Redescription of female specimens of Corycaeus (Corycaeus) crassiusculus Dana and Corycaeus (Onychocorycaeus) catus Dahl (Poicilostomatoida: Corycaeidae) from Kavarathi Atoll, Laks...

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Redescription of female specimens of *Corycaeus* (*Corycaeus) crassiusculus* Dana and *Corycaeus* (*Onychocorycaeus*) *catus* Dahl (Poicilostomatoida: Corycaeidae) from Kavarathi Atoll, Lakshadweep island, India

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ABSTRACT - In 1929 and 1911, the female specimen of *Corycaeus crassiusculus* (Dana, 1848) and *Onychocorycaeus catus* (Dahl 1894) was first recorded in the Indian ocean by Farran and in the Arabian sea by Sewell in 1947. The two species are redescribed by a combination of morphological characteristics as follows in females (1) ornamentation of the first endopodal segment of the antenna of *C. crassiusculus* (2) overlapping of genital segment on anal segment at the dorsal margin in *C. crassiusculus* (3) distal margin of the genital and anal somite ornamented with spines ventrolaterally in both (4) presence of four spines in the third exopodal segments of first, second & third swimming leg in *O. catus* (5) length to width of 1st endopodal segment of the antenna (6) length ratio of coxal seta: 1st endopodal seta; (7) in P1 to P3 exp-3, length ratio of terminal spine to distal segment and to outer distal spine; (8) in P4 exp-3, length ratios of terminal spine to proximal spine and to distal segment. A comparison of the morphological variability with existing descriptions from other regions have also been provided.

KEYWORDS – Taxonomy, Corycaedae, Cyclopoida, Poicilostomatoida, Kavarathi, Arabian sea.

Introduction

The genus *Corycaeus* was established by Dana in 1846. The family Corycaeidae (Dana 1852) including two genera, *Corycaeus* Dana (1845) and *Farranula* (Wilson,1932) are marine pelagic copepods occurring typically in epipelagic zone of tropical to temperate seas (Motoda, 1963; Boxshall & Halsey, 2004; Wi *et al.*, 2013) These groups of copepods are easily recognized by peculiar structure of their bodies and by their large paired eyes, and they are very useful indicator forms of warm ocean currents (Motoda, 1963; Mulyadi, 2003). The genus *Corycaeus* is widely distributed in the Mediterranean Sea (Wilson, 1942); the Indian and Pacific Oceans (Giesbrecht, 1891, 1892); Farran, 1911; Dahl, 1912; Sewell, 1947; Tanaka, (1957, 1960), the North Pacific Ocean (Motoda, 1963), the East China Sea and Yellow Sea (Chen *et al*.,1974; Zheng *et al*.,1982; Kang *et al.*,1990), and Japanese waters (Itoh, 1997). Seven subgenera have been recognized under a single genus *Corycaeus* by Dahl (1912), *Corycaeus* (*Agetus*) (Kröyer, 1849), *Corycaeus* (*Corycaeus*) (Dana, 1845), *Corycaeus* (*Ditrichocorycaeus*) (Dahl,1912), *Corycaeus* (*Monocorycaeus*) (Dahl,1912), *Corycaeus* (*Onychocorycaeus*) (Dahl,1912), *Corycaeus* (*Urocorycaeus*) (Dahl, 1912), and *Corycaeus* (*Corycella*) (Farran, 1911). The genus *Onychocorycaeus* (Dahl, 1912) includes seven species, *O. giesbrechti* (Dahl,1894), *O. agilis* (Dana, 1849), *O. catus* (Dahl, 1894), *O. latus* (Dana, 1849), *O. ovalis* (Claus, 1863), *O. pacificus* (Dahl, 1894), and *O. pumilus* (Dahl, 1912). In this article we provide a comparison of the morphological variability with existing descriptions from other regions and a detailed description on the female specimen of both the species coming under the order Poicilostomatoida from Kavarathi Island,

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Lakshadweep, a part of Arabian Sea and Indian Ocean.

Marine ecosystems of the Lakshadweep Islands are unique, having a very high degree of biodiversity and are highly productive. Study on copepods in Lakshadweep islands seems to be very relevant in this context, as these organisms are greatly diverse, numerically abundant especially in the euphotic zone and primary position in energy transfer at secondary level, forms an important link between primary producers and higher trophic levels in all pelagic food webs.

Materials and methods

Lakshadweep is an archipelago of twelve atolls, three reefs and five submerged banks located in the Arabian sea situated between 8–12°N latitude and 71°45'–73°45' E longitude. Kavarathi, located along latitude 10°33' N and longitude 72°36'E has its lagoon oriented in north to south direction which is approximately 4,500 m long and 1200 m wide with a maximum depth of 3.5m Studies on zooplankton of Lakshadweep atolls are few despite its high productivity and biodiversity. Zooplankton was collected from Kavarathi Island (10^{o} 32' and 10^{o} 35' N latitude and 72^{o} 35' and 72^{o} 40' E longitude,) (Fig.1) using a plankton net (mesh size 200 im) with a mouth area of 0.28 m^{2}. The net was attached with a calibrated flow meter (General Oceanics model number-2030 R, 2012) and was towed horizontally just below the surface with a fixed speed of ~1 knot for a duration of 10 minutes. The samples were then preserved in 4% formalin prepared in seawater and 90% ethyl alcohol for analysis in the laboratory. Specimens of *Onychocorycaeus catus* and *Corycaeus crassiusculus* were sorted under the stereomicroscope; taxonomically important parts were dissected, observed under higher magnifications and mounted in glycerol. Drawings were made with the aid of Camera Lucida using an ALCO compound microscope. Specimens were measured using an ocular micrometer. The descriptive terminology follows Huys and Boxshall (1991).

