

A Faunistic Study on the Brackish-water Calanoid Copepods from South Korea

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ABSTRACT

Eight calanoid species of 4 genera in 4 families are reported from the various brackish waters such as estuaries, brackish-water lakes, and coastal marshes in South Korea. Among them, *Eurytemora affinis* (Poppe) and *Acartia (Acanthacartia) tsuensis* Ito are newly added to Korean copepod fauna. Collection data, brief descriptions, illustrations and distribution maps for the eight species are prepared. A key to the genera and species of the brackish-water calanoids from Korea is also presented.

Key words: taxonomy, Copepoda, Calanoida, brackish-water, Korea

INTRODUCTION

The taxonomic study on the brackish-water calanoid copepods is scanty in Korea. After Chang and Kim (1986) recorded three brackish-water species (*Sinocalanus tenellus*, *S. sinensis*, and *Pseudodiaptomus inopinus*), Yoo and Lim (1989) reported the three species above from Yeongsan Lake. Yoo's (1995) "Illustrated Encyclopedia" on marine zooplankton included a few brackish-water calanoid species. Soh et al. (2001) confirmed the distribution of four *Pseudodiaptomus* species in the Korean seacoasts. Among them, *P. inopinus* and *P. poplesia* occur in brackish waters from Korea.

Recently, the authors have tried to make a comprehensive study on the copepod fauna inhabiting the various brackish waters such as estuaries, brackish-water lakes, and coastal marshes in South Korea. As a provisional result of the researches, we confirmed eight calanoid species of four genera in four families: *Sinocalanus sinensis* (Poppe, 1889), *S. tenellus* (Kikuchi, 1928) of the Centropagidae, *Eurytemora affinis* (Poppe, 1880), *E. pacifica* Sato, 1913 of the Temoridae, *Pseudodiaptomus inopinus* Burckhardt, 1913, *P. poplesia* Shen, 1955 of the Pseudodiaptomidae, *Acartia (Acanthacartia) tsuensis* Ito, 1956, and *A. (Odontacartia) pacifica* Steuer, 1915 of the Acartiidae. Among them, *E. affinis* and *A. tsuensis* are newly added to Korean fauna.

This paper deals with the systematic accounts of them, based on the morphological characters, a key to the species, distribution maps in Korea, and illustrations for the significant traits of the species.

MATERIALS AND METHODS

Materials examined in the present study were collected from the various brackish waters, such as estuaries and coastal salt marshes since the year 1987. Collections were made with a plankton net or a dipnet of 64 µm mesh aperture. Copepods were fixed and stored in 4% 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 BX-51) equipped with Nomarski optics. All drawings and measurements were made with the aid of a camera lucida.

Abbreviations used in the text and figure legend: A1, antennule; enp 1-3 or exp 1-3, the first to third endopodal or exopodal segment of each leg; Fu, furcal rami (caudal rami); P1-P6, first to sixth pereopods (thoracic legs).

SYSTEMATIC ACCOUNTS

Subclass Copepoda Sars, 1886

Order Calanoida Sars, 1903

Family Centropagidae Giesbrecht, 1892

Genus *Sinocalanus* Burckhardt, 1913

¹**Sinocalanus sinensis* (Poppe, 1889) (Fig. 1)

Limnocalanus sinensis Poppe, 1889 in Guerne and Richard, 1889, p. 131, pl. 4, figs. 4, 15, 15a, 16.

Sinocalanus sinensis: Burckhardt, 1913, p. 346; Shen and Song, 1979, p. 60, fig. 21; Chang and Kim, 1986, p. 51,

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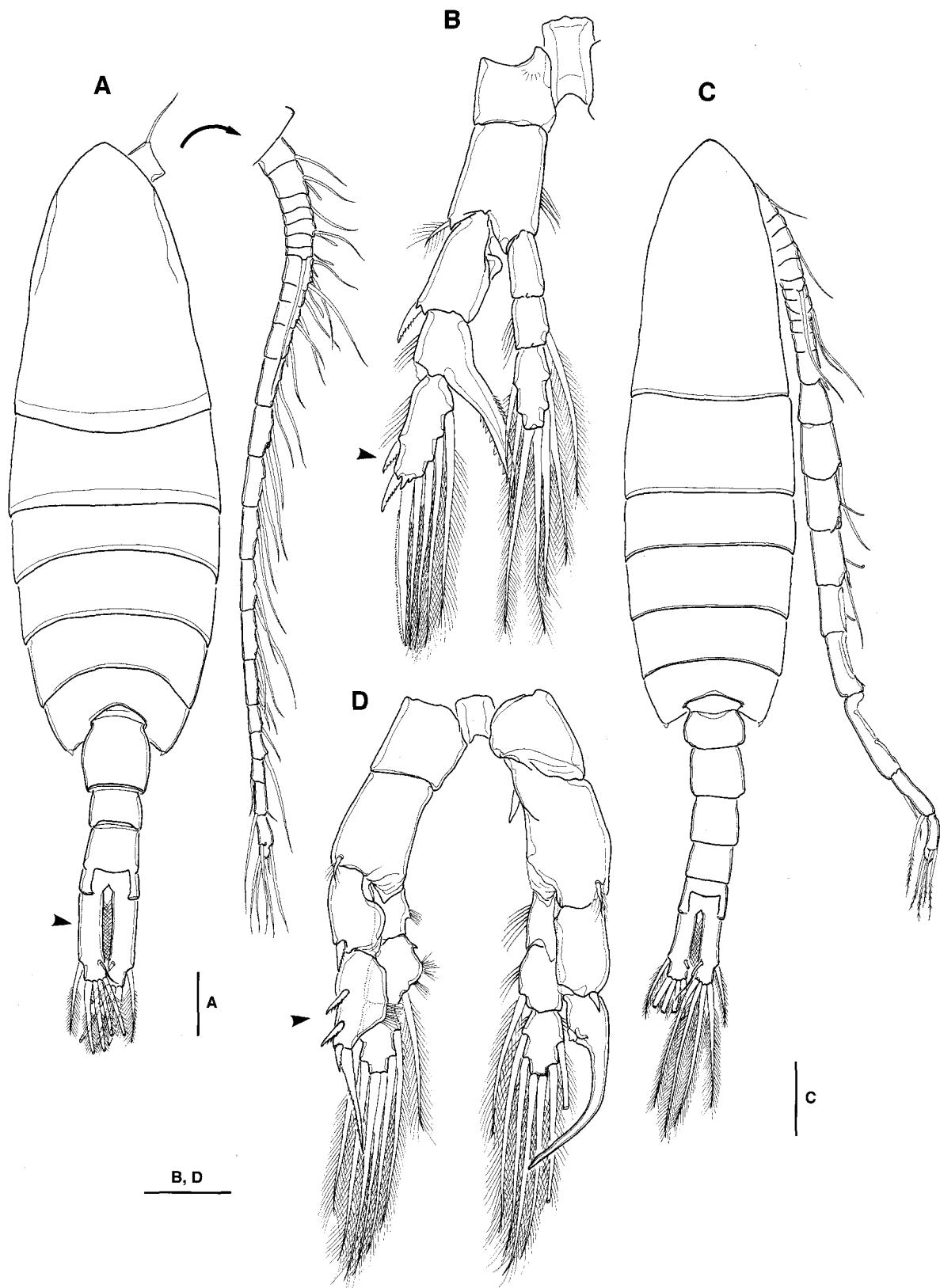


Fig. 1. *Sinocalanus sinensis* (Poppe). A-B, female: A, habitus, dorsal; B, P5. C-D, male: C, habitus, dorsal; D, P5. Scale bars=0.1 mm (A, C), 0.05 mm (B, D).

pl. I, figs. 1-3; Chihara and Murano, 1997, p. 767, pl. 87; Dussart and Defaye, 2002, p. 27.

Previous records. Shinjeong-ri (reed marsh), Ganghwado Is.; estuary of Geumgang R., Gunsan; estuary of Dongjintang R., Buan (Chang and Kim, 1986). Yeongsanho Lake (Yoo and Lim, 1989).

Material examined. 9 ♀♀, 11 ♂♂, estuary of Han R., Gimpo, 24 Oct. 2004 (H.S. Rho); 2 ♀♀, 1 ♂, Namyangho Lake, 20 May 1997 (C.Y. Chang).

Diagnosis. Body length 1.4-1.6 mm in female, 1.2-1.3 mm in male. Cephalosome pointed anteriorly. Distolateral corner of prosome not forming wing-like protrusion, with 1 small spine. Urosome nearly symmetrical.

Female: genital somite nearly as long as wide, shorter than sum of next urosomites, slightly swollen laterally, without lateral spines or projection; Fu usually 3.5-4 times as long as wide, not more than 5 times (Fig. 1A, arrow); A1 25-segmented, slightly beyond anal somite; P5 exp 3 with 2 outer spines (Fig. 1B, arrow), 1 spiniform seta and 4 plumose setae; exp 2 with 1 stout, serrated protrusion distomedially; exp 3 with 6 plumose setae in total.

Male: P5 with 1 sharp, pointed projection on inner margin of right basis; left exp 2 with 3 spines (Fig. 1D, arrow) along outer margin and 1 spiniform seta apically.

Remarks. This species inhabits estuaries, brackish-water lakes, and coastal marshes in the western coast of South Korea (Fig. 13). This species is endemic to the brackish waters around the Yellow Sea. In recent years, it tends to be restricted to the northern part of western coast of South Korea, and seemingly becomes rare. The length to width ratio of caudal rami shows somewhat wide variation range from 3.4 to 5.0 in Korean population.

Distribution. Korea (western coast), China, Japan (Ariake Sea in western Kyushu).

¹**Sinocalanus tenellus* Kikuchi, 1928 (Figs. 2, 3)

Limnocalanus sinensis var. *tenellus* Kikuchi, 1928, p. 67, pl. 18, figs. 1-8.

Sinocalanus tenellus: Smirnov, 1929, p. 320, figs. 4-9; Ueno, 1935, p. 89; Shen and Song, 1979, p. 61, fig. 22; Lai and Fernando, 1981, p. 161, figs. 1-2; Mizuno and Miura, 1984, p. 476, fig. 256; Kim, 1985, p. 99, pl. 32, figs. a-d; Chang and Kim, 1986, p. 51, pl. I, figs. 4, 5; Yoo, 1995, p. 186, fig. 128; Chihara and Murano, 1997, p. 768, pl. 87; Dussart and Defaye, 2002, p. 27.

Previous records. Yeongrangho Lake, Sokcho; Gyeongpoho Lake, Gangreung; estuary of Nakdong River, Busan (Chang

and Kim, 1986). Yeongsanho Lake, Mokpo (Yoo and Lim, 1989).

