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MEDITERRANEAN FISHES IN THE INDIAN OCEAN *

ENRICO TORTONESE
Museum of Natural History, Genova, Italy

ABSTRACT

A number of fishes living in the Mediterranean are also recorded from the Indian Ocean. Many of them are surely present in this area. Some are pelagic or bathypelagic species, widely distributed in different oceans. Others exist only in the SW or western part of the Indian Ocean and may be present all around Africa. They are evidently adapted to rather various environmental conditions. A small number, like *Syngnathus acus*, have been reported from several Indian localities but their taxonomic status is not exactly known. Of particular interest are the fishes living in the Red Sea. Nearly 30 species immigrated from this sea into the Mediterranean, where some are now spreading westwards. A much smaller number of species (about 7-8) moved in the opposite direction, but do not seem to have gone far from Suez. Their present status is not at all clear and awaits further investigations.

INTRODUCTION

ABOUT 550 species of fishes (of which 80 belong to Chondrichthyes) live in the Mediterranean. Many of them have been recorded also from the Indian Ocean. Some identifications are correct, but some names employed in the old and even recent literature, are definitely wrong : such is, for instance, the case of *Hippocampus guttulatus*, a Mediterranean fish which in Indian waters is replaced by *H. kuda*.

As is well known, a clear understanding of the taxonomic situations is essential for zoogeographical purposes. Unfortunately, we still lack accurate information about the relationships between many similar fishes found in the Mediterranean and in the Indian Ocean.. So, at the present moment, we can only summarise some available data and suggest what future researches appear to be desirable. This paper is chiefly intended as a short review of unanswered questions rather than of solved problems.

MEDITERRANEAN AND INDIAN OCEAN ICHTHYOFAUNA

The Mediterranean and the Indian Ocean are strictly connected historically, both having been parts of the great ocean existing long ago : the Tethys or Mesogea. These marine areas were joined during millions of years and became separated in Miocene times. As Ekman (1953) writes ' ....in the Eocene and Oligocene the Mediterranean region and the more easterly parts of the Tethys Sea formed a fairly uniform zoogeographical province, the Indo-European.... '. The early Tertiary Mediterranean fauna had therefore a marked tropical, Indo-Pacific character, which disappeared later on, when the connection of the areas was lost and a new fauna of Atlantic type was formed. Such history has been often outlined by authors

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dealing with the Red Sea and its faunistic relationships with the Mediterranean (Marshall, 1952; Klausewitz, 1968; and others). Till now similar analyses focused on the Indian Ocean are not available. Tortonese's notes (1937-38) are quite out of date.

The Indian Ocean, reaching about 35° lat. S. includes parts rather different both biologically and physically. This ocean is essentially a warm zone, that is a main section of the wide Indo-Pacific region (or 'Indo-West Pacific' according to Ekman). Its ichthyofauna consists of a very high number of species. No figure can be given, as no check-lists have hitherto been published. A lot of descriptions and partial catalogues are scattered in papers of variable size and value. It seems superfluous to quote here the old literature, but I cannot avoid to mention Weber and Beaufort's volumes (1911-62) on the Indo-Australian fishes. We are indebted for valuable works to Blegvad (1944: Iranian Gulf), Munro (1955: Ceylon), Smith (South Africa, 1950, and the Western Indian Ocean, 1956-65) and to a group of students of the fauna of the Red Sea (Marshall, Klausewitz, Steinitz, and others). In recent years important results were obtained during several expeditions (e.g. 'Calypso', 'A. Bruun').

