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Morphology of the male of *Pseudocharopinus narcinae* (Pillai) (Copepoda : Lernaeopodidae)

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Abstract. The male of *Pseudocharopinus narcinae* (Pillai) is described and illustrated for the first time. All the other known males of the genus *Charopinus* Kroyer, *Pseudocharopinus* Kabata, *Schistobrachia* Kabata, *Dendrapta* Kabata and *Charopinopsis* Yamaguti are compared with that of *Pseudocharopinus narcinae.*

Keywords. Lernaeopodidae; *Charopinus*-group; Copepoda; male of *Pseudocharopinus narcinae.*

1. Introduction

Pseudocharopinus narcinae was originally described by Pillai (1962) as *Charopinus narcinae* obtained from the gill arches of *Narcine timlei* Bloch and Sch. Subsequent to the revision of the genus *Charopinus* Kroyer by Kabata (1964) the species was transferred to the genus *Pseudocharopinus* Kabata, 1964 where it rightly belonged (Pillai 1967). The female of *P. narcinae* was adequately described by Pillai (1962). The male of this species has never been described.

During the present study of lernaeopodid copepods occurring along the South-West Coast of India we obtained 10 specimens of the hitherto unknown male of *P. narcinae.* This paper gives a detailed description of the male with special reference to the morphology of all the appendages.

2. Materials and methods

Of the 10 males collected eight were found attached to the genital tubercle of the females, while the other two were unusually found attached to the gill filaments of the host fish *Narcine timlei.* All the specimens were fixed and preserved in 10% neutral-buffered formalin. Temporary mounts of the entire animal as well as their appendages were prepared in lactic acid. All the figures were drawn with the aid of a camera lucida.

3. Description of the male

The body (figure 1) divisible into cephalothorax and trunk, the former consisting of an anterior and a posterior portion placed at right angles to each other. Anterior portion swollen, strongly arched dorsally, covered by a well-developed carapace, large mouth tube at the anterior end and posterior margin rounded. Posterior portion cylindrical, two-segmented; first segment, not distinctly delimited from the anterior portion, with massive second maxillae on ventral surface; second segment carrying the maxillipeds, the latter attached to its ventral surface by means of a thick, cylindrical process with a median eminence. This process with two annular thickenings on its disto-lateral surface, a mediative process between the bases of the maxillipeds, and a pair of tubercle-like processes some distance behind the mediative process.

Trunk fully segmented, cylindrical, and in dorsal view slightly narrowing towards the posterior end. Ventral surface of first segment fused with the basal cylindrical process of the maxillipeds by a cuticular extension. Second trunk segment similar to the first but with a slight indentation on its ventral surface. Two pairs of thoracopods also present on the trunk. Genital segment (figure 2) with two short, cylindrical genital processes (gp) on either side of the genital opening; latter covered by the genital plates (gpl). Abdomen small, nearly half the size of the genital segment, with anal laminae (uropods) on the posterior margin.

First antenna (figures 3, 4) indistinctly segmented; basal part slightly inflated; middle region with a long and slender seta; terminal part cylindrical, with a tubercle (solus) at about mid-length of the segment on its dorso-median margin; apical armament with the usual six elements, namely, tubercles 1, 2 and 3 and the setae 4, 5 and 6, numbered according to the method adopted by Kabata (1964).

