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Records of *Carcharhinus* spp. (Chondrichthyes: Carcharhinidae) from off the Algerian coast (southern Mediterranean)

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Six species of the genus Carcharhinus *were recorded off the Algerian coast (southern Mediterranean). The bignose shark,* C. altimus, *bronze whaler,* C. brachyurus, *spinner shark,* C. brevipinna, *dusky shark,* C. obscurus *and sandbar shark,* C. plumbeus *were positively identified. The sixth species was examined, but its definitive identification requires further observations. Observations are given concerning the species observed most frequently. Their occurrence in the study area and in the Mediterranean is described and compared.*

Key words: Chondrichthyes, Carcharhinidae, *Carcharhinus* spp., distribution, size, Algerian coast, Mediterranean Sea

INTRODUCTION

Formerly, a single species of whaler or requiem shark of genus *Carcharhinus*, the sandbar shark, *Carcharhinus plumbeus*, was reported in Algerian waters where it was considered as a rare inshore species by DIEUZEIDE *et al.* (1953). Further research conducted by HEMIDA (1998) and HEMIDA and LABIDI (2001) showed that other *Carcharhinus* spp. also occurred off the Algerian coast. In this paper, recent captures of these sharks offer the opportunity to present preliminary data and to enlarge and improve the knowledge of *Carcharhinus* spp. distribution in both Algerian and Mediterranean waters.

MATERIAL AND METHODS

Between 1996 and 2002, 105 sharks were caught during trawling and longlining operations at depth between 30 and 150 m off the Algerian coast, which is divided into three areas: western, central and eastern area (Fig. 1).

They were observed at different commercial fishing sites along the Algerian coast and *in situ* at the Algiers fish market where they were landed as by-catch species. The specimens were

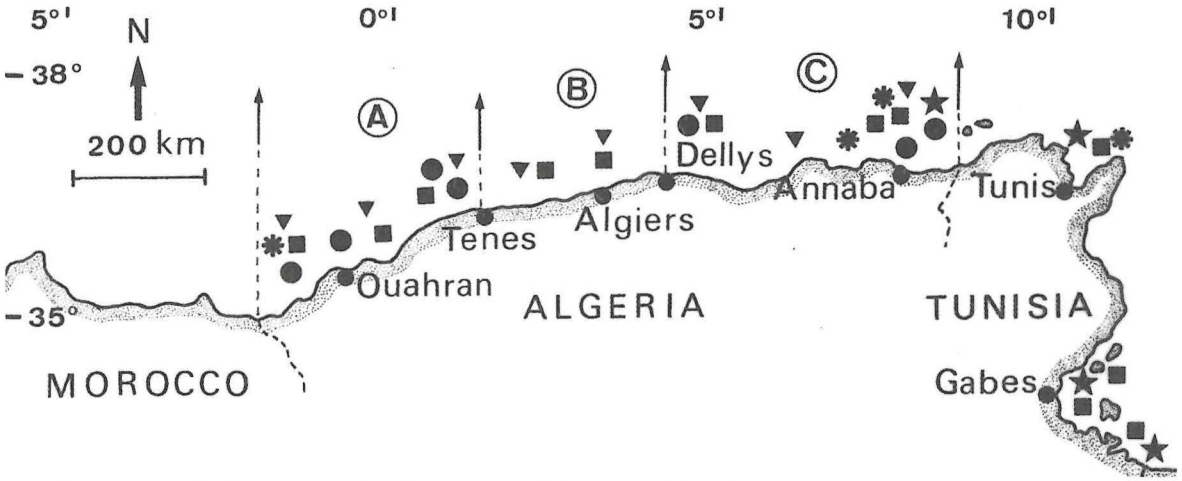

Fig. 1. Map of the Maghrebin coast showing the three fishing areas of the Algerian coast. A: western area, B: central area, C: eastern area. Fishing locations of one or more Carcharhinus spp. captures. C. altimus (black circles); C. brachyurus (black triangles); C. brevipinna (black stars); C. obscurus (black asterisks); C. plumbeus (black squares)

identified following morphometric information reported by TORTONESE (1956), BINI, (1967), BASS *et al.* (1973), CAPAPÉ *et al.* (1979), CADENAT and BLACHE (1981), FISCHER *et al.* (1981), BAUCHOT (1987), GARRICK (1982), COMPAGNO (1984), MORENO (1982, 1995), MORENO and HOYOS (1983 a, b), BARRULL and MATE (1996, 2002), NOTARBARTOLO di SCIARA and BIANCHI (1998). The specimens were sexed and measured for total length (*TL*) with tail in natural position. They were eviscerated as soon as they were landed on the boat deck, consequently their eviscerated weight (*Ev W*) was only given when possible.

