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BIOLOGY OF ADULT *ISOPODA (CRUSTACEA)* PARASITIZING FISHES OF NORTH-WEST AFRICA SHELF

BIOLOGIA DOROSŁYCH *ISOPODA (CRUSTACEA)* PASOŻYTÓW RYB SZELFU PÓŁNOCNO-ZACHODNIEJ AFRYKI

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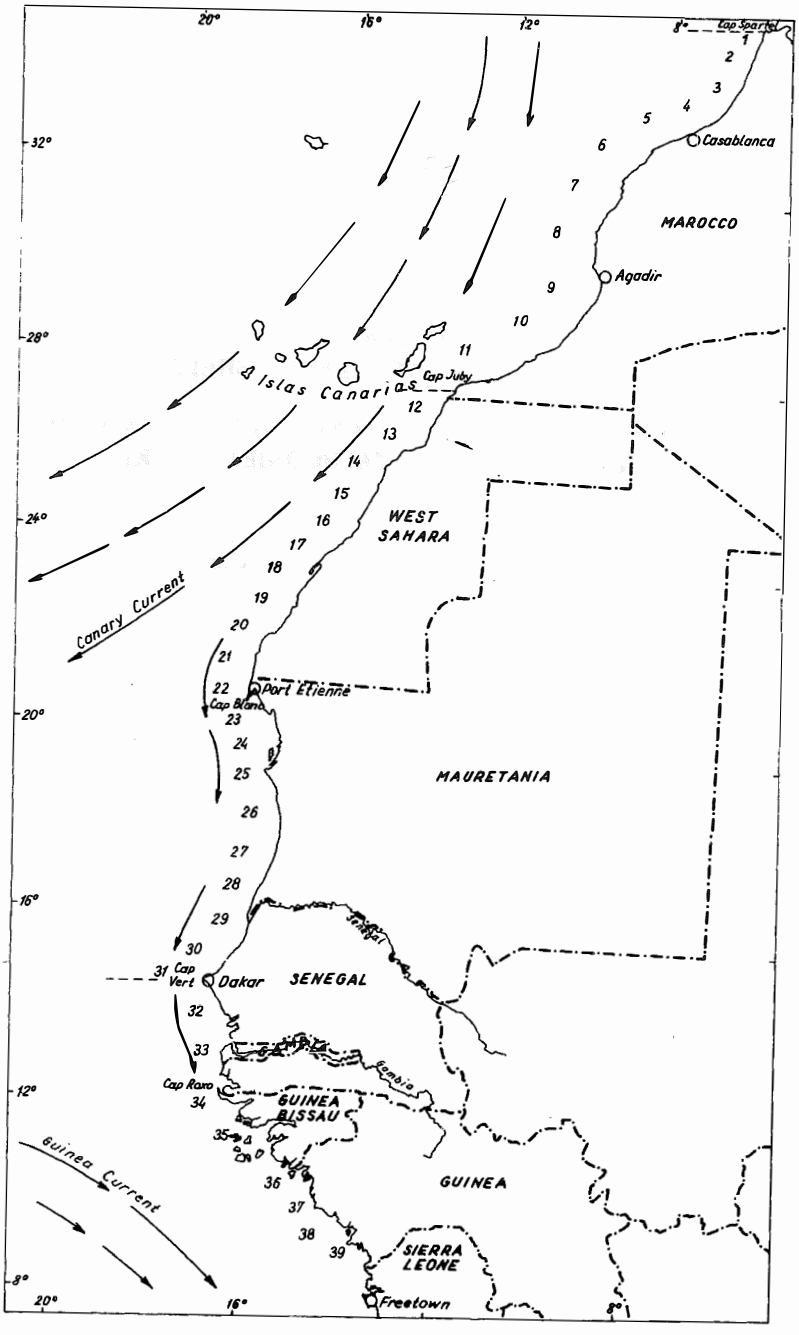
Studies on the biology of adult *Isopoda*, parasites of the fishes in North-West Africa shelf embraced: vertical distribution of the parasite-host systems, ecological analysis of the presented systems, and specificity of parasitic *Isopoda* toward their hosts.

INTRODUCTION

Literature dealing with the biology of parasitic *Isopoda* in North-West Africa shelf is restricted to a few papers only. Monod (1924a) was the first scientist to undertake more comprehensive studies on the problems, dealing with the isopods of Atlantic coast of Sahara (Mauretania). In his taxonomic review (7 species and 2 subspecies) this author presented several observations as to the morphological variety of some *Isopoda* species, preferences regarding their hosts, frequency of occurrence in fishes from the region under study. In an annex to the earlier paper, Monod (1924b) presented comments as to the morphology and distribution of *Meinertia (Ceratothoa* at present) *collaris*. Isopods of North-West Africa shelf were also mentioned in the reports from scientific cruises (Rokicki, 1977, 1981) and museal possessions, but these contained little information on the biology.



Map. 1. The North-West Africa shelf

Table 1

Distribution of the isopods from North-West Africa shelf within the ichthyofauna (according to own studies and literature data).

( ) doubtful host, additionally

Parasite	North-West Africa shelf		Totally in the whole range	
	species	family	species	family
Aega deshayesiana	–	–	1(1)	1(1)
Anilocra capensis	6(1)	4	15(4)	8
Anilocra frontalis	–	–	21(4)	8
Anilocra physodes	1	1	29(6)	15
Nerocila cephalotes	15(2)	13	19(7)	17
Nerocila maculata	4	4	12(5)	11
Nerocila orbignyi	2	2	14	9
Nerocila rhabdota	5	5	9	7
Nerocila armata	1	1	7	6
Lironeca sinuata	1	1	3	3
Ceratothoa collaris	8	2	13(2)	4
Ceratothoa oestroides	3(4)	3	15(7)	9
Ceratothoa parallela	1	1	8	6
Ceratothoa steindachneri	1	2	9(2)	4
Ceratothoa italica	2	2	6(2)	2
Ceratothoa oxyrrhynchaena	2	2	5(2)	4
Cymothoa plebeia	1	1	2	2
Cymothoa slusarskii	1	1	1	1
Irona trillesi	2	1	2	1

Consequently, hardly any progress has been made as regards studies on parasitic isopods in North-West Africa coast. The present paper aims at filling up these gaps in our knowledge. It deals with the ecology and biology, as well as with the parasite specificity toward fishes.

Fishing areas from which own collections of *Isopoda* were obtained haąe been denoted in the text by a letter „Ł" with a number referring to the enclosed map. 19 species of *Isopoda* are delt with in the paper (see Tab. 1), in this all those known so far in North-West Africa shelf, and two new ones, viz. *Cymothoa slusarskii sp. n.* and *Irona trillesi sp. n.* (Rokicki, in print). Fishes under study are presented in Tab. V.

In preparing this paper I have been advised and helped by several people, to whom I would like to express my gratitude.

VERTICAL DISTRIBUTION OF THE EXISTING PARASITE-HOST SYSTEMS IN NORTH-WEST AFRICA SHELF

Parasitic isopods of North-West Africa shelf are to a large extent connected with the ecology of their hosts. Structure of fish infestation with the parasites is differentiated in particular zones of North-West Africa shelf. The following species predominated quantitatively in the pelagic zone (neritic zone): *Scomber japonicus, Sarda sarda, Trachurus trachurus, Caranx rhonchus, Licha vadigo, Sardina pilchardus, Sardinella eba, Sardinella aurita* and *Etmoloza fimbriata* These fishes form large shoals either throughout the year, or periodically. Less numerous pelagic fishes (neritic zone) embraced: *Neothunnus albacora, Auxis thazard, Stromateus fiatola* and other. With rare exceptions they were totally free of *Isopoda.* They could have been compared to fishes of the oceanic pelagial, which are also free of the isopods, the only exception being the flying fishes.

The second group consisted of bathypelagic fishes, such as: *Trichiurus lepturus, Trichiurus caudatus* and *Brama raii.* They were sometimes infested with the isopods *Nerocila cephalotes* and *Lironeca sinuata.*

The third group was most infested with the isopods. It consisted of benthic and profundal species, such as: *Dentex canariensis, D. macrophthalmus, Sparus auratus, Synaptura lusitanica.*

In North-West Africa shelf *Ceratothoa collaris* was found in *Sparidae, Rajidae* and *Maenidae* in shallow waters of the coastal zone. In places where the parasite was present the bottom was sandy or rocky. *D. macrophthalmus* was present at the depths of 160–350 m, but the infested fishes were caught from 29–42 m. They were usually males, at the age of 2–6 years, and of total length of 18–25 cm. *Pagrus pagrus* was present at the depth of 50–100 m, but the infested fishes originated from 20 m and were grazing. The fishes were usually young, of total length about 30 cm.

