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## TWO SPECIES OF *PARAMOLGUS* (COPEPODA: POECILOSTOMATOIDA: LICHOMOLGIDAE) ASSOCIATED WITH THE SCLERACTINIAN *PAVONA* IN NEW CALEDONIA WITH A KEY TO FEMALES OF *PARAMOLGUS*

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ABSTRACT

Two poecilostomatoid copepods (Lichomolgidae) are recorded from the scleractinian coral *Pavona praetorta* Dana in New Caledonia: *Paramolgus pavonae* n. sp. and *Paramolgus setellus* Humes, 1992. A key is given for females of the genus *Paramolgus*.

## INTRODUCTION

Among the approximately 50 nominal species of the Indo-Pacific coral genus *Pavona* (see Veron, 1986), several are known to have copepod associates. The present records are as follows: (Madagascar) - *Pavona angulata* Klunzinger: *Odontomolgus* (= *Lichomolgus*) *actinophorus* (Humes & Frost, 1964) (see Humes & Stock, 1973:254), *Xarifia longipes* Humes, 1962; - *Pavona danai* (Milne Edwards & Haime): *Odontomolgus actinophorus* (see Humes & Ho, 1968c); - *Pavona danai* or *Pavona angularis* (Klunzinger): *Odontomolgus actinophorus* (see Humes & Ho, 1968c); - *Pavona* ? *venusta* (Dana): *Odontomolgus actinophorus* (see Humes & Ho, 1968c); - *Pavona cactus* (Forskål): *Odontomolgus actinophorus* (see Humes & Frost, 1964); - *Pavona* sp.: *Odontomolgus* (= *Lichomolgus*) *rhadinus* (see Humes & Ho, 1967a, and Humes & Stock, 1973:255), *Xarifia diminuta* Humes & Ho, 1967a.

(Mauritius) - *Pavona varians* (Verrill): *Xarifia finitima* Humes, 1985.

(New Caledonia) - *Pavona cactus* (Forskål): *Xarifia finitima*; - *Pavona varians*: *Xarifia finitima*.