Cosmopolitan Species

Cosmopolitan species living in the Mediterranean and the Indian Ocean are numerous and many were included by Briggs (1960) in his comprehensive list. Most of them are better defined as circumtropical. At least five sharks exist in both areas: *Hexanchus griseus* (only in the southern Indian Ocean), *Isurus oxyrhynchus*, *Carcharodon carcharias*, *Alopias vulpinus* and *Prionace glauca* (not truly tropical, absent in the Red Sea). The second of these species has been usually called *I. glaucus*, but Garrick (1967) has shown that this is simply a synonym. Such widespread genera of Selachians as *Rhineodon*, *Galecerdo* and *Manta*, present in all the oceans, have never been found in the Mediterranean. As regards pelagic and deep sea species three Mediterranean Myctophids have been surely collected in the Indian Ocean: *Electrona rissoi*, *Hygophum hygomi*, and *Lampanyctus pusillus* (Nafpaktitis, 1969). *Lobianchia gemellari* is probably to be added. *Chauliodus sloanei* seems to be absent only in the more northern part of the Indian Ocean (Gibbs-Hurwitz, 1967). *Stomias boa* exists only in the southern part (Gibbs, 1969).

The following is a list of more or less cosmopolitan fishes living under different ecological niches in both areas considered here: *Maurolicus muelleri*, *Nemichthys scolopaceus*, *Exocoetus volitans*, *Regalecus glesne*, *Zu cristatus*, *Lampris regius*, *Macrorhamphosus scolopax*, *M. gracilis*, *Hoplostethus mediterraneus*, *Mugil cephalus*, *Pomatomus saltator*, *Naucrates ductor*, *Seriola dumerili*, *Caranx hippos*, *C. dentex*, *Coryphaena hippurus*, *C. equiselis*, *Ruvettus pretiosus*, *Brama raji*, *Scomber japonicus*, *Thunnus thynnus*, *Th. alalunga*, *Euthynnus pelamis*, *Xiphias gladius*, *Remora remora*, *Remilegia australis*, *Echeneis naucrates*, *Mola mola* and *Ranzania laevis*. Of course, this list cannot be accepted without some criticism, concerning the true cosmopolitism of the species or the identity between their Mediterranean and Indian representatives. Furthermore, these species are not necessarily present throughout the Indian Ocean. For instance, the Bluefin Tuna (*Thunnus thynnus*) occurs around Australia and off South Africa, and the Albacore (*Th. alalunga*) is restricted between 5°N and 30°S (Collette-Gibbs, 1963). The doubts referred to above arise for *Hoplostethus mediterraneus*, *Mugil cephalus*, *Caranx hippos* and *Scomber japonicus*. Perhaps the latter is polytypic, with a subspecies (*S. j. colias*) in the Mediterranean and the

Atlantic; the nominal form would be Indo-Pacific. Further cases of differentiation at a subspecific level may be expected.

Species with Discontinuous Distribution

Arambourg (1965) has explained how the oceans became populated by similar or closely related forms, through the Tethys. He stated that the present Mediterranean fauna is chiefly a descendant of the oligomiocenic Paleomediterranean fauna. In the latter were included some families no more present today. Fossil Dussumieriidae from Upper Miocene were found in Sicily and Algeria, but this Indo-Pacific family is now represented in the Mediterranean simply because two species (*Dussumieria acuta* and *Etrumeus teres*) recently penetrated from the Red Sea. It is interesting to remind that some Mediterranean fishes are apparently absent in the Indian Ocean, but reappear—with the same or a very similar species—in the Far East. *Cubiceps gracilis* (Mediterranean, Atlantic, Philippines) is a good example. The Japanese *Zeus* is probably a subspecies (*japonicus*) of *Z. faber*. *Ophisurus macrorhynchus* and *Lophius litulon* of Japanese waters are very similar to *O. serpens* and *L. piscatorius* living in the Mediterranean. Still more surprising is the existence —as will be said later on—in the Mediterranean of *Upeneus asymmetricus*, elsewhere reported only from the Philippines.