Material examined. 18 ♀♀, 12 ♂♂, Daemyeong-ri (reservoir), Ganghwado Is., 13 Dec. 2004 (H.W. Lim); 2 ♀♀, 2 ♂♂, Gwangpoho Lake, Sokcho, 13 Jun. 1986 (I.H. Kim); 1 ♀, 1 ♂, Hyangho Lake, Jumunjin, 12 Oct. 2005 (H.W. Lim); 6 ♀♀, 9 ♂♂, Nampo tidal embankment, Boryeong, 2 May 2007 (C.Y. Chang and H.J. Yoon); 18 ♀♀, 21 ♂♂, Janggodo Is. (coastal marsh), Boryeong, 7 Aug. 2003 (J.M. Lee and J.M. Jeon); 11 ♀♀, 5 ♂♂, Goraebul (estuary), Yeongdeok, 3 Apr. 2004 (C.Y. Chang and J.M. Lee); 1 ♀, Yongyeon Res., Pohang, 26 May 1988 (C.Y. Chang); 1 ♀, 1 ♂, estuary of Hyeongsan R., Pohang, 24 Sep. 2005 (H.W. Lim); 3 ♀♀, 1 ♂, Taehwagang R. (Myeongchon Br.), Ulsan, 31 Mar. 2007 (C.Y. Chang); 4 ♀♀, 1 ♂, Taehwagang R. (Beonyeong Br.), Ulsan, 29 Jan. 2005 (J.M. Jeon); 2 ♀♀, 1 ♂, estuary of West-Nakdong R., Busan (Jungrimgang R.), 7 Aug. 1986 (C.Y. Chang); 5 ♀♀, 3 ♂♂, estuary of West-Nakdong R. (Gangdong Br.), Gimhae, 17 Dec. 2003 (C.Y. Chang); 5 ♀♀, 8 ♂♂, Ungcheon (estuarine marsh), Jinhae, 24 Jun. 2007 (C.Y. Chang); 5 ♀♀, 1 ♂, Jukjeon tidal embankment (salt marsh), Jindong, Masan, 3 Jun. 2007 (H.S. Yeo); 4 ♀♀ (1 ovi.), 1 ♂, estuary of Gwangogcheon Str., Hadong, 26 Apr. 2007 (C.Y. Chang, J.M. Lee and H.J. Yoon); 2 ♀♀, 1 ♂, Gyehwado Is. (reed marsh), Buan, 18 Aug. 1986 (I.H. Kim); 5 ♀♀, 1 ♂, Bojeonpo tidal embankment (salt marsh), Jindo Is., 29 Jun. 2004 (H.W. Lim and J.M. Jeon); 1 ♂, Seongsanpo (reed marsh), 12 Feb. 1987 (C.Y. Chang); 18 ♀♀, 9 ♂♂, Saeseom islet (salt marsh), Seogwipo, Jeju Is., 11 Feb. 1987 (C.Y. Chang).

Diagnosis. Body length 1.2-1.3 mm in female, about 1.2 mm in male. Body slender. Distolateral corner of prosome not forming wing-like protrusion, with 1 small spine. Urosome nearly symmetrical.

Female: genital somite nearly as long as wide, much longer than sum of next urosomites, slightly swollen laterally, without lateral spines or projection; Fu 8 times or more as long as wide (Fig. 2A, C, arrows); A1 and male right A1 exceeding posterior end of Fu; P5 exp 3 with only 1 outer spine (Fig. 3B).

Male: P5 (Fig. 3E, arrow) with blunt, bifurcate projection on inner margin of right basis; left exp 2 with only 1 short spine on outer margin.

Remarks. This species occurs frequently and abundantly in various brackish-waters around the coasts of South Korea, except the northern part of western coast (cf. Fig. 13). Sometimes this species extends its distributional range to nearly pure freshwaters of tidal river.

Distribution. Korea, Japan, Russia (Kuril Is., Sakhalin Is.),

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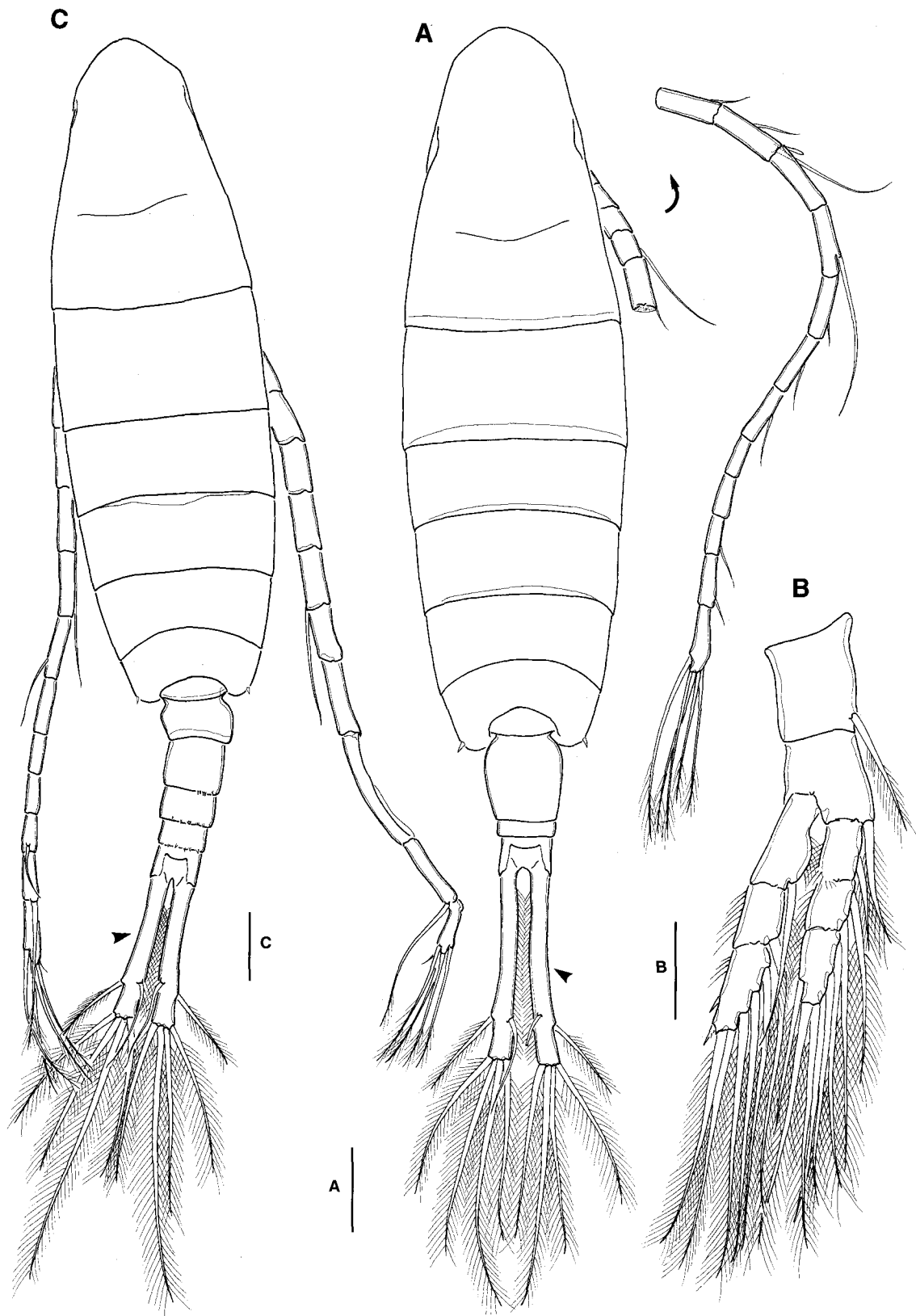


Fig. 2. *Sinocalanus tenellus* (Kikuchi). A-B, female: A, habitus, dorsal; B, P1. C, male habitus, dorsal. Scale bars=0.1 mm (A, C), 0.05 mm (B).

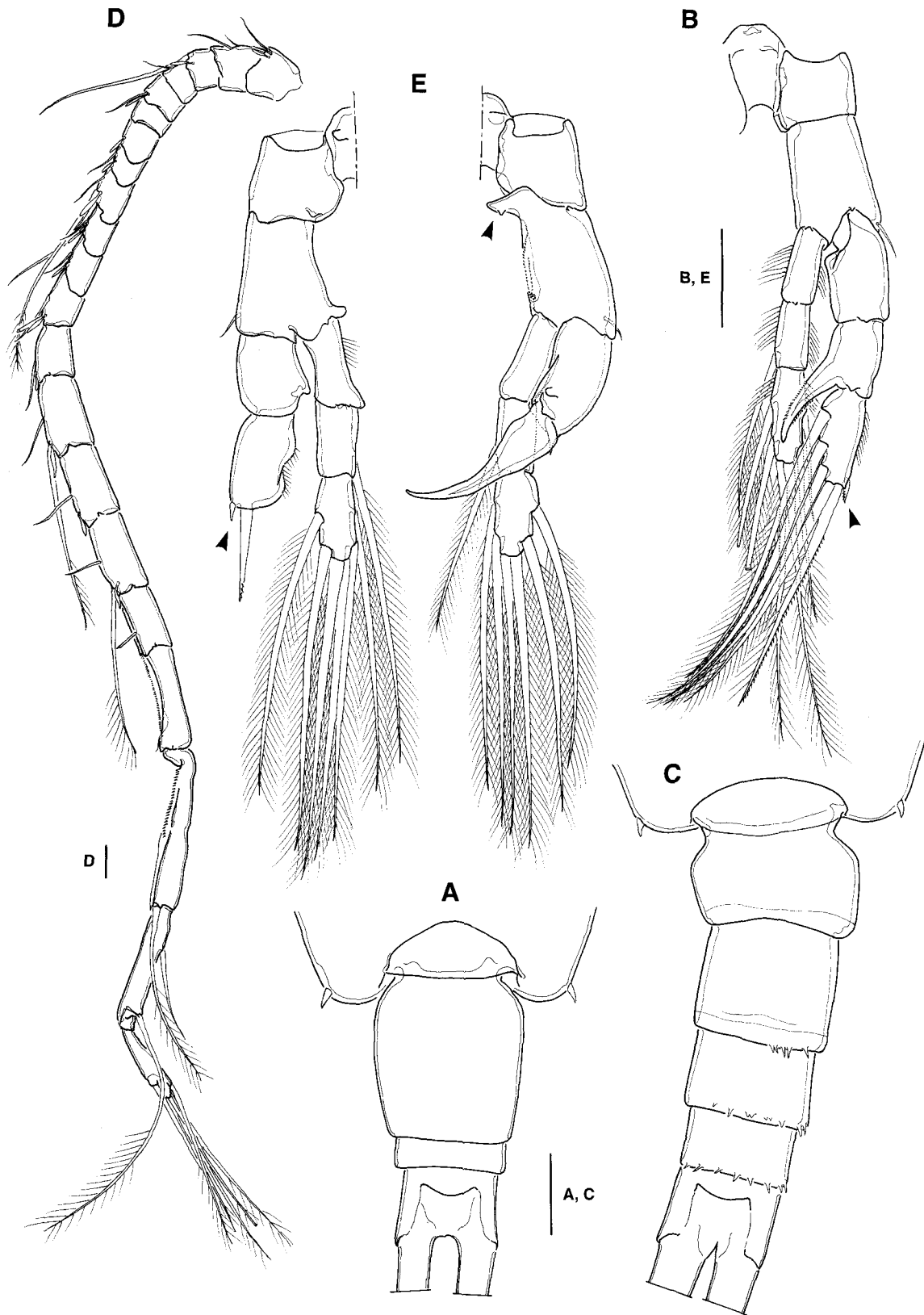


Fig. 3. *Sinocalanus tenellus* (Kikuchi). A-B, female: A, 5th pediger and urosome, dorsal; B, P5. C-E, male: C, 5th pediger and urosome, dorsal; D, A1; E, P5 (left, left leg; right, right leg). Scale bars=0.05 mm (A-E).

