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Redescription of *Nerocila exocoeti* Pillai, 1954 (Crustacea: Isopoda: Cymothoidae) parasitic on beloniform (Exocoetidae and Hemiramphidae) hosts with *Nerocila madrasensis* Ramakrishna & Ramaniah, 1978 placed into synonymy

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Abstract

Nerocila exocoeti Pillai, 1954 is re-described based on the neotype and additional material from exocoetid hosts. *Nerocila madrasensis* Ramakrishna & Ramaniah, 1978 (from Madras) is placed into synonymy with *N. exocoeti*. *Nerocila exocoeti* is characterized by the presence of short coxae, postero-lateral angles of the first five pereonites not backwardly produced, pereonites 6–7 are reduced, cephalon sub-quadrate with anterior border straight; first antenna composed of eight articles and endopod of uropod half the size of exopod. *Nerocila exocoeti* is only known from beloniform hosts; *Parexocoetus brachypterus* and *Exocoetus volitans* (Exocoetidae); *Hemiramphus* sp. and *Rhynchorhamphus malabaricus* (Hemiramphidae) are the identified hosts for the species.

Key words: Cymothoidae, *Nerocila exocoeti,* synonym, re-description, India

Introduction

Nerocila Leach, 1818 is one of the largest genera of the family Cymothoidae comprising more than forty species (Bruce & Schotte 2008), and they belong to the group of externally attaching cymothoids that includes most commonly *Anilocra* Leach, 1818, *Creniola* Bruce, 1987, *Renocila* Miers, 1880 and *Pleopodias* Richardson, 1910. Among them, twelve species have been reported from India (Trilles *et al*. 2011, 2013; Aneesh *et al.* 2013, 2017). Despite recent reports (Trilles *et al.* 2013; Aneesh *et al.* 2017), many of the species of *Nerocila* still require revision not resolve cases of species validity, synonymies and to re-describe historically poorly known species.

The correct identification of most of the species of *Nerocila* Leach, 1818 is difficult at species level and many of the Indian species of *Nerocila*, following the original description, have not been subsequently reported, for instance *Nerocila hemirhamphusi* Shyamasundari, Hanumantha Rao & Kumari, 1990, *Nerocila priacanthusi* Kumari, Hanumantha Rao & Shyamasundari, 1990 and *Nerocila pulicatensis* Jayadev & Sanjeeva, 1980 and the whereabouts of the type material for these species remains unknown.

Nerocila madrasensis was minimally described by Ramakrishna & Ramaniah (1978) who suggested that this species resembled *N. serra* Schioedte & Meinert, 1881 and *N. trichiura* (Miers, 1877). But drawings of *N. madrasensis* provided by Ramakrishna & Ramaniah (1978) matched perfectly with *Nerocila exocoeti*; the key to Indian species of *Nerocila* which included four species, *N. sundaica* Bleeker, 1857, *N. serra, N. phaeopleura* Bleeker, 1857 and *N. madrasensis*, but did not include *N. exocoeti*, described from Travancore, India by Pillai

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(1954) from specimens recovered from *Parexocoetus brachypterus* (Exocoetidae). Bruce (1987) suggested that it was possibly related to *N. trichiura*. Later, *N. madrasensis* and *N. trichiura* were provisionally synonymised by Trilles (1994) and Trilles *et al.* (2013). In the present work, Trilles's *et al.* (2013) neotype designation for *Nerocila exocoeti* Pillai, 1954 is validated and the species is re-described based on neotype and additional materials collected from exocoetid host. The validity of *N. madrasensis* is re-assessed by examination the type and non-type materials of *N. madrasensis.*

Material and methods

Several fresh and live specimens of *Nerocila exocoeti*, were collected from the Marina Beach fish landing centre, Chennai, India (13°050'N, 80°28°E; Bay of Bengal) from *Parexocoetus brachypterus* (Exocoetidae), and from the Ayyikkara fish landing centre (11°51'N, 75°22'E; off the Malabar Coast, India) from *Rhynchorhamphus malabaricus* (Hemiramphidae). The collected live cymothoids were killed and fixed in 5% formalin for 2 hrs and then thoroughly washed in distilled water to remove the formaldehyde. The fixed parasites were then dehydrated through graded alcohol series and preserved in 75% ethanol.

The type series of *N. madrasensis*, comprising the holotype and two paratypes in good condition, were also examined. Methods for dissection and mounting of appendages were according to Aneesh *et al.* (2016). The specimens were microphotographed using multi focusing dissection microscope Leica-M205A and image capturing software (Leica Application Suit). Drawings of the mouthparts and appendages were performed using a camera lucida attached to the microscope. Fish taxonomy and host nomenclature were performed according to Fish Base (Froese & Pauly 2015) and Catalogue of Fishes (Eschmeyer 2015). The non-type materials are deposited in National Zoological Collections of Zoological Survey of India (NZC-ZSI).

New material has all been deposited in National Zoological Collections of Zoological Survey of India (NZC-ZSI).

Taxonomy

Suborder Cymothoida Wagele, 1989

Superfamily Cymothooidea Leach, 1814

Family Cymothoidae Leach, 1814

Genus *Nerocila* Leach, 1818

Nerocila Leach, 1818: 351.—Desmarest 1825: 307; Edwards 1840: 250; Dana 1853: 747; Schiodte & Meinert 1881: 4; Gerstaecker 1882: 231; Richardson 1905: 219; Hale 1926: 202; Monod 1931: 5; Van Name, 1936: 431; Barnard, 1936: 163; Brian & Dartevelle, 1949: 135; Szidat, 1955: 216; Kensley 1978: 82; Kussakin 1979: 275; Brusca 1981: 150; Menzies & Kruczynski 1983: 55; Brusca & Iverson 1985: 45; Bruce 1987: 355–412; Yu & Li, 2002: 266–269.

