ADDITIONAL REPORT ON CALANOID COPEPODS FROM THE IZU REGION
PART 4. *HALOPTILUS, AUGAPTILUS, CENTRAUGAPTILUS, PSEUDAUGAPTILUS,* AND *PACHYPTILUS*

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With 7 Text-figures

The species studied in the series of additional report on calanoid copepods from the Izu region have been collected by the R/V *Tansei Maru* of the Ocean Research Institute, University of Tokyo, in 1964 and 1965. Sampling data including date, locality, sampling method, and depth is given in Part 1 of the report. Figure 1 shows approximate position of the sampling stations. The present paper deals with taxonomy of 17 species in 5 genera of Augaptilidae (Table 1). *Haloptilus chierchiae, H. validus,* and *Pseudaugaptilus polaris* have not previously been known from the surrounding waters of Japan.

Table 1. List of species

1.	*Haloptilus chierchiae* (GIESBRECHT)	10.	*Augaptilus megalurus* GIESBRECHT
2.	*H. longicornis* (CLAUS)	11.	*Centraugaptilus cuculatus* (SARS)
3.	*H. ornatus* (GIESBRECHT)	12.	*C. horridus* (FARRAN)
4.	*H. oxycephalus* (GIESBRECHT)	13.	*C. rattrayi* (T. SCOTT)
5.	*H. spiniceps* (GIESBRECHT)	14.	*Pseudaugaptilus polaris* BRODSKY
6.	*H. validus* SARS	15.	*Pachyptilus abbreviatus* (SARS)
7.	*H.* species	16.	*P. eurygnathus* SARS
8.	*Augaptilus glacialis* SARS	17.	*P. pacificus* JOHNSON
9.	*A. longicaudatus* (CLAUS)		

HALOPTILUS GIESBRECHT, 1898

Haloptilus chierchiae (GIESBRECHT, 1889)

(Fig. 2, a-g)

Hemicalanus chierchiae GIESBRECHT, 1889, p. 813; GIESBRECHT, 1892, p. 384, pl. 27 figs. 16, 17, 25, pl. 42 figs. 2, 27, 28.

Haloptilus chierchiae (GIESBRECHT).—SARS, 1925, p. 245, pl. 70; SEWELL, 1947, p. 190, fig. 49.

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Publ. Seto Mar. Biol. Lab., XIX (4), 249-268, 1971. (Article 18)

Occurrence: Sta. 115–2, 1♀.

Descriptive notes: Female, 5.25 mm. The cephalothorax and abdomen are in the proportional lengths 82:18. The cephalothorax is 2.4 times as long as wide.

