

DESCRIPTION OF LARVAE OF A HIPPOLYTID SHRIMP, *LEBBEUS GROENLANDICUS*, REARED IN SITU IN KACHEMAK BAY, ALASKA

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ABSTRACT

Larvae of *Lebbeus groenlandicus*, a hippolytid shrimp, were reared in situ in Kachemak Bay, Alaska, from the first zoea (Stage I) through the megalopa (Stage III). Each of the three stages is described and illustrated, and then compared with descriptions of larvae of *Lebbeus* spp. given by other authors.

Information on the larval stages of the genus *Lebbeus* is meager. Pike and Williamson (1961), in their summary of the generic characteristics of *Spirontocaris* and related genera, note that the only larva of *Lebbeus* known for certain is a larva of *L. polaris* dissected from a well-developed egg. During studies on rearing larvae of pandalid shrimp for descriptive purposes (Haynes 1976, 1978), I succeeded in rearing larvae of *L. groenlandicus* to the megalopa stage. This report describes and illustrates each of the two zoeal stages and megalopa of *L. groenlandicus*, and compares the stages obtained from rearing in situ and from plankton in Kachemak Bay with provisionally identified larvae of *L. groenlandicus* reported by other authors.

METHODS

A complete discussion of rearing technique, methods of measurement, techniques of illustration, and nomenclature of gills and appendages is given by Haynes (1976). Briefly, the rearing technique consists of obtaining Stage I zoeae from known parentage in the laboratory and then rearing the zoeae to postlarvae in 500-ml flasks suspended upright beneath the surface of the sea. Cast skins and larvae removed from the flasks were examined in the laboratory to determine sequence and morphology of each stage. Larval stage was also verified using larvae from plankton reared in the same manner as larvae obtained in the laboratory.

In the illustrations (Figures 1-3), for clarity, setules on setae are usually omitted but spinulose

setae are shown. The terms are defined as follows:

- setose - set with bristles (setae)
- spinose - bearing many spines
- spinous - spinelike
- spinulose - set with little spines.

The figures are in part schematic and represent typical setal counts.

STAGE I ZOEAE

Total length of Stage I (Figure 1A) 6.9 mm (range 6.4-7.4 mm; 10 specimens). Live specimens characterized by bright orange color extending along ventral surface of body from antennules to fourth abdominal segment, orange gut, small orange chromatophore at anus, and greenish internal thoracic organs; remainder of zoea translucent. Rostrum slightly sinuate, without teeth, about two-thirds length of carapace. Carapace with dorsal rounded prominence at base of rostrum and near posterior edge; no supraorbital spines. Usually at least two minute spinules occur along ventral margin of carapace immediately posterior to pterygostomian spine.

ANTENNULE (FIGURE 1B).—First antenna, or antennule, consists of an unsegmented cylindrical basal portion and two distal conical projections; largest conical projection bears four aesthetascs of various lengths; smallest conical projection bears a single heavily plumose seta.

ANTENNA (FIGURE 1C).—Consists of inner flagellum (endopodite) and outer antennal scale (exopodite). Flagellum two-segmented, about twice length of scale; distal segment styliform and terminating in narrow projection. Two simple

