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## SOME FEATURES IN THE BIOGEOGRAPHY OF THE ICHTHYOFAUNA OF THE INDIAN OCEAN

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### ABSTRACT

The paper summarises the investigations on some important features of the zoogeography of the Ichthyofauna in the Indian Ocean with special reference to the widely distributed families Clupeidae, Engraulidae and Carangidae.

Investigations on the ichthyofauna of the Indian Ocean are of vital importance both from theoretical and practical standpoints. The Indian Ocean can and must yield more fish for the high density of population which lives in the surrounding countries. The potentialities of such an increase, as pointed out by Panikkar (1966 and 1968) have been increasingly realised during the last few years. The total catch taken from the Indian Ocean which, according to my estimate has reached 2,000,000 tons in 1960 (Rass, 1965), increased to 2,780,000 tons in 1970 (FAO, 1971).

The ichthyofauna of the Indian Ocean is most closely related to that of the western Pacific, being in fact a part of a unique Indo-West Pacific fauna (Ekman, 1953).

At the same time some connections can be traced with the ichthyofauna of other regions and these, require further zoogeographical analysis. The fact can be exemplified by the widely distributed families of Clupeidae, Engraulidae and Carangidae which are rich in species.

The large family of Clupeidae, is comprised of 6-7 subfamilies about 50 genera and 190 species (Svetovidov, 1952; Rass, 1971). The family, dates back to Lower Cretaceous (Berg, 1955). More than 50 species of this family live in the Indian Ocean off the coasts of India, Ceylon and Burma (Day, 1889). The interrelations of some Indian Ocean groups of this family is of great interest. The tropical-boreal subfamily Alosinae (Clupeidae) consists of three genera: *Hilsa*, *Gudusia* and *Alosa*. *Hilsa* species are anadromous, entering the rivers

of the Indian and West Pacific Oceans along the coasts of southwestern Africa upto Indonesia and Korea. The genus has five species: three of them are Indo-West Pacific: *H.kelee* (Cuv), *H.toli* (Val.) and *H.ilisha* (Ham.Buch.) and two are West Pacific: *H.reevesii* (Rich.) and *H.macrura* (Blkr.). The genus *Gudusia* (related to *Hilsa* but differing from it and from *Alosa* by its smaller scales is represented in the rivers of India and Burma by two species: *G.chapra* (Ham. Buch) and *G.variegata* (Day). The genus *Alosa* occurs on both the coasts of the Atlantic: six species—along the coasts of North America, six species along the coasts of western Europe, three species in the Black Sea Caspian basin and three species in the Caspian sea (Svetovidov, 1964).

Most of these species are anadromous, but freshwater forms too are known. In the waters of America, the genus falls into two subgenera (*Alosa* s.s., *Pomolobus*). In the European waters it forms up to 30 subspecies. The findings of fossil remains of related genera and species (*Pseudochilsa* Menner and others, from the Miocene of the southeastern Caucasus) point to some connections between the ranges of the genera of this group. The history of these connections may be presumed to be the following: the primary ancestral forms, related to the species of the genus *Gudusia*, inhabited the rivers of southeastern Asia. A part of their descendants migrated downstream into the seas of eastern and southern Asia, became anadromous and gave rise to the generic group *Hilsa*. Another part of their descendants migrated westwards, crossed the Atlantic Ocean and began inhabiting the waters of America as *Alosa* species.

The explanation to the great diversity of forms in this genus as observed from the Caspian Sea lies in the history of the genus during the Meotis-Akchagyl period. During the last junction of the Caspian Sea with the Ponto Azov basin, its ancestors invaded its still unoccupied pelagic zone and have flourished there ever since (Svetovidov, 1952).

The purely tropical subfamily Pristigasterinae, comprising of 8 genera and nearly 50 species (Fowler, 1941; Hildebrand, 1964; Norman, 1966; Whitehead, 1970), is more richly represented in the waters of America than in the Indo-West-Pacific zoogeographical region. Three out of the four Indo-West-Pacific genera: *Ilisha*, *Pellona*, *Opisthopterus* and *Raconda* also occur at the coasts of America along with the four purely American genera *Odontognathus*, *Pristigaster*, *Plios-teostoma* and *Neopisthopterus*; and only *Raconda* is lacking. The genera *Ilisha*, *Pellona*, *Opisthopterus* are represented in the Indo-West-Pacific waters by marine or estuarine species (*I. elongata*, *I. filigera*, *I. indica*, *I. megaloptera*, *I. macro-gaster*, *I. pristigastroides*, *P. ditchela*, *O. tardoore*, *O. valenciennesi*), and in the American waters by freshwater species, mainly of the Atlantic basin (*I. amazonica*, *P. castelnaeana*, *P. flavipinnis*) and marine species at the Atlantic (*P. harroweri*, *P. narragansetal*) and the Pacific (*O. dovii*, *O. macrops*, *O. aequatorialis*) coasts.

A species of the genus *Ilisha*, *I. africana*, occurs along the Western coast of Africa, thus connecting in a remarkable way the western and eastern ranges of the genus which is separated by the African continent and the Atlantic Ocean.

