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# Amphipod crustaceans (Gammaridea) from Beijing, P. R. China

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## Abstract

Seven freshwater and terrestrial amphipod species from Beijing, including one new species, *Jesogammarus (Annanogammarus) debilis*, are reported. A detailed description and illustrations of this new species are given and differences between these seven species are discussed. A key to the amphipods of Beijing and their distribution data are also presented.

**Keywords:** *Beijing, China, freshwater, Gammaridea, new species, terrestrial*

## Introduction

Beijing (39.9°N, 116.4°E), in the northern part of the North China Plain (33.0–40.5°N, 113.0–119.5°E), is surrounded by mountains to the west, north and north-east. Major rivers flowing through Beijing include Jumahe River, Yongdinghe River, Beiyunhe River, Chaobaihe River, and Jiyunhe River. These rivers flow through the rugged surrounding mountains towards the south-eastern plain of Beijing and discharge in the Bohai Sea.

The amphipods of Beijing were first studied by Chen (1939). Five species, including *Gammarus annandalei* Tattersall, 1922, *G. pulex* (Linnaeus, 1758), *Orchestia japonica* Tattersall, 1922, *Dikerogammarus spinipalmus* Chen, 1939, and *Hyale changi* Chen, 1939, were reported. After careful study of his paper, we have come to the conclusion that *Gammarus annandalei*, *G. pulex*, and *Orchestia japonica* described by Chen (1939) were misidentified. At the same time, the restudy of the two species, *Dikerogammarus spinipalmus* and *Hyale changi*, have been hindered in several ways. First, the type material of both species has disappeared. Second, the type locality for both species, “Jade Fountain Hill”, a spring today called Yuquanshan, has been dry for 30 years. Great efforts were made in the last 5 years to establish topotypes, but in vain. Third, the description and illustrations by Chen (1939) are insufficient to allow recognition of either species. Therefore, we treat *Dikerogammarus spinipalmus* Chen, 1939 and *Hyale changi* Chen, 1939 as *nomina dubia* in the current paper.

Post-1939, the amphipods of Beijing were studied by several authors (Anonymous 1964; Karaman 1989; Hou et al. 2002; Hou and Li 2003a, 2003b). The current paper presents a

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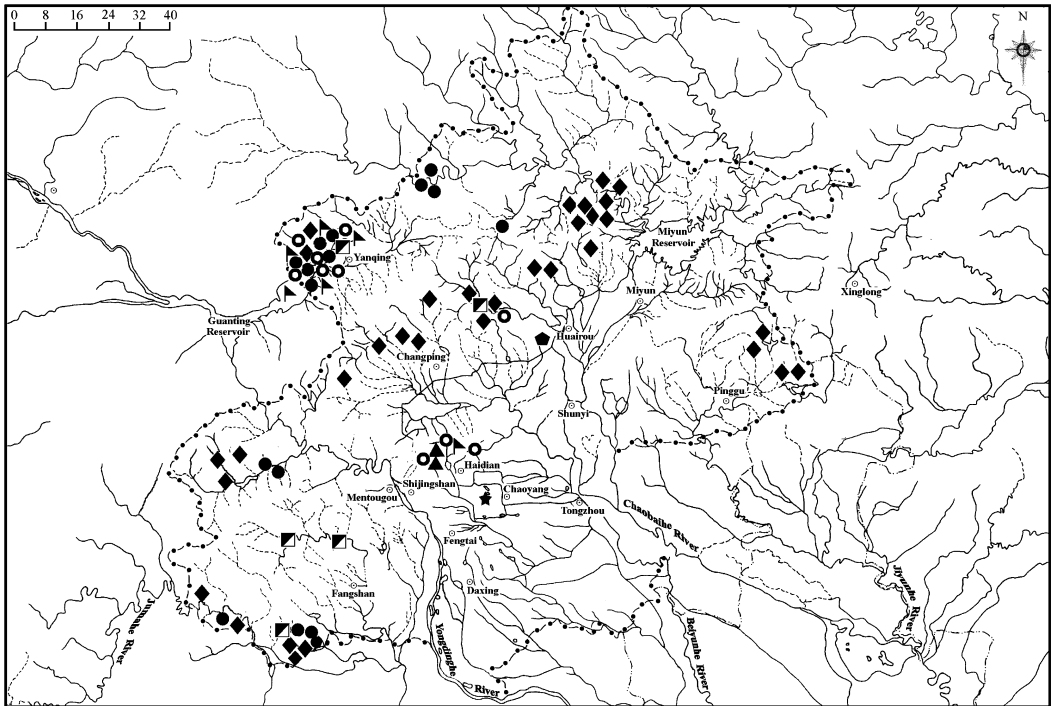
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review of all the currently known amphipods of Beijing based on 95 samples deposited in the Institute of Zoology, Chinese Academy of Sciences (IZCAS). A total of seven species belonging to four families (Gammaridae Leach, 1814, Pseudocrangonyctidae Holsinger, 1989, Talitridae Rafinesque, 1815, and Anisogammaridae Bousfield, 1977) was found in this area. They are *Gammarus electrus* Hou and Li, 2003a, *G. lacustris* Sars, 1863, *G. nekkensis* Uchida, 1935, *Procrangonyx limpidus* Hou and Li, 2003b, *Platorchestia japonica* Tattersall, 1922, *Jesogammarus (J.) hebeiensis* Hou and Li, 2004, and *Jesogammarus (Annanogammarus) debilis* sp. nov. A detailed description and illustrations of the new species and a diagnosis of six other species are given in the present paper. A key to these seven amphipods and their distribution data (Map 1) are also presented.

## Material and methods

Specimens were collected with a fine-mesh hand-net and then preserved in 75% ethanol. Prior to dissection, the body length was recorded by holding the specimen straight and measuring the distance along the dorsal side of the body from the base of the first antennae to the base of the telson. All dissected appendages were mounted on slides according to the methods described by Holsinger (1967). Appendages were drawn using an Olympus BX51 compound microscope equipped with a drawing tube.

Specimens used were restricted to the Beijing Municipality (Xu 2000).



Map 1. Distribution of freshwater amphipods from Beijing. Pentangle, Centre of Beijing (Tian'anmen Square); triangle, *Gammarus electrus*; circle, *G. lacustris*; diamond, *G. nekkensis*; pentagon, *Procrangonyx limpidus*; concentric circle, *Platorchestia japonica*; flag, *Jesogammarus (J.) hebeiensis*; half-filled square, *J. (A.) debilis* sp. nov.

**Systematic section****Family GAMMARIDAE** Leach, 1814***Gammarus electrus*** Hou and Li, 2003*Gammarus electrus* Hou and Li 2003a, p 241–248.*Material examined*

Cherry Valley, Beijing Botanical Garden: five males, two females and three juveniles, 25 December 1994, collected by Dezeng Liu; 10 males and 10 females, December 1992, collected by Yixiong Cai; 12 males and eight females, 22 December 2002, collected by Chenglong Xiong.

*Diagnosis*

Gnathopod 1 with long curled setae on posterior margin of propodus; carpus and propodus of gnathopod 2 of the male with long curled setae dorsally; inner ramus of uropod 3 less than half of primary article of outer ramus, and both rami armed with simple setae, the telson with groups of long facial setae.

*Remarks*

*Gammarus electrus* is only known from Cherry Valley in Beijing. It can be distinguished from other *Gammarus* species by uropod 3 having long simple setae and gnathopod 2 having long curled setae on dorsal margins of carpus and propodus of gnathopod 2.

***Gammarus lacustris*** Sars, 1863

*Gammarus lacustris* Sars 1863, p 207; Pinkster 1972, p 166–169; Karaman and Pinkster 1977, p 32–34; Barnard and Dai 1988, p 92–94.

*Gammarus pulex*: Dahl 1915, p 1–32.

*Gammarus scandinavicus*: S. Karaman 1931, p 101.