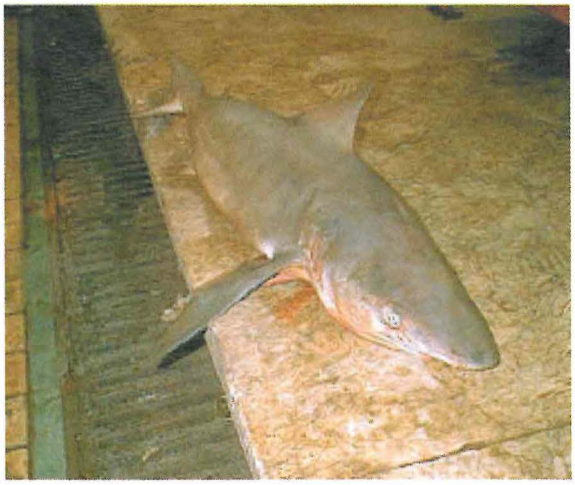

Fig. 2. Carcharhinus altimus, *female, 1470 mm* TL *caught, in the eastern area of the Algerian coast*

RESULTS

Out of the six species observed, five were positively identified: the bignose shark, *Carcharhinus altimus*, the bronze whaler, *C. brachyurus*, the spinner shark, *C. brevipinna*, the dusky shark, *C. obscurus* and the sandbar shark, *C. plumbeus*. The sixth species was examined, but its definitive identification requires further observations.

Carcharhinus altimus (Figs. 2, 3)

The sample included 41 specimens among them, males, 24 specimens, outnumbered females, 17 specimens (ratio *M/F* = 1.41: 1).

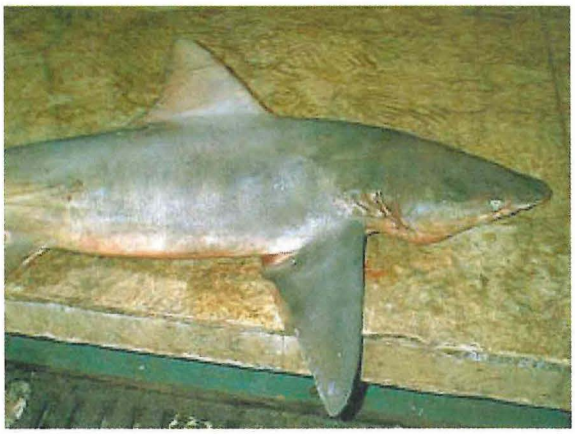

Fig. 3. Carcharhinus altimus, *body anterior region of the same female (see Fig. 2)*

Females *TL* ranged from 1320 to 2140 mm (mean *SD* 1740.4 ± 21.82) and their weight from 7.2 to 39 kg (mean *SD*: 17.57 ± 9.53). Males *TL* ranged from 1150 to 2820 mm (mean *SD* 1675.0 ± 32.08) and their weight from 12.5 to 114 kg (mean *SD*: 30.70 ± 29.89. There is no significant differences in mean size and weight between males and females ($p > 0.05$). According to COMPAGNO (1984) males being mature over 2160 to at least 2670 mm *TL* and females from 2260 to 2820 mm *TL*, in the sample all the specimens were juvenile except the largest male and the largest female which probably were adults.

Both males and females were mainly captured during summer and autumn (Table 1). Eight females and 14 males were caught in the eastern area and nine females and 10 males in the western area. *C. altimus* practically occurred throughout the Algerian coast.

Table 1. Seasonal collection of Carcharhinus altimus *from off the Algerian coast*

Seasons	Females	Males	Total
Spring	1	1	2
Summer	10	14	24
Autumn	6	8	14
Winter	0	1	1
Total	17	24	41

Carcharhinus brachyurus (Figs. 4, 5)

Twenty specimens were observed. As in *C. altimus*, males, 17 specimens, outnumbered females, three specimens only were collected (ratio: *M/F* = 6.6:1). Males *TL* ranged from 1800 to 3030 mm, (mean *SD* 2832.4 ±523.8) the females were 1620, 1680 and 1930 mm *TL* (mean *SD* 1743.3 ± 164.4). COMPAGNO (1984) reported that males matured between 2000 to 2290 mm, females below 2400 mm, maximal size reported was 2920 mm. The majority of males, nine specimens were over 2000 mm, and it seems reasonable to assume that they were mature, whereas the three females were probably juveniles. The largest male observed, 3030 mm *TL* was larger than the maximal size reported for this species: 2920 mm (COMPAGNO, 1984). *C. brachyurus* historically recorded to our knowledge. The three females were juvenile. Eleven males and a single female were caught off the western area, six males and two females in the eastern area. *C.brachyurus* were mainly captured in summer (Table 2).

