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Shark infested internet: an analysis of internet-based media reports on rare and large sharks of Turkey

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Abstract
Following a survey of the internet-based media sources, 268 specimens of sharks representing 10 families, 16 species, as well as 2 genera, were identified from Turkish seas. The majority of the identified species is composed by the records of the bluntnose sixgill shark, *H. griseus* (51.8%; 139 out of 268 specimens), and followed by the common thresher (*A. vulpinus*; 12.6%; n=34), sandbar (*C. plumbeus*; 8.9%; n=24), shortfin mako (*I. oxyrinchus*; 6.3%; n=17), and bigeye thresher sharks (*A. superciliosus*; 5.2%; n=14). The urgent need for a non-invasive and non-destructive method for data collection, legitimating the reasonable use of internet-based media, as a source of data, in the research of sharks, which is also confirmed by the results of the present study. Such an approach in extracting scientific data from the mentioned digital sources requires a certain standardization of best practice. Despite the current weaknesses of such a methodological approach, it can obviously allow an increased research effort at low coast in research of sharks, in a non-destructive way.

Keywords: Sharks, Turkey, Internet, Occurrence, Non-destructive methodology.
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Introduction

With the invent of internet and internet-based social media platforms, opportunities of communication have leaped to a level, beyond any imagination. Since social media has revolutionized how people communicate with one another (Shiffman 2018), nowadays Twitter, Facebook, Instagram, You Tube and numerous blogs can offer many advantages for fisheries scientists and management professionals, who are willing to use those revolutionary communication platforms. In a recent study on utilization of social media for fisheries science purposes, Shiffman (2018) emphasizes that, if utilized correctly, social media can provide an efficient tool for science communication, translating technical scientific results into formats that non-experts can understand. Yet in a more recent survey on a data collection on large elasmobranchs in the Mediterranean and Black seas, which is named as The Mediterranean Large Elasmobranchs Monitoring (MEDLEM) database, Mancusi et al. (2020) stated that, significant observations on sharks can be derived from social media, particularly Facebook and You Tube, if the uploaded images allowing species identification.

Sharks, as apex predators, likely play an important role in the structure and function of marine communities (Camhi et al. 1998). Although, sharks arose in world's oceans at least 400 million years ago and have key roles in the marine ecosystems, currently they are among the most threatened vertebrates in the ocean (Bargnesi et al. 2020). Dulvy et al. (2014) estimate that one-quarter of 1,041 chondrichthyan fishes – sharks, rays, and chimaeras – are threatened, and overall chondrichthyan extinction risk is substantially higher than for other vertebrates. According to Dulvy et al. (2016), Mediterranean Sea as a key hotspot of extinction risk, presented some of the most extreme population declines, where 54 percent (22 out of 41 species) of sharks are faced an elevated risk of extinction.

In the recently published National Action Plan for the Conservation of Cartilaginous Fishes in the Turkish Waters, Öztürk (2018) summarised the priority issues, which include the intensification of scientific studies on elasmobranchs. Despite the urgent need for the intensification of the data collection of sharks from Turkish

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waters (Öztürk 2018), the dramatic decline of shark populations shown in the Mediterranean (Ferreti et al. 2008; Dulvy et al. 2016), calls for alternative and non-destructive ways to collect data on species distributions and abundance. Since sharks are characterised by k-selected life history traits (Camhi et al. 1998), which make these species highly vulnerable to exploitation, regardless either for commercial or scientific purposes, social media survey (SMS) could offer an excellent and non-destructive opportunity for data collection (Mieras et al. 2017; Shiffman 2018, 2020). Since the expansion of the use of internet and social-media in the last 20 years has likely increased the probability to detect the captures of any rare and/or large shark (Kabasakal et al. 2017; Moro et al. 2020; Mancusi et al. 2020), the role of this new and boundless way of communication cannot be totally ruled out in the monitoring of shark captures in the future.

In two previous studies, Kabasakal (2003, 2010) demonstrated that the printed media can provide the opportunity for tracing the extension of both historical and contemporary sightings and/or records of sharks in Turkish waters. In the present article, authors provided an analysis of rare and/or large shark captures in Turkish waters, based on data solely derived from internet and social media sources. Furthermore, authors reported first records of two carcharhinids, the copper shark, *Carcharhinus brachyurus* (Günther, 1870), and the silky shark, *C. falciformis* (Bibron, *in* Müller and Henle, 1839), in Turkish seas.

