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THE DEEP-SEA AMPHIPOD *PARACYPHOCARIS PRAEDATOR* (GAMMARIDEA: LYSIANASSIDAE) ASSOCIATED WITH THE PELAGIC SHRIMP *OPLOPHORUS NOVAEZEELANDIAE* AS AN EGG-MIMIC

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Abstract.—Three specimens of the amphipod *Paracyphocaris praedator* were found among the attached eggs of the shrimp *Oplophorus novaezeelandiae.* The posterior pereon of the amphipod was greatly distended and filled with oily globules, causing it to resemble in form and color the eggs of the shrimp. It is suggested that *P. praedator* is an egg-mimic that feeds upon the *Oplophorus* eggs. The prehensile pereopods of *Paracyphocaris,* and perhaps those of other cyphocarid genera, prevent it from being dislodged by the host's grooming.

Paracyphocaris is one of a group of genera of Lysianassidae designated by Barnard (1969) as "cyphocarids." The genus comprises three species: the type-species *P. praedator* Chevreux, 1905, *P. brevicornis* Birstein and Vinogradov, 1955, and *P. distincta* Birstein and Vinogradov, 1963. All captures of the three species have been made in the deep-sea pelagial. *Paracyphocaris distincta* is known only from the Philippine Trench, and *P. brevicornis* has been found at two localities, the Kurile-Kamchatka Trench (Birstein and Vinogradov 1955) and near the Solomon Islands (Birstein and Vinogradov 1960). *Paracyphocaris praedator* has a wide known distribution, having been recorded from seven localities in the North Atlantic (summarized by Shoemaker 1945) and two localities in the Indian Ocean, NW of Rodriguez Island and NE of the Chagos Archipelago (Birstein and Vinogradov 1964). Its known range is extended herein to include the South Pacific off southern Chile, where three specimens have been found among the eggs attached to the pleopods of the pelagic shrimp *Oplophorus novaezeelandiae.*

Paracyphocaris praedator Chevreux
Fig. 1

Paracyphocaris praedator Chevreux, 1905:1, figs. 1–3; 1935:25–27, pl. 10, fig. 3, pl. 11, figs. 2–3.—Stephensen, 1923:54; 1933:10.—Schellenberg, 1926:216; 1927: 667–668, fig. 61.—Birstein and Vinogradov, 1960:170–171, fig. 1; 1964:156.—Shoemaker, 1945:189, text-fig. 2.—Gurjanova, 1962:71–73, figs. 11A, 11B.

Material.—Complete specimen about 8.7 mm in length and specimen lacking pleonite 3 and urosome judged to be about same length (USNM 211073), from among ova of 2 different specimens of *Oplophorus novaezeelandiae* De Man (USNM 211072), *Eltanin* cruise 25, sta 303, off Santiago, Chile, 33°11′–33°14′S, 72°40′–72°38′W, 400–475 m, 25 Sep 1966. Complete specimen about 9.5 mm in length (USNM 213334) from among ova of *Oplophorus novaezeelandiae* (USNM 213333), *Eltanin* cruise 25, sta 322, off Osorno, Chile, 41°01′–41°08′S, 78°59′–78°56′W, 380–475 m, 7 Oct 1966.

