

# *Pteriacartia*, A new genus of Acartiidae (Calanoida, Diaptomoidea) for *Acartia josephinae* Crisafi, 1974

G. Belmonte \*

Stazione di Biologia Marina di P. Cesareo, Dipartimento di Biologia, Università di Lecce, 73100 Lecce, Italy

Revised 15 May 1997; accepted 26 September 1997

## Abstract

*Acartia josephinae* is currently not ascribed to any of the existing *Acartia* subgenera. In the original description, morphological affinities with *A. (Paracartia) latisetosa* were suggested. No holotype or paratypes were deposited. The adult female has a fin-like, asymmetrical, prominence on the right side of the genital segment. Asymmetry of the genital segment is present in some representatives of the superfamily Diaptomoidea, but it is unique to the family Acartiidae. The adult male has a typical *Acartia* morphology. The distinctive morphological features of the species *Acartia josephinae* allow its inclusion in a new genus, *Pteriacartia*. *Pteriacartia josephinae* is here described. A neotype and paratypes have been deposited. © 1998 Elsevier Science B.V. All rights reserved.

**Keywords:** Copepoda; Acartiidae; *Pteriacartia Josephinae*; Taxonomy

## 1. Introduction

Crisafi (1974) described the new species *Acartia josephinae*, without designating a type. Furthermore, he did not refer the new species to any of the subgenera of the genus *Acartia* Dana (1846), while pointing out that females resembled *A. (Paracartia) latisetosa* (Kriczaguin, 1873) more than any other *Acartia* species he studied. However, Crisafi (1974) did not state on what grounds this resemblance was based. The resemblance could be due to sharing two distinctive genital pores, fifth pair of prosome legs (p5) very small, and a gelatinous apron on the ventral side of the urosome in the females of both taxa.

The subgenus *Paracartia* is presently ranked at generic level (as already proposed by Scott, 1894),

and comprises species sharing features not present in *A. josephinae* (see Steuer, 1923, for a definition of *Paracartia* as a subgenus of *Acartia*).

After its description, *A. josephinae* was found in different areas of the southern Mediterranean (Garcia-Rodriguez, 1985; Belmonte, 1988; Lakkis and Zeidane, 1990; Coen and Gravina, 1992; Quarta et al., 1992; Mocci, 1995; Zagami et al., 1996) and a study was carried out on the deposition of resting eggs by females of this species (Belmonte and Puce, 1994).

## 2. Material and methods

Crisafi (1974) did not deposit any type of the new species *Acartia josephinae*. Original specimens were

\* Tel.: +39-832-320615. Fax: +39-832-320626.

lost or destroyed during his office moving after his death. I looked for them unsuccessfully either at the Crisafi Institute and at his home.

Specimens (adults and late copepodids) utilised for the present description were collected in the coastal area of Porto Cesareo, in the Gulf of Taranto, Ionian Sea (at least one specimen of the Crisafi's collection derived from Taranto sea), and in the brackish water basin of Acquatina (South Adriatic coast), both on the Salento Peninsula, Italy, at different periods of the year, from 1986 to 1996.

Samples were collected in a plankton net of 200  $\mu\text{m}$  of mesh size, towed from 10 m depth to the surface. Morphological features were observed under a compound microscope (from 100 to 400 $\times$ ), and drawn using a camera lucida. Some specimens were observed with the SEM. Eggs and nauplii were obtained in the laboratory from mature females soon after collection. The terminology follows Huys and Boxshall (1991).

### 3. Taxonomy

*PTERICARTIA* Belmonte, gen. nov.

*Diagnosis:* Two rostral filaments. Marked sexual dimorphism. Postero-lateral sides of last prosome segment rounded. male urosome slender, 5-segmented, short furcal rami. female urosome comparatively shorter, 3-segmented, genital segment asymmetric, longer than half the urosome, genital pores paired, laterally placed, without opercula, fin-like expansion on the right side of the genital segment. Male right antennule (a1) geniculate, without swellings. Female fifth leg (p5) reduced to little buttons, each with 1 long bristle. Male p5 with right leg larger, terminating with a long claw curved inwards, subterminal article of right leg with finger-like protrusion originating from the distal half of the article. The left leg ends with a 'half moon' article, with spines at either end. Spermatophore fixed by a gelatinous 'apron' on the ventral side of the female genital segment.

*Etymology:* The name (from the Greek 'pteria', wing, or fin) refers to the typical prominence on the right side of the genital segment in adult females.

### *Pteriacartia josephinae* (Crisafi, 1974)

*Synonym:* *Acartia josephinae* Crisafi, 1974

*Neotype:* One adult male from Porto Cesareo (44°15'00"N, 17°53'28"E, Italy), on the Apulian coast of the Gulf of Taranto, Ionian Sea, Mediterranean; specimen deposited at the National Museum of Natural History, Leiden, the Netherlands; registration number: RMNH F 1046.

*Paratypes:* 14 females, 10 males, 1 male copepodid (C V), 4 female copepodids (C V), from the same locality and sample as the neotype, collection date 13 July 1990. Specimens deposited at the National Museum of Natural History, Leiden, the Netherlands, registration number: RMNH F 1047.

*Other material:* Adult specimens from the Acquatina brackish water basin (44°25'14"N, 18°14'08"E), and Porto Cesareo, samples collected from 1986 to 1996, and stocked in the museum of the Stazione di Biologia Marina di Porto Cesareo.