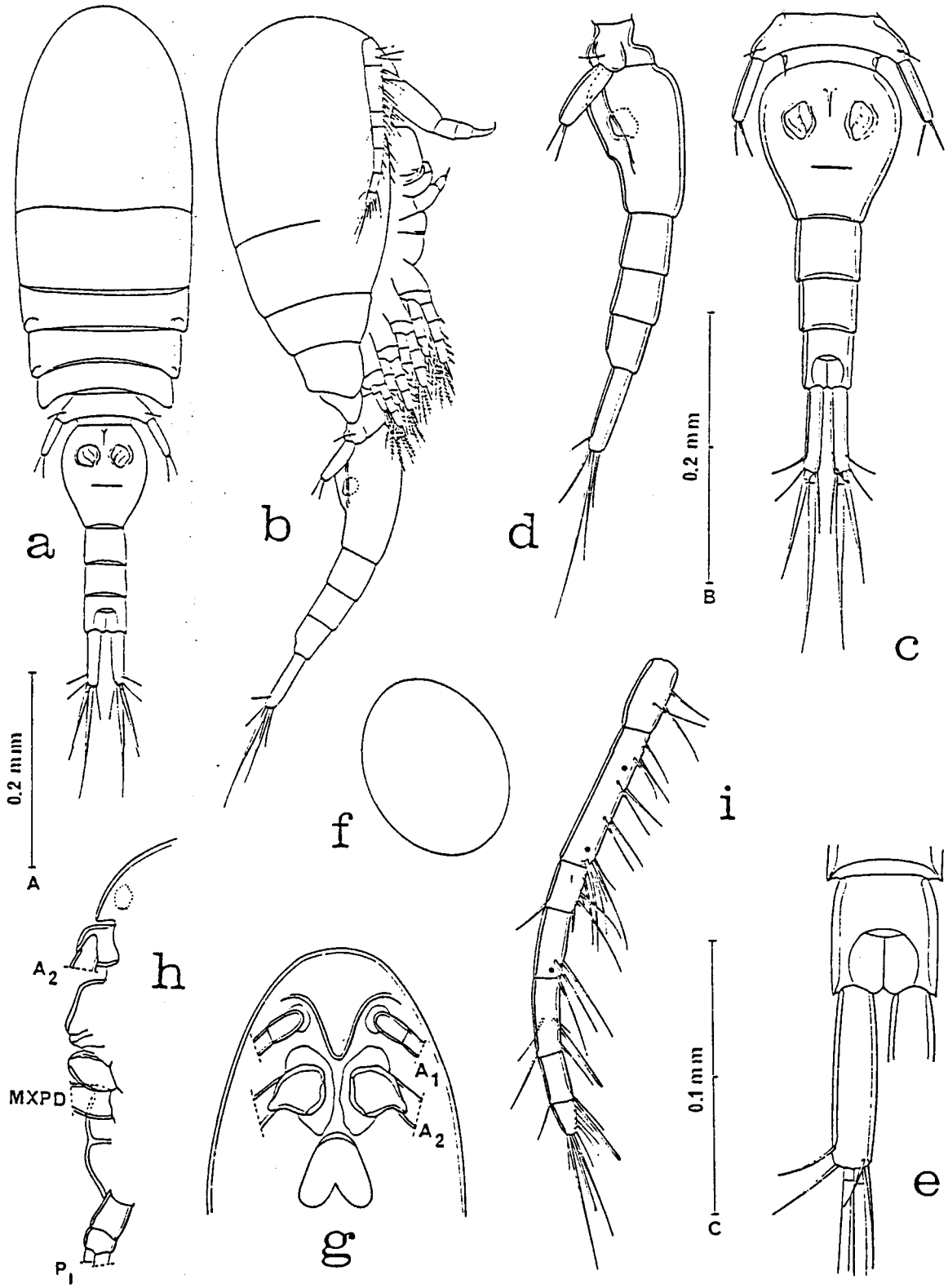


Fig. 1a-i. *Paramolgus pavonae* n. sp., female. a, dorsal (scale A); b, lateral (A); c, urosome, dorsal (B); d, urosome, lateral (B); e, anal somite and caudal ramus, dorsal (C); f, egg, ventral (B); g, rostrum and labrum, ventral (B); h, cephalosome, outline of ventral side, lateral (B); i, antennule, dorsal (C).

## MATERIAL AND METHODS

The copepods were collected by washing the coral in approximately 5% ethanol in sea water. The wash water was passed through a fine net and the copepods retrieved from the sediment retained.

The copepods were measured and dissected in lactic acid. The figures were drawn with the aid of a camera lucida. The letter after the explanation of each figure refers to the scale at which it was drawn.

## SYSTEMATIC DESCRIPTIONS

Order Poecilostomatoida Thorell, 1859
Family Lichomolgidae Kossmann, 1877
Genus *Paramolgus* Humes & Stock, 1972

**Paramolgus pavonae** n. sp.
Figs. 1a-i, 2a-l, 3a-h

Type material.- 192 ♀♀ 175 ♂♂ from *Pavona praetorta* Dana, in 2 m, Ile Ndié, near Nouméa, New Caledonia, 22°13'15"S 166°24'26"E, 6 July 1971. Holotype ♀ (ZMA Co. 200741), allotype (ZMA co. 200742), and 335 paratypes (175 ♀♀, 160 ♂♂) (ZMA co. 200743) deposited in the Zoologisch Museum, Amsterdam. Remaining paratypes in the collection of the author.

Female.- Body (fig. 1a,b) with slender prosome. Length (not including setae on caudal rami) 0.68 mm (0.66-0.72 mm) and greatest width 0.18 mm (0.17-0.19 mm), based on 10 specimens in lactic acid. Greatest dorsoventral thickness 0.18 mm. Somite bearing leg 1 separated from cephalosome by dorsal transverse suture. Epimera of somites bearing legs 3 and 4 rounded. Ratio of length to width of prosome 2.14:1. Ratio of length of prosome to that of urosome 1.30:1.

Somite bearing leg 5 (fig. 1c) 34 x 104 µm. Genital double somite 104 x 96 µm, ratio 1.08:1, in dorsal view broadest in anterior half with smoothly rounded lateral margins; in lateral view (fig. 1d) showing small dorsal angulation. Weak transverse sclerotization probably denoting fusion of 2 somites. Genital areas located dorsally in anterior part of double somite, both with 2 extremely small setae. Three postgenital somites from anterior to posterior 42 x 47, 36 x 40, and 41 x 36 µm.

Caudal ramus (fig. 1c) elongate, unornamented, 62 x15.5 µm, ratio 4.07:1. Outer lateral seta 22 µm, dorsal seta 9 µm, outermost terminal seta 29 µm, innermost terminal seta 35 µm, and 2 median swollen terminal setae 68 µm (outer) and 120 µm (inner). All setae smooth.

Dorsal surface of body without visible sensilla.

Egg sac with single egg 125 x 99 µm (fig. 1f).