Material and Methods

Since 54 percent of the Mediterranean sharks are at an elevated risk of extinction (Dulvy et al. 2016), sampling of the present study was a typical representative of opportunistic research (Jessup 2003), in which the internet data sources, such as fisheries blogs, websites of local and national newspapers, and social media platforms were regularly screened, covering a period between years of 2006 and 2020. Since online communities and website administrators may react negatively to the use of their online content by researchers, following the ethical code proposed by Monkman et al. (2017), all internet content scraping activity was performed responsibly to avoid compromising any personal data or image.

To extract data from electronic sources, a structured BOOLEAN search was performed on search engines such as Google, Internet Explorer or Yahoo, and online video sharing platforms such as YouTube or Dailymotion, as well as websites of local or national newspapers. An individual record of a shark was considered valid, if the respective digital photograph depicts the specimen from a clear side view, or in case of a video footage, the shark should have been appeared through a reasonable time, nearly for 5 seconds, allowing to capture a still image for identification of the species of shark. Internet or social media sources of identified specimens of sharks are given as electronic supplementary documents at the appendix of the present article. For each specimen to be identified, still of video images were extracted from at least two different sources; triple or quadruple check of different sources of the same specimen was also performed, if available. To avoid any biases in the identification process, both authors examined and cross-checked the specimens independently. Identification and taxonomic nomenclature of the shark species follows Serena (2005). Distribution of sharks in Turkish waters were based on Bilecenoğlu et al. (2014) and Kabasakal (2020). The amount of information collected in the current database allowed us to perform a first preliminary assessment of the sightings and/or records of rare and large sharks in Turkish waters, solely based on data extracted from internet and social media. Length and weight data of specimens were derived by the information reported in the data sources. IUCN criteria for the conservation of the identified sharks follows Otero et al. (2019). Approximate locations of sightings and/or records of sharks were plotted on map, in order to create a graphic depiction of the spatial aggregations of those sightings and/or records, following the procedure presented in Mancusi et al. (2020).

Figure 1. The copper shark, *Carcharhinus brachyurus* (Günther, 1870), captured from Mersin (Silifke/Taşucu).

Results

New records for the sharks of Turkish waters: Following the detailed examination of the images of sharks revealed from internet sources, two carcharhinid sharks, the copper shark, *C. brachyurus* (Günther, 1870) (Fig. 1), and the silky shark, *C. falciformis* (Bibron, *in* Müller and Henle, 1839) (Fig. 2) were recorded for the first time in Turkey. Five specimens of *C. brachyurus* were recorded off the coasts of Adana (20 September 2014 and 6 August 2018), Mersin (7 February 2015 and 3 December 2019) and Antalya (24 December 2019). The following descriptive characters were observed on the specimens, identified as *C. brachyurus*: coloration bronzy to greyish bronzy above and whitish below; body fairly slender with a moderately long narrowly rounded snout, long pectoral fins, and a large and falcate first dorsal fin with narrowly rounded apex and a short rear tip, of which the origin over pectoral rear tips; and a small second dorsal fin with a short free rear tip (Compagno 1984) (Fig. 1).

Three specimens of *C. falciformis* were recorded off the coasts of Antalya (29 January 2009) and Mersin (15 November 2014 and 27 June 2019). Based on the following descriptive characters, those specimens identified as *C. falciformis*: coloration dark grey to greyish brown above, whitish below; body fairly slender with a moderately long and rounded snout, first dorsal fin moderately-sized and falcate with broadly rounded apex, origin of first dorsal fin behind pectoral free rear tips; second dorsal-fin very small and low, its free tip very long, greater than twice the fin height; interdorsal ridge present (Compagno 1984) (Fig. 2).

General remarks on recorded shark species: A total of 268 specimens of sharks representing 10 families, 16 species, as well as 2 genera, were identified in the examined internet-based media (Table 1; Fig. 3). The majority of the identified species is composed by the records of the bluntnose sixgill shark, *H. griseus* (51.8%; 139 out of 268 specimens), and followed by the common thresher (*A. vulpinus*; 12.6%; n=34), sandbar (*C. plumbeus*; 8.9%; n=24), shortfin mako (*I. oxyrinchus*; 6.3%; n=17), and bigeye thresher sharks (*A. superciliosus*; 5.2%; n=14) (Table 1). Remaining species are represented with specimen numbers $\leq$6, of which the highest number was recorded for the white shark, *C. carcharias* (2.2%; n=6) (Table 1). Seven specimens of *Carcharhinus* (2.6%) and 4 specimens of *Squatina* (1.5%) remained unidentified (Table 1). The smallest shark specimen was an

