

## ***Gammarus* species from River Jumahe, China (Crustacea, Amphipoda, Gammaridae)**

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***Gammarus* species from River Jumahe, China (Crustacea, Amphipoda, Gammaridae).** - Three *Gammarus* species are reported from River Jumahe. *Gammarus madidus* sp. n. is characterized by antenna 2 with groups of long setae along the anterior and posterior margins, inner ramus of uropod 3 reaching about 40% of length of outer ramus and both rami fringed with long simple setae. *G. lacustris* Sars, 1863 is distinguished by epimeral plates 2 and 3 with sharp posterodistal corners, inner ramus of uropod 3 reaching about 75% of length of outer ramus and both rami armed with plumose setae. *G. nekkensis* Uchida, 1935 differs from congeneric species by pereopod 3 with long curled setae on the posterior margin and inner ramus of uropod 3 reaching 50% of outer ramus. Distribution data of these gammarids are presented.

**Keywords:** Amphipoda - *Gammarus* - new species - taxonomy - China.

### INTRODUCTION

On December 27, 2002, China started its gigantic South-to-North Water Transfer Project, which is expected to take 50 years to complete and will cost 58 billion US dollars. The project involves three canals running 1,300 kilometers across the eastern, middle and western parts of China, linking four major rivers, the Yangtze, Yellow, Huaihe and Haihe River (Anonymous, 2002). This project is thought to be an important infrastructural work for the optimal allocation of water resources in China.

Beijing is one of the target cities of the Middle Line Project within the South-to-North Water Transfer Project. To better understand the ecological effects of this gigantic project, we have investigated the current *Gammarus*-fauna in most water systems around Beijing. In this paper we present a *Gammarus* inventory of the River Jumahe.

River Jumahe, 254 km long, is one of five water systems running through Beijing City. Its source is located in Laiyuan County of Hebei Province and its mid-upper stretch runs through Fangshan District of Beijing, about 100 km away from urban Beijing. In Zhangfang Town it divides into the Rivers South-Jumahe and North-Jumahe, and then runs into the River Daqinghe and further into Bohai Sea.



*Gammarus* is among the most species-rich groups of epigeal freshwater amphipods (Hou & Li, 2002a, b, 2003a; Hou, Li & Morino, 2002). Our intensive investigation of the *Gammarus* fauna of the River Jumahe began in May 2000, although previous collection is also used in the current study. Collecting was done at possible locality on both sides of the river where we could stop our car. Although most samples taken in 2001-2004 contained no *Gammarus*, we continued our search all along the river. This yielded three amphipod species: *Gammarus lacustris*, *G. nekkensis* and *G. madidus* sp. n., the latter of which is new to science. A detailed description of this new species, as well as the localities of all three species (Map 1) is given.

## MATERIAL AND METHODS

Specimens were collected by a net and then preserved in 75% alcohol. For each species three to five specimens of each sex were dissected and appendages were mounted on slides according to the methods described by Holsinger (1967). The drawings were made with the aid of a drawing tube mounted on an Olympus BX-41 compound microscope.

Holotype of the new species is deposited at the Institute of Zoology, Chinese Academy of Sciences (IZCAS), Beijing, China. Additional specimens, including paratypes of the new species are deposited at the same institute and at the Muséum d'histoire naturelle, Geneva (MHNG), Switzerland.

## DESCRIPTIONS

### *Gammarus lacustris* Sars, 1863

*Gammarus lacustris* Sars, 1863: 207; Pinkster, 1972: 166-169, Figs 1-2; Karaman & Pinkster, 1977: 32-34, Fig. 12; Barnard & Dai, 1988: 92-94, Figs 1-5.

*Gammarus pulex* Dahl, 1915: 1-32, Fig. 1.

*Gammarus scandinavicus* S. Karaman, 1931: 101, Fig. 6a.

*Gammarus bolkayi* S. Karaman, 1934: 325, Fig. 1.

*Gammarus* (*Rivulogammarus*) *lacustris* Schellenberg, 1937: 490, Figs 2-6.

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

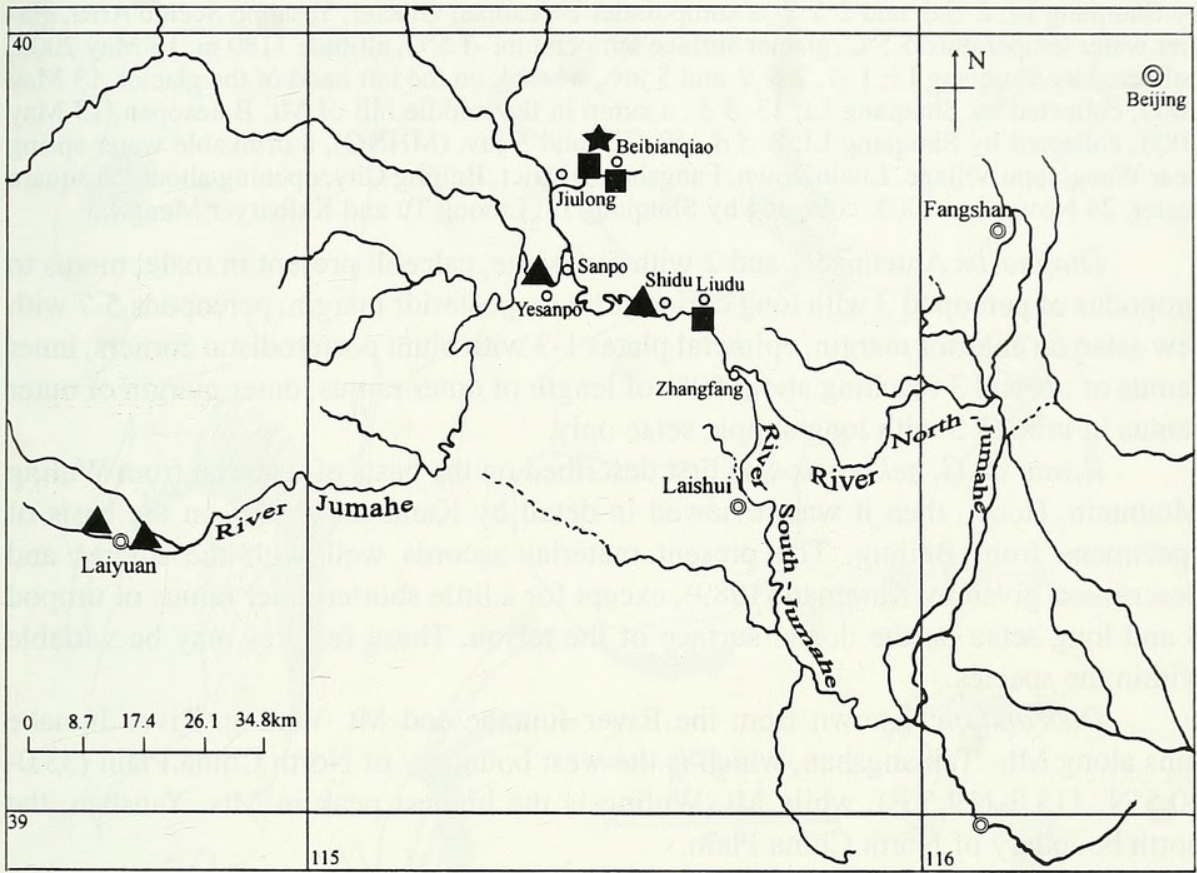
*Gammarus lacustris lacustris* Bousfield, 1958: 80.

