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Implementation of the ecosystem approach to fisheries for the demersal fisheries of the Mediterranean coast of Egypt: baseline report

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Preparation of this document

The Food and Agriculture Organization of the United Nations (FAO) and the General Authority for Fish Resources Development (GAFRD), Cairo, Egypt, started the implementation of a pilot case study on the ecosystem approach to fisheries (EAF) in the Mediterranean coast of Egypt in 2015, within the framework of the FAO Mediterranean Project EastMed ("Scientific and Institutional Cooperation to Support Responsible Fisheries in the Eastern Mediterranean"). The pilot case study focuses on the demersal fisheries of the Mediterranean coast of Egypt. The case study was funded by the FAO EastMed project and implemented in collaboration with GAFRD.

One of the first steps in the pilot case study was the elaboration of an EAF Baseline Report (EAF-BL), which is presented in this publication. The objective of the EAF–BL is to complete the EAF planning phase by defining the scope of the case study. The EAF–BL is a document that outlines the available information on the demersal fisheries that can assist with the rest of the EAF management planning process. It documents all relevant information about the fishery, the species and geographical areas covered in the case study, the socio-economic profile of the fishery and the institutional arrangements for its management.

Abstract

The Egyptian capture fisheries production from the Mediterranean Sea is showing a decreasing trend that began in 2008 and continued to the present. Most of the production comes from the capture of species in the coastal zone and over the continental shelf. The Egyptian Mediterranean fishing fleet is dominated by trawlers, which represent the backbone of the fleet in terms of both economic value and employment. Trawlers work from fishing ports along the Egyptian Mediterranean coast and are not restricted by geographic boundaries; consequently, the landed fish species cannot be attributed to certain fishing grounds or definite geographic areas. Trawl fisheries are essentially multispecies, targeting shrimps, common cuttlefish and some fish species like *Mullus* spp., soles, brushtooth lizard fish and species of the family Sparidae. Most of the stock assessments recommend a reduction of fishing mortality by about 40 percent, with the recommendations lower for some fisheries and higher for others. Trawlers mainly sell their production through wholesalers while the small-scale and artisanal vessels channel their production primarily through the fish market. Generally, fishery management in Egypt is challenged by the complex nature of the associated social-ecological systems. The EAF could therefore contribute by helping to sustainably manage this fishery.

Contents

List of acronyms

EAF	ecosystem approach to fisheries
EAF-BL	ecosystem approach to fisheries baseline report
EEZ	exclusive economic zone
FAO	Food and Agriculture Organization of the United Nations
GAFRD	General Authority for Fish Resources Development in the Ministry of Agriculture
GDP	gross domestic product
GT	gross tonnage
ICCAT	International Commission for the Conservation of Atlantic Tunas
LOA	length overall
NIOF	National Institute of Oceanography and Fisheries
SAC	Scientific Advisory Committee on Fisheries
SL	standard length
TL	tail length
USD	United States dollars
VMS	vessel monitoring system
WGSAD	Working Group on Stock Assessment of Demersal Species

1. INTRODUCTION

Egypt is located in the northeastern corner of the African continent. Its population of 87 million (2014), is the fifteenth largest in the world, the largest in the Arab region and the third largest in Africa. In recent years, Egypt's population has grown at a constant rate of about 1.48 million per year.

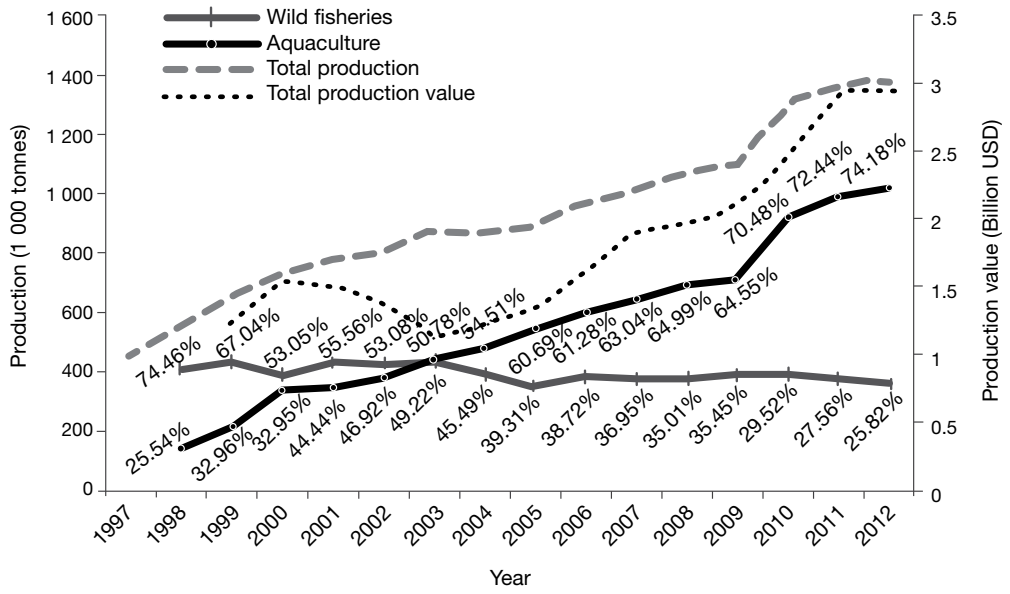
Egypt borders the Mediterranean Sea between Libya and the Gaza Strip, and the Red Sea north of Sudan. It has a total land area of about 1 million km^2 and 6 000 km^2 are covered by water. The country has a long coastline of about 2 450 km along both the Mediterranean Sea and the Red Sea.

The Mediterranean coast of Egypt extends for about 950 km from Rafah to the east of Sinai, to Sallum, west of the Egyptian–Libyan border (Bird, 2010). It is one of the longest Mediterranean coastlines in North Africa (identified by the General Fisheries Commission for the Mediterranean [GFCM] as Geographical Sub-area 26 [GSA 26] Southern Levant Sea) with connections to six coastal lagoons. These are the Maruit, Edku, Burollus, Manzala, Port Fouad and Bardawil lagoons. The continental shelf is narrow in the western area, compared to the wider central Nile Delta region and the eastern coast. The seabed is flat and mostly muddy or sandy along the central and eastern coast. Limited grounds for trawling are available on the west coast where the substrate is sandy and rocky.

Being surrounded by two seas and having more freshwater than any other country in the region, it is not surprising that fisheries are an important part of Egyptian culture and society. Fishing has been conducted in the country since the dawn of humanity and continues to be an important activity. Egyptian fisheries in the Mediterranean generate an estimated net profit of USD 42.5 million, representing 23 percent of the gross revenues (FAO EastMed, 2014).

