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Four new species of the genus *Leucon* (Crustacea: Cumacea) from the Atlantic Frontier Margin

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Four new species of the genus *Leucon* and subgenus *Leucon* (*sensu* Watling, 1991) are described from the Atlantic Frontier Margin and other north-east Atlantic localities. They are *L. sarsi* sp. nov., *L. holti* sp. nov., *L. hanseni* sp. nov. and *L. afeni* sp. nov. *Leucon hanseni* sp. nov. has previously been wrongly identified as *L. serratus*, the holotype of which is illustrated here. A lectotype is selected for *L. nathorsti* and the species is redescribed from the type series and from Atlantic Frontier Margin material. A list of other *Leucon* (*Leucon*) species found in the Atlantic Frontier Environmental Network surveys is given.

INTRODUCTION

In 1996, 20,000 square kilometres of seabed lying to the west of Shetland that had been licensed for oil and gas exploration before or during 1996 was mapped and sampled by the Atlantic Frontier Environmental Network (AFEN). In 1998, a further 10,000 square kilometres north and west of Scotland that covered the 17th oil licensing round was surveyed (see Bett 1997, 1999 and 2001a for the survey area and sampling details). The aim of the AFEN surveys was to give a broad view of the seabed habitats and faunal community, in order to provide a regional context in which to place site-specific surveys and future monitoring. Seven families of cumaceans were recorded with a total of 101 taxa and 788 individuals. Twenty-seven of these taxa are either new species or species that are poorly described and causing taxonomic problems.

More recently, in 2000, the UK Department of Trade and Industry (DTI) conducted a survey in the area north-west of Scotland in the Faeroe–Shetland channel (2000 'White Zone' survey) as part of preparations for a 19th round of oil licensing (see Bett, 2001b for cruise and station details). The DTI survey recorded 52 cumacean taxa from depths of 141 to 1697 m, 11 of which are probably new species. In most cases further material from other surveys in the north-east Atlantic is available to assist in the descriptions.

The family Leuconidae G.O. Sars, 1878 and the genus *Leucon* contain strong deep-water components, and although the north-east Atlantic has been relatively heavily sampled, it still contains new species. For instance, a new species of *Leucon* was described by Watling & Gerken (1999) from a survey of the area around the Faeroe Islands (BIOFAR programme) carried out between 1987 and 1990. The present paper provides descriptions of four new species in the subgenus *Leucon* as restricted by Watling 1991, of the genus *Leucon* Krøyer, 1846 represented in the AFEN surveys. One of the new species had been confused with *L. serratus* Norman, 1879, the holotype of which is illustrated. Another of the new species is somewhat similar to *L. nathorsti* Ohlin, 1901, of which a lectotype is selected and a re-description, based largely on Atlantic Frontier Margin material, is provided because the original description was very brief.

MATERIALS AND METHODS

Details of the Atlantic stations from which specimens were obtained are shown in Table 1. Measurements on specimens were made according to Bishop (1981). In the descriptions, the term 'lacuna' is used for a small emargination of the antero-ventral margin of each pseudorostral lobe very close to the tip of the pseudorostrum. The term 'preparatory female' is used for the developmental stage prior to a brooding instar, in which oostegites are present as non-overlapping buds; in iteroparous species, this morphology would include inter-brood females. The term 'preparatory male' is used for the instar prior to the mature stage in which the antennal notch is very shallow, the pleopods possess distinct rami but lack long setation, and the flagellum of the 2nd antenna reaches at most half way along the body. All stages preceding the preparatory male are called immature males. The long plumose setation of the exopods of the 3rd maxilliped and the 1st–3rd pereopods are not illustrated in the diagrams.

The AFEN material, including the White Zone, has been deposited in the National Museum of Scotland (NMS)/(NMSZ). Material from the Scottish Association for Marine Science (SAMS; formerly SMBA) and Woods Hole Oceanographic Institution (WHOI) is deposited in the British Museum (Natural History) (BMNH). Material from Centre Océanologique de Bretagne (COB) is going to be deposited in the Muséum National d'Histoire Naturelle, Paris.

SYSTEMATICS

Leucon (Leucon) sarsi sp. nov.
(Figure 1)

Material examined

Holotype: 'Discovery' 10112#2, brooding ♀, length 3.7 mm, BMNH 2002.97.

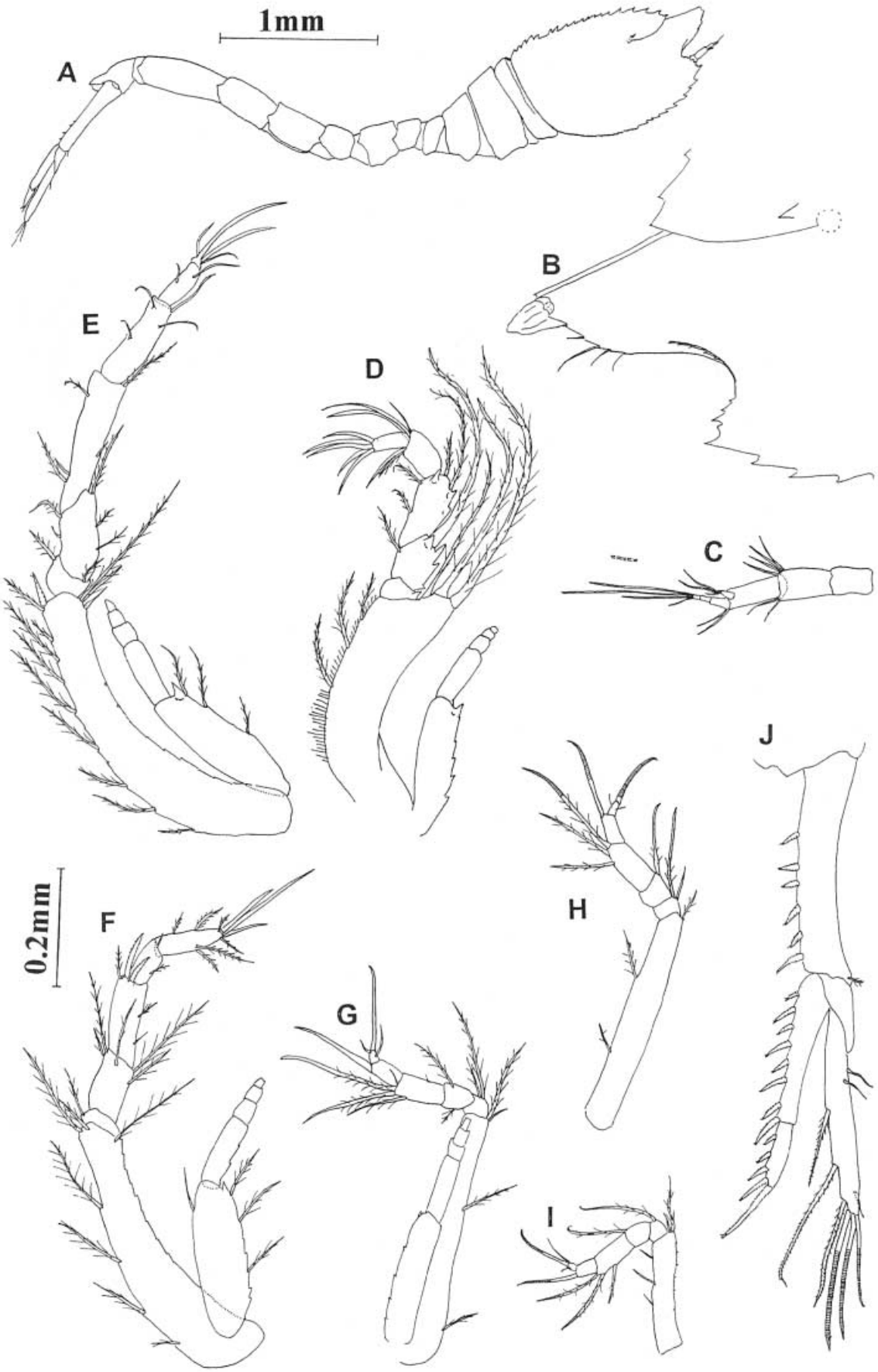

Figure 1. *Leucon* (*Leucon*) *sarsi* sp. nov. (**A–B**) Holotype: BMNH 2002.97, 'Discovery' Station 10112#2 brooding female; (**C–J**) Paratype BMNH 2002.101–107, SMBA ES 10 preparatory female. (A) Whole animal lateral view; (B) carapace lateral view; (C) first antenna; (D) third maxilliped; (E) first pereopod; (F) second pereopod; (G) third pereopod; (H) fourth pereopod; (I) fifth pereopod; (J) uropod. Scale bars: A, 1 mm; B–J, 0.2 mm.

