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CRUSTACEANA

REDESCRIPTION OF *NARICOLAX STOCKI* (ROUBAL, 1981) (COPEPODA, CYCLOPOIDA, BOMOLOCHIDAE) RECOVERED FROM *ACANTHOPAGRUS SCHLEGELII* (BLEEKER, 1854) (ACTINOPTERYGII) IN JAPAN, WITH THE DESCRIPTION OF ITS COPEPODID V

BY

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ABSTRACT

Naricolax stocki (Roubal, 1981) is redescribed based on specimens of both sexes, recovered from the blackhead seabream *Acanthopagrus schlegelii* (Bleeker, 1854) (Perciformes, Sparidae) in Japan. Both sexes of its copepodid V are described for the first time.

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

RÉSUMÉ

Naricolax stocki (Roubal, 1981) est redécrit à partir de spécimens des deux sexes, prélevés sur la daurade à tête noire *Acanthopagrus schlegelii* (Bleeker, 1854) (Perciformes, Sparidae) du Japon. Les deux sexes de son copépodite V sont décrits pour la première fois.

Mots clés. — Copépodes parasites, Cyclopoida, Bomolochidae, copépodite V, caractères de dimorphisme sexuel, Sparidae

INTRODUCTION

Naricolax stocki (Roubal, 1981) is redescribed based on specimens of both sexes, recovered from the blackhead seabream *Acanthopagrus schlegelii* (Bleeker, 1854) (Perciformes, Sparidae) in Japan. Both sexes of its copepodid V are herein described for the first time.

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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

Naricolax stocki (Roubal, 1981)
(figs. 1-8)

Bomolochus stocki Roubal, 1981: 14-16, figs. 38-58; Byrnes, 1986: 226-231, figs. 1-22; Ho & Sey, 1996: 62.
Naricolax atypicus — Ho & Lin, 2005: 607-611, fig. 5-7.
Naricolax holinorum Izawa, 2021: 1137-1144, figs. 1-2.
Not *Naricolax stocki* — Ho & Lin, 2005: 600-607, figs.1-4.
Not *Naricolax typicus* Ho, Do & Kasahara, 1983: 6-8, figs. 22-60.

Material examined.— One female and 3 males, recovered from the bucco-branchial cavity of *Rhabdosagrus sarba* (Forsskål, 1775) (Sparidae), in the Sea of Kumano, Mie Prefecture, on 7 June 2022 (NSMT K-880); 3 males and 2 copepodid V males, from the nasal cavity of *R. sarba*, in same localidy, on 4 August 2022 (NSMT K-884); 1 copepodid V male, from the nasal cavity of *Acanthopagrus schlegelii* (Bleeker, 1854) (NSMT K-897); 3 females, 5 males, 1 copepodid V female, and 2 copepodid V males, from same site of *A. schlegelii*, at Kii-Nagashima, Mie Prefecture, on 26 and 30 September 2022 (NSMT K-899); 9 males and 1 copepodid V female, from same site of *R. sarba*, at Owase, Mie Prefecture, on 3 October 2022 (NSMT K-902); 1 copepodid V male, from same site of *A. schlegelii* (NSMT K-903); 1 female, from same site of *A. schlegelii*, at Toba, Mie Prefecture, on 29 Nobember 2022 (NSMT K-909); 1 copepodid V male, from same site of *A. schlegelii*, at Toba, on 16 December 2022 (NSMT K-910); 1 female, from same site of *A. schlegelii*, in the Sea of Kumano, Mie Prefecture, on 22 February 2023 (NSMT K-111).

Female (figs. 1-2).— Habitus (fig. 1A), body length excluding caudal rami 1.58-2.03 mm (1.79 ± 0.24) ($n = 6$), cephalothorax 0.37-0.61 (0.49 ± 0.08) × 0.65-1.00 mm (0.86 ± 0.11), width ratios of pedigers 2 and 3 to cephalothorax 0.72 and 0.55, respectively. Genital somite 1.2 times as wide as long, with leg 6 in dorsolateral gonopore of each side (fig. 1B, p6), represented by small lobe tipped by 3 setae. Abdomen 3-segmented, anal somite 1.2 times as wide as long, spinulose ventrally (fig. 1C). Caudal ramus (fig. 1C) 2.0 times as long as wide, spinulose ventrally, with 6 setae including 2 major setae.