Some Mediterranean fishes exist only in the western part of the Indian Ocean and may be restricted to the more southwestern area (South Africa : Natal). Once more, we meet a good degree of taxonomic uncertainty. Smith's book (1950) on South African marine fishes has of course a foremost interest. However, not all records appear to be reliable. *Argentina sphyraena* probably corresponds to a species of *Glossanodon* (Cohen, 1958). *Argyropelecus hemigymnus* is replaced in the Indian Ocean by *A. intermedius* (Schultz, 1961). The following are said to reach at least Natal : *Chlorophthalmus agassizi, Ophisurus serpens, Scomberesox saurus, Syngnathus acus, Zeus faber, Liza ramada, Polyprion americanus, Serranus scriba, S. cabrilla, Diplodus sargus, Lithognathus mormyrus, Stromateus fiatola, Schedophilus medusophagus, Lepidopus caudatus* and *Lophius piscatorius*. As a whole, the real presence and the distribution of these fishes in the Indian Ocean deserve to be investigated. *S. acus* has been recorded from Madagascar, Zanzibar, Réunion, Seychelles, Sumatra and Java. It is doubtful if this little, benthic fish, common in the Mediterranean and NE Atlantic, really occurs in so wide an area. *S. medusophagus* is noteworthy because it is supposed to live also in the Pacific Ocean; this remarkable distributional gap may suggest that different species are involved. *S. cabrilla*, as will be said later on, was recorded from the Red Sea. The two Sparoids (*D. sargus* and *L. mormyrus*) included in the above list seem to be really found all along the East coast of Africa : the former reaches the Persian Gulf, the latter the Red Sea. Thus there are two species completely circum-African in distribution.

How can the presence of these few fishes of the Mediterranean and Eastern Atlantic in the Indian Ocean be explained? It is presumed that they are comparatively recent arrival in the Indian Ocean, coming from the Atlantic and following the coasts of South Africa. These fishes can evidently adapt to different environmental conditions. The successful diffusion of some Sparoids is perhaps also related to the abundance of these fishes in the South African waters, that appear to be a main center of dispersal (not necessarily the area of origin of the family). The other species of *Lithognathus* (two, beyond *L. mormyrus*) are strictly South African.

Diplodus and *Pagellus* are chiefly Atlantic genera of Sparoids, with only a few species in the western Indian Ocean.

Just as fishes of 'Atlantic type' occur along the shores of East Africa, so there are some of 'Indo-Pacific type' along the shores of West Africa. *Lethrinus*, *Drepane*, *Monodactylus*, *Periophthalmus* are well represented in the Indian ocean, but include a single Atlantic species, characteristic of West Africa and geographically isolated. These genera, that are now missing in the Mediterranean, are evidently proofs of the closer connection that in Tertiary times existed between the two faunas. May be they derive directly from the Tethys fauna, may be they passed from one ocean to the other moving along the South African coasts.

Ichthyofauna of the Red Sea and Suez Canal

When considering the relationships between the Mediterranean and the Indian Ocean faunas, a peculiar interest is offered by the Red Sea. Recent studies have revealed more and more that in this basin, showing so many peculiar features, live a number of endemic species and subspecies, so that a particular zoogeographical unit must be recognized. 'Erythrean region' seems to be a well acceptable name for it. Klausewitz (1959) explained the divergence at a specific or subspecific level of several Red Sea and Indian Ocean fishes. The degree of divergence seems to be even greater than that observed comparing Atlantic and Mediterranean species. It may be pointed out here that 'pairs' of related species are also found when the faunas of the Mediterranean and the Red Sea are compared. *Torpedo marmorata*, *Diplodus annularis* and *Scyris alexandrinus* live in the Mediterranean; their Erythrean relatives are *T. panthera*, *D. noct* and *S. gallus*.

After the opening of the Suez Canal (1869), exchanges occurred between the animal populations of the seas placed at the opposite extremities. A far greater amount of immigration took place in a S-N direction, as a remarkable number of species penetrated into the Mediterranean. From an ichthyological point of view this matter has been carefully dealt with by Ben Tuvia (1966). At least 24 species of Red Sea origin exist now in the eastern Mediterranean, constituting 9 % of its fish fauna. Besides these, Ben Tuvia (1966) also quotes several doubtful records of other species. Among the Erythrean fishes surely present in the Mediterranean there are several species well known in the Indian Ocean, as *Himantura uarnak*, *Hemirhamphus far*, *Holocentrus ruber*, *Atule djeddaba*, *Siganus rivulatus*, etc. A few others have a more restricted distribution, as *Dollfusichthys sinusarabici* (Red Sea) and *Stephanolepis diaspros* (Red Sea, Persian Gulf). All the immigrants are littoral and none, of course, is associated with coral reefs.

