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## A new species of *Huntemannia* (Copepoda: Harpacticoida: Huntemanniidae) from the Yellow Sea, Korea

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### Abstract

*Huntemannia doheoni* **sp. nov.** is described from a muddy sand flat off the coast of the Yellow Sea, Korea. The new species can be distinguished from its congeners by a combination of characters that include: a strong, hook-like outer process on the P1 coxa; incompletely fused exopod segments and reduced setal formulae of the P2–P4 in the female; and modified outermost spine on the distal segment of P3–P4 in the male. In addition, a key to the species of *Huntemannia* is provided.

**Key words:** *Huntemannia*, taxonomy, Asia, marine, dichotomous key, SEM

### Introduction

The family Huntemanniidae, established by Por (1986) from the Cletodidae, is an important harpacticoid group on the muddy substrates and in the deep sea. Although this family still presents several phylogenetic problems, 38 valid species are assigned to this taxon (Boxshall & Halsey 2004), including three recorded from the Asia: *Huntemannia biarticulatus* Shen and Tai, 1973 from China; *Nannopus unisegmentatus* Shen and Tai, 1964 from Kwangtung Province, China; *Nannopus palustris* Brady, 1880 from Lake Hinuma, Japan (Kikuchi & Yokota 1984) and from the west coast of Korea (Yoo & Lee 1995). These Asian species are known only from fresh- or brackish water. To date, only four species of *Huntemannia* Poppe, 1884 are recognized from marine and freshwater habitats: *H. jadensis* Poppe, 1884; *H. micropus* Monard, 1935; *H. lacustris* M.S. Wilson, 1958 and *H. biarticulatus* Shen and Tai, 1973. During our investigation of the marine harpacticoid fauna from intertidal, muddy sand flats of the Korean Yellow Sea, one new species of *Huntemannia* was collected. This species was abundant on the muddy sand flats from April to June 2001 and is described herein.

### Materials and methods

Specimens were collected from seagrass beds of *Zostera japonica* Ascher and Graeb. on the muddy sand flats of Seungbong Island in the Yellow Sea, Korea. Specimens were fixed in 5% buffered formalin and cleared and dissected in lactic acid. Dissected parts were mounted on slides in lactophenol mounting medium. Preparations were sealed with transparent nail varnish. All drawings were prepared using a drawing tube attached to an Olympus BX60 microscope with differential interference contrast (i.e. Nomarski optics).

Nine females and seven males selected for examination with the scanning electron microscope (SEM). These were prefixed overnight at 4 in 2.5% glutaraldehyde, and then post-fixed with 1% osmium tetroxide for two hours. After dehydration through a graded ethanol series (50%–100%, 10% intervals for 20 minutes each), the specimens were critical-point dried, coated with gold-palladium, and examined using a Hitachi S4200 scanning electron microscope.

The descriptive terminology used herein is adopted from Huys *et al.* (1996). Abbreviations used in the text are: ae, aesthetasc; exp, exopod; enp, endopod; P1–P5, first to fifth swimming leg; P6, sixth leg; exp (enp)-1 (2, 3), proximal (middle, distal) segment of a ramus. The term acrothek is used to denote the conjoined setae (two) and aesthetasc found apically on the distal antennular segment.

Type specimens are deposited in the collections of The U.S. Natural History, Smithsonian Institution, Washington, D.C. and Invertebrate Resources Bank of Korea (IRBK) at Seoul National University. Scale bars in all figures are indicated in  $\mu\text{m}$ .

## Description

### Family Huntemanniidae Por, 1986

### Genus *Huntemannia* Poppe, 1884

#### *Huntemannia doheoni*, new species

(Figs 1–6)

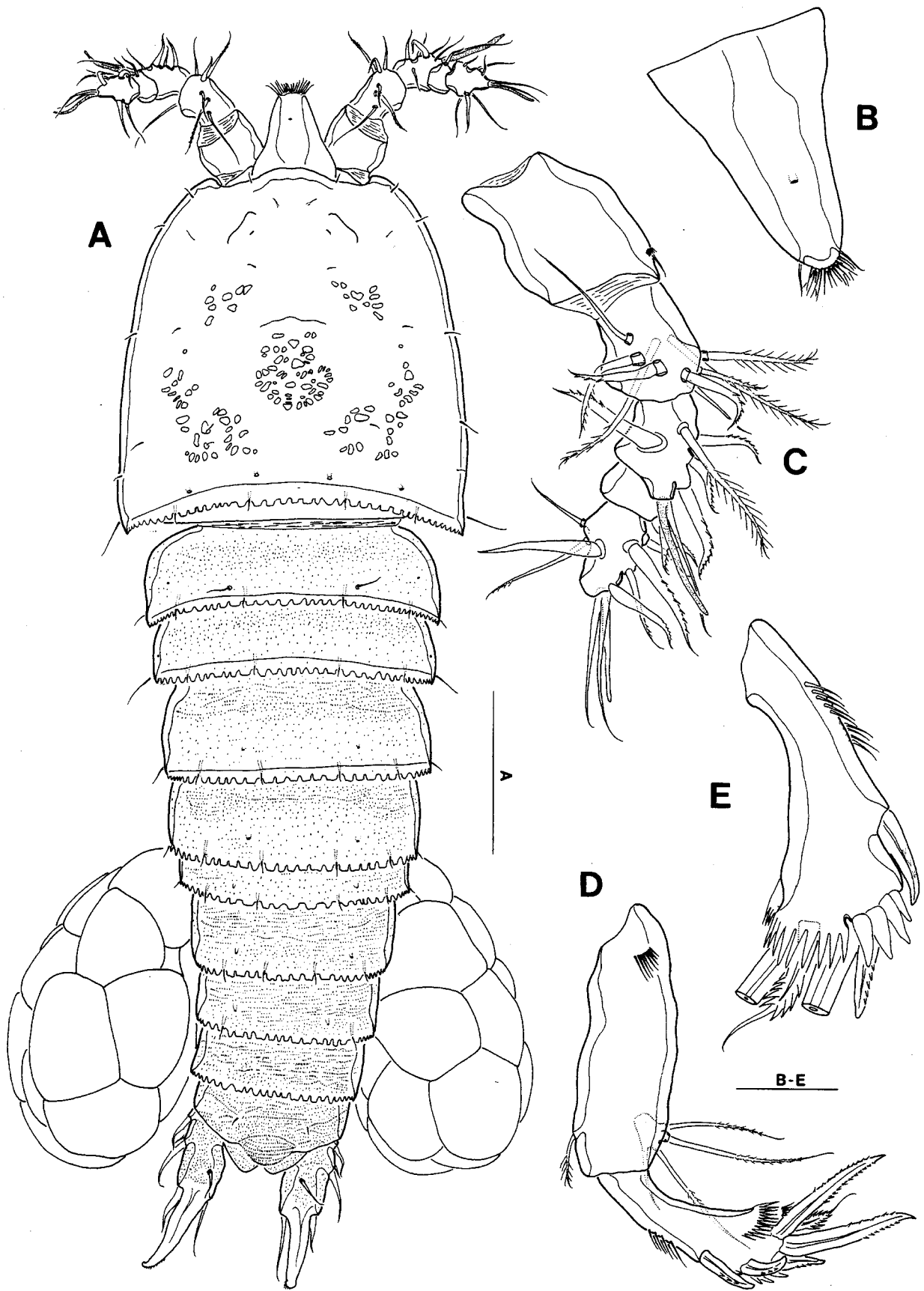
**Material examined.** Holotype, ovigerous female in alcohol (reg. No. NMNH 1080685) coll. Sung Joon Song, 24 May 2001. Allotype, one male dissected on 15 slides (reg. no. IRBKR 003494). Paratypes, 7 females (4 ovigerous) and 10 males preserved in alcohol (reg. No. NMNH 1080686); 1 female dissected on 15 slides (reg. no. IRBKR 003481); 5 females and 6 males on a SEM stub (reg. no. IRBKR 003495); collection data as for holotype.

