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On three new species of *Mesochra* Boeck, 1865 (Harpacticoida: Canthocamptidae) from Iceland

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Abstract

Three new species of *Mesochra* Boeck, 1865, were found during two surveys in south-western Iceland of the feeding ecology of juvenile lumpsucker *Cyclopterus lumpus* Linnaeus, 1758, in floating seaweed and the seasonality of harpacticoids in a low intertidal pool. Only two species of the genus, *M. lilljeborgi* Boeck, 1864 and *M. rapiens* (Schmeil, 1894), have been found in previous studies in Iceland. The three new species, *Mesochra ingolfssoni* sp. nov., *Mesochra snoppa* sp. nov., and *Mesochra freyri* sp. nov. resemble *M. stellfeldi* Jakobi, 1954 in the normal (not dwarfed) outer seta of both male and female P5 EXP, but differ in that *M. stellfeldi* possesses unequal inner baseoendopodal setae on the female P5. The three new species resemble *M. pygmaea* (Claus, 1863) in the equal inner baseoendopodal setae of the female P5, but differ in the dwarfed outer seta of the male and female P5 EXP present in *M. pygmaea*, and can be easily separated by shape of the rostrum, female P6, number of pinnate elements on the second antennular segment, general shape of the antenna and shape of the lateral and distal inner spines, among other character states.

Keywords: *Copepoda, Harpacticoida, Iceland,* Mesochra, *new species, taxonomy*

Introduction

Three new species of *Mesochra* Boeck, 1865 were found during two ecological investigations in south-western Iceland. The investigations dealt with the feeding ecology of juvenile lumpsucker *Cyclopterus lumpus* Linnaeus, 1758 in floating seaweed (Ingólfsson and Kristjánsson 2002) and with the seasonality of harpacticoids in a low intertidal pool (Steinarsdóttir et al. 2003). One new *Mesochra* species (*M. ingolfssoni* sp. nov.) is here described from floating seaweed clumps taken during the former investigation. The same species was also found in an earlier investigation of harpacticoid communities harboured by floating seaweeds (see Ólafsson et al. 2001) but was identified as *M. pygmaea* (Claus, 1863). Most species found on floating seaweed clumps in Iceland have also been found in the intertidal zone (Ólafsson et al. 2001), but *M. ingolfssoni* sp. nov. has not been found elsewhere. In the latter investigation, more than 70 harpacticoid species were recorded from the red alga *Chondrus crispus* Stackhouse, 1797, many of which were not identified to

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the species level. In the present paper, two new *Mesochra* species are described from that study (*M. snoppa* sp. nov. and *M. freyri* sp. nov.). They were both among the 10 most common species and were found to have different seasonality from each other, during the sampling period. Ovigerous females of *M. snoppa* sp. nov. were frequently found throughout the year, while ovigerous females of *M. freyri* sp. nov. were rarely found (Steinarsdóttir et al. 2003). Of these two species, *M. snoppa* sp. nov. has been found on floating seaweed clumps (A. Ingólfsson, E. Ólafsson, and M. B. Steinarsdóttir, unpublished data). Two other species of *Mesochra* have been found previously in Iceland, *M. lilljeborgi* Boeck, 1864 and *M. rapiens* (Schmeil, 1894) (Ólafsson 1994; Scher et al. 2000).

Materials and methods

Specimens of *Mesochra* from Eiðsvík, south-western Iceland, were collected by B. K. Kristjánsson and H. Sveinbjörnsson (see Ingólfsson and Kristjánsson 2002) and by M. B. Steinarsdóttir and M. Karlsdóttir in Seltjarnarnes, near Reykjavík, south-western Iceland (see Steinarsdóttir et al. 2003). Specimens found in Eiðsvík were from colonization experiments. Branches of the brown alga *Ascophyllum nodosum* Le Jolis, 1863 were first collected at Bygggarðar, Seltjarnarnes, and then taken directly to the bay of Eiðsvík. The branches were tethered to anchored buoys on the surface of the sea and collected approximately 10 days later. Samples were collected monthly from May 1995 to November 1996 (for more details see Ingólfsson and Kristjánsson 2002).

At Snoppa, Seltjarnarnes, samples of the red alga *C. crispus* were collected monthly from a saline tidal pool in the low rocky intertidal zone. Samples were collected monthly from January 1999 to January 2000 (for more details see Steinarsdóttir et al. 2003). All samples were preserved in 5% formalin solution. After preservation, animals were washed from the algae and those retained by a 63 µm sieve were kept in 70% alcohol.

Morphological observations and drawings were made from whole and dissected specimens. Observations and drawings were made using a Leica compound microscope equipped with drawing tube at magnifications of 1000×. Additional observations were made also at 1250×. The type material has been deposited in the collection of marine invertebrates of the Icelandic Institute and Museum of Natural History (IMNH) and in the collection of the Natural History Museum (London) (NHM).

The terminology proposed by Huys and Boxshall (1991) for morphological descriptions was adopted. Abbreviations in text: ae, aesthetasc; P1–P6, first to sixth swimming legs; EXP, exopod; ENP, endopod; P1(P2–P4) EXP(ENP)1(2, 3) denotes the proximal (middle, distal) exopodal (endopodal) segment of P1, P2, P3, or P4.

Taxonomic account

Mesochra ingolfssoni sp. nov.
(Figures 1–8)

Type material

One female holotype (IMNH-23456) and one male allotype (IMNH-23451) preserved in alcohol, one female (IMNH-23446) and one male (IMNH-23441) dissected paratypes, and two female and one male paratype (NMH 2006.1488–1490) and one female and one

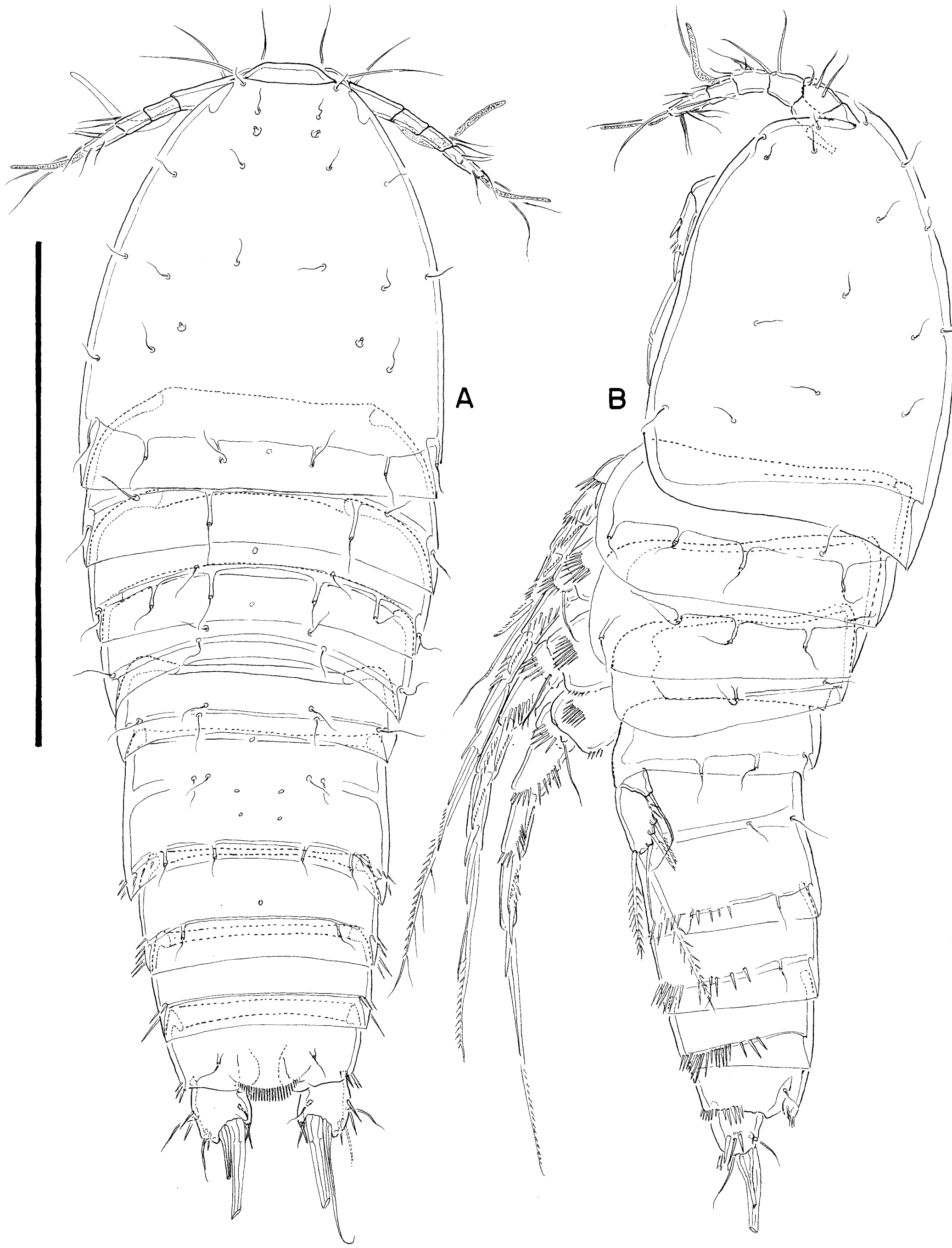

Figure 1. *Mesochra ingolfssoni* sp. nov., female. (A) Habitus, dorsal; (B) habitus, lateral. Scale bar: 214 µm.

male paratypes preserved in alcohol (IMNH-23436), 15 November 1995, coll. B. K. Kristjánsson and H. Sveinbjörnsson. The sample of floating seaweed was taken within an area 300–600 m from the shore, where bottom depth was 7–14 m below mean low water of springs.

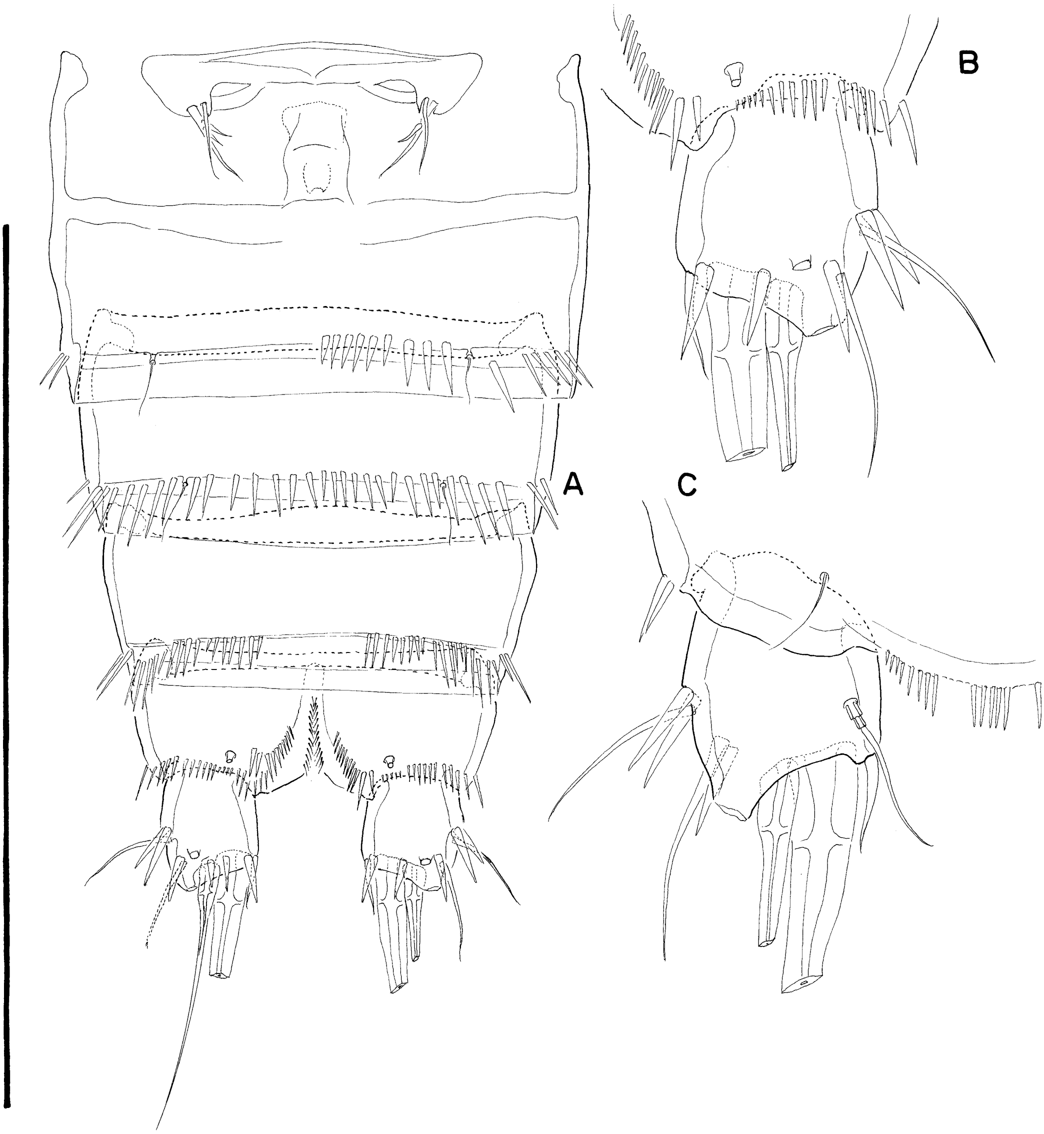

Figure 2. *Mesochra ingolfssoni* sp. nov., female. (A) Urosome, ventral, P5-bearing somite omitted; (B) left caudal ramus, ventral; (C) left caudal ramus, dorsal. Scale bar: 200 μm (A); 100 μm (B, C).

