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Isopod-infected prosoponids from the Upper Jurassic of Poland

ABSTRACT: Some of the prosoponids, *i.e.* small brachyuran decapods of the family Prosopidae von Meyer, occurring in Upper Jurassic (Oxfordian) deposits of Poland bear their carapaces modified by the presence of isopods infecting the branchial cavities. The analysis of the life activity of the isopods and of the reaction of the prosoponids against the intruders leads to a conclusion that the prosoponid/isopod relationship is of the commensal character, and there is no evidence of the previously postulated parasitism.

INTRODUCTION

The brachyuran decapods (crabs) of the family Prosopidae von Meyer, 1860 (*cf.* Glaessner 1969), are enough frequent fossils in some lithofacial members of the Upper Jurassic sequence in Poland. These are usually confined to various moderate or deep neritic facies developed either as massive (butten) or chalky, as well as organodetrital (skeletal or "reef") limestones. The prosoponids were described and illustrated by Roemer (1870) from the environs of Olsztyn, Beurlen (1929) from a few localities, and Wiśniewska-Żelichowska (1971) from Rudniki in the Polish Jura Chain, Wójcik (1914) from Kruhel, and Patrulius (1966) from Woźniki, both from the slump exotics in the Carpathian flysch, and by Barczyk (1961) from Sulejów in the western margin of the Holy Cross Mts (*cf.* Fig. 1). These were also noted by other authors from a number of localities of which Opoczno in the latter region (*cf.* Fig. 1) was of their greatest frequency (*cf.* Merta 1972).

The present author, when collecting the prosoponid and other Upper Jurassic (Oxfordian) decapod material being now available for paleontological investigation, has paid his attention to some ecological

features which affected the morphology of prosoponids' carapaces. A record of some infected individuals which throws a light on biological conditions of the prosoponids' life, as well as on the interspecific relationships in the past, is the subject of this contribution.

THE INFECTED PROSOPONIDS

In the collected material of Middle and Upper Oxfordian prosoponids, the infected individuals are very rare. Over five-hundred-prosoponid collection has yielded only seven infected animals: five from Opoczno in the Holy Cross margin, and every one from Wyczerpy near Częstochowa and Raciszyn near Działoszyn in the Polish Jura Chain (*cf.* Fig. 1).

All the infected prosoponids (Pls 1—2) bear normal, their specifically determined features, except of the third segment of their cephalotoraces, one side of which is more or less strongly inflated (*cf.* Figs 1*a*—1*b* in Pl. 1 and Pl. 2, presenting the most elevated forms) and looks as if being morbidly swollen, whereas the opposite side remains undisturbed. Anatomically, the discussed third segment comprises, at its sides, the gill (branchial) cavities.

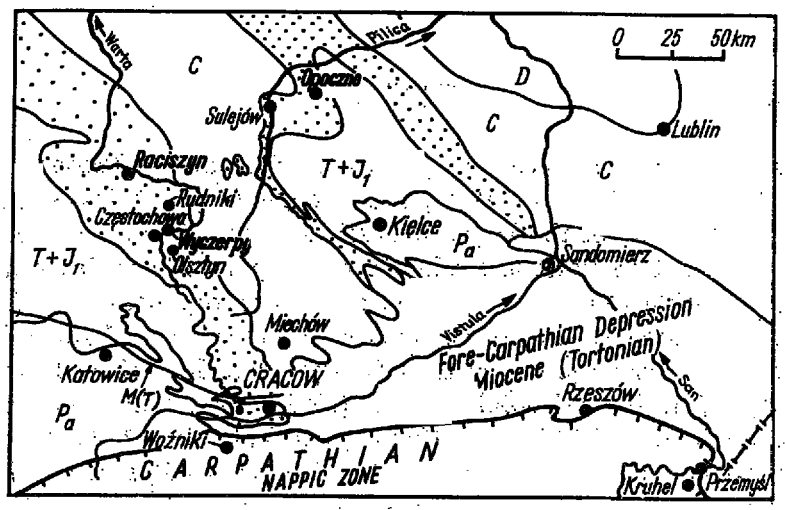


Fig. 1

Geological sketch-map of mid-southern Poland (after Samsonowicz, 1952; simplified) depicting situation of Middle and Upper Jurassic deposits (stippled) with the prosoponid-bearing localities; bold-faced are localities yielding the isopod-infected prosoponids