**Other material.** 6 females (1 ovigerous), 4 males and 6 juveniles collected from a sandy beach at Daecheon, Chungchungnam-do coll. Sung Joon Song, 20 May 2004; 4 females, 10 males and 12 juveniles collected from a sandy bottom at Baeal Island (Estuary of Seomjin River), Kwangyang City, coll. Sung Joon Song, 9 May 2006.

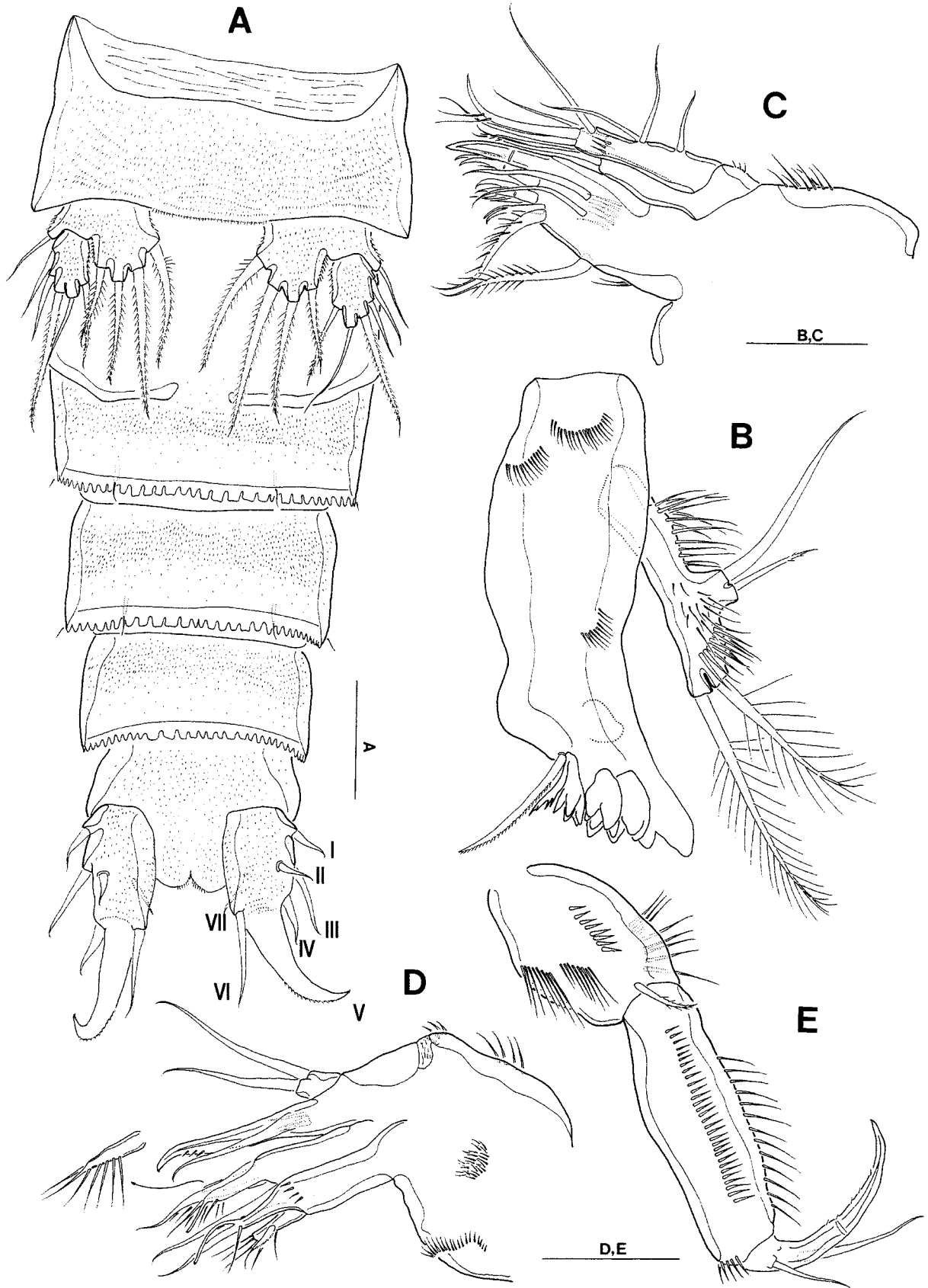
**Type locality.** Seungbong Island (371008N, 1261735E), the Yellow Sea of Korea; muddy sand flat in sea-grass bed (*Zostera japonica*).