The main sources of fish production in Egypt are marine fisheries; inland fisheries in lakes, lagoons, the Nile River, irrigation and drainage canals; and aquaculture. Total production levels increased by more than 50 percent over the period 2000 to 2009 from 724 300 tonnes in 2000 to 1.1 million tonnes in 2009. The rise in production was primarily obtained from significant increases in aquaculture production, while wild capture fisheries production remained almost constant (389 398 tonnes in 2009). By 2009 the share of total production provided by aquaculture had risen to 65 percent (up from 47 percent in 2000). Of the total aquaculture production in 2009, 84.75 percent was derived from farm pond culture (from an area of 151 757 hectares); 9.64 percent from cage culture; 5.34 percent from rice field culture; and 0.26 percent from intensive culture (10–12 kg/m^3) (Figure 1). Egypt's Mediterranean fisheries accounted for about 20 percent of the total capture production (FAO EastMed, 2014).

FIGURE 1
Total national fish production in Egypt for the period 1997 to 2012, including wild fisheries and aquaculture (tonnes year-1) and their percentage, and annual total production value (USD) for the period 1999 to 2012



Source: Samy-Kamal, 2015.

The total number of Egyptian registered fishing vessels operating in the Mediterranean Sea is 4 249 fishing boats, 2 973 of which are equipped with inboard engines of 50 to 1 000 HP (Table 1) (GAFRD, 2014). The most important fishing gear types in the Egyptian Mediterranean fisheries are bottom trawl, purse seine, longline and fixed nets.

The official number of bottom trawlers, compared to the total fleet, is very high (25 percent) (Figure 2). If one considers only the motorized fleet, this number rises to 35 percent, which is relatively high when compared to the artisanal nature of most of the Mediterranean fishing fleets, where normally less than 10 percent of the total fleet is made up of trawlers and more than 50 percent are small-scale vessels using static gears. Furthermore, the number of vessels working with a trawl is probably higher because in practice, a number of longliners use trawl gear as their main fishing gear (FAO EastMed, 2014).

The bottom trawls probably represent the backbone of the Egyptian Mediterranean fisheries, in terms of both economic value and employment. One of the reasons for Egyptian knowledge and skill in the use of trawlers is that fishers gained experience working on the trawlers of other Mediterranean countries and on the high seas during the 1960s and 1970s (FAO EastMed, 2014).

FIGURE 2
Egyptian Mediterranean fishing fleet/fishing gear (2014)

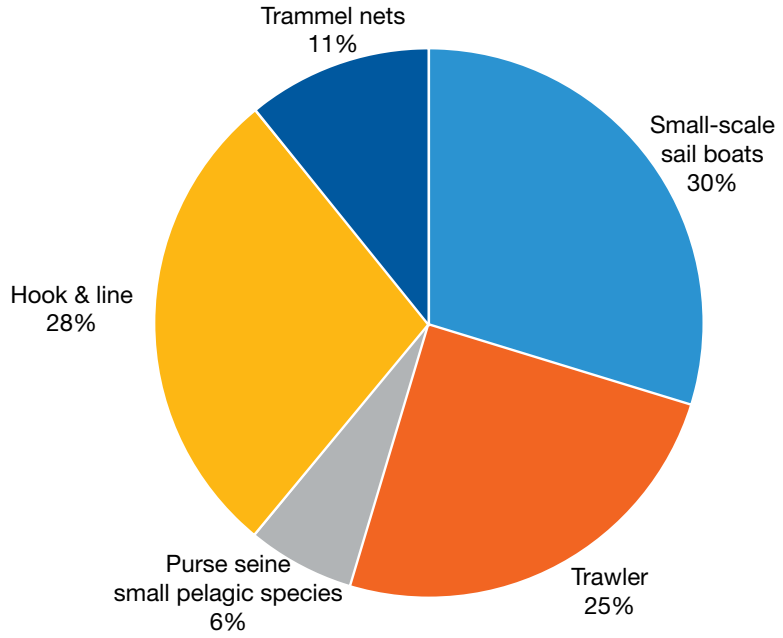


TABLE 1
Number of vessels in the Egyptian Mediterranean fishing fleet/fishing gear (2014)

Category	No. of vessels	Mean length overall (LOA) (m)	Mean range of HP	Mean range of gross tonnage (GT)
Small-scale vessels with engine 0–6 m	8	5.37	15.73 (9.9–46)	1.82 (1–2.7)
Small-scale vessels with engine 6–12 m	340	8.75	30.44 (8.5–81)	5.87 (1.7–16)
Polyvalent 12–24 m	99	14.07	72.08 (40–230)	23.13 (10–67)
Longliners 12–24 m	1 166	14.04	74.97 (10–580)	26.21 (1.0–131)
Purse seiners 12–24 m	241	18.45	246.24 (12–1150)	56.17 (9.6–152.8)
Trawlers 12–24 m	1 020	19.64	225.81 (16–1250)	66.65 (4.4–361.6)
Trawlers >24 m	29	25.50	645.45 (222–3 486)	148.96 (100.5–313.5)
Grand total (2014)	**2 903**	**15.85**	**142.39 (8.5–3 486)**	**42.56 (1.0–361.6)**

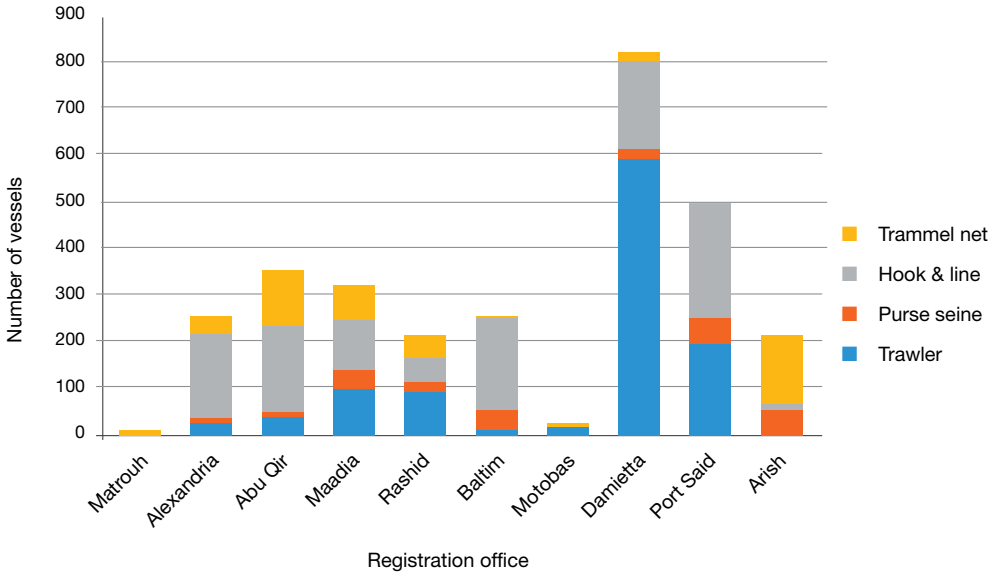
2. OVERVIEW OF THE FISHERY AND THE RESOURCES EXPLOITED

2.1. Fishing gear used and areas fished

According to GAFRD, the registered fleet targeting demersal species comprises two types of boats that use different fishing gears. These include trawlers of different sizes that exploit fishing grounds of various depths and distance from the port, and small-scale vessels using static fishing gears (trammel nets) that are used to target various demersal species during periods of seasonal abundance. The wide expanse of the continental shelf off the central delta region and its seabed (flat, muddy and sandy) has favoured trawling along the eastern coast. Consequently, there is fishing activity along the continental shelf off the Nile Delta, extending to the eastern side of Port Said, but rarely west of Alexandria, while artisanal fishers exploit inshore areas. Limited

trawling grounds are available on the western coast. The main fishing ports along the Egyptian Mediterranean coast are Matrouh, Alexandria (Anfoshi), Alexandria (Abu Qir), Maadia, Rashid, Motobas (Burullus), Baltim, Damietta (Izbet El-Borg), Port Said and Arish (Figure 3) (GAFRD, 2014).