*Gammarus wigrensis* Micherdzinski, 1959: 598-599, Fig. 81.

**Material examined:** 97 ♂♂, 163 ♀♀ and 29 juv. (No. 1), a spring near Shidu (39°38.521'N, 115°38.273'E), Fangshan District, Beijing, altitude 160-190 m, water temperature 6°C, 12 May 2000, collected by Shuqiang Li; 38 ♂♂, 40 ♀♀ and 7 juv. (MHNG, No. 2), same data as No. 1; 46 ♂♂, 87 ♀♀ and 10 juv. (No. 3), same data as No. 1 except for the collecting day 13 May 2000; 75 ♂♂, 108 ♀♀ and 16 juv. (No. 4), same data as No. 3; 23 ♂♂, 28 ♀♀ and 10 juv. (No. 5), spring near Cave Yugudong (39°45.434'N, 115°24.312'E), Yesanpo Scenic Area, Laishui County, Hebei Province, altitude 340 m, 13 May 2000, collected by Shuqiang Li; 8 ♂♂, 7 ♀♀ and 2 juv. (No. 6), same data as No. 5; 55 ♂♂ and 50 ♀♀, a fishery without name, Laiyuan County (39°18'N, 114°42'E), Hebei Province, 8 August 1988, collected by Shuqiang Li; 32 ♂♂ and 32 ♀♀, headwaters of River Jumahe, Laiyuan County, Hebei Province, 5 September 2004, collected by Zhong-E Hou and Yucheng Lin.

**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.





MAP 1

Localities of freshwater amphipods along the River Jumahe. Triangle = *Gammarus lacustris* Sars, 1863; square = *G. nekkensis* Uchida, 1935; pentangle = *G. madidus* sp. n..

*Remarks:* *G. lacustris* was redescribed by Karaman & Pinkster (1977) based on samples from all over the distribution area, while Barnard & Dai (1988) redescribed it in detail with material from Yunnan, China. The specimens examined accord well with the figures and description of *G. lacustris* given by Barnard & Dai (1988), except that the bases of pereopods 5-7 is a little more elongate, epimeral plates 2 and 3 without very sharp posterodistal corners and telson with 1 basolateral spine.

*Distribution:* Karaman & Pinkster (1977) recorded the known distribution of the species as follows: Afghanistan, Austria, Balkan region, Canada, Czech Republic, Denmark, Finland, France, Germany, India, Ireland, Italy, Norway, north Poland, Scotland, Slovakia, Sweden, Switzerland, Spain, Turkey, northern parts of U.S.A. According to the material deposited in IZCAS, *G. lacustris* also occurs in Nepal (Parbat Distr.) and China (Yunnan Province, Hebei Province and Xinjiang Uygur Autonomous Region).

***Gammarus nekkensis* Uchida, 1935**

*Gammarus nekkensis* Uchida, 1935: 1-6, pls 1-4; Barnard & Barnard, 1983: 463; Karaman, 1984: 147-148; Karaman, 1989: 19-35, Figs 1-5.

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

*Material examined:* 20 ♂♂, 21 ♀♀ and 5 juv., Mt. Baicaopan, Beibianqiao Village, Jiulong Town, Yesanpo Scenic Area, Laishui County, Hebei Province, 13 May 2000, collected



by Shuqiang Li; 2 ♂♂ and 2 ♀♀, a sump under Baicaopan Glacier, Yesanpo Scenic Area, glacier water temperature 5.5°C, glacier surface temperature -1.5°C, altitude 1180 m, 13 May 2000, collected by Shuqiang Li; 1 ♂, 2 ♀♀ and 5 juv., a brook on the left hand of the glacier, 13 May 2000, collected by Shuqiang Li; 13 ♂♂, a sump in the middle hill of Mt. Baicaopan, 13 May 2000, collected by Shuqiang Li; 8 ♂♂, 10 ♀♀ and 5 juv. (MHNG), a drinkable water spring near Wanglaopu Village, Liudu Town, Fangshan District, Beijing City, opening about 0.5 square meter, 24 November 2003, collected by Shuqiang Li, Lihong Tu and Kaibaryer Meng.

