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Foreword

The Mediterranean and the Black Sea are home to some of the world's oldest fishing traditions, yet they also face some of the most complex sustainability challenges. For years, the region experienced an accelerating decline in fish stocks and rising exploitation rates, threatening both ecosystems and the communities that depend on them. Today, however, this edition of *The State of Mediterranean and Black Sea Fisheries* confirms significant advances towards sustainable and productive aquatic food systems: overfishing continues to decrease, the biomass of commercial stocks is growing, and aquaculture is significantly contributing to increase overall aquatic food production.

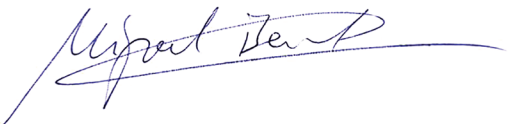
The positive trends on fish stocks are particularly striking when considered alongside the stability of wild-capture landings. Over the past ten years, fisheries in the region have consistently supplied around one million tonnes of seafood annually. In other words, while providing markets and communities with roughly the same quantity of fish, the gradual shift towards more responsible fishing practices, improved monitoring and control, and the collective commitment of GFCM members to sustainability have enabled biomass at sea to begin recovering towards maximum sustainable levels.

At the same time, the sector as a whole is delivering more food than ever before. Total aquatic food production has increased by 25 percent over the last decade, driven by the rapid expansion of aquaculture. This growth not only provides more local food in the region but also supports communities by creating additional jobs and revenues.

Despite the encouraging developments achieved, significant challenges remain. Progress towards sustainability and the implementation of effective measures are uneven across the region, with many stocks still falling short of the biomass levels required to achieve sustainability and some fleet segments bearing a heavier burden in adapting to the necessary adjustments. Meanwhile, the rapid growth of aquaculture brings new sustainability considerations related to environmental management, biosecurity and spatial planning. Across both fisheries and aquaculture, broader human-driven pressures, including pollution and the accelerating impacts of climate change, continue to amplify ecosystem vulnerabilities and place additional stress on coastal communities.

This edition of *The State of Mediterranean and Black Sea Fisheries* reaffirms the importance of placing fisheries and aquaculture at the core of broader regional and global agendas. In the context of the United Nations Sustainable Development Goals, FAO's Four Betters and the vision of Blue Transformation, the GFCM continues to demonstrate how the fisheries and aquaculture sector can bridge global ambitions with local action. The policy commitments underpinning the GFCM's work and its strategic framework position regional collaboration as the cornerstone for ensuring long-term sustainability.

The results outlined in this report should inspire renewed commitments. The progress achieved so far must be safeguarded through continued dedication to evidence-based, efficient management, diligent implementation of agreed measures, targeted and effective capacity development, and broadened cooperation across sectors and borders. Together, by strengthening our actions and reinforcing the link between sound science and collaborative governance, we can consolidate recovery and secure sustainable fisheries and aquaculture for generations to come.



Miguel Bernal
Executive Secretary
General Fisheries Commission
for the Mediterranean

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Abbreviations

ABMT	area-based management tool
ACBS	Scientific Advisory Committee for the Black Sea (formerly Working Group on the Black Sea [GFCM])
ADC	Aquaculture Demonstration Centre
ALDFG	abandoned, lost or otherwise discarded fishing gear
AVL	authorized vessel list
AZA	allocated zone for aquaculture
B	biomass
B_{lim}	limit biomass
B_{MSY}	biomass relative to maximum sustainable yield
B_{PA}	biomass precautionary reference point
CBD	Convention on Biological Diversity
COVID-19	Coronavirus disease 2019
CPCs	contracting parties and cooperating non-contracting parties (GFCM)
DCRF	Data Collection Reference Framework (GFCM)
EMFAF	European Maritime, Fisheries and Aquaculture Fund
EFH	essential fish habitat
EUMOFA	European Market Observatory for fisheries and aquaculture products
F	fishing mortality
F_{MSY}	fishing mortality producing maximum sustainable yield
FAD	fish aggregating device
FAO	Food and Agriculture Organization of the United Nations
FRA	fisheries restricted area
FTE	full-time equivalent
GCF	gross cash flow
GDP	gross domestic product
GEF	Global Environment Facility
GFCM	General Fisheries Commission for the Mediterranean
GFCM 2030 Strategy	GFCM 2030 Strategy for sustainable fisheries and aquaculture in the Mediterranean and the Black Sea
GSA	geographical subarea (GFCM)
GT	gross tonnage
GVA	gross value added
HCR	harvest control rule
IMO	International Maritime Organization
LEK	local ecological knowledge
LOA	length overall
MCS	monitoring, control and surveillance
MCRS	minimum conservation reference size
MSE	management strategy evaluation
MSP	marine spatial planning
MSY	maximum sustainable yield
NIS	non-indigenous species

OECM	other effective area-based conservation measures
RPOA-IUU	Regional Plan of Action to Combat Illegal, Unreported and Unregulated Fishing in the GFCM Area of Application
RPOA-SSF	Regional Plan of Action for Small-Scale Fisheries in the Mediterranean and the Black Sea
SAC	Scientific Advisory Committee on Fisheries (GFCM)
SAF	stock assessment form
SIPAM	Information System for the Promotion of Aquaculture in the Mediterranean (GFCM)
SSF	small-scale fisheries
STAR	stock assessment results
STB	standardized trade balance
SSF Forum	Small-Scale Fishers' Forum
TAG	Technical Advisory Group
VME	vulnerable marine ecosystem
VPA	virtual population analysis
WGBS	Working Group on the Black Sea

Executive summary

This report is the sixth edition of the biennial series *The State of Mediterranean and Black Sea Fisheries* prepared by the General Fisheries Commission for the Mediterranean (GFCM) of the Food and Agriculture Organization of the United Nations (FAO). It provides an up-to-date overview of the status, trends and governance of fisheries and aquaculture in the Mediterranean and Black Sea region. The report begins with a general overview of aquatic food production in the region, followed by chapters on capture fisheries production (Chapter 1), bycatch (Chapter 2), status of fisheries resources (Chapter 3), aquaculture production (Chapter 4), socioeconomic characteristics of the fisheries and aquaculture sector (Chapter 5), fisheries management (Chapter 6) and aquaculture management (Chapter 7). Data and information are presented mostly up to 2023. The information contained in this report is based on data officially submitted by GFCM contracting parties and cooperating non-contracting parties (CPCs), in accordance with GFCM binding decisions, through established data submission tools. Where necessary, estimates derived from the best available data from other sources or standard methodologies were used. All analyses were validated by the Scientific Advisory Committee on Fisheries, the Working Group on the Black Sea and the Scientific Advisory Committee on Aquaculture.

Aquatic food systems in the Mediterranean and the Black Sea in a nutshell

Mediterranean and Black Sea marine capture fisheries and marine and brackish water aquaculture produce a combined 2 057 700 tonnes of aquatic food, injecting USD 21.5 billion into the regional economy and generating 1.17 million jobs along the value chain. The operating fishing fleet responsible for capture fisheries production consists of 83 075 vessels. Aquaculture production relies on more than 35 000 enterprises active across the region.

Fisheries and aquaculture harvest-related jobs account for 26 percent of total sector employment, while pre-harvest and post-harvest operations represent 9 percent and 65 percent, respectively. Women occupy 29 percent of all jobs along the value chain, while young people represent less than 7 percent of the workforce in half of the countries in the region.

The share of marine and brackish water aquaculture production has steadily increased since 2019, reaching 940 000 tonnes in 2023 and accounting for more than 45 percent of total aquatic food production in the region. In contrast, capture fisheries production has remained relatively stable, fluctuating around 1 million tonnes per year over the past decade and reaching 1 117 700 tonnes in 2023.

From 2013 to 2023, the GFCM accelerated the adoption of regional and national measures, including 11 management plans and 11 fisheries restricted areas. It also strengthened regional capacity development and guidance towards sustainable aquaculture growth through Technical Advisory Groups and a network of Aquaculture Demonstration Centres. As a result, average overall fishing pressure declined by 50 percent across the region, the percentage of sustainable stocks doubled and biomass increased by 25 percent. At the same time, increased investment, enhanced technologies, improved feeds and stronger legal frameworks allowed total aquaculture production to double, driven in particular by increased finfish production.

Aquaculture is dominated by finfish production, representing around 86 percent of total marine and brackish water production. This number jumps to over 98 percent in North Africa and western Asia, mainly driven by brackish water production systems in Egypt and marine cage farming in Türkiye. In contrast, production in the European Union is more diversified, with finfish accounting for roughly 67 percent of production and Mediterranean mussel, Japanese carpet shell and oysters making up the remaining third.

Türkiye remains the largest aquatic food producer, dominating in both capture fisheries and marine and brackish water aquaculture. Italy is the second largest producer in capture fisheries and the fourth in aquaculture, while Egypt is the second largest producer in aquaculture and ninth in capture fisheries.

Looking ahead, fisheries and aquaculture in the region face significant challenges. Currently, 52 percent of stocks are still considered overexploited and hot spots of discards and incidental catch of vulnerable species threaten the environmental sustainability of capture fisheries. Profitability is uneven, and in some segments marginal, while the workforce is ageing and the percentage of women and young people remains limited. Meanwhile, aquaculture attracts greater interest among younger generations, but faces considerable challenges linked to climate change, impacts of pathogens, non-indigenous species, and complex and heterogeneous legal frameworks that limit investments and potential growth. Overall, aquatic food production in the region will need to increase between 14 percent and 29 percent by 2050 to meet the demands of population growth and ensure that all countries reach at least current global average per capita consumption.

MAIN FINDINGS BY CHAPTER

Capture fisheries production

Annual landings for the Mediterranean and the Black Sea amounted to 1 117 700 tonnes in 2023, representing a 13 percent increase from 2022. However, when averaging over two years, landings are similar to those reported in the 2023 edition of *The State of Mediterranean and Black Sea Fisheries* (1 053 100 tonnes in 2022–2023 versus 1 056 600 in 2020–2021), highlighting the relative stability of landings in recent years and their short-term fluctuations, particularly in the Black Sea. The operating fishing fleet consists of 83 075 vessels, with a total capacity of 908 100 gross tonnage and exceeding 35 years of age on average. More than 6 000 fishing vessels, accounting for 7.3 percent of the total fleet, are authorized to operate under the GFCM's fishery management plans, management measures and fisheries restricted areas. When averaged over 2022–2023, Türkiye remains the leading country in terms of landings (330 700 tonnes, 31.4 percent of the total), fleet size (14 400 fishing vessels, 17.4 percent of the total) and fishing capacity in gross tonnage (156 200 gross tonnage, 17.2 percent of the total), with 61 percent of its fleet and 88.9 percent of its landings operating in, and coming from, the Black Sea. Italy operates 9 648 vessels (11.6 percent) and is the second country in terms of landings (112 500 tonnes, 10.7 percent) and gross tonnage (125 600 gross tonnage, 13.8 percent). Greece has a higher number of vessels than Italy (12 151 vessels, 14.6 percent) with a much lower gross tonnage (62 600 gross tonnage, 6.9 percent), highlighting the predominance of small-scale vessels in its fleet. The Mediterranean fleet (87 percent) makes up 60.5 percent of capture production, with the western Mediterranean accounting for the

second highest number of landings in the region (19.3 percent) and the eastern Mediterranean hosting the largest fleet (28.2 percent). Around 10 800 fishing vessels operate in the Black Sea (13 percent of the total fleet) and produce 39.5 percent of total landings. The "Small-scale vessels" group accounts for 81 percent of the total fleet (around 66 000 fishing vessels), contributes 13 percent of annual landings and is most prominent in the central and eastern Mediterranean. It is followed by the "Trawlers and beam trawlers" group (nearly 7 000 vessels, 8.6 percent), responsible for 17.4 percent of landings. The "Purse seiners and pelagic trawlers" group accounts for the largest share of landings in the region (63.1 percent of the total), reaching up to 84.4 percent in the Black Sea, despite representing only 5.2 percent of the total operating fleet. In all subregions, landings are highly dominated by small pelagic species. Black Sea catches (39.5 percent of the total) are largely composed of European anchovy, while western (19.3 percent of the total), central (14.5 percent of the total) and eastern (14.2 percent of the total) Mediterranean landings rely on a more diverse group of species. Adriatic Sea catches (12.5 percent of the total) are predominantly sardine. Regional landings remained steady overall, yet several countries have experienced marked declines in catches. For example, in Italy and Spain, catches fell by 9 percent and 11 percent, respectively, between 2020–2021 and 2022–2023, continuing the downward trend observed over the last decade. At the same time, fishing mortality of priority species covered by management plans and measures has decreased and biomass at sea is showing a positive trend. These results demonstrate the effectiveness of current management measures in rebuilding stocks and securing ecological sustainability. However, this progress also entails socioeconomic costs, including reduced production and increased economic pressure on certain fleets and communities.

Bycatch: discards and incidental catch of vulnerable species

Discards dynamics vary according to fishing gear type and subregional context, including factors such as market demand, local consumption, social conditions and regulatory frameworks. Bottom trawlers remain the main contributors to discards, often ranging between 20 and 40 percent, while purse seiners and longliners show consistently low levels. Small-scale fisheries are highly variable, with rates influenced by seasonality, fishing grounds and the increasing presence of non-indigenous species in some areas. Hot spots of incidental catches of elasmobranchs and sea turtles are found in the central and eastern Mediterranean and the Adriatic Sea, underscoring the need for spatially targeted, multitaxa mitigation measures. Interactions involving seabirds are more localized and mainly associated with longline fisheries, while cetacean incidental catch is largely concentrated in small-scale fisheries, particularly in the Black Sea. Over the past decade, GFCM-led initiatives such as MedSea4Fish and BlackSea4Fish, together with the adoption of standardized sampling protocols, have significantly expanded and improved data on discards and incidental catch across fleets and areas. Despite this progress, gaps and inconsistencies remain, underlining the need for stronger observer coverage, fisher engagement and integration of spatial–effort data to fully support science-based management. Data collected through monitoring programmes reveal potential hot spots of discards and vulnerable species interactions with fishing activities. While these patterns are not yet fully consolidated, they provide a growing evidence base that could inform the design of spatially and temporally targeted monitoring and mitigation measures under an ecosystem-based management approach.

Status of fishery resources

The number of active stock assessments enabling the estimation of overall stock status in the Mediterranean and the Black Sea has steadily increased from 45 stocks in 2008 to 120 stocks in 2023. In 2023, 67 stock assessments provided F/F_{MSY} estimates, with 51 also delivering reference points for biomass. In this year's edition, the percentage of overexploited stocks has dropped to 52 percent, the lowest level recorded in the time series. The current F/F_{MSY} ratio is estimated to range between 0.74 and 1.1, indicating a decrease in overexploitation rates of 48 percent to 64 percent since 2013. During the same period, the overall biomass of commercial species assessed has increased by 25 percent, marking a significant step forward towards achieving the targets of the GFCM 2030 Strategy for sustainable fisheries and aquaculture in the Mediterranean and the Black Sea (GFCM 2030 Strategy). Most priority

species show a notable reduction in fishing mortality, with consistent downward trends observed for red mullet and giant red shrimp. However, regional patterns vary, especially for species such as sardine and European hake. While biomass levels largely remain below target reference points, the reduction in fishing pressure is driving a marked upward trend in biomass. In 2023, European anchovy, deep-water rose shrimp and common sole were assessed as sustainably exploited across the region ($F/F_{MSY} < 1$ and $B/B_{MSY} > 1$). Most key stocks under management plans, technical or spatial measures – including European hake, giant red shrimp and deep-water rose shrimp in the Strait of Sicily; European hake and common sole in the Adriatic Sea; and turbot in the Black Sea – have achieved fishing mortality below F_{MSY}. These successes are reflected in clear biomass improvements, signaling effective stock rebuilding. Notable examples include a 42 percent reduction in fishing mortality and a 64 percent increase in biomass since 2019 for common sole in the Adriatic Sea, as well as an 86 percent reduction in fishing mortality and a 310 percent increase in biomass since 2013 for turbot in the Black Sea.

Aquaculture production

Aquaculture production in Mediterranean and Black Sea countries reached 2.97 million tonnes in 2023, generating USD 9.3 billion. Freshwater aquaculture continues to dominate, accounting for 58 percent of total production, mainly due to tilapia and mullet farming in Egypt. Marine aquaculture production expanded to 36 percent, while brackish water aquaculture contributed the remaining 6 percent. Marine and brackish water aquaculture in the Mediterranean and the Black Sea reached 940 000 tonnes in 2023, worth approximately USD 5.2 billion. Production remains highly concentrated, with nine countries accounting for over 95 percent of the total. Türkiye leads in terms of production with 43 percent (400 000 tonnes), followed by Egypt (16 percent, 147 000 tonnes) and Greece (15 percent, 139 000 tonnes). Italy is the largest mollusc producer, while Spain, Croatia, Malta and Tunisia contribute significant volumes through cage-based finfish and Atlantic bluefin tuna production. Gilthead seabream and European seabass are the main species reared, accounting for 34 percent and 30 percent of total production, respectively. Mediterranean mussel, rainbow trout and meagre together make up most of the remaining production. Diversification is gradually expanding, with growing interest in emerging species, such as greater amberjack, sole, sea cucumbers and macroalgae, as well as in restorative aquaculture using bivalves and macroalgae. Marine cage farming remains the backbone of production, accounting for 83 percent, distantly followed by suspension culture of bivalves. Innovative systems such as integrated multitrophic aquaculture, recirculating aquaculture systems and aquaponics are gaining ground as resilient and circular models. Around 90 percent of finfish hatcheries are concentrated in Egypt and western Asia, while 92 percent of mollusc hatcheries are located in Europe and crustacean farming remains marginal. As production volumes continue to grow, the aquaculture sector must also confront environmental pressures, including heatwaves, disease outbreaks and non-indigenous species, underscoring its vulnerability and urgent need for adaptation.

Socioeconomic characteristics of the fisheries and aquaculture sector

Fisheries

Marine capture fisheries generated USD 3.1 billion in first-sale revenue and contributed an estimated USD 8.05 billion to the wider economy, exhibiting relatively stable performance from 2020 onwards, following earlier declines. The sector supports 750 000 jobs along the value chain, including 197 000 people employed directly on board fishing vessels. Women represent only about 10 percent of jobs on board fishing vessels; however across the full value chain, they account for about 28 percent of all fisheries-related jobs, mainly in post-harvest and processing roles. Despite an overall positive gross cash flow across the regional fleet, industrial fleets show a notable contraction in short-term profitability, partly due to a 32 percent increase in energy costs, making them increasingly reliant on subsidies. In the Mediterranean, sardine, deep-water rose shrimp, European hake, European anchovy and common octopus dominate landings in terms of value. In the Black Sea, European anchovy alone accounts for 54 percent of total landing value.

Aquaculture

Marine and brackish water aquaculture generated USD 5.2 billion in 2023, a 63 percent increase since 2013, with Türkiye, Greece and Egypt accounting for two-thirds of total revenue. The sector directly employed over 113 000 people in 2023, mainly in North Africa and western Asia; women represent 17 percent of the workforce and 14 percent of workers are under 25. The contribution of farmed aquatic foods to the apparent consumption of aquatic foods in the GFCM area of application varies widely among countries, ranging from 82 percent in Egypt, where it plays a key role in food security, to as low as 0.6 percent in Morocco. Aquaculture production in the region relies on more than 35 000 enterprises of varying sizes and operational characteristics, ranging from small-scale shellfish producers to large finfish farms, with notable differences between countries. While aquaculture's contribution to national economies, in terms of gross domestic product, remains modest in most countries, it plays a more prominent economic role in specific contexts, particularly in Malta (1.2 percent), Greece (0.3 percent) and Tunisia (0.23 percent).

Fisheries management

Over the past decade, the GFCM has significantly and progressively shaped the landscape of fisheries management in the region through the adoption of 11 adaptive multiannual management plans and 11 fisheries restricted areas. These plans represent the most tangible expression of the current state of fisheries management in the region, reflecting a dynamic and evolving approach that aligns with the objectives of the GFCM 2030 Strategy. Since the 2023 edition of *The State of Mediterranean and Black Sea Fisheries*, significant progress has been made: one new multiannual management plan was adopted, three management plans entered their long-term phase, and three plans were revised based on improved data. New management measures were also introduced for emerging stocks and fisheries in the region. Advances in the spatial management of fisheries include the establishment of a new fisheries restricted area (FRA) in the southern Adriatic Sea. This FRA aims to protect vulnerable marine ecosystems and essential fish habitats for crustacean species. Scientific evidence increasingly demonstrates the effectiveness of FRAs as robust tools for restoring marine biodiversity in the Mediterranean Sea. By limiting fishing activities, FRAs contribute to the recovery of fish stocks, the conservation of benthic habitats and the overall resilience of marine ecosystems. They also provide countries with a valuable tool to support the achievement of global biodiversity targets, including those outlined in the Kunming-Montreal Global Biodiversity Framework. In line with the Regional Plan of Action for Small-Scale Fisheries in the Mediterranean and the Black Sea, small-scale fisheries (SSF) management is advancing through a two-pronged approach, which on the one hand ensures enhanced data collection to integrate SSF effort and catches into stock assessments and, on the other, promotes participatory, ecosystem-based management involving fishers and stakeholders. Countries are making substantial strides in collecting data, with notable improvements in data quality and reporting on social indicators. In 2025, 19 CPCs had SSF data collection systems in place to contribute to stock assessments, compared to eight in 2022. At the same time, stakeholder engagement is growing. Over 120 fishers participated in peer-to-peer learning via the Small-Scale Fishers' Forum and 17 CPCs reported having taken decisions through stakeholder consultation, reflecting a growing shift towards inclusive and participatory management models. The GFCM is expanding its research programmes and pilot studies to support evidence-based fisheries management, through the MedSea4Fish and BlackSea4Fish capacity development initiatives. Covering a wide range of topics, from priority species and key fisheries to specific ecosystem monitoring and socioeconomic analyses, these initiatives aim to provide a robust scientific foundation for policy and management decisions. By fostering regional cooperation and capacity development, they strengthen the science–policy interface and promote sustainable fisheries in the region. Recent research has also informed the management of European eel, red coral, rapa whelk and common dolphinfish fisheries, while creating solid networks of researchers across the region. The GFCM's management approach, which combines multiannual plans, spatial measures, management-oriented research and capacity development, is delivering measurable improvements in fisheries sustainability in the Mediterranean and Black Sea, with several key stocks showing signs of recovery. Together with advances made on a more holistic and participatory approach to SSF management,

the GFCM is driving a transformative shift towards sustainable fisheries through integrated, science-based management and inclusive governance.

Aquaculture management

Aquaculture is the fastest-growing segment of global aquatic food production, playing a critical role in addressing food insecurity and supporting resilient food systems. Regional efforts are aligned with the GFCM 2030 Strategy and the FAO Blue Transformation Roadmap, targeting a 35–40 percent increase of sustainable aquaculture by 2030. Most countries in the region have modernized legal frameworks, integrated aquaculture into marine spatial planning and established allocated zones for aquaculture to optimize site selection and ensure environmental sustainability. However, licensing remains a major bottleneck and some countries lack comprehensive legislation. Progress in the region includes new financing mechanisms, infrastructure upgrades and improved traceability systems. Funding and national incentives have supported modernization in some countries, but challenges persist for small-scale producers, particularly in non-European Union countries, due to complex regulations and limited access to finance. Enabling conditions are expanding, although unevenly. Investment incentives, shared infrastructure, certification and traceability systems are advancing, particularly in European Union countries. However, smaller producers across the region continue to face high compliance costs, limited finance and restricted market access. Regional initiatives such as Aquaculture Demonstration Centres, Technical Advisory Groups and training programmes have expanded technical expertise and fostered collaboration. Nonetheless, disparities in capacity and technology remain, particularly in areas such as climate resilience and advanced environmental monitoring. Climate change and aquatic animal health pose critical risks. Rising temperatures, extreme weather events and recurrent disease outbreaks are already impacting production. Stronger biosecurity, early-warning systems and climate-resilient planning are urgently needed. The way forward requires inclusiveness and collaboration. Updating legal frameworks, streamlining licensing, strengthening monitoring and fostering transparent communication with stakeholders – particularly farmer organizations – are key to building equity, social acceptability and shared commitment to sustainable aquaculture.

Overview of aquatic food systems in the Mediterranean and the Black Sea

Aquatic foods are critical for food security around the world. They supply high-quality animal proteins and essential nutrients that meet over 20 percent of the protein needs of more than 3 billion people, while providing livelihoods for around 600 million people (FAO, 2024). Considering their importance, the Food and Agriculture Organization of the United Nations (FAO) advocates for the transformation of aquatic food systems to enhance nutrition, strengthen local economies and build resilience against climate change (Box 1).

In 2023, Mediterranean and Black Sea marine capture fisheries and marine and brackish water aquaculture produced a combined 2 057 700 tonnes of aquatic foods, marking a 9 percent increase compared to 2022. The share of aquaculture production has increased steadily since 2019 and now represents more than 45 percent of total aquatic food production in the region. In contrast, capture fisheries production has leveled off, with production fluctuating around 1 million tonnes over the past decade and reaching 1 117 700 tonnes in 2023 (Figure 1). For capture fisheries, 80 percent of production comes from 18 species, while for aquaculture production 99 percent of production originates from 11 species.

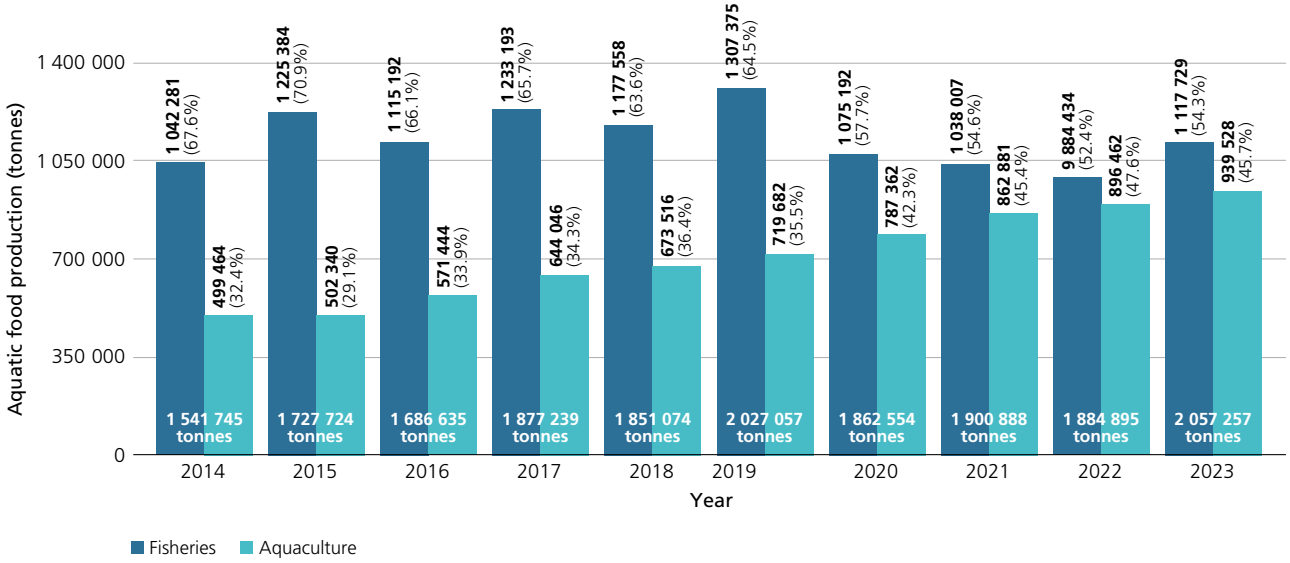
Fishing activities are carried out by at least 83 075 vessels using a variety of fishing gear, with gleaning and other shore-based practices also contributing to total production. Aquaculture production in the region relies on over 35 000 enterprises that vary in size and operational characteristics.

The relative importance and contribution of capture fisheries and aquaculture to consumption varies across the region. In Greece, Libya, Morocco and Tunisia, less than 10 percent of the total aquatic foods consumed originate from aquaculture, indicating reliance on capture fisheries. In contrast, Romania (83 percent), Egypt (82 percent) and Albania (68 percent) largely rely on aquaculture production.

Aquatic foods in the Mediterranean and the Black Sea significantly contribute to the regional economy, reaching a total estimated value of USD 21.5 billion. Trade of aquatic foods in the region continues to grow, with exports from Mediterranean and Black Sea countries accounting for 9 percent of total global exports, underscoring the strategic role of aquatic foods for these countries. The sector supports as a whole 1.17 million jobs along the value chain, with harvest-related jobs representing 26 percent of total sector employment, while pre-harvest and post-harvest operations represent 9 percent and 65 percent respectively. Only 12 percent of harvest jobs are carried out by women; however when also considering pre- and post-harvest operations, this number increases to 29 percent of all jobs along the value chain. With the exception of Egypt, which reports 40 percent of the workforce under 25 years old, the sector is ageing, with at least 11 countries reporting less than 7 percent of their workforce under 25 years old.

Effectively managing such a diverse sector requires significant efforts and strategic decisions at the national and regional levels. The MedFish4Ever and Sofia ministerial declarations, signed in 2017 and 2018, outline regional commitments towards sustainable fisheries and aquaculture in the Mediterranean and the Black Sea, respectively (FAO, 2025a, 2025b). They focus on restoring fish stocks, improving fisheries governance, enhancing scientific data, fighting illegal fishing, sustainably developing aquaculture and supporting coastal communities through coordinated regional action. These policy commitments led the General Fisheries Commission for the Mediterranean (GFCM) to develop a dedicated GFCM 2030 Strategy for sustainable fisheries and aquaculture in the Mediterranean and the Black Sea (GFCM 2030 Strategy), which identifies the priority actions needed to advance towards

FIGURE 1. Aquatic food production by sector in the Mediterranean and the Black Sea, 2014–2023



Notes: Fisheries data refer to total landings, excluding tuna-like species, in the GFCM area of application except the Azov Sea.
Aquaculture data refer to marine and brackish water aquaculture production.
Percentages indicate the share of total aquatic food production.
Values in white indicate total aquatic food production.

agreed goals, including through a specific capacity development target (Box 2).

One of the most tangible results of the MedFish4Ever and Sofia ministerial declarations, as well as the as well as GFCM strategic action, is the adoption of a comprehensive regional management framework. Between 2013 and 2023, 11 multiannual management plans and several technical measures were adopted on the basis of scientific and technical advice, supported by dedicated monitoring and scientific programmes (Box 3). Eleven fisheries restricted areas, including a large area encompassing depths greater than 1 000 m, complete the suite of management tools at disposal of the GFCM, protecting approximately 60 percent of the Mediterranean Sea from significant adverse impacts from fishing activities, mainly bottom contact fishing activities, and contributing to enhancing the productivity of essential fish habitats. All these measures are compiled in the Compendium of GFCM decisions (GFCM, 2025a), currently including a total of 102 decisions in force.

As a result of all measures adopted, average overall fishing pressure has declined in the last decade by approximately 50 percent across the region. Fishing mortality is approaching fishing mortality at maximum sustainable yield and the percentage of sustainable stocks has doubled. In the same period, biomass increased by 25 percent overall, and several stocks under GFCM multiannual management plans are showing signs of recovery, with biomass approaching or reaching biomass at maximum sustainable yield. However, 52 percent of stocks are still considered overexploited, and the region remains among those in the world with a high overexploitation ratio (FAO, 2024).

Meanwhile, the recent adoption of four GFCM guidelines (FAO, 2022a, 2022b, 2023a, 2023b) and the work of five Technical Advisory Groups and seven Aquaculture Demonstration Centres have laid the foundations for regional guidance towards sustainable aquaculture development. These regional structures have assisted countries in increasing and diversifying their production, including through the exchange of information and best practices. From 2013 to 2023, increased investment, enhanced technologies, improved feeds and stronger legal frameworks allowed total aquaculture production to double, in particular as a result of increased finfish production. The decade also saw the establishment of environmental monitoring programmes and the integration of aquaculture development into national plans and strategies, including marine spatial planning.

While positive advancements have been made, aquatic food systems in the Mediterranean and the Black Sea face significant challenges ahead. To meet regional demand and maintain the per capita consumption levels of 2022, production must increase by 14 percent by 2050. However, if countries with below-average aquatic food consumption rates increase their per capita consumption to average levels, production would need to rise by at least 29 percent. Increasing production to these levels while ensuring sustainability requires effective and efficient measures. The shared nature of marine resources and markets in the region underscores the critical need to continue advancing in a coordinated manner, both at the national and regional levels.

Box 1. Towards Blue Transformation

What is Blue Transformation and what does it mean for the General Fisheries Commission for the Mediterranean?

Blue Transformation is the strategic vision of FAO to reshape aquatic food systems (FAO, 2025a), in line with the Four Betters – better production, better nutrition, a better environment and a better life for all – which underpin FAO's strategic framework and its contribution to the broader 2030 Agenda for Sustainable Development (FAO, 2021a). It includes three main pillars:

- Sustainable aquaculture growth: intensifying and expanding aquaculture to meet global food demand.
- Effective fisheries management: ensuring all marine fisheries are sustainably managed, with a focus on eradicating illegal, unreported and unregulated fishing.
- Upgraded value chains: promoting transparency, traceability and reduced waste to ensure equitable returns and social inclusion.

For the GFCM, this transformation is both a necessity and an opportunity, as well as a cornerstone of the GFCM 2030 Strategy for sustainable fisheries and aquaculture in the Mediterranean and the Black Sea (FAO, 2021b). With an expected growing demand for aquatic food in the region, the GFCM plays a pivotal role in ensuring that fisheries and aquaculture meet this demand while remaining sustainable pillars of the livelihoods of coastal communities. Through a regional, science-based and inclusive approach, the GFCM is aligning its strategies with the core objectives of Blue Transformation to ensure healthy ecosystems, equitable livelihoods and resilient value chains.

GFCM strategic actions and success stories

The GFCM is driving Blue Transformation through the implementation of 11 multiannual management plans and 11 fisheries restricted areas (FRAs). These measures have led to tangible stock recovery, notably in the Adriatic Sea where the management plan for demersal fisheries, coupled with the establishment of the Jabuka/Pomo Pit FRA, has driven key demersal stocks towards sustainable exploitation. Building on these successes, future efforts will expand management coverage, enhance FRA effectiveness and strengthen adaptive strategies to ensure resilient, sustainable fisheries.

Key drivers of Blue Transformation in the region also include activities linked to sustainable aquaculture development. Through the establishment of allocated zones for aquaculture and the implementation of environmental monitoring programmes, the GFCM ensures that this expansion is conducted in a sustainable and environmentally responsible manner. Seven Aquaculture Demonstration Centres now operate across the region, offering hands-on training and innovation platforms that have benefited over 5 000 participants, including young people and small-scale producers. These initiatives contribute to improving productivity, resource efficiency and environmental performance across the Mediterranean and Black Sea region.

In addition, the GFCM is empowering small-scale fishers, for instance through the Small-Scale Fishers' Forum (SSF Forum; FAO, 2025b), organizing peer-to-peer workshops on different topics such as fishing gear selectivity, marine pollution and non-indigenous species. Between 2023 and 2024, the SSF Forum engaged with over 120 participants from across the region.

To further support Blue Transformation, the GFCM is expanding scientific assessments. In 2023, 120 stock assessments were conducted, covering 55 percent of total reported landings. Capacity development initiatives such as MedSea4Fish and BlackSea4Fish, as well as technical assistance, training and subregional data preparation, have reinforced national capacity in data collection, analysis and stock assessment. Concurrently, management-oriented research has strengthened the scientific basis for advice while complementary socioeconomic and gender-disaggregated studies are now routinely integrated into management-oriented research, ensuring inclusive and adaptive decision-making.

In parallel, the GFCM promotes certification, traceability and consumer awareness across fisheries and aquaculture value chains.

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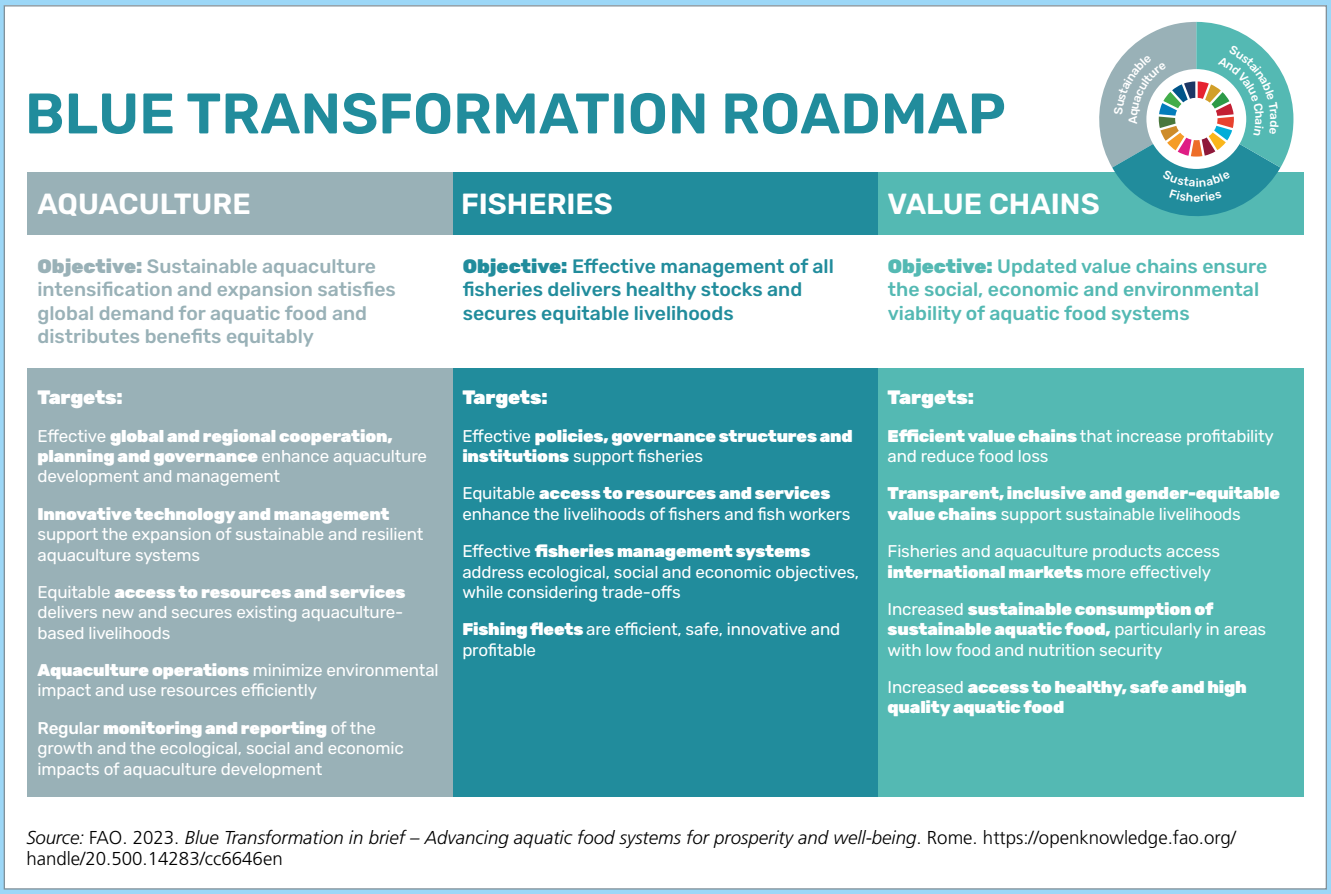
Box 1 (Continued)

FAO Blue Transformation Roadmap



Source: FAO. 2023. *Blue Transformation in brief – Advancing aquatic food systems for prosperity and well-being*. Rome. https://openknowledge.fao.org/handle/20.500.14283/cc6646en

Through targeted surveys, price monitoring, and collaboration with Globefish and the European Market Observatory for Fisheries and Aquaculture Products, the GFCM is enhancing transparency and promoting inclusive trade strategies, while helping countries develop tailored approaches to improve domestic and export market access. These efforts are complemented by socioeconomic studies and the collection of gender-disaggregated data, as well as work to develop a regionally harmonized value chain data collection methodology, that together aim to inform equitable value chain development and consumer engagement.

Sources:

FAO. 2021a. *Strategic Framework 2022–2031*. Rome. https://openknowledge.fao.org/handle/20.500.14283/cb7099en
FAO. 2021b. *GFCM 2030 Strategy for sustainable fisheries and aquaculture in the Mediterranean and the Black Sea*. Rome. https://doi.org/10.4060/cb7562en
FAO. 2025a. Blue Transformation. In: *Food and Agriculture Organization of the United Nations*. Rome. [Cited 4 November 2025]. https://fao.org/fishery/bluetransformation
FAO. 2025b. Small-Scale Fishers' Forum. In: *General Fisheries Commission for the Mediterranean*. Rome. [Cited 4 November 2025]. https://fao.org/gfcm/activities/fisheries/small-scale-fisheries/ssfforum

Box 2. The GFCM 2030 Strategy for sustainable fisheries and aquaculture in the Mediterranean and the Black Sea: five targets, two seas, one vision

The GFCM 2030 Strategy for sustainable fisheries and aquaculture in the Mediterranean and the Black Sea (GFCM 2030 Strategy) offers a common vision and guiding principles to achieve sustainable fisheries and aquaculture in the region, federating efforts to deliver on ambitious national, regional and global commitments. Building upon the progress made and concerted action between all stakeholders, it addresses the social, economic and environmental aspects of sustainability in order to strengthen resilience against global challenges.

More than an aspirational vision, the GFCM 2030 Strategy is guided by clearly defined aims and rooted in practical actions organized under five targets.

Target 1 – Fisheries and ecosystems: healthy seas and productive fisheries. The overexploitation of scientifically assessed resources in the Mediterranean and the Black Sea and threats to the biodiversity of these two semi-enclosed basins remain a challenge. Target 1 tackles the sustainability of fisheries from a broad perspective, integrating social, economic and environmental principles, with the objective of reaching exploitation at maximum sustainable yield while addressing the conservation of biodiversity.

Target 2 – Compliance and enforcement: a level playing field to eradicate illegal, unreported and unregulated fishing. In pursuing the implementation of the Regional Plan of Action to Combat Illegal, Unreported and Unregulated Fishing in the GFCM Area of Application, Target 2 aims to end illegal, unreported and unregulated fishing by strengthening compliance and enforcement as well as progressing in the field of monitoring, control and surveillance in a coordinated and transparent way.

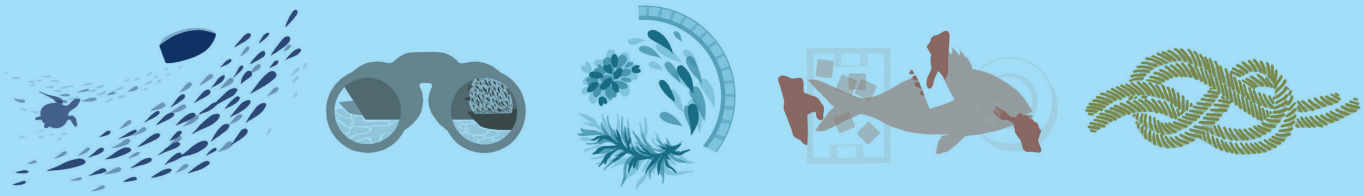
Target 3 – Aquaculture: a sustainable and resilient sector growing to its full potential. Target 3 ensures the sustainable development of aquaculture and its contribution to sustainable food systems, working towards the resilience of the sector against global challenges, such as climate change and pollution.

Target 4 – Livelihoods: decent employment and engaged fishers towards profitable fisheries. Recognizing the importance of promoting resilient fisheries-based livelihoods while fully and efficiently implementing the Regional Plan of Action for Small-Scale Fisheries in the Mediterranean and the Black Sea, Target 4 aims to address, in an integrated way, issues such as employment, socioeconomic knowledge, value chains and participatory decision-making.

Target 5 – Capacity development: technical cooperation, knowledge sharing and efficient partnerships in a subregional perspective. Developing capacity and providing technical support at the national and subregional levels ensures that policy commitments made by the GFCM Membership are met. Target 5 builds upon past technical assistance achievements and successful cooperation mechanisms, capitalizing on the implementation of the subregional approach to fisheries management, as well as on the experience of ad hoc GFCM technical assistance projects. Broad and inclusive partnerships underpin the overarching principle of solidarity.

The GFCM 2030 Strategy integrates cross-cutting themes within its core principles. The role of women and young people in fisheries and aquaculture is one example: the GFCM 2030 Strategy contains a series of measures to promote equal opportunities for women across the board and to substantially increase vocational youth training, to support the fishing communities of the future. Furthermore, the GFCM 2030 Strategy recognizes the unique and irreplaceable social, economic and cultural role played by small-scale fisheries in the region and accelerates efforts, across all targets, to strengthen their overall resilience and increase their long-term sustainability.

Source:
FAO. 2021. *GFCM 2030 Strategy for sustainable fisheries and aquaculture in the Mediterranean and the Black Sea*. Rome. https://doi.org/10.4060/cb7562en



Box 3. The GFCM fisheries and aquaculture advisory process

The advice informing GFCM decisions on fisheries and aquaculture relies on a science-based, participatory process: data are collected at the national level, analysed by experts and translated into technical proposals that are then channelled through the dedicated GFCM scientific advisory committees. The resulting advice is used to inform the binding recommendations and non-binding resolutions that contracting parties adopt at the GFCM session, thus helping to ensure the conservation and sustainable use of marine living resources and the sustainable development of aquaculture across the Mediterranean and Black Sea region. During the GFCM session, contracting parties also determine and inform GFCM activities for the next intersessional period, and the advisory process cycles back to the beginning. Compliance and enforcement measures are threaded throughout this process to ensure that mandatory requirements and data quality are effectively implemented.

While the GFCM fisheries and aquaculture advisory processes have a similar overarching structure, each displays unique characteristics.

Fisheries

The process begins when stakeholders from the GFCM undertake data collection through monitoring programmes, management-oriented research activities, surveys-at-sea and socioeconomic surveys. The targeted GFCM capacity development projects, MedSea4Fish and BlackSea4Fish, directly support this phase. Once these data are collected, they are communicated to the GFCM through its Data Collection Reference Framework and other data transmission mechanisms. Workshops and working groups bring together scientists, technical experts and other stakeholders to harmonize the findings, perform data analysis, elaborate forecasts and identify priorities, thereby providing the basis for scientific advice. These expert analyses are used to evaluate the feasibility and effectiveness of management scenarios, guiding management planning through the formulation of technical elements for management. These technical elements reflect subregional specificities and regional priorities, including key fisheries, spatial management, small-scale fisheries, recreational fisheries and vulnerable species. Based on the findings and scenario evaluations, the Scientific Advisory Committee on Fisheries and the Scientific Advisory Committee for the Black Sea (formerly Working Group on the Black Sea) discuss, identify management options and formulate comprehensive advice, including scientific, social and economic aspects, to support GFCM decision-making.

Aquaculture

The process involves the participation of multiple stakeholders, notably the National Focal Points who feed the Information System for the Promotion of Aquaculture in the Mediterranean with data on aquaculture production, production centres and markets. These data are then enriched by the activities of the Aquaculture Demonstration Centres, which provide tailored capacity development trainings and support the transfer of best practices. In parallel, the Technical Advisory Groups conduct technical reviews of priority areas and generate scientific insights. Equipped with these outcomes, the Scientific Advisory Committee on Aquaculture brings together representatives from GFCM contracting and cooperating non-contracting parties, experts and observers, such as farmer organizations, to monitor and assess sustainable aquaculture development and identify effective science-based strategies. This inclusive process, based on participatory and cyclical methods, enables the Committee to formulate comprehensive scientific advice that reflects technical knowledge and specific priorities while supporting the sustainable growth and resilience of the aquaculture sector and guiding GFCM decision-making.

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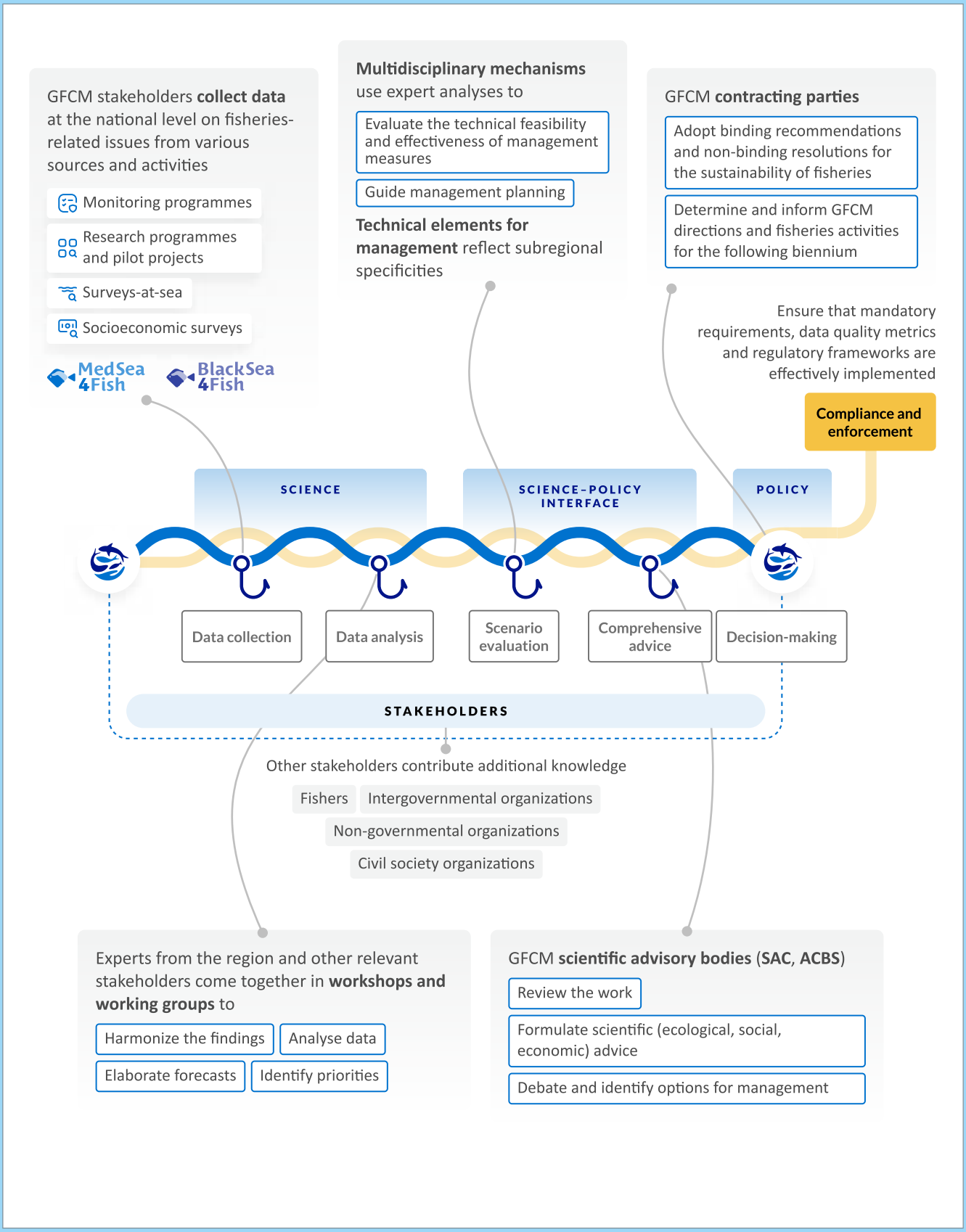
Box 3. (Continued)

The GFCM fisheries advisory process: from raw data to targeted management



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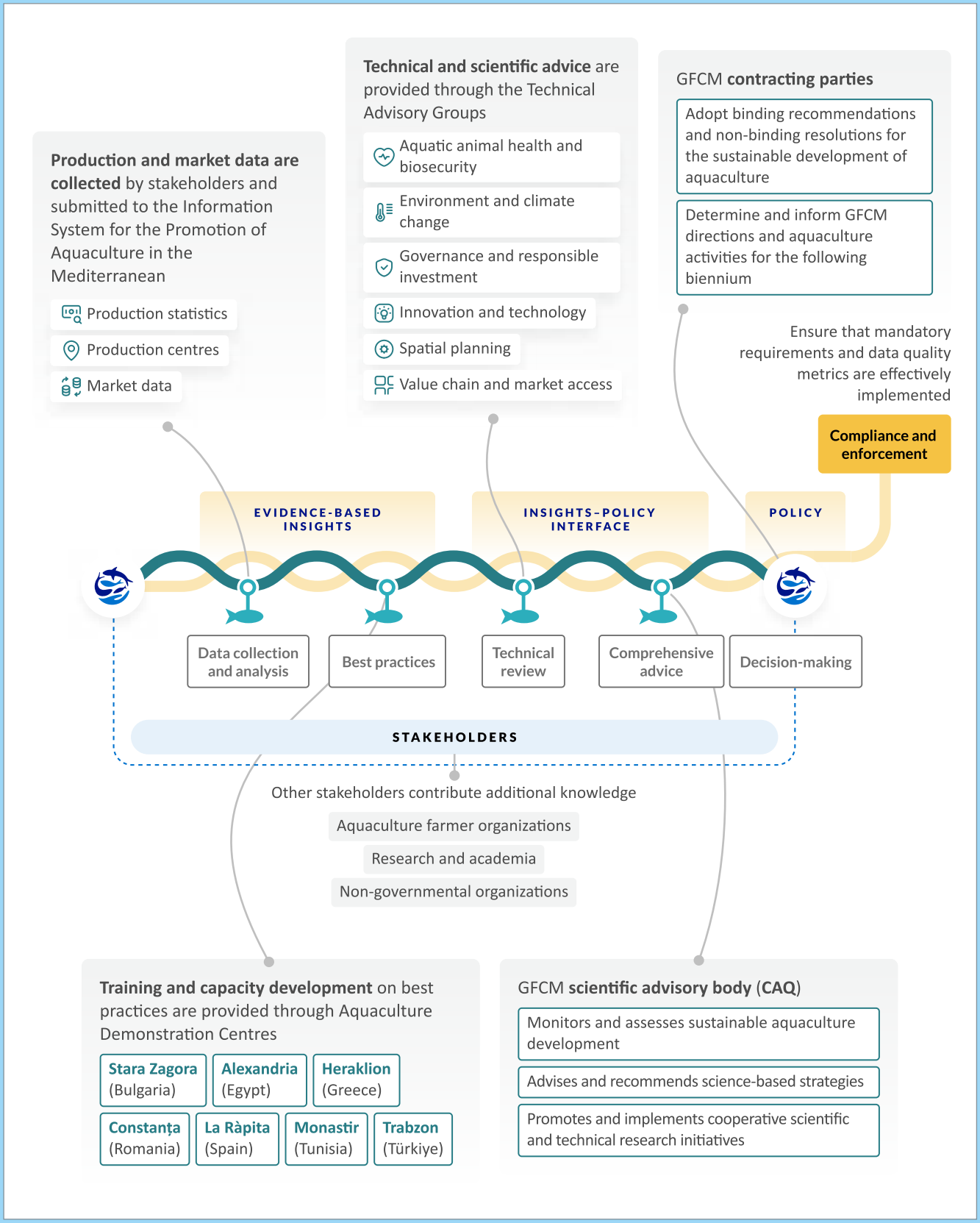
Box 3. (Continued)

The GFCM aquaculture advisory process: from science and information to effective governance and best practices



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PART 1

Status and trends of Mediterranean and Black Sea fisheries and aquaculture

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1. Capture fisheries production

This chapter provides a comprehensive overview of the structure of the fishing fleet and capture fisheries production (expressed in tonnes) in the GFCM area of application. It includes the most up-to-date information available, including 2023 data on landings, fishing fleet and landing ports. The analysis covers the Mediterranean Sea (geographical subareas [GSAs] 1 to 27) as well as the Marmara Sea and the Black Sea (GSAs 28 and 29, respectively),[1] at the national, subregional and regional levels. Key aspects of the fishing fleet, such as size, capacity, engine power, age and fleet segment composition (defined by vessel groups and length classes) are analysed in the context of current GFCM management plans, management measures and fisheries restricted areas (FRAs). Historical fishing fleet and production trends are presented, together with an overview of the main species and species groups contributing to the catch across the spatial scales considered.

The information presented in this chapter is sourced from national data officially submitted to the GFCM by its contracting parties and cooperating non-contracting parties (CPCs) through the GFCM Data Collection Reference Framework (DCRF; Box 4), in line with GFCM recommendations (GFCM, 2025a). Data on

[1] FAO Subarea 37.4 (Black Sea) includes the Marmara Sea (GSA 28), the Black Sea (GSA 29) and the Azov Sea (GSA 30), while in this report, the Black Sea subregion encompasses the Marmara Sea and the Black Sea (GSAs 28 and 29) but excludes the Azov Sea (GSA 30).

capture production are also based on the annual data calls sent by FAO, on behalf of the GFCM, to Mediterranean and Black Sea countries, within the framework of the Coordinating Working Party on Fisheries Statistics.

The analysis in this chapter contributes to the objectives of the GFCM 2030 Strategy for sustainable fisheries and aquaculture in the Mediterranean and the Black Sea (GFCM 2030 Strategy; see Box 2), aiming to ensure productive fisheries and resilient ecosystems through improved data collection, science-based management and regional cooperation.

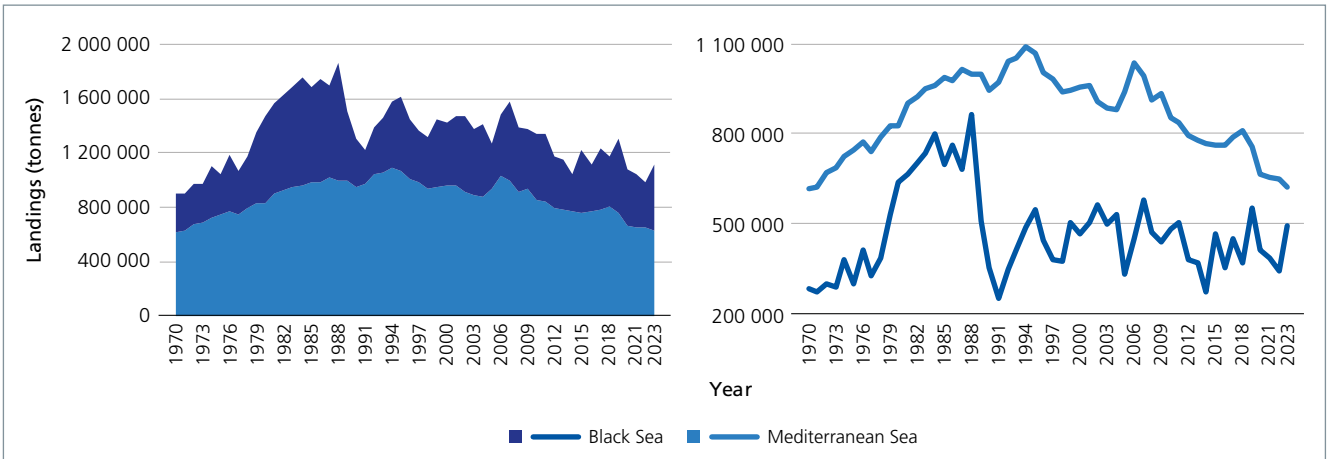
HISTORICAL TRENDS AND CURRENT CAPTURE FISHERIES PRODUCTION

Annual landings in the Mediterranean and the Black Sea in 2023 amounted to 1 117 700 tonnes (excluding tuna-like species),[2] corresponding to a 13 percent increase from 2022 (Figure 2). When averaging over two years, landings are however similar to those reported in the previous edition of *The State of Mediterranean and Black Sea Fisheries* (1 053 100 tonnes in 2022–2023 versus 1 056 600 tonnes in 2020–2021), highlighting both the relatively stable trend of landings in recent years and their short-term fluctuations, particularly in the Black Sea. Overall, total capture fisheries production in the Mediterranean and the Black Sea increased unevenly from 895 500 tonnes in 1970 to nearly 1 862 000 tonnes in 1988. Total landings then remained relatively stable throughout most of the 1980s, before dropping sharply in 1990 and 1991, primarily due to the collapse of pelagic fisheries in the Black Sea. In the Mediterranean Sea, landings continued to rise until 1994, peaking at 1 087 400 tonnes, and then declined irregularly to 761 900 tonnes in 2015. Over the following three years, production rose to 808 100 tonnes in 2018 but subsequently decreased to 665 400 tonnes in 2020 and continued declining to 624 200 tonnes in 2023 (55.8 percent of landings in the entire GFCM area of application). In the Black Sea, landings have fluctuated considerably year-on-year since 1990, showing an overall increasing trend between 1992 and 1995, followed by a downward trend from 1996 to 1998 and subsequent fluctuations until 2023, when total reported landings in the Black Sea reached 493 500 tonnes (44.2 percent of landings in the entire GFCM area of application). These figures exclude recreational fisheries, for which data are notably limited, although preliminary findings (Box 5) indicate that their impacts are not negligible.

When considering both the Mediterranean and Black Sea basins, Türkiye remains the dominant contributor of fisheries landings in the GFCM area of application (413 600 tonnes in 2023, 37 percent of total landings; Table 1). Türkiye's production has shown a fluctuating downward trend since the early 1990s, stabilizing at variable levels in

[2] The following FAO International Standard Statistical Classification for Aquatic Animals and Plants species groups were excluded from the analysis of catch carried out in this report: 11 ("Carps, barbels and other cyprinids"), 13 ("Miscellaneous freshwater fishes"), 36 ("Tunas, bonitos, billfishes"), 41 ("Freshwater crustaceans"), 91 ("Brown seaweeds"), 92 ("Red seaweeds") and 94 ("Miscellaneous aquatic plants").

FIGURE 2. Total annual landings in the Mediterranean and the Black Sea, 1970–2023



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

recent years. Italy, the second-largest producer, landed 105 400 tonnes in 2023 (9.4 percent), marking an all-time low and a 74 percent reduction from its production peak of 406 000 tonnes in the mid-1980s (Figure 3). Tunisia and Algeria (Figure 4) follow closely with 93 500 tonnes and 90 050 tonnes, respectively. Tunisia's catches have fluctuated around current levels over the past decade, while Algeria's landings have declined from a mid-2000s peak. Notably, Croatia, Cyprus, Egypt, France, Greece, Israel and Spain have all experienced significant decreases in catches over time (Figure 4 and Figure 5).

In terms of current production (averaged over 2022–2023), Türkiye remains by far the main producer with 330 700 tonnes (31.4 percent of the total), followed by Italy (112 500 tonnes, 10.7 percent), Tunisia (96 800 tonnes, 9.2 percent) and Algeria (93 200 tonnes, 8.9 percent). Other countries that contribute at least 5 percent of the total catch are Georgia (73 900 tonnes, 7 percent), Greece (61 000 tonnes, 5.8 percent) and Croatia (58 600 tonnes, 5.6 percent) (Table 1). All the remaining countries combined account for 16.5 percent with 175 000 tonnes.

When analysing changes since the previous edition of *The State of Mediterranean and Black Sea Fisheries* (2020–2021 average versus 2022–2023 average), Türkiye records the largest absolute increase, with landings rising from an average of 296 500 tonnes in 2020–2021 to 330 700 tonnes in 2022–2023 (+11.6 percent), largely due to high anchovy catch both in the Mediterranean and the Black Sea. On the other extreme, Ukraine reports

Box 4. The GFCM Data Collection Reference Framework

The GFCM Data Collection Reference Framework (DCRF; GFCM, 2018) 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 recommendations adopted by the GFCM. The DCRF aims to improve the integration of data and management measures, thereby supporting the formulation of sound and robust scientific advice by relevant GFCM subsidiary bodies for fisheries – namely the Scientific Advisory Committee on Fisheries (SAC) and the Scientific Advisory Committee for the Black Sea (formerly Working Group on the Black Sea). This advice informs the work of the Compliance Committee and ultimately contributes to evidence-based decision-making.

The DCRF provides a standardized and streamlined approach to reporting the following categories of national fisheries data required by the GFCM:

- global figures on national fisheries;
- catch data, including landings, catch by species, fishing activities, landing points and designated ports (within the context of GFCM management plans);
- incidental catch data on vulnerable species;
- fishing fleet data, including information on authorized vessels (within the context of GFCM management plans);
- fishing effort data, such as fleet segment composition, fishing gear used and catch per unit effort;
- socioeconomic data, including economic and social indicators, operating costs and species value; and
- biological data, including inputs for stock assessment, length-frequency, size at first maturity, maturity and ecosystem indicators.

The DCRF is a flexible and evolving tool, regularly reviewed and updated to meet new GFCM requirements, including those arising from recently adopted recommendations or decisions taken by the SAC and the Scientific Advisory Committee for the Black Sea. These reviews also aim to streamline existing data calls issued by the GFCM (GFCM, 2025a, 2025b). To support CPCs, the DCRF provides a comprehensive manual detailing the data to be collected and an online platform for data entry and official submission.

In 2025, recurring fisheries data submissions related to the DCRF and in line with GFCM recommendations accounted for approximately 67 percent of all GFCM requests for data and information. The remaining 33 percent comprised requests not directly data-driven, such as national management measures and plans, inspection plans and spatial or temporal restrictions.

Sources:

GFCM. 2018. *Data Collection Reference Framework. Version: 25.2*. Rome. https://fao.org/gfcm/data/dcrf
GFCM. 2025a. *Report of the Workshop on data collection and submission (WKDATA) 25–26 March 2025, Florence, Italy*. [Cited 11 October 2025]. https://fao.org/gfcm/technical-meetings/detail/en/c/1742748
GFCM. 2025b. *Report of the Working Group on the management of fishing capacity (WGCAP), 27–28 March 2025, Florence, Italy*. [Cited 11 October 2025]. https://fao.org/gfcm/technical-meetings/detail/en/c/1739315

Box 5. Recreational fisheries in the Mediterranean and the Black Sea: main outcomes and insights from pilot studies in Italy, Tunisia and Türkiye (Black Sea)

Marine recreational fisheries are a vital component of coastal life in the Mediterranean and Black Sea region. They operate across the entire area, contributing not only to cultural traditions and coastal tourism, but also to local economies. Despite their widespread nature and potential socioeconomic importance, these fisheries are often overlooked in scientific assessments and policymaking. Their role in overall fishing mortality is not negligible, yet the sector remains severely data-deficient. Monitoring efforts vary significantly between countries, hampering the development of coordinated and sustainable management strategies at the regional level.

In response to this need for improved data, the *Handbook for data collection on recreational fisheries in the Mediterranean and the Black Sea* (Grati *et al.*, 2021) provides a methodological framework designed to support the implementation of harmonized sampling and survey strategies across countries in the region. It outlines a core set of essential data requirements for effective monitoring, while also offering flexibility to address national contexts and specific information needs. The handbook's approach has been field-tested through three pilot studies conducted in different areas: Italy, Tunisia and Türkiye (Black Sea). These pilots reflect a variety of national situations and offer valuable insights into the diversity and scale of marine recreational fishing across the region.

In Italy, the study focused on the central and northern Adriatic Sea – geographical subarea (GSA) 17 – where approximately 240 000 marine recreational fishers were active in 2019. These fishers engaged in about 5.5 million fishing trips, averaging 14.7 fishing days per year. The most common fishing method was shore fishing (46 percent of total fishing days), followed by boat fishing (37 percent) and spearfishing (17 percent). Key target species included striped seabream (*Lithognathus mormyrus*), grey mullets nei, Mediterranean horse mackerel (*Trachurus mediterraneus*), gilthead seabream (*Sparus aurata*) and black seabream (*Spondyliosoma cantharus*). The average catch per fisher was estimated at 18.4 kg per year, leading to a total estimated catch of 4 400 tonnes in GSA 17 in 2019, of which nearly 30 percent consisted of released individuals.

Tunisia exhibited a 5.7 percent participation rate in marine recreational fisheries, meaning that around 695 000 individuals were involved this activity in 2020. These fishers engaged in about 9 million fishing trips, averaging 12.8 fishing days per year. The most common fishing method was shore fishing (60 percent of total fishing days), followed by boat fishing (23 percent) and spearfishing (17 percent). The most active fishing areas were GSA 12 (64 percent of effort), followed by GSA 13 and GSA 14. Tunisian recreational fishers targeted nearly 80 different species, with common cuttlefish (*Sepia officinalis*), gilthead seabream, common octopus (*Octopus vulgaris*) and grey mullets among the most frequently retained, and African blue swimming crab (*Portunus segnis*) and white seabream (*Diplodus sargus*) among the most frequently released.

In Türkiye's Black Sea area, data collected during 2021–2022 estimated a participation rate of 18.5 percent of the population, suggesting that around 4.5 million people engage at least once per year in recreational fisheries on the Black Sea coast. This translates to roughly 30 million fishing days annually. This figure may have been influenced by the timing of the survey towards the end of the COVID-19 pandemic, which could have temporarily increased the participation rate, as an indirect effect of the pandemic lockdown. The predominant fishing method was shore fishing (80.8 percent), followed by boat fishing (19 percent) and underwater fishing (0.2 percent). The average annual catch per fisher was 16.5 kg, resulting in an estimated total biomass of 74 000 tonnes. Twenty-four fish species were recorded, with Mediterranean horse mackerel being the most common in both catch volume and frequency, followed by red mullet (*Mullus barbatus*) and bluefish (*Pomatomus saltatrix*). A portion of the catch, especially smaller individuals, was released, with release rates reaching 25 percent for Mediterranean horse mackerel and bluefish.

Pilot studies demonstrate widespread participation in marine recreational fisheries and substantial catches, ranging from tens to thousands of tonnes annually across countries. These findings underscore the need for greater consideration of the contribution of marine recreational fisheries to fishing mortality of concerned stocks. The variety of recreational fishing practices and target species, as well as uneven data availability across countries, highlight the importance of a standardized data collection approach to ensure comparability of information at the regional level. The GFCM handbook provides an essential tool for harmonizing methodologies and promoting a better understanding of recreational fisheries. Incorporating data on recreational fisheries into broader fisheries management frameworks is essential for developing effective conservation strategies, ensuring the sustainable use of marine resources and recognizing the socioeconomic value of this important yet underrepresented sector. Continued collaboration between national authorities, fishers and regional organizations is crucial to closing data gaps and integrating recreational fisheries into sustainable fisheries governance across the Mediterranean and the Black Sea. In 2025, the GFCM officially launched a research programme on recreational fisheries, which aims to boost collaboration and improve the body of knowledge to support decision-making on this topic.

Source:
Grati, F., Carlson, A., Carpentieri, P. & Cerri, J. 2021. *Handbook for data collection on recreational fisheries in the Mediterranean and the Black Sea*. FAO Fisheries and Aquaculture Technical Paper No. 669. Rome, FAO. https://doi.org/10.4060/cb5403en

FIGURE 3. Total annual landings of the two largest producers (Türkiye and Italy) in the Mediterranean and the Black Sea, 1970–2023

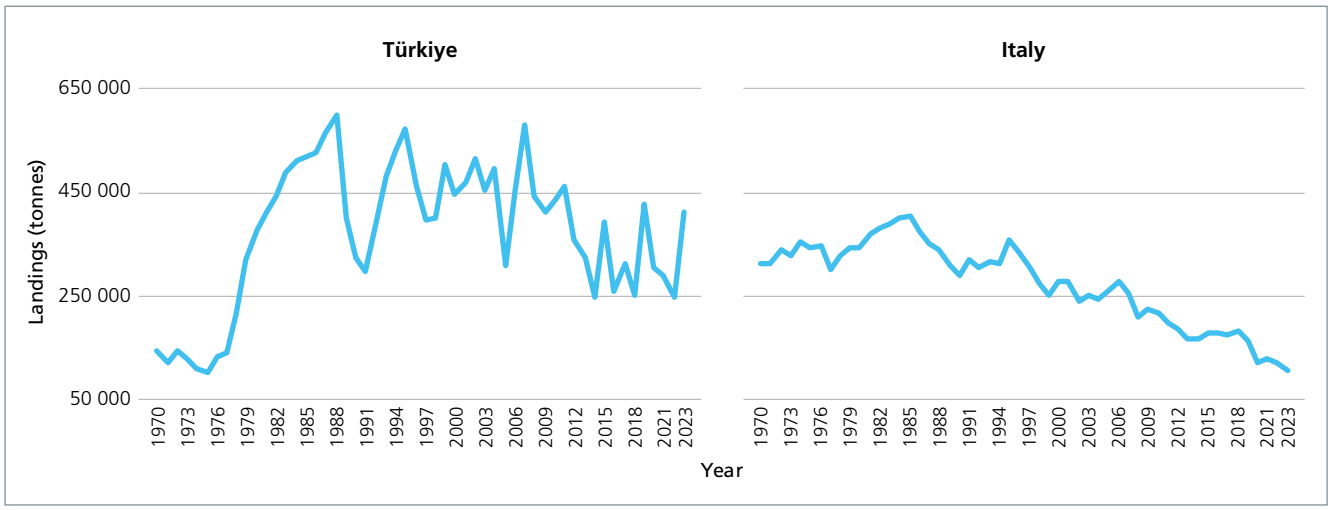


FIGURE 4. Total annual landings by GFCM contracting party, cooperating non-contracting party and non-contracting party catching up to 150 000 tonnes, 1970–2023

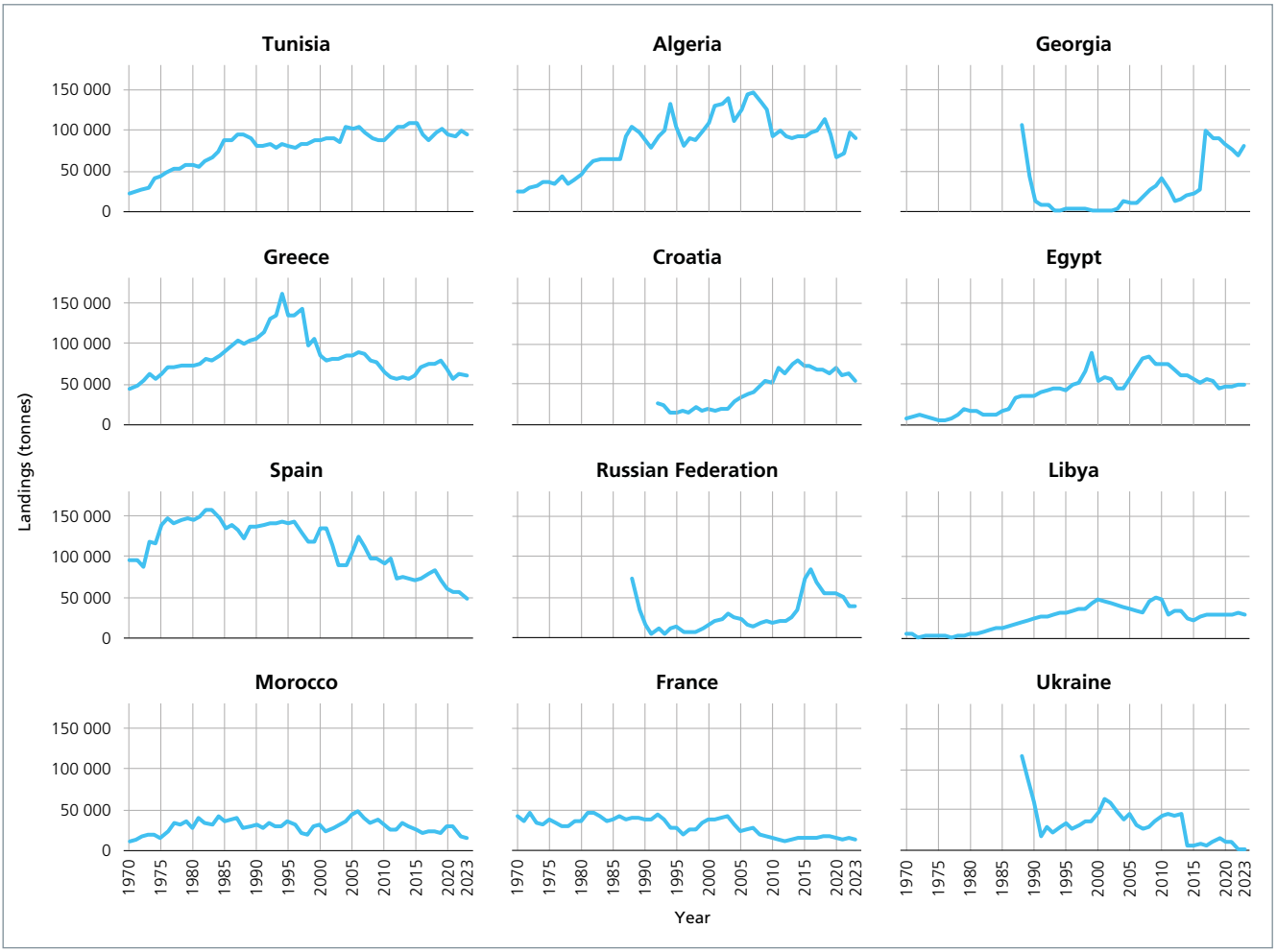
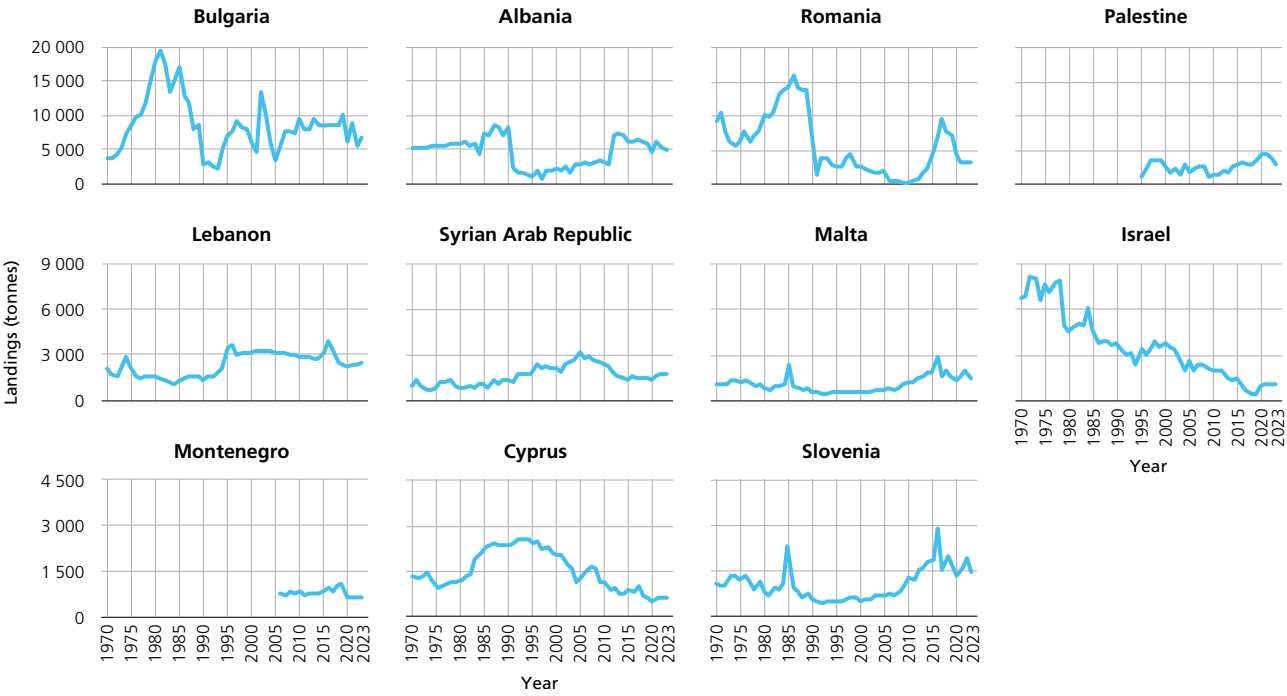


FIGURE 5. Total annual landings by GFCM contracting party, cooperating non-contracting party, non-contracting party and relevant non-state actor catching up to 20 000 tonnes, 1970–2023



the steepest decrease, with landings in 2022–2023 averaging almost 99 percent less than in 2020–2021.

LANDINGS BY COUNTRY AND SUBREGION

In the Mediterranean Sea (averaged over 2022–2023), Italy continues to be the main producer (17.7 percent), followed by Tunisia (15.2 percent), Algeria (14.6 percent), Greece (9.6 percent), Croatia (9.2 percent), Spain (8.1 percent), Egypt (7.8 percent) and Türkiye (5.8 percent) (Figure 6).

In the Black Sea, Türkiye dominates catches (294 100 tonnes), accounting for 70.6 percent. This represents an increase compared to 2020–2021, when Türkiye contributed 246 400 tonnes (61.9 percent) of the total catch in the Black Sea (398 100 tonnes). Other countries contributing to the total catch in 2022–2023 are Georgia (73 900 tonnes, 17.7 percent), the Russian Federation (38 900 tonnes, 9.3 percent), Bulgaria (6 100 tonnes, 1.5 percent), Romania (3 200 tonnes, 0.8 percent) and Ukraine (111 tonnes, 0.1 percent) (Figure 7).

While total landings in the Mediterranean and the Black Sea (averaged over 2022–2023) remained very similar to those reported in the previous edition of *the State of Mediterranean and Black Sea fisheries* (FAO, 2023c) (1 053 100 tonnes in 2022–2023 versus 1 056 600 tonnes in 2020–2021), national-level data reveal significant variations across countries (Table 1, Figure 8). In the Mediterranean, the strongest decreases are found in Morocco (13 400 tonnes, –45.7 percent), Türkiye (13 400 tonnes, –26.8 percent), Spain (6 600 tonnes, –11.3 percent), Croatia (7 000 tonnes, –10.7 percent) and Italy (10 700 tonnes, –8.7 percent). Meanwhile, the highest percentage increase is shown by Algeria (25 000 tonnes), which raised its contribution in 2022–2023 by 36.6 percent compared to 2020–2021 (Table 1, Figure 8). In the Black Sea, compared to 2020–2021, the landings of Türkiye increased by 19.4 percent (47 700 tonnes) while they decreased for Ukraine (8 900 tonnes, –98.8 percent, Table 1), the Russian Federation (13 200 tonnes, –25.3 percent), Bulgaria (1 500 tonnes, –19.5 percent), Romania (600 tonnes, –14.7 percent) and Georgia (5 300 tonnes, –6.7 percent).

These results also highlight the contrasting situations faced by Türkiye's fisheries in the

TABLE 1. Annual landings and averages by GFCM contracting party, cooperating non-contracting party, non-contracting party and relevant non-state actor, 2022–2023

CPCs, non-contracting parties and non-state actors	Landings		Average		Percentage variation between 2020–2021 and 2022–2023
	2022	2023	2020–2021	2022–2023	
Albania	5 302	4 871	**5 428**	**5 087**	–6.3
Algeria	96 312	90 057	**68 207**	**93 185**	+36.6
Bulgaria	5 502	6 666	**7 557**	**6 084**	–19.5
Croatia	62 343	54 913	**65 661**	**58 628**	–10.7
Cyprus	603	586	**557**	**595**	+6.8
Egypt	49 495	50 371	**47 628**	**49 933**	+4.8
France	14 344	13 421	**14 099**	**13 883**	–1.5
Georgia	68 483	79 267	**79 215**	**73 875**	–6.7
Greece	62 038	59 913	**62 245**	**60 976**	–2.0
Israel	1 010	1 040	**985**	**1 025**	+4.1
Italy	119 490	105 420	**123 148**	**112 455**	–8.7
Lebanon	2 400	2 410	**2 303**	**2 405**	+4.4
Libya	30 280	29 840	**29 605**	**30 060**	+1.5
Malta	1 948	1 443	**1 453**	**1 696**	+16.7
Montenegro	603	597	**614**	**600**	–2.3
Morocco	16 258	15 556	**29 308**	**15 907**	–45.7
Palestine	3 940	3 070	**4 382**	**3 505**	–20.0
Portugal	35	35	**38**	**35**	–7.9
Romania	3 176	3 296	**3 795**	**3 236**	–14.7
Russian Federation*	39 559	38 326	**52 120**	**38 943**	–25.3
Slovenia	128	111	**132**	**120**	–9.1
Spain	55 353	47 535	**58 011**	**51 444**	–11.3
Syrian Arab Republic	1 770	1 770	**1 587**	**1 770**	+11.5
Tunisia	100 044	93 514	**92 992**	**96 779**	+4.1
Türkiye	247 848	413 639	**296 487**	**330 744**	+11.6
Ukraine	164	58	**9 042**	**111**	–98.8
TOTAL	**988 434**	**1 117 731**	**1 056 605**	**1 053 087**	**–0.3**

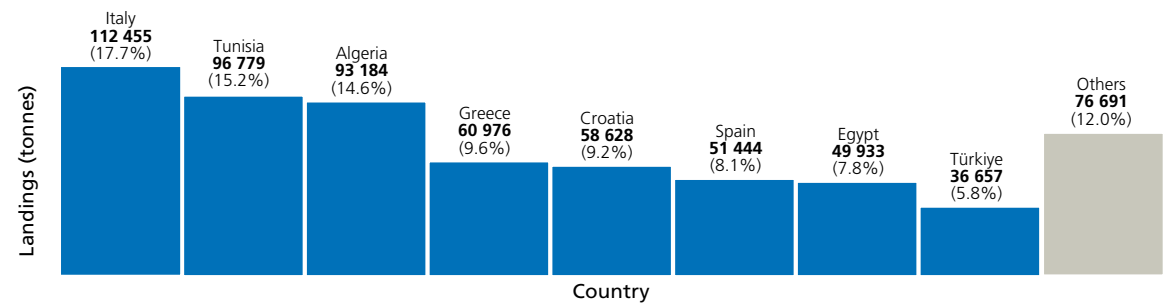
Notes: *Information provided by the Russian Federation includes statistical data for the Autonomous Republic of Crimea and the city of Sevastopol, Ukraine, temporarily occupied by the Russian Federation and is presented without prejudice to relevant United Nations General Assembly and United Nations Security Council resolutions, which reaffirm the territorial integrity of Ukraine. This disclaimer applies also to following figures, as relevant, in this publication.
Bosnia and Herzegovina and Monaco are not included in the fleet analysis, having reported that they had no operating fishing vessels at the time of publication. For reasons of comparability and consistency, they are also excluded from the landings analysis.

two basins. In the Black Sea, landings are primarily driven by anchovy. Black Sea anchovy landings are generally high, making the CPCs exploiting this resource (Türkiye and Georgia) top producers in the Black Sea. Nevertheless, the anchovy population fluctuates significantly across both space and time, resulting in marked year-to-year variability in catches. In contrast, Türkiye's landings in the Mediterranean have steadily declined since 2018 and remain relatively modest, representing around 5 percent of the total Mediterranean catch and approximately 11 percent of Türkiye's national total catch.

