

Jadwiga GRABDA, Ibrahim Abdel Fattah Mahmoud SOLIMAN

Parasitology

**COPEPODS - PARASITES OF THE GENUS *MERLUCCIUS*
FROM THE ATLANTIC OCEAN AND MEDITERRANEAN SEA**

**PASOŻYTNICZE WIDŁONOĞI RYB RODZAJU *MERLUCCIUS*
Z OCEANU ATLANTYCKIEGO I MORZA ŚRÓDZIEMNEGO**

Institute of Ichthyology

3 species of parasitic copepods were found on Atlantic hakes caught off the western coasts of Europe, Africa, the Mediterranean Sea (off Alexandria), and North America. The species are: *Chondracanthus merluccii*, *Brachiella merluccii* and *Parabrachiella australis*.

The parasites importance as indicators of the affinities between hakes is discussed. Various hypotheses concerning the origin of the genus *Merluccius* are presented.

INTRODUCTION

Studies on parasites as biological indicators of their host's population status, affinities, migrations, origin and zoogeographic distribution are a valuable method to explain many problems of biology of fish. The parasitic species of a narrow specificity are particularly interesting as indicators. The parasitic copepods of the genera *Chondracanthus*, *Brachiella* and *Parabrachiella* appear to play such a role in hake.

During the investigations on species variability within the genus *Merluccius* from the Atlantic and Mediterranean Sea (Soliman, 1973), the parasitic copepods were collected in order to utilize them as possible indicators of specific affiliations and affinities between the hakes investigated.

MATERIALS AND METHOD

The parasites were collected in 1971–1973 from mouth and gill cavities of the fishes examined.

Table 1 and the chart enclosed (Fig. 1) summarize number of fishes examined, fishing grounds and catching time of particular hake stocks.