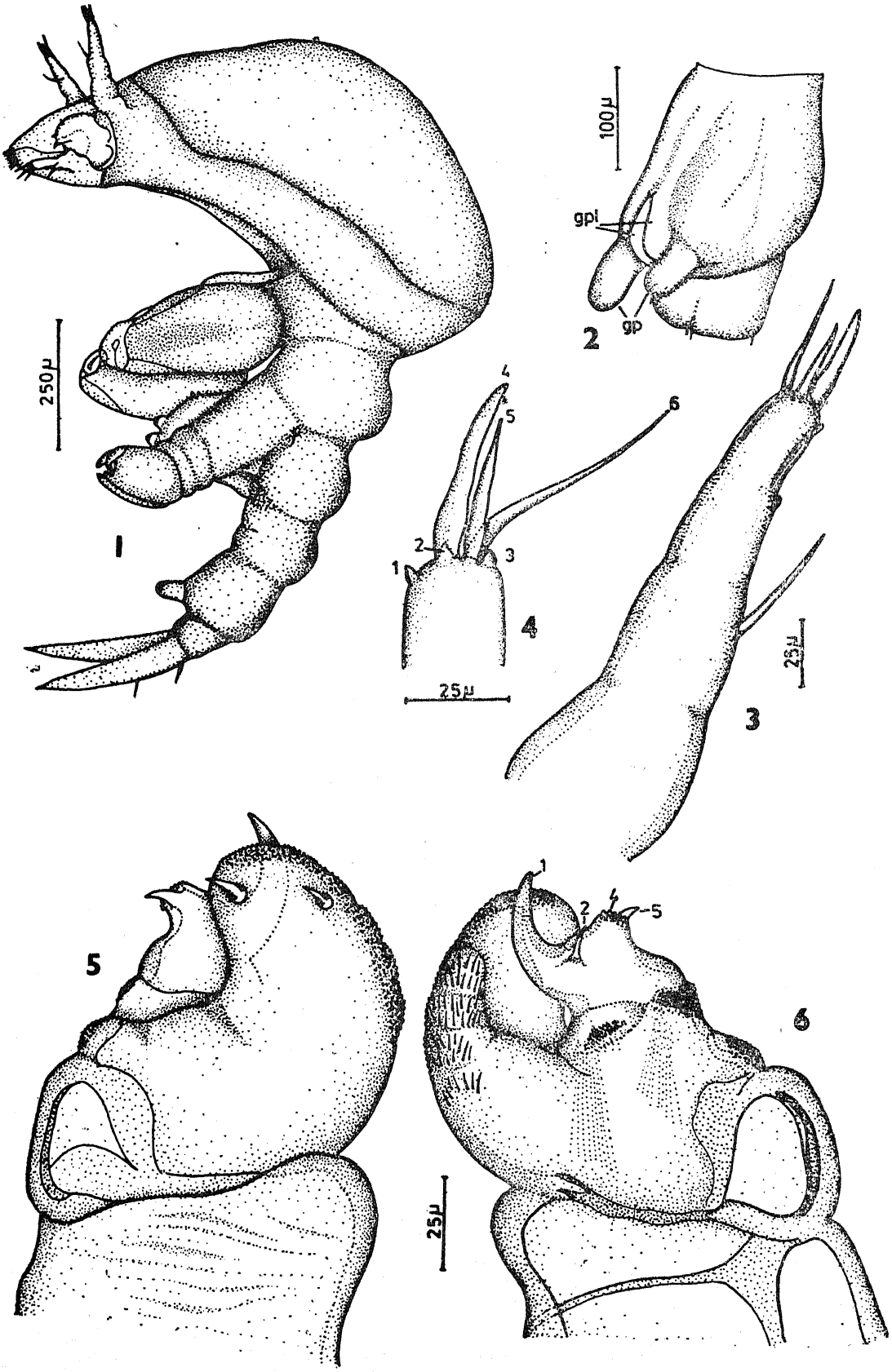
Second antenna (figures 5, 6) biramous, with indistinctly two-segmented sympod; basal segment of sympod unarmed, distal segment with a small pad of minute denticles on its ventral margin. Endopod two-segmented; proximal segment with a spiny pad on its distal ventral margin and a strip of fine spinules on its inner lateral surface; terminal segment with a strong hook (1), a subsidiary spine (2) near base of the hook, ventrally with a process (5) arising from the medial surface of a denticulated pad (4). Exopod large, laminate and covering the endopod from outside; surface armed with numerous denticles and with two prominent papillae; inner proximal end with a thumb-shaped demarcation on lateral margin, covered by slender setae (figure 6).

Tip of labrum (figure 7) with a prominent rostrum and rimmed with numerous flat setae; inner wall with a median process (buccal stylet?) broad at base and tipped with two setiform processes.