Anilocra capensis was found in North-West Africa shelf in fishes belonging to the families *Sparidae, Bramidae* and *Serranidae*, and outside of this zone also in *Sciaenidae,*

Mullidae and *Gadidae*. The species can be present in a variety of environments, as it was found in *B. raii* and *D. macrophthalmus* at considerable depths, and in *D. canariensis* at a depth of 5 and 8 m (Monod, 1924a). Infested *Spondyliosoma cantharus* caught in June, at the depth of 27–33 m (Ł. 17 and 18), were in course of their migration to the spawning grounds (V stage of gonad development, according to Mayer), located in shallow areas (30–60 m) between Cap Barbas and Bissagos (F.G. 21–35). *S. cantharus* spawns from April till May (Klimaj, 1973). Hence, it can be assumed that the fishes caught in November were migrating to the grazing areas, which are located between S. Cap Bajador and Tamzat (F.G. 15–27), at the depths of 100–200 m (Klimaj, 1973).

Nerocila cephalotes was found in *Trichurus lepturus* during spawning (May – July), at the fishing grounds F.G. 17–20. Fishes of this species caught at different fishing grounds and in different periods were not infested with the isopods. Infested *Pomatomus saltatrix* were also caught during spawning, which took place from April till July, between Punta Negra and Cap Timiris (F.G. 20–25).

Part of the parasitic isopods in North-West Africa shelf had only a limited number of hosts. These embraced *Cymothoa plebeia* (Fig. 6) which was found also in Australian coastal waters (Avdeev, 1978) in *Pagrosomus sp. (Sparidae)*, a family of which the representatives have many common features with *Brachydeuterus auritus (Lutianidae)*. The latter species occurs at both sides of the Atlantic Ocean, in shallow shelf waters of the subtropical and tropical region, but it is a host for *C. plebeia* only in west coast of Africa (Fig. 8). This would suggest that the parasite became connected with *Brachydeuterus auritus* much later, already after having spread to new habitats, or when the new habitats became inhabited by a stock of fishes in good condition, this certainly not being the case with individuals infested by the parasites. *Brachydeuterus auritus* inhabiting coastal waters of South America is a potential host for *C. plebeia*, although it is ecologically separated from it.

Ceratothoa steindachneri was rarely found in North-West Africa shelf. It was found in *Serranus cabrilla (Serranidae)* near *Casablanca* (Dollfus and Trilles, 1976). The parasite is much more frequent in the Mediterranean Sea (French and Tunesian coast) in fishes belonging to the families *Serranidae, Sparidae, Scorpaenidae* and *Rajidae*, i.e. in stationary species of shelf waters, connected with rocky bottom.

Ceratothoa italica was once found at the height of Cap Blanc (Mauretania) by Monod (1924a). This species occurs in *Sparidae* of the Mediterranean Sea. Montalenti (1948) found it frequentlly in *Pagellus mormyrus* and other *Pagelli*, i.e. in bathypelagic waters of medium depth (100–200 m).

Ceratothoa oxyrrhynchaena was found in the shelf in *Zeus faber (Zeidae)* caught from shallow waters, and *D. macrophthalmus (Sparidae)* caught at a depth of 30 m, over a sandy bottom. In the Mediterranean Sea this parasite prefers *Maenidae , Sparidae* and *Rajidae* inhabiting bottom zone of shallow waters, with rocky bottom or overgrown by plants.

Anilocra physodes was found in Zeus faber in North-West Africa shelf (Fig. 2), at the height of Casablanca (Trilles, 1975a). In the Mediterranean Sea the parasite was found in

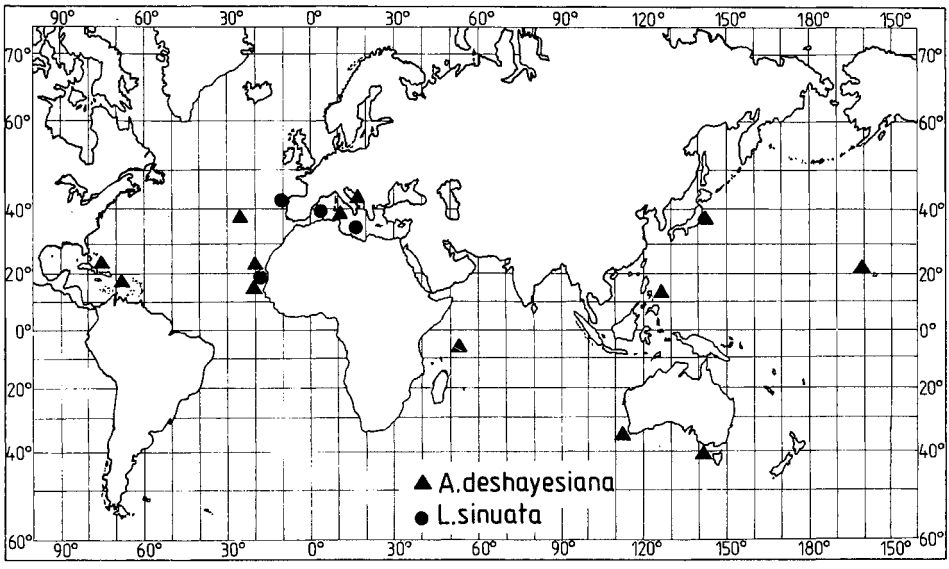


Fig.1. Distribution of Aega deshayesiana /M.Edwards/ and Lironeca sinuata Koelbel

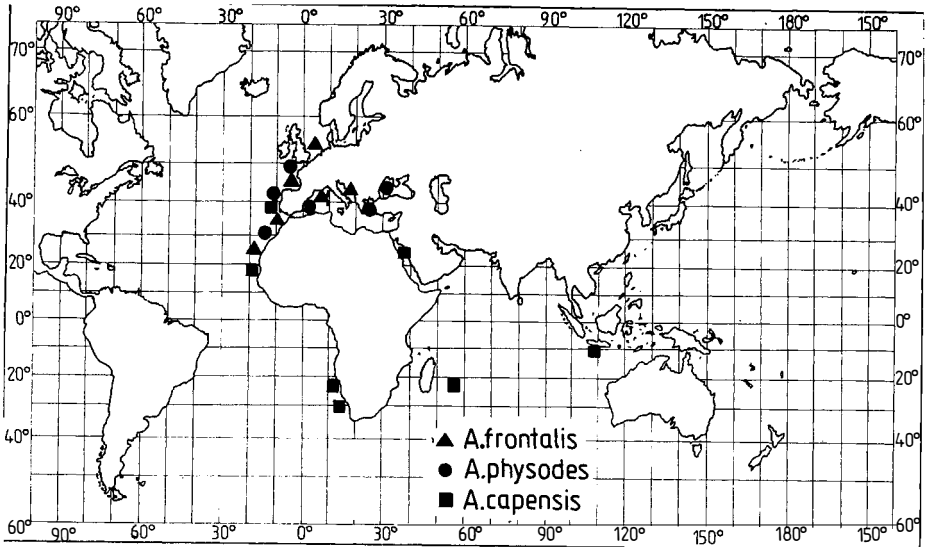


Fig.2. Distribution of Anilocra frontalis M.Edwards, A.physodes /Linnaeus/ and A.capensis Leach

many fishes (Trilles, 1964), mainly from the families *Sparidae (Boops boops, Pagellus erythrinus*) and *Maenidae (Maena smaris, M. maena, M. chryselis*), i.e. in fishes which are present also in North-West Africa shelf. Trilles (1965) is of the opinion that this parasite is a typical Mediterranean species, which can sporadically occur in the adjacent regions. This suggestion is confirmed by the present studies.

Anilocra frontalis in the Mediterranean Sea occurs mainly in *Labridae*. Single specimens were also found in *Gadidae* and *Gobidae*. According to Trilles (1965) the parasite is especially frequent in two *Labridae species*, viz. *Labrus bergylta* and *Crenilabrus melops*.

Nerocila rhabdota occurs in many species, both of the bottom zone (*Psetus sebae* – in North-West Africa shelf), and in pelagic and periodically pelagic species in the Mediterranean Sea.

