

## First record and redescription of *Pontella princeps* Dana, 1849 (Copepoda: Pontellidae) in the Red Sea with notes on its feeding habits

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### ABSTRACT

During a regular plankton sampling programme around Sharm El-Sheikh area, a copepod *Pontella princeps* Dana, 1849 (Calanoida: Pontellidae) was reported for the first time in the Red Sea water. Both sexes were collected and fully redescribed. The zoogeographical distribution of the species confirms that it is of Indo-Pacific origin. Gut contents analysis revealed that this species is a carnivore that feeds on a variety of planktonic copepods.

**Key words:** Copepods, First record, Pontellidae, *Pontella princeps*, Egypt, Red Sea, Sharm El-Sheikh.

### INTRODUCTION

The Red Sea is considered a unique water body because of its partial isolation from the open ocean, its geographical position in an arid zone, high salinity and characteristic prevailing wind system (Halim, 1984). The Red Sea contains representatives of all the major tropical communities except estuaries (Head, 1987). These communities include coral reefs, mangroves, seagrasses, shallow lagoons as well as oceanic waters. Although there is a high interest in plankton ecology and its distribution in the Red sea in the past two decades, our knowledge of the plankton diversity is still fragmented and incomplete. Most of the previous studies (Weikert, 1980; Alemida Prado-Por, 1983; 1985; 1990; Böttger, 1987; Böttger-Schnack, 1990a and b; Echelman and Fishelson, 1990) were carried out during a limited time period and were also restricted to oceanic waters. However, the richest and most exciting plankton communities are those of the shallow coastal waters along the Red Sea margins needed to be explored.

The genus *Pontella* Dana, 1846 accommodates 43 species (Boxshall and Halsey, 2004), most of them are common in the subtropical and tropical marine neuston. Although most of the copepod inhabiting the Red Sea are Indo-Pacific in origin, only two *Pontella* species have been recorded namely *P. fera* Dana, 1846 and *P. karachiensis* Fazal-Ur-Rehman, 1973 (El-Sherbiny, 1997; El-Sherbiny and Ueda, 2008) compared to 19 species recorded from Indian Ocean (Silas and Pillai, 1973). Occurrence of *Pontella princeps* Dana, 1849 is reported in the Red Sea waters for the first time in this paper. Also, full redescription of the species is given with notes on its feeding habits.

### MATERIALS AND METHODS

Within the plankton sampling framework by the Department of Marine Science, Suez Canal University around Sharm El-Sheikh area, the northern Red Sea. Specimens, of *Pontella princeps* Dana, 1849 were collected from neuston samples using 40 cm diameter plankton net (325 µm mesh size) towed for 15 minutes at a speed of about 2 knots. The collected specimens

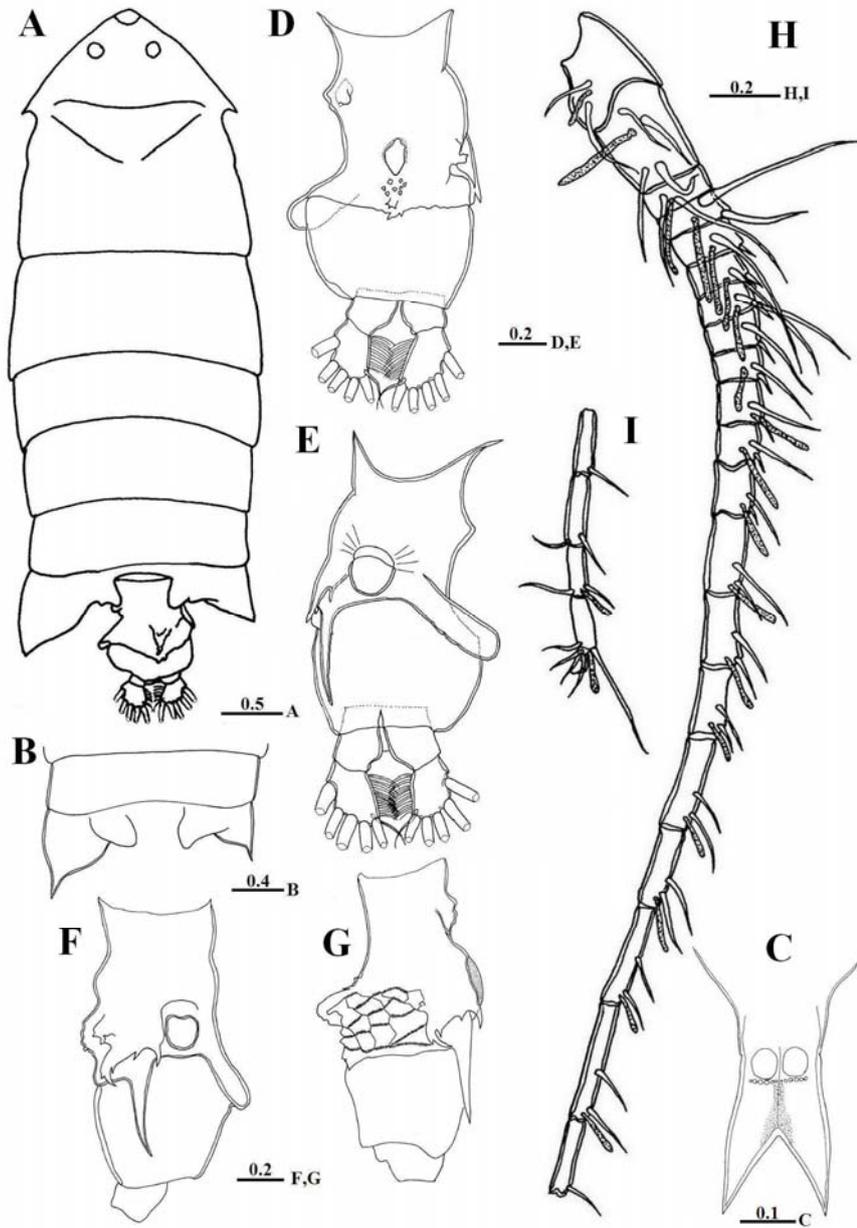
were preserved by concentrating and fixing them with 4% neutralized formalin in seawater immediately after capture and then placed in 70% alcohol. Specimens were examined whole or dissected as a temporary preparation mounted in lactophenol. For gut contents analysis, eight intact adult females were dissected and guts removed from the cephalothoraxes were mounted and examined on glass slides. The percentage of occurrence of food items in the guts was calculated as: (number of individuals with a certain food item in their guts) / (total number of examined individuals) X 100. All observations were made using differential interference microscope (Nikon E600) and SEM (JOEL, JSM-5600LV). Drawings were made with the aid of a camera lucida and measurements were made using an ocular micrometer. The terminology in the description follows Huys and Boxshall (1991).