#### 3.1. Description of collected material

*Male, adult:* Length of neotype, excluding furcal setae, 796  $\mu\text{m}$ . Length of 10 paratypes 788–828  $\mu\text{m}$ . Prosome–urosome length ratio, 3.00:1.

Body slender; two rostral filaments, one eye on the head, 3-lobed labrum. Body surface without patterns of cuticle striae; postero-dorsal border of somites (prosome and urosome) smooth (Fig. 1A, Fig. 6C, D) with exception of the last prosomite which shows 1 hair sensillum and 4 spines on each latero-dorsal border (Fig. 6B, D), and a series of bristles on the latero-ventral side. Urosome 5-segmented. Rows of spinules on dorsal side of all the urosome segments (Fig. 6C, D).

Two rostral filaments (Fig. 5E). Right antennula (a1), 18 articles, geniculated (Fig. 2, a1); left a1, 23 articles. Labrum (lb) (Fig. 1C, D, Fig. 5C), 3-lobed, one transversal groove, spine clusters. Antenna (Fig. 2, a2), basis 1 seta; long and slender endopodite (endp), first article longer than exopodite (exp), with 8 interconnected setae plus 1 distal seta, 2nd article with 6 setae, small 3rd article with 7 setae; exp 3-articled with 1, 2, 3 setae respectively. Mandible (Fig. 3, mb), well-developed gnathobasis, isolated tooth on one side; endp 2-articled, 2, 4 setae; exp

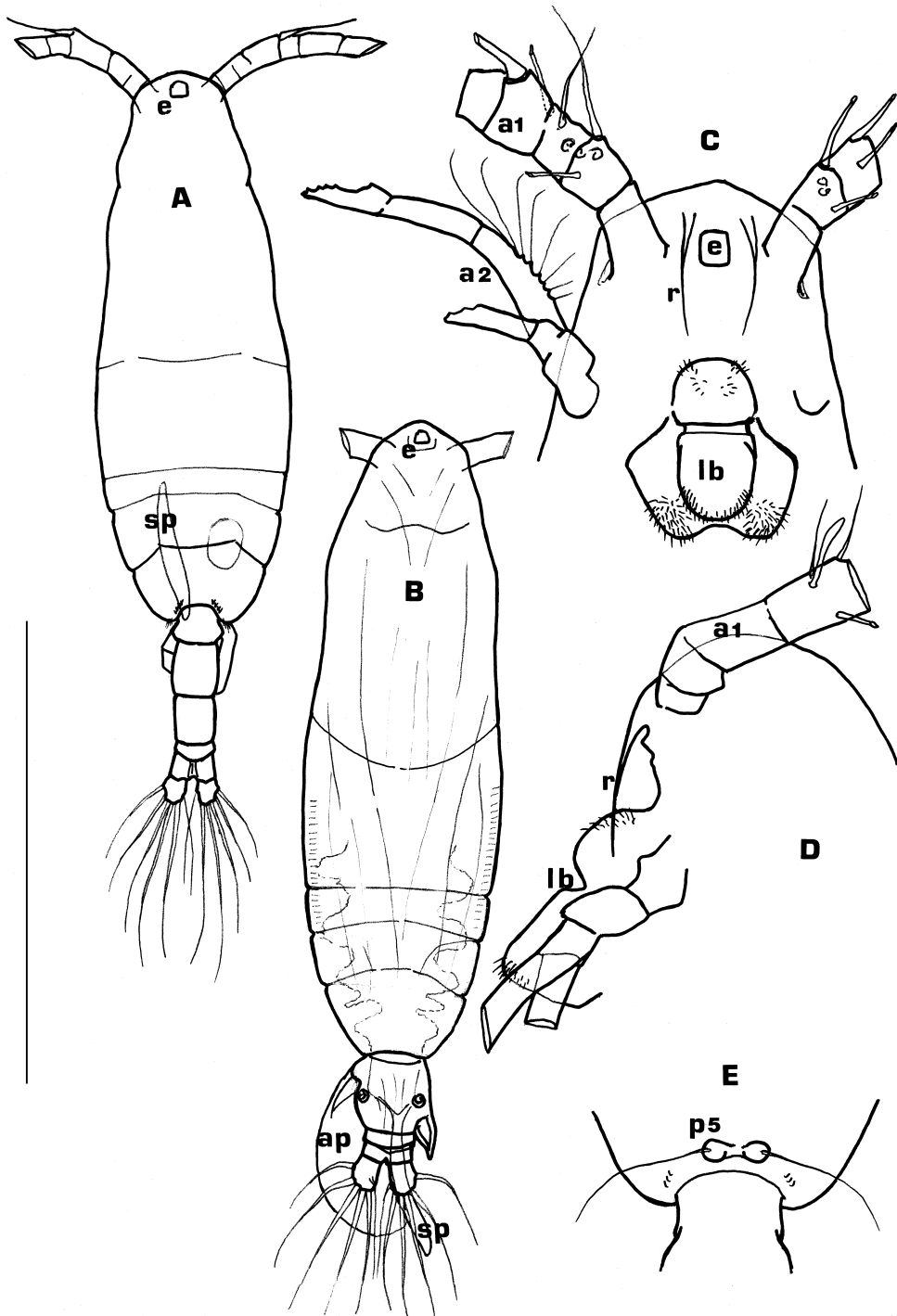


Fig. 1. *Pteriacartia josephinae* (Crisafi, 1974), body shape of male (A), and female (B), dorsal views. Particulars of the male, ventral view (C) and female, lateral view (D) heads. Female *p5*, ventral view (E). *a1* = antennule; *a2* = antenna; *ap* = apron; *e* = eye; *lb* = labrum; *p5* = fifth pair of prosome legs; *r* = rostral filament; *sp* = spermatophore. Scale bar: 500  $\mu\text{m}$  (A, B); 200  $\mu\text{m}$  (C, D, E).

