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The Chondrichthyans of the Adriatic Sea

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The list of the Chondrichthyans found in the Adriatic Sea is presented. It was prepared using data from the literature and original observations in the south-western Adriatic. The discrepancies among several lists of Adriatic Chondrichthyans are discussed. The occurrence of 52 species is established; information about the presence and frequency of most of them is supplemented. An overview of the situation of the Adriatic Chondrichthyans shows that the populations of several species have been severely harmed by fishing.

Key Words: Chondrichthyans, Adriatic Sea, geographical distribution, check list, overfishing

INTRODUCTION

In 1975, the late Professor Tonko ŠOLJAN published "I pesci dell'Adriatico" (The fishes of the Adriatic), the Italian updated edition of a work firstly issued in 1948 in Croatian language. ŠOLJAN (1975) carefully reviewed all the available informations to prepare his work, which, incidentally, is not just an "iconographic species-determinator for the fishes of the Adriatic" as stated by the subtitle. Indeed, the second part, "systematic survey", contains valuable information and reflections on many species of fishes. Unfortunately, the work by ŠOLJAN (*op.cit.*), despite its importance, has often been disregarded by subsequent authors dealing with the geographical distribution of the Mediterranean fishes; see several cases concerning bony fishes in BELLO and RIZZI (1988).

Following ŠOLJAN (1975), synthetic data on the overall Adriatic distribution of Chondrichthyans are reported in COMPAGNO (1984), as far as sharks are concerned, in the first volume of FNAM (WHITEHEAD *et al.*, 1984), in BAUCHOT (1987), and in the check-list of the Italian vertebrates by AMORI *et al.* (1993).

Detailed information on the distribution of demersal Chondrichthyans is given by JARDAS (1984a). His data come from surveys conducted mostly in the eastern side of the Adriatic (Croatian and Albanian coasts); the south-western part, i.e. in front of the Apulian coasts, was not surveyed at all. JARDAS (1984b) also discussed the biogeography of the Adriatic chondrichthyofauna. The same author, lastly, published a list of the Adriatic fishes (JARDAS, 1985), which introduced a couple of

changes about Chondrichthyans with respect to his own previous papers.

TORTONESE (1985 and 1987) presented an overall review of the Mediterranean Chondrichthyans, from the point of view of both systematics and distribution. An insight into the population ecology and geographical distribution of the Mediterranean Chondrichthyans was brought forth by CAPAPÉ (1989).

The main purpose of this paper is to settle the discrepancies among the several lists of Adriatic Chondrichthyans. To prepare the present list, data from the available literature and personal unpublished data on the south-western Adriatic have been taken into account. Some aspects of the overall situation of the Adriatic Chondrichthyans are also discussed.

COMMENTED LIST OF THE ADRIATIC CHONDRICHTHYANS

The Adriatic Chondrichthyans are classified herebelow according to the classification by COMPAGNO (1991), who recognizes four evolutionary lines, or superorders, for the living Elasmobranchs, namely Squalomorphii, Squatinomorphii, Rajomorphii, and Galeomorphii. In the present list, the Galeomorphii are placed as the first superorder, in order to comply with SHIRAI's (1992b) cladogram that retains Lamnoidei + Carcharhinoidei + Orectoloboidei + Heterodontoidei (*i.e.* Galeomorphii *sensu* COMPAGNO, 1991) as the functional outgroup with respect to all remaining Elasmobranchs, which make up the functional ingroup. In this way, it is also maintained herein the traditional listing of "sharks" followed by "rays".

In this list, recent references (*i.e.*, later than 1975, the publication date of ŠOLJAN's work) on the Adriatic occurrences of Chondrichthyan species are reported. In the cases no reference is given, refer to TORTONESE (1956), BINI (1967), and ŠOLJAN (1975). Notes are printed in small types.

Class CHONDRICHTHYES
Subclass ELASMOBRANCHII

Superorder GALEOMORPHII
Order LAMNIFORMES

Family **Odontaspididae** MÜLLER & HENLE, 1839

Odontaspis ferox (RISSO, 1810). A specimen about 1.8 m long was trawled 24 NM North of Mola di Bari, on a sandy bottom, between 410 and 440 m of depth, on the 17 March 1995 (personal observations). Only the head was examined by the present author; length given by fishermen.

