



BRILL

Crustaceana 96 (5) 481-491

CRUSTACEANA



REDESCRIPTION OF *TRICERACOLAX CHRYSOPHRYENUS* (ROUBAL, ARMITAGE & ROHDE, 1983) (COPEPODA, CYCLOPOIDA, BOMOLOCHIDAE) RECOVERED FROM *PAGRUS MAJOR* (TEMMINCK & SCHLEGEL, 1843) (ACTINOPTERYGII) IN JAPAN, WITH THE DESCRIPTION OF ITS COPEPODID IV

BY

KUNIHICO IZAWA¹)

Izawa Marine Biological Laboratory, 795-16 Kannonji, Tsu, Mie 514-0062, Japan

ABSTRACT

Triceracolax chrysophryenus (Roubal, Armitage & Rohde, 1983) is redescribed based on specimens of both sexes, recovered from the nasal cavity of the red sea bream, *Pagrus major* (Temminck & Schlegel, 1843) (Perciformes, Sparidae) in Japan. Leg 1 exopod of the female of the species is recognized to be 2-segmented.

Key words. — Parasitic copepods, Cyclopoida, Bomolochidae, copepodid IV, sexually dimorphic features, Actinopterygii, Sparidae

RÉSUMÉ

Triceracolax chrysophryenus (Roubal, Armitage & Rohde, 1983) est redécrit à partir de spécimens des deux sexes collectés dans la cavité nasale de la dorade japonaise, *Pagrus major* (Temminck & Schlegel, 1843) (Perciformes, Sparidae) au Japon. L'exopodite de la patte 1 de la femelle est reconnue comme bisegmentée.

Mots clés. — Copépodes parasites, Cyclopoida, Bomolochidae, copépodite IV, caractères sexuellement dimorphiques, Actinopterygii, Sparidae

INTRODUCTION

Triceracolax chrysophryenus (Roubal, Armitage & Rohde, 1983) is redescribed based on specimens of both sexes, recovered from the nasal cavity of the red sea bream, *Pagrus major* (Temminck & Schlegel, 1843) (Perciformes, Sparidae) in

¹) e-mail: izawakun@zc.ztv.ne.jp

Japan. A correction to an earlier description of the species is made. In addition, the copepodid IV stage of both sexes is described.

MATERIAL AND METHODS

Specimens recovered from hosts were fixed in formalin and preserved in 70% alcohol. The specimens were stained with chlorazol black E in lactic acid and examined with a differential interference contrast microscope using the “wooden slide method” of Humes & Gooding (1964). Drawings were made with the aid of a drawing tube. The terminology for copepod morphology is based on Huys & Boxshall (1991). Common and scientific names of the hosts follow Froese & Pauly (2022). The specimens were deposited in the National Museum of Nature and Science, Tsukuba (NSMT).

TAXONOMIC DESCRIPTIONS

Triceracolax chrysophryenus (Roubal, Armitage & Rohde, 1983) (figs. 1-8)

Uicolax chrysophryenus Roubal, Armitage & Rohde, 1983: 14-16, figs. 38-58.

Naricolax chrysophryenus — Hutson & Tang, 2007: 99-112, figs. 3-9.

Triceracolax pagri Izawa, 2021: 90-95, figs. 9-12.

Material examined.— One male, from the nasal cavity of *Pagrus major* (Temminck & Schlegel, 1843) (Sparidae), in the Sea of Kumano, Mie Prefecture, on 3 August 2022 (NSMT K-885); 1 male, 1 copepodid IV female and 1 copepodid IV male, from same site on same host, in the same locality, on 10 September 2022 (NSMT K-896); 1 female and 2 males, from same site on same host, at Owase, Mie Prefecture, on 15 November 2022 (NSMT K-907).

Female (figs. 1-2).— Habitus (fig. 1A), body length excluding caudal rami 1.71 mm ($n = 1$), cephalothorax 0.47×0.73 mm. width ratios of pedigers 2 and 3 to cephalothorax 0.85 and 0.49, respectively. Genital somite as long as wide, with leg 6 in dorsolateral gonopore of each side (fig. 1F, p6), represented by small lobe tipped by 3 setae. Abdomen 3-segmented, anal somite 1.2 times as wide as long, spinulose ventrally (fig. 1G). Caudal ramus (fig. 1G) 2.0 times as long as wide, with 6 setae including 2 major setae (fig. 1G).