LANDINGS BY SPECIES AND SUBREGION

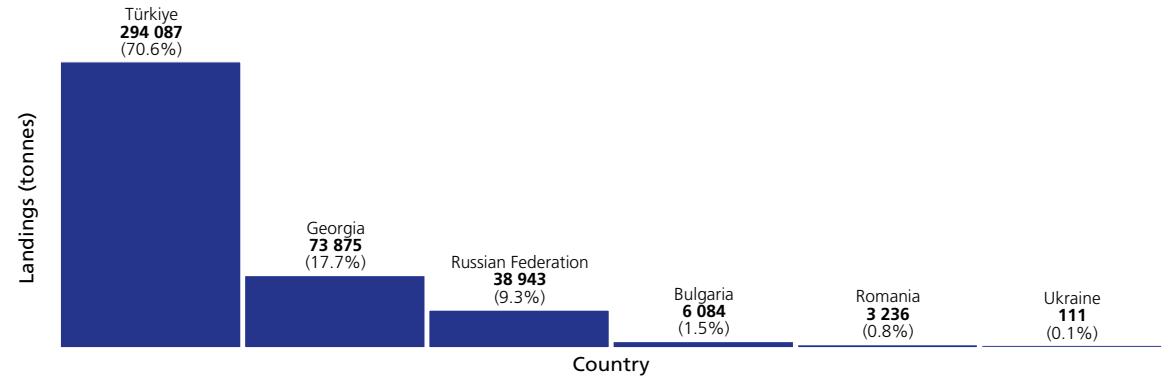
The three most caught species groups over the period 2022–2023 continue to be "Herrings, sardines, anchovies" (598 200 tonnes, 56.8 percent), "Miscellaneous coastal fishes"

FIGURE 6. Average annual landings by GFCM contracting party, cooperating non-contracting party and non-contracting party contributing at least 5 percent of the total catch in the Mediterranean Sea, 2022–2023 average



Note: Percentages indicate relative contributions of countries to total landings in the Mediterranean Sea, 2022–2023 average.

FIGURE 7. Average annual landings by GFCM contracting party, cooperating non-contracting party and non-contracting party in the Black Sea, 2022–2023 average



Note: Percentages indicate relative contributions of countries to total landings in the Black Sea, 2022–2023 average.

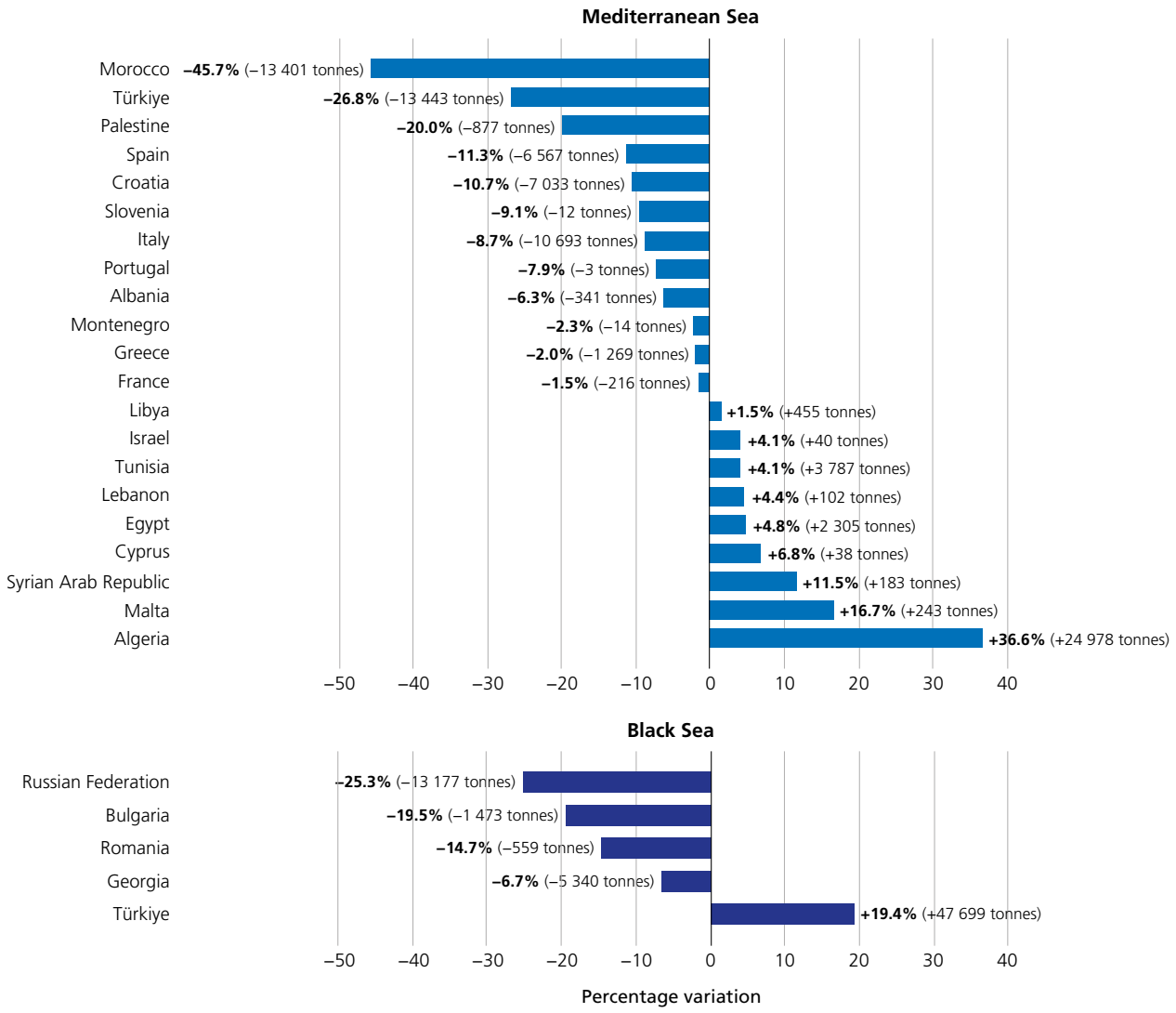
(110 700 tonnes, 10.5 percent) and "Miscellaneous pelagic fishes" (85 500 tonnes, 8.1 percent). These three groups combined constitute 75.4 percent of the total reported landings in the entire GFCM area of application. Five other species groups contribute more than 1.5 percent of the total landings, amounting altogether to 17 percent of the total landings, and the combination of all remaining species groups contributing 1.5 percent or less of the total landings amounts to 7.6 percent overall (Figure 9).

Across the GFCM area of application, European anchovy (*Engraulis encrasicolus*) and sardine (*Sardina pilchardus*) continue to be the main species captured (360 500 tonnes and 125 800 tonnes on average, respectively), followed by sardinellas nei (*Sardinella* spp.) with 55 200 tonnes and European sprat (*Sprattus sprattus*) with 43 500 tonnes. Fourteen other species appear in the list of species contributing 1 percent or more of the total catch (Figure 10).

In the Mediterranean basin, sardine (19.5 percent) and European anchovy (12.6 percent) continue to be the prevalent species, together accounting for 32.1 percent of total landings (Figure 11). In the Black Sea, the predominant species is European anchovy with 67.8 percent of total landings, followed by European sprat with 10.4 percent: both species together account for 78.2 percent of landings (Figure 12).

Trends in landings of the main priority species over the period 1970–2023 (Figure 13 and Figure 14) reveal a variety of dynamics. Landings of the main pelagic priority species show large fluctuations, but with contrasting

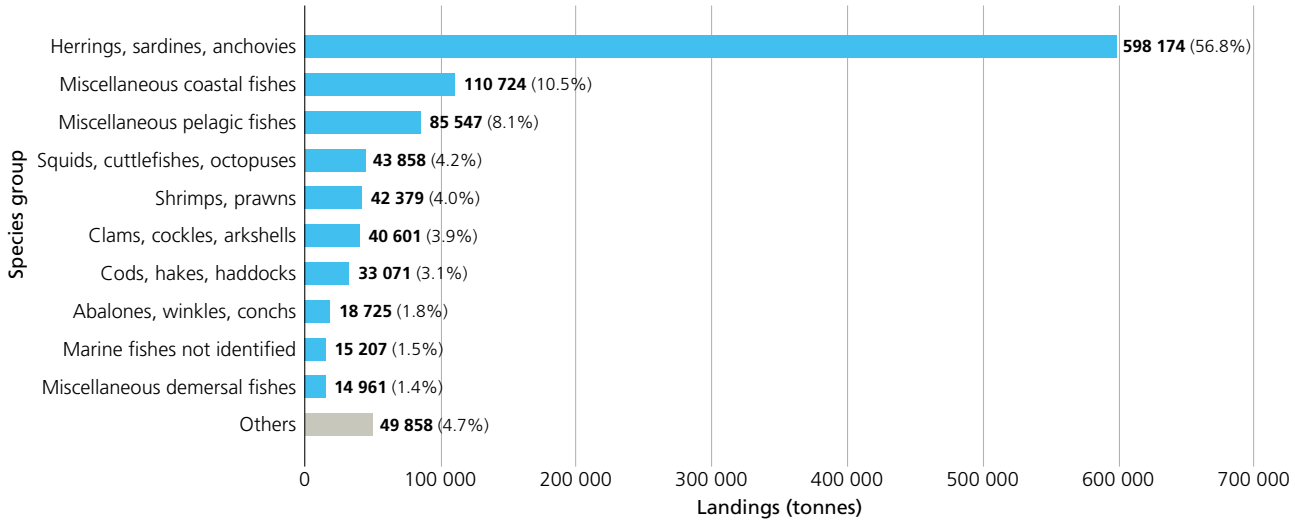
FIGURE 8. Percentage variation between total landings over 2020–2021 and total landings over 2022–2023 by GFCM contracting party, cooperating non-contracting party, non-contracting party and relevant non-state actor



Note: Notes: Bosnia and Herzegovina and Monaco are not included in the fleet analysis, having reported that they had no operating fishing vessels at the time of publication. For reasons of comparability and consistency, they are also excluded from the landings analysis.
With a variation of –98.8 percent, Ukraine is not represented in the figure.

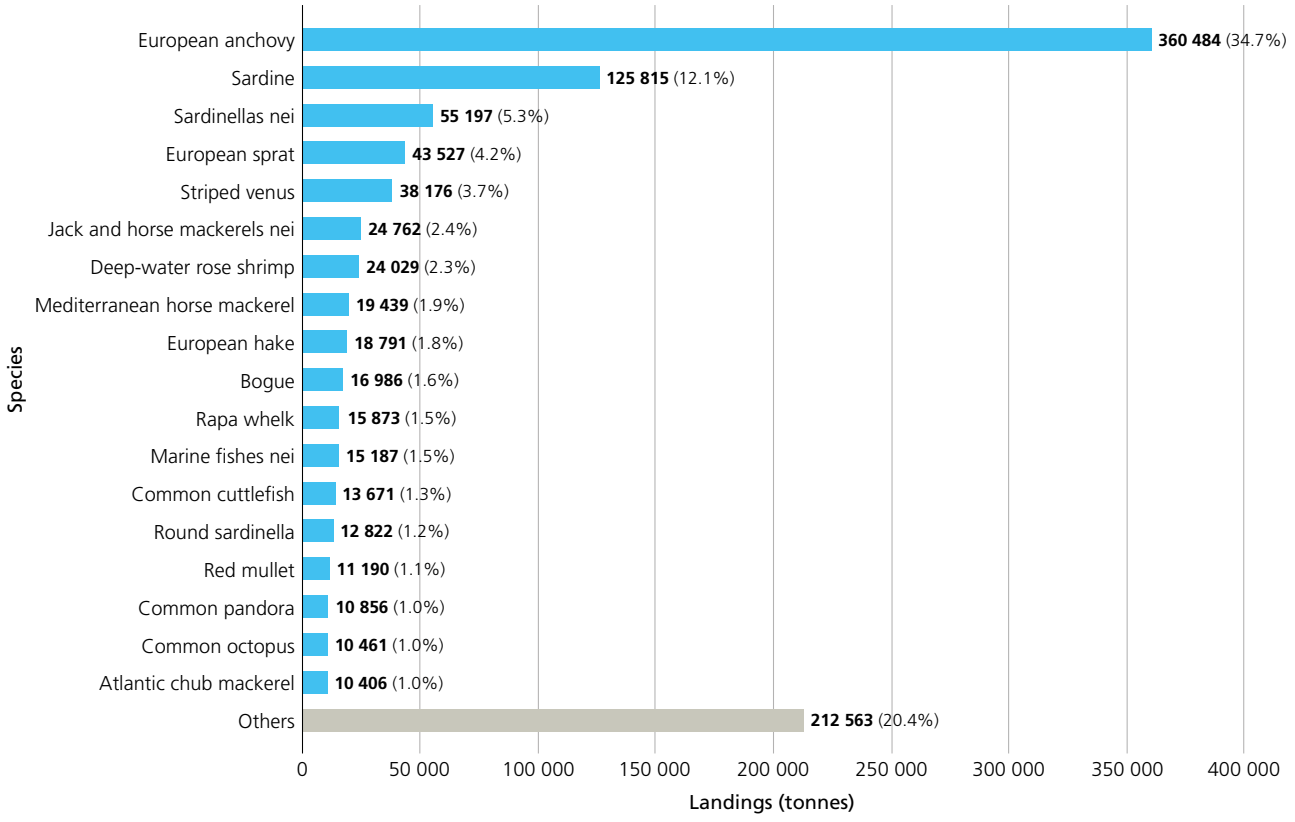
long-term trends. While European anchovy and European sprat show a stable average across the time series, sardine shows a clear decline since the late 1980s, with current catches being the lowest in the time series. On the other hand, Mediterranean horse mackerel (*Trachurus mediterraneus*) catch abruptly declined in the early 1990s (from around 100 000 tonnes to around 20 000 tonnes) and remains at a low level, amounting to 19 400 tonnes in 2023. For demersal species, deep-water rose shrimp (*Parapenaeus longirostris*) exhibits a strongly oscillating yet overall increasing trend, with a minimum of 6 700 tonnes in 1971 and a maximum of 25 900 tonnes in 2018, reaching 24 000 tonnes in 2023. European hake (*Merluccius merluccius*), whiting (*Merlangius merlangus*), Norway lobster (*Nephrops norvegicus*) and turbot (*Scophthalmus maximus*) have continuously declined in catch since the 1980s–1990s, while common sole (*Solea solea*) abruptly declined in the late 1990s (from more than 8 000 tonnes to less than 5 000 tonnes) and has remained at low levels since. Both red mullet (*Mullus barbatus*) and surmullet (*Mullus surmuletus*), as well as priority mollusc species and most of the crustacean species, i.e. common cuttlefish (*Sepia officinalis*),

FIGURE 9. Total annual landings by main species group in the GFCM area of application, 2022–2023 average



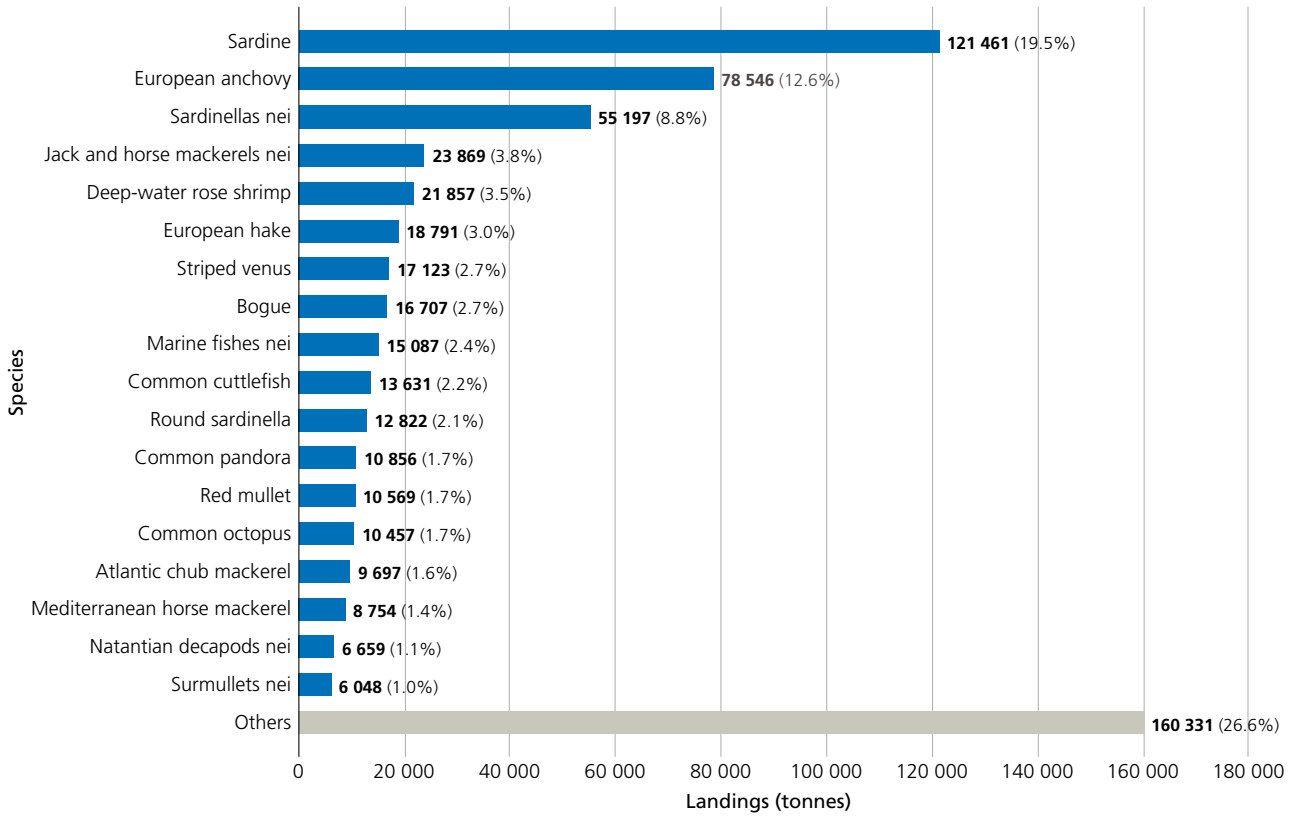
Note: Percentages indicate relative contributions of main species groups to total landings in the GFCM area of application, 2022–2023 average.

FIGURE 10. Total annual landings by main species contributing at least 1 percent of the total catch in the GFCM area of application, 2022–2023 average



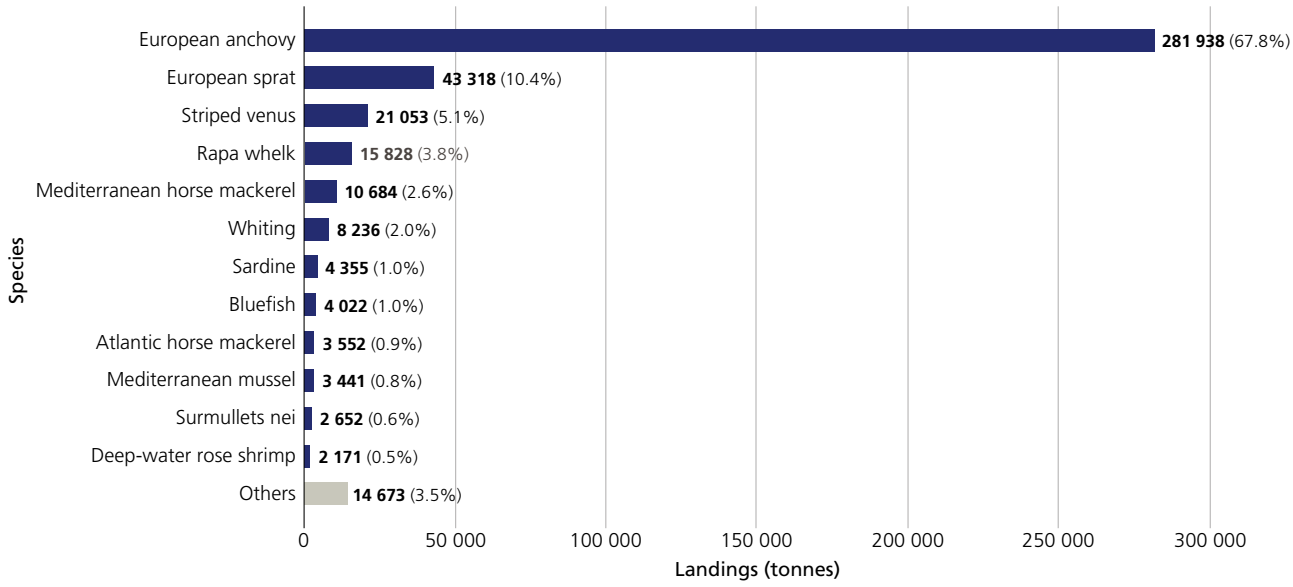
Note: Percentages indicate relative contributions of main species to total landings in the GFCM area of application, 2022–2023 average.

FIGURE 11. Total annual landings by main species contributing at least 1 percent of the total catch in the Mediterranean Sea, 2022–2023 average



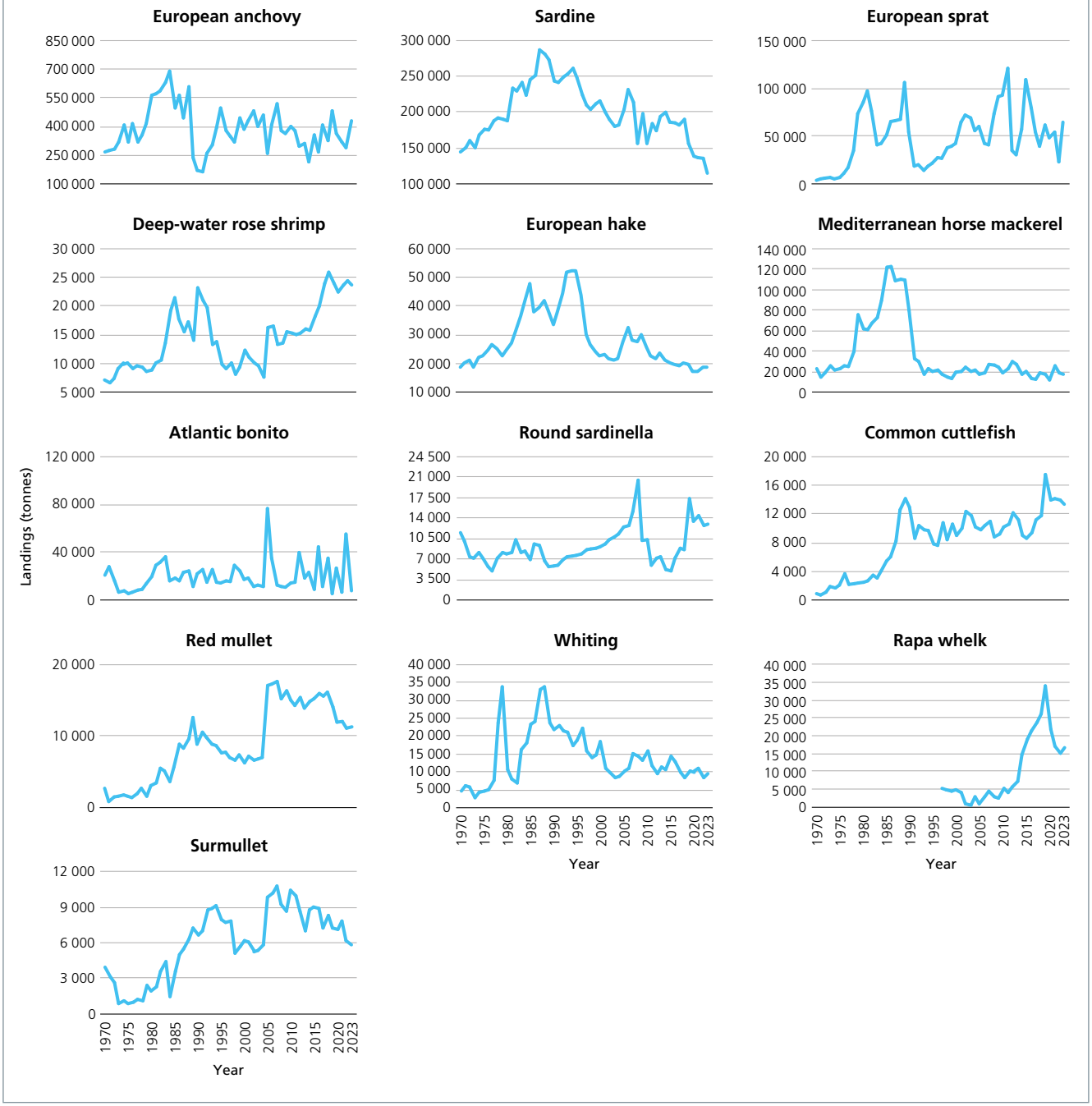
Note: Percentages indicate relative contributions of main species to total landings in the Mediterranean Sea, 2022–2023 average.

FIGURE 12. Total annual landings by main species contributing at least 0.5 percent of the total catch in the Black Sea, 2022–2023 average



Note: Percentages indicate relative contributions of main species to total landings in the Black Sea, 2022–2023 average.

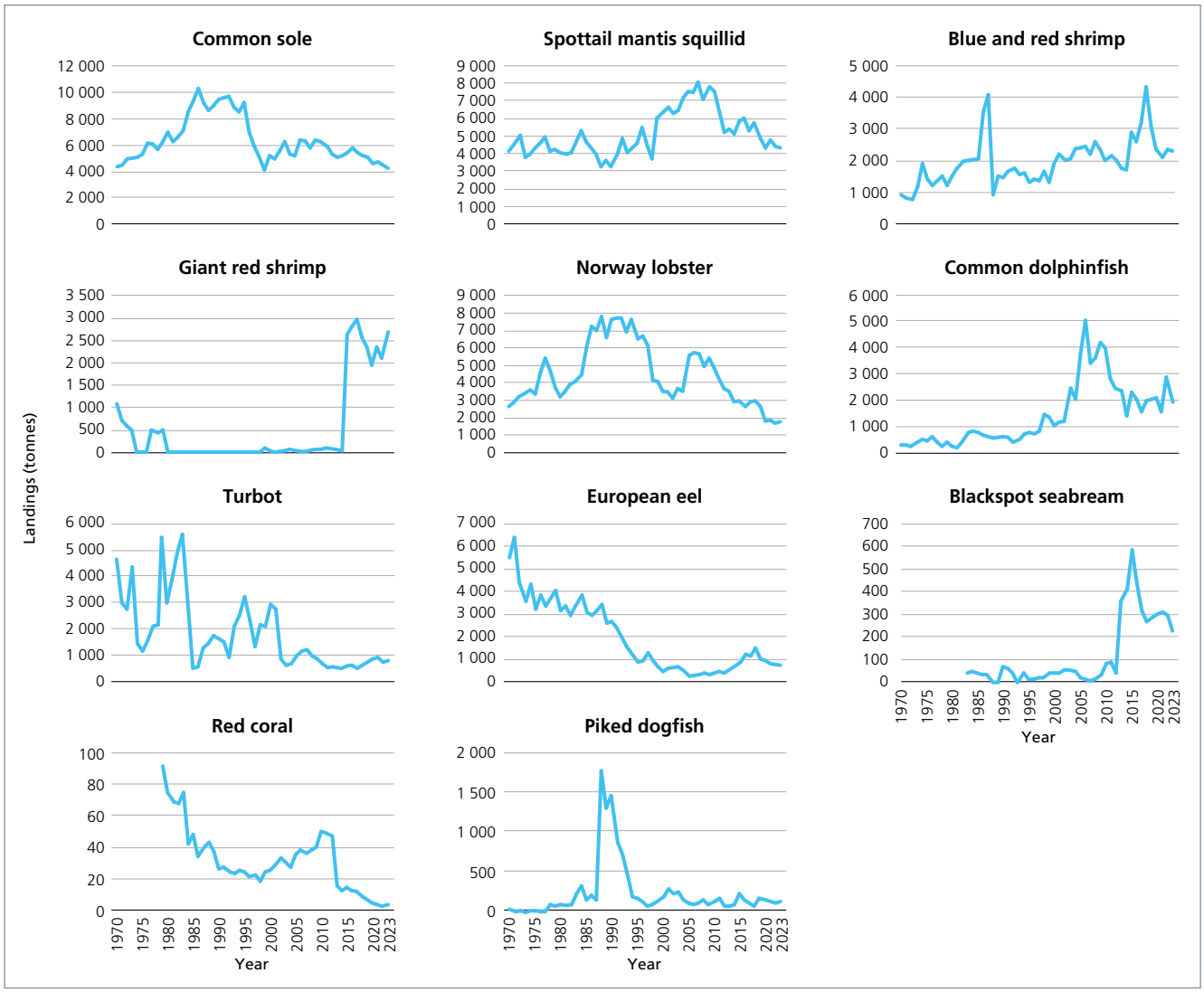
FIGURE 13. Annual landings of priority species averaging more than 5 000 tonnes between 2022 and 2023 in the GFCM area of application, 1970–2023



rapa whelk (*Rapana venosa*), spottail mantis squillid (*Squilla mantis*), blue and red shrimp (*Aristeus antennatus*) and giant red shrimp (*Aristaeomorpha foliacea*), show a generally increasing trend, with fluctuations in some cases over recent years. As for species of conservation concern, such as piked dogfish (*Squalus acanthias*) and to a lesser extent European eel (*Anguilla anguilla*), landings have steeply declined.

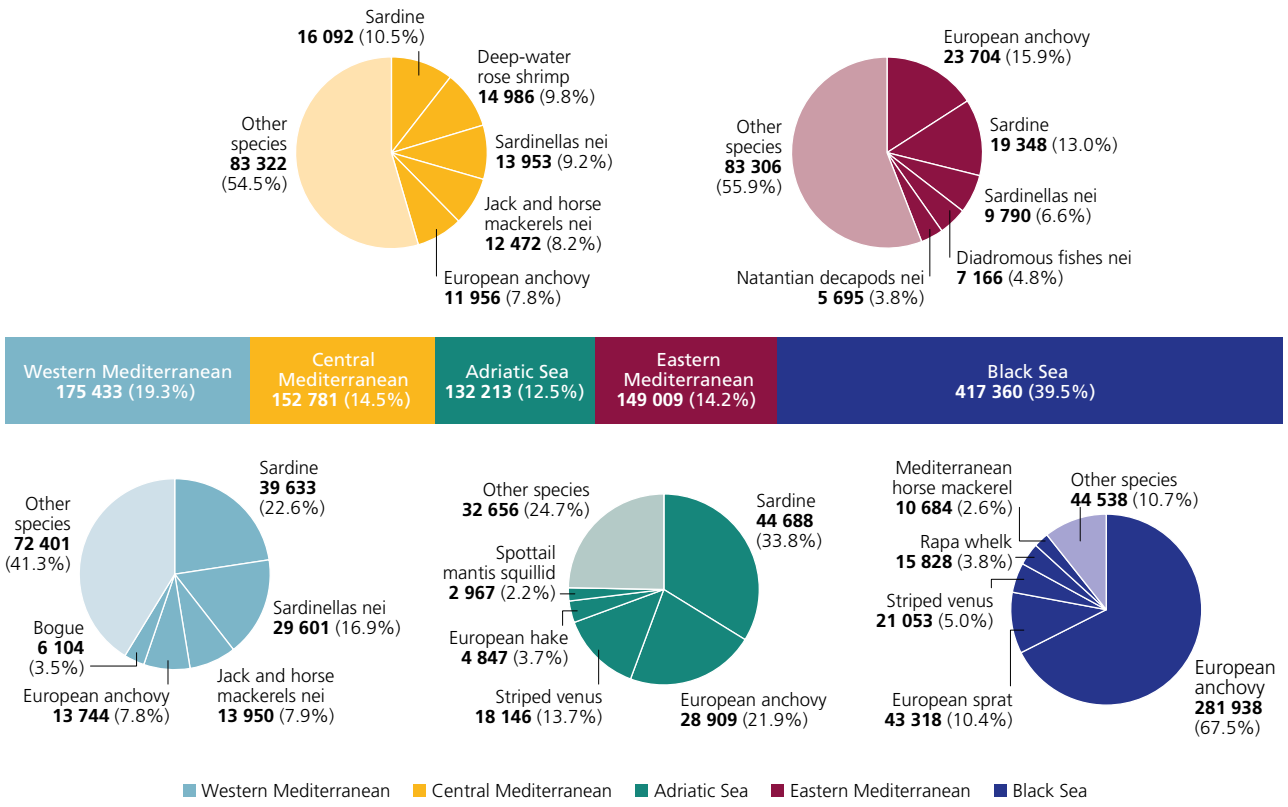
Landings across the Mediterranean and the Black Sea reveal distinct geographical patterns in species composition (Figure 15). In the western Mediterranean, which represents 19.3 percent of total landings in the GFCM area of application, catches are widely diversified, with sardine and sardinellas nei contributing 22.6 percent and 16.9 percent of landings, respectively. In the central Mediterranean

FIGURE 14. Annual landings of priority species averaging less than 5 000 tonnes between 2022 and 2023 in the GFCM area of application, 1970–2023



(14.5 percent of total landings in the GFCM area of application), landings are also diverse but show the notable importance of deep-water rose shrimp, representing 9.8 percent of the total, and sardinellas nei (9.2 percent), alongside sardine (10.5 percent). The Adriatic Sea (12.5 percent of total landings) is characterized by a limited number of dominant species, with sardine and European anchovy clearly predominant, contributing 33.8 percent and 21.9 percent of landings, respectively. In addition, molluscs, such as striped venus (*Chamelea gallina*), and demersal species, such as European hake, provide 13.7 percent and 3.7 percent of landings, confirming the Adriatic as a subregion where small pelagics dominate but demersal resources remain significant. In the eastern Mediterranean (14.2 percent of total landings), the fishery is characterized by high diversity and the absence of a single dominant species. European anchovy (15.9 percent) and sardine (13 percent) remain important, but a range of other resources, including sardinellas nei (6.6 percent), diadromous fishes nei (4.8 percent) and natantian decapods nei (3.8 percent), reflect the highly multispecies nature of fisheries in this subregion. By contrast, the Black Sea (39.5 percent of total landings) is dominated by European anchovy, which accounts for 67.5 percent of total landings, followed by European sprat at 10.4 percent. Other resources, such as striped venus (5 percent) and rapa whelk (3.8 percent), are of secondary importance, underlining the limited diversity of exploited species compared with Mediterranean subregions.

FIGURE 15. Total annual landings of main species by GFCM subregion, 2022–2023 average



Notes: Landings are expressed in tonnes.
Percentages indicate relative contributions of GFCM subregions to total landings in the GFCM area of application as well as the share of main species in total landings within the respective subregions, 2022–2023 average.

FISHING FLEET

The operating fishing fleet over the period 2022–2023 in the GFCM area of application totalled 83 075 fishing vessels (87 percent operating in the Mediterranean and 13 percent in the Black Sea), with a total capacity of 908 100 gross tonnage (GT) and around 5 806 000 kilowatts (kW) (Figure 16). Four countries – Türkiye, followed by Greece, Tunisia and Italy – account for 58 percent of the total fishing fleet (Figure 17). Of the total fishing fleet, over 6 000 fishing vessels (7.3 percent) are authorized to operate within the framework of 11 management plans, three dedicated management measures and three fisheries restricted areas (see Box 6).

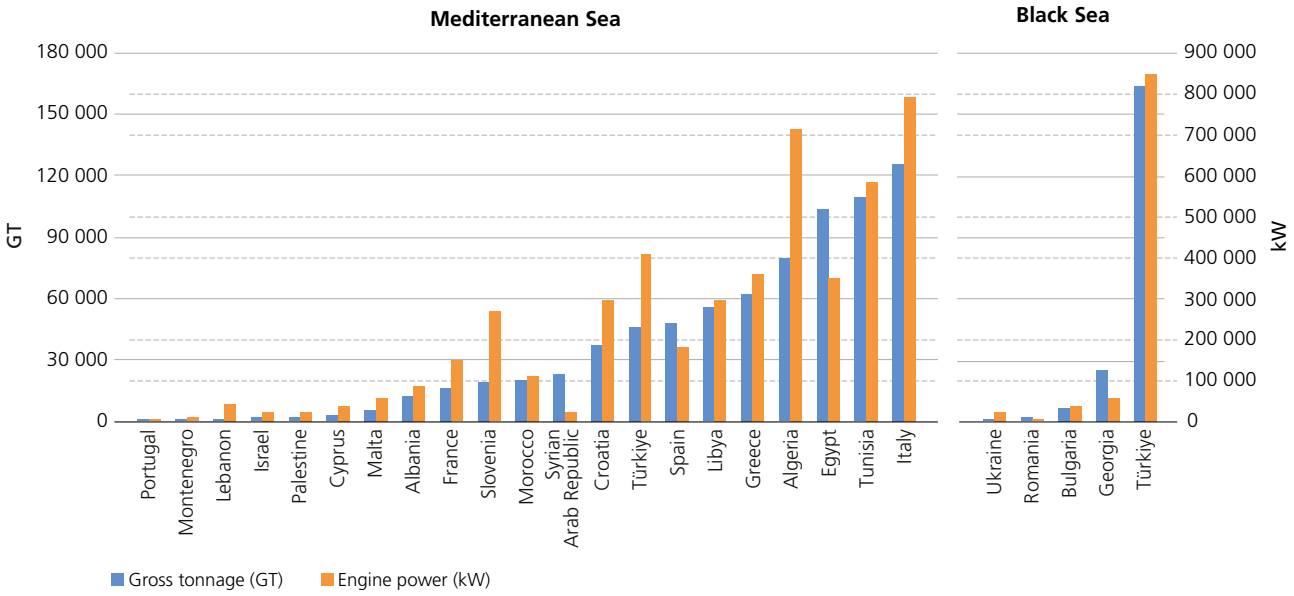
Five countries alone account for around 63 percent of the total fishing capacity in GT: Türkiye (17 percent), Italy (14 percent), Tunisia (12 percent), Egypt (11 percent) and Algeria (9 percent).

Italy is the highest contributor in GT in the Mediterranean Sea (16 percent), followed by Tunisia (14 percent). Türkiye is the predominant country in the Black Sea (82 percent), followed by Georgia (13 percent). Overall, there is a correspondence between total GT and total landings, although with some national and subregional patterns.

The available information on the year of fishing vessel construction (Figure 18), taking into consideration the differences of data coverage (78 percent in the Mediterranean Sea; 88 percent in the Black Sea) reveals similar patterns between the Mediterranean and the Black Sea. Fishing vessels over 35 years old are predominant in both basins, with 55.1 percent of the Mediterranean fishing fleet and more than 44 percent of the Black Sea fishing fleet located in this age class; the Black Sea comprises a significant portion of newer fishing vessels, with more than 39 percent under 25 years old.

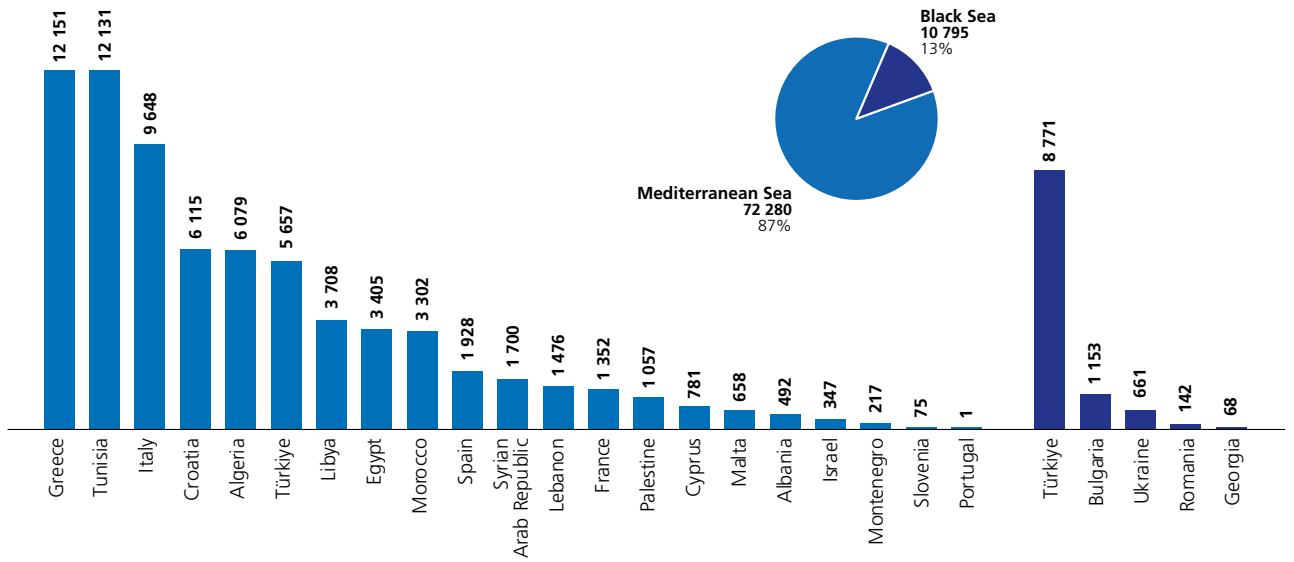
From a subregional point of view, the western Mediterranean has the youngest fishing fleet,

FIGURE 16. Fishing capacity by GFCM contracting party, cooperating non-contracting party, non-contracting party and relevant non-state actor in the Mediterranean and the Black Sea, 2022–2023 average



Notes: Bosnia and Herzegovina and Monaco are not included, having reported that they had no operating fishing fleet at the time of publication.
The Russian Federation did not provide data on its fishing fleet in the GFCM area of application and is not included in this analysis.
Reported values for the Libyan fishing fleet are based on the most recent national data officially submitted to the GFCM through the Data Collection Reference Framework and were subsequently estimated using information from comparable national fleets in the region.
Tunisian fleet capacity data are available only for fishing vessels with a gross tonnage exceeding 5 tonnes.
Data are presented as averages for the 2022–2023 reference period, except for countries and relevant non-state actors where data transmission to the GFCM was unavailable: Libya (2021), Palestine (2022), Syrian Arab Republic (2019) and Ukraine (2020).

FIGURE 17. Number of operating fishing vessels by GFCM contracting party, cooperating non-contracting party, non-contracting party and relevant non-state actor in the Mediterranean and the Black Sea, 2022–2023 average



Notes: Bosnia and Herzegovina and Monaco are not included, having reported that they had no operating fishing fleet at the time of publication.
The Russian Federation did not provide data on its fishing fleet in the GFCM area of application and is not included in this analysis.
Reported values for the Libyan fishing fleet are based on the most recent national data officially submitted to the GFCM through the Data Collection Reference Framework and were subsequently estimated using information from comparable national fleets in the region.
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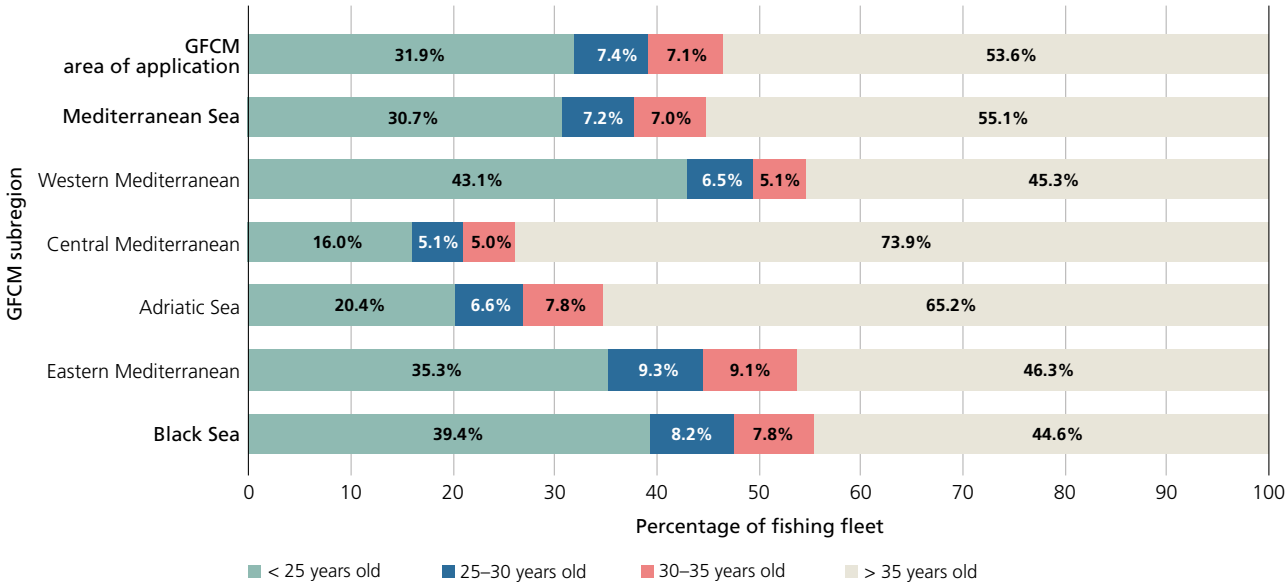
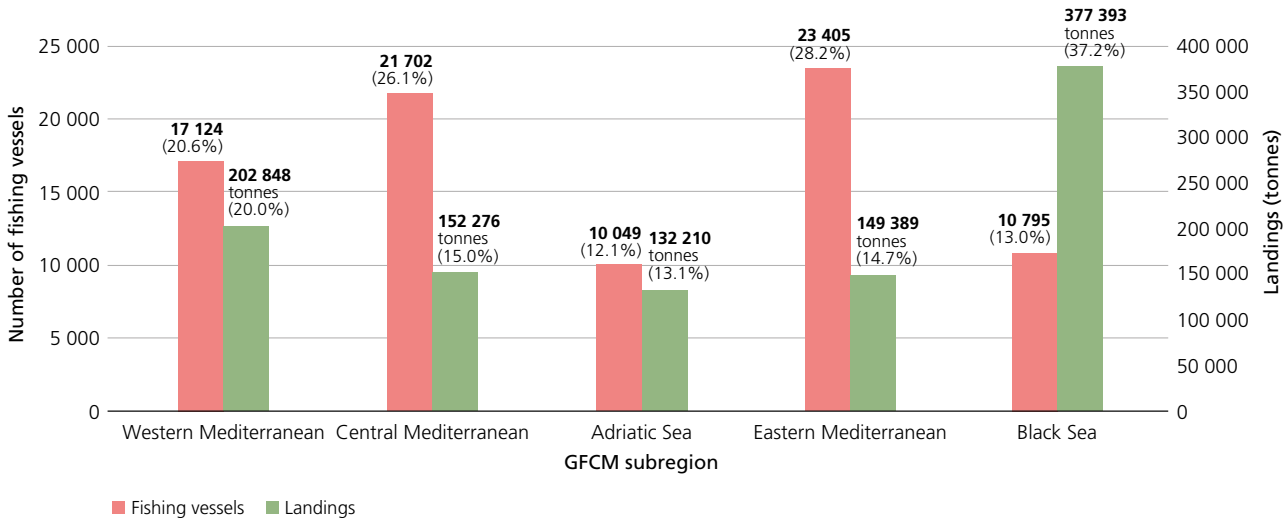
Data are presented as averages for the 2022–2023 reference period, except for countries and relevant non-state actors where data transmission to the GFCM was unavailable: Libya (2021), Palestine (2022), Syrian Arab Republic (2019) and Ukraine (2020).

FIGURE 18. Age composition of the fishing fleet in the GFCM area of application



Notes: Bosnia and Herzegovina and Monaco are not included, having reported that they had no operating fishing fleet at the time of publication.
The Russian Federation did not provide data on its fishing fleet in the GFCM area of application and is not included in this analysis.
Lebanon and the Syrian Arab Republic did not provide information on the age of their fishing fleets.

FIGURE 19. Operating fishing vessels and annual landings by GFCM subregion, 2022–2023 average

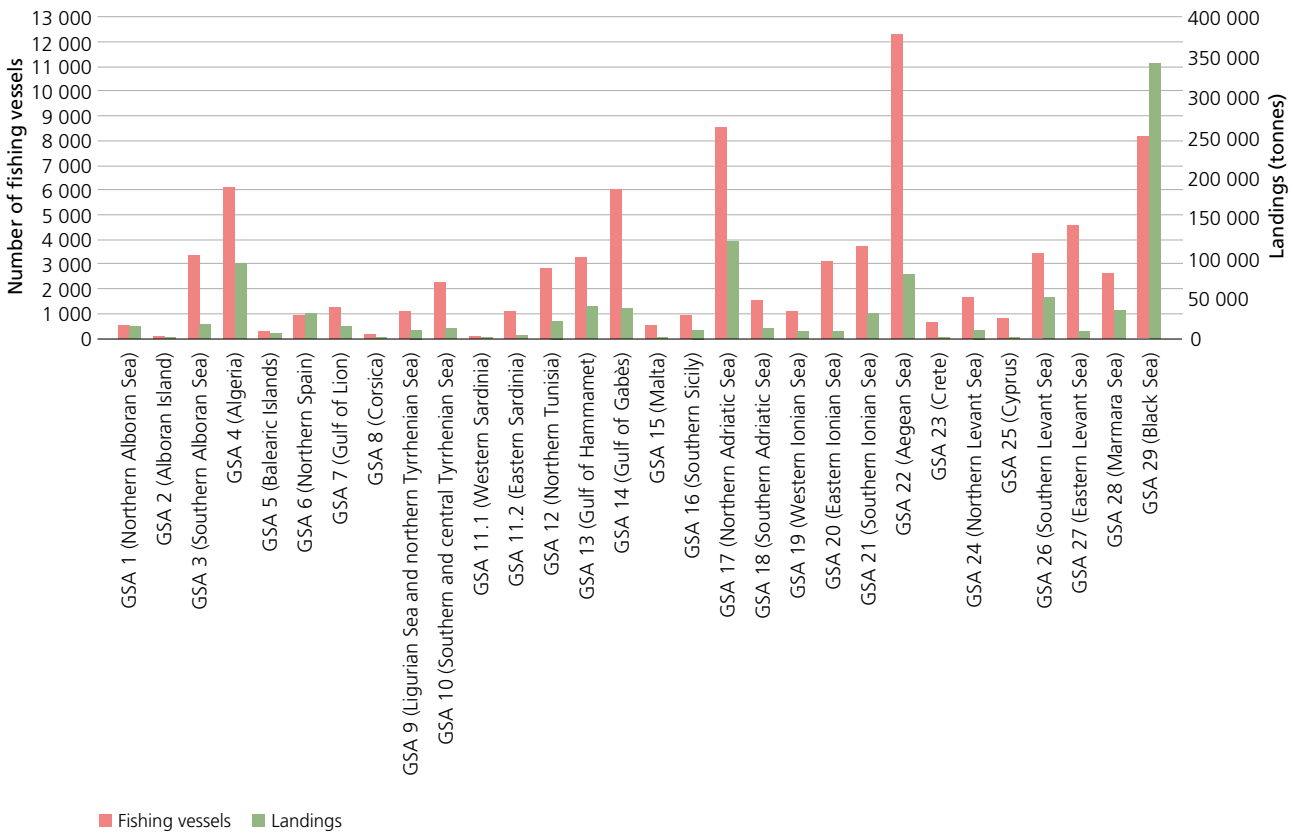


Notes: Percentages indicate relative contributions of GFCM subregions total number of vessels and total landings, 2022–2023 average.
Bosnia and Herzegovina and Monaco are not included, having reported that they had no operating fishing fleet at the time of publication.
The Russian Federation did not provide data on its fishing fleet in the GFCM area of application and is not included in this analysis.
Data are presented as averages for the 2022–2023 reference period, except for countries and relevant non-state actors where data transmission to the GFCM was unavailable: Libya (2021), Palestine (2022), Syrian Arab Republic (2019) and Ukraine (2020).

with 43.1 percent of fishing vessels under 25 years old, while the central Mediterranean fleet has the oldest fishing fleet with almost 74 percent of fishing vessels over 35 years old.

As of September 2025, 41 percent (4 569 vessels) of fishing vessels of 20 m length overall or more recorded in the GFCM regional fleet are registered with an International Maritime Organization number (Box 7). The increase in fishing vessel coverage, compared to the 22 percent reported in *The State of Mediterranean and Black Sea Fisheries 2022*

FIGURE 20. Operating fishing vessels and annual landings by geographical subarea, 2022–2023 average



Notes: Bosnia and Herzegovina and Monaco are not included, having reported that they had no operating fishing fleet at the time of publication.
The Russian Federation did not provide data on its fishing fleet in the GFCM area of application and is not included in this analysis.
Reported values for the Libyan fishing fleet are based on the most recent national data officially submitted to the GFCM through the Data Collection Reference Framework and were subsequently estimated using information from comparable national fleets in the region.
Tunisian fishing fleet capacity data are available only for fishing vessels with a gross tonnage exceeding 5 tonnes.
Data are presented as averages for the 2022–2023 reference period, except for countries and relevant non-state actor where data transmission to the GFCM was unavailable: Libya (2021), Palestine (2022), Syrian Arab Republic (2019) and Ukraine (2020).

(FAO, 2022c), marks a significant step forward in enhancing fishing vessel traceability and transparency under Target 2 "Compliance and enforcement: a level playing field to eradicate illegal, unreported and unregulated fishing" of the GFCM 2030 Strategy. This progress enables more effective monitoring, control and surveillance and strengthens efforts to combat illegal, unreported and unregulated fishing across the Mediterranean and the Black Sea.

Data from 2022–2023 highlight notable differences in landings and fishing fleet composition across the five subregions of the GFCM area of application (Figure 19). The largest shares of operating fishing vessels are found in the eastern (28.2 percent, 23 400 fishing vessels) and central Mediterranean (26.1 percent, 21 700 fishing vessels). However, the Black Sea (37.2 percent, 377 400 tonnes) and the western Mediterranean (20 percent, 202 800 tonnes) remain the most productive subregions in terms of landings. Notably, the Black Sea records the highest landings despite having one of the lowest numbers of fishing vessels, suggesting the prevalence of a large-scale fishing fleet targeting anchovy and European sprat. In contrast, the high number of fishing vessels in the eastern and central Mediterranean correlates with the presence of a larger percentage of small-scale vessels. In the Adriatic Sea, the number of fishing vessels is relatively low, yet the amount of landings is comparatively high, again linked to the predominance of small pelagic fisheries.

A breakdown of available data at GSA level (Figure 20) reveals that four GSAs together account for 62 percent of total landings (around 663 300 tonnes) and 42 percent of the total

operating fishing fleet (around 35 100 fishing vessels) in the GFCM area of application. These are GSA 4 (Algeria), GSA 17 (northern Adriatic Sea), GSA 22 (Aegean Sea) and GSA 29 (Black Sea). The largest subarea, GSA 29, contributes the greatest share of landings, with 33.7 percent of the total (341 500 tonnes) – slightly less than three times more the second-ranking subarea, GSA 17, which records 119 100 tonnes (11.7 percent of the total). In terms of operating fishing fleet, GSA 22 has the largest number of fishing vessels, with 12 300 operating fishing vessels (14.8 percent of the total).

In the Mediterranean Sea, five GSAs account for approximately 52 percent of all operating fishing vessels: GSA 22 (Aegean Sea, 17 percent), GSA 17 (northern Adriatic Sea, 11.8 percent), GSA 4 (Algeria, 8.4 percent), GSA 14 (Gulf of Gabès, 8.4 percent) and GSA 27 (eastern Levant Sea, 6.3 percent). In terms of landings, GSA 17 contributes the most (18.7 percent), followed by GSA 4 (14.6 percent), GSA 22 (12.5 percent) and GSA 26 (southern Levant Sea, 7.8 percent). Together, these four GSAs represent more than half of the total capture fisheries production in the Mediterranean Sea.

In 2023, 20.1 percent of the total catch in the Mediterranean Sea (127 900 tonnes) were landed in ten ports, all located in the southern part of the basin. In the Black Sea, the ten main landing ports received around 54.9 percent of total landings in the basin (228 500 tonnes).

In terms of operating fishing vessels, the ten main ports are all located in the Mediterranean Sea and account for 8.5 percent of all fishing vessels operating in the GFCM area of application and 9.8 percent of Mediterranean fishing vessels (Box 8).

FISHING FLEET SEGMENTS

The analysis of fishing fleet segments[3] operating in the Mediterranean and the Black Sea during the 2022–2023 period is based on a total of 54 segments – defined as the intersections of all predefined vessel groups and length classes. As with results reported in *The State of Mediterranean and Black Sea Fisheries 2022* (FAO, 2022c), the current analysis reveals a heterogeneous approach to data collection across countries, resulting in overlapping length ranges among fishing fleet segments. This heterogeneity prevents detailed national-level comparisons across all fishing fleet segments. However, excluding the group "Unallocated fishing vessels" (which represents around 2 percent of the total), the data show that around 81 percent of all fishing vessels operating in the GFCM area of application fall under the "Small-scale vessels" group. It is followed by "Trawlers and beam trawlers" (8.6 percent), "Purse seiners and pelagic trawlers" (5.4 percent) and "Other fleet segments" (4.8 percent) (Table 2). The prevalence of the "Small-scale vessels" group is slightly higher in the Black Sea (83.2 percent) compared to the Mediterranean Sea (80.9 percent). Similarly, the fishing fleet segment group "Trawlers and beam trawlers" shows a higher percentage in the Black Sea (9.9 percent) than in the Mediterranean Sea (8.2 percent).

Based on available data, the "Small-scale vessels" group accounts for over 90 percent of the operating fishing fleet in 11 countries – nine in the Mediterranean (Croatia, Cyprus, France, Greece, Israel, Lebanon, Montenegro, Tunisia and Türkiye) and two in the Black Sea (Bulgaria and Ukraine).

As was the case in *The State of Mediterranean and Black Sea Fisheries 2023* (FAO, 2023c), the "Purse seiners and pelagic trawlers" group continues to account for the largest share of total landings in the GFCM area of application, contributing 63.1 percent overall. This group is responsible for 49.8 percent of landings in the Mediterranean Sea – ranging from 40.6 percent in the central Mediterranean to 57.9 percent in the Adriatic Sea – and a dominant 84.4 percent in the Black Sea (Figure 21). The "Trawlers and beam trawlers" group ranks second, contributing 17.4 percent of total landings. Its relative importance is greater in the Mediterranean (24.6 percent) than in the Black Sea (5.8 percent), with the eastern Mediterranean showing the highest share at 29 percent. The "Small-scale vessels" group is more prominent in the Mediterranean, where it represents 19.2 percent of total landings, reaching 34 percent in the central Mediterranean, compared with just 3.2 percent in the Black Sea.

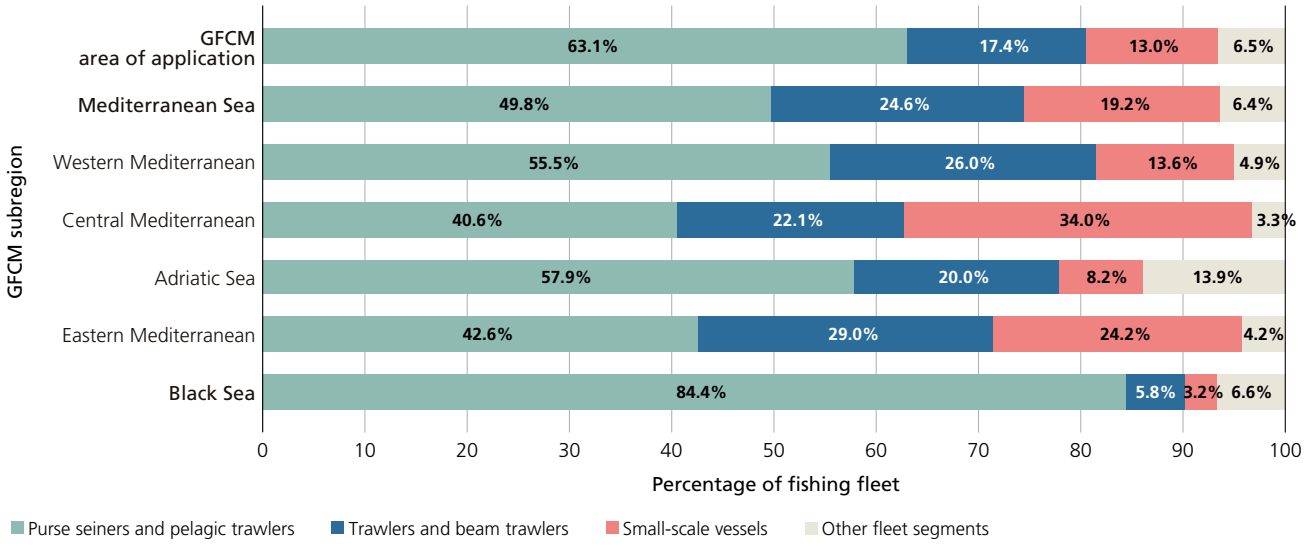
[3] Recommendation GFCM/41/2017/6 on the submission of data on fishing activities in the GFCM area of application defines the concept of fishing fleet segment flexibility for data reporting by CPCs. In line with the guidance provided in the GFCM Data Collection Reference Framework manual, each fishing vessel is assigned to a fleet segment based on the dominant gear used – defined as the gear employed for more than 50 percent of the fishing vessel's time at sea over the course of the year.

TABLE 2. Number of operating fishing vessels by fleet segment group and by GFCM contracting party, cooperating non-contracting party, non-contracting party and relevant non-state actor

CPCs, non-contracting parties and non-state actors	Fleet segment group					Total	
	Small-scale vessels	Trawlers and beam trawlers	Purse seiners and pelagic trawlers	Other fleet segments	Unallocated	Vessels	Share of total fleet (in percent)
Mediterranean Sea							
Albania	353	123	15	1		**492**	**0.7**
Algeria	3 955	552	1 540	32		**6 079**	**8.4**
Croatia	5 633	306	155	21		**6 115**	**8.5**
Cyprus	728	5		48		**781**	**1.1**
Egypt	1 372	794	240	999		**3 405**	**4.7**
France	1 229	74	9	40		**1 352**	**1.9**
Greece	11 602	239	211	99		**12 151**	**16.8**
Israel	329	10	8			**347**	**0.5**
Italy	5 883	2 151	442	1 172		**9 648**	**13.3**
Lebanon	1 384		83	9		**1 476**	**2**
Libya	2 719	212	115	662		**3 708**	**5.1**
Malta	532	18	4	104		**658**	**0.9**
Montenegro	195	9	13			**217**	**0.3**
Morocco	2 954	182	122	44		**3 302**	**4.5**
Palestine	829	15	213			**1 057**	**1.5**
Portugal				1		**1**	
Slovenia	64	11				**75**	**0.1**
Spain	969	587	175	198		**1 928**	**2.7**
Syrian Arab Republic					1 700	**1 700**	**2.4**
Tunisia	11 141	399	377	214		**12 131**	**16.8**
Türkiye	5 218	224	142	73		**5 657**	**7.8**
Total	**57 089**	**5 911**	**3 864**	**3 717**	**1 700**	**72 280**	
Share of total (in percent)	**79.0**	**8.2**	**5.3**	**5.1**	**2.4**		
Black Sea							
Bulgaria	1 079	10	47	17		**1 153**	**10.7**
Georgia		17	51			**68**	**0.6**
Türkiye	7 188	1 014	462	107		**8 771**	**81.3**
Romania	102	19		21		**142**	**1.3**
Ukraine	614	4		43		**661**	**6.1**
Total	**8 983**	**1 064**	**560**	**188**		**10 795**	
Share of total (in percent)	**83.2**	**9.9**	**5.2**	**1.7**			

Notes:
Bosnia and Herzegovina and Monaco are not included, having reported that they had no operating fishing fleet at the time of publication.
The Russian Federation did not provide data on its fishing fleet in the GFCM area of application and is not included in this analysis.
Data are presented as averages for the 2022–2023 reference period, except for countries and relevant non-state actors where data transmission to the GFCM was unavailable: Libya (2021), Palestine (2022), Syrian Arab Republic (2019) and Ukraine (2020).

FIGURE 21. Fleet segment composition and their contributions to annual landings in the GFCM area of application, 2022–2023 average



Notes: Tunisia (central Mediterranean) and Ukraine (Black Sea) were included in the analysis by applying the ratio from their most recent complete submission of data by fleet segment (2018 for Tunisia and 2020 for Ukraine) to their total landings.
Bosnia and Herzegovina (Adriatic Sea), Libya (central Mediterranean), the Russian Federation (Black Sea) and the Syrian Arab Republic (eastern Mediterranean) are not included, as they did not provide data on national landings by fleet segment under the GFCM Data Collection Reference Framework.

The miscellaneous group "Other fleet segments" accounts for 6.5 percent of total landings, with a slightly higher share in the Black Sea (6.6 percent) than in the Mediterranean (6.4 percent), peaking in the Adriatic Sea at 13.9 percent.

CONCLUDING REMARKS

Overall, both landings and the operating fishing fleet in the region remain stable since *The State of Mediterranean and Black Sea Fisheries 2023* (FAO, 2023c), despite differing trends among countries. In the Mediterranean, specifically in some of the main producers including Greece, Italy and Spain, landings have shown a downward trend over the long term. In the Black Sea, landings have fluctuated over the long term, also reflected in the main Black Sea producer, Türkiye. Changes in landings result from a combination of factors, such as management measures (including output controls like catch limits; see Chapter 6), fluctuations in natural resources and changes in the fishing fleet, including as a result of adopted measures. Some of the short-term changes observed in this chapter are likely related to the impacts of the COVID-19 pandemic and the subsequent increase in fishing activity, while abrupt changes like the large decrease in catches from Ukraine is related to cessation of fishing activity in the northwest Black Sea.

In areas with large abundance of small pelagics, where these species dominate the landings, in particular in the Black Sea and the Adriatic Sea, variability in landings is larger than elsewhere, reflecting the natural, partially climate-driven, fluctuation of these short-lived resources. Nevertheless, some of these species, while fluctuating, also exhibit long-term declining trends (e.g. in the Adriatic Sea) or boom-and-bust dynamics (e.g. in the Black Sea where there was a historical collapse of small pelagics).

Importantly, in parallel with the stabilization of landings and specific decrease in various countries and priority species under management plans, there is an overall increase of biomass at sea, as reported in Chapter 3, pointing, on the one hand, to the effectiveness of management actions in place (Chapter 6) and, on the other, to the impacts of those measures on production and socioeconomic indicators (Chapter 5).

Box 6. Fishing vessels authorized to operate under GFCM management plans and measures and within fisheries restricted areas

This box presents the most up-to-date information on the number of fishing vessels, average overall length and fishing capacity for the fishing fleets authorized to operate in GFCM priority fisheries and fisheries restricted areas (FRAs). Fisheries are listed in alphabetical order, with countries having submitted a list of authorized fishing vessels in brackets.

Based on the most recent information available in the GFCM databases (September 2025), over 6 000 fishing vessels – corresponding to 7.3 percent of the total fishing fleet in the GFCM area of application – are authorized to operate under 11 GFCM multiannual management plans, three GFCM management measures and within three FRAs. Approximately 1 000 of these fishing vessels are authorized to operate in more than one key fishery (i.e. managed by more than one GFCM decision). This situation is quite evident in the Strait of Sicily and the Black Sea, where 617 and 331 fishing vessels are engaged, respectively.

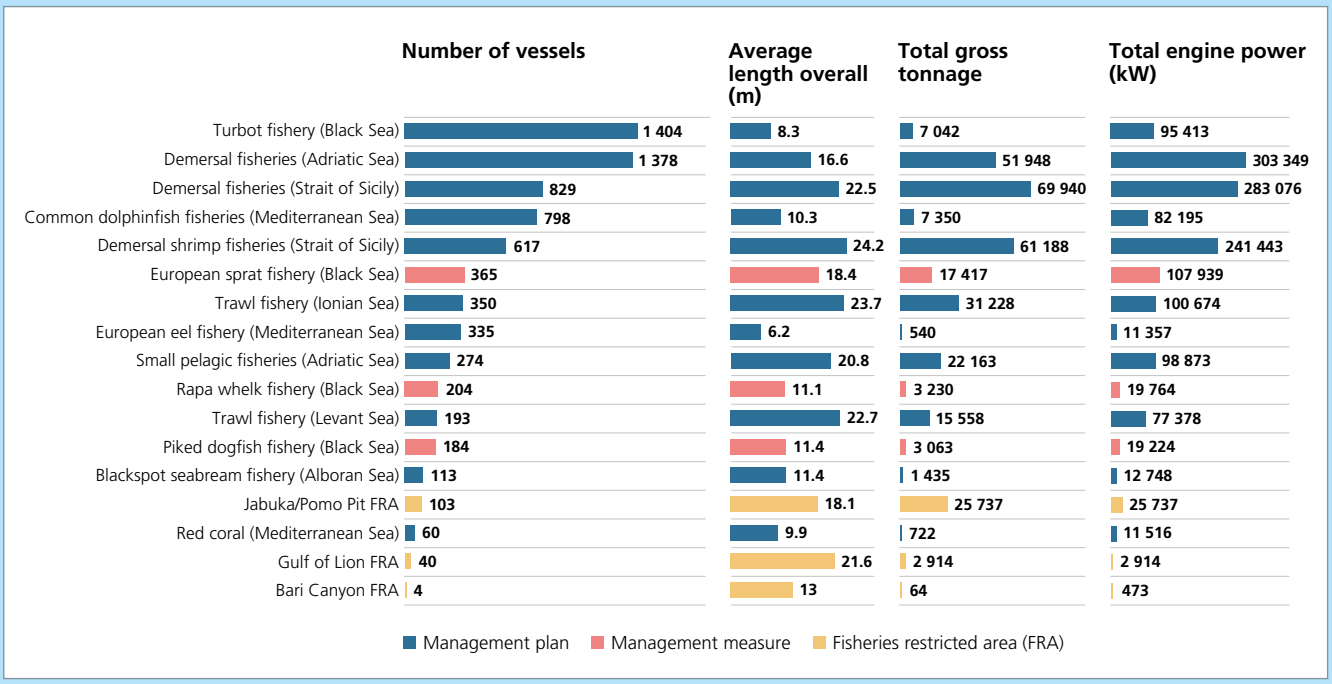
The greatest number of authorized fishing vessels (1 404) operate under the multiannual management plan for turbot fisheries in the Black Sea, with around 53 percent of this fishing fleet belonging to Türkiye. This is closely followed by the multiannual management plan for demersal fisheries in the Adriatic Sea (1 378 fishing vessels), with Italy contributing 64 percent of the authorized fishing fleet.

A total of 147 fishing vessels are authorized to operate in the three FRAs where regulated fishing activities are permitted. Of these, 70 percent operate in the Jabuka/Pomo Pit (geographical subarea [GSA] 17), 27 percent in the Gulf of Lion (GSA 7) and 3 percent in the Bari Canyon (GSA 18). In the Jabuka/Pomo Pit, Croatia and Italy contribute nearly equally to the composition of the fishing fleet, whereas in the Gulf of Lion, Spain accounts for 70 percent of fishing vessels and France accounts for 30 percent. The Italian fishing fleet is the only one operating in the Bari Canyon FRA.

Blackspot seabream (*Pagellus bogaraveo*) fishery in the Alboran Sea – GSAs 1 to 3 (Morocco and Spain)
113 fishing vessels (around 1 400 gross tonnage [GT]) are authorized. Morocco and Spain contribute around 60 percent and 40 percent of the total fishing fleet, respectively.

Common dolphinfish (*Coryphaena hippurus*) fisheries using anchored fish aggregating devices in the Mediterranean Sea (Italy, Malta, Spain and Tunisia)
798 fishing vessels (7 350 GT) are authorized on a seasonal basis. In terms of fishing capacity, Tunisia accounts for 52 percent of the total fleet fishing common dolphinfish with anchored fish aggregating devices in the Mediterranean Sea.

Number and main characteristics of fishing vessels authorized to operate in GFCM priority fisheries and fisheries restricted areas



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Box 6. (Continued)

Demersal fisheries in the Adriatic Sea – GSAs 17 and 18 (Albania, Croatia, Italy, Montenegro and Slovenia)
1 378 fishing vessels (almost 52 000 GT) operate. These vessels are bottom trawlers authorized for demersal fisheries in the Adriatic Sea, with around 64 percent of the total fishing fleet belonging to Italy.

Demersal fisheries in the Strait of Sicily – GSAs 12 to 16 (Cyprus, Italy, Malta, Spain and Tunisia)
829 fishing vessels (almost 70 000 GT), all bottom trawlers, are authorized for demersal fisheries in the Strait of Sicily. Tunisia and Italy account for around 52 percent and 46 percent of the total fishing fleet, respectively.*

Demersal shrimp fisheries in the Strait of Sicily – GSAs 12 to 16 (Cyprus, Italy, Malta, Spain and Tunisia)
617 fishing vessels (around 61 200 GT) operate. These vessels are trawlers authorized for deep-water shrimp fisheries in the Strait of Sicily. Tunisia accounts for around 70 percent of the total fishing fleet.*

European eel (*Anguilla anguilla*) fishery in the Mediterranean Sea (Croatia, France, Greece, Spain and Tunisia)
335 fishing vessels (around 540 GT) operate in transitional and brackish waters, mostly acting as auxiliary boats. France accounts for 58 percent of the total fishing fleet. Albania, Egypt and Italy also participate in this fishery without a specific authorized vessel list.

European sprat (*Sprattus sprattus*) fishery in the Black Sea – GSA 29 (Bulgaria, Romania and Türkiye)
365 fishing vessels (around 17 400 GT) exploit this priority species in the Black Sea, with 58 percent of the total fishing fleet belonging to Türkiye.

Rapa whelk (*Rapana venosa*) fishery in the Black Sea – GSA 29 (Bulgaria and Romania)
204 fishing vessels (around 3 200 GT) are involved in the rapa whelk fishery in the Black Sea, with Bulgaria accounting for 80 percent of the total fishing fleet.

Red coral (*Corallium rubrum*) in the Mediterranean Sea (Croatia, France, Italy and Tunisia)
60 fishing vessels (720 GT) are used for harvesting red coral in the Mediterranean Sea. Tunisia accounts for around 50 percent of the total fishing fleet. Croatia has recently closed the red coral harvesting activity but is still included in this analysis with the latest data.

Small pelagic fisheries in the Adriatic Sea – GSAs 17 and 18 (Albania, Croatia, Italy, Montenegro and Slovenia)
274 fishing vessels (around 22 100 GT) operate. These vessels are purse seiners and pelagic trawlers authorized to fish for priority small pelagic stocks in the Adriatic Sea (GSAs 17 and 18). Croatia and Italy account for around 51 percent and 32 percent of the fishing fleet, respectively.

Trawl fishery in the Ionian Sea – GSAs 19 to 21 (Greece, Italy and Malta)
350 fishing vessels (around 31 200 GT) operate. These vessels are bottom trawlers authorized for demersal fisheries targeting giant red shrimp (*Aristaeomorpha foliacea*) and blue and red shrimp (*Aristeus antennatus*) in the Ionian Sea. Greece accounts for around 65 percent of the total fishing fleet.

Trawl fishery in the Levant Sea – GSAs 24 to 27 (Cyprus, Egypt, Israel, Italy and Türkiye)
193 fishing vessels (around 15 600 GT) operate. These vessels are bottom trawlers authorized for demersal fisheries targeting giant red shrimp and blue and red shrimp in the Levant Sea. Türkiye and Egypt account for around 48 percent and 27 percent, respectively.

Turbot (*Scophthalmus maximus*) fishery in the Black Sea – GSA 29 (Bulgaria, Romania, Türkiye and Ukraine)
1 404 fishing vessels (approximately 7 000 GT) operate. Vessels using bottom-set gillnets are authorized to fish for turbot. Türkiye and Ukraine account for around 53 percent and 33 percent, respectively. Georgia contributes with low significant impact on the fishing capacity with coastal bycatch fishing.

Note: *The reported data include all Tunisian trawlers, i.e. not only those officially authorized.

Box 7. International Maritime Organization number

The International Maritime Organization (IMO) number, assigned under the IMO ship identification number scheme, is a well-established and reliable unique vessel identifier (IMO, 1987). It enables the clear and consistent identification of vessels and plays a key role in combating illegal, unreported and unregulated fishing.

Resolution GFCM/44/2021/6 on the application of an International Maritime Organization number, amending Resolution GFCM/41/2017/6 (GFCM, 2025) defines two new criteria for the assignment of IMO numbers:

- fishing vessels with a length overall (LOA) of 20 m or more, regardless of hull material (steel or non-steel); and
- fishing vessels operating in international waters.

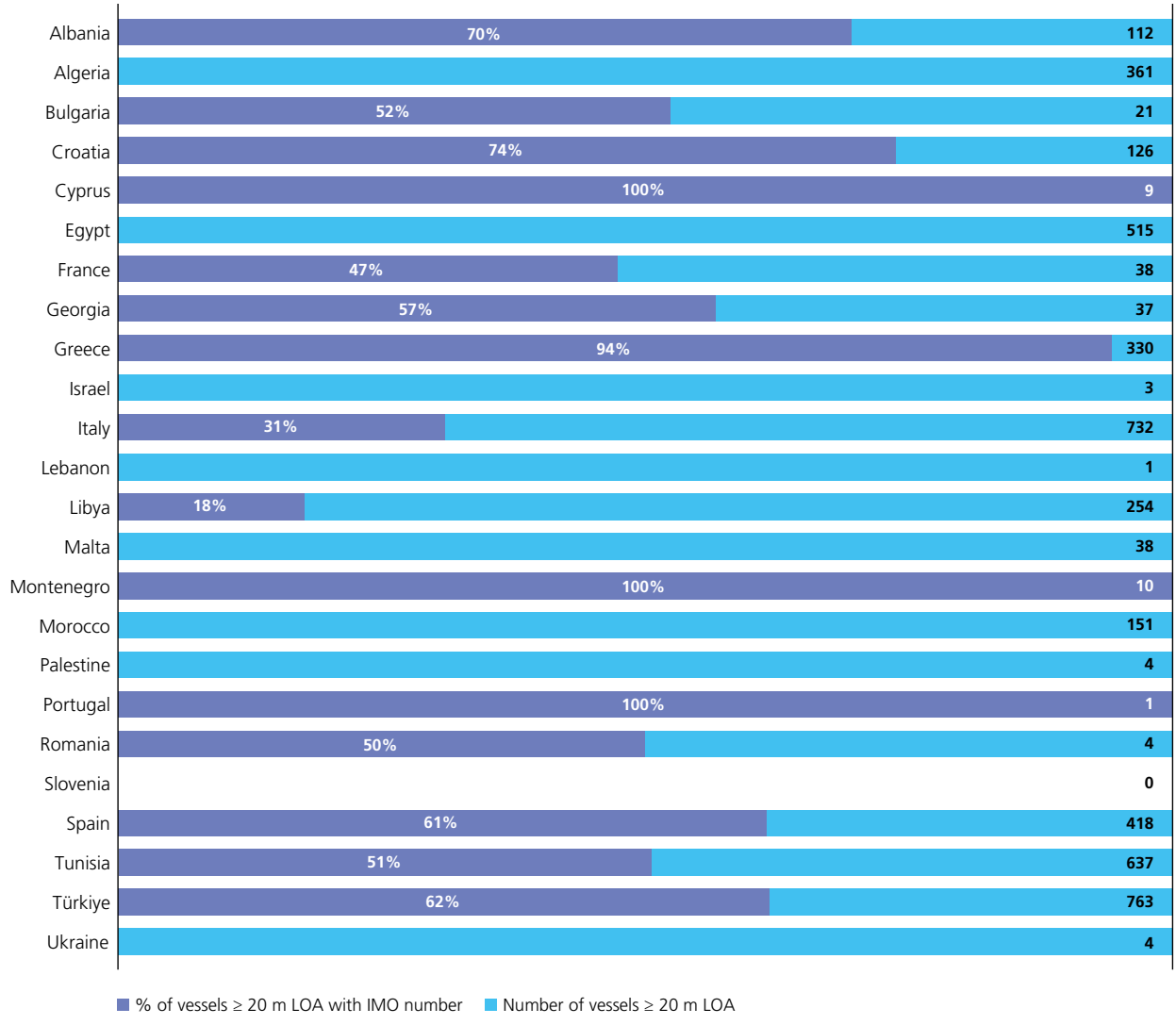
As the GFCM does not hold information on fishing vessels' operating waters, only the first criterion – fishing vessels 20 m LOA or longer – is considered in this analysis.

Reported data reveal that over 41 percent of the total fishing fleet above 20 m LOA (4 569 fishing vessels) have an IMO number.

Only Cyprus, Montenegro and Portugal, which have the smallest fishing fleets in this size category, report full coverage of IMO number assignment. They are followed by Greece, Croatia and Türkiye with assignment rates of 94 percent, 74 percent and 62 percent, respectively.

Sources:
GFCM. 2025. *Compendium of GFCM decisions*. Rome. https://fao.org/gfcm/decisions
IMO. 1987. *Resolution A.600(15)*. London. Resolution subsequently amended by Resolution A.1078(28) and Resolution A.1117(30).

Fishing vessels with 20 m length overall or more and percentage with an International Maritime Organization number, by contracting party, cooperating non-contracting party, non-contracting party and relevant non-state actor



Notes: Bosnia and Herzegovina and Monaco are not included, having reported that they had no operating fishing fleet at the time of publication.
The Russian Federation and the Syrian Arab Republic did not provide data on their fishing fleets in the GFCM area of application.
Slovenia has no fishing vessels with a length overall of 20 m or more.

Box 8. Main landing ports in the Mediterranean and the Black Sea

This box provides an analysis of the main fishing ports in the Mediterranean and the Black Sea, in terms of landings and operating fishing vessels, based on voluntary data submissions from Mediterranean and Black Sea countries.

Main ports by volume of landings

Based on the available information, the ten main ports in terms of volume of landings in the GFCM area of application are distributed as follows: two in the Mediterranean Sea (one in Egypt and one in Tunisia) and eight in the Black Sea (one in Georgia and seven in Türkiye). This group of ports receives around 23.3 percent of total landings in the GFCM area of application, while its combined operating fishing vessels account for about 14 percent of the total fishing fleet.

The breakdown by area shows that the ten leading ports by volume of landings in the Mediterranean Sea – accounting collectively for approximately 20.1 percent of total landings – are all located in the southern part of the basin (one in Algeria, three in Egypt and five in Tunisia), with the exception of one port in Croatia.

In the Black Sea, nine of the main ports by volume of landings are located in Türkiye and one in Georgia. Together, they account for approximately 54.9 percent of total landings in the area.

Main ports by volume of landings in the GFCM area of application

Port	Country	Landings (tonnes)	Percentage contribution
Batumi (Black Sea)	Georgia	66 250	6.29
Dereköy B.B. (Black Sea)	Türkiye	30 082	2.86
Teboulba (Mediterranean)	Tunisia	23 812	2.26
Samsun Merkez B.B. (Black Sea)	Türkiye	23 586	2.24
Yakakent B.B. (Black Sea)	Türkiye	23 141	2.20
Ezbet El Borg (Mediterranean)	Egypt	18 994	1.80
Demirci Köyü B.B. (Black Sea)	Türkiye	15 117	1.44
Giresun Merkez B.B. (Black Sea)	Türkiye	15 076	1.43
Güzelkent B.B. (Black Sea)	Türkiye	14 847	1.41
Inebolu Gemiciler B.B. (Black Sea)	Türkiye	14 010	1.33

Note: Percentage contributions reflect the share of each main port in the total landings in the GFCM area of application for the reference year 2023, with the exception of Bosnia and Herzegovina (2018), Libya (2021), the Syrian Arab Republic (2018) and Ukraine (2018).

Main ports by volume of landings in the Mediterranean Sea

Port	Country	Landings (tonnes)	Percentage contribution
Teboulba	Tunisia	23 812	3.74
Ezbet El Borg	Egypt	18 994	2.98
Chebba	Tunisia	12 865	2.02
Port Saïd	Egypt	12 157	1.91
Gabès	Tunisia	11 267	1.77
Ghazaouet	Algeria	10 761	1.69
El-Burullus	Egypt	9 772	1.53
Kélibia	Tunisia	9 423	1.48
Zarzis	Tunisia	8 874	1.39
Zadar–Gaženica	Croatia	8 497	1.33

Main ports by volume of landings in the Black Sea

Port	Country	Landings (tonnes)	Percentage contribution
Batumi	Georgia	66 250	15.91
Dereköy B.B.	Türkiye	30 082	7.23
Samsun Merkez B.B.	Türkiye	23 586	5.67
Yakakent B.B.	Türkiye	23 141	5.56
Demirci Köyü B.B.	Türkiye	15 117	3.63
Giresun Merkez B.B.	Türkiye	15 076	3.62
Güzelkent B.B.	Türkiye	14 847	3.57
Inebolu Gemiciler B.B.	Türkiye	14 010	3.36
Terme B.B.	Türkiye	13 265	3.19
Vakfıkebir B.B.	Türkiye	13 120	3.15

(Continued)

Box 8. (Continued)

Main ports by number of operating fishing vessels

The ranking of the ten main ports across the GFCM area of application shifts significantly when considering the number of operating fishing vessels contributing to landings, rather than the volume of landings alone. Based on the available information, the ten leading ports by number of operating fishing vessels are all located in the Mediterranean Sea – one in Egypt, two in Libya, two in Morocco and five in Tunisia. Collectively, these ports represent approximately 8.5 percent of all fishing vessels operating in the GFCM area of application (or 9.8 percent when considering only Mediterranean fishing vessels). They also account for 8.4 percent of the region's total landings and 14 percent of landings within the Mediterranean alone.

In the Black Sea, nine out of the ten most important ports by number of operating fishing vessels are located in Türkiye and one is in Bulgaria. They account for around 16.4 percent of the fishing vessels operating in the Black Sea and contribute 13.9 percent of the total landings.

Main ports by volume of landings, by Mediterranean subregion

In the western Mediterranean, the ten most important landing ports are located in Algeria (eight ports) and Morocco (two ports). In the central Mediterranean, the ten leading landing ports are found in Tunisia (nine ports) and Italy (one port). In the Adriatic Sea, the ten main landing ports are located in Italy (six ports) and Croatia (four ports). In the eastern Mediterranean, the ten most important landing ports are in Egypt (six ports), Greece (two ports) and Türkiye (two ports).

Main ports in terms of number of operating fishing vessels, by Mediterranean subregion

When ranking countries by number of operating fishing vessels at their main landing ports – rather than by volume of landings – different patterns emerge across the GFCM subregions.

In the western Mediterranean, the ten leading ports are located in Algeria and Morocco. In the central Mediterranean, all ten most important ports are located in Tunisia. In the Adriatic Sea, five of the ten main ports are located in Italy, four in Croatia and one in Albania. In the eastern Mediterranean, the ten main ports are spread across Egypt (six ports), Türkiye (two ports), Lebanon (one port) and the Syrian Arab Republic (one port).