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Table 1. *Details of stations from which specimens were obtained. DTI, UK Department of Trade and Industry; AFEN, Atlantic Frontier Environmental Network; IOS, Institute of Oceanographic Sciences—Deacon Laboratory; COB, Centre Océanologique de Bretagne; SMBA, Scottish Marine Biological Association; WHOI, Woods Hole Oceanographic Institution; DATII, Department of Agriculture and Technical Instruction for Ireland.*

Institution, ship and/or cruise	Station	Year	Latitude	Longitude	Depth (m)	Gear
DTI—White Zone	55204#2	2000	59°40.65′N	08°42.27′W	1295	MC
	55224#1		59°44.86′N	08°45.34′W	1310	MC
	55247#1/3		60°00.05′N	05°31.33′W	804	MC
AFEN—RRS 'Charles Darwin'	54519#1/3	1998	61°44.4′N	01°41.56′W	1192	MEGA11
	54563#3/4		59°44.49′N	07°21.19′W	996	MEGA04
	54566#1/3		59°44.09′N	07°01.66′W	1095	MEGA08
	54575#1/3		59°32.98′N	07°35.06′W	964	MEGA06
	54576#1/2		59°37.11′N	07°12.5′W	1035	MEGA08
	54592#2		58°40.07′N	09°55.07′W	1832	MEGA08
	54606#2		58°48.79′N	07°56.45′W	791	BCE
	54627#1/3		59°34.59′N	07°05.23′W	1036	MEGA06
	54629#5/6		59°46.04′N	07°28.68′W	895	MEGA04
	54634#2/3		59°21.49′N	07°20.11′W	937	MEGA04
	53902#1	1996	61°01.8′N	02°33.35′W	584	BC
IOS—'Discovery'	10112#2	1979	50°25.2′N	13°20.3′W	2640–2650	BN1.5/3M
COB—BIOGAS VI	CP23a	1974	44°04′N	04°21′W	1980	Chalut à perche, accessory net
	DS86		44°05′N	04°19′W	1950	ES
SMBA	ES10	1973	56°37.5′N	11°08.5′W	1944	ES
	ES12		56°49.1′N	10°15.5′W	2076	ES
	ES 15		56°43.6′N	09°28.4′W	1632	ES
	ES18		56°44′N	09°20′W	392	ES
	ES20		56°46′N	09°17′W	1271	ES
	ES22		56°41′N	09°11′W	1028	ES
	ES27		54°39.8′N	12°15.9′W	2920	ES
	ES59		54°40′N	12°20′W	~2900	ES
	ES289	1985	57°19′N	10°25′W	2190	ES
WHOI—'Chain' 106	313	1972	51°32.2′N	12°35.9′W	~1500	ES
WHOI—'Atlantis II' 60	242	1971	38°17′S	51°56′W	4382–4402	ES
	256		37°41′S	52°19′W	3906–3917	ES
'Ingolf'	24	1895–1896	63°06′N	56°00′W	2193	
	32		66°35′N	56°38′W	582	
	36		61°50′N	56°21′W	2624	
	126		67°19′N	15°52′W	536	
DATII—'Helga'	CXX	1901	77 miles W.N.W of Achill Head, Co. Galway, Ireland		699	Trawling tow-nets
King Charles Island	34	1898	78°50′N	29°39′E	60–70	
'Valorous'	9	1875	59°10′N	50°25′W	3203	

MC, multiple corer; MEGA, mega core; BC, box core; BN1.5/3M, triple net epibenthic sledge; ES, epibenthic sledge.

Paratypes: 'Discovery' 10112#2, 1 brooding ♀, 2 immature ♂♂ BMNH 2002.98-100; SMBA ES10, 3 preparatory ♀♀, 4 brooding ♀♀ BMNH 2002.101-107; AFEN 54575#1/3, 1 preparatory ♂, NMSZ 1999.238.0001; AFEN 54606#2, 2 preparatory ♀♀, NMSZ 1999.238.0002; AFEN 54627#1/3, 1 preparatory ♀, NMSZ 1999.238.0003; AFEN 54629#5/6, 1 ♂ manca, NMSZ 1999.238.0004; White Zone YR 16 55224#1, 1 preparatory ♂, NMSZ 2000.249.0001.

Other material examined: SMBA ES12, 1 immature ♂, BMNH 2002.108; SMBA ES18, 1 brooding ♀, BMNH 2002.109; SMBA ES20, 1 brooding ♀, BMNH 2002.110; 'Chain' Station 313, 1 brooding ♀.

Diagnosis

One lateral spine on the frontal lobe, inconspicuous minutely toothed ridge running from antennal notch onto side of pseudorostrum, pseudorostrum short, first antenna short, uropodal endopod slightly shorter than exopod, endopod distal segment with 3–4 stout setae on the median margin plus one terminal setulose stout seta.

Preparatory and brooding-form females (Figure 1A): body length 2.8–3.77 mm. Carapace depth 0.73–0.76 times carapace length. Pereon 0.70–0.94 times carapace length. Pleon two times carapace length.

Carapace (Figure 1A,B): laterally compressed, deep, with lateral spine on the frontal lobe. Dorsal crest with row of ~18–19 teeth ending just before the posterior margin; this row unbroken or with short gap near posterior end. Anterior portion of ventral margin with ~7–8 teeth. Posterior portion of ventral margin with ~10–12 small

teeth ending slightly before the posterior margin. Antero-lateral corner rounded-acute. Antennal notch U-shaped with one blunt small tooth and three pointed teeth, gradually decreasing in size, on ventral margin (Figure 1B). Pseudorostrum short, 0.22–0.24 times carapace length, deep lacuna, ventral margin finely serrated. Minutely toothed ridge running from antennal notch onto side of pseudorostrum.

First antenna (Figure 1C): short, not exceeding the tip of the pseudorostrum. Peduncle and flagellum both 3-segmented. First segment of peduncle 0.7 the length of second segment; second and third segments of the peduncle sub-equal. One-segmented accessory flagellum reaching half way or slightly further along 1st segment of the main flagellum.

Third maxilliped (Figure 1D): basis 1.3 times length of the distal articles combined; dorsal lateral projection does not extend beyond ischium. Ischium plus merus sub-equal to carpus. On the lateral margin, ischium with one tooth, merus with 2–3 teeth and carpus with two teeth. Merus and carpus distal corner with a strong projecting tooth. Exopod slender, slightly shorter than basis, basal segment with one strong sub-terminal tooth and 3–4 teeth on the lateral margin.

First pereopod (Figure 1E): slender, carpus not exceeding the antero-lateral corner of the carapace. Basis 0.95 times the distal articles combined, with one stout setulose seta on the ventral distal corner and 7–8 very fine teeth on lateral margin. Ischium plus merus 0.8 times carpus. Dactyl 0.5 times propodus. Exopod slender, slightly shorter than basis, basal segment with one strong sub-terminal tooth.

Second pereopod (Figure 1F): basis sub-equal to the distal articles combined, lateral margin with nine very small teeth. Ischium 0.3 times merus; ischium plus merus sub-equal to carpus; propodus 0.6 times dactyl. Carpus with two setulose stout setae on the ventral distal corner. Exopod slender, exceeding basis, basal segment with one strong sub-terminal tooth.

Third pereopod (Figure 1G): basis long and cylindrical, 1.8 times distal articles combined. Exopod sub-equal to basis, basal segment with sub-terminal tooth.

Fourth and fifth pereopods (Figure 1H,I): no exopod; basis of fourth pereopod ~1.5 times length of distal articles combined.

Uropod (Figure 1J): 0.26–0.27 times body length, peduncle 1.1 times the length of the exopod. Endopod slightly shorter than exopod, extends 0.91–0.93 of way along exopod. First segment of endopod 2.3 times length of 2nd. Number of setulose stout setae on median margin: peduncle, 6; 1st segment of endopod, eight alternating in length; 2nd segment of endopod 3–4 setae and one terminal seta. Terminal seta of 2nd segment of endopod equal in length to the segment. Exopod distal segment with three long plumose setae on the median margin and three simple annulate setae terminally.

Preparatory male: body length 3.0–3.4 mm. Carapace depth 0.7–0.8 times carapace length. Pereon 0.7–0.8 times carapace length. Pleon 1.6–1.8 times carapace length. Carapace dentition similar to that of female, antennal notch slightly shallower than that of female.

Remarks

The species is named in honour of the carcinologist G.O. Sars for his great contribution to cumacean taxonomy. *Leucon sarsi* sp. nov. is clearly related to other species included in the subgenus *Leucon* by Watling (1991). It is therefore referred to that subgenus despite the possession of an accessory flagellum on the first antenna reaching the midpoint of the first segment of the main flagellum, which would indicate its inclusion in *Crymoleucon* Watling, 1991 according to the original definition of that subgenus. The new species does not appear closely related to *Leucon tener* Hansen, 1920, the type species of *Crymoleucon*.