Rostral plate (fig. 1B, r) concave antero-ventrally, without ventral processes. Antennule (fig. 1B) 7-segmented, first segment forming pedestal, number of setal elements per segment (base to apex) as follows: 0, 5, 5 + 7, 5 + 3, 4, 3, 8, fourth and fifth setae on first free segment and first seta of succeeding segment modified. Antenna (fig. 1D) 5-segmented, first segment unarmed, second with distal seta,

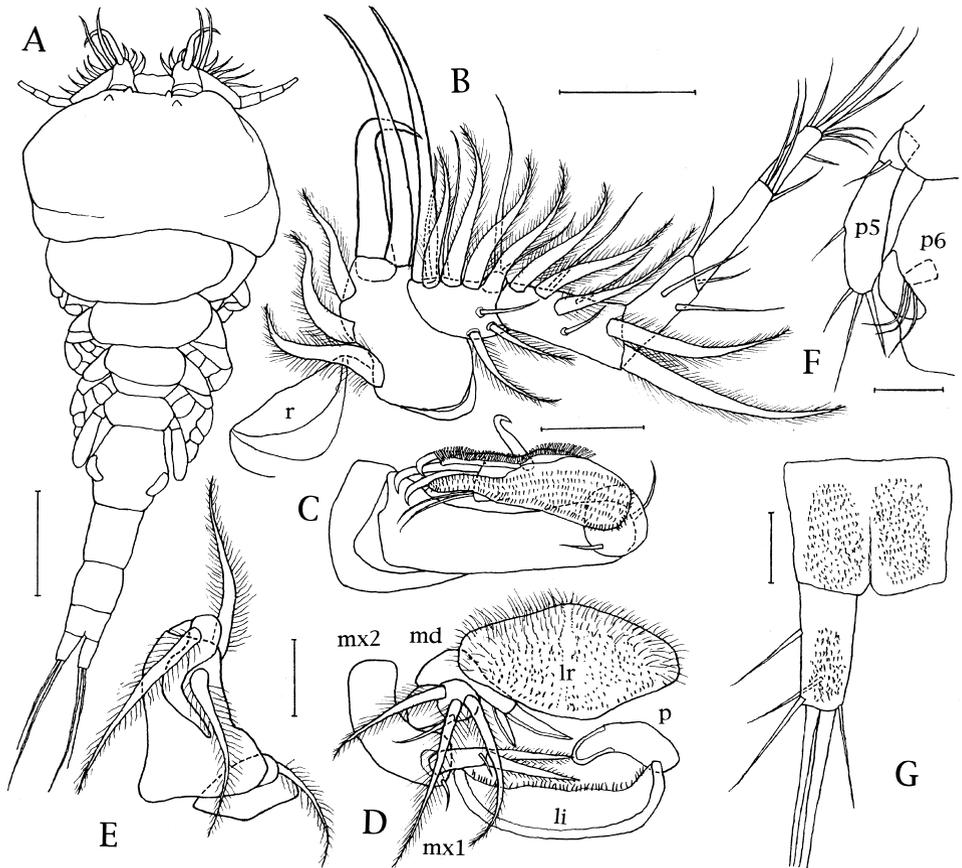


Fig. 1. *Triceracolax chrysophryenus* (Roubal, Armitage & Rohde, 1983), female. A, Habitus, dorsal; B, rostral plate and antennule, ventral; C, antenna, ventral; D, mouthparts, ventral; E, maxilliped, ventral; F, legs 5 and 6, dorsal; G, anal somite and caudal ramus, ventral. Abbreviations: li, labium; lr, labrum; md, mandible; mx1, maxillule; mx2, maxilla; p, paragnath; p5, leg 5; p6, leg 6; r, rostral plate. Scale bars: 0.3 mm for A; 0.1 mm for B, F; 0.05 mm for C-E, G.

third with medial seta, fourth narrowed distally, spinulose ventrally, with comb-plate and hook-like seta anteriorly, fifth with 3 hook-like setae and 2 simple setae distally.

Mouthparts (fig. 1D), labrum (lr) ciliate ventrally; mandible (md) with 2 blades; paragnath (p) thumb-shaped, pectinate on distal lobe; maxillule (mx1) with 4 setae; maxilla (mx2) 2-segmented, first segment with distal seta, second segment with setula distally and tipped by 2 pectinate processes; labium (li) spinulose on distal margin. Maxilliped (fig. 1E) 3-segmented, syncoxa with seta medially, basis broadened proximally, with 2 setae mediolaterally, endopod forming recurved claw, claw with seta proximally, without accessory process.