Nerocila armata occurs in various fish families at both sides of the Atlantic Ocean, in the tropical and subtropical region. *Lagocephalus laevigatus* is a shallow water fish, similarly as *Mugil auratus*, which inhabits coastal waters. Some hosts of *N. armata* and *Cichla ocellari* can periodically occur in fresh waters, but so far *N. armata* was not found to infest these species in fresh waters. It is possible that when the fishes migrate from marine to freshwater environment, the parasites disappear. Such phenomena were described by Ślusarski (1958).

Nerocila orbignyi occurs both in coastal and pelagic waters, as well as in the bottom zone, infesting fishes from the families *Pleuronectidae* and *Soleidae*.

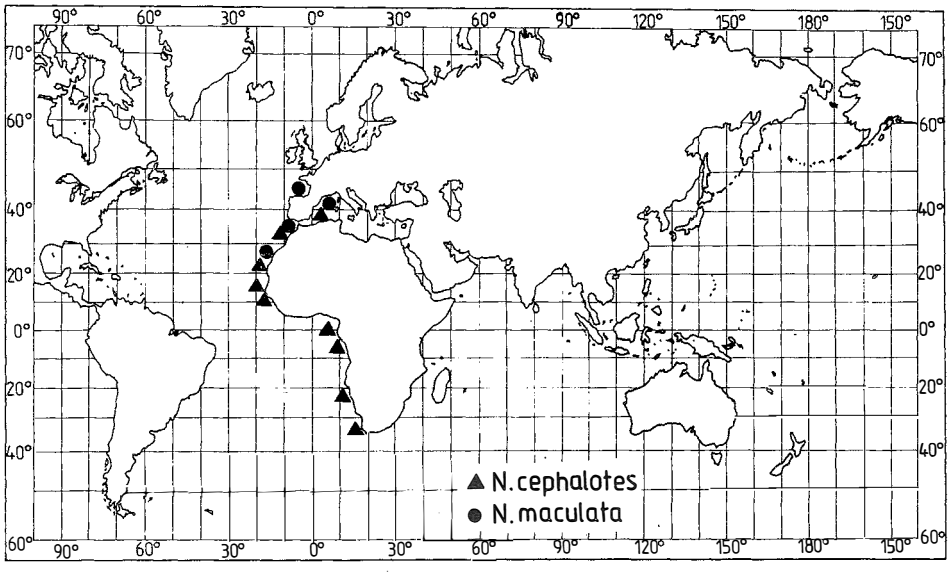


Fig.3. Distribution of Nerocila cephalotes Schioedte et Meinert i N. maculata M.Edwards

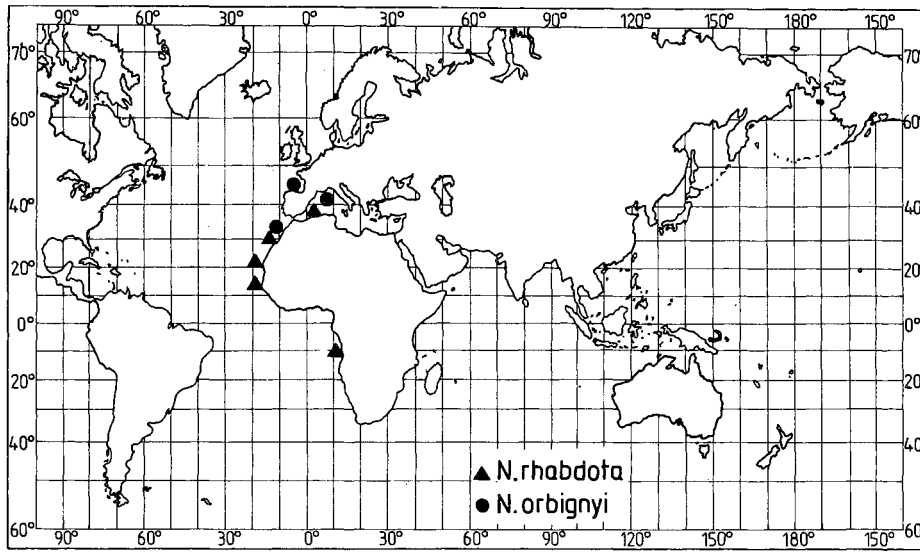


Fig.4. Distribution of Nerocila rhabdota Koelbel and N. orbignyi /Guerin-Meneville/

Nerocila maculata is present in fishes inhabiting both deeper waters and coastal zone.

Lironeca sinuata was so far found in bathypelagic fishes *(Cepola rubescens, Raja miraletus, Brama brama).*

Ceratothoa parallela occurs mainly in *Boops boops*. This species is a coastal one, especially as young. Older fishes inhabit also open and slightly deeper waters.

Cymothoa slusarskii was found in *Dentex macrophthalmus*, a bottom fish of shelf waters.

Irona trilles was present in pelagic fishes (*Ablennes hians* and *Belone belone)* which keep close to the shore, frequently at river mouths, but found also in open waters of seas and oceans.

Ceratothoa oestroides was found in fishes from different biotopes, both in pelagic and bottom zones. From among the discussed isopods of North-West Africa shelf, most were the species occurring in marine salt waters, and only two: *Nerocila armata* and *Irona trillesi* can contact fresh waters through their hosts. This is probably the reason for an almost total lack of parasitic isopods in African inland waters (Bruska, 1981).

ECOLOGICAL ANALYSIS OF THE PRESENTED SYSTEMS

As regards the zone of occurrence, most frequent infestation with the isopods in North-West Africa shelf was observed in fishes of near-bottom waters of the coastal zone

Table 2

Probable origin of parasitic isopods in North-West Africa coast

Parasite	Thetyde	Pacific	Other
Aega deshayesiana		+	cosmopolitan
Anilocra capensis		+	
Anilocra frontalis	+		
Anilocra physodes	+		
Nerocila cephalotes	+		
Nerocila maculata	+		
Nerocila orbignyi	+		
Nerocila rhabdota	+		
Nerocila armata	+		
Lironeca sinuata	+		
Ceratothoa collaris	+		
Ceratothoa oestroides	+		
Ceratothoa parallela	+		
Ceratothoa steindachneri	+		
Ceratothoa italica	+		
Ceratothoa oxyrrhynchaena	+		
Cymothoa plebeia		+	
Cymothoa slusarskii			+
Irona trillesi			+
total	14	3	

Table 3

Distribution of parasitic Isopoda in North-West Africa coast. Biogeographic classification of the ocean according to Demel (1969), modified.

Zone / Subzone / Section / parasite	Arctic	Temperate			Tropical			Tempe-rate S	Antar-ctic
		atlantic		Pacific	atlantic		Indopa-cific		
		boreal	Mediter-ranean		eastern	western			
Aega deshayesiana			+	+	+	+	+	+	
Anilocra capensis					+		+	+	
Anilocra frontalis		+			+				
Anilocra physodes			+						
Nerocila cephalotes			+		+			+	
Nerocila maculata			+		+				
Nerocila orbignyi			+						
Nerocila rhabdota			+		+				
Nerocila armata					+	+			
Lironeca sinuata			+		+				
Ceratothoa collaris			+		+				
Ceratothoa oestroides			+		+	+			
Ceratothoa parallela			+						
Ceratothoa steindachneri			+						
Ceratothoa italica			+		+				
Ceratothoa oxyrrhynchaena			+	+	+		+		
Cymothoa plebeia					+		+		
Cymothoa slusarskii					+				
Irona trillesi					+				

(6 species), and bottom fishes (6 species). Isopods were less frequent in bathypelagic fishes (3 species of *Isopoda*), and pelagic fishes (3 species). Fishes in near-bottom and bottom waters led a more stationary life. Most of them were found in the shelf waters, especially upon shallow bottom near the shore. They were represented mostly by *Sparidae* and *Serranidae*. Also *Pleuronectiformes* fishes were found in shallow bottom waters. On the other hand, *Gadiformes* were found in deeper waters.

Higher percentage of infested fishes was found in shallow waters protected by headlands (Cap Blanc, Cap Timris), and in river estuaries (Gambia). The same was observed by Guthrie and Kroger (1974) in cause of *Brevoortia tyrannus* infested with an isopod *Olencira preagustator*. These authors suggested that infested fishes migrated from shelf waters to river estuary in order to regain strength, and that they mixed there with young fishes. Bruska (1981) suggested that specific physical properties of the estuaries could favour broader spreading of the isopods, so that fish infestation was generally higher. According to this author, wounded fishes are migrating to shallow waters to get well. It is possible that this was the reason for an erratic conclusion by Brian and Dartevelle (1949) that the isopods from the genus *Nerocila* parasitize mostly wounded fishes.