Carcharias taurus (RAFINESQUE, 1810) [*Odontaspis ferox* RAFINESQUE, 1810; *Eugomphodus taurus* (RAFINESQUE, 1810)]. The genus *Carcharias* was reinstated by the International Commission on Zoological Nomenclature (1987).

Family **Alopiidae** BONAPARTE, 1838

Alopias vulpinus (BONNATERRE, 1788). Several specimens are caught in the southern Adriatic Sea by drifting longline set for swordfish (MARANO *et al.*, 1983; subsequent personal observations).

Family **Cetorhinidae** GILL, 1862

Cetorhinus maximus (GUNNERUS, 1765). A specimen of this species (4.3m long) was captured by bottom trawl off Mola di Bari (south-western Adriatic Sea) on the 22 November 1994 (personal observations).

Family **Lamnidae** MÜLLER & HENLE, 1838

Lamna nasus (BONNATERRE, 1788). Occasionally caught in the southern Adriatic Sea by drifting longline set for swordfish (MARANO *et al.*, 1983).

Carcharodon carcharias (LINNAEUS, 1758)

Isurus oxyrinchus RAFINESQUE, 1810

Order CARCHARHINIFORMES

Family **Scyliorhinidae** GILL, 1862

Scyliorhinus canicula (LINNNAEUS, 1758). A very common fish (JARDAS, 1984a and 1984b; BELLO *et al.*, 1988; UNGARO *et al.*, 1996).

Scyliorhinus stellaris (LINNAEUS, 1758). It is comparatively common on the eastern side of the Adriatic Sea (JARDAS, 1984b), whereas it is rare on the Italian side of the sea (UNGARO *et al.*, 1996).

Galeus melastomus RAFINESQUE, 1810. TORTONESE (1956) states that it is "considerato rarissimo in Adriatico" (very rare in the Adriatic). BINI (1967) reports that it is rather rare in the North Adriatic; he says nothing about the South Adriatic. According to ŠOLJAN (1975) hundreds of this catsharks were captured for the first time in the South Adriatic pit during the HVAR expedition (1948-49). Indeed, *G. melastomus* is very common on South Adriatic bathyal grounds (JARDAS, 1984a; BELLO *et al.*, 1988; BELLO, 1997). It is commonly found in Apulian fish markets.

Family **Triakidae** GRAY, 1851

Galeorhinus galeus (LINNAEUS, 1758). It was previously included into Carcharhinidae (ŠOLJAN, 1975). CAPAPÉ and BEN BRAHIM (1986) suggest that this species could be placed into a family by its own.

Mustelus mustelus (LINNAEUS, 1758). This is the most appreciated food-chondrichthyan in Apulian markets. It became comparatively rare in the south-western Adriatic Sea (BELLO *et al.*, 1988 and personal observations).

Mustelus asterias CLOQUET, 1821. This smoothhound is rarely caught in the south-western Adriatic Sea (UNGARO *et al.*, 1996)

Mustelus punctulatus RISSO, 1826 (*M. mediterraneus* QUIGNARD & CAPAPÉ, 1972). This species is not reported by ŠOLJAN (1975) and JARDAS (1984a) in the Adriatic Sea. COMPAGNO (1984), BRANSTETTER (1984), BAUCHOT (1987) and AMORI *et al.* (1993) infer its presence in the Adriatic. COMPAGNO (1984) states "Probably regularly captured and utilised for human consumption in the Mediterranean, but details not certain because of confusion of this species with *Mustelus mustelus*." Documented finds of this shark in the North Ionian Sea are reported by KASPIRIS (1974). *M. punctulatus* is herein listed *fide* JARDAS (1985), who states "U Jadranu se [...] dosad izričito ne spominje, premda je vrlo brojna." (In the Adriatic [...] it is not explicitly mentioned, although it is very numerous).

Family **Carcharhinidae** JORDAN & EVERMANN, 1896

Carcharhinus plumbeus (NARDO, 1827). Not reported in the Adriatic by BRANSTETTER (1984), in spite of the fact this sea represents the Type Locality (*cf.* COMPAGNO, 1984; TORTONESE, 1985); BINI (1967) writes "Nei nostri mari più comune nell'Adriatico settentrionale" (among our seas, it is most common in the northern Adriatic).

