



## A revision of the genus *Halectinosoma* (Copepoda: Harpacticoida: Ectinosomatidae): the *H. herdmani* (Scott & Scott) group of species

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Ectinosomatid material was examined from extensive collections around the British Isles and from several additional world localities and museum collections, permitting a revision of the genus *Halectinosoma*. This paper redescribes *H. herdmani* and describes five new species: *H. bodotriaensis* sp. nov., *H. pilosum* sp. nov., *H. britannicum* sp. nov., *H. itoi* sp. nov. and *H. huysi* sp. nov. These species, together with *H. tenerum* (Sars) and *H. kunzi* Lang, are referred to the 'herdmani species group', on the basis of close similarity. *H. herdelongata* (Marcus) is synonymized with *H. herdmani*. *H. elongatum* (Sars), previously regarded as *incertae sedis*, is also redescribed. Despite a superficial resemblance to the *herdmani* group of species, *H. elongatum* was found to be morphologically quite distinct. *H. intermedium* (Nicholls) was found to be a synonym of *H. elongatum*. The species *H. finmarchicum* (T. Scott) is discarded; the original description was found to be based largely on material of *H. elongatum* but mistakenly included the female fifth leg from *H. angulifrons* (Sars). A key for the identification of females of the *herdmani* group of species is provided.

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ADDITIONAL KEY WORDS:—meiobenthos – copepod – taxonomy.

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## INTRODUCTION

Species of *Halectinosoma* Lang, 1944 are often dominant members of the harpacticoid copepod assemblage of marine sediments and yet their identification is notoriously difficult. Differences between species within this large genus of 58 species (Huys *et al.*, 1996) are often subtle and a lack of appreciation of this subtlety has caused much taxonomic confusion and the production of descriptions which, in many cases, do not permit the accurate identification of species.

Clément & Moore (1995) commenced a revision of *Halectinosoma* with a reappraisal of *H. sarsi* (Boeck, 1872) and descriptions of 11 related species. In this second paper in the series we re-examine *H. herdmani* (Scott & Scott, 1894) and describe a group of related species which share the distinctive, elongate body shape of *H. herdmani*. Several of these species can be found living sympatrically, generally in sandy sediments, and it is highly probable that considerable misidentification of these species has occurred in the past.

## MATERIAL AND METHODS

Most of the material examined was from sediment samples collected by the authors from around the British Isles (Table 1). In the descriptions of species that follow, the provenance of this material is given by citing the sample code from Table 1. Material from other locations around the world was also examined.

Specimens were dissected in lactic acid and mounted on slides in polyvinyl lactophenol. All figures were prepared with the aid of a drawing tube. Habitus length measurements are from the base of the rostrum to the posterior edge of the anal somite. Because this measure varies significantly due to the telescoping action of the body somites, an additional and more reliable method for measuring the length of the animal was used. The specimen was placed on its side and the length of each individual somite measured along the dorsal margin (Clément & Moore, 1995). The length of the somite was taken from its anterior margin, defined by a thickened cuticular ring, often embedded in the preceding somite, to the posterior edge, which includes the hyaline frill when present and the pseudopericulum of the penultimate urosomite. This measure is referred to in the text as the sum of all somites, and excludes the rostrum and caudal rami.

As a means of facilitating the description of the location of the surface seta of the exopod of the fifth leg, we have introduced the term, surface-seta insertion line. This is a hypothetical straight line passing from the distal margin of the exopod at the junction of the middle and outer exopod lobes, through the base of the surface seta (not including its small basal lobe) and terminating at the suture of the exopod with the baseoendopod (Fig. 1J).

The length/width ratio of the caudal ramus is calculated from the length of the inner margin, including the part embedded in the anal somite, and the greatest width. Nomenclature follows that of Huys *et al.* (1996), including the system for numbering the seta of the caudal rami. The only abbreviations used in the text are P1 to P6 for legs 1 to 6. For practical considerations we have retained the terms *lacinia* and *pars incisiva* for the coxal gnathobase of the mandible.

Descriptions are based on the material examined as a whole, except for new

TABLE 1. Details of the sediment samples collected by the authors containing *Halectinosoma* material described in this study. The locations are in British waters unless stated otherwise

Sample code	Location	Sediment type	Depth (m)	Date
S2	Tanera More Bay, Summer Isles	sand	16	5.vii.1988
S6	Bunnessan, Isle of Mull	sandy mud	9	14.viii.1984
S19	Firth of Forth, 56°10.30'N 2°58.72'W	sand	16	7.xi.1983
S20	Firth of Forth, 56°11.10'N 2°36.50'W	sandy mud	50	7.xi.1983
S21	Firth of Forth, 55°57.85'N 3°02.70'W	mud	10	10.xi.1983
S22	Firth of Forth, 56°00.70'N 2°32.88'W	fine sand	10	10.xi.1983
S24	Galway Bay, Ireland, 53°13.57'N 9°6.71'W	muddy sand	17	15.v.1985
S25	Isle of Man, 54°03.8'N 4°41.8'W	muddy gravelly sand	19	28.i.1977
S28	Isle of Man, 54°10.9'N 4°44.8'W	fine sand	16	12.i.1977
S29	Isle of Man, 54°05.1'N 4°46.9'W	fine sand	17	13.xiii.1976
S30	Isle of Man, 54°06.8'N 4°45.6'W	fine sand	19	15.xii.1976
S32	Isle of Man, 54°02.7'N 4°55.5'W	muddy gravelly sand	56	3.xii.1976
S33	Isle of Man, 53°55.8'N 4°56.3'W	muddy gravelly sand	72	3.xii.1976
S36	Lyme Bay, 50°41.93'N 2°45.39'W	muddy sand	17	15.vii.1980
S57	North Sea, 55°00.0'N 1°40.0'E	sand	27	19.iv.1984
S59	North Sea, 54°30.0'N 0°40.1'E	sand	65	20.iv.1984
S60	North Sea, 54°29.9'N 1°59.9'E	sand	19	20.iv.1984
S62	North Sea, 54°00.0'N 1°40.0'E	sand	38	21.iv.1984
S63	North Sea, 54°00.0'N 0°00.2'E	gravel	27	21.iv.1984
S64	North Sea, 53°00.0'N 3°05.2'E	sand	34	22.iv.1984
S65	Banyuls, France, 42°30.1'N 3°12.6'E	mud	90	1976
S66	Sullom Voe, Shetland	gravelly mud	25	13.iv.1987
S84	Port Erin Bay, Isle of Man	fine sand	1	1973
S86	North Sea, 54°00.0'N 0°39.9'E	sand	49	21.iv.1984
S88	Banyuls, France	fine sand	subtidal	1976
S90	Eilean Fada Mor, Summer Isles	maerl	2	4.vii.1988
S91	Glenuig, 56°49.77' 5°49.00'W	sand	lower shore	iv.1988
S92	Muskelburgh, 55°56.83'N 3°03.50'W	sand	lower shore	29.xi.1987
S93	Scafield, 55°57.83'N 3°07.50'W	sand	lower shore	29.xi.1987
S94	Cramond, 55°58.78'N 3°17.33'W	sand	lower shore	1.xi.1987

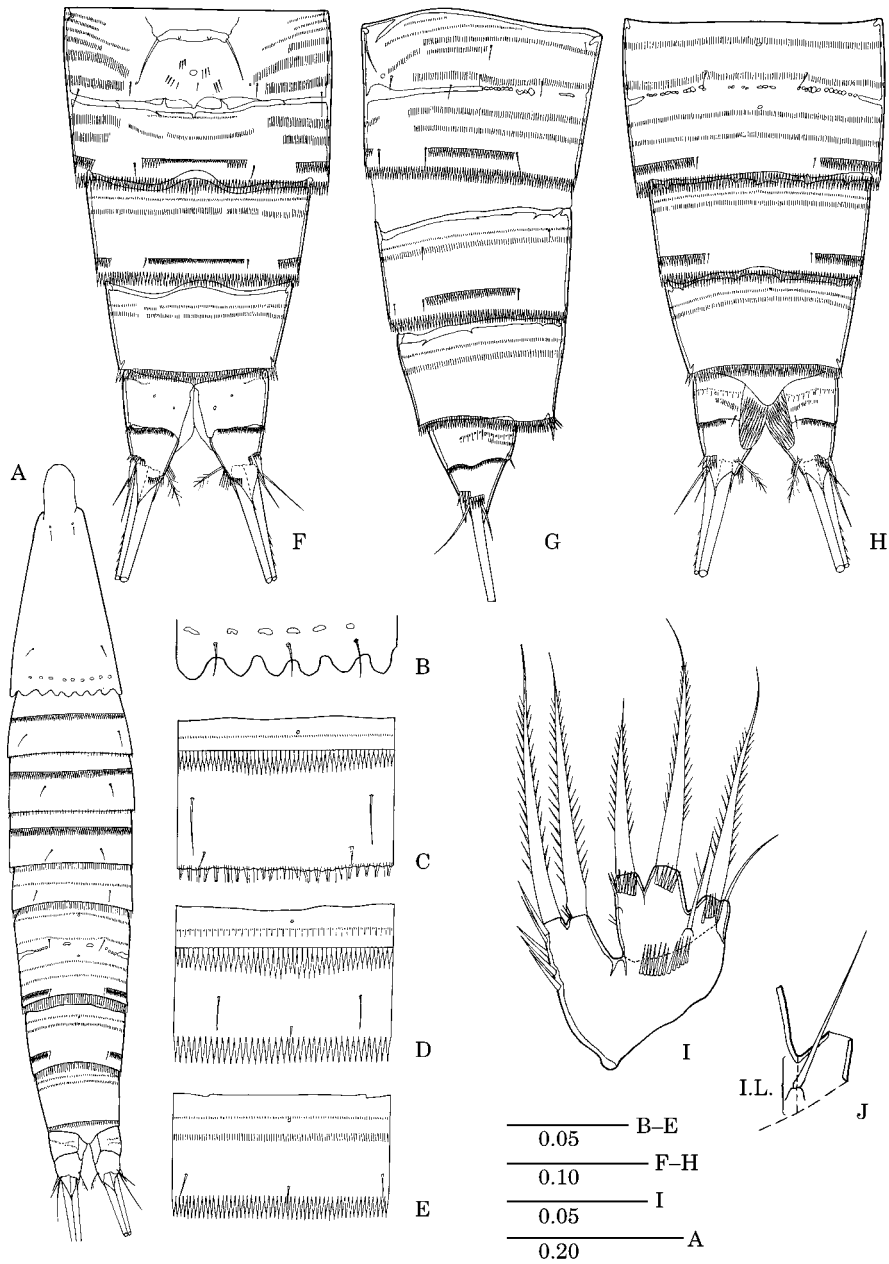


Figure 1. *Halectinosoma herdmani* (Scott & Scott, 1894): Female (S92): A, habitus, dorsal; B, posterior margin of cephalothorax, dorsal; C, surface ornamentation of first free thoracic somite, dorsal; D, surface ornamentation of third free thoracic somite, dorsal; E, surface ornamentation of first urosomite, dorsal; F, urosomites 2-6, ventral; G, urosomites 2-6, lateral; H, urosomites 2-6, dorsal; I, P5; J, part of P5 exopod showing insertion line (i.l.) of surface-seta.

species, where the holotype is first described. Illustrations of cephalosomic appendages may be based on more than one specimen and the origin of the specimen drawn is

given in the legend. Most of the British material examined in this study has been deposited at the Natural History Museum, London. Natural History Museum registration numbers are given the prefix NHM.