Type locality

Eiðsvík, south-western Iceland (64°09′N, 21°49′W).

Etymology

The species was named in honour of Professor Agnar Ingólfsson (University of Iceland, Institute of Biology) for his contribution to the knowledge of intertidal organisms.

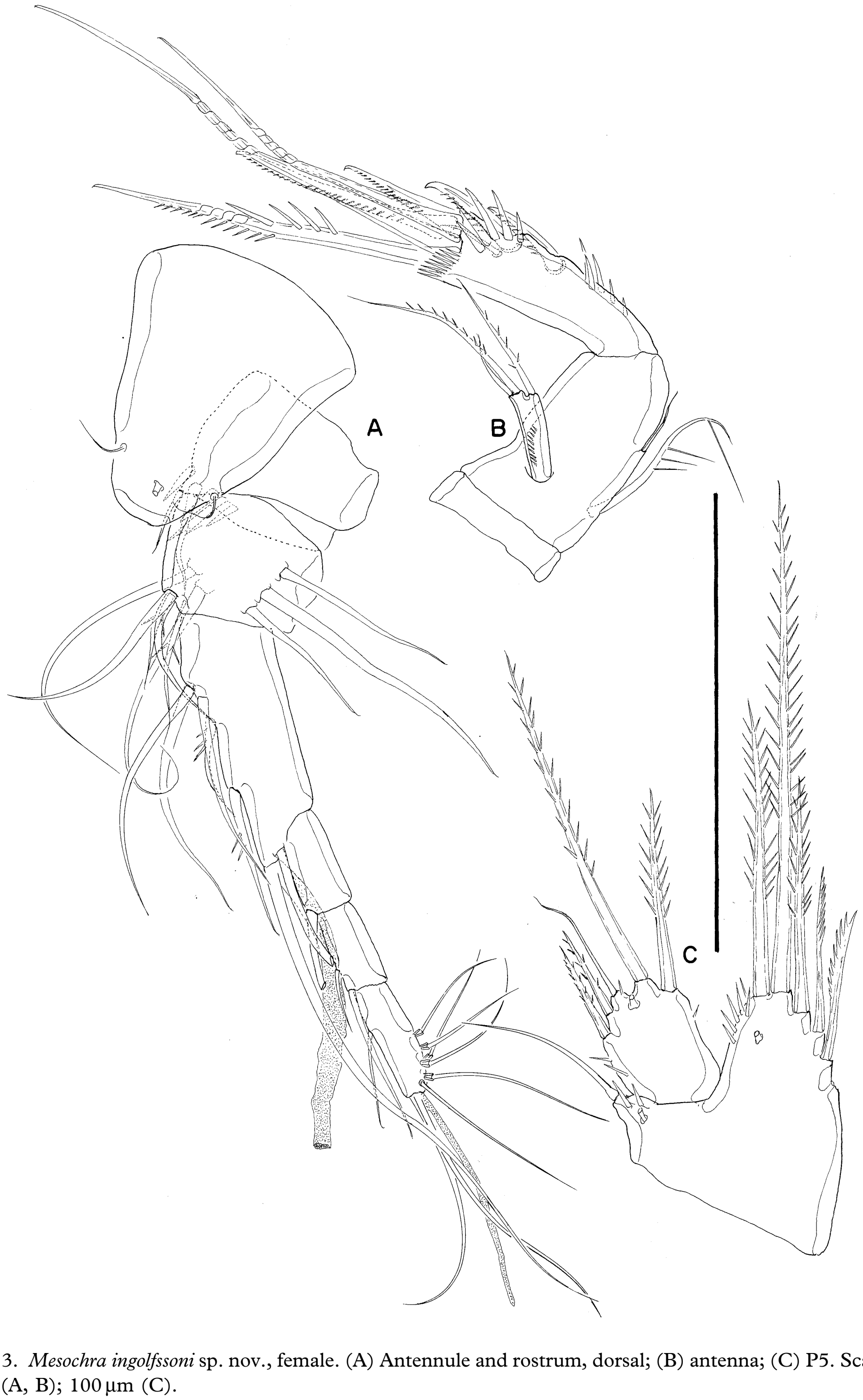

Figure 3. *Mesochra ingolfssoni* sp. nov., female. (A) Antennule and rostrum, dorsal; (B) antenna; (C) P5. Scale bar: 70 µm (A, B); 100 µm (C).

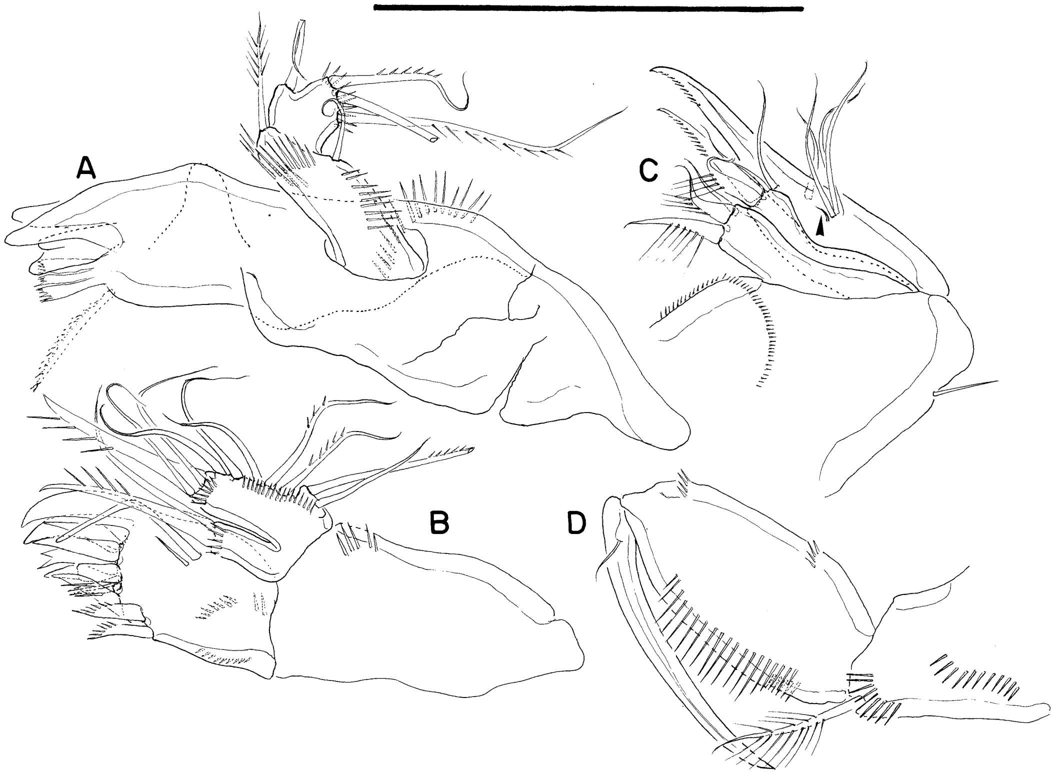

Figure 4. *Mesochra ingolfssoni*. sp. nov., female. (A) Mandible; (B) maxillule; (C) maxilla; (D) maxilliped. Scale bar: 50 μm.

Female

Body fusiform (Figure 1A, B). Total body length, measured from tip of rostrum to posterior margin of caudal rami, ranging from 230 to 260 μm (mean=245 μm; n=5) (holotype, 260 μm). Greatest width near posterior edge of cephalothorax, the latter about one-third of total body length. Rostrum distinct, bell-shaped, with tube pore ventrally (Figure 3A). Dorsal surface of cephalothorax and free prosomites without spinular ornamentation, with plain hyaline frill. First urosomite (P5-bearing somite) as previous somite. Second and third urosomites fused (genital double-somite), with vestige of division between somites visible in lateral (Figure 1B) and ventral view (Figure 2A); second urosomite (first genital somite) without, third urosomite (second genital somite) with spinules along posterior margin laterally (Figure 1B) and ventrally (Figure 2A); genital pore (Figure 2A) in first genital somite. Fourth and fifth urosomite as second genital somite. Anal somite somewhat shorter than preceding somite, with spinules close to joint with caudal rami laterally (Figure 1B) and ventrally (Figure 2A, B); with rounded anal operculum ornamented with spinules along posterior margin (Figures 1A, 2C). Caudal rami (Figures 1A, B, 2A–C) about as long as wide; with six setae; seta II inserted midway along outer margin of rami and flanked by two strong spinules; seta III inserted ventrally and accompanied by strong spinule; seta VI small; seta VII inserted rather internally; caudal rami with large, outer pore distally (Figure 2B, C) and with smaller pore ventrally close to seta III.

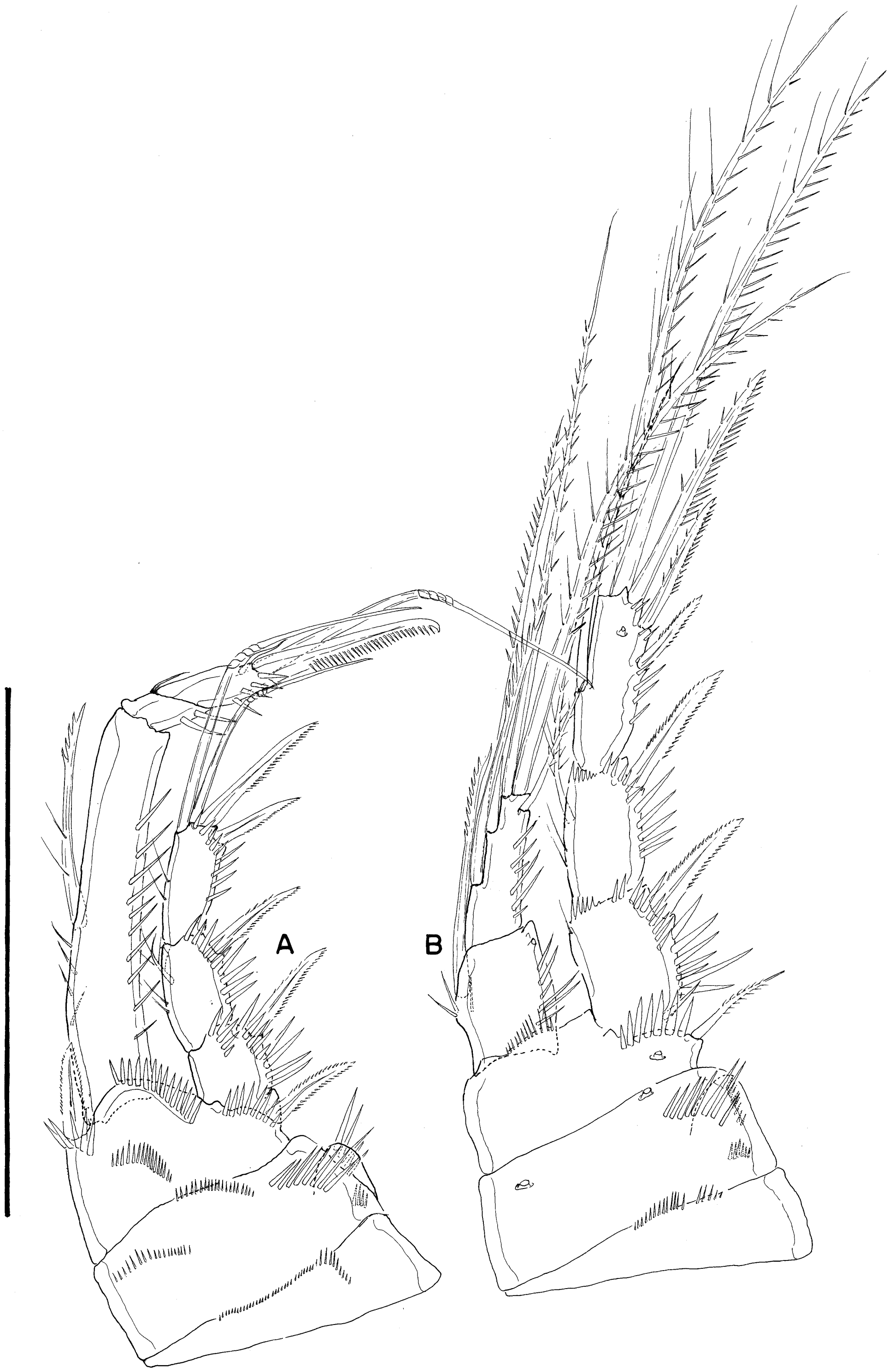

Figure 5. *Mesochra ingolfssoni* sp. nov., female. (A) P1; (B) P2. Scale bar: 100 µm.

