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Adriatic Chondrichthyes by the biogeographical standpoint*

Chondrichthyes Jadranskog mora s biogeografskog gledišta

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The Adriatic is a part of the Mediterranean Sea. However, owing to its peculiarities it makes an independent biogeographical and ecological subunit what is evident from the composition and properties of its life communities (biocoenoses).

The Adriatic is a part of the northern Mediterranean. It is linked to it (Ionian Sea) by the wide Otranto Strait (about 741 m depth). The surface area of the Adriatic, including islands, amounts to 138.595 square kilometres what makes about 4.6% of the total Mediterranean surface area.

The Adriatic is shallow sea. Shelf occupies the major part of it (about 73.9%) and the slope the smaller one. The greatest depth of the Adriatic is 1233 m (South Adriatic Pit). Mean depth is 251 m (Tešić, 1963, 1969).

The Adriatic basin is characterized by high salinity of about 38.3‰. This value exceeds the values recorded from the western Mediterranean (about 37‰) and is lower than those recorded from its eastern part (39‰) (Buljan and Zore-Armanda, 1971, 1976).

One of the Adriatic properties is the anathermic water type; in its open parts the surface temperature varies in summer from 22 to 25°C while down to the bottom it is reduced to only 11.5° (Jabuka Pit) or 12.7°C (South Adriatic Pit) (Buljan, 1956). In the open part of the Adriatic winter surface temperature amounts, on the averge, to about 13.4°C, what indicates that the Adriatic is a warm sea.

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About 400 fish species and subspecies have been recorded from the Adriatic. This makes up about 78% of the Mediterranean fish species and subspecies. From the Chondrichthyes group alone a total of 53 species have

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been recorded of which 29 Pleurotremata species (53.7%), 23 Hypotremata species (44.4%) and 1 species of Chimaerea. These make up about 69% of the Chondrichthyes species recorded throughout the Mediterranean (about 77 species).

Total number of the Adriatic fish species and subspecies is not the definite one and will probably change by the future ichthyofaunal researches in the deepest southern Adriatic and by establishing the new taxonomic status of some species and subspecies. Some of the Chondrichthyes species are held not to inhabit the Adriatic all their life cycle throug, but to imigrate there temporarily, such as *Carcharodon carcharias, Lamna nasus, Cetorhinus maximus, Sphyrna* spp., *Pristis pectinata, Rhinobatos rhinobatos* and some others. Some of these species has been very rarely recorded from the Adriatic (M o r o v i ć, 1973). In addition, some of the species recorded from the Adriatic are generally rare *(Heptranchias perlo, Odontaspis* spp., *Echinorhinus brucus).*

Zoogeographically, the highest number of the Adriatic Chondrichthyes fishes belong to the Atlanto-Mediterranean species group (32 species or 59.2%). These are mainly smaller Pleurotremata fishes (Scyliorhinidae, Squatinidae, *Mustelus* spp., *Oxynotus centrina, Etmopterus spinax)* and the major part of Hypotremata fishes (Torpedinidae, major part of Rajidae, Myliobatidae and others). Ten species represent tropical biogeographical element (for instance *Centrophorus granulosus, Squatina oculata, Pteromylaeus bovinus, Mobula mobular* and some others) and eight the boreal one (for instance *Mustelus* spp., some species of genus *Raja, Chimaera monstrosa* and some others). Some species (about 8) deeply entering both the tropical and boreal biogeographical regions of the eastern Atlantic Ocean (for instance *Oxynotus centrina, Etmopterus spinax, Rhinobatos rhinobatos, Torpedo torpedo,* some species of genus *Raja*), and some of them even inhabit the area of the southern Indian Ocean (S m i t h, 1965). Six species at most are of the amphiatlantic biogeographical area.