## SYSTEMATICS

Ectinosomatidae Sars, 1903

*Halectinosoma* Lang, 1944

*Halectinosoma herdmani* (Scott & Scott, 1894)

*Ectinosoma herdmani* Scott & Scott, 1894: 432–433, pl. 36 figs 16, 44, pl. 37 figs 3, 16, 29, 54, pl. 38 figs 7, 25, 33, 47

?*Ectinosoma herdmani* - Sars, 1904: 33–34, pl. 18 fig. 2

?*Ectinosoma* (*Halectinosoma*) *herdmani* - Lang, 1948: 209, figs 112.5, 116.2

*Ectinosoma intermedium* Marcus, 1965: 88–91, figs 3–4

*Halectinosoma herdmani* - Lang, 1965: 36

*Halectinosoma herdelongata* - Marcus, 1967: 36–37

*Type material*

As far as we have been able to ascertain type material of *H. herdmani* does not exist.

*Material examined*

NORWAY: 1 ♀ in tube F12674 and 1 ♀ (presumably also from Norway) on slide F7372 from the G. O. Sars collection, Zoology Museum, Oslo. SCOTLAND: S2 (1 ♀); S19 (7 ♀ ♀); S20 (1 ♀); S21 (1 ♀); S22 (20 ♀ ♀); S66 (1 ♀); S91 (11 ♀ ♀, 2 ♂ ♂); S92 (12 ♀ ♀); S94 (15 ♀ ♀, 7 ♂ ♂); 8 ♀ ♀ in tube 1955.63.131, from Aberdeen Bay, 1901, Royal Museum of Scotland; 9 ♀ ♀ in tube NHM42791-800, from Aberdeen Bay, 1902, Norman collection; 1 ♀ on slide NHM1911.11.18. M2235 (labelled *E. erythrops*), Little Cumbrae, 9.viii.1888. ENGLAND: S56 (1 ♀); S57 (5 ♀ ♀); S60 (19 ♀ ♀); S62 (17 ♀ ♀); S63 (9 ♀ ♀); S64 (2 ♀ ♀), S86 (28 ♀ ♀, 1 ♂); 20 ♀ ♀ in tube and 1 ♀ on slide NHM42781 from Plymouth, 1903, Norman collection; 1 ♀ from Innisidgen, Penninis Head, Scilly Isles, University of London expedition, 1966, Natural History Museum, London. ISLE OF MAN: S84 (11 ♀ ♀). NORTHERN IRELAND: 9 ♀ ♀, 2 ♂ ♂ from Carrickfergus, upper shore, coarse sand, collected by I. Fuller, 1985. IRELAND: 1 ♀ on slide from station 5c and 1 ♀ on slide from station 5d, Clontarf, Dublin Bay (labelled *Pararenosetella erythrops*), collected by C. E. O’Riordan, National Museum of Ireland. GERMANY: the following material from the Klie collection held in the Zoology Museum, Kiel: 1 ♀ on slide Cop.260, Kieler Bucht, collected by A. Remane, 15.iv.1932; 1 ♀ on slide Cop.261, collected by H. W. Schäfer, 6.ix.1935; 1 ♂ on slide Cop.260, collected by H. W. Schäfer, 4.10.1935; 18 ♀ ♀, 7 ♂ ♂, 14 copepodites in tube Cop.1843 and 12 ♀ ♀, 1 ♂, 3 copepodites in tube Cop. 1842, collected by H. W. Schäfer, 5.ix.1935. FRANCE: S65 (3 ♀ ♀); S88 (5 ♀ ♀). ISRAEL: 1 ♀ (labelled paratype of *Ectinosoma diops* Por 1964) from the W. Vervoort collection, station 69, Nakhal Rubin, Mediterranean coast, Israel, National Museum of Natural History, Leiden. ROMANIA: 1 ♀ on slide 52 (labelled holotype

*H. herdelongata*) and 1 ♀ and 1 ♂ on slide (labelled paratypes *H. herdelongata*) from Black Sea, Grigore Antipa Museum, Bucharest.

*Description of female*

Length ( $n=10$ ): habitus 575–785  $\mu\text{m}$ ; sum of all somites 720–785  $\mu\text{m}$ ; cephalothorax 210–220  $\mu\text{m}$ ; genital double-somite 100–115  $\mu\text{m}$ . Habitus (Fig. 1A) elongated fusiform. Colour of preserved specimens pale yellowish brown to colourless. Cephalothorax narrowly elongated and slightly attenuated anteriorly. Rostrum long (clearly longer than wide), subrectangular in shape with rounded apex (often appearing truncate when apex bent posteriorly) and finished with two sensilla subapically. Labrum prominent and terminating in a spinous projection (Fig. 2G). Genital double-somite subdivided by a transverse chitinous stripe which is unbroken ventrally and laterally but represented by small patches of chitin dorsally (Fig. 1A, F–H). Pseudopericulum well-developed, unadorned and narrowly convex in shape (Fig. 1H). Anal somite deeply cleft and with overlapping rows of lappets along inner dorsal side (Fig. 1H).

*Caudal ramus* (Fig. 1F–H). About as long as broad and furnished with seven setae: seta II and seta III slender and issuing near distal outer corner, seta III the more dorsal and accompanied by a short row of spinules near base; seta I stouter and proximal to these setae and accompanied by a short row of spinules near base; setae IV and V well-developed, seta IV being shorter and spinulose along its outer margin; seta VI diminutive, issuing from inner distal corner; seta VII slender plumose with bi-articulate base near dorsal inner margin. Posterior edge of ramus terminating dorsally and ventrally with an acuminate lappet. Base of ramus with a row of fine spinules.

*Somatic ornamentation* (Fig. 1A–H). Body somites, apart from penultimate, sparsely covered with sensilla (Fig. 1A). Cephalothorax and pedigerous somites with surface sculpture of fine longitudinal furrows (only clearly discernible at  $1000\times$  magnification). Cephalothorax with row of chitinous patches near posterior margin; posterior margin distinctly sinuate (Fig. 1B). First two free thoracic somites with two transverse rows of spinules, the more posterior row with large spinules; the posterior margin finely sinuate and fringed with small hairs, representing the hyaline frill (Fig. 1C). Third free thoracic somite as in preceding two somites except posterior edge with a semi-incised subulate hyaline frill (Fig. 1D). First urosomite with two transverse rows of fine spinules and a semi-incised hyaline frill (Fig. 1E). Genital double-somite dorsally with four spinula rows, ventrally with a complex arrangement of spinular rows, and laterally with a characteristic row of strong spinules just anterior to the semi-incised subulate hyaline frill. Fourth urosomite with two continuous spinular rows, a mid-ventral row of fine spinules and a lateral row of strong spinules just anterior to semi-incised subulate hyaline frill. Penultimate somite with two continuous rows of fine spinules near anterior margin and a row of spinules along posterior edge, although dorsally a bare pseudopericulum extends posteriorly beyond this row. Anal somite ventrally with two sets of small pores and dorsally with rows of fine spinules, two pores and two sensilla.

*Antennule* (Fig. 2A). Moderately elongated and 6-segmented. First segment with one plumose seta at anterior distal corner. Second segment furnished with 10 setae. Third segment with eight setae, one of which is sharing a common base with a long and slender aesthetasc at anterior distal corner. Fourth segment about equal in length



Figure 2. *Halectinosoma herdmani* (Scott & Scott, 1894): Female (S92): A, antennule; B, antenna; C, mandible; D, maxillule; E, maxilla; F, maxilliped; G, labrum.

to preceding segment and furnished with one seta mid-way along anterior margin. Penultimate segment armed with four setae. Distal segment protruding beyond penultimate one and furnished with three apical setae sharing a common base and, along posterior margin, a set of six diminutive setae with biarticulate bases.



*Antenna* (Fig. 2B). Coxa (not illustrated) indistinctly demarcated at base. Basis subrectangular in shape and furnished with a row of spinules near outer margin and a set of close setules near inner distal corner. Endopod two-segmented: first segment unadorned; second segment armed with two juxtaposed setae near inner margin accompanied by two more proximal spinule rows, a row of strong spinules near distal margin, and seven terminal setae of which three are geniculate, three are strongly spinulose and one is diminutive and plumose. Exopod three-segmented: first segment furnished with a row of spinules and a finely spinulose seta at inner distal corner, second segment armed with a strong spinulose seta, and distal segment with two terminal spinulose setae and a few spinules near distal margin.

*Mandible* (Fig. 2C). Coxal gnathobase armed with one spiniform seta at ventral base of unidentate *pars incisiva* and a *lacinia* furnished with four sharp teeth. Basis with spinular rows on surface, a close set of long setules issuing from proximal inner margin, and three broad and strongly spinulose setae at inner distal corner. Exopod one-segmented, spinulose along outer margin, and armed with three plumose setae. Endopod one-segmented, with a row of setules along outer margin, and furnished with ten setae.

*Maxillule* (Fig. 2D). Praecoxal arthrite elongated and armed with three spinulose unguiform spines, one hairy seta accompanied by a dwarfed seta and proximal to these, a pair of adjacent slender setae. Coxa very short and armed with a short bare seta. Basis with both endites bearing three setae. Exopod small, one-segmented, and armed with two plumose setae. Endopod one-segmented with three pairs of setae fused at base.

*Maxilla* (Fig. 2E). Syncoxa short with three transverse rows of spinules around outer edge and three endites along distal half of inner margin: proximal endite armed with four spinulose setae, middle and distal endites with 2 and 3 setae respectively. Allobasis about twice as long as syncoxa, with a broad base and furnished with a short spinulose seta accompanied by a diminutive seta and a slender plumose seta at inner proximal corner, and a slender seta near apex. Endopod three-segmented: first segment armed with a thick geniculate seta and a slender seta (the origin of this latter seta is very difficult to determine and it is possible that it is borne from the allobasis); second segment armed with a thick geniculate seta and a short bare seta (not visible in Fig. 2E); third segment represented by a broad base from which one lateral and three distal confluent slender setae arise.

*Maxilliped* (Fig. 2F). Syncoxa short, furnished with one finely spinulose seta and with one row of spinules on posterior surface. Basis long (ratio length/greatest width = 4.0), and furnished with spinules and setules. Endopod short, armed with one spinulose seta along inner margin, one bipinnate seta subapically, and two closely set apical setae, one of which is small and can be difficult to see.

*P1–P4* (Fig. 3A–D). Praecoxa apparently represented by an indistinct rectangular area at outer proximal corner of coxa (not illustrated). Exopod and endopod three-segmented with setal formula as follows:

	Exopod	Endopod
P1	0:1:123	1:1:221
P2	1:1:223	1:1:221
P3	1:1:323	1:1:221
P4	1:1:323	1:1:221