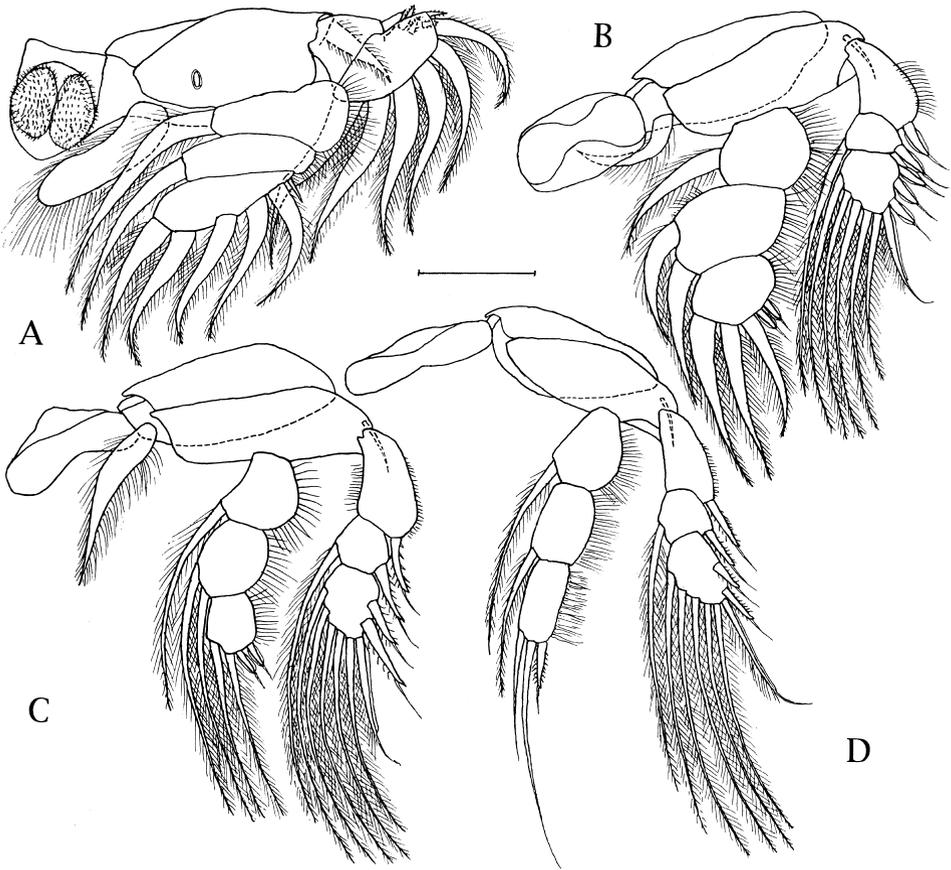


Fig. 2. *Triceracolax chrysophryenus* (Roubal, Armitage & Rohde, 1983), female. A, Leg 1, ventral, with 2-segmented exopod; B, leg 2, ventral; C, leg 3, ventral; D, leg 4, ventral. Scale bar: 0.1 mm for A-D.

Legs 1-4 (fig. 2A-D) each with intercoxal plate, biramous, rami 3-segmented except 2-segmented exopod of leg 1 (see fig. 2A). Formulae for spines (Roman numerals) and setae (Arabic numerals) of these legs as follows:

Leg 1 coxa 0-1 basis 1-1 exopod I-0; IV, 6 endopod 0-1; 0-1; I, 5

Leg 2 coxa 0-1 basis 1-0 exopod I-0; I-1; III, I, 5 endopod 0-1; 0-2; II, 3

Leg 3 coxa 0-1 basis 1-0 exopod I-0; I-1; II, I, 5 endopod 0-1; 0-2; II, 2

Leg 4 coxa 0-0 basis 1-0 exopod I-0; I-1; II, I, 5 endopod 0-1; 0-1; I, 2

Medial seta of leg 1 basis atrophied, lateral spines of exopods of legs 2-4 pectinate on both sides, tipped with flagella, distal spines of exopod segments 3 of legs 2-4 pectinate laterally and pinnate medially, distal spines of endopod segments 3 of legs 2-4 pectinate on both sides, tipped with flagella. Leg 5 (fig. 1F, p5) 2-