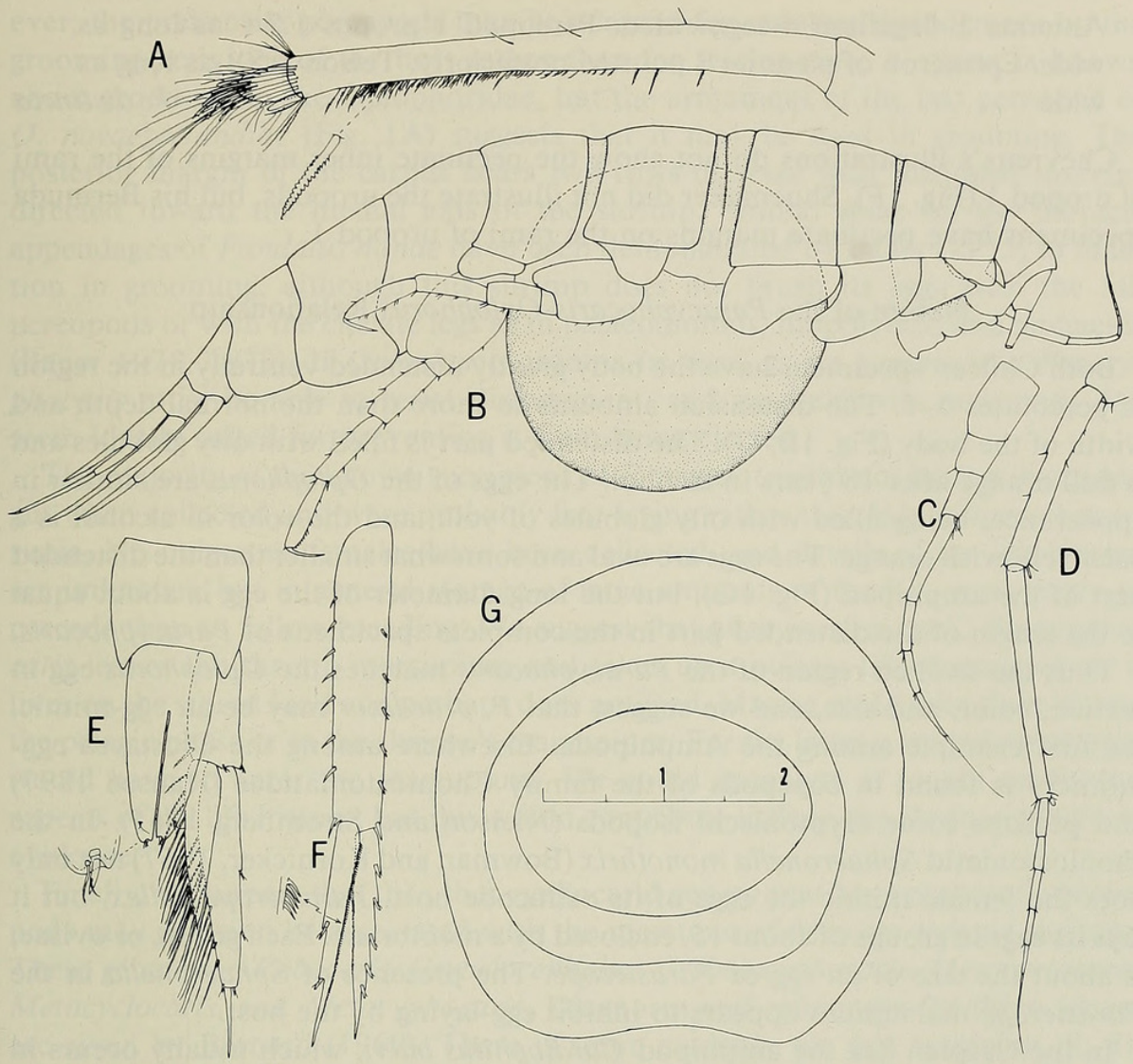

Fig. 1. A, *Oplophorus novaezeelandiae,* ovigerous ♀, pereopod 5 propus and dactyl. B–F, *Paracyphocaris praedator* from *Oplophorus marsupium*: B, Habitus, lateral, most appendages omitted; C, Antenna 1; D, Antenna 2, segments 1 and 2 of peduncle omitted; E, Telson and uropod 1; F, Uropod 3; G, Outer and middle circles, outlines of distended area of pereon of *P. praedator* viewed ventrally; middle circle is specimen in B; inner circle, outline of egg of *O. novaezeelandiae.* Scale in mm applies to B and G.

Diagnostic characters.—The Chilean specimens match the illustrations of Chevreux (1905) and Shoemaker (1945), as far as could be seen without dissection. The characters that distinguish *P. praedator* from its congeners are given in the key that follows.

Key to the Species of *Paracyphocaris*

1. Antenna 2 shorter than antenna 1. Pereopod basis wider than long .... *P. brevicornis*
– Antenna 2 longer than antenna 1. Pereopod 4 basis longer than wide .. 2
2. Antenna 1 flagellum 5-segmented. Pereopod 1 propus 2.3× as long as wide. Epimeron of pleonite 3 rounded posteriorly. Telson 2.3× as long as wide ..... *P. praedator*

– Antenna 1 flagellum 4-segmented. Pereopod 1 propus 1.7× as long as wide. Epimeron of pleonite 3 pointed posteriorly. Telson 1.5× as long as wide ..... *P. distincta*

Chevreux's illustrations do not show the pectinate inner margins of the rami of uropod 1 (Fig. 1F). Shoemaker did not illustrate the uropods, but his Bermuda specimens have pectinate margins on the rami of uropod 1.

