

Stage-I zoeae of laboratory-hatched *Lopholithodes mandtii* (Decapoda, Anomura, Lithodidae)

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Of the approximately 25 species of Lithodidae of the northern North Pacific Ocean, larvae have been described, at least in part, for 11 species: *Dermaturus mandtii* Brandt, *Cryptolithodes typicus* Brandt, *Hapalogaster grebnitzkii* Schalfeew, *H. mertensii* Brandt, *Lithodes aequispina* Benedict, *Paralithodes brevipes* (Milne Edwards and Lucas), *P. camtschaticus* (Tilesius), *P. platypus* Brandt, *Placetron wosnessenskii* Schalfeew, *Rhinolithodes wosnessenskii* Brandt, and *Hapalogaster dentata* (De Haan). A review of the published descriptions of these larvae, except *H. dentata*, has been given by Haynes (1984). In this paper I describe and illustrate Stage-I zoeae of *Lopholithodes mandtii* Brandt and compare its morphology with the larvae reviewed by Haynes and with the published description of *H. dentata*.

Methods

Zoeae were hatched in the laboratory by an ovigerous female collected 4 April 1989 at Little Port Walter, southern Baranof Island, Alaska. The female was transported to the Auke Bay Laboratory 14 April 1989 and kept in an aquarium with running seawater. The zoeae began hatching about 2 wk later and were active swimmers, congregating near the surface of the aquarium. About 25 of the hatched zoeae were preserved every 2 or 3 d during 2-31 May 1989, until no zoeae remained alive in the aquarium. No attempt

was made to rear the zoeae. Water temperatures in the aquarium were 5.6-6.5°C during collection of the larvae. No prezoae were seen. None of the zoeae collected had molted to Stage II and no morphological differences were noted among the zoeae studied.

Methods of measuring zoeae and their appendages and techniques of illustrations follow Haynes (1984). Processes on the telson are numbered from the outermost to innermost (medial) pair. For clarity in the illustrations, setules on plumose setae and spinules on telsonal spines are omitted, but spinulose setae are shown. At least 5 zoeae were used to verify segmentation and setation; 10 zoeae were used for carapace and total length measurements.

Description of zoeae

Carapace (Fig. 1A,B) Mean carapace length, 1.3 mm (range 1.1-1.5 mm); mean total length (excluding telsonal processes), 5.7 mm (range 5.1-6.0 mm). Carapace with medially curved, long (>1/4 carapace length) posterolateral spines, and pronounced dorsal ridge. No supraorbital spines. Eyes sessile.

Antennule (Fig. 1C) First antenna (antennule) with unsegmented tubular portion (peduncle) and distal conical projection. Peduncle with ventral plumose seta. Conical projection with 5-6 aesthetascs and a simple seta terminally and two aesthetascs subterminally.

Antenna (Fig. 1D) Antenna with endopod and scale. Endopod slightly shorter than scale, and tipped with two hook-like projections. Antennal scale unsegmented, with fringe of 9 heavily plumose setae along terminal inner margin and prominent spine on distal outer margin. Ventral surface of protopodite with spinulose spine at base of endopod and naked spine at base of antennal scale.

Mandibles (Fig. 1E) Incisor process of right and left mandibles tooth-like with minute serrations. Right mandible: anterior margin with small teeth and denticulated projection; dorsal margin of molar with two denticular ridges; posterior margin with two denticulated projections. Left mandible: anterior margin with premolar denticles. Mandibles without subterminal processes, movable premolar denticle, palp, or palp bud.

Maxillule (Fig. 1F) Endopod 3-segmented, with 3 setae terminally, long distal seta on second segment, and short distal seta on 1st segment; coxal endite unsegmented with 4 plumodenticulate setae and 3 setae subterminally that sometimes have either a few minute spinules or setules; basal endite with 2 elongate, spinelike teeth armed with small denticles and 2 naked setae subterminally; no fine hairs on maxillule.

Maxilla (Fig. 1G) Endopod bilobed, setation formula 3,1,3; basal and coxal endites bilobed; coxal endite with 7 (sometimes 6) terminal and 1 subterminal setae on proximal lobe, 3 terminal and 1 subterminal setae on distal lobe, basal endite with 4 terminal and 1 subterminal setae on proximal lobe and 3 terminal and 1 subterminal setae on distal lobe; scaphognathite with 4 long, marginal plumose setae; fine

hairs on outer margin of endopod and proximal lobe of coxal endite.

Maxilliped 1 (Fig. 1H) No coxal setae, setation formula of basipod 2,2,3,3; endopod 5-segmented, setation formula 3,2,1,2,4+I (Roman numeral denoting subterminal seta); exopod partially segmented with 4 plumose natatory setae; endopod barely longer than exopod.

Maxilliped 2 (Fig. 1I) No coxal setae; basipod with 1 distal thin spine, armed with marginal spinules plus 1 naked seta and a naked seta in proximal half; endopod 4-segmented, first 3 segments each with distal thin spine armed with marginal spinules plus 1 plumose seta, fourth with 4+I plumose setae; exopod incompletely 2-segmented, 4 plumose natatory setae.