China, Philippines, Thailand.

Family Temoridae Sars, 1903

Genus *Eurytemora* Giesbrecht, 1881

¹**Eurytemora affinis* (Poppe, 1880) (Fig. 4)

Temora affinis Poppe, 1880, p. 55 (cited from Dussart, 1967).

Eurytemora affinis: Guerne and Richard, 1889, p. 136; Gurney, 1931, p. 202; Rylov, 1935, p. 193; Dussart, 1967, p. 73, fig. 16; Chihara and Murano, 1997, p. 917, pl. 181; Dussart and Defaye, 2002, p. 55.

Material examined. 10 ♀♀ (3 ovi.), 10 ♂♂, Cheongchoho Lake, Sokcho, 28 Dec. 2006 (C.Y. Chang and J.M. Lee); 4 ♀♀, 2 ♂♂, Hyangho Lake, Jumunjin, 28 Dec. 2006 (C.Y. Chang and J.M. Lee); 3 ♀♀, 2 ♂♂, Hajodae, Yangyang, 24 May 1981 (I.H. Kim); 183 ♀♀, 105 ♂♂, Goraebul (lower reaches of stream), Yeongdeok, 3 Apr. 2004 (C.Y. Chang and J.M. Lee); 1 ♀, 1 ♂, estuary of Ilgwangcheon Str., Busan, 21 Jun. 2006 (C.Y. Chang and J.M. Lee).

Diagnosis. Female: body 1.3-1.4 mm long; distolateral corner of prosome forming wing-like protrusion (Fig. 4A, arrow), its tip reaching middle of genital somite; genital somite nearly symmetrical, protruding laterally in middle of lateral margin, a little longer than wide; urosomites hirsute at dorsolateral surface; Fu 5-6 times as long as wide, covered with minute setules (Fig. 4A, arrow); A1 24-segmented, its tip slightly beyond posterior margin of third pediger; P1 endopod 1-segmented, with 6 plumose setae in total; P5 symmetrical, exp 1 bearing 1 stout protrusion distomedially, its margin smooth (Fig. 4C, arrow).

Male: body slender, 1.1-1.2 mm long; Fu 8 times longer than wide; P5 (Fig. 4E) uniramous, without endopod; inner margin of left basis not strongly swollen; tip of left exp 2 lacking barb-like projection (Fig. 4E, arrow); innerproximal margin of right basis smooth, without projection.

Remarks. In South Korea, this species occurs in the coastal lagoons and estuaries faced to eastern and southeastern coasts (Fig. 13). *Eurytemora affinis* is known as euryhaline, and sometimes found in freshwaters not far from sea shore.

Distribution. Korea, Japan, Kuril Is., Caspian Sea, Europe, Azores Is., Canada, U.S.A., Argentine.

²**Eurytemora pacifica* Sato, 1913 (Fig. 5)

Eurytemora pacifica Sato, 1913, p. 34, figs. 87-89; Chen and Zhang, 1965, p. 66, pl. 21, figs. 5-9; Kim, 1985, p. 83, pl. 25, figs. e-i; Yoo, 1995, p. 175, fig. 117; Chihara and Murano, 1997, p. 917, pl. 181; Dussart and Defaye, 2002, p. 58.

Previous records. Western and southern coasts of South Korea (Kim, 1985; Yoo, 1995).

Material examined. 3 ♀♀ (2 ovi.), 1 ♂, Taehwa R. (Myeongchon Br.), Ulsan, 31 Mar. 2007 (C.Y. Chang).

Diagnosis. Female: body 1.2-1.4 mm long; distolateral corner of prosome forming wing-like protrusion, its tip beyond posterior margin of genital somite (Fig. 5A, arrow); genital somite asymmetrical, protruding laterally near middle of lateral margin in left side, while at posterior half of lateral margin in right side; Fu 3-4 times as long as wide; P5 asymmetrical, exp 1 bearing 1 stout, serrated protrusion distomedially (Fig. 5B, arrow); distal segment with shorter outer spine and much longer spiniform seta apically.

Male: 0.9-1.1 mm long; Fu 5-6 times longer than wide; P5 (Fig. 5D, arrow) inner margin of left basis strongly swollen; tip of left exp 2 with barb-like projection (Fig. 5D, arrow); innerproximal margin of right basis smooth, without projection.

Remarks. This species inhabits basically neritic waters, but occasionally brackish waters. This species must be boreal in consideration of its geographical distribution. Kim (1985) reported that this species was abundant during winter season at innermost part of Karolim Bay, northern Taean Peninsula, western part of Korea. Chihara and Murano (1997) mentioned *E. pacifica* occurred at Hakata Bay, Setonaikai Sea (Seto Inland Sea) and the estuary of Tokyo bay in winter and spring.

Distribution. Korea (East Sea=Sea of Japan), Japan, Sakhalin, Okhotsk, Bering Straits, Alaska.

Family Pseudodiaptomidae Sars, 1903

Genus *Pseudodiaptomus* Herrick, 1884

³**Pseudodiaptomus inopinus* Burckhardt, 1913 (Figs. 6, 7)

Pseudodiaptomus inopinus Burckhardt, 1913, p. 379, pl. 11E, figs. 2-5, 7, 8, pl. 11F, figs. 1-4, 9, 10, pl. 11G, figs. 1-4, 6-8, pl. 11H, figs. 1-4, 7, 8, 10, 11; Wright, 1928, p. 588; Brehm, 1925, p. 269; Smirnov, 1929, p. 318, figs. 1-3; Kikuchi, 1936, p. 280; Mizuno and Miura, 1984, p. 481, fig. 260; Walter, 1986, p. 132; Walter, 1987, p. 367; Yoo, 1995, p. 187; Chihara and Murano, 1997, p. 893; Soh et al., 2001, p. 204, fig. 3C.

Schmackeria inopinus: Marsh, 1933, p. 44, pl. 22, fig. 1; Shen and Tai, 1962, p. 101; Shen and Li, 1963, p. 579; Shen and Song, 1979, p. 69, fig. 27; Chang and Kim, 1986, p. 52, pl. I, figs. 6-9.

Schmackeria inopina: Dussart and Defaye, 2002, p. 42.

Previous records. Han. R. (Haengjunaru) (Kim and Lee,

¹*닭은넙잡이빨노벌레 (신칭), ²*넙잡이빨노벌레, ³*술어리민물긴노벌레

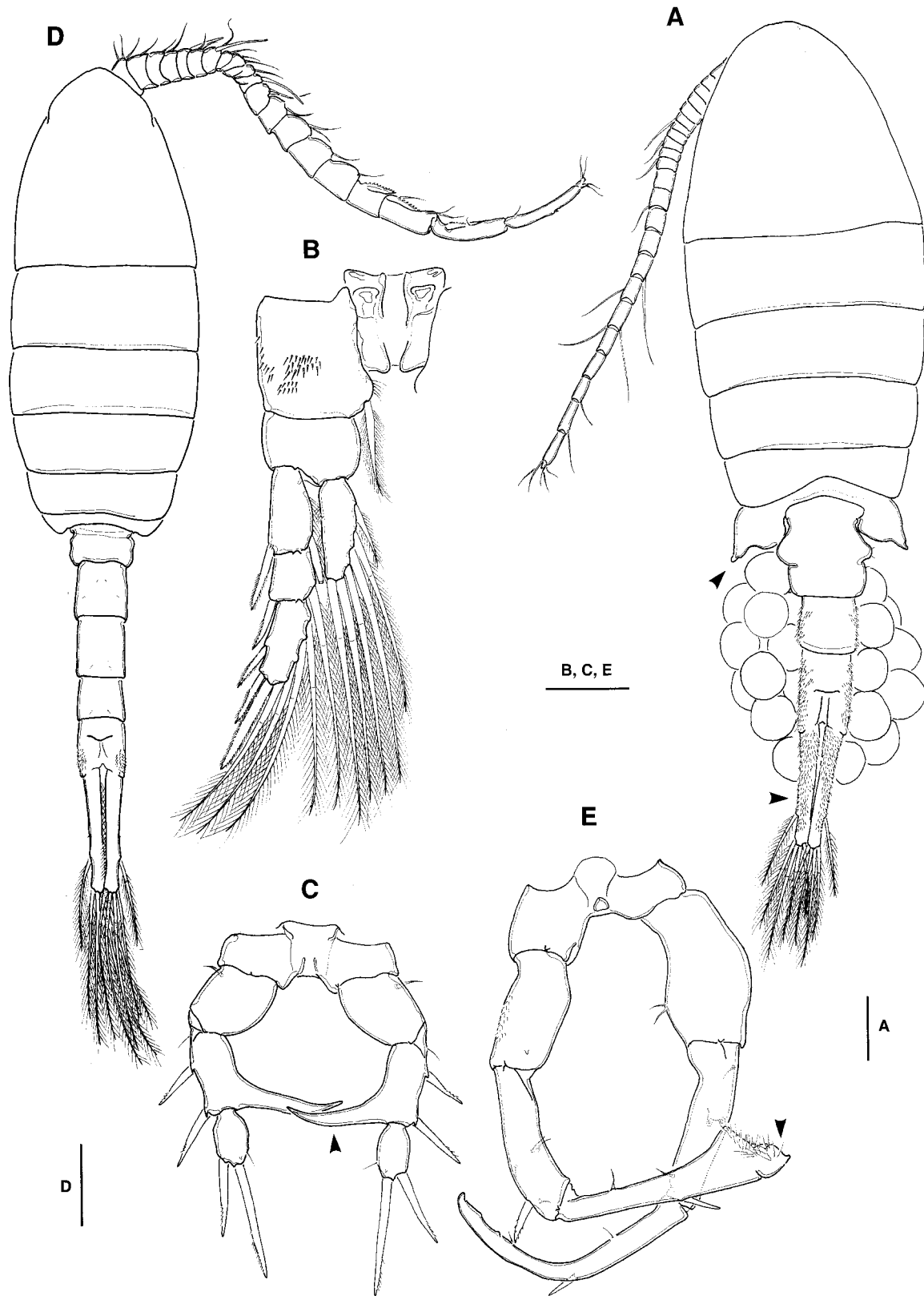


Fig. 4. *Eurytemora affinis* (Poppe). A-C, female: A, habitus, dorsal; B, P1; C, P5. D-E, male: D, habitus, dorsal; E, P5. Scale bars=0.1 mm (A, D), 0.05 mm (B, C, E).

