

Harpacticoid Copepods of Genus *Onychocamptus* (Laophontidae) from Korea

Ji Min Lee and Cheon Young Chang*

(Department of Biology, College of Natural Sciences, Daegu University,
Gyeongsan 712-714, Korea)

ABSTRACT

Three harpacticoid species of the genus *Onychocamptus* are reported from the inland waters of South Korea: *O. vitiospinulosa* (Shen and Tai), *O. mohammed* (Blanchard and Richard) and *O. bengalensis* (Sewell). Of these, *O. vitiospinulosa* and *O. mohammed* are newly added to Korean copepod fauna. *Onychocamptus vitiospinulosa* is redescribed. Systematic accounts on the morphological details and the intraspecific variabilities are provided with a key to the *Onychocamptus* species from Korea.

Key words: taxonomy, *Onychocamptus*, Harpacticoida, inland water Copepoda, Korea

INTRODUCTION

The Laophontidae, one of the biggest harpacticoid families, consists of more than 56 genera. Laophontid copepods are known as usually marine, and mostly inhabiting the intertidal or shallow subtidal zone. However, members of the genus *Onychocamptus* Daday, 1903 frequently occurred from inland waters, and often showed the worldwide distribution and euryhaline occurrences, that is, tolerating the various type of inland waters from pure freshwaters to saline waters like brackish lagoons.

* To whom correspondence should be addressed

Tel: 82-53-850-6454, Fax: 82-53-850-6459, E-mail: cychang@daegu.ac.kr

Lots of confusions on the taxonomic position within the genus *Onychocamptus* and the relationships between its related genera have been existed. Recently, Lee and Huys (1999) made a revisional work on the genus and its related genera with the re-assessment on the taxonomic validity of many species and the re-allocation of them to the appropriate genera. They made a redefinition of the genus and provided a key to seven species recognized. Among them, *O. vitiospinulosa* from Southeast China was not fully confirmed, because it had not been sufficiently described yet. Thereafter, Gómez (2001) added one more species to *Onychocamptus*, so total eight species have been currently recorded in the genus.

In South Korea, the taxonomic study on the laophontid harpacticoids from inland waters is still nearly lacking. As for the genus *Onychocamptus*, only one species of *O. bengalensis* (Sewell) was once reported from the coast of Jindo Island by Song and Chang (1995). As one of the serial faunistic researches on the freshwater harpacticoid copepods from South Korea, the authors re-examined the laophontid specimens stocked in the specimen room of the Department of Biology, Daegu University, and found three *Onychocamptus* species. This paper is given for the taxonomic accounts on them, and a redescription of *O. vitiospinulosa* with the detailed illustrations on the basis upon the Korean specimens.

MATERIALS AND METHODS

Samplings were made with a dipnet of no. 25 mesh aperture from the various freshwaters and brackish-waters in South Korea since 1994. Copepods were fixed and stored in 5% buffered formalin. Specimens were dissected and mounted in lactophenol on H-S slide (Shirayama et al., 1993), a recent variation of Cobb slide, after the treatment in a solution of 5% glycerin -95% ethyl alcohol for 1-2 days, then observed using a differential interference contrast microscope (Olympus BX51) equipped with Nomarski optics. All drawings and measurements were made with the aid of a camera lucida.

Terminology mostly follows Huys and Boxshall (1991). Abbreviations used in the text and figures legend: enp1-3 or exp1-3, the first to third endopodal or exopodal segment of each leg; Fu, caudal rami; L/W, length to width ratio; P1-6, the first to sixth legs (pereopods).

TAXONOMIC ACCOUNTS

Family Laophontidae T. Scott, 1904

Genus *Onychocamptus* Daday, 1903

1. **Onychocamptus vitiospinulosa* (Shen and Tai, 1963) (Figs. 1-3)

Laophonte vitiospinulosa Shen and Tai, 1963, p. 423, figs. 42-46.

Onychocamptus mohammed vitiospinulosa: Lang, 1965, p. 447.

Onychocamptus vitiospinulosa: Shen and Tai, 1979, p. 296, figs. 147-148; Dussart and