Ichthyophilus Latreille, 1802: 133.
Emphylia Koelbel, 1879: 413–414.
Pterisopodus Boone, 1918: 596.
Nerocila (Emphylia) Miers, 1880: 4.—Bowman 1978: 34.

Type species: *Nerocila blainvillei* Leach, 1818 (see Bruce 1987).

Neotype designation for *Nerocila exocoeti* Pillai, 1954: Trilles *et al.* (2013) designated a neotype for *Nerocila exocoeti* Pillai, 1954, though this action was not justified by the authors and thus did not meet the requirements of The Code Article 75.3 (Anon 1999), and as such is not valid. The original description of *Nerocila exocoeti* Pillai, 1954 was accompanied by brief descriptions of the adult female. Pillai (1954) specified that the only distinguishing character of *N. exocoeti,* was the proportional size of the coxal plates, coxa 2 being small, not extending beyond the

posterior border of the segment and the coxa 7 reaching the anterior margin of pleonite 1 and that the whole body was 'steel blue' in colour; males were not described. Although the description contains some species-specific details, the level of detail is inadequate by modern standards. Fortunately the type locality (Trivandrum, Kerala Coast) and the type host of *N. exocoeti* were clearly stated, namely *Parexocoetus brachypterus* (Richardson) (Exocoetidae). Pillai (1954) stated that the holotype was deposited in Indian museum, Kolkata but they didn't give a registration number. Enquiries at the Indian museum failed to reveal any material that could be definitely identified, or indeed even potentially considered as the type material for material for *N. exocoeti*. As there are no museum records of Pillai's (1954) material it seems that, inevitably, the types were either not deposited or have been subsequently lost.

There are few subsequent records of this species; Bruce and Harrison-Nelson (1988), reported *N. exocoeti* from *P. brachypterus* and *Scomberomorus multiradiatus* (Scombridae) (may be as gut content) from Papua New Guinea, Indonesia, and from Taiwan. Sivasubramanian *et al.* (2011) published photographs of *N. exocoeti* from flying fish *Exocoetus volitans* (Exocoetidae) collected from the Parangipettai, southeastern coast of India without providing any description. The most recent account and redescription is that of Trilles *et al.* (2013).

The new material of *Nerocila exocoeti* Pillai, 1954 described here is from the type host *Parexocoetus brachypterus* (Exocoetidae) from Marina Beach, Chennai, India, 13.0500°N, 80.2824°E, Bay of Bengal. We uphold the Trilles *et al.* (2013) neotype designation (MNHN-IU-2009-1937) from *Exocoetus volitans* (Exocoetidae) collected from Parangipettai, South Eastern Coast of India coll. by Rameshkumar on 12 April 2011 and submitted in MNHN by J.P. Trilles. The Parangipettai, South Eastern Coast of India, is approximately 450 km away from Pillai's (1954) original type locality (Trivandrum, Kerala Coast). We consider the new type locality resulting from the neotype designation to be similar from the original type locality "as nearly as practicable from the original type locality" (Anon 1999, ICZN, Art. 75.3.6).

The present Indian material agrees well with the description and figures given by Pillai (1954)—the proportional size of the coxal plates, coxa 2 not extending beyond the posterior border of the segment and coxae 7 reaching the anterior of pleonite 1, and that the entire dorsal surface of the body is steel blue in color. The present material is 28 mm in size. We are confident that the present material from Parangipettai, South Eastern Coast of India (MNHN-IU-2009-1937) from *Exocoetus volitans* Linnaeus (Exocoetidae), submitted in MNHN by J.P. Trilles, coll. Rameshkumar on 12 April 2011 and Pillai's material from Trivandrum, Kerala Coast is the same species, and we have taken the decision to designate a neotype in order to conserve Pillai's (1954) name and concept of this species and the future use of this name.

Nerocila exocoeti Pillai, 1954

(Figs 1–7)

Nerocila exocoeti Pillai 1954: 12–13, fig. 6.—Kurochkin 1980: 289; Bruce 1987: 404; Bruce & Harrison-Nelson 1988: 592–593, fig. 4; Bruce & Bowman 1989:1; Trilles 1994: 89; Kensley 2001: 233; Sivasubramanian *et al.* 2011: 99–101, figs 1–4; Aneesh 2014: 23–62, figs 2.9 c–d; Trilles, Rameshkumar & Ravichandran 2013: 1273–1286, figs. 2c, 7a–i, 8, 9.
Nerocila madrasensis Ramakrishna & Ramaniah, 1978: 177–180, figs 1–3 (**new synonymy**).

Materials examined. *Type material*: ***Neotype***—1♀ , 28 mm, ovigerous, Parangipettai, southeastern coast of India from *Exocoetus volitans* Linnaeus (Exocoetidae), deposited in MNHN by J.P. Trilles, coll. Rameshkumar on 12 April 2011 (MNHN-IU-2009-1937).

Holotype—1 ♀, 27 mm, ovig., Madras (Tamil Nadu), from *Hemiramphus* sp. coll. P. Venkata Ramaniah, (C-1680/2); ***Paratypes***—2 ♀, 26 mm, ovig., 24 mm partially molted, Madras (Tamil Nadu), coll. P. Venkata Ramaniah, (C-1681/2) [originally deposited as *Nerocila madrasensis* by Ramakrishna & Ramaniah (1978)]

Non type material: 1 ♀, 26 mm, ovig., Marina Beach fish landing centre, Chennai, India, 13°05'N, 80°28'E, Bay of Bengal, from *Parexocoetus brachypterus* (Richardson) (Exocoetidae), coll. P.T. Aneesh on 22 April 2017 (C-7151/2); 1 ♀, 26 mm, ovig., Ayyikkara fish landing centre, 11°51'N, 75°22'E, Malabar Coast of Kerala, India from *Rhynchorhamphus malabaricus* (Hemiramphidae) coll. P.T. Aneesh & A.K. Helna on 8 August 2017 (C-7152/2).