No parasitic isopoda were found in fishes of pelagic waters (oceanic zone) outside the North-West Africa shelf, and in canyons with Cayar near the mouth of Senegal River. As regards the whole *Isopoda* order, only species from the genus *Glossobius* were present in

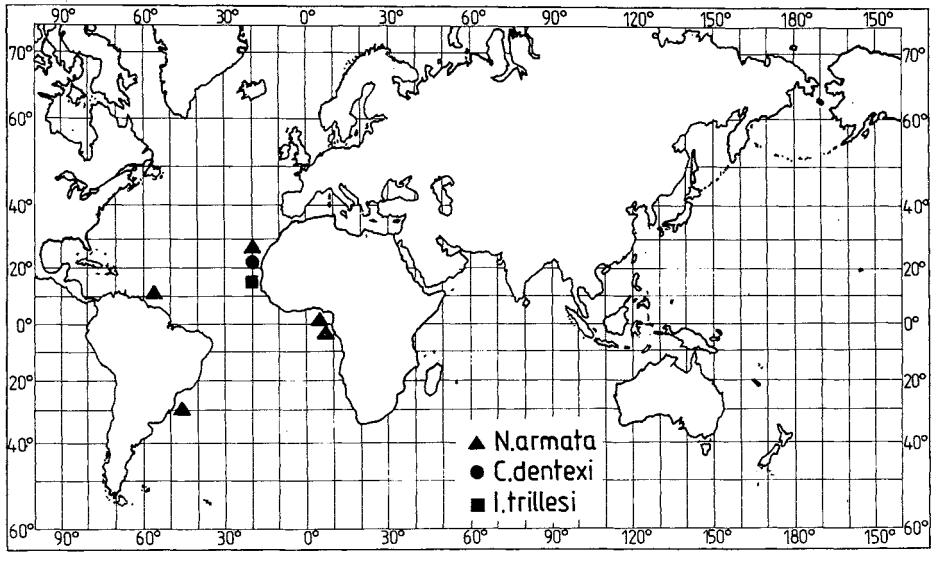


Fig.5. Distribution of Nerocila armata Dana, Cymothoa dentexi Rokicki and Irona trillesi Rokicki

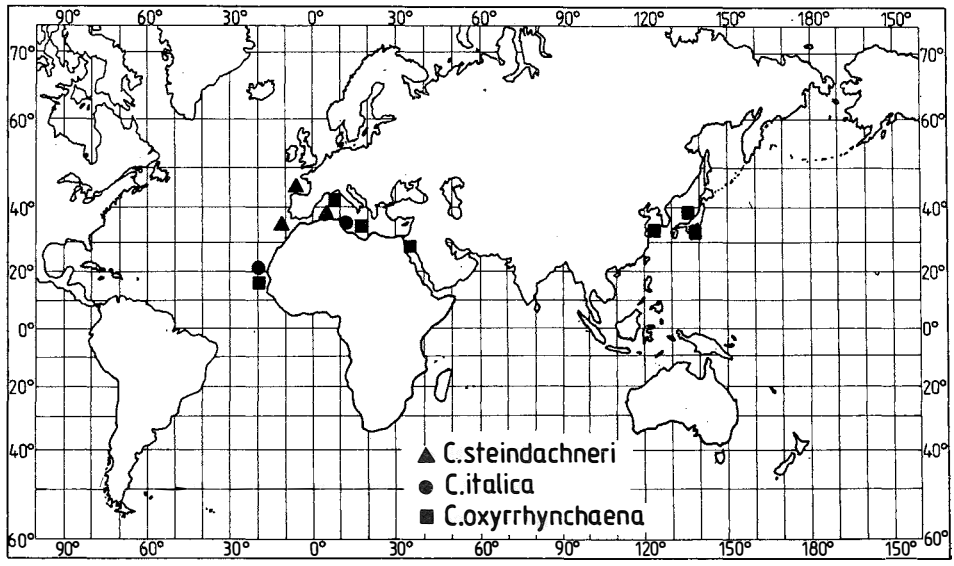


Fig.6. Distribution of Ceratothoa steindachneri Koelbel, C. italica Schioedte et Meinert and C. oxyrrhynchaena Koelbel

the pelagial of neritic and oceanic zone. This type of distribution might have resulted from the phylogenesis of *Isopoda*. In the Tertiary period, in Paleogen and Neogen, there was a rapid development of teleost fishes (main hosts of the isopods) thanks to the evolution of structure of particular systems. Consequently, the fishes were able to spread to different environments. I am of the opinion that parasitic isopods were not able to spread to ocean waters due to lack of proper adaptations, mainly as regards the reproduction, resembling those developed by the teleost fishes. Pelagic fishes lay thousands of light, floating eggs, so that their reproduction is assured notwithstanding many enemies. In an isopod marsupium there are only 300–600 eggs on the average. Moreover, pelagic fishes are excellent swimmers. *Isopoda*, being stationary parasites, have lost this ability. Their movements are restricted to crawling, or swimming at short distances in the male stage. For instance, *Cymothoidae* can swim only in the juvenile stage. *Aegidae* are essentially benthic forms. They leave the bottom to attach themselves to a swimming-by fish.

Totally, the parasitic isopods have lost the ability to swim, and did not develop a feature characteristic of pelagic fishes, i.e. laying of large numbers of eggs. It can be assumed that this is a reason for an almost total absence of *Isopoda* in open oceanic waters.

Some fish species undertake long periodic migrations, so that they assure less favourable conditions for the isopods than local shelf fishes. For instance, it is known

that *Thynnus thynnus, Scomber japonicus, Belone belone* and *Galeorhinus galeus* undertake long feeding migrations to waters more to the north. In these fishes no such interesting phenomenon was recorded as that observed in *Belone belone* from Pomeranian Gulf, which can be infested with some helmints upon distant feeding grounds in the North Sea (Grabda, 1981).

On the basis of the existing literature and the present studies it can be stated that from among the fishes in North-West Africa shelf, the most frequent infestation with the parasitic isopods was observed in species belonging to the families *Sparidae, Lutianidae, Serranidae, Trichiuridae* and *Bramidae*, i.e., in fishe living in near-bottom zones.

SPECIFICITY OF PARASITIC ISOPODS TOWARD THEIR HOSTS

Isopods of broad specificity are characterized by a distribution of potentially wider range than the species of narrow specificity. A list of host species in North-West Africa shelf is different for particular species of the isopod, from a long to a short one. This suggests different degree of relationships between parasites and fishes, and range of their occurrence. These relationships have been grouped into a few types and subtypes of specificity (Chabaud, 1957). On the basis of this classification, Trilles (1964) distinguished ecologic and neogenic specificity of *Cymothoidae* in the Mediterranean Sea. Ecologic specificity has a broad range, this being connected with feeding behaviour of the host, and possibility of infestation in natural conditions. Neogenic specificity is characterized by narrow range of the hosts and no plasticity. Classification presented by Trilles (1964) is not of an uniform character due to the fact that ecologic specificity has been based on definite mechanisms regulating mutual relationships between parasite and host, while neogenic specificity refers to historic development of the relationships between parasites and their hosts. In case of helmints, type of food consumed by the host in frequently the main factor determining the type of specificity, whereas in case of *Isopoda* ecological factors seem to be more important, especially the possibility of meeting between host and parasite. Physiologic aspect of specificity should also be taken into account. Physiologic specificity is considered as very important for some ectoparasitic hematophags (Piotrowski, 1963).

In the recent years attention was given to an opinion (Odening, 1974) that specificity can be discussed only as a result of interaction between ecological, physiological and phylogenetic factors, and not as an independent property of some genera. Hence, we can discuss only narrow specificity, when a complex of host species is restricted, and of broad specificity, when the hosts are represented by a variety of species.

In studying the parasitic isopods of the North-West Africa shelf attention has been given to the frequency of occurrence of the isopods in particular hosts, distinguishing the species occurring sporadically in these waters. It also seemed appropriate to give attention to the distribution in relation to the extent of specificity, basing on a community of *Isopoda* hosts.