**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:** *G. nekkensis* was first described on the basis of material from Wuling Mountain, Hebei, then it was reviewed in detail by Karaman (1989) on the basis of specimens from Beijing. The present material accords well with the figures and description given by Karaman (1989), except for a little shorter inner ramus of uropod 3 and long setae on the dorsal surface of the telson. These features may be variable within the species.

**Distribution:** Known from the River Jumahe and Mt. Wuling. River Jumahe runs along Mts. Taihangshan, which is the west boundary of North China Plain (33.0-40.5°N, 113.0-119.5°E), while Mt. Wuling is the highest peak in Mts. Yanshan, the north boundary of North China Plain.

### *Gammarus madidus* sp. n.

Figs 1-6

**Material examined:** Holotype (IZCAS-I-A0111), ♂, a sump on the middle hill of Mt. Baicaopan, Yesanpo Scenic Area, Laishui County, Hebei Province, 13 May 2000, collected by Shuqiang Li; paratypes, 195 ♂♂, 172 ♀♀ and 13 juv. (IZCAS), 20 ♂♂ and 20 ♀♀ (MHNG), same data as holotype.

**Etymology:** The latin epithet "madidus" (= wet, moist) refers to the habitat of the species.

**Diagnosis:** Peduncular articles 4 and 5 with groups of long setae along anterior and posterior margins, calceoli present in male; gnathopods 1 and 2 with straight setae; pereopod 3 with long, weakly curled setae on posterior margin; inner ramus of uropod 3 reaching about 40% of length of outer ramus, both rami fringed with long simple setae.

**Description of male holotype:** Body length 14.0 mm.

Head (Fig. 1A): Inferior antennal sinus deep, eyes medium in size.

Antenna 1 (Fig. 5A): Peduncular articles 1-3 with length ratio 1: 0.7 : 0.5, bearing some distal setae; flagellum with 30 articles, most articles with aesthetascs, accessory flagellum with 5 articles.

Antenna 2 (Figs 5B, F, G): Peduncular article 4 about as long as article 5, both with 5-7 groups of long setae on inner margin, 6-7 groups of long setae on inner surface and 3-5 groups of long setae on outer margin; flagellum with 15 articles, calceoli present.

Upper lip (Fig. 1C): Convex, with minute setae.

Lower lip (Fig. 1J): Inner lobe absent.





FIG. 1

*Gammarus madidus* sp. n., holotype, male. A, head; B, urosomites 1-3 (dorsal view); C, upper lip; D, left mandible; E, maxilliped; F, incisor and lacinia mobilis of right mandible; G, maxilla 2; H, left maxilla 1; I, palp of right maxilla 1; J, lower lip.



Mandibles (Figs 1D, F): Left incisor with 5 teeth; lacinia mobilis with 4 denticles; spine row with 9 plumose setae; molar bearing 1 plumose seta; article 2 of palp bearing 21 stiff setae, article 3 about 75% of length of article 2, bearing a group of 5 A-setae on outer surface, 4 B-setae on inner surface, a row of plumose D-setae and 5 long E-setae. Right incisor with 4 teeth, lacinia mobilis bifurcate, each with crenulations at edge.

Maxilla 1 (Figs 1H, I): Asymmetrical, inner margin of inner plate bearing several setules basally and 17 plumose setae evenly distributed between base and apex; outer plate bearing 11 serrated spines; palp with 2 articles, left second article falcate, bearing 8 slender spines apically accompanied by 4 apico-facial setae; right second article bearing 5 blunt spines associated with 2 stiff setae.

Maxilla 2 (Fig. 1G): Inner plate bearing a diagonal row of 15 plumose setae on inner margin, some pubescent setae on outer margin and many stiff setae apically; outer plate with long stiff setae apically and some setules on outer margin.

Maxilliped (Fig. 1E): Inner plate bearing 1 subapical spine and 3 apical blunt spines; outer plate with row of 16 blade spines and 4 pectinate setae; palp with 4 articles.

Coxal plates: Coxal plate 1 (Fig. 2A) weakly dilated distally, bearing 3 setules on anteroventral corner and 2 setules on posteroventral corner; coxal plates 2 and 3 subrectangular (Figs 2B, 3B), bearing 2 setules on anteroventral corner and 1 setule on posteroventral corner; coxal plate 4 excavated on posterior margin (Fig. 3A), bearing 2 setules on anteroventral corner and 5 setules on posterior margin; coxal plates 5 and 6 with small anterior lobe (Figs 4A, B), bearing 2 setules on posterior margins; coxal plate 7 shallow (Fig. 4C), bearing 4 setules on posterior margin.

Coxal gills present on gnathopod 2 and pereopods 3-7 (Figs 2B, 3A, B, 4A-C).

Gnathopod 1 (Figs 2A, C): Basis bearing long setae on antero-proximal and posterior margin; carpus about 75% of length of propodus, densely setose, with long setae on posterior margin; propodus ovate, palm oblique, bearing 1 palmar medial spine, 4 pairs of spines and 1 spine on posterior margin and 6 spines on inner surface, these associated with groups of long, naked setae on posterior margin; dactylus with 1 seta on outer margin and 2 setules at hinge of nail.

Gnathopod 2 (Figs 2B, D): Basis similar to that of gnathopod 1; carpus reaching about 75% of length of propodus; propodus subrectangular, palm weakly oblique, bearing 1 medial palmar spine, 4 spines on inner posterodistal corner and 2 spines on outer posterodistal corner, these associated with groups of setae on posterior margin; dactylus bearing 1 seta on outer margin and 2 setules at hinge of nail.

Pereopod 3 (Figs 3B, C): Basis with groups of long setae on posterior margin; merus to propodus densely set with long, weakly curled setae on posterior margins, carpus and propodus accompanied by 4-5 spines; dactylus bearing 1 plumose seta on outer margin and 2 setae at hinge of nail.