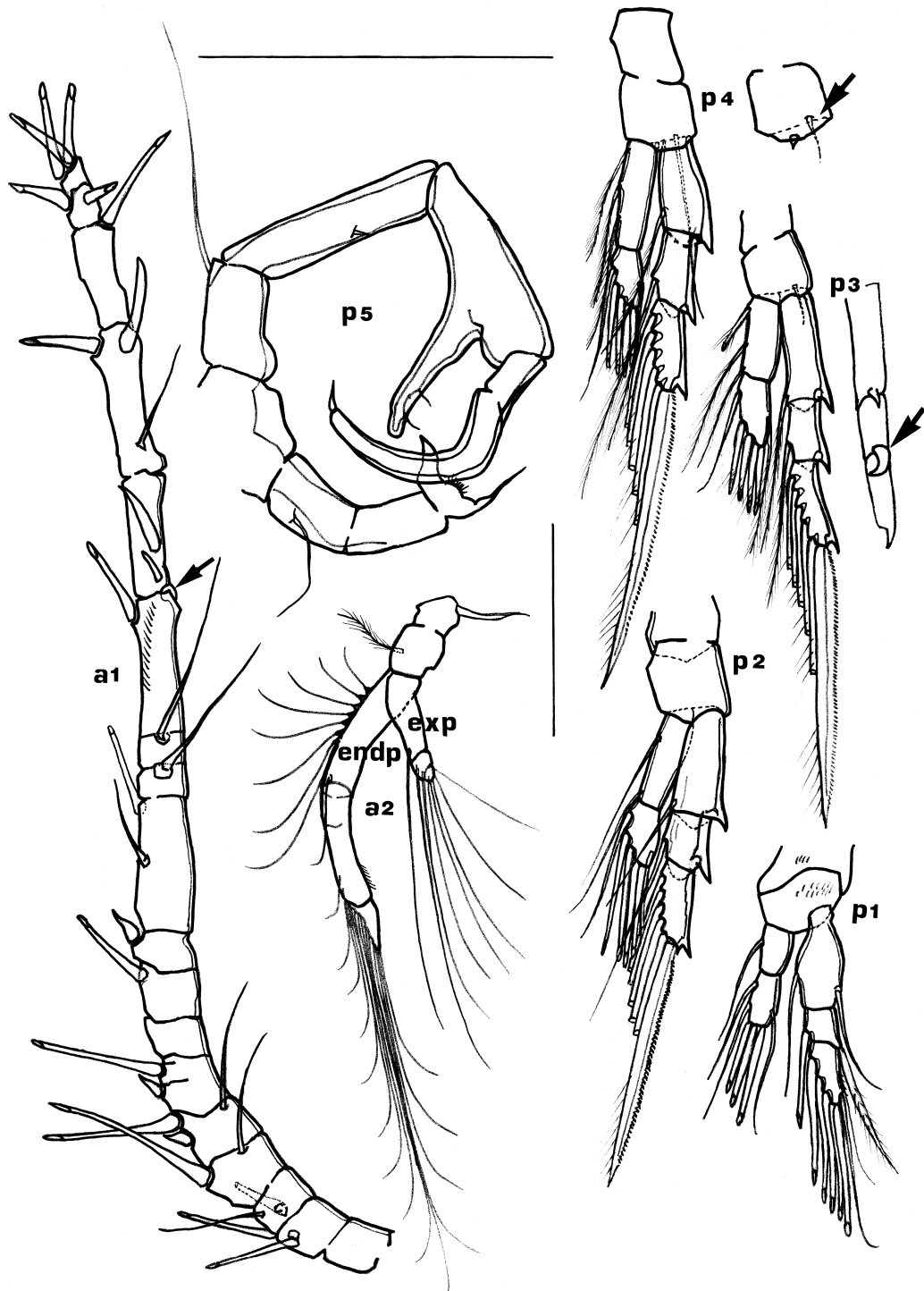


Fig. 2. *Pteriacartia josephinae* (Crisafi, 1974). *a1* = right antennule of male, the arrow indicates the geniculation point; *a2* = antenna; *endp* = endopodite; *exp* = exopodite; *p1*, *p2*, *p3*, *p4* = right swimming legs of female, anterior view, the arrows indicate differences in the male; *p5* = copulatory legs of male. Scale bars: 100  $\mu\text{m}$  (the longest refers to *p5*).