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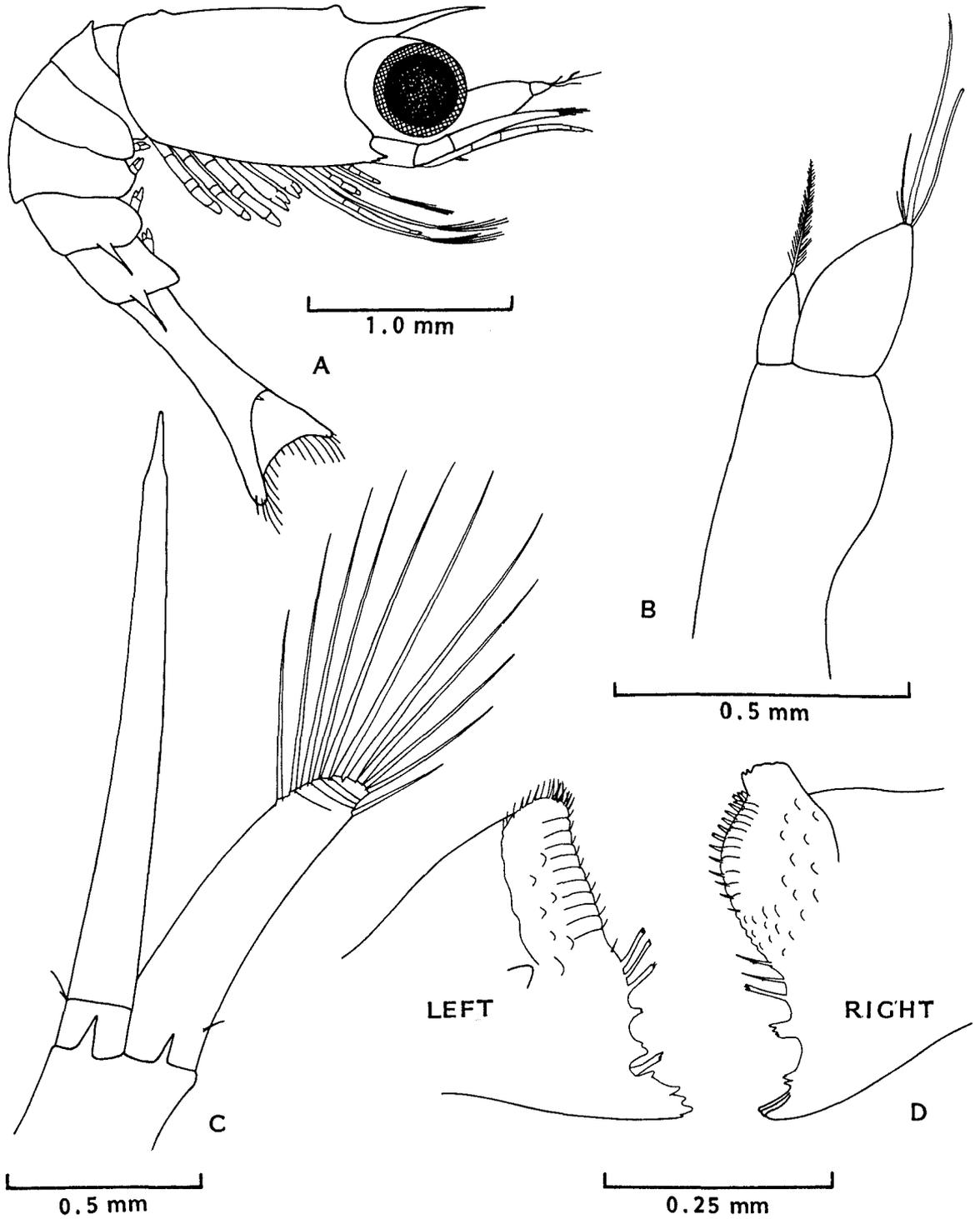


FIGURE 1.—Stage I zoea of *Lebbeus groenlandicus*: A, whole animal; B, antennule; C, antenna; D, mandibles (right and left).