**Description of female.** Total body length 684  $\mu\text{m}$ , measured from anterior margin of rostrum to posterior margin of caudal rami. Largest width measured at posterior margin of cephalic shield: 205.4  $\mu\text{m}$ . All prosomites and urosomites with crenulated posterior margin (Fig. 1A), except for anal somite with smooth margin. Urosome gradually tapering posteriorly, with 2 egg sacs attached. Cephalothorax ornamented with a few integumental sensilla and pores as figured (Fig. 1A). Many depressions present on mid-surface. Pleural areas well developed and rounded without lobate posteolateral angles. Rostrum (Fig. 1B) large, triangular and directed downward, with middorsal paired sensilla and numerous setules located near apex. Pedigerous somites and urosomites (Figs 1A, 2A) covered with tiny spinules. Body constricted between individual somites.

Urosome (Figs 1A, 2A) 5-segmented, comprising P5-bearing somite, genital double-somite and 3 free abdominal somites. Genital double-somite (Figs 1A, 2A) wider than long, with transverse surface ridge dorsally and laterally, indicating original segmentation; completely fused ventrally. Genital field (Fig. 3E) positioned anteriorly with very small copulatory pore located in median depression. P6 (Fig. 3E) with seta on small protuberance. Anal somite (Fig. 1A) with pair of dorsal sensilla anterior to operculum. Caudal rami



**FIGURE 1.** *Huntemannia doheoni* sp. nov., female, paratype (IRBKR 003481). A, habitus, dorsal; B, rostrum; C, antennule; D, antenna, inner; E, distal portion of antennary endopod, outer. Scales: A=100  $\mu$ m, B–E=30  $\mu$ m.



**FIGURE 2.** *Huntemannia doheoni* sp. nov., female, paratype (IRBKR 003481). A, urosome, ventral; B, mandible; C, maxillule, anterior; D, maxilla; E, maxilliped, anterior. Scales: A=100  $\mu$ m, B–E=20  $\mu$ m.

(Figs 1A, 2A) longer than wide; whole surface covered with tiny spinules, each ramus with 7 setae; setae I and II bare and subequal in length, setae III, IV and VI bare, seta V fused basally and directed outward, distal half of seta V pinnate along inner margin, and largest, seta VII tri-articulate at base.

Antennule (Fig. 1C) 5-segmented; segment 1 longest with small, bare seta at distal anterior margin; segment 3 with aesthetasc fused basally to bare seta on pedestal at distal end; segment 4 shortest. Armature formula: 1-[1], 2-[2 bare + 3 spinulose + 4 pinnate], 3-[5 spinulose + 1 pinnate + (1 bare + ae)], 4-[1 spinulose], 5-[2 bare + 3 spinulose + 2 pinnate + trithek].

Antenna (Figs 1D–E, 6A) with allobasis and free 1-segmented endopod. Allobasis elongate with spinular row and bipinnate abexopodal seta in distal quarter. Endopod slightly shorter than allobasis, ornamented with spinules along outer margin and 2 transverse hyaline frills subapically. Lateral armature consisting of 2 spines. Distal armature consisting of 3 spines and 1 serrated seta. Exopod 1-segmented, bearing 4 long setae.

Labrum with elaborate spinular ornamentation and paragnaths well developed lobes; with ornamentation pattern in Fig. 5B.

Mandible (Fig. 2B) with well-developed gnathobase bearing several multicuspidate teeth on distal margin and unipinnate seta on distal corner; 3 spinular rows on surface. Palp small, exopod and endopod fused to basis, bearing 1 long, bare seta and 1 small seta on outer peduncle and 2 plumose setae on distal peduncle respectively.

Maxillule (Fig. 2C). Praecoxa with few spinules around inner and outer margins. Arthrite strongly developed, with pinnate seta on inner margin, 2 naked setae on anterior surface, and 7 spines/setae around distal margin. One row of spinules on posterior surface. Coxa with cylindrical process bearing 2 long, pinnate setae. Exopod and endopod fused to basis, with 3 naked setae on outer margin and 4 setae on distal margin.