Rostral plate (fig. 1D) concave antero-ventrally, without ventral processes. Antennule (fig, 1E) 7-segmented, first segment forming pedestal, number of setal

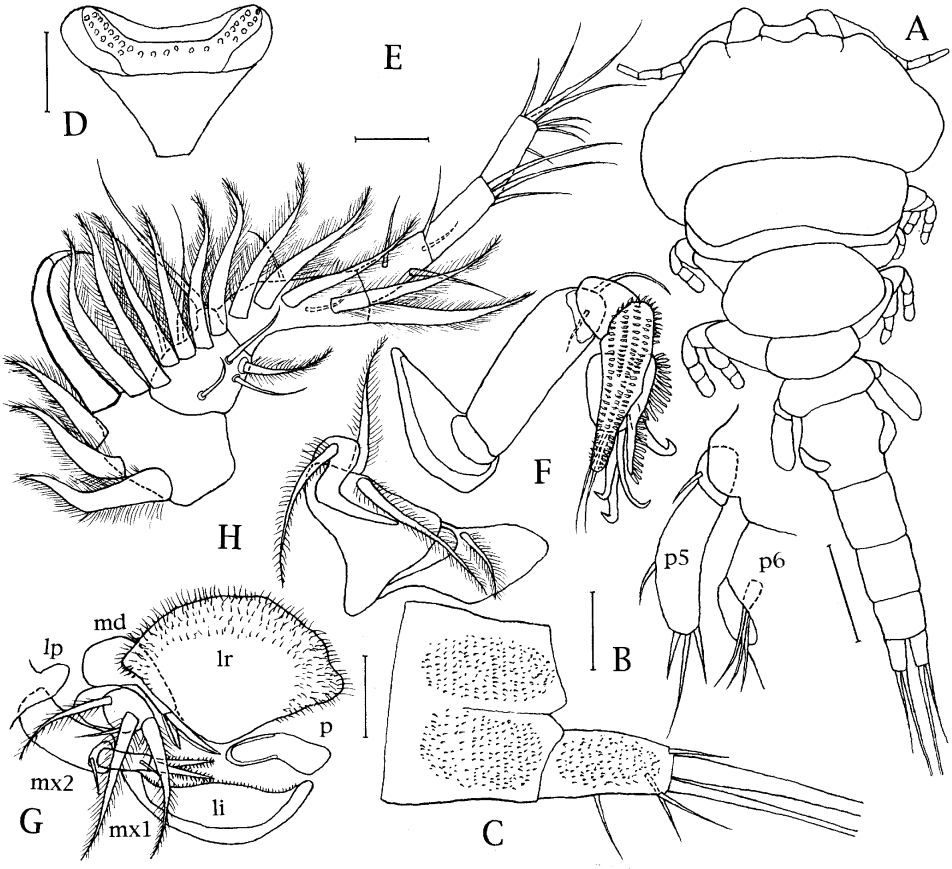

Fig. 1. *Naricolax stocki* (Roubal, 1981), female. A, Habitus, dorsal; B, legs 5 and 6, dorsal; C, anal somite and caudal ramus, ventral; D, rostral plate, ventral; E, antennule, ventral; F, antenna, ventral; G, mouthparts, ventral; H, maxilliped, ventral. Abbreviations: li, labium; lp, lateral process; 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; 0.05 mm for B-H.

elements per segment (base to apex) as follows: 0, 5, 5 + 7, 5 + 2, 4, 3, 8, fourth seta on first free segment modified. Antenna (fig. 1F) 5-segmented, first segment unarmed, second with distal seta, 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. 1G), labrum (lr) ciliate antero-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. 1H) 3-segmented, syncoxa with seta medially, basis