Rostrum in ventral view narrowly linguiform (fig. 1g) in lateral view beaklike (fig. 1h). Antennule (fig. 1i) 170 µm long, 7-segmented. Lengths of segments (measured along their posterior nonsetiferous margins): 29, 53, 15, 26, 29, 21, and 10 µm, respectively. Armature: 3, 13, 6, 3, 4 + 1 aesthete, 2 + 1 aesthete, and 7 + 1 aesthete. All setae smooth. Antenna (fig. 2a) 135 µm long, 4-segmented. Claw 26 µm. No setae visible.

Labrum with 2 posteroventral lobes (fig. 1g), in lateral view conspicuously raised (fig. 1h). Mandible (fig. 2b) small, 40 µm long, with weak scalelike area. Paragnath not seen. Maxillule (fig. 2c) with 2 setae. Maxilla (fig. 2d) without armature except for few small spines on lash. Maxilliped (fig. 2e) with 2 setae on second segment and 2 on third segment.

Ventral area between maxillipeds and first pair of legs (fig. 2f) slightly protuberant (fig. 1b).

Legs 1-4 (fig. 2g-j) segmented and armed as follows (Roman numerals indicating spines, Arabic numerals representing setae):

| | | | | | | |
|---|---|---|---|---|---|---|
| $P_1$ | coxa | 0-1 | basis | 1-0 | exp I-0; I-1; | III,I,5 |
| | | | | | enp 0-1; 0-1; | 1,5 |
| $P_2$ | coxa | 0-1 | basis | 1-0 | exp I-0; I-1; | III,I,5 |
| | | | | | enp 0-1; 0-2; | I,II,3 |
| $P_3$ | coxa | 0-1 | basis | 1-0 | exp I-0; I-1; | III,I,5 |
| | | | | | enp 0-1; 0-2; | I,II,2 |
| $P_4$ | coxa | 0-1 | basis | 1-0 | exp I-0; I-1; | II,I,5 |
| | | | | | enp 0-1; | II |

Inner seta on coxa prominent and feathered in legs 1-3, but small, 6 µm, and smooth in leg 4 (fig. 2j). Leg 4 with exopod 71 µm. Endopod (fig. 2k) with first segment 17 x 12 µm, its inner feathered seta 26 µm; second segment 32 x 10 µm, its 2 terminal spines 18 µm and 25 µm, both with extremely small barbules.