Key to stratigraphic symbols: *Pa* Paleozoic, $T+J_1$ Triassic and Lower Jurassic, *C* Cretaceous, *D* Danian, *M(T)* probable extent of the marine Miocene (Tortonian)

The first record of the pathologically altered branchial cavities in prosoponids was noted by Remeš (1921, 1923) from the Tithonian limestones at Štramberk, Moravia. The intensive exploration of diversified crustacean fauna from Štramberk and similar locality at Ernstbrunn in Austria caused a common knowledge of such "sick" prosoponids both in Czechoslovak (Remeš 1921, 1923; Houša 1963, 1965) and Austrian (Bachmayer 1948, 1955, 1964, 1969) literature (*cf.* also Glaessner 1969); in other countries the infected prosoponids seem to have hitherto been very infrequent and presented only in the Tithonian of Sicily (Gemmellaro's, 1869, find — reinterpreted by Houša, 1963). Since Remeš' (1921, 1923) time, the infections in the branchial cavities have been interpreted as caused by isopods of the family Bopyridae Giard & Bonnier, 1887, or generally of the suborder Epicaridea Latreille, 1831 (*cf.* Beurlen 1929; Bachmayer 1948, 1955, 1964, 1969; Houša 1963, 1965; Hessler 1969; Glaessner 1969). The same isopods are also believed to be responsible for infections in the anomuran decapods, exclusively of the family Galatheidae Samouelle, 1819, being frequently found in these prosoponid-yielding localities at Štramberk and Ernstbrunn [1] (references the same). In these bopyrid isopods, infecting is the female which grows and enlarges during the successive moltings of the decapods; the male is dwarfish and associated to the genital region of the female (*cf.* Sars 1899; and references by Houša, 1963). The identity of the infection effects both in the investigated prosoponids from the Middle and Upper Oxfordian of Poland, and in the forms referenced above, allows to suppose the presence and life activity of the same, bopyrid intruders within the prosoponid body.

The investigated, isopod-infected prosoponids (Pls 1—2) from the Polish localities (*cf.* Fig. 1) are to be characterized (for taxonomy *see* v. Meyer 1860, Barczyk 1961, Glaessner 1969) as follows:

1. *Pithonoton (Pithonoton) marginatum* (v. Meyer) from Opoczno (Middle Oxfordian, Transversarium Zone; *cf.* Merta 1972) — infected is left branchial cavity (Pl. 1, Figs *1a—b*);
2. *Pithonoton (Pithonoton) rostratum* (v. Meyer) from Raciszyn (Upper Oxfordian, Bimammatum or Planula Zone) — infected is left branchial cavity (Pl. 1, Fig. 2);
3. *Nodoprosopon heydeni* (v. Meyer) from Opoczno — infected is left branchial cavity (Pl. 1, Fig. 3);
4. *Pithonoton (Pithonoton) marginatum* (v. Meyer) from Opoczno, a large specimen with the best preserved carapace — infected is left branchial cavity (Pl. 1, Fig. 4);
5. *Pithonoton (Pithonoton) marginatum* (v. Meyer) from Wyczerpy (Middle Oxfordian, Transversarium Zone) — infected is right branchial cavity (Pl. 2, Figs 1*a*—1*b*);

[1] It is noteworthy that the prosoponid- and galatheid-inhabited environment, represented in these two localities, Štramberk and Ernstbrunn, was also colonized by various free-living isopods (*cf.* Bachmayer 1955, Hessler 1969).