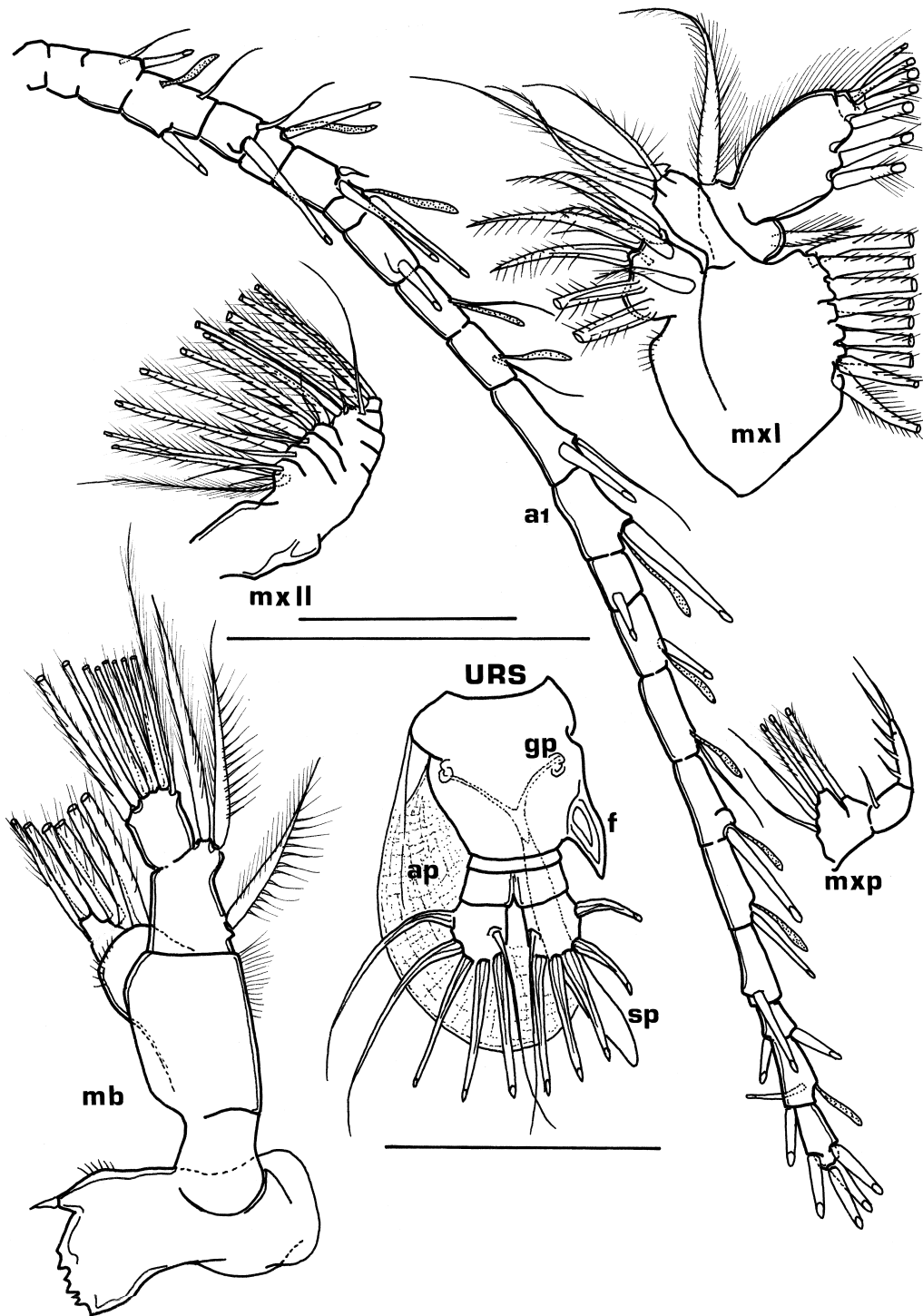


Fig. 3. *Pteriacartia josephinae* (Crisafi, 1974), female. *a1* = antennula; *ap* = apron; *f* = fin-like expansion; *gp* = genital pore; *mb* = mandible; *mxl* = maxillule; *mxII* = maxilla; *m xp* = maxillipede; *sp* = spermatophore; *URS* = urosome (dorsal view). Scale bars: 150  $\mu\text{m}$  (on the bottom, referring to URS only), 100  $\mu\text{m}$  (at the center, the longer refers to *mb* and *mxl*, the shorter refers to *a1*, *mxII*, *m xp*).

3-articled, 1, 2, 7 setae. Maxillula (Fig. 3, mxI), prae-coxal arthrite with 9 spines and setae; coxal endite and basal endites, 0, 3, 1 setae; endp absent;

exp, fringed border, 2 + 5 setae; coxal epipodite and basal exite, 9, 1 setae. Maxilla (Fig. 3, mxII), exp absent; prae-coxal, coxal and basal endites, 5, 2, 3,

