Cah. Biol. Mar. (1999) 40 : 1-14

Two new species and a new record of Cymothoid Isopods from the Red Sea

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Abstract: Two new species of cymothoid isopods, *Ceratothoa marisrubri* sp. nov. and *Livoneca papernea* sp. nov., are described from the Red Sea coast of Israel and the Sinai peninsula. A third isopod, *Nerocila sigani*, is reported again from the Gulf of Eilat. A part of the specimens live as parasites on fish caught in recent years in the Gulf of Eilat; another part were recovered from the National Fish Collection of the Hebrew University of Jerusalem.

Résumé : *Deux espèces nouvelles et une nouvelle signalisation d'Isopodes Cymothoidés de la Mer Rouge.* Deux espèces nouvelles d'Isopodes Cymothoidae, *Ceratothoa marisrubri* sp. nov. et *Livoneca papernea* sp. nov., sont décrites des côtes Israéliennes de la Mer Rouge et de la péninsule du Sinaï. Une troisième espèce, *Nerocila sigani*, est à nouveau signalée dans le Golfe d'Eilat. Une partie des spécimens étudiés parasitaient des poissons pêchés récemment dans le Golfe d'Eilat ; les autres ont été récoltés sur des poissons conservés dans la collection nationale de l'Université Hébraïque de Jérusalem.

Keywords : Crustacea, Cymothoidae, Red Sea, *Nerocila, Ceratothoa, Livoneca*.

Introduction

A number of cymothoid isopods from the Red Sea and the Suez Canal were described by Kossmann (1880), Stebbing (1910), Monod (1933a,b & 1937), Trilles (1972b, 1975a,b, 1976 & 1979), Avdeev (1978), Bruce & Harrison-Nelson (1988). They include: *Cymothoa eremita* (Brünnich); *Cymothoa selari* Avdeev ; *Cymothoa borbonica* Schioedte & Meinert; *Ceratothoa oxyrrhynchaena* (Koelbel); *Ceratothoa imbricata* (Fabricius); *Ceratothoa venusta* (Avdeev); *Irona nanoides* Stebbing, transferred to *Livoneca* (see Bruce, 1986) and then, to *Elthusa* (see Bruce, 1990); *Irona vatia* Schioedte & Meinert a junior synonym of *Mothocya plagulophora* (Haller), as suggested by Bruce, 1986; *Irona cypselurus* Avdeev, transferred to *Mothocya* and accepted as a junior synonym of *Mothocya melanosticta* (Schioedte & Meinert) (see Bruce, 1986); *Anilocra leptosoma* Bleeker; *Nerocila bivittata* (Risso) and *Nerocila sigani* Bowman & Tareen. A teratological specimen of *Nerocila* that could not be identified was reported by Monod as *Nerocila* sp. (see Monod, 1937) and by Trilles as *Nerocila* sp. 2 (see Trilles, 1994).

Only a few cymothoid isopods have been reported from the coast of Israel (Trilles & Paperna, 1980; Bruce & Harrison-Nelson, 1988), and only two species, *Cterissa apogonae* Trilles & Paperna and *Nerocila sigani* Bowman & Tareen, have been positively identified from the Gulf of

Reçu le 12 janvier 1998 ; accepté après révision le 12 mai 1998
Received 12 January 1998 ; accepted in revised form 12 May 1998

Eilat. Trilles & Paperna (1980) also reported three other specimens, two belonging to the genus *Livoneca* and one to *Nerocila* (Livoneca sp. 1, *Livoneca* sp. 2 and *Nerocila* sp. 1 = *Nerocila* sp. 16 Trilles, 1994).

This article describes three species of cymothoid isopods from the Red Sea coast of Israel and the Sinai peninsula. A part of the specimens live as parasites on fish caught in recent years (1995, 1996) in the Gulf of Eilat and another part were recovered from fish preserved in the National Fish Collection of the Hebrew University of Jerusalem. *Ceratothoa marisrubri* sp. nov. and *Livoneca papernea* sp. nov., are new species. A bio-ecological study on *Livoneca* sp., now identified as *Livoneca papernea* sp. nov., has been published (Colorni & al., 1997). The third species was identified as *Nerocila sigani* Bowman & Tareen, 1983, a senior synonym to *Nerocila arres* according to Bruce & Harrison-Nelson, 1988. A description of the mouthparts, omitted by previous investigators, is given and the range of the hosts is extended

All specimens are deposited in the Hebrew University of Jerusalem (HUJ) collection.

Ceratothoa Dana, 1852.
Restricted synonymy
Ceratothoa Dana, 1852; Bruce & Bowman 1989; Trilles 1994.
Oniscus Fabricius, 1775.
Cymothoa Fabricius, 1793.
Canolira Risso, 1826.
Codonophilus Haswell, 1881.
Meinertia stebbing, 1893.

In a recent work on species from the mouths of flying fishes and Halfbeaks (Beloniformes), Bruce & Bowman (1989), discussing the validity of the genus *Ceratothoa*, suggest a provisional diagnosis of a female *Ceratothoa* and propose the synonymy as well with *Cteatessa* Schioedte & Meinert (a junior synonym of Ceratothoa), *Rhexana* Schioedte & Meinert and *Rhexanella* Stebbing. For the moment, this suggestion is only accepted as valid for the synonymy *Rhexana* = *Rhexanella* (Trilles, 1972b, 1994).

Ceratothoa marisrubri sp. nov.
Figs. 1, 2, and 3

Specimens : one holotype and eleven paratypes, deposited in the HUJ collection.
Eight specimens were collected from the oral cavity of the deep water red mullet *Upeneus subvittatus* (Temminck & Schlegel) (Mullidae) from different sites. 30 November 1989, Eilat Red Sea, female, holotype, TL (total length) 25 mm (Huj.Isop 1); 11 November 1989, Eilat, female TL 18 mm (Huj.Isop 2); 18 January 1990, Red Sea, female and male TL 25 mm and 12 mm respectively (Huj.Isop 3); 20 April 1990, Eilat, female and male TL 22 mm and 11mm respectively (Huj.Isop 4); 26-27 May 1990, Red Sea, female TL 30 mm (Huj.Isop 5); 28 July 1990, Eilat, female TL 26 mm (Huj.Isop 6).