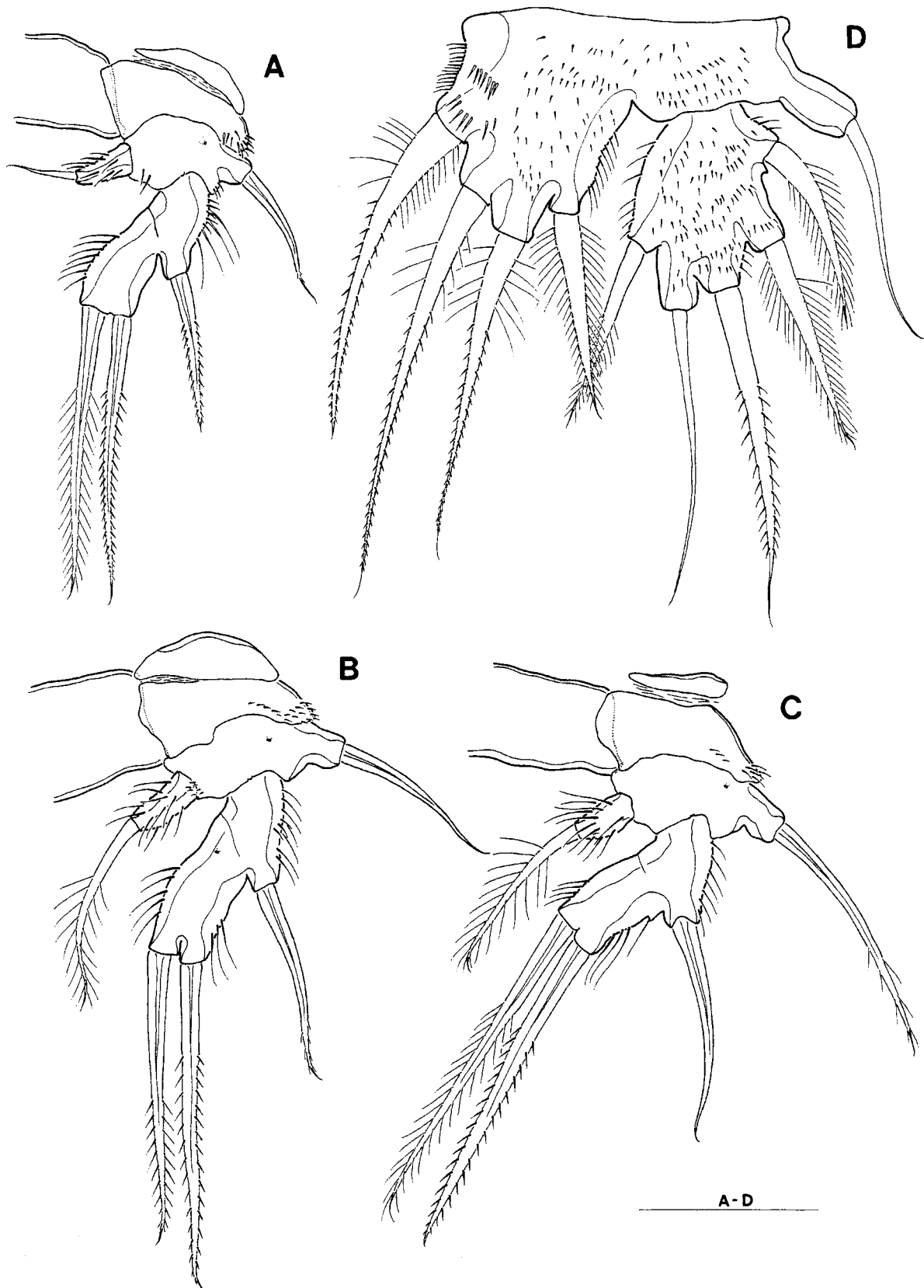
Maxilla (Fig. 2D). Syncoxa fused to allobasis, with row of spinules on inner surface, cluster of spinules midlength, and 2 endites on syncoxa. Two endites each with 3 ornamented spines (innermost 1 fused to base). Proximal endite with few spinules on surface. Allobasis drawn out into unipinnate claw; accessory armature consisting of bare seta and 3 spinules on posterior surface. Endopod represented by small protuberance bearing 2 long, bare setae.

Maxilliped (Fig. 2E) with pinnate seta and 3 rows of setules and row of spinules on syncoxa. Basis with 2 rows of setules along outer and anterior surface, and row of setules apically. Endopod drawn out into long, unipinnate claw, with 2 long, bare setae.

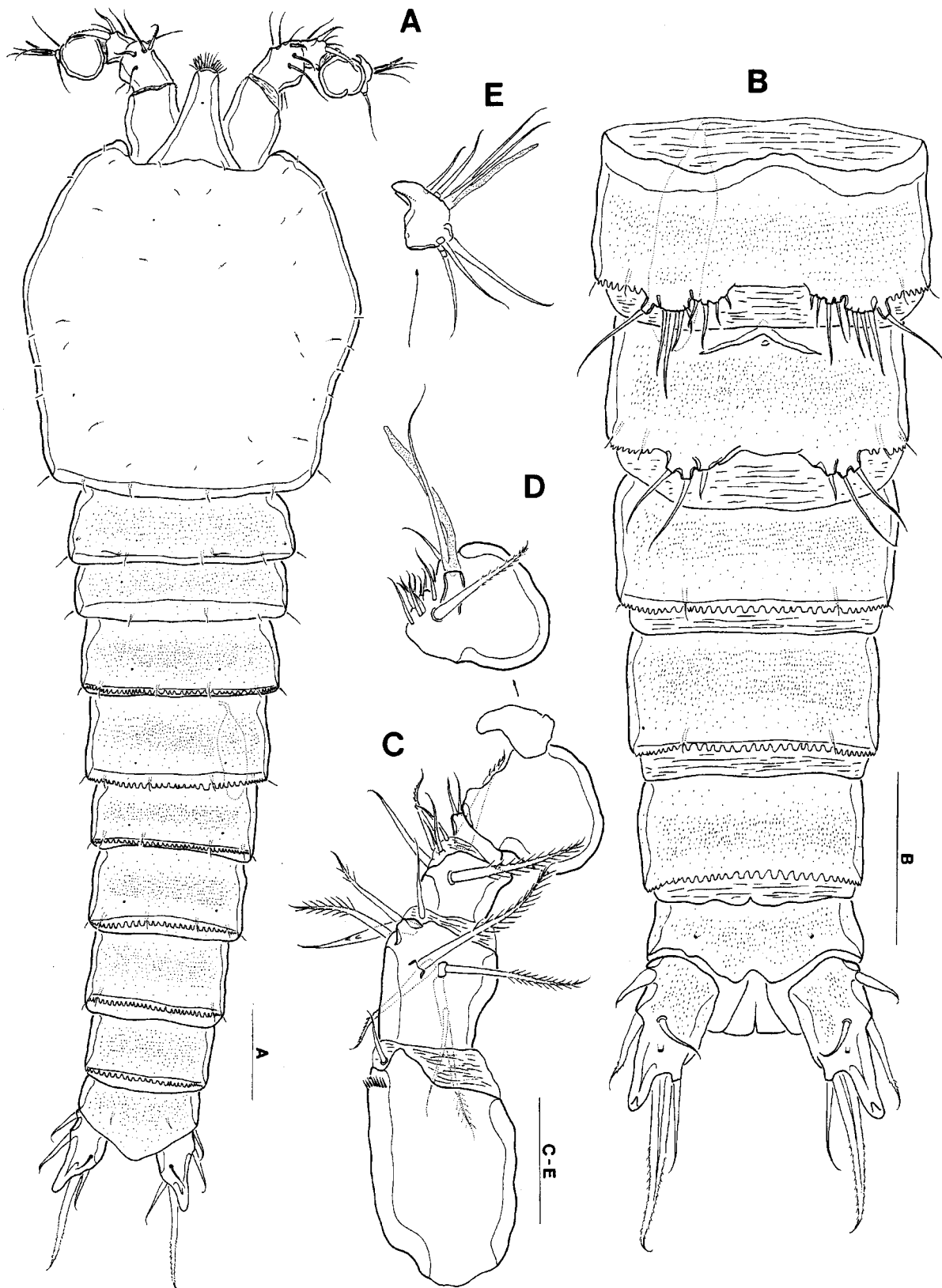
P1 (Fig. 5A). Coxa with 2 rows of spinules on anterior surface and strongly developed, hook-like process on outer distal corner. Basis broad oval form with 3 spinular rows of spinules on anterior surface of protuberances; outer spine stout and inner spine represented by small protuberances bearing 3 or 4 spinules apically. Exopod 3-segmented; exp-1 and exp-2 with 2 spinular rows on subdistal surface and stout spine respectively; exp-3 with spinular row on anterior surface and with stout spine, bipinnate spine, bare seta and long seta ornamented with hairs distally, as shown in Fig. 5A. Endopod 1-segmented and widened distally, with many spinules on anterior surface and 2 stout spines apically.