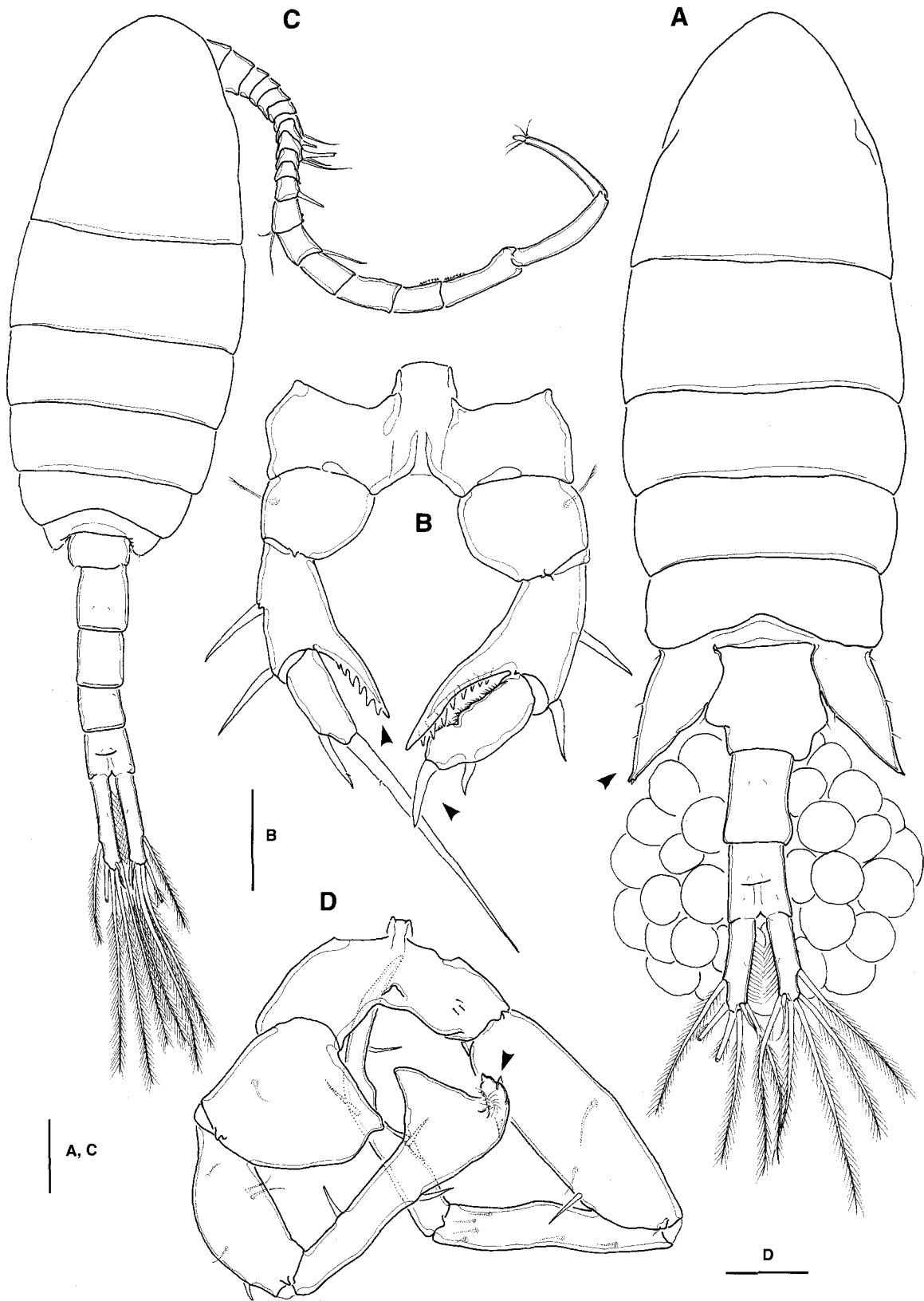


Fig. 5. *Eurytemora pacifica* (Sato). A-B, female: A, habitus, dorsal; B, P5. C-D, male: C, habitus, dorsal; D, P5. Scale bars=0.1 mm (A, C), 0.05 mm (B, D).

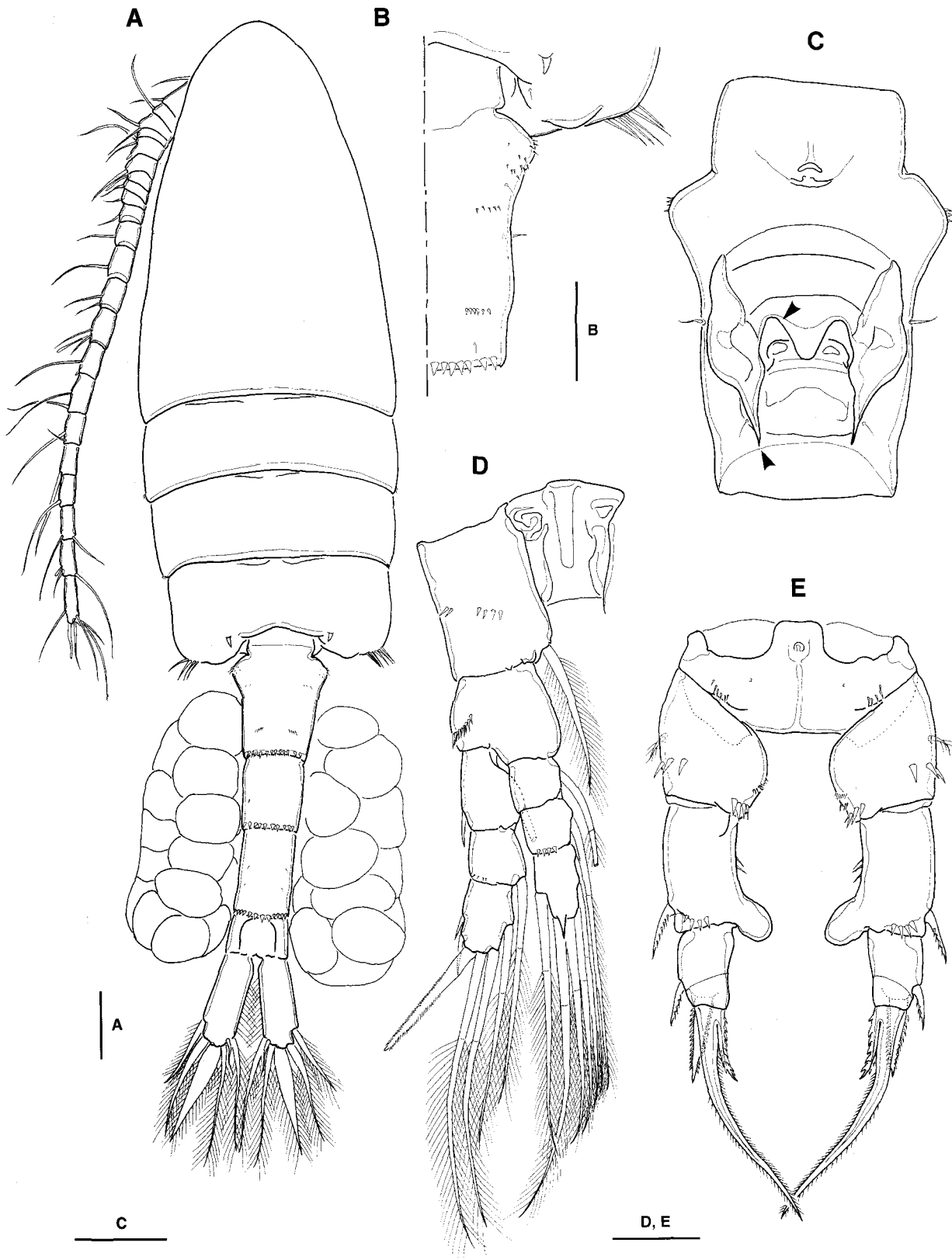


Fig. 6. *Pseudodiaptomus inopinus* Burckhardt, female. A, habitus, dorsal; B, 5th pediger and urosome; C, genital segment, ventral; D, P1; E, P5. Scale bars=0.1 mm (A), 0.05 mm (B-E).