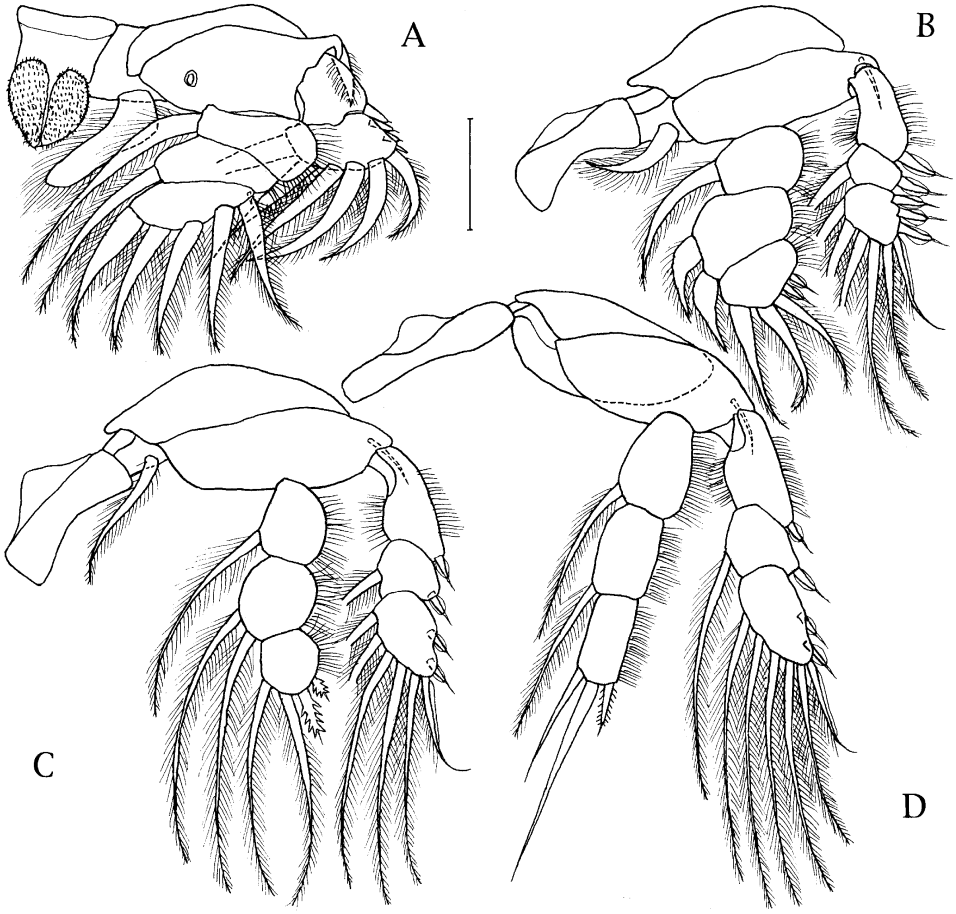

Fig. 2. *Naricolax stocki* (Roubal, 1981), female. A, Leg 1, ventral; B, leg 2, ventral; C, leg 3, ventral; D, leg 4, ventral. Scale bar: 0.1 mm for A-D.

broadened proximally, with 2 setae mediodistally, endopod forming recurved claw, claw with seta proximally, without accessory process.

Legs 1-4 (fig. 2A-D) each with intercoxal plate, biramous, rami 3-segmented except 2-segmented exopod of leg 1. 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; III, 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