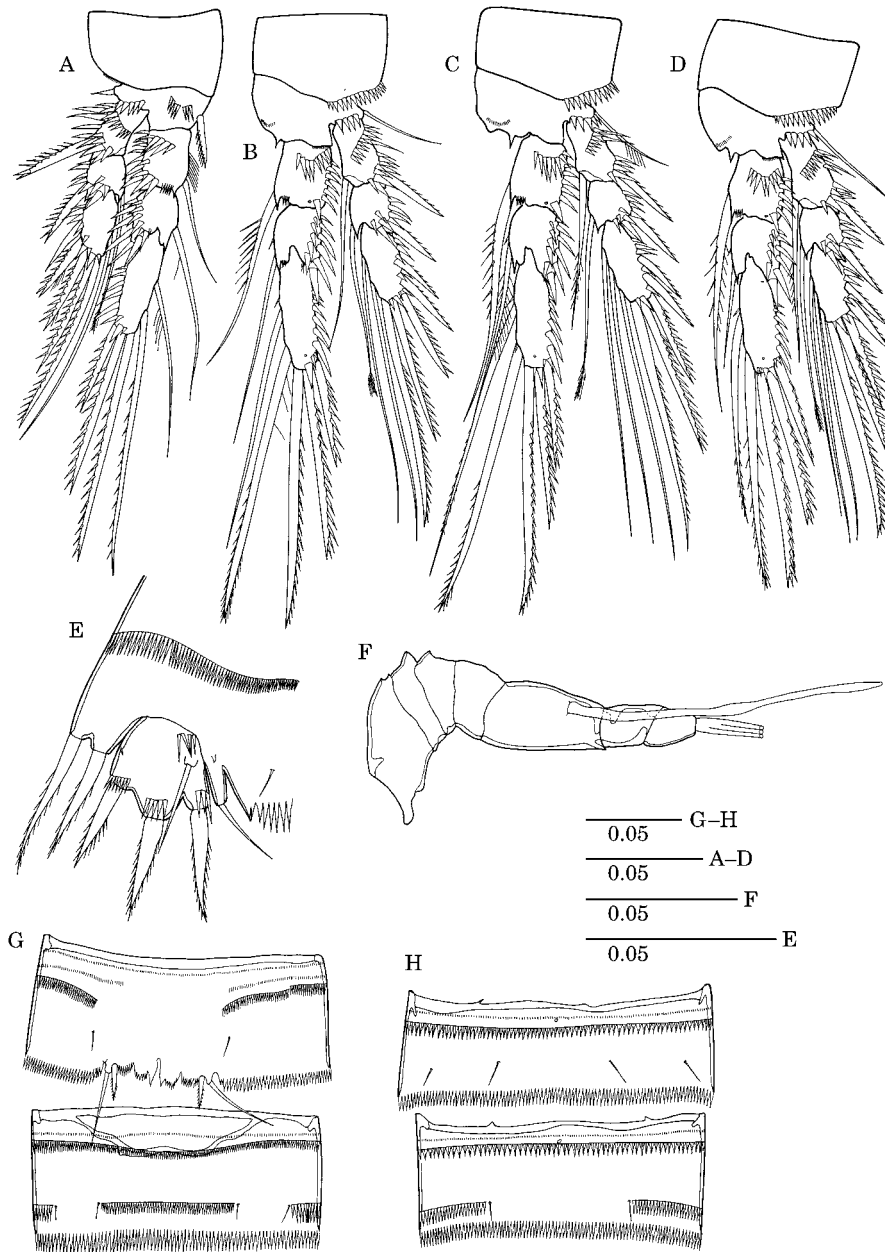


Figure 3. *Halectinosoma herdmani* (Scott & Scott, 1894). Female (S92): A, P1; B, P2; C, P3; D, P4. Male (S92): E, P5; F, antennule (setae omitted); G, surface ornamentation of urosomites 2-3, ventral, showing P6; H, surface ornamentation of urosomites 2-3, dorsal.

Spinulation of posterior surface consists of a short row of spinules near proximal outer corner of coxa and on the second and third segment of the endopod (not illustrated).

P1 (Fig. 3A). Coxa subrectangular and fringed with fine spinules along outer distal

margin. Basis furnished with a row of strong spinules at articulation with exopod, a row of minute spinules at articulation with endopod (not illustrated), a curved row of spinules medially on anterior surface, a short spiniform seta on outer edge, and a thick spinulose seta on inner edge.

*P1–P4* (Fig. 3B–D). Outer distal corner of coxa fringed with spinules. Basis furnished with a curved row of fine spinules and a short pointed expansion at inner distal corner, a row of strong spinules at articulation with exopod, a row of minute spinules at articulation with endopod, and a slender seta at outer distal corner. First and third segment of endopod with an inconspicuous pore subdistally on anterior surface.

*P5* (Fig. II). Exopod slightly broader than long and confluent with baseoendopod on anterior surface only. Baseoendopod shorter than greatest width, spinulose along distal half of inner margin: endopodal lobe reaching to about halfway along exopod and armed with two spinulose setae of subequal length reaching beyond the tip of innermost seta of exopod, outer expansion furnished with a slender short basal seta. Exopod with a pore accompanied by few spinules mid-way along inner margin and armed with three terminal setae each issuing from a spinulose lobe: middle and outer setae subequal in length and longer than innermost seta. Surface-seta inserted just within proximal half of surface-seta insertion line (i.l. in Fig. 1J) and accompanied by a row of spinules issuing from the baseoendopod.

#### *Description of male*

Length ( $n = 5$ ): habitus 450–510  $\mu\text{m}$ ; sum of all somites 580–625  $\mu\text{m}$ ; cephalothorax 175–190  $\mu\text{m}$ . Second and third urosomites distinct. Otherwise as in female except for the following features.

*Somatic ornamentation* (Fig. 3G,H). Second urosomite with two spinular rows in anterior half of somite, the posterior row with much coarser spinules, and the posterior margin with a semi-incised subulate hyaline frill. Third urosomite as in Fig. 3G,H.

*Antennule* (Fig. 3F). 7-segmented. First segment with a short row of fine spinules on anterior surface and a spinulose seta at antero-distal corner. Segment 2 short and bearing one seta at antero-distal corner. Segment 3 and 4 of about equal length and furnished with 10 and 6 setae respectively. Segment 5 elongated and moderately swollen: dorsal surface furnished with a large aesthetasc, ventral surface with a complex arrangement of setae and two small grasping processes. Penultimate segment slightly swollen and greatly sclerotized, and furnished with a seta at antero-distal corner. Distal segment small, with three apical setae sharing a common base and a few accessory setae.

*P5* (Fig. 3E). Baseoendopod confluent with somite: endopodal lobe armed with two setae of subequal length, outer expansion furnished with a short slender basal seta. Exopod clearly demarcated from baseoendopod and armed distally with three spiniform setae each issuing from a spinulose lobe: innermost seta about as long as exopod. Surface-seta issuing from proximal half of insertion line and accompanied by a few spinules.

*P6* (Fig. 3G). A plate with two setae at outer distal corner: inner seta stout and spinulose, the outer seta slender, bare and about 2.5 times as long as inner seta. Inner distal margin of plate denticulate.

*Variability*

Two females examined from Banyuls were significantly smaller than the British material and measured as follow: habitus 530–570  $\mu\text{m}$ , sum of all somites 545–595  $\mu\text{m}$ , cephalothorax 175–180  $\mu\text{m}$ , genital double-somite 80  $\mu\text{m}$ . No other morphological differences were found amongst specimens examined.

*Remarks*

Although it appears that the type material of *H. herdmani* does not exist, we were able to identify the material examined with the description given by Scott & Scott (1894). A characteristic feature of *H. herdmani* is the length of the transverse chitinous stripe present on the genital double-somite of the female. Although this stripe has been observed in all the other species mentioned in this paper, it is only in *H. herdmani* that the stripe reaches to the dorsal half of the somite, thus separating the ventral side in its full width. Scott & Scott (1894) have indicated this feature by drawing a continuous stripe mid-way across the ventral side of the genital double-somite. Minor discrepancies do exist between our material and the original description. They include the relative setal lengths of the P5 and the shape of the mandibular gnathobase, but it is likely that Scott & Scott (1894) did not always attach much importance to such characteristics and may not have drawn them accurately.

The description of *H. herdmani* given by Sars (1904) is incomplete and, given the complexity of this group of species, we can only speculate as to the identity of the specimen he described. Furthermore, the examination of specimens labelled as *H. herdmani* from Sars' collection revealed that they consisted of three species, one of which was appropriately labelled *H. herdmani* and two species that are new to science and are described herein.

The specimen labelled as paratypes of *H. diops* (Por, 1964) in the W. Vervoort collection were examined and identified as *H. herdmani*. This material was lent to the Leiden Museum of Natural History by Dr F. D. Por. It is presumed that the specimens were mislabelled. Specimens of these two species were collected at the same locality in Israel (Por, 1964).

The description given by Bodin (1970) of an unidentified *Halectinosoma* species (*H.* sp. 1) is that of a female copepodite V of *H. herdmani*.

A re-examination of the type material used by Marcus (1965) to describe *H. herdelongata* has shown that it is identical to *H. herdmani* and is therefore regarded as a synonym.

In recording the infestation of *H. herdmani* by acanthocephalans, Huys & Bodin (1997) describe some aspects of the morphology of the host and provide some excellent SEM micrographs showing the ornamentation of the somites. According to Huys & Bodin the female antennule is five-segmented, with the distal segment only partially divided by an incomplete surface suture. This region of the antennule is very difficult to discern, even with the aid of the SEM. We believe the suture to be complete but would not disregard the possibility of a five-segmented antennule. Another difference in interpretation concerns the maxilla. According to Huys & Bodin the proximal endopod segment bears both a geniculate seta and a long bare seta; we cannot be certain whether this bare seta is borne from this segment or whether its origin is close to the apex of the allobasis.

*H. herdmani* shares many morphological features with *H. kunzi* Lang, one of which

being the row of spinules on the first segment of the A2 exopod. Lang (1965) omitted this feature in his description but we were able to confirm its presence after re-examination a syntype of *H. kunzi* (Naturhistoriska Riksmuseet, Stockholm, tube 2187). These two species can be distinguished by the shape of the posterior margin of the cephalothorax which is deeply sinuate in *H. herdmani* but linear in *H. kunzi*. There are also differences in the ornamentation of the somites, the relative length of the chitinous stripe on the genital double-somite, and the relative lengths of the setae of the P5 baseoendopod.

*H. tenerum* Sars is another species closely related to *H. herdmani*. This species was not found during our survey of the British Isles. However, we have examined a specimen from the G. O. Sars collection (labelled lectotype on slide 12679 by Wells in 1967). Despite the poor condition of the specimen, we were able to observe some distinguishable features for this species. As mentioned by Sars (1920), *H. tenerum* has an unusually large maxilla and a very elongated maxilliped (ratio length/greatest width = 10.0). The antennule is also more elongated than *H. herdmani*, the third segment being twice as long as wide as measured on the anterior margin. The cephalothorax of *H. tenerum* is quadratic in shape and is attenuated only near the base of the rostrum. The chitinous stripe on the ventral side of the genital double-somite does not reach dorsally in *H. tenerum*. The P5 exopod has setiform setae as in *H. herdmani* but the shape of the exopod is more quadratic in *H. tenerum*. We believe these characters are sufficient to retain *H. tenerum* as a valid species, but a full redescription, based on new material, is needed to fully characterize *H. tenerum*.

All previous descriptions of *H. herdmani*, with the exceptions of Bodin (1970), Moore (1976) and Huys & Bodin (1997) are difficult to ascertain because most authors have overlooked important morphological features such as the ornamentation of the somites (Chislenko, 1967; Klic, 1949; Becker, 1970). Records of *H. herdmani* must also be regarded with great caution as it is probable that much misidentification has occurred in the past due to the inherent complexity associated with the group of species described in this study.

*H. herdmani* is a common species around the British Isles. Although this species can be found in many different sediment types, it is predominately associated with sandy habitats.

### *H. bodotriaensis* sp. nov.

#### *Type material*

1 ♀ holotype on slides (NHM1990.352), 2 ♀ paratypes on slides (NHM1990.353–354) and 3 ♂ paratypes on slides (NHM1990.355–357) collected by C. G. Moore by grab from Largo Bay, Firth of Forth (site S19).

#### *Material examined*

NORWAY: 5 ♀ ♀ (labelled *E. herdmani*) from G. O. Sars collection, tube F21252, Zoology Museum, Oslo. Location unknown but presumed to be Norway. SCOTLAND: S19 (type material); S6 (1 ♀). ENGLAND: S59 (19 ♀ ♀); S60 (1 ♀); S62 (13 ♀ ♀). ISLE OF MAN: s28 (4 ♀ ♀); S29 (11 ♀ ♀); S30 (2 ♀ ♀). IRELAND: S24 (1 ♀, 2 ♂ ♂). FRANCE: S88 (8 ♀ ♀, 2 ♂ ♂).

*Description of female holotype*

Length: habitus 500  $\mu\text{m}$ ; sum of all somites 535  $\mu\text{m}$ ; cephalothorax 160  $\mu\text{m}$ ; genital double-somite 70  $\mu\text{m}$ . Habitus (Fig. 4A) elongated fusiform. Colour of preserved specimens yellowish brown. Surface of cuticle covered with small perforations. Cephalothorax gradually tapering anteriorly. Rostrum and labrum as in *H. herdmani*. Genital double-somite subdivided by a transverse chitinous stripe mid-ventrally and with patches of chitin dorsally. Penultimate somite with a broadly convex, unadorned pseudoperculum.