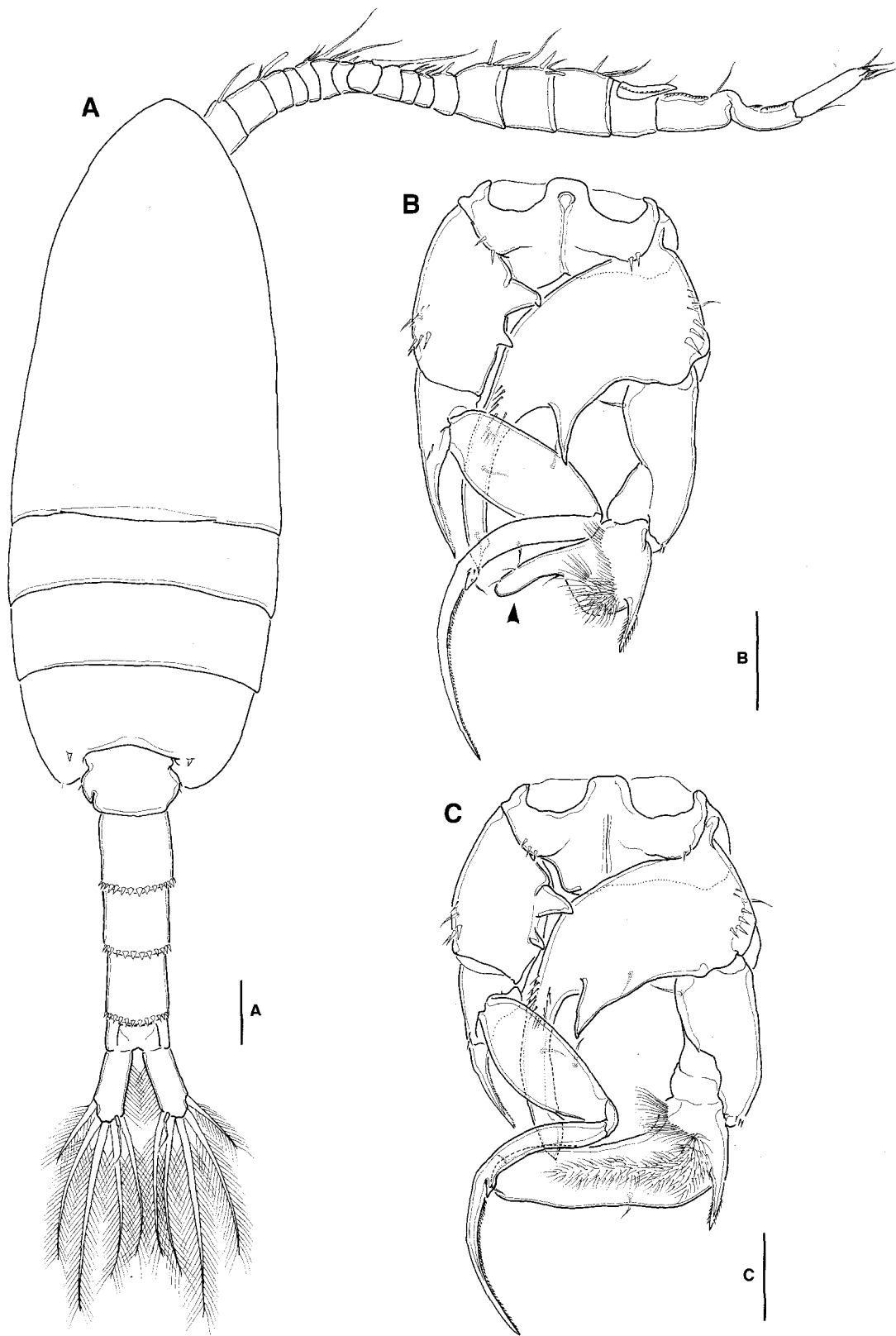


Fig. 7. *Pseudodiaptomus inopinus* Burckhardt, male. A, habitus, dorsal; B, P5 (finger form), anterior; C, P5 (shoe form), anterior. Scale bars=0.1 mm (A), 0.05 mm (B, C).

1978). Estuary of Geumgang R.; Seomjingang R. (Hadong) (Chang and Kim, 1986). Estuary of Geumgang R. (tidal embankment), Gunsan; estuary of Mangyeonggang R., Gimje; estuary of Yeongsanho Lake, Mokpo (Soh et al., 2001).

Material examined. 1 ♀ (ovi.), Han R. (Yanghwa Br.), Seoul, 7 Jul. 1987 (C.Y. Chang); 1 ♂, Han R. (Haengjunaru), 4 Jul. 1987 (C.Y. Chang); 2 ♀ ♀, 2 ♂ ♂, Yangchon-ri (bog), Gimpo, 11 Apr. 2004 (G.S. Min); 1 ♀, 1 ♂, Bulgeunori Str., Yeongheungdo Is., Incheon, 11 Nov. 2005 (H.W. Lim); 4 ♀ ♀ (2 ovi.), Hwajinpo, Goseong, 21 Jun. 1986 (S.M. Yoon); 1 ♀, estuary of Dongmyeongcheon Str., Yangyang, 1 Mar. 2005 (C.Y. Chang, J.M. Lee, J.M. Jeon and H.W. Lim); 3 ♀ ♀ (1 ovi.), 3 ♂ ♂, lower reaches of Geumgang R. (Hwang-sannaru, Ganggyeong), 2 Aug. 1986 (C.Y. Chang); 2 ♀ ♀, 2 ♂ ♂, estuary of a streamlet, Obo-ri, Yeongdeok, 4 Nov. 2006 (C.Y. Chang); 1 ♀, 1 ♂, estuary of Osipcheon Str., Ganggu, Yeongdeok, 3 Nov. 2006 (H.S. Lee); 5 ♀ ♀ (3 ovi.), 3 ♂ ♂, mouth of Gokgang Str., Chilpo, Pohang, 3 Feb. 2007 (C.Y. Chang, J.M. Lee and S.W. Lee); 1 ♀, 1 ♂, estuary of Hyeongsan R., Pohang, 24 Oct. 2005 (C.Y. Chang); 2 ♀ ♀, Gameunsaji (well), Gyeongju, 26 May 2007 (B.S. Kim); 1 ♀, 1 ♂, Taehwagang R. (Beonyeong Br., Myeongchon Br.), Ulsan, 31 Mar. 2007 (C.Y. Chang); 2 (ovi.) ♀ ♀, 3 ♂ ♂, Nakdong R., Mulgeum, Busan, 28 Apr. 1987; 2 ♀ ♀, 1 ♂, Jungrim R. (West-Nakdong R.), Busan, 7 Aug. 1986 (C.Y. Chang); 5 ♀ ♀, 3 ♂ ♂, estuary of West-Nakdong R. (Gangdong Br.), Gimhae, 17 Dec. 2003 (C.Y. Chang); 4 ♀ ♀ (1 ovi.), 1 ♂, estuary of Gwangogcheon Str., Hadong, 26 Apr. 2007 (C.Y. Chang, J.M. Lee and H.J. Yoon); 1 ♀, 1 ♂, Gyehwado Is. (swamp), Buan, 19 Aug. 1986 (I.H. Kim); 2 ♀ ♀ (1 juv.), Dunjeon (tidal embankment), Jindo Is., 19 Oct. 2004 (H.W. Lim and J.M. Jeon); 1 ♀ (ovi.), 2 ♂ ♂, Seongsanpo (reed marsh), 21 Feb. 1987 (C.Y. Chang).

Diagnosis. Body length 1.6-1.9 mm in female, 1.6-1.8 mm in male. Cephalosome and first pediger fused into cephalothorax; fourth and fifth pedigers completely fused. Distolateral corner of prosome not forming wing-like protrusion, with setule row; dorsoposterior margin with 1 pair of triangular processes.

Female: genital double-somite nearly symmetrical; both anterolateral sides swollen, with patches of minute spinules; paired gonopore located ventromedially; genital operculum forming elongated and sharp processes (Fig. 6C, posterior arrow), reaching near posterior margin of genital somite; curvature ahead gonopores deeply concaved (Fig. 6C, anterior arrow); Fu nearly 3 times as long as wide; medial terminal caudal seta usually swollen; A1 22-segmented, a little beyond posterior margin of prosome; P1 endopod 3-seg-

mented; P5 uniramous, symmetrical; exp 2 bearing 1 stout, spiniform process apically, with 1 outer spine; exp 3 apically bearing 1 long, curved spine flanked with 1 serrated spiniform process medially.

Male: P5, right basis with 2 unequal spinous processes on proximal part of inner margin; exp 1 with outer spine; exp 3 with 1 long, serrated, sickle-shaped spine; basis and endopod of left leg completely fused, forming stout inner process (Fig. 7B), with 1 strong projection in the middle of posterior margin; left exp 2 elongated to 1 finger-shaped process distally (Fig. 7B, arrow) with 1 spine and 1 short seta along posterior margin (morphologically dimorphic males with shoe-like process on P5 exp 2 also found, as shown in Fig. 7C)

Remarks. *Pseudodiaptomus inopinus* is the most frequently occurring and widely distributed species among brackish-water copepods from South Korea (Fig. 13). This species is known as euryhaline, and sometimes found in freshwaters near seashore. It often co-occurs with *Sinocalanus tenellus* in South Korea. About 90% of individuals found in Korean brackish waters show the swollen base of terminal caudal seta.

Distribution. Korea, China, Japan, Russia, U.S.A. (estuary of Columbia R., Pacific coast).

¹*Pseudodiaptomus poplesia* (Shen, 1955) (Fig. 8)

Schmackeria poplesia Shen, 1955, p. 78, pl. 2, figs. 7-9; Chen and Zhang, 1965, p. 81, pl. 31, figs. 1-6; Shen and Song, 1979, p. 69, figs. 29-30; Dussart and Defaye, 2002, p. 42.

Pseudodiaptomus poplesia: Walter, 1986, p. 132; Walter, 1987, p. 367; Soh et al., 2001, p. 204, figs. 2, 3A, B, 4-6.

Previous records. Geumgang R. (tidal embankment), Gunsan; Mangyeonggang R. (estuary), Gimje; Yeongsanho Lake, Mokpo (Soh et al., 2001).

Material examined. 2 ♀ ♀, 1 ♂, Nampo tidal embankment (reed marsh), 3 May 2007 (H.J. Yoon and C.Y. Chang).

Diagnosis. Body length 1.6-1.9 mm in female, 1.4-1.8 mm in male. Cephalothorax rather pointed anteriorly in dorsal view; fourth and fifth pedigers completely fused. Distolateral corner of prosome not forming wing-like protrusion, with setule row; dorsoposterior margin with 1 pair of triangular processes.

Female: genital double-somite with paired gonopore ventromedially; posterior part of genital operculum not elongated as in *P. inopinus*, posterior processes reaching around middle of genital somite; curvature ahead gonopores rounded (Fig. 8B, arrow), not deeply concaved; Fu, A1, P1-P4

