

New species of benthopelagic copepod *Xantharus* (Calanoida: Scolecitrichidae) from the upper slope, eastern central New Zealand

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Abstract *Xantharus* Andronov, 1981 is reported, for the first time from New Zealand, from the upper slope (306 m) off the southeastern coast of North Island (41°04.10'S, 176°22.05'E). *Xantharus cryeri* n. sp. females differ from the three known species by a combination of characters: antennules that extend to the distal border of pedigerous somite 2; ancestral segment XVIII of the antennule with 1 seta; mandible basis with 3 setae; maxilla endite 1 with 5 setae; leg 1 basis with inner distal border lined with small spinules; and leg 5 is squat, with all segments as long as wide and the 2 terminal spine-like extensions of the terminal segment approximately as long as the articulated, inner, subterminal spine.

Keywords Copepoda; Calanoida; benthopelagic; Scolecitrichidae; new species; *Xantharus cryeri* n. sp.; New Zealand

INTRODUCTION

The benthopelagic calanoid copepod fauna of the New Zealand region is being described from samples taken from Wellington Harbour and the upper slope of the southeastern coast of North Island (Bradford 1969; Bradford-Grieve 1999, 2001a,b, 2003, 2004). Among the most plentiful of copepods taken in these samples were members of families (Scolecitrichidae, Phaennidae, and Tharybidae) that have setae on the endopod of the maxilla modified into chemo-sensory structures. These families made up 16–24% of the individuals in samples (Bradford-Grieve 2001a).

Among these specimens were four small females that proved to be an undescribed species of *Xantharus* Andronov, 1981. Only three species are currently known: *X. formosus* Andronov, 1981, sampling interval 200–235 m on the outer shelf off the east coast of the United States; *X. renatehaassae* Schulz, 1998, sampling interval 500–1040 m in 1050 m of water near the Antarctic Peninsula; and *X. siedleckii* Schulz & Kwasniewski, 2004, sampling interval 200–377 m in 330–380 m of water in a glacial fjord on the west coast of Spitsbergen Island. *Xantharus* was originally thought to belong to the Phaennidae. Nevertheless, the presence of 3 worm-like and 5 brush-like sensory setae and, in *X. renatehaassae*, an additional unmodified seta on the maxilla endopod, resulted in this genus being placed provisionally in the Scolecitrichidae (Vyshkvartzeva 1989; Schulz 1998; Boxshall & Halsey 2004). Ohtsuka et al. (2003) believe that this arrangement is temporary pending a comprehensive phylogenetic revision of a number of related families.

The species described here, is the first record of the genus in the New Zealand region and the fourth *Xantharus* species to be described.

METHODS

Calanoid copepods were collected in a non-closing plankton net with a 250 µm mesh net that was attached to the warps of the trawl boards of the 28 m R.V. *Kaharoa* when it was fishing on the upper slope

on the southeast coast of North Island, New Zealand (Bradford-Grieve 2001a). The net was set to fish 4–6 cm above the sea floor. The sediment and organisms taken by the net were preserved in 2% formaldehyde.

Sorted copepods were observed whole in glycerine or lactic acid, and dissected parts mounted, unstained, or stained with chlorazol black, in gum-chloral (Pantin 1964). Mounted specimens were observed using phase contrast and Nomarski differential interference contrast microscopy. The system of morphological nomenclature used is based on that of Huys & Boxshall (1991).

SYSTEMATICS

Scolecitrichidae

Genus *Xantharus* Andronov, 1981

Xantharus cryeri n. sp.

Materials examined

An undissected adult female from KAH0001/79 was designated as the holotype and is deposited in the NIWA collection in Wellington H832. One undissected, damaged female P1381/1 and two dissected paratype females P1381/2, P1381/3 were deposited in the NIWA Invertebrate Collection, Wellington. Total measured: 4 females 0.98–1.02 mm total length (mean 1.00 mm). The descriptions are based on two dissected paratype specimens.

Type locality

Off the southeastern coast of North Island, New Zealand, 41°04.10'S, 176°22.05'E, 23 Feb 2000, near the sea floor in 306 m of water.