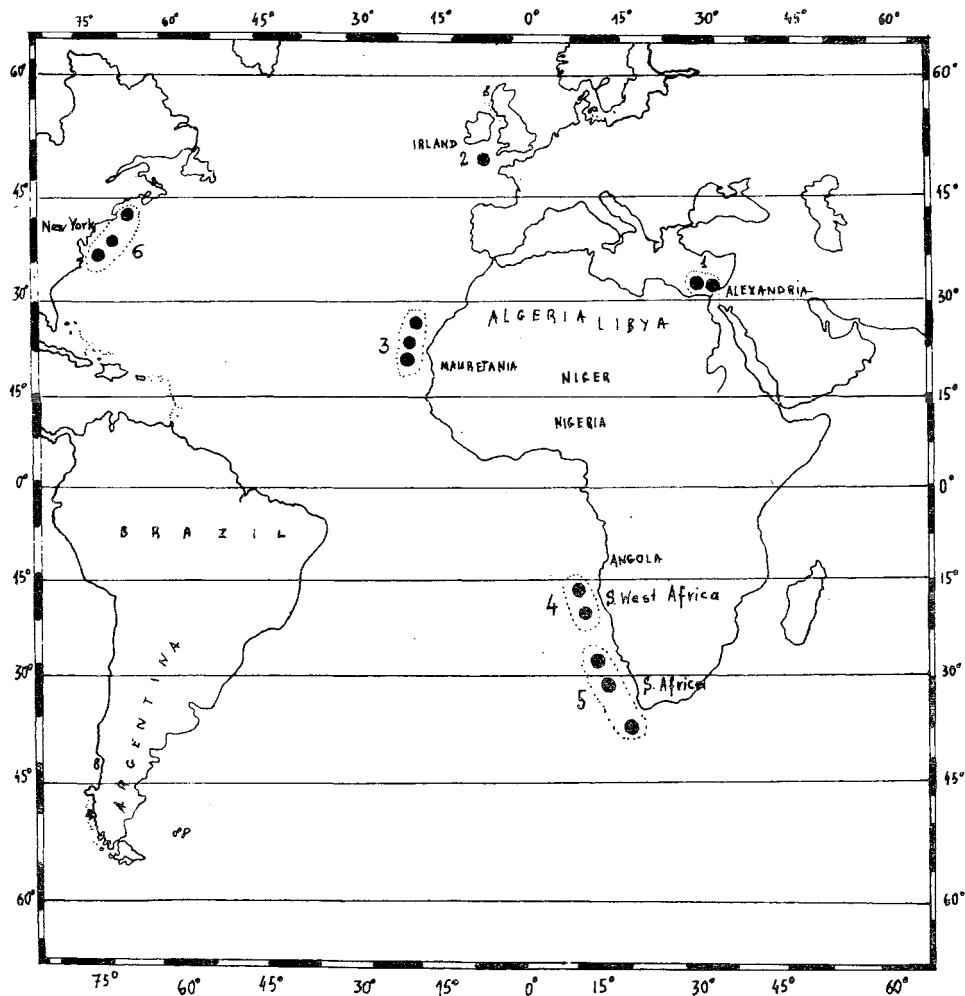


Fig. 1. Locations and number of samples of: 1. *Merluccius merluccius mediterraneus*; 2. *M. m. atlanticus*; 3. *M. m. senegalensis*; 4. *M. m. capensis*; 5. *M. m. paradoxus*; 6. *M. bilinearis* (from Soliman, 1973)

As a whole, 3 following parasitic copepod species were found:

1. *Chondracanthus merluccii* (Holten, 1802) Kröyer, 1837;
2. *Brachiella merluccii* Bassett-Smith, 1896;
3. *Parabrachiella australis* Wilson, 1923.

All the species are specific for the genus *Merluccius*. The degrees of infestation in particular hake populations are presented in Table 2.

Table 1

List of examined species of *Merluccius*

Species of fish	Date of fishing	Fishing ground	Number of fishes examined
<i>M.m. mediterraneus</i>	XI–XII 1972	Mediterranean Sea, Alexandria	85
<i>M.m. atlanticus</i>	III 1971	N.E. Atlantic, South Ireland	20
<i>M.m. senegalensis</i>	VIII 1971	Mauretania 21°55'N, 17°22'W	111
	XI 1971	19°00'N, 16°42'W	79
<i>M.m. capensis</i>	III 1972	S.E. Atlantic, Angola 16°46'S, 11°23'E	146
	III 1972	S.W. Africa	28
<i>M.m. paradoxus</i>	III 1972 I 1973	S. Africa	133
<i>M. bilinearis</i>	IV 1971	N.W. Atlantic 38°00'N, 74°20'W	52
	IX 1971	42°00'N, 67°11'W	125

Table 2

Incidence and intensity of the infestation of parasitic copepods on the examined species of *Merluccius*

Species of fish	Species of parasite	Fishing ground	<i>Chondracanthus merluccii</i>		<i>Brachiella merluccii</i>		<i>Parabrachiella australis</i>	
			Icid. Intens.	Locali- sation	Icid. Intens.	Locali- sation	Icid. Intens.	Locali- sation
1		2	3	4	5	6	7	8
<i>M.m. mediterraneus</i>		Alexandria	$\frac{5.9\%}{1-6}$	upper and lower jaw	$\frac{5.9\%}{1}$	gill rakers	—	—
<i>M.m. atlanticus</i>		South Ireland	—	—	$\frac{10\%}{1-3}$	—	—	—
<i>M.m. senegalensis</i>		Mauretania	$\frac{27.02\%}{1-5}$	upper jaw	—	—	—	—
		—	$\frac{22.8\%}{1-4}$	—	—	—	—	—

	1	2	3	4	5	6	7	8
<i>M.m. capensis</i>		Angola	$\frac{0,68\%}{1}$	gill filaments	$\frac{2,7\%}{1}$	gill rakers	$\frac{10,9\%}{1-7}$	gill filaments
		S.W. Africa	$\frac{17,1\%}{1}$	upper jaw	—	—	—	—
<i>M.m. paradoxus</i>		S. Africa	—	—	—	—	—	—
<i>M. bilinearis</i>		N. W. Atlantic	$\frac{7,2\%}{1}$	upper and lower jaw	—	—	—	—
		"	$\frac{3,9\%}{4-3}$	upper jaw	—	—	—	—

Both the incidence and intensity of invasion are determined from numbers of females encountered since the dwarf males of these species usually live attached to females and rather easily fall away.

DESCRIPTION OF PARASITES FOUND

Chondracanthus merluccii (Holten, 1802)

(*Chondracanthidae*, *Chondracanthinae*). The parasites occur in the mouth cavity of fish, attached to upper and lower jaws posteriorly behind the teeth; exceptionally they are encountered in the gill cavity. Dwarf males are attached to ventral side of females near the genito-abdomen (Fig. 2, a,b).