Description. *Female. Body* symmetrical, about 2.4–2.8 times as long as wide, widest at pereonite 5–6. Cephalon longer than wide, anterior margin rounded; eyes with facets not much developed and indistinct. All coxae visible in dorsal view, 2–4, produced into rounded processes, not exceeding beyond posterior margin of

pereonites; coxae 5–7 longer than the anterior and the posterior margin acute, extending beyond posterior of pereonites. Pereonites 1 and 5–6 longest, 2–4 subequal; pereonite 7 slightly shorter than 6; posterior angles of pereonites 1–5 not produced; postero-lateral angles of pereonite 6 reduced and 7 produced posteriorly as a pointed process. Pereonites 5–6 widest and slightly wider than pereonite 7. Pleonites all visible, pleonite 1 shortest, pleonite 5 longest and widest, pleonies 2–4 subequal; Ventro-lateral margins of pleonites 1–2 posteriorly directed and acute, extending beyond the pleonite 5; pleonites 3–5 lateral margins weakly acute. Pleotelson 1.1 times as wide as long, lateral margins convex.

FIGURE 1. *Nerocila exocoeti* Pillai, 1954, Female neotype (28 mm, ovig.) (MNHN-IU-2009-1937). A, dorsal view; B, ventral view; C, lateral view; D, cephalon.

FIGURE 2. *Nerocila exocoeti* Pillai, 1954, from *Parexocoetus brachypterus* (Richardson) (Exocoetidae), female (26 mm, ovig.) (C-7151/2). A, dorsal view; B, ventral view; C, lateral view.

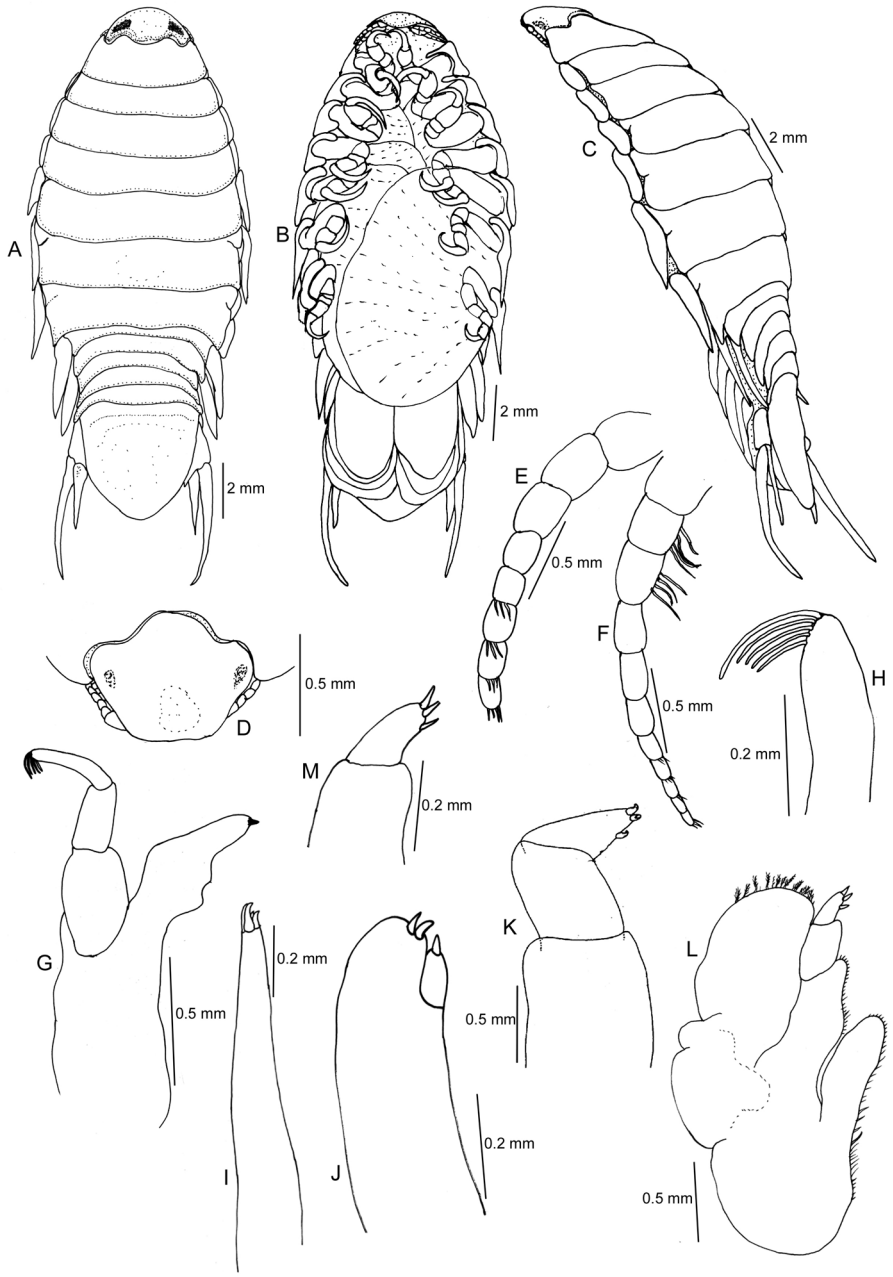

FIGURE 3. *Nerocila exocoeti* Pillai, 1954, from *Parexocoetus brachypterus* (Richardson) (Exocoetidae), female (26 mm, ovig.) (C-7151/2). A, dorsal view; B, ventral view; C, lateral view; D, cephalon; E, antennula; F, antenna; G, mandible; H, mandible palp apical segment; I, maxillula; J, maxilla; K, maxilliped of non-ovigerous female; L, maxilliped of ovigerous female; M, distal segment of maxilliped palp.