Prionace glauca (LINNAEUS, 1758). This species, very common in the whole Adriatic Sea (*e.g.*, MARANO *et al.*, 1983 and 1988; personal observations), is not reported there by BRANSTETTER (1984). The central-north Adriatic Sea is a nursery area for this species (BIANCHI, 1993 and personal communication).

With regard to records of other carcharinid species in the Adriatic, TORTONESE (1987) casts doubts on the distribution of *Carcharhinus brevipinna* (MÜLLER & HENLE, 1839) in the whole Mediterranean, as reported by BRANSTETTER (1984) and, later on, by BAUCHOT (1987) and AMORI *et al.* (1993) (this shark is frequent in the southern Mediterranean; see also CAPAPÉ, 1989). In fact, there are no records of its occurrence in the Adriatic.

The presence of *Glyphis glyphis* (MÜLLER & HENLE, 1839) (= *Carcharias glyphis*) is reported in the Adriatic with doubt by ŠOLJAN (1975). Indeed, *G. glyphis*-like sharks have been found between south-eastern Asia and Australia (COMPAGNO, 1984).

The figure accompanying "*Carcharias lamia* RISSO" in the key by ŠOLJAN (1975) corresponds to *Carcharhinus longimanus* (POEY, 1861), the occurrence of which in the Mediterranean is questionable (COMPAGNO, 1984; BRANSTETTER, 1984; BAUCHOT, 1987). Furthermore ŠOLJAN (1975) refers that a few sharks found in the Adriatic where assigned to the questionable species *Carcharias lamia* RISSO. In accordance with ŠOLJAN (1975), it is most probable that other *Carcharhinus* species, in addition to *C. plumbeus*, have been found in the Adriatic. Additional finds are needed to clear up the situation.

Carcharhinus limbatus (VALENCIENNES, 1839), possibly a lessepsian migrant (QUIGNARD and CAPAPÉ, 1972), is reported in the Adriatic by COMPAGNO (1984), but indeed there are no records; see negative evidence in ŠOLJAN (1975) and JARDAS (1985).

Family **Sphyrnidae** GILL, 1872

Sphyrna zygaena LINNAEUS, 1758. Very rarely caught in the southern Adriatic Sea by drifting longline (personal observations).

Sphyrna tudes (VALENCIENNES, 1822). The silhouette drawing and the maximum size (3m) reported by ŠOLJAN (1975) do not correspond to the features of this species as reported by other authors (max. size = 1.5m) (BINI, 1967; COMPAGNO, 1984; QUÉRO, 1984; BAUCHOT, 1987). There has been too much confusion about this name; McEACHRAN and SÉRET (1987) point out that it has been applied to three different species: "Until 1950 it was generally applied to the great hammerhead shark, *S. mokarran*, and between then and 1981 it was apparently applied to both *S. tudes* and *S. couardi*." I was unable to trace back the Adriatic find reported by ŠOLJAN, which is seemingly the one referred to by subsequent authors (JARDAS, 1985; BAUCHOT, 1987; AMORI *et al.*, 1993). The occurrence of *S. tudes* in the Adriatic Sea needs to be confirmed.

Superorder SQUALOMORPHII
Order HEXANCHIFORMES

SHIRAI (1992b) pointed out the systematic affinities between this order and squaloids, thus corroborating the classification by COMPAGNO (1991).

Family **Hexanchidae** GRAY, 1851

Hexanchus griseus (BONNATERRE, 1788)

Heptranchias perlo (BONNATERRE, 1788)

There is a third species of this family in the Mediterranean, namely *Hexanchus nakamurai* TENG, 1962 (*H. vitulus* SPRINGER & WALLER, 1969), as testified by a Mediterranean specimen kept at the Zoological Museum "LA SPECOLA" in Florence (Icthyological collection n. 6028; adult female; exact place and date of collection unknown) (see also TORTONESE, 1985 and BOESEMAN, 1973). AMORI *et al.* (1993) infer, with doubt, its presence in the Adriatic Sea, although the species was never recorded there.