Pereopod 4 (Figs 3A, D) shorter than pereopod 3; basis with long setae on posterior margin; merus with 5 groups of long setae on posterior margin; carpus bearing 2-3-2-1 spines accompanied by long setae on posterior margin; propodus bearing 2-1-1-1 spines accompanied by some long setae on posterior margin; dactylus bearing 1 plumose seta on outer margin and 2 setae at hinge of nail.



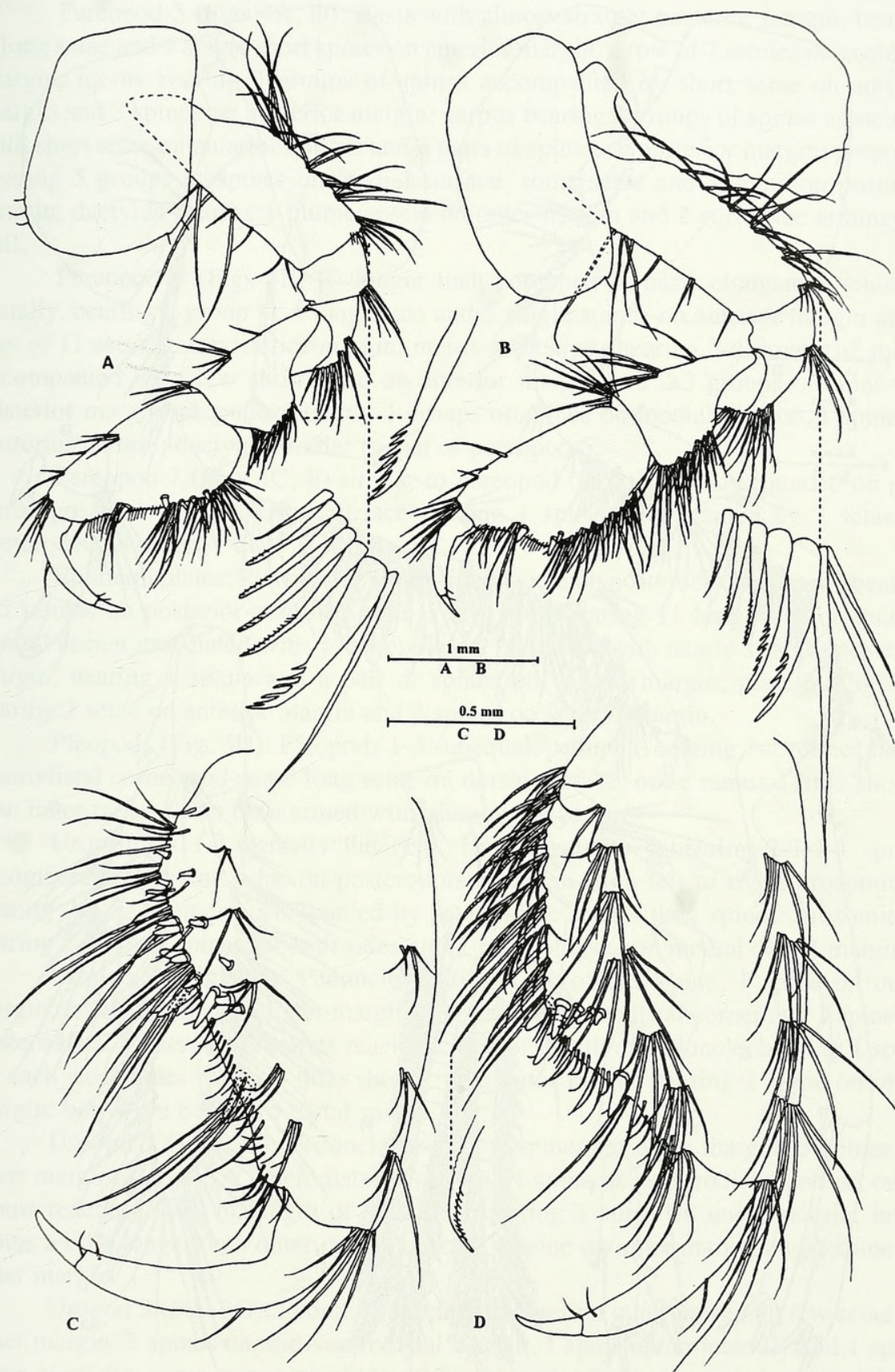


FIG. 2

*Gammarus madidus* sp. n., holotype, male. A, gnathopod 1; B, gnathopod 2; C, propodus of gnathopod 1; D, propodus of gnathopod 2.