Both the holotype and the paratype are deposited in the Marine Biology Museum, School of Marine Sciences, Cochin University of Science & Technology

Abbreviations: MBM: Marine Biology Museum, School of Marine Sciences, Cochin University of Science & Technology, Cochin, Kerala, India. DBT: Department of Biotechnology. ae, aesthetasc; CR, caudal rami;PR,Prosome; GS/GDS, Genital somite/Genital double somite; AS, Anal somite; P1- P6, first to sixth thoracopods; exp 1-3, exopods1-3;enp 1-3, endopods1-3;Mxp, Maxilliped.

Systematics and Discussion

Order Poecilostomatoida

Family Corycaeidae Dana, 1852

Corycaeus (Corycaeus) crassiusculus Dana, 1848

Material examined*: Holotype:* female, INDIA: Kerala, Lakshadweep, Kavarathi, 10^{o} 32' and 10^{o} 35' N latitude and 72^{o} 35' and 72^{o} 40' E longitude,3.5 m,collected by Radhika.R and party on April 2013,MBM/DBT/01/14

Description

Female: Dorsally total length measured 0.78 mm (Fig. 2A). Measurements were taken from the anterior end of the prosome to the posterior margin of caudal rami.

Prosome four-segmented, frontal margin arc shaped, with two large separate cuticular lenses; distance between the lenses 44.1µm; prosome about twice longer than urosome including caudal rami (2.6:1.3); about 1.8

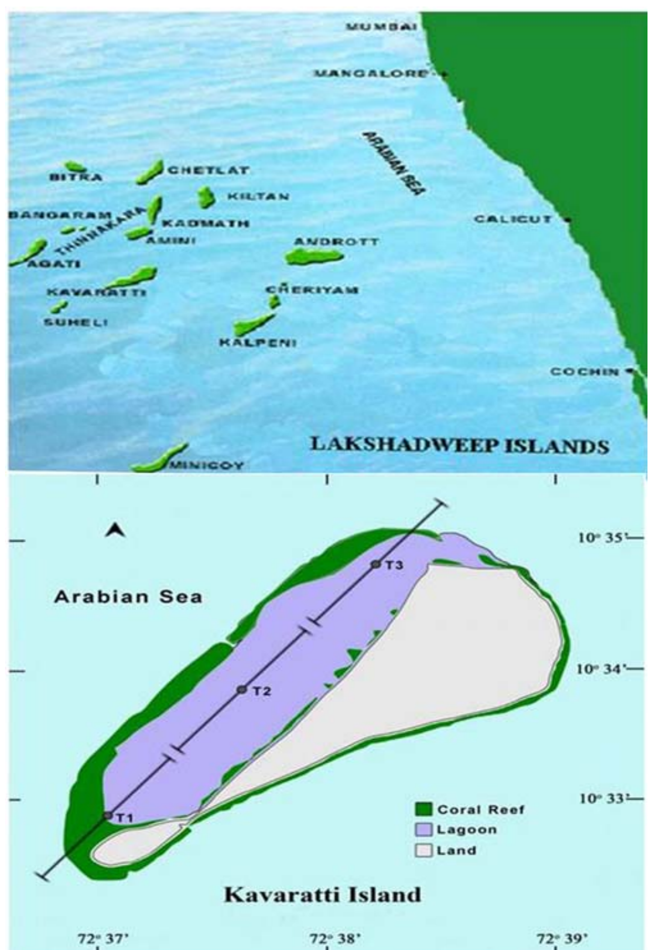

Fig.1. Map of Lakshadweep Island showing the Kavaratti lagoon.