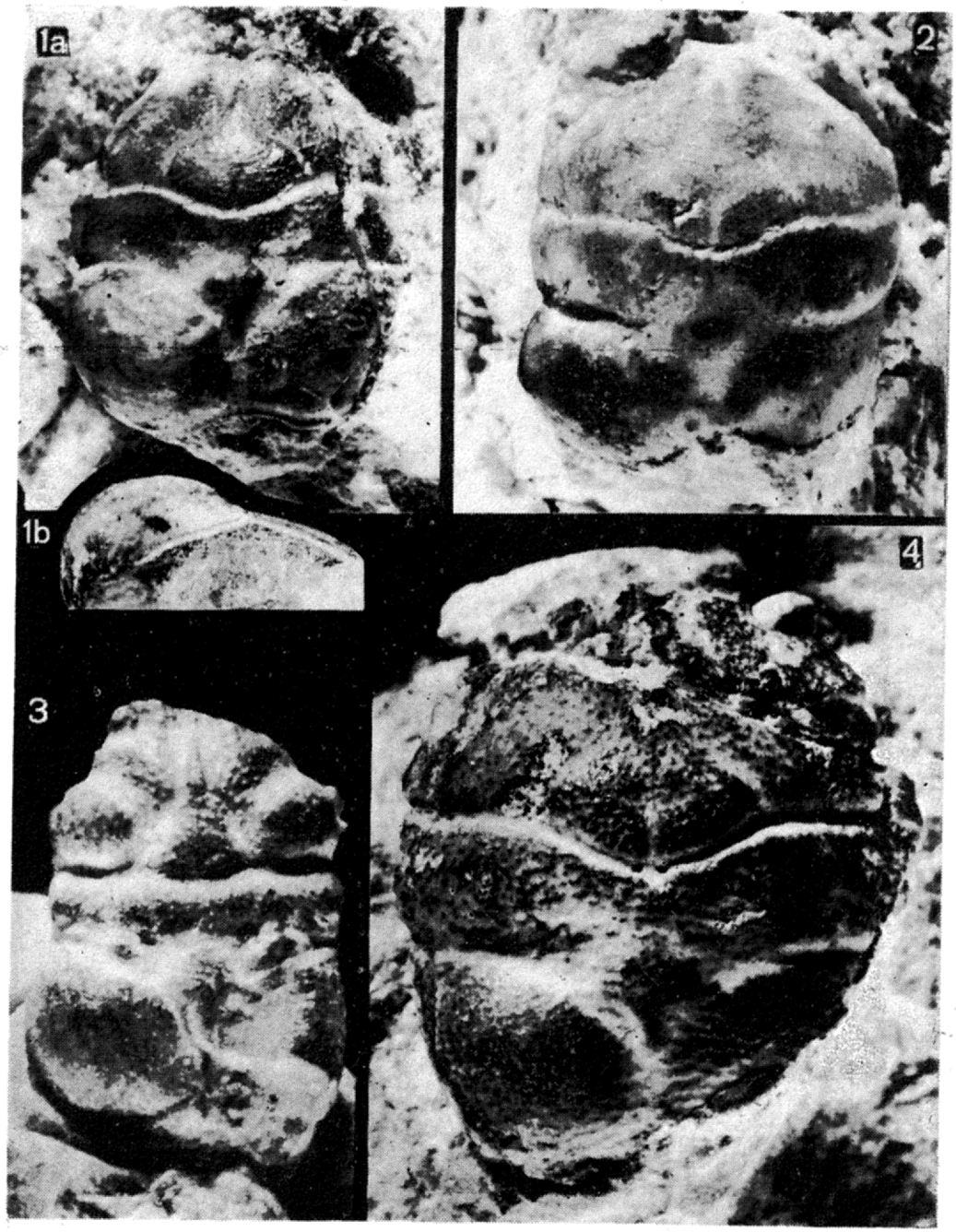
6. *Pithonoton (Pithonoton) marginatum* (v. Meyer) from Opoczno — infected is left branchial cavity (Pl. 2, Fig. 2);
7. *Pithonoton (Pithonoton) marginatum* (v. Meyer) from Opoczno — infected is right branchial cavity (Pl. 2, Fig. 3).

As it appears from the referenced bibliography, the presented material from the Polish Middle and Upper Oxfordian is stratigraphically the oldest of all the hitherto known isopod-infected prosoponids, being previously recorded only from the Tithonian, mostly of Štramberk and Ernstbrunn, and occasionally from Sicily (*cf.* Houša 1963, Table 3).

