EARLY ZOEAL STAGES OF *PLACETRON WOSNESSENSKII* AND *RHINOLITHODES WOSNESSENSKII* (DECAPODA, ANOMURA, LITHODIDAE) AND REVIEW OF LITHODID LARVAE OF THE NORTHERN NORTH PACIFIC OCEAN

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ABSTRACT

Stage I zoeae of *Placetron wosnessenskii*, and Stage I and Stage II zoeae of *Rhinolithodes wosnessenskii*, which were reared in the laboratory, can be distinguished from other described zoeae of Lithodidae: *P. wosnessenskii* have long, blunt spines on posterior margins of abdominal somites 2-5 and sinuate curvature of long, blunt, posterolateral spines on abdominal somite 5; *R. wosnessenskii* zoeae have a spine in the middorsal, posterior portion of the carapace. Zoeae of Lithodidae can be distinguished from zoeae of Pagurinae by body shape, size of the eyes, spines on the carapace, development of uropods, and presence or absence of the anal spine. Stages of lithodid zoeae can be distinguished by eye attachment, number of natatory setae on maxillipeds, and development of pleopods, uropods, and telson. Keys, based on spination of the carapace, rostrum, abdomen, and telson, distinguish between zoeae and glaucothoe of each described species of Lithodidae from the northern North Pacific Ocean.

Crabs of the family Lithodidae constitute a major component of the reptant decapod fauna of the northern North Pacific Ocean. Of about 25 species of Lithodidae in the northern North Pacific Ocean, larvae have been described, at least in part, for eight species: *Dermaturus mandtii* Brandt, *Cryptolithodes typicus* Brandt, *Hapalogaster grebnitzkii* Schalfeew, *H. mertensii* Brandt, *Lithodes aequispina* Benedict, *Paralithodes brevipes* (Milne Edwards and Lucas), *P. camtschatica* (Tilesius), and *P. platypus* Brandt. Most descriptions are scattered in foreign scientific journals, however, and published reviews of the larvae are limited in species and scope. This report describes and illustrates Stage I zoeae of *Placetron wosnessenskii* Schalfeew and Stages I and II zoeae of *Rhinolithodes wosnessenskii* Brandt reared in the laboratory from ovigerous females. I characterize the morphological differences between zoeae of the Lithodidae and subfamily Pagurinae (family Paguridae), compare the morphology of lithodid larvae of the northern North Pacific Ocean, and provide keys for identifying the described larvae to species and stage.

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METHODS AND RESULTS

In March 1982, ovigerous females of *Placetron wosnessenskii* and *Rhinolithodes wosnessenskii* were collected near Auke Bay, Alaska, in traps and by divers using scuba. The females were transported to the laboratory and kept in filtered seawater (about 6°C) until the zoeae hatched about 1 wk later. After hatching, about 50 zoeae of each species were transferred to each of four 4 l glass jars containing about 2,500 ml of seawater at 6.1°C. Seawater in the jars was changed about every other day. Zoeae were fed live plankton strained through a 0.333 mm mesh. About 10 ml of live plankton was added to each jar every other day. The live plankton consisted mostly of phytoplankton and barnacle nauplii. A more detailed description of the rearing system and type and duration of illumination is given in Haynes and Ignell (1983).

Zoeae of *Placetron wosnessenskii* hatched at night, and samples of zoeae were taken the following morning. No prezoeae of *P. wosnessenskii* were seen. *Rhinolithodes wosnessenskii* zoeae hatched at night and during the day, and those examined about 10 min after hatching had remnants of prezoeal exuviae attached to the cephalothorax and telson. The remnant exuviae are not described in this paper.

Although food was seen in the guts of some *Placetron wosnessenskii* zoeae, none molted to Stage II. Zoeae of *Rhinolithodes wosnessenskii* fed actively and molted to Stage II about 20 d after hatching. Failure to change the seawater on schedule prevented rearing the zoeae of *R. wosnessenskii* beyond Stage II.

DESCRIPTION OF ZOEAE

Terminology, methods of measuring zoeae and their appendages, techniques of illustration, and nomenclature of appendages follow Haynes (1979). Carapace length refers to the straight-line distance from posterior margin of eye orbit to middorsal posterior margin of carapace, excluding the middorsal spine. Spines on the telson are numbered from the outermost to innermost (medial) pair. Setation formulae are the number of setae per segment from the distal segment to the proximal segment. For clarity in the illustrations, setules on plumose setae are usually omitted, but