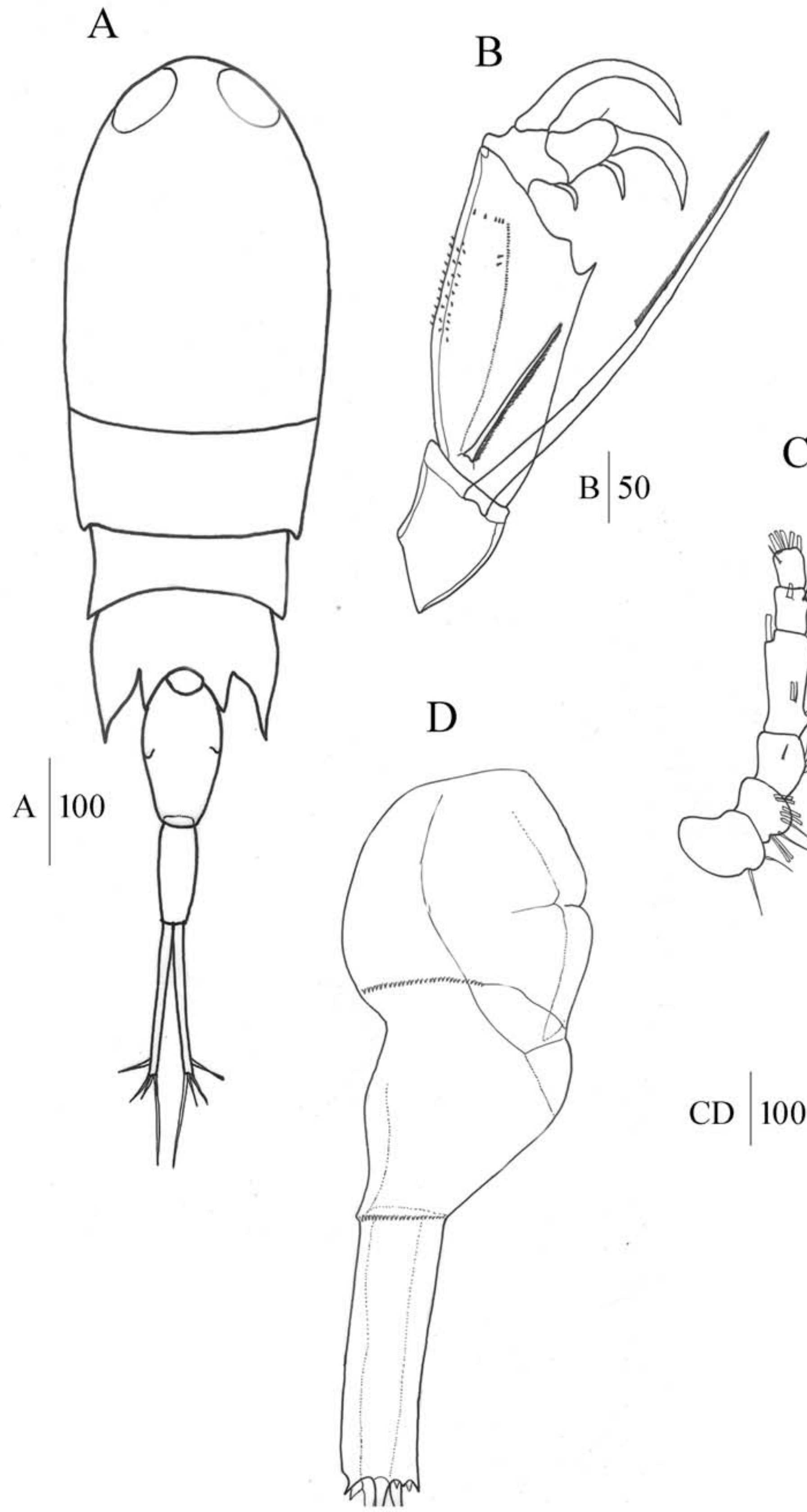

Fig.2. *Corycaeus crassiusculus* female. A, Habitus (dorsal); B, Antenna; C, Antennule; D, Urosome (lateral view).Measurements expressed in µm.

times as long as wide (2.6:1.4). Genital segment is shorter than anal somite and caudal rami combined.

Urosome (Fig. 2D) two segmented with very divergent caudal rami. Genital somite overlaps anal somite at dorsal margin. Width of the anal somite at proximal margin is more than that at the distal margin (12.6:10.2).Proportional lengths of the urosomal somites and CR is 14.7:8.5:10. Genital somite is oval and shorter than anal somite and caudal rami combined. Distal margin of the genital somite bear a horizontal row of spines ventrolaterally. Genital segment is as long as wide.

Anal somite is rectangular shaped with its distal margin ornamented with spinules ventrolaterally; 0.98 times as long as wide at base; slightly shorter than genital somite.

Caudal rami (Fig.2A) divergent, about 1.3 times longer than maximum width at base; 1.1 times longer than anal somite and slightly shorter than genital somite. Each ramus armed with six setae: slender anterolateral setae II,outer posterolateral seta III,shorter,robust and spiniform,Outer terminal seta IV reduced, Inner terminal seta V longest terminal accessory seta VI short and stout and dorsal seta VII.

Antennule (Fig.2C) short, six segmented. Armature formula-1-[2],2-[8],3-[2+ae],4-[3+ae],6-[5+(1+ae)]. Proportional lengths of the segments taken along posterior non setiferous margin 32.5:22.5:27.5:50:27.5:17.5.

Antenna (Fig.2B) four-segmented, with coxa and basis fused bearing three endopodal segments. Coxobasis 1.6 times longer than wide; inner distal margin bears a long stout setae fringed with minute spinules along the inner distal and terminal margin. Endopod three segmented and unequal; first endopodal segment robust, extremely longer than other two endopodal segments, about 2.3 times as long as wide at base; bears unipinnate setae, on inner proximal margin; 2.5 times shorter than coxobasal setae. Midventral surface vertically adorned with smooth denticles along the length of the first endopodal segment. Outer lateral margin randomly decorated with small denticles in which anterolateral margin bears a serial row of five denticles; marginal two are placed equidistant and other three serially. Adjacent to mid ventral row of denticles, along the anteroventral margin two more denticles are also present in which the proximal one is the longest Inner distal margin formed of two comparatively stout teeth like process. Second endopodal segment, shortest of the three bears three elements (a) curved hook like stout spine arising from outer distal margin and is longest (b) a small spine adjacent to its base (c) a blunt end curved spine arising from the inner margin. Third endopodal segment cylindrical slightly as long as wide at base, with a humb like protrusion at the distal part bearing a naked spiniform setae and is drawn into a curved terminal claw with a small blunt spine at inner base.

Maxilla (Fig. 3A) two segmented with syncoxa unarmed. Inner margin of the allobasis bears one element with comb like spine. The other one forms unipinnate spine distally tapering.

Mandible (Fig. 3B) with gnathobase bearing two elements ie, spine and blade where spine is slightly broad and robust. Blade forms spinous process surrounded by patch of spinules around base.

Maxillule (Fig. 3C) with precoxal arthrite bearing four articulated spine like process: 1) innermost one is blunt like without spinules; 2) longest, solid and distal margin has spine like process; 3) short with some spinules on lateral margin and has spine like process on distal margin; 4) short & naked & almost equal in length of (3). Length ratio of the spines 15:25:15:15.

Maxilliped (Fig. 3D) three segmented; solid & expanded basis; 1.8 times as long as wide at base, with an element adorned with spinules at the anterior inner margin. 3.5 times longer than width at base; Endopodal segment formed into a long curved claw, naked and slightly shorter than basis.