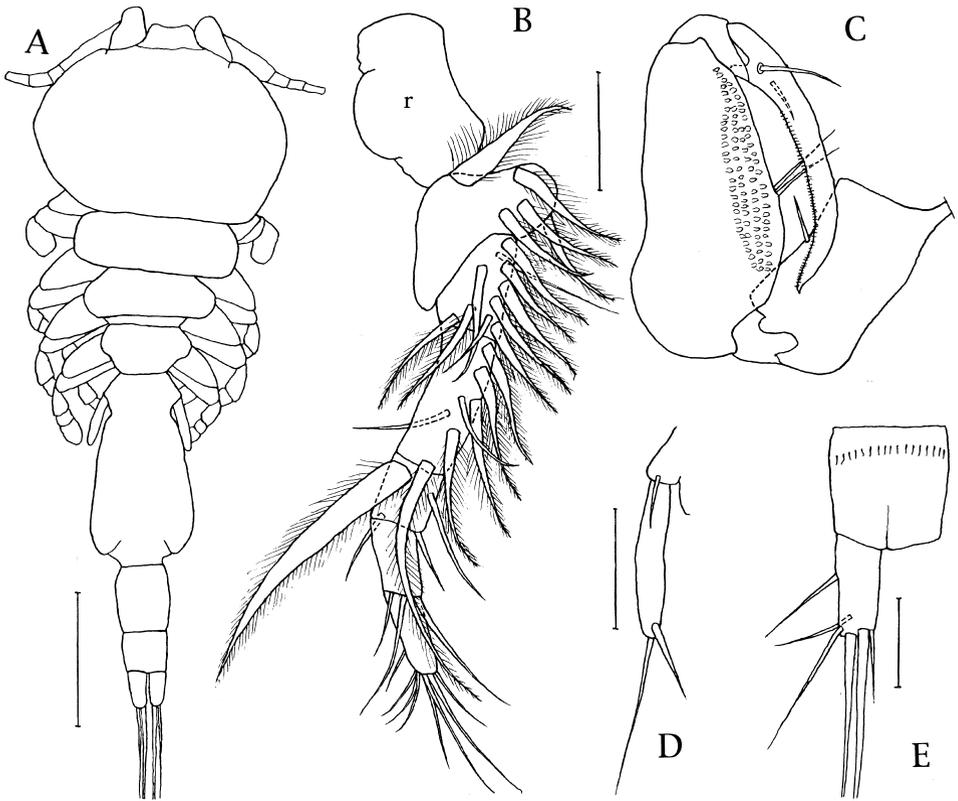


Fig. 3. *Triceracolax chrysophryenus* (Roubal, Armitage & Rohde, 1983), male. A, Habitus, dorsal; B, rostral plate and antennule, ventral; C, maxilliped, ventral; D, leg 5, dorsal; E, anal somite and caudal ramus, ventral. Scale bars: 0.2 mm for A, 0.05 mm for B-E.

segmented, first segment with dorsodistal seta, second segment 3.2 times as long as wide, with 4 setal elements.

Male (figs. 3-4).— Habitus (fig. 3A), body length excluding caudal rami 0.89-1.00 mm (0.95 ± 0.04) ($n = 4$), cephalothorax 0.28-0.30 (0.29 ± 0.008) \times 0.33-0.37 mm (0.35 ± 0.01), pedigers 2-4 successively decreasing in width, genital somite 1.5 times as long as wide, with genital slits ventrodistally, abdomen 2-segmented. Anal somite (fig. 3E) 1.1 times as long as wide, with transverse row of spinules anteroventrally. Caudal ramus (fig. 3E) 2.9 times as long as wide, with 6 setae including 2 major setae.

Rostral plate (fig. 3B, r) sexually dimorphic, slightly concave anteriorly, without ventral processes. Antennule (fig. 3C) sexually dimorphic, 7-segmented, first segment forming pedestal, number of setal elements per segment (base to apex) as follows: 0, 5, 5 + 5, 5 + 2, 1 + 3, 3, 8. Antenna and mouthparts (not illustrated) almost as in female. Maxilliped (fig. 3D) sexually dimorphic, subchelate, 3-

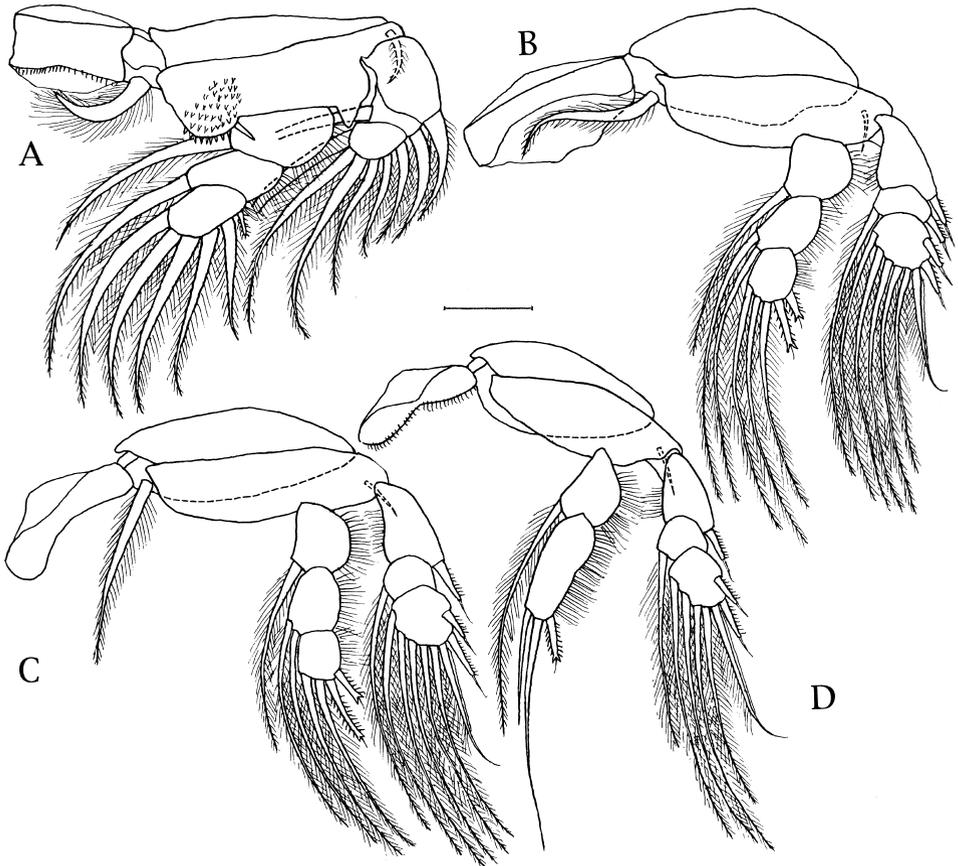


Fig. 4. *Triceracolax chrysophryenus* (Roubal, Armitage & Rohde, 1983), male. A, Leg 1, ventral; B, leg 2, ventral; C, leg 3, ventral; D, leg 4, ventral. Scale bar: 0.05 mm for A-D.

segmented, syncoxa with anterior seta, basis tuberculose along inner margin, with 2 inner setae, endopod forming claw, claw notched on inner margin, with 2 setae proximally.