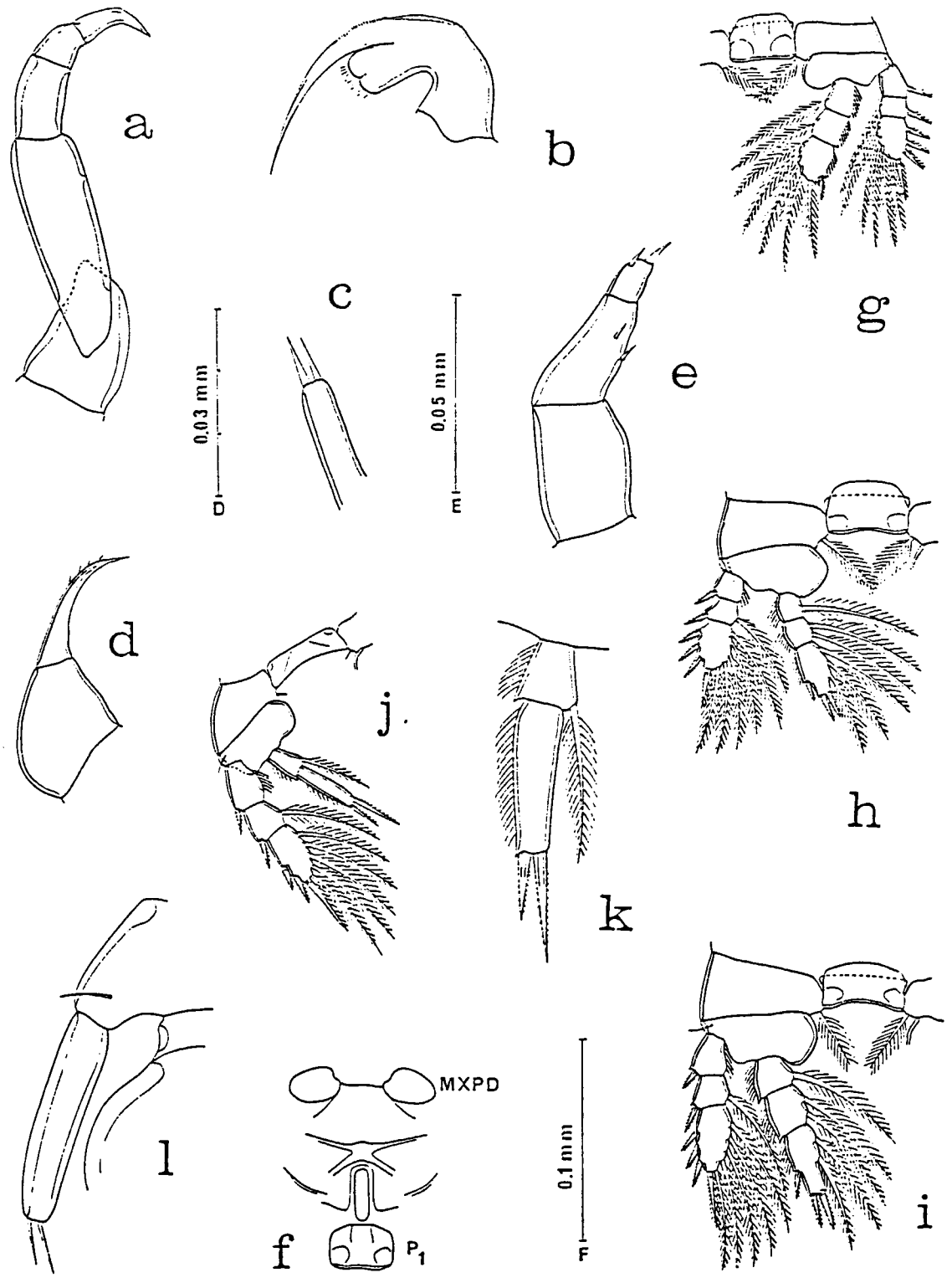


Fig. 2a-l. *Paramolgus pavonae* n. sp., female. a, antenna, outer (scale C); b, mandible, posterior (D); c, maxillule, ventral (D); d, maxilla, posterior (E); e, maxilliped, posterior (E); f, area between maxillipeds and first pair of legs, ventral (F); g, leg 1 and intercoxal plate, anterior (F); h, leg 2 and intercoxal plate, anterior (F); i, leg 3 and intercoxal plate, anterior (F); j, leg 4 and intercoxal plate, anterior (F); k, endopod of leg 4, anterior (E); l, leg 5, dorsal (E).

Leg 5 (fig. 2l) with elongate unornamented free segment 52 x 12 µm, ratio 4.33:1. Two terminal setae 13 µm and 20 µm. Adjacent dorsal seta on body 15 µm. All setae smooth.

Leg 6 probably represented by 2 very small setae on genital area (fig. 1c).

Color of living specimens in transmitted light pale tan, eye red, egg sacs gray.

Male.- Body (fig. 3a) slender as in female. Length 0.70 mm (0.67-0.72 mm) and greatest width 0.17 mm (0.17-0.19 mm), based on 10 specimens in lactic acid. Greatest dorsoventral thickness 0.18 mm. Ratio of length to width of prosome 2.08:1. Ratio of length of prosome to that of urosome 1.06:1.

Somite bearing leg 5 (fig. 3b) 23 x 91 µm. Genital somite 156 x 130 µm, longer than wide, ratio 1.2:1. Four postgenital somites from anterior to posterior 23 x 43, 26 x 44, 26 x 39, and 25 x 36 µm.

Caudal ramus similar to that of female, 62 x 15.5 µm,

Body surface smooth as in female.

Rostrum similar to that of female. Antennule resembling that of female but 3 aesthetes added, at points indicated by dots in fig. 1i. Antenna (fig. 3c) sexually dimorphic, with few small spines along inner side of second segment.

Labrum, mandible, maxillule, and maxilla like those of female. Maxilliped (fig. 3d) with second segment bearing 2 setae and interrupted row of spinules. Claw 94 µm with 2 very unequal proximal setae.

Ventral area between maxillipeds and first pair of legs as in female.

Legs 1-4 like those of female, but sexual dimorphism in endopod of leg 1, with formula 0-l; 0-l; I,I,4 (fig. 3e).

Leg 5 (fig. 3f) with free segment 22 x 7 µm, ratio 3.14:1.

Leg 6 (fig. 3g) posteroventral flap on genital somite bearing 2 very short hyaline setae.

Spermatophore (fig. 3h) elongate, approximately 160 x 57 µm.

Etymology.- The species is named for the host coral *Pavona*.

