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Elasmobranch Fisheries, Biodiversity, and Landing-Site Characteristics in the Gulf of Sirte, Libya.

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ABSTRACT: The Libyan coastline extends for nearly 2,000 km and hosts diverse marine habitats that support numerous vulnerable elasmobranch species. This study provides the first integrative assessment of artisanal fisheries targeting cartilaginous fishes in the Gulf of Sirte, central Libya. A frame survey was conducted from March to June 2024 following the FAO-GFCM protocol to document landing-site infrastructure, fishing fleets, gear types, species composition, catch estimates, and biological characteristics of selected species. A total of 43 landing sites were identified, of which 81% operate seasonally. The local fleet is composed entirely of small artisanal craft ("Fluka"), with 303 units recorded. The predominant fishing gears used for elasmobranchs were the traditional Kellabia net and longlines. Sixteen shark and ray species were documented, including several threatened taxa such as Carcharhinus plumbeus, Squatina squatina, and Rhinobatos cemiculus. Biological data were collected from embryos of Mustelus mustelus. Bycatch of turtles, dolphins, and seabirds was also recorded. Numerous ecological and socio-economic challenges were identified, including fishing during breeding seasons, pollution from oil operations, lack of management, and insufficient awareness among fishers. Recommendations are proposed to support sustainable elasmobranch conservation and fisheries management in the region.

KEYWORDS: Elasmobranchs, artisanal fisheries, fishing fleets, Sirte Gulf and Libya.

INTRODUCTION

Libyan coast extends for about 2,000 kilometres and is one of the longest coasts in the Mediterranean as it occupies about 3.9% of the southern coast of this sea, from a bathymetric point of view; according to the topography and the type of habitats, the Libyan coastline was divided into three distinguished main regions: Eastern region, Sirt Gulf and Western region (Shakman, 2008, Shakman *et al*., 2023) closely associated with major structural features of the African continent (Zupanovic and El-Buni, 1982). Elasmobranchs are very vulnerable to overexploitation and generally considered as most sensitive and low resilient species (Stevens *et al*., 2000). In fact, they also represent an important bycatch of the industrial and artisanal fishery, especially for adult individuals (Quignard and Capapé, 1971).

***Objectives*:**

The survey aimed to:

1. Conduct a frame survey of landing sites, fleets, and infrastructure following FAO-GFCM standards.
2. Document the biodiversity of elasmobranchs in the Gulf of Sirte.

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3. Estimate catches of elasmobranch species during the 2024 season.
4. Collect biological data on selected targeted species.
5. Establish datasets for national, regional, and international sharing.

METHODOLOGY

Study area

Sirte gulf is located in the middle of the Libyan coast which extending about 700 km in the south Mediterranean (fig. 1). The beach includes different habitats, topographies and protected areas such as Al-hisha and Tawergha. The area from Buerat El Hassun to Benghazi is mainly constituted by salt marshes including Sultan, Besher, Kweim, Shwerab, and Karkora (SPA RAC, 2020). It is mostly sandy beaches interspersed with small rocky areas, it is providing suitable habitat for fish species, thereby supporting a wider marine food webs, which includes larger pelagic fish species (e.g. Bluefin Tuna and sharks), Sea turtles, seabirds, marine mammals. Moreover, it is considered as important habitat for different endangered elasmobranches species and sea turtles.

Frame survey:

A standardized frame survey was conducted between 15 March and 1 June 2024 using the FAO-GFCM protocol. The survey collected information on:

- landing-site characteristics and infrastructure,
- fleet composition and operational status,
- fishing gears used for elasmobranchs,
- interviews with fishers on species targeted, fishing history, and challenges,
- catch estimates and bycatch observations,
- biological measurements of elasmobranch embryos.

Species identification and biological sampling:

Elasmobranch species were documented based on fisher reports and inspections at the landing sites. Embryos were measured for total length (TL), weight, and sex.