Legs 1-4 (fig. 4A-D) sexually dimorphic, each with intercoxal plate, biramous, rami 3-segmented except 2-segmented endopod of leg 4. Formulae for spines (Roman numerals) and setae (Arabic numerals) of these legs as follows:

Leg 1 coxa 0-1 basis 1-1 exopod 1-0; 1-1; 6 endopod 0-1; 0-1; I, 5

Leg 2 coxa 0-1 basis 1-0 exopod 1-0; 1-1; II, I, 5 endopod 0-1; 0-2; II, 3

Leg 3 coxa 0-1 basis 1-0 exopod 1-0; 0-1; II, I, 5 endopod 0-1; 0-2; II, 2

Leg 4 coxa 0-0 basis 1-0 exopod 1-0; 0-1; II, I, 4 endopod 0-1; I, 2

Leg 1 basis with protrusion between rami, lateral spines of exopods of legs 2-4 pectinate laterally, tipped with flagella, distal spines of exopod segments 3 of legs 2-4 pectinate laterally and pinnate medially, distal spines of endopods of legs 2-

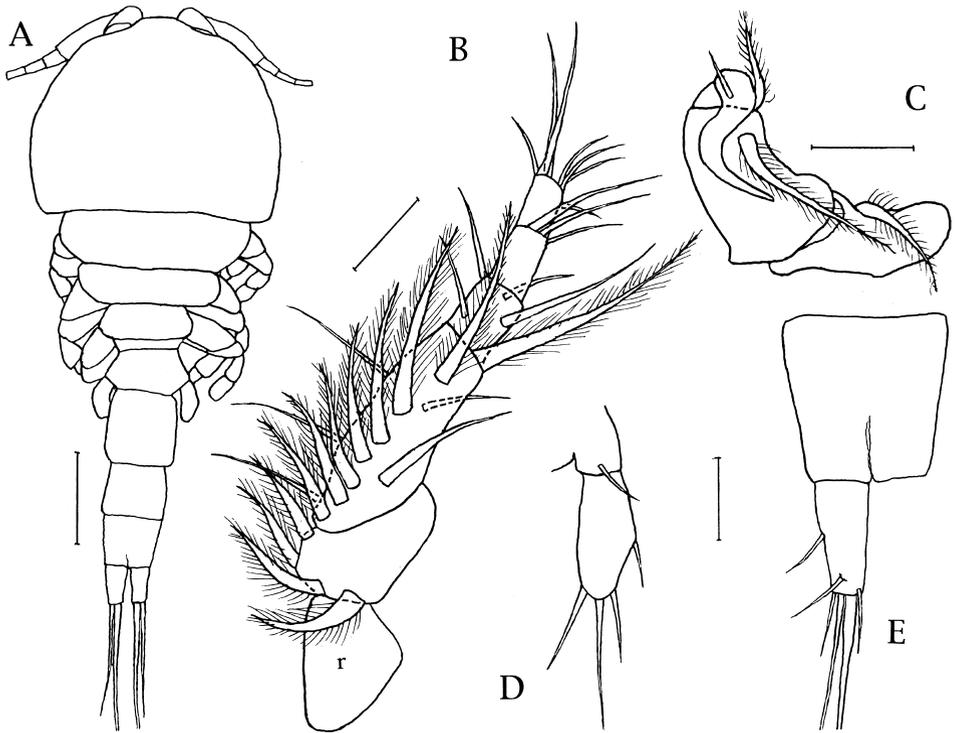


Fig. 5. *Triceracolax chrysophryenus* (Roubal, Armitage & Rohde, 1983), copepodid IV female. A, Body, dorsal; B, rostral plate and antennule, ventral; C, maxilliped, ventral; D, leg 5, dorsal; E, anal somite and caudal ramus, ventral. Scale bar: 0.1 mm for A; 0.03 mm for B-E.

4 pectinate on both sides, tipped with flagella. Leg 5 (fig. 3D) 2-segmented, first segment with dorsodistal seta, second segment 5.3 times as long as wide, with 2 setal elements.

Copepodid IV female (figs. 5-6).— Body (fig. 5A) 0.60 mm long except caudal rami ($n = 1$), cephalothorax wider than long, 0.21×0.26 mm, pedigers 2-4 successively diminishing in width, genital somite 1.1 times as long as wide, without gonopores and legs 6, abdomen 2-segmented. Anal somite (fig. 5E) as long as wide, caudal ramus about 2.1 times as long as wide, with 6 setae including 2 major ones.