FIGURE 3
Egyptian fleet working in the Mediterranean Sea during 2014 (GAFRD, 2014)



2.2. Resources exploited

Over the course of a year, trawlers target mainly shrimps (*Penaeus* spp., *Metapenaeus* spp., *Marsupenaeus* spp., *Parapenaeus* spp. and *Aristaeomorpha* spp.), common cuttlefish (*Sepia officinalis*) and some fish species like *Mullus* spp., *Saurida undosquamis* and species of the family Sparidae. Many other commercial species are regarded as bycatch. Discards are mainly composed of small-sized fish and species with no commercial value, including some invertebrates. Trammel nets are used to target various demersal species according to seasonal abundance (Table 2).

The peregrine shrimp *Metapenaeus stebbingi* is a Lessepsian species. It is one of the most important commercial shrimp species caught off the eastern Mediterranean coast of Egypt (GSA, 26). Landings amounted to 1 935 tonnes during 2014. Six shrimp species were recorded in the trawl catch of the eastern Mediterranean (GSA, 26), of which *Metapenaeus stebbingi* constituted about 24 percent (Mahmoud, El-Haweet and Dimech, 2015c).

The family Synodontidae is represented in the Egyptian Mediterranean waters (GSA, 26) by two species: *Saurida undosquamis* and *Synodus saurus*. Brushtooth lizardfish *Saurida undosquamis* is considered one of the most important target species of the commercial fishery in Egypt. It represented about 70 percent (597 tons) of total landings of the family Synodontidae in 2014, which is nearly equal to one percent of the total Egyptian Mediterranean landed catch. The bulk of the landed catch of *Saurida undosquamis* came from the trawl vessels, while the artisanal catch of this species was so minor as to be negligible (Mahmoud, El-Haweet and Dimech, 2015b).

The red mullet *Mullus sermuletus* is one of the most important commercial species landed on the eastern Mediterranean coast of Egypt (GSA 26). Its landings were 2 268 tonnes during 2011; 1 442 tonnes during 2012; 1 058 tonnes during 2013; and

779 tonnes during 2014. Four species of Mullidae (*Mullus surmuletus, Mullus barbatus, Upeneus moluccensis* and *Upeneus asymmetricus*) were recorded in the catch taken from this area. The bulk of the landed catch of red mullet came from the trawl vessels, while the artisanal catch of this species was so minor as to be negligible. *Mullus surmuletus* constituted about 55 percent of the red mullets in GSA 26 (Mahmoud, El-Haweet and Dimech, 2015a).

Soles are an important commercial fish in Egyptian Mediterranean waters and are exploited mainly by trawl and trammels nets. Common sole, *Solea solea* and Egyptian sole, *Solea aegyptiaca* are the most common species (Eid, 2015). Landings totalled 801 tons during 2014.

TABLE 2:
Main demersal fish species exploited in Egyptian Mediterranean waters (modified after GAFRD, 2014)

Family	Scientific name	English name
Mullidae	*Mullus surmulatus*	Surmullets
	Mullus barbatus	Red mullets
Penaeidae	*Penaeus japonicus*	Kuruma shrimp
	Metapenaeus stebingi	Peregrine shrimp
	Penaeus semisulcatus	Green tiger prawn
	Trachypenaeus curvirostris	Southern rough shrimp
Portunidae	*Portunus pelagicus*	Blue swimmer crab
Sepiidae	*Sepia officinalis*	Common cuttlefish
Serranidae	*Serranus cabrilla*	Comber
Sepiolidae	*Sepia officinalis*	Common cuttlefish
Soleidae	*Solea vulgaris*	Common sole
	Solea aegyptiaca	Egyptian sole
Synodontidae	*Saurida undosquamis*	Brushtooth lizardfish
	Synodus saurus	Atlantic lizardfish
Sparidae	*Boops boops*	Bogue
	Diplodus annularis	Annular sea bream
	Diplodus sargus	White sea bream
	Sparus aurata	Gilthead sea bream
	Pagrus pagrus	Red porgy
	Pagellus erythrinus	Red pandora
Ttiglidae	*Eutrigla gurnardus*	Grey gurnard
	Trigloporus lastoviza	Streaked gurnard
Rhinobatidae	*Chondrichthyes* spp.	Cartilagenous fish nei

2.3. Number of fishers and land-based workers by sector

The fishing industry's importance is significant in the coastal regions, especially the Nile Delta, where it is the main source of income and employment and provides a livelihood for many people. The fishing industry's role is even more essential when one considers the indirect employment created by the sector (FAO EastMed, 2014). Most of the fishing communities live along the Mediterranean coast. At present, there

are 11 854 professional fisher cards (plus 1 241 for fishers without boats) issued by the Mediterranean offices of GAFRD. Fisheries provide livelihoods for fishers and their families, because most children of fisher families help with the transport, processing and selling of the catch. One in three fishers in the marine sector is employed in production and two in secondary activities, including post-harvest processing, marketing and distribution (FAO EastMed, 2014).

About 55 percent of trawler owners identify fishing as their main source of income. Furthermore, most of the owners are directly involved in the fishing activities, with the bigger trawlers having the lowest percentage (45 percent) of direct involvement. In Egypt it is common for the ownership of fishing vessels to be shared between different partners. This occurs mainly in the trawler segment of the fleet where the average portion of shares held by each partner is 46 percent. With smaller vessels, the portion tends to be higher (FAO EastMed, 2014).

The most represented age group of the fishing crews in Egypt is 30 and 40 years, which is relatively young when compared with other Mediterranean countries such as Lebanon with an average age of 48 (FAO EastMed, 2014).

The EastMed project determined that the Egyptian Mediterranean fleet provides an annual salary of approximately USD 2 662 per person to around 22 173 fishers. This is higher than the official minimum wage of the country which is USD 1 416. The relatively high salary stems from the fact that the Egyptian industry is heavily subsidized by the very low cost of fuel (FAO EastMed, 2014).