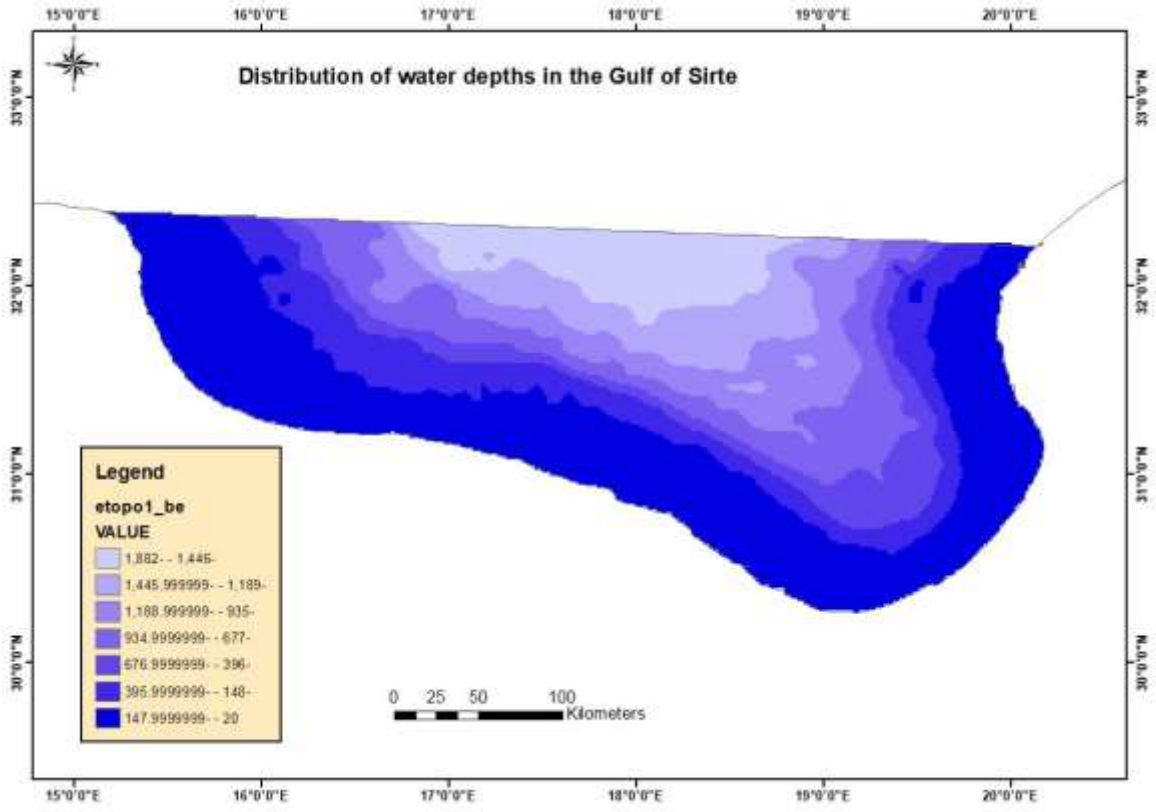


Fig. 1. The middle region (Sirte Gulf), showing the depth

RESULTS

Description of the landing sites

A total of 43 landing sites have been found, 35 of them are seasonal landing sites which represent more 81% (fig. 2), these landing sites are distributed in the Sirte gulf, started from Qaser Ahmed east to Misrata until Shaat Al Badean south to Benghazi.

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Landing-Site Characteristics

A total of 43 landing sites were identified, of which 81% are seasonal. Sites range from basic wooden or metal huts (20 - 60 m²) (fig. 3), usually powered by small generators and equipped with water tanks transported from nearby cities. Access is difficult due to sand dunes and unpaved roads, requiring 4×4 vehicles. Only 20% of sites were active during the survey season (fig. 4).

