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National Inventory and status of Chondrichthyes in the South Mediterranean Sea (Libyan Coast)

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ABSTRACT Libya has the longest coastline in the southern Mediterranean Sea, which is distinguished by the diversity of habitats and marine species; chondrichthyans are one component of this diversity. They are vulnerable to overexploitation due to their reproduction pattern and are generally regarded as a few resilient species. A total of 59 Elasmobranchs belonging to 24 families have been recorded along the Libyan coast out of about 88 documented species (FAO, 2018a; FAO, 2018b; Serena and Barone, 2023). Most of these species breed in the central part of Libya (Gulf of Sirt). A total of 8 elasmobranchs species were identified as by-catch in the Libyan tuna longline fishery (*Prionace glauca, Isurus oxyrinchus, Odontaspis ferox, Alopias superciliosus, Heptranchias perlo, Mustelus mustelus, Pteroplatytrygon violacea* and *Carcharhinus plumbeus*). The Tiger shark, *Galeocerdo cuvier*, is the most recently documented species on the western coast of Libya. This study provides some important information on elasmobranchs in Libyan waters to fill the gap of knowledge about these species in Libya and the southern Mediterranean regions.

KEY WORDS Taxonomy; sharks; batoids; chimaera; checklist; Libya.

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INTRODUCTION

Libyan coast extends for about 2,000 kilometres and is one of the longest coasts in the Mediterranean Sea as it occupies about 3.9% of the southern coast of this sea. From a bathymetric point of view, three areas may be distinguished along the coast of Libya, closely associated with major structural features of the African continent (Zupanovic & El-Buni, 1982). Elasmobranches are very vulnerable to overexploitation and generally considered as most sensitive and resilient species (Stevens et al., 2005). In fact, they also represent an important by-catch of the industrial and artisanal fishery, especially for adult individuals (Quignard & Capapé, 1971). At a global level, the Chondrichthyes include sharks, batoids (skates and rays), and chimaeras belonging to about 57 families, 219 genera, and over 1,280 living species (Ebert & Stehmann, 2013; Last et al., 2016; Nelson et al., 2016; Scharpf & Lazara, 2019; Roskov et al., 2020). At the Mediterranean level, the Chondrichthyes fish fauna is relatively di-

verse with at least 89 species (approximately 7% of total living chondrichthyans), comprising 49 species of sharks from 21 families, 38 batoid species from 10 families, and 2 probably species of chimaera (mimeo) (Serena & Barone, 2023). Among the 89 species known in the Mediterranean Sea, only 73 were assessed within the framework of the International Union for Conservation of Nature (IUCN) Red List. About 40 percent are Vulnerable and Endangered to Critically Endangered (Dulvy et al., 2016). Many chondrichthyans are generally slow growing, have low fecundity and late to mature, long gestation periods, high natural survivorship of all age classes, and a relatively long lifespan (Camhi, 1998; Cailliet et al., 2006; Fowler & Cavanagh, 2005; Steven, 2005). Their biology makes them more susceptible to fishing mortality than most teleost species (Steven, 2005). Such intrinsic biological features have serious implications for the survival of chondrichthyan populations, especially in this almost enclosed sea, severely limiting their capacity to sustain fisheries or to recover from significant fishery-induced population declines (Camhi, 1998; Cailliet et al., 2006). Sharks, rays, and chimaeras are by far the most threatened marine fishes in the Mediterranean Sea, with 31 species (40%) in threatened categories. Species of the orders Hexanchiformes, Lamniformes, Squatiniformes, Rhinopristiformes, and are of particular concern, as 67–100% of species in these orders are in threatened categories. Additionally, 60% of species of the Rajiformes and Myliobatiformes are considered Threatened or Near Threatened. Even though sharks and rays are among the most studied marine fish species, 6 orders (Hexanchiformes, Carcharhiniformes, Squaliformes, Torpediniformes, Myliobatiformes, and Chimaeriformes) in particular, have relatively high, numbers of species (33–100%) listed as Data Deficient in the Mediterranean Sea (Walker et al., 1997). There is international concern about the decline in the abundance and diversity of chondrichthyans resulting from fishing pressure and the nature of their biology and habitat impairment, so attention was recently on improving the conservation and management of these species and highlighting it (FAO, 2018a). Many action plans were elaborated on this issue, first of all, the International Plan of Action for the Conservation and Management of Sharks (FAO, 1999; Fischer et al., 2012) but also the UNEP Mediterranean Action Plan, etc. (Valls et al., 2001; Séret & Serena 2002; SPA/RAC, 2020).

The cartilaginous fishes occupy a wide range of habitats, including freshwater riverine and lake systems, inshore estuaries and lagoons, coastal waters, the open sea, and the deep ocean (Ebert & Stehmann, 2013). Most species have a relatively restricted distribution, occurring mainly along continental shelves and slopes and around islands, with some endemic to small areas or confined to narrow depth ranges (Bigelow & Schroeder, 1948; Compagno, 1984). Others are disjunctive in their distribution, represented by many populations occurring in widely separated areas around the world (Cailliet et al., 2006). The first evaluation of the conservation status of the Libyan chondrichthyans (Valls et al., 2011) highlighted four endemic species (*Leucoraja melitensis* (Clark, 1926), *Raja asterias* Delaroche, 1809, *R. polystigma* Regan, 1923 and *R. radula* Delaroche, 1809) mentioned by Serena (2005) as well. In fact, to date, systematically studies on the populations of chondrichthyans in Libyan waters have not been done. Therefore, this paper wants to present the status of the cartilaginous fishes in the south Mediterranean Sea, in particular along the Libyan coasts, favouring their better knowledge from a biological point of view.

MATERIAL AND METHODS

Records of cartilaginous fishes were based on a compilation of published articles, articles in the press, grey literature, and unpublished data, including surveys and awareness campaigns carried out in the last two decades. The samples were recorded along the entire Libyan coast during two periods: from January 2005 to March 2006 and from January 2013 to January 2017 (Table 1). These surveys, including all the landing sites (131) were conducted along the Libyan waters, in three main regions (East Region [ER], Central Region (= Gulf of Sirte) [CR] and West Region [WR]) (Fig. 1). More consideration was on the seasonal landing site were distributed in the area from Misrata to Benghazi coast (Gulf of Sirte). This area is a good habitat for the reproduction of several Elasmobranchs species (pers. observ.). Here fishermen use a kind of gill net (kellabia): 1000–1500 m long and 2–3 m high gill net of 25–30 cm mesh size, (handmade), targeted to catch several species of sharks such as *Carcharhinus plumbeus*, *C. brevipinna*, *C. limbatus*, also some data were collected from observers on board two Libyan tuna longliners

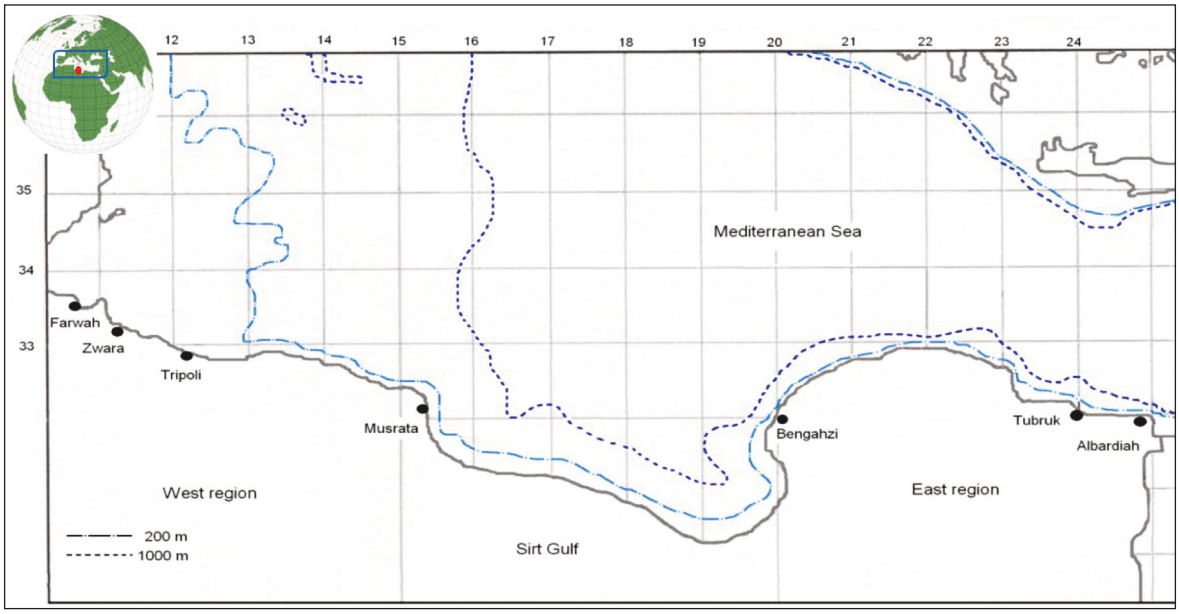

Fig. 1. Map of the Libyan coast, showing the main sampling sites.