Female

Cephalosome fused with pedigerous somite 1; pedigerous somites 4 and 5 fused with fusion line visible dorsally (Fig. 1A,B). Rostrum (Fig. 1C) in form of terminally bifurcate cuticular extension of anterior head with pair fine, distal filaments. Posterolateral corners of prosome extend posteriorly into rounded flaps that cover less than half of genital double-somite. Urosome of 4 free somites (Fig. 1D); surfaces of somites more-or-less naked although difficult-to-see spinules evident. Genital double-somite without lateral swellings and with patch of dorsolateral spinules proximally on at least left side; posterior border of somite bordered by serrated hyaline frill (Fig. 2A, B). Single, ventral, oblong genital operculum situated slightly anterior to

centrally on somite. Urosome segments 2 and 3 (ancestral urosomites 3 and 4) with serrated hyaline frill. Anal somite short, not visible on dorsal surface. Caudal rami (Fig. 1E) symmetrical, 1.25 times longer than wide, apparently without seta in position I; seta II short, located laterally near base of seta III; 4 strong terminal plumose setae in positions III–VI; seta VII small, situated on ventral surface, long hairs lining inner border and extending onto dorsal surface (Fig. 2B).

Antennule (Fig. 3A,B) 24-segmented, extending to posterior border of pedigerous somite 2, ancestral segments XXII–XXVII short, segment XXV has narrow proximal border giving impression segments XXV–XXVIII have wider arc of movement than other antennule segments; armature elements referring to ancestral segments as follows: I-3 (all plumose), II–IV-6 + aesthetasc, V-2 + aesthetasc, VI-2, VII-2 + aesthetasc, VIII-2, IX-2 + aesthetasc, X–XI-4 + aesthetasc, XII-1, XIII-1, XIV-2 + aesthetasc, XV-1, XVI-2 + aesthetasc, XVII-1, XVIII-1, XIX-1, XX-2, XXI-1 (length of seta could not be determined) + aesthetasc, XXII-1, XXIII-1, XXIV-1 + 1, XXV-1 + 1, XXVI-1 + 1, XXVII–XXVIII-5 + aesthetasc.

Antenna (Fig. 3C) With endopod 0.80 times length of exopod; coxa and basis separate, coxa with seta and tuft of posterior surface hairs, basis with 2 setae; endopod segment 1 with 2 setae, segment 2 with 14 (8 + 6) setae and with outer border lined with small spinules. Exopod 6-segmented, segment 2 includes completely fused ancestral segments II–IV and ancestral segment V almost completely fused; segment 1 without seta; segments 2–5 with 1 seta each; segment 6 with 3 terminal setae and 1 seta placed just proximally to midlength.

Mandible (Fig. 3D) Gnathobase with c. 7 teeth (3 large, elongate, sharply pointed and 4 small) and 1 setose dorsal seta; row of spines adjacent to palp; basis with 3 setae and oblique row of distal spinules proximal to endopod; endopod 2-segmented; segment 1 with 3 setae (1 very short) and few outer edge spinules; segment 2 with 9 distal setae and at least 1 spinule on outer edge; exopod with 6 setae.

Maxillule (Fig. 3E) Damaged, praecoxal arthrite appears to have 8 terminal spines and 4 posterior surface setae; coxal endite with at least 1 seta, basal endite 1 with at least 2 setae, basal endite 2, basis, endopod and exopod damaged; coxal epipodite with 9 setae; basal exite without seta.