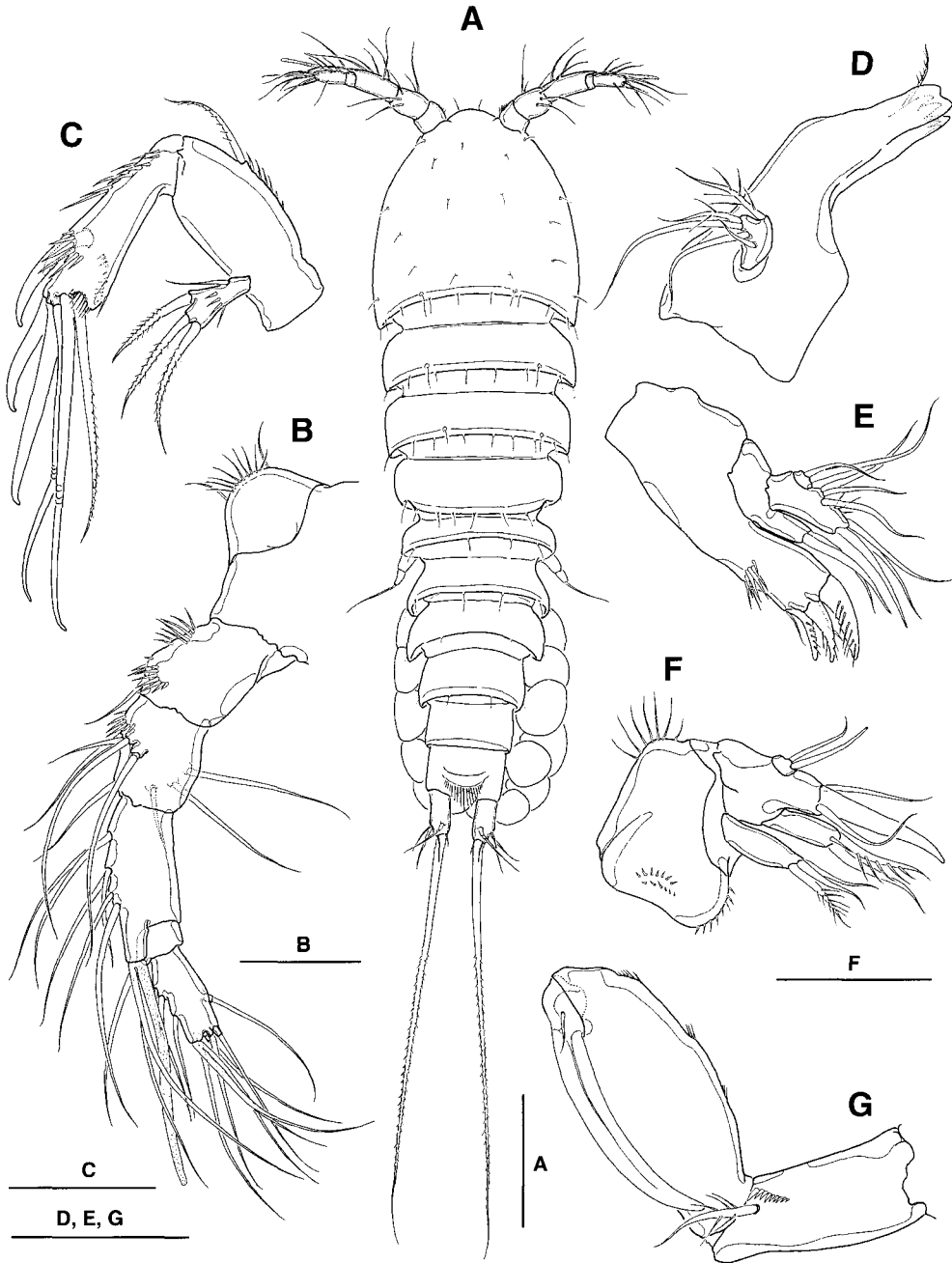


Fig. 1. *Onychocamptus vitiospinulosa*, female. A, habitus, dorsal; B, rostrum and antennule; C, antenna; D, mandible; E, maxillule; F, maxilla; G, maxilliped. Scale bars = 0.02 mm (F), 0.03 mm (B-E, G), and 0.1 mm (A).

Defaye, 1990, p. 278; Ishida, 1990, p. 46, pl. 4; Lee and Huys, 1999, p. 318; Ishida, 2000, p. 34, fig. 57.