Antennula distinctly stouter than antenna, 8 articled, distal margin of articles 5–7 with cluster of esthetes, article 8 with 4–6 terminal esthetes.

Antenna, 10–11 articled, decreasing gradually in width, article 7–10 with distal setae and article 2 and 3 with 3 elongated setae.

Mandible palp, article 1 longest and widest and article 3 with 4–5 marginal setae and one long apical recurved seta.

Maxillula with 4 apical spines slightly recurved.

Bi-lobed *maxilla* with 2 spines on median lobe and 1 spine on lateral lobe.

Maxilliped with oostegial lobe with many plumose setae and a palp with 2 apical and one lateral small recurved spines on article 3.

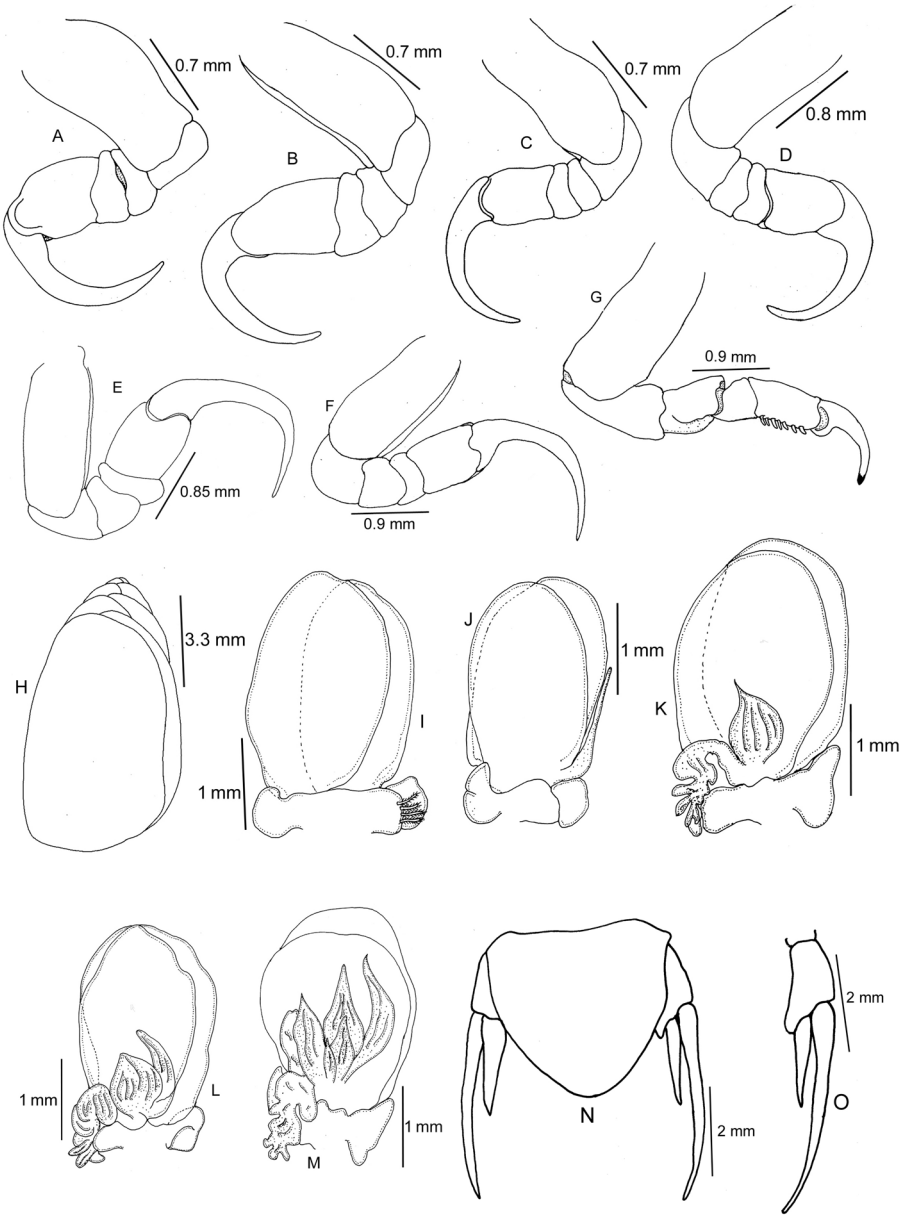

FIGURE 4. *Nerocila exocoeti* Pillai, 1954, from *Parexocoetus brachypterus* (Richardson) (Exocoetidae), female (26 mm, ovig.) (C-7151/2). A–G, pereopods 1–7; H, brood pouch; I–M, pleopods 1–5; N, uropods and pleotelson; O, uropod rami.

Pereopods gradually increase in size from 1 to 7. *Pereopods* 1–6 without marginal robust setae, dactylus longer than propodus; propodus of *pereopod* 7 with 5–7 marginal spines.