(Al-Fajer E-Munear and Annajma El-Byda) during the months of May and July. A total of 8 elasmobranches species were identified as by-catch in the Libyan tuna longline fishery during May and Jun 2006 (Table 2). As routine, the by-catch species were sorted for identification. The by-catch species were identified according to some identification field guides (Compagno, 1984; Smale & Cowley, 1992; Williams et al., 2008; Fischer et al., 2012; Ebert & Stehmann, 2013). The fishing gear used is a drifting surface longline equipped with plurifilament main line and clips, utilizing a maximum of 3,500 hooks per set, baited with squid (*Illex* spp.), mackerel (*Scomber japonicus*), sardine (*Sardinella aurita*) and milkfish (*Chanos chanos*). Fishing is undertaken in the Gulf of Sirte and extends to the east Libyan coast at depths ranging from 200 to 1,200 meters. Several samples were immediately washed with salt water and were identified according to FAO-Field Identification Guides (Rousset, 1990; Smale & Cowley, 1992; Smale & Cowley, 1992; Ferreira et al., 2015; FAO, 2018a, b; Fricke, 2020; Seren & Barone, 2023). Some specimens were preserved in 10% of formaldehyde. Standard morphometric and meristic measurements were taken. Specimens have been labelled and documented for preservation in the Natural History Museum of Zoology Department, Tripoli University; the nomenclature adopted in this paper follows the Catalog of Fishes (Fricke, 2020) and ASFIS for the common names (FAO-ASFIS, 2002). Libyan Authority for Research, Science, and Technology funded this study.

RESULTS

Fifty-seven species have been recorded along the Libyan coast representing 27 families and 10 orders. The Familia Rajidae is more abundant (Fig. 2; Table 1) with 12 species (21.05%). Indeed, in recent decades scientific programs carried out in Libyan waters have recorded a positive trend in terms of the number of chondrichthyan species (Fig. 3).

The status of these species showed that most of them are of Least Concern (more than 19%) followed by Endangered (more than 17%) and the lowest percentage is Not Evaluated (more than 5%) (Fig. 4).

The current level of knowledge of the occurrence and geographical distribution of sharks, batoids, and chimaeras in Libyan waters is described by the ordination suggested by Eschmeyer's Catalog of Fishes and WoRMS (Fricke, 2020; Yaglioglu et al., 2015). The presence of these species is listed below organized by taxa and therefore orders, families, and species. Inside Family, the species are organized in alphabetic order.

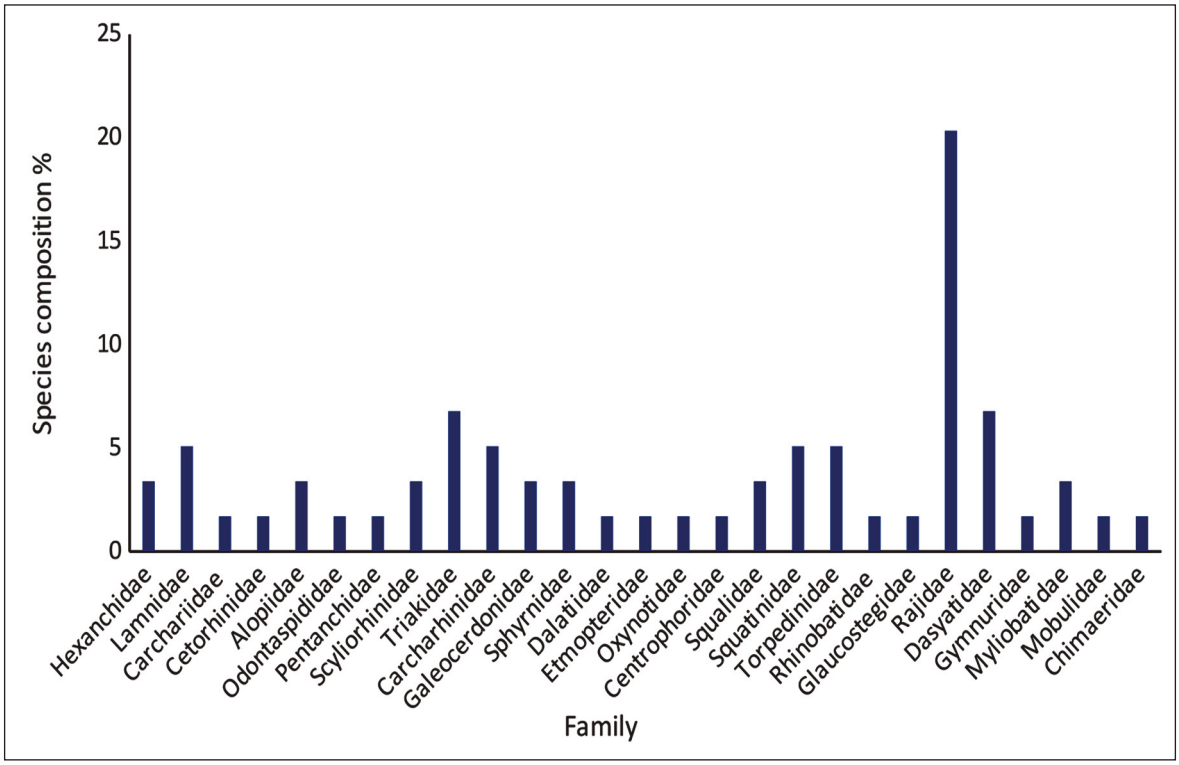

Figure 2. Composition of Cartilaginous species on the Libyan coast by Familia.

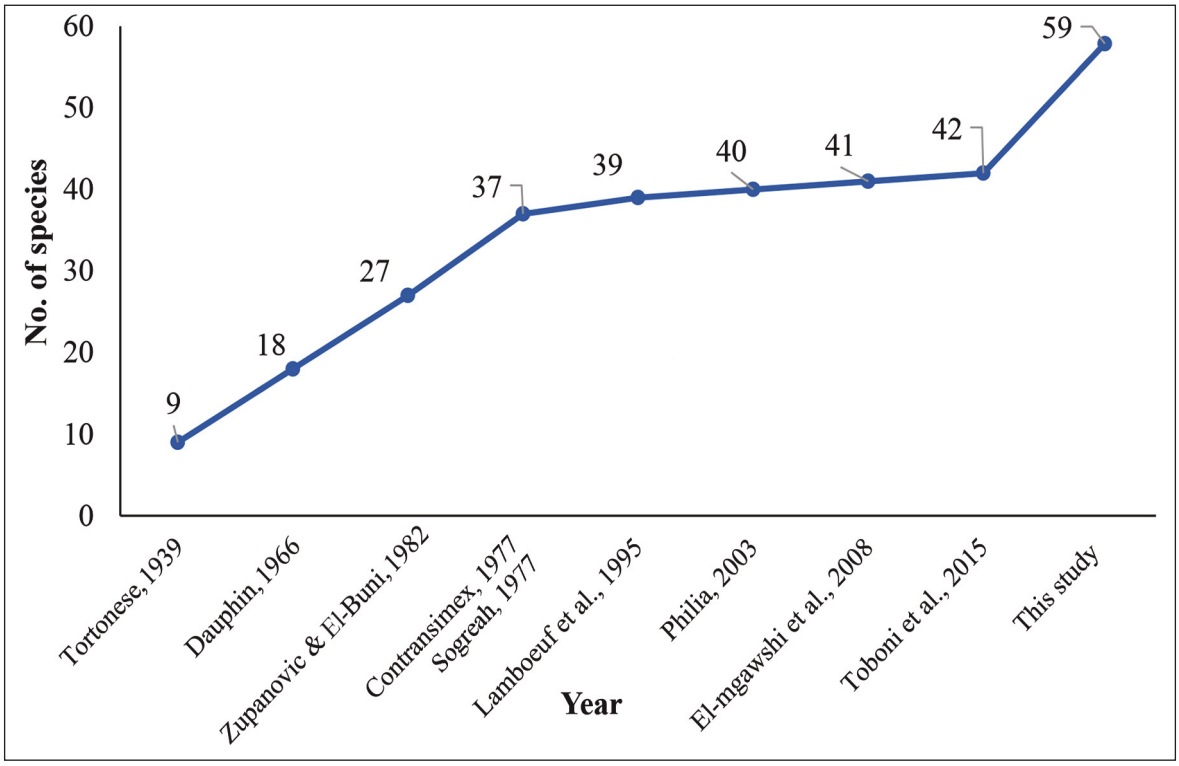

Figure 3. The number of species in different years according to references of Cartilaginous species in the Libyan coast.