Remarks.- Three species of *Paramolgus* have a slender body similar to that of the new species, with the ratio of length to width of the prosome in the female more than 2:1. In all other species of *Paramolgus* the prosome is broader, with this ratio 1.90:1 or less. In *P. angustus* Humes, 1992a, the ratio is 2.52, in *P. eparmatoides* Humes, 1992a, it is 2.6:1, and in *P. gibberulus* Humes, 1992a, it is 2.44:1. In all three species the urn-shaped genital double somite is very different from that in *P. pavonae*.

**Paramolgus setellus** Humes, 1992a

Material studied.- 10 ♀♀, 15 ♂♂ from *Pavona praetorta* Dana, in 2 m, Ile Ndié, near Nouméa, New Caledonia, 22°13'15"S 166°24'26"E, 6 July 1971, preserved in the collection of the author.

These specimens are smaller than the type material of *P. setellus* Humes, 1992a. Their smaller size is shown in the following selected characters of the female: length of body 1.26 mm (1.21-1.32 mm) versus 1.63 mm (1.57-1.73 mm) in *P. setellus*; caudal ramus 143 x 29 µm, ratio 4.93:1, versus 200 x 37 µm, ratio 5.4:1, in *P. setellus*; second segment of antenna 200 x 21 µm, ratio 10:1, versus 200 x 26 µm, ratio 8.5:1, in *P. setellus*; and free segment of leg 5 117 x 18 µm, ratio 6.5:1, vers--s 130 x 23 µm, ratio 5.65:1, in *P. setellus*. In spite of their smaller size, the specimens from *P. praetorta*, appear to be conspecific with *P. setellus* from *Gardineroseris planulata* (Dana) at Poelau Gomumu, in the Moluccas.

## KEY TO FEMALES OF THE GENUS *PARAMOLGUS*

(A species determined in the key should always be verified by reference to the original description and figures.)

1. Prosome slender, ratio of length to width greater than 2.10:1 ..... 2
- Prosome broad, ratio of length to width 1.90:1 or less..5
2. Free segment of leg 5 small, oval, 21 x 12 µm, ratio 1.75:1 ..... *P. angustus* Humes, 1992a:315 (with *Gardineroseris planulata* (Dana) (Scleractinia) - Moluccas)
- Free segment of leg 5 elongate, at least 4:1 ..... 3
3. Genital double somite in dorsal view with evenly rounded sides; 2 median terminal setae on caudal ramus swollen ..... *P. pavonae* n. sp.

(with *Pavona praetorta* Dana (Scleractinia) - New Caledonia)

- Genital double somite in dorsal view expanded anteriorly, abruptly constricted posteriorly; 2 median terminal setae on caudal ramus not swollen....4

4. Cephalosome in lateral view with distinct dorsal prominence; free segment of leg 5 with ratio 5.11:1.... ....*P. gibberulus* Humes, 1992a:325 (with *Gardineroseris planulata* (Dana) (Scleractinia) - Moluccas)

- Cephalosome in lateral view lacking dorsal prominence; free segment of leg 5 with ratio 6.2:1.... ....*P. eparmatoides* Humes, 1992a:321 (with *Gardineroseris planulata* (Dana) (Scleractinia) - Moluccas)

5. Inner side of free segment of leg 5 with distally directed thumblike process.... ....*P. pollicaris* Humes & Dojiri, 1979a:56 (with *Cespitularia multipinnata* (Quoy & Gaimard) (Alcyonacea) - Moluccas)

- Inner side of free segment of leg 5 without thumblike process....,....6

6. Ratio of length to width of caudal ramus more than 4:1....7

- Ratio of length to width of caudal ramus less than 4:1 ....11

7. Ratio of caudal ramus 16.8:1.... ....*P. extendens* Humes & Dojiri, 1979a: 53 (with *Cespitularia multipinnata* (Quoy & Gaimard) (Alcyonacea) - Moluccas)

- Ratio of caudal ramus less than 6:1....8

8. Length of body (not including setae on caudal rami) exceeding 2 mm.. *P. inconstans* Humes & Dojiri, 1979b: 567 567 (with *Lobophytum crassum* von Marenzeller (Alcyonacea) - Moluccas) (with *Lobophytum pauciflorum* (Ehrenberg) (Alcyonacea) - New Caledonia)
Length of body less than 2 mm....9

9. Length of body 1.63 mm (1.57-1.73mm).... ....*P. setellus* Humes, 1992a:328 (with *Gardineroseris planulata* (Dana) (Scleractinia) - Moluccas) (with *Pavona praetorta* Dana (Scleractinia) - New Caledonia)
Length of body less than 1 mm....10

10. Free segment of leg 5 short, smooth, 29 x 13 µm ....*P. ampullaceus* Humes, 1992b;51 (with *Gardineroseris planulata* (Dana) (Scleractinia) - Great Barrier Reef, Australia)