Females of *L. sarsi* sp. nov. can be distinguished from all other members of the subgenus *Leucon* by the combination of: (1) the possession of a single lateral spine on the frontal lobe near the posterior end of the frontal suture of the carapace; (2) the uropodal exopod exceeding the endopod; and (3) the entire dorsal crest of the carapace being occupied by a row of teeth uninterrupted or interrupted only by a very short gap in the posterior third. Coupled with an accessory flagellum that at most only slightly exceeds the midpoint of the first segment of the main flagellum of the first antenna, the above three characters also distinguish *L. sarsi* from all species included in the subgenus *Crymoleucon* by Watling (1991) and Watling & Gerken (1999). Characters distinguishing this species from *L. holti* sp. nov. are discussed under that species.

Distribution

Leucon sarsi appears so far to be exclusive to the middle and lower slopes of the Atlantic Frontier Margin, but more predominantly the lower slope. The species has been found from the Rockall Trough, the Porcupine Sea Bight and to the north of the Flannan Isles, at depths of 791–2650 m.

Leucon (Leucon) holti sp. nov.
(Figure 2)

Material examined

Holotype: AFEN 54592#2, preparatory ♀, length 3.2 mm, NMSZ 1999.238.0005.

Paratypes: White Zone 55204#2, 1 immature ♂, NMSZ 2000.249.0002; SMBA ES12, 2 preparatory ♀♀, 1 immature ♀, 3 immature ♂♂, 1 mature ♂ (anterior part only), BMNH 2002.111–118.

Other material examined: SMBA ES 15, 1 manca, 2 preparatory ♀♀, BMNH 2002.119–121; SMBA ES 18, 2 preparatory ♀♀, 1 brooding ♀, BMNH 2002.122–124; SMBA ES 20, 1 manca, 4 preparatory ♀♀, 1 preparatory ♂, BMNH 2002.125–130; BIOGAS VI CP23a, 1 preparatory ♀; BIOGAS VI DS86, 1 preparatory ♀, 4 brooding ♀♀, 2 immature ♂♂; SMBA ES 289, 2 preparatory ♀♀, 2 brooding ♀♀, 1 preparatory ♂; 'Helga' CXX, 1 mature ♂, 1 immature ♀ (recorded as *Leucon pallidus* by Calman 1905).

Diagnosis

Two small lateral spines on the frontal lobe, first antenna long, uropodal endopod shorter than exopod,

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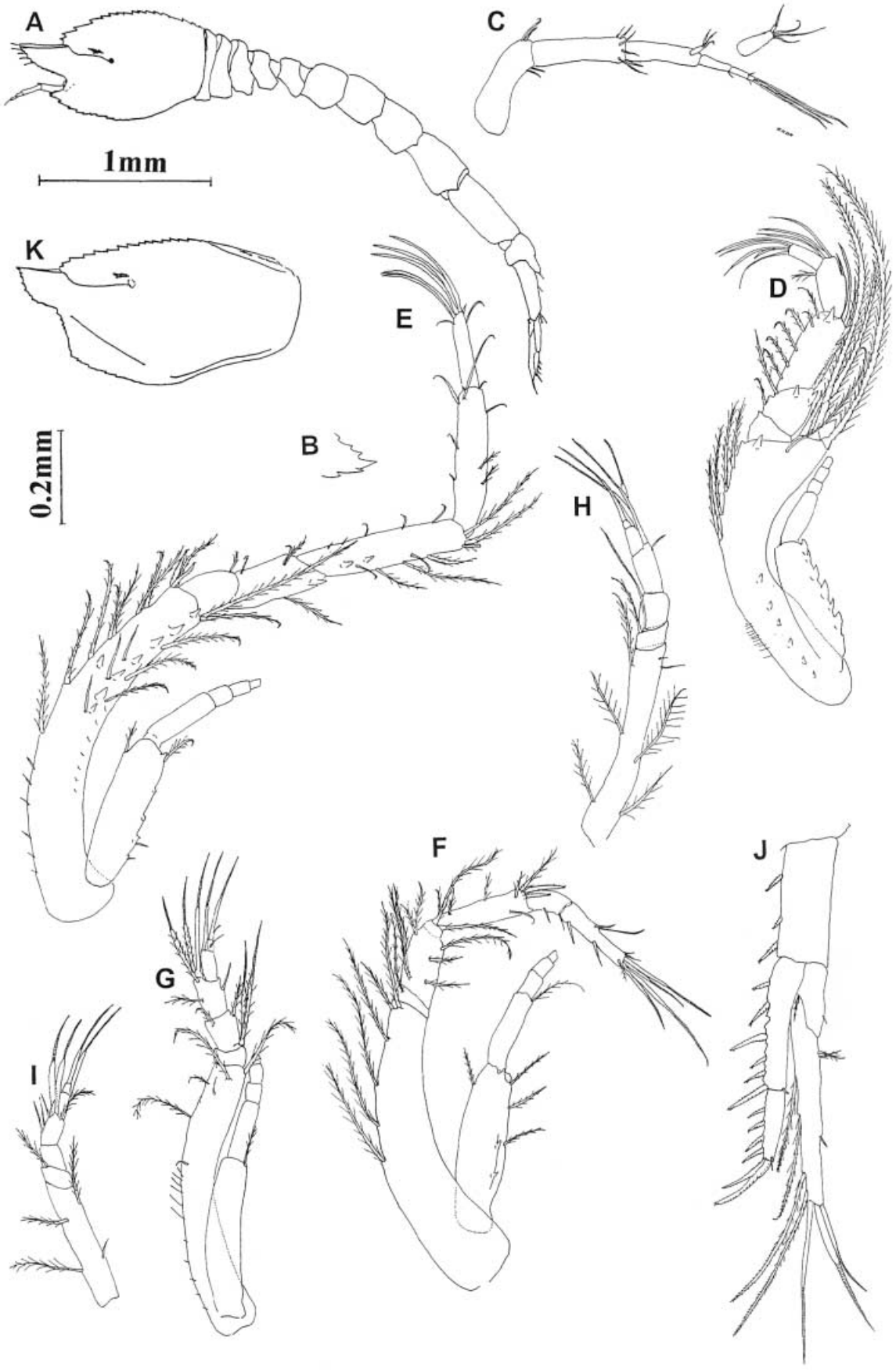

Figure 2. *Leucon* (*Leucon*) *holti* sp. nov. (**A**) Holotype: NMSZ 1999.238.0005, AFEN 54592#2 preparatory female; (**B–J**) BIOGAS VI DS86 brooding female; (**K**) Paratype: BMNH 2002.111–118, SMBA ES 12 incomplete mature male. (A) Whole animal lateral view; (B) antero-lateral angle of carapace lateral view; (C) first antenna; (D) third maxilliped; (E) first pereopod; (F) second pereopod; (G) third pereopod; (H) fourth pereopod; (I) fifth pereopod; (J) uropod; (K) mature male carapace lateral view. Scale bars: A&K, 1 mm; B–J, 0.2 mm.

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endopod distal segment with five stout setae on the median margin.

Preparatory and brooding-form females (Figure 2A): body length 3.2–5.2 mm. Carapace depth 0.70–0.73 times carapace length. Pereon 0.71–0.85 times carapace length. Pleon 2.1–2.2 times carapace length.

Carapace (Figure 2A,B): laterally compressed, with two small lateral spines on the frontal lobe, the posterior one the smaller. Dorsal crest with anterior row of ~16–18 teeth separated by short gap from posterior row of 3–5 teeth ending at the posterior margin. Anterior portion of ventral margin with regular row of 12–14 teeth. Posterior portion of ventral margin with very small teeth. Antero-lateral corner acute, antennal notch U-shaped with three similar size small teeth on ventral margin (Figure 2B). Pseudorostrum long, 0.3 times carapace length, horizontal, no lacuna, entire ventral margin finely serrated.

First antenna (Figure 2C): long, extending slightly beyond the tip of the pseudorostrum. Peduncle and flagellum both 3-segmented. First and second segments of peduncle sub-equal in length. Third segment 0.8 times length of the first segment. One-segmented accessory flagellum about half the length of the lst segment of the main flagellum and inserted slightly proximal to its base.

Third maxilliped (Figure 2D): basis longer than the distal articles combined; distal projection not extending beyond ischium. Ischium 0.5 times length of merus; merus with two teeth, one at the distal point of the lateral margin and one on the ventral margin. Carpus subequal to propodus plus dactyl. Carpus with three teeth, one at the mid-distal part and two at the lateral margin. Exopod slender, sub-equal to basis; basal segment with six teeth; flagellum of four articles.

