysis of the total landings indicator (Table 1) can vary from simple averages of historical catch to more sophisticated methods like depletion-corrected average catch. Other approaches look at the trend in catch to determine if it has been sustainable and, in simple terms, treat a decline in catch as an indication that the population is over-exploited. However, catch-based methods need a time series of catch data going back to when exploitation began, which prevents their use in some cases.

Table 1: Current indicators and the corresponding assessed criteria

Indicator	GES definition	Related Operational Objective	Reference level	Spatial Coverage
Fishing mortality	Populations of selected commercially exploited fish and shellfish are within biologically safe limits, exhibiting a population age and size distribution that is indicative of a healthy stock.	Fishing mortality in the stock does not exceed the level that allows MSY (F≤ FMSY).	- FMSY or its proxy - Decreasing or increasing temporal trend of exploitation ratio with relative level F/FMSY = 1 using linear regression and percentage of change.	Regional, subregional and stock level
Total Landing	Populations of selected commercially exploited fish and shellfish are within biologically safe limits, exhibiting a population age and size distribution that is indicative of a healthy stock.	Total landing and/or catch of commercial species does not exceed the Maximum Sustainable Yield (MSY) and the bycatch is reduced.	Decreasing or increasing trend using linear regression and percentage of change.	Regional and subregional
Spawning Stock Biomass	Achieving or maintaining good environmental status requires that SSB values are equal to or above SSBMSY, the level capable of producing maximum sustainable yield (MSY).	The Spawning Stock Biomass is at a level at which reproduction capacity is not impaired	-SSBMSY or its proxy -Decreasing or increasing trend with relative level SSB/ SSB33%= 1	Regional, subregional and stock level

Spawning Stock Biomass (SSB) (EO3CI9)

32. In terms of biomass, assessments are nearly always based on spawning stock biomass (SSB), an indicator that refers to the total weight (biomass) of the part of the stock that has already spawned at least once, or that is ready to spawn during the reference year. The assessment of SSB helps in detecting potential situations of "recruitment overfishing". Recruitment overfishing happens when the parental biomass is reduced by fishing, resulting in a reduction in the production of new individuals, which in turn may end up in a reduced number of reproductive individuals, jeopardizing the capacity of the stock to self-renovate. It is characterized by a decreasing proportion of older fish in the catch as well as a large reduction of spawning stock biomass and recruitment.

Area.

33. For the present analysis, the study area is corresponding to GFCM area of application (FAO major fishing area 37), in most cases with a focus on the Mediterranean Sea from the Straits of Gibraltar to Bosphorus, which comprises 27 Geographical Sub-Areas (GSAs) (Figure 1). Whenever possible, information was aggregated to provide a subregional (the Western, Central and Eastern Mediterranean and the Adriatic Sea; Fig. 1) and regional outline of the status of resources. Stock assessments are mostly conducted by management units based on the mentioned GSAs (Figure 1). This method does not ensure that the whole stock is assessed, since stocks may cover several different management units. In some cases, when there is scientific evidence of a stock spreading through different GSAs, as well as information on species from different GSAs, existing information is combined across GSAs. This is then defined as a "joint stock assessment of a shared stock".

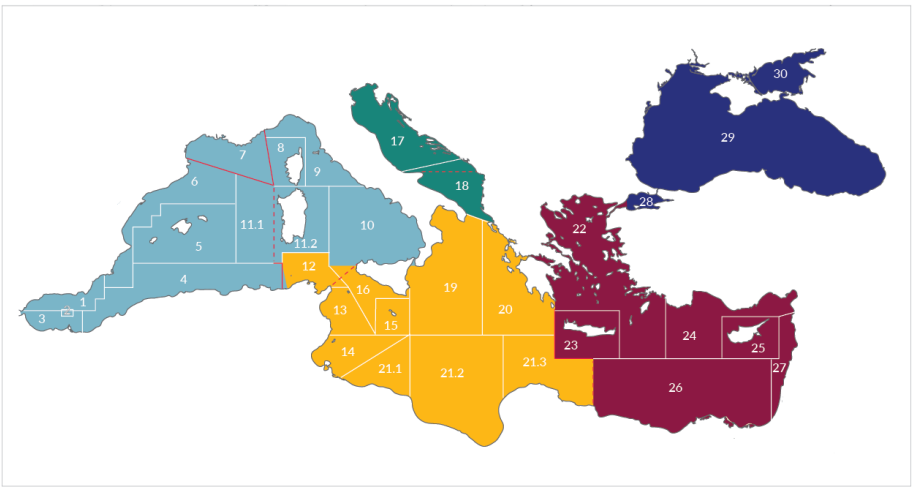
Species

34. Special attention was given to priority stocks agreed upon by the GFCM (Table 2).

Table 2 :Main species analysed in The State of Mediterranean and Black Sea Fisheries: priority species driving fisheries for which assessments are regularly (or planned to be) carried out

		Western Mediterranean Sea	Central Mediterranean Sea	Adriatic Sea	Eastern Mediterranean Sea	Black Sea
GFCM subregions →						
GFCM geographical subareas →		1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	12, 13, 14, 15, 16, 19, 20, 21	17, 18	22, 23, 24, 25, 26, 27	28, 29, 30
Countries →		Algeria, France, Italy, Monaco, Morocco, Spain	Italy, Greece, Libya, Malta, Tunisia	Albania, Bosnia and Herzegovina, Croatia, Italy, Montenegro, Slovenia	Cyprus, Egypt, Greece, Israel, Lebanon, Syrian Arab Republic, Türkiye	Bulgaria, Georgia, Romania, Russian Federation, Türkiye, Ukraine
Scientific name	Common name					
Pelagic species						
Engraulis encrasicolus	European anchovy	■	■	■	■	■
Sardina pilchardus	Sardine	■	■	■	■	
Sardinella aurita	Round sardinella	■	■		■	
Sprattus sprattus	European sprat					■
Trachurus mediterraneus	Mediterranean horse mackerel					■
Demersal species						
Aristaeomorpha foliacea	Giant red shrimp		■		■	
Aristeus antennatus	Blue and red shrimp		■		■	
Lagocephalus sceleratus	Silver-cheeked toadfish	■	■	■	■	
Merlangius merlangus	Whiting					■
Merluccius merluccius	European hake	■	■	■	■	
Mullus barbatus	Red mullet	■	■	■	■	
Mullus surmuletus	Surmullet	■	■		■	
Nephrops norvegicus	Norway lobster	■	■	■		
Pagellus bogaraveo	Blackspot seabream	■				
Parapenaeus longirostris	Deep-water rose shrimp	■	■	■	■	
Pterois miles	Devil firefish	■	■	■	■	
Rapana venosa	Rapa whelk					■
Scophthalmus maximus	Turbot					■
Sepia officinalis	Common cuttlefish			■		
Solea solea	Common sole			■		
*Squalus acanthias**	Piked dogfish					■
Squilla mantis	Spottail mantis shrimp			■		
Additional species						
Anguilla anguilla	European eel	■	■	■	■	
Corallium rubrum	Red coral	■	■	■	■	
Coryphaena hippurus	Common dolphinfish		■	■	■	
Sarda sarda	Atlantic bonito					■
Saurida lessepsianus	Lizardfish				■	

Note: * indicates species included in Appendix III (species whose exploitation is regulated) of the Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean (SPA/BD Protocol) of the Convention for the Protection of the Mediterranean Sea Against Pollution (Barcelona Convention).



FAO statistical divisions — GFCM geographical subareas (GSAs)

GFCM subregions

Western Mediterranean | Central Mediterranean | Adriatic Sea | Eastern Mediterranean | Black Sea

01. Northern Alboran Sea	07. Gulf of Lion	13. Gulf of Hammamet	19. Western Ionian Sea	25. Cyprus
02. Alboran Island	08. Corsica	14. Gulf of Gabès	20. Eastern Ionian Sea	26. Southern Levant Sea
03. Southern Alboran Sea	09. Ligurian Sea and northern Tyrrhenian Sea	15. Malta	21.1. Southwestern Ionian Sea 21.2. Southern Ionian Sea 21.3. Southeastern Ionian Sea	27. Eastern Levant Sea
04. Algeria	10. Southern and central Tyrrhenian Sea	16. Southern Sicily	22. Aegean Sea	28. Marmara Sea
05. Balearic Islands	11.1. Western Sardinia 11.2. Eastern Sardinia	17. Northern Adriatic Sea	23. Crete	29. Black Sea
06. Northern Spain	12. Northern Tunisia	18. Southern Adriatic Sea	24. Northern Levant Sea	30. Azov Sea

Note: At its forty-fifth session in November 2022, the GFCM agreed to divide GSA 21 (Southern Ionian Sea) into three marine subareas. The subdivision of GSA 21 into GSAs 21.1, 21.2 and 21.3 will be applied in 2023.

Figure 1 :Map of the GFCM area of application (Subregions and GSA- Geographical Subareas). Note; for the purpose of this QSR most of the analysis presented, with the exception to overall indexes as included in SoMFi (FAO 2022) include only the Mediterranean Sea.

Sources of data.

35. The analysis of landings is based on information from two distinct sources that feed into the existing GFCM regional databases on capture fisheries production. The first one provides data on annual catch by species and FAO subdivision reported by Mediterranean and Black Sea countries through the FAO/GFCM STATLANT 37A questionnaire to FAO and the GFCM (FAO, 2020b). The STATLANT questionnaire was developed by the FAO Coordinating Working Party on Fishery Statistics and is annually sent out by the Organization on behalf of the GFCM to relevant national authorities; it covers the time series from 1970 to 2020. The second source of information is the national data officially submitted to the GFCM by its contracting parties and cooperating non-contracting parties (CPCs) in line with GFCM binding recommendations, mainly through the Data Collection Reference Framework (DCRF); these data cover the 2018–2020 time series.

36. Data used for the analysis of F and SSB are mainly based on information available in stock assessment forms (SAFs) as well as the GFCM capture production online database (both available in the GFCM webpage: http://www.fao.org/gfcm). Stocks assessments carried out from 2008 to 2020 were compiled, and the most recent stock assessment for each stock was used in the analysis. Only those stocks validated by the SAC at the time of preparation of this analysis have been included in the analysis, with reference year 2020. Information from these sources has also been complemented with information publicly available, including from the European Union Scientific, Technical and Economic Committee for Fisheries (STECF) website (https://stecf.jrc.ec.europa.eu). SAFs include data on fisheries (e.g., fishing gear, fleet), and historical trends on catches, biological parameters of growth and maturity, as well as the set of reference points used and results obtained (i.e., F, SSB etc.). They also include information on the stock assessment methods used within the study area, the indicators of stock status and the set of established reference points. Since 2019, the numeric outputs of the assessments are also stored in the stock assessment results (STAR) framework, which was designed to facilitate more integrated analyses of assessment results.

Reference points

37. FAO (1997) and Fletcher et al., (2002) define a fishery reference point as "a benchmark against which to assess the performance of management in achieving an operational objective". The reference points are crucial elements for assessing stock status and provision advice for fisheries management (GFCM, 2014a). In general, the reference points serve to compare the current value of estimated indicators with the target ones, which allows quantify how far or near the estimated indicator from the desirable situation. When possible the quality assessment on the different indicators on the status of exploited population of fish has been carried out in relation to reference points as validated by the SAC.

