

To Dr. Isabel Perez Farfante
with my compliments
Y. Hanamura

Description of a New Species *AcanthePHYra brevicarinata*
(Crustacea, Decapoda, Caridea) from the Eastern Tropical
Pacific, with Notes on Biological Characteristics

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Description of a New Species *Acantheephyra brevicarinata* (Crustacea, Decapoda, Caridea) from the Eastern Tropical Pacific, with Notes on Biological Characteristics^{1), 2)}

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Abstract

A new species of deep-sea pelagic caridean shrimp of the genus *Acantheephyra* (Caridea, Olophoridae) is described, with brief notes on biological characteristics. The specimens were taken abundantly with mid-water trawls made around Dowd Tablemount (13°28'N, 119°49'W) in the eastern tropical Pacific Ocean, 12-13 February 1979. This new species is closely allied to *Acantheephyra curtirostris* WOOD-MASON, 1891, but is different from the latter in the shape of the rostrum, the large eye, the carina supporting the branchiostegal spine, the shape of the exopod of the 1st maxilliped and the body size at sexual maturity.

On the cruise of the R.V. "Kaiyo-Maru" of the Fishery Agency of Japan to the eastern North Pacific from December 1978 to March 1979, mid-water trawls with a KOC-T net (rectangular net, 9 m² in effective mouth area) were carried out. In the collections taken around Dowd Tablemount, located in the southernmost area of the Baja California Seamount Province, 160 specimens of an unknown pelagic caridean shrimp belonging to the genus *Acantheephyra* were obtained.

The specimens are closely allied to *Acantheephyra curtirostris* WOOD-MASON, 1891, but are different from the latter in certain features. It is convinced that some previously reported *Acantheephyra curtirostris* from the eastern tropical Pacific (e.g., FAXON 1895) are identical with the present new species.

The holotype (NC 0159), allotype (NC 0160), paratypes (NC 0018, NC 0019) and the rest are deposited at the Far Seas Fisheries Research Laboratory, Shimizu, Japan. A part of paratypes (IORDIN 79-73, IORDIN 79-74) are deposited at the Marine Biological Center, Tokai University, Shimizu, Japan.

Acantheephyra brevicarinata n. sp.

(Figs. 1, 2)

Acantheephyra curtirostris (not WOOD-MASON) FAXON, 1895, p. 164 (at least, part), Pl. 43, Figs. 4, 5 (?Figs. 2, 3).

Acantheephyra brevicarinata HANAMURA, 1983, pp. 53, 54 (nomen nudum).

Types. Holotype (NC 0159), male (29.0 mm cl), 13°28.7'N, 119°53.9'W, daytime haul of 1617-0 m, Feb. 12, 1979. Allotype (NC 0160), female (25.0 mm cl) ovigerous, 13°27.7'N, 120°07.2'W,

¹⁾ Accepted 26 December 1983

²⁾ 北太平洋東部熱帯域より得られた十脚甲殻類コエド類の1新種 *Acantheephyra brevicarinata*.