Legs 1-3 (Fig. 3E–G) with coxa, basis and three-

Table1. Aramture formula of P1 to P4 of *Corycaeus crassuisculus* female

Leg	Coxa	Basis	Exopod	Endopod
P1	0-1	1-0	1-0;1-1;II,4	0-1;0-1;0,2,3
P2	0-1	0-0	1-0;1-1;II,5	0-1;0-2;0,1,3
P3	0-0	1-0	1-0;1-1;III,5	0-1;0-2;0,1,1
P4	0-0	1-0	1-0;1-1; I,6	0,1,0

Roman numerals indicate spine, Arabic numerals indicate setae

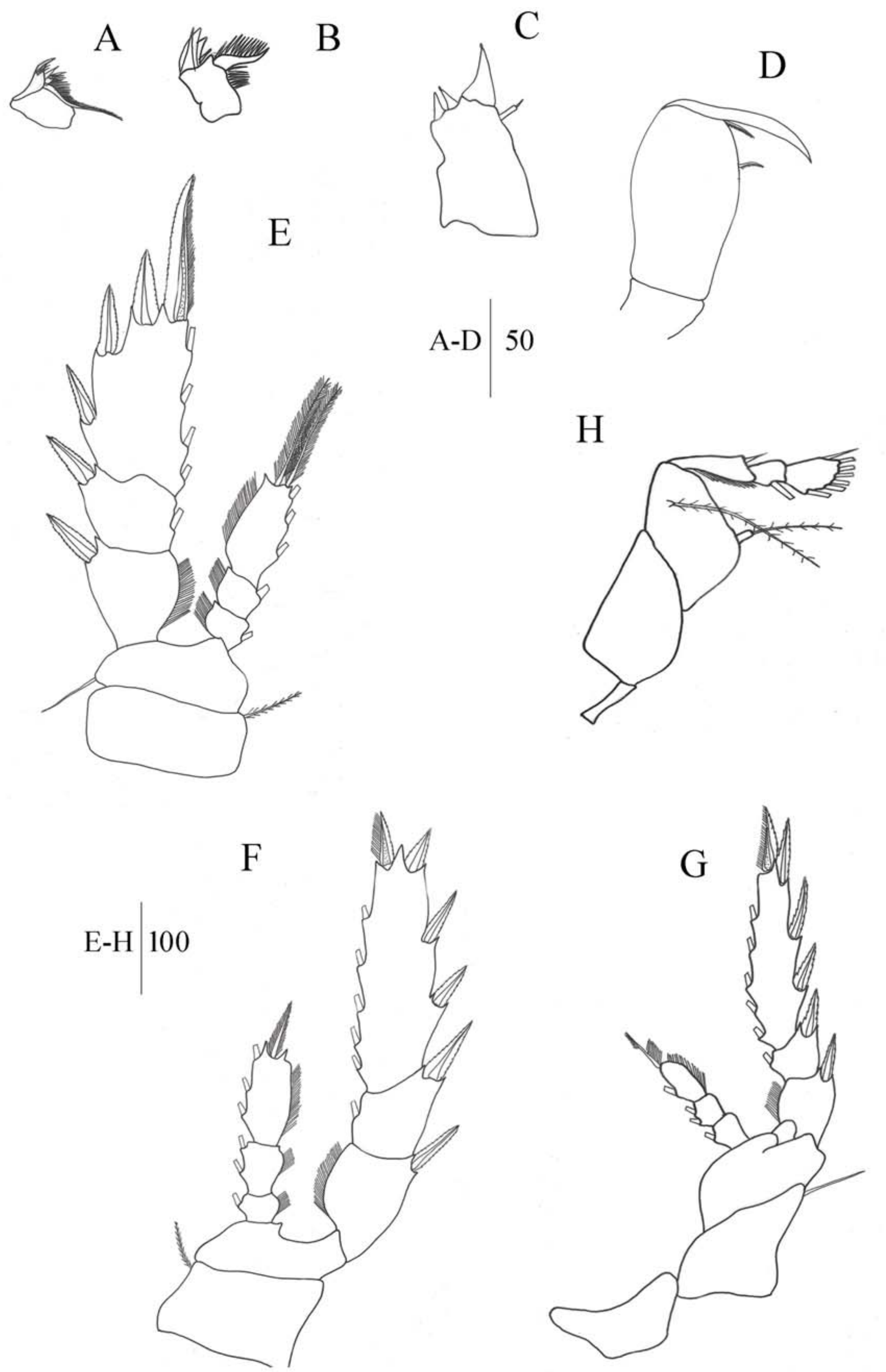

Fig.3. *Corycaeus crassiusculus* female. A, maxilla B, mandible; C, maxillule; D, maxilliped; E, P1; F, P2; G,P3; H,P4.Measurements expressed in µm.

segmented rami.Intercoxal sclerite well developed, P1 and P2 with plumose inner seta; basis of P1 & P3 with outer seta; exopods distinctly longer than endopods.

Exopods P1 to P3: inner margin of proximal segments fringed with long setules, relative length ratios of the terminal spine to distal outer spine and distal segment of P1-3 different: in P1, 1.8:1.1 and 1.8:1, in P2, 2.3:1 and 2.3:1and in P3, 7:2.3 and 7:3

Endopods of P1 to P3: outer margin of segment fringed with long setules; distal segment of P2 longest and that of P1shortest; length ratio of the distal segments of P1-3 approximately 30:40:37.5.

P4 (Fig. 3H) with transversely extended intercoxal sclerite,coxa present, basis with outer basal seta arising from posterior surface. Exopod well developed, three segmented, bears spinules along inner margin of the first segment; proportional length ratio of proximal, distal and terminal segment respectively, 80:50:75 (along setiferous margin);distal segment about 1.3 times as long as terminal spine. Endopod reduced to knob like segment with long plumose/bipinnate seta extending up to the distal portion of outer terminal setae of exp (2). Basal seta 1.6 times longer than that of endopodal seta (1.6:1)

Armature formula for swimming legs as in Table 1.

Systematics

Order Poecilostomatoida

Family Corycaeidae Dana, 1852

Subgenus *Onychocorycaeus* Dahl, *1894*

Corycaeus (Onychocorycaeus) catus Dahl, 1894

Material examined*: Holotype:* female, INDIA: Kerala, Lakshadweep, Kavarathi, 10° 32' and 10° 35' N latitude and 72° 35' and 72° 40' E longitude,3.5 m,collected by Radhika.R and party on April 2013,MBM/DBT/02/14.