Order SQUALIFORMES

Family **Echinorhinidae** GILL, 1862

Echinorhinus brucus (BONNATERRE, 1788). McEACHRAN and BRANSTETTER (1984) do not report this species in the Adriatic Sea, notwithstanding its well established occurrence in this sea (*cf.* TORTONESE, 1956; BINI, 1967; JARDAS, 1985).

Family **Squalidae** DE BLAINVILLE, 1816

Squalus acanthias LINNAEUS, 1758. Curiously, it is not reported in the Adriatic Sea by McEACHRAN and BRANSTETTER (1984). Indeed, it is a fairly common species in the Adriatic (JARDAS, 1984b; BELLO *et al.*, 1988; UNGARO *et al.*, 1996), where it is also

sold on markets (author's own observations and Irene BIANCHI, personal communication).

Squalus blainvillei (RISSO, 1826) [*Squalus fernandinus* MOLINA, 1782; *cf.* LÉDOUX (1970)]. McEACHRAN and BRANSTETTER (1984) do not report this species in the Adriatic Sea. Its presence is also attested by JARDAS (1984a, 1984b, 1985).

Centrophorus granulosus (BLOCH & SCHNEIDER, 1801). A comparatively rare species (JARDAS, 1984a; UNGARO *et al.*, 1996; author's own observations).

Etmopterus spinax (LINNAEUS, 1758). Not reported for the whole eastern Mediterranean, including the Adriatic, by McEACHRAN and BRANSTETTER (1984). This species is very common on bathyal grounds (JARDAS, 1984b; UNGARO *et al.*, 1996; BELLO, 1997).

Dalatias licha (BONNATERRE, 1788) (*Scymnorhinus licha*). It is not reported in the Adriatic by McEACHRAN and BRANSTETTER (1984) and COMPAGNO (1984). It is infrequently caught by bottom trawl on southern Adriatic bathyal grounds (author's own observations; UNGARO *et al.*, 1996); also *cf.* JARDAS (1984a) about its actual presence in this sea.

Oxynotus centrina (LINNAEUS, 1758). Caught in the south-eastern Adriatic Sea (JARDAS, 1984a,b).

AMORI *et al.* (1993) doubtfully list *Somniosus rostratus* (RISSO, 1826) for the Adriatic Sea, although there is no definite record for it.

Superorder SQUATINOMORPHII

Order SQUATINIFORMES

SHIRAI (1992b) established that *Squatina* is systematically closer to Rajiformes *sensu lato* than Squaliformes, thus corroborating the erection of the superorder Squatinomorphii by COMPAGNO (1991).

Family **Squatinidae** BONAPARTE, 1838

Squatina squatina (LINNAEUS, 1758). Infrequently caught in the south-eastern side (JARDAS, 1984b) and rarely netted in the south-western side (personal observations) of the Adriatic Sea.

Squatina oculata BONAPARTE, 1840

AMORI *et al.* (1993) report *Squatina aculeata* CUVIER, 1829 in the central-northern Adriatic, although there is no record of its occurrence there.

Superorder RAJOMORPHII

Order PRISTIFORMES

Family **Pristidae** BONAPARTE, 1838

Pristis pectinata LATHAM, 1794. This sawfish is not a member of the Adriatic chondrichtyan community, although stray specimens may have rarely entered this sea. TORTONESE (1987) states "Ritengo che i Pristidae (Pesci sega) non possano oggi annoverarsi fra gli elementi mediterranei, poiché della loro presenza non abbiamo alcuna documentazione precisa e valida, recente o no" (I think that sawfish cannot be listed within the Mediterranean species, as there is no definite and valid record, either recent or past, of their presence). According to ŠOLJAN (1975) a specimen was captured in the Adriatic in 1906; its toothed snout, kept at the Natural History Museum in Split, is the evidence of that event. BINI (1967) reports findings from Israel coasts, Messina and Latium; KREFFT and STEHMANN (1973) report records from Israel and Messina. STEHMANN and BÜRKEL (1984a) state that "Mediterranean records are questionable"; however they report a find from Israel. Lastly BAUCHOT (1987) writes, as a general statement, that sawfish can be occasionally found in the Mediterranean waters and reports the Israel

record. The opinion of BAUCHOT (*op.cit.*) supports the thesis that a stray specimen may have entered the Adriatic.