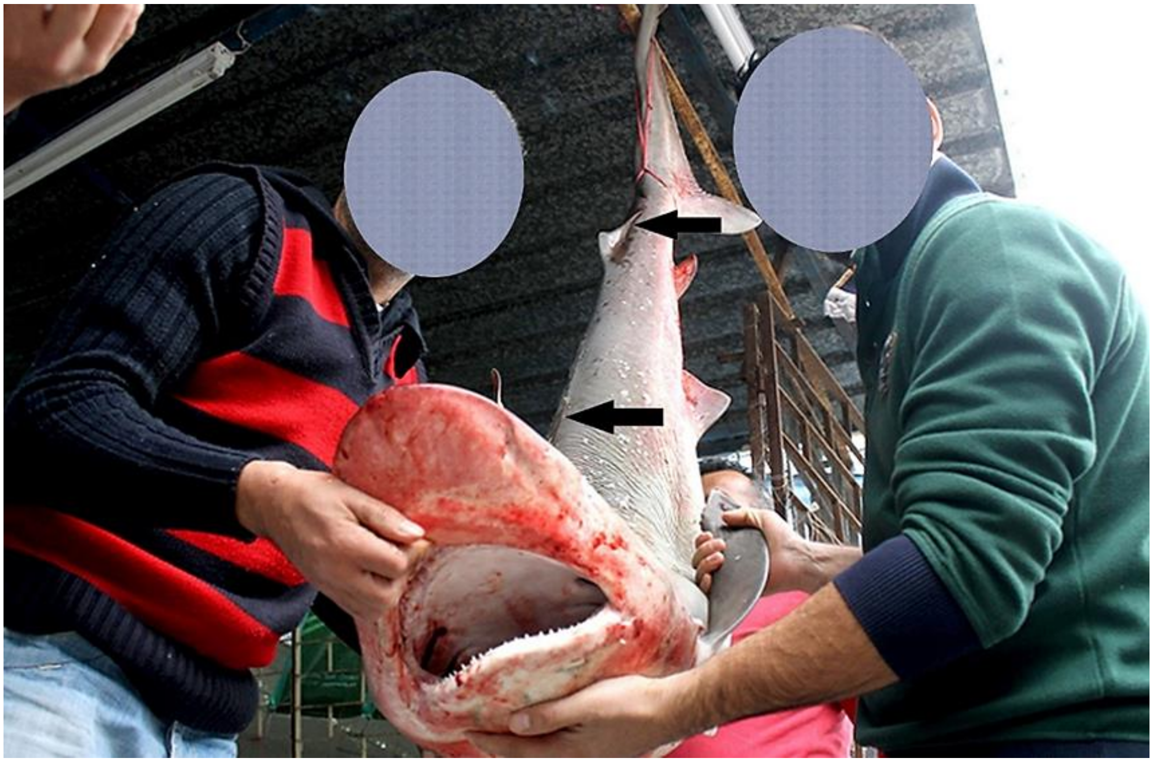

Figure 2. Silky shark, *Carcharhinus falciformis* (Bibron, in Müller and Henle, 1839), captured from Mersin (Erdemli).

