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A revision of the genus *Halectinosoma* (Harpacticoida: Ectinosomatidae): a reappraisal of *H. sarsi* (Boeck) and related 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 describes 12 morphologically similar species and erects five new species. *H. sarsi* (Boeck) is regarded as *species incertae sedis*, while *H. sarsi sensu* Sars (1904) is redescribed as ***H. pseudosarsi* sp. nov.**; *H. sarsi sensu* T. & A. Scott (1894) is synonymized with *H. canaliculatum* (Por). *H. propinquum* is regarded as a junior subjective synonym of *H. chrystalli* (T. Scott). *H. clavatum* (Sars) is resurrected, having previously been regarded as a synonym of *H. brunneum* (Brady). A key for the identification of females belonging to this group of species is provided.

ADDITIONAL KEY WORDS:—Meiobenthos – copepod – taxonomy.

CONTENTS

INTRODUCTION

Species of *Halectinosoma* are often important constituents of the harpacticoid community of marine sediments. However, the systematics of this genus is

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problematic and species identification is very difficult due to the inadequacy of most of the descriptions in the literature. The morphological distinctions between species can be very subtle, and published descriptions often lack sufficient detail to permit unequivocal assignation of specimens to species. Only a detailed study of morphological features as required by modern harpacticoid taxonomy can resolve the taxonomic problems surrounding the genus. The present investigation aims to do so with a detailed taxonomic revision of a group of *Halectinosoma* species that are morphologically very similar and have often been confounded in the past. Particular emphasis is given on describing the fine ornamentation of the somites and the morphology of the cephalosomic appendages; these morphological features have been shown to be of great taxonomic importance in distinguishing between species of *Halectinosoma* (Lang, 1965).

MATERIAL AND METHODS

The initial list of subtidal sites around Britain and Ireland from which most of the material was collected is given by Moore & O'Reilly (1989). Details of additional collection sites around Great Britain are provided in Table 1. Material from other locations around the world was also examined. In the descriptions of species that follow, the provenance of British material examined is given using the sample number from Table 1 (or from Moore & O'Reilly, 1989: Table 1) prefixed by 'S'. A sample code is also given in

TABLE 1. Details of sediment samples containing *Halectinosoma* material. Details of additional samples are provided by Moore & O'Reilly (1989: Table 1).

Sample number	Sample code		Location	Sediment type
66		Shetland	Sullom Voe	gravelly mud
67		Summer Isles	Anchorage Bay	muddy sand
68		Summer Isles	Anchorage Bay	mud
69		Glenuig	56°49.77′N 5°25.33′W	muddy sand
70		Loch Creran	56°31.27′N 5°20.63′W	mud
71	OC	Forth Estuary	56°01.71′N 3°36.30′W	coarse silt
72		Forth Estuary	56°02.28′N 3°33.57′W	coarse sand
73		Forth Estuary	56°02.28′N 3°33.57′W	muddy sand
74	54	Firth of Forth	56°07.06′N 2°42.3′W	sandy mud
75	BR1	Firth of Forth	56°27.00′N 2°10.00′W	medium sand
76	BR9	Firth of Forth	56°25.00′N 2°13.62′W	fine sand
77	BR15	Firth of Forth	56°25.00′N 2°13.62′W	fine sand
78	BR17	Firth of Forth	56°25.00′N 2°06.19′W	fine sand
79	BR23	Firth of Forth	56°24.00′N 2°10.00′W	medium sand
80	SA3	Firth of Forth	56°05.50′N 2°07.25′W	muddy sand
81	SA13	Firth of Forth	56°04.50′N 2°07.25′W	muddy sand
82	SA15	Firth of Forth	56°04.50′N 2°05.46′W	muddy sand
83	SA25	Firth of Forth	56°02.50′N 2°07.25′W	muddy sand
84		Isle of Man	Port Erin Bay	fine sand
85	CS2	Celtic Sea	50°30′N 7°00′W	muddy sand
86	MAFF7	North Sea	54°00.0′N 0°39.9′E	sand
87	MAFF10	North Sea	51°40.07′N 1°19.07′E	coarse sand
88		France	Banyuls-sur-Mer, France	fine sand
89		Gullmar fjord	58°15.13′N 11°28.07′E	

Table 1 for several of the samples, as this appellation is used for the same sites in other studies.

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 owing 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 (Fig. 1A). 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 pseudoperculum 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.

Specimens used for S.E.M. were fixed in 5% formalin and then transferred for dehydration in an ethanol series (20, 40, 60, 80, 90, 95 and 100% EtOH) at 20 minute intervals. They were then transferred to 100% acetone for critical point drying and coated with gold before examination.

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 Lang (1965) except for the use of endopod, exopod and baseoendopod. 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 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

***Halectinosoma pseudosarsi* sp. nov.**

Ectinosoma sarsi Boeck, 1872, *sensu* Sars (1904)

Material examined

Type material (Scotland): S74 (1 ♀ holotype dissected on slides, NHM#1990.254; 1 ♀ paratype dissected on slides, NHM#1990.255); S20 (1 ♀ paratype preserved in alcohol, NHM#1990.256; 1 ♀ paratype dissected on slides).

Zoology Museum, Oslo: 37 ♀♀ (as *Ectinosoma sarsi*) from G.O. Sars collection, Norway, preserved in alcohol in tube F20038.

Canadian Museum of Nature, Ottawa: 1 ♀ from Frobisher Bay, Canada,

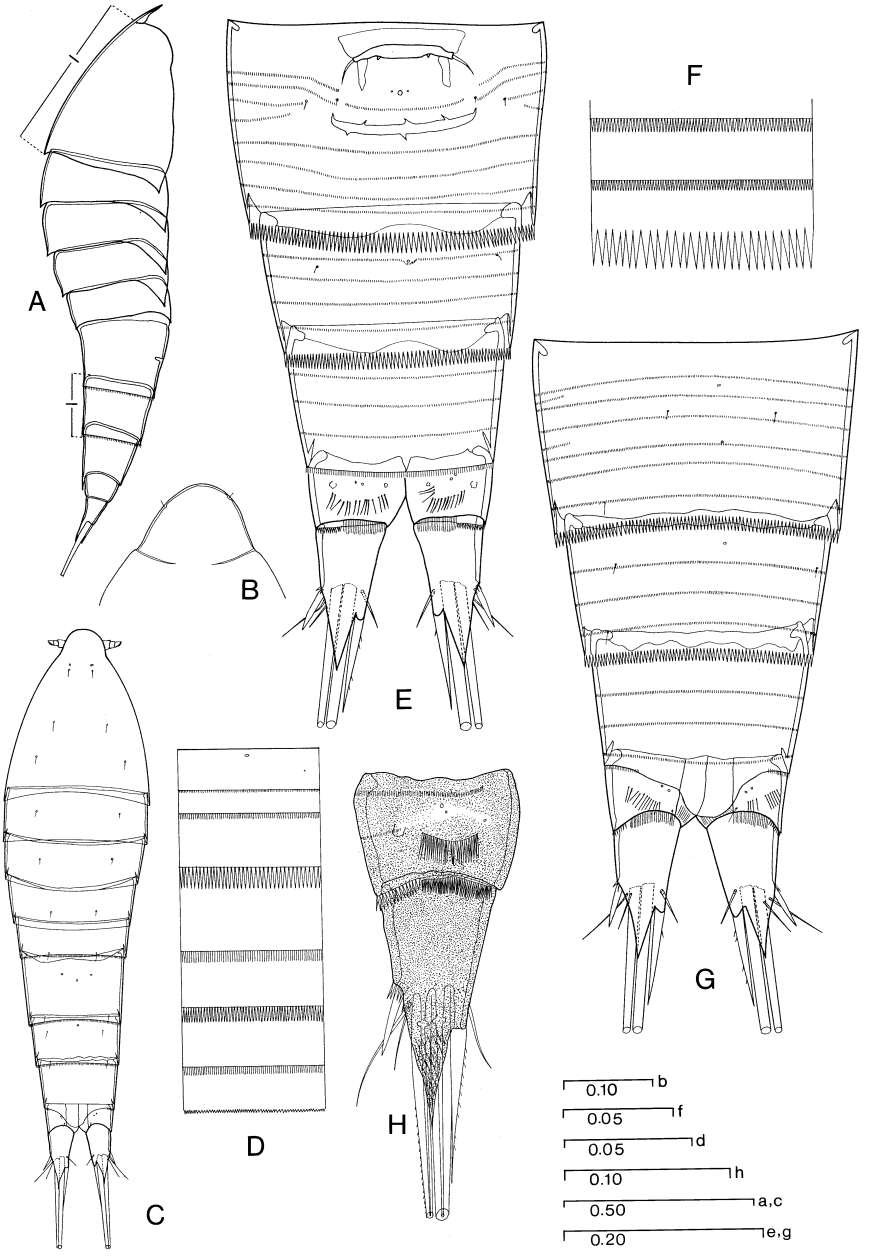

Figure 1. ***Halectinosoma pseudosarsi* sp. nov**. Female holotype: A, Habitus, lateral (l = length of somite); B, Rostrum; C, Habitus, dorsal; D, Surface ornamentation of first free thoracic somite, dorsal; E, Urosomites 2–6, ventral; F, Posterior margin of genital double somite, ventral; G, Urosomites 2–6, dorsal; H, Anal somite (part) and caudal ramus, ventral.

63°25′N 68°10′W, Aug. 15 1979, bottom collection at 50 m depth by E.H. Grainger, tube NMC1990-0359.

Description of female holotype

Length: habitus, 1350 μm; sum of all somites 1470 μm; cephalothorax 430 μm; genital double somite 160 μm. Habitus (Fig. 1C) fusiform and robust, greatest width at junction of cephalothorax and first free thoracic somite. Colour of preserved specimen dark brown. Surface of cuticle densely covered with small perforations (as in Fig. 1H). Cephalothorax as long as its basal width and gradually tapering anteriorly. Rostrum well developed (Fig. 1B), broadly rounded, partially fused at base with the cephalothorax and furnished with two sensilla subapically. Labrum prominent and terminating in a spinous projection (Fig. 2H). Original segmentation of genital double somite marked ventrally by a transverse chitinous stripe. Penultimate somite with a broadly convex pseudoperculum.

Caudal ramus (Fig. 1H). About 1.5 times as long as greatest width and furnished with seven setae: two adjacent slender setae issuing near distal outer corner, one of which is diminutive, slightly shifted dorsally, and accompanied by a short row of spinules near base; a stouter lateral seta proximal to the slender setae and accompanied by a short row of spinules; two well-developed terminal setae, the outer seta being shorter than the inner one and spinulose along outer margin; one seta issuing from inner distal corner, spinulose along inner margin and as long as furcal ramus; one slender dorsal inner seta with biarticulate base. Posterior edge of rami dorsally and ventrally terminating as an acuminate lappet, the ventral lappet slightly longer than the dorsal and covered with scale-like spinules. Surface of ramus densely covered with fine hair (not illustrated). Base of ramus with a transverse row of closely set spinules ventrally and dorsally.

Somitic ornamentation (Fig. 1C–G). Body somites, apart from the penultimate, sparsely furnished with sensilla and pores (Fig. 1C, E, G). Posterior margin of cephalothorax and first two free thoracic somites denticulate (Fig. 1D). First and second free thoracic somites dorsally with six dorsal spinule rows. Third and fourth free thoracic somites with five rows of fine spinules and a semi-incised subulate hyaline frill. Genital double somite with a semi-incised subulate hyaline frill (Fig. 1F) and eight rows of fine spinules: three continuous rows around somite, three rows interrupted in middle of ventral surface, and two ventral rows. Fourth urosomite with three continuous and one ventral row of spinules and a hyaline frill as in preceding somite, except slightly weaker. Penultimate somite with three continuous rows of spinules on surface and with a fine fully-incised hyaline frill interrupted dorsally by a bare pseudoperculum. Anal somite with two conspicuous rows of hairs on dorsal and ventral surface, and a row of spinules along outer distal margin.

Antennule (Fig. 2A). Short and 6-segmented. First segment with transverse rows of spinules on anterior surface and one bare seta issuing from anterior distal corner. Second segment armed with 9 bare and well-developed setae and a dwarfed seta near anterior distal corner. Third segment longest and with eight setae, one of which is sharing a common base with an aesthetasc at anterior distal corner. Fourth segment short and furnished with one bare seta. Penultimate segment armed with four bare setae. Distal segment barely

Figure 2. ***Halectinosoma pseudosarsi* sp. nov**. Female holotype: A, Antennule; B, Antenna; C, Mandible; D, Maxillula; E, Maxilla; F, Distal end of maxilla showing endopod; G, Maxilliped; H, Labrum.

protruding beyond penultimate one and furnished with three apical setae sharing a common base and along posterior margin a set of six diminutive setae each with biarticulate base.

Antenna (Fig. 2B). Coxa indistinctly demarcated at base (not illustrated). Basis longer than wide, with a short row of spinules near outer margin and a close set of long setules issuing from inner margin. Endopodite two-segmented; first segment unadorned, second one with strong spinules at inner proximal corner and just inside distal edge, and armed with two juxtaposed spinulose setae near inner margin and seven distal setae of which three are spinulose geniculate, three are spinulose and one dwarfed plumose. Exopodite three-segmented and well-developed; first segment with a bare slender seta distally, second segment with a stout spinulose seta, distal segment with a short row of spinules subapically and two well-developed spinulose setae of subequal length.

Mandible (Fig. 2C). Coxal gnathobase armed with two subequal short setae at ventral base of unidentate *pars incisiva* and quadridentate *lacinia*. Basis with spinular rows on surface, a close set of long setules on inner margin in proximal half, and three setae issuing from distal inner corner. Exopodite one-segmented, armed with one inner and two terminal plumose setae. Endopodite one-segmented, furnished with spinules along inner and outer margin, and armed with ten setae: three setae issuing half-way along inner margin, one short subdistal spiniform seta on outer margin, and six distal setae with undefined bases.

Maxillula (Fig. 2D). Praecoxal arthrite furnished along distal edge with three unguiform spines, one short hairy seta accompanied by a diminutive seta and, proximal to these, a pair of adjacent slender setae. Coxa very short and armed with a bare seta. Basis with two groups of three setae along inner margin. Exopodite small, one-segmented, fringed with spinules along inner margin and armed with two plumose setae with broad bases. Endopodite one-segmented with three groups of two setae, the two outermost setae plumose.

Maxilla (Fig. 2E). Syncoxa broad, with three transverse rows of spinules around outer edge, a small group of spinules near outer distal corner, and three endites along distal half of inner margin; proximal endite armed with four setae, middle and distal endites with 2 and 3 setae respectively. Basis narrower than syncoxa and armed with one stout spiniform seta accompanied by a diminutive seta and a slender bare seta midway along inner edge, and two slender setae near apex. Endopodite three-segmented, the first two segments each armed with a thick geniculate seta and the distal segment represented by a broad base from which one lateral and three distal confluent slender setae arise (Fig. 2F, 30C).

Maxilliped (Fig. 2G). Syncoxa short, armed with two setae and with a transverse row of spinules on posterior face. Basis segment long, slightly tapering distally and furnished with slender hairs along outer margin, some spinules on the surface and a spinular row along inner margin. Endopodite segment short, armed with a bare seta on inner margin, a bipinnate stout subapical outer seta and two closely set apical setae, one of which is dwarfed and can be difficult to see.

P1–P4 (Fig. 3A–E). Praecoxa apparently represented by an indistinct

rectangular area at inner proximal corner of coxa (not illustrated). Exopod and endopod 3-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

All pereiopods spinulose along outer margins of endopod and exopod.

P1 (Fig. 3A). Coxa subrectangular with short row of spinules near outer proximal corner on posterior surface; anterior surface furnished with fine rows of spinules near distal edge, and distal outer margin fringed with fine spinules. Intercoxal plate small and notched in the middle. Basis furnished with a row of spinules at articulation with endopod and exopod, a curved row of spinules about half-way on anterior surface, a short spiniform seta on outer edge, and a thick spinulose spine on inner distal corner. First segment of endopod broad, with a transverse row of spinules near base and near inner distal corner. Second segment with a short row of fine spinules at distal inner corner and a row of larger spinules on posterior surface (Fig. 3B). Third segment with two short transverse row of spinules on posterior side near inner margin. Exopod much shorter than endopod, first segment with a transverse row of spinules near outer and inner margins and a fully incised fine subulate hyaline frill at inner distal corner. Tip of inner seta of segment 2 of exopod distinctly plumose.

P2–P4 (Fig. 3C–E). Coxa with short row of spinules on posterior surface near proximal outer corner (except P4); outer distal corner fringed with spinules. Distal margin of intercoxal plate concave. Basis with a plumose seta on outer edge (considerably longer in P4) and a row of spinules at articulation with exopod and endopod; inner edge with a subtriangular expansion, a close set of long setules issuing from posterior surface near distal corner and lying against basis (not illustrated), and a curved row of spinules. First and third segment of endopodite with an inconspicuous pore subdistally on anterior surface. First segment of endopodite with a transverse row of long spinules near proximal outer corner; spinulation on posterior and anterior surface face of segments 2 and 3 as in P1. First segment of exopodite with only one short row of spinules near proximal outer corner and a fully-incised subulate hyaline frill at inner distal corner. Tip of inner seta of segment 2 of exopodite distinctly plumose.

P5 (Fig. 3F). Exopod confluent with baseoendopod on anterior surface but separated by a suture on posterior surface. Inner expansion of baseoendopod reaching to about 3/4 of exopod, furnished with spinules along its inner margin and armed with two bare spiniform setae, the outer being about 2/3 as long as the inner seta. Outer expansion of baseoendopod furnished with a short slender seta. Inconspicuous pore present on anterior surface of baseoendopod. Exopod slightly longer than wide (ratio length/width = 1.25). Distal edge of exopod with three somewhat sinuate lobes, each accompanied by a row of spinules and armed with a bare seta: inner seta very short, not extending beyond outer seta of baseoendopod; middle seta about three times as long as inner seta and almost twice as long as outer seta. Surface seta

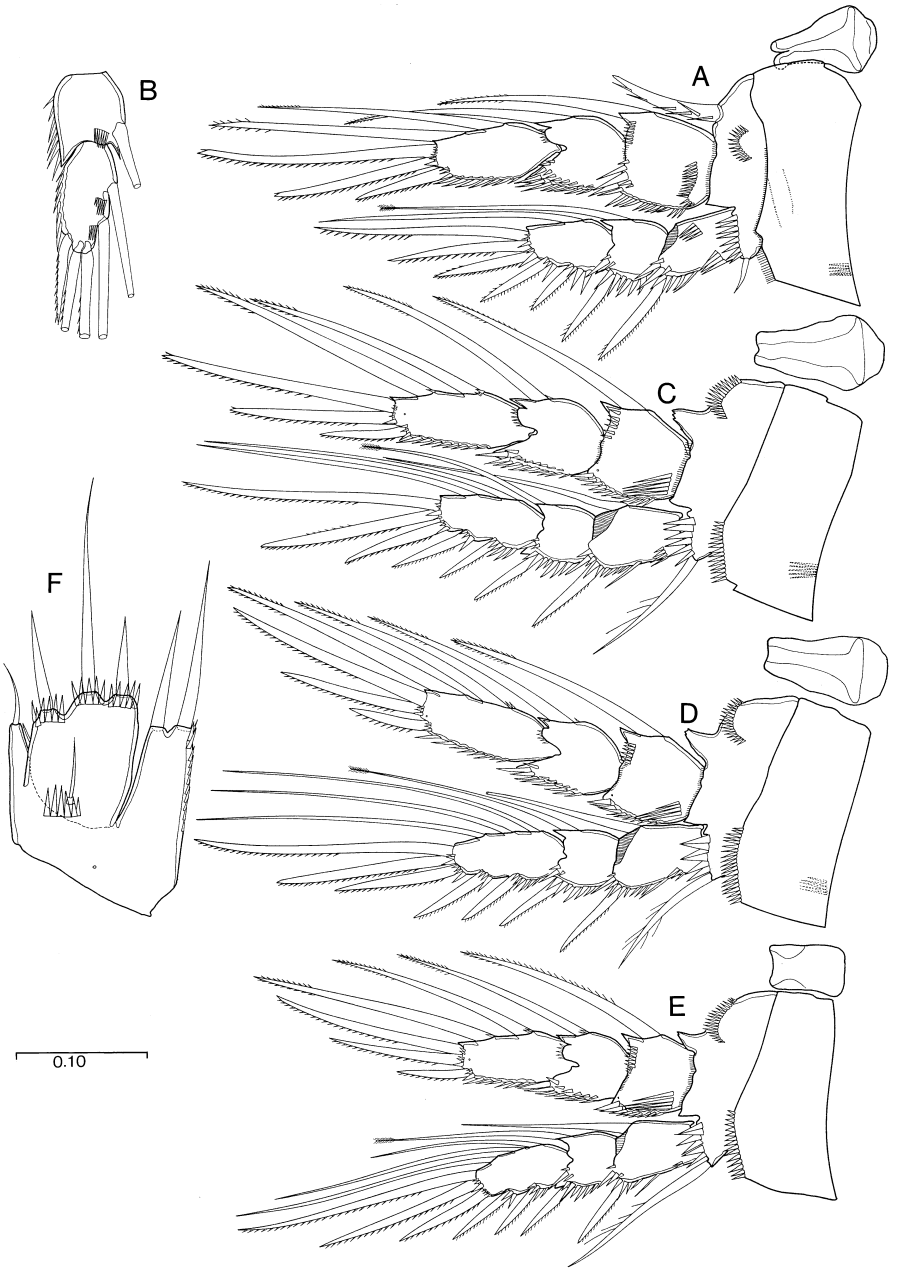

Figure 3. ***Halectinosoma pseudosarsi* sp. nov**. Female holotype: A, P1, anterior view; B, Second and third segments of P1 endopod, posterior view; C, P2; D, P3; E, P4; F, P5.

articulating on a small lobe accompanied by a row of six spinules and issuing from a point distal to the exopod-baseoendopod suture (representing a distance of about 1/8 of exopod length).

Variability

The following variation in length was observed ($n = 10$): habitus, 1000–1500 μm; sum of all somites, 1435–1510 μm; cephalothorax 420–450 μm;

genital double somite 150–190 μm. One specimen from S20 had a few spinules near the distal edge of the inner expansion on one P5 baseoendopod only, suggesting that it probably represents an anomaly.