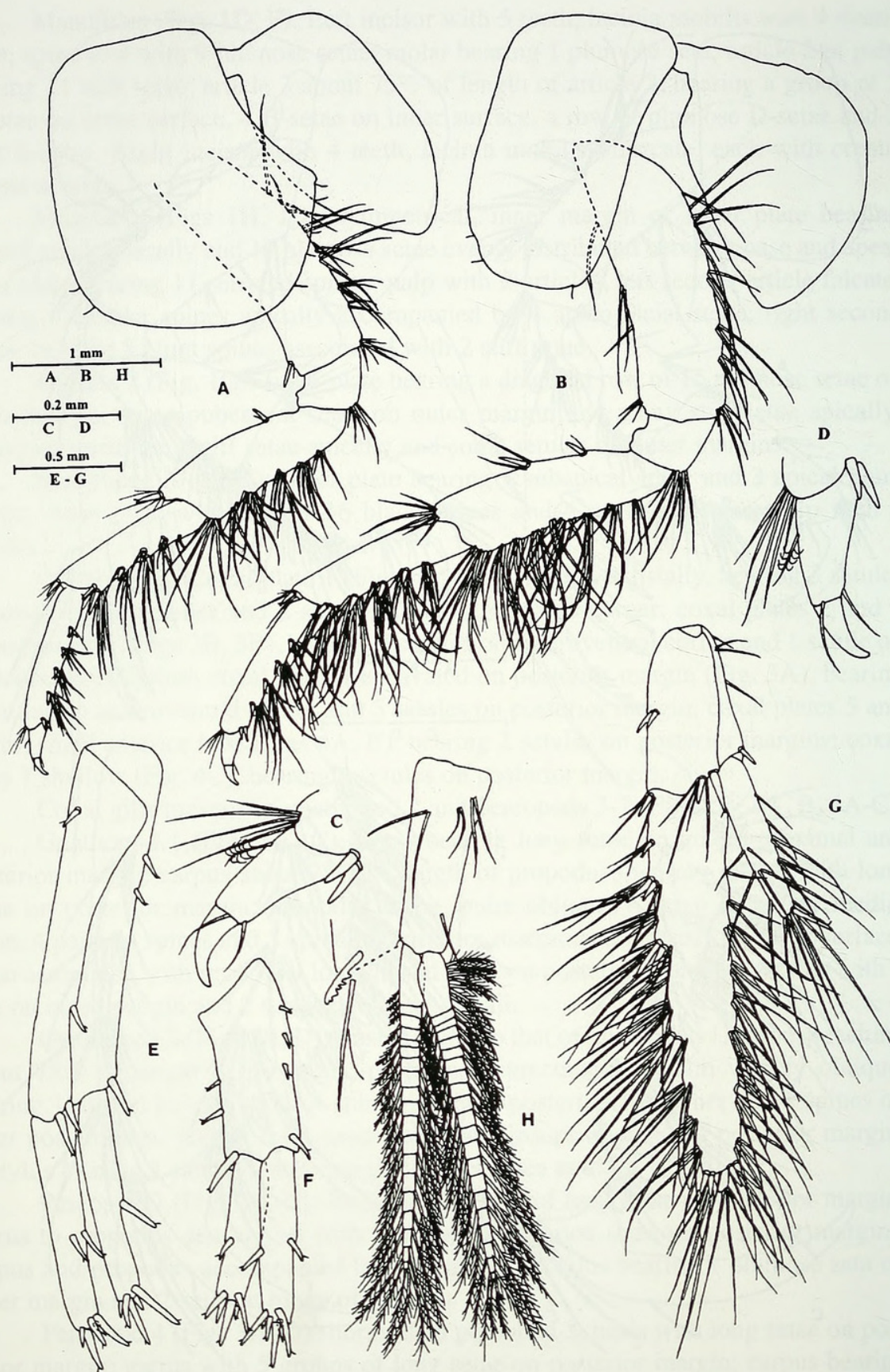


FIG. 3

*Gammarus madidus* sp. n., holotype, male. A, pereopod 4; B, pereopod 3; C, dactylus of pereopod 3; D, dactylus of pereopod 4; E, uropod 1; F, uropod 2; G, uropod 3; H, pleopod 1.



Pereopod 5 (Figs 4A, D): Basis with almost straight posterior margin, bearing 5 long setae and 5 single short spines on anterior margin, a row of 7 setules on posterior margin; merus bearing 3 groups of spines accompanied by short setae on anterior margin and 3 spines on posterior margin; carpus bearing 4 groups of spines associated with short setae on anterior margin and 3 pairs of spines on posterior margin; propodus bearing 5 groups of spines on medial surface, some setae and 1 spine on posterior margin; dactylus bearing 1 plumose seta on outer margin and 2 stiff setae at hinge of nail.

Pereopod 6 (Figs 4B, E) longer than pereopod 5, basis elongate, attenuated distally, bearing a group of 4 long setae and 5 single spines on anterior margin and a row of 11 setules on posterior margin; merus and carpus bearing 3-4 groups of spines accompanied by a few short setae on anterior margin and 2-3 groups of spines on posterior margin; propodus bearing 4 groups of spines on medial surface, 1 spine on posterior margin; dactylus similar to that of pereopod 5.

Pereopod 7 (Figs 4C, F) similar to pereopod 6, basis weakly rounded on proximal posterior margin, inner surface bearing 1 spine accompanied by 3 setae on posterodistal corner.

Epimeral plates: Plates 1-3 progressively acute on posterodistal corners, bearing 3-5 setules on posterior margins; plate 1 (Fig. 5C) bearing 11 long setae on antero-ventral corner associated with 1 spine; plate 2 (Fig. 5D) with nearly straight posterior margin, bearing 1 setule and a pair of spines on ventral margin; plate 3 (Fig. 5E) bearing 2 setae on anterior margin and 3 spines on ventral margin.

Pleopods (Fig. 3H): Pleopods 1-3 subequal, peduncle bearing 1-2 retinacula on anterodistal corner and some long setae on dorsal surface; outer ramus a little shorter than inner ramus, both rami armed with plumose setae.

Urosomites 1-3 dorsally flat (Fig. 1B), urosomite 1 bearing 2-1-1-1 spines accompanied by some setae on posterodorsal margin from left to right; urosomite 2 bearing 2-1-1-2 spines accompanied by setae, setae longer than spines; urosomite 3 bearing 2 pairs of spines on both sides and 2 pairs of setae on medial dorsal margin.

Uropod 1 (Fig. 3E): Peduncle bearing 1 basofacial spine, 1 spine on outer margin, 2 single spines on inner margin, 2 spines on anterodistal corner and 1 spine on posterodistal corner; outer ramus reaching 57% of length of peduncle, bearing 1 spine on each side; inner ramus a little shorter than outer ramus, bearing 1 spine on inner margin; both rami bearing 5 distal spines.

Uropod 2 (Fig. 3F): Peduncle bearing 2 spines on outer margin, 3 spines on inner margin, 1 spine on anterodistal corner and 1 spine on posterodistal corner; outer ramus reaching 90% of length of peduncle, bearing 1 spine on outer margin; inner ramus a little longer than outer ramus, bearing 1 spine on inner margin and 1 spine on outer margin.

