Food and Agriculture Organization of the United Nations

General Fisheries Commission for the Mediterranean
Commission générale des pêches pour la Méditerranée

ISSN 2413-6905

The State of Mediterranean and Black Sea Fisheries

2016

The State of Mediterranean and Black Sea Fisheries

GENERAL FISHERIES COMMISSION FOR THE MEDITERRANEAN
COMMISSION GÉNÉRALE DES PÊCHES POUR LA MÉDITERRANÉE

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, 2016

ISBN 978-92-5-109159-3

Foreword

Few other parts of the world offer the confluence of multifaceted ecological, economic, cultural, social and legal realities that can be found in the Mediterranean and the Black Sea region. Historically, fishing in these seas has always been an important economic activity that has provided livelihood opportunities for hundreds of thousands of people and has shaped the cultural fabric of the region's coastal towns and communities. Today, the sea still plays a central role, proving to be increasingly pivotal for the region's sustainable development. The marine resources and ecosystems of this region, however, have come under increasing pressure in recent decades, driven by demographic and economic growth as well as by diversification and intensification of marine and maritime activities. Pollution, alien species, illegal fishing and overfishing all pose threats, not only to the ecosystems but also to the well-being of Mediterranean and Black Sea coastal communities and riparian States. Within this context, the work of the General Fisheries Commission for the Mediterranean to promote the development, conservation, rational management and best utilization of living marine resources in this area is of paramount importance.

This first edition of the *State of Mediterranean and Black Sea Fisheries* stems from the need to provide a comprehensive overview of the status of fisheries in this region, looking at their main features and trends, in order to better inform their management and better examine the challenges that they will face in the near future. The report is the fruit of an effort strongly supported by our Commission which, at its thirty-eighth session in May 2014, formally requested the Secretariat to prepare a publication, based on data submitted by its member countries and on information produced by its scientific bodies. The aim was to produce a document that could provide useful analysis and direction for decision-making and future action. In this respect, this publication also represents a convenient source of information for the FAO Committee on Fisheries and offers a practical complement to the data provided in the *State of World Fisheries and Aquaculture* published by the FAO Fisheries and Aquaculture Department.

The Mediterranean and Black Sea region has been a pioneer in the advancement of collaboration towards common management of fisheries resources. From as early as 1948, this region has benefitted from a common forum, the GFCM, for the promotion of regional cooperation. Established under the auspices and support of FAO, the GFCM has always enjoyed the support of a large number of Mediterranean and Black Sea States and has emerged as a point of reference among regional fisheries management organizations. Not only does it play a crucial role in regional dialogue and policy coordination among its 24 contracting parties and two cooperating non-contracting parties, but it also facilitates important interaction and cooperation with other international organizations.

In recent years, enormous strides have been made in improving the knowledge and conservation of the region's living marine resources. For example, through the Scientific Advisory Committee on Fisheries, our Commission has considerably improved both the quantity and the quality of its scientific advice, the results of which are evident in this report. Action has also been taken to adopt management plans to promptly invert the trend of the most critically unsustainably exploited stocks in the region and to protect vulnerable habitats.

Although much progress has been made, much is still much to be done. Chief among the principal management challenges for Mediterranean and Black Sea fisheries is the fight against illegal, unreported and unregulated (IUU) fishing, the implementation of additional management plans for the exploitation of all fish stocks, and measures to reduce bycatch, including both discards and incidental catch of vulnerable species. The need to integrate socio-economic analysis into management efforts is also of particular importance. As demonstrated

by the Blue Growth approach promoted by the FAO, which is anchored in the principles set out in the benchmark Code of Conduct for Responsible Fisheries back in 1995, efforts to promote conservation and resource management also hold the potential to reduce poverty and promote food security. In this regard, encouraging the sustainable development of small-scale fisheries is imperative. By endorsing the concept of "Blue Growth", particularly through small-scale fisheries, we look to the sea to generate economic opportunity and to promote the sustainable development of coastal communities and States.

This report offers an important benchmark from which to measure our future action on these crucial challenges. We see it as marking an important step towards the regular dissemination of information on the status of Mediterranean and Black Sea fisheries. It is our hope that this work bears much fruit by informing analyses of Mediterranean and Black Sea fisheries, supporting strategic decision-making and helping to monitor progress towards the sustainability of our fisheries for generations to come.

Abdellah Srour
Executive Secretary
General Fisheries Commission for the Mediterranean

Table of contents

Acknowledgements

This report stems from the request made by our Commission at its thirty-eighth session, in May 2014. During preparation work, the GFCM Secretariat has been supported by several consultants, whose expenses were covered as part of a wider grant agreement stipulated between the GFCM and the European Commission (Directorate-General for Maritime Affairs and Fisheries). A large number of experts and members of the GFCM Scientific Advisory Committee for Fisheries have provided their valuable support and comments. This work has also benefited from the contribution and inputs of several FAO services, in particular the Fisheries and Aquaculture Department. Special thanks are due to Stefania Vannuccini, who provided important information and comments on trade in Mediterranean and Black Sea riparian States. Last but not least, recognition is extended to the FAO regional projects for having contributed to this work with useful background information and for having actively participated – together with the FAO Fisheries and Aquaculture Department, the International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM-Bari), the Network of Marine Protected Area Managers in the Mediterranean (MedPAN), the World Wide Fund for Nature (WWF) Mediterranean Programme and the Government of Malta – in the Regional Symposium on Sustainable Small-Scale Fisheries in the Mediterranean and Black Sea, organized by the GFCM in Malta in December 2013. The analysis included in Chapter 6 of this report is based on the outcomes of this event.

Contributors

The State of Mediterranean and Black Sea Fisheries has been prepared by the staff of the GFCM Secretariat, under the general supervision of Abdellah Srour, GFCM Executive Secretary, with the contribution of consultants and external experts. Members of the writing team, led by Miguel Bernal (GFCM fishery resources officer) and Marcelo Vasconcellos (former GFCM consultant), were (in alphabetical order): Anna Carlson (consultant for socio-economic issues), Paolo Carpentieri (consultant for fishery data collection), Federico De Rossi (GFCM data compliance officer), Roberto Emma (GFCM data analyst), Nicola Ferri (GFCM fishery officer – institutional and legal matters), Pilar Hernández (former GFCM information management officer) and Aurora Nastasi (consultant for environmental issues). The preparation of this document has benefited from the consultancy of Jean-Jacques Maguire, who provided comments on the structure and reviewed a draft version of the report. Chapter 4 on bycatch was co-authored by Vero Cortés and Jacob González-Solís (Universitat de Barcelona, Spain) who contributed their scientific expertise and provided the section on seabirds. The editorial, graphics, layout and publishing were coordinated by Dominique Bourdenet (GFCM scientific editor), with the assistance of Coline Carmignac. Clare Pedrick performed the final editing and Magda Morales did the graphic design and layout.

Reference:

FAO. 2016. *The State of Mediterranean and Black Sea Fisheries*. General Fisheries Commission for the Mediterranean. Rome, Italy.

Abbreviations and acronyms

ACCOBAMS	Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area
CBCP	Community-based data collection programme
CCRF	Code of Conduct for Responsible Fisheries
CESTMed	Centre d'étude et de sauvegarde des tortues marines de Méditerranée
CFS	Committee on World Food Security
CIHEAM	International Centre for Advanced Mediterranean Agronomic Studies
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CNRDPA	Centre national de recherche et de développement de la pêche et de l'aquaculture
COFI	FAO Committee on Fisheries
CPUE	Catch per unit effort
CSO	Civil society organizations
CWP	Coordinating Working Party on Fishery Statistics
DCRF	Data Collection Reference Framework
EAF	Ecosystem approach to fisheries
ECB	European Central Bank
EEZ	Exclusive economic zone
EIFAAC	European Inland Fisheries Advisory Commission
EU	European Union
FAD	Fish aggregating devices
FAO	Food and Agriculture Organization of the United Nations
FRA	Fisheries restricted area
GFCM	General Fisheries Commission for the Mediterranean
GFCM-AVL	GFCM record of vessels over 15 m authorized to operate in the GFCM area
GSA	Geographical subarea
GT	Gross tonnage
ICCAT	International Commission for the Conservation of Atlantic Tunas
ICES	International Council for the Exploration of the Sea
ICZM	Integrated coastal zone management
IEO	Spanish Institute of Oceanography
ILO	International Labour Organization
INRH	Institut national de recherche halieutique
INSTM	Institut national des sciences et technologies de la mer
ISSCAAP	FAO International Standard Statistical Classification for Aquatic Animals and Plants
IUCN	International Union for Conservation of Nature
IUU	Illegal, unreported and unregulated (fishing)
LOA	Length overall
MaPAMed	Marine protected areas in the Mediterranean
MCS	Monitoring, control and surveillance
MDG	Millennium Development Goals
MedArtNet	Mediterranean Platform of Artisanal Fishermen
MedPAN	Network of Marine Protected Area Managers in the Mediterranean
MPA	Marine protected area

NGO	Non-governmental organizations
OECD	Organisation for Economic Co-operation and Development
RFMO	Regional fisheries management organizations
ROV	Remotely operated underwater vehicles
SAC	Scientific Advisory Committee on Fisheries
SAF	Stock assessment forms
SAM	State-space assessment model
SDG	Sustainable Development Goals
SPA/BD Protocol	Protocol concerning specially protected areas and biological diversity in the Mediterranean
SSB	Spawning stock biomass
SSF	Small-scale fisheries
SSF Guidelines	Voluntary Guidelines for Securing Small-scale Fisheries in the Context of Food Security and Poverty Eradication
SSF Symposium	First Regional Symposium on Sustainable Small-Scale Fisheries in the Mediterranean and Black Sea
SPAMI	Specially protected area of Mediterranean interest
STECF	Scientific, Technical and Economic Commission for Fisheries
SURBA	Survey-based assessment
UNEP-MAP	United Nations Environment Programme – Mediterranean Action Plan for the Barcelona Convention
UNFSA	United Nations Fish Stocks Agreement
WGEEL	Joint EIFAAC/ICES/GFCM Working Group on Eels
VME	Vulnerable marine ecosystems
VMS	Vessel monitoring system
WGBS	GFCM Working Group on the Black Sea
WWF	World Wide Fund for Nature
XSA	Extended survivor analysis

Executive summary

This first issue of *The State of Mediterranean and Black Sea Fisheries* is a comprehensive review of the status and trends of fisheries in the Mediterranean and the Black Sea. It includes eight chapters, divided into two sections: a first part on the status and trends of different aspects of Mediterranean and Black Sea fisheries, including fleet, catches, socio-economic variables and bycatch, and a second part that gives an overview on small-scale fisheries and describes a variety of management measures adopted by the General Fisheries Commission for the Mediterranean (GFCM) of the Food and Agriculture Organization of the United Nations (FAO), which aim to achieve sustainability of fisheries in the area.

The report is largely based on the most up-to-date data available submitted by GFCM contracting and cooperating non-contracting parties, including information on stock status, national catches, fleet and socio-economic aspects up to 2014. This is complemented by information obtained from other sources, including literature review and, specifically in the case of small-scale fisheries, material drawn from the outcomes of the First Regional Symposium on Sustainable Small-Scale Fisheries in the Mediterranean and Black Sea (SSF Symposium), organized by the GFCM in 2013 in Malta. Information is discussed at the regional (Mediterranean and Black Sea), subregional (western and eastern Mediterranean, Ionian Sea, Adriatic Sea and Black Sea) and country level. The main highlights of this report are summarized in the paragraphs below.

Status of the fishing fleet

The officially reported fishing fleet operating in the Mediterranean and the Black Sea comprises some 92 700 vessels. The fishing fleet is unevenly distributed in the GFCM area of application, with the eastern Mediterranean accounting for the largest share of vessels (28 percent), followed by the Ionian Sea (27 percent), the western Mediterranean (19 percent), the Adriatic Sea (14 percent) and the Black Sea (12 percent). Turkey, Greece, Italy and Tunisia are, in decreasing order of importance, the countries with the largest fleets, accounting for more than 60 percent of the total number of vessels reported to the GFCM.

Small-scale vessels, identified as polyvalent small-scale vessels up to 12 m length overall (LOA), are the dominant fleet segments, accounting for 80 percent of the total number of vessels. Other fleet segments of regional relevance in terms of numbers are trawlers (12–24 m LOA; 6 percent), polyvalent vessels (> 12 m LOA; 4 percent), purse seiners (> 12 m LOA; 3.5 percent), and longlines (> 6 m LOA; 2 percent). Besides being the most numerous, the small-scale fleet segments employ the highest number of fishers in the region. In terms of total landings by weight, purse seiners are the most important fleet segments. In terms of landing value, trawlers are the leading segment.

Capture fisheries production

Total landings in the Mediterranean and the Black Sea increased irregularly from about one million tonnes in 1970 to almost two million tonnes in 1982. Total landings remained relatively stable during most of the 1980s before declining abruptly in 1989 and 1990, largely due to the collapse of pelagic fisheries in the Black Sea. In the Mediterranean, landings continued to increase until 1994, reaching 1 087 000 tonnes, and subsequently declined irregularly to 787 000 in 2013. In the Black Sea, landings have varied considerably from one year to the next since 1990, showing a generally increasing trend. In 2013, the total reported landings in the Black Sea were 376 000 tonnes. Algeria, Greece, Italy, Spain, Tunisia, Turkey and Ukraine are together responsible for slightly more than 80 percent of total landings in the Mediterranean and the Black Sea.

A group of 13 main species accounts for some 65 percent of landings, with anchovy (393 500 tonnes) and sardine (186 100 tonnes) being by far the dominant species. In contrast with other regions, clams (56 000 tonnes), mussels (21 000 tonnes) and the species group of squid, cuttlefish and octopus (58 000 tonnes) account for substantial landings.

Socio-economic characteristics

The total value of fish landings across the Mediterranean and the Black Sea is estimated to be a minimum of US$3.09 billion. The subregion with the highest landing value is the western Mediterranean (US$1.57 billion), followed by the Ionian Sea (US$1.41 billion), the eastern Mediterranean (US$1.07 billion), the Adriatic Sea (US$979 million) and the Black Sea (US$691 million). Similar average landing prices were observed in the western Mediterranean (US$3 947 per tonne), the Ionian Sea (US$3 902 per tonne) and the Adriatic Sea (US$3 849 per tonne) and it is worth noting that the average landing price in these three subregions is at least double that of the eastern Mediterranean (US$1 893 per tonne) and the Black Sea (US$1 516 per tonne). Despite such differences, fisheries present a more significant economic contribution to regional economies in the eastern Mediterranean, compared with other subregions.

Five countries account for approximately 80 percent of the total landing value of GFCM fisheries: Italy, Turkey, Greece, Spain, and Algeria, in that order. Italy is the country with the highest landing value in the region (close to US$900 million). Trawlers (12–24 m LOA), purse seiners (>12 m LOA) and polyvalent small-scale vessels with engine (6–12 m LOA) are the fleet segments associated with the highest landing value (US$761 million, US$549 million and US$438 million, respectively).

Based on the data reported by GFCM members, at least one-quarter of a million people are employed on fishing vessels in the Mediterranean and the Black Sea.

Bycatch: discards and incidental catch of vulnerable species

The volume of fishery discards in the Mediterranean is in the order of 230 000 tonnes per year, or about 18 percent of total catches. Bottom trawls are responsible for the bulk of discards (more than 40 percent). Discard rates for pelagic fisheries, such as pelagic trawls and purse seiners, are generally lower than those of bottom trawls: for the pelagic trawl fishery, discard values range between 10 and 50 percent; for purse seines, values of between 2 and 15 percent have been reported. Information on discards for small-scale fisheries is relatively scarce, but available data report a discard ratio lower than 10 percent for trammel and gillnets. In the Black Sea, discards are estimated at about 45 000 tonnes or between 10–15 percent of the catch. The various discard rates, by fishery, are as follows: 25–45 percent for trawl fisheries, 15 percent for small-scale fisheries, approximately 5 percent for midwater trawlers targeting small pelagic species, 1–5 percent for purse seines and about 11 percent for sea snail dredge fisheries. Most common discarded groups of species in fisheries are benthic invertebrates (e.g. gastropods, porifers, cnidarians, echinoderms) elasmobranch species with no commercial value, but also non-commercial individuals of target fish, crustaceans and cephalopods species.

Annual absolute values of incidental catches of vulnerable species are not available, although this report collects information on the relative importance of different types of fishing gear and the main species affected. Sharks, rays and skates, which occur in the shallow coastal shelves of the Mediterranean, are mainly affected by bottom trawlers targeting demersal fish and invertebrate species. Longlines (both pelagic and demersal) have a significant impact on sharks, sea turtles and seabirds. Static nets also incidentally catch a conspicuous number of sea turtles. Finally, in the Black Sea, the turbot gillnet fishery is associated with high rates of incidental catches of demersal sharks (e.g. piked dogfish) and dolphins.

Status of stocks

About 85 percent of Mediterranean and Black Sea stocks assessed are fished at biologically unsustainable levels[1]. Demersal stocks experience higher fishing mortality rates, while small pelagic stocks show average fishing mortality rates close to the target. Hake stocks in the Mediterranean Sea show the highest fishing pressure, with a fishing mortality rate that is an average of 5 times higher than the target, and for some specific stocks, up to 12 times higher than the target. Conversely, small pelagic stocks show average fishing mortality rates that are close to the target, while for some specific stocks, the fishing mortality rate is estimated to be below the target. These figures require urgent action, and the GFCM strategy to improve the status of stocks is described in Part II of the report.

The percentage of landings assessed has nearly doubled in recent years, rising from about 20 percent in 2013 to around 45 percent in 2014 and 2015. Moreover, there are regional differences in the knowledge of stock status, with fewer stock units assessed in the Ionian Sea and eastern Mediterranean, compared with the western Mediterranean, the Adriatic Sea and the Black Sea.

Insights on small-scale fisheries

Artisanal or small-scale fisheries in the Mediterranean and the Black Sea play a significant social and economic role: they constitute more than 80 percent of the fishing fleet, employ at least 60 percent of those workers directly engaged in fishing activity and account for approximately 20 percent of the total landing value from capture fisheries in the region. Despite its importance, the sector has historically lacked an integrated strategy for its monitoring, management and sustainable development.

In 2013, the GFCM organized the SSF Symposium (St. Julian's, Malta) with the goal of providing a regional platform where the main recurring issues related to small-scale fisheries in the Mediterranean and the Black Sea could be discussed and addressed by all interested parties. The conclusions of the symposium highlighted the widespread interest in securing sustainable small-scale fisheries consistent with the FAO Code of Conduct for Responsible Fisheries and with the recently adopted FAO Voluntary Guidelines for Securing Small-Scale Fisheries in the Context of Food Security and Poverty Eradication. Key priorities for the sector include the need for strong political commitment, intergovernmental cooperation and the provision of technical assistance to Mediterranean and Black Sea riparian States. New transversal governance and management approaches are identified as the main requirements for improving the sector's position. Other essential prerequisites are a consolidated knowledge base, improved data collection and analysis and the development of management and co-management mechanisms that are integrated with environmental objectives, including marine protected areas (MPAs).

Conservation measures

To date, a total of 16 management and conservation measures have been adopted by the GFCM to ensure the conservation and sustainable exploitation of living marine resources, while safeguarding habitats and vulnerable species from the impact of fishing activities. In general, these binding decisions include: 1) spatial management measures; 2) mitigation measures for the incidental catch of vulnerable species; and 3) other technical conservation measures. The oldest GFCM conservation measure, which prohibits fishing using bottom towed gear at depths beyond 1 000 m, was endorsed in 2005 at the twenty-ninth session of the Commission. Four fisheries restricted areas (FRAs), located both in high seas and national waters, were later established to protect deep sea sensitive habitats and fish spawning areas in Cyprus, Egypt, Italy and France. The total area protected under 1 000 m depth covers 1 731 097 km^2 ,representing 58 percent of the total surface of the Mediterranean and the Black Sea, while the four FRAs cover a total area of 17 678 km^2, i.e. approximately 0.7 percent of the Mediterranean Sea's surface. With regard to

1 Based on the FAO classification on the status of stocks, biologically unsustainable levels imply that either fishing mortality is higher than the target fishing mortality, or that biomass is lower than the target biomass level.

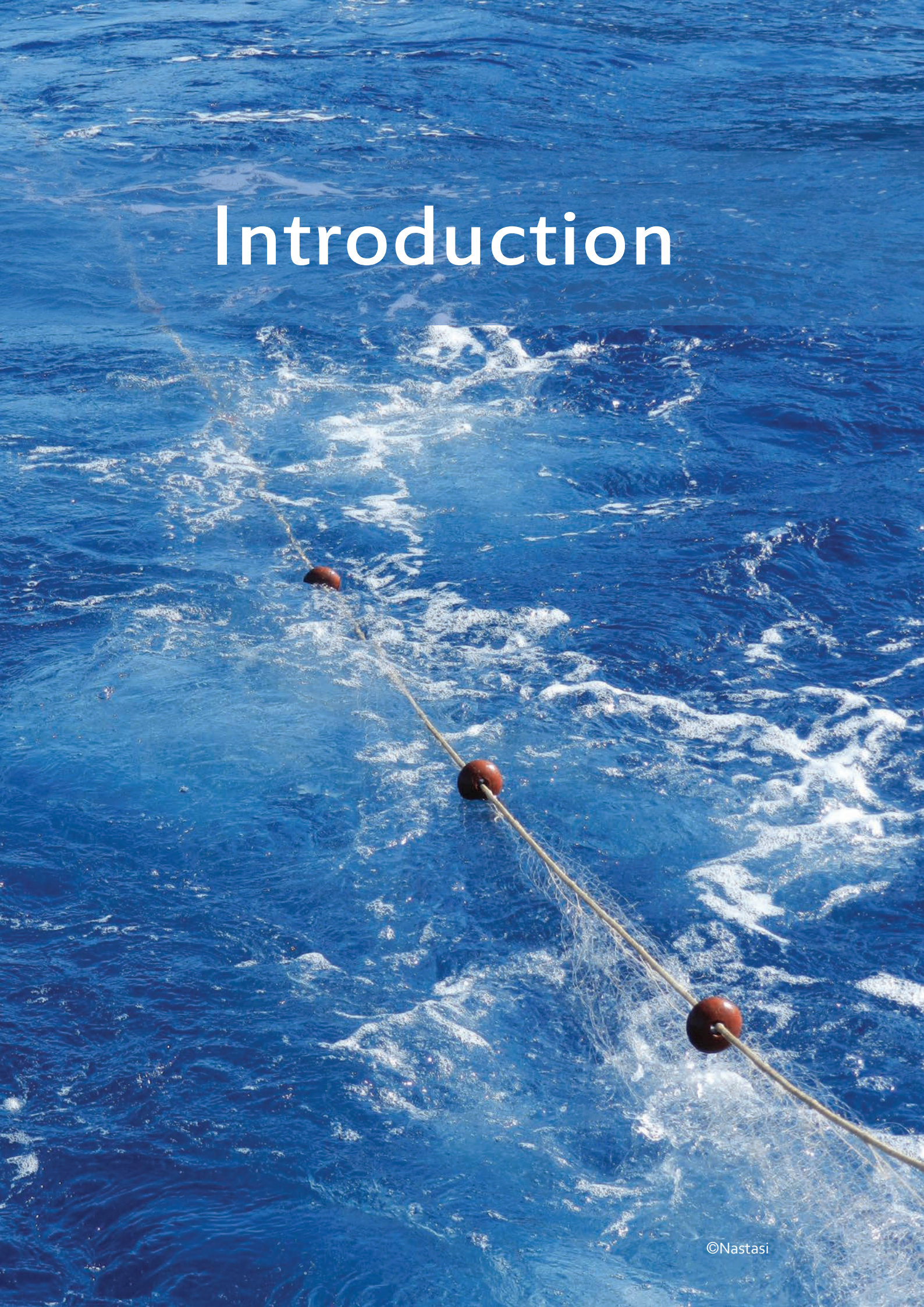
vulnerable large marine vertebrates, nine recommendations have been adopted to mitigate the incidental catch of marine mammals, seabirds, sea turtles and sharks and to improve monitoring and data collection. Other measures, such as the establishment of minimum legal sizes, gear restrictions and fishery closed seasons have also been adopted to promote sustainable use of resources in the GFCM area of application. In addition, the following fisheries are addressed by common regional measures: dolphinfish fisheries using fish aggregating devices (FAD); demersal trawling fisheries and red coral (*Corallium rubrum*) harvesting.

GFCM multiannual management plans

In addition to conservation measures, fishery management plans are increasingly advocated as an essential tool for fisheries management in the GFCM area of application. GFCM use of this tool is relatively recent. It started with the adoption of general guidelines for the development of multiannual management plans at the thirty-sixth session of the Commission, in 2012, followed by a number of actions that provided the technical background for the development of management plans.

As a result of this effort, the Commission adopted an adaptive multiannual management plan for small pelagic species in the Adriatic Sea in 2013. Subsequently, three recommendations were adopted in 2015, setting the framework for, and requesting the development of complete multiannual management plans for demersal fisheries in the Strait of Sicily, and turbot and piked dogfish in the Black Sea. In recent years, the Commission has been actively working on the development and implementation of these plans, with two revisions of the management plan for the Adriatic Sea already completed (2014 and 2015) and the provision of advice to finalize management plans for the other fisheries listed above.

Introduction



©Nastasi

Introduction

The Mediterranean and the Black Sea have sustained important fisheries activities since ancient times. Today, industrial, semi-industrial and small-scale fisheries coexist in the region, using a large variety of fishing gear. A characteristic of the Mediterranean and the Black Sea fisheries is that, in contrast with other major fishing areas, they generally lack large mono-specific stocks, and instead exploit a variety of benthic and pelagic stocks of fish, as well as mollusc and crustaceans. In addition, due to the geographic configuration of the semi-enclosed Mediterranean Sea and the Black Sea, the stocks are often shared among fleets from different countries. For this reason, strong regional cooperation is essential for the rational management of fisheries. The fishery sector plays an important role in the region: despite its relatively low economic output compared with other economic activities in the region (e.g. tourism, oil and gas exploration), the area's annual production of roughly 1.5 million tonnes offers various employment opportunities to several hundred thousand people and supplies seafood products for human consumption to local and regional markets.

However, the sustainability of Mediterranean and Black Sea fisheries is affected by different threats, including the effects of increased pollution from human activities, habitat degradation, the introduction of alien species, overfishing and the impacts of climate-driven changes in the marine ecosystem. The dramatic ecosystem changes that have occurred in the Black Sea during the past few decades are testimony of the need to account for these different processes and stressors in the management of fisheries in the region, in line with an ecosystem approach to fisheries (EAF).

Recognizing the importance and peculiarities of fisheries in the Mediterranean and the Black Sea, and the need for strong regional cooperation for the rational utilization of fisheries resources, the GFCM was established by its member countries with the objective of promoting the development, conservation, rational management and best utilization of living marine resources, as well as the sustainable development of aquaculture in the region. Among its various responsibilities, the Commission is charged with regularly reviewing the state of living resources and fisheries, including economic and social aspects of the fishing industry, as a basis for the formulation and recommendation of management and capacity development actions conducive to sustainable and responsible fisheries.

In 2014, at its thirty-eighth session, the Commission requested the GFCM Secretariat to prepare, on a biennial basis, a report on the status and trends of fisheries in the GFCM area of application. This report is expected to become the main tool for the regular dissemination of information on fisheries in the Mediterranean and the Black Sea, based on data submitted by member countries and information produced by GFCM scientific bodies. It should also provide the Commission with a useful instrument to monitor progress towards its objectives and, as such, support strategic decision-making on issues of relevance to the GFCM countries.

At the same time, the GFCM and its Scientific Advisory Committee on Fisheries (SAC) have been discussing the need to collect and analyse data in a structured way, so as to present summaries that are useful for managers and decision-makers. Based on this discussion, the GFCM has approved the GFCM Data Collection Reference Framework (DCRF, see Box 1). This encompasses all aspects of fisheries information that the SAC considers crucial for providing advice in support of fisheries management. The DCRF has been used to shape the contents of this report, which covers the main technical aspects considered critical for policy-makers and provides information in a variety of spatial scales, so as to facilitate discussion at the regional, subregional and national levels.

This publication is the first issue of the report on the state of fisheries in the Mediterranean and the Black Sea. It is organized in two parts. Part one is divided into six chapters describing

the current status and trends in different aspects of fisheries in the region, including fishing fleets, fisheries production, the socio-economic characteristics of capture fisheries, discards and incidental catch of vulnerable species and the status of stocks. Part two focuses on fisheries governance, starting by a dedicated chapter on small scale fisheries, and then summarizing the current efforts of the Commission to manage fisheries in its area of application through binding technical conservation measures and multiannual management plans.

Information in all chapters is provided at different spatial levels of aggregation. At the regional scale (the Mediterranean and the Black Sea), summaries are presented to give a general overview of relevant aspects of fisheries in the GFCM area of application. At the subregional level, and using the subregions as defined in the DCRF (Figure 1, Table 1), the report provides a comparative analysis of the main characteristics in the western and eastern Mediterranean, the Ionian Sea, the Adriatic Sea and the Black Sea. It also includes information for policy-makers at the level of States and relevant non-State actors. Finally, when considered relevant, information is presented at smaller aggregation level, called "geographical subareas" (GSAs; Figure 1 and Table 1). These are commonly used in the GFCM as the minimal management unit.

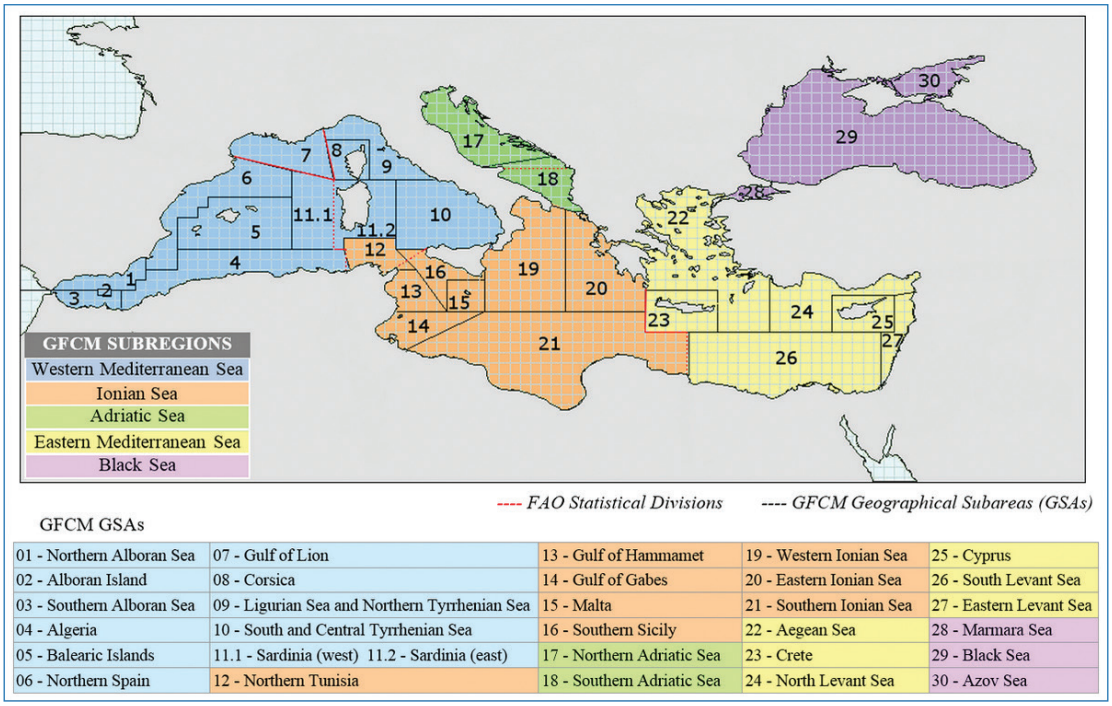


FIGURE 1
GFCM area of application, subregions and GSAs

Table 1 List of GSAs included in each subregion

GFCM SUBREGIONS	GSAs
Western Mediterranean Sea	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11
Ionian Sea	12, 13, 14, 15, 16, 19, 20, 21
Adriatic Sea	17, 18
Eastern Mediterranean Sea	22, 23, 24, 25, 26, 27
Black Sea	28, 29, 30

Box 1 GFCM Data Collection Reference Framework (DCRF)

The collection of fisheries data in the GFCM area of application has been organized within the newly established GFCM DCRF, the tool used by the SAC to collect required information for the provision of advice. The DCRF is the first GFCM comprehensive framework for the collection and submission of fisheries-related data requested as per existing GFCM recommendations and in support of the SAC mandate.

The DCRF is devised as a flexible tool, which should be regularly reviewed by the SAC in the light of possible requirements emanating from the Commission, including those requested as part of new recommendations. Endorsed by the Commission in May 2014 (for the first part related to the structure of data collection) and in May 2015 (for the second part on the methodologies), the DCRF should be instrumental in achieving a more efficient data collection programme in the whole GFCM region and in better integrating data collection and subregional multiannual management plans. It encompasses all the necessary indications for the collection of fisheries data by GFCM members in a standardized way, in order to provide the GFCM with the minimum set of data needed to support fisheries management decision-making processes.

The data covered by the DCRF, and their potential uses, are described below:

Task I	Global figures of national fisheries – General overview of fisheries in each country, with indication of capacity and total landings. This task requires annual data on total landing, number of vessels, total capacity and total engine power by country.
Task II	Catch – Monitoring of total annual biomass landed by fleet segment, country and area, plus the trends of total catches (landing and discards) of the main commercial species by country, GSA and fleet segment.
Task III	Incidental catch of vulnerable species – Quantification of incidental catches of vulnerable species by fleet segment, and assessment of the impact of fisheries on species of conservation concern. This task involves gathering the number of specimens of vulnerable species taken as incidental catches (i.e. seabirds, turtles, marine mammals and shark species) by area, country and fishing gear.
Task IV	Fleet – Monitoring of fishing capacity in the GFCM area. Register of fishing vessels with identification features (i.e. vessel name, registration number, port, fishing gear, GSA, etc.), and information on technical features (i.e. gross tonnage, kilowatt, overall length etc.) of fleets operating in the GFCM area of application.
Task V	Effort – Accounting for the amount of effort deployed and evaluating fishing pressure and trends in catch per unit effort (CPUE). This task gathers fishing effort data, calculated as a combination of capacity and activity by country, GSA, fleet segment and fishing gear, plus information on CPUE for the main commercial species.
Task VI	Socio-economics – Assessing the economic value and social implications of fisheries. This task gathers data related to economic and social variables of fisheries by country, GSA and fleet segment.
Task VII	Biological information – This task enables information gathering for the assessment of the general status of the main exploited stocks in the Mediterranean and the Black Sea, of marine ecosystems and of stocks of special interest, such as red coral, eel and dolphinfish.

Part 1

OVERVIEW OF THE STATUS AND TRENDS OF MEDITERRANEAN AND BLACK SEA FISHERIES

1.

Fishing fleet

©Tonachella

1. Fishing fleet

1.1 INTRODUCTION AND SOURCES OF INFORMATION

Two main sources of data on fishing fleets operating in the GFCM area of application were used in this report, both derived from binding recommendations that require GFCM member countries to submit data according to the specifications laid down in such decisions[1]. Data used in this chapter have been updated with information received from members as of February 2015.

The first source of data is the GFCM fleet register, which was established in 2009 (Recommendation GFCM/33/2009/5 on the establishment of the GFCM regional fleet register) with the objective of hosting information on all vessels used for commercial fishing in the GFCM area of application. Also in 2009, Recommendation GFCM/33/2009/6 established a GFCM record of vessels over 15 m LOA authorized to operate in the GFCM area of application (GFCM-AVL). According to this recommendation, vessels longer than 15 m not entered in the record are deemed not to be authorized to fish for, retain on board, tranship or land species covered by the Commission. Therefore, each vessel of more than 15 m LOA in the fleet register should be accompanied by its authorization status. An analysis of the GFCM vessel records shows however that the regional database encompassing both the GFCM fleet register and the GFCM-AVL presents shortcomings. For instance, in some countries the fleet register does not contain data on small-scale vessels. Moreover, since not every vessel authorized to fish is actually in operation, the GFCM vessel records does not always provide an accurate picture of the actual fishing capacity of the fleet.

The other source of data on fishing fleets is the GFCM Task 1, established in 2009 by Recommendation GFCM/33/2009/3 on the implementation of the GFCM Task 1 statistical matrix. Since 2010, GFCM contracting parties and cooperating non-contracting parties have been required to make an annual submission of various types of information about the operations of national fishing fleets in the GFCM area of application, including the number and capacity of vessels, catch and effort, as well as technical, economic and biological variables of the fleets. Data are provided by individual vessels, as opposed to fleet segments, based on the size of the vessels, propulsion and dominant fishing gear (Box 2, Plate 1). The GFCM Task 1 data are therefore quite comprehensive and thus provide the most accurate picture of the fishing fleets in operation in the GFCM area at an aggregated level. In this chapter, both vessel records and Task 1 data are used to characterize the status and trends of the fishing fleet.

In addition to the sources mentioned above, complementary sources of information such as the national reports to the SAC, questionnaires or any other information submitted by countries to the GFCM are used to provide the most updated figures on the size of the fleet in the Mediterranean and the Black Sea.

1 Information on fleet, as well as other relevant aspects of fisheries covered by this report, is expected to be collected from 2017 within the DCRF, see Box 1.

Box 2 GFCM fleet segments, as defined by Recommendation GFCM/33/2009/3

The main types of gear and target species of each segment, based on the most recent Task 1 data submitted by countries, are the following:

Polyvalent SS w/o engine < 12 m LOA. All vessels less than 12 m in LOA, without an engine (wind or propulsion), using different gear during the year without a clear predominance of any type of gear, or using gear not considered in this classification.

Main gear: gillnets and entangling nets, traps, hooks and lines.

Main target species: miscellaneous demersal fish and molluscs.

Polyvalent SS w/ engine < 6 m LOA. All vessels under 6 m LOA, with engine, using different gear during the year without a clear predominance of any type of gear, or using gear not considered in this classification.

Main gear: gillnets and entangling nets, hooks and lines, traps, surrounding nets.

Main target species: miscellaneous demersal fish, miscellaneous coastal fish, miscellaneous pelagic fish, tuna, bonito, billfish, molluscs and crustaceans.

Polyvalent SS w/ engine 6–12 m LOA. All vessels between 6 and 12 m LOA, with engine, using different gear during the year without a clear predominance of any type of gear, or using gear not considered in this classification.

Main gear: gillnets and entangling nets, hooks and lines, traps, surrounding nets.

Main target species: miscellaneous demersal fish, miscellaneous coastal fish, miscellaneous pelagic fish, tuna, bonito, billfish, molluscs and crustaceans.

Trawlers < 12 m LOA. All vessels less than 12 m LOA, allocating more than 50 percent of their effort to operating with a demersal trawl.

Main gear: trawls, gillnets and entangling nets.

Main target species: miscellaneous coastal fish, miscellaneous demersal fish, molluscs.

Trawlers 12–24 m LOA. All vessels, between 12 and 24 m LOA, allocating more than 50 percent of their effort to operating with a demersal trawl.

Main gear: trawls, surrounding nets.

Main target species: demersal slope species, miscellaneous coastal fish, demersal shelf species, miscellaneous demersal fish, molluscs, crustaceans.

Trawlers > 24 m LOA. All vessels over 24 m LOA, allocating more than 50 percent of their effort to operating with a demersal trawl.

Main gear: trawls, surrounding nets.

Main target species: miscellaneous coastal fish, miscellaneous demersal fish, demersal shelf species, demersal slope species, crustaceans.

Purse seiners 6–12 m LOA. All vessels between 6 and 12 m LOA, allocating more than 50 percent of their effort to operating with a purse seine.

Main gear: seine nets, surrounding nets.

Main target species: small pelagics.

Purse seiners > 12 m LOA. All vessels over 12 m LOA, allocating more than 50 percent of their effort to operating with a purse seine, excluding those using a tuna seine at any time of the year.

Main gear: seine nets, surrounding nets.

Main target species: small pelagics, miscellaneous pelagic fish, miscellaneous coastal fish, miscellaneous demersal fish.

Longliners > 6 m LOA. All vessels over 6 m LOA, allocating more than 50 percent of their effort to operating with a longline.

Main gear: hooks and lines, surrounding nets.

Main target species: demersal shelf species, demersal slope species, large pelagics, miscellaneous demersal fish.

Pelagic trawlers > 6 m LOA. All vessels over 6 m LOA, allocating more than 50 percent of their effort to operating with a pelagic trawl.

Main gear: trawls.

Main target species: small pelagics, miscellaneous demersal fish, tuna, bonito, billfish, miscellaneous pelagic fish.

Tuna seiners. All vessels operating with a tuna seine for any length of time during the year.

Main gear: surrounding nets.

Main target species: tuna, bonito, billfish.

Dredgers > 6 m LOA. All vessels over 6 m LOA, allocating more than 50 percent of their effort to operating with a dredge.

Main gears: dredges, surrounding nets.

Main target species: sessile, molluscs, crustaceans.

Polyvalent > 12 m LOA. All vessels over 12 m LOA, using different gear during the year without a clear predominance of any type of gear, or using gear not considered in this classification.

Main gear: hooks and lines, gillnets and entangling nets.

Main target species: miscellaneous coastal fish, miscellaneous pelagic fish, tuna, bonito, billfish, miscellaneous demersal fish, small pelagics, molluscs.

Polyvalent SS w/o engine < 12 m LOA

©Carpentieri

Polyvalent SS w/ engine < 6 m LOA

©Massa

Polyvalent SS w/ engine 6–12 m LOA

©Carpentieri

Trawlers < 12 m LOA

©Tonachella

Trawlers 12–24 m LOA

©Carpentieri

Trawlers > 24 m LOA

©Carpentieri

Purse Seiners 6-12 LOA

©DeRossi

Purse seiners > 12 m LOA

©FAO

Longliners > 6 m LOA

©Carpentieri

Pelagic trawlers > 6 m LOA

©Nastasi

Tuna seiners

©Sabatella

Dredgers > 6 m LOA

©Tonachella

Polyvalent > 12 m LOA

©Carpentieri

PLATE 1

Examples of fishing vessels in each fleet segment in the GFCM area of application

1.2 SIZE OF FISHING FLEET

According to the most recent data submitted to the GFCM (Task 1, fleet register, authorized vessel list, or other), the fishing fleet in operation in the Mediterranean and the Black Sea consists of about 92 700 vessels (Table 2). This number should be considered an underestimate of the real size of the fleet, given the lack of data on some parts of the fleet (especially small-scale fleets) from some Mediterranean and Black Sea riparian States or non-State actors (FAO, 2015). The countries with the largest fleets are Turkey (17.7 percent of the total reported number), Greece (16.9 percent), Tunisia (14.91 percent) and Italy (13.4 percent). The Eastern and Ionian subregions have the largest share of vessels, with 28 percent and 27 percent respectively, followed by the western subregion, which accounts for 19 percent of the total (Table 2, Figure 2).

1.3 FISHING CAPACITY

Table 2 provides the available data on fishing capacity by riparian States or territories. Given that capacity measure is not always reported in gross tonnage (GT), it is difficult to assess the relative importance of each country, or non-State actor, in proportion to the overall fishing capacity. On the other hand, given that engine power and vessel tonnage are strongly and positively correlated in all motorized fleet segments, it is possible to use the cumulative engine power of the fleets as an indication of the distribution of fishing capacity. It can be inferred from the available data that Turkey and Italy are the countries with the greatest fishing capacity in the GFCM area of application, together accounting for 35 percent of total fishing capacity. Other fleets of substantial capacity are those from Libya, Algeria, Tunisia, Greece, Egypt, Croatia and Spain.

Table 2 Number of fishing vessels per GFCM contracting party, cooperating non-contracting party, non-contracting party or relevant non-State actor in the Mediterranean and the Black Sea

Name	Vessels		Capacity		Engine power	Reporting year
	Number	% of the total				
Albania*	**511**	0.55	10 768	GT	62 378	2011
Algeria*	**4 778**	5.15	69 711	GT	542 569	2015
Bulgaria*	**704**	0.76	3 743	GT	25 696	2015
Croatia*	**7 733**	8.34	53 380	GT	424 818	2015
Cyprus*	**943**	1.02	3 388	GT	40 265	2015
Egypt*	**2 988**	3.22	72 336	GT	368 286	2014
France*	**1 461**	1.58	15 777	GT	137 941	2015
Georgia****	**47**	0.05	N/A	N/A	N/A	2015
Greece*	**15 688**	16.92	74 811	GT	447 249	2015
Israel****	**400**	0.43	N/A	N/A	N/A	2015
Italy*	**12 469**	13.45	163 994	GT	1 009 010	2015
Japan**	**229**	0.25	134 982	GT	163 035	2015
Lebanon*	**2 623**	2.83	6 474	GT	33 917	2015
Libya***	**4 641**	5	164 928	GT	384 100	2015
Malta*	**1 015**	1.09	7 020	GT	72 735	2015
Monaco	**na**					-
Montenegro*	**135**	0.15	1 309	GT	9 278	2015
Morocco***	**2 146**	2.31	15 354	GRT	80 319	2015
Palestinian Territories***	**759**	0.82	N/A	N/A	28 066	2015
Portugal**	**2**	0	391	GT	915	2014
Romania*	**159**	0.17	790	GT	6 111	2015
Russian Federation****	**33**	0.04	N/A	N/A	N/A	2013
Slovenia*	**168**	0.18	597	GT	8 554	2015

Name	Vessels		Capacity		Engine power	Reporting year
	Number	% of the total				
Spain*	**2 663**	2.87	56 607	GT	227 470	2015
Syrian Arab Republic*	**31**	0.03	2 462	GT	-	2008
Tunisia***	**13 826**	14.91	114 030	GT	465 638	2015
Turkey*	**16 447**	17.74	175 328	GT	1 125 751	2015
Ukraine****	**135**	0.15	N/A	N/A	N/A	2015
TOTAL	**92 734**	100			5.586.506	

Source of data:
* GFCM vessel records (fleet register)
** GFCM authorized vessel list (> 15m LOA only)
*** GFCM Task 1
**** Other GFCM sources (e.g. questionnaires) or combination of previous sources
na = not applicable (no fishing vessels)
N/A = data not available (data either not reported or not transmitted)

Table 3 Groups of fleet segments used for the analysis in this chapter

Group	Fleet segments
Small-scale	• Polyvalent SS w/o engine < 12 m LOA • Polyvalent SS w/ engine < 6 m LOA • Polyvalent SS w/ engine 6–12 m LOA
Trawlers	• Trawlers < 12 m LOA • Trawlers 12–24 m LOA • Trawlers >24 m LOA
Purse seiners and pelagic trawlers	• Purse seiners 6–12 m LOA • Purse seiners > 12 m LOA • Pelagic trawlers > 6 m LOA
Others	• Longliners > 6 m LOA • Tuna seiners • Dredgers > 6 m LOA • Polyvalent > 12 m LOA

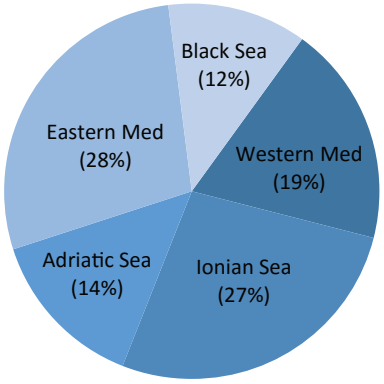


FIGURE 2
Percentage of fishing vessels by subregion and group of fleet segment

Subregions	% of the total vessels	Group of fleet segments			
		Small-scale	Trawlers	Purse seiners and pelagic trawlers	Others
Western Med	**19 %**	69 %	12 %	11 %	8 %
Ionian Sea	**27 %**	84 %	6 %	3 %	7 %
Adriatic Sea	**14 %**	68 %	17 %	4 %	11 %
Eastern Med	**28 %**	85 %	6 %	3 %	6 %
Black Sea	**12 %**	88 %	4 %	4 %	5 %
	100 %	**80 %**	**8 %**	**5 %**	**7 %**

1.4 AGE OF VESSELS

Table 4 reports the average construction year of vessels in each State or relevant non-State actor. Notwithstanding the low coverage of data in some countries, especially Morocco and Tunisia, it emerges that the youngest fleets are found in Romania (18 years), Tunisia (19 years) and Bulgaria (21 years). The oldest fleets are found in Albania (37 years in 2011), Slovenia (37 years), Croatia (34 years) and France (33 years). The ageing of the fleet in the latter countries may be a matter of concern for safety, while the substitution of ageing vessels can also represent a problem for the increase in fishing capacity if no rules are in place to regulate the entry of new vessels in the fishery.

Table 4 Average age of fishing vessels in the GFCM vessel records database

Name	Average year of construction	Data coverage
Albania	1974	49,70%
Algeria	1996	96,40%
Bulgaria	1994	92,20%
Croatia	1981	97,90%
Cyprus	1990	100,00%
Egypt	N/A	-
France	1982	100,00%
Georgia	N/A	-
Greece	1986	100,00%
Israel	N/A	-
Italy	1983	100,00%
Japan	1988	100,00%
Lebanon	1987	97,80%
Libya	1998	5,10%
Malta	1987	100,00%
Monaco	na	-
Montenegro	1983	15,80%
Morocco	1992	20,70%
Palestinian Territories	N/A	-
Portugal	2001	100,00%
Romania	1998	98,70%
Russian Federation	N/A	-
Slovenia	1978	100,00%
Spain	1984	100,00%
Syrian Arab Republic	N/A	-
Tunisia	1996	1,70%
Turkey	1993	57,00%
Ukraine	N/A	-

*Coverage indicates the percentage of data records with information on the construction year of the vessel
na = not applicable (no fishing vessels)
N/A = data not available (either data not reported or data not transmitted)

1.5 FLEET SEGMENTS

Table 5 shows that more than 90 percent of the fishing vessels are engine-powered. Overall, small-scale vessels are the dominant fleet segments, accounting for 80 percent of the total. At the State or relevant non-State actor level (Figure 3), the small-scale fleet segment generally exceeds 65 percent of the total fleet size; the exceptions to this are Portugal (which only reported two polyvalent vessels longer than 12 m in operation in 2013), Georgia (4 percent), Egypt (20 percent) and Spain (40 percent). Breakdown of data by fleet segment is not available for Israel, the Russian Federation and the Syrian Arab Republic.

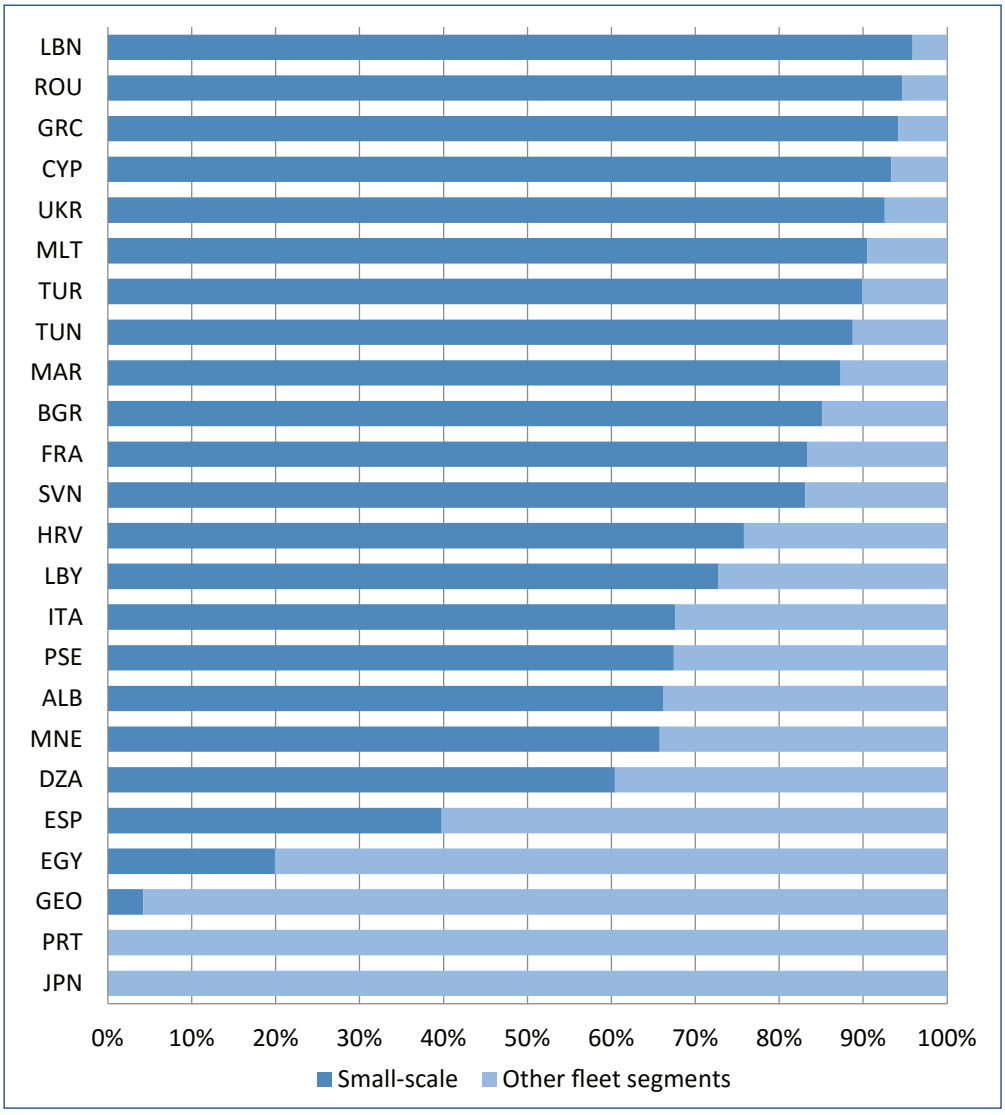


FIGURE 3

Composition of fleet segments by GFCM contracting party, cooperating non-contracting party, non-contracting party or relevant non-State actor in the Mediterranean and the Black Sea

Small-scale refers to the sum of vessels in the segments *Polyvalent SS w/o engine < 12 m LOA, Polyvalent SS w/ engine < 6 m LOA and Polyvalent SS w/ engine 6–12 m LOA.*

Table 5 Number of fishing vessels by fleet segment and by GFCM contracting party, cooperating non-contracting party, non-contracting party or relevant non-State actor in the Mediterranean and the Black Sea

	FLEET SEGMENTS														
Name	Polyvalent SS w/o engine <12m	Polyvalent SS w/ engine <6m	Polyvalent SS w/ engine 6-12m	Trawlers <12 m	Trawlers 12-24m	Trawlers >24m	Purse Seiners 6-12m	Purse Seiners >12m	Long Liners >6m	Pelagic Trawlers >6m	Tuna Seiners	Dredgers >6m	Polyvalent >12m	Unlocated	
Albania**		266	72	71	50	32							20		511
Algeria**		2.058	828		462	88	415	872			17		38		4.777
Bulgaria**	51	190	358				2		50	23			30		704
Croatia**	117	2.513	3.233	396	435	28	71	296	216			57	371		7.733
Cyprus**		72	808		13			2					48		943
Egypt**		32	563		1.096	28		208	936				125		2.989
France**		361	856	16	36	30	16	12	73	5	20	10	26		1.461
Georgia****	1		1		15			23		7					47
Greece**	236	5.424	9.112		116	165	1	251					383		15.688
Israel**														400	400
Italy**		2.608	5.819	188	1.985	218	13	174	170	145	12	698	439		12.468
Japan***														229	229
Lebanon**		638	1.877				108								2.623
Libya*	77	1.663	1.635		170	93		143	11		39		810		4.641
Malta**		504	413		15	6		3	53	1	1		19		1.014
Monaco															na
Montenegro**	6	46	36	5	16	4	16	4		2					133
Morocco*		1.818	56		97	9	6	118	22				20		2.146
Palestinian Territories*		65	447		17		180	50							759
Portugal*													2		2
Romania**	27	21	102		6	3									158
Russian Federation****														33	33
Slovenia**		67	73		20			8							169
Spain**		113	946	20	459	137	26	219	389			180	174		2.664
Syrian Arab Republic**														31	31
Tunisia*	6.100	527	3.600		215	159	33	365		10	38		475		11.522
Turkey**		2.781	12.007	139	400	60		455		101		24	480		16.448
Ukraine****	7	34	84										10		135
TOTAL	6.621	21.802	42.928	835	5.624	1.060	887	3.203	1.920	294	126	969	3.468	693	90.428
%	7,3	24,1	47,5	0,9	6,2	1,2	1	3,5	2,1	0,3	0,1	1,1	3,8	0,8	100

Sources of information:
* GFCM Task 1 (data as transmitted to GFCM)
** GFCM Task 1 and GFCM vessel records (vessel numbers per fleet segment are estimated by applying a ratio of vessels per fleet segment, as historically reported through previous Task 1 submissions, to the most recent total fleet segment data, as reported in the GFCM vessel records)
*** GFCM authorized vessel list (> 15 m LOA only)
**** Other GFCM sources (e.g. GFCM questionnaires)
na = not applicable (no fishing vessels)

Other fleet segments of regional relevance in terms of numbers are trawlers (12–24 m LOA), purse seiners (> 12 m LOA), longliners (> 6 m LOA) and polyvalent vessels (> 12 m LOA) (Table 5, Figure 4). Taking into account the contribution of each fleet component to total landings, purse seiners (> 12 m LOA) is the segment responsible for the largest share of total landings (41 percent), followed by trawlers (12–24 m LOA) with 14 percent, polyvalent vessels (> 12 m LOA) and polyvalent small-scale vessels (6–12 m LOA), accounting for about 10 percent and 9 percent of landings respectively.