Two specimens on the blueskin seabream *Polysteganus coeruleopunctatus* (Klunzinger) (Sparidae): 19 June 1990, Eilat Red Sea, female TL 28 mm and one male TL 12 mm (Huj.Isop 7).

Two specimens on the king soldierbream *Argyrops spinifer* (Forsskål) (Sparidae): 18 March 1992, Eilat Red Sea, female TL 14 mm and male TL 9 mm (Huj. Isop.8).

Etymology: from the type locality.

Description
*Female** (Figure 1a, b; Figure 2a-i,u; Figure 3a-g).
The body is symmetrical, ovoid, and convex. In females, the body length varies from 14 to 30 mm. The first four pereonites are longer than the following three. The seventh pereonite is very curved medially, especially at its distal edge, and almost entirely covers pleonite 1 and large part of pleonite 2, whereas the last three pleonites are completely visible. The pleotelson is wider than it is long; its distal edge, which is barely surpassed by the uropods, has a medial depression.

The triangular cephalon is well-developed and surrounded laterally by the latero-anterior extensions of pereonite 1. These reach the middle of the head. The eyes are relatively well-developed.

The antennules (Fig. 2a) and the antennae (Fig. 2b) are both composed of seven segments. The only recognizable ornamentation is a short, setal bristle on the latero-anterior edge of the fifth segment of antennae.

The mandibular palp (Fig. 2c) has three segments and a group of three very short setal bristles at the distal end of the last segment. Two other similar setae protrude from the anterior internal angle of the second segment.

The maxillules (Fig. 2d) have three to four stout, distal spines. The maxillae (Fig. 2e) have smaller spines, grouped into two bundles : five spines on the coxal endite and four spines on the basal endite.

The maxillipeds (Fig. 2f, g) have three blunt extensions at their distal end.

The pereopods (Fig. 3) sequentially increase in size, from the first to the last pair. A very well-developed carina, similar to that of *Ceratothoa oxyrrhynchaena*, is present on the P7 basipodite.

The pleopods (Fig. 2g, h) are typical and the uropod endites are of the same length (Fig. 2u).

* Cymothoid Isopods are protandrous hermaphrodites. These fish parasites pass through successive male and female sexual stages (Trilles, 1969).

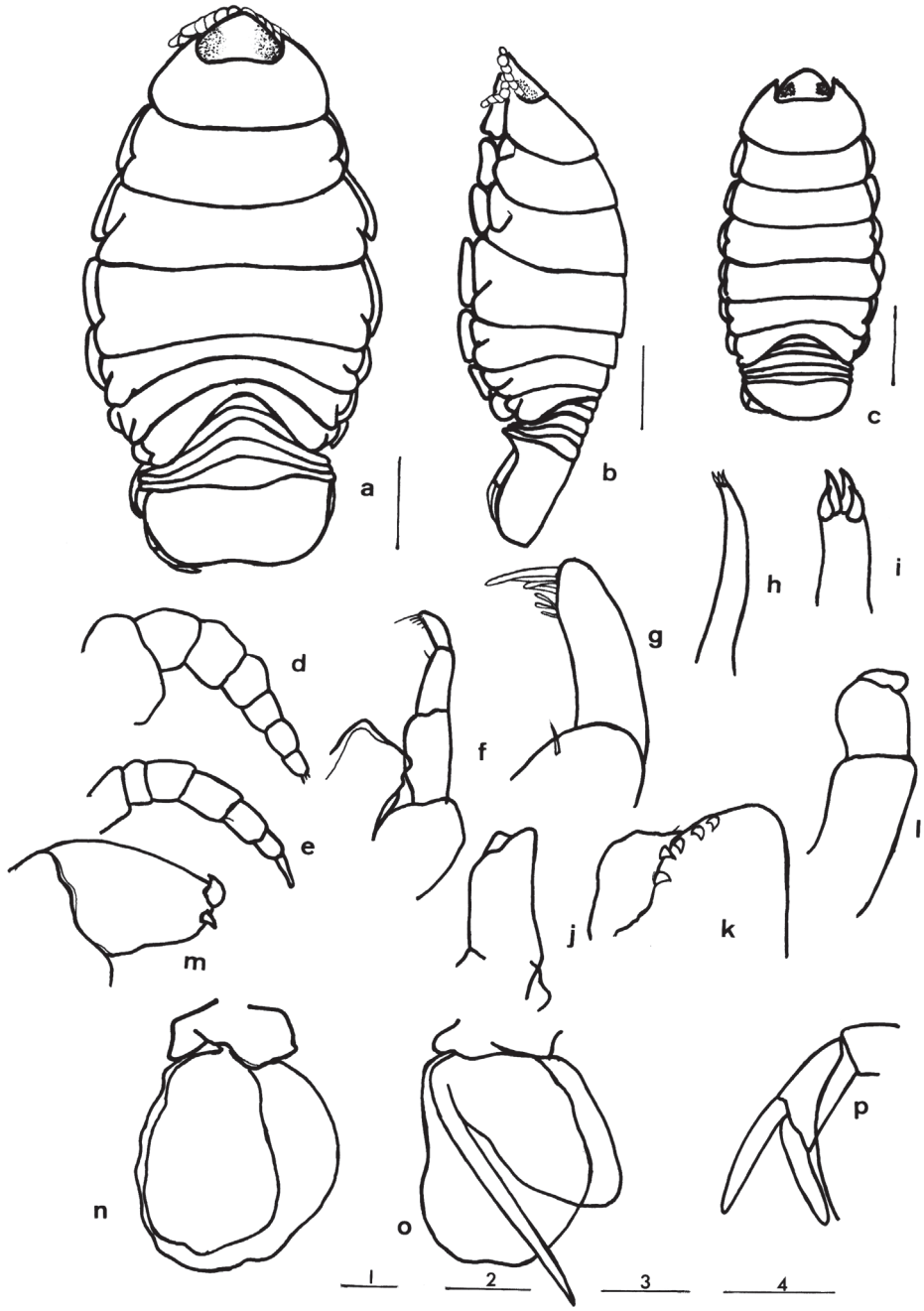

Figure 1. *Ceratothoa marisrubri* sp. nov.
(a) and (b) female, dorsal and lateral views (bars = 4 mm).
(c) male, dorsal view (bar = 4 mm).
(d-p) appendages of the male. (d) antennule; (e) antenna; (f) mandibular palp; (g) detail of the mandibular palp; (h) maxillule; (i) distal end of the maxillule; (j) maxilla; (k) detail of the distal end of the maxilla; (l) maxilliped; (m) detail of the maxilliped; (n) pleopod 1; (o) pleopod 2; (p) uropod.
Scale bars: 1= 500 µm for n, o and p; 2= 500 µm for d and e; 3= 300 µm for f, h, j and l; 4= 100 µm for g, i, k and m.