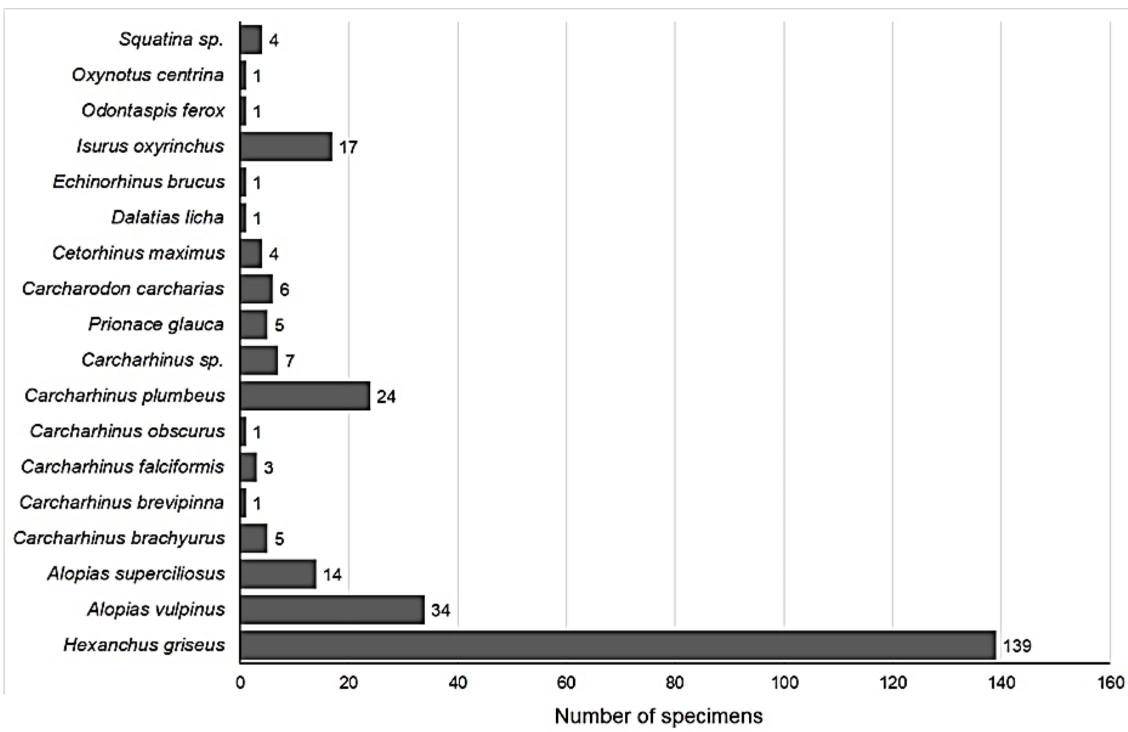

Figure 3. Numerical frequency of shark specimens identified in the present study.

angular rough shark, *O. centrina* (50 cm of TL), and the largest one was a basking shark, *C. maximus* (800 cm of TL). The minimum weight recorded was 10 kg for a spinner shark, *C.* cf *brevipinna*, and the maximum recorded weight was 2000 kg for a basking shark, *C. maximus*. Total number, length range and mean length, weight range and mean weight, of the examined specimens are presented in Table 1.

Table 1. Identified families, genera and species of sharks, with general remarks on examined specimens. CR: Critically Endangered; EN: Endangered; VU: Vulnerable; NT: Near Threatened; LC: Least Concern; DD: Data Deficient; NE: Not Evaluated (Otero et al. 2019).

Family / Species	Total number of cases	Length Range	Mean Length	Weight Range	Mean Weight	IUCN Criteria
HEXANCHIDAE						
Hexanchus griseus (Bonnaterre, 1788)	139	150 - 600 (n=118)	353,2	60 - 1500 (n=123)	442,2	LC
ECHINORHINIDAE						
Echinorhinus brucus (Bonnaterre, 1788)	1	200 (n=1)	-	140 (n=1)	-	EN
OXYNOTIDAE						
Oxynotus centrina (Linnaeus, 1758)	1	50 (n=1)	-	-	-	CR
DALATIIDAE						
Dalatias licha (Bonnaterre, 1788)	1	100 (n=1)	-	-	-	VU
SQUATINIDAE						
Squatina sp.	4	160 – 160 (n=2)	160	60 (n=1)	-	CR
ODONTASPIDIDAE						
Odontaspis ferox (Risso, 1810)	1	600 (n=1)	-	700 (n=1)	-	CR
ALOPIIDAE						
Alopias superciliosus (Lowe, 1839)	14	200 - 600 (n=12)	402,5	95 - 1250 (n=10)	343,1	EN
Alopias vulpinus (Bonnaterre, 1788)	34	300 - 700 (n=31)	429,6	100 - 800 (n=32)	307,8	EN
CETORHINIDAE						
Cetorhinus maximus (Gunnerus, 1765)	4	230 - 800 (n=4)	520	70 - 2000 (n=3)	746,7	EN
LAMNIDAE						
Carcharodon carcharias (Linnaeus, 1758)	6	85 - 300 (n=6)	175,8	12 - 300 (n=4)	110,5	CR
Isurus oxyrinchus Rafinesque, 1810	17	100 - 350 (n=5)	230	15 - 400 (n=4)	136,3	CR
CARCHARHINIDAE						
Carcharhinus brachyurus (Günther, 1870)	5	250 (n=1)	-	135 (n=1)	-	DD
Carcharhinus cf. *brevipinna* (Müller and Henle, 1839)	1	-	-	10 (n=1)	-	NE
Carcharhinus falciformis (Bibron, in Müller and Henle, 1839)	3	140 - 250 (n=2)	195	75 - 750 (n=2)	412,5	NE
Carcharhinus cf. *obscurus* (Lesueur, 1818)	1	-	-	-	-	DD
Carcharhinus plumbeus (Nardo, 1827)	24	180 - 300 (n=10)	228	70 - 150 (n=7)	114,6	EN
Carcharhinus sp.	7	150 - 250 (n=3)	196,3	15 - 150 (n=4)	63,8	
Prionace glauca (Linnaeus, 1758)	5	200 - 350 (n=4)	250	200 - 250 (n=3)	233,3	CR

Spatial distribution of identified records and/or sightings: In Turkish waters, distribution of *H. griseus*, extends from eastern Levant Sea to the western Black Sea; however, the majority of the occurrences were recorded in the Sea of Marmara (Fig. 4). The highest number of occurrences of the bluntnose sixgill shark were recorded in the southwestern Sea of Marmara, where the frequency of occurrence of the species was represented by 15 to 20 specimens in certain localities. On the other hand, only a single occurrence of *H. griseus* was recorded off western Black Sea coast (Fig. 4). Occurrences of *H. griseus* in Turkish Aegean and Mediterranean waters were represented by 1 to 10 specimens, throughout the entire coastline, where the Gulf of Mersin was the highest point of occurrence with 10 specimens at one locality (Fig. 4).