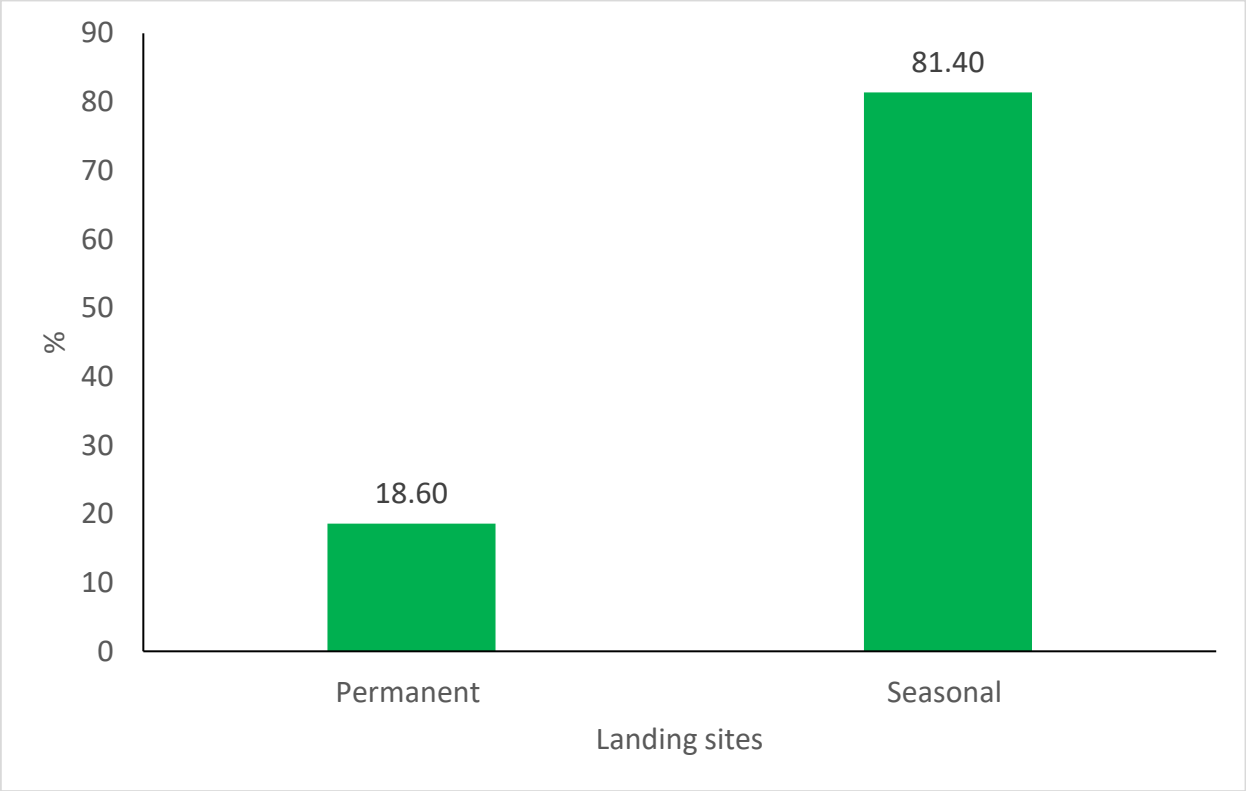


Fig. 2. Landing sites in the Sirte gulf



Fig. 3. Seasonal landing sites in the Sirte gulf

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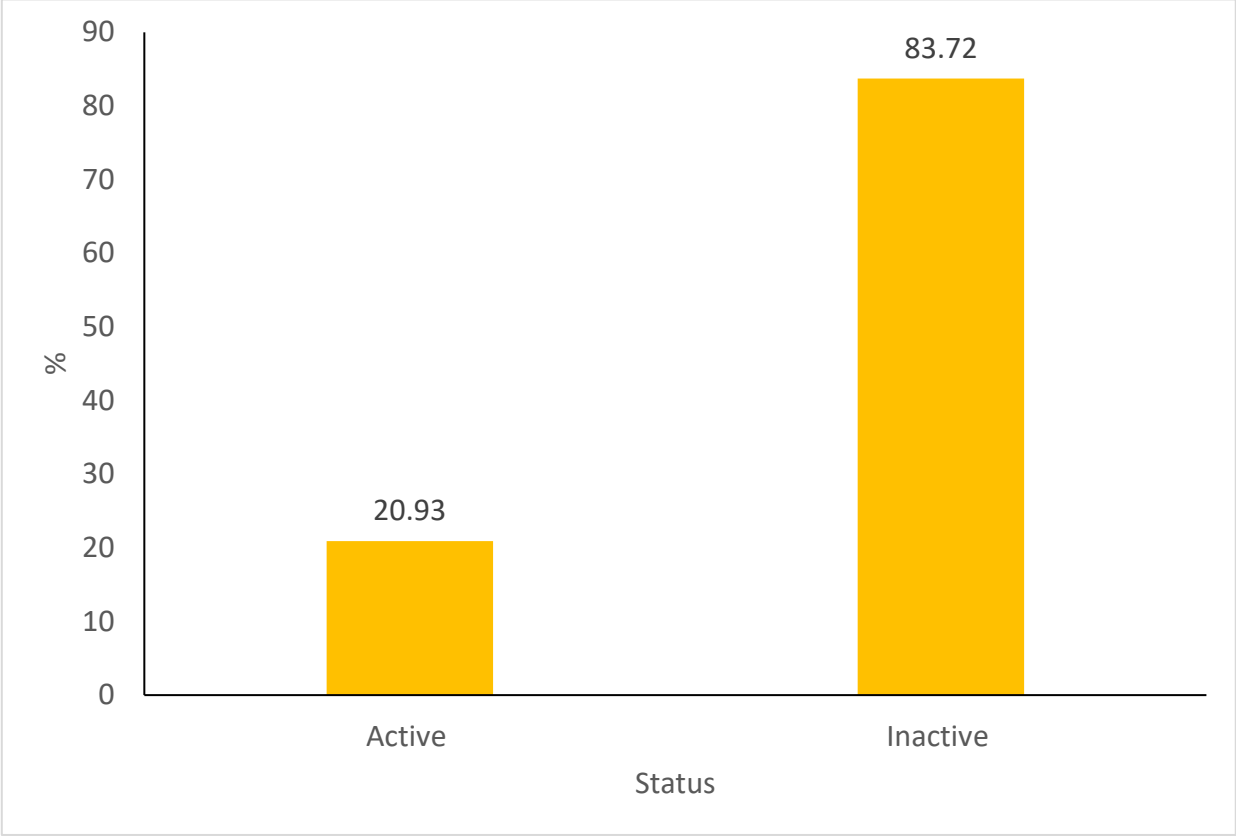


Fig. 4. Status of the landing sites in the Sirte gulf in this season

Fleet Composition

All fishing units recorded were artisanal *Fluka* boats. 303 units were documented, lengths ranged from 3–8 m, with 5-m units is the most common (fig. 5). Hulls were primarily fiberglass (>94%) (fig. 6). The operational status is 48% non-operative, >40% active, remainder abandoned. Moreover, Engine power ranged from 15–115 hp, with 40-hp engines dominating (>90%) (fig. 7).