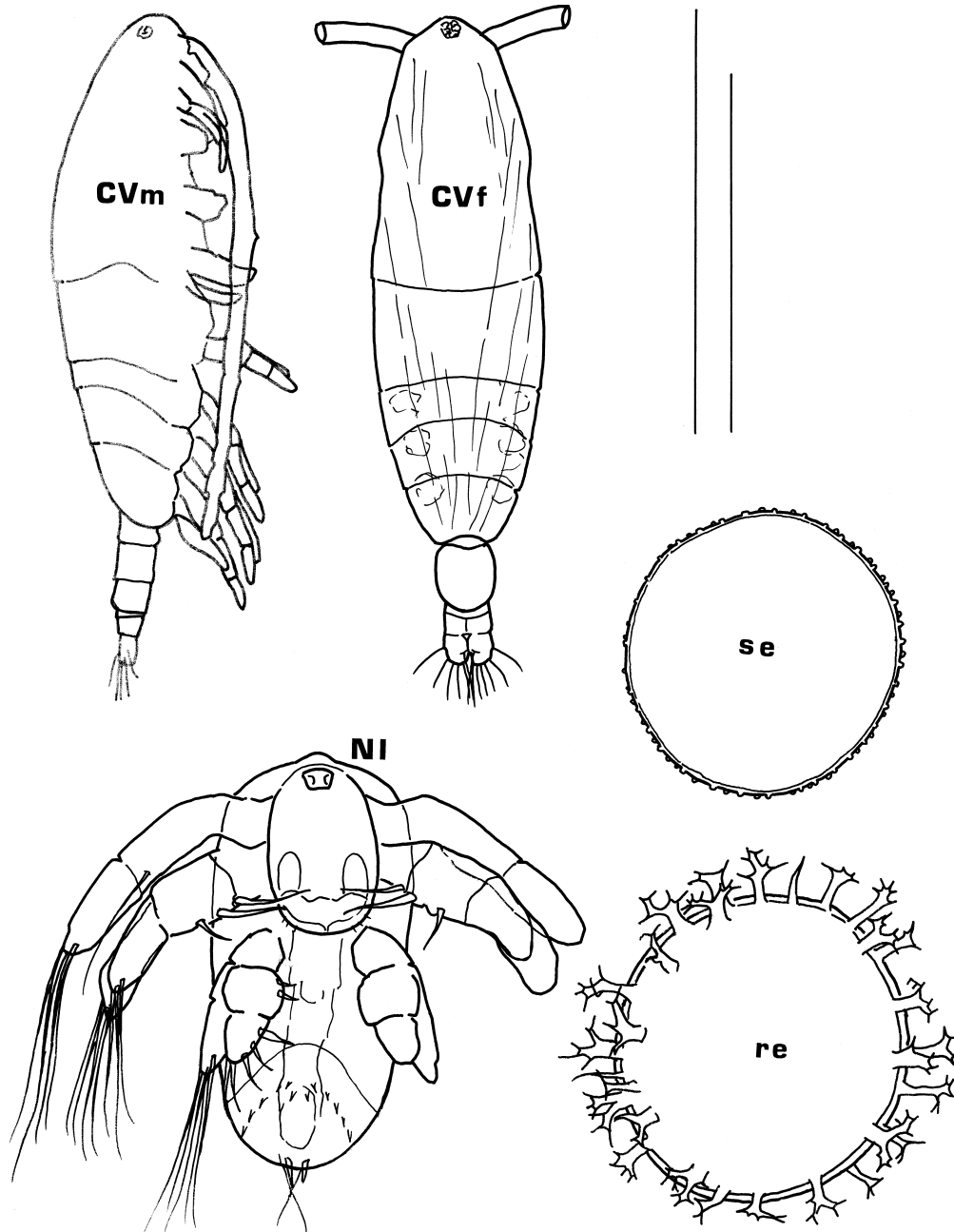


Fig. 4. *Pteriacartia josephinae* (Crisafi, 1974), developmental stages. Body shape of male fifth copepodid (CVm), lateral view; of female fifth copepodid (CVf), dorsal view; of first nauplius (NI), ventral view. Subitaneous egg (se), resting egg (re). Scale bars: 500  $\mu\text{m}$  (the longer, referring to CVm, CVf), 100  $\mu\text{m}$  (the shorter, referring to NI, se, re).