Figure 1. *Ceratothoa marisrubri* sp. nov.
(a) et (b) femelle, vue dorsale et vue latérale (échelles = 4 mm).
(c) mâle, vue dorsale (échelle = 4 mm).
(d-p) appendices du mâle. (d) antennule; (e) antenne ; (f) palpe mandibulaire; (g) détail du palpe mandibulaire; (h) maxillule; (i) détail de l'extrémité distale de la maxillule ; (j) maxille; (k) détail de l'extrémité distale de la maxille; (l) maxillipède; (m) détail du maxillipède; (n) pléopode 1; (o) pléopode 2; (p) uropodes.
Échelles : 1 = 500 µm pour n, o et p ; 2 = 500 µm pour d et e ; 3 = 300 µm pour f, h, ,j, e, l ; 4 = 100 µm pour g, i, k et m.

Figure 2. *Ceratothoa marisrubri* sp. nov.

(a –i) appendages of the female. (a) antennule; (b) antenna; (c) mandible; (d) maxillule; (e) maxilla; (f) maxilliped; (g) detail of maxilliped; (h) pleopod 1; (i) pleopod 2; (u) uropod.

(j-p) pereopods of the male. (j) pereopod 1 = P1; (k) P2; (l) P3; (m) P4; (n) P5; (o) P6; (p) P7.

Scale bars: 1= 500 µm for i and h; 2= 500 µm for a, b, f, j, k, l, m, n, o, p and u; 3 = 300 µm for c, d, e and g.

Figure 2. *Ceratothoa marisrubri* sp. nov.

(a-i) appendices de la femelle. (a) antennule ; (b) antenne ; (c) mandibule ; (d) maxillule; (e) maxille ; (f) maxillipède ; (g) détail du maxillipède ; (h) pléopode 1 ; (i) pléopode 2 ; (u) uropode.

(j-p) péréiopodes du mâle :(j) péréiopode 1 = P1 ; (k) P2 ; (l) P3 ; (m) P4 ; (n) P5 ; (o) P6 ; (p) P7.

Échelles : 1 = 500 µm pour i et h ; 2 = 500 µm pour a, b, f, j, k, l, m, n, o, p et u ; 3 = 300 µm pour c, d, e et g.

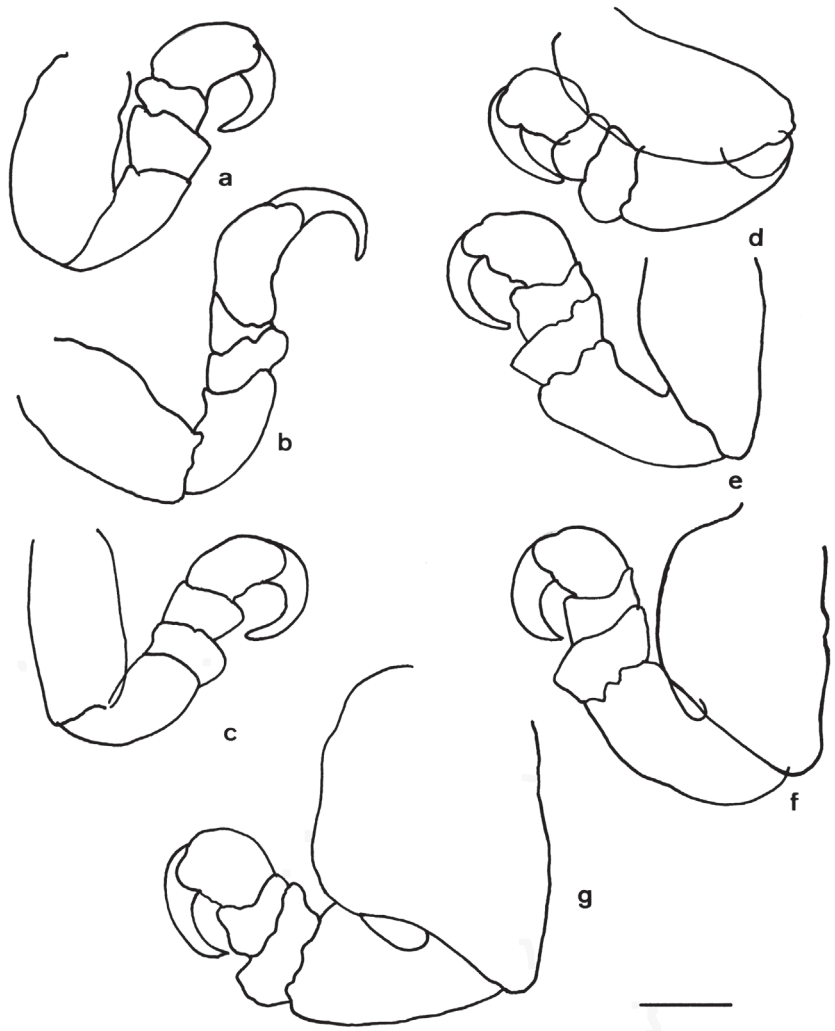

Figure 3. *Ceratothoa marisrubri* sp. nov.
Pereopods of the female. (a) pereopod 1(P1); (b) P2; (c) P3; (d) P4; (e) P5; (f) P6;
(g) P7. Scale bar: 1 mm.
Figure 3. *Ceratothoa marisrubri* sp. nov.
Péréiopodes de la femelle. (a) péréiopode 1(P1) ; (b) P2 ; (c) P3 ; (d) P4 ; (e) P5 ; (f) P6 ; (g) P7. Échelle = 1 mm.

Male (Figure 1c-p).
The body is elliptical and quite globular. The length varies from 9 to 12 mm. The largest width is at the level of the fifth pereonite. Dorsally, all thoracic segments are about the same length, except the first one, which is longer, and the last one, which is shorter. The first segment distinctly protrudes anteriorly, at the level of its two latero-anterior angles, and the two resulting extensions reach the median level of the cephalon (Fig. 1c). The pleotelson is much wider than it is long and the posterior edge is broadly rounded.