Species	Common name	Occurrence	IUCN Categories	Reference
Sharks				
Alopias superciliosus	Bigeye thresher	Rare	VU	Zupanovic & El-Buni, 1982
Alopias vulpinus	Thresher	Rare	VU	This study
Carcharhinus brevipinna	Spinner shark	Occasional	VU	Zupanovic & El-Buni, 1982
Carcharhinus limbatus	Blacktip shark	Occasional	VU	Tortonese, 1939
Carcharhinus plumbeus	Sandbar shark	Frequent	EN	Zupanovic & El-Buni, 1982
Carcharias taurus	Sand tiger shark	Rare	CR	This study
Carcharodon carcharias	Great white shark	Rare	VU	This study
Centrophorus uyato	Gulper shark	Common	EN	Zupanovic & El-Buni, 1982
Cetorhinus maximus	Basking shark	Rare	EN	This study
Dalatias licha	Kitefin shark	Rare	VU	This study
Etmopterus spinax	Velvet belly	Rare	VU	This study
Galeocerdo cuvier	Tiger shark	Rare	NT	Toboni et al., 2015
Galeorhinus galeus	Tope shark	Occasional	CR	Dauphin, 1966
Galeus melastomus	Blackmoth catshark	Occasional	LC	Zupanovic & El-Buni, 1982 2
Heptranchias perlo	Sharpnose sevengill shark	Occasional	NT	Lamboeuf et al., 1995
Hexanchus griseus	Bluntnose sixgill shark	Occasional	NT	This study
Isurus oxyrinchus	Shortfin mako	Occasional	EN	This study
Lamna nasus	Porbeagle	Rare	VU	This study
Mustelus asterias	Starry smooth-hound	Common	NT	Zupanovic & El-Buni, 1982
Mustelus mustelus	Smooth-hound	Frequent	EN	Tortonese, 1939
Mustelus punctulatus	Blackspotted smooth-hound	Common	VU	This study
Odontaspis ferox	Smalltooth sand tiger	Rare	VU	This study
Oxynotus centrina	Angular roughshark	Rare	EN	Tortonese, 1939
Prionace glauca	Blue shark	Rare	NT	El Mgawshi et al., 2008
Scyliorhinus canicula	Small-spotted catshark	Frequent	LC	Philia, 2003
Scyliorhinus stellaris	Nursehound	Occasional	VU	Zupanovic & El-Buni, 1982
Sphyrna lewini	Scalloped hammerhead	Rare	CR	This study
Sphyrna zygaena	Smooth hammerhead	Rare	VU	Zupanovic & El-Buni, 1982
Squalus acanthias	Piked dogfish	Occasional	VU	Sogreah, 1977
Squalus blainville	Longnose spurdog	Frequent	DD	This study
Squatina aculeata	Sawback angelshark	Occasional	CR	Zupanovic & El-Buni, 1982
Squatina oculata	Smoothback angelshark	Occasional	CR	Lamboeuf et al., 1995
Squatina squatina	Angel shark	Occasional	CR	Dauphin, 1966
Batoids				
Aetomylaeus bovinus	Bull ray	Occasional	CR	Contransimex, 1977
Bathytoshia lata	Roughtail stingray	Occasional	VU	Contransimex, 1977
Dasyatis pastinaca	Common stingray	Common	VU	Tortonese, 1939
Dipturus batis	Blue skate	Rare	CR	Contransimex, 1977
Dipturus oxyrinchus	Longnosed skate	Common	NT	Dauphin, 1966
Glaucostegus cemiculus	Blackchin Guitar fish	Common	CR	Tortonese, 1939
Gymnura altavela	Spiny butterfly ray	Common	EN	Dauphin, 1966

Leucoraja fullonica	Shagreen ray	Occasional	VU	Contransimex, 1977
Leucoraja melitensis	Maltese ray	Occasional	CR	Dauphin, 1966
Leucoraja naevus	Cuckoo ray	Occasional	LC	Sogreah, 1977
Mobula mobular	Devil fish	Rare	EN	This study
Myliobatis aquila	Common eagle ray	Common	CR	Sogreah, 1977
Pteroplatytrygon violacea	Pelagic stingray	Frequent	LC	This study
Raja asterias	Mediterranean Starry ray	Occasional	NT	Sogreah, 1977
Raja clavata	Thornback ray	Common	NT	Dauphin, 1966
Raja miraletus	Brown ray	Occasional	LC	Tortonese, 1939
Raja montagui	Spotted ray	Occasional	LC	Sogreah, 1977
Raja polystigma	Speckled ray	Common	LC	Dauphin, 1966
Raja radula	Rough ray	Common	EN	Sogreah, 1977
Rhinobatos rhinobatos	Common guitar fish	Common	CR	Dauphin, 1966
Rostroraja alba	White skate	Occasional	EN	Tortonese, 1939
Taeniurops grabatus	Round stingray	Occasional	NT	This study
Tetronarce nobiliana	Great Torpedo Ray	Rare	LC	Dauphin, 1966
Torpedo marmorata	Marbled electric ray	Rare	VU	Tortonese, 1939
Torpedo torpedo	Ocellate Torpedo	Common	VU	Tortonese, 1939
Chimaeras				
Chimaera monstrosa	Rabbit fish	Rare	VU	This study

Table 1. List of cartilaginous species on the Libyan coast. IUCN Categories are considered: NT = Near Threatened, VU = Vulnerable, LC = Least Concern, EN = Endangered, CR = Critically Endangered, DD = Data Deficient (IUCN, Red List). The species are in alphabetical order.

SHARKS

Ordo HEXANCHIFORMES Compagno, 1973
Familia HEXANCHIDAE Gray, 1851
Genus *Heptranchias* Rafinesque, 1810

Heptranchias perlo (Bonnaterre, 1788)

Tropical and temperate seas, excluding the northeast Pacific. Western Atlantic: North Carolina, USA, and northern Gulf of Mexico to Cuba, then from Venezuela to Argentina. Eastern Atlantic: Morocco to Namibia, including the Mediterranean Sea. Indian Ocean: southwestern India, Aldabra Island, southern Mozambique, and South Africa. Western Pacific: Japan to China, Indonesia, Australia, and New Zealand. Southeast Pacific: off northern Chile.

Genus *Hexanchus* Rafinesque, 1810

Hexanchus griseus (Bonnaterre, 1788)

This species is widely distributed in temperate and tropical seas of the continental and insular shelves of the Pacific, Atlantic (including the type locality in the Mediterranean Sea) and Indian oceans. It occurs from the surface to at least 2,000 m, on continental and insular shelves, and upper slopes (including seamounts).

Ordo LAMNIFORMES Garman, 1885
Familia LAMNIDAE Bonaparte, 1835
Genus *Carcharodon* Smith, 1838

Carcharodon carcharias (Linnaeus, 1758)

The great white shark has a global range throughout most seas and oceans with concentrations in temperate coastal seas (Compagno, 2001). Possibly a result of subtropical submergence (Ebert

& Stehmann, 2013). A recent study revealed that the Mediterranean Sea subpopulation is genetically distinct from the Atlantic subpopulation (Gubili et al., 2011). Within the Mediterranean Sea, the great white shark has been found most frequently in the Strait of Sicily and the Adriatic Sea (Bradaï & Saïdi, 2013; Fergusson, 1996) and more recently in the Aegean Sea (Kabasakal & Gedikoglu, 2008; Kabasakal et al., 2009) but is believed to occur or have recently occurred throughout the basin.

Genus *Isurus* Rafinesque 1810

Isurus oxyrinchus (Rafinesque, 1810)

Cosmopolitan species of temperate and tropical waters of the Atlantic, Pacific, and Indian oceans. From the Gulf of Maine to southern Brazil and Argentina, including the Gulf of Mexico and the Caribbean. In the Eastern region, from Norway to South Africa, including the Mediterranean. In the Indo-Pacific area, from East Africa to Hawaii and south Australia and New Zealand until southern California, USA to Chile (Compagno, 2001; Zupa et al., 2010).