It seems now necessary to point out that:

(*a*) two more immigrants have been recently found: *Scomberomorus commersoni* (Lebanon: George and Athanassiou, 1965) and *Epinephelus tauvina* (Israel: Ben Tuvia and Luria, 1969).

(*b*) according to George and Athanassiou (1966) the Erythrean Mullid previously reported from the Mediterranean as *Upeneus tragula* is really another species: *U. asymmetricus*.

(*c*) a gradual spreading of some immigrants in a western direction has been noticed. *Lelognathus klunzingeri* reached Tunisia (Ben Tuvia, 1966), *Stephanolepis diaspros* reached South Italy (Tortonese, 1967), *Siganus*

rivulatus reached Libya (Tortonese, 1970). So, we may expect that the Erythrean animals are going to play a greater role in the composition of the fauna inhabiting not only the eastern, but also the central Mediterranean (at least).

The Mediterranean fishes occurring in the Red Sea show a much different picture, as already remarked by Ben Tuvia (1966) and Steinitz (1967). Such fishes are few, if we are to leave out the cosmopolitans. The Suez Canal was populated for a variable length by *Sardinella maderensis*, *Caranx fusus*, *Blennius pavo* and a limited number of other species come from the north. *Engraulis encrasicholus*, *Syngnathus abaster* (=*S. algeriensis*), *Dicentrarchus labrax*, *Umbrina cirrosa*, *Argyrosomus regius* and *Solea vulgaris* reached the Gulf of Suez, but failed to go farther. They are more or less euryhaline. *Branchiostoma lanceolatum* penetrated into the Canal, where it was found abundant (Gruvel, 1933). In the Red Sea, lives another Leptocardian, probably the cosmopolitan *Asymmetron lucayanum* ; Steinitz (1962) observed *Asymmetron* in the Gulf of Eilat.

Two main reasons can explain the scarce penetration of Mediterranean fishes in the Red Sea :

(*a*) their difficulty of enduring higher temperatures ;

(*b*) their difficulty of finding unexploited ecological niches : the Red Sea harbours a very rich fauna, so that there is a ' faunistic pressure ' unfavourable to new arrivals.

Serranus cabrilla has been known as a ' Red Sea fish ' for a long time and does not appear to have crossed the Suez Canal. But comparative studies on Mediterranean and Erythrean materials have never been done and, on the other hand, this Serranid seems to be rare in the Red Sea : On the contrary, *Lithognathus mormyrus* that, as mentioned above, exists all around Africa, has been collected during the cruise of ' Manihine ' (Marshall, 1952). *Cypselurus rondeleti*, a common Mediterranean flying-fish, was recorded from Java (Weber and Beaufort, 1922) and from the Red Sea (Tortonese, 1955). The distribution of this species is not exactly known. Today, the situation of the fishes living in the Mediterranean and in the Red Sea (with the exception of those cosmopolitan or immigrated northwards through the Suez Canal) is not at all clear and needs further researches concerning their taxonomy and their distribution.

Conclusion

In conclusion, it may be emphasised that this picture, simple and probably rough, shows the inadequacy of our knowledge of the relationships between the Mediterranean and Indian Ocean ichthyofaunas. A close co-operation between Indian and ' Mediterranean ' ichthyologists is absolutely necessary for better understanding of the problems. As in many other fields of modern science, there are problems that cannot be solved by an individual, even if very competent. It is hoped that this account will stimulate further research in this field to unravel many of the unsolved problems.

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