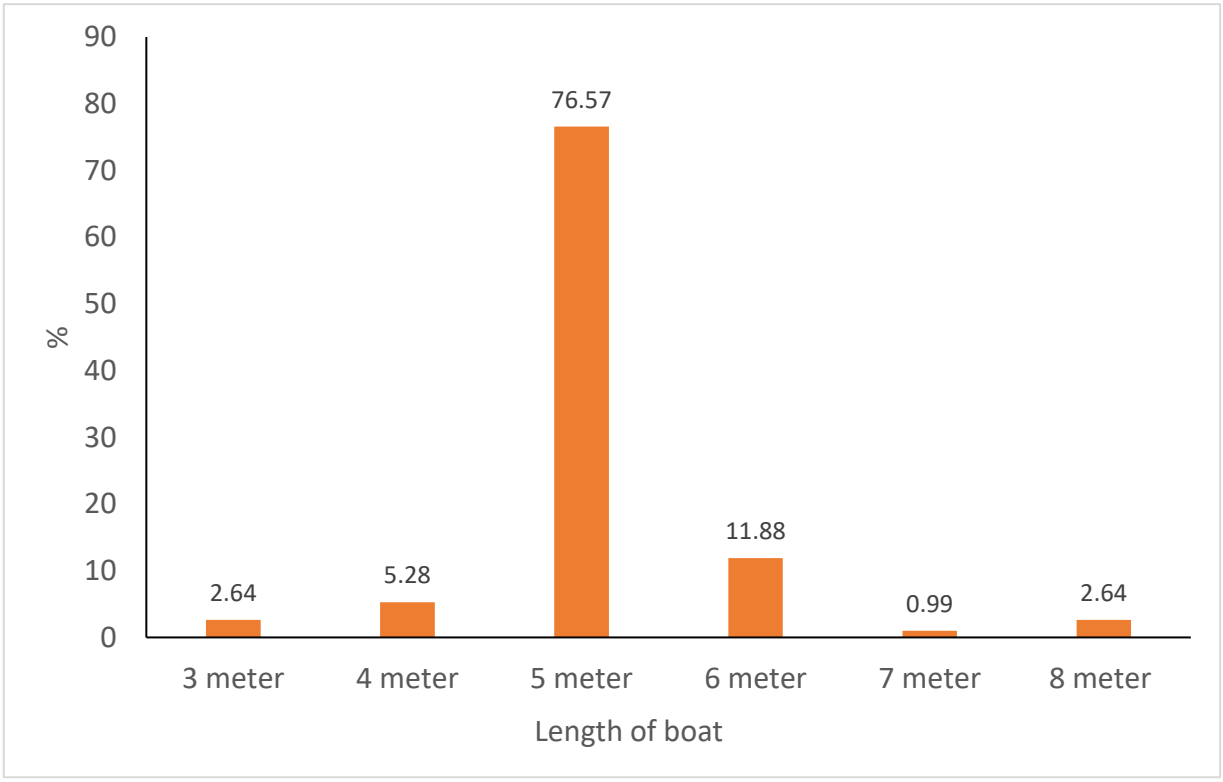


Fig. 5. Length of Fluka in the Sirt gulf

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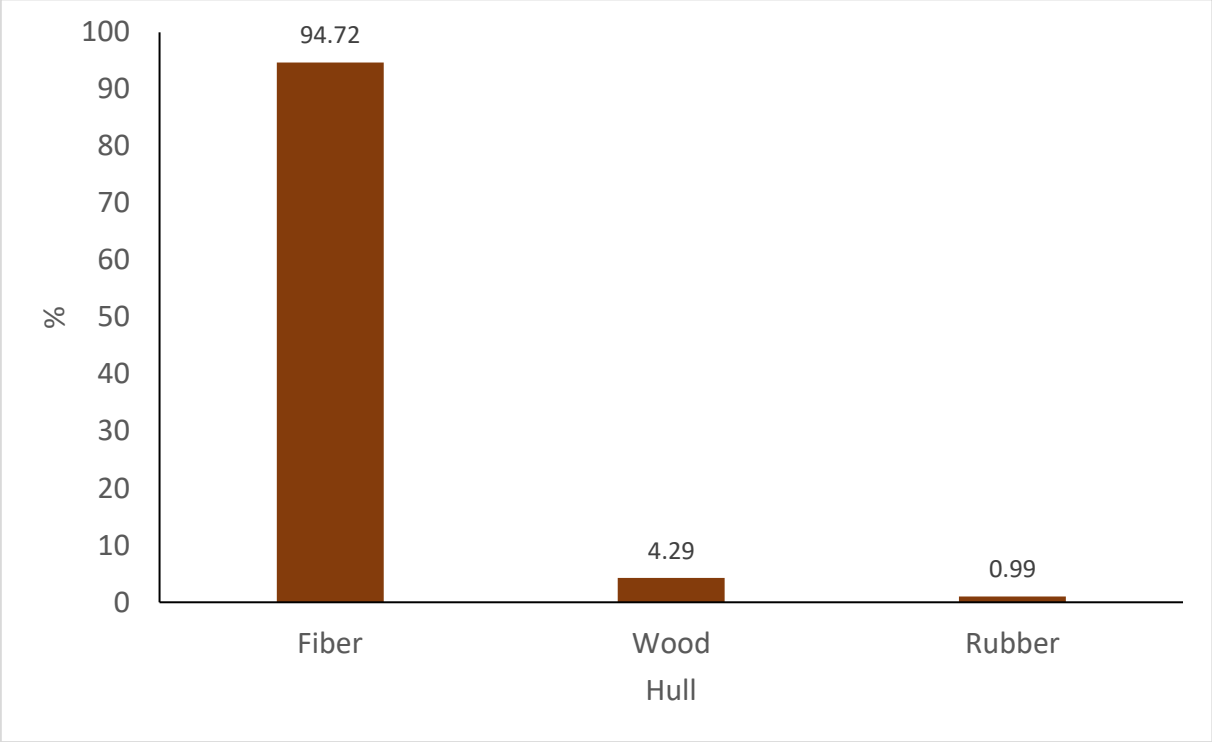