*Gammarus bolkayi*: S. Karaman 1934, p 325.

*Gammarus (Rivulogammarus) lacustris*: Schellenberg 1937, p 490.

*Rivulogammarus lacustris*: Dussart 1948, p 101–102; Straskraba 1967, p 208.

*Gammarus lacustris lacustris*: Bousfield 1958, p 80.

*Gammarus wigrensis*: Micherdzinski 1959, p 598–599.

*Material examined*

Zhenzhuquan Spring, Caishihe River, Yanqing County: six males and seven females, 26 August 2001, collected by Shuqiang Li and Guoqing Zhang. Badaohe River, lower reaches of Baihepu Reservoir, Yanqing County, collected by Shuqiang Li and Guoqing Zhang: 36 males, 21 females and 12 juveniles, 26 August 2001; one female, 26 August 2001; 167 males, 116 females and 35 juveniles, 7 April 2004. Maquan Spring, Shangbanquan Town, Yanqing County: 11 males and 17 females, 26 August 2001, collected by Shuqiang Li and Guoqing Zhang. Fengsui Relic, Xiabanquan Village, Yanqing County: one female, 18 May 2004, collected by Shuqiang Li and Zhong-E Hou. Guanting Reservoir, Heilongmiao Village, Yanqing County, collected by Shuqiang Li and Zhong-E Hou: one male and one

female, 18 May 2004; two females, 18 May 2004; 29 males, 30 females and two juveniles, 18 May 2004; 47 males and 47 females, 18 May 2004. Beiganchi Village, Changgou Town, Fangshan District: two males, 7 December 1992; 101 males, 97 females and 28 juveniles, 15 September 2001, collected by Yuezhao Wang and Shuqiang Li. Xiganchi Village, Changgou Town, Fangshan District: 123 males, 121 females and five juveniles, 15 September 2001, collected by Yuezhao Wang and Shuqiang Li. A spring from Shidu Scenic Area, Fangshan District: 97 males, 163 females and 29 juveniles, 12 May 2000, collected by Shuqiang Li. Qingshuihe River, near Xihulin Village, Mentougou District, collected by Shuqiang Li and Kaibaryer Meng: two males and one female, 13 October 2001; six males and three females, 13 October 2001. Zhenzhu Spring: one male, September 1994, collected by Yixiong Cai.

### *Diagnosis*

Body large and stout; peduncle of antenna 2 with few short setae, calceoli present in male; pereopods 3 and 4 with long straight setae on posterior margins; epimeral plates 2 and 3 with sharp posterodistal corners; inner ramus of uropod 3 reaching about 75% of length of outer ramus, both rami set with plumose setae.

### *Remarks*

*Gammarus lacustris* was redescribed by Karaman and Pinkster (1977) based on samples from all over its distributional area, while Barnard and Dai (1988) redescribed it in detail with material from Yunnan, China. The material examined from Beijing accords well with the figures and description of *G. lacustris* given by Barnard and Dai (1988), except that the bases of pereopods 5–7 are a little more elongate, epimeral plates 2 and 3 without very sharp posterodistal corners and telson with one basolateral spine.

### *Gammarus nekkensis* Uchida, 1935

*Gammarus nekkensis* Uchida 1935, p 1–6; Barnard and Barnard 1983, p 463; Karaman, 1984, p 147–148; 1989, p 19–35.

*Gammarus (Rivulogammarus) nekkensis*: Barnard and Dai 1988, p 90.

### *Material examined*

Beiganchi Village, Fangshan District, collected by Yixiong Cai: four males, four females and three juveniles, 7 December 1992; 92 males, 75 females and eight juveniles, 7 December 1992; 75 males and 56 females, 7 December 1992. Between Shidu and Yesanpo Scenic Area, Fangshan District: two males and one female, 12 May 2000, collected by Shuqiang Li. A sump from Baicao pang, Yesanpo Scenic Area, Fangshan District: two males and two females, 13 May 2000, collected by Shuqiang Li. A spring near Wanglaopu Village, Liudu Town, Fangshan District: eight males, 10 females and five juveniles, 24 November 2003, collected by Shuqiang Li. A spring about 2 km from the west of Baiyu Village, Mentougou District: 50 males, 41 females and 15 juveniles, 13 October 2001, collected by Shuqiang Li and Kaibaryer Meng. A spring near Shangqingshui Village, Mentougou District: 133 males, 101 females and 23 juveniles, 13 October 2001, collected by Shuqiang Li and Kaibaryer Meng. Longmen Gully, Yanjiatai Village, Mentougou District: 14 males, two females and five juveniles. Xiaolongmen Forestry Centre,

Mentougou District: 42 males, 16 females and nine juveniles, 2 October 2004, collected by Yucheng Lin and Kaibayer Meng. A spring beside Longquanyu Great Wall, Yanqing County: 65 males, 33 females and 20 juveniles, 27 October 2001, collected by Kevin Li, Ye Tao and Kaibayer Meng. Maquan Spring, Shangbanquan Town, Yanqing County: 124 males, 164 females and 30 juveniles, 26 August 2001, collected by Shuqiang Li and Guoqiang Zhang. Guanting Reservoir, Heilongmiao Village, Yanqing County: 38 males and 34 females, 18 May 2004, collected by Shuqiang Li and Zhong-E Hou. A spring at foot of hill, near Baihe Village, Changping District: six males, five females and 15 juveniles, 3 December 2001, collected by Shuqiang Li and Zhong-E Hou. Huanglou Fall, Baiyanggou, Changping District: 35 males, nine females and 30 juveniles, 20 October 2001, collected by Shuqiang Li and Zhong-E Hou. A spring of upper stream of Xiangtan Reservoir, Changping District: 220 males, 153 females and 20 juveniles, 20 October 2001, collected by Shuqiang Li and Zhong-E Hou. Huyu Spring, Changping District, collected by Yixiong Cai: five males, 4 November 1992; 12 males, 20 females and 15 juveniles, 4 December 1992. A spring of Duijiuyu Scenic Area, Changping District: 42 males and 24 females, 5 November 1992, collected by Yixiong Cai. Zhenzhu Spring, Huairou District: 123 males, 121 females and 15 juveniles, 2 June 2001, collected by Shuqiang Li. Huamu Spring, Huamu Village, Huairou District: 53 males, 25 females and 35 juveniles, 2 June 2001, collected by Shuqiang Li. Lianhuachi Spring, Yanqi Town, Huairou District: 57 males, 61 females and nine juveniles, 2 June 2001, collected by Shuqiang Li. A brook between Li Village and Detian Village, Huairou District, collected by Shuqiang Li: 39 males, 13 females and two juveniles, 26 May 2001; 109 males, 114 females and nine juveniles, 26 May 2001. A spring near Yudaohu Village, Huairou District, collected by Guoqiang Zhang: 300 males, 289 females and 75 juveniles, 26 May 2001; 20 males and 20 females, 26 May 2001. Jinglinggu, Sihetang Town, Miyun County: eight males and seven females, 1 December 1992, collected by Yixiong Cai. Sihetang Village, Miyun County: 16 males, five females and nine juveniles, 26 December 1994, collected by Yixiong Cai. Liukeyu Village, Sihetang Town, Miyun County, collected by Yixiong Cai: 52 males, 21 females and 12 juveniles, 1 December 1992; 21 males, 34 females and 10 juveniles, 1 December 1992. Xianren Fall, Huangtuliang Village, Sihetang Town, Miyun County: 54 males, 12 females and three juveniles, 30 November 1992, collected by Yixiong Cai. Huangcaowa Village, Pinggu District, collected by Yixiong Cai: 65 males and 42 females, 7 December 1992; 14 males and 10 females, 2 December 1992. Hudongshui Lake, Pinggu District, collected by Yixiong Cai: 51 males and 19 females, 2 December 1992; 13 males and seven females, 2 December 1992.