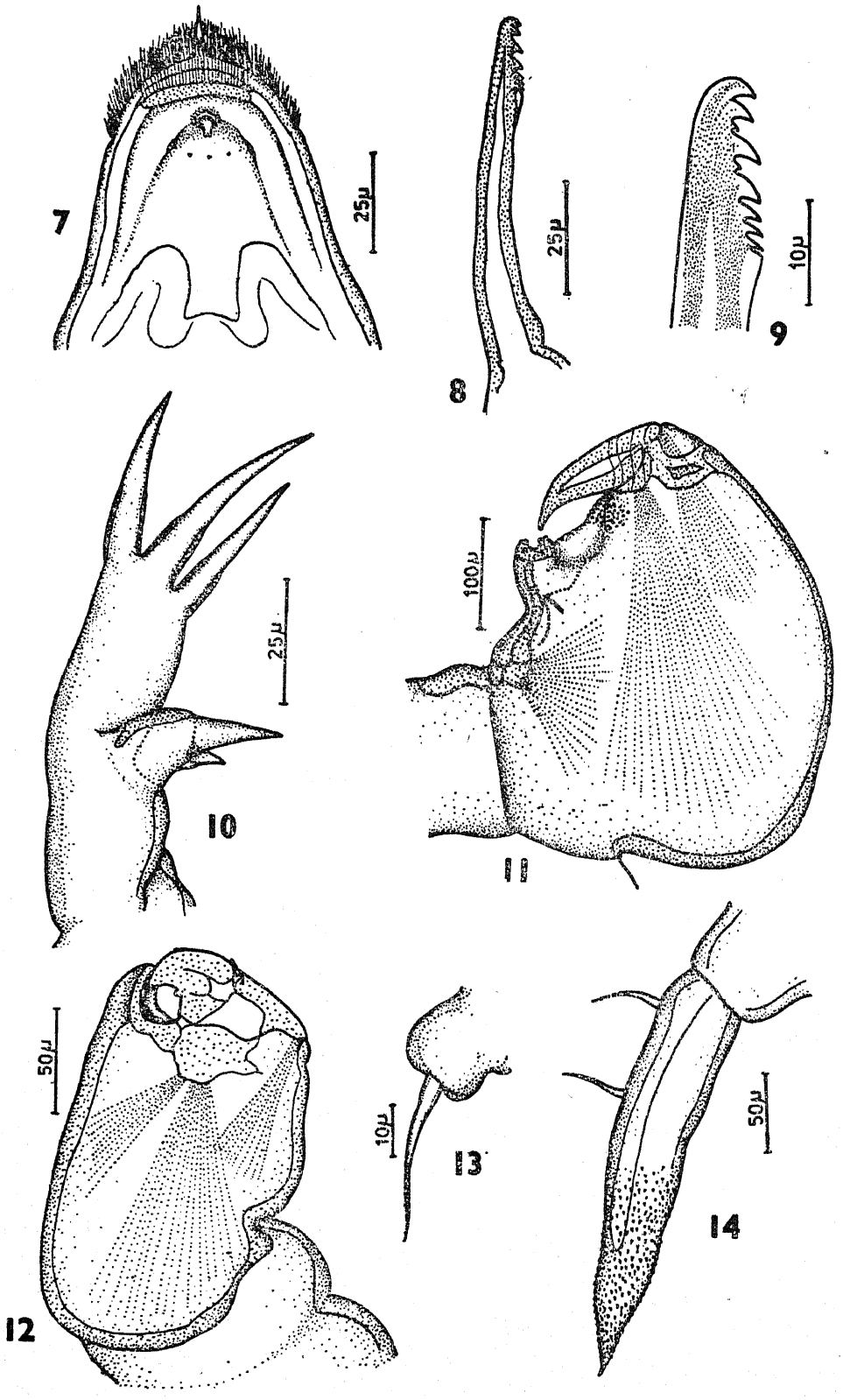
Mandible (figures 8, 9) elongate, slender, with a distal series of three primary teeth followed by a basal series of four progressively smaller teeth. In all the mandibles examined during the present study the first secondary tooth was found missing from its place between the first and second primary. The dental formula: P2, S1, P1, S1, B4.

First maxilla (figure 10) tripartite, inner apical seta smaller than the other two; palp conical with two similar but unequal setae.

Second maxilla (figure 11) sub-chelate, basal segment robust, only slightly longer than broad, and linked with its opposite member by a cuticular membrane;



Figures 1–6. *P. narcinae, male* **1.** Entire, lateral; **2.** Genital segment, ventro-lateral, **3.** First antenna, dorso-lateral; **4.** Same, tip, ventral; **5.** Second antenna, outer view; **6.** same, inner view.



Figures 7–14. *P. narcinae, male* **7.** Labrum, inner view; **8.** Mandible, lateral; **9.** same, tip, lateral; **10.** First maxilla, lateral; **11.** second maxilla, dorsal; **12.** maxilliped, dorsal; **13.** Thoracopod; **14.** Uropod.

medial margin of basal segment raised in the form of a large tubercle tipped with a small cavity surrounded by few blunt denticulate projections; another small prominence on ventral surface near the base of medial tubercle, housing the opening of a duct presumably of maxillary gland. A strip of small denticles also present on the inner distal surface of the basal segment. Sub-chela slender, unarmed with fine tip.

Maxilliped (figure 12) also sub-chelate, smaller than the maxillae. Basal segment longer than broad, distal medial part with an anterior elongation, latter containing a cavity with crenate margin. Sub-chela short, thick with broad base and rapidly tapering tip; short seta near base on ventral surface and tooth-like prominence on inner margin.

Thoracopods (figure 13) simple, papilliform tipped with a long seta.

Uropod (figure 14) cylindrical, drawn out into a fine tip with two slender setae on its lateral surface; cuticle of distal half covered by minute spines.

4. Discussion

Wilson (1915) while revising the family Lernaeopodidae attached considerable importance to the morphology of male in distinguishing the different genera of the Lernaeopodidae. According to him each genus has a distinct type male, and described the type male of the genus *Charopinus* thus : " Anterior portion of the cephalothorax at right angles to the posterior portion and the trunk; no distinct dorsal carapace; thorax segmented with an enlarged genital segment; a well-defined and segmented abdomen, carrying anal laminae. First antenna indistinctly 4-jointed; second antenna biramose, rami usually curved and chelate; first maxilla tripartite, palp with two setae; second maxillae and maxillipeds some distance behind the other mouth parts and close together ".