The species occurs typically in the Atlantic hakes. Holten (1802) described it in *Merluccius ssp.* from the Atlantic and Mediterranean. According to Yamaguti (1963), the species was recorded also on *Merluccius hubbsi* in Brasil by Paiva Carvalho (1951) and on *M. capensis* in Angola by Nunes-Ruivo (1936). Recently Ho (1971, 1974) has noted its occurrence on *M. bilinearis*, *M. merluccius* and *M. capensis*, while Evdokimowa (1974) on *M. hubbsi* from Argentine.

A record of *Ch. merluccii* on *Gadus luscus*, given by Leigh-Sharpe (1934) in Plymouth (after Yamaguti, 1963) seems to be an exceptional case.

Our own material originates from *M.m. mediterraneus* (10♀, 8♂), *M.m. senegalensis* (72♀, 68♂), *M.m. capensis* (4♀; 3♂), and *M. bilinearis* (16♀, 11♂). As a whole, 102 females and 90 males were found.

The species discussed occurred most frequently on the Atlantic hakes examined. Only *M.m. atlanticus* was free from this parasite, but a small number of fishes of this subspecies available to examination could possibly account for that (Table 1).

M.m. senegalensis off the Mauretania coasts show the strongest infestation, while the parasite seems to withdraw from *M.m. capensis*.

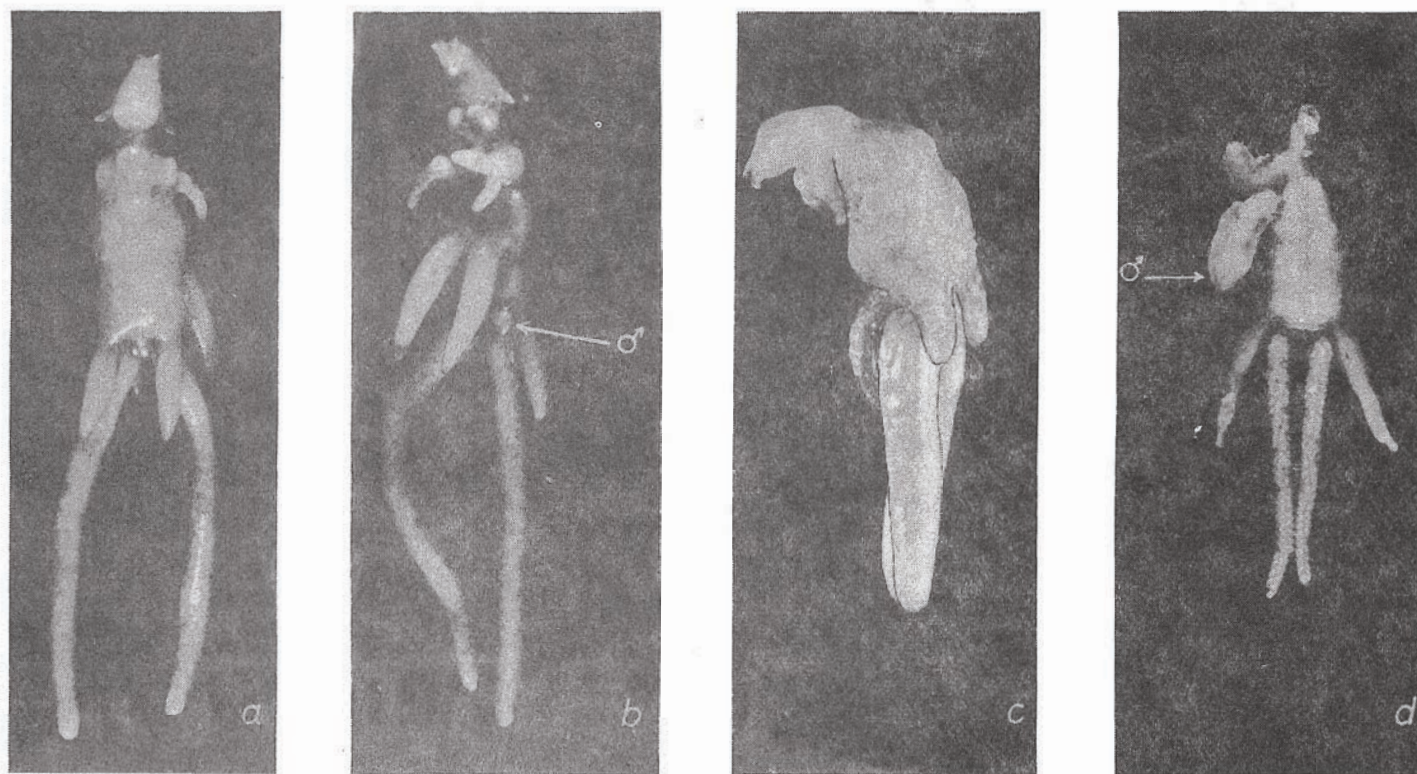


Fig. 2. Parasitic copepods of *Merluccius*: a, b. *Chondracanthus merluccii*; c. *Brachiella merluccii*; d. *Parabrachiella australis*