P2–P4 (Fig. 3A–C) with wide intercoxal sclerites lacking ornamentation. Praecoxae weakly developed. Coxae with several spinules on outer distal corner. Bases transversely elongated; with anterior pore in proximal third; with fine setules on anterior surface; outer distal setae bipinnate (P2, P4) or bare (P3). Exopod 1-segmented and bilobed; with vestigial suture line as junction of 2 segments; with 3 bipinnate setae. Endopod small and slightly tapering, with setules on anterior surface; with bipinnate seta (P2 with bare seta).

P5 (Fig. 3D) not fused to supporting somite; rami separate and scattered tiny setules on the whole anterior surfaces as figured. Baseoendopod transversely elongated, with setule line along inner margin. Endopodal lobe extending to distal third of exopod, with 3 semiplumose setae and 1 plumose seta. Exopod longer than wide, with setules along inner and outer margins; with 3 plumose setae, 1 bipinnate and 1 bare seta, and each seta arising from distinct cylindrical process.



**FIGURE 3.** *Huntemannia doheoni* sp. nov., female, paratype (IRBKR 003481). A–D, P2–P5; E, genital field and P6. Scales: 30  $\mu$ m.



**FIGURE 4.** *Huntemannia doheoni* sp. nov., male, paratype (IRBKR 003494). A, habitus, dorsal; B, urosome, ventral; C, antennule; D, antennular segment 5; E, antennular segment 6. Scales: A–B=100  $\mu$ m; C–E=50  $\mu$ m.

**Description of male.** Total body length 1146  $\mu$ m measured from anterior margin of rostrum to posterior margin of caudal rami. Largest width measured at middle margin of cephalic shield: 372.3  $\mu$ m. Prosome 4-seg-



mented, comprising cephalothorax and 3 free pedigerous somites. Cephalothorax (Figs 4A, 6A) with smooth posterior margin; swollen middle area, ornamented with a few integumental sensillae and pores as figured. Pleural areas and rostrum as in female. Pedigerous somites ornamented with sensillae and a few pores; P4-bearing somite with crenulated posterior margin.

Urosome (Fig. 4A–B) 6-segmented, comprising P5-bearing somite, genital somite and 4 abdominal somites. All somites ornamented with small spinules dorsally and ventrally, with crenulated posterior margin except anal somite. Spermatophore small, as long as P5-bearing somite. Caudal rami (Fig. 4A–B) similar to female in appearance; whole surface covered with tiny spinules, each ramus with 7 setae; setae I and II bare and subequal in length, setae III bipinnate, seta IV fused basally and directed inwardly, seta V long bipinnate, seta VI bare and longest, seta VII tri-articulate at base.

Antennule (Figs 4C–E, 6B) 6-segmented; subchirocer, with geniculation between segment 4 and 5. Segment 1 longest, with small, bare seta and spinular row at distal anterior margin. Segment 4 smallest and represented by small sclerite. Segment 5 swollen. Segment 6 with triangular distal half. Armature formula: 1-[1], 2-[1 spinulose + 2 bare + 6 pinnate], 3-[1 spinulose + 2 pinnate + 4 bare], 4-[2 bare], 5-[1 pinnate + 10 bare + (1 bare + ae)], 6-[5 bare + trithek].

Antenna, mouth appendages, P1 and P2 as for female.

P3 (Fig. 5C) with wide intercoxal sclerites, without ornamentation. Praecoxa small, lacking setules or spinules. Coxa with spinular row posteriorly. Basis widened, with spinules on inner lobe; with anterior tube-pore midlength outer distal seta bipinnate. Exopod 2-segmented; exp-1 shorter than exp-2; with lines of tiny spinules along outer margin and bare seta on distal corner; exp-2 slightly widened distally ornamented with spinules on outer margin, bearing modified spine distally and 2 bipinnate setae subdistally. Endopod 1-segmented and narrow, with 2 bipinnate setae.

P4 (Fig. 5D) with wide intercoxal sclerites, without ornamentation. Praecoxa small. Coxa transversely elongated with spinules on outer and inner distal surface. Basis widened with spinules on inner lobe; with anterior tube-pore near middle; outer distal seta bipinnate. Exopod 2-segmented; exp-1 with tiny spinules on outer surface and on inner distal lobe; and bearing long, bare seta; exp-2 as long as exp-1, with modified strong spine distally four-tipped. Endopod 1-segmented and narrow distally, without ornamentation on surface, with bipinnate seta.