The cephalon is well-developed, with an anterior, ovoid-shaped edge.

The antennules (Fig. 1 d) and the antennae (Fig. 1e) have seven segments with no ornamentation, except for three, short, distal, setal bristles on the last segment of A1, and a similar setal bristle on the antero-posterior edge of the fourth segment of A2.

The mandibular palp (Fig. 1 f, g) is composed of three segments, with a row of six to seven setal bristles increasing in size on the internal distal edge of the last segment and one smaller, supplementary setal bristle on the penultimate segment.

The maxillules (Fig. 1 h, i) carry a distal group of 4 slightly hooked spines; five smaller spines are also visible on the maxillae (Fig. 1 j, k), three on the basal endite and two (plus a short setal bristle) on the coxal endite.

The maxillipeds (Fig. 1 l) are composed of three segments. The last one has two spines relatively hooked at its distal end.

The size of the pereopods increases in length and width from the first to the last pereopod. They do not display any ornamentation. However, the seventh pair of pereopods, as in the female, have a very high carina visible at the level of the basipodite.

The pleopod structure is typical. There are no hooking retinacula on the basipodites. The appendix masculina is visible on Pl_2 (Fig. 1 o); its length distinctly surpasses the distal edge of the corresponding endopodite.

The two uropod endites are the same length and do not extend past the posterior edge of the pleotelson (Fig. 1 p).

Taxonomic remarks: Some morphological features of the adult female manifestly places this parasite in the genus *Ceratothoa*, especially : (1) cephalon more-or-less immersed in pereonite I, with anterolateral angles extended and encompassing cephalon; (2) antennules with basal article flattened, broad, in contact; (3) pereopod I-III more slender than V-VII; (4) V-VII basipodites with prominent posterior expansion more-or-less manifestly developped; (5) pleonite I (or pleonite I and II) much narrower than posterior pleonites and immersed in pereon.

The well-developed carina on the P7 basipodite of the female indicates that it is closely related to *Ceratothoa oxyrrhynchaena* Koelbel, 1878; however it differs from this species in the more globular shape of the female, similar to that of *C. steindachneri* Koelbel, 1878, which however has a distinct dorsal hollow on the cephalon which is lacking in *C. marisrubri*.

Furthermore, *C. marisrubri* differs from *C. oxyrrhynchaena* by the presence of: 1) a distinctive setation or spinulation on the mouthpart; 2) a very well-developed carina on the basipodite of P_7 in both the female and the male, whereas in *C. oxyrrhynchaena* this feature is present only in the female (Trilles, 1972a).

Pullus II, which could have provided further distinctive characteristics, was unavailable for comparison.

Finally, it appears that, like other *Ceratothoa* species, *C. marisrubri* is non-specific in its host selection. However, more material is needed to confirm this assumption. The complete geographic range of the species also remains to be determined.

Livoneca Leach, 1818

The validity, limits and synonymy of the genus *Livoneca*, compared with others genera such as *Elthusa* Schioedte & Meinert, 1884 and *Mothocya* Costa (in Hope, 1851), have been recently discussed by Bruce (1986, 1990).

Livoneca papernea sp. nov.
Figs. 4, 5, 6, and 7

Livoneca sp. nov. Colorni, Trilles, Golani, 1997.

Informations on the biology of this parasite was recently reported (Colorni & al., 1997). Its provisional taxonomy is completed here.

Specimens : one holotype and eight paratypes, deposited in the HUJ collection.

The specimens were collected in shallow water on the silverside *Atherinomorus lacunosus* (Forster) (Atherinidae): 22 December 1994, female (with 194 *pulli* I), Holotype, TL 13 mm (Huj Isop. 9); 22 December 1994, male, TL 10 mm (Huj.Isop 9); 22 February 1996, female (with eggs) TL 9 mm and male TL 8 mm (Huj. Isop 10); 22 February 1996, female (with eggs) TL 12 mm (Huj. Isop 11); 22 February 1996, male TL 10 mm (Huj. Isop 12); 22 April 1996, female (non gravid) TL 10 mm and a male TL 8 mm (Huj. Isop 13); 22 February 1996, female (non gravid) TL 8 mm (Huj. Isop 14).

Etymology: this new species is named after Prof. Ilan Paperna, a world renowned parasitologist from the Hebrew University of Jerusalem, to honor his extensive contribution to ichthyoparasitology.

Description

Female (Figure 4a, b; Figure 5a-o; Figure 7h-m).

The body is symmetrical and dorso-ventrally flattened (Fig. 4 a, b). The length in females varies from 8 to 16.5 mm. A very blunt dorsal carina marks the middle of the body wall. The first pereonite is the longest; the following three are about the same length while the size of the last three progressively decreases. All pleonites are visible as none is covered by the pereon. Posteriorly, the pleotelson has a regular, rounded shape; the uropods clearly extend past its posterior edge.

The cephalon is well-developed, triangulate, and encased in the first pereonite. Its anterior end is slightly extended and truncate. The eyes are conspicuous.

The antennules (Fig. 5 a) have eight segments; the second to the eighth, carry each one, two or three short setal bristles, located at either the latero-anterior end, or at the distal end. The antennae (Fig. 5 b) have nine segments; the last segment has a tuft of very short setal bristles at its distal end.

The mandibular palp has three segments, with no particular ornamentation (Fig. 5 c). The maxillules (Fig. 5 d, e) end with four distal slightly hooked spines. The maxillae (Fig. 5 f, g) also carry four spines, two on each endite.