Fishing mortality (F) (EO3CI7)

38. The fishing mortality reference point conceptually preferred by most RFMOs, including the GFCM, is FMSY, as the value of F expected to produce the long-term maximum sustainable yield. FMSY can be estimated from analytical models with a variety of approaches, either based on model assumptions or through simulations analyzing the long-term sustainability of the stock under different fishing mortality. When FMSY is not available, a proxy that is considered similar can be used. The SAC uses mainly two different proxies for FMSY, one is F0.1, defined as the fishing mortality at which the slope of the Yield per Recruit (YPR) curve is 10 percent of its slope at the origin (FAO, 2014). Another proxy is based on exploitation rate (the rate between fishing mortality and total mortality E=F/Z), for which a value of 0.4 (E0.4) has been shown to provide an approximation of maximum sustainable yields for small pelagic species worldwide. F0.1 can be estimated for a wider number of stocks and is considered a conservative proxy for FMSY, and is widely used in the context of the GFCM, especially for demersal stocks. E0.4 is on the other hand used for small pelagics when no robust analytical estimate of FMSY or F0.1 can be obtained (GFCM, 2016). For the purpose of this work, F0.1 and E0.4 are considered adequate proxies for FMSY and therefore all information presented compares current F with any of the three reference points indistinctly and in general terms called FMSY.

39. Current F is estimated by the stock-assessment and using the associated reference points the exploitation ratio (F/FMSY) is estimated and used to determine the stock status. This indicator measures how far or near is the examined stock from its target level, i.e. the associated reference point (Table 1). The indicators of current fishing mortality used herein are: i) terminal fishing mortality (i.e. the fishing mortality estimated in the last year of the time series used for an assessment) for small pelagic stocks and demersal

stocks assessed with forward assessment methods and ii) the average fishing mortality over the last three years for demersal stocks assessed with backward methods. Special attention has been given to priority stocks agreed upon by the GFCM.

Spawning Stock Biomass (SSB) (EO3CI9)

40. Biomass reference points are nearly always based on SSB, which is one of the most important stock status indicators and the primary indicator for the reproductive capacity of the stock. Achieving or maintaining good environmental status requires that SSB values are equal to or above SSBMSY (the level capable of producing maximum sustainable yield). While MSY reference points (or proxies) for the indicator on fishing mortality (EO3CI7) exist for most of the stocks assessed, validated biomass reference points only exist for a few stocks. In the absence of validated MSY reference points, the WGSA often carry out an empirical analysis of the time series of biomass estimates coming from a validated stock assessment or in its absence from direct estimation based on surveys at sea. Two different approaches are currently used by the WGs:

1. For the case of demersal species, the 33rd and 66th percentiles of the SSB time series are used to classify current stock biomass as low, intermediate or high.

2. For the case of small pelagic species, and when the time series show a recovery after a historical low value, the lowest biomass from which a recovery is observed is considered BLOSS and a precautionary limit is estimated as 2*BLoss

41. In the presence of analytical reference points linked to MSY, i.e. BMSY, the ideal way to carry out a regional indicator-based stock assessment is to calculate an Exploitation Biomass Ratio (EBR, i.e. relative biomass) for each stock as follows:

$$EBR = SSBcurrent / SSBMSY$$

42. In the absence of a validated reference point related to MSY one of the two options described above as reference points are used to estimate proxies for a limit and precautionary biomass reference points (i.e. BLIM = 33% or BLoss; BPA = 66% or 2 * BLOSS), and the overall status of the stock is described based on a traffic light approach in relation to the existing proxy reference points. Current biomass (SSBcur) of a stock can thus be categorised into low, intermediate and high with respect to BLIM and BPA as follows:

$$SSBcur \leq SSBLIM \rightarrow Low\ biomass$$

$$SSBLIM < SSBcur \leq SSBPA \rightarrow Intermediate\ biomass$$

$$SSBcur > SSBPA \rightarrow High\ biomass$$

43. This is generally done by species and management unit (i.e. a Geographical Sub-Area (GSA) or combinations of GSAs) but can also be aggregated at different levels e.g. for the whole region or sub-region or by functional group (e.g. small pelagics, demersal bony fish and crustaceans) thus allowing the exploration of temporal changes for different units (Table 1).

44. Although it continues to improve, scientific advice on the status of resources in relation to biomass is scarcer than advice with respect to fishing mortality. This difference is mainly due to a lack of biomass reference points, which in turn reflects an uncertainty in the absolute values of recruitment and biomass provided by some of the stock assessment models. In the reference year 2020, estimates of biomass values are available for a total of 67 Mediterranean stocks, of which only 14 have biomass reference points, and

very few are available for Black Sea stocks. For those stocks with reference points for biomass available, the current biomass of horned octopus, common sole, common cuttlefish and great Mediterranean scallop in GSAs 17–18 (northern and southern Adriatic Sea), axillary seabream in GSA 25 (Cyprus), European hake in GSAs 12–16 (central Mediterranean) and sardine and anchovy in GSA 9 (Ligurian Sea and northern Tyrrhenian Sea) were compared to the biomass at MSY (BMSY) reference point. For European hake in GSAs 17–18 (northern and southern Adriatic Sea), sardine and anchovy in GSA 7 (Gulf of Lion), the biomass BPA (precautionary reference point) and BLIM (limit reference point) were considered. The biomass of blackspot seabream in GSA 1 and 3 (northern and southern Alboran Sea) was compared using only Blim. Recently, B40% (the biomass corresponding to 40 percent of the unfished biomass) was used as a reference point for the spottail mantis squillid in GSA 17 (northern Adriatic Sea). In all cases, values above the reference point were considered high and those below the reference point considered low. For demersal stocks without reference points, biomass is classified as high, intermediate, or low by comparing the current estimate with the 66th and 33rd percentiles of the available time series of SSB. Consequently, while the number of stocks with estimated biomass reference points has increased since the last edition of SoMFi (FAO, 2020), most information is still derived from available time series, and emerging results should be considered as relative and pending a full quantitative analysis.

45. The terminology "within" or "outside" "biologically sustainable limits", agreed in the context of FAO (FAO, 2014), is used to describe stocks for which indicators (fishing mortality and/or stock biomass) are inside or outside the limits established by relevant reference points.

46. Whenever possible, information has been aggregated to provide a subregional and regional outline of the status of resources, using indicators agreed upon in the GFCM framework for the provision of advice. Fishing activity in 2020 was affected by the COVID-19 pandemic, which resulted in stock status and fishing mortality being subject to the impacts of fishing pressure fluctuations.

Stock assessment methods

47. The status of a stock is ideally based on a validated stock assessment model, whose inputs include total landings, from which indicators of stock status (e.g., biomass, fishing mortality, recruitment) are obtained, and reference points are agreed for the chosen indicators. When possible, analytical stock assessment models that incorporate both fishery-dependent (e.g., catches or total landings) and independent information (e.g. surveys) are used, although surveys alone are used for some stocks. Different stock assessment models are used in the GFCM area of application, including variations of virtual population models (from pseudo-cohort based models, such as VIT, to tuned versions, such as extended survivor analysis – XSA), statistical catch at age analysis (e.g. state-space assessment model – SAM and assessment for all models – a4a), integrated analysis methods (e.g. stock synthesis – SS3), biomass models (BioDyn, SpiCT, JABBA, two-stage biomass models, etc.) as well as data-limited approaches (e.g. LBSPR). Some stock assessment methods are only based on information from scientific surveys at sea (e.g. acoustic estimates of biomass).

48. When no analytical assessment model or reference points are validated by the SAC, advice can still be provided on a precautionary basis, in cases where there is evidence that the stock may be threatened (high fishing pressure, low biomass, habitat loss, etc.). When possible, advice on stock status should be based both on biomass and on fishing pressure, using indicators and reference points for both quantities.

49. Concerning the spatial analysis, the stock assessment is often conducted by management units based on the mentioned GSAs (Figure 1). This method does not ensure that the whole stock is assessed, since

stocks may cover several different management units. In some cases, when there is scientific evidence of a stock spreading through different GSAs, as well as information on species from different GSAs, existing information is combined across GSAs. This is then defined as a "joint stock assessment of a shared stock".

3. Drivers, Pressures, State, Impact, Response (DPSIR)

50. The DPSIR framework can be applied to specific fisheries segments and sectors, for example artisanal fisheries in certain countries or specific GSA for instance. Yet this requires further adaptation to former concepts, as the drivers and pressures differ within the same country and surely across segments, target species and gear type. In a single country assessment of artisanal fisheries, the socio-economic factors of the fishery are identified as the driver, while in other cases they identified as the pressure. Other ecological stressors such as pollution, climate change, over-exploitation, hydrological modification, habitat destruction, and invasion of non-indigenous species can also play a leading cause of marine ecosystem degradation impacting fish abundance and reducing the fisheries yields and are identified as drivers. Therefore, applying the DPSIR framework to Mediterranean Sea fisheries is not technically sound nor practical, due to the multi-gear fisheries, the diversity of the priority species, the competition of non-indigenous species and the physical and operational characteristics of the fleet and gear used.

4. Good environmental status (GES) / alternative assessment

i. Spatial and temporal coverage of advice on stock status

51. The number of non-deprecated validated stocks increased progressively between 2006 and 2020, peaking in 2020 with 99 in total; of these, since 2018, more than 75 percent were carried out in the terminal year (i.e. less than 25 percent of the assessments used are more than one year old) (Table 3), reflecting an improvement in spatial and temporal coverage. The percentage of catch assessed by the Scientific Advisory Committee on Fisheries (SAC) and the Working Group on the Black Sea (WGBS) reached 53 percent in 2015 (Figure 2), fluctuating between 30 to 50 percent since then, mostly due to the percentage of catch of key Black Sea small pelagic species, e.g. Black Sea anchovy (Engraulis encrasicolus ponticus) and sprat (Sprattus sprattus), whose landings are around 200 000 tonnes and 64 000 tonnes in 2021, respectively. Pending the finalization of a benchmark process, the last validated assessment for Black Sea anchovy was carried out in 2017, and therefore this assessment is considered deprecated in 2020, causing the percentage of catch assessed to fall below 30 percent. The number of stocks for which advice was provided on a qualitative (precautionary) basis remained around 25 percent since the reference year 2018 (Figure 2), while the percentage of the catch assessed on a qualitative basis decreased from 14 percent to 8 percent over the same period. Status and trends of priority species

Table 3 :Number of validated and non-deprecated stock assessments available per year, 2003–2020

Year	Validated assessments	Non-deprecated assessments
2003	1	1
2006	17	18
2007	27	32
2008	32	46
2009	28	47
2010	37	57
2011	25	59
2012	35	65
2013	29	66
2014	25	67
2015	38	60
2016	57	70
2017	56	79
2018	50	84
2019	71	95
2020	79	99