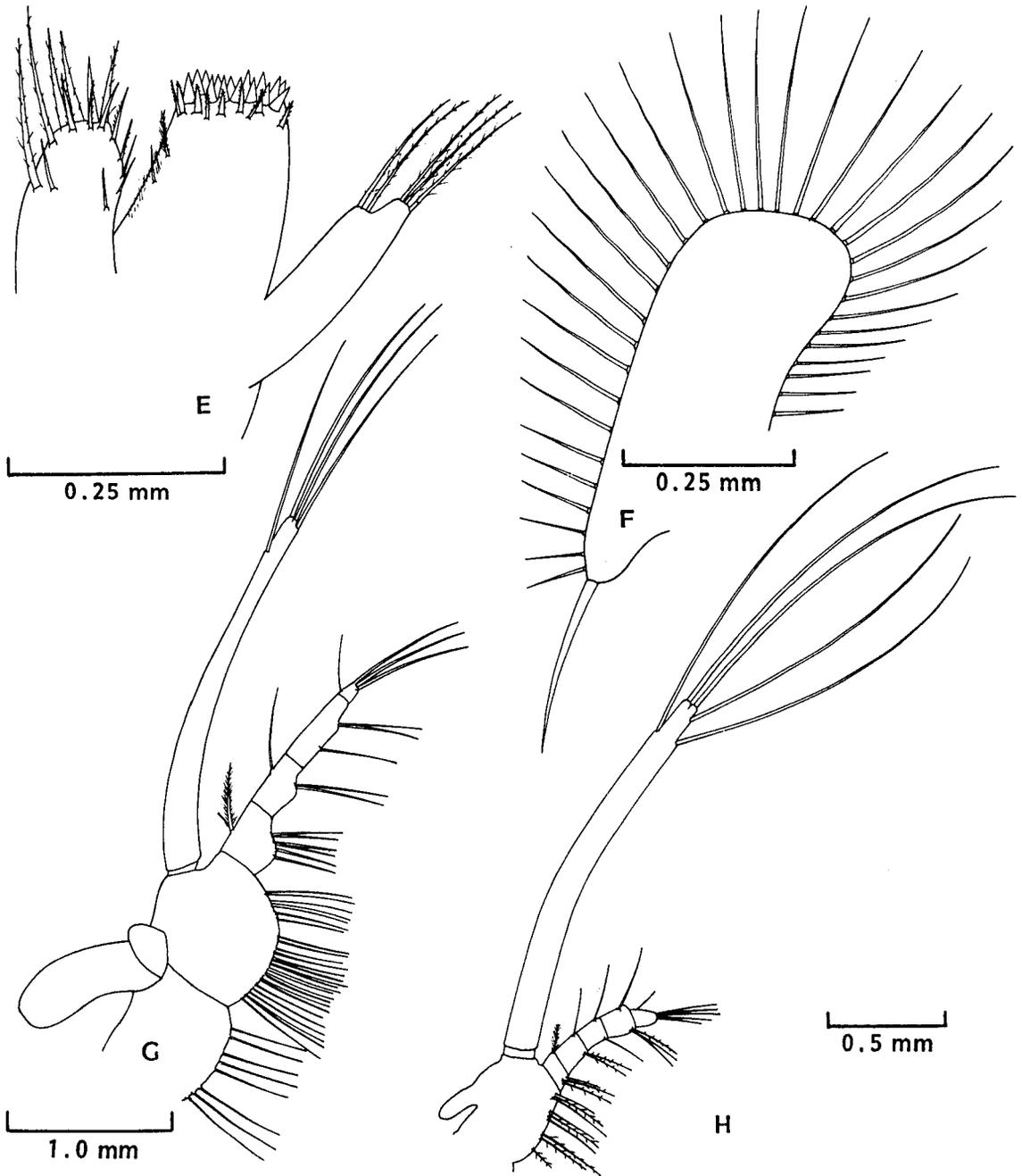


FIGURE 1.—Stage I zoea of *Lebbeus groenlandicus*: E, maxillule; F, scaphognathite of maxilla; G, first maxilliped; H, second maxilliped.

setae occur at joint. Antennal scale distally divided into four segments (proximal joint often incomplete) and fringed with 11 heavily plumose setae along terminal and inner margins. A small seta often occurs proximally near lateral

margin. Protopodite bears two simple spines ventrally, one at base of flagellum and one at base of scale.

MANDIBLES (FIGURE 1D).—Without palps;