### Diagnosis

Antennae 1 and 2 with few setae, calceoli present in male; merus to propodus of pereopod 3 with long curled setae on posterior margin; pereopods 5–7 with few setae on anterior margin; epimeral plates 1–3 with blunt posterodistal corners; inner ramus of uropod 3 reaching about 50% of length of outer ramus, outer margin of outer ramus in uropod 3 with long simple setae only.

### Remarks

*Gammarus nekkensis*, widely distributed in North China, was first described based on material from Wuling Mountain, Hebei Province, after which it was reviewed in detail by

Karaman (1989) based on specimens from Beijing. The present material accords well with the figures and description given by Karaman (1989), except for the variable numbers and length of setae on the margins of the uropods and urosomites. These features may be variable characters within the species.

**Family PSEUDOCRANGONYCTIDAE** Holsinger, 1989

***Procrangonyx limpidus*** Hou and Li, 2003

*Procrangonyx limpidus* Hou and Li 2003b, p 1179–1188.

*Material examined*

One male and one female, a well of Beizhai Village, Qiaozhi Town, Huairou District, 5 November 2002, collected by Shuqiang Li.

*Diagnosis*

Eyes absent, inferior antennal sinus indistinct; pereopods 3–7 slender and elongate; epimeral plates 1–3 sub-rounded, pleonites and urosomites with fine setae on dorsal margin; uropod 3 uniramous; telson apical margin divided by a shallow excavation.

*Remarks*

*Procrangonyx limpidus* is a subterranean species collected from a well in a farmyard. It is the first species of the genus *Procrangonyx* recorded from China and only the second species described. It differs from *P. japonicus* Uéno, 1930 in the following characters: inner plate of maxilla 1 with five plumose setae, inner plate of maxilla 2 with seven plumose setae, palp article 3 of mandible with A-setae, ramus of uropod 3 about five times as long as peduncle.

**Family TALITRIDAE** Rafinesque, 1815

***Platorchestia japonica*** Tattersall, 1922

*Talorchestia japonica* Tattersall 1922, p 452.

*Platorchestia japonica*: Bousfield 1982, p 27.

*Platorchestia japonica*: Morino and Dai 1990, p 7; Hou and Li 2003c, p 2441–2460.

*Material examined*

Fengsui Relic, Xiabanquan Village, Yanqing County, collected by Shuqiang Li and Zhong-E Hou: one female, 26 August 2001; eight males, 7 April 2004; four males, 7 April 2004; 57 males, 7 April 2004; nine males and nine females, 18 May 2004; three males and five females, 18 May 2004; 34 males, 40 females and one juvenile, 18 May 2004; three males and four females, 18 May 2004; seven males and five females, 18 May 2004; seven males and five females, 18 May 2004; 22 males and 33 females, 18 May 2004. Guanting Reservoir, Heilongmiao Village, Yanqing County, collected by Shuqiang Li and Zhong-E Hou: two males and six females, 18 May 2004; 14 males and 14 females, 18 May 2004; three males and five females, 18 May 2004. Yuanmingyuan Park: 40 males and 65 females, 25 May 2004, collected by Zhong-E Hou and Yucheng Lin. Paddyfield near Jingmiyingshuiqu River, Xibeiwang Village: 65 males and 24 females, 22 August 2000, collected by Shuqiang Li and Zhong-E Hou. River at the foot of Mt Yuquanshan: five males and five females, 22 May

2001, collected by Shuqiang Li and Zhong-E Hou. Huamu Spring, Huamu Village, Huairou District: four females, 2 June 2001, collected by Shuqiang Li.

#### Diagnosis

Left mandibular lacinia mobilis five-dentate; male gnathopod 1 with swollen carpus and propodus; gnathopod 2 powerfully subchelate; female gnathopod 2 with anteriorly broadened basis and posteriorly tumescent carpus and propodus; carpus of pereopod 4 short; outer ramus of uropod 1 marginally unarmed.

#### Remarks

*Platorchestia japonica* was firstly recorded as *Talorchestia japonica* from Lake Biwa by Tattersall (1922). Bousfield (1982) ascribed it to the genus *Platorchestia*. Morino and Dai (1990) redescribed *P. japonica* from specimens collected along the Changjiang River, China, after which this species was reported based on specimens collected from Beijing (Hou et al. 2002). The present material well accords with the figures and description of *P. japonica* given by Hou et al. (2002), except the variable size of the eyes and variable spines and setae on the appendages.

#### Family ANISOGAMMARIDAE Bousfield, 1977

#### *Jesogammarus (Jesogammarus) hebeiensis* Hou and Li, 2004

*Jesogammarus (Jesogammarus) hebeiensis* Hou and Li 2004, p 455–466.

#### Material examined

Fengsui Relic, Xiabanquan Village, Yanqing County, collected by Shuqiang Li and Zhong-E Hou: one male and one female, 7 April 2004; one female, 18 May 2004. Guanting Reservoir, Heilongmiao Village, Yanqing County, collected by Shuqiang Li and Zhong-E Hou: one female, 18 May 2004; three males, four females and one juvenile, 18 May 2004; six juveniles, 18 May 2004; 35 juveniles, 18 May 2004. Heilongmiao Village, Yanqing County: one female and two juveniles, 23 April 2002, collected by Lihong Tu and Wei Chen. Beijing (10147), no detailed locality: five males and three females, 21 November 1928. Hehua Pond in the campus of Tsinghua University, Haidian: two males and two females, 14 May 1929, collected by T. Lin.

#### Diagnosis

Mandibular palp article 1 with two distal spines; inner lobes of lower lip distinct; pleonites 1–3 without dorsomarginal spine; uropod 3 lanceolate, inner ramus about one-third of outer ramus; telson longer than maximum basal width.

#### Remarks

*Jesogammarus (J.) hebeiensis* can distinguished from related *Jesogammarus (J.)* species by the spinose mandibular palp article 1, setose pleonites, sexually dimorphic setation in pereopods 5–7, and elongate telson.

*Jesogammarus (J.) hebeiensis* and *Jesogammarus (Anmanogammarus) debilis* sp. nov. can coexist in the same environment.



***Jesogammarus (Annanogammarus) debilis* sp. nov.**

(Figures 1–6)

*Type material examined*

One male holotype (IZCAS-I-A0115), Beixinzhuang Village, Hebei Town, Fangshan District, 15 September 2001, collected by Yuezhao Wang and Shuqiang Li; one female allotype (IZCAS-I-A0116) and 10 males and 12 females paratypes, same data as holotype.

*Other material*

Beixinzhuang Village, Hebei Town, Fangshan District: one male, 15 September 2001, collected by Lihong Tu. Jiudaohu Village, Fangshan District: one female, 15 September 2001, collected by Yuezhao Wang and Shuqiang Li. Beiganchi Village, Changgou Town, Fangshan District: three males and one female, 15 September 2001, collected by Yuezhao Wang and Shuqiang Li. Fengsui Relic, Xiabanquan Village, Yanqing County: 15 males, 54 females and three juveniles, 7 April 2004, collected by Shuqiang Li and Zhong-E Hou. Huamu Spring, Huamu Village, Huairou District: eight males, seven females and three juveniles, 2 June 2001, collected by Shuqiang Li. Beijing (10147), no detailed locality: 26 males and 23 females, 21 November 1928. Beijing (BJ0141), no detailed record on the label: three males and four females.

*Etymology*

This specific name *debilis* alludes to the body shape, which seems slender.

*Diagnosis*

Peduncular article 1 of antenna 1 lacking a distal spine; mandibular palp articles with setae alone; propodus of male gnathopod 2 slender; propodus palmar margin of female gnathopod 2 with weakly pectinated stiff setae; outer ramus of uropod 2 marginally bare; uropod 3 with more than three plumose setae; telson longer than maximum basal width.

*Description*

*Male.* Body length 10.5 mm.

Head as long as deep (Figure 1A), eyes medium in size, subreniform.