¹*무릎어리민물진노벌레

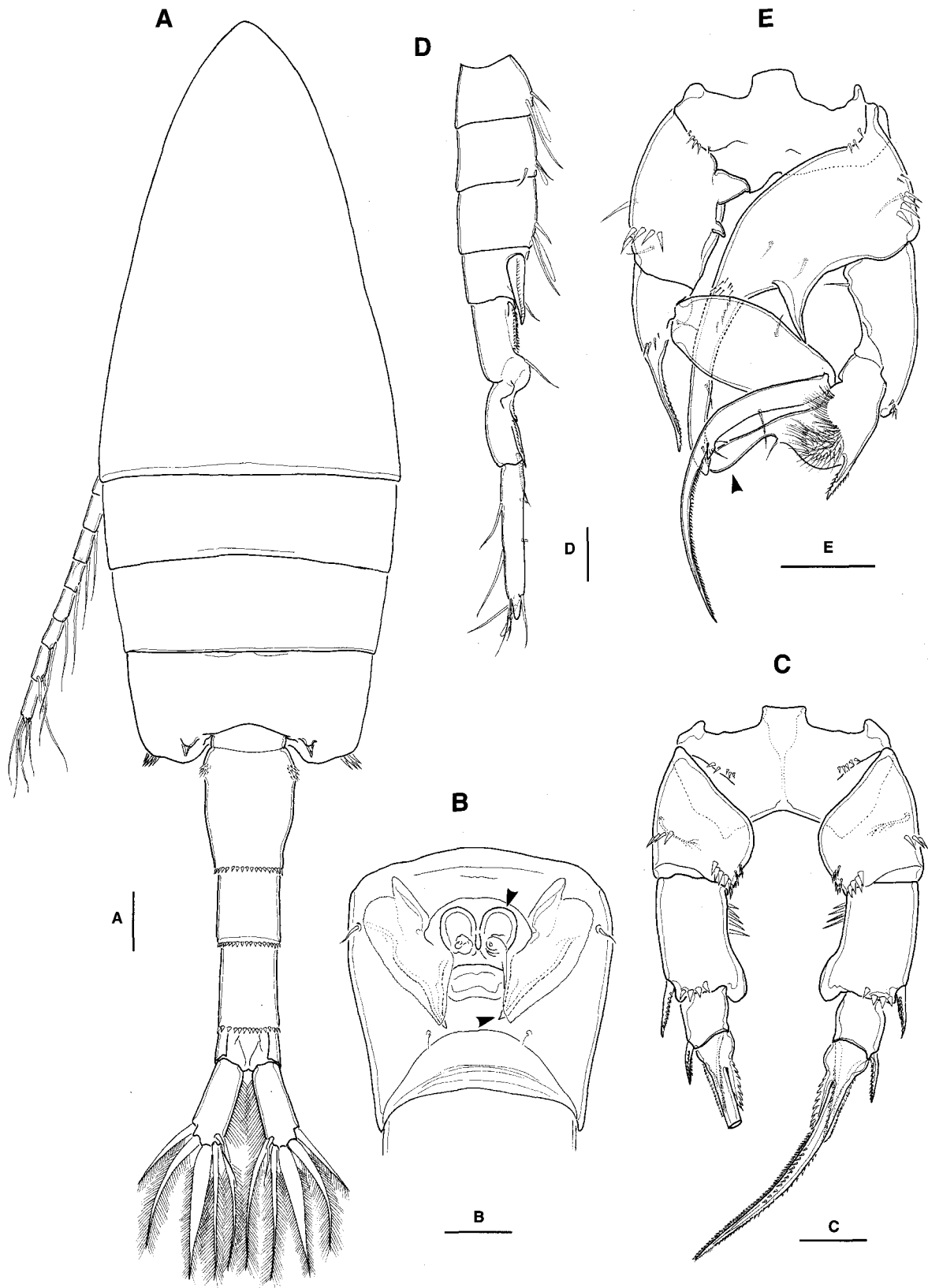


Fig. 8. *Pseudodiaptomus poplesia* (Shen). A-C, female: A, habitus, dorsal; B, genital somite, ventral; C, P5. D-E, male: D, A1; E, P5, anterior. Scale bars=0.1 mm (A), 0.05 mm (B-E).

similar to those of *P. inopinus*; P5 uniramous, symmetrical; exp 1 produced distomedially; exp 2 bearing 1 stout, spiniform process apically, with 1 outer spine; exp 3 apically bearing 1 long, curved spine flanked with 1 serrated spiniform process medially.

Male: right A1 prehensile, geniculate between penultimate and antepenultimate segments; last 3 segments each with spiniform, pectinate process; basis and endopod of left P5 completely fused, forming stout inner process (Fig. 8E), with 1 strong projection in the middle of posterior margin; left exp 2 elongated to 1 process, its distal part swollen (Fig. 8E, arrow), proximal part constricted, with 1 spine and 1 short seta along posterior margin (morphologically dimorphic males with shoe-like process on P5 exp 2 also found, as in *P. inopinus*).

Remarks. This species is restricted to the Yellow Sea coasts of Korea and China. Soh et al. (2001) discussed the distribution of four *Pseudodiaptomus* species (*P. inopinus*, *P. marinus*, *P. poplesia*, and *P. nihonkaiensis*) in the Korean sea coasts, and compared the morphology of their genital area. This species shows the morphological dimorphism in the shape of male leg 5, the finger-type and shoe-type, as in *P. inopinus*. According to them, the finger-type individuals comprise more than 95% of the Korean population from the brackish waters in the Yellow Sea. This species sometimes co-occurs with *P. inopinus* in the brackish waters of South Korea (Fig. 13), however, the ratio of *P. poplesia* was relatively very rare in the authors' collection.

Distribution. Korea (western coast), China, Taiwan.

Family Acartiidae Sars, 1903

Genus *Acartia* Dana, 1846

¹**Acartia (Acanthacartia) tsuensis* Ito, 1956 (Figs. 9, 10)

Acartia tsuensis Ito, 1956, p. 470, fig. 2; Dussart and Defaye, 2002, p. 58.

Acartia (Acanthacartia) tsuensis: Chihara and Murano, 1997, p. 677.

Material examined. 1 ♀, Jukjeon tidal embankment (salt marsh), Jindong, Masan, 3 Jun. 2007 (H.J. Choi); 3 ♀ ♀, 1 ♂, Dangyun tidal embankment, Changseondo Is., Namhae, 20 Sep. 2004 (H.W. Lim and J.M. Jeon); 8 ♀ ♀, 3 ♂ ♂, Seongcheon port, Jungmun, Jeju Is., 13 Jan. 2007 (C.Y. Chang and J.M. Lee).

Diagnosis. Body length 0.9-1.1 mm in female, about 0.8-0.95 mm in male.

Female: body slender; distolateral corner of prosome rounded, not forming wing-like protrusion, with 4-5 minute spinules (Fig. 9B, arrow); urosome nearly symmetrical; gen-

ital somite a little longer than wide, with row of about 10 spinules along posterior margin, lacking lateral spines or projection on both sides; second urosomite with 6 spinules along posterior margin; Fu a little longer than wide; lateral caudal seta locating at middle of lateral margin of Fu; A1 exceeding posterior end of prosome; P1 endopod 2-segmented (Fig. 9C); P5 uniramous, symmetrical, exp 2 with 2 projections at distolateral margin (Fig. 9D, arrow).

Male: last prosomite similar to that of female; first urosomite with 1 row of setules on posterolateral corner; second urosomite swollen laterally, with 1 row of spinules along posterior margin; third and fourth urosomites with 4 and 6 spinules on posterior margin, respectively (Fig. 10B, arrow); P5, right exp 2 protruded medially; exp 3 elongate with 1 small spine near middle of inner margin, 1 claw-like spine at tip; left basis with 1 protrusion on posterior surface and 1 plumose seta on outer margin; exp 2 hooked distally, with 1 sharp spine at tip, and 1 stout pectinate spine near middle of inner margin.

Remarks. Since described from a fish pond in Tsu City, Mie Prefecture, Japan by Ito (1956), this species has been known as endemic to Japan, and distributed from southern Honshu (Kinki region) to Ryukyu Is. This species is regarded as a genuine brackish-water *Acartia* species (Chihara and Murano, 1997). In Korea, specimens were collected from a river mouth in Jeju Is. and from the salt marshes around reclaimed tidal flats at the southern coast (Fig. 13), where co-occurred with *Sinodiaptomus tenellus*, *Pseudodiaptomus inopinus* (Calanoida), *Tachidius triangularis*, *Shizopera clandestina* (Harpacticoida), *Paracyclopina nana*, and *Oithona davisae* (Cyclopoida). Korean specimens coincide well with the original description of Ito (1956).

Distribution. Korea, Japan (from southern Honshu to Ryukyu Is).

²**Acartia (Odontacartia) pacifica* Steuer, 1915 (Figs. 11, 12)

Acartia pacifica Steuer, 1915, p. 205; Farran, 1936, p. 120, fig. 22; Brodsky, 1950, p. 422, fig. 298; Tanaka, 1965, p. 395, fig. 247; Chen and Zhang, 1965, p. 112, pl. 49, figs. 9-12; Kim, 1985, p. 135, pl. 45, figs. e-f, pl. 46, fig. a; Yoo, 1995, p. 215.

Acartia (Odontacartia) pacifica: Chihara and Murano, 1997, p. 679; Dussart and Defaye, 2002, p. 50.

Previous records. Yellow Sea (Kim, 1985).

Material examined. 2 ♀ ♀, 1 ♂, estuary of Hoiyacheon Str. (Seosaenggyo Br.), Ulsan, 24 Sep. 2006 (S.B. Lim and S.Y. Cho); 3 ♀ ♀, Dadaepo (reed marsh), Busan, 28 Sep. 2005