*Caudal ramus* (Fig. 4E,F). Distinctly shorter than greatest width. Setation and spinulation as in *H. herdmani* except seta VI longer and stouter.

*Somatic ornamentation* (Fig. 4B–F). As in *H. herdmani* except for the following features. Posterior margin of cephalothorax very broadly sinuate (Fig. 4B). Third free thoracic somite and first urosomite with 3 spinular rows (Fig. 4C,D). Urosomites covered with distinctive rows of long spinules interceded by shorter ones (Fig. 4E,F). Genital double-somite dorsally with six spinular rows interrupted mid-ventrally. Fourth urosomite with three spinular rows, one of which is interrupted mid-ventrally, and a mid-ventral row of fine spinules just anterior to the semi-incised subulate hyaline frill. Penultimate somite dorsally with three rows of spinules, one of which is interrupted ventrally, and a row of spinules along posterior margin, interrupted dorsally by the pseudoperculum.

*Antennule, antenna and mouthparts* as in *H. herdmani*.

Segmentation, principal setation and general form of P1–P4 as in *H. herdmani*.

*P5* (Fig. 4G). Exopod confluent with baseoendopod on anterior surface only. Baseoendopod shorter than broad: endopodal lobe spinulose along inner margin and armed with two terminal spinulose setae, the outer seta being slightly shorter than inner one. Exopod shorter than broad and distally with three lobes accompanied by spinules and each armed with a spinulose seta with broad base: innermost seta slightly shorter than middle seta but about as long as outermost one and reaching slightly beyond outer seta of endopodal lobe. Surface-seta issuing from the proximal half of the surface-seta insertion line and accompanied by a row of spinules on the baseoendopod.

*Description of male paratypes*

Length: habitus 390–420  $\mu\text{m}$ ; sum of all somites 460–505  $\mu\text{m}$ ; cephalothorax 140–150  $\mu\text{m}$ . Second and third urosomites distinct, the third somite with two pairs of chitinous patches ventrally (see Fig. 4I). Otherwise as in female apart from the following features.

*Somatic ornamentation* (Fig. 4I,J). Second urosomite with three rows of spinules of unequal length interrupted mid-ventrally, and dorsally with a short row just anterior to the semi-incised subulate hyaline frill. Third urosomite identical to distal half of double genital somite of female.

*Antennule*. 7-segmented with setation and form as in *H. herdmani*.

*P5* (Fig. 4H) Endopodal lobe armed with two distal setae, the inner seta being distinctly longer than outer one. Exopod clearly demarcated from baseoendopod and with three distal lobes accompanied by spinules, except for the innermost lobe, and each furnished with a short setiform seta of subequal length: the innermost seta distinctly longer than exopod. Surface-seta issuing just in proximal half of surface-seta insertion line and accompanied by a short row of spinules on exopod.

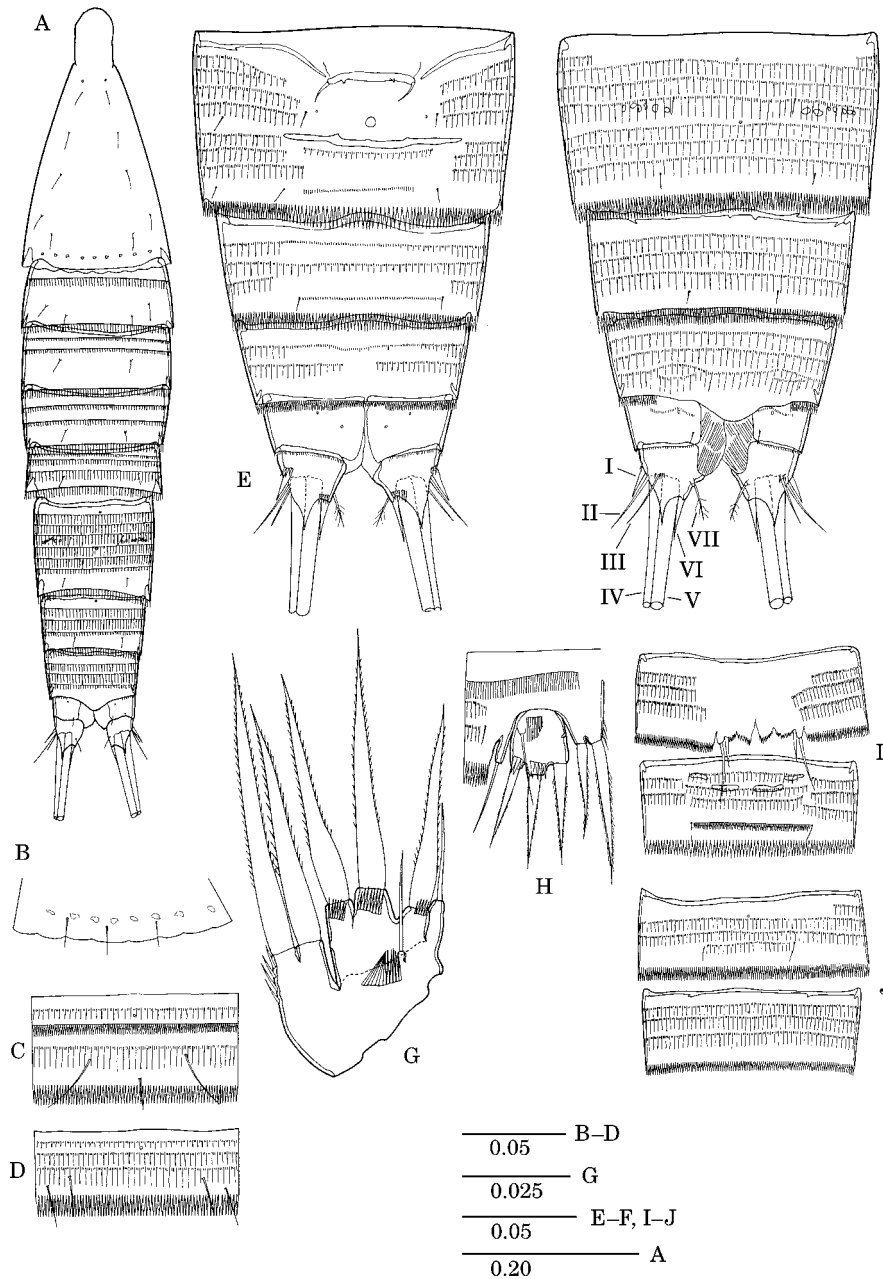


Figure 4. *Halectinosoma bodotriaensis* sp. nov. Female holotype (S19): A, habitus, dorsal; B, posterior margin of cephalothorax, dorsal; C, surface ornamentation of second free thoracic somite, dorsal; D, surface ornamentation of third free thoracic somite, dorsal; E, urosomites 2-6, ventral; F, urosomites 2-6, dorsal, showing numbering system for setae of the caudal rami; G, P5. Male paratype (S19): H, P5; I, surface ornamentation of urosomites 2-3, ventral, showing P6; J, surface ornamentation of urosomites 2-3, dorsal.



*P6* (Fig. 4I). A plate with two setae at outer distal corner, the outer seta about twice as long as inner seta. Inner distal margin of plate denticulate.

#### *Variability*

The following variation in length was observed in the female ( $n=13$ ): habitus 415–600  $\mu\text{m}$ ; sum of all somites 540–575  $\mu\text{m}$ ; cephalothorax 165–180  $\mu\text{m}$ ; genital double-somite 70–80  $\mu\text{m}$ . The specimens from Banyuls, France were significantly smaller than the British material and had the following lengths: female habitus ( $n=4$ ) 420–445  $\mu\text{m}$ , sum of all somites 470–480  $\mu\text{m}$ , cephalothorax 150–160  $\mu\text{m}$ , genital double-somite 60  $\mu\text{m}$ ; male habitus ( $n=2$ ) 310–380  $\mu\text{m}$ , sum of all somites 410  $\mu\text{m}$ ; cephalothorax 135–140  $\mu\text{m}$ .

#### *Etymology*

The species name is derived from the Roman name for the type locality.

#### *Remarks*

*H. bodotriaensis* differs from *H. herdmani* by having more conspicuous spinular rows on the urosomites, each row being composed of long spinules interspersed with short ones. The length of the caudal ramus relative to its greatest width is significantly shorter in *H. bodotriaensis* than in *H. herdmani*. Sets VI of the caudal ramus is also more developed in *H. bodotriaensis*. Other differences with *H. herdmani* include an almost linear posterior edge of the cephalothorax, a broadened pseudopericulum, a less fusiform habitus, and a smaller body size. In the female of *H. bodotriaensis* the transverse chitinous stripe on the ventral side of the genital double-somite is shorter, not extending into the dorsal half of the somite. In both the male and female of *H. bodotriaensis* the innermost seta of the P5 exopod extends slightly beyond the outer seta of the endopodal lobe of the baseopod, which is the opposite to *H. herdmani*. Another difference in the female P5 is the point of insertion of the surface-seta. In *H. bodotriaensis* the surface-seta is inserted well within the proximal half of the surface-seta insertion line, very near the base of the exopod, whereas it is inserted just within the proximal half of the surface-seta insertion line in *H. herdmani*. It also appears that in the male P5 of *H. bodotriaensis* the innermost distal lobe of the exopod is devoid of spinules. We believe that these differences are sufficient to consider *H. bodotriaensis* a separate species from *H. herdmani*. Both species have been found to co-exist at various sites in Britain and elsewhere. *H. bodotriaensis* has only been collected subtidally, where it is found predominantly in sandy sediments.

### *Halectinosoma pilosum* sp. nov.

#### *Type material*

1 ♀ holotype on slide NHM1990.358, 1 ♀ paratype preserved in authors' collection and 1 ♂ paratype on slides NHM1990.358. Collected by C. G. Moore from maerl sediment at 2 m depth in channel between Eilean Fada Mor and Tanera Beg, Summer Isles, Scotland (site S90).



*Material examined*

SCOTLAND: S19 (2 ♀ ♀); S90 (type material). ENGLAND: S59 (2 ♀ ♀). ISLE OF MAN: S32 (1 ♀)

*Description of female holotype*

Length: habitus 650 µm; sum of all somites 675 µm; cephalothorax 200 µm; genital double-somite 95 µm. Habitus (Fig. 5A) elongated fusiform. Cephalothorax moderately tapering anteriorly. Rostrum and labrum as in *H. herdmani*. Genital double-somite subdivided by a transverse chitinous stripe mid-ventrally and patches of chitin dorsally. Penultimate somite with a broadly convex pseudopericulum whose surface is apparently striated (Fig. 5G).

*Somitic ornamentation* (Fig. 5B–G). As in *H. herdmani* except for the following features. Posterior margin of cephalothorax moderately sinuate (Fig. 5B). First free thoracic somite with two rows of fine spinules (Fig. 5C). Second and third free thoracic somites with four rows of spinules (Fig. 5D). First urosomite with three rows of spinules, the anterior row having very fine spinules (Fig. 5E). Genital double-somite with five rows of irregularly-shaped spinules and a subposterior row of regular spinules all interrupted mid-ventrally. Fourth urosomite with two continuous rows of irregularly-shaped spinules in anterior half and a row of coarse spinules in posterior half. Penultimate somite with two rows of irregularly-shaped fine spinules, and, posterior to these, two rows of regular spinules, one row interrupted ventrally, the other dorsally. Anal somite as in *H. herdmani*.

*Caudal ramus* (Fig. 5F,G) Distinctly shorter than greatest width, with setation and spinulation as in *H. herdmani* except seta VI longer and stouter.

*Antennule, antenna, and mouthparts* as in *H. herdmani*.