P5 (Figs 5E, 6D) confluent exopod and baseoendopod, with tiny spinules on surface; represented by 3 lobes; exopodal lobe with 4 bipinnate setae, second outermost one is longest; baseoendopodal lobe with 4 setae.

P6 (Figs 5F, 6D) represented by well-developed lobe bearing 2 plumose setae, distalmost longest, and 1 spine.

**Variability.** Female: 583.4–758.9 m (mean=651.4 m; n=21), Male 643.5–1173.0 m (mean=842.0 m; n=19).

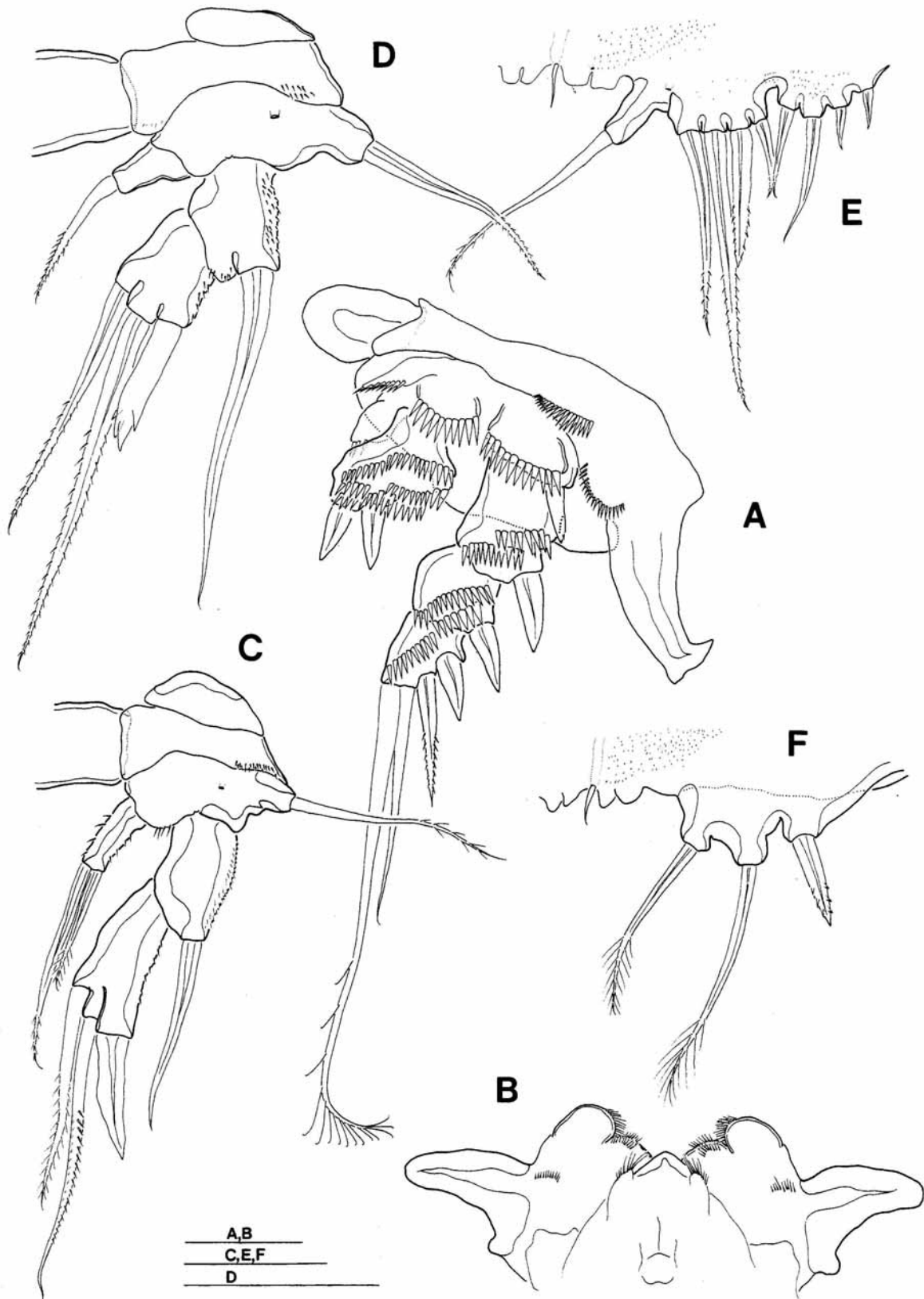
P3 endopod of male usually possesses two distal setae as in all species of *Huntemannia*, but one male among 25 males studied have only one seta distally. A non-modified, outer distal seta on P4 exopod fused to two segments has also been observed in male. No variability was observed in females.

**Etymology.** The species is named in honour of Dr. Do Heon Kwon, Inje University of South Korea who made outstanding systematic contributions in the field of terrestrial Isopoda.