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daytime haul of 835-0 m, Feb. 12, 1979. Paratypes (NC 0018), 10 males (11.5-30.0 mm cl) from the same collection as holotype; —(NC 0019), 5 females (15.0-24.0 mm cl) incl. 2 ovigerous, from the same collection as holotype; —(IORDIN 79-73), 9 males (11.4-26.8 mm cl), 5 young (9.5-11.1 mm cl) from the same collection as allotype; —(IORDIN 79-74), 27 females (15.1-26.0 mm cl) incl. 19 ovigerous, 11 young (9.8-12.0 mm cl), from the same collection as allotype. *Additional materials.* 4 females (18.1-25.4 mm cl), 2 young (10.4, 10.6 mm cl), 13°28.7'N, 119°53.9'W, daytime haul of 1632-0 m and 10 young (6.5-11.4 mm cl), daytime haul of 1617-0 m, Feb. 12, 1979; 1 specimen (12.2 mm cl), 13°28.3'N, 119°59.6'W, daytime haul of 472-0 m, Feb. 12, 1979; 2 males (19.4, 25.5 mm cl), 2 females (14.0, 22.6 mm cl) incl. 1 ovigerous, 5 young (5.5-10.8 mm cl), 13°27.7'N, 120°07.2'W, daytime haul of 845-743 m and 24 young (5.3-8.5 mm cl), daytime haul of 835-0 m, Feb. 12, 1979; 1 female (12.2 mm cl), 1 specimen (15.4 mm cl), 1 young (12.0 mm cl), 13°29.0'N, 119°56.9'W, nighttime haul of 500-0 m, Feb. 13, 1979; 16 males (13.9-25.4 mm cl), 10 females (13.6-22.2 mm cl) incl. 2 ovigerous, 11 young (7.8-11.6 mm cl), 13°25.1'N, 120°04.5'W, daytime haul of 1307-0 m and 1 female (12.3 mm cl), daytime haul of 1142-0 m, Feb. 13, 1979.

Description. Integument firm. Rostrum triangular in lateral view, somewhat variable in length and shape; dorsal margin nearly straight, slightly concave or slightly convex, with 7-9 spines; ventral margin usually nearly straight or sometimes slightly convex, with 1-2

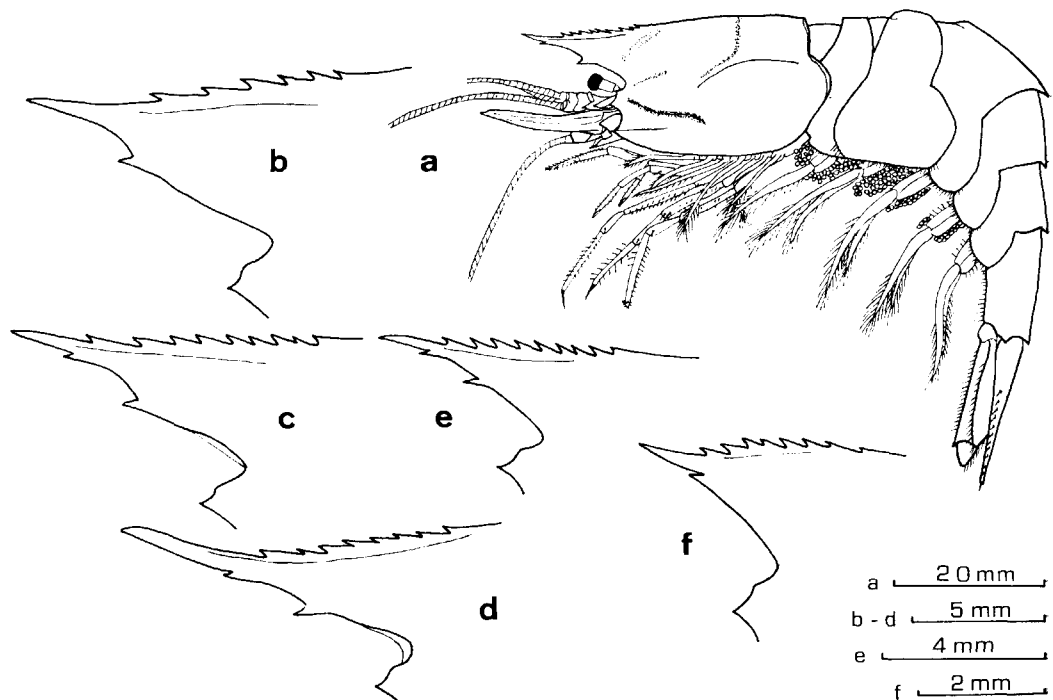


Fig. 1. *AcanthePHYRA brevicarinata* n. sp.: a, allotype, female 25.0 mm cl; b-f, rostrum; b, female 26.0 mm cl; c, male 22.8 mm cl; d, female 21.2 mm cl; e, young 11.4 mm cl; f, young 8.2 mm cl.

spines (82% of specimens examined have 2 ventral spines); apex reaches middle to distal sixth of antennal scale. Well developed carina or ridge usually present on lateral side, parallel to upper margin of rostrum.