Setation and form of P1–P4 as in *H. herdmani*.

*P5* (Fig. 5H). Exopod confluent with baseoendopod on anterior surface only. Baseoendopod distinctly shorter than greatest width: endopodal lobe spinulose along inner margin and armed with two setiform setae, the outer seta being slightly shorter than the inner one. Exopod with three spinulose terminal lobes each armed with a long setiform seta: innermost seta reaching to about tip of outer seta of endopodal lobe. Surface seta issuing from proximal half of surface-seta insertion line and accompanied by a row of spinules on baseoendopod.

*Description of male paratype*

Length: habitus 475 µm; sum of all somites 580 µm; cephalothorax 170 µm. Second and third urosomites distinct, the third somite with two pairs of chitinous patches ventrally (Fig. 5J). Otherwise as in female except for the following features.

*Somitic ornamentation* (Fig. 5J,K). Second urosomite as in male of *H. bodotriaensis* sp. nov. Third urosomite identical to posterior half of genital double-somite of female dorsally.

*Antennule*. 7-segmented. Setation and form as in male of *H. herdmani*.

*P5* (Fig. 5I). Endopodal lobe armed with two distal setae, the outer seta distinctly shorter than the inner one. Exopod clearly demarcated from baseoendopod and with three distal lobes, the innermost lobe without spinules, and each furnished with a seta: middle seta distinctly longer than innermost seta and about as long as outer one. Surface-seta issuing just inside proximal half of surface-seta insertion line and accompanied by a short row of spinules on exopod.

*P6* (Fig. 5J). As in *H. bodotriaensis*.

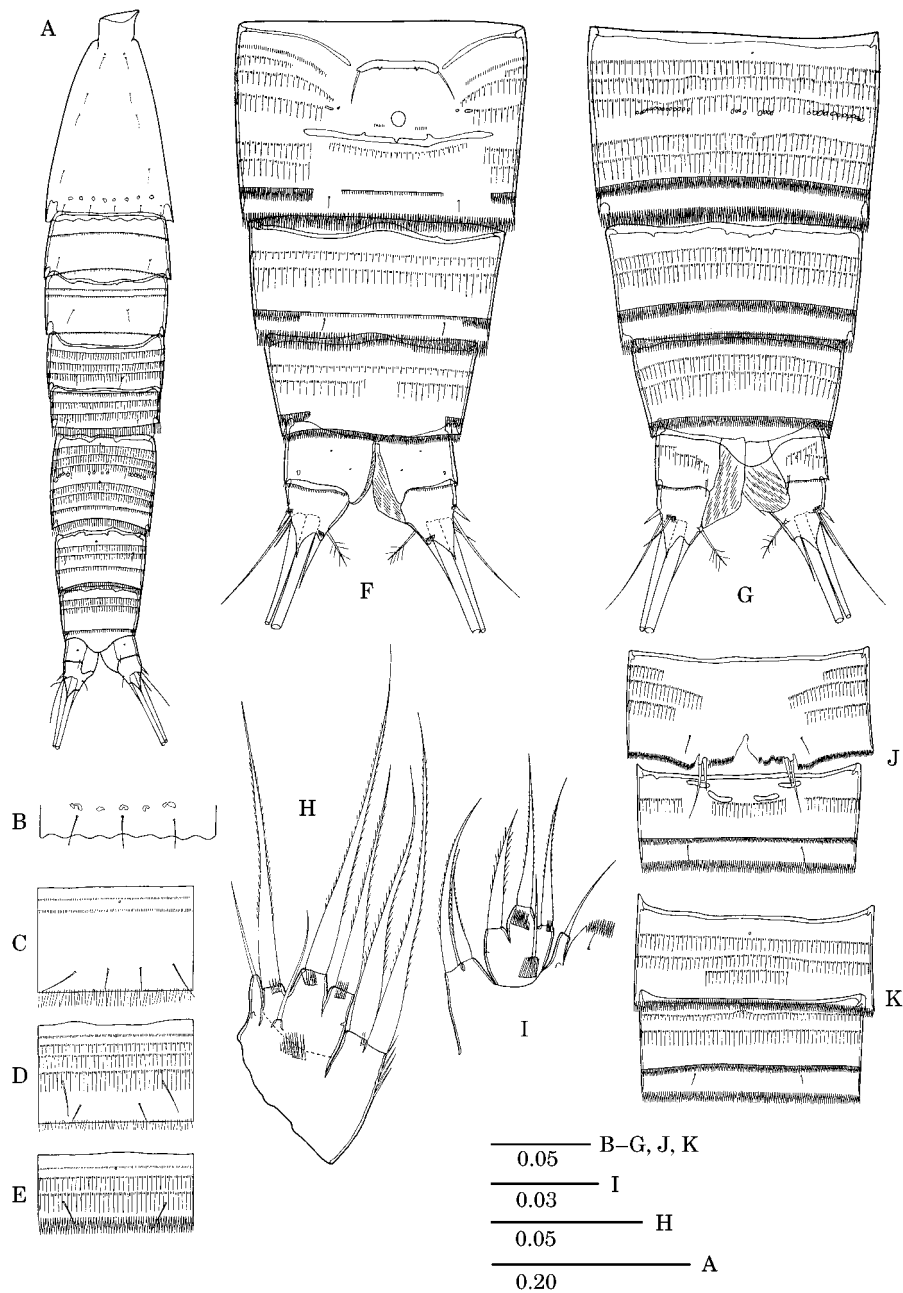


Figure 5. *Halectinosoma pilosum* sp. nov. Female holotype (S90): A, habitus, dorsal; B, posterior margin of cephalothorax, dorsal; C, surface ornamentation of first free thoracic somite, dorsal; D, surface ornamentation of second free thoracic somite, dorsal; E, surface ornamentation of first urosomite, dorsal; F, urosomites 2-6, ventral; G, urosomites 2-6, dorsal; H, P5. Male paratype (S90); I, P5; J, surface ornamentation of urosomites 2-3, ventral, showing P6; H, surface ornamentation of urosomites 2-3, dorsal.

*Variability*

The following variation in size was observed in females ( $n = 3$ ): habitus 515–569  $\mu\text{m}$ ; sum of all somites 640–685  $\mu\text{m}$ ; cephalothorax 195–200  $\mu\text{m}$ ; genital double-somite 100  $\mu\text{m}$ .

*Etymology*

The species name alludes to the rich somitic ornamentation of fine spinules.

*Remarks*

*H. pilosum* shares many affinities with *H. bodotriaensis*, especially regarding the type of ornamentation of the somites. There are, however, some distinctive morphological features separating the two species. In the female of *H. pilosum* the somitic spinular rows are similar to those found in *H. bodotriaensis* except for the last row just anterior to the hyaline frill on the urosomites which is composed of regularly shaped spinules. Another morphological feature of *H. pilosum* is the P5 which is armed with relatively longer and more setiform distal setae than in *H. bodotriaensis*. The outermost seta of the P5 exopod is distinctively longer than the innermost one and reaches beyond it in *H. pilosum*, whereas in *H. bodotriaensis* the outermost seta is slightly shorter than the innermost one and does not reach beyond it. *H. pilosum* is slightly longer than *H. bodotriaensis* when the sum of all somites is measured.

***Halectinosoma britannicum* sp. nov.***Type material*

1 ♀ holotype on slides NHM1990.363 and 1 ♀ paratype on slides NHM1990.364, collected by R. J. Law by grab from sand at 65 m, North Sea (site S59).

*Material examined*

SCOTLAND: S91 (1 ♀). ENGLAND: S28 (1 ♀), S59 (type material).

*Description of female holotype*

Length: habitus 460  $\mu\text{m}$ ; sum of all somites 560  $\mu\text{m}$ ; cephalothorax 160  $\mu\text{m}$ ; genital double-somite 80  $\mu\text{m}$ . Habitus fusiform (Fig. 6A). Rostrum and labrum as in *H. herdmani*. Genital double-somite with transverse chitinous stripe mid-ventrally and patches of chitin dorsally. Pseudoperculum very broadly shaped.

*Somatic ornamentation* (Fig. 6B–F). As in *H. herdmani* except for the following features. Cephalothorax with posterior margin moderately sinuate (Fig. 6A,B). The third free thoracic somite and the first urosomite with slightly finer spinules (Fig. 6C,D). Genital double-somite with five rows of spinules: four rows interrupted ventrally and a lateral row; the row nearest to anterior margin with fine, irregularly shaped spinules. Penultimate somite with two spinular rows near anterior margin and a subposterior row of coarser spinules. Anal somite with a row of spinules dorsally.

*Caudal ramus* (Fig. 6E,F). Distinctly shorter than greatest width. Setation and spinulation as in *H. herdmani* except seta VI longer and stouter.

*Antennule, antenna, mouthparts* and *P1–P4* as in *H. herdmani*.

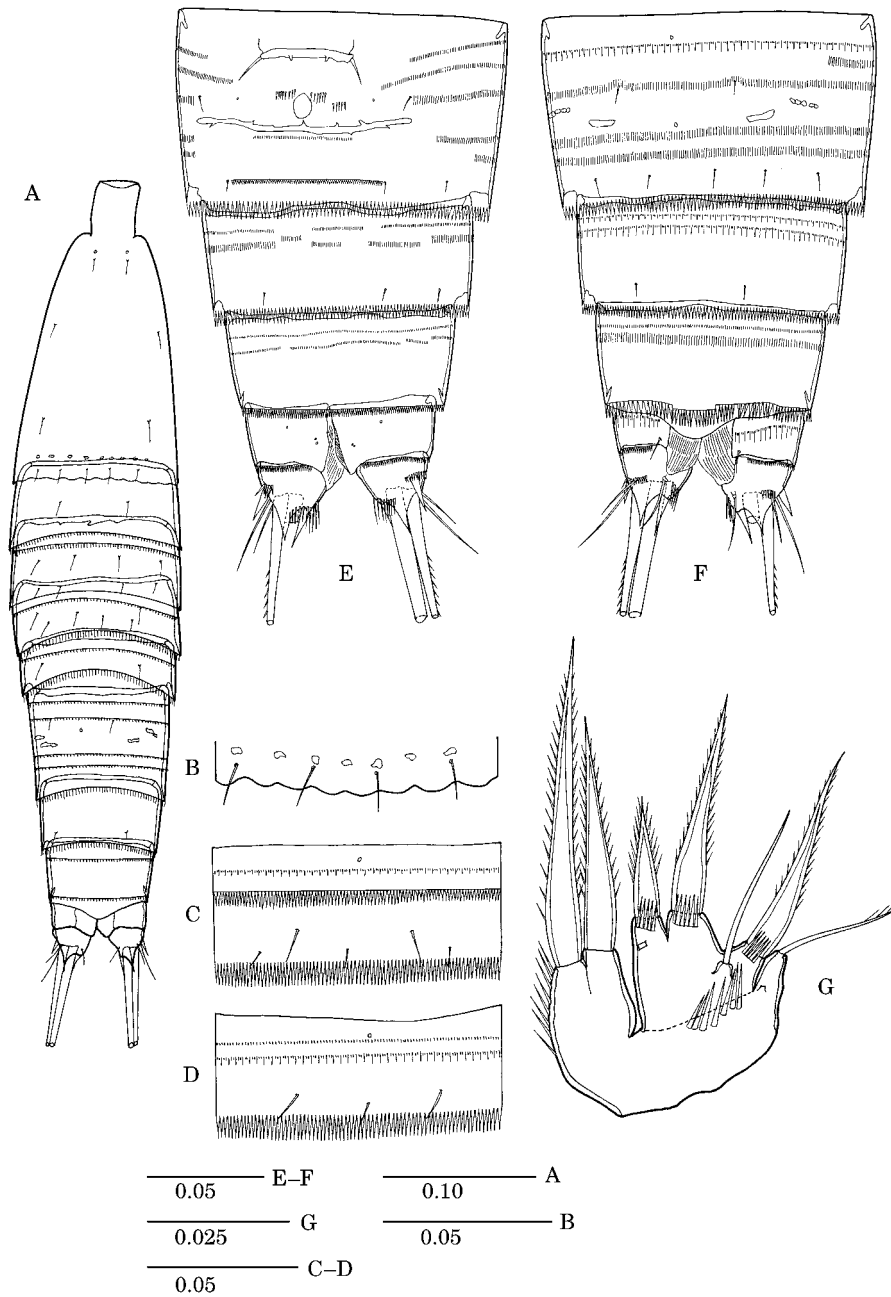


Figure 6. *Halectinosoma britannicum* sp. nov. Female holotype (S59): A, habitus, dorsal; B, distal margin of cephalothorax, dorsal; C, surface ornamentation of third free thoracic somite, dorsal; D, surface ornamentation of first urosomite, dorsal; E, urosomites 2-6, ventral; F, urosomites 2-6, dorsal; G, P5.