Maxilliped 3 (Fig. 1J) Exopod and endopod undeveloped; exopod partially segmented, with 3 undeveloped setae terminally; endopod with undeveloped seta terminally.

Pereopods (Fig. 1K) Poorly developed, without exopods; 1st pereopod bilobed; 5th pereopod arises medially between 1st and 2nd pereopods.

Abdomen and telson (Fig. 1L) Abdomen with 5 somites and telson (somite 6 fused with telson); somites 2-4 each with 3 pairs of spines, 2 pairs posterodorsal, 1 pair lateral, lateral pair longest; posterodorsal spines of somite 2 generally equal-sized; median pair of somites 2-4 strongest; lateral pair on somite 5 long (~1.4 times somite width), pointed, somewhat sinuate; telson margin convex with median cleft and 8+8 processes (1,i,3-8), 1st an articulated simple spine, 2nd an anomuran hair (i), 3rd-8th denticulate spines, 4th pair longest, about equal to maximum telson width; all articulated with telson; no uropods or anal spine.

Distinction between *L. mandtii* and other lithodid zoeae

Stage-I zoeae of *L. mandtii* are typical of Stage-I lithodid larvae of the northern North Pacific Ocean as

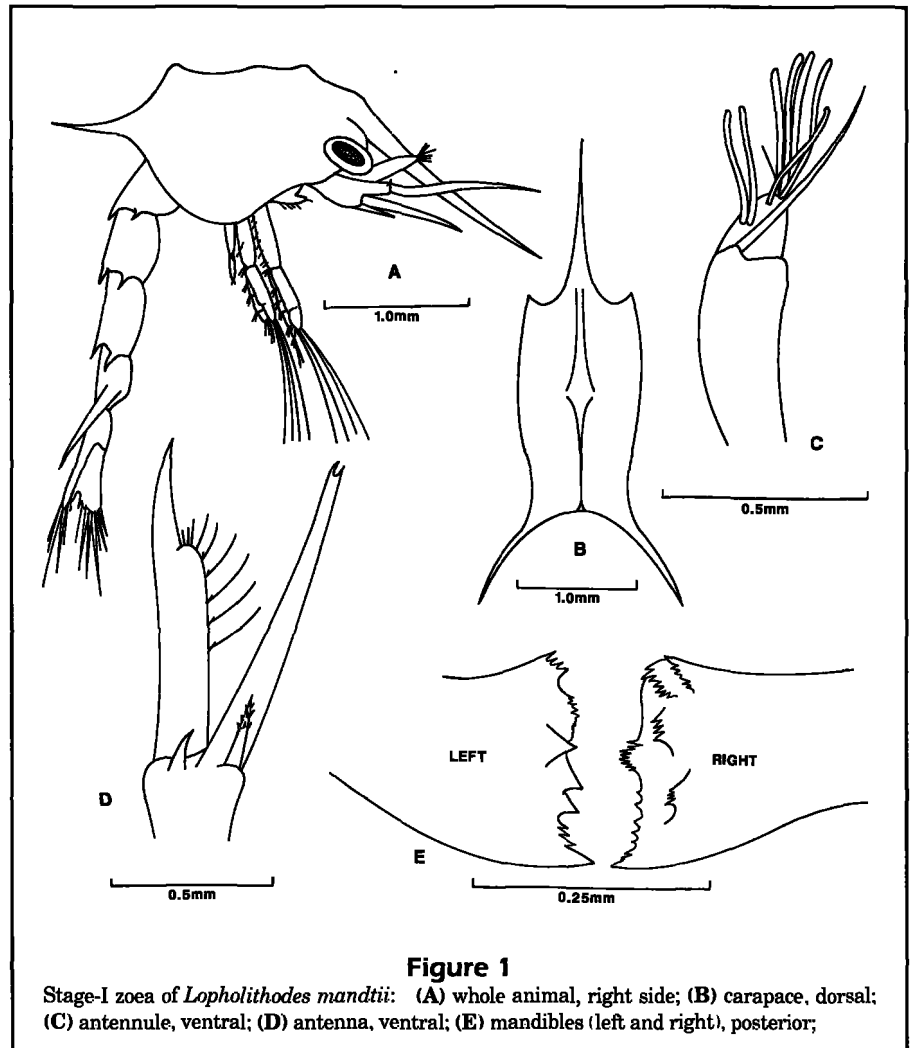
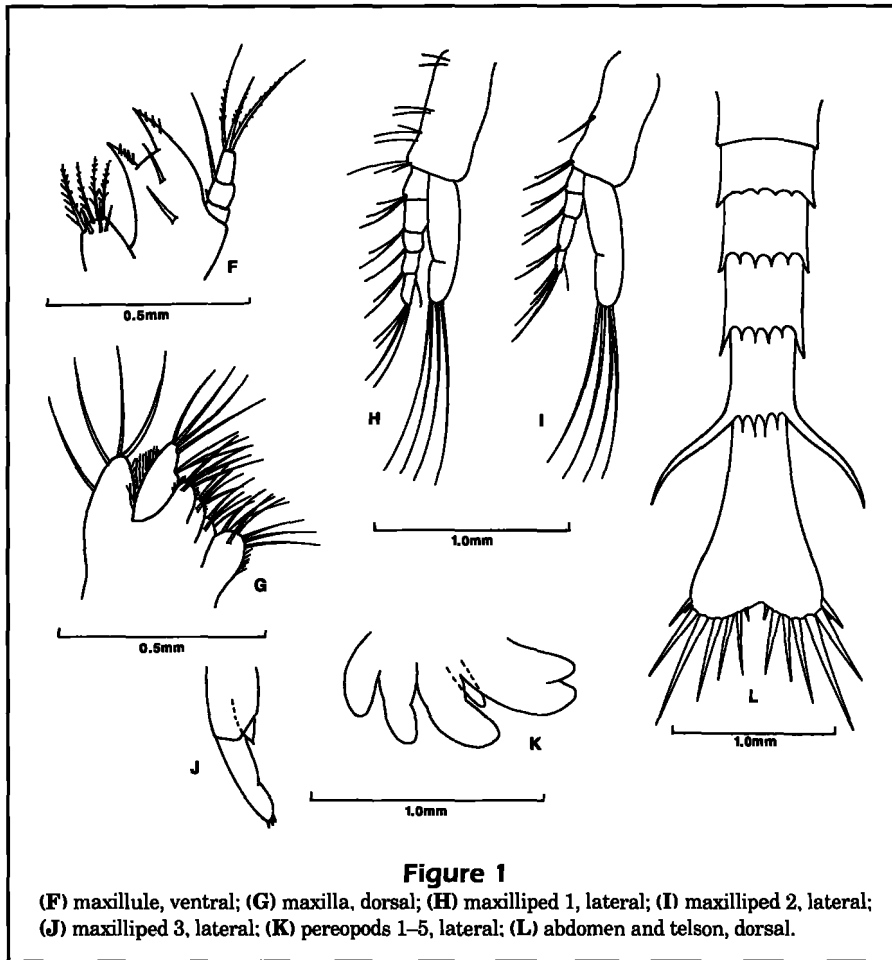