Main ports by number of operating fishing vessels in the Mediterranean Sea

Port	Country	Fishing vessels
Ezbet El Borg	Egypt	1 200
Zarzis	Tunisia	887
Chebba	Tunisia	754
Sfax	Tunisia	733
Nador	Morocco	676
Al Hoceima	Morocco	639
Bizerte	Tunisia	558
Zuwarah	Libya	548
Misurata	Libya	543
Teboulba	Tunisia	513

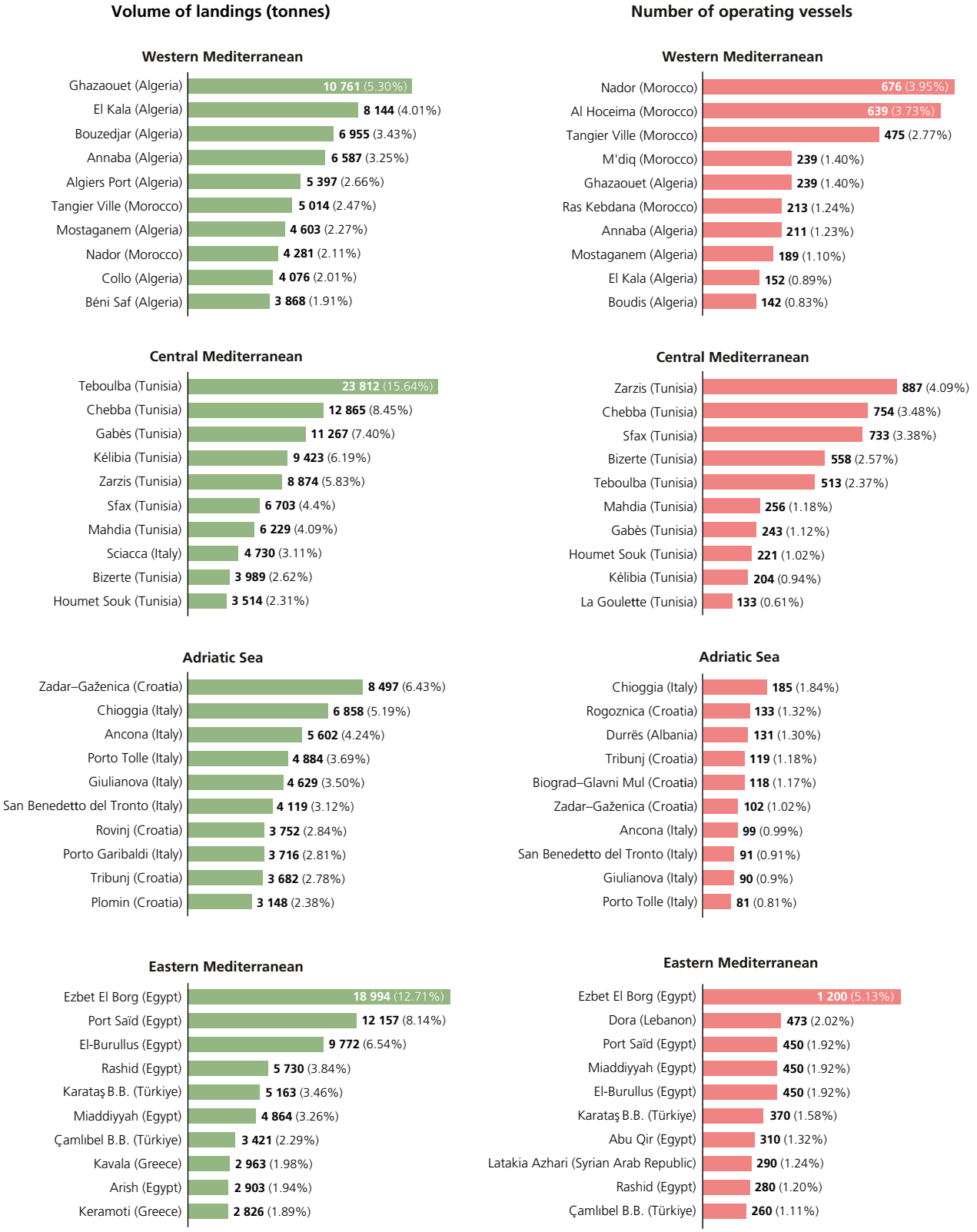
Main ports by number of operating fishing vessels in the Black Sea

Port	Country	Fishing vessels
Dereköy B.B.	Türkiye	269
Inebolu Gemiciler B.B.	Türkiye	255
Yakakent B.B.	Türkiye	252
Güzelkent B.B.	Türkiye	252
Demirci Köyü B.B.	Türkiye	200
Samsun Merkez B.B.	Türkiye	134
Terme B.B.	Türkiye	111
Giresun Merkez B.B.	Türkiye	104
Sozopol	Bulgaria	100
Vakfıkebir B.B.	Türkiye	92

(Continued)

Box 8. (Continued)

Main ports in terms of volume of landings and number of operating vessels by Mediterranean subregion



Note: Percentages indicate the relative contributions of the main ports to total landings (left) and to the total number of operating fishing vessels (right) in their respective Mediterranean subregions, 2022–2023 average.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2. Bycatch: discards and incidental catch of vulnerable species

Bycatch, which includes both discards and the incidental catch of vulnerable species, remains a central ecological and management challenge in Mediterranean and Black Sea fisheries. Discards, defined as the practice of returning to the sea part of the catch, whether dead or alive, occur due to regulatory, market or selectivity reasons (FAO, 2019a). They result in unreported fishing mortality which, if not adequately accounted for, can reduce recruitment, alter trophic dynamics and undermine stock assessment. The methodologies for data collection on discards and incidental catch of vulnerable species in the Mediterranean and the Black Sea (FAO, 2019a; 2019b), along with the recommendations adopted by the GFCM (GFCM, 2025a)[4] and the outputs of the GFCM stock assessment working groups, place particular emphasis on measures aimed at preventing overfishing and minimizing discards. In this context, the integration of discard information is essential

[4] Recommendation GFCM/40/2016/5 establishing a minimum conservation reference size for European hake in the Mediterranean Sea; Recommendation GFCM/43/2019/3 amending Recommendation GFCM/41/2017/4 on a multiannual management plan for turbot fisheries in the Black Sea (geographical subarea 29); and Recommendation GFCM/45/2022/7 on a multiannual management plan for sustainable demersal trawl fisheries targeting giant red shrimp and blue and red shrimp in the Levant Sea (geographical subareas 24 to 27), repealing Recommendation GFCM/42/2018/3.

for improving fishing mortality estimates and strengthening scientific advice, especially in mixed multispecies fisheries that are typical of the region.

The interactions with vulnerable species (i.e. elasmobranchs, sea turtles, seabirds and marine mammals) occur across different types of fishing activities. Although often episodic, these interactions can have significant demographic impacts on long-lived, slow-reproducing species. The decline of such species may trigger cascading effects throughout the food web, potentially compromising the resilience and productivity of marine environments. Therefore, reducing the incidental catch of vulnerable species is not only a conservation priority but also a key component of broader ecosystem-based fisheries management.

Addressing these challenges requires a coherent governance response that translates scientific evidence into coordinated monitoring, mitigation and management actions. Over the past decade, regional and international commitments have driven significant progress, with the GFCM playing a pivotal role in coordinating efforts to tackle both discards and interactions of fishing activities with vulnerable species. The GFCM 2030 Strategy for sustainable fisheries and aquaculture in the Mediterranean and the Black Sea (GFCM 2030 Strategy; see Box 2) and the Regional Plan of Action to Monitor and Mitigate Interactions between Fisheries and Vulnerable Species in the Mediterranean and the Black Sea (GFCM, 2025a)[5] have reinforced the political and technical framework for action, calling for science-based measures, stronger data collection and the implementation of practical mitigation tools tailored to different fisheries and fleet segments. In parallel, the GFCM Data Collection Reference Framework (DCRF; see Box 4) has standardized reporting on discards and incidental catch across the region, while technical assistance and capacity development initiatives such as MedSea4Fish and BlackSea4Fish (FAO, 2025c, 2025d) have enabled several countries to collect harmonized data on catch composition, discards and incidental catch of vulnerable taxa across multiple fishing gear types and vessel groups. Together, these instruments and initiatives provide the basis for identifying fisheries with a high discard rate or significant interactions with vulnerable species and informing adaptive strategies that are consistent with an ecosystem-based approach.

[5] Resolution GFCM/46/2023/4 on a regional plan of action to monitor and mitigate interactions between fisheries and vulnerable species in the Mediterranean and the Black Sea

DISCARDS

Discards continue to represent a major management and conservation concern in Mediterranean and Black Sea fisheries, particularly in mixed demersal trawl fisheries, where juveniles of commercial species are often affected. While the ecological consequences of discards are well established, attention has recently shifted towards improving data collection and integrating discard information into stock assessments. Advances under the DCRF, coupled with national observer programmes and pilot projects, have gradually expanded the availability of standardized data across fishing gear and subregions.

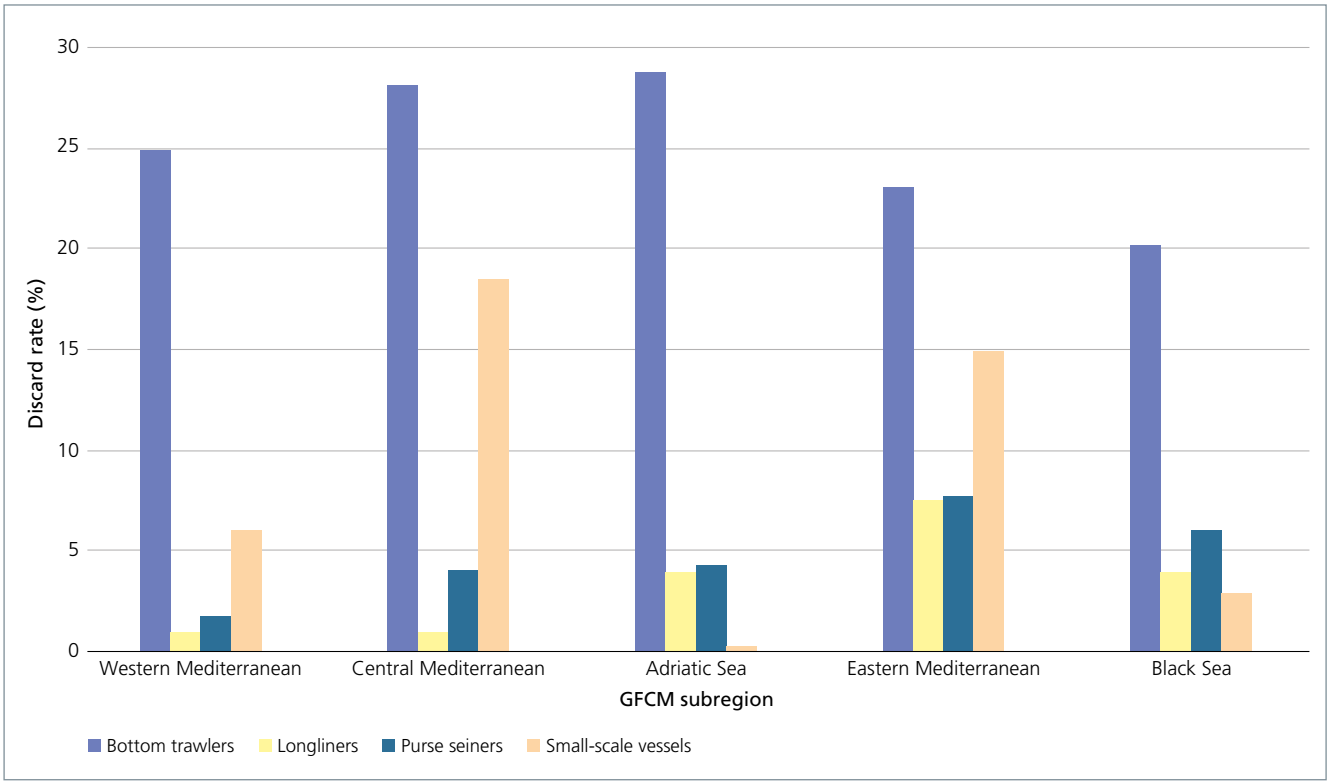
This chapter provides an overview of average discard rates by vessel group and GFCM subregion, summarizing the most recent data gathered through regional monitoring programmes, the DCRF, the outcomes of the Working Group on the Analysis of Fisheries Monitoring Data (GFCM, 2023) and scientific literature (i.e. peer-reviewed scientific papers, grey literature and technical papers). The data illustrate that discards are not uniformly distributed across the region, and both fishing gear type and subregional context (e.g. market demand, local consumption patterns, social conditions and regulatory frameworks) play key roles in shaping discard dynamics. Complementary information on marine litter was also gathered, offering preliminary additional insights into the wider environmental impacts affecting both ecosystems and fisheries (Box 9).

DISCARD RATE BY VESSEL GROUP AND GFCM SUBREGION

Bottom trawlers

Bottom trawling, which involves the exploitation of demersal species, is a widespread fishing method across the GFCM area of application. Although contributing to regional economies and seafood supply (see Chapter 5), this fishing method is responsible for the highest discard rate

FIGURE 22. Average discard rate of vessel groups by GFCM subregion, 2015–2025



across all vessel groups, ranging from 20 percent in the Black Sea to over 28 percent in the Adriatic Sea (Figure 22).

In the western Mediterranean, the discard rate is highly variable and strongly influenced by depth, season and fishing grounds, typically averaging around 24 percent (Lucchetti *et al.*, 2021; GFCM, 2023). Studies indicate that discards tend to be higher in shallow strata than in deeper grounds, with depth acting as the main driver of species composition in discards (Tiralongo *et al.*, 2021; Blanco *et al.*, 2023). Across the western basin, discard peaks are often linked to specific species: at the shelf break (100–200 m), European hake (*Merluccius merluccius*) and deep-water rose shrimp (*Parapenaeus longirostris*) are dominant, while horse mackerel (*Trachurus* spp.) discards are more common at around 150 m depth, and red mullet (*Mullus barbatus*) is mostly discarded in waters shallower than 100 m (El Arraf *et al.*, 2024; Tsagarakis *et al.*, 2024).

In the central Mediterranean, the average discard rate is comparatively high, at approximately 28 percent, with discards mainly composed of juvenile European hake, red mullet, cephalopods and various benthic invertebrates. In this subregion, higher values are observed in shallow coastal grounds and in shrimp-oriented fishing activities (Vitale *et al.*, 2018). In shrimp trawl fisheries in the Strait of Sicily targeting for example giant red shrimp (*Aristaeomorpha foliacea*) and deep-water rose shrimp, the discard rate typically ranges between 25 percent and 40 percent (Milisenda *et al.*, 2017; Geraci, 2023). Other observations across the subregion confirm comparable levels, with values within a 15–40 percent range, depending on the depth and target assemblages (FAO, 2023c). Localized peaks have been reported in the eastern Ionian Sea, where discard levels are around 42 percent, with some hauls reaching up to 83 percent (Karris *et al.*, 2018). Preliminary studies in the southern part of the subregion indicate a discard rate of approximately 11 percent, with juveniles of European hake, small ray species, horse mackerel and invertebrates dominating the discarded fraction (Buzaid, Ali and El Mor, 2017).

In the Adriatic Sea, the average discard rate is also relatively high, at 28 percent, comparable to those reported for the central Mediterranean, with values occasionally exceeding 50 percent (Petetta *et al.*, 2023). This is mainly attributable to the shallow bathymetry and broad continental shelves,

which favour high bycatch levels of juveniles of demersal species (FAO, 2022c). Variability is influenced by season, fishing depth and fleet characteristics (Petetta, 2023). Targeting mainly European hake, red mullet and deep-water rose shrimp, these fisheries discard large volumes of undersized individuals, non-target benthic fauna (including crustaceans, echinoderms and sponges) and small elasmobranchs such as small-spotted catshark (*Scyliorhinus canicula*) (Petetta, 2023; GFCM, 2023).

In the eastern Mediterranean, the average discard rate is slightly lower, at around 23 percent, with values showing high variability, ranging from 15 percent to over 60 percent. This variability is mainly driven by differences in fishing gear types, seasonal dynamics and the proximity of fishing operations to nursery grounds. Moderate values between 17 percent and 20 percent are commonly associated with undersized red mullets, flatfish, juvenile cephalopods and non-commercial crustaceans (FAO, 2022c; GFCM, 2023; Tsagarakis *et al.*, 2024). In shallower strata, the discard rate often rises to 18–28 percent, with blennies, small ray species and benthic crustaceans dominating the unwanted fraction (Edelist *et al.*, 2011). Some fisheries exhibit even higher levels, with rates between 30 percent and 45 percent, characterized by a high presence of small elasmobranchs, low-value benthic fish and non-indigenous species (NIS) such as silver-cheeked toadfish (*Lagocephalus sceleratus*) (Yemişken, Dalyan and Eryilmaz, 2014; FAO, 2022c). In the Aegean Sea, discard levels in shallow waters can range between 36 percent and 63 percent, with the largest fraction consisting of juvenile red mullet and common pandora (*Pagellus erythrinus*) (Cerim *et al.*, 2022).

In the Black Sea, bottom trawl fisheries are usually associated with a moderate discard rate, averaging around 20 percent. However, higher levels have also been reported, with some surveys recording a discard rate of around 31 percent of the total catch (Uzer, Yıldız and Karakulak, 2017). Discard rates of 42 percent were documented in coastal trawl operations, with significant depth-related variation (Ceylan, Şahin and Kalaycı, 2014). The species composition of discards typically includes mainly juveniles of whiting (*Merlangius merlangus*) and turbot (*Scophthalmus maximus*), along with some benthic fish (*Gobius* spp., *Callionymus* spp.) and occasionally elasmobranchs such as piked dogfish (*Squalus acanthias*).

Longliners

Longline fisheries generally exhibit a low discard rate compared to other fishing gear, typically below 5 percent across most subregions, with slightly higher values observed in the eastern Mediterranean, where they may reach 7–8 percent (Figure 22). Despite the relatively small discard volumes, the ecological implications of longline incidental catch are significant, as vulnerable and threatened elasmobranchs are often incidentally caught. Examples include smooth-hound (*Mustelus* spp.), guitarfish (*Rhinobatos* spp.) and sandbar shark (*Carcharhinus plumbeus*), particularly in the western and central Mediterranean, as well as blue shark (*Prionace glauca*), which are mainly associated with pelagic longliners in the Adriatic Sea (Saïdi *et al.*, 2019; Saïdi, Enajjar and Bradai, 2023; Mancusi *et al.*, 2020; Serena *et al.*, 2020; Carbonara *et al.*, 2024). Although species diversity is lower than in the Mediterranean, the incidental capture of threatened elasmobranchs remains a management concern in the Black Sea too (Bengil and Başusta, 2018).

In the western Mediterranean, demersal longliners are among the most selective fishing gear, with an average discard rate of around 1 percent and rarely exceeding 2 percent (e.g. in the northern part of the subregion) (GFCM, 2023). Most of the unwanted catch consists of small benthic sharks, such as small-spotted catshark and blackmouth catshark (*Galeus melastomus*) (Dulvy *et al.*, 2016; Serena *et al.*, 2020; Carpentieri *et al.*, eds., 2021), together with small individuals of teleosts, including blackspot seabream (*Pagellus bogaraveo*), red porgy (*Pagrus pagrus*) and slender rockfish (*Scorpaena elongata*).

In the central Mediterranean, the discard rate remains low, averaging around 1 percent (FAO, 2020, 2022c). There is evidence that discards increasingly include non-commercial benthic teleosts and a growing proportion of NIS, such as silver-cheeked toadfish (Kleitou *et al.*, 2022; Christidis *et al.*, 2024). The rising incidence of NIS has raised ecological and socioeconomic concerns, given both their impact on native biodiversity and the economic losses caused by fishing gear damage; however it has also created new potential opportunities (Katsanevakis *et al.*, 2014; Kleitou *et al.*, 2022).

In the Adriatic Sea, the average discard rate from longline fisheries is consistently low, usually under 5 percent. Also in this case, incidental catch

mainly consists of small elasmobranchs such as small-spotted catshark, rays and non-commercial benthic teleosts, many of which are reused as bait or occasionally retained for consumption (FAO, 2023c; Carbonara *et al.*, 2024).

In the eastern Mediterranean, average discard levels are relatively higher, reaching up to 8 percent (Tsagarakis *et al.*, 2014). Discards are mainly composed of non-commercial benthic fish, small elasmobranchs and NIS, notably the silver-cheeked toadfish and other pufferfish, which often represent a significant fraction of discarded biomass (Öndes *et al.*, 2018; Ulman *et al.*, 2023). Other NIS, such as rabbitfish (*Siganus* spp.) and devil firefish (*Pterois miles*), are also recurrent (Carpentieri *et al.*, eds., 2021; Papageorgiou and Moutopoulos, 2023).

In the Black Sea, demersal longline fisheries operating in coastal waters typically display an average discard rate of around 5 percent (FAO, 2023c). The discarded fraction is dominated by small benthic teleosts and elasmobranchs, such as piked dogfish and thornback ray (*Raja clavata*) (Çebin, Yeşilçiçek and Kalaycı, 2024).

Purse seiners

Purse seine fisheries exhibit some of the lowest discard rates across all vessel groups and subregions, typically ranging from about 2 percent in the western Mediterranean to around 8 percent in the eastern Mediterranean (Figure 22). This reflects the inherently high selectivity of the fishing gear, which targets dense schools of small pelagic species such as European anchovy (*Engraulis encrasicolus*), sardine (*Sardina pilchardus*) and round sardinella (*Sardinella aurita*).

In the western Mediterranean, purse seiners generally display a low average discard rate of around 2 percent; in the central Mediterranean, the discard rate is around 4 percent, while in the Adriatic Sea it is slightly below 5 percent. In some areas, effective handling, market alignment and fishing gear configuration and selectivity, coupled with the schooling behaviour of target species, can bring the rate down to nearly zero (Tsagarakis, Palialexis and Vassilopoulou, 2012; Scarcella, Sala and Ligas, 2020; STECF, 2021; FAO, 2023c).

In the eastern Mediterranean, purse seine discard levels are more variable, averaging around 7.5 percent and ranging from 2 percent to 15 percent, depending on the area and season. For instance, purse seiners in the Aegean Sea record a discard rate of around 4.5 percent, mainly composed of small or damaged fish (Tsagarakis, Palialexis and Vassilopoulou, 2012). Other studies report values of around 3 percent, although peaks of up to 30 percent have been observed in anchovy fisheries under specific conditions (Düzbastılar *et al.*, 2023). These relatively elevated discard rates are likely driven by fluctuations in school composition and by the occasional occurrence of non-target or low market value species.

In the Black Sea, the discard rate generally averages around 6 percent. However, there is considerable spatial variability across the subregion. Along the southern Black Sea coast, discard rates are generally low, with both anchovy and horse mackerel purse seine fisheries averaging around 1.5 percent (Şahin, Ceylan and Kalaycı, 2015). In contrast, other studies have indicated values of up to 8 percent in horse mackerel fisheries and 37 percent in anchovy fisheries, highlighting considerable variability depending on local ecological and operational factors (Kasapoğlu and Düzgüneş, 2017).

Small-scale vessels

Small-scale fisheries show the greatest heterogeneity in average discard rates, with values ranging from around 0.5 percent in the Adriatic Sea to over 15 percent in the central and eastern Mediterranean (Figure 22). This variability reflects the diversity of the fishing gear used (e.g. trammel nets, gillnets, traps), the influence of NIS, the seasonal availability of juveniles, the market-driven selectivity and the occurrence of some important interactions with vulnerable species, reported mainly in the Adriatic Sea (marbled electric ray [*Torpedo marmorata*] and common stingray [*Dasyatis pastinaca*]; Iveša *et al.*, 2021) and the Black Sea (harbour porpoise [*Phocoena phocoena relicta*]; see Chapter 6)

The average discard rate in the western Mediterranean is typically around 6 percent. Broad reviews report similar values with trammel nets and gillnets, occasionally reaching 17 percent (Cornet, 2024; GFCM, 2023). However, certain trammel net fisheries targeting common spiny lobster (*Palinurus elephas*) may reach up to 40 percent.

In the central Mediterranean, the discard rate is generally higher, around 18 percent on average, although higher values have been recorded, depending on the target species, season and grounds (Falsone *et al.*, 2020; FAO, 2022c). The expansion of NIS, particularly silver-cheeked

toadfish and rabbitfish, which have become increasingly important components of discards in this subregion, contributing to both economic losses and fishing gear damage (Coro *et al.*, 2018; Kleitou *et al.*, 2022; Liontakis and Vassilopoulou, 2023; Christidis *et al.*, 2024).

In the Adriatic Sea, the average discard rate is typically very low (below 2 percent), although wide fluctuations can occur (Pranovi *et al.*, 2016). Catch comparison experiments documented trammel net discard rates ranging from 5 percent to 44 percent, with higher values associated with shallow sandy habitats, seasonal peaks in the abundance of juveniles of certain species and longer soak times (Petetta *et al.*, 2020).

In the eastern Mediterranean, the average discard rate is higher and more variable, averaging around 15 percent across the subregion, particularly in coastal fisheries where NIS dominate the catch. Rabbitfish, silver-cheeked toadfish and devil firefish are increasingly prevalent in discards, undermining the economic viability of small-scale fishing gear (Kondylatos *et al.*, 2023; Christidis *et al.*, 2024). In the southern part of the subregion, coastal small-scale vessels display discard rates that notably vary by fishing gear: trammel nets discard approximately 13 percent, while gillnets discard around 6 percent of the total catch weight, thereby underlining gear-specific differences in selectivity (Saber *et al.*, 2022).

In the Black Sea, small-scale passive fishing gear usually reports an average discard rate below 5 percent. By contrast, average discard levels can be substantially higher in specific fisheries: up to 30 percent for flatfish and goby gillnets, 58 percent for trammel nets and around 7 percent for bonito gillnets (Kasapoglu and Duzgunes, 2017). Along the southeastern Black Sea coast, whiting gillnet fisheries show a higher discard rate in shallow waters due to increased juvenile bycatch (Kalaycı and Yeşilçiçek, 2014).

CONCLUDING REMARKS ON DISCARDS

Across the GFCM area of application, bottom trawlers remain the main contributors to discards, with average rates starting at around 20 percent and generally ranging from moderate to high. These values are mainly driven by the capture of undersized individuals of target species, benthic invertebrates and non-target fish, with depth, season and proximity to nursery grounds acting as key drivers. By contrast, longliners generally display low discard levels, usually below 5 percent, although their ecological implications remain significant due to the incidental catch of vulnerable elasmobranchs. Purse seiners maintain very low discard rates in almost all subregions, with slightly higher values in parts of the eastern Mediterranean linked to seasonal fluctuations in school composition. Small-scale vessels exhibit the greatest variability, ranging from very low values in the Adriatic Sea to higher levels in the central and eastern Mediterranean, particularly where NIS dominate discards. In this context, the increasing presence of NIS in discards is particularly evident across several types of fishing gear, including trawls, longlines and those used in small-scale fisheries. While their proliferation still raises ecological and socioeconomic concerns due to impacts on native biodiversity, economic losses and fishing gear damage, their exploitation is already providing socioeconomic opportunities in some areas and fisheries, particularly in the eastern Mediterranean, such as along the Turkish coast and parts of Greek coasts, where several NIS (e.g. rabbitfish and devil firefish) are increasingly utilized or marketed (Öztürk, 2021; Kleitou *et al.*, 2022; Papageorgiou and Moutopoulos, 2023). These emerging uses could be more widely promoted as part of adaptive management strategies.

Overall, discard hot spots are strongly gear-related, being concentrated in trawl fisheries, while longliners raise conservation rather than discard concerns and purse seiners minimally contribute to unwanted catches. Reducing trawl discards should therefore remain a management priority, complemented by targeted monitoring and co-management for small-scale fisheries, as well as the mitigation of incidental catch in longliners. Despite recent progress, data collection remains uneven and often incomplete, which limits the integration of discards into stock assessments and weakens the scientific basis for management advice. Strengthening monitoring, improving reporting and fostering regional cooperation is essential to address discard issues and ensure the long-term sustainability of Mediterranean and Black Sea fisheries.

INCIDENTAL CATCH OF VULNERABLE SPECIES

Increasing attention is being paid to interactions between fisheries and vulnerable taxa (i.e. elasmobranchs, sea turtles, seabirds and marine mammals) in the Mediterranean and the Black Sea. While the ecological risks of such interactions are well recognized, recent progress has focused on improving monitoring and reporting systems. Initiatives such as the MedBycatch project (FAO, 2025e), national observer programmes and enhanced data collection under the DCRF have significantly expanded the evidence base (GFCM, 2018; FAO, 2019b; ACCOBAMS, 2022). Since the last editions of *The State of Mediterranean and Black Sea Fisheries* (FAO, 2022c, 2023c), efforts have continued towards obtaining more disaggregated data by species group, fishing gear type, vessel group and subregion, providing a clearer picture of the scale and distribution of interactions.

Areas with high interactions between vessel groups and vulnerable species

At the regional level, available data suggest that vulnerable elasmobranchs account for around 64.6 percent of total incidental catch and sea turtles for 30.7 percent, while seabirds (1.1 percent) and marine mammals (3.6 percent) appear to have much lower, or at least less frequently reported, interactions with fishing activities.

The composition of the incidental catch of vulnerable species varies substantially across subregions (Figure 23). Incidental catch of elasmobranchs is reported primarily in the central Mediterranean (46.7 percent), followed by the western Mediterranean (27.5 percent) and the eastern Mediterranean (24.7 percent). Sea turtles represent the largest share of incidental catch in the central Mediterranean (45.2 percent), the Adriatic Sea (22.9 percent) and the eastern Mediterranean (22.4 percent). The incidental catch of marine mammals is overwhelmingly concentrated in the Black Sea (94.3 percent), while seabird interactions, though limited overall, are most common in the western Mediterranean (72.1 percent) and central Mediterranean (24.3 percent). Incidental catch composition also varies by vessel group, with bottom trawlers emerging as the dominant contributor to total incidental catch, accounting for over 60 percent of elasmobranch and 34.5 percent of sea turtle interactions. Small-scale vessels account for the vast majority of incidental catch of marine mammals and over half of seabird interactions. Longliners contribute significantly to the incidental catch of sea turtles (22.1 percent) and seabirds (48.6 percent) (Figure 24). These proportions reflect the relative composition of reported interactions within each subregion and vessel group; however absolute values are not directly comparable due to sampling limitations.

FIGURE 23. Relative contributions of GFCM subregions to the total incidental catch of vulnerable species in the GFCM area of application, 2015–2025

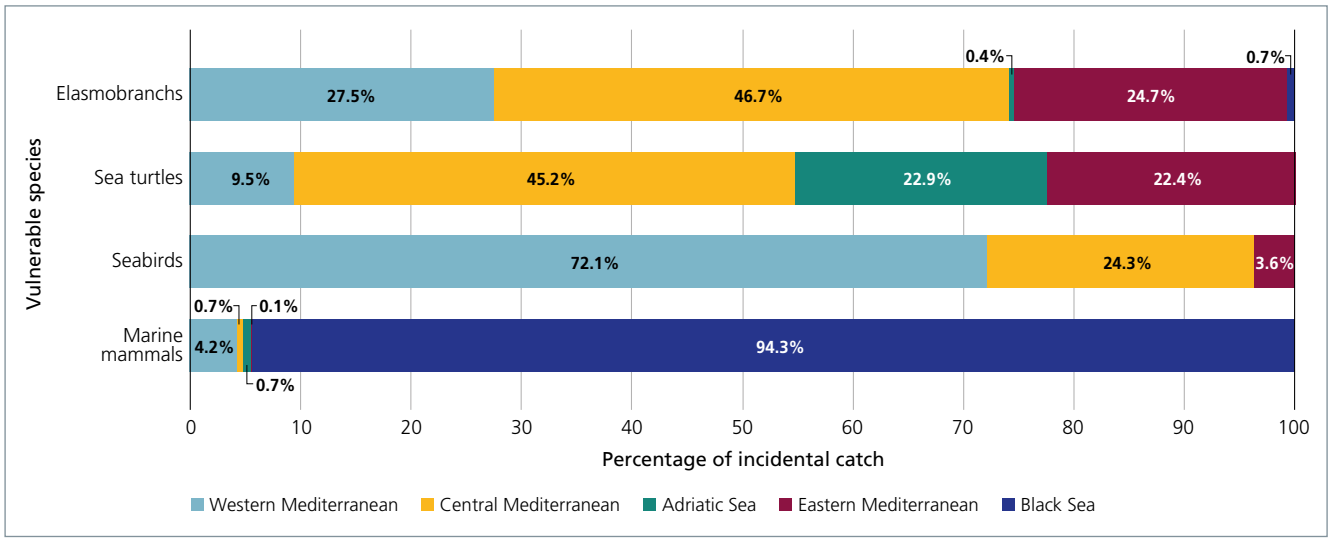
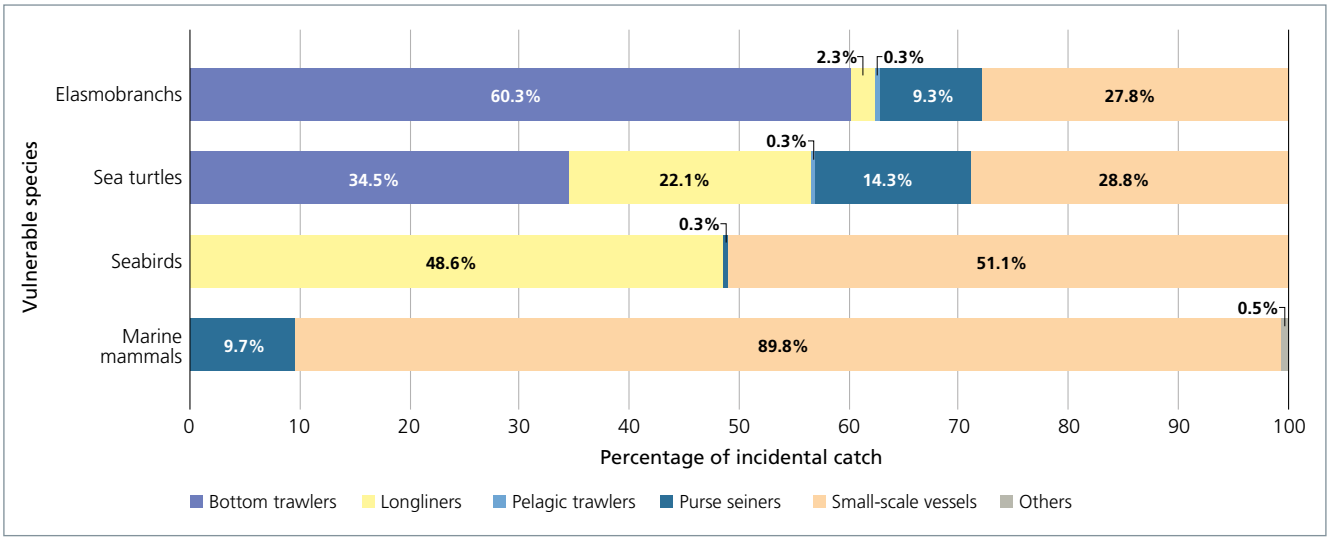


FIGURE 24. Relative contributions of vessel groups to the total incidental catch of vulnerable species in the GFCM area of application, 2015–2025



Elasmobranchs

Elasmobranchs (sharks and rays) are among the groups that are most affected by incidental catch in the region, mainly due to their high vulnerability to different types of fishing gear (Figure 25) and the overlap of their habitats with several fishing activities (Serena *et al.*, 2020; FAO, 2023c). Their life history traits, such as slow growth, late maturity and low fecundity (Stevens *et al.*, 2000), make them especially sensitive to fishing mortality (FAO, 2023c). Available data suggest that trawlers generate a substantial portion of incidental catch (more than 20 percent) across several subregions (Figure 26).

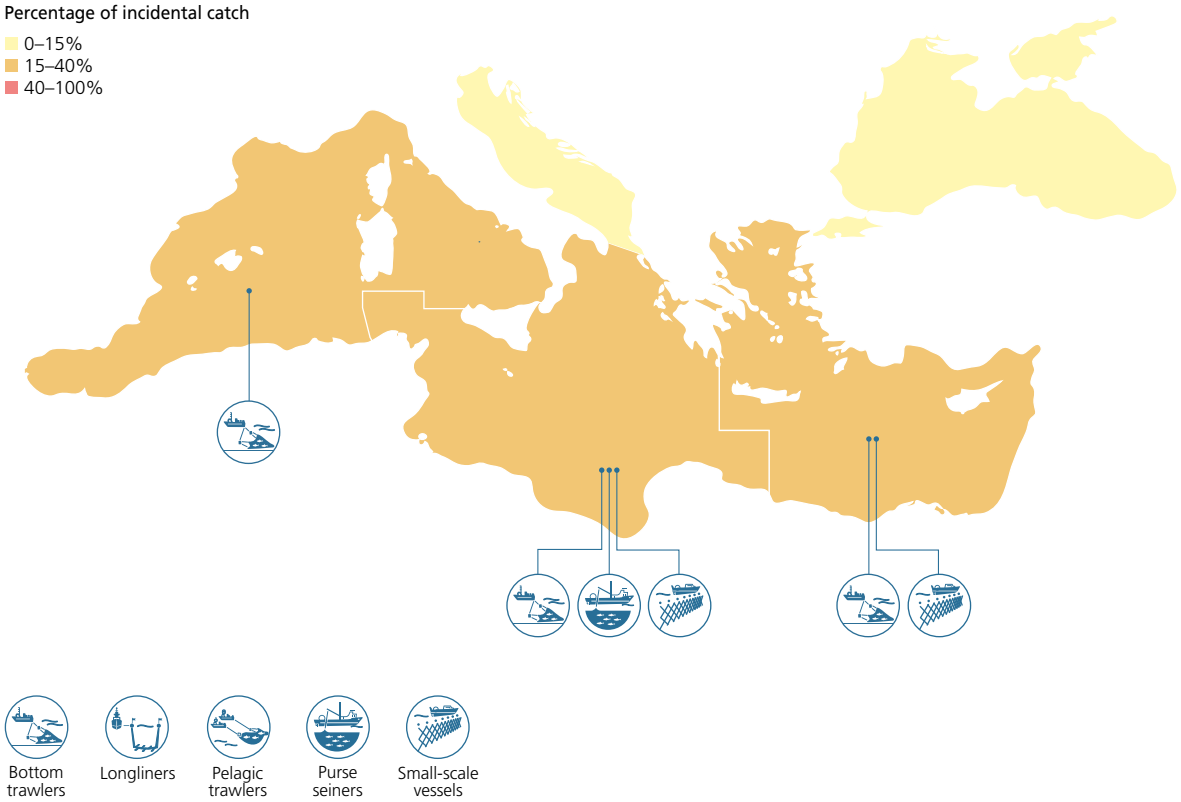
In the western Mediterranean, bottom trawlers account for 98 percent of reported elasmobranch incidental catch, indicating a hot spot of interaction, especially with deep-water demersal species. More common species include small-spotted catshark, blackmouth catshark and velvet belly (*Etmopterus spinax*), alongside vulnerable species like common stingray, rough ray (*Raja radula*) and piked dogfish (Serena *et al.*, 2020). The region's diverse fleet and habitats increase the exposure of various species to fishing pressure, including pelagic and semi-pelagic sharks such as the blue shark, shortfin mako shark (*Isurus oxyrinchus*) and smooth hammerhead shark (*Sphyrna zygaena*) (Nuez, Gazo and Cardona, 2021).

In the central Mediterranean, elasmobranchs are incidentally caught across multiple fishing gear types, with bottom trawlers accounting for 47 percent of interactions, followed by small-scale vessels (30 percent), purse seiners (20 percent) and longliners (3 percent). Observations of bycatch involving several pelagic and demersal species, including blue shark, shortfin mako (*Isurus oxyrinchus*), smooth-hound and common stingray, suggest a broad spatial overlap between fishing operations and elasmobranch habitats (Saïdi *et al.*, 2019; Saïdi, Enajjar and Bradai, 2023). Seasonal and spatial factors, in addition to potential overlap with nursery grounds, increase the vulnerability of these species.

In the Adriatic Sea, a broad spatial overlap between vulnerable species and multiple fishing activities is evident: bottom trawlers (23 percent), pelagic trawlers (28 percent) and longliners (28 percent, mainly in the southern part). The multigear nature of fisheries and the variation in seasonal and depth-related incidental catch risk (Maioli *et al.*, 2024), combined with the presence of some important elasmobranch nursery areas (Balàka *et al.*, 2023), suggest the need for targeted mitigation measures adapted to seasons and locations.

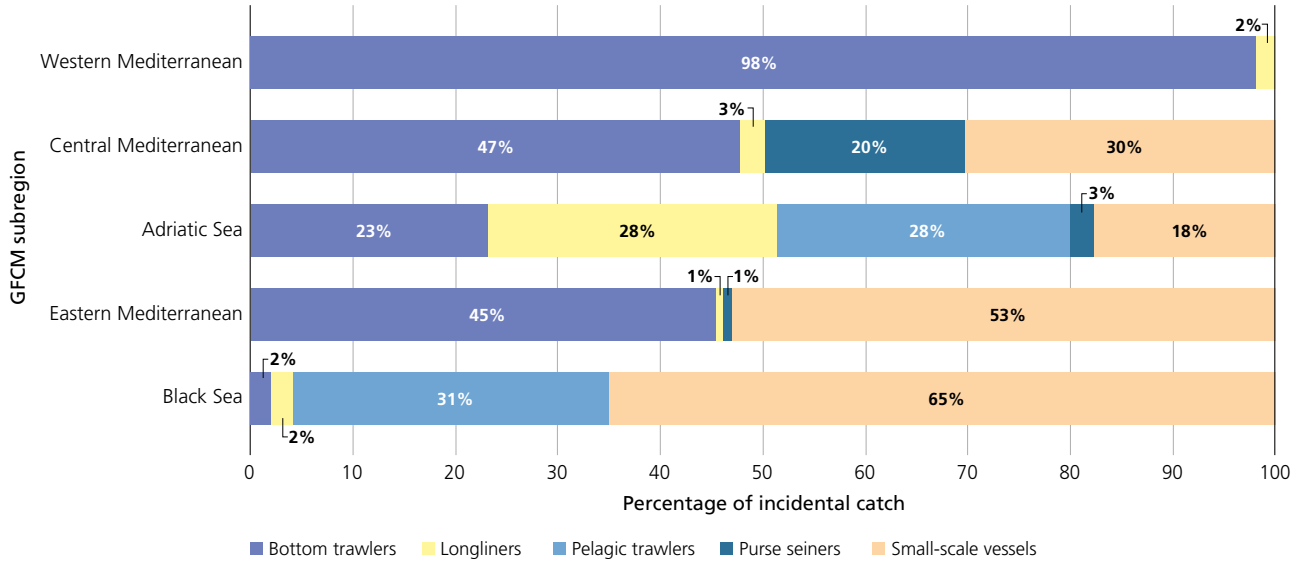
In the eastern Mediterranean, small-scale vessels (53 percent) and bottom trawlers (45 percent) dominate incidental catch. Coastal fishing gear, such as gillnets and trammel nets, affect benthic species, while deep-water trawling (e.g. the deep-water red shrimp fishery) is frequently responsible for the incidental catch of velvet belly (10.9 percent) and blackmouth catshark (6.6 percent) (Fakıoğlu *et al.*, 2025). There may be localized hot spots or unreported

FIGURE 25. Contributions of GFCM subregions to total annual incidental catch of elasmobranchs in the GFCM area of application and main vessel groups responsible, 2015–2025



Note: Refer to the disclaimer on page ii for the names and boundaries used in this map.
Source: Base map redrawn from United Nations. 2024. United Nations Geospatial Clear Map. In: *United Nations*. New York, USA. [Cited 23 October 2025]. https://geoservices.un.org/Html5Viewer/index.html?viewer=clearmap

FIGURE 26. Relative contributions of vessel groups to the total incidental catch of elasmobranchs by GFCM subregion, 2015–2025



Note: Analysis carried out on approximately 395 000 reported individuals over 2015–2025.

interactions, but these have not been identified due to limited species-specific data.

In the Black Sea, small-scale vessels (65 percent) and pelagic (midwater) trawlers (31 percent) are the main sources of incidental catch, with minimal impact from bottom trawlers and longliners (Bengil and Başusta, 2018; Serena *et al.*, 2020). Due to the limited number of affected elasmobranch species (mainly piked dogfish and thornback ray) and the narrower range of fishing gear types operating in this basin, these interactions are likely to be highly localized and subject to considerable interannual variability.

Sea turtles

Sea turtles remain one of the most frequently reported vulnerable species groups affected by incidental catch, particularly in areas where demersal trawling and longline fisheries are widespread (Lucchetti *et al.*, 2019; Casale, 2018). This may be due to their regular use of shallow coastal zones and open pelagic areas as foraging, migratory and breeding habitats, which increases the probability of interaction with multiple fishing gear (Figure 27 and Figure 28). Subregional data suggest that the Adriatic Sea and the central Mediterranean are among the most critical areas for sea turtle interactions, likely reflecting the overlap of important fishing effort with key foraging and migratory habitats (Lucchetti and Sala, 2016). These areas also support significant aggregations of both juvenile and adult loggerhead turtle (*Caretta caretta*) (Cardona *et al.*, 2024), resulting in potentially high exposure over a significant portion of the year.

Although the western Mediterranean shows relatively lower levels of interaction than the Adriatic Sea and the central Mediterranean, localized risks remain, particularly near known migratory corridors or nursery grounds (Báez *et al.*, 2019; Cardona *et al.*, 2024). Interactions occur for example, along the Algerian coasts or near the Balearic Islands, where juvenile turtles are known to forage (Cardona *et al.*, 2024). While overall fishing effort from high-risk fishing gear may be lower in the western Mediterranean compared to other subregions, some areas could still benefit from targeted monitoring and mitigation. In the subregion, incidental catch is mostly associated with longliners (58 percent) but interactions involving bottom trawlers (22 percent) and small-scale vessels (19 percent) using passive gear have also been reported.

In the central Mediterranean, incidental catch by vessel group is relatively evenly distributed across fishing fleets: purse seiners (30 percent), bottom trawlers (29 percent), small-scale vessels (23 percent) and longliners (18 percent) (Figure 28). Multiple fishing activities that are likely to exert pressure on sea turtles, coupled with the presence of migratory corridors and key developmental habitats, are responsible for an increased and widespread risk of incidental catch (Casale, 2018).

In the Adriatic Sea, bottom trawlers (58 percent) are the main vessel group responsible for incidental catch, mainly because their coastal activity overlaps with sea turtle habitats (Lucchetti *et al.*, 2019). Small-scale vessels (32 percent) and longliners (7 percent), albeit to a lesser extent, also contribute to the incidental catch of sea turtles. Seasonal peaks, particularly during spring and early summer, when sea turtles are more active in neritic zones, may intensify overlap with fishing activities (Lucchetti and Sala, 2016).

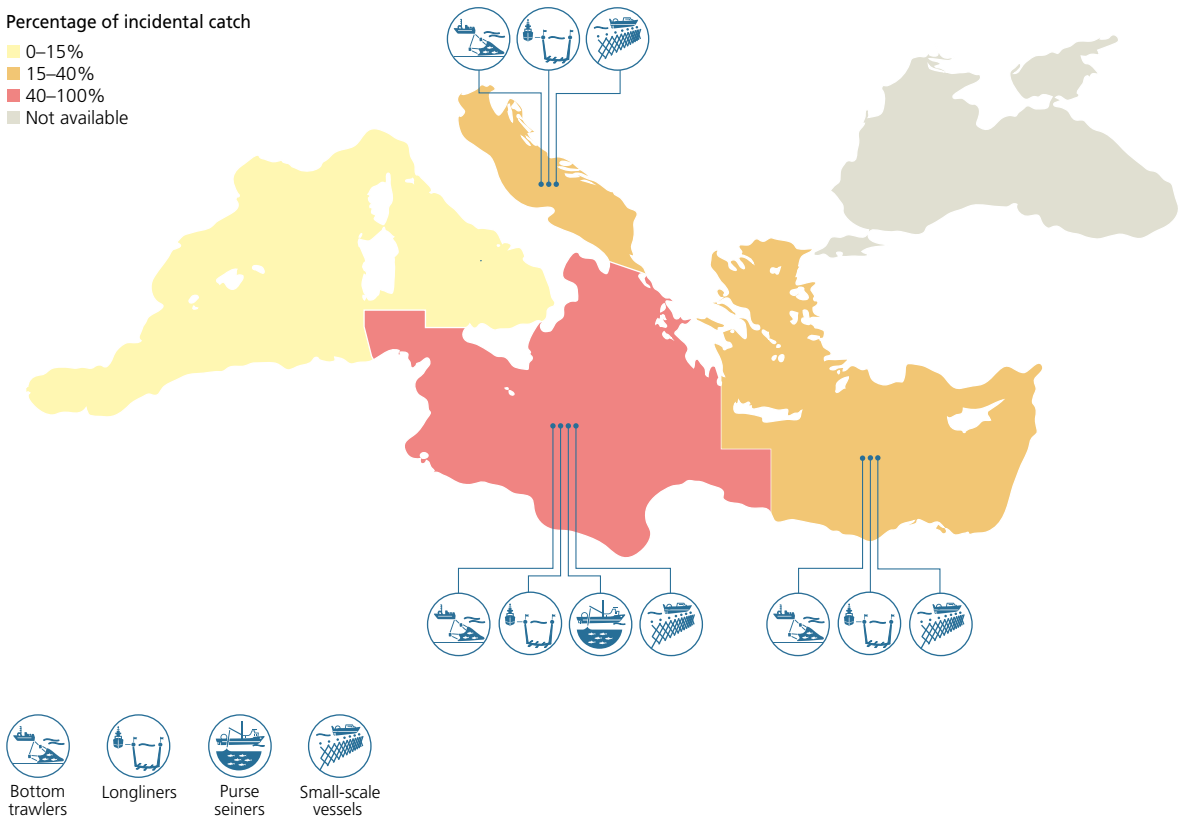
In the eastern Mediterranean, longliners (31 percent) and small-scale vessels (41 percent) are key contributors to the incidental catch of sea turtles, affecting both loggerhead turtle and green sea turtle (*Chelonia mydas*). The presence of nesting beaches and the overlap of migratory routes and fishing grounds (Haywood *et al.*, 2020; Snape *et al.*, 2013) increase entanglement risk, while limited monitoring and mitigation in small-scale fisheries may lead to additional localized impacts.

Available information suggests potential hot spots of interaction mainly in the central Mediterranean (Figure 27), but also in the eastern Mediterranean and the Adriatic Sea. These areas may benefit from reinforced mitigation measures, such as the wider deployment of turtle excluder devices in trawlers, deep setting and circle hooks in longline fisheries, and seasonal or area-based management options aimed at reducing overlap between fishing activities and sea turtle presence. Additional measures, including improved onboard safe handling and release protocols, fisher training and incidental catch reporting, could further support conservation objectives, especially in areas where interactions are frequent but underdocumented (Lucchetti *et al.*, 2019).

Seabirds

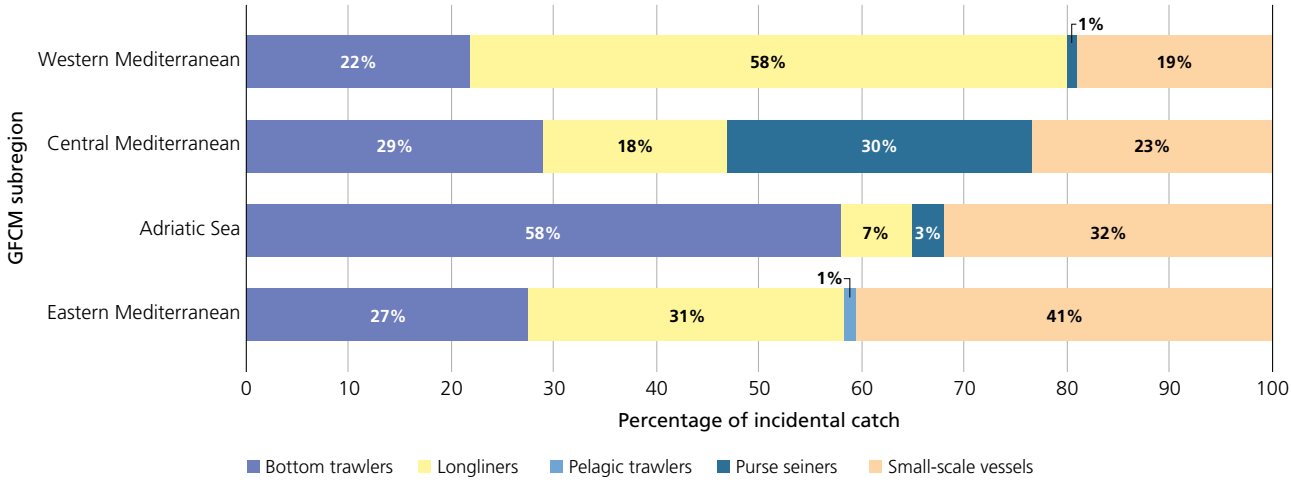
The incidental catch of seabirds in the Mediterranean has historically been underreported, but recent data suggest emerging concerning patterns, particularly involving

FIGURE 27. Contributions of GFCM subregions to total annual incidental catch of sea turtles in the GFCM area of application and main vessel groups responsible, 2015–2025



Note: Refer to the disclaimer on page ii for the names and boundaries used in this map.
Source: Base map redrawn from United Nations. 2024. United Nations Geospatial Clear Map. In: *United Nations*. New York, USA. [Cited 23 October 2025]. https://geoservices.un.org/Html5Viewer/index.html?viewer=clearmap

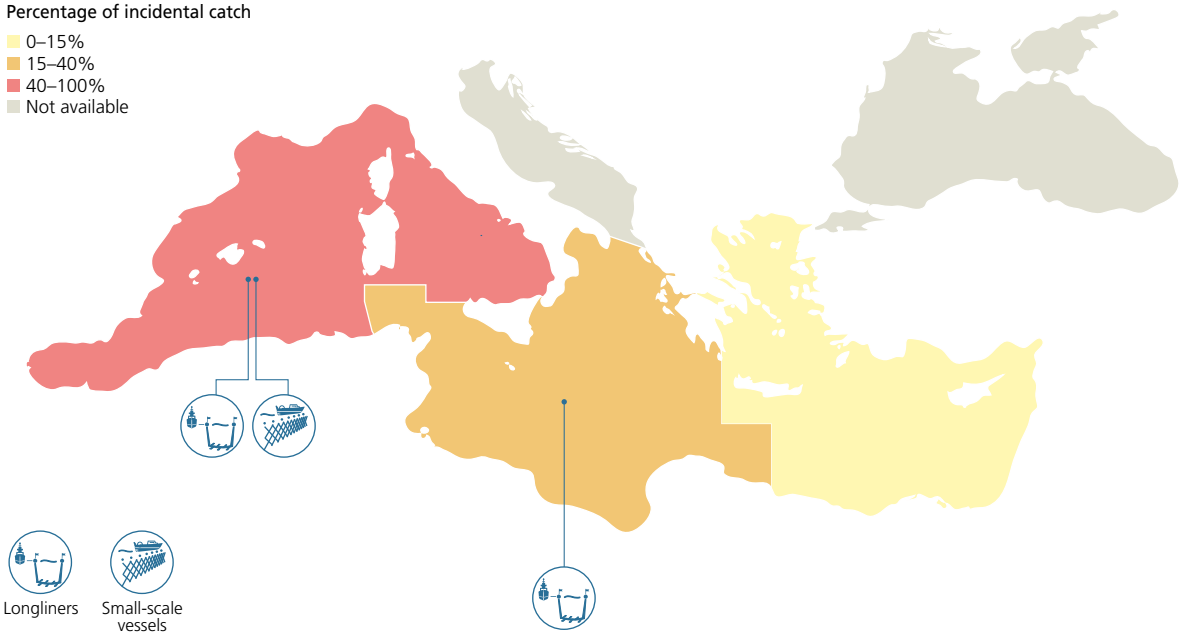
FIGURE 28. Relative contributions of vessel groups to the total incidental catch of sea turtles by GFCM subregion, 2015–2025



Notes: Analysis carried out on approximately 140 000 reported individuals over 2015–2025.
The presence of sea turtles is not confirmed in the Black Sea.

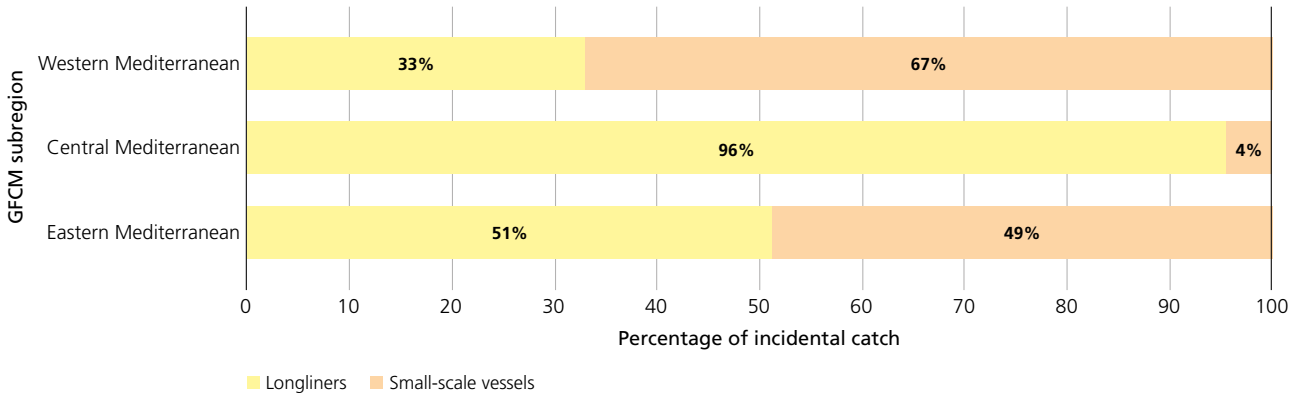
longliners and small-scale vessels (Ramírez *et al.*, 2024; Cortés, Arcos and González-Solís, 2017). Such underreporting may be partly due to low observer coverage in many small-scale fisheries and the difficulty of detecting seabird interactions, particularly when mortality occurs at sea and individuals are not retrieved. Nevertheless, available evidence indicates that incidental catch could be more widespread than previously assumed. The geographic distribution of interactions (Figure 29 and Figure 30) highlights potential hot spots in the central and western Mediterranean. Notably, there appears to be no recorded or reported data for the Adriatic Sea and

FIGURE 29. Contributions of GFCM subregions to total annual incidental catch of seabirds in the GFCM area of application and main vessel groups responsible, 2015–2025



Note: Refer to the disclaimer on page ii for the names and boundaries used in this map.
Source: Base map redrawn from United Nations. 2024. United Nations Geospatial Clear Map. In: *United Nations*. New York, USA. [Cited 23 October 2025]. https://geoservices.un.org/Html5Viewer/index.html?viewer=clearmap

FIGURE 30. Relative contributions of vessel groups to the total incidental catch of seabirds by GFCM subregion, 2015–2025



Notes: Analysis carried out on approximately 5 200 reported individuals over 2015–2025.
There are no reported data for the Adriatic Sea and the Black Sea.

the Black Sea, highlighting geographic gaps in monitoring.

In the western Mediterranean, offshore and nearshore fisheries pose risks to threatened seabirds like the Balearic shearwater (*Puffinus mauretanicus*), whose distribution range overlaps with areas where small-scale vessels and longliners, targeting demersal species, operate (Figure 29). Small-scale vessels, accounting for 67 percent of seabird incidental catch, close to nesting sites are likely to interact with fledglings and foraging birds, especially during chick rearing (Cortés, Arcos and González-Solís, 2017). Demersal longliners also contribute to incidental catch, particularly when operating during daylight in productive zones (Cortés, Arcos and González-Solís, 2017).

In the central Mediterranean, longliners largely dominate seabird incidental catch, accounting for over 90 percent of interactions (Figure 30). The subregion is a key migratory corridor, with peak seabird activity occurring during both spring and autumn (Ramírez *et al.*, 2024). Bait visibility and gear-setting timing further increase risks. Small-scale vessels also contribute to incidental catch, especially in coastal areas or at specific times of the year, as static fishing gear can entangle diving seabirds.

In the eastern Mediterranean, incidental catch is almost equally distributed between longliners (51 percent) and small-scale vessels (49 percent) (Figure 30). Although the overall level of incidental catch is generally lower, hot spots exist near islands and coastal foraging grounds. However, diverse fishing practices and scattered breeding sites complicate risk assessments. Species such as yellow-legged gull (*Larus michahellis*) and dalmatian pelican (*Pelecanus crispus*) often frequent fishing areas in search of discards or bait, thereby increasing their vulnerability to entanglement (Ramírez *et al.*, 2024).

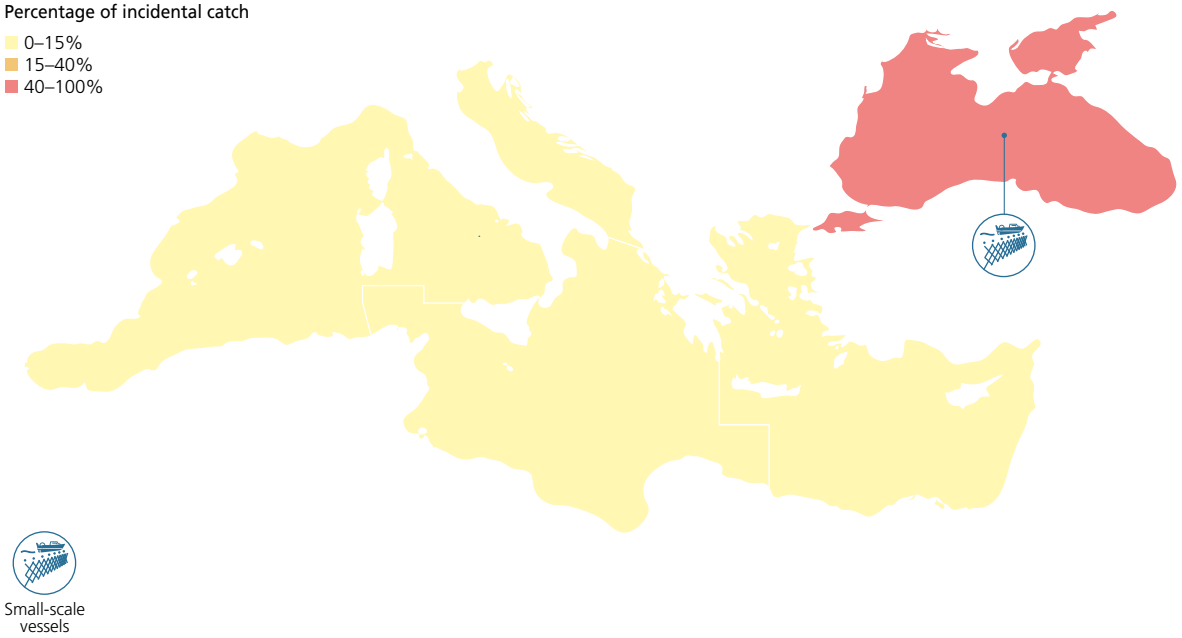
These observations support the need to further explore incidental catch mitigation options, specifically for longline fisheries (e.g. seabird scaring lines, setting lines at night, and the use of weighted fishing gear to reduce bait availability at the sea surface). The effectiveness of these measures has been documented in other regions and may be transferable to Mediterranean contexts with appropriate adaptation (Cortés and González-Solís, 2018). For small-scale fisheries, awareness campaigns and voluntary good practices represent an important initial step to reduce interactions in identified risk areas. Moreover, integrating seabird incidental catch indicators into regional monitoring frameworks and strengthening collaboration with conservation organizations could help build a more robust knowledge base to inform future action (Ramírez *et al.*, 2024).

Marine mammals

The incidental catch of marine mammals is heavily concentrated in the Black Sea (Figure 31), primarily affecting Black Sea harbour porpoise. In this subregion, around 93 percent of the reported cases involve small-scale vessels, particularly those using gillnets and trammel nets (Figure 32; Popov *et al.*, 2023). These static nets, mainly targeting turbot, are often set in nearshore habitats used by dolphins for feeding and daily activities, resulting in significant overlap (ACCOBAMS, 2021). The enclosed nature of the basin and the presence of resident cetacean species already under stress from pollution and noise further heighten concern (Popov *et al.*, 2023). The GFCM CetaByM pilot project tested porpoise alerting devices in turbot gillnet fisheries across Bulgaria, Romania and Türkiye (see Chapter 6; FAO, 2023d). Over 95 trials, these devices reduced the incidental catch of harbour porpoise by 69 percent without affecting turbot catches. However, repeated interactions can lead to learned behaviours (e.g. depredation), thereby increasing entanglement risks over time (Feyrer *et al.*, 2025). Trawlers and longliners play a minimal role, with incidental catch mainly confined to shallow areas and limited to specific seasons.

In the Adriatic Sea and the central and eastern Mediterranean, the incidental catch of marine mammals is sporadic, with few records involving mainly purse seiners, small-scale vessels and pelagic trawlers (Figure 32). Limited data suggest interactions with species such as striped dolphin (*Stenella coeruleoalba)*, Risso's dolphin (*Grampus griseus)* and Black Sea bottlenose dolphin (*Tursiops truncatus ponticus*), often linked to opportunistic feeding or depredation (ACCOBAMS, 2021). In areas where trawl or purse seine activity overlaps with feeding grounds, interactions may occur; however, these are mostly unrecorded due to insufficient monitoring or limited species identification capacity. The few cases reported in the western Mediterranean reveal the existence of potential localized risks near continental shelf edges

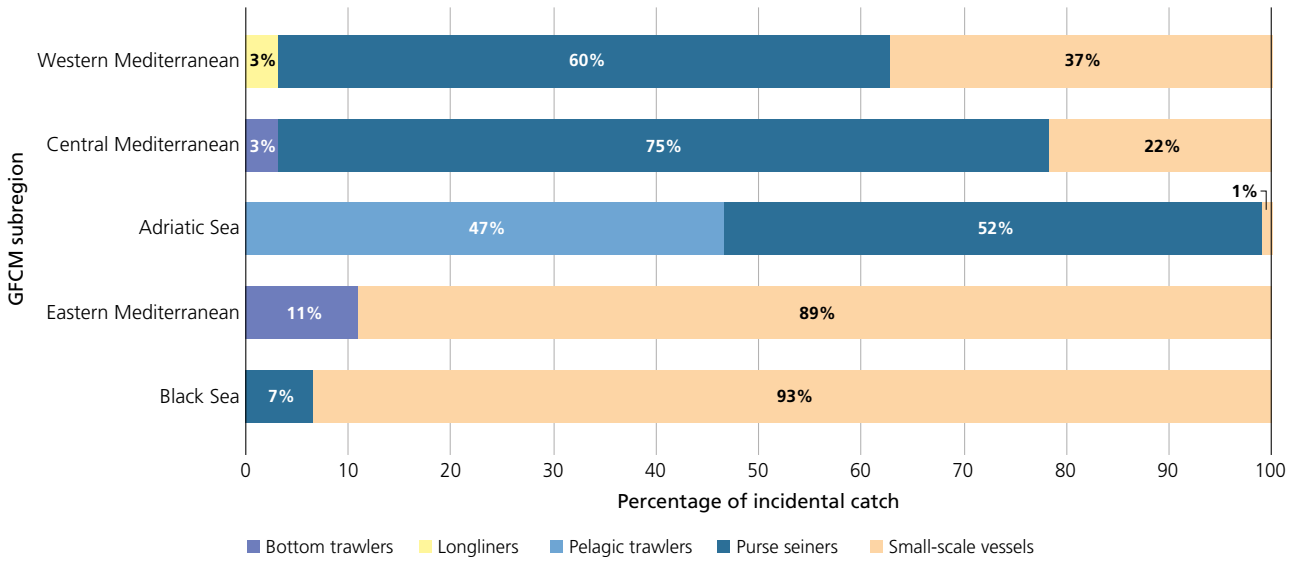
FIGURE 31. Contributions of GFCM subregions to total annual incidental catch of marine mammals in the GFCM area of application and main vessel groups responsible, 2015–2025



Note: Refer to the disclaimer on page ii for the names and boundaries used in this map.

Source: Base map redrawn from United Nations. 2024. United Nations Geospatial Clear Map. In: *United Nations*. New York, USA. [Cited 23 October 2025]. https://geoservices.un.org/Html5Viewer/index.html?viewer=clearmap

FIGURE 32. Relative contributions of vessel groups to the total incidental catch of marine mammals by GFCM subregion, 2015–2025



Note: Analysis carried out on approximately 16 200 reported individuals over 2015–2025.

and canyons, where marine mammal densities overlap with fishing activities. The absence of systematic observer programmes in small-scale fisheries likely contributes to the underreporting of incidental catch.

CONCLUDING REMARKS ON INCIDENTAL CATCH OF VULNERABLE SPECIES

Reducing the incidental catch of vulnerable species remains a collective responsibility that requires sustained cooperation throughout the Mediterranean and Black Sea region. While notable progress in monitoring and mitigation demonstrates that coordinated science-based efforts can yield tangible conservation outcomes, this analysis also highlights persistent gaps and inconsistencies in incidental catch data. Nonetheless, it clearly identifies high-risk areas and fisheries, particularly small-scale and trawl fisheries operating within specific geographical subareas. Elasmobranchs and sea turtles are the most heavily affected species groups, while seabirds, although less affected overall, display spatially concentrated interactions, and marine mammals show localized peaks, especially in the Black Sea. These findings also point to subregions where multiple vulnerable taxa (mainly elasmobranchs and sea turtles) are simultaneously affected, such as the central and eastern Mediterranean, which emerge as multispecies hot spots. Such cumulative pressures reinforce the need for mitigation measures that should not be limited to fishing gear or species-specific approaches when operating in multispecies risk areas, but rather be spatially targeted and responsive to both habitat sensitivity and the presence of other vulnerable species groups. Addressing these challenges requires strengthening standardized data collection, expanding spatial and temporal monitoring, integrating georeferenced fishing effort data, and accelerating the adoption of proven mitigation measures. Combined with active fisher engagement and open data sharing, these measures are essential for advancing evidence based, adaptive management aligned with the GFCM 2030 Strategy and the Regional Plan of Action to Monitor and Mitigate Interactions between Fisheries and Vulnerable Species in the Mediterranean and the Black Sea.

Box 9. Marine litter

Marine litter – including plastics, metals, glass and fishing gear-related debris – is a growing concern in the Mediterranean and the Black Sea, given its persistence in the environment and wide-ranging impacts on marine ecosystems and the sustainability of fishing activities. It can damage fishing gear, reduce catches, increase operational costs and negatively affect non-target species, benthic habitats and vulnerable marine ecosystems. Although not the primary source of marine litter, which is mainly land-based, fisheries operations can be a source of abandoned, lost or otherwise discarded fishing gear (ALDFG), also known as ghost gear. However, fisheries also offer valuable opportunities in terms of monitoring, prevention and mitigation measures.

Fishing gear marking and abandoned, lost or otherwise discarded fishing gear

Within the GFCM framework, marine litter has been addressed through key initiatives. Recommendation GFCM/42/2018/11 on the regional marking of fishing gear calls on contracting parties and cooperating non-contracting parties (CPCs) to ensure the marking of passive fishing gear, including set nets, pots, lines and longlines used by vessels over 15 m in length overall (GFCM, 2025), in line with national laws and the FAO Voluntary Guidelines on the Marking of Fishing Gear (FAO, 2019a). Fishing gear marking enhances accountability by allowing the identification of ownership and supporting compliance (e.g. distinguishing between legal and illegal fishing and discouraging abandonment) (FAO, 2025), although it does not in itself reduce ghost fishing. Resolution GFCM/44/2021/14 on abandoned, lost or otherwise discarded fishing gear urges CPCs to adopt measures on ALDFG prevention, monitoring and retrieval (GFCM, 2025). The GFCM *Catalogue of fishing gear in the Mediterranean and Black Sea region* (Lucchetti *et al.*, 2023) details fishing gear types and materials, including plastic-based ones (e.g. nylon nets, polyethylene ropes and buoys), thereby supporting the identification of marine litter sources and fishing gear design improvements. In addition, Recommendation GFCM/46/2023/14 establishing a multiannual management plan

(Continued)

for the sustainable exploitation of common dolphinfish in the Mediterranean Sea, repealing Recommendations GFCM/30/2006/2, GFCM/43/2019/1 and GFCM/44/2021/11 sets out provisions regarding the use of specific, including biodegradable, materials for the construction of fish aggregating devices, contributing to the reduction of potential marine litter (GFCM, 2025).

Monitoring of marine litter through fisheries data collection

In 2018, the GFCM launched the monitoring and collection of data on marine litter in the Mediterranean and Black Sea, carried out within the framework of its programmes on discards and incidental catch of vulnerable species, as well as during the implementation of scientific surveys-at-sea. These activities follow established protocols (FAO, 2019b, 2019c; Carpentieri, Bonanno and Scarcella, 2020) and allow CPCs to voluntarily report common litter (e.g. bottles, bags) and fishing-related debris (e.g. ropes, net fragments), contributing to consistent data collection across the region. The different types of fishing gear show varying capacities to sample marine litter. Preliminary results indicate that trawlers tend to collect higher quantities and a greater diversity of litter types due to their contact with the seabed, with marine litter typically representing about 1 percent to 8 percent of the total catch weight. Plastics are consistently dominant, accounting between 40 percent and 70 percent of litter weight, and occasionally even higher proportions. Small-scale and polyvalent vessels also encounter marine litter, though at lower and more variable levels, usually representing about 1 percent to 4 percent of catch weight, depending on gear configuration and fishing areas. Purse seiners, operating in pelagic waters, typically show the lowest interactions with marine litter, generally well below 4 percent of catch weight, as their fishing operations rarely come into contact with seabed debris.

Overall, these results, which have involved substantial monitoring effort across all fishing gear types and GFCM subregions, confirm that marine litter interactions are widespread across all fishing gear and areas, with plastics representing by far the dominant component. These patterns highlight the importance of maintaining gear-specific monitoring and developing targeted mitigation measures to reduce marine litter interactions in both the Mediterranean and the Black Sea. A more integrated analysis across datasets is needed to identify the main litter types and potential spatial hot spots in the future.

GFCM innovation at sea: trawlers for marine litter collection

Recent GFCM pilot initiatives have explored the use of trawlers equipped with experimental nets specifically designed to collect marine litter from the seabed without harming marine resources or habitats. Prototype trials have already been conducted in several areas, with plans to expand these initiatives. Further testing on larger vessels across the Mediterranean is also foreseen.

Sources:

Carpentieri, P., Bonanno, A. & Scarcella, G. 2020. *Technical guidelines for scientific surveys in the Mediterranean and the Black Sea*. FAO Fisheries and Aquaculture Technical Papers No. 641. Rome, FAO. https://doi.org/10.4060/ca8870en

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Lucchetti, A., Petetta, A., Bdioui, M., Gökçe, G., Saber, M., Sacchi, J., Ozbilgin, H., Carlson, A. & Carpentieri, P. 2023. *Catalogue of fishing gear in the Mediterranean and Black Sea region*. FAO Fisheries and Aquaculture Technical Papers, No. 695. Rome, FAO. https://doi.org/10.4060/cc7260en


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3. Status of fishery resources

This chapter presents the status of fishery resources at the regional and subregional levels, in line with Target 1 "Fisheries and ecosystems: healthy seas and productive fisheries" of the GFCM 2030 Strategy for sustainable fisheries and aquaculture in the Mediterranean and the Black Sea (GFCM 2030 Strategy; see Box 2).

The analysis is based on validated assessments for the period 2008–2023, with 2023 as a reference year. Data until 2018 come from stock assessment forms (FAO, 2025f), while data from 2019 onwards come from validated outcomes of the Stock Assessment Results (STAR) database (FAO, 2025g). Both datasets originate from the GFCM working groups on stock assessment. The analysis includes active stock assessments – i.e. no older than three years, for small pelagic species, and five years, for demersal species – while preliminary assessments without scientific advice are excluded. Advice on stock status relies mostly on two-year-old data, but since 2019, a number of stocks, including all Black Sea priority stocks, rely on one-year-old data thus reducing the lag between scientific advice and implementation of potential measures. Fishing mortality and biomass estimates are indexed against reference points that produce the maximum sustainable yield (MSY), i.e. F_{MSY} and B_{MSY}, or agreed proxies. Indicators are available at the regional and subregional levels, thereby aligning with the subregional approach, and support the evaluation of management plan implementation and effectiveness. A short-term disruption in 2020 linked to the COVID-19 pandemic affected fishing activity and effort, with

immediate signals in fishing mortality and stock status (FAO, 2022c).

The analysis in this chapter is based on two complementary approaches to assessing trends in the status of stocks.

The forward approach, used in the previous editions of *The State of Mediterranean and Black Sea Fisheries,* tracks scientific advice emerging from active stock assessments over the period 2008–2023. For each year of the time series, the forward approach uses the outputs of the stock assessments presented and validated by the Scientific Advisory Committee on Fisheries and the Working Group on the Black Sea for the terminal year of the assessment (i.e. the relevant reference year). As such, this approach can be influenced by stock assessment updates, including changes in stock assessment models and re-estimation of fishing mortality targets, therefore adding structural uncertainty.

The backward approach, briefly introduced in *The State of Mediterranean and Black Sea Fisheries 2022* (FAO, 2022c), is now fully implemented in the current edition and evaluates current stock status in relation to the sustainable fisheries goals of the GFCM. This approach is based solely on the most recent stock assessments (reference year 2023) and uses the time series of fishing mortality and biomass estimated by each stock assessment. It relies on the last assessment model validated for each stock, thereby eliminating structural uncertainty and increasing precision, but incorporating any potential bias introduced by the latest assessment model used.

The biomass analysis and the backward approach introduced in this edition of *The State of Mediterranean and Black Sea Fisheries* necessitated a comprehensive overhaul of the database and a refinement of analytical procedures, which allowed for the improvement of consistency across the years. The share of assessed stocks with agreed biomass reference points (target, precautionary and/or limit) was 62 percent in 2023. These improvements, combined with the fact that some assessments have shifted between quantitative and qualitative status over time, explain some of the variations observed in validated and active assessments and F/F_{MSY} values derived from the forward approach, both within the same year and compared to previous editions of *The State of Mediterranean and Black Sea Fisheries*.

TEMPORAL AND SPATIAL COVERAGE OF SCIENTIFIC ADVICE ON STOCK STATUS

The number of active stock assessments steadily increased from 45 stocks in 2008 to 120 stocks in 2023 (Table 3 and Table 4). Notably, 84 percent of the stock assessments used for the analysis were less than two years old, indicating an improvement in both spatial and temporal coverage. Quantitative advice is available for 67 stocks, 51 of which include information on biomass targets (Figure 33).

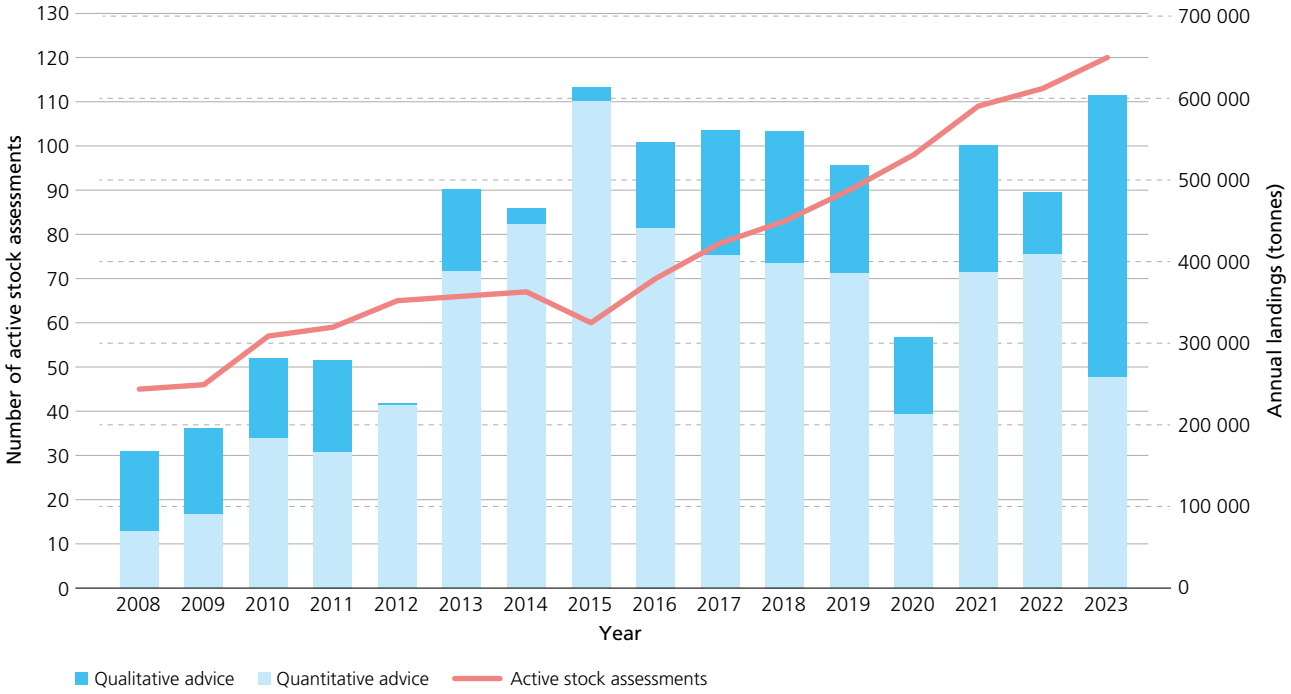
Assessed stocks account for 620 000 tonnes of the catch, representing 55 percent of the total reported landings in the GFCM area of application (Figure 33), with significant contributions from European anchovy (*Engraulis encrasicolus*) and European sprat (*Sprattus sprattus*) in the Black Sea, amounting to 271 000 tonnes and 59 000 tonnes, respectively. In 2022 and 2023, scientific advice was provided on a precautionary basis (i.e. qualitative advice) for 33 percent of the stocks. The share of the catch assessed on a qualitative basis increased

TABLE 3. Number of stock assessments validated in 2023 and active stock assessments available per year, 2008–2023

Year	Validated stock assessments in 2023	Active stock assessments
2008	32	45
2009	28	46
2010	37	57
2011	25	59
2012	35	65
2013	29	66
2014	25	67
2015	38	60
2016	57	70
2017	56	78
2018	50	83
2019	67	90
2020	80	98
2021	88	109
2022	83	113
2023	94	120

Note: Active assessments – referred to in previous editions of *The State of Mediterranean and Black Sea fisheries* as "non-deprecated assessments" – denotes those that are no older than three years for small pelagic species and no older than five years for demersal species.

FIGURE 33. Number of active stock assessments and annual landings assessed, 2008–2023, with an indication of the quality of the advice associated with assessed landings



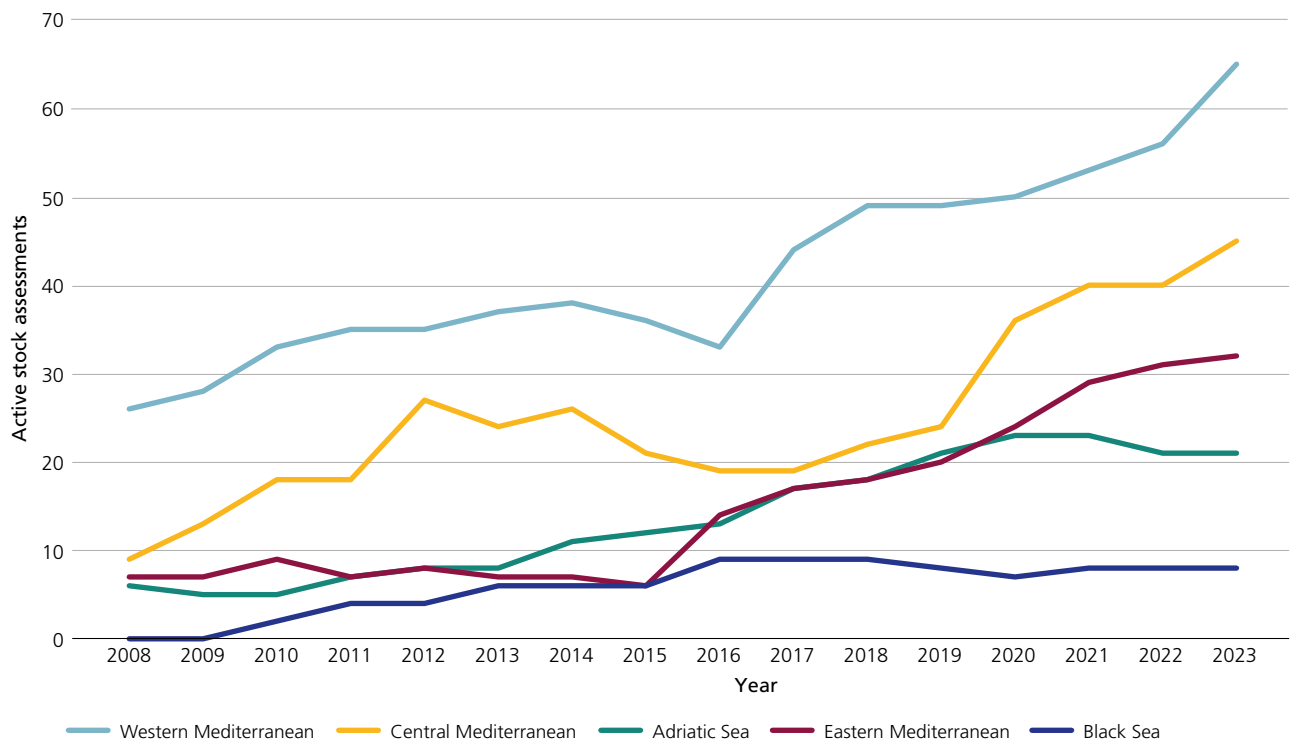
Notes: Active assessments – referred to in previous editions of *The State of Mediterranean and Black Sea fisheries* as "non-deprecated assessments" – denotes those that are no older than three years for small pelagic species and no older than five years for demersal species.
Bars represent annual landings assessed.
Qualitative advice refers to validated stock assessments on a precautionary basis, with no quantitative estimates.
Quantitative advice refers to advice based on stock assessments providing quantitative estimates of current fishing mortality and/or biomass and respective reference points.

from 16 percent in 2022 to 58 percent in 2023, primarily due to European anchovy in the Black Sea being assessed qualitatively pending completion of the benchmark process (Figure 33).

The proportion of qualitative stock assessments validated annually markedly declined from 33 percent in 2008 to 6 percent in 2014, reflecting a strong shift towards data-rich evaluations. This downward trend reversed following the launch of the benchmarking process in 2017 within the GFCM, which not only consolidated and standardized stock assessment practices but also introduced increased scrutiny, resulting in more assessments being considered qualitative. As the total number of assessments expanded and benchmark standards were progressively applied, the proportion of qualitative assessments began to rise again, reaching 33 percent in 2023. This trend underscores both the success in expanding stock assessment coverage and the ongoing need to strengthen data collection and analytical capacity to support the transition of newly assessed stocks towards fully quantitative evaluations.

The coverage of stock assessments by GFCM subregion has significantly improved over time (Figure 34), with at least one stock assessment performed in each geographical subarea (GSA) in 2023 (Figure 35). Since 2020, stock assessment coverage has increased in the central Mediterranean in GSAs 12–16 (northern Tunisia, Gulf of Hammamet, Gulf of Gabès, Malta and southern Sicily), GSA 19 (western Ionian Sea), GSA 21 (southern Ionian Sea) and GSA 20 (eastern Ionian Sea). Compared to 2021, active stock assessments have increased in the western Mediterranean, in GSA 5 (Balearic Islands), GSA 6 (northern Spain) and GSA 9 (Ligurian Sea and northern Tyrrhenian Sea), indicating expanded stock coverage, as well as in the eastern Mediterranean in GSA 24 (northern Levant Sea) and GSA 25 (Cyprus). This has substantially reduced disparities in stock assessment coverage between areas with historically low and high coverage within the GFCM area of application (Figure 35). In contrast, coverage in the Black Sea (GSA 29) and Adriatic Sea has remained

FIGURE 34. Active stock assessments per year by GFCM subregion, 2008–2023



Note: Active assessments – referred to in previous editions of *The State of Mediterranean and Black Sea fisheries* as "non-deprecated assessments" – denotes those that are no older than three years for small pelagic species and no older than five years for demersal species.

relatively stable in recent years (Figure 34 and Figure 35).