The three-segmented maxillipeds have two spines on the distal segment (Fig. 5 h)

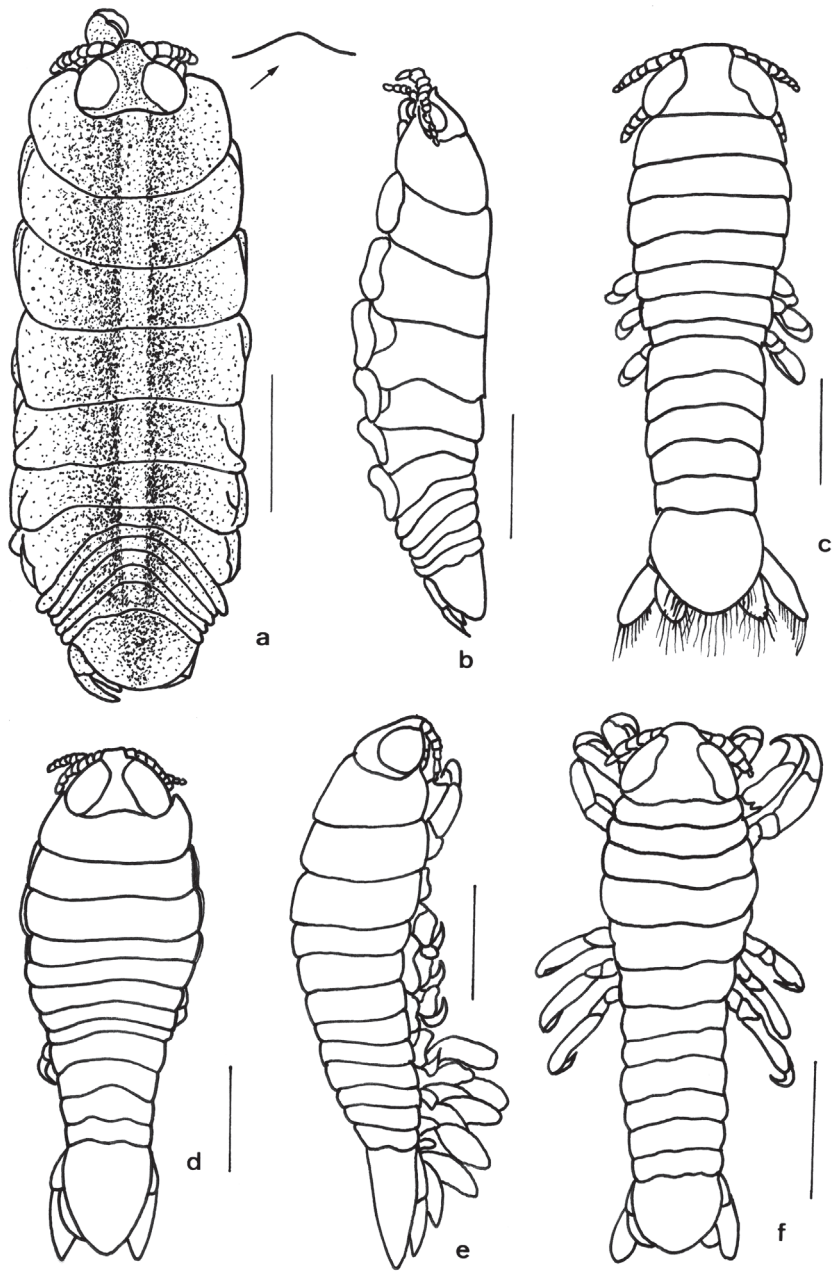

Figure 4. *Livoneca papernea* sp. nov.
(a) and (b) female, dorsal and lateral views (arrow: dorsal carina profile); (c) young male, dorsal view; (d) and (e) adult male, dorsal and lateral views; (f) *pullus* I with only six pairs of pereopods.
Scale bars: 2 mm for a, b, c, d, e and 1 mm for f.
Figure 4. *Livoneca papernea* sp. nov.
(a) et (b) femelle, vue dorsale et vue latérale (flèche : profil de la carène dorsale) ; (c) jeune, mâle vue dorsale ; (d) et (e) mâle adulte, vue dorsale et vue latérale ; (f) *pullus I* avec seulement six paires de péréiopodes.
Échelles = 2 mm pour a, b, c, d, e et 1 mm pour f.

The length of the pereopods is constant, except the first pair. The first three (Fig. 5 i, j, k), (in particular P_2), are the most massive and the last four are the narrowest (Fig. 5 l, m, n, o).

The pleopods are typical, without hooking retinacula. Their size is similar for Pl_1, Pl_2, Pl_3, more reduced for Pl_4 and especially reduced for Pl_5 (Fig. 7 h-l). The uropode exopodite and endopodite are approximately the same length and shape (Fig. 7 m).