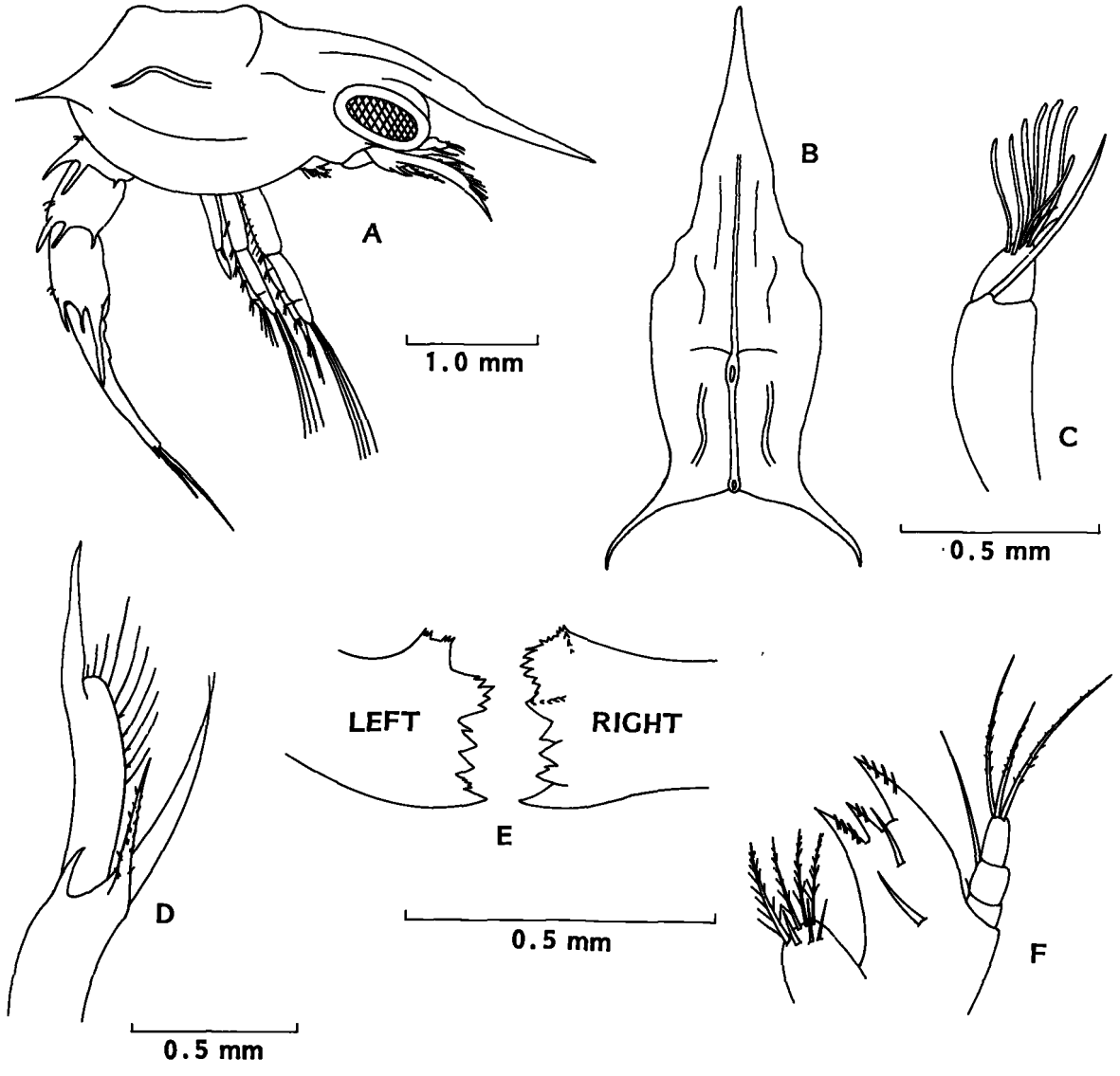
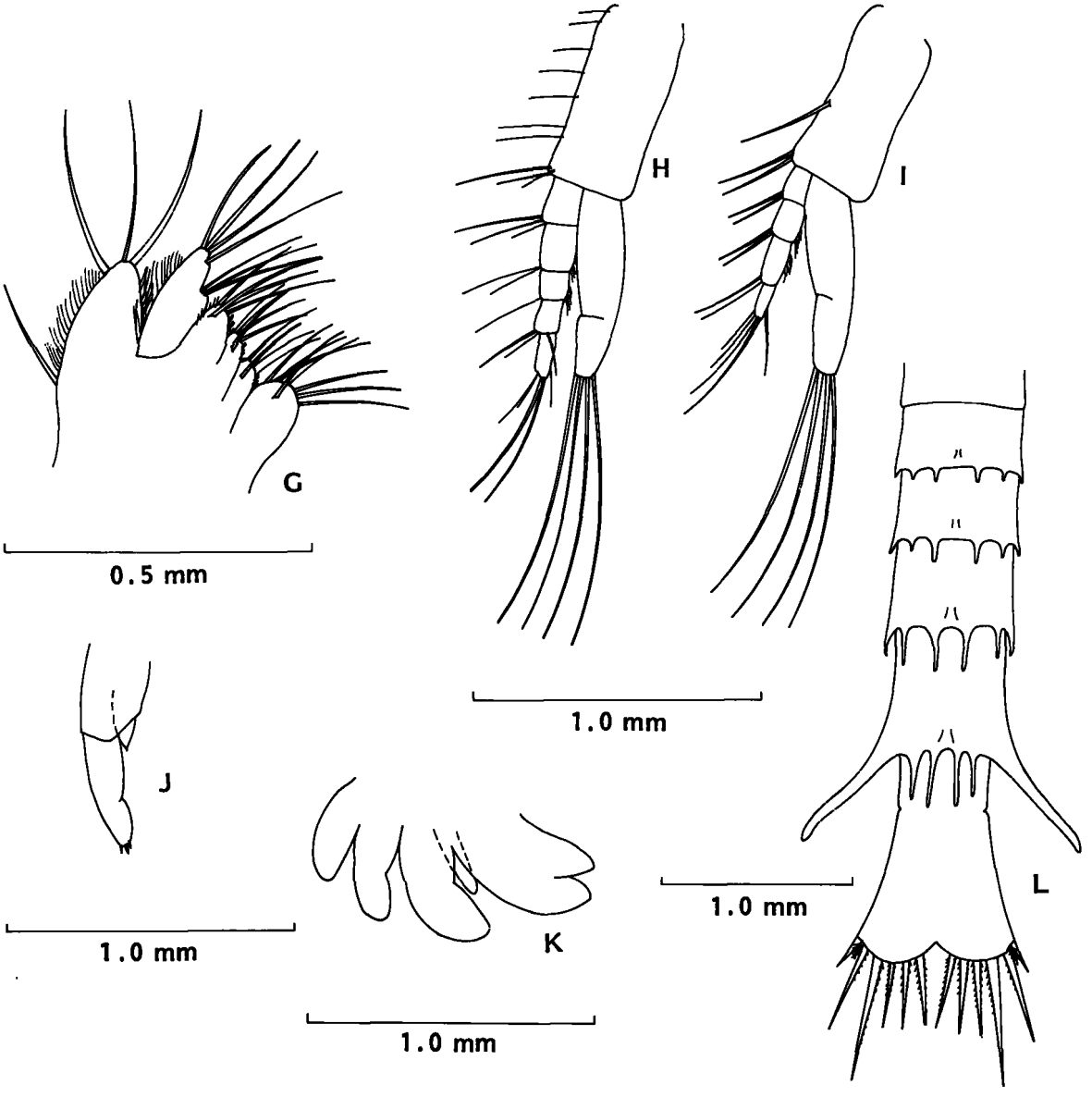