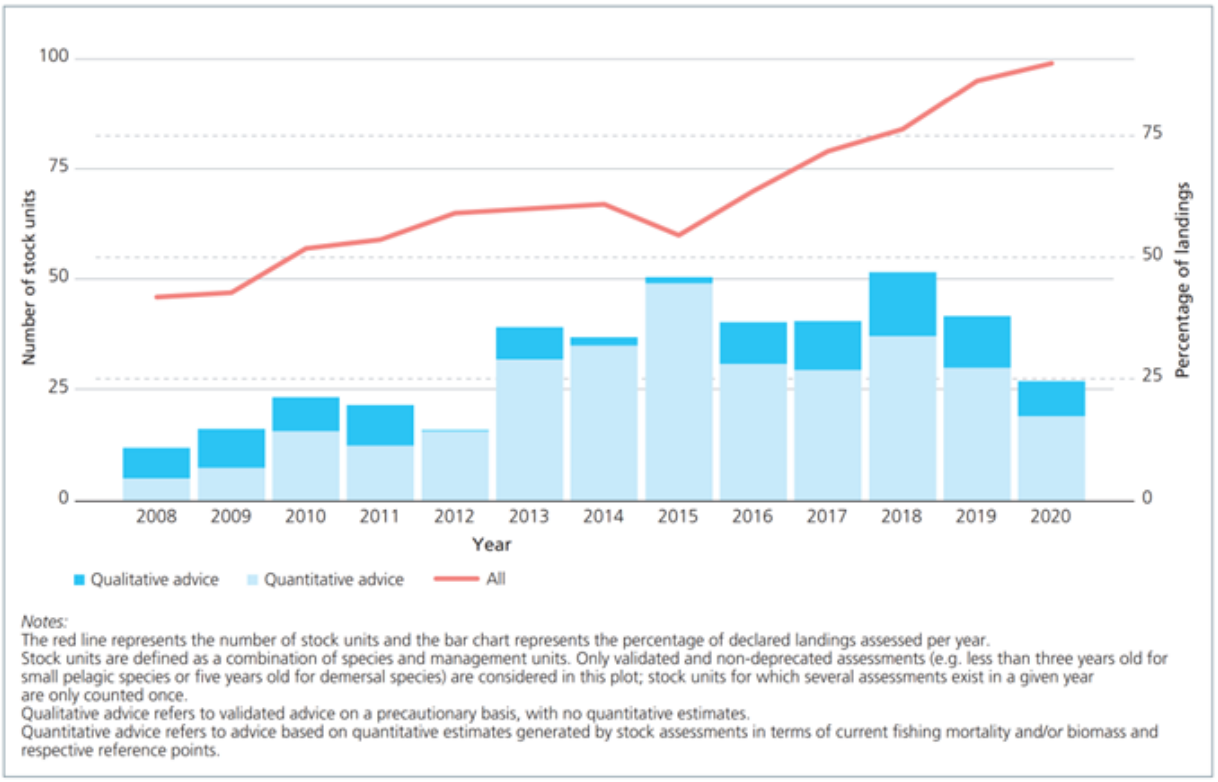


Figure 2 : Number of stock units and percentage of declared landings assessed per year, 2008–2020, with an indication of the quality of the advice emerging from the assessments.

52. The overall increase in validated assessments compared to 2018 is consistent across all Mediterranean subregions. The central Mediterranean showed the steepest increase in the number of validated assessments since 2018, although the degree of increase varied among geographical subareas (GSAs) in the subregion (Figure 3). Coverage increased visibly in the central Mediterranean in GSAs 12–16 (northern Tunisia, Gulf of Hammamet, Gulf of Gabès, Malta and southern Sicily) and GSA 20 (eastern Ionian Sea) and in the Adriatic Sea (GSAs 17–18). Furthermore, GSA 5 (Balearic Islands), GSA 9 (Ligurian Sea and northern Tyrrhenian Sea), GSA 19 (western Ionian Sea), GSA 21 (southern Ionian Sea), GSA 24 (northern Levant Sea) and GSA 25 (Cyprus) increased by one stock assessed between 2018 and 2020, bridging the gap between areas with low and high assessment coverage in the GFCM area of application (Figure 3).

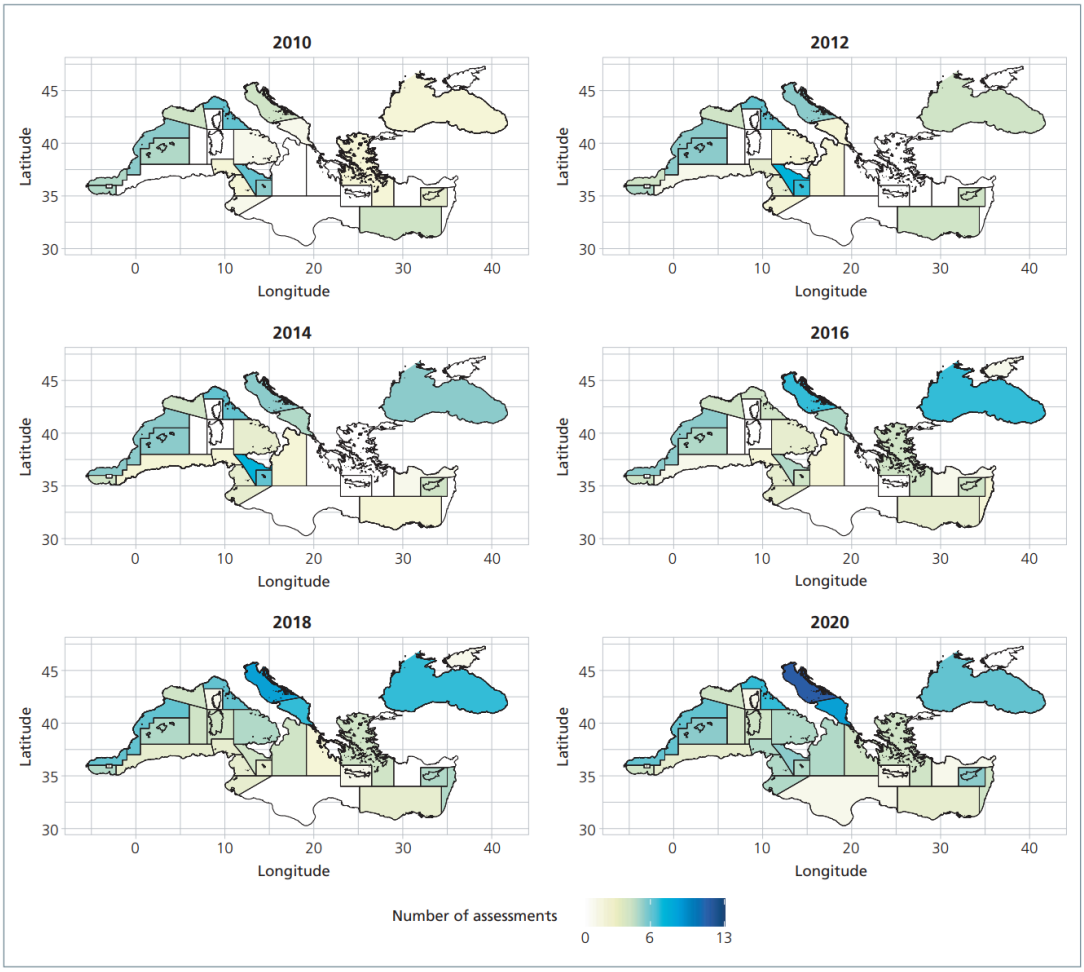


Figure 3 :Number of validated stock assessments per year by GFCM subregion, 2008–2020

ii. Overview of the status of stocks in the Mediterranean and the Black Sea

53. Biomass reference points are not commonly available for assessed stocks. Therefore, the percentage of stocks fished outside biologically sustainable limits is mainly estimated by comparing the level of fishing mortality to the fishing mortality reference point. Most stocks for which validated assessments are available continue to be fished outside biologically sustainable limits (Figure 4). Nevertheless, there has been a 10 percent decrease in the percentage of stocks in overexploitation since 2012; in 2020, 73 percent of stocks were found to be outside biologically sustainable limits (the same value as in 2016 and the lowest since 2009) (Figure 4).

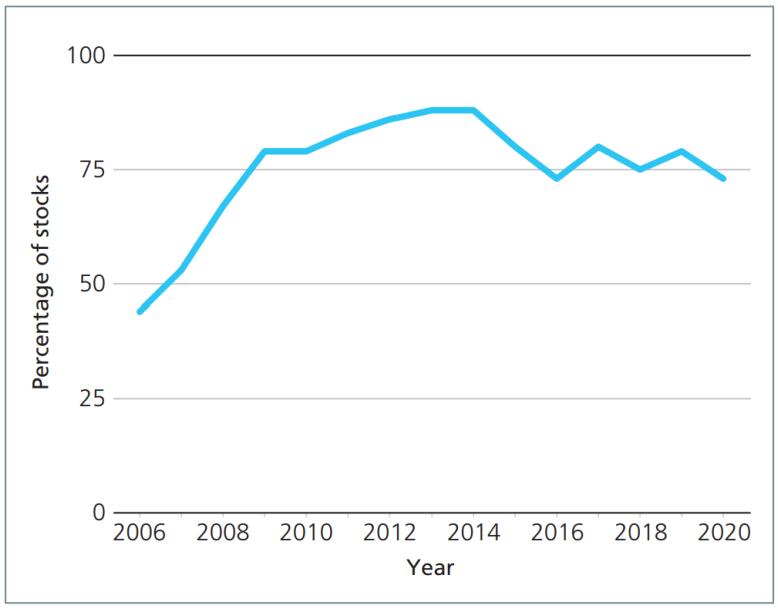


Figure 4 :Percentage of stocks in overexploitation in the GFCM area of application, 2008–2020

iii. Remarks on the quality of assessments and future developments

54. The coverage of assessments in the Mediterranean has been increasing steadily over the past decade, reaching an historical maximum in this edition. The introduction of the benchmarking process in 2017 has improved the quality of assessments, owing to greater scrutiny of the input data and the adoption of more stringent standards. This development has resulted in a quarter of assessments failing to meet the full standards to provide quantitative advice in the reference year 2020. In parallel, significant work has been, and is being, carried out towards assessing data-limited stocks, as well as towards data collection, and this progress has resulted in an increase in coverage in the eastern Mediterranean in particular. Nevertheless, efforts are still required to extend assessment coverage to all GSAs and to advance towards full quantitative coverage. Currently, most stock assessments are based on time series that are shorter than the available historical knowledge on fishing activities, and in some cases, even shorter than the complete time series of landings available. With a view to making future improvements in the quality of assessments, the importance of considering all auxiliary historical information available on stocks and fisheries through an analysis of the added value provided by timelines. This approach, together with the benchmarking process, may help to improve the estimates of reference points and increase the number of stocks with quantitative advice on biomass, while also ensuring full comparability between years in the future. Finally, when taking a regional view of the analysis of trends in fishing mortality, the method currently employed rests on the use of a time series constructed per stock from fishing mortality estimates for the reference year of each year's assessment. With the aim of improving the picture of overexploitation over time at the regional level by ensuring that all available information is considered.