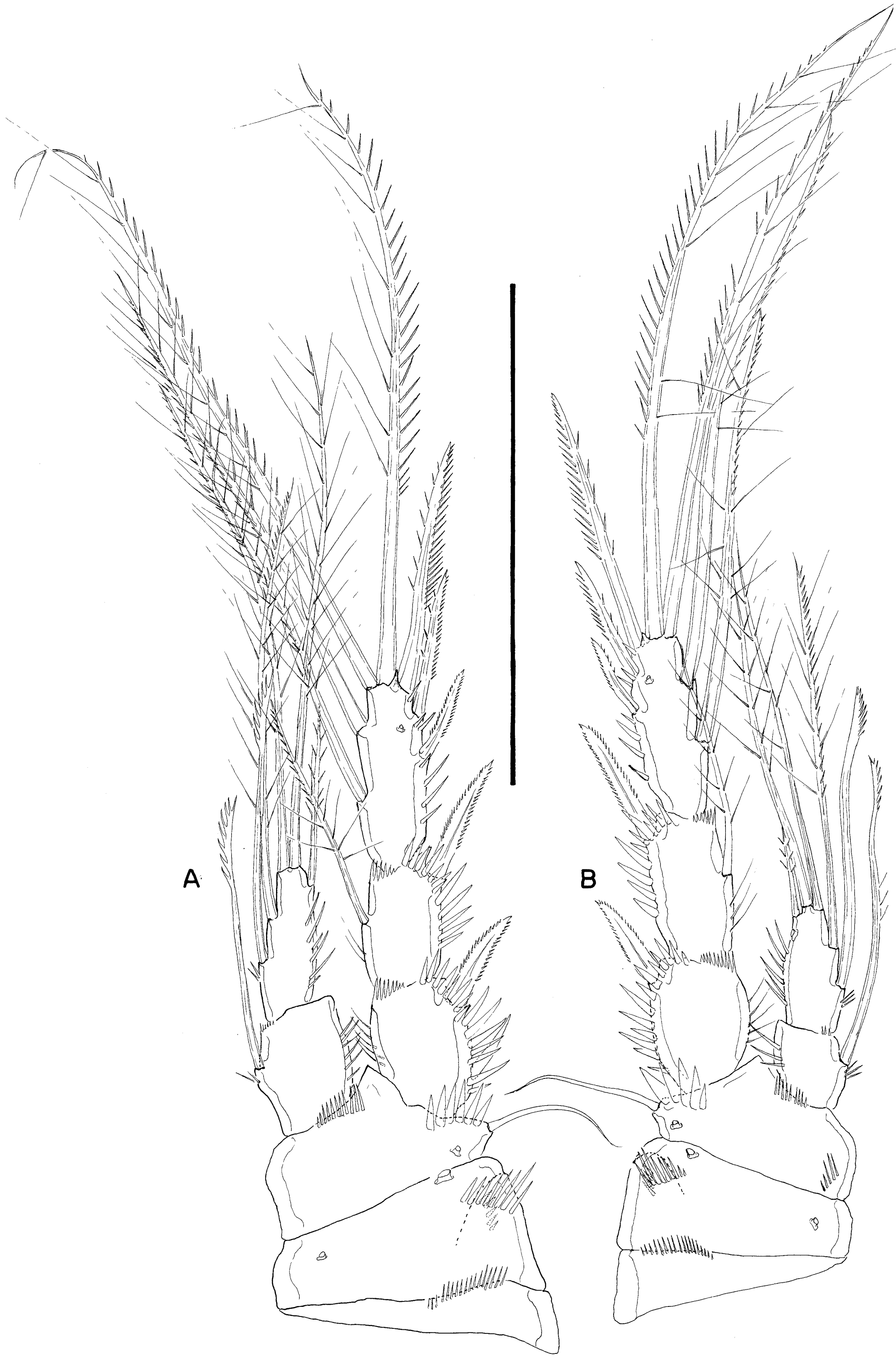

Figure 6. *Mesochra ingolfssoni* sp. nov., female. (A) P3; (B) P4. Scale bar: 100 µm.

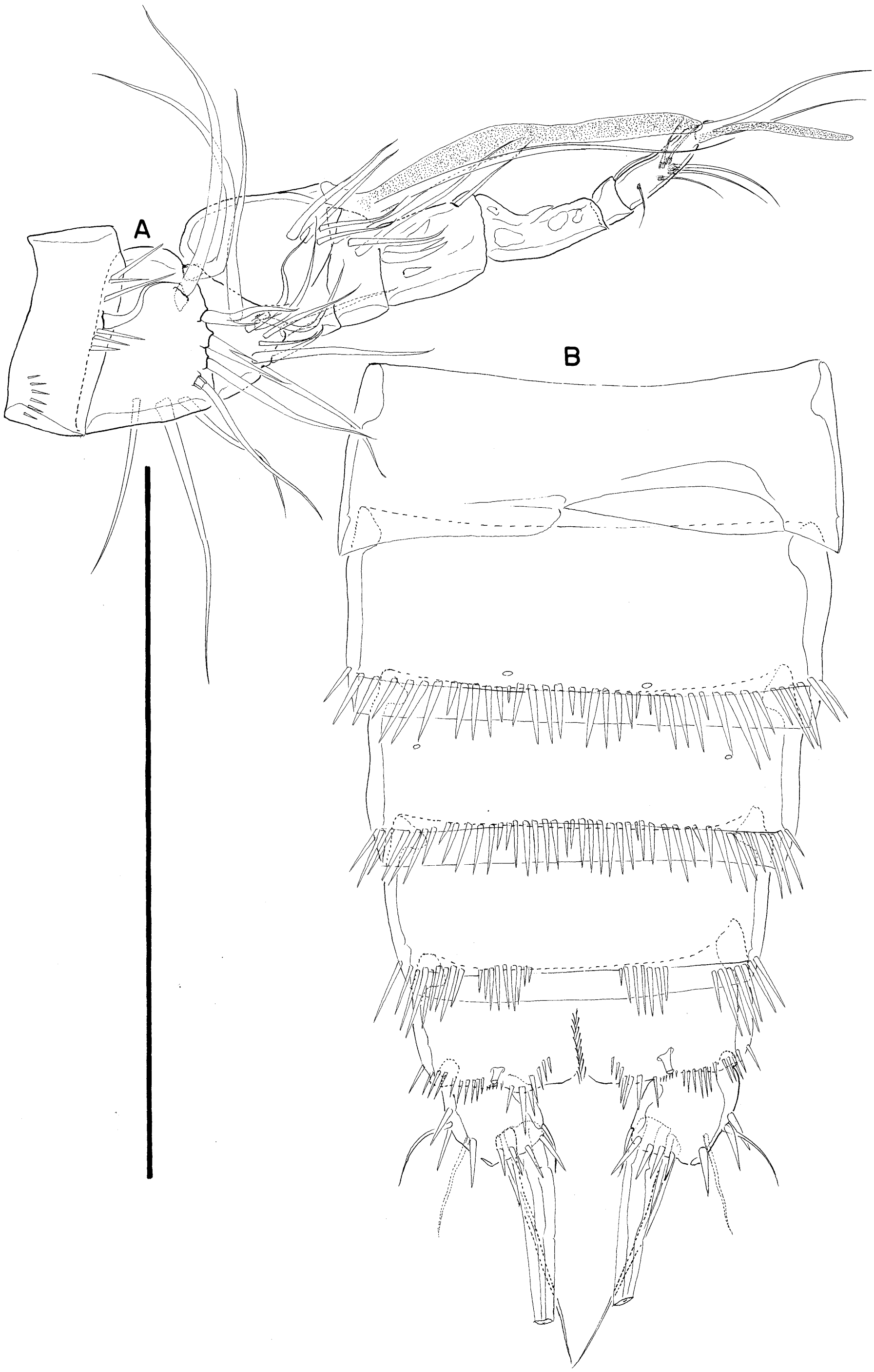

Figure 7. *Mesochra ingolfssoni* sp. nov., male. (A) Antennule, dorsal; (B) urosome, ventral, P5-bearing somite omitted. Scale bar: 100 µm (A); 143 µm (B).

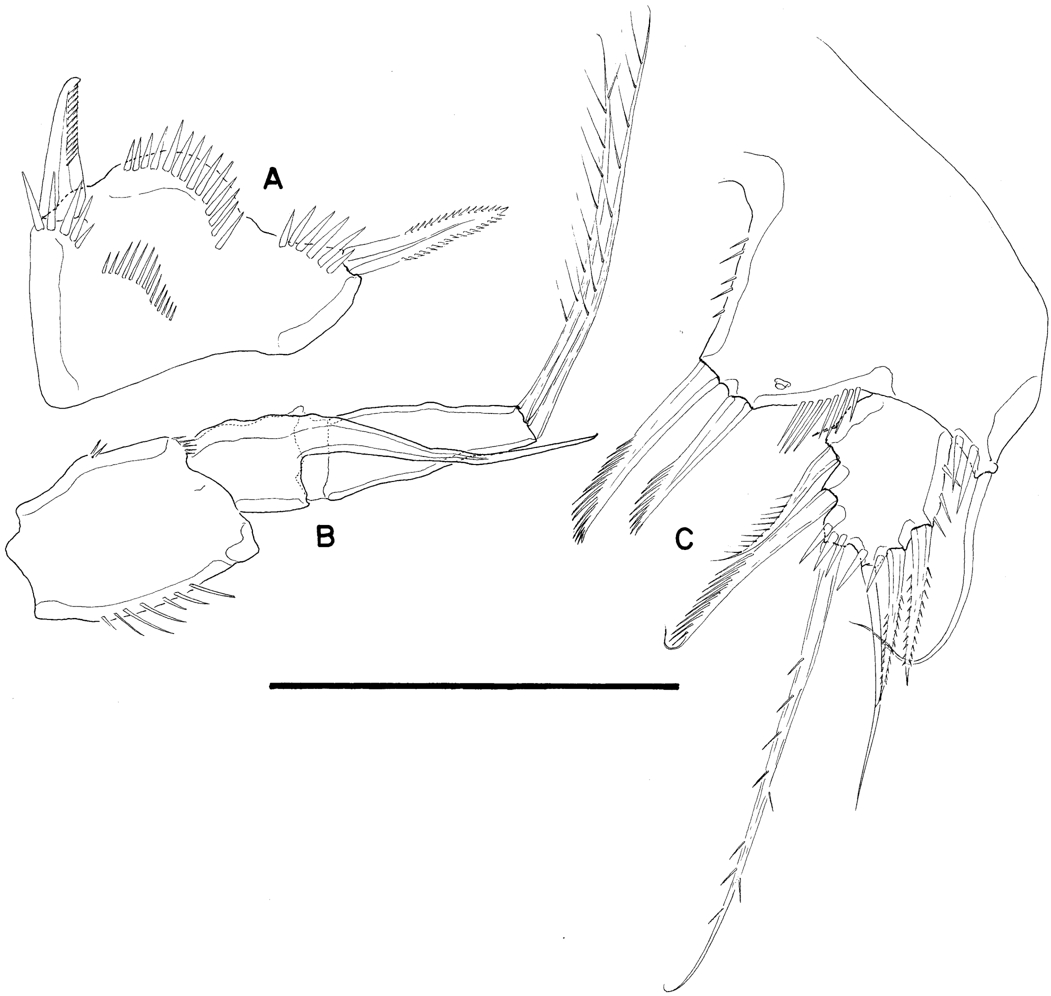

Figure 8. *Mesochra ingolfssoni* sp. nov., male. (A) Basis of P1; (B) P3 ENP; (C) P5. Scale bar: 50 µm.

Antennule (Figure 3A) six-segmented. Surface of segments smooth, except for some spinules on first segment. First and second segment about as long as wide; third segment longest, being about three times longer than wide; fourth, fifth, and sixth segments about twice as long as wide. All setae smooth except for two pinnate setae on second and third segment. Armature formula: I(1)-II(9)-III(6+(1+ae))-IV(1)-V(2)-VI(7+acrotheke). Acrotheke consisting of aesthetasc and two setae.

Antenna (Figure 3B): allobasis with two abexopodal setae, proximal one long, distal one very small. Exopod one-segmented, with one lateral, long seta, and two distal elements (one of them small). Endopod with strong spinules along inner margin proximally and subdistally, with deeply incised outer frill apically; with two lateral spines and one slender seta, and five distal elements (two spines, two geniculate setae, and one spinulose element).

Mandible (Figure 4A): biting edge formed by strong teeth and one seta. Basis long, ornamented with spinular rows as figured, and armed with one seta. Exopod represented by single seta. Endopod one-segmented, with three distal and one lateral seta.

Maxillule (Figure 4B): praecoxal arthrite ornamented with some minute spinules posteriorly; with one surface seta accompanied by a small spinule; with seven strong spines and two spinule-like elements distally, and two pinnate elements laterally. Coxa and basis fused; coxal endite with two setae. Rami fused to basis; endopod and exopod apparently represented by two and three setae, respectively. Basis with two lateral, two subdistal, and one distal pinnate seta.

Maxilla (Figure 4C): syncoxa ornamented with spinular row along inner margin; with two endites, bearing three setae each. Basis produced into strong claw accompanied with one anterior and one posterior seta. Endopod represented by three long and one very small seta (the latter arrowed in Figure 4C).

Maxilliped (Figure 4D): syncoxa ornamented with spinular rows as figured, and armed with one plumose seta. Basis with longitudinal row of long spinules along inner margin, and with smaller outer spinules proximally and subdistally. Endopod with smooth claw and a small accompanying seta.

P1 (Figure 5A): praecoxa, coxa and basis ornamented as figured. Basis with inner and outer spine. Exopod three-segmented, reaching distal third of first endopodal segment. Endopod three-segmented; ENP1 about 5.3 times longer than wide, inner seta inserted midway along inner margin and barely reaching tip of supporting segment.

P2–P4 (Figures 5B, 6A, B): praecoxa, coxa, and basis ornamented as figured; coxa with two, basis with one pore. Basis of P2 with outer spine-like element, of P3 and P4 with outer seta. Exopod three-segmented; EXP1 without, EXP2 with inner seta; P2 EXP3 with one, P3 and P4 EXP3 with two inner setae. Endopod two-segmented; of P2 and P3 reaching tip of second exopodal segment, of P4 barely reaching proximal half of EXP2; ENP1 with one inner seta, ENP2 with two inner, two apical, and one outer seta.

P5 (Figure 3C): exopod distinct, with five elements. Baseoendopodal lobe with five elements as figured. Baseoendopod with pores on baseoendopodal lobe and close to basal seta.

P6 (Figure 2A) represented by two setae. Copulatory pore in anterior half of genital-double somite.