Stock assessment coverage varies geographically for each priority species (Table 4). For European hake (*Merluccius merluccius*) and red mullet (*Mullus barbatus*), recent assessments exist for most GSAs, with improved coverage since 2022, although still incomplete for European hake in the eastern Mediterranean. Coverage for deep-water rose shrimp (*Parapenaeus longirostris*) is solid in the western Mediterranean, central Mediterranean and Adriatic Sea. Assessments of giant red shrimp (*Aristaeomorpha foliacea*) have further expanded, with the species evaluated for the first time in GSA 24 and GSA 26 (southern Levant Sea) and coverage extended to all GSAs in the central Mediterranean. The assessment of blue and red shrimp (*Aristeus antennatus*) now includes GSA 20, GSA 24 and GSA 26, while surmullet (*Mullus surmuletus*) is assessed in GSA 6 and GSA 22 (Aegean Sea).

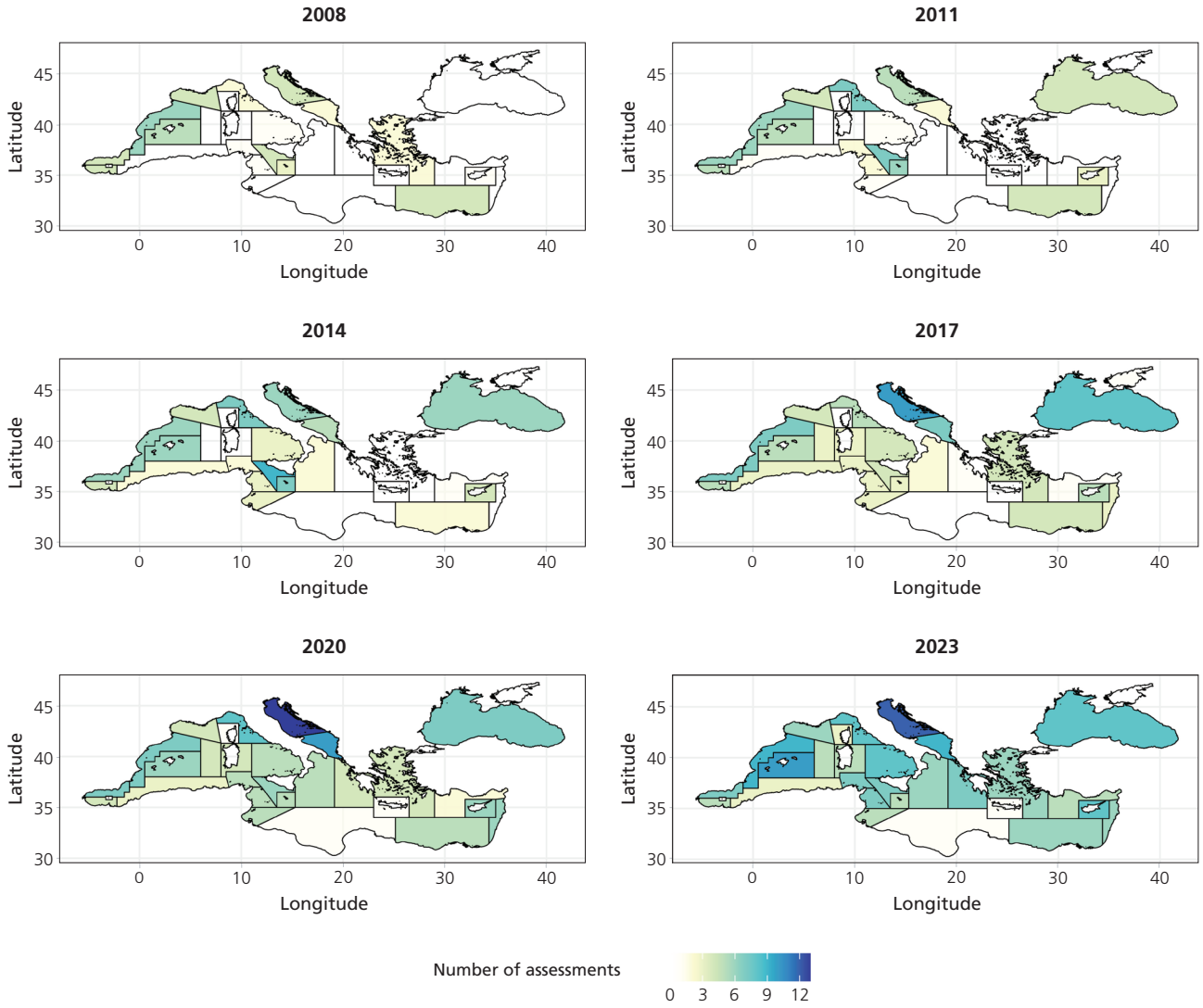
Compared to the 2022 edition of *The State of Mediterranean and Black Sea Fisheries*, three new stocks were assessed: goldband goatfish (*Upeneus moluccensis*) in the southern and northern parts of GSA 27 (eastern Levant Sea) and lessepsian lizardfish (*Saurida lessepsianus*) in GSA 24. For small pelagics, coverage has expanded by 13 stocks as a result of stock assessments of sardine (*Sardina pilchardus*) and European anchovy in GSA 5, GSA 10 (southern and central Tyrrhenian Sea), GSA 12 (northern Tunisia), GSA 13 (Gulf of Hammamet) and GSA 26, and of round sardinella (*Sardinella aurita*) in GSA 24, GSA 26 and the southern and northern parts of GSA 27.

OVERVIEW OF STOCK STATUS

Overexploitation levels – referring exclusively to fishing mortality and taking into account active assessments – have significantly declined since 2020, reaching 52 percent in 2023, the lowest level recorded in the time series (Figure 36). This recovery coincides with a threefold increase in the number of stocks subject to scientific advice.

In 2023, fishing mortality was found to be below the target reference point for 43 stocks (Table 5), compared to 14 stocks in 2020 (FAO, 2022c).

FIGURE 35. Number of active stock assessments performed per three-year period, by geographical subarea, 2008–2023



Notes: Refer to the disclaimer on page ii for the names and boundaries used in this map.
Active assessments – referred to in previous editions of *The State of Mediterranean and Black Sea fisheries* as "non-deprecated assessments" – denotes those that are no older than three years for small pelagic species and no older than five years for demersal species.

Source: Base map redrawn from United Nations. 2024. United Nations Geospatial Clear Map. In: *United Nations*. New York, USA. [Cited 30 October 2025]. https://geoservices.un.org/Html5Viewer/index.html?viewer=clearmap

This improvement is reflected in a steady decrease in the average exploitation rate across the Mediterranean and the Black Sea, with values approaching F_{MSY} in 2023 (F/F_{MSY} = 1.1 under the forward approach and 0.74 under the backward approach) (Figure 37). This corresponds to an average decrease in overexploitation rates of 64 percent (forward approach) and 48 percent (backward approach) since 2013, marking a significant step towards achieving the targets of the GFCM 2030 Strategy.

STATUS AND TRENDS OF PRIORITY SPECIES

Despite a clear overall decline in exploitation ratios across species, species-specific estimates of fishing mortality (Table 5) and biomass (Table 6) reveal varying trends (Figure 38). Sardine and European anchovy, often caught by the same fleets (e.g. purse seiners or pelagic trawlers), exhibit distinct exploitation patterns. Since 2008, fishing mortality for European anchovy has remained below 75 percent of the reference

TABLE 4. Year of the latest validated stock assessment by priority species and geographical subarea

	Western Mediterranean											Central Mediterranean								Adriatic Sea		Eastern Mediterranean						Black Sea	
	3	1	5	6	7	2	4	8	9	10	11	12	13	14	15	16	21	20	19	18	17	22	23	24	25	26	27	28	29
Demersal																													
European hake	2023	2023					2023	2023				2023						2023	2023	2023		2023	2021						
Red mullet	2023	2023		2023	2023				2023	2022	2021	2023		2022	2023			2023	2023	2023		2023		2023	2022				2023
Deep-water rose shrimp	2023	2023	2023	2023			2023	2023				2023						2023				2021							
Giant red shrimp								2023				2023						2023						2023		2023			
Blue and red shrimp		2023	2023	2023		2023			2020									2023						2023		2023			
Surmullet			2023	2023																		2023			2020	2019			
Norway lobster			2023	2023					2022											2023	2023								
Horned octopus					2023															2023									
Blackbellied angler					2023																2019								
Common octopus			2023																						2022				
Axillary seabream																									2020		2020		
Blackspot seabream	2023																												
Thornback ray			2023																						2021				
Common sole																					2023								
Turbot																													2023
Rapa whelk																													2023
Whiting																													2023
Blue whiting				2023																									
Common cuttlefish																					2023								
Spottail mantis squillid																					2023								
Goldband goatfish																											2023		
Lessepsian lizardfish																								2023					
Purple dye murex																					2019								
Velvet belly																									2021				
Sand steenbras																											2019		
Common pandora																											2019		
Great Mediterranean scallop																					2020								
Comber																									2020				
Picarel																									2022				

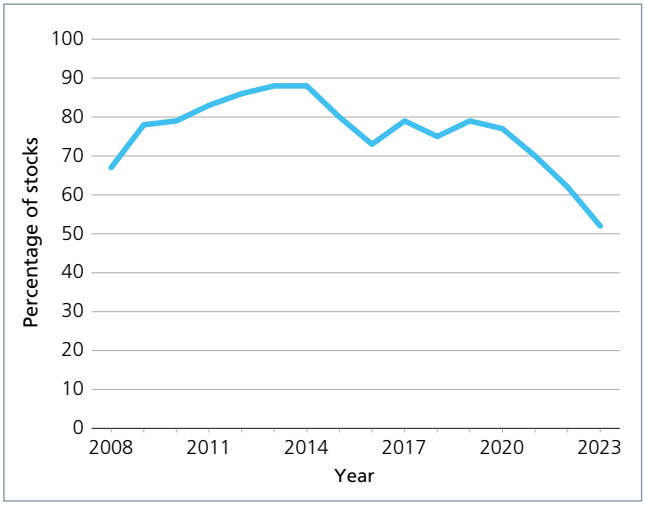
(Continued)

TABLE 4. (Continued)

	Western Mediterranean											Central Mediterranean								Adriatic Sea		Eastern Mediterranean						Black Sea	
	3	1	5	6	7	2	4	8	9	10	11	12	13	14	15	16	21	20	19	18	17	22	23	24	25	26	27	28	29
Small pelagic species																													
Sardine	2023	2023	2023	2023	2023		2023		2023			2023				2021		2023		2023		2023				2023			
Round sardinella																								2023		2023			
European sprat																													2023
European anchovy		2023	2023	2023	2023				2023			2023				2021		2022		2023		2023				2023	2021		2023
Mediterranean horse mackerel																													2023
Species of regional importance																													
Common dolphinfish	2023																												
Species of conservation concern																													
Piked dogfish																													2023
European eel																													
Red coral																													

Notes: Active assessments – referred to in previous editions of *The State of Mediterranean and Black Sea fisheries* as "non-deprecated assessments" – denotes those that are no older than three years for small pelagic species and no older than five years for demersal species.
This table presents 120 active stocks for which quantitative and qualitative advice was provided in 2023. Norway lobster in geographical subarea 17 was assessed as three independent functional units (central, northwestern and northeastern) in 2023.

FIGURE 36. Percentage of stocks in overexploitation in the GFCM area of application, 2008–2023

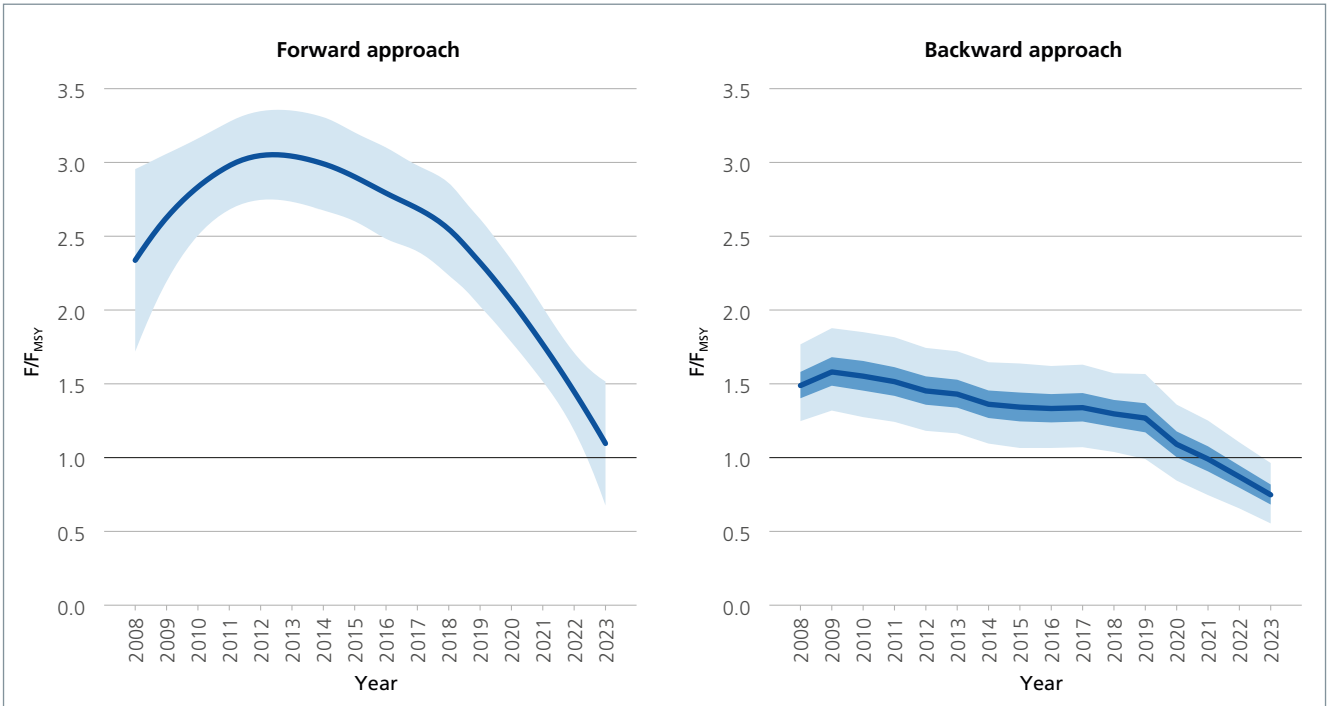


point, whereas comparable levels for sardine were only reached after 2020, indicating prolonged exposure to higher fishing pressure. This lower fishing pressure on European anchovy may have contributed to a healthy biomass across the Mediterranean (Figure 38), while sardine stocks show signs of biomass depletion.

Among demersal species, European hake and red mullet, primarily targeted by bottom trawlers, exhibit similar downward trends in exploitation, though with differing magnitudes and outcomes (Figure 38). For red mullet, reduced fishing effort since 2008 has led to a drop in F/F_{MSY} from around 2 to less than 1 (0.81), resulting in biomass recovery, with B/B_{MSY} increasing from 0.50 in 2008 to 0.86 in 2023 and maintaining a strong upward trajectory (Figure 38).

In contrast, European hake stocks exhibit an overall F/F_{MSY} of 2.5 in 2008, with high variability across subregions. Although exploitation has decreased by 38 percent (F/F_{MSY} = 1.55), biomass recovery only began to show modest signs in 2021 (Figure 38). This time lapse highlights the delayed response of medium-lived species to management measures and underscores the need for more refined, species-specific strategies.

FIGURE 37. Exploitation ratios (F/F_{MSY}) for all assessed species, 2008–2023, under the forward and backward approach



Notes: The forward approach (left) tracks trends in scientific advice over time. The backward approach (right) is based on the outcomes of most recent assessments for the reference year 2023.
Under the forward approach, average $F/F_{MSY} \approx 1.1$ in 2023.
Under the backward approach, average $F/F_{MSY} \approx 0.74$ in 2023.
Light-shaded and dark-shaded areas show the 95 percent confidence intervals and 50 percent confidence intervals, respectively. Solid lines represent the estimated trends.

TABLE 5. Exploitation ratios (F/F_{MSY}) resulting from active quantitative stock assessments

	Western Mediterranean											Central Mediterranean								Adriatic Sea		Eastern Mediterranean						Black Sea	
	3	1	5	6	7	2	4	8	9	10	11	12	13	14	15	16	21	20	19	18	17	22	23	24	25	26	27	28	29
Demersal																													
European hake			3.66						2.19			0.87							1.13	1.11			6.09						
Red mullet	1.41			1.17	0.71				0.996	0.22	0.8	3.32		2.98	0.3			1.88	0.73	0.19		0.78		1.39	2.81				0.48
Deep-water rose shrimp	0.95		0.63	0.95			1.12		0.92			0.87							1.13										
Giant red shrimp									1.29					1.12				0.71											
Blue and red shrimp			0.6	3.06		0.64			4.6									2.69								3.7			
Surmullet			0.94	2.91																		0.55							
Norway lobster			0.7						1.11											0.5	0.62								
Horned octopus																													
Blackbellied angler																													
Common octopus																													
Axillary seabream																									1.05				
Blackspot seabream	2.04																												
Thornback ray																													
Common sole																					0.73								
Turbot																													0.67
Rapa whelk																													2.3
Whiting																													2.72
Blue whiting				4.0																									
Common cuttlefish																					0.73								
Spottail mantis squillid																					0.86								
Goldband goatfish																													
Lessepsian lizardfish																													
Purple dye murex																					1.08								
Velvet belly																													
Sand steenbras																											2.07		
Common pandora																											1.9		
Great Mediterranean scallop																					2.86								
Comber																									0.67				
Picarel																													

(Continued)

TABLE 5. (Continued)

	Western Mediterranean											Central Mediterranean								Adriatic Sea		Eastern Mediterranean						Black Sea	
	3	1	5	6	7	2	4	8	9	10	11	12	13	14	15	16	21	20	19	18	17	22	23	24	25	26	27	28	29
Small pelagic species																													
Sardine	0.42	0.47		0.53	0.003				0.13							3.5				1.45		1.5				1.05			
Round sardinella																								0.51		1.12			
European sprat																													0.46
European anchovy		0.64		0.34	0.02				0.27							0.94				1.03		0.39							
Mediterranean horse mackerel																													
Species of regional importance																													
Common dolphinfish																													
Species of conservation concern																													
Piked dogfish																													0.39
European eel																													
Red coral																													

Notes: Active assessments – referred to in previous editions of *The State of Mediterranean and Black Sea fisheries* as "non-deprecated assessments" – denotes those that are no older than three years for small pelagic species and no older than five years for demersal species.
This table presents the results from 81 active stock assessments providing quantitative advice on fishing mortality for reference year 2023.
Norway lobster in geographical subarea 17 was assessed as three independent functional units (central, northwestern and northeastern) in 2023 and averaged F/F_{MSY}.
Exploitation ratios of stocks under sustainable exploitation are highlighted in green.
Stock units sharing F/F_{MSY} values belong to the same stock.

TABLE 6. Exploitation ratios (B/B_{MSY}) resulting from active stock assessments with biomass reference points

	Western Mediterranean											Central Mediterranean								Adriatic Sea		Eastern Mediterranean						Black Sea	
	3	1	5	6	7	2	4	8	9	10	11	12	13	14	15	16	21	20	19	18	17	22	23	24	25	26	27	28	29
Demersal																													
European hake			0.06						0.07					0.76					0.15		0.48								
Red mullet	0.48				0.16				0.36							1.26		0.60	2.70		0.38	0.41		0.42					0.61
Deep-water rose shrimp	2.36		0.04				0.75		0.96					1.00							0.34								
Giant red shrimp									1.01					1.26					0.81										
Blue and red shrimp			0.59																0.48										
Surmullet			0.78																			0.61							
Norway lobster			1.84																	0.93	0.87								
Horned octopus																													
Blackbellied angler																													
Common octopus																													
Axillary seabream																													
Blackspot seabream	0.13																												
Thornback ray																													
Common sole																					1.27								
Turbot																													0.37
Rapa whelk																													0.85
Whiting																													
Blue whiting																													
Common cuttlefish																					0.33								
Spottail mantis squillid																					0.73								
Goldband goatfish																													
Lessepsian lizardfish																													
Purple dye murex																													
Velvet belly																													
Sand steenbras																													
Common pandora																													
Great Mediterranean scallop																													
Comber																													
Picarel																													

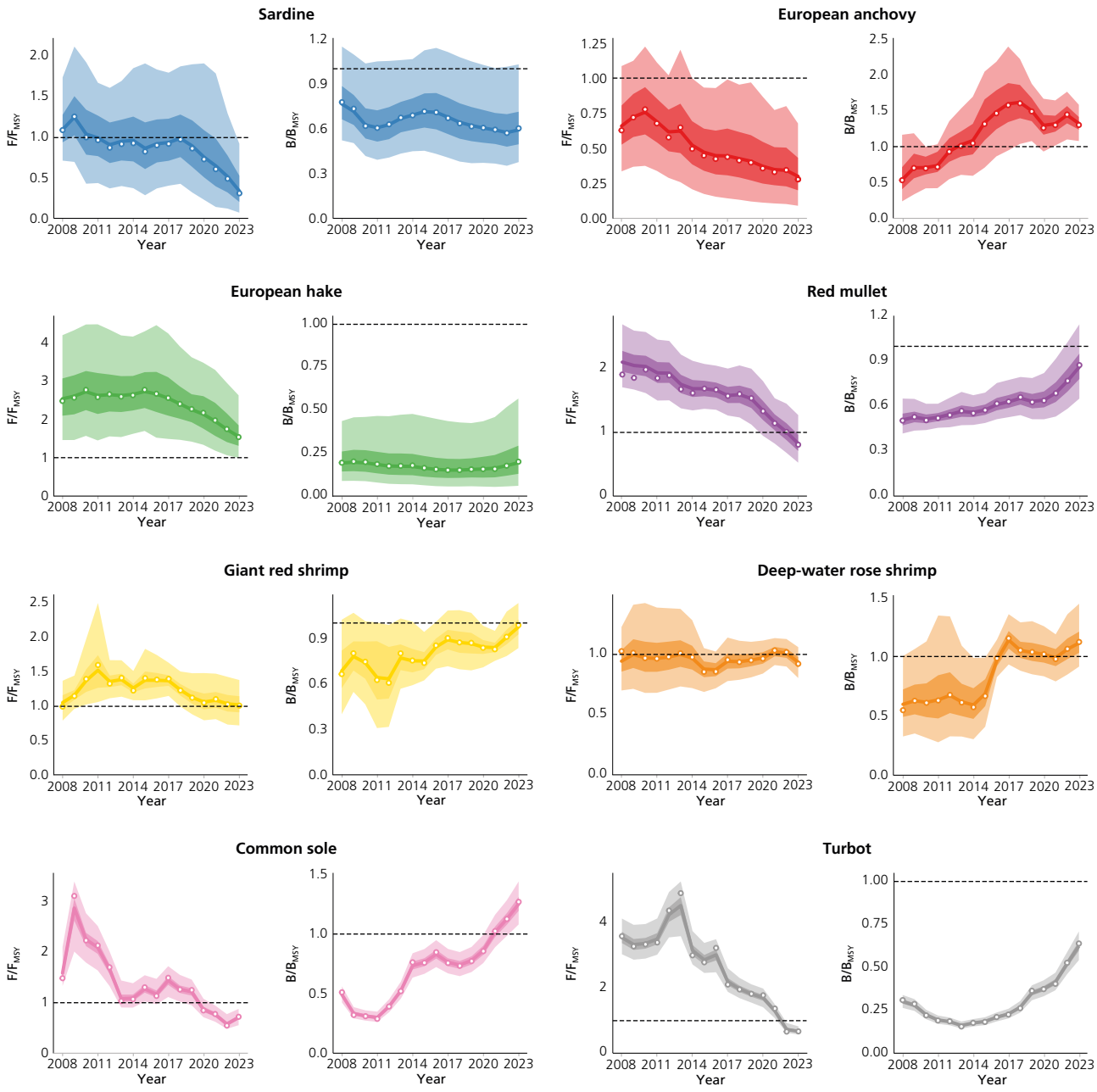
(Continued)

TABLE 6. (Continued)

	Western Mediterranean											Central Mediterranean								Adriatic Sea		Eastern Mediterranean						Black Sea	
	3	1	5	6	7	2	4	8	9	10	11	12	13	14	15	16	21	20	19	18	17	22	23	24	25	26	27	28	29
Small pelagic species																													
Sardine		0.67			2.34				0.90											1.10		0.66				1.10			
Round sardinella																								0.90		1.20			
European sprat																													
European anchovy		0.46		2.22	0.35				0.68											1.70		0.65							
Mediterranean horse mackerel																													
Species of regional importance																													
Common dolphinfish																													
Species of conservation concern																													
Piked dogfish																													0.03
European eel																													
Red coral																													

Notes: Active assessments – referred to in previous editions of *The State of Mediterranean and Black Sea fisheries* as "non-deprecated assessments" – denotes those that are no older than three years for small pelagic species and no older than five years for demersal species.
This table presents the results from 51 active stock assessments providing quantitative advice on biomass levels for reference year 2023.
Exploitation ratios of stocks under sustainable exploitation are highlighted in green. In the absence of B/B_{MSY}, blue cells present B/B_{PA}.
Norway lobster in geographical subarea 17 was assessed as three independent functional units (central, northwest and northeast) in 2023 and averaged B/B_{MSY}.

FIGURE 38. Trends in exploitation (F/F_{MSY}) and biomass (B/B_{MSY}) ratios of select priority species, 2008–2023

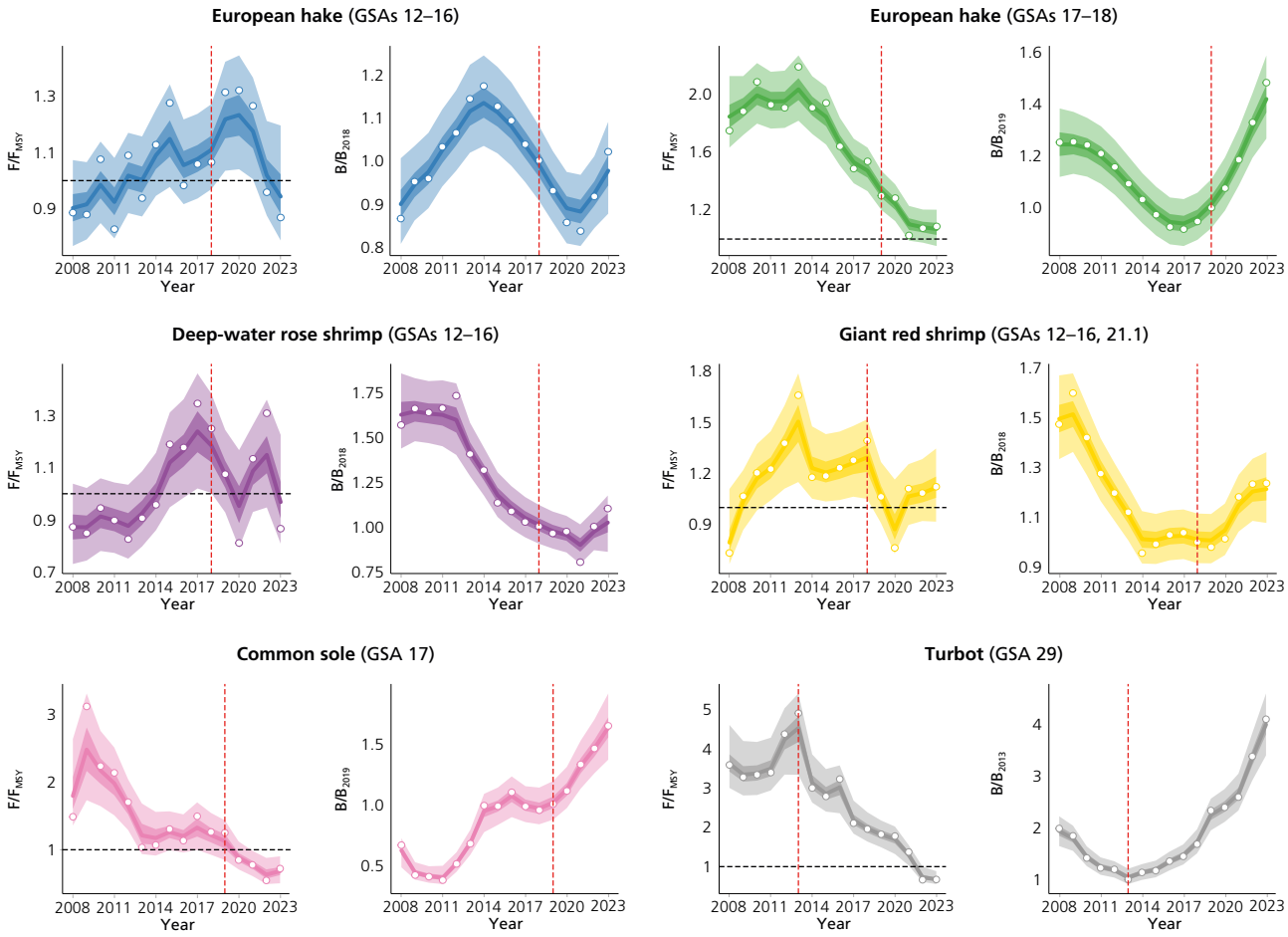


Notes: Light-shaded and dark-shaded areas show the 95 percent and 50 percent confidence intervals, respectively. Solid lines represent trends. Dots indicate the values obtained by applying the Bayesian state–space approach with an ad hoc normal approximation of the number of assessments carried out at the species level in 2023.

Giant red shrimp stocks have maintained exploitation ratios consistently above 1, but below 2, throughout the time series, approaching $F/F_{MSY} \approx 1$ in recent years (Figure 38). This moderate decline in fishing mortality enabled biomass to increase from 0.68 in 2008 to 0.97 in 2023 (Figure 38). In contrast, deep-water rose shrimp (*Parapenaeus longirostris*) has experienced lower exploitation levels ($F/F_{MSY} \approx 0.9$), with occasional years of slight overexploitation ($F/F_{MSY} \approx 1$) (Figure 38). This exploitation regime supported a marked biomass recovery between 2014 and 2017, and stocks have remained sustainably exploited through 2023 (Figure 38).

Common sole (*Solea solea*) in the Adriatic Sea shows a marked reduction in overexploitation,

FIGURE 39. Trends in exploitation (F/F_{MSY}) and biomass ratios relative to the start year of each stock-specific multiannual management plan



Notes: Light-shaded and dark-shaded areas show the 95 percent and 50 percent confidence intervals, respectively. Solid lines represent trends. Dots indicate the values obtained by applying the Bayesian state–space approach with an ad hoc normal approximation of the number of assessments carried out at the species level in 2023.
Dashed red lines indicate the start year of the multiannual management plan for each species.

with fishing mortality decreasing from three times the sustainable level (F_{MSY}) in 2009 to approximately two-thirds of F_{MSY} by 2023 (Figure 38). This substantial decline in fishing pressure has facilitated a steady recovery in biomass, rising from less than 0.5 B_{MSY} in 2011 to 1.25 B_{MSY} in 2023 (Figure 38).

A similar trend is observed for turbot (*Scophthalmus maximus*) in the Black Sea. In 2013, the exploitation rate was critically high, with F/F_{MSY} reaching 4.53. Over the following decade, this has reduced to 0.67 (Figure 39), representing an 86 percent decrease in fishing mortality. This reduction has enabled biomass to recover from a severely depleted state, rising from 0.16 B/B_{MSY} in 2013 to 0.62 B/B_{MSY} in 2023. Although biomass has not reached the target level, the consistent upward trend since 2013, with a notable acceleration from 2021 onwards, suggests that turbot biomass is on track to exceed B_{MSY} in the coming years.

TRENDS OF KEY SPECIES UNDER MANAGEMENT PLANS

Since 2013, when the first multiannual management plan was adopted, the status of key commercial stocks across the region has progressively improved. Overall, fishing pressure (F/F_{MSY}) has declined by approximately 50 percent, now approaching sustainable levels, while biomass has increased by about 25 percent

compared to 2013 (see Chapter 6, Figure 90). These results suggest a general positive trajectory for stock recovery under the current management framework. Building on this regional perspective, this section examines trends for individual species in relation to specific management plans, focusing on changes in exploitation rates and biomass over time. In the Strait of Sicily (GSAs 12–16), the exploitation rate of European hake exhibits a delayed response to the 2018 management plan, with fishing mortality beginning to decline only in 2021. This reduction subsequently triggered a positive shift in biomass, which increased in 2022 and 2023 (Figure 39). In contrast, European hake in the Adriatic Sea experienced a significant decline in fishing mortality starting from 2014, five years prior to the implementation of its management plan. This early reduction, which also included initial management measures in the Jabuka/Pomo Pit, laid the foundations for biomass rebuilding. This recovery was further consolidated during the management plan period, continuing on an upward trajectory through 2023 (Figure 39).

For deep-water rose shrimp in the Strait of Sicily (GSAs 12–16), which shares a management plan with European hake, the average exploitation rate has decreased from above 1.2 to around 1, following the implementation of the management plan in 2019. As a result, biomass in 2023 exceeded the levels observed in 2019 (Figure 39). Similarly, giant red shrimp in the Strait of Sicily (GSAs 12–16 and GSA 21.1), under a management plan since 2018, has seen a reduction in overfishing from approximately 1.2 to 1.1. This modest decline in fishing pressure is accompanied by a 20 percent increase in biomass between 2018 and 2023 (Figure 39).

Common sole in the Adriatic Sea has experienced a 42 percent reduction in fishing mortality and a 64 percent increase in biomass since 2019, while turbot in the Black Sea has shown an 86 percent reduction in fishing mortality and a 310 percent increase in biomass since 2013 (Figure 39). These outcomes underscore the potential effectiveness of targeted management plans in reversing overexploitation and supporting stock recovery across the region.

CONCLUDING REMARKS

The overall exploitation ratio in the Mediterranean and the Black Sea has continued to decline, dropping from 88 percent in 2013 to 52 percent in 2023, the lowest level in the time series. This decline is also reflected in the average exploitation rate (F/F_{MSY}), which decreased from a range of 1.4 (backward approach) to 3.0 (forward approach) in 2013 to a range of 0.7 (backward approach) to 1.1 (forward approach). This represents a 48 percent and 64 percent decrease in average exploitation rate based on the backward and forward approaches, respectively, and highlights that average fishing pressure is close to sustainable levels in 2023, irrespective of the approach used.

In 2023, a significant milestone was achieved, with 67 stocks subject to quantitative advice, 51 of which include biomass estimates relative to target or threshold reference points, marking a shift from the previous nominal approach based on percentiles (FAO, 2022c). The backward approach allows, for the first time, an analysis of biomass trends, revealing a 25 percent increase in biomass relative to 2013, the year when multiannual management plans began to be implemented across the region (see Figure 90). The combined trends in fishing mortality and biomass indicate a consolidated trend towards sustainable exploitation and, importantly, biomass recovery.

The percentage of stocks with active assessments has increased by 10 percent since the 2022 edition of *The State of Mediterranean and Black Sea Fisheries* (FAO, 2022c), with notable improvements in the western, central and eastern Mediterranean. This progress is also reflected in the expanded geographical coverage of assessments. The increased coverage of stock assessments – accounting for around 620 000 tonnes, the highest level recorded in the time series – underscores the regular evaluation of key stocks with significant landings, particularly anchovy in the Black Sea (271 000 tonnes). The ongoing revision of the GFCM framework for the provision of advice, combined with sustained technical assistance in data collection and capacity development efforts in stock assessment (Box 10) – including specialized training, such as the stock assessment summer school and subregional data preparation meetings – has been instrumental in driving these improvements. Nevertheless, further efforts are required to

ensure full assessment coverage of all priority species across all GSAs.

Species-level analyses show consistent declines in fishing mortality and signs of biomass recovery, although the trends vary according to the species life span, the timing of management plan implementation and responsiveness to reduced fishing pressure. Key fisheries demonstrate clear recovery trends likely linked to management measures: European hake, deep-water rose shrimp and giant red shrimp in the Strait of Sicily, common sole and European hake in the Adriatic Sea, and turbot in the Black Sea all show significant biomass increases and reduced fishing pressure.

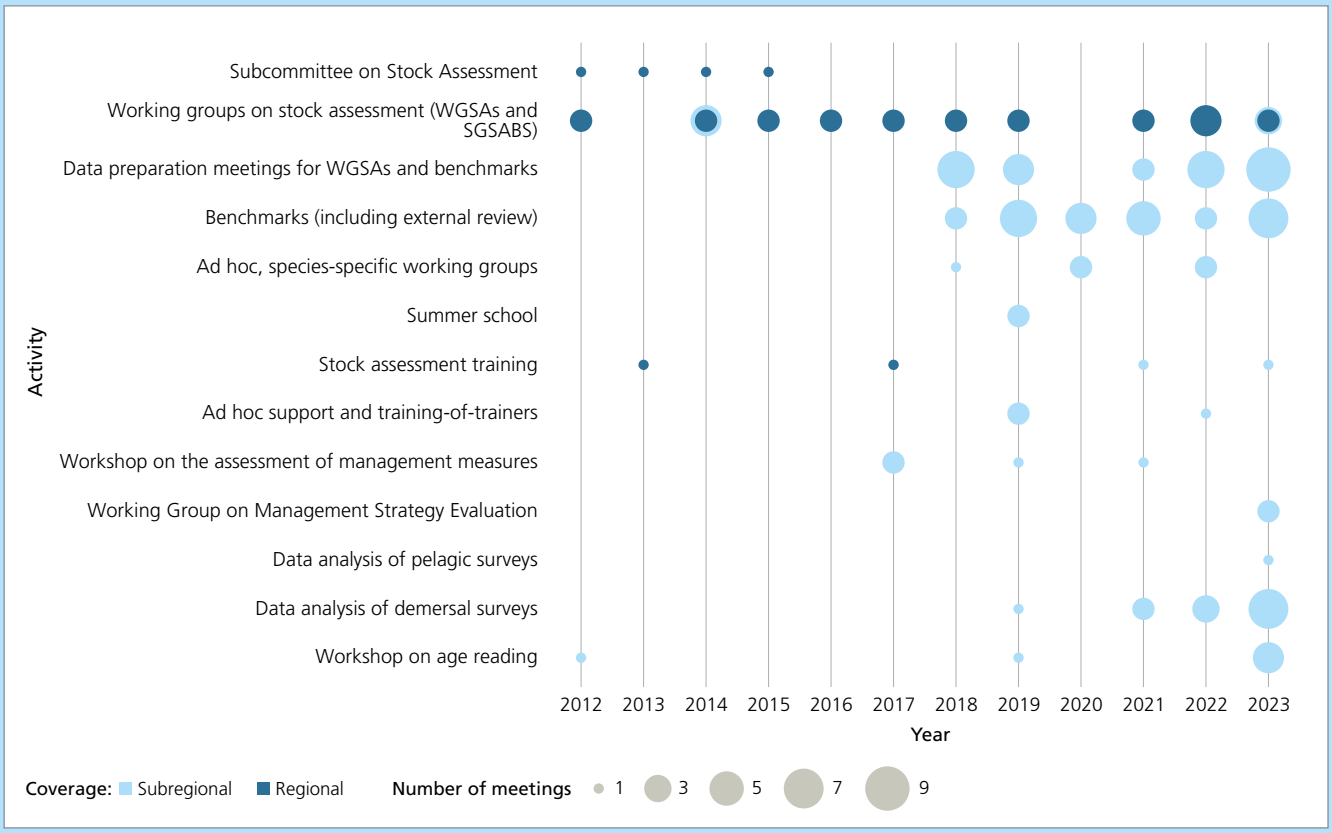
These outcomes highlight the potential effectiveness of targeted management plans in reversing overexploitation and supporting stock recovery across the region. Implemented measures include management plans with effort controls or quota-based systems for certain species, the establishment of fisheries restricted areas, and spatio-temporal closures to protect essential habitats and life stages at the regional and national levels (see Chapter 6). Nonetheless, the slow recovery of some key stocks and the need to achieve the targets of the GFCM 2030 Strategy underscore the importance of continuing to strengthen and expand effective management frameworks, including through improved data collection and capacity development to enhance advice in support of decision making.

Box 10. Capacity development in stock assessment

Reporting the status of fishery resources is a key priority of the GFCM. Since 2016, this has been carried out regularly in a comprehensive and standardized manner through the successive editions of *The State of Mediterranean and Black Sea Fisheries* (FAO, 2016, 2018, 2020, 2022, 2023), in line with the targets of the GFCM 2030 Strategy for sustainable fisheries and aquaculture in the Mediterranean and the Black Sea.

To ensure the best quality advice on the status of fishery resources, the GFCM has implemented a suite of activities aimed at strengthening regional and subregional capacity in data analysis and stock assessment. Since 2017, two regional

Capacity development activities for stock assessment in the GFCM area of application, 2012–2023



(Continued)

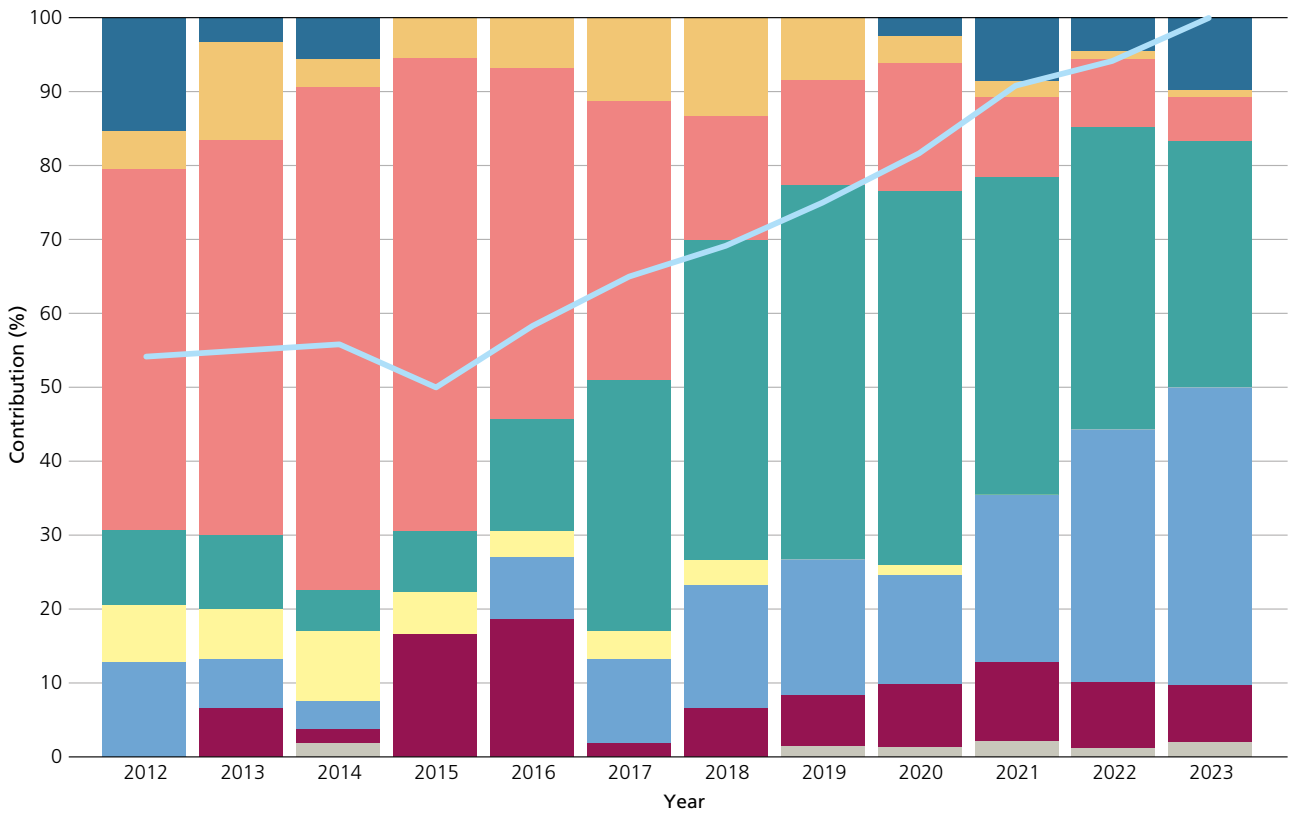
Box 10. (Continued)

trainings on quantitative stock assessment have been conducted, complemented by subregional initiatives such as targeted stock assessment training in national languages and train-the-trainer programmes. Furthermore, a formal rigorous benchmark process was introduced in 2018 to improve the assessment of key priority species through in-depth scientific work, supported by an external expert review and ad hoc targeted data preparation meetings. These activities, together with the annual subregional data preparation meetings held in advance of the Working Groups on Stock Assessment in the Mediterranean and the Subregional Group on Stock Assessment for the Black Sea, have become key mechanisms for disseminating knowledge and best practices.

Capacity development is a continuous process that requires complementary actions. These include bilateral meetings to support specific assessments when needed, initiatives to improve data quality (e.g. acoustic data processing and age reading workshops) and ad hoc working groups. Increased engagement has led to a significant expansion, both in number and scope, of technical meetings addressing scientific and management aspects of the advisory process, rising from four meetings with 99 participants in 2012 to 36 meetings with 793 participants in 2023. This represents a ninefold increase over the analysed period. Concurrently, the establishment of the GFCM fisheries capacity development projects, BlackSea4Fish and MedSea4Fish, has substantially enhanced the quality and quantity of data collected at the national level across the region.

As a result, there has been a progressive evolution and refinement of assessment models used to support advice, along with an increase in coverage, with the number of active stock assessments increasing from 66 to 120 between 2013 and 2023. Stock assessments performed in the GFCM area of application between 2012 and 2023 fall into eight main categories: length-based,

Contribution of assessment methods to the provision of scientific advice for active stocks in the GFCM area of application, 2012–2023



Notes: VPA = virtual population analysis
The light blue line indicates the percentage of stocks with validated assessments related to 120 active stock assessments in 2023.

(Continued)

Box 10. (Continued)

pseudo-cohort virtual population analysis (VPA), VPA-based, statistical age-structured, surplus production, survey-based, integrated models and other. Prior to 2014, most relied on classical VPA and only 55 percent of the active stock assessments in 2023 were performed in 2014. Over time, VPA use declined and was replaced by statistical age-structured methods and, later, by integrated analysis and surplus production models – the latter becoming dominant in 2023 due to their suitability for short- and medium-lived species. Length-based and pseudo-cohort VPA methods have remained steady at around 15 percent of active assessments, evolving in form but still vital for data-limited stocks.

The improved regional capacity nowadays supports the implementation of sex-, fleet- and spatially-structured models, where appropriate, backed by the necessary data. This progress illustrates how sustained capacity development has enhanced both the quality and coverage of scientific advice on stock status. Notably, it has facilitated the integration of biomass reference points (target, threshold and limit), paving the way for further improvements and targeted adaptive management.

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4. Aquaculture production

This chapter examines aquaculture production in Mediterranean and Black Sea countries in the context of the GFCM 2030 Strategy for sustainable fisheries and aquaculture in the Mediterranean and the Black Sea (GFCM 2030 Strategy; see Box 2), with a particular focus on Target 3 "Aquaculture: a sustainable and resilient sector growing to its full potential", which that aims to foster a sustainable and resilient aquaculture sector through responsible investment, best practices, social acceptability and innovation.

The analysis begins with an overview of total aquaculture production, before focusing on marine and brackish water aquaculture. It explores production trends, species composition and diversity, as well as production systems and technologies. Examples of adaptation strategies (Box 11) and innovative production systems (Box 12) are also presented, as these approaches are increasingly recognized as key pathways to enhance the aquaculture sector's sustainability.

The production data and information in this chapter are drawn primarily from national data submitted in accordance with Recommendation GFCM/41/2017/1 on the reporting of aquaculture data and information, repealing Recommendation GFCM/35/2011/6 (GFCM, 2025a). These are collected through two databases within the Information System for the Promotion of Aquaculture in the Mediterranean (SIPAM): Aquaculture production statistics and Aquaculture production centres. This information is regularly cross-checked for consistency with FAO FishStat data (FAO, 2025h), and dedicated actions are taken when discrepancies arise. The FishStat

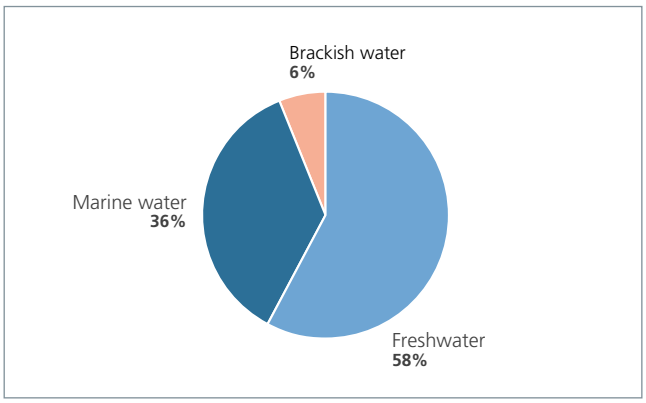
database is also used to supplement SIPAM datasets where data gaps are identified. The regional grouping "Europe" and "North Africa and western Asia" follows the classification used for Sustainable Development Goals indicators as defined by the United Nations.

OVERVIEW OF AQUACULTURE PRODUCTION

In 2023, total aquaculture production in Mediterranean and Black Sea countries reached 2 969 100 tonnes, generating USD 9.3 billion in revenue (FAO, 2025h, 2025i).[6] Freshwater aquaculture continues to underpin the aquaculture sector, accounting for 58 percent of total production (1.72 million tonnes). Marine aquaculture – namely cages and coastal installations – contributes 36 percent (1.07 million tonnes), while brackish water environments – primarily lagoons, estuaries and salt-marsh ponds – make up the remaining 6 percent (0.18 million tonnes) (Figure 40).

Freshwater production remains heavily concentrated in Egypt, which alone accounts for 1 405 255 tonnes (about 82 percent of all freshwater production in the Mediterranean and the Black Sea). This production is largely driven by a sustained demand for Nile tilapia (*Oreochromis niloticus*) and mullets nei (Mugilidae), and has been sustained by the expansion of semi-intensive farming in earthen ponds. Türkiye contributes an additional 156 758 tonnes (9 percent), dominated by the production of rainbow trout (*Oncorhynchus mykiss*) in ponds and freshwater cages systems. The remaining 9 percent is also dominated by rainbow trout production, mainly by Mediterranean European Union countries, with Italy contributing 34 100 tonnes, France 28 600 tonnes and Spain 17 500 tonnes, alongside smaller volumes from other countries (20 100 tonnes). Although less prominent than Nile Tilapia or rainbow trout, common carp (*Cyprinus carpio*) production reaches 22 200 tonnes, with main contributions from – listed in order of production volume – Ukraine, Romania, Bulgaria, Croatia, Israel, France and Algeria.

FIGURE 40. Aquaculture production by environment in Mediterranean and Black Sea countries, 2023



Marine aquaculture production continues to be driven by three major species – gilthead seabream (*Sparus aurata*), European seabass (*Dicentrarchus labrax*) and Mediterranean mussel (*Mytilus galloprovincialis*).

Brackish water aquaculture, although modest, is led by the production of gilthead seabream, European seabass, mullets nei and meagre (*Argyrosomus regius*) in Egypt, as well as Japanese carpet shell (*Ruditapes philippinarum*), also known as Manila clam, in Italy.

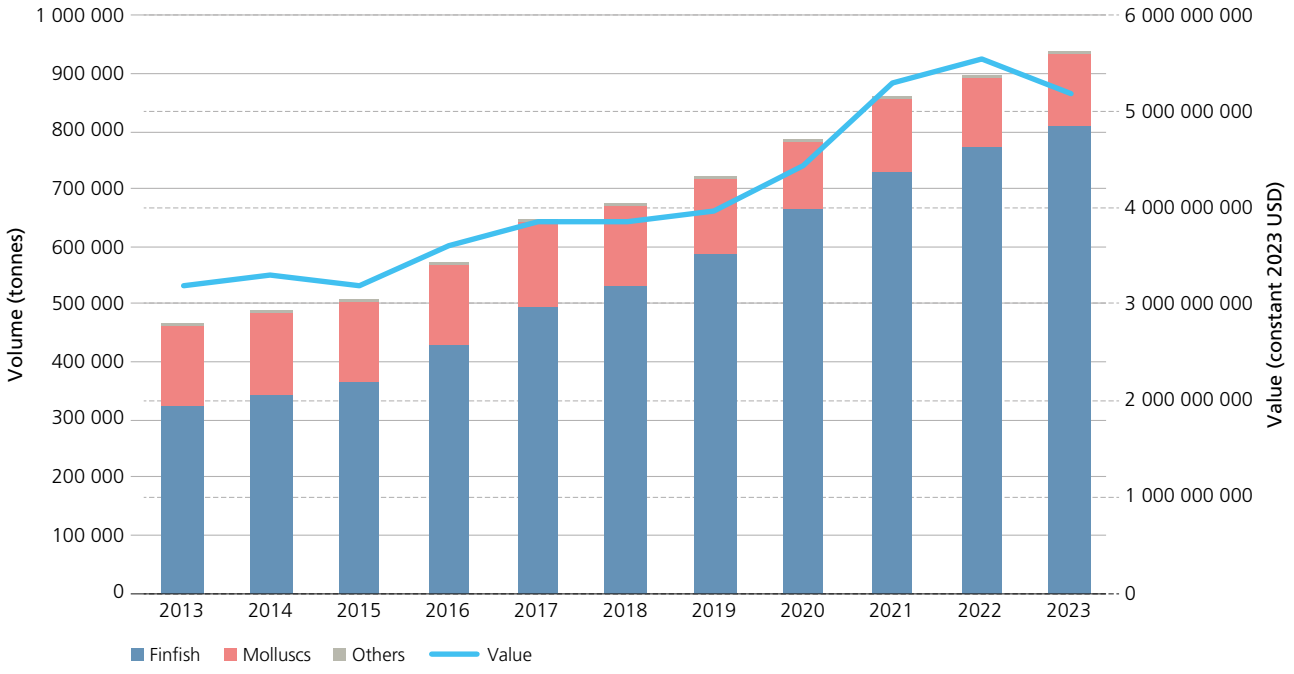
TRENDS IN MARINE AND BRACKISH WATER AQUACULTURE PRODUCTION

Between 2013 and 2023, marine and brackish water aquaculture production in the Mediterranean and the Black Sea[7] doubled, increasing from just over 470 000 tonnes to approximately 940 000 tonnes (Figure 41). During the same period, the aquaculture sector's value at constant prices grew by 63 percent, rising from around USD 3.2 billion to USD 5.2 billion. Finfish production saw the most significant increase, growing from 324 000 tonnes to over 807 000 tonnes. Meanwhile, mollusc production remained relatively stable, fluctuating between 120 000 and 140 000 tonnes. The "Others" category, which includes crustaceans and algae, remained marginal, with just over 1 750 tonnes produced in 2023.

[6] The analysis covers all environments (freshwater, marine and brackish water) and statistical areas reported by Mediterranean and Black Sea countries (FAO Major Fishing Areas 01, 04, 05, 27, 34, 37). For France, Morocco and Spain, this includes aquaculture production from the Atlantic coast. The Russian Federation is not included in this analysis.

[7] Marine and brackish water aquaculture producers from the Mediterranean and the Black Sea included in this analysis: Albania, Algeria, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Egypt, France, Greece, Israel, Italy, Lebanon, Malta, Montenegro, Morocco, Slovenia, Spain, Tunisia and Türkiye (FAO Major Fishing Areas: 01, 04, 05 and 37).

FIGURE 41. Trend in marine and brackish water aquaculture production in the Mediterranean and the Black Sea, 2013–2023



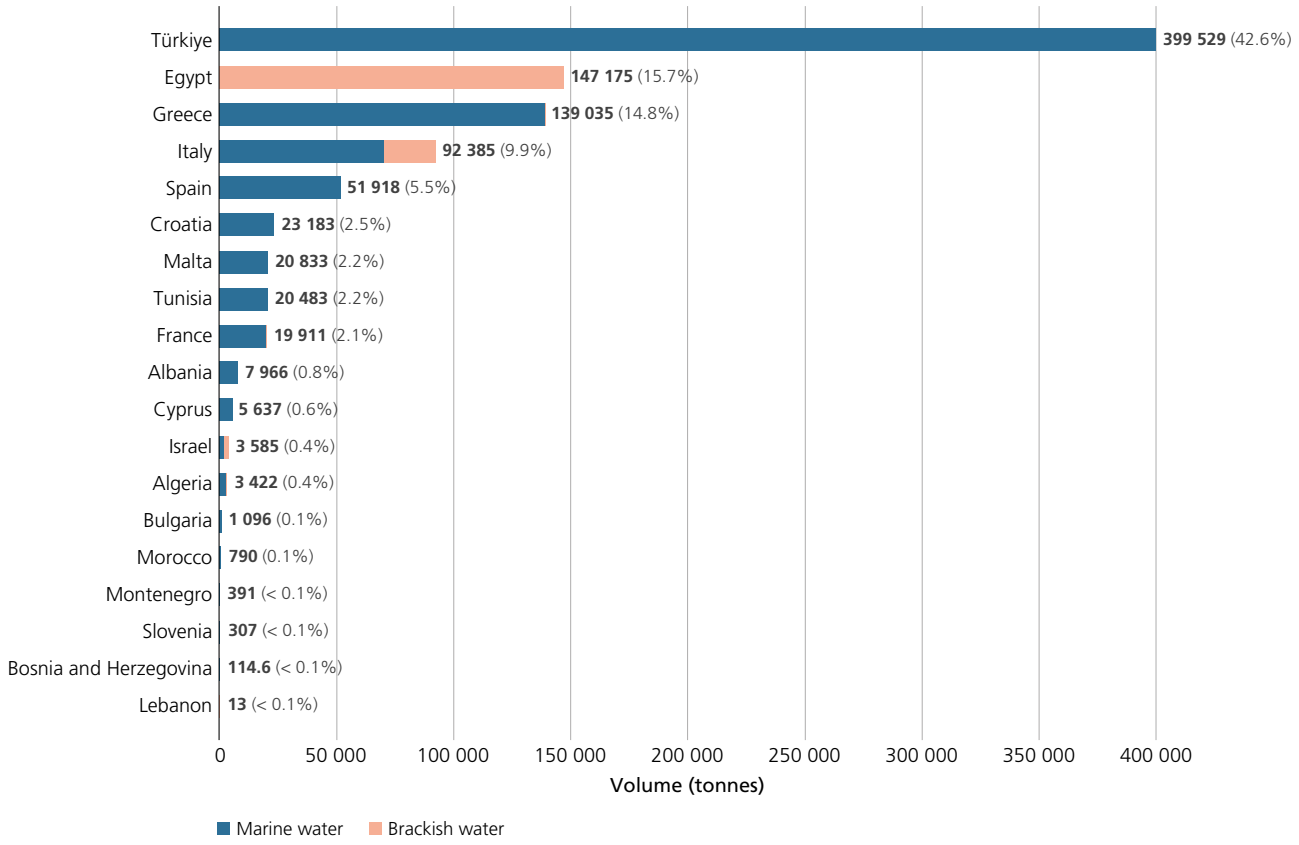
Note: "Others" refers to algae and crustacean species.

Despite record production levels in 2023, the overall value of marine and brackish water output declined compared to 2021 and 2022 (Figure 41). This decrease is likely due to: i) a shift in the production mix towards lower-priced finfish, alongside stagnant mussel production; ii) price volatility in key markets; and iii) sharp currency fluctuations – particularly the significant depreciation of the Egyptian pound and the Turkish lira – which have reduced dollar-denominated revenues (World Bank, 2023, 2024).

In 2023, marine and brackish water aquaculture production in Mediterranean and Black Sea countries remained highly concentrated, with the top nine producers accounting for over 95 percent of the total (Figure 42). Türkiye maintains a lead, producing about 399 500 tonnes (42.6 percent of the regional volume), almost entirely consisting of marine finfish – primarily European seabass, gilthead seabream and rainbow trout. Egypt ranks second with slightly less than 147 200 tonnes (15.7 percent) and stands out as the only large-scale producer in brackish water environments, mainly rearing gilthead seabream, mullets nei, European seabass and meagre. Greece follows closely, producing over 139 000 tonnes (14.8 percent), largely consisting of gilthead seabream, European seabass and Mediterranean mussel. Italy produced nearly 92 400 tonnes (9.9 percent), with a strong emphasis on molluscs, such as Mediterranean mussel and Japanese carpet shell, which make up over 85 percent of its marine and brackish water production (Box 11). Spain contributes over 51 900 tonnes (5.5 percent), with production split among European seabass, Atlantic bluefin tuna (*Thunnus thynnus*), gilthead seabream and meagre. Croatia, France, Malta and Tunisia each produced between 19 000 and 23 000 tonnes, each accounting for more than 2 percent of the regional total. In these countries, the production is dominated by cage-reared European seabass and gilthead seabream, with Malta also contributing Atlantic bluefin tuna. The remaining ten countries collectively account for less than 5 percent of the total production volume.

Regional growth in 2022–2023 was driven by a few large producers (Figure 43). Aquaculture production increased in 11 of the 19 countries considered, remained stable in one (Italy), and decreased in seven. Türkiye leads the growth in volume with a 22.2 percent production increase (nearly 70 000 tonnes), surpassing the combined production volume of the other ten countries.

FIGURE 42. Marine and brackish water aquaculture production by GFCM contracting party and cooperating non-contracting party, 2023



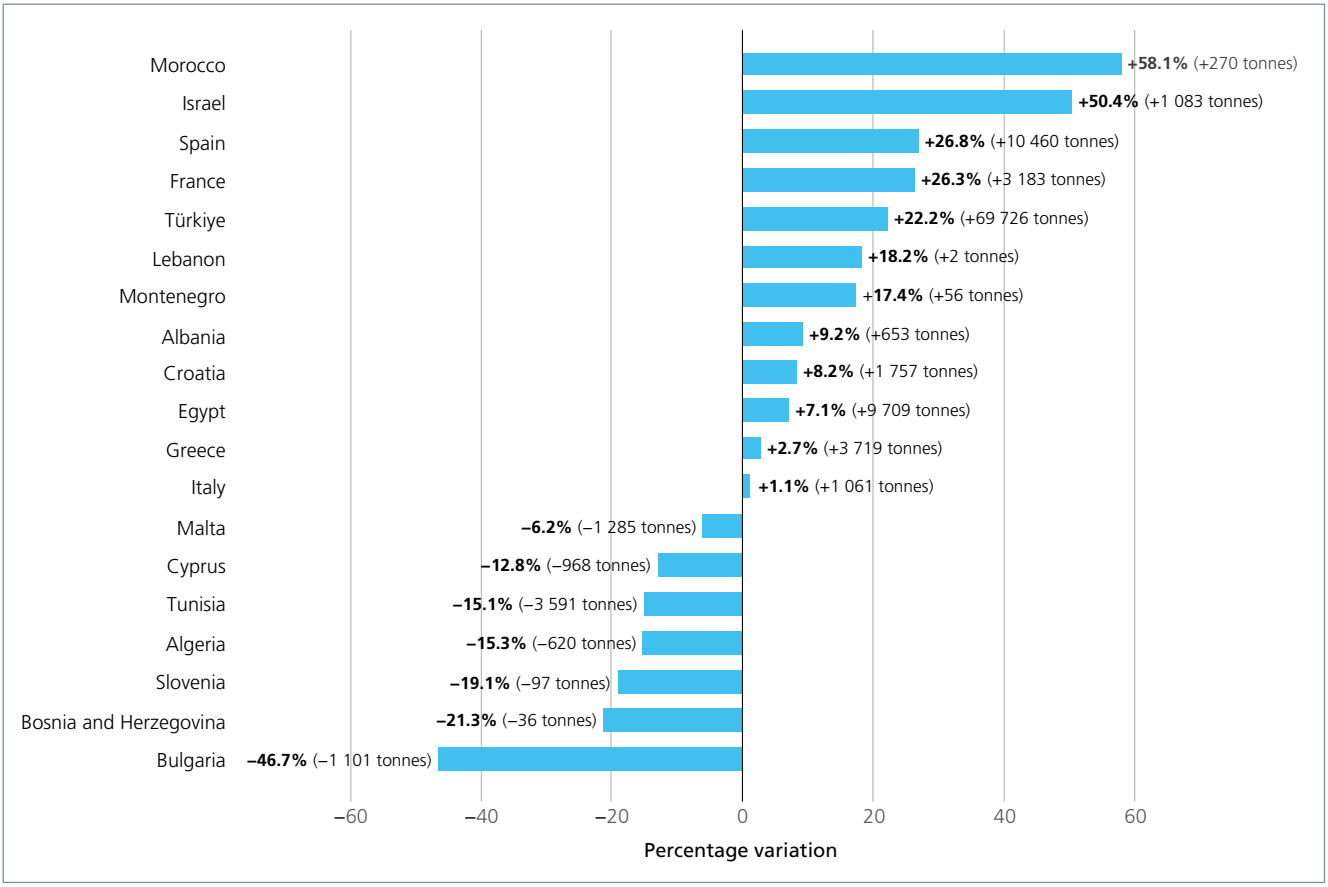
Note: Percentages indicate the contributions of countries to total marine and brackish water aquaculture production in the Mediterranean and the Black Sea in 2023.

Spain, Egypt, Greece and France exhibit the most significant production increases, of approximately 10 000 tonnes, 9 700 tonnes, 3 700 tonnes and 3 000 tonnes, respectively. Morocco and Israel experience the steepest percentage growth, with increases of 58.1 percent and 50.4 percent, respectively, albeit from relatively low production volumes. On the other hand, Bulgaria records the steepest decline, with production shrinking by nearly half. This decline in production is due to a combination of factors, including extreme sea warming in the Black Sea causing mass mortalities. Other notable reductions include Algeria, with a 15.3 percent drop, likely caused by fingerling supply disruptions in 2022 that limited grow-out cycles in 2023. Tunisia experiences a similar 15.1 percent reduction, largely due to climate change-related impacts, while Malta's production shows the smallest decline, at 6.2 percent.

SPECIES COMPOSITION AND DIVERSITY

Marine and brackish water aquaculture in the Mediterranean and the Black Sea exhibits both high species concentration and uneven distribution in the region. Overall, in the Mediterranean and the Black Sea, finfish contribute 86.1 percent of total aquaculture production, molluscs 13.7 percent and crustaceans and algae together account for a mere 0.2 percent (Figure 44). In North Africa and western Asia, finfish show a striking dominance, accounting for 98.1 percent of total aquaculture production, while molluscs are almost non-existent. This dominance is particularly driven by Egypt's brackish water production systems and Türkiye's cage farming. In contrast, production in the European Union is more diversified, with finfish making up 67.1 percent of the total. Mediterranean mussel, Japanese carpet shell and oysters contribute to about one third of the volume.

FIGURE 43. Percentage variation between average annual aquaculture production over 2020–2021 and 2022–2023, by GFCM contracting party and cooperating non-contracting party



In 2023, out of the 39 species reported, 11 accounted for 98.9 percent of the total production volume (Figure 45). Gilthead seabream (over 323 500 tonnes) and European seabass (around 278 500 tonnes) remain the dominant species, together representing 64.2 percent of the total production, thereby confirming their role as cornerstones of regional aquaculture.

Mediterranean mussel ranks a distant third with over 93 600 tonnes (10 percent), followed by rainbow trout (around 66 100 tonnes, 7 percent), meagre (nearly 52 300 tonnes, 5.6 percent), Atlantic bluefin tuna (around 37 800 tonnes, 4 percent) and mullets nei (approximately 34 900 tonnes, 3.7 percent). Niche species – including Japanese carpet shell, various oyster species and

FIGURE 44. Relative contributions of species groups to marine and brackish water aquaculture production by region, 2023

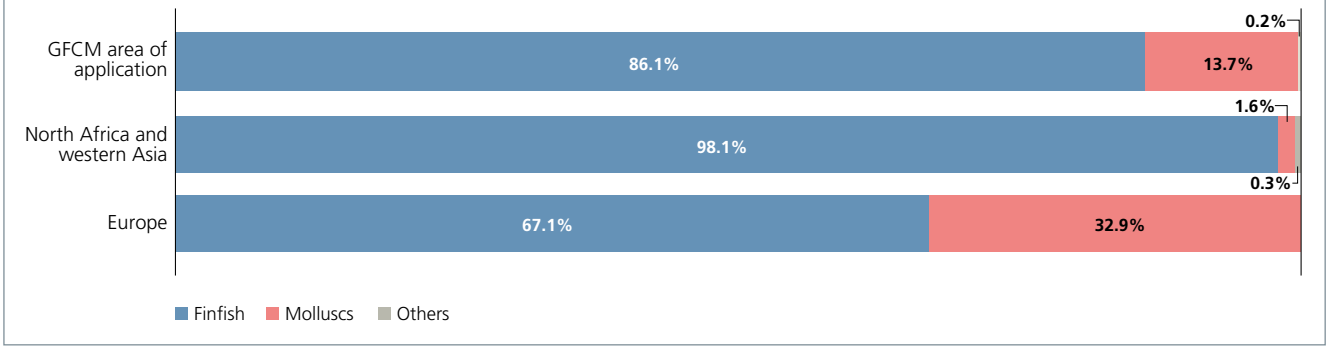
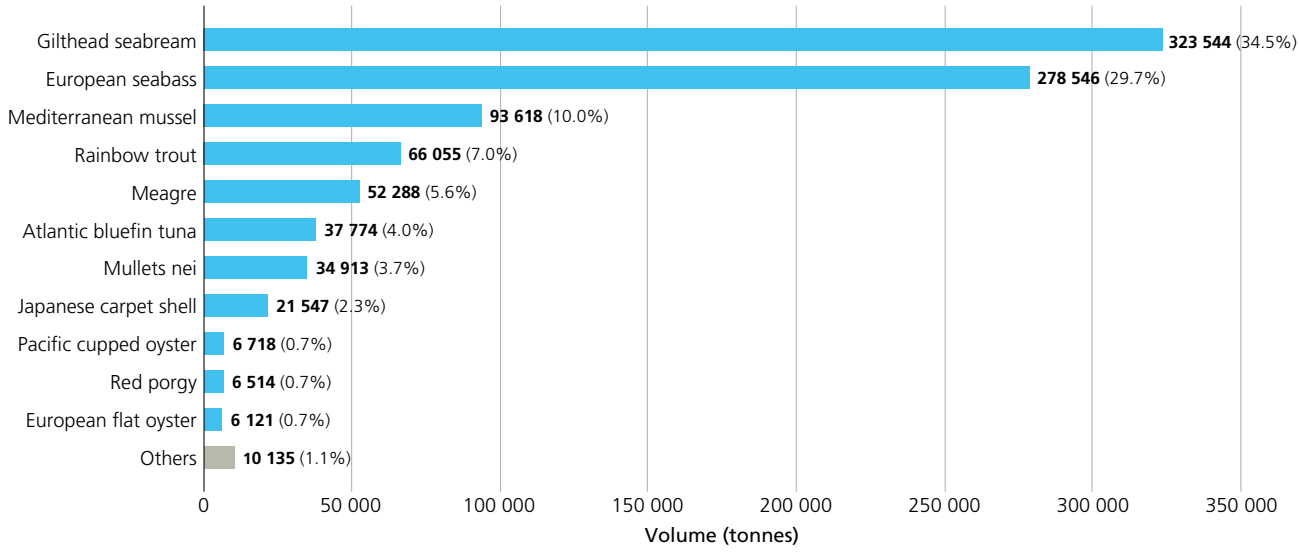


FIGURE 45. Marine and brackish water aquaculture production by main species reared in the Mediterranean and the Black Sea, 2023



Note: Percentages indicate the relative contributions of the main species reared to total marine and brackish aquaculture production in the Mediterranean and the Black Sea in 2023.

red porgy (*Pagrus pagrus*) – collectively contribute approximately 4.4 percent of the total production. Twenty-eight additional minor taxa account for just 1.1 percent (around 10 100 tonnes).

The significant growth in marine and brackish water aquaculture production in recent years has mainly been driven by the increase in production of finfish species. Looking at the recent trends (Table 7), the dominance of gilthead seabream and European seabass has been reinforced by steady growth since 2019, while rainbow trout has increased more than sevenfold over the same period. This recent five-year window captures short-term variability in production, including fluctuations linked to the post-COVID-19 recovery phase, climatic events and market adjustments. By contrast, most mollusc species, including Mediterranean mussel, have shown relative stability, with only minor year-to-year fluctuations. Crustacean farming, almost entirely based on whiteleg shrimp (*Penaeus vannamei*), showed some volatility but remained marginal. Algae production was very limited with less than 100 tonnes recorded in 2023, highlighting that seaweed farming is still at an early stage of development in the region. In parallel with these production trends, restorative aquaculture initiatives are gradually emerging in the region (Box 13). Although still limited in scale, they represent an important complement to conventional production, aiming not only to diversify aquaculture activities but also to provide ecological benefits, such as improving water quality, enhancing biodiversity and rehabilitating coastal habitats.

PRODUCTION SYSTEMS AND TECHNOLOGIES

In 2023, marine-cage farming accounted for 83 percent of all marine and brackish water production in the Mediterranean and the Black Sea (Figure 46). Suspension culture follows as a distant second, contributing 9 percent, with France, Italy and Spain responsible for nearly all the region's bivalve production. Low-input lagoon farming is prominent in Italy, while pond-based systems are common in Egypt and Türkiye. Together, these methods contribute just under 4 percent to total production. The remaining 4 percent come from a mix of diverse production systems, including raceways, tanks and bottom culture. Emerging alternative systems such as integrated multitrophic aquaculture, recirculating aquaculture systems and aquaponics modules have gradually been gaining traction across the region (Box 12).

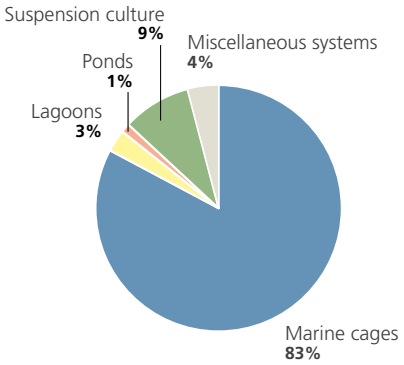
Cage-based production in the Mediterranean and the Black Sea is concentrated in a limited

TABLE 7. Annual production and species composition in marine and brackish water aquaculture in the Mediterranean and the Black Sea, 2019–2023

Species	2019	2020	2021	2022	2023	Percentage (2023)
	Production (in tonnes)					
Finfish	**588 886**	**664 171**	**732 940**	**774 326**	**807 522**	
Gilthead seabream	247 714	262 012	303 593	322 612	323 544	40.1
European seabass	247 324	261 948	284 360	277 237	278 546	34.5
Rainbow trout	9 411	18 182	31 509	45 454	66 055	8.2
Meagre	37 133	53 846	42 733	49 822	52 288	6.5
Atlantic bluefin tuna	25 596	33 671	32 080	37 204	37 774	4.6
Mullets nei	16 452	27 702	31 180	35 006	34 913	4.3
Red porgy	2 933	3 034	4 614	5 191	6 514	0.8
Others	2 322	3 776	2 870	1 800	7 887	1.0
Molluscs	**129 927**	**118 466**	**122 853**	**118 273**	**128 497**	
Mediterranean mussel	98 154	88 308	93 130	84 256	93 618	72.9
Japanese carpet shell	25 903	24 338	23 054	21 000	21 547	16.8
Pacific cupped oyster	5 648	5 419	6 217	6 558	6 718	5.2
European flat oyster	80	132	213	146	6 121	4.7
Grooved carpet shell	72	190	165	318	263	0.2
Others	69	78	74	5 995	231	0.2
Crustaceans	**162**	**2 172**	**3 460**	**1 756**	**1 718**	
Whiteleg shrimp	136	2 154	3 437	1 744	1 693	98.5
Others	26	18	23	12	25	1.5
Algae	**323**	**210**	**114**	**255**	**98**	
Slender wart weed	273	190	84	174	35	36
Spirulina nei				2	1	1.0
Warty gracilaria	50	20	30	79	62	63

number of countries (Figure 47). Türkiye stands out as the largest producer, with approximately 383 500 tonnes produced in marine cages, accounting for roughly 61 percent of the regional total volume. This production is primarily driven by gilthead seabream, European seabass and rainbow trout. Greece follows with around 120 900 tonnes, almost entirely focused on European seabass and gilthead seabream. Spain, with nearly 47 000 tonnes, produces a mix of Atlantic bluefin tuna, European seabass, gilthead seabream and meagre. Croatia, Tunisia and Malta – by volume of production – each contribute between 18 000 and 22 000 tonnes, predominantly of European seabass and gilthead seabream, with Malta also farming Atlantic bluefin tuna. Together, five other countries (Albania, Cyprus, France, Italy and Slovenia) contribute over 17 000 tonnes.

FIGURE 46. Relative contributions of production methods to marine and brackish water aquaculture production in the Mediterranean and the Black Sea, 2023



Note: "Miscellaneous systems" refers to a mix of other production systems such as raceways, tanks and bottom culture systems.
The portion of total production reported without a specified production method (18.8 percent) was excluded from this analysis.

Box 11. Shellfish production under a changing environment: the Italian experience

The Mediterranean region is a hot spot for climate change. Since 1970, southwestern Europe has experienced a temperature increase of approximately 0.2°C per decade, with the most significant warming occurring during the summer months, especially in coastal areas (Alvarez *et al.*, 2024). This trend is expected to impact aquaculture in various ways, particularly inshore shellfish farming, which in the Mediterranean is predominantly located in protected environments such as bays, gulfs, canals and coastal lagoons. As such, continued adaptation efforts are crucial and several strategies are already being tested or implemented across the region.

Along the Italian Adriatic coast – the primary area for mollusc farming in Italy – farms are located nearshore, typically 1 km to 2 km from the coastline and at an average depth of 10 m. The proximity to shore and shallow farming depths make shellfish production increasingly vulnerable to extreme weather events, which are becoming more frequent and intense. Among these, prolonged seawater temperature spikes, known as marine heatwaves, have become more common, lasting longer and covering wider areas, with greater intensity (Salini *et al.*, 2024). From 2008 to 2022, a noticeable shift towards higher summer temperatures was observed, especially in August and September (Darmaraki *et al.*, 2024). In response, farmers are adapting their management practices by adjusting seeding and harvesting schedules. Where bathymetric conditions allow, mussel lines are being submerged to greater depths to reduce exposure to elevated surface temperatures during peak summer heat. On the research front, collaborative efforts are underway to identify heat-tolerant mussel strains and other physiological traits better suited to increasingly variable farming conditions.

These heatwaves have detrimental effects on mussel production, especially when seawater temperatures surpass the thermal tolerance limits for mussel growth. In recent years, several farms along the Italian coasts have reported massive die-offs of Mediterranean mussels (*Mytilus galloprovincialis*), which are highly vulnerable to climate-related stressors such as elevated water temperatures. Additionally, limited food availability, caused by a reduction in suspended sediment transport from freshwater rivers, further hampers production (Bracchetti *et al.*, 2024; Luppichini, Lazzarotti and Bini, 2024). To address these challenges, initiatives are underway to improve water management at the river basin level. In parallel, research efforts are focusing on the development of early warning systems using neural network algorithms. These systems are designed to alert farmers when water quality risks rise, enabling them to adjust practices – such as postponing mussel harvesting – to mitigate potential impacts.

Similarly, Japanese carpet shell (*Ruditapes philippinarum*) aquaculture production in Italy has been on the decline over the past decade, although the trend shows annual fluctuations. Notably, the availability of spat from natural recruitment consistently decreased (Martini *et al.*, 2025). While the exact causes of this decline are still under investigation, the primary contributing factors seem to be related to changing environmental conditions in coastal marine ecosystems. These include water quality degradation resulting from both natural processes and anthropogenic activities (Ponti *et al.*, 2017). In response, hatchery technologies for clam seed production are being enhanced, along with the development of pre-fattening systems that grow juvenile clams to a larger, more resilient size – reducing their vulnerability to natural mortality after seeding in lagoons.

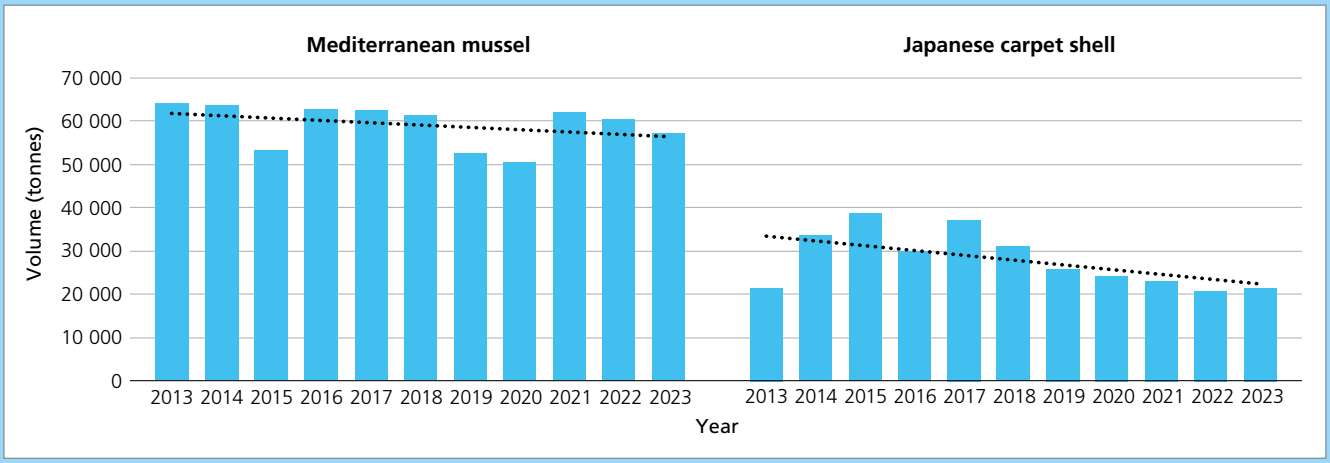
An additional threat to clam farming in Italy emerged in the summer of 2023 with the proliferation of blue crab (*Callinectes sapidus*), which led to significant predation and to the loss of both seed and market-size Japanese carpet shells (Chiesa *et al.*, 2025). This had severe consequences for aquaculture in the region, although the full extent of the impact will become clearer as forthcoming production data are released. In the meantime, several practical measures are being implemented. In the Po Delta, operators are installing iron reinforced nets in the lagoons to protect mussel and clam farms from the invasive blue crab. Juvenile clams are being seeded within these nets, effectively reducing blue crab predation. In parallel, producers – working in collaboration with research institutes and authorities – are exploring market opportunities for blue crab. More broadly, blue crab and other non-indigenous species (NIS) are proliferating across the Mediterranean and Black Sea, posing serious challenges to aquaculture and coastal ecosystems, while at the same time opening up new opportunities for the fisheries sector (Öztürk, 2021).

At the regional level, the GFCM is intensifying efforts to support climate-resilient aquaculture. Through its technical advisory groups, the GFCM is promoting tools such as allocated zones for aquaculture, which support the climate adaptation of aquaculture practices, as well as the proposed Aquaculture Climate Change Observatory, designed to monitor climate impacts and facilitate knowledge sharing to inform adaptation strategies. In addition, the recently established Aquaculture Demonstration Centre in Spain promotes restorative aquaculture as a practical response to climate-related risks, highlighting approaches that integrate production

(Continued)

Box 11. (Continued)

Production trends of Mediterranean mussel and Japanese carpet shell in Italy, 2013–2023



with the delivery of ecosystem services. The GFCM also supports a range of initiatives to monitor and research the appearances, impacts and potential opportunities associated with NIS, including through a NIS Observatory recently established in Antalya, Türkiye, and a dedicated research programme on blue crabs (FAO, 2025). Together, these initiatives aim to strengthen the aquaculture sector's capacity to respond to an increasingly variable and uncertain environment.

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Box 12. Transforming aquaculture through innovation: supporting sustainability in the Mediterranean and the Black Sea

Aquaculture in the Mediterranean and the Black Sea is undergoing a significant transformation, driven by innovative technologies designed to enhance sustainability, efficiency and environmental compatibility. These innovations are evolving traditional practices into integrated systems that recycle resources, minimize waste and diversify production. Integrated multitrophic aquaculture, aquaponics and recirculating aquaculture systems are complementary approaches that contribute to achieving Target 3 of the GFCM 2030 Strategy for sustainable fisheries and aquaculture in the Mediterranean and the Black Sea (FAO, 2021), which aims to foster a sustainable and resilient aquaculture sector. These approaches do not replace traditional systems but, together, they mitigate risks and enhance carrying capacity under constraints.

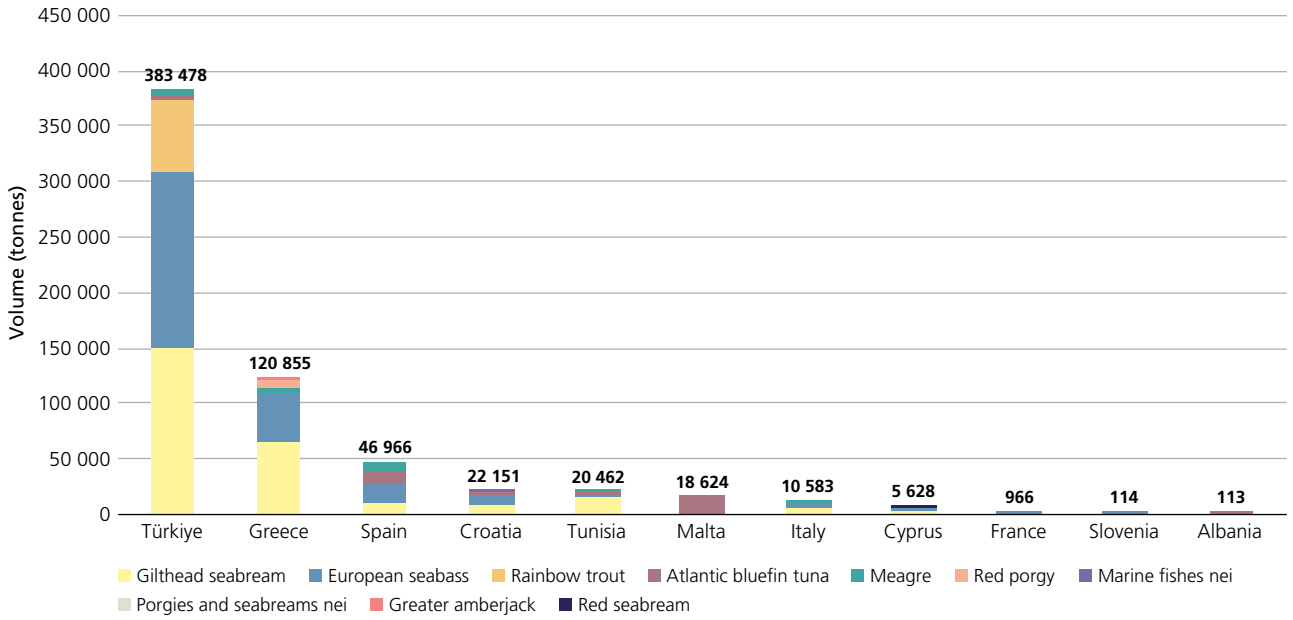
Overview of innovative aquaculture systems

Aquaculture system	Description	Optimal application context	Advantages	Constraints
Integrated multitrophic aquaculture	Co-culturing fed finfish with extractive species (bivalves/seaweeds) for nutrient uptake	• Coastal sites with regulated nutrient emission thresholds • Farms seeking product diversification without additional feed	• Reduces nutrient footprint • Diversifies revenue by cultivating additional species such as bivalves and seaweeds • Provides ecosystem services	• Design and operational complexity • Spatial planning and licensing requirements • Market development for co-products
Aquaponics	Integrated production of fish and plants in recirculating loops (hydroponics and recirculating aquaculture systems)	• Urban farming or land-scarce zones • Educational projects and/or small and medium enterprises • Water-stressed areas	• High water-use efficiency • Year-round production with shorter value chains • Accessible for small operators	• High energy demand and skilled operation and maintenance requirements • Limited species options
Recirculating aquaculture systems	Land-based, highly controlled tanks with treatment/recirculation (> 90% water reuse)	• Hatcheries and nurseries • High-value grow-out near markets • Sites with space constraints	• Enhanced biosecurity and disease control • Flexible siting options • Proximity to market ensuring freshness	• High capital and operating expenditures* • Energy-intensive • Technical skills required • Complex water-quality management

Note: * Capital expenditures refer to substantial long-term investments (e.g. tanks or equipment), while operating expenditures cover ongoing running costs (e.g. labour, feed and energy).