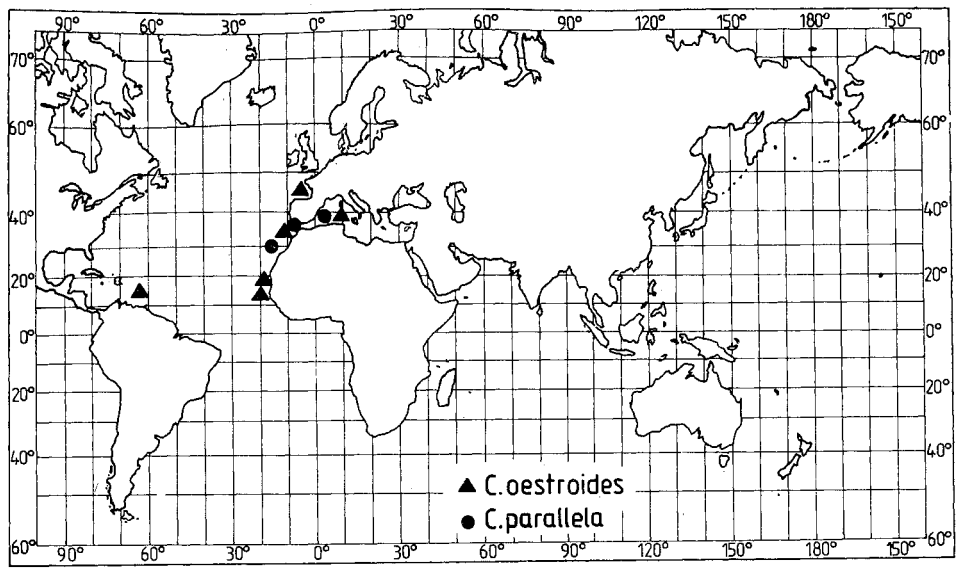


Fig.7. Distribution of Ceratothoa oestroides /Risso/ and C. parallela /Otto/

Aega deshayesiana was so far recorded in *Cetorhinidae* and an unknown species of shark (Tab. I). Since the species can easily leave the host, and there is no closer knowledge of the latter, it is difficult to determine type of specificity for this parasite.

Caratothoa italica in the Mediterranean Sea, and in North-West Africa shelf (where it was sporadic) was connected with fishes from the family *Sparidae*. According to Trilles (1964), this species is characterized by neogenic specificity.

Ceratothoa oestroides was rarely found in North-West Africa shelf, and only in 3 fish species (from the families *Sparidae, Maenidae* and *Pomacentridae*). Trilles (1968) determined specificity of this species in the Mediterranean Sea as an ecologic one. In these waters *C. ostreoides* occurs in various fish species.

Ceratothoa collaris was present in many fishes (Tab. IV) from the family *Sparidae*, and one species of *Scianidae*. Shoals of these fishes live in the same biotopes at least for part of the year, so that they mix partly. The parasite is characterized by considerable plasticity within *Sparidae* family, and even outside of it. Stronger infestation of some species, and weaker or even sporadic of other, would point to a certain narrowing of the host circle. Trilles and Raibaut (1971) stated single occurrence of this parasite at Tunis coasts in *Spicara sp., Smaris sp. (Maenidae)* and *Raja miraletus (Rajidae)*. It seems, however, that these hosts were accidental, whereas the proper ones are the fishes from *Sparidae* family. The most frequently infested fishes were *Dentex macrophthalmus, Pagrus pagrus*, and according to Monod (1924b), also young *D. filosus*. We deal here with broad specificity of narrowing circle of the hosts.

Table 4

Quantitative presentation of the isopods found in North-West Africa shelf

taxonomic group	number of species			
	totally	for which new host were found		new for North-West Africa shelf
		for science	for North-West Africa shelf	
Aegidae				
Aega	1	–	–	1
Cymothoidae				
Ceratothoa	6	5	5	–
Anilocra	3	–	–	–
Nerocila	5	9	9	1
Lironeca	1	–	–	–
Cymothoa	2	1	1	1
Irona	1	1	1	1

Ceratothoa steindachneri occurred sporadically in North-West Africa shelf. In other waters it was found in different fish species and families (Tab. 1). Its specificity is fairly broad.

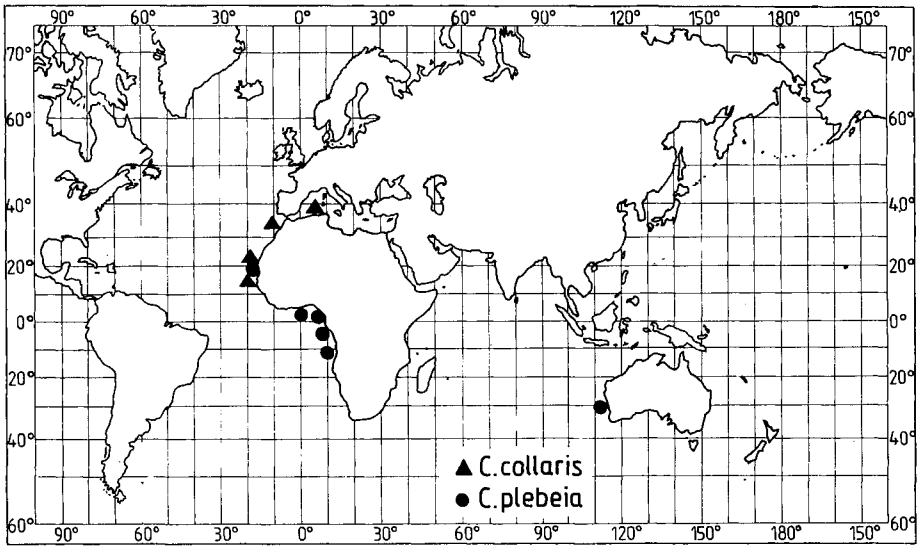


Fig.8. Distribution of Ceratothoa collaris Schioedte et Meinert and Cymothoa plebeia Schioedte et Meinert

Cerathoa oxyrrhynchaena was rare in North-West Africa shelf. This species preferred fishes from the families *Maenidae* and *Sparidae*. According to Trilles (1964) it shows features of an ecologic specificity (Tab. 1).

Anilocra capensis was present in different fishes, mostly belonging to *Sparidae*. This species was more frequent in *Dentex macrophthalmus* and *Morone punctatus (Serranidae)*. *Sparidae* in North-West Africa shelf occupy homologous biotopes for part of the season. In January *Dentex macrophthalmus* spawns at a depth of 160–250 m, in the region between Cap Barbas and Cap Timris (Ł. 14–25). At the same time *Cantharus lineatus* lives at depths of 100–185 m, at fishing grounds from S. Cap Bajador to Cap Blanc (Ł. 14–22). In March *Dentex macrophthalmus* spawns at depths of 120–350 m, between 18° and 22°N, while feeding *Dentex canariensis* concentrates at depths of 80–160 m. In May *D. macrophthalmus* forms feeding shoals, whereas spawners of *D. canariensis* move to overlapping regions and depth range. In these periods it becomes possible for *A. capensis* to enlarge its circle of hosts. *A. capensis* females parasitizing fishes produce numerous larvae which can swim actively, and thus are able to attach themselves to fishes in the same or near-by shoal. Both *Serranidae* and *Sparidae* are bottom fishes, and frequently inhabit the same biotopes, so that an exchange of their parasites may take place. *A. capensis* in representatives of different families suggests considerable plasticity of this parasite, and its broad specificity.

Anilocra physodes and *A.frontalis* were sporadic in North-West Africa shelf, the hosts of *A. frontalis* being unknown (Tab. 1). In the Mediterranean Sea *A. physodes* parasitized mostly *Sparidae* and *Centracanthidae*, having an ecologic specificity, whereas *A. frontalis* was a specific parasite of *Labridae* (Trilles, 1965). *Zeus faber (Zeidae)* is also on the long list of *A. physodes* hosts.

Lironeca sinuata, Nerocila maculata, N. armata, N. orbignyi and *Ceratothoa paralella* were very rare in the area under study. Their hosts are usually unknown, so it is not possible to determine specificity of these parasites. According to Brian and Dartevelle (1949), *Nerocila armata* at the height of Congo (Zair at present) was present mostly in *Carangidae*.

Nerocila rhabdota was characterized by a very differentiated range of host families. This would point to broad specificity of this parasite.

Nerocila cephalotes in North-West Africa shelf was found in different fishes, more frequently in *Trichiuridae (Trichiurus lepturus)* and *Bramidae (Brama raii)*. According to Monod (1924a), *N. cephalotes* was frequent in *Lutianidae (Diagrama mediterraneum)* and *Serranidae*, while Brian and Dartevelle (1949) found it in *Carangidae*. The parasite was collected from both fishes living in coastal and deep waters, in pelagic and near-bottom zones. This results from lack of specificity of this parasite, and its ability to swim for longer periods.

Cymothoa plebeia is specific for *Brachydeuterus auritus (Lutianidae)*, but was sporadically found also in *Otholithes dux (Sciaenidae)* and *Pagrosomus sp. (Sparidae)*.