Maxilla (Fig. 3F,G) Praecoxal endites 1 and 2 with

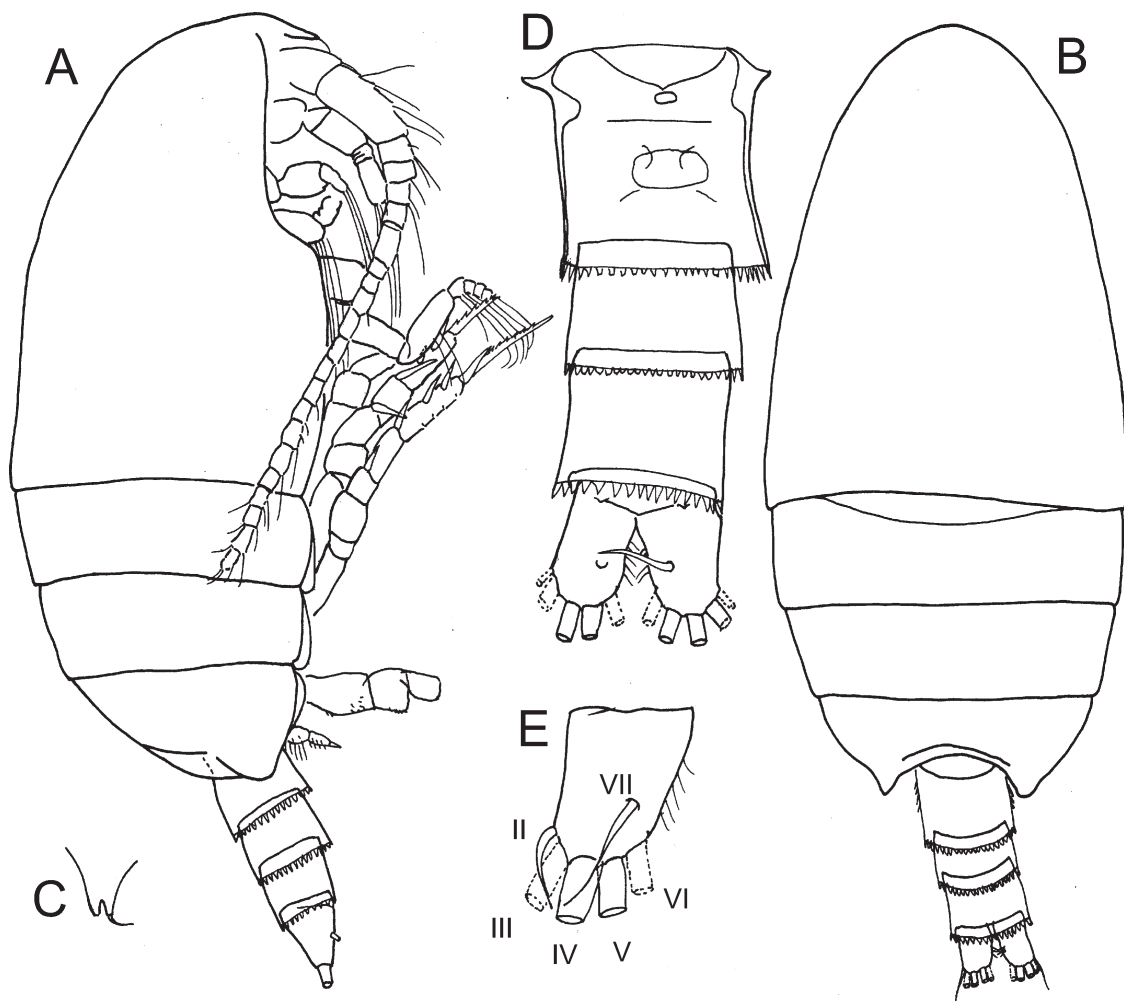


Fig. 1 *Xantharus cryeri* n. sp. female P1381/2: **A**, lateral view; **B**, dorsal view; **C**, rostrum; **D**, urosome, ventral view; **E**, right caudal ramus, ventral view.

5 and 3 setae respectively; coxal endites 1 and 2 with 2 longer and 1 short setae; basal endite large with 1 stout seta, 1 long and 1 short seta and 1 worm-like sensory seta; endopod with 3 worm-like and 5 brush-like sensory setae. It is not possible to be sure about the presence or absence of additional normal seta on endopod.

Maxilliped (Fig. 2D,E) Syncoxa and basis of approximately equal length; syncoxa with 1, 2, 3, 3 setae numbered from proximal to distal, endite 1 with small spinules at base of long seta that is sparsely setulated; endite 2 longer seta appears to have distal part like chemo-sensory seta, second seta short; endite 3 with patch of small spinules adjacent to 3

setae, 1 seta very small, middle setae plumose, distal seta modified into brush-like sensory seta; endite 4 with 3 setae, 1 thicker and curved; basis with 3 medial setae, and elongate patch of spinules extending from proximal part of segment to just beyond distal seta; endopod slightly less than half length of basis, segment 1 apparently incorporated into basis with 2 setae, free segments 2–6 with 4, 3, 3, 3+1, and 4 setae respectively.