Nature of the *Paracyphocaris-Oplophorus* Relationship

Both Chilean specimens have the body greatly distended ventrally in the region of pereonites 5–7. The distension amounts to more than the normal depth and width of the body (Fig. 1B, G). The distended part is filled with oily globules and is dull orange after 18 years in alcohol. The eggs of the *Oplophorus* are similar in appearance, being filled with oily globules of yolk, and the color in alcohol is a paler yellowish orange. The eggs are oval and somewhat smaller than the distended part of the amphipod (Fig. 1G), but the long diameter of the egg is about equal to the length of the distended part in the complete specimens of *Paracyphocaris.*

Thus the swollen region of the *Paracyphocaris* matches the *Oplophorus* egg in texture, color, and size, and we suggest that *P. praedator* may be an egg-mimic, the first example among the Amphipoda. Elsewhere among the Crustacea egg-mimicry is found in copepods of the family Choniostomatidae (Hansen 1897) and perhaps some cryptoniscid isopods (Nielson and Stromberg 1965). In the choniostomatid *Sphaeronella monothrix* (Bowman and Kornicker, 1967) not only does the female mimic the eggs of its ostracode host, *Parasterope pollex,* but it lays its eggs in groups of about 15, enclosed by a membrane. Each group, or ovisac, is about the size of an egg of *Parasterope.* The presence of *Sphaeronella* in the *Parasterope* marsupium appears to inhibit egg-laying by the host.

In the Caspian Sea the amphipod *Cardiophilus baeri,* which usually occurs in the mantle cavity of the cockle *Cerastoderma lamarcki,* has been found in the marsupium of the amphipods *Corophium curvispinum* and *C. spinulosum* by Osadchikh (1977), who believes that early development of *C. baeri* takes place there. Osadchikh did not suggest that *Cardiophilus* either mimics or feeds on the *Corophium* eggs or young.

Paracyphocaris does not inhibit egg-laying by *Oplophorus.* The two Chilean shrimps from station 25 carried six and ten eggs respectively, rather loosely packed. In comparison, a South Atlantic *O. novaezeelandiae* of about the same length in the Division of Crustacea collections has 20 closely clustered eggs. This difference, together with the distended condition and appearance of the amphipod guts, suggests that the amphipods feed on the eggs of the shrimp. Thus the *Paracyphocaris* gains from its association a protected and concealed habitat where energy requirements are minimal and also a readily available source of rich food.

Seven of the 12 genera grouped as "cyphocarids" by Barnard (1969:300) are characterized by the prehensile nature of from 2–4 of the pereopods posterior to pereopod 2. In a recent discussion of Gammaridea having prehensile pereopods, Vader (1983) divided them into two groups: (1) abyssopelagic or bathypelagic species, which he considered to be probably all predators; (2) those living in direct contact with the mouthparts or appendages of large Crustacea. Vader placed the cyphocarids in the first group. *Paracyphocaris* is not necessarily predaceous, how-

ever; the prehensile pereopods may be adapted for resisting dislodgment by the grooming activities of the host rather than for seizing prey. Nothing is known about grooming in the Oplophoridae, but the armament of the last pereopod of *O. novaezeelandiae* (Fig. 1A) suggests that it may be used in grooming. The posterior margin of the carpus bears two rows of setae with scalloped margins directed toward the medial axis of the shrimp. Similar setae on the thoracic appendages of *Pandalus danae* have been demonstrated by Bauer (1975) to function in grooming, although this shrimp does not brush its eggs with the 5th pereopods or with the chelate legs as in palaeomonids, hippolytids, and alphaeids (Bauer 1975, 1979). If *Oplophorus* grooms its eggs, as we suspect, the *Paracyphocaris* must be able to resist dislodgment, and its prehensile pereopods 3–6 seem ideally suited for preventing it from being ejected.

The majority of the known specimens of *P. praedator* did not have a distended gut when collected and were probably free-living rather than inhabitants of marsupia. No ovigerous females have been collected, and details of the life history are unknown, but in general storage of large amounts of food is more likely to precede than to follow breeding. We suggest that after gorging itself, *Paracyphocaris* leaves the shrimp marsupium and takes up a pelagic life, during which it lives on the stored food and perhaps does not feed. Mating could take place during the pelagic phase or in the shrimp's marsupium. For the latter a second amphipod would have to enter the marsupium. We could speculate at length on further aspects of the life history, but this would contribute little in the absence of factual evidence.

Finally, we suspect that the other cyphocarid genera that have prehensile pereopods may prove to be associated with the marsupia of deep-sea pelagic shrimps. These genera are *Cebocaris, Crybelocephalus, Crybelocyphocaris, Mesocyclocaris, Metacyclocaris,* and *Metacyphocaris.* Diagnoses and references for these genera are given by Barnard (1969). There is some evidence for this suspicion. K. H. Barnard (1932) reported that the ventral surface of smaller specimens of *Metacyphocaris helgae* was bulging, and Shoemaker (1945) found this condition in an immature female of the same species.

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