Carapace carinated in anterior three-fifths (height of carina gradually decreases backward), and smoothly rounded at posterior dorsal margin. Length of carapace inclusive of rostrum equal to distance from 1st abdominal somite to anterior or middle part of 5th somite. Antennal tooth prominent. Branchiostegal spine (left one is broken in holotype) supported by a carina which extends back to middle or three-fifths of lower part of antennal region, but not reaching to end of hepatic groove. Cervical sulcus weakly grooved laterally. Suprabranchial ridge obscure, but visible. Hepatic groove deep.

Eye reaching as far as distal end of 1st antennular peduncle, well developed and broad. In dorsal view, cornea as wide as breadth of 2nd segment of stalk. A marked hollow present at middle part of outer margin of stalk.

Antennal scale 0.58-0.73 times ($\bar{x}=0.65$) as long as carapace, narrower at its distal end; outer margin slightly convex, ending in a tooth which extends beyond apex of lamella.

First abdominal somite dorsally rounded. Second to 6th somites dorsally carinated and

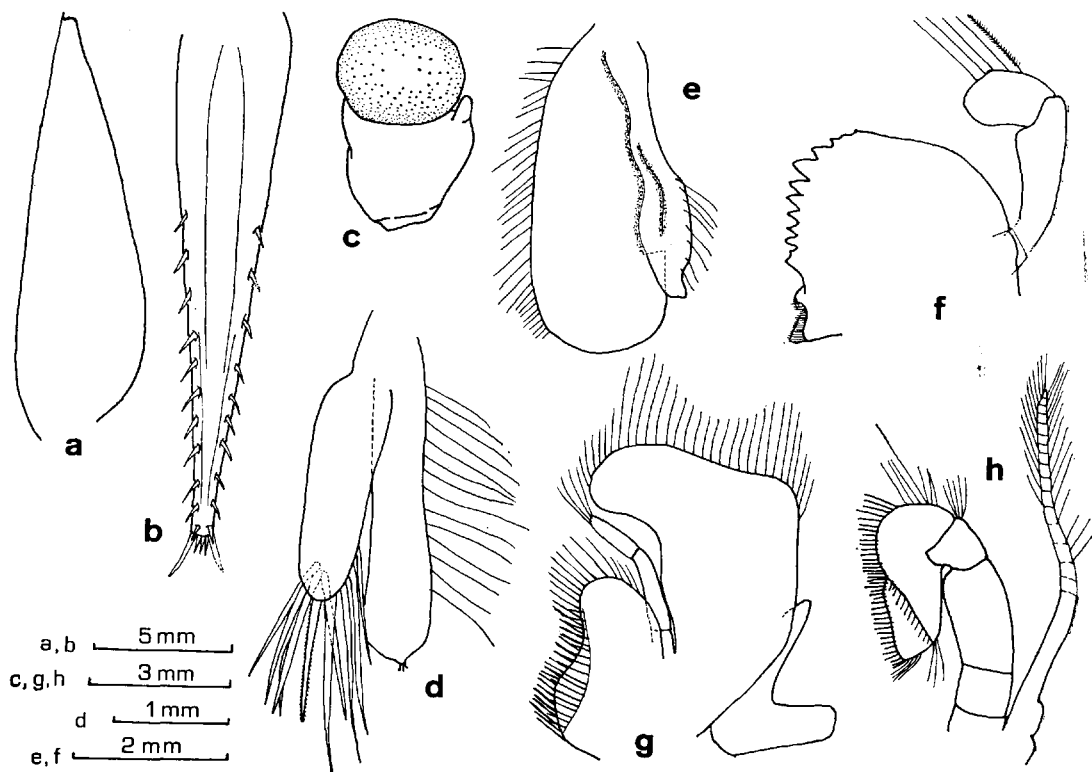


Fig. 2. *AcanthePHYRA brevicarinata* n. sp.: male 26.4 mm cl; a, antennal scale; b, telson; c, eye (left); d, appendix masculina; e, endopod of 1st pleopod; f, mandible; g, 1st maxilliped; h, 2nd maxilliped.

last 4 somites provided with a median posterior tooth, of which 3rd one is comparatively strong. Sixth somite about 1.64 times as long as 5th, and about 2.31 times the posterior height of 6th somite.