Armature formula of female P1–P5 as follows:

	P1	P2	P3	P4	P5
EXP	0-1-022	0-1-123	0-1-223	0-1-223	5
ENP	1-1-120	1-221	1-221	1-221	5

Male

Body (not shown) as in female except for genital double-somite (Figure 7B). Total body length ranging from 205 to 230 μm (mean=219 μm; n=3) (allotype, 230 μm). Spinular ornamentation on urosomites, anal somite, and anal operculum as in female; caudal rami as in female (Figure 7B).

Antennule (Figure 7A) subchirocer, nine-segmented. Surface of segments smooth except for spinules on first segment. Segments IV and IX with aesthetasc. All setae smooth except for two pinnate setae on second segment. Armature formula difficult to define.

Mouthparts, P1 (basis, Figure 8A), P2, and P4 (not illustrated) as in female.

P3 as in female, except for three-segmented endopod (Figure 8B); ENP1 without inner seta; ENP2 with inner sinuous apophysis, reaching beyond ENP3; the latter with two apical setae.

P5 (Figure 8C) with medially fused baseoendopods. Exopod reaching beyond endopodal lobe and armed with six setae as figured. Endopodal lobe with two elements of unequal length.

P6 (Figure 7B) represented by two asymmetrical plates, one of them distinct, the other fused to somite.

Mesochra snoppa sp. nov.

(Figures 9–17)

Type material

One female holotype (IMNH-23431) and one male allotype (IMNH-23426) preserved in alcohol, two female (IMNH-23416, IMNH-23421) and two male (IMNH-23411, IMNH-23406) dissected paratypes, and one female and one male paratype preserved in alcohol (NMH 2006.1483–1484), 12 August 1999, coll. M. B. Steinarsdóttir and M. Karlsdóttir. Elevation of the tidal pool from where the samples were collected during low tide was 1.14 m above chart datum, just below level of mean low-water neaps.

Type locality

Snoppa, Seltjarnarnes, south-western Iceland (64°10′N, 22°01′W).

Etymology

The species was named after the locality from which it was described.

Female

Body fusiform (Figures 9A, 10A). Length, measured from tip of rostrum to posterior margin of caudal rami, ranging from 325 to 340 µm (mean=328 µm; n=4) (holotype, 325 µm). Greatest width near posterior edge of cephalothorax, the latter about one-third of total body length. Rostrum distinct, bell-shaped, with tube pore ventrally (Figure 12A). Dorsal surface of cephalothorax and free prosomites without spinular ornamentation, with plain hyaline frill. First urosomite (P5-bearing somite) as previous somite. Second and third urosomites fused (genital double-somite), with vestige of division between somites visible in lateral (Figure 10A) and ventral view (Figure 11); second urosomite (first genital somite) without, third urosomite (second genital somite) with spinules along posterior margin laterally (Figure 10A) and ventrally (Figure 11); genital pore (Figure 11) in first genital somite. Fourth and fifth urosomite as second genital somite. Anal somite shorter than preceding somite, with spinules close to joint with caudal rami laterally (Figure 10A) and ventrally (Figure 11); with rounded anal operculum ornamented with spinules along posterior margin (Figure 9A, B). Caudal rami (Figures 9A, B, 10A, 11) about as long as wide; with six setae; seta II inserted midway along outer margin and flanked by two strong spinules; seta III inserted in outer distal corner and accompanied by strong spinule; seta VI small; seta VII inserted rather internally; caudal rami with outer pore distally (the latter arrowed in Figure 9B).

Antennule (Figure 12A) six-segmented. Surface of segments smooth, except for some spinules on first segment. First and second segment about as long as wide; third segment longest, being about two times longer than wide; fourth, fifth, and sixth segments about

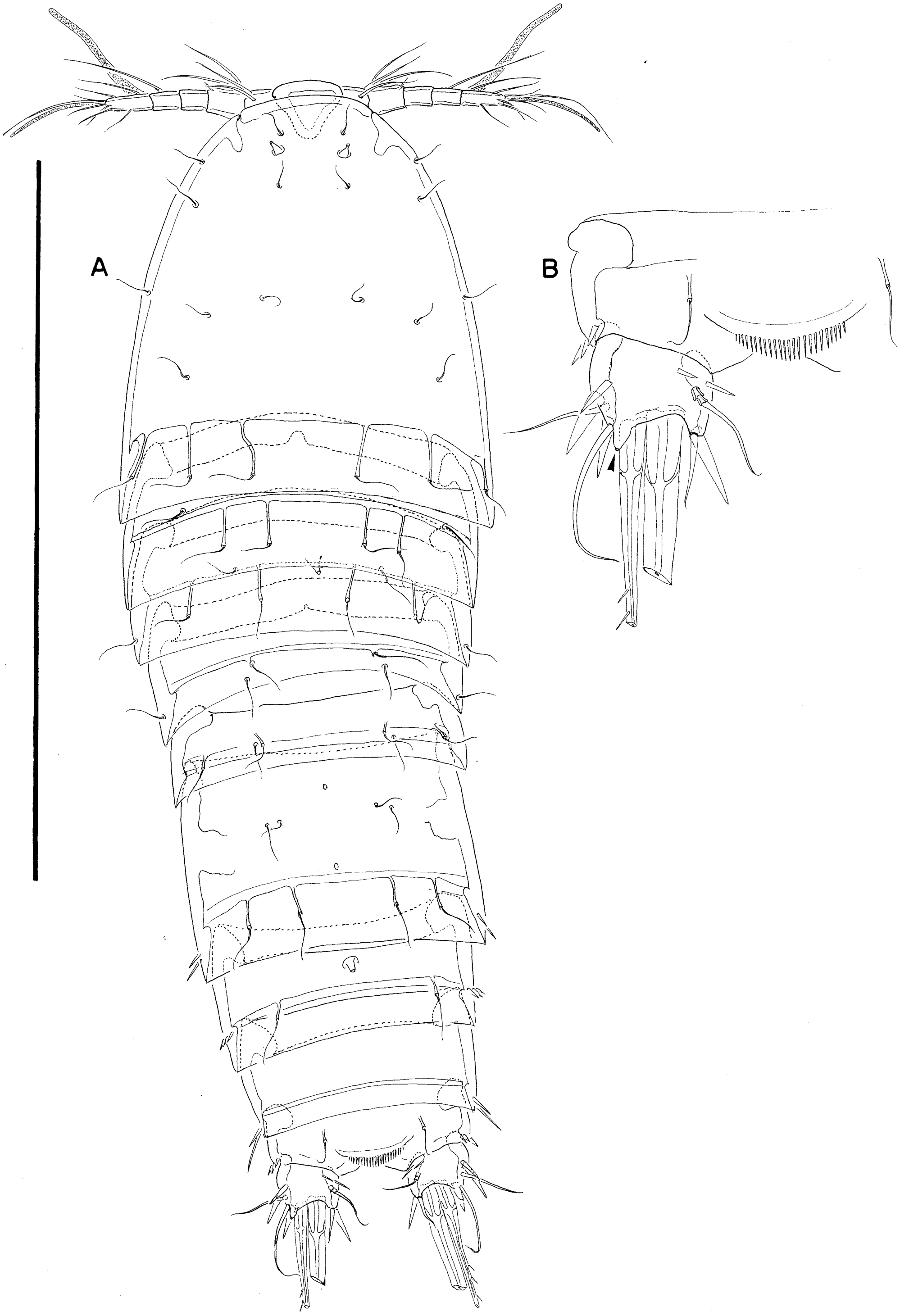

Figure 9. *Mesochra snoppa* sp. nov., female. (A) Habitus, dorsal; (B) anal somite and left caudal ramus, dorsal, distal outer pore arrowed. Scale bar: 200 µm (A); 100 µm (B).

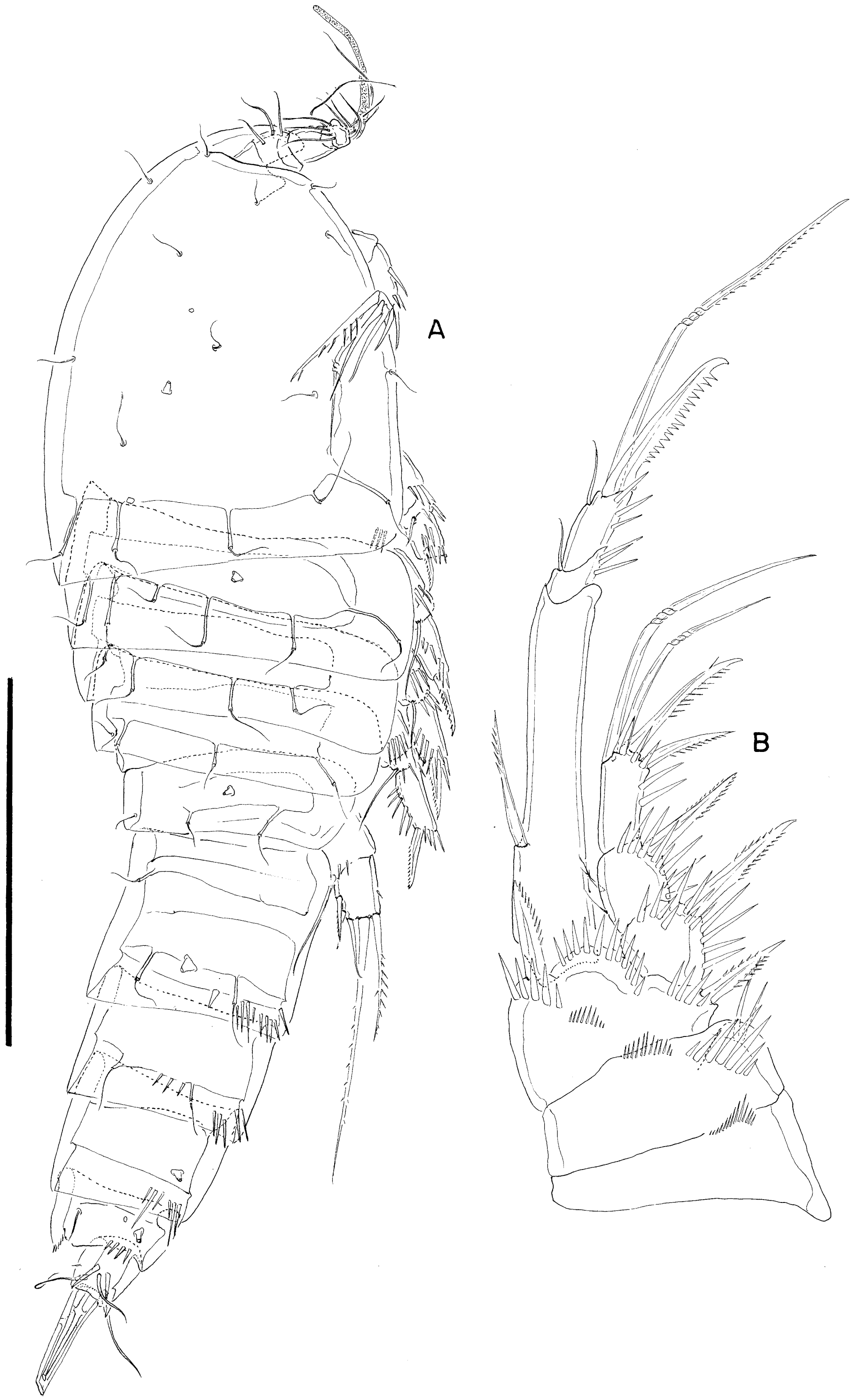

Figure 10. *Mesochra snoppa* sp. nov., female. (A) Habitus, lateral; (B) P1. Scale bar: 100 µm (A); 50 µm (B).

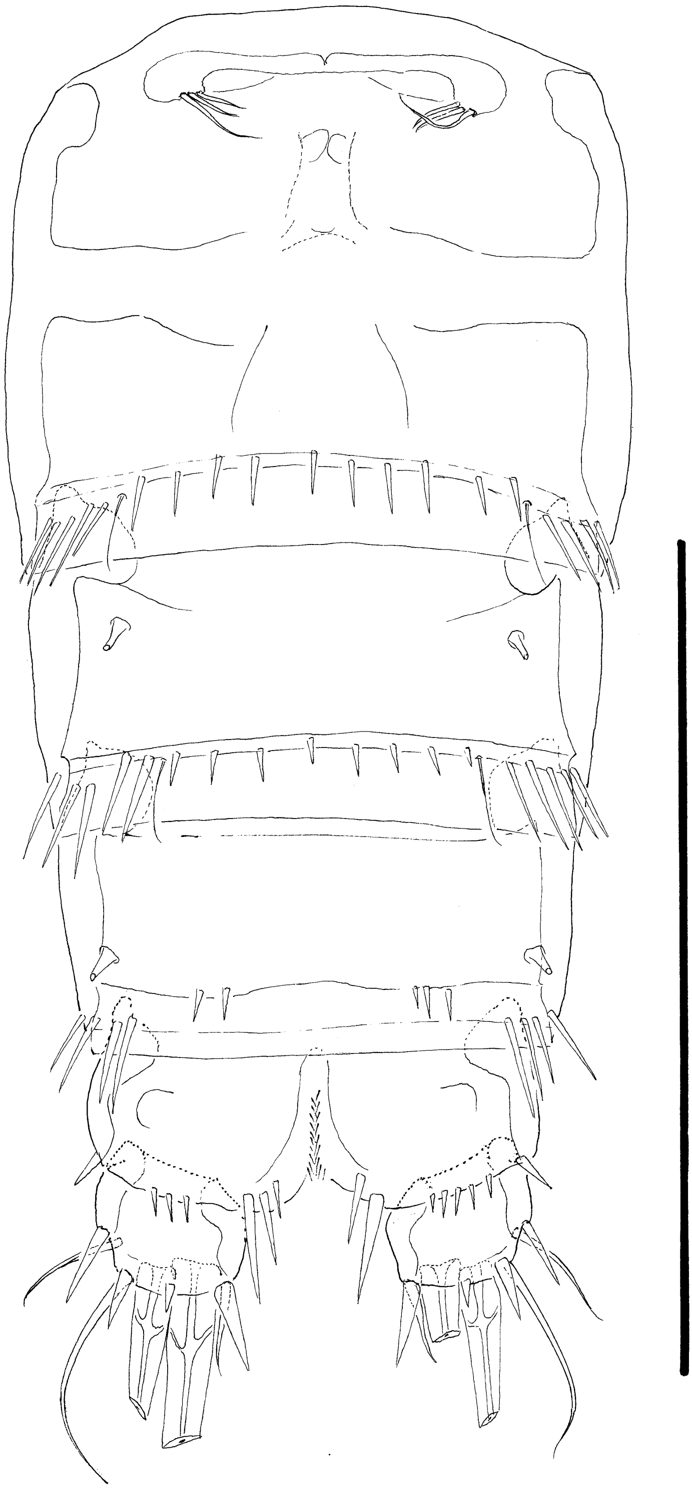

Figure 11. *Mesochra snoppa* sp. nov., female. Urosome, ventral, P5-bearing somite omitted. Scale bar: 100 µm.