FIGURE 1.—Stage I zoea of *Placetron wosnessenskii*: A, whole animal, right side; B, carapace, dorsal; C, antennule, ventral; D, antenna, ventral; E, mandibles (left and right), posterior; F, maxillule, ventral; G, maxilla, dorsal; H, first maxilliped, lateral;

spinulose setae are shown. Five zoeae were used to verify segmentation and setation; 10 zoeae were used for measurements. Only those morphological characteristics useful for readily identifying each stage are given.

Placetron wosnessenskii — Stage I Zoeae

Mean carapace length, 2.12 mm (range 2.08-2.21 mm, 10 specimens); mean total length, 6.22 mm (range 5.90-6.70 mm, 10 specimens) (Fig. 1A, B). Live zoeae orange throughout except for colorless appendages and posterolateral spines on carapace and abdomen. Carapace with medially curved, long (>1/4 carapace length), posterolateral spines; markedly pronounced lateral ridges and dorsoventral ridge; and two middorsal angular prominences: one near center of carapace and other at posterior edge. No supraorbital spines. Eyes sessile.



I, second maxilliped, lateral; J, third maxilliped, lateral; K, pereopods 1-5, lateral; L, abdomen and telson, dorsal.

Antennule (Fig. 1C).—First antenna (antennule) with unsegmented tubular basal portion (peduncle) and distal conical projection. Peduncle with ventral plumose seta. Conical projection with seven aesthetascs and two simple setae terminally.

Antenna (Fig. 1D).—Second antenna (antenna) with inner flagellum (endopodite) and outer antennal scale (exopodite). Flagellum unsegmented, shorter than scale, and tipped with two simple setae. Antennal scale without distal joint, has fringe of 10 heavily plumose setae along terminal inner margin and prominent spine on distal outer margin. Ventral surface of protopodite with spinulose spine at base of flagellum and naked spine at base of antennal scale.

Mandible (Fig. 1E).—Incisor process of right mandible a tooth; left mandible with biserrate incisor process. Anterior margins of each mandible with premolar denticles. Mandibles without subterminal processes or movable premolar denticle (lacinia mobilis).

Maxillule (Fig. 1F).—First maxilla (maxillule) with coxopodite, basipodite, and endopodite. Coxopodite (proximal lobe) unsegmented with four large spinulose spines and three simple spines terminally. Basipodite (median lobe) with three spines terminally (each spine with several spinules) and two simple spines subterminally. Three-segmented endopodite originates from lateral margin of basipodite. Endopodite with three setae terminally, a long distal seta on second segment, and a short distal seta on first segment. Fine hairs on inner and outer margins of exopodite, outer margin of endopodite, both lobes of basipodite, and distal lobe of coxopodite.