### RESULTS

#### General description of the species

##### (A) Female

Body length ranges between 5.08 and 5.51 mm (5.30 ± 0.153, n = 10). Body (Fig. 1A) robust; cephalosome with pair of well developed dorsal lenses located anteriorly and prominent lateral hooks; cephalosome and first pediger, fourth and fifth pediger separated; posterior margin of fifth pediger produced posteriorly into asymmetrical flaps on each urosome side (Fig. 1B), terminating with acuminate lobes (of which left one longer) reaching two-third of genital compound somite (Fig. 1A). Rostrum (Fig. 1C) bifid, thickened basally, tapering distally and directed ventrally with 2 moderately developed rostral lenses. Urosome (Figs. 1D-G) 2 free somites with a distinct dorsal suture which may indicate fusion of several segments (Fig. 2A). Genital compound somite (GCS) asymmetrical, with anterodorsal swelling on the left side, mid-dorsal process upward directly, a group of short scale-like outgrowths and a prominent process on the right side; left side concave at middle with large finger-like lateral process ventrally in origin; ventrally GCS with 5



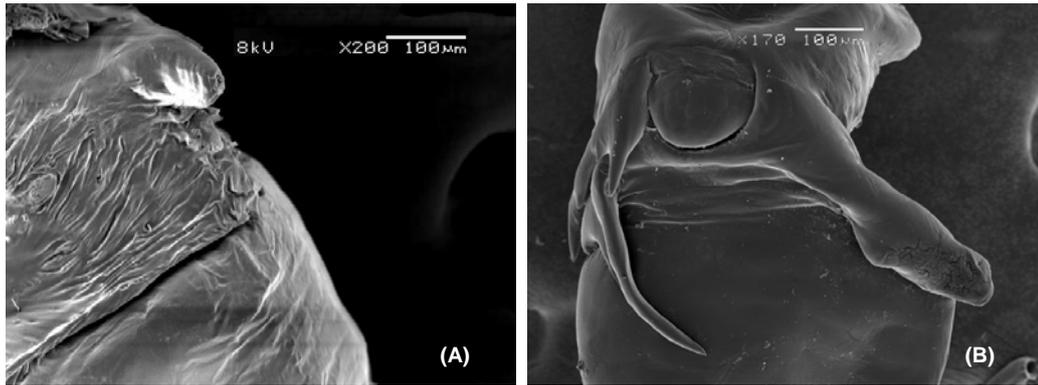
**Figure (1):** *Pontella princeps* female from the Red Sea. (A) Habitus, dorsal view. (B) Prosomal end, dorsal view. (C) Rostrum, frontal view. (D) Urosome, dorsal view. (E) Urosome, ventral view. (F) Urosome, ventrolateral view (right). (G) Urosome, lateral view (right). (H, I) Antennule. All scale bars in mm.

subequal small processes and a long one reaching the right distal end of GCS (Fig. 2B); genital operculum prominent, located midway; anal somite asymmetrical bifid posteriorly, left lobe larger. Caudal rami asymmetrical, right one longer and broader; each ramus bearing 5 plumose and small setae.