*P5* (Fig. 6G). Baseoendopod shorter than greatest width: endopodal lobe spinulose along inner margin and armed with two spinulose setae, the inner seta slightly

longer than the outer one. Exopod confluent with baseopod on anterior surface only and with three distal spinulose lobes each armed with a short spinulose seta: inner seta spiniform and about half as long as middle and outer setae and not reaching beyond tip of outer seta of endopodal lobe. Inner margin of exopod with a pore in distal half. Surface-seta issuing from distal half of surface-seta insertion line and accompanied by a row of spinules on baseopod.

#### *Variability*

The following variations in length were observed in females ( $n=2$ ): habitus 410–535  $\mu\text{m}$ ; sum of all somites 480–595  $\mu\text{m}$ ; cephalothorax 155–185  $\mu\text{m}$ ; genital double-somite 65–85  $\mu\text{m}$ . No other variations were observed amongst specimens examined.

*Male* unknown.

#### *Etymology*

The species name reflects the origin of the type material.

#### *Remarks*

This species is characterized by the spiniform setae on the female P5. The innermost seta of the P5 exopod is also distinctively short and reaches to about half-way along the middle seta. Another feature of *H. britannicum* is the prominent surface-seta insertion line. The outermost seta of the endopodal lobe of the P5 baseopod issues from a lobe which extends beyond that of the inner seta. The ornamentation of the urosomites differs also from *H. bodotriaensis* and *H. pilosum*. This is particularly evident on the dorsal side of the genital double-somite which has six continuous rows of fine spinules in the latter two species but only four in *H. britannicum*. All three species have been found to co-exist at one site in Britain.

### ***Halectinosoma itoi* sp. nov.**

#### *Type material*

1 ♀ holotype on slide NHM1990.366 and 2 ♀ paratypes on slides NHM1990.367–368, collected by R. J. Law by grab from sand at 19 m, North Sea (site S60); 2 ♂ paratypes on slides NHM1990.367–368, collected by C. G. Moore from fine sand in Banyuls Bay, France (site S88).

#### *Material examined*

NORWAY: 8 ♀ ♀ (labelled *E. herdmani*) from the G. O. Sars collection, tube F21253, Zoology Museum, Oslo. ENGLAND: S60 (type material); S62 (1 ♀). ISLE OF MAN: S25 (1 ♀); S29 (1 ♀). FRANCE: S88 (16 ♀ ♀ and 2 ♂ paratypes).

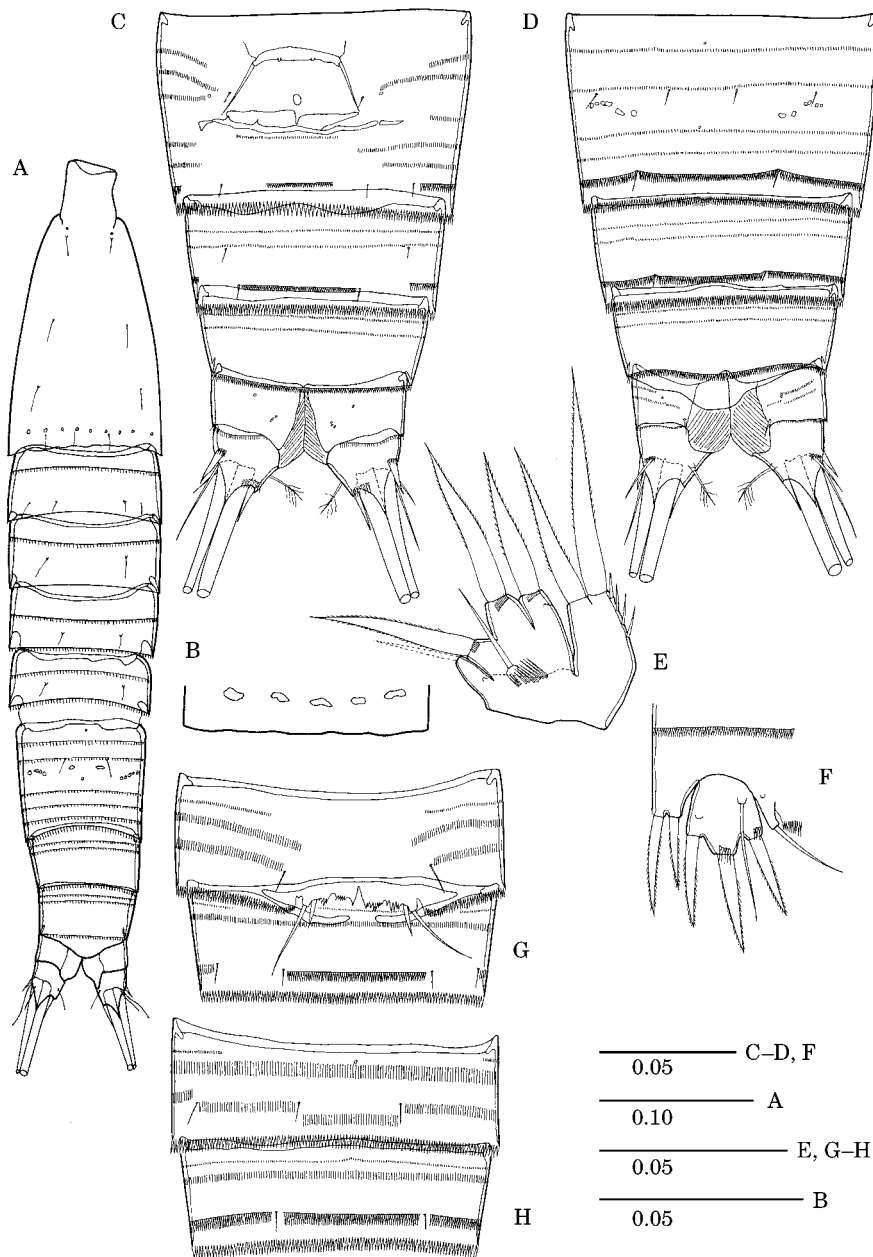


Figure 7. *Halectinosoma itoi* sp. nov. Female paratype (S60): A, habitus, dorsal; B, posterior margin of cephalothorax, dorsal; C, urosomites 2-6, ventral; D, urosomites 2-6, dorsal; E, P5. Male paratype (S88): F, P5; G, surface ornamentation of urosomites 2-3, dorsal.

*Description of female holotype*

Length: habitus 480  $\mu$ m; sum of all somites 485  $\mu$ m; cephalothorax 160  $\mu$ m; genital double-somite 65  $\mu$ m. Habitus elongated fusiform (Fig. 7A). Cephalothorax narrowly elongated and slightly tapering anteriorly. Rostrum and labrum as in *H. herdmani*.

Genital double-somite subdivided mid-ventrally by a transverse chitinous stripe and dorsally with patches of chitin. Pseudopericulum broadly convex (Fig. 7D).

*Somitic ornamentation* (Fig. 7A–D). As in *H. herdmani* except for the following features. Posterior margin of cephalothorax almost linear (Fig. 7B). Genital double-somite with six rows of spinules: five rows interrupted mid-ventrally and one lateral row (Fig. 7C,D). Fourth urosomite with three rows of spinules, the most posterior row continuous dorsally but interrupted ventrally. Penultimate somite with three rows of spinules.

*Caudal ramus* (Fig. 7C,D). Distinctly shorter than greatest width. Setation and spinulation as in *H. herdmani* except seta VI longer and stouter.

*Antennule, antenna, mouthparts and P1–P4* as in *H. herdmani*.

*P5* (Fig. 7E). Exopod confluent with baseoendopod on anterior surface only. Baseoendopod shorter than greatest width: endopodal lobe spinulose along inner margin and armed with two broad spinulose setae, the outer seta shorter than the inner one. Exopod with three terminal lobes each accompanied by a short row of fine spinules and furnished with a short and broad spinulose seta: innermost seta reaching to outer seta of endopodal lobe and slightly shorter than middle and outer seta. Pore located at about 3/4 distance along inner margin of exopod. Surface-seta issuing from proximal half of surface-seta insertion line and accompanied by a row of spinules on baseoendopod.

#### *Description of male paratype*

Length: habitus 400 µm; sum of all somites 445 µm; cephalothorax 155 µm. Second and third urosomites distinct, the second somite with a semi-incised subulate hyaline frill (Fig. 7G,H). Otherwise as in female except for the following features.

*Antennule*. 7-segmented. Setation and form as in male of *H. herdmani*.

*P5* (Fig. 7F). Exopod clearly demarcated from baseoendopod. Baseoendopod confluent with somite: endopodal lobe armed with two setae. Exopod with three terminal lobes: innermost lobe devoid of spinules and furnished with a short spiniform seta; middle and outer lobes accompanied by a short row of spinules and furnished with a spiniform seta about as long as innermost seta. Surface-seta issuing from proximal half of surface-seta insertion line.

*P6* (Fig. 7G) A plate with two setae at outer distal corner: inner seta short and finely spinulose, outer seta long and slender. Inner distal margin of plate denticulate.

#### *Variability*

The following variation in length was observed in females from the British Isles and Norway ( $n=4$ ): habitus 415–420 µm; sum of all somites 480–535 µm; cephalothorax 160–165 µm; genital double-somite 65–70 µm. The female specimens examined from Banyuls, France did not differ significantly from the British material and had the following length ( $n=8$ ): habitus 480–515 µm; sum of all somites 515–535 µm; cephalothorax 170–175 µm; genital double-somite 70–75 µm. No other morphological differences were found among specimens examined.

#### *Etymology*

The species is named in honour of Dr Tatsunori Itô for his important contributions to harpacticoid copepod taxonomy.



*Remarks*

This species is very similar to *H. bodotriaensis* except for the following morphological features. The somitic ornamentation is clearly much reduced in *H. itoi* compared to *H. bodotriaensis*. In the female P5 position of the pore along the inner margin of the exopod can be used to differentiate the two species. In *H. bodotriaensis* the pore is located about mid-way along the inner margin whereas it is located nearer the distal end in *H. itoi*. The shape of the P5 exopod and the relative size of its spinules also differ in the female of both species. In the male of *H. itoi* the setae of the endopodal lobe of the P5 baseopod are distinctly more spiniform than those of *H. bodotriaensis* and the surface-seta is unusually long, almost reaching the tip of the outermost seta of the exopod. A small pore at the base of the outer expansion of the P5 baseopod is present in the male and female of *H. itoi* but is absent in *H. bodotriaensis*. *H. itoi* was found to be consistently smaller in body length than *H. bodotriaensis* when the sum of all somites was measured for the British, Norwegian, and Mediterranean material examined. Both species found to co-exist at these localities.

***Halectinosoma huysi* sp. nov.***Type material*

1 ♀ holotype dissected on two slides NHM1990.373, collected by C. G. Moore by Craib corer from muddy gravelly sand at 72 m depth off the Isle of Man, Irish Sea (site S33); 1 ♀ paratype dissected on two slides NHM1990.374, collected by C. G. Moore by grab from sandy mud at 50 m depth off the Isle of May, Firth of Forth (site S20).