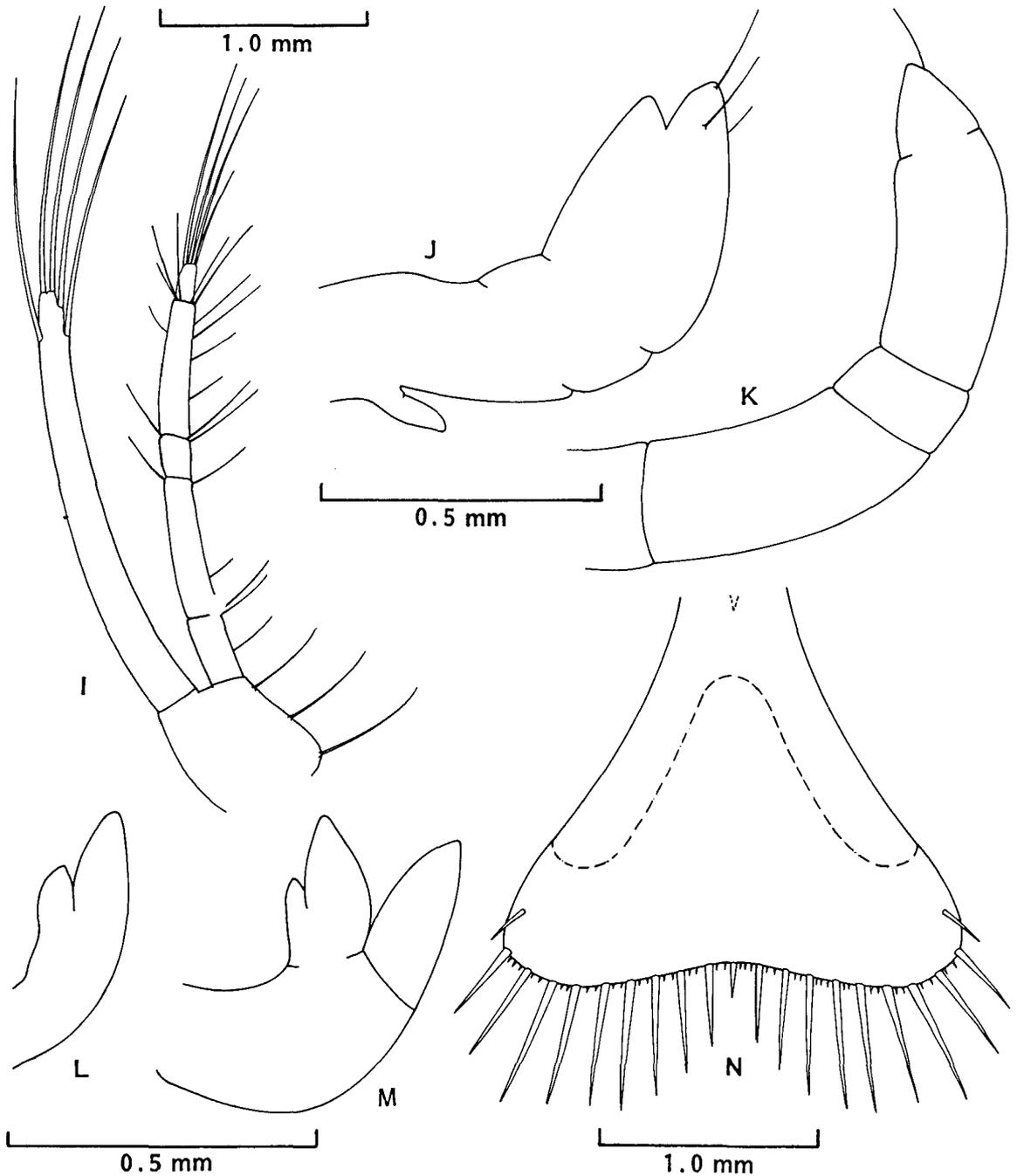


FIGURE 1.—Stage I zoea of *Lebbeus groenlandicus*: I, third maxilliped; J, first pereopod; K, third pereopod; L, first pleopod; M, second pleopod; N, telson.

well developed. Incisor process of left mandible bears five teeth, one of them located near movable premolar denticle (*lacinia mobilis*), in contrast to triserrate incisor process of right mandible. Both

mandibles bear well-developed denticles along terminal margin. Truncated end of molar process of right mandible formed into curved lip. Only left mandible bears a subterminal process.

MAXILLULE (FIGURE 1E).—First maxilla, or maxillule, bears coxal and basal endites and an endopodite. Proximal lobe (coxopodite) bears 15 setae, most of them spinulose. Median lobe (basipodite) bears 24 spines terminally, 9 of them spinulose; and 2 spines subterminally, 1 of them plumose and the other simple. A series of fine hairs occurs in vicinity of the simple spine. Endopodite originates from lateral margin of basipodite and bears three terminal and two subterminal spinulose setae. No evidence of outer seta on maxillule.