2.4. Interactions with other fisheries

The Egyptian fishing fleet is dominated by trawlers which represent the backbone of the fleet, both in terms of technical characteristics and activity, making Egypt an exceptional case in the Mediterranean, where the national fleets are generally dominated by small-scale fishing vessels. According to a study by the EastMed project (FAO EastMed, 2014), vessels licensed as trawlers make up 36 percent of the motorized vessels in terms of number, and 60 percent in terms of the engine power of the fleet. However, the results of this study also show that in terms of the actual gear used, this percentage is higher because a higher number of vessels use trawl gear as their main fishing gear. The results show that 33 percent of longliners, 5 percent of vessels in the 6 to 12 m LAO category using minor gear, and 4 percent of purse seiners use trawl as their main fishing gear. If these values are taken into account, the number of vessels using trawls as their main gear rises from 36 percent to 41 percent. This makes trawling the most important fishing activity in Egypt and management should focus on the trawler segment of the fleet. This is especially important in Egypt because the current management regime has a big impact on the other fleet segments (FAO EastMed, 2014).

The lack of a management regime in the trawl fishery has probably led over time to the replacement of small-scale fishing vessels with trawlers. In fact, the small-scale fishery is poorly represented and fishers that utilize artisanal gears such as longlines, also use trawl as their main fishing gear. The small-scale fisheries use longlines, trammel and gill nets as the main gears and are problematic for the trawl fishery because their fishing grounds are shared by trawlers. Since the area around the Nile Delta is characterized by shallow water and a sandy seabed with very few rocky areas, trawl activities are practically conducted everywhere, thus limiting the area that the small-scale and passive gear fishery can exploit without the interference of trawlers. In this respect the small-scale fishery is constantly in competition with the trawl fleet for the exploitation of the same fishing grounds (FAO EastMed, 2014).

3. AVAILABLE SCIENTIFIC AND TRADITIONAL KNOWLEDGE OF THE RESOURCES

3.1. Biology of the major species

The red mullets

The red mullets (*Mullus surmuletus* and *M. barbatus*) are major target species of Mediterranean demersal fisheries and are exploited by more than one gear type. They are mainly exploited at depths of 3 to 90 m on sandy or muddy bottoms, but also at times on rocky ground. These species are benthic carnivores and feed on small invertebrates (crustaceans, molluscs and polychaetes) that live on or within the bottom substrates. Red mullets are among the most valuable and highly priced fish species caught in Egypt and although they are widely distributed along the entire Mediterranean coast, the major fisheries are located in the area from Alexandria to Port Said. Red mullets are mainly exploited by the trawl fishery and contribute about 10 percent of the total trawl landings in the Mediterranean (GAFRD annual reports). Although *Mullus surmuletus* and *M. barbatus* comprise most of the catch, some species of Red Sea origin have been recorded in the eastern Mediterranean. The striped red mullet, *Mullus surmuletus* is the most common species and constitutes about 65 percent of red mullet landings (Mehanna, 2009c).

Brushtooth lizardfish

The brushtooth lizardfish *Saurida undosquamis* is one of the main coastal demersal target species of commercial interest in the Eastern Mediterranean, particularly in Egypt. The species is caught almost exclusively by trawlers operating on the shelf of the Egyptian Mediterranean (Mahmoud, El-Haweet and Dimech, 2014).

Saurida undosquamis is a demersal species inhabiting sandy and muddy bottoms, at depths generally above 100 m. Standard lengths (SL) of up to 50 cm have been reported for the species, although specimens ranging from 20 to 30 cm total length (TL) are common. The natural distribution range of *Saurida undosquamis* includes the Indo-West Pacific Ocean (Red Sea, Persian Gulf, Eastern Africa to Japan and Australia), but it has penetrated into the eastern Mediterranean Sea via the Suez Canal. The first specimens were collected in 1953 along the coast of Israel and 266 tonnes were landed by commercial local trawlers during 1956. Catches have since remained high, with some fluctuations. This alien species is one of the most successful colonizers throughout the Levant basin, which extends as far as the Aegean Sea (Gökçe *et al*., 2007).

Peregrine shrimp

Peregrine shrimp is native to the Indo-West Pacific; it was first recorded in the Mediterranean Sea off Egypt in 1924. It has subsequently been recorded in Israel, Lebanon, southern Turkey, Syria and Tunisia. This shrimp reaches a maximum length of 11 cm in males and 14 cm in females. The smooth carapace is cream-coloured and speckled with rust-coloured spots. The antennae and margins of the tail fan are reddish. The rostrum has 7 to 10 teeth on the upper margin. The first and third pairs of walking legs have a basal spine. The longest segment of the fifth walking leg of males (the merus) bears a notch on the inner margin.

Peregrine shrimp inhabits sandy or sandy-muddy bottoms down to 90 m in depth. Juveniles occur in shallow coastal waters and adults usually further offshore, buried in the substrate in daytime and foraging at night. Females attain sexual maturity at a relatively small size (5.5 cm to 6.0 cm in length). The highest percentage of mature females occurs between May and June, but the breeding season generally lasts from April to October (Otero *et al*., 2013).

Sepia officinalis

The common cuttlefish (*Sepia officinalis*) is an important commercial resource and one of the most appreciated cephalopods in Egyptian Mediterranean waters. It is a target species for the trawl fishery.

Sepia officinalis is a nekto-benthic species occurring predominantly on sandy and muddy bottoms from the coastline (2 to 3 m depth) to approximately 200 m depth, with the greatest abundance in the upper 100 m of the water column. Life in inshore waters exposes this species to hydrologically unstable conditions and because of this *Sepia officinalis* is relatively tolerant to fluctuations in salinity. The common cuttlefish exhibits a high degree of physiological flexibility, which allows it to endure changing environments, not only during its adult phase but also in the early juvenile stages (Guerra, 2006). *Sepia officinalis* is a large species that can attain a maximum mantle length of 490 mm and a body weight of 2 kg in temperate waters, and 300 mm and 2 kg in subtropical regions. Both adults and young bury in the sand during the day, ambushing their prey from their hiding place in the sand and feeding on a wide variety of prey, including crustaceans, molluscs, polychaetes, small demersal fish and other cuttlefish (cannibalism is common when the abundance of other prey is low). They are preyed upon by sharks, demersal fishes and other cephalopods. Growth rates are rapid, leading to a life span of one to two years. During autumn and winter individuals migrate to deeper water (approximately 100 m), returning to shallow water in spring and summer. In the Mediterranean large males return to shallow waters ahead of females, with females and smaller individuals joining them throughout the spring and summer. Those young that hatch in spring usually spawn in the autumn of the following year, while those that hatch in autumn usually spawn in the spring of their second year. Young are restricted to shallow water until their cuttlebones are fully formed. Due to post spawning mortality in females, there is sometimes a bias towards adult males (Barratt and Allcock, 2012).