Antenna 1 (Figure 1B, D): peduncular articles 1–3 in length ratio 1:0.77:0.53, peduncular article 1 lacking posterodistal spine, with distal setae, peduncular articles 2 and 3 bearing setae on posterior margin; flagellum with 26 articles, most of which with aesthetascs; accessory flagellum with five articles.

Antenna 2 (Figure 1C, E): peduncular article 4 about as long as article 5, with two to four groups of setae along anterior and posterior margins; flagellum with 14 articles, proximal nine articles with cup-calceoli.

Upper lip (Figure 1F): convex, with minute setae.

Mandibles (Figure 1G, H, O, P): left and right incisor with five and four teeth, respectively; left lacinia mobilis with four dentitions, right lacinia mobilis bifurcate; article 1 of palp unarmed, article 2 with seven marginal and nine submarginal setae, article 3 reaching 89% of length of article 2, with two cluster of A-setae and one B-seta.

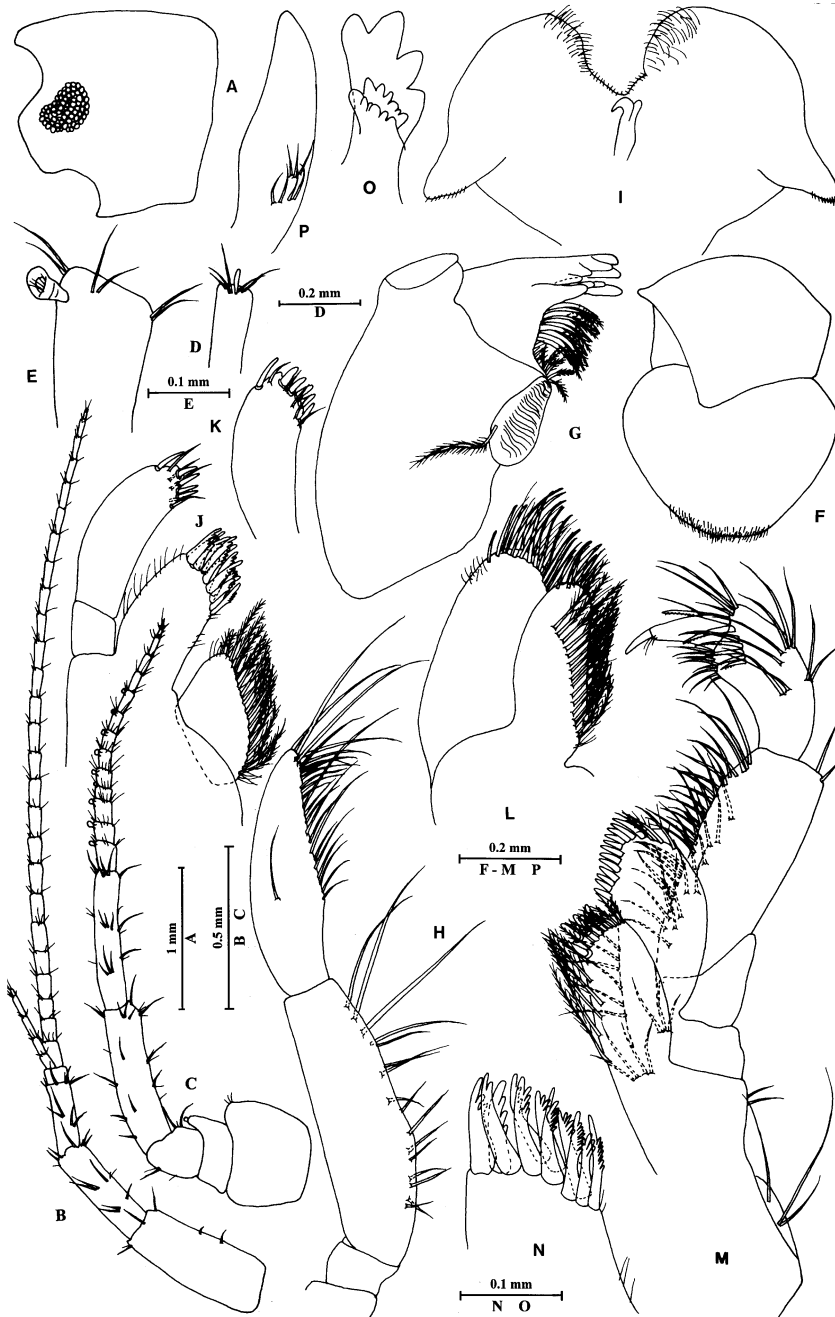


Figure 1. *Jesogammarus* (*Annanogammarus*) *debilis* sp. nov., holotype, male. (A) Head; (B) antenna 1; (C) antenna 2; (D) flagellum of antenna 1; (E) flagellum of antenna 2; (F) upper lip; (G) incisor of left mandible; (H) palp of left mandible; (I) lower lip; (J) left maxilla 1; (K) palp of right maxilla 1; (L) maxilla 2; (M) maxilliped; (N) outer plate of maxilla 1; (O) incisor of right mandible; (P) inner surface of palp of left mandible.

Lower lip (Figure 1I): inner lobes absent.

Maxilla 1 (Figure 1J, K, N): asymmetrical, inner plate with 16 plumose setae medially; outer plate with 11 serrated spines apically, outer margin with setules; article 2 of left palp with six spines and four setae apically; article 2 of right palp with six spines and five setae apically.

Maxilla 2 (Figure 1L): inner plate with a diagonal row of 16 plumose setae.

Maxilliped (Figure 1M): inner plate with one subapical spine and three apical spines; outer plate with 13 spines on medial margin and three pectinate setae apically.

Gnathopod 1 (Figure 2A, C, E): coxal plate lower and anterodistal margins setose, posterodistal corner with one stiff seta; anterior and posterior margins of basis setose; propodal palmar margin bearing seven inner and nine outer striated peg-spines, anterior margin with three groups of setae; dactylus with posterior accessory blade longer than nail, bearing one seta on outer margin and two setae on inner margin.

Gnathopod 2 (Figure 2B, D, F, G): coxal plate lower and anterodistal margins setose, posterodistal corner with one stiff seta; anterior and posterior margins of basis setose; propodus more slender than in gnathopod 1, palmar margin bearing eight inner and eight outer striated peg-spines; dactylus with posterior accessory blade longer than nail, bearing one seta on outer margin and two setae on inner margin.

Pereopod 3 (Figures 2H, 3A, J): coxal plate subrectangular, anterodistal margin with two setae, posterodistal margin with one seta and one stiff seta; basis with long setae on anterior and posterior margins; merus with three groups of long stiff setae on posterior margin; carpus with spines accompanied by setae on posterior margin; propodus with four single spines accompanied by setae on posterior margin; dactylus with one plumose seta on outer margin and two setae at hinge of nail.

Pereopod 4 (Figures 2I, 3B): coxal plate excavated on posterior margin, anterodistal margin with one seta, posterodistal margin with seven setae; basis with long setae on posterior margin; merus with three groups of stiff setae on posterior margin; carpus with one spine accompanied by setae; propodus with spines accompanied by setae; dactylus similar to that of pereopod 3.

Pereopod 5 (Figures 2J, 3C, I): coxal plate with one distal seta on anterior lobe, posterodistal corner of posterior lobe with one spine; basis with one group of setae on anteroproximal margin, anterodistal margin spinose, posterior margin nearly straight, with stiff setae; merus to propodus with marginal spines; dactylus with one plumose seta on outer margin and one seta at hinge of nail.

Pereopod 6 (Figures 2K, 3D): longer than pereopod 5, coxal plate with one spine on posterodistal corner; basis with one group of setae on anteroproximal margin and spines on anterodistal margin, posterior margin weakly sinuate, with a row of setae associated with short spines; merus to propodus with marginal spines; dactylus similar to that of pereopod 5.