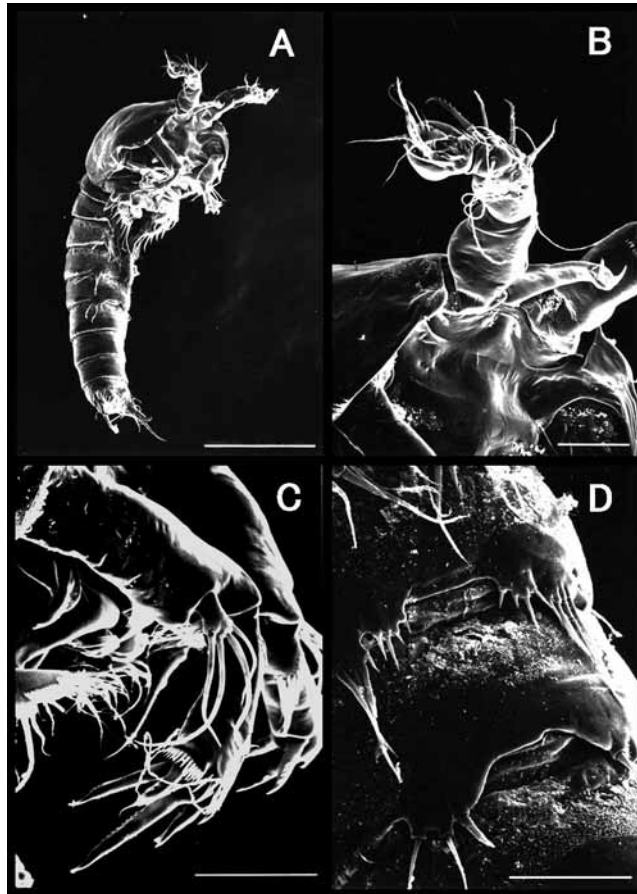
## Discussion

The genus *Huntemaina* is the type genus of the family Huntemanniidae created by Por (1986), and is defined by a combination of characters: 1-segmented mandibular palp, P1 inner basal spine absent, P2–P4 exopod 2-segmented exopod and the caudal ramus with a spinous process (Huys *et al.* 1996; Boxshall & Halsey 2004).

Prior to the present study, only four species were assigned to the genus: *H. jadensis* Poppe, 1884 and *H. micropus* Monard, 1935 from marine ecosystem, and *H. lacustris* M.S. Wilson, 1958 and *H. biarticulatus* Shen and Tai, 1973 from freshwater habitat.



**FIGURE 5.** *Huntemannia doheoni* sp. nov., female, paratype (IRBKR 003481). A, P1. male, paratype (IRBKR 003494). B, oral area showing labrum and paragnaths; C–F, P3–P6. Scales: A, C–F=30 m, B=50 m.



**FIGURE 6.** *Huntemannia doheoni* sp. nov., male, paratype (IRBKR 003494). A, habitus; B, antennule; C, antenna; D, P5 & P6. Scales: A=300  $\mu$ m; B–D = 50  $\mu$ m.

*Huntemannia jadensis* was originally described from Jadebusen in Germany but it has since been recorded from in Norway, Sweden, England and other parts of Germany (Lang 1948). It is also a common intertidal harpacticoid on the northwestern coast of North America and was found to be the most abundant harpacticoid species from mud flats in British Columbia (Feller 1980).

*Huntemannia micropus* was recorded by Monard (1935) with a single female specimen collected from a tuft of algae *Fucus platycarpus* at Roscoff, France and was recorded a single female again by Wells (1963) from sandy bottom of the River Exe Estuary, Devon. Later Geddes (1968) described the male based on two specimens collected from the shore of Gallows Point, Beaumaris. As he pointed out, *H. micropus* has peculiar sexual dimorphism in the proximal outer spine of P3 exopod, that is very similar to that of *H. jadensis* in Letova (1982). But *H. micropus* is easily distinguished from its congeners by 2-segmented exopod of P1 and setal formula of swimming legs, i.e. 3 setae on P2 exp-2 in both sexes, female P3 exp-2 with 3 setae, male exp-2 with 5 setae and female P5 with 4 setae.

*Huntemannia lacustris* was described from the Bear Lake, Utah by M.S. Wilson (1958) but no appendages were drawn and thus a detailed comparison can not be made. According to the description, *H. lacustris* had a variable number of in setae on P1 exopod (2- to 3-segmented), the P2 endopod (1- to 2-segmented), and the 2<sup>nd</sup> segment of P3 exopod (5- to 6-segmented) and endopod (1- to 2-segmented) in the female (Table 1). Only this species could be identified with only the original description, of Wilson (1958) or with the table of Geddes (1968: p. 447, Table 2 ).

**TABLE 1.** Morphological features of the species of *Huntemannia* Poppe, 1884.

	Sex	Body length (mm)	No. of setae										Habitat	Distribution
			P1 *		P2 *		P3*		P4*		P5*			
			Exp.	Enp.	Exp.	Enp.	Exp.	Enp.	Exp.	Enp.	Exp.	Benp.		
<i>H. jadensis</i>	f	0.90–1.05	2–3	1	1, 5	2	1, 6	1	1, 6	1	5	4	Marine, brackish water	Norway, Sweden, Germany, England, USA
	m	0.85–0.90	2–3	1	1, 5	2	1, 8	2	1, 6	2	8			
<i>H. micropus</i>	f	1	2	1	1, 3	1	1, 3	1	1, 4	1	4	4	Marine	France, England
	m	0.85–0.90	2	1	1, 3	1	1, 6	2	1, 5	1	8			
<i>H. biarticu- latus</i>	f	0.75	3	2	1, 4	1	1, 6	1	1, 5	1	5	4	Freshwa- ter	China
	m	0.7	3	2	1, 4	1	1, 7	2	1, 7	1	8			
<i>H. lacustris</i>	f	0.80–0.86	2–3	1	1, 5	12	1, 56	12	1, 6	1	5	4	Freshwa- ter	U.S.A.
	m	0.70–0.95	2–3	1	1, 5	2	1, 8	2	1, 7	1	8			
<i>H. doheoni</i> <b>n. sp.</b>	f	0.58–0.76	3	1	3	1	3	1	3	1	5	4	Marine	Korea (West, South)
	m	0.64–1.17	3	1	3	1	1, 3	2	1, 3	1	8			

f=female; m=male; \* Setal formula (NB for male, the number given is the total number of setae on the fused rami)

*Huntemannia biarticulatus* Shen and Tai, 1973, described from freshwater in China, was the first species of Huntemanniidae recorded from the East Asia. The species can be separated from the species of the genus by the presence of a two-segmented P1 exopod having three stout outer spines and two long setae on its distal segment (second outermost spine is very small). In addition, the distal segment of maxilliped was as long as proximal one (the distal one is longer than the proximal one in the new species).