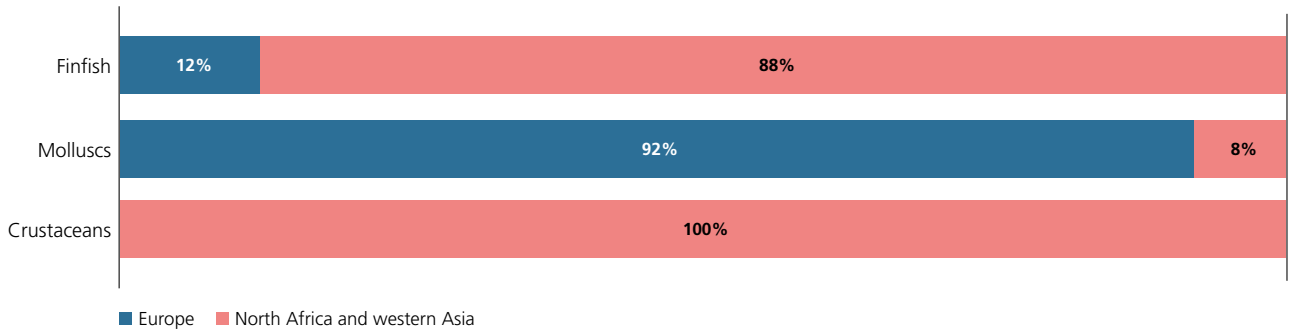
Source:
FAO. 2021. *GFCM 2030 Strategy for sustainable fisheries and aquaculture in the Mediterranean and the Black Sea*. Rome. https://doi.org/10.4060/cb7562en

FIGURE 47. Marine cage aquaculture production by GFCM contracting party, 2023



Note: This analysis only includes the 11 GFCM contracting parties that reported using marine cages as a culture structure.

FIGURE 48. Percentage distribution of hatcheries by marine and brackish water species group per region



Note: Marine and brackish water aquaculture data originate from 13 GFCM contracting parties (reference year in parentheses): Algeria (2018), Croatia (2023), Cyprus (2023), Egypt (2019), France (2023), Greece (2023), Israel (2022), Italy (2023), Malta (2022), Morocco (2022), Spain (2022), Tunisia (2023) and Türkiye (2023).

This concentration of cage farming – and thus finfish supply – in a few coastal hubs underscores the need for capacity development and knowledge sharing, which would allow smaller producers to scale sustainably and ensure a broader, more resilient production in the region, in line with the GFCM 2030 Strategy.

Access to reliable seed infrastructure plays a crucial role in determining the producers who can engage in aquaculture and how quickly they can scale their operations. The vast majority of finfish hatcheries (88 percent) are concentrated in Egypt and western Asia (Figure 48). Other North African countries often depend on their neighbours, especially the European Union and Türkiye, for the supply of finfish fry such as European seabass, gilthead seabream and meagre, due to the higher concentration of hatcheries in these areas. The European Union's dominance in mollusc hatcheries reflects its long-standing tradition of mussel and oyster farming, supported by the nutrient-rich waters of the northern Mediterranean and the Black Sea. Meanwhile, crustacean farming remains a

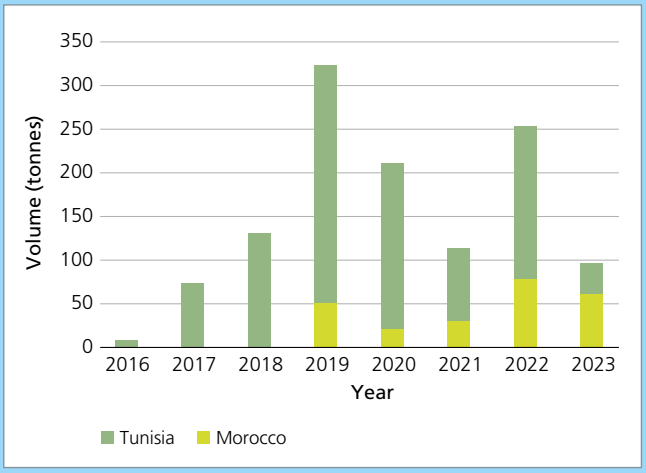
Box 13. Emerging species and restorative approaches in the Mediterranean Sea

In recent years, Mediterranean aquaculture has increasingly focused on diversifying production, especially through emerging species with strong potential for sustainable growth. Countries in the region have begun investing in lesser-known species such as *Gracilaria* spp., sea cucumbers, *Solea* spp. and greater amberjack (*Seriola dumerili*). These species, which vary in development from experimental trials to established national industries, offer opportunities for innovation, resilience and regional valorization within Mediterranean aquaculture. Among these emerging species, low trophic organisms – such as macroalgae, bivalves and sea cucumbers – underscore the growing importance of restorative aquaculture, an innovative approach integrating environmental health with sustainable marine food production. This approach not only diversifies production but also enhances ecosystem services, supports biodiversity and contributes to habitat restoration efforts.

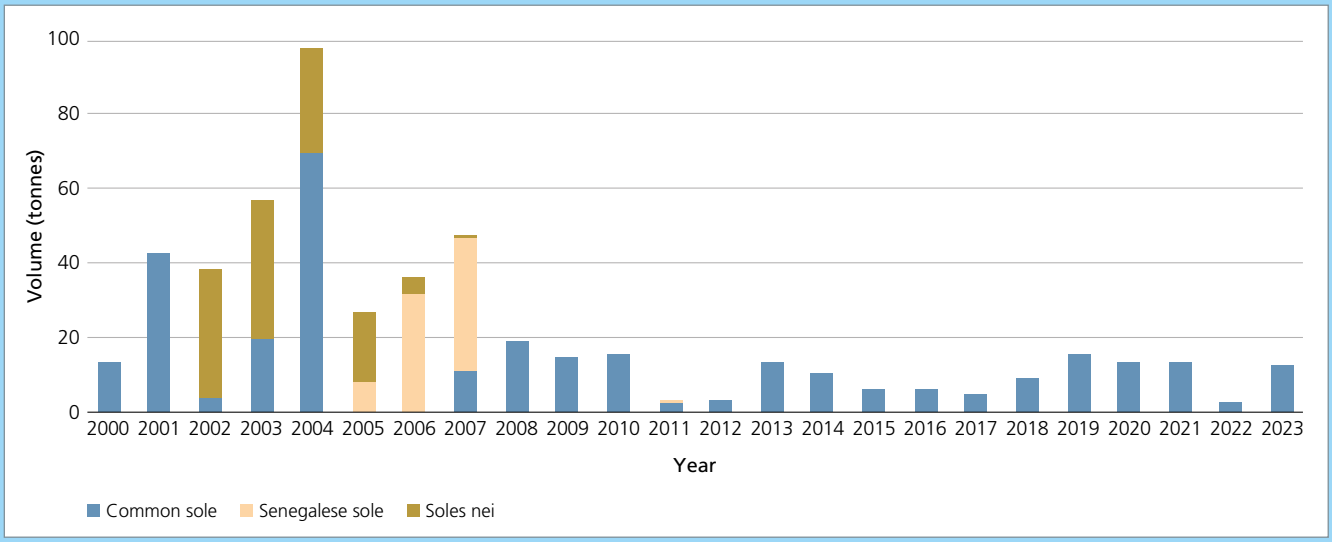
Macroalgae cultivation in the Mediterranean Sea is still in its early stages compared to global production, which is predominantly concentrated in Asia, accounting for approximately 97.4 percent of total global production (more than 34.8 million tonnes in 2019) (Cai *et al.*, 2021; Mantri *et al.*, 2023). In contrast, production in the Mediterranean amounted to 97 tonnes in 2023, all from countries in North Africa. Specifically, *Gracilaria gracilis* is farmed in Morocco and Tunisia, reaching 35.1 tonnes and 61.5 tonnes in 2023, respectively.

In recent years, commercial interest in Mediterranean sea cucumbers has surged, driven by the depletion of Indo-Pacific stocks and increasing market demand in East Asia. While sea cucumber aquaculture is well-established in countries like China, where more than six billion juveniles are produced annually, sea cucumber aquaculture is still in its early stages in the Mediterranean and the Black Sea. Currently, no full-cycle farming system in Europe is capable of consistently producing juveniles, and the few facilities attempting controlled reproduction are still in the experimental phase (Ciriminna *et al.*, 2024). Additionally, there is growing interest in integrated multitrophic aquaculture, where sea cucumbers are used as extractive species to recycle organic waste and enhance system sustainability. Although artificial reproduction protocols have been developed for most commercially relevant European species

Macroalgae production in the Mediterranean Sea



Sole production in the Mediterranean Sea



(Continued)

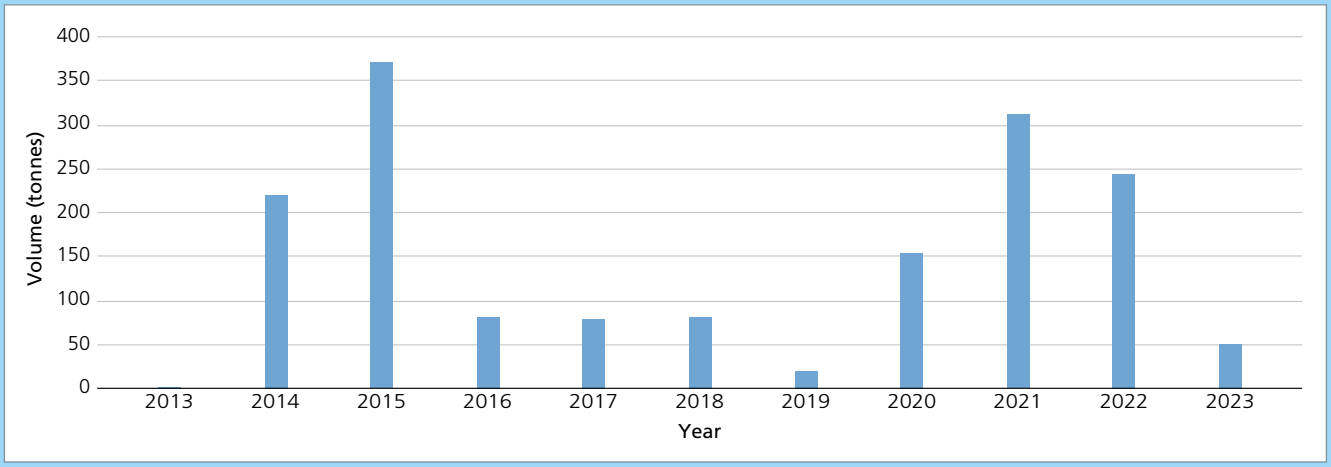
Box 13. (Continued)

– except royal cucumber (*Parastichopus regalis*) – the settlement phase remains a significant bottleneck in hatchery production (Ciriminna *et al.*, 2024).

In relation to emerging finfish species, *Solea* spp., including common sole (*Solea solea*) and Senegalese sole (*Solea senegalensis*), are cultivated in several countries across the Mediterranean. Common sole is farmed in Algeria, Greece, Italy and Spain. In Algeria, production is modest, with 2 tonnes reported in 2022 and 2023 from brackish waters. Italy, with its long tradition of sole cultivation but irregular production reporting, primarily records production from brackish water systems known as *vallicoltura*. Between 2008 and 2023, production fluctuated, with annual quantities ranging from less than 1 tonne to a peak of 10.6 tonnes in 2019. In 2023, production was recorded at 7.6 tonnes. In Spain, the farming of Senegalese sole is concentrated along the Atlantic coast, with Mediterranean sites reporting only sporadic production and minimal tonnage prior to 2011.

For greater amberjack, recent production data are only available for Greece and Spain. Greece's production increased from 64 tonnes in 2020 to 172 tonnes in 2021, but declined thereafter, with 44 tonnes in 2022 and 50 tonnes in 2023. Spain's Mediterranean amberjack production reached 90.1 tonnes in 2020 and surged to 200 tonnes in 2022.

Greater amberjack production in the Mediterranean Sea



Sources:
Cai, J., Lovatelli, A., Aguilar-Manjarrez, J., Cornish, L., Dabbadie, L., Desrochers, A., Diffey, S., *et al.* 2021. *Seaweeds and microalgae: an overview for unlocking their potential in global aquaculture development*. FAO Fisheries and Aquaculture Circular No. 1229. Rome, FAO. https://doi.org/10.4060/cb5670en
Ciriminna, L., Signa, G., Cilluffo, G., Rakaj, A. & Vizzini, S. 2024. Aquaculture of emerging species in north-eastern Atlantic and Mediterranean Sea: A systematic review on sea cucumber farming and potential development. *Frontiers in Marine Science*, 11: 1381836.
Mantri, V.A., Kambey, C.S.B., Cottier-Cook, E.J., Usandizaga, S., Buschmann, A.H., Chung, I.K., Liu, T., *et al.* 2023. Overview of global *Gracilaria* production, the role of biosecurity policies and regulations in the sustainable development of this industry. *Reviews in Aquaculture*, 15(2): 801–819.

niche, pre-commercial activity, primarily carried out in North Africa and western Asia. For this activity, robust seed systems not only enhance production capabilities but also support social and governance goals by fostering local and national expertise, reducing transboundary biosecurity risks and promoting multistakeholder collaboration in the sustainable development of aquaculture.

CONCLUDING REMARKS

Over the past decade, aquaculture production has doubled, driven by countries' commitment to sustainable aquaculture development, rising demand for aquatic food, improvements in management practices, including spatial planning (see Chapter 7), and increased production efficiency through innovations in genetics, feed technology, product differentiation and species diversification.

However, the region's heavy reliance on two finfish species – gilthead seabream and European seabass – underscores the need for broadening the production base. Diversifying into bivalves and emerging species offers opportunities to reduce feed reliance, increase local economic value and employment and reduce market and climate change risks. Within this evolving landscape, resilience has emerged as a central driver of production decisions, alongside competitiveness.

As production volumes continue to grow, the aquaculture sector must also confront environmental pressures, including heatwaves, disease outbreaks and non-indigenous species. Addressing these challenges requires placing environment-related measures – such as spatial planning, carrying capacity estimation, environmental monitoring programmes and early diagnosis of emerging pathogens (see Chapter 7) – alongside socioeconomic objectives like employment, value addition and price stability.[8] Strengthening governance capacity to support these efforts remains a cornerstone of the GFCM 2030 Strategy,[9] which ultimately aims to foster a more resilient and sustainable aquaculture sector in the region.

[8] An analysis of socioeconomic performance and value chains is presented in Chapter 5, which focuses on the socioeconomic characteristics of the fisheries and aquaculture sector.

[9] Further details on the objectives, governance instruments and implementation of the GFCM 2030 Strategy are provided in Chapter 7.

5. Socioeconomic characteristics of the fisheries and aquaculture sector

Promoting resilient livelihoods sustained by fisheries and aquaculture, through productive employment opportunities and enhanced profitability, is central to achieving the targets of the GFCM 2030 Strategy for sustainable fisheries and aquaculture in the Mediterranean and the Black Sea (GFCM 2030 Strategy; see Box 2), notably those under Target 4 "Livelihoods: decent employment and engaged fishers towards profitable fisheries", and advancing Blue Transformation in the region (see Box 1). Achieving these goals requires that fisheries management and aquaculture development be grounded in comprehensive socioeconomic data that reflect the realities of the sector. Outcomes in fisheries and aquaculture are influenced not only by stock status and environmental factors but also by economic dynamics and human behaviour. Elements such as revenues, costs, employment patterns, demographic shifts, and value chain structures drive behaviour, constrain choices and enable change. Interpreting these interconnected indicators helps clarify sector performance, anticipate future developments, and identify effective levers for policy and management. In the context of Target 5 "Capacity

development: technical cooperation, knowledge sharing and efficient partnerships in a subregional perspective" of the GFCM 2030 Strategy, substantial progress has been made in recent years to strengthen socioeconomic knowledge and tailor it to the needs of decision-makers.

This chapter presents the most recent insights into the economic performance and socioeconomic characteristics of the capture fisheries and aquaculture sector across the Mediterranean and the Black Sea. It begins with a regional overview of marine capture fisheries socioeconomic characteristics, offering a detailed review of revenue and employment by subregion, country and fleet segment group. It then delves into additional analyses covering key commercial species, the economic viability of fleets, social dynamics within the sector, trends related to the marketing and trade of catch, and socioeconomic impacts of management measures. Additionally, Box 14 illustrates examples of socioeconomic and local ecological knowledge studies conducted within the context of management-oriented initiatives. The chapter then provides insights into the socioeconomic characteristics of the aquaculture sector. It starts with a detailed presentation of revenue, employment and contribution to gross domestic product (GDP), by subregion and country. Revenue data are analysed according to the most important species and groups of species, type of farming, production environment and size of farming enterprises. The analysis provides information on the structure and dynamics of farmed species prices and their contributions to the overall per capita consumption of farmed aquatic foods in the region. Finally, the chapter examines relevant data in terms of value chain and trade for both fisheries and aquaculture.

For marine capture fisheries, the regular submission of socioeconomic data by contracting parties and cooperating non-contracting parties (CPCs) to the GFCM via the Data Collection Reference Framework (DCRF; see Box 4) online platform underpins detailed assessments of the sector's performance, covering key indicators such as revenue, gross value added (GVA), employment and remuneration. These data also enable time-series analyses of landing values and average prices of commercially important species, as well as evaluations of profitability and cost structures across different fleet segments. Such analyses are instrumental to anticipating the social and economic outcomes of management decisions and contribute to positioning the fisheries sector within a broader vision for the region's Blue Transformation.

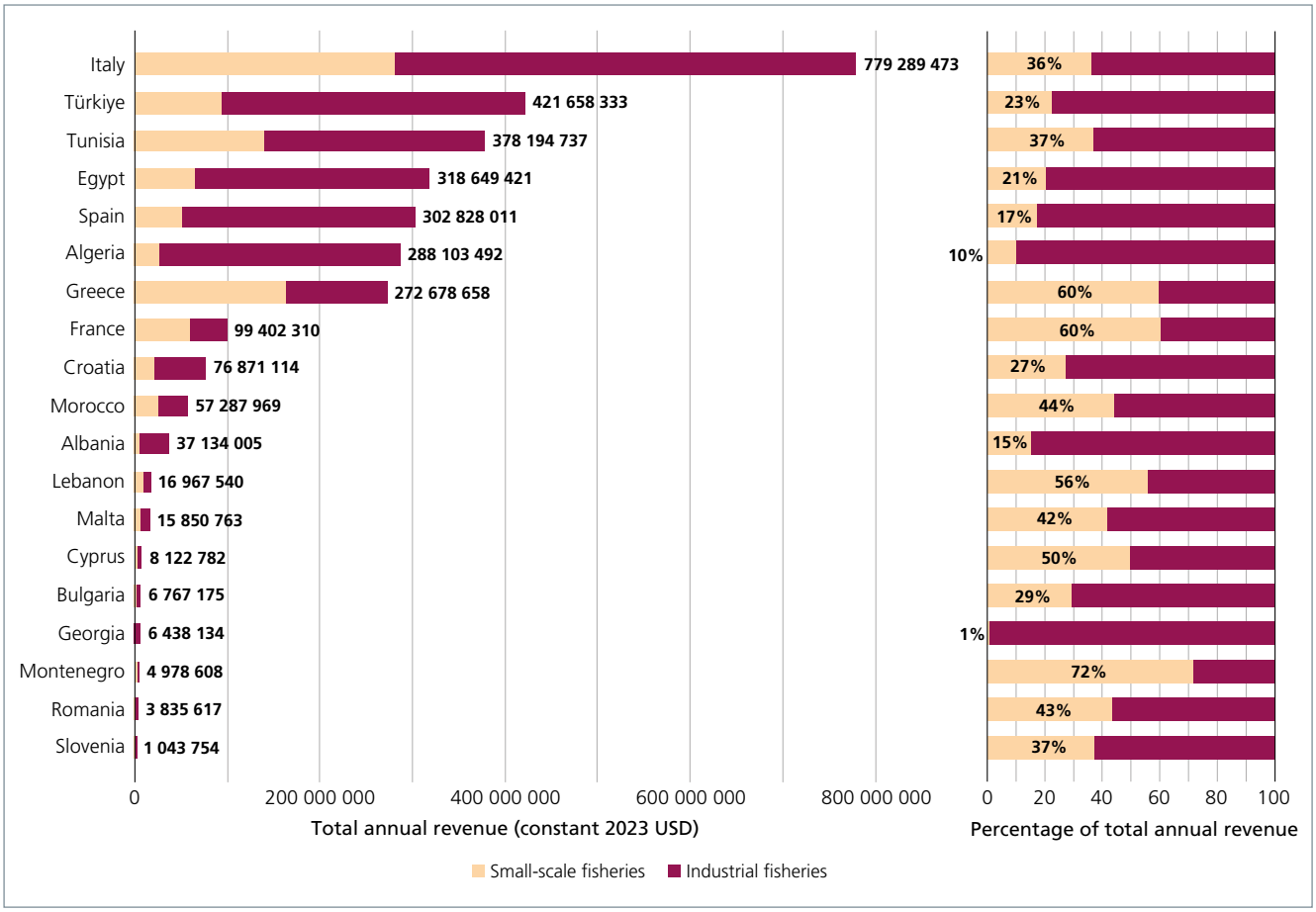
For aquaculture, the analysis is based on data on revenue from farming in marine and brackish waters; contributions to national GDP; employment, disaggregated by gender and age; per capita consumption; and farmed fish prices. Resulting trends over the period 2013–2023 are provided. The Information System for the Promotion of Aquaculture in the Mediterranean and FAO statistical databases are the main data sources, complemented with targeted surveys on farmed fish prices, consumption patterns of farmed fish, types of farming and enterprise size. These data and their analyses are valuable for building a good understanding of the socioeconomic drivers of aquaculture development in the GFCM area of application.

SOCIOECONOMIC CHARACTERISTICS OF MARINE CAPTURE FISHERIES

Regional socioeconomic review

In 2023, marine capture fisheries within the GFCM area of application generated an estimated revenue of USD 3.1 billion, comprising USD 2.8 billion from the Mediterranean and USD 293 million from the Black Sea. These figures reflect the value at first sale of fish landed by vessel-based fisheries operating in FAO Major Fishing Area 37, prior to any processing or value-adding activities. They do not include contributions from shore-based activities, such as gleaning (i.e. foot-based fishing, including shellfish collecting). Seven countries, namely Italy, Türkiye, Tunisia, Egypt, Spain, Algeria and Greece, in decreasing order, collectively account for approximately 90 percent of the total revenue (Figure 49). While the value at first sale provides an important metric for assessing economic performance, the broader economic impact of fisheries in the region, considering direct, indirect and induced effects along the value chain, remains substantially higher. If the wider economic impact is assumed to be 2.6 times the value at first sale (FAO, 2020), the overall economic contribution of the capture fisheries sector in 2023 can be estimated at approximately USD 8.05 billion. This calculation suggests that even in countries where the value at first sale may be modest, the overall

FIGURE 49. Revenue from marine capture fisheries by GFCM contracting party and cooperating non-contracting party



contribution of fisheries to the economy can still be considerable.

Compared to 2021 – the reference year for the 2023 edition of *The State of Mediterranean and Black Sea Fisheries* (FAO, 2023c) – revenue from fisheries in 2023 rose modestly, by an estimated USD 94 million, with the Black Sea showing the largest gains. However, adjusting for inflation and expressing the values in constant 2023 USD (Figure 50) neutralizes these gains, revealing a broader downward trend since 2016, although revenues show signs of stabilization from 2020 onwards.

Small-scale fisheries (SSF) account for 31 percent of total revenue across the GFCM area of application (33 percent in the Mediterranean and 15 percent in the Black Sea). This figure represents a 5.6 percent increase compared to the previous edition of *The State of Mediterranean and Black Sea Fisheries* (FAO, 2023c). As in past years, revenue from SSF can vary widely between countries. In Cyprus, France, Greece, Lebanon and Montenegro, SSF contribute more than 50 percent of the total revenue from marine capture fisheries, accounting for as much as 72 percent in some countries (Figure 49).

As highlighted under Target 4 of the GFCM 2030 Strategy, productive and resilient fisheries-based employment is crucial to a sustainable fisheries sector. In 2023, an estimated 197 000 individuals were employed on board fishing vessels across the GFCM area of application (174 500 in the Mediterranean and 22 500 in the Black Sea). Six countries, namely Tunisia, Türkiye, Egypt, Italy, Morocco and Algeria, in decreasing order, accounted for nearly 80 percent of this total (Figure 51). Compared to 182 900 total jobs in 2021 (FAO, 2023c), this figure marks an overall 8 percent increase, reflecting an 11 percent increase in onboard employment in the Mediterranean and a 10 percent decline in the Black Sea.

At the regional level, SSF accounted for 114 000 jobs in 2023, up slightly from 111 500 jobs

FIGURE 50. Revenue from marine capture fisheries per year by fleet segment group in the GFCM area of application, 2016–2023

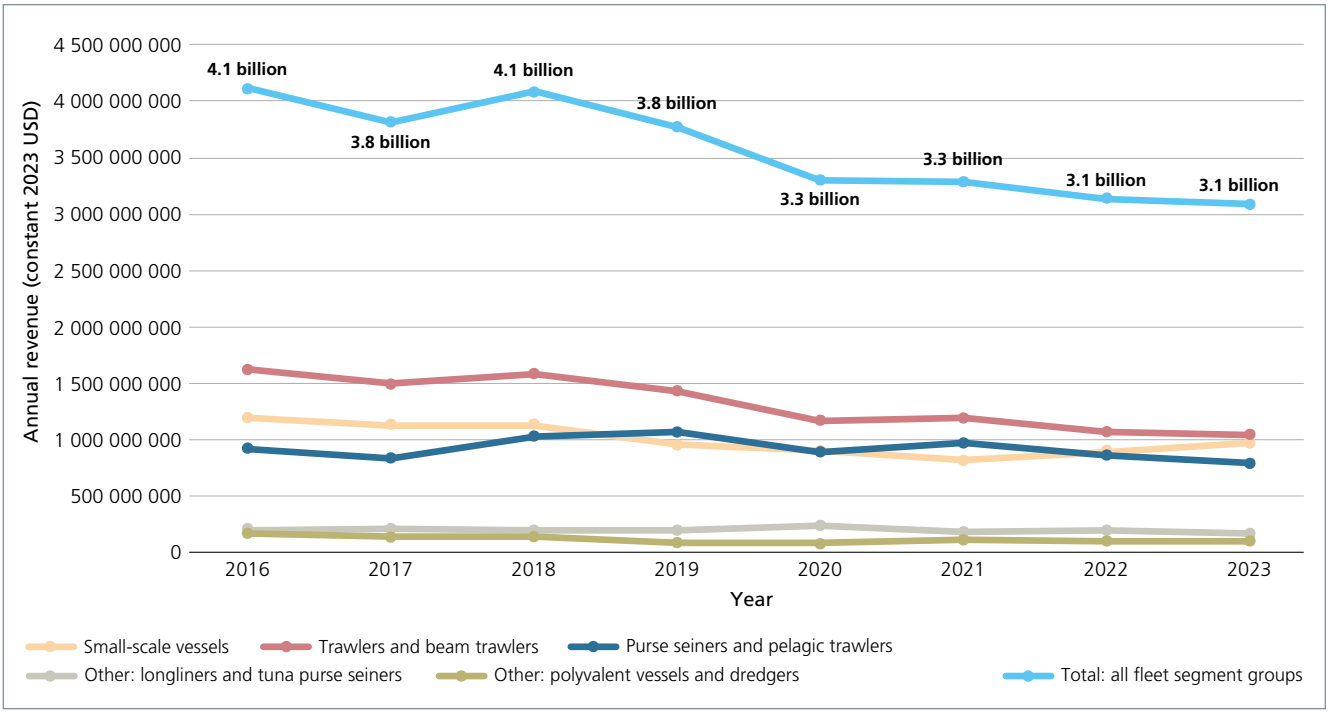


FIGURE 51. Employment on board small-scale and industrial fishing vessels by GFCM contracting party and cooperating non-contracting party

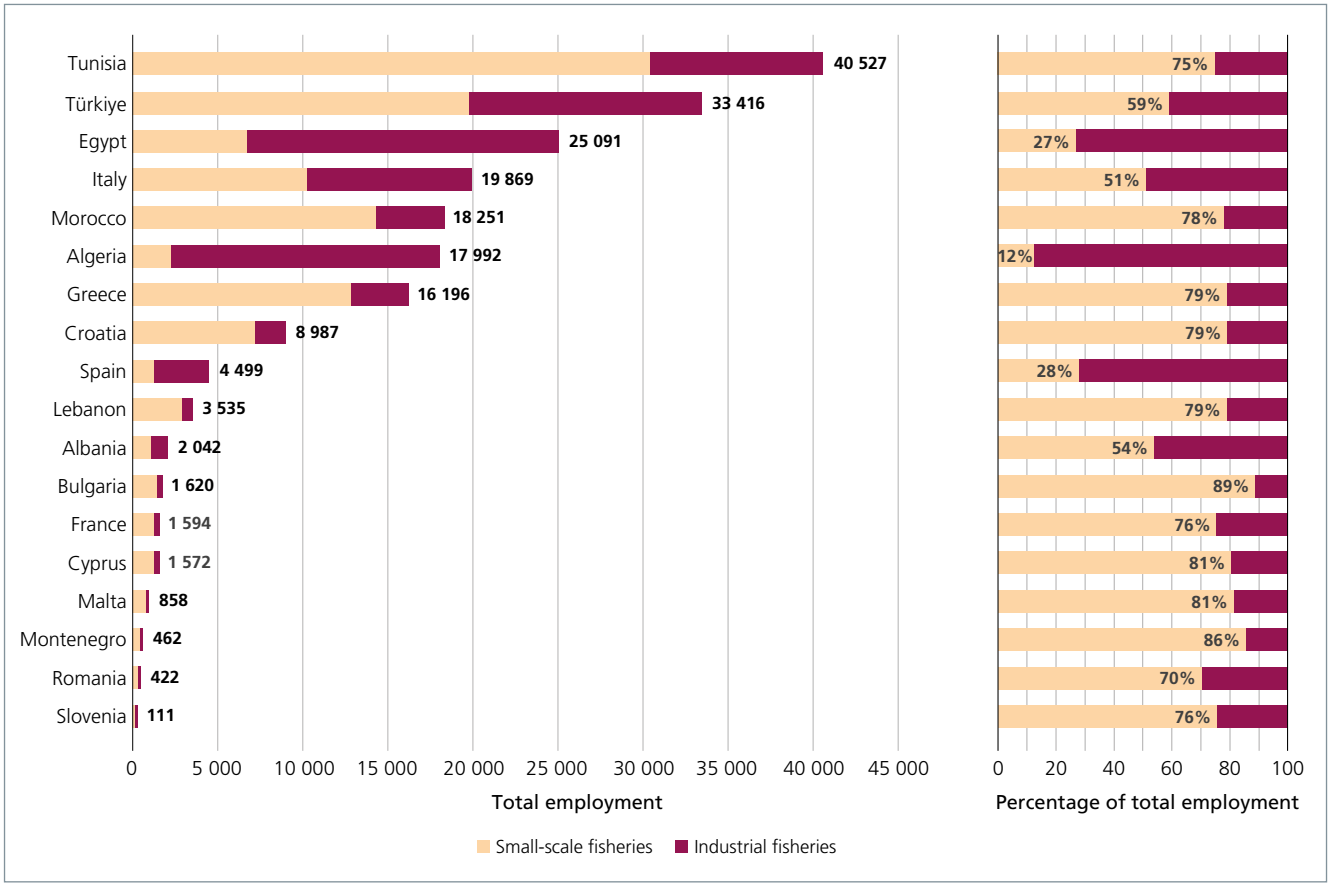
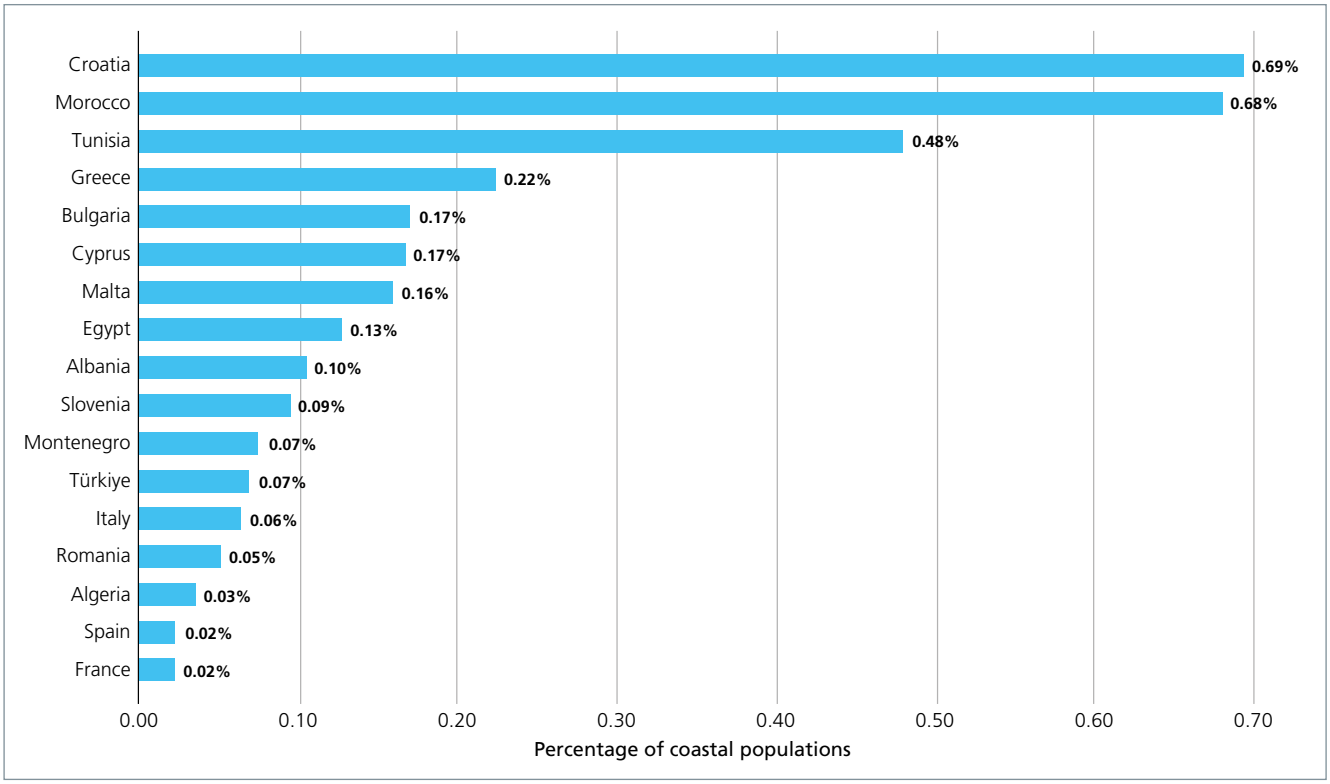


FIGURE 52. Percentage of coastal populations employed on board fishing vessels by GFCM contracting party and cooperating non-contracting party



in 2021. Despite this increase in total jobs, the share of SSF as a portion of total onboard employment declined from 61 percent in 2021 to 58 percent in 2023 (59 percent in the Mediterranean and 52 percent in the Black Sea). This trend suggests that job growth is mainly concentrated in the industrial fleet segment groups. Since 2021, the most notable declines in SSF employment were observed in Algeria and Spain, while Malta, Morocco and Romania reported significant increases. In 2023, SSF represented more than 80 percent of onboard jobs in Bulgaria, Cyprus, Malta and Montenegro (Figure 51).

These figures, however, capture only part of the picture. Employment on board vessels excludes a wide range of non-vessel-based harvesting roles, such as shore-based fishing (i.e. gleaning), while fisheries-dependent work in pre-harvest and post-harvest provide substantial employment opportunities, particularly for women (see section on Value chain and trade in fisheries and aquaculture).

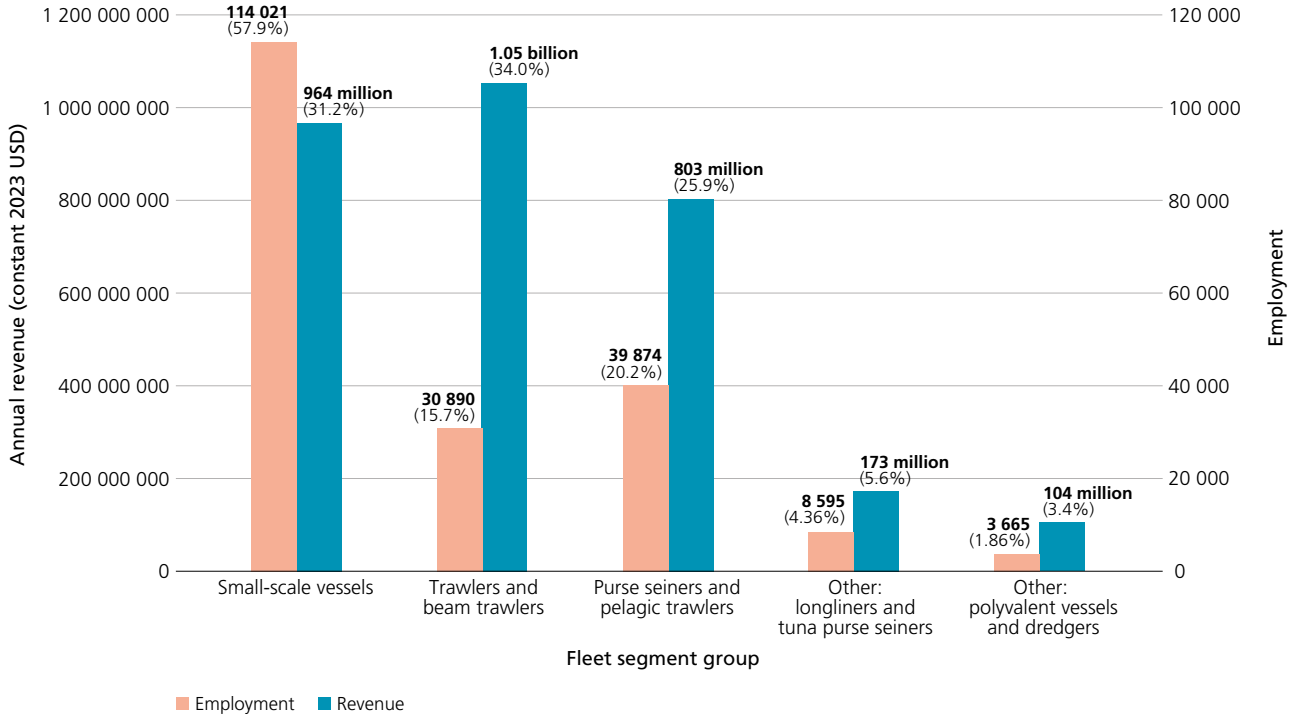
Fisheries continue to play a vital role in sustaining coastal livelihoods, particularly in rural and remote areas. On average, onboard employment accounts for about 0.09 percent of coastal populations (i.e. approximately one fisher per 1 100 residents). In some countries, such as Croatia and Morocco, this proportion is significantly higher, close to 0.7 percent (i.e. approximately one fisher for every 140 coastal inhabitants) (Figure 52).

The economic and employment benefits of the fisheries sector are unevenly distributed between SSF and industrial fisheries (Figure 49 and Figure 51). On average, SSF account for 58 percent of total employment but only 31 percent of total revenue. In contrast, the industrial fleet, which employs 42 percent of fishers, captures 69 percent of the total revenue of the sector (composed of 34 percent from "Trawlers and beam trawlers", 26 percent from "Purse seiners and pelagic trawlers", 6 percent from "Other: longliners and tuna purse seiners",[10] and 3 percent from "Other: polyvalent vessels and dredgers") (Figure 53).

A comparative analysis of capture fisheries across GFCM subregions (Figure 54) highlights

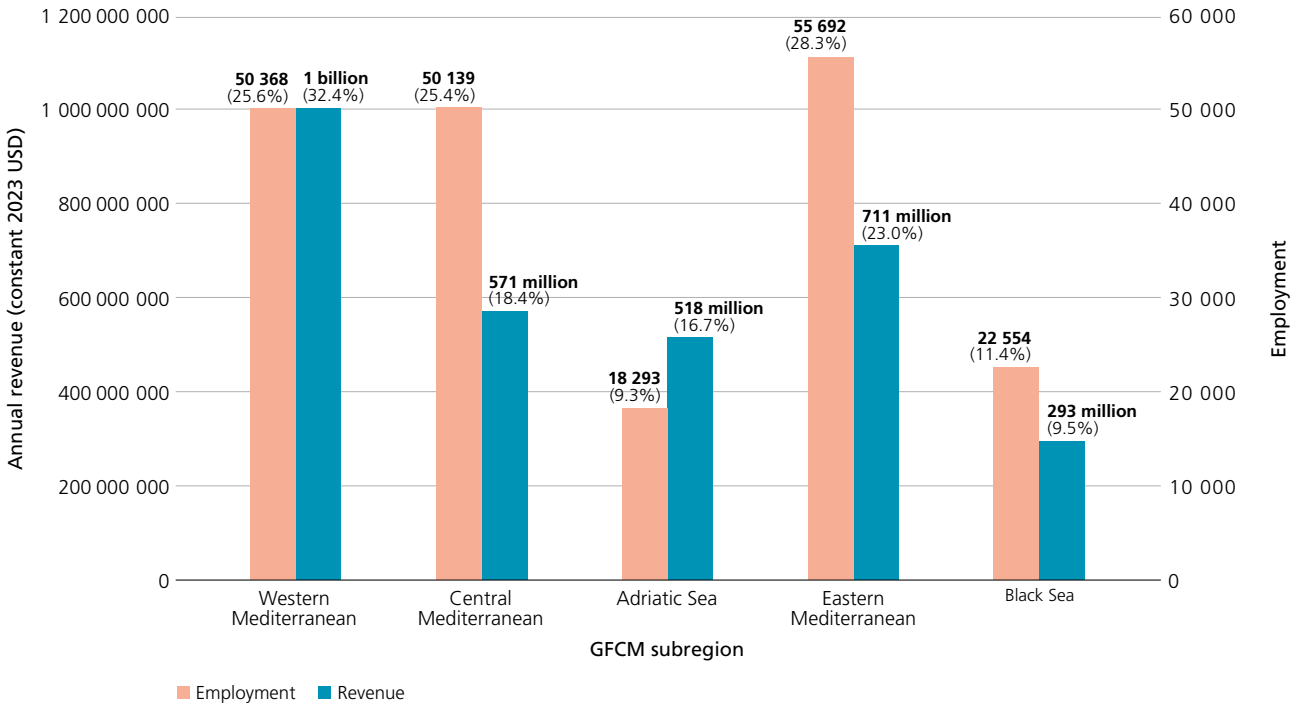
[10] Tuna and tuna-like species are excluded from the analysis for tuna purse seiners, as they fall outside the remit of the GFCM, while revenue from bycatch and other species of interest to the GFCM is included.

FIGURE 53. Comparison of revenue and employment from marine capture fisheries by fleet segment group in the GFCM area of application



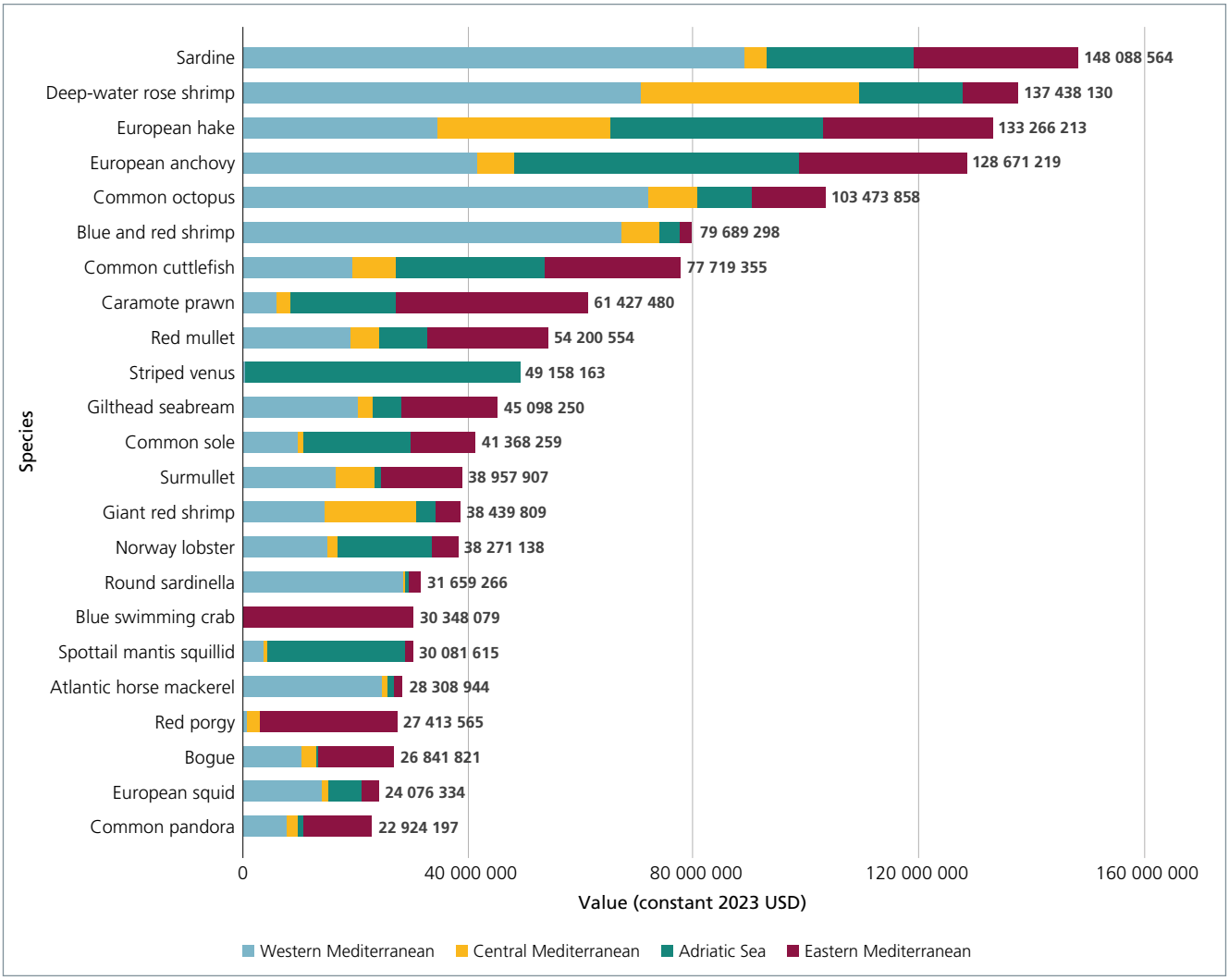
Note: Percentages indicate the relative contributions of fleet segment groups to revenue and employment totals in the GFCM area of application.

FIGURE 54. Comparison of revenue and employment from marine capture fisheries by GFCM subregion



Note: Percentages indicate the relative contributions of GFCM subregions to revenue and employment totals in the GFCM area of application.

FIGURE 55. Main commercial species (in terms of value) in the GFCM Mediterranean subregions



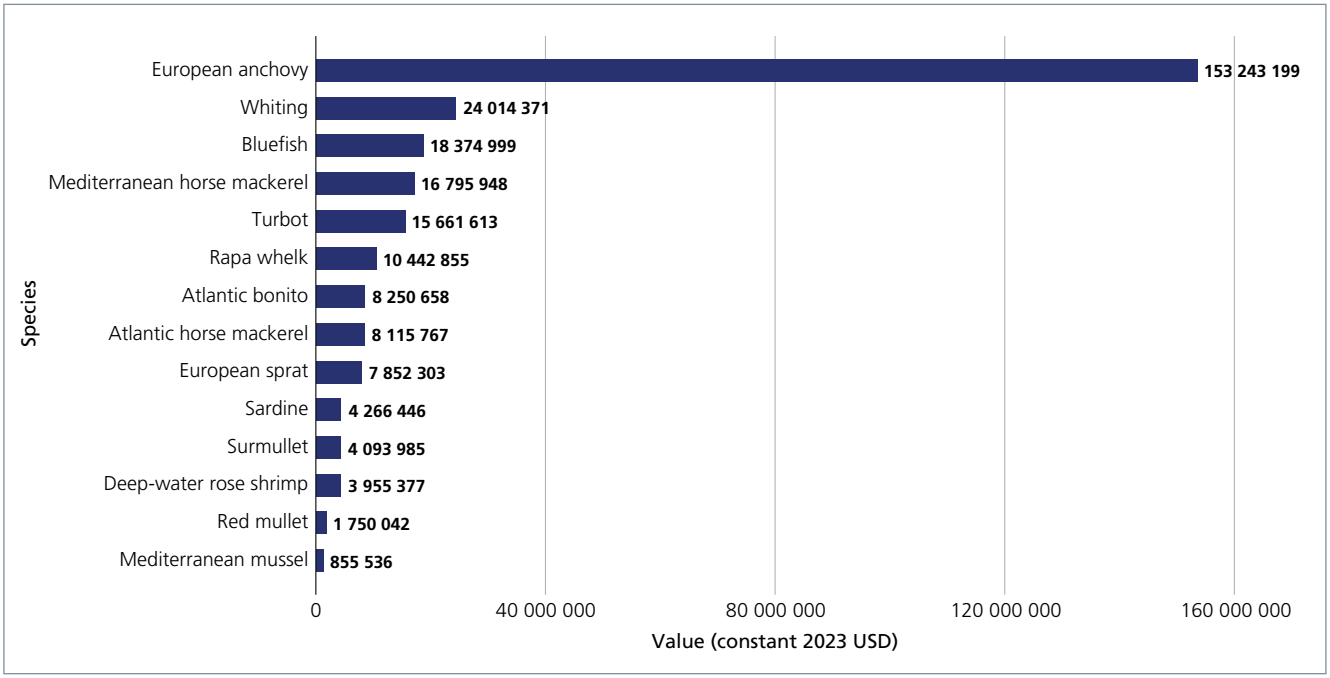
notable differences in economic output and labour distribution. The western Mediterranean and Adriatic Sea stand out for their economic efficiency. The western Mediterranean leads in revenue and is among the subregions with the highest numbers of fisheries jobs, reflecting a strong and balanced sector. The Adriatic Sea, while generating much lower revenue and employment, nonetheless has the highest per capita productivity of all subregions, suggesting a capital-intensive, higher-value fishery sector. In contrast, the central Mediterranean, eastern Mediterranean and Black Sea support a large share of employment with respect to their economic output, with lower revenue per employee, likely influenced by a predominance of SSF as well as lower-value catches in these subregions. These characteristics support the need for tailored policies that consider the productivity and employment dynamics specific to each subregion. Deeper analyses of these figures by fleet segment group are presented in the following sections of this chapter.

Species of commercial importance in the GFCM area of application

Although fisheries in the Mediterranean and the Black Sea are largely multispecies, a relatively small number of species continue to account for the majority of the economic value generated. In the Mediterranean, 23 species contribute nearly 74 percent of the total landing value at first sale (Figure 55), while in the Black Sea, only 8 species make up 90 percent of the total landing value (Figure 56).

In the Mediterranean, the species with the highest total annual landing value include sardine (*Sardina pilchardus*, USD 148 million),

FIGURE 56. Main commercial species (in terms of value) in the Black Sea



deep-water rose shrimp (*Parapenaeus longirostris*, USD 137 million), European hake (*Merluccius merluccius,* USD 133 million), European anchovy (*Engraulis encrasicolus,* USD 129 million), common octopus (*Octopus vulgaris*, USD 103 million) and blue and red shrimp (*Aristeus antennatus*, USD 80 million). Together, these six species account for just under 40 percent of total landing value in the Mediterranean. In the Black Sea, European anchovy alone dominates the sector, representing 54 percent of the total landing value (USD 153 million).

There is significant variation in the species of commercial importance across fleet segment groups and subregions (Figure 57). For SSF, for example, the species of greatest commercial importance by subregion are: common octopus in the western Mediterranean, European hake in the central Mediterranean, common cuttlefish (*Sepia officinalis*) in the Adriatic Sea and eastern Mediterranean, and turbot (*Scophthalmus maximus*) in the Black Sea. Given the vital role of SSF in supporting livelihoods in the region, ensuring the sustainable management of these key species is essential to safeguard the socioeconomic resilience of coastal communities, in line with the GFCM 2030 Strategy.

Economic performance of the fishing fleet

Revenue

Distinct regional patterns in the economic contributions of different fleet segments emerge across the five subregions (Figure 58), complementing the regional overview of revenue by fleet segment group and subregion (Figure 53 and Figure 54). In the western Mediterranean, "Trawlers and beam trawlers" dominate in terms of revenue, generating approximately USD 423 million, which constitutes the highest share in this subregion (42 percent), followed by "Small-scale vessels" with USD 262 million (26 percent) and "Purse seiners and pelagic trawlers" with USD 257 million (26 percent). Similarly, in the Adriatic Sea, "Trawlers and beam trawlers" generate USD 208 million (40 percent), followed by "Small-scale vessels" at USD 178 million (34 percent). In the central Mediterranean, "Small-scale vessels" lead with about USD 222 million (39 percent), followed by "Trawlers and beam trawlers" at USD 181 million (32 percent). A similar pattern emerges in the eastern Mediterranean, where "Small-scale vessels" generate about USD 258 million (36 percent), followed by "Trawlers and beam trawlers" at USD 199 million (28 percent). The Black Sea exhibits a markedly different pattern, with

FIGURE 57. Top five commercial species (in terms of value) by fleet segment group in the GFCM Mediterranean subregions and in the Black Sea

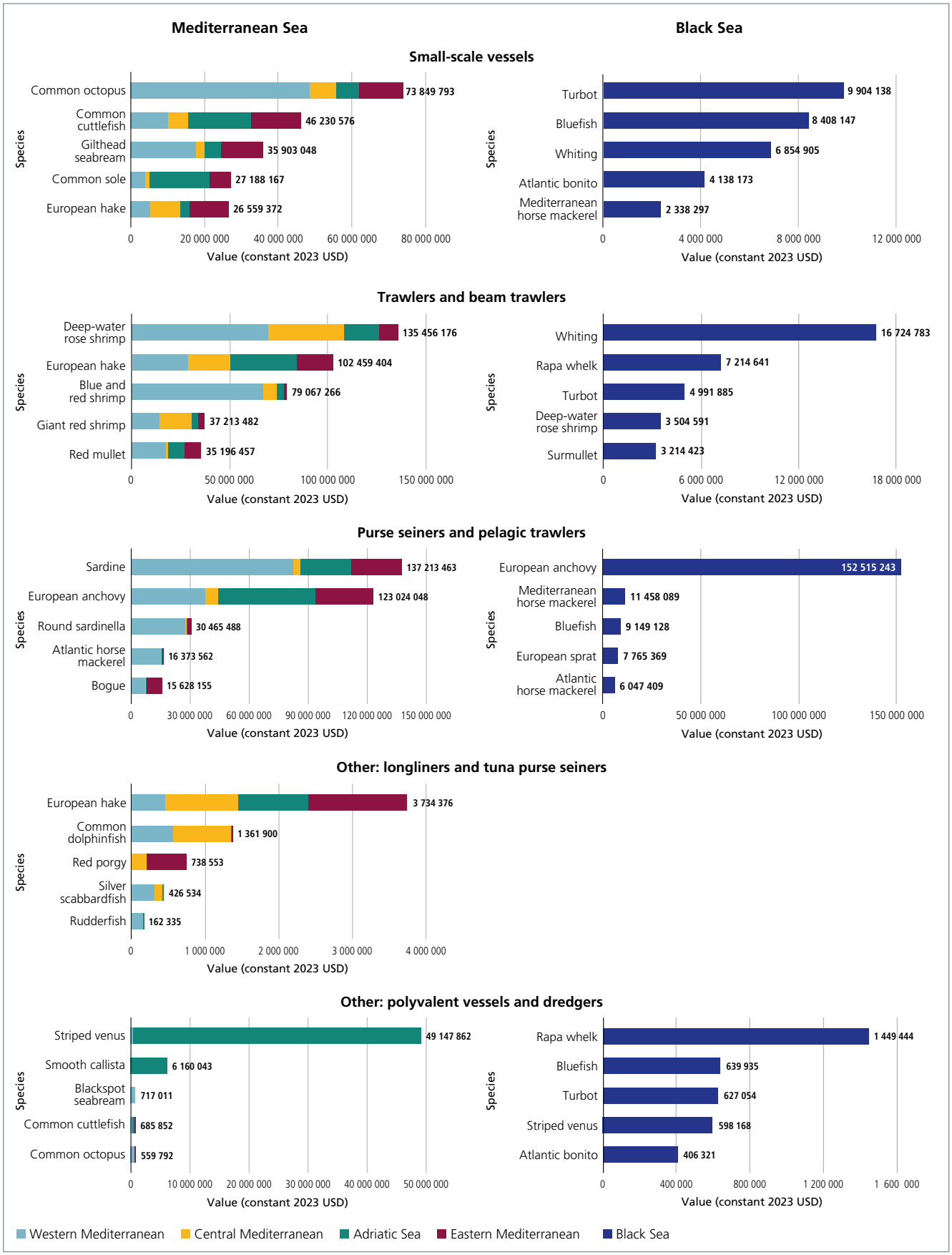
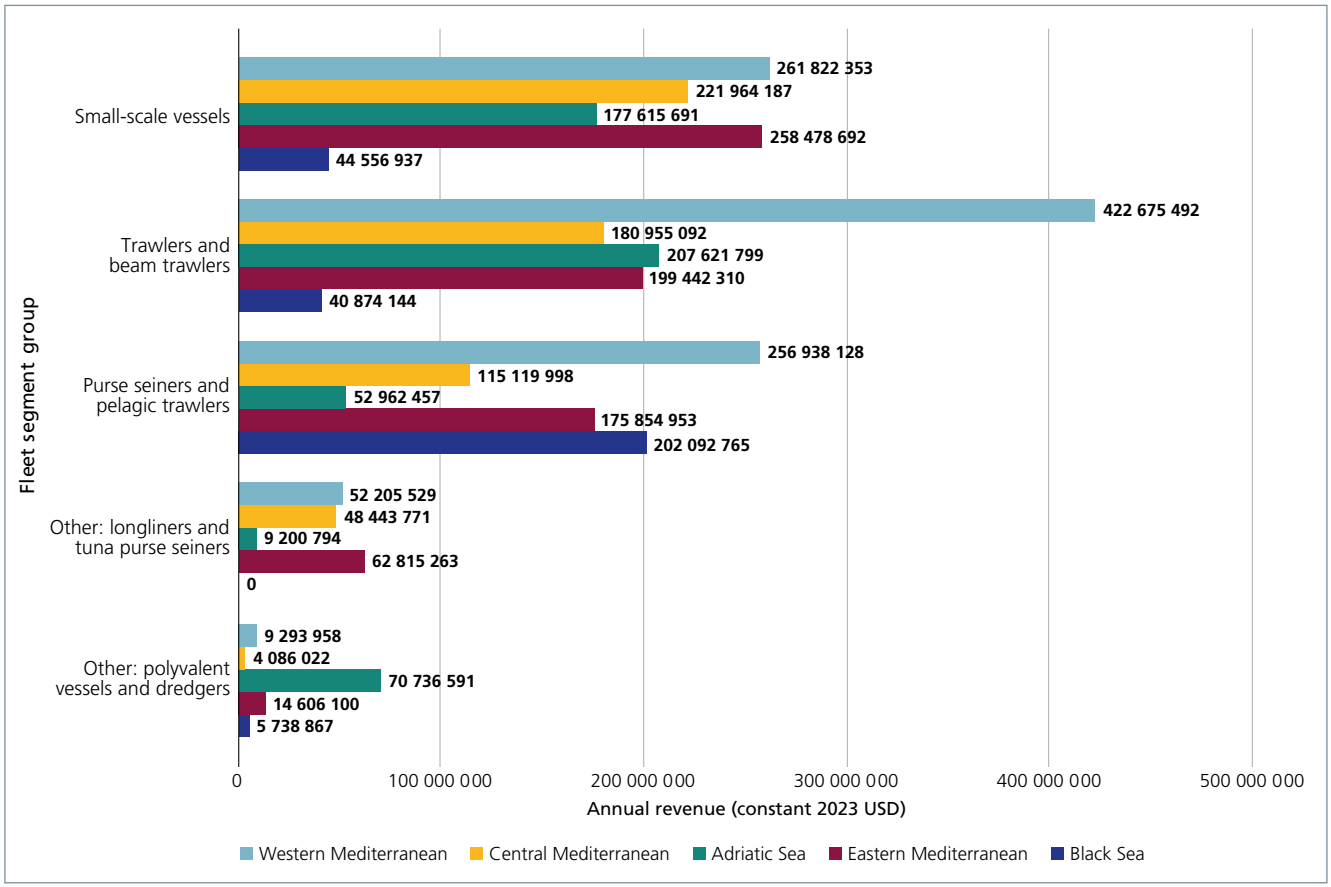


FIGURE 58. Revenue from marine capture fisheries by fleet segment group and GFCM subregion



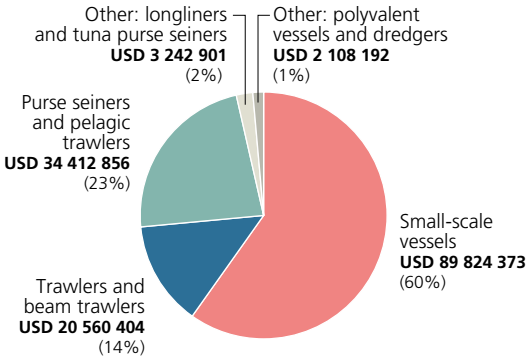
"Purse seiners and pelagic trawlers" dominating revenue generation. This fleet segment accounts for USD 202 million (69 percent of total revenue) and stands out as the most significant concentration of revenue among all regions and fleet groups. Although revenue from the "Other" fleet segments, namely longliners and tuna purse seiners and polyvalent vessels and dredgers, is relatively low across all subregions, their role is still notable in certain areas. In particular, the Adriatic Sea displays a moderate contribution from polyvalent vessels and dredgers, amounting to USD 71 million (14 percent of the subregion's total revenue).

According to data reported via the DCRF, while commercial fishing remains the primary source of revenue for fishing vessels in the region, the use of the regional fleet for other activities generates approximately USD 150 million (4.8 percent of total revenue in the region). These revenue sources include the use of vessels for tourism or recreational activities (e.g. pescatourism), vessel rentals as support boats for aquaculture activities or marine extraction industries (oil, gas, etc.), and income from leasing quotas or fishing rights. Notably, 60 percent of this supplementary income is generated by the SSF fleet, underscoring the growing importance of livelihood diversification for this segment (Figure 59). This trend aligns with Target 4 of the GFCM 2030 Strategy, which emphasizes decent work and activity diversification.

Operating costs

Operating costs include both variable and fixed costs necessary to carry out fishing activities. Variable costs cover: personnel costs (crew remuneration, social security costs, etc.); energy costs (fuel consumption, vessel lubricants, etc.); repair and maintenance costs (for fishing equipment, fishing gear, vessel parts, etc.); commercial costs (fish market or wholesaler fees, materials for marketing the catch, including ice, boxes and packaging, etc.); and other variable costs (goods and services directly or indirectly related to fishing effort, such as bait, food consumed during fishing operations, etc.). Fixed costs cover expenses that are not directly

FIGURE 59. Other income from vessel use by fleet segment group



Note: Percentages indicate the relative contributions of fleet segment groups to total other income from vessel use in the GFCM area of application.

connected to the operational activities of the vessel and remain fixed, regardless of the level of fishing activity in a given year. These include bookkeeping, vessel insurance, legal and banking fees, annual quotas for fisher associations, dock fees and renewals of fishing licenses.

Overall, personnel costs remain the largest component of operating expenses, accounting for 48 percent, followed by energy costs, at 26 percent. However, cost structures vary significantly across fleet segments (Figure 60). For "Small-scale vessels", personnel costs dominate, at 55 percent of total costs, while energy costs are relatively low, at 17.5 percent of total costs. In contrast, "Trawlers and beam trawlers" face a heavier energy burden, with fuel accounting for 41 percent of their total costs and personnel costs accounting for 36 percent. "Purse seiners and pelagic trawlers" report the highest share of commercial costs among all fleet segments (15 percent), partly due to the typical end-use of their catch in post-harvest processing. "Longliners and tuna purse seiners" also stand out, with other variable costs accounting for 15.5 percent of their total operating expenses, largely due to their heavy reliance on bait.

Since 2020 – the reference year for the 2022 edition of *The State of Mediterranean and Black Sea Fisheries* (FAO, 2022c), when operating costs were last analysed – average energy costs have surged by 28 percent. Industrial fleet segments have been hit hardest, with a 32 percent increase in energy costs, while small-scale fleet segments experienced a more moderate rise of 13 percent. These shifts underscore the growing impact of fuel prices on fleet economics, particularly for energy-intensive segments.

Profitability and wealth generation

To gain a more comprehensive understanding of the economic performance of the fisheries sector, it is essential to analyse revenue and operating costs together. Gross cash flow (GCF), defined as total revenue (including subsidies received) minus operating costs, serves as a key indicator of short-term economic viability, capturing the annual cash generated by fishing activities. A positive

FIGURE 60. Operating cost structure (as a percentage of the total costs) by fleet segment group

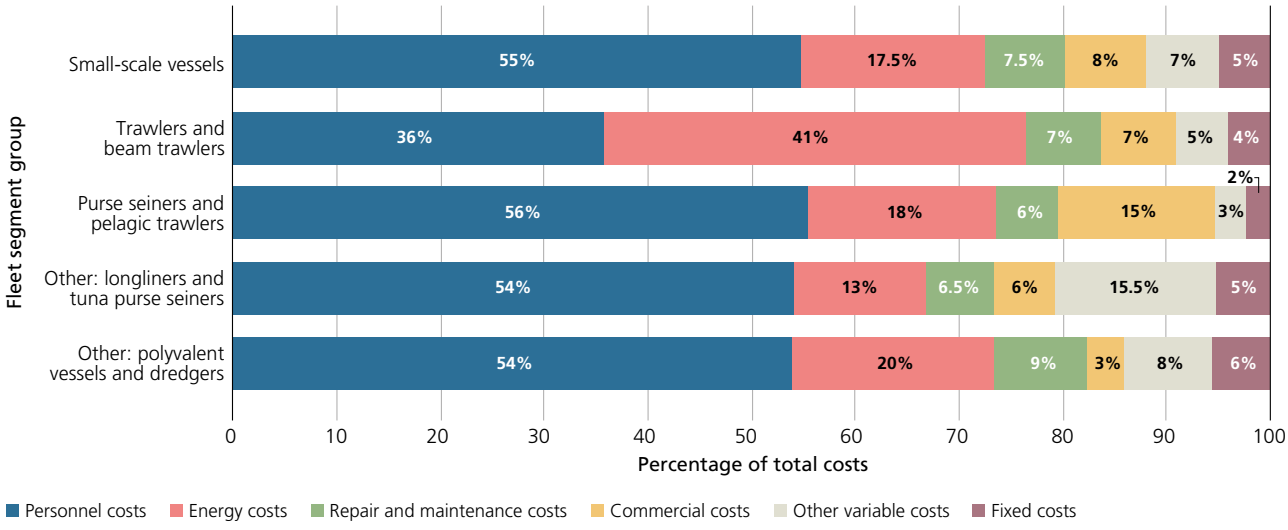
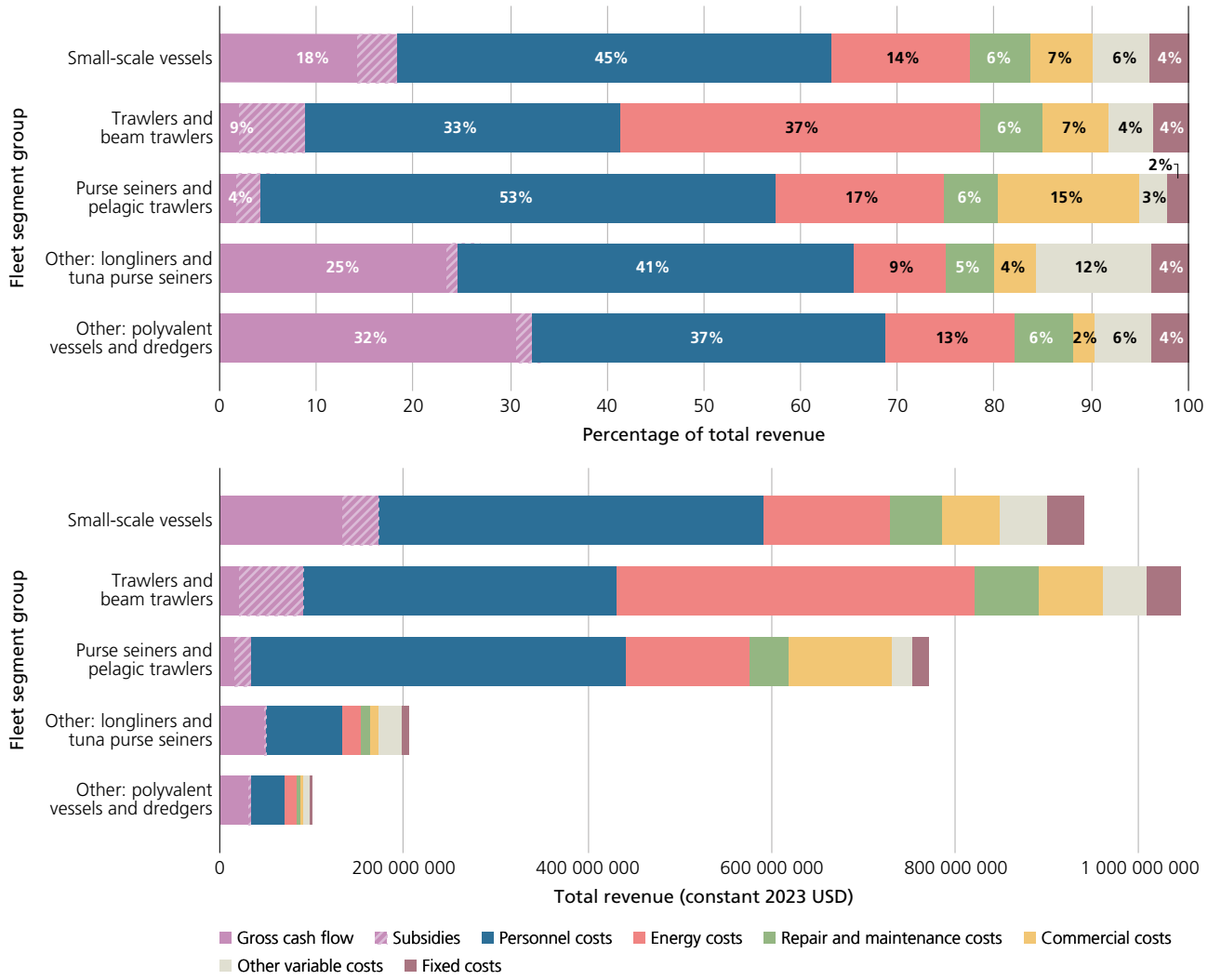


FIGURE 61. Gross cash flow and operating cost structure by fleet segment group



Notes: Gross cash flow (GCF) includes subsidies, as such, total GCF is represented by the purple bar together with the purple shaded area. Gross value added is calculated as the sum of GCF (purple bar and purple shaded area) and personnel costs (blue bar).

GCF indicates that revenues from landings exceed total gross costs and therefore generally indicates profitability of the fleet. In 2023, GCF remained positive across all fleet segments, averaging around 13 percent of total revenue, for a total value of USD 380 million (Figure 61). While this figure suggests that, overall, the regional fleet continues to operate on a sound economic footing, it represents a decline from 2020, when GCF amounted to 24 percent of total revenue (FAO, 2022c).

However, disaggregated data reveal diverging trends between industrial fleet segments and SSF. For "Purse seiners and pelagic trawlers", for example, GCF as a share of revenue declined sharply from 28 percent in 2020 (FAO, 2022c) to 4 percent in 2023, while "Trawlers and beam trawlers" saw a similar decline from 25 percent in 2020 to 9 percent in 2023, pointing to an important contraction in short-term profitability for both fleet segment groups. Conversely, the SSF sector recorded a slight improvement in economic performance, with GCF rising from 17 percent to 18 percent of revenue over the same period.

In addition to evaluating the profitability of fishing activities in the region, the overall wealth generated by fisheries must be considered. Fisheries play a critical role in sustaining livelihoods in the region, and GVA provides a meaningful indicator of the sector's contribution to the economy, as well as a directly relevant metric for measuring progress against Target 4 of

the GFCM 2030 Strategy. Gross value added is calculated as the difference between total revenue and operating costs, excluding personnel cost – in other words, as GCF plus personnel costs (Figure 61). This approach treats personnel costs not as a deduction from revenue, but as a positive contribution to economic welfare, reflecting income distributed to households. Focusing on the current economic output of the sector, GVA can be considered as a more precise, yet basic, measure of the sector's contribution to GDP.

In 2023, GVA from fishing in the GFCM area of application was estimated at approximately USD 1.6 billion, representing about 55 percent of total fisheries revenue and 0.03 percent of the GDP of CPCs. As with GCF, the GVA of "Trawlers and beam trawlers" also showed a decline, from 56 percent of revenue in 2020 to 41 percent in 2023. For the other fleet segment groups, GVA remained relatively stable over the same period.

The contribution of each fleet segment group to GVA also varies across the different GFCM subregions. "Purse seiners and pelagic trawlers" represent the main contributor to GVA in the Black Sea, accounting for 68 percent of total GVA from fishing in the subregion. "Trawlers and beam trawlers" represent the main contributor to GVA in the western Mediterranean, with 36 percent of total GVA in the subregion. "Small-scale vessels" represent the main contributor to GVA in the rest of the Mediterranean Sea, accounting for 45 percent of GVA in both the central Mediterranean and the Adriatic Sea, and 39 percent of GVA in the eastern Mediterranean.

While assessing the wealth generated by fishing activities, as reflected by GVA, the extent to which this economic output is supported by operating subsidies should also be considered. These subsidies are direct monetary transfers from governments to fishing vessel owners, aimed at sustaining fishing activities or facilitating investments. Operating subsidies can take multiple forms, ranging from capacity-enhancing support, such as fuel subsidies, to direct financial assistance for fishers. These transfers can significantly influence the profitability and viability of fleet operations, especially in regions or segments facing economic pressures.

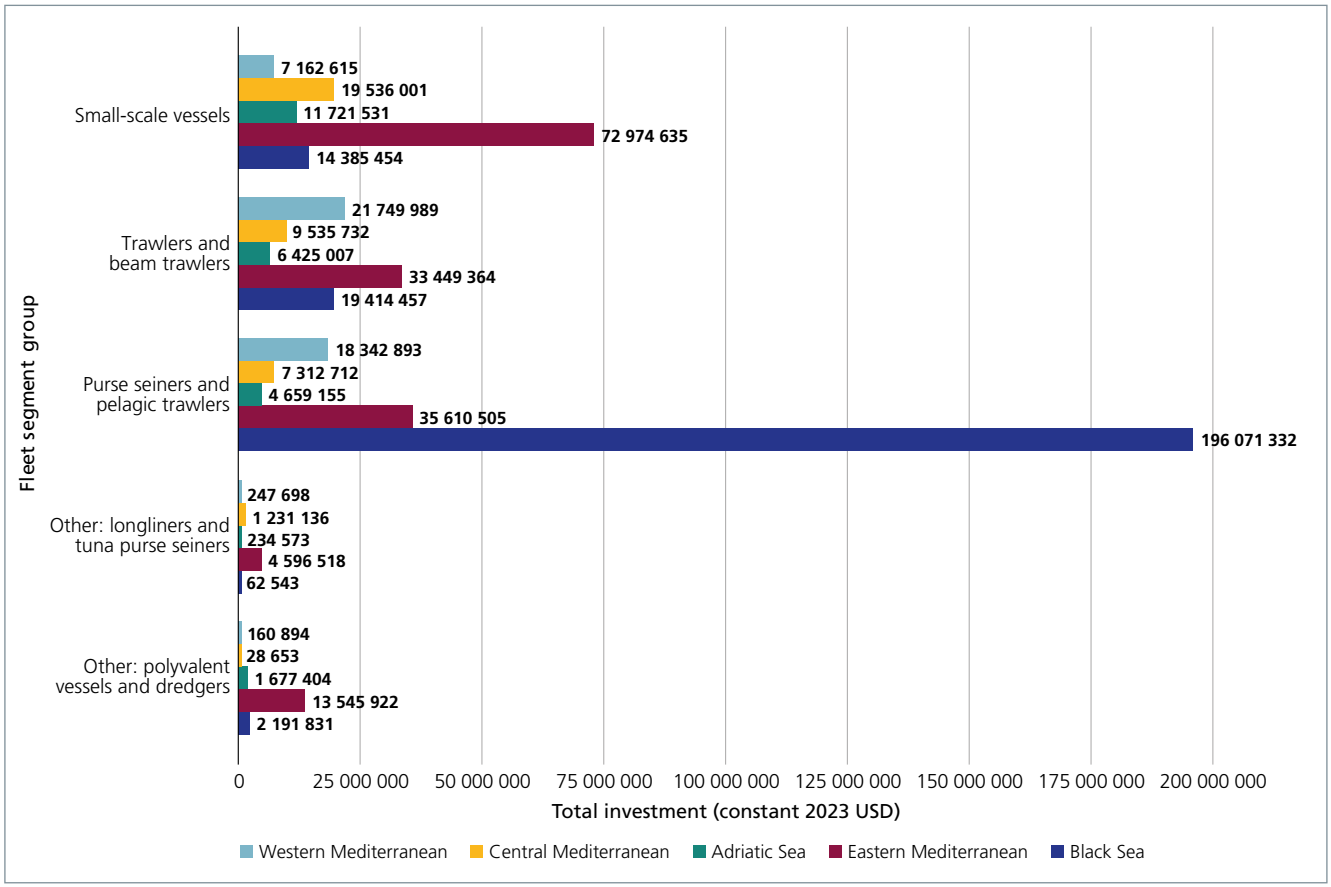
Approximately USD 130.6 million in operating subsidies were allocated in 2023, representing 8.1 percent of total GVA across all fleet segment groups. This marks a notable increase from 2020, when subsidies amounted to USD 99.9 million, equivalent to 5.8 percent of GVA (FAO, 2022c), highlighting an upward trend in public financial support for capture fisheries. However, the distribution of subsidies across fleet segment groups was uneven. "Trawlers and beam trawlers" received the largest share – just over USD 70 million – accounting for 54 percent of total subsidies for fisheries (Figure 61), which corresponds to 17 percent of the fleet segment group's GVA and 77 percent of its GCF. This marks a significant increase from USD 44 million in subsidies for "Trawlers and beam trawlers" in 2020, when they accounted for 44 percent of total subsidies for fisheries in that year. Similarly, "Purse seiners and pelagic trawlers", which have limited profit margins, also depend on subsidies, which amount to more than half of their GCF. In contrast, "Small-scale vessels" received USD 39 million, or 30 percent of total subsidies for fisheries, representing an increase in absolute value from USD 33 million in 2020, but a decrease in the relative share of total subsidies, down from 33 percent. Subsidies for SSF equate to 6.5 percent of their GVA and 22.7 percent of their GCF.

Physical capital (fleet value)

The estimated value of the fishing fleet in the Mediterranean and the Black Sea – including vessel hulls, engines, onboard equipment and fishing gear, collectively referred to as physical capital – was approximately USD 3.3 billion in 2023, up from USD 2.8 billion in 2020. This substantial figure underscores the scale of investment in the regional fleet and closely mirrors the sector's annual revenue, highlighting its capital-intensive nature.

At the fleet segment group level, "Purse seiners and pelagic trawlers" account for the largest share of total physical capital value (41 percent), followed by "Trawlers and beam trawlers" (29 percent) and "Small-scale vessels" (23 percent). However, the distribution of physical capital varies markedly across subregions. As in previous years, "Trawlers and beam trawlers" dominate in the central Mediterranean, Adriatic Sea and western Mediterranean, representing 47 percent, 39 percent and 39 percent of the total fleet value in those subregions, respectively. In the Black Sea, "Purse seiners and pelagic trawlers" make up the majority, at 69.7 percent of the subregional fleet value. Meanwhile, in the eastern

FIGURE 62. Total annual investments in physical capital by fleet segment group and GFCM subregion



Mediterranean, "Small-scale vessels" contribute the largest share of physical capital, accounting for 36 percent of the subregional total. The distribution of physical capital across subregions and fleet segment groups has remained generally stable, increasing proportionately to the overall fleet value increase in recent years. A notable exception is observed, however, in the western Mediterranean, where the value of the "Trawlers and beam trawlers" fleet has declined sharply from USD 466 million (64 percent of total fleet value) in 2020 to USD 181 million, representing 39 percent of total fleet value, in 2023.

Annual investments

Annual investments aimed at upgrading vessels, fishing gear or equipment contribute significantly to the sector's economic dynamics, reflecting ongoing efforts to enhance efficiency, productivity and long-term sustainability. In 2023, total investments across the Mediterranean and Black Sea fishing fleet were estimated at approximately USD 502 million. More than half of this amount (52 percent) was directed towards "Purse seiners and pelagic trawlers", while "Small-scale vessels" accounted for 25 percent and "Trawlers and beam trawlers" received 18 percent of total regional investment.

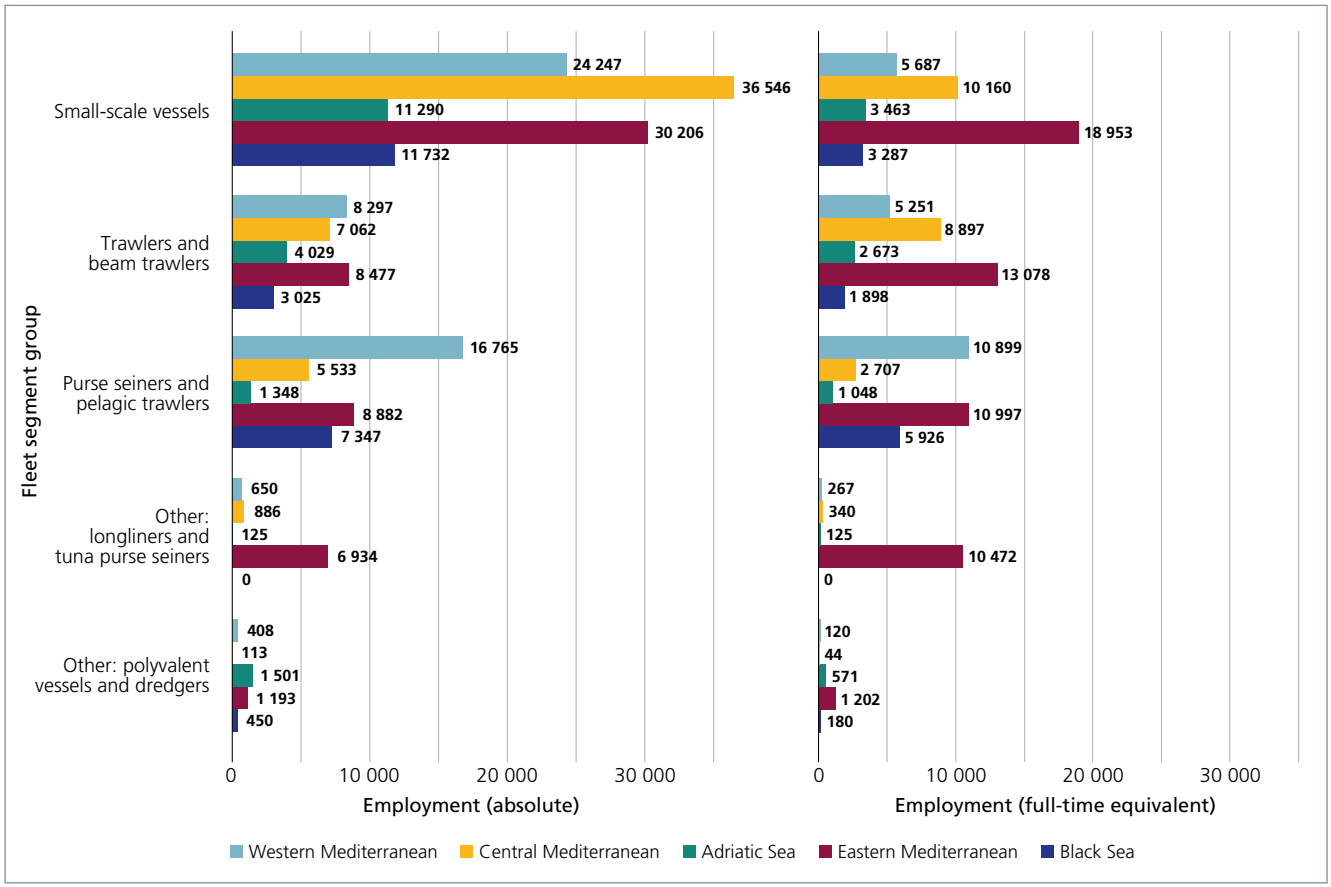
Investments vary significantly across GFCM subregions, as illustrated in Figure 62. The high value of investments in SSF is noteworthy in the central and eastern Mediterranean, representing 52 percent and 46 percent of total investments in the subregions, respectively. In the Black Sea, "Purse seiners and pelagic trawlers" not only represent the fleet segment group with the highest value, but also receive the majority of investments amounting to 85 percent of the subregion's total.