Uropod 3 (Fig. 3G): Peduncle bearing 2 spines on outer margin, a few setae on inner margin, 2 spines on mid-ventrodistal margin, 1 spine apico-laterally and 1 spine apico-medially; inner ramus reaching 40% of length of outer ramus, bearing 1 long distal spine; article 1 of outer ramus bearing 1-2-2-2 spines on outer margin and 2 pairs of distal spines; article 2 shorter than adjacent spines; both rami densely fringed with long simple setae.



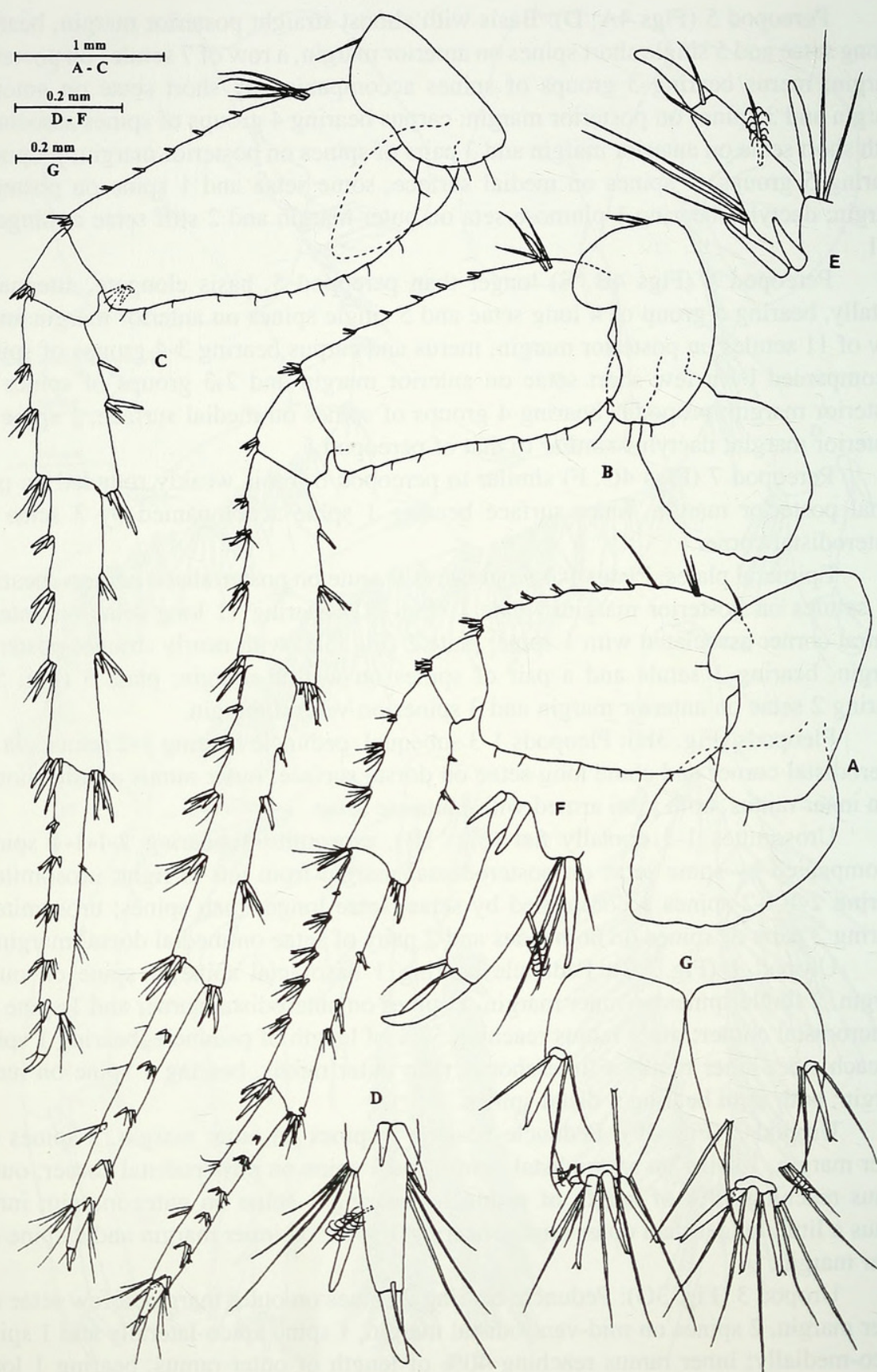


FIG. 4

*Gammarus madidus* sp. n., holotype, male. A, pereopod 5; B, pereopod 6; C, pereopod 7; D, dactylus of pereopod 5; E, dactylus of pereopod 6; F, dactylus of pereopod 7; G, telson.



Telson deeply cleft (Fig. 4G), each lobe bearing 1 lateral spine accompanied by long setae, 3-4 distal spines accompanied by long setae and some facial setae.

*Description of female:* Body length 13.5 mm.

Antenna 2 (Fig. 5H): Peduncular articles 4 and 5 bearing groups of long setae along anterior and posterior margins; flagellum with 12 articles, calceoli absent.

Gnathopod 1 (Fig. 6A): Propodus ovate, palm not as oblique as that of male, bearing 8 spines on posterodistal corner; dactylus bearing 1 seta on outer margin and 2 setules at hinge of nail.

Gnathopod 2 (Fig. 6B): Propodus subrectangular, palm truncate, bearing 5 spines on posterodistal corner; dactylus bearing 1 seta on outer margin and 2 setules at hinge of nail.

Pereopods 5-7: Bases shorter than those of male (Figs 6C-E).

Uropod 3 (Fig. 6F): Inner ramus reaching 44% of length of outer ramus, bearing 1 lateral and 1 distal spines; outer ramus with 1-2-2 spines on outer margin and 1 spine on inner margin, both rami fringed with simple setae.