First pereopod (Figure 2E): long and slender, carpus ending just beyond antero-lateral corner of the carapace. Basis 0.8 times the length of the distal articles combined. Basis with group of 6–7 teeth in distal half of the segment, one tooth on the first third of the ventral margin and two setulose stout setae on the ventral distal corner. Ischium plus merus 0.82 times the length of carpus; carpus and propodus sub-equal; dactyl half as long as propodus. Exopod slender, sub-equal to basis; basal segment with strong distal lateral tooth and three lateral teeth.

Second pereopod (Figure 2F): basis subequal to the distal articles combined; ischium plus merus subequal to carpus; carpus 0.8 times the length of propodus plus dactyl; dactyl two times propodus. Carpus with two setulose stout setae on the distal ventral corner. Exopod slender; exceeding the basis; basal segment with strong median distal tooth and two lateral teeth.

Third pereopod (Figure 2G): basis 2.2 times the distal articles combined. Exopod sub-equal to basis, basal segment exceeding the length of the distal articles combined.

Fourth and fifth pereopods (Figure 2H,I): no exopod; basis ~1.5 and 1.1 times length of the distal articles combined in the 4th and 5th pereopod respectively.

Uropod (Figure 2J): 0.23 times body length, peduncle 0.7–0.8 times the length of the exopod. Endopod clearly shorter than exopod, extends 0.84–0.87 of way along exopod. First segment of endopod 1.58–1.87 times length of 2nd. Number of setulose stout setae on median margin: peduncle, 3; lst segment of endopod, 6–7; 2nd segment of endopod, five plus one terminal seta. The terminal seta of the 2nd segment of endopod 0.9 times length of the 2nd segment. Exopod distal segment with four long plumose setae on the median margin and three simple annulate setae terminally.

Preparatory male: body length 4.2–4.4 mm. Carapace depth 0.75 times carapace length. Pereon 0.86 times carapace length. Pleon 1.95 times carapace length. Carapace dentition similar to that of female, antennal notch slightly shallower than that of female.

Mature male (Figure 2K): carapace dorsal crest dentition similar to that of female. Pseudorostrum shorter than that of female and immature male, 0.22 times carapace length, its entire ventral margin serrated. Carapace without antennal notch.

Remarks

The species is present in the collections from the west coast of Ireland obtained by E.W.L. Holt and reported by Calman (1905); it is named after Holt, and also after S.H.S.'s husband. Females of *Leucon* (*Leucon*) *holti* sp. nov. can be distinguished from all other members of the subgenus by the combination of: (1) the possession of two adjacent lateral spines on the frontal lobe; (2) the uropodal exopod exceeding the endopod; and (3) the entire dorsal crest of the carapace being occupied by a row of teeth interrupted only by a short gap in the posterior third. On the last two criteria, *L. holti* is similar to *L. assimilis* Sars, 1887, *L. robustus* Hansen, 1920 and *L. sarsi* sp. nov., which also possess spines on the frontal lobe. However, *L. assimilis* and *L. robustus* have three well-separated spines on the frontal lobe, while *L. sarsi* has a single spine. The two new species *L. sarsi* and *L. holti* also differ in the length and shape of the pseudorostrum, the length of the first antenna relative to the pseudorostrum, and in the possession by *L. sarsi* alone of a minutely denticulate ridge running from the antennal notch onto the side of the pseudorostrum.

Distribution

This species has been found almost exclusively on the lower slope of the Hebrides Ridge (Atlantic Frontier Margin), the Rockall Trough and Biscay at depths of 1271–2190 m. There is one record from the middle slope, at 699 m off Achill Head, Galway.

Leucon (Leucon) hanseni sp. nov.
(Figure 3)

Leucon serratus: Hansen (1920) plate l, figure 6.

Material examined

Holotype: SMBA ES22, brooding ♀, length 3.7 mm, BMNH 2002.131.

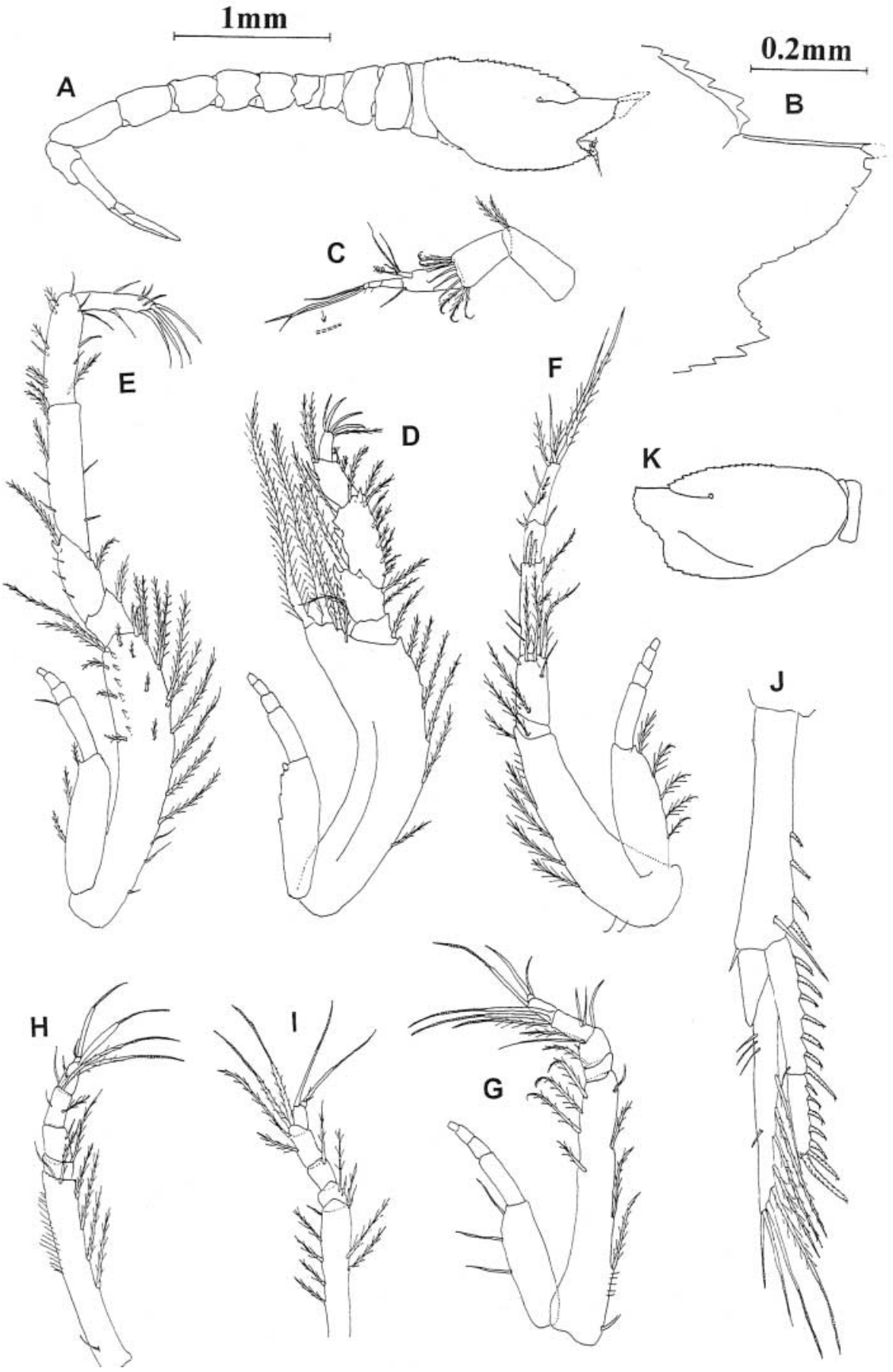

Figure 3: *Leucon* (*Leucon*) *hanseni* sp. nov. (**A**, **C–J**) Holotype: BMNH 2002.131, SMBA ES 22 brooding female; (**B**) Paratype: NMSZ 1999.238.0009, AFEN 54575#1/3 brooding female; (**K**) BMNH 2002.132–141, SMBA ES 22 mature male. (A) Whole animal lateral view; (B) carapace lateral view; (C) first antenna; (D) third maxilliped; (E) first pereopod; (F) second pereopod; (G) third pereopod; (H) fourth pereopod; (I) fifth pereopod; (J) uropod; (K) mature male carapace lateral view. Scale bars: A&K, 1 mm; B–J, 0.2 mm.