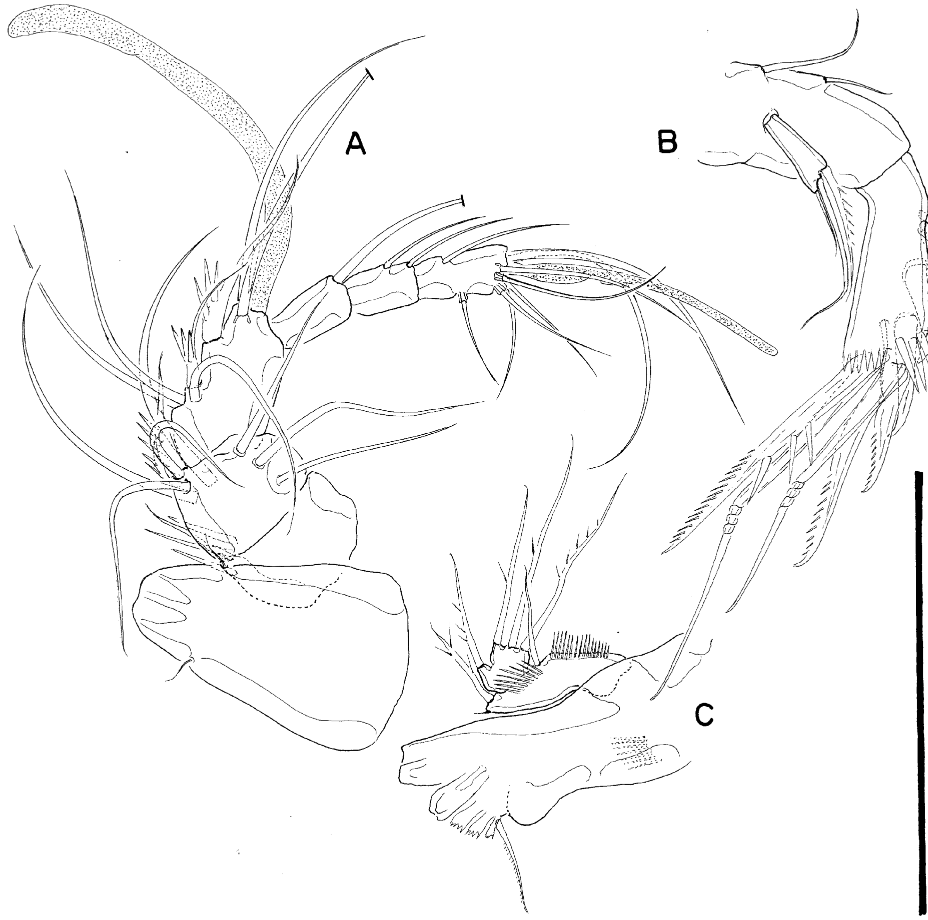

Figure 12. *Mesochra snoppa* sp. nov., female. (A) Antennule and rostrum, dorsal; (B) antenna; (C) mandible. Scale bar: 50 µm.

twice as long as wide. All setae smooth except for two pinnate setae on second and third segment. Armature formula: I(1)-II(9)-III(6+(1+ae)-IV(1)-V(2)-VI(7+acrotheke). Acrotheke consisting of aesthetasc and two setae.

Antenna (Figure 12B): allobasis with two abexopodal setae, proximal one long, distal one small. Exopod one-segmented, with two long and one small seta. Endopod with spinules along inner margin proximally and subdistally, with deeply incised outer frill apically; with two lateral spines and one slender seta, and five distal elements (two spines, two geniculate setae, and one spinulose element).

Mandible (Figure 12C): biting edge with strong teeth and one seta. Basis long, ornamented with longitudinal and transverse spinular rows as figured, and armed with one seta. Exopod represented by single seta. Endopod one-segmented, with three distal and one lateral setae.

Maxillule (Figure 13A): praecoxal arthrite with some minute spinules; with one surface seta; with six strong spines and two spinule-like elements distally, and two elements laterally. Coxa and basis fused; coxal endite with two setae. Rami fused to basis; endopod and exopod apparently represented by two and three setae, respectively. Basis with two lateral, two subdistal, and one distal, pinnate seta.

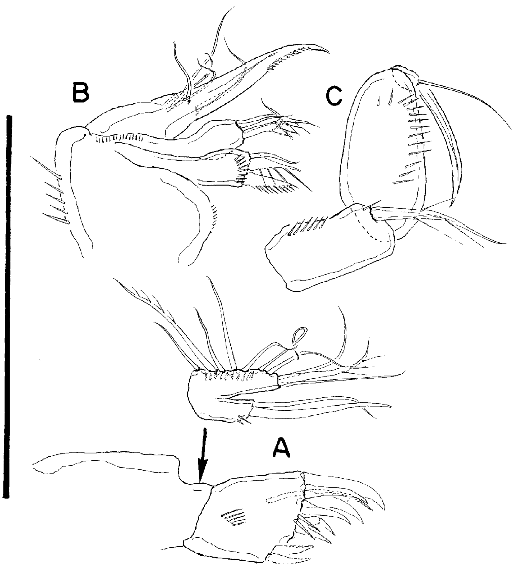

Figure 13. *Mesochra snoppa* sp. nov., female. (A) Maxillule; (B) maxilla; (C) maxilliped. Scale bar: 50 µm.

Maxilla (Figure 13B): syncoxa with spinular rows as figured; with two endites, bearing three setae each. Basis produced into strong claw accompanied with one anterior and one posterior seta. Endopod represented by three setae.

Maxilliped (Figure 13C): syncoxa ornamented with spinular rows as figured, and armed with one seta. Basis with longitudinal row of long spinules along inner margin. Endopod with smooth claw and a long accompanying seta.

P1 (Figure 10B): praecoxa, coxa, and basis ornamented as figured. Basis with inner and outer spine. Exopod three-segmented, reaching middle of first endopodal segment. Endopod three-segmented; ENP1 about 5.3 times longer than wide, inner seta in proximal third of supporting segment, barely reaching distal third of supporting segment.

P2–P4 (Figures 14A, B, 15A): praecoxa, coxa, and basis with spinules and pores as figured. Basis of P2 with outer spine-like element, of P3 and P4 with outer seta. Exopod three-segmented; EXP1 without, EXP2 with inner seta; P2 EXP3 with one, P3 and P4 EXP3 with two inner setae. Endopod two-segmented; of P2 reaching tip of EXP2, of P3 reaching middle EXP2, of P4 barely reaching tip of EXP1; ENP1 with one inner seta, ENP2 with two inner, two apical and one outer seta.

P5 (Figure 15B): exopod distinct, with five elements. Baseoendopodal lobe with five elements as figured. Baseoendopod with two pores on baseoendopodal lobe and one pore close to outer basal seta.

P6 (Figure 11) represented by three setae. Copulatory pore in anterior half of genital-double somite.

Armature formula of female P1–P5 as follows:

	P1	P2	P3	P4	P5
EXP	0-1-022	0-1-123	0-1-223	0-1-223	5
ENP	1-1-120	1-221	1-221	1-221	5

Figure 14. *Mesochra snoppa* sp. nov., female. (A) P2; (B) P3. Scale bar: 50 µm.

Figure 15. *Mesochra snoppa* sp. nov., female. (A) P4; (B) P5. Scale bar: 50 µm.

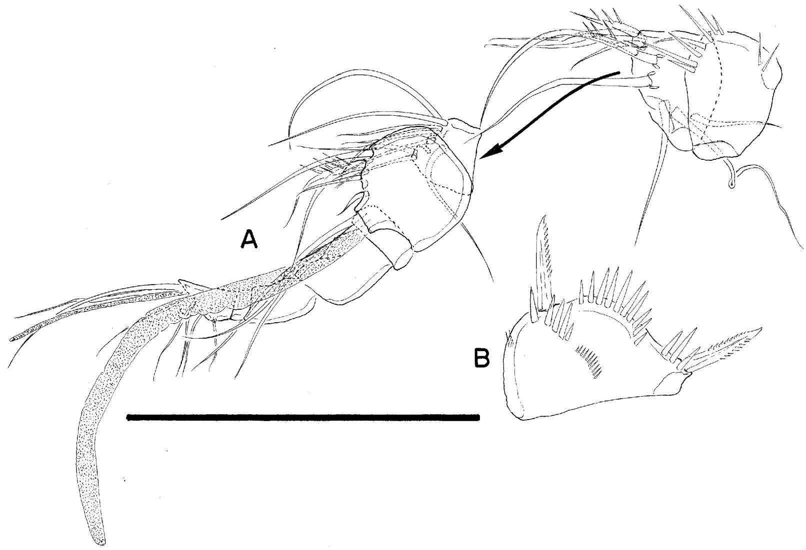

Figure 16. *Mesochra snoppa* sp. nov., male. (A) Antennule, ventral; (B) basis of P1. Scale bar: 50 µm.

Male

Body (not shown) as in female except for genital double-somite (Figure 17A). Total body length ranging from 305 to 315 µm (mean=311 µm; n=4) (allotype, 315 µm). Third to fifth urosomite with more spinules than in female (Figure 17A). Anal somite, anal operculum, and caudal rami (not shown) as in female.

Antennule (Figure 16A) subchirocer, nine-segmented. With spinules on first segment only. Segments IV and IX with aesthetasc. All setae smooth except for two and one pinnate elements on second and third segment, respectively. Armature formula difficult to define.

Mouthparts, P1 (basis, Figure 16B), P2, and P4 (not illustrated) as in female.

P3 as in female, except for three-segmented endopod (Figure 17B); ENP1 without inner seta; ENP2 with inner sinuous apophysis reaching beyond ENP3; the latter with two apical setae.

P5 (Figure 17C) with medially fused baseoendopods. Exopod reaching beyond endopodal lobe and armed with six setae as figured. Endopodal lobe with two elements of subequal length.

P6 (Figure 17A) represented by two asymmetrical plates, one of them distinct, the other fused to somite.

Mesochra freyri sp. nov.
(Figures 18–22)

Type material

One female holotype (IMNH-23396) and one male allotype (IMNH-23391) preserved in alcohol, two female (IMNH-23386, NMH 2006.1485) and one male (IMNH-23376) dissected paratypes, and one and two male paratypes preserved in alcohol (IMNH-23371, NHM 2006.1486–1487, respectively), 12 August 1999, coll. M. B. Steinarsdóttir and M. Karlsdóttir. Elevation of the tidal pool, from where the samples were collected during low tide, was 1.14 m above chart datum, just below level of mean low-water neaps.

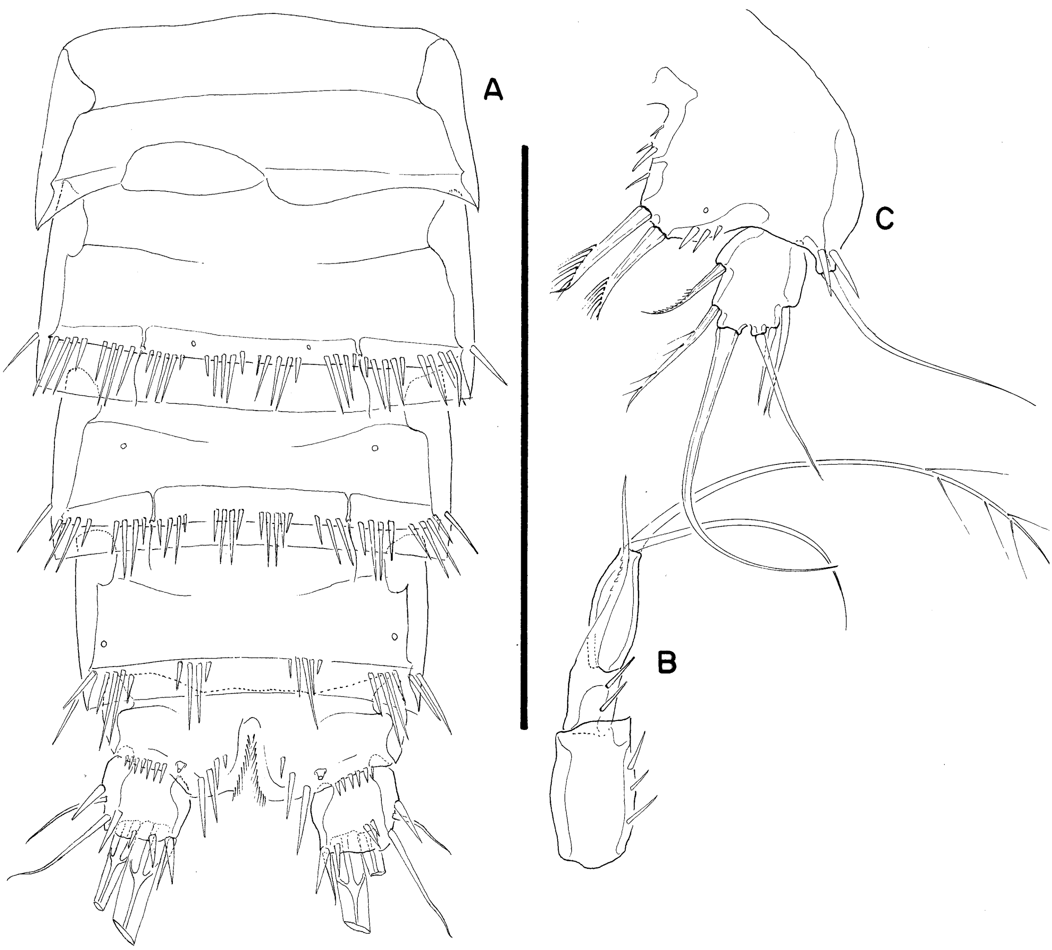

Figure 17. *Mesochra snoppa* sp. nov., male. (A) Urosome, ventral, P5-bearing somite omitted; (B) P3 ENP; (C) P5. Scale bar: 100 µm (A); 70 µm (B, C).