Totally 19 species of parasitic *Isopoda* were analysed (Tab. 1), belonging to 6 genera of different specificity.

Frequently present species, in a way typical of North-West Africa shelf, can be divided into:

I. Species of low specificity. *Cymothoa plebeia* belongs to this group. Range of its distribution is limited to the environment of one host species. The parasite can be considered as phylogenetically older, and strict specificity can constitute an additional taxonomic feature.

II. Species parasitizing on a broad range of hosts. These are: *Ceratothoa collaris, Anilocra capensis, Nerocila cephalotes* and *N. rhabdota.* Range of their distribution is much broader than of group I, and the host environments are fairly differentiated. These parasites are phylogenetically younger, and they search their proper hosts.

ZOOGEOGRAPHY OF ISOPODA UNDER STUDY

Number of parasitic *Isopoda* present in North-West Africa shelf in the temperate zone amounts to 15, and is only slightly higher than the number noted in the tropical zone, the latter being 13.

When no attention is given to *Anilocra frontalis*, which occurred sporadically in the North Sea, there were no boreal species of *Isopoda* in the area under study. They were also not recorded in Arctic and Antarctic zones (Tab. III). According to Kusakin (1979), phylogenetically the oldest *Isopoda* are present in the tropical and subtropical fauna, boreal species are younger, whereas deep-water and Arctic ones are very young.

Table I presents a division of the ocean into 5 zones (according to Demel, 1969), some subzones and sections. North-West Africa shelf is situated partly in north temperate zone, and partly in tropical zone. Canary Islands are considered as the boarder-line (Demel, 1969). This biogeographic division can also be taken advantage of to divide the parasitic isopods of North-West Africa shelf into Mediterranean and tropical ones. The boarder of zoogeographic division between the transitional littoral zone and the tropical zone, given by Urbański (1962) as running at the height of Cap Blanc, is too far to the south for parasitic Isopoda.

Avdeev (1979) defined the Mediterranean zone of North-West Africa shelf as the North-West Africa region adjacent to the Mediterranean Sea. When the two water areas are joined together, no attention is given to noticeable specifics of the shelf. Such isopod species as *Nerocila armata, Cymothoa plebeia* and *Anilocra capensis* are not present in the Mediterranean Sea. These species are typically tropical ones, and most probably considerable decreases of water temperatures in the Mediterranean Sea prevent their spreading to this sea.

In North-West Africa shelf the most frequently found species were: *Cymothoa plebeia, Anilocra capensis, Nerocila cephalotes, Ceratothoa collaris* . These species are very rare or not present at all in the Mediterranean Sea (Figs. 2, 3, 8). On the other hand, species typical of the Mediterranean fauna (Trilles, 1968) were not present in the shelf, or were found sporadically. A question arises as to the possible reasons of this phenomenon. The

answer should be looked for in the past history of the Mediterranean Sea and North-West Africa coast. There are two possibilities: the antenats of contemporary parasitic *Isopoda* colonized the coast of West Africa coming from the Thetyde Sea, and finding suitable conditions developed rapidly into many species. The other possibility is that rich tropical fauna of the Mediterranean Sea disappeared during Pliocene and Pleistocene Periods as a result of glaciation.

Analyses of historical development of parasitic isopods in the area under study, and determination of the areas of this development and ways and directions of isopod expansion in relation to past geologic and geographic conditions, made it possible to distinguish the following groups of the isopods:

Atlantic species:

species present both in North-West Africa coast and the Mediterranean Sea;

species present both in North-West Africa coast and the Pacific and Indian Ocean.

Most isopods living at North-West Africa coast show relationship with the Mediterranean Sea (14 species). These are: *Aega deshayesiana, Anilocra physodes, Nerocila rhabdota, N. cephalotes, Ceratothoa italica, C. parallela, C. oxyrrhynchaena, C. collaris, Lironeca sinuata.* They were found both in the Mediterranean Sea and in North-West Africa coast (Figs. 1–4, 7–8). The same is true of *Anilocra frontalis, Nerocila maculata, N. orbignyi, Ceratothoa cestroides, C. steindachneri*, which occur also in cooler waters (Atlantic coast of Europe) (Figs. 2–4, 6–7). Distribution of Isopoda is connected with phylogenesis of their hosts, although Brusca (1981) is of the opinion that phylogensis of *Isopoda* hosts is too little known to draw more definite conclusions. Nevertheless, it is well noticeable that isopod species which are not present in the Mediterranean Sea parasitize mainly the fish species also not present in this sea. The isopods occurring in North-West Africa coast and in the Mediterranean Sea parasitized mainly fishes the geographic distribution of which embraced both these water areas.

Isopoda represent an old group of crustaceans, of considerable endemism (Avdeev, 1979). Hence, their distribution can be analysed taking into account the opinions on the history of geological changes on Earth (Tab. II).

Distribution of *Ceratothoa oxyrrhynchaena* (Fig. 6) can be related to the past of seas and oceans. The species was found in the Japanese Sea at China coasts, in the Mediterranean Sea, Red Sea, and in North-West Africa shelf. It seems that *C. oxyrrhynchaena* is connected with subtropical water zone. During Pleistocene glaciation the subtropical zone was displaced more to the south, and the species was characterized by a compact range of distribution. After glacial period and shifting of the subtropical zone, waters situated more to the north appeared suitable for development of this parasite, so that its distribution became disrupted. Since distribution of *Isopoda* in the Indian Ocean is not fully known as yet, it cannot be excluded that this species occurs also along the coasts af the Indian Ocean and Pacific.

Another explanation of the distribution of this species might be the fact that since Carboniferous period till late Tertiary period (over 200 million years), the Thetyde Sea extended parallel of latitude, from present coasts of Atlantic to present coasts of Pacific

(Łomniewski et al., 1974). Area of the present Mediterranean Sea, together with the adjascent areas, constituted part of the Thetyde Sea. Many common species were found for the Mediterranean Sea and the coasts of Japan (Bertin and Arambourg, 1958), in this a few species of fishes. Disrupted range of distribution of *Ceratothoa oxyrrhynchaena* reflects former continuity of the environment, and allows for reconstructing the history. Adopting this view it can be stated that when Thetyde was broken, distribution of *C. oxyrrhynchaena* was disrupted. Appearance of *C. oxyrrhynchaena* in North-West Africa shelf would be a secondary phenomenon then. However, it cannot be excluded that the parasite disappeared from the Mediterranean Sea during glacial period – in Pleistocene, and its recolonization went exactly from Atlantic. Avdeev (1982) presented another explanation to the distribution of *C. oxyrrhynchaena*. This author assumed that the species reached the Mediterranean Sea in modern times through Suez Canal, and then moved to North-West Africa shelf. This explanation, however, seems little probable. Occurrence of *C. oxyrrhynchaena* only in Suez Gulf suggests rather dispersion from the Mediterranean Sea in the direction of Red Sea, and not the other way around.

Composition of the parasitic isopod fauna at both sides of the Atlantic is totally different. Studies by Trilles (1973) on parasitic Cymothotidae of South America revealed their rich composition, but also the differences compared to east Atlantic. The ampphi – Atlantic specios are *Nerohia armata, Aega deshayesiana* and possibly also *Ceratothoa oestroides.* (Tab. III).

Collections of the Museum National d'Histoire Naturelle in Paris (Trilles, 1972) contain one specimen of *Ceratothoa oestroides* from Guadelupe region (Small Antilles), but this might have been a mistake. Parasitic isopod fauna of South America, similarly as that of Atlantic coasts of Europe and Africa, originates from Thetyde, as pointed out by Szidat (1944, 1955). Division between South and North America and Africa began about 180 million years ago, and the process ended about 65 million years ago. Bruska (1981) is of the opinion that many species and genera developed at that time at Atlantic coasts of South America as a result of a variety of dispersion phenomena. According to an analysis by this author, *Nerocilla* and the related genera constitute the most primitive taxa of this family. Consequently, although both sides of the Atlantic are very similar as regards the hydrobiological conditions, the evolution went differently and led to different results.

Cymothoa plebeia, Aega deshayesiana and *Anilocra capensis* occur in the Malaya-Australian region, and in West Africa coast. Taking into consideration the theory of continent driffting, and later formation of Atlantic compared to Pacific, these species would be of Pacific origin (Tab. II). Distribution of these isopods suggests their dispersion from South Africa.

Isopods of North-West Africa shelf, similarly as other parasitic crustaceans, can disperse actively and passively. Their dispersion stages float with the Canary and Guinea Currents, to the equator. They can also move at short distances, swimming actively. Passive dispersion consists of their transfer by hosts and other animals living in their vicinity.