Cosmopolitan species are somewhat less represented as well as the species showing rather wide geographical distribution (19 species od 35.2%). All bigger Pleurotremata fishes belong to this group (Hexanchidae, Odontaspididae, Lamnidae, Sphyrnidae, some of Carcharhinidae) as well as *Dasyatis pastinaca* of Hypotremata fishes. These species mainly show circumglobal distribution in warm and/or temperate seas *(Hexanchus, Heptranchias, Odontaspis, Carcharodon, Isurus* and some others) or bipolar distribution properties *(Lamna, Cetorhinus, Scymnorhinus).*

Three species of the Mediterranean endemic Chondrichthyes species have been recorded from the Adriatic as well. These are species of *Raja* genus *(R. asterias, R. polystigma* and *R. radula).*

Atlanto-Mediterranean Chondrichthyes species recorded from the western Mediterranean, such as *Etmopterus spinax, Scymnorhinus lichia* and *Raja undulata,* have also been recorded from the Adriatic. Generally speaking, the similarity between the Adriatic and western Mediterranean ichthyofauna exceeds that between the Adriatic and eastern Mediterranean ichthyofauna though the Adriatic geographically belongs to the eastern Mediterranean.

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As to the horizontal and bathymetric distribution of Chondrichtyes species in the Adriatic several modes may be distinguished. They depend on the morphological and ecological properties of the Adriatic as well as on the ecological valence of individual species. Thus the distinction may be made between the species generally distributed throughout the Adriatic within the limits of their ecological tolerance (*Raja clavata, R. miraletus, Torpedo marmorata, Myliobatis aquila, Dasyatis pastinaca, Scyliorhinus canicula, Mustelus* spp. and some others) and those with the distribution limited to individual larger Adriatic parts (Fig. 1). Thus, for example, *Squalus blainvillei* inhabit

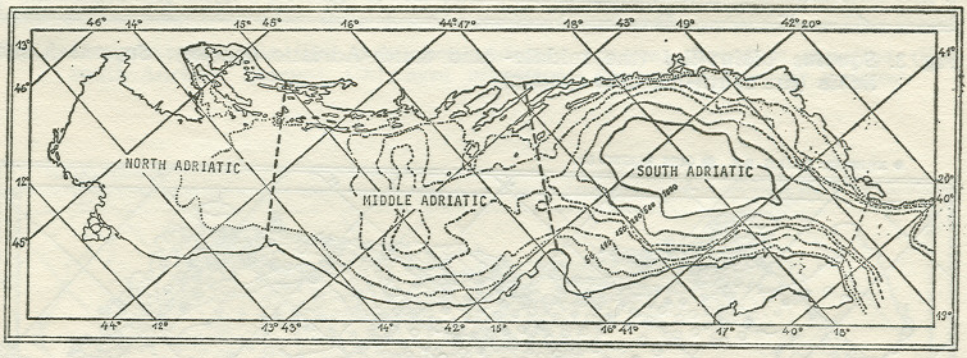

Fig. 1. Common division of the Adriatic Sea: north, middle and south part

the middle and southern Adriatic parts and *S. acanthias* its northern, shallower part. Mesopelagic Chondrichthyes species such as *Hexanchus griseus* and bathial benthic species such as *Galeus melastomus, Centrophorus granulosus, Etmopterus spinax, Echinorhinus brucus* and *Chimaera monstrosa* are restricted to mainly (or exclusively) deep south Adriatic.

Some examples of different geographical distribution of benthic Chondrichthyes fishes in the Adriatic are given below (Figs. 2—9).

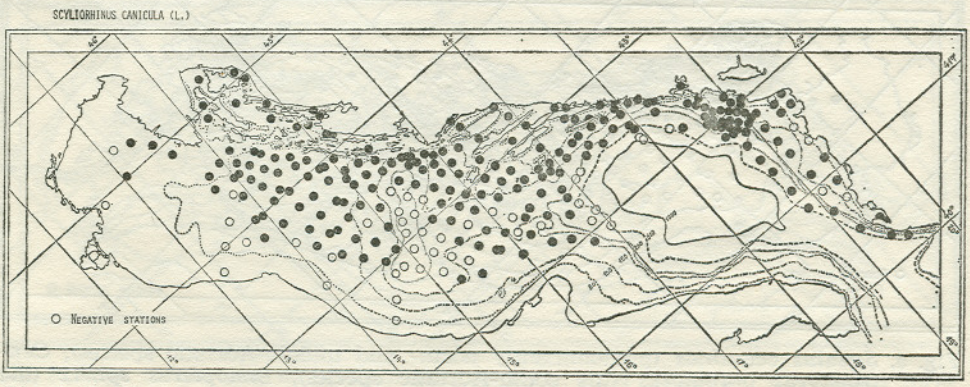

Fig. 2. *Scyliorhinus canicula* (the throughout-Adriatica species)