Genus *Lamna* (Cuvier, 1816)

Lamna nasus (Bonnaterre, 1788)

Circumglobal species of temperate waters, not in equatorial areas. Eastern Atlantic, from Morocco to Iceland and the Barents Sea, included the Mediterranean Sea. Western Atlantic, and Southern Hemisphere (Pacific and Indian Oceans) (Compagno, 1984).

Familia CETORHINIDAE Gill, 1861
Genus *Cetorhinus* Blainville 1816

Cetorhinus maximus (Gunnerus, 1765)

In the North Atlantic, the species occurs from the transition between Atlantic and Arctic waters (including the Gulf of Maine, south and west of Iceland, and off the North Cape of Norway and Russia) to the Mediterranean, and occasionally as far south as Senegal and Florida. In the North Pacific, around Japan, and off the Chinese coast, and from California north to British Columbia. In the southern hemisphere, recorded from South Africa, Brazil to Ecuador in South America, southern Australia, and New Zealand (Compagno, 1984). Most records are from surface waters during spring and summer, with some reports from deep water in winter (Sims, 2003; Mancusi, 2005; Dulvy et al., 2016). A seasonal migration may occur, either from deep to shallow water or from lower to higher latitudes in warmer weather (the latter is not supported by recent UK observations (Sims, 2003; Mancusi, 2005). Most records occur within a narrow range of water temperatures: 8–14 °C in the UK, Japan and Newfoundland, but up to 24 °C in New England, USA. Records in warmer waters are generally of moribund or stranded specimens. At least some populations are migratory (Sims, 2003) and possibly seasonally segregated by sex; the winter distribution of most populations and locations used by pregnant females are unknown, although it seems likely that wintering sharks occur mainly in deep shelf water (Sims, 2003). The different morphological characteristics of basking sharks in the Pacific and the North and South Atlantic oceans are not thought to indicate separate species (Compagno, 1984). However, they are geographically isolated populations.

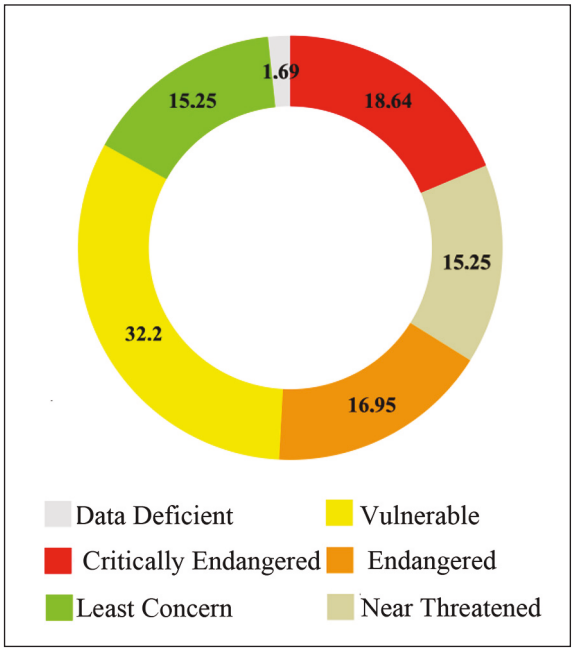

Figure 3. The number of species in different years according to references of cartilaginous species in the Libyan coast.

Familia ALOPIIDAE Bonaparte, 1835
Genus *Alopias* Rafinesque, 1810

Alopias superciliosus Lowe, 1841

This oceanic and coastal shark occurs in tropical and temperate seas (Compagno, 2001). Western Atlantic: from north to south (New York, Florida, Texas, Mexico, Bahamas, Cuba, Venezuela, Brazil, Uruguay, and almost certainly Argentina). Eastern Atlantic: from eastern Portugal and Spain, Madeira, near Azores, Morocco, Canary Islands, Senegal, Guinea to Sierra Leone, Angola, and South Africa, including the Mediterranean Sea not in the Black Sea. Indian Ocean: from South Africa to Madagascar, Arabian Sea (Somalia), Gulf of Aden, Maldives, Sri Lanka. Western Pacific: Southern Japan, Taiwan, Viet Nam, New Caledonia, Australia (northwestern coast), New Zealand, and the Central Pacific. Eastern Pacific: from California, Mexico to Peru, including west of Galapagos Islands, Ecuador, and probably northern Chile (Compagno, 2001).

Alopias vulpinus (Bonnaterre, 1788)

This oceanic and coastal shark is is widespread in tropical to cold-temperate seas, but is most common in temperate waters (Compagno, 2001) Western Atlantic: from Canada to southern Argentina (Bigelow & Schroeder, 1948; Russell, 1993; Anonymous, 1997; Compagno, 2001) Eastern Atlantic: from Norway and the UK to Madeira and Azores, including the Mediterranean and Black seas, and down to the coast of western Africa until South Africa (Compagno, 2001). Indian Ocean: from South Africa to Somalia; coasts of north western Madagascar and Maldives, included the Red Sea, India (Gubanov, 1972; Stevens *et al*., 2000; Compagno, 2001) Western Pacific: southern Japan, Korea, China, Taiwan, Australia, New Zealand and several of the Pacific Islands (Compagno, 2001; Last et al., 2016) Eastern Pacific: from British Columbia to south of Panama, and from Colombia to southern Chile, also reported off the Hawaiian Islands (Compagno, 2001).

Ordo CARCHARHINIFORMES
Familia PENTANCHIDAE Smith, 1912
Genus *Galeus* Rafinesque 1810

Galeus melastomus Rafinesque, 1810

This species is relatively common in the Mediterranean Sea over a wide depth range. It occurred in ~27% of hauls during the International Trawl Survey in the Mediterranean (MEDITS) conducted throughout the northern region (Alboran to the Aegean Sea) from 1994–2019 at depths of 10–800 m (Baino et al., 2001; Bertrand et al., 2002; Abella et al., 2017). MEDITS survey data showed no significant temporal trend in density indices (Bertrand et al., 2000) although in some parts of the Mediterranean Sea (Tyrrhenian Sea), the Blackmouth Catshark population trend increased slightly with seasonal fluctuations in biomass, reaching a maximum in winter and a minimum in summer (Baino et al., 2001).

Familia SCYLIORHINIDAE Gill, 1862
Genus *Scyliorhinus* Blainville 1816

Scyliorhinus canicula (Linnaeus, 1758)

It is widespread in the Northeast and Eastern Central Atlantic. In the northern extent of its range, it can be found in the waters surrounding the Shetland Islands and Norway. Its range extends southwards towards West Africa. It is also found throughout the Mediterranean and Black seas (Compagno et al., 2005; Stehmann, 2005; Abella, 2017b).

Scyliorhinus stellaris (Linnaeus, 1758)

In the eastern Atlantic, this species occurs in coastal and shallow shelf seas from the Shetland Isles and southern Norway in the north to northwest Africa in the south. Around the British Isles, it is uncommon throughout the North Sea but locally abundant in areas of the southern and western coasts. In particular, it seems most abundant in parts of the English Channel, Bristol Channel, Cardigan Bay and around the Lleyn Peninsula and Anglesey (Ellis et al., 2005). In the Mediterranean Sea, it appears to be more abundant in the Adriatic and Ionian Seas and along the Albanian coast, compared to the western Mediterranean Sea (Baino et al., 2001). It was absent from trawl surveys conducted off the coasts of Morocco, Spain and France, and does not occur in the Black Sea (Compagno et al., 2005). Its depth limits are one to 409 m.

Familia TRIAKIDAE Gray 1851
Genus *Mustelus* Linck, 1790

Mustelus asterias Cloquet, 1819

It is distributed from the Shetland Islands and southern Norway in the Northeast Atlantic, south, including the Mediterranean to north-western Africa in the Eastern Central Atlantic (Compagno et al., 2005). Northeast Atlantic: from Scotland and southern Norway in the North to North-west Africa in the south, occurring in the waters of Norway, Sweden, Denmark, Germany, The Netherlands, Belgium, France, United Kingdom, Ireland, Spain, and Portugal. Whole Mediterranean Sea, but not in the Black Sea (Notarbartolo di Sciara, 1998). Eastern Central Atlantic: Morocco, Western Sahara.

Mustelus mustelus (Linnaeus, 1758)

Distributed from the UK in the Northeast Atlantic, south, including the Mediterranean Sea, Canary Islands, Morocco, and south along the western African coast to eastern South Africa (Compagno et al., 2005; Stehmann, 2005; Williams et al., 2008) Mediterranean Sea: Whole Mediterranean, not in the Black Sea.