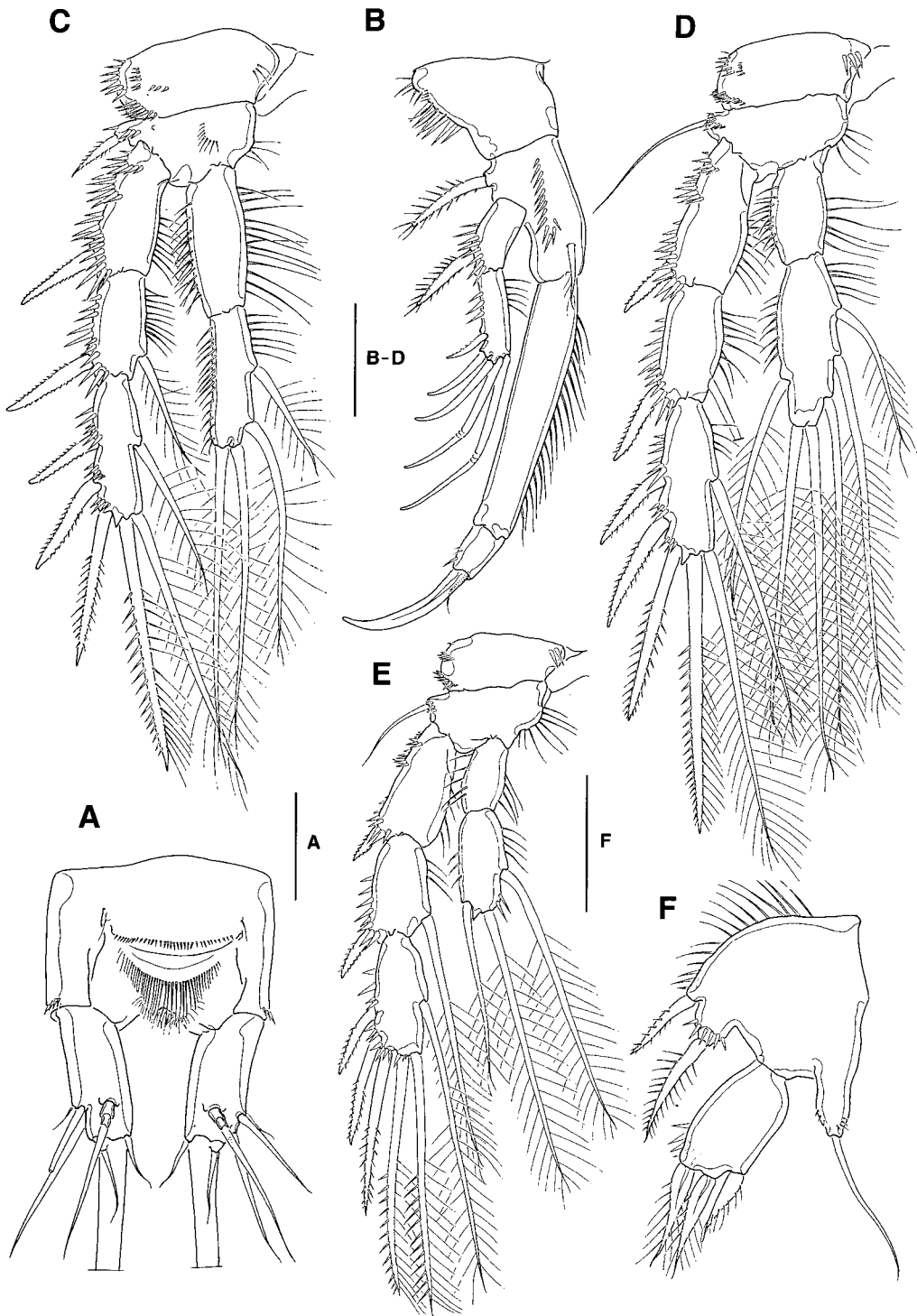


Fig. 2. *Onychocamptus vitiospinulosa*, female. A, anal somite and Fu, dorsal; B-F, P1-5. All scale bars 0.03 mm.

Material examined. 1 ♀, lower reaches of Sopocheon Stream, Jindo Is., 24 Jul. 1994 (C. Y. Chang and S. J. Song); 2 ♂♂, 4 ♀♀ (1 ovi.), reed marsh of the lower reaches of Gonyangcheon Stream, Gonyang, 27 Jul. 2004 (C. Y. Chang and J. M. Lee).

Description. Female 535–546 µm long. Body (Fig. 1A) sub-cylindrical, narrowing posteriorly, a little depressed dorsoventrally, markedly constricted between individual somites. Cephalothorax and body somites (except penultimate and anal somites) bearing sensillae along posterior margin; papillary tubercles not apparent or vestigial. Urosome narrowing posteriorly. Genital double-somite transversely divided dorsally and laterally showing original segmentation, fused ventrally. Distolateral margins of genital double-somite and next somite a little protruded but not pointed each without sensilla. Anal operculum (Fig. 2A) gently rounded at posterior margin, bordered with 1 row of spinules, followed by numerous well developed anal setules.

Fu (Fig. 2A) cylindrical, both sides a little convergent posteriorly; L/W about 2.2; furnished with 7 caudal setae; 2 lateral caudal setae (setae I and II) present; outer terminal caudal seta (seta IV) very short and smooth, 0.6 times as long as Fu; inner terminal caudal seta (seta V) stout and prominent, about 5/6 times as long as body length, pinnate after proximal third; dorsal caudal seta (seta VII) socketed.

Rostrum (Fig. 1B) bell-shaped, with 8–9 setules medially and 2 sensillae laterally along round anterior margin. Antennule (Fig. 1B) 5-segmented, third segment with 1 long aesthetasc, its tip much exceeding distal segment; penultimate segment short. Antenna (Fig. 1C) with allobasis about 2.3 times as long as maximum width; exopod about 2 times longer than wide, with 3 pinnate distal and 1 naked lateral setae. Mandible (Fig. 1D) with well developed gnathobase bearing several multicuspidate teeth along distal margin and 1 seta at dorsal corner; palp small; endopod and exopod fused together with basis, bearing 3 naked and 2 pinnate setae. Praecoxal arthrite of maxillula (Fig. 1E) with several long spinules around outer margin; coxal arthrite with cylindrical endite bearing 1 seta and 1 long, curved spine; basis with 1 spine and 2 setae apically; endopod nearly incorporated in basis, with 3 setae; exopod 1-segmented, with 2 setae. Maxilla (Fig. 1F) with 2 coxal endites, each bearing 3 spines or setae distally; allobasis bearing strong claw, flanked by 2 setae; endopod represented by small protuberance with 2 long setae. Maxilliped (Fig. 1G) prehensile; syncoxa with 1 pinnate seta and 1 row of spinules; basis with 3 spinule rows along outer margin; endopod represented by 1 stout, curved claw, bearing 1 short, naked seta as accessory armature.