5. Key findings per CI

Fishing mortality

55. Overall, fishing mortality for all species and management units combined continues to be more than twice the target (Table 4). However, there has been a 21 percent reduction in this ratio since 2012 (when it was nearly three times higher), with the current ratio (F/FMSY = 2.25) representing the lowest of the time series. The highest average values of exploitation ratios are found for blue and red shrimp (Aristeus antennatus), followed by European hake and some small pelagic species, e.g., sardine (Table 4). Most of the highest values (i.e., fishing mortality higher than four times the value of FMSY), have been found in the western Mediterranean for European hake, blue and red shrimp and red mullet.

56. European hake deserves a special mention as this species has experienced a very large reduction in F/FMSY throughout the Mediterranean Sea, excluding the western Mediterranean where some very high ratios are still found (Table 4). In detail, the average overexploitation ratio (F/FMSY) of European hake in the region has declined by 39 percent since 2013, although it remains on average four times higher than the reference point.

57. A total of 16 stocks show exploitation rates below FMSY (although some show very low biomass and are still considered to be overexploited); of these, the majority are found in the western Mediterranean, while the central Mediterranean hosts only one stock with exploitation rates below the reference point (Table 4).

Table 4 :Exploitation ratio (F/FMSY) by priority species and geographical subarea, with average value per species

	Western Mediterranean											Central Mediterranean								Adriatic Sea		Eastern Mediterranean						Black Sea			Mean
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	19	20	21	17	18	22	23	24	25	26	27	28	29	30	
Demersal species																															
European hake	4.41		8.08		4.41	4.41	4.41	3.12	3.12	3.12	3.12	1.24	1.24	1.24	1.24	1.24	1.86	1.86		2.47	2.47					4.13					3.01
Red mullet	6.48					5.06	1.37		0.71	0.78		3.13	3.13	3.13	1.95	0.81	1.87	1.10			0.96			1.42				1.27		2.21
Deep-water rose shrimp	1.73		2.14	2.14	2.07	1.60			1.22	1.22	1.22	1.34	1.34	1.34	1.34	1.34	2.30			2.30	2.30										1.68
Giant red shrimp									2.14	2.14	2.14						1.38				1.38										1.84
Blue and red shrimp	1.64	1.68			3.61	6.20			4.60	4.60	4.60																				3.85
Norway lobster					0.69	3.80			0.50											1.58	1.58										1.63
Surmullet					1.97																					3.70					2.84
Blackspot seabream	0.78		0.78																												0.78
Turbot																													1.75		1.75
Common cuttlefish																				1.17											1.17
Common sole																				0.81											0.81
Spottail mantis shrimp																	2.54			0.79	2.54										1.95
Purple dye murex																				1.08											1.08
Horned octopus																					0.77										0.77
Sand steenbras																											2.07				2.07
Axillary seabream																									1.05						1.05
Common pandora																									0.45		1.90				1.17
Great Mediterranean scallop																				2.86											2.86
Comber																									0.67						0.67
Goldband goatfish																															
Whiting																															
Rapa whelk																															
Peregrine shrimp																										2.85					2.85
Caramote prawn																				2.11											2.11
Brushtooth lizardfish																											1.87				1.87
Bogue																									1.20						1.20
Small pelagic species																															
Sardine			2.77			1.72	0.05		0.19							2.78				4.49	4.49										2.36
European anchovy							0.05		0.35							1.55				1.51	1.51										0.99
European sprat																													0.9		0.90
Mediterranean horse mackerel																															
Round sardinella																															
Species of regional importance																															
Common dolphinfish																															
Species of conservation concern																															
Piked dogfish																															
European eel																															
Red coral																															

Note: Ratios of stocks in sustainable exploitation are highlighted in green.

58. Overall, all priority species with enough available information show an improved situation concerning fishing pressure in comparison with the previous edition of The State of Mediterranean and Black Sea Fisheries (FAO, 2020). Blue and red shrimp presents an exception, with average fishing pressure having steadily increased since 2015, as well as deep-water rose shrimp, which shows an overall stable fishing pressure at nearly twice the level considered sustainable (Figure 5). In contrast, European anchovy shows a general decreasing trend in its exploitation ratio, driven also by low exploitation ratios in the western Mediterranean. The exploitation ratios of sardine across the Mediterranean are characterized by high variation and the average exploitation ratio steadily increased until 2018, at which point the trend reversed, again owing to low exploitation ratios of stocks in the western Mediterranean (Figure 5). Among demersal species, previously observed decreasing trends in exploitation ratios for European hake and common sole (Figure 5) are showing a reduction of 75 percent since 2011, and European hake showing a reduction of 39 percent and 62 percent, respectively, since 2013. The fishing mortality of deep-water rose shrimp has increased by 3.5 percent since its lowest level in 2017 (F/FMSY = 1.71). Likewise, blue and red shrimp continues to show a rather significant increase in its exploitation ratio (F/FMSY = 4) since a lowest recorded value in 2015 (F/FMSY below 2), coupled with increasing catch. Finally, the catch of Norway lobster has decreased since 2017, as has the exploitation ratio (34 percent decrease) (Figure 5).

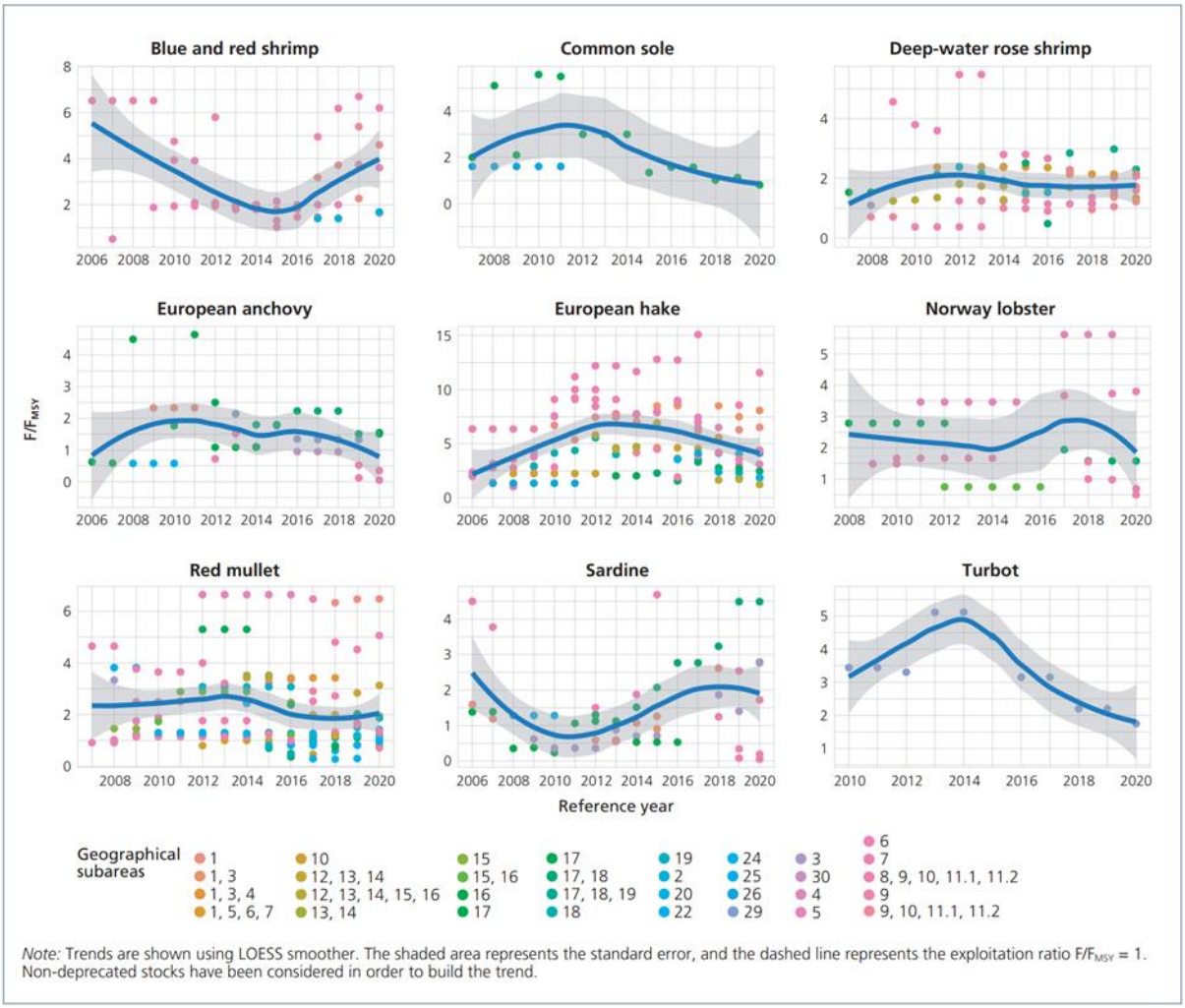


Figure 5 : Trends in the exploitation ratios (F/FMSY) of select priority species until 2020

Spawning stock biomass

59. The overall analysis of the current biomass levels of Mediterranean stocks reveals a prevalence of stocks with relatively low biomass, although the percentage remains lower than the sum of the intermediate and high biomass percentages (Figure 6; Table 5).