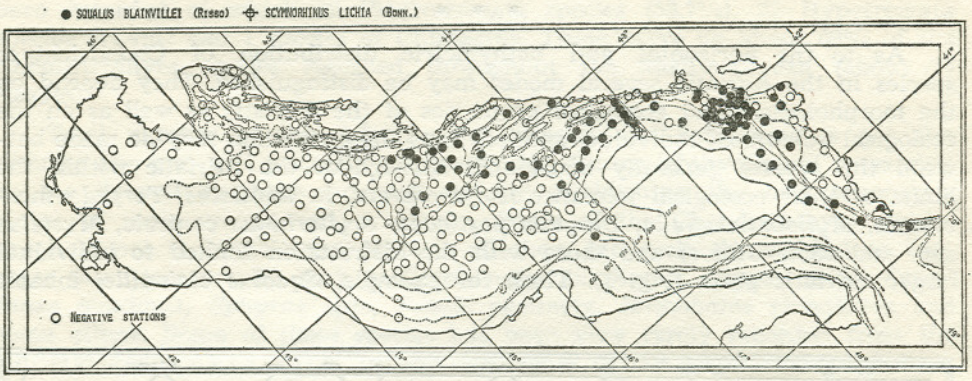

Fig. 3. *Squalus blainvillei* (the middle- and south-Adriatic species), *Scymnorhinus lichia* (the south-Adriatic species)

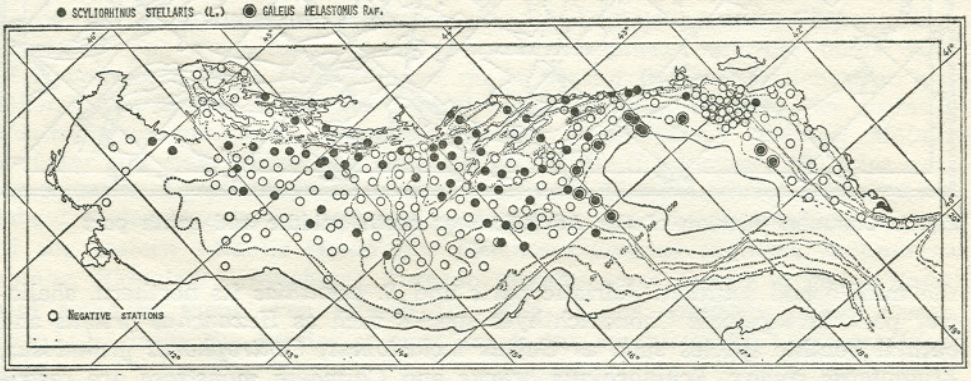

Fig. 4. *Scyliorhinus stellaris* (the throughout-Adriatic species), *Galeus melastomus* (the south-Adriatic species)