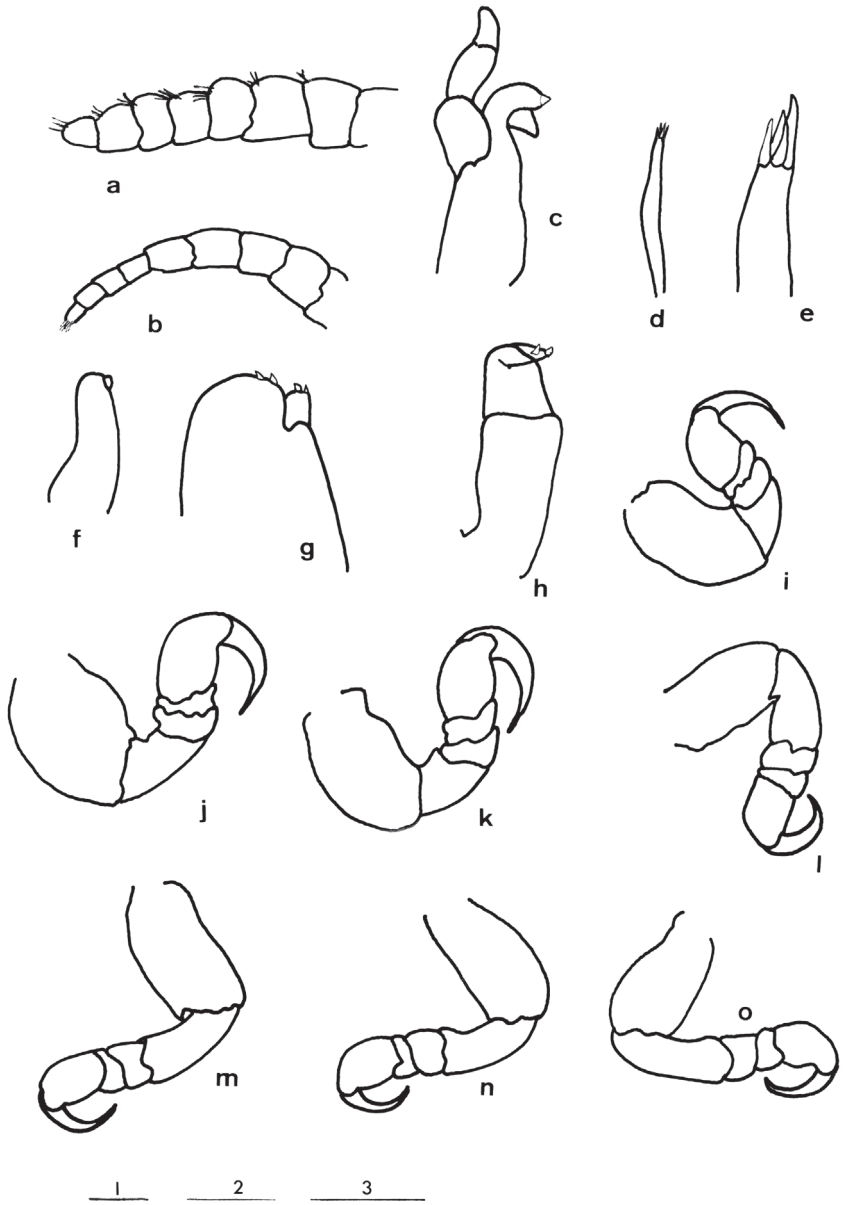

Figure 5. *Livoneca papernea* sp. nov.
(a - o) appendages of the female. (a) antennules; (b) antennae; (c) mandible; (d) maxillule; (e) detail of the maxillule; (f) maxilla; (g) detail of the maxilla; (h) maxilliped; (i) pereopod 1(P1); (j) P2; (k) P3; (l) P4; (m) P5; (n) P6; (o) P7.
Scale bars: 1= 500 µm for i, j, k, l, m, n and o; 2= 300 µm for a, b, c, d, f and h; 3= 100 µm for e and g.
Figure 5. *Livoneca papernea* sp. nov.
(a - o) appendices de la femelle. (a) antennule ; (b) antenne ; (c) mandibule ; (d) maxillule ; (e) détail de la maxillule ; (f) maxille ; (g) détail de la maxille ; (h) maxillipède ; (i) péréiopode 1(P1) ; (j) P2 ; (k) : P3 ; (l) P4 ; (m) P5 ; (n) P6 ; (o) P7
Échelles : 1 = 500 µm pour i, j, k, l, m, n et o ; 2 = 300 µm pour a, b, c, d, f, et h ; 3 = 100 µm pour e et g.

Male (Figure 4c-e; Figure 6a-p; Figure 7a-g).

They are usually symmetrical, sometimes slightly right- or left-bent, conforming to the host branchial cavity they occupy. The body length varies from 7.5 to 10.2 mm and is widest at the third and fourth pereonite (Fig. 4 c-e).

The cephalon is well-developed; as in the female, the anterior end is clearly extended and truncate. The eyes are well-developed and occupy a large part of the dorsal surface of the adult head.

The antennules (Fig. 6 a) are stocky and composed of

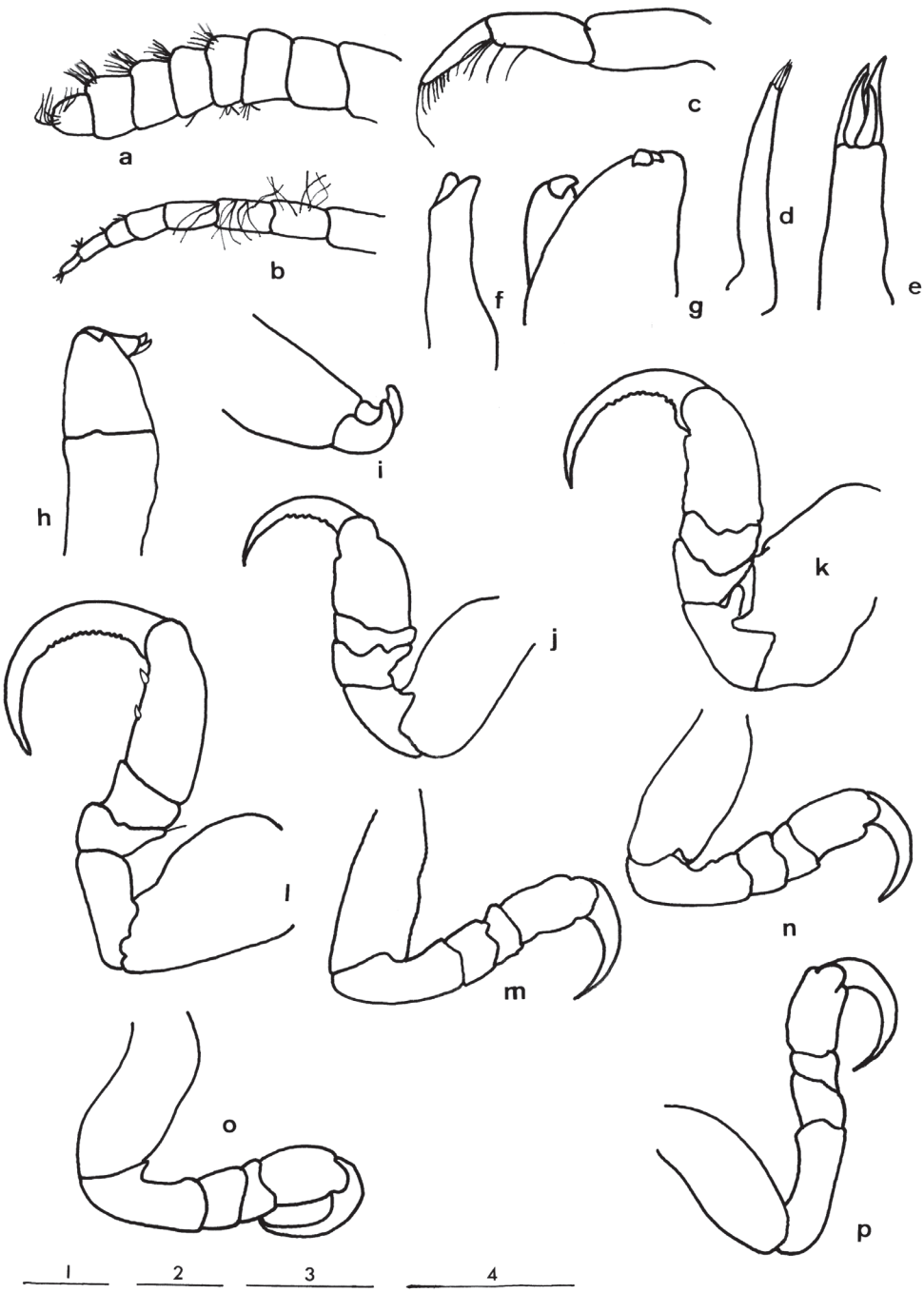

Figure 6. *Livoneca papernea* sp. nov.