Broad specificity characteristic of most isopods under study theoretically should facilitate expansion of the parasites (see specificity). There are, however, many obstacles preventing broader distribution of *Isopoda*. Avdeev (1979) mentioned the following barriers to isopod expansion: water depth, too low or too high temperature, meridional location of penisulas an islands.

Formation of Atlantic about 200 million years ago, and of a connection with Thetyde Sea, created favourable conditions for isopod expansion to the shelves of Europe and Africa. Since then the process of isopod fauna formation has continued at West Africa coasts. The species differentiated, especially abundantly in the tropical zone. Notwithstanding this, number of endemic forms in West Africa coast is very low. This suggests weak rate of Isopoda evolution in East Atlantic, and can result from the fact that most genera of *Isopoda* developed (according to Brusca. 1981) during sea radiation of Thetyde, at the turn of Permian and Trias periods. Later on there was no geographic isolation between West Africa coast and the Mediterranean Sea.

Table 5

List of North-West Africa shelf fishes under study

no.	family	species	individuals	Isopoda present
1	2	3	4	5
1.	*Lamnidae*	*Alopias vulpinus* (Bonnaterre, 1788)	5	–
2.	*Carcharhinidae*	*Prionace glauca* (L., 1758)	400	–
		Galeorhinus galeus (L., 1758)	11	–
3.	*Sphyrnidae*	*Sphyrna zygaena* (L., 1758)	18	–
4.	*Isuridae*	*Lamna nasus* (Bonnaterre, 1788)	15	–
5.	*Rajidae*	*Raja clavata* (L., 1758)	5	–
6.	*Mobulidae*	*Manta birostris* (Walbaum, 1792)	3	–
7.	*Elopidae*	*Elops lacerta* (Valenciennes, 1846)	2	–
8.	*Clupeidae*	*Sardinella aurita* (Valenciennes, 1847)	134	(+)
		Sardina pilchardus (Walbaum, 1792)	1673	(+)
		Sardinella eba (Valenciennes, 1847) [syn. *Sardinella granigera* (Valenciennes, 1847)]	1600	(+)
		Ethmalosa fimbriata (Bowdich, 1825)	170	–
9.	*Exocoetidae*	*Exocoetus volitans* L., 1758	4	–
10.	*Belonidae*	*Belone belone* (L., 1758)	1	+
11.	*Lampididae*	*Lampris guttatus* (Brünnich, 1788) [syn. *Lampris regius* (Bonnaterre, 1788)]	2	–
12.	*Sphyraenidae*	*Sphyraena barracuda* (Walbaum, 1792)	5	–
13.	*Polynemidae*	*Galeoides decadactylus* (Bloch, 1795)	12	–
14.	*Bramidae*	*Brama brama* (Bonnaterre, 1788)	2150	+

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1	2	3	4	5
15.	*Serranidae*	*Dicentrarchus labrax* L. 1758	15	+
16.	*Pomadasyidae*	*Brachydeuterus auritus* (Valenciennes, 1831)	3132	+
		Pomadasys peroteti (Cuvier, 1830)	150	–
		Pomadasys jubelini (Valenciennes, 1830)	58	–
17.	*Carangidae*	*Trachurus trachurus* (L., 1758)	204	(+)
		Caranx rhonchus (G. Saint-Hilare, 1809)	240	(+)
		[syn. *Lichia vadigo* (Risso, 1810)	41	–
		Lichia glauca (L., 1758)]	41	–
		Lichia amia (L., 1758)	10	–
		Chloroscombrus chrysurus (L., 1766)	62	(+)
18.	*Pomatomidae*	*Pomatomus saltator* (L., 1766)	143	+
19.	*Sparidae*	*Spondyliosoma cantharus* (L., 1758)	14	+
		Sparus aurata L., 1758	284	+
		Dentex macrophthalmus (Bloch, 1791)	803	+
		Dentex canariensis Steindachner, 1881	14	+
		Dentex gibbosus (Rafinesque, 1810)	2	+
		[syn. *Dentex filosus* (Valenciennes, 1843)]		
		Boops boops (L., 1758)	1360	–
		Pagrus pagrus (L., 1758)	47	+
		Pagrus ehrenbergi (Valenciennes, 1830)	131	–
		Diplodus vulgaris (G. Saint-Hilaire, 1817)	7	–
		Diplodus trifasciatus (Rafinesque, 1810)	10	–
		[syn. *Diplodus cervinus* (Lowe, 1841)]		
20.	*Scombridae*	*Scomber japonicus* (Houttuyn, 1782)	92	(+)
		Orcynopsis unicolor (G. Saint–Hilaire, 1817)	92	–
		Acantocybium solandri (Guvier, 1832)	30	–
		Sarda sarda (Bloch, 1793)	23	–
		Scomberomorus maculatus (Mitchill, 1815)	80	–
21.	*Thunnidae*	*Thunnus albacores* (Bonnatere, 1788)	135	–
		[syn. *Neothunnus albacores* (Lowe, 1839)]		
		Thunnus obesus (Lowe, 1839)	35	–
		Katsuwonus pelamis (L., 1758)	15	–
		Auxis thazard (Lacépède, 1802)	15	–
		Thunnus alalunga (Bonnaterre, 1788)	135	–
		[syn. *Germo alalunga* (Bonnaterre, 1788)]		
22.	*Xiphiidae*	*Xiphias gladius* (L., 1758)	35	–
23.	*Istiophoridae*	*Tetrapterus albidus* Poey, 1860	30	–
		Makaira nigricans Lacépède, 1802	28	–
24.	*Trichiuridae*	*Trichiurus lepturus* (L., 1758)	241	+
25.	*Stromateidae*	*Stromateus fiatola* (L., 1758)	100	(+)

cd. tabeli 5

1	2	3	4	5
26.	*Echeneidae*	*Echeneis naucrates* (L., 1758)	2	–
27.	*Ariidae*	*Thachysurus gambensis* (Bowdich, 1825)	24	–
28.	*Scorpaenidae*	*Scorpaena scrofa* (L., 1758)	1	–
29.	*Cynoglossidae*	*Cynoglossus sp.*	2	+
30.	*Tetraodontidae*	*Lagocophalus laevigatus* (L., 1758)	2	+
31.	*Lophiidae*	*Lophius piscatorius* (L., 1758)	3	+

Legend: + Isopoda *present*; (+) doubtful host; – no *Isopoda*.

CONCLUSIONS

1. Occurrence of parasitic *Isopoda* in North-West Africa shelf is connected with biology of this group of animals, and biology of the hosts, and is reflected in a type of parasite-host relationship.

a. Isopods of North-West Africa shelf usually parasitize more than one fish species, so that they have more possibilities of expansion and widening of the distribution range than more specialized species (*Cymothos plebeia*), restricted to one host species only.

b. Free-living juvenile stages of the isopods participate to a different extent in the parasite dispersion.

c. Vertical distribution of the isopods in North-West Africa shelf is connected with the ecology of their hosts.

2. Present geographic distribution of the parasitic *Isopoda* under study is explained by their past development, past changes on Earth, and barriers limiting expansion of the species.

3. Occurrence of particular *Isopoda* species in different water areas (see zoogeographic maps) and in particular fish species can constitute a practical index.

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PASOŻYTNICZE ISOPODA RYB SZELFU PÓŁNOCNO-ZACHODNIEJ AFRYKI

Streszczenie

Niniejsza praca obejmuje obszar wód szelfu północno-zachodniej Afryki (por. Mapa). Jest ona szerokim i szczegółowym spojrzeniem na występowanie pasożytniczych Isopoda w badanym regionie wodnym i związków ich z biologią żywicieli. Rozprzestrzenienie Isopoda oparte jest na fakcie związków pasożyt-żywiciel, trwalszych lub luźniejszych, wywołujących różnego rodzaju zmiany adaptacyjne, specyficzności wąskiej lub szerokiej, trwających z reguły przez większy okres życia równonogów. Na tym tle o rozprzestrzenieniu Isopoda możemy mówić w oparciu o znajomość występowania ryb-żywicieli w poszczególnych warstwach wód, podziale ryb na stacjonarne, wędrowne i odbywające wędrówki okresowe. Obraz rozprzestrzenienia geograficznego badanych Isopoda wynika ze stwierdzeń innych autorów. W obecnej pracy podjęto próbę interpretacji takiego rozprzestrzenienia, dróg rozsiedlenia wynikłych z głównych rejonów ich występowania, przemian geologicznych w przeszłości Ziemi i barier uniemożliwiających ekspansję gatunków.