Rostral plate (fig. 5B, r) flattened anteriorly, without ventral processes. Antennule (fig. 5B) 6-segmented, first segment forming pedestal, number of setal elements per segment (base to apex) as follows: 0, 4, 8 + 5, 4, 3, 7. Antenna and mouthparts (not illustrated) almost as in adult. Maxilliped (fig. 5C) almost as in adult female.

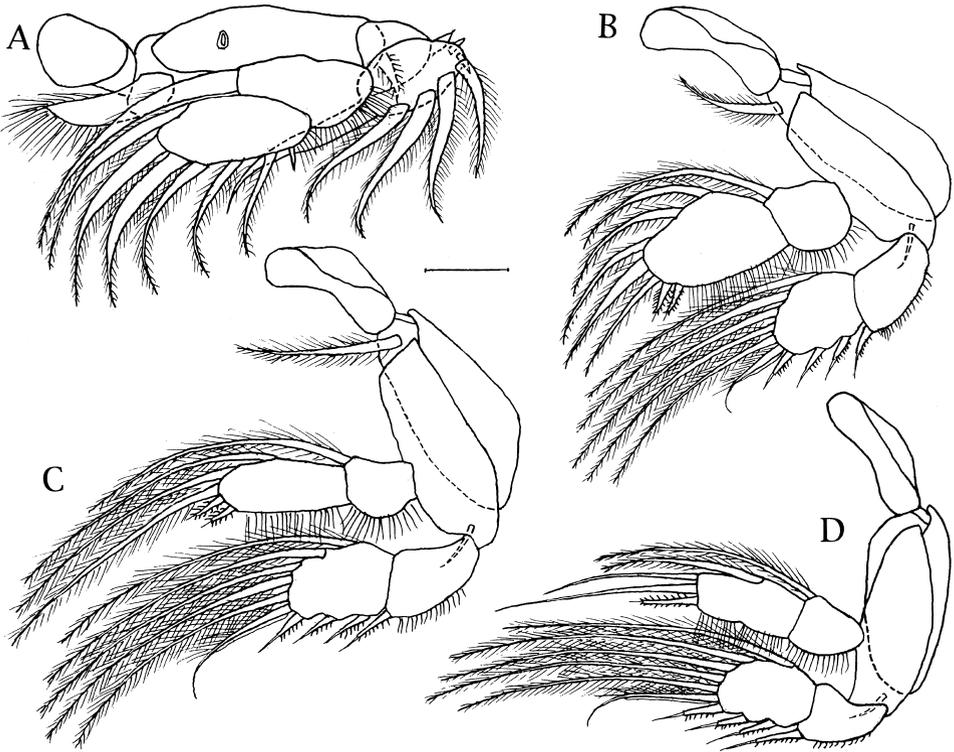


Fig. 6. *Triceracolax chrysophryenus* (Roubal, Armitage & Rohde, 1983), copepodid IV female. A, Leg 1, ventral; B, leg 2, ventral; C, leg 3, ventral; D, leg 4, ventral. Scale bar: 0.03 mm for A-D.

Legs 1-4 (fig. 6A-D) each with intercoxal plate, biramous, rami 2-segmented, formulae for spines (Roman numerals) and setae (Arabic numerals) of these legs as follows:

- Leg 1 coxa 0-1 basis 1-1 exopod I-0; II, 5 endopod 0-1; I, 6
- Leg 2 coxa 0-1 basis 1-0 exopod I-0; III, I, 5 endopod 0-1; II, 5
- Leg 3 coxa 0-1 basis 1-0 exopod I-0; III, I, 5 endopod 0-1; II, 3
- Leg 4 coxa 0-0 basis 1-0 exopod I-0; III, I, 5 endopod 0-1; I, 3

Medial seta of leg 1 basis atrophied, lateral spines of exopods of legs 2-4 pectinate laterally, tipped with flagella, distal spines of exopod segment 2 of legs 2-4 pectinate laterally and pinnate medially, distal spines of endopods of legs 2-4 pectinate on both sides, tipped with flagella. Leg 5 (fig. 5D) 2-segmented, first segment with dorsodistal seta, second segment about 2.2 times as long as wide, with 4 setal elements.

Copepodid IV male (figs. 7-8).— Body (fig. 7A) 0.54 mm long excluding caudal rami ($n = 1$), cephalothorax slightly wider than long, 0.19×0.20 mm, pedigers 2-4 successively diminishing in width, genital somite longer than wide, 1.5 times