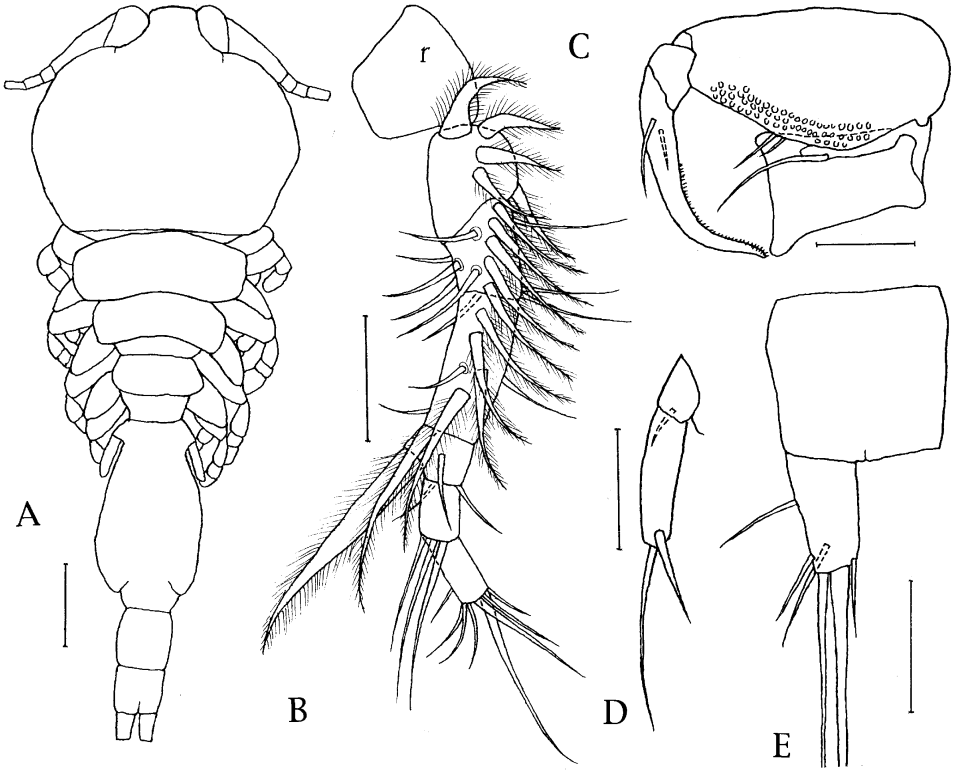

Fig. 3. *Naricolax stocki* (Roubal, 1981), male. A, Habitus, dorsal; B, rostral plate and antennule, ventral; C, maxilliped, ventral; D, leg 5, ventral; E, anal somite and caudal ramus, ventral. Scale bars: 0.1 mm for A; 0.05 mm for B-E.

3 of legs 2-4 pectinate on both sides, tipped with flagella. Leg 5 (fig. 1B, p5) 2-segmented, first segment with dorsodistal seta, second segment 3.3 times as long as wide, with 4 setal elements.

Male (figs. 3-4).— Habitus (fig. 3A), body length excluding caudal rami 0.67-0.96 mm (0.81 $\pm$ 0.08) (n = 20), cephalothorax, 0.23-0.31 (0.26 $\pm$ 0.02) $\times$ 0.27-0.34 mm (0.31 $\pm$ 0.02), pedigers 2-4 successively decreasing in width, genital somite 1.8 times as long as wide, with genital slits ventrodistally, abdomen 2-segmented. Anal somite (fig. 3E) 1.1 times as wide as long. Caudal ramus (fig. 3E) 1.8 times as long as wide, with 6 setae including 2 major setae.

Rostral plate (fig. 3B, r) sexually dimorphic, slightly convex anteriorly, without ventral processes. Antennule (fig. 3B) sexually dimorphic, 7-segmented, first segment forming pedestal, number of setal elements per segment (base to apex) as follows: 0, 5, 5 + 9, 5 + 3, 1 + 3, 3, 8. Antenna and mouthparts (not illustrated) almost as in female. Maxilliped (fig. 3C) sexually dimorphic, subchelate, 3-segmented, syncoxa with ventral seta, basis tuberculose along inner margin, with