Remarks

A re-examination of Sars' material ascribed by him to *H. sarsi* (Boeck) has revealed major discrepancies with the original description given by Boeck (1872). Boeck's description is poor and incomplete. As far as we know, the type material of *H. sarsi* does not exist. Boeck mentioned the following morphological characteristics of the P5 for *H. sarsi*: "The fifth pair of legs is elongated. The baseoendopod is very elongated with two inner setae equally long. The exopod is about two times as long as broad, with two broad inner setae which are a lot shorter than the exopod and from the tip of the outer lobe extends the outer seta". This differs from Sars' (1904) description in which the P5 has a subtriangular shape and the exopod is about as long as broad. Contrary to Boeck's description, the middle seta of the P5 exopod is setiform and clearly longer than the exopodite in all the specimens we have examined. Two morphological features given by Boeck, shape of the furca and size of habitus, do agree with Sars' material, but these features together are of little use for distinguishing species of *Halectinosoma*. Furthermore, because Boeck did not describe any cephalosomic appendages, we cannot be certain that the species he described belongs to the genus *Halectinosoma*. The morphology of the maxilla and maxilliped are important diagnostic features used to distinguish between *Halectinosoma* and *Pseudobradya*. In order to provide stability to the taxonomy of this difficult group of *Halectinosoma* species, *H. sarsi* (Boeck) is placed as *species incertae sedis* and the species described by Sars is renamed *H. pseudosarsi* sp. nov.

In his key to the genera of ectinosomatids, Lang (1965) distinguishes between *Halectinosoma* and *Pseudobradya* on the basis of the number of maxillary endopod segments. However, *H. pseudosarsi* and the other species described in this paper share with *Pseudobradya* the possession of three endopod segments. The segmentation is difficult to discern, although it is more obvious in some of the other species described here, such as *Halectinosoma brunneum* (Fig. 19E).

It was revealed during the course of this study that many of the earlier records of *H. sarsi* were incorrect or otherwise suspect owing to the small differences existing between species and the confusion resulting from inadequate descriptions. This is particularly true with regard to Monard's (1928) description of *H. sarsi* from specimens collected at Banyuls. Monard himself had doubts about the identity of his material and gave only a brief account. Consequently, the material examined in this paper represents the only verifiable published records of *H. pseudosarsi*. Wells' (1965) description of the male of *H. sarsi* was found to be incorrect after a re-examination of his material. The two specimens he examined belong to the genus *Ectinosoma*. The poor condition of these specimens prevented any identification below generic level.

H. pseudosarsi can easily be distinguished from other species of this group by the length of the female, which makes it the largest known species of *Halectinosoma*, the morphology of the P5, and the shape of the cephalothorax,

which is unusually short in relation to the rest of the body. The presence of a pore on the P5 baseoendopod of the female is another characteristic feature of this species but could be easily missed. Its significance is unknown, but it is possibly homologous with the small pore found on the first segment or on the distal segment of the endopod P2–P4. The presence of small perforations covering the surface of the cuticle is a feature shared by all species mentioned in this study, and although there are small variations in the size of these perforations amongst species, these variations could not be appropriately described nor quantified.

H. pseudosarsi is a rare species in Britain and only three specimens from two localities in the Firth of Forth were found. Sars (1904) stated that he found this species not infrequently in the upper part of the Oslo and Trondhjem fjords in Norway. Its occurrence in Frobisher Bay suggests that *H. pseudosarsi* has an arcto-boreal distribution.

Halectinosoma neglectum (Sars, 1904)

Ectinosoma neglectum Sars, 1904

Material examined

Zoology Museum, Oslo: 1 ♀ lectotype in G.O. Sars collection, tube #F12676, Tananger, Norway; 1 ♀ in tube #F20038 (labelled *E. sarsi*), Norway.

Scotland: S1 (16 ♀♀, 2 ♂♂); S2 (13 ♀♀); S5 (3 ♀♀); S6 (2 ♀♀); S67 (1 ♀).

Northern Ireland: 20 ♀♀ from Taggart Bay, collected intertidally in glutinous mud.

Iceland: 1 ♀ collected at low tide on sandy beach, Reykjavik, Aug. 1988.

Canadian Museum of Nature, Ottawa: 1 ♀ from Frobisher Bay, Canada, 63°25′N 68°10′W, Aug. 15 1979, bottom collection at 50 m depth by E.H. Grainger.

Sweden: S89 (1 ♀).

Natural History Museum, London from the Norman collection: 50 ♀♀ in tube #42670-689 labelled *Ectinosoma sarsi* from Vadso, East Finnmark, Norway; 9 ♀♀ whole mounts on slide #1900.3-6-640 (as *Ectinosoma spinipes*), Tobermory, Scotland; 10 ♀♀ in tube #42640-659 (as *Ectinosoma sarsi*), Trondhjem Fjord, Norway.

The following morphological details amend Sars' original description and complement the subsequent description by Chislenko (1967) and drawings by Lang (1965).

Description of female

Length: habitus, 1000–1240 μm; sum of all somites 1215–1295 μm; cephalothorax 350–390 μm; genital double somite 145–160 μm. Habitus fusiform as figured by Lang (1965). Rostrum prominent, partly fused at base with cephalothorax and with two subapical sensilla. Colour of preserved specimen dark brown. Surface of cuticle densely covered with minute perforations. Caudal ramus about 1.5 times as long as broad and covered

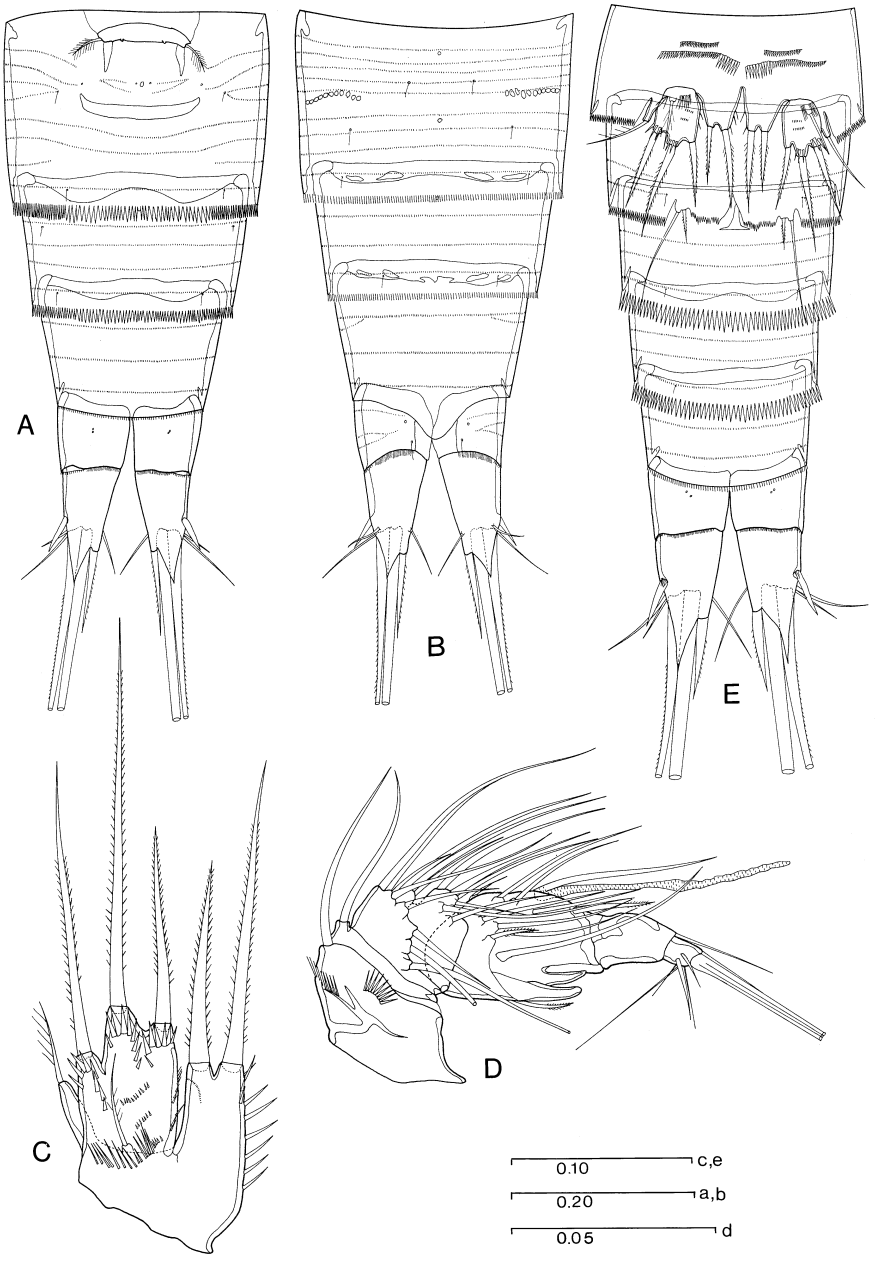

Figure 4. *Halectinosoma neglectum* (Sars, 1904). Female (S1): A, Urosomites 2–6, ventral; B, Urosomites 2–6, dorsal; C, P5. Male (S1): D, Antennule; E, Urosome, ventral.

with a few rows of fine spinules ventrally (as figured by Lang, 1965) and dorsally, otherwise as in *H. pseudosarsi.*

Somitic ornamentation (Fig. 4A, B). Cephalothorax dorsally with subcuticular chitinous patches near denticulate posterior margin. Body somites ornamented as in *H. pseudosarsi*, apart from the following features: genital double somite with second most distal row of spinules interrupted ventrally and dorsal

surface with nine spinular rows and patches of chitin near lateral margin; penultimate somite with an additional row of spinules ventro-laterally and a pseudoperculum that is slightly more convex and finely denticulate; anal somite with four rows of fine spinules dorsally and ventrally.

Principal segmentation, setation and ornamentation of cephalosomic appendages as in *H. pseudosarsi*, except the postero-distal seta of penultimate segment of antennule thick and coarsely spinulose. P1–P4 as figured by Lang (1965) but with the following additions: pore near distal edge of first and last segments of endopod P2–P4; posterior surface of second and last segments of endopod P1–P4 with short row of spinules near inner margin; basis with a group of long setules at inner distal corner; praecoxa as in *H. pseudosarsi*; coxa of P1–P4 with a short row of spinules near proximal outer corner on posterior surface.

P5 (Fig. 4C). Exopod confluent with baseoendopod on anterior surface only. Inner expansion of baseoendopod reaching to about 2/3 of exopod and furnished with strong spinules along inner edge and a row of very fine spinules near outer margin; distal edge cleft in the middle and with two setiform setae, the inner seta about 1/3 longer than the outer. Exopod longer than broad (length/width ratio = 1.45) and furnished with two transverse rows of fine spinules on anterior surface and along inner margin. Distal edge of exopod formed by three unequal lobes each accompanied by a row of spinules and armed with a setiform bipinnate seta: inner seta projecting beyond second outermost seta of baseoendopod; middle lobe projecting well beyond inner lobe and armed with a seta twice as long as the inner seta; outer lobe projecting well short of inner lobe and bearing a seta 1/3 shorter than middle seta. Surface-seta issuing from a lobule just opposite to the exopod-baseoendopod suture and accompanied by a row of spinules.

Variability

No variation was observed amongst specimens examined.

Description of male

Length: habitus, 760–765 μm ($n = 2$); sum of all somites 780–820 μm; cephalothorax 250 μm. Second and third urosomites distinct. Otherwise as in female apart from the following features.

Somitic ornamentation (Fig. 4E). First urosomite with two conspicuous transverse rows of spinules mid-ventrally. Second urosomite with fine spinular rows interrupted ventrally and a fine semi-incised subulate hyaline frill. Third urosomite with a small chitinous patch mid-ventrally. Otherwise as in female.

Antennule (Fig. 4D). 7-segmented. First segment with rows of spinules on anterior surface and a seta at anterior 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 moderately swollen with a complex arrangement of setae; anterior edge with a large aesthetasc sharing a common base with a slender seta; posterior margin modified as two stout grasping processes. Penultimate segment slightly swollen, greatly sclerotized at base, and furnished with a seta at antero-distal corner. Distal segment small with three terminal setae with common base, a short

slender seta at antero-distal corner and a few accessory dwarfed setae along posterior edge.

P5 (Fig. 4E). Baseoendopod confluent with somite: inner expansion with few spinules along inner edge and armed with two distal setae; outer expansion armed with a plumose seta. Exopod clearly demarcated from baseoendopod, reaching well beyond inner expansion of baseoendopod, and armed with three distal setae. Surface of exopod with two transverse rows of very fine spinules. Innermost lobule of exopod devoid of spinules. Surface-seta issuing from a lobule on exopodite and accompanied by a row of fine spinules.

P6 (Fig. 4E). A plate with two setae at outer distal corner: inner seta short and spinulose, the outer seta bare, issuing from a lobule, and about 3.5 times longer than inner seta. Inner distal margin of plate denticulate.

Remarks

H. neglectum shares many morphological features with *H. pseudosarsi*, but can be readily distinguished from the latter by the shape, spinulation and long setiform setae of the P5, and the habitus size and shape. Lang (1965) also found affinities between *H. neglectum* and *H. ornatum*, a species he described from California. *H. ornatum* is markedly smaller than *H. neglectum* and also possesses other distinct morphological features which distinguish it from *H. neglectum* (see Lang, 1965).

The only certain record of *H. neglectum*, beside the material we have examined, is that of Chislenko (1967: Fig. 4). The specimen he collected from *Laminaria* in the Karelian Sea agrees with our re-description. Chislenko also described two unusual specimens taken from silty sand, which he ascribed to *H. neglectum* although they clearly differed from Sars' original description. These two specimens have now been ascribed to *H. chislenki* sp. nov., based on a detailed examination of material later found in the Beaufort Sea and Franz Joseph Land (see below). All other records of *H. neglectum* must be regarded with great caution owing to the confusion that existed in this difficult group of species and the insufficient information provided by many authors. This is exemplified by the records given by Monard (1935) for Roscoff and Grandori (1913) for the Adriatic sea. Our survey indicates that *H. neglectum* is a relatively common species with an arcto-boreal distribution similar to that of *H. pseudosarsi*. The occurrence of both species in a sample from Frobisher Bay also indicates that they are sympatric. Sars (1910) also found it abundantly in several places along the Norwegian coast, from the Oslofjord to Vadso, and from polar islands north of Grinnell Land. Sars (1916) apparently recorded this species from Monaco, but he gave no indications about the locality where his material was collected.

***Halectinosoma chislenki* sp. nov.**

Ectinosoma neglectum Sars, 1904, *sensu* Chislenko (1967 p. 80–82, Fig. 6)

Material examined

Canadian Museum of Nature, Ottawa: 1 ♀ holotype dissected on slides #NMC1990-0353; 1 ♀ paratype dissected on slides, 1 ♀ paratype preserved

in alcohol, #NMC1990-0355. All from Beaufort Sea, 70°14′N 139°04′W, collected by E.H. Grainger 18 July 1975 with vertical plankton haul, 113-0 m.

Royal Museum of Scotland, W.S. Bruce Arctic collection: 1 ♀ dissected on 5 slides NMS #1921.145.345, from Franz Joseph Land, collected on 20 July 1898 at 110 m.

As there is already a description of this species with adequate illustrations (Chislenko, 1967), only the diagnostic features have been drawn from the designated holotype.

Description of female holotype

Length: habitus 1285 μm; sum of all somites 1430 μm; cephalothorax 370 μm; genital double somite 190 μm. Habitus fusiform and as in Chislenko (1967). Colour of preserved specimens dark brown. Rostrum prominent and slightly tapering anteriorly with two sub-apical sensilla. Labrum as in *H. neglectum*. Genital double somite ventrally with a transverse chitinous stripe. Pseudoperculum as in *H. neglectum*.

Caudal ramus (Fig. 5E). Twice as long as broad with setation as in *H. neglectum*, and with one transverse row of spinules midway along outer margin.

Somitic ornamentation. As in *H. neglectum*.

The cephalosomic appendages are as in *H. neglectum*, except for the mandibular gnathobase, which is armed with a tri-dentate *lacinia* (Fig. 5D).

P1–P4. Principal setation and form as in *H. neglectum*.

P5 (Fig. 5F). Exopod confluent with baseoendopod on anterior surface only. Inner expansion of baseoendopod reaching to 3/4 of exopod and armed with two setiform setae: outer seta slightly shorter than inner one and extending to tip of innermost seta of exopod. Baseoendopod spinulose along inner margin and with a distinct row of spinules on anterior surface just inside suture with body somite. Exopod with three terminal setiform setae issuing from spinulose lobes. Anterior surface of exopod with a row of small spinules midway and two rows along inner margin. Surface seta plumose and issuing from exopod near suture with baseoendopod and accompanied by a row of spinules.

Variability

The following lengths were taken from one of the paratypes: habitus 1245 μm; sum of all somites 1350 μm; genital double somite 185 μm; cephalothorax 345 μm. No other differences were observed amongst specimens examined.

Remarks

Chislenko (1967) collected two specimens of this species from silty sand in the Karelian Sea and ascribed them to *H. neglectum*, although he noted morphological differences with another specimen collected from *Laminaria*, which agreed with Sars' (1904) original description. Although *H. chislenki* sp. nov. shows great similarity with *H. neglectum*, it possesses distinctive features which we believe clearly separate it from the latter. The presence of a row of spinules near the base of the baseoendopod is unique amongst the group of species revised in this study. This species also differs from *H. neglectum*

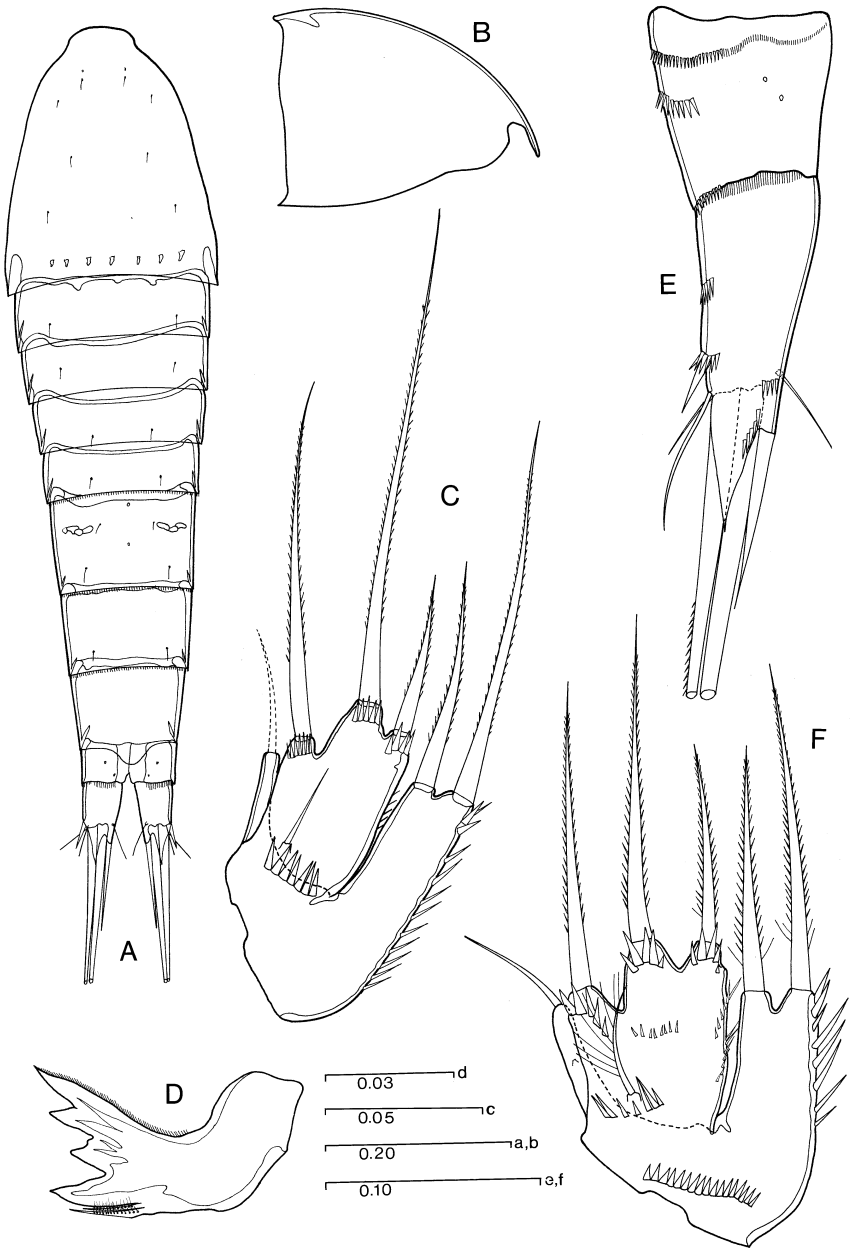

Figure 5. *Halectinosoma clavatum* (Sars, 1920). Female lectotype: A, Habitus, dorsal; B, Cephalothorax, lateral; C, P5. ***Halectinosoma chislenki* sp. nov**. female holotype: D, Mandibular gnathobase; E, Anal somite (part) and caudal ramus, ventral; F, P5.

by its length, the more elongated caudal ramus, and the tridentate lacinia which suggests a different feeding habit. *H. chislenki* sp. nov. has only been recorded from the Arctic and, except for the sediment type mentioned by Chislenko, no precise information is available on its habitat.

Halectinosoma clavatum (Sars, 1920)

Ectinosoma clavatum Sars, 1920

Material examined

Zoology Museum, Oslo, G.O. Sars collection: 1 ♀ designated lectotype dissected on two slides, F20036b and F20036c; 1 ♀ paralectotype dissected on two slides, F20036d and F20036e; 13 ♀ paralectotypes in tube F20036a. All collected at Risør in muddy sand at 55 m.

Royal Museum of Scotland, W.S. Bruce Arctic collection: 1 ♀ dissected on two slides, #1921.145.350, Franz Joseph Land, 1898.

Description of female

Length ($n = 8$): habitus 685–795 μm; sum of all somites 825–880 μm; genital double somite 100–110 μm; cephalothorax 250–270 μm. Body shape robust and sub-clavate (Fig. 5A), with short cephalothorax curving strongly ventrally in lateral view (Fig. 5B). Rostrum obtusely blunted anteriorly. Colour of preserved specimens dark brown. Labrum as in *H. pseudosarsi*. Pseudoperculum well developed and as in Fig. 5A.

General form and principal setation of the mouthparts and swimming legs as in *H. pseudosarsi*, with the exception of minor differences in spinulation.