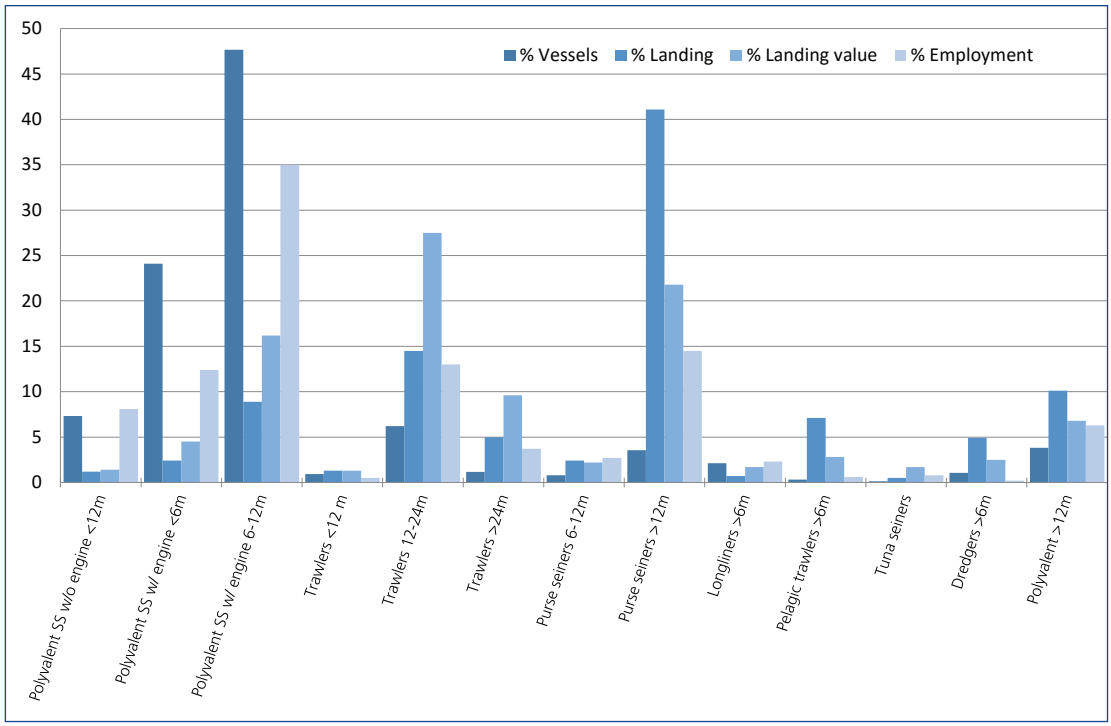


FIGURE 4
Relative importance of each GFCM fleet segment in terms of percentage of total number of fishing vessels, landings, landings value and employment

When the value of landings is accounted for, three segments are clearly more significant: trawlers longer than 12 m LOA (sum of trawlers 12–24 m LOA and trawlers > 24 m LOA), which account for 38 percent of total landed value, purse seiners longer than 6 m LOA (sum of purse seiners 6–12 m LOA and purse seiners > 12 m LOA), accounting for 27 percent, and polyvalent small-scale vessels up to 12 m LOA (polyvalent small-scale vessels), accounting for 22 percent of total landed value.

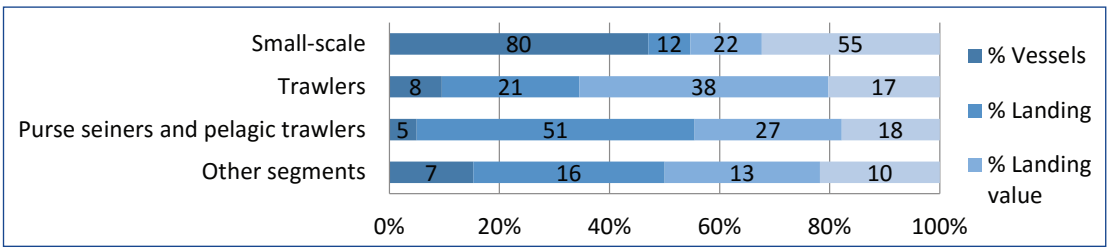


FIGURE 5
Relative importance of the four groups of GFCM fleet segment in terms of percentage of total number of fishing vessels, landings, landing value and employment

According to the available data (Figure 5), the small-scale fleet segments account for about 55 percent of the total number of people directly employed in fisheries in the GFCM area of application (Chapter 3).

SMALL-SCALE

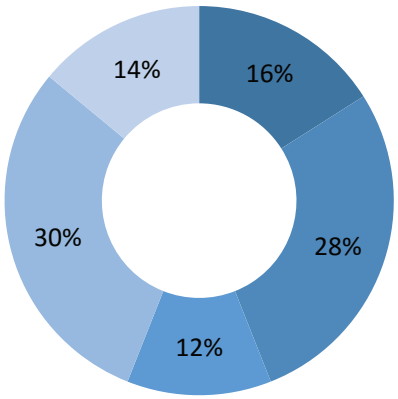


FIGURE 6
Distribution of small-scale fleet segments by GFCM subregion

TRAWLERS

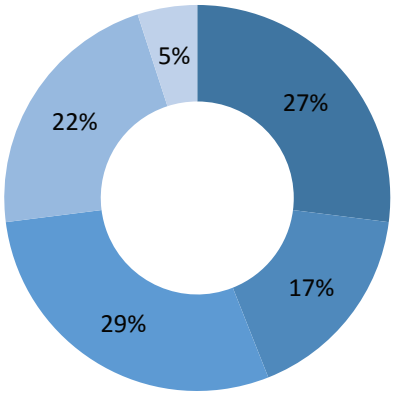


FIGURE 7
Distribution of trawler fleet segments by GFCM subregion

PURSE SEINERS

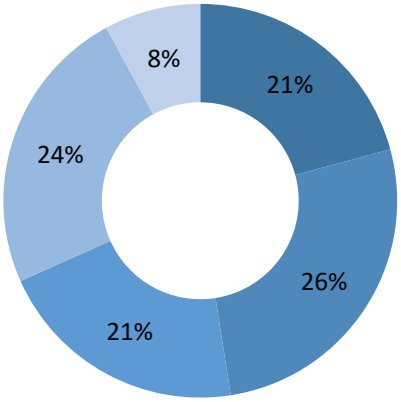


FIGURE 8
Distribution of purse seiners fleet segments by GFCM subregion

OTHER FLEET SEGMENTS

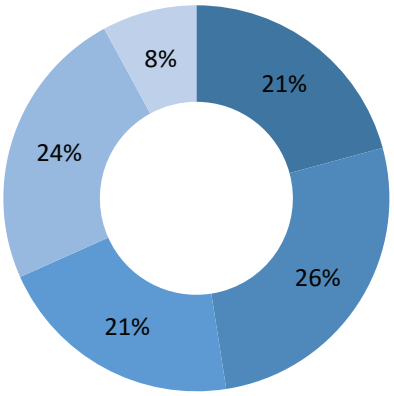


FIGURE 9
Distribution of other fleet segments by GFCM subregion

Western Med Ionian Sea Adriatic Sea Eastern Med Black Sea

The subregional distribution of the main fleet segments is shown in Figures 6 to 9. Small-scale fleet segments are present in higher numbers in the eastern and Ionian subregions. Trawlers tend to be found more in the Adriatic and western subregion, while purse seiners are mainly present in the western subregion.

2. Capture fisheries

©Nastasi

2. Capture fisheries

2.1 INTRODUCTION AND SOURCES OF INFORMATION

National catch data in the GFCM area of application (FAO major fishing area 37 Mediterranean and the Black Sea) are mainly collected through the FAO/GFCM STATLANT 37A questionnaire. This form is part of the STATLANT system of questionnaires developed by the Coordinating Working Party on Fishery Statistics (CWP) and dispatched by FAO on behalf of regional fisheries management organizations (RFMO) to the relevant national authorities. Countries report their annual catch by species and subdivision, into which FAO major fishing area 37 has been divided for statistical purposes.

Box 3 Estimation of production in FAO/GFCM STATLANT 37A

National catch figures, as reported annually by countries through the STATLANT 37A questionnaire, are processed by the GFCM Secretariat and compared with the data collected by FAO at the "major fishing area" level, without the breakdown of catches by species and statistical subdivision. At the end of this process, the original figures may be revised and missing values estimated, in order to ensure coherence with the FAO Global Capture Production database, at least for ISSCAAP* groups of species. The following ISSCAAP groups are excluded from the analysis of catches carried out in this report:

- Carp, barbel and other cyprinids;
- Miscellaneous freshwater fish;
- Tuna, bonito, billfish;
- Freshwater crustaceans;
- Brown seaweeds;
- Red seaweeds;
- Miscellaneous aquatic plants.

* FAO International Standard Statistical Classification for Aquatic Animals and Plants

2.2 HISTORICAL TRENDS OF CATCHES IN THE MEDITERRANEAN AND BLACK SEA

Total landings in the Mediterranean and the Black Sea increased irregularly from about 1 million tonnes in 1970 to almost 2 million tonnes in 1982. They remained relatively stable during most of the 1980s, before declining abruptly in 1989 and 1990, largely due to the collapse of pelagic fisheries in the Black Sea. In the Mediterranean basin, landings continued to increase until 1994, reaching 1 087 000 tonnes, but subsequently declined in an irregular fashion, to a figure of 787 000 tonnes in 2013. In the Black Sea, landings rose rapidly from around 400 000 tonnes in 1970 to more than 900 000 tonnes in 1988, with the development of the small pelagics fishery in the area. After 1988, a rapid collapse of the fishery reduced landings to between 300 000 and 600 000 tonnes, with an overall slightly upward trend, interspersed by substantial interannual fluctuations. Landings in the Black Sea in 2013 totalled 376 000 tonnes.

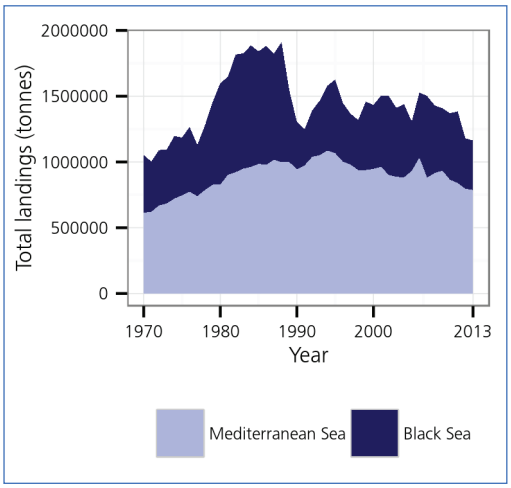


FIGURE 10
Trends in cumulative landings in the Mediterranean and the Black Sea between 1970 and 2013

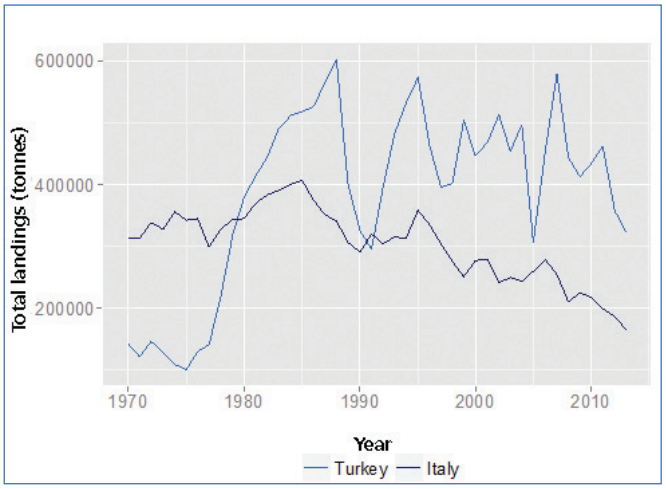


FIGURE 11
Trends in landings between 1970 and 2013 in the Mediterranean and the Black Sea

Table 6 Average landings in the 2000–2013 period in the Mediterranean and the Black Sea, as reported by GFCM contracting parties, cooperating non-contracting parties and non-contracting parties, as well as relevant non-State actors, sorted in decreasing order

Code	Country	Average landings (t)	Percentage
TUR	Turkey	459 400	31.18
ITA	Italy	249 500	16.93
DZA	Algeria	115 400	7.83
ESP	Spain	108 100	7.34
TUN	Tunisia	101 400	6.88
GRC	Greece	81 900	5.56
UKR	Ukraine	68 900	4.68
EGY	Egypt	67 300	4.57
HRV	Croatia	42 100	2.86
LBY	Libya	41 700	2.83
MAR	Morocco	35 600	2.42
RUS	Russian Federation	32 000	2.17
FRA	France	29 900	2.03
GEO	Georgia	12 600	0.86
BGR	Bulgaria	7 715	0.52
LBN	Lebanon	3 574	0.24
ALB	Albania	2 801	0.19
SYR	Syrian Arab Republic	2 768	0.19
ISR	Israel	2 643	0.18
PSE	Palestinian Territories	2 118	0.14
CYP	Cyprus	1 749	0.12
MLT	Malta	1 419	0.1
ROU	Romania	1 258	0.09
SVN	Slovenia	937	0.06
MNE	Montenegro	645	0.04
MCO	Monaco	2	0

Turkey (459 400) and Italy (249 500) are landing considerably more tonnage than the other countries (accounting for more than 30 percent and 15 percent respectively of total Mediterranean and Black Sea catches. Seven States (Turkey, Italy, Algeria, Spain, Tunisia, Greece, and Ukraine) account for more than 80 percent of total Mediterranean and Black Sea landings.

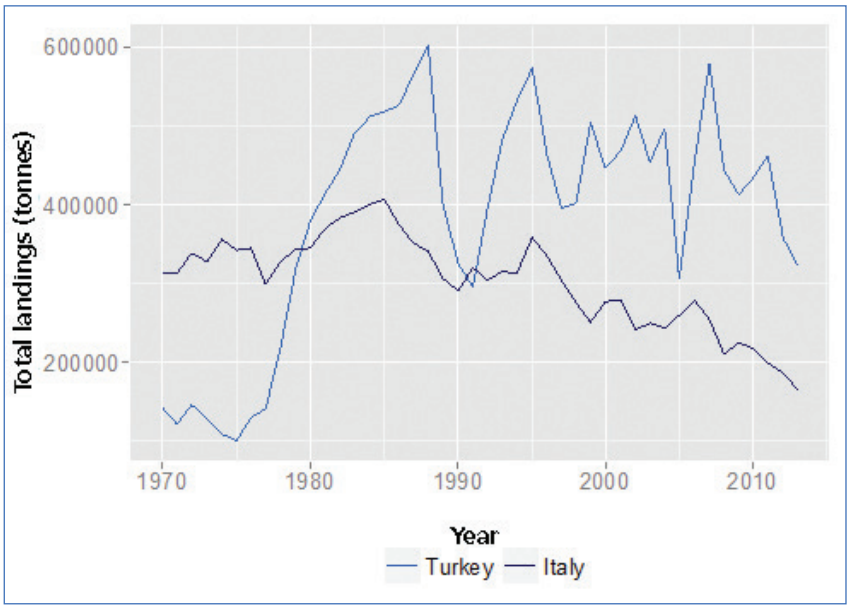


FIGURE 12
Trends in landings by country between 1970 and 2013 for Turkey and Italy

Figure 12 shows that landings by Turkey in the 1970s were generally less than 150 000 tonnes, but these increased very rapidly during the late 1970s and most of the 1980s to reach 600 000 tonnes in 1988. Since reaching a peak in 1988, landings have shown large interannual fluctuations between 300 000 tonnes and almost 600 000 tonnes, with no clear trend. Landings for Italy increased irregularly from about 300 000 tonnes in 1970 to 400 000 tonnes in 1985, and have been spiralling downwards since then to 165 000 tonnes in 2013.

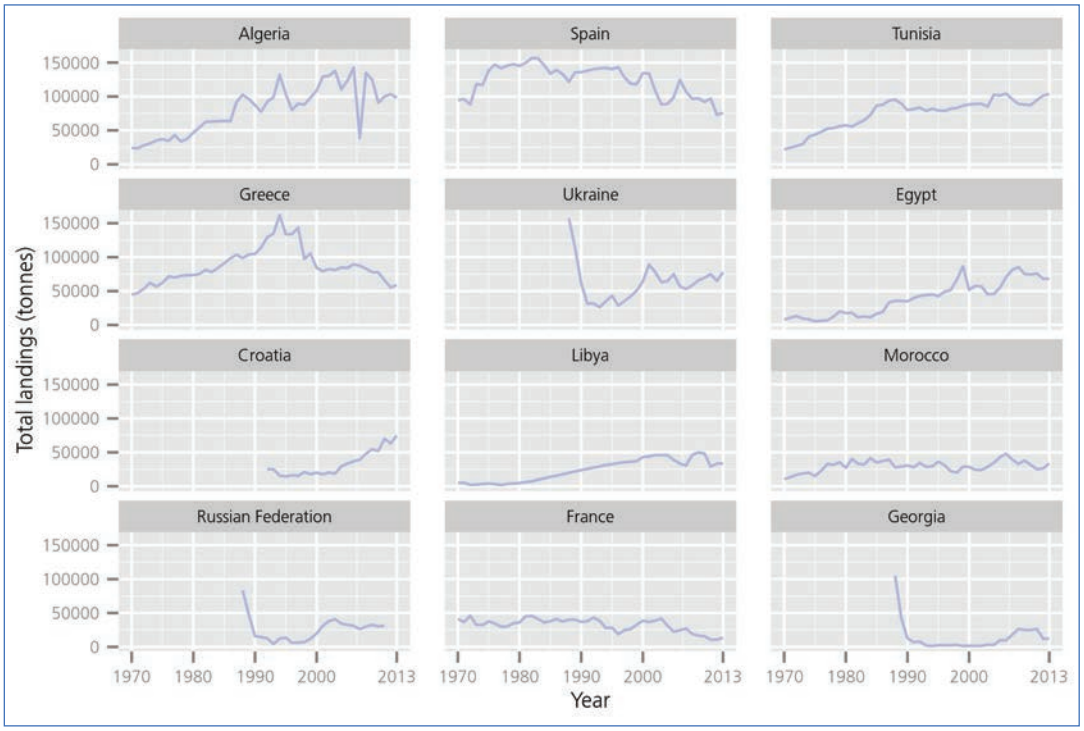


FIGURE 13
Trends in landings by country between 1970 and 2013

Figure 13 shows that landings by Algeria, Tunisia, Egypt, Libya and Croatia have generally been increasing since the 1970s. Landings by Spain, Morocco, France and Russia have been relatively stable, although some decreasing trend can be seen in the Spanish catches. Landings by Greece increased during more than half the period, but have been declining since 1994. Landings by Ukraine, Russia and Georgia declined steeply from the late 1980s to the early 1990s. Landings by Ukraine increased relatively steadily from the mid-1980s, those for Russia increased in the 2000s and those for Georgia rose in the late 2000s.

Landings from Bulgaria have fluctuated between 2 300 tonnes and nearly 20 000 tonnes, with current values close to 10 000 tonnes. Romania has fluctuated between 300 tonnes and around 16 000 tonnes, with current values being low (1 600 tonnes). Lebanon, Albania, Israel, Syrian Arab Republic, Palestinian Territories, Cyprus, Slovenia, Malta, Montenegro and Monaco catch less than 10 000 tonnes. Israel and Slovenia show a clear decreasing trend, with current landing figures of 2 200 tonnes (Israel) and 232 tonnes (Slovenia), while Monaco currently reports no catches (Figure 14).

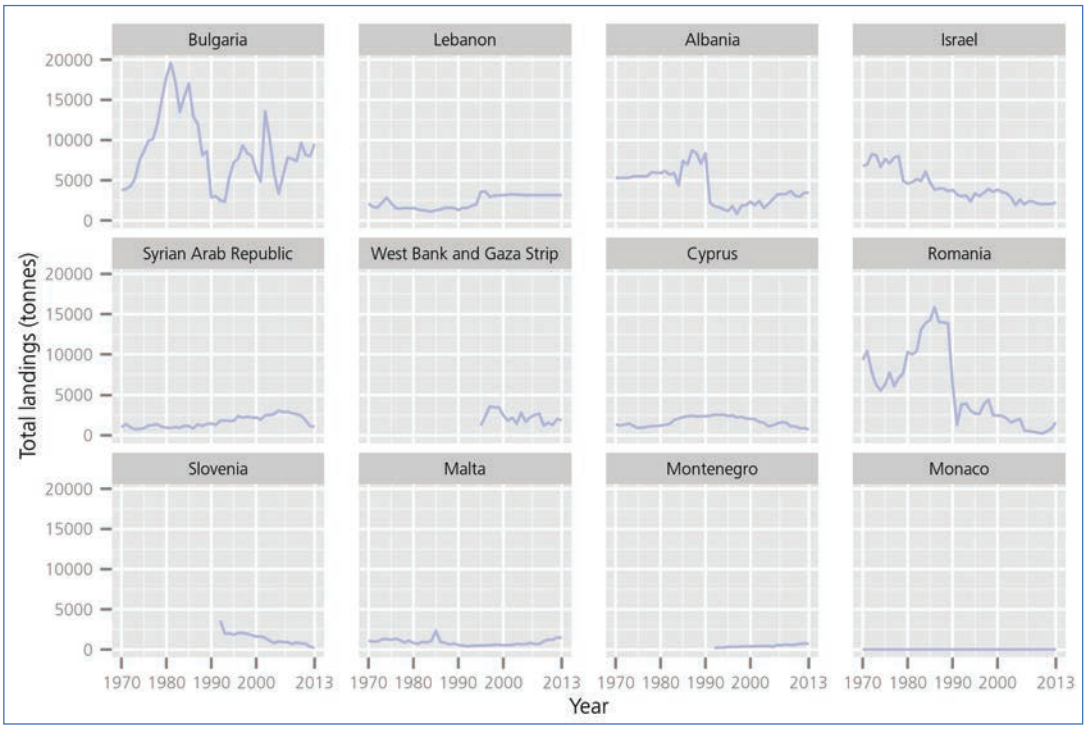


FIGURE 14
Trends in landings by country between 1970 and 2013

2.3. MAIN SPECIES AND GROUPS CONTRIBUTING TO MEDITERRANEAN AND BLACK SEA CATCHES

Anchovy (393 500 tonnes) and sardine (186 100 tonnes) are by far the dominant species in the GFCM area of application (Table 7). The 13 main species account for about 65 percent of landings. Clams (56 000 tonnes) and mussels (21 000 tonnes) account for substantial landings, as do the species group of squid, cuttlefish and octopus (58 000 tonnes), which are characteristic of the Mediterranean and not common in other parts of the world.

Table 7 Average landings in the 2000–2013 period by species contributing to at least 1 percent of total landings, sorted in decreasing order

Code	Species	Average landings	Percentage
ANE	*Engraulis encrasicolus*	393 500	26.21
PIL	*Sardina pilchardus*	186 100	12.4
JAX	Trachurus spp	74 900	4.99
SPR	*Sprattus sprattus*	62 100	4.14
SIX	Sardinella spp	57 400	3.82
SVE	*Chamelea gallina*	52 600	3.5
BOG	*Boops boops*	27 000	1.8
HKE	*Merluccius merluccius*	24 900	1.66
MUL	Mugilidae	22 600	1.51
BON	*Sarda sarda*	22 200	1.48
MSM	*Mytilus galloprovincialis*	20 000	1.33
BFT	*Thunnus thynnus*	17 700	1.18
CLA	*Clupeonella cultriventris*	17 500	1.17
MOL	*Unallocated mollusca*	15 200	1.01
MZZ	*Unallocated osteichthyes*	66 600	4.44
OTH	Other species*	451 000	30.04

*sum of species with average landings below 1 percent of the total

Table 8 Average landings in the 2000–2013 period by group of species contributing at least 1 percent of total landings, sorted in decreasing order

Group of species	Average landings	Percentage
Herrings, sardines, anchovies	710 200	51
Miscellaneous coastal fish	165 570	12
Miscellaneous pelagic fish	130 430	9
Unidentified marine fish	66 601	5
Squids, cuttlefish, octopus	58 000	4
Clams, cockles, arkshells	56 100	4
Cod, hake, haddock	51 470	3
Shrimp, prawns	36 710	3
Shad	21 380	2
Mussels	20 710	1
Miscellaneous demersal fish	20 450	1
Miscellaneous marine molluscs	15 180	1
*Other**	48 930	4

*sum of species with average landings below 1 percent of the total

2.4. SUBREGIONAL TRENDS IN LANDINGS IN THE MEDITERRANEAN AND BLACK SEA

An analysis by GFCM subareas shows that, in the western Mediterranean, Algeria, Spain and Italy (in decreasing order in terms of landings) together account for 75 percent of landings, with Morocco and Tunisia also making sizeable contributions. Landings in the Adriatic Sea are dominated by Italy and Croatia, with almost equal volumes, together representing more than 99 percent of catches. In the Ionian Sea, Italy and Tunisia together account for 75 percent of landings, with Libya accounting for another 19 percent. In the eastern Mediterranean, Egypt makes the largest contribution (38 percent), followed by Greece (29 percent) and Turkey (27 percent), each of these making almost equal contributions. In the Black Sea, Turkey is by far the largest contributor (68 percent), followed by Ukraine, Russian Federation and Georgia.

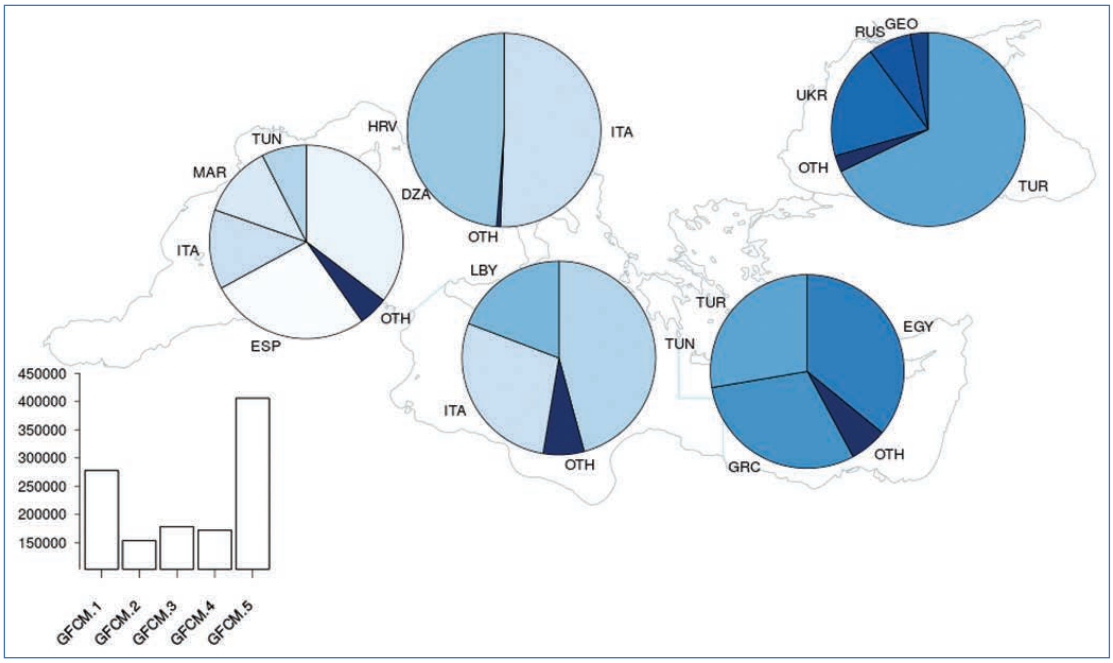


FIGURE 15
2013 landings by GFCM area and by country

Pie charts reflect the percentage of landings by country (in three letters alpha-code, with OTH meaning the sum of other countries not explicitly mentioned in the chart) in the different GFCM areas (GFCM.1 = western Mediterranean, GFCM.2 = Adriatic Sea, GFCM.3 = Ionian Sea, GFCM.4 = eastern Mediterranean and GFCM.5 = Black Sea). Bar plot on the bottom left represents absolute values of landings (t) by GFCM area.

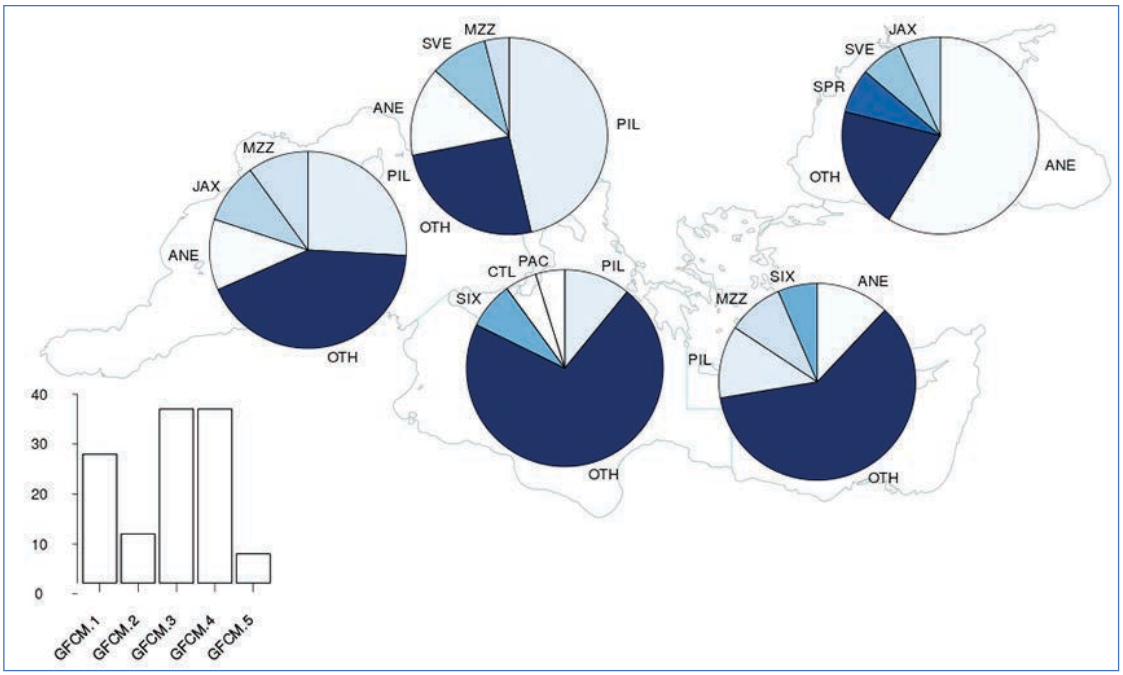


FIGURE 16
2013 landings by GFCM area and by species

Pie charts reflect the percentage of landings by species (in three letters alpha-code, with OTH meaning the sum of other species not explicitly mentioned in the chart) in the different GFCM areas (GFCM.1 = western Mediterranean, GFCM.2 = Adriatic Sea, GFCM.3 = Ionian Sea, GFCM.4 = eastern Mediterranean and GFCM.5 = Black Sea). Bar plot on the bottom left represents the number of species or groups of species that account for 90 percent of the total catch in the respective GFCM area.

In terms of species, a minimum of 30 species contribute to 90 percent of the landings in all Mediterranean subareas, with the exception of the Adriatic Sea, where cathes are dominated by less than 15 species. The most important single species in all Mediterranean areas is sardine (*Sardina pilchardus*), followed by anchovy (*Engraulis encrasicolus*), with percentage of both species being very similar in the Ionian Sea. Catches in the Black Sea are dominated by a smaller number of species (less than 10 species account for more than 90 percent of the catches), anchovy being the predominant species.

3. Socio-economics

©De Rossi

3. Socio-economics

3.1 INTRODUCTION AND SOURCES OF INFORMATION

This chapter provides an overview of the socio-economic characteristics of fisheries in the Mediterranean and the Black Sea. The GFCM Task 1 statistical matrix[1] was used as the primary data source for the analysis performed, as these data are reported directly to the GFCM from contracting parties. The reporting year for Task 1 data is 2013, unless otherwise stated[2]. When necessary, the Task 1 data were supplemented by official data from FAO, the World Bank, the European Central Bank (ECB), the International Labour Organization (ILO) and, where methodologically compatible, the Organisation for Economic Co-operation and Development (OECD).

Through an analysis of these data, a series of indicators was developed with regard to landing values, employment, fishing productivity and fish trade. Indicators were considered for inclusion in this report when data were available for the majority of GFCM contracting parties. Attempts were also made to include, when available, data for cooperating non-contracting parties, and those non-contracting parties and relevant non-State actors that fish in the Mediterranean and the Black Sea. Where relevant, data was also aggregated and analysed at both GFCM region-wide level and subregional level, as well as at the fleet segment level.

All monetary values in this chapter have been adjusted for inflation and are presented in constant 2005 US$[3]. This adjustment was made in order to standardize exchange rates between different national currencies over time, as well as to facilitate comparison with official World Bank economic indicators, which are reported as constant 2005 US$ or current US$. Since the recent euro-US$ exchange rate has been volatile, this conversion to constant 2005 US$ allows for a more standardized comparison of the data reported by the contracting parties (given that the reporting year ranges from 2011–2014).

3.2 SOCIO-ECONOMIC IMPORTANCE OF MEDITERRANEAN AND BLACK SEA FISHERIES: VALUING FISHERIES

The data presented in this chapter provide indicators of the socio-economic importance of the primary fishing sector, as well as an overview of the value of trade in the region. Indicators used include value at first sale, fishing employment productivity and the value of imports and exports.

In addition, some insights into the value of recreational fisheries and an approximate estimation of the total impact of fisheries into the economies of the region are provided in boxes 4 and 5. These values are to be considered approximate, as in order to provide an accurate valuation of the socio-economic importance of Mediterranean and Black Sea fisheries, a complete value chain analysis would be needed. Much of the socio-economic data needed to do such a comprehensive value chain analysis is incomplete and beyond the scope of the GFCM's mandate; therefore, these data are not addressed in this chapter.

[1] Recommendation GFCM/33/2009/3 on the implementation of the GFCM Task 1 statistical matrix and repealing Resolution GFCM/31/2007/1.

[2] 2013 Task 1 data are unavailable for certain contracting parties, cooperating non-contracting parties, non-contracting parties and relevant non-State actors. Task 1 data from the following reporting years were used instead: 2011 (Egypt, Lebanon), 2012 (Albania, Tunisia), 2014 (Palestinian Territories).

[3] Values were adjusted for inflation by calculating the percent change of the consumer price index (CPI) from the reporting year to 2005. Values reported in euros were adjusted for inflation using the ECB's harmonized index of consumer prices (HICP) and then exchanged to US$ using official ECB annual exchange rates. For those values reported in other currencies, World Bank CPI data and official average annual exchange rates were used.

Box 4 The socio-economic value of recreational fisheries

By definition, recreational fisheries are "a non-commercial (i.e. not for sale, barter, or trade) subset of capture/harvest fisheries; motivated by catching fish for fun, pleasure, or sport" (Gaudin and De Young, 2007, p. 6). Based on this definition, although recreational fisheries do not generate a direct commercial output, studies have shown that they make a significant contribution to coastal economies (Gaudin and De Young, 2007, p. 11). In particular, recreational fisheries generate considerable economic impact in the tourism sector. Furthermore, recreational fisheries have significant non-use value (altruistic, bequest and existence values) and option value (potential for future use) that can be estimated using non-market valuation techniques (Pearce, *et. al.*, 2006).

Although studies on the economic value of recreational fishing in the Mediterranean and the Black Sea are limited, economic valuation techniques, such as the travel-cost method, hedonic pricing method or contingent valuation, have been applied in certain case studies to calculate the value of this activity. In one such study by Tragsatec, and revised by R. Franquesa for the Spanish Ministry of Agriculture, Fisheries and Food (*Estudio del impacto socioeconómico de la pesca recreativa en el Mediterráneo español*), a hedonic pricing method was used to value recreational fishing activity on Spain's Mediterranean coast. This study concluded that recreational fishing contributes between €550–650 million annually to the economy of this region.

Box 5 An approximate estimate of the economic impact of Mediterranean and Black Sea fisheries

Although a precise calculation of the economic impact of Mediterranean and Black Sea fisheries – including the value of upstream and downstream activities of the fisheries value chain – is not feasible due to data limitations, it is evident that these fisheries are of great socio-economic importance to the region. As noted by Dyck and Sumaila: "The importance of (the fishing sector) to the economy may be understated when considering only the direct values obtained though the usual methods of national accounts" (2010, p. 229). In their study, *Economic impact of ocean fish populations in the global fishery*, Dyck and Sumaila apply a Leontief model of input-output analysis to global fishery production, to estimate the total direct, indirect and induced economic effect of the fisheries sector.

The output multipliers for individual countries and non-State actors estimated by Dyck and Sumaila have been applied to the landing values of fish captured in FAO major fishing area 37 by these riparian States and non-State actors in the GFCM area of application. This has enabled a preliminary estimation of the potential economic impact of Mediterranean and Black Sea fisheries. On average throughout the region, the economic impact of fisheries is estimated to be 2.65 times the value at first sale (landing value).

Total landed value in GFCM area of application (2005 US$)	Average multiplier	Estimated GFCM regional economic impact of fisheries (2005 US$)
US$3 094 000 000	2.65	US$6 954 000 000*

(Multiplier source: Dyck & Sumaila, 2010)

*The value listed is the sum of all individual outputs, based on individual multipliers, rather than the total landed value multiplied by the average multiplier.

3.3. VALUE AT FIRST SALE

3.3.1 Landing value at first sale

The total value at first sale of fish landings across the Mediterranean and the Black Sea region is approximately US$3.09 billion[4]. This accounts for the value at first sale of fish from capture fisheries in FAO major fishing area 37, prior to any processing or value addition activities.

To offer a subregional comparison, landing values have been aggregated by GFCM subregion and are shown in Figure 17. The highest aggregate landing values are seen in the western Mediterranean (27 percent of total landing value), while lower aggregate landing values are seen in the Black Sea (12 percent of total landing value). In the case of countries that border more than one subregion (e.g. Greece, Italy and Turkey), their total landing values have been included in the calculations for both subregions. This approach is necessary because the landing value data given in the Task 1 statistical matrix are reported by individual country or non-State actor, rather than by GSA. A more accurate calculation of landing values by subregion would require landing value data to be reported by GSA, a limitation that is expected to be corrected with the implementation of the DCRF.

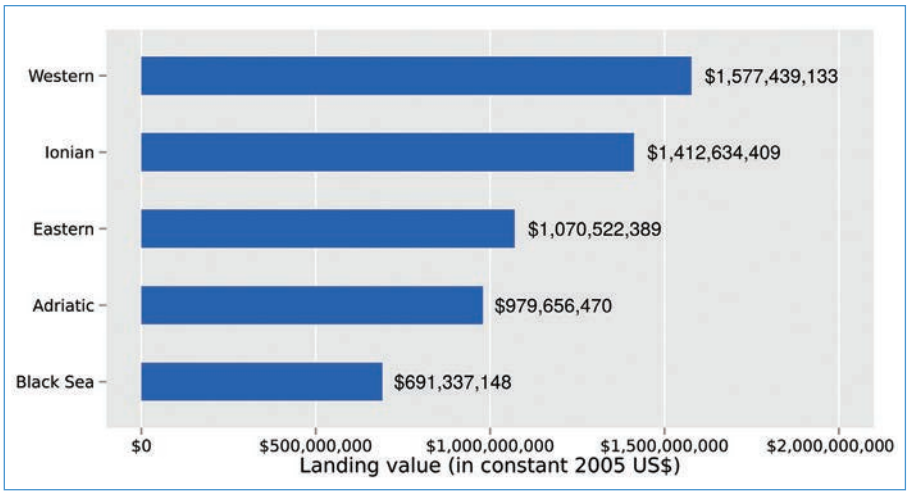


FIGURE 17
Total landing value by GFCM subregion

Although the real value of landings is highest in the western Mediterranean, the relative contribution of this value to the overall economy of riparian States in the western Mediterranean (0.02 percent of GDP) is less significant than in the other subregions. First sales of fish landings present a more significant economic contribution to the regional economies in the eastern Mediterranean (0.1 percent of GDP), the Ionian Sea (0.07 percent of GDP), the Adriatic Sea (0.05 percent of GDP) and the Black Sea (0.03 percent of GDP).

A further breakdown of this indicator is shown in Figure 18, which gives the total landing value per country for landings from Mediterranean and Black Sea waters (FAO major fishing area 37)[5].

[4] Data are primarily from the Task 1 statistical matrix. Data for Egypt come from FAO EastMed (2014), data for Greece come from the OECD database (2012) and data for Black Sea riparian countries that are cooperating non-contracting parties or non-contracting parties (Georgia, Ukraine and the Russian Federation) come from the FAO Fishery Commodities Global Production and Trade database (2012). Information from Bosnia and Herzegovina, Israel, Libya, Monaco, Portugal and the Syrian Arab Republic have not been reported, but they are expected to have a low contribution to the total.

[5] Ibid.

The total landing value in Italy is notable, as it represents close to one-third of the total regional value. However, the landing value in Italy represents a less significant percentage of national GDP than it does elsewhere. The landing value at first sale of fishery products as a percentage of national GDP in Tunisia, Algeria, Malta, Albania, Croatia, Greece, Egypt, Palestinian Territories, Turkey, Montenegro, Lebanon, Ukraine and Georgia, respectively, are all higher than that of Italy.

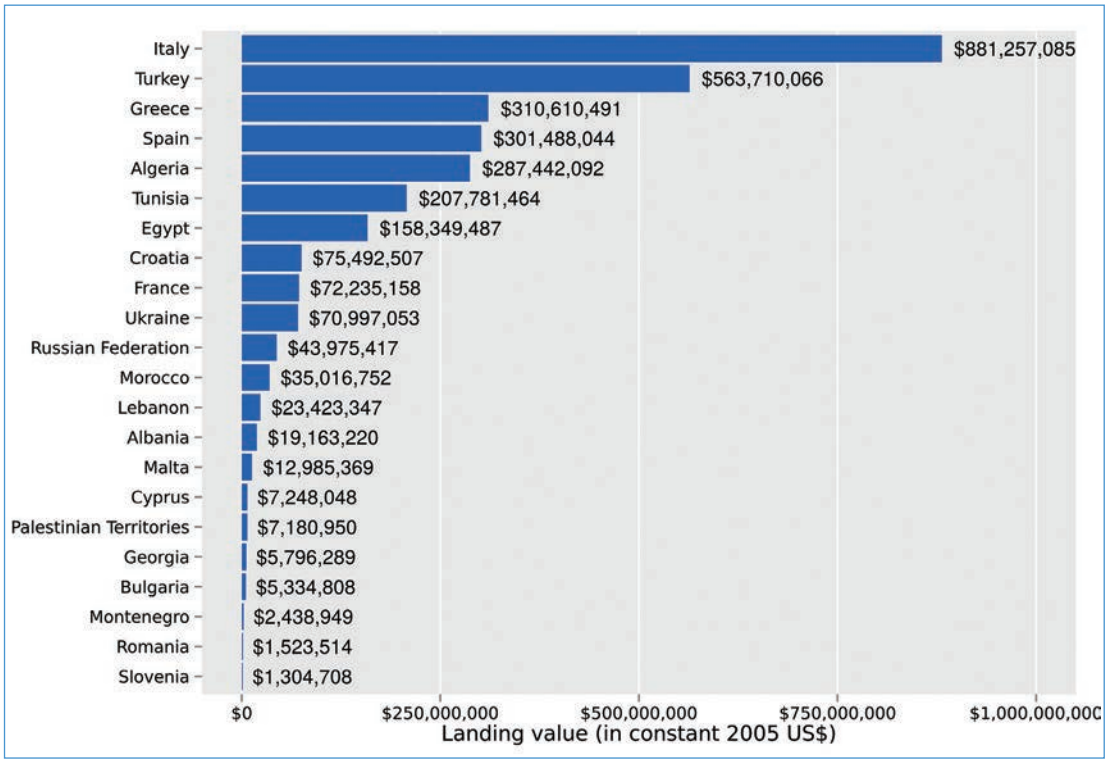


FIGURE 18
Landing values as reported by contracting parties, cooperating non-contracting parties and non-contracting parties of the GFCM, as well as relevant non-State actors

Figure 19 provides a calculation of the total landing value per fleet segment aggregated across the entire GFCM area of application[6]. These data offer a better understanding of the economic contribution of each fleet segment, which is important for the consideration of different management plans. Trawlers from 12 to 24 m LOA, purse seiners more than 12 m LOA, and polyvalent small-scale vessels with engines from 6 to 12 m LOA, respectively, were the fleet segments that earned the highest landing values. At the other end of the spectrum, polyvalent small-scale vessels without engines less than 12 m LOA, trawlers less than 12 m LOA, and tuna seiners, respectively, earned the lowest landing values in the region. Of particular note is the important economic role of the small-scale fleet segment of polyvalent vessels between 6 and 12 m LOA, which alone accounts for close to 17 percent of the total value of landings.

[6] Data are from the Task 1 statistical matrix. Data were not reported for Bosnia and Herzegovina, Georgia, Greece, Israel, Japan, Libya, Monaco, Portugal, the Russian Federation, the Syrian Arab Republic or Ukraine. Therefore the values shown are probably an underestimate.

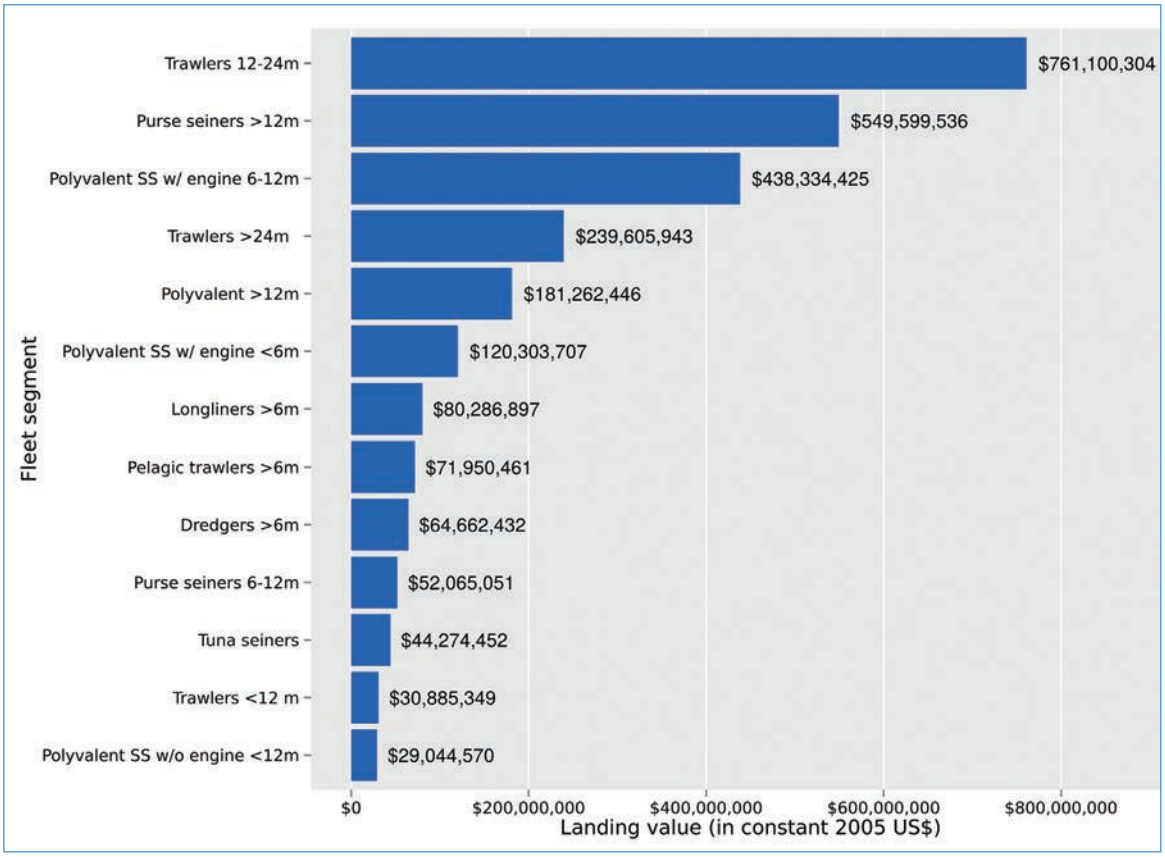


FIGURE 19
Total landing value per fleet segment
See Chapter 2 on fishing fleets for characteristics and definitions of each fleet segment

3.3.2 Landing price at first sale

According to the most recent data on landing values and landing weight submitted through the GFCM Task 1 statistical matrix and the FAO Fishery Commodities Global Production and Trade database, the average landing price per tonne in the GFCM area of application is US$2 509.76 (in constant 2005 US$)[7].

An analysis of the average landing prices per tonne in GFCM subregions shows that the three subregions where the highest price per tonne is observed – the western Mediterranean, the Ionian Sea and the Adriatic Sea – earn a price that is more than double that earned in the eastern Mediterranean and the Black Sea, which show lower landing prices (Figure 20).

[7] These data do not include statistics from Bosnia and Herzegovina, Greece, Israel, Japan, Libya, Monaco, Portugal or the Syrian Arab Republic, for which data on landing value, landing weight, or both, were unavailable. Data for Black Sea riparian countries that are GFCM cooperating non-contracting parties or non-contracting parties (Georgia, the Russian Federation and Ukraine) were taken from the FAO Fishery Commodities Global Production and Trade database.

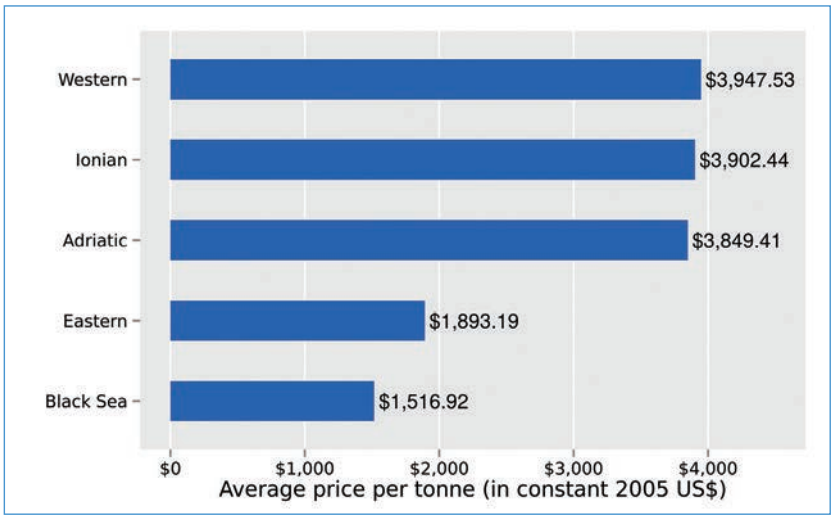


FIGURE 20
Average landing prices by GFCM subregion

Figure 21 shows the average landing prices in each GFCM contracting party, cooperating non-contracting party, non-contracting party and relevant non-State actor, where data were reported. Despite Italy having the highest total landing value, Cyprus, Malta and Slovenia have higher average landing prices. The lowest average landing prices are found in Georgia, Bulgaria and Romania. There is a greater than 13-fold difference between the lowest and highest landing prices.