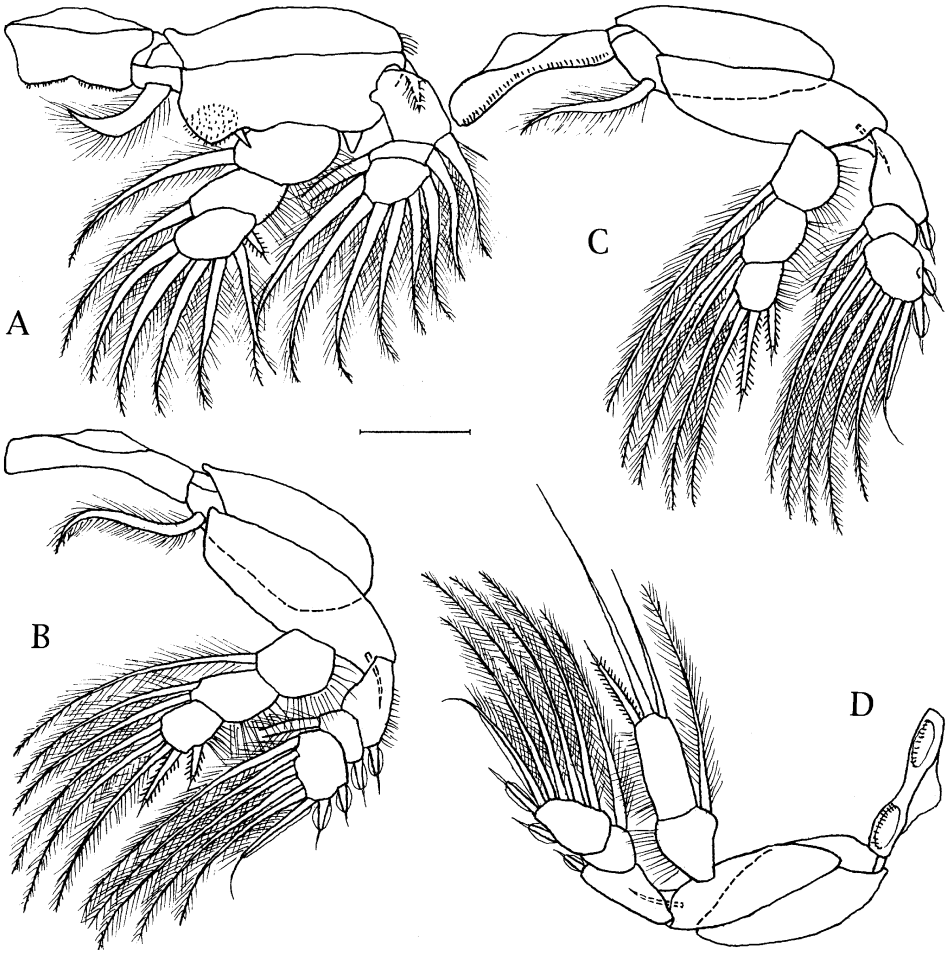

Fig. 4. *Naricolax stocki* (Roubal, 1981), male. A, Leg 1, ventral; B, leg 2, ventral; C, leg 3, ventral; D, leg 4, ventral. Scale bar: 0.05 mm for A-D.

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 I-0; I-1; II, I, 5 endopod 0-1; 0-2; II, 3
Leg 3 coxa 0-1 basis 1-0 exopod I-0; 0-1; II, I, 5 endopod 0-1; 0-2; II, 2
Leg 4 coxa 0-0 basis 1-0 exopod I-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 on both sides, tipped with flagella, distal spines of exopod segment 3 of

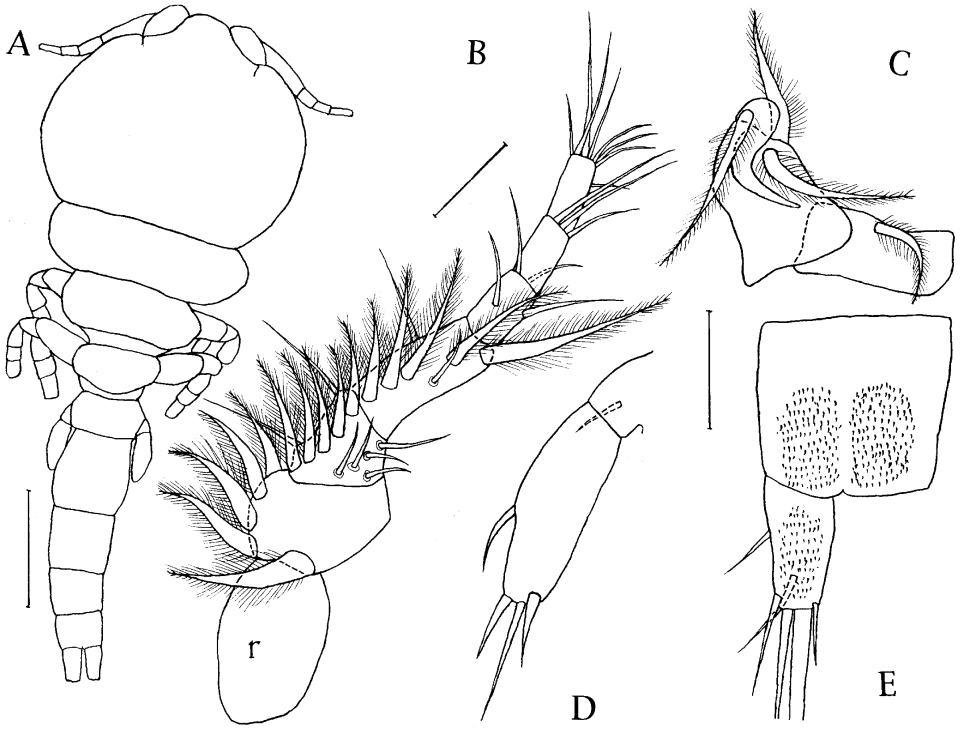

Fig. 5. *Naricolax stocki* (Roubal, 1981), copepodid V female. A, Body, dorsal; B, rostral plate and antennule, ventral; C, maxilliped, ventral; D, leg 5, ventral; E, anal somite and caudal ramus, ventral. Scale bar: 0.2 mm for A; 0.05 mm for B-E.

legs 2-4 pectinate laterally and pinnate medially, distal spines of endopod of legs 2-4 pectinate on both sides, tipped with flagella. Leg 5 (fig. 3D) 2-segmented, first segment with dorsodistal seta, second segment 3.8 times as long as wide, with 2 setal elements.