Pleopods not distinctly visible in dorsal view; pleopod 1–2, endopod without lobes, protopod medial margin of pleopod 1 with few plumose setae. *Pleopod* 2 with appendix masculina about half the length of endopod; endopod of pleopod 3 with a single lobe, 4 with 2–3 lobes and pleopod 5 with several lobes and several large folds. Proximo-medial lobe of pleopod 3-5 well-developed and folded.

Uropod rami slender, tapering and sub-linear exopod and endopod, exopod about two times longer than endopod. Endopod extending scarcely beyond the posterior margin of pleotelson and exopod extending far beyond it.

Brood pouch with 4 pairs of overlapping oostegites arising from the bases of pereopods 2, 3, 4 and 6. Number of eggs or larvae per brood pouch ranges from 130 to 300 according to the size of the female.

Size. Ovigerous female (16–28; avg. 26 mm), non-ovigerous female (13–26; avg. 22 mm).

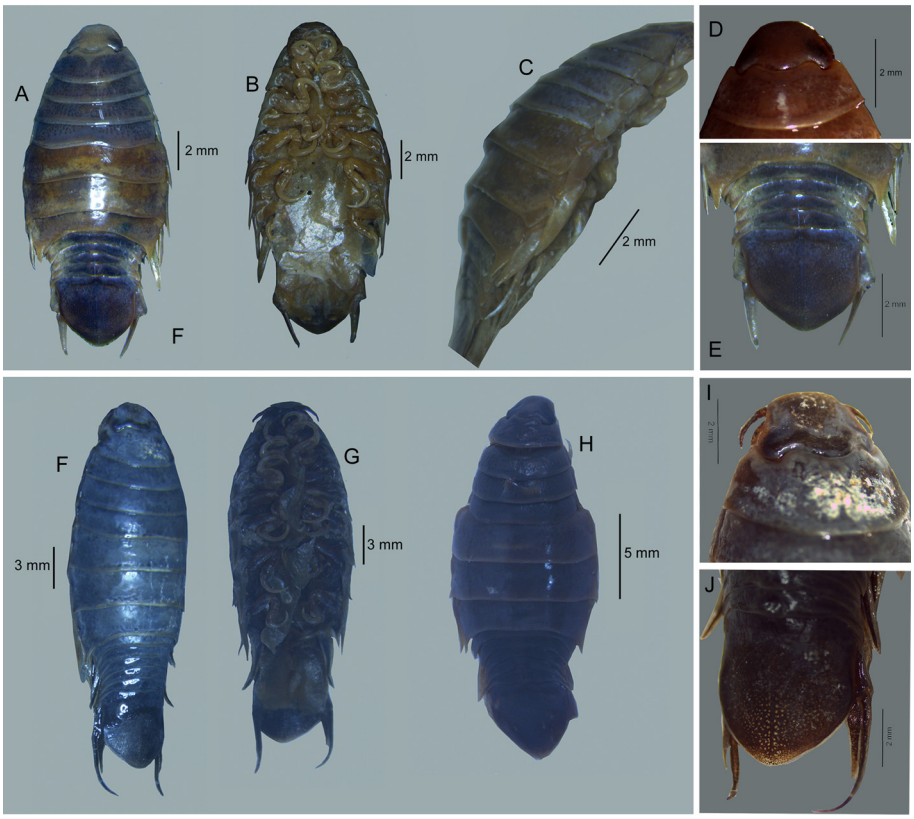

FIGURE 5. *Nerocila madrasensis* described by Ramakrishna & Ramaniah (1978); A–E, female, holotype (C-1680/2), F–J, female, paratype(C-1681/2). A, dorsal view; B, ventral view; C, lateral view; D, cephalon; E, posterior region, F, dorsolateral view; G, ventral view; H, dorsal view of female (partially molted); I, cephalon; J, posterior region.

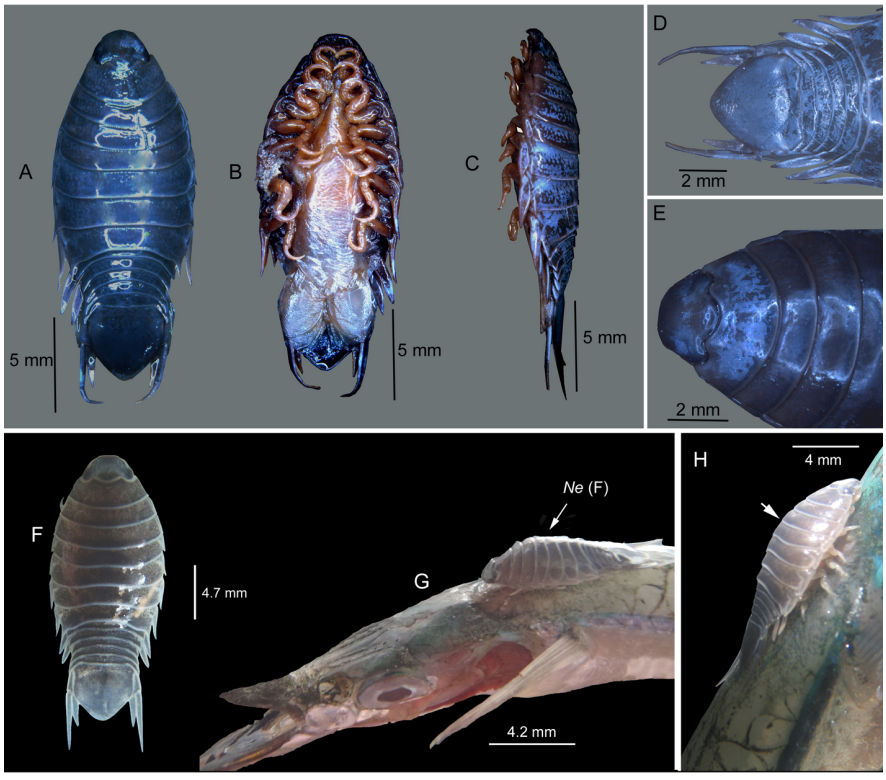

FIGURE 6. *Nerocila exocoeti* Pillai, 1954, collected from *Rhynchorhamphus malabaricus,* female (26 mm, ovig.)(C-7152/2). A–E, alcohol preserved, A, dorsal view: B, ventral view; C, lateral view; D, posterior region: E, anterior region, F, dorsal view, live/fresh color; G–H, live on host fish *Rhynchorhamphus malabaricus*.