Leg 1 (Fig. 4A) Coxa with long hairs along inner border, patch of outer hairs that curves around onto posterior surface and anterior row of spinules along outer half of distal border. Basis with inner border of long hairs and curved row of distal inner short

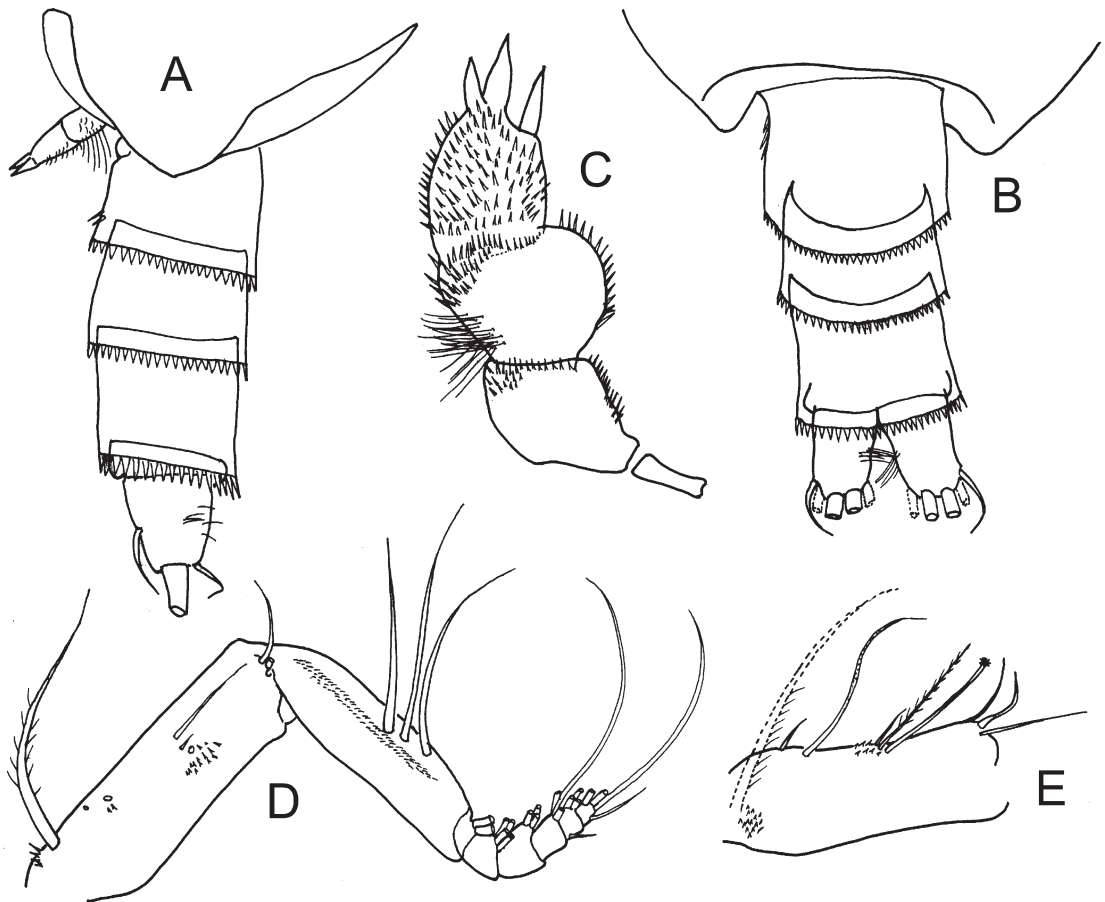


Fig. 2 *Xantharus cryeri* n. sp. female P1381/2: **A**, urosome, lateral view; **B**, urosome, dorsal view; **C**, leg 5, posterior view; **D**, maxilliped; **E**, maxilliped syncoxa.

spinules that extends onto posterior surface at base of inner seta. Endopod outer swelling decorated with fine spinules and with small, distal, teat-like protrusion.

Leg 2 (Fig. 4B) Coxa with inner seta and long hairs, proximal half of outer border lined with spinules. Basis naked apart from group of c. 4 inner distal spinules. Endopod segment 2 with several patches of posterior surface small spinules. Exopod segment 2 with inner distal posterior surface spinules and outer distal anterior surface spinules; all outer articulated spines bordered by teeth; terminal spine bordered by c. 11 coarse outer teeth.