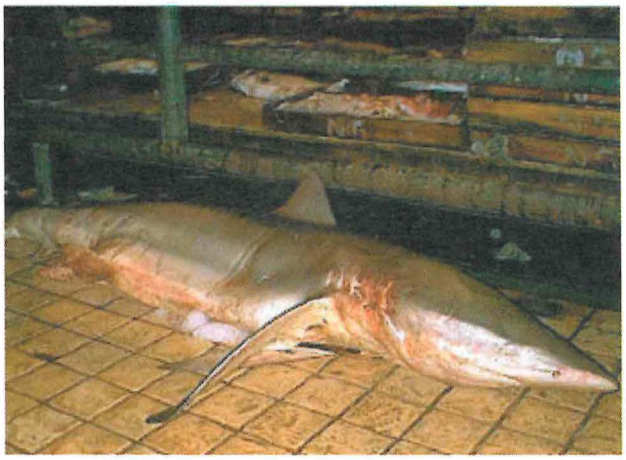

Fig. 4. Carcharhinus brachyurus, *male, 2850 mm* TL *caught, in the eastern area of the Algerian coast*

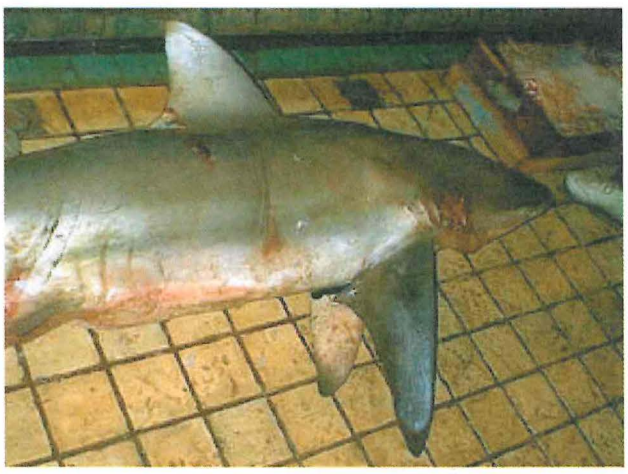

Fig. 5. Carcharhinus brachyurus, *anterior region of the same male (see Fig. 4)*

Table 2. Seasonal collection of Carcharhinus brachyurus *from off the Algerian coast*

Seasons	Females	Males	Total
Spring	0	4	4
Summer	0	7	7
Autumn	2	3	5
Winter	1	3	4
Total	3	17	20

Carcharhinus brevipinna (Figs. 6,7)

Two specimens, a male and a female having 1970 mm and 2180 mm *TL* respectively were captured in summer off the eastern area. According to COMPAGNO (1984) males matured at 1590 to 2030 mm *TL* and females at 1700 to 2000 mm *TL*. All the observed specimens were adults.

Carcharhinus obscurus (Figs. 8, 9, 10)

Ten specimens were observed, six males and four females. Males *TL* ranged from 1270 to 1780 mm (mean *SD* 1647.3 ±199.4), females *TL* from 1510 to 2140 mm (mean *SD* 1835.0. ± 327.8). Using maturity-length provided by CADENAT and BLACHE (1981) and COMPAGNO (1984), all the observed specimens were juveniles.

Carcharhinus plumbeus (Fig. 11)

Males, 17 specimens, outnumbered females, 11 specimens (ratio: *M/F* = 1.54:1). Males *TL* ranged from 1400 to 1880 mm *TL* (mean *SD*: 1622.4 ± 154.7) and their weight from 13 to 28 kg (mean *SD*: 18.36 ± 4.79). Females *TL* ranged from 1520 to 2030 mm *TL* (mean *SD* 1791.8 ± 172.4) and their weight from 18 to 40 kg (mean *SD*: 22.75 ± 8.26). There is no significative differences in mean size and weight

Fig. 6. Carcharhinus brevipinna, *female, 2180 mm* TL *caught, in the eastern area of the Algerian coast*