Unlike *Ilisha* and *Pellona*, the genus *Opisthopterus* does not occur along east of America. It is represented in the waters of the Indian Ocean, and Indo-Australian archipelago by *O. tardoore* and *O. valenciennesi*, and at the western shores of tropical America by *O. dovii*, *O. macrops* and *O. aequatorialis*.

The spreading of the subfamily Pristigasterinae seems to have another course and apparently reflects another epoch so different from that of Alosinae.

Interesting and somewhat enigmatic is the history of *Etrumeus teres* (De Kay) belonging to the subfamily Dussumierrinae (Dussumieridae), whose distribution has recently been described by Whitehead (1963 and 1965). The species occurs mainly in warm-temperate waters off southeastern Africa, southern Australia, Japan, the Hawaiian and Galapagos Islands, at the western and eastern coasts of North America; it has been encountered also in the Red Sea and in the eastern part of the Mediterranean.

Since the species does not occur in the eastern part of the Atlantic Ocean it is thought "most likely that the Mediterranean specimen is an immigrant from the Red Sea" (Whitehead, 1965, p. 236). However, fossil remains of *Etrumeus* have been encountered in the Miocene deposits of Sicily and Alger in the Eocene-Oligocene periods of Germany and Irak (Danilchenko, 1964). Thus the species appears to be a relict in the Mediterranean.

The family Engraulidae with 16 genera and 120-130 species probably appeared during the Eocene. Fifteen genera at present inhabit the coastal tropical and subtropical waters of America, Africa, Asia and Australia but one genus, *Engraulis*, lives in the warm-temperate waters of both northern and southern hemispheres. In contrast to the Clupeidae, the American tropical and subtropical genera of Engraulidae do not occur along the coasts of Asia, while the Asiatic genera are absent on the coasts of America. Only the warm-temperate *Engraulis* occurs in the southern and northern waters of America (with the exception of the Atlantic coasts of North America), Europe, Africa, Asia and Australia. The aloofness between the American and Asiatic Engraulidae can be accounted for by their coastal modes of life as compared to the Clupeidae, as well as by relatively later appearance historically. Recent findings of Whitehead (1964) on the representatives of the genus *Engraulis* indicate their distribution in tropical waters of Central America (off the coasts of Venezuela and Tobago), in the waters of western Africa, off the Comoro and Seychelles Islands in the Indian Ocean, to the west of Japan on Long. 175°E, and along the shores of Indonesia.

According to Soviet and Japanese data for the western waters of the Pacific and from the American data for the Hawaiian Islands, larvae, fry and adult specimens of Engraulidae may be carried by the currents away from the coast for several hundred miles, without losing their vitality. The presence of *Engraulis capensis* in the western waters of the Arabian Sea, may be explained from the drift coming from the southern coast of Africa, particularly because the presence of a patch of relatively colder water has been reported off the eastern coast of Africa between northern Madagascar and Southern Arabia. The appearance of the warm-temperate species *E. capensis* off northern Madagascar and the Seychelles can also be explained from the above assumption. It will be shown below that an analogous picture is presented by the family Carangidae.

The family Carangidae includes some 30 genera with more than 200 species. Like Engraulidae, nearly all the representatives of Carangidae are found in tropical and subtropical waters, and only the species of the genus *Trachurus* (like the genus *Engraulis*) are characteristic of temperate waters along the coasts of America, Europe, Africa, Asia and Australia. Similar to the findings of the warm-temperate genus *Engraulis* in the northwestern waters of the Indian Ocean described above, some specimens of the genus *Trachurus* have been discovered by Soviet scientists in the north-western part of the Arabian Sea, in the Gulf of Aden, the Gulf of Suez and the Red Sea. These were compared with the specimens from the Mediterranean *Trachurus mediterraneus* and the species has been described as an Indian subspecies *T. mediterraneus indicus* Necrassov (Necrassov, 1966 and 1970). However, a comparison with the South African species *T. capensis* shows that the above subspecies is very close to the latter as regards the number of scales on the lateral line (65-75 in the former and 66-76 in the latter), differing substantially in this character from the Mediterranean forms with 72-95 scales. (Necrassov, 1970). The distribution of this species in the north-western part of the Arabian Sea is confined to the areas of cooler waters than that of the genus *Engraulis*.

All these findings indicate that while the ichthyofauna of the Indian Ocean as a whole belongs to the fauna of the Indo-West Pacific region, ancient connections can be traced between it and the Atlantic-Mediterranean ichthyofauna (as regards the Clupeidae-Alosinae, Pristigasterinae and Dussumierinae). Apparently more recent connections seems to result from the penetration of warm-temperate species of *Engraulis* (Engraulidae) and *Trachurus* (Carangidae) into the western waters of the Arabian Sea. The recent immigrants are evidently able to exist in the tropical waters of the Arabian Sea. The presence of a patch of relatively cool water between northern Madagascar and Southern Arabia is the only area which seems incompatible to them. If this assumption is correct we may expect to find in the warmer region many more representatives of warm-temperate ichthyofauna, not typical of the Indo-West-Pacific zoogeographical region.

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