Maxilla (Fig. 1G).—Second maxilla (maxilla) with platelike exopodite (scaphognathite). Exopodite with three long plumose setae terminally and a subterminal plumose seta on outer margin; no proximal expansion of exopodite. Endopodite unsegmented, setation formula 3, 1, 3. Basipodite and coxopodite bilobed. Basipodite with four setae on distal lobe and five setae on proximal lobe. Coxopodite with four setae on distal lobe and eight (sometimes seven) setae on proximal lobe. Fine hairs on inner and outer margins of scaphognathite, outer margins of endopodite, and distal margins of basipodite and coxopodite.

First maxilliped (Fig. 1H).—Exopodite partially segmented with four natatory setae. Endopodite slightly longer than exopodite and distinctly five segmented; setation formula 5, 3, 1, 2, 3. Protopodite unsegmented with 10 setae.

Second maxilliped (Fig. 1I).—Similar to first maxilliped except endopodite slightly shorter than exopodite. Endopodite four segmented, setation formula 5, 2, 2, 2. Protopodite with three lateral setae.

Third maxilliped (Fig. 1J).—Exopodite and endopodite undeveloped. Exopodite partially segmented, with three undeveloped setae terminally. Endopodite with undeveloped seta terminally.

Pereopods (Fig. 1K).—Poorly developed, without exopodites. First pereopod bilobed. Fifth pereopod arises medially between first and second pereopods.

Abdomen and telson (Fig. 1A, L).—Abdomen with five somites and telson (somite 6 fused with telson). Somites 2-5 have six bluntly tipped spines on posterior margin and two minute dorsal setae. Outer pair of posterior spines on somite 5 are long (about 1.2 times somite width), blunt, and somewhat sinuate. Telson with medial invagination posteriorly and 6 + 6 spines. Third pair of telsonic spines longest (about 3/4 maximum telson width). All spines jointed with telson. Minute seta between spinal pairs 1 and 2 originates from ventral surface; seta often without setules; spinules on spinal pairs 2-6. No uropods or anal spine.

Rhinolithodes wosnessenskii

Stage I Zoeae

Mean carapace length, 1.29 mm (range 1.21-1.34 mm, 10 specimens); mean total length, 4.45 mm (range 4.02-4.62 mm, 10 specimens) (Fig. 2A, B). Cephalothorax and base of maxillipeds orange; remainder of maxillipeds, most of rostrum, and all of abdomen colorless. Carapace with middorsal angular prominence and spine at middorsal posterior margin; medially curving, long (>1/4 carapace length), posterolateral spines; markedly pronounced lateral ridge. No supraorbital or anal spine. Eyes sessile.

Antennule (Fig. 2C).—Distal conical projection unsegmented from peduncle. Peduncle with ventral plumose seta. Conical projection with seven