P1 (Fig. 2B), coxa much wider than long basally, with many spinules along outer margin; basis elongated with 1 plumose distomedial seta and 1 row of spinules on posterior surface; enp1 strikingly elongate, furnished with 1 row of setules along medial margin; medial (inner) seta lacking; enp2 a little longer than wide, bearing 1 claw and 1 bare seta apically; exp2 a little longer than exp1 bearing 3 spines and 2 apical, geniculate setae. P2–P4 (Fig. 2C–E) each with 2-segmented endopod and 3-segmented exopod. Ornamentation of legs 2–4 as follows (in armature formula, Roman numerals indicate spines and Arabic numerals represent setae):

Leg 2: basis I-0; exp I-0; I-1; III, 2, 1; enp 0-0; 0, 2, 2

Leg 3: basis I-0; exp I-0; I-1; III, 2, 1; enp 0-0; 1, 2, 3

Leg 4: basis I-0; exp I-0; I-1; III, 2, 1; enp 0-0; 1, 1, 1

P5 (Fig. 2F) with exopod and baseoendopod separated. Baseoendopod not protruded, with 2

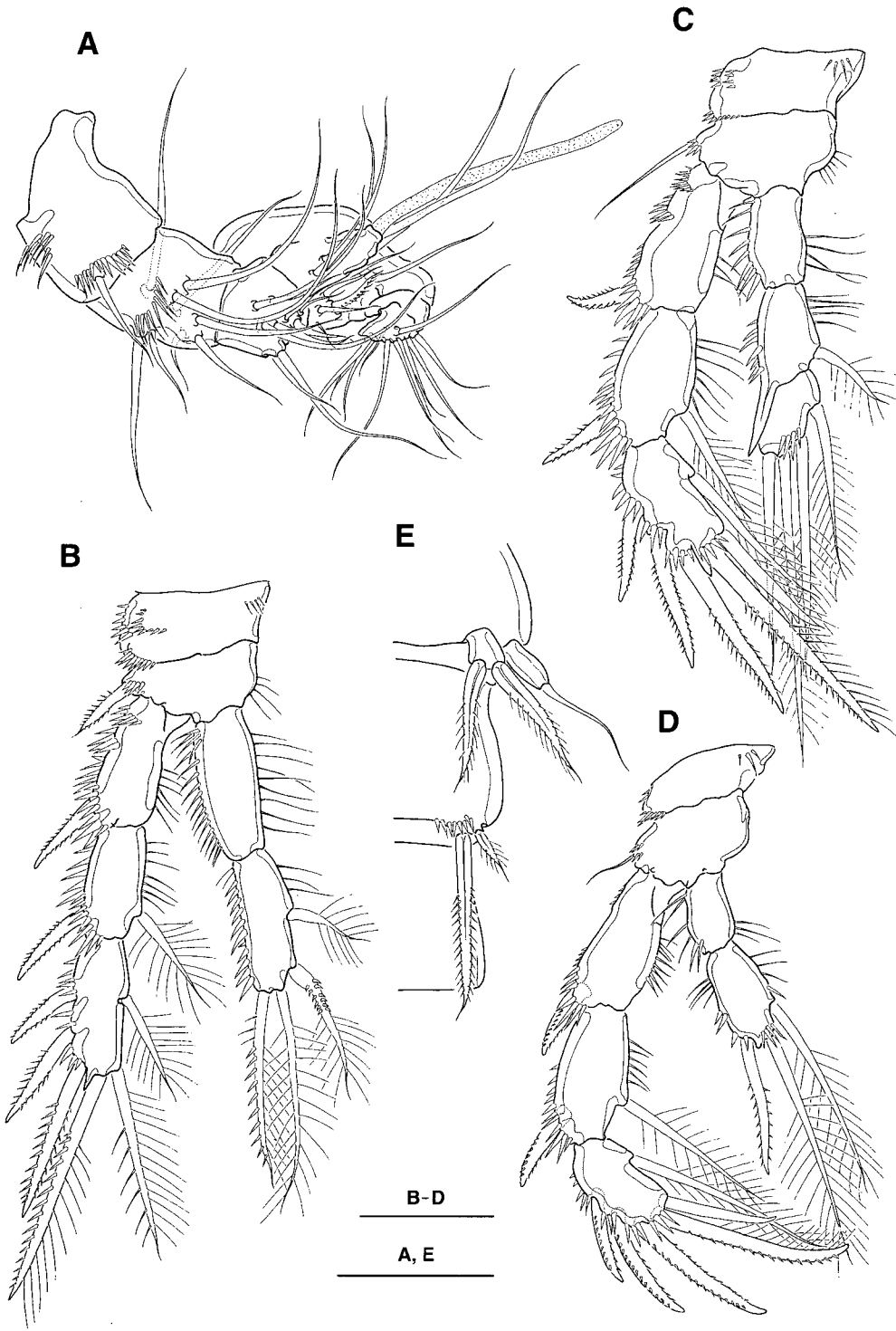


Fig. 3. *Onychocamptus vitiospinulosa*, male. A, antennule; B-D, P2-4; E, P5 and P6, ventral. All scale bars = 0.03 mm.