Despite the patchy distribution pattern of alopiid sharks, occurrences of *A. superciliosus* and *A. vulpinus* were recorded in Mediterranean, Aegean and Marmara seas (Fig. 5). Regarding the highest point of occurrences for both alopiids, 5 specimens of *A. superciliosus* were recorded in a single locality off western coast of Kaş peninsula, and 6 specimens of *A. vulpinus* were recorded in a single locality in Gulf of Mersin (Fig. 5). The majority of the occurrences of carcharhinid sharks were recorded in the Turkish Mediterranean waters, with a

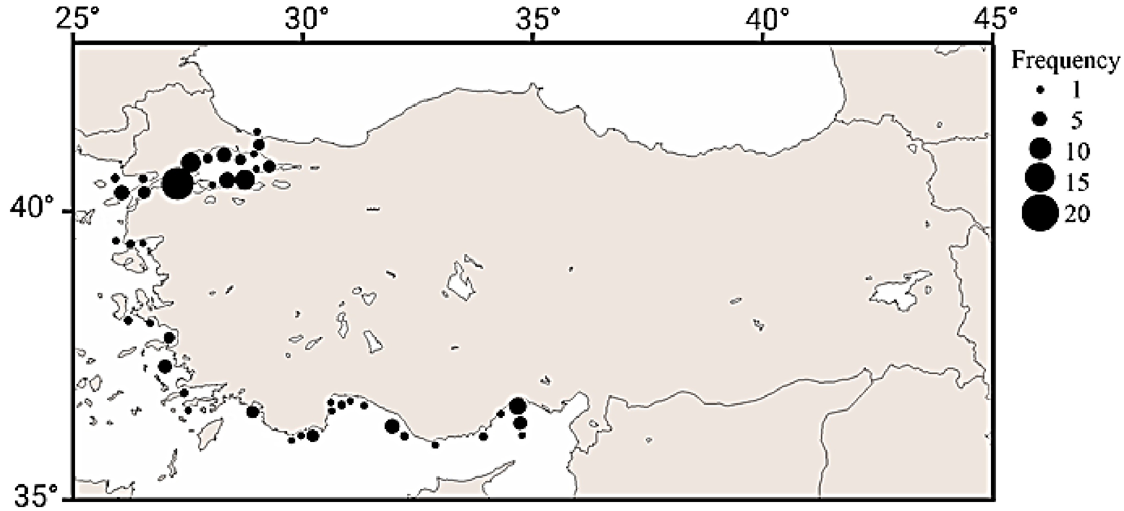

Figure 4. Point of occurrences of *Hexanchus griseus* in Turkish waters, with frequency (number of specimens) data at each locality.

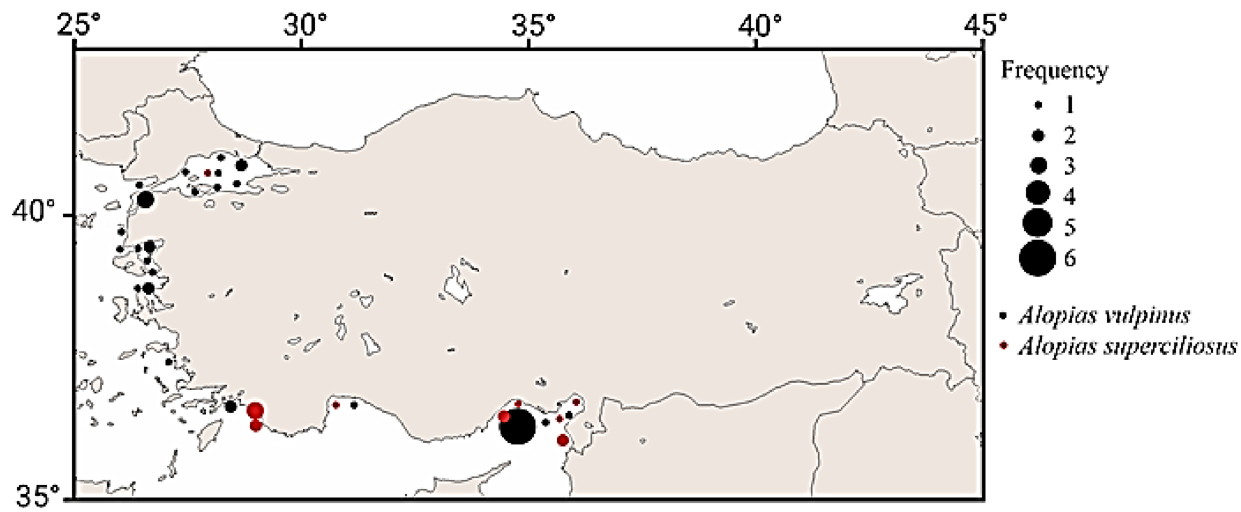

Figure 5. Point of occurrences of *Alopias superciliosus* and *A. vulpinus* in Turkish waters, with frequency (number of specimens) data at each locality.