Fig. 7. Carcharhinus brevipinna, *caudal region of the same female (see Fig. 6)*

Fig. 8. Carcharhinus obscurus, *female, 2090 mm* TL *caught, in the western area of the Algerian coast. Anterior region*

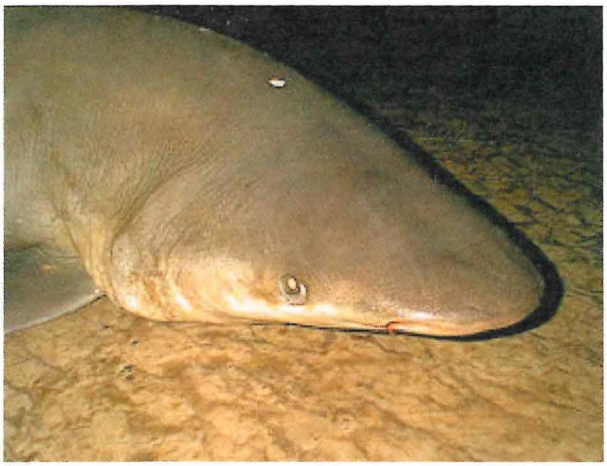

Fig. 9. Carcharhinus obscurus, *head of the same female (see Fig. 8)*

Fig. 10. Carcharhinus obscurus, *dorsal face showing interdorsal ridge (arrow) of the same female (see Fig. 8)*

Fig. 11. Carcharhinus plumbeus, *female, 1790 mm* TL *caught, in the eastern area of the Algerian coast. Anterior region*

Table 3. Seasonal collection of Carcharhinus plumbeus *from off the Algerian coast*

Seasons	Females	Males	Total
Spring	0	0	0
Summer	6	11	17
Autumn	3	6	9
Winter	2	0	2
Total	11	17	28

between males and females ($p > 0.05$). According to CAPAPÉ (1984) males and females matured for 1660 mm and 1700 mm *TL* in Tunisian waters. Out of the 28 observed specimens, 10 were juveniles. The seasonal distribution summarized in Table 3 shows that both males and females were caught in summer and in autumn. This phenomenon is probably related to reproductive processes as demonstrated in Tunisia (CAPAPÉ, 1984).

Carcharhinus sp.

Out of four observed females, two were caught in the western area and they were 3060 mm and 1700 mm *TL*, two others in the eastern area, and they were 2310 and 1920 mm *TL*.

HEMIDA and LABIDI (2001) suggest that it was *C. falciformis*, but further investigations are requested in order to confirm this previous identification. The species seems to be not uncommon in the area.

DISCUSSION

The bignose shark distribution is circumtropical in warm and warm-temperate waters. It occurs in the western Atlantic especially in the Caribbean Sea, off Cuba and southern Florida, and in both eastern

and western Pacific (COMPAGNO, 1984). It was recorded by FOURMANOIR (1961) off Madagascar. Off eastern Atlantic, the species was reported from Ivory Coast to Senegal by FISCHER *et al.* (1981). It was considered as common, off Casamance, in southern Senegal, by CADENAT and BLACHE (1981) but rare northwards, off the Cape Verde Peninsula (CAPAPÉ *et al.*, 1994). In contrast, it was not reported by MAURIN and BONNET (1970) and MAIGRET and LY (1986) off Mauritania and by COLLIGNON and ALONCLE (1972) off Morocco. *C. altimus* was recorded for the first time in the Mediterranean Sea by MORENO and HOYOS (1983 b) off Spain, in the Alboran Sea, and off the coast of Morocco. It could be considered as an immigrant from the eastern tropical Atlantic through the Straits of Gibraltar. At present time, *C. altimus* is increasingly captured off the Algerian coast and its establishment seems to be successful in the area. The species was not reported in the adjacent Tunisian waters (CAPAPÉ, 1987) nevertheless it was recorded in the eastern Levant Basin (GOLANI, 1996). With regard to the latter report a Lessepsian migration through the Suez Canal cannot be excluded, *C. altimus* being reported in the Red Sea (COMPAGNO, 1984). FERGUSSON (personal communication, data in prep.) has indicated that *C. altimus* also occurs off the Libyan coast, based on recent (2002) photos examined by him.