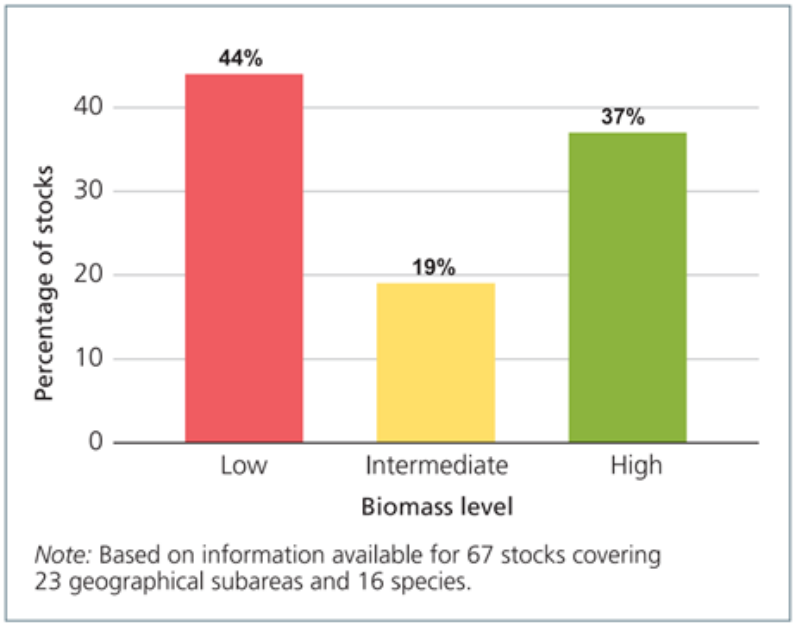
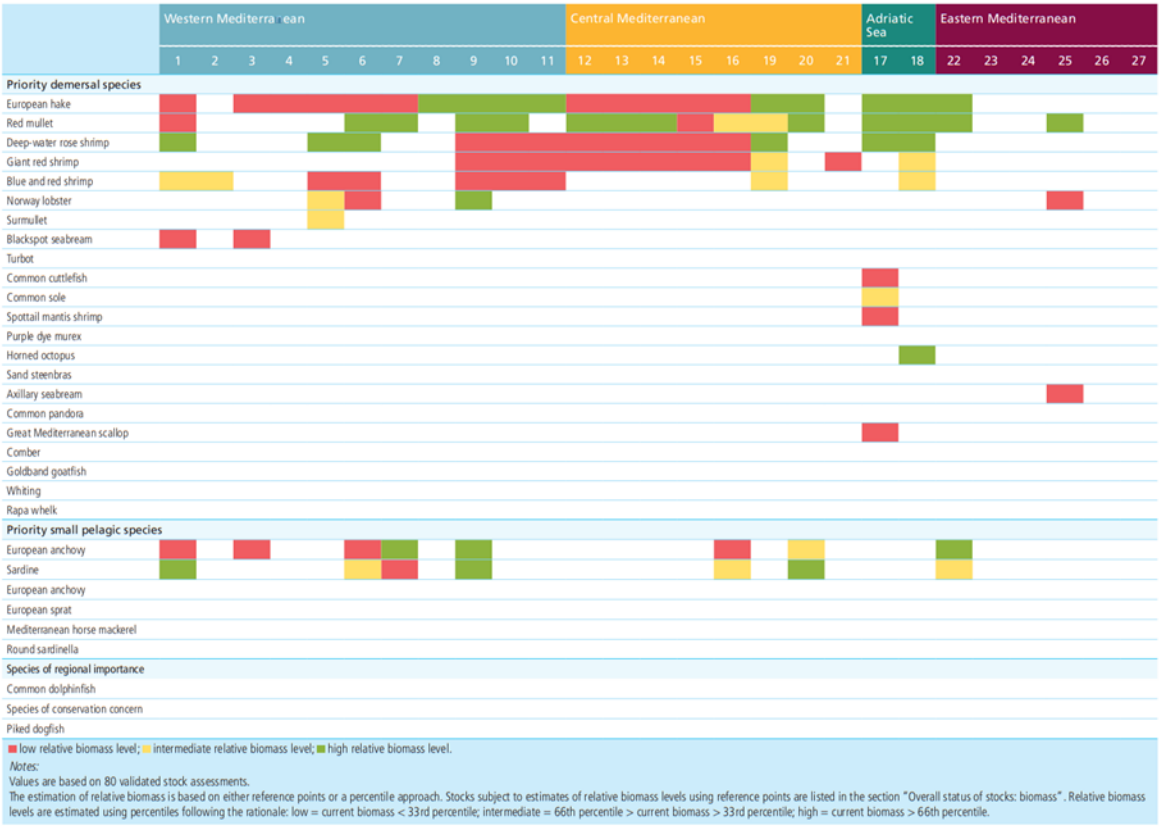


Figure 6 :. Percentage of Mediterranean stocks at low, intermediate, and high relative biomass levels

Table 5 :Relative biomass level by priority species and geographical subarea in the Mediterranean Sea



60. A comparative analysis with the reference year 2018, based on the 45 stocks for which biomass information was available in both years, reveals that most stocks remain in the same biomass level group (30 stocks), while 10 stocks have dropped to lower levels of biomass and 5 stocks have improved (Figure 7). Notably, the relative biomass of deep-water rose shrimp in GSAs 9–11, as well as of European hake in GSAs12–16 appears to have declined in these two years, while European hake in GSAs 8–11, deep-water rose shrimp in GSA 5 and common sole in GSA 17 show improvements, among other stocks (Figure 7). Considering the comparable stocks between the current edition and previous edition (FAO, 2020), the decrease in stocks with a high relative level of biomass was partially compensated for by improvements in other stocks to the intermediate category.

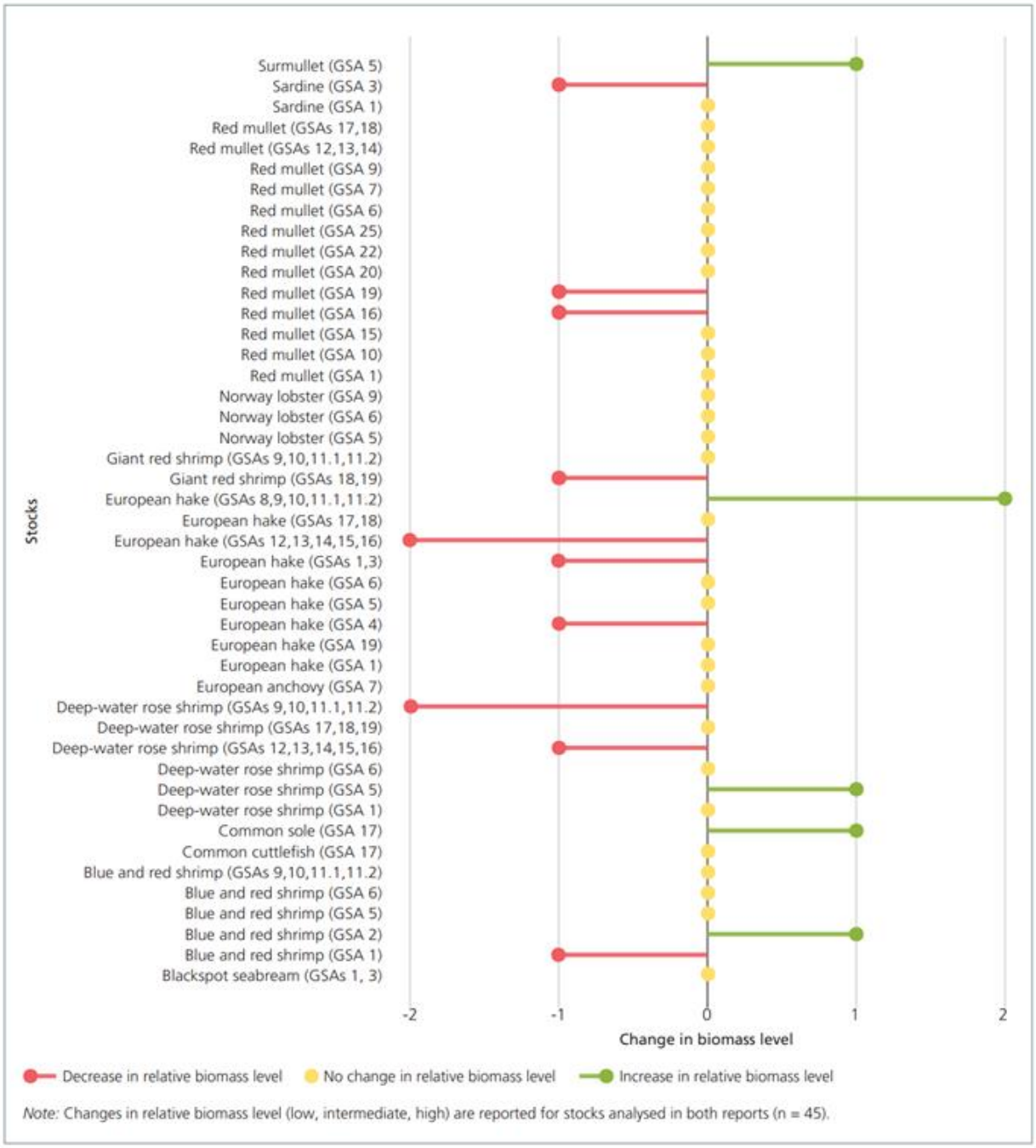
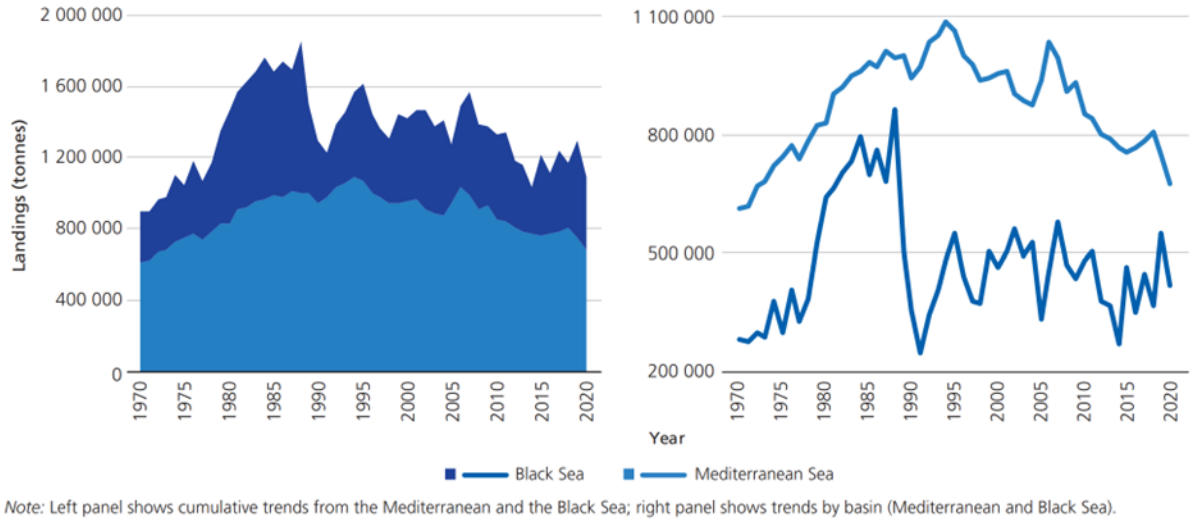


Figure 7 :Comparison of biomass levels between the previous and current edition of The State of Mediterranean and Black Sea Fisheries

Total landings

61. Overall, total capture fisheries production in the Mediterranean and the Black Sea increased irregularly from 1 000 000 tonnes in 1970 to almost 1 788 000 tonnes in 1988. Total landings remained relatively stable during most of the 1980s, before declining abruptly in 1990 and 1991, largely due to the collapse of pelagic fisheries in the Black Sea. In the Mediterranean Sea, landings continued to increase until 1994,