Appendages of the male. (a) antennules; (b) antennae; (c) mandibular palp; (d) maxillule; (e) detail of the maxillule; (f) maxilla; (g) detail of the maxilla; (h) maxilliped; (i) distal end of maxilliped; (j) pereopod 1(P1); (k) P2; (l) P3; (m) P4; (n) P5; (o) P6; (p) P7.

Scale bars 1= 500 µm for j, k, l, m, n, o and p; 2= 300 µm for a and b; 3= 300 µm for c, d, f and h; 4= 100 µm for e, g and i.

Figure 6. *Livoneca papernea* sp. nov.

Appendices du mâle. (a) antennule ; (b) antenne ; (c) palpe mandibulaire ; (d) maxillule; (e) détail de la maxillule ; (f) maxille ; (g) détail de la maxille ; (h) maxillipède ; i : extrémité distale du maxillipède ; (j) péréiopode 1 (P1) ; (k) P2 ; (l) P3 ; (m) P4 ; (n) P5 ; (o) P6 ; (p) P7.

Échelles : 1 = 500 µm pour j, k, l, m, n, o et p ; 2 = 300 µm pour a et b ; 3 = 300 µm pour c, d, f et h ; 4 = 100 µm pour e, g et i.

Figure 7. *Livoneca papernea* sp. nov.
(a - g) appendages of the male. (a): pleopod 1; (b): pleopod 2; (c): pleopod 3; (d): pleopod 4; (e): pleopod 5; (f): detail of endopodite of Pl5; (g): uropod.
(h - m) appendages of the female. (h): pleopod 1; (i): pleopod 2; (j) pleopod 3; (k): pleopod 4; (l): pleopod 5; (m): uropod.
Scale bar: 500 µm.
Figure 7. *Livoneca papernea* sp. nov.
(a - g) appendices du mâle. (a) : pléopode 1 ; (b) : pléopode 2; (c) : pléopode 3 ; (d) : pléopode 4 ; (e) : pléopode 5 ; (f): détail de l'endopodite de Pl5 ; (g) : uropode.
(h - m) appendices de la femelle. (h) : pléopode 1 ; (i) : pléopode 2 ; (j) : pléopode 3 ; (k) : pléopode 4 ; (l): pléopode 5 ; (m) : uropode.
Échelle = 500 µm.

eight segments of almost the same length, some of which (three to eight) carry setal bristles on the anterior and/or posterior side.

The antennae (Fig. 6 b), more slender, have eight segments, of similar length in the first four and slightly decreasing in the following four ; the second and third

segments have long setal bristles on the anterior edge, while the fifth, sixth, seventh and eighth segments have one to three very short spines at the antero-distal angle.

The mandibular palp has three segments; the two distal segments have a row of setal bristles (Fig. 6 c). The setae length is the same in the second segment, whereas in the third segment their size increases gradually, except for the last bristle which is considerably longer. The maxillules (Fig. 6 d, e) typically end with four distal spines, only slightly hooked. The maxillae (Fig. 6 f, g) have two spines on the basal endite and one on the coxal endite. The maxillipeds (Fig. 6 h) are three-segmented and have two clearly hooked spines at the distal end of the third segment.

In the young male (Fig. 4 c), the first six pereonites are about the same size: the seventh is definitely shorter. In the adult male, the first pereonite is the longest; the following two are about the same length and slightly shorter than the first one; the last four are shortest and their size gradually and progressively decreases (Fig. 4 d, e).

The pereopods sharply increase from the first to the third (Fig. 6 i, j, k); they all have very well-developed dactyles, with a conspicuous row of indentations on the anterior surface ; a setal bristle is also visible at the postero-anterior angle of meropodite of P_2 ; P_3 has a setal bristle with two short additional spines on the anterior edge of the propodite. The P_4, P_5, P_6 and P_7 are devoid of ornamentation and are more slender than the preceding ones; their dactylopodites are less developed and do not have indentations (Fig. 6 m-p).

The pleopods are the same size, except for Pl_1 which are smaller than the others (Fig. 7 a). The basipodites of the symmetrical pleopods have short setal bristles and/or sparse hooking retinacula. The Pl_2 carry an appendix masculina, slightly shorter than the related endopodite (Fig. 7 b). Pl_1 to Pl_4 are like a typical pleopod, whereas the endopodites of Pl_5 show a leaf-like growth which increases the surface of contact with the environment (Fig. 7 e, f). The uropod exopods and endopods are relatively larger than in the female (Fig. 7 g).

Taxonomic remarks

The generic placement of this species is difficult and some characters, halfway between those of *Livoneca* and *Elthusa* recently clarified by Bruce (1990), suggest that the species could be assigned to a new genus. The morphology of the brood pouch and pleopods of the female is not conform to the morphology of the genus *Livoneca* described by Bruce (1990) and it is closely related to *Elthusa*. However, the absence of the oostegial lobe at the level of the maxillipeds of the ovigerous female, the pleonites not immersed in the pereon, the mandible palp of the female without setae, the male pleopods with folding on the endopod, clearly differentiate this species from *Elthusa*.

Several features rule out its assignment to the closely related genera *Enispa* Schioedte & Meinert, 1884 and *Norileca* Bruce, 1990: the posterior edge of the cephalon, not deeply divided into three lobes, and the five to seven coxal plates, not any longer than the respective segments, distinguish *Livoneca papernea* from the genus *Enispa*; the mandibular palp is neither flattened nor wide, and therefore also different from the genus *Norileca*.

At present, until further studies, it is better to maintain this species in the genus *Livoneca*, than regard it as *incertae sedis*.

This isopod does not correspond to any known species of the genera *Livoneca* and *Elthusa*. The most important, distinctive features are the absence of dissymmetry, the fairly parallel lateral edges, the median carina in the female and the presence in the male of lobes on the endopodites of Pl_5 which are lacking in the female.

These specimens and those described by Colorni & al. (1997) parasitized the Red Sea silverside *Atherinomorus lacunosus*. They were not found in any other species of fish, including *Hypoatherina temminckii* (Bleeker), another Red Sea silverside that shares the shallow coastline habitat with *A. lacunosus* (Colorni & al., 1997). Thus *Livoneca papernea* appears to have a monospecific host range.