The bronze whaler is reported in Eastern Pacific from southern California to Gulf of California and off Peru, in Western Pacific, off China and Japan (COMPAGNO, 1984). It occurred off Australia (LAST and STEVENS, 1994) and New Zealand (GARRICK, 1982). BASS *et al.* (1973) reported *C. brachyurus* off South Africa but the species was not reported with certainty in the eastern tropical Atlantic (CADENAT and BLACHE, 1981; FISCHER *et al.*, 1981). In the Mediterranean Sea, the occurrence of *C. brachyurus* was reported for the first time by GARRICK (1982) from specimens deposited in the Naturhistorisches Museum of Vienna, the Museum National d'Histoire Naturelle de Paris and captured off Nice, southern France and off "Constantinopel near Trieste", in the Adriatic Sea. CIGALA FULGOSI (1983) described a female, 1850 mm *TL*, captured in the Sicilian Channel, and landed at Mazara del Vallo fish market. MORENO and HOYOS (1983 a) recorded specimens from southern Spain and reported as *Carcharhinus acarenatus* (n. sp. = *C. brachyurus*). CIGALA FULGOSI (1983) wrote: "*C. brachyurus* is apparently very rare in the Mediterranean where it is to be considered an occasional visitor. This is demonstrated by the fact that no ichthyologist including those working in Tunisia has ever recorded it".

The captures presently observed were apparently not fortuitous. They confirm the occurrence of *C. brachyurus* in the Mediterranean Sea. They also suggest that the species should be included in the Algerian fish fauna. Off the Algerian coast captures were more numerous in the western area that in the eastern area. GARRICK (1982) examined specimens caught off southern Morocco. This suggests that the observed specimens probably entered the Mediterranean Sea through the Straits of Gibraltar. BEN-TUVIA (1966, 1971) considered *C. brachyurus* as a Lessepsian immigrant, but according to GARRICK (1982), CIGALA FULGOSI (1983) and COMPAGNO (1984) this opinion remains hypothetical and requires confirmation. However, FERGUSSON (1994) recorded a small juvenile *C. brachyurus* from Falirak, off Rhodes confirmed by dentition.

C. brevipinna had a worldwide distribution in warm and warm-temperate waters. *C. brevipinna* was reported in Mediterranean from eastern Levantin Basin to Straits of Gibraltar. BEN-TUVIA (1966, 1971) considered the species as a recent Lessepsian immigrant, which increasingly invaded the southern Mediterranean. CAPAPÉ (1989) noted a competition pressure between carcharhinids in the Gulf of Gabès (southern Tunisia). This area was previously inhabited by the sandbar shark, *C. plumbeus*, where it developed and reproduced (CAPAPÉ, 1984) and the new migrant seemed to be unable to definitively establish in the area. It migrate northward in the Gulf of Tunis where it was at present caught more frequently than in the Gulf of Gabès. In

the opposite, captures of *C. plumbeus* in the Gulf of Tunis were occasional. Then, *C. brevipinna* reached the eastern area of the Algerian coast, which confirms the CAPAPÉ's opinion. GARRICK (1982) noted that he did not find differences between specimens "from the Red Sea and others from the eastern North Atlantic, which latter might equally well have been the source of the Mediterranean stock". Migration of *C. brevipinna* through the Straits of Gibraltar seems to be less probable. CADENAT and BLACHE (1981) observed specimens from Angola to Mauritania. But, at present time, the species appears to be less frequent that its sympatric species, *C. limbatus*, especially off the coast of Senegal (CAPAPÉ *et al.*, 1994).

C. obscurus has a worldwide distribution which "includes both sides of the Atlantic, the northeastern Pacific, and the western Indian Ocean" according to GARRICK (1982). In the Mediterranean, the species was recorded for the first time by CAPAPÉ *et al.* (1979). It was a gravid female, 4000 mm *TL* with 7 full developed fetuses, caught off Sidi Daoud, in northern Tunisia. CIGALA FULGOSI (1983) and VACCHI and SERENA (1997) observed two specimens at the Mazara del Vallo fish market caught in the Sicilian Channel. From the same area, FERGUSSON and COMPAGNO (2000), citing CIGALA FULGOSI as pers. comm., reported captures of three adult females that occurred in summer 1983. They also reported the first record of *C. obscurus* from Malta, an adult male, 3110 mm *TL*, and considered its occurrence off Sardinia, as likely the relatively abundant captures of *C. obscurus* off the Algerian coast confirm MORENO's opinion (1982) that reported captures of *C. obscurus* in the Alboran Sea in southern Spain and in the Gulf of Characinas, northern Morocco, noting that the species probably was not uncommon in the area. According to FERGUSSON and COMPAGNO (2000), *C. obscurus* most probably entered the Mediterranean Sea from North Atlantic through the Straits of Gibraltar, but they were uncertain "if a proportion of these animals remain essentially resident once having passed into the Mediterranean". The record of a female with full developed fetuses off Tunisia (CAPAPÉ *et al.*, 1979), distributions summaries of *C. obscurus* in western and central Mediterranean provided by MORENO (1982) and FERGUSSON and COMPAGNO (2000) together with the captures reported in this paper suggest that *C. obscurus* could be considered as a possible resident supporting the hypothesis of FERGUSSON and COMPAGNO.