3.2. Geographic distribution of the species

As mentioned before, there is fishing activity along the entire continental shelf off the Nile Delta, extending to the eastern side of Port Said, but rarely west of Alexandria (owing to limited trawling grounds on the western coast). Artisanal fishers typically exploit inshore areas. In general, trawlers work from fishing ports along the Egyptian Mediterranean coast (Alexandria, Madaaia, Rashid, Motobas, Baltim, Damietta and Port Said) and are not restricted by geographic boundaries within Egyptian Mediterranean waters. They do not carry a vessel monitoring system (VMS) and consequently it is impractical to link the landed fish species to certain fishing grounds or definite geographic areas.

3.3. Status of the stocks

The number of stock assessments conducted in Egypt has increased in the past ten years, with most being undertaken by the National Institute of Oceanography and Fisheries (NIOF). Stock assessments have been conducted for several demersal species (Table 3). Although some of the assessments do not cover the entire Egyptian Mediterranean coast, all of them show a state of overexploitation (Table 3). Most of the assessments recommend a reduction of fishing mortality by about 40 percent, with the recommendations lower for some fisheries and higher for others. The stock assessments also suggest other management measures to reduce fishing mortality, such as improving trawl selectivity by increasing mesh sizes, the identification and protection of nursery and spawning areas, the introduction of a minimum distance from the coast within which trawlers may not operate, and closed areas and seasons (FAO EastMed, 2014).

TABLE 3
Summary table for stock assessments of Egyptian fisheries resources in the Mediterranean (modified after FAO EastMed 2014).

Family	Scientific name	Stock Status	Reference Years	Presented to GFCM	References
Bogue	*Boops boops*	Overexploited	2008	Yes	Mehanna, 2010a
Common pandora	*Pagellus erythrinus*	Overexploited	2010, 2011	Yes	Mehanna, 2010b; El-Haweet *et al*., 2011
Lizardfish	*Saurida undosquamis*	Overexploited	2012	Yes	El-Haweet *et al*., 2012
Cuttlefish	*Sepia officinalus*	Overexploited	2010	No	Mehanna & Haggag, 2011a
Egyptian sole	*Solea aegyptiaca*	Overexploited	2005, 2010	No	Mehanna, 2007a; Mehanna & Haggag, 2011b
Hake	*Merluccius merluccius*	Overexploited	2007	Yes	Mehanna, 2009a
Striped red mullet	*Mullus surmuletus*	Overexploited	2008	Yes	Mehanna, 2009b, 2009c
Red mullet	*Mullus barbatus*	Overexploited	2008	Yes	Mehanna, 2009d
Sea bream	*Sparus aurata*	Overexploited	2005	No	Mehanna, 2007b

The results of an assessment of common sole (*Solea solea*) stocks off Alexandria city (at the center of GSA 26) showed that the stock is overexploited (Eid, 2015).

Similarly, stocks of streaked Gurnard (*Trigloporus lastoviza*) in Egyptian Mediterranean waters off Alexandria were studied and found to be overexploited (E = 0.72) and suffering from high fishing pressure (El-Serafy *et al*., 2015).

An assessment of stocks of Bogue (*Boops boops*) from Egyptian Mediterranean waters suggested a decreasing trend in the average fishing mortality during the study period by about 40 percent (Mehanna, 2014).

Two fish species, lizardfish (*Saurida undosquamis*) and red mullet (*Mullus surmuletus*), and one crustacean species, peregrine shrimp (*Metapenaeus stebbingi*) were assessed and the results of the assessment have been presented to the GFCM working groups. They showed that the in GSA 26 these species are in a state of overexploitation (Mahmoud, El-Haweet and Dimech, 2015a, 2015b, 2015c). Detailed results are provided below:

Striped red mullet

According to the GFCM recommendation, the ratios between F_{cur} and $F_{0.1}$ (1.82, 2.08, 2.128 and 2.381 for 2011, 2012, 2013 and 2014 respectively; 2.703 for the merged data of the four years) indicate that, the stock of *Mullus surmuletus* is severely overexploited. A more sustainable harvest strategy is advised, which can be achieved by reducing fishing mortality. Such a reduction can be achieved by limiting fishing activity, for example by reducing the number of working days; improving the selection pattern of the trawl fishery; enforcing the closed season and applying a minimum fish size at landing (Mahmoud, El-Haweet and Dimech, 2015a).

Brushtooth lizardfish

According to the results obtained over four years (2011, 2012, 2013 and 2014) and from the combination of these results, the current fishing level of the lizardfish is higher than the biological reference points ($F_{0.1}$ and F_{max}) and the ratio between F_{cur} and $F_{0.1}$ during 2011, 2012, 2013 and 2014 and 2.632 for the four years together shows that the lizardfish (*Saurida undosquamis*) resources in GSA 26 are overexploited (according to GFCM recommendations, 2012). Based on the fact that the length at first capture is smaller than the length at first maturity, it seems that the fishery is focused on catching juvenile fish (Mahmoud, El-Haweet and Dimech, 2015b).

It has been recommended to reduce the fishing mortality to $F_{0.1}$ through the limitation of trawl fishing activities, the improvement of the selection pattern of the trawl fishery and the enforcement of the closed fishing season (Mahmoud, El-Haweet and Dimech, 2015b).

Peregrine shrimp
The stock is overfished and therefore it is necessary to consider a considerable reduction of fishing mortality in order to achieve $F_{0.1}$. A more sustainable harvest strategy is advised, which can be achieved by the reduction of fishing mortality. Such a reduction can be achieved by limiting fishing activity, for example by reducing the number of working days; improving the selection pattern of the trawl fishery; enforcing the closed season and applying a minimum fish size at landing. The fishery depends on age group 0 and the high vulnerability of juvenile shrimp to capture by trawling may affect and reduce the future yield of the stock. Thus, the protection of juveniles is probably the key factor for the sustainability of the resource. This could be achieved through the establishment of reserves in the eastern Mediterranean so as to protect the nursery grounds. However, the protection of the parental stock is crucial to prevent stock collapse. In this context, a map for the spawning and nursery grounds of the peregrine shrimp should be prepared on the basis of sound biological research (Mahmoud, El-Haweet and Dimech, 2015c).

3.4. Direct interactions with the ecosystem

Bottom trawl fisheries in Egyptian Mediterranean waters are essentially multispecies fisheries. The high marketability of small fish encourages the targeting of the juvenile component of some stocks. Consequently, demersal populations are overfished, shallow areas (within the three-mile coastal limit or depths of less than 50 m deep) are trawled and small mesh sizes are used (Tudela, 2004). Shrimp trawling contributes the highest levels of discard catch ratios of any fisheries, ranging from 3:1 to 15:1 and the amount of bycatch varies in relation to target species (Alsayes, Fattouh and Abu-Enin, 2009). The impact of discards goes far beyond single-species demographic effects because discarded biomass can alter ecosystem structure by favouring scavengers. The consequences of the fishing-driven increase in food supply stemming from discards have seldom been addressed by specific studies (Tudela, 2004).