Contribution of fisheries to livelihoods

Employment

Capture fisheries continue to play a crucial role in supporting livelihoods across the Mediterranean and Black Sea region, providing opportunities for decent employment, resilient livelihoods and improved access to social protection, in line with Target 4 of the GFCM 2030 Strategy. However,

FIGURE 63. Employment in marine capture fisheries by fleet segment group and GFCM subregion



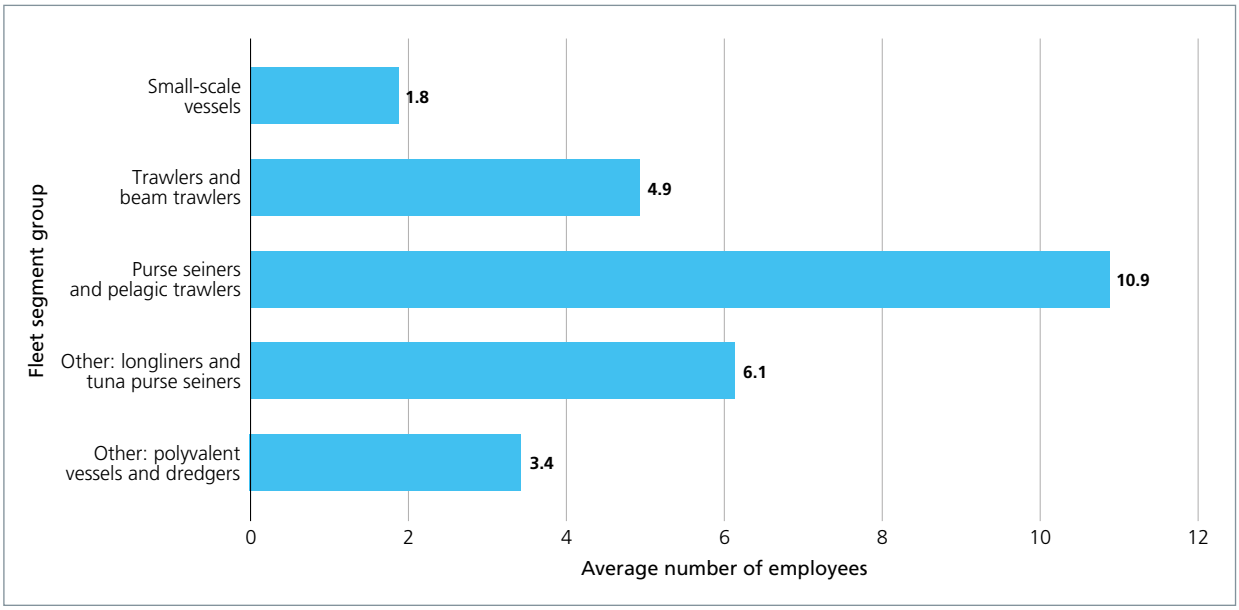
employment on board fishing vessels varies widely depending on the subregion and fleet segment (Figure 53 and Figure 54). At the regional level, "Small-scale vessels" account for the largest share of onboard employment, generating 58 percent of total jobs, followed by "Purse seiners and pelagic trawlers" (20 percent) and "Trawlers and beam trawlers" (16 percent) (Figure 53).

A closer look at subregional data (Figure 63) confirms the continued dominance of "Small-scale vessels" as employers. They represent the majority of onboard employment in every subregion, accounting for 73 percent of jobs in the central Mediterranean, 62 percent in the Adriatic Sea, 54 percent in the eastern Mediterranean, 52 percent in the Black Sea, and 48 percent in the western Mediterranean. "Purse seiners and pelagic trawlers" are the second largest source of employment in the Black Sea (33 percent), the western Mediterranean (33 percent) and the eastern Mediterranean (16 percent), while "Trawlers and beam trawlers" are the second most significant employers in the Adriatic Sea (22 percent) and the central Mediterranean (14 percent).

Absolute employment data take into account the number of individuals employed on board vessels, including part-time crew. However, pluriactivity, describing fishers who also engage in other professional activities, such as agriculture, manufacturing or tourism, is widespread in the sector. To account for differences in work intensity and to enable a more meaningful comparison of employment across fleet segments and regions, the full-time equivalent (FTE) indicator is also used. Full-time equivalent employment standardizes labour input by dividing total hours worked by a benchmark average value of annual hours worked, which is typically defined in fisheries as 2 000 hours per year. Any labour input below this threshold is considered part-time.

When measured in FTE terms, the employment landscape changes (Figure 63). While "Small-scale vessels" still account for the largest share of jobs, their contribution falls to 35 percent, reflecting the high prevalence of part-time work in this segment. Conversely, the relative contribution of industrial fleets increases, with "Trawlers and beam trawlers" accounting for

FIGURE 64. Average number of employees per vessel by fleet segment group



27 percent of total FTE employment, and "Purse seiners and pelagic trawlers" representing another 27 percent. However, FTE analyses do not fully capture the nature of SSF work, as they only consider time at sea, whereas a significant part of SSF work is shore-based.

Across the region, the importance of each fleet segment group in FTE terms also varies significantly. In both the western Mediterranean and the Black Sea, the fleet segment group accounting for the highest number of FTE jobs is "Purse seiners and pelagic trawlers", representing 49 percent of FTE employment in the western Mediterranean and 53 percent in the Black Sea. In all other subregions, "Small-scale vessels" account for the largest share of FTE jobs, with 46 percent in the central Mediterranean, 44 percent in the Adriatic Sea and 35 percent in the eastern Mediterranean. Notably, in the eastern Mediterranean, long working hours aboard industrial vessels in Egypt result in higher FTE figures relative to absolute employment.

Furthermore, the nature of the work carried out on board, as well as the number of people working on board a vessel at a given time, differ by fleet segment group. "Small-scale vessels" employ, on average, 1.8 fishers per vessel, whereas "Purse seiners and pelagic trawlers" employ on average around 11 fishers and "Trawlers and beam trawlers" employ approximately 5 fishers (Figure 64).

Remuneration per fisher

While employment figures help illustrate the social relevance of fisheries, other indicators offer deeper insight into how the sector supports fisher livelihoods. In addition to GVA, remuneration is a key measure of livelihood quality. Remuneration includes both monetary and in-kind payments (such as a portion of the catch for personal consumption) and may be structured as a fixed wage or tied to the vessel's profit (e.g. revenue minus certain operating costs). Available data on remuneration per fisher only reflect cash earnings, calculated by dividing total personnel costs by the number of fishers, and do not account for in-kind compensation.

In 2023, the average annual remuneration per fisher across the GFCM area of application was approximately USD 7 143, up from USD 6 086 in 2020. Fishers working on industrial vessels earned significantly more, averaging USD 10 271 per year, nearly double the average income of small-scale fishers, who earned an average of USD 4 347 (Figure 65).

Remuneration patterns across GFCM subregions should be contextualized, given the significant differences observed (Figure 66), while also considering the high prevalence of part-time work in the sector. In 2023, the western Mediterranean and the Adriatic Sea recorded the highest average remuneration for industrial fisheries, at USD 15 680 and USD 14 189, respectively. However, these

FIGURE 65. Annual remuneration per fisher by fleet segment group

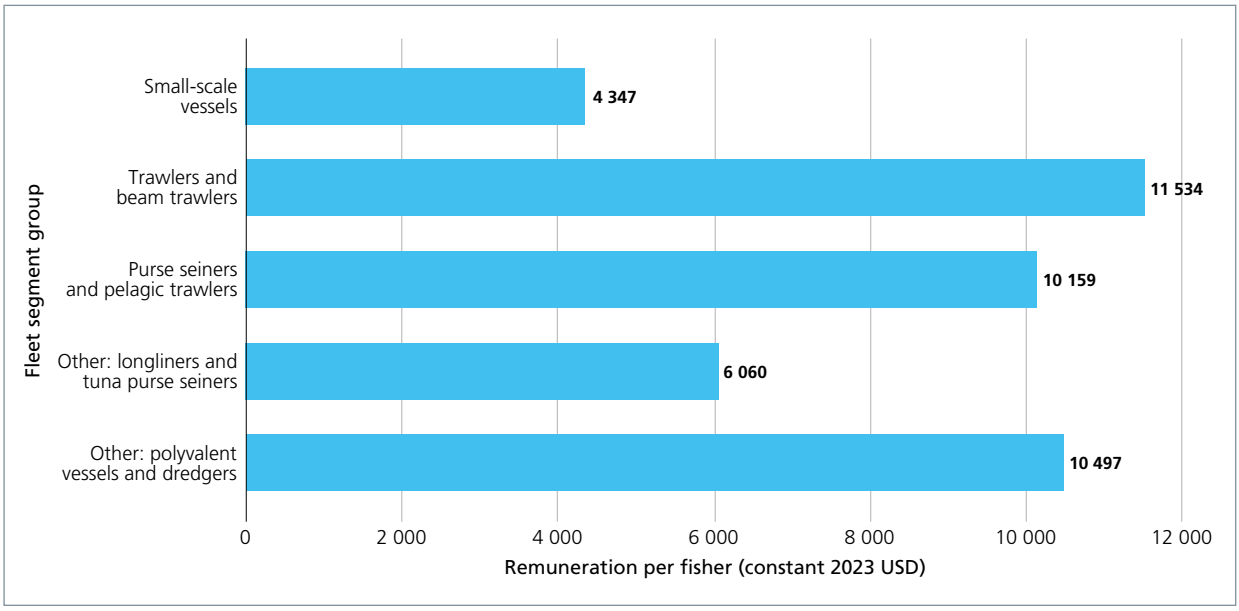
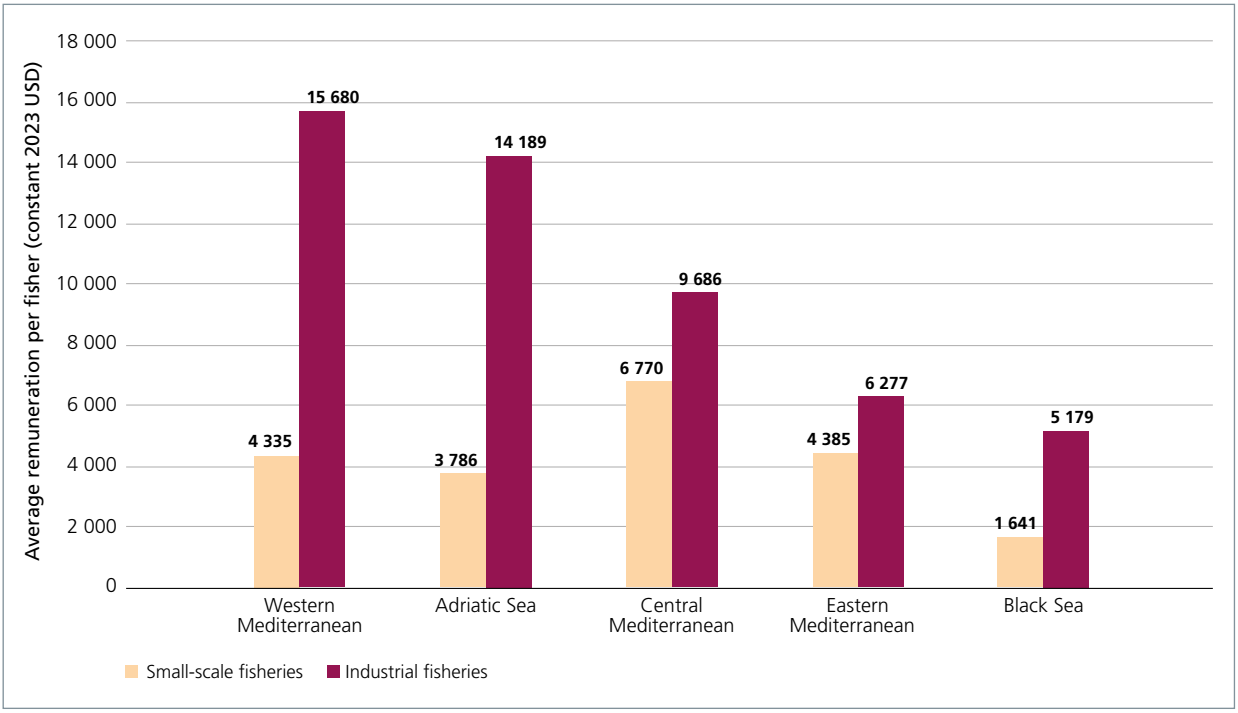
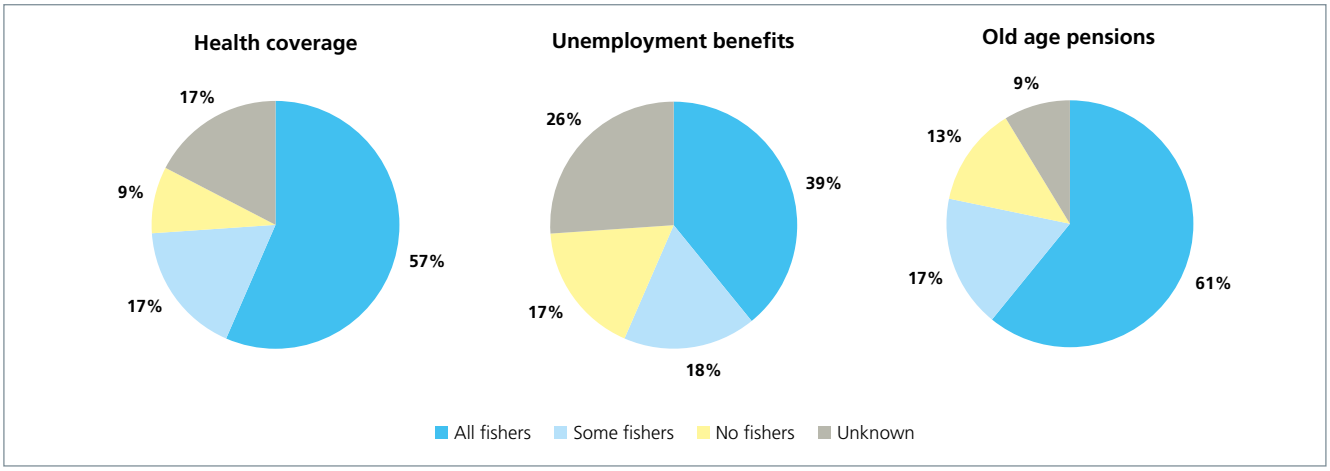


FIGURE 66. Comparison of average remuneration within small-scale and industrial fisheries by GFCM subregion



subregions also showed the largest disparities between industrial fisheries and SSF, with SSF earning nearly three times less (USD 4 335 and USD 3 786, respectively). In contrast, the central Mediterranean reported the highest remuneration for SSF (USD 6 770), and the gap between SSF and industrial fisheries was narrower, with industrial fisheries earning USD 9 686 on average. The eastern Mediterranean and the Black Sea exhibited the lowest levels of remuneration overall, with SSF earning only USD 4 385 and USD 1 641, respectively. Significant differences across countries within each of the GFCM subregions exist; therefore, the average values

FIGURE 67. Percentage of GFCM contracting parties and cooperating non-contracting parties providing small-scale fishers with access to social protection programmes



reported here come with a large associated variance in each subregion.

An essential indicator of livelihood quality and access to decent work is the availability of social protection for fishers. In certain contexts, contributions to such programmes may form part of a fisher's remuneration, with payments made on their behalf by vessel owners. In other cases, they are universally provided by national governments. However, it is imperative that these programmes are appropriately tailored to the specific conditions and challenges of fisheries (FAO, 2019c).

Aligned with the principles of decent work promoted in the Regional Plan of Action for Small-Scale Fisheries (RPOA-SSF), data were collected on small-scale fishers' access to social protection programmes. Since the adoption of the RPOA-SSF in 2018, there has been a continued positive trend in expanding access to these programmes. Currently, health coverage is available to small-scale fishers in 74 percent of CPCs, unemployment benefits in 57 percent, and old-age pensions in 78 percent (Figure 67). These figures represent a significant improvement compared to the 2022 edition of *The State of Mediterranean and Black Sea Fisheries* (FAO, 2022c), particularly regarding unemployment benefits, which were previously accessible in only 37 percent of CPCs, and old-age pensions, which were formerly available in 67 percent of CPCs. Moreover, five CPCs now report having dedicated social protection programmes specifically designed for the SSF sector, up from just one in the previous reporting period. Finally, the number of CPCs indicating a lack of available data on this topic has declined, reflecting a growing awareness of the importance of social protection in fostering a resilient and sustainable fisheries sector.

Demographic characteristics

The age distribution of fishers employed on board vessels offers valuable insights into the demographic trends shaping fisheries in the Mediterranean and Black Sea region. Historically, the sector has faced the challenge of an ageing workforce, with limited entry from younger generations. Recent data show an increase in the reported share of fishers under the age of 25, rising from 10 percent in 2020 (FAO, 2022c) to 20 percent in 2023, as well as among crew aged 25 to 40 years, whose share slightly grew from 38 percent to 39 percent. By contrast, the proportion of fishers over 40 years old has declined from 52 percent to 41 percent during the same period.

Additional insights emerge when further examining the workforce by fleet segment group (Figure 68). Fishers under 25 years old represent between 17 percent, for "Small-scale vessels", and 31 percent, for "Other: longliners and tuna purse seiners", of the total workforce. The oldest workforce is found in the small-scale segment, where 47 percent of fishers are over 40 years old, followed by the "Trawlers and beam trawlers" segment group, with 41 percent over the age of 40.

Geographically, the eastern Mediterranean stands out as the region with the highest

Box 14. Fishery socioeconomic and local ecological knowledge studies underpinning targeted research

To effectively manage fisheries, it is crucial to understand not only ecological factors but also the social and economic drivers that influence fisher behaviour. Socioeconomic and local ecological knowledge (LEK) studies are valuable tools for gaining insight into how fishers and their communities depend on living marine resources for their livelihoods. Understanding these aspects enables managers to anticipate the potential effects of management measures on the sector, assess potential risks, and design adaptive management strategies or explore alternative options. In recent years, the GFCM has increasingly employed LEK and targeted socioeconomic studies – focused on specific fisheries, species or areas – to inform its fisheries management decision-making process. In particular, these studies have become a regular output of the GFCM's management-oriented research initiatives (i.e. research programmes and pilot studies), adapting the standard methodology used for national fleet socioeconomic surveys (Pinello, Gee and Dimech, 2017) to the needs and specificities of the fishery, species or area under investigation.

As part of the BlackSea4Fish project, the first dedicated socioeconomic and LEK study on the rapa whelk (*Rapana venosa*) fishery in the Black Sea was conducted in 2023. A tailored 78-question survey was implemented across 87 ports, covering 38 vessels in Bulgaria, 23 in Romania and 185 in Türkiye (246 in total). The study provided detailed indicators on effort, revenue, employment, costs, investments and demographics, confirming that rapa whelk represents the main source of income for many coastal fishers and sustains a significant number of jobs, but also highlighting high fuel dependency, ageing crews and a widespread perception of declining catches. In parallel, a pilot socioeconomic and LEK study on piked dogfish (*Squalus acanthias*) was also conducted in Bulgaria and Romania, with interviews covering 41 vessels and 5 vessels, respectively. This exercise generated initial indicators on employment, cost structures, fuel efficiency and fisher perceptions, pointing to the relatively limited, but economically significant, role of piked dogfish fisheries. Together, these studies provide the first comprehensive socioeconomic evidence base for two priority Black Sea fisheries, strengthening adaptive and participatory management.

Under the umbrella of the GFCM Research programme on red coral, the first ever study investigating socioeconomic aspects of the red coral fishery across the GFCM area of application was also carried out in 2023. A socioeconomic questionnaire consisting of 46 questions, customized and adapted for the red coral fisheries in France, Italy (Sardinia region) and Tunisia, was prepared and 95 red coral fishers and divers were interviewed (corresponding to 70 percent of the active population sampled). This enabled the development of national and regional indicators for effort, revenue, employment, costs, investments and demography. The study highlighted the high profitability of the business, despite the relatively high costs and the small segment of employment which, in 2023, featured around 100 authorized red coral divers and 60 vessels at the regional level.

The 2023–2024 roadmap towards informing the GFCM long-term management plan for European eel (*Anguilla anguilla*) in the Mediterranean Sea built its multi-objective appraisal of alternative management measures in part on the results of an LEK and socioeconomic questionnaire, essentially comprising the first management strategy evaluation-like process to also consider socioeconomic drivers. The questionnaire consisted of around 106 questions (15 on LEK and 91 on socioeconomics) customized and adapted to the European eel fishery across nine countries. Approximately 719 European eel fishers and cooperative members or presidents were interviewed (around 28 percent of the active population sampled), enabling the development of national and regional indicators for fishing effort, revenue, employment, cost structure, profitability, wealth generation and demographics. Overall, the study results indicated that European eel fisheries were profitable, with a positive gross cash flow, and the interviewed fishers demonstrated an overall acceptance of measures aimed at the protection and conservation of the species, provided that these measures were applied equitably to all countries and that fisher efforts were adequately supported and recognized. Beyond providing valuable insights on the sector, the study also fostered trust between scientists and eel fishers, enabling fishers to move beyond their initial distrust and opposition following the implementation of fishing closures. This process encouraged many – often for the first time – to engage in dialogue with researchers and openly share their perspectives.

The pilot study on bamboo coral (*Isidella elongata*) in the southern Adriatic Sea included the implementation of an ad hoc socioeconomic and LEK survey covering the main fleets operating in the proposed fisheries restricted area of the Otranto Channel. The survey consisted of 78 questions and aimed to obtain main indicators (effort, revenue, employment, costs, investments) for the fishing activities of vessels using bottom otter trawl gear below depths of 400 m. In total, 102 fishers – primarily vessel owners or individuals with knowledge of the vessel's operations – were interviewed, representing around 75 percent of the active population sampled,

(Continued)

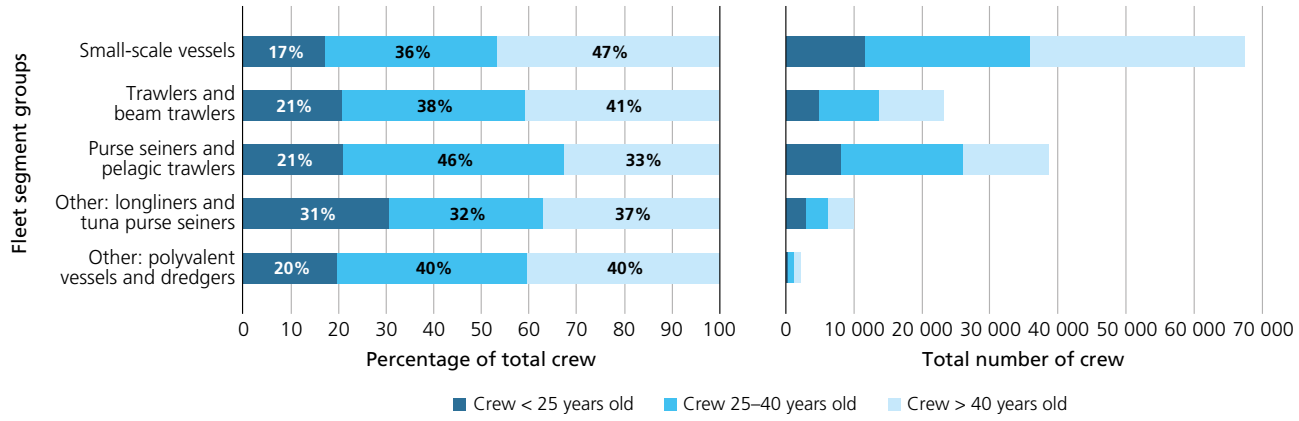
Box 14. (Continued)

including 94 percent in Albania and 56 percent in Italy. Indicators were produced for fishing effort, landings and revenue with respect to fishing activity inside and outside the proposed fisheries restricted area. The results highlighted that, for the Albanian fleet, the majority of the total revenue came from fishing within the shallower depth stratum (less than 400 m) while, for the Italian fleet, the most important depth stratum was 400–500 m. The LEK information confirmed these results and indicated that bamboo coral is found as bycatch, although its presence has decreased over time.

Socioeconomic surveys support the implementation of informed fisheries management measures and constitute an important entry point for engaging with stakeholders. Notably, data and indicators derived from fisher interviews can sometimes present a picture of the sector that differs from official national statistics. To reconcile these differences, the GFCM engages with national administrations to clarify discrepancies and validate findings. Such variations are expected and can offer valuable complementary insights.

Source:
Pinello, D., Gee, J. & Dimech, M. 2017. *Handbook for fisheries socio-economic sample survey – principles and practice.* FAO Fisheries and Aquaculture Technical Paper No. 613. Rome, FAO. https://openknowledge.fao.org/handle/20.500.14283/i6970e

FIGURE 68. Age distribution of crew by fleet segment group



concentration of young fishers, accounting for 30 percent of all fishers under 25 years of age. It is followed by the western Mediterranean (21 percent) and the central Mediterranean (13 percent). In contrast, the GFCM subregions with the oldest fishing populations are the Adriatic Sea and the Black Sea, where 75 percent and 52 percent of fishers, respectively, are more than 40 years old.

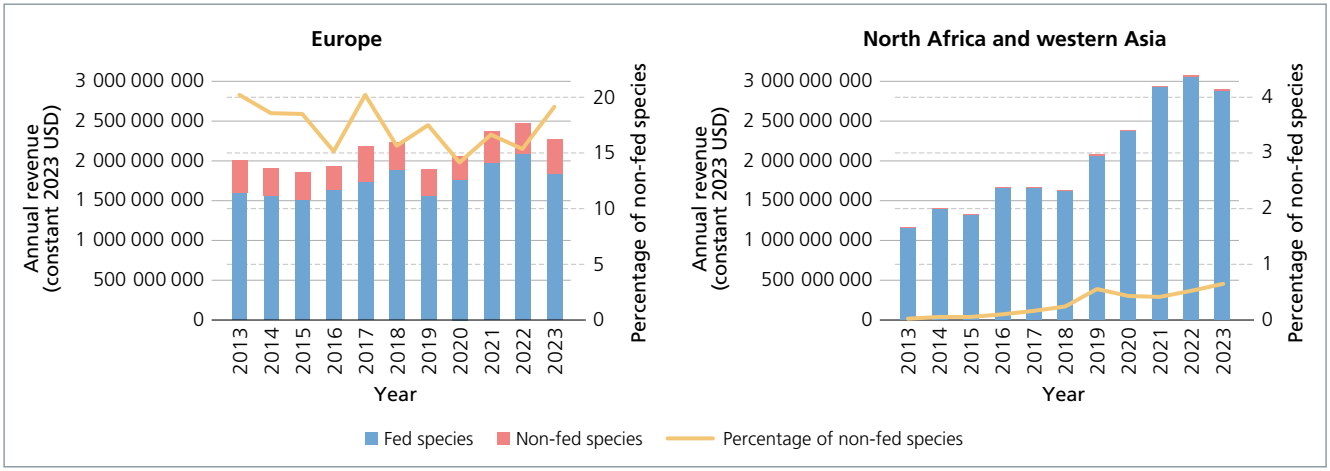
SOCIOECONOMIC CHARACTERISTICS OF AQUACULTURE

Aquaculture revenue

In 2023, total revenue from aquaculture in marine and brackish waters in the GFCM area of application was estimated at USD 5.2 billion.[11] This figure captures the value at first sale of all

[11] Marine and brackish water aquaculture producers included in this analysis are: Albania, Algeria, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Egypt, France, Greece, Israel, Italy, Lebanon, Malta, Montenegro, Morocco, Slovenia, Spain, Tunisia and Türkiye.

FIGURE 69. Contributions of fed and non-fed-species to aquaculture revenue and trends by region, 2013–2023



the farmed aquatic organisms (fish, molluscs, crustaceans and algae), prior to any processing or value-adding activities. Revenue from aquaculture of fed species continued to outpace that of aquaculture of non-fed species in CPCs across Europe, North Africa and western Asia. Over the period 2013–2023, the whole region experienced a significant overall increase of 63 percent in revenue, rising from USD 3.18 billion in 2013 to USD 5.18 billion in 2023.

In European CPCs, the overall growth in revenue during this period was 13 percent, with aquaculture of fed species increasing by 14 percent and aquaculture of non-fed species increasing by 7 percent. Contributions from non-fed species ranged between 14 percent and 20 percent. Total revenue from marine and brackish water aquaculture was notably higher in European CPCs until 2019, however they were subsequently surpassed by North African and western Asian CPCs (Figure 69).

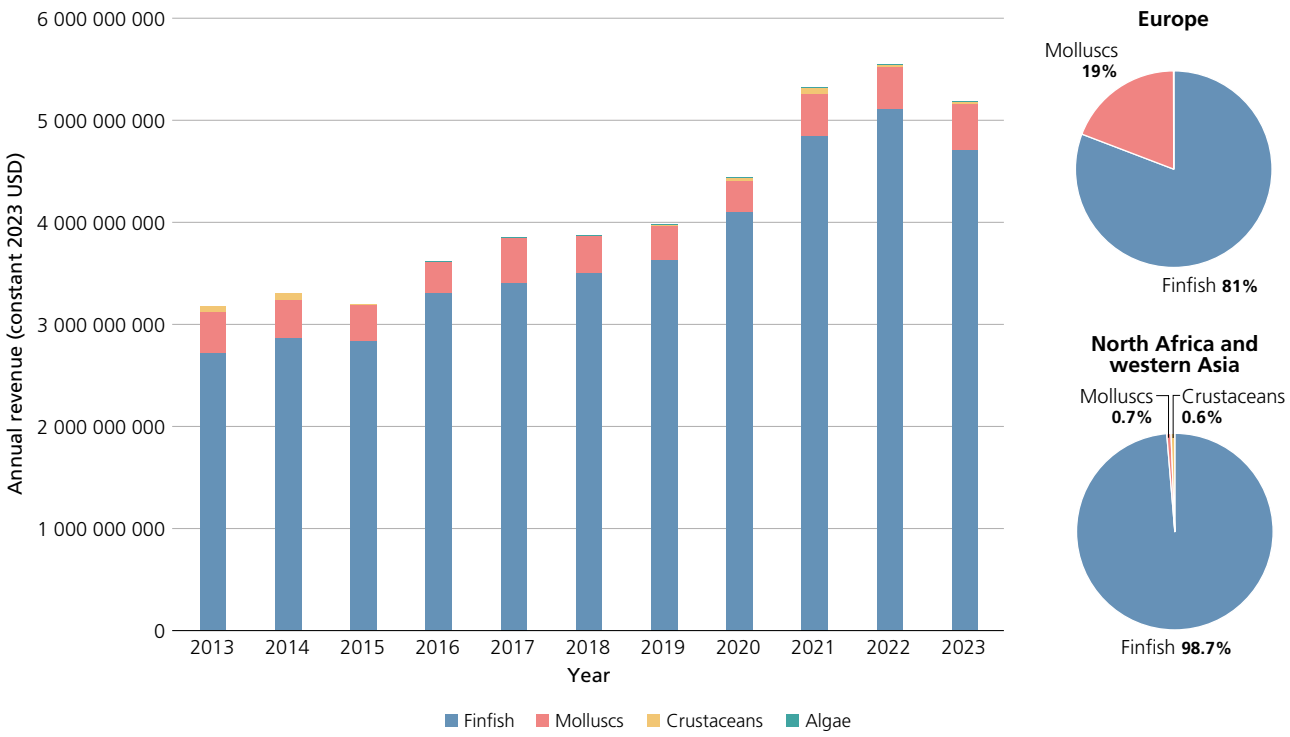
In North African and western Asian CPCs, overall growth in revenue over the same period reached a remarkable 150 percent, from USD 1.16 billion in 2013 to USD 2.9 billion in 2023. This expansion was driven almost entirely by higher revenues from fed marine species, in particular European seabass (*Dicentrarchus labrax*), gilthead seabream (*Sparus aurata*) and meagre (*Argyrosomus regius*), all of which recorded substantial production and value increases across the decade. On the other hand, contributions from non-fed species remained marginal (less than 1 percent) over the same period, despite their exponential increase in value, from USD 323 000 in 2013 to USD 18.86 million in 2023.

Farming of finfish (various species) represents by far the greatest contributor to total marine and brackish water aquaculture revenue in the Mediterranean and the Black Sea, accounting on average for 90 percent of all revenue, followed by molluscs at 9 percent, while crustaceans and algae contribute marginally, each representing less than 1 percent. In 2023, total revenue from finfish farming in North African and western Asian CPCs was estimated at USD 2.87 billion, representing 99 percent of the total revenue from all species farmed. In Europe, for the same year, finfish farming generated an estimated USD 1.83 billion, accounting for 81 percent of the total revenue from all species farmed, followed by molluscs (mainly mussels and oysters), which contributed USD 437.47 million, accounting for 19 percent of total revenue (Figure 70).

Over the period 2013–2023, marine aquaculture accounted on average for 83 percent of total revenue from marine and brackish water production combined. This share was considerably higher in Europe, where marine production generated 89 percent of revenue, compared with 77 percent in North Africa and western Asia. In 2023, 90 percent of revenue generated in European CPCs originated from marine aquaculture while only 10 percent derived from brackish water production. Meanwhile, in North African and western Asian CPCs, 84 percent of aquaculture revenue originated from marine aquaculture, with the remaining 16 percent coming from brackish water aquaculture (Figure 71).

Türkiye accounts for the highest share of the region's total aquaculture revenue, contributing

FIGURE 70. Revenue from aquaculture by group of species, 2013–2023, and by region, 2023



Note: In Europe, crustaceans accounted for 0.02 percent of revenue from aquaculture. In North Africa and western Asia, algae accounted for less than 0.01 percent of revenue from aquaculture.

FIGURE 71. Revenue from aquaculture by production environment, 2013–2023, and by region, 2023

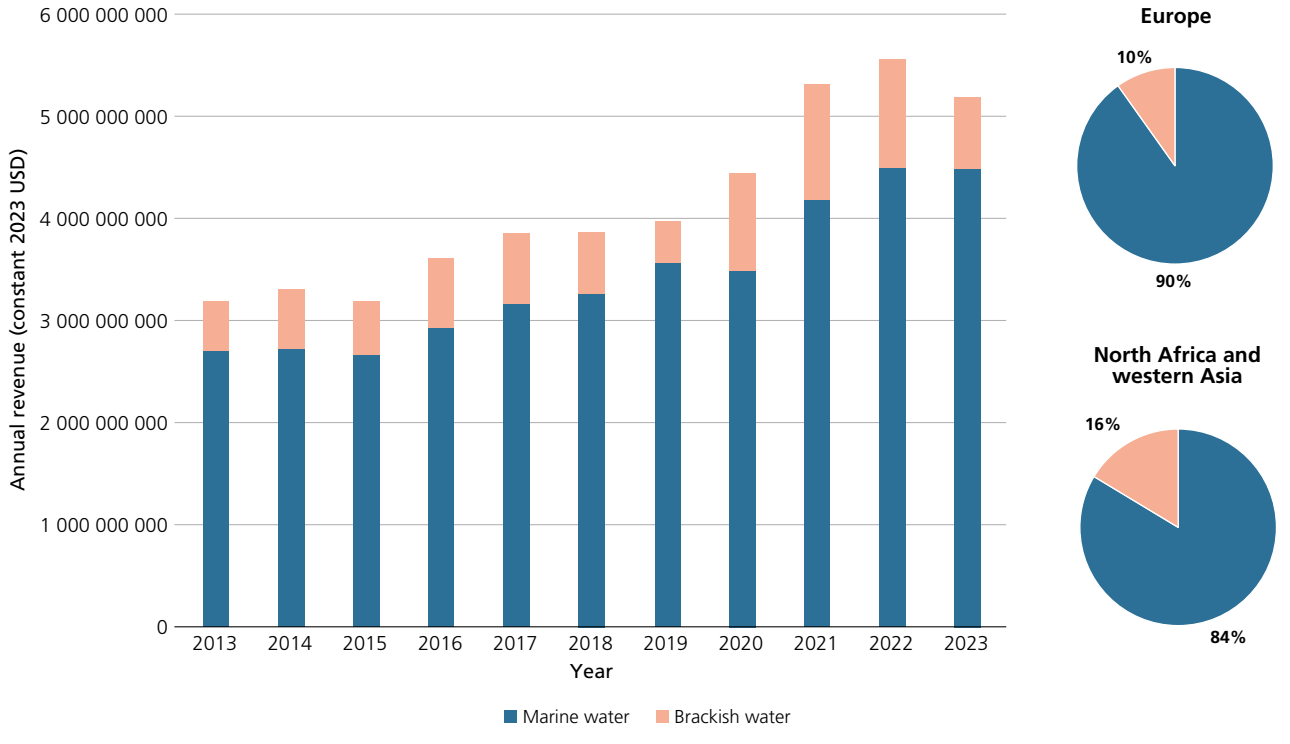
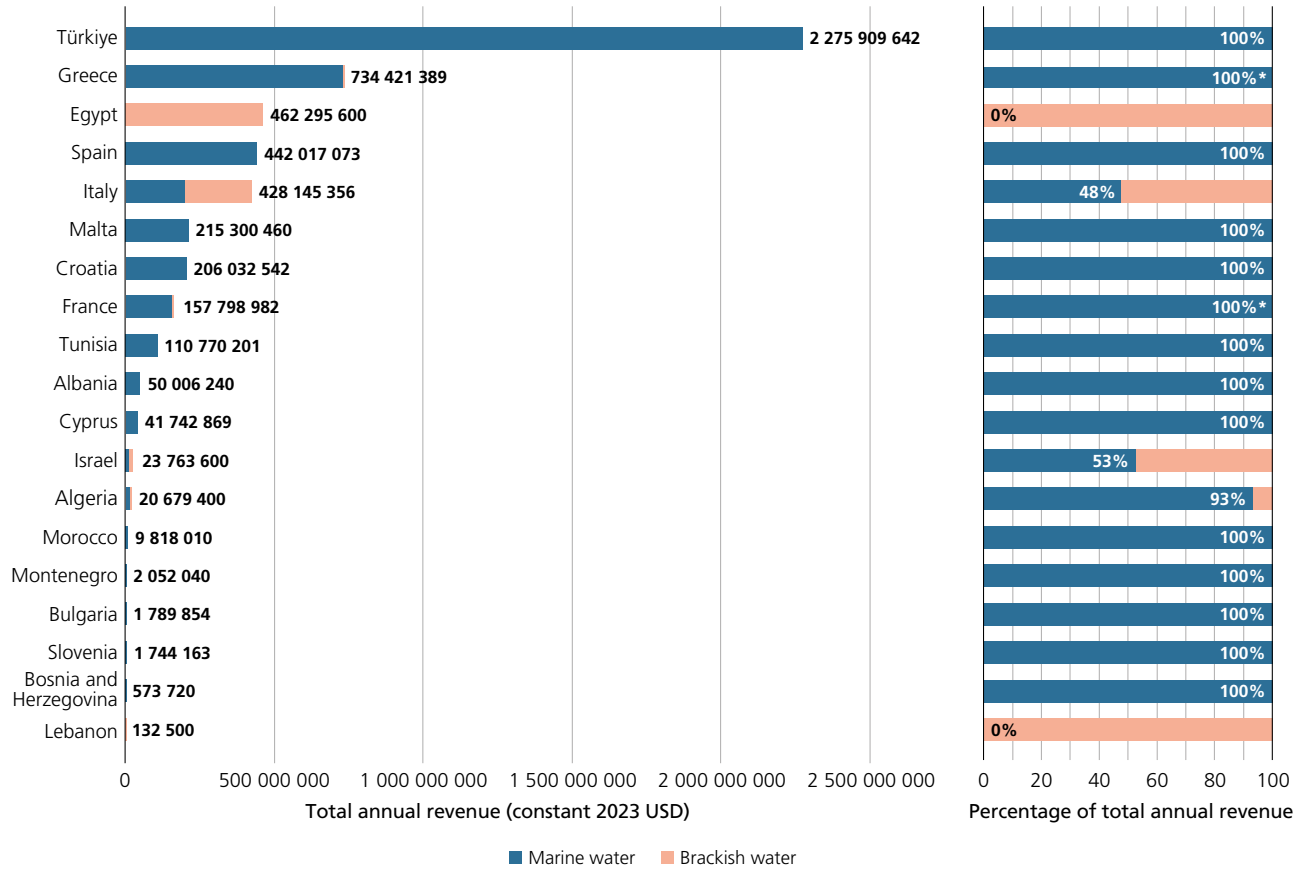


FIGURE 72. Revenue from marine and brackish water aquaculture by GFCM contracting party and cooperating non-contracting party



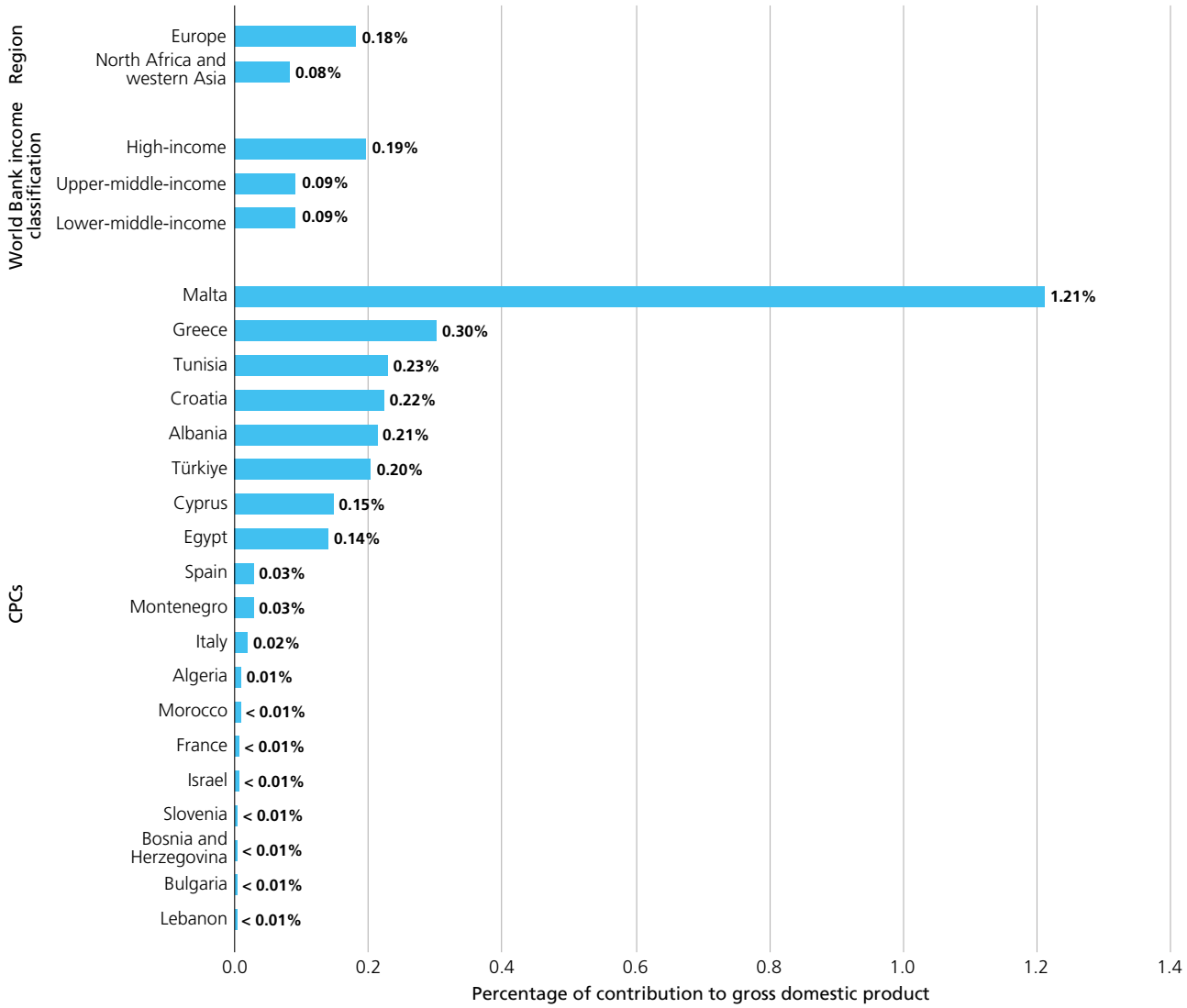
Note: *Brackish water aquaculture represents less than 0.5 percent of the total.

43.9 percent or an estimated USD 2.27 billion, followed by Greece with 14.2 percent or an estimated total value of USD 734.42 million, with both countries relying exclusively on marine aquaculture. Egypt ranks third, generating an estimated total value of USD 462.3 million, corresponding to 8.9 percent, exclusively from brackish water. Together, Türkiye, Greece and Egypt account for just over two-thirds (67 percent) of the region's total revenue from marine and brackish water aquaculture. Another six countries – Croatia, France, Italy, Malta, Spain and Tunisia – combined contribute 30 percent of the region's total revenue, while the remaining 3 percent is distributed among ten countries: namely Algeria, Albania, Bulgaria, Bosnia and Herzegovina, Cyprus, Israel, Lebanon, Montenegro, Morocco and Slovenia (Figure 72).

The relative importance of aquaculture revenue as a share of GDP in 2023 was assessed by country from the first sale of products farmed in marine and brackish waters. This assessment is only indicative, as cost data were not available at the time of this analysis. Malta ranks highest, with aquaculture contributing 1.21 percent of total GDP – mainly due to the relatively small size of the country's economy and high revenue generated from tuna ranching – followed by Greece, at 0.30 percent. Overall, in European CPCs, the average contribution to GDP is estimated at 0.18 percent, significantly higher than in North African and western Asia countries, where the average contribution stands at 0.08 percent.

Similarly, the contribution of aquaculture revenue to national GDP is, on average, significantly higher for countries classified as high-income economies under the World Bank country classification by income level (0.19 percent) (Metreau, Young and Eapen, 2025). In contrast, for both lower-middle income and upper-middle income economies, average contributions to GDP are estimated

FIGURE 73. Percentage contributions of aquaculture to gross domestic product by region, income group classification and GFCM contracting party and cooperating non-contracting party



Note: World Bank income classifications are based on gross national income per capita. High-income economies include Bulgaria, Croatia, Cyprus, France, Greece, Israel, Italy, Malta, Slovenia and Spain; upper-middle-income economies include Albania, Algeria, Bosnia and Herzegovina, Montenegro and Türkiye; and lower-middle-income economies include Egypt, Lebanon, Morocco and Tunisia.

Sources:

FAO. 2025a. FishStat: Global aquaculture production 1950–2023. In: *Food and Agriculture Organization of the United Nations.* Rome. [Cited 5 June 2025]. https://fao.org/fishery/en/topic/fishstat

FAO. 2025b. Information System for the Promotion of Aquaculture in the Mediterranean (SIPAM). In: *General Fisheries Commission for the Mediterranean.* Rome. [Cited 10 September 2025]. https://fao.org/gfcm/activities/aquaculture/innovation/sipam

Metreau, E., Young, K.E. & Eapen, S.G. 2025. Understanding country income: World Bank Group income classifications for FY26 (July 1, 2025–June, 2026). In: *World Bank Blogs*. Washington, DC. [Cited 17 November 2025]. https://blogs.worldbank.org/en/opendata/understanding-country-income--world-bank-group-income-classifica

at 0.09 percent, i.e. less than half of that of the high-income group (Figure 73).

Structure of the aquaculture sector

The great diversity of the aquaculture sector in the GFCM area of application is evident when examining the different types of farming and the size of enterprises. Size categories vary across the different farming types, mainly due to differences in the level of infrastructure capital requirements and production output. The results of a survey for the year 2023[12] show that Türkiye dominates in the number of both cage farms

[12] Egypt was not included in the analysis by size category and type, as only aggregated data were reported (approximately 26 000 enterprises in 2022).

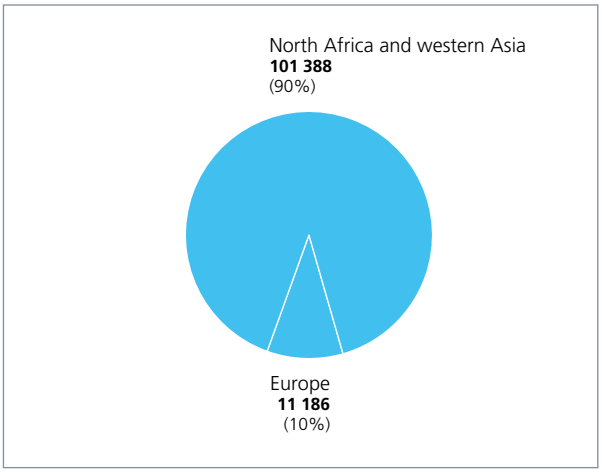
TABLE 8. Aquaculture enterprises by size category and farming type, 2023

	On-growing cage farms for marine and brackish-water finfish						On-growing land-based farms for marine and brackish-water species						On-growing farms for mussels, oysters and other bivalve molluscs					
	< 250 tonnes	250–500 tonnes	500–1 000 tonnes	1 000–5 000 tonnes	> 5 000 tonnes	**Total**	< 30 tonnes	30–100 tonnes	100–250 tonnes	250–500 tonnes	> 500 tonnes	**Total**	< 30 tonnes	30–100 tonnes	100–250 tonnes	250–500 tonnes	> 500 tonnes	**Total**
Albania	8	3	1	4	–	**16**	3	5	3	–	–	**11**	5	–	–	–	–	**5**
Algeria	–	85	–	–	–	**85**	13	10	9	7	–	**39**	45	–	–	–	–	**45**
Croatia	23	1	3	3	1	**31**	22	9	3	3	1	**38**	109	8	–	–	–	**117**
Cyprus	–	3	3	3	–	**9**	1	–	–	–	–	**1**	–	–	–	–	–	**–**
France	27	1	1	2	–	**31**	165	48	28	25	17	**283**	1 189	617	325	121	65	**2 317**
Greece	49	37	15	19	3	**123**	53	20	8	3	3	**87**	200	51	100	37	12	**400**
Italy	11	5	3	3	–	**22**	64	58	16	16	20	**174**	108	45	45	31	42	**271**
Spain	NC	NC	NC	NC	NC	**37**	6	5	–	1	61	**73**	–	–	14	–	1 932	**1 946**
Tunisia	–	3	8	10	–	**21**	–	–	1	–	1	**2**	–	3	–	–	–	**3**
Türkiye	450	155	281	163	–	**1 049**	927	108	68	31	15	**1 149**	2	2	1	6	58	**69**

Notes: Tonnes refer to the annual production per farm.
NC = not communicated.

and land-based farms, with 1 049 enterprises and 1 149 enterprises respectively, many in the small- to medium-scale categories (especially less than 250 tonnes annual production for cage farms and less than 30 tonnes for land-based farms), reflecting a large but fragmented industry. Greece exhibits a balanced aquaculture sector, with 123 cage farm enterprises and 400 mussel and oyster enterprises, combining small- and medium-scale farms, but also hosting the highest proportion of very large enterprises (three with over 5 000 tonnes of annual production). France is the leader in mussel and oyster farming, with over 2 300 enterprises, a significant number of which are small-scale (less than 100 tonnes annual production), reflecting a strong tradition of artisanal shellfish farming. Spain also has a vast mussel and oyster sector, almost entirely composed of very large-scale farms (with over 500 tonnes of annual production), indicating industrial production.[13] Meanwhile, Croatia and Italy show a moderate diversity in farm types and sizes, while Albania, Cyprus and Tunisia have smaller sectors mainly focused on small- to medium-scale production (Table 8).

FIGURE 74. Total employment in aquaculture by region



Employment in aquaculture

Aquaculture plays a crucial role in supporting livelihoods across coastal and rural areas of the Mediterranean and the Black Sea, especially where alternative employment is often scarce. Direct employment in marine and brackish water aquaculture in the GFCM area of application[14] in 2023 was estimated at a total of 112 574 persons.

[13] Data for mussels and oyster farms from France and Spain do not make a distinction between Mediterranean and Atlantic farms.

[14] Data originate from 15 CPCs, namely Albania, Algeria, Bulgaria, Croatia, Cyprus, Egypt, France, Greece, Italy, Lebanon, Morocco, Slovenia, Spain, Tunisia and Türkiye.

The vast majority (90 percent) corresponded to employees in the North African and western Asian CPCs of the Mediterranean and Black Sea region, with Egypt dominating due to its large volume of production of brackish water species (mainly mullets and tilapias) and important number of small-scale production units. Comparatively, European CPCs contributed only 10 percent to total direct aquaculture employment across the wider region. This is mainly due to much of the European seabass and gilthead seabream (*Sparus aurata*) production being carried out by a small number of large, highly industrialized companies, rather than by many small farms, which reduces the overall number of workers needed (Figure 74).

Demographic characteristics of employment in aquaculture

According to data on employment by gender in 2023, in the Mediterranean and Black Sea region, aquaculture was dominated by male employees, accounting for 83 percent of the total direct workforce. The proportion of female employees was higher in European CPCs (22 percent) compared to North African and western Asian CPCs (10 percent), with France recording the highest share of female employees (37 percent) among all CPCs (Figure 75).

In 2023, the overall recruitment of younger people was relatively low, with only 14 percent of the workforce under 25 years old, based on data from 11 CPCs[15] that provided relevant information. Meanwhile, 41 percent of employees were aged between 25 and 40, and 45 percent were over 40 years old. This trend of low recruitment of young people was more pronounced among European CPCs, where only 7 percent of the workforce was under 25, while more than half (53 percent) were over 40. In contrast, North African and western Asian CPCs showed a more balanced distribution of age groups, with 27 percent of the total workforce under 25 years old, 41 percent between 25 and 40 years old and the remaining 32 percent over 40 years old (Figure 76).

[15] Albania, Algeria, Bulgaria, Croatia, Cyprus, Egypt, Greece, Italy, Lebanon, Morocco and Spain provided data. Given the comparatively high number of employees reported by Egypt, regional averages by age group were calculated as the unweighted mean of national percentages, to better reflect the diversity of reporting countries. Using totals instead would result in a 38 percent share represented by youth employment, compared to 14 percent based on national averages.

Contribution of aquaculture to aquatic food consumption in the GFCM area of application

A survey was conducted in 2023 among CPCs to assess the contribution of aquaculture to the overall per capita supply of aquatic foods. Fourteen countries[16] out of the twenty-six surveyed provided the requested information, with some noting that the data were estimates and others submitting information on consumption from both capture fisheries and aquaculture.

The contribution of farmed aquatic foods to the apparent consumption of aquatic foods in the GFCM area of application in 2023 varied widely among countries (Figure 77), reflecting differences in social, economic, production and consumption contexts. Per capita consumption of farmed aquatic foods ranged from as low as 0.1 kg in Morocco, representing 0.6 percent of total aquatic food consumption, to as high as 17.4 kg in Egypt, equivalent to 82.2 percent of total aquatic food consumption.

On a global scale, per capita aquatic food consumption in 2022 reached 20.8 kg per year, with aquaculture supplying more than 57 percent of this total (FAO, 2024). Several CPCs with per capita consumption above or close to the global average rely moderately to significantly on aquaculture for the supply of aquatic foods to their populations. This is the case of Egypt, Italy and France, where products from aquaculture provided, respectively, 82.2 percent, 50 percent and 29.5 percent of their total apparent per capita of aquatic food consumption in 2023. Likewise, some countries with a low per capita aquatic food consumption compared to the global average, such as Romania, Albania and Türkiye also rely significantly on aquaculture, with respectively 83 percent, 68 percent, and 52 percent of their total apparent per capita aquatic food consumption.

Countries such as Greece, Libya, Morocco and Tunisia rely more heavily on marine capture fisheries to supply their domestic markets, reflecting a long-standing tradition of consuming marine capture fisheries species, in particular small pelagics, which are often more affordable than aquaculture products. Moreover, countries such as Morocco mainly count on imports of farmed fish species, although major investments are underway to significantly boost marine aquaculture production in the future.

[16] Albania, Algeria, Cyprus, Egypt, France, Greece, Croatia, Italy, Lebanon, Libya, Morocco, Romania, Türkiye and Tunisia.

FIGURE 75. Gender-disaggregated aquaculture employment by GFCM contracting party and cooperating non-contracting party and by region

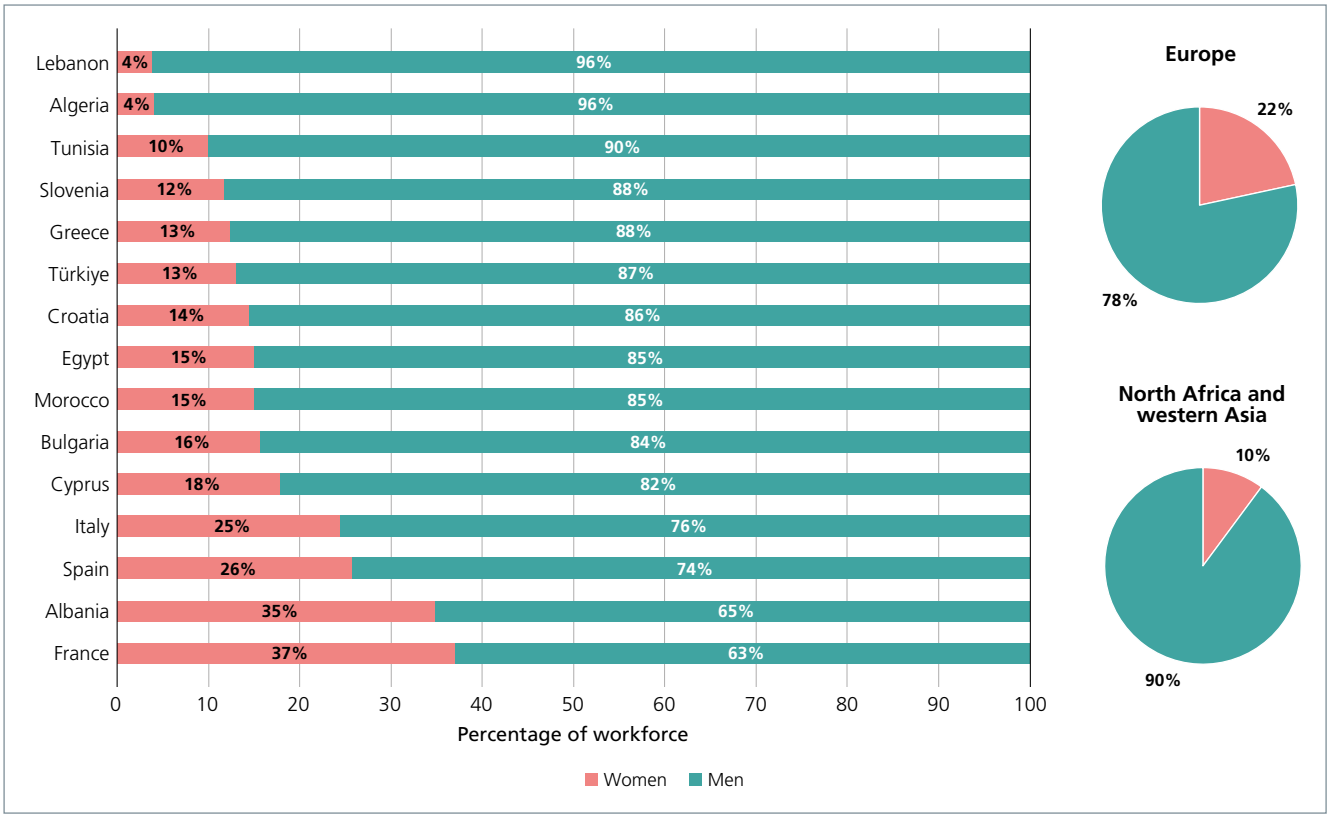
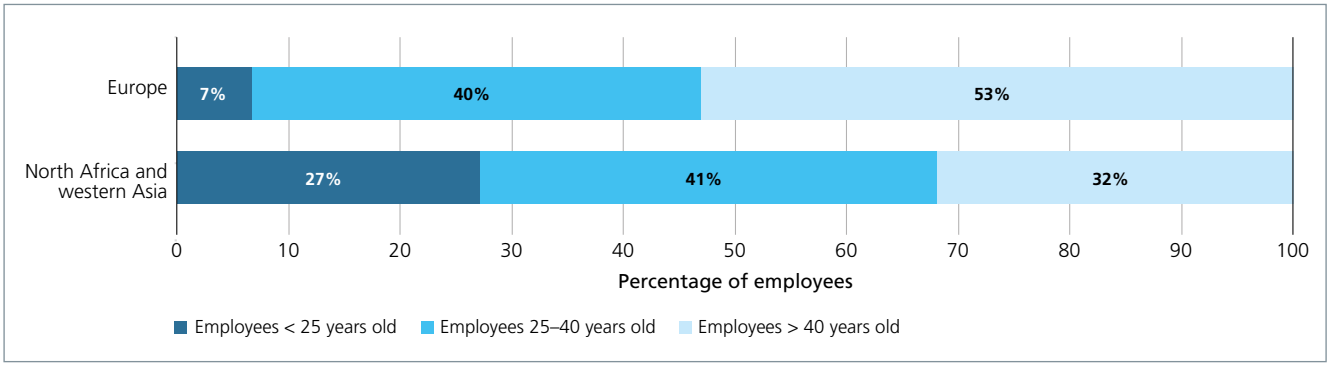


FIGURE 76. Age distribution of aquaculture employment by age group and region



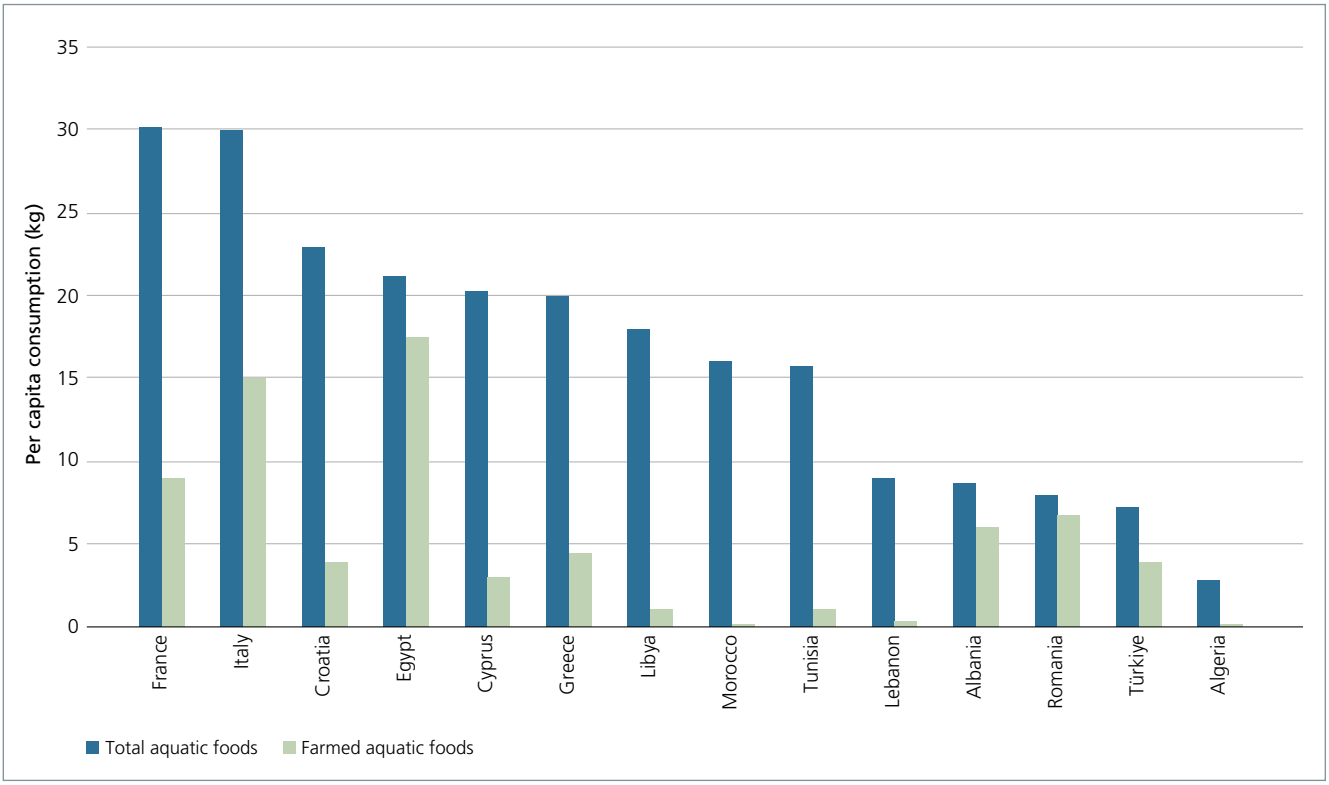
While Egypt's policy has focused on food security, directing nearly 100 percent of its aquaculture production towards domestic consumption, other major marine aquaculture producers, such as Greece and Türkiye, have placed a strong emphasis on export markets. Similarly, countries like Greece, France, Italy and Spain have promoted national aquaculture production, supplemented by imports to ensure timely and appropriate supply to the domestic market, including restaurants and food services catering to the large number of tourists visiting these countries.

VALUE CHAIN AND TRADE IN FISHERIES AND AQUACULTURE

Value chain

Beyond the employment and revenue at first sale generated by the fisheries and aquaculture harvesting sector, a comprehensive assessment

FIGURE 77. Per capita apparent consumption of total aquatic foods and farmed aquatic foods by GFCM contracting party, 2023



of its social and economic impacts, as well as its role in a Blue Transformation (see Box 1), necessitates a consideration of the entire value chain. Fisheries contribute significantly to livelihoods and income generation across a range of upstream and downstream activities, including boat construction, net manufacturing and repair, fish processing and marketing. Additionally, non-vessel-based fishing practices such as shore-based fishing and gleaning provide significant employment opportunities.

In aquaculture, economic and livelihood benefits extend beyond farming operations to encompass activities such as hatchery operations, feed production, equipment maintenance, water quality management, laboratory and veterinary services, post-harvest handling, trade and distribution. These related subsectors are critical to the functioning and growth of aquaculture systems and often provide opportunities for diverse employment and value addition.

Importantly, women commonly work in these ancillary pre- and post-harvest segments of both fisheries and aquaculture. Therefore, a more nuanced understanding of value chain dynamics is critical, not only to enhance the visibility of women's contributions but also to support gender-responsive policy development.

Improving knowledge of benefit distribution along the value chain is also essential for identifying the socioeconomic drivers that influence fisher and aquaculture worker behaviour, which, in turn, has implications for effective fisheries management and sustainable aquaculture development. Furthermore, such insights are crucial for identifying opportunities to add value, reduce inefficiencies and foster innovation, while also ensuring that vulnerable groups, particularly women, are not marginalized in the process.

Employment along the value chain, including the contribution of women

It is estimated[17] that 1.17 million people are employed along the fisheries and aquaculture value chain in the Mediterranean and Black Sea region (Figure 78), with 9 percent of employment falling within the pre-harvest sector,

[17] The methodology used for this estimation was refined and enhanced with respect to previous estimates presented in earlier editions of *The State of Mediterranean and Black Sea Fisheries*. It is based on the methodology used for the publication *Women in fisheries in the Mediterranean and Black Sea region: roles, challenges and opportunities* (Merayo, Vakhitova and Carlson, 2024).

FIGURE 78. Total gender-disaggregated fisheries and aquaculture employment by value chain stage in the GFCM area of application

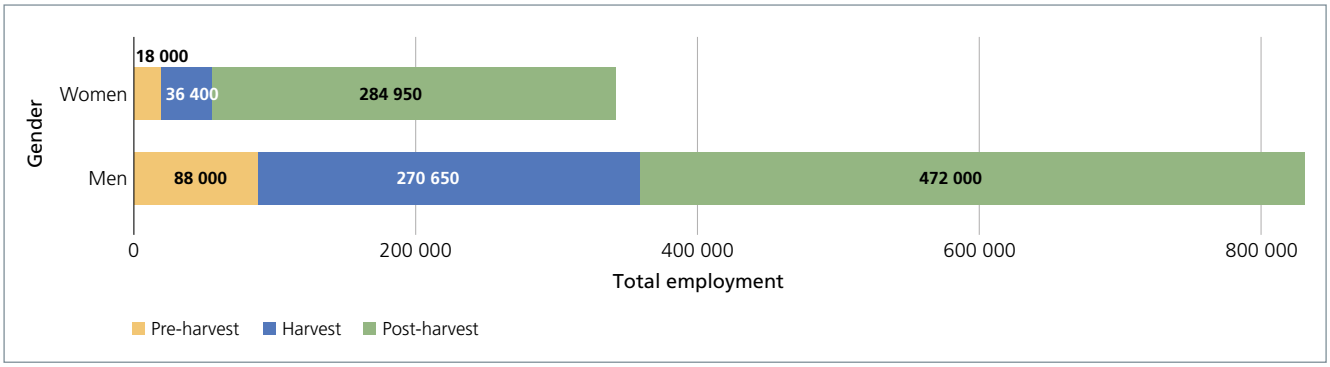
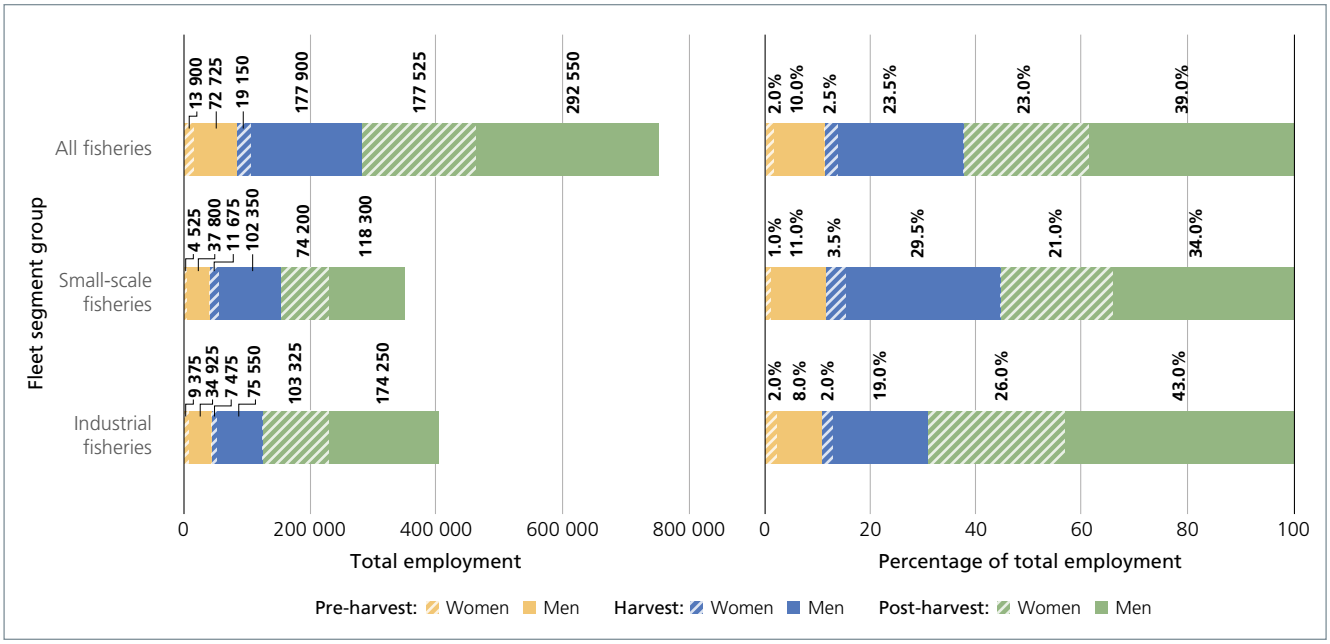


FIGURE 79. Relative contributions of men and women to total fisheries employment by value chain stage and fleet segment group

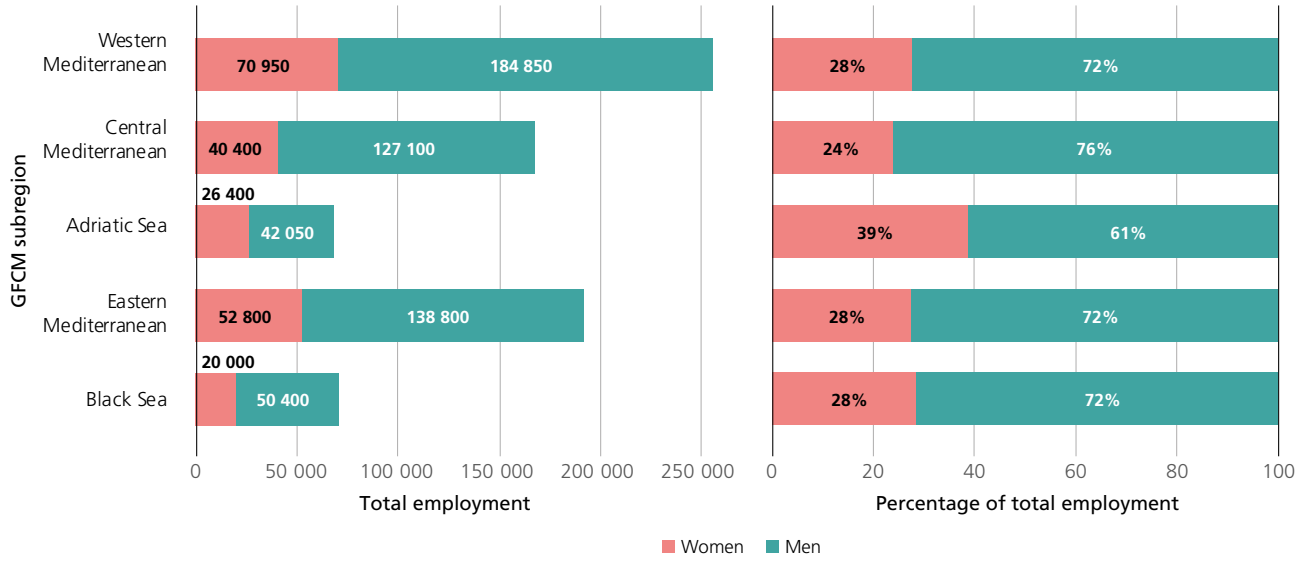


26 percent in the harvesting sector and 65 percent in the post-harvest sector. Approximately 340 000 women are estimated to be employed in fisheries and aquaculture, representing 29 percent of all jobs along the value chain. Women's employment is concentrated primarily in the post-harvest sector, occupying 38 percent of post-harvest jobs; however, women are also estimated to represent 17 percent of pre-harvest jobs and 12 percent of harvest-related fisheries and aquaculture jobs.

Within the fisheries sector alone, specifically across small-scale and industrial fisheries, a more granular analysis of employment offers valuable insights into gendered participation along the value chain (Figure 79). In SSF, women are estimated to constitute approximately 26 percent of total employment, representing around 90 400 individuals. In contrast, women account for a slightly higher proportion (30 percent) of employment in the industrial fisheries value chain, corresponding to an estimated 120 175 individuals.

While these figures suggest greater female employment in industrial fisheries and highlight the link between industrial fisheries and post-harvest processing – where women commonly work – they likely also underestimate women's actual participation in the small-scale sector. This is particularly true for small-scale,

FIGURE 80. Total gender-disaggregated employment and relative contributions of men and women to total fisheries employment by GFCM subregion



non-vessel-based activities such as shore-based fishing, gleaning, processing and marketing, where women's work is often informal and underreported due to the absence of systematic data collection mechanisms.

The analysis of employment along the fisheries value chain also reveals notable subregional differences. For instance, while the Adriatic Sea subregion records the lowest total employment across the fisheries value chain, it stands out for having the highest proportion of fisheries-related jobs along the value chain held by women (39 percent) (Figure 80).

Prices along the value chain of farmed aquatic species

A survey was conducted among CPCs to collect data on the price of farmed species throughout the aquaculture value chain in 2023. Although the information gathered[18] has some limitations and its coverage varied from one country to another, the results of this survey capture an important snapshot of wholesale and retail price trends for key species[19] in the aquaculture sector in 2023. Aggregating the information into nine groups of main farmed species offered for consumption in the GFCM area of application (Table 9) shows that prices varied significantly between countries for similar species and within countries for different species. The price ranges, although indicative as they were not weighed by volume offered for sale, show differences of up to a factor of three between countries, except for oysters, which displayed prices sometimes more than six times higher in some countries than in others. In countries producing significant quantities of a species, prices for the species were typically lower than in countries with a

TABLE 9. Price range data collected by the GFCM for select aquaculture species groups, 2023

Aquaculture species groups	2023 GFCM price range (USD/kg)		2023 Globefish price range (USD/kg)
	Wholesale	Retail	
Seabass, seabream	3.2–10.8	8.1–24.9	5.8–10.4
Trout	3–11.9	6–13	14.8–15.7
Carp	1.2–5.4	1.3–8.2	
Tilapia	1.6–5.5	4.9–8.2	
Sturgeon		9.3–22.9	
Other finfish	3.6–13	5.6–13	10–10.8
Mussels	0.9–8.2	1.5–10.2	2.3–2.6
Oysters	3.9–24.6	3.9–26.8	12.2–28.5
Shrimp	5.6–10.8	8.6–21.6	24.4–33

[18] Out of the 26 surveyed, 20 countries provided the requested information, while 2 countries did not provide data, citing concerns over the quality of the information collected.

[19] These include 16 finfish species, 5 bivalve mollusc species and 2 crustacean species.

more limited production of such species or with significant imports. Likewise, retail prices were two to three times higher than wholesale prices for European seabass, blackspot seabream (*Pagellus bogaraveo*), rainbow trout (*Oncorhynchus mykiss*) and, to some extent, oysters. For other species groups, the gap was smaller, reflecting that most aquaculture products are offered for retail with minimal processing.

Since 1984, FAO has been collecting, analysing and disseminating information on global fish prices and markets, using an extensive network of market correspondents from the industry and direct access to the most up-to-date market data worldwide (FAO, 2025j), including the European Market Observatory for fisheries and aquaculture products (EUMOFA) database (EUMOFA, 2025), which is highly relevant to the GFCM and its CPCs. The data on price ranges for farmed species, collected by the GFCM through the aforementioned survey (Table 9) overlap and, in some cases, align with those reported in the Globefish price dashboard for similar species groups in 2023. However, Globefish ranges tend to be narrower, possibly reflecting the high frequency of data collection (mostly weekly) at major market platforms.

To support future value chain analysis, enhancing the systematic and frequent monitoring of fish price data across all CPCs is essential, both for farmed species (already initiated) and for key species from capture fisheries. For key farmed species in the Mediterranean – particularly European seabass, blackspot seabream, meagre, mussels and oysters – existing price data from Globefish and EUMOFA already provide a reliable foundation to support GFCM regional studies. Several CPCs, including France, Greece, Italy, Spain, Tunisia and Türkiye, are major producers and/or traders of these species, and their price databases are frequently updated, providing valuable and reliable insights into the trade of farmed aquatic species in the Mediterranean and the Black Sea.

The FAO Fish Price Index (FPI) is a key barometer of global fish markets that measures monthly changes in international prices for a basket of fisheries and aquaculture commodities (FAO, 2025k). It is calculated as the average of 15 individual price series, representing the five main species groups: salmon, shrimp, tuna, pelagic fish (excluding tuna) and whitefish. An index value of 100 represents the average price over the period 2014–2016. Price data are sourced from EUMOFA, Statistics Norway, the Danish Fisheries Agency, INFOFISH and INFOPESCA.

The FPI shows that prices declined slightly from 2022 to 2023, falling from 119 to 117. The downward trend continued throughout 2024, reaching 114, before showing some recovery signs in 2025. These fluctuations observed between 2022 and 2023 were mostly driven by variations in the salmon price index, while fluctuations in other farmed aquatic species were comparatively lower. The lowest FPI recorded was 87 in 2015, compared to a peak of 119 in 2022.

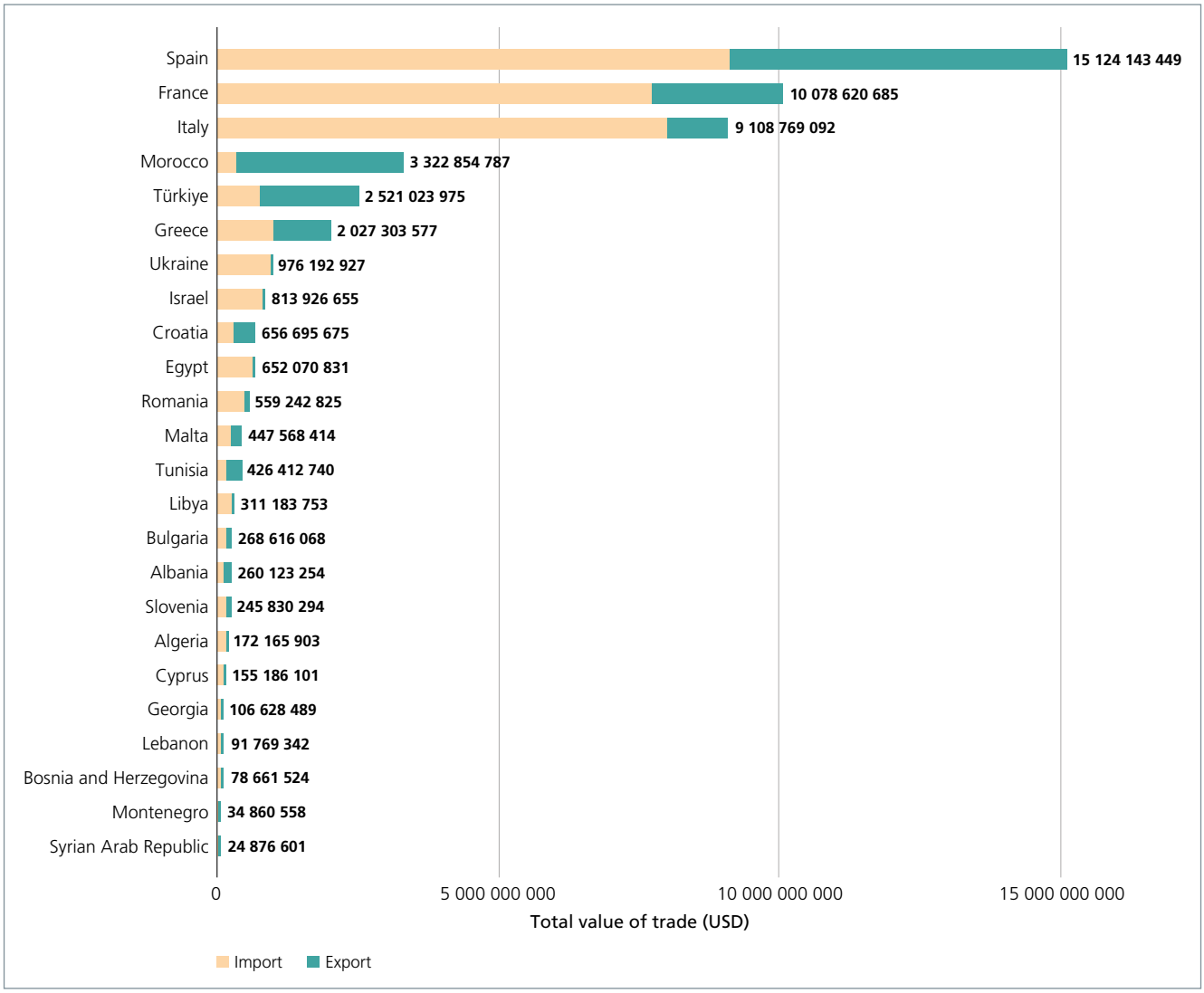
Trade of fish products

Fish trade constitutes a pivotal element of the fisheries and aquaculture value chain and a major driver of economic output. On a global scale, aquatic products rank among the most traded food commodities worldwide, involving over 230 countries and generating more than USD 195 billion in total export value in 2022 (FAO, 2024). This dynamic is also evident in the Mediterranean and the Black Sea, where commercial exchanges of fish products, especially between European Union (EU) and non-EU CPCs, are instrumental to the financial viability of the regional fisheries and aquaculture sector. Notably, trade extends beyond industrial fisheries and aquaculture, playing also a crucial role in supporting SSF and small-scale family farms. In several countries, despite the prevalence of short value chains and direct-to-consumer sales, certain high-value species targeted by SSF are predominantly destined for export markets, with the European Union being the primary recipient. This globalized trade underscores the need for consistent, timely, independent and trusted market information, to ensure transparency, reduce inefficiencies and support the design and implementation of efficient and inclusive market and trade strategies.

In 2023, the total value of traded fish products (imports plus exports) from capture fisheries and aquaculture by CPCs reached USD 48.5 billion[20] (Figure 81), with exports from these countries representing approximately 9 percent of the total

[20] Trade data are aggregated at the country level. As a result, export figures include fish products originating outside the GFCM area of application (particularly for countries such as Egypt, France, Morocco and Spain, which border multiple FAO fishing areas) as well as re-exports, while imports also include products originating outside the GFCM area of application.

FIGURE 81. Total value of traded fish products (imports and exports) by GFCM contracting party and cooperating non-contracting party

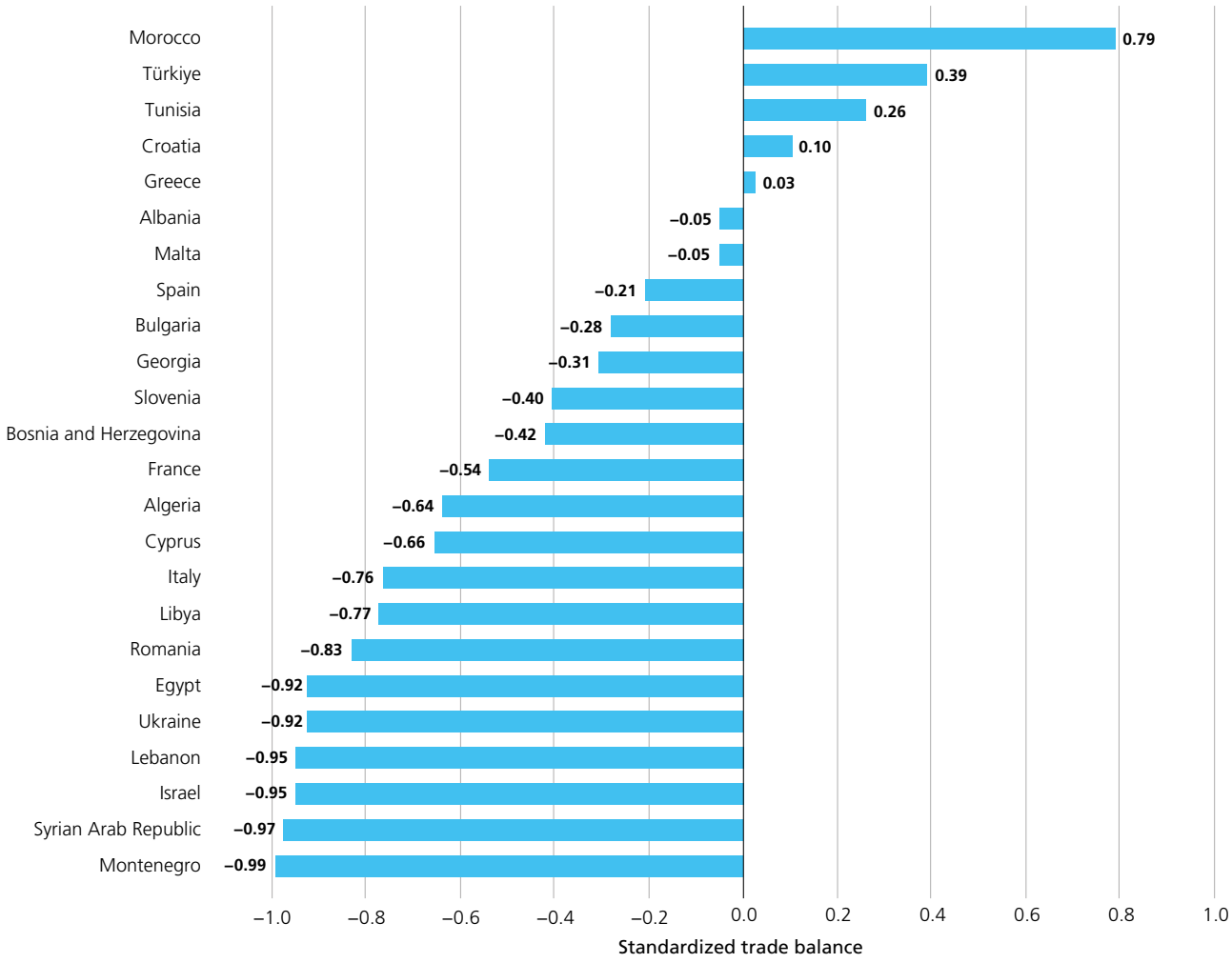


global export value. The total value of traded fish products by CPCs exhibits a 29.7 percent increase compared to 2020 (USD 37.4 billion) and reflects a combination of factors: international prices rising faster than trade volumes, a rebound in seafood demand following the COVID-19 pandemic, significant growth in regional aquaculture, and increased exports of high value fish species (particularly to EU markets). Collectively, these drivers pushed the regional trade value to nearly six times the first sale value from fisheries and aquaculture recorded in the same year.