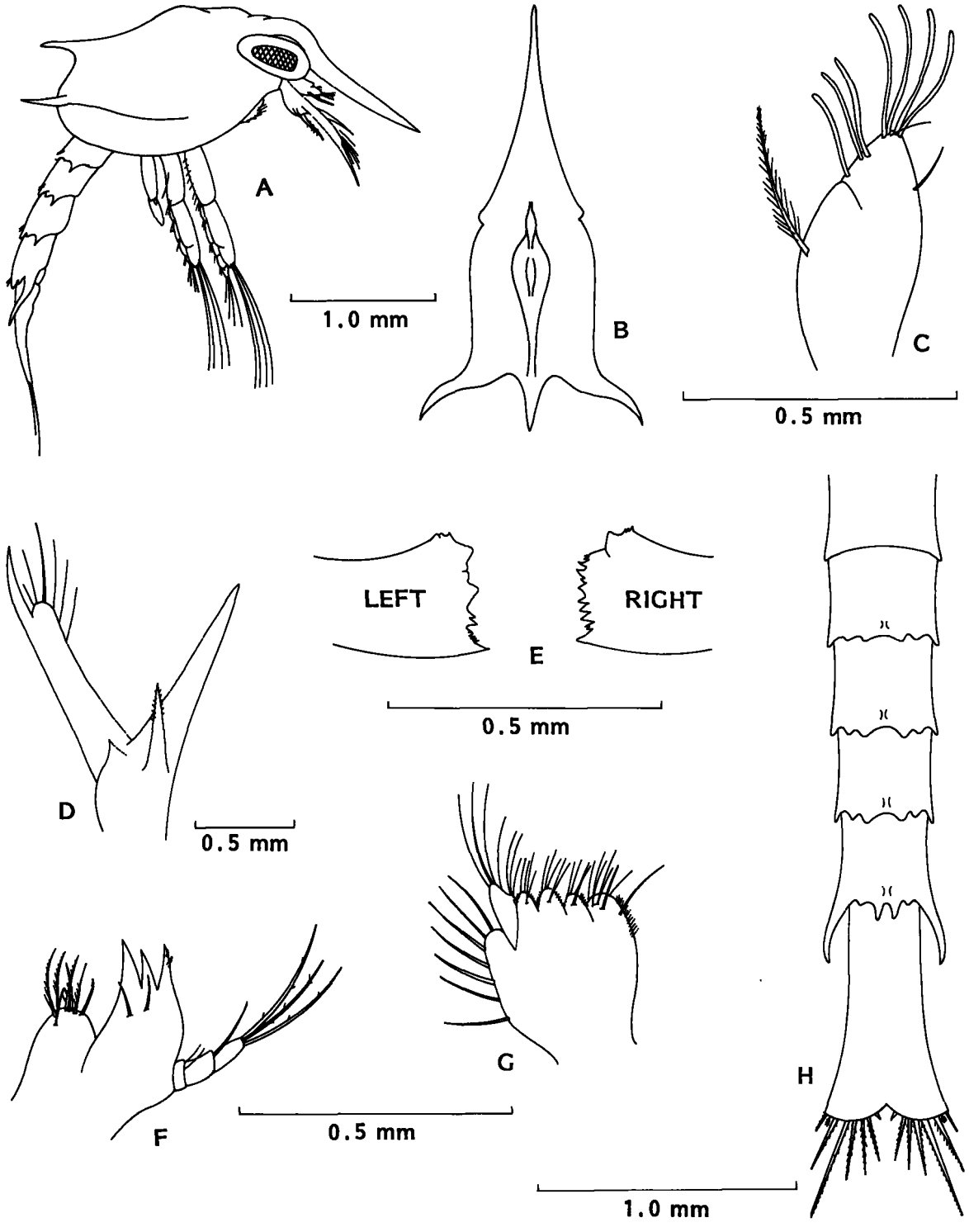


FIGURE 2.—Stage I zoea of *Rhinolithodes wosnessenskii*: A, whole animal, right side; B, carapace, dorsal; C, antennule, ventral; D, antenna, ventral; E, mandibles (left and right), posterior; F, maxillule, ventral; G, maxilla, dorsal; H, abdomen and telson, dorsal.

aesthetascs and two simple setae (one terminal and one lateral).

Antenna (Fig. 2D).—Antenna with inner flagellum and outer antennal scale; flagellum without setae and shorter than scale. Antennal scale unjointed distally, fringed with six heavily plumose setae along terminal and inner margins, and prominent spine distally on outer margin. Ventral surface of protopodite with spinulose spine at base of flagellum and smaller naked spine at base of scale.

Mandible (Fig. 2E).—Incisor processes of left and right mandibles a single tooth. Anterior margins of each mandible with premolar denticles. No subterminal processes or movable premolar denticles.

Maxillule (Fig. 2F).—Similar to Stage I *Placetron wosnessenskii* except spines of basipodite less spinulose and proximal segment of endopodite with two simple setae terminally instead of one.

Maxilla (Fig. 2G).—Scaphognathite with seven long plumose setae on outer margin, no proximal expansion, setation formulae of endopodite, basipodite, and coxopodite same as in Stage I *Placetron wosnessenskii*. Fine hairs on margins of basipodite and coxopodite.

Maxillipeds 1-3 and pereopods 1-5.—Nearly identical in shape and number of setae to those of Stage I *Placetron wosnessenskii*.

Pleopods.—Absent.

Abdomen and telson (Fig. 2A, H).—Short blunt spines on abdominal somites 2-5; length of outer pair on somite 5 about 0.8 times maximum width of somite. Telson with medial invagination and 7 + 7 posterior spines. Third pair of telsonic spines longest, about 3/4 maximum telson width; minute seta between spinal pairs 1 and 2 sometimes without setules; spinules on spinal pairs 2-6. No uropods or anal spine.

Stage II Zoeae

Mean carapace length, 1.30 mm (range 1.21-1.34 mm, 10 specimens); mean total length, 4.81 mm (range 4.02-5.03 mm, 10 specimens). No supraorbital spine. Eyes stalked. Characters not mentioned are nearly identical to characters of Stage I.

Antennule.—Distal conical projection segmented from peduncle.

Antenna.—Tip of flagellum may have small spine. Antennal scale with seven plumose setae along terminal and inner margins.

Mandible.—Right mandible with five teeth between incisor and molar processes.

Maxillule.—Basipodite with five terminal spines (four slightly spinulose).

Maxilla.—Scaphognathite with 11 plumose setae on outer margin; no proximal expansion. Setation formulae of endopodite 4, 1, 3.

First and second maxillipeds.—Exopodite with seven natatory setae terminally.

Third maxilliped (Fig. 3).—Exopodite with six plumose setae terminally. Endopodite with two plumose setae terminally.

Pleopods.—May be present as minute buds.

Abdomen and telson.—Identical to Stage I except joint between somite 6 and telson indicated by small indentation in lateral margins.