Although bottom trawling is inherently unselective, bycatch and discards can be minimized. Trawling can be limited and technical measures can be introduced to improve selectivity. Trawl selectivity within an area depends on many factors, ranging from the depth exploited or the kind of seabed, to the season. Most impacting scenarios could be avoided by restricting trawling both spatially and temporally. Trawl gears could be made more selective by using larger mesh sizes or incorporating special exclusion devices, such as those based on rigid grids. The former solution may be difficult to apply in Mediterranean waters for social and political reasons, but the development and compulsory use of exclusion devices that increase selectivity (such as those used in some North Atlantic fisheries) deserve attention. Alternatively, the use of a square mesh can also improve selectivity. It is also important to mention that shorter trawling hauls are known to reduce discard rates (Tudela, 2004).

3.5. Traditional knowledge about the fishery and the resources exploited

Egyptian fishing communities have their own knowledge about fish stocks and other marine resources, including information on the location of resources, movements and seasonal abundance of species of economic importance, and details on their reproductive and feeding behaviour. Local people also often have a good understanding of how resources and the environment have changed over time, and possible explanations for the change.

Local communities may have their own names and classifications (or "taxonomy") for resources, places (particularly significant sites such as fish spawning aggregation sites, fishing grounds and landing sites), and marine-related activities. The ways in which these elements are classified may not reflect the scientific taxonomy used by biologists. For example, factors such as palatability and seasonal availability may be used by local communities to categorize resources (IUCN, 2004).

Local or traditional knowledge is generally passed by word of mouth between the generations and is not often recorded in writing. Gathering information of this nature therefore requires techniques such as interviews, focus groups and other participatory methods.

4. ANNUAL CATCHES

Figure 4 shows the trend in landings for the main demersal species from the Egyptian Mediterranean, as indicated in the official GAFRD statistics for the period 2005 to 2014 (GAFRD, 2014). A general fluctuation in landings can be seen for most of the species over the period illustrated in the graph. The main species in terms of quantity are shrimp (several species) followed by bogue (*Boops boops*) and blue swimming crab (*Portunus pelagicus*).

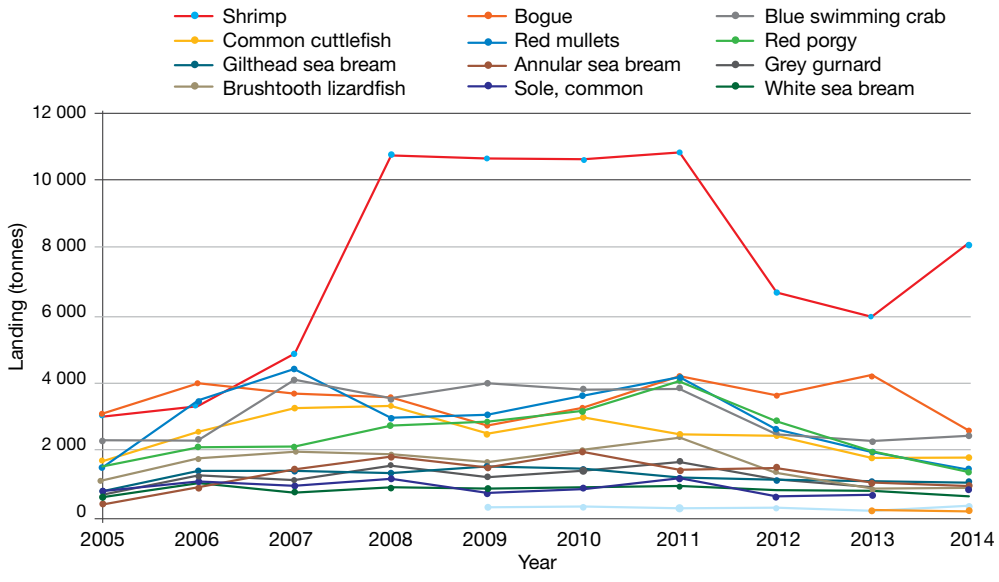
From the figure, it can be seen that for the period 2008 to 2011, landings of shrimp soared remarkably from around 3 000 tonnes to more than 10 000 tonnes and then declined again in 2012 to reach around 8 000 tonnes in 2014. This remarkable increase may be explained by the expansion of fishing activity to new fishing grounds in the eastern part of the Egyptian Mediterranean waters, and to deeper areas. The later decline in catch could be due to overfishing of these new fishing grounds.

Bogue's landing numbers shown here are not exclusive to trawl and trammel nets because the species is caught by bottom trawls, purse seines, beach seines and trammel nets and the different fishing gears are not distinguished in the official GAFRD statistics.

It is worth noting that the landings of cartilaginous fish (as termed in the official GAFRD statistics) increased from 577 tonnes in 2005 to 1 843 tonnes in 2014.

FIGURE 4

Trends in landings for the main demersal species from the Egyptian Mediterranean Sea over the period 2005 to 2014



5. IMPORTANCE OF THE FISHERY TO THE NATIONAL ECONOMY

5.1. Value of the catches

The Egyptian capture fisheries production from the Mediterranean Sea increased steadily over the years until 2008, when a decreasing trend began. This has continued to the present. Currently, production is around 63 000 tonnes, most of which comes from the capture of species in the coastal zone and over the continental shelf. The waters of the Mediterranean Sea are generally poor in marine resources, but the discharge of drainage water with high nutrient levels from the Nile Delta region increases the productivity of the coastal region (FAO EastMed, 2014).

The total value of landings is about USD 182 million. The trawler fleet contributes 48 percent of total value, while the purse seine fleet targets low value species and contributes 15 percent. The contribution of longliners is 23 percent, while the two minor gear segments and the polyvalent segment contribute 10 percent and 4 percent respectively (FAO EastMed, 2014).

The Mediterranean fisheries generated a net profit of USD 42.5 million, representing 23 percent of the gross revenues. The average price per kilogram of production in Egypt ranged between USD 3.6/kg and USD 4.3/kg for the trawlers; USD 2.4/kg for the purse seiners and between USD 3.2/kg to USD 4.0/kg for the other four segments using passive gears. The prices are generally lower than European prices (USD 6.1/kg), however when one considers the macroeconomic structure of the country, seafood is quite expensive for the local population in relation to their purchasing power. The first sale of seafood products occurs mostly through the auction markets (56 percent) and through the wholesalers (40 percent). The revenue of the fleet provides an annual salary of about USD 2 662 per fisher to about 22 173 fishers. For the fishers who are the sole vessel owners (approximately 60 percent), their revenue also includes the net profit, which is on average USD 14 196 per vessel. This results in an overall gross income of USD 16 858 per fisher for those who are sole vessel owners (fisher–owner). The income per fisher is much higher than the official minimum wage in Egypt (USD1 416), higher than the mean wage of employees in the aquaculture sector (US 1 700) and also higher than the national gross domestic product (GDP) per capita of USD 2 781 (World Bank, available at https://data.worldbank.org/indicator/ny.gdp.pcap.cd). When one considers the national average wage, fisheries is a reasonably profitable activity, however it is extremely important to note that this profitability partly derives from the fact that the industry is heavily subsidized by the very low cost of fuel, which is one of the main operating costs (26 percent) (FAO EastMed, 2014).