MAXILLA (FIGURE 1F).—Bears platelike exopodite (scaphognathite) with 33 long, plumose setae along outer margin, and a longer, thick seta at the proximal end. Endopodite not segmented; setae spinous, setation formula 2, 2, 1, 2, 3. Both basipodite and coxopodite bilobed. Basipodite bears 29 setae, 14 on distal lobe and 15 on proximal lobe. Coxopodite bears 23 setae, 5 on distal lobe and 18 on proximal lobe.

FIRST MAXILLIPED (FIGURE 1G).—Protopodite segmented; bears 27 setae on distal segment and 8 on proximal segment, most of them spinulose. Endopodite four-segmented; setation formula 4, 3, 3, 7. Basal segment of endopodite bears conspicuous setulose spine. Exopodite segmented at base; bears four natatory setae. Epipodite distinctly bilobed.

SECOND MAXILLIPED (FIGURE 1H).—Protopodite not segmented; bears nine setae, five of them spinulose. Endopodite five-segmented; fourth segment expanded somewhat laterally; terminal segment tipped by five setae and bears single seta subterminally; basal segment bears conspicuous setulose spine like that on basal segment of endopodite of first maxilliped; setation formula 6, 4, 2, 3, 4. Exopodite about three times longer than endopodite; bears five natatory setae. Epipodite present but not bilobed.

THIRD MAXILLIPED (FIGURE 1I).—Protopodite not segmented; bears three setae. Endopodite five-segmented; as long as exopodite; number of setae somewhat variable. Exopodite bears five natatory setae. No epipodite.

FIRST PEREPOD (FIGURE 1J).—Endopodite relatively short, wide, and partially segmented; chela partially formed; dactylopodite bears three simple spines. Exopodite a small lobe.

SECOND PEREPOD.—Similar in shape to first pereopod except narrower, exopodite smaller, and chela more deeply cleft.

THIRD (FIGURE 1K) TO FIFTH PEREPODS.—Each pair essentially identical except that they decrease slightly in size from third to fifth. No exopodites.

PLEOPODS.—First pleopod (Figure 1L) slightly cleft, without joints or setae. Second pleopod (Figure 1M) bilobed; outer lamella segmented; inner lamella usually only partially segmented but bears bud of appendix interna. Third to fifth pleopods essentially identical to second pleopod except both lamellae distinctly segmented.

ABDOMEN AND TELSON (FIGURES 1A, 1N).—Abdomen consists of five segments and telson (somite six is fused with telson in Stage I). Fourth and fifth abdominal segments each with pair of posterolateral spines nearly as long as segments themselves. Telson slightly emarginated distally; bears 19-21 densely plumose setae; small spinules occur between bases of all setae except two outermost pairs. Enclosed uropods visible. Anal spine present.

STAGE II ZOEAE

Total length of Stage II 8.3 mm (range 8.1-8.7 mm; 8 specimens). Color similar to Stage I zoea but more diffuse. Rostrum (Figure 2A) arched upward; slightly blunter than in Stage I; without teeth. Carapace bears supraorbital, antennal, and pterygostomial spines in addition to several spinules along anteroventral margin.

ANTENNULE (FIGURE 2B).—Shows considerable change from Stage I. Largest conical projection segmented at tip; terminal segment bears three setae of different lengths; proximal segment bears six groups of five aesthetascs each in addition to row of four aesthetascs laterally and single seta distally. Smallest conical projection bears three nonplumose setae, one long and two short. Peduncle of antennule rounded laterally, not segmented, and bears five plumose setae that originate ventrally.

ANTENNA (FIGURE 2C).—Flagellum of antenna still two-segmented, but slightly stouter and projection at tip smaller than in Stage I; a few