Mustelus punctulatus Risso, 1827

Eastern Atlantic and Mediterranean Sea: Western Sahara and Mediterranean Sea (absent from the Black Sea) (Compagno et al., 2005).

Genus *Galeorhinus* Blainville, 1816

Galeorhinus galeus (Linnaeus, 1758)

In southern Australia, the species occurs from Perth in Western Australia to Morton Bay in Queensland, including Lord Howe Island (uncertain) and Tasmania. It also occurs in the Southwest Atlantic (on the shelf from southern Brazil to Patagonia) and Northeast Atlantic (including the Mediterranean where it is present but uncommon (Notarbartolo di Sciara, 1998; Williams et al., 2008), eastern North Pacific (from British Columbia to southern Baja California including the Gulf of California), off Peru and Chile, and in the South Pacific, New Zealand and off South Africa (Compagno et al., 2005). In the Subequatorial Africa region, it ranges from Namibia to East London on the southeast coast of South African (Compagno et al., 2005). It is absent from the Northwest Atlantic and Northwest Pacific.

Familia CARCHARHINIDAE Jordan et Evermann, 1896
Genus *Carcharhinus* Blainville, 1816

Carcharhinus brevipinna (Valenciennes, 1839)

This species is cosmopolitan in warm temperate, subtropical, and tropical continental and insular shelf waters. It is known from off Cape Cod, Massachusetts (USA), to southern Brazil in the western Atlantic. It is found from the Mediterranean Sea southward to central Africa in the eastern Atlantic; the species is widespread in the Indian Ocean from South Africa to western Australia, including the Red Sea and the Gulf of Oman; and in the western Pacific Ocean, it is recorded from throughout the Indo-Australian Archipelago, the China Sea and the north and east coasts of Australia (Compagno et al., 2005).

Carcharhinus limbatus (Valenciennes, 1839)

Carcharhinus limbatus is widespread in warm temperate, subtropical, and tropical waters. Primarily it is a continental species, although it is found around some oceanic islands. In the western Atlantic it ranges from Massachusetts, United States, to southern Brazil; in the eastern Atlantic it is known from the Mediterranean Sea southwards to central Africa; it is widespread in the Indian Ocean from South Africa to western Australia, including the Red Sea and Persian Gulf; and in the Pacific Ocean it is recorded from throughout the Indo-Australian Archipelago, at oceanic islands such as Hawaii, Tahiti and the Marquesas, and in the eastern Pacific from California, USA, to Peru (Garrick, 1982; Compagno, 1984; Last et al., 2016).

Carcharhinus plumbeus (Nardo, 1827)

This species occurs in tropical and warm temperate waters. Western Atlantic: USA from Gulf of Maine, Massachusetts to Yucatan, Mexico, Cuba and Bahamas; possibly to Belize, Honduras, Costa

Rica, Panama, Columbia, Trinidad and Tobago and Venezuela; southern population extending from southern Brazil to northern Argentina (Compagno et al., 2005). Eastern Atlantic: Portugal, possibly Canary Islands, Spain, Morocco, Senegal, Cape Verde Islands, Guinea, Guinea Bissau, Liberia, Ivory Coast, Ghana, Benin, Togo, Nigeria, Cameroon, Equatorial Guinea, Gabon, Congo, Zaire, Sao Tome and Principe (Compagno et al., 2005). Mediterranean Sea: Corsica, Egypt, Greece, Israel, Italy, Croatia, Slovenia, Lebanon, Libya, Malta, Spain, Syria, Tunisia and Turkey (Compagno et al., 2005). Western Indian Ocean: South Africa, Madagascar, Mozambique, Tanzania, Mauritius, Seychelles, Red Sea, Gulf of Oman (Compagno et al., 2005). Western Pacific: Viet Nam, China, Taiwan, Japan, Indonesia (Aru Island), Australia (Queensland, New South Wales), and New Caledonia (Compagno in prep). Eastern Indian Ocean: Western Australia and the Northern Territory (Compagno et al., 2005).

Genus *Galeocerdo* Mueller et Henle, 1837

Galeocerdo cuvier (Péron et Lesueur, 1822)

Galeocerdo cuvier the Tiger Shark has a circumglobal range in tropical and warm temperate oceans ranging between latitudes of approximately 40°N to 36°S. In the western Atlantic, the species ranges from the USA (Massachusetts) to Uruguay, including the Gulf of Mexico, islands of the Caribbean, and isolated islands such as Fernando de Noronha. In the eastern Atlantic, it is found along the West Africa coast, from Morocco to Angola, including the Canary Islands and the Azores (Ebert & Stehmann, 2013). It has been reported off Libya in the Mediterranean, though whether it is resident or vagrant is unknown (UNEP-MAP RAC/SPA, 200). This shark is distributed throughout the Indo-Pacific. In the Indian Ocean, the Tiger Shark is found from the east coast of Africa to South Africa, including remote islands such as Reunion and Chagos Archipelago, north to the Red Sea, and throughout the tropical Indian Ocean. In the western and central Pacific, it occurs from Australia north to eastern China and Japan, and throughout Pacific islands including Palau, east to the Solomon, Marshall, and Hawaiian Islands, south to northern New Zealand, as well as French Polynesia and more isolated atolls (Compagno, 1984; Randall, 1992). In the eastern Pacific, it ranges from southern California to Peru, including the Galapagos and Revillagigedo Islands. The Tiger Shark also appears seasonally in cool temperate waters, most likely following warmer currents. The presence of this shark in temperate regions has been reported from the United Kingdom (Compagno, 1984) and Iceland (Matsumoto et al., 2005) in the Atlantic, Alaska in the Northeast Pacific (Mecklenburg et al., 2002), the southern coasts of New South Wales and Western Australia in Australia (Pepperell, 1992; Holmes et al., 2014; Ferreira et al., 2015), and in South Africa (Dicken & Hosking, 2009).

Genus *Prionace* Cantor, 1849

Prionace glauca (Linnaeus, 1758)

Prionace glauca (the Blue Shark) is one of the most wide-ranging of all sharks, found throughout all oceans in tropical and temperate waters (Ebert & Stehmann, 2013; Last et al., 2016).

Familia SPHYRNIDAE Bonaparte, 1840
Genus *Sphyrna* Rafinesque, 1810

Sphyrna lewini (Griffith et Smith, 1834)

Sphyrna lewini has a circumglobal distribution in coastal warm temperate and tropical seas (Compagno, 1984). Western Atlantic: the species ranges from New Jersey to Uruguay, including Gulf of Mexico and Caribbean Sea (Compagno, 1984), Eastern Atlantic: this shark possibly occurs in the Mediterranean Sea and around the Azores. Probably present all along the western Africa coast, confirmed from Mauritania, Senegal, Gambia, Ivory Coast, Guinea, Guinea Bissau, Sierra Leone, Gabon, and Congo (Compagno, 1984). Indian Ocean: recorded from South Africa (Western Cape to kwaZulu-Natal), Maldives, and Red Sea to Pakistan, India, Myanmar (Compagno, 1984). Western Pacific: this shark occurs from Thailand, Vietnam, Indonesia, China, Taiwan, Japan, Philippines, Australia (Queensland, Western Australia), New Caledonia (Compagno, 1984). Eastern Pacific in the Eastern Pacific, the Scalloped Hammerhead ranges from southern California and Gulf of California to Panama, Ecuador and possibly northern Peru (Compagno, 1984).

Sphyrna zygaena (Linnaeus, 1758)

This shark is found in coastal and open ocean (Compagno, 1984) temperate and tropical waters, with a wider range than other members of its Family (Compagno, 1984). The full extent of this species' range in tropical waters may be incompletely known at present, due to probably confusion with the more abundant scalloped hammerhead (*S. lewini*) (Compagno, 1984). Western Atlantic: From Nova Scotia to Florida, USA and Virgin Islands to southern Argentina (Compagno, 2001; Last et al., 2016). Eastern Atlantic: from the UK and as a vagrant in the North Sea, southwards, including the Mediterranean Sea, where has been reported as more common in the western basin, to Mauritania, Senegal, Cape Verde Islands, Guinea, Ivory Coast, and Angola (Compagno, 1984; Last et al., 2016). Indian Ocean: South Africa and southern Mozambique, Comoros Islands, southern India, Sri Lanka, and Australia (Western Australia, South Australia, Victoria, Tasmania) (Compagno, 1984; Last et al., 2016). Western Pacific: from Viet Nam (Gulf of Tonkin) to Japan and southern Russia in the Northwest Pacific. Australia (New South Wales), New Zealand, Lord Howe and Kermadec Islands in the Southwest Pacific (Compagno, 1984; Last et al., 2016). Eastern Pacific: from northern California, USA, to Gulf of California, Mexico, Panama, and from Ecuador to Chile, including Galapagos Islands (Compagno, 1984; Last et al., 2016).