Telson longer than exopod of uropod, dorsally sulcated, and provided with 9-13 dorso-lateral spines, truncated apex bearing 5 distal marginal spines. Exopod of uropod about 4.2 times as long as broad. Endopod of uropod barely reaching diaeresis of exopod of uropod.

Mandible (left) with 11 teeth on incisor. Distal segment of mandibular palp nearly ovate in shape. Palp of 1st maxilla distally narrowed, armed with a strong spine at distal part of ventral side. Palp of 2nd maxilla mitten-shaped, and its upper endite bilobed, of which anterior one is larger. First maxilliped with exopod strongly extended inward at distal part. Third maxilliped attains to distal fourth of antennal scale.

The relative length of segments of pereopods and the number of spines on them are somewhat variable. The following description is given on the holotype.

First pereopod reaching 2nd antennular peduncle segment. Second pereopod attaining to middle of antennal scale; merus armed with a spine near distal end. Third pereopod reaching apex of antennal scale; dactylus slightly shorter than half the length of propodus; carpus with 6 (right leg with 4) spines; merus and ischium armed with a row of spines on posterior and outer margins. Fourth pereopod attains to apex of 3rd maxilliped; dactylus about one-third the length of propodus; armature of spines allied to that of 3rd pereopod. Fifth pereopod slightly exceeds 2nd antennal peduncle segment; carpus with a spine at near distal end; merus with 4 (right leg with 5) posterior and 5 (right leg with 6) lateral spines.

Endopod of 1st pleopod of male oval in shape, with a finger-shaped small process concaved slightly at the apex. In 2nd pleopod, appendix masculina slightly shorter than appendix interna, armed with about 10 or more denticulated setae on distal part.

Remarks. *Acanthephyra brevicarinata* n. sp. is closely allied to *A. curtirostris* WOOD-MASON, 1891 (in WOOD-MASON & ALCOCK 1891) among the species within the genus by having a firm integument, relatively short rostrum, dorsal carinae on the 2nd to 6th abdominal somites and dorsally sulcated telson. However, *A. brevicarinata* n. sp. is distinguished from the latter species by the differences in (1) the shape of the rostrum, (2) the relative length of the carina supporting the branchiostegal spine, (3) the size of the eye, (4) the shape of the exopod of the 1st maxilliped, and (5) the body size at sexual maturity. These are summarized in Table 1. The above discrepancies, except items (4) and (5), are similarly observed in rather young specimens.

A. brevicarinata n. sp. also resembles *A. acutifrons* BATE, 1888, in general appearance, but is distinguished from the latter by the absence of the dorsal carina on the 1st abdominal somite and by the smoothly rounded posterior dorsal margin of the carapace. The number of dorsolateral spines of the telson is also different between the two species; 9-13 for *A. brevicarinata* and 5-6 for *A. acutifrons*.

FAXON (1895) recorded *A. curtirostris* from the eastern tropical Pacific. He recognized three varieties of this species other than typical form by the characteristic form of the rostrum; which he termed α , β and γ . The author has not had a chance to examine the FAXON's

TABLE 1. COMPARISON IN EXTERNAL MORPHOLOGY AND SIZE OF SEXUAL MATURITY BETWEEN *Acantheephyra curtirostris* WOOD-MASON and *Acantheephyra brevicarinata* n. sp.