¹*잔가지작은노벌레 (신칭), ²*태평작은노벌레

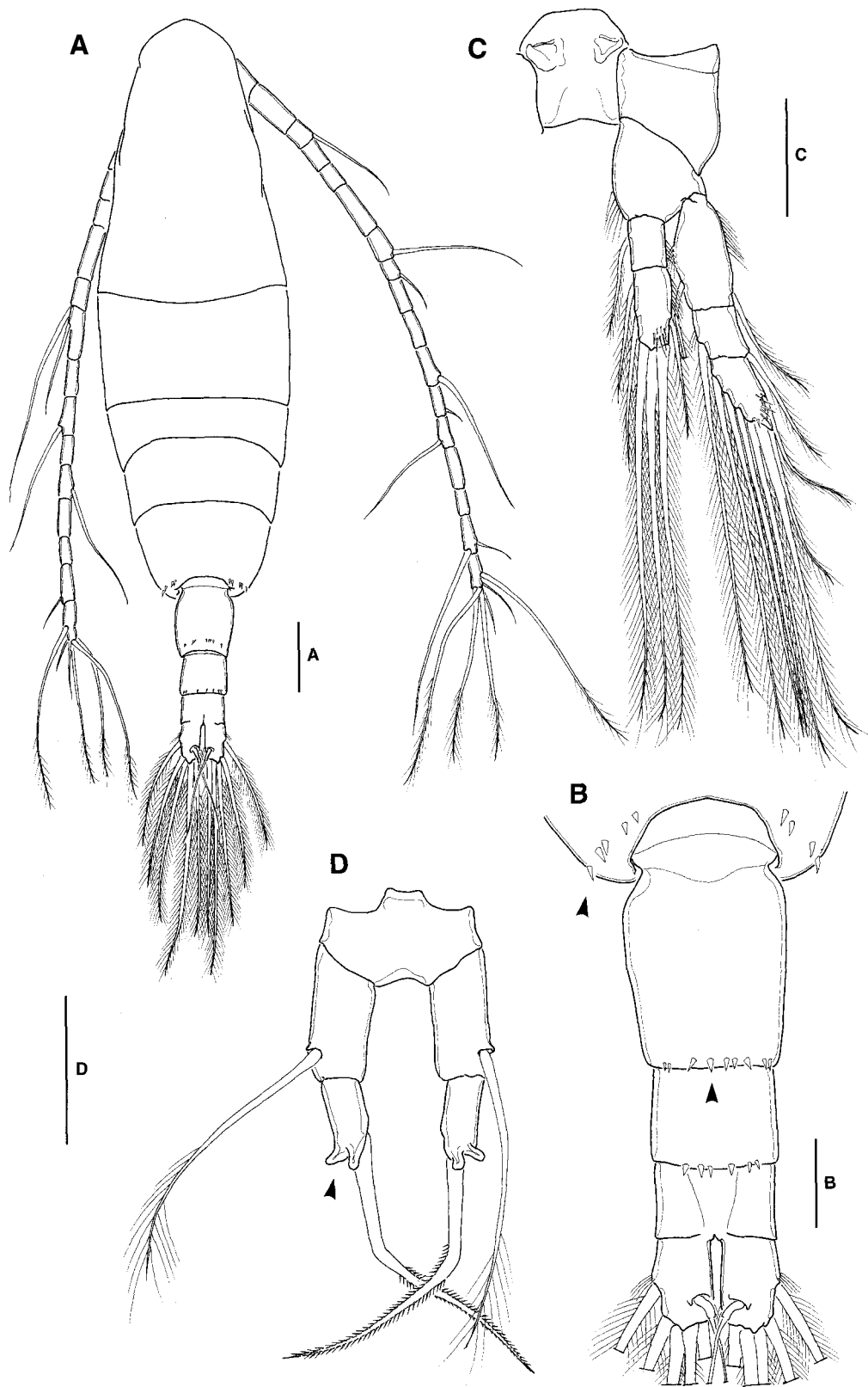


Fig. 9. *Acartia (Acanthacartia) tsuensis* Ito, female. A, habitus, dorsal; B, 5th pediger and urosome; C, P1; D, P5. Scale bars=0.1 mm (A), 0.05 mm (B-D).

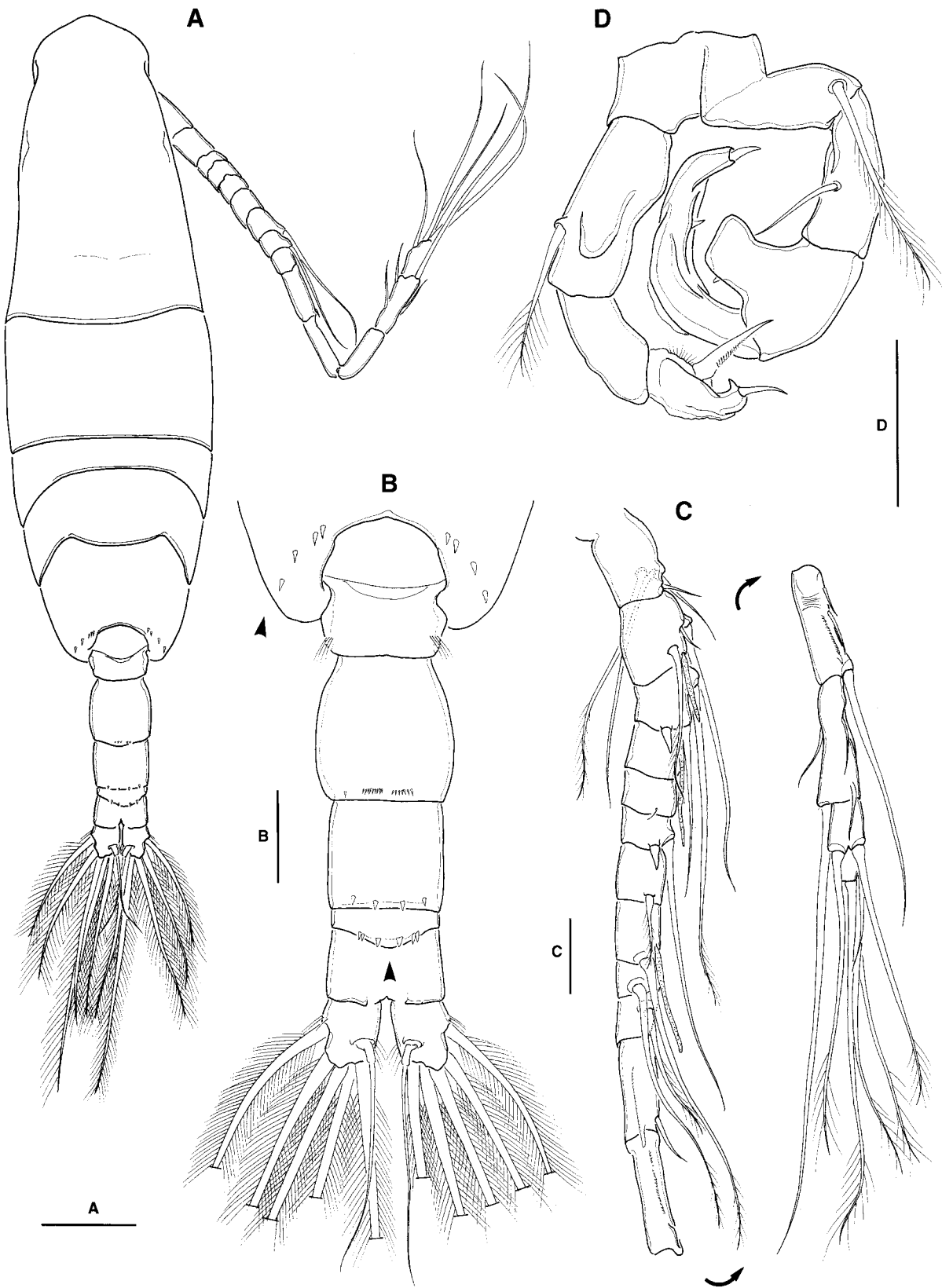


Fig. 10. *Acartia (Acanthacartia) tsuensis* Ito, male. A, habitus, dorsal; B, 5th pediger and urosome; C, A1; D, P5. Scale bars=0.1 mm (A), 0.05 mm (B-D).

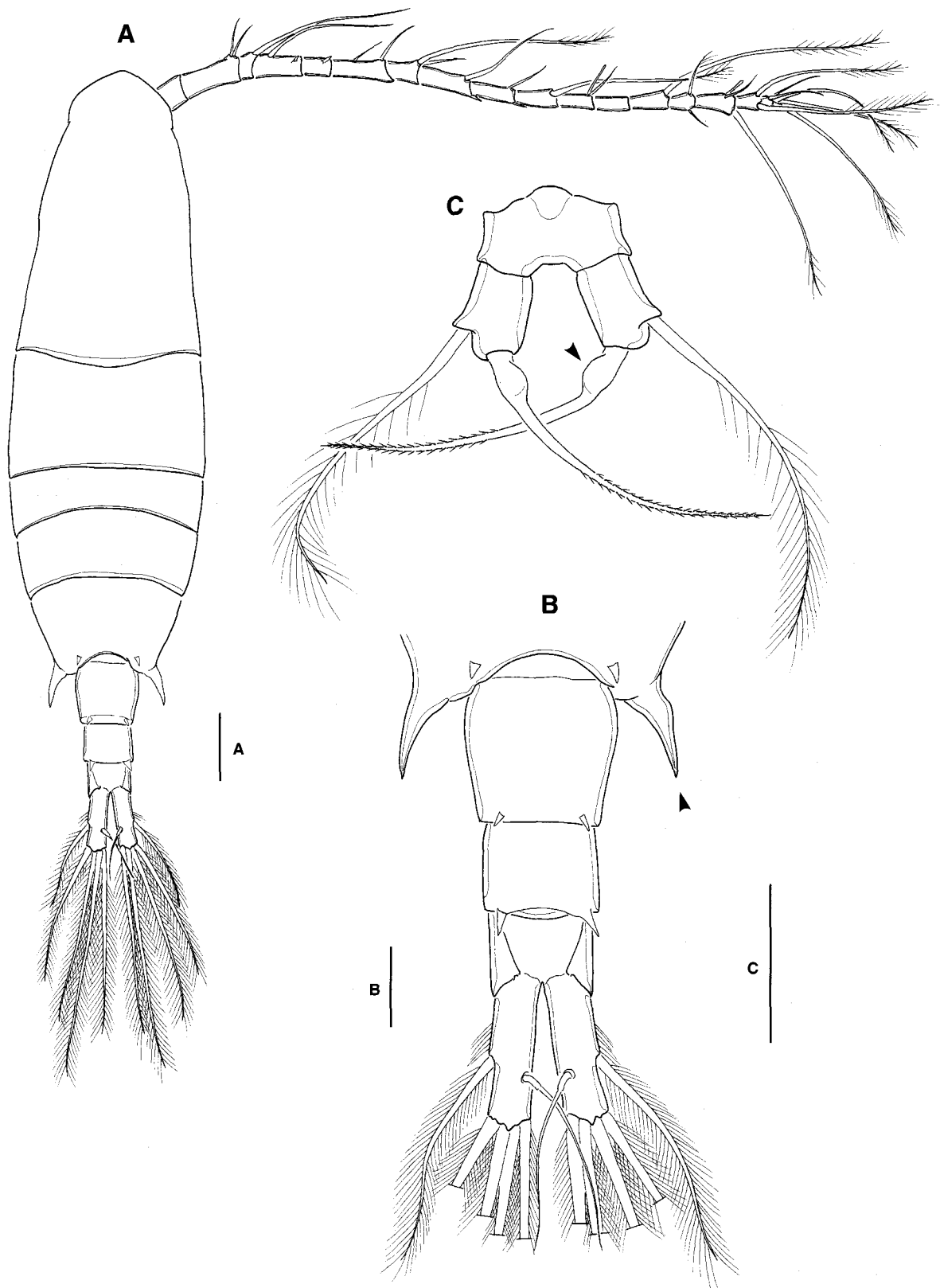


Fig. 11. *Acartia (Odontacartia) pacifica* Steuer, female. A, habitus, dorsal; B, 5th pediger and urosome; C, P5. Scale bars=0.1 mm (A), 0.05 mm (B, C).