Fig. 6. Hull made of Fluka in the Sirt gulf

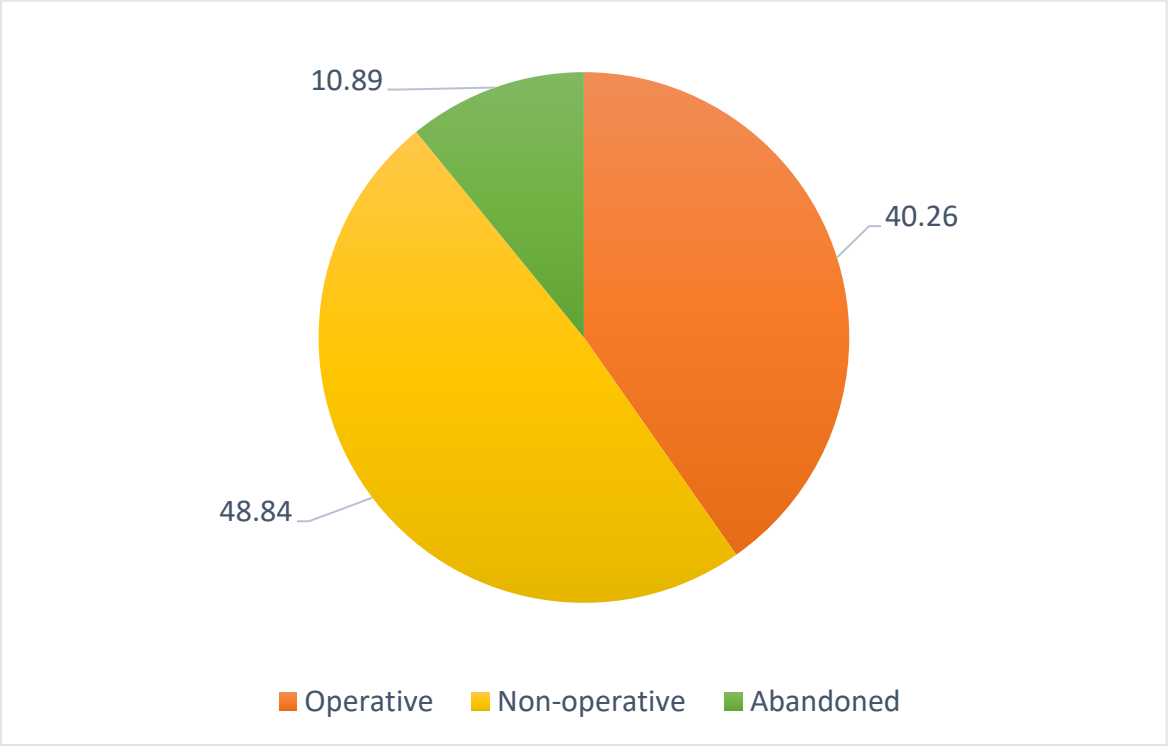


Fig. 7. Status of Fluka in the Sirte gulf

Fishing Gears

The two main gears targeting elasmobranchs were Kellabia nets: nylon gillnets, 400 - 4000 m long, 2 - 4 m deep, mesh 14 - 28 cm, used in <50 m depth and Longlines: operated from 20 - 200 m depth with various hook sizes. All active sites used Kellabia nets (100%), while 66.7% also used longlines.