	<i>Acantheephyra curtirostris</i> WOOD-MASON	<i>Acantheephyra brevicarinata</i> n. sp.
1) Rostrum	Relatively short, not surpassing antennular peduncle, with 6-9 dorsal teeth on frontal peak and 1 large ventral spine; ventral margin forming marked angle and dorsal margin slightly elevated from dorsal line of carapace.	Relatively long, exceeding beyond antennular peduncle, with 7-9 dorsal and usually (>82%) 2 ventral teeth; ventral margin nearly straight or slightly convex and dorsal margin nearly straight, concave, or slightly convex; apex sometimes upturned.
2) Branchiostegal spine	Supported by a carina extending to end of hepatic groove.	Supported by a carina extending to middle to 3/5 of lower part of antennal region, not reaching to end of hepatic groove.
3) Eye	Cornea slightly narrower than eye-stalk, about 2/3 as long as stalk length; ocular tubercle attaining to middle of cornea.	Cornea as wide as eye-stalk, as long as stalk; ocular tubercle attaining to proximal 1/3- 1/4 of cornea (relatively longer in young specimens).
4) 1st maxilliped	Exopod with distal part slightly extending inward.	Exopod with distal part strongly extending inward (extension increases with size of body).
5) Size of sexual maturity	Up to 20 mm cl or so; smallest male with appendix masculina 9.8 mm cl, smallest male with spermatophore 14.3 mm cl; smallest ovigerous female 15.4 mm cl.	Up to 30 mm cl; smallest male with appendix masculina 11.4 mm cl; smallest male with spermatophore 20 mm cl; smallest ovigerous female 21.1 mm cl.

specimens. However, his descriptions and figures for varieties β and γ are closely allied to the present specimens, being possibly identical with the present species. On the specimens catalogued as variety α , the shape of the rostrum is included within the variation of the present species, although the dorsal elevation on the posterior margin of the carapace was not observed among specimens of the present sample.

As to the allied species *A. curtirostris*, KRYGIER & PEARCY (1981) recorded specimens attaining 27 mm cl from off Oregon, which were much larger than those from Japanese waters and Baja California (cf. HANAMURA 1983). According to ZIEMANN (1975), body size of Hawaiian specimens is also smaller (less than 17 mm cl) than Oregon specimens. The difference in the clutch size, as well as adult body size, between Oregon specimens and Hawaiian specimens is distinct. Females from off Oregon bear no less than 1367 to 3010 ($\bar{x}=2188$) eggs (KRYGIER & PEARCY 1981), while those from Hawaiian waters bear 345 to 925 ($\bar{x}=550$) eggs (ZIEMANN 1975). Specimens of *A. curtirostris* from Oregon waters are only similar to *A. brevicarinata* in both the body size and the clutch size.

A. curtirostris recorded by CHACE (1937) from lower California and the Gulf of California was also large in adult body size (as large as 24 mm cl). ABBES & CASANOVA (1973) recorded the largest specimen of *A. curtirostris*, attaining 28 mm cl, from the eastern tropical Atlantic Ocean. Unfortunately, adequate descriptions were not given by them, but these specimens seem to be much larger than the size range known for *A. curtirostris* from the subtropical

Pacific. There is a possibility that these specimens also belong to the present new species.

Etymology. The name "*brevicarinata*" refers to short carina, which is supporting the branch-iostegal spine, compared with the allied species *A. curtirostris*.

Distribution. The present specimens were found in the collections made around Dowd Tablemount (13°28'N, 119°49'W) located in the southernmost area of the Baja California Seamount Province. The depths of net hauls were from 1600 m to the surface. The most individuals of the present specimens occurred between 900 m and 600 m in the daytime. FAXON (1895) reported varieties β and γ of *Acantheephyra curtirostris* from off the Pacific coasts of Central America, from the Gulf of California to the Gulf of Panama, which is now recognized as being identical with the present species.