- Free segment of leg 5 elongate, with spinules, 110 x 25 µm....*P. nephtheanus* Humes, 1980:50 (with *Nephthea chabrolii* Audouin, *N. sphaerophora* Kükenthal, *N. cupressiformis* Kükenthal, *N. albida* (Holm), and *N. galbuloides* Verseveldt (Alcyonacea) - Moluccas)

11. Caudal ramus quadrate, 30 x 30 µm.... ....*P. spathophorus* Humes & Ho, 1968a:674 (with *Sarcophyton trocheliophorum* von Marenzeller (= *S. glaucum* (Quoy & Gaimard), *S. acutangulum* (von Marenzeller), *S. stolidotum* Verseveldt, and *Lobophytum pauciflorum* (Ehrenberg) (Alcyonacea) - Madagascar) (with *S. acutangulum*, *S. elegans* Moser, *S. trocheliophorum* (= *S. glaucum*), *Lobophytum crebriplicatum* von Marenzeller, and *L. pauciflorum* (Alcyonacea) - New Caledonia)

- Caudal ramus longer than wide.... 12

12. Caudal ramus with ratio 3.65-3.80:1....13

- Caudal ramus with ratio less than 3:1....16

13. Terminal setae on caudal ramus much shorter than ramus....14

- Terminal setae on caudal ramus distinctly longer than ramus ....15

14. Length of body more than 2 mm.... ....*P. clavatus* Humes & Ho, 1968b:730 (with *Coelogorgia palmosa* Milne Edwards & Haime (Telestacea) - Madagascar)

- Length of body 0.95 mm (0.87-1.02 mm) .... ....*P. resectus* Humes & Dojiri, 1979c:338 (with *Litophyton stuhlmanni* (May) (Alcyonacea) - Moluccas)

15. Length of body 1.78 mm (1.61-1.94 mm); caudal ramus 190 x 52 µm....*P. politus* Humes & Ho, 1967:3 (with *Rhodactis rhodostoma* (Ehrenberg) (Actiniaria) - Madagascar)

- Length of body 0.62 mm (0.59-0.65 mm); caudal ramus 52 x 14 µm....*P. prominulus* Humes, 1980:54 (with *Nephthea sphaerophora* Kükenthal, *N. cupressiformis* Kükenthal, and *N. albida* (Holm) (Alcyonacea) - Moluccas)

16. Free segment of leg 5 slightly sigmoid, held at right angle to body....*P. ostentus* Humes, 1973:144 (with *Lobophytum pauciflorum* (Ehrenberg) (Alcyonacea) - Enewetak Atoll, Marshall Islands)

- Free segment of leg 5 not sigmoid, not held at right angle to body....17

17. Free segment of leg 5 subtriangular, inner side much expanded....18

- Free segment of leg 5 not subtriangular, though may be proximally expanded on inner side....20

18. Caudal ramus subquadrate, 39 x 32 µm, ratio 1.22:1; free segment of leg 5 unornamented .... ....*P. antillianus* Stock, 1975:109 (with *Ricordea florida* Duchassaing & Michelotti (Corallimorpharia) - Puerto Rico)
Caudal ramus distinctly longer than wide; free segment of leg 5 with spinules....19

19. Caudal ramus 49 x 27 µm, ratio 1.82:1; length of body 1.31 mm (1.30-1.36 mm).... ....*P. abruptus* Humes, 1990:67 (with *Lobophytum cristagalli* von Marenzeller (Alcyonacea) - Madagascar)
Caudal ramus 34 x 24 µm, ratio 1.42:1; length of body 0.99 mm (0.88-1.13 mm).... ....*P. eniwetokensis* Humes, 1973:137 (with *Lobophytum pauciflorum* (Ehrenberg) (Alcyonacea) - Enewetak Atoll, Marshall Islands)