Pereopod 7 (Figures 2L, 3E): coxal plate with a group of long setae on anterior margin and three short setae on posterior margin; basis with two long setae on anteroproximal margin and spines on anterodistal margin, posterior margin expanded, with short spines and setae, inner surface bearing one posterodistal spine and one seta; merus to propodus with marginal spines; dactylus similar to that of pereopod 5.

Coxal gills of gnathopod 2 and pereopods 3 and 4 subequal to their bases in length (Figure 2G–I), anterior accessory lobe of each gill larger than posterior lobe, about one-quarter of main gill in length. Gill of pereopod 5 (Figure 2J) longer than basis, anterior accessory lobe larger than posterior lobe, about one-third of main gill. Gill of pereopod 6 (Figure 2K) shorter than basis, accessory lobe about half of main gill. Gill of pereopod 7 (Figure 2L) a little longer than half of basis, accessory lobe less than one-quarter of main gill.

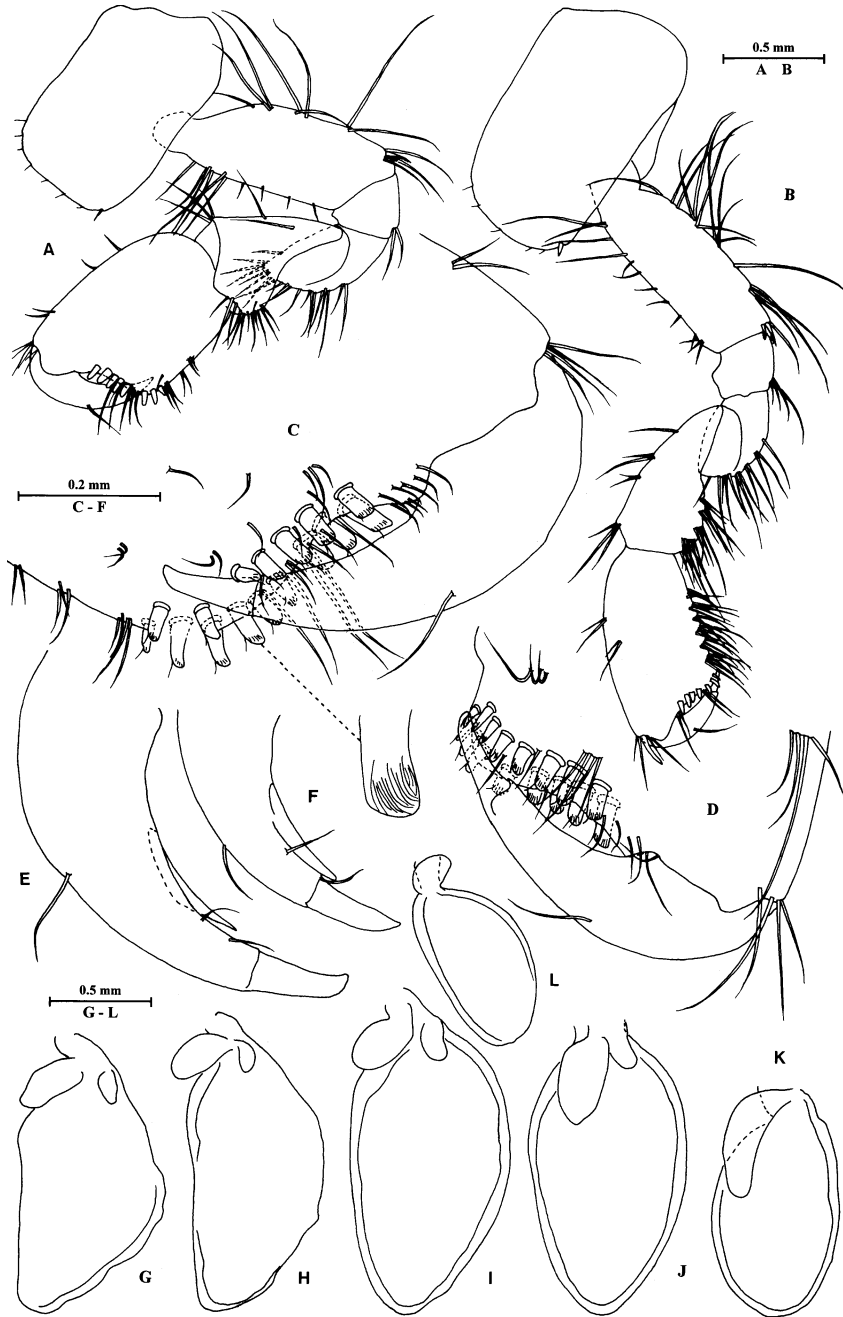


Figure 2. *Jesogammarus* (*Annanogammarus*) *debilis* sp. nov., holotype, male. (A) Gnathopod 1; (B) gnathopod 2; (C) propodus of gnathopod 1; (D) propodus of gnathopod 2; (E) dactylus of gnathopod 1; (F) dactylus of gnathopod 2; (G-L) coxal gills of gnathopod 2 and pereopods 3-7.