Additional Notes on Biological Characteristics

Size and growth. The present specimens of *Acantheephyra brevicarinata* ranged from 5.3 mm to 30.0 mm in carapace length. This corresponds to 17.0 mm to 84.5 mm in length from the orbital margin to the posterior margin of 6th abdominal somite (body length). Relationship of the body length (bl) to carapace length (cl) of *A. brevicarinata* is as follows (Fig. 3):

$$bl \text{ (mm)} = 2.78 \text{ cl (mm)} + 4.14 \quad (r=0.997)$$

The size distribution of the present specimens of *A. brevicarinata* is given in Fig. 4. The sex ratio of males to females was 1.00:1.33. Development of sexual characters at four developmental stages is as follows:

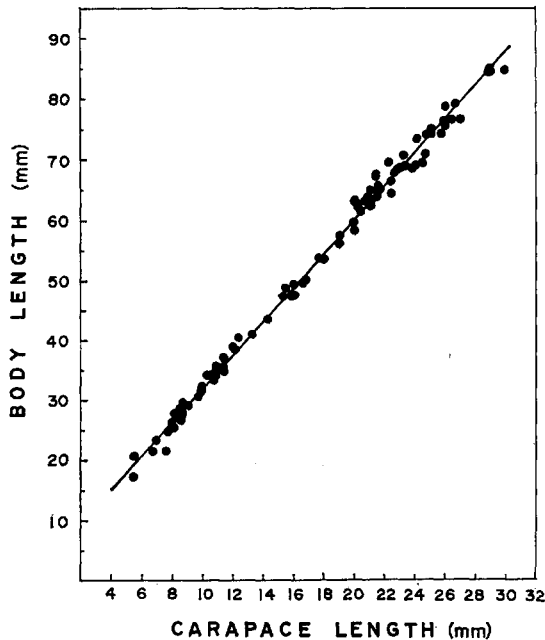


Fig. 3. Relation of body length (bl) to carapace length (cl) for *Acantheephyra brevicarinata* n. sp. ($n=111$).

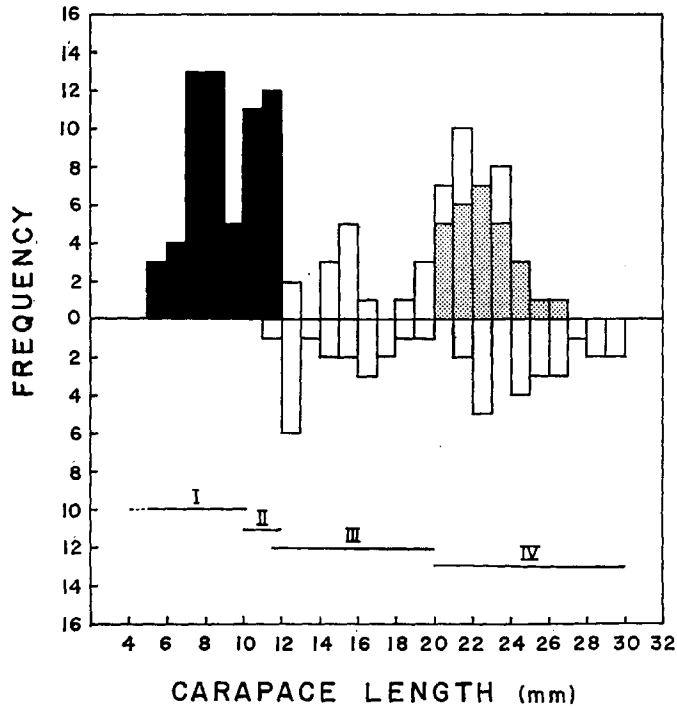


Fig. 4. Size frequency distribution of four developmental stages of *Acantheephyra brevicarinata* n. sp. Above: young (filled columns), non-ovigerous females (open columns), ovigerous females (dotted columns); below: males. I: Stage I (juvenile stage); II: Stage II (sexing stage); III: Stage III (subadult stage); IV: Stage IV (adult stage).