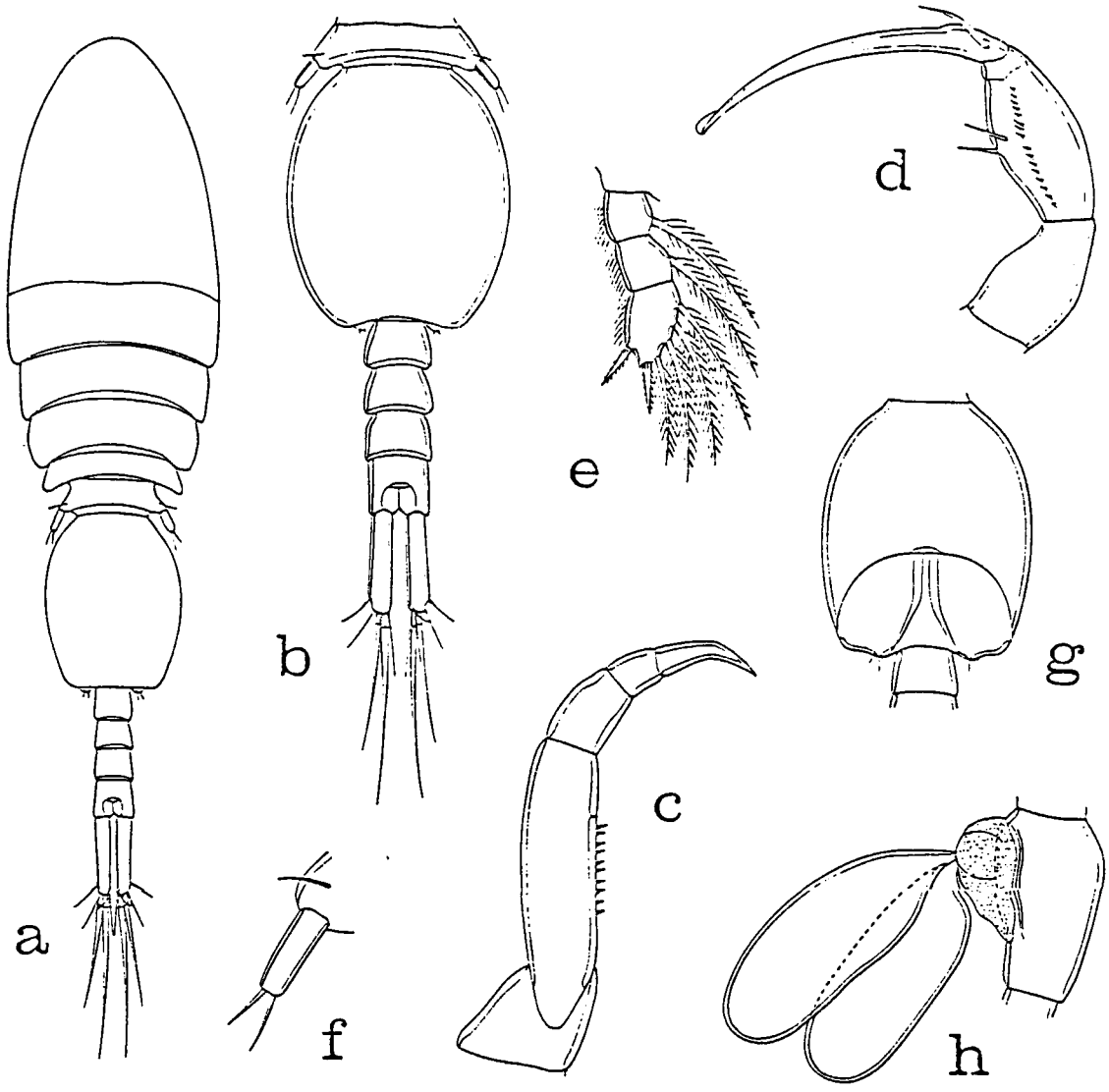


Fig. 3a-h. *Paramolgus pavonae* n. sp., male. a, dorsal (scale A); b, urosome, dorsal (B); c, antenna, outer (C); d, maxilliped, posterior (C); e, endopod of leg 1, anterior (C); f, leg 5, dorsal (E); g, genital somite and first postgenital somite, showing leg 6, ventral (B); h, spermatophores, attached to genital double somite of female, lateral (B).

20. Genital double somite smooth, barrel-shaped in dorsal view, with sides subparallel..... .....*P. alcyoniicus* Humes, 1990:70 (with *Alcyonium simplex* Thomson & Dean and *A. legitimum* Tixier-Durivault (Alcyonacea) - New Caledonia)
- Genital double somite otherwise, with sides expanded to some extent..... 21

21. Free segment of leg 5 with proximal inner expansion, even though slight.....22
- Free segment of leg 5 without proximal inner expansion.....29

22. Genital double somite sharply indented laterally.....23
- Genital double somite not sharply indented laterally..25

23. Proximal inner expansion on free segment of leg 5 large, round, balloonlike ..... .....*P. ellisellae* Humes, 1974:432 (with *Ellisella ramosa* (Simpson) (Gorgonacea) - Madagascar)

- Proximal inner expansion on free segment of leg 5 small, rounded, not balloonlike.....24