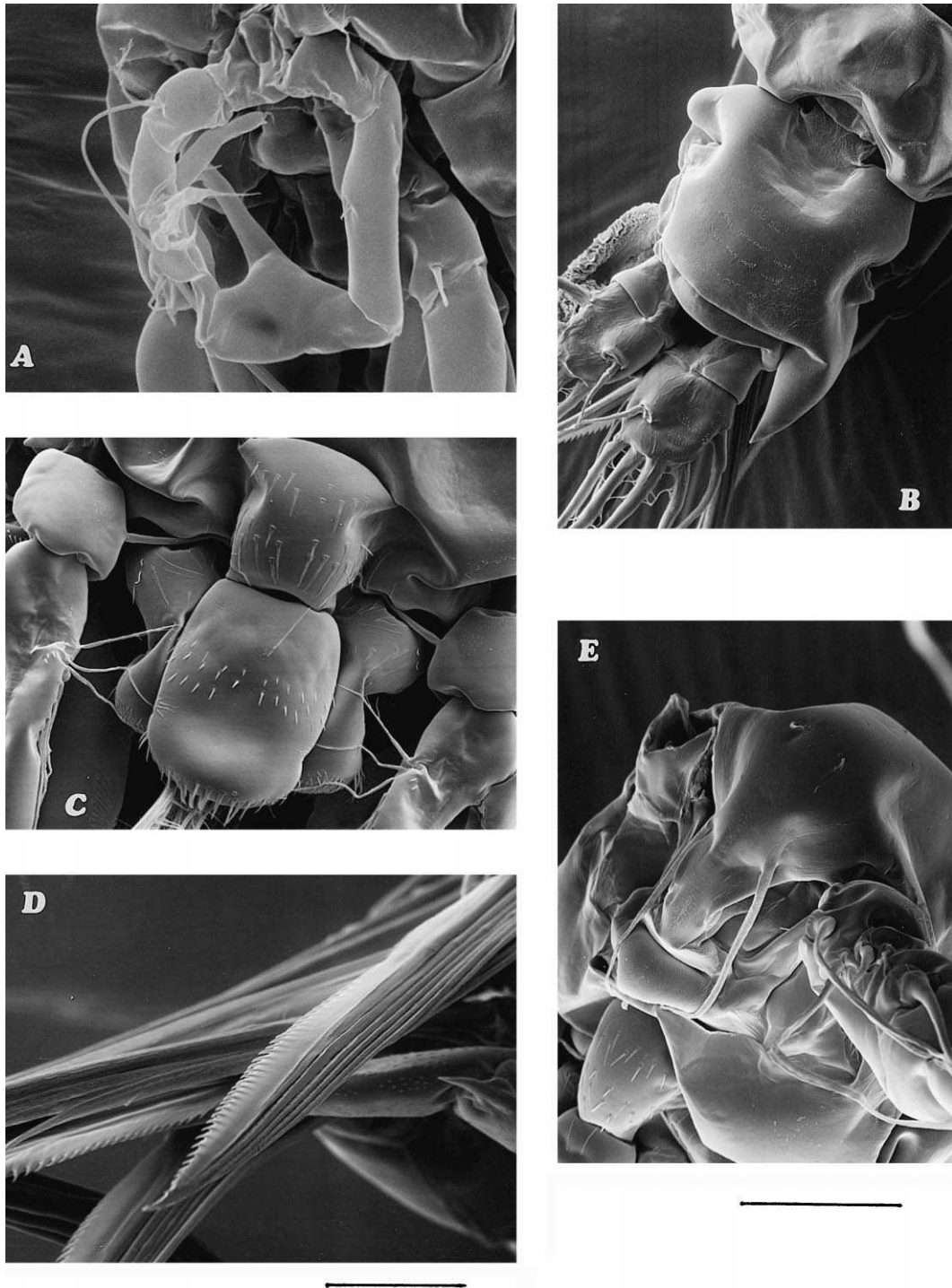


Fig. 5. *Pteriacartia josephinae* (Crisafi, 1974), SEM images. Male p5 (A); female urosome (B), dorsal view; male labrum (C); female swimming legs, bristles (D); male rostral filaments (E). Scale bars: 20  $\mu\text{m}$  (A, C, D), 40  $\mu\text{m}$  (B, E).

2, 2 setae; endp, 7 setae. Maxilliped (Fig. 3, mxp), reduced, exp absent; coxal endites, 5 setae; basis, 1 seta; endp, 4 short setae. Swimming legs (Fig. 2, p1–p4), slender with long natatory setae; exp 3-

articled; endp 2-articled; on legs 2–4 the latero-distal border of each exp article is expanded in a conspicuous, inarticulated tooth; tooth of 2nd article of right leg 3 exp, curved backward. Terminal seta of legs