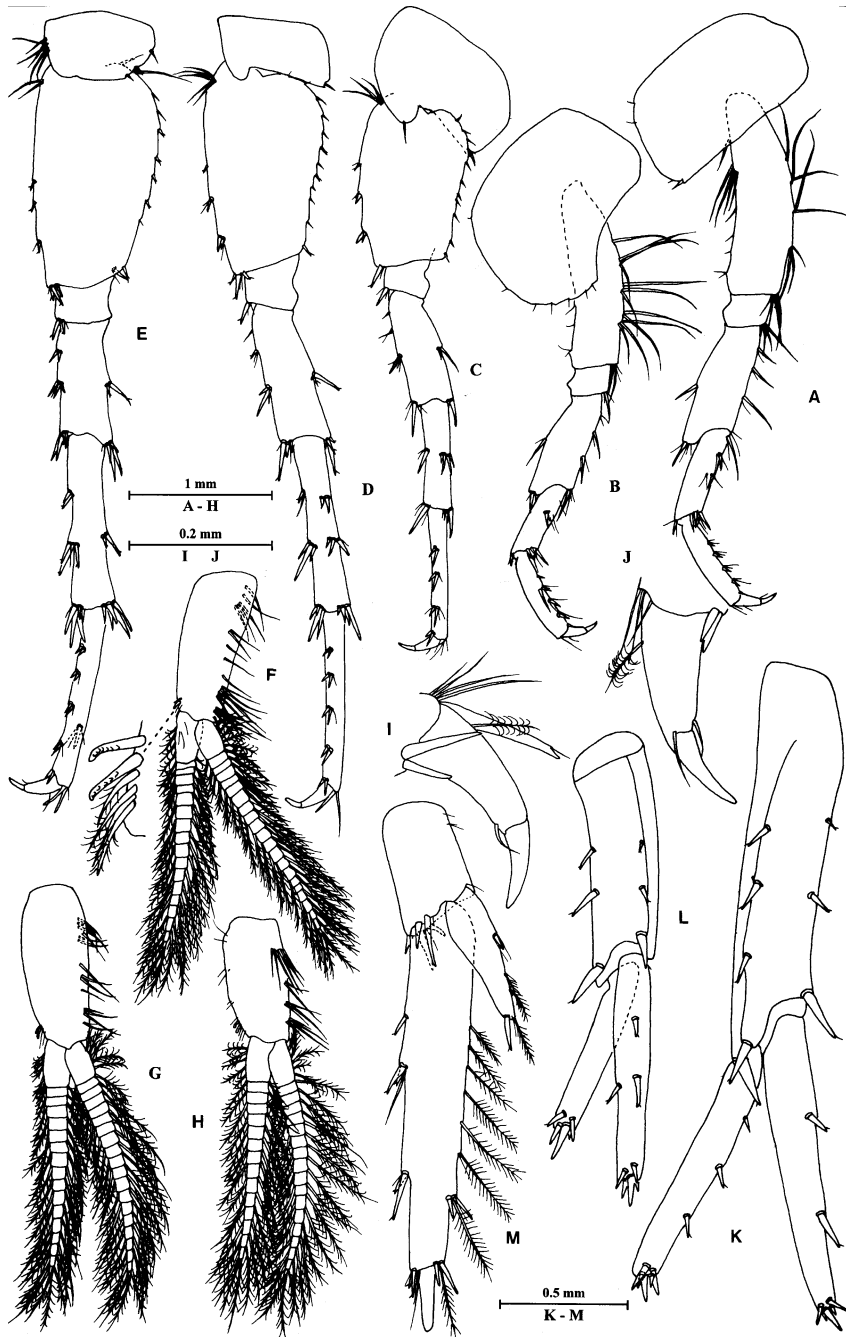


Figure 3. *Jesogammarus (Annanogammarus) debilis* sp. nov., holotype, male. (A) Pereopod 3; (B) pereopod 4; (C) pereopod 5; (D) pereopod 6; (E) pereopod 7; (F) pleopod 1; (G) pleopod 2; (H) pleopod 3; (I) dactylus of pereopod 5; (J) dactylus of pereopod 3; (K) uropod 1; (L) uropod 2; (M) uropod 3.

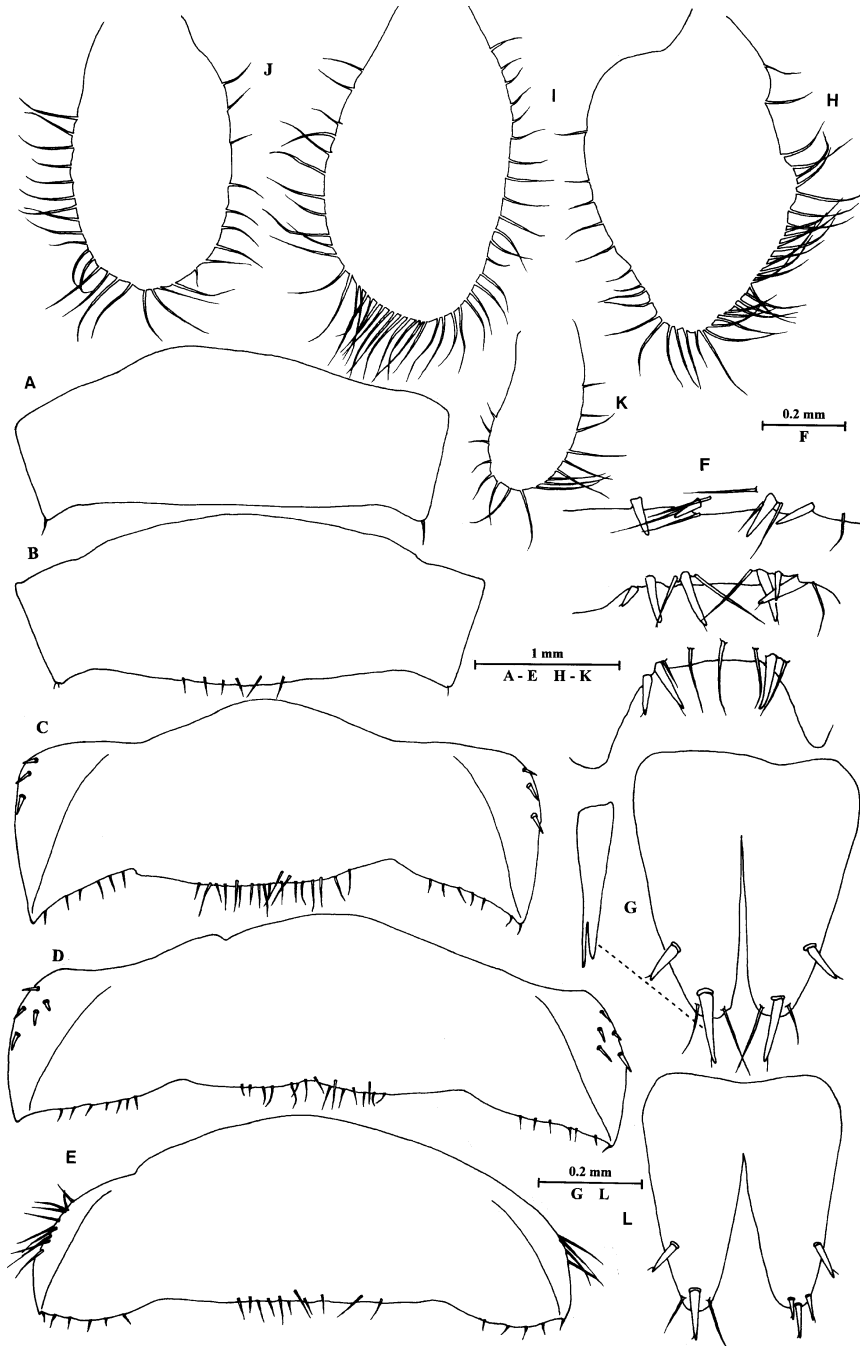


Figure 4. *Jesogammarus* (*Annanogammarus*) *debilis* sp. nov. (A–G) Male; (H–L) female. (A) Pereonite 6; (B) pereonite 7; (C) pleonite 3; (D) pleonite 2; (E) pleonite 1; (F) urosomites 1–3; (G) telson; (H) oostegite 2; (I) oostegite 3; (J) oostegite 4; (K) oostegite 5; (L) telson.

Pereonite 6 (Figure 4A): posterodorsal margin bare.

Pereonite 7 (Figure 4B): posterodorsal margin with six setae.

Pleonites 1–3 (Figure 4C–E): posterodorsal margins with 11 marginal setae, 16 marginal setae, and 17 marginal and two submarginal setae, respectively; lateral plate 1 with about 10 long setae on anteroventral corner and six setules on posterior margin; lateral plate 2 with three anteroventral marginal spines and two submarginal spines, posterior margin with a row of seven setules; lateral plate 3 with three spines on anteroventral margin and six setules on posterior margin.

Pleopods 1–3 (Figure 3F–H): subequal in length, peduncle with long setae on outer margin, bearing two retinacula accompanied by three or four plumose setae on anterodistal corner; outer ramus a little shorter than inner ramus, both rami armed with plumose setae.

Urosomites (Figure 4F): urosomites 1 and 2 bearing a pair of dorsomarginal lateral spines and medial spine-clusters associated with setae; urosomite 3 with a pair of dorsomarginal lateral spines and two medial setae.

Uropod 1 (Figure 3K): basofacial spine in peduncle present or absent, outer and inner margins with two or three spines, respectively; outer ramus with three spines on inner margin; inner ramus with two spines on inner margin.

Uropod 2 (Figure 3L): peduncle with marginal spines on inner and outer margins; outer ramus marginally bare; inner ramus with one spine on outer margin and two spines on inner margin.

Uropod 3 (Figure 3M): peduncle with short setae on inner margin; outer ramus with two articles, outer margin of proximal article with one spine and two pairs of spines sequentially, inner margin with seven plumose setae and a pair of spines; terminal article distinct, 18% of length of proximal article, longer than distal spines of proximal article; inner ramus about one-third of proximal article, with one spine and two plumose setae on inner margin, and one apical spine accompanied by one plumose seta.

Telson (Figure 4G): medially cleft for 72% of its length, basal maximum width 90% of length, with apical and distolateral spines.

*Female.* Body length 8.2 mm.

Gnathopod 1 (Figure 5A, C, E, G, H): coxal plate with setae on lower and posteroproximal margins; basis with numerous long setae on anterior and posterior margins; propodus oval, bearing two spines on inner posterodistal corner and two spines on outer posterodistal corner, and five pectinate stiff setae; dactylus with posterior accessory blade shorter than nail, bearing one seta on outer margin.