In his recent review Kabata (1964) divided Kroyer's original genus *Charopinus* into five distinct genera, namely, *Charopinus* Kroyer 1863, *Pseudocharopinus* Kabata 1964, *Schistobrachia* Kabata 1964, *Dendrapta* Kabata 1964 and *Charopinopsis* Yamaguti 1963. All these five genera together constitute the well-known " *Charopinus*-group " of the family Lernaeopodidae. With the exception of the genus *Charopinopsis* all the genera of this group possess morphologically identical type males, the general features of which resemble the type male described by Wilson (1915).

Relatively few descriptions and illustrations of the males of the *Charopinus*-group occur in literature. Most of the existing descriptions are inadequate and do not include the complete series of appendages and the characteristic details of their armament. This may probably be due to the fact that the males of this group are difficult to secure in sufficient numbers for a detailed morphological study. Kabata and Gussev (1966) however, have given a fairly detailed account of the male of *Dendrapta cameroni longiclavata* Kabata and Gussev. Very recently Kabata (1979) has produced an excellent description of the male of *Charopinus dubius* T. Scott, 1900. No such detailed descriptions are so far available for the males of the genus *Pseudocharopinus*, *Schistobrachia* and *Charopinopsis*.

A remarkable feature in the morphology of the male of *P. narcinae* is the presence of a peculiar thumb-shaped demarcation on the inner lateral margin of the exopod of second antennae (figure 6). No such structure has hitherto been

noticed in any of the species belonging to the genus *Charopinus*, *Pseudocharopinus*, *Schistobrachia*, *Dendrapta* and *Charopinopsis* (cf. Kabata 1964 and 1979). This feature seems to be quite rare among Lernaeopodidae.

In its overall structure and in the structure of practically all the appendages the male of the present species *P. narcinae*, closely resembles that of *Charopinus dubius* described by Kabata (1979) except in certain details. The male of *C. dubius* lacks a carapace and the trunk is not distinctly segmented. Minute differences between the males of these two species are also evident in the structure of the second antennae and the mandibles. In *C. dubius* the mandible of the male has a dental formula P1, S2, P1, S1, B5, whereas in the male of *P. marcinae* it is P2, S1, P1, S1, B4.

A comparison of the male of *P. narcinae* with that of *Dendrapta cameroni longiclavata* Kabata and Gussev, 1966 shows that the two are identical in many respects. However, the following differences are noteworthy. In the male of *D. cameroni longiclavata*, unlike those of *P. narcinae* and *C. dubius*, the trunk is swollen and is separated from the cephalothorax by a distinct waist. This male thus shows an affinity with the type male of the genus *Brachiella*. The first antenna in *D. cameroni longiclavata* carries, in addition to the usual set of spines, the spine III and II (Kabata and Gussev 1966) on the dorso-lateral aspect of the basal segment and second segment respectively. No such spines are discernible in the present case. The characteristic spinulations of the first maxilla and maxillipeds in the male of *D. cameroni longiclavata* are absent from the corresponding appendages in the male of *P. narcinae*. Notable also is the apparent absence of segmentation of the uropods in *P. narcinae*.

As the previous descriptions of the males of the genus *Pseudocharopinus* are insufficient in many structural details a full comparison is not possible. However, in its general appearance and shape the male of *P. narcinae* differs only little from the males of the other known species of the genus *Pseudocharopinus*, namely, *P. malleus* (Nordmann) (cf. Vogt 1877), *P. dentatus* (Wilson 1912), *P. pastinacae* (van Beneden) (cf. Capart 1946), *P. markewitschi* (Gussev) (cf. Markewitch 1956) and *P. dasyaticus* (Rangnekar) (cf. Pillai 1962).

In this connection mention may also be made of the genus *Schistobrachia* and *Charopinopsis*. In general build the male of *P. narcinae* resembles that of *Schistobrachia ramosa* (Kroyer) (cf. Yamaguti 1963; Kabata 1979) and *Schistobrachia tertia* Kabata 1970. But it strongly differs from the male of *Charopinopsis quarternia* (Wilson) figured by Yamaguti (1963). In the latter species the cephalothorax is not divided into anterior and posterior portions and moreover the second maxillae and the maxillipeds are placed close to the mouth tube.

From the foregoing it is clear that in all its essential details the male of *P. narcinae* resembles that of *C. dubius* more closely than that of *D. cameroni longiclavata*. A study of several more specimens of the type males of the different genera, however, is needed to elucidate the exact range of variations of their morphological features occurring within the *Charopinus*—group of Lernaeopodidae.

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