Historically, *C. plumbeus* was the first carcharhinid recorded off the Algerian coast. Previously considered as rare in the area, these captures show that the species could be considered as a permanent inhabitant of the area. Eighteen specimens were caught off the eastern area, six in the western area, two in the central area and the fishing site of two specimens remained unknown. GARRICK (1982) wrote "*C. plumbeus* is an abundant tropical-subtropical species with a wide distribution in coastal waters of the Atlantic, Mediterranean, Indian and Pacific Oceans". The reproductive biology of the species is well known and summarized by CAPAPÉ (1984). Similarity of morphological and biological data indicated that several populations scattered throughout the world in warm temperate or tropical waters. This uniformity favors the hypothesis of migratory exchange. *C. plumbeus* is at present time commonly caught off Algeria as well as off other southern Mediterranean areas. The abundance of the sandbar shark in the southern Straits of Gibraltar, in the eastern tropical Atlantic and southern Suez Canal, in the Red Sea offers various sources of the Mediterranean stock, suggest the species permanently lives in the Mediterranean Sea.

CONCLUSIONS

At present time, out of the six *Carcharhinus* spp. occur off the Algerian coast. All the species recorded were previously reported in the Mediterranean Sea by various authors (TORTONESE, 1939, 1956; COMPAGNO, 1984; CAPAPÉ *et al.*, 1979; GARRICK, 1982; MORENO, 1982, 1995; MORENO and HOYOS, 1983 a, b; CAPAPÉ, 1989; BARRULL and MATE, 1996; FERGUSSON and COMPAGNO,

2000). It appears that the first *Carcharhinus* sp. recorded in this sea is *C. plumbeus*, probably the most abundant and the best known (CAPAPÉ, 1984; FERGUSSON and COMPAGNO, 2000). Is *C. plumbeus* a Mediterranean endemic species or a migrant entering from both sides of this sea, the Suez Canal and the Straits of Gibraltar? This remains questionable. On the contrary, the other *Carcharhinus* spp are more recent migrants. *C. altimus*, *C. brachyurus*, *C. obscurus* entered Mediterranean Sea through the Straits of Gibraltar corroborating previous observations and conclusions (MORENO, 1982; CIGALA FULGOSI, 1983; FERGUSSON and COMPAGNO, 2000). The case of *C. brevipinna* seems to be different, a migration through Suez Canal remains the most probable. The species reached the Libyan coast (TORTONESE, 1939), then southern Tunisian coast where it was reported for the first time (QUIGNARD and CAPAPÉ, 1972). It becomes more and more abundant in northern Tunisian waters, consequence of interspecific competition with its sympatric species according to CAPAPÉ (1989). The occurrence of *C. brevipinna* off the Algerian coast presumably verified this hypothesis. At present time, the area revealed a qualitative and quantitative abundance of elasmobranch species (HEMIDA, 1998; HEMIDA and LABIDI, 2001; HEMIDA and CAPAPÉ, 2002; HEMIDA *et al.*, 2002) which suggest that despite a fishing pressure these species find sufficient resources to reproduce and develop.

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Nalazi vrsta *Carcharhinus* spp. (Chondrichthyes: Carcharhinidae) izvan alžirske obale (južni dio Sredozemlja)

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SAŽETAK

U vanjskim alžirskim vodama utvrđeno je šest vrsta roda *Carcharhinus* i to: velikonosni pas *C. altimus*, brončani pas, *C. brachyurus*, kratkoperajni pas, *C. brevipinna*, mrki pas, *C. obscurus* i pas trupan šiljokrilac *C. plumbeus*. Šesta vrsta je proučavana, ali konačno utvrđivanje iziskuje daljnje promatranje. U ovom radu su iznesena zapažanja koja se odnose na najčešće vrste. Opisana je i uspoređena njihova učestalost u istraživanom području i Sredozemlju općenito.

Ključne riječi: Chondrichthyes, Carcharhinidae, *Carcharhinus* spp, rasprostranjenost, veličina, alžirska obala, Sredozemno more