Brachiella merluccii Basset-Smith, 1896

(*Lernaeopodidae*, *Clavellinae*). The parasite occurs on the hake gill attached to tops of gill rakers (Fig. 2,c).

B. merluccii is specific for the East Atlantic hakes. Basset-Smith described it from *Gadus merluccius* (= *Merluccius merluccius*) off Plymouth, while Brian (1906) found it in the Mediterranean Sea and Nunes-Ruivo (1956) off Angola. Ho (1974) considers the species to be typical of *M. merluccius* and *M. capensis*.

Kirtisinghe (1964) exceptionally found *B. merluccii* on *Johnius diacanthus* (Lac.) from Pearl Banks off Ceylon.

Our own materials were collected from *M.m. mediterraneus* (5♀), *M.m. atlanticus* (3♀), and *M.m. capensis* (4♀). As a whole, 12 specimens of *B. merluccii* were taken. All the specimens were mature females with egg sacs. No male was encountered (Table 2).

Too small number of individuals found does not allow to conclude on variability of the species, but a great size diversity is striking. Specimens from *M.m. atlanticus* were at least twice as large as those from *M.m. capensis*. The latter exhibited also the smallest degree of infestation indicating to a tendency of losing *B. merluccii* as it was the case in *Chondracanthus merluccii*.

All the specimens were found on tops of gill rakers which are their characteristic locality indicated by Basset-Smith in his original species description.

Parabrachiella australis Wilson, 1923

(*Lernaeopodidae*, *Clavellinae*). The species is typical of *M.m. capensis*; Wilson described it from Cape Colony. The male is usually found attached dorsally to a female thorax. The parasites live on fish gill filaments (Fig. 2,d).

According to Kabata (1970), the genus *Parabrachiella* as created by Wilson (1915) is invalid, consequently the species *P. australis* should be transferred to the genus *Brachiella* as *Brachiella australis* (Wilson, 1923) Kabata, 1970. The decision, however, needs further detailed morphological studies; thus in the present paper the original name given by the author of the species is maintained.

Our own materials come from *M.m. capensis* caught off the Angola coasts. As a whole, 40 females and 18 males were encountered (Table 2).

Out of the three parasitic copepod species found on *M.m. capensis*, *P. australis* plays a dominating part.

DISCUSSION

Soliman (1973), basing on detailed biometric and osteologic analyses concluded, as some authors previously did, that the genus *Merluccius* inhabiting the East Atlantic from the European coasts to the South Africa splits into different local populations, i.e., geographic races of at most subspecies level. He distinguishes between *M.m. atlanticus*, *M.m. mediterraneus*, *M.m. senegalensis*, *M.m. capensis*, and *M.m. paradoxus*.

Greater differences on the specific level, particularly those in skull and otoliths enable us to regard *M.bilinearis* as a separate species.

Although the parasitologic material collected is too scarce to allow a firm generalization, it seems to confirm Soliman's conclusions. Such highly selective species as *Chondracanthus merluccii* occurs in mouth cavities of hake from both the West (*M.bilinearis*, *M.hubbsi*) and East Atlantic (*M.m.mediterraneus*, *M.m.senegalensis*, and *M.m.capensis*). Close affinities between the Atlantic hakes and their origin from a common stem are thus evidenced.

No individuals of *Ch.merluccii* were found on *M.m.paradoxus*, the southernmost subspecies which was free from other parasitic copepods too. On the other hand, the Atlantic hakes specific differentiation is reflected in the remaining copepods.

The West-Atlantic hakes from both the northern and southern hemispheres contain *Brachiella lageniformis* (Szidat, 1955, 1956; Ho, 1974), while *B.merluccii* was found on the East Atlantic hakes, the parasite tending to disappear, as mentioned above, southwards. The dominant species on *M.m.capensis* is *Parabrachiella australis* indicating to the most distinct character of the subspecies, not evidenced, however, by morphometric examination.