Leg 3 (Fig. 4C) Coxa with inner seta and long hairs, proximal half of outer border lined with

spinules that extend slightly round onto anterior surface. Basis naked apart from group of inner distal spinules. Endopod segment 2 with patch of spinules and row of outer distal spinules on posterior surface, endopod segment 3 with inner, longitudinal patch of strong, posterior surface spinules as well as outer patch of minute additional spinules. Exopod segment 2 with horizontal row of 4 spinules on distal border of posterior surface; outer articulated spines bordered by teeth; terminal spine with c. 11 coarse outer teeth.

Leg 4 (Fig. 4D) Incomplete on all specimens, coxa with inner seta and stout, posterior surface spinules; outer surface with patch of spinules on posterior surface centred on midlength, and small patch of outer distal spinules. Basis with posterior surface

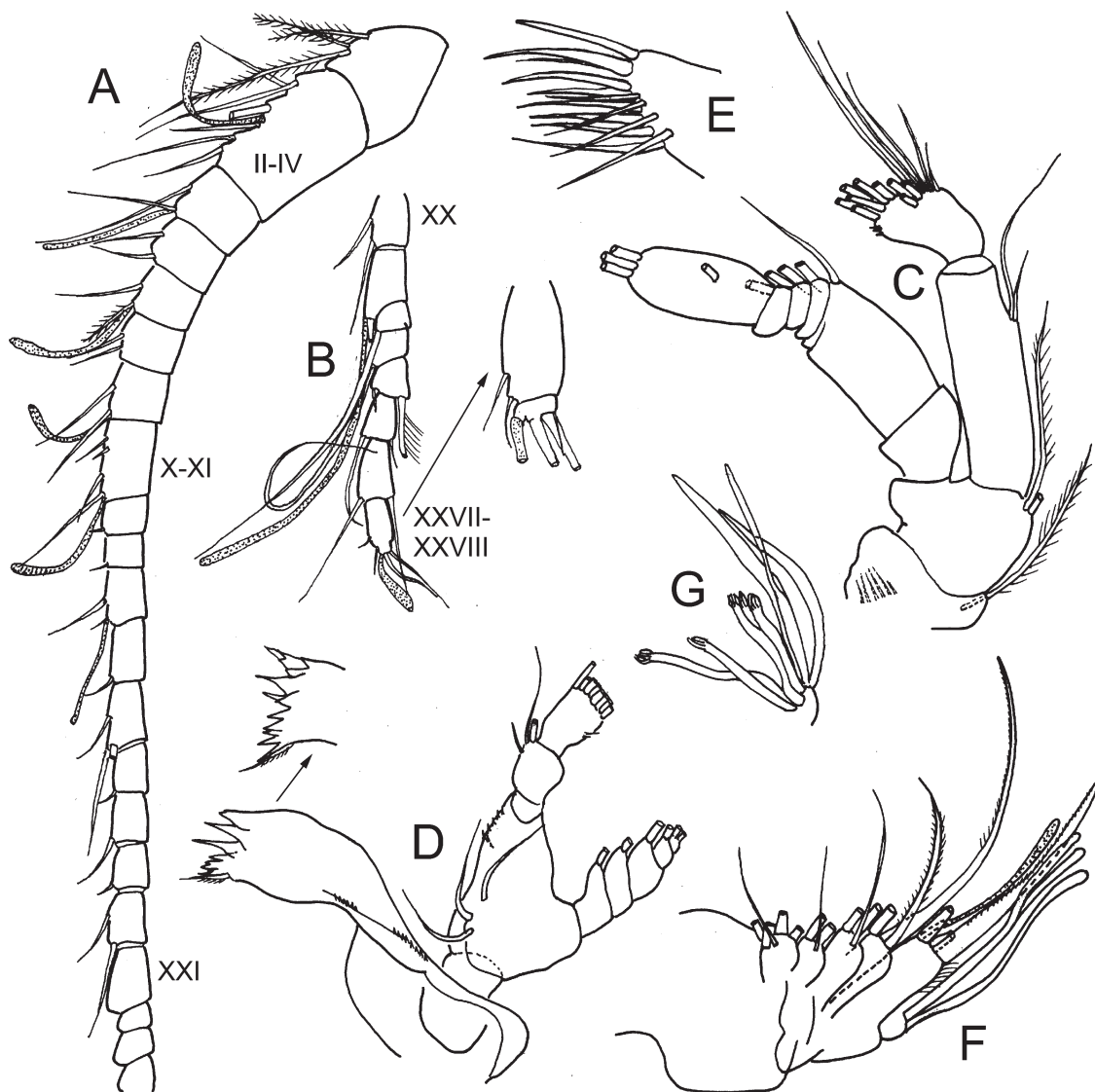


Fig. 3 *Xantharus cryeri* n. sp. female: **A**, antennule, ancestral segments I–XXIV; **B**, antennule, ancestral segments XX–XXVIII; **C**, antenna; **D**, mandible; **E**, maxillule, praecoxal arthrite; **F**, maxilla; **G**, maxilla endopod. A–C, F, G from specimen P1381/2, D, E from specimen P1381/3.