Caudal ramus (Fig. 5A). Slightly longer than wide with setation as in *H. pseudosarsi*. Seta at inner distal corner distinctly longer than ramus.

Somitic ornamentation. As in *H. neglectum*.

P5 (Fig. 5C). Distinctly longer than greatest width. Exopod fused with baseoendopod on anterior surface only. Inner expansion of baseoendopod reaching to about 3/4 of exopod, spinulose along inner margin, and armed with two setiform setae, the outer seta reaching slightly beyond innermost seta of exopod. Exopod slightly spinulose along inner margin and armed with three terminal setae, the middle seta very long, reaching far beyond the innermost seta of the baseoendopod and about three times as long as the innermost seta of exopod. Surface seta issuing from a lobe just distal to exopod-baseoendopod suture and accompanied by a row of strong spinules.

Variability. None amongst specimens examined.

Male. Unknown.

Remarks

Lang (1948) synonymized this species with *H. brunneum* (Brady), but a re-examination of specimens of *H. clavatum* collected by Sars and upon which, presumably, he based his description has revealed important differences. The habitus of *H. clavatum* is characterized by a short and broadly shaped cephalothorax with a blunted rostrum, which gives it a sub-clavate appearance compared with the more fusiform habitus of *H. brunneum*. Furthermore, *H. clavatum* differs from *H. brunneum* in the absence of scale-like spinules on its urosome and in the overall morphology of the mouthparts, which is more similar to *H. pseudosarsi*. We think that these differences are sufficient to consider *H. clavatum* as a separate species from *H. brunneum*. *H. clavatum* is also close to *H. neglectum* but is distinguished from the latter by its habitus, the shape of the caudal ramus, and the shape and spinulation of the P5.

The only probable record of *H. clavatum* is that of Chislenko (1967, as *H. brunneum*).

Halectinosoma chrystalli (T. Scott, 1894)

Ectinosoma chrystalli T. Scott, 1894
Ectinosoma propinquum T. & A. Scott, 1894

Material examined

Natural History Museum, London: 4 ♀ syntypes, NHM#93.4.22.224-227, collected in Bay of Guinea, 1893.

Scotland: S6 (1 ♀); S17 (1 ♀); S19 (2 ♀♀); S20 (24 ♀♀); S21 (5 ♀♀); S22 (1 ♀); S70 (2 ♀♀); S74 (16 ♀♀); S80 (3 ♀♀); S83 (2 ♀♀).

England: S60 (1 ♀); S61 (1 ♀, 4 ♂♂).

Zoology Museum, Oslo: 1 ♀ from the Sars collection, tube F-20040, as *Ectinosoma proximum*, Risør.

Canadian Museum of Nature, Ottawa: 1 ♀ from River Bourgeois, Nova Scotia, 45°38′N 60°57′30″W, tube NMC1990-360, collected in muddy sediment at 8.5m depth with Ekman grab.

Sweden: S89 (2 ♀♀)

Description of female

Length: habitus 690–1050 μm; sum of all somites 1030–1090 μm; cephalothorax 325–345 μm; genital double somite 110–130 μm. Habitus fusiform (Fig. 6A). Cuticle of preserved specimen dark brown and with small perforations on the surface. Cephalothorax distinctly longer than its basal width (ratio length/width = 1.2). Rostrum well developed, partly fused at base, and with two subapical sensilla (Fig. 30A). Genital double somite with chitinous patches dorsally and a transverse chitinous stripe ventrally. Pseudoperculum tongue-shaped and fringed with small spinules (Fig. 6D).

Caudal ramus (Fig. 6D). Longer than broad (ratio length/width = 1.3). Principal setation as in *H. pseudosarsi* except seta at inner distal corner slightly longer than ramus. Dorsal acuminate lappet much shorter than ventral one. Surface of ramus covered with a few rows of fine spinules. Base of ramus with a dense row of spinules.

Somitic ornamentation (Fig. 6A–C). Body somites with sensilla and pores positioned as in *H. pseudosarsi.* Posterior edge of cephalothorax denticulate and with patches of chitin. Dorsal surface of first two free thoracic somites with six rows of fine spinules and a denticulate posterior edge. Third and fourth thoracic somites with five and four rows of fine spinules respectively and a semi-incised fine subulate hyaline frill. Genital double somite with nine rows of fine spinules, of which six are interrupted mid-ventrally; hyaline frill semi-incised subulate and much coarser mid-ventrally. Fourth urosomite with four ventral and three dorsal rows of fine spinules; hyaline frill as in preceding somite but finer. Penultimate somite with three rows of fine spinules and a fully incised subulate hyaline frill. Surface of anal somite covered with a few rows of fine spinules.

Antennule (Fig. 7A). 6-segmented. Principal setation and form as in *H. pseudosarsi* but spinulation differs as follow: two setae on segment 2 are finely

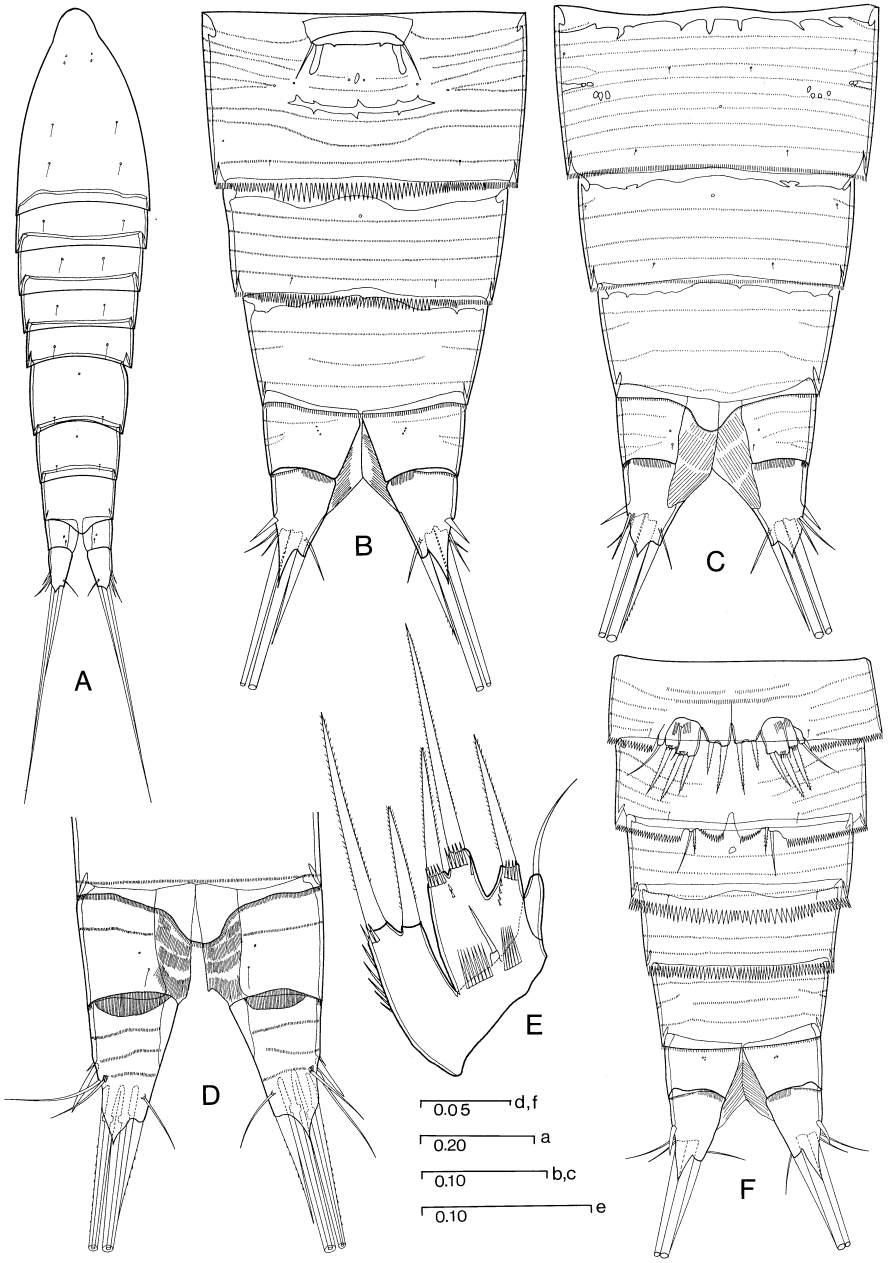

Figure 6. *Halectinosoma chrystalli* (T. Scott, 1894). Female (S20): A, Habitus, dorsal; B, Urosomites 2–6, ventral; C, Urosomites 2–6, dorsal; D, Pseudoperculum, anal somite, caudal ramus, ventral view; E, P5. Male (S16): F, Urosome, ventral.

spinulose along anterior edge and the postero-distal seta of penultimate segment is thick and coarsely spinulose.

Antenna (Fig. 7B). As in *H. pseudosarsi.*

Mandible (Fig. 7C). As in *H. pseudosarsi* except basis with only one row of spinules and endopodite without spinules on outer margin.

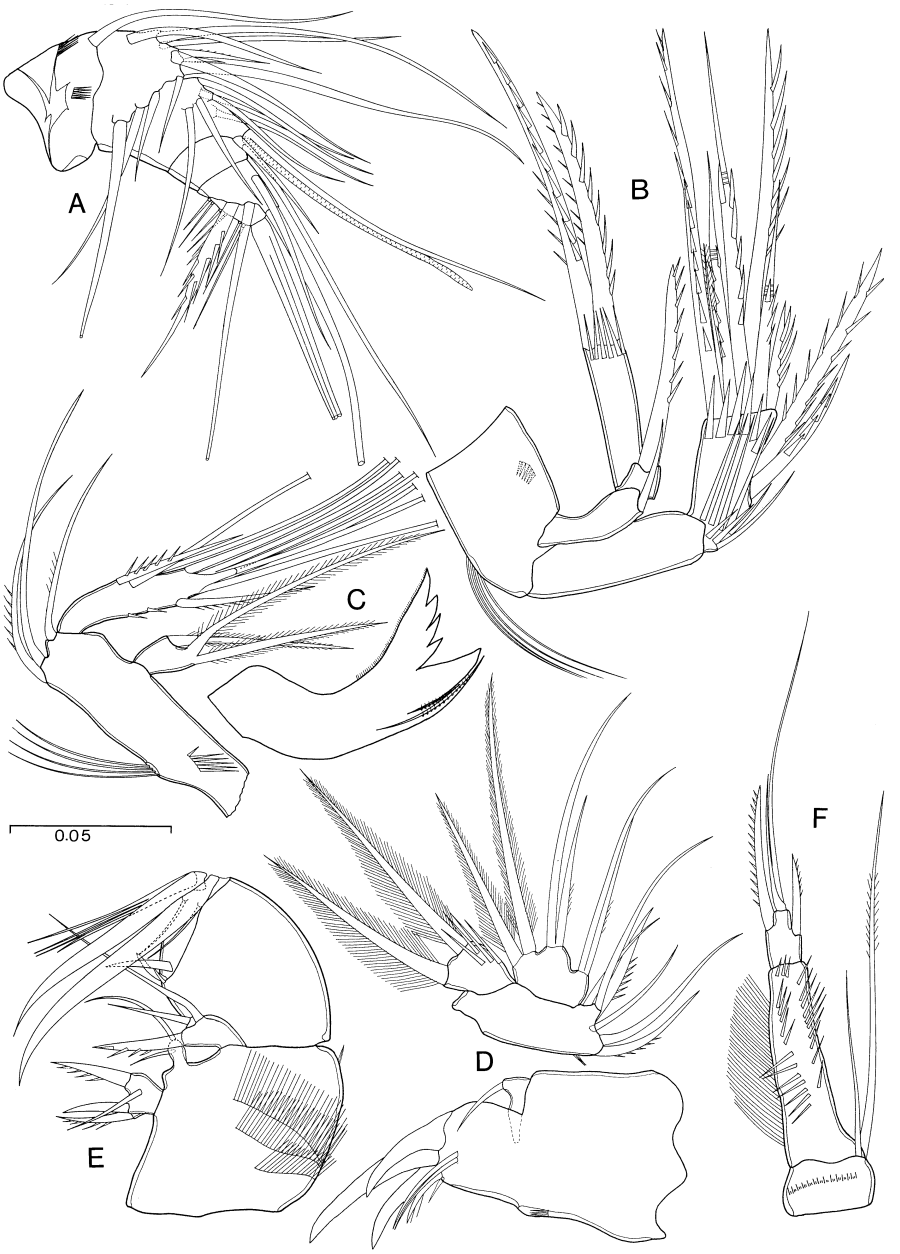

Figure 7. *Halectinosoma chrystalli* (T. Scott, 1894). Female (S20): A, Antennule; B, Antenna; C, Mandible; D, Maxillula; E, Maxilla; F, Maxilliped.

Maxillula (Fig. 7D). As in *H. pseudosarsi* except unguiform setae short and thick.

Maxilla (Fig. 7E). As in *H. pseudosarsi* apart from syncoxa with three dense rows of longer spinules and basis shorter and broader.

Maxilliped (Fig. 7F). As in *H. pseudosarsi.*

P1–P4 (Fig. 8A–D). Principal setation and spinulation as in *H. pseudosarsi* except outer setae of exopodites somewhat thicker.

P5 (Fig. 6E) Exopod distinctly demarcated from baseoendopod by a suture on posterior surface only. Inner expansion of baseoendopod reaching to about 2/3 of exopod and armed with two spiniform setae, the inner one being twice as long as the outer. Outer expansion of baseoendopod furnished with one slender seta. Exopod with three distal lobes each accompanied by a short row of spinules and bearing a spiniform bipinnate seta: inner seta reaching well beyond outer seta of baseoendopod and about half the length of middle seta of exopod; middle lobe extending well beyond inner one; outermost lobe separated from middle lobe by an incision reaching to about 2/5 of exopod. Surface-seta short, accompanied by a dense row of slender spinules, and issuing from a lobule just opposite exopod-baseoendopod suture.

Description of male

Habitus length 570–600 μm ($n = 2$); sum of all somites 655–695 μm; length of cephalothorax 215–220 μm. Second and third urosomites distinct. Otherwise as in female apart from the following features.

Somitic ornamentation (Fig. 6F). Second urosomite with rows of fine spinules and a fine semi-incised subulate hyaline frill.

Antennule. 7-segmented. Principal setation and general form as in male of *H. neglectum.*

P5 (Fig. 6F). Baseoendopod confluent with somite: inner expansion armed with two spiniform setae. Exopod demarcated from baseoendopod by a suture and armed with three spiniform distal setae: innermost seta reaching well beyond outer seta of baseoendopod. Surface-seta issuing from exopod and accompanied by a row of spinules at base. Outer expansion of baseoendopod with one slender seta.

P6 (Fig. 6F). Represented by a plate with two setae, the inner seta spinulose and about half as long as outer bare seta. Inner distal margin of plate denticulate.

Variability

No differences were observed amongst specimens examined.

Remarks

This species was described by T. Scott in 1894 from material collected in the Bay of Guinea, but his account of this species is poor. Of significant importance is the omission from his drawings of the surface-seta on the P5 exopod of the female, which has subsequently led Lang (1948, 1965) wrongly to include this diagnostic feature in his key to *Halectinosoma* species. Our re-examination of the syntypes of *H. chrystalli* has confirmed the presence of a surface-seta at the base of the P5 exopod. Two syntypes had one of the P5 with a surface-seta missing, but the characteristic lobule to which the surface-seta is usually attached was still present at the base of the exopod. This re-examination enabled us to ascribe specimens, collected around the British Isles and elsewhere, to *H. chrystalli.* Furthermore, we have little doubt that *H. chrystalli* is the same species described by T. and A. Scott (1894) in their British monograph as *H. propinquum.* We have been unable to locate the type specimens of *H. propinquum* but material collected in the vicinity of the locality where this species was first recorded agrees with T. and A. Scott's

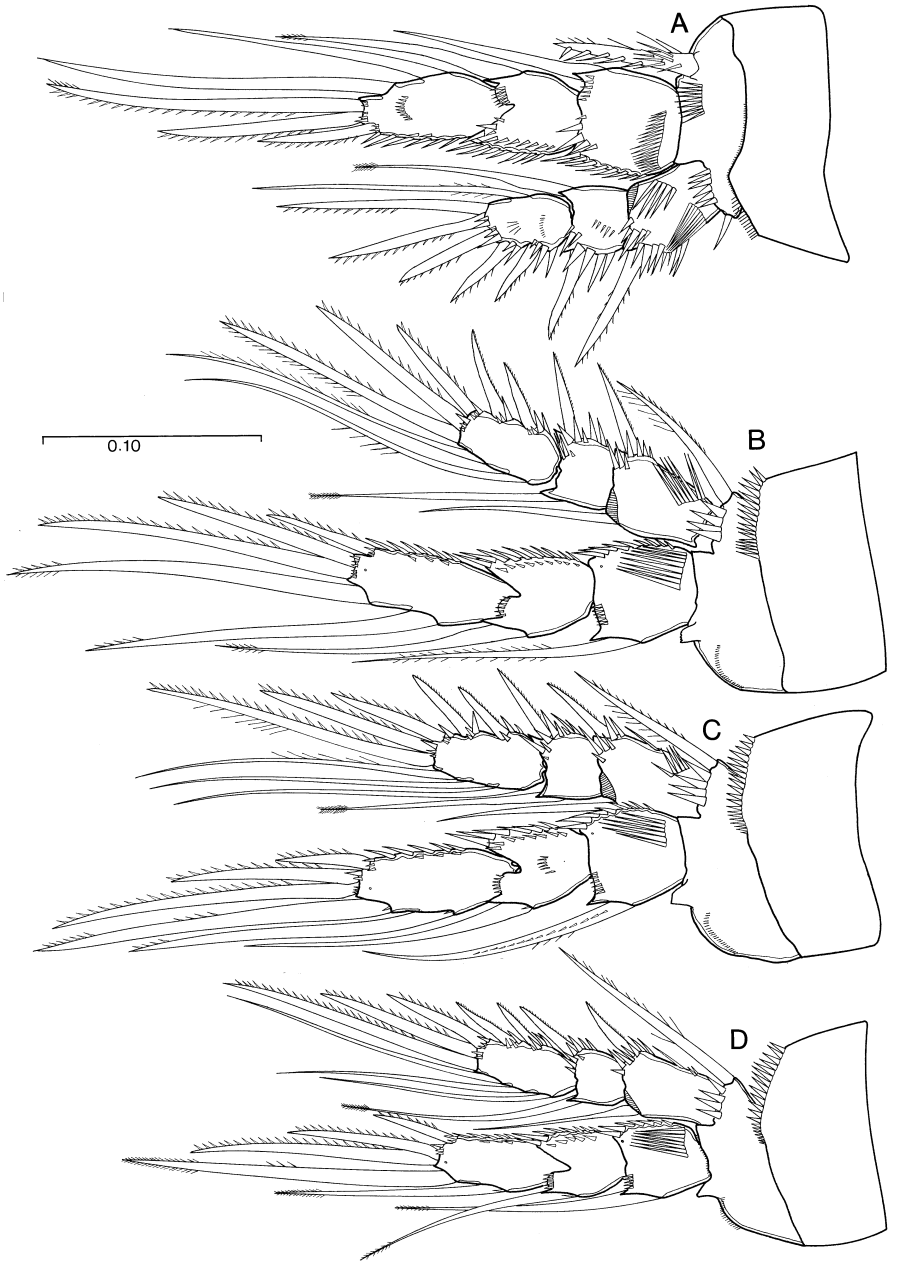

Figure 8. *Halectinosoma chrystalli* (T. Scott, 1894). Female (S20): A, P1; B, P2; C, P3; D, P4.

description and can only be ascribed to *H. chrystalli*. The description of *H. chrystalli* (T. Scott, 1894) precedes that of *H. propinquum* (T. & A. Scott, 1894) in the same volume of the same journal, and so the former name takes priority.

Much emphasis in the past was placed on the morphology of the P5, to the neglect of other features, for distinguishing species of *Halectinosoma*. This had possibly led T. and A. Scott to consider *H. propinquum* distinct from *H.*

chrystalli on the wrong assumption that the P5 surface-seta was absent in the latter species. None of the previous records of *H. propinquum* is sufficiently reliable to be firmly ascribed to *H. chrystalli*. This is particularly true for Sars' (1904) description, as we later discovered that his material labelled *H. propinquum* contained specimens of two different taxa, *H. angulifrons* (Sars) and *H. crenulatum* sp. nov. Bodin (1964) has ascribed some male and female specimens to *H. propinquum* but his account is brief and cannot be verified with certainty. Because of the confusion surrounding the taxonomy of *H. chrystalli*, the material examined in this study represents the only verifiable records.

H. chrystalli is most closely related to *H. neglectum* (Sars) and *H. ornatum* Lang. *H. chrystalli* is significantly smaller than *H. neglectum* and can also be distinguished by the setal length and spinulation of the P5, the presence of fine hairs on the margin of the pseudoperculum, and the much shorter outer seta of the male P6. The morphological differences between *H. chrystalli* and *H. ornatum* are more subtle. The P5 exopod of *H. chrystalli* has a more pronounced V-shaped incision between the middle and outer lobe than *H. ornatum*. There are also differences in the relative length of the terminal setae of the P5 between these two species. The innermost seta of the P5 exopod reaches just beyond the outer seta of the baseoendopod in *H. chrystalli* but not in *H. ornatum*. *H. chrystalli* has also a less prominent pseudoperculum, which is characteristically fringed with minute hairs, and the seta at the inner distal corner of the caudal ramus is significantly longer than in *H. ornatum*. An examination of a syntype of *H. ornatum* from Lang's collection confirmed these differences. As far as we know, *H. ornatum* has been recorded only from the Californian coast. *H. chrystalli* is a relatively common species around the British Isles but appears to be widely distributed, having been found in the Gullmarfjord and the eastern coast of Canada.

Halectinosoma proximum (Sars, 1919)

Ectinosoma proximum Sars, 1919

Material examined

Scotland: S80 (1 ♀).

Natural History Museum, London: 1 ♀ from the Norman collection, in tube 42843-847 (as *Ectinosoma propinquum*) from East Finnmark, Norway.

Description of female

The following description is based on the female collected at S80.