Order RHINOBATIFORMES

Family **Rhinobatidae** MÜLLER & HENLE, 1838

Rhinobatos rhinobatos (LINNAEUS, 1758)

McEACHRAN and CAPAPÉ (1984a) report for the Adriatic also *Rhinobatos cemiculus* GEOFFROY SAINT-HILAIRE, 1817; AMORI *et al.* (1993) quote the species for the central-northern Adriatic with a question-mark. However, there is no record of this species in this sea.

Order TORPEDINIFORMES

Family **Torpedinidae** BONAPARTE, 1838

Torpedo torpedo (LINNAEUS, 1758). BAUCHOT (1987) does not report it for the Adriatic. This electric ray is rarely captured on the south-western and south-eastern sides of the Adriatic Sea (author's own observations and JARDAS, 1984a, respectively).

Torpedo marmorata RISSO, 1810. According to JARDAS (1984a), *T. marmorata*, the most frequent Adriatic electric ray, has become rather rare in the western part of the sea. Indeed, single specimens are occasionally caught by Italian trawlers fishing in the South-western Adriatic (author's own observations; UNGARO *et al.*, 1996). It is the most frequently caught electric ray.

Torpedo nobiliana BONAPARTE, 1835. BAUCHOT (1987) does not report it for the Adriatic. It is occasionally netted in the south-western Adriatic Sea (personal observations) and in front of the mouth of river Bojana, Croatia (JARDAS, 1984a).

Order RAJIFORMES

Family **Rajidae** BONAPARTE, 1831

Raja clavata LINNAEUS, 1758. It is the most frequently caught skate, the one that appears to withstand better the fishing pressure (JARDAS, 1984a,b; BELLO *et al.*, 1988; UNGARO *et al.*, 1996).

Raja asterias DELAROCHE, 1809. Infrequently caught, mostly in the southern Adriatic Sea (JARDAS, 1984a; BELLO *et al.*, 1988; UNGARO *et al.*, 1996).

Raja miraletus LINNAEUS, 1758. It is much more common in the eastern than the western part of the Adriatic Sea (JARDAS 1984a; BELLO *et al.*, 1988; UNGARO *et al.*, 1996).

Raja montagui FOWLER, 1910. A comparatively rare skate, caught more frequently in the eastern than the western part of the southern Adriatic Sea (JARDAS, 1984a; BELLO *et al.*, 1988; UNGARO *et al.*, 1996).

Raja polystigma REGAN, 1923. Recently recorded in the south-western Adriatic Sea (UNGARO *et al.*, 1996).

Raja radula DELAROCHE, 1809. Recorded on the eastern side of the central Adriatic Sea by JARDAS (1984a).

Raja circularis COUCH, 1838. Caught only around the South Adriatic pit, mostly on the slope (JARDAS, 1984a). According to BELLO *et al.* (1988), it is the second most frequently caught skate on deep south-western Adriatic grounds.

Raja alba LACEPÈDE, 1803. It has been recently found only on the eastern side of the Adriatic Sea (JARDAS, 1984a).

Raja undulata LACEPÈDE, 1802

Raja batis LINNAEUS, 1758. A comparatively rare skate found only in the eastern part of the central Adriatic Sea (JARDAS, 1984a).

Raja oxyrinchus LINNAEUS, 1758. It is comparatively rare in the eastern Adriatic Sea

(JARDAS, 1984a) and very rare in the south-western part of the sea (personal observations).

Raja fullonica LINNAEUS, 1758. TORTONESE (1956) states that it is "rara in Adriatico", whereas BINI (1967) writes that, if it is present in the Mediterranean, it is distributed in the western basin only. ŠOLJAN (1975) casts doubts on its actual presence in the Adriatic as reported by POLJAKOV *et al.* (1958). JARDAS (1984a) states that no specimen of the species was caught after 1948, and corroborates ŠOLJAN's doubts; however, the same author (JARDAS, 1985) lists it as "very rare" in the Adriatic. *R. fullonica* is reported in the Adriatic by STEHMANN and BÜRKEL (1984b), BAUCHOT (1987) and AMORI *et al.* (1993). Lastly, STEHMANN (*in litteris*) suggests that some deep-water records of *R. fullonica* in the Mediterranean may be due to misidentification of similar species. Its occurrence in the Adriatic needs to be confirmed.