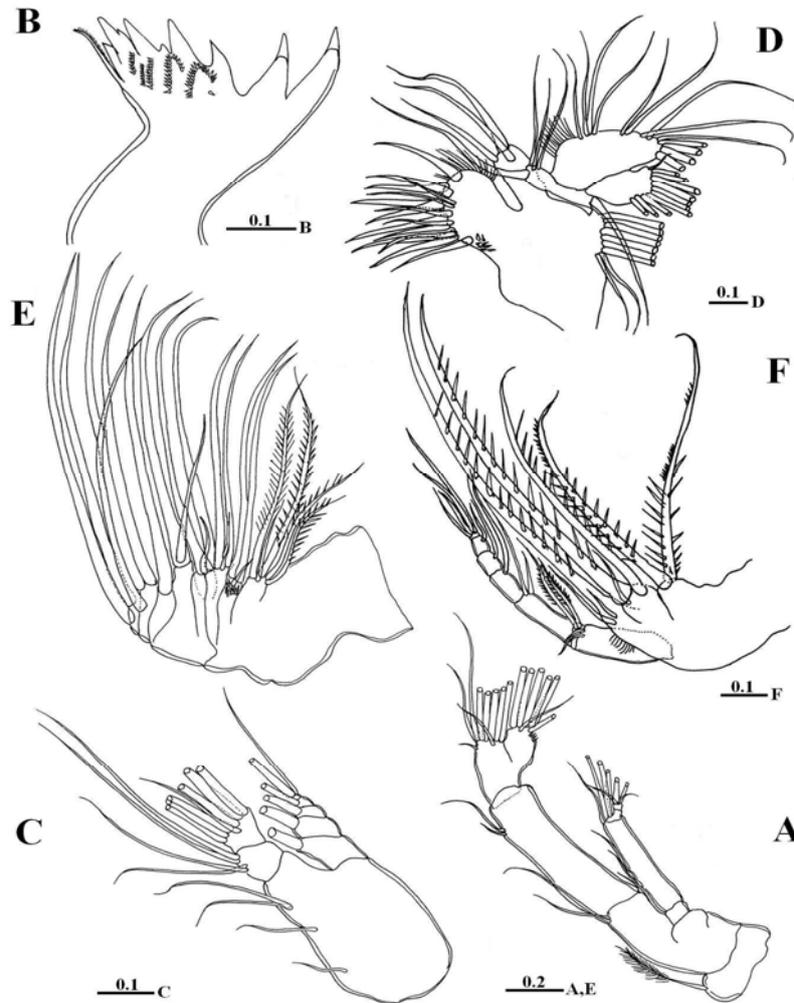
Antennule (Figs. 1H-I) symmetrical; 25-segmented, not extending beyond third pedigerous somite. Segmentation pattern and setal armature were as follows: I (1) = 2+aesthetasc (ae), II-IV (2) = 4+ae, V (3) = 2+ae, VI (4) = 2+ae, VII (5) = 2+ae, VIII (6) =

2+ae, IX (7) = 2+ae, X (8) = 2+ae, XI (9) = 2+ae, XII (10) = 2+ae, XIII (11) = 2+ae, XIV (12) = 2+ae, XV (13) = 2+ae, XVI (14) = 2+ae, XVII (15) = 2+ae, XVIII (16) = 2+ae, XIX (17) = 2+ae, XX (18) = 2+ae, XXI (19) = 2+ae, XXII (20) = 1, XXIII (21) = 1, XXIV (22) = 1+1, XXV (23) = 1+1+ae, XXVI (24) = 1+1, XXVII-XXVIII (25) = 4+ae.

Antenna (Fig. 3A) biramous; coxa with 1 plumose seta anteriorly; basis with 2 distomedial setae of unequal length; exopod 5-segmented; first segment with 1 seta; second segment cylindrical with 3 setae; third and



**Figure (2):** SEM micrographs of *Pontella princeps* female from the Red Sea. (A) Partial genital compound somite showing mid dorsal process, lateral view. (B) Partial genital compound somite, ventral view.



**Figure (3):** *Pontella princeps* female from the Red Sea. (A) Antenna. (B) Mandibular cutting edge. (C) Mandibular palp. (D) Maxillule. (E) Maxilla. (F) Maxilliped. All scale bars in mm.

fourth segments bearing 1 and 2 setae, respectively; terminal segment globular with 2 long and 2 short setae; endopod 2-segmented; first segment elongated bearing 2 distal setae of unequal length medially; second segment lamellar, produced into proximal and distal lobe; proximal lobe with 9 setae; distal lobe with 6 long, 1 median setae and row of posterior spinules.