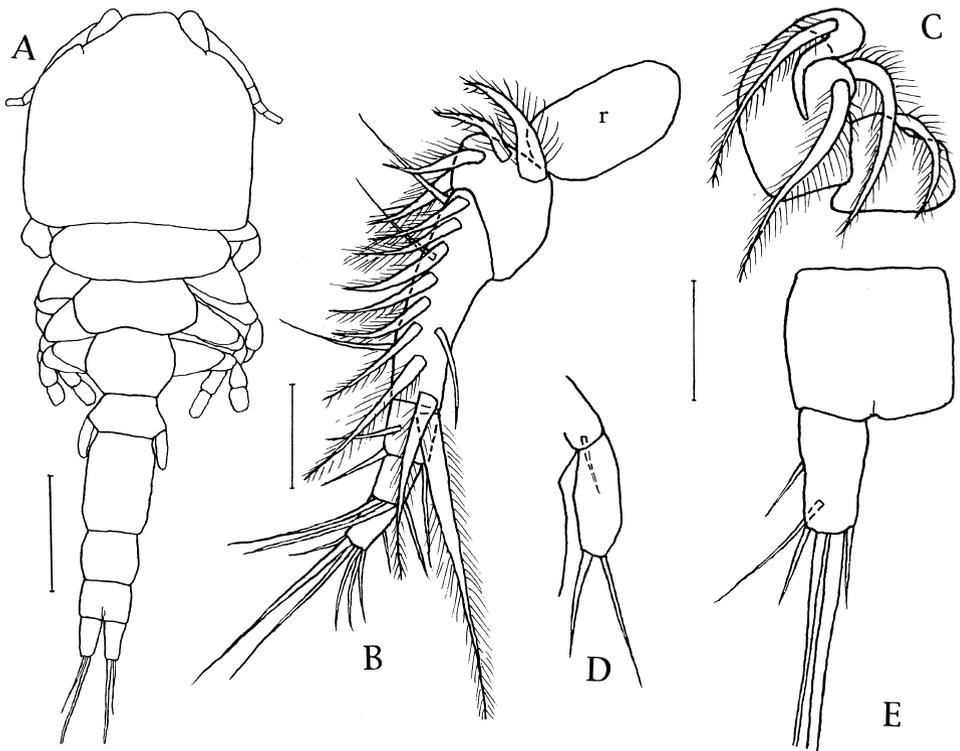


Fig. 7. *Triceracolax chrysophryenus* (Roubal, Armitage & Rohde, 1983), copepodid IV male. A, Body, dorsal; B, rostral plate and antennule, ventral; C, maxilliped, ventral; D, leg 5, ventral; E, anal somite and caudal ramus, ventral. Scale bars: 0.1 mm for A; 0.03 mm for B-E.

as long as wide, abdomen 2-segmented. Anal somite (fig. 7E) slightly wider than long, 1.1 times as wide as long, caudal ramus 1.8 times as long as wide, with 6 setae including 2 major ones.

Rostral plate (fig. 7B, r) flattened anteriorly, without ventral processes. Antennule (fig. 7B) 6-segmented, first segment forming pedestal, number of setal elements par segment (base to apex) as follows: 0, 4, 8 + 4, 1 + 3, 3, 7. Antenna and mouthparts (not illustrated) almost as in adult. Maxilliped (fig. 7C) of female type.

Legs 1-4 (fig. 8A-D) each with intercoxal plate, biramous, rami 2-segmented, formulae for spines (Roman numerals) and setae (Arabic numerals) of these legs as follows:

- Leg 1 coxa 0-1 basis 1-1 exopod 1-0; 6 endopod 0-1; I, 5
- Leg 2 coxa 0-1 basis 1-0 exopod I-0; III, I, 5 endopod 0-1; II, 4
- Leg 3 coxa 0-1 basis 1-0 exopod I-0; III, I, 5 endopod 0-1; II, 3
- Leg 4 coxa 0-0 basis 1-0 exopod I-0; III, I, 4 endopod 0-1; I, 2

Leg 1 basis with protrusion between rami, lateral spines of exopods of legs 2-4 pectinate laterally, tipped with flagella, distal spines of exopods of leg 2-4 pectinate