Length: habitus, 810 μm; sum of all somites 990 μm; cephalothorax 290 μm; genital double somite 140 μm. Habitus fusiform (Fig. 9A). Colour of preserved specimen brown. Surface of cuticle covered with small perforations. Cephalothorax slightly longer than its basal width (ratio length/width = 1.1) and rapidly tapering anteriorly. Rostrum well developed, partially fused at base, and furnished with two sensilla subapically. Labrum as in *H. pseudosarsi*. Genital double somite subdivided by a transverse chitinous stripe mid-ventrally. Pseudoperculum semi-circular in shape.

Caudal ramus (Fig. 9B, C). Distinctly longer than broad (ratio of

length/width = 1.5). Principal setation and form as in *H. pseudosarsi* except seta at inner distal corner shorter than length of ramus, acuminate lappets relatively shorter, and surface of ramus covered with rows of fine spinules ventrally and dorsally.

Somitic ornamentation (Fig. 9A–C). Body somites covered with sensilla and pores as in *H. pseudosarsi*. Posterior edge of cephalothoracic somites denticulate except for fourth free thoracic somite with a semi-incised subulate hyaline frill. All free thoracic somites dorsally with six rows of fine spinules. Genital double somite with complex surface ornamentation and a semi-incised subulate hyaline frill. Fourth urosomite with four continuous rows of fine spinules (one inconspicuous and not shown in Fig. 9) and a semi-incised subulate hyaline frill. Penultimate somite with two continuous and one ventral row (inconspicuous and not shown in Fig. 9B) of fine spinules, and a fully-incised subulate hyaline frill interrupted dorsally by a bare pseudoperculum. Anal somite dorsally with two rows of fine spinules.

Antennule (Fig. 10A). 6-segmented. Principal setation and form as in *H. pseudosarsi*, apart from one seta on segment 2, which is spinulose along anterior margin and the posterio-distal seta on segment 5 is thick and strongly spinulose.

Antenna (Fig. 10B). Principal setation and form as in *H. pseudosarsi*.

Mandible (Fig. 10C). Differs from *H. pseudosarsi* only by the degree of spinulation. Inner edge of endopodite without spinules. Quadridentate *lacinia* with two finer teeth adjacent to unidentate *pars incisiva*.

Maxillula (Fig. 10D). As in *H. pseudosarsi*.

Maxilla (Fig. 10E). As in *H. pseudosarsi* except basis short and with rounded lateral margins.

Maxilliped (Fig. 10F). As in *H. pseudosarsi*, apart from proximal seta of endopodite, which is thick and coarsely spinulose.

P1–P4 (Fig. 11A–D). Setation as in *H. pseudosarsi*. Segments of exopod and endopod elongated and coarsely spinulose along outer margin. Coxa of P1–P4 with a short row of spinules near proximal outer corner on posterior surface. Subtriangular expansion at inner distal edge of basis small. Setae on exopod P3–P4 relatively longer and more slender than in *H. pseudosarsi*. Otherwise as in *H. pseudosarsi*.

P5 (Fig. 9D). Exopod confluent with baseoendopod on anterior surface only. Inner expansion of baseoendopod reaching to middle of exopod, spinulose along distal half of inner margin and armed distally with two setae; inner seta strongly spinulose and reaching below innermost seta of exopod, inner seta extending well beyond outer seta. Exopod about 1.5 times longer than broad, with distal margin formed by three distinct lobes, each accompanied by spinules and armed with a bipinnate setiform seta; middle and outer lobes separated by a characteristic incision extending beyond middle of exopod. Inner edge of exopod with spinules. Surface-seta issuing from small lobe just opposite exopod-baseoendopod suture and accompanied by a row of spinules.

Male. Unknown.

Remarks

H. proximum shares many morphological features with *H. neglectum* and *H. chrystalli* but can be easily distinguished by the presence of a much deeper

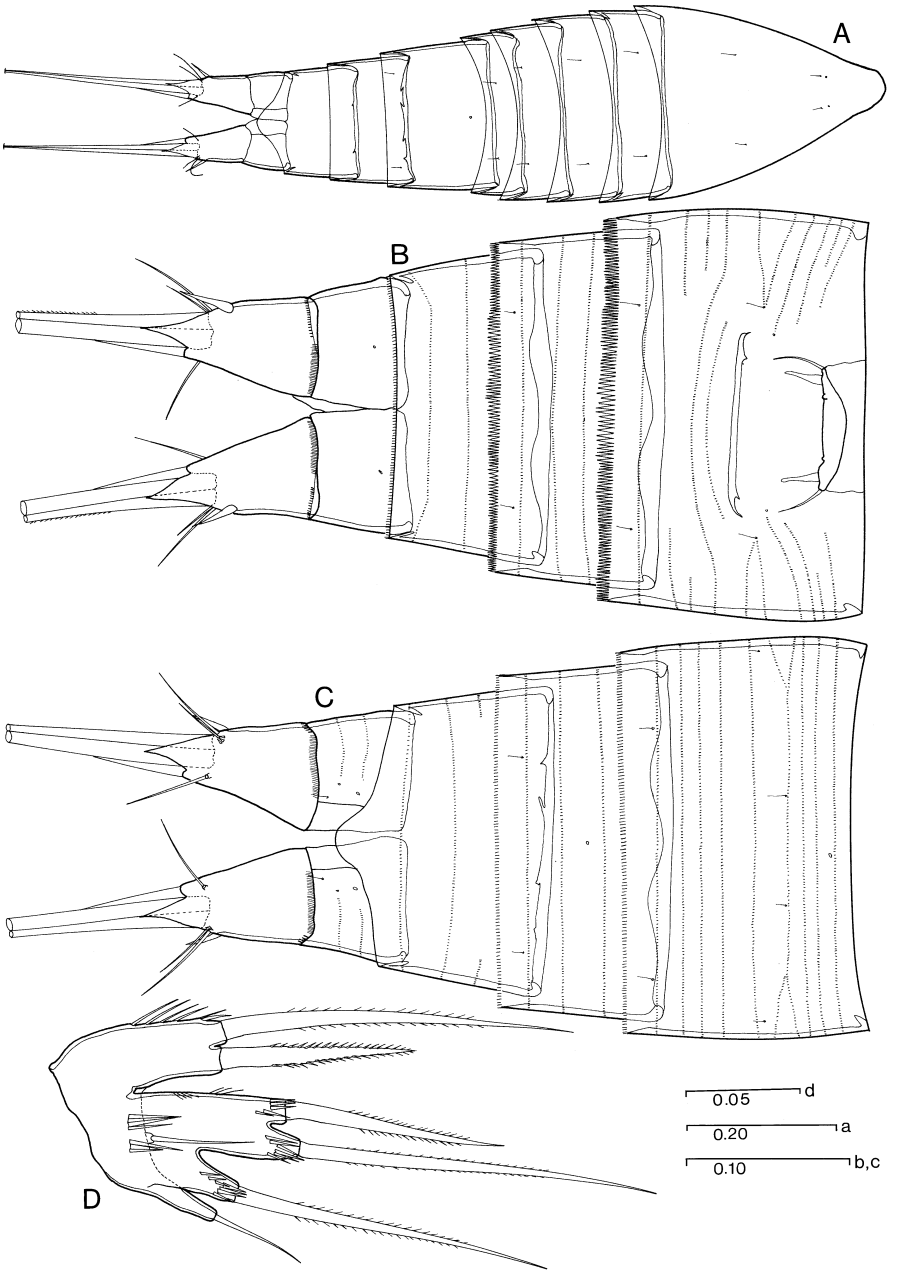

Figure 9. *Halectinosoma proximum* (Sars, 1919). Female (S80): A, Habitus, dorsal; B, Urosomites 2–6, ventral; C, Urosomites 2–6, dorsal; D, P5.

and broader incision separating the middle lobe from the outer lobe of the P5 exopod. This incision reaches to within the proximal half of the inner margin of the P5 exopod in *H. proximum*, whereas it only reaches within the distal half of the inner margin of the exopod in the other *Halectinosoma* species described in this study. *H. proximum* is also significantly smaller than *H. neglectum* and does not have transverse rows of fine spinules on the

Figure 10. *Halectinosoma proximum* (Sars, 1919). Female (S80). A, Antennule; B, Antenna; C, Mandible; D, Maxillula; E, Maxilla; F, Maxilliped.

surface of the P5 exopod. Other features of the P5 distinguishing *H. proximum* from *H. chrystalli* are the shape and the relative length of the innermost and outermost setae of the exopod. These setae are setiform in *H. proximum*, with the outermost seta being much longer than the innermost one. In contrast, these setae are spiniform and of subequal length in *H. chrystalli.*

The specimens that we have examined from Sars' collection labelled *H.*

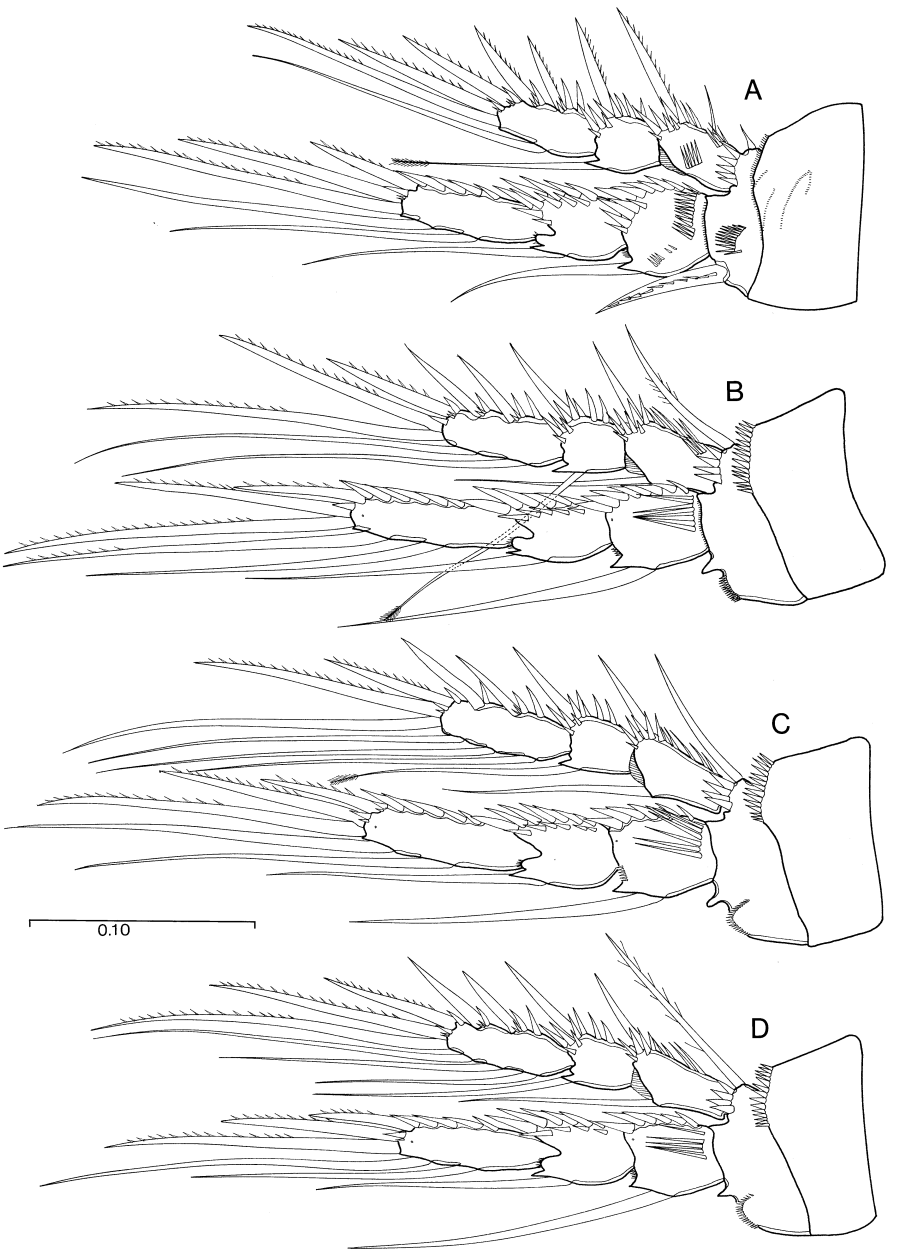

Figure 11. *Halectinosoma proximum* (Sars, 1919). Female (S80). A, P1; B, P2; C, P3; D, P4.

proximum belonged to three different species, none of which could be ascribed to the original description given by Sars (1919). Although we have been unable to examine the type specimens of *H. proximum*, which have probably been lost to science, there is little doubt that the material we describe here is ascribable to this species, particularly in view of the agreement in the structure of the distinctive fifth legs. Sars found this species at Bejan, outside the Trondhjem fjord, and at Risør in depths ranging from 37 to 91 m. Lang

(1936) also recorded it from the Oresund. Earlier records by Pesta (1927) and Monard (1935) are dubious.

Halectinosoma angulifrons (Sars, 1919)

Ectinosoma angulifrons Sars, 1919

Material examined

Zoology Museum, Oslo: 1 ♀ lectotype dissected on slide F12673, Risør, Norway; 6 ♀♀, 1 ♂ paralectotypes in tube F12672; 24 ♀♀ in tube F20033 (as *H. propinquum*), Norway; 2 ♀♀ in tube F20040 (as *Ectinosoma proximum*), Risør, Norway.

Scotland: S6 (60 ♀♀); S8 (3 ♀♀); S19 (21 ♀♀); S20 (7 ♀♀); S67 (17 ♀♀, 3 ♂♂); S68 (2 ♀♀); S70 (8 ♀♀); S72 (1 ♀); S74 (5 ♀♀); S76 (1 ♀); S81 (1 ♀).

England: S52 (4 ♀♀); S58 (2 ♀♀); S59 (19 ♀♀); S61 (1 ♀); S62 (6 ♀♀); S63 (2 ♀♀); S86 (1 ♀).

Isle of Man: S31 (1 ♀); S32 (6 ♀♀); S33 (2 ♀♀); S39 (1 ♀); S46 (1 ♀).

Shetland: S66 (1 ♀).

France: S65 (2 ♀♀).

Description of female

Length: habitus 620–810 μm; sum of all somites 830–870 μm; cephalothorax 250–270 μm; genital double somite 95–110 μm. Habitus fusiform (Fig. 12A). Colour of preserved specimen yellowish brown. Surface of cuticle covered with fine perforations. Cephalothorax distinctly longer than its basal width (ratio length/width = 1.4). Rostrum well developed (Fig. 12B), partly fused at base, and with two subapical sensilla. Genital double somite with chitinous patches dorsally and a transverse chitinous stripe ventrally. Pseudoperculum distinctly broad.

Caudal ramus (Fig. 12C). Slightly shorter than broad (ratio length/width 0.9). Surface of ramus and acuminate lappet covered with rows of minute spinules (not illustrated). Otherwise as in *H. pseudosarsi*.

Somitic ornamentation (Fig. 12A, D, E). Body somites covered with sensilla and pores as in *H. pseudosarsi*. Cephalothorax with subcuticular patches of chitin near denticulate posterior edge. First and second free thoracic somites with five rows of minute spinules and a denticulate posterior edge. Third and fourth free thoracic somites with a semi-incised subulate hyaline frill and four rows of fine spinules. Urosomites with rows of fine spinules as shown in Fig. 12D, E. Genital double somite with a semi-incised subulate hyaline frill which is much coarser mid-ventrally. Fourth urosomite also with a semi-incised subulate hyaline frill but finer than in preceding somite. Penultimate somite with a fine fully-incised subulate hyaline frill interrupted dorsally by an unadorned pseudoperculum. Anal somite ventrally with a short row of spinules at outer distal margin.

Antennule (Fig. 13A). 6-segmented. Principal setation and form as in *H. pseudosarsi*. Differs from *H. pseudosarsi* by having a few finely spinulose setae.

Antenna. (Fig. 13B) As in *H. pseudosarsi*.

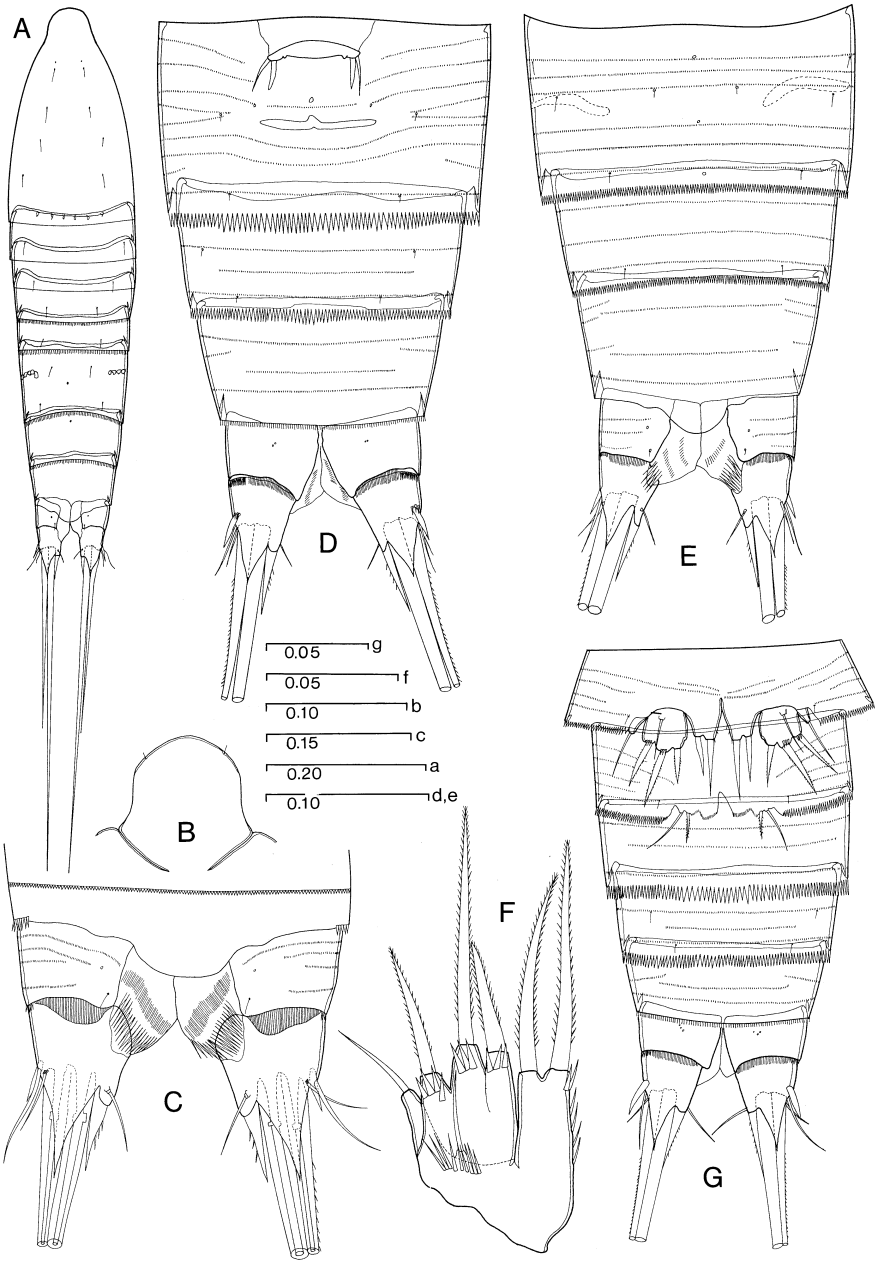

Figure 12. *Halectinosoma angulifrons* (Sars, 1919). Female (S6): A, Habitus, dorsal; B, Rostrum, dorsal; C, Pseudoperculum, anal somite and caudal ramus, dorsal; D, Urosomites 2–6, ventral; E, Urosomites 2–6, dorsal; F, P5. Male (S70): G, Urosome, ventral.

Mandible (Fig. 13C). As in *H. pseudosarsi* except coxal gnathobase armed with one seta at base of unidentate *pars incisiva* and tridentate *lacinia*.

Maxillula (Fig. 13D). As in *H. pseudosarsi* except unguiform setae short and thick.

Maxilla (Fig. 13E). As in *H. pseudosarsi* except basis broader.

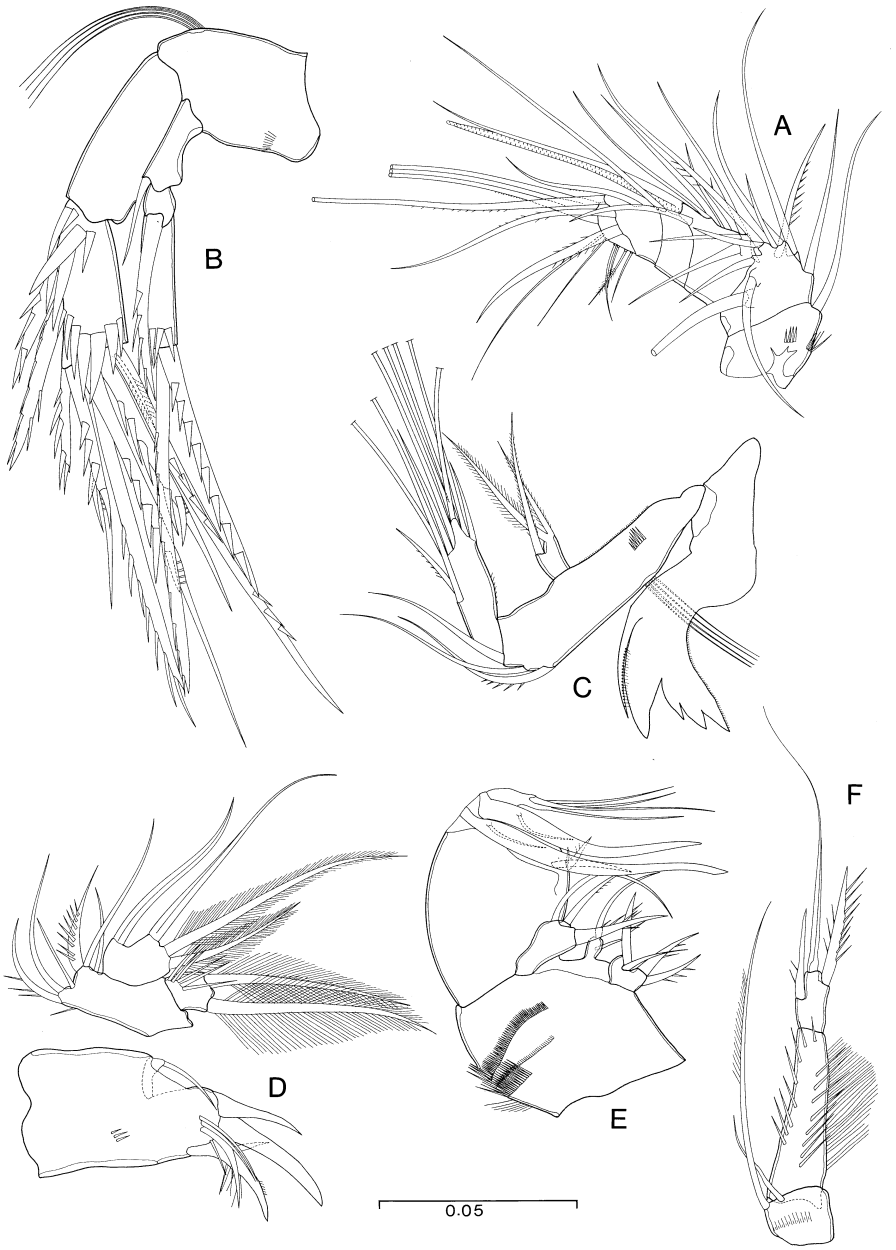

Figure 13. *Halectinosoma angulifrons* (Sars, 1919). Female (S6): A, Antennule; B, Antenna; C, Mandible; D, Maxillula; E, Maxilla; F, Maxilliped.