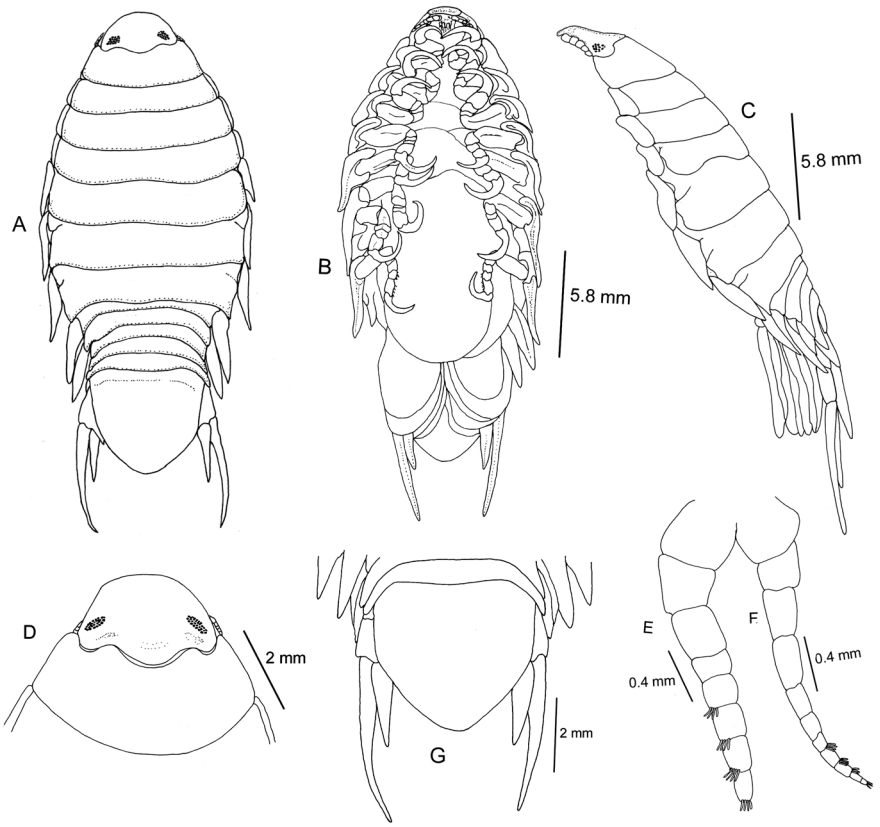

FIGURE 7. *Nerocila exocoeti* Pillai, 1954, collected from *Rhynchorhamphus malabaricus* female (26 mm, ovig.)(C-7152/2). A, dorsal view; B, ventral view; C, lateral view; D, cephalon; E, antennula; F, antenna; G, uropods and pleotelson.

Colour. Steel blue.

Host. *Scomberomorus multiradiatus* (Scombridae) (may be from gut contents); *Parexocoetus brachypterus* and *Exocoetus volitans* (Exocoetidae); *Hemiramphus* sp. and *Rhynchorhamphus malabaricus* (Hemiramphidae) (Pillai 1954; Ramakrishna & Ramaniah 1978; Bruce & Harrisson-Nelson 1988; Sivasubramanian *et al.* 2011; Trilles *et al.* 2013; Aneesh 2014).

Distribution. Trivandrum (Kerala, India) (Pillai 1954); Madras (Tamil Nadu, India) (Ramakrishna & Ramaniah 1978; present study); Papua New Guinea, Indonesia and from Taiwan (Bruce & Harrisson-Nelson 1988); Parangipettai, Southeastern coast of India (Sivasubramanian *et al.* 2011; Trilles *et al.* 2013); Malabar Coast, Kerala (Aneesh 2014; present study).

Remarks. *Nerocila exocoeti* can be easily distinguished from the other known species of the genus *Nerocila* by the following characters: short coxae, postero-lateral angles of the first five pereonites not posteriorly produced, those of 6–7 reduced, cephalon sub-quadrate with anterior border straight; first antenna composed of eight articles and endopod of uropod half the size of exopod. *Nerocila exocoeti* exhibits oligoxenous host specificity towards beloniform fishes; *Parexocoetus brachypterus* and *Exocoetus volitans* (Exocoetidae); *Hemiramphus* sp. and *Rhynchorhamphus malabaricus* (Hemiramphidae) are the identified hosts for the species. So far, only *N. exocoeti* and *N. trichiuri* have been collected from fishes belonging to the family Exocoetidae and both of these species are readily distinguished from each other. In *N. exocoeti* the uropods are much longer, exopod and endopod extending far beyond the distal margin of pleotelson. In *N. trichiuri* the coxae and postero-lateral angles of pereonites bluntly rounded and the live specimens of *N. trichiuri* are pale in colour.