Mandible gnathobase (Fig. 3B) heavily chitinized with cutting edge bearing 7 teeth and spinulose seta; both third and fourth teeth bicuspidate; a patch of dagger-like spinules present distally on anterior surface of gnathobase at the base of third to seventh teeth; palp biramous (Fig. 3C); basis longer than wide bearing 4 setae; exopod 5-segmented with setal formula of 0, 1, 1, 1, 3; endopod 2-segmented; proximal segment with 4 setae; distal segment with 6 long and 1 short setae.

Maxillule (Fig. 3D) with praecoxal arthrite carrying 15 setae on and around the distal margin; coxal endite with 3 unequal apical stout setae; coxal epipodite with 7 long and 2 short setae; basis with one long seta representing basal exite; first and second endites with 4 and 3 setae, respectively; basis fused to endopod; first and second endopodal segments fused each bearing 2 setae; distal segment with 5 apical setae; exopod one-segmented, bearing 10 long and 1 short setae distally.

Maxilla (Fig. 3E) with praecoxa and coxa fused; first and second praecoxal endites with 5 and 3 setae, respectively; first and second coxal endites both carrying 3 setae; basis with 1 long and 1 short setae; endopod with total of 6 long setae.

Maxilliped (Fig. 3F) 8-segmented; with 3 syncoxal endites bearing 2, 3 and 3 setae, respectively; distal part of syncoxa produced distally covering basal part of the basis; basis medial margin fringed with row of stout teeth and bearing 2 short unequal setae distally;

endopod 6-segmented with setal formula of 2, 2, 1, 1, 1, and 4.

Swimming legs 1 to 4 (Figs. 4A-D) biramous with 3-segmented exopods. Seta and spine formula of legs 1 to 4 are shown in Table (1). Leg 1 (Fig. 4A) with 3-segmented endopod; third endopodal segment ending in acute process; legs 2 to 4 with 2-segmented endopod and similar to each other except the number of medial setae on the second endopodal segment and the presence of long medial seta on basis and patch of hair dorsally on first exopodal segment of leg 4.

Leg 5 (Fig. 4E) asymmetrical; biramous; left side slightly shorter; basis with long plumose seta reaching nearly one-third of exopodal segment; exopod and endopod one-segmented; exopod terminating in 2 unequal processes; each exopod with 2 processes dorsally near the tip and 1 process on the medial margin; endopod bifid at tip, lateral spine smaller.

(B) Male

Body length ranges between 4.81 and 5.42 mm ( $5.08 \pm 0.20$ ,  $n = 12$ ). Body (Figs. 5A, B) robust similar to that of female; cephalosome and first pediger separated, with 2 lateral cephalic hooks and 2 dorsal eye lenses as in female. Fourth and fifth pedigers separated ending with asymmetrical sharply pointed expansion (left one longer). Rostrum (Fig. 6A) bifid with slight indication of lenses, terminating in 1 pair of spines. Urosome (Fig. 6B) 5-segmented; genital compound somite asymmetrical; left side weakly swollen with genital aperture located ventrolaterally at posterior rim; second urosomite with 2 lateral sensilla on each side; third urosomite longer than following 2 somites combined; caudal rami almost symmetrical and elongated, each armed with 5 plumose and small dorsal setae. Right antennule (Fig. 6C) geniculate; 18-segmented,

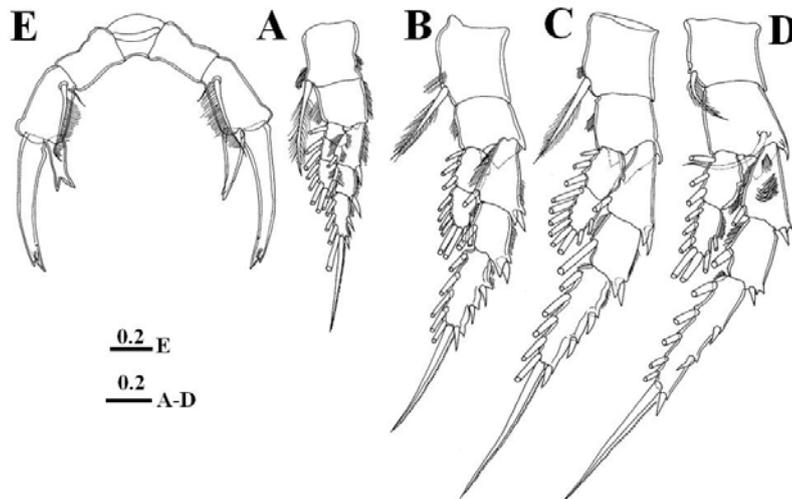
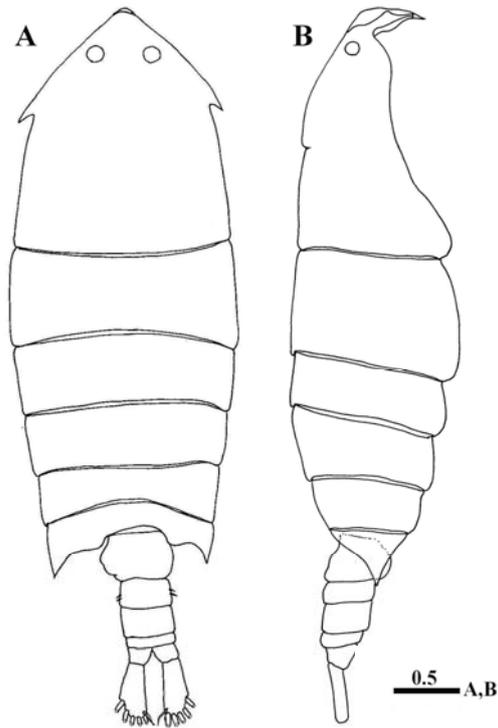