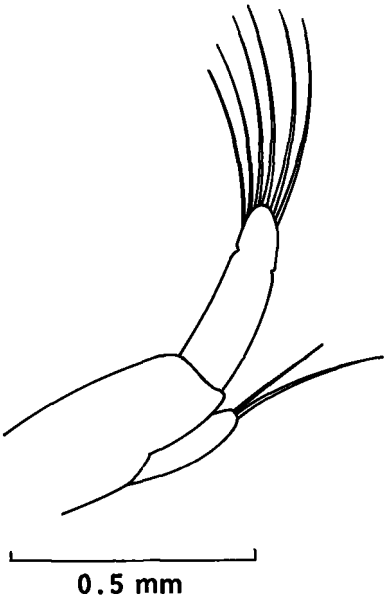


FIGURE 3.—Stage II zoea of *Rhinolithodes wosnessenskii*: third maxilliped, lateral.

DISTINCTION BETWEEN ZOEAE OF LITHODIDAE AND PAGURINAE

Zoeae of the family Lithodidae have long been considered similar morphologically to those of the subfamily Pagurinae (family Paguridae) and differ only in reduction or disappearance of the uropods (Gurney 1942; MacDonald et al. 1957). Recent descriptions of zoeae of *Cryptolithodes typicus*, *Lithodes aequispina*, *L. antarctica*, and *Paralomis granulosa* (Hart 1965; Haynes 1982; Campodonico 1971; Campodonico and Guzman 1981) have extended the range of zoeal characters of the Lithodidae and show that zoeae of the Lithodidae and Pagurinae can be distinguished by size of the eyes and morphology of the carapace and abdominal appendages (Table 1). In general, zoeae of the Lithodidae (except *Cryptolithodes typicus*) are characterized by stoutness, small eyes, posterolateral spines in middle or lower half of carapace, uniramous uropods, and no anal spine. Zoeae of the Pagurinae are characterized by slenderness, large eyes, posterolateral spines in the middle or upper half of the carapace, biramous uropods, and an anal spine. The glaucothoe of the Lithodidae and Pagurinae are readily distinguished from each other by their similarity to the adults (Haynes 1982).

TABLE 1.—Characters useful for distinguishing between zoeae of Lithodidae and zoeae of Pagurinae from the northern North Pacific Ocean. Zoeae of *Cryptolithodes typicus* (Lithodidae) are an exception and are not characterized in this table.

Lithodidae	Pagurinae
1. General appearance, stout.	General appearance, slender.
2. Longitudinal diameter of eye less than width of abdomen.	Longitudinal diameter of eye greater than width of abdomen.
3. Posterolateral spines of carapace in middle or lower half of posterior margin.	Posterolateral spines of carapace in middle or upper half of posterior margin.
4. Lateral margins of carapace nearly parallel.	Lateral margins of carapace converge posteriorly.
5. No anal spine in any stage.	Anal spine present until Stage III in some species.
6. More than eight pairs of telsonic spines in some species (excluding minute seta).	Never more than eight pairs of telsonic spines (excluding seta).
7. Uropods (when present) uniramous and terminal margin blunt with (usually three or four) short setae.	Uropods biramous; exopodite stylliform terminally with usually more than three or four long setae along medial margin.

MORPHOLOGY OF LITHODID LARVAE

Lithodidae of the northern North Pacific Ocean have four zoeal stages and a glaucothoe. Stage I zoeae are characterized by sessile eyes, four natatory setae on maxillipeds 1 and 2; maxilliped 3 is undeveloped and without natatory setae; pleopods and uropods are absent; and the telson and abdominal somite 6 are fused. Beginning in Stage II, the eyes are movable, and maxillipeds have at least six natatory setae. In Stage III, undeveloped pleopods and uropods are present, and the telson and abdominal somite 6 are articulated. In Stage IV, the pleopods are biramous, and the uropods are two segmented and usually have three or four apical setae. Table 2 and the keys are provided for distinguishing described zoeae and glaucothoe of Lithodidae of the northern North Pacific Ocean. Glaucothoe of *H. grebnitzkii*, *P. wosnessenskii*, and *R. wosnessenskii* have not been described.

TABLE 2.—Characters useful for distinguishing between Stages I-IV of lithodid zoeae of the northern North Pacific Ocean. *Paralithodes brevipes* may have only three zoeal stages (Kurata 1956), thus, may not always conform to the descriptions in this table.

Characteristic	Stage I	II	III	IV
Eyes	sessile	movable	movable	movable
Natatory setae				
First maxilliped	4	≥6	≥6	≥6
Second maxilliped	4	≥6	≥6	≥6
Third maxilliped	0	≥6	≥6	≥6
Pleopods	absent	absent	absent or present as buds	present
Uropods	absent	absent	present; unsegmented	present; two segmented
Telson and sixth abdominal somite	fused	fused	articulated	articulated

Described Lithodid Zoeae of the Northern North Pacific Ocean

1a. Carapace without posterolateral spines; uropods absent in all stages; posterior margin of telson without medial invagination ..... *Cryptolithodes typicus*

1b. Carapace with posterolateral spines; uropods present in later stages (usually Stages III and IV); posterior margin of telson with medial invagination 2