pinnate setae distally; with row of long setules along medial margin; surface hirsute. Exopod oblong, about 2 times as long as wide, with 3 plump plumose setae distally and 1 row of spinules along distomedial corner.

Male about 480 μm long, excluding caudal setae. General body shape similar to that of female. Antennule (Fig. 3A) 8-segmented; first segment with 1 naked seta and 2 groups of spinules; fourth and fifth segments partly fused, with long aesthetasc on peduncular process and strong pinnate spiniform seta on anterodorsal margin; last segment with 11 setae in total. P2 (Fig. 3B) with 3-segmented exopod and 2-segmented endopod; distomedial seta on enp2 modified, with several whorls of spinules at its basal part. Both endopod and exopod of P3 (Fig. 3C) 3-segmented; distomedial seta of exp3 modified into short spine; enp2 with 1 medial seta and acute spinous apophysis distolaterally; enp3 with 2 medial and 2 apical plumose setae. P4 (Fig. 3D) with 2-segmented endopod; distomedial seta of exp3 modified into short spine; enp1 without distomedial seta; enp2 bearing 1 medial and 1 apical plumose setae with 1 pinnate spine; 2 apical setae of exp3 modified as spiniform in male. Baseoendopod of P5 (Fig. 3E) completely fused into fifth pedigerous somite, bearing only outer basal seta with socket; exopod rectangular, with 2 spiniform setae distally. P6 (Fig. 3E) represented by small plate with 2 spiniform setae, outer of which much smaller than inner seta.

Remarks. By far, eight species have been recognized as valid in the genus *Onychocamptus*: *O. mohammed* (Blanchard and Richard, 1891), *O. bengalensis* (Sewell, 1934), *O. besnardi* Jakobi, 1954, *O. vitiospinulosa* (Shen and Tai, 1963), *O. anomalus* (Ranga Reddy, 1984), *O. taifensis* Kikuchi, Dai and Ito, 1993, *O. krusensterni* Schizhan and Shirley, 1994, and *O. fratrisaustralis* Gomez, 2001. *Onychocamptus vitiospinulosa* was described as *Laophonte vitiospinulosa* from the delta of the Pearl River in South China (Kwangtung Province) by Shen and Tai (1963). As the original description was insufficiently or rather inadequately prepared, and *O. mohammed* had been known as the wide spreading and somewhat variable species, *O. vitiospinulosa* was regarded as a subspecies of *O. mohammed* by Lang (1965), but later reinstated as a valid species by Lee and Huys (1999). Through the subsequent reports from Japan by Ishida (1990, 2000) and this study, the morphological differences between *O. vitiospinulosa* and the other congeneric species become somewhat clear. *Onychocamptus vitiospinulosa* fits well with Lee and Huys' (1999) redefinition of the genus *Onychocamptus*, except for the nearly smooth posterior margins of cephalothorax and body somites, lacking the prominent papillary tubercles. The tubercles were not apparent and rather vestigial in all the specimens from Korea. They are supposed to be secondarily lost during its speciation in East Asia. Considering the setal formula of P2-4, this species is most allied with *O. mohammed* and *O. bengalensis*, as already written in Lee and Huys' (1999) key. Another decisive character differentiating *O. vitiospinulosa* from the two species is the shape and setal armature of female P5, that is, baseoendopod and exopod is confluent in *O. bengalensis*; and baseoendopod with three setae in *O. mohammed*, while with only two setae in *O. vitiospinulosa*.

Korean specimens are in accord with the original description, and largely coincide with the figures of Ishida (1990), except for the minor differences in the size arrangement of setae on P5 exopod in both sexes.

Korean specimens were collected from the reed marshes at the lower reaches of two streams (Gonyangcheon Stream and Sopocheon Stream, Jindo Is.), both locating at southern coast of