Raja naevus MÜLLER & HENLE, 1841 is reported for the Adriatic by STEHMANN and BÜRKEL (1984b) and AMORI *et al.* (1993), although there is no definite record.

Order MYLIOBATIFORMES

Family **Dasyatidae** JORDAN, 1888

Dasyatis pastinaca (LINNAEUS, 1758). JARDAS (1984a) reports several finds of this fish in the eastern Adriatic Sea. It is occasionally caught in the south-western Adriatic Sea (personal observations)

Dasyatis centroura (MITCHILL, 1815). *Dasyatis thalassia* (MÜLLER & HENLE, 1841), doubtfully reported by ŠOLJAN (1975), is a synonym of *D. centroura*. In recent times, it has been recorded only in the eastern Adriatic Sea (JARDAS, 1984a).

Dasyatis violacea (BONAPARTE, 1832). This stingray is not reported in the Adriatic and adjacent seas by McEACHRAN and CAPAPÉ (1984b); in fact it is captured by drifting longline in both the south Adriatic Sea and the Gulf of Taranto (author's own observations) and in the north Adriatic Sea by sport fishermen by hook-and-line (Irene BIANCHI, personal communication).

McEACHRAN and CAPAPÉ (1984b) infer the presence of *Dasyatis tortonesei* CAPAPÉ, 1977, a species close to *D. pastinaca*, in the Adriatic. The distribution of this species in the Adriatic is also reported by AMORI *et al.* (1993). However, SÉRET and McEACHRAN (1986) placed *D. tortonesei* into synonymy with *D. pastinaca*.

Family **Gymnuridae** FOWLER, 1934

Gymnura altavela (LINNAEUS, 1758). In recent years, a few juvenile specimens have been collected by trawling in the south-western Adriatic Sea (personal observations).

Family **Myliobatidae** BONAPARTE, 1838

Myliobatis aquila (LINNAEUS, 1758). It appears to be more frequent in the eastern Adriatic Sea (JARDAS, 1984a) than the south-western part of the sea, where a few specimens are occasionally caught (personal observations).

Pteromylaeus bovinus (GEOFFROY SAINT-HILAIRE, 1817). Its occurrence has been recorded twice along the eastern Adriatic coast (JARDAS, 1984a). A few juvenile specimens have been collected in the south-western Adriatic Sea (personal observations).

Family **Rhinopteridae** JORDAN & EVERMANN, 1896

Contrary to the distribution given by McEACHRAN and CAPAPÉ (1984c), there is no documented find of *Rhinoptera marginata* (GEOFFROY SAINT-HILAIRE, 1817) in the Adriatic. See also TORTONESE (1987) and BAUCHOT (1987).

Family **Mobulidae** GILL, 1893

Mobula mobular (BONNATERRE, 1788). Adult and subadult devil rays are occasionally caught in the southern Adriatic Sea by drifting longline (MARANO *et al.*, 1983; author's own observations).

Subclass HOLOCEPHALI

Order CHIMAERIFORMES

Family **Chimaeridae** RAFINESQUE, 1815

Chimaera monstrosa LINNAEUS, 1758. The note in ŠOLJAN (1975: 436) implies the rarity of this species. Indeed, it is rather common in the slope area around the South Adriatic pit (JARDAS, 1985; VACCARELLA *et al.*, 1992; personal observations).

DISCUSSION

The present list reports *Mustelus punctulatus* as a species new to the Adriatic Sea with respect to ŠOLJAN (1975). On the contrary the Adriatic occurrence of *Sphyrna tudes* is questioned. Two more species, the presence of which was already
Doubted by ŠOLJAN (1975), namely *Carcharias lamia* and *Carcharias glyphis,* have been removed from the list of Adriatic Chondrichthyans.