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Paratypes: SMBA ES22, 13 preparatory ♀♀, 15 brooding ♀♀, 8 manca ♂♂, 22 immature ♂♂, 9 mature ♂♂, BMNH 2002.132–141; AFEN 54519#1/3, 1 brooding ♀, NMSZ 1999.238.0006; AFEN 54563#3/4, 1 preparatory ♂, NMSZ 1999.238.0007; AFEN 54566#1/3, 4 preparatory ♀♀, 1 brooding ♀, 1 preparatory ♂, NMSZ 1999.238.0008; AFEN 54575#1/3, 1 preparatory ♀, 1 preparatory ♂, NMSZ 1999.238.0009; AFEN 54576#1/2, 1 preparatory ♀, 4 preparatory ♂♂, NMSZ 1999.238.0010; AFEN 54627#1/3, 3 manca, 2 preparatory ♀, 2 preparatory ♂♂, NMSZ 1999.238.0011; AFEN 54634#2/3, 1 preparatory ♀, NMSZ 1999.238.0012.

Other material examined: SMBA ES 27, 1 manca, 8 preparatory ♀♀, 2 brooding ♀♀, 2 immature ♂♂, 1 mature ♂, BMNH 2002.142–151; SMBA ES 59, 5 manca, 6 preparatory ♀♀, 4 brooding ♀♀, 5 immature ♂♂. 'Ingolf' Station 24, 1 brooding ♀; Station 36, 2 preparatory ♂♂.

Diagnosis

No lateral spines on the frontal lobe, pseudorostrum short and deep with lacuna, first antennae very short with distal ring of recurved setae on second peduncle segment, uropodal endopod shorter than exopod, distal segment with 5–6 median stout setae and one terminal seta.

Preparatory and brooding-form females (Figure 3A): body length 3.1–4.4 mm. Carapace depth 0.62–0.70 times carapace length. Pereon 0.80–0.85 times carapace length. Pleon 1.9–2.0 times carapace length.

Carapace (Figure 3A,B): laterally compressed, without lateral spine on or near the frontal lobe. Dorsal crest with row of ~16–18 teeth extending into the posterior half, then a short gap followed by a row of 4–6 teeth near the posterior margin. Anterior portion of ventral margin with ~10 teeth. Posterior portion of ventral margin with ~12–14 small teeth ending slightly before the posterior margin. Antero-lateral corner acute. Antennal notch V-shaped with 3–4 very small teeth on ventral margin (Figure 3B). Pseudorostrum short, 0.21–0.26 times carapace length, not upturned, small lacuna, entire ventral margin finely serrated and continuous with antennal notch. Branchial siphon relatively long, clearly exceeding pseudorostrum.

First antenna (Figure 3C): very short, not exceeding the tip of the pseudorostrum. Peduncle and flagellum both 3-segmented. 1st segment of peduncle 1.6 times 2nd segment, 2nd and 3rd segments of the peduncle sub-equal. Second segment of peduncle with distal ring of setae which are recurved when complete. One-segmented accessory flagellum, about two-thirds the length of the 1st segment of the flagellum and inserted proximally to its base. Accessory flagellum with three simple setae and one aesthetasc.

Third maxilliped (Figure 3D): basis longer than the distal articles combined; distal projection extends just beyond ischium. Ischium 0.5 times length of merus, merus with two teeth on the lateral margin and one on the distal margin. Carpus sub-equal to propodus plus dactyl with two teeth at the lateral margin, one at the ventral distal corner and a less pronounced one at the median distal margin. Propodus about two times length of dactyl with a strong tooth at the lateral distal corner. Exopod slightly shorter than basis, basal segment with projecting tooth at the distal lateral margin and three very small teeth laterally.

First pereopod (Figure 3E): slender, carpus not extending beyond the antero-lateral corner of carapace. Basis slender, 0.7 times length of the distal articles combined, distal ventral corner with two short setulose setae. Ischium plus merus 0.8 times carpus, merus dorsal margin with big subterminal tooth. Carpus 1.24 times propodus. Dactyl cylindrical, 0.7 times propodus. Exopod sub-equal to basis, basal segment with distal tooth.

Second pereopod (Figure 3F): basis short, 0.8 times the distal articles combined, antero-lateral angle pronounced. Ischium 0.32 times length of merus, ischium plus merus sub-equal in length to carpus. Carpus ventral distal corner with one pair of setulose stout setae. Dactyl 1.5 times propodus. Exopod longer than basis, basal segment with one tooth distally.

Third pereopod (Figure 3G): basis long and cylindrical, very clearly longer than the distal articles combined. Exopod sub-equal to basis, basal segment with a feeble tooth on the lateral distal corner.

Fourth and fifth pereopods (Figure 3H,I): no exopod, basis clearly longer than the distal articles combined, ~1.6 and 1.3 times their length in the 4th and 5th pereopod respectively.

Uropod (Figure 3J): slender, 0.24 times body length, peduncle slightly shorter than the exopod. One long simple seta near the distal end of the peduncle. Endopod clearly shorter than exopod, extending 0.82 of way along exopod. First segment of endopod 1.7 times length of 2nd. Number of setulose stout setae on median margin: peduncle 4; 1st segment of endopod 7; 2nd segment of endopod 5–6 plus one terminal seta. The terminal seta 0.8 times length of the 2nd segment of endopod. Exopod distal segment with four long plumose setae and one plumose annulate seta on the median margin, three simple annulate setae terminally.

Mature male (Figure 3K): body length 3.9–4.3 mm. Carapace depth 0.65–0.67 times carapace length. Pereon 0.76 times carapace length. Pleon 1.86 times carapace length. Carapace without lateral spine on the frontal lobe. Dorsal crest with row of ~13–14 teeth extending into the posterior half, then a gap followed by a row of 3–4 teeth near the posterior margin. Pseudorostrum shorter than that of female and immature male, 0.19 times carapace length, its entire ventral margin finally serrated. Carapace without antennal notch.

Remarks

Specimens of this species from the Danish 'Ingolf' Expedition were referred to *Leucon serratus* Norman, 1879 by H.J. Hansen (1920), and the species is named in his honour. *Leucon hanseni* sp. nov. differs from true *L. serratus* (as defined by the holotype) in its shallower carapace, interrupted dentition of the dorsal crest, and longer pseudorostrum relative to the carapace. The distal ring of