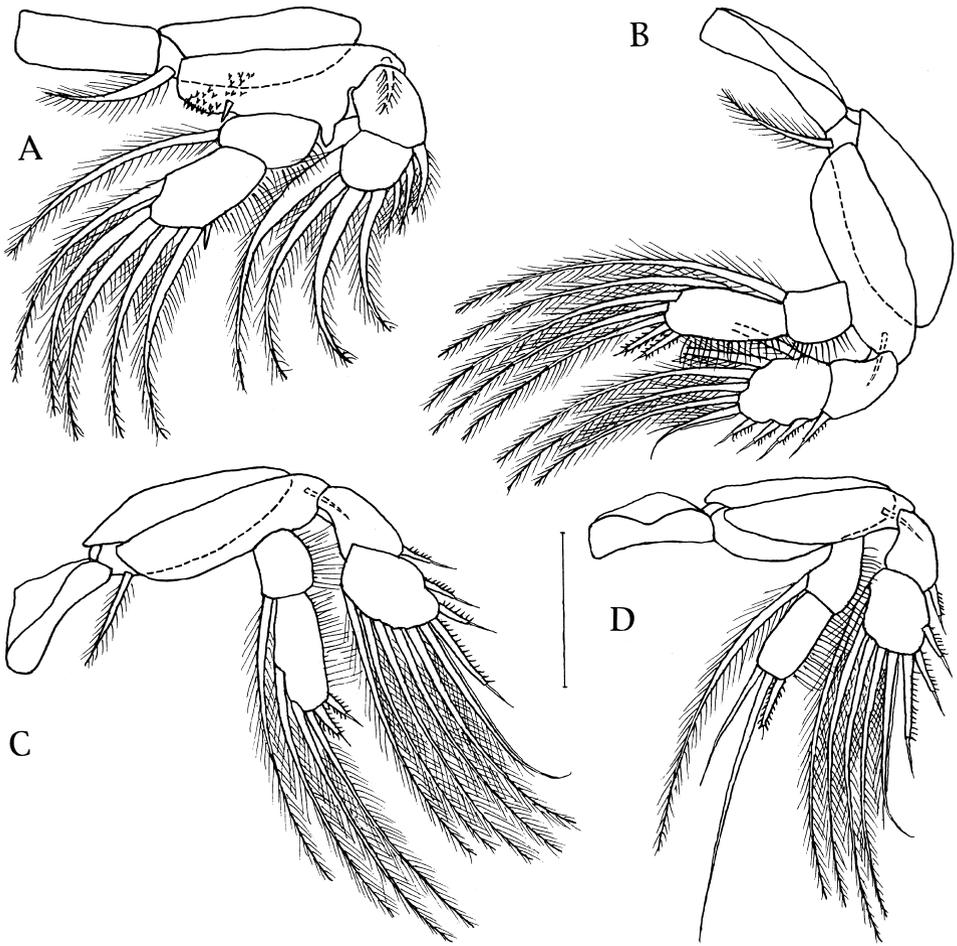


Fig. 8. *Triceracolax chrysophryenus* (Roubal, Armitage & Rohde, 1983), copepodid IV male. A, Leg 1, ventral; B, leg 2, ventral; C, leg 3, ventral; D, leg 4, ventral. Scale bar: 0.05 mm for A-D.

laterally and pinnate medially, distal spines of endopods of legs 2-4 pectinate on both sides, tipped with flagella. Leg 5 (fig. 7D) 2-segmented, first segment with dorsodistal seta, second segment about 2.6 times as long as wide, with 2 setal elements.

Remarks.— The nominal species described earlier as new, *Triceracolax pagri* Izawa, 1921, appears to be a junior synonym of *Triceracolax chrysophryenus* (Roubal, Armitage & Rohde, 1983). This is acknowledged herein in the synonymy of *T. chrysophryenus* presented above. The specimens upon which the description by Roubal et al. (1983) was based, had been recovered from the pectoral fin and sediment of the silver seabream, *Pagrus auratus* (Forster, 1801) (family Sparidae) (cf. Roubal et al., 1983, as *Chrysophrys auratus*). *T. chrysophryenus*

was redescribed based on specimens recovered from the nasal cavity of *P. auratus* (cf. Hutson & Tang, 2006, as *Naricolax chrysophryenus*).

Specimens used in the original description of the nominal species *Triceracolax pagri* were recovered from the bucco-branchial cavity of *Pagrus major*, while all specimens used in this study were recovered from the nasal cavity of that same host. A correction on the segmentation of the leg 1 exopod of the female in *T. pagri* is made: it is 2-segmented. This condition agrees with that (re-)described by Hutson & Tang (2006) for *N. chrysophryenus*.

ACKNOWLEDGEMENTS

I am indebted to S. Mitsui, Suzuka, Mie Prefecture for giving his catch to the author for this study. Hearty thanks are due to anonymous reviewers and to the editors of *Crustaceana* for their useful suggestions in ameliorating the manuscript.

REFERENCES

- FRÖSE, R. & D. PAULY (eds.), 2022. FishBase. Available online at <http://www.fishbase.org/>.
- HUMES, A. G. & R. U. GOODING, 1964. A method for studying the external anatomy of copepods. *Crustaceana*, **6**: 238-240.
- HUTSON, K. S. & D. TANG, 2007. *Naricolax hoi* n. sp. (Cyclopoida: Bomolochidae) from *Arius maculatus* (Siluriformes: Ariidae) off Taiwan and a redescription on *N. chrysophryenus* (Roubal, Armitage & Rohde, 1983) from a new host, *Seriola lalandi* (Perciformes: Carangidae), in Australia waters. *Syst. Parasitol.*, **68**: 98-113.
- HUYS, R. & G. A. BOXSHALL, 1991. Copepod evolution: 1-468. (Ray Society, London; no. 159 of the Series).
- IZAWA, K., 2021. Some new and known species of Bomolochidae (Copepoda, Cyclopoida) parasitic on Japanese actinopterygian fishes, 2 — with the description of two new genera. *Crustaceana*, **94**: 77-96.
- ROUBAL, F. R., J. ARMITAGE & K. ROHDE, 1983. Taxonomy of metazoan ectoparasites of snapper, *Chrysophrys auratus* (family Sparidae), from southern Australia, eastern Australia and New Zealand. *Aust. J. Zool., Suppl. Ser.*, **31**(94): 1-68.

First received 8 February 2023.

Final version accepted 23 February 2023.

Published online 17 May 2023.