Maxilliped (Fig. 13F). As in *H. pseudosarsi.*

P1–P4 (Fig. 14A–D). As in *H. pseudosarsi* apart from the following features. Coxa of P2–P4 with a row of spinules along inner distal edge. Segments and setae more elongated and overall spinulation of legs coarser than in *H. pseudosarsi.* Inner setae of distal segment of exopod of leg 2 distinctly slender.

P5 (Fig. 12F). Exopod confluent with baseoendopod on anterior surface

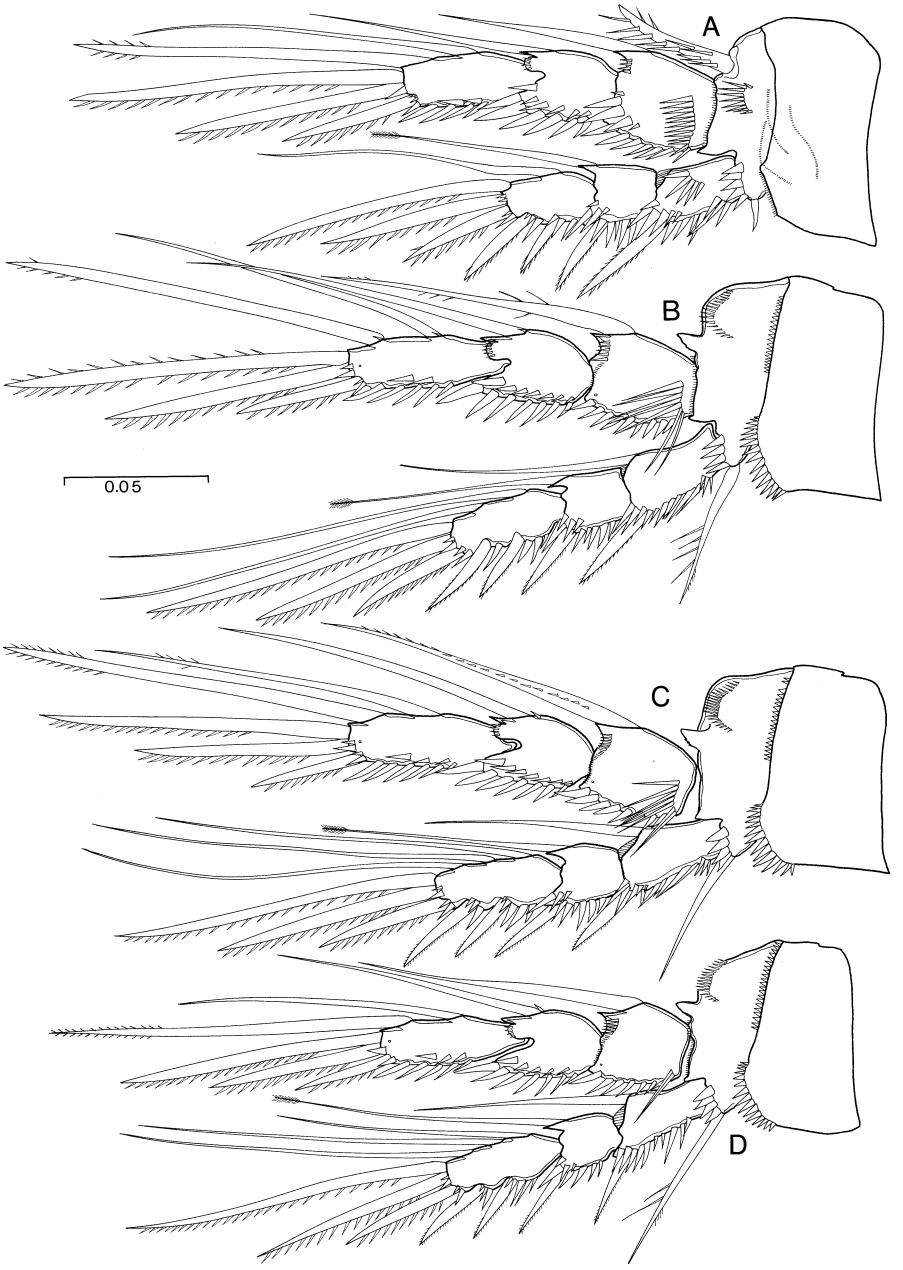

Figure 14. *Halectinosoma angulifrons* (Sars, 1919). Female (S6). A, P1; B, P2; C, P3; D, P4.

only. Inner expansion of baseoendopod reaching to about 3/4 of inner margin of exopod and armed with two subequal spinulose setae, the outer seta reaching well beyond innermost seta of exopod. Inner margin of baseoendopod with a few long spinules; outer expansion armed with a slender seta. Exopod with three distal lobes each accompanied by few spinules and armed with a bipinnate seta: inner seta spiniform and half the

length of middle seta; outermost seta slightly longer than innermost seta. Surface-seta issuing from a small lobe accompanied by a row of 9–10 spinules and located opposite exopod-baseoendopod suture.

Variability

No differences were observed between specimens examined.

Description of male

Habitus length 420–430 μm ($n = 2$); sum of all somites 525–550 μm; length of cephalothorax 170 μm. Second and third urosomites distinct and ornamented as in Fig. 12G. Otherwise as in female apart from the following features.

Antennule. 7-segmented. Principal setation and form as in male of *H. neglectum.*

P5 (Fig 12G). Baseoendopod confluent with somite; inner expansion with a few spinules on inner margin and armed distally with two spiniform setae, outer expansion furnished with a slender seta. Exopod demarcated from baseoendopod by a suture and distally with three spiniform setae; innermost seta issuing from an unadorned lobule and reaching beyond outer seta of baseoendopod. Surface-seta issuing from exopod.

P6 (Fig. 12G). A plate with two setae issuing from outer distal corner. Inner distal margin of plate finely denticulate.

Remarks

Sars (1919) mentioned in his description the angular shape of the rostrum as a distinctive feature and named the species accordingly. A reexamination of his material from the type locality has shown that this is an aberrant feature not shared by all the specimens examined. We have often observed, in this and in other *Halectinosoma* species, that the rostrum could take many shapes as a result of infolding. It is not known whether such folds are present in living animals or are simply created during fixation of the specimens. Thus it is now believed that many authors failed to identify this species correctly in the past. While *H. angulifrons* resembles *H. neglectum*, it can be recognized by some distinctive features: a caudal ramus which is shorter than broad, the absence of transverse rows of spinules on the P5 exopod, a three-toothed *lacinia*, a much smaller habitus size, a broadly-shaped pseudoperculum, and the presence of spinules along the inner distal margin of the coxa of P2–P4. *H. angulifrons* is a common species around the British Isles and has been found with *H. neglectum* in a sample from the Isle of Mull. Records of this species by Monard (1935) and Pesta (1927) must be considered as uncertain.

***Halectinosoma argyllensis* sp. nov.**

Material examined

Type material (S70, Scotland): ♀ holotype dissected on slides, NHM # 1990.341; 21 ♀♀ paratypes (18 ♀♀ in tubes, NHM # 1990.677-686, 3 ♀♀ dissected on slides, NHM # 1990.342-4); 3 ♂♂ paratypes (2 ♂♂ in tubes, NHM # 1990.687-688, 1 ♂ dissected on slides, NHM # 1990.345).

Scotland: S6 (2 ♀♀); S18 (27 ♀♀, 1 ♂); S20 (11 ♀♀); S21 (2 ♀♀); S71 (1 ♀, 1 ♂); S73 (11 ♀♀); S74 (3 ♀♀).

Isle of Man: S37 (1 ♀); S38 (95 ♀♀); S39 (5 ♀♀); S45 (1 ♀); S46 (1 ♀); S47 (7 ♀♀).

England: S63 (1 ♀).

Description of female holotype

Length: habitus 550 μm; cephalothorax 195 μm; genital double somite 78 μm. Body shape fusiform (Fig. 15A), cuticle yellowish brown and with very fine perforations on its surface. Rostrum prominent (Fig. 15B), semi-circular anteriorly, partly fused at base and with two subapical sensilla. Cephalothorax slightly longer than its basal width. Genital double somite with a transverse chitinous stripe ventrally. Pseudoperculum narrowly tongue-shaped.

Caudal ramus (Fig. 15C, D). Slightly longer than broad (ratio length/width = 1.1). Seta at inner distal corner slightly longer than ramus. Surface of ramus densely covered with fine spinules (not illustrated). Base of ramus with a dense row of short spinules. Otherwise as in *H. pseudosarsi.*

Somitic ornamentation (Fig. 15A, C, D). Sensilla and pores positioned as in *H. pseudosarsi.* Cephalothorax dorsally with subcuticular patches of chitin near denticulate posterior edge. Free thoracic somites with posterior edge as in *H. pseudosarsi* and dorsally with five rows of fine spinules, except for last somite which has three. Urosomites with rows of fine spinules as in Fig. 15C, D. Genital double somite with a semi-incised subulate hyaline frill which is much stronger mid-ventrally; following urosomite with similar type of hyaline frill except much finer. Penultimate somite with a fine, fully-incised subulate hyaline frill interrupted dorsally by a pseudoperculum fringed with very fine hairs.

Antennule (Fig. 16A). 6-segmented, short and robust. Principal setation as in *H. pseudosarsi* except one seta at antero-distal corner of second segment is finely spinulose along anterior edge. Penultimate segment with seta nearest to posterior edge finely spinulose.

Antenna (Fig. 16B). As in *H. pseudosarsi.*

Mandible (Fig. 16C). Coxal gnathobase armed with one seta adjacent to unidentate *pars incisiva* and a quadridentate *lacinia.* Endopodite without spinulation. Otherwise as in *H. pseudosarsi.*

Maxillula (Fig. 16D). As in *H. pseudosarsi* except unguiform setae shorter.

Maxilla (Fig. 16E). As in *H. pseudosarsi* except basis much shorter and broader at base.

Maxilliped (Fig. 16F). As in *H. pseudosarsi* except outermost seta of endopod coarsely spinulose.

P1–P4 (Fig. 17A–D). Principal setation as in *H. pseudosarsi.* Coxa of P2–P4 with a row of very fine spinules at inner edge with basis. Setae and segments somewhat more slender than in *H. pseudosarsi.* Otherwise as in *H. pseudosarsi.*

P5 (Fig. 15E). Exopod confluent with baseoendopod on anterior surface only. Inner expansion of baseoendopod reaching to 2/3 of exopod and armed with two finely spinulose setae: outer seta about 2/3 the length of inner seta and extending beyond innermost seta of exopod. Inner margin of baseoendopod with spinules. Exopod with three distal lobes, each accompanied

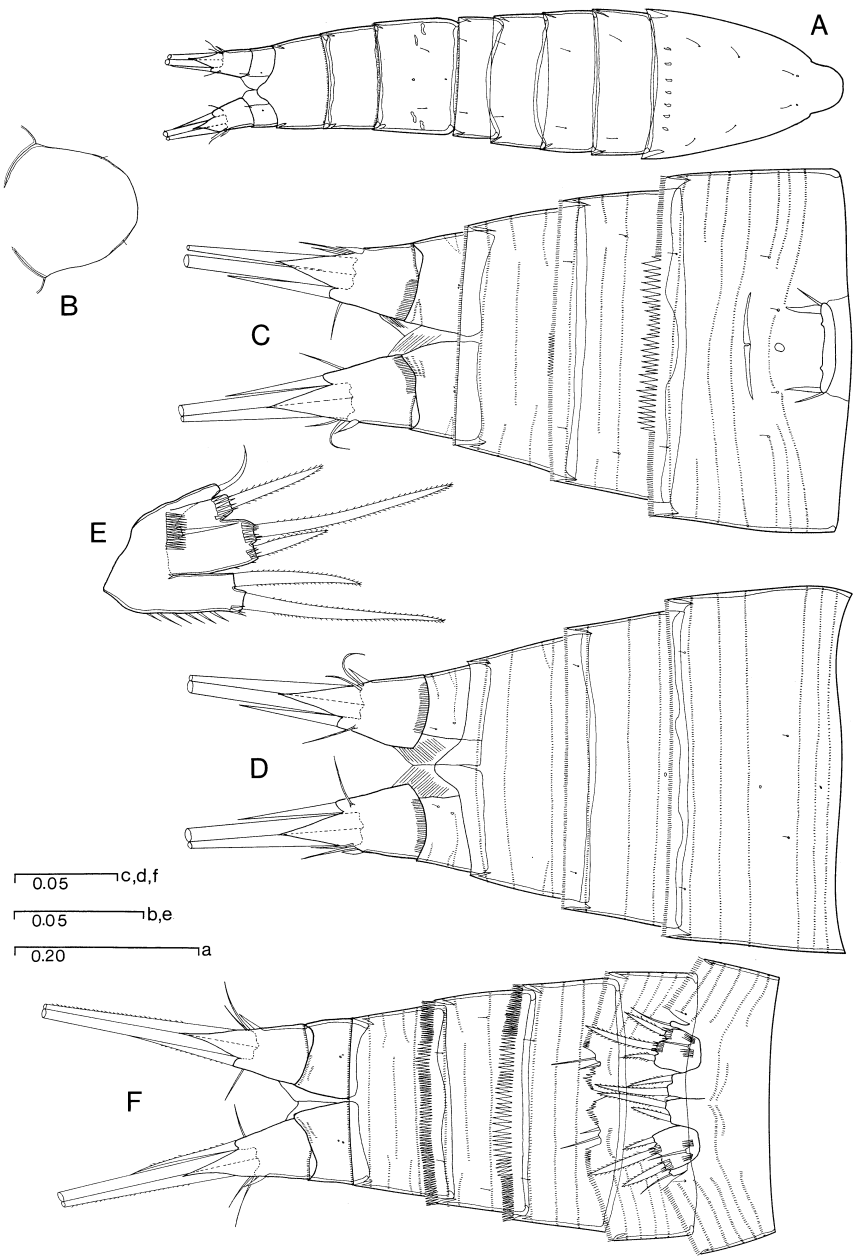

Figure 15. ***Halectinosoma argyllensis*** **sp. nov**. Female paratype (S70): A, Habitus, dorsal. B, Rostrum, dorsal. Female holotype (S70): C, Urosomites 2–6, ventral; D, Urosomites 2–6, dorsal; E, P5. Male paratype (S20): F. Urosome, ventral.

by spinules and armed with a spinulose seta: innermost seta spiniform; middle seta 2.5 times longer than inner seta and 2.0 times longer than outermost seta. Surface-seta issuing from a small lobe accompanied by a dense row of spinules slightly distal to the exopod-baseoendopod suture seen on opposite surface.

Figure 16. ***Halectinosoma argyllensis* sp. nov**. Female paratype (S70): A, Antennule; B, Antenna; D, Maxillula; E, Maxilla; F, Maxilliped. Female holotype: C, Mandible.

Description of male paratype

Length: habitus 459 μm; sum of all somites 535 μm; cephalothorax 170 μm. Second and third urosomites distinct and with fine rows of spinules (Fig. 15F). Otherwise as in female apart from the following features.

Antennule. 7-segmented. Principal setation and form as in male of *H. neglectum.*

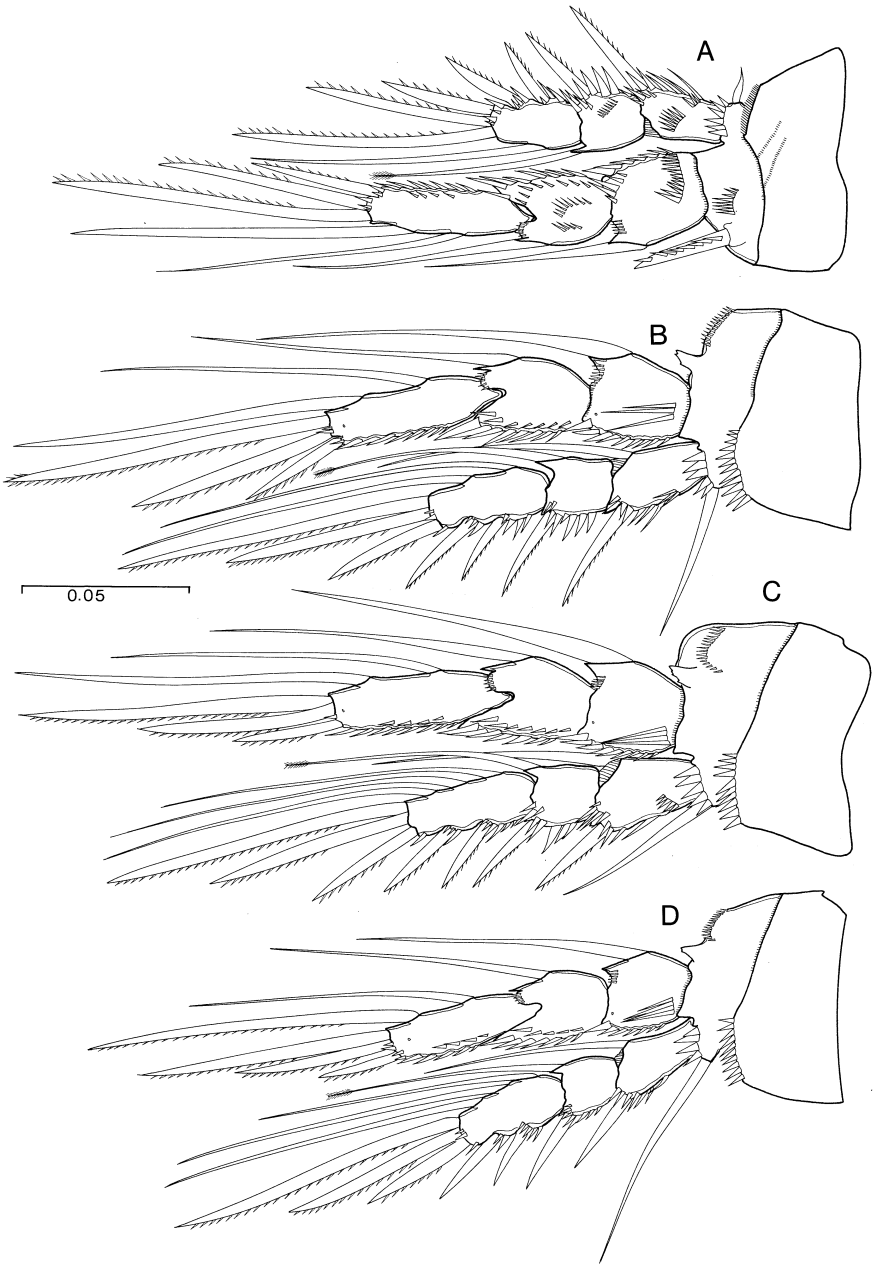

Figure 17. ***Halectinosoma argyllensis*** **sp. nov**. Female holotype: A, P1; B, P2; C, P3; D, P4.

P5 (Fig. 15F). Baseoendopod confluent with somite and armed with two distal setae, the inner seta twice as long as outer one. Exopod with three distal setae, the middle seta 2.5 times longer than inner seta. Innermost lobe of exopod without spinules. Surface-seta issuing near base of exopod and accompanied by a row of fine spinules.

P6 (Fig. 15F). A plate with two unequal setae at outer distal corner and a denticulate inner distal edge.

Variability

Length of female specimens examined varied as follow: habitus 485–620 μm; sum of all somites 610–665 μm; cephalothorax 190–200 μm; genital double somite 70–80 μm. The following measurements were taken from a male specimen from S18: habitus 470 μm, sum of all somites 555 μm, cephalothorax 170 μm. Patches of chitin on the dorsal surface of the genital double somite were present in many specimens examined.

Remarks

The absence of scale-like spinules on the urosome and the overall morphology of the P5 relate *H. argyllensis* to a group of species which includes *H. angulifrons, H. neglectum, H. chrystalli* and *H. ornatum.* However, *H. argyllensis* is easily distinguished from these species by its much smaller size, its quadratic caudal ramus and ornamentation of the urosomites. *H. argyllensis* also possesses a pseudoperculum which is narrowly shaped and is very distinct from the broadly shaped pseudoperculum of *H. angulifrons.* Another feature which distinguishes this species from *H. angulifrons* is the shape of the mandibular gnathobase. We believe that these differences are sufficient to consider *H. argyllensis* as a distinct species. Furthermore, *H. argyllensis* has often been found at the same site as *H. neglectum* and *H. angulifrons*, and is also sympatric with *H. chrystalli. H. argyllensis* is not uncommon around the British Isles.

Halectinosoma brunneum (Brady, 1905)

Ectinosoma brunnea Brady, 1905
Ectinosoma brunneum (Brady, 1905) *sensu* Lang (1948)

Material examined

Natural History Museum, London: 2 ♀♀ designated 'type', dissected on slides NHM # 1951.8.10.506-507, collected in a salt-water pond near Amble, England. From Norman collection, Tobermory, Scotland, July 1866: 1 ♀ whole mounted with 9 ♀ *H. neglectum* (all as *Ectinosoma spinipes*), NHM # 1900-3-6-640; 1 ♀ whole mounted with 13 ♀ *H. neglectum* (all as *E. spinipes*), NHM # M.2261; 1 ♀ whole mounted with 60 ♀ *H. neglectum* (all as *E. spinipes*), NHM # M.2262.

Scotland: S18 (14 ♀♀); S70 (1 ♀); S72 (4 ♀♀, 1 ♂); S73 (9 ♀♀, 3 ♂).