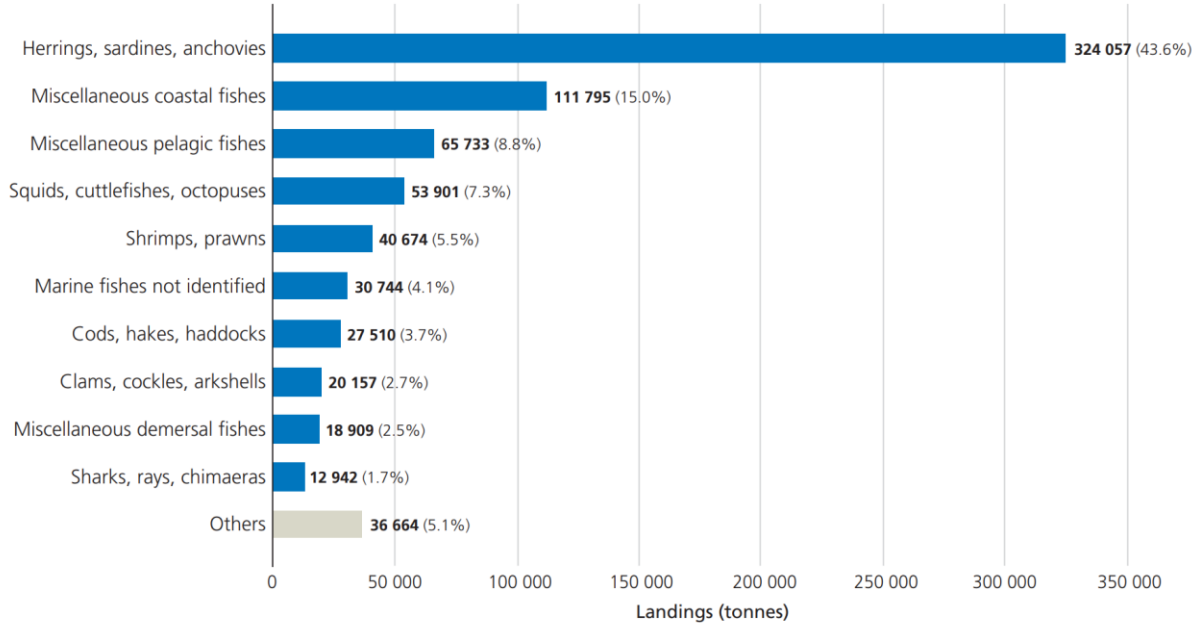
reaching 1 087 100 tonnes, and subsequently declined irregularly to 760 000 tonnes in 2015. Over the following three years, production reached 805 700 tonnes in 2018, but it notably decreased to 674 500 tonnes in 2020 (Figure8). The drop in catch in 2020 was also likely exacerbated by COVID-19 restrictions, which not only included temporal closures on fishing activity, but also led to a decrease in demand linked to the nearly total shutdown of tourism and impacts on trade (GFCM, 2020a, 2020b). The combined average landings for the Mediterranean and the Black Sea over the 2018–2020 period amount to 1 189 200 tonnes (743 100 tonnes in the Mediterranean, accounting for 62.5 percent of the total, and 446 100 tonnes in the Black Sea). This value is slightly higher (1.1 percent) than the catch from the 2016–2018 period, with a decrease of 5.7 percent in the Mediterranean Sea and an increase of 15 percent in the Black Sea.



Note: Left panel shows cumulative trends from the Mediterranean and the Black Sea; right panel shows trends by basin (Mediterranean and Black Sea).

Figure 8 : Total landings in the Mediterranean and the Black Sea per year, 1970–2020

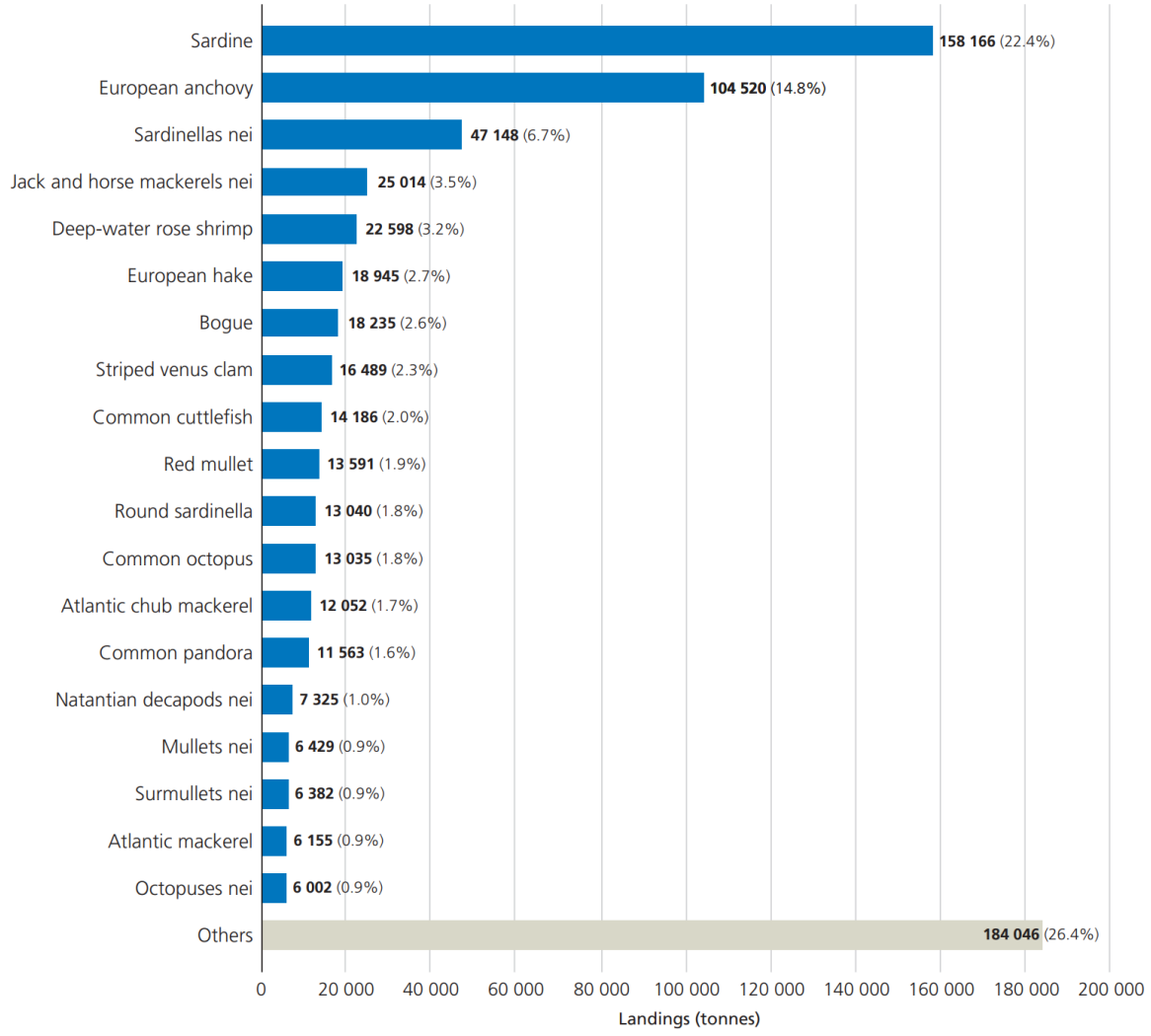
62. The main species groups comprising Mediterranean Sea landings show very similar percentages in calculations for the whole GFCM area of application, except for “Clams, cockles, arkshells” (2.7 percent in the Mediterranean Sea and 4.6 percent in the whole GFCM area of application) and “Abalones, winkles, conchs”, which are not present in Mediterranean Sea catches. Nonetheless, the contribution of small pelagic species (i.e. the combination of “Herrings, sardines, anchovies” and “Miscellaneous pelagic fishes”) is moderately lower (52.4 percent of Mediterranean landings versus 63.4 percent of total GFCM area of application landings). A slight increase is noted for “Miscellaneous coastal fishes” (5.1 percent more than in the whole GFCM area of application) and “Squids, cuttlefishes, octopuses” (2.8 percent more) (Figure 9).



Note: Percentages indicate relative contributions of each main species group to total landings in the Mediterranean Sea, 2018–2020 average.

Figure 9 : Total landings by main species group in the Mediterranean Sea, 2018–2020 average

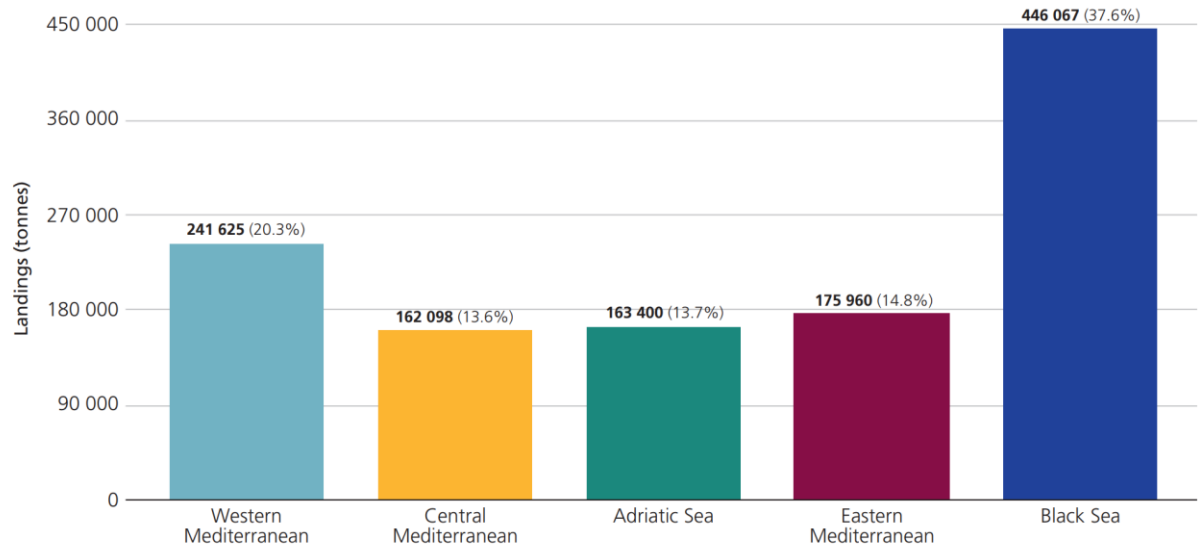
63. In the Mediterranean basin, sardine (14.8 percent) and European anchovy (22.4 percent) continue to be the most prevalent species, together accounting for 37.2 percent of total landings (in line with data from the period 2016–2018, which also showed a large diversity of species significantly contributing to the catch, i.e. 17 species accounting for at least 1 percent of total landings) (Figure 10).



Note: Percentages indicate relative contributions of main species to total landings in the Mediterranean Sea, 2018–2020 average.

Figure 10 : Total landings by main species contributing at least 1 percent of the total catch in the Mediterranean Sea, 2018–2020 average.