Description

*Female:*Body cylindrical, tapering posteriorly. Total length measured dorsally 0.65 mm (Fig. 4A) measured from the anterior end of the prosome to the posterior margin of the caudal rami. Urosome narrower than the prosome

Prosome four-segmented, frontal part arc shaped, with two large separate cuticular lenses with a distance of about 50µm; more than twice as long as urosome including caudal rami (4.9:1.9), about 3.39 times as long as urosome excluding caudal rami (4.9:1.4), about 1.75 times as long as wide (4.9:2.8)

Urosome (Fig. 4B) two segmented with divergent caudal rami. Genital somite oval, 1.5 times as long as maximum width at anterior mid region (1.8:1.2); longer than anal somite and caudal rami combined; Genital area formed into flaps derived from P6 (but not figured and could not be mounted satisfactorily)

Anal somite rectangular shaped, about 1.3 times as long as wide at base (4.5:3.5); distal margin bears spinules ventrolaterally; 3.9 times shorter than genital somite and 1.3 times shorter than caudal rami.

Caudal rami divergent, 1.67 times longer than wide at base, about 0.35 times shorter as long as genital somite and 1.38 times as long as anal somite. Each ramus antiparallell, divergent, armed with six setae.

Antennule (Fig. 4F) short, six segmented. Armature formula- 1-[2], 2-[5], 3-[2+ae], 4-[2+ae], 5-[1], 6-[4]. Proportional lengths of the segments taken along posterior non setiferous margin 25:17.5:25:30:15:15.

Antenna (Fig. 4C) four segmented with coxa and basis with strong unipinnate setae on inner distal margin. Endopod three segmented and unequal in length; first segment about 1.86 times a long as width at base bearing short unipinnate seta on ventral proximal margin much shorter than coxobasal seta, inner distal margin formed into two stout teeth. Second segment short bearing two elements a) curved stout short spine arising from outer distal margin and is longer than the other and b) comparatively smaller spine arising from the inner margin; third segment cylindrical, 1.2 times as long as wide at base, armed with a curved terminal claw and a short spine arising from the inner distal margin.

Mandible (Fig. 4D) with gnathobase bearing two elements ie, spine & blade where spine is slightly broad and robust. Blade forms spinous process surrounded by patch of spinules around base

Maxillule not mounted satisfactorily to allow detailed examination.

Maxilla (Fig. 4E) with syncoxa unarmed and unornamented. Inner margin of the allobasis produced into spiniform process and bears two elements; one is broad and robust with comb like spine; the other is smaller than former with smaller combs but have many spinous processes adjacent to it.

Maxilliped (Fig. 5E) three segmented, strong and expanded basis, syncoxa unarmed, with an element ornamented with spinules along inner margin, 2.5 times longer than width at base;endopodal segment produced into a long curved claw which is 5.2 times as long as wide at base; longer than basis and unornamented; accessory armature consists unipinnate spine on inner proximal margin of claw.

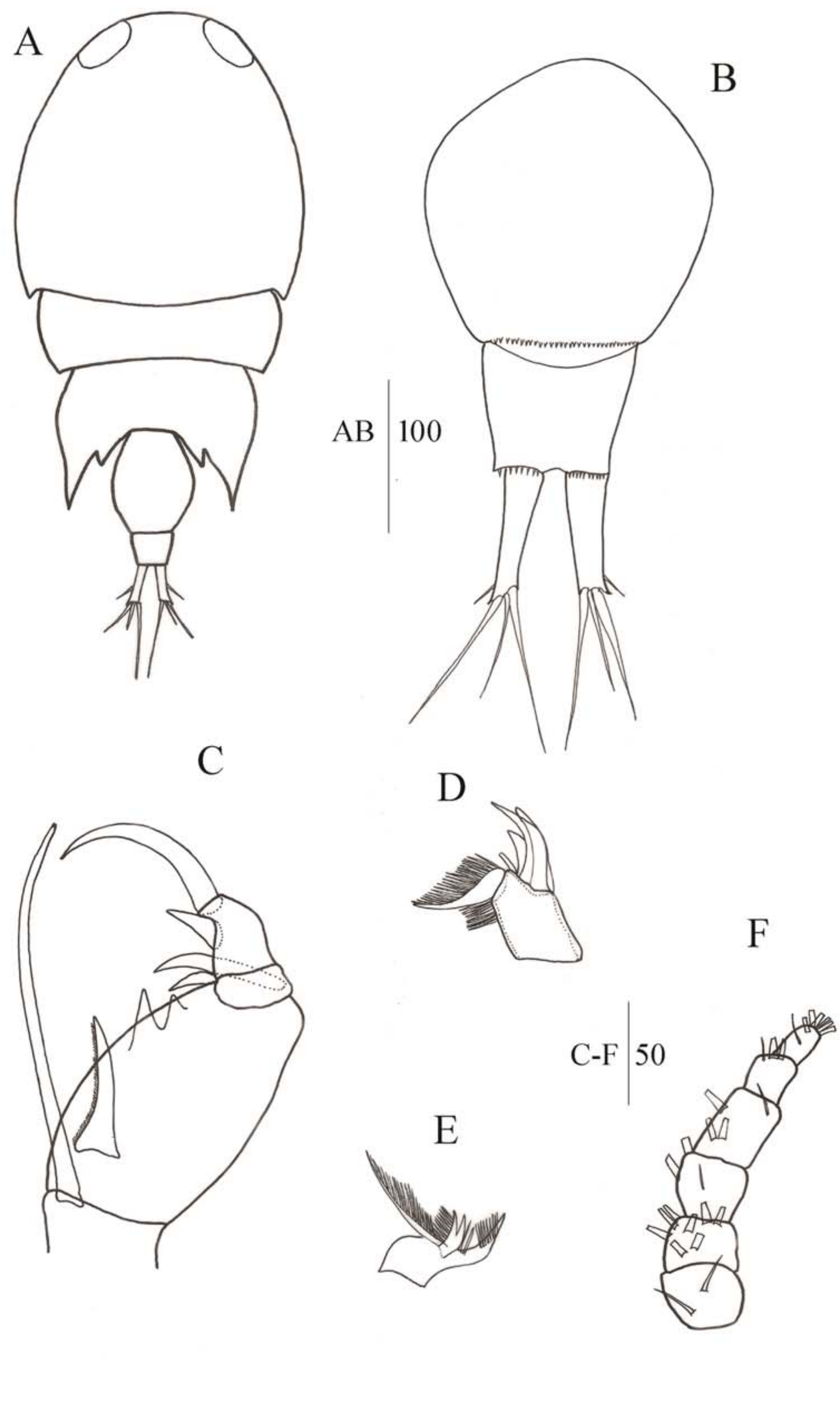

Fig.4. *O.catus* female. A, Habitus (dorsal); B, Urosome (ventral view); C, Antenna; D, Mandible; E, Maxilla; F, Antennule. Measurements expressed in µm.