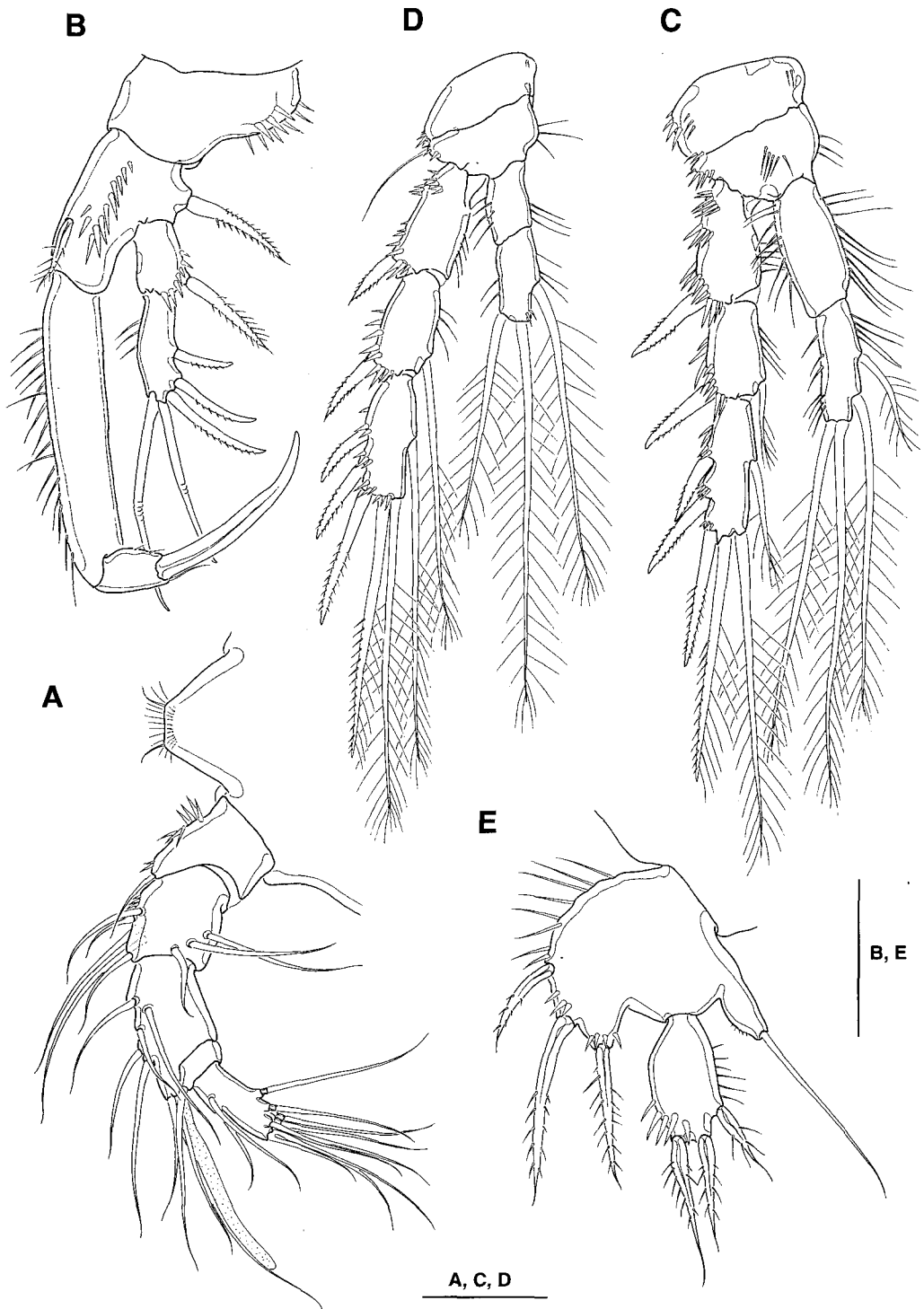


Fig. 4. *Onychocamptus mohammed*, female. A, rostrum and antennule, dorsal; B, P1; C, P2; D, P4; E, P5
 All scale bars = 0.03 mm.

Korea. Considering the habitats hitherto known, this species is supposed to favor the estuarine brackish-waters and oligohaline lakes near seashore.

Distribution. China (Kwangtung), Japan (Hokkaido, Okinawa) and Korea.

2. **Onychocamptus mohammed* (Blanchard and Richard, 1891) (Figs. 4, 5A, B)

Laophonte Mohammed Blanchard and Richard, 1891, p. 526, pl. IV, figs. 1-15; Wilson, 1932, p. 269, fig. 167.

Laophonte mohammed: Borutskii, 1952, p. 345, figs. 102, 103:1-15; Shen and Tai, 1962, p. 397, figs. 20-32.

Onychocamptus talipes Wilson, 1932, p. 265, fig. 167; Fiers, 1998, p. 1.

Onychocamptus mohammed: Lang, 1948, p. 1417, Abb. 576; Lang, 1965, p. 447; Dussart, 1967, p. 457, fig. 209; Shen and Tai, 1979, p. 293, figs. 145-146; Ishida, 2000, p. 34, fig. 56.

Material examined. 1 ♀, Daecheong Lake, 12 Aug. 2002 (C. Y. Chang and J. M. Lee); 1 ♀, Yedang Reservoir, Boseong, 12 Aug. 2004 (J. M. Lee).