Gnathopod 2 (Figure 5B, D, F, I): coxal plate with one seta on anterodistal corner and 15 setae on posterior margin; basis with setae along anterior and posterior margins; carpus and propodus slender, propodus parallel-sided, palmar margin with five simple spines on inner margin and three simple spines and two weakly pectinate stiff setae on outer margin; dactylus with posterior accessory blade shorter than nail, bearing one seta on outer margin.

Pereopod 3 (Figures 5J, 6A): coxal plate with setae on posterior margin; basis with long setae on anteroximal and posterior margins; merus and carpus with long stiff setae on posterior margin; propodus with spines on posterior margin.

Pereopod 4 (Figure 6B): coxal plate with setae on posterior margin; basis with long setae on posterior margin; merus with stiff setae on posterior margin.

Pereopod 5 (Figure 6C): basis with one seta on posterodistal margin of inner surface; merus to propodus spinose.

Pereopod 6 (Figure 6D): coxal plate with long setae on anterior margin; basis with two groups of setae and one posterodistal seta on inner surface.

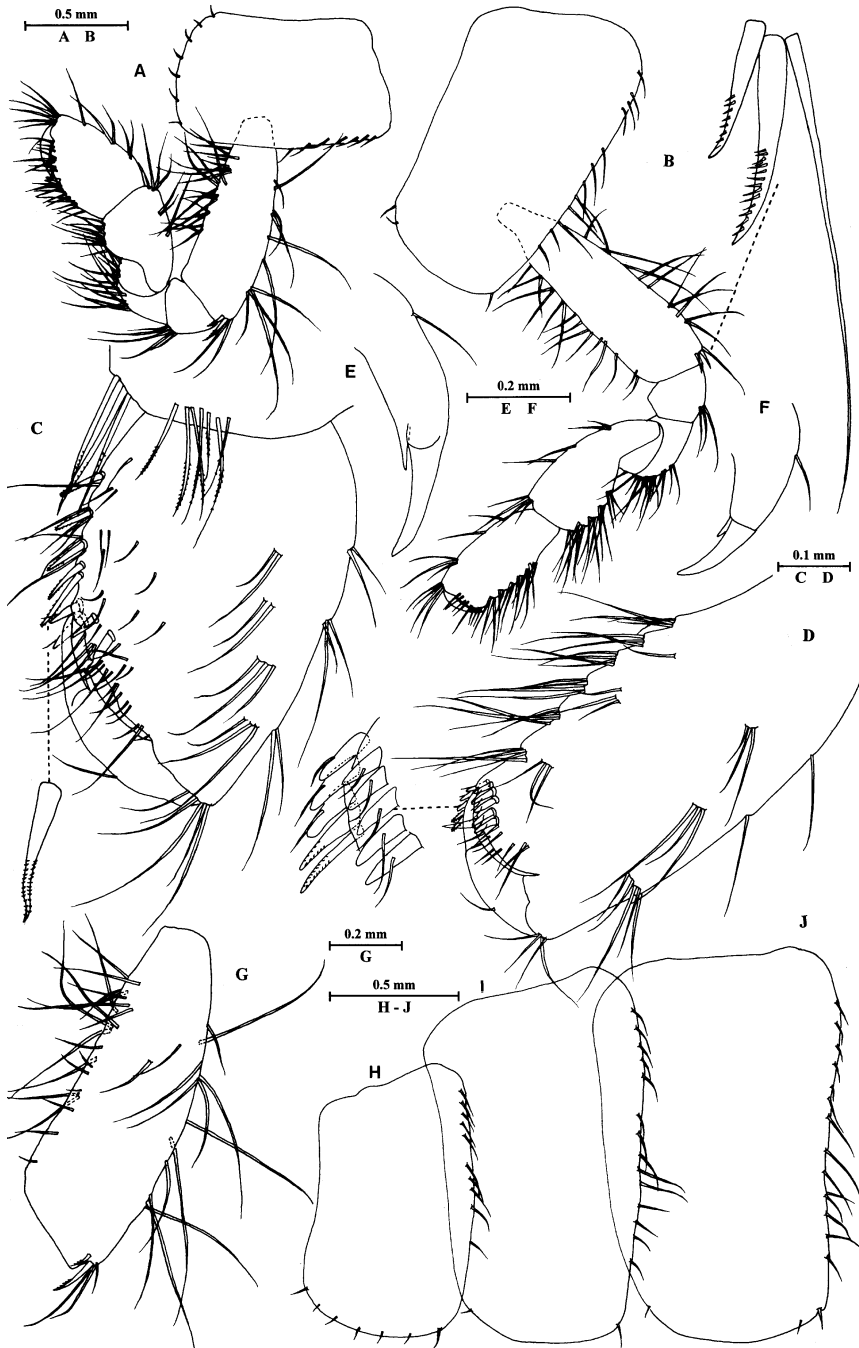


Figure 5. *Jesogammarus (Annanogammarus) debilis* sp. nov., female. (A) Gnathopod 1; (B) gnathopod 2; (C) propodus of gnathopod 1; (D) propodus of gnathopod 2; (E) dactylus of gnathopod 1; (F) dactylus of gnathopod 2; (G) basis of gnathopod 1; (H) basis of gnathopod 1; (I) basis of gnathopod 2; (J) basis of pereopod 3.