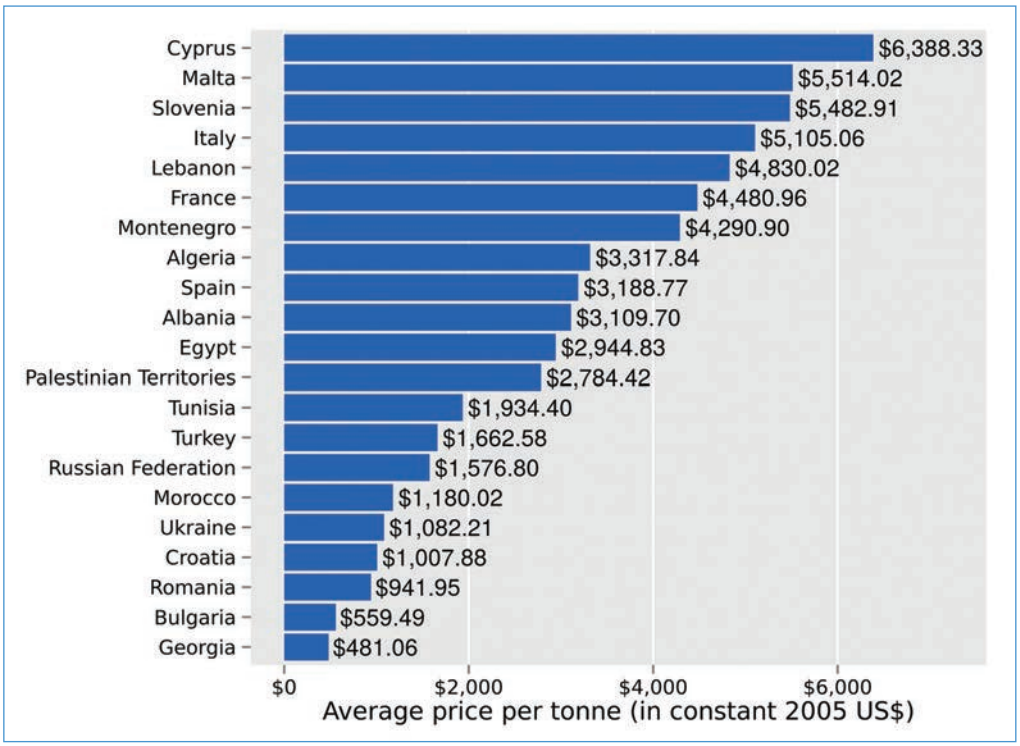


FIGURE 21
Average landing price as reported by contracting parties, cooperating non-contracting parties and non-contracting parties of the GFCM, as well as relevant non-State actors

3.4 EMPLOYMENT

According to data submitted through the GFCM Task 1 statistical matrix, just under a quarter of a million people (221 797) are directly employed on fishing vessels in the GFCM area of application[8] [9]. This represents approximately 0.11 percent of the combined total working population in the GFCM countries where data are reported. Data on total working population were obtained through a calculation of World Bank population data and ILO statistics on the economically active population percentage. This statistic does not include those employed in additional jobs that are also highly dependent on the fishing industry (such as fish processing, fish marketing or boat maintenance), which by some estimates may account for as much as half of total employment in the fisheries sector (Sauzade and Rousset, 2013).

Employment data have been aggregated by GFCM subregion in both absolute terms (Figure 22 – total employment on fishing vessels) and relative terms (Figure 23 – employment as a percentage of the working population). Although the absolute employment varies across the subregions, in relative terms, employment in the eastern Mediterranean, Adriatic Sea, western Mediterranean and the Black Sea is similar. However, employment in the Ionian Sea is notable. Both the highest levels of absolute and relative employment are found in this region. Furthermore, the level of relative employment in the Ionian Sea is approximately three times higher than that in all the other subregions. Considering the high landing values and landing prices, these figures indicate an important socio-economic role of the fishing sector in this subregion.

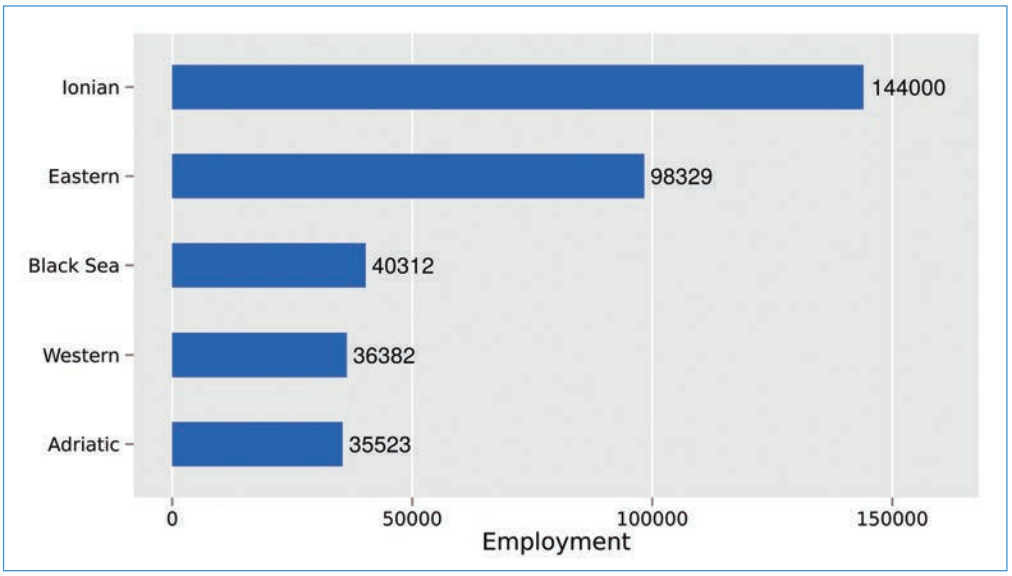


FIGURE 22
Total employment on fishing vessels per GFCM subregion

[8] The Task 1 reporting year for employment data is 2012, except in the case of Libya and Romania (for which the reporting year is 2013) as well as Algeria, Egypt and Lebanon (for which the reporting year is 2011).

[9] Data on employment were unavailable through the GFCM Task 1 statistical matrix for Algeria, Bosnia and Herzegovina, Israel, Japan, Monaco, Montenegro, Morocco, Portugal, Spain, the Syrian Arab Republic as well as Black Sea riparian countries that are GFCM cooperating non-contracting parties or non-contracting parties (Georgia, Ukraine and the Russian Federation). Statistics for Montenegro were included based on data reported by the Statistical Office of Montenegro (MONSTAT). Data for Spain were obtained from the Scientific, Technical and Economic Commission for Fisheries (STECF – employment in FAO major fishing area 37 only).

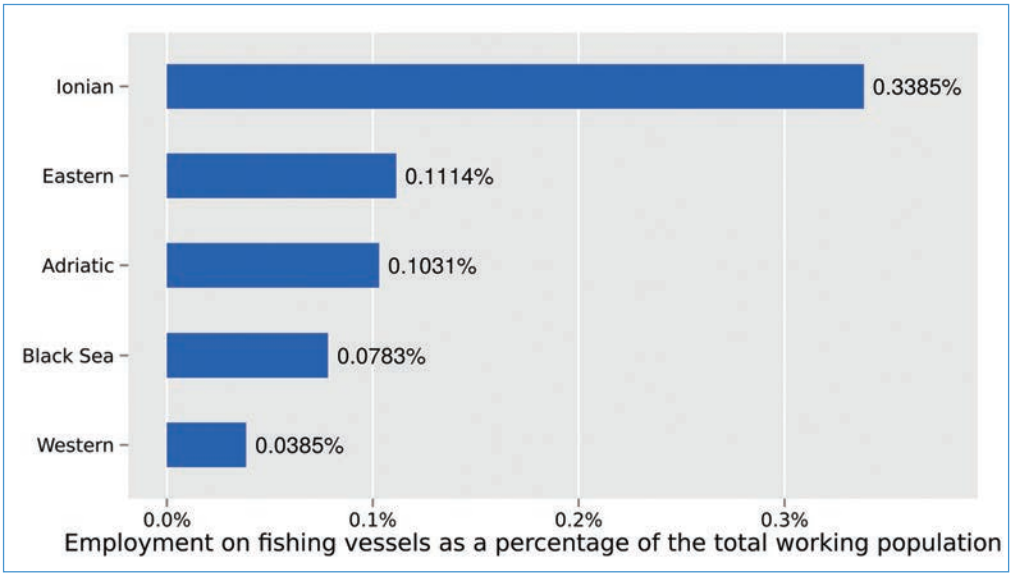


FIGURE 23
Total employment on fishing vessels as a percentage of the total working population in GFCM subregions

Figure 24 shows the total employment on fishing vessels for GFCM contracting parties, cooperating non-contracting parties and non-contracting parties, as well as relevant non-State actors, where data are reported. Tunisia, Greece and Turkey report the highest number of employees on fishing vessels, while Montenegro, Slovenia and Romania report the lowest.

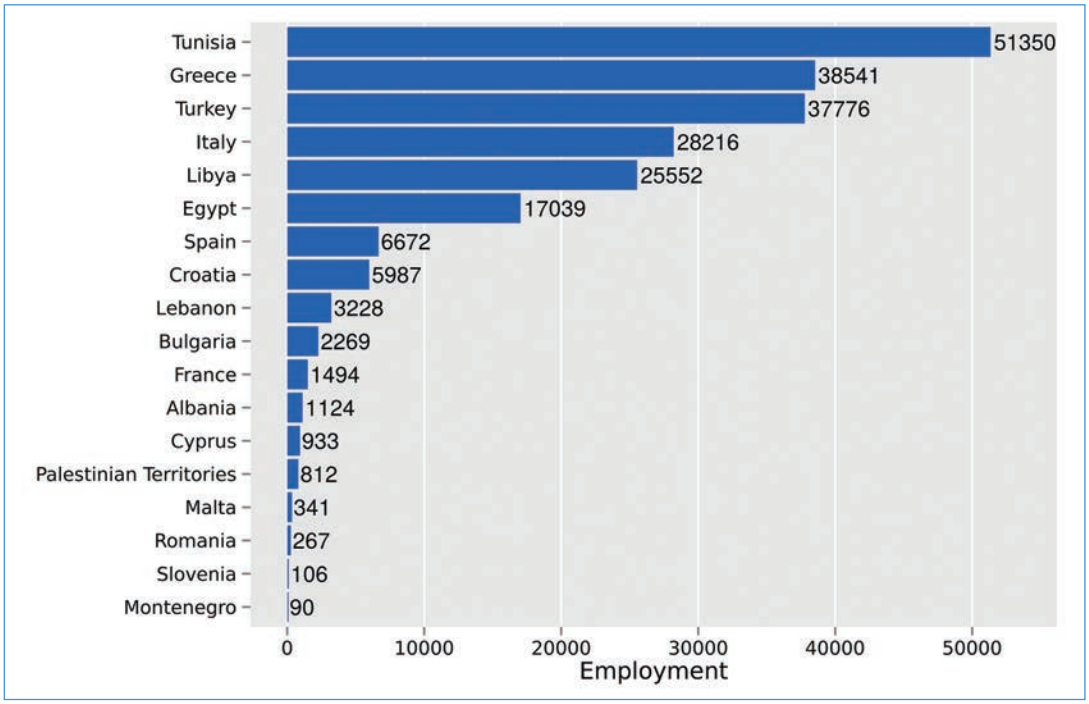


FIGURE 24
Total employment on fishing vessels as reported by GFCM contracting parties, cooperating non-contracting parties and non-contracting parties, as well as relevant non-State actors

Figure 25 shows the total employment on fishing vessels as a percentage of the total working population. This indicator demonstrates the contribution of the fishing sector to national employment figures. For example, data submitted through the Task 1 statistical matrix show that the fishing industry is a relatively important employer in Tunisia, with close to 1.2 Tunisians out of every 100 employed on fishing vessels, while it is much less significant in Romania, where only 2.4 Romanians out of every 100 000 are employed on fishing vessels. The high fisheries employment levels in Tunisia, both in absolute and relative terms, sheds further light on the significant role of employment on fishing vessels in the Ionian Sea.

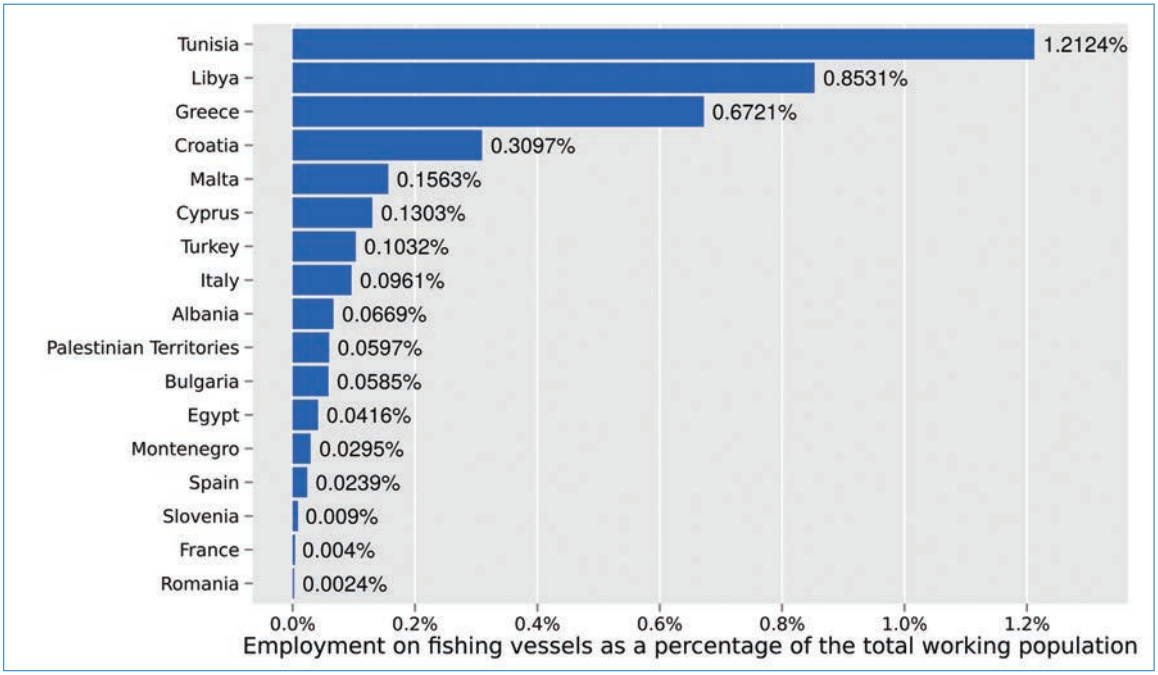


FIGURE 25
Total employment on fishing vessels as a percentage of the total working population in GFCM contracting parties, cooperating non-contracting parties, and non-contracting parties, as well as relevant non-State actors

An analysis of employment is also provided by fleet segment (Figure 26). Of particular note are polyvalent small-scale fleet segments: vessels without engines less than 12 m LOA, vessels with engines less than 6 m LOA, and vessels with engines from 6 to 12 m LOA which together account for more than 60 percent of total employment in the sector. The latter small-scale fleet segment alone accounts for approximately 40 percent of all employment in the GFCM area of application.

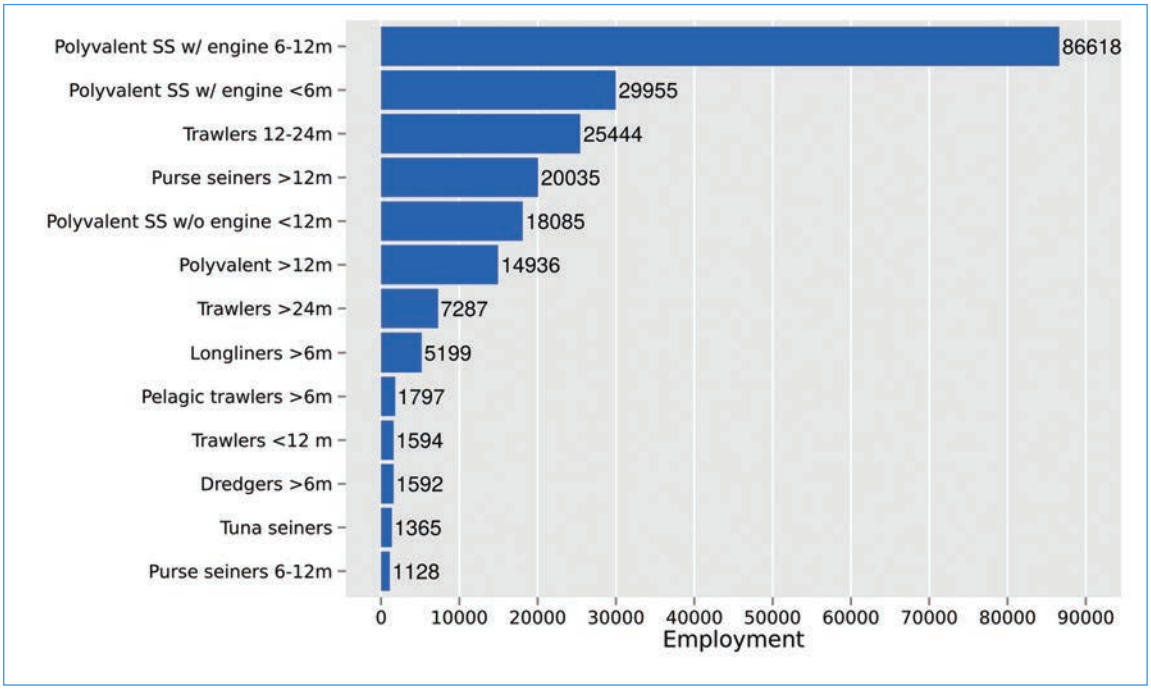


FIGURE 26
Total employment on fishing vessels per fleet segment

3.5 PRODUCTIVITY

3.5.1 Landing value per employee

In this section, the average production in terms of value at first sale for each worker is presented (Franquesa, *et. al.*, 2001, p. 4), offering an indication of the efficiency of production. According to the data reported through the GFCM Task 1 statistical matrix, on average, across the GFCM area of application, each worker produces US$14 447.90 in catch value.

This indicator was calculated using the data reported in sections 3.3.1 and 3.4. Data for landing values, employment, or both, were not reported in the Task 1 statistical matrix for Algeria, Bosnia and Herzegovina, Egypt, Greece, Israel, Japan, Libya, Monaco, Montenegro, Morocco, Palestinian Territories, Portugal, Spain and the Syrian Arab Republic. Moreover, data were not reported for those countries in the Black Sea that are not GFCM contracting parties (Ukraine, the Russian Federation and Georgia). Of particular note is the high employee productivity in the Adriatic Sea. All other subregions exhibit relatively similar employee productivity levels.

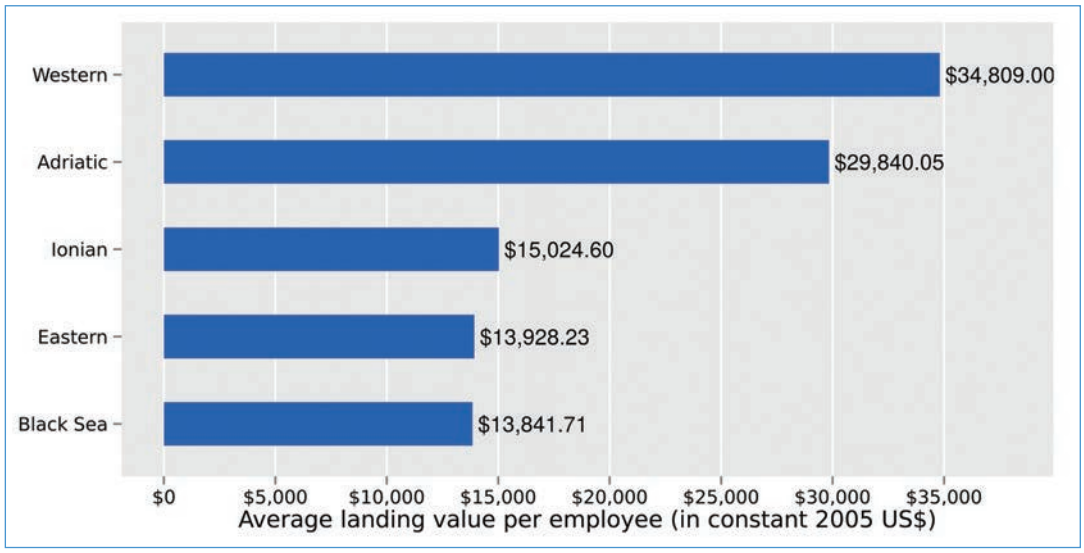


FIGURE 27
Landing value per employee per GFCM subregion

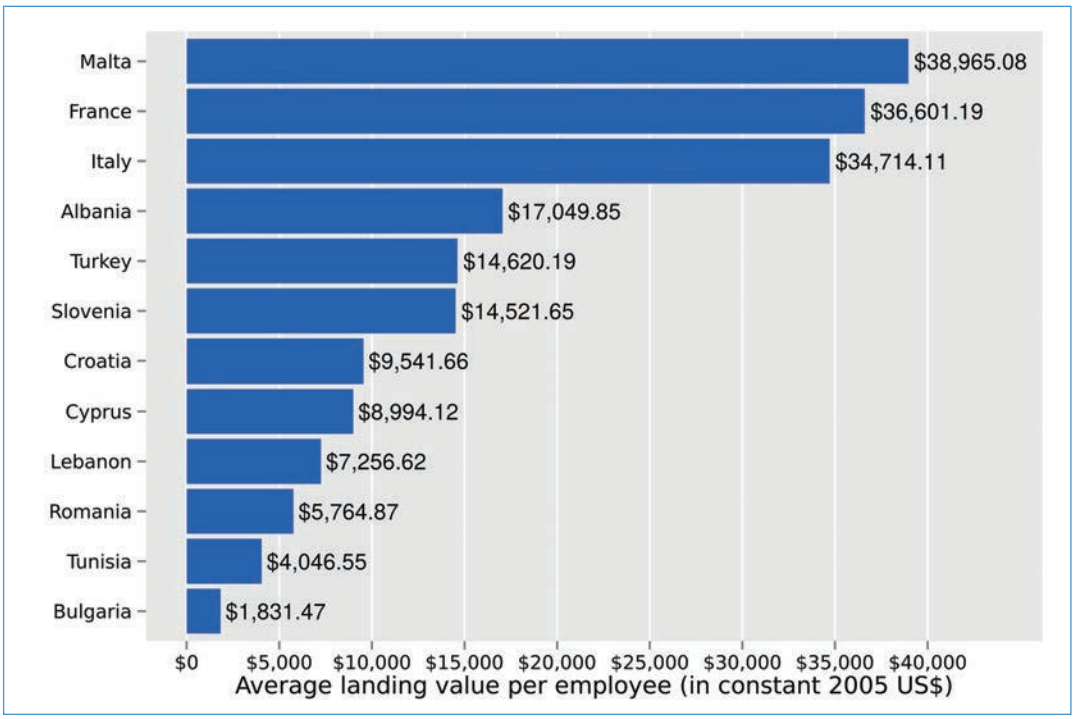


FIGURE 28
Landing value per employee by GFCM contracting party, cooperating non-contracting party, non-contracting party and relevant non-State actor

3.5.2 Vessel productivity (landing value per vessel)

The vessel productivity indicator presents average production in terms of value at first sale (landing value) for each vessel (Franquesa *et al.*, 2001, p. 4). According to the data reported through the GFCM Task 1 statistical matrix, the average vessel productivity in the GFCM area of application is a landing value of US$41 263 (in constant 2005 US$) per vessel.

Data for landing values, numbers of vessels, or both, were not reported in the Task 1 statistical matrix for Bosnia and Herzegovina, Greece, Israel, Japan, Libya, Monaco, Portugal and the Syrian

Arab Republic, and therefore data for these countries were not included in the calculation of this indicator. Moreover, data were not reported for those countries in the Black Sea that are not GFCM contracting parties (Ukraine, the Russian Federation and Georgia).

Calculations of vessel productivity by GFCM subregion and by individual GFCM contracting party, cooperating non-contracting party, non-contracting party and relevant non-State actor, are presented in Figures 29 and 30, respectively.

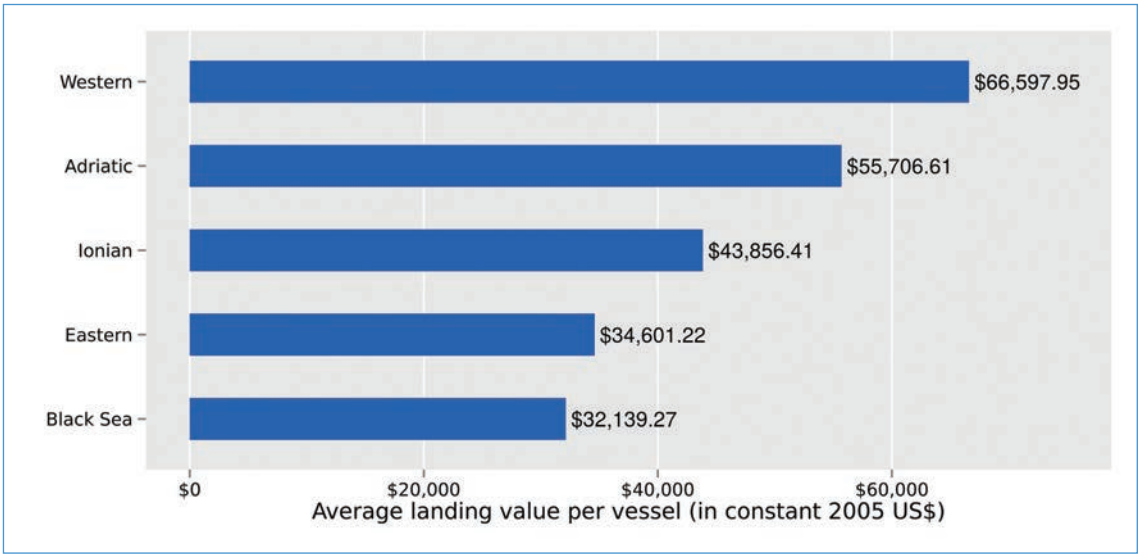


FIGURE 29
Average fish landing value per fishing vessel in GFCM subregions

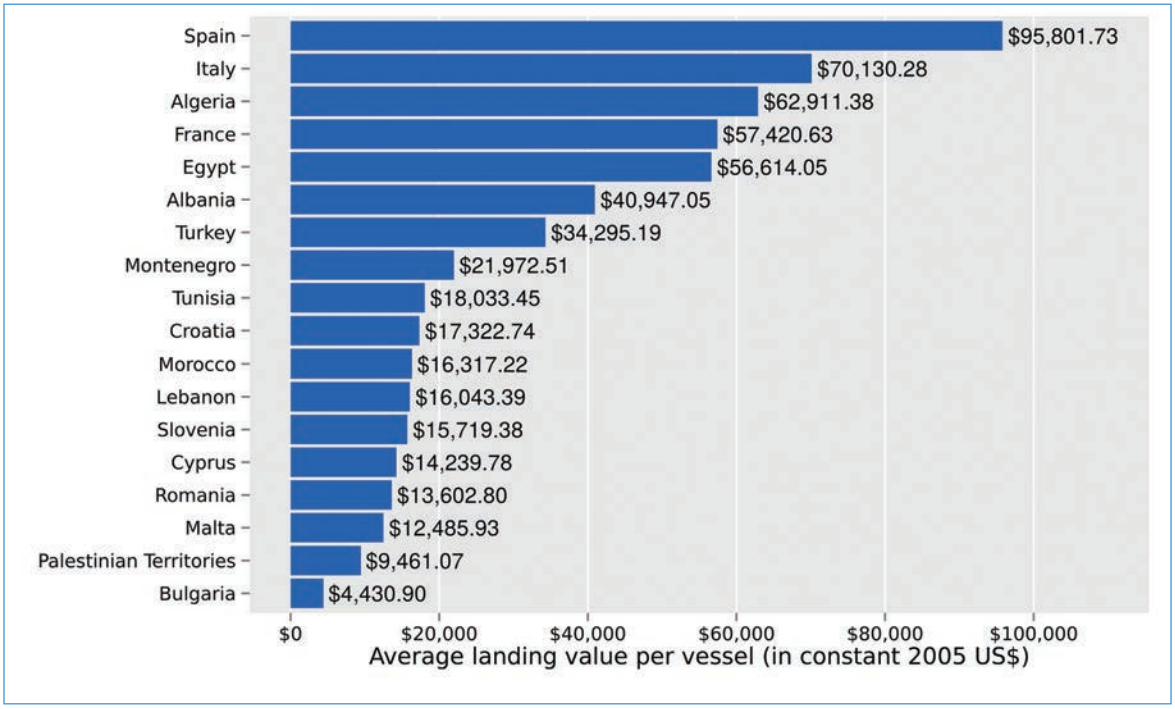


FIGURE 30
Average fish landing value per fishing vessel in GFCM contracting parties, cooperating non-contracting parties and non-contracting parties of the GFCM, as well as in relevant non-State actors

3.6. TRADE

Fish trade within the GFCM area of application is an important activity that has intensified in the past 30 years (Malvarosa and De Young, 2010). Of particular importance are the trade relationships between the European Union (EU) and non-EU GFCM contracting parties. Malvarosa and De Young note that "non-European Mediterranean countries tend to import products from EU countries characterized by a smaller commercial value, while they export to the EU molluscs, fresh and chilled fish and crustaceans, characterized by a higher commercial value".

3.6.1 Standardized trade balance

Based on data from the FAO Fishery Commodities Global Production and Trade database, a calculation of the standardized trade balance has been performed for all contracting parties, cooperating non-contracting parties and non-contracting parties within the GFCM area of application, as well as relevant non-State actors. This indicator provides a percentage ratio between the simple balance (exports minus imports) and the total volume of fish trade within the region, offering a clear indication of who is a net importer or exporter of fish products. A standardized trade balance of negative one indicates 100 percent imports, while a balance of one indicates 100 percent exports (with a balance of 0 indicating perfectly balanced imports and exports). This indicator has been estimated at the contracting party level (Figure 31), at the GFCM subregion level (Figure 32), as well as by Mediterranean cardinal region (northern, southern, and eastern Mediterranean, and the Black Sea – Figure 33). It is important to note, however, that data for this analysis include both capture fishery and aquaculture statistics. In addition, in the case of countries bordering more than one FAO major fishing area, such as France, Spain, Morocco, Egypt and the Russian Federation, trade data include both major fishing areas and are not isolated only by fishery products originating in FAO major fishing area 37.

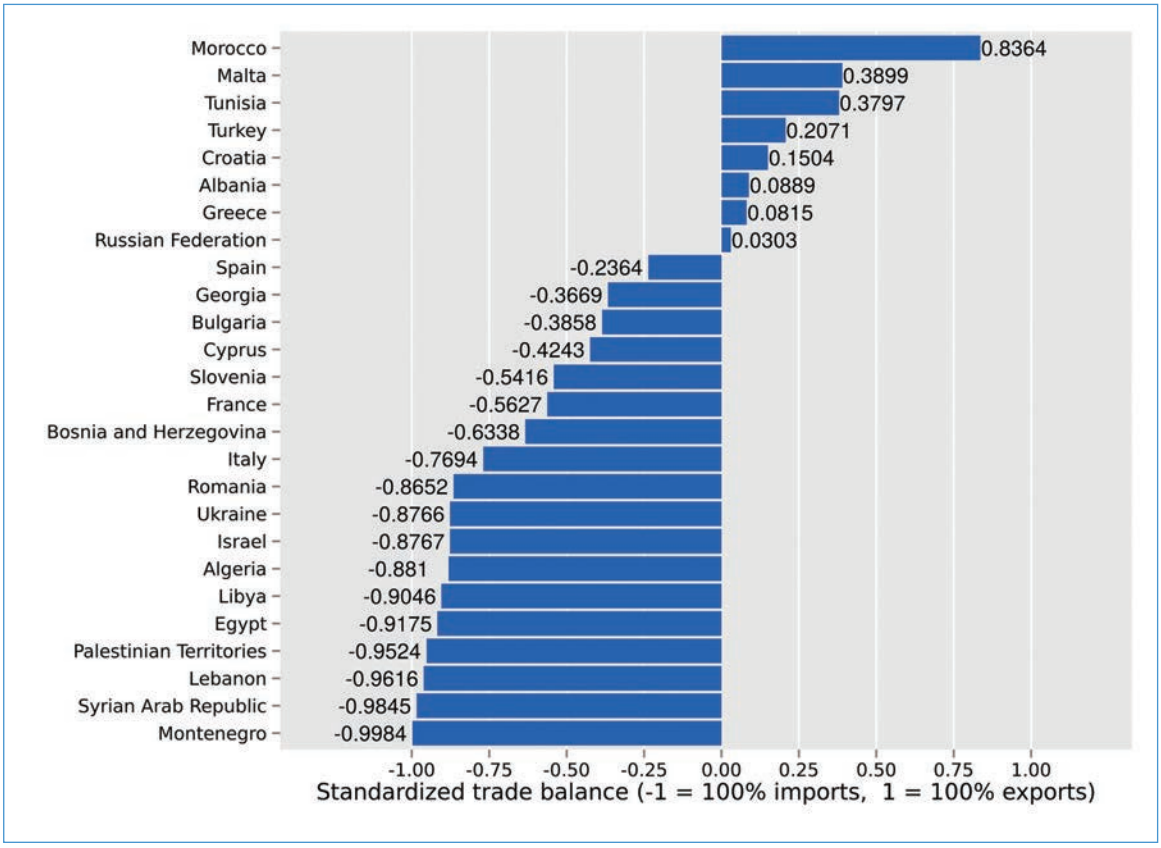


FIGURE 31
Standardized trade balance by GFCM contracting party, cooperating non-contracting party, non-contracting parties and relevant non-State actor

As can be seen in Figure 31, on average a strongly negative standardized trade balance is found in the GFCM area of application, indicating that most Mediterranean and Black Sea riparian States and non-State actors are net importers of fish products. Morocco, followed by Malta and Tunisia, are exceptions in the region, all with relatively strong positive trade balances (.84, .39 and .38 respectively). The trade balances for Turkey, Croatia, Albania, Greece and the Russian Federation also result as positive, although closer to zero, indicating a more even balance of imports and exports in these countries.

However, an analysis of this indicator by GFCM subregion (Figure 32) reveals that all subregions are net importers, with the Adriatic Sea and the Ionian Sea being the most heavily dependent on imports.

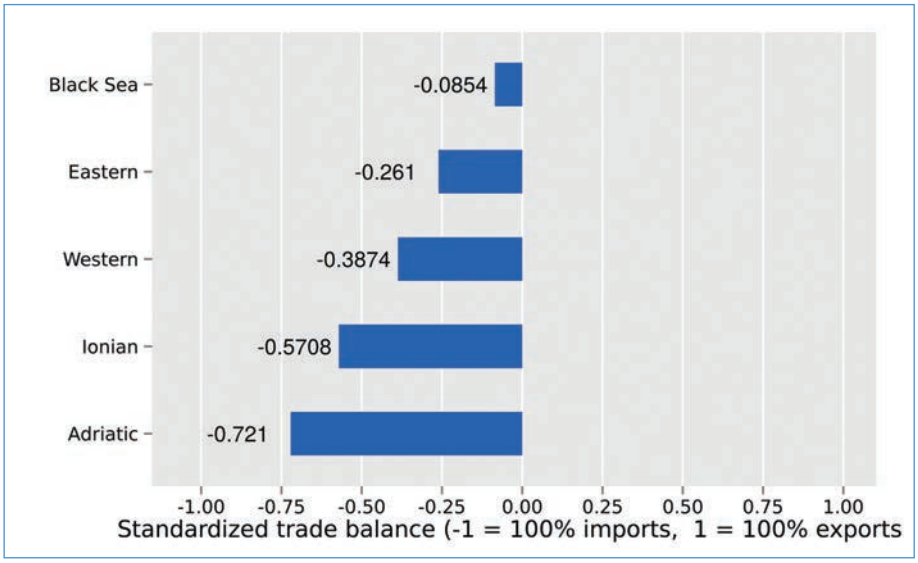


FIGURE 32
Standardized trade balance by GFCM subregion

Further regional analysis is provided in Figure 33, which illustrates the trade balance by cardinal regions of the GFCM area of application (northern Mediterranean, southern Mediterranean, eastern Mediterranean and Black Sea countries). This figure shows that the countries of the northern and eastern Mediterranean are more heavily reliant on imports, while the Black Sea, although still negative, has more balanced imports and exports. The southern Mediterranean is the only region where net exports are seen.

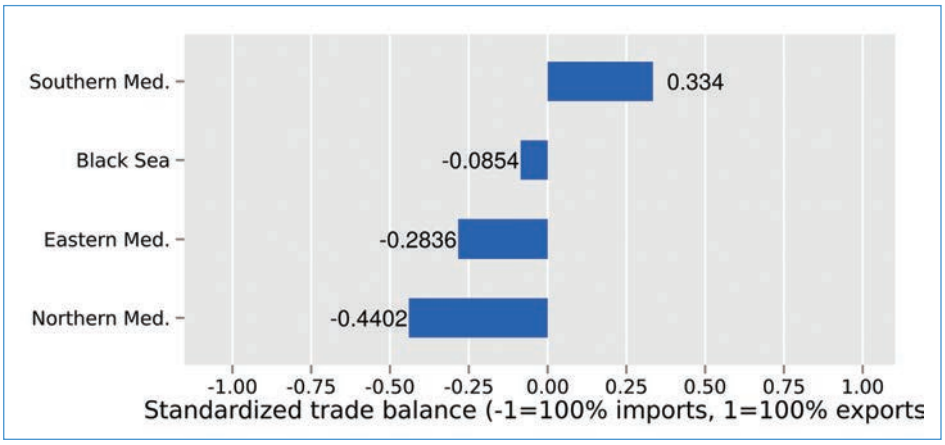


FIGURE 33
Standardized trade balance by cardinal region of the GFCM area of application

3.6.2 Trade flows

Given the strongly negative trade balance in the Mediterranean and the Black Sea, an analysis of trade flows proves useful for understanding the movement of fish products within this region. Using data from the UN Comtrade database[10], an analysis of the trade of fish products by GFCM contracting parties, cooperating non-contracting parties and non-contracting parties, as well as relevant non-State actors, was conducted to shed light on the volume and directional flows of the fish product trade in this region. Although these data provide an important snapshot of the quantity and movement of fish products in the Mediterranean and the Black Sea region, it is important to highlight that they do not consist solely of fish products originating in capture fisheries in the GFCM area of application. Indeed, these data do not distinguish between fish products originating from aquaculture or capture production and, in the case of the Mediterranean and the Black Sea countries that border more than one FAO major fishing area (Egypt, France, Morocco, Russian Federation and Spain), the data do not distinguish between the major fishing area of production. Despite these limitations, the following provides a useful analysis of the value and flow of fish trade in this region.

The total export of fish products from the riparian countries and relevant non-State actors of the Mediterranean and the Black Sea is valued at approximately US$25 billion and represents just below 20 percent of total global fish exports (FAO, 2014). Of this US$25 billion, intra-Mediterranean and Black Sea trade of fish products is valued at approximately US$4.8 billion, while the remaining US$20 billion represents extra-Mediterranean and Black Sea exports. Overall, international fish trade to/from this region and the rest of the world (the sum of extra-Mediterranean and Black Sea exports and imports) is valued at approximately US$27 billion.

This analysis of the flows and values of fishery product trade between the GFCM region and other global geographical regions is illustrated in Figure 34, using a circular plot. The flow of traded fish products is indicated by the curved segment connecting different regions on the plot, with the colour of the curve indicating the exporting region. The value of trade (in millions of US$) is indicated by the numeric values along the perimeter of the plot, which results in the curved segment becoming wider as the trade value increases. The black arc within each regional segment indicates the part of the total value expended in import.

As can be seen in Figure 34, the primary regional trade partner for fish products from the Mediterranean and the Black Sea riparian countries and relevant non-State actors are European countries that are not Mediterranean or Black Sea riparian countries, both in terms of imports and exports. In terms of total trade, Asia is the next largest overall trade partner, with the Americas trailing close behind. Although the total value of trade (both imports and exports) with the Americas is lower than it is with Asia, the Americas import more from the Mediterranean and the Black Sea countries than Asia does.

[10] Data used are an average annual value over the period 2010–2013.

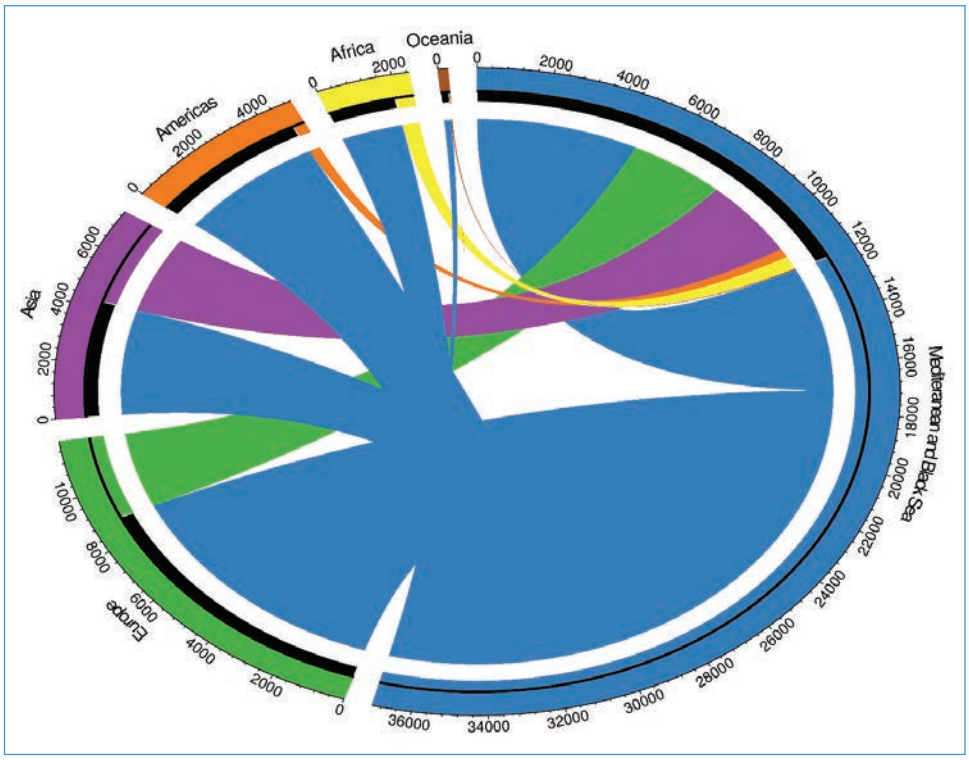


FIGURE 34
Trade between Mediterranean and Black Sea countries and the rest of the world (in millions of US$)

Further analysis of trade by individual Mediterranean and Black Sea riparian countries and relevant non-State actors was also performed. In terms of total value of trade (imports plus exports), Spain, France, Italy and the Russian Federation, respectively, conduct the highest total value of trade in the region (Figure 35). Together, these four countries represent just over 80 percent of the value of fishery products traded by Mediterranean and Black Sea riparian countries and non-State actors. The dominant role of these four countries may be attributed to one of the limitations of the data used for this analysis, namely, that data are aggregated by country, and it is not possible to distinguish trade of fishery products originating only in FAO major fishing area 37. As Spain, France and the Russian Federation each border more than one FAO major fishing area, the inclusion in their trade data of catches from waters outside the Mediterranean and the Black Sea probably skews this analysis.

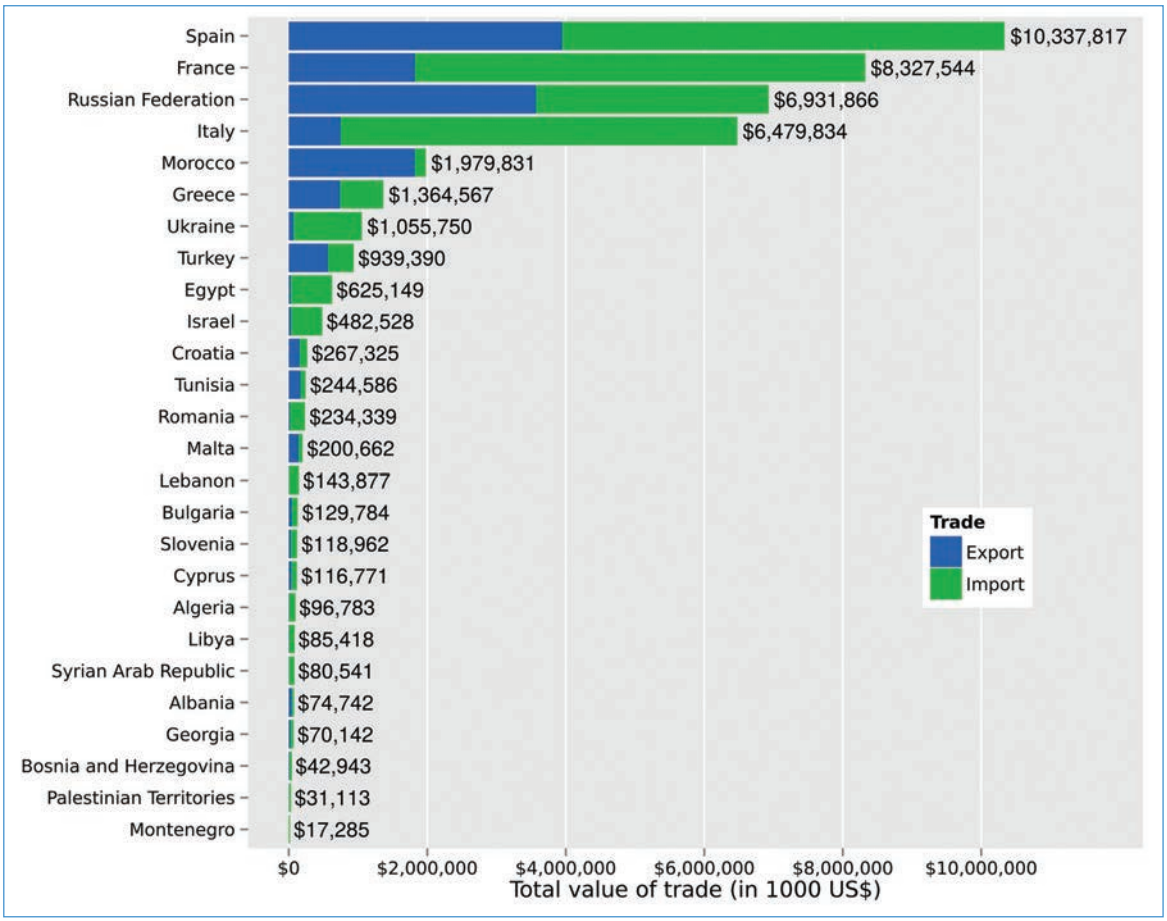


FIGURE 35
Total value of traded fish product per the GFCM contracting party, cooperating non-contracting party, non-contracting party and relevant non-State actor (imports + exports)

To provide further perspective on the value of fish trade originating in Mediterranean and Black Sea capture fisheries, Figure 36 offers an indication of the type and area of fish production for each of the GFCM contracting parties, cooperating non-contracting parties, and non-contracting parties, as well as relevant non-State actors[11].

[11] Production data are taken from FAOSTAT. Data provided are an average over the period 2010–2013.

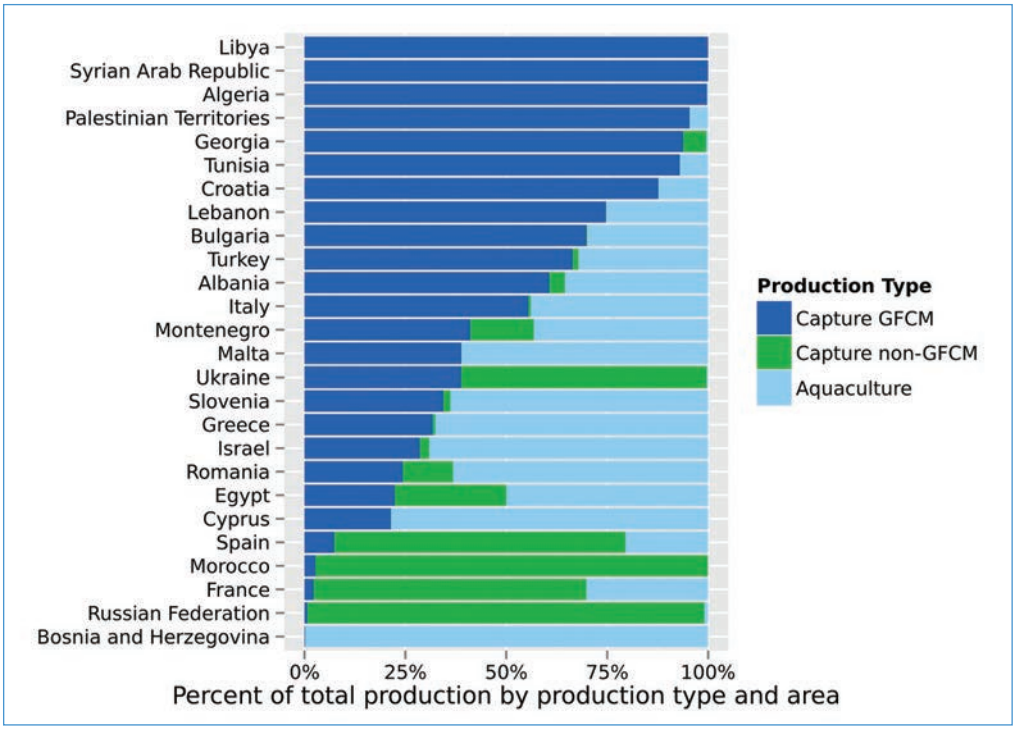


FIGURE 36
Production originating from capture fisheries as a percentage of total fish production

The trade flows of individual Mediterranean and Black Sea riparian countries and non-State actors were also analysed, using a circular plot (Figure 37). Named countries account for 95 percent of the total import-export value, while remaining Mediterranean and Black Sea countries and non-State actors are aggregated as "other". Non Mediterranean and Black Sea countries engaged in import-export activity with Mediterranean and Black Sea countries and non-State actors are included as "Non Med_BS." The value of trade (in millions of US$) is again indicated by the numeric values along the perimeter of the plot.

As previously mentioned, Spain, France, Italy and the Russian Federation, respectively, conduct the highest volume of trade (in terms of value) of all GFCM contracting parties, cooperating non-contracting parties and non-contracting parties, as well as relevant non-State actors. Figure 37 indicates that the primary trade partners of these four countries are non-Mediterranean and Black Sea countries, although significant trade is also conducted between Spain, France and Italy. Similar trends are seen in the trade flows for other Mediterranean and Black Sea riparian countries and non-State actors: fish products are primarily exported to non-Mediterranean and Black Sea countries, although significant trade is also conducted between neighbouring countries (i.e. from Greece to Italy or from Morocco to Spain). Trade among GFCM countries is minimal in comparison to trade with external partners.

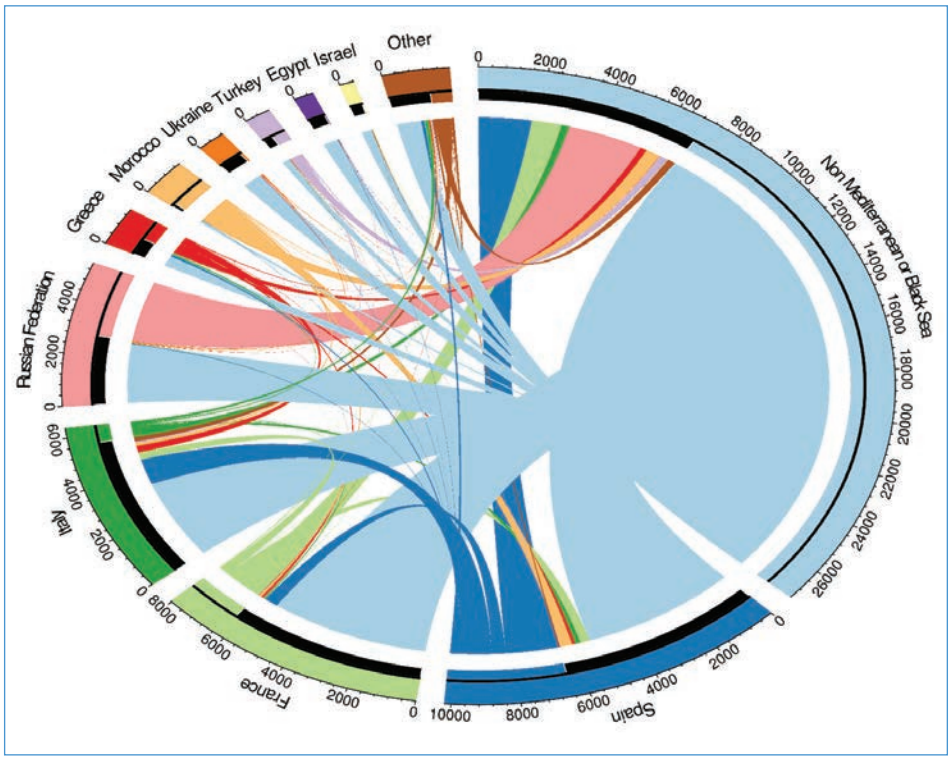


FIGURE 37
Trade of fish products to/from Mediterranean and Black Sea riparian countries (in millions of US$)

3.7. CONCLUSION

From the information presented, it can be concluded that capture fisheries in the Mediterranean and the Black Sea are multi-faceted and highly diverse, but they also represent a sector of enormous socio-economic importance. Fisheries in this region make an important contribution to food security and offer a flexible last resort for some of the region's most vulnerable populations, offering a way to supplement income or food supply in times of need (see also Chapter 6). Furthermore, evidence from value chain analyses and case studies indicates that the total economic value of fisheries in this region may be more than twice that which is indicated by landing values and employment rates alone.

Further studies are needed to estimate the value of the secondary processing sector, trade in fish services, recreational fisheries and other elements of the value chain. Similarly, further study and improved data collection is needed to identify the socio-economic impacts of this sector at a more detailed subregional level. As shown by the outcomes of the SSF Symposium (Chapter 6), fisheries in this region are of great socio-economic importance at the small-scale level, to coastal populations, and for women. Data collection is expected to improve, and further analysis at a more detailed level should be made possible, with the implementation of the DCRF, which among others, mandates the submission of socio-economic data by GFCM contracting parties.

4. Bycatch

©Carpentieri

4. Bycatch

4.1 INTRODUCTION AND SOURCES OF INFORMATION

Fishing activities often involve the capture of non-target organisms. This has been globally acknowledged as an important issue for fishery resource management and ocean conservation, though the quantity and quality of catches of non-target organisms vary greatly according to fisheries and regions. The term "bycatch" is widely used to refer to "unwanted" catches. Bycatch can reduce the sustainability of fisheries; it may result in mortality for some species and it can ultimately affect the ecosystem. If bycatch mortality is not monitored adequately, it is more difficult for scientists to understand the total impact of fishing activities on various species.