BIOLOGICAL AND ECOLOGICAL INTERPRETATION

All the investigated, isopod-infected prosoponids (Pls 1—2) are mature and attain a normal size, typical of the adult specimens both in the local environment and in type-locality areas of particular species (*cf.* v. Meyer 1860). For the species *Pithonoton (Pithonoton) marginatum* (v. Meyer) being the most frequent at Opoczno (*cf.* Merta 1972), where its population comprises *c.* 300 individuals, the infected specimens (Pl. 1, Figs 1 and 3—4; Pl. 2, Figs 2—3) are of the normal or greatest dimensions. It therefore appears that the isopod infection did not check and retard the ontogenic development of the prosoponids, and it does not hint to be any cause of the prosoponids' death. On the other hand, all the swells are evidently well manifested, and point to a maturity of the intruders which must have been tolerated by the prosoponid organism, and hence they could have been prospering well, too. There is no record of infection of both branchial cavities in any collected specimens; in the Upper Jurassic of other European regions such a single case was noted only by Beurlen (1929, Fig. 6) in a galatheid anomuran, *Gastrosacus*. It therefore seems that there must have been a biological regulation during or just after insertion (more correctly: settling down) of the isopod larvae in a prosoponid body. The regulation resulted in a development of only one larva in a prosoponid branchial cavity, as well as in a remaining the opposite cavity non-infected. The five of seven investigated specimens bear infected their left gill cavities (Pl. 1, Figs 1—4 and Pl. 2, Fig. 2); a record once discussed (Houša 1963) on a preference of the right gill cavities to be easier infected in the galatheid anomurans, is therefore not of a general acceptance in the isopod-infected decapods (*cf.* also Bachmayer 1948).

The presented remarks lead to a conclusion that the infecting isopod, benefiting in a prosoponid gill cavity, has developed well in such a case when the host prospered in good condition. On the other hand, the isopod has gained the life space protected against its possible enemies, and lived here being tolerated and not annihilated by the prosoponid. The



Isopod-infected prosoponids

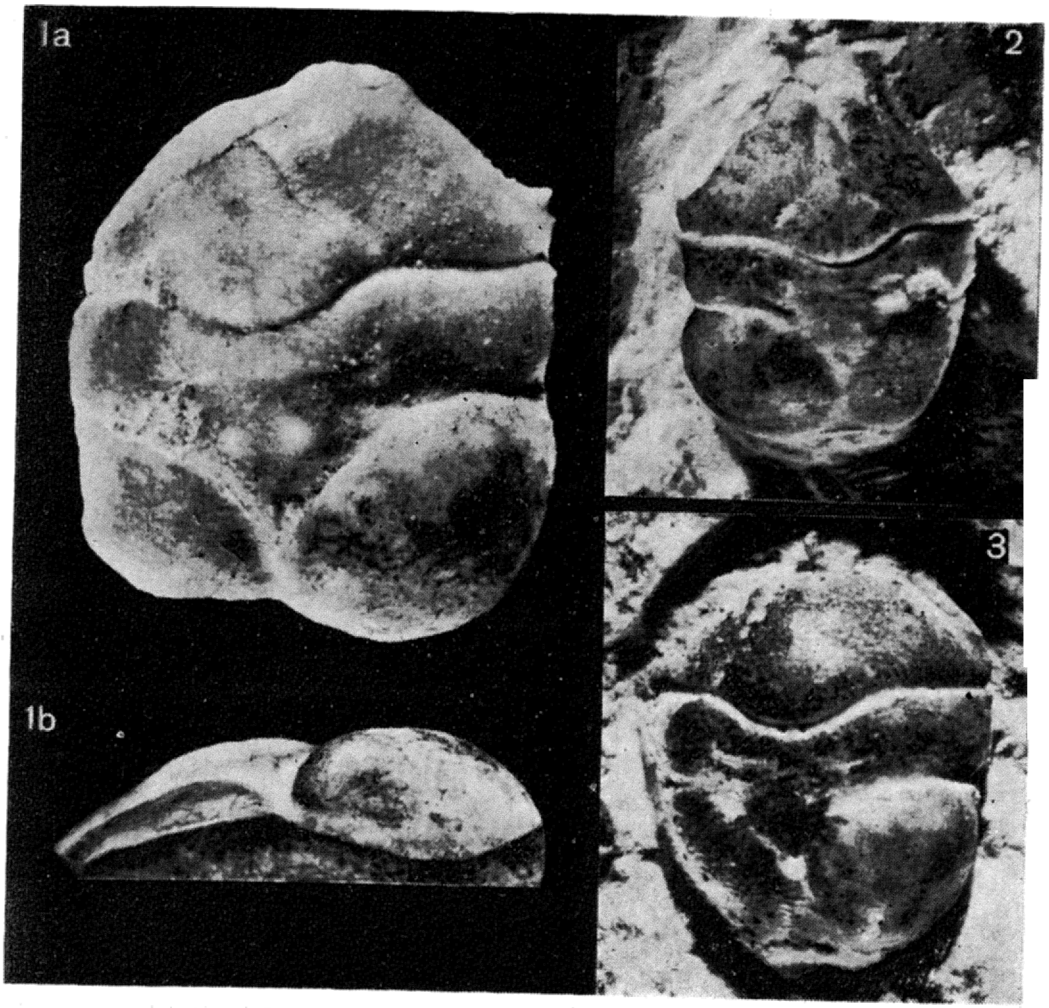
1 — *Pithonoton (Pithonoton) marginatum* (v. Meyer); Middle Oxfordian (Transversarium Zone), Opoczno in the western margin of the Holy Cross Mts; *coll.* T. Merta, M. Sc. (1968). *1a* general view, *1b* posterior view to show the strongly inflated left branchial cavity.