Type locality

Snoppa, Seltjarnarnes, south-western Iceland (64°10′N, 22°01′W).

Etymology

The species was named in honour of Freyr, the Nordic god of fertility.

Female

Body fusiform (Figure 18A). Length, measured from tip of rostrum to posterior margin of caudal rami, ranging from 280 to 330 µm (mean=300 µm; n=3) (holotype, 280 µm). Greatest width near posterior edge of cephalothorax, the latter about one-third of total body length. Rostrum distinct, rectangular, with tube pore ventrally (Figure 19C). Dorsal surface of cephalothorax and free prosomites without spinular ornamentation, with plain hyaline frill. First urosomite (P5-bearing somite) as previous somite. Second and third

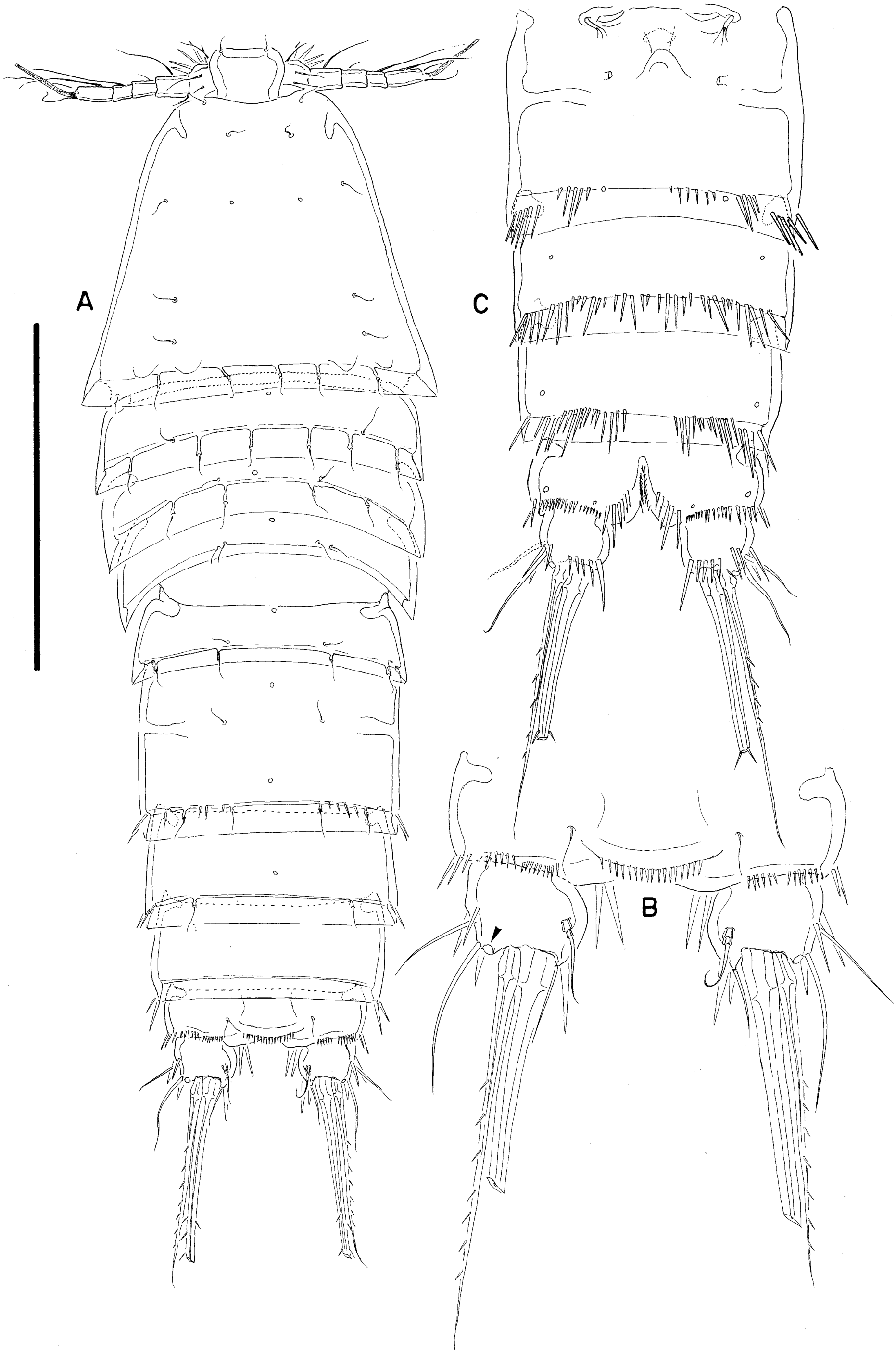

Figure 18. *Mesochra freyri* sp. nov., female. (A) Habitus, dorsal; (B) anal somite and caudal rami; (C) urosome, ventral, P5-bearing somite omitted. Scale bar: 100 µm (A); 50 µm (B); 83 µm (C).

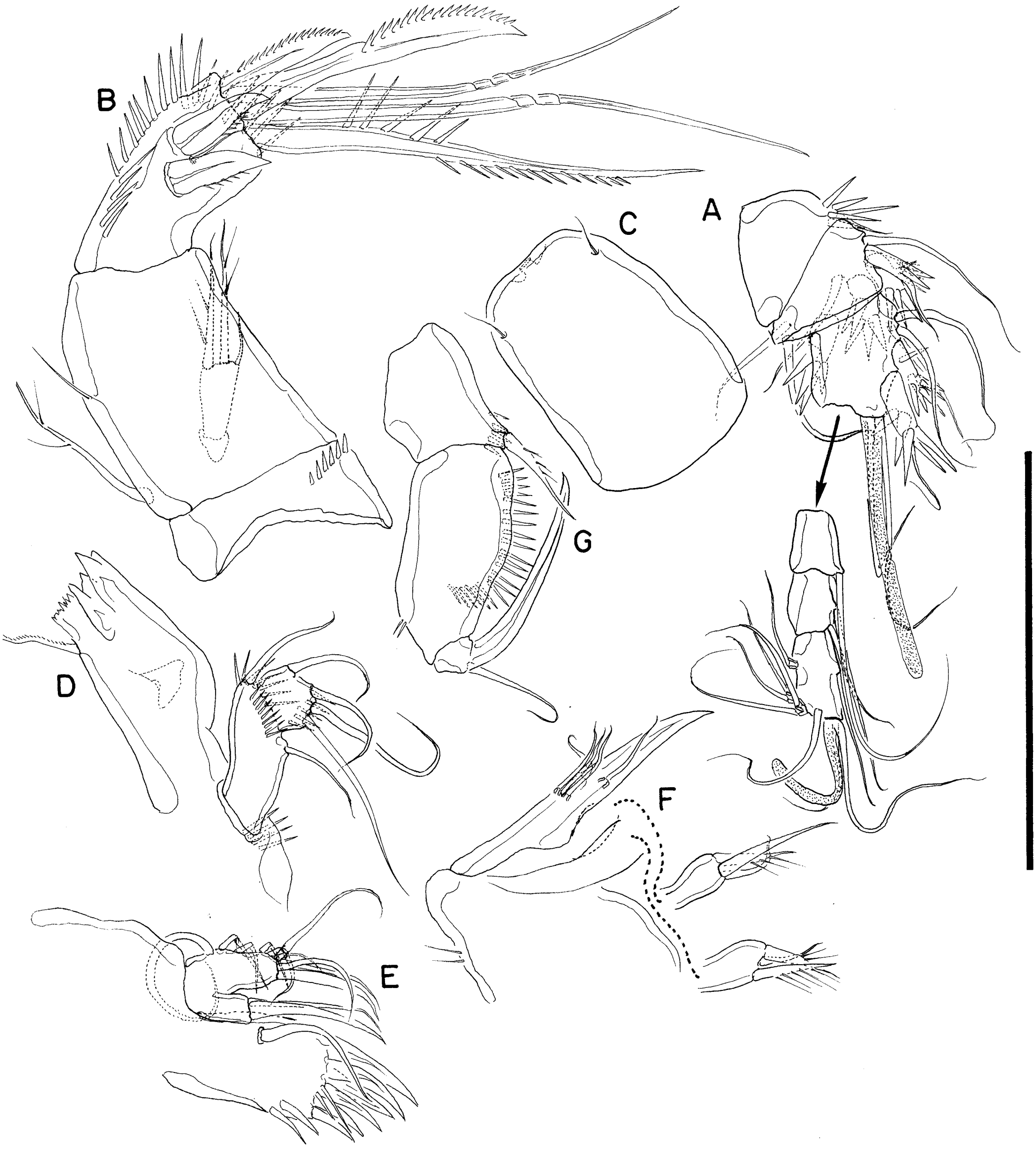

Figure 19. *Mesochra freyri* sp. nov., female. (A) Antennule, ventral; (B) antenna; (C) rostrum; (D) mandible; (E) maxillule; (F) maxilla; (G) maxilliped. Scale bar: 50 µm (A, C); 33 µm (B, D–G).

urosomites fused (genital double-somite), with vestige of division between somites visible in lateral (not shown) and ventral view (Figure 18C); second urosomite (first genital somite) without, third urosomite (second genital somite) with spinules along posterior margin dorsally and ventrally (Figure 18A, C); genital pore (Figure 18C) in second urosomite (first genital somite). Fourth and fifth urosomite as third urosomite (second genital somite). Anal somite half the length of the preceding somite, with spinules close to joint with caudal rami dorsally (Figure 18A, B) and ventrally (Figure 18C); with rounded anal operculum ornamented with spinules along posterior margin (Figure 18A, B). Caudal rami

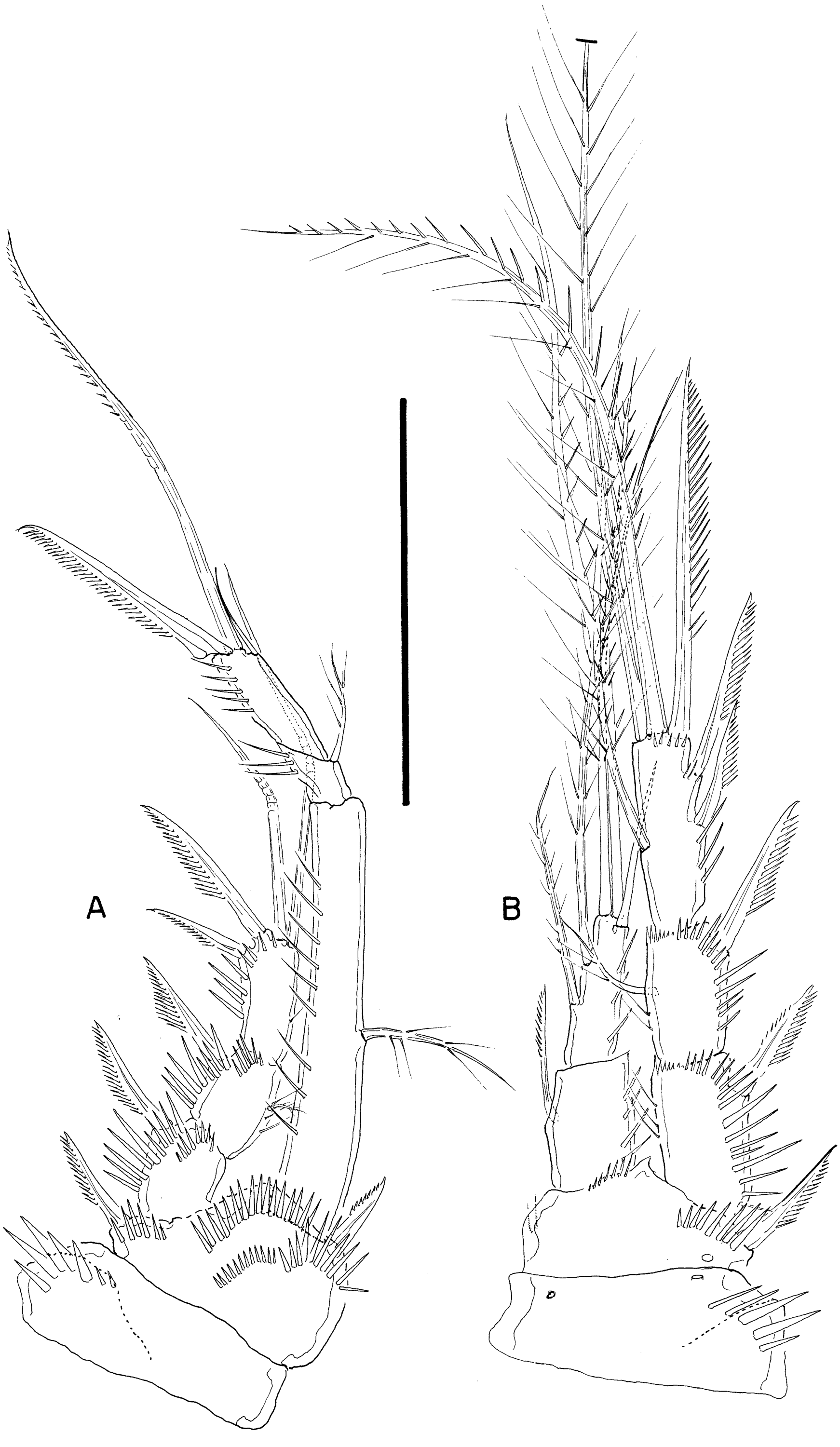

Figure 20. *Mesochra freyri* sp. nov., female. (A) P1; (B) P2. Scale bar: 50 µm.