This chapter provides an overview of characteristics of the main components of bycatch in the Mediterranean and the Black Sea: discards and incidental catches of vulnerable species. To this end, quantitative information has been collected, mainly drawn from scientific publications, national and regional statistics and regional databases (namely GFCM, FAO). Secondary sources of information, such as grey literature (e.g. personal communications, theses, etc.) and technical reports have also been consulted. Combining this information, the percentage of discards to total catch is presented, both by GFCM subregion and by major fishing fleet. The impact of fishing activities in the Mediterranean and the Black Sea on the main groups of vulnerable species is also considered.

The analysis made in this chapter is based on definitions of total catch, target species and bycatch agreed within the GFCM DCRF (see Box 1). These take account of the multispecies/multigear fisheries characteristic of the GFCM area of application, where target species are not always clearly defined *a priori*. The definitions are given below and explained in Figure 38.

Total catch is widely recognized as the amount of marine biological resource taken by fishing gear, which reaches the deck of a fishing vessel. This includes catches of target species, which are usually kept on board and retained, and bycatch, which refers to incidental catches of species that are not targeted, whether or not they have commercial value.

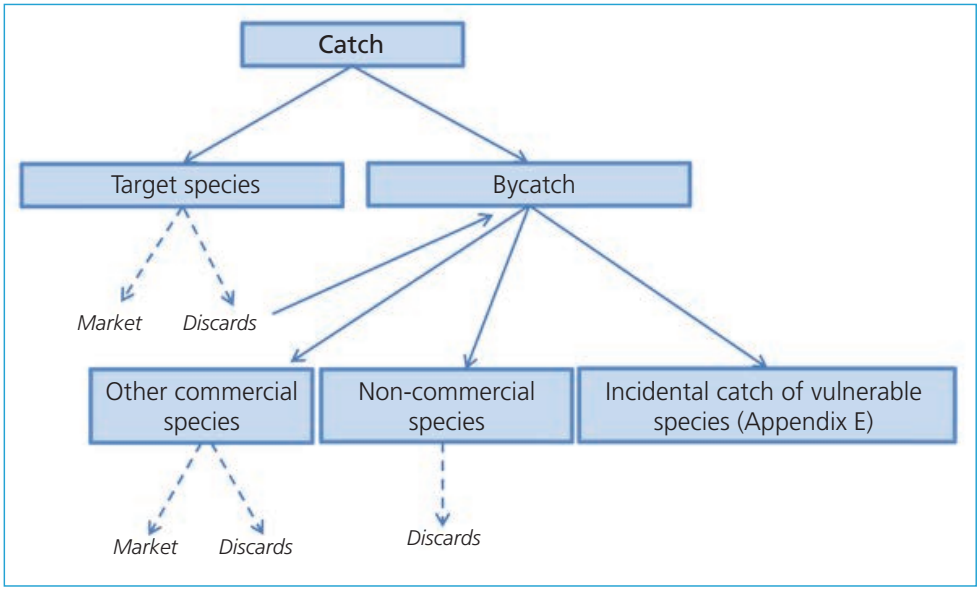


FIGURE 38
Scheme representing the different components of the catch as defined by the GFCM DCRF

Target species are those primarily sought by fishers in a particular fishery and are the subject of a directed fishing effort. Both primary, as well as secondary target species may exist (Blackhart *et al.*, 2006). Identification of target species may be relatively simple in a fishery related to single or few species (e.g. tuna and swordfish, halibut and dolphinfish) and with a static marketing base. However, in the Mediterranean and the Black Sea, identifying target species may be not simple, since most fisheries are multi-target and rely on different types of gear and fishing techniques. In such multi-species fisheries, and/or when market forces play a significant role in commercial decision-making, there may be a number of target species. The target species may also be subject to daily change. In the case of a volatile market situation, the target may even change during a fishing operation. "One day's waste and nuisance catch can be tomorrow's target" (Clucas, 1997).

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

Discard is the part of the catch that is not retained on board and is discarded at sea. This may include the catch of target species, or any other species (both commercial and non- commercial) discarded at sea. Estimates of discards at both regional and subregional scale, as well as by main fishing gear and main species affected, are presented below

Incidental catch of vulnerable species is defined here as a subset of bycatch, which includes species that for some reason are considered vulnerable (i.e. long-lived vertebrates with low reproductive rates such as marine mammals, but also sea turtles, seabirds and elasmobranchs).

4.2. OVERVIEW OF DISCARDS BY FISHERY IN THE GFCM AREA OF APPLICATION

Discards in the Mediterranean are estimated at around 230 000 tonnes, corresponding to approximately 18 percent of catches, with trawls responsible for the bulk of discards (ranging from 15 to 65.5 percent). Discard rates for pelagic fisheries, such as pelagic trawls and purse seiners, are generally lower compared with those for bottom trawls: for the pelagic trawl fishery, discard values range between 10 and 50 percent; for purse seines, values have been reported at between 2 and 15 percent. Information on discards for small-scale fisheries is relatively scarce, but the data available reflect a discard rate that is lower than 10 percent for trammel and gillnets.

Almost 80 percent of the total catch in the Black Sea is obtained by purse seines and pelagic trawls. Discards in this region are estimated at around 45 000 tonnes, or between 10 and 15 percent of the catch. Fisheries in the Black Sea have the following discard rates: trawl fisheries 25–45 percent; small-scale fisheries less than 15 percent; pelagic trawlers targeting small pelagic species about 5 percent; purse seine 1 to 5 percent; sea snail dredge fishery around 11.5 percent.

Reasons for discards may be economic (e.g. low market prices), legal (e.g. minimum landing sizes), environmental (e.g. weather conditions affecting sorting practices), technical (e.g. vessel capacity), biological (e.g. poisonous fish, jellyfish), and/or based on personal decisions (Alverson *et al.*, 1994; Hall *et al.*, 2000; Machias *et al.*, 2001; Rochet and Trenkel, 2005). Moreover, the extent of discarding is dependent on a number of variables which include the gear and fishing method practised, the fishing ground, fishing season, depth, duration of the trip, duration of the haul, the market situation and fluctuation in the abundance of juvenile fish.

Studies on discards only cover a small proportion of total fishing activity in the Mediterranean and the Black Sea, indicating a shortage of information (Carbonell *et al.*, 2003a; Fabi and Grati, 2005; Machias *et al.*, 2001; Moranta *et al.*, 2000; Sanchez *et al.*, 2007; Santojanni *et al.*, 2005; Tzanatos *et al.*, 2007). This issue, among others, has been acknowledged as an important constraint on performing reliable stock assessments (Caddy, 2009). High and variable discard rates may lead to imprecise estimates of fishing mortality, as well as a skewed appraisal of the status of stocks, if relevant data on discards are not taken into account.

This section presents a compilation and review of information on discard levels in different fisheries within the GFCM area of application. As a general approach, and in order to compare discard practices between subregions and draw an overall trend, fisheries were separated into three broad categories depending on their discard rates: high discard fisheries (> 40 percent of total catch), medium discard fisheries (15–39 percent) and low discard fisheries (< 15 percent) (Table 9). Figure 39 summarizes the range (in percentage) of discard rate by fishery.

Table 9 Summary of discard rates in Mediterranean and the Black Sea

	High discard rates (> 40%)			Medium discard rates (15–39%)		Low discard rates (< 15%)		
	Beam trawls	**Bottom trawls**	**Dredges**	**Beach and boat seines**	**Pelagic trawls**	**Longlines**	**Small-scale fisheries**	**Purse seines**
Target species/ family	Solea vulgaris Pecten spp. Penaeus sp. Squilla mantis Rapana venosa	*Demersal fish (Merluccius merluccius, Mullus barbatus Mullus surmuletus, Pagellus sp., Merlangius merlangus, Lophius spp., Trachurus sp., Psetta maxima, Sparidae)* *Crustaceans (Parapenaeus longirostris, Nephrops norvegicus, Aristeus antennatus, Aristaemorpha foliacea, Penaeus sp.)* *Cephalopods (Illex sp., Octopus vulgaris, Eledone spp., Loligo vulgaris)*	*Chamelea gallina* *Solen marginatus,* *Donax sp.* *Tellina sp.* *Cerastoderma sp.*	*Clupeidae,* *Sparidae,* *Mugilidae,* *Carangidae* *Scombridae* *Siganidae* *Mullidae* *Carangidae*	*Engraulis encrasicolus,* *Sardina pilchardus* *Trachurus sp.,* *Scomber spp.* *Carangidae* *Boops boops* *Sprattus sprattus*	*M. merluccius* *Sparidae* *Triglidae* *Helicolenus dactylopterus* *Conger conger*	*M. barbatus* *M. surmuletus,* *Sparidae,* *Mugilidae,* *Siganidae* *Scorpaena sp.* *Solea sp.* *Lithognatus mormyrus* *Sepia officinalis* *Octopus sp.* *Penaeus sp.*	*Engraulis encrasicolus,* *Sardina pilchardus* *Trachurus sp.,* *Sprattus sprattus* *Sardinella spp.,* *Boops boops* *Scomber spp.* *Spicara smaris*
Discard composition	Benthic invertebrates; bivalves; crustaceans (e.g. crabs); molluscs; porifers	Gastropods; cnidarians ; echinoderms; other demersal fish; bivalves; elasmobranchs; lessepsian species small individuals of target species.	Clams and other benthic invertebrates Small individuals of target species	Other demersal and benthic fish; macro-invertebrates lessepsian species	Elasmobranchs; pelagic fish small individuals of target species	Elasmobranchs; large pelagic species; other demersal fish	Macro-invertebrates; lessepsian species; other demersal fish	Other pelagic fish small individuals of target species
Reasons for discarding	Damaged specimens species with low or no commercial value; undersize target species	Undersize specimens; damaged specimens; species with low or no commercial value small individuals with no commercial value	Species with no commercial value; damaged specimens undersize specimens	Small individuals with no or low commercial value damaged specimens	Species with no commercial value undersize specimens vulnerable species	Species with no commercial value damaged specimens; vulnerable species	Species with low commercial value; undersize specimens; specimens damaged or in poor condition	Species with low commercial value; undersize specimens; specimens damaged or in poor condition

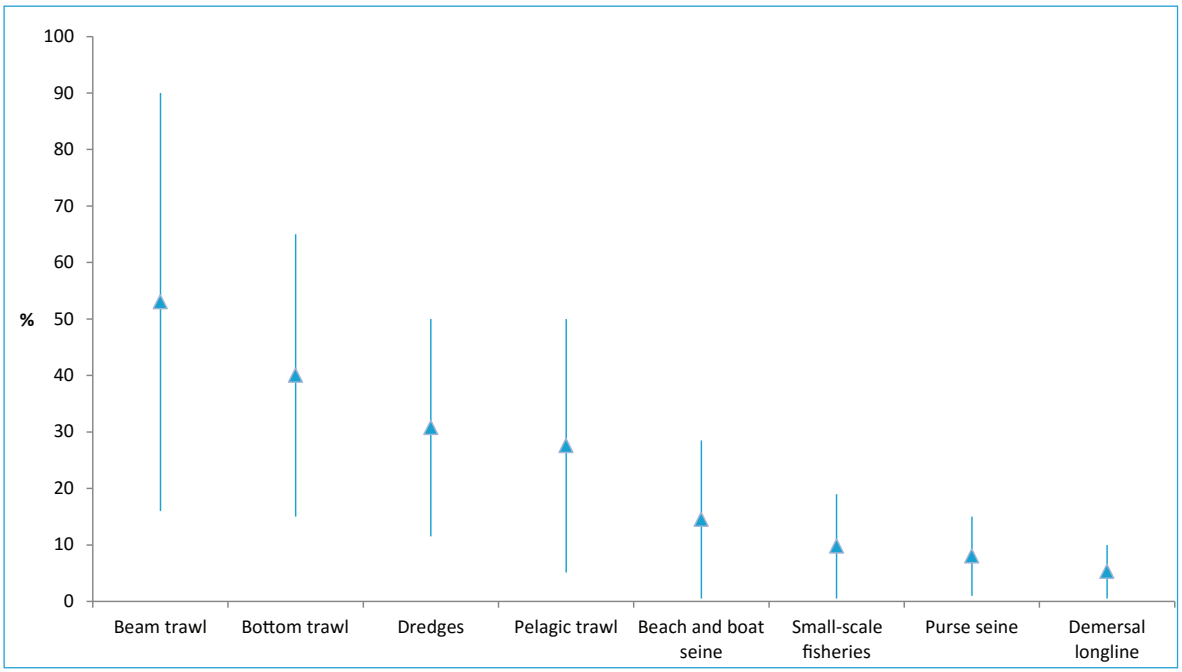


FIGURE 39
Range (%) of discard behaviour by fishing activity

4.2.1. Bottom trawl

In the trawl fishery, the discard rate varies between hauls, days, areas and seasons, reflecting the differences in local market demand and species compositions. Trawling is usually characterized by high discard values: from 15 to 65.5 percent in all Mediterranean and Black Sea subregions (Figure 40). Aside from some exceptions, such as the Syrian trawl fishery where discards are negligible, Kelleher (2005) reported a mean discard value of 45–50 percent. Other studies have estimated the amount of trawling discards as 20 to 50 percent of the biomass caught in all the Mediterranean areas (Moranta *et al.*, 2000; Machias *et al.*, 2001; D'Onghia *et al.*, 2003; Sartor *et al.*, 2003; Sanchez *et al.*, 2004; Tsagarakis *et al.*, 2013).

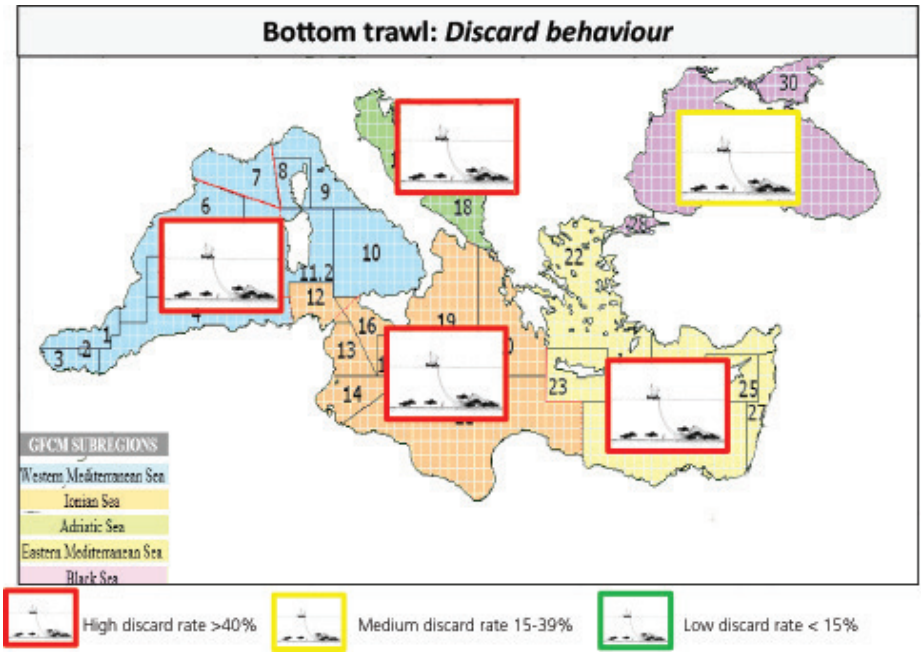


FIGURE 40
Discard rates (in percentage) for bottom trawl fisheries operating in the GFCM subregions

In the western Mediterranean, discard rates range between 14 and 60 percent. In Spanish GSAs, the discard composition varies greatly, depending on the areas and/or fishing grounds considered (Moranta *et al.*, 2000; Carbonell *et al.*, 2003a, 2003b; Sánchez *et al.*, 2004, 2007). In general, discard rates are higher on shallower bottoms (up to 50–60 percent of the total biomass caught may be discarded) than in the deeper waters, such as the Norway lobster and red shrimp (e.g. *A. foliacea*, *A. antennatus*) fishing grounds (Coll *et al.*, 2015). Recent results indicate that, in the Spanish Mediterranean, bottom trawl fisheries have a mean discard rate of between 20 and 40 percent by weight (EU, 2011). Discards of *M. merluccius* and *Mullus spp*. in Spanish Mediterranean waters are virtually non-existent due to their high market value. By contrast, in Italy (both in the Tyrrhenian and Sardinian Sea), it is reported that around 30 percent of *M. merluccius* specimens caught are discarded, especially in the summer when there are large amounts of juveniles (Sartor *et al.*, 2003). In those areas, a discard value corresponding to 20–35 percent of total catch has been calculated (Sartor *et al.*, 2003; EU, 2011; Piroddi *et al.*, 2014). The trawling discard rate for the French Mediterranean is estimated at between 27 and 40 percent (Ifremer, 2010; Bultel *et al.*, 2015). In Morocco, trawler fisheries (mainly catching cephalopods and/or shrimp) are associated with higher rates of discards: between 12 and 46 percent (Kelleher, 2005; Veguila, 2011; Belhabib *et al.*, 2013). In Algeria, high values of discards of up to 50 percent, mainly related to the shrimp fishery, have also been recorded (Bouaicha, 2011; Belhabib *et al.*, 2013).

In the Ionian Sea, trawl fisheries (mainly targeting shrimp) generate high volumes of discards in the Italian GSAs: around 50 percent in the case of the western Ionian Sea (D'Onghia *et al.*, 2003) and around 49 percent for the Strait of Sicily (Castriota *et al.*, 2001). In these areas, the quantity of discards depends primarily on the depth and the type of fishing grounds exploited: macro-invertebrates (echinoderms, porifera, crustaceans, etc.) and fish represent the bulk of discards (EU, 2011). In the Greek western Ionian Sea, discard rates are estimated at between 38 and 49 percent of total catch biomass, with fish species discard rates at 34–44 percent (Machias *et al.*, 2001; EU, 2011; Tsagarakis *et al.*, 2013). For bottom trawl fisheries operating in the Ionian Sea and targeting *M. merluccius* and *M. barbatus*, discards correspond to 38 percent of biomass catch, ranging from 6.5 to 55 percent (Tsagarakis *et al.*, 2008). For the Maltese waters, Kelleher (2005) has estimated a trawl discard rate of approximately 45 percent. In Libya, a rate of discarded fish biomass to total landings of about 25.5 percent is reported (Khalfallah *et al.*, 2015). Similar values are reported for Tunisia, where estimated trawl discard rates, based on a reconstruction of total catches, are calculated at some 20 percent (Halouani *et al.*, 2015).

Several studies conducted in the eastern Mediterranean Sea (Egypt – Rizkalla, 1995; Faltas *et al.*, 1998, El-Mor *et al.*, 2002; Turkey and Israel – Alsayes *et al.*, 2009; Edelist *et al.*, 2013; Ceylan *et al.*, 2014) report a discard rate of between 9.6 percent (Atar and Malal, 2010) and 70.3 percent (Duruer *et al.*, 2008) of total catch. Discard contribution varies according to depth. For example, in Mediterranean Turkish waters, the discard biomass is calculated at 44 percent for areas shallower than 60 m (Yemisken *et al.*, 2014). Overall, the average discard rate was found to be around 32.2 percent (Yemisken *et al.*, 2014). In Israel, trawl discards in recent years have ranged between 23 and 47.2 percent, making trawl fisheries a major source of discards (Edelist *et al.*, 2011; 2013). These values are comparable with bottom trawl fisheries operating in Greece (discard rates of around 38–45 percent; Stergiou *et al.*, 1998, Tsagarakis *et al.*, 2008; Machias *et al.*, 2001; Tsagarakis *et al.*, 2013). Here, two commercial species (*M. merluccius* and *M. barbatus*) and two non-commercial species (*Lepidotrigla cavillone* and *Argentina sphyraena*) are the main sources of discards (Machias *et al.*, 2001; Tsagarakis *et al.*, 2008). Gücü (2001) observed that the total discard biomass was 37 percent for trawl fisheries of the Turkish fleet operating in the Aegean Sea. Similarly, the discard rate of bottom trawls was found to be 36 percent in the Bay of Izmir, again in the Aegean Sea (Özbilgin *et al.*, 2006). The lowest values are reported for Cyprus and Egypt. In Cyprus, total discard quantities represented around 13 percent of total catch and, aside from *S. smaris*, all commercial species have low discard volumes in terms of biomass (Cyprus pilot study, 2006). In Egypt, around 14.7–26.6 percent by weight of total catch collected by bottom trawls can be categorized as discards (Faltas *et al.*, 1998; Alsayes *et al.*,

2009; Tsagarakis *et al.*, 2013). Generally, in the eastern Mediterranean Sea, newly added shallow lessepsian species (small or venomous) have been recorded, further adding to the increase in discard rates (Edelist *et al.*, 2013).

Recent studies carried out in the Adriatic Sea have estimated that the mean discard rate in bottom trawl fisheries ranges between 20 and 67 percent of total catches, with a rate that varies according to fishing intensity (Sanchez *et al.*, 2007; EU, 2011; Vassilopoulou, 2011). According to Raicevich (2008), the ratio between discards and landings in bottom trawls in the North Adriatic ranges between 4:1 (Italian fishing grounds) and 17:1 (Croatian fishing grounds). Lower values (between 20–23 percent) are estimated in Albania (Moutopoulos *et al.*, 2015). Overall, in Adriatic fishing grounds, the catch of approximately 13 target species was totally retained, while that of 30 species was partially retained and that of 49 species was totally discarded. The discarded fraction contained harvested fish species, such as poor cod (*Trisopterus minutus capelanus*), red bandfish (*Cepola rubescens)*, European anchovy (*E. encrasicolus*), mackerel (*Scomber scombrus*) and European pilchard (*S. pilchardus*), whereas cephalopods showed low or no discard rates (EU, 2011).

The bottom trawl discard values in the Black Sea, along the Romanian, Georgian and Turkish coasts, ranged between 25 and 45 percent (Ceylan *et al.*, 2014; Bănaru *et al.*, 2015; Ulman and Divovich, 2015). Those values are much higher than the discard rate estimated for Ukraine (2 percent) and Bulgaria (3 percent) (Keskin *et al.*, 2015; Ulman *et al.*, 2015a). The weighed discard rate calculated for the Turkish coast is around 42 percent (Ceylan *et al.*, 2014).

In the case of bottom trawlers (primarily coastal shrimp fisheries) operating in the Sea of Marmara, 16–37 percent of total catch is discarded (Zengin and Akyol, 2009; Tsagarakis *et al.*, 2013; Keskin *et al.*, 2015). The diversity of species in the Black Sea is lower than in other seas (i.e. Aegean Sea or western Mediterranean Sea – Bat *et al.*, 2011), especially for benthic species, and this may help to explain the slightly lower discard rate.

4.2.2. Pelagic trawl

Discard rates for pelagic trawls are generally lower than for bottom trawls (Figure 41).

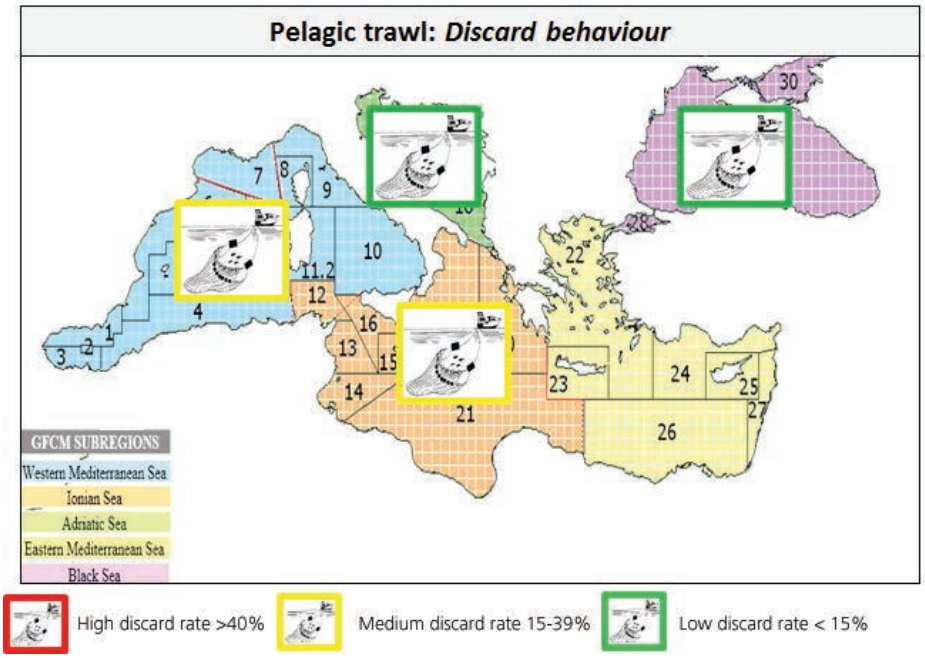


FIGURE 41
Discard rates (in percentage) for pelagic trawl fisheries operating in the GFCM subregions

The discard rate of pelagic trawls operating in the Adriatic Sea area is up to 15 percent (Santojanni *et al.*, 2005). Raicevich (2008) also reports very low discard values of commercial species for pelagic trawls operating in the northern Adriatic Sea.

In the Ionian Sea, for the pelagic trawl fishery operating in the Italian GSAs, discard values range between 10 and 50 percent: the highest level of discards relates to small anchovies in winter. This is the main target species of pelagic trawls in the area and discards during this season involve more than 50 percent of the catch. The lowest level of discarding takes place in summer (around 10–15 percent) (EU, 2011). In the Greek areas, Vassilopolou (2011) and Tsagarakis *et al.* (2013) reported a discard rate of about 28.3 percent.

For the pelagic trawlers operating in France (western Mediterranean Sea), a discard rate comprised between 6–15 percent of total catch (Ifremer, 2010) has been estimated. In Algeria, discard values accounted for around 20 percent of the pelagic trawl landing in 2010 (MPRH, 2011).

In the Turkish and Bulgaria Black Sea, discard rates for pelagic trawls are estimated to be around 5.1 percent of total catch (Kelleher, 2005; Keskin *et al.*, 2015).

4.2.3. Beam trawl

Beam trawl, even if only operating in a few areas, is one of the highest discard-generating fishing practices in the Mediterranean (Tudela, 2004). For example, the so-called "rapido" trawl, a modified beam trawl targeting either flatfish or scallops in the Adriatic Sea, produces extremely high discard volumes (between 69.4 and 90.4 percent of total catch), mostly consisting of benthic invertebrates (e.g. echinoderms, crustaceans, molluscs and porifers – Pranovi *et al.*, 2001) (Figure 42). Beam trawls targeting flatfish and scallops in the Adriatic Sea produce discard quantities that are, respectively, 2.3 and 9 times higher than their landing quantities (Pranovi *et al.*, 2001).

A coastal beam trawl shrimp fishery operates in the Sea of Marmara, where a discard rate of around 16 percent of total catch has been reported (Zengin and Akyol, 2009). Bök *et al.* (2011) reported the discard (i.e. the damaged target species and/or non-commercial species) of beam trawlers in the Marmara Sea for a mesh size of 36 mm and 40 mm to be 28.9 percent and 27.8 percent, respectively. Additionally, Zengin and Akyol (2009) have estimated a discard value of 35.5 percent from the coastal shrimp beam trawl fishery in Turkey.

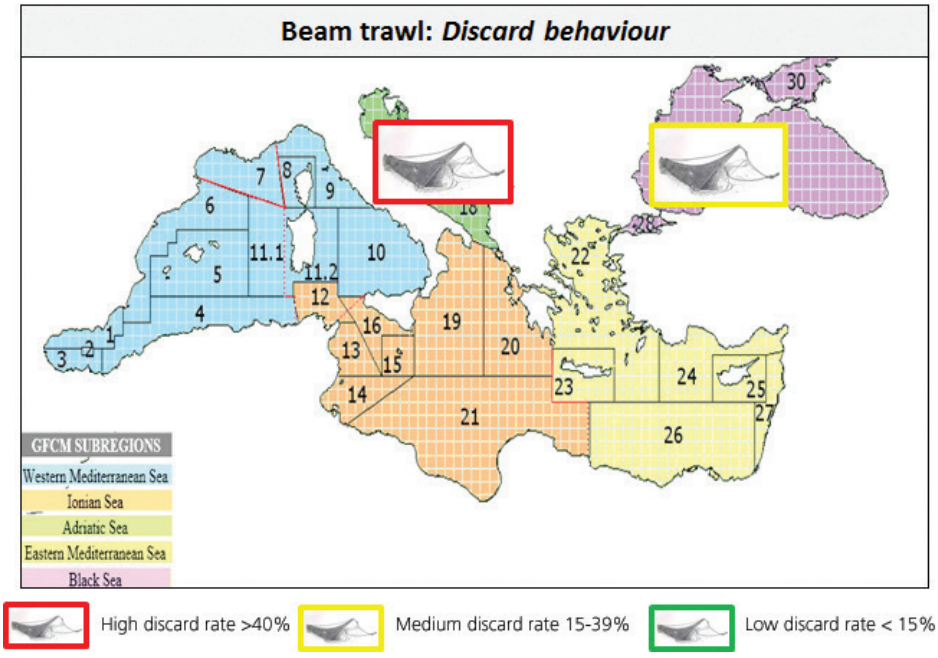


FIGURE 42
Discard rates (in percentage) for beam trawl fisheries operating in the GFCM subregions

Beam trawls are also used in the rapa whelk *Rapana venosa* fishery in Bulgaria (Black Sea). The *Rapana* fishery commenced in 1994, and scuba divers originally caught the species. This fishery was banned in 2001 to protect vulnerable benthic biotic communities, such as mussel beds, but has been allowed again since 2012 in restricted parts of Bulgarian marine areas (Keskin *et al.*, 2015). Estimates of discards for these fisheries are approximately 7.5 percent of total catch (Kelleher, 2005), and the negative effects of this fishing gear on mussel beds have been described by Konsulova *et al.* (2001).

4.2.4. Purse seines

Purse seiners are distributed all along the Mediterranean and the Black Sea, with the majority of vessels registered in Algeria, Tunisia, and Egypt for the southern basin, and Croatia, Spain, Italy and Greece for the northern basin (Sacchi, 2011). This fishery has attracted little attention for discards, possibly because it produces low discard rates (Tsagarakis *et al.*, 2013) (Figure 43). However, purse seines are responsible for an important fraction of the total catch in the Mediterranean and the Black Sea (Chapter 2), meaning that even with relatively lower discard rates, this fishery may still produce large volumes of discards (22 percent of total discards, according to Tsagarakis *et al.*, 2013). According to Kelleher (2005), the weighted average concerning discards for purse seines is 1.6 percent. Target species (i.e. *E. encrasicolus* and *S. pilchardus*) usually represent more than 90 percent of the catch (Şahin *et al.* 2008; Tsagarakis *et al.* 2012), and most of the discards mainly consist of damaged commercial species.

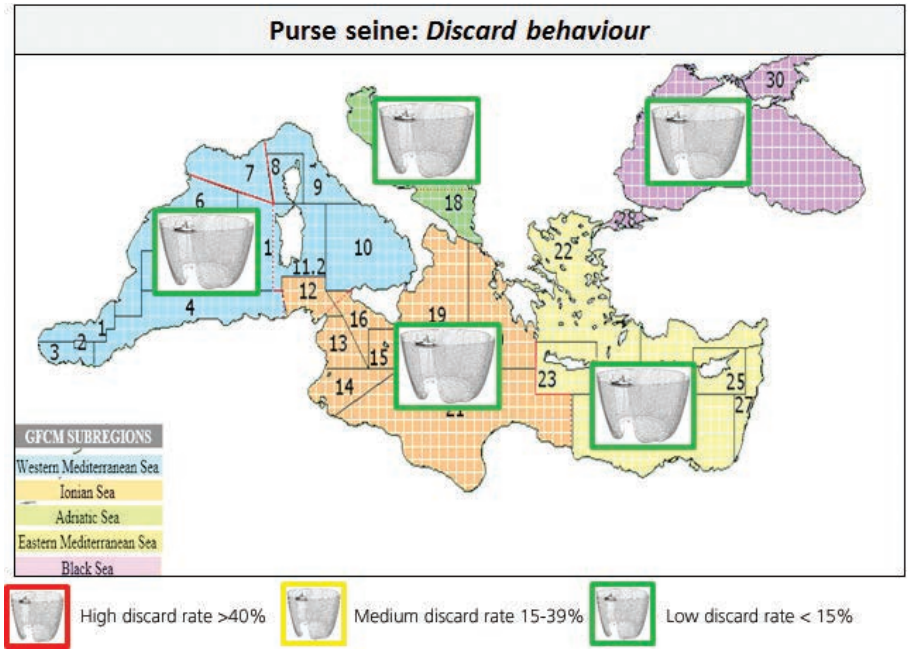


FIGURE 43
Discard rates (in percentage) for purse seine fisheries operating in the GFCM subregions

A rough assessment of discard rates for purse seines in the western Mediterranean Sea, carried out by the Sea Around Us Project (SAUP, 2012), has estimated values of between 8.5 percent (mainly for the Italian GSAs) and 15 percent (in the Spanish GSAs) (Piroddi *et al.*, 2014; Coll *et al.*, 2015). The lowest values (around 1–2 percent) have been reported in both the northern Tyrrhenian Sea and the Gulf of Lion (SIBM, 2006; Bultel *et al.*, 2015).

In addition to the mean discard value of 8.5 percent estimated for all Italian GSAs (Piroddi *et al.*, 2014), in the Adriatic Sea, similar discard values (between 2 and 15 percent), both in terms of numbers of species and total landing, have been reported with respect to the surrounding nets with light (the so-called *lampara* net) (Santojanni *et al.*, 2005). The volume of discards is only high

in cases of exceptional catches (EU, 2011). In Croatian waters, discard rates have been estimated as almost non-existent (around 0 percent – Matić-Skoko *et al.*, 2011)

Information available for the Ionian Sea (Italian fishing grounds) suggests that purse seine fisheries have a low discard rate (between 5 and 10 percent of catches) (EU, 2011), with a mean value of about 7.5 percent (Piroddi *et al.*, 2014). A mean discard value, corresponding to 2.2 percent of total catch (ranging between 2 and 5 percent), was reported for the Greek side of the Ionian Sea (Tsagarakis et al. 2012).

For the eastern Mediterranean Sea, discards are negligible in the case of Lebanese purse seine fisheries (Bariche *et al.*, 2006), while lower values, ranging from 2 to 5 percent, are reported for the Aegean Sea (Tsagarakis *et al.*, 2012) and Turkish waters (Keskin *et al.*, 2015).

For the Black Sea, low discard values are reported in all subregions (i.e. Bulgaria, Turkey), ranging from 1 to 5 percent of total catch (Sahin *et al.*, 2008; Bănaru *et al.*, 2015; Keskin *et al.*, 2015; Ulman *et al.*, 2015a). Recent studies have determined the weighted discard rates as 1.64 percent for the Black Sea coasts of Turkey (Sahin *et al.*, 2015). The low discard values (if compared with the Mediterranean side) are probably due in part to the fact that most discards are used for fishmeal (Kelleher, 2005).

4.2.5. Demersal longlines

Longlines are usually classified as pelagic or demersal, according to their target species. With regard to discard rates, performance varies greatly between pelagic and demersal longlines. Usually, pelagic longlines target swordfish (*Xiphias gladius*), bluefin tuna (*T. thynnus*) and albacore (*Thunnus alalunga*), and they also incidentally catch a large number of vulnerable species (e.g. large marine vertebrates, see Section 4.3), while producing low or zero fish discards (EU, 2011). On the other hand, for demersal longlines the rate of discards is higher than that of pelagic longlines, still generally low, compared with other types of fisheries (Figure 44). In fact, demersal longlines are among the most selective fisheries, producing minimal discards (between 0 and 9 percent) (Stergiou *et al.*, 2002).

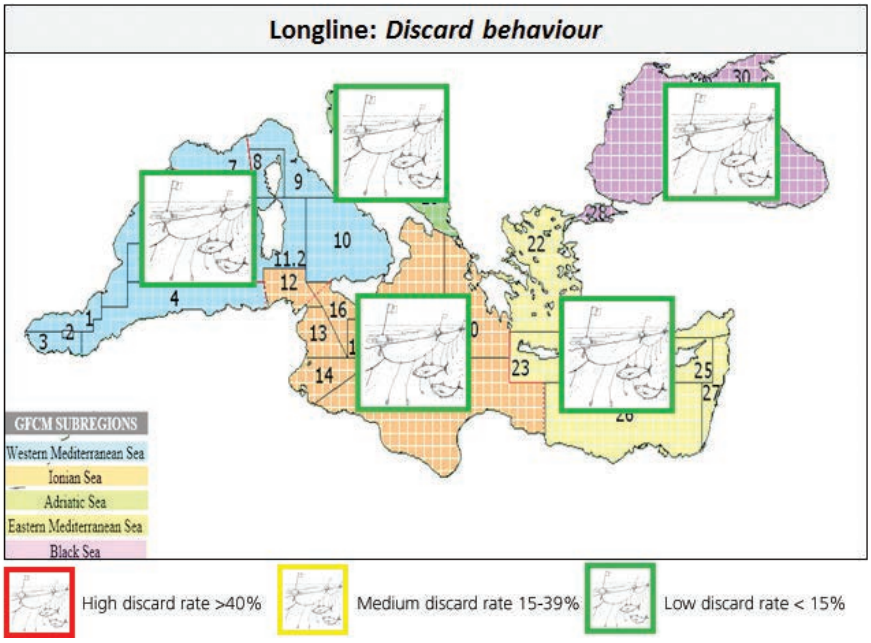


FIGURE 44
Discard rates (in percentage) for demersal longline fisheries operating in the GFCM subregions

In the Italian GSAs of the western Mediterranean Sea, discard rates for demersal longlines are estimated at between 0.5 and 7 percent of total catch (SIBM, 2006). In Spanish areas, data regarding discards from longline is less readily available, and a common discard value of about

10 percent has been estimated (Coll *et al.*, 2015). In the Ionian Sea, for demersal longlines fisheries operating in the Italian GSAs, discard rates range between 0.5 and 9 percent (SIBM, 2006). Similar values (between 1.8 and 7.5 percent) are estimated for Greek waters in the eastern Mediterranean Sea (Stergiou *et al.*, 2002; EU, 2011). Slightly higher values are reported for the Adriatic side, where the incidence of discarded species mostly refers to *Galeus melastomus* and may account for an important percentage of deeper bottom longlines (Ungaro *et al.*, 2005). In the Black Sea (i.e. Bulgaria) discard rates are estimated at about 8.2 percent of total catch (Kelleher, 2005; Keskin *et al.*, 2015).

4.2.6. Dredges

Dredges are benthic fishing gear that have a significant impact on the ecosystem (EU, 2011) (Figure 45). In the productive Adriatic Sea, where this kind of fishery is common (mainly in the northern part), discards are estimated at 50 percent of total catch. Of this, 30 percent regard undersized target species and 20 percent represent other benthic invertebrates (Morello *et al.*, 2005). According to Raicevich (2008), the ratio between discards and landing from hydraulic dredges in the northern Adriatic Sea is 7:1 (EU, 2011).

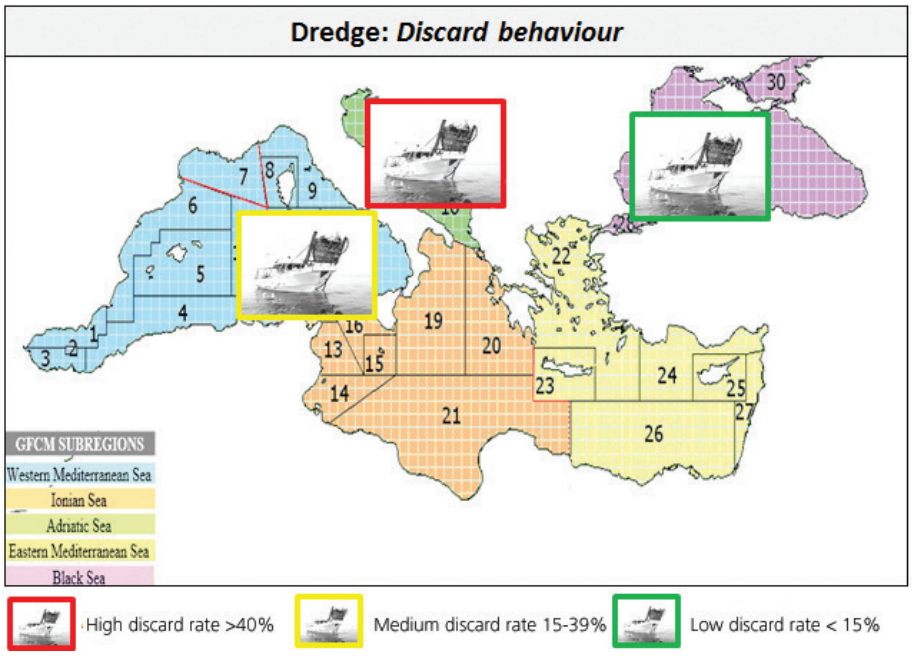


FIGURE 45
Discard rates (in percentage) for dredges operating in the GFCM subregions

Discard values of approximately 20 percent of total catch biomass are estimated for dredges operating in the central and southern Tyrrhenian Sea (western Mediterranean Sea – Piroddi *et al.*, 2014). For dredges gathering "cockles" (*Cerastoderma* sp.) in the inshore Turkish coast of the Black Sea, a discard value below 11.5 percent is reported (Kelleher, 2005; Ulman *et al.*, 2013b). The same value, around 11.5 percent, has been estimated for dredges ("sea snail" dredges) operating in Bulgaria (Keskin *et al.*, 2015).

4.2.8. Beach and boat seines

Boat seines and beach seines (i.e. coastal encircling nets) present similar discard rates in all subregions (Kelleher, 2005), with values ranging between 0.03 and 28.5 percent (SIBM, 2006; Petrakis *et al.*, 2009; Vassilopolou, 2011; Keskin *et al.*, 2015) (Figure 46). In the Aegean Sea, a ratio of discarded fish biomass to total landings ranging between 4.5 to 10.3 percent was reported (EU, 2011). A higher rate (28.5 percent by weight) was reported for the Croatian Adriatic boat seines operating over *Posidonia* meadows (Cetinić *et al.*, 2011), although currently boat seining, as well

as all fishing activity using any other kind of towed nets, dredges, or purse seines over seagrass beds, is banned in EU countries (EC regulation no 1967/2006). Akyol (2003) analysed discards of beach seining in the Turkish Aegean Sea (i.e. eastern Mediterranean Sea) and reported a relatively high discard value (21 percent), mainly composed of juvenile fish from the littoral zone. For beach and boat seines operating in the Black Sea (along the Bulgarian coast) a discard rate of about 4.4 percent of total catch was estimated (Keskin *et al.*, 2015).

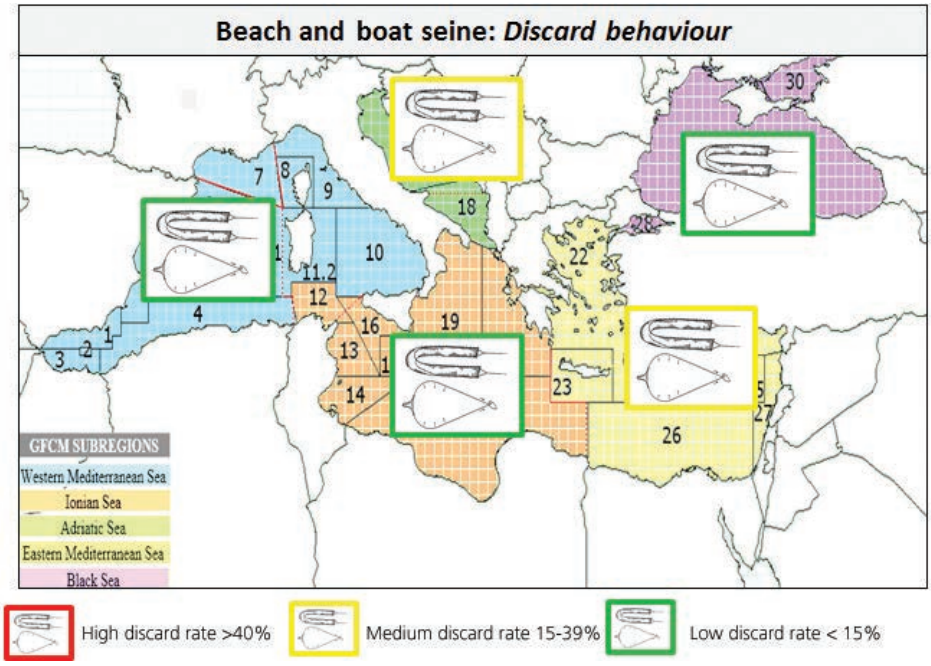


FIGURE 46
Discard rates (in percentage) for beach and boat seine fisheries operating in the GFCM subregions

4.2.9. Small-scale fisheries

Small-scale fisheries are generally characterized by a large number of boats of low tonnage (between 1 and 4 tonnes). These are extremely diverse, and by using selective low-impact fishing gear (e.g. trammel net, gillnet, pot and traps etc.), they target a wide variety of species (Chapter 6). However, there is scant information at the regional or subregional level on their production volumes, socio-economic dimension or on their contribution to sustainable development and their potential impact on marine ecosystems. Most studies report a discard ratio of lower than 10 percent for trammel nets and gillnets, since the catch of low value commercial species is used by fishers for personal consumption or bait (Kelleher, 2005). Some estimates of the discard fraction of gillnets, trammel nets and traps and pots are given below.

Gillnets and trammel nets

Gillnets and trammel nets are the static nets most commonly used in small-scale Mediterranean fisheries. These nets are often deployed at night. The length of nets depends on the size of the fishing boat, and the mesh size depends on the target species.

For the eastern Mediterranean Sea, discards are negligible in the Syrian waters (Ulman *et al.*, 2015b). Very low values are also estimated for Lebanon (Nader *et al.*, 2014). For small-scale fisheries operating in Cyprus, a 10 percent discard rate is estimated (Ulman *et al.*, 2013a). In Israel, the proportion of discards to total catch is estimated to be about 3 percent (Edelist *et al.*, 2013). The discard rate of trammel nets operating in Greece ranges between 10 and 14.7 percent of total catch (Goncalves *et al.*, 2007; Tzanatos *et al.*, 2007; Vassilopoulou *et al.*, 2007; EU, 2011, Tsagarakis *et al.*, 2013). In the same area, Stergiou *et al.* (2002) also report a low discard value for gillnets (ranging from 2.9 to 7.3 percent).

According to Fabi and Grati (2005), discard rates of commercial species in small-scale fisheries are very low in the central Adriatic, representing 7 percent in terms of weight of total catch. This value (up to 7 percent) is confirmed by other studies conducted in the area (SIBM, 2006; EU, 2008, 2011). Discards can be considered negligible (close to 0 percent) for Croatian small-scale fisheries (Matić-Skoko *et al.*, 2011).

The information available suggests that in the Ionian Sea, small-scale fisheries also have a low discard rate (between 5 and 10 percent of total catch) (EU, 2011). The discard rate in Malta is approximately 5 percent of artisanal landings per year (Malta Centre for Fisheries Sciences, 2006). In Italian waters, a very low volume of discards (< 5 percent) is produced by gillnet and entangling net fisheries (EU, 2008, 2011). For trammel nets and gillnets, operating in the eastern Ionian Sea, a discard rate of about 10 percent has been estimated (Tzanatos *et al.*, 2007). The percentage of discards by gear, compared with total landing, was estimated in Tunisia, where the discard rate for monofilament fishing nets was about 2 percent (Halouani *et al.*, 2015). In Libya, a mean discard rate of some 8.8 percent has been estimated (Khalfallah *et al.*, 2015).

For the Black Sea, the discard rate in the case of Romanian small-scale fisheries (i.e. artisanal crawl fishery) is estimated at below 1.1 percent (Kelleher, 2005; Bănaru *et al.*, 2015). Gillnet and trammel net fisheries operating along the Bulgarian coast of the Black Sea are estimated to produce 0.5 percent of discards (Kelleher, 2005). Studies on gillnet fisheries on the Black Sea coast of Turkey reported values ranging between 6.2 and 17.98 percent (Gray *et al.*, 2005; Kalayci and Yeşilçiçek, 2014). These differences in the discard rates can be attributed to species compositions resulting from mesh size.

Low discard values (from 0.5 to 5 percent) are reported in all Italian GSAs in the western Mediterranean Sea (SIBM, 2006; Piroddi *et al.*, 2014). In Morocco, discards from small-scale fisheries were previously considered non-existent (Baddyr, 1989). However, recent studies estimated a rate of between 10 and 19 percent of total catch (Kelleher, 2005; Belhabib *et al.*, 2013). Discards from small-scale fisheries in the French Mediterranean are known to be grossly underreported (Le Guilloux and Pauly, 2010), with some estimations giving a rate comprised between 2 and 5 percent (Ifremer, 2010; Bultel *et al.*, 2015). In Spain, an overall discard rate of approximately 8 percent has been estimated for small-scale fisheries (i.e. static nets) (Coll *et al.*, 2015).

In general, as reported above, gillnets and trammel nets are characterized by moderate to low discard rates. However, specific fisheries present higher discard rates. These include trammel nets for cuttlefish (25.5 percent; Kelleher, 2005), shrimp (around 43.5 percent for Turkey in the Aegean Sea – Gokce and Metin, 2007) and common spiny lobster (*Palinurus elephas*) (Quetglas *et al.*, 2004). For the latter, discard rates corresponding to 42.1 percent and 32.1 percent of total catch were recorded in Spain and Tunisia respectively (Quetglas *et al.*, 2004; Tsagarakis *et al.*, 2013). Furthermore, in Tunisian waters, discard values range between 22 percent (trammel net for cuttlefish) and 38 percent (trammel net for shrimp) (Harrabi, 2003; Halouani *et al.*, 2015).

Additionally, for Turkey the following discard rates have been recorded: 77 percent discards from the commercial prawn trammel net fishery in the Aegean Sea (Gökçe and Metin, 2007), 77.8 percent discard rate for monofilament nets and 22.8 percent for multifilament net fishing in the gillnet fishery in the Turkish Aegean Sea (İlker *et al.*, 2008). Nevertheless, as also mentioned by Tzanatos *et al.* (2007), in some cases the high discard value recorded for small-scale fisheries could be linked to the relatively high quantities of small species that are of low commercial value because of their size and/or taste.

Traps and pots

Traps and pots mainly targeting cephalopods and shrimp are among the most selective types of gear, with little discards (ranging from 1 to 9 percent) throughout the Mediterranean and the Black Sea (Castriota *et al.*, 2004; Fabi and Grati, 2005; Tsagarakis *et al.*, 2013).

4.3. OVERVIEW ON INCIDENTAL CATCHES OF VULNERABLE SPECIES

Marine mammals, sea turtles, seabirds and sharks are large marine vertebrates that interact in different ways with fishing activities. These groups appear as bycatch in some Mediterranean and Black Sea fisheries, and some species of sharks and rays could be the target of specific fisheries.

This section highlights relevant aspects of interactions of the different groups of vertebrate listed above and different types of fisheries. It also offers insights into which fisheries have the greatest impact on the various groups. In most cases, estimates are considered only a relative indicator, since information is subject to a number of shortcomings, thereby increasing uncertainty. Estimates of annual incidental catches in Mediterranean fisheries are provided for seabirds and sea turtles; the former were obtained by interpolating GFCM fishery data and bibliography, the latter from bibliography only. Estimates of annual incidental catches of dolphins in the Black Sea are provided based on bibliography.

4.3.1. Marine mammals

Interactions between dolphins and fisheries, including bycatch mortality events, have been reported by a number of authors throughout the Mediterranean basin (e.g. Di Natale and Notarbartolo di Sciara, 1994; Roditi-Elasar *et al.*, 2003; Bearzi *et al.,* 2004; Tudela *et al.*, 2005; Díaz López, 2006; Van Canneyt and Peltier, 2006; Brotons *et al.*, 2008; Canadas and Hammond 2008; Fortuna *et al.*, 2010; Morizur *et al.*, 2011). However, most studies focused on limited areas or fisheries and no attempt to assess the impact of fishery-related mortality on cetacean populations has been made for the Mediterranean Sea, due to the lack of robust data at regional scale. For the Black Sea countries, absolute numbers of population losses due to incidental catches in fisheries were estimated for the first time by Birkun *et al.* (2014).

Interactions between marine mammals and fisheries in the Mediterranean Sea mainly involve coastal fisheries and cetaceans, such as common bottlenose dolphins (*Tursiops truncatus*), which are typically found on the continental shelf, and short-beaked common dolphins (*Delphinus delphis*). The striped dolphin (*Stenella coeruleoalba*) – by far the most abundant cetacean in the Mediterranean – has a pelagic distribution and largely feeds on non-commercial prey species (Notarbartolo di Sciara and Demma, 2004), so it rarely interacts with fisheries, especially coastal ones (Bearzi, 2002).

The fauna of cetaceans in the Black Sea includes three subspecies – the Black Sea harbour porpoise (*Phocoena phocoena relicta*), the Black Sea common dolphin (*Delphinus delphis ponticus*) and the Black Sea bottlenose dolphin (*Tursiops truncatus ponticus*). Although Black Sea cetaceans face a number of threats (habitat degradation, pollution, introduction of alien species, overexploitation of fishery resources), incidental catch in fishing nets constitutes the most important danger. Existing cetacean bycatch records indicate that all three species are incidentally caught in fishing gear throughout the waters of all Black Sea's riparian countries, though by species, porpoises account for the largest proportion of incidental catches (often > 90 percent of annual estimates), compared with common and bottlenose dolphins (Birkun *et al.*, 2014).

Trawls

Few studies exist on the effect on incidental catches of cetaceans by pelagic and bottom trawlers in the Mediterranean and the Black Sea (e.g. Gonzalvo *et al.,* 2008), although incidental catches of common and bottlenose dolphins are reported by trawlers (Duguy *et al.*, 1983; Sacchi, 2008b). Dolphins usually come in the vicinity of trawls, attracted by the fish that escape or are discarded, and may be caught incidentally as a result. In the Adriatic Sea, Fortuna *et al.* (2010) noted that groups of bottlenose dolphins were sighted, in more than 30 percent of cases, close to the net during pair trawl fishing, often interacting with the fishing operation (e.g. persistently following trawlers during tows, entering the net and swimming around the codend during the final part of hauling operations, or feeding on discarded fish). However, given the low coverage of the observations and considering the actual pelagic trawling effort in the study area, reliable estimates of total mortality were not obtained for that study.