Ordo SQUALIFORMES Compagno, 1973
Familia DALATIIDAE Gray, 1851
Genus *Dalatias* Rafinesque, 1810

Dalatias licha (Bonaterre, 1788)

The Kitefin Shark has a widespread yet patchy distribution in the Atlantic and Indo-West and Central Pacific Oceans (Ebert and Stehmann, 2013).

Familia ETMOPTERIDAE Fowler, 1934
Genus *Etmopterus* Rafiesque, 1810

Etmopterus spinax (Linnaeus, 1758)

Common in the Mediterranean Sea, particularly in the western part of the basin (Spain, France, Italy, Tunisia, Algeria, Morocco (Baino et al., 2001), and less so in the central and mid-eastern areas (Albania, Malta, Libya and Greece) (Stehmann, 2005). It can also be found as far east as Israel and Cyprus (Gilat & Gelman, 1984; Galil & Goren, 1994; Giusto & Ragonese, 2014).

Familia OXYNOTIDAE Gill, 1863
Genus *Oxynotus* Rafiesque, 1810

Oxynotus centrina (Linnaeus, 1758)

Eastern Atlantic Ocean and Mediterranean Sea (entire coast from Straits of Gibraltar, but absent from the Black Sea), down to South Africa. Possibly off Mozambique in the Indian Ocean (Compagno, 1984).

Familia CENTROPHORIDAE Bleeker, 1859
Genus *Centrophorus* Muller et Henle, 1837

Centrophorus uyato (Rafinesque, 1810)

Present along the coasts of the Italian seas, excluding the upper and middle Adriatic. All-round the Mediterranean (Serena et al., 2020).

Familia SQUALIDAE de Blainville, 1816
Genus *Squalus* Linnaeus, 1758

Squalus acanthias Linnaeus, 1758

In the Northeast Atlantic, this species occurs as far northeast as Russia's Murmansk Coast and the White Sea. It occurs as far west as Iceland and can be found around the Faroe Islands and in Norwegian waters. It is also found in the Celtic and North Seas (but rarely in the western Baltic Sea) and southwards towards the Eastern Central Atlantic where it is known from France, Portugal, Madeira, and the Canary Islands, and further south along the coast (Ebert & Stehmann, 2013). Within the Mediterranean Sea, this dogfish is most abundant in the eastern central area (southern Adriatic, Ionian, and Albanian Seas), less so in the eastern Aegean Sea, and scarce elsewhere. It is also present throughout the Black Sea.

Squalus blainville (Risso, 1827)

The geographic range of this species is unde-

fined, due to taxonomic confusion with several different species; however, it is suspected to occur in both the waters of the eastern Atlantic and Mediterranean Sea. In the Northeast Atlantic, nominal records have been reported from the Bay of Biscay to the coastal waters of France (Compagno, 1984; Ebert & Stehmann, 2013). Its suspected range continues southwards to the Eastern Central Atlantic, in the coastal waters of Morocco, Mozambique, the Canaries, Senegal, to the Congo and possibly Namibia, but records are probably based on a different species (Compagno, 2001; Ebert & Stehmann, 2013). Records of this species have also been reported from the Mediterranean and Black Seas.

Ordo SQUATINIFORMES
Familia SQUATINIDAE de Blainville, 1816
Genus *Squatina* Dumeril, 1806

Squatina aculeata Cuvier, 1829

Squatina aculeata (the sawback angelshark) occurs along the southern Mediterranean Sea coast from Algeria to the eastern basin and along the northern coast from Turkey possibly to Albania. It is confirmed as extant in Tunisia, Sicily, Northern Cyprus, Turkey, the Aegean Islands, and eastern mainland Greece. Its presence is uncertain in Algeria, Sardinia, Malta, Libya, Egypt, Palestine, Lebanon, Syria, southern Cyprus, Crete, western mainland Greece, and Albania. In the Eastern Atlantic Ocean, it is extant in Senegal, Gambia and Sierra Leone. Its presence is uncertain in Mauritania, Guinea-Bissau, Guinea, and Liberia.

Squatina oculata Bonaparte, 1840

Historically, *Squatina oculata* (the smoothback angelshark) occurred in the Mediterranean Sea from France and Tunisia to the eastern basin and the Sea of Marmara. In the Eastern Central and Southeast Atlantic, this species occurred from Mauritania to Senegal. The species has not been reported from many areas in the region over the past several decades and may now be absent from some areas that have been subject to heavy fishing pressure.

Squatina squatina (Linnaeus, 1758)

The angelshark originally ranged from Scandinavia to North-western Africa (Morocco and the Canary Islands), including the Mediterranean and Black Seas. Current distribution appears to be reduced from this historic range, because of severe population depletion resulting in range contraction and localized extinctions; for example, it is now considered to be locally extinct in the North Sea (ICES, 2012), although there is a museum record from Denmark in 2002 (Zidowitz unpubl. data 2016) and is no longer encountered in some areas of the northern Mediterranean. However, reports of angelshark individuals from the Celtic Seas ecoregion (ICES. 2013), Natural Resources Wales data, Shark Trust data, (‘Fitzmaurice et al., 2003; Worm et al., 2006), Tyrrhenian Sea (Giusto & Ragonese, 2014; Cavallaro et al., 2015), North Adriatic Sea (Florio et al., 2003), Aegean Sea (Öğretmen et al., 2005; Karakulak. & Bilgin, 2006; Kabasakal et al., 2009; Ismen et al., 2009), the Sea of Marmara (Kabasakal & Kabasakal, 2014) and Mediterranean coasts of Turkey (Yatsu, 1995; Abella et al., 2017), and Algeria (Ramdane & Trilles, 2008) demonstrate that the species is still extant in these areas. In addition, it is still sighted regularly around the Canary Island archipelago (Meyer et al., 2017).

BATOIDS

Ordo TORPEDINIFORMES
Familia TORPEDINIDAE Henle, 1834
Genus *Tetronarce* Gill, 1862

Tetronarce nobiliana (Bonaparte, 1835)

The species is found throughout much of the Atlantic. In the Northeast Atlantic, this ray occurs from the northern British Isles to Morocco. It is also present in the Mediterranean Sea, but not the Black Sea (Stehmann, 1995; Stehmann, 2005).

Genus *Torpedo* Duméril, 1806

Torpedo marmorata Risso, 1810

Eastern Atlantic and Mediterranean Sea: from the northern UK, south to Cape of Good Hope, South Africa, and throughout the Mediterranean Sea (Williams et al., 2008).

Torpedo torpedo (Linnaeus, 1758)

Torpedo torpedo occurs throughout continental shelf waters of the Mediterranean Sea, where it is most common in African waters (Ebert & Stehmann, 2013). Outside the Mediterranean region, the species extends in the Eastern Atlantic Ocean from northern Spain to Angola.

Ordo RHINOPRISTIFORMES
Familia RHINOBATIDAE Bonaparte, 1835
Genus *Rhinobatos* Linck, 1790

Rhinobatos rhinobatos (Linnaeus, 1758)

Occurs throughout the Mediterranean coasts, but appears more prevalent in the southern and eastern regions (Capapé, 1989; Williams *et al*., 2008) in particular around the Gulf of Gabes, on the East coast of Tunisia (Quignard and Capapé, 1971) East Atlantic: Morocco, Mauritania, Senegal, Gambia, Guinea Bissau southwards possibly to Namibia.

Familia GLAUCOSTEGIDAE Last, Séret et Naylor 2016
Genus *Glaucostegus* Bonaparte, 1846

Glaucostegus cemiculus (Geoffroy St. Hilaire, 1817)

This species is widely distributed in the eastern Atlantic Ocean from the northern coast of Portugal to Angola, including the Mediterranean Sea (where it appears to be more prevalent in the southern and eastern regions) (Capapé, 1977; Last et al., 2016).
Ordo RAJIFORMES
Familia RAJIDAE de Blainville, 1816
Genus *Dipturus* Rafinesque, 1810

Dipturus cf. ***batis*** (Linnaeus, 1758)

Range of *D.* cf. *batis* covered much of the continental shelf of the North-east Atlantic, to Iceland and northern Norway (Last et al., 2016). In several parts of its range, including the Western Baltic and southern North Sea, it is considered scarce (Stehmann, 1995). Its occurrence in the Mediterranean basin is questionable (Serena et al., 2020). At the start of the twentieth century, it was considered to have a wide distribution over the shallower waters of the continental shelf surrounding the British Isles, albeit more common in the northern and western regions (Whitehead et al., 1984). Though individual specimens are reported very occasionally from the Irish Sea, Bristol Channel and central North Sea, the current range tends to occupy the deeper waters off north-western Scotland and in Celtic Sea, and along the edge of the continental shelf.