*Material examined*

SCOTLAND: S20 (1 ♀ paratype). ISLE OF MAN: S33 (1 ♀ holotype).

*Description of female holotype*

Length: habitus 480 µm; sum of all somites 605 µm; cephalothorax 185 µm; genital double-somite 80 µm. Habitus (Fig. 8A) elongated fusiform. Cephalothorax narrowly elongated and slightly attenuated anteriorly. Rostrum and labrum as in *H. herdmani*. Genital double-somite subdivided mid-ventrally by a transverse chitinous strip and patches of chitin dorsally. Pseudopericulum broadly convex (Fig. 8H).

*Somitic ornamentation* (Fig. 8A–H). As in *H. herdmani* except for the following features. Posterior margin of cephalothorax linear (Fig. 8B). Free thoracic somites with three rows of spinules, except for the second somite which has four rows (Fig. 8C–E). Genital double-somite dorsally with five rows of irregularly-shaped spinules (Fig. 8H). Fourth urosomite with two dorsal and three ventral rows of spinules. Penultimate somite with two continuous rows of irregularly-shaped spinules and a posterior spinule row interrupted dorsally.

*Caudal ramus* (Fig. 8G,H) Shorter than greatest width. Setation and spinulation as in *H. herdmani* except seta VI longer and stouter.

*Antennule, antenna, mouthparts* and *P1–P4* as in *H. herdmani*.

*P5* (Fig. 8I). Baseopod slightly shorter than greatest width: endopodal lobe reaching to about halfway along inner margin of exopod, with only a few fine

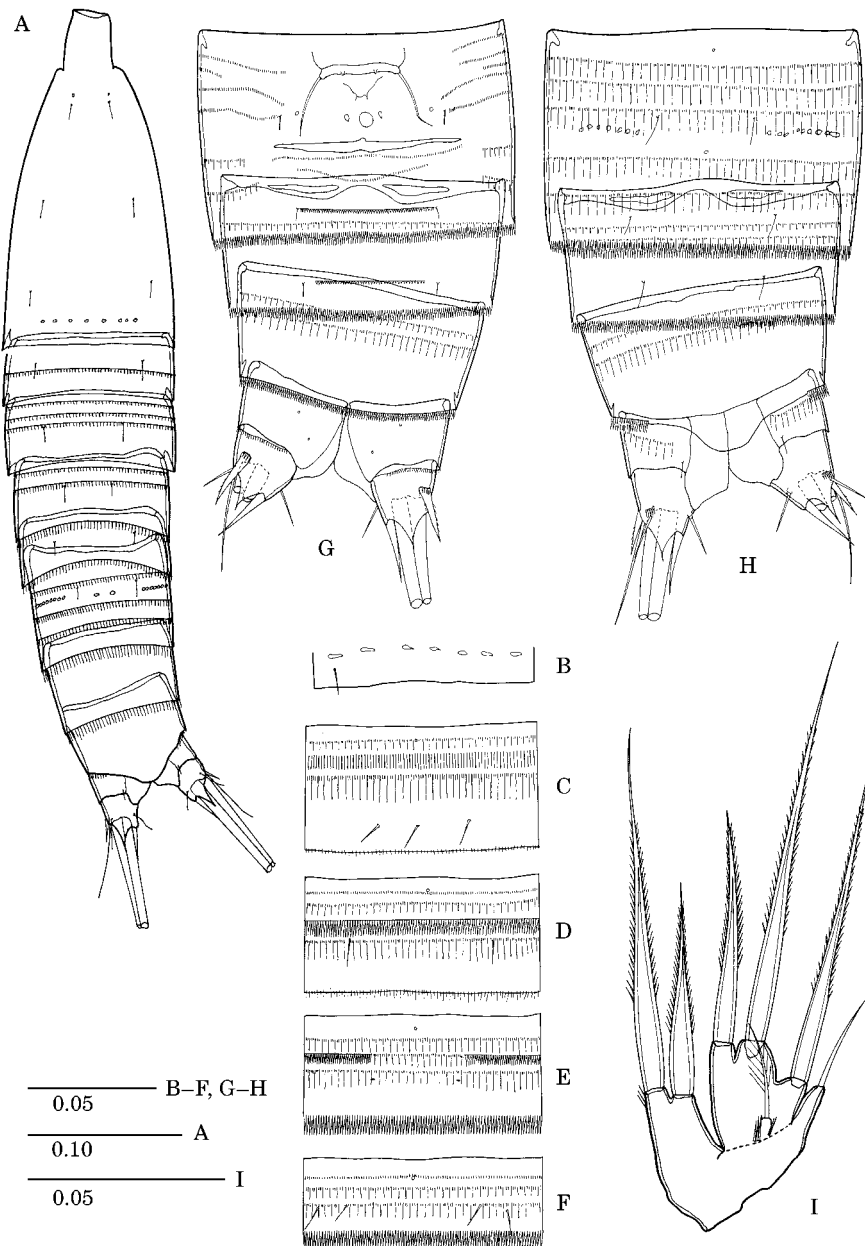


Figure 8. *Halectinosoma huysi* sp. nov. Female holotype (S33): A, habitus, dorsal; B, posterior margin of cephalothorax, dorsal; C, surface ornamentation of first free thoracic somite, dorsal; D, surface ornamentation of second free thoracic somite, dorsal; E, surface ornamentation of third free thoracic somite, dorsal; F, surface ornamentation of first urosomite, dorsal; G, urosomites 2-6, ventral; H, urosomites 2-6, dorsal; I, P5.

spinules at inner distal corner, and armed with two spinulose setae, the outer seta much shorter only and with distal margin consisting of three lobes devoid of spinules and each armed with a long spinulose seta: innermost seta much shorter than middle

and outer setae and reaching well beyond outer seta of endopodal lobe. Inconspicuous pore present at base of inner lobe along inner margin of exopod and at base of outer expansion of baseoendopod. Surface-seta plumose and issuing from proximal half of surface-seta insertion line and accompanied by a few spinules at base of exopodite.

*Male* unknown.

#### *Variability*

The size of the paratype differed from the holotype as follows: habitus 520  $\mu\text{m}$ ; sum of all somites 630  $\mu\text{m}$ ; cephalothorax 200  $\mu\text{m}$ . No other morphological differences were found.

#### *Etymology*

The species is named in honour of Dr Rony Huys for his contributions to the taxonomy of copepods, which include important work on the related species, *H. herdmani*.

#### *Remarks*

This species is characterized by the elongated setiform setae on the female P5 and the lack of spinules on the distal lobes of the P5 exopod. *H. huysi* is very similar to *H. valeriae* Soyer, 1973. The latter is also apparently devoid of spinules on the distal lobes of the female P5 exopod, although they may have been omitted in the author's drawings (Soyer, 1973). We were unsuccessful in obtaining any type specimens from Dr Soyer's personal collection and we had to rely solely on his description for comparison. The row of spinules on the first segment of the antennal exopod, which typifies this closely-related group of species, is apparently absent in *H. valeriae*. The general shape of the maxilla differs in the two species. The syncoxa of the maxilliped bears only one seta in *H. huysi* as compared to two in *H. valeriae*. *H. huysi* has a more pronounced pseudoperculum and a distinctive ornamentation on all the free thoracic somites (Fig. 8C–F). The posterior margin of the penultimate abdominal somite of *H. valeriae* consists of a continuous row of spinules whereas in *H. huysi* this same spinular row is interrupted by the pseudoperculum. In *H. huysi* the cephalothorax possesses small patches of chitin near its posterior margin but these are noted as being absent in *H. valeriae*.

#### *Halectinosoma elongatum* (Sars, 1904)

*Ectinosoma finmarchicum* p.p. Scott, 1903: 9, pl. 1 figs 7–12 (not fig. 13)

*Ectinosoma elongatum* Sars, 1904: 32–33, pl. 18 fig. 1

*Ectinosoma intermedia* Nicholls, 1939: 247–249, fig. 2

?*Ectinosoma* (*Halectinosoma*) *finmarchicum* - Lang, 1948: 210–211, fig. 116.4

?*Ectinosoma* (*Halectinosoma*) *elongatum* - Lang, 1948: 212, figs 112.8, 116.6

*Halectinosoma intermedia* - Lang, 1965: 33

*Halectinosoma elongatum* - Lang, 1965: 38

*Type material*

1 ♀ lectotype dissected on slide M12683 by J. B. J. Wells and with abdomen in tube M12682, Norway, G. O. Sars collection, Zoology Museum, Oslo.

*Material examined*

NORWAY: 1 ♀ lectotype and 1 ♀ (labelled *E. herdmani*) in tube F21251, locality unknown, from the G. O. Sars collection, Zoology Museum, Oslo; 7 ♀ ♀ labelled 'cotypes' in tube NHM42848-850, 1895, from the Norman collection, Natural History Museum, London.

SCOTLAND: S91 (1 ♀); S93 (15 ♀ ♀); S94 (3 ♀ ♀, 1 ♂).

GERMANY: 2 ♀ ♀ and 8 ♂ ♂ collected by H.-U. Dahms, intertidal sand, Jad, southern German Bight, 1985; the following material from the Klie collection, Zoology Museum, Kiel: 35 ♀ ♀, 10 ♂ ♂ in tube Cop.1845, collected by Remane from Kieler Brueth, off Landgrund, March 1927; 20 ♀ ♀ in tube Cop.2059, Eckernförde, 13 July 1949; 1 ♂ on slide Cop.274, 'Vor Labo.', 12 December 1927.

CANADA: 12 ♀ ♀ labelled 'types' of *E. intermedium* Nicholls, from Trois-Pistoles, Quebec, Natural History Museum, London.

*Description of female*

Length ( $n=11$ ): habitus 500–720 µm; sum of all somites 695–775 µm: cephalothorax 200–225 µm: genital double-somite 95–110 µm. Habitus elongated fusiform (Fig. 9A). Cephalothorax moderately attenuated anteriorly; posteriorly, the chitinous patches present in the previous species is replaced by a continuous narrow chitinous stripe (Fig. 9B). Rostrum as in *H. herdmani*. Genital double-somite subdivided mid-ventrally by a transverse chitinous stripe and with a few patches of chitin around dorsal half of somite. Pseudoperculum poorly developed (Fig. 9D).

*Caudal ramus* (Fig. 9C,D). As long as broad. Principal setation as in *H. herdmani* except seta VI much more developed and about as long as ramus.

*Somitic ornamentation* (Fig. 9A,C,D). Body somites, apart from penultimate, sparsely covered with sensilla (Fig. 9A). Posterior margin of cephalothorax linear (Fig. 9B). Free thoracic somites with one row of fine spinules; distal margin of first and second somites fringed with small hairs, the third somite with a semi-incised subulate hyaline frill. Urosomites with a complex arrangement of rows of fine spinules as in Fig. 9C, D. Genital double-somite and fourth urosomite with a semi-incised subulate hyaline frill. Penultimate somite with row of spinules along posterior edge, although dorsally the bare pseudoperculum extends posteriorly beyond this row.

*Antennule* (not illustrated). 6-segmented, setation and form as in *H. herdmani*.

*Antenna*. As in *H. herdmani* except ventral surface of segment-1 of exopod without spinules (Fig. 9F).