Description. Sensillar tubercles developed along posterior margin of cephalothorax and body somites (except penultimate and anal somites); distolateral margins of genital double-somite and next urosomal somite markedly projected posterolaterally, ending into sensilla each (Fig. 5B); posterior margin of operculum slightly rounded with about 30 spinules; anal setules well developed, forming “V”-shape posteriorly (Fig. 5A); Fu cylindrical, a little elongate, L/W 2.0-2.4; outer medial terminal seta (seta IV) short, 0.7-1.0 times as long as Fu (Fig. 5A, B); antennule (Fig. 4A) 5-segmented with 1 aesthetasc on third segment; rostrum triangular with truncated anterior margin (Fig. 4A); P1 (Fig. 4B) of typical shape in *Onychocamptus*, with elongate, 2-segmented endopod, ending with well developed terminal claw, exopod 2-segmented; P2 enp2 with 2 medial setae (Fig. 4C); P4 exp3 with 3 lateral spines, enp2 with 1 medial and 2 apical setae (Fig. 4D); female P5 (Fig. 4E), exopod and baseoendopod separated; P5 baseoendopod with 3 pinnate setae; P5 exopod elongate, about 2 times longer than wide, with row of setules along lateral margin, bearing 3 pinnate spiniform setae, medialmost one longest.

Remarks. The length of outer terminal caudal seta (seta IV) showed some variability between the specimens from the two localities above as well as the French population in Dussart (1967): the length ratios of the caudal setae to Fu are 0.7 (Yedang Reservoir) -1.0 (Daecheong Lake) and about 1.5 (Dussart, 1967). The size arrangement in baseoendopodal setae of female P5 is also variable: lateralmost seta is the longest in the original description (Blanchard and Richard, 1891), Dussart (1967) and Ishida (2000), while middle seta is the longest in Shen and Tai (1962) and our specimens from Korea.

In the figure of Japanese specimen (Ishida, 2000, Fig. 56a), Fu are shown as ornamented with hairs along medial margin. However, other references (Borutskii, 1952; Dussart, 1967; Shen and Tai, 1979) as well as ours from Korea show the smooth medial margin of Fu.

This species are known as cosmopolitan and euryhaline. Korean specimens occurred from the bottom (about 50 m deep) of Daecheong Lake, a big, purely freshwater lake located at the inland area of South Korea, and from Yedang Reservoir, an oligohaline reservoir for irrigation near