Dipturus oxyrinchus (Linnaeus, 1758)

In the Northeast Atlantic this skate occurs on the outer continental shelf and continental slope from central Norway southwards (Heintz, 1962; Stehmann, 1995). It is found in the Barents Sea, in the Norwegian Sea mainly along the coastline south of latitude 65°N, and in very low numbers in the North Sea (ICES, 2012; Wögerbauer et al., 2014). The species was last encountered in trawl surveys around the Faroe Islands in 2001, and is only occasionally caught on the Rockall Survey in offshore waters west of Scotland (ICES, 2012). In the Bay of Biscay, Iberian waters, and the Azores and mid-Atlantic ridge, it is still encountered by fisheries and trawl surveys in low numbers. This skate was historically found throughout the Mediterranean Sea in both shelf and slope areas (Stehmann, 1995; Spedicato et al., 2003), with the greatest survey catches occurring around Corsica, Sardinia and Malta Islands, and throughout the eastern part of the basin including Dodecanese waters. By contrast it is not very present in the western Mediterranean Sea, along the French and Spanish coasts, and the Northern Adriatic Sea (Serena et al., 2011).

Genus *Leucoraja* Malm, 1877

Leucoraja fullonica (Linnaeus, 1758)

Northeast Atlantic: occurs in the offshore waters of the continental shelf from Madeira and northern Morocco northwards to Iceland, Faeroe Islands and Norway, including the Skagerrak (Stehmann, 1995). It is an offshore species usually occurring on the outer parts of the continental shelf, and, in the northern part of its range, is typically encountered in the northern North Sea, off

North-west Scotland, west of Ireland and Celtic Sea. It does not usually occur in shallower areas (e.g., southern North Sea and Irish Sea). Mediterranean Sea: western and central-eastern Mediterranean to Tunisia and western coasts of Greece (except the Adriatic Sea). Countries of occurrence; Algeria, France, Greece, Italy, Morocco, Spain and Tunisia (Bauchot, 1987; Stehmann, 1995; Bertrand et al., 2000; Relini et al., 2000; Tobuni et al., 2016). However, like Serena et al. (2020) stated, we need to confirm the real occurrence of this species in the Mediterranean Sea.

Leucoraja melitensis (Clark, 1926)

Endemic to the Mediterranean, known off Algeria, Tunisia, Malta and Italy, its range being rather restricted to the Strait of Sicily and Malta waters.

Leucoraja naevus (Müller et Henle, 1841)

From the Northeast and Eastern Central Atlantic, Cuckoo Skate occurs off coasts northward from the Shetland Isles and southern Norway in the north, to Morocco in the south (Stehmann, 1995). It is common in the North Sea ecoregion, especially in the northwest area and occurs in low numbers around the Faroe Islands. It occurs throughout the Celtic Seas, including the Irish Sea, outer Bristol Channel, and outer western English Channel. In the Spanish survey of Porcupine Bank, west of Ireland, it is found mainly around the central mound of the bank (ICES, 2013). In the Mediterranean Sea this skate occurs in northern, western and central-eastern waters, excluding the Adriatic Sea. It has been recorded in waters off Algeria, France, Greece, Italy, Malta, Morocco, Spain (including the Balearic Islands) and Tunisia (Bauchot, 1987; Bertrand et al, 2000; Relini et al., 2000; Jukic-Peladic et al., 2001; Serena et al., 2011; Tobuni et al., 2016).

Genus *Raja* Linnaeus, 1758

Raja asterias Delaroche, 1809

Can be considered endemic in the Mediterranean Sea, recently also occurred in the Atlantic, near the southern coast of Portugal (Stehmann, 1995; Ordines et al., 2017). It has been reported for the northern and southern areas of the Balearic Islands of the western Mediterranean Sea (Massutì & Moranta, 2003). In the Tyrrhenian Sea of the northern Mediterranean (Romanelli et al., 2007), as well as along the Tunisian coasts (Capapé, 1977).

Raja clavata Linnaeus, 1758

It is one of the most abundant skates in north European coastal waters and can be the dominant skate in commercial landings and research vessel catches (Rousset, 1990). It is widely distributed from Iceland and Norway (south of the Arctic Circle) to the North Sea (where it is now less abundant in south-eastern areas (Whitehead et al., 1984), the Mediterranean, the western Black Sea, Madeira, the Atlantic coasts of Africa, and as far south as South Africa and the south-western Indian Ocean (Stevens et al., 2000). The status of this species in West and South African waters, and its relationship with *R.* (*Raja*) cf. *clavata*, which is reported from the waters off Namibia and southern Africa (Smale & Cowley, 1992; Ebert & Stehmann, 2013), needs further research. *Raja clavata* is recorded off Atlantic coast of Morocco (Lloris & Rucabado,1998).

Raja miraletus Linnaeus, 1758

Found in the eastern Atlantic, Mediterranean and western Indian Ocean where it apparently forms distinct subpopulations, northeast Atlantic from northern Portugal to Madeira, Mediterranean, Angola to southern Namibia in the vicinity of the Orange River in the south-eastern Atlantic with an apparent gap in distribution along the Western Cape coast to False Bay, South Africa where it reappears and ranges north-east to KwaZulu-Natal, Mozambique and Kenya (McEachran et al.,1989; Compagno et al., 1991).

Raja montagui Fowler, 1910

Widely distributed in the Northeast Atlantic, ranging from Morocco in the south to the Shetland Isles and Skagerrak and Kattegat in the north, including the Mediterranean Sea (Bauchot, 1987; Stehmann, 1995). Within the North-eastern Atlantic it tends to occur in inshore waters and shallow shelf seas, in depths of 8 to 283 m (Ellis et al., 2005), though it is most abundant in waters less than 100 m. Juveniles tend to occur closer inshore on sandy

Scientific name	No	%	Kg	%
Alopias superciliosus	2	1.92	534	16.49
Carcharhinus plumbeus	1	0.96	90	2.77
Heptranchias perlo	30	28.84	142	4.38
Isurus oxyrinchus	16	15.38	1,217	37.59
Mustelus mustelus	1	0.96	13	0.4
Odontaspis ferox	1	0.96	127	3.92
Prionace glauca	17	16.34	949	29.31
Pteroplatytrygon violacea	36	34.61	165.5	4.83
Total	**104**	**100**	**3,237.5**	**100**

Table 2. Composition of elasmobranchs by-catch.

sediments, with adults also common further offshore on sand and coarse sand-gravel substrates.

Raja polystigma Regan, 1923

Endemic in the Mediterranean Sea (Stehmann, 1995). Moderately common throughout the Mediterranean Sea, particularly in the western (Morocco, Spain and France) and western central areas (Tyrrhenian, Corsica, Sardinia and Sicily (Stehmann, 1995; Baino et al., 2001; Florio et al., 2003; Follesa et al., 2003; Tinti et al., 2003; Mancusi, 2005), rare in Adriatic and Ionian Seas (Notarbartolo di Sciara, 1998), common along northern African coasts (Stehmann, 1995).

Raja radula Delaroche, 1809

Occurs throughout the Mediterranean Sea, but mainly in the western region and around the Balearic Islands. It is absent from the Black Sea (Stehmann, 1995). Reports from off Portugal and the northern coasts of Morocco suggest that its range may extend into the eastern Atlantic, but these records require verification as they may be misidentifications of other *Raja* species.

Genus *Rostroraja* Hulley, 1972

Rostroraja alba (Lacepède, 1803)

Its presence is reported along all the coasts of the Italian seas including western Mediterranean (to Tunisia and western Greece). Eastern Atlantic: Ireland and England southward round the Cape (South Africa) to central Mozambique.

Ordo MYLIOBATIFORMES
Familia DASYATIDAE Jordan et Gilbert, 1879
Genus *Bathytoshia* Whitley, 1933

Bathytoshia lata (Garman, 1880)

This species is broadly but discontinuously distributed in the coastal waters of the eastern Atlantic Ocean, from the southern Bay of Biscay to Angola, including the Mediterranean Sea, Madeira, and the Canary Islands. A single record was in Quilon, India.