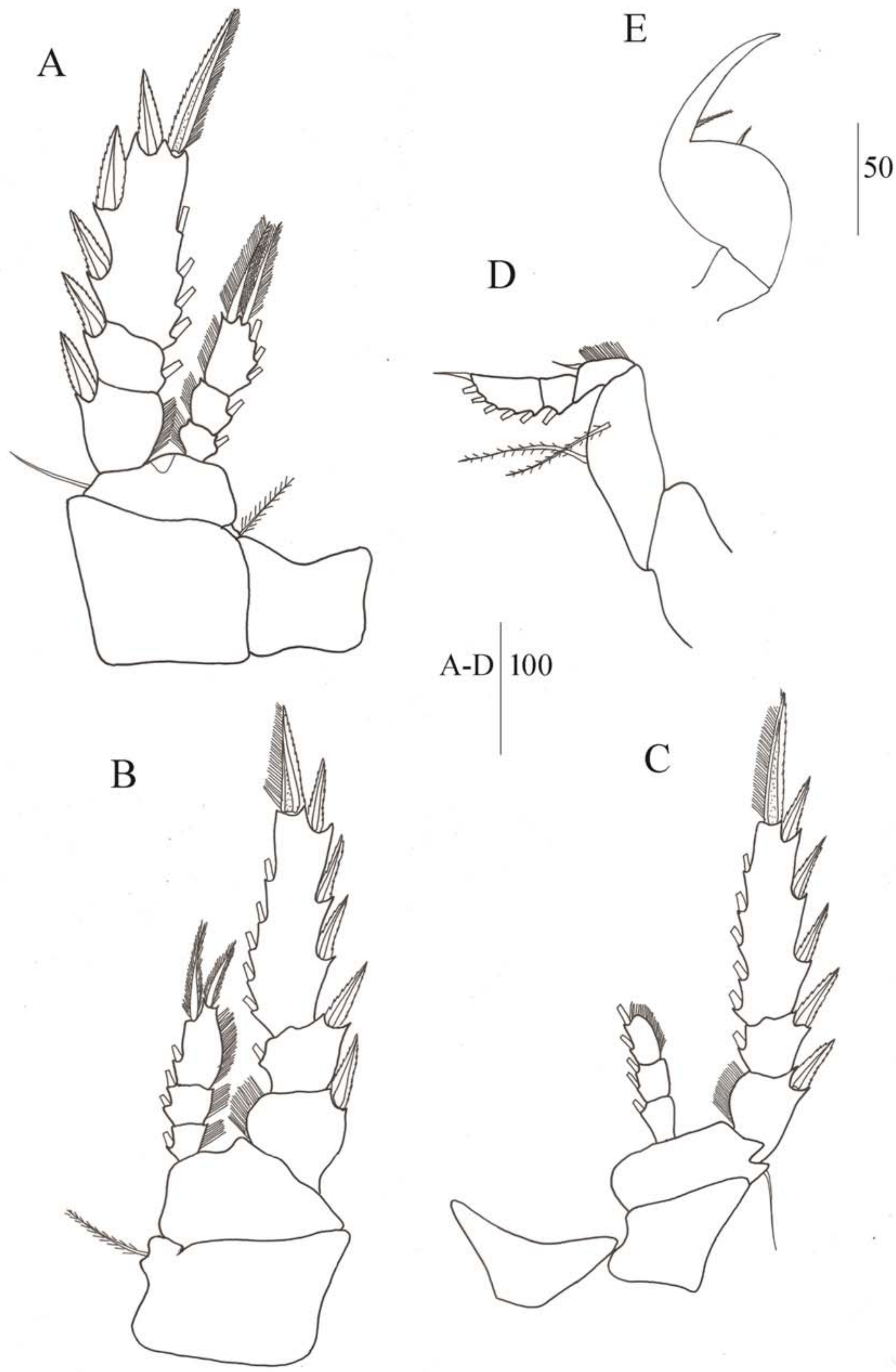

Fig.5. *O.catus* female. A, P1; B, P2; C, P3; D, P4; E, maxilliped. Measurements expressed in µm.

Legs 1–3 (Fig. 5A–C) with coxa, basis and three-segmented rami.Intercoxal sclerite well developed, P1 and P2 with plumose inner seta; basis of P1 & P3 without outer seta; exopods distinctly longer than endopods.

Exopods P1 to P3: Inner margin of proximal segments fringed with long setules, relative length ratios of the terminal spine to distal outer spine and distal segment of P1-3 different: in P11.8:1.1 and 1.8:1, in P2 1.6:1 and 1.6:1and in P3 2.4:1 and 2.4:1.

Endopods of P1 to P3: Outer margin of segment fringed with long setules; distal segment of P2 longest and that of P1shortest; length ratio of the distal segments of P1-3 approximately 27.5:37.5:32.5.

P4 (Fig. 5D) with transversely extended intercoxal sclerite, coxa present, basis with outer basal seta arising from posterior surface. Exopod well developed, three segmented, bears spinules along inner margin of the proximal segment; proportional length ratio of proximal, distal and terminal segment respectively, 27.5:15:20 (along setiferous margin); terminal spine twice longer than distal segment (2:1). Endopod reduced to knob like segment with long plumose terminal seta extending upto the distal portion of outer proximal spine of exopod two; endopodal seta slightly longer than basal seta (1.09:1.0).