Oostegites (Fig. 5I) present on gnathopod 2 and pereopods 3-5.

*Remarks:* *Gammarus madidus* sp. n. is similar to *G. electrus* Hou & Li (see Hou & Li, 2003c), which is distributed in and around Beijing City and to *G. curvativus* Hou & Li (see Hou & Li, 2003b), which occurs in Yunnan and Sichuan Province. All three species possess (1) antenna 2 with calceoli, (2) inner ramus of uropod 3 reaching about 40% of length of outer ramus and both rami armed with long simple setae, (3) urosomites 1-3 flat, with 4 groups of spines and setae. *G. madidus* sp. n. differs from *G. electrus* (character states of *G. electrus* in parentheses) in (1) peduncular articles 4 and 5 of antenna 2 bearing groups of long setae along anterior and posterior margins (short setae), (2) gnathopods 1 and 2 with long straight setae (gnathopod 1 with long curled setae on posterior margin of propodus, gnathopod 2 with long curled setae on dorsal margins of carpus and propodus), (3) pereopod 3 with long straight setae on posterior margin (long curled setae). *G. madidus* sp. n. differs from *G. curvativus* (character states of *G. curvativus* in parentheses) by (1) accessory flagellum of antenna 1 with 4 or 5 articles (2 articles); (2) gnathopod 2 with straight setae (gnathopod 2 with long curled setae on dorsal margin of carpus and weakly curled setae on dorsal margin of propodus); (3) telson with 1 lateral spine (no spines).

*Gammarus madidus* sp. n. is also similar to *G. nekkensis* in (1) antenna 2 with calceoli, (2) epimeral plates 1-3 progressively acute, (3) inner ramus not more than half of outer ramus. The new species can be distinguished from *G. nekkensis* (character states of *G. nekkensis* in parentheses) by (1) antenna 2 with long setae on peduncular articles 4 and 5 (short setae), (2) pereopod 3 with long straight setae (curled setae), (3) both rami of uropod 3 bearing long simple setae (outer margin of outer ramus bearing long simple setae, but inner margin of outer ramus and both margin of inner ramus bearing plumose setae).

*Gammarus madidus* sp. n. coexists with *G. nekkensis* at Mt. Baicaopan.

*Distribution:* Known only from Mt. Baicaopan, Hebei Province.



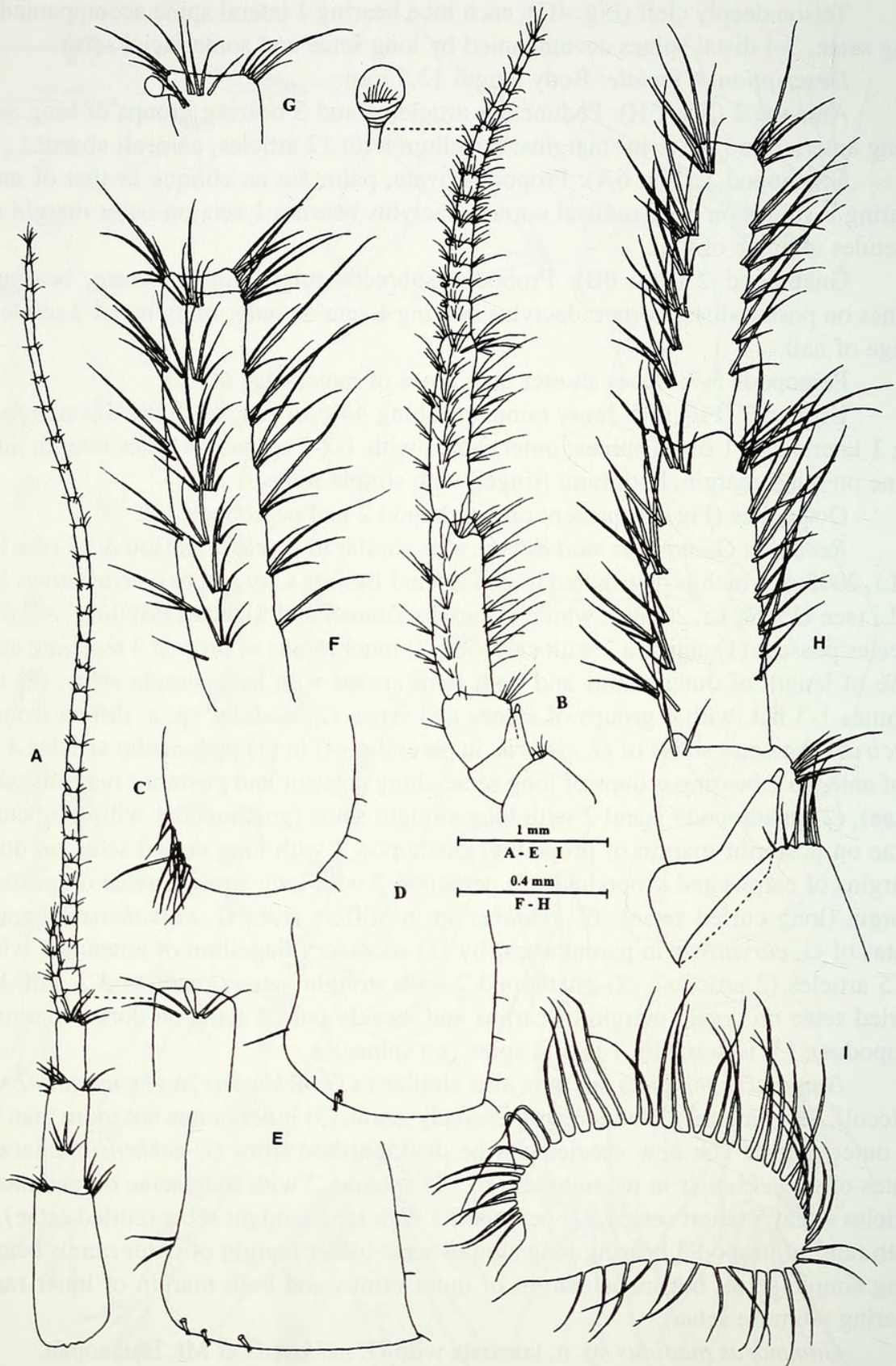


FIG. 5

*Gammarus madidus* sp. n., male: A-G; female: H, I. A, antenna 1; B, antenna 2; C, epimeral plate 1; D, epimeral plate 2; E, epimeral plate 3; F, peduncular article 5 of antenna 2; G, one flagellomere of antenna 2; H, peduncular articles 3-5 of antenna 2; I, oostegite 2.