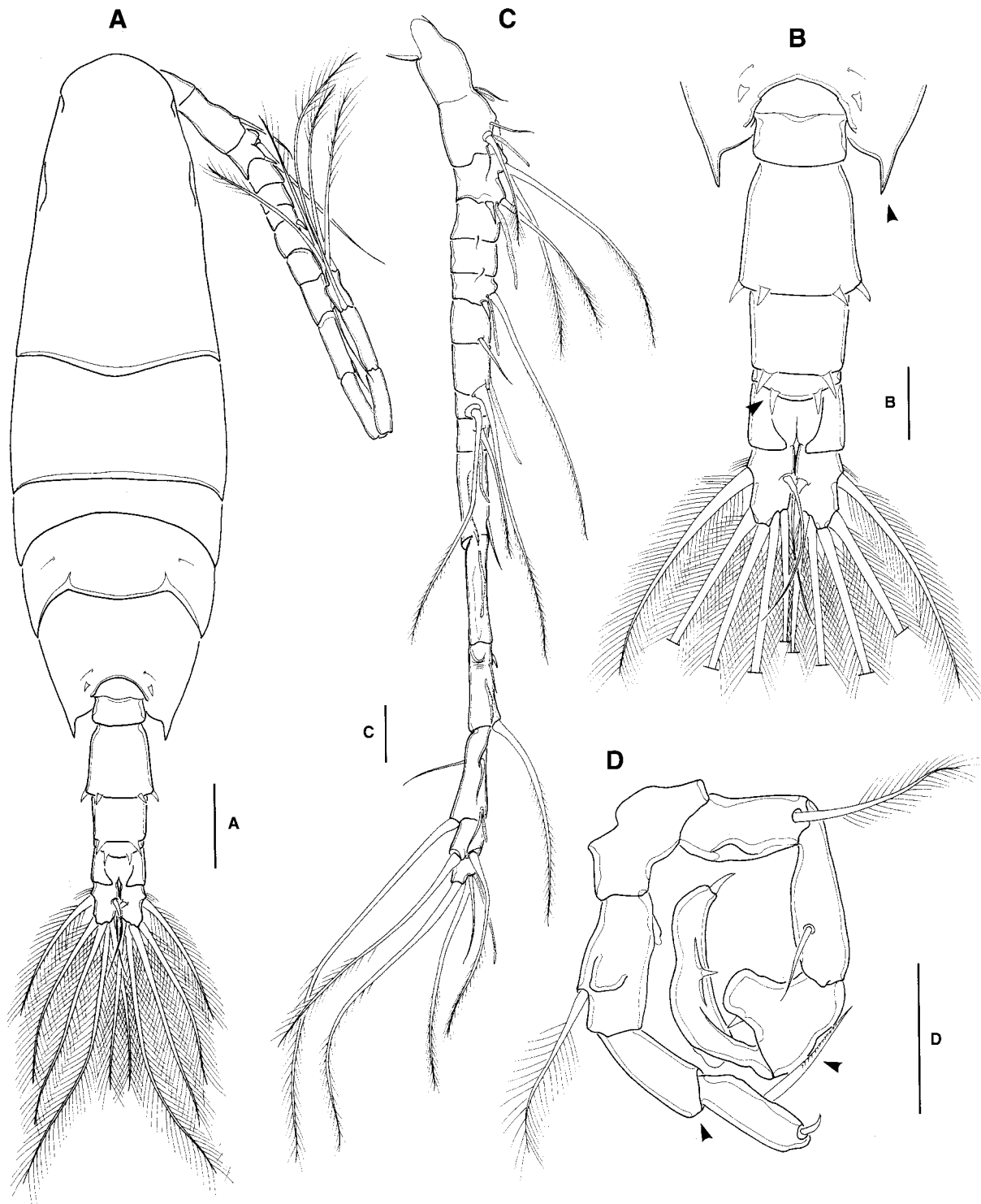


Fig. 12. *Acartia (Odontacartia) pacifica* Steuer, male. A, habitus, dorsal; B, 5th pediger and urosome; C, A1; D, P5. Scale bars=0.1 mm (A), 0.05 mm (B-D).

(C.Y. Chang, J.M. Lee and H.W. Lim); 1 ♀, 2 ♂♂, Ungcheon (estuarine marsh), Jinhae, 24 Jun. 2007 (C.Y.

Chang); 7 ♀♀ (2 ovi.), 2 ♂♂, estuary of Gasancheon Str., Chukdong, Sacheon, 26 Apr. 2007 (C.Y. Chang, J.M. Lee

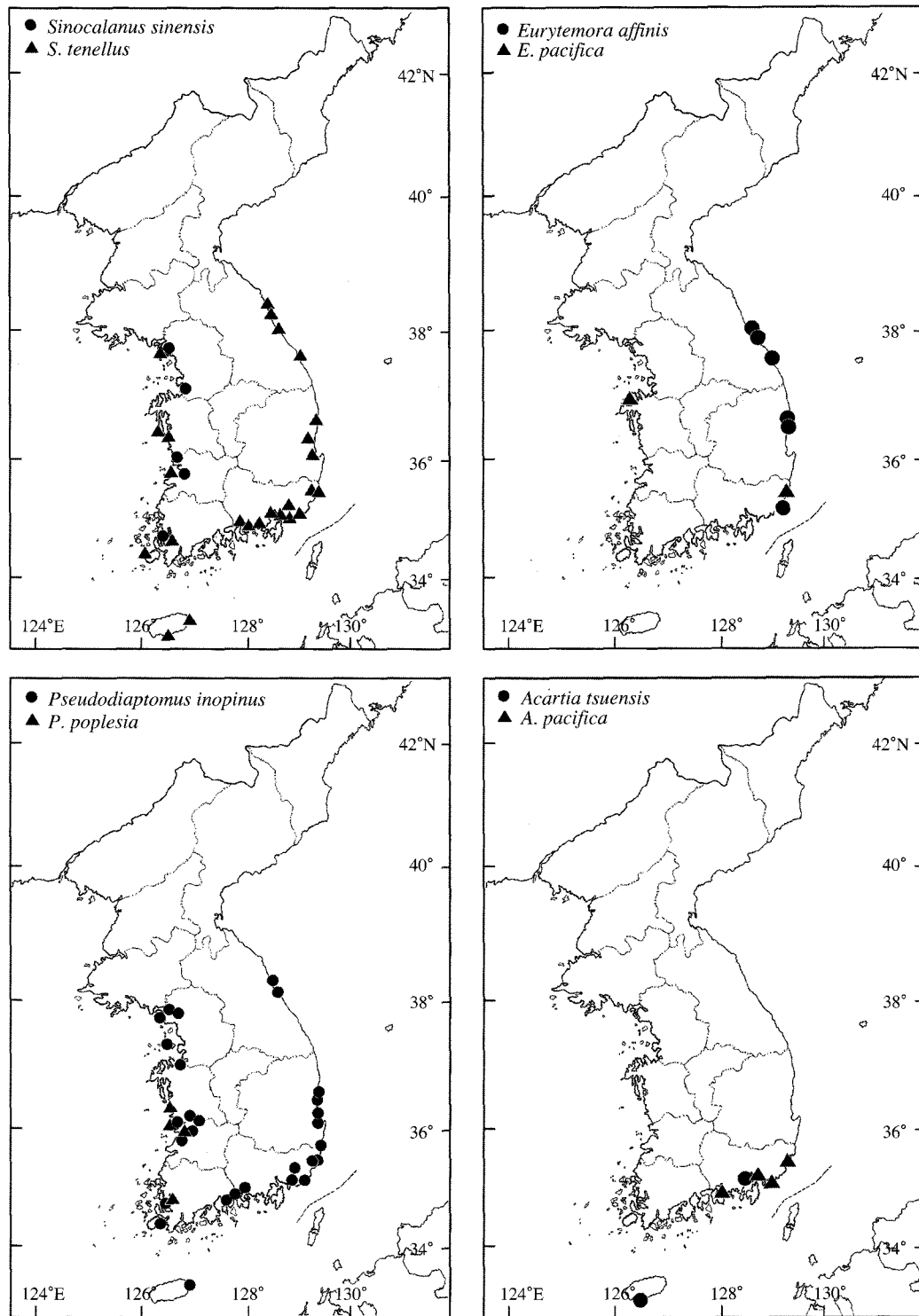


Fig. 13. Distribution of brackish-water calanoids in South Korea.

and H.J. Yoon).

Diagnosis. Body length 1.0-1.3 mm in female, about 1.0-1.2 mm in male.

Female: body slender; distolateral corner of prosome protruded, forming wing-like protrusion, flanking 1 triangular process medially (Fig. 11B, arrow); urosome nearly sym-

metrical; genital somite a little longer than wide, with 1 pair of small projections at posterior margin; second urosomite with 1 pair of rather big projections at posterior margin; A1 17-segmented, far beyond posterior end of genital segment, lacking sharp spinous process on first segment; P5 uniramous, symmetrical, distal segment bulbous proximally (Fig. 11C, arrow).

Male: last prosomite similar to that of female (Fig. 12B, arrow); first urosomite small, symmetrical, without setules or spinules; second urosomite widened posteriorly, with 2 pairs of spiniform processes at posterolateral corner; third and fourth urosomites each with paired spiniform processes dorsally at posterior margin, respectively (Fig. 12B, arrow); P5, right exp 2 protruded medially; exp 3 elongate with 1 small spine near middle of inner margin, 1 claw-like spine at tip; left exp 1 lacking seta on outerodistal corner (Fig. 12D, arrow); exp 2 with 1 sharp spine distally, and 1 long pectinate spine near middle of inner margin.

Remarks. This species is known as a coastal planktonic species, generally abundant in the neritic waters and embayments, favoring warm waters (Chihara and Murano, 1997). In Korea, this species occurs from the estuarine or coastal marshes in eastern part of southern coast (Fig. 13).

Distribution. Korea, Japan, China.

A Key to the Families, Genera and Species of the Brackish-water Calanoids in Korea

1. Female P5 as swimming leg, with 1 big protrusion on inner margin of exp 2; male P5 usually swimming leg 2 (Centropagidae)
 - Both female and male P5 not as swimming legs 3
2. Fu 3.5-5 times as long as wide; male P5 with spiniform protrusion on inner margin of right basis *Sinocalanus sinensis*
 - Fu 8 times as long as wide; male P5 with blunt protrusion on inner margin of right basis *S. tenellus*
3. Both female and male P5 without endopod 4
 - Both female and male P5 with 1- or 2-segmented endopod Diaptomidae
4. P1 endopod 1-segmented 5 (Temoridae)
 - P1 endopod 3-segmented 6 (Pseudodiaptomidae)
 - P1 endopod 2-segmented 7 (Acartiidae)
5. Female genital somite nearly symmetrical; female P5 exp 1 with smooth protrusion; distal segment of male left P5 without protrusion *Eurytemora affinis*
 - Female genital somite not symmetrical; female P5 exp 1 with serrated protrusion; distal segment of male left P5 with spiniform protrusion *E. pacifica*
6. Male left P5 exp 2 with finger-shaped protrusion; female genital operculum well-developed with long, pointed projection posteriorly, nearly reaching posterior margin of genital somite *Pseudodiaptomus inopinus*
 - Male left P5 exp 2 with distally-swollen protrusion, its proximal portion strongly constricted; female genital operculum not developed with short projection, apart from posterior margin of genital somite *P. poplesia*
7. Posterolateral edge of prosome not protruding; posterior margins of prosomites and abdominal somites each with several spinules *Acartia tsuensis*
 - Posterolateral edge of prosome pointed; posterior margins of prosomites and abdominal somites each with paired tooth-shaped projections *A. pacifica*

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