Figure (4): *Pontella princeps* female from the Red Sea. (A-D) Legs 1-5. All scale bars in mm.

**Table (1):** Spines and setal formula of female legs 1 to 4 of *Pontella princeps* from the Red Sea.

	Coxa	Basis	Exopod			Endopod		
			1	2	3	1	2	3
Leg 1	0-1	0-0	I-1;	I-1;	II, I, 4	0-1;	0-2;	1,2,3
Leg 2	0-1	0-0	I-1;	I-1;	III, I, 5	0-3;	2, 2, 4	
Leg 3	0-1	0-0	I-1;	I-1;	III, I, 5	0-3;	2, 2, 4	
Leg 4	0-1	1-0	I-1;	I-1;	III, I, 5	0-3;	2, 2, 3	

Note: Roman numeral: spines; Arabic numeral: setae.



**Figure (5):** *Pontella princeps* male from the Red Sea. (A) Habitus, dorsal view. (B) Habitus, lateral view. All scale bars in mm.

extending to the middle of third thoracic somite. Segments XIII to XIV completely fused posteriorly; Segment XIV with long modified spine, terminating with a curved flagellum; anterior margin of segment XVI with a short and stout spine; anterior margin of segment XVII with coarse-lamellate plate extending to segment XVI; segment XVIII with 1 plate carrying acuminate sharp teeth; fused segment XIX-XXI with 1 spur-like strong process fused at base distally and 2 toothed plates; proximal teeth coarse and denticulate, distal one villiform. Segmentation pattern and setal armature as follows: I (1)= 3+ae, II-III (2)= 4+2ae, IV (3)= 2+ae, V (4)= 2+ae, VI (5)= 3+ae, VII (6)= 4+ae, VIII (7)= 2+ae, IX (8)= 2+ae, X (9)= 2+ae, XI (10)=2+ae, XII (11)= 2+ae, XIII (12)= 1, XIV (13)= 2+ae, XV (14)= 3+ae, XVI (15)= 2+ae, XVII (16)= 1+ae, XVIII (17)= 1+ae, XIX-XXI (18)= 2+process,

XXII-XXVIII (19)= 6+3+ae. Mouth parts and legs (1-4) were similar to those in female.