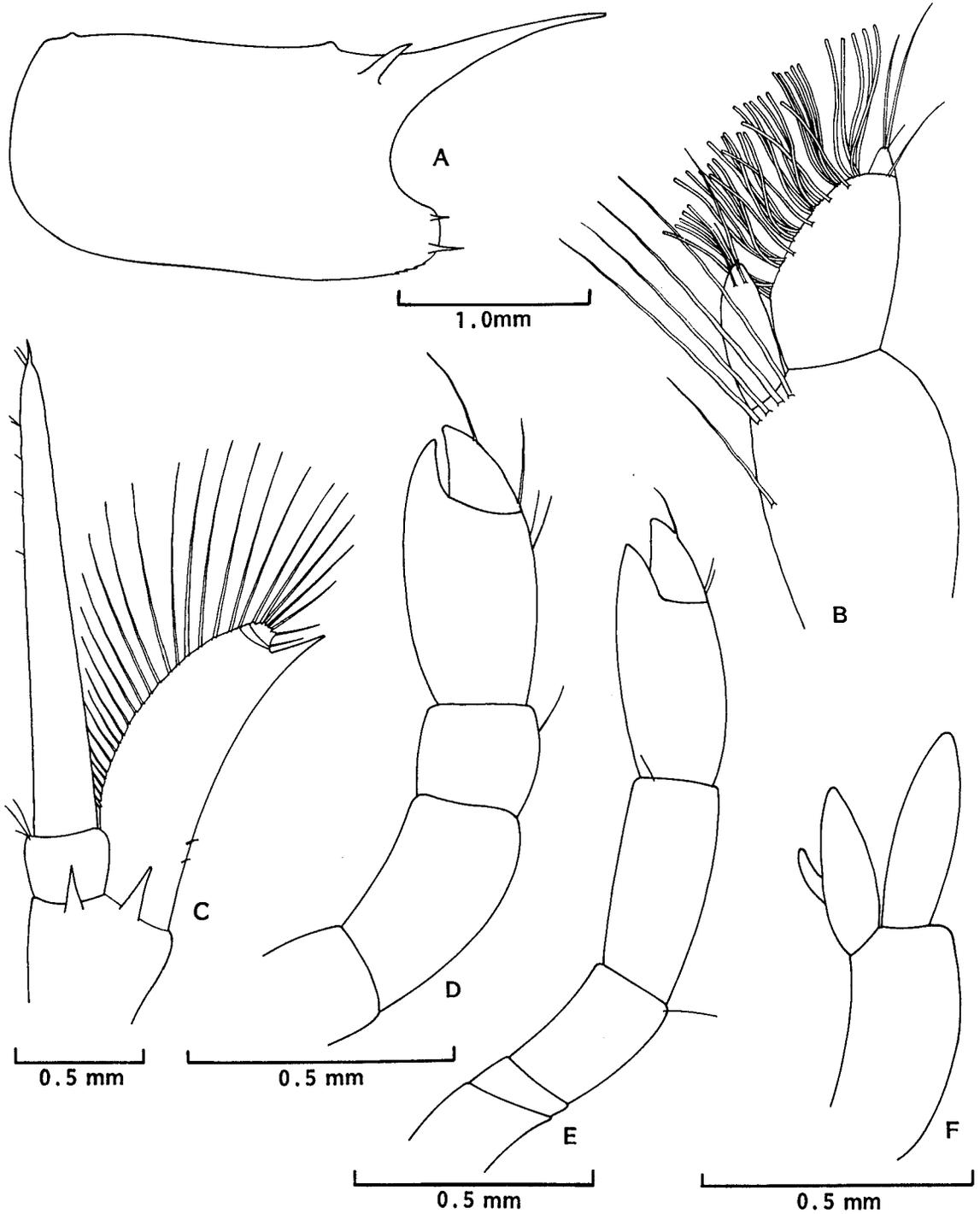


FIGURE 2.—Stage II zoea of *Lebbeus groenlandicus*: A, carapace; B, antennule; C, antenna; D, first pereopod; E, second pereopod; F, second pleopod.

small setae occur along lateral margin. Antennal scale distally divided into two segments and fringed with 29 or 30 thin, plumose setae along terminal and inner margins; distal outer projection a stout spine. Protopodite bears two stout spines, one at base of flagellum and other at base of scale.

MANDIBLES, MAXILLULE, AND MAXILLA.—Essentially identical to Stage I except scaphognathite of maxilla usually bears 35 setae along outer margin, in addition to the longer and thicker seta at proximal end, and proximal cleft slightly deeper.

MAXILLIPEDS.—Essentially identical to Stage I except exopodites of first, second, and third maxillipeds bear 5, 16, and 16 natatory setae, respectively.

FIRST PEREOPOD (FIGURE 2D).—Segmented; without exopodite; chela functional.