Spojrzenie na literaturę dotyczącą biologii pasożytniczych Isopoda szelfu pn.-zach. Afryki pozwala stwierdzić, że jest ona niezwykle skąpa, mimo że egzemplarze z tego regionu trafiały się w kolekcjach prywatnych, bądź muzeach i były opracowywane już w ubiegłym wieku (por. wprowadzenie).

Rozprzestrzenienie pasożytniczych Isopoda związane jest w znacznym stopniu z ekologią swych żywicieli. Na szelfie pn.-zach. Afryki najczęściej zarażone są równonogami ryby wód przybrzeżnych strefy przydennej (6 gatunkami) i dennej (6 gatunkami). Rzadziej spotyka się te pasożyty u ryb batypelagicznych (3 gatunkami) i pelagicznych (4 gatunkami). Spośród ryb częściej zarażone są gatunki z rodzin: Sparidae, Lutianidae, Serranidae, Trichiuridae i Bramidae. Są to rodziny ryb przydennych. Pozbawione pasożytniczych Isopoda okazały się ryby zasiedlające wody pelagialu (strefa oceaniczna), poza szelfem pn.-zach. Afryki oraz kaniony z Cayar znajdującym się w pobliżu rzeki Senegal.

W badaniach nad Isopoda szelfu pn.-zach. Afryki zwróciłem uwagę na częstość występowania pasożytów u poszczególnych żywicieli, wyodrębniając gatunki stwierdzone sporadycznie w tym obszarze wodnym. Gatunki często spotykane, niejako typowe dla szelfu pn.-zach. Afryki można podzielić na: 1 . Gatunki o wąskiej specyficzności. Należy tu Cymothoa plebeia. 2. Gatunki o szerokim wachlarzu żywicielskim. Zaliczyć można tu: Ceratothoa collaris, Anilocra capensis, Nerocila cephalotes i N. rhabdota.

Liczba gatunków pasożytniczych Isopoda szelfu pn.-zach. Afryki występujących w krainie umiarkowanej (15) nieznacznie przewyższa liczbę gatunków notowanych w krainie tropikalnej (13). Gatunków borealnych, nie licząc sporadycznego występowania Anilocra frontalis w Morzu Północnym, zupełnie brak, jak również nie stwierdzono ich w krainach: arktycznej i antarktycznej (Tabl. 1). W rozważaniach nad historycznym kształtowaniem się isopodofauny pasożytniczej ryb badanego obszaru, nad poszukiwaniem ośrodków ich powstania oraz dróg i kierunków ekspansji uzależnionych od minionych warunków geologicznych i geograficznych danego regionu, nasuwa się podział Isopoda na: gatunki atlantyckie; gatunki występujące równocześnie u wybrzeży pn.-zach. Afryki i w Morzu Śródziemnym; gatunki występujące równocześnie u wybrzeży pn.-zach. Afryki, w Pacyfiku i O. Indyjskim. Najwięcej równonogów batujących u wybrzeży pn.-zach. Afryki wykazuje związek z M. Śródziemnym (14 gatunków). Należy do nich: Aega deshayesiana, Anilocra physodes, Nerocila rhabdota, N. cephalotes, Ceratothoa italica, C. parallela, C. oxyrrhynchaena, C. collaris, Lironeca sinuata. Notowane są one w M. Śródziemnym i u wybrzeży pn.-zach. Afryki (Ryc. 1–4, 7–8). Podobnie Anilocra frontalis, Nerocila maculata, N. orbignyi, Ceratothoa oestroides, C. steindachneri wykazujące poza tym zasięg występowania rozszerzony o wody chłodniejsze (atlantyckie wybrzeże Europy), (Ryc. 2–4, 6–7). Powstanie około 200 mln lat temu Atlantyku i utworzenie połączenia z Morzem Tetydy stworzyło warunki ekspansji równonogom na nowe obszary szelfów Europy i Afryki. Od tej chwili do czasów obecnych trwa proces formowania się isopodofauny wybrzeży zachodniej Afryki.

Ежи Рокицки

БИОЛОГИЯ ВЗРОСЛЫХ ISOPODA (CRUSTACEA) ПАРАЗИТОВ РЫБ ШЕЛЬФА СЕВЕРО-ЗАПАДНОЙ АФРИКИ

Резюме

Настоящая работа охватывает территории вод шельфа северозападной Африки (ср. Карта). Она явля-

ется широким и подробным взглядом на присутствие паразитных **Isopoda** в исследуемом водном районе и их связей с биологией хозяев. Распространение опирается на факте связей паразит хозяин, более прочных или более свободных, вызывающих различного рода адаптационные изменения, специфики узкой или широкой, продолжающейся как правило больший период жизни равноногих ракообразных. На этом фоне о распространении Isopoda можем говорить опираясь на знаниях присутствия рыб-хозяев в отдельных слоях вод, подразделении рыб на постоянные, мигрирующие и совершающие периодические миграции. Картина географического распространения исследуемых Isopoda вытекает из констатации других авторов. В настоящей работе предпринята попытка собственного толкования такого распространения, путей расселения вытекших из главных районов их присутствия, геологических изменений в прошлом Земли и барьеров затрудняющих экспансию видов.

Взгляд на литературу касающуюся паразитных Isopoda шельфа сев.-зап. Африки разрешает утверждать, что она чрезвычайно скупая, несмотря на то, что экземпляры из этого района попадались в частных коллекциях или музеях и были разработаны уже в прошлом столетии.

Распространение паразитных Isopoda в значительной степени связано экологией своих хозяев. В шельфе сев.-зап. Африки чаще всего заражены рыбы прибрежных вод придонной зоны (6 видами) и донной (6 видами). Реже встречаются эти паразиты у рыб батипелагических (3 видами) и пелагических (4

видами). Среди рыб чаще всего заражены виды из семей: Sparidae, Lutianidae, Serranidae, Trichiuridae и Bramidae. Это семьи придонных рыб. Лишены паразитных Isopoda оказались рыбы поселившиеся в водах пелагиала (океаническая зона), вне шельфа сев.-зап. Африки, а также каньоны из Каяр находящиеся вблизи реки Сенегал.

В исследованиях Isopoda шельфа сев.-зап. Африки я обратил внимание на частоту присутствия паразитов у отдельных хозяев, выделяя виды, установлены спорадически в этом водном районе. Виды часто встречаемые, как будто бы типичные для шельфа сев.-зап. Африки можно разделить на: 1. Виды с узкой специфичностью. Принадлежит здесь: Cymothoa plebeia. 2. Виды с широкими питательными возможностями. Сюда отнести можно: Ceratothoa collaris, Anilocra capensis, Nerocila cephalotes N. rhabdota.

Количество паразитных видов Isopoda шельфа сев.-зап. Африки присутствующих в умеренном регионе (15) немного превышает количество видов отмеченных в тропическом регионе (13). Бореальные виды, не учитывая спорадического присутствия Anilocra frontalis в Северном Море, вообще отсутствуют, как тоже не были они установлены в регионах: арктическом и антарктическом (табл.1). В рассуждениях о историческом образовании паразитной фауны рыб исследуемого района, поисков центров их возникновения, путей и направлений экспансий, зависящих от прошлых геологических и географических

условий данного района, возникает разделение Isopoda на: атлантические виды; виды выступающие одновременно у побережья сев.-зап. Африки и Средиземного моря; виды выступающие одновременно у побережья сев.-зап Африки, в Тихом океане и Индийском океане. Самое большое число равноногих ракообразных бытовавших у побережья сев.-зап. Африки проявляет связь с Средиземным морем (14 видов). К ним принадлежит: Aega deshayesiana , Anilocra physodes, Nerocila rhabdota, N.cephalotes, Ceratothoa italica, C.parallela, C.oxyrrhynchaena, C. collaris, Lironeca sinuata.

Они отмечаются в Средиземном море и у побережья сев.-зап. Африки (Рис. 1-4, 7-8). Подобным образом Anilocra frontalis, Nerocila maculata, N.orbignyi, Ceratothoa oestroides, C. steindachneri проявляющие кроме того дальность присутствия расширенной прохладнейшими видами (атлантическое побережье Европы); (Рис. 2-4, 6-7).Возникновение около 200 млн лет тому назад Атлантики и образование соединения с морем Тетиды создало условия экспансии равноногих ракообразных на новые территории шельфов Европы и Африки. С этого момента до настоящего времени продолжается процесс формирования фауны Isopoda побережья Западной Африки.

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