The taxonomy of Chondrichthyes has substantially progressed in the last two or three decades (*cf.* TORTONESE, 1985; COMPAGNO, 1991; SHIRAI, 1992a,b) and the nomenclature of several taxa has changed accordingly. A few problems concerning the identity of Chondrichthyans that very rarely occurred in the Adriatic, of which no specimen has been saved nor satisfactorily figured (*e.g.* the case of *Sphyrna tudes*), are left unresolved.

The discrepancies among the most recent general lists of Mediterranean fishes (WHITEHEAD *et al.*, 1984; BAUCHOT, 1987; AMORI *et al.*, 1993) concerning the distribution of Chondrichthyans in the Adriatic Sea are in some instances perplexing (see the individual cases in the present list). The limits of those important reference works were already pointed out in BELLO and RIZZI (1988), as far as the Adriatic distribution of bony fishes is concerned.

JARDAS (1984b), in discussing the overall composition of the Adriatic chondrichthyofauna from the geographical standpoint, distinguished a group of occasional and rare species that do not inhabit this sea throughout their life cycle and enter it temporarily (*Carcharodon carcharias, Lamna nasus, Cetorhinus maximus, Sphyrna* spp., *Pristis pectinata, Rhinobatos rhinobatos, Heptranchias perlo, Odontaspis* spp., *Echinorhinus brucus* and others). These are highly mobile fishes (*cf.* CAPAPÉ, 1989) that, indeed, have been very rarely recorded in the Adriatic. However, a preliminary survey of the longline fishery for swordfish, *Xiphias gladius*, in the southern Adriatic (MARANO *et al.*, 1983) showed that some large pelagic Chondrichthyans, such as *Lamna nasus, Alopias vulpinus* and *Mobula mobular* are not so rare as previously stated. Furthermore, some sharks appear to be even rarer than they actually are because of the fact their captures are not reported to ichthyologists and marine biologists. This is the case, for instance, of the one specimen of *Odontaspis ferox* described in the list. That shark was butchered, dressed and skinned on board soon after its capture, to be sold on the local market as "palombo" (*i.e.* smoothhound, *Mustelus mustelus*), whose meat is highly appreciated. The writer of this paper came across that specimen by mere chance and could identify it thanks to the examination of head and teeth, just a few minutes before that remain was to be thrown away. An additional example is represented by the remains of a butchered juvenile of *Cetorhinus maximus* (head, tail, and fins) found in the countryside of Bitonto (Apulia, Italy) in April 1997; this specimen had been probably caught by an Apulian trawler in the southern Adriatic Sea (Nicola UNGARO, personal communication).

Among pelagic sharks the most abundant is *Prionace glauca*. It is the most important bycatch of the swordfish fishery in the Adriatic Sea (MARANO *et al.*, 1983 ; 1988); furthermore the north-central Adriatic Sea represents a nursery area for blue sharks (ANONYMOUS, 1993; Irene BIANCHI, personal communication). CAPAPÉ (1989) discusses the distribution of carcharhinid sharks (genus *Carcharhinus*) in the southern Mediterranean

Sea, especially in front of the Tunisian coasts. He gives evidence of the relationships of reciprocal avoidance among populations of these sharks. It can be suggested that similar mechanisms of niche occupancy and competition avoidance are at work in the Adriatic Sea, where *Prionace glauca* predominates among the group of sharks of similar niche requirements (similar size and feeding habits).

The Adriatic distribution of *Squalus blainvillei* and *Squalus acanthias* appears to follow the same sort of mechanisms. According to JARDAS (1984b) the former shark inhabits the middle and south-eastern Adriatic, whereas the latter lives in the northern shallower area. As reported in Introduction, JARDAS (1984a and 1984b) did not survey the western side of the South Adriatic. According to JARDAS' reasoning one would expect to find *S. blainvillei* in the deep south-western Adriatic; in fact, there is no record for it. On the contrary *S. acanthias* is frequently caught there by bottom trawlers. The population of this species appears to have increased in the last two decades in the south-western Adriatic; at the same time the catches of *Mustelus mustelus* have sharply declined because of overfishing (see further on). Since "l'activité trophique constitue le moteur essentiel de leurs [*i.e.* Chondrichthyans] déplacements" (CAPAPÉ, 1989), one is lead to suspect a connection between the two phenomena, although the feeding niches of *S. acanthias* and *M. mustelus* do not overlap largely (*cf.* BAUCHOT, 1987; CAPAPÉ, 1989, Table 1).