Copepodid V female (figs. 5-6).— Body (fig. 5A), body length except caudal rami 1.07-1.39 mm (average 1.23) ($n = 2$), cephalothorax wider than long, 0.36-0.41 (0.39) × 0.44-0.47 mm (0.46), pedigers 2-4 successively diminishing in width, genital somite almost as long as wide, without gonopores and legs 6, abdomen 3-segmented. Anal somite (fig. 5E) 1.1 times as wide as long, spinulose ventrally, caudal ramus about 1.9 times as long as wide, spinulose ventrally, with 6 setae including 2 major ones.

Rostral plate (fig. 5B, r) gently convex anteriorly, without ventral processes. Antennule (fig. 5B) 7-segmented, first segment forming pedestal, number of setal elements per segment (base to apex) as follows: 0, 5, 5 + 7, 5 + 2, 4, 3, 8. Antenna and mouthparts (not illustrated) almost as in adult. Maxilliped (fig. 5C) almost as in adult female.

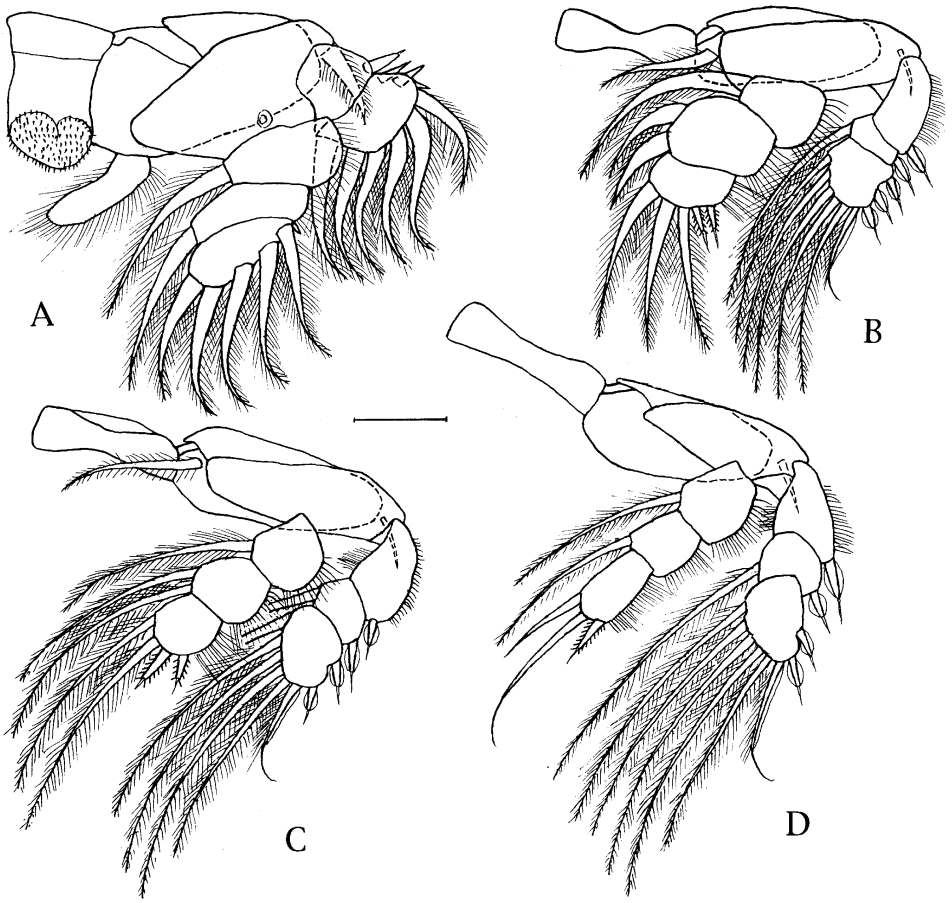

Fig. 6. *Naricolax stocki* Roubal, 1981), copepodid V female. A, Leg 1, ventral; B, leg 2, ventral; C, leg 3, ventral; D, leg 4, ventral. Scale bar: 0.05 mm for A-D.