Genus *Dasyatis* Rafinesque, 1810

Dasyatis pastinaca (Linnaeus, 1758)

North-eastern Atlantic Ocean, the Mediterranean Sea, and the African coast southwards to Senegal.
Genus *Pteroplatytrygon* Fowler, 1910

Pteroplatytrygon violacea (Bonaparte, 1832)

Probably cosmopolitan in tropical and subtropical seas. Eastern Atlantic: south-eastern coasts of the Mediterranean and off Sicily. It has been reported in Cape Verde. Eastern Pacific: California (USA), Baja California (Mexico), and the Galapagos Islands Reported off Vancouver and from Chile Western Atlantic. There are 4 records from southern Africa.

Genus *Taeniurops* Garman, 1913

Taeniurops grabatus (Geoffroy St. Hilaire, 1817)

Eastern Atlantic: Canary Islands and Mauritania to Angola, including Cape Verde. It is also in the Mediterranean from Tunisia to Egypt. There was only one record in the north-western Mediterranean Sea.

Familia GYMNURIDAE Fowler, 1934
Genus *Gymnura* van Hasselt, 1823

Gymnura altavela (Linnaeus, 1758)

Reasonably widespread in the Eastern (Senegal, Gambia, Sierra Leone, Cameroon, and Democratic Republic of the Congo) and Western Atlantic (from Chesapeake Bay, US through the Gulf of Mexico to

Brazil; not recorded from the Greater or Lesser Antilles).

Familia MYLIOBATIDAE Bonaparte, 1835
Genus *Aetomylaeus* Garman, 1908

Aetomylaeus bovinus (Geoffroy St. Hilaire, 1817)

From Portugal and Morocco to Angola, including the Mediterranean, Madeira and the Canary Islands; then from Saldanha Bay to Natal (South Africa) and southern Mozambique.

Genus *Myliobatis* Cuvier, 1816

Myliobatis aquila (Linnaeus, 1758)

Eastern Atlantic: Madeira, Morocco and the Canary Islands north to the western coasts of Ireland and British Isles and the southwestern North Sea, south to Natal, South Africa, as well as throughout the Mediterranean.

Familia MOBULIDAE Gill, 1893
Genus *Mobula* Rafinesque, 1810

Mobula mobular (Bonnaterre, 1788)

Mobula mobular occurs throughout the Mediterranean Sea, and possibly in the nearby Northeast Atlantic, but is absent from the Black Sea. Outside the Mediterranean, it has been reported from the coast of northwest Africa (Morocco to Senegal), the Canary Islands, Madeira, the Azores, Portugal, and as a vagrant off southern Ireland (Notarbartolo di Sciara, 1998; Stehmann, 2005; Ebert.& Stehmann 2013), *M. mobular* can be assessed as a circumglobally distributed species.

CHIMAERAS

Ordo CHIMAERIFORMES
Familia CHIMAERIDAE Rafinesque 1815
Genus *Chimaera* Linnaeus, 1758

Chimaera monstrosa Linnaeus, 1758

This species is widespread throughout the northeastern Atlantic from the southern Arctic to Morocco including the Mid-Atlantic Ridge and Mediterranean. Common in the western and central Mediterranean, rare in the Eastern Mediterranean, and absent from the North and central Adriatic and Black Sea.

DISCUSSION

Available evidence indicates that chondrichthyans are declining in abundance and numbers all around the world. In the Mediterranean, diversity and range distribution are probably facing a worse scenario than chondrichthyan populations elsewhere in the world (Stehmann & Burkel, 1984; Whitehead et al., 1984). These critical situations can be attributed to several factors, including the life history characteristics of chondrichthyans in combination with the semi-enclosed nature of the Mediterranean Sea and intense fishing activity throughout its coastal and pelagic waters, and the effects of habitat loss, environmental degradation, and pollution (Stehmann & Burkel, 1984; Whitehead et al., 1984). Large coastal species (which are biologically the most vulnerable to exploitation) and species found in areas subjected to prolonged and/or intensive fishing pressure are of particular concern, especially when compared to teleost fishes (Cailliet et al., 2006). Chondrichthyans are slow growing, mature late, have low fecundity and productivity, long gestation periods, high natural survivorship of all age classes, and live for a long time (Camhi, 1998; Cailliet et al., 2006). These biological traits result in low reproductive potential and low capacity for population increase for many species; such characteristics have serious implications for chondrichthyans populations, limiting their capacity to sustain fisheries and recover from declines. An analysis of threat levels across all sharks, rays, and chimaeras has revealed the Mediterranean Sea, where there are a total of 32 chondrichthyan families, as a key hotspot of extinction risk. Indeed, over 90% of fish stocks are overfished in the Mediterranean basin (Dulvy et al., 2016; WWF, 2019). The International Union for the Conservation of Nature (IUCN) is the authority on the conservation status of organisms world-wide. They estimate that between 53 and 71% of shark and ray species (there are at least 85)

in the Mediterranean are at risk of extinction (Dulvy et al., 2016). Where 21 families have been recorded along the Libyan coasts, where they are generally considered to be the most sensitive species and ecosystems have been altered in many ways according to the IUCN's updated list of elasmobranches in the Mediterranean Sea.

More than 22.81% of chondrichthyans in Libya were classified as Vulnerable, including (*Carcharodon carcharias, Isurus oxyrinchus, Lamna nasus, Cetorhinus maximus, Alopias vulpinus, Alopias superciliosus, Mustelus mustelus, Galeorhinus galeus, C. plumbeus, Oxynotus centrina*, *Squalus* spp. Most species are taken as retained valuable bycatch in small-scale and large-scale trawl and net multispecies fisheries. Benthic trawl effort has increased in the shelf and slope area of the Mediterranean over the past 50 years (Aldebert, 1997). The increased fishing intensity and technological advancement of fishing gear have resulted in a decline in many chondrichthyan species commercially captured by trawls in the northwestern Mediterranean (Whitehead et al., 1984). One of the main problems in dealing with elasmobranch fisheries is that they are long-lived with slow growth rates and late sexual maturation; most species have low fecundity, and these factors result in low reproductive (Hall et al., 2000; Gallucci et al., 2006; Dulvy et al., 2016; WoRMS, 2020). Potentially further, they are usually the top predators in their communities. When we look at the composition of cartilaginous fish species in Libya waters, we find a good variety of families (Bradai et al., 2018). The family of the Rajidae has the highest diversity, followed by Carcharhinidae, Triakidae, and Dasyatidae. Other families are represented by only one species like Cetorhinidae, Odontaspididae, Dalatiidae, Etrmopteridae, Oxynotidae, Centrophoridae, Gymnuridae, Chimaeridae, etc. This means there is an interesting biological diversity among the chondrichthyans species in the Libyan coasts which find an appropriate environment and shelter for their life history. On the opposite side, bycatch are such that fishing pressure has produced local extinctions or stock reductions of some elasmobranchs, making certain fishing activities no longer economically viable in the Mediterranean Sea. Such phenomena are less intense in the southern part of the basin, especially along the Libyan coasts, which are becoming a nursery for many other elasmobranchs as the Gulf of Gabès, south of Tunisia (Bradai et al., 2018). In this area, some artisanal fisheries using fixed gillnets (Echwikhi et al., 2013), longlines, still target cartilaginous fish such as Carcharhinidae, Lamnidae, *Rhinobathos* spp., and *Squatina squatina* (Bradai et al., 2005) and trawls (Hamdaoui, 2009). This is confirmed by the increasing numbers of cartilaginous fish in Libya. There has been an increasing trend in the number of cartilaginous species along the Libyan coast over the last few decades, with a particularly steep slope between the 1940s and 2017. According to references of cartilaginous species in the Libyan coast (in this study), the number of species has reached 57, which necessitates extensive knowledge of the presence of juveniles, female gravity, and other biological (i.e., size at first maturity) determinations of the incubation area in order to draw strong conclusions to restrict and protect areas in the future. This study has concentrated on doing the first inventory of these species on the southern coast of the Mediterranean Sea (Libyan coast) and giving some information on these species, their distribution, and their status so that in the future it can conduct a comprehensive study on several of these species, particularly biological and environmental, as well as the impact on biodiversity on this coast. The large pelagic sharks were dominated by the blue shark, *P. glauca,* and followed by the shortfin mako, *I. oxyrinchus* (Table 2). The prevalence of the blue shark over other species of large pelagic sharks is probably due to its advantageous reproductive strategy, which provides an elevated renewal rate and numerous large embryos per litter (Mejuto & Garcia-Cortes, 2005). This paper focused on these species along the southern coast of the Mediterranean Sea (Libyan coast) and gave an idea of the number of these species, their distribution, and their status, so that in the future it can conduct a comprehensive study on several of these species, particularly from a biological and environmental perspective.

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