24. Caudal ramus 64 x 34 µm, ratio 1.88:1; 1 seta on third segment of antenna very long, longer than fourth segment.....*P. constrictus* Humes, 1969:2 (with *Antipathes ericoides* (Pallas) (Antipatharia) - Madagascar)
- Caudal ramus 133 x 49 µm, ratio 2.65:1; all setae on third segment of antenna short, much shorter than fourth segment .....*P. insectus* Humes, 1969:10) (with *Antipathes* cf. *spinescens* Gray. *A. myriophylla* Pallas, *A. abies* (L.) (Antipatharia) - Madagascar) (with *Antipathes* sp. (Antipatharia) - Philippines)

25. Ratio of length to width of caudal ramus at least 2:1..26
- Ratio of length to width of caudal ramus less than 1.6:1 .....28

26. Proximal inner expansion on free segment of leg 5..... small, rounded..... .....*P. litophyticus* Humes & Dojiri, 1979c:342 (with *Litophyton acutifolium* (Kükenthal) (Alcyonacea) - Moluccas)
    Proximal inner expansion on free segment of leg 5 prominent.....27

27. Genital double somite in dorsal view slightly expanded with smooth margin; terminal claw on antenna elongate, slender, nearly as long as fourth segment..... .....*P. timendus* Humes, 1990:85 (with *Alcyonium simplex* Thomson & Dean (Alcyonacea) - New Caledonia)
    Genital double somite in dorsal view subquadrate; terminal claw on antenna stout, shorter than fourth segment.....*P. subincisus* Humes, 1990:83 (with ?*Xenia* sp. (Alcyonacea) - Moluccas) (with *Heteroxenia* sp. (Alcyonacea) - New Caledonia)

28. Proximal inner expansion on free segment of leg 5 pointed; second segment of antenna with few spinules .....*P. simulans* Humes & Ho, 1967b:6 (with *Rhodactis rhodostoma* (Ehrenberg) (Actiniaria) - Madagascar)
    Proximal inner expansion on free segment of leg 5 rounded; second segment of antenna without spinules.....*P. modicus* Humes, 1990:77 (with *Lobophytum latilobatum* Verseveldt (Alcyonacea) - Madagascar)

29. Free segment of leg 5 elongate, at least 3.2:1 .....30
- Free segment of leg 5 short, less than 2.5:1.....32

30. Genital double somite sharply incised laterally..... .....*P. delicatulus* Humes, 1992c:739 (with *Antipathes* sp. (Antipatharia) - Philippines)
    Genital double somite not sharply incised laterally.....31

31. Free segment of leg 5 42 x 13 µm, ratio 3.23:1; 1 seta on second segment of maxilliped very long, much longer than segment .....*P. accinctus* Humes, 1980:57 (with *Nephthea sphaerophora* Kükenthal, *N. cupressiformis* Kükenthal, *N. albida* (Holm), and *N. galbuloides* Verseveldt) (Alcyonacea) - Moluccas)
- Free segment of leg 5 62 x 13 µm, ratio 4.77:1; setae on second segment of maxilliped short, much shorter than segment.....*P. dapsilis* Humes, 1993: 1082 (with *Suberogorgia reticulata* (Ellis & Solander) (Gorgonacea) - Moluccas, Philippines)

32. Endopod of leg 4 with second segment long, nearly 2.3 times longer than first segment; fourth segment of antenna about 3 times longer than third segment .....*P. quadrangulus* Humes, 1990:80 (with *Sinularia dura* (Pratt) (Alcyonacea) - New Caledonia, Moluccas)
    Endopod of leg 4 with second segment short, about 2 times as long as first segment; fourth segment of antenna less than 3 times longer than third segment.....33

33. Length of body 1.19 mm (1.06-1.27 mm); genital double somite widest in anterior half, tapering posteriorly.....*P. centor* Humes, 1990:72 (with *Paralemnalia thyrsoides* (Ehrenberg) (Alcyonacea) - New Caledonia, Moluccas)
    Length of body 0.86 mm (0.77-0.94 mm); genital double somite widest at midregion, constricted posteriorly .....*P. congruus* Humes, 1990:74 (with *Parerythropodium fulvum* (Forskål) (Alcyonacea) - Madagascar)

The species in the genus *Paramolgus* are associated only with Cnidaria, two with Actiniaria, one with Coralliomorpharia, 19 with Alcyonacea, one with Telestacea, two with Gorgonacea, six with Scleractinia, and three with Antipatharia. All species of *Paramolgus* occur in the shallow tropical waters of the Indo-Pacific, except *P. antillianus* which is found in Puerto Rico.

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