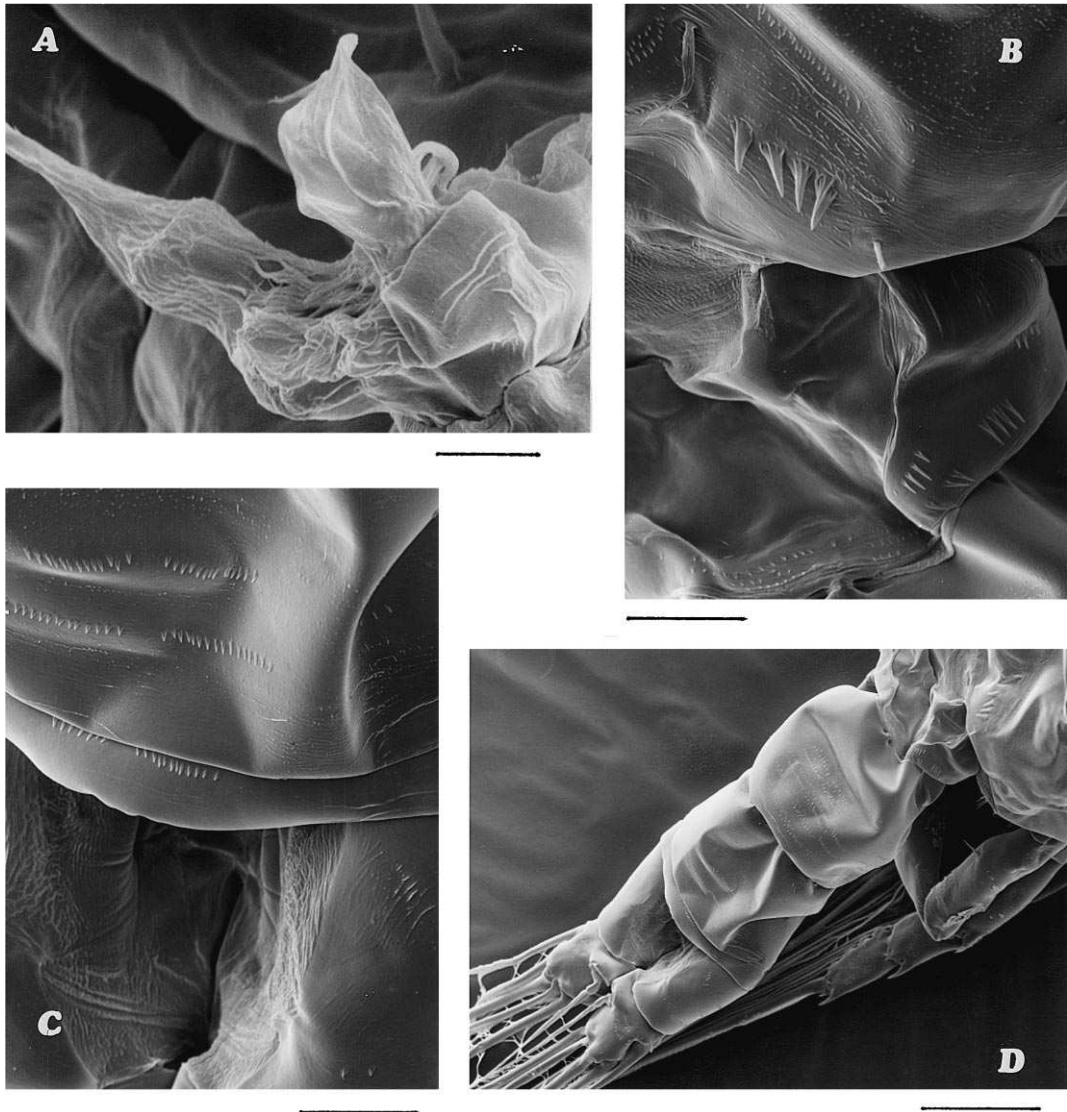


Fig. 6. *Pteriacartia josephinae* (Crisafi, 1974), SEM images, male. Terminal article (half moon shaped) of the left p5 (A), posterior view; postero-lateral portion of the last prosome segment (B); dorsal close up of the last three urosome segments (C); dorsal view of the urosome (D). Scale bars: 4  $\mu\text{m}$  (A), 10  $\mu\text{m}$  (B, C), 40  $\mu\text{m}$  (D).



2–4 with outer edge dentate. Leg 3 basis, 1 spine on posterior side. Leg 4 basis, 1 short seta on posterior side. Spines and setae as follows:

	coxa	basis	exp			endp
p1	0	0-0	I-1;	I-1;	II-I-5	0-1; 1-2-3
p2	0	0-0	0-1;	0-1;	0-I-5	0-2; 1-2-3
p3	0	1-0	0-1;	0-1;	0-I-5	0-2; 1-2-3
p4	0	1-0	0-1;	0-1;	0-I-5	0-3; 1-2-3

Last prosome legs (Fig. 2, p5, Fig. 5) modified for spermatophore transfer during copulation. Right leg uniramous ending in a clasper formed by an inner ‘finger like’ protuberance originating from the distal half of the subterminal article, and a terminal curved inwards claw. Left leg ending in a ‘half moon’ structure with central cluster of spinules.

*Female, adult*: Length of 14 paratypes, 796–887  $\mu\text{m}$ . Prosome–urosome length ratio, 4.19:1 ( $N = 14$ ).

Rostrum, eye, labrum, as in the male (Fig. 1C). Antennule (Fig. 3, a1), 22 articles; a2, mb, mxI, mxII, mxp, p1, p2, as those of the male; p3, basis, short seta on the posterior border, exp, 2nd article of the right leg without the curved tooth; p4, basis, 1 seta; p5, reduced (Fig. 1E), only one article, 1 distal seta for each leg. One hair sensillum on each latero-dorsal side of the posterior border of the prosome; genital segment asymmetric, longer than the rest of the urosome (Fig. 3, URS; Fig. 5B). Right side of genital segment with a ‘fin-like’ prominence which gives the name to the genus. A tapering process is present on the left anterior side of the genital segment is the area of attachment of a gelatinous ‘apron’ which probably fixes the spermatophore at correct position. Genital segment without ventral prominence if observed in lateral view. Transversal rows of spinules present on dorsal side of all urosome segments and furcal rami (Fig. 5B).

*Late copepodids (C V)*: Male (Fig. 4, CVm), total length of 1 paratype, 695; 5-segmented urosome; well developed, but still immature, p5. Female (Fig.

4, CVf), total length of 4 paratypes, 690–702  $\mu\text{m}$ ; 3-segmented urosome; genital segment longer than the rest of urosome, and symmetrical.

*Early nauplius (N I)*: Total length, 97–103  $\mu\text{m}$  ( $N = 8$ ). Body shape (Fig. 4, NI) typical of Acartiidae nauplii (e.g., Sazhina, 1985). a1 3-articled (0, 1, 4 bristles). a2 biramous; coxopodite, 1 slender spine; basipodite, 2 slender spines, endp, 4 bristles; exp, 4 bristles. mb, biramous; basipodite, 2 spines; endp, 3 spines; exp, 6 bristles. Abdomen ending with two bristles and two spines, the ventral side surrounded by a crown of spinules.

*Eggs*: During spring and summer females lay subitaneous eggs, diameter of about 76  $\mu\text{m}$ , and chorion pointed by small tubercles (Fig. 4, se). During autumn females lay resting eggs, diameter of about 83  $\mu\text{m}$ , with spiny egg coat (Fig. 4, re; see also Belmonte and Puce, 1994).