Most demersal Chondrichthyans represent sedentary components of the Adriatic ichthyofauna. The surveys conducted in the last decade in the deep southern Adriatic (BELLO *et al.*, 1988; VACCARELLA *et al.*, 1992; personal observations) have shown the abundance of three bathyal species, *Galeus melastomus*, *Etmopterus spinax*, and *Chimaera monstrosa*.

The former two species live on the same grounds and seem to occupy somewhat similar niches (BELLO, 1997). CAPAPÉ (1989) discusses the guild composed by *G. melastomus*, *E. spinax*, and *Centrophorus granulosus* (the latter shark is rather rarely caught in the South Adriatic) and states that "malgré la compétition interspécifique ces guildes se maintiennent sans qu'apparemment l'une des espèces s'impose." In addition to size and reproduction factors differentiating the species within a guild (CAPAPÉ, 1989), differences in the feeding periodicity and mode of preying (BELLO, 1997 and 1998) appear to play a role in the maintenance of the southern Adriatic *G. melastomus*-*E. spinax* guild.

Fifteen years ago JARDAS (1984b) pointed out the greater abundance of many chondrichthyan fishes on the eastern (*i.e.* Croatian and Albanian) side with respect to the western (*i.e.* Italian) side. He stressed that such a situation was "not the result of unfavourable environmental ecological factors" but was due to the "trawling intensity in the western part of the Adriatic [which] led to the over-fishing of cartilaginous fishes." Afterwards BELLO *et al.* (1988) mentioned the sharp rarefaction of *Mustelus mustelus* in the south-western Adriatic. It can be added herein that several other species, especially rajiforms, appear to have followed the same fate as *M. mustelus*. For instance the author, who examined the catches of several hundreds hours of trawling on South Adriatic grounds down to 650 m of depth, never saw any specimen of *Raja polystigma, Raja radula, Raja alba, Raja undulata,* and *Raja batis*, whereas most of these skates were reported by JARDAS (1984a) in the eastern side of the Adriatic. Furthermore the catches of all rays, including the electric rays *Torpedo marmorata* and *Torpedo torpedo*, have considerably decreased. Only *Raja clavata* appears to withstand to some extent the fishing pressure presently exerted on south-western Adriatic demersal communities. In this regard it was rather instructive to examine the catches of Apulian trawlers that went trawling, a few years ago, in Albanian waters (*i.e.* on the eastern side of the Adriatic), where a close-to-virgin situa-

tion existed: large rays of several species and smoothhounds were overabundant.

Cartilaginous fishes are highly vulnerable to trawl fishery because of their modes of reproduction. The issue of overfishing of Chondrichthyans and the danger of populations extinction in the Mediterranean Sea is addressed by CAPAPÉ (1989). His heavy question "On peut alors se demander si les Sélaciens ont un avenir en Méditerranée" is well fit for the Adriatic chondrichthyofauna. Today edible rays and sharks represent just a by-catch of quite limited commercial value in the Italian trawl fishery and fishermen do not care too much for their advancing decline (for instance, the overall mean CPUEs for *Raja* spp. and *M. mustelus* in two seasonal surveys of 1985 in the south-western Adriatic were 0.6 kg h^{-1} and 13 gr h^{-1} respectively; BELLO *et al.*, 1988).

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Hrskavične ribe Jadranskoga mora

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SAŽETAK

U radu je predstavljen popis hrskavičnih riba Jadranskoga mora. Pripremljen je uporabom podataka iz literature i izvornih opažanja u jugozapadnome Jadranu. Raspravljene su nesuglasice iz različitih popisa hrskavičnih riba. Ustanovljena je pojava 52 vrste; nadopunjena je podacima o njihovoj nazočnosti i učestalosti.

Pregled stanja hrskavičnih riba Jadrana ukazuje na činjenicu da su populacije nekih vrsta devastirane ribarenjem.