In conclusion, the present study re-described the species based on the neotype collected from exocoetid host, *Parexocoetus brachypterus* and also compared the material collected from hemiramphid hosts; such as *Hemiramphus* sp. and *Rhynchorhamphus malabaricus* and also thoroughly examined the type materials (holotype and two paratypes) of *Nerocila madrasensis.* All morphological characters of *Nerocila exocoeti* collected from hemiramphid host (*Rhynchorhamphus malabaricus*) and the type material of *Nerocila madrasensis* collected from

Hemiramphus sp. showed substantial similarity to *Nerocila exocoeti* collected from exocoetid host (*Parexocoetus brachypterus*). The present study clearly states that the *Nerocila madrasensis* described from Madras sea shore waters, by Ramakrishna &Ramaniah, (1978) should be treated as a synonym of *Nerocila exocoeti* Pillai, 1954.

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References

Aneesh, P.T., Sudha, K., Arshad, K., Anilkumar, G. & Trilles, J.P. (2013) Seasonal fluctuation of the prevalence of cymothoids representing the genus *Nerocila* (Crustacea, Isopoda), parasitizing commercially exploited marine fishes from the Malabar Coast, India. *Acta Parasitologica,* 58, 80–90.
https://doi.org/10.2478/s11686-013-0112-3

Aneesh, P.T., Sudha, K., Helna, A.K. & Anilkumar, G. (2016) *Mothocya renardi* (Bleeker, 1857) (Crustacea: Isopoda:Cymothoidae) parasitizing *Strongylura leiura* (Bleeker) (Belonidae) off the Malabar coast of India: Redescription, occurrence and life-cycle. *Systematic Parasitology*, 93 (6), 583–599.
https://doi.org/10.1007/s11230-016-9646-8

Aneesh, P.T., Valarmathi, K. & Santanu, M. (2017) Re-description of *Nerocila recurvispina* Schioedte and Meinert, 1881: (Crustacea: Isopoda) from Hooghly river Kolkata, India. *Marine Biodiversity.* [Published online: 27 September 2017]
https://doi.org/10.1007/s12526-017-0799-8

Aneesh, P.T. (2014) *Studies on parasitic crustaceans infesting the fishes of Malabar Coast*. PhD Thesis, Kannur University, 147 pp.

Anonymous (1999) *International Code of Zoological Nomenclature*. International Commission on Zoological Nomenclature, London, i–xxx, 306 pp.

Barnard, K.H. (1936) Isopods collected by the R.I.M.S. "Investigator". *Records of the Indian Museum*, *Calcutta*, 38, 147–191.

Boone, P.L. (1918) Descriptions of ten new isopods. *Proceedings of the United States National Museum*, 54, 591–604.
https://doi.org/10.5479/si.00963801.54-2253.591

Bowman, T.E. (1978) Restoration of the subgenus *Emphylia* Koelbel for the parasitic isopod *Nerocila sundaica* Bleeker (Flabellifera, Cymothoidae). *Crustaceana,* 34, 33–44.
https://doi.org/10.1163/156854078X00538

Brian, A. & Dartevelle, E. (1949) Contribution à l'étude des isopodes marins et fluviatiles du Congo. *Annales du Musée du Congo Belge, Série C, Zoologie*, 1, 2 (Supplement 3), 77–208.

Bruce, N.L. & Bowman, T.E. (1989) Species of the parasitic isopod genera *Ceratothoa* and *Glossobius* (Crustacea: Isopoda) from the mouths of flying fishes and half beaks (Beloniformes). *Smithsonian Contributions to Zoology,* 489, 1–28.

Bruce, N.L. & Harrison-Nelson, E.B. (1988) New records of fish parasitic marine Isopod Crustaceans (Cymothoidae, subfamily Anilocrinae) from the Indo-West Pacific. *Proceedings of Biological Society of Washington,* 101, 585–602.

Bruce, N.L. (1987) Australian species of *Nerocila* Leach, 1818, and *Creniola* n. gen. (Isopoda: Cymothoidae), crustacean parasites of marine fishes. *Records of Australian Museum*, 39, 355–412.
https://doi.org/10.3853/j.0067-1975.39.1987.174

Bruce, N.L. & Schotte, M. (2008) *Nerocila* Leach, 1818. *World Marine, Freshwater and Terrestrial Isopod Crustaceans database*. Available from: http://www.marinespecies.org/aphia.php?p=taxdetails&id=118417 (accessed 29 November 2017)

Brusca, R.C. & Iverson, E.W. (1985) A guide to the marine isopod Crustacea of Pacific Costa Rica. *Revista de Biologia Tropical*, 33 (Supplemento 1), i–iv, 1–77.

Brusca, R.C. (1981) A monograph on the Isopoda Cymothoidae (Crustacea) of the eastern Pacific. *Zoological Journal of the Linnaean Society,* 73, 117–199.
https://doi.org/10.1111/j.1096-3642.1981.tb01592.x

Dana, J.D. (1853) Crustacea, Part 11. *In:* Dougal, W.H., Stuart, F.D. & Wilkes, C. (Eds.), *United States Exploring Expedition during the years 1838, 1839, 1840, 1841, 1842, under the command of Charles Wilkes, U.S.N.* Vol. 14. C Sherman,