Figure 1
Stage-I zoea of *Lopholithodes mandtii*: (A) whole animal, right side; (B) carapace, dorsal; (C) antennule, ventral; (D) antenna, ventral; (E) mandibles (left and right), posterior;

characterized by Haynes (1984). The morphological characteristics of Stage-I lithodid larvae are: sessile eyes and 4 natatory setae each on maxillipeds 1 and 2, maxilliped 3 undeveloped and without natatory setae, pleopods and uropods absent, telson and 6th abdominal somite fused. Lithodid species with typical Stage-I zoeae have 4 zoeal stages. Thus, *L. mandtii* probably has 4 zoeal stages also.

Since the review of lithodid larvae of the northern North Pacific Ocean by Haynes (1984), larvae of *Hapalogaster dentata* have been described by Konishi (1986) who noted that zoeae of *H. dentata* are most similar to those of *Dermaturus mandtii* and can be distinguished from the latter by setation of the antennal scale (7 vs. 10 setae) and the absence of a minute subterminal spine on the antennal endopod in *D. mandtii*. Stage-I zoeae of *H. dentata* are readily distinguished from Stage-I *L. mandtii* by the short ($\leq 1/4$ carapace length) posterolateral spines on the carapace and 7+7 telsonal processes.



Comparing Stage-I *L. mandtii* with published descriptions of Stage-I lithodid larvae of the northern North Pacific, they are most similar to Stage-I *Paralithodes camtschaticus*, *P. platypus*, and *Placetron wosnessenskii*. These four species are characterized by a relatively long, pointed rostrum and by relatively long posterolateral spines on the carapace (Sato 1958, Kurata 1964, Makarov 1967, Haynes 1984).

Stage I of *L. mandtii* can be distinguished from *Paralithodes camtschaticus* and *P. platypus* by the shape of the posterolateral spines on the carapace and on somite 5 of the abdomen. In *L. mandtii*, the posterolateral spines on the carapace are slightly longer and have more outward curvature, and the posterolateral spines on somite 5 are longer and more sinuous than in *P. camtschaticus* or *P. platypus*. Also, Stage-I *P. camtschaticus* has fewer plumose setae on the antennal scale than Stage-I *L. mandtii* (5 vs. 9), and Stage-I *P. platypus* has 9+9 telsonal processes rather than 8+8.

Stage-I *L. mandtii* can be distinguished from Stage-I *Placetron wosnessenskii* by general appearance and

spination of the abdomen and telson. Individuals of the latter species are noticeably more rugose; the carapace is more heavily ridged and the rostrum is deeper than in Stage-I *L. mandtii*. In Stage-I *P. wosnessenskii* the abdominal spines are relatively long (those of abdominal somite 2 are one-half the length of abdominal somite 3), wide, and blunt, whereas in Stage-I *L. mandtii* the abdominal spines are short (those of somite 2 about one-third the length of somite 3), narrow, and pointed. Also, the telson of *P. wosnessenskii* has 7+7 terminal processes whereas the telson of *L. mandtii* has 8+8 terminal processes.

Citations

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