SECOND PEREOPOD (FIGURE 2E).—Adult in shape; chela functional; ischiopodite articulates somewhat laterally with basipodite. No exopodite.

THIRD TO FIFTH PEREOPODS.—Similar to Stage I except ischiopodite articulates somewhat laterally with meropodite and basipodite.

PLEOPODS.—First pleopod slightly more developed than in Stage I but still only about one-third length of second pleopod and without appendix interna. Second pleopod (Figure 2F) larger and narrower than in Stage I; outer lamella about one-fourth longer than inner lamella; both lamellae and appendix interna fully segmented at their bases. Third to fifth pleopods essentially identical to second pleopods.

ABDOMEN AND TELSON.—Posterolateral spines on fourth and fifth abdominal somites still present, those on fourth somite being only slightly shorter in relation to length of somite than in Stage I. Telson essentially identical to Stage I except segmented from sixth abdominal segment and bears 20 or 21 densely plumose setae. Uropods still enclosed.

STAGE III (MEGALOPA)

Total length of Stage III 7.5 mm (range 7.4-7.6 mm; two specimens). Antennal spine of carapace larger and pterygostomian spine smaller than in Stage II; no evidence of minute spinules along anteroventral margin. Rostrum (Figure 3A) short; bears single tooth at base in addition to dorsal protuberance. Antennules similar in shape to adult; outer flagellum six-segmented; inner flagellum five-segmented; peduncle three-segmented,

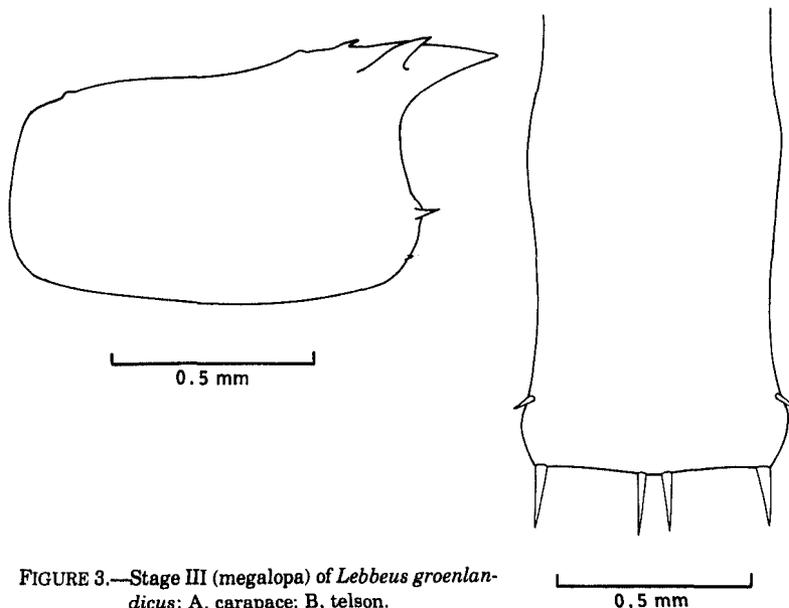


FIGURE 3.—Stage III (megalopa) of *Lebbeus groenlandicus*: A, carapace; B, telson.

lateral spine of proximal segment well developed. Antennal flagellum with at least 30 segments; about four times length of scale. Mandibles with unsegmented palps bearing four or five short teeth. Endopodite of maxillule reduced. Maxillipeds shaped as in adult, exopodites reduced. Dactylopodites of first and second pereopods well developed; carpopodite of second pereopod six- (sometimes seven-) segmented. Lateral margins of pleopods fringed with setae; appendix internae with minute cincinnuli. Posterolateral spines on abdominal segments four and five remnant or lacking. Telson (Figure 3B) rectangular in shape; bears two pairs of spines terminally and one pair laterally (one or two additional spines may occur centrally on terminal margin). Uropods exposed; fully developed except transverse hinge not complete.