Purse seines

Purse seine fleets targeting tuna and small pelagic fish are widespread throughout the Mediterranean Sea. The incidental capture of common and striped dolphins has been investigated for purse seining off the coasts of southern Spain, southern Italy and northern Africa (Aguilar *et al.*, 1995; Zahri *et al.*, 2007). Tudela (2004) noted that Spanish purse seine fleets may catch as many as 5 700 dolphins annually, the majority of which are released alive. Recently, interactions between bottlenose dolphins and purse seines have been recorded in Tunisian and Moroccan fisheries that are targeting anchovies and sardines. Bottlenose dolphins try to eat fish that are entangled in the nets, damaging the gear, which has a negative economic impact on local fishers. It is noted that *Tursiops truncatus* usually eat medium or large-sized demersal fish, and depletion of demersal stocks may have driven a change in the local population's diet (Vingada *pers. comm.*).

Static nets

Static nets are commonly used in the small-scale fisheries sector in the Mediterranean and the Black Sea. However, little quantitative information exists on the nature and extent of interactions between dolphins and small-scale commercial fisheries in the Mediterranean, the costs of such interactions to the fisheries, or the effects of such interactions on dolphin populations (ICRAM 2001; Díaz López 2005, 2006). Incidental catches in static nets are also reported for the Mediterranean monk seal (*Monachus monachus*), mainly when the nets are set close to reproduction areas or discarded close to the coast (Panou *et al.*, 1993; Cebrian 1998a; Johnson *et al.*, 2006; Karamanlidis *et al.*, 2008). The monk seal is considered to be critically endangered and its current Mediterranean distribution is limited to Greece and the Mediterranean coasts of Turkey and Cyprus (IUCN[1]). As in the case of turtles and dolphins, seals can become entangled in bottom static nets when attempting to feed on the catch, and may die by drowning, while also causing serious damage to the fishing nets (Gazo 2008; Güclüsoy, 2008; Sacchi, 2008).

In the Black Sea, bottom set gillnets for turbot (*Psetta maxima*) are reported to be a considerable threat to cetaceans (Birkun 2002; Birkun, 2006; Birkun *et al.*, 2014). Birkun *et al.* (2014) recently estimated rates of dolphins' incidental catch in the Black Sea turbot fishery using data from observations on board, fishery independent video surveillance and recordings of fishing operations. They estimated that more than 11 000 porpoises and over 7 000 dolphins are caught each year in this fishery. However, the reliability of these estimates may be called into question by difficulty in species identification during data collection (survey at sea, interviews with fishers, etc.). On the other hand, given that illegal, unreported and unregulated (IUU) catches of turbot and sturgeon are considered to be larger than those officially reported, the total impact on cetacean populations could be higher than that estimated.

Longlines

Interactions between marine mammals and longlines in the Mediterranean Sea are documented in several studies (e.g. Di Natale 1991, Mussi *et al.*, 1998; Macías López *et al.*, 2012). However, longline fisheries have been traditionally defined as having a low impact on marine mammals (Macías López *et al.*, 2012), often because the animals are released alive at sea by fishers or are able to disentangle themselves. The primary factor driving interactions of marine mammals with longlines is depredation: the bait on hooked longlines as well as the catch itself attract marine mammals. This can subsequently develop into a habit of interacting with these fisheries. Although interactions can occur with demersal longlines, pelagic longlines targeting swordfish and tuna are the main fisheries involved. The striped dolphin, the false killer whale (*Pseudorca crassidens*), the Risso's dolphin (*Grampus griseus*) (Duguy *et al.*, 1983; Tudela 2004; Macías López *et al.*, 2012), the common dolphin, the killer whale (*Orcinus orca*) (Cañadas and de Stephanis 2006) and the pilot whale (*Globicephala melas*) (Tudela 2004) appear to be the most frequent

[1] http://www.iucnredlist.org/details/13653/0

cetacean species interacting with longline fisheries. From time to time, individuals of these species have been reported as having been killed by surface longlines in Italian and Spanish waters (Di Natale 1989; Tudela 2004). Killer whales, which in the Mediterranean mainly occur in the Straits of Gibraltar, are reported to eat the catch of Spanish and Moroccan tuna longlines (both small-scale and industrial) (Guinet *et al.*, 2007) causing economic losses to fishers.

4.3.2. Sea turtles

All species of sea turtles are long-lived and slow-growing, characterized by a complex life cycle and living in a wide range of habitats. Because of their long life span, a life cycle that requires several habitat types, and their extensive distribution in terms of the distance they cover, sea turtles are affected by a range of different factors, some natural and others caused by human activities (including fishing operations), at all stages of their life cycle.

Reliable data on sea turtle abundance worldwide, and on the different causes of sea turtle deaths, are generally unavailable. There is, however, evidence that some sea turtle populations have declined dramatically in recent decades, and all sea turtle species whose conservation status has been assessed are considered to be threatened or endangered (FAO, 2009).

The Mediterranean region is an important breeding area for two marine turtle species: the loggerhead *Caretta caretta* and the green sea turtle *Chelonia mydas.* Both are classified as endangered by IUCN[2]. The distribution range of loggerhead populations extends from the eastern to the western Mediterranean limits, with nesting beaches in ten countries (Cyprus, Egypt, Greece, Israel, Italy, Lebanon, Libya, Syria, Turkey and Tunisia). Green sea turtles are restricted to the eastern basin. They nest predominantly in Cyprus and Turkey (where 99 percent of recorded nesting occurs), but occasionally also along the coasts of Syria, Lebanon, Israel and Egypt. Other species distributed across the whole region are the leatherback *Dermochelys coriacea* and the hawksbill *Eretmochelys imbricata,* while the Kemp's ridley *Lepidochelys kempii* occurs only occasionally in the Mediterranean Sea (FAO, 2004; Casale 2011). In the case of the Black Sea, the presence of *C. caretta* is reported only in deep waters and near river mouths in the western part (FAO, 2004). However, this species does not nest in the Black Sea area. Observations of other species are infrequent (Marquez and Bauchot, 1987) and, because of this, there is little information on interactions with fisheries in the Black Sea (FAO, 2004).

Incidental capture in fishing gear that could cause death or severe injuries is believed to be one of the main threats to turtles in the Mediterranean and the Black Sea. Many authors reported that most incidental catches of sea turtles occur in fisheries using longlines, towed nets and gillnets (Argano and Baldari, 1983; De Metrio *et al.*, 1983; Delaugerre, 1987; Camiñas, 1988; Laurent, 1991; Margaritoulis *et al.*, 1992; Argano *et al.*, 1992; Laurent and Lescure, 1994; Aguilar *et al.*, 1995; Laurent *et al.*, 1996; Godley *et al.,* 1998; FAO, 2004; Piovano *et al.*, 2004; Casale, 2011). In some areas, trade in sea turtle shells and meat still exists, despite national and international bans on fishing and marketing of sea turtles (Mayol and Castelló Mas 1983; Gramentz 1989; Laurent 1990; Laurent *et al.*, 1998; Margaritoulis *et al.*, 2003; FAO, 2004; Nada and Casale, 2011; Venizelos, 2000).

Several attempts have been made to quantify the number of sea turtles incidentally caught each year during fishing operations in the Mediterranean Sea. These studies usually apply to specific areas and fisheries and are, therefore, poorly suited to extrapolating regional estimates. Estimated catch rates could also be biased by the fact that individual sea turtles may be captured multiple times. This phenomenon results in an overall overestimation of sea turtle mortality caused by fisheries. For example, a study of Italian swordfish captures in the Mediterranean Sea revealed that 92 percent of loggerhead turtles that were caught had one or more hooks either lodged externally or internally, while some individuals had as many as three hooks lodged in their stomachs (Piovano *et al.*, 2004).

[2] http://www.iucnredlist.org/

At present, the most comprehensive review of the impact of incidental catches on Mediterranean Sea turtle populations is that carried out by Casale (2011). According to the author, overall, a minimum of 132 000 incidental captures are estimated to occur annually in the Mediterranean basin; of these 39 000 occur in bottom trawlers, 57 000 in pelagic longlines, 13 000 in demersal longlines and 23 000 in set nets (Figure 47 and Figure 48). These captures would imply a minimum of 44 000 deaths, the majority occurring in small-scale fisheries.

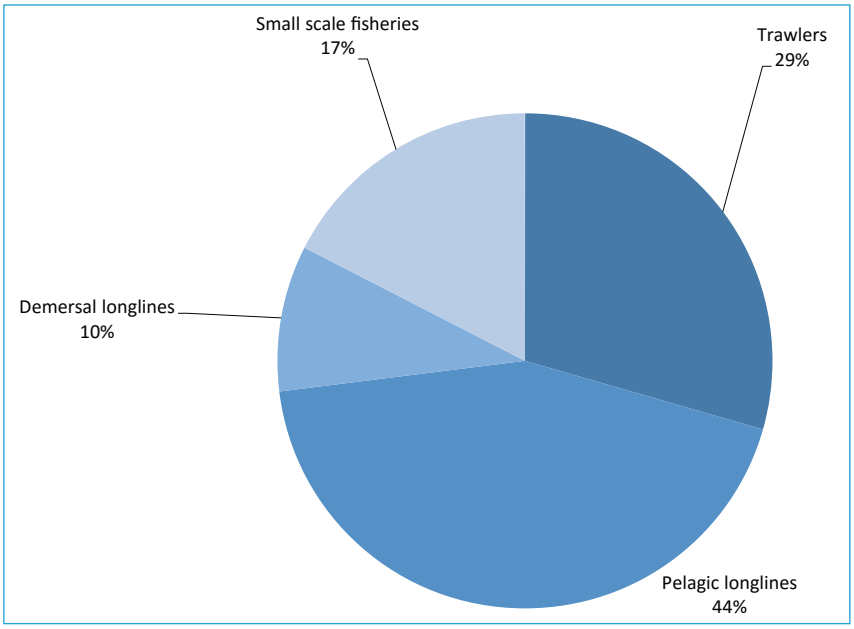


FIGURE 47
Contribution to sea turtle incidental catch (100 percent = 132 000 individuals per year) estimated by fishery type in the Mediterranean countries (adapted from Casale, 2011)

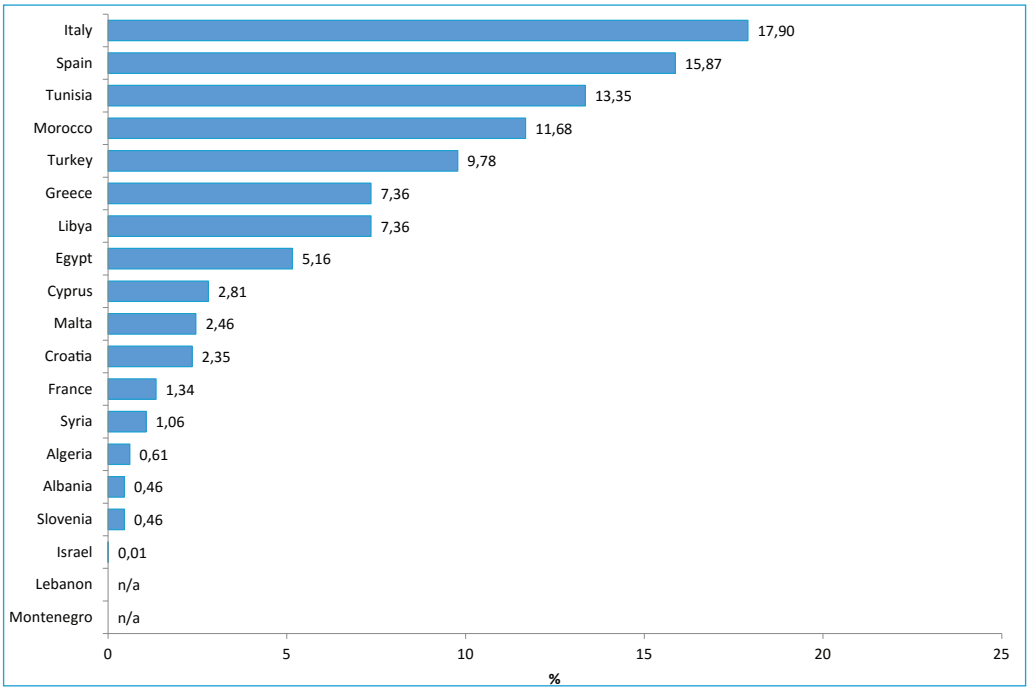


FIGURE 48
Contribution to sea turtle incidental catch (100 percent = 132 000 individuals per year) estimated by country in the Mediterranean Sea (adapted from Casale, 2011) n/a: data not available

Trawls

Trawling close to nesting beaches may have a significant impact on sea turtles in terms of mortality, disturbance and destruction of habitats (Hall *et al.*, 2000). There are no reliable estimates of the extent of trawl fishing in areas where sea turtles occur, but according to Laurent *et al.* (2001) and Casale (2011), the mortality caused by trawlers is less significant than that associated with pelagic longlines. Casale (2011) reported that the most seriously affected marine areas by trawls are the North African continental shelves (Tunisia, Libya and Egypt), the Adriatic Sea, the Levantine basin and the Aegean Sea, which together account for some 39 000 incidental catches per year in bottom trawling.

Incidental captures of green turtles in trawls are reported from Egypt (Nada and Casale, 2011), Greece (Margaritoulis *et al.*, 2003), Tunisia (Laurent, 1990) and Turkey (Laurent *et al.*, 1996; Oruc *et al.*, 1997). However, it is probable that this species is captured by bottom trawlers wherever it occurs in neritic foraging habitats, mainly in the Levantine basin, between southern Turkey and Libya (Casale *et al.*, 2010).

Loggerhead turtles move through corridors from nesting beaches to courtship areas, foraging or resting areas (Laurent *et al.*, 2001). These areas are, in many cases, situated above the continental shelf; pelagic and bottom trawlers may incidentally capture sea turtles when fishing activities overlap with loggerheads' habitat (FAO, 2004; Fortuna *et al.*, 2010).

Longlines

According to the FAO (2004), all sea turtle species are affected by pelagic longlines targeting different species, such as albacore *Thunnus alalunga*, bluefin tuna *Thunnus thynnus* and swordfish *Xiphias gladius*. The loggerhead and leatherbacks sea turtles are globally the most frequently caught species. High incidental catch levels (1 000 and more captures per year and country) are estimated in Morocco, Italy, Greece, Malta, Egypt, Libya and Tunisia (Casale, 2011). Experimental studies on mortality rates of individuals injured by fishing gear show that 20–30 percent of sea turtles caught by Spanish longlines may die (Aguilar *et al.*, 1995). Around 80 percent of specimens are released with the hook still fixed in the mouth, pharynx or oesophagus (Camiñas and Valeiras, 2001). Demersal longlines typically use smaller hooks than pelagic ones, therefore post-release mortality induced by hooks may be lower. In the case of demersal longlines, more than 1 000 captures per year are estimated in four countries (Turkey, Libya, Tunisia and Greece) (Casale, 2011). The most seriously affected marine areas are the North African continental shelf, the Levantine basin and the Aegean Sea.

Other fisheries

It is estimated that almost 23 000 turtles per year are caught by set nets in the Mediterranean (Casale, 2011). The most seriously affected marine areas are the North African continental shelf (Tunisia, Libya, Egypt), the Levantine basin, the Aegean Sea and the Adriatic Sea (Casale, 2011). Coastal bottom gillnets are often set close to shore near sea turtles' feeding areas. Sea turtles that become entangled in these nets face a high risk of drowning (FAO, 2009). In some areas of the world, sea turtles are also occasionally captured by purse seine fisheries targeting tuna. Some interactions occur when sea turtles are attracted by floating objects, such as FAD and are captured when the object is encircled. In most cases, sea turtles are found alive in purse seine nets and can be released over the side of the vessel (FAO, 2004).

4.3.3. Seabirds

Fisheries and seabirds usually concentrate in areas of high biological productivity. As a result, birds' foraging areas and fishing operations largely overlap (Brothers *et al.*, 1999; Karpouzi *et al.*, 2007; Pichegru *et al.*, 2009), creating multiple and complex interactions between them (Tasker *et al.*, 2000; Montevecchi, 2002). Most seabird species are attracted to vessels to obtain easy food from discards and offal produced by fisheries. This extra source of food can have profound effects on the breeding biology, distribution and population dynamics of seabirds, by making

available in a predictable way demersal and benthonic species otherwise naturally inaccessible (Wagner and Dee Boersma 2011, Bicknell *et al.* 2013, Oro *et al*, 2013). However, fishery-seabird interactions can also result in mortality and serious injuries when seabirds become entangled or hooked in fishing gear (Tasker *et al.,* 2000; Furness, 2003).

Mortality caused by fisheries generates conservation problems for seabird populations, due to their life-history strategy. Most seabirds are long-lived species with high adult survival, delayed maturity and low fecundity rates, so any factor that increases adult mortality will have important consequences on their population dynamics (Furness, 2003). Seabird incidental catch may occur in small-scale fisheries with static nets (e.g. gillnets), trawlers and longlines. Gillnets produce mortality of diving birds due to entanglements since the birds are not able to see the gillnet underwater (Zydelis *et al.,* 2013). In the case of trawlers, mortality may occur as a result either of collision with the net sonde or warp cables, or of entanglements with nets when birds dive for fish (Weimerskirch, 2000; Løkkerborg, 2008). Incidental catches in longlines occur when birds try to steal bait from the hooks while the fishing gear is being set. In these attempts, birds may become entangled or hooked, drowning when the gear sinks (Brothers *et al.,* 1999).

The Mediterranean region is inhabited by varied seabird populations with a high level of endemism. Most of these Mediterranean endemic species are threatened and included in the IUCN red list categories[3], as well as in Annex II of the Protocol concerning specially protected areas and biological diversity in the Mediterranean (the SPA/BD Protocol)[4]. They include the Scopoli's shearwater (*Calonectris diomedeal*), the Balearic shearwater (*Puffinus mauretanicus*) and the Mediterranean shearwater (*P. yelkouan*).

Scopoli's shearwater is the only species breeding in medium to large colonies within the Mediterranean (Zotier *et al.,* 1999). Global population is estimated to range from 140 000 to 217 000 pairs (Anselme and Duran, 2012), and is mainly concentrated in the Ionian Sea (Tunisia, Italy and Greece), although important breeding colonies also occur in the western Mediterranean.

The Balearic shearwater, which only breeds in the Balearic Islands, is classified as "critically endangered" and considered to be the most endangered seabird in Europe, according to IUCN. Recent estimates using counts at sea have revealed an overall population of 25 000 birds (around 5 000 breeding pairs) (Arcos *et al.,* 2011).

The Mediterranean shearwater is classified by IUCN as "vulnerable", due to a declining trend in populations. These birds' breeding colonies are mainly located in the Ionian Sea and in the eastern Mediterranean (between 11 000 and 52 000 pairs), especially in Italy and Greece. However, during the non-breeding season, large numbers of shearwaters are concentrated on the western coast of the Black Sea, with numbers reaching several thousands (Bourgeois, 2012).

In the Mediterranean and the Black Sea, incidental catches are mainly reported in longline fisheries and static nets (e.g. gillnets). Incidental catch events have also been documented for other gear used in Mediterranean fisheries, such as bottom trawls, purse seiners and traps (Table 10, ICES, 2008; Abelló and Esteban, 2012; SEO/Birdlife, 2014; Cortés and González-Solís, unpublished data). However, in these fisheries, seabird catches are infrequent and they do not seem to have a significant biological impact on seabird populations.

[3] http://www.iucnredlist.org/

[4] Annex II, List of endangered or threatened species (2013).

Table 10 Seabird species incidentally caught by different types of fishing gear from those countries with data available

Fishing gear class	Gear type	Country	Seabird species affected	Reference
Longlines	Demersal longlines	Spain, Greece, Malta, France, Italy	Scopoli's, Mediterranean and Balearic shearwaters, yellow-legged gull, Audouin's gull, northern gannet, black-legged kittiwake, Mediterranean gull, Mediterranean shag, great skua, Pomarine skua	Cortés and González-Solís (unpublished data); Dimech et al., 2009; Karris et al., 2013; SEO/Birdlife, 2014.
	Pelagic longlines	Spain, Greece, Malta, Italy, Tunisia	Scopoli's, Mediterranean and Balearic shearwaters, yellow-legged gull, Audouin's gull, northern gannet, great skua and cormorants	Cortés and González-Solís (unpublished data), Dimech et al., 2009, Karris et al., 2013; SEO/Birdlife, 2014; García-Barcelona et al., 2010; Valerias and Camiñas, 2003.
Nets	Trammel nets	Spain	Mediterranean shearwater, Mediterranean shag	Cortés and González-Solís (unpublished data); Louzao and Oro, 2002; SEO/Birdlife, 2014.
	Gillnet nets	Spain, Greece	Mediterranean shag	Louzao and Oro, 2002; SEO/ Birdlife, 2014; Karris et al., 2013.
Trawls	Bottom trawls	Spain	Balearic shearwater	Abelló and Esteban, 2012.
Surrounding nets	Purse seiners	Spain	Shearwaters and auks	SEO/Birdlife, 2014.
Traps	Fish traps	Spain	Mediterranean shag, great cormorant	Cortés and González-Solís (unpublished data).

Trawls

Bottom trawlers usually attract a large number of birds due to their high rate of discarding (see Section 4.2.1), and have been reported to produce significant mortality rates in the Benguela current (from South Africa to Namibia). In the Mediterranean, however, no evidence of relevant incidental catches has been found in a large number of trawler operations monitored in the western Mediterranean during the period 1994–2003 (Oro and Ruiz 1997; Arcos and Oro 2002; Abelló *et al.,* 2003; Louzao *et al.,* 2011). Data collected by questionnaires with fishers in Spain and Malta support this evidence, showing that, during trawl fishing operations, incidental catches are very infrequent (Dimech et al., 2009; SEO/Birdlife, 2014).

Nevertheless, trawler activity can influence seabird incidental catches in other fisheries, especially in longlines. Several studies carried out in the western Mediterranean found an increase in seabirds attending longlines or incidental capture events during non-working days of trawlers (e.g. holidays, weekends and moratorium period) (Laneri *et al.,* 2010; Báez *et al.,* 2014; Cortés *et al.,* 2015). When trawlers do not operate, seabirds can change their feeding behaviour and focus their attention on other fleets, such as longlines or polyvalent small-scale vessels, resulting in an increase of incidental catch risk.

Static nets

In the case of gillnet fisheries, information from the Mediterranean Sea is scarce and fragmented. Nevertheless, the studies carried out in this region indicate that incidental catches in static nets may be occurring at lower levels than elsewhere in the world (Zydelis *et al.,* 2013). Even so, more data are needed to assess the actual impact of these fisheries on seabird species. Generally, seabirds most susceptible to incidental catches in gillnet fisheries are pursuit diving species, such as auks, seaducks and shearwaters (Zydelis *et al.,* 2013). In the Mediterranean, gillnet and trammel fisheries appear mainly to affect the Mediterranean shag (*Phalacrocorax aristotelis desmarestii*) (Louzao and Oro, 2004; Karris *et al.,* 2013, Cortés and González-Solís, unpublished). However, shearwaters and gulls may also be caught in this gear (SEO/Birdlife, 2014). Previous

interviews with fishers from the French Mediterranean coast reported catches of Balearic/Mediterranean shearwaters (Besson, 1973). Considering the fishing effort during the studied period, it was estimated that 800 shearwaters were killed annually in this fishery.

Currently, the only information available on seabird incidental catches in bottom gillnet and trammel fisheries comes from fishers' questionnaire surveys carried out in Spain and Greece (Louzao and Oro, 2004; Karris *et al.*, 2013; SEO/Birdlife, 2014) and opportunistic information (Cortés and González-Solís, unpublished). Incidental catches of seabirds in static nets seems to be infrequent and mortality events rarely reached large numbers of birds (SEO/Birdlife, 2014).

Longlines

On a global scale, longline fisheries are estimated to have high incidental catch rates of seabirds, which in some cases poses a considerable risk to seabirds, and could result in several species coming close to extinction (Gales, 1998; Brothers *et al.*, 1999; Gilman, 2001; Rivalan *et al.*, 2010). In the Mediterranean and the Black Sea, incidental catches in longline fisheries are reported to be the main source of seabird mortality (Tudela, 2004; ICES, 2008), and could be the primary cause in the decline of some seabird populations (Belda and Sánchez, 2001). Nevertheless, the information available about the impact of fisheries on Mediterranean seabirds is still scarce and only limited to some regions where longline fisheries operate (Cooper *et al.*, 2003). From the data available for the Mediterranean, it is known that at least 11 species are susceptible to incidental catches in longline fleets, including the Balearic shearwater (Table 11). This species shows a declining trend in numbers, caused by unusually low adult survival rate, and mortality at sea is the main cause of its decrease (Oro *et al.*, 2004). It is very likely that incidental catches in longline fisheries significantly contribute to this decline. The negative trend associated with low adult survival was also found in the Maltese and French populations of the Mediterranean shearwater (Oppel *et al.*, 2011), and fishing mortality appears to be the most likely cause of population decline.

A review of seabird mortality rates in Mediterranean longlines, available from different sources in six countries (France, Greece, Italy, Malta, Spain and Tunisia), is presented in Table 11.

Table 11 Information currently available on seabird mortality caused by different gear types used in the Mediterranean area

Data refer to the GSAs where the study was carried out and present estimated mortality per year, study period, source of data collected and sampling effort

Country	Gear type	GSA	Seabird mortality (individuals/year)	Period	Seabird species	Source	Sampling effort
France	Small-scale (demersal)	7	-	Unknown	Scopoli's shearwater, Balearic and Mediterranean shearwater	Opportunistic information[1]	-
Greece	Demersal longliners	20	355	2010	Scopoli's shearwater, Mediterranean shag	Questionnaires[2]	133 surveys
Greece	Pelagic longliners	20	42	2010	Scopoli's shearwater	Questionnaires[2]	48 surveys
Greece	Pelagic longliners	20, 22, 23	0	2004–2006	-	Observations on board[3]	139 710 hooks, 18 vessels
Italy	Small-scale (pelagic and demersal)	8, 9, 10, 11	-	1988–2001	Scopoli's, Balearic and Mediterranean shearwater, Audouin's gull, Mediterranean gull	Opportunistic information[3]	-

Country	Gear type	GSA	Seabird mortality (individuals/ year)	Period	Seabird species	Source	Sampling effort
Malta	Demersal longliners	15	1 231	2007	Scopoli's and Mediterranean shearwater	Questionnaires[4]	146 surveys (pelagic and demersal)
Malta	Pelagic longliners	15	5	2007	Scopoli's shearwater	Questionnaires[4]	146 surveys (pelagic and demersal)
Malta	Pelagic longliners	15	0	2008	-	Observations on board[5]	109 155 hooks, 6 vessels
Spain	Demersal and pelagic	6	656 - 2 829	1998–1999	Scopoli's and Balearic shearwater, Audouin's gull	Observations on board[6]	48 724 hooks (demersal), 40 088 hooks (pelagic) from Columbretes Islands
Spain	Demersal longliners	6	1 307	2011–2014	Scopoli's, Balearic and Mediterranean shearwater, Audouin's gull	Observations on board[7]	227 939 hooks, 11 vessels
Spain	Demersal and pelagic longliners	5, 6	-	2003–2014	Scopoli's, Balearic and Mediterranean shearwater, Audouin's gull, Mediterranean gull, Mediterranean shag	Opportunistic information[7]	619 carcasses reported by fishers
Spain	Small-scale (demersal)	5	633	2013–2014	Scopoli's and Balearic shearwater, Audouin's gull	Observations on board[7]	69 410 hooks, 8 vessels from the Minorca Island
Spain	Demersal longliners and small-scale (demersal)	1, 2	0 - 30	2014	Shearwaters, gulls and cormorants	Questionnaires[7]	24 surveys
Spain	Small – scale (demersal)	3	0	2014		Observations on board[7]	13 825 hooks, 3 vessels
Spain	Demersal longliners	1, 2	0	2014		Observations on board[7]	27 810 hooks, 1 vessel
Spain	Small-scale (demersal)	1	0	2014		Observations on board[7]	11 980 hooks, 5 vessels
Spain	Pelagic longliners	1, 5, 6	506 ± 203	2000–2009	Scopoli's, Balearic and Mediterranean shearwater, Audouin's gull	Observations on board[8]	5 398 297 hooks, 82 vessels
Turkey	Pelagic	22	0	2008–2013		Observations on board[9]	50 survey operations

[1]Cooper *et al.*, 2003; [2] Karris *et al.*, 2013;[3] Peristeraki *et al.*,2008 ; [4]Dimech et al., 2009 ; [5] Burgess *et al.*, 2010 ; [6] Belda and Sanchez, 2001 ; [7] Cortés and González-Solís (unpublished data) ; [8] Barcelona *et al.*, 2010; [9]Ceyhan and Akyol, 2014.

Many studies have been carried out in the Mediterranean waters of Spain: several authors reported an incidental catch rate of 1–5 birds/100 000 hooks in the Spanish pelagic longlines (Belda and Sánchez, 2001; Valerias and Camiñas, 2003; García-Barcelona *et al.*, 2010) adding up to around 500 seabirds caught per year (Belda and Sánchez, 2001; Barcelona *et al.*, 2010). However, Cortés and Gonzalez-Solís (unpublished data) estimated that for demersal longlines in the Balearic Sea, without considering most of the small-scale fleet, at least 2 000 seabirds may be caught each year. Similarly, Belda and Sánchez (2001) estimated an annual mortality around 650 and 2 800 seabirds in the longline fleet of the Columbretes Islands.

Spanish studies demonstrated that the species most affected by longlines are the Scopoli's shearwater, the yellow-legged gull (*Larus michahellis*) and the Balearic shearwater (Belda and Sánchez, 2001; Valerias and Camiñas, 2003, García-Barcelona *et al.*, 2010). Belda and Sánchez (2003) found that 60 percent of Scopoli's shearwater birds caught incidentally were adults; these catches may have a significant effect on the Scopoli's shearwater population.

In Malta, interviews with fishers indicated that significant incidental shearwater catches occur in Maltese longlines (Dimech et al., 2009). The highest mortality rate was found in demersal longlines. The most seriously affected species was the Scopoli's shearwater, while the Mediterranean shearwater was caught occasionally. It has been estimated that around 1 200 Scopoli's shearwater specimen may be caught annually in Maltese longlines, mostly demersal.

Karris *et al.* (2013) also used questionnaires to assess the rate of seabird incidental catches in Greece, particularly from the local longline fleet that operates in the southern Ionian Sea. They found that the species most susceptible to incidental catches was Scopoli's shearwater, in both demersal and pelagic longlines. However, demersal longlines were the main cause of seabird incidental catches. The study estimated that around 400 Scopoli's shearwater birds may be caught annually in the Greek Ionian longline fleet, with approximately 90 percent of catches occurring in demersal longlines.

Italy, France and Tunisia also reported seabird incidental catches in their longline fleet, especially affecting Scopoli's shearwaters (Cooper *et al.*, 2003). However, data available is anecdotic and does not enable quantification or impact assessment of longlining on seabird populations. However, these countries host important breeding colonies of Scopoli's and Mediterranean shearwaters, and it is therefore reasonable to believe that the number of incidental catches may be significant in longline fisheries in these areas.

Box 6 presents an estimation of seabirds' annual mortality in Mediterranean and Black Sea longline fisheries according to GFCM Task 1 data. It is estimated that at least 5 100 seabirds could die annually in these fisheries: around 3 200 birds in demersal longlines and 2 008 in pelagic longlines. These estimates are likely to be an underestimate of the actual figures, due to a combination of factors such as not incorporating mortality due to polyvalent small-scale vessels using hooks and lines, as well as potentially underreported number of vessels and total effort in the Mediterranean.

Box 6 Estimated annual seabird mortality in longline fisheries according to GFCM Task 1 data

Estimated annual seabird mortality for Mediterranean countries was extrapolated from incidental catch rates obtained in previous studies for the western Mediterranean (demersal longlines: Cortés and González-Solís, unpublished; pelagic longlines: García-Barcelona *et al.*, 2010) and from GFCM Task 1 data. Seabird mortality was estimated for countries where longline fishery (number of vessels) and effort data (days at sea) were available to the GFCM. The incidental catch rate applied was higher for those GSAs where important breeding colonies of the most susceptible seabird species occur. Extrapolations of incidental catches, based on the size of available fleet data, pointed out that this method was likely to result in an underestimation of actual seabird mortality throughout the Mediterranean, if compared with estimates from literature.

Country	GSA	Nb of vessels	Seabird mortality in demersal longlines (individuals/year)	Seabird mortality in pelagic longlines (individuals/year)
Bulgaria	29	50	53	43
Croatia	17	216	535	-
France	7	73	600	63
	8		141	12
Greece*	20	-	355	42
Italy	10	170	25	131
	16		-	294
	18		249	115
	19		384	947
Malta	15	53	99	190
Spain	1	389	307	106
	5		584	29
	6		-	78
	7		203	-

*Mortality estimated from fishers questionnaire surveys

4.3.5. Sharks and rays

Sharks, skates and rays, collectively referred to as elasmobranchs (class Chondrichthyes, subclass Elasmobranchii), form a relatively small taxonomical group that is conservative from an evolutionary perspective. This group has evolved successfully in diverse marine and freshwater ecosystems for over 400 million years. Because of their biological characteristics such as slow growth, late maturity and low fecundity, elasmobranchs have very low rates of population increase and limited recovery potential from fishing mortality, whether caused by direct or indirect fishing (Cavanagh and Gibson, 2007; Ferretti *et al.*, 2008; Camhi *et al.*, 2009; Worm *et al.*, 2013; Coll *et al.*, 2013; Guisande *et al.*, 2013; Dulvy *et al.*, 2014). A decline in elasmobranch populations has been observed throughout the world and, according to Dulvy *et al.* (2014), was particularly marked in the Indo-Pacific and Mediterranean Sea areas.

Around 80 elasmobranch species are found in the Mediterranean and the Black Sea and these represent about 7 percent of the total number of species of this group worldwide (Serena, 2005; Cavanagh and Gibson, 2007). According to Cavanagh and Gibson (2007), fisheries targeting

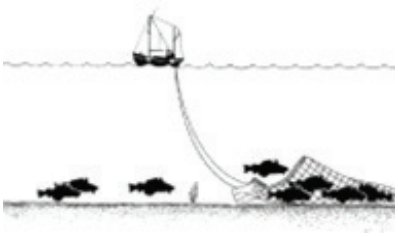
about 15 species of sharks and rays used to exist in the Mediterranean, but the local abundance of target elasmobranch populations largely declined, and few fisheries that directly target elasmobranchs now remain (see also Serena and Abella, 1999). Abella (2011) and Bradai *et al.* (2012) indicated that elasmobranch fisheries in the Mediterranean and the Black Sea are rare, and only some small-scale vessels in the Adriatic Sea and in the Gulf of Gabès (Tunisia) still target (with gillnets) hound sharks (*Mustelus* sp.), dogfish sharks (*Squalus* sp.), sandbar sharks (*Carcharhinus plumbeus*) and guitarfishes (*Rhinobatos* sp.). In the Black Sea, the piked dogfish (*Squalus acanthias*) is caught by fisheries targeting turbot (*Psetta maxima*). However, in Black Sea riparian countries, there is little market for shark meat, and it is mostly exported fresh or chilled to Greece, Italy, Norway and Spain (Başusta *et al.*, 2006).

It should be highlighted that even if sharks and rays are not targeted by any major fishing fleet in the GFCM area of application, when caught they are either discarded at sea or retained and landed to be sold, according to the species. However, misreporting or unreporting of elasmobranch catches are common (Abella, 2011; Bradai *et al.*, 2012; Coll *et al.*, 2013; Dulvy *et al.*, 2014).

Trawls

Bradai *et al.* (2012) reported that almost all elasmobranch species of the Mediterranean and the Black Sea can potentially be caught by both pelagic and bottom trawlers (Table 12). For example, 62 species were recorded in trawl catches in Greece and 62 in Spain and in Italy. However, the proportion of bycatch and landed/discarded species varies greatly in terms of weight and species among different subregions (see Section 4.2). Nevertheless, data availability is not homogeneous and comparisons remain difficult. In general, the western basin (Tyrrhenian and Aegean Sea and the Balearic Islands) is the most closely studied zone, whereas in the eastern and southern part of the Mediterranean, with the exception of the Gulf of Gabès, there are no studies assessing incidental catches of elasmobranchs in fisheries (Bradai *et al.*, 2012).

Table 12 Some of the elasmobranch species incidentally caught by pelagic and bottom trawlers in the Mediterranean and the Black Sea (from Serena, 2005; Bradai et al., 2012)

	*Isurus oxyrinchus*
	Prionace glauca
	Rhinoptera marginata
	Myliobatis aquila
	Mobula mobular
	Alopias vulpinus
	Carchardon carcharias
	Cetorhinus maximus
	*Galeus melastomus*
	Etmopterus spinax
	Scyliorhinus canicula
	Mustelus spp.
	Raja clavata
	Raja radula
	Raja miraletus

Coll *et al.* (2013) recently found a very low abundance of the Mediterranean endemic starry ray (*R. asterias*) in the northwestern Mediterranean and related this to the impact of bottom trawling fisheries. Bottom trawlers also have an impact on juveniles of pelagic sharks, because

these live close to the coast during early life stages; it has been estimated that in the Ionian Sea, and especially the Gulf of Gabès, bottom trawlers are responsible for a significant percentage of total incidental catches of juveniles of white sharks and bluntnose sixgill sharks (*Hexanchus griseus*) (about 30 and 80 percent of total incidental catches of these species in this region; Bradai *et al.*, 2012).

Longlines

In addition to incidental catches of large marine vertebrates, at least 15 species of sharks and rays are reported to be caught by pelagic longlines (Bradai *et al.*, 2012) (Table 13). In several areas examined throughout the Mediterranean Sea, sharks represented about 10–15 percent in biomass of the catch sampled in swordfish and tuna longlines. The blue shark *P. glauca* is the most frequently hooked species, and it accounts for more than 70 percent of elasmobranch captures, followed by the mako *Isurus oxyrinchus*. Demersal longlines are responsible for the incidental capture of demersal species such as *Mustelus* sp., *Squalus* sp., *Torpedo* sp. and some Rajidae species. In northern Mediterranean areas, sharks generally account for 6 percent in numerical terms, and 13 percent in biomass terms, of the total catch of demersal longlines (Megalofonou *et al.*, 2005).

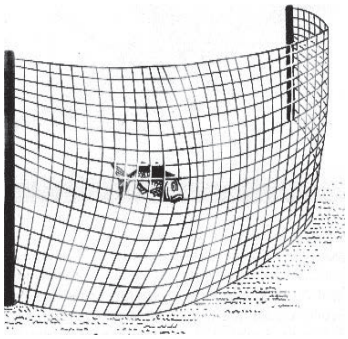
Table13 Examples of elasmobranch species incidentally caught in pelagic longlines in the Mediterranean and the Black Sea (Bradai *et al.*, 2012)

Alopias vulpinus
Alopias superciliosus
Carcharinus plumbeus
Carcharodon carcharias
Cetorhinus maximus
Dasyatis violacea
Galeorhinus galeus
Hexanchus griseus
Isurus oxyrinchus
Lamna nasus
Mobula mobular
Mustelus mustelus
Prionace glauca
Sphyrna zygaena
Squalus blainvillei

Other fishing gear

Often, gillnets entangle demersal shark and ray species (Table 14). In the Black Sea, bottom-set gillnet fisheries targeting turbot (*Psetta maxima*) capture a sizeable number of piked dogfish *Squalus acanthias* every year. There are also incidental captures of the thornback ray *Raja clavata* and the common stingray *Dasyatis pastinaca* (Maximov and Staicu, 2008). For trammel nets, a study in the Balearic Islands demonstrated that these can capture up to 12 species of elasmobranchs, accounting for 10 percent in terms of numbers, and 28 percent in terms of biomass of the total catch. The most common species caught were *Dasyatis pastinaca*, *Raja radula* and *Torpedo marmorata,* representing respectively 48 percent, 24 percent and 15 percent of elasmobranch catches. In the Aegean Sea, elasmobranchs (mainly Rajidea) represented 6 to 10 percent by weight of total catches by trammel nets. It is estimated that 30 percent of the total catch of basking sharks *Cetorhinus maximus* juveniles in the Mediterranean occurs in trammel nets (Bradai *et al.*, 2012).

Table 14 Examples of elasmobranch species incidentally caught in static nets in the Mediterranean and the Black Sea (Bradai *et al.*, 2012)

	*Carcharhinus sp.*
	Centrophorus granulosus
	Dasyatis pastinaca
	Dasyatis sp.
	Galeus melastomus
	Myliobatis aquila
	Pteromylaeus bovinus
	Raja clavata
	Scyliorhinus canicula
	Scyliorhinus stellaris
	Squalus acanthias
	Torpedo sp.

With regard to incidental catch in encircling nets (*i.e.* purse seines) little information is available in literature. However, these nets in fisheries targeting bluefin tuna and small pelagic species occasionally capture pelagic sharks such as *Isurus oxyrinchus*, *Cetorhinus maximus*, *Alopias vulpinus* and stingrays. In the Ionian Sea, over 70percent of incidental catches of adult great white sharks are estimated to be due to purse seiners (Bradai *et al.*, 2012).

4.3.6. Remarks on incidental catch of vulnerable species in the GFCM area of application

As shown in this chapter, and as noted by previous studies (e.g. Alverson *et al.*, 1994; Kelleher, 2005; Davies *et al.*, 2009; Tsagarakis *et al.*, 2013) there are important gaps in the knowledge of the actual extent of bycatch in the Mediterranean and the Black Sea. The overview also demonstrated that incidental captures of vulnerable species, as well as discards, are serious issues hampering the sustainability of fishery activities in the GFCM area of application. Most available studies cover limited areas in limited temporal frames. Moreover, important data come from grey literature (e.g. technical or project reports, publications of local interest and local databases).

For some fisheries, a reduction in incidental catches together with measures to mitigate bycatch have already been identified as a priority, with binding decisions adopted (Chapter 7). In those cases, appropriate monitoring will be needed to ensure that the measures are efficiently implemented, and that they are adequate to address the issues identified. Currently, existing GFCM recommendations incorporate requirements for countries to report information on bycatch and incidental catches. However, reported incidental catches of vulnerable species are very likely to be an underestimate of the real figures for the Mediterranean and the Black Sea. Robust estimates of the actual mortality rates of vulnerable species caused by fishing operations will require the presence of observers on vessels, sampling the fleets in a representative manner (Birkun *et al.*, 2014; Hall, 2015). These estimates, in turn, would enable the GFCM to obtain a more complete picture of the situation across the region and, based on that, set priority areas for conservation and management initiatives.

In order to address the issues of lack of data and uncertainty in the estimates, the GFCM has been working on a strategy aimed at: i) collecting and compiling available data in a regional database and, ii) developing a regional pioneer sampling programme with observers on board. Furthermore, in 2015, the GFCM and the Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS) launched a two-year project which also aims to test mitigation measures in order to reduce incidental catches of vulnerable species in selected fisheries of the western Mediterranean and to enhance capacity building on data collection (Box 7). The results of these actions are expected to provide better information to support estimates of bycatch rates of different group of species in the main commercial fisheries in the Mediterranean and the Black Sea.

Box 7 ACCOBAMS/GFCM project on mitigating interactions between vulnerable marine species and fishing activities (funded by the MAVA Foundation)

In April 2015, the ACCOBAMS and GFCM Secretariats launched a two-year project (2015–2016) with the aim to enhance the conservation of vulnerable marine species such as cetaceans, sharks, sea turtles and seabirds, and to promote responsible fishing practices in the Mediterranean Sea. The project is articulated in two operational components: i) reducing negative interactions between endangered marine species and fishing activities, and ii) reducing pressure on marine species through the diversification of small-scale fisheries by promoting the development of ecotourism activities. The first component of the project is carried out through the following six pilot actions. After a first phase of data collection and identification of priorities, fishing measures should be implemented in these fisheries in order to mitigate incidental catch of vulnerable species as well as depredation events.

- Purse seine for small pelagic species in the Moroccan Mediterranean Sea (coordinated by the Institut national de recherche halieutique – INRH)
- Bluefin tuna artisanal fisheries in the Strait of Gibraltar (coordinated by INRH)
- Swordfish and albacore pelagic longlines in southern Spain (coordinated by the Spanish Institute of Oceanography– IEO)
- Bottom and surface longlines in the Gulf of Gabès (coordinated by the Institut national des sciences et technologies de la mer – INSTM)
- Purse seine for small pelagic species in Kelibia (coordinated by INSTM)
- Gillnet fisheries in southern France and in Balearic Islands (coordinated by the Centre d'étude et de sauvegarde des tortues marines de Méditerranée – CestMed and by the Alnitak Marine Research and Education Centre)

In addition, a preliminary study on the occurrence and extent of incidental catches of cetaceans and depredation events in Algerian fisheries is coordinated by the Centre national de recherche et de développement de la pêche et de l'aquaculture (CNRDPA).

5. Status of stocks

5. Status of stocks

5.1 INTRODUCTION AND SOURCES OF INFORMATION

Data for the assessment of stocks are collected through stock assessment forms (SAF), which also contain information on reference points and outcomes of the assessment (e.g. fishing mortality, exploitation rate, spawning stock biomass, recruitment etc.). Assessments of stock status have been presented to the SAC since its establishment in 1997. Since 2007, SAF have been collected in digital format. Initially, this was done using Excel files, but since 2012, stock assessment has been conducted using an online system that incorporates a Word template, metadata providing key information for the formulation of advice on stock status and input files from the stock assessment model. The analysis provided in this chapter is mainly based on information contained in the metadata database of SAF from 2007 to 2014. Only those stocks validated by the SAC at the time of preparation of this report have been used for the analysis presented in this chapter. Overall analysis of stock status is carried out in relation to approved reference points. These are mainly linked to indicators of fishing mortality, since few stocks have agreed biomass reference points. The terminology "within" or "outside" "biologically sustainable limits", agreed in the context of FAO (FAO, 2014), is used to describe stocks for which indicators (fishing mortality, stock biomass) are inside or outside the limits established by the reference points (see Box 8). Terminal fishing mortality for small pelagic stocks (i.e. the fishing mortality estimated at the last year of the time series used for assessment), and the average fishing mortality of the last three years for demersal stocks, are the indicators used in the analysis for this chapter.

5.2 STOCKS VERSUS MANAGEMENT UNITS

Stock assessment in the GFCM area of application is often conducted by management units, based on GSAs (see Introduction). This method does not ensure that the whole stock is assessed, since stocks may cover several different management units. In some cases, when there is scientific evidence of a stock spreading through different GSAs, as well as information on species from different GSAs, existing information is combined across GSAs. This is then defined as a "joint stock assessment of a shared stock". The GFCM recommends that when scientific evidence of shared stocks exists, joint stock assessments should be attempted. A number of activities aimed at achieving a better definition of stock boundaries are currently being conducted at the GFCM level.

In the remainder of this chapter, the portion of stock inside a management unit is called "stock", regardless of whether or not it covers the entire area of distribution. Stocks can therefore refer to the portion of a population of a given species inside a management unit. This may be a single GSA, or, in the case of joint stock assessment, a number of GSAs.

5.3 SPATIAL AND TEMPORAL COVERAGE ON STOCK STATUS ADVICE

The number of stocks assessed by the SAC currently fluctuates between 20 and 40 per year. The number of stock assessments that have been validated has shown a gradual increase in recent years. Starting from 2007, when the electronic SAF was established – and assuming that a validated assessment for small pelagic stocks remains valid for a maximum of two years and for demersal species for a maximum of four years – the accumulated number of stock units for which an assessment exists is almost 100 (Figure 49). The percentage of landings being assessed has nearly doubled, from approximately 20 percent in 2013 to some 45 percent in 2014 (Figure 49). This increase is mainly the result of an assessment for Black Sea anchovy (*Engraulis encrasicolus ponticus*) having been validated for the first time. The catches for this stock are significant –

around 200 000 tonnes, accounting for nearly 20 percent of total catches in the GFCM area of application (Chapter 2). As a result, the percentage of catches assessed has risen significantly, following assessment of this stock.

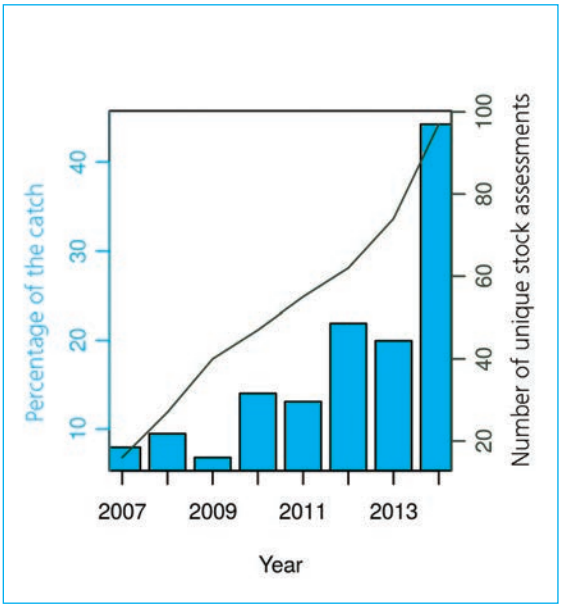


FIGURE 49
Number of stock units (blue line) and percentage of declared landings assessed in the period 2007–2014
Stock units are defined as a combination between species and management units (see text). Each stock unit is considered to have been assessed if assessment has been conducted at least once during the 2007–2014 period; stock units for which several assessments exist in the period are only counted once

There are regional differences in the extent of knowledge of stock status, with fewer stock units assessed in the Ionian Sea and eastern Mediterranean, compared with the western Mediterranean and the Adriatic Sea (Figure 50). The Black Sea comes somewhere in between, although the diversity of species in catches is lower (Chapter 2), therefore the percentage of catches assessed in this area is higher than in the Mediterranean (48 percent in the Black Sea, compared with 36 percent in the Mediterranean).

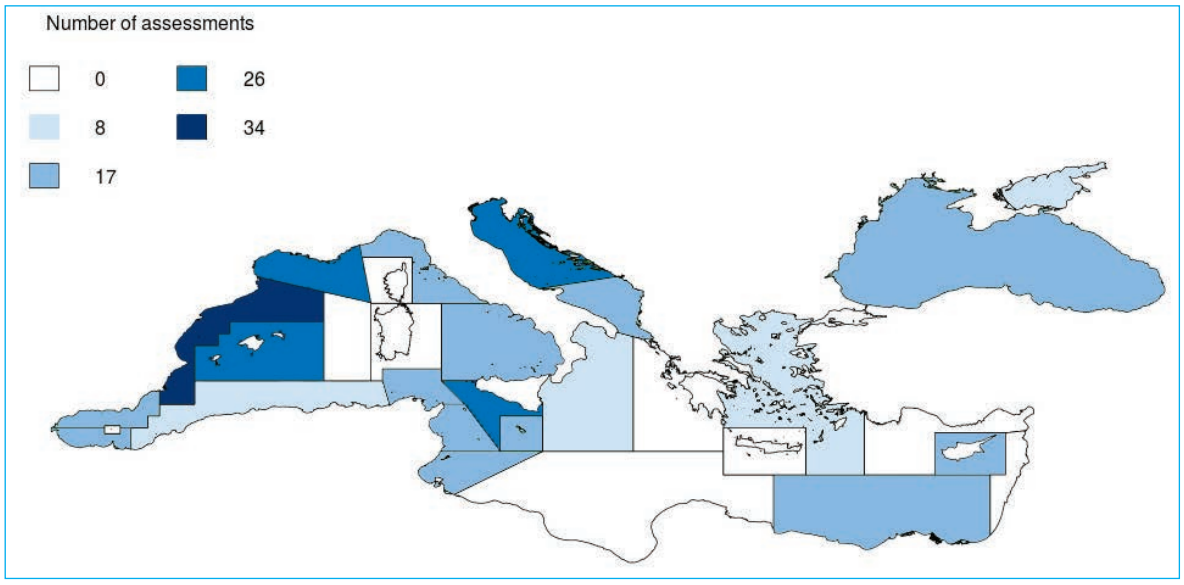


FIGURE 50
Number of validated assessments in the period 2007–2014 by GSA

5.4 OVERVIEW OF STATUS OF STOCKS IN THE MEDITERRANEAN AND THE BLACK SEA

The majority (85 percent) of stocks for which a validated assessment exist are fished outside biologically sustainable limits. Biomass reference points are not commonly available for assessed stocks; therefore this percentage is mainly estimated from the level of fishing mortality in relation to the fishing mortality reference point. Current fishing mortality rates can be up to 12 times higher than the target for some stocks of hake. Most stocks fished within biologically sustainable limits are of small pelagic species (sardine, anchovy or sprat), while only a few stocks of demersal species, such as whiting, some shrimp species, picarel and red mullet, are estimated to be fished at or below the reference point for fishing mortality (Figure 51).

Box 8 Estimation of stock status

Advice on the status of stocks is ideally based on a validated stock assessment model, from which indicators of stock status (e.g. biomass, fishing mortality, recruitment) are obtained, and reference points are agreed for the chosen indicators. When possible, analytical stock assessment models that incorporate both fishery-dependent (e.g. catches) and independent information (e.g. surveys) are used, although direct surveys are used for some stocks. Different stock assessment models are used in the GFCM area of application, including variations of virtual population models (from pseudo-cohort based models, such as VIT, to tuned versions, such as extended survivor analysis – XSA), statistical catch at age analysis (e.g. state-space assessment model – SAM or stock synthesis – SS3) and biomass models (BioDyn, two-stage biomass models, etc.). Some stock assessment methods are only based on information from scientific surveys at sea (e.g. survey-based assessment – SURBA, or acoustic estimates of biomass). When no analytical assessment model or reference points are validated by the SAC, advice can still be provided on a precautionary basis, in cases where there is evidence that the stock may be threatened (high fishing pressure, low biomass, habitat loss, etc.). When possible, advice on stock status should be based both on biomass and on fishing pressure, using indicators and reference points for both quantities. Although nearly all validated stock assessments have some reference points for fishing pressure, biomass reference points have not yet been agreed for a significant percentage of the stocks for which a validated stock assessment exist, especially in the case of small pelagic stocks. To allow comparison among the maximum number of stocks, only fishing mortality reference points are used in this report. A range of fishing pressure reference points is available for the GFCM assessments. For demersal stocks, the most common ones are $F_{0.1}$ or F_{MSY}, while for small pelagic stocks, the most common reference point is an exploitation rate (E = F/(F+M)) of 0.4 (Patterson, 1992). For the comparative analysis made in this report, F_{MSY} is used as the target reference point. For demersal species, when F_{MSY} is not available, $F_{0.1}$ is used as its proxy. For small pelagic species, F_{MSY} is estimated from Patterson's E=0.4 by using an estimate of natural fishing mortality. Natural mortality estimates are available for all small pelagic stocks for which an analytical assessment model exists, often by using the formula of Gislason *et al.* (2010). A full description of the GFCM framework for the provision of advice is available in the GFCM guidelines for the preparation of technical advice in support of management plans (OTH-GFCM/36/2012/4) and in the framework for describing stock status and providing management advice, approved by the SAC at its sixteenth session in 2014.