Beyond total trade value, the standardized trade balance offers further insight into the trade dynamics of fishery products. The standardized trade balance indicates whether a country is a net importer or exporter, calculated as the ratio between the trade balance (exports minus imports) and the total trade volume (exports plus imports). Expressed as a value between –1 and 1, a standardized trade balance of –1 indicates complete reliance on imports, 1 indicates full reliance on exports and 0 reflects a perfect trade equilibrium.

Across the GFCM area of application, most CPCs are net importers of fishery products (Figure 82). Certain CPCs, such as Israel, Lebanon, Montenegro, the Syrian Arab Republic and Ukraine, rely heavily on imports to meet domestic demand. Conversely, countries such as Morocco, Tunisia and Türkiye, maintain a positive trade balance, although their net export ratios have slightly declined compared to

FIGURE 82. Standardized trade balance by GFCM contracting party and cooperating non-contracting party



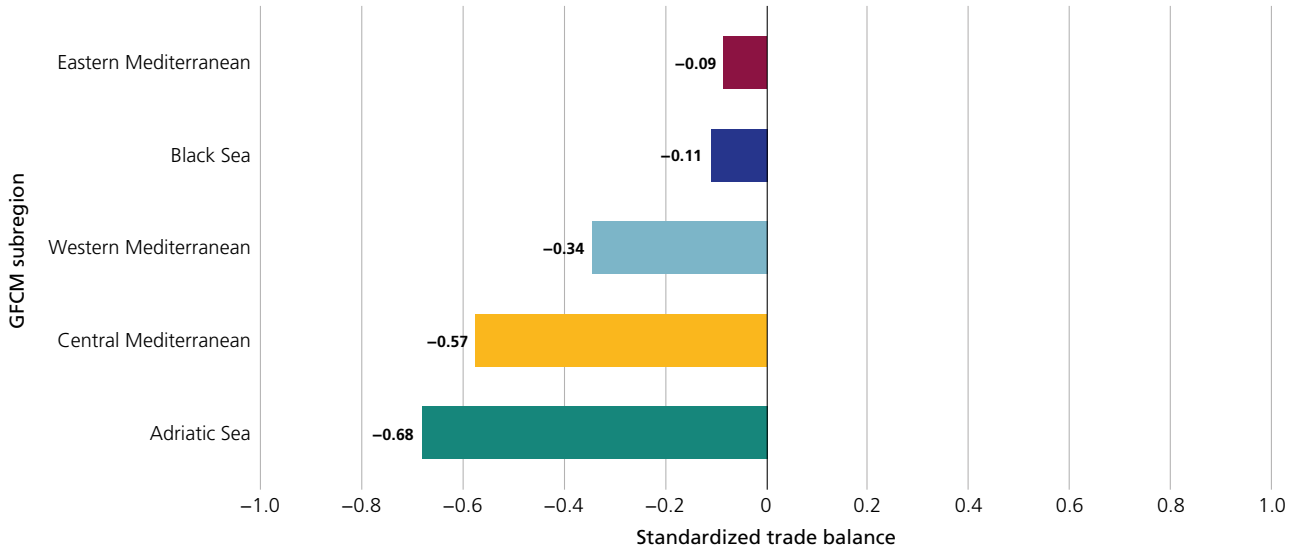
Note: −1 = 100% imports; 1 = 100% exports.

2020, as reported in the previous edition of *The State of Mediterranean and Black Sea Fisheries* (FAO, 2022c).

At the subregional level, all GFCM subregions remain net importers of fishery products (Figure 83), with the Adriatic Sea subregion showing the highest import dependency. Compared to the previous edition of *The State of Mediterranean and Black Sea Fisheries* (FAO, 2022c), the Adriatic Sea and the central Mediterranean subregions have shown a slight increase in import reliance, while the other subregions have reduced theirs, with the most significant decrease observed in the eastern Mediterranean.

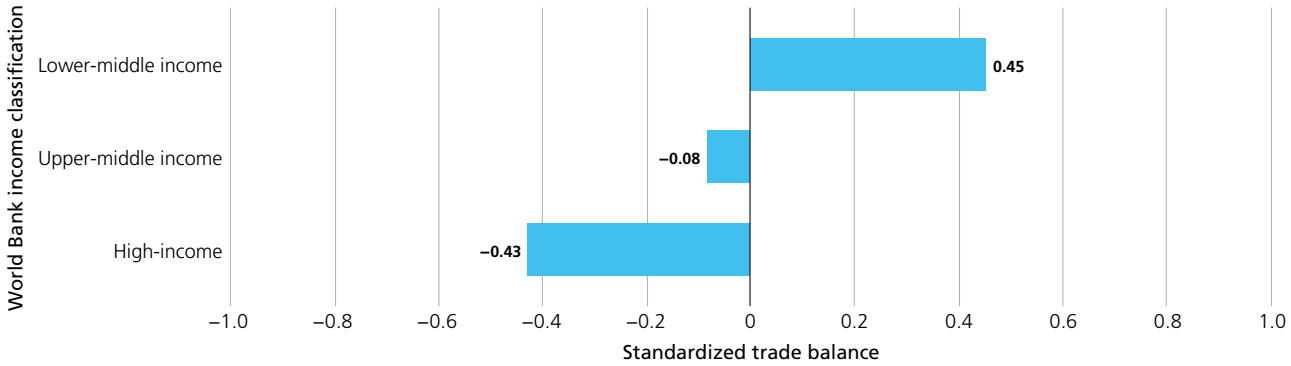
When analysed through the lens of the World Bank country classification by income level, a clear pattern emerges: lower-income countries with significant production levels tend to be net exporters, while higher-income countries are more likely to be net importers, even when their production is substantial, which may reflect a reliance on external supply to satisfy domestic demand (Figure 84). Notably, since the previous edition of *The State of Mediterranean and Black Sea Fisheries* (FAO, 2022c), several upper-middle income countries have shifted from predominantly exporting to predominantly importing, signaling a potential transformation in trade dynamics and domestic consumption patterns.

FIGURE 83. Standardized trade balance by GFCM subregion



Note: –1 = 100% imports; 1 = 100% exports.

FIGURE 84. Standardized trade balance by income group classification



Note: –1 = 100% imports; 1 = 100% exports.

Source: World Bank income classifications are based on Metreau, E., Young, K.E. & Eapen, S.G. 2025. Understanding country income: World Bank Group income classifications for FY26 (July 1, 2025–June, 2026). In: *World Bank Blogs*. Washington, DC. [Cited 17 November 2025]. https://blogs.worldbank.org/en/opendata/understanding-country-income--world-bank-group-income-classifica

CONCLUDING REMARKS

The socioeconomic analysis of fisheries and aquaculture in the Mediterranean and the Black Sea highlights the enduring importance of the sector for coastal communities, while also revealing differences between the two components. Both fisheries and aquaculture are generally profitable and represent vital sources of employment and income, with aquaculture generating higher revenues and capture fisheries playing a critical role in employment and livelihoods.

In 2023, capture fisheries accounted for two-thirds of all direct employment in the fisheries and aquaculture sector, and more than half of these jobs were in SSF. Remarkably, SSF maintain these high employment levels while accounting for just 12 percent of total landings in the region (see Chapter 1), albeit with relatively lower remuneration per fisher. Nevertheless, in recent years, employment and revenue across the capture fisheries sector have stagnated at around 197 000 jobs and USD 3.1 billion respectively. Profitability remains constrained by rising operational costs (particularly fuel) and, in some

cases, sustained by subsidies, posing challenges for the future.

By contrast, marine and brackish water aquaculture across the region has experienced a marked growth over the past decade, steadily expanding to exceed USD 5 billion in revenue and provide 112 574 jobs in 2023. The expansion of aquaculture production and revenue has likely contributed to stabilizing prices and enhancing food security in the region, with aquaculture supplying over half of aquatic food consumption in countries such as Albania, Egypt and Türkiye, and emerging as an economically dynamic sector with opportunities for further development.

Across the region, younger generations remain underrepresented in both fisheries and aquaculture, underscoring the need to support generational renewal in order to address the potential structural challenges posed by an ageing workforce. Women also play an important role, representing nearly 30 percent of total employment across the value chain, mainly in post-harvest and processing, where their contributions are essential yet often undervalued.

These findings reflect the priorities set out in the GFCM 2030 Strategy (Target 1, Target 3 and Target 4), the MedFish4Ever and Sofia Declarations, the RPOA-SSF and the Blue Transformation Roadmap 2022–2030, which call for sustainable management of fisheries resources, the development of a resilient aquaculture sector, the creation of decent employment and improved economic opportunities.

Looking ahead, the stabilization of fisheries revenues may signal the expected trade-offs of rebuilding stocks, reflecting progress but also highlighting challenges on the path to long-term sustainability. Meanwhile, aquaculture is projected to further expand and intensify to meet the increasing demand for aquatic food, including in the GFCM area of application. This growth presents a significant opportunity to create employment and stimulate economic development.

To fully realize these socioeconomic benefits, targeted policies are needed to create an enabling environment for investment in sustainable aquaculture infrastructure, services and operations. Such policies should be informed by a thorough understanding of aquaculture potential and of the farming types, technologies and farm sizes most suitable for each country and subregion. This requires a detailed analysis of costs and benefits across different segments of the sector, supported by more robust and detailed data collection.

While this chapter shows important advances, additional efforts are needed to strengthen social protection access and provide decent work opportunities, as well as to support greater inclusion of women and young people. Safeguarding resources while supporting livelihoods remains a cornerstone of Blue Transformation in the Mediterranean and the Black Sea.

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PART 2

Management of Mediterranean and Black Sea fisheries and aquaculture


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6. Fisheries management

Fisheries management in the Mediterranean and the Black Sea is undergoing a pivotal transformation, marked by a shift from transitional, short-term measures to adaptive, long-term frameworks. This transition reflects a growing maturity in regional governance, where management is increasingly grounded in scientific evidence, responsive to environmental and socioeconomic dynamics, and aligned with four of the five targets of the GFCM 2030 Strategy for sustainable fisheries and aquaculture in the Mediterranean and the Black Sea (GFCM 2030 Strategy; see Box 2): Target 1 "Fisheries and ecosystems: healthy seas and productive fisheries"; Target 2 "Compliance and enforcement: a level playing field to eradicate illegal, unreported and unregulated fishing"; Target 4 "Livelihoods: decent employment and engaged fishers towards profitable fisheries"; and Target 5 "Capacity development: technical cooperation, knowledge sharing and efficient partnerships in a subregional perspective". The adoption of 11 multiannual management plans, some of which are now evolving from transitional to long-term phases, demonstrates tangible progress towards achieving Target 1 and Target 2, particularly through the implementation of ecosystem-based approaches, stock-specific measures and monitoring, control and surveillance (MCS) measures such as international joint inspection schemes. Significant strides have also been made on stakeholder engagement and small-scale fisheries (SSF), contributing to the realization of Target 4. Finally, efforts have been made to roll out management-oriented actions in

support of enhancing science, knowledge sharing and capacity development.

This chapter provides a progress check against the GFCM 2030 Strategy targets, synthesizing key developments in fisheries management since the last edition of *The State of Mediterranean and Black Sea Fisheries* in 2023 (FAO, 2023c), drawing on the outcomes of GFCM expert meetings, the Regional Plan of Action for Small-Scale Fisheries in the Mediterranean and the Black Sea (RPOA-SSF) monitoring framework questionnaire, and the Compendium of GFCM decisions (GFCM, 2025a). The chapter reviews newly implemented and revised management plans and measures, spatial measures including fisheries restricted areas (FRAs), advances in SSF governance, and the role of management-oriented research in supporting evidence-based decision-making. It concludes with a discussion of cross-cutting challenges and future directions, including the integration of climate change considerations across the advisory process (Box 15).

MULTIANNUAL MANAGEMENT PLANS AND MANAGEMENT MEASURES

Over the past decade, the GFCM has significantly and progressively shaped the landscape of fisheries management in the Mediterranean and the Black Sea through the adoption of 11 adaptive multiannual management plans (Table 10). These plans represent the clearest and most tangible expression of the current state of fisheries management in the region, reflecting a dynamic and evolving approach that aligns with the objectives of the GFCM 2030 Strategy. In particular, they embody the principles of adaptive and resilient management, essential to achieving Target 1 through the implementation of the actions outlined under Output 1.1 "Technical advice on the status of fisheries and potential management scenarios improved to provide a solid basis for decision-making"; Output 1.2 "Evidence-based adaptive fisheries and ecosystem management implemented"; and Output 1.3 "Efficient area-based conservation measures, technical and nature-based solutions strengthened to conserve biodiversity and enhance the productivity of marine living resources".

While some plans have been based on specific long-term measures since inception (e.g. the management plan for turbot [*Scophthalmus maximus*] fisheries in the Black Sea), as of 2022, most have adopted a step-wise approach. This involves implementing transitional measures while progressively working towards the identification of long-term measures, guided by the continuous collection and integration of new scientific data. Each plan includes built-in adaptive mechanisms designed to respond to evolving stock conditions, fishing practices, and potential environmental changes, ensuring that management remains effective and sustainable over time.

Over the past two years, this evolution has accelerated. A new multiannual management plan was adopted for common dolphinfish (*Coryphaena hippurus*) in the Mediterranean Sea, while three existing plans transitioned to a long-term phase – small pelagics in the Adriatic Sea, and European eel (*Anguilla anguilla*) and red coral (*Corallium rubrum*) in the Mediterranean Sea. Additionally, three plans underwent substantial revision – demersal fisheries in the Adriatic Sea, blackspot seabream (*Pagellus bogaraveo*) in the Alboran Sea and turbot in the Black Sea – to better reflect current scientific understanding and management needs. Six new recommendations entered into force, setting management measures for emerging stocks and fisheries, including rapa whelk (*Rapana venosa*) in the Black Sea, and minimum conservation reference sizes (MCRS) for blackspot seabream and deep-water red shrimp species. This section summarizes these advances.

New multiannual management plans

Common dolphinfish fisheries and use of anchored fish aggregating devices in the Mediterranean Sea

Common dolphinfish is a GFCM priority species managed across the whole Mediterranean. Following transitional measures for the use of anchored fish aggregating devices (FADs) adopted in 2019 and amended in 2021, a multiannual management plan was established for this fishery in 2023,[21] informed by research outcomes and subregional technical inputs.

With the overall goal of maintaining maximum sustainable yield (MSY), and consistent with the precautionary approach, this multiannual

[21] Recommendation GFCM/46/2023/14 establishing a multiannual management plan for the sustainable exploitation of common dolphinfish in the Mediterranean Sea, repealing Recommendations GFCM/30/2006/2, GFCM/43/2019/1 and GFCM/44/2021/11

TABLE 10. Summary of the main management and conservation measures contained in GFCM decisions and in other technical documents

	Geographical subareas	Main management and conservation measures																							
		Authorized fishing gear	Authorized landing ports	Bycatch reporting obligation	Catch certification scheme	Catch limit/total allowable catch	Catch record	Discard landing obligation	Essential fish habitat/ vulnerable marine ecosystem protection through a GFCM fisheries restricted area	Finning prohibition	Total fishing ban	Fishing authorizations register and authorized vessel lists	Fishing effort record	Fishing effort restrictions[1] (fishing days and/or fleet capacity)	Fishing gear characteristics[2]	Good practice and species identification guides	Harvest control rule/ fishing mortality target	International inspection scheme	Logbook/vessel monitoring system[3]	Marine recreational fishing[4] ban or limit	Minimum conservation reference size	Precautionary closures	Protection framework	Spatial/temporal restrictions to fisheries (other than fisheries restricted areas)	Transshipment prohibition[5]
Fisheries																									
Blackspot seabream	1–3		45/2022/3	45/2022/3		45/2022/3 47/2024/3	45/2022/3 47/2024/3					45/2022/3	45/2022/3 47/2024/3	45/2022/3 47/2024/3	45/2022/3		45/2022/3		45/2022/3	45/2022/3	*44/2021/2 45/2022/3 46/2023/15			45/2022/3 47/2024/3	45/2022/3
Common dolphinfish	1–27	46/2023/14	46/2023/14			46/2023/14	46/2023/14					46/2023/14	46/2023/14	46/2023/14	46/2023/14		46/2023/14	46/2023/17	33/2009/7 43/2019/3 46/2023/14	46/2023/14	46/2023/14			30/2006/2 46/2023/14	
Deep-water red shrimp	12–16		45/2022/5			45/2022/5	45/2022/5					45/2022/5	45/2022/5	45/2022/5			45/2022/5	45/2022/5 45/2022/15	45/2022/5		46/2023/2			45/2022/5	45/2022/5
	19–21		45/2022/6	45/2022/6		45/2022/6	45/2022/6					45/2022/6	45/2022/6	45/2022/6			45/2022/6	45/2022/6	45/2022/6		46/2023/3			45/2022/6	45/2022/6
	24–27		45/2022/7	45/2022/7		45/2022/7	45/2022/7					45/2022/7	45/2022/7	45/2022/7			45/2022/7		45/2022/7		46/2023/4			45/2022/7	42/2018/3 44/2021/6
Demersal species	9								46/2023/1					46/2023/1						46/2023/1	*44/2021/2				
	12–16		42/2018/5 44/2021/12			45/2022/4	45/2022/4		45/2022/4			45/2022/4	45/2022/4	45/2022/4			45/2022/4	45/2022/4 45/2022/15	45/2022/4	45/2022/4	44/2021/2 45/2022/4			45/2022/4	45/2022/4
	17–18			43/2019/5			43/2019/5		41/2017/3 43/2019/5 44/2021/2 47/2024/6			43/2019/5	43/2019/5 44/2021/1	43/2019/5 44/2021/1 45/2022/8 46/2023/6 47/2024/5			43/2019/5	43/2019/5 46/2023/18	43/2019/5	41/2017/3	43/2019/5 *44/2021/2			43/2019/5 47/2024/5	43/2019/5
European anchovy and sardine	17–18					40/2016/3 44/2021/20 46/2023/5 47/2024/4	37/2013/1 44/2021/20		42/2018/8 44/2021/20			37/2013/1 40/2016/3 42/2018/8 44/2021/20	37/2013/1 44/2021/20	40/2016/3 42/2018/8 44/2021/20			37/2013/1 44/2021/20 47/2024/4	42/2018/1 44/2021/20 46/2023/18	37/2013/1 44/2021/20		37/2013/1 *44/2021/2 46/2023/5			38/2014/1 39/2015/1 40/2016/3 42/2018/8 44/2021/20 47/2024/4	
European eel	1–27	46/2023/16 47/2024/1	46/2023/16			46/2023/16	46/2023/16					46/2023/16	46/2023/16	46/2023/16 47/2024/1						46/2023/16		46/2023/16		46/2023/16 47/2024/1	
Piked dogfish	29		44/2021/9	39/2015/4 44/2021/10			36/2012/3 39/2015/4 42/2018/2	39/2015/4				44/2021/10	44/2021/10		39/2015/4	Available	39/2015/4		44/2021/10		39/2015/4		44/2021/10	36/2012/3 39/2015/4 42/2018/2	44/2021/10
Rapa whelk	29		47/2024/9				47/2024/9					47/2024/9	47/2024/9	47/2024/9					47/2024/9						47/2024/9
Red coral	1–27	43/2019/4	43/2019/4		43/2019/4 46/2023/19	43/2019/4 47/2024/2	43/2019/4 47/2024/2					43/2019/4 47/2024/2	43/2019/4 47/2024/2	47/2024/2							43/2019/4 47/2024/2	43/2019/4		43/2019/4 47/2024/2	43/2019/4
European sprat	29		44/2021/9	44/2021/9			44/2021/9					44/2021/9	44/2021/9						44/2021/9 46/2023/10						
Sturgeons	29			44/2021/5 47/2024/11							47/2024/11				47/2024/11	Available			44/2021/5 47/2024/11	47/2024/11			44/2021/5 46/2023/3 47/2024/11		
Turbot	29	37/2013/2 39/2015/3	39/2015/3 41/2017/4	37/2013/2 43/2019/3 41/2017/4	43/2019/3 44/2021/17 46/2023/20	41/2017/4 43/2019/3 45/2022/9 46/2023/7 47/2024/8	41/2017/4 43/2019/3					41/2017/4 43/2019/3	41/2017/4 43/2019/3	41/2017/4 43/2019/3	37/2013/2 39/2015/3 41/2017/4			41/2017/4 43/2019/3	41/2017/4 43/2019/3		37/2013/2 41/2017/4 43/2019/3 47/2024/8			41/2017/4 43/2019/3	41/2017/4 43/2019/3
Vulnerable species and habitats																									
Cetaceans	1–27 and 29			36/2012/2												Available							36/2012/2		
	29			36/2012/2 43/2019/2 44/2021/15											37/2013/2	Available								44/2021/15	
Monk seal	1–27			35/2011/5																			35/2011/5		35/2011/5
Seabirds	1–27 and 29			35/2011/3												Available							35/2011/3		
Sea turtles	1–27 and 29			35/2011/4												Available							35/2011/4		35/2011/4
Conservation-priority sharks and rays	1–27					44/2021/16										Available							44/2021/16		
	1–27 and 29			36/2012/3 42/2018/2			36/2012/3 42/2018/2			36/2012/3 42/2018/2						Available							36/2012/3 42/2018/3	36/2012/3 42/2018/2	36/2012/3 42/2018/2
Vulnerable marine ecosystems	1–27 and 29			*43/2019/6					29/2005/1							Available									
	18								47/2024/6																
	19								30/2006/3																
	25								30/2006/3																
	26								30/2006/3																

Notes: * indicates GFCM resolutions.[1] Recommendation GFCM/46/2023/12 on the establishment of a regional fishing capacity management plan [2] Recommendation GFCM/22/1997/1 on the limitation of the use of driftnets in the Mediterranean [3] Recommendation GFCM/45/2022/13 on the establishment of a GFCM logbook, amending Recommendation GFCM/35/2011/1 [4] Recommendation GFCM/45/2022/12 on the establishment of a set of minimum rules for sustainable recreational fisheries in the Mediterranean Sea [5] Recommendation GFCM/45/2022/14 on the regulation of transshipment in the GFCM area of application

management plan comprises an initial three-year transitional period (2024–2026) foreseeing the following measures:

- catch limits, set on the basis of either the average of landings of any two years over 2018–2022 or the landings in 2022, at the discretion of the GFCM contracting parties and cooperating non-contracting parties (CPCs);
- a maximum level of FADs per vessel and CPC;
- prohibition of FAD fisheries from 1 January to 14 August of each year;
- fleet capacity set at levels of 2019;
- a set of technical measures (MCRS of 35 cm total length; measures related to FAD composition, location, maintenance and replacement);
- a set of MCS measures (e.g. authorized vessels list, marking of FADs, authorized landing points, vessel monitoring systems for vessels over 15 m length overall, an international joint inspection and surveillance scheme supported by a dedicated recommendation);[22] and
- contracting parties and cooperating non-contracting parties not included in this management plan but intending to engage in common dolphinfish fisheries are expected to submit a management plan for this stock, together with a development plan between the entry into force of the recommendation and the adoption of long-term management measures, to be reviewed by the Scientific Advisory Committee on Fisheries (SAC).

In a second step, the SAC will evaluate the transitional measures and, based on robust stock assessments and optimal harvest control rules (HCRs), propose long-term actions for 2027–2031. The plan is adaptive, with future

[22] Recommendation GFCM/46/2023/17 on an international joint inspection and surveillance scheme for common dolphinfish fisheries outside waters under national jurisdiction in the Mediterranean Sea

Box 15. Network of experts on fisheries and climate change

Climate change is increasingly impacting marine ecosystems in the Mediterranean and the Black Sea, where warming is occurring approximately 20 percent faster than the global average (UNEP/MAP, 2021). This poses challenges to sustainable fisheries by altering species distribution, reducing biodiversity, disrupting ecosystem productivity and increasing the vulnerability of coastal communities and their livelihoods, particularly for small-scale fishers.

With this in mind, the GFCM – guided by its 2030 Strategy for sustainable fisheries and aquaculture in the Mediterranean and Black Sea (GFCM 2030 Strategy; FAO, 2021), the outcomes of a dedicated session at the 2024 Forum on Fisheries Science (FAO, 2024), and the consultative process within the GFCM fisheries advisory framework – established a network of experts on fisheries and climate change to strengthen the scientific basis for climate-informed management advice.

The network operates through a specific working group, with a core team acting as a facilitator, supported by the GFCM Secretariat. Its work flows through the subregional committees to the Scientific Advisory Committee on Fisheries and the Scientific Advisory Committee for the Black Sea (formerly Working Group on the Black Sea), ultimately informing the GFCM decision-making process.

The network supports the implementation of the GFCM 2030 Strategy, particularly Target 1 "Fisheries and ecosystems: healthy seas and productive fisheries" and Output 1.4 "Threats to fisheries and the marine environment, including plastic pollution, climate change and the expansion of non-indigenous species, prevented and mitigated", which promote adaptive approaches to addressing the bidirectional impacts of climate change and fisheries. It brings together scientists, researchers and other professionals with both multidisciplinary and highly focused expertise in climate change and fisheries, including individuals affiliated with academic institutions, international organizations and other expert networks, as well as those nominated by national administrations.

The working group supporting the network provides targeted scientific and technical inputs on fisheries–climate interactions, contributing to climate change mitigation and adaptation, as well as the integration of climate change into fisheries management.

The main areas of work of the working group include:

- contributing to the understanding of climate–fisheries interactions by applying scientific knowledge, sharing operational experience and knowledge, and utilizing relevant tools, datasets, and methodologies;
- supporting the identification of potential adaptation and mitigation options by sharing expert knowledge, lessons learned and best practices across regions and contexts;
- supporting the identification and assessment of potential trade-offs between different proposed adaptation and mitigation options;
- participating actively in relevant GFCM working groups, technical meetings, or other fora as appropriate;

(Continued)

HCRs designed to ensure a less than or equal to 5 percent risk of spawning biomass falling below the limit biomass (B_{lim}), and safeguards defined by the precautionary reference point (B_{PA}) and B_{lim} reference point.

Multiannual management plans transitioned into long-term phases

European eel in the Mediterranean Sea

Recognizing the ongoing critical status of European eel across its distribution range, new long-term measures for European eel fisheries in the Mediterranean were adopted in 2024[23] and are set for review in 2029, based on the 2023–2024 roadmap and discussions held within the 2024 Expert Group on European Eel in the Mediterranean (GFCM, 2024a). These measures include the confirmation of previously set closure period options and a ban on recreational fishing. They are complemented by a regulated two-month glass eel fishery for CPCs under strict conditions (20-year operation record, scientific monitoring, artisanal passive gear, fishing gear freeze at 2024 levels and traceability).

Red coral in the Mediterranean Sea

Following the first phase of the GFCM Research programme on red coral (FAO, forthcoming) and the 2024 Working Group on Red Coral (GFCM, 2024b), long-term measures for Mediterranean red coral fisheries were adopted for 2025–2027.[24] These include maintaining exploitation levels at those of 2015–2017 (or any post-2000 three-year

[23] Recommendation GFCM/47/2024/1 on long-term measures for European eel in the Mediterranean Sea

[24] Recommendation GFCM/47/2024/2 on long-term measures for the sustainable exploitation of red coral, amending Recommendation GFCM/43/2019/4 and repealing Recommendations GFCM/45/2022/2 and GFCM/46/2023/13

Box 15. (Continued)

- supporting coherence with broader GFCM activities by ensuring alignment with workstreams on topics such as non-indigenous species, decarbonization and carbon management, and the operationalization of ecosystem-based management;
- reviewing or contributing to GFCM documents or technical outputs related to climate change and fisheries; and
- following the preparatory processes established within the network to ensure coordinated and fit-for-purpose contributions.

These areas may evolve over time, according to emerging needs.

The first task of the network of experts on fisheries and climate change and its working group foresees supporting the piloting of methodologies to incorporate environmental variables and climatic indices into stock assessment models for European sprat (*Sprattus sprattus*) in the Black Sea, as identified by the Working Group on the Black Sea in 2025 (GFCM, 2025a), in line with Recommendation GFCM/47/2024/7 on management measures for the sustainable exploitation of European sprat in the Black Sea (geographical subarea 29), amending Recommendation GFCM/44/2021/9 and repealing Recommendation GFCM/46/2023/10 (GFCM, 2025b). This should be done in collaboration with the Subregional Group on Stock Assessment for the Black Sea.

The network's flexible and dynamic structure allows for rapid responses to emerging climate-related challenges, fosters cross-disciplinary collaboration, and bridges science and policy at the regional level. It also enhances coherence with broader climate and ocean governance initiatives, including those under FAO, the United Nations Framework Convention on Climate Change and the United Nations Sustainable Development Goals, which recognize the essential role of aquatic food systems in climate adaptation.

The establishment of this network marks a key step towards building climate-resilient fisheries in the region and reinforces the GFCM's commitment to leading a coordinated response as a regional body that links scientific advice with policy, in the face of accelerating environmental change.

Sources:

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period) and fishing authorizations at 2019 levels. Voluntary measures include a ban on harvesting shallower than 60 m, a ten-day closure (between May and September), a 10 mm minimum harvest diameter and enhanced data reporting. The use of remotely operated vehicles is permitted only in the context of the second phase of the GFCM Research programme.

Small pelagic fisheries in the Adriatic Sea

To support the sustainable exploitation of small pelagic stocks in the Adriatic Sea (geographical subareas [GSAs] 17 and 18), a management strategy evaluation (MSE) was conducted in 2024 (Box 16). The MSE identified suitable HCRs to set annual catch limits aligned with long-term objectives of the multiannual management plan. Based on these results, the GFCM adopted a long-term fishing regime, establishing for the first time catch limits for species in 2025.[25]

Revised multiannual management plans

Demersal fisheries in the Adriatic Sea

The overall objective of the multiannual management plan for demersal fisheries in the Adriatic Sea[26] is the management of the fishing effort of operating bottom-towed gear to obtain

[25] Recommendation GFCM/47/2024/4 on a long-term fishing regime and the establishment of catch limits in 2025 for small pelagic stocks in the Adriatic Sea (geographical subareas 17 and 18), stemming from Recommendation GFCM/44/2021/20

[26] Recommendation GFCM/43/2019/5 on a multiannual management plan for sustainable demersal fisheries in the Adriatic Sea (geographical subareas 17 and 18)

Box 16. Management strategy evaluation in the GFCM framework

Management strategy evaluation (MSE) is a cornerstone of modern fisheries management, including within the framework of the GFCM (FAO, 2018, Box 12). In response to the fishing pressure exerted on marine resources and the complexity of balancing ecological, economic and social goals, MSE offers a structured, transparent and scientifically rigorous process for evaluating alternative management strategies before they are put into practice. The process encompasses data collection, analytical assessments and the implementation of harvest control rules (HCRs), all unified into a closed-loop feedback system replicating the GFCM management framework.

The significance of MSE in the GFCM context lies in its ability to foster informed decision-making, quantify trade-offs among competing objectives and ensure that management choices are robust amid uncertainty. Management strategy evaluation simulates thousands of possible futures, each incorporating different types of uncertainty, ranging from recruitment variability to observation errors (e.g. catch and survey data), errors in the assessment model, implementation (advised and actual catch) and environmental uncertainty. Involving a wide range of stakeholders (i.e. fishers, scientists, policymakers, non-governmental organizations and local communities), MSE strengthens transparency and builds trust in the management process. Ultimately, by minimizing surprises and proactively addressing potential risks, MSE guides fisheries management towards sustainability, safeguarding both marine ecosystems and the livelihoods that depend on them.

The case of small pelagic fisheries in the Adriatic Sea

The MSE process in the Adriatic Sea was conducted in the context of implementing the multiannual management plan established under Recommendation GFCM/44/2021/20 on a multiannual management plan for the sustainable exploitation of small pelagic stocks in the Adriatic Sea (geographical subareas 17 and 18) (GFCM, 2025). Its main goal was to test and identify the most appropriate HCRs, to ensure the sustainable exploitation of sardine (*Sardina pilchardus*) and European anchovy (*Engraulis encrasicolus*) in geographical subareas 17 and 18, while considering biological, environmental and socioeconomic factors. The process underpinned the transition to a long-term regime based on stock status and adaptive management. The MSE models were based on previous assessments and simulations, including the stochastic surplus production in continuous time (SPiCT) and stock synthesis models for sardine, as well as the state–space assessment model (SAM) for European anchovy. Various types of HCRs were considered, such as fixed fishing mortality at maximum sustainable yield (F_{MSY}), the biomass below which a stock is considered to have reduced reproductive capacity ($B_{escapement}$) and one based on the example of the Bay of Biscay, aiming to test their effectiveness in a simulated closed management loop.

The selection of the best performing HCRs followed a multistep approach: i) performance evaluation over short-term (2026–2030) and long-term (2031–2050) periods, focusing on average catch, catch stability and biological risk; ii) robustness testing against scenarios

(Continued)

Box 16. (Continued)

of reduced recruitment and changes in natural mortality; iii) refinement and adjustment of HCRs based on robustness test results; and iv) final selection of candidates for implementation.

Out of the 29 tested HCR scenarios for sardine, eight passed the long-term risk tests of biomass falling below limit biomass (B_{lim}) and remaining above the precautionary reference point (B_{PA}). These biomass safety thresholds were set to ensure that selected HCRs were in line with the objectives of the multiannual management plan to provide high long-term yields and guarantee a low risk of stock collapse. Scenarios that passed the biomass safety thresholds were further evaluated for their performance – assessments of fishing mortality rates and biomass relative to maximum sustainable yield (B_{MSY}), long-term average catch and interannual variability of available catch – and for their robustness against low recruitment regimes, increased natural mortality (e.g. from bluefin tuna [*Thunnus thynnus*] predation) and low environmental productivity. All scenarios demonstrated satisfactory results, and based on the observed stability of catch advice, low interannual variability, acceptable risk profile and stakeholder preferences for stability, the final selection for sardine was an HCR with thresholds at B_{lim}, B_{PA} and 1.1 B_{MSY} and catch limits between 20 000 tonnes and 50 000 tonnes.

For European anchovy, out of the initial 23 scenarios, only one Bay of Biscay-type HCR passed the same robustness tests as in the case of sardine, confirming the results from the MSE process performed in 2021. Additional adjusted scenarios were tested, but none significantly outperformed the first. Two scenarios came close to passing the tests and were considered secondary candidates. The final selected HCR for European anchovy had thresholds at B_{lim} (16 200 tonnes) and B_{PA} (21 400 tonnes) and a maximum and minimum catch of 35 000 and 15 000 tonnes, respectively.

Based on this work, the GFCM adopted Recommendation GFCM/47/2024/4 on a long-term fishing regime and the establishment of catch limits in 2025 for small pelagic stocks in the Adriatic Sea (geographical subareas 17 and 18), stemming from Recommendation GFCM/44/2021/20, setting individual catch limits for sardine and European anchovy for 2025 (GFCM, 2025).

This step marked the first-ever implementation of fisheries management based on HCRs that were direct outputs of an MSE process in the GFCM area of application and provided a basis for setting the species' annual catch limit.

Future developments

Given the numerous GFCM recommendations requiring MSE, and recognizing its value in supporting informed decisions by integrating multiple factors (e.g. stakeholder inputs, climate drivers and socioeconomic impacts), the forty-eighth session of the GFCM endorsed a concept to streamline MSE processes on a case-by-case approach based on available data and assessments, using one of three methods: i) GFCM HCR – the use of a standard (predefined) GFCM advice rule in the form of an HCR; ii) MSE-lite – the use of a short-cut MSE-lite framework to identify and test the most appropriate HCR; and iii) full feedback loop MSE – including refitting the assessment model within a complete feedback control loop.

The MSE-lite framework was implemented in 2025 for blackspot seabream (*Pagellus bogaraveo*) stocks in the Alboran Sea, in line with Recommendation GFCM/45/2022/3 on a multiannual management plan for the sustainable exploitation of blackspot seabream in the Alboran Sea (geographical subareas 1 to 3), repealing Recommendations GFCM/44/2021/4, GFCM/43/2019/2 and GFCM/41/2017/2 (GFCM, 2025). This method enabled the dynamic simulation of management procedures through robustness testing, guiding the selection of nine candidate HCRs, ranging from moderate catch limits to near-closure scenarios. Clear rebuilding milestones were set for 2030, 2035 and 2045, balancing short-term sacrifices with long-term sustainability through performance metrics and technical measures. These results provided the essential information needed to make informed management decisions for stock recovery.

This streamlined approach has the potential to accelerate the implementation of MSE within the GFCM and improve the effectiveness of the management measures that are being implemented across the region. Nevertheless, MSE will always be resource-intensive and require adequate knowledge, and it will need to be accompanied by further development of the current framework to engage stakeholders and ensure buy-in.

Note: An HCR is a pre-agreed decision rule that determines how fishing opportunities (e.g. catch limits or fishing mortality) are adjusted based on the status of the fish stock.

Sources:

FAO. 2018. *The State of Mediterranean and Black Sea Fisheries 2018*. General Fisheries Commission for the Mediterranean. Rome. https://openknowledge.fao.org/handle/20.500.14283/ca2702en
GFCM. 2025. *Compendium of GFCM decisions*. Rome. https://fao.org/gfcm/decisions

a linear reduction in fishing mortality able to achieve MSY (F_{MSY}) in 2026 for all key species – otter trawl for red mullet (*Mullus barbatus*), European hake (*Merluccius merluccius*), deep-water rose shrimp (*Parapenaeus longirostris*) and Norway lobster (*Nephrops norvegicus*); and beam trawl for common sole (*Solea solea*). Accordingly, based on the status of the stocks of each species, the GFCM adopted in 2024 a recommendation setting a reduced fishing effort allocation by fleet segment for 2025, while strengthening the spatial regulation tailored for protection of Norway lobster.[27]

Blackspot seabream in the Alboran Sea

Despite measures in place under the 2022 multiannual management plan,[28] the blackspot seabream stock in the Alboran Sea continued to decline, reaching a record low in 2023. In response, the GFCM adopted additional remedial measures in 2024,[29] introducing a 30 percent catch limit reduction for 2025, initiating an MSE to identify suitable HCRs and enforcing fleet-level closures for at least two months, between January and March, to protect spawning.

Turbot in the Black Sea

To support the continued recovery of the turbot stock in the Black Sea, the GFCM amended its multiannual management plan in 2024[30] by setting a new, slightly increased, total allowable catch for 2025–2028, reaffirming the 45 cm MCRS and establishing a working group to refine technical measures – particularly regarding juvenile catch and cetacean incidental catch – based on findings from the CetaByM pilot project (FAO, 2023d).

Newly established management measures

Rapa whelk in the Black Sea

Rapa whelk is a large predatory sea snail fished in the Black Sea by means of beam trawls and divers. It is a non-indigenous species (NIS) that has been exploited since 1949 and is now scientifically considered as overexploited and in overexploitation. Based on the outcomes of a GFCM research programme, the GFCM adopted in 2024 transitional management measures for this fishery,[31] including fleet capacity and effort limits, authorized vessel lists, reporting mechanisms, designated landing points, and geopositioning tracking systems for vessels over 12 m in length overall, as well as provisions to continue the research programme.

Sturgeons in the Black Sea

The status of several species of sturgeon (Acipenseridae) present in the Black Sea is critical, and their peculiar anadromous life cycle significantly complicates their management. Based on dedicated work performed under a pilot project and on the discussions of the Working Group on the Black Sea, the GFCM adopted a recommendation establishing measures for these endangered species.[32] This decision permanently bans fishing (targeted and not) of sturgeons in Black Sea marine waters and requests the implementation of legislation and mitigation measures to minimize and eliminate their incidental catch. These measures are complemented by appropriate actions for the effective and safe onboard handling and release of sturgeon bycatch to fully ensure the survivability of bycaught individuals, the collection and reporting of relevant information, and the engagement of stakeholders through awareness-raising campaigns.

Minimum conservation reference size

Minimum conservation reference size is used in fisheries management to regulate the smallest size that can be legally retained or landed, ensuring that individuals of a species are able to reproduce before being caught. This measure is useful in combination with other management measures that regulate

[27] Recommendation GFCM/47/2024/5 on the implementation of a fishing effort regime for key demersal stocks in the Adriatic Sea (geographical subareas 17 and 18) in 2025, stemming from Recommendation GFCM/43/2019/5

[28] Recommendation GFCM/45/2022/3 on a multiannual management plan for the sustainable exploitation of blackspot seabream in the Alboran Sea (geographical subareas 1 to 3), repealing Recommendations GFCM/44/2021/4, GFCM/43/2019/2 and GFCM/41/2017/2

[29] Recommendation GFCM/47/2024/3 on the adoption of additional remedial measures for blackspot seabream in the Alboran Sea (geographical subareas 1–3), amending Recommendation GFCM/45/2022/3

[30] Recommendation GFCM/47/2024/8 on a multiannual management plan for turbot fisheries in the Black Sea (geographical subarea 29), amending Recommendations GFCM/43/2019/3 and GFCM/41/2017/4

[31] Recommendation GFCM/47/2024/9 on management measures for the sustainable exploitation of rapa whelk in the Black Sea (geographical subarea 29)

[32] Recommendation GFCM/47/2024/11 establishing measures on sturgeons (Acipenseridae) in the Black Sea (geographical subarea 29)

the capture of young specimens, e.g. mesh size and the protection of nursery areas. In 2023, to further support existing multiannual management plans, the GFCM adopted four recommendations setting MCRS for three species, as follows:

- blackspot seabream in the Alboran Sea:[33] 30 cm total length from 1 January 2024, until a size of 33 cm is adopted by CPCs; and
- blue and red shrimp (*Aristeus antennatus*) and giant red shrimp (*Aristaeomorpha foliacea*) in the Strait of Sicily,[34] the Ionian Sea[35] and the Levant Sea:[36] 25 mm carapace length, with a tolerance of 5 percent by weight.

The step-wise structure of the management plans, with an initial transitional phase and the identification of long-term measures supported by rigorous science, ensure the flexibility needed for minimizing socioeconomic impacts while addressing the evolution of stock status and potentially accounting for constant changes in the marine environment. Together, these developments underscore the GFCM's commitment to an adaptive, science-based and ecosystem-oriented management framework, marking a significant step forward in ensuring the long-term sustainability of fisheries in the region, consistent with Target 1 of the GFCM 2030 Strategy.

SPATIAL MANAGEMENT MEASURES

The Agreement under the United Nations Convention on the Law of the Sea on the Conservation and Sustainable Use of Marine Biological Diversity of Areas beyond National Jurisdiction defines an area-based management tool (ABMT) as "a tool, including a marine protected area, for a geographically defined area through which one or several sectors or activities are managed with the aim of achieving particular conservation and sustainable use objectives in accordance with this Agreement" (United Nations, 2024). Area-based management tools involve a system of rights and responsibilities that are overseen by a designated authority (United Nations General Assembly, 2007) and provide a high level of protection to the area in question. They can range from sector-specific spatial instruments (e.g. targeting individual activities, such as fisheries) to integrated, cross-sectoral approaches that address multiple uses, such as marine protected areas and marine spatial planning (Muraki Gottlieb *et al.*, 2018).

The GFCM has used ABMTs in support of fisheries management since 2005, when the first FRA was established. A FRA can be established to enhance the productivity of marine living resources (i.e. essential fish habitats [EFHs]) and/or to protect marine ecosystems and sensitive habitats (vulnerable marine ecosystems [VME]) from potentially significant adverse impacts, including in the deep sea (FAO, 2009). From 2005 to 2024, 11 FRAs have been established by the GFCM – five protect mainly EFHs, four mainly VMEs and two address both issues equally (Figure 85 and Table 11). In addition, coastal measures, including a year-round trawl ban in areas shallower than 50 m across the entire GFCM area of application are in place (Table 12). Details of the first ten FRAs established are provided in the previous editions of *The State of Mediterranean and Black Sea Fisheries* (FAO, 2016, 2018, 2020, 2022c, 2023c), while this section highlights the recent advances, in line with Target 1 (Output 1.3) of the GFCM 2030 Strategy. It summarizes recent decisions made on FRAs, updates information on the main scientific tool to identify and advise on potential FRAs and details the minimum standards to ensure an efficient scientific monitoring of FRAs.

Recent GFCM decisions on spatial management

Otranto Channel fisheries restricted area

The process to establish the Otranto Channel FRA in the southern Adriatic Sea (GSA 18) began in 2018 with a technical proposal put forth by the non-governmental organization MedReact. This proposal was followed by the adoption and implementation by concerned GFCM contracting

[33] Recommendation GFCM/46/2023/15 on the revision of the minimum conservation reference size for blackspot seabream in the Alboran Sea (geographical subareas 1 to 3), amending Recommendation GFCM/45/2022/3

[34] Recommendation GFCM/46/2023/2 on the definition of a minimum conservation reference size for giant red shrimp and blue and red shrimp in the Strait of Sicily (geographical subareas 12 to 16)

[35] Recommendation GFCM/46/2023/3 on the definition of a minimum conservation reference size for giant red shrimp and blue and red shrimp in the Ionian Sea (geographical subareas 19 to 21)

[36] Recommendation GFCM/46/2023/4 on the definition of a minimum conservation reference size for giant red shrimp and blue and red shrimp in the Levant Sea (geographical subareas 24 to 27)

FIGURE 85. GFCM fisheries restricted areas

Note: Refer to the disclaimer on page ii for the names and boundaries used in this map.
Source: Base map redrawn from United Nations. 2024. United Nations Geospatial Clear Map. In: *United Nations*. New York, USA. [Cited 23 October 2025]. https://geoservices.un.org/Html5Viewer/index.html?viewer=clearmap

parties of a pilot study on bamboo coral in 2021[37] to address identified knowledge gaps in the initial FRA proposal. Based on the results of the pilot study, the FRA was formally adopted in 2024.[38] Its surface area covers 2 702 km^2 and addresses both EFHs for commercial crustacean species (e.g. deep-water red shrimp species) and VMEs formed by bamboo coral (*Isidella elongata*). According to the minimum standards for FRAs established by Recommendation GFCM/45/2022/11,[39] the Otranto Channel FRA foresees the full package of measures required to ensure its effectiveness and comprises two distinct areas (Figure 86):

- Zone A – a core area where any professional demersal fishing activity or recreational demersal fishing activity is prohibited; and
- Zone B – a buffer area where fishing activities with bottom-set nets, bottom trawls, set longlines and traps are prohibited for a two-month period between September and November each year, starting from 2025, unless the vessel and/or its captain are in possession of a specific authorization and historical fishing activities in Zone B are demonstrated.

An important aspect of the work to establish the FRA was the consolidation of a network of key stakeholders, including scientific experts and representatives of national administrations from the CPCs involved and of the fishing industry, who joined forces in collecting, providing and analysing the required information, resulting in buy-in from all (see Box 14). The Otranto Channel FRA illustrates a balanced approach that supports both marine conservation and sustainable fisheries.

Other decisions

Over the past two years, three key decisions have further advanced the identification and management of FRAs. A resolution launched pilot projects to assess the feasibility of extending the deep-water trawling ban from depths over 1 000 m to over 800 m,[40] with preliminary results

[37] Resolution GFCM/44/2021/3 on a roadmap for the establishment of a fisheries restricted area in the southern Adriatic Sea (geographical subarea 18)

[38] Recommendation GFCM/47/2024/6 on the establishment of a fisheries restricted area in the Otranto Channel (geographical subarea 18), stemming from Recommendation GFCM/43/2019/5 and Resolution GFCM/44/2021/3

[39] Recommendation GFCM/45/2022/11 on the establishment of a set of minimum standards for fisheries restricted areas in the GFCM area of application

[40] Resolution GFCM/46/2023/1 on the launch of pilot projects for the revision of the deep-water fisheries restricted area in the Mediterranean Sea towards the adoption of adequate protection and management measures

TABLE 11. GFCM fisheries restricted areas established from 2005 to 2024

No	GFCM fisheries restricted area	Year of establishment	Geographical subarea	Surface area (km²)	Depth range (m)	Type of restriction	Main conservation objective	Main demersal stocks	Main vulnerable marine ecosystem indicators	Fishing gear and/or fleet	Authorized vessel list
1	Deep-water FRA (> 1 000 m)	2005[i]	Multiple	1 731 094 (total); 1 462 045 (Mediterranean Sea only)	1 000–5 200	Year-round closure	Protect fish stocks and deep-sea habitats (VMEs and EFHs)	Deep-sea bottom dwelling species, in particular the crustaceans *Aristaeomorpha foliacea*, *Aristeus antennatus* and *Plesionika* spp.	All potential VMEs occurring below 1 000 m	Towed dredges and trawl nets	No: FRA recommendation does not foresee an AVL; all CPCs are responsible for ensuring that fishing does not occur in the relevant area
2	Lophelia reef off Capo Santa Maria di Leuca	2006[ii]	19	977	750–2 500	Year-round closure	Protect VMEs		*Lophelia pertusa* and other deep-sea corals	Towed dredges and bottom trawl nets	No: FRA recommendation does not foresee an AVL; all CPCs are responsible for ensuring that fishing does not occur in the relevant area
3	Nile Delta area cold hydrocarbon seeps	2006[ii]	26	4 374	50–1 100	Year-round closure	Protect VMEs		Species associated with hydrocarbon seeps (chemosynthetic organisms such as polychaetes and bivalves)	Towed dredges and bottom trawl nets	No: FRA recommendation does not foresee an AVL; all CPCs are responsible for ensuring that fishing does not occur in the relevant area
4	Eratosthenes Seamount	2006[ii]	25	10 298	760–2 750	Year-round closure	Protect VMEs		*Caryophyllia calveri*, *Desmophyllum cristagalli*, *Hamacantha implicans* and *Kadophellia bathyalis*	Towed dredges and bottom trawl nets	No: FRA recommendation does not foresee an AVL; all CPCs are responsible for ensuring that fishing does not occur in the relevant area
5	Gulf of Lion	2009[iii]	7	2 016	100–1 690	Year-round (Zone A) and seasonal closures (Zone B)	Protect important EFHs of demersal stocks	*Merluccius merluccius*, *Nephrops norvegicus*, *Lophius piscatorius*, and others	Possible existence of rare deep-water corals (e.g. *Lophelia pertusa* and *Madrepora oculata*)	Towed nets, bottom and mid-water longlines, bottom-set nets	Yes: France, Spain
6	East of Adventure Bank	2016[iv]	16	614	50–290	Year-round closure with a 1-nautical mile buffer area	Protect important EFHs of demersal stocks	*Merluccius merluccius*, *Parapenaeus longirostris* and others	*Isidella elongata*, *Funiculina quadrangolaris*, *Cladopsammia rolandi*, *Lophelia pertusa*, *Madrepora oculata* and *Dendrophyllia cornigera*	Demersal fishing, including recreational fisheries	Yes: Italy, Malta, Tunisia

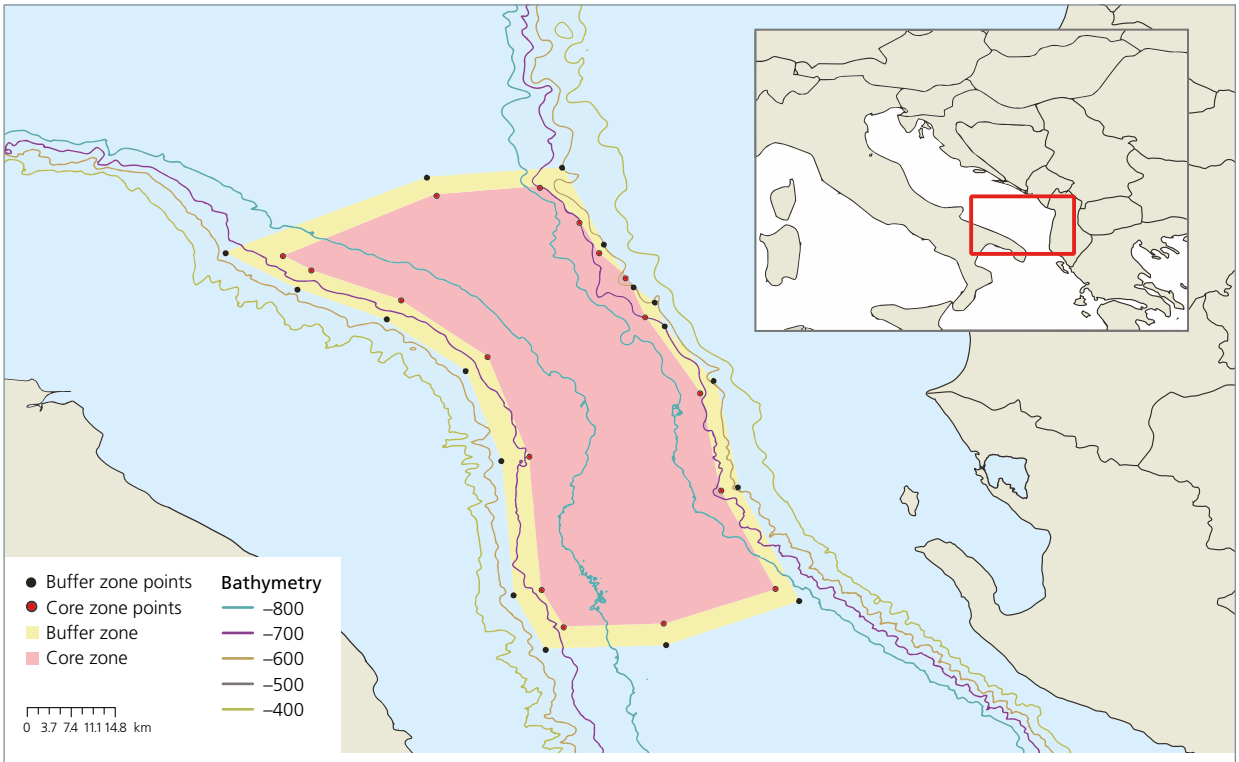
(Continued)

TABLE 11. (Continued)

No	GFCM fisheries restricted area	Year of establishment	Geographical subarea	Surface area (km²)	Depth range (m)	Type of restriction	Main conservation objective	Main demersal stocks	Main vulnerable marine ecosystem indicators	Fishing gear and/or fleet	Authorized vessel list
7	West of Gela Basin	2016[iv]	16	618	10–740	Year-round closure with a 1-nautical mile buffer area	Protect important EFHs of demersal stocks	*Merluccius merluccius*, *Parapenaeus longirsotris* and others	*Isidella elongata*, *Funiculina quadrangolaris*, *Cladopsammia rolandi*, *Lophelia pertusa*, *Madrepora oculata* and *Dendrophyllia cornigera*	Demersal fishing, including recreational fisheries	Yes: Italy, Malta, Tunisia
8	East of Malta Bank	2016[iv]	15, 19	468	50–1 490	Year-round closure with a 1-nautical mile buffer area	Protect important EFHs of demersal stocks	*Merluccius merluccius*, *Parapenaeus longirsotris* and others	*Isidella elongata*, *Funiculina quadrangolaris*, *Cladopsammia rolandi*, *Lophelia pertusa*, *Madrepora oculata* and *Dendrophyllia cornigera*	Demersal fishing, including recreational fisheries	Yes: Italy, Malta, Tunisia
9	Jabuka/Pomo Pit	2019[v]	17	3 140	200–300	Year-round (Zone A) and seasonal closures (Zone B and Zone C)	Protect important EFHs of demersal stocks and small pelagic stocks	*Merluccius merluccius*, *Nephrops norvegicus*, *Lophius* spp. and others	*Funiculina quandrangularis* and others	All types of fisheries, including recreational fisheries	Yes: Croatia, Italy
10	Bari Canyon	2021[vi]	18	627		Year-round (Zone A) and seasonal closures (Zone B)	Protect VMEs	*Merluccius merluccius*, *Conger conger* and *Pagellus bogaraveo*	*Madrepora oculata*, *Lophelia pertusa*, *Dendrophyllia cornigera* and *Pachastrella monilifera*	All types of fisheries, including recreational fisheries	Yes: Italy
11	Otranto Channel	2024[vii]	18	2 702		Year-round (Zone A) and seasonal closures (Zone B)	Protect VMEs and EFHs	Deep-sea bottom-dwelling species, in particular the crustaceans *Aristaeomorpha foliacea*, *Aristeus antennatus* and *Plesionika* spp.	*Isidella elongata*	Demersal fishing, including recreational fisheries	Yes: Albania, Italy

Notes:
FRA = fisheries restricted area; VME = vulnerable marine ecosystem; EFH = essential fish habitat; AVL = authorized vessel list; CPCs = contracting parties and cooperating non-contracting parties.
Blue = protection of essential fish habitats; green = protection of vulnerable marine ecosystems; orange = protection of vulnerable marine ecosystems and essential fish habitats.
[i] Recommendation GFCM/29/2005/1 on the management of certain fisheries exploiting demersal and deep-water species and the establishment of a fisheries restricted area below 1 000 m
[ii] Recommendation GFCM/30/2006/3 on the establishment of fisheries restricted areas in order to protect the deep-sea sensitive habitats
[iii] Recommendation GFCM/46/2023/1 on the establishment of a fisheries restricted area in the Gulf of Lion (geographical subarea 7) to protect spawning aggregations and deep-sea sensitive habitats, repealing Recommendation GFCM/44/2021/5
[iv] Recommendation GFCM/45/2022/4 on a multiannual management plan for the sustainable exploitation of demersal stocks in the Strait of Sicily (geographical subareas 12 to 16), repealing Recommendations GFCM/44/2021/12 and GFCM/42/2018/5
[v] Recommendation GFCM/44/2021/2 on the establishment of a fisheries restricted area in the Jabuka/Pomo Pit in the Adriatic Sea (geographical subarea 17), amending Recommendation GFCM/41/2017/3
[vi] Recommendation GFCM/44/2021/3 on the establishment of a fisheries restricted area in the Bari Canyon in the southern Adriatic Sea (geographical subarea 18)
[vii] Recommendation GFCM/47/2024/6 on the establishment of a fisheries restricted area in the Otranto Channel (geographical subarea 18), stemming from Recommendation GFCM/43/2019/5 and Resolution GFCM/44/2021/3

FIGURE 86. Otranto Channel fisheries restricted area (geographical subarea 18, southern Adriatic Sea)



Note: Refer to the disclaimer on page ii for the names and boundaries used in this map.

Source: Base map redrawn from United Nations. 2024. United Nations Geospatial Clear Map. In: *United Nations*. New York, USA. [Cited 23 October 2025]. https://geoservices.un.org/Html5Viewer/index.html?viewer=clearmap

reviewed by the SAC in 2025 and final discussions expected in 2026. In the Alboran Sea, national measures were introduced to protect deep-sea VMEs and EFHs in the Cabliers coral mound province, while a GFCM resolution updated the roadmap for the establishment of a FRA.[41] Additionally, a roadmap[42] was adopted for a joint project to collect scientific evidence to establish long-term measures under the multiannual management plan for demersal fisheries in the Strait of Sicily, including confirming potential nursery areas of European hake in the southern portion of the Strait of Sicily.

GFCM data repositories

To continue supporting science-based fisheries management and biodiversity conservation, the GFCM enhanced its database on sensitive benthic habitats and species (FAO, 2022c, Box 22). The database now includes nearly 30 000 quality-controlled records of VME indicators and is recognized as a crucial tool supporting scientific work towards the identification of priorities for spatial protection in the Mediterranean Sea.

Minimum standards for fisheries restricted areas and scientific monitoring

To strengthen FRAs as tools for sustainable fisheries and biodiversity conservation, the GFCM adopted minimum standards in 2022,[43] based on a FRA toolkit (FAO, 2022c). These standards aim to harmonize management across subregions, improve monitoring and compliance, and enhance the coherence and effectiveness of the FRA network. Among other provisions, minimum standards ensure that all FRAs are managed through zoned protection (permanent and temporary) and robust MCS measures (e.g. authorized vessel lists, vessel tracking, fishing gear marking and reporting of infractions), and that they are linked, to the extent

[41] Resolution GFCM/47/2024/2 on a roadmap for the implementation of a fisheries restricted area in the Cabliers coral mounds in the Alboran Sea, amending Resolution GFCM/46/2023/2

[42] Resolution GFCM/47/2024/1 on a roadmap for a joint project to collect all required and identified scientific evidence to provide a basis for the discussion of potential additional measures for the long-term portion of the management plan for demersal fisheries in the Strait of Sicily, in response to Recommendation GFCM/45/2022/4

[43] Recommendation GFCM/45/2022/11 on the establishment of a set of minimum standards for fisheries restricted areas in the GFCM area of application

TABLE 12. Additional coastal fishing restrictions established at the GFCM level

Number	Name	Year of establishment	Geographical subarea	Type of restriction	Main conservation objective	Fishing gear/fleet
1	Coastal trawl ban (< 50 m)	2012[i]	Multiple	Year-round closure	Conserve sharks, rays and coastal habitats	Trawl nets
2	Gulf of Gabès (0–200 m)	2016[ii]	14	Temporal closure	Protect important essential fish habitats of demersal stocks	Trawl nets

[i] Recommendation GFCM/42/2018/2 on fisheries management measures for the conservation of sharks and rays in the GFCM area of application, amending Recommendation GFCM/36/2012/3
[ii] Recommendation GFCM/45/2022/4 on a multiannual management plan for the sustainable exploitation of demersal stocks in the Strait of Sicily (geographical subareas 12 to 16), repealing Recommendations GFCM/44/2021/12 and GFCM/42/2018/5

possible, to multiannual management plans and associated with scientific monitoring (including catch and activity data), with a view to improving compliance and conservation outcomes. Effective FRA monitoring relies on tailored scientific plans that are based on standardized protocols for VME and EFH areas (FAO, 2022c). Scientific monitoring plans are currently being reviewed by the SAC, but scientific evidence has, in some cases, already been collected to support the effectiveness of some FRAs towards their conservation objectives and showcase the overall potential of fisheries management measures to mainstream biodiversity (Box 17).[44]

The GFCM's use of ABMTs, particularly FRAs, demonstrates a strong commitment to integrating biodiversity conservation into fisheries management. Through scientifically grounded planning, stakeholder engagement, and robust monitoring and control measures, FRAs contribute directly to the protection of VMEs and EFHs. These efforts align with global biodiversity goals such as the 30×30 target set by the Kunming-Montreal Global Biodiversity Framework under the Convention on Biological Diversity (Box 17) and support the achievement of United Nations Sustainable Development Goal 14 "Life under water" by promoting the sustainable use of ocean resources and enhancing marine ecosystem resilience. Aligned with Target 1 of the GFCM 2030 Strategy, the GFCM's evolving FRA network exemplifies how regional fisheries management organizations can play a pivotal role in mainstreaming biodiversity and advancing ocean sustainability.

[44] Mainstreaming biodiversity refers to the process of integrating biodiversity considerations into policies, strategies, and practices across sectors – in this case fisheries – so that biodiversity conservation and sustainable use, together, become part of decision-making.

SMALL-SCALE FISHERIES MANAGEMENT

Small-scale fisheries in the Mediterranean and Black Sea region are highly diverse and of considerable socioeconomic importance, supporting a large share of fisheries-based livelihoods (see Chapter 5). The GFCM 2030 Strategy recognizes that the full implementation of the RPOA-SSF, in particular the engagement of fishers in participatory management processes, is crucial to achieving its Target 4. However, the complexity and scope of SSF often result in underrepresentation in the management advisory process, including in data collection, decision-making and stakeholder engagement. To better address the biological, ecological and socioeconomic dimensions of SSF, the GFCM endorsed in 2023 a two-pronged approach to SSF management. This approach promotes, on the one hand, enhanced data collection towards the integration of SSF effort and catches into stock assessments of key species, and on the other hand, participatory ecosystem-based management involving fishers and other stakeholders in science-informed decision-making to improve the ownership and effectiveness of management measures.

The two-pronged approach marked a strategic shift towards a more holistic and participatory framework for fisheries management that includes SSF, directly supporting Target 4 of the GFCM 2030 Strategy and the implementation of the RPOA-SSF. As 2024 marked the mid-term point of the RPOA-SSF implementation, the GFCM revised the monitoring framework used for tracking its progress and streamlined indicators to align them with the two-pronged approach.

Since the endorsement of the two-pronged approach to SSF management, the GFCM has

Box 17. GFCM fisheries restricted areas towards mainstreaming biodiversity

The recent Kunming-Montreal Global Biodiversity Framework under the Convention of Biological Diversity (CBD) sets a target to protect 30 percent of the planet by 2030, also called the 30×30 target. This target can be met either by increasing the number of protected areas or by recognizing that already existing spatial management measures may also contribute to biodiversity and ecosystem conservation through other effective area-based conservation measures (OECMs). An OECM is "a geographically defined area other than a protected area, which is governed and managed in ways that achieve positive and sustained long-term outcomes for the *in situ* conservation of biodiversity, with associated ecosystem functions and services and where applicable, cultural, spiritual, socioeconomic, and other locally relevant values" (CBD, 2018). Thus, while marine protected areas are more widely known spatial tools used to protect coastal and marine areas and preserve marine biodiversity and ecosystems, OECMs provide an opportunity for fisheries area-based management tools – such as GFCM-managed fisheries restricted areas (FRAs) – to contribute to preserving marine biodiversity and address global biodiversity targets through sustainable fisheries management. They create an essential connection between biodiversity and livelihoods, food security and the health of ecosystems that sustain human well-being (FAO, 2022, 2023).

Unlike other regional fisheries management organizations, such as the North-East Atlantic Fisheries Commission, the GFCM has not reported any of its FRAs to the CBD as OECMs. Nonetheless, this box outlines how some GFCM-managed FRAs effectively meet the first four CBD criteria for OECMs (CBD, 2018), demonstrating their potential to contribute to biodiversity conservation and restoration (see table).

Criterion A: Area is not currently recognized as a protected area

Ten out of the 11 GFCM-established FRAs do not overlap with existing protected areas; the exception is the GFCM deep-water FRA (1 000 m).

Criterion B: Area is governed and managed

The GFCM-managed FRAs are all geographically defined spaces with clear, legitimate governance and management frameworks under the GFCM. They are established by adopted GFCM recommendations that set their boundaries, outline management measures and define their applicability. They are all found in parts of the GFCM area of application where active management is consistent with the ecosystem approach to fisheries. Fisheries restricted areas form an integral part of sustainable fisheries management strategies in the Mediterranean under the umbrella of the GFCM. They are adopted either as part of multiannual management plans (e.g. FRAs in the Strait of Sicily that are integrated into multiannual management plans for demersal fisheries) or complement them. Recommendation GFCM/45/2022/11 on the establishment of a set of minimum standards for fisheries restricted areas in the GFCM area of application establishes processes to evaluate the effectiveness of FRA governance and management (GFCM, 2025). Its main elements are organized under five main areas (legal; fisheries management; authorized fishing vessels; monitoring, control and surveillance; and compliance and enforcement), setting in motion a process that, once fully consolidated, will allow for a swift appraisal of strengths and weaknesses in compliance – as exemplified in the following table.

Additionally, the FRA proposal process places strong emphasis on the active engagement of stakeholders, creating a system that can be sustained over the long term and ensures buy-in from all those involved.

Criterion C: Area achieves sustained and effective contributions to *in situ* conservation of biodiversity

The main aim of FRAs is to manage fisheries, so that in turn, effective management delivers positive biodiversity results, including by preventing any negative adverse impact on important benthic ecosystems (i.e. vulnerable marine ecosystems [VMEs]). All FRAs, in particular those most recently established, are established based on a proposal that summarizes all available information on the area protected. Among the information required are the exact geographical location, a site description (physical and biological features, as well as fisheries information), the regional importance of the site, a description of activities and impacts inside and outside the site, and a description of the proposed management and its objectives. In terms of biodiversity, information is provided on the flora and fauna present in the area, allowing for the identification of the full range of biodiversity attributes and features for which the site is considered important (see table). This process, in turn, enables determining the benefits of managing fisheries in a way that achieves, or is expected to achieve, positive and sustained outcomes for the *in situ* conservation of biodiversity. This latter concept is exemplified in different ways by several FRAs, as follows:

- Deep-water FRA: the *in situ* conservation benefits are implicit – i.e. banning bottom trawling at

(Continued)

Box 17. (Continued)

depths beyond 1 000 m is bound to have positive outcomes for deep-sea biodiversity.

- Otranto Channel: the *in situ* conservation benefits are explicit – to support the adoption of the FRA, ad hoc sampling with a remotely operated vehicle confirmed the previously reported presence of bamboo coral (*Isidella elongata*) gardens in the area.
- Fisheries restricted areas established to enhance the productivity of essential fish habitats, such as the Jabuka/Pomo Pit: the fishery closure triggers a series of positive effects, which allow many demersal stocks to recover, resulting in a generalized increase in abundance of commercial and non-commercial fish species. The Jabuka/Pomo Pit area has long been recognized as the most important spawning and nursery ground in the Adriatic subregion for several overexploited demersal stocks, including European hake (*Merluccius merluccius*) and Norway lobster (*Nephrops norvegicus*), providing critical ecosystem functions and services (see figure) and comprising an area of importance for ecological connectivity. Concurrently, it supports VME indicator species (e.g. *Funiculina quadrangularis*) and communities of deep-sea sharks.

Restoring biodiversity can take decades, even after pressures disappear, which requires long-term management to ensure lasting benefits and continued recovery. Indeed, FRAs are all

Properties, biodiversity attributes and features of four GFCM fisheries restricted areas, showcasing their suitability as other effective area-based conservation measures

Compliance and enforcement: reported inspections and infringements				
Fisheries restricted area	Total number of inspections at sea in 2024	Percentage of inspections documenting infringements at sea in 2024	Total number of inspections at port in 2024	Percentage of inspections documenting infringements at port in 2024
Bari Canyon	697	0.00	1 565	0.19
East of Adventure Bank	474	0.00	4 043	0.02
Gulf of Lion	439	11.62	346	8.09
Jabuka/Pomo Pit	1 123	1.07	3 897	0.38

Selected monitoring, control and surveillance measures				
Fisheries restricted area	Percentage of inspections confirming updated authorized vessel list	Percentage of inspections confirming regulatory frameworks in line with GFCM decisions	Percentage of inspections confirming geolocation system on board	Percentage of inspections confirming fishing gear marking
Bari Canyon	100	100	100	100
East of Adventure Bank	100	100	100	100
Gulf of Lion	100	100	100	100
Jabuka/Pomo Pit	100	100	100	100

Selected biodiversity attributes and features				
Fisheries restricted area	High productivity and support for the wider food web	Rare or endemic species	Noteworthy ecological processes	Intactness/habitat integrity
Bari Canyon		✓	✓	✓
East of Adventure Bank	✓		✓	
Gulf of Lion	✓		✓	
Jabuka/Pomo Pit	✓	✓	✓	

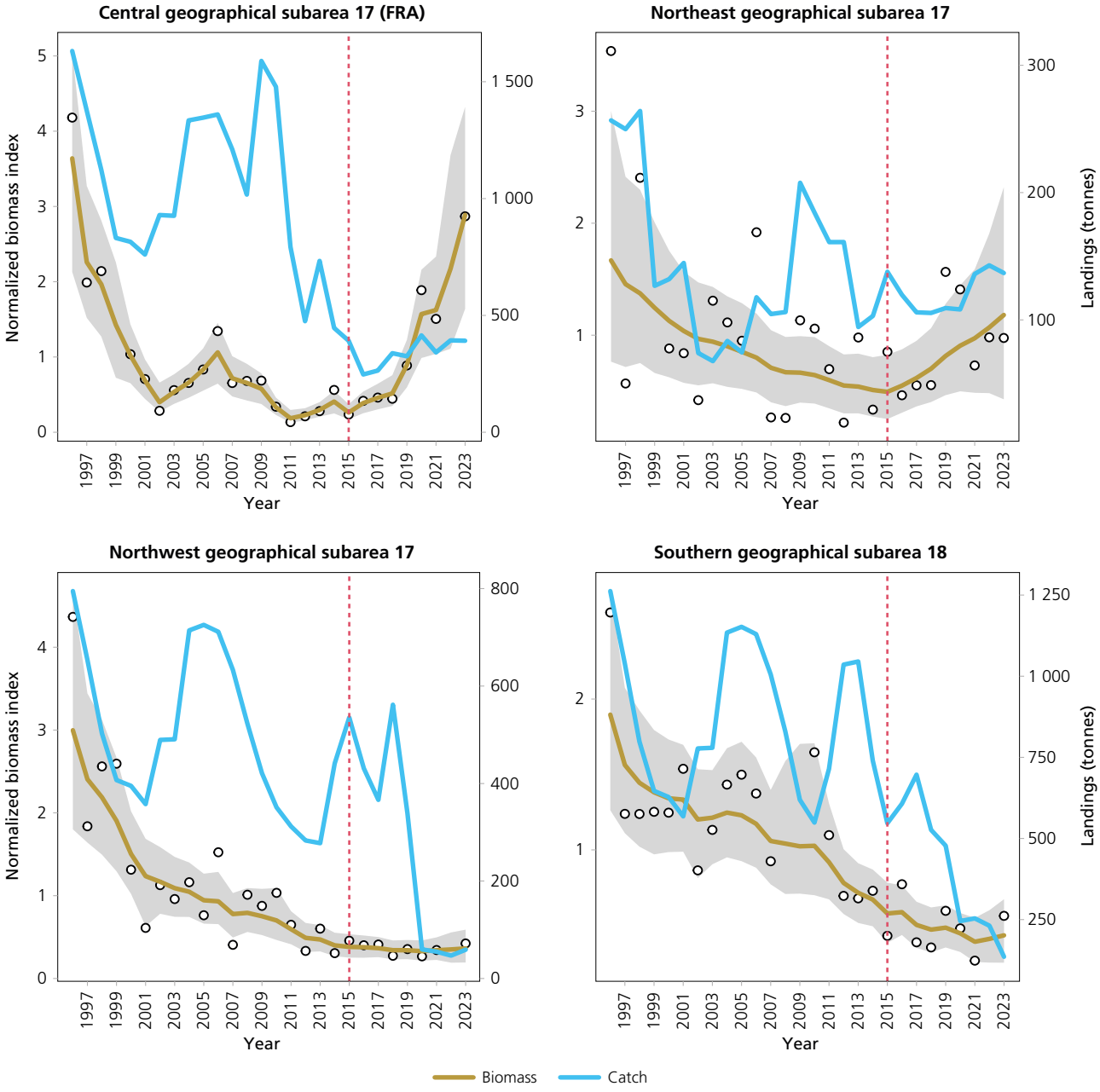
Notes: The properties are based on reported data by relevant contracting parties and cooperating non-contracting parties, while the biodiversity attributes and features are based on relevant fisheries restricted area (FRA) proposals and scientific information.
The FRAs in the Strait of Sicily and in the Adriatic Sea are covered by a joint international inspection system enforcing monitoring, control and surveillance in international waters, while the Gulf of Lion FRA is monitored through national/European Union inspection programmes.

(Continued)

Box 17. (Continued)

currently established for the long term. The policy frameworks and regulations in place (i.e. relevant GFCM decisions) include adaptive mechanisms that allow for recognition and responsiveness to potential emerging threats. Finally, under Recommendation GFCM/45/2022/11, work is underway to ensure the scientific monitoring of the effectiveness of FRAs, both from a fisheries productivity point of view and with respect to biodiversity, including the health of ecosystems.

Normalized biomass-at-sea indices and catches of Norway lobster in the central, northeast and northwest (geographical subarea 17) and southern (geographical subarea 18) Adriatic Sea



Notes: The Jabuka/Pomo Pit fisheries restricted area (FRA) is included in central geographical subarea 17.
Dashed red lines represent the year of establishment of the first spatial management measures in the Jabuka/Pomo pit (2015), and the grey shading represents uncertainty (95 percent confidence intervals).

(Continued)

Box 17. (Continued)

Criterion D: Associated ecosystem functions and services, and cultural, spiritual, socioeconomic and other locally relevant values

In many areas, VMEs also support significant essential fish habitats for commercial fisheries of socioeconomic relevance for the community – the Otranto Channel FRA and the Jabuka/Pomo Pit FRA are notable examples. Restricting fisheries in these areas has the benefit of increasing productivity by enhancing the crucial life stages of important commercial resources while conserving the ecosystems that support them, with a net benefit for the livelihoods of nearby human populations. In the Jabuka/Pomo Pit area in the central Adriatic Sea (geographical subarea [GSA] 17), the establishment of the first spatial management measures in 2015, followed by a formal FRA in 2017 and a multiannual management plan, collectively yielded impressive results for key commercial species, exemplified by Norway lobster (see figure). The recovery of this species' biomass at sea in and around the Jabuka/Pomo Pit FRA – labelled as "Central geographical subarea 17 (FRA)" in the figure – since the first spatial measures in 2015 is striking, coupled with the stabilization effect on landings, which had been declining until then. Norway lobster biomass in adjacent areas connected with the central Adriatic Sea – labelled as "Northeast geographical subarea 17" in the figure – followed suit, through seeding, while there is no evidence of any positive impact on unconnected areas – labelled as "Northwest geographical subarea 17" and "Southern geographical subarea 18" in the figure. These results illustrate how the protection of a relatively small (3 140 km^2; approximately 3 percent of the surface area of GSAs 17 and 18 together) but essential area can have wider-ranging benefits.

In the context of the ecosystem approach to fisheries, as well as the Agreement under the United Nations Convention on the Law of the Sea on the Conservation and Sustainable Use of Marine Biological Diversity of Areas beyond National Jurisdiction and the global biodiversity targets set by the CBD, it is crucial to find cooperative pathways to maintain functioning socioecological systems based on the sustainable use of marine resources to ensure food security, while concurrently conserving and preserving biodiversity to maintain healthy ecosystems that can continue providing services. Work is underway to assist GFCM contracting parties and cooperating non-contracting parties in reporting potential fishery-related OECMs, including existing FRAs, as a means of contributing to Kunming-Montreal Global Biodiversity Framework targets. This box provides a series of examples that could be further explored. Effective management of all fisheries plays a key role in the reciprocal mainstreaming of biodiversity and Blue Transformation, and FRAs are a tool available to the GFCM to achieve this.

Sources:

CBD. 2018. *Decision adopted by the Conference of the Parties to the Convention on Biological Diversity on Protected areas and other effective area-based conservation measures*. Agenda item 24 of the Fourteenth meeting of the Convention on Biological Diversity, 17–29 November 2018, Sharm El-Sheikh, Egypt. CBD/COP/DEC/14/8. Montreal, Canada. https://www.cbd.int/doc/decisions/cop-14/cop-14-dec-08-en.pdf

FAO. 2022. *A handbook for identifying, evaluating and reporting other effective area-based conservation measures in marine fisheries*. Rome. https://doi.org/10.4060/cc3307en

FAO. 2023. *Report of the expert meeting on fisheries-related other effective area-based conservation measures in the Mediterranean*. FAO Fisheries and Aquaculture Report No. 1416. Rome. https://doi.org/10.4060/cc4870en

GFCM. 2025. *Compendium of GFCM decisions*. Rome. https://fao.org/gfcm/decisions

identified priorities and dedicated activities to promote its application. An initial analysis of SSF data available within the GFCM Data Collection Reference Framework was carried out, and the Working Groups on Stock Assessment and related data preparation meetings, as well as the GFCM Subregional Committees, worked towards identifying the main data gaps for interactions between SSF and GFCM priority species. This analysis led to the prioritization of data collection on SSF interactions with European hake, particularly in the central and eastern Mediterranean Sea. In fact, the current stock assessments for this species are mainly based on data from trawling activities, whose exploitation pattern is skewed towards the smaller-sized individuals of the population, with high rates of juveniles caught. On the

other hand, passive fishing gear interacting with this species (including longlines, trammel and gillnets) are known to target and catch the adult fraction of the population, including the so-called mega-spawners, but data from these fleet segments are often not available for use. As the ad hoc Working Group on European Hake also remarked in 2025 (GFCM, 2025b), enhancing and including these data in stock assessment models would be fundamental to improve the understanding of fisheries removals, which would be conducive to more informed stock assessments and an estimation of partial fishing mortality (F) from different fleet segments, thereby providing the basis for more detailed and strengthened management advice. To this end, action has been taken to enhance data for European hake, notably in the central and eastern Mediterranean subregions. In order to collect all the required scientific evidence and provide a basis for the discussion of potential additional measures for the long-term portion of the management plan for demersal stocks in the Strait of Sicily (2026–2030),[45] the GFCM adopted a resolution in 2024.[46] By enhancing SSF data collection and involving stakeholders, this resolution aims *inter alia* to better understand and obtain more information on the different sources of fishing mortality of European hake (i.e. trawling versus SSF) and of the impacts of different types of fishing gear on the size structure of European hake, including mega-spawners, as well as to identify potential mega-spawner refugia.

In parallel, the Working Group on Small-Scale Fisheries examined the diverse participatory management models in the region, such as the ecosystem approach to fisheries and co-management. This exercise aimed to identify best practices, success factors and key entry points for enhancing stakeholder engagement. This work and subsequent discussions led to the identification of a potential case study, including a market study, for the implementation of the ecosystem approach to fisheries for the management of the round sardinella (*Sardinella aurita*) fishery in Lebanon.

[45] Recommendation GFCM/45/2022/4 on a multiannual management plan for the sustainable exploitation of demersal stocks in the Strait of Sicily (geographical subareas 12 to 16), repealing Recommendations GFCM/44/2021/12 and GFCM/42/2018/5

[46] Resolution GFCM/47/2024/1 on a roadmap for a joint project to collect all required and identified scientific evidence to provide a basis for the discussion of potential additional measures for the long-term portion of the management plan for demersal fisheries in the Strait of Sicily, in response to Recommendation GFCM/45/2022/4

To better capture the breadth of efforts underway across CPCs in implementing the two-pronged approach to SSF management and, more broadly, their progress towards meeting the RPOA-SSF objectives, the RPOA-SSF monitoring framework questionnaire was circulated to all CPCs in 2025.[47] The results of this questionnaire inform the following sections.

Advances in the two-pronged approach to small-scale fisheries management

Enhancing data collection

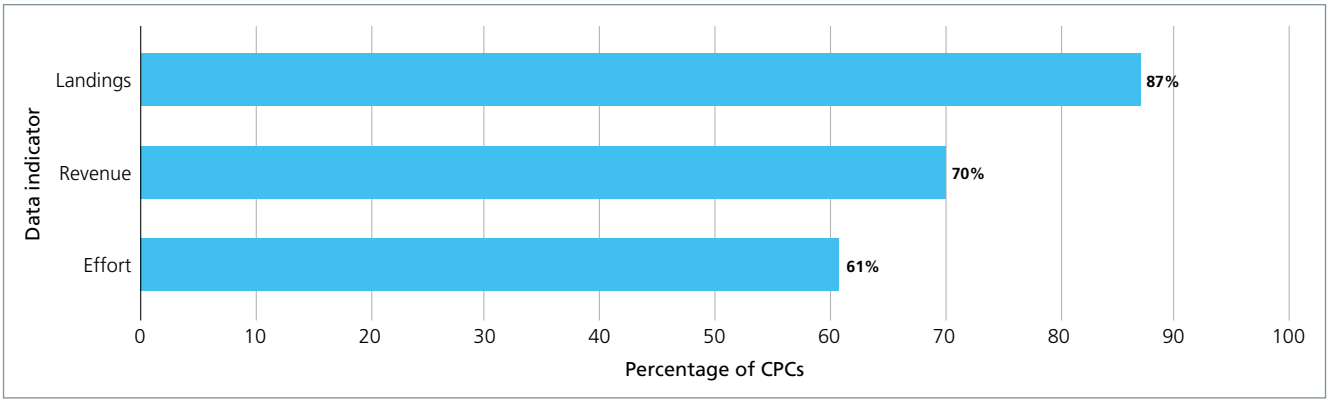
Improving data on SSF is at the heart of enhanced and effective SSF management, and the availability of complete, reliable and timely data on the SSF sector's activity is essential.

Between 2018, when the RPOA-SSF was adopted, and 2023, the number of CPCs reporting landing, effort and revenue data for SSF fleet segments generally remained steady, with, on average, 19, 17 and 15 CPCs reporting these key indicators, respectively. Over this period, some additional countries have started reporting them (i.e. Georgia), while data reporting has stalled in other countries (e.g. Ukraine). The number of CPCs requiring SSF to report landings through logbooks or other catch reporting mechanisms has, however, steadily increased from 13 in 2018 to 17 in 2025. Perhaps owing to more widespread use of detailed catch reporting tools, improvements in SSF data quality and completeness have also been observed in the data reported by many CPCs, facilitating a more detailed analysis of key indicators. Furthermore, as noted in Chapter 5, CPC reporting of social indicators, such as employment, age, gender and access to social protection programming has been improving, facilitating a more nuanced analysis of the critical socioeconomic role of SSF. Nevertheless, data gaps remain, and efforts are needed to reach full data reporting by all CPCs (Figure 87).

To further support accurate SSF data collection, CPCs are also increasingly recognizing the fundamental importance of an updated fleet register that includes SSF vessels. Of the 23 CPCs with SSF vessels operating in the Mediterranean and the Black Sea, 22 CPCs now have a fleet

[47] Excluding Bosnia and Herzegovina, Jordan, Monaco and the Republic of Moldova, which do not report SSF vessels operating in the Mediterranean or the Black Sea.

FIGURE 87. Percentage of GFCM contracting parties and cooperating non-contracting parties currently reporting key data indicators for small-scale fisheries fleet segments



register that at least partially includes their SSF fleet – an increase from 18 in 2022. Georgia and Libya have indicated making progress to include a portion of their SSF vessels within their fleet registers, while the Syrian Arab Republic reported no longer having an updated fleet register for SSF. Continued efforts are needed to ensure that fleet registers are regularly updated and are complete with all SSF vessels to foster better monitoring of the sector.