*Mandible* (Fig. 9G). Coxal gnathobase armed with one spiniform seta at base of unidentate *pars incisiva* and quadridentate *lacinia*; the two teeth proximal to the *pars incisiva* are distinctly broad with rounded edges. Basis with a row of long hairs at base and midway along outer margin, a row of long setules about mid-way along inner margin, and a set of three slender setae at inner distal corner, the innermost seta being finely spinulose. Exopod one-segmented, with hairs along outer margin, and furnished with three setae: innermost seta thick, spinulose and issuing about midway along inner margin; middle seta long, slender, and plumose; outer seta

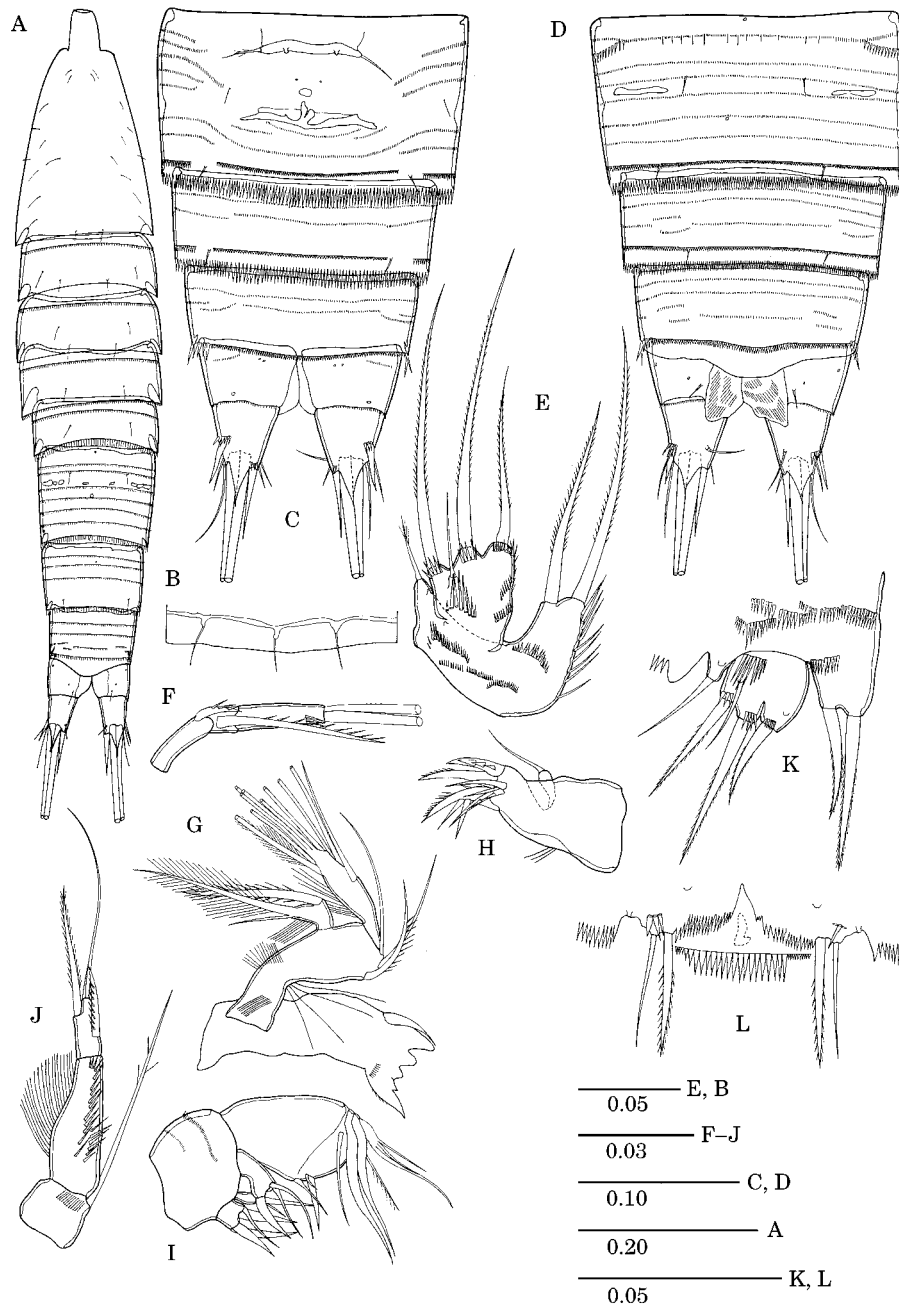


Figure 9. *Halectinosoma elongatum* (Sars, 1904). Female (S94): A, habitus, dorsal; B, posterior margin of cephalothorax, dorsal; C, urosomites 2-6, ventral; D, urosomites 2-6, dorsal; E, P5; F, exopod of antenna; G, mandible; H, praecoxal arthrite and coxa of maxillule; I, maxilla; J, maxilliped. Male (S94): K, P5; L, P6.

diminutive and hair-like. Endopod one-segmented, plumose along outer margin, and furnished with ten setae.

*Maxillule* (Fig. 9H) Praecoaxal arthrite elongated and armed with three short unguiform setae. Otherwise as in *H. herdmani*.

*Maxilla* (Fig. 9I). As in *H. herdmani* except allobasis with a narrow base and with a set of three setae issuing midway along inner margin, and the three segmented endopod furnished with much shorter setae.

*Maxilliped* (Fig. 9J). As in *H. herdmani* except basis relatively shorter (ratio length/width = 2.8).

*P1–P4* (not illustrated) Setation and segmentation as in *H. herdmani*.

*P5* (Fig. 9E). Exopod confluent with endopod on anterior surface only. Baseo-endopod broader than long and with two small pores and four rows of spinules on anterior surface: three transverse rows in proximal half and one row near base of endopodal lobe. Endopodal lobe spinulose along inner margin and armed with two distal setae. Exopodite with two transverse rows of spinules near inner margin and furnished with three distal setae, each issuing from a spinulose lobe. Surface-seta issuing in distal half of surface-seta insertion line, very near the distal margin, and accompanied by a row of strong spinules. A small pore is also present at the distal end of inner margin of exopod.

#### *Description of male*

Length ( $n = 1$ ): habitus 490  $\mu\text{m}$ . Second and third urosomites distinct. Otherwise as in female except for the following features.

*Antennule* (not illustrated): 7-segmented. Setation and form as in *H. herdmani*.

*P5* (Fig. 9K). Exopod clearly demarcated from baseoendopod. Endopodal lobe with a row of spinules at outer proximal corner with exopod and furnished with two spinulose setae. Exopod with three distal setae each issuing from a spinulose lobe. Surface-seta issuing about half-way along surface-seta insertion line and accompanied by a row of strong spinules.

*P6* (Fig. 9L). A plate with two setae at distal outer corner, the inner seta is well developed, thick and spinulose, while the outer one is slender and bare, and is accompanied by three spinules near its base. Inner distal margin of plate denticulate.

#### *Variability*

No differences were found amongst specimens examined.

#### *Remarks*

Por (1964) had doubts about the status of this species and Bodin (1988) classified it as *incertae sedis*. However, a re-examination of the lectotype of *H. elongatum* and the study of the material collected around the British Isles has confirmed, without any doubts, the specific status of this species. *H. elongatum* has probably often been confounded with *H. herdmani*. We were able to bring to light some major morphological differences between *H. elongatum* and all the other species described in this study. *H. elongatum* has distinctive rows of spinules on the female P5 with the surface-seta located near the distal margin, the first segment of the exopod of the antenna lacks the row of spinules on its surface, the anterior somites lack the surface sculpture of longitudinal furrows, the cephalothorax lacks the discrete chitinous patches near the posterior margin and the male P6 is armed with two subequal setae accompanied by three spinules near their bases.

A re-examination of the type material of *H. intermedium* (Nicholls, 1940) has shown



that it is identical to the material we have identified as *H. elongatum* and is therefore considered as a synonym. We also re-examined the type material of *H. finmarchicum* (Scott, 1903). This material consists of two slides (NHM1911.11.8.M2239 and M2240) and one tube (NHM1911.11.8.42851-854). We discovered that Scott (1903) based its original description on a male and a female dissected on the two slides and which were found to be identical to *H. elongatum*. The tube contained six males and one female and were also identified as *H. elongatum*. However, we also discovered that the female P5 on the slide did not belong to *H. elongatum* but was that of *H. angulifrons* (Sars, 1919), which we have recently redescribed (Clément & Moore, 1995). We were unable to find the specimen from which the P5 was dissected. Scott (1903) drew this female P5 by mistake and it consequently resulted in great confusion surrounding *H. finmarchicum*. We have no doubts that Scott based the description of *H. finmarchicum* on two different taxa. We therefore recommend that *H. finmarchicum* be withdrawn from classification.

Previous records of *H. elongatum* must be taken with great caution. The only probable record is that of Chislenko (1967).

#### DISCUSSION

Apart from *H. elongatum*, the species described above represent a closely related group of species, which can be referred to as the *herdmani* group and which can be distinguished by possession of the following characteristics. The habitus and rostrum are more elongated than most species in the genus. The surface of the cephalothorax and free-thoracic somites is sculptured with longitudinal furrows and there are distinct chitinous patches near the posterior margin. The antennule is 6- (or possibly 5-) segmented. The first segment of the antennal exopod is furnished with a short seta and a row of spinules. The outer distal seta of the mandibular exopod is distinctly smaller than the other two setae of this ramus. The syncoxa of the maxilliped is furnished with just one seta. The pereopod setation formula is that of *H. pseudosarsi*. The surface seta of the exopod of the fifth leg clearly extends beyond the distal margin of the exopod. The spinulation on the anterior surface of the fifth leg is restricted to short rows close to the insertion point of the marginal and surface setae. So far as we know, the possession of the spinule row on the antennal exopod is unique to the *herdmani* group.

Of the remaining species in the genus, examination of type material has confirmed that *H. kunzi* and *H. tenerum* also belong to the *herdmani* group. *H. valeriae* Soyer, 1973 and *H. arenicola* (Rouch, 1962) may also be members, although they apparently differ in some respects from the aforementioned species. We have been unable to examine them to confirm these differences. Rouch (1962) provided a brief first description of *H. arenicola* from a Brazilian beach. Itô (1973) provided a subsequent detailed description of material, ascribed to *H. arenicola*, from a Japanese sandy beach. The Japanese material does have strong similarities with the original description, although there are apparent differences, such as the lack of a seta on the first segment of the antennal exopod in the Japanese material. In view of the small differences separating many of the species of *Halectinosoma* it cannot be assumed that the specimens from Brazil and Japan are conspecific. More detailed examination of material from the type locality is necessary before the true characteristics and affinities of *H. arenicola* can be clarified.



KEY TO THE FEMALES OF THE *HERDMANI* GROUP OF SPECIES

The following key facilitates identification of confirmed members of this species group, the diagnostic characteristics of which are given above.

1. Genital double-somite with transverse chitinous stripe unbroken ventrally and extending into the dorsal half of the somite (Fig. 1F–H); posterior margin of cephalothorax distinctly sinuous (Fig. 1A,B).....*herdmani* (Scott & Scott, 1894)
  - Ventral chitinous stripe of genital double-somite not extending laterally (Fig. 4E); posterior margin of cephalothorax straight or slightly sinuous (Fig. 6B).....2
2. P5 exp. with innermost seta about same length as exp. ....3
  - P5 exp. with innermost seta much longer than exp.....4
3. P5 exp. with innermost seta broadly spiniform (Fig. 6G)
  - .....***britannicum* sp. nov.**
  - P5 exp. with innermost seta slender .....*tenerum* (Sars, 1920)
4. Body somites with transverse rows of alternating short and long spinules (Fig. 4, 5, 8) .....5
  - Body somites with regular spinule rows (Fig. 7).....7
5. P5 exp. with outer seta shorter than inner seta (Fig. 4G).....
  - .....***bodotriaensis* sp. nov.**
  - P5 exp. with outer seta longer than inner seta (Fig. 5H, 8I).....6
6. P5 exp. with spinulose distal lobes (Fig. 5H).....***pilosum* sp. nov.**
  - P5 exp. with distal lobes devoid of spinules (Fig. 8I) .....***huysi* sp. nov.**
7. Furca about as long as broad.....*kunzi* Lang, 1965
  - Furca distinctly shorter than broad (Fig. 7).....***itoi* sp. nov.**

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