England: 1 ♀ collected among *Corallina* by R. Hamond, West Runton.

Description of female

Length: habitus 760–890 μm; sum of all somites 875–940 μm; cephalothorax 270–285 μm; genital double somite 100–115 μm. Habitus fusiform (Fig. 18A). Cuticle of preserved specimen of a yellowish brown colour and with small perforations on its surface. Cephalothorax about 1.3 times longer than its basal width and tapering anteriorly. Rostrum well developed and tongue-shaped (Fig. 18B), partly fused at base with cephalothorax and furnished with two subapical sensilla. Genital double somite subdivided by a transverse chitinous stripe ventrally. Pseudoperculum well-developed and tongue-shaped (Fig 30E).

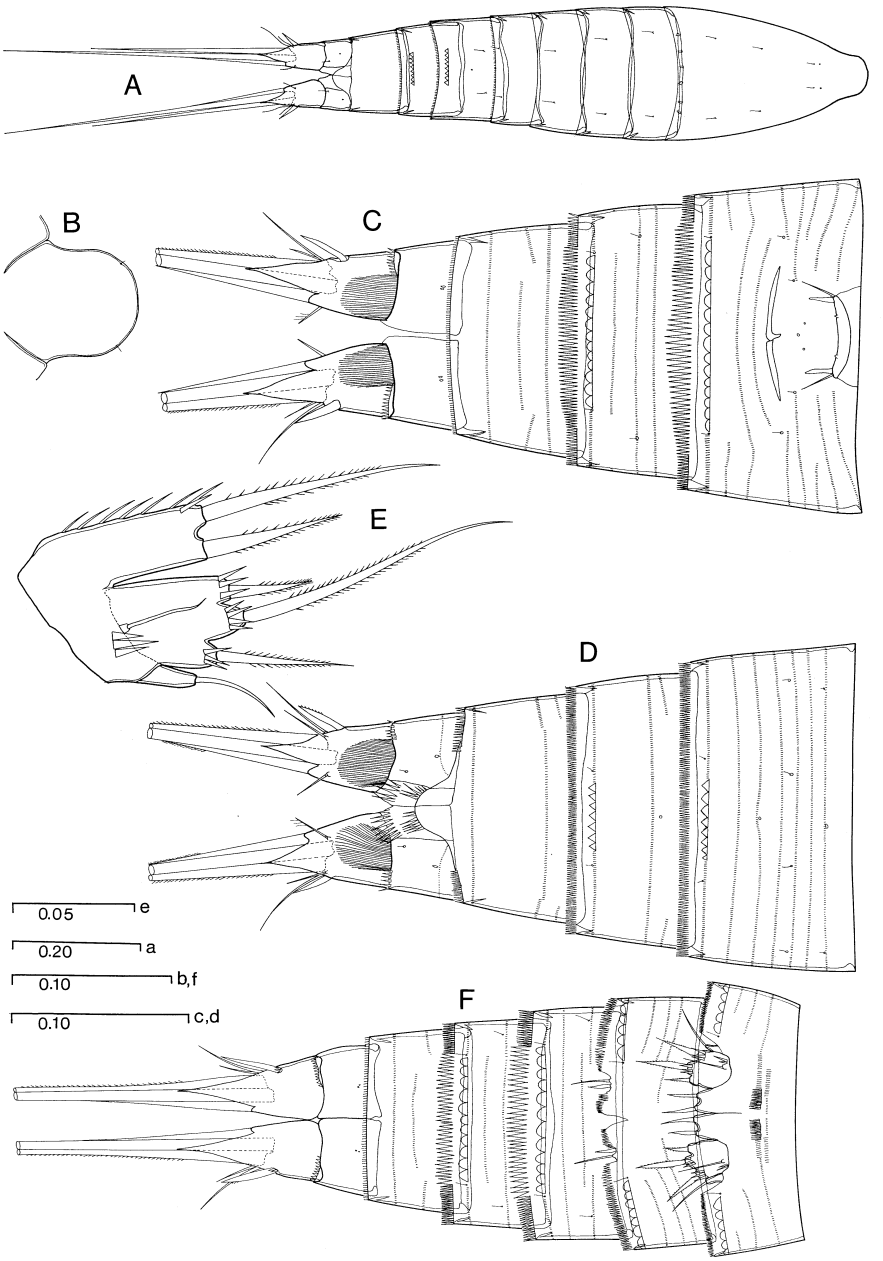

Figure 18. *Halectinosoma brunneum* (Brady, 1905). Female (S72): A, Habitus, dorsal; B, Rostrum, dorsal; C, Urosomites 2–6, ventral; D, Urosomites 2–6, dorsal; E, P5. Male (S72): F, Urosome, ventral.

Caudal ramus (Fig. 18C, D). Slightly longer than broad (ratio length/width = 1.1). Setation as in *H. pseudosarsi* except seta at inner distal corner twice as long as ramus. Surface of ramus and acuminate lappet covered with scale-like spinules. A dense row of long spinules present at base of ramus dorsally and ventrally (Fig. 30E).

Somitic ornamentation (Fig. 18A, C, D). Body somites covered with sensilla and pores as in *H. pseudosarsi*. Cephalothorax with subcuticular patches of chitin near denticulate posterior edge. First and second free thoracic somites with denticulate posterior edge and dorsally with four rows of fine spinules. Third and fourth free thoracic somites dorsally with four and two rows of fine spinules respectively and a semi-incised subulate hyaline frill. Urosome with rows of fine spinules as shown in Fig. 18C, D. Genital double somite and following somite with posterior spinular row modified into a row of rounded scales mid-ventrally (Fig. 30F) and triangular scales mid-dorsally, with about half as many scales present dorsally; hyaline frill semi-incised subulate except ventro-laterally where it becomes fully-incised. Penultimate somite with a fully incised subulate hyaline frill which is interrupted dorsally by an unadorned pseudoperculum. Inner surface of anal somite modified into overlapping rows of spinuliform lappets (Fig. 30E).

Antennule (Fig. 19A). 6-segmented. Principal setation and form as in *H. pseudosarsi*. Two setae on second segment are spinulose along anterior side. Penultimate somite with a thick spinulose seta.

Antenna (Fig. 19B). As in *H. pseudosarsi*.

Mandible (Fig. 19C). Coxal gnathobase with one seta adjacent to unidentate *pars incisiva*. *Lacinia* quadridentate but with the second innermost tooth much reduced. Otherwise as in *H. pseudosarsi*.

Maxillula (Fig. 19D), *maxilla* (Fig. 19E) and *maxilliped* (Fig. 19F) as in *H. pseudosarsi*.

P1–P4 (Fig. 20A–D). Principal setation and form of P1–P4 as in *H. pseudosarsi*. Coxa of P2–P4 with a row of spinules along distal inner edge. Basis of P2–P4 with two subtriangular expansions at inner distal edge. Otherwise as in *H. pseudosarsi*.

P5 (Fig. 18E). About as long as wide. Exopod confluent with baseoendopod on anterior surface only and slightly longer than wide. Inner expansion of baseoendopod almost reaching to tip of innermost lobe of exopod and armed with two spinulose setae: the inner seta is slightly less than twice the length of outer seta, which extends well beyond innermost seta of exopod. Inner margin of baseoendopod spinulose and outer expansion armed with a slender seta. Exopod with three distal lobes, each accompanied by few spinules and armed with a spinulose seta: innermost seta short and spiniform, middle seta almost four times as long as inner seta, outer seta about 1.5 times longer than inner seta. Surface-seta issuing from a small lobe situated opposite exopod-baseoendopod suture and accompanied by a row of 3–5 spinules.

Description of male

Length ($n = 2$): habitus 700 μm; sum of all somites 725–735 μm; length of cephalothorax 220–225 μm. Second and third urosomites distinct. Otherwise as in female apart from the following features.

Somitic ornamentation (Fig. 18F). First two urosomites with a distal row of semi-circular scales interrupted mid-ventrally by P5 and P6 respectively.

Antennule. 7-segmented. Principal setation and form as in male of *H. neglectum*.

P5 (Fig. 18F). Baseoendopod confluent with somite; inner expansion furnished with two spiniform setae; outer expansion with a slender seta.

Figure 19. *Halectinosoma brunneum* (Brady, 1905). Female (S72): A, Antennule; B, Antenna; C, Mandible; D, Maxillula; E, Maxilla; F, Maxilliped.

Exopod with three distal spiniform setae. Surface-seta issuing from a lobule on exopod and accompanied by a few spinules.

P6 (Fig. 18F). A plate with two setae on distal corner and an inner denticulate fringe.

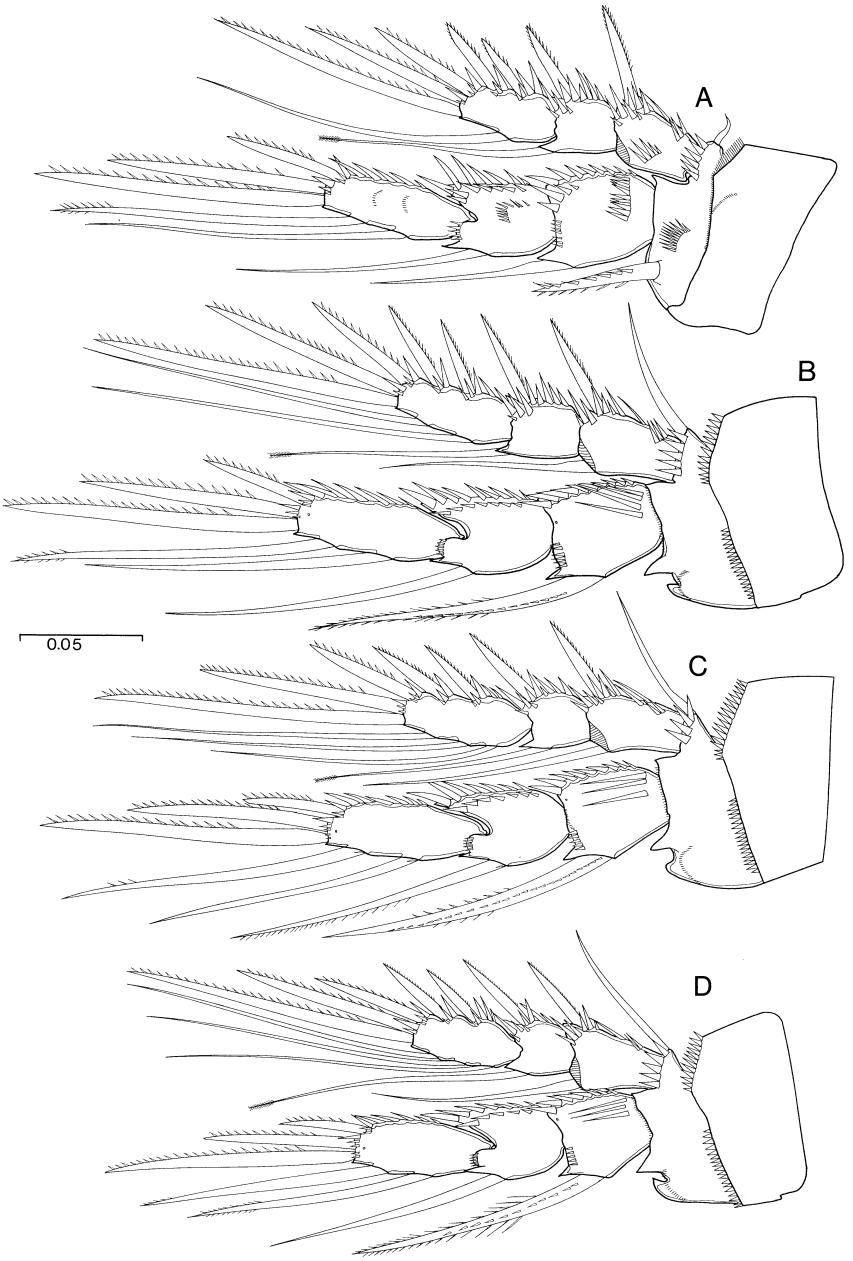

Figure 20. *Halectinosoma brunneum* (Brady, 1905). Female (S72): A, P1; B, P2; C, P3; D, P4.

Variability

The number of scales on the mid-ventral surface of the urosomites of the female varied from 15–20 on the genital double somite and from 12–14 on the following somite.

Remarks

The poor original description of *H. brunneum* given by Brady (1905) has added to the general confusion surrounding the group of species revised in

this study. A re-description based on material collected in the Firth of Forth and Brady's type specimens was necessary in order to clarify the status of this species. *H. brunneum* is very closely related to *H. perforatum* Itô but can be recognized by having a much shorter caudal ramus and a broader pseudoperculum. *H. perforatum* is also a larger species and has been recorded only from Japan. Previous records of *H. brunneum* are uncertain because none of the authors provided sufficient information to confirm the identity of their material. *H. brunneum* is a relatively rare species and has been found in only five localities around the British Isles.

Halectinosoma canaliculatum (Por, 1964)

Ectinosoma canaliculatum Por, 1964
Ectinosoma sarsi Boeck, 1872, *sensu* T. & A. Scott (1894)

Material examined

Israel: 1 ♀ syntype dissected on slide COP.7, Zoology Department of the Hebrew University, Jerusalem.

Museum of Natural History, Leiden: 2 ♀ syntypes lent by F. D. Por to W. Vervoort, collected at Stn 140, Nakhal Rubin, Mediterranean coast of Israel.

Scotland: S6 (1 ♀); S8 (1 ♀); S19 (42 ♀♀, 1 ♂); S20 (1 ♀); S22 (46 ♀♀); S69 (2 ♀♀); S70 (1 ♀); S72 (2 ♀♀); S75 (1 ♀).

England: S57 (3 ♀♀); S60 (3 ♀♀); S62 (1 ♀); S86 (2 ♀♀).

Isle of Man: S29 (1 ♀); S84 (6 ♀♀).

Natural History Museum, London: 1 ♀ whole mount on slide (as *Ectinosoma propinquum*), Belligally Bay, Antrim, 7 m, NHM # 1951.8.10.513; 14 ♀ whole mounts on slide (as *Ectinosoma spinipes* Brady), Whitby, England, 9 m, NHM # 1900.3-6.641.

National Museum of Ireland: C. E. O'Riordan collection–3 ♀♀ on slides, collected at station 9A-B, Seapoint, Dublin, 1–2.7 m depth in fine sand; 1 ♀ on slide, collected at Dunlaoghaire, 10.7 m depth in muddy sand with some shell debris. 5 ♀♀ in alcohol collected by G. S. Brady at Westport Bay, County Mayo, 1902.

Helgoland: 1 ♀ from the Klie collection of the Zoology Museum, Kiel, slide COP 272 (as *Ectinosoma sarsi*).

France: S88 (13 ♀♀, 3 ♂♂).

Description of female

Length: habitus, 810–1010 μm; sum of all somites 1055–1175 μm; cephalothorax 320–340 μm; genital double somite 125–150 μm. Habitus fusiform (Fig. 21A). Cuticle of preserved specimen yellowish brown and with small perforations on its surface. Cephalothorax distinctly longer than its basal width and rapidly tapering anteriorly. Rostrum prominent, slightly tapering at apex, partly fused at base and furnished with 2 subapical sensilla. Labrum as in *H. pseudosarsi*. Genital double somite subdivided ventrally by a chitinous stripe. Pseudoperculum well developed and tongue-shaped.

Caudal ramus (Fig. 21B, C). Slightly shorter than broad (ratio length/width = 0.9). Setation as in *H. pseudosarsi* except seta at inner distal

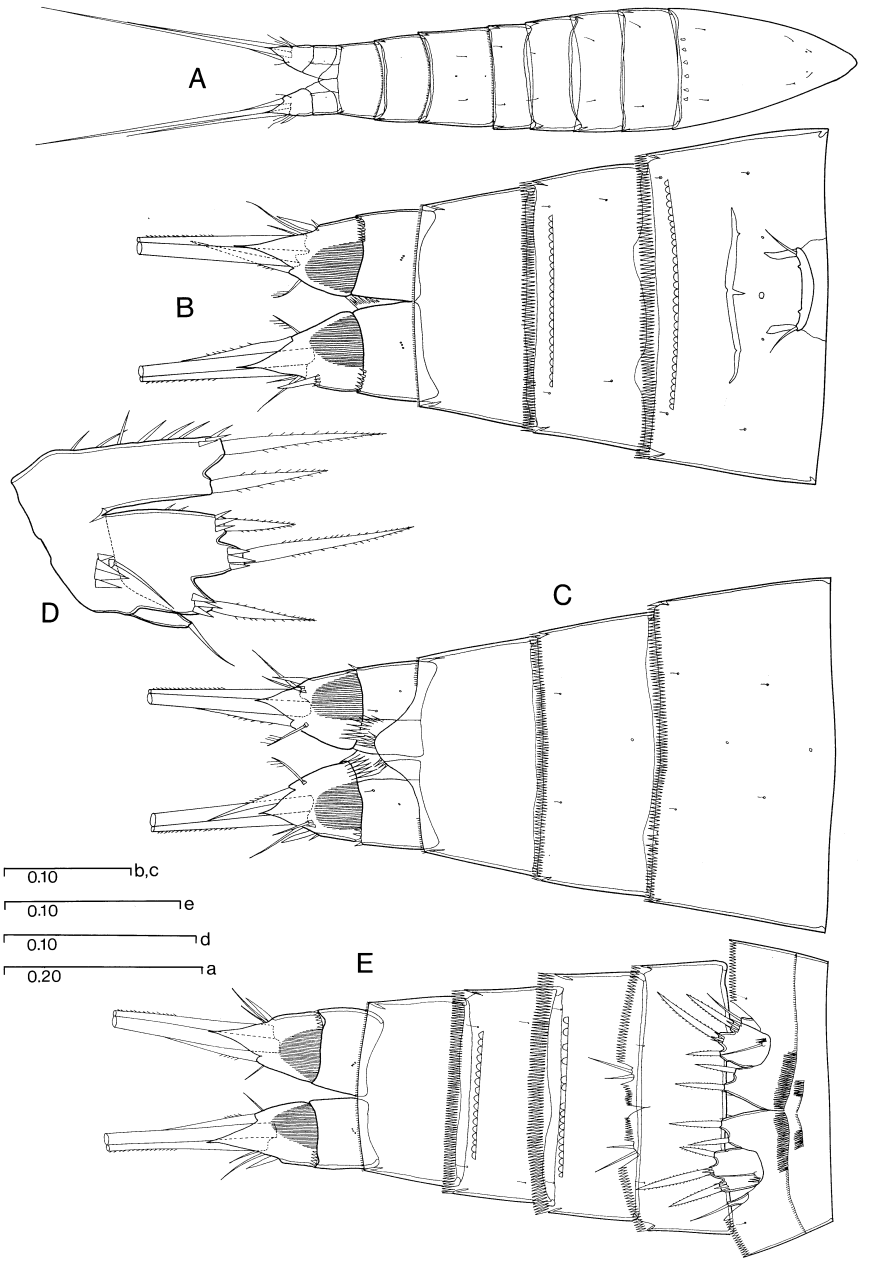

Figure 21. *Halectinosoma canaliculatum* (Por, 1964). Female (S19): A, Habitus, dorsal; B, Urosomites 2–6, ventral; C, Urosomites 2–6, dorsal; D, P5. Male (S19): E, Urosome, ventral.

corner longer than ramus. Base of ramus with a dense row of long spinules. Surface of ramus and acuminate lappets covered with scale-like spinules (Fig. 30D).

Somitic ornamentation (Fig. 21A–C). Body somites covered with sensilla and pores as in *H. pseudosarsi*. Cephalothorax with subcuticular patches of chitin near denticulate posterior edge. Free thoracic somites with only two rows of

fine spinules dorsally; first and second somites with a denticulate posterior edge, third and fourth somites with a fine semi-incised subulate hyaline frill. Urosomites 2–6 with rows of very fine spinules, difficult to see at high magnification apart from genital double somite and following somite with a somewhat conspicuous row of scale-like spinules mid-ventrally, just anterior to the semi-incised subulate hyaline frill; penultimate somite with a fine, fully-incised subulate hyaline frill interrupted dorsally by an unadorned pseudoperculum. Anal somite with spinules along outer distal edge and overlapping rows of spinuliform lappets on inner surface.

Antennule (Fig. 22A). 6-segmented. Differs from *H. pseudosarsi* only in the degree of spinulation: second segment with two finely spinulose setae and penultimate segment with one finely spinulose seta.

Antenna (Fig. 22B). As in *H. pseudosarsi.*

Mandible (Fig. 22C). Coxal gnathobase with one hairy seta adjacent to unidentate *pars incisiva* and a tridentate *lacinia.* Endopodite without any spinulation. Otherwise as in *H. pseudosarsi.*

Maxillula (Fig. 22D). As in *H. pseudosarsi* except unguiform setae shorter and with a stronger spinulation.

Maxilla (Fig. 22E, 30C) and *maxilliped* (Fig. 22F). As in *H. pseudosarsi* but with minor differences in the degree of spinulation.

P1–P4 (Fig. 23A–D). Principal setation as in *H. pseudosarsi.* Coxa of P2–P4 with a row of spinules along inner half of inner distal edge. Inner distal corner of basis of P2–P4 with two subtriangular expansions and a relatively short outer seta. Distal and outer setae of exopodite and endopod P1–P4 thicker than in *H. pseudosarsi.* Inner setae of last segment of exopod P4 distinctly short, not reaching beyond the outermost distal seta. Otherwise as in *H. pseudosarsi.*

P5 (Fig. 21D). About as long as broad. Exopod slightly longer than wide and confluent with baseoendopod on anterior surface only. Inner expansion of baseoendopod reaching slightly beyond inner lobe of exopod and represented distally by two unequal lobes each armed with a spinulose seta: inner seta about a third longer than outer one and reaching to about middle seta of exopod; outer seta reaches beyond innermost seta of exopod. Inner margin of baseoendopod with spinules. Exopod with three distinct terminal lobes each accompanied by few spinules and furnished with a spiniform seta: the outer lobe is separated from the middle lobe by an incision reaching to about 2/5 of exopod: middle seta about 2.5 times longer than inner seta; outer seta 1.5 times longer than inner seta. Surface-seta issuing from a small lobe opposite exopod-baseoendopod suture and accompanied by a row of 3–5 spinules near base.

Description of male

Habitus length 800 μm ($n = 1$). Second and third urosomites distinct and ornamented as in Fig. 21E. Otherwise as in female apart from the following features.