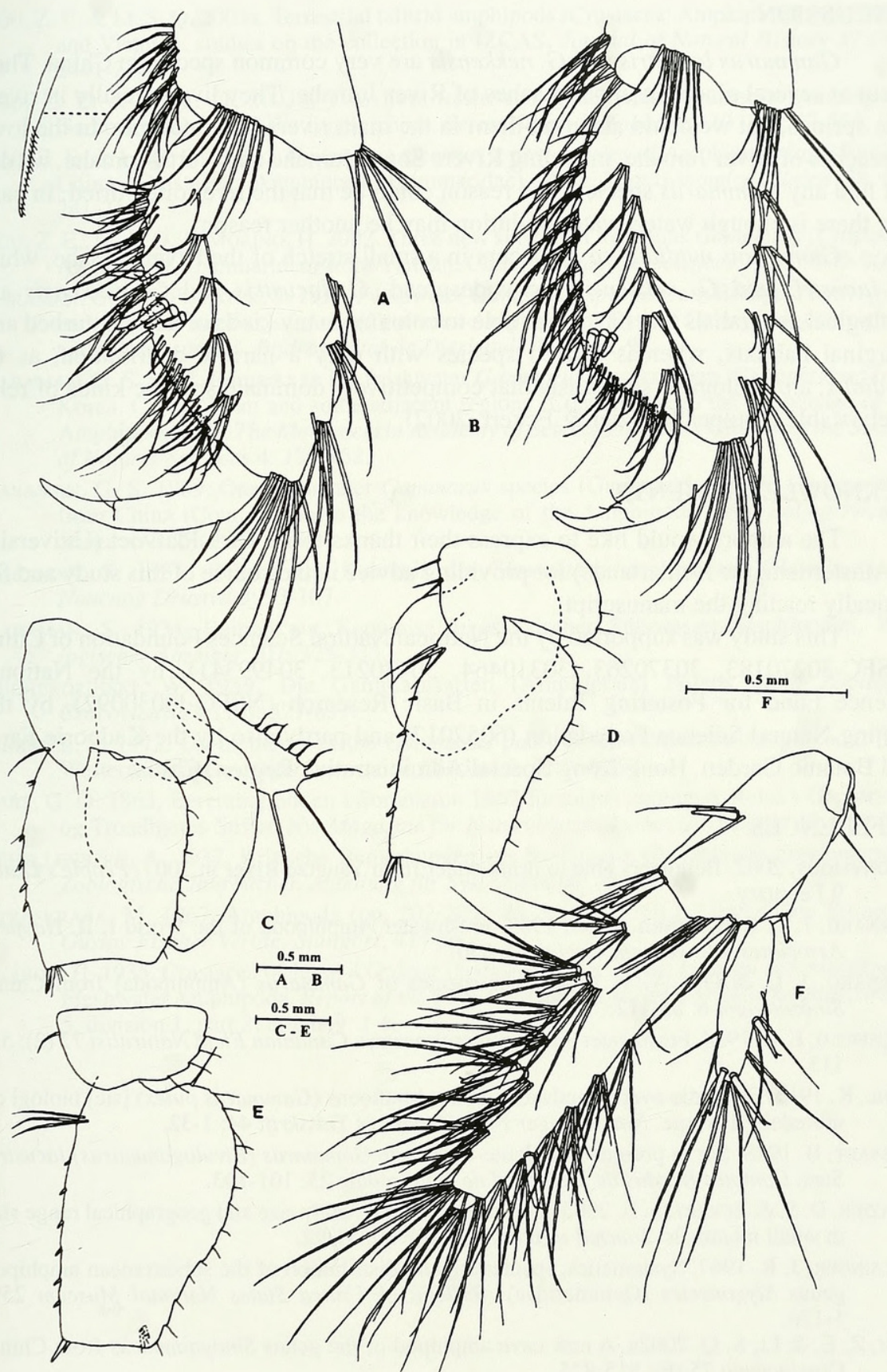


FIG. 6

*Gammarus madidus* sp. n., female. A, propodus of gnathopod 1; B, propodus of gnathopod 2; C, basis of pereopod 5; D, basis of pereopod 6; E, basis of pereopod 7; F, uropod 3.



## DISCUSSION

*Gammarus lacustris* and *G. nekkensis* are very common species in China. They occur at several places in upper reaches of River Jumahe. They live specially in river-side springs, but we could also find them in the main rivers in wintertime. In the lower reaches of River Jumahe, including Rivers South-Jumahe and North-Jumahe, we did not find any *Gammarus* species. The reason could be that the river often dried. In case that there is enough water, water pollution may be another reason.

*Gammarus madidus* sp. n. occurs in a small stretch of the River Jumahe, while *G. lacustris* and *G. nekkensis* are widespread. *G. lacustris* and *G. nekkensis* are ecological generalists that have been able to colonize many kinds of new, disturbed and marginal habitats, whereas related species with only a narrow distribution, as *G. madidus*, are ecological specialists that competitively dominate specific kinds of relatively stable biotopes (Glazier & Eckert, 2002).

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