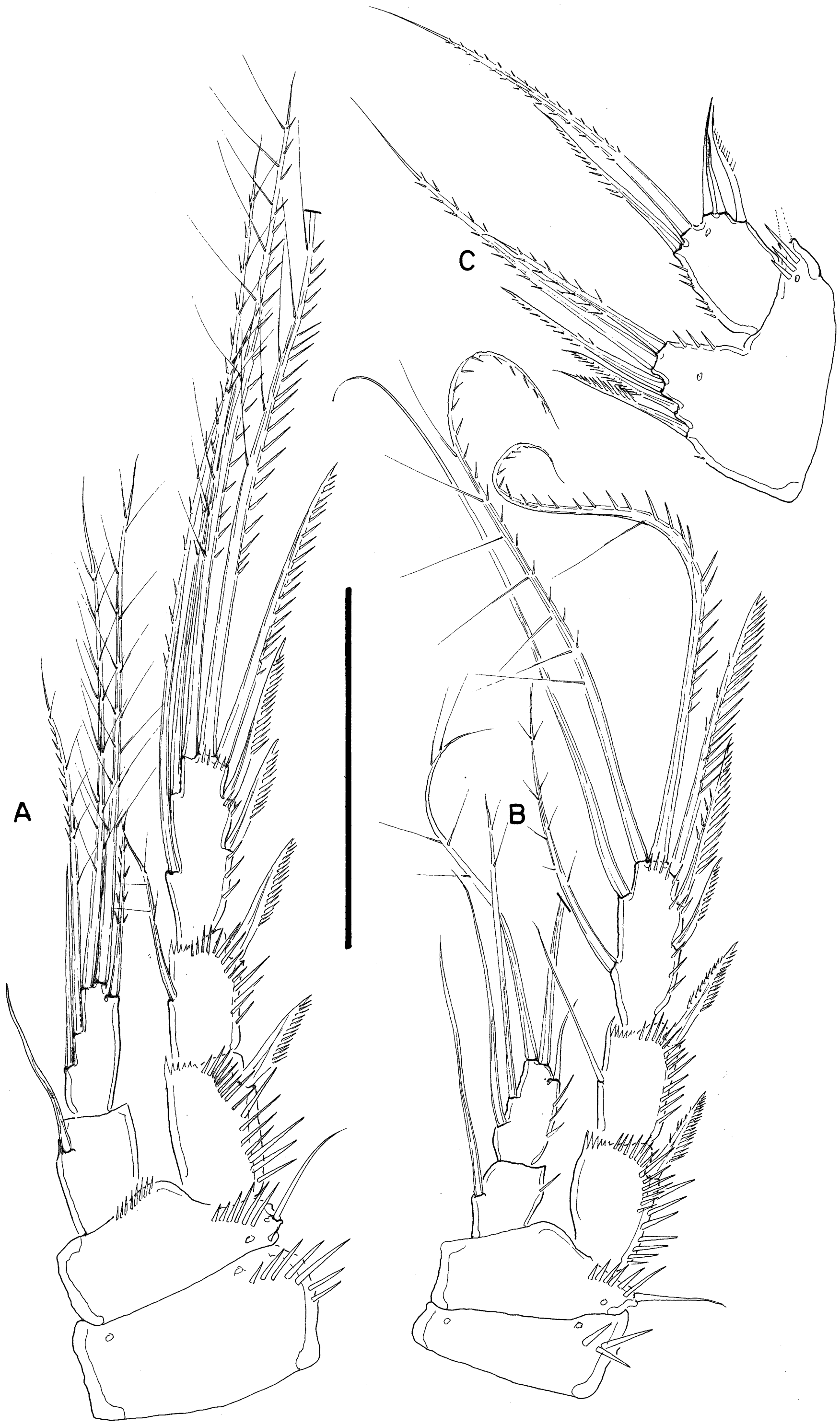

Figure 21. *Mesochra freyri* sp. nov., female. (A) P3; (B) P4; (C) P5. Scale bar: 50 µm.

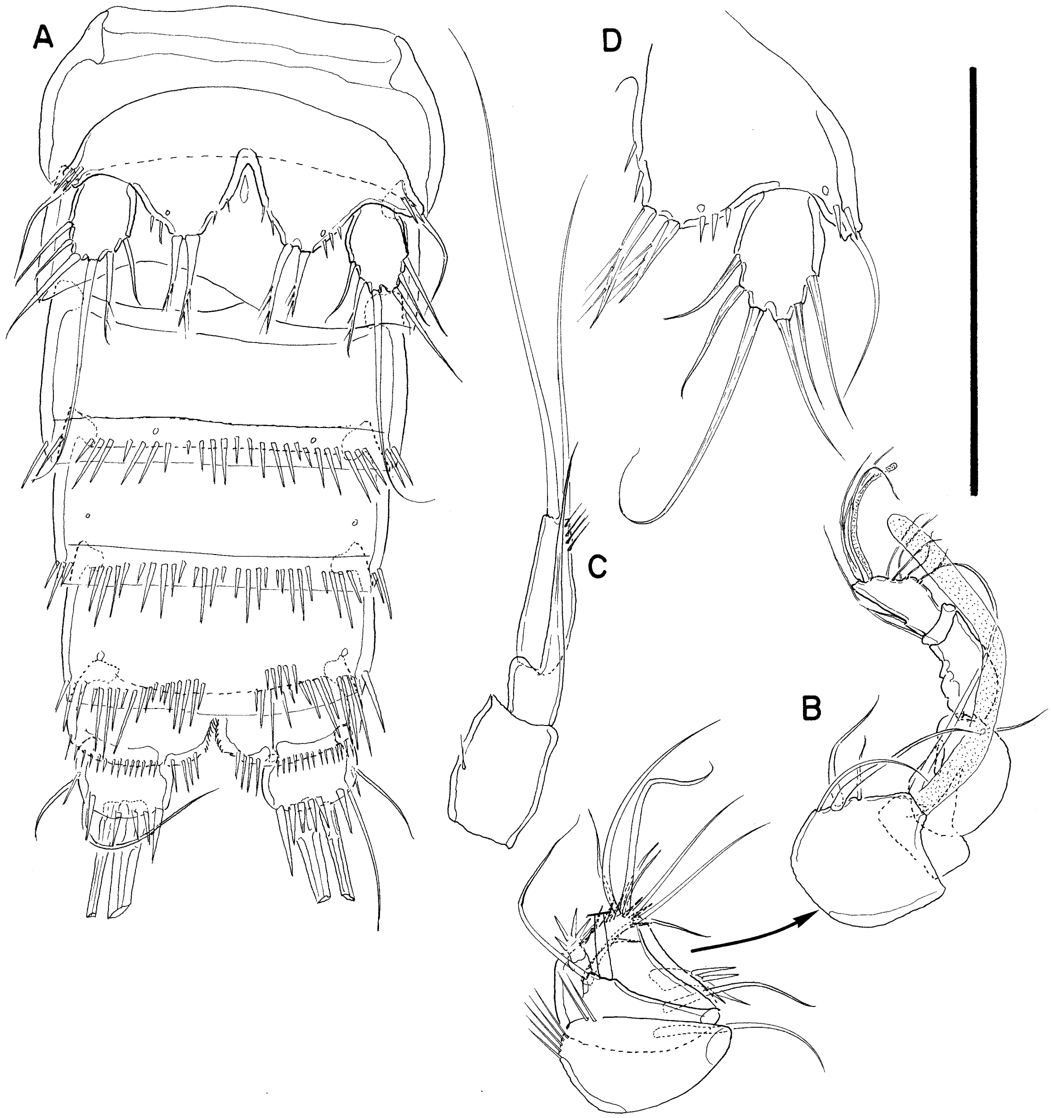

Figure 22. *Mesochra freyri* sp. nov., male. (A) Urosome, ventral; (B) antennule, ventral; (C) P3 ENP; (D) P5. Scale bar: 71 µm (A); 50 µm (B–D).

(Figure 18A–C) about as long as wide; with six setae; seta II inserted midway along outer margin and flanked by two strong spinules; seta III inserted on outer distal corner and accompanied by a strong spinule; seta VI small; seta VII situated rather internally; caudal rami with outer pore distally (arrowed in Figure 18B).

Antennule (Figure 19A) six-segmented. Surface of segments smooth, except for some spinules on first segment. First and second segment wider than long, third segment about 1.5 times longer than wide; fourth, fifth, and sixth segments about twice as long as wide. All setae smooth except for five and two pinnate setae on second and third segments. Armature formula: I(1)-II(9)-III(6+(1+ae))-IV(1)-V(2)-VI(7+acrotheke). Acrotheke consisting of aesthetasc and two setae. Two posterior pinnate seta masked by anterior element on second segment, thus not visible in Figure 19A.

Antenna (Figure 19B): allobasis with two abexopodal setae, proximal one long, distal one very small. Exopod one-segmented, with two long and one small seta. Endopod with spinules along inner margin, seemingly without distal frill; with two robust lateral spines and one very small and slender seta, and five distal elements (two strong spines, two geniculate setae, and one spinulose and geniculate element).

Mandible (Figure 19D): biting edge formed by strong teeth and one seta. Basis long, with spinules as figured, and armed with one seta. Exopod represented by single seta. Endopod one-segmented, with three distal and one lateral seta.

Maxillule (Figure 19E): praecoxal arthrite with one surface seta; with six strong spines and two spinule-like elements distally, and two short spines laterally. Coxa and basis fused; coxal endite with two setae. Rami fused to basis; endopod and exopod apparently represented by two and three setae, respectively. Basis with two lateral, two subdistal setae and one distal element.

Maxilla (Figure 19F): syncoxa with two endites, bearing three setae each. Basis produced into strong claw accompanied with one anterior and one posterior seta. Endopod represented by three setae.

Maxilliped (Figure 19G): syncoxa with spinules as figured, and armed with one seta. Basis with longitudinal row of long spinules along inner margin. Endopod with smooth claw and a long accompanying seta.

P1 (Figure 20A): coxa and basis ornamented as figured. Basis with inner and outer spine. Exopod three-segmented, reaching slightly beyond middle of first endopodal segment. Endopod three-segmented; ENP1 about 6.6 times longer than wide, inner seta small, about as long as ENP2 and 3 combined.

P2–P4 (Figures 20B, 21A, B): coxa and basis with spinules and pores as figured. Basis of P2 with outer spine-like element, of P3 and P4 with outer seta. Exopod three-segmented; EXP1 without, EXP2 with inner seta; P2 EXP3 with one, P3 and P4 EXP3 with two inner setae. Endopod two-segmented; of P2 reaching tip of EXP2, of P3 and P4 reaching middle of EXP2; ENP1 with one inner seta, ENP2 with two inner, two apical, and one outer seta.

P5 (Figure 21C): exopod distinct, with five elements. Baseoendopodal lobe with five elements as figured. Baseoendopod with a pore on baseoendopodal lobe and close to basal seta; exopod with pore distally.

P6 (Figure 18C) represented by one seta. Copulatory pore in anterior half of genital-double somite.

Armature formula of female P1–P5 as follows:

	P1	P2	P3	P4	P5
EXP	0-1-022	0-1-123	0-1-223	0-1-223	5
ENP	1-1-120	1-221	1-221	1-221	5

Male

Body (not shown) as in female except for genital double-somite (Figure 22A). Total body length ranging from 255 to 292 μm (mean=265 μm; n=4) (allotype, 257 μm). Third to fifth urosomite with more spinules than in female ventrally (Figure 22A). Anal somite, anal operculum, and caudal rami as in female.

Antennule (Figure 22B) subchirocer, nine-segmented. With spinules on first and second segment. Segments IV and IX with aesthetasc. All setae smooth except for two and one pinnate element on second and third segment. Armature formula difficult to define.

Mouthparts, P1, P2, and P4 (not illustrated) as in female.

P3 as in female, except for three-segmented endopod (Figure 22C); ENP1 without inner seta; ENP2 with inner sinuous apophysis reaching beyond ENP3; the latter with two apical setae.

P5 (Figure 22D) with medially fused baseoendopods. Exopod reaching beyond endopodal lobe and armed with six setae as figured. Endopodal lobe with two elements, outermost shorter.

P6 (Figure 22A) represented by two asymmetrical plates, one of them distinct, the other fused to somite.