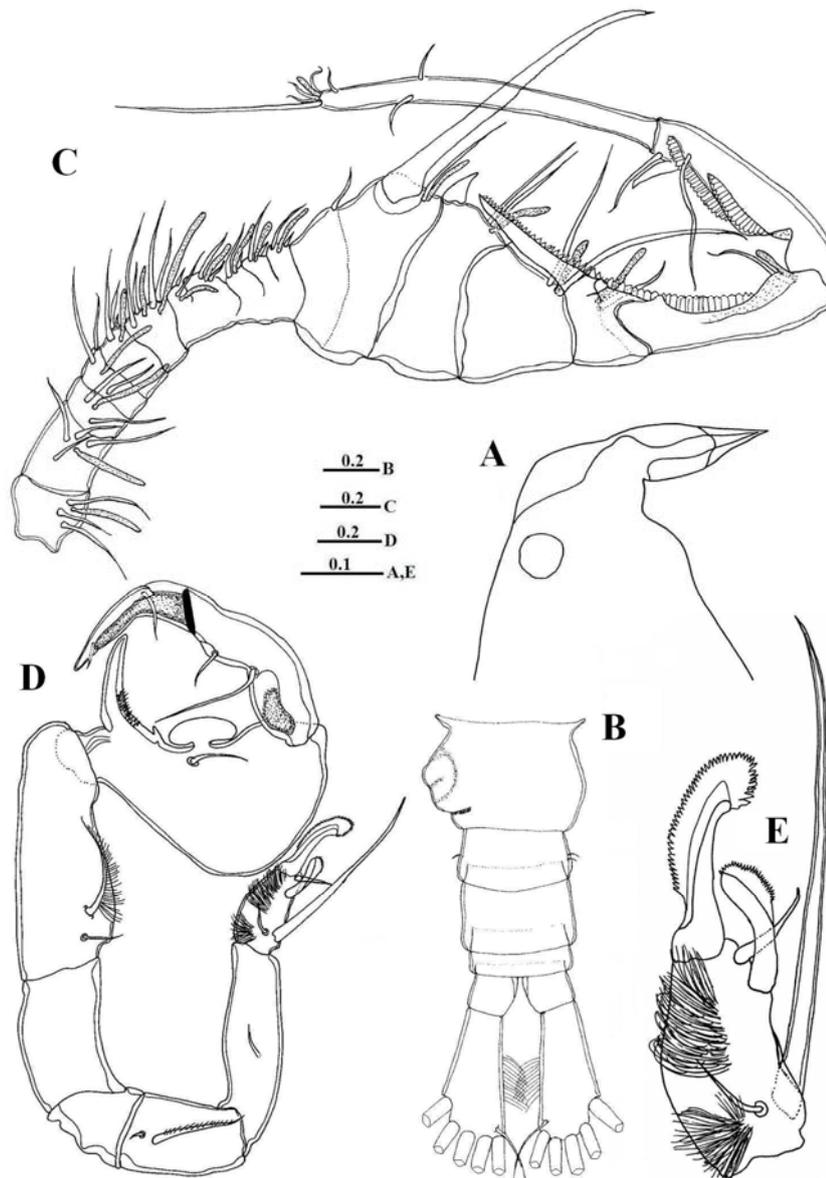
Leg 5 (Fig. 6D) is typical of pontellides; uniramous; asymmetrical; left leg 5 (Figs. 6D, E) short; coxa separated from intercoxal sclerite; basis with 1 long and 1 short setae; exopod 2-segmented; first segment with 1 plumose seta on posterior surface; second segment with a long spine laterally; apex with 1 spine and 2 unequal spatulate processes; longer one with finely crenulated margin; shorter one with denticulated tip; medial margin of second exopodal segment hirsute carrying spine proximally. Right leg 5 (Fig. 6D) with coxa fused to intercoxal sclerite; basis with 1 long plumose seta and 1 small-naked articulated seta; exopod 2-segmented forming a stout chela; medial margin of first exopodal segment (chela) with semicircular, bluntly rounded, process and 1 seta at base (Fig. 7); thumb of chela long, ending in long slender process curving inward with some spinules near its medial base and scale like process near its articulation point with basis; second exopodal segment (finger) elongate, not tapering with 3 unequal setae along medial margin and 1 seta on anterior surface distally; proximal part of finger with a shallow ventral depression; distal part with a deep one cutting through dorsal part of the last third.

(C) Variations

The presence, absence and number of sensilla on second male urosomites were differ within individuals. Medial base of thumb may have some spinules or without.

**Distribution**

*Pontella princeps*, like many *Pontella* species, is widely distributed in the tropical and subtropical, neritic and oceanic water of the Indo-Pacific region: Gulf of Manner (Thompson and Scott, 1903); Bay of Bengal (Sewell, 1912); Andaman Sea (Sewell, 1932); Ceylon Pearl Banks, Trivandrum coast (Saraswathy, 1966); Laccadive Sea (Silas and Pillai 1973); Arabian Sea, Central Indian Ocean and west coast of Australia (Voronina, 1962); west Pacific (Wilson, 1950); Japanese waters (Tanaka, 1964; Matsuo and Marumo, 1982); China Sea (Zheng *et al.*, 1989) and coastal waters of Java, Indonesia (Mulyadi, 2000).



**Figure (6):** *Pontella princeps* male from the Red Sea. (A) Rostrum, lateral view. (B) Urosome, dorsal view. (C) Right antennule. (D) Leg 5, posterior view. (E) Second exopodal segment of left leg 5, posterior view. All scale bars in mm.

### Feeding

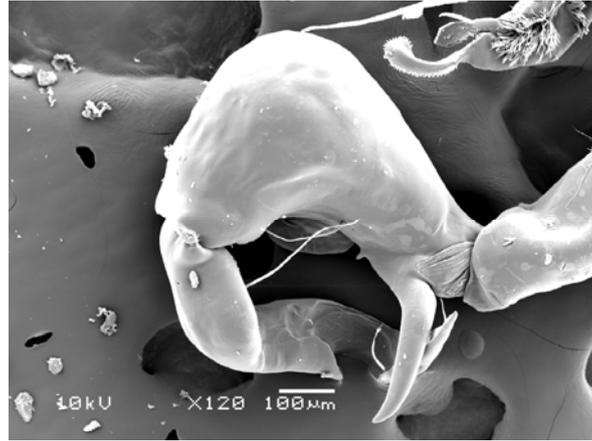
Gut contents investigation suggested that this species is a carnivore feeding on a variety of copepods. Almost all preys found in the guts were crushed into pieces, apparently being masticated by the action of the cutting edges of mandibles (Figs. 8A-D). Some fragments were evidently identified as copepod nauplii (37.5%) and harpacticoids (62.5%). Unidentified remains of sticky materials were also existed.