Philadelphia, pp. 689–1618. Atlas, pls. 1–99, 1885.
Desmarest, A.G. (1825) *Considération générales sur la classe des Crustacés*. Strasbourg : F.G. Levrault, Paris, pp xix + 446, 56 pls.
Eschmeyer, W.N. (2015) Catalog of fishes: Genera, Species Reference.
Froese, R. & Pauly, D. (2015) Fishbase. Version (02/2015) World Wide Web electronic publication. Available from: http://www.fishbase.org (accessed 30 March 2017)
Gerstaecker, A. (1882) Sechste Ordnung. Isopoda Asseln (Part), *In:* Hoffmann, C.K., (Ed.), *Dr. H.G. Bronn's Klassen und Ordnungen des Thier-Reichs, wissenschaftlich dargestellt in Wort und Bild.* Leipzig und Heidelberg,C. F. Winter, pp. 97–278., pls 1, 24.
Hale, H.M. (1926) Review of Australian isopods of the Cymothoid group. Part 11. *Transactions of the Royal Society of South Australia*, 50, 201–234, pls 26, 27.
Kensley, B. (1978) *Guide to the marine isopods of southern Africa*. South African Museum, Cape Town, 173 pp.
Kensley, B. (2001) Biogeography of the marine Isopoda of the Indian Ocean, with a check-list of species and records. *In*: Kensley, B. & Brusca, R.C. (Eds.), *Isopod systematics and evolution,* 13. CRC Press, Taylor & Francis Group , England , pp. 205–264.
Koelbel, K. (1879) Veber einige neue Cymothoiden. *Sitzungsberichte der Mathematisch-N aturwissenschaftlichen Klasse der Kaiserlichen Akademie der Wissenschaften,* 78 (1), 40, 1–416, pls 1, 2.
Kurochkin, Y.V. (1980) On the parasitic fauna of flying fishes (family Exocoetidae) in the world ocean. *Akademii Nauk, Trudy Instituta Okeanografii,* 97, 276–296. [In Russian with English summary]
Kussakin, O.G. (1979) *Marine and Brackish water isopod Crustacea*. Suborder Flabellifera. Akademy of Science, USSR, Leningrad, 470 pp. [in Russian]
Latreille, P.A. (1802) *Histoire naturelle des Crustacés et Insectes*. Volumes 5, 6.F. Dufart,An X-XIII, Paris, 391 pp.
Leach, W.E. (1814) Crustaceology. *In*: Brewster, D. (Ed.), *The Edinburgh Encyclopaedia*. Baldwin, London, pp. 383–437.
Leach, W.E. (1818) Cymothoadées. *In*: Cuvier, F. (Ed.), *Dictionnaire des Sciences Naturelles*. Strasbourg et Levrault, Paris, pp. 338–354.
Menzies, R.J. & Kruczynski, W.L. (1983) Isopoda Crustacea (exclusive of Epicaridea). *Memoirs of the Hourglass Cruises* 6, 1–126.
Miers, E.J. (1880) On a collection of Crustacea from the Malaysian Region - Part IV. Penaeidae, Stomatopoda, Isopoda, Suctoria, and Xiphosura. *Annals and Magazine of Natural History 5 series,* 5, 457–467.
Milne Edwards, H. (1840) *Histoire naturelle des Crustaces comprenent l'anatomie la physiologie et la classification de ces animaux*. Librairie encyclopédique de Roret, Paris, 605 pp.
Monod, T. (1931) Sur quelques crustaces aquatiques d'Afrique (Cameroun et Congo). *Revue de Zoologie et de Botanique Africaine,* 21, 1–36.
Pillai, N.K. (1954) A preliminary note on the Tanaidacea and Isopoda of Travancore. *Bulletin of the Central Research Institute, University of Travancore,* 3 (series C), 1–21.
Ramakrishna, G. & Venkataramaniah, P. (1978) A new cymothoid of the Genus *Nerocila* from Madras. *Bulletin of zoological Survey of India,* 1 (2), 177–180.
Richardson, H. (1905) A monograph on the isopods of North America. *Bulletin of the United States National Museum*, 54, 1–727.
https://doi.org/10.5479/si.03629236.54.i
Schiodte, J.C. & Meinert, F.R. (1881) Symbolae ad monographium Cymothoarum crustaceorum isopodum familiae. 11. *Anilocridae. Naturhistorisk Tidsskrift Series 11,* 12, 1–166, pls 1–10.
Sivasubramanian, K., Ravichandran, S., Rameshkumar, G. & Allayie, S.A. (2011) Infestation of *Exocoetusvolitans* (Linnaeus, 1758), a new host of *Nerocilaexocoeti* (Crustacea, Isopoda, Cymothoidae). *Scientia Parasitologica,* 12, 99–101
Szidat, L. (1955) Beitrage zur Kenntnis der Reliktfauna des La Plata-Stromsystems. *Archiv fur Hydrobio1ogie,* 51, 209–260.
Trilles, J.P., Ravichandran, S. & Rameshkumar, G. (2011) A checklist of the cymothoidae (Crustacea, Isopoda) recorded from Indian fishes. *Acta Parasitologica*, 56, 445–459.
https://doi.org/10.2478/s11686-011-0077-z
Trilles, J.P., Rameshkumar, G. & Ravichandran, S. (2013) *Nerocila* species (Crustacea, Isopoda, Cymothoidae) from Indian marine fishes. *Parasitology Research,* 112, 1273–1286.
https://doi.org/10.1007/s00436-012-3263-5
Trilles, J.P. (1994) Les Cymothoidae (Crustacea, Isopoda) du Monde. *Prodrome pour une Faune. Studia Marina,* 21/22 (1991), 1–288.
Van Name, W.G. (1936) The American land and fresh-water isopod Crustacea. *Bulletin of the American Museum of Natural History*, 71, 1–535.
Wägele, J.-W. (1989) Evolution und phylogenetisches System der Isopoda. Stand der Forschung und neue Erkenntnisse. *Zoologica*, 140, 1–262.
Yu, H. & Li, X. (2002) A new species of the Genus *Nerocila* (Isopoda: Cymothoidae) from the East China Sea. *Chinese Journal of Oceanology and Limnology,* 20 (3), 266–269.
https://doi.org/10.1007/BF02848857