Legs 1-4 (fig. 6A-D) each with intercoxal plate, biramous, rami 3-segmented except 2-segmented exopod of leg 1, 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; III. 6 endopod 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 segment 3 of legs 2-4 pectinate laterally and pinnate medially, distal spines of endopod segment 3 of legs 2-4 pectinate on both sides, tipped with flagella. Leg 5 (fig. 5D) 2-

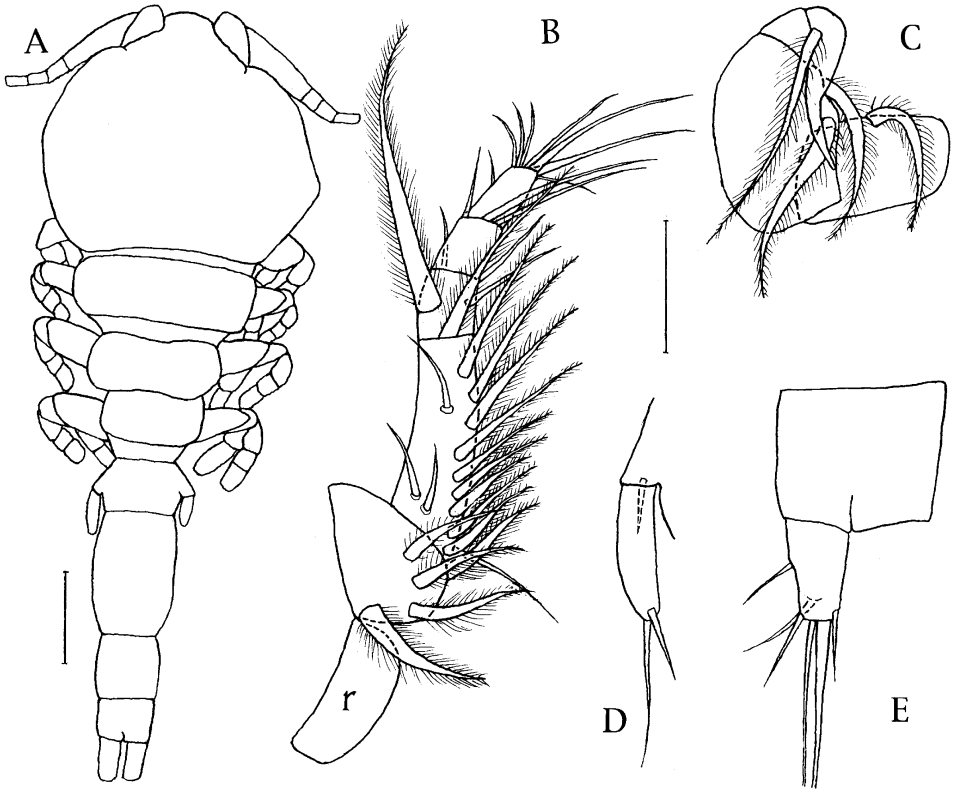

Fig. 7. *Naricolax stocki* (Roubal, 1981), copepodid V male. A, Body, dorsal; B, rostral plate and antennule, ventral; C, maxilliped, ventral; D, leg 5, ventral; E, anal somite and caudal ramus, ventral. Scale bars: 0.1 mm for A; 0.05 mm for B-E.

segmented, first segment with dorsodistal seta, second segment about 2.8 times as long as wide, with 4 setal elements.

Copepodid V male (figs. 7-8).— Body (fig. 7A), body length except caudal rami 0.61-0.95 mm (0.79 ± 0.12) ($n = 7$), cephalothorax slightly wider than long, 0.22-0.31 (0.27 ± 0.03) × 0.24-0.38 mm (0.30 ± 0.04), pedigers 2-4 successively diminishing in width, genital somite longer than wide, 1.4 times as long as wide, without genital slits, abdomen 2-segmented. Anal somite (fig. 7E) slightly wider than long, 1.2 times as wide as long, caudal ramus 1.5 times as long as wide, with 6 setae including 2 major ones.

Rostral plate (fig. 7B, r) slightly convex anteriorly, without ventral processes. Antennule (fig. 7B) 6-segmented, first segment forming pedestal, number of setal elements per segment (base to apex) as follows: 0, 5, 10 + 4, 1 + 3, 3, 8. Antenna and mouthparts (not illustrated) almost as in adult. Maxilliped (fig. 7C) of female type.