5.2. Products and markets

The fisheries production from the Mediterranean Sea is composed mostly of fish (approximately 70 percent), followed by crustaceans (approximately 20 percent) and molluscs (approximately 10 percent). The landing composition shows that the importance of crustaceans has grown over the years. The share of total production that is attributed to crustaceans has doubled in the last nine years, growing from about 10 percent to 20 percent. With respect to the fish, the most important species in 2011 were the bogue (*Boops boops*: 4 156 tonnes) and red mullets (*Mullus* spp. and *Upeneus* spp.: 4 124 tonnes) (FAO EastMed, 2014).

In general, the Egyptian fishing fleet sells its production almost exclusively through indirect transaction channels with a markedly different pattern between the trawlers, which mainly sell through wholesalers, and the small-scale and artisanal vessels that channel their production primarily through the fish market. In the case of trawlers, it is clear that the bigger the vessel, the bigger the share of product sold through the wholesaler. The share of self-consumption was generally about one percent of total production (FAO EastMed, 2014).

6. FISHERIES MANAGEMENT PLAN AND OBJECTIVES

Within the primary fisheries legislation, there are no policy objectives for the management of marine fisheries in Egypt and the Act No. 124 of 1983 is primarily an administrative tool. However, the Act does specify (under Article 65) the areas in which the Minister for Agriculture (or the President) can make decrees relating to fisheries. These specific areas are broad and include, among others:

1. Establishing required specifications for fishing vessels.
2. Demarcation of areas in which fishing is prohibited, or where specific fishing gear is prohibited.
3. Specification of the species of fish or other marine life that is prohibited to catch.
4. Specification of the minimum sizes and lengths of fish which it is prohibited to catch, sell or possess.
5. Specification of the number and types of licenses that can be issued in each area.
6. Regulation of amateur fishers and the establishment of the fees payable by them.

As well as a lack of specific policy objectives within the Fisheries Act, there is also no stated policy framework for marine fisheries by the GAFRD or the Ministry of Agriculture and, therefore, marine fisheries policy needs to be inferred from actions taken (or not taken) by the GAFRD. However, the GAFRD prepared a strategy for the development of fisheries for the period 1997 to 2017. The strategy has three main objectives:

1. To increase fish production, mainly from aquaculture, in order to raise per capita consumption to 16.5 kg/year in 2017 for an estimated population of 90 million people.
2. To raise the quality of fish and fish products to reach an international standard and to establish new markets for Egyptian fish exports.
3. To optimize the use of natural and human resources.

7. LEGAL FRAMEWORK

The main fisheries legislation in Egypt is the Act No. 124 of 1983 on Fishing, Aquatic Life and Aquaculture. The legislation deals with administrative issues in the first section, water pollution and obstructions to fishing operations in the second section, and aquatic resources and the regulation of fish farms in the third section (Table 4).

The fisheries legislation does not address the issue of Egyptian fishing vessels operating outside Egyptian waters. The licensing of Egyptian vessels intended to be used for fishing on the high seas, or in the waters of a third country, is not required.

With respect to international agreements, Egypt has ratified the United Nations Convention on the Law of the Sea and declared an exclusive economic zone (EEZ). In the Mediterranean there is an agreement with only one country, that is between Egypt and Cyprus and it concerns the delimitation of the EEZ, which is measured by the median line between the baselines of the two countries.

Egypt has also signed the 1995 United Nations Fish Stocks Agreement but has not yet taken steps to ratify it. This may indicate the reluctance of Mediterranean states to be bound by Part VI of the Agreement on compliance and enforcement, which under certain conditions authorizes inspectors of a State Party to the Agreement to board and inspect fishing vessels flying the flag of another State Party to the Agreement (Cacaud, 2005).

Egypt is also a member of the GFCM, but the country has not ratified the 1997 amendment on the obligation to contribute to the GFCM's autonomous budget (Suárez de Vivero, 2012).

In 2009, the International Commission for the Conservation of Atlantic Tunas (ICCAT) allocated a bluefin tuna quota to Egypt. The total quota was 67.08 tonnes, corresponding to 0.5 percent of total allowable catch. Two Egyptian purse seine vessels are registered in the ICCAT record of authorized vessels (FAO EastMed, 2014).

TABLE 4
List of fisheries legislation in Egypt, showing the main laws and their regulatory measures

Law name	Year of issuing	Main regulatory measure
Law 124	1983	Provides the GAFRD with responsibility for: 1. The development and management of fishery resources, including aquaculture. 2. Issuing fishing licenses. 3. Supervising fisheries cooperatives. 4. Producing statistical data.
Art. 2		Stipulates that every vessel should have a fishing license issued by the GAFRD.
Art. 8 and Art. 9		Indicate the gear type used by the vessel and the allowed fishing grounds. Prohibit the use of other gear, or fishing in areas other than those specified in the license.
Art. 11		Prohibits fishing of undersized fish, according to the length and size established by the Minister of Agriculture.
Art. 13		Prohibits the use of destructive, poisonous or illegal fishing practices.
Art. 19		Prohibits the collection and removal of fish fry from the sea or lakes without permission.
Art. 20		Prohibits draining any area of a lake for fishery exploitation.
Art. 27		Stipulates that licenses should be renewed every year.
The decree no. 174	1989	Defines the minimum mesh size and length of nets by fishing gear.
The resolution no. 342	1992	Prohibits the issuing of any new fishing licenses for trawl in either the Red Sea or the Mediterranean Sea from 1 January 1994.

Source: Samy-Kamal, 2015

8. INSTITUTIONAL AND ADMINISTRATIVE FRAMEWORKS FOR FISHERIES MANAGEMENT

In the Ministry of Agriculture, the GAFRD is responsible for the development and management of fishery resources, including aquaculture, as designated by law 124 of 1983. The GAFRD is responsible for issuing fishing licences, supervising fisheries cooperatives and producing statistical information on fish production, consumption and trade, among other things. The GAFRD is the only branch of government that may draft fisheries and aquaculture legislation, renew or issue new: (i) licences for fishing vessels; (ii) licences for fishing; and (iii) leases for land holding aquaculture farms. It monitors and regulates transportation of fry and fingerlings between hatcheries and aquaculture farms, and signs international treaties dealing with capture fisheries and aquaculture. The Authority undertakes its tasks from its headquarters, working through seven regional offices.

The Co-operative Union of Aquatic Resources deals with fishers' and aquaculturists' social and economic conditions. In addition, the Egyptian Coast Guard and the Ministry of the Environment also deal with fisheries issues.