2 — *Pithonoton (Pithonoton) rostratum* (v. Meyer); Upper Oxfordian (Bimammatum or Planula Zone), Raciszyn in the Polish Jura Chain; *coll.* Dr. A. Wierzbowski (1970).

3 — *Nodoprosopon heydeni* (v. Meyer); Opoczno.

4 — *Pithonoton (Pithonoton) marginatum* (v. Meyer); Opoczno, *coll.* T. Merta, M. Sc. (1969).

All figures × *7.5; taken by B. Drozd, M. Sc.*



Isopod-infected prosoponids

1 — *Pithonoton (Pithonoton) marginatum* (v. Meyer); Middle Oxfordian (Transversarium Zone), Wyczerpy in the Polish Jura Chain; *coll.* W. Brochwicz-Lewiński, M. Sc. (1968). *1a* general view, *1b* posterior view to show the strongly inflated right branchial cavity.

2 — *Pithonoton (Pithonoton) marginatum* (v. Meyer); Opoczno.

3 — *Pithonoton (Pithonoton) marginatum* (v. Meyer); Opoczno.

All figures × 7.5; taken by B. Drozd, M. Sc.

prosoponid therefore has presumably not lost anything except of a plumping up its carapace and, less evidently, of a smothering of the gills within or on which the isopod inhabited. Consequently, it may be inferred that the prosoponid/isopod relationship should not be regarded as parasitic, as hitherto interpreted *e.g.* by Remeš (1921, 1923), Bachmayer (1948) and Houša (1963, 1965), and it supposedly is commensal in its principle. The conclusion agrees with a recent definition of commensalism by Ager (1963): the isopod gains (+) and the prosoponid does not lose (0), except of the inflating of the carapace to accomodate the intruder [2].

Studying the commensal relationships in the crustaceans, particularly in the cirripeds (*cf.* Bałuk & Radwański 1967) the analogous situation, consisting in the presence of the crustacean (cirriped) guest highly trouble- and burdensome for the host, but not parasitic, has been stated to be common. The most instructive examples are given by the genus *Octolasmis* Gray, 1825 — its subgenus *Octolasmis* s. s., the species of which (*cf.* Pilsbry 1907) live mainly as commensals on the gills or on the walls of the gill cavities of various shallow- and deep-water crabs or lobsters. Of the species living in the branchial cavity of brachyurans, the best recognized are *Octolasmis (Octolasmis) geryonophila* Pilsbry, 1907, prospering in deep-water crabs *Geryon,* as well as *Octolasmis (Octolasmis) muelleri* (Coker, 1902) domiciling on the gills of some shallow-water crabs (*cf.* Pilsbry 1907).