*Huntemannia doheoni* **sp. nov.** was collected from seagrass beds of *Zostera japonica* on the muddy sand flats of Seungbong Island in the Yellow Sea in 2001 and from the sandy bottom of Baeal Island in the South Sea of Korea in 2006. This species, *H. doheoni* **sp. nov.**, was found to be very abundant and was the first marine species of *Huntemannia* collected in East Asia.

*Huntemannia doheoni* **sp. nov.** is distinguished from its congeners by several characteristics including the body length, incompletely fused exopod segments in P2–P4 and reduced setal formulae in the swimming legs in female and modification of outer spines on P3 and P4 in male. In general, females in the genus *Huntemannia* have a longer body length than males, however in *H. doheoni* the body of the male is longer than the female. The new species also showed sexual dimorphism in the swimming legs. As mentioned above, in *H. doheoni* the exopods of P2–P4 of the female are incompletely fused; in the female there is a only suture line on dorsal surface of the exopod but in the male the exopod is clearly two-segmented. A similarly incomplete suture line on the distal segment of the P1 exopod is found in *H. jadensis* as figured by Sars (1909), Chappuis (1958) and Mielke (1975), and in Letova's (1982) specimen collected from East Murman, Russia. This new species also has a reduced number of setae on the swimming legs (Table 1); all segments P2–P4 in the female have only three setae while the distal segments of P3–P4 in the male have one spine and two setae respectively. Finally, the most important diagnostic feature of the new species is the presence, in the male, of sexual modification on the P3–P4 exp-2, although in all other species of *Huntemannia* only the P3 exopod of the male has a modified spine. In *Huntemannia doheoni* **sp. nov.** the outer spine on P3 exp-2 is modified as in Fig. 5C and that of P4 is represented by robust spine with four tiny thorns at the tip.

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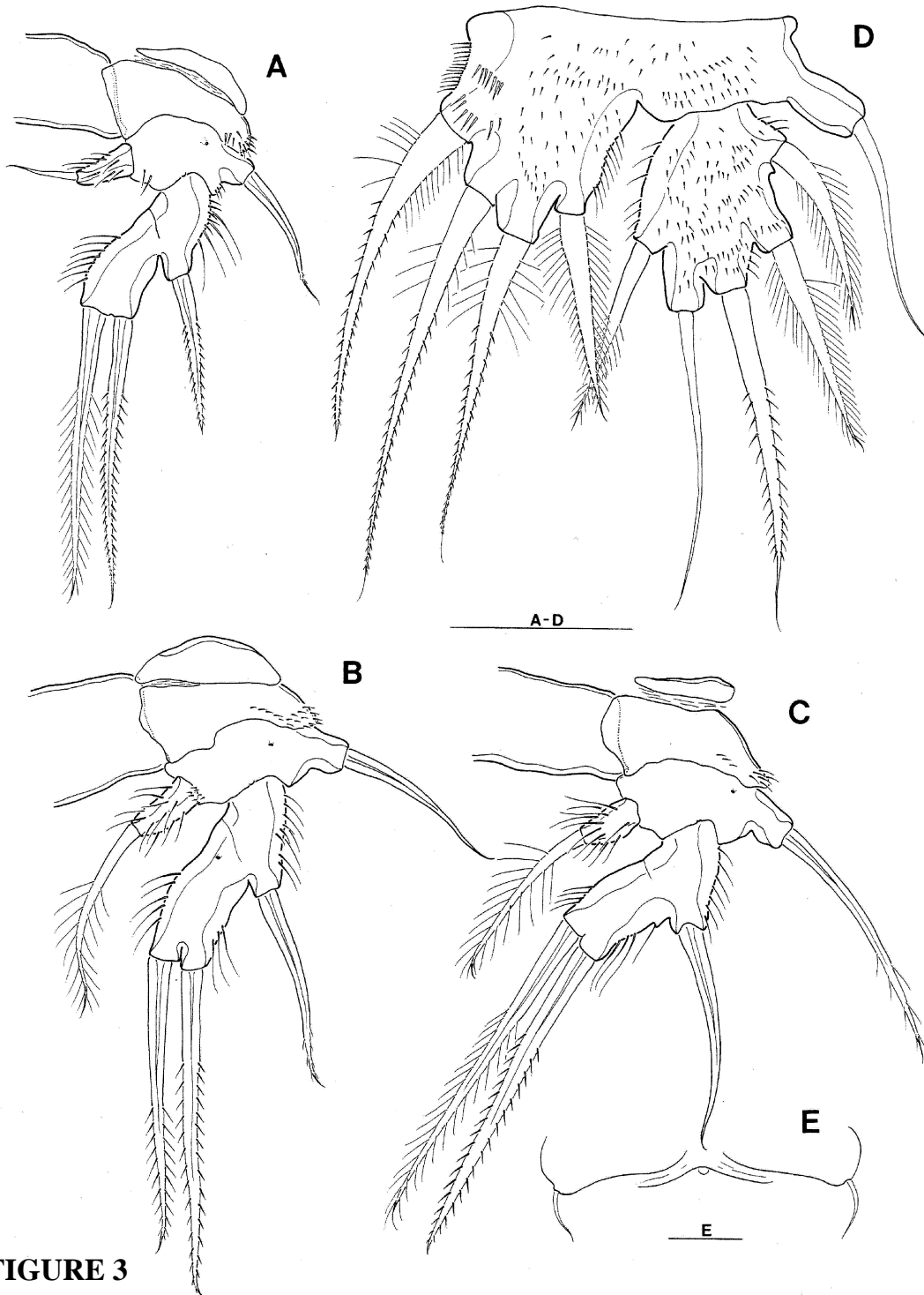
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The legends of Figures 1–6: m should read  $\mu\text{m}$  in the legend Fig. 1 on page 39, Fig. 2 on page 40, Fig. 3 on page 42, Fig. 4 on page 43, Fig. 5 on page 45 and Fig. 6 on page 56. Fig. 3 should to be replaced by the following one.



**FIGURE 3**