Stage I (juvenile stage): The size of this stage is up to about 9.7 mm cl. No sexual differentiation was observed in external morphology.

Stage II (sexing stage): The size varies from about 9.7 mm to 12 mm cl. In this stage, the endopod of the 1st pleopod is differentiated into two forms among specimens, one with a small clump at the tip of the endopod, and another without it. This clump indicates the budding of male 1st pleopodal structure, but the appendix masculina in the 2nd pleopod is not yet formed.

Stage III (subadult stage): Body size is about 12 mm-20 mm cl. Sexes can be determined with certainty by features of the anterior two pairs of pleopods; distinctive shape of the endopod of 1st pleopod, and the presence (male) or absence (female) of the appendix masculina in the 2nd pleopod.

Stage IV (adult stage): Specimens larger than 20 mm cl are included in this stage. Females may possess external eggs (fertilized eggs) as evidence of maturation, and males may bear spermatophores at the base of the 5th pereopod.

Observations on eggs: Observations were made on the eggs preserved in buffered 10% formalin sea water. The number of eggs carried by females is large, similar to other members of the

genus. For example, a large female (26.0 mm cl) carried 2600 eggs.

The eggs carried by females increase in size during the course of embryonic development, especially the long axis. The embryos can be classified roughly into the following four developmental stages:

Stage 1: 0.75–0.80 mm × 0.60–0.62 mm; the yolk fills whole parts of egg; no apparent differentiation of embryo (Fig. 5a). Stage 2: 0.80–0.83 mm × 0.63–0.67 mm; the yolk disappears from the posteroventral side of egg, and the ventral cleft appears (Fig. 5b). Stage 3: 0.85–0.90 mm × 0.65–0.70 mm; the eye is indicated as brownish pigments; primordia of appendages appear in the cephalothorax (antennular, antennal, and maxillipedal limbs); the telson bears 6 pairs of marginal setae (Fig. 5c). Stage 4: 0.90–1.11 mm × 0.65–0.70 mm; the ommatidia have been developed; the abdomen develops, extends along ventral to anterior end, finally reaches posterodorsal part of the head; the rostrum appears, somewhat flattened, developing to a lanceolate process with growth; the telson is obcordate, with 7 pairs of marginal setae; the median posterior part of the 3rd abdominal somite shows slight elevation in larger embryo; a small quantity of yolk still remains in the cephalothorax; the egg membrane is fragile, and the embryos are ready to hatch (Fig. 5d–g).

In addition, a small number of opaque, whitish eggs were observed with Stage 1 eggs. These eggs were abnormally large in size, especially along the shorter axis (ca. 0.81 mm × 0.71