The other examples in the cirripeds may be cited such as the genus *Tubicinella* Lamarck, 1802, living in the nostril skin of some whales (*cf.* Darwin 1854), the species *Stomatolepas elegans* (da Costa, 1838) living *i.a.* in the throat of some turtles (*cf.* Pilsbry 1910, Zullo & Bleakney 1966), and all the subfamily Creusiinae living in alive corals, mostly colonial, and modifying their skeletons (*cf.* Bałuk & Radwański 1967) [3]. In the latter two cases, in the turtle throats and in the coral colonies, it may be expected that an enormous settling and gregarious development of cirripeds might have led to the death of the hosts, but such situations seem to be rather speculative or, at least, quite extraordinary (*cf.* Bałuk & Radwański 1967, pp. 492—493); in the prosoponid/isopod relationship there is no hint to such a case so far. This latter relationship differs from

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[2] It should be stressed that it is difficult to recognize correctly the physiologic reactions in such extinct animals as the discussed prosoponids, *i.e.* the representatives of the subfamilies Prosopinae von Meyer, 1860, and Pithonotinae Glaessner, 1933 (*cf.* Glaessner 1969). The Recent epicaridean isopods are believed to be exclusively parasitic, although there is a lack of detailed studies on the nature of infection by these isopods and on the behaviour of the infected decapods (*cf.* Sars 1899, Hessler 1969), then consequently, on the mutual relationship of these crustaceans. At the time of appearance of this relationship, in the Upper Jurassic (*cf.* Hessler 1969), it might have been of the commensal type, and successively, till the Recent, it changed in extant decapods into the parasitism.

[3] Other examples of the commensalism in cirripeds are discussed or referenced by Bałuk & Radwański (1967, pp. 493—494) and Ross & Newman (1967).

the preceding ones only in the fact that both the host (prosoponid) and the guest (isopod) are the eumalacostracans.

The infecting Jurassic isopods, supposedly of the family Bopyridae Giard & Bonnier, 1887, being adopted only to the discussed commensal life in the decapods' branchial cavities, appear to have been very rare in the prosoponid-inhabited environments in the Polish Jurassic. Previously, these were Bachmayer (1955) who recognized that only 2% of all the decapod (brachyuran and anomuran) individuals were infected in the Ernstbrunn environment, and Houša (1963) who found some 4% for the Štramberk decapods. Similar number is to be noted in the localities most prolific in prosoponids, the only decapods therein, both at Opoczno in the Holy Cross margin, and in the Polish Jura Chain. The bopyrid isopods may therefore be regarded as a very rare and difficult-to-be-discernible, but characteristic component of many of the decapod communities in the European Upper Jurassic.

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„CHORE" PROZOPONY Z OKSFORDU POLSKI

(Streszczenie)

Wśród rozmaitych prozoponów, tj. małych krabów należących do rodziny Prosopidae von Meyer, 1860 (*cf.* Glaessner 1969), a pochodzących z szeregu stanowisk osadów środkowego i górnego oksfordu na obrzeżeniu Gór Świętokrzyskich i na Jurze Polskiej (*por.* fig. 1), stwierdzono u kilku okazów obecność zmian w budowie pancerza, polegających na wydęciu jednej z komór skrzelowych usytuowanych w trzecim segmencie głowotułowia (pl. 1—2). Wydęcia te, spowodowane osiedleniem się równonogów (Isopoda) z rodziny Bopyridae (*por.* Remeš 1921, 1923; Bachmayer 1948; Houša 1963, 1965; Glaessner 1969), znalezione zostały tylko u osobników dorosłych i dobrze wyrośniętych, co wskazuje, że rozwój równonoga nie prowadził do śmierci

prozopona. Na podstawie tego faktu oraz analizy reakcji organizmu prozopona, stosunek gospodarza (prozopon) do gościa (równonóg) zinterpretowano jako komensalizm (*sensu* Ager 1963), wskazując jednocześnie, że nie ma wyraźnych dowodów pozwalających uznać ten stosunek za pasożytnictwo, jak to przyjmowano poprzednio. Postulowany stosunek komensalizmu wykazuje w rozważanym układzie bliskie analogie do istniejącego pomiędzy niektórymi wąsonogami a określonym typem gospodarzy, w obrębie których wąsonogi te się gnieżdżą (*por.* Darwin 1854; Pilsbry 1907, 1910; Zullo & Bleakney 1966; Ross & Newman 1967; Bałuk & Radwański 1967).

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