P5 and P6 present but not figured satisfactorily.

P6 represented by genital flap; armed with long naked seta (but not figured)

Armature formula for swimming legs as in Table 2.

Taxonomy of *C. crassiusculus* Female

Females of *C.crassiusculus* are largely identified by the overlapping of genital segment on anal segment at the dorsal margin; the specimen described here is characterized by body length of 0.78 mm; two segmented urosome with very divergent caudal rami; ventro lateral ornamentation of the anal somite; six segmented antennule; ornamentation of the first endopodal segment of the antenna.

Females of *C.crassiusculus* showed variations from the illustrations given by Tanaka (1957) from Japanese waters in some morphological features: total length generally greater (1.44-1.57 mm) than those of Kavarathi specimens (0.78 mm); length ratio of the PR: UR (including CR) (2.1:1.1) slightly lesser than those of Kavarathi specimen (2.6:1.3); proportional lengths of the Urosomal somites and CR greater (40:21:39) as compared to Kavarathi specimens (14.7:8.5:10); length width ratio of the genital segment more in Japanese waters (1.3) when compared to Kavarathi specimen (1.0); length width ratio of the CR much more (6:1) when compared to those of Kavarathi specimen (1.33:1). On the other hand similar features also exist such as identical width ratio of the anal somite at proximal margin to distal margin (12.6:10.2) almost similar to those of Japanese waters (8:7) and genital somite overlaps anal somite at dorsal margin

Descriptions of *C. crassiusculus* by Dana's (1848, 1952–55) were based exclusively on male specimens. Yet, the female of *C. venustus* described in the same papers was later identified by. Dahl (1912) as the female of *C. crassiusculus.* Therefore the name *C. venustus* was dropped.

Female of *C. crassiusculus* described from Kavarathi waters of Lakshadweep is consistent with the typical morphological characteristics of the descriptions of Motoda, 1963 from Hawaiian waters ie. length ratio of the PR: UR is almost equal (1.6 to 1.9 vs. 2 in Kavarathi specimen); divergent and shorter CR . Conversely variations are also there in the following features such as length ratio of the CR to remaining abdominal segments is 0.43 times shorter than GS and AS combined in Kavarathi specimen vs. 0.5 to 0.8 times longer in Hawaiian specimens; the ratio of length to breadth of the anal segment (distal margin) varied with the range of 1.1–1.8.- in Hawaiian specimen while that of Kavarathi specimen being a value of 1.43. Besides, Motoda, 1963 identified Hawaiian specimens as female of *C. crassiusculus* largely because the genital segment overlaps the anal segment at the dorsal margin; the feature which was very much evident in Kavarathi

Table 2. Aramture formula of P1 to P4 of *Onychocorycaeus catus* female

Leg	Coxa	Basis	Exopod	Endopod
P1	0-1	1-0	1-0;1-1;III,4	0-1;0-1;0,2,3
P2	0-1	0-0	1-0;1-1;III,4	0-1;0-2;0,2,2
P3	0-0	1-0	1-0;1-1;III,5	0-1;0-2;0,1,1
P4	0-0	1-0	1-0;0-1;I,5	0,1,0

Roman numerals indicate spine, Arabic numerals indicate setae

Table.3. Length and width proportions of body segments of *C.crassiusculus* female and *O.catus* female (PR,prosome;UR,urosome;GS,GenitalSomite;CR,caudal rami;P1-P4,1-4 thoracopods;exp,exopods.)

Character/species (F)	***Corycaeus crassiusculus*** female	***Onychocorycaeus catus*** female
Total Length	0.78mm	0.65mm
GS:AS:CR	14.7:8.5:10	177.5:45:62.5
PR		
Ratio of length to maximum width of PR	2.6:1.4	4.9:2.8
PR:UR (+CR)	2.6:1.3	4.9:1.9
Length ratio of PR to GS	5.2:1.02	4.9:5.2
GS/GDS		
Ratio of length to maximum widthof GS	1.4:1.5	1.8:1.2
Length ratio of GS to CR	1.4:1	2.84:1
GS:anal somite	1.73:1	3.94;1
AS		
Length to width at base	1.47:1.5	4.5:3.5
CR		
Length to width	1.3:1.0	1.67:1
Antenna		
Length to width of 1st endopodal segment	2.3:1	1.86:1.0
Length ratio of coxal seta:1st endopodal seta	2.48:1.0	2.5:1
Maxilliped		
length to width of basis	1.8:1	1.93:1
Length to width of endopodal element	3.5:1	5.28:1
P1/P2/P3exp-3		
Distal segment to terminal spine	1:1.8/1:2.3/2.3:1	1:1.8/1:1.6/1.0:2.4
Terminal spine to distal outer spine	1.8:1.1/2.3:1/3:1	1.8:1.1/1.6:1/2.4:1
P4exp		
proximal spine to terminal spine	1.0:1.36	1.0:1.0
terminal spine to distal segment	1.0:1.3	2.0:1.0
Endopodal seta to Basal seta	1.0:1.6	1.09:1.0

specimen as well.

Sewell, 1947 got the values for the proportional length of CR to the remainder of the abdomen as 0.5–0.6 which shows only slight variation with that of Kavarathi specimen being 0.43. The deformity of the CR in this species and overlapping of genital segment to anal segment at dorsal margin unlike that of female *C. speciosus* was reported by Chiba, 1955; Farran, 1929,(p. 292, Figs. 35, 36) mentioned that, the females of this species from New Zealand waters do not have such a slender abdomen as those figured by (Giesbrecht, 1892) or (Dahl, 1912), and they closely resemble the female of *C. clausi*. (Dahl, 1912, p. 22) opined that the length of the CR in *C. crassiusculus* may vary with individuals and also described the anal segment of the female *C. crassiusculus* as tapering posteriorly and being 1.5 times as long as the breadth at its distal margin whereas the present study revealed that AS of female *C. crassiusculus* is only 0.98 times as long as wide at base. Eventhough Dahl (1912) has mentioned of such an overlap of the genital segment on anal segment in the female of *C. (C.) clausi*, his key and figure do not show it.