patches of spinules located inner and outer distally. Endopod segments 1 and 2 posterior surface covered with short spinules. Exopod segment 1 with patch of small spinules on posterior surface.

Leg 5 (Fig. 2C) Uniramous, symmetrical, coxae separated from intercoxal sclerite with short spinules lining inner and posterodistal borders. Basis fused to exopod with fusion line partly visible on anterior

face, with short spines lining inner and posterodistal borders, outer proximal border with fine long hairs that are direct posteriorly (Fig. 1A, 2A). Exopod 1-segmented, with naked inner spine articulated subterminally to segment, and 2 terminal spine-like extensions of segment; posterior surface covered in short spinules. This description agrees with both dissected paratypes and what can be discerned of holotype when viewed in whole mount.

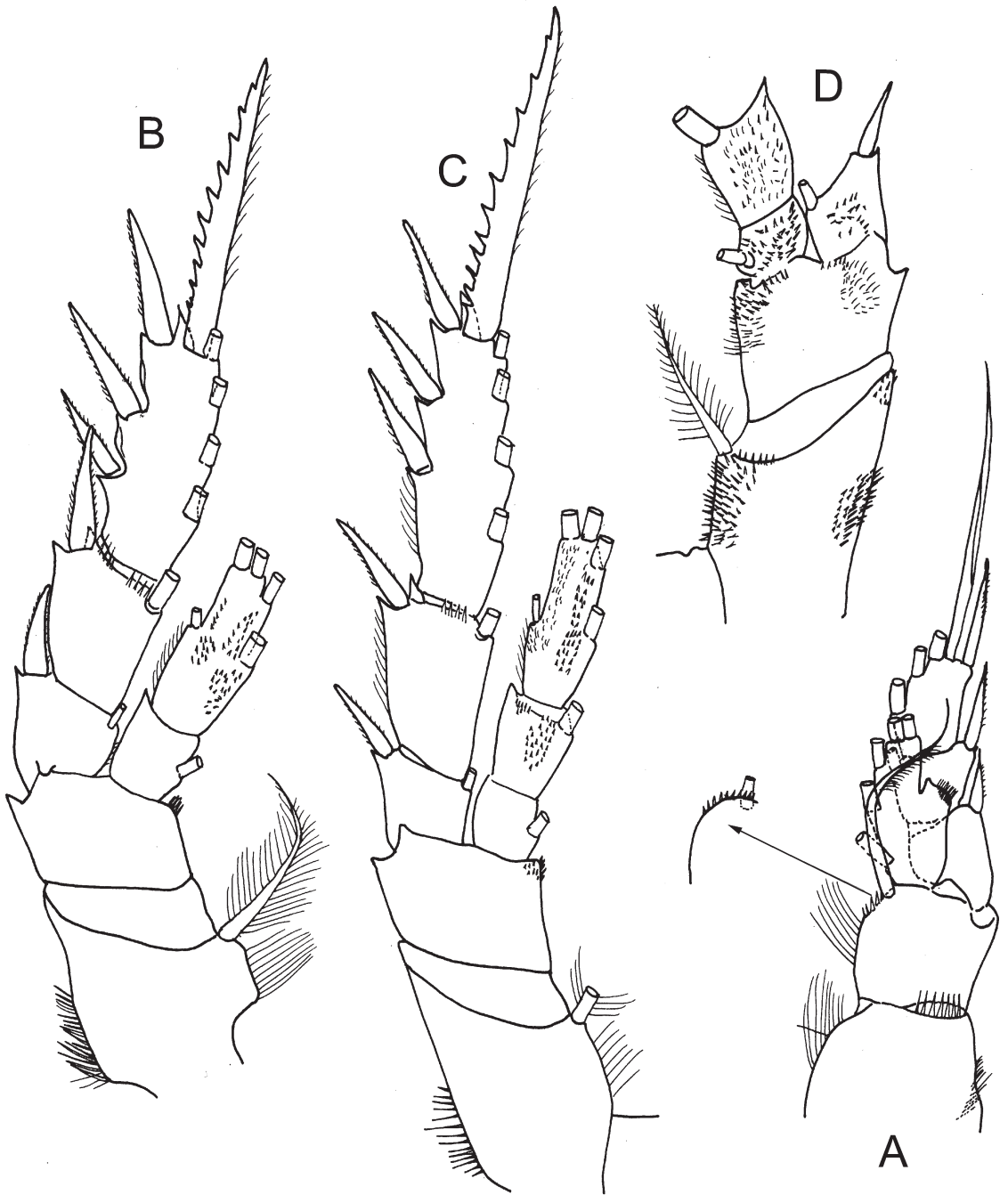


Fig. 4 *Xantharus cryeri* n. sp. female P1381/2: A, leg 1, anterior view; B, leg 2, posterior view; C, leg 3, posterior view; D, leg 4, posterior view.

Table 1 Comparison of distribution, total length (TL), and mouthparts of known species of female *Xantharus*. (A1, antennule; B, basis; b, brush-like; C, coxa; Li, endite; Mn, mandible; Mx1, maxillule; Mx2, maxilla; ped., pedigerous; Ri, endopod; s, sclerotised seta; w, worm-like.)

| Species | Known distribution | TL (mm) | A1 length: extends | A1 segment XVIII, setae | Mn, B, setae | Mx1, Ri, setae | Mx2, Li1, no. setae | Mx2, Ri setae |
|------------------------|----------------------------|-----------|------------------------------------|-------------------------|--------------|----------------|---------------------|---------------|
| <i>X. formosus</i> | NW Atlantic, United States | 1.00 | beyond distal border ped. somite 2 | ? | 3 | ? | 4 | 3w, 5b* |
| <i>X. renatehaasae</i> | Antarctic Pensinsula | 1.36 | to middle of ped. somite 2 | 2 | 4 | 11 | 5 | 3w, 5b |
| <i>X. siedleckii</i> | Arctic, Spitsbergen | 1.2–1.54 | to distal border ped. somite 1 | 1 | 3 | 10 | 4 | 3w, 5b, 1s |