Its geographic distribution is probably restricted to the Red Sea. *A. lacunosus* is a lessepsian immigrant into the Mediterranean Sea (Ben Tuvia, 1966; Ben-Tuvia & Golani, 1993), but *L. papernea* has not been detected in fish caught in the Mediterranean Sea and preserved in the collection of the Hebrew University. This suggests that, unlike its host, the isopod failed to survive in the new habitat (Colorni & al., 1997).

Females always occupied the oral cavity of their host, firmly holding onto the tongue. All gravid female, carrying either eggs or *pulli* (Figure 4f) in the marsupium, were coupled with a male settled in either branchial cavity.

Nerocila Leach, 1818
Restricted synonymy
Nerocila Leach, 1818:351
Cymothoa Risso, 1816:143.
Anilocra Risso, 1826 :124.
Ichthyophilus Latreille, 1829:133.
Lironeca Van Beneden, 1871:32.
Pterisopodus Boone, 1918:596-598.
Rosca Stebbing, 1923:10.

The synonymyzation with *Emphylia* Koelbel, 1879 and *Nerocila (Emphylia)* Miers, 1880 is also proposed by Bruce 1987, who recognized two species groups within *Nerocila*: the *Nerocila* group and the *Emphylia* group, the last including particularly *Nerocila sigani* Bowman & Tareen, 1983.

Nerocila sigani Bowman and Tareen, 1983
Fig. 8 a-l
Nerocila (Nerocila) sigani Bowman & Tareen, 1983:12, Fig. 9.
Nerocila sigani.- Bruce, 1987:406; Bruce & Harrison-Nelson, 1988: 597-598, Figs 6G, H, J.
Nerocila (Nerocila) arres Bowman & Tareen, 1983: 7, 8, 12-17, Figs 10-12.
Nerocila arres.- Trilles, 1994:82.

Specimens: one specimen from the caudal fin of the red mullet *Upeneus subvittatus* (Temminck & Schlegel) (Mullidae):11 November 1989, Eilat, Female TL 23 µm (Huj.Isop 15; National Fish Collection of the Hebrew University of Jerusalem).

Identification

Previously described in Kuwait (Arabian Gulf) on the basis of a single female specimen and differenciated from *Nerocila arres* by Bowman & Tareen (1983), this species is considered by Bruce & Harrinson-Nelson, 1988, as the senior synonym of *Nerocila arres*. *Nerocila sigani* is also closely related to N*erocila trivittata* Bleeker, 1856 (= *Nerocila serra* Schioedte & Meinert, 1881). However, it clearly differs from *N. trivittata* in the shape and the size of the latero-posterior extensions of the various pereonites (Fig. 8 a, b), in particular the 6th and the 7th, in the more massive shape of the uropod endopodite (a detail of taxonomic importance according to Bowman & Tareen, 1983), and in the larger size of the indentations visible on its external edge (Fig. 8 c). Similar indentations are also present on both edges of the endopodites in *Nerocila monodi* Hale, 1940 (Bruce, 1987). The mouthparts of *N. sigani*, are described for the first time (Fig. 8 d-k), for further detailed comparaisons and discussions. The mandibular palp is triarticulated, with two setal bristle on the last segment (Fig. 8 d, e). The maxillules (Fig. 8 f, g)

Figure 8. *Nerocila sigani* (female).
(a, b): dorsal and lateral views (bar = 4 mm).
(c - l) appendages. (c): uropods; (d): mandibular palp; (e): distal end of the mandibular palp; (f): maxillule; (g): distal end of the maxillule; (h): maxilla; (i): distal end of the maxilla; (j): maxilliped; (k): distal end of maxilliped; (l): Pereopod (1) with *dactylus* nodules.
Scale bars: 1 = 500 µm for c; 2 = 500 µm for l; 3 = 500 µm for j; 4 = 300 µm for d, f, h, and k; 5 = 100 µm for e, g and i.

Figure 8. *Nerocila sigani* (femelle).
(a, b) : Vue dorsale et vue latérale. Échelles = 4 mm.
(c – l) appendices (c) : uropodes ; (d) : palpe de la mandibule ; (e) : extrémité distale du palpe mandibulaire ; (f) : maxillule ; (g) : extrémité distale de la maxillule ; (h) : maxille ; (i) : extrémité distale de la maxille ; (j) : maxillipède ; (k): extrémité distale du maxillipède ; (l) : péréiopode 1 P1), dactylopodite avec nodules.
Échelles : 1 = 500 µm pour c ; 2 = 500 µm pour l ; 3 = 500 µm pour j ; 4= 300 µm pour d, f, h et k ; 5= 100 µm pour e, g et i.

carry a distal group of 4 slightly hooked spines; two smaller spines are visible on the basal endite of the maxillae (Fig. 8 h, i). The maxillipeds are tri-articulated and have three spines at the distal end of the last segment (Fig. 8 j, k).

Geographic distribution

This species is now known from the Western Indian Ocean and the Northern Indo-Pacific (Bruce & Harrisson-Nelson, 1988).

Hosts

The five female specimens reported by Bowman & Tareen (1983) belong to the collection of the United States National Museum, Smithsonian Institution, Washington. Four were collected in 1977 from *Epinephelus tauvina* (Forskål) (Epinephelidae), *Acanthopagrus latus* (Houttuyn) (Sparidae), *Nemipterus japonicus* (Bloch) (Nemipteridae) and *Siganus oramin* (Bloch & Scheider) (Siganidae), whereas the fifth was collected in 1982 from *Nemipterus tolu* (Valenciennes) (Nemipteridae).

Bruce & Harrison-Nelson (1988) recorded this species from: *Sciaenia dussumier*i (Valenciennes), *Argyrosoma hololepidotus* (Lacépède), *A. macrocephalus* (Tang), *A. nibe* (Jordan & Thompson) (Sciaenidae), *Parastromateus niger* (Bloch) (Carangidae) and *Pomadasys* sp. (Pomadasydae).

The present material has been collected from a red mullet *Upeneus subvittatus* (Temminck & Schlegel) (Mullidae). This extends the range of the hosts. Like many of the others *Nerocila* spp., this species does not seem to be demanding in its host selection.

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