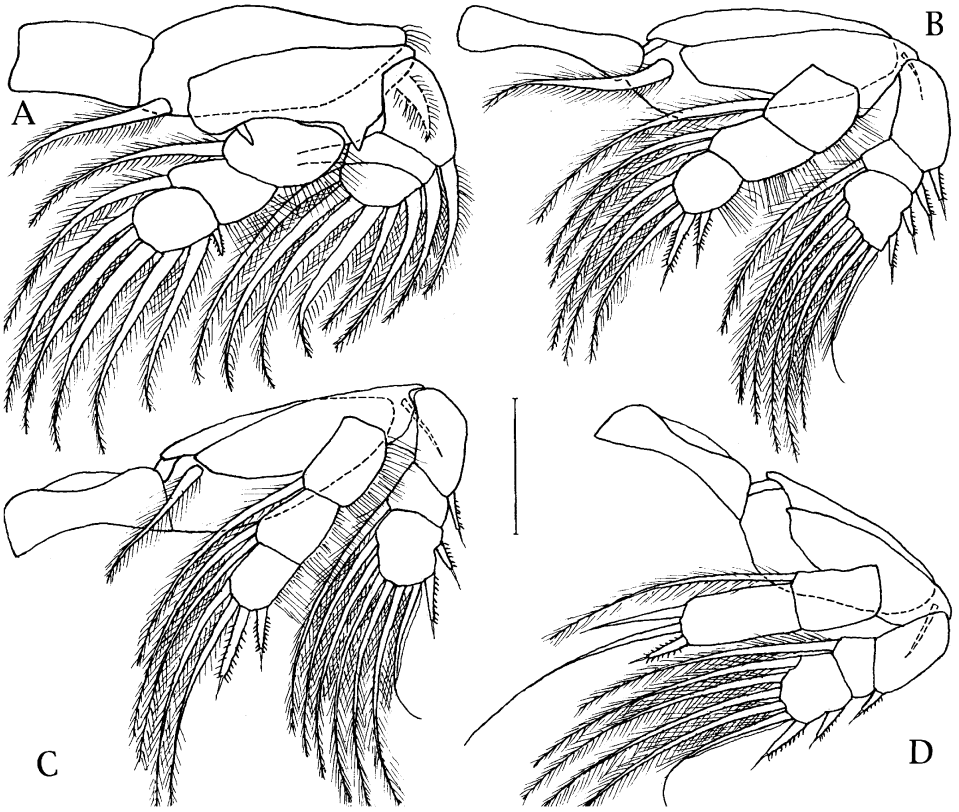

Fig. 8. *Naricolax stocki* (Roubal, 1981), copepodid V male. A, Leg 1, ventral; B, leg 2, ventral; C, leg 3, ventral; D, leg 4, ventral. Scale bar: 0.05 mm for A-D.

Legs 1-4 (fig. 8A-D) 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; I, 5 endopod 0-; 0-1; I, 5
Leg 2 coxa 0-1 basis 1-0 exopod I-0; I-1; II, I, 5 endopod 0-1; 0-2; II, 3
Leg 3 coxa 0-1 basis 1-0 exopod I-0; 0-1; 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, 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 segment 3 of leg 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. 7D) 2-segmented, first segment with dorsodistal seta, second segment 3.6 times as long as wide, with 2 setal elements.

Remarks.— *Naricolax stocki* was described by the original author based on specimens recovered from *Acanthopagrus australis* (Günther, 1859) in Australia

(cf. Roubal, 1981), and after that it was redescribed by Byrnes (1986) from four species of the Australian bream, *A. butcheri* (Munro, 1949), *A. australis*, *A. berda* (Forsskål, 1775), and *A. latus* (Houttuyn, 1782). This species was reported from *A. berda* in Kuwait by Ho & Aey (1996). *N. stocki* was redescribed by Ho & Lin (2005) based on specimens recovered from *Arius maculatus* (Thunberg, 1792) (Siluriformes, Ariidae) in Taiwan, however, their *N. stocki* was a distinct species. It was described as *N. hoi* Hutson & Tang, 2006 (cf. Hutson & Tang, 2006). On the other side, "*N. typicus*" as redescribed by Ho & Lin (2005) on the basis of specimens recovered from *Acanthopagrus schlegelii* in reality was *N. stocki*.

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