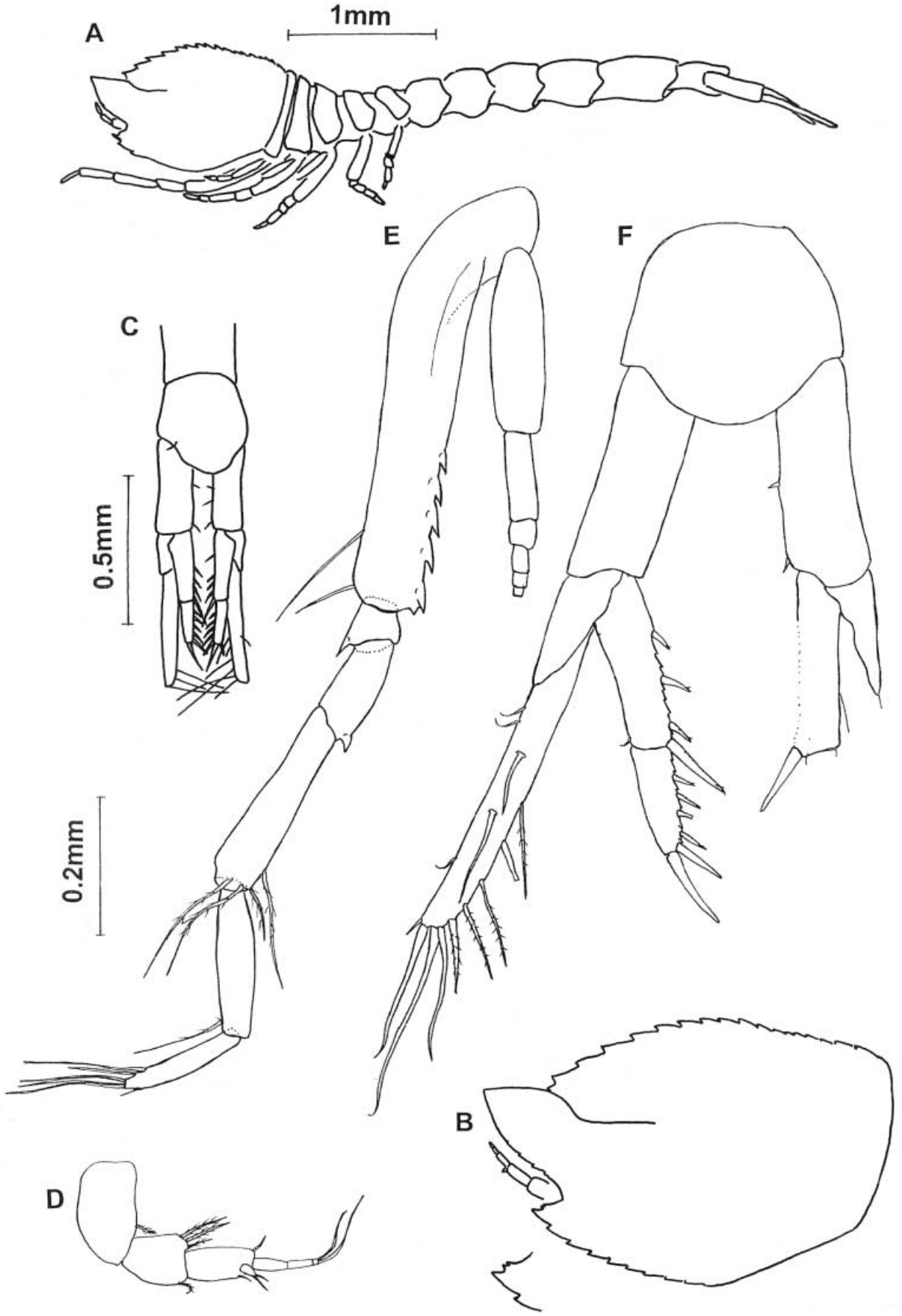

Figure 4. *Leucon* (*Leucon*) *serratus* Norman, 1879. (**A–C**) Holotype: BMNH 1911.11.8.5252, 'Valorous' Station 9 immature female; (**D–F**) 'Atlantis II' Cruise 60, Station 242 immature female. (A) Whole animal lateral view; (B) carapace lateral view; (C) uropod; (D) first antenna; (E) first pereopod; (F) uropod. Scale bars: A, 1 mm; B&C, 0.5 mm; D–F, 0.2 mm.

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re-curved setae on the second peduncular segment of the lst antennae in *L. hanseni* are not present in *L. serratus*. Females of *L. hanseni* share with a number of other members of the subgenus the combination of: (1) the absence of lateral spines on the frontal lobe; (2) the uropodal exopod exceeding the endopod; and (3) the dorsal crest of the carapace being occupied by an anterior row of teeth interrupted by a gap before a shorter group of teeth near the posterior margin. Of the other species sharing these characters, *L. affinis* Fage, 1951 is larger, has a relatively longer pseudorostrum, which is less clearly serrated on the antero-ventral margin, and has longer, more slender first antennae; the distal segment of the uropodal endopod of *L. affinis* is relatively longer. *Leucon fulvus* Sars, 1865 is larger, has a shorter carapace relative to the rest of the body, and the second pereopod has the carpus shorter than, or at most equal to, the dactylus, while the carpus is longer than the dactylus in *L. hanseni*. *Leucon kobiakovae* Lomakina, 1955 has a very distinctive carapace, with a strong lateral fold, fewer, relatively larger dorsal teeth, and a clearly upturned pseudorostrum. *Leucon magnadentatus* Given, 1961 and *L. varians* Gamô, 1962 both have a small number of relatively large dorsal teeth anteriorly on the carapace, followed by a long gap and a single posterior tooth (which may be missing in *L. varians*); the pseudorostrum is almost perfectly triangular and slightly upturned; the number and arrangement of median setae on the uropodal peduncle and rami differ from those of *L. hanseni* in both species.

Leucon acutirostris Sars, 1865, *Leucon americanus* Zimmer, 1943 and *Leucon simanensis* Gamô, 1962 also lack lateral spines on the frontal lobe and have the uropodal exopod exceeding the endopod, but differ from *L. hanseni* in lacking the posterior group of dorsal teeth on the carapace.

Distribution

This species has been found in some quantity on the lower slope on both sides of the North Atlantic. Records from the west of Shetland, Hebrides Ridge, Rockall Trough and Davis Strait are at depths between 937 and 2920 m.

Leucon serratus Norman, 1879
(Figure 4)

non *Leucon serratus*: Hansen (1920) plate 1, figure 6,=*L. (L.) hanseni* sp. nov.

Material examined

Holotype: A.M. Norman collection,'Valorous' Station 9, Davis Strait, 1 immature ♀, BMNH 1911.11.8.5252.

Other material examined: 'Atlantis II' Cruise 60, Station 242, 5 manca, 7 immature ♀♀, 4 brooding ♀, 12 immature ♂♂, 2 preparatory ♂♂; Station 256, 2 juveniles, 1 preparatory ♀, 4 immature ♂♂.

Remarks

The holotype specimen agrees well with Norman's original description but belongs to a species that does not appear to have been found again near the recorded type locality off Greenland. It does, however, occur in the south-east Atlantic at comparable depths to the type locality ('Atlantis II' Cruise 60). From the holotype, an immature female which was not dissected, and from the 'Atlantis II' Cruise 60, it was possible to confirm the continuous serration on the dorsal crest (Figure 4A,B) and the relatively small size of the lst antennae in relation to the pseudorostrum (Figure 4B). There are seven teeth on the basis of the lst pereopod (six in the specimen illustrated in Figure 4E), as noted by Norman, plus a single distal tooth on both the ischium and merus. The proportions and armature of the uropods agree closely with Norman's description (Figure 4C&F).

Leucon (Leucon) afeni sp. nov.
(Figure 5)

Material examined

Holotype: AFEN 54563#3, brooding ♀, length 3.5 mm, NMSZ 1999.238.0013.

Paratypes: SMBA ES20, 1 manca, 1 preparatory ♀, 3 brooding ♀♀, BMNH 2002.152–156.

Diagnosis

Pseudorostrum very short and acute-tipped, one lateral spine on the frontal lobe, first antenna clearly much longer than pseudorostrum, uropodal endopod longer than exopod, endopod distal segment with five stout median setae and one terminal seta.

Brooding female (Figure 5A): body length 3.5 mm. Carapace depth 0.75 times carapace length. Pereon subequal to carapace length. Pleon 2.5 times carapace length.

Carapace (Figure 5A,B): laterally compressed, deep, with lateral spine on the frontal lobe. Dorsal crest with anterior row of ~ 11 teeth separated by gap from posterior row of two teeth, ending some way before the posterior margin. Ventral margin with regular row of teeth decreasing in size posteriorly. Antero-lateral corner acute. Antennal notch V-shaped with three small teeth on ventral margin (Figure 5B). Pseudorostrum very short, 0.20 times carapace length, acute, slightly upturned, ventral margin finely serrated.

First antenna (Figure 5C): long, extending well beyond the tip of the pseudorostrum. Peduncle and flagellum both 3-segmented. First segment 0.8 times length of the second segment and subequal in length to the third segment. A circle of simple setae at the distal end of peduncle second segment. One-segmented accessory flagellum about half the length of the lst segment of the main flagellum and inserted proximal to its base.

Third maxilliped (Figure 5D): basis 1.2 times the distal articles combined; distal projection not extending beyond ischium. Ischium 0.4 times length of merus. Merus with one big tooth on the lateral margin. Carpus 1.4 times the length of ischium and merus combined with two teeth on the lateral margin. Propodus subequal in length to ischium and merus combined. Dactyl short, 0.7 times the length of propodus. Exopod shorter than basis.

First pereopod (Figure 5E): relatively short, carpus ending before the antero-lateral corner of the carapace. Basis