2a. Posterolateral spines of carapace short (< 1/4 carapace length) 3

2b. Posterolateral spines of carapace long (> 1/4 carapace length) 5

3a. Posterolateral spines and denticles on abdominal somites 3 and 4 about same length; posterior margins of carapace concave ..... *Hapalogaster grebnitzkii*

3b. Posterolateral spines obviously longer than denticles on abdominal somites

3 and 4; posterior margin of carapace convex 4

4a. Carapace length 1.2-1.4 mm; antennal flagellum and scale (including distal spine) about same length; antennal scale ≤5 times as long as wide ..... *Dermaturus mandtii*

4b. Carapace length 1.4-1.7 mm; antennal flagellum longer than antennal scale (including distal spine); antennal scale about 9 times as long as wide ..... *Paralithodes brevipes*

5a. Carapace with middorsal posterior spine ..... *Rhinolithodes wosnessenskii*

5b. Carapace without middorsal posterior spine 6

6a. Antennal scale with ≤6 markedly short (<1/2 scale width), lightly plumose setae ..... *Hapalogaster mertensii*

6b. Antennal scale with ≥6 long (≥1/2 scale width), heavily plumose setae 7

7a. Posterolateral spines of carapace project somewhat laterally; telson has ≥11 pairs of spines (excluding minute hair); longest (third) pair of telsonic spines fused to telson ..... *Lithodes aequispina*

7b. Posterolateral spines of carapace do not project laterally; telson has ≤8 pairs of spines (excluding minute hair); longest (third) pair of telsonic spines jointed with telson 8

8a. Spines on posterior margins of abdominal somites 2-5 markedly long and tips blunt; posterolateral spine on abdominal somite 5 blunt and sinuate ..... *Placetron wosnessenskii*

8b. Spines on posterior margins of abdominal somites 2-5 typically short and tips pointed; posterolateral spine on abdominal somite 5 pointed and not sinuate 9

9a. Telsonic spines 8 + 8 (excluding minute hair) ..... *Paralithodes platypus*

9b. Telsonic spines 7 + 7 (excluding minute hair) ..... *Paralithodes camtschatica*

Described Lithodid Glaucothoe of the Northern North Pacific Ocean. Glaucothoe of *Hapalogaster grebnitzkii*, *Placetron wosnessenskii*, and *Rhinolithodes wosnessenskii* have not been described.

1a. Dorsal surface of carapace without spines 2

1b. Dorsal surface of carapace with spines 4

2a. Carapace triangular ..... *Cryptolithodes typicus*

2b. Carapace rectangular 3

3a. Lateral margin of carapace with teeth in branchial region but not in hepatic region ..... *Hapalogaster mertensii*

3b. Lateral margin of carapace with teeth in branchial and hepatic regions ..... *Dermaturus mandtii*

4a. Tips of anterolateral spines of rostral complex spinulose; most, if not all, spines on dorsal surface of carapace bifid ..... *Lithodes aequispina*

4b. Tips of anterolateral spines of rostral complex styliform or bifid; most, if not all, spines on dorsal surface of carapace styliform 5

5a. Carapace with 15 pairs of spines on dorsal surface ..... *Paralithodes platypus*

5b. Carapace with <15 pairs of spines on dorsal surface 6

6a. Carapace with 14 pairs of spines on dorsal surface .. *Paralithodes camtschatica*

6b. Carapace with 13 pairs of spines on dorsal surface ..... *Paralithodes brevipes*

Paralithodes brevipes may have three stages; thus, Table 2 may not always be appropriate for distinguishing the stages of this species. Kurata (1956) reared and described the larvae of *P. brevipes* from ovigerous females collected in Japanese waters. In Kurata's description, *P. brevipes* has three zoeal stages instead of the four that characterize the genus, and Stage III zoeae correspond morphologically to Stage IV zoeae of the genus. Makarov (1967), however, found four zoeal stages of *P. brevipes*, including a Stage III zoea, in plankton of the west Kamchatkan coast that correspond morphologically to Stage III zoeae of the genus. Kurata's zoeae may have skipped Stage III of the genus because growing conditions in the laboratory were especially favorable (Makarov 1967).

Only Stage I zoeae of *Placetron wosnessenskii*, and Stages I and II zoeae of *Rhinolithodes wosnessenskii* have been described (this report). Because these zoeal stages are morphologically typical of lithodid species with four zoeal stages, *P. wosnessenskii* and *R. wosnessenskii* likely have the four zoeal stages characterized in Table 2.

Brief descriptions and comparisons of previously described lithodid zoeae follow.

Cryptolithodes typicus.—Based on the description by Hart (1965), *Cryptolithodes typicus* zoeae are markedly different morphologically from other described lithodid zoeae. In *C. typicus* zoeae, the carapace lacks posterolateral spines in all stages, the proximal expansion of the maxilla is present in Stage II, and the telson does not have a medial posterior invagination. In all other lithodid zoeae, the carapace has posterolateral spines in all stages, the proximal expansion of the maxilla is absent until Stage IV, and the telson has a medial posterior invagination. The large eyes of *C. typicus*, however, are typical of zoeae of the Pagurinae, and the absence of posterolateral spines on the carapace is similar to zoeae of some species of the Diogenidae. The shape of the telson, the fused abdominal somite 6 and telson in Stages III and IV, and the absence of uropods in *C. typicus* are characters similar to those of some porcellanid zoeae.