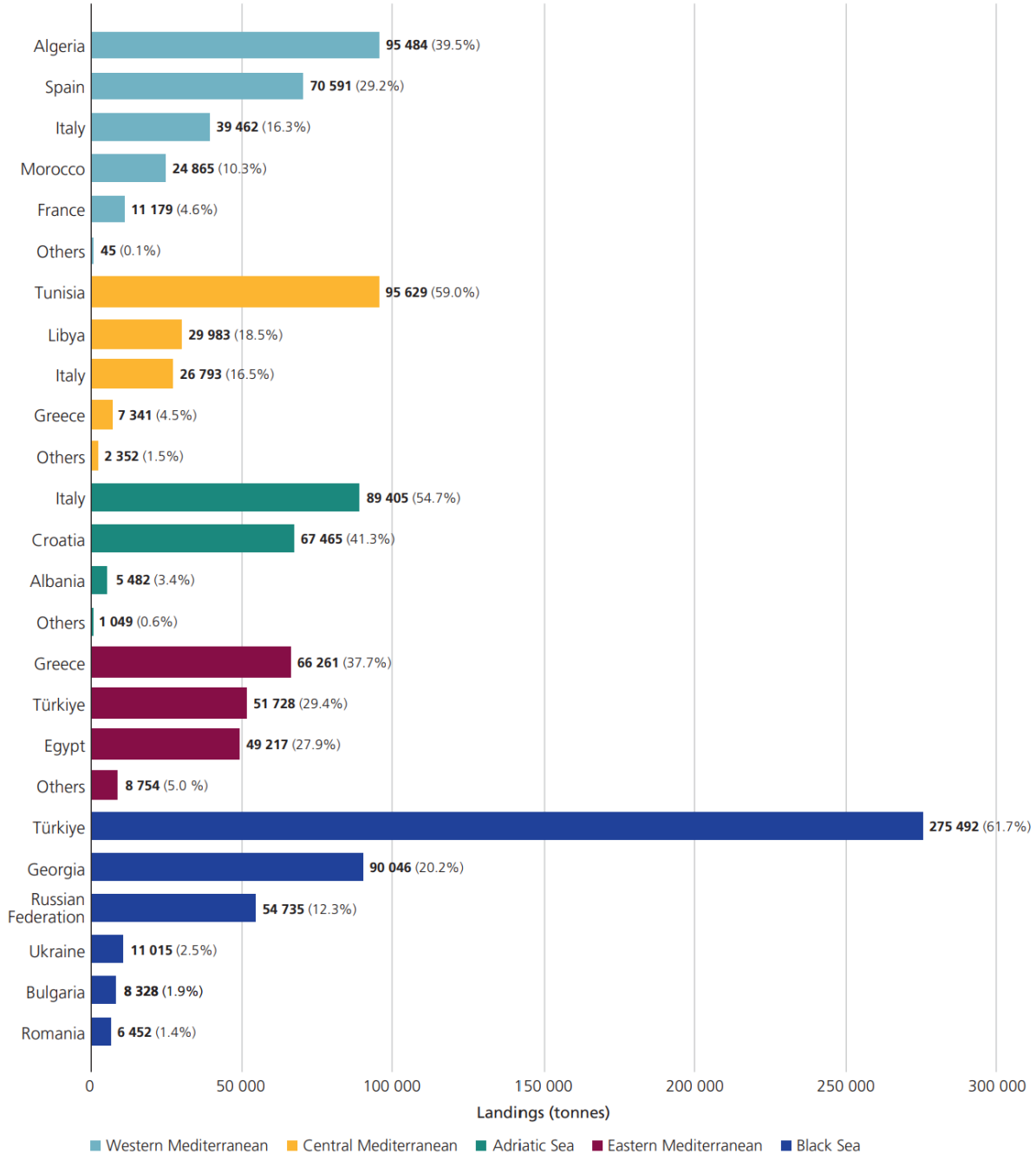
64. The breakdown of capture fisheries production by GFCM subregion is here reproduced on the basis of the available landing data as transmitted by countries to the GFCM through the DCRF (Task I "Global figures of national fisheries", Task II.1 "Landing data" [operating vessels by GSA and fleet segment] and Task II.2 "Catch data per species" [total catch by GSA and fleet segment for main commercial species]) for the period 2018–2020. After submission, the data were then extrapolated to produce the total catch statistics for the Mediterranean and the Black Sea that are stored in the STATLANT 37A database (FAO, 2020b). The results of the analysis show that the western Mediterranean continues to be the most productive Mediterranean subregion (20.3 percent of total landings, with 241 600 tonnes). The eastern Mediterranean, the Adriatic Sea and the central Mediterranean have almost the same share of landings, accounting for 14.8 percent (176 000 tonnes), 13.7 percent (163 400 tonnes) and 13.6 percent (162 100 tonnes), respectively. The Black Sea has the highest capture fisheries production in weight overall (37.5 percent of the total, with 446 100 tonnes) (Figure 11).



Note: Percentages indicate relative contributions of GFCM subregions to total landings in the GFCM area of application, 2018–2020 average.

Figure 11 : Total landings by GFCM subregion, 2018–2020 average

65. In general, the dynamics reported in The State of the Mediterranean and Black Sea Fisheries 2020 (FAO, 2020a) continue to hold true, with the large majority of the catch in each subregion being declared by countries belonging to this subregion and only a few cases of fleets from countries outside the subregion contributing a small percentage of its total catch (Figure 12). In the western Mediterranean, Algeria (39.5 percent) brings in the largest share of landings by weight, followed by Spain (29.2 percent) and Italy (16.3 percent). The three together account for 85 percent of all landings in the subregion, with Morocco, France and "Others" contributing the remaining 10.3 percent, 4.6 percent and 0.1 percent, respectively. In the Adriatic Sea, landings by weight are dominated by Italy (54.7 percent) and Croatia (41.3 percent), which account for 96 percent of all landings in the subregion, followed by Albania (3.4 percent) and "Others" (0.6 percent). In the central Mediterranean, landings by weight are dominated by Tunisia (59 percent), followed by Libya (18.5 percent) and Italy (16.5 percent), the three of which account for 94 percent of all landings in the subregion, followed by Greece (4.5 percent) and "Others" (1.5 percent). In the eastern Mediterranean, landings by weight are mostly split between Greece (37.7 percent), Türkiye (29.4 percent) and Egypt (27.9 percent), which together account for 95.1 percent of all landings in the subregion, followed by "Others" (5 percent).

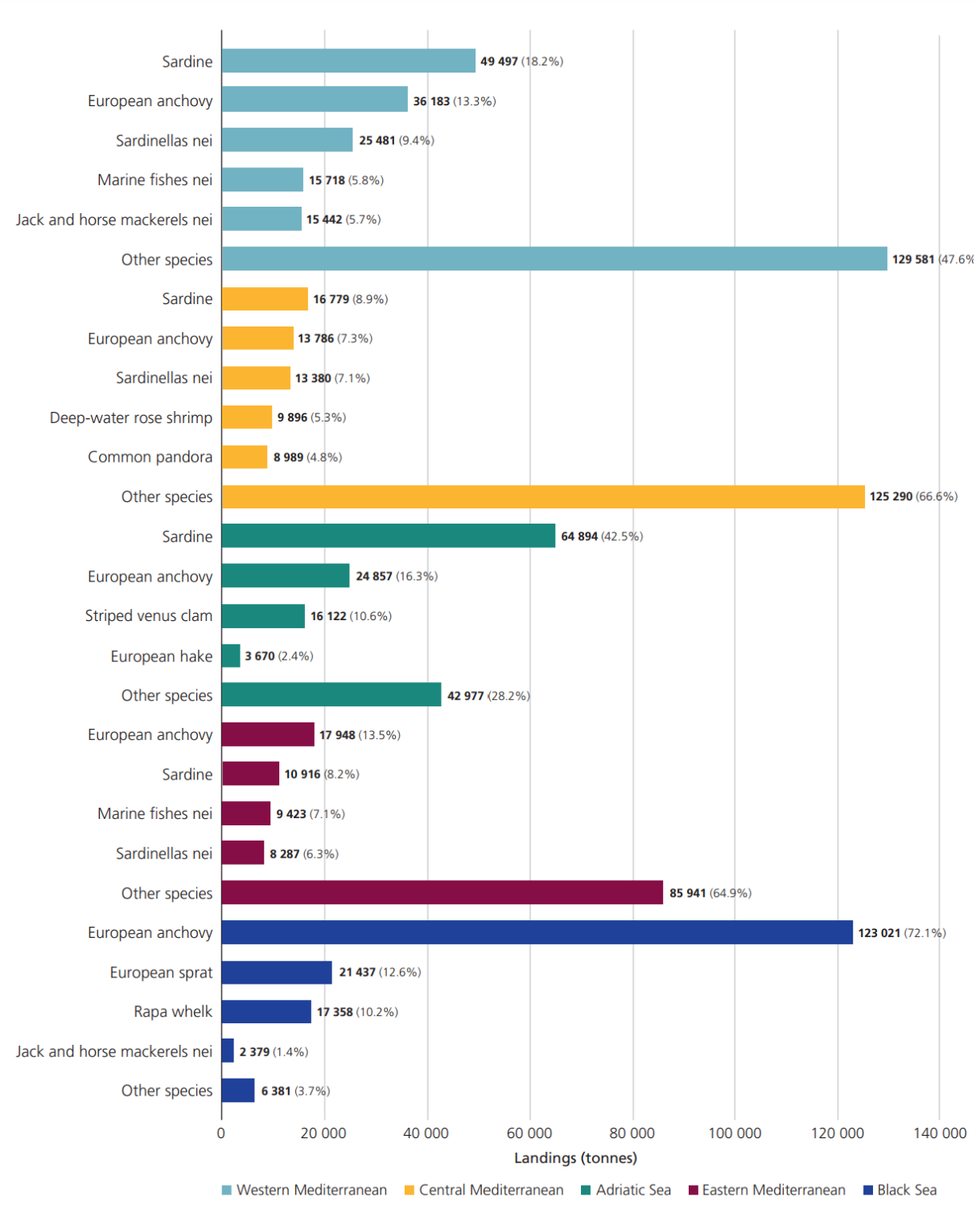


Note: Percentages indicate relative contributions of countries to total landings in their respective GFCM subregions, 2018–2020 average.

Figure 12 : Average annual landings by country in each GFCM subregion, 2018–2020

66. In terms of species contributions to the landings of the different subregions (Figure 31), sardine is the main captured species in the Adriatic Sea (64 900 tonnes, 42.5 percent), the western Mediterranean (49 500 tonnes, 18.2 percent) and the central Mediterranean (16 800 tonnes, 8.9 percent), while European anchovy is the predominant species in the eastern Mediterranean (17 900 tonnes, 13.5 percent) and the Black Sea (123 000 tonnes, 72.1 percent). In the western Mediterranean, European anchovy (36 200 tonnes, 13.3 percent) and sardinellas nei (Sardinella spp.) (25 500 tonnes; 9.4 percent) are the second and the third main

species, whereas the remaining 59.1 percent (160 700 tonnes) corresponds to a large number of species contributing to the catch in this region (Figure 13). In the central Mediterranean, other prevalent species are European anchovy (13 800 tonnes; 7.3 percent), sardinellas nei (13 400 tonnes; 7.1 percent), deep-water rose shrimp (9 900 tonnes; 5.3 percent) and common pandora (9 000 tonnes; 4.8 percent). The sum of all other species, each of which contributes less than 5 percent of the total, constitutes the remaining 66.6 percent, at 125 300 tonnes (Figure 13). In the Adriatic Sea, four species, namely sardine (64 900 tonnes; 42.5 percent), European anchovy (24 900 tonnes; 16.3 percent), striped venus clam (16 100 tonnes; 10.6 percent) and European hake (3 700 tonnes; 2.4 percent), account for 71.8 percent of the landings. The sum of all other species, each of which contributes less than 5 percent of the total, constitutes the remaining 28.2 percent, at 43 000 tonnes (Figure 13). In the eastern Mediterranean, sardine (10 900 tonnes; 8.2 percent), marine fishes nei (9 400 tonnes; 7.1 percent) and sardinellas nei (8 300 tonnes; 6.3 percent) are the other prevalent species, with all others together accounting for the remaining 64.9 percent with 85 900 tonnes (Figure 13).



Note: Percentages indicate relative contributions of main landed species to total landings in each respective GFCM subregion, 2018–2020 average.