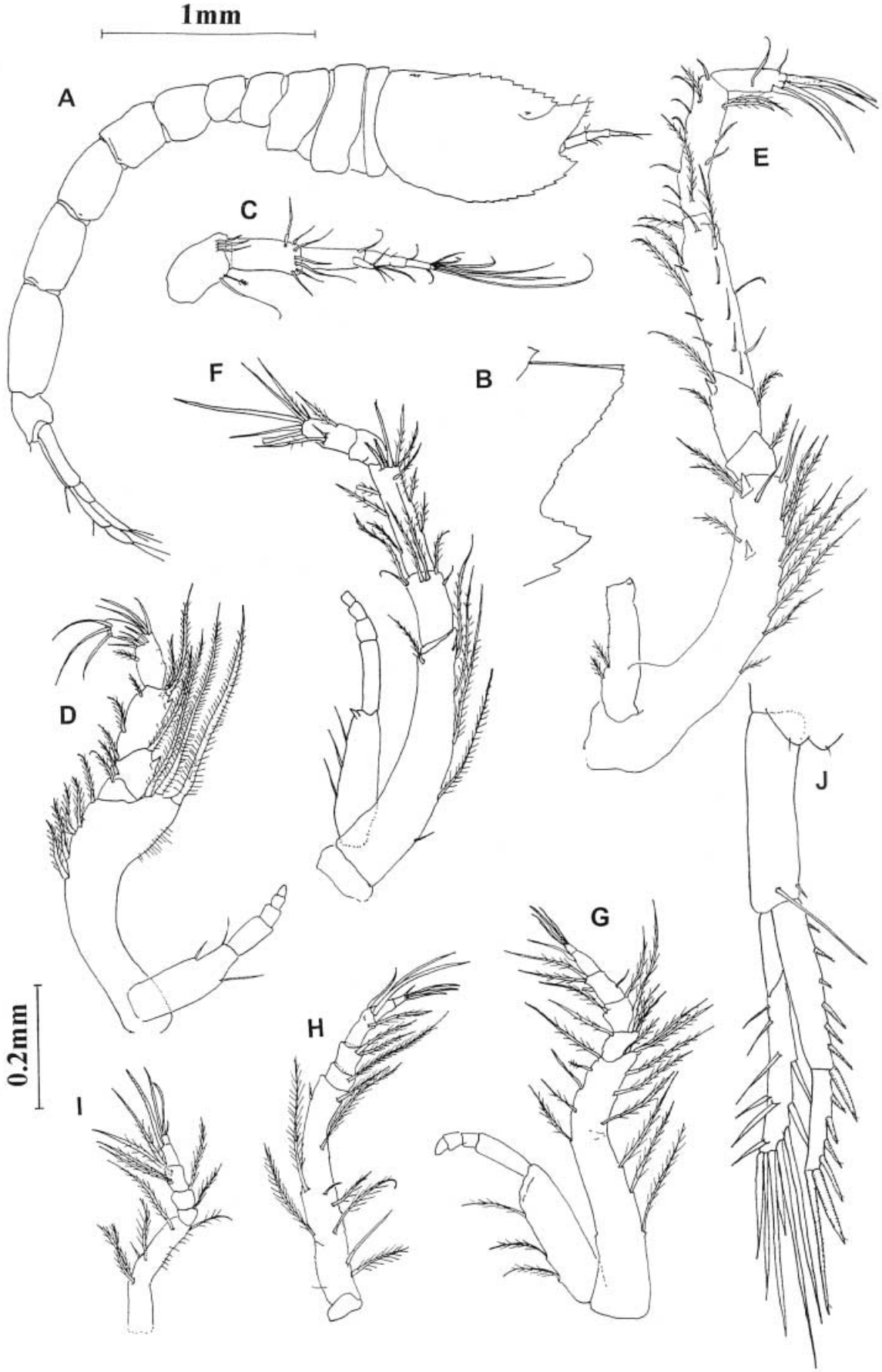

Figure 5. *Leucon* (*Leucon*) *afeni* sp. nov. (**A–E**, **G–J**) Holotype: NMSZ 1999.238.0013, AFEN 54563#3 brooding female; (**F**) Paratype: BMNH 2002.152–156, SMBA ES20 brooding female. (A) Whole animal lateral view; (B) carapace lateral view; (C) first antenna; (D) third maxilliped; (E) first pereopod; (F) second pereopod; (G) third pereopod; (H) fourth pereopod; (I) fifth pereopod; (J) uropod. Scale bars: A, 1 mm; B–J, 0.2 mm.

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0.75 times length of the distal articles combined, with two teeth in distal third of the segment. Ischium short, merus with one tooth on the distal corner. Carpus long, 1.7 and 1.3 times the length of ischium plus merus, and propodus, respectively. Dactyl half as long as propodus.

Second pereopod (Figure 5F): basis 0.9 times the distal articles combined; ischium very short, ischium plus merus 0.7 times the length of the carpus; carpus 1.3 times the length of propodus plus dactyl; dactyl 1.7 times the length of propodus. Distal ventral corner of carpus carrying three different sizes of setulose setae. Exopod slender, longer than basis, basal segment with strong tooth distally.

Third pereopod (Figure 5G): basis long, around two times the distal articles combined. Exopod slender, not exceeding basis.

Fourth and fifth pereopods (Figure 5H,I): no exopod; basis clearly longer than all the distal articles combined.

Uropod (Figure 5J): 0.2 times body length. Peduncle cylindrical, 0.8 length of endopod. Endopod slightly longer than exopod (exopod extends 0.9 of way along endopod). First segment of endopod 1.7 times length of second. Number of setulose stout setae on median margin: peduncle l; lst segment of endopod, seven of differing size; 2nd segment of endopod five and one terminal seta. The terminal seta 1.4 times length of 2nd segment of endopod.

Remarks

The species here is named in honour of the AFEN group, in appreciation of their funding to investigate deep-sea communities in relation to oil and gas explorations. Females of *Leucon (Leucon) afeni* sp. nov. share only with *Leucon nathorsti* Ohlin, 1901 the combination of: (1) the possession of a single lateral spine on the frontal lobe; (2) the uropodal endopod exceeding the exopod; and (3) the dorsal crest of the carapace being occupied by an anterior row of teeth interrupted by a gap before a group of two teeth near the posterior margin. However, the new species is distinguished by the extremely short pseudorostrum, clearly exceeded by the long first antenna, and the relatively prominent antero-lateral angle. *Leucon profundus* Hansen, 1920 also has a single lateral spine on the frontal lobe and the uropodal endopod exceeding the exopod, but is a larger species with a relatively long pseudorostrum, and the two groups of teeth on the dorsal crest are separated only by a short gap, with the posterior group comprising several teeth.

Distribution

This species has been recorded twice so far from the lower slopes of the Atlantic Frontier Margin, north of the Flannan Isles and west of St Kilda at depths of 996 and 1271 m.

Leucon nathorsti Ohlin, 1901
(Figure 6)

Material examined

Lectotype: Ohlin Collection, King Charles Islands Station 34(?), brooding ♀ (marsupium empty), length 5.1 mm, SMNH 5491.

Paralectotypes: Ohlin Collection, King Charles Islands Station 34(?), 9 preparatory ♀♀, 2 brooding ♀♀, 5 immature ♂♂, 1 preparatory ♂, SMNH 5738.

Other material examined: AFEN 53902#1, 1 preparatory ♂, NMSZ 1999.238.0014; White Zone FSC 800 55247#2/3, 1 preparatory ♀, NMSZ 2000.249.0003; 'Ingolf' Expedition, Station 32, 6 specimens; 'Ingolf' Expedition, Station 126, 5 specimens.

Diagnosis

Body robust, pseudorostrum short and acute-tipped, one lateral spine on the frontal lobe, surface of body with numerous fine setae, first antenna slightly longer than pseudorostrum, uropodal endopod longer than exopod, endopod distal segment with four stout median setae and one terminal seta.

Preparatory female (Figure 6A): body length 5 mm. Carapace depth 0.8 times carapace length. Pereon 1.1 times carapace length. Pleon 2.3 times carapace length.

Carapace (Figure 6A,B): laterally compressed, covered with fine setae, deep with one small lateral spine above the frontal lobe. Dorsal crest with anterior row of ~15 teeth separated by a gap from posterior row of two teeth, ending some way before the posterior margin. Anterior portion of ventral margin with regular row of ten teeth. Posterior portion of ventral margin with small teeth. Antero-lateral corner weakly pronounced. Antennal notch shallow, L-shaped, with three different-sized teeth on ventral margin (Figure 6B). Pseudorostrum short, 0.24 times carapace length, not upturned, very small lacuna, ventral margin serrated.

First antenna (Figure 6C): extending slightly beyond the tip of the pseudorostrum. Peduncle and flagellum both 3-segmented. Second segment of peduncle 1.3 times length of the first. Third segment 0.8 times length of the first segment. A circle of simple setae at the distal end of peduncle second segment. One-segmented accessory flagellum about one third the length of the lst segment of the main flagellum and inserted slightly proximal to its base.

Third maxilliped (Figure 6D): basis long, 1.6 times the distal articles combined; distal projection not extending beyond ischium. Ischium 0.4 times length of merus. Ischium plus merus sub-equal to carpus. Merus and carpus each have two large distal teeth. Dactyl short, 0.6 times the length of propodus. Exopod slender; sub-equal to basis; basal segment with three lateral teeth and one strong distal tooth.

First pereopod (Figure 6E): relatively robust, carpus ending before the antero-lateral corner of the carapace. Basis 0.8 times length of the distal articles combined, with group of six teeth in distal half of the segment and one pair of stout setuliferous setae on the distal corner of the ventral margin. Ischium short with one strong tooth on the distal corner of the ventral margin. Merus with one distal tooth. Carpus 1.4 times the length of ischium plus merus; carpus and propodus sub-equal; dactyl half as long as propodus. Exopod slender, subequal to basis, basal segment with strong distal tooth and three lateral teeth.