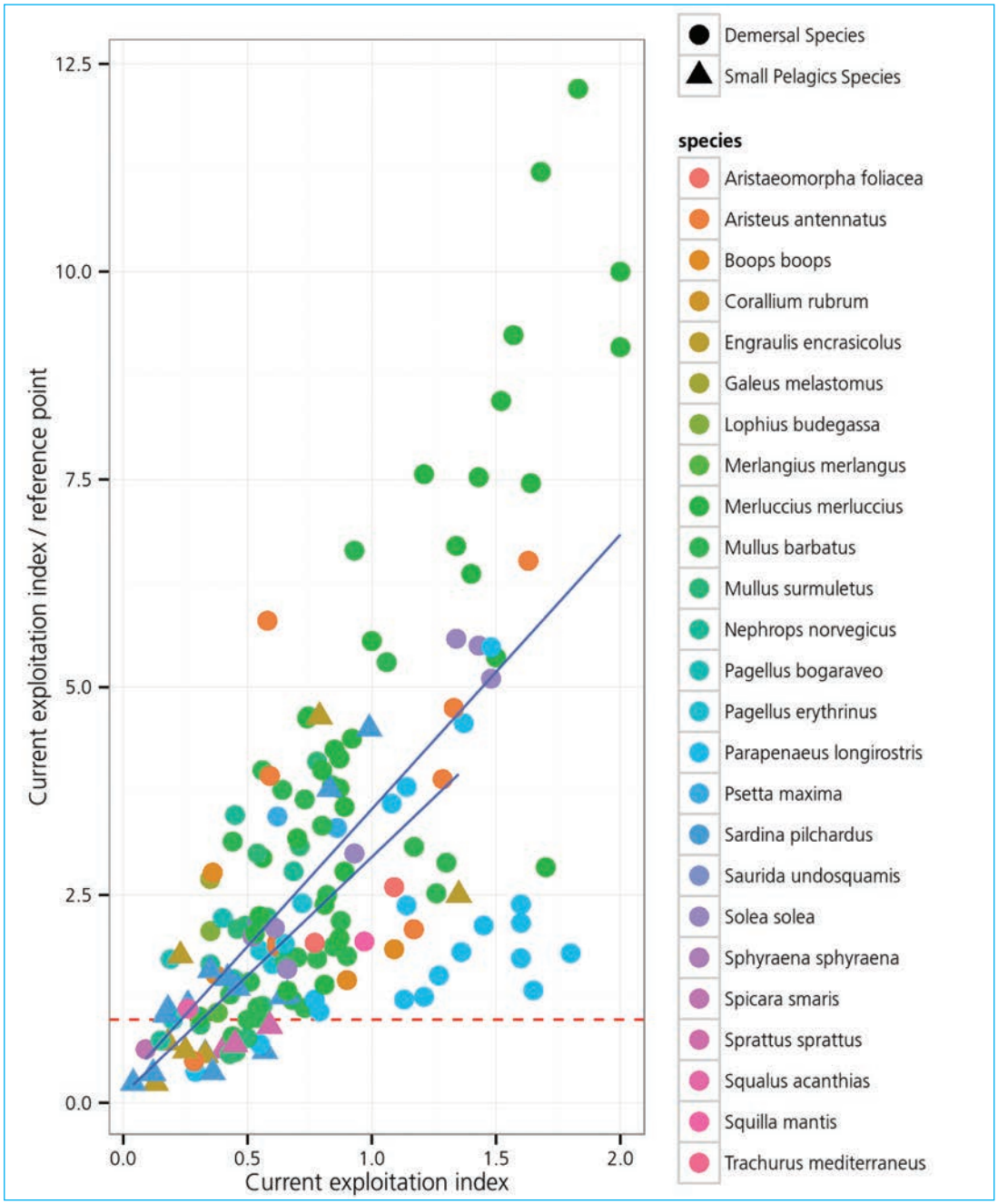


FIGURE 51
Overexploitation index (ratio between exploitation rate and target exploitation rate) for all stocks for which an assessment exists in the period 2007–2014
Colours denote the different species, with triangles representing small pelagic species and circles representing demersal species. Straight lines represent a linear model between F/FMSY ratio and F (upper line for demersal stocks, lower one for small pelagic stocks)

By species, hake is subject to the highest fishing mortality. On average, across the Mediterranean, the fishing mortality rate for hake is more than 5 times higher than the target fishing mortality level (Table 15). In the Black Sea, turbot has the highest fishing mortality rate, which is about 3.5 times higher than the target level. In general, demersal species suffer higher exploitation rates than small pelagic species, with the latter showing average fishing mortality rates that are close to the target. Only two species (sprat and picarel) have average fishing mortality rates that are close to the target, but in both cases the estimate is based on a single management unit and on few stock assessments.

Table 15 Average overexploitation index (ratio between current and target fishing mortality) for the main commercial species in the Mediterranean and the Black Sea

Species	Exploitation index
Merluccius merluccius	5.2056
Solea solea	3.5571
Psetta maxima	3.3761
Aristeus antennatus	3.1801
Galeus melastomus	2.6923
Mullus barbatus	2.6042
Aristaeomorpha foliacea	2.2601
Saurida undosquamis	2.1600
Parapenaeus longirostris	2.1406
Lophius budegassa	2.0647
Nephrops norvegicus	2.0299
Pagellus erythrinus	1.9529
Squilla mantis	1.9400
Boops boops	1.9084
Mullus surmuletus	1.8698
Pagellus bogaraveo	1.6482
Engraulis encrasicolus	1.5821
Sardina pilchardus	1.3905
Squalus acanthias	1.1304
Merlangius merlangus	1.0857
Sprattus sprattus	0.7500
Spicara smaris	0.6429

Overall fishing mortality for all species and management units combined is around 2.5 higher than the reference point. There is no clear trend for the average overexploitation ratio since 2007 (Figure 52), with a fluctuating average and a wide range of fishing mortality estimates around the average. An increase in the upper values of fishing mortality was observed between 2010 and 2012 (possibly related to the increase of validated assessments for hake, which often has a high mortality rate), while a reduction in average and extreme fishing mortality rates was estimated in 2014.

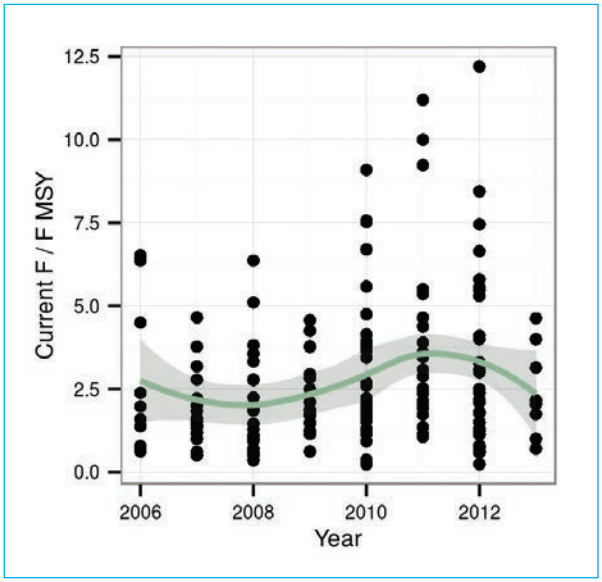


FIGURE 52
Ratio of current fishing mortality to target fishing mortality for all species and management units from 2006 to 2013
Solid line represents the average ratio, while shaded blue area represents the standard errors and dots represent the ratios for each given stock assessed in that year

5.5 FINAL REMARKS

There are several ongoing initiatives at the GFCM aimed at improving coverage (spatial and temporal) of advice on stock status, so as to obtain a more comprehensive view of the status of Mediterranean and Black Sea stocks, as well as their temporal trend. On the one hand, stock assessments carried out before 2007 are being digitalized and included in the database of stock assessments to enable an analysis of temporal trends of stock status. In addition, an initiative is under way to increase the number of stocks assessed, by using both data collected through the GFCM DCRF (Box 1, Chapter 1) and so-called data limited stock assessment methods. Results from these initiatives will be included in future assessments on the status of Mediterranean and Black Sea stocks.

Part 2

MANAGEMENT OF MEDITERRANEAN AND BLACK SEA FISHERIES

6.

Small-scale fisheries

©Carpentieri

6. Small-scale fisheries

6.1 INTRODUCTION

Artisanal or small-scale fisheries (see definition in Box 9) represent an important share of the fisheries sector in the Mediterranean and the Black Sea and the considerable role that they play in the region has long been recognized. Small-scale fisheries have the potential to make a significant contribution to food security, economic growth and rural development and to provide valuable employment opportunities. Furthermore, they are strongly anchored in local communities, reflecting often historic links with traditions, culture and values. Small-scale fisheries are a vibrant and multi-dimensional sector, where traditional local knowledge and cultural heritage coexist and are embedded in the surrounding environment. Moreover, they are important vectors of local knowledge and good practices and they have a relatively low environmental impact.

Box 9 Definition of small-scale fisheries

At present, the terms "artisanal fisheries" and "small-scale fisheries"[1] are often used interchangeably to refer broadly to a multi-faceted fisheries segment practised along coastal areas in the Mediterranean and the Black Sea, and indeed worldwide. Definitions vary between countries in the GFCM area of application. Small-scale fisheries are generally characterized by a large number of boats of low tonnage (between 1 and 4 tonnes), which are highly diversified and use selective low-impact fishing gear to target a wide variety of species. Fishers exploit areas that are usually very close to the coast where they live and shelter their boats. Small-scale fisheries usually require low capital investment, in contrast to industrial fishing, but they are an important source of income and make a significant contribution to food security, especially in coastal communities.

In the Mediterranean and the Black Sea, the small-scale fishery segment represents about 80 percent of the entire fleet (Chapter 1). Small-scale fisheries encompass a large number of fishing techniques, using more than 50 types of fishing gear, and they target numerous species, adapting to fishing seasons based on a rotational system. Landing sites are not restricted to fishing ports, but are usually widely distributed along the coasts, making it extremely challenging to perform monitoring, control and surveillance (MCS) activities. At present, small-scale fishers account for the main share of the active population operating in the region's fishery sector. It has been estimated that of approximately 250 000 people employed in the fishing industry, about 60 percent are working in the small-scale fisheries sector (Chapters 2 and 3). Small-scale fisheries activities are often family-based and linked to other sectors, such as food related services and tourism.

In 1980, in Resolution GFCM/15/1980/1, the GFCM called for "the definition of a national strategy indicating in particular the place of artisanal fisheries in management schemes". Although regional analysis in the Mediterranean and the Black Sea has been carried out periodically since then, several issues have not been fully addressed, due to the complexity of defining strategies that encompass small-scale fisheries in terms of monitoring, management

[1] In this document both definitions are equally used.

and sustainable development. This is even more true at present, since the fisheries sector is experiencing a systemic crisis and there is an urgent need for strategies that focus on small-scale fisheries through existing RFMO. Since 2003, FAO and other organizations have embarked on a process of awareness-raising on the key role played by small-scale fisheries for marginalized communities worldwide. In 2011, the FAO Committee on Fisheries (COFI) recommended the development of an international instrument – the Voluntary Guidelines for Securing Small-scale Fisheries in the Context of Food Security and Poverty Eradication (SSF Guidelines) – to complement the 1995 Code of Conduct for Responsible Fisheries (CCRF). The final text of the SSF Guidelines was endorsed by the thirty-first session of COFI in 2014. The SSF Guidelines are global in scope, with a special focus on the needs of developing countries. They aim to address small-scale fisheries issues at the national and regional level, with a view to contributing to sustainable development and to the achievement of the Millennium Development Goals (MDG)[2]. The SSF Guidelines outline a number of key guiding principles, described in detail below, which should become an integral part of regional, national and local policies, strategies and action plans to secure the sustainability of small-scale fisheries.

6.2 SMALL-SCALE FISHERIES IN THE MEDITERRANEAN AND THE BLACK SEA

Building upon the participatory approach used for the development of the FAO SSF Guidelines, a First Regional Symposium on Sustainable Small-Scale Fisheries in the Mediterranean and the Black Sea was organized from 27 to 30 November 2013 by the GFCM, in partnership with CIHEAM Bari, the FAO Fisheries Department including its regional projects, MedPAN and the WWF Mediterranean Programme. The SSF Symposium was hosted by the Government of Malta. The aim of the event was to provide a regional platform where the main recurring issues related to small-scale fisheries in the Mediterranean and the Black Sea could be duly addressed and all interested stakeholders could bring their opinions, ideas and expertise to the fore. The symposium was attended by more than 170 participants, including policy-makers, scientists, fishery representatives, civil society organizations, non-governmental organizations (NGO), research institutions and international organizations, who shared their views, opinions and experiences during the meeting.

The symposium was structured in following five thematic sessions covering priority issues of relevance to small-scale fisheries in the GFCM area of application: i) Current situation of small-scale fisheries in the Mediterranean and the Black Sea: strategies and methodologies for an effective analysis of the sector. ii) Management and co-management options for small-scale fisheries in the Mediterranean and the Black Sea. iii) Integration of small-scale fisheries in MPAs. iv) Enhancing small-scale fisheries value chains in the Mediterranean and the Black Sea. v) Setting up a regional platform to promote the implementation of the SSF Guidelines.

This chapter presents a summary of the information gathered at the SSF Symposium, as well as the salient conclusions developed from the meeting and drawn up by the GFCM Secretariat (FAO, 2015; Boxes 10, 11, 12, 13 and 14). It is expected that these outcomes will constitute the building blocks with which to steer strategic and programmatic actions in the near future, with the aim of improving the livelihood of local communities engaged in small-scale fisheries in the region through the sustainable exploitation of living marine resources.

6.2.1 Current situation of small-scale fisheries in the Mediterranean and the Black Sea: strategies and methodologies for an effective analysis of the sector

An analysis of the different aspects of small-scale fisheries at the national and subregional level, including in the Bulgarian and Romanian sectors of the Black Sea, in the Adriatic Sea, in the eastern Mediterranean, and in Albania, Cyprus, Egypt, Greece, Lebanon, Malta, Morocco and

[2] i) To eradicate extreme poverty and hunger; ii) To achieve universal primary education; iii) To promote gender equality; iv) To reduce child mortality; v) To improve maternal health; vi) To combat HIV/AIDS, malaria, and other diseases; vii) To ensure environmental sustainability; viii) To develop a global partnership for development

Tunisia, confirmed the socio-economic significance of the sector for the region and the need to improve its monitoring to support regional policies aimed at securing sustainable small-scale fisheries.

The wide distribution of landing sites for small-scale fisheries along coasts hinders the monitoring, control and surveillance of this fisheries sector. As a result, it is difficult to quantify the number of small-scale fishers and vessels in operation in the GFCM area of application. Information regarding fishing fleets is sparse. In particular, many small boats, and especially those without engines, are not registered. Moreover, information on capacity is often missing or, in the case of larger vessels, incorrect. In spite of these deficiencies, the data available indicate that the sector is of enormous importance to fisheries in the Mediterranean and the Black Sea, accounting for about 80 percent of the total number of vessels and for approximately 60 percent of the total number of people directly employed in the sector (Chapter 1 and Chapter 3). However, these estimates understate the importance of small-scale fisheries, since national statistics do not usually account for fishers without a boat or with non-motorized vessels, nor do they generally take account of the large population of occasional fishers, or fish workers involved in post-harvesting activities.

Small-scale fisheries have historically accounted for an important share of the fish caught in the GFCM area of application. With the industrialization of fisheries occurring during the second half of the last century, the relative contribution of small-scale production declined. According to the most recent data reported to the GFCM, catches from the sector currently represent a minimum of 14 percent of the total for the Mediterranean and the Black Sea (Chapter 2). Small-scale fisheries target a high variety of species, including demersal fish, crustaceans and some small and large pelagic species. Production is of high economic value, as the catch is generally sold fresh in local markets or directly to private consumers or restaurants, and in some cases is directly exported. It is estimated that the production of small-scale fleet segments represents about 20 percent of the total value of capture fishery landings in the region (Chapter 3). The limited monitoring of small-scale catches makes it difficult to evaluate the relative contribution of the sector to the exploitation of stocks assessed by the GFCM.

Small-scale fisheries are affected by a wide range of possible conflicts in the region. These are mainly related to competition with industrial fisheries for target species, space and markets, but also include aquaculture, other coastal users (e.g. the tourist industry, pollutant industries) and administrations (e.g. construction of big ports and other infrastructures).

For many small-scale fishers and fish workers, the sector represents a way of life and embodies a diversity and cultural richness that is of global significance. The sector is diverse and dynamic and its characteristics vary from one location to another. It tends to be strongly rooted in local communities, reflecting their traditions and values. Many small-scale fishers and fish workers (employed in associated jobs, in particular in fish processing, distribution and marketing) are self-employed and engaged both in directly providing food for their household and in commercial fishing, processing and marketing. The family not only offers support to fishers, but often provides the human capital needed for basic fishery-related activities. The active role of women in small-scale fisheries in GFCM countries is significant, and often fundamental. Small-scale fishers are usually organized in different types of professional and producer organizations or cooperatives.

As stated previously, despite its importance, information on small scale fisheries is scarce and it is difficult to conduct a comprehensive analysis of the state of these fisheries in the Mediterranean and the Black Sea. To fill this knowledge gap, various initiatives are planned at the regional level within the GFCM. Among requirements, it is worth citing the need to develop appropriate information systems and tools to collect and disseminate relevant data on the various dimensions of small-scale fisheries, and the need to create a Mediterranean network of small-scale fisheries organizations, building on existing organizations, with the objective of strengthening the role of small-scale fisheries in fisheries management and decision-making processes.

Box 10 Key actions recommended by the SSF Symposium to improve strategies and methodologies for an effective analysis of the small-scale fisheries sector

- Bridge gaps in data and information on small-scale fisheries, their interactions with other human activities and their socio-economic aspects, with a view to developing permanent national, subregional and regional databases and information systems, building on the lessons learned from case studies undertaken so far.
- Develop an information monitoring system to improve knowledge on small-scale fisheries and collect relevant data and information on the activities of the fleet, including parameters and synthetic indicators of social, economic and environmental relevance.
- Launch a survey on small-scale fisheries in Mediterranean and Black Sea countries to provide a detailed status of small-scale fisheries.
- Recognize the socio-economic specificities of small-scale fisheries, as well as seasonal and unstable features of the sector, in order to enable investments for their development, to improve the human conditions of the people involved and eradicate poverty.
- Include small-scale fisheries in national fisheries management plans and MCS activities to deter IUU fishing, identify fishing grounds and address aspects such as safety at sea, while building capacity and raising awareness among stakeholders.

6.2.2 Management and co-management options for small-scale fisheries in the Mediterranean and the Black Sea

There is consensus in the region that participatory management and multi-level governance approaches are necessary to strengthen small-scale fisheries in the Mediterranean and the Black Sea. This view has been motivated by different factors, including the current state of overexploitation of a significant percentage of marine living resources, the lack of government resources to fully implement and enforce management measures, especially for coastal fisheries, and recognition that small-scale fisheries are in many cases excluded from management processes, despite their substantial importance in the region.

In this context, decentralization and co-management seem to represent viable governance alternatives for small-scale fisheries in the GFCM area of application. Co-management covers a wide range of collaborative decision-making mechanisms between government and communities or user groups, and enables the sharing of responsibility and authority at different levels of fisheries management. It is a dynamic partnership based on the capacities of both local fishers and communities and on the state's ability to provide enabling policies and legislation, enforcement and assistance with the participation of civil society and scientists.

Co-management has proved to be crucial to ensuring the proactive participation of fishers in setting-up fisheries management plans that account for local institutional arrangements and knowledge. Involving fishers in data collection, the identification of management measures, monitoring and control, helps to raise their awareness about the environment, enhance their sense of ownership and stewardship over resources and increase commitment and compliance to rules and regulations.

Some experiences have shown that the co-management approach has already been adopted successfully in the Mediterranean and the Black Sea. On the Mediterranean coast of France, professional organizations of fishers, known as *prud'hommies,* have been present since medieval times and currently comprise large numbers of small-scale fishers, who together work on more than 1 500 fishing vessels. The work of these organizations typically covers fishing grounds within 12 miles of the coast and generally focuses on issues of regulation and conflict resolution, both internally among members and externally. Historically, these institutions were efficient in keeping their fisheries sustainable and economically viable, mostly by regulating gear authorization and

characteristics, sharing space between fisheries in coastal salty ponds and setting fixed dates for the start and end of fishing seasons. Their role in fisheries management seemed to weaken with the establishment of committees of marine fisheries and the priority given to the development of trawling fleets in the 1970–1980s. In spite of this trend, the community fishers' organizations are still in existence and they continue to ensure that national and European regulations remain relevant and appropriate for small-scale multi-species fleets.

Fishers' guilds in Spain, named *cofradias*, also have a long history of fisheries management. In general, the *cofradia* is the institutional system for 83 percent of fisheries employment in Spain, bringing many benefits for members. Today, 229 *cofradias* are spread out along the entire Spanish coastline and throughout the islands. Most of these have different organizational structures and operational methods, but in general they have the following key characteristics:(1) They include nearly all fishers working in their geographical area; (2) They have a democratic structure with two equally represented groups: the owners and the crew; (3) They are disaggregated by gear, where trawl is usually the most important, followed by purse seines, longlines, or shell gathering; (4) Members should only sell their catch through the local first sale port market of their own *cofradia*, with a sales fee to cover administrative costs; (5) They are not-for-profit and any surplus is used to improve infrastructures and equipment, or is sometimes distributed among members; (6) Under the general laws and rules established by the European Commission, Spanish ministry and autonomous communities, *cofradias* can establish their own rules, such as control of fishing seasons; they can ban fishing gear in specific areas and accept new members or suspend current ones; (7) They present evolved systems of control, surveillance and enforcement; for example, all members can participate in the surveillance of collective agreements and the transgressor is punished in real time at the market: their products cannot be sold in the market or he/she is forced to sell last (with lower prices). Another penalization system is social isolation or lack of provision of collective services (shops, ice, bar, etc.).

Other examples in the Mediterranean where co-management, or at least some elements of it, are present include local cooperatives in Turkey, the management of coastal clam fisheries in Italy, the *Grenelle de la Mer* in France, and the co-management committee of the Catalan sand eel fishery.

Independent of the social-ecological conditions of the fishery, or whether it is centrally or co-managed, there is a need to collect information to assess the state of the resource, as well as to monitor whether fishing regulations are effective to maintain the long-term sustainability of the resource and the livelihoods of those depending on it. For co-managed fisheries, it is critical to determine in advance who will have financial responsibility for various aspects of a monitoring programme, and in most cases, to consider requirements for fishers to fund at least a portion of the management and monitoring costs. Community-based data collection programmes (CBCP), where fishers are trained to collect fishery dependent and independent information, are a cost-effective way of collecting data to assess the status of the resource and monitor the fishery. These CBCPs are usually more feasible and effective under strong co-management regimes, improving the quality and quantity of relevant fishery information by enhancing spatial, temporal and categorical resolution, as well as significantly reducing the financial cost of data collection. Indeed, CBCPs are probably the most efficient way of overcoming widespread problems of inadequate data in the small-scale fisheries sector.

With regard to control, the establishment of co-management arrangements allow fishers to assume greater responsibility in complying with MCS mechanisms and reduces the responsibility borne by management authorities. In some co-managed small-scale fisheries, the strengthening of local institutions has led to the implementation, by fishers themselves, of effective MCS procedures. These have reduced governmental enforcement costs and increased the effectiveness of management strategies based on the control of catches and effort, contributing to the overall sustainability of the fishery. An existing enabling legal environment is essential in efforts to both sustain existing local level fisheries management systems and/or to develop new co-management systems. Although there are many features that can contribute to

effective policies and legislation for implementation of co-management schemes, the existence of specific legal frameworks is not a prerequisite for co-management *per se*. On the contrary, political will is key to the establishment of co-management mechanisms. This is a fundamental prerequisite, without which co-management initiatives are unlikely to succeed. Political will must also be reflected in attitudes and demeanour, as well as in support within policy, legislation and actions specific to the fisheries sector.

Finally, capacity-building initiatives to empower fishing communities and other actors, so that they can actively participate in fisheries co-management, are also crucial for effective co-management. Capacity-building initiatives can facilitate understanding of what co-management entails, and how stakeholders can organize themselves to participate proactively. It can also provide knowledge and information about existing environmental problems, needs, constraints and opportunities affecting the fishery, as well as fostering participatory and communication skills and providing other tools to support collective action.

In conclusion, co-management has the potential to become an effective delivery mechanism for sustainable fisheries in the Mediterranean and the Black Sea. Joint multi-stakeholder decision-making results in increased adherence by fishers to rules for the sector, and in a stronger sense of ownership. Additionally, co-management committees can foster community-based data collection programmes, gather valuable traditional environmental knowledge and involve fishers in MCS activities, thereby reducing costs and increasing efficiency. Overall, co-management allows for the adaptive management of fishing activities tailored to specific local realities. However, for co-management to succeed, there is a need for more experience and an adequate flow of information on lessons learned and capacity-building programmes, so as to enable different stakeholders to acquire essential skills.

Box 11 Key actions recommended by the SSF Symposium on management and co-management options

- Support the implementation of co-managed fisheries, including through a critical analysis of available case studies, the compilation of best practices and wide dissemination of main achievements.
- Promote in a participatory way the creation of an active network of fisheries co-management pilot projects in the GFCM area of application, which should ideally include, on the basis of the proposed regional programme on small-scale fisheries, at least one per country and ensure an equitable geographical coverage at the subregional level.
- Evaluate capacity-building needs for fisheries co-management based on lessons learned, including support to community-based data collection programmes and MCS.

6.2.3 Integration of small-scale fisheries in marine protected areas

MPAs are a type of spatial management measure that has received increased attention in recent decades for its potential role in marine conservation and sustainable fisheries. Different types of MPAs exist in the Mediterranean and the Black Sea, with distinct objectives and levels of protection. Some MPAs are exclusively aimed at managing fisheries, such as the French "fisheries reserves", which focus on the management of small-scale fisheries. More commonly, however, MPAs have been used as a conservation measure to protect the environment and its resources from sources of degradation and biodiversity loss, including the negative impacts of some fisheries and coastal development. In some cases, MPAs are completely closed to fisheries and some other human activities, and while no-take zones can effectively guarantee greater protection, they often cause opposition from fishers who are excluded from working in those

areas. Recently, there has been a tendency for more moderate approaches to MPAs, which consider the socio-economic dimensions of the protected area and the associated benefits of multiple uses.

MPAs have a particular relevance for small-scale fisheries in the Mediterranean and the Black Sea. Small-scale fisheries have a strong territorial basis, operating in coastal areas relatively close to their landing place, within the limits of a very narrow continental shelf. In these coastal areas, small-scale fisheries face many different types of threats resulting from conflicts with industrial fisheries, coastal development and recreational activities and with nature conservation projects that modify the access of fishers to their traditional fishing areas. In this context, the establishment of MPAs can affect small-scale fisheries in different ways. If, on the one hand, MPAs can help secure small-scale fishing in coastal areas by regulating access by different stakeholders or generating positive long-term effects on the stocks, they can also be a source of insecurity when established without taking into account the territorial nature and dynamics of small-scale fisheries. As a result, there are specific issues and prospects for cooperation between small-scale fisheries and MPAs, which justify the integration of small-scale fisheries in the planning of MPAs.

Several studies around the world, including in the Mediterranean, have demonstrated the potential positive biological effects of no-take MPAs. Effects such as an increase in the size of organisms, biomass and density of populations and diversity of species are commonly reported inside no-take zones. In some circumstances, spillover effects in areas outside a no-take zone have also been reported. Far less is known about the biological/ecological effects of multi-use MPAs, since fewer studies have been conducted on this aspect. These are also much less obvious because an area is ecologically protected, but also managed with a view to economic sustainability, where regulations prevail over bans. From a fishery viewpoint, MPAs can result in different costs and benefits. MPA costs are related to the regulatory constraints associated with its existence, including technical and spatial bans over time, limitations, authorizations, loss of working territory, costs relating to MPA monitoring and supervision, smaller catches (at least in the short term) and activity transfer to/concentration in unprotected adjacent areas, which could lead to increased conflicts. Also, since an MPA may or may not voluntarily favour certain types of fisheries (e.g. fisheries using selective gear), these costs will not be necessarily be the same for all. On the positive side, by protecting stocks and critical habitats, MPAs can lead to increased catches and rent in the long term, both within and outside the reserve (given spillover effects), and create a buffer against the risk of overfishing and other anthropogenic impacts on stocks. Other potential positive effects include the increased participatory management of areas under protection, as well as the possibility of developing – or diversifying – alternative activities to fisheries (e.g. tourism, crafts, etc.).

In analysing the challenges and opportunities offered by integrating small-scale fisheries within MPAs, it is important to consider the differences and synergies between fisheries and MPA governance. It was noted that fisheries governance has evolved alongside that of MPAs. Initial methods were based on a conservationist (preservation of spaces/emblematic species) or single-species approach (management per stock or groups of stock exploited by industrial fleets). Progressively, there has been a shift from a top-down approach to governance of both MPAs and fisheries towards a mix of top-down and bottom-up approaches, attributing a more important role to actors and other non-governmental stakeholders in decision-making processes. The result, for both ideological and practical reasons, has been a more dynamic and participatory system of governance. This change has strongly contributed to a mutual understanding between fishing and environmental governance, especially regarding the implementation of internationally agreed requirements, such as the ecosystem-based approach and the precautionary approach. Examples of successful integration of MPAs and small-scale fisheries management in the Mediterranean are: the marine extension to the Taza national park (Algeria), natural reserves of Bonifacio and Scandola (Corsica, France), the Côte bleue marine park (France), Torre Guaceto MPA (Italy), the Portofino MPA (Italy), the North Sporades marine park (Greece) and networks of

fishing reserves in the Spanish Mediterranean. In spite of these examples, there is a generalized lack of studies addressing ecological and socio-economic aspects of small-scale fisheries management in Mediterranean MPAs.

Finally, with the objective of contributing guidance for the optimal and sustainable integration of small-scale fisheries within MPAs, it is helpful to highlight some of the main expectations of small-scale fishers and managers with respect to MPAs. These include: avoiding worsening regulatory and spatial constraints regarding access to and use of fishery resources; improving the quality/resilience of natural environments acting similarly and complementarily on other causes of damage to the marine environment (e.g.: on pollution or tourism pressure) and fish mortality; developing tools to improve the productivity of the marine environment (e.g. artificial reefs as means of compensation); maintaining the versatility of fishing units, in terms of techniques used, target species, seasons and fishing areas; encouraging conservation of coastal area in favour of small-scale fishing (priority area for access and use); improving planning/decision-making mechanisms in terms of fisheries and MPAs.

Some of the main expectations of MPA managers towards small-scale fisheries include: agreement on the joint management of fisheries based on knowledge, sustainability principles and transparent, constructive discussions (including with enforcement and surveillance bodies); discussions and proposals to value the diversity of fishing units, the diversification of fishing activities and the quality of products (including labels); concrete and equitable recommendations for management of conflicting uses such as tourism (e.g. diving) and recreational fisheries; promotion of MPAs as a positive tool to jointly manage fisheries and the habitats on which they depend.

Box 12 Key actions recommended by the SSF Symposium to better integrate small-scale fisheries in MPAs

- Enhance a participatory and bottom-up approach that is inclusive of small-scale fisher communities in all phases leading to the establishment of MPAs, and promote a stronger involvement of small-scale fishers in MCS, so as to manage MPAs more effectively by developing a sense of ownership and responsibility.
- Facilitate the development and implementation of a work plan aimed at the adequate management of resources in and around MPAs, actively involving small-scale fishers and fisheries managers, as well as relevant institutions (i.e. the GFCM and other national and international bodies as per their mandate) and other partners in the implementation of the proposed regional programme on small-scale fisheries.
- Ensure that the network of MPA managers in the GFCM area of application contributes to facilitating cooperation between MedPAN and small-scale fishers' platforms with the support of the GFCM, to strengthen understanding, capacity-building, relationships and synergies required for effective participatory processes and/or co-management mechanisms for the conservation of marine ecosystems.

6.2.4 Enhancing small-scale fisheries value chains in the Mediterranean and the Black Sea

Generally, a value chain is defined as a sequence of activities conducted by different organizations involved in production/farming, processing, marketing, distribution, sale, consumption and disposal of consecutive units and steps. Passing through the chain, the product gains value. The chain of activities as a whole gives the product more added value than the sum of independent activities. A value chain perspective of the small-scale fisheries sector can reveal response strategies that enhance the sustainability and competitiveness of the entire value chain and the economic agents that comprise it. Such a perspective is of crucial importance to developing

policies that safeguard the interests of small-scale producers, not only by enabling them to access national, regional and/or international markets, but also to obtain prices and margins that let them achieve long-term sustainability from an economic, social and biological resource standpoint.

Value chain analysis can help to understand and identify the binding constraints that affect the sector in a systematic manner. Some aspects of value chain analysis that are of relevance to the fisheries sector have been highlighted. At its most basic, a value chain analysis can map the economic agents involved in the production, distribution, marketing and sales of a particular product. Value chain analysis can play a key role in identifying the distribution of benefits to economic agents in the chain. For instance, studies have shown that the majority of benefits generated by a value chain are captured by the retail, wholesale and secondary processing sectors of the fish industry. A value chain analysis can also be used to examine the role of upgrading within the chain, including an assessment of the profitability of actors within the chain, as well as information on current constraints. Finally, a value chain analysis can highlight the role of governance in a value chain. This refers to the structure of relationships and coordination mechanisms that exist between economic agents in that value chain. Governance is important from a policy perspective, through identification of the institutional arrangements that may need to be targeted in order to improve capabilities in the value chain, remedy distributional distortions and increase value added in the sector.

The market both provides for and restricts livelihood opportunities for small-scale fishers. Constraints to market access include weak bargaining power and poor marketing strategies, monopolies among traders, poor product holding infrastructure, difficulties in meeting quality standards and lack of market information. In the case of specialized traders, fishers often have little, if any, control over marketing outlets and the prices that they receive. Relations and potential inequalities between fishers and traders point to the need to find better ways to address these issues, so as to increase the return received by fishers and to better sustain fisheries resources.

In this context, several potential strategies for adding value to small-scale fisheries production include product diversification and differentiation, labelling and shortening distribution channels, so to bypass intermediaries in the value chain. For instance, a proposal was made for the creation of a collective brand for the differentiation of fish products from small-scale fisheries in the region of Emilia-Romagna (Italy). However, a feasibility study demonstrated that the initiative had little chance of success, partly due to the high impact of short-run commitments, compared with the expected benefits and uncertainties about consumer response.

Different forms of cooperation to address management and marketing issues are also emerging and a number of examples of projects and ongoing cooperative arrangements of relevance to small-scale fisheries exist in the Mediterranean. Cooperation in fisheries is considered essential for an efficient allocation of production, as well as for optimal management of resources and negotiation with buyers. However, it has been noted that these outcomes are rarely achieved due to several factors, such as uncertainties in resource potential, difficult relations in the exploitation of common resources, lack of controls and high coordination costs.

Another observation is the importance of considering the diversification of fishers' livelihoods and of recognizing the multi-functionality of fishing activities in strategies for the sustainable development of small-scale fisheries. While multi-functionality refers to existing non-trade benefits of fisheries, that is, benefits other than commerce and food production (e.g. environmental, territorial and social functions), diversification involves fishers opting to change something in their economic activity, by undertaking new work outside the fisheries sector, such as ecotourism).

Reviewing experiences from case studies in the southern Mediterranean, lessons learned that are of general relevance to small-scale fisheries in the region are:

- Long-term poverty reduction can only be achieved by increasing the value of catches, as opposed to their quantity.

- Efforts cannot be applied to the targeted stocks alone; instead, there is a need for a more holistic approach, which takes into account key and related ecosystems.
- Intervention should occur at all stages: when resources are still in the water, when they are landed, and as they enter the transformation and marketing cycle.
- Small-scale fishers are almost always better off when they organize and form cooperatives. These cooperatives in turn must be supported by local, regional and national authorities, and be provided with significant capacity building.
- Regional lesson sharing is key, as illustrated by the case of artificial reefs, where the approach adopted in Morocco was initially piloted in Tunisia, for similar fisheries.
- Since these initiatives are complex and interrelated, different donors must cooperate, so as to avoid overlap and gaps.

The multi-dimensional nature of poverty in small-scale fishing communities, including low incomes and other factors that impede full enjoyment of human rights, is an acknowledged fact. Small-scale fishing communities are commonly located in remote areas and tend to have limited or disadvantaged access to markets, and may have poor access to health, education and other social services. The opportunities available are limited, since small-scale fishing communities may face a lack of alternative livelihoods, as well as youth unemployment, unhealthy and unsafe working conditions, forced labour and child labour.

Increased responsibility of fishers' organizations for co-management objectives (also achieved through new forms of territorial rights) is an important step for the sustainable development of small-scale fisheries. However, this technical-productive approach will probably be insufficient to guarantee the economic competitiveness of small enterprises, without common marketing strategies and forms of vertical and horizontal cooperation.

Given the fragmentation of the upstream sector and the imbalance of bargaining power between large marketing firms and fisheries operators, the role of cooperatives and fishers' associations assumes greater importance. The benefit accrues not only in the form of concentration of supply, but also as an institution that can support individual producers in the process of adaptation and promotion of fishery products through the mechanisms of supply chain coordination, implementation of the quality system and labelling.

Local strategies for an integrated development of coastal areas should imply the active participation of partnerships, including public and private actors. Fishers must be key actors in this process, and an empowering strategy is necessary to develop their potential in both economic and social terms. Bottom-up approaches should consider the needs of both men and women and should be participatory with regard to needs assessments, design, implementation and monitoring. However, the development of coastal areas should not be exclusively left to local initiatives.

From a broader perspective, small-scale fishing communities need access to the full spectrum of financial, social and institutional services and resources, so as to sustain their livelihoods, and public organizations should support investment in human resource development such as health, education, literacy and other skills training. The scale and priorities of this state intervention may change considerably, depending on location (i.e. northern vs. southern coasts of the Mediterranean, urban vs. rural areas). However, public institutions should ensure that small-scale fishing communities have access to essential public services, starting with decent housing, sanitation, potable water and electricity. Small-scale fishers and fish workers should also be covered by unemployment insurance and social security schemes, with benefits that equal those of other professional groups in the country.

In order to coordinate institutional (i.e. national and international) development strategies and local initiatives, public interventions should provide adequate extension and advisory services for supporting small-scale fisheries governance and development. For this reason, the development and support of small-scale fisheries, even if adhering to different legislative paths and conceptual frameworks of the various Mediterranean and Black Sea riparian States, should

follow a common operational approach, so as to converge on shared goals and solutions and guarantee successful local strategies in the coastal areas of the Mediterranean and the Black Sea.

A common development policy for small-scale fisheries that sees the participation of all countries in the Mediterranean basin would surely and concretely facilitate the overcoming of difficulties and would strengthen support tools within the different coastal areas of the Mediterranean.

Box 13 Key actions recommended by the SSF Symposium to enhance small-scale fisheries value chains

- Support private and public stakeholders in the sector in acquiring better knowledge on local and regional value chains, particularly in connection with issues relating to the creation of added value and revenue distribution through the implementation of good practices/quality systems, eco-labelling, enhancing human resources and concerted actions with local and regional authorities/organizations.
- Identify the needs of Mediterranean and Black Sea countries for an educational and scientific programme, while supporting national institutions in the implementation of actions to empower fisheries coastal communities, highlighting the importance of multi-functionality and diversification activities.
- Set up technological information systems and networks to obtain and share information and policies on multi-functionality, diversification and supply chains and assist decision-makers in the development of strategies on small-scale fisheries at national and regional level.
- Lay the basis, through the proposed regional programme on small-scale fisheries, for integrated horizontal and vertical coordination, with special emphasis on north-south interactions throughout the global supply chain, including via strengthening the role of regional organizations and identifying best practices for professional stakeholders.
- Encourage the creation of cooperatives and consortiums of professionals, namely to enable direct sales.

6.2.5 Setting up a regional platform to promote the implementation of SSF Guidelines

The SSF Guidelines were endorsed by COFI in 2014. While the approval of the instrument itself is of critical importance, the real challenge lies in its implementation. For this, concerted efforts and strong collaboration by all parties across the world will be required.

The SSF Guidelines are intended to support the visibility, recognition and enhancement of the important role of small-scale fisheries and to contribute to global and national efforts towards the eradication of hunger and poverty. They apply to small-scale fisheries in all contexts, to all actors – men and women – throughout the value chain. They are global in scope, but have a specific focus on the needs of developing countries.

The SSF Guidelines are based on international human rights standards, responsible fisheries governance and sustainable development according to the Rio+20 outcome document *The future we want*. The SSF Guidelines are closely linked to the Voluntary Guidelines on Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security (the Tenure Guidelines), endorsed by the FAO Committee on World Food Security (CFS) in 2012. The Voluntary Guidelines on the Progressive Realization of the Right to Adequate Food in the Context of National Food Security (the Right to Food Guidelines) are another important international instrument. This was adopted by FAO member States in 2004 and considers economic, cultural and social rights as an integral part of the work of food and agriculture agencies.

The SSF Guidelines outline an important number of key guiding principles that will underpin their implementation: human rights and dignity; respect of cultures; non-discrimination; gender equality and equity; equity and equality; consultation and participation; rule of law; transparency; accountability; economic, social and environmental sustainability; holistic and integrated approaches; social responsibility; feasibility and social and economic viability.

The SSF Guidelines address five main thematic areas: i) Governance of tenure in small-scale fisheries and resource management; ii) Social development, employment and decent work; iii) Value chains, postharvest and trade; iv) Gender equality (cross-cutting); and v) Disaster risks and climate change (cross-cutting). The guidelines also cover four areas related to creating an enabling environment and supporting implementation: i) Policy coherence, institutional coordination and collaboration; ii) Information, research and communication; iii) Capacity development; and iv) Implementation support and monitoring.

With regard to the SSF Guidelines implementation and future work, two international workshops, organized by FAO in Rome, have provided specific recommendations:

- The Workshop on international guidelines for securing sustainable small-scale fisheries, held in February 2012, noted the need for an integrated approach. The preparation and implementation of the SSF Guidelines should not be seen as separate events, but as an integral part of other initiatives. There is a need to build bridges between different stakeholder visions – within the fisheries sector as well as outside – to ensure coherence. Partnerships will be essential in this context and implementation will require concerted efforts and organizational development and strengthening of capacities at all levels.

- The Workshop on strengthening organizations and collective action in fisheries: a way forward in implementing the international guidelines for securing sustainable small-scale fisheries, held in March 2013, explored the roles of different types of fisheries collective action and cooperative organizations and proposed elements for a capacity development strategy to strengthen organizations and collective action in small-scale fisheries. A number of different types of collective action and cooperative organizational forms were explored. These included customary community-based organizations, cooperatives and societies, and advocacy groups and networks. The workshop recognized that organizations provide a platform through which small-scale fisheries' stakeholders exercise their right to organize, participate in the development and decision-making processes and influence fisheries management outcomes.

In September 2013, a meeting was organized by the FAO subregional office in Tunisia, in collaboration with local partners, to discuss the strengthening of small-scale fisheries organizations in North African countries. The meeting was attended by participants from Algeria, Libya, Mauritania, Morocco and Tunisia and it showed the interest of stakeholders in developing capacity to be able to position themselves at the national, regional and international levels and to identify common regional objectives.

Several topics need to be taken into consideration for the implementation of the SSF guidelines in the region: i) Understanding the key challenges, opportunities and strengths for small-scale fisheries in the region and the peculiarities of each country and location; ii) Identifying the current situation and needs in terms of access to basic economic, social and cultural rights, as well as experiences and challenges in applying a human rights approach to fisheries in the region; iii) Understanding key social and economic development issues for the sector and existing good practices with regard to integrated approaches to fisheries that can inform SSF Guidelines implementation, and iv) Understanding national experiences of collective action and organizations and the needs for organizational strengthening, including through capacity development and the creation of regional and subregional associations.

Experience with implementation of the FAO-ArtFiMed project on small-scale Mediterranean fisheries in Morocco and Tunisia showcased various possibilities for achieving sustainable development in the sector. The project implemented a holistic approach that combines actions in support of small-scale fisheries management and social development. It promoted co-management and participatory mechanisms, supporting the creation of alternative livelihoods

and encouraging social and gender equality and equity, based on training to develop expertise and human capacity.

With regard to organizations and collective action, the Mediterranean Platform of Artisanal Fishermen (MedArtNet), an organization for artisanal fishers in the European Mediterranean, should be considered as a tool to support the implementation of SSF guidelines in the Mediterranean. The mission of MedArtNet is to promote, encourage and defend responsible and sustainable small-scale fishing as a dynamic feature of coastal communities in the Mediterranean. There are six main strategic objectives: i) Representation and participation in the decision-making process and promotion of co-management; ii) Development of a sustainable activity in all its dimensions (economic, social and environmental); iii) Social recognition; iv) Recognition of local ecological knowledge; v) Fair trade committed to the sea; and vi) Dissemination, awareness and cooperation. One of the main achievements of the organization has been to ensure the representation of the small-scale fisheries sector in national and international political forums. In the area of fisheries management, the organization has actively fostered the development of co-management arrangements for small-scale fisheries. MedArtNet has also supported various scientific projects and trade strategies (with cooperatives and catering companies in Catalonia, Spain) for small-scale fisheries products.

Despite its importance, the small-scale fisheries sector suffers from low visibility, and the success of the SSF Guidelines will ultimately depend on the possibility of ensuring increased recognition of, and attention to the sector's importance. Implementation of the guidelines will require concerted efforts on the part of a wide range of actors, as well as political will and resources. Civil society organizations (CSO) – representing fishers, fish workers and their communities – governments, NGO, research institutions and other stakeholders are therefore called upon to support this process. In this context, there has been recognition for efforts by FAO and other partners to promote and support small-scale fishers and fish workers' organizations. Collaboration, communication and sharing of experiences and knowledge should define future actions to be undertaken.

Box 14 Key actions recommended by the SSF Symposium to set up a regional platform to promote implementation of the SSF Guidelines

- Increase the visibility of small-scale fisheries actors and facilitate the engagement of CSO and other stakeholders in the implementation of the SSF Guidelines.
- Integrate the provisions of the SSF Guidelines in regional, national and local policies, strategies and action plans, taking into account the need to consider responsible fisheries in parallel to social and economic development and to apply a human rights-based approach, and allocate adequate human and financial resources for their implementation.
- Support the establishment and development of organizations and networks created for and by small-scale fisheries actors and have clear and shared objectives as well as adequate funding to transform shared concerns and problems into shared solutions.
- Facilitate the establishment of regional confederations to gather relevant professional organizations and platforms.
- Promote the inclusion of both men and women in decision-making processes, develop community-based monitoring and evaluation systems, ensure the collection of gender disaggregated data, support women's organizations and work towards gender equality.
- Work together within the remit of the proposed regional programme on small-scale fisheries to create and support, following a participatory approach, one or more platforms of small-scale fishers and fish workers for enhanced communication and information to support small-scale fisheries and the implementation of the SSF Guidelines.

6.3 FINAL REMARKS

There is widespread interest in securing sustainable small-scale fisheries in the Mediterranean and the Black Sea, consistent with the CCRF, as well as with commitments taken within the framework of the United Nations Conference on Sustainable Development (Rio+20 Conference) and with the 17 Sustainable Development Goals[4] (SDG) which incorporate 169 targets, including a pledge to "provide access for small-scale fishers to marine resources and markets" (Target 14b of Goal 14 – Conserve and sustainably use the oceans, seas and marine resources for sustainable development).

Strong political commitment, intergovernmental cooperation and technical assistance for Mediterranean and Black Sea riparian States are therefore urgently needed. New transversal governance and management approaches to small-scale fisheries must be developed and translated into actions underpinning the consolidation of the knowledge base, data collection and analysis, management and co-management mechanisms and integration with environmental objectives, including MPAs.

Given the success of the of the SSF Symposium and the adoption (June, 2014) of the FAO SSF Guidelines, a first regional programme on sustainable small-scale fisheries in the Mediterranean and the Black Sea (2014–2018) was endorsed by the GFCM at its thirty-eighth session (May 2014, FAO headquarters). This regional programme should build on the outcomes of the SSF Symposium to develop specific projects aimed at promoting the successful management of small-scale fisheries in the Mediterranean and the Black Sea, delivering on the ecosystem approach to fisheries (EAF), while improving the livelihoods, economies and food security of coastal communities.

In parallel, the GFCM has also introduced significant changes in its institutional and legal framework to increase the focus on small-scale fisheries and local communities, and has launched a comprehensive data collection tool that provides for the annual submission of its contracting parties of data on small-scale fisheries.

[4] Resolution A/RES/70/1, September 2015.

7.

Conservation measures

7. Conservation measures

7.1 INTRODUCTION

A principal objective of the GFCM is to promote the management, conservation and sustainable use of living marine resources in the Mediterranean and the Black Sea. To achieve this aim, the Commission has, among other duties, the responsibility to formulate and adopt appropriate measures for the conservation and rational management of living marine resources. It also has a mandate to ensure the appropriate implementation of and compliance with these measures.

Over the years, various measures have been adopted by the GFCM, with the aim of achieving sustainable levels of fishing pressure and safeguarding habitats and endangered species from the impacts of fishing activities. More recently, the GFCM has started to develop management plans with specific objectives (sustainable exploitation, healthy target stocks and associated species, etc.). These are discussed in a separate chapter (Chapter 8), due to their complexity and importance for the area. In this chapter, all other conservation-related decisions are summarized according to the following categories: 1) spatial management measures; 2) mitigation measures for the incidental catch of vulnerable species, and 3) other technical conservation measures. In addition to these conservation initiatives, the GFCM also implements all International Commission for the Conservation of Atlantic Tunas (ICCAT) measures of relevance to the regulation of tuna fisheries in the Mediterranean and the Black Sea. A concise summary of the recommendations on conservation and management measures adopted by the GFCM to date is presented in Table 17.

7.2 SPATIAL MANAGEMENT MEASURES

Aware of the potential role of MPAs as a tool for fisheries management (FAO, 2011), the GFCM has been promoting the establishment of fisheries restrictions within limited areas with the goal of preserving fisheries resources, as well as of minimizing the impact of fishing on specific habitats of high ecological value (GFCM & RAC/SPA, 2007; GFCM, 2012; GFCM, 2013). It is worth mentioning that the GFCM is one of the few RFMOs worldwide entitled to adopt spatial management measures that regulate or restrict human activities in the high seas, for example by introducing closures or prohibiting the use of certain types of fishing gear.

In 2005, the GFCM was also one of the first RFMOs to follow the provisions included in the United Nations Fish Stocks Agreement (UNFSA)[1] (1995) in relation to the protection of the deep sea benthic environment, by prohibiting bottom trawling activities in waters deeper than 1 000 m (Recommendation GFCM/29/2005/1 on the management of certain fisheries exploiting demersal and deepwater species). Subsequently, in 2006, Recommendation GFCM/30/2006/3 on the establishment of fisheries restricted areas in order to protect the deep sea sensitive habitats established three FRAs, both in high seas and national waters, to guarantee the protection of deep sea sensitive habitats in well delineated sites. These areas were defined as:

- Deep sea FRA *Lophelia* reef off Capo Santa Maria di Leuca (976 429 km^2, GSA 19, Italy). This area was protected to guarantee the conservation of a unique ecosystem of cold water corals.

[1] Agreement for the Implementation of the Provisions of the United Nations Convention of the Law of the Sea of 10 December 1982, Relating to the Conservation and Management of Straddling Fish Stocks. The UNFSA entered into force on 11 December 2001.

- Deep sea FRA Nile Delta area cold hydrocarbon seeps (4 377.5 km², GSA 26, Egypt). This area hosts an exceptionally high concentration of cold hydrocarbon seeps supporting unique living communities of presumably chemosynthetic organisms such as polychaetes and bivalves.
- Deep sea FRA Eratosthenes Seamount (10 306.2 km², GSA 25, Cyprus). This area has a rich and diverse ecosystem, comprising species of scleractinian corals (*Caryophyllia calveri* and *Desmophyllum cristagalli*), which were the first living records from the Levant basin and significantly extended the species' depth ranges, as well as a rare deep water sponge *Hamacantha implicans*, known previously from a canyon in the western Mediterranean, a remarkably dense population of the deep water actinarian *Kadophellia bathyalis* and unidentified zoantharians and antipatharians. The high faunal diversity and density here indicate a uniquely rich environment in the Levant basin, possibly an isolated refuge for relict populations of species that have disappeared from the adjacent continental slope.

In these areas, fishing activities with towed dredges and bottom trawl nets have been prohibited. In addition, concerned GFCM contracting parties and cooperating non-contracting parties are required to call on the appropriate authorities to protect the areas from the impact of any other activity that might jeopardize the conservation of features that characterize these particular deep sea habitats. 7.3 Mitigation of incidental catch of vulnerable species.

In 2009, Recommendation GFCM/33/2009/1 on the establishment of a fisheries restricted area in the Gulf of Lion to protect spawning aggregations and deep sea sensitive habitats established an FRA within the Gulf of Lion (2 018 4 km², GSA 07, France). The recommendation stipulates that in this area, the fishing effort should not increase compared with the 2008 effort level. This measure was taken to avoid excessive fishing pressure on important demersal fish spawners' aggregations that are reported to occur in the area of the Gulf of Lion.

The total area protected by Recommendation GFCM/29/2005/1 (bottom trawling forbidden at depths below 1 000 m) covers 1 731 097 km² representing 58 percent of the total surface area of the Mediterranean and the Black Sea. The four FRAs cover a total area of 17 678 km², or approximately 0.7 percent of the Mediterranean Sea's surface area (Figure 53).