Figure 13 : Average annual landings of the main landed species in each GFCM subregion, 2018–2020

67. Overall, the diversity of species in the catch is much higher in the central, eastern and western Mediterranean (roughly 44 species). In comparison, the lowest number of species that can be summed

together to account for 90 percent of the total catch in the Adriatic and the Black Sea is smaller (slightly less than 20 for the Adriatic and less than five for the Black Sea) (Figure 14)

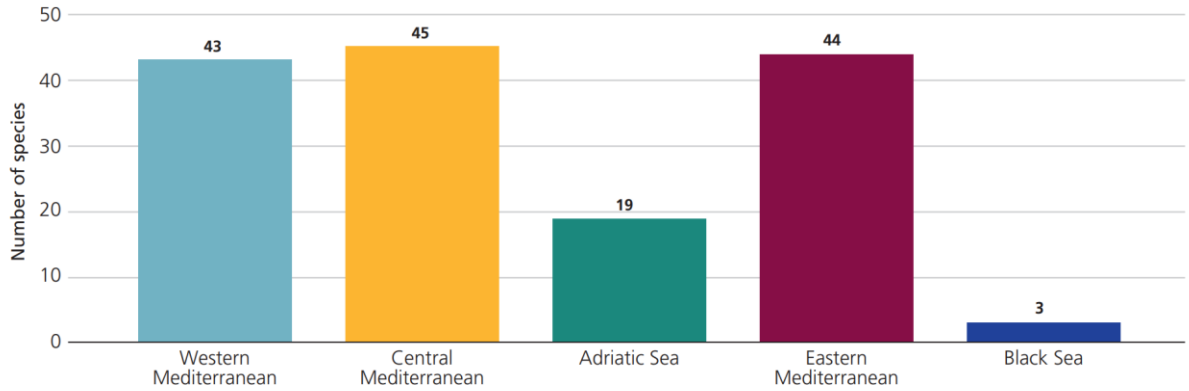


Figure 14 : Number of species or species groups accounting for 90 percent of the total catch of each GFCM subregion, 2018–2020

6. Measures and actions required to achieve GES

68. The percentage of stocks with validated assessments has continued to increase since the last edition of The State of Mediterranean and Black Sea Fisheries (FAO, 2020a), particularly in the western Mediterranean, as has the geographical coverage of assessments. Nevertheless, efforts are still required to extend assessment coverage to all GSAs, while the decrease observed in the percentage of landings assessed highlights the need to ensure the regular assessment of key stocks with high landings.

69. Results show that since 2012, the average fishery exploitation ratio in the Mediterranean has consistently decreased. However, in the Mediterranean Sea, the percentage of stocks with low biomass remains high, although lower than the cumulative percentage of stocks with intermediate and high biomass. Low biomass in an overall scenario of decreasing exploitation rates may be explained by either a delay in the response of stock biomass to declining fishing pressure or a reduction in fishing pressure insufficient to promote a recovery of biomass, or both. In the reference year 2020, 87 percent of the stocks assessed in the GFCM area of application were of medium- or long-lived demersal species, which may require several years to show an observable response in biomass.

70. A number of stocks of priority species (e.g., European hake in the Strait of Sicily, and common sole in the Adriatic Sea) have consistently shown improvements in their exploitation ratios over recent years. In contrast, the decrease in the exploitation ratio observed for a number of hake stocks (e.g. in the Tyrrhenian Sea and the Strait of Sicily) is not matched so closely by corresponding increases in biomass; this disparity not only reflects the different biological characteristics of the two species, but also serves as an important reminder that early signs of reversing the trend in fishing mortality should not be taken as a guarantee of sustainability (Figure 15).

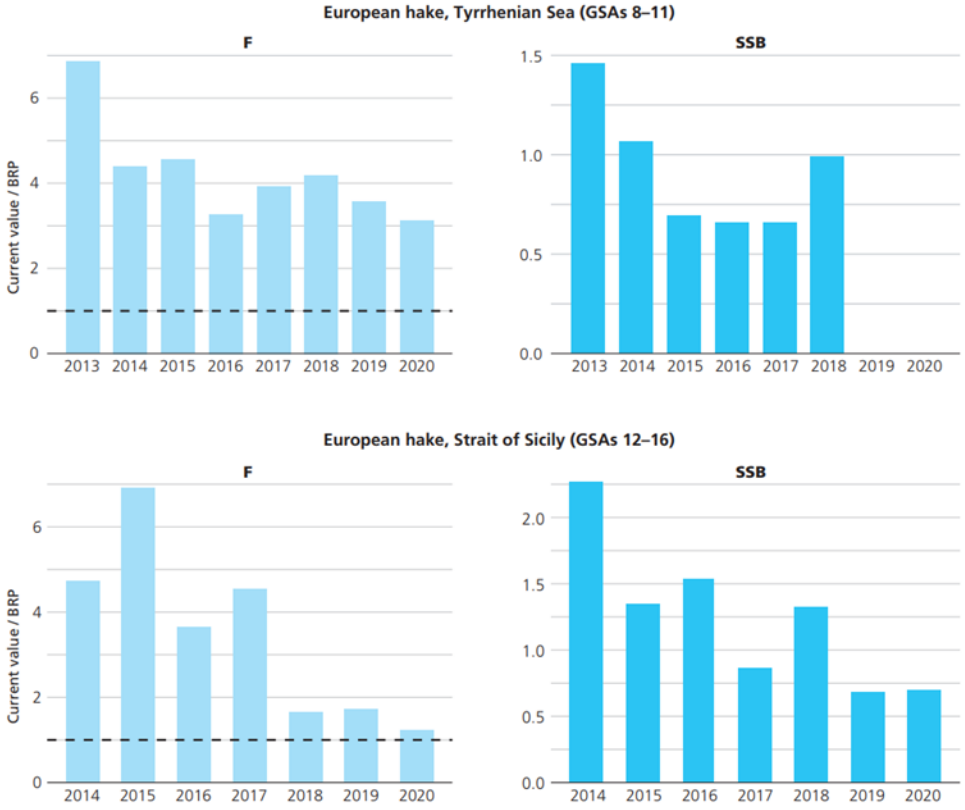


Figure 15 : Annual progression in biomass (B/BPA) (right) and exploitation ratio (F/FMSY) (left) for European hake in the Tyrrhenian Sea and the Strait of Sicily

71. Conversely, blue and red shrimp shows an increasing trend in exploitation ratio, though this observation rests on an overall lack of assessments, as only seven stocks have been assessed to date, mostly in the western Mediterranean. Along with a lack of information on the origin of catch in the eastern-central Mediterranean, this shortcoming has hindered a fully informed implementation of the multiannual management plans and management measures in place in the Ionian Sea, Levant Sea and the Strait of Sicily, respectively.

72. The positive signs for fishing pressure provided by this overall analysis are most likely related to the adoption of a significant number of national and regional management measures in the recent past, underpinned by an increase in the quality and coverage of scientific advice, particularly on priority species and key fisheries. Measures consist of adopting multiannual management plans that include effort control measures and/or the introduction of quota-based management for some species, as well as the establishment of fisheries restricted areas (FRAs) and spatio-temporal limits to protect essential habitats and life stages. Nevertheless, the slow recovery in biomass of certain key stocks and the need to honour the objectives of the GFCM 2030 Strategy for sustainable fisheries and aquaculture in the Mediterranean and the Black Sea point to the importance of continuing to implement an effective and generalized management framework, including through strengthening existing management plans and defining new ones, as well as ensuring the effective implementation of those in place. Since 2018, research programmes have been incorporated, through specific recommendations, into the GFCM workplans for the Mediterranean. Research

programmes share the common aim of improving the scientific basis for the provision of advice on existing and potential management measures through dedicated actions towards increasing the quality and quantity of information on resources and addressing previously identified knowledge gaps and shortcomings in relevant scientific or technical advice. More recently, research programmes have been complemented by pilot studies and projects. Pilot studies and projects rest on similar principles, i.e. conducting scientific data collection and analysis on specific themes, fisheries or species, but have a more limited geographical and temporal scope. In all cases, the core principle is to take full advantage of ongoing research at the country level by providing experts with a regional platform for coordination, knowledge exchange and capacity building enriched by new activities developed based on common methodologies. The data collected through these initiatives are generally aimed at providing the scientific basis for determining the most appropriate management measures for selected fisheries.

7. Knowledge gaps

Spawning stock biomass and fishing mortality

73. The advice on the status of Mediterranean commercially exploited stocks, as provided by the GFCM SAC have largely improved in recent years, as recognized by Mediterranean riparian states. However, the level of information differs between species and geographical areas, with information concentrating on a few stocks and lacking or being fragmented in other commercially exploited stocks.

74. The correct estimation of fishing mortality requires a precise understanding of riparian states' fishing capacity. Due to the specificities of the Mediterranean fleet, composed of a large majority of small scale polyvalent vessels, information on fishing capacity is sometimes incomplete or inaccurate. Furthermore the estimation of robust reference points for fishing mortality requires the use of long time series and the incorporation of environmental and ecosystem variables, as well as the design of robust methods that can integrate information from different sources.

75. Even if stock assessments and advice are now available for an increasing number of stocks, the number of stocks for which MSY-based SSB reference points (or its proxy) exist is still very limited. Thus, it is not possible to establish reproductive potential levels relative to MSY, and the indication on current biomass levels is often based (as in this assessment) on an empirical analysis of often short time series.

76. The update and adoption of new specific binding recommendations related to the mandatory requirements for data collection and submission, underpinned by the GFCM Data Collection Reference Framework (DCRF) has greatly improved the quality of the data in support of advice, in line with the need expressed by riparian states. The GFCM 2030 strategy for sustainable fisheries and aquaculture in the Mediterranean and the Black Sea is also contributing in this endeavour through specific actions such as, for example, the execution of harmonized scientific surveys-at-sea.

Total landings

77. The correct estimation of total landings requires a precise knowledge of the fishing activities carried out by the active fishing fleet operating in the Mediterranean. The specificities of the Mediterranean fleet, composed by a large majority of small scale polyvalent vessels, as well as the existing variety of landing sites, and the different capacity of Mediterranean riparian states to accurately monitor the landings in such sites, make difficult an accurate estimation of landings in the region.

78. Furthermore, Illegal, Unregulated or Unreported (IUU) fishing activities in the area also affects the estimates.

79. Ultimately, the ideal indicator for the production of fisheries as well as the removal of organisms due to fisheries should be total catch, but information on discards is still fragmented, despite large efforts are being deployed for the implementation of discards monitoring programmes across the region under the hat of the GFCM 2030 strategy for sustainable fisheries and aquaculture in the Mediterranean and the Black Sea

80. The GFCM has proposed a number of solutions to improve the quality of the estimation of total catch. On one hand, the GFCM DCRF provides the technical elements to improve and harmonize the collection of information on fisheries throughout the Mediterranean and on the other the GFCM 2030 strategy provides an effective instrument to guide an increase in the collection of sound information (e.g. bycatch monitoring programme and a survey of small-scale fisheries), as well as the implementation of dedicated actions to assess and curb IUU fishing, which are expected to largely improve the quality of the estimates for this indicator.

81. Care needs to be taken in interpreting trends in the indicator for total landings because variations in total catch/landing may be a result of various factors, including the state of the stock, changes over time in the selectivity of fishing gear, changes in the species targeted by fishing activities, as well as inconsistencies in the reporting.

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