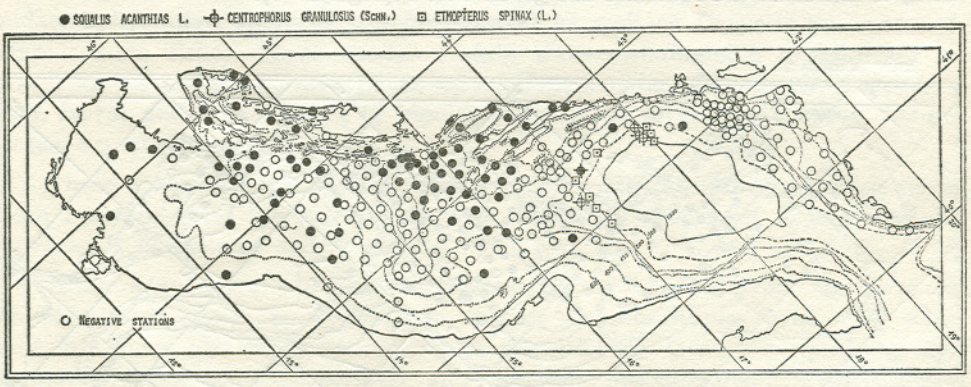

Fig. 5. *Squalus acanthias* (predominantly north- and middle-Adriatic species), *Centrophorus granulosus* (the south-Adriatic species), *Etmopterus spinax* (the south-Adriatic species)

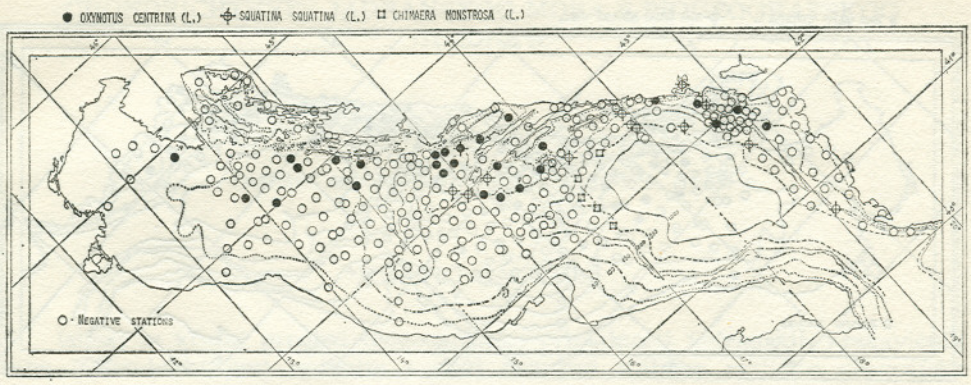

Fig. 6. *Oxynotus centrina* (the throughout-Adriatic species), *Squatina squatina* (the south-Adriatic species), *Chimaera monstrosa* (the south-Adriatic species)

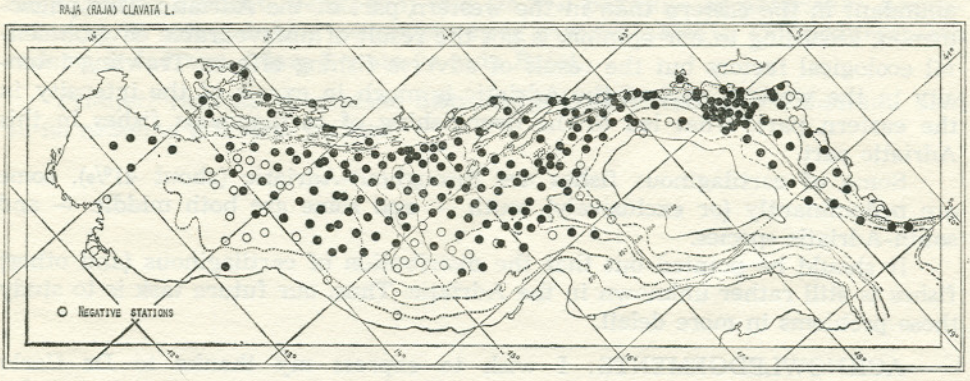

Fig. 7. *Raja (Raja) clavata* (the throughout-Adriatic species)