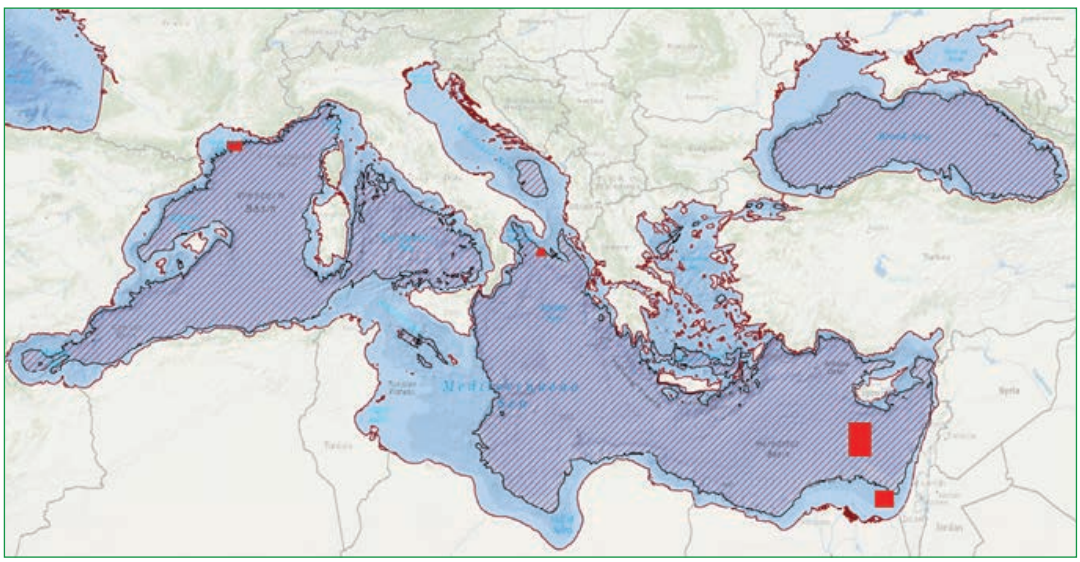


FIGURE 53
Location of the four GFCM FRAs and the 1000 m isobaths in the Mediterranean and the Black Sea from left to right: FRA in the Gulf of Lion, FRA off Santa Maria di Leuca, FRA above the Eratosthenes Seamount and FRA off the Nile delta area

Furthermore, in 2012, Recommendation GFCM/36/2012/3 on fisheries management measures for the conservation of sharks and rays in the GFCM arear (see below) established permanent closure to fishing activities with trawl nets in the area within three nautical miles of the coast of its contracting parties.

Finally, Resolution GFCM/37/2013/1 on area-based management of fisheries, including through the establishment of FRAs in the GFCM convention area and coordination with the United Nations Environment Programme – Mediterranean Action Plan for the Barcelona Convention (UNEP-MAP) initiatives on the establishment of specially protected areas of Mediterranean interest (SPAMI) entrusts the GFCM with the task of designating FRAs, including when their location totally or partly coincides with a SPAMI, in particular in the high seas.

It should be also noted that the GFCM FRAs have been recognized as examples of spatial measures adopted in areas beyond national jurisdiction to prevent significant adverse impacts of bottom fisheries on vulnerable marine ecosystems (VME)[2].

Several other protected areas exist in the Mediterranean and the Black Sea, established by national laws and international agreements. According to the Marine protected areas in the Mediterranean (MaPAMed) database [3], a total of 677 protected sites were created in the Mediterranean Sea as of 2012, covering an area of 114 556 km^2 (4.56 percent of the area of the Mediterranean Sea).

7.3 MITIGATION OF INCIDENTAL CATCH OF VULNERABLE SPECIES

In line with an ecosystem approach to fisheries, any attempt at adopting sustainable fisheries should involve ensuring the conservation of marine species whose populations' survival can be directly and indirectly affected by fishing. In recent years, the GFCM has regularly undertaken activities aimed at dealing with the conservation of vulnerable and endangered species incidentally captured by commercial fisheries. Fisheries bycatch is considered one of the most serious threats to marine mammal, shark, seabird and sea turtle populations in the Mediterranean and the Black Sea. However, there are few studies on the extent of incidental catches and mortality rates for these species in the Mediterranean and the Black Sea, and these only cover a small proportion of total fishing activity in the GFCM area of application (Chapter 4).

The GFCM has developed a number of initiatives related to the incidental catch of vulnerable species, including the organization of several meetings involving other partner organizations and national experts. As a result of these consultations and activities, several binding decisions have been adopted by the GFCM in the past few years.

7.3.1 Sharks and rays

As previously mentioned, Recommendation GFCM/29/2005/1 bans fishing activities beyond a depth of 1 000 m. This measure also contributes to reducing the threat of potential pressure on highly vulnerable deep water species of chondricthyans, such as the Portuguese dogfish (*Centroscymnus coelolepis*) and the little sleeper shark (*Somniosus rostratus*), which occur below 1 000 m (Cavanagh and Gibson, 2007).

In 2010 and 2011, the GFCM endorsed two ICCAT recommendations to protect pelagic sharks caught as bycatch in pelagic fisheries (Recommendations GFCM/34/2010/4 (C) concerning the recommendation by ICCAT on the conservation of thresher sharks caught in association with fisheries in the ICCAT convention area and GFCM/35/2011/7 (C) on Hammerhead sharks (family Sphyrnidae) caught in association with fisheries managed by ICCAT). These measures prohibited the retention, transhipment, storage, landing and sale of the bigeye thresher shark (*Alopias superciliosus*) and partially banned (developing countries excepted under certain circumstances) the retention, transhipment, storage, landing and trade of most hammerhead sharks (*Sphyrna* spp.). In addition, the GFCM endorsed GFCM/35/2011/7 (B) on Atlantic Shortfin Mako sharks

[2] http://www.fao.org/in-action/vulnerable-marine-ecosystems/en/
[3] http://www.medpan.org/en/mapamed

caught in association with fisheries managed by ICCAT, which aims to improve data collection for Atlantic shortfin mako *Isurus oxyrinchus*.

Finally, Recommendation GFCM/36/2012/3 adopted a specific management measure for the conservation of sharks and rays in the Mediterranean and the Black Sea. This measure banned finning practices and the capture and trade of shark and ray species listed in Annex II of the SPA/BD Protocol in the entire Mediterranean and Black Sea area (Table 16). In particular, the recommendation commits GFCM contracting parties to ensuring that:

- The beheading and skinning of specimens on board and before landing is prohibited. Beheaded and skinned sharks cannot be marketed at the first sale markets after landing.
- The purchase, offer for sale or selling of shark fins that have been removed, retained on board, transhipped or landed in contravention of the GFCM decision is prohibited.
- Trawl fishing in coastal areas within three nautical miles of the coast is prohibited, so as to enhance protection of coastal sharks.
- Specimens of shark species listed in Annex II of the SPA/BD Protocol are not retained on board, transhipped, landed, transferred, stored, sold or displayed or offered for sale and that these elasmobranch species listed in Annex II are released unharmed and alive to the extent possible.
- Information on fishing activities, catch data, incidental taking, release and/or discarding events for shark species listed either in Annex II or III of the SPA/BD Protocol must be recorded and reported to the national authorities for notification to the GFCM Secretariat.

Table 16 Elasmobranch species for which capture and trade have been prohibited since 2012 by Recommendation GFCM/36/2012/3.

Carcharias taurus (Rafinesque, 1810)
Carcharodon carcharias (Linnaeus, 1758)
Cetorhinus maximus (Gunnerus, 1765)
Galeorhinus galeus (Linnaeus, 1758)
Isurus oxyrinchus (Rafinesque, 1810)
Lamna nasus (Bonnaterre, 1788)
Leucoraja circularis (Couch, 1838)
Leucoraja melitensis (Clark, 1926)
Mobula mobular (Bonnaterre, 1788)
Odontaspis ferox (Risso, 1810)
Oxynotus centrina (Linnaeus, 1758)
Pristis pectinata (Latham, 1794)
Pristis pristis (Linnaeus, 1758)
Rhinobatos cemiculus (E. Geoffroy Saint-Hilaire, 1817)
Rhinobatos rhinobatos (Linnaeus, 1758)
Rostroraja alba (Lacépède, 1803)
Sphyrna lewini (Griffith & Smith, 1834)
Sphyrna mokarran (Rüppell, 1837)
Sphyrna zygaena (Linnaeus, 1758)
Squatina aculeata (Dumeril, in Cuvier, 1817)
Squatina oculata (Bonaparte, 1840)
Squatina squatina (Linnaeus, 1758)

7.3.2 Sea turtles, seabirds and cetaceans

To ensure the implementation of management measures aimed at reducing the risk of incidental catch of sea turtles, cetaceans and seabirds during fishing operations, specific decisions have been adopted by the GFCM.

Recommendation GFCM/35/2011/3 on reducing the incidental bycatch of seabirds in fisheries in the GFCM area of application, commits GFCM contracting parties to developing mechanisms to ensure that incidental taking of seabirds in fishing activities is monitored, recorded and kept to the lowest level possible, particularly for species that come under Annex II of the SPA/BD Protocol of the Barcelona Convention. Any event of incidental taking and release shall be recorded in the logbook and reported to national authorities for notification to the GFCM Secretariat.

Recommendation GFCM/35/2011/4 on the incidental bycatch of sea turtles in fisheries in the GFCM area of application, requires the implementation of fisheries management measures that strongly mitigate or eliminate the risk of incidental taking of sea turtles in fishing operations and/or mortality associated with those incidental takings. Specimens of sea turtles accidentally taken in fishing gear shall be safely handled and released unharmed and alive to the extent possible. It is also prohibited to take on board, tranship and land sea turtles, unless otherwise required to rescue and to secure assistance for the recovery of harmed and comatose individual animals. Any event of incidental taking, as well as releasing or discarding, shall be recorded in the logbook and reported to national authorities for notification to the GFCM Secretariat. Countries are also required to ensure that fishing vessels using purse seines and surrounding nets for pelagic species avoid encircling sea turtles in fishing operations. In addition, fishing vessels using longline and bottom set nets are required to carry on board safe handling, disentanglement and release equipment capable of releasing sea turtles unharmed and in a manner that maximizes the probability of their survival.

PLATES 2 AND 3
Bottlenose dolphins (*Tursiops truncatus*) and a specimen of green sea turtle (*Chelonia mydas*) (©GFCM Secretariat).

Recommendation GFCM/36/2012/2 on mitigation of incidental catches of cetaceans in the GFCM area, prohibits the deployment of gillnet fisheries with monofilament with a diameter greater than 0.5 mm and requires vessels to promptly release alive or unharmed to the extent practicable cetaceans that have been incidentally caught and brought alongside the vessel.

Recommendation GFCM/37/2013/2 on the establishment of a set of minimum standards for bottom-set gillnet fisheries for turbot and conservation of cetaceans in the Black Sea, establishes measures to mitigate the impact of bottom-set gillnet fisheries on cetacean populations. The main measure is to ensure that monofilament or twine diameter does not exceed 0.5 mm. Specific provisions to measure the diameter of the monofilament are also provided. The decision calls for the establishment of an adequate monitoring programme to collect information on the impact of bottom-set gillnets on cetacean populations in the Black Sea.

7.3.3 Monk seal

Mediterranean monk seals *Monachus monachus* are classified as critically endangered on IUCN Red List, with < 600 individuals split into three isolated subpopulations, the largest of which inhabits the eastern Mediterranean Sea. Mediterranean monk seals continue to face numerous threats, including human disturbance, habitat degradation, exposure to pollution and fisheries interactions leading to accidental mortality by entanglement in gear or deliberate killing by fishers (Murphy *et al.*, 2012).

Recommendation GFCM/35/2011/5, on fisheries measures for the conservation of the Mediterranean monk seal (*Monachus monachus*) in the GFCM area of application prohibits taking on board, transhipping and landing monk seals, unless otherwise required to rescue and to secure assistance for the recovery of harmed individual animals. Any event of incidental taking and release has to be recorded in the logbook and reported to the respective national authorities for notification to the GFCM Secretariat. Countries are required to adopt fisheries management measures to ensure a very low risk of the incidental taking of monk seals and their mortality in fishing activities/operations. Moreover, to support scientific and conservation work, countries are required to provide related map and geographical positions identifying the location of known past and current monk seal caves, together with information on fishing fleets using bottom-set nets registered in the ports close to the locations of the caves within a maximum range of 20 nautical miles.

7.4 OTHER TECHNICAL CONSERVATION MEASURES

Other technical conservation measures have been implemented to regulate different aspects of Mediterranean and Black Sea fisheries. Recommendations such as minimum legal size, gear restrictions and closed seasons have been adopted by the GFCM since 1997 in order to promote a more sustainable use of resources in its area of application. These measures are summarized below, according to the type of fisheries.

7.4.1 Dolphinfish fisheries using fish aggregating devices (FAD)

According to Recommendation GFCM/30/2006/2 on the establishment of a closed season for the dolphinfish fisheries using FAD, which is designed to protect the dolphinfish (*Coryphaena hippurus*), in particular small fish, dolphinfish fisheries using FAD shall be prohibited from 1 January to 14 August of each year, in all GSAs. By way of derogation, if a country can demonstrate that due to bad weather, fishers were unable to operate on their normal fishing days, the country can carry over days lost by this fleet in FAD fisheries until 31 January of the following year. These measures should be notified to the GFCM Secretariat, who will inform all member countries.

7.4.2 Demersal trawling fisheries

Recommendation GFCM/33/2009/2 on the establishment of geographical subareas in the GFCM area of application amending Resolution GFCM/31/2007/2 requires countries to adopt and implement, at latest by 31 January 2012, a minimum 40 mm square mesh codend or a diamond mesh size of at least 50 mm, of acknowledged equivalent or higher size selectivity, for all trawling activities exploiting demersal stocks when operating in the GFCM area of application. This provision is without prejudice to certain local and seasonal trawl fisheries operating in derogation to a minimum 40 mm codend mesh size until 31 May 2010, as authorized under the provisions of Recommendation GFCM/31/2007/1 on the mesh size of trawl nets exploiting demersal resources. Countries are also required to communicate every three months to the Secretariat the list of fishing vessels – and their percentage of the entire national demersal trawl fleet – that are equipped with the stipulated trawl codend mesh size.

7.4.3 Red coral

Pending the development of an adaptive management plan for red coral harvested in the Mediterranean, the GFCM has issued two recommendations (GFCM/35/2011/2 on the exploitation of red coral in the GFCM area of application and GFCM/36/2012/1 on further measures for the exploitation of red coral in the GFCM area of application) establishing minimum common harvesting standards for the species.

Recommendation GFCM/35/2011/2 prohibits the use of any kind of towed gear, irrespective of the specific name, to exploit red coral. The only permitted gear shall be a hammer used by a scuba diver. The use of remotely operated underwater vehicles (ROV) for the exploitation of red coral is also prohibited. The use of ROV for exploratory and prospecting purposes may be authorized in zones under national jurisdiction only, subject to specific conditions detailed in the recommendation. The exploitation of red coral at depths of less than 50 m is prohibited. Harvesting red coral less than 50 m depth may only be authorized provided that an appropriate national management framework has been developed, thus ensuring an authorization system, and that only a limited number of red coral banks are exploited based on the establishment of adequate spatio-temporal closures.

Recommendation GFCM/36/2012/1 requires countries to ensure that red coral colonies whose basal diameter is smaller than 7 mm at the trunk are not harvested, retained on board, transhipped, landed, transferred, stored, sold or displayed or offered for sale as a raw product. Countries may authorize a maximum tolerance limit of 10 percent in live weight of undersized (< 7 mm) red coral colonies, provided that a strict national management framework has been developed, thus ensuring an authorization system, and that specific monitoring and control programmes are in place.

Table 17 Summary of binding recommendations on conservation and management measures adopted by the GFCM

Type of measure	Recommendation	Details	Scope		
			Fishery	Species / habitats	Areas / countries
Spatial management	GFCM/29/2005/1	Prohibits the use of towed dredge and trawler fisheries at depths greater than 1 000 m	Towed dredges and bottom trawl	Deep water benthic habitats and species.	Mediterranean and Black Sea
	GFCM/30/2006/3	Establishes three FRAs in order to protect deep sea sensitive habitats from bottom fisheries	Towed dredges and bottom trawl	Deep water corals and other invertebrate communities	Lophelia reef off Capo Santa Maria di Leuca (GSA 19, Italy); the Nile Delta area cold hydrocarbon seeps (GSA 26, Egypt); the Eratosthenes Seamount (GSA 25, Cyprus)
	GFCM/33/2009/1	Freezes the fishing effort applied to demersal stocks in the FRA, which shall not exceed the level of fishing effort applied in 2008, and makes other provisions	Towed nets, bottom and mid-water longlines, bottom-set nets	Demersal species	Gulf of Lion (GSA 07, France)
	GFCM/36/3012/3	Prohibits fishing activities with trawl nets within 3 nautical miles of the coast	Bottom and pelagic trawling	Coastal sharks and rays	Mediterranean and Black Sea

Type of measure	Recommendation	Details	Scope		
			Fishery	Species / habitats	Areas / countries
Mitigation measures for the incidental catch of vulnerable species	GFCM/2005/3(A) [3]	Prohibits the use of driftnets larger than 2.5 km in the GFCM area	Driftnet	Large marine vertebrates, including pelagic sharks, cetaceans, sea turtles and seabirds.	Mediterranean and Black Sea
	GFCM34/2010/4 (C)	Prohibits retaining on board, transhipping, landing, storing, selling or offering for sale any part or whole carcass of bigeye thresher sharks (Alopias superciliosus) in any fishery	Any tuna fisheries regulated by ICCAT (including longline and purse seine)	Bigeye thresher sharks (Alopias superciliosus)	Mediterranean and Black Sea
	GFCM/35/2011/7 (C)	Prohibits retaining on board, transhipping, landing, storing, selling or offering for sale any part or whole carcass of hammerhead sharks (except for S. tiburo), except for developing countries under certain circumstances	Any tuna fisheries regulated by ICCAT (including longline and purse seine)	Hammerhead sharks, with exception of S. tiburo.	Mediterranean and Black Sea
	GFCM/36/2012/3	Prohibits finning, fishing of species listed in Annex II of SPA/ BD Protocol as well as trawl fishing in coastal areas	All types of fisheries.	Sharks and rays	Mediterranean and Black Sea
	GFCM/35/2011/3	Requires the implementation of measures to ensure that incidental taking of seabirds is monitored, recorded and kept to the lowest level possible	All types of fisheries	Seabirds	Mediterranean and Black Sea
	GFCM/35/2011/4	Requires the implementation of measures to ensure that incidental taking of sea turtles is monitored, recorded and kept to the lowest level possible	All types of fisheries. Specific provisions for purse seine, surrounding nets, longline and bottom-set nets	Sea turtles	Mediterranean and Black Sea
	GFCM/35/2011/5	Requires the implementation of measures to monitor and mitigate the risk of incidental taking of monk seals during fishing operations	All types of fisheries	Monk seal	Mediterranean and Black Sea
	GFCM/36/2012/2	Requires the implementation of actions to study, monitor, prevent, mitigate and, to the extent possible, eliminate incidental taking of cetaceans during fishing operations	All types of fisheries. Specific provisions for gillnet fisheries	Cetaceans	Mediterranean and Black Sea

Type of measure	Recommendation	Details	Scope		
			Fishery	Species / habitats	Areas / countries
	GFCM/37/2013/2	Requires the implementation of actions to study, monitor, prevent, mitigate and, to the extent possible, eliminate incidental taking of cetaceans during fishing operations. Other provisions regarding management measures for turbot	Bottom gillnet fisheries	Cetaceans, turbot	Black Sea
Other technical conservation measures	GFCM/30/2006/2	Establishes closed season for dolphinfish fisheries with FAD from 1 January to 14 August	Dolphinfish fisheries using FAD	Dolphinfish	Mediterranean and Black Sea
	GFCM/33/2009/2	Requires the adoption of a minimum 40 mm square mesh codend or a diamond mesh size of at least 50 mm	Demersal trawling	Demersal species	Mediterranean and Black Sea
	GFCM/35/2011/2	Prohibits the use of towed gear and ROV for red coral harvesting. Prohibits harvesting of coral below 50 m depth	Red coral harvesting	Red coral	Mediterranean and Black Sea
	GFCM/36/2012/1	Prohibits harvesting red coral colonies whose basal diameter is less than 7 mm	Red coral harvesting	Red coral	Mediterranean and Black Sea

8.

Multiannual management plans

©Nastasi

8. Multiannual management plans

8.1 INTRODUCTION

Management plans are increasingly advocated as an essential tool for fisheries management (FAO, 1996; 2003). In principle, well developed management plans can guide the implementation of agreed management measures, as well as their adaptation to take account of changing conditions, thereby helping managers to make more informed decisions for the sustainable use of fisheries resources. Indeed, management plans can be a practical instrument for the implementation of precautionary and adaptive fishery management arrangements, making them a central element of an ecosystem approach to fisheries (FAO, 2003). Management plans are formal arrangements, between a fishery management authority and interested parties. They specify the agreed objectives for the fishery, the rules and regulations to be applied and other information that may be relevant to fisheries management. Plans can be developed at the local, national and regional level, depending on the jurisdiction of the management authority and the characteristics of the fishery being managed. This chapter describes recent efforts by the GFCM to apply plans aimed at managing fisheries in the Mediterranean and the Black Sea.

8.2 MANAGEMENT PLANS IN THE GFCM

Although there have been previous attempts to set up generic principles for fisheries management plans in the GFCM area of application (e.g. GFCM Recommendation 35/2011/2 on the exploitation of red coral in the GFCM area of application and Recommendation 36/2012/1 on further measures for the exploitation of red coral), the adoption of general guidelines for the development of multiannual management plans by the thirty-sixth session of the Commission[1] in 2012 marked a new phase. These guidelines triggered a number of actions that furthered the implementation of subregional multiannual management plans. The actions were a precursor to the adoption of the first multiannual management plan in the GFCM area of application, that of small pelagic fisheries in the Adriatic Sea. In addition, in 2014, the Commission explicitly acknowledged the importance of the use of subregional multiannual management plans as a tool for achieving GFCM objectives, by incorporating the concepts of management plans and a subregional approach within the amendment of the Agreement for the establishment of the GFCM.

Various recent activities designed to support implementation of management plans in a number of fisheries, both in the Mediterranean and the Black Sea, are detailed below.

8.2.1 Testing the feasibility of the GFCM guidelines on management plans

The GFCM guidelines on management plans recognize the role of the GFCM in developing and adopting multiannual management plans for fisheries that exploit demersal and small pelagic stocks, in particular when shared among GFCM contracting parties and when operating in one or more adjacent GSAs. Furthermore, according to the guidelines, the adoption of management plans by the GFCM should not prevent countries from developing their own national management plans, so long as the objectives and measures contained in national plans are neither less strict than, nor contradictory to those in the subregional plans adopted by the GFCM.

Given that the overall objective of these management plans is to counteract and prevent overfishing, the guidelines provide examples of specific objectives for the management plans, suggesting that they should be attained on the basis of specific biological reference points. Examples of the types of management measures that could be employed in order to achieve the

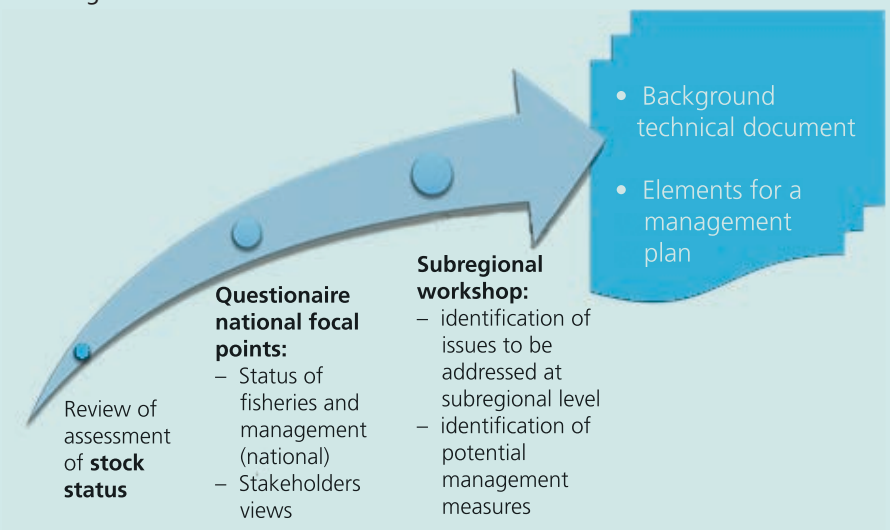
[1] Guidelines on a general management framework and presentation of scientific information for multiannual management plans for sustainable fisheries in the GFCM area of application. Thirty-sixth session of the Commission (Morocco, 2012). Available at: http://www.fao.org/gfcm/reports/statutory-meetings/statutory-meeting-detail/en/c/296253/

objectives are also provided, including effort regulation, gear selectivity and spatio-temporal closures. Finally, the guidelines propose roles for the GFCM contracting and cooperating non-contracting parties and the SAC in the implementation of management plans.

Following the approval of the guidelines on multiannual management plans by the thirty-sixth session of the Commission, a roadmap for testing their technical feasibility was developed. The execution of this roadmap was subsequently incorporated into the activities of the first GFCM Framework Programme. The guidelines' feasibility depends on various aspects, including the capacity to identify and assess the status of shared resources and the capacity to work together in an effective manner towards a common management plan for these shared fisheries. In this regard, a participatory approach was required in order to define common issues to be addressed at the subregional level, as well as to delineate the contents of the management plan, including its objectives, strategies, measures and indicators. The aim of the initiative was therefore to use subregional case studies to explore possible alternative strategies to address these issues. Box 15 describes the methodology that was applied in each case study.

Box 15 Methodological approach to test the feasibility of the GFCM guidelines for multiannual management plans.

A methodological approach to test the feasibility of the GFCM guidelines was approved at a technical meeting held at GFCM headquarters, Rome, Italy on 6–7 December 2012. Consistent with GFCM guidelines and with the FAO EAF, the methodology involves a sequence of steps aimed at building the baseline information needed to formulate the core elements of a management plan (see figure below). Attention was paid to collecting the best available scientific knowledge about the status of fisheries resources and to capturing the views and perceptions of stakeholders about the issues to be addressed in the subregional management plan. National focal points were selected in each country to participate in the activity, providing updated information about the different aspects of fisheries at national level, gathering the views of local stakeholders and representing the country in subregional technical meetings. A literature review was used throughout the process, together with questionnaires and technical workshops, and the results were consolidated in baseline reports (background technical documents) containing a description of the environmental, technical, socio-economic and institutional aspects of the fisheries, as well as a synthesis of the main issues that needed to be addressed in the management plans. The final output of this process was the development of an outline of the management plans, jointly prepared and agreed on by participating countries, with a proposed minimum structure, criteria and measures for fisheries management.



Six case studies of representative fisheries in the different GFCM subregions were initially selected for the first activities developed for implementation of management plans (Figure 54). These fisheries were identified, in consultation with the SAC and FAO regional projects in the Mediterranean, taking into account, among other aspects, the biological information available about stock units and boundaries, the fisheries sharing the resources and the ongoing scientific collaboration among countries sharing the resources.

- Adriatic Sea: fisheries for small pelagic resources;
- Western Mediterranean: fisheries for small pelagic resources in the Alboran Sea;
- Ionian Sea: fisheries for deep water rose shrimp and associated species in the Strait of Sicily;
- Eastern-central Mediterranean: fisheries for deep water blue and red shrimp and giant red shrimp in the eastern-central Mediterranean basin;
- Black Sea: fisheries for turbot, fisheries for small pelagic species.

During implementation of the feasibility phase, efforts were also made to address management of the European eel *Anguilla anguilla* at regional scale. The work on eels followed a different format and attempted to identify information available and the major gaps, as well as building a roadmap for future action by the GFCM (see above).

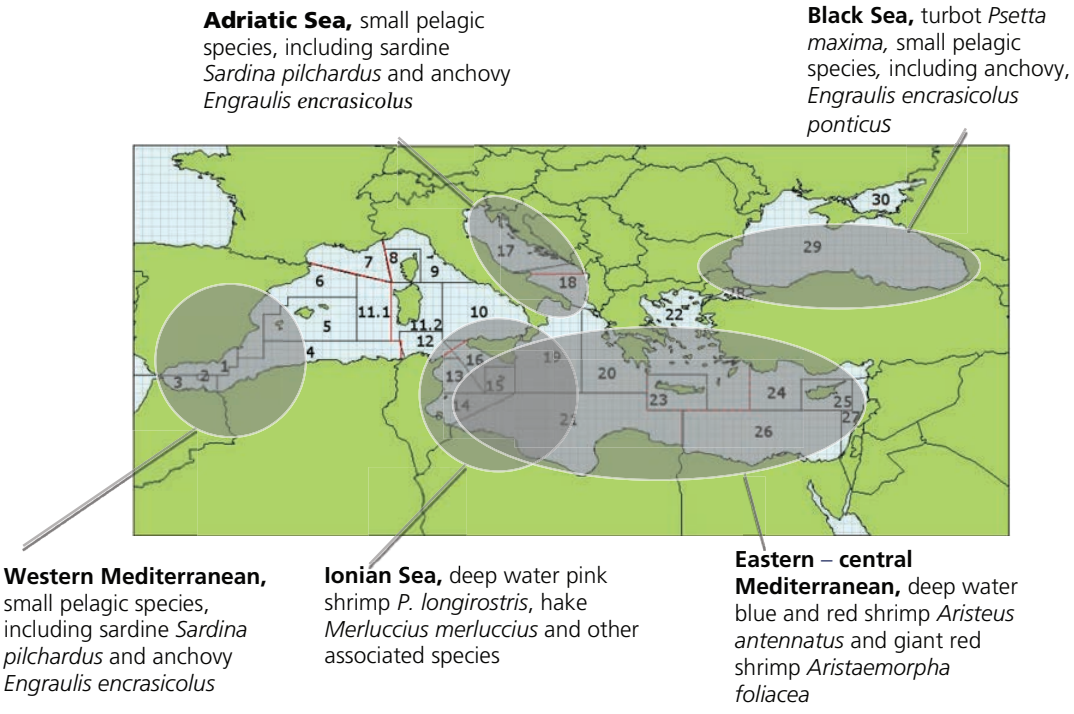


FIGURE 54
Case studies of shared resources in the GFCM area of application

Outcomes of the feasibility phase

The GFCM guidelines on multiannual management plans are based on the principle that to manage fisheries sustainably, it is necessary to implement an adaptable and precautionary system that maintains the target and associated stocks within safe biological limits. This concept was widely accepted by the participating countries in the feasibility phase, and in effect, the need to adopt such precautionary systems was viewed as a priority in all case studies. Other common emerging issues concerned the interactions of fisheries in the ecosystem and the need to evaluate the socio-economic consequences of management measures and plans.

In all case studies, countries were generally in favour of adopting a common or harmonized set of measures for the management of selected fisheries. However, they were not unanimous

on the idea of managing the fishery through a common subregional plan. This reluctance was generally due to uncertainties about stock units.

Besides testing the guidelines' feasibility, the case studies enabled the preparation of baseline information that could form the foundation for developing management plans for these fisheries in the future. One important outcome of this process was the development of a proposed minimum structure, with criteria and measures for the management of each case study fishery (GFCM, 2013a, 2013b). The minimum structure provides an outline of the main elements of a management plan, including potential objectives, indicators, reference points and technical measures, whilst also highlighting priorities for research. These documents were then drawn on to provide technical background information for decision-makers at the Commission. The main elements were subsequently used to make a number of recommendations towards the management of several of the case studies discussed in the feasibility study described here (see sections below).

8.2.2 Multiannual management plan for small pelagic fisheries in the Adriatic Sea

The multiannual plan for small pelagic fisheries in the Adriatic Sea – Recommendation GFCM/37/2013/1 on a multiannual management plan for fisheries on small pelagic stocks in the GFCM GSA 17 (northern Adriatic Sea) and on transitional conservation measures for fisheries on small pelagic stocks in GSA 18 (southern Adriatic Sea), Recommendation GFCM/38/2014/1 amending Recommendation GFCM/37/2013/1 and on precautionary and emergency measures for 2015 on small pelagic stocks in the GFCM GSA 17 and Recommendation GFCM/39/2015/1 establishing further precautionary and emergency measures in 2016 for small pelagic stocks in the Adriatic Sea (GSA 17 and GSA 18) – establishes management measures and harvest control rules for fisheries targeting sardine *Sardina pilchardus* and anchovy *Engraulis encrasicolus* in the northern Adriatic Sea (GSA 17) and transitional conservation measures for small pelagic fisheries in the southern Adriatic Sea (GSA 18). The plan seeks to maximize the long-term yield of small pelagic fisheries and guarantee a low risk of stock collapse, while maintaining sustainable and relatively stable fisheries. To this end, three specific objectives were adopted in the original Recommendation GFCM/37/2013/1 for GSA 17: i) Maintain the exploitation rate below a precautionary generic reference point (exploitation rate lower than 40 percent on appropriate age groups, both for anchovy and sardine stocks); ii) Maintain mid-year spawning stock biomass (SSB) above a precautionary level (initially set at 109 200 tonnes for sardine and 250 600 tonnes for anchovy) and ensure with a set of predefined harvest control rules that SSB does not fall below a biomass level limit (179 000 tonnes for anchovy or 78 000 tonnes for sardine), below which the reproductive capacity is expected to be impaired, and iii) Ensure that the fishing fleet capacity and fishing effort do not exceed the effort exerted in 2011. Assessment of the status of stocks after the adoption of recommendations showed that stocks were below precautionary biomass levels, while the scientific revision of the assessment models and reference points included in the original recommendation revealed some uncertainties and potential biases. For this reason, the original recommendation was slightly revised, and a number of emergency measures were adopted through Recommendations GFCM/38/2014/1 and GFCM/39/2015/1, in 2015 and 2016, respectively. These emergency measures reduce the fishing effort for vessels targeting small pelagic stocks in GSA 17, requiring vessels targeting anchovy to not exceed 144 fishing days per year. They also call for the application of a spatio-temporal closure of 15 to 30 continuous days between 1 April and 31 August, in order to protect nursery and spawning areas. The management plan allows the GFCM to decide on modalities to ensure adaptation of the fishing effort to the changing conditions of the stock. At the same time, the SAC was given the mandate to provide technical support on a number of aspects of the original recommendation, including stock assessment methods, reference points, harvest control rules and implications of different management scenarios. This revision is expected to be completed in 2016 and a revision of the initial recommendation is due to be discussed at the fourtieth session of the Commission in May 2016.

8.2.3 Turbot fisheries in the Black Sea

Work has been under way to develop multiannual management plans for the Black Sea, particularly with regard to turbot fisheries. In 2014, the GFCM Working Group on the Black Sea (WGBS) held a workshop to test the feasibility of implementing multiannual management plans in the Black Sea (24–25 February 2014, Trabzon, Turkey). The main threats for Black Sea fisheries were discussed, including IUU fishing and high fishing effort and overfishing for important stocks such as turbot. Supporting the development of multiannual management plans in the Black Sea are management measures such as minimum standards for bottom-set gillnet fisheries for turbot in the Black Sea (Recommendation GFCM/37/2013/2 on the establishment of a set of minimum standards for bottom-set gillnet fisheries for turbot and conservation of cetaceans in the Black Sea) and measures adopted recently to prevent, deter and eliminate IUU fishing in turbot fisheries in the Black Sea (Recommendation GFCM/39/2015/3 on the establishement of a set of measures to prevent, deter and eliminate illegal, unreported and unregulated fishing in turbot fisheries in the Black Sea). This latter recommendation requires, among other things, the maintenance of an updated register of vessels authorized to carry out specific fishing activities that target turbot. It also sets out measures for identifying bottom-set gillnets operating in the turbot fishery, the recovery of unmarked abandoned gillnets and the designation of proper landing points for turbot in GSA 29. This recommendation also obliges contracting parties to establish national MCS activity.

8.2.4 Demersal fisheries in the Strait of Sicily

In 2015, steps were taken to set minimum standards for bottom trawling demersal fisheries in the Strait of Sicily (Recommendation GFCM/39/2015/2 on the establishment of a set of minimum standards for bottom trawling fisheries of demersal stocks in the Strait of Sicily, pending the development and adoption of a multiannual management plan). These standards were set in order to promote the conservation of demersal stocks and prepare scientific advice on stock management, in preparation of a forthcoming multiannual management plan for GSAs 12, 13, 14, 15 and 16. Through this recommendation, technical management measures were adopted to prohibit the capture, on board retention, transshipment, transfer, storage, sale or display of deep water rose shrimp (*Parapenaeus longirostris*) smaller than a minimum reference conservation size of 20 mm (carapace length) and hake (*Merluccius merluccius*) smaller than a minimum reference conservation size of 20 cm (total length). Fleet management measures were also adopted to identify bottom trawling vessels targeting demersal stocks in the Strait of Sicily, requiring these vessels to be equipped with a vessel monitoring system (VMS), and outlining capacity reduction measures that have been taken by GFCM contracting parties. This recommendation highlights the role of the SAC in evaluating the effectiveness of these measures, with a view to formulating future advice and eventually establishing a GFCM scale multiannual management plan for demersal fisheries in the Strait of Sicily.

8.2.5 Red coral

At the request of its members, the GFCM has engaged in several initiatives over the past five years to develop a regional management plan for red coral, *Corallium rubrum*. Specific management measures for the species were adopted in 2011 and 2012 (Chapter 7). In 2013, a proposal for an adaptive regional management plan, which took into consideration the measures already in place, was presented to the SAC. The management plan was further discussed and refined during an ad hoc working group held in Brussels in 2014. At the thirty-eighth session of the Commission (FAO headquarters, 2014), guidelines were adopted to facilitate preparation of a regional management plan for red coral in the Mediterranean. The guidelines provide elements to maintain the *status quo* of the resource in the absence of data that could allow a formal assessment to be performed. It has the main objective of promoting compliance with the minimum size of 7 mm adopted by Recommendation GFCM/36/2012/1. The guidelines also propose actions to prepare the necessary data that will allow the future inclusion of a

management objective based on yield. In 2014, the first set of data was received and indications for stock assessment methods, as well as recommendations for gathering independent data, were drawn up. In addition, research areas needed to fill knowledge gaps for this resource have been highlighted through a research plan that includes surveys at sea and socio-economic analysis of various options for this fishery.

8.2.6 European eel

The management of European eel in the Mediterranean has become a priority since the inclusion of *Anguilla anguilla* in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in 2009. According to CITES regulations, trade in eels can be permitted only if the specimen was legally obtained and if its export will not be detrimental to the survival of the species. To many countries, these requirements represent a real challenge to the continued trading of the listed species. The European Union established a set of measures for the recovery of the stock, including the required implementation of eel management plans under European Council Regulation EC No. 1100/2007. In addition, all international trade of European eel into and out of the EU was banned in 2010, and a joint EIFAAC/ICES/GFCM Working Group on Eels (WGEEL) was established to provide advice to support the development and implementation of management plans.

At the GFCM level, the Transversal workshop on European eels, held in Salammbô, Tunisia, 23–25 September 2010, recommended the development of management plans for the European eel covering all subregions of the Mediterranean. It was also recommended that a case study on the European eel be discussed during the Subregional workshop to test the feasibility of implementing multiannual management plans (western and eastern Mediterranean and Ionian Sea), held in Tunisia, 7–10 October 2013.

At that meeting, several countries expressed their views on challenges, opportunities and priorities for research and management of eels in the Mediterranean. Priorities for research and management are summarized below:

Management priorities

- Development of management plans at the national level, focusing particularly on coastal lagoons;
- Fostering the conservation of coastal lagoons;
- Integrating eel management plans into legal and administrative instruments for integrated coastal zone management (ICZM);
- Undertaking habitat restoration actions;
- Improving traceability of catches;
- Increasing awareness of stakeholders on the conservation status of eels.

Research priorities

- Improving fisheries monitoring and data collection to support stock assessment;
- Further studies on migration routes and distribution patterns in the Mediterranean;
- Improving knowledge on mortality factors (e.g. fisheries, habitat, migration barriers, parasites, pollution, competition with non-native species, etc.), in order to prioritize management actions;
- Encouraging research collaboration among countries sharing the eel resource, working within research networks supported by the GFCM and the FAO regional projects;
- For aquaculture, the availability of seeds (glass eels), currently sourced from wild stocks, is considered the main bottleneck for this sector. High costs and the current lack of technologies for breeding in captivity are factors affecting the future availability of glass eels for farming.

In 2014, GFCM joined the International Council for the Exploration of the Sea (ICES) and the European Inland Fisheries Advisory Commission (EIFAAC) in the organization of the WGEEL with a meeting held at FAO headquarters in November. On that occasion, the data gaps in the Mediterranean region were identified and a plan of action developed for 2015. This plan was aimed at providing assistance to countries in collecting a minimum set of data required for stock assessment models adapted to the Mediterranean context (i.e. data poor fisheries and mainly coastal habitats). Participants agreed to take advantage of the momentum gained for the design of a proper roadmap for the regular assessment of eel stocks. Some questions still remain to be addressed by the Commission, including the advisability of adopting common management objectives and reference points with other non-Mediterranean European countries and the appropriateness of existing measures in relation to those objectives[2].

8.3 FUTURE OUTLOOK

The adoption of a management plan for small pelagic fisheries in the Adriatic has been a first step in the implementation of management plans in the GFCM area of application. Even though the original management plan included in Recommendation GFCM/37/2013/1 had to be revised due to a number of technical and practical application shortcomings, it is clear that it has triggered advances in the management of these fisheries, which were previously unregulated, and for which there is now a set of management measures that are expected to facilitate the recovery of stocks in the near future.

The recent amendment of the Agreement for the establishment of the GFCM, which has included the adoption of subregional multiannual management plans as a priority for GFCM members, indicates the importance of this tool to ensure the sustainability of Mediterranean and Black Sea fisheries. Several proposals for management plans were presented at the thirty-eighth and thirty-ninth session of the GFCM, and discussions on management plans for demersal fisheries in the Strait of Sicily, turbot and anchovy in the Black Sea, and red coral and eel in the Mediterranean are expected to produce new management plans in the near future.

Technical and operational issues are also due to be discussed in the coming years, which will facilitate the provision of advice for the GFCM, enabling it to take decisions on management plans.

One such technical aspect is determining the best way of evaluating the effectiveness of alternative management measures in meeting the objectives of the plan. Different methods could be used, varying from quantitative simulation studies (e.g. management strategy evaluation) to more qualitative evaluations based on expert/stakeholder judgement. The choice of the method will depend largely on the availability of biological and socio-economic data needed for assessments. The feasibility of these different methods is the scope of current technical discussions among participating countries and the SAC.

Operational aspects also need to be addressed to facilitate implementation of subregional plans and their revision over time. For instance, appropriate arenas for discussion at subregional level will have to be created, so as to allow countries to advance discussions and deliberations on fisheries management in their subregion. The participation of stakeholders in these fora is also considered of crucial importance, since it will facilitate the identification of sensible management measures, as well as future implementation.

The approval of the guidelines, coupled with recent efforts to test their feasibility, is providing the GFCM with a set of additional tools to advance the sustainable use of fisheries resources in the Mediterranean and the Black Sea. With improvements in the understanding of stock boundaries, it is expected that a larger number of fisheries will require mechanisms for jointly managing shared resources at the subregional level. The experience being gained through the multiannual management plans is therefore opportune, and is likely to prove instrumental in helping the GFCM to reach its objectives.

[2] A recent WGEEL meeting took place in November-December 2015 in Turkey, the report is available at www.fao.org/gfcm/reports/technical-meetings/detail/en/c/379811/

References

References

Abella, A. 2011. *General review on the available methods for stock assessment of elasmobranchs, especially in data shortage situations*. GFCM SAC Workshop on Stock Assessment of Selected Species of Elasmobranchs in the GFCM area. Brussels, Belgium, 12–16 December 2011.

Abelló, P., Arcos, J. M. & Gil de Sola, L. 2003. Geographical patterns of seabird attendance to a research trawler along the Iberian Mediterranean coast. *Scientia Marina,* 67, pp. 69–75.

Abelló, P. & Esteban, E. 2012. Trawling bycatch does affect Balearic Shearwaters Puffinus Mauretanicus. *Revista Catalana d'Ornitologia*, 28, pp. 34–39.

Aguilar, R., Mas, J. & Pastor, X. 1995. Impact of Spanish swordfish longline fisheries on the loggerhead sea turtle *Caretta caretta* population in the western Mediterranean. *In* J.L. Richardson & T.H. Richardson, eds. *Proceedings of the 12th Annual Workshop on Sea Turtle Biology and Conservation*. NOAA Tech. Mem. NMFS-SEFSC-361, pp. 361.

Akyol, O. 2003. Retained and trash fish catches of beach-seining in the Aegean coast of Turkey. *Turkish Journal of Veterinary and Animal Sciences,* 27, pp. 1111–1117.

Alsayes, A., Fattouh, Sh. & Abu-Enin, S. 2009. By-catch and discarding of trawl fisheries at the Mediterranean coast of Egypt. *World Journal of Fish and Marine Sciences*, 1(3): 199 *Turkish Journal of Veterinary and Animal Sciences,* 205.

Alverson, D.L., Freeberg, M. H., Murawski, S. A. & Pope, J.G. 1994. *A global assessment of fisheries bycatch and discards*. FAO Fisheries Technical Paper, No. 339. Rome, FAO. 233 pp.

Anselme L. & Durand J.P. 2012. *The Cory's Shearwater Calonectris diomedea diomedea, updated state of knowledge and conservation of the nesting populations of the small Mediterranean islands*. Initiative PIM, 23 pp.

Arcos, J. M., Bécares, J., Rodríguez, B., Ruiz, A. & Oro, D. 2011. *How many Balearic shearwaters are out there? Discrepancies between breeding and at sea estimates.* Presentation at the 13th MEDMARAVIS Pan-Mediterranean Symposium, Alghero, Sardinia. 14–17 October 2011.

Arcos J. M. & Oro, D. 2002. *Significance of fisheries discards for a threatened Mediterranean seabird, the Balearic Shearwater Puffinus mauretanicus*. Marine Ecology Progress Series, 239, pp. 209–220.

Argano, R. & Baldari, F. 1983. *Status of western Mediterranean sea turtles*. Rapports et procès-verbaux des réunions de la Commission internationale pour l'exploration scientifique de la mer Méditerranée, 28(5)., pp. 233–235.

Argano, R., Basso, R., Cocco, M. & Gerosa, G. 1992. New data on loggerhead (Caretta caretta) movements within Mediterranean. *Bollettino Museo Istituto Biologia Università di Genova*, pp. 56–57; 137–163.

Atar, H. H. & Malal, S. 2010. Determination of bycatch and discard catch rates on trawl fishing in Mersin-Anamur fishing ground. *Journal of Food, Agriculture and Environment,* 8, pp. 348–352.

Baddyr, M. 1989. *The biology of the squid Loligo vulgaris in relation to the artisanal fishing site of Tifnit, Morocco*. University of Michigan. 113 pp.

Báez, J.C., García-Barcelona, S., Mendoza, M., Ortiz de Urbina, J. M., Real, R. & Macías, D. 2014. *Cory's Shearwater by-catch in the Mediterranean Spanish commercial longline fishery: Implications for management, biodiversity and conservation,* 23, pp. 661–81.

B□naru, D., Le Manach, F., Färber, L., Zylich, K. & Pauly, D. 2015. *From bluefin tuna to gobies: a reconstruction of the fisheries catch statistics in Romania, 1950–2010.* Fisheries Centre Working Paper 2015 48. University of British Columbia, Vancouver, Canada. 10 pp.

Barcelona, S., Ortiz de Urbina, J. M., de la Serna, J. M., Alot, E. & Macías, D. 2010. Seabird bycatch in Spanish Mediterranean large pelagic longline fisheries, 2000–2008. *Aquatic Living Resources,* 23, pp. 363–371.

Bariche, M., Alwan, N. & El-Fadel, M. 2006. Structure and biological characteristics of purse seine landings off the Lebanese coast (eastern Mediterranean). *Fisheries Research,* 82, pp. 246–252.

Bat, L., Sezgin, M., Satılmış, H. H., Şahin, F., Üstün, F., Birinci-Özdemir, Z. & Gökkurt-Baki, O. 2011. Biological diversity of the Turkish Black Sea coast. *Turkish Journal of Fisheries and Aquatic Sciences,* 11, pp. 683–692.

Bearzi, G. 2002. Interactions between cetacean and fisheries in the Mediterranean Sea. *In* G. Notarbartolo di Sciara, ed. *Cetaceans of the Mediterranean and Black Seas: state of knowledge and conservation strategies*. ACCOBAMS Secretariat. Section 9, 20 pp.

Bearzi, G., Holcer, D. & Notarbartolo di Sciara, G. 2004. The role of historical dolphin takes and habitat degradation in shaping the present status of northern Adriatic cetaceans. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 14(4), pp. 363–379.

Belda, E. J. & Sánchez**, A.** 2001. Seabird mortality on longline fisheries in the western Mediterranean: factors affecting by-catch and proposed mitigating measures. *Biological Conservation,* 98, pp. 357–363.

Belhabib, D., Harper, S., Zeller, D. & Pauly, D. 2013. *Reconstruction of marine fisheries catches for Morocco (north, central and south), 1950–2010*. Fisheries Centre Working Paper 2015–48. University of British Columbia, Vancouver, Canada. 18 pp.

Besson, J., 1973. *Remarques sur la mort accidentelle de Puffinus yelkouans*. Alauda 41, pp. 165–167.

Bicknell, A. W. J., Oro, D., Camphuysen, C. J. & Votier, S.C. 2013. Potential consequences of discard reform for seabird communities. *Journal of Applied Ecology* 50, pp. 649–658.

Birkun, A., Jr. 2002. Interaction between cetaceans and fisheries: Black Sea. pp. 98–107. . *In* G. Notarbartolo di Sciara, ed. *Cetaceans of the Mediterranean and Black Seas: state of knowledge and conservation strategies*. ACCOBAMS Secretariat, Monaco. 219 pp.

Birkun, A. Jr. 2006. Common bottlenose dolphin (*Tursiops truncatus ponticus*), Black Sea subspecies. *In* R. Reeves & G. Notarbartolo di Sciara, eds. *The Status and Distribution of Cetaceans in the Black Sea and Mediterranean Sea.* IUCN Centre for Mediterranean Cooperation, Málaga, Spain pp.

Birkun, A. Jr, Northridge, S. P., Willsteed, E. A., James, F. A., Kilgour, C., Lander, M. & Fitzgerald, G. D. 2014. *Studies for carrying out the common fisheries policy: Adverse fisheries impacts on cetacean populations in the Black Sea*. Final report to the European Commission. Brussels, Belgium, 347 pp.

Blackhart, K., Stanton, D. & Shimada, A. 2006. *NOAA Fisheries Glossary*. NOAA Technical Memorandum NMFS-F/SPO-69. National Oceanic and Atmospheric Administration. Silver Spring, Maryland, US. [Cited 2 March 2016]. http://www.st.nmfs.noaa.gov/st4/documents/FishGlossary.pdf

Bök, T. D., Goktürk, D., Kahraman & A. E. 2011. Bycatch in 36 and 40 mm PA Turkish twin rigged beam trawl codends. *African Journal of Biotechnology,* Vol. 10(37), pp. 7294–7302.

Bouaicha, M. 2011. Étude de suivi des rejets de la pêcherie crevettière dans la baie de Bou-Ismail. Centre national d'étude de la pêche et de l'aquaculture, Bou-Ismail. 37 pp.

Bourgeois, K. 2012. *Yelkouan shearwater Puffinus yelkouan, updated state of knowledge and conservation of the nesting populations of the small Mediterranean islands*. Initiative PIM, 24 pp.

Bradai, M. N., Saidi, B. & Enajjar, S. 2012. *Elasmobranchs of the Mediterranean and Black Sea: status, ecology and biology bibliographic analysis*. Studies and Reviews. General Fisheries Commission for the Mediterranean. No. 91. Rome, FAO, 2012. 103 pp.

Brothers N. P., Cooper J. & Løkkeborg S. 1999. *The incidental catch of seabirds by longline fisheries: worldwide review and technical guidelines for mitigation*. FAO Fisheries Circular No. 937. FAO, Rome. 100 pp.

Brotons J. M., Grau A. M. & Rendell L. 2008. Estimating the impact of interactions between bottlenose dolphins and artisanal fisheries around the Balearic Islands*. Marine Mammal Science*, 24(1), pp. 112–127.

Bultel, E., Le Manach, F., Ulman, A. & Zeller, D. 2015. *Catch reconstruction for the French Mediterranean Sea, 1950-2010*. Fisheries Centre Working Paper 2015–38, University of British Columbia, Vancouver, Canada. 20 pp.

Burgess, E., Dimech, M., Caruana, R., Darmanin, M., Raine, H., Harrison, A. & Schembri, P. J. 2010. Non-target by-catch in the Maltese Bluefin tuna (*Thunnus thynnus*) longline fishery (Central Mediterranean). *Collective Volume of Scientific Papers*. ICCAT, 65, pp. 2262–2269.

Caddy, J.F. 2009. Practical issues in choosing a framework for resource assessment and management of Mediterranean and Black Sea fisheries. *Mediterranean Marine Science* 10, 83–119.

Camhi, M. D., Valenti, S. V., Fordham, S.V., Fowler, S. L. & Gibson, C. 2009. *The conservation status of pelagic sharks and rays: Report of the IUCN Shark Specialist Group Pelagic Shark Red List Worksho*p. IUCN Species Survival Commission Shark Specialist Group. Newbury, UK.

Camiñas, J. A. *1988. Incidental captures of Caretta caretta (L.) with surface long-lines in the western Mediterranean*. Rapports et procès-verbaux des réunions de la Commission internationale pour l'exploration scientifique de la Méditerranée, 31(2), pp. 285.

Camiñas, J. A. & Valeiras, X. 2001. *Proyecto europeo para la evaluación de las capturas accidentales de tortugas marinas en las pesquerías de palangre de superficie y arrastre en el Mediterráneo (EMPT)*. Primeros resultados. 1ª Simposium de la Sociedad Española de Cetáceos, Ceuta, 23–27 febrero 2000. Libro de resúmenes: 5–9.

Cañadas, A. & de Stephanis, R. 2006. Killer whale, or Orca Orcinus orca (Strait of Gibraltar subpopulation). *In* R.R. Reeves & G. Notarbartolo di Sciara, eds. *The status and distribution of cetaceans in the Black Sea and Mediterranean Sea*. IUCN Centre for Mediterranean Cooperation, Malaga, Spain. pp. 34–38.