Taxonomy of *O. catus* Female

When compared with the descriptions of Tanaka (1957) from Japanese waters, females of *O. catus* from Kavarathi waters, Lakshadweep showed almost similar

Table 4. Comparison of total length and respective proportion for each segment of *C. crassiusculus and O.catus*with previous records.

*, present study; †, M. Dahl (1912);• ,Farran(1936);§,Sewell (1947);£.Tanaka.(1957);®, Vilela (1968);¶, Motoda. (1963); ©Kang et.al (1990); ¥,Karanovic. (2003).

Character/species (F/M)	*Corycaeus crassiusculus*	*Onychocorycaeus catus*
Total length	0.78mm* 1.44 -1.57mm [£]	0.65mm* 0.92-1.01mm[•] 0.80 - 0.867[§] 0.93 -1mm[£] 0.89 - 0.96[®] 1.14mm¶ 0.87 -0.95[©] 1.06mm[¥]
Length ratio of prosome to Urosome	2.6:1.3* 2.1:1.1[£]	4.9:1.9* 9:4[£] 2:1[¶]
Length ratio of Urosomal somite to caudal ramus	14.7:8.5:10* 40:21:39[£]	177.54.5:62.5* 58:20:22[£]
Ratio of length to width of genital somite	1.4:1.5* 1.3:1[£]	
Ratio of length to width of caudal ramus	1.33:1* 6:1[£]	1.67:1*
Ratio of length to width of Anal somite(distal margin)	0.98* 1.8[¶] 1.5†	1.3* 0.87[£] 1.3[¶] 0.8[¥]
Length ratio of caudal rami to remaining abdominal segments	0.43* 0.8[¶] 0.5[§]	

length ratio of PR: UR (including CR) where PR being more than 2 times the length of UR (4.9:1.9 vs. 9:4).However, a few morphological variations in the former description were also there regarding the total body length being smaller (0.65 mm vs 0.93–1 mm), length width ratio of the anal somite being slightly different (4.5:3.5 vs 7:8), length width ratio of the CR being smaller (1.67 vs. 4) and length proportion of the GS: AS: CR being much large (177.5:45:62.5 vs. 58:20:22).The present study provides a detailed description on the morphometry ofA1, A2, Urosome, P1–P4. Mouth parts such as maxilla, mandible, maxillule and maxilliped in addition to the former.

On the contrary, females of *O. catus* described by (Motoda, 1963) from Hawaiian waters differed from those of the Kavarathi specimens in the proportional lengths of PR: UR (including CR) where PR about twice the length of UR in Hawaiian waters vs. more than twice in Kavarathi specimen and the total body length being larger (1.14 mm vs.0.65 mm) whereas the morphological characteristics such as GS longer than AS and CR combined; AS 1.3 times as long as wide (4.5:3.5) and slightly shorter than CR, were found to be similar.

In contrast, from the descriptions of female *O. catus* by (Karanovic, 2003) from Australian waters, the body length seems larger being 1.06mm when compared to 0.65 mm of Kavarathi specimen. Variations also appear in the length width ratio of prosome which being larger in Kavarathi specimen from that of Australian specimen (1.75 vs. 1.0) as well the details like surface of the cephalic shield of the prosomites with numerous small sensilla and cuticular pores. While Karanovic (2003) explains that genital somite is only slightly longer than wide in Australian specimen, Kavarathi specimens varies from it by the genital somite being 1.5 times longer than the maximum width and anal somite about 0.8 times as long as wide in Australian specimen which is smaller to that of Kavarathi specimen (0.8 vs.1.3). Anal somite 3.9 times shorter than genital somite in Kavarathi specimen while that of Australian specimen is only 0.4 times as long as genital somite, which explains another variation.

Onychocorycaeus catus from Kavarathi is the smallest ever reported (0.65 mm).Interestingly, it is noted that, *O. pumilus* reported by Dahl, 1912 and *O. catus* reported by Karanovic, 2003 with an abnormal armature of the second swimming leg has only three spines on the third exopodal segment while Kavarathi specimen has four spines on the third exopodal segment . This certainly is an abnormality that also occurs on the first and the third swimming leg with only three spines on the third exopodal segment of *O. catus* reported by Karanovic, 2003 while Kavarathi specimen has four spines in the third exopodal segment of first and third swimming leg. This certainly is a difference that is useful in species identification as the armature of first three swimming legs is very conservative in the family Corycaeidae Dana, 1852.

Length and width proportions of body segments of *C.crassiusculus* female and *O. catus* female given in Table 3 and comparison of total length and respective proportion for each segment of *C. crassiusculus* and *O. catus* with previous records given in Table 4.

Conclusions

Female specimens of both the species show variations as well as similarities when compared with the previous literatures which are clearly described in the discussion part. Despite of this, we also provide additional information on morphometry of both the species which have not been noticed in the previous literatures. They are (1) ornamentation of the first endopodal segment of the antenna of *C. crassiusculus* (2) overlapping of genital segment on anal segment at the dorsal margin in *C. crassiusculus* (3) distal margin of the genital and anal somite ornamented with spines ventrolaterally in both (4) presence of four spines in the third exopodal segments of first, second & third swimming leg in *O. catus* (5) length to width of 1st endopodal segment of the antenna (6) length ratio of coxal seta: 1st endopodal seta (7) in P1 to P3 exp-3, length ratio of terminal spine to distal segment and to outer distal spine; (8) in P4 exp-3, length ratios of terminal spine to proximal spine and to distal segment.

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