few sporadic records in south-eastern Aegean waters, as well (Fig. 6). The sandbar shark, *C. plumbeus*, was the most abundant shark, and regarding the highest point of occurrence, 30 sandbar sharks were recorded in a single locality off Gazipaşa coast (Fig. 6). Occurrence of remaining carcharhinids (*C. brachyurus*, *C. brevipinna*, *C. falciformis*, *C. obscurus*, *P. glauca*) and unidentified *Carcharhinus* sp., were represented by vagrant single specimens, of which seldomly occurred along Turkish Mediterranean and Aegean coasts (Fig. 6).

Point of occurrence of the following shark species were represented by ≤8 specimens, from respective localities along Marmara, Aegean and Mediterranean coasts (Fig. 7): *E. brucus*, *O. centrina*, *D. licha*, *O. ferox*, *C. maximus*, *C. carcharias* and *I. oxyrinchus,* and *Squatina* sp. The highest number of points of occurrence was recorded for *I. oxyrinchus* (n=8) in Bay of Antalya and *Squatina* sp. (n=8) near southern entrance of Istanbul Strait, and followed by *C. carcharhias* (n=5) in Edremit Bay (Fig. 7). Four specimens of *C. maximus* were recorded off Çanakkale (n=2), Mersin (n=1) and Hatay (n=1) coasts. Occurrences of *E. brucus*, *O. centrina*, *D. licha* and *O. ferox* were represented by single specimens (Fig. 7).

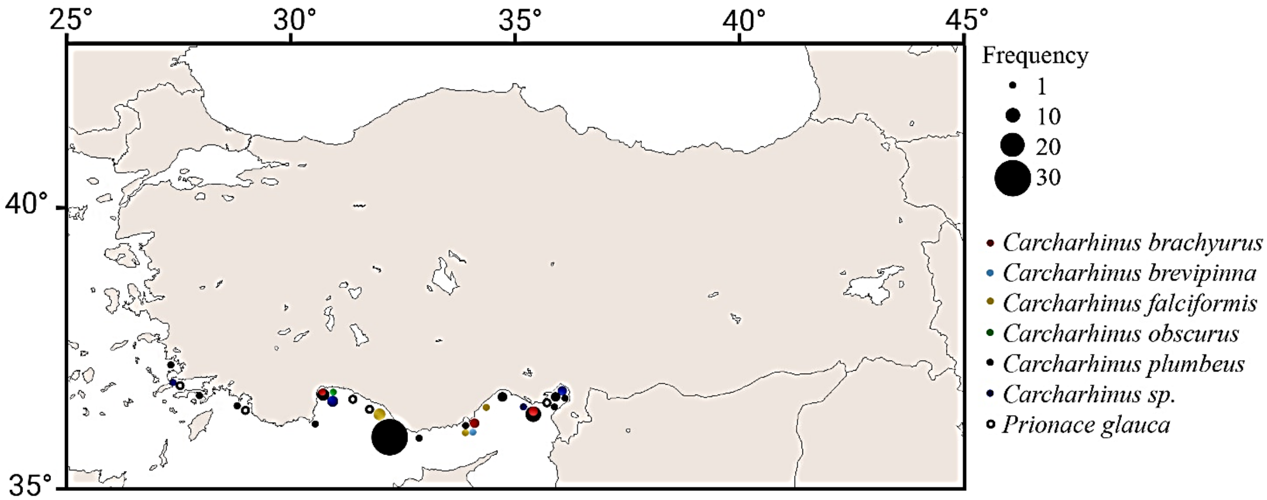

Figure 6. Point of occurrences of carcharhinid sharks in Turkish waters, with frequency (number of specimens) data at each locality.