The majority of fisheries research in Egypt is carried out by the NIOF, which has some 1 500 staff, of which 700 are researchers and research assistants. Its research covers both living resources (fish biology, stock monitoring and assessment, fish technology, aquaculture, fishery statistics and economics, and pollution monitoring and control) and limnology and physical oceanography. It has a number of stations in Egypt and carries out ecological and fisheries surveys along the Mediterranean and Red Sea coasts, as well as inland fisheries research.

8.1. National and regional forums for discussions about fisheries management

At the national level, the GAFRD is responsible for consulting with the Supreme Committee for Fisheries, which is formed of representatives of stakeholders (high-level scientists, GAFRD managers, fisheries cooperative chiefs, etc.). The committee's role is to help shape general policies and procedures for the fisheries sector and develop a management plan to guarantee its sustainability. The committee consults with expert working groups on specific areas of relevance to the fisheries sector (e.g. social and economic issues).

At the regional level, Egypt cooperates in many regional workshops, seminars and conferences concerning the fisheries sector. Egypt is a member of several regional bodies such as the GFCM and the Scientific Advisory Committee on Fisheries (SAC) and its sub-committees (e.g. Working Group on Stock Assessment of Demersal Species [WGSAD]) and always welcomes any cooperation under the umbrella of FAO.

9. MANAGEMENT MEASURES AND TOOLS CURRENTLY IN USE AND STATUS OF IMPLEMENTATION

As mentioned before, within the primary fisheries legislation, there are no policy objectives established for the management of marine fisheries in Egypt and the Act is primarily an administrative tool. However, the Act does specify (under Article 65) the areas in which the Minister for Agriculture (or the President) can make decrees relating to fisheries. In this respect there have been several decrees and resolutions issued since 1983 on issues relating to port development, fishers' cooperatives and other administrative matters. However the only decrees and resolutions that have been issued that relate to the management of fisheries have been:

a) Decree No 174 of 1989 which specifies the minimum mesh size and length of nets by fishing method. The mesh size regulations were set at low levels relative to scientific advice.
b) In 1992, the GAFRD issued a resolution (Resolution 342 of 1992) which stated that no more licenses for trawl fishing would be issued in either the Red Sea or the Mediterranean Sea from 1 January 1994. However, it is understood that this resolution has not been implemented effectively and additional licenses have, indeed, been issued.
c) Resolution No. 376 of 28 March 2000 specified that for the year 2000 the use of nets, including trawl nets, is prohibited from 1 April to 15 May, except for surrounding nets that can be used at night time (Article 1), use of fishing rods is allowed from 1 April to 15 May in the area extending from Rashid and Salloum (Article 2); and trawlers licensed to fish in the Gulf of Suez and the Red Sea are not allowed to operate in the Mediterranean Sea (Article 3).
d) A closed season for trawling from 1 June to 30 September each year. This closed season appears to have been made by administrative decision rather than decree or resolution.

9.1. Effectiveness of the current management measures

Like other developing countries, fishery management in Egypt is challenged by the complex nature of the associated social–ecological systems. The fisheries are described as labour intensive, multispecies and multi-gear, they are widely distributed along the coast and associated with high levels of community dependence (Samy-Kamal, 2015).

In such a context, it is difficult to control fishers' behaviour or to enforce regulations. The demand for fishery resources has been gradually increasing as a result of the rise in population and tourism development. This has led to increased pressure on stocks and the use of destructive and illegal gear and techniques. Most of the destructive methods

are prohibited by law but continue to be used due to a lack of surveillance, enforcement and public awareness (Samy-Kamal, 2015).

Despite the robustness of the national legislation and the power that exists within it to address fisheries management issues, these powers have not been used to any great extent. As a result, the marine fisheries of Egypt are essentially unregulated with no management plans and the implicit policy framework has been one of development rather than restriction (FAO EastMed, 2014).

At present the management of the trawl activities is very limited. There are no minimum mesh sizes nor minimum landing sizes for the target species; no closed seasons or other temporal limitations, and no minimum distance from the coast in which trawling activities can be conducted. The latter shortcoming influences considerably the fishing activities of the small-scale fleet, which shares the entire fishing grounds with trawlers (FAO EastMed, 2014).

9.2. Enforcement and compliance issues

Despite vigorous efforts through national legislation to address fishery management issues, the weak enforcement, low compliance and unregulated fishing suggest the need to restructure the fisheries management system. Improving enforcement is essential and this involves the need for more effective fishery patrols, which in turn may improve community education regarding environmental and fishery issues. Management measures are enforced by the Coast Guard, Navy and national Police while local fishers' cooperatives actively work with the GAFRD to ensure compliance with the few management measures that are in place in the artisanal fishery.

10. OTHER COMMENTS RELEVANT TO THE CURRENT MANAGEMENT OF THE FISHERY AND THE WAY FORWARD FOR THE INTRODUCTION OF AN ECOSYSTEM APPROACH TO FISHERIES

Ultimately Egyptian fishing communities and an entire economic sector supported by fisheries resources are at stake. There is a pressing need to take action to reverse the current state of fisheries in Egypt. Appropriate management strategies and plans to improve the current situation are necessary, as is the monitoring of the success of these strategies and the enforcement of regulations. Most measures and regulations relating to fisheries are outdated and largely violated, which makes it difficult to have adequate control over the fisheries sector (Samy-Kamal, 2015). The EAF, as a pragmatic approach, can facilitate the practical translation of high-level sustainability goals into implementation on the ground. Implementing EAF is an opportunity to enhance fisheries management effectiveness in Egypt, despite some challenges that could be overcome if supported by stakeholders and led by political determination. Furthermore, EAF encourages the incorporation of the fishing sector itself into management decisions and actions. This aids in understanding community priorities and behaviour, so as to adapt management tools appropriate to their needs. The fruitful cooperation of all stakeholders is necessary for the success of any management plan and the benefit resulting from the application of the EAF will reflect positively on the Egyptian fisheries sector in general.

11. CONCLUSION

The bottom trawlers in Egyptian Mediterranean waters probably represent the backbone of the marine fishing sector in terms of both economic value and employment. Bottom trawl fisheries are essentially multispecies fisheries and the high marketability of small fish encourages the targeting of the juvenile portion of the stocks of some species. Consequently, demersal populations are overfished and most of the stock assessments of demersal species recommend a reduction of fishing mortality by about 40 percent, although this is lower for some species and higher for others.

Generally, fishery management in Egypt is challenged by the complex nature of the associated social-ecological systems. The EAF could therefore contribute by helping to sustainably manage this fishery.

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This technical paper presents a baseline report for the Egyptian Mediterranean demersal fisheries. It documents all the available information about the fisheries, including the species fished, the geographical areas covered, the socio-economic characteristics of the fisheries and the institutional arrangements for their management.

The baseline report was prepared under a pilot case study on the ecosystem approach to fisheries in the Mediterranean coast of Egypt. The case study was implemented within the framework of the FAO Mediterrean Project EastMed (Scientific and Institutional Cooperation to Support Responsible Fisheries in the Eastern Mediterranean).

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