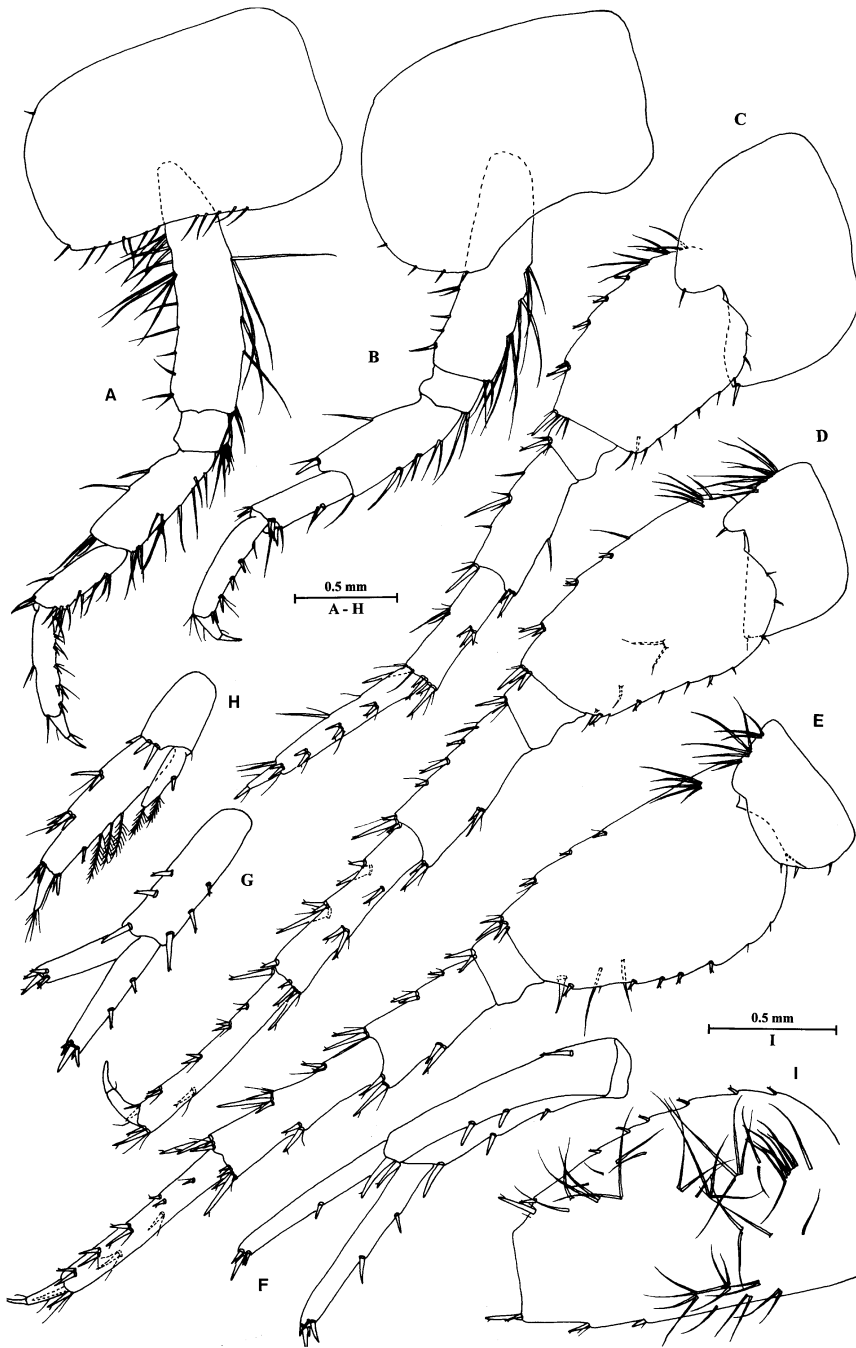


Figure 6. *Jesogammarus (Annanogammarus) debilis* sp. nov., female. (A) Pereopod 3; (B) pereopod 4; (C) pereopod 5; (D) pereopod 6; (E) pereopod 7; (F) uropod 1; (G) uropod 2; (H) uropod 3; (I) inner surface of basis of pereopod 7.

Pereopod 7 (Figure 6E, I): coxal plate with two groups of long setae on anterior margin; basis with numerous long setae and one posterodistal spine on inner surface.

Accessory gills: anterior lobe of accessory gills of gnathopod 2 and pereopod 3 much larger than posterior lobe; anterior lobe of accessory gill of pereopod 4 a little larger than posterior lobe; anterior lobe of accessory gill of pereopod 5 about one-third of main gill; accessory gill of pereopod 6 about half of main gill; accessory gill of pereopod 7 about one-third of main gill.

Oostegites on gnathopod 2 to pereopod 5 progressively attenuated (Figure 4H–K), fringed with many marginal setae.

Uropod 1 (Figure 6F): peduncle with or without basofacial spine, bearing marginal spines; outer ramus with one spine on inner margin; inner ramus with two spines on inner margin.

Uropod 2 (Figure 6G): peduncle with marginal spines; outer ramus marginally bare; inner ramus with two spines on inner margin.

Uropod 3 (Figure 6H): proximal article of outer ramus with two groups of spines on outer margin, inner margin with three plumose setae and one spine, and bearing two pairs of distal spines, reaching half of terminal article length; terminal article 23% of length of proximal article; inner ramus 40% of length of proximal article, with one spine and two plumose setae on outer margin.

Telson (Figure 4L): medially cleft 72% of length, basal maximum width 87% of length, with apical and distolateral spines.

#### Variation

Basofacial spine on peduncle uropod 1 present or absent in males and females.

#### Remarks

This subgenus contains five species: *J. (A.) annandalei* (Tattersall, 1922), *J. (A.) naritai* Morino, 1985, *J. (A.) fluvialis* Morino, 1985, *J. (A.) suwaensis* Morino, 1986, and *J. (A.) koreaensis* Lee and Seo, 1990. *Jesogammarus (A.) debilis* is closely related to *J. (A.) annandalei* in peduncular article 1 of antenna 1 without posterodistal spine, many setae on pleonites, and antenna 2 with short setae; it differs from *J. (A.) annandalei* in having bases of pereopods 6–7 without long setae, inner ramus of uropod 3 elongate and both rami with more plumose setae. *Jesogammarus (A.) debilis* can be distinguished from *J. (A.) koreaensis* and *J. (A.) fluvialis* by peduncular article 1 of antenna 1 without posterodistal spine and propodus palmar margin of female gnathopod 2 with weakly pectinate stiff setae. *Jesogammarus (A.) debilis* differs from *J. (A.) naritai* and *J. (A.) suwaensis* by pleonites without spines on dorsal margins.

This discovery of a new *Annanogammarus* species from a suburb of Beijing is interesting from a zoogeographical viewpoint. It is probable that *Annanogammarus* has invaded from the continent, through the Korean Peninsula to Japan.

#### Conclusion and discussion

Based on intensive collection of amphipods in Beijing over the last 10 years, and other collections in IZCAS dated to 1928, seven freshwater and terrestrial amphipod species are now known from Beijing. A key to the males of all species is given below.

## Key to the males collected in the Beijing region

- 1 Eyes absent, always living in subterranean water . . . . . *Procrangonyx limpidus*  
 – Eyes present, living in surface water. . . . . 2
- 2 Antenna 1 short, no accessory flagellum; mandible without palp; palp of maxilla 1 rudimental, inner plate with two apical stout setae, outer plate with nine spines; uropod 3 uniramous; coxal gills 2–6 present . . . . . *Platorchestia japonica*  
 – Antenna 1 strong, accessory flagellum present; palp of mandible with three articles; palp of maxilla with two articles, inner plate with a row of plumose setae, outer plate with 11 spines; uropod 3 biramous; coxal gills 2–7 present . . . . . 3
- 3 Propodus palm of gnathopods 1 and 2 with peg-shaped spines; accessory coxal gills present . . . . . 4  
 – Propodus palm of gnathopods 1 and 2 with spines; accessory coxal gills absent . . . . . 5
- 4 Accessory lobes of coxal gills 2–5 subequal in length or posterior accessory lobe longer than anterior accessory lobe . . . . . *Jesogammarus (J.) hebeiensis*  
 – Accessory lobes of coxal gills 2–5 unequal in length, posterior lobe shorter than anterior accessory lobe . . . . . *Jesogammarus (A.) debilis*
- 5 Inner ramus of uropod 3 reaching about 40% of length of outer ramus, both rami armed with long simple setae. . . . . *Gammarus electrus*  
 – Inner ramus of uropod 3 longer than half of length of outer ramus, both rami armed with plumose setae . . . . . 6
- 6 Inner ramus of uropod 3 about half of length of outer ramus, outer margin of outer ramus with long simple setae only; epimeral plates 2 and 3 with blunt posterodistal corners . . . . . *Gammarus nekkensis*  
 – Inner ramus of uropod 3 longer than half of length of outer ramus, both margins of outer ramus with plumose setae; epimeral plates 2 and 3 with very sharp posterodistal corners . . . . . *Gammarus lacustris*

The freshwater amphipod crustaceans from Beijing include three *Gammarus* species, among which *G. lacustris* and *G. nekkensis* are generalists in ecotype. In almost all habitats where freshwater amphipods can be found, both species are present. *Gammarus electrus*, by contrast, is a specialist and occurs in Cherry Valley of the Beijing Botanical Garden only. In 2002, *G. electrus* was found in a spring in Cherry Valley, but disappeared from other places in Cherry Valley.

*Procrangonyx limpidus* is the only subterranean crustacean found in Beijing and only two individuals were collected. Whenever we talked with the local people during our collection, many farmers told us that they have seen subterranean crustaceans before, but none after 1990. This is obviously a result of over-exploitation and exhaustion of the groundwater in Beijing. In fact, due to the high speed of economic development, over-population, changing climate and deterioration of water resources, the level of the groundwater in Beijing has been reduced and reduced (Tang et al. 2004).

Meanwhile, due to a decline in surface water, some terrestrial amphipods also became limited in distribution. *Jesogammarus (Jesogammarus) hebeiensis* could be found in Hehua Pond in the campus of Tsinghua University in 1929 but Hehua Pond is now filled with water transferred from another area and amphipods cannot be found there today.

In general, today's distribution pattern of amphipod crustaceans from Beijing is a result of both natural and anthropogenic changes. A study of the meta-population of amphipod crustaceans based on molecular techniques and rich collections from Beijing is being conducted by the same authors and further comments on the distribution patterns of amphipod crustaceans will follow.

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