Extremely different hypotheses emerged when attempts were made to use parasitic indicators to explain the origin and evolution of the genus *Merluccius*.

According to Svetovidov (1948), *Gadidae* including the genus *Merluccius* appeared during the Oligocene in the Pontic basin, a remnant of the former Tethys Sea, later on spreading southwards along the African coasts of the Atlantic Ocean. The oldest fossils of the gadids from the middle Oligocene found in the central Europe and Caucasus confirm this statement.

Evdokimova (1974) supports Svetovidov's hypothesis. The author found *Ch.merluccii*, the species typical of the European and African hakes, in the Argentine hake, what in her opinion is as evidence of a close affinity between the hakes as well as the origin of *M.hubbsi* from the South-African species, since the hakes spread southwards along the African coasts.

Evdokimova states that the whole parasitic fauna of the Argentine hake, the typical species included, is relatively poor; she ascribes this fact to the distance from the centre of hake origin.

Szidat (1955, 1956), basing on the parasitic fauna of *M.hubbsi* (the parasitic copepods included) suggests the North Pacific as the home habitat for the genus *Merluccius* and *M.productus* as the form most closely resembling the ancestor. The hake evolution in his opinion proceeded along two paths: one running along the western coasts of North and South America to the Atlantic with *M.hubbsi* emerging and the other leading northwards around the North America, in the Pliocene reaching North Atlantic and giving rise to *M.bilinearis* and *M.merluccius*. Szidat assumes, among the others, 3 species of parasitic copepods: *B.lageniformis*, *Ch.palpifer*, and *Trifur tortuosus* to be the parasitic indicators.

Kabata's (1970) finding of *Brachiella lageniformis* on the gills of *M.productus* off the Canadian coasts seems to confirm Szidat's hypothesis.

Ho (1974) promotes the Atlantic origin of the genus *Merluccius*. In his opinion the North Atlantic is the ancestral habitat of hake, *M.bilinearis* from the eastern coasts of North America being the original species. Other hake species, both the Atlantic and Pacific ones, spread and evolved from this point according to Ho.

M.bilinearis is a host of two highly specific parasites: *Ch.merluccii* and *B.lageniformis*; *Chondracanthus* has not changed during the hake evolution, while *Brachiella merluccii* has replaced *B.lageniformis* in the East-Atlantic hakes. The Pacific hakes tend to lose their specific parasite *Ch.merluccius*, while *Brachiella* evolves into a new species.

However, the question of hake origin and phylogenesis remains still open; further detailed studies are necessary, both from the ichthyologic and parasitologic point of view, to elucidate the problem.

REFERENCES

- Bassett-Smith P.W., 1896: Notes on the parasitic Copepoda of fish obtained at Plymouth, with descriptions of new species. Ann. and Mag. Nat. Hist., Ser. VI, 18: 8–16.
- Ho J.-S., 1971: Parasitic Copepods of the Family Chondracanthidae from Fishes of Eastern North America. Smithsonian Contributions to Zoology, No. 87: 1–39.
- Ho J.-S., 1974: Parasitic Copepods as Indicator of hake's (*Merluccius*) Zoogeography. Third Inter. Congress of Parasitology, Proc. Vol. 3: 1633–1634, München.
- Kabata Z., 1970: Discovery of *Brachiella lageniformis* (Copepoda: Lernaepodidae) in the Canadian Pacific and its Significance to Zoogeography of the Genus *Merluccius* (Pisces: Teleostei). J. Fish. Res. Bd. Canada, 27: 2159–2165.
- Kirtisinghe P., 1964: A Review of the Parasitic Copepods of Fish recorded from Ceylon with Descriptions of Additional Forms. Bull. Fish. Res. Stn., Ceylon, 17, 1: 45–132.
- Soliman I.A.F.M., 1973: Variations of Fishes of Genus *Merluccius* in Atlantic Ocean and Mediterranean Sea. Acta Ichthyol. et Piscat. 3, 2: 29–65.
- Svetovidov A.N., 1948: Treskoobraznye. In „Fauna SSSR Ryby”, T.IX, wyp. 4, Izdat. Akad. Nauk SSSR, Moskva – Leningrad.
- Szidat L., 1955: La fauna de parasitos de "Merluccius hubbsi" como caracter auxiliar para la Solucion de problemas sistematicos y zoogeograficos del genero "Merluccius" L. Comun. Inst. Nac. Invest. Cienc. Nat. (Zool.), 3, 1: 1–54.
- Szidat L., 1956: Geschichte, Anwendung und einige Folgerungen aus den parasitogenetischen Regeln. Z.f. Parasitenk., 17: 237–268.
- Wilson C.B., 1915: North American parasitic copepods belonging to Lernaepodidae, with the revision of the entire family. Proc. U.S. Nat. Mus., 47: 565–729.
- Wilson C.B., 1923: New species of parasitic copepods from Southern Africa. Meddelanden f. Göteborgs Mus. Zool. Avdelning, 19: 1–12.
- Yamaguti S., 1963: Parasitic Copepoda and Branchiura of Fishes. Intersci. Publ. New York – London – Sydney.