Hapalogaster grebnitzkii, *Dermaturus mandtii*, and *P. brevipes.*—Makarov (1967) briefly described larvae collected off west Kamchatka that he provisionally identified as *Hapalogaster grebnitzkii*, based on distribution of adults. Zoeae of *H. grebnitzkii* are morphologically similar to zoeae of *Dermaturus mandtii* and *Paralithodes brevipes* but can be distinguished by length of the posterolateral spines on abdominal somites 3-5. In zoeae of *H. grebnitzkii*, posterolateral spines on somites 3 and 4 are short (slightly longer than the denticles that fringe the posterior margin), and the posterolateral spines on somite 5 are shorter than the width of somite 5. In zoeae of *D. mandtii* and *P. brevipes*, posterolateral spines on somites 3 and 4 are long (at least twice the length of the denticles), and posterolateral spines on somite 5 are longer than the width of somite 5 (Kurata 1956).

Based on Kurata's (1956) brief descriptions, zoeae of *P. brevipes* can be distinguished from zoeae of *D. mandtii* by size of the carapace and morphology of the antenna. *Paralithodes brevipes* zoeae are slightly larger (carapace length, 1.4-1.7 mm) than *D. mandtii* zoeae (carapace length, 1.2-1.4 mm). The antennal flagellum of *P. brevipes* zoeae is noticeably longer than the antennal scale (including distal spine), and the antennal scale is about nine times as long as wide. The antennal flagellum and antennal scale of *D. mandtii* zoeae are about the same length, and the scale is not more than five times as long as wide.

Hapalogaster mertensii.—Larvae of *Hapalogaster mertensii* were collected from ovigerous females at Fidalgo Island, Wash., and then reared and described by Miller and Coffin (1961). Unfortunately, their description is brief and lacks detail and, therefore, has limited value. Apparently, the only characters useful for distinguishing *H. mertensii* zoeae from zoeae of other lithodid species are size and number of setae on the antennal scale. In zoeal Stages I-III of *H. mertensii*, the antennal scale has six setae and, in Stage IV, four setae. In all stages of *H. mertensii*, the setae are markedly short ($< \frac{1}{2}$ scale width) and lightly plumose. In most other lithodid zoeae, the antennal scale in Stage I has more than six heavily plumose setae that increase in number in later stages, and the setae are as long as, or longer than, the width of the antennal scale.

Lithodes aequispina.—Larvae of *Lithodes aequispina* were reared and described from ovigerous females collected in waters of southeastern Alaska (Haynes 1982). Zoeae of *L. aequispina* are most similar to zoeae of *Paralithodes camtschatica* and *P. platypus* but can be readily distinguished from their zoeae by the number of telsonic spines and the manner in which the third (longest) pair of telsonic spines is attached to the telson. In *L. aequispina*, the telson has ≥ 11 pairs of telsonic spines, and the third pair of spines is fused to the telson. In *P. camtschatica* and *P. platypus* zoeae, the telson has ≤ 8 pairs of telsonic spines, and the third (longest) pair of spines is jointed with the telson.

Paralithodes brevipes, *P. camtschatica*, and *P. platypus.*—Larvae of *Paralithodes brevipes*, *P. camtschatica*, and *P. platypus* have been described (Marukawa 1933; Kurata 1956, 1960, 1964; Hoffman 1958; Sato 1958; Makarov 1967). Zoeae of *P. brevipes* can be distinguished from zoeae of *P. camtschatica* and *P. platypus* by several characters. In *P. brevipes* zoeae, posterolateral spines on the carapace are short and ventrally curved, the dorsal posterolateral margin of the carapace is convex, the rostrum is short (about equal to the length of the antennal flagellum), and the telson has (excluding the hairlike process) six pairs of spines in Stage I and seven pairs of spines in Stages II-IV. In contrast, zoeae of *P. camtschatica* and *P. platypus* have long, posterolateral spines

on the carapace that are not ventrally curved, the dorsal posterolateral margin of the carapace is concave, the rostrum is noticeably longer than the antennal flagellum, and the number of pairs of telsonic spines in all zoeal stages (excluding the hairlike process) is 7 + 7 in *P. camtschatica* and 8 + 8 in *P. platypus*.

Placetron wosnessenskii and *Rhinolithodes wosnessenskii*.—Zoeae of *Placetron wosnessenskii* and *Rhinolithodes wosnessenskii* are readily distinguished from all other described zoeae of the Lithodidae. *Placetron wosnessenskii* zoeae are distinguished by markedly long, blunt spines on the posterior margins of abdominal somites 2-5 and the sinuate curvature of the long, blunt, posterolateral spines on abdominal somite 5. Zoeae of *R. wosnessenskii* have a spine in the middorsal, posterior margin of the carapace.

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