### 3.2. Remarks

Adult body size varies seasonally, being smaller in the summer than in the winter (Table 1). Males are always smaller than females. In the Acquatina lake (samples collected in 1988) males ranged from 714 to 893  $\mu\text{m}$  ( $N = 104$ ), and females ranged from 778 to 986  $\mu\text{m}$  ( $N = 121$ ). The species is endemic of the Mediterranean where it lives in coastal areas of the south, from March to October.

The apron is not present on the genital segment of virginal females (i.e., without attached spermatophore) which are rare in natural populations (8.5% in the Acquatina lake,  $N = 107$ ; 0% in the Porto Cesareo area,  $N = 125$ ). The spine recorded by Crisafi (1974) on the left side of the genital segment is not a genital segment structure, but the shape of the apron attachment. Juveniles (copepodids C I–C V) do not show the asymmetries of the adults (i.e., right a1 and right leg3 spine of male, and genital segment of female).

Table 1

Variation of the body size (total length,  $\mu\text{m}$ ) in *Pteriacartia josephinae* (Crisafi, 1974), females and males, in the Acquatina lake (South Adriatic coast) from January to December 1988

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Females	–	–	–	920	856	829	844	816	860	882	–	–
Males	–	–	828	866	839	780	793	761	795	–	–	–

Crisafi (1974) suggested that the female of *A. josephinae* resembles that of *A. latisetosa*, but *A. josephinae* differs from all the *Paracartia* species (to which *A. latisetosa* is presently referred), in the lack of the expansions on the postero-lateral border of the prosome, and the enlarged seta on each furcal ramus. Furthermore, the female genital segment of *Pteriacartia josephinae* has a unique morphology among all the Acartiidae, being asymmetrical and bearing, on the right side, a fin-like expansion. The male geniculate a1 lacks the swelling present in other *Paracartia*. In addition, the subterminal joint of the p5 right leg bears a finger-like prominence on the distal half, whereas a similar prominence is present on the proximal half of the subterminal joint of the right p5 in *Paracartia*. *Pteriacartia josephinae* differs from all other Acartiidae also in resting egg morphology (Belmonte and Puce, 1994).

### Acknowledgements

I thank Janet Bradford-Grieve, who indirectly encouraged this work, and then supported it with constructive suggestions. Dr. Anna Miglietta (University of Lecce) and Dr. Angelo De Stradis (University of Potenza) supported me with the SEM techniques. Financial support derived from MURST grant (40%, 60%) and from funds of the 'Stazione di Biologia Marina di Porto Cesareo'.

### References

Belmonte, G., 1988. Lo zooplankton del bacino di Acquatina Frigole-Lecce. Prime osservazioni. *Thalassia Salentina* 18, 141–152.

- Belmonte, G., Puce, M., 1994. Morphological aspects of subitaneous and resting eggs from *Acartia josephinae* (Calanoida). *Hydrobiologia* 292–293, 131–135.
- Crisafi, P., 1974. Inquinamento e speciazione: *Acartia josephinae* e *A. enzoi* (Copepoda, Calanoida) specie nuove del mare Mediterraneo. *Boll. Pesca. Piscic. Idrobiol.* 29 (1), 5–10.
- Coen, R., Gravina, M.F., 1992. Associazioni di specie del genere *Acartia* (Copepoda) nel basso Adriatico. *Oebalia* 17 (2 (suppl.)), 339–340.
- Dana, J.D., 1846. Notes on some genera of Cyclopacea. *Ann. Mag. Nat. Hist. London* 18, 181–185.
- García-Rodríguez, M., 1985. El zooplankton de la laguna litoral Mar Menor (Murcia, SE de España). Parte I: La comunidad de copépodos en febrero–marzo de 1980. *Bol. Inst. Esp. Oceanogr.* 2 (2), 37–40.
- Huys, R., Boxshall, G.A., 1991. Copepod evolution. The Ray Society, London, 468 pp.
- Lakkis, S., Zeidane, R., 1990. Associations congénériques d'*Acartia* (Copepoda, Calanoida) dans les eaux côtières Libanaises: calcul des indices d'overlap et de niche hypervolume. *Rapp. Comm. Int. Mer Médit.* 32 (1), 223.
- Mocci, A., 1995. Sul ritrovamento di sei specie del genere *Acartia* (Copepoda) in alcune lagune sarde. *Biol. Mar. Medit.* 2 (2), 547–548.
- Quarta, S., Belmonte, G., Caroppo, C., Pacifico, P., Petraroli, A., 1992. Zooplankton seasonal trend in the Lesina and Varano lagoons (Apulian coast of Italy). *Oebalia* 17 (2 (suppl.)), 403–404.
- Sazhina, L.I., 1985. Naupliusi massovik vidov pelagicheskik copepod mirovogo oceana. *Oprelliteli. Naukova Dumka, Kiev*, 238 pp.
- Scott, T., 1894. Report on Entomostraca from the Gulf of Guinea, collected by John Rattrey, B.Sc. *Trans. Linn. Soc. London, Zool.* 2 6, 1–161.
- Steuer, A., 1923. Bausteine zu einer monographie der copepodengattung *Acartia*. *Arb. Zool. Inst. Univ. Innsbruck*, Bd. 1.
- Zagami, G., Badalamenti, F., Guglielmo, L., Manganaro, A., 1996. Short term variations of the zooplankton community near the straits of Messina (North-eastern Sicily): Relationships with the hydrodynamic regime. *Estuarine Coastal Shelf Sci.* 42, 667–681.