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PASOŻYTNICZE WIDŁONOĞI RYB RODZAJU MERLUCCIOUS Z OCEANU ATLANTYCKIEGO I MORZA ŚRÓDZIEMNEGO

Streszczenie

W czasie badań nad zmiennością ryb z rodzaju *Merluccius* przez Solimana (1973) znaleziono 3 gatunki specyficznych pasożytniczych widłonożów, są to:

1. *Chondracanthus merluccii* (Holten, 1802) w jamie gębowej *M.m.mediterraneus*, *M.m.senegalensis*, *M.m.capensis* i *M.bilinearis*.
2. *Brachiella merluccii* Bassett-Smith, 1896 na wyrostkach filtracyjnych łuków skrzelowych *M.m.mediterraneus*, *M.m.atlanticus* i *M.m.capensis*.
3. *Parabrachiella australis* Wilson, 1923 na płatkach skrzelowych *M.m.capensis*.

Występowanie *Ch.merluccii* we wschodniej i zachodniej części Atlantyku świadczy o bliskim pokrewieństwie morskich wędłonożów atlantyckich.

Zróżnicowanie rodzaju *Brachiella* uwarunkowane jest geograficznym rozmieszczeniem morskich wędłonożów.

Natomiast *P.australis* jest gatunkiem specyficznym dla *M.m.capensis* i wskazuje na dość dużą odrębność *M.m.capensis* od pozostałych podgatunków, mimo że brak tu różnic morfometrycznych, jak to wykazał Soliman (1973).

Omówiono również różne teorie o pochodzeniu morskich wędłonożów oraz próby zastosowania pasożytniczych widłonożów jako indykatorów dla wyjaśnienia ewolucji i wędrówek morskich wędłonożów (Svetovidov, 1948; Szidat, 1955, 1956; Ho, 1974).

ПАРАЗИТИЧЕСКИЕ РАЧКИ У РЫБ ИЗ РОДА MERLUCCIOUS В АТЛАНТИЧЕСКОМ ОКЕАНО И СРЕДИЗЕМНОМ МОРЕ

Р е з ю м е

Во время опытов по изучению изменчивости рыб из рода *Merluccius*, проводимых Солиманом (1973) обнаружены 3 вида специфических паразитических рачков, а именно:

1. *Chondracanthus merluccii* (Holten, 1802) в ротовой полости *M.m.mediterraneus*, *M.m.senegalensis*, *M.m.capensis* и *M.bilinearis*.
2. *Brachiella merluccii* (Bassett-Smith, 1896) на фильтровальных придатках жаберных дуг *M.m.mediterraneus*, *M.m.atlanticus* и *M.m.capensis*.
3. *Parabrachiella australis* (Wilson, 1923) на жаберных пластинках *M.m.capensis*.

Присутствие *Ch.merluccii* в восточной и западной частях Атлантики свидетельствует о близком родстве разновидностей атлантической мерлузы.

Разнообразие рода *Brachiella* обусловлено географическим размещением мерлузы.

P.australis специфическим видом для *M.m.capensis* и указывает на значительную обособленность *M.m.capensis* от остальных подвигов, несмотря на отсутствие в данном случае морфометрических различий, что было установлено Солиманом (1973).

В работе обсуждаются разные теории о происхождении мерлузы и попытки использования паразитических рачков в качестве индикаторов для объяснения эволюции и миграций мерлузы (Световидов, 1948; Шидат, 1955, 1956; Хо, 1974).

Address:

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Dr Jadwiga Grabda
Instytut Ichtiologii AR
71-550 Szczecin, ul. Kazimierza Królewicza 4
Polska — Poland