Beyond improving key indicators to characterize the sector, the two-pronged approach also emphasizes the need to better integrate SSF into stock assessment processes, thereby supporting more effective management. This entails both better integrating SSF data within stock assessments of GFCM priority species, as well as improving assessments of those stocks that may not be priority species but that are particularly relevant for SSF (see Chapter 5). As illustrated by the example of European hake, outlined earlier in this section, efforts are underway to identify and address the main data gaps for SSF interacting with GFCM priority species. On the other hand, countries are also making substantial strides in collecting data to facilitate stock assessments for those species of particular importance for SSF. In 2025, 19 CPCs (74 percent of CPCs) indicated having a data collection system in place to facilitate the assessment of stocks of interest for SSF, representing a significant increase from eight CPCs in 2022. Fourteen of these 19 CPCs collect data on a regular basis, while five CPCs indicated that ad hoc data collection occurred. Three CPCs (13 percent of CPCs) indicated that they did not have such a data collection system.

Contracting parties and cooperating non-contracting parties are also enhancing efforts to conduct dedicated research activities with a view to producing technical advice on topics of relevance to the SSF sector. The questionnaire findings show that 14 CPCs (61 percent of CPCs) have such activities in place for SSF. These activities reflect the growing commitment of CPCs to address both the potential opportunities and risks associated with NIS, as well as interactions between SSF and vulnerable species, the selectivity of SSF gear and MCS for SSF (Figure 88).

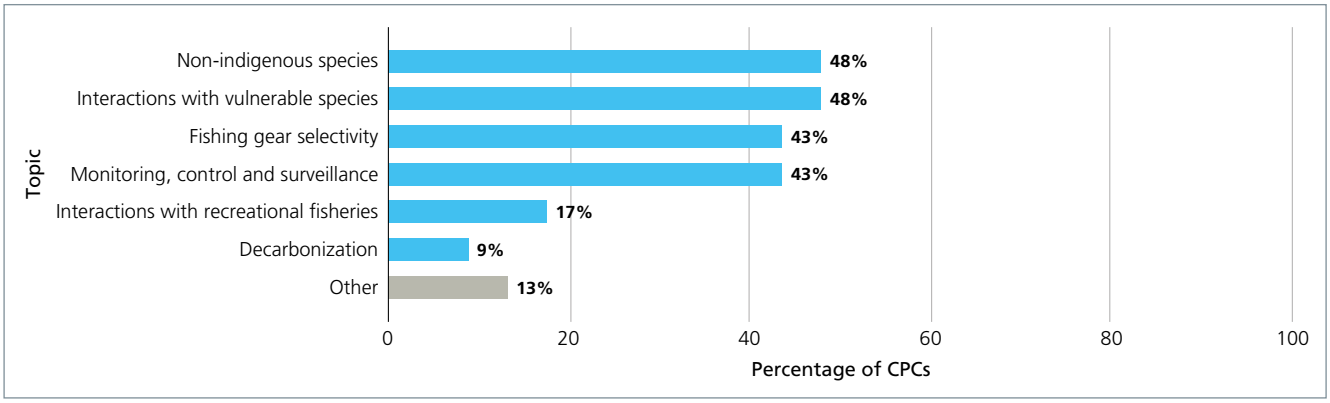
Regarding NIS, CPCs are increasingly taking action to address these species within their waters. As of 2025, nine CPCs (39 percent of CPCs) reported having developed specific plans for the adaptation to and/or mitigation of NIS, marking an increase from six CPCs in 2022. Furthermore, 13 CPCs (57 percent of CPCs) reported having plans for the valorization and/or utilization of NIS, including in the context of SSF, a notable increase from four CPCs in 2022.

The inclusion of SSF in scientific and research agendas is a critical step towards gathering additional knowledge of this sector and developing tailored and effective management frameworks. While promising momentum has been observed, there remains a need to deepen scientific efforts in less explored but highly relevant areas, such as decarbonization and interactions with recreational fisheries.

Engaging stakeholders

A critical pillar for strengthening SSF management is the active engagement of stakeholders in the advisory process, recognized also via Output 4.4 "Engagement of fishers in

FIGURE 88. Percentage of GFCM contracting parties and cooperating non-contracting parties with research or scientific programmes related to small-scale fisheries, by topic



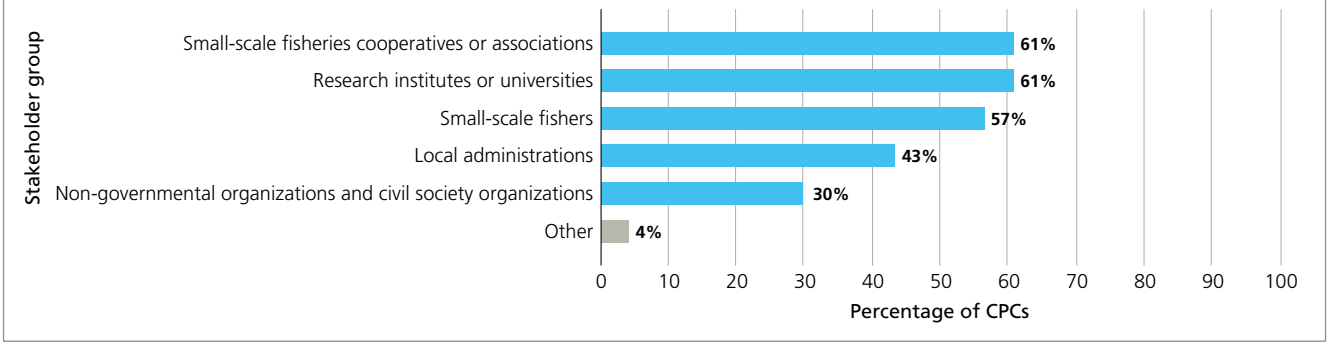
participatory management processes promoted, facilitating their role as guardians of the sea" of the GFCM 2030 Strategy. Recognizing that SSF are deeply embedded in the social and economic fabric of coastal communities, the GFCM continues to promote participatory processes through stakeholder consultations, capacity-development initiatives and opportunities for peer-to-peer learning, such as the Small-Scale Fishers' Forum (SSF Forum; Box 18). This section presents recent developments by CPCs in enhancing stakeholder engagement, from consultative platforms and fisher representation to training and empowerment efforts, reflecting the growing momentum towards participatory SSF management.

Participatory management often depends on the existence of relevant SSF organizations, which can play a vital role in representing the interests of small-scale fishers and contributing to advisory processes. These organizations serve as key entry points for co-management, consultation and capacity development processes. Most CPCs have some form of organization or cooperative representing small-scale fishers at various levels (i.e. local, subnational, national and regional), and the GFCM is working to map the main SSF actors to further support the engagement of relevant stakeholders. Furthermore, many CPCs are actively working to develop the capacity of these SSF actors, including by promoting gender equity and generational turnover in the sector. Nine CPCs (39 percent of CPCs) have measures or initiatives in place to promote the equal participation of women in SSF, including through bureau positions in SSF organizations and leadership roles in fisheries administrations, while ten CPCs (43 percent of CPCs) have mechanisms in place to engage with and promote young fishers.

Progress has also been made in enhancing SSF stakeholder engagement in formal management processes. Seventeen CPCs (74 percent of CPCs) reported having adopted fisheries management decisions, such as recommendations, decrees, regulations, or management plans, in concerted consultation with relevant stakeholders. This represents an important increase from ten CPCs in 2022, reflecting a shift towards participatory models, including in the context of RPOA-SSF implementation. Among the SSF stakeholders consulted, the most frequent interactions were with SSF organizations, research institutes and small-scale fishers, while local administrations, non-governmental organizations and civil society organizations were consulted less frequently (Figure 89). In particular, Morocco, Romania, Spain, Tunisia and Türkiye stand out for their broad stakeholder engagement, involving five or more different types of stakeholder groups in decision-making processes.

Finally, monitoring the implementation of management measures is crucial to strengthening their effectiveness. Participatory monitoring programmes that engage fishers in data collection and MCS activities can generate comprehensive information and promote fisher ownership of management measures. Eleven CPCs (48 percent of CPCs) have such programmes in place, representing a continued increase from 2022, when eight CPCs had reported similar participatory monitoring and MCS mechanisms. Nevertheless, more than half of all CPCs reported not having such programmes in

FIGURE 89. Percentage of GFCM contracting parties and cooperating non-contracting parties consulting small-scale fisheries stakeholder groups within management decision-making processes



Box 18. The Small-Scale Fisher's Forum in 2023–2024

The Small-Scale Fisher's Forum (SSF Forum) is a regional peer-to-peer learning and capacity-development initiative designed for small-scale fishers and fish workers across the Mediterranean and the Black Sea. Launched in 2020 in response to the recommendations of the Regional Plan of Action for Small-Scale Fisheries in the Mediterranean and the Black Sea, it consists of a series of workshops and training courses on topics of interest to small-scale fishers, aiming to share knowledge and further develop capacities and skills. The SSF Forum is organized in collaboration with the Friends of SSF platform, as well as local partners such as non-governmental organizations or local small-scale fisheries (SSF) organizations, and takes the form of hands-on workshops and training courses.

Aligning with a participatory approach, a consultation was held in March 2023 at FAO headquarters with the objective of defining the SSF Forum programme for 2023–2024 and giving small-scale fishers a stronger voice to communicate their priorities in the region. The SSF Forum consultation brought together over 50 fishers and fish workers from 13 countries across the region to participate in a two-day brainstorming session, discussing the capacity development topics of interest for the SSF sector and identifying workshops that reflect the needs of the sector. Participants agreed on a series of four workshops characterized by the cross-cutting themes of gender and generational turnover:

- Non-indigenous species: from health and safety to marketing opportunities
  (20–23 November 2023 in Akyaka, Gökova Bay, Türkiye)
- Strengthening SSF organizations: the basis for developing projects and funding requests
  (18–20 April 2024 in Torrevieja, Spain)
- Marine pollution: impacts, interactions and solutions
  (29–30 October 2024 in Monastir, Tunisia)
- Gear selectivity: impacts, interactions and solutions
  (9–10 April 2025, in Split, Croatia)

Each workshop was held in person and featured peer-to-peer learning and field visits to foster exchange and dialogue among participants. For example, the workshop on non-indigenous species (NIS) – held in Akyaka, Türkiye and hosted by the Akyaka Fishery Cooperative and the Mediterranean Conservation Society, a local non-governmental organization – brought together 50 small-scale fishers and stakeholders from ten Mediterranean countries to discuss how to address and capitalize on the NIS growing presence. Participants shared experiences in developing new markets for these species and discussed management strategies, highlighting initiatives such as the one in Gökova Bay to monitor devil firefish (*Pterois miles*), train fishers on safe handling and encourage commercialization of this species. Key recommendations from participants included improving awareness, supporting product transformation and promoting a participatory, bottom-up approach to NIS management. The workshop also underscored the importance of fisher–scientist collaboration, and its conclusions were presented to the experts of the GFCM pilot study on NIS.

In total, the 2023–2024 SSF Forum programme engaged over 120 participants from across the region. Conclusions and key takeaways were compiled for each session and were presented to relevant GFCM expert meetings to inform the GFCM advisory process and ensure that experiences and insights from small-scale fishers were considered in decision-making.

place, pointing to an important area for further development.

In general, while the overall proportion of CPCs practicing stakeholder consultation leaves room for improvement, the growing depth and diversity of engagement in several countries signal a promising shift towards participatory and locally tailored SSF management. As participatory approaches remain a cornerstone of the two-pronged approach to SSF management and are at the core of RPOA-SSF objectives, expanding monitoring frameworks and consultation processes involving relevant stakeholders will be essential to achieving more adaptive and socially grounded management outcomes in the context of Target 4 of the GFCM 2030 Strategy.

MANAGEMENT-ORIENTED RESEARCH

Since 2018, research programmes and pilot projects and studies – collectively categorized as management-oriented research – have been included in the GFCM workplan for both the Mediterranean and the Black Sea. They are at the core of Target 5 of the GFCM 2030 Strategy and are implemented under the umbrella of the GFCM capacity development initiatives, MedSea4Fish (FAO, 2025c) and BlackSea4Fish (FAO, 2025d). Research programmes are initiated in cases where advances in the sustainability and management of a specific fishery are expected to benefit from improved quantity and quality of information on the resource and its exploitation, addressing knowledge gaps. Pilot projects and pilot studies are based on similar principles, but typically have more limited geographical or temporal scopes. In all cases, the core principle is to take full advantage of ongoing research at the national level by providing a platform for coordination, creating networks of scientists, filling information gaps with new activities and providing support to capacity development. The overall aim is to provide a sound scientific basis for the identification of the most appropriate management options in the context of relevant GFCM working groups, subregional committees and subsidiary bodies, according to the GFCM fisheries advisory process (see Box 3). This section reports on newly launched management-oriented research initiatives, as well as recently completed ones (Table 13, Table 14, Table 15; for additional details, see also FAO, 2020, 2023c). These initiatives are grouped by contribution topics: i) science underpinning fisheries management measures; ii) expanding regional knowledge of biodiversity and ecosystems; and iii) mitigating discards and the incidental catch of vulnerable species in fishing gear.

The GFCM Research programme on European eel started a process that allowed for the development of a coordinated framework for the collection, collation and analysis of data, creating the basis for the assessment and management of the resource and laying the foundations of the current long-term multiannual management plan for European eel in the Mediterranean. Importantly, the second phase of the research programme was conducive, for the first time globally, to a comprehensive socioeconomic study of European eel fisheries, carried out with a tailored approach to socioeconomic data collection, based on the standard FAO socioeconomic data collection methodology (see Box 14). The socioeconomic data fed into a multi-objective appraisal of alternative management measures that enabled the identification of a wider pool of options for long-term fishery, habitat and conservation measures in the Mediterranean.

The GFCM Research programme on red coral enabled the collection of information from both shallow and deep-sea red coral populations and from exploited and unexploited banks; these data were used to explore the application of stock assessment models designed for data-poor situations. A regional genetic study was also conducted with around 700 samples of red coral collected within the framework of the research programme. For the first time worldwide, a comprehensive socioeconomic study of the red coral fishery was carried out, providing a tailored approach to socioeconomic data collection.

The GFCM Research programme on dolphinfish resulted in a new multiannual management plan bringing together several countries targeting the resource, shedding light on previously unknown aspects of this wide-ranging but very seasonal and peculiar fishery.

The GFCM Research programme on rapa whelk advanced the knowledge of

TABLE 13. Summary of GFCM research programmes, pilot projects and studies underpinning fisheries management measures

Species/topic	Reference period	Origin	CPCs involved	Key objectives, work packages and activities	Resulting decisions (if any)	Related outputs
Research programme on European eel	2020–2022 (Phase 1); 2023–2024 (Phase 2)	FAO. 2019. *General Fisheries Commission for the Mediterranean – Report of the twenty-first session of the Scientific Advisory Committee on Fisheries, Cairo, Egypt, 24–27 June 2019.* FAO Fisheries and Aquaculture Report No. 1290. Rome. https://openknowledge.fao.org/handle/20.500.14283/ca6704b	Albania, Algeria, Egypt, France, Greece, Italy, Spain, Tunisia, Türkiye	**Phase 1:** WP1. Review of management and protection measures. WP2. Common framework for long-term monitoring. WP3. Information on European eel stock and eel habitats in the Mediterranean. WP4. Common framework for assessing stock status and analysing management scenarios. WP5. Coordination, networking and capacity-building activities. **Phase 2:** Roadmap for 2023–2024 informing the GFCM long-term multiannual management plan by i) enhancing the database of data-rich sites; ii) performing a socioeconomic study of European eel fisheries in the Mediterranean; and iii) performing a multi-objective appraisal of management measures accounting for fisheries objectives, conservation benefits and estimated socioeconomic impacts.	Recommendation GFCM/47/2024/1 on long-term measures for European eel in the Mediterranean Sea Recommendation GFCM/46/2023/16 on a long-term management plan for European eel in the Mediterranean Sea, repealing Recommendations GFCM/45/2022/1 and GFCM/42/2018/1	Ciccotti, E. & Morello, E.B. (eds). 2023. *European eel in the Mediterranean Sea – Outcomes of the GFCM Research programme.* Studies and Reviews No. 103 (General Fisheries Commission for the Mediterranean). Rome, FAO. https://doi.org/10.4060/cc7252en GFCM. 2024. *Report of the Expert Group on European Eel in the Mediterranean (EGEMed), including the 2024 session of the Working Group on the Management of European Eel, FAO headquarters, Rome, Italy (hybrid), 4–5 June 2024.* Rome. https://fao.org/gfcm/technical-meetings/detail/en/c/1698135
Research programme on red coral	2020–2023	Recommendation GFCM/43/2019/4 on a management plan for the sustainable exploitation of red coral in the Mediterranean Sea	Algeria, Croatia, France, Greece, Italy, Malta, Morocco, Tunisia	A1. Investigate harvested populations of red coral and provide precautionary advice on the status of populations. A2. Strengthen and harmonize existing traceability. A3. Conduct genetic analyses. A4. Develop suitable stock assessment models. A5. Perform a socioeconomic analysis of red coral fisheries.	Recommendation GFCM/47/2024/2 on long-term measures for the sustainable exploitation of red coral, amending Recommendation GFCM/43/2019/4 and repealing Recommendations GFCM/45/2022/2 and GFCM/46/2023/13	FAO. (forthcoming). *Red coral in the Mediterranean Sea – Outcomes of the GFCM Research programme.* Studies and Reviews, No. 106 (General Fisheries Commission for the Mediterranean). Rome.
Research programme on dolphinfish	2021–2024	Recommendation GFCM/43/2019/1 on a set of management measures for the use of anchored fish aggregating devices in common dolphinfish fisheries in the Mediterranean Sea	Italy, Malta, Spain, Tunisia	WP1. Establish a framework for stock assessment. WP2. Assess the impacts of fish aggregating devices on stock sustainability and on the ecosystem. WP3. Identify and appraise management measures. WP4. Coordination, networking and capacity building.	Recommendation GFCM/46/2023/14 establishing a multiannual management plan for the sustainable exploitation of common dolphinfish in the Mediterranean Sea, repealing Recommendations GFCM/30/2006/2, GFCM/43/2019/1 and GFCM/44/2021/11	
Research programme on blue crab	2022–ongoing	Recommendation GFCM/42/2018/7 on a regional research programme on blue crab in the Mediterranean Sea	Algeria, Croatia, Cyprus, Egypt, Greece, Italy, Montenegro, Morocco, Slovenia, Spain, Tunisia, Türkiye	WP1. Collect information on the biological and ecological characteristics of the two species of blue crabs. WP2. Collect fisheries-independent data. WP3. Collect fisheries-dependent data. WP4. Establish an ad hoc framework for blue crab stock assessment. WP5. Perform a socioeconomic study of blue crab fisheries, including the value chain. WP6. Develop adaptive management measures.		In preparation.

(Continued)

TABLE 13. (Continued)

Species/topic	Reference period	Origin	CPCs involved	Key objectives, work packages and activities	Resulting decisions (if any)	Related outputs
Research programme on recreational fisheries	2023–ongoing	Recommendation GFCM/45/2022/12 on the establishment of a set of minimum rules for sustainable recreational fisheries in the Mediterranean Sea	Bulgaria, Cyprus, Egypt, Greece, Lebanon, Malta, Montenegro, Morocco, Romania, Spain, Tunisia, Türkiye, Ukraine	WP1. Enhance recreational fisheries data collection. WP2. Develop a framework for the integration of recreational fisheries data into stock assessments. WP3. Identify and appraise existing recreational fisheries management measures. WP4. Facilitate networking among and engagement with relevant recreational fisheries stakeholders (recreational fisher organizations, scientific experts, etc.) to close the gap between decision-making and practice.		
Research programme on rapa whelk	2019–ongoing	Recommendation GFCM/42/2018/9 on a regional research programme for rapa whelk fisheries in the Black Sea (geographical subarea 29)	Bulgaria, Georgia, Romania, Türkiye, Ukraine	A1. Conduct studies on the biology and ecology of the species. A2. Perform standardized scientific beam trawl surveys-at-sea. A3. Conduct biological sampling of catch, bycatch and fishing effort. A4. Assess the status of the stock. A5. Perform socioeconomic surveys. A6. Perform a management strategy evaluation.	Recommendation GFCM/47/2024/9 on management measures for the sustainable exploitation of rapa whelk in the Black Sea (geographical subarea 29)	In preparation.
Research programme on piked dogfish	2021–2024	Recommendation GFCM/44/2021/10 on management measures for sustainable piked dogfish fisheries in the Black Sea (geographical subarea 29)	Bulgaria, Georgia, Romania, Türkiye, Ukraine	WP1. Stakeholder engagement WP2. Bycatch WP3. Biological data collection WP4. Spatial dynamics of piked dogfish WP5. Target piked dogfish fisheries WP6. Post-release mortality	Recommendation GFCM/47/2024/10 on the extension of transitional management measures for sustainable piked dogfish fisheries in the Black Sea (geographical subarea 29), amending Recommendation GFCM/44/2021/10 and repealing Recommendation GFCM/46/2023/8	In preparation. FAO. 2023. *Piked dogfish in the Black Sea – Join our urgent action to restore highly threatened regional populations*. Rome. https://openknowledge.fao.org/handle/20.500.14283/cc5271en
Pilot study on bamboo coral in the southern Adriatic Sea	2022–2024	Resolution GFCM/44/2021/3 on a roadmap for the establishment of a fisheries restricted area in the southern Adriatic Sea (geographical subarea 18)	Albania, Italy	WP1. Create a network of scientific experts and key stakeholders. WP2. Perform a remotely operated vehicle survey. WP3. Perform data analysis. WP4. Study age and growth of *Isidella elongata*. WP5. Identify the most appropriate spatial management in geographical subarea 18.	Recommendation GFCM/47/2024/6 on the establishment of a fisheries restricted area in the Otranto Channel (geographical subarea 18), stemming from Recommendation GFCM/43/2019/5 and Resolution GFCM/44/2021/3	Carbonara, P., Chimienti, G., Bellodi, A., Bakiu, R., Bitetto, I., Calcagnile, L., D'Elisa, M., *et al.* 2025. Age and growth of bamboo coral *Isidella elongata* (Esper, 1788): a Mediterranean Vulnerable Marine Ecosystem indicator taxa. *Coral Reefs*, 44(4): 1403–1418.

Note: CPCs = contracting parties and cooperating non-contracting parties; WP = work package; A = activity

TABLE 14. Summary of the GFCM research programmes, pilot projects and studies on biodiversity and ecosystem interactions

Species/topic	Reference period	Origin	CPCs involved/ GSAs	Key objectives, work packages and activities	Related outputs
Underwater radiated noise and potential effects on fish resources	2021 and 2023	FAO. 2019. *General Fisheries Commission for the Mediterranean – Report of the twenty-first session of the Scientific Advisory Committee on Fisheries, Cairo, Egypt, 24–27 June 2019.* FAO Fisheries and Aquaculture Report No. 1290. Rome. https://openknowledge.fao.org/handle/20.500.14283/ca6704b	GSAs 17 and 18	Evaluate the potential impact of underwater radiated noise on fish and invertebrates, highlighting the ecological footprint of sound emissions from bottom trawling and demersal longliners.	Pace, F., Welch, S.J., Ferri, N. & Nastasi, A. 2024. Footprint of sound emissions from fishing vessels in the Adriatic Sea. In: A.N. Popper, J.A Sisneros, A. D. Hawkins & F. Thomsen, eds. *The Effects of Noise on Aquatic Life: Principles and Practical Considerations*. Cham, Switzerland, Springer International Publishing. Borsani, J.F & Caradonna, V. 2023. *Sound monitoring baseline data report, Durrës, Albania*. Rome, FAO. https://fao.org/gfcm/about/funding/gef/fishebm-med Robinson, C., Pace, F. & Sertlek, Ö. 2023. *Acoustic footprint of bottom trawling in the Adriatic Sea, Durrës, Albania*. Rome, FAO & Dartmouth, Canada, JASCO Applied Sciences. https://fao.org/gfcm/about/funding/gef/fishebm-med
Pilot study on non-indigenous species in the eastern Mediterranean Sea	2023–ongoing	FAO. 2022. *General Fisheries Commission for the Mediterranean – Report of the twenty-third session of the Scientific Advisory Committee on Fisheries, FAO headquarters, Rome, Italy, 21–24 June 2022*. FAO Fisheries and Aquaculture Report No. 1395. Rome. https://doi.org/10.4060/cc3109en	Cyprus, Greece, Israel, Palestine, Syrian Arab Republic, Türkiye	WP1. Coordination, networking, dissemination, and sustainability. WP2. Perform an ecosystem approach to fisheries baseline study. WP3. Test local ecological knowledge protocols towards effective and long-term participatory non-indigenous species monitoring. WP4. Analyse data. WP5. Provide technical recommendations for non-indigenous species management.	
Research programme on jellyfish	2023–2025	Resolution GFCM/45/2022/2 on a research programme on jellyfish in the western Mediterranean (geographical subareas 1 to 3)	Morocco	WP1. Bibliographic review WP2. Monitoring, sampling and citizen science WP3. Hydrodynamic modelling WP4. Solutions and mitigation measures	In preparation.
Environmental DNA metabarcoding for monitoring fisheries in the Mediterranean	2022–2025	FAO. 2022. *General Fisheries Commission for the Mediterranean – Report of the twenty-third session of the Scientific Advisory Committee on Fisheries, FAO headquarters, Rome, Italy, 21–24 June 2022*. FAO Fisheries and Aquaculture Report No. 1395. Rome. https://doi.org/10.4060/cc3109en	Greece, Italy, Malta, Türkiye	Assess the potential and accuracy of eDNA in reconstructing catches and broader community structures.	Maiello, G., Bellodi, A., Cariani, A., Carpentieri, P, Carugati, L, Cicala, D., Ferrari, A., *et al*. 2024. Fishing in the gene-pool: implementing trawl-associated eDNA metaprobe for large scale monitoring of fish assemblages. Reviews in *Fish Biology and Fisheries*, 34: 1293–1307. Maiello, G., Talarico, L., Brodie, C, Carpentieri, P., Sbrana A., Shum, P., Mariani, S. & Russo, T. 2023. Net gain: Low-cost, trawl-associated eDNA samplers upscale ecological assessment of marine demersal communities. *Environmental DNA*, 6(1): e389.

Note: GSA = geographical subarea; CPCs = contracting parties or cooperating non-contracting parties; WP = work package.

TABLE 15. Summary of GFCM research programmes, pilot projects and studies on bycatch mitigation measuress

Species/topic	Reference period	Origin	CPCs involved/GSAs	Key objectives, work packages and activities	Resulting decisions (if any)	Related outputs
Pilot project on sturgeons in the Black Sea (Acipenseridae)	2022–2024	Resolution GFCM/44/2021/5 on the mitigation of fisheries impacts for the conservation of sturgeons in the Black Sea (geographical subarea 29)	Bulgaria, Georgia, Romania, Türkiye, Ukraine	WP1. Networking and awareness raising (creating networks, awareness raising and fisher engagement) WP2. Collation of information (collation of existing information, exploring fisher knowledge) WP3. Analysis and proposed future actions	Recommendation GFCM/47/2024/11 establishing measures on sturgeons (Acipenseridae) in the Black Sea (geographical subarea 29)	FAO. 2023. Sturgeons in the Black Sea – *Join our urgent action to protect an iconic species group.* Rome. https://openknowledge.fao.org/handle/20.500.14283/cc5272en
CetaByM pilot project (Black Sea cetaceans)	2022–2024	GFCM. 2021. *Report of the ninth meeting of the Working Group on the Black Sea, online, 28–30 July 202*1. Rome. https://www.fao.org/gfcm/technical-meetings/detail/en/c/1440228/	Bulgaria, Georgia, Romania, Türkiye	WP1. Awareness raising and fisher engagement in bycatch mitigation measures WP2. Estimation of spatial and temporal distribution of active fishing effort WP3. Tests of porpoise alerting devices under commercial conditions WP4. Experimental tests of porpoise alerting devices and alternative mitigation measures		FAO. 2023. *Join the work towards cetacean-free turbot fisheries in the Black Sea – Play a part in CetaByM, our pilot project to assess cetacean bycatch in Black Sea turbot gillnet fisheries and to test measures to mitigate the incidental catch of cetaceans.* Rome. https://openknowledge.fao.org/handle/20.500.14283/cc6046en
Mitigation trials to reduce interaction between vulnerable species and fishing activities	2023–2025	Resolution GFCM/46/2023/4 on a regional plan of action to monitor and mitigate interactions between fisheries and vulnerable species in the Mediterranean and the Black Sea	GSA 5 (Balearic Islands): seabird bycatch in demersal longline fisheries GSA 17 (northern Adriatic, Croatia): shark and ray bycatch in gillnets and combined nets GSA 24 (northern Levant Sea): sea turtle, shark and ray bycatch in trawl fisheries GSA 3 (southern Alboran Sea): shark and ray bycatch in trawlers; dolphin depredation in purse seiners GSA 19 (western Ionian Sea): Dolphin depredation in gillnets and combined nets	Identify workable solutions and support broader efforts to safeguard marine biodiversity and ensure sustainable fishing practices.		
Studies on fishing gear selectivity	2023–ongoing	Pilot study for the selectivity of bottom trawl fisheries exploiting demersal stocks in the Strait of Sicily Available in FAO. 2022. *General Fisheries Commission for the Mediterranean – Report of the twenty-third session of the Scientific Advisory Committee on Fisheries, FAO headquarters, Rome, Italy, 21–24 June 2022*. FAO Fisheries and Aquaculture Report No. 1395. Rome. https://doi.org/10.4060/cc3109en	GSAs 12 and 16	Test the effectiveness of two selectivity measures (the 90° turned mesh [T90] panel and selective grids) in reducing bycatch (e.g. juveniles) of the demersal trawl fishery targeting European hake and deep-water rose shrimp.		Geraci, M.L., Sardo, G., Scannella, D., Falsone, F., Di Maio, F., Gancitano, V., Fiorentino, F., Chiro, P., Massi, D. & Vitale, S. 2023. Exploring the feasibility of technological transfers of two by-catch reduction devices in the crustacean bottom trawling of the central Mediterranean. *Frontiers in Marine Science*, 10.

Note: GSA = geographical subarea; CPCs = contracting parties and cooperating non-contracting parties; WP = work package; A = activity.

the biology, ecology and fishery dynamics of this non-indigenous but economically important species, with notable work done on age determination, the collection of fishery-dependent and fishery-independent data and stock assessment. Socioeconomic studies were completed and stakeholders consultations advanced in support of management in key Black Sea countries. A standardized scientific beam trawl survey for rapa whelk across the Black Sea, carried out twice per year from 2020 to 2023 and then once annually in spring since 2024, stands out as one of the most remarkable achievements, supporting regional collaboration in managing fisheries exploiting this species.

Within the framework of the pilot study on bamboo coral in the southern Adriatic Sea, the GFCM conducted, for the first time, a local ecological knowledge and socioeconomic study (see Box 14) tailored to deep-sea fisheries. It allowed for the quantification of fishery landings and revenues and helped to capture fisher perceptions of bamboo coral bycatch over the years. Supported by the first GFCM remotely operated vehicle survey to map bamboo coral presence in both impacted and unimpacted fishing areas, this work fostered stakeholder buy-in and resulted in the adoption of a new FRA.

The CetaByM pilot project marked the first coordinated regional effort to assess and mitigate cetacean bycatch in turbot gillnet fisheries in the Black Sea, generating practical mitigation insights and fostering stakeholder engagement. Across these and other management-oriented initiatives, such as the Research programme on piked dogfish and the sturgeon pilot project, awareness-raising has been a consistent focus, helping to shift perceptions and practices among fishers and other stakeholders. These activities promoted safe release practices, improved bycatch reporting, and built stronger links between science, management and the fishing community (Box 19).

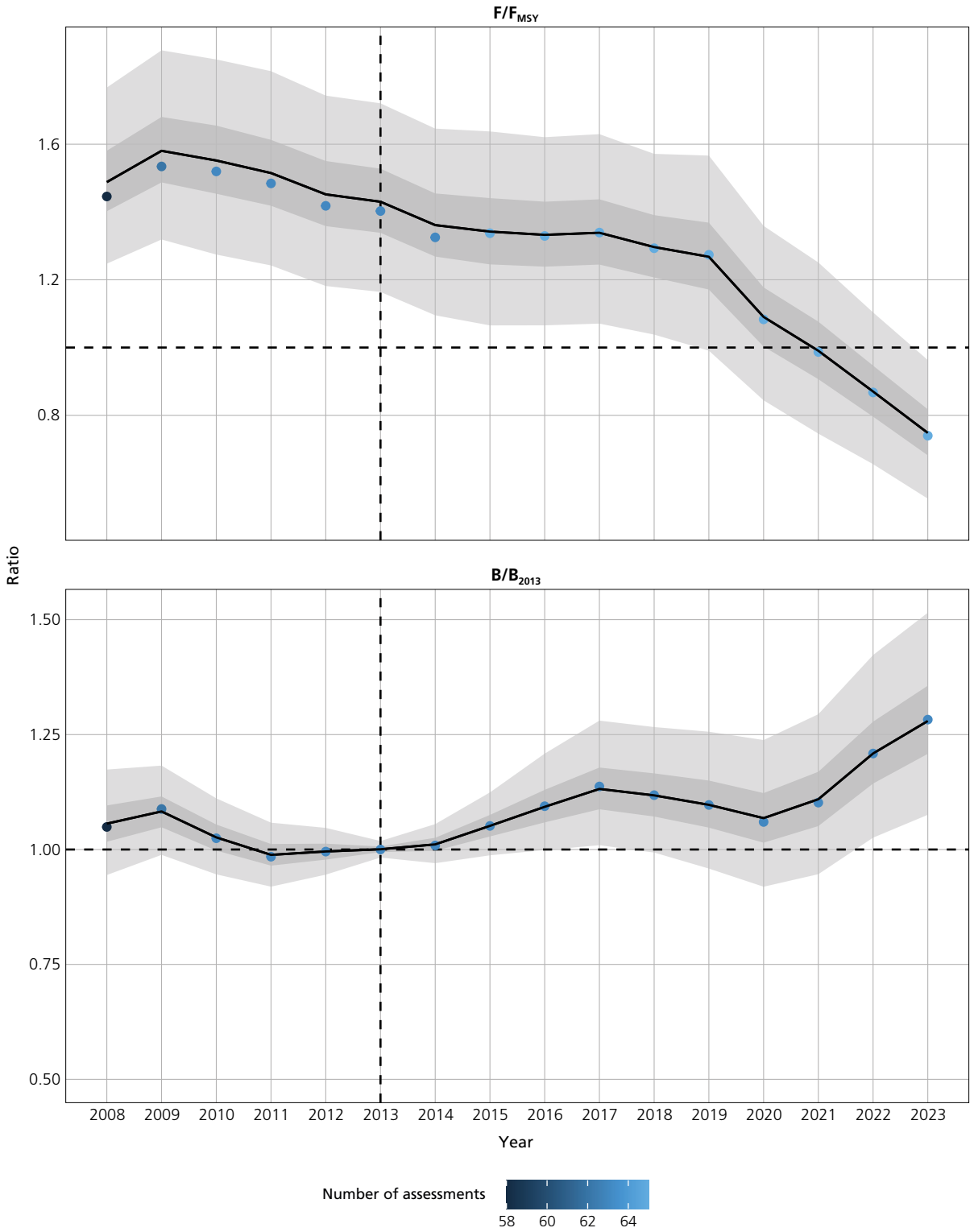
One of the most significant and relevant outcomes of all GFCM management-oriented research is the establishment of regional platforms bringing together experts from European Union (EU) and non-EU countries – professionals who, outside the GFCM framework, would be unlikely to meet and discuss shared challenges and goals. These platforms serve as a robust interface where science and policy converge to explore solutions that address the needs of the community as a whole. In the Black Sea region, awareness-raising has been a strong component of management-oriented research initiatives, with tangible impacts on the behaviour of fishing communities and their sensitivity to biodiversity and environmental issues (Box 19).

CHALLENGES AND FUTURE DIRECTIONS

Fisheries management in the Mediterranean and the Black Sea has entered a new phase of maturity, marked by the adoption of adaptive multiannual management plans, many of which are transitioning to their long-term phases, complemented by spatial measures. This evolution reflects a growing commitment to ecosystem-based and inclusive governance in the region. These developments are closely aligned with the four relevant targets of the GFCM 2030 Strategy and the broader objectives of the MedFish4Ever and Sofia ministerial declarations. Yet, as the region continues to evolve, several cross-cutting challenges must be addressed to consolidate progress and ensure long-term sustainability.

Since 2013, 11 multiannual management plans have been adopted, complemented by 11 FRAs, with the aim of achieving sustainable exploitation of key commercial species. These plans incorporate combinations of input and output controls (e.g. effort and catch limits, respectively), alongside technical and spatial measures. The results are very promising: average fishing pressure (F/F_{MSY}) has declined overall by approximately 50 percent across the region since 2013 and is now close to 1, while biomass (B/B_{2013}) has increased overall by 25 percent over the same period, indicating a general positive trajectory for stock biomass recovery (Figure 90). Indeed, several stocks managed under GFCM management plans are showing significant signs of recovery, including: i) European hake in the Strait of Sicily (Box 19); ii) European hake, Norway lobster (Box 17), red mullet and common sole in the Adriatic Sea; and iii) turbot in the Black Sea (see Chapter 3). These improvements are likely the results of integrated management approaches that include adaptive multiannual management plans, spatial protection and improved MCS, including joint international inspection schemes (e.g. in the Adriatic Sea and the Strait of Sicily). The Adriatic Sea provides a particularly positive

FIGURE 90. Trends in average fishing pressure (F/F_{MSY}) and biomass relative to 2013 (B/B_{2013})



Notes: F = fishing mortality; B = biomass; MSY = maximum sustainable yield.
The reference year 2013, applicable to biomass, marks the start of the implementation of multiannual management plans, based on the backward assessment approach.

case, where demersal resources benefit from a combination of effort regimes, spatio-temporal measures, and three FRAs – in particular, the Jabuka/Pomo Pit (Box 17). Additionally, the completion of a rigorous MSE in the Adriatic led to a landmark decision: the adoption of single-species HCRs and annual catch limits for sardine (*Sardina pilchardus*) and European anchovy (*Engraulis encrasicolus*), replacing joint catch limits and promoting both ecological sustainability and economic stability.

However, sustaining and expanding these gains requires further action. The effectiveness of multiannual management plans must be continuously and consistently assessed, not only in terms of ecological outcomes but also with regard to their socioeconomic impacts (see Box 14 and Box 16). Simulation tools like MSE have proven invaluable in this regard, helping to identify optimal strategies and assess resource resilience under different scenarios (see Box 16), promoting adaptiveness. Given the technical and data demands of these tools, the GFCM is investing in capacity development through the MedSea4Fish and BlackSea4Fish capacity development initiatives, while also exploring more streamlined methodologies for data-limited contexts. These efforts are essential to maintaining a level playing field across the region and ensuring that all CPCs can contribute to and benefit from science-based management.

Compliance and enforcement remain critical challenges. While new recommendations and plans have been adopted, their implementation is uneven across CPCs. Strengthening MCS systems is vital to ensure that management measures are effectively applied. The development of FRA effectiveness and control plans is a step forward, but broader institutional support and investment in scientific monitoring and enforcement capacity are needed to ensure transparency and accountability.

Small-scale fisheries are increasingly recognized as a cornerstone of coastal economies and cultures, and important strides have been made in improving their management. A growing number of countries are collecting SSF data suitable for stock assessments, and stakeholder consultations are being more widely integrated into advisory processes. These developments reflect a shift towards participatory and locally tailored SSF governance, supported by initiatives like the SSF Forum and the GFCM's ongoing work to strengthen inclusive decision-making. Nevertheless, SSF must be fully embedded into formal governance structures, with co-management models institutionalized and monitoring frameworks expanded to ensure that SSF voices are consistently represented.

Management-oriented research continues to play a catalytic role in shaping adaptive strategies. Regional platforms have fostered collaboration between EU and non-EU experts, enhancing the science–policy interface and enabling shared learning. The inclusion of NIS in formal management (e.g. rapa whelk in the Black Sea) marks a significant milestone and sets a precedent for future biodiversity-sensitive management. Looking ahead, mainstreaming climate adaptation and NIS management into research, planning and advisory processes will be essential. The integration of climate drivers into long-term management objectives, as emphasized by the GFCM 2030 Strategy, is already underway and must be further supported by sustained scientific and institutional efforts.

To build on these achievements and address remaining gaps, including with respect to the GFCM 2030 Strategy, a set of pragmatic priorities should guide future action. These include expanding multiannual management plans to cover all priority species and key fisheries (Output 1.1 and Output 1.2); enhancing the FRA network (Output 1.3) using the GFCM database on sensitive benthic habitat and species to identify priority areas and support global biodiversity goals such as the 30×30 target (Box 17); consolidating adaptive harvest strategies through broader application of MSEs and refinement of HCRs (Output 1.1 and Output 1.2); mainstreaming climate and NIS considerations into all aspects of management (Output 1.4); fully embedding SSF into governance through participatory approaches and improved data systems (Target 4); and strengthening compliance and enforcement mechanisms across the region (Target 2).

Together, these priorities form a coherent roadmap for advancing the GFCM 2030 Strategy, ensuring that fisheries in the Mediterranean and the Black Sea become sustainable while remaining resilient, productive, and equitable in the face of evolving environmental and socioeconomic challenges.

Box 19. Assessing the effectiveness of GFCM management plans

Assessing the effectiveness of management plans allows for the timely adjustment of measures based on biological, ecological and socioeconomic feedback and ensures that multiannual management plans are adaptive and serve as dynamic frameworks capable of evolving with the fisheries they govern.

Considering the structure of existing GFCM multiannual management plans, their effectiveness can be assessed using three categories of indicators:

- Technical indicators refer to direct observations, often regulated by the management measures, e.g. volume of landings for target species, number of vessels, gross tonnage and power (in kW), and the number of fishing days.
- Biological (stock status) indicators include trends in fishing mortality (F) and biomass (B) compared to their relevant reference points (e.g. F/F_{target} and B/B_{target}, respectively) as determined through the stock assessment process.
- Socioeconomic indicators capture the impacts of management plans on livelihoods, e.g. number of jobs, value of landings, revenue or catch per vessel.

Despite improved data collection, some gaps remain, posing challenges for fully assessing the effectiveness of management plans. Full information is available on stock status for most key species covered by management plans in place, with very few exceptions, and data on technical indicators are available for most countries and for the majority of fisheries managed. However, socioeconomic information remains unavailable in the fisheries-specific context required by this analysis. In cases where extrapolation from available GFCM Data Collection Reference Framework submissions might be possible, the current reference year (set to two years prior for most assessments) hinders timely and responsive monitoring of the socioeconomic impacts of management plans. In addition, short time series limit long-term trend analysis while environmental factors beyond management control add uncertainty in attributing results to specific measures.

The specific example of the demersal fisheries targeting European hake (*Merluccius merluccius*) and deep-water rose shrimp (*Parapenaeus longirostris*) in the Strait of Sicily illustrates the process used to assess the effectiveness of GFCM management plans.

Trawl fisheries for demersal stocks in the Strait of Sicily have been managed through a series of GFCM recommendations aiming to bring fishing mortality to sustainable levels and maintain biomass above precautionary thresholds. The most recent

Biological indicators used to assess the multiannual management plan for the sustainable exploitation of demersal stocks in the Strait of Sicily

Biological indicators		Value in 2019	Value in 2023	Percentage change
F/F_{target}	European hake	1.314	0.869	–33%
	Deep-water rose shrimp	1.061	0.854	–19%
B/B_{target}	European hake	0.821	0.901	+9%
	Deep-water rose shrimp	0.732	0.837	+14%

Technical indicators used to assess the multiannual management plan for the sustainable exploitation of demersal stocks in the Strait of Sicily

Technical indicator	Value in 2021	Current value	Year of current value	Percentage change	Comment
Total catch of species covered by the management plan (tonnes)	2 923	2 438	2023	–16%	Total catch of European hake and deep-water rose shrimp as reported in the GFCM Data Collection Reference Framework for European Union Member States only
Total effort of fleets covered by the management plan (fishing days)	23 805	19 619	2023	–17%	Total effort attributed to European Union fleets targeting European hake
Total number of authorized vessels under the management plan	1 045	828	2024	–20%	Number of vessels authorized to fish the target species in European Union Member States and Tunisia
Total gross tonnage of authorized vessels under the management plan	79 799	69 822	2024	–12%	Gross tonnage of vessels authorized to fish the target species in European Union Member States and Tunisia
Total power (in kW) of authorized vessels under the management plan	324 017	282 487	2024	–12%	kW of vessels authorized to fish the target species in European Union Member States and Tunisia

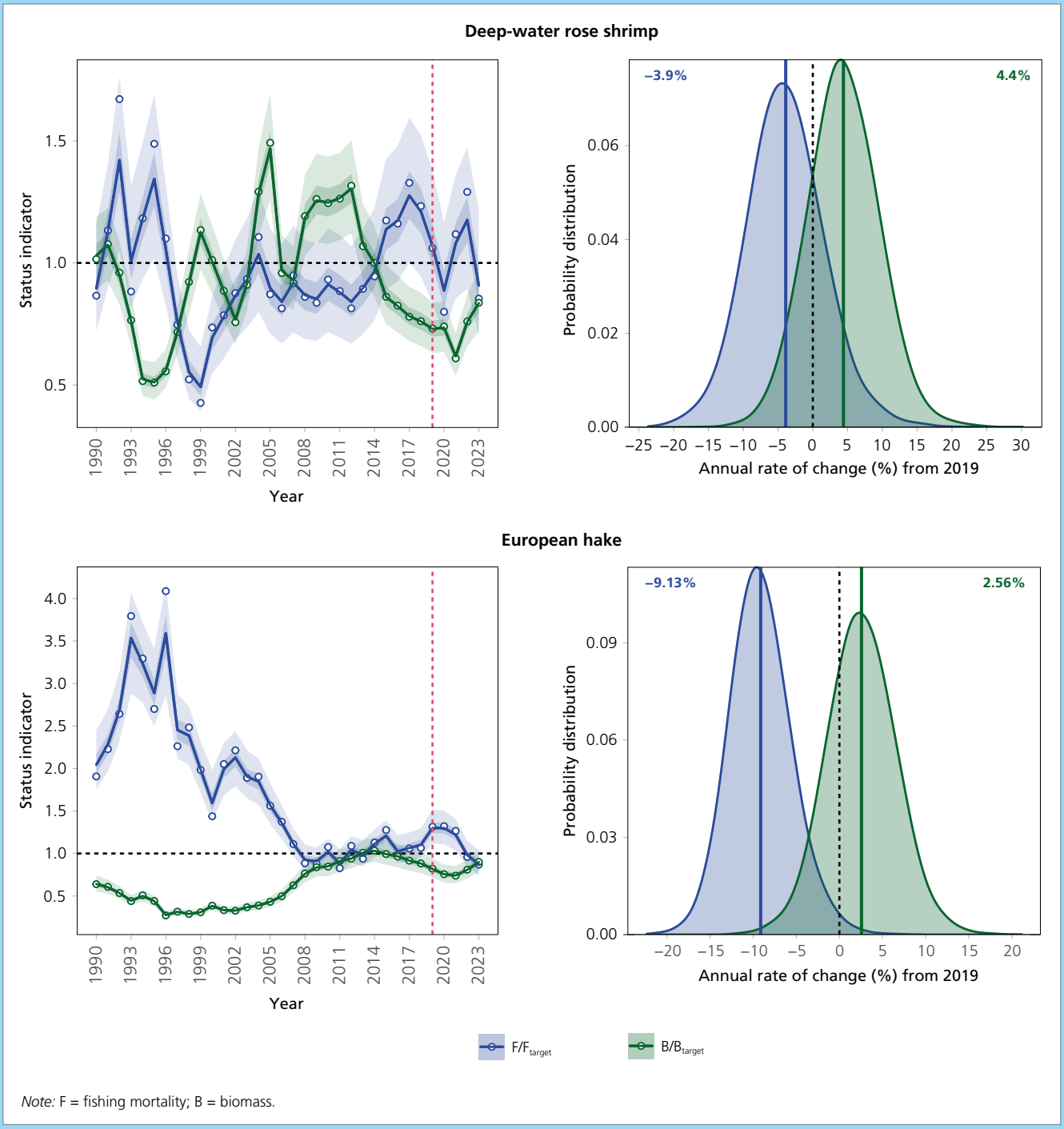
Note: The year 2021 was used as a starting point for reduction of deep-water rose shrimp catch limits and ceiling year for fleet capacity.

(Continued)

Box 19. (Continued)

of these is Recommendation GFCM/45/2022/4 on a multiannual management plan for the sustainable exploitation of demersal stocks in the Strait of Sicily (geographical subareas 12 to 16), repealing Recommendations GFCM/44/2021/12 and GFCM/42/2018/5 (GFCM, 2025). Key actions include limiting trawler fishing effort on European hake, establishing catch limits for deep-water rose shrimp, implementing seasonal and spatial (i.e. fisheries restricted areas) closures, and enforcing monitoring

Trends in biomass and fishing mortality compared to target values for deep-water rose shrimp and European hake in the Strait of Sicily, and associated probability density distributions



Note: F = fishing mortality; B = biomass.

(Continued)

Box 19. (Continued)

and reporting to promote both biological recovery and socioeconomic stability.

Two categories of indicators were assessed against the provisions of the multiannual management plan according to available data from the GFCM Data Collection Reference Framework; however, currently available socioeconomic data were not sufficient to conduct any substantial analysis at the time of writing. For the period 2021–2023, the total catch of the species under the management plan dropped by 16 percent, aligning with a 17 percent decrease in the number of fishing days. At the same time, fleet capacity in terms of number of vessels dropped by 20 percent, while both gross tonnage and total power dropped by 12 percent.

A favourable change in the ratio of F/F_{target} over the period 2019–2023 was observed for both key species, with a 33 percent decrease in the ratio for European hake and a 24 percent decrease for deep-water rose shrimp, bringing both stocks below the target values according to the latest assessment. At the same time, biomass increased by 9 percent for European hake and by 14 percent for deep-water rose shrimp compared to target values (B/B_{target}) over the same period; nevertheless, for both species, biomass was still below target values. The figure in this box also shows the trends in stock status indicators (F/F_{target} and B/B_{target}).

The approach described enables to understand whether management objectives are on track to be met, with the aim of ensuring adaptiveness in all contexts – biological, social and economic. Currently, emphasis is placed on linear tracking of key stock status metrics, such as fishing mortality and stock biomass, against both target and limit reference points; this enables a response to the safeguards embedded in all management plans, whereby provisions are in place to trigger remedial measures, should the spawning biomass of any of the key stocks fall below precautionary (B_{PA}) and limit (B_{lim}) biomass reference points. Alongside annotated timelines (FAO, 2022), this information significantly contributes to supporting the basic needs of adaptive management, by allowing for timely and evidence-based adjustments. Despite challenges in data completeness and comparability, particularly for socioeconomic indicators, the development of a standard evaluation approach that includes additional indicators offers a consistent tool for future assessments. Moving forward, this approach should be implemented across GFCM management plans according to available data, with regular updates and refinements based on evolving data availability and scientific advice, ensuring that management remains responsive, transparent and effective.

Sources:

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GFCM. 2025. *Compendium of GFCM decisions.* Rome. https://fao.org/gfcm/decisions

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7. Aquaculture management

This chapter presents an analysis of the evolution of aquaculture management in the Mediterranean and the Black Sea, with a focus on policy, governance structures, enabling environment and technical measures. It highlights efforts to modernize legal frameworks, planning and management, as well as to enhance value chains, social acceptability and capacity development, laying the groundwork for a more sustainable and resilient aquaculture sector capable of effectively addressing regional challenges and contributing to the GFCM 2030 Strategy for sustainable fisheries and aquaculture in the Mediterranean and the Black Sea (GFCM 2030 Strategy; see Box 2). Following an introduction on the state of aquaculture in the Mediterranean and the Black Sea, the chapter describes aquaculture governance and planning, including frameworks, zoning and management. It then proceeds with presenting how relevant policies, investments and market conditions contribute to creating an enabling environment, followed by a summary of capacity development and knowledge-sharing activities including through recently established Aquaculture Demonstration Centres (ADCs). Regional comparisons and trends are then presented, laying the ground for a concluding discussion on the way forward for aquaculture in the region, including next steps and opportunities.

The preparation of this chapter is based on a survey carried out by the Technical Advisory Group on Governance and Responsible Investment in Aquaculture within the Scientific Advisory Committee on Aquaculture to monitor Target 3 "Aquaculture: a

sustainable and resilient sector growing to its full potential" of the GFCM 2030 Strategy. Fourteen contracting parties and cooperating non-contracting parties (CPCs) participated in this survey and data gaps were supplemented by other GFCM sources, including a regional survey on environmental monitoring programmes, a survey on responsible investment and a survey on Blue Transformation success stories, all conducted between 2024 and 2025.

BACKGROUND: GLOBAL TRENDS AND SUSTAINABILITY PRINCIPLES

Over the past 50 years, aquaculture has emerged as the fastest-growing component of the fisheries and aquaculture sector globally. In 2022, its production reached an unprecedented 130.9 million tonnes, valued at USD 312.8 billion, consisting of 94.4 million tonnes of aquatic animals and 36.5 million tonnes of algae, and representing 59 percent of total fisheries and aquaculture output (FAO, 2024). Amid persistent food insecurity affecting 2.3 billion people and inability to afford a healthy diet for 2.6 billion (FAO *et al.*, 2025), aquaculture plays an increasingly vital role in enhancing food system resilience, supporting nutrition and promoting sustainable livelihoods. The adoption of the FAO Guidelines for Sustainable Aquaculture in 2024 represented a key step in promoting responsible growth through improved governance and management (FAO, 2025l). In the Mediterranean and the Black Sea, aquaculture production has grown significantly (see Chapter 4). This growth is supported by a set of regional guidelines that address governance, environmental, economic and social dimensions, providing decision-makers with a tool for policy development (FAO, 2022a, 2022b, 2023a, 2023b). These efforts align with the Blue Transformation Roadmap 2022–2030, which targets a 35–40 percent increase in sustainable aquaculture by 2030 (FAO, 2022d). The GFCM 2030 Strategy (see Box 2) further incorporates aquaculture within its wider framework of food security, climate adaptation and coastal zone management.

GOVERNANCE AND PLANNING: FRAMEWORKS, ZONING AND MANAGEMENT

Over the past decade, most CPCs have significantly strengthened governance and planning tools to support the sustainable and well-regulated development of aquaculture. Nearly 89 percent of CPCs[48] now have aquaculture-related legislation, strategies or plans in place, with many integrating aquaculture into marine spatial planning (MSP) processes and establishing allocated zones for aquaculture (AZAs). The region's collective progress reflects a strong commitment to implementing GFCM guidelines and fostering coordinated, science-based management practices.

Legal and institutional modernization has been a central feature of this progress. Several CPCs, including Algeria, Georgia, Greece, Morocco and Türkiye, have successfully revised or adopted specific aquaculture laws and policies that improve transparency, streamline licensing procedures and enhance coordination among competent authorities. Institutional measures, such as one-stop-shop licensing systems and the establishment of aquaculture councils or committees, are examples of approaches that can further enhance the efficiency and coherence of licensing processes, as highlighted in the GFCM *Guidelines for streamlining aquaculture licensing and leasing processes* (FAO, 2022a).

The integration of aquaculture into MSP has progressed significantly in the Mediterranean and the Black Sea. A growing number of countries (83 percent) are now using AZAs (Box 20) as a structured spatial management tool to optimize site selection while ensuring environmental sustainability (Macías *et al.*, 2019); 6 percent are in the process of implementing AZAs while 11 percent have not yet adopted AZAs or similar zoning systems.[48] Allocated zones for aquaculture are defined on the basis of explicit spatial and environmental criteria, including water depth, current patterns, water quality, substrate type, distance from sensitive habitats, and competing uses and users. Their designation typically follows strategic environmental and

[48] Based on the 2024 survey on environmental monitoring programmes and the 2025 follow-up survey monitoring progress under Target 3 of the GFCM 2030 Strategy, 18 countries reported data: Albania, Algeria, Bulgaria, Croatia, Egypt, France, Georgia, Greece, Italy, Lebanon, Libya, Malta, Montenegro, Morocco, Romania, Spain, Tunisia and Türkiye.

socioeconomic assessments, ensuring that aquaculture development occurs within areas of demonstrated ecological and logistical suitability. Once established, AZAs provide a framework for setting carrying capacity limits, buffer zones and environmental quality standards, allowing authorities to manage cumulative impacts and monitor ecosystem performance. Greece and Spain have taken the lead in creating legislation to establish organized aquaculture zones; Italy and other Adriatic CPCs have integrated aquaculture into MSP; and several CPCs in North Africa, such as Algeria, Morocco and Tunisia, have mapped priority coastal areas for aquaculture, either prior to the establishment of farms (as in Morocco) or during the development process (as in Algeria and Tunisia) (Box 21).

Environmental monitoring and management requirements have also become standard practice in the region. More than 80 percent of countries now mandate and enforce environmental monitoring programmes, ensuring oversight of water quality, benthic impacts, biodiversity and ecosystem health. Around 10 percent are in the process of integrating such programmes into their national frameworks, while another 10 percent have yet to establish them. These monitoring efforts provide regulators with the evidence needed to adjust farm operations as necessary, enhancing sustainability and strengthening public confidence in both aquaculture farms and aquatic products.

Likewise, stakeholder engagement has improved. National advisory bodies have been inspired by regional platforms promoting transparency and social acceptability, such as the GFCM Aquaculture Multistakeholder Platform (GFCM, 2013), along with national mirror platforms that address concerns related to competition with tourism, fisheries and conservation.

However, dedicated aquaculture legislation and spatial planning are still needed in several countries, particularly in Lebanon, Libya and the Syrian Arab Republic. Where such schemes do exist, they are sometimes partially or slowly implemented. For instance, Egypt has adopted AZAs, but a comprehensive marine zoning system is not yet in place. In Greece, the process for establishing organized aquaculture zones has been ongoing for over eight years.

Licensing also remains a significant bottleneck. In some countries, approval processes can take over a year, creating uncertainty for investors. Streamlining efforts, such as the "one-stop-shop" approach implemented in Morocco, should be promoted as best practices for replication across the region.

Levels of compliance and enforcement vary across the region. In some cases, environmental agencies face technical and financial constraints that can limit their capacity to carry out inspections or respond effectively to monitoring data. Sanctions for non-compliance are in place in many countries, though their effectiveness is sometimes limited. Cross-border cooperation also presents opportunities for further strengthening, particularly given the transboundary nature of many aquaculture-related impacts. Enhanced regional coordination remains crucial for the effective management of shared water bodies, the prevention of aquatic animal disease outbreaks and the mitigation of risks associated with non-indigenous species.

Finally, social acceptability of aquaculture continues to require careful attention. In some areas, public concerns persist – often linked to negative perceptions of environmental impacts, such as pollution, and issues related to aquatic animal welfare. While these concerns are not always supported by scientific evidence, they nonetheless play a significant role in shaping public attitudes towards aquaculture. Overall, stakeholder engagement has improved, with producers making notable efforts to comply with regulations and contribute to responsible practices. However, there remains a need for more systematic and inclusive approaches to strengthen trust and transparency. Proactive communication strategies, grounded in dialogue, education and evidence, can help address concerns constructively and foster greater public support for sustainable aquaculture development.

ENABLING ENVIRONMENT: POLICIES, INVESTMENTS AND MARKET CONDITIONS

In addition to sound governance, an enabling environment is crucial for fostering the growth of aquaculture. An enabling environment is characterized by investment incentives, as well as access to finance, infrastructure, services, research and innovation. In the Mediterranean and the Black Sea, significant progress has been made

Box 20. Allocated zones for aquaculture: building a regional framework for sustainable spatial planning

The establishment of allocated zones for aquaculture (AZAs) – i.e. designated areas for aquaculture delineated within marine spatial planning processes – is a cornerstone of sustainable aquaculture development in the Mediterranean and the Black Sea. The policy foundations for AZAs in the region were laid in 2012, when the GFCM adopted Resolution GFCM/36/2012/1 on guidelines on allocated zones for aquaculture (GFCM, 2025). Since then, the GFCM has promoted a harmonized, science-based and inclusive approach to aquaculture spatial planning, helping countries identify suitable sites, minimize conflicts and ensure environmental sustainability.

Over the past decade, training initiatives have progressively built regional expertise on aquaculture spatial planning, evolving from fundamental site selection principles to more advanced applications such as carrying capacity estimation and modelling, and the use of geographic information systems and remote sensing. These initiatives have provided countries across the region with both conceptual knowledge and practical tools to support the identification and management of suitable zones for aquaculture.

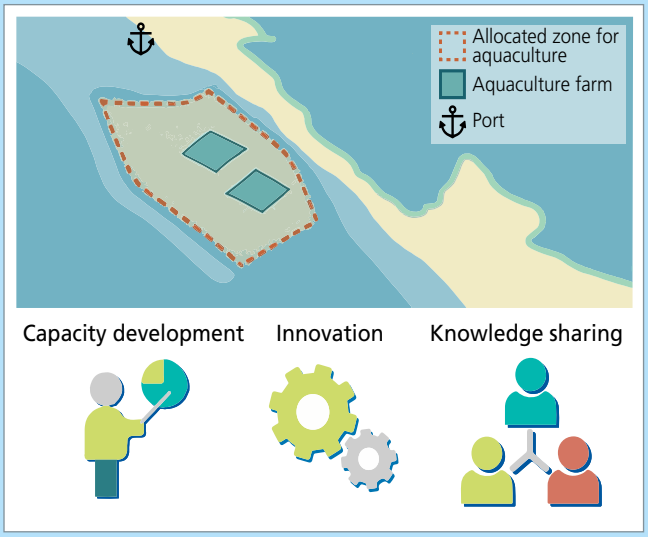
These efforts have been supported by technical tools and publications developed by the GFCM and its experts, such as a guide for the establishment of allocated zones for aquaculture in the Mediterranean and the Black Sea (Macías *et al.*, 2019), a toolkit on allocated zones for aquaculture (FAO, 2019), and a manual on the use of geographic information systems for the identification of allocated zones for aquaculture (Fourdain, Macías and Porporato, 2024).

Alongside training, the GFCM has also facilitated knowledge exchange through its Scientific Advisory Committee on Aquaculture and Technical Advisory Groups, in particular the Technical Advisory Group on Spatial Planning for Aquaculture. This advisory group has supported regional collaboration and promoted harmonized methodologies for environmental monitoring and advanced shared tools for planning, including in the context of climate change.

Methods for establishing AZAs are increasingly being integrated into broader marine planning frameworks, such as the ecosystem approach to aquaculture and marine spatial planning. This integration contributes to effective coastal zone management and the protection of sensitive ecosystems, and aligns with national climate adaptation strategies.

Overall, these efforts have enabled countries across the region to apply spatial planning principles to aquaculture in a consistent and informed manner. By combining in-person and digital learning with methodological innovation and institutional dialogue, the GFCM has fostered the development of a regional community of practice on sustainable aquaculture development.

Building sustainable aquaculture through allocated zones for aquaculture, capacity development and knowledge sharing



Sources:
FAO. 2019. *Toolkit on allocated zones for aquaculture – Benefits, implementation and management*. Rome. https://openknowledge.fao.org/handle/20.500.14283/ca5736en
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GFCM. 2025. *Compendium of GFCM decisions*. Rome. https://fao.org/gfcm/decisions
Macías, J.C., Avila Zaragozá, P., Karakassis, I., Sanchez-Jerez, P., Massa, F., Fezzardi, D., Yücel Gier, G. *et al.* 2019. *Allocated zones for aquaculture – A guide for the establishment of coastal zones dedicated to aquaculture in the Mediterranean and the Black Sea*. Studies and Reviews (General Fisheries Commission for the Mediterranean), No. 97. Rome, FAO. https://openknowledge.fao.org/handle/20.500.14283/ca7041en

in this area, including the introduction of new funding and financing mechanisms, improved access to technology and initiatives aimed at enhancing product traceability and quality.

In several countries, particularly in Europe, aquaculture has been integrated into development strategies and blue economy plans. Governments have adopted incentives, including tax benefits, co-financing mechanisms and sectoral aquaculture investment bodies. European Union (EU) subsidies, mainly under the European Maritime, Fisheries and Aquaculture Fund (EMFAF), have encouraged the modernization of productive infrastructures and equipment and helped promote more environmentally friendly and climate-resilient systems through research and development, innovation and collective marketing.

There have been marked improvements in infrastructure across the European Union, with the development of shared aquaculture parks, cold storage facilities, hatcheries and data platforms boosting efficiency and reducing costs for producers. Public–private partnerships and foreign direct investment have also played a role in sectoral development and technology transfer.

The traceability and certification of products and production processes are also gaining ground. All EU Member States implement complete traceability from farm to fork, and non-EU countries are progressively implementing electronic solutions to comply with export demands. Certification schemes, such as organic certifications for shellfish, are also gaining popularity.

However, market competition remains challenging. Smaller local producers generally experience higher production costs and less market access opportunities compared to global players. They face competition from low-cost imports originating from countries with less

Box 21. Strategic directions for aquaculture in North Africa

North Africa is a key region for aquaculture development on the African continent. Despite natural limitations such as freshwater scarcity and arid conditions, it produces nearly 70 percent of Africa's total aquaculture output, demonstrating strong innovation capacity and resilience in the face of environmental constraints and geopolitical pressures. Egypt is by far the largest producer in the region, accounting for over 98 percent of North Africa's total aquaculture output. However, economic risks such as high inflation, currency instability and a reliance on imports continue to pose long-term challenges for the industry.

Tunisia and Algeria have adopted more diversified, climate-smart approaches. Tunisia has operationalized pilot allocated zones for aquaculture, integrated artificial intelligence into monitoring systems and piloted integrated multitrophic aquaculture. Algeria is scaling up the use of biofloc technology – an aquaculture technique for enhancing water quality and using feed waste in the aquaculture system (Neupane *et al.*, 2020) – and tilapia in brackish water, while promoting aquaponics and implementing a comprehensive environmental, social and governance-aligned investment code. In Morocco, the national Halieutis strategy – supported by dedicated aquaculture legislation and a specialized agency – aims to capitalize on the country's favourable coastal conditions to develop marine aquaculture while also clustering coastal allocated zones for aquaculture. In Libya, aquaculture is progressing at a slower pace due to ongoing institutional challenges. Nonetheless, the country holds considerable potential that could be unlocked with targeted international support and well-designed development programmes.

Prompt policy action is needed to reduce North Africa's vulnerability to climate stress, enhance regional trade in aquaculture inputs and address its dependence on imported feeds and seeds. Common challenges – such as water scarcity and import dependency – require regional solutions that integrate environmental management, inclusive development, innovation and technology transfer.

In conclusion, North Africa's potential to upscale aquaculture into a catalyst for food security and inclusive growth relies on investing in collaboration, innovation and climate resilience. With public and private investment facilitated by development finance, sound policy frameworks and the successful transfer and adaptation of knowledge, the region can transition from a volume-based approach to one based on sustainability, equity and global competitiveness.

Source:
Neupane, P., Adhikari, M., Thapa, M.K., & Pandeya, A.K. 2020. Bio-Floc Technology: Prospects & Challenges in Fish Farming of Nepal. *International Journal of Applied Sciences and Biotechnology*, 8(2): 140–145.

stringent compliance regulations. Value addition through processing, branding and certification continues to be a core component of delivering improved access to markets, according to current demand structures. Achieving an enabling environment is closely related to the social acceptability of the sector: in places where the public image of aquaculture is poor, the sector faces opposition and difficulty in attracting new entrants, particularly in countries of the northern Mediterranean. Efforts to improve public perception through education, transparency and outreach remain essential. The GFCM 2030 Strategy, as well as ADCs and Technical Advisory Groups (TAGs) (Box 22) are helping to improve the perception of aquaculture.

At the same time, disparities in access to resources for climate resilience and innovation persist across the region. Some countries face constraints in mobilizing adequate investment for research, adaptation and technology development or transfer, potentially intensifying differences in performance and sustainability.

Other obstacles in the Mediterranean and the Black Sea include complex administrative requirements, high compliance costs and limited access to appropriate financial services, particularly for non-EU countries, where small- and medium-sized enterprises often struggle to meet regulatory requirements and may not have access to affordable financing or insurance. The recently adopted Resolution GFCM/47/2024/3 on principles for responsible investment in aquaculture offers a promising tool for national and international development organizations and financial institutions (GFCM, 2025a). These principles provide guidance in designing development finance instruments and supporting inclusive, innovative financial services. They also aim to attract private investment to support the sustainable and equitable growth of aquaculture across the region.

Overall, regulatory frameworks for aquaculture in the region have made significant progress; however, further improvements are needed – including simplifying licensing processes, increasing access to finance, reinforcing value chains and achieving social acceptability. By addressing these areas, countries can create an enabling environment for responsible and equitable growth, contributing to food security, employment and economic diversification.

CAPACITY DEVELOPMENT AND KNOWLEDGE SHARING

The GFCM supports training, technology transfer and data exchange, including through its ADCs (Box 23). The GFCM promotes technical workshops and networks, including the Aquaculture Experts Database (FAO, 2025m), the regional network of institutions for pathogen diagnosis and treatment[49] hosted under the Information System for the Promotion of Aquaculture in the Mediterranean (FAO, 2025i), and the TAGs network. It also organized Regional Aquaculture Conferences in Bari, Italy, in 2014 (FAO, 2017) and Heraklion, Greece, in 2024 (FAO, 2025n) to measure sector progress and sustainability.

Across the region, government institutions have expanded aquaculture education, strengthened research institutions and enhanced extension services. Producer associations and regional platforms facilitate knowledge transfer and the exchange of valuable know-how. Universities and research institutes are conducting cutting-edge work in genetics, nutrition and ecosystem impacts, enabling extension services to begin transferring this knowledge into practice at the farm level. Meanwhile, regional platforms and databases promote transparency and information exchange, helping countries to compare progress and exchange innovations.

Nevertheless, capacity and know-how remain uneven across the region. Some CPCs lack specialized aquaculture professionals or extension services, and, in some cases, do not have the financial resources to train their staff, creating bottlenecks for further growth. Knowledge does not always reach small-scale farmers, who often lack tailored advisory services. Data collection systems remain weak in some cases, limiting evidence-based policymaking and enforcement. Furthermore, new priorities, such as climate resilience and adaptation, as well as new technologies like artificial intelligence and restorative aquaculture, require new skills and capacity needs that are not yet fully available throughout the region.

In summary, capacity development has expanded significantly in the region but remains an ongoing priority. Key objectives include closing

[49] Resolution GFCM/47/2024/4 on the establishment of a network of institutions for pathogen diagnosis and treatment in aquaculture

the capacity gap between countries, promoting the exchange of best practices, institutionalizing training and leveraging modern communication and information-sharing technologies. The GFCM's coordinating role remains central in ensuring that innovations and best practices are widely disseminated and adequately shared across the region.

INTEGRATING ENVIRONMENTAL SUSTAINABILITY: CLIMATE CHANGE, BIODIVERSITY AND COASTAL MANAGEMENT

Climate change, biodiversity conservation and coastal zone management are cross-cutting issues that must be integrated into aquaculture planning, expansion and intensification. The Mediterranean is a climate change hot spot, with rising sea temperatures, extreme weather events and ocean acidification threatening the viability of aquaculture as it is currently practised. In response to this situation, countries have started adopting measures such as relocating farms to deeper waters, breeding more resilient species and investing in early warning systems, particularly to address emerging diseases and the resulting increase in mortality and losses. However, contingency planning and climate-smart investments are insufficient and need to be expanded.

Aquaculture planning must incorporate the conservation of biological diversity. Sensitive habitats are protected through aquaculture zoning, in line with AZA principles (Macías *et al.*, 2019), and by promoting low-impact and restorative farming (e.g. seaweed and shellfish). Actions to reduce escapes, optimize the use of fish meal in the feed industry and adopt welfare standards while increasing production have become more routine; however, their cumulative impacts and potential conflicts with conservation objectives remain a concern.

Aquaculture is also increasingly being incorporated into integrated coastal zone management and marine spatial planning. Almost all CPCs now recognize aquaculture as a legitimate coastal activity that must be balanced with fisheries, tourism, conservation and other activities in coastal areas. While progress has been made, cross-border coordination remains a work in progress, particularly in addressing common challenges such as the management of emerging aquatic pathogens.

Box 22. Technical Advisory Groups: driving regional progress through expertise and collaboration

The Technical Advisory Groups (TAGs) were established in 2022 within the Scientific Advisory Committee on Aquaculture as a result of the second performance review of the GFCM. Their mandate is to enhance consultation among stakeholders, ensure the refinement of technical proposals submitted to the Scientific Advisory Committee on Aquaculture, and provide a structured platform for exchange among actors from different countries.

From their inception, TAGs have played a significant role in the development of science-based regional policy frameworks and in supporting their implementation through concerted technical and policy work. Their thematic orientations – including marine spatial planning, sustainability and socially acceptable practices, technology uptake efforts and responsible investment attraction and promotion – show how technical expertise informs governance processes and regional strategies.

Key achievements

- **Governance and responsible investment:** Principles for responsible investment in aquaculture were developed to guide national and international development organizations, as well as financial intermediaries, in designing and delivering development finance and inclusive, innovative financial service packages. These principles aim to support the sustainable and transformative development of aquaculture in the region, as outlined in Resolution GFCM/47/2024/3 on principles for responsible investment in aquaculture (GFCM, 2025).
- **Value chains and efficiency:** Harmonized methodologies for aquaculture value chain analysis are under preparation, and production losses from hatchery to market are being assessed. These efforts help to identify inefficiencies, successfully implement circular-economy

(Continued)

REGIONAL COMPARISON AND TRENDS

Aquaculture in the Mediterranean and the Black Sea has followed different developmental paths and trajectories across countries.

In the European Union, unlike fisheries, aquaculture competence is shared between the European Union and its Member States. Nevertheless the sustainable development of aquaculture is a core objective of the Common Fisheries Policy, and aquaculture is often referenced in policy frameworks and instruments, including the European Green Deal (European Commission, 2025a), which recognizes aquaculture as a source of low-carbon protein for food and feed, and more recently the Ocean Pact (European Commission, 2025b), which includes aquaculture as a key area for sustainable blue economy development and environmental protection.

Since the adoption of a strategy for the sustainable development of European aquaculture in 2002, the European Commission has adopted, in 2013, non-binding strategic guidelines for the sustainable development of EU aquaculture (European Commission, 2002, 2013). These strategic guidelines were updated in 2021 to promote a more sustainable and competitive aquaculture sector within the European Union and were supported in 2024 with the adoption of a regulatory and administrative framework for aquaculture (European Commission, 2024a), as well as a guiding document focused on spatial planning and access to water for marine aquaculture (European Commission, 2024b). The current policy serves as the basis for the development of specific national strategic plans for aquaculture by EU countries, supported by funding from the EMFAF. However, the aquaculture sector is perceived to remain subject

Box 22. (Continued)

behaviour, enhance profitability and establish direct pathways between research findings and policymaking.

- **Aquaculture emerging diseases:** A priority list of pathogens to be addressed through joint coordination was identified, as outlined in Resolution GFCM/47/2024/4 on the establishment of a network of institutions for pathogen diagnosis and treatment in aquaculture (GFCM, 2025).
- **Spatial planning and governance:** Support is being provided for the implementation of allocated zones for aquaculture and aquaculture management areas in marine and inland areas. This includes capacity development initiatives, geographic information system-based identification and the refinement of the allocated zones for aquaculture toolbox to integrate climate change effects and new engineering innovations. The work also involves defining aquaculture zones for restoration and establishing frameworks for the designation of aquaculture management areas in inland waters. These actions contribute to improved spatial planning, stronger governance and more effective policy alignment.
- **Environmental monitoring programmes:** Regional guidelines for monitoring marine finfish cage farming were developed, including quality standards, new techniques and thresholds. These developments promote evidence-based decision making and support the long-term sustainability of the sector.
- **Capacity development and innovation:** Contributions were made to the design of modules on digital monitoring, climate-resilient production systems and youth engagement strategies, which feed into regional training initiatives organized through the Aquaculture Demonstration Centres.

Technical Advisory Groups play a key role in shaping science-based aquaculture policies and supporting their implementation across the region. By providing technical expertise on issues such as spatial planning, environmental sustainability, social acceptability, innovation and investment, they inform and guide national actions. Their continued work is essential to address emerging challenges and contribute to the GFCM 2030 Strategy for sustainable fisheries and aquaculture in the Mediterranean and the Black Sea (FAO, 2021).

Sources:

FAO. 2021. *GFCM 2030 Strategy for sustainable fisheries and aquaculture in the Mediterranean and the Black Sea*. Rome. https://doi.org/10.4060/cb7562en
GFCM. 2025. *Compendium of GFCM decisions*. Rome. https://fao.org/gfcm/decisions

to complex and long licensing and monitoring procedures under EU and national regulations, thus creating a challenging business and investment environment for new entrants and limiting growth for existing operators. While efforts are being made to improve governance and reduce bureaucratic burdens and associated regulatory compliance costs, some issues still require further attention, especially regarding small-scale producers and their access to existing financial support mechanisms, such as the EMFAF.

By contrast, policies and realities in non-EU countries are very diverse. Türkiye has developed a strong legal framework and has become a global exporter of European seabass (*Dicentrarchus labrax*) and blackspot seabream (*Pagellus bogaraveo*). In the eastern Mediterranean, several countries are still in the process of consolidating foundational policies and institutions. Meanwhile, a number of North African countries have made important policy advancements but continue to face challenges in attracting the necessary investments to fully realize their aquaculture potential.

There are also significant differences in production trends within the region. Egypt and Türkiye are the largest producers overall, yet their production profiles are markedly different. Egypt's aquaculture is mainly based on freshwater and brackish water systems in the Nile Delta, focusing on Nile tilapia (*Oreochromis niloticus*), common carp (*Cyprinus carpio*) and mullets nei (Mugilidae) for domestic consumption, with marine inland aquaculture emerging over the past ten years. Meanwhile, Türkiye is focusing mainly on marine finfish farming for the export market. In the northern Mediterranean, on the other hand, aquaculture maintains stable but slower growth, prioritizing high-value species, such as European seabass, blackspot seabream and low trophic species like oysters and mussels, and increasingly experimenting with diversification into faster-growing species like greater amberjack (*Seriola dumerili*), which make processing and value addition more cost-effective.

North African countries, including Algeria, Morocco and Tunisia, currently produce relatively modest volumes but have articulated ambitious growth plans, leveraging their extensive coastlines, enabling investment environment and warm-water conditions. In the Black Sea, Türkiye is the main producer, while Bulgaria, Georgia and Romania contribute at smaller scales, mainly with rainbow trout (*Oncorhynchus mykiss*) and mussel farming.

The differences are also reflected in institutional capacity. In countries like France, Italy, Greece and Spain, research institutes, extension services and specialized agencies are well developed and financially supported. They promote and invest in innovation and technology development, provide timely services and reliable statistics, and can respond effectively to emerging issues such as disease outbreaks, climate change and natural disasters. In contrast, in other countries, including

Box 23. Aquaculture Demonstration Centres: accelerating knowledge, innovation and cooperation in the region

Aquaculture Demonstration Centres (ADCs), established in accordance with Article 59 of the 2018 Sofia Ministerial Declaration (FAO, 2025a), are dedicated facilities located in each subregion of the Mediterranean and Black Sea region. Tailored to local needs, these centres support countries in advancing sustainable aquaculture production and in achieving the targets of the GFCM 2030 Strategy for sustainable fisheries and aquaculture in the Mediterranean and the Black Sea (FAO, 2021).

Since 2018, ADCs have made important contributions in scaling up technical know-how through experimentation with new approaches. The first two centres were established in 2018 in the Black Sea – one for shellfish at the National Institute for Marine Research and Development "Grigore Antipa" in Constanţa, Romania, and one for finfish at the Central Fisheries Research Institute in Trabzon, Türkiye. They serve as a model for practical training and knowledge exchange in the subregion. In recent years, other centres were created in Tunisia (Monastir, 2022), Egypt (Alexandria, 2023) and more recently, in 2025, in Bulgaria (Stara Zagora), Greece (Heraklion) and Spain (La Ràpita). Each ADC covers priority themes, including species diversification, restorative aquaculture, marine finfish production and the integration of new technologies.

For instance, the ADC in Alexandria, Egypt, contributes to national marine aquaculture

(Continued)

Box 23. (Continued)

Aquaculture Demonstration Centres in the Mediterranean and the Black Sea

Notes: Refer to the disclaimer on page ii for the names and boundaries used in this map.
ADC = Aquaculture Demonstration Centre.

Source: Base map redrawn from United Nations. 2024. United Nations Geospatial Clear Map. In: *United Nations*. New York, USA. [Cited 23 October 2025]. https://geoservices.un.org/Html5Viewer/index.html?viewer=clearmap

development plans by cooperating with the Marine Aquaculture Development Project in Egypt, while the ADC in Heraklion, Greece – operated at the Hellenic Centre for Marine Research in collaboration with the European Reference Centre for the Welfare of Aquatic Animals – covers the entire finfish production cycle, with a strong emphasis on animal welfare and best practice operations. The Mediterranean Restorative ADC in La Ràpita, Spain – established in collaboration with the Institute of Agrifood Research and Technology and the Catalan authorities – has emerged as a global leader in restorative aquaculture and nature-based solutions. The ADC in Stara Zagora, Bulgaria, implemented by Trakia University, supports innovation through its trout culture trials in the Black Sea, representing an important step towards diversification.

Furthermore, the ADCs have delivered hands-on training in a wide range of topics, including hatchery management, fish health, seaweed and shellfish farming, turbot production and restocking, feed optimization and environmental monitoring. They are also serving as venues for major knowledge-sharing events, such as the International Symposium on Fisheries and Aquatic Sciences (FAO, 2025b).

To date, more than 5 000 individuals have participated in ADC programmes, joining in-person workshops, online courses and collaborative research initiatives. These centres are strengthening regional capacity and are instrumental in fostering an active cross-border community of professionals, institutions and producers working together to create solutions for a more inclusive and sustainable aquaculture future.

Sources:
FAO. 2021. *GFCM 2030 Strategy for sustainable fisheries and aquaculture in the Mediterranean and the Black Sea*. Rome. https://doi.org/10.4060/cb7562en
FAO. 2025a. Sofia Ministerial Declaration. In: *General Fisheries Commission for the Mediterranean*. Rome. [Cited 16 October 2025]. https://fao.org/gfcm/meetings/blackseaconference2018/sofiadeclaration
FAO. 2025b. The International Symposium on Fisheries and Aquatic Sciences (SOFAS 2023) focuses on innovation and sustainability in aquaculture. In: *General Fisheries Commission for the Mediterranean*. Rome. [Cited 16 October 2025]. https://fao.org/gfcm/news/detail/en/c/1656019

Georgia, Lebanon and Libya, technical support for aquaculture remains at an early stage, with limited specialized institutions and trained human resources, which contributes to gaps in translating policy into practical industry development. While regional cooperation within the framework of the GFCM has helped narrow some of these gaps, addressing the remaining challenges will require sustained political commitment, recognition of the sector's potential and long-term investment in human and institutional capacity to ensure a level playing field.

At the Mediterranean and Black Sea level, strong early engagement with regional initiatives has played a key role in shaping national aquaculture development. Notably, the Regional Conference "Blue Growth in the Mediterranean and the Black Sea: developing sustainable aquaculture for food security" (Bari, Italy, 2014) (FAO, 2017), followed by the Regional Aquaculture Conference "Shaping the future of sustainable aquaculture in the Mediterranean and the Black Sea" (Heraklion, Greece, 2024) (FAO, 2025n) provided important momentum. These events reviewed progress, set new priorities for the sector and catalyzed significant advancements in regulatory frameworks, aquaculture zoning and investment promotion. While progress has varied across countries, these regional efforts have clearly influenced national-level reforms in areas where it was most needed, in particular in non-EU countries – albeit at different speeds and intensities. For example, between 2015 and 2021, Algeria, Morocco and Tunisia have all adopted modern aquaculture legislation and are now progressing towards the establishment of mapped aquaculture zones and pilot projects, while also attracting increased private sector interest. Other countries, particularly those that have only recently begun implementing reforms, remain in the early stages of development. Although the pace and scale of progress vary, all countries are actively working to develop and strengthen their aquaculture sectors. This reflects a shared recognition of aquaculture's potential to sustainably enhance food security, generate income, improve livelihoods, reduce poverty (especially in areas with limited alternatives) and contribute to broader economic and social development. The convergence of national ambitions further underscores the importance of regional frameworks, such as the GFCM 2030 Strategy, in guiding countries towards common goals of sustainability and resilience.

CONCLUDING REMARKS AND WAY FORWARD

Despite ongoing challenges, the Mediterranean and Black Sea region is increasingly emerging as a secure enabling environment to attract investment in aquaculture, with significant advances in governance, investment policies and environmental sustainability.

Moving forward, priorities for the sector should include: i) an update of all legal national frameworks, taking into account the importance of attracting environmentally responsible and socially impactful investment; ii) expanding work on AZAs and updating the selection criteria in all countries; iii) streamlining procedures for licensing and leasing; iv) reinforcing environmental monitoring and control; v) accrediting training that focuses on equitable growth, inclusive of women, young people and small-scale farmers; vi) guaranteeing a better acceptability and traceability system; vii) reinforcing existing networks and regional platforms, such as the Information System for the Promotion of Aquaculture in the Mediterranean; viii) including aquaculture in strategies on climate change resilience and adaptation and biodiversity preservation; and ix) encouraging the active participation of CPCs – including financial contributions – to address emerging needs and to strengthen and expand synergies among all countries through the initiatives of the GFCM. By prioritizing these actions and actively engaging national and regional farmers' organizations, local communities, consumer representatives and other relevant stakeholders, the Mediterranean and Black Sea region can enhance aquaculture's global contribution to food security, livelihoods and environmental sustainability.

The MedFish4Ever Ministerial Declaration (FAO, 2025a) included only initial references to aquaculture; however, momentum is growing for future declarations to more explicitly articulate aquaculture priorities, accelerate progress and strengthen regional cooperation, reinforcing the commitment of CPCs to common objectives in the aquaculture sector.

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The State of Mediterranean and Black Sea Fisheries 2025

This 2025 edition of the GFCM flagship publication *The State of Mediterranean and Black Sea Fisheries* presents the most comprehensive and up-to-date review of fisheries and aquaculture status and trends in the Mediterranean and Black Sea region.

The sixth installment of this report is the most ambitious to date and comes as a result of an unprecedented collaborative effort across the region. It reflects incremental scientific work, strengthened monitoring and significant innovations in data collection and analysis. *The State of Mediterranean and Black Sea Fisheries 2025* expands temporal coverage and incorporates new data on both fisheries and aquaculture, providing a clear and accurate picture of trends and challenges across the region and assessing progress towards the targets set by the GFCM 2030 Strategy for sustainable fisheries and aquaculture in the Mediterranean and the Black Sea.

The report begins with an overview of aquatic food systems in the Mediterranean and the Black Sea, before diving into a detailed analysis of capture fisheries production, bycatch and the status of fisheries resources in Chapters one through three. Chapter four explores the rapidly expanding aquaculture sector in the region. Chapter five examines the human dimension of fisheries and aquaculture through socioeconomic data and Chapters six and seven highlight the measures taken and the efforts needed to secure the sustainability of fisheries and aquaculture in the region.

This report aims to provide objective, accurate and complete information to support evidence-based decision-making, monitor progress towards sustainability goals and inspire renewed commitments.

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