### DISCUSSION

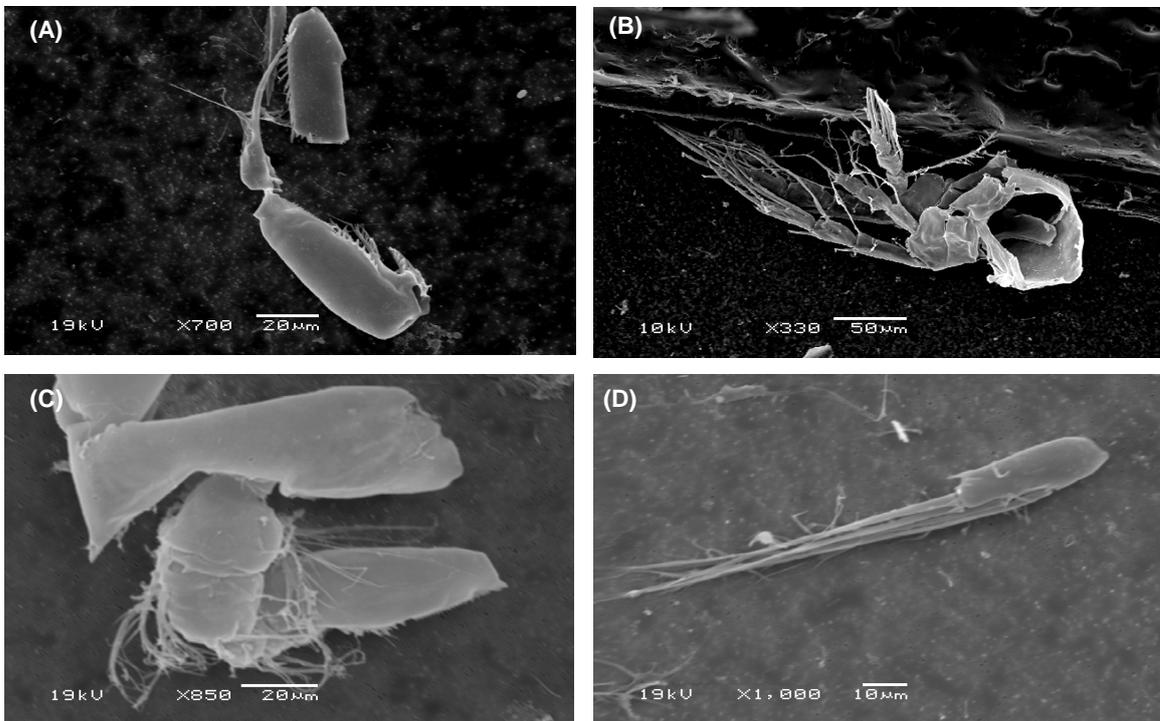
The diversity of the Red Sea pontellid copepods is distinctly low, although Red sea plankton is the

originated from Indian Ocean. Silas and Pillai (1973) recorded 71 species of pontellid copepods from the Indian Ocean belonging to seven genera compared to 13 species from the Red Sea (Halim, 1969; Ünal and Shmeleva 2002; El-Sherbiny and Ueda, 2008). The low number of recorded pontellid species in the Red Sea may be due to the characteristic neustonic nature of this genus (Mauchline, 1998), sampling methods and time and/or limited sampling effort.

The original descriptions of both sexes were brief and the drawings incomplete. Some aspects of which were probably overlooked or undescribed by previous authors (Giesbrecht, 1892; Tanaka, 1964; Silas and Pillai, 1973;



**Figure (7):** SEM micrograph of second exopodal segment of right leg 5 of male *Pontella princeps* from the Red Sea.



**Figure (8):** SEM micrographs of gut contents of *Pontella princeps* female from the Red Sea. (A) A piece of maxilliped of a copepod. (B) A piece of prosome of a copepod. (C) A piece of cephalic appendage of a copepod. (D) A piece of exopodal segment a copepod leg.