Fishing Season

The elasmobranch fishing season runs from February to June, coinciding with the reproductive periods of several species including *Carcharhinus limbatus*, *C. plumbeus*, and *Mustelus mustelus*.

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Species Composition

Sixteen cartilaginous species were recorded, including sharks, rays, and guitarfishes. Key species observed included where several of these species are globally threatened (table 1).

Table 1. Cartilaginous fishes that have been caught in the Sirte gulf

No.	Scientific name	Local name	Common name	Status
1	*Centrophorus granulosus*	كلب بوعين	Gulper shark	EN
2	*Carcharhinus limbatus*	كلب بوريشة	Blacktip shark	VU
3	*Carcharhinus plumbeus*	بودريوة	Sandbar shark	EN
4	*Isurus oxyrinchus*	زرقاية	shortfin mako	EN
5	*Pteroplatytrygon violacea*	بقرة	Violet stingray	LC
6	*Mustelus mustelus*	متسولة	Smoothhound	EN
7	*Squalus blainvillei*	كلب بوشوكة	Longnose spurdog	DD
8	*Prionace glauca*	كلب ازرق	Blue shark	NT
9	*Myliobatis aquila*	فار	Common eagle ray	CR
10	*Squatina squatina*	شكالطو	Angelshark	CR
11	*Squatina aculata*	سفن مشوك	Sawback angelshark	-
12	*Rhinobatos rhinobatos*	محراث	Common guitarfish	CR
13	*Sphyrana lewini*	بومطرقة	Smooth hammerhead	-
14	*Galeorhinus galeus*	كلب عادي	Top shark	CR
15	*Hexanchus griseus*	كلب لبوة	Bluntnose six-gill shark	NT
16	*Rhinobatos cemiculus*	محراث داكن	Blackchin guitarfish	CR

Biological Measurements

Ten embryos of *Mustelus mustelus* were examined. Total length (TL) ranged from 36 to 41 cm, the weight ranged from 16 to 24 g, whilst the sex ratio was 80% females and 20% males.

Bycatch

The investigating of bycatch resulted in many untargeted species including threatened taxa such as: Loggerhead turtle (*Caretta caretta*), Common bottlenose dolphin (*Tursiops truncatus*) and Seabirds caught in nets and longlines.

Catch Estimation of cartilaginous fishes

Interviews with professional fishers provided estimated total catches of cartilaginous fish for the season. *Carcharhinus plumbeus* was the most caught species, while the lowest fished species was *Carcharhinus limbatus* (fig. 8).