| <i>X. cryeri</i> | Off New Zealand | 0.98–1.02 | to distal border ped. somite 2 | 1 | 3 | ? | 5 | 3w, 5b† |

*From Ohtsuka et al. 1998.

†It is not possible to be absolutely sure there is not also a normal seta present.

Table 2 Comparison of legs 1 and 5 of known species of female *Xantharus*: (Legs. B, basis; P1, leg 1; P5, leg 5; Re, exopod; Ri, endopod.)

| Species | P1, B | P1, Ri, shape inner lobe | P5 general proportions | P5, B, inner border shape | P5, B and Re | P5, no. Re spines | P5 Re inner spine, relative to other spine(s) length and articulation |
|------------------------|----------------------------|--------------------------|------------------------|---------------------------|--------------|-------------------|---|
| <i>X. formosus</i> | With inner distal spinules | With distal outer teat* | Squat | Not very swollen | separate | 3 | Much longer, separate |
| <i>X. renatehaasae</i> | Naked | With distal outer teat | Elongate | Not swollen | separate | 2 | Absent |
| <i>X. siedleckii</i> | Naked | Smoothly rounded | Elongate | Not very swollen | fused | 3 | Subequal, separate |
| <i>X. cryeri</i> | With inner distal spinules | With distal outer teat | Squat | Very swollen | fused | 3 | Subequal, separate |

*Confirmed from E. Markhaseva's examination of the holotype.

Male

Unknown.

Etymology

This species is named after Dr Martin Cryer, NIWA, Auckland, who obligingly allowed collection of this species and other benthopelagic organisms during a scampi survey off eastern New Zealand.

DISCUSSION

Xantharus cryeri is distinguished from the three other described species by a combination of characters (Tables 1 and 2): antennules that extend to the distal border of pedigerous somite 2; ancestral segment XVIII of the antennule with 1 seta; mandible basis with 3 setae; maxilla endite 1 with 5 setae; leg 1 basis with inner distal border lined with small spinules; and leg 5 is squat, with all segments as long as wide and the 2 terminal spine-like extensions of the terminal segment are approximately as long as the articulated, inner, subterminal spine.