Discussion

Taxonomic remarks

After analysing the available descriptions of some species of *Mesochra*, Hamond (1971) regarded as unidentifiable his own *Mesochra* sp. (see Hamond 1971, p 12), *M. prowaseki* Douwe, 1907, Sewell's (1924) *Mesochra* sp. and Margalef's (1953) *Mesochra* sp. cfr. *heldti*, and concurred with Lang's (1948, p 956) view that *M. lybica* Blanchard and Richard, 1891 probably belongs to *Cletocamptus* Schmankewitsch, 1875. He also questioned the validity of Borutzky's (1952) *M. aestuarii* s. 1, and suggested that Petkovski's (1964) doubts regarding the validity of *M. reducta* Klie, 1950 were not supported. Hamond (1971) also noted that *M. pontica* Apostolov, 1969 was preoccupied by *M. pontica* Marcus, 1965 and that the former is "almost certainly identical" with *M. aestuarii* Gurney, 1921, while the latter, although insufficiently described, should be considered as valid. Also, not without reserve, he considered *M. alaskana* M. S. Wilson, 1958 and *M. quadrispinosa* Shen and Tai, 1965 (due to the setal formula used by Shen and Tai 1965, he was not certain whether *M. quadrispinosa* possesses two or three outer spines on the P2–P4 EXP3, thus appearing twice in his key) as valid species. Hamond (1971) recognized 31 valid species and presented a key (based on Lang's 1948 key) in which he used the number of segments and the location of the major aesthetasc on the antennule as one of the major discriminating features. Fiers and Rutledge (1990) shed some light on the setal formula used by Shen and Tai (1965) for the description of *M. quadrispinosa*, and concluded that this species possesses in fact three outer spines on the P2–P4 EXP3. They also presented a key to the species of *Mesochra* in which they included some species described after Hamond's (1971) paper (*M. hinumaensis* Kikuchi, 1972, *M. schmidti* Mielke, 1974, *M. bodini* Kunz, 1975, and *M. pallaresi* Soyer, 1977) and included Mielke's (1974) *Mesochra* sp. in their key, but omitted *M. prowaseki*, Nicholls' (1941) *M. pygmaea*, Margalef's (1953) *Mesochra* sp. cfr *heldti*, Por's (1960) *M. rapiens*, Bodin's (1972) *M. heldti* Monard, 1935, and Hamond's (1971) *Mesochra* sp., and reallocated *M. neotropica* Jakobi, 1956 into the genus *Amphibiterita* Fiers and Rutledge, 1990 as *Amphibiterita neotropica* (Jakobi, 1956). Also, Fiers and Rutledge (1990) showed that the seven-segmented antennule of, at least, *M. rostrata* Gurney, 1927 is a misinterpretation since the supposed first segment is, in fact, a strongly sclerified socle and therefore suggested that this character should be avoided for discriminating between species of *Mesochra*. In their key, Fiers and Rutledge (1990) recognized, apart from Mielke's (1974) *Mesochra* sp., 34 valid species. The number of species increased to 36 with the addition of *M. pacifica* Gómez Noguera and Fiers, 1997 and *M. pseudoparva* Gómez Noguera and Fiers, 1997. In their paper, Gómez Noguera and Fiers (1997) presented some amendments to Fiers and Rutledge's (1990) key to incorporate these two species. Following Fiers and Rutledge's (1990) amended key, only 12 species (*M. alaskana*, *M. arenicola* Nicholls, 1940, *M. bodini*, *M. flava* Lang, 1933, *M. nana* Brady, 1910, *M. pallaresi*, *M. paranaensis* Jakobi, 1954, *M. pestai* Lang, 1948, *M. pontica*, *M. pygmaea*, *M. stellfeldi* Jakobi, 1954, and *M. xenopoda* Monard, 1935) share a three-segmented P1 ENP as long as or longer than the entire exopod, and the presence of three outer spines on P2–P4 EXP3. Of these species, only *M. nana* possesses a P1 ENP1 two times longer than the entire exopod, and *M. bodini* is the only one without an inner seta on P1 EXP2. Apart from a series of character states shared also with some other species bearing a three-segmented P1 ENP and three outer spines on the P2 EXP3 (i.e. length ratio of P1 ENP/EXP, number of setae/spines on P2 and P3 ENP2, presence of an inner seta on P1 ENP2 and P2 EXP3, and P1 EXP2 with a very small inner seta), *M. ingolfssoni* sp. nov., *M. snoppa* sp. nov., and *M. freyri* sp. nov. resemble *M. stellfeldi* in the normal (not dwarfed) outer seta of both male and female P5 EXP, but differ in the unequal inner baseoendopodal setae of the female P5 observed in *M. stellfeldi*. *Mesochra ingolfssoni* sp. nov., *M. snoppa* sp. nov., and *M. freyri* sp. nov. resemble *M. pygmaea* in the equal inner baseoendopodal setae of the female P5, but differ in the dwarfed outer seta of the male and female P5 EXP present in *M. pygmaea*. A number of character states can be useful to separate *M. ingolfssoni* sp. nov., *M. snoppa* sp. nov., and *M. freyri* sp. nov. These are: a distal, outer pore in caudal rami (large in *M. ingolfssoni* sp. nov. and *M. freyri* sp. nov., but small in *M. snoppa* sp. nov.); shape of the rostrum (bell-shaped in *M. ingolfssoni* sp. nov. and *M. snoppa* sp. nov., but rectangular in *M. freyri* sp. nov.); female P6 (with two, three, and one seta in *M. ingolfssoni* sp. nov., *M. snoppa* sp. nov., and *M. freyri* sp. nov., respectively); number of pinnate elements on the second antennular segment (two in *M. ingolfssoni* sp. nov. and *M. snoppa* sp. nov., but five in *M. freyri* sp. nov.); general shape of the antenna (more robust in *M. freyri* sp. nov.) and shape of the lateral and distal inner spines (visibly stronger in *M. freyri* sp. nov.); relative length of the accompanying seta of the endopodal claw of the maxilliped (very small in *M. ingolfssoni* sp. nov., but very long in *M. snoppa* sp. nov. and *M. freyri* sp. nov.); relative length and insertion site of the inner seta of P1 ENP1 (P1 ENP1 1.7, 2.7, and 2.7 times longer than inner seta in *M. ingolfssoni* sp. nov., *M. snoppa* sp. nov., and *M. freyri* sp. nov., respectively; inserted in the middle in *M. ingolfssoni* sp. nov. and *M. freyri* sp. nov., but inserted in the proximal third in *M. snoppa* sp. nov.); P1 ENP1:EXP length ratio (1.3 in *M. ingolfssoni* sp. nov. and *M. freyri* sp. nov., but 1.6 in *M. snoppa* sp. nov.); relative length of the inner seta of P2 ENP1 (as long as ENP1 and ENP2 combined and reaching far beyond ENP2 in *M. ingolfssoni* sp. nov., but as long as ENP1 in *M. snoppa* sp. nov. and *M. freyri* sp. nov.); relative length of the inner seta of P3 ENP1 (as long as ENP1 and ENP2 combined and reaching far beyond ENP2 in *M. ingolfssoni* sp. nov., but not reaching the tip of ENP2 in *M. snoppa* sp. nov., and barely reaching the tip of ENP2 in *M. freyri* sp. nov.); relative length of the innermost seta of P3 ENP2 (longer than ENP1 and ENP2 combined in *M. ingolfssoni* sp. nov., but noticeably shorter in *M. snoppa* sp. nov. and *M. freyri* sp. nov.); shape of the outer spines on P2–P4 EXP3 (comparatively stronger in *M. freyri* sp. nov.); relative size of the apical setae of the male P3 ENP3 (equal in *M. ingolfssoni* sp. nov., but unequal in *M. snoppa* sp. nov. and *M. freyri* sp. nov.); relative size of the two setae of the male baseoendopodal lobe (unequal in *M. ingolfssoni* sp. nov. and *M. freyri* sp. nov., but equal in *M. snoppa* sp. nov.).

Remarks on the world distribution of Mesochra rapiens *and* Mesochra lilljeborgi *and distribution of the new species herein presented in Iceland*

The world distribution of *M. lilljeborgi* and *M. rapiens* show that they are circumpolar species restricted to the Northern Hemisphere (Figure 23). Lang's (1948) monograph was

Figure 23. World distribution of *Mesochra lilljeborgi* (●) and *M. rapiens* (○). Lang's (1948) monograph was the main source of the species distributions. When Lang (1948) quoted that the distribution of a given species ranged from one location to another, only the two locations were indicated in this figure, not the whole area between them. Also, if any two locations of a given species were close to each other, only one symbol was put on the figure. The symbol for *M. rapiens* on the coast of Alaska (USA) only represents the fact that the species was found in the area (Wilson 1956), but not exactly where it was found. The location of a *Mesochra rapiens* variant found in Bear Lake, Utah (USA) (Wilson 1972) is shown on the figure. (▲): locations where both Mesochra species were found.

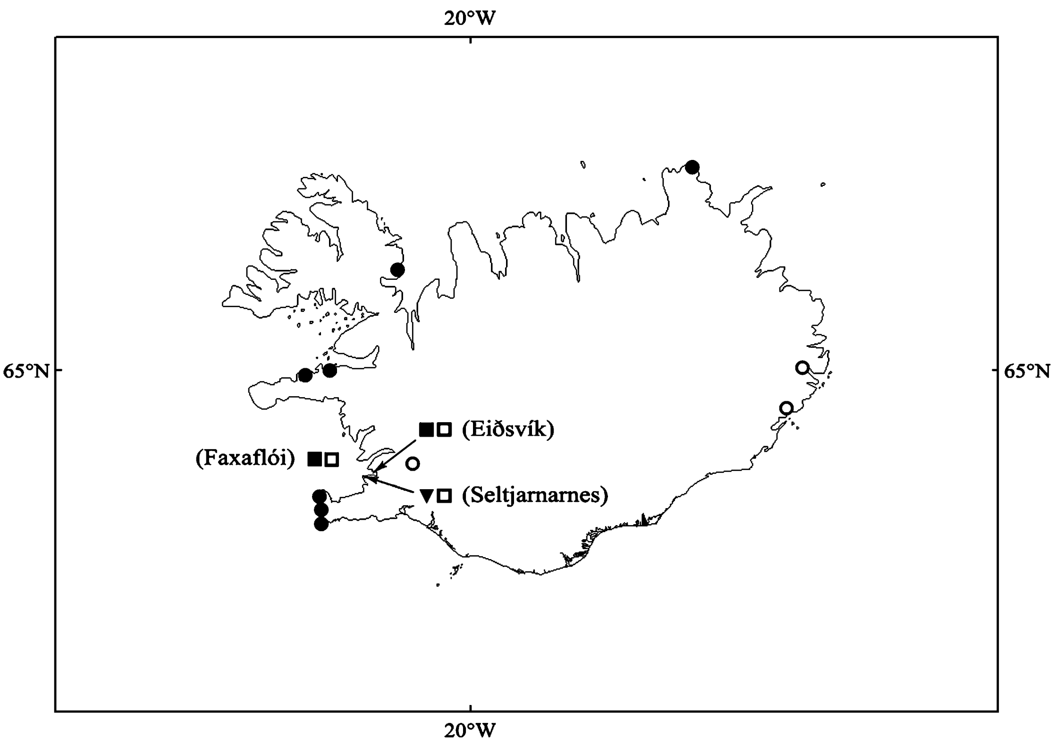

Figure 24. Distribution of *Mesochra* species found in Iceland. (○) *Mesochra rapiens*; (●) *Mesochra lilljeborgi*; (■) *Mesochra ingolfssoni* sp. nov.; (□) *Mesochra snoppa* sp. nov.; (▼) *Mesochra freyri* sp. nov.

used here as a main source for the distribution of the species. However, some papers not mentioned by Lang (1948) or published after 1948 (e.g. Carl 1940; Veldre and Maemets 1956; Wilson 1956, 1972; Noodt 1970; Castel 1984; Ishida 1987; Ólafsson 1994; Cordell et al. 1997; Scher et al. 2000; Sadyrin 2002; Rybnikov et al. 2003; Sytsma et al. 2004; Alcaraz et al. 2007) gave additional information about the distribution of these species. Also, some websites with additional information about this subject are available (e.g. http://www.tmbl.gu.se/libdb/taxon/neat_pdf/NEAT*Crustacea.pdf; http://www.zin.ru/projects/caspdiv/caspian_rotifera_cladocera_copepoda.html). The most noticeable addition to the species distribution is their finding in north-western America and Iceland. Sytsma et al. (2004) reported *M. rapiens* and *M. lilljeborgi* from the lower Columbia river (USA), but they suggested that they might have been introduced. *Mesochra rapiens* was reported before from this region (Lost Lagoon, Western Canada) by Carl in 1937 and from the coast of Alaska (USA) by Wilson in 1956. Also, *M. rapiens* was found in both brackish and fresh-water bodies of the Bering sea coast. Wilson (1956, 1972) reported a variant of *M. rapiens* in Bear Lake, Utah (USA) (location shown in Figure 23).

At present, five species of *Mesochra* have been found in Iceland. *Mesochra rapiens* and *M. lilljeborgi* were found in littoral mudflats (Ólafsson 1994). *Mesochra rapiens* has also been found in a shallow freshwater body in south-western Iceland (Scher et al. 2000) (see Figure 24 for species distribution). *Mesochra ingolfssoni* sp. nov. and *M. snoppa* sp. nov. have been found on floating seaweeds in Eiðsvík and Faxaflói Bay (Ólafsson et. al. 2001; A. Ingólfsson, E. Ólafsson and M. B. Steinarsdóttir, unpublished data) (Figure 24). *Mesochra snoppa* sp. nov. and *M. freyri* sp. nov. were found living on the alga *Chondrus crispus* in a rocky shore in Seltjarnarnes.

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