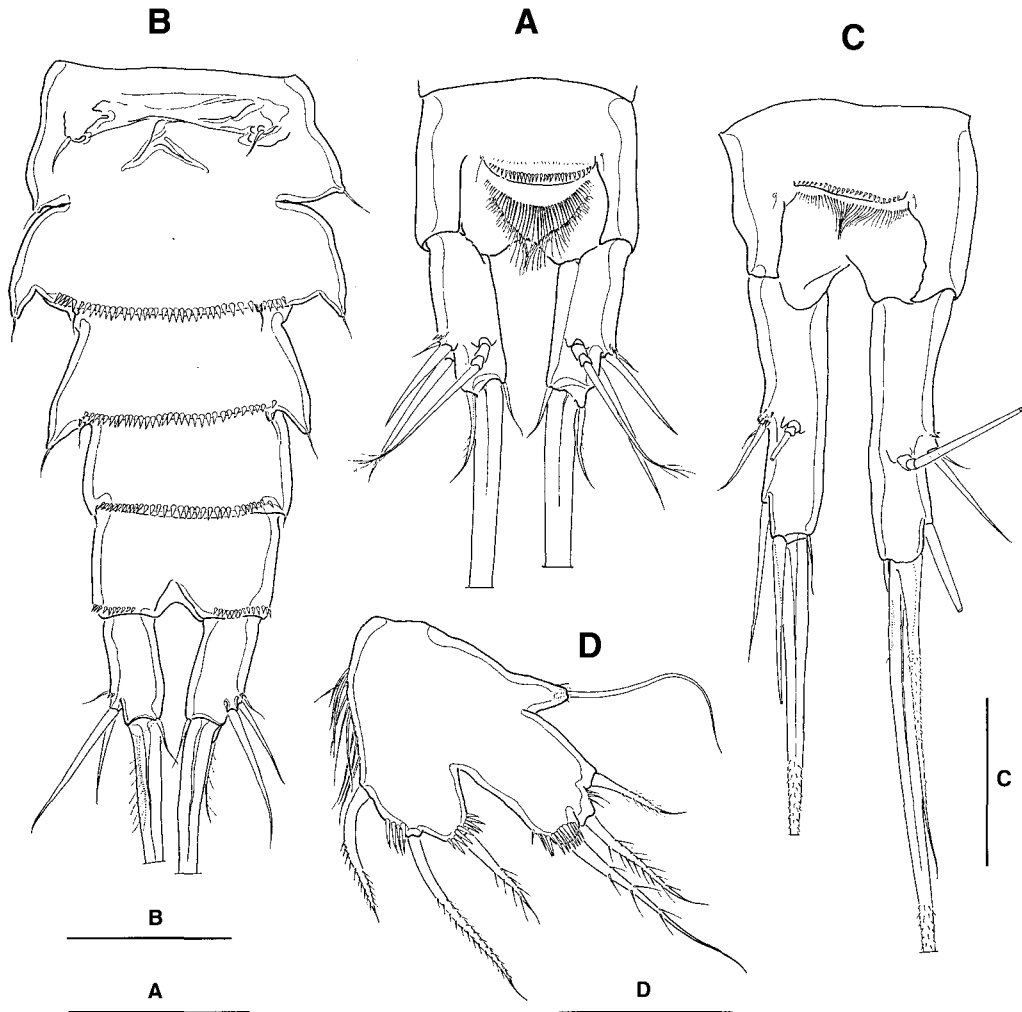


Fig. 5. A-B, *Onychocamptus mohammed*, female. A, anal somite and Fu, dorsal; B, urosome, ventral. C-D, *Onychocamptus bengalensis* (Sewell), female. C, anal somite and Fu, dorsal; D, P5. All scale bars = 0.05 mm.

southern coast.

Distribution. Cosmopolitan (Africa, Europe, Russia, North America, Australia, China, Japan and Korea).

3. **Onychocamptus bengalensis* (Sewell, 1934) (Fig. 5C, D)

Laophonte bengalensis Sewell, 1934, p. 98, fig. 10 (cited from Lang, 1948).

Onychocamptus bengalensis: Lang, 1948, p. 1420, figs. 571: 9, 578: 2; Hamond, 1973, p. 406, figs. 42-65; Song and Chang, 1995, p. 72, fig. 6.

Material examined. 1♀, estuary of Ssangcheon Stream, Mt. Seorak, 14 Aug. 1996 (S. M.

Yoon).

Description. Genital-double somite divided dorsally and laterally; distolateral margin of genital double-somite and next urosomal somite projected, ending into sensilla; operculum not convex, with row of spinules along posterior margin; Fu (Fig. 5C) elongate, L/W 3.8-4.0, slightly narrowing posteriorly; outer medial terminal seta long, 1.3 times as long as Fu, with numerous whorls of spinules; P1-4 of both sexes nearly same with those of preceding species; female P5 (Fig. 5D) exopod and baseoendopod fused, each with 3 setae; male P5 nearly same with preceding species; male P5 baseoendopod fused into fifth pedigerous somite, exopod rectangular with 2 spiniform setae distally.

Remarks. *Onychocamptus bengalensis* is characteristic in having the elongate caudal rami. However, the length to width ratio of caudal rami is supposedly somewhat variable. Lang (1948) mentioned that it was about 3 times longer than wide, and Hamond (1973) wrote about 6 times in his redescription. L/W ratio of Korean specimens ranges from mean 3.03 in the female specimens from Jindo Is. (Song and Chang, 1995) to 3.8 in this study.

Generally the shape and ornamentation of anal operculum is treated as an important taxonomic character, but it seems to be much variable in this species. Hamond (1973) described operculum as deeply curved with a smooth edge, while Korean specimen has anal operculum little curved with a spinule row on its posterior margin.

An abnormality was also found in the Korean specimen, that is, caudal rami are unsymmetrical, with much shorter setae in one side than in other side (cf. Fig. 5C).

Considering the previous collection records of Calcutta, India (type locality), saline lakes in southeast Australia and crab burrows in the exposed mud flat at Jindo Is., Korea in summer, this species was supposed to be a tropical or subtropical species. By this report from the lower reaches of Ssangcheon Stream, Sokcho, flowing into East Sea (Sea of Japan), it extends its distribution range much northward (38° 10'N).

Distribution. India, Australia and Korea.

A key to the species of genus *Onychocamptus* from Korea

1. Fu elongate, about 4 times longer than wide; exopod and baseoendopod of P5 confluent
..... *O. bengalensis* (Sewell)
- Fu less than 2.5 times longer than wide; exopod and baseoendopod of P5 divided 2
2. Baseoendopod of P5 with 3 setae in total; distolateral margins of every somites (except last two urosomal somites) projected, with well developed papillary tubercles ending into sensilla
..... *O. mohammed* (Blanchard and Richard)
- Baseoendopod of P5 with 2 setae in total; distolateral margin of somites little protruded, without marked papillary tubercles *O. vitiospinulosa* (Shen and Tai)

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한국산 발톱갈고리노벌레속 (발톱갈고리노벌레과)의 요각류

이 지 민 · 장 천 영*

(대구대학교 자연과학대학 생명과학과)

요 약

한국의 육수역에 서식하는 발톱갈고리노벌레속 (*Onychocamptus*)의 3종, 가시발톱갈고리노벌레 (*O. vitiospinulosa*), 돌출발톱갈고리노벌레 (*O. mohammed*) 및 벵갈발톱갈고리노벌레 (*O. bengalensis*)을 보고한다. 이 중 가시발톱갈고리노벌레와 돌출발톱갈고리노벌레는 한국미기록종이다. 가시발톱갈고리노벌레를 재기재하였다. 이들 3종의 미세 형태학적 형질과 종내변이성에 대한 분류학적 검토를 수행하였고, 그림과 함께 검색표를 작성하였다.