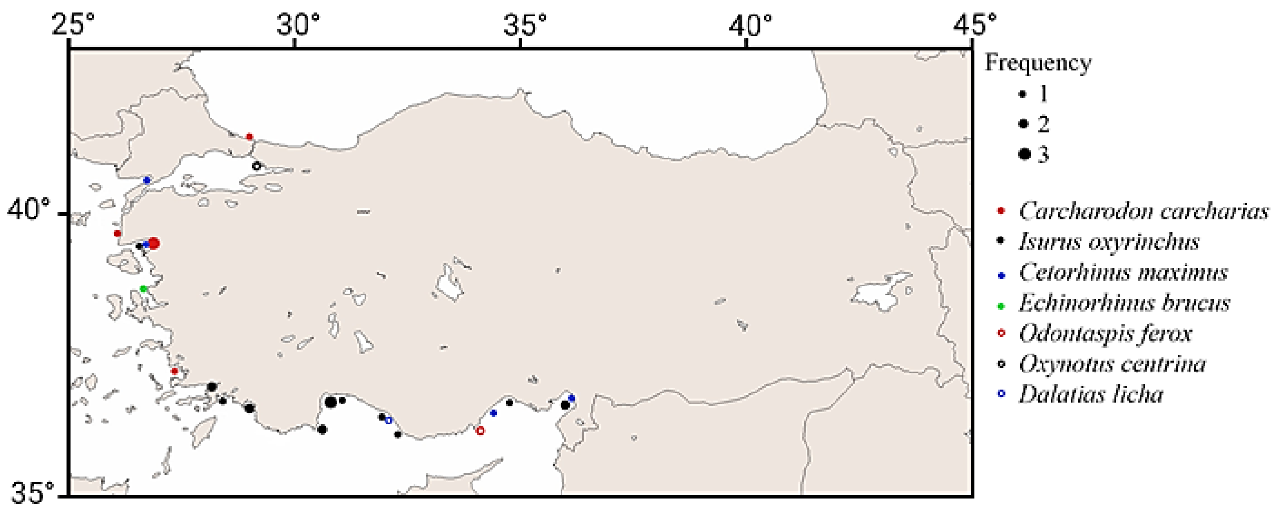

Figure 7. Point of occurrences of squaliform, lamniform and squatiniform sharks in Turkish waters, with frequency (number of specimens) data at each locality.

Discussion

With the first records of *C. brachyurus* and *C. falciformis*, total number of shark species in Turkish waters (n=36; Kabasakal 2020), increased to 38. Since the records of both carcharhinids are based on photographic evidences, retrieved from internet media, further investigation is needed to obtain physical sampling of *C. brachyurus* and *C. falciformis*, in Turkish waters. Remaining species listed in Table 1, are the well-documented sharks of the Turkish ichthyological fauna (Bilecenoğlu et al. 2014; Kabasakal 2020). The occurrences of *C. brachyurus* and *C. falciformis* in eastern Mediterranean have been reported by Bariche (2012) and recently confirmed by Azab et al. (2019).

The list of identified sharks of the present study includes rare and large elasmobranchs species. The rarity or occasional occurrences of *E. brucus*, *O. centrina*, *D. licha*, *O. ferox* and *Squatina* sp., have been previously emphasized by several researchers (Serena 2005; Bariche 2012; Kabasakal and Bilecenoğlu 2014; Kabasakal and Bayrı 2019; Ergüden et al. 2017; Kabasakal 2015a, 2020). According to Ferretti et al. (2008), large sharks were defined as species with a maximum length >2 m, and regarding the maximum lengths of the specimens examined in the present article, 14 species (87.5%; 14 out 16 species) are coincided with the definition of large shark. Although, no measurements were reported for single specimens of *C. brevipinna* and *C. obscurus* in internet sources, the reported maximum total lengths for these carcharhinids are 278 and 400 cm, respectively (Serena 2005).

The occurrence and distribution of large sharks in Turkish waters and in eastern Mediterranean in a broader perspective, were investigated by several researchers. In an extensive survey on the occurrences of large sharks in south-eastern Mediterranean Sea, Damalas and Megalofonou (2012) found that, large sharks (10 species) comprised less than 3 percent of the total catch of the pelagic fishing gear. In the Mediterranean Large Elasmobranches Monitoring (MEDLEM) database, which contains more than 3000 records, observed from 1666 to 2017, the most frequent large shark reported is the basking shark (*C. maximus*, 18.8%), followed by the blue shark (*P. glauca*, 12.5%), the great white shark (*C. carcharias*, 6.9%), and the thresher and bluntnose sixgill sharks (*A. vulpinus* and *H. griseus*, each with 3.6%) (Mancusi et al. 2020). Recently, Kabasakal et al. (2017) reported 392 large sharks recorded in Turkish waters between 1990 and 2015, and contrary to findings of Mancusi et al. (2020), *H. griseus* dominated the large shark captures in Turkish waters (43.2% of total captures; n=169). Similarly, the majority of the records of the present study is also comprised by the captures of *H. griseus* (51.8%; n=139; Table 1). With the addition of 139 specimens, total number of *H. griseus* records in Turkish waters for the last 30 years increased to 308 specimens.