Mulyadi, 2000). General characteristics of male and female *P. princeps* from the Red Sea are in good agreement with the description offered by Giesbrecht (1892) and Silas and Pillai (1973), however, some differences concerning female genital compound somite, female leg 5 and male leg 5 are noticed. Silas and Pillai (1973) in their study drew the female with the genital compound somite possessing a mid-dorsal process long enough to reach the dorsal suture line, whereas in the Red Sea specimen, this process is noticeably short not reaching the suture line with subsequent outgrowths. Ventrally the authors indicated the presence of suture line in the genital compound somite with 3 processes on the right side whereas in the

examined Red Sea female, it appears completely fused with 6 processes. Female leg 5 of the Indian Ocean has 3 minute lateral processes on the exopod (Silas and Pillai, 1973) but the Red Sea specimen have 2 processes dorsally near the tip and 1 process on the medial margin. Regarding the difference in the male, the second exopodal segment of right leg 5 appeared in most of the previous studies with a long process (Tanaka, 1964; Silas and Pillai; 1973; Mulyadi, 2000), however, examination of the Red Sea specimens indicated the absence of this process (as figured by Giesbrecht, 1892 pl. 24 fig. 39, 40) which could be described as a ventral depression cutting through the dorsal edge of the finger. Also, in their descriptions, left

leg 5 with ending apex carrying a large spatulate process and another small truncate one, but in the Red Sea specimens, the two processes are spatulate and with crenulated margin. Hence, the source of difference is that description of leg 5 by the former authors may have been based on drawings of this part from a specific angle.

Based on the shape of posterior corners of prosome, genital compound somite, rostrum, symmetrically of caudal rami, and leg 5 of both sexes, the Indo-West Pacific species of *Pontella* can be divided into 6 species groups namely, *alata*, *andersoni*, *fera*, *danae*, *labuanensis* and an unassigned group (Mulyadi, 1997; 2003). *Pontella princeps* is closely related to *alata* group (include *P. alata*, *P. surrecta* and *P. rostraticauda*) due to their similarity in the following characteristics: female GCS possesses mid-dorsal process upward directly, right furcal ramus larger than left one, asymmetry of leg 5, exopod naked or with very minute processes. However, in *P. princeps*, urosome mid-dorsal process is quite short not extending to the dorsal suture line that exists in the GCS; right furcal ramus relatively larger than left; left exopod slightly shorter than right one; each exopod with 2 processes dorsally near the tip and 1 process on the medial margin; medial margin of first exopodal segment of male right leg 5 (chela) with semicircular, bluntly rounded, process; second exopodal segment of male left leg 5 with apex carrying 2 unequal spatulate processes. Accordingly, *P. princeps* does not belong to the *alata* group despite the apparent similarity.

According to Ohtsuka and Onbe (1991) the pontellid genera *Pontellina* and *Pontellopsis* are typical carnivores based on the structure of mouth parts and gut contents, while other genera (*Anomalocera*, *Epilabidocera*, *Labidocera* and *Pontella*) are omnivores as reported by Park (1966), Turner (1984; 1985) and Ohtsuka and Onbe (1991). On the other hand, gut contents analysis of the Red Sea *P. princeps* revealed that it is carnivore feeding on a variety of planktonic copepods. The difference in its feeding habits may be explained by its opportunistic feeding nature as many pontellid species which feeds on almost anything available in its environment (e.g. Turner 1984; Ohtsuka and Onbe 1991). The low phytoplankton biomass (Klinker *et al.*, 1978; Sommer 2000; Sommer *et al.*, 2002) and the dominance of ultraphytoplankton with size less than 8 µm (e.g. Lindell and Post 1995; Li *et al.*, 1998; Yahel *et al.*, 1998) rendered them difficult to be captured by *P. princeps* mouth parts. Furthermore, the small number of specimens examined during the present study represented a single sample. Therefore results of stomach content analysis might not characterize the feeding habits of this species. The presence of the amorphous sticky substances in the examined guts may be derived from a variety of sources (i.e. detrital materials or soft bodied larvaceans) which breaks down immediately after ingestion. As a result of the poor old

descriptions of pontellid species that may cause taxonomic confusion, as well as the large variations within species in female's abdomen and leg 5 of both sexes, a complete revision of the family is therefore recommended.

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**إعادة توصيف بونتيللا برنسبس (مجدافية الأرجل-قشريات)  
المسجله لأول مرة فى البحر الأحمر وعاداتها الغذائية**

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**الملخص العربى**

أثناء دراسة مجتمع الهائمات الحيوانية فى منطقة شرم الشيخ شمال البحر الأحمر تم تسجيل نوع من مجموعة مجدافية الأرجل (بونتيللا برنسبس) لأول مرة فى البحر الأحمر. وقد تم تجميع هذه المجموعة ممثلة من ذكور وإناث وقد تم توصيفهم ووصفهم وصف كامل. وقد وجد أن هذا النوع مصدره منطقة المحيط الهندى والهادئ. كما أنضح من دراسة وتحليل محتوى المعدة للإناث أن هذا النوع من الأنواع اللاحمة والتي تتغذى على أنواع نباتية من مجموعة مجدافية الأرجل.