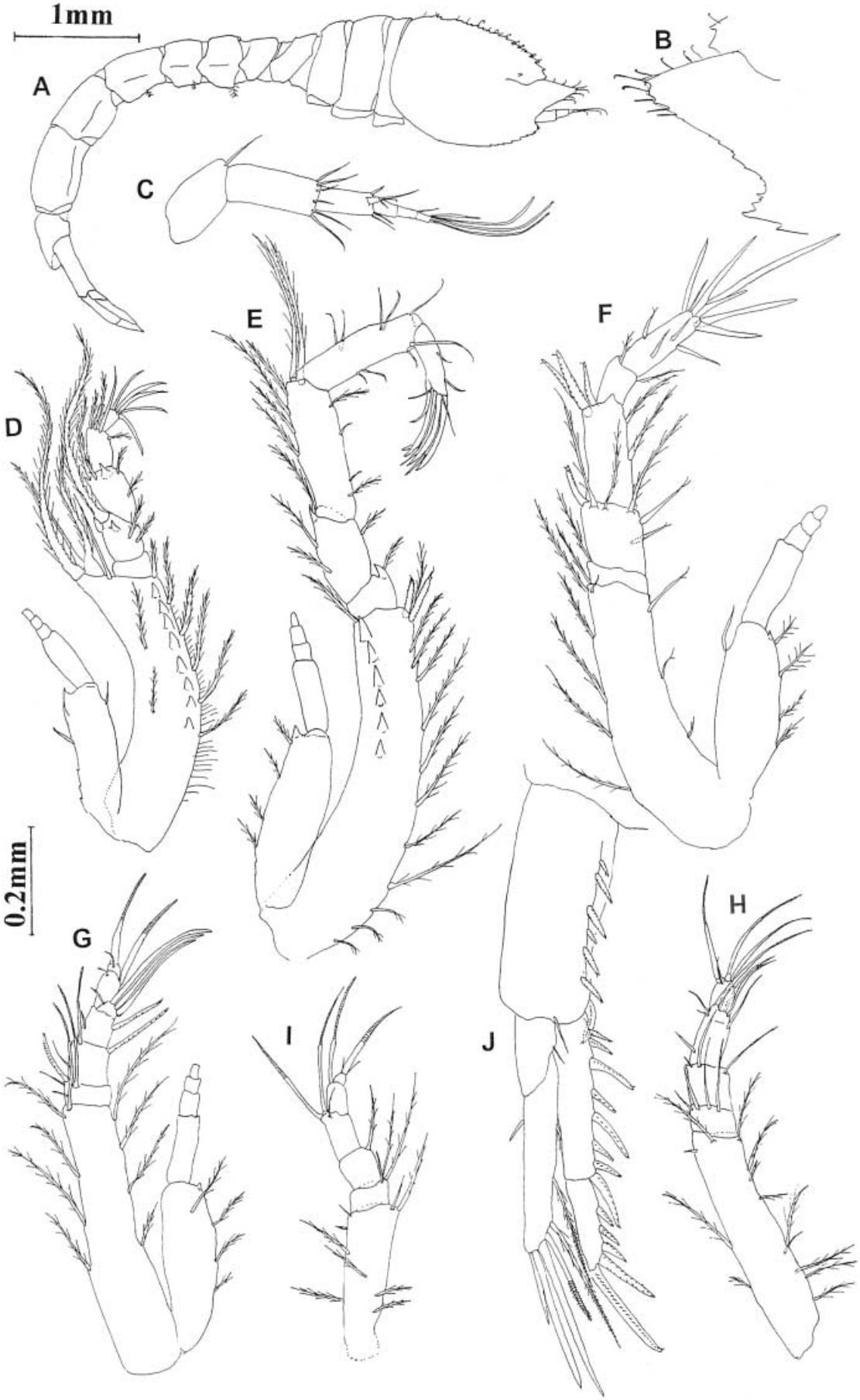

Figure 6. *Leucon* (*Leucon*) *nathorsti*. (**A–J**) NMSZ 2000.249.0003, White Zone FSC 800 55247#2/3 preparatory female. (A) Whole animal lateral view; (B) carapace lateral view; (C) first antenna; (D) third maxilliped; (E) first pereopod; (F) second pereopod; (G) third pereopod; (H) fourth pereopod; (I), fifth pereopod; (J), uropod. Scale bars: A, 1 mm; B–J, 0.2 mm.

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Second pereopod (Figure 6F): basis 1.1 times the distal articles combined; ischium plus merus 0.75 times the length of the carpus; carpus 0.8 times the length of propodus plus dactyl; dactyl two times the length of propodus. Distal ventral corner of merus and carpus carrying one and three setulose stout setae respectively. Exopod slender, exceeding basis, basal segment with distal tooth.

Third pereopod (Figure 6G): basis two times the distal articles combined. A single stout plumose seta on ischium distal ventral corner, merus and carpus distal dorsal corners, respectively. Exopod exceeding basis, basal segment with distal tooth.

Fourth and fifth pereopod (Figure 6H,I): no exopod; basis of fourth pereopod 1.4 times all the distal articles combined.

Uropod (Figure 6J): 0.21 times body length, peduncle cylindrical, 0.9 the length of the endopod. Endopod slightly longer than exopod (exopod extends 0.93 of way along endopod). First segment of endopod 1.75 times length of second. Number of setulose stout setae on median margin: peduncle seven of different sizes; lst segment of endopod, eight of different sizes; 2nd segment of endopod, four and one terminal seta. Terminal seta 1.2 times the length of 2nd segment of endopod.

Preparatory male: body length 3.7 mm. Carapace depth 0.77 times carapace length. Pereon subequal to carapace length. Pleon 2.3 times carapace length. Carapace dentition similar to that of female, antennal notch slightly shallower than that of female.

Remarks

A mature female (with fully formed but empty brood pouch) from a tube labelled King Charles Islands Station 34 is designated here as lectotype of *L. nathorsti*. This specimen and a preparatory male had been jointly selected as types ('Typen') by Zimmer (1926) and had been placed together in a separate small vial labelled to this effect. Ohlin (1901) listed only three specimens from Station 34 but a total of 18 specimens (including the two designated by Zimmer) were in the tube from this station received on loan. Material from Station 32, from which Ohlin listed many specimens, is missing (K. Sindemark, *in litt.*), and it seems possible that specimens from Stations 32 and 34, from similar depths in the same region, have become mixed. The single specimen received on loan from Station 33 is not considered to belong to *L. nathorsti*. A mature male attributed to *L. nathorsti* was described by Zimmer (1980).

Distribution

This boreal species is present on both sides of the North Atlantic. It was previously recorded from the shelf of the King Charles Islands, in the Barents Sea, at depths between 60 and 70 m (Ohlin, 1901) and from the middle slopes of Iceland and of the Davis Strait at depths of 536 and 582 m (Hansen, 1920). The present records are from west of Shetland and Orkney at 584 and 804 m.

OTHER *LEUCON (LEUCON)* SPECIES FOUND IN THE AFEN SURVEYS

Five other species of *Leucon* (*Leucon*) were identified from AFEN and White Zone samples, bringing the total to ten species for this subgenus. They are listed below with indication of stations at which they were found. See Bett (1997, 1999 and 2001b) for station details.

Leucon fulvus Sars, 1865: AFEN Stations 53873#2, 53905#1 (depth range 546–783 m); also recorded by Hansen (1920).

Leucon nasica nasica (Krøyer, 1841): AFEN Stations 53725#1, 53775#1, 53782#3, 53802#2 (depth range 500–754 m); also recorded by Hansen (1920).

Leucon pallidus Sars, 1865: AFEN Stations 53715#1, 53771#1–2, 53794#1, 53804#1, 53814#5, 53829#1, 53833#1, 53835#1, 53836#2, 54580#1A/B, 54512#2, 54513#2, 54515#3, 54518#1, 54523#1–2, 54524#2 (depth range 249–1727 m); White Zone Stations 55206#1–4, 55231#1–3, 55248#1–3, 55264#1–3, 55265#1–2, 55268#1–3, 55284#1, 55300#1, 55313#2–3, 55323#1–2, 55350#1, 55354#1, 55382#1–2, 55385#1–2, 55446#1–2, 55447#2–3, 5–6, 11–15, 55450#1, 55450#1, 55454#1 (depth range 850–1657 m); also recorded by Calman (1905).

Leucon acutirostris Sars, 1865: AFEN Station 53830#1, (depth 1057 m); also recorded by Hansen (1920).

Leucon profundus Hansen, 1920: AFEN Station 54580#1A/B; (depth 1612 m); see also Hansen (1920).

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