Occurrences of *A. superciliosus* and *A. vulpinus* in Turkish waters and elsewhere in eastern Mediterranean, are well-documented (Bariche 2012; Kabasakal 2007, 2019; Lanteri et al. 2017), and Kabasakal (2007) also reported on the occasional occurrence of the latter species in the Black Sea. *Alopias superciliosus* is a rarely captured large shark in the Mediterranean and its occurrence data based on the records of 40 specimens, which captured between 1952 and 2017 (Lanteri et al. 2017). Once it was one of the most abundant large sharks in the Mediterranean, drastic declines have been recorded for both the abundance and biomass (>95% for both parameters) of *A. vulpinus*, and in a recent IUCN evaluation, both thresher sharks have been evaluated as endangered species in the Mediterranean Sea (Otero et al. 2019).

Despite the frequent appearance of the sandbar shark, *C. plumbeus*, in the internet-based media examined in the present analysis, the remaining carcharhinids (*C. brachyurus*, *C. brevipinna*, *C. falciformis*, *C. obscurus* and *P. glauca*) were seldomly reported in the mentioned sources. *Prionace glauca* is another indicator species of the alarming status for Mediterranean large sharks, of which drastic declines (>90%) were reported with respect to biomass and abundance (Ferretti et al. 2008), and now it is considered as critically endangered in the Mediterranean (Otero et al. 2019). Since the requiem sharks, the genus *Carcharhinus*, are a diverse group of predators characteristic of coastal environments, Ferretti et al. (2008) speculated that they may have declined most precipitously and earlier. According to Damalas and Megalofonou (2012), *P. glauca* was the predominant, comprising approximately 70 percent (174 out of 249) of large sharks encountered in the pelagic fisheries in the southwestern Mediterranean Sea; however, in two recent reports, the blue shark comprised the 3.3 to 12.5 percent of the total catches (Kabasakal et al. 2017; Mancusi et al. 2020). Requiem sharks (genus *Carcharhinus*) comprised only 3 to 4 percent of the total captures (Damalas and Megalofonou 2012; Kabasakal et al. 2017). Recent IUCN evaluations (Otero et al. 2019) of the examined carcharhinids are presented in Table 1.

Last but not least, low numbers of occurrences of lamniform sharks, *O. ferox* (n=1), *C. maximus* (n=4), *I. oxyrinchus* (n=17) and *C. carcharias* (n=6), in the present analysis, provide further evidence for the rare or occasional occurrences of these species in Aegean and Mediterranean waters (Bariche 2012). Ferretti et al. (2008) reported >99.99% declines, both in abundance and biomass, for *I. oxyrinchus* in the Mediterranean. The shortfin mako shark is composed only 3.6 to 5.35 percent of the total catches of large sharks, in the entire Mediterranean and in eastern part of the region, respectively (Kabasakal et al. 2017; Mancusi et al. 2020). For *C. maximus* and *C. carcharias*, similar results were obtained in the entire Mediterranean (18.8 and 6.9%, respectively), and in eastern part of the region (2.55 and 13.5%, respectively) (Kabasakal et al. 2017; Mancusi et al. 2020). Furthermore, Moro et al. (2020) reported an intense (96%, range 92 to 100%) decline in the records of *C. carcharias*, in the Marmara Sea. These 4 lamniform sharks are considered endangered (*C. maximus*) or critically endangered (*O. ferox*, *I. oxyrinchus* and *C. carcharias*) in the Mediterranean (Otero et al. 2019).

The potential utilization of printed or internet-based digital media, as a data source for the exploration of sharks in Turkish waters, was proposed in several studies (Kabasakal 2003, 2007, 2010, 2013a, b, 2014, 2015a, b; Kabasakal et al. 2017); however, the present study is differentiating from the previous studies, due to rely solely on internet-based media, as source of data. As it is already mentioned in the introduction part, the urgent need for a non-invasive and non-destructive method for data collection, legitimating the reasonable use of internet-based media, as a source of data, in the research of sharks, which is also confirmed by the results of the present study. Since collaborating with citizen scientists in research has become increasingly popular in natural resource management (Miras et al. 2017), and the use of digital cameras and other digital media has brought sharks into households around the world (Gibson et al. 2019), such an approach in extracting scientific data from the mentioned digital sources requires a certain standardization of best practice. Despite the current weaknesses of such a methodological approach, it can obviously allow an increased research effort at low coast in research of sharks, in a non-destructive way.

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Supplementary material: Table S1. Dataset of rare and large sharks of Turkey.