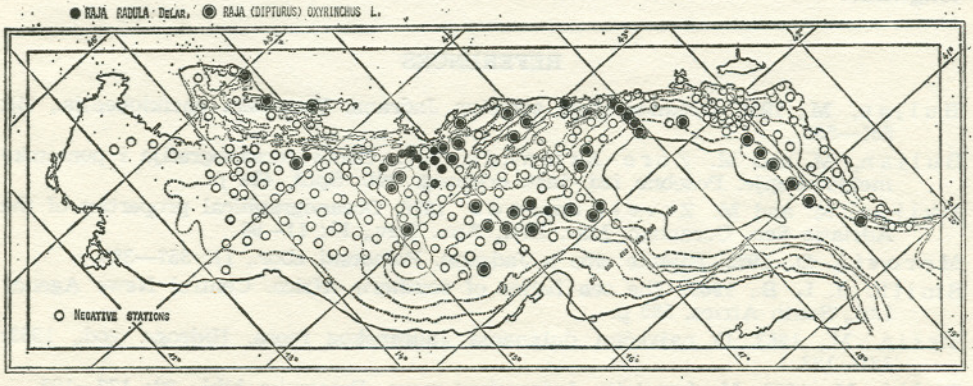

Fig. 8. *Raja radula* (the middle-Adriatic species?), *Raja (Dipturus) oxyrinchus* (predominantly middle- and south-Adriatic species)

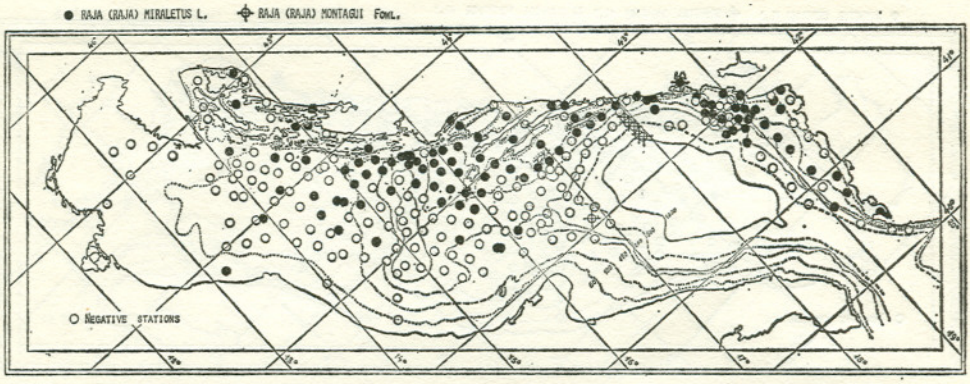

Fig. 9. *Raja (Raja) miraletus* (the throughout-Adriatic species), *Raja (Raja) montagui* (the middle- and south-Adriatic species)

Large number of species — as shown in the enclosed figures — are more abundant in the eastern than in the western part of the Adriatic. This phenomenon, according to our opinion, is not the result of unfavourable environmental ecological factors but the result of adverse fishing effects. Trawling intensity in the western part of the Adriatic is much in excess of the intensity in the eastern part, what led to the over-fishing of cartilaginous fishes in this Adriatic part.

Some of cartilaginous fishes are throughout-Adriatic (about 41%), some are pedominantly (or exclusively) south — and some are both middle — and south-Adriatic species.

It should be pointed out that the distribution of cartilaginous (and other) fishes is still rather unknown in the Adriatic. Thus, our future task is to study these problems in more delail.

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CHONDRICHTHYES JADRANSKOG MORA S BIOGEOGRAFSKOG GLEDIŠTA

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KRATKI SADRŽAJ

Iznosi se kratki pregled biogeografske pripadnosti jadranskih hrskavičnih riba (Chondrichthyes) općenito i neki primjeri njihove različite geografske distribucije u Jadranskom moru (za bentoske vrste).

Od ukupno 53 vrste hrskavičnih riba zabilježenih u Jadranu većina je Atlantsko-mediteranske biogeografske pripadnosti (59,2%): 10 vrsta predstavlja tropski, 8 vrsta borealni, 6 vrsta hol-istočno-atlantski i 8 vrsta amfiatlantski biogeografski element. Veliki broj rsta (35,2%) pokazuje karakteristike kozmopolitskog ili nekog drugog geografski šireg rasprostranjenja. Od mediteranskih endema u Jadranu dolaze 3 vrste (iz roda *Raja).*

Primjeri različite geografske distribucije hrskavičnih riba u Jadranu dani su na nekoliko grafičkih prikaza.