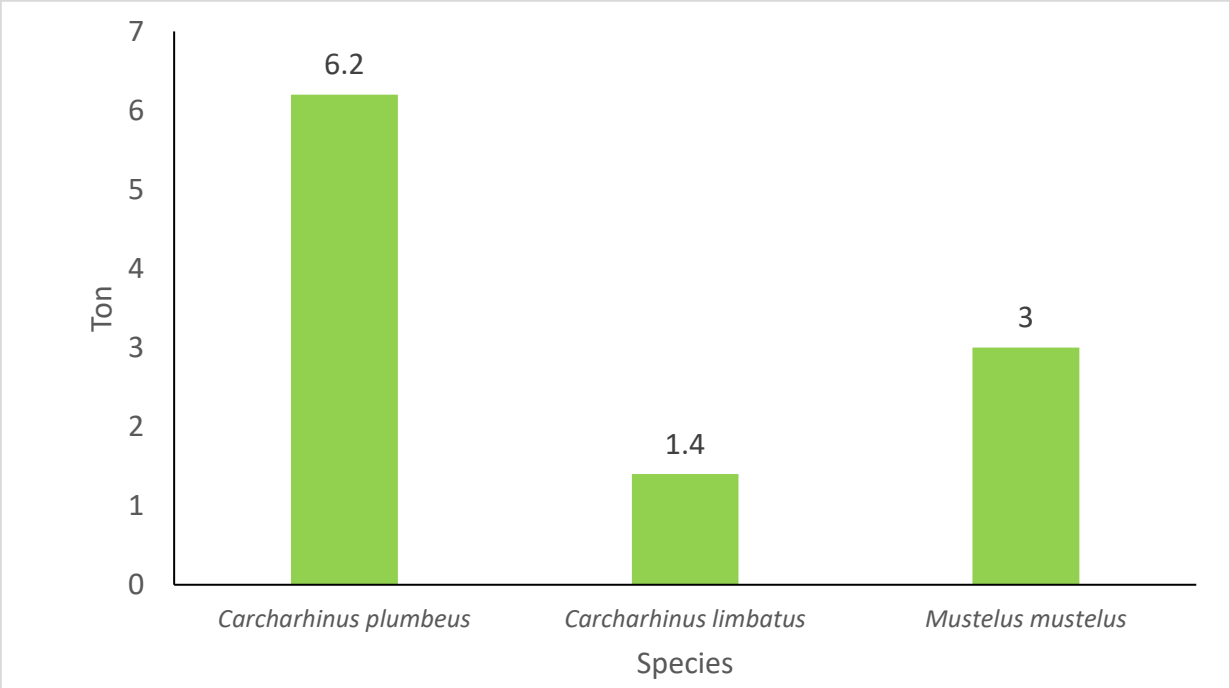


Fig. 8. Estimation catch of cartilaginous fish in the Sirte gulf

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Bony fishes

There were seven species of bony fish that are caught in the study area during different seasons (Table 2). These species are usually caught as a hobby and for consumption.

Table 2. Bony fish fishes that have been caught in the Sirte gulf

No.	Scientific name	Local name	Common name
1	*Epinephelus costae*	دوت	Golden grouper
2	*Epinephelus marginatus*	فروج	Dusky grouper
3	*Seriola dumerili*	شولة	Greater amberjack
4	*Scomberomorus commerson*	بلاميطة يمنية	Narrow-barred Spanish mackerel
5	*Sphyraena sphyraena*	مغزل الشاوش	European barracuda
6	*Dentex dentex*	دندشي	Common dentex
7	*Dentex gibbosus*	جغالي	Pink dentex

DISCUSSION

This study provides the first comprehensive description of artisanal shark and ray fisheries in the Gulf of Sirte. The dominance of small, low-technology fleets and gear types reflects traditional practices; however, fishing during peak reproductive seasons raises substantial conservation concerns, especially given the vulnerability of elasmobranch species (Simeon *et al*., 2019).

Kellabia nets, in particular, pose documented ecological risks, including habitat damage, ghost fishing, and high bycatch of turtles and dolphins. Longlines used at greater depths further increase interactions with non-target species (Wallace *et al*., 2008). High rates of non-operative vessels may indicate economic challenges or fluctuating market conditions.

The biological data on *Mustelus mustelus* embryos highlight direct removal of pregnant females, raising concerns about local population recruitment. The presence of threatened species such as *Squatina squatina* and *R. cemiculus* underscores the need for immediate management actions. The statement highlights the critical need for urgent conservation for these species. both facing severe threats, primarily from overfishing and bycatch, leading to their critically endangered status, especially in the Mediterranean. Immediate management actions, such as implementing regional conservation plans (like the MedRAP), improving fisheries regulations, and utilizing citizen science, are essential to protect their few remaining strongholds to prevent further population collapse and potential extinction (Shakman *et al*., 2019; UNEP/MAP-SPA/RAC, 2021).

Environmental pressures including oil-related pollution, coastal development, and unregulated tourism compound the ecological impact of fishing activities. The absence of fisheries management, limited enforcement, and lack of fisher awareness further exacerbate these issues (Hoffmann, 2010).

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