Antennule. 7-segmented. Principal setation and form as in male of *H. neglectum.*

P5 (Fig. 21E). Baseoendopod confluent with somite; inner expansion furnished with two spiniform setae; outer expansion with a slender seta.

Figure 22. *Halectinosoma canaliculatum* (Por, 1964). Female (S19): A, Antennule; B, Antenna; C, Mandible; D, Maxillula; E, Maxilla; F, Maxilliped.

Exopod with three distal spiniform setae. Surface-seta issuing from a lobule on exopod and accompanied by a few spinules.

P6 (Fig. 21E). A plate with two setae on distal outer corner and an inner denticulate fringe.

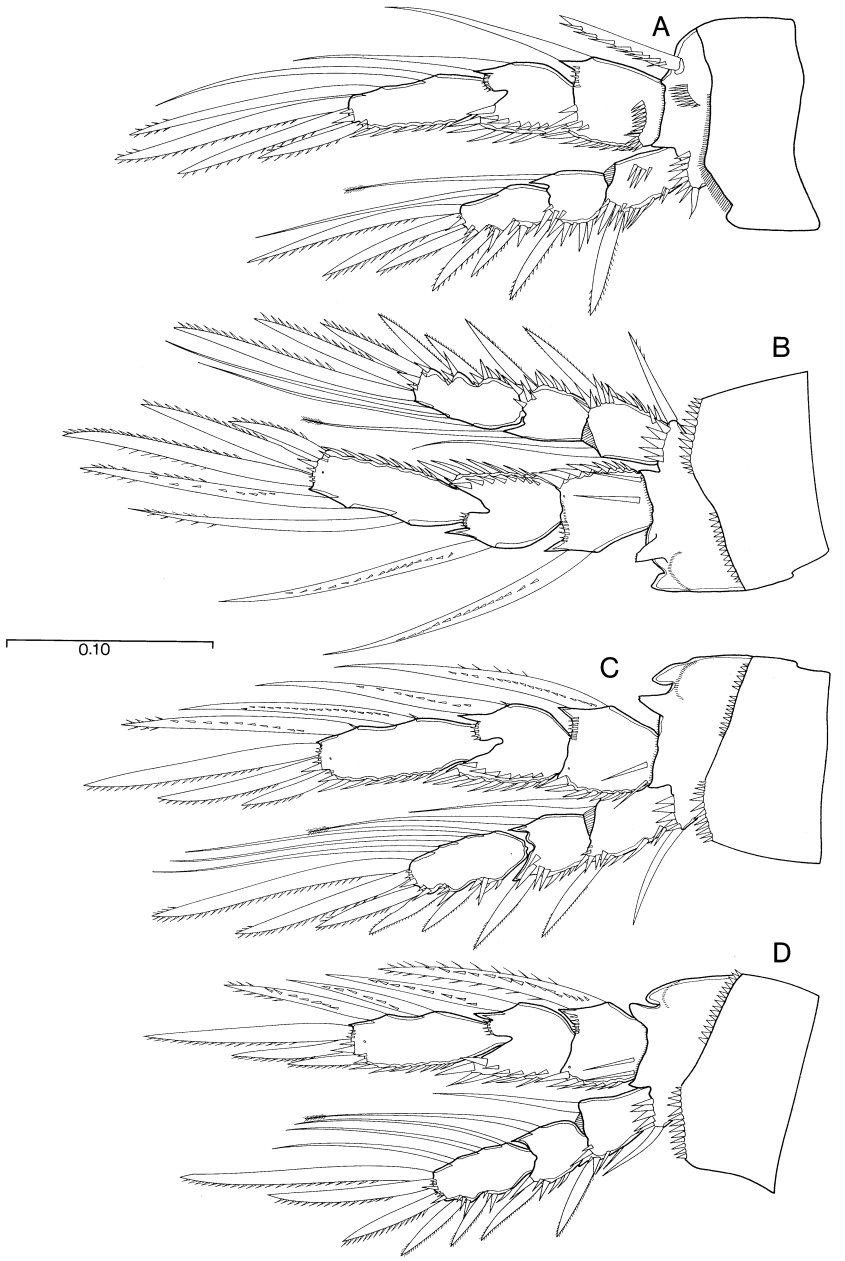

Figure 23. *Halectinosoma canaliculatum* (Por, 1964). Female (S19): A, P1; B, P2; C, P3; D, P4.

Variability

The number of scales present mid-ventrally on the urosomites of females examined varied from 28 to 34 on the genital double somite and from 24 to 30 on the following somite.

Remarks

T. and A. Scott (1984) gave the first description of this species in their monograph and ascribed it to *H. sarsi* (Boeck). As mentioned previously, the

status of *H. sarsi* (Boeck) is uncertain because of the poor original description. We were unable to locate the material of T. and A. Scott. Although their description is not to the standards required in modern harpacticoid taxonomy, it does provide sufficient information for a comparative study with material that we have collected in the Firth of Forth. The morphology of the P5, the shape of the caudal rami, size of habitus, and shape of the mandibular gnathobase as given by T. and A. Scott agree with *H. canaliculatum* (Por), a species described from Israel. We have re-examined the syntypes of *H. canaliculatum* and we were able to assign specimens found in the Firth of Forth, as well as from many other sites around the British Isles, to this species. We have little doubt about synonymizing *H. sarsi sensu* T. and A. Scott with *H. canaliculatum*. T. and A. Scott also listed *H. spinipes* (Brady) as a synonym of *H. sarsi*. We were unable to locate Brady's type material, and, given that the original description is poor and inaccurate, *H. spinipes* is regarded as *species dubium*.

H. canaliculatum is most closely related to *H. brunneum* (Brady) and *H. perforatum* Itô. All three species possess scale-like spinules on the genital double somite and the following somite. These scale-like spinules are present only mid-ventrally in *H. canaliculatum* and are less prominent. *H. canaliculatum* also possesses a much shorter caudal ramus than *H. perforatum*, a species of similar size recorded only in Japan. Beside urosome ornamentation, *H. brunneum* and *H. canaliculatum* can be differentiated on the basis of their size, furcal shape, number of teeth on the mandibular gnathobase, and length of the middle seta of the P5 exopod. *H. canaliculatum* is a much more common species than *H. brunneum*. The two species were found together in Loch Creran, Scotland.

***Halectinosoma crenulatum* sp. nov.**

Material examined

Type material (Scotland): S6 (♀ holotype dissected on slides, NHM # 1990.328; 2 ♀ paratypes dissected on slides, NHM # 1990.329 and NHM # 1990.330; 2 ♀ paratypes preserved in alcohol, NHM # 1990.480–481); S70 (1 ♂ paratype dissected on slides, NHM # 1990.331).

Scotland: S8 (2 ♀♀); S18 (1 ♀); S19 (1 ♀); S20 (4 ♀♀, 1 ♂); S70 (2 ♀♀); S74 (2 ♀♀); S77 (2 ♀♀); S78 (2 ♀♀); S79 (1 ♀); S82 (1 ♀).

Natural History Museum, London: 2 ♀♀ from the Norman collection in tube 42628-29 (as *Ectinosoma sarsi*), Eddystone lighthouse, England.

Celtic sea: S85 (2 ♀♀).

Zoology Museum, Oslo: 4 ♀♀ from the Sars collection in tube F20038 (as *E. sarsi*), Norway; 4 ♀♀ in tube F20040 (as *E. proximum*), Risør, Norway.

France: S65 (28 ♀♀, 14 ♂♂); S88 (4 ♀♀); 1 ♀ on slide CCCXVIII from P. Bodin, collected at Brest.

Description of female holotype

Habitus length 760 μm. Body shape fusiform and robust (Fig. 24A). Cuticle yellowish brown and with minute perforations on its surface. Cephalothorax distinctly longer than its basal width. Rostrum prominent and furnished with

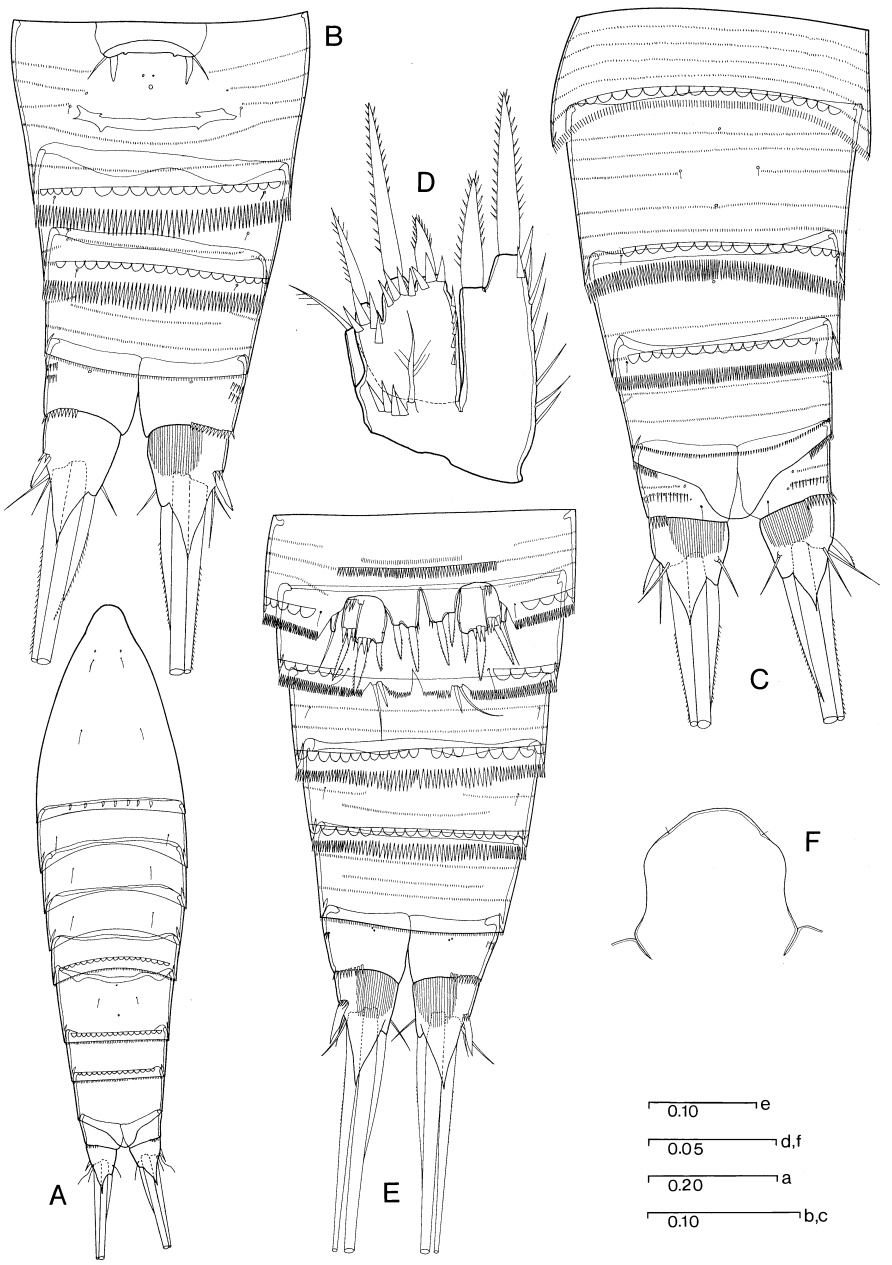

Figure 24. ***Halectinosoma crenulatum*** **sp. nov**. Female holotype (S6): A, Habitus, dorsal; B, Urosomites 2–6, ventral; C, Urosome, dorsal; D, P5; F, Rostrum, dorsal. Male paratype (S20): E, Urosome, ventral.

two subapical sensilla (Fig. 24F). Genital double somite with a transverse chitinous stripe ventrally. Pseudoperculum tongue-shaped.

Caudal ramus (Fig. 24B, C). Slightly shorter than broad (ratio length/width = 0.9). Setation as in *H. pseudosarsi* except seta at inner distal

corner distinctly longer than ramus. Base of ramus with a dense row of long spinules. Surface of ramus covered with broad overlapping scales (not illustrated).

Somitic ornamentation (Fig. 24A–C). Sensilla and pores positioned as in *H. pseudosarsi*. Cephalothorax dorsally with subcuticular patches of chitin near denticulate posterior edge. Free thoracic somites dorsally with four rows of fine spinules and with hyaline frill as described for *H. pseudosarsi*. Fourth free thoracic somite dorsally with an additional row of rounded scale-like spinules. Urosomites 2–6 with spinular rows as shown in Fig. 24B, C. Genital double somite and following somite with a row of rounded scale-like spinules interrupted laterally by fine spinules and located just anterior to the strong semi-incised subulate hyaline frill. Penultimate somite with a fully-incised subulate hyaline frill interrupted dorsally by an unadorned pseudoperculum.

Antennule (Fig. 25A). 6-segmented. Principal setation and form as in *H. pseudosarsi* apart from spinulation. Two setae on segment 2 coarsely spinulose at antero-distal corner. Penultimate segment bearing a thick, strongly spinulose seta at postero-distal margin.

Antenna (Fig. 25B). As in *H. pseudosarsi*.

Mandible. (Fig. 25C). Coxal gnathobase with one seta adjacent to unidentate *pars incisiva*, and a quadridentate *lacinia* in which the second outermost tooth is much reduced. Endopod devoid of spinulation. Otherwise as in *H. pseudosarsi*.

Maxillula (Fig. 25D) and *maxilla* (Fig. 25E) as in *H. pseudosarsi*.

Maxilliped (Fig. 25F). As in *H. pseudosarsi* apart from basis slightly shorter.

P1–P4 (Fig. 26A–D). Principal setation and form as in *H. pseudosarsi*. Overall spinulation much coarser and setae thicker than in *H. pseudosarsi*. Coxa of P2–P4 with a row of spinules along inner edge with basis. Inner distal corner of basis of P2–P4 with two subtriangular expansions. Otherwise as in *H. pseudosarsi*.

P5 (Fig. 24D). About as long as wide. Exopod slightly longer than wide and confluent with baseoendopod on anterior surface only. Inner expansion of baseoendopod spinulose along inner margin and distally with two unequal lobes each armed with a spiniform bipinnate seta: outer seta extending beyond inner seta of exopod and about 2/3 the length of inner seta. Exopod with three distal lobes accompanied by few spinules and armed with a spiniform bipinnate seta: middle seta three times longer than inner seta; outer seta about 1.5 longer than innermost seta. Inner margin of exopod spinulose. Surface-seta sparsely plumose and issuing from a lobe accompanied by four spinules and located slightly proximal to the suture seen on the opposite surface.

Description of male paratype

Habitus length 736 μm. Second and third urosomites distinct. Otherwise as in female apart from the following features.

Somitic ornamentation (Fig. 24E). First urosomite with a conspicuous row of spinules mid-ventrally just anterior to P5, and a distal row of scale-like spinules interrupted mid-ventrally by P5. Second urosomite with a distal row of scale-like spinules interrupted mid-ventrally by P6. Third and fourth urosomites each with a continuous, distal row of scale-like spinules.

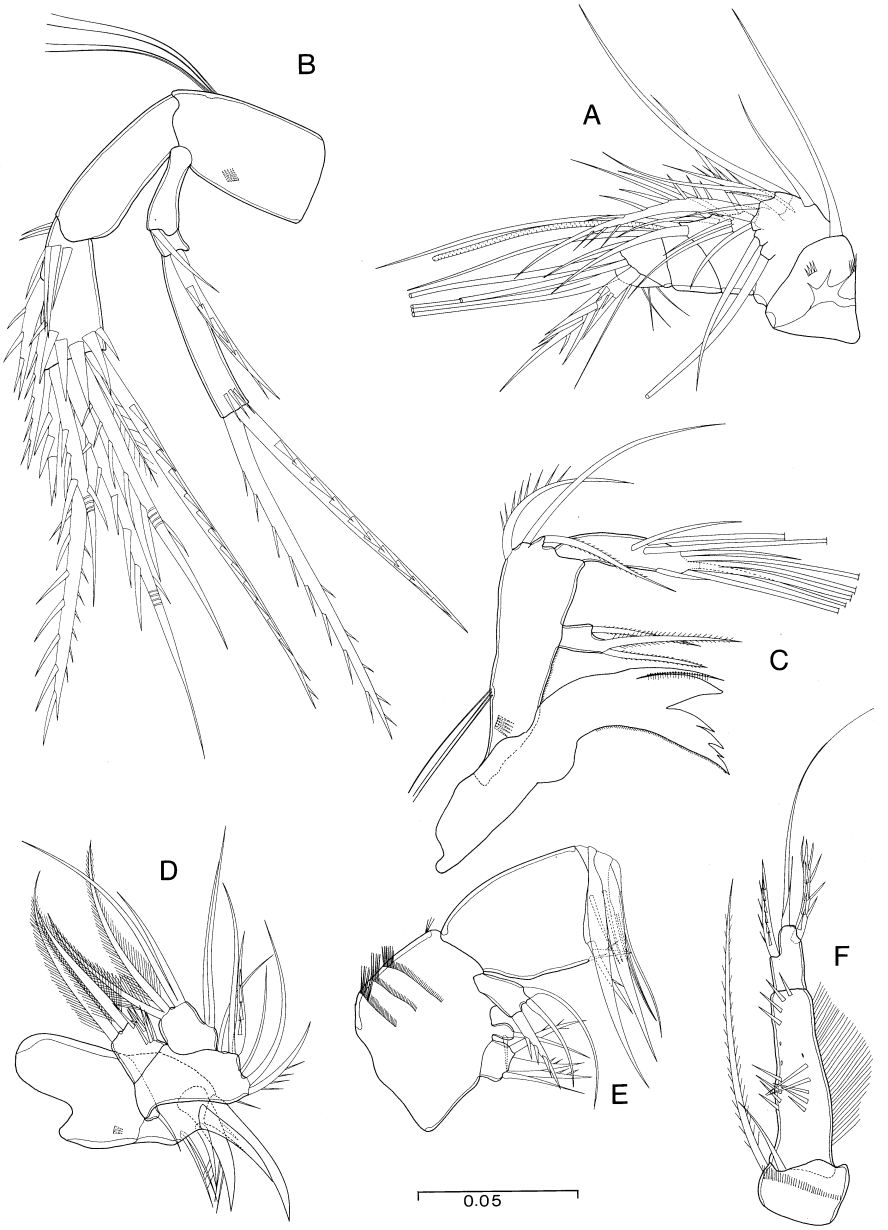

Figure 25. ***Halectinosoma crenulatum*** **sp. nov**. Female holotype: A, Antennule; B, Antenna; C, Mandible; D, Maxillula; E, Maxilla; F, Maxilliped.

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

P5 (Fig. 24E). Baseoendopod confluent with somite, inner expansion reaching to about halfway along exopod and armed with two spiniform setae. Exopod with distinct suture at base and armed with three distal spiniform setae. Innermost lobe of exopod without spinules. Surface-seta issuing from exopod and accompanied by three spinules.

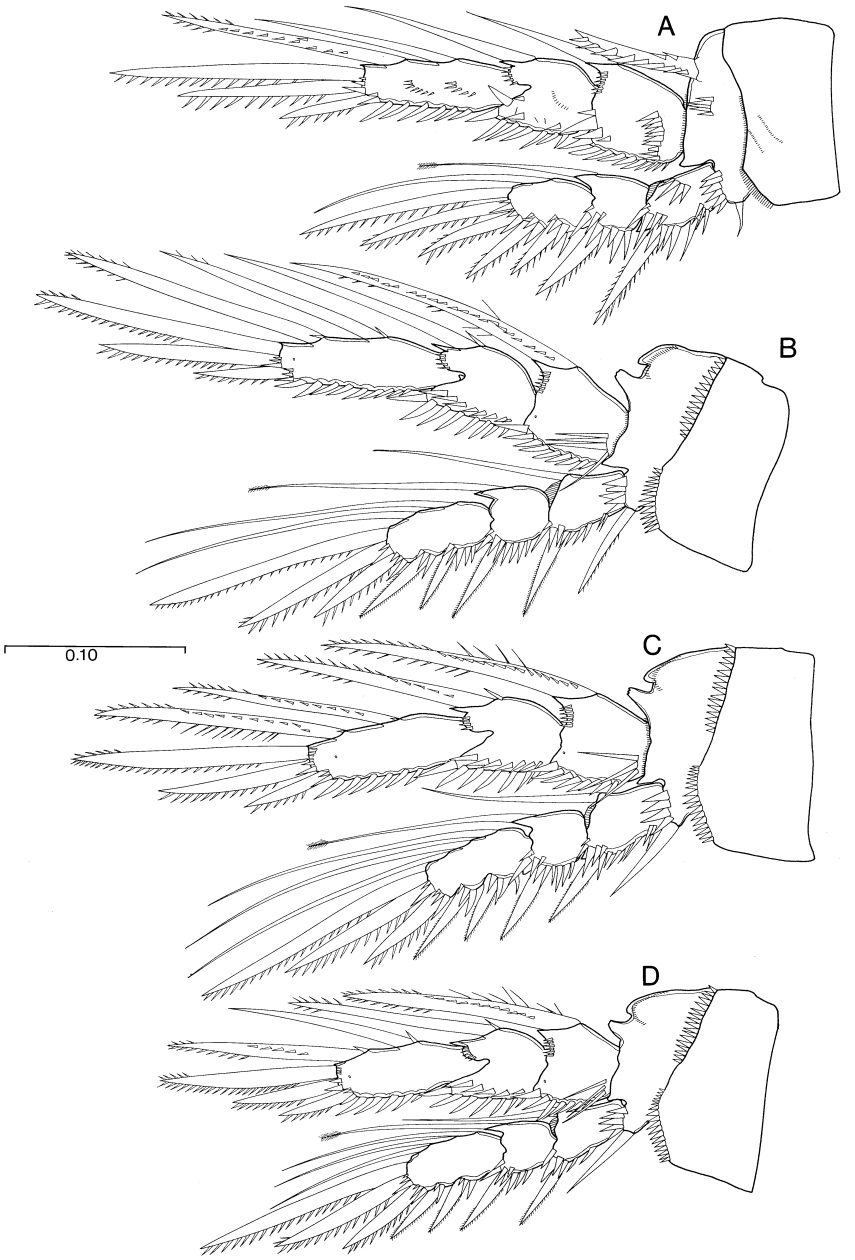

Figure 26. ***Halectinosoma crenulatum* sp. nov**. Female holotype: A, P1; B, P2; C, P3; D, P4.