Xantharus cryeri appears to be most like *X. siedleckii* although the latter is greater in length, the antennules appears to be slightly shorter, maxilla endite 1 has 4 setae (*X. cryeri* has 5 setae) and the maxilla endopod has an additional sclerotised seta (no such seta could be seen in *X. cryeri*), leg 1 basis with an inner distal border naked (this border lined with spinules in *X. cryeri*), and leg 5 is elongate with all segments longer than wide, basis inner border is not very swollen and exopod longer than basis (in *X. cryeri* the leg 5 is squat, inner border of the basis is very swollen and the basis and exopod are of similar lengths).

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REFERENCES

- Andronov VN 1981. *Xantharus formosus* gen. et sp. n. (Copepoda, Calanoida) from the northwest Atlantic. *Zoologicheskii Zhurnal* 60: 1719–1722.
- Boxshall GA, Halsey SH 2004. An introduction to copepod diversity. London, The Ray Society. 966 p.
- Bradford JM 1969. New genera and species of benthic calanoid copepods from the New Zealand slope. *New Zealand Journal of Marine and Freshwater Research* 3: 473–505.
- Bradford-Grieve JM 1999. New species of benthopelagic copepods of the genus *Stephos* (Calanoida: Stephidae) from Wellington Harbour, New Zealand. *New Zealand Journal of Marine and Freshwater Research* 33: 13–27.
- Bradford-Grieve JM 2001a. A new species of benthopelagic copepods of the genus *Tharybis* (Calanoida: Tharybidae) from the upper slope, north-eastern New Zealand. *New Zealand Journal of Marine and Freshwater Research* 35: 421–433.
- Bradford-Grieve JM 2001b. Two species of benthopelagic calanoid copepods of the genus *Neoscolecithrix* Canu, 1896 s.s. from New Zealand and the segregation of *Cenognatha* n. gen. *New Zealand Journal of Marine and Freshwater Research* 35: 781–793.
- Bradford-Grieve JM 2003. A new species of benthopelagic calanoid copepod of the genus *Bradyidius* Giesbrecht, 1897 (Calanoida: Aetideidae) from New Zealand. *New Zealand Journal of Marine and Freshwater Research* 37: 95–103.
- Bradford-Grieve JM 2004. Two new species of *Xanthocalanus* and the first record of *Brachycalanus* (Copepoda: Calanoida: Phaennidae) from the upper slope, north-eastern New Zealand. *New Zealand Journal of Marine and Freshwater Research* 38(4): 621–647.
- Huys R, Boxshall GA 1991. Copepod evolution. London, The Ray Society. 468 p.
- Ohtsuka S, Takeuchi I, Tanimura A 1998. *Xanthocalanus gracilis* and *Tharybis magna* (Copepoda: Calanoida) rediscovered from the Antarctic Ocean with baited traps. *Journal of Natural History* 32: 785–804. [redescription of *Xantharus*]
- Ohtsuka S, Boxshall GA, Fosshagen A 2003. A new species of *Neoscolecithrix* (Crustacea; Copepoda; Calanoida) from off Okinawa, southwestern Japan, with comments on the generic position in the Superfamily Clausocalanoidea. *Bulletin of the National Science Museum, Tokyo, Series A* 29: 53–63.
- Pantin CFA 1964. Notes on microscopical technique for zoologists. Cambridge University Press. 76 p.

- Schulz K 1998. A new species of *Xantharus* Andronov, 1981 (Copepoda: Calanoida) from the mesopelagic zone of the Antarctic Ocean. *Helgoländer Meeresuntersuchungen* 52: 41–49.
- Schulz K, Kwasniewski S 2004. New species of benthopelagic calanoid copepods from Kongsfjorden (Spitsbergen, Svalbard Archipelago). *Sarsia* 89: 143–159.
- Vyschkvartzeva NV 1989. *Puchinia obtusa* gen. et sp. n. (Copepoda, Calanoida) from the ultra-abyssal of the Kuril-Kamchatsk Trench and the place of the genus in the family Scolecitrichidae. *Zoologicheskii Zhurnal* 68: 29–38.