COMPARISON OF LARVAL STAGES WITH DESCRIPTIONS BY OTHER AUTHORS

Under the name "*Spirontocaris*-larva No. 1A," Stephensen (1935) included four specimens that were morphologically identical to zoeae provisionally identified by him as Stage I *S. polaris* (= *Lebbeus polaris* (Sabine)) except that they differed by lacking spines on abdominal segments four and five, exopodites on any pereopods, or free uropods. He regarded these four zoeae as belonging to either *Spirontocaris groenlandica* (= *L. groenlandicus*), *S. gaimardii* (= *Eualus gaimardii* (H. Milne Edwards)), or *S. spinus* (Sowerby). Pike and Williamson (1961) have shown that the absence of spines on abdominal segments four and five eliminates the zoeae from being either *E. gaimardii* or *S. spinus*. They agree with Stephensen that his specimens of "*Spirontocaris*-larva No. 1A" are closely allied to zoeae he tentatively described earlier (Stephensen 1917, 1935) as *S. polaris* (= *L. polaris*). They suggest, therefore, that Stephensen's "*Spirontocaris*-larva No. 1A" probably belongs to the genus *Lebbeus* and specifically to *L. groenlandicus*.

Comparison of my zoeae of *L. groenlandicus* with the descriptions given by Stephensen for "*Spirontocaris*-larva No. 1A" shows that "*Spirontocaris*-larva No. 1A" are not zoeae of *L. groenlandicus*. My Stage I zoeae bear remnant exopodites on the first and second pereopods and lateral spines on abdominal segments four and five, but Stephensen's Stage I zoeae bear neither

the exopodites nor the spines. My Stage I zoeae do not bear supraorbital spines, the peduncle of the antennule is without joints or a ventral spine, and there is no indication of the carpopodite of the second pereopod being jointed; Stephensen's Stage I zoeae bear supraorbital spines, the peduncle of the antennule is three-jointed and bears a distinct ventral spine, and the carpopodite of the second pereopod is partially jointed. In addition, the chelae of the first and second pereopods are not as well formed in my Stage I zoeae as they are in Stephensen's Stage I zoeae.

Several of the morphological characteristics described by Stephensen as pertaining to "*Spirontocaris*-larva No. 1A" are typical of later stage zoeae, a fact already noted by Pike and Williamson (1961) in their discussion of the morphology of the zoeae of *L. polaris* and which prompted them to suggest that Stephensen's zoeae were actually in the second, or penultimate, zoeal stage. Even if Stephensen was mistaken in identifying his zoeae as Stage I rather than Stage II, the morphological differences between my zoeae and his are too great to consider them identical species. My Stage II zoeae bear spines on abdominal somites four and five and the telson is segmented from the sixth abdominal somite, whereas Stephensen's zoeae do not bear spines on abdominal somites four and five and the telson is not segmented from the sixth abdominal somite. Also, in my Stage II zoeae the peduncle of the antennule does not bear a ventral spine and is unsegmented but in Stephensen's zoeae the peduncle bears a ventral spine and is segmented.

I have no further evidence on the identity of Stephensen's "*Spirontocaris*-larva No. 1A." Of the three members of the genus recorded from Greenland waters, *L. polaris*, *L. groenlandicus*, and *L. microceros* (cf. Holthuis 1947; Squires 1966), *L. microceros* was not recorded by Stephensen. Apparently it is rare and its larvae have not been described. Also, the advanced development of Stephensen's "*Spirontocaris*-larva No. 1A" makes it unlikely that it belongs to another genus of the spirontocarid group (cf. Pike and Williamson 1961). Apparently Stephensen's "*Spirontocaris*-larva No. 1A" is either the zoea of *L. microceros* or that of another species of *Lebbeus* not yet recorded from Greenland waters.

On the basis of descriptions of "*Spirontocaris*-larva No. 1A" by Stephensen (1935) and a late stage embryo of *Hippolyte polaris* (= *L. polaris*) by Krøyer (1842), Pike and Williamson (1961)

characterized larvae of the genus *Lebbeus* as having two (or three) zoeal stages, five-segmented pereopods, and a small rostrum in Stage I, and pereopods without exopodites in the last zoeal stage. My description of larvae of *L. groenlandicus* confirms the generic characteristics for *Lebbeus* larvae as given by Pike and Williamson. As noted by Pike and Williamson, however, larvae are described for only a few species of hippolytids, including the genus *Lebbeus*, and further confirmation of the generic characteristics of the larvae is desirable.

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