P6 (Fig. 24E). A plate with two setae at outer distal corner, the inner seta about half as long as outer seta. Inner distal edge of plate denticulate.

Variability

Length of females examined from British material varied as follows ($n = 10$): habitus 740–975 μm; sum of all somites 985–1085 μm; cephalothorax 310–

350 μm; genital double somite 90–130 μm. Females examined from Banyuls were smaller and had the following lengths ($n = 5$): habitus 700–840 μm; sum of all somites 880–935 μm; genital double somites 90–100 μm; cephalothorax 300–320 μm. The following measurements were taken on males from Banyuls ($n = 5$): habitus 520–660 μm; sum of all somites 590–660 μm; cephalothorax 200–215 μm. Exopodite of female P5 with ratio of length of middle seta to length of inner seta varying between 3.0–3.5. There are also differences in females for the number of scales in each row bordering the hyaline frill of the following somites: dorsal row of last thoracic somite with 15–25 scales, the genital double somite with 18–23 scales ventrally and 13–19 scales dorsally, and the following somite with 17–22 scales ventrally and 12–18 dorsally.

Remarks

H. crenulatum shows many affinities with a group of species that includes *H. canaliculatum, H. brunneum* and *H. perforatum.* All these species have rows of characteristic scale-like spinules on the urosomites and a very similar morphology of the P5. However, *H. crenulatum* has a caudal ramus slightly broader than long, which distinguishes it from *H. brunneum* and *H. perforatum.* Also, *H. crenulatum* differs from *H. canaliculatum* by its slightly smaller size and habitus shape, the ornamentation of the urosomites, the shape of the mandibular gnathobase and spinulation of the antennules. Furthermore, the coexistence of *H. crenulatum* with *H. brunneum* and *H. canaliculatum* at more than one site in our survey demonstrates that each of these three species must be considered as distinct.

Halectinosoma denticulatum sp. nov.

Material examined

Type material (Scotland): S18 (♀ holotype dissected on slides, NHM # 1990.3197; 28 ♀ paratypes (23 in tubes, NHM # 1990.744–753, 5 dissected on slides, NHM # 1990.320–324); 1 ♂ paratype dissected on slides, NHM # 1990.325.

Scotland: S6 (33 ♀♀, 1 ♂); S8 (2 ♀♀); S17 (4 ♀♀); S20 (3 ♀♀); S67 (2 ♀♀, 1 ♂); S70 (6 ♀♀); S72 (5 ♀♀); S73 (10 ♀♀, 3 ♂♂); S74 (11 ♀♀).

Shetland: S66 (4 ♀♀).

England: S61 (1 ♀); S63 (2 ♀♀); S87 (2 ♀♀).

Isle of Man: S45 (2 ♀♀); S46 (4 ♀♀).

Natural History Museum, London: 2 ♀♀ from the Norman collection, slide M.2263 (as *E. spinipes*), collected 1889, Cattewater, Plymouth.

France: S65 (3 ♀♀, 1 ♂).

Description of female holotype

Habitus length 750 μm. Body shape fusiform (Fig. 27A). Cuticle of mounted specimen yellowish brown and with small perforations on the surface. Rostrum prominent, tongue-shaped, partly fused at base and with two subapical sensilla. Cephalothorax distinctly longer than its basal width. Labrum as in *H. pseudosarsi.* Genital double somite subdivided by a transverse chitinous stripe ventrally. Pseudoperculum parabolic in shape.

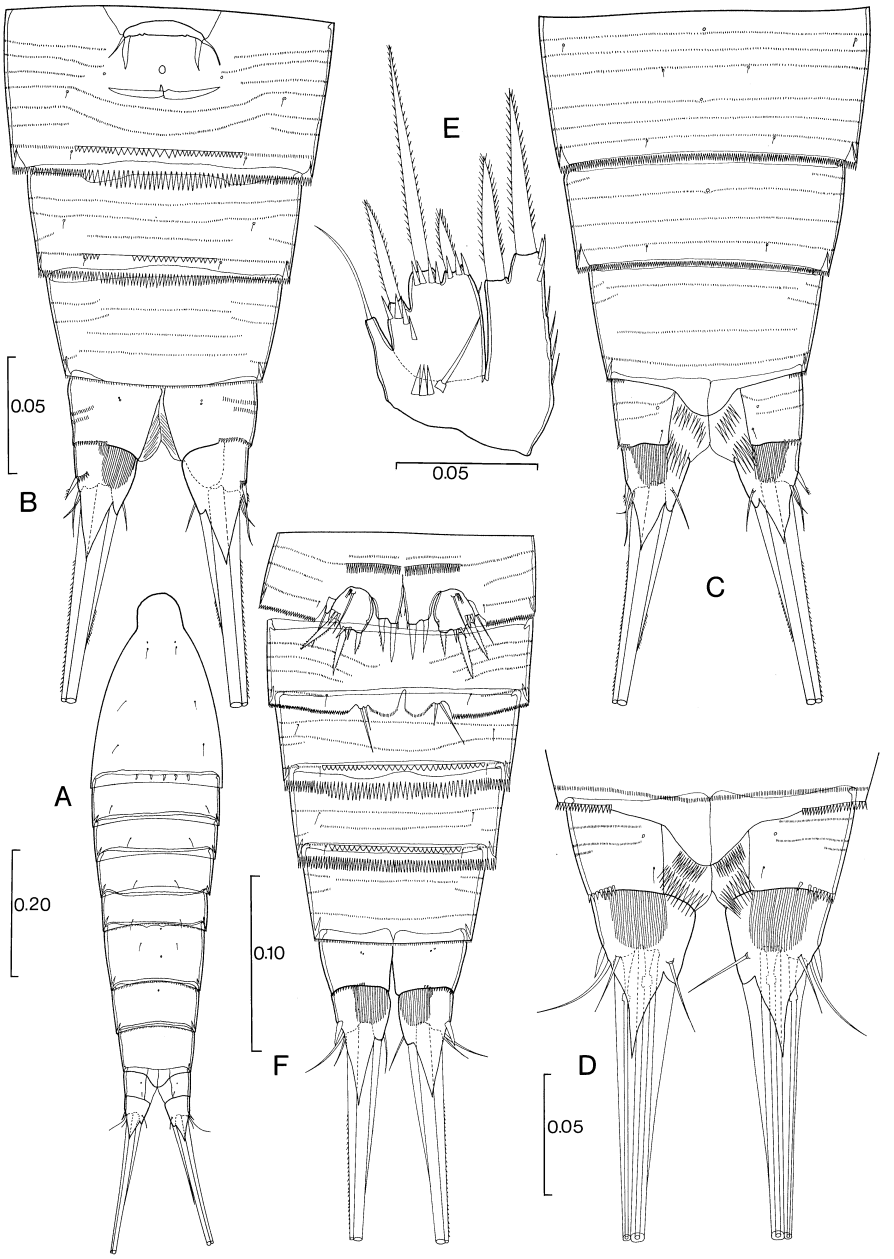

Figure 27. ***Halectinosoma denticulatum* sp. nov**. Female paratype (S18): A, Habitus, dorsal; D, Pseudoperculum, anal somite, and caudal ramus, dorsal. Female holotype (S18): B, Urosomites 2–6, ventral; C, Urosomites 2–6, dorsal; E, P5. Male paratype (S18): F, Urosome, ventral.

Caudal ramus (Fig. 27D). Distinctly shorter than broad (ratio length/width = 0.85). Setation as in *H. pseudosarsi* except seta at inner distal corner about twice as long as ramus. Ramus terminating in an acuminate lappet ventrally and dorsally and covered with broad scale-like spinules. A

dense row of long spinules present ventrally and dorsally at base of ramus and covering most of its surface.

Somitic ornamentation (Fig. 27A–C). Body somites covered with sensilla and pores as in *H. pseudosarsi*. Cephalothorax dorsally with subcuticular patches of chitin near denticulate posterior edge. First and second free thoracic somites dorsally with five rows of fine spinules and a denticulate posterior edge. Third and fourth free thoracic somites with four and three rows of fine spinules respectively and a fine semi-incised subulate hyaline frill. Urosomites with spinular rows as shown in Fig. 27B, C. Genital double somite and following somite with a row of triangular scale-like spinules mid-ventrally and a semi-incised subulate hyaline frill (Fig. 30B). Penultimate somite with a fine fully-incised subulate hyaline frill interrupted dorsally by a bare pseudoperculum. Anal somite with inner surface as overlapping rows of spinuliform lappets.

Antennule (Fig. 28A). 6-segmented. Principal setation and form as in *H. pseudosarsi* except for spinulation: second segment with two spinulose setae, penultimate segment with one thick spinulose seta.

Antenna (Fig. 28B). As in *H. pseudosarsi*.

Mandible (Fig. 28C). Coxal gnathobase with one seta adjacent to unidentate *pars incisiva* and a quadridentate *lacinia*, of which the second outermost tooth is much reduced. Endopodite without spinules along outer and inner margins. Otherwise as in *H. pseudosarsi*.

Maxillula (Fig. 28D). As in *H. pseudosarsi* except unguiform setae thicker and shorter.

Maxilla (Fig. 28E). As in *H. pseudosarsi* apart from basis which is shorter and broader.

Maxilliped (Fig. 28F). As in *H. pseudosarsi*.

P1–P4 (Fig. 29A–D). Principal setation and form as in *H. pseudosarsi*. Setae distinctly short and broad apart from inner setae of exopod. Coxa with a row of spinules along inner edge with basis. Otherwise as in *H. pseudosarsi*.

P5 (Fig. 27E). Similar to *H. crenulatum* except with finer spinulation.

Description of male

Habitus length 550–595 μm ($n = 4$); sum of all somites 625–680 μm; length of cephalothorax 205–210 μm. Second and third urosomites distinct. Otherwise as in female apart from the following features.

Somitic ornamentation (Fig. 27F). First urosomite with a conspicuous row of spinules mid-ventrally. Distal spinular row of the third and fourth urosomites modified into subtriangular scale-like spinules mid-ventrally, as in the female.

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

P5 (Fig. 27F). As in *H. crenulatum* sp. nov. except terminal setae not as broad.

P6 (Fig. 27F). As in *H. crenulatum* sp. nov. except inner distal edge of plate more finely denticulate.

Variability

Length of females from British material varied as follows ($n = 10$): habitus 570–780 μm; sum of all somites 815–870 μm; genital double somite 85–105 μm; cephalothorax 260–270 μm. Females examined from Banyuls were

Figure 28. ***Halectinosoma denticulatum* sp. nov**. Female paratype (S18): A, Antennule; B, Antenna; C, Mandible; D, Maxillula; E, Maxilla; F, Maxilliped.

smaller and had the following lengths ($n = 3$): habitus 590–610 μm; sum of all somites 745–795 μm; genital double somite 85–90 μm; cephalothorax 245–270 μm. The number of triangular scales bordering the ventral hyaline frill of the genital double somite varied between 31–43 and on the following somite between 24–34.

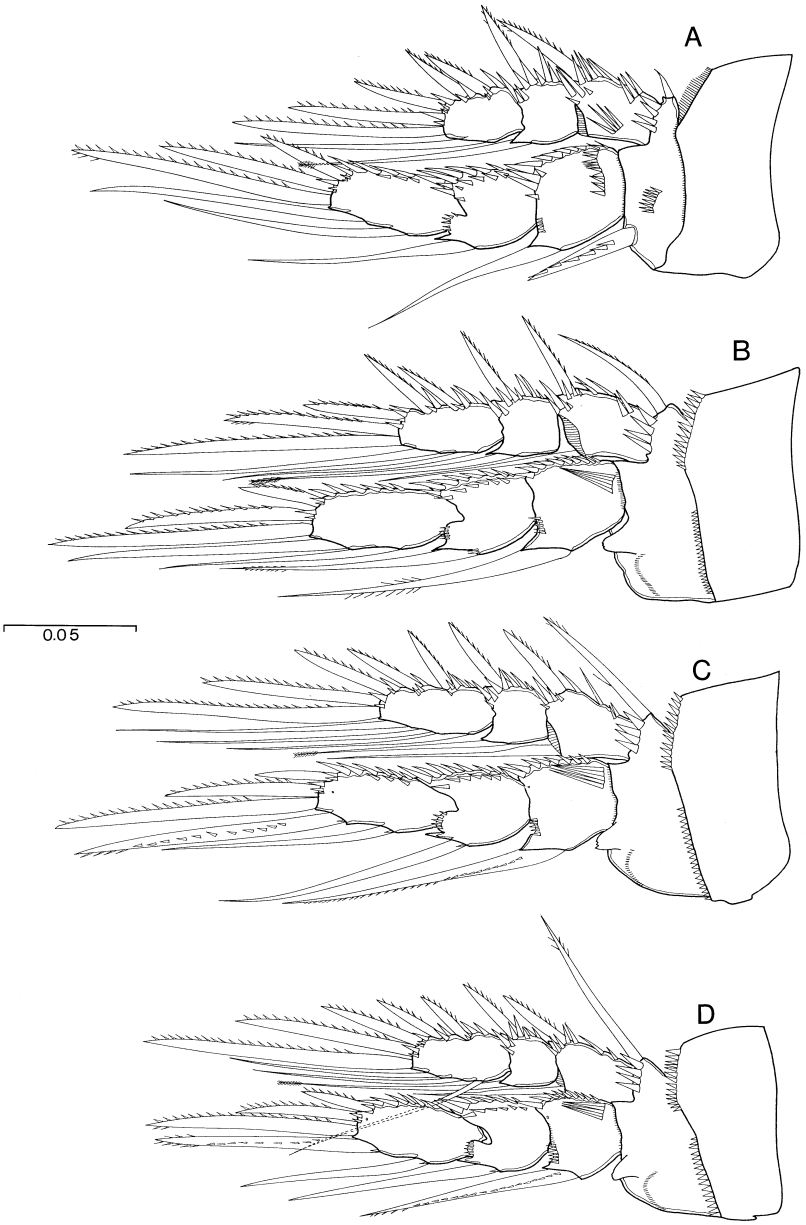

Figure 29. ***Halectinosoma denticulatum* sp. nov**. Female holotype: A, P1; B, P2; C, P3; D, P4.

Remarks

This species is very similar to *H. crenulatum*, especially regarding the morphology of the P5. A close examination has revealed significant differences in ornamentation of the urosomites between these two species. *H. denticulatum* possesses scale-like spinules only on the ventral side of the genital double somite and the following somite. These are typically triangular in shape, whereas the scales found on *H. crenulatum* are more conspicuous and have

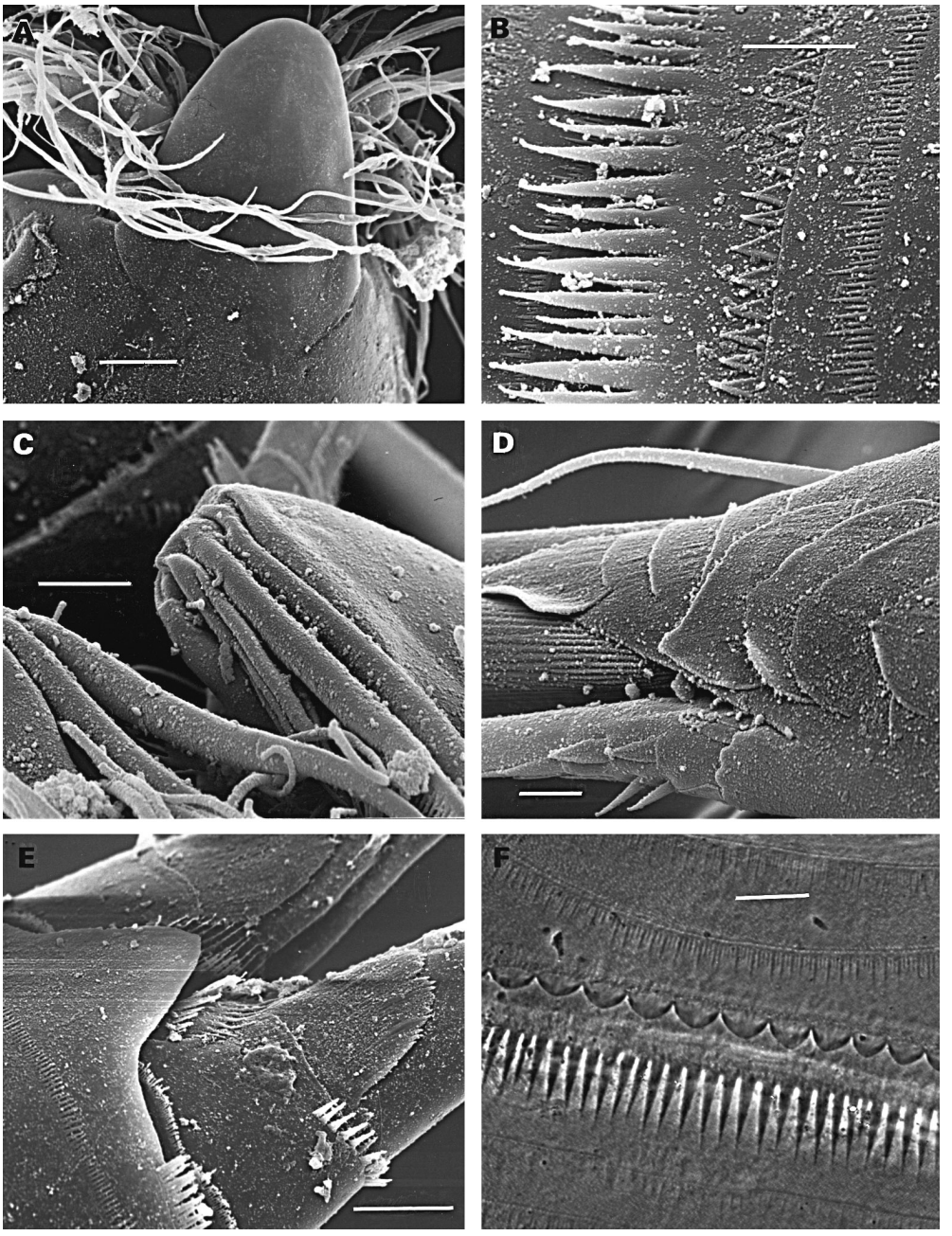

Figure 30. Scanning electron micrographs of (A) *Halectinosoma chrystalli* ♀, rostrum; (B) *H. denticulatum* ♀, ventral posterior margin of genital double somite; (C) *H. canaliculatum* ♀, maxilla; (D) *H. canaliculatum* ♀, caudal ramus; (E) *H. brunneum* ♀, caudal region. (F) Phase contrast micrograph of *H. brunneum* ♀, ventral posterior margin of genital double somite. Scale bars: A = 20 μm, B, C, F = 10 μm, D = 5 μm, E = 20 μm.

a rounded shape. *H. crenulatum* has additional rows of scale-like spinules dorsally in both sexes. *H. denticulatum* is significantly smaller than *H. crenulatum* and possesses a shorter caudal ramus. The two species were found to co-exist at many sites in Scotland and also in Banyuls.

PARTIAL KEY TO THE FEMALES OF *HALECTINOSOMA*

A new key to the species of *Halectinosoma* must await future papers in this series, which will re-examine certain species and describe new ones. In the interim, to facilitate the identification of species described here, the key to females of Lang (1965) can be amended. Couplets 13 to 21 in Lang's key should be ignored. Couplet 12 of Lang's key should read:

12. Surface-seta exp. P5 situated just at or very near base ..... go to the key below
    Surface-seta exp. P5 not situated just at or very near base ..... go to couplet 22 of Lang's key

1. P5 exp. with middle distal lobe separated from outer lobe by a deep V-shaped incision extending to proximal half ..... *proximum* (Sars, 1919)
   Not like this 2
2. Distal segment P1 exp. with five setae and spines in all ..... *oblongum* (Kunz, 1949)
   Distal segment P1 exp. with six setae and spines in all 3
3. Rostrum elongate with rounded or truncate distal margin; A2 exp.-1 with a row of spinules medially; P5 benp. broader than long ..... *arenicola* (Rouch, 1962)
   Rostrum short, broad at base with rounded apex or tapering distally; A2 exp.-1 without spinules; P5 benp. as long as or longer than broad. 4
4. Genital double somite ventrally with a row of conspicuous scales just anterior to hyaline frill 5
   Genital double somite ventrally with a row of fine spinules just anterior to hyaline frill 9
5. Furca about 1.5 times longer than broad ..... *perforatum* Itô, 1981
   Furca as long as or shorter than broad 6
6. Genital double somite dorsally with a row of conspicuous scale-like spinules just anterior to hyaline frill 7
   Genital double somite without scale-like spinules dorsally 8
7. Furca as long as broad ..... *brunneum* (Brady, 1905)
   Furca shorter than broad ..... ***crenulatum* sp. nov.**
8. Third and fourth urosomites with a ventral row of triangular scales ..... ***denticulatum* sp. nov.**
   Third and fourth urosomites with a ventral row of semi-circular scales. ..... *canaliculatum* (Por, 1964)
9. Furca distinctly shorter than broad 10
   Furca as long as or longer than broad 11
10. P5 exp. with innermost seta longer than outer seta of inner expansion

of benp. ..... *travei* Soyer, 1973
P5 exp. with innermost seta much shorter than outer seta of inner expansion of benp. ..... *angulifrons* (Sars, 1919)

11. P5 benp. with a row of strong spinules near base ..... ***chislenki* sp. nov.**
P5 benp. without a row of spinules near base 12

12. P5 exp. with innermost seta shorter than outer seta of inner expansion of benp. and not reaching beyond the tip of that seta 13
P5 exp. with innermost seta about as long as outer seta of inner expansion of benp. and reaching beyond its tip 16

13. Furca as long as wide ..... ***argyllensis* sp. nov.**
Furca longer than wide 14

14. P5 exp. with outermost seta shorter than exp. ..... ***pseudosarsi* sp. nov.**
P5 exp. with outermost seta longer than exp. 15

15. Cephalothorax subtriangular in dorsal view. Seta at inner distal corner of caudal ramus much shorter than ramus ..... *ornatum* Lang, 1965
Anterior half of cephalothorax comparatively broad (Fig. 5A). Seta at inner distal corner of caudal ramus much longer than ramus ..... *clavatum* (Sars, 1920)

16. Anterior surface of P5 exp. with a row of spinules at base and with two short rows of fine spinules more distally; pseudoperculum unadorned ..... *neglectum* (Sars, 1904)
P5 exp. with a row of spinules near base only; pseudoperculum fringed with fine spinules ..... *chrystalli* (T. Scott, 1894)

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