Cañadas, A. & Hammond, P. S. 2008. Abundance and habitat preferences of the short-beaked common dolphin Delphinus delphis in the southwestern Mediterranean: implications for conservation. *Endangered Species Research,* 4(3), pp. 309.

Carbonell, A., Pomar, G., Gaza, M., Torres, A., García, M., Pereda, P., Esteban, A. & Pérez Gil, J.L. 2003a. The deep-water red shrimp fishery in the Spanish Mediterranean Sea. *Journal of Northwest Atlantic Fishery Science,* 31, pp. 353.

Carbonell, A., Alemany, F., Merella, P., Quetglas, A. & Román, E. 2003b. The by-catch of sharks in the western Mediterranean (Balearic Islands) trawl fishery. *Fisheries Research*, 61, pp. 7–18.

Casale, P., Margaritoulis, D. & Aksissou, M. 2010. Overview. *In* Casale, P. & Margaritoulis,D., eds. *Sea Turtles in the Mediterranean: Distribution, Threats and Conservation Priorities*. Gland, Switzerland, IUCN.

Casale, P. 2011. Sea turtle by-catch in the Mediterranean. *Fish and Fisheries*, vol. 12(3), pp. 299–316.

Castriota, L., Campagnuolo, S. & Andaloro, F. 2001. *Shrimp trawl fishery by-catch in the Straits of Sicily (Central Mediterranean Sea)*. Serial No. N4501 NAFO SCR Doc. 01/113.

Castriota, L., Falautano, M., Romeo, T., Florio, G., Pelusi, P., Finoia, M. G. & Andaloro, F. 2004. Crustacean fishery with bottom traps in an area of the southern Tyrrhenian Sea: species composition, abundance and biomass. *Mediterranean Marine Science*, 5/2, pp. 15–22.

Cavanagh, R. D. & Gibson, C. 2007. *Overview of the conservation status of cartilaginous fishes (Chondrichthyans) in the Mediterranean Sea*. IUCN, Gland, Switzerland and Malaga, Spain. 42 pp.

Cebrian D. 1998a. *La foca monje (Monachus monachus Hermann 1779) en el Mediterráneo Oriental (Grecia y Croacia).* PhD. Universidad Complutense. Madrid. 367 pp..

Cetinić, P., Škeljo, F. & Ferri, J. 2011. Discards of the commercial boat seine fisheries on Posidonia oceanica beds in the eastern Adriatic Sea. *Scientia Marina,* 75, pp. 289–300.

Ceyhan, T. & Akyol, O. 2014. On the Turkish surface longline fishery targeting swordfish in the Eastern Mediterranean Sea*. Turkish Journal of Fisheries and Aquatic Sciences*, 14, pp. 825–830.

Ceylan, Y., Sahin, C. & Kalaycı, F. 2014. Bottom trawl fishery discards in the Black Sea coast of Turkey. *Mediterranean Marine Science*, 15(1), pp. 156-164; 172–178.

Clucas, I. 1997. *A study of the options for utilization of bycatch and discards from marine capture fisheries*. FAO Fisheries Circular. No. 928. Rome, FAO. 1997. 59 pp.

Coll, M., Navarro, J., & Palomera, I. 2013. Ecological role, fishing impact, and management options for the recovery of a Mediterranean endemic skate by means of food web models*. Biological conservation*, 157, pp. 108–120.

Coll, M., Carreras, M., Cornax, M. J., Massuti, E., Morote, E., Pastor, X., Quetglas, A., Saez, R., Silva, L., Sobrino, I.,Torres, M., Tuledi, S., Harper, S., Zeller, D. & Pauly, D. 2015. *An estimate of the total catch in the Spanish Mediterranean Sea and Gulf of Cadiz regions (1950-2010)*. Fisheries Center, University of Columbia - Working Paper: 2015–60. University of British Columbia, Vancouver, Canada. 53 pp.

Cooper, J., Baccetti, N., Belda, E. J., Borg, J. J, Oro, D., Papaconstantinou, C. & Sanchez, A. 2003. Seabird mortality from longline fishing in the Mediterranean Sea and Macaronesian waters: a review and a way forward. *Scientia Marina*, 67 (Suppl. 2), pp. 57–64.

Cortés, V., Soriano-Redondo, A., Reyes-González, J. M., Guallar, S., Rodríguez, B., Bécares, J., Arcos, J. M. & González-Solís, J. 2015. *May changes in common fisheries policy lead to an increase in Mediterranean seabirds' bycatch?* 2nd World Seabird Conference, Cape Town, South Africa.

Cyprus Pilot Study. 2006. *Pilot study on the evaluation of discards of the Cyprus fishery*. (EU Data Collection Regulation (DCR) No 1543/2000, No 1639/2001 and No 1581/2004). 41 pp.

Davies, R. W. D., Cripps, S. J., Nickson, A. & Porter, G. 2009. Defining and estimating global marine fisheries bycatch. *Marine Policy*, 33(4), pp. 661–672.

De Metrio, G., Petrosino, G., Matarese, A., Tursi, A. & Montanaro, C. 1983. *Importance of the fishery activities with drift lines on the populations of Caretta caretta (L.) and Dermochelys coriacea (L.) (Reptilia, Testudines), in the Gulf of Taranto*. Oebalia IX (n.s.), pp.43–53.

Delaugerre, M. 1987. Statut des tortues marines de la Corse (et de la Méditerranée). *Vie et Milieu,* 37, pp. 243–264.

Di Natale, A. 1989. *Marine mammals interactions in fishery activities: the Mediterranean case*. Paper presented at 1st International Conference on Marine Mammals, Riccione, Italy, 30 August–2 September 1989.

Di Natale, A. *1991. Interactions between marine mammals and Scombridae fishery activities: the Mediterranean case*. FAO Fisheries Report, 449, 167–174.

Di Natale, A. & Notarbarolo di Sciara, G. 1994. *A review of the passive fishing nets and trap fisheries in the Mediterranean Sea and of cetacean bycatch*. Report International Whaling Commission, Special Issue, 15, 189–202.

Díaz López, B. 2005. *Interactions between bottlenose dolphins with trammel nets in the Sardinia Island.* International Council for the Exploration of the Sea, Copenhagen, Denmark.

Díaz López, B. *2006.* Interactions between Mediterranean bottlenose dolphins (Tursiops truncatus) and gillnets off Sardinia, Italy. *ICES Journal of Marine Science*, 63, pp. 946–951.

Dimech, M., Darmanin, M., Caruana, R. & Raine, H. 2009. Preliminary data on seabird by-catch from the Maltese longline fishery (Central Mediterranean). *Collective Volume of Scientific Papers*. ICCAT, 64 (7), pp. 2335–2341.

D'Onghia, G., Carlucci, R., Maiorano, P. & Panza, M. 2003. Discards from deep-water bottom trawling in the Eastern-Central Mediterranean Sea and effects of mesh size changes. *Journal of Northwest Atlantic Fishery Science,* 31, pp. 245–261.

Duguy, R., Besson, J., Casinos, A., Di Natale, A., Filella, S., Raduàn, A., Raga, J. A. & Viale, D. 1983. *L'impact des activités humaines sur les cétacés de la Méditerranée occidentale*. Rapports de la Commission Internationale pour l'Exploration Scientifique de la Mer Méditerranée, 28, pp. 219–222.

Dulvy, N. K., Fowler, S.L., Musick, J. A., Cavanagh, R.D., Kyne, P. M., Harrison, L. R. *et al.* 2014. *Extinction risk and conservation of the world's sharks and rays*. eLife, 3: e00590.

Duruer E. Ç., Kinacigi, T., Soykan O. **& T. Zafer.** 2008. Contribution to some biological and fishery aspects of commercial penaeid prawns in Mersin Bay (North-eastern Mediterranean, Turkey). *Crustaceana,* 81, pp. 577–585.

Dyck, A. & Sumaila, U. R. 2010. Economic impact of ocean fish populations in the global fishery. *Journal of Bioeconomics*, *12*(3), pp. 227–243. doi: 10.1007/s10818-010-9088-3.

Edelist, D., Scheinin, A., Sonin, O., Shapiro, J., Salameh, P., Gil, R., Benayahu, Y., Schulz, D. & Zeller, D. 2013. Israel: Reconstructed estimates of total fisheries removals in the Mediterranean, 1950–2010. *Acta Adriatica*, 4(2), pp. 253–246.

Edelist, D., Sonin, O., Golani, D., Rilov, G. & Spanier, E. 2011. *Spatiotemporal patterns of catch and discards of the Israeli Mediterranean trawl fishery in the early 1990s: ecological and conservation perspectives. Scientia Marina* 75(4), December 2011. doi: 10.3989/scimar.2011.75n4641.

El-Mor, M., El-Etreby, J. S., Mohammad, S. & Sapota, M. R. A. 2002. Study on trash catch of the bottom trawl along Port-Said coast, Egypt. *Oceanological Studies*, 31, pp. 45–55.

EU. 2008. *On the implementation of the policy to reduce unwanted by-catch and eliminate discards in European fisheries*. Commission non-paper. 13 pp.

EU. 2011. *Impact assessment of discard reducing policies. EU Discard Annex.* Studies in the field of the Common Fisheries Policy and Maritime Affairs. Impact Assessment Studies related to the CFP. European Commission. Project: ZF0926_S10, Brussels, Belgium.

European Central Bank. *Euro foreign exchange reference rates*. [Cited 2 March 2016] https://www.ecb.europa.eu/stats/exchange/eurofxref/html/eurofxref-graph-usd.en.html.

European Central Bank. *Indices of Consumer Prices: Harmonised Index of Consumer Prices (HICP). S*eries Key: ICP.M.U2.N.000000.4.INX. [Cited 2 March 2016] http://sdw.ecb. europa.eu/quickview.do?SERIES_KEY=122.ICP.M.U2.N.000000.4.INX.

Fabi, G. & Grati, F. 2005. Small-scale fisheries in the maritime department of Ancona (Central Northern Adriatic Sea). *In Adriatic Sea Small-scale Fisheries. Report of the AdriaMed Technical Consultation on Adriatic Sea Small-Scale Fisheries*. Split, Croatia, 14–15 October 2003. GCP/RER/010/ITA/TD15. AdriaMed Technical Documents, 15: 64–84.

Faltas, S. N., Akel, H. E. K. & Abdallah, A. 1998. A study on trash catch of the bottom trawl in Abu-Qir Bay, Egypt. *Bulletin National Institute of Oceanography and Fisheries* 24, pp. 349–363.

FAO EastMed. 2014. *Socio-economic analysis of Egyptian fisheries: Options for improvement*. GCP/INT/041/EC – GRE – ITA/TD-19.

FAO. 2016. *Fisheries and Aquaculture DepartmentFAO Fishery Commodities Global Production and Trade* [Database]. [Cited 2 March 2016]. <http://www.fao.org/fishery/statistics/global-commodities-production/query/en>

FAO. 2015. *First Regional Symposium on sustainable small-scale fisheries in the Mediterranean and Black Sea, 27–30 November 2013, Saint Julian's, Malta*. Edited by Abdellah Srour, Nicola Ferri, Dominique Bourdenet, Davide Fezzardi & Aurora Nastasi. FAO Fisheries and Aquaculture Proceedings No. 39. Rome. 519 pp.

FAO.2014. *The State of World Fisheries and Aquaculture: Opportunities and challenges (SOFIA).* Rome.

FAO. 2004. *Papers presented at the Expert Consultation on Interactions between sea turtles and fisheries within an ecosystem context*. Rome, 9–12 March 2004. FAO Fisheries Report. No. 738, Suppl. Rome, FAO. 2004, 238 pp.

FAO. 2009. *Guidelines to reduce sea turtle mortality in fishing operations.* Fisheries Department, Food and Agriculture Organization of the United Nations. Rome. 128 pp.

FAO. 1996. *Precautionary approach to fisheries. Part 2: scientific papers*. Prepared for the Technical Consultation on the Precautionary Approach to Capture Fisheries (Including Species Introductions). Lysekil, Sweden, 6–13 June 1995. FAO Fisheries Technical Paper. No. 350, Part 2. Rome. 210 pp.

FAO. 2003. *The ecosystem approach to fisheries*. FAO Technical guidelines for responsible fisheries. Rome. 112 pp.

FAO. 2011. *Fisheries management. Marine protected areas and fisheries*. FAO Technical Guidelines for Responsible Fisheries. No. 4, Suppl. 4. Rome. 198 pp.

Ferretti, F., Myers, R. A., Serena, F. & Lotze, H.K. 2008. Loss of large predatory sharks from the Mediterranean Sea. *Conservation Biology* 22, pp. 952–964.

Fortuna, C. M., Vallini, C., Filidei, E. Jr., Ruffino, M., Consalvo, I., Di Muccio, S., Giona, C., Scacco, U., Tarulli, E., Giovanardi, O. & Mazzola, A. 2010. By-catch of cetaceans and other species of conservation concern during pair trawl fishing operations in the Adriatic Sea (Italy). *Chemistry and Ecology*, Vol. 26, Supplement, June 2010, pp. 65–76.

Franquesa, R., Idrissi, M. & Alarcón, J. 2001. *Feasibility assessment for a database on socio-economic indicators for Mediterranean fisheries*. General Fisheries Commission for the Mediterranean. Studies and Reviews No. 71. Rome, FAO. 2001. 55p.

Furness R. W. 2003. Impact of fisheries on seabird communities. *Scientia Marina,* 67 (Suppl. 2), pp. 33-45.

Gales, R., Brothers, N. & Reid, T. 1998. Seabird mortality in the Japanese tuna longline fishery around Australia, 1988-1995. *Biological Conservation*, pp. 37–56.

García-Barcelona, S. Macías, D., Ortiz de Ubina, J. M., Estrada, A., Real, R. & Báez, J.C. 2010. Modelling abundance and distribution of seabird by-catch in the Spanish Mediterranean longline fishery. *Ardeola,* 57 (Especial), pp. 65–78.

Gaudin, C. & De Young, C. 2007. *Recreational fisheries in the Mediterranean countries: a review of existing legal framework.* General Fisheries Commission for the Mediterranean. Studies and Reviews No. 81. Rome, FAO. 87 pp.

Gazo M., Gonzalvo J. & Aguilar A. 2008. Pingers as deterrents of bottlenose dolphins interacting with trammel nets. *Fisheries Research*, 92, pp. 70–75.

GFCM & RAC/SPA. 2007. *Report of the Transversal Workshop on Marine Protected Areas (MPAs)* (GFCM & RAC/SPA). Salammbô, Tunisia, 24–25 May 2007. **GFCM**. 2012. *Report of the Transversal Workshop on Spatial Based Approach to Fisheries Management, Rome, Italy, 6–8 February* 2012. 2 March 2016]. Available at https://gfcmsitestorage.blob.core.windows.net/documents/Reports/2012/GFCM-Report-2012-SAC-SCs-Spatial-Approach.pdf

GFCM. 2013. *Report of the Working Group on Marine Protected Areas,* Bar, Montenegro, 3 February 2013.

GFCM. 2013a. *Report of the Workshop on fisheries data collection and management in the Adriatic Sea.* Split, Croatia, 20–22 March 2013.

GFCM. 2013b. *Report of the Subregional Technical Workshop on Fisheries Multiannual Management Plans for the Western, Central and Eastern Mediterranean*. 7–10 October 2013, Tunis, Tunisia.

Gilman, E. 2001. Integrated management to address the incidental mortality of seabirds in longline fisheries. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 11, pp. 391–414.

Gislason, H., Daan, N., Rice, J. C. & Pope, J.G. 2010. Size, growth, temperature and the natural mortality of marine fish. *Fish and Fisheries*, 11(2), pp. 149–158. doi:10.1111/j.1467-2979.2009.00350.x

Godley, B.J., Gucu, A. C., Broderick, A. C., Furness, R. W. & Solomon, S. E. 1998. Interaction between marine turtles and artisanal fisheries in the eastern Mediterranean: a probable cause for concern? Zoology in the Middle East, 16, pp. 49–64.

Gokce, G. & Metin, C. 2007. Landed and discarded catches from commercial prawn trammel net fishery. *Journal of Applied Ichthyology* 23, pp. 543–546.

Goncalves, J. M. S., Stergiou, K. I., Hernabo, J.A., Puente, E., Moutopoulos, D. K., Arregi, L. Soriguer, M. C., Vilas, C., Coelho, R. & Erzini, K. 2007. Discards from experimental trammel nets in southern European small-scale fisheries. *Fisheries Research*, 88, pp. 5–14.

Gonzalvo, J., Valls, M., Cardona, L. & Aguilar, A. 2008. *Factors determining the interaction between common bottlenose dolphins and bottom trawlers off the Balearic Archipelago (western Mediterranean Sea). Journal of Experimental Marine Biology and Ecology*, 367(1), pp. 47–52.

Gramentz, D. 1989. Marine turtles in the central Mediterranean Sea. *Centro*, 1(4), pp. 41–56.

Gray, C. A., Johnson, D. D., Broadhurst, M. K. & Young, D.J. 2005. Seasonal, spatial and gear-related influences on relationships between retained and discarded catches in a multi-species gillnet fishery. *Fisheries Research* 75, pp 56–72.

Güçlüsoy H. 2008 Damage by monk seals to gear of the artisanal fishery in the Foca Monk Seal Pilot Conservation Area, Turkey. *Fisheries Research* (Amsterdam), 90, 1–3 (Apr 2008), pp. 70–77.

Gücü, A.C. 2001. Development of northeastern Mediterranean fishing fleet: Impacts on/of ecosystem changes. In *Technological developments in fisheries (Balikcilikta teknolojik gelismeler)*, Izmir, Turkey 19–21 June 2001. Ege University, Izmir. p–

Guisande, C., Patti, B., Vaamonde, A., Manjarrés-Hernández, A., Pelayo-Villamil, P. *et al*. 2013. Factors affecting species richness of marine elasmobranchs. *Biodiversity Conservation* 22, pp. 1703–1714. doi:10.1007/s10531-013-0507-3.

Guinet, C., Domenici, P., De Stephanis, R., Barrett-Lennard, L., Ford, J. K. B. & Verborgh, P. 2007. Killer whale predation on bluefin tuna: exploring the hypothesis of the endurance-exhaustion technique. *Marine Ecology Progress*, Series 347, pp. 111–119.

Hall, M. A., Alverson, D. L. & Metuzals, K.I. 2000. By-catch: problems and solutions. *Marine Pollution Bulletin,* 41, pp. 1–6; 204–219.

Hall, M. A. 2015. More on bycatches: Changes, evolution, and revolution. *In* G. H. Kruse, H. C. An, J. Di Cosimo, C. A. Eischens, G. S. Gislason, D. N. McBride, C. S. Rose, and C. E. Siddon, eds. *Fisheries Bycatch: Global Issues and Creative Solutions.* Alaska Sea Grant, University of Alaska Fairbanks, United States.

Halouani, G., Lasram, F., Khalfallah, M., Zeller, D. & Pauly, D. 2015. *Reconstruction of marine fisheries catches for Tunisia* (1950–2010). Fisheries Centre Working Paper #2015–95, University of British Columbia, Vancouver, Canada, 11 pp.

Harrabi, H. 2003. *Analyse des captures principales, accessoires et des rejets des filets droits destinés à la pêche des crevettes, des céphalopodes et des poissons dans la région côtière Mahrès*. National Agronomic Institut of Tunisia, 131 pp.

ICES. 2008. *Report of the Working Group on Seabird Ecology (WGSE), 10–14 March 2008, Lisbon, Portugal*. ICES CM 2008/LRC:05. 99 pp.

ICRAM. 2001. *Report of the Workshop on Interactions between Dolphins and Fisheries in the Mediterranean: Evaluation of Mitigation Alternatives.* Rome, 4–5 May 2001. Edited by Randall R. Reeves, Andrew J. Read and Giuseppe Notarbartolo di Sciara.

Ifremer. 2010. *Panorama des rejets dans les pêcheries françaises*. Edited by Guérine, L., Rochet, M.J., Peronnet. 49 pp.

İlker, A., Gökhan, G. **& Cengiz, M.** 2008. The effects of netting twine on discard rates of commercial red mullet gillnets in Izmir Bay. *Turkish Journal of Fisheries and Aquatic Sciences*, 8, pp. 373–376.

International Labour Office (ILO). *ILOSTAT: Labour Force Participation Rate by Sex and Age (%) Database.* Geneva.

Johnson, W. M., Karamanlidis, A. A., Dendrinos, P., Fernández de Larrinoa, P., Gazo, M., González, L. M., Güçlüsoy, H., Pires, R. & Schnellmann, M. 2006. *Mediterranean Monk Seal (Monachus monachus). Monk Seal Fact Files*. [Cited 2 March 2016]. http://www.monachus-guardian.org/factfiles/medito1.htm

Kalayci, F. & Yeşilçiçek, T. 2014. Influence of season, depth and mesh size on the trammel nets catch composition and discard in the Southern Black Sea, Turkey. *Marine Biology Research*, Volume 10, Issue 8, pp. 824–832.

Karamanlidis, A. A., Androukaki, E., Adamantopoulou, S., Chatzispyrou, A., Johnso, W. M., Kotomatas, S., Papadopoulos, A., Paravas, V., Paximadis, G., Pires, R., Tounta, E. & Dendrinos, P. 2008. Assessing accidental entanglement as a threat to the Mediterranean monk seal Monachus monachus. *Endangered Species Research,* 5, pp 205–213.

Karpouzi, V. S., Watson, R. & Pauly, D. 2007. Modelling and mapping resource overlap between seabirds and fisheries on a global scale: a preliminary assessment. *Marine Ecology Progress*, Series 343, pp. 87–99.

Karris, G., Fric, J., Kitsou, Z., Kalfopoulou, J., Giokas, S., Sfenthourakis, S. et al. 2013. Does by-catch pose a threat for the conservation of seabird populations in the southern Ionian Sea (eastern Mediterranean)? A questionnaire-based survey of local fisheries. *Mediterranean Marine Science*, 14, pp. 19–25.

Katsanevakis S. 2008. *Marine debris a growing problem: sources, distribution, composition and impacts in marine pollution research*. Edited by Tobias N. Hofer . Nova Science Publisher Inc New York. Pp. 53–100.

Kelleher, K. 2005. *Discards in the world's marine fisheries. An update.* FAO. Rome. No. 470, 131 pp.

Keskin, Ç., Ulman, A., Raykov, V., Daskalov, G. M., Zylich, K., Pauly, D. & Zeller, D. 2015. *Reconstruction of fisheries catches for Bulgaria: 1950–2010*. Fisheries Centre Working Paper 2015–20. University of British Columbia, Vancouver, Canada, 18 pp.

Khalfallah, M., Belhabib, D., Zeller, D. & Pauly, D. 2015. *Reconstruction of marine fisheries catches for Libya (1950–2010).* Fisheries Centre Working Paper 2015–47. University of British Columbia, Vancouver, Canada, 15 pp.

Konsulova, T., Todorova, V. & Konsulov, A. 2001. *Investigations on the effect of ecological method for protection against illegal bottom trawling in the Black Sea –Preliminary results.* Rapports de la Commission Internationale pour l'Exploration Scientifique de la Mer Méditerranée 36, 287 pp..

Laneri, K., Louzao, M., Martínez-Abraín, A., Arcos, J. M., Belda, E. J., Guallart, J., Sánchez, A., Giménez, M., Maestre, R. & Oro, D. 2010. Trawling regime influences longline seabird bycatch in the Mediterranean. New insights from a small-scale fishery. Marine Ecology Progress, Series, 420, pp. 241–252.

Laurent, L. 1990. Les tortues marines en Algérie et au Maroc (Méditerranée). *Bulletin Société Herpétologique de France,* 55, pp. 1–23.

Laurent, L. 1991. Les tortues marines des côtes françaises méditerranéennes continentales. *Faune de Provence* (C.E.E.P.) 12, pp. 76–90.

Laurent, L., Abd El-Mawla, E. M., Bradai, M. N., Demirayak, F. & Oruc, A. 1996. *Reducing sea turtle mortality induced by Mediterranean fisheries: trawling activity in Egypt, Tunisia and Turkey.* Report for the WWF International Mediterranean Programme. WWF Project 9E0103., 32 pp..

Laurent, L., Camiñas, J. A., Casale, P., Deflorio, M., de Metrio, G., Kapantagakis, A., Margaritoulis, D., Politou, C. Y. & Valeiras X. 2001. *Assessing marine turtle bycatch in European drifting longline and trawl fisheries for identifying fishing regulations.* Project-EC-DG Fisheries 98-008. Joint project of BIOINSIGHT, IEO, IMBC, STPS and University of Bari. Villeurbanne, France.

Laurent, L., Casale, P. & Bradai, M. N. 1998. Molecular resolution of marine turtle stock composition in fishery bycatch: a case study in the Mediterranean. *Molecular Ecology*, 7, pp. 1529–1542.

Laurent, L. & Lescure, J. 1994. L'hivernage des tortues caouannes *Caretta caretta* (L.) dans le sud tunisien. *Revue d'écologie: la terre et la vie,* 49, pp. 63–86.

Le Guilloux, E. & Pauly, D. 2010. *Description synthétique des pêcheries françaises en 2007*. Prepared for the French Ministry of Fisheries. Bloom Association and Sea Around Us, with the support of IFREMER, IRD and MNHN, Paris, France. 32 pp.

Løkkeborg, S. 2008. *Review and assessment of mitigation measures to reduce incidental catch of seabirds in longline, trawl and gillnet fisheries*. FAO Fisheries and Aquaculture Circular. No. 1040. Rome, FAO. 24 pp.

Louzao, M. & Oro, D. 2004. *Resultados preliminaries sobre la captura accidental de aves marinas en las Islas Baleares*. IMEDEA Consellaria Medi Ambient (Illes Balears). Technical Report.

Louzao, M., Arcos, J. M., Guijarro, B., Valls, M. & Oro, D. 2011. *Seabird-trawling interactions: Factors affecting species-specific to regional community utilization of fisheries waste. Fisheries Oceanography,* 20, pp. 263–77.

Machias, A., Vasilopoulou, V., Vatsos, D., Bekas, P., Kallianotis, A., Papaconstantinou, C. & Tsimenides, N. 2001. Bottom trawl discards in the north-eastern Mediterranean Sea. *Fisheries Research,* 53, pp. 181–195.

Macías López, D., Barcelona, S. G., Báez, J. C., De la Serna, J. M., & Ortiz de Urbina, J. M. 2012. Marine mammal bycatch in Spanish Mediterranean large pelagic longline fisheries, with a focus on Risso's dolphin *(Grampus griseus). Aquatic Living Resources*,25(04), pp. 321–331.

Malvarosa, L. & De Young, C. 2010. *Fish trade among Mediterranean countries: intraregional trade and import-export with the European Union* (GFCM Studies and Reviews No. 86). Rome, Italy: FAO. [Cited 2 March 2016]. <https://gfcmsitestorage.blob.core.windows.net/documents/StudiesReviews/GFCM-SR-86.pdf>

Margaritoulis, D., Argano, R. & Baran, I. 2003. Loggerhead turtles in the Mediterranean Sea: present knowledge and conservation perspectives. *In* A.B. Bolten & B. Witherington, eds. *Loggerhead Sea Turtles*. Smithsonian Institution Press, Washington DC, USA, pp. 175–198.

Margaritoulis, D., Kouslas, N., Nicolopoulou, G. & Teneketzis, K. 1992. Incidental catch of sea turtles in Greece: the case of Lakonikos Bay. *In* M. Salmon & J. Wyneken, eds. *Proceedings of the 11th Annual Workshop on Sea Turtle Biology and Conservation* (NOAA) Tech. Mem. NMFS-SEFSC-302, Miami, FL, USA, pp. 168–170.

Márquez, R. & Bauchot, M. 1987. Tortues. *In* Fischer, W., Schneider, M. & Bauchot, M. eds. *Méditerranée et mer Noire, zone de pêche 37*. Bol. 11 Vertébrés. Fiches FAO d'identification des espèces pour les besoins de la pêche. pp. 1423–1438.

Matić-Skoko, S., Stagličić, N., Pallaoro, A., Kraljević, M., Dulčić, J., Tutman, P. & Dragičević, B. 2011. Effectiveness of conventional management in Mediterranean type artisanal fisheries. *Estuarine, Coastal and Shelf Science*, 91, pp. 314–324.

Maximov, V. & Staicu, I. 2008. Evolution of demersal fish species catches from the Romanian Marine Area between 2000 and 2007. *Cercetări marine/Recherches Marines*, 37, pp. 305–323.

Mayol, J. & Castello Mas, M. 1983. *Contrihuion al conocimiento de la Tortuga Boba en las Baleares*. Palma de Mallorca, Spain. ICONA.

Megalofonou, P., Yannopoulos, C., Damalas, D., De Metrio, G., Deflorio, M., De La Serna, J. M. & Macias, D. 2005. Incidental catch and estimated discards of pelagic sharks from the swordfish and tuna fisheries in the Mediterranean Sea. *Fishery Bulletin*, 103, pp. 620–634.

MONSTAT: Statistical Office of Montenegro. Fishing data. *Workers in Fishing Industry, Ships and Boats, in 2012* [Data file]. [Cited 2 March 2016]. http://www.monstat.org/eng/page.php?id=1006&pageid=162

Montevecchi, W. A. 2002. *Interactions between fisheries and seabirds*. CRC Press.

Moranta J., Massutí E. & Morales-Nin B. 2000. Fish catch composition of the deep-sea decapod crustacean fisheries in the Balearic Islands (western Mediterranean). *Fisheries Research*, 45, pp. 253–264.

Morello, E.B., Froglia, C., Atkinson, R. J. A. & Moore, P. G. 2005. Hydraulic dredge discards of the clam (Chamelea gallina) fishery in the western Adriatic Sea, Italy. *Fisheries Research*, 76, pp. 430–444.

Morizur, Y., Demaneche, S., Fauconnet, L., Gaudou, O. & Badts, V. 2011. *Captures accidentelles de cétacés dans les pêches professionnelles françaises en 2010.* Contribution au rapport national sur la mise en œuvre du Règlement européen (CE) No 812/2004 – (année 2010). juillet 2011. R.INT.STH/LBH/2011.

Moutopoulos, D. K., Brady, B. & Pauly, D. 2015. *Reconstruction of Albanian fishery catches by fishing gear, 1950 to 2010.* Fisheries Centre, University of British Columbia, Vancouver, 13 pp.

MPRH. 2011. *Canevas des statistiques locales mensuelles*. Ministère des pêches et des ressources halieutiques, 34 pp.

Murphy, S., Spradlin, T. R., Mackey, B., McVee, J., Androukaki, E., Tounta, E., Karamanlidis, A. A. , Dendrinos, P., Joseph, E., Lockyer, C. & Matthiopoulos, J. 2012. Age estimation, growth and age-related mortality of Mediterranean monk seals *Monachus monachus*. *Endangered Species Research*, 16(2), pp. 149–163.

Mussi, B., Gabriele, R., Miragliuolo, A. & Battaglia, M. 1998. Cetacean sightings and interactions with fisheries in the archipelago Pontino Campano, southern Tyrrhenian Sea, 1991-1995. *European Research on Cetaceans*, 12, pp. 63–65.

Nada, M. & Casale, P. 2011. Sea turtle bycatch and consumption in Egypt threatens Mediterranean turtle populations. *Oryx,* Volume 45, Issue 01, pp. 143–149.

Nader, M. R., Indary, S. & Moniri, N. R. 2014. *Historical fisheries catch reconstruction for Lebanon (GSA 27), 1950–2010.* Fisheries Centre Working Paper 2014–11, Fisheries Centre, University of British Columbia, Vancouver, Canada, 19 pp.

Notarbartolo di Sciara, G. & Demma,M. 2004 *Guida dei mammiferi marini del Mediterraneo*. Franco Muzzio Editore, Padova, Italy. 264 pp.

OECD. StatExtracts. *National landing in domestic ports (FISH.NLD)* [Data file]. [Cited 2 March 2016]. http://stats.oecd.org/

Oppel, S., Raine, A. F., Borg, J. J., Raine, H., Bonnaud, E., Bourgeois, K. & Breton, A. R. 2011. Is the Yelkouan shearwater Puffinus yelkouan threatened by low adult survival probabilities? *Biological conservation*, 144(9), pp. 2255–2263.

Oro, D., Aguilar, J. S., Igual, J. M. & Louzao, M. 2004. Modelling demography and extinction risk in the endangered Balearic shearwater. *Biological Conservation,* 116, pp. 93–102.

Oro, D. & Ruiz, X. 1997. Exploitation of trawler discards by breeding seabirds in the north-western Mediterranean: Differences between the Ebro Delta and the Balearic Islands areas. *ICES Journal of Marine Science*, pp. 695–707.

Oro, D., Genovart, M., Tavecchia, G., Fowler, M.S. & Martínez-Abraín, A. 2013. *Ecological and evolutionary implications of food subsidies from humans*. Ecology letters, 16(12), pp. 1501–1514.

Oruç, A., Demirayak, F. & Sat, G. 1997. *Trawl fisheries in the eastern Mediterranean and its impact on sea turtles.* Dogal Hayati Koruma Dernegi, Istanbul, Turkey DHKD, Coastal Management Section Report No 96/1, 17 pp.

Özbilgin, Y., Tosunoğlu, Z. **& Özbilgin, H.** 2006. By-catch in a 40 mm PE demersal trawl codend. *Turkish Journal of Veterinary and Animal Sciences*, 30, pp. 179–185.

Panou, A. J. Jacobs & Panos, D. 1993. The endangered Mediterranean monk seal Monachus monachus in the Ionian Sea, Greece. *Biological Conservation*, 64(2), pp. 129–140.

Patterson, K. 1992. Fisheries for small pelagic species: an empirical approach to management targets. *Reviews in Fish Biology and Fisheries*, 2, pp. 321–338.

Pearce, D. W., Atkinson, G. & Mourato, S. 2006. *Cost-Benefit Analysis and the Environment: Recent Developments*. OECD, Paris.

Peristeraki, P., Kypraios, N., Lazarakis, G. & Tserpes, G. 2008. Bycatch and discards of the Greek swordfish fishery. *Collective Volume of Scientific Papers*. ICCAT, 62, pp. 1070–73.

Petrakis, G., Kavadas, S., Siapatis, A., Segovia, M., Lefkaditou, E. & Sourlas, E. 2009. *Assessment of impacts of the boat seine fishery on fisheries resources.* Technical report (in Greek), HCMR, Athens, Greece, 129 pp.

Pichegru, L., Ryan, P. G., Bohec, C., Van der Lingen, C. D., Navarro, R., Petersen, S., Lewis, S., Van der Wesrhuizen, J. & Grémillet, D. 2009. Overlap between vulnerable top predators in the Benguela upwelling system: implications for marine protected areas. *Marine ecology progress*, series 391, pp. 199–208.

Piovano, S., Di Marco, S., Dominici, A., Giacoma, C. & Zannetti, A. 2004. Loggerhead (Caretta caretta) bycatches on longlines: the importance of olfactory stimuli. *Italian Journal of Zoology*, Supplement 2, pp. 213–216.

Piroddi, C., Gristina M., Zylich, K., Ulman, A., Zeller, D. & Pauly, D. 2014. Reconstruction of Italy's marine fisheries catches (1950–2010). *Fisheries Research,* Volume172, pp. 137–147.

Pranovi, F., Raicevich, S., Franceschini, G., Torricelli P. & Giovanardi, O. 2001. Discard analysis and damage to non-target species in the "rapido" trawl fishery. *Marine Biology*, 139, pp. 863–875.

Quetglas, A., Gaamour, A., Reñones, O., Missaoui, H., Zarrouk, T., Elabed, A. & Goñi, R. 2004. Common spiny lobster (Palinurus elephas Fabricius 1787) fisheries in the western Mediterranean: A comparison of Spanish and Tunisian fisheries. *Bolleti de la Societat d'Historia Natural de les Balears,* 47, pp. 63–80.

Raicevich, S. 2008. *Discard in the Northern Adriatic Sea multi-gear fishing activities: ecological consequences and implications for mitigation strategies*. Presented at Workshop on discards organized by DGMARE, Brussels, Belgium, 27–28 May 2008.

Rivalan, P., Barbraud, C., Inchausti, P. & Weimerskirch, H. 2010. Combined impacts of longline fisheries and climate on the persistence of the Amsterdam Albatross *Diomedia amsterdamensis*. *Ibis* ,152,pp. 6–18.

Rizkalla, S. I. 1995. A study on the trash fish obtained by the Egyptian Mediterranean trawlers*. Bulletin of the National Institute of Oceanography and Fisheries*, 21, pp. 529–543.

Rochet, M. J. & Trenkel, V. M. 2005. Factors for the variability of discards: assumptions and field evidence. *Canadian Journal of Fisheries and Aquatic Sciences,* 62, pp. 224–235.

Roditi-Elasar, M., Kerem, D., Hornung, H., Kress, N., Shoham-Frider, E., Goffman, O. & Spanier, E. 2003. Heavy metal levels in bottlenose and striped dolphins off the Mediterranean coast of Israel. *Marine Pollution Bulletin*, 46, pp. 503–512.

Sacchi J. 2008. *Impact des techniques de pêche sur l'environnement en Méditerranée*. Études et revues. Commission générale des pêches pour la Méditerranée. No. 84. Rome, FAO. 2008. 62 pp.

Sacchi, J. 2008b. The use of trawling nets in the Mediterranean. Problems and selectivity options. *Options méditerranéennes,* B 62, pp. 87–96.

Sacchi, J. 2011. *Background on marine mammal's bycatch issue in the Mediterranean and Black Sea.* Background document prepared for the GFCM 2nd Transversal Working Group on By-Catch (in collaboration with ACCOBAMS). 7–9 December 2011, Antalya, Turkey. 18 pp.

Şahin, C., **Ceylan, Y. & Kalayci, F.** 2015. Purse seine fishery discards on the Black Sea coasts of Turkey. *Turkish Journal of Fisheries and Aquatic Sciences,* 15, pp.81–91.

Şahin, C., Hacımurtezaoğlu, N., Gözler, A. **M., Kalaycı, F. &** Ağırbaş, E. 2008. A preliminary study on investigation of purse seine bycatch composition in the south-eastern Black Sea. *Journal of Fisheries Sciences,* 2, pp. 677–683.

Sánchez, P., Sartor, P., Recasens, L., Ligas, A., Martin, J., De Ranieri, S. & Demestre, M. 2007. Trawl catch composition during different fishing intensity periods in two Mediterranean demersal fishing grounds. *Scientia Marina* 71, pp. 765–773.

Sánchez, P., Demestre, M. & Martin, P. 2004. Characterisation of the discards generated by bottom trawling in the north-western Mediterranean. *Fisheries Research*, 67, pp. 71–80.

Santojanni, A., Cingolani, N., Arneri, E., Kirkwood, G., Belardinelli, A., Giannetti, G., Colella, S., Donato, F. & Barry, C. 2005. Stock assessment of sardine (Sardina pilchardus, Walb.) in the Adriatic Sea with an estimate of discards. *Scientia Marina*, 69, pp. 603–617.

Sartor, P., Sbrana, M., Reale, B. & Belcari, P. 2003. Impact of the deep sea trawl fishery on demersal communities of the northern Tyrrhenian Sea (western Mediterranean). *Journal of Northwest Atlantic Fishery Science,* 31, pp. 275–284.

SAUP, 2012. *Sea Around Us Project – Landings by gear type in LME: Mediterranean Sea. 2012*. [Cited 2 March 2016]. http://www.seaaroundus.org.

Sauzade, D. & Rousset, N. 2013. *Greening the Mediterranean fisheries: tentative assessment of the economic leeway.* Plan Bleu, Valbonne, France.

Scientific, Technical and Economic Committee for Fisheries (STECF). *2014_EU Fleet Econom and Transversal data_fleet segment level.xlsx* [Data file]. [Cited 2 March 2016]. http://stecf.jrc.ec.europa.eu/ewg1405

SEO/BirdLife 2014. *Encuestas sobre pesca y aves marinas en España Peninsular y Baleares, Noviembre de 2011 - Diciembre de 2012*. Informe de SEO/BirdLife para el Proyecto LIFE+ INDEMARES.

Serena, F. 2005. *Field identification guide to the sharks and rays of the Mediterranean and Black Sea.* FAO Species Identification Guide for Fishery Purposes. Rome, FAO. 97 pp.

SIBM. 2006. *Relazione Finale 2005*. Programma Nazionale per la Raccolta Dati Alieutici (Reg. CE 1543/2000, 1639/2001 e 1581/2004), Campionamento Biologico degli Scarti, Luglio 2006, 171 pp.

Stergiou, K.I., Economou, A., Papaconstantinou, C., Tsimenides, N. & Kavadas, S. 1998. Estimates of discards in the Hellenic commercial trawl fishery. *Rapport Commission internationale pour l'exploration scientifique de la mer Méditerranée*, 35, pp. 490–491.

Stergiou K. I., Moutopoulos D. K. & Erzini K. 2002. Gillnet and longlines fisheries in Cyclades waters (Aegean Sea): species composition and gear competition. *Fisheries Research*, 57, pp. 25–37.

Tasker, M. L, Camphuysen, C. J., Cooper, J., Garthe, S., Montevecchi, W. A. & and Blaber, S. J. M. 2000. The impacts of fishing on marine birds. *ICES Journal of Marine Science: Journal Du Conseil*, 57, pp. 531–47.

Tragsatec. *Estudio del impacto socioeconómico de la pesca recreativa en el Mediterráneo español.* Revised by R. Franquesa. [Cited 2 March 2016]. http://gfcmsitestorage.blob.core.windows.net/documents/old/GfcmWebSite/SAC/2010/Recreational_Fisheries/doc/Tragsatec.pdf.

Tsagarakis, K., Machias, A., Giannoulaki, M., Somarakis, S. & Karakassis, I. 2008. Seasonal and temporal trends in metrics of fish community for otter-trawl discards in a Mediterranean ecosystem. *ICES Journal of Marine Science,* 65, pp. 539–550.

Tsagarakis K., Vassilopoulou V., Kallianiotis A. & Machias A. 2012. ()Discards of the purse seine fishery in the Eastern Mediterranean Sea. *Scientia Marina* ,76(3), pp. 561–572.

Tsagarakis, K.; Palialexis, A. & Vassilopoulou, V. 2013. Mediterranean fishery discards: review of existing knowledge. *ICES Journal of Marine Science*, doi:10.1093/icesjms/fst074.

Tudela, S. 2004. *Ecosystem effects of fishing in the Mediterranean: an analysis of the major threats of fishing gear and practices to biodiversity and marine habitats*. Studies and Reviews. General Fisheries Commission for the Mediterranean. No. 74. Rome, FAO. 2004. 44 pp.

Tudela, S., Kai Kai, A., Maynou, F., El Andalossi, M. & Guglielmi, P. 2005. Driftnet fishing and biodiversity conservation: the case study of the large-scale Moroccan driftnet fleet operating in the Alboran Sea (SW Mediterranean). *Biological Conservation,* 121, pp. 65–78.

Tzanatos, E., Somarakis, S., Tserpes, G. & Koutsikopoulos, C. 2007. Discarding practices in a Mediterranean small-scale fishing fleet (Patraikos Gulf, Greece). *Fisheries Management and Ecology*, 14, pp. 277–285.

Ulman, A., Çiçek, B., Salihoglu, I., Petroud, A., Patsalidou, M., Pauly, D. & Zeller, D. 2013a. *The reconstructed and unified marine fisheries catches of Cyprus, 1950–2010*. Fisheries Centre Working Paper Series, Fisheries Centre, University of British Columbia, Vancouver, Canada. 73 pp.

Ulman, A., Bekişoğlu, Ş., Zengin, M., Knudsen, S., Ünal, V., Mathews, C., Harper, S., Zeller, D. & Pauly, D. 2013b. From bonito to anchovy: a reconstruction of Turkey's marine fisheries catches (1950–2010). *Mediterranean Marine Science,* 14(2), pp. 309–342.

Ulman, A. & Divovich, E. 2015. *The marine fishery catch of Georgia (including Abkhazia), 1950-2010.* Fisheries Centre Working Paper 2015–88, University of British Columbia, Vancouver, Canada. 25 pp.

Ulman, A., Shlyakhov, V., Jatsenko, S. & Pauly, D. 2015a. A reconstruction of the Ukraine's marine fisheries catches, 1950-2010. Fisheries Centre Working Paper 2015–86, University of British Columbia, Vancouver, Canada. 23 pp.

Ulman, A., Saad, A., Zylich, K., Pauly, D. & Zeller, D. 2015b. *Reconstruction of Syria's fisheries catches from 1950-2010: Signs of overexploitation*. Fisheries Centre Working Paper 2015–80, University of British Columbia, Vancouver, Canada. 26pp.

UN Comtrade. Fishery commodities trade data. [Cited 2 March 2016]. http://comtrade.un.org/db/mr/daCommodities.aspx

Ungaro, N., Marano, G., De Zio, V., Pastorelli, A. M. & Rositani, L. 2005. Some information on offshore bottom longline fishery in the southern Adriatic Sea (GFCM Geographical Sub-Area 18) (by): *In* Adriatic Sea small-scale fisheries. *Report of the AdriaMed Technical Consultation on Adriatic Sea Small-Scale Fisheries*. Split, Croatia, 14–15 October 2003. GCP/RER/010/ITA/TD15. AdriaMed Technical Documents, 15, pp. 98–102.

Valeiras, J. & Caminas, J. A. 2003. The incidental capture of seabirds by the Spanish drifting longline fisheries in the Western Mediterranean Sea. *Scientia Marina,* 67, pp. 65–68.

Van Canneyt, O. & Peltier, H. 2006. *Les* échouages *de mammifères marins sur le littoral français en 2005*. CRMM France. 45 pp.

Vassilopoulou, V., Anastasopoulou, K., Haralabous, C., Christides, G., Glykokokalos, S., Nikolaou, Y., Bekas, P. & Kallias, E. 2007. *Preliminary results of monitoring discards by coastal fishery vessels in Greek waters.* Proceedings of the 13th Panhellenic ichthyological symposium. September 2007, Mytilini, , pp. 109–112 (in Greek with English abstract).

Vassilopoulou, V. 2011. *Review of existing knowledge on fisheries bycatch and discards in the GFCM area.* Background document prepared for the GFCM 2nd Transversal Working Group on By-Catch (in collaboration with ACCOBAMS). 7–9 December 2011, Antalya, Turkey. 22 pp.

Veguila, V. 2011. La gestion localisée de conflits «invisibles». Les mobilisations socio-économiques des jeunes Sahraouis a Dakhla. p. 4 *In* Aufauvre, C. & Najar, S. eds. *Marges, normes et éthique Institut de recherche sur le Maghreb contemporain*, Rabat, Morocco. 310 pp.

Venizelos, L. 2000. *Ten years of marine turtle conservation in the Mediterranean (1989-1999).* Proceedings of the 20th International Symposium on Sea Turtle Biology and Conservation (29 Feb. - 4 March 2000) NMFS-SEFSC, USA.

Wagner, E. L., & Dee Boersma, P. 2011. Effects of fisheries on seabird community ecology. *Reviews in Fisheries Science,* 19, pp. 157–67.

Weimerskirch, H., Capdeville, D. & Duhamel, G. 2000. Factors affecting the number and mortality of seabirds attending trawlers and longliners in the Kerguelen area. *Polar Biology*, 23, pp. 236–49.

World Bank. World Development Indicators. *GDP (constant 2005 US$)*[Data file]. [Cited 2 March 2016]. http://data.worldbank.org/indicator/NY.GDP.MKTP.KD

World Bank. World Development Indicators. *Official exchange rate (LCU per US$, period average)* [Data file]. [Cited 2 March 2016]. http://data.worldbank.org/indicator/ PA.NUS.FCRF.

World Bank. World Development Indicators. *Population, total* [Data file]. [Cited 2 March 2016]. http://data.worldbank.org/indicator/SP.POP.TOTL.

World Bank. World Development Indicators. *Real interest rate (%)* [Data file]. [Cited 2 March 2016]. http://data.worldbank.org/indicator/ FR.INR.RINR.

Worm, B., Davis, B., Kettemer, L., Ward-Paige, C. A., Chapman, D., Heithaus, M. R., Kessel, S. T. & Gruber, S. H. 2013. Global catches, exploitation rates, and rebuilding options for sharks. *Marine Policy*, 40, pp. 194–204. doi: 10.1016/j.marpol.2012.12.034.

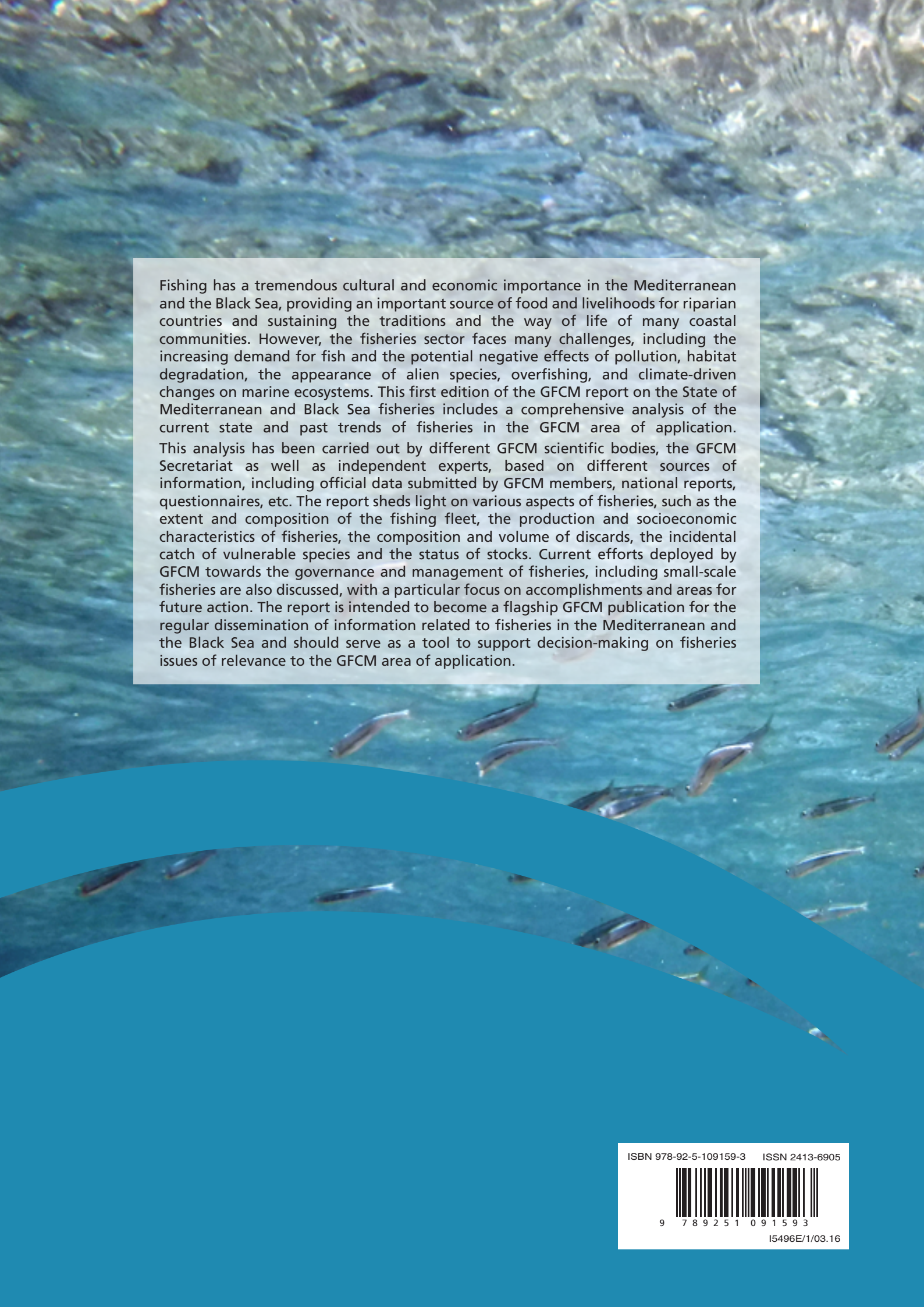
Yemisken, E., Dalyan, C. & Eryilmaz, L. 2014. Catch and discard fish species of trawl fisheries in the Iskenderun Bay (north-eastern Mediterranean) with emphasis on lessepsian and chondricthyan species. *Mediterranean Marine Science*, 15/2,pp. 380–389.

Zahri, Y., Najih, M., El Ouamari, N., Abdellaoui, B., Kada, O. et al. 2007. *Interactions between the delphin Tursiops truncatus and the purse seine nets in Morocco Mediterranean: acoustics repulsive tests and repercussion evaluation*. CIESM, Monaco.

Zengin, M. & Akyol, O. 2009. Description of by-catch species from the coastal shrimp beam trawl fishery in Turkey. *Journal of Applied Ichthyology,* 25, pp. 211–214.

Zotier, R., Bretagnolle, V. & Thibaullt, J. C. 1999. Biogreography of the marine birds if a confined sea, the Mediterranean. *Journal of Biogeography*, 26, pp. 297–313.

Zydelis, R., Small, C. & French, G. 2013. The incidental catch of seabirds in gillnet fisheries: A global review. *Biological Conservation,* 162, pp. 76–88.



Fishing has a tremendous cultural and economic importance in the Mediterranean and the Black Sea, providing an important source of food and livelihoods for riparian countries and sustaining the traditions and the way of life of many coastal communities. However, the fisheries sector faces many challenges, including the increasing demand for fish and the potential negative effects of pollution, habitat degradation, the appearance of alien species, overfishing, and climate-driven changes on marine ecosystems. This first edition of the GFCM report on the State of Mediterranean and Black Sea fisheries includes a comprehensive analysis of the current state and past trends of fisheries in the GFCM area of application. This analysis has been carried out by different GFCM scientific bodies, the GFCM Secretariat as well as independent experts, based on different sources of information, including official data submitted by GFCM members, national reports, questionnaires, etc. The report sheds light on various aspects of fisheries, such as the extent and composition of the fishing fleet, the production and socioeconomic characteristics of fisheries, the composition and volume of discards, the incidental catch of vulnerable species and the status of stocks. Current efforts deployed by GFCM towards the governance and management of fisheries, including small-scale fisheries are also discussed, with a particular focus on accomplishments and areas for future action. The report is intended to become a flagship GFCM publication for the regular dissemination of information related to fisheries in the Mediterranean and the Black Sea and should serve as a tool to support decision-making on fisheries issues of relevance to the GFCM area of application.

ISBN 978-92-5-109159-3 ISSN 2413-6905

9 789251 091593

I5496E/1/03.16