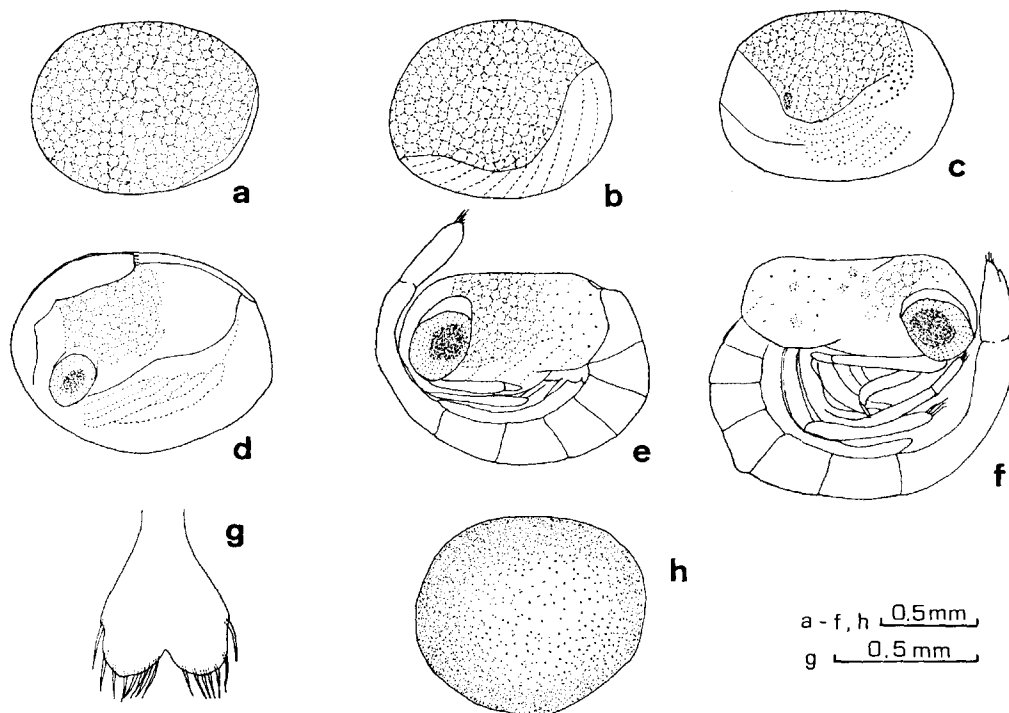


Fig. 5. Embryonic development of *Acantheephyra brevicarinata* n. sp.: a: Stage 1; b, Stage 2; c, Stage 3; d–f, Stage 4 (egg membrane removed in Figs. e–g); g, telson of Stage 4 embryo; h, whitish egg.

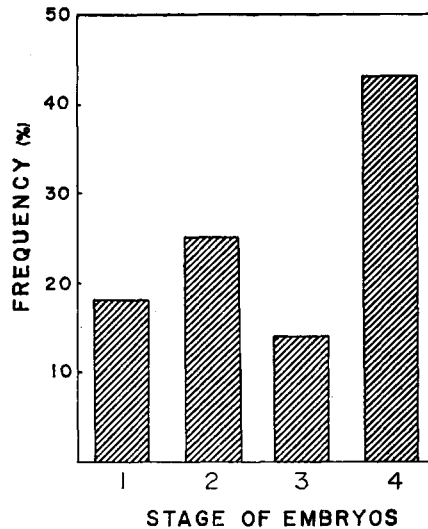


Fig. 6. Composition of females of *Acanthephyra brevicarinata* carrying embryos of different developmental stages.

mm) without yolk of cleavage, and are possibly out of the normal process of embryonic development (Fig. 5h).

Fig. 6 shows the composition of females carrying embryos of different developmental stages. All the eggs carried by a single female are in synchronous development. A comparatively high frequency (43%) of females carrying Stage 4 embryos suggests that an extensive hatch will occur within near future. If eggs carried by females of *A. brevicarinata* require approximately two and a half months until hatching, as observed in vitro in some species of the genus (see HERRING 1974), the hatching season of this population of *A. brevicarinata* would last to May.

Acknowledgements

This study was carried out at the Marine Biological Center, Tokai University Shimizu. The author wishes to express his sincere thanks to Prof. SIGERU MOTODA, Curator of the center, for his geniality and kind guidance during the study. He is deeply indebted to Mr. EIICHI FUJII, one of the scientific staff on the R.V. "Kaiyo-Maru" cruise, and Mr. KEISUKE OKADA of the Far Seas Fisheries Research Laboratory, Shimizu, for their kindness providing the specimens for this study. He is grateful to Dr. YASUSHI AIZAWA of the Nansei Regional Fisheries Research Laboratory, Hiroshima, who gave valuable information on pelagic shrimp to the author. Thanks are also due to Messrs. SOSHI HAMAOKA and SHIN-ICHI JIN for their kindness in various ways. He expresses his sincere appreciation of Prof. MAYUMI YAMADA, Faculty of Science, Hokkaido University, for his kind advice on this study, and to Dr. EARL E. KRYGIER, Alaska Trollers Association, for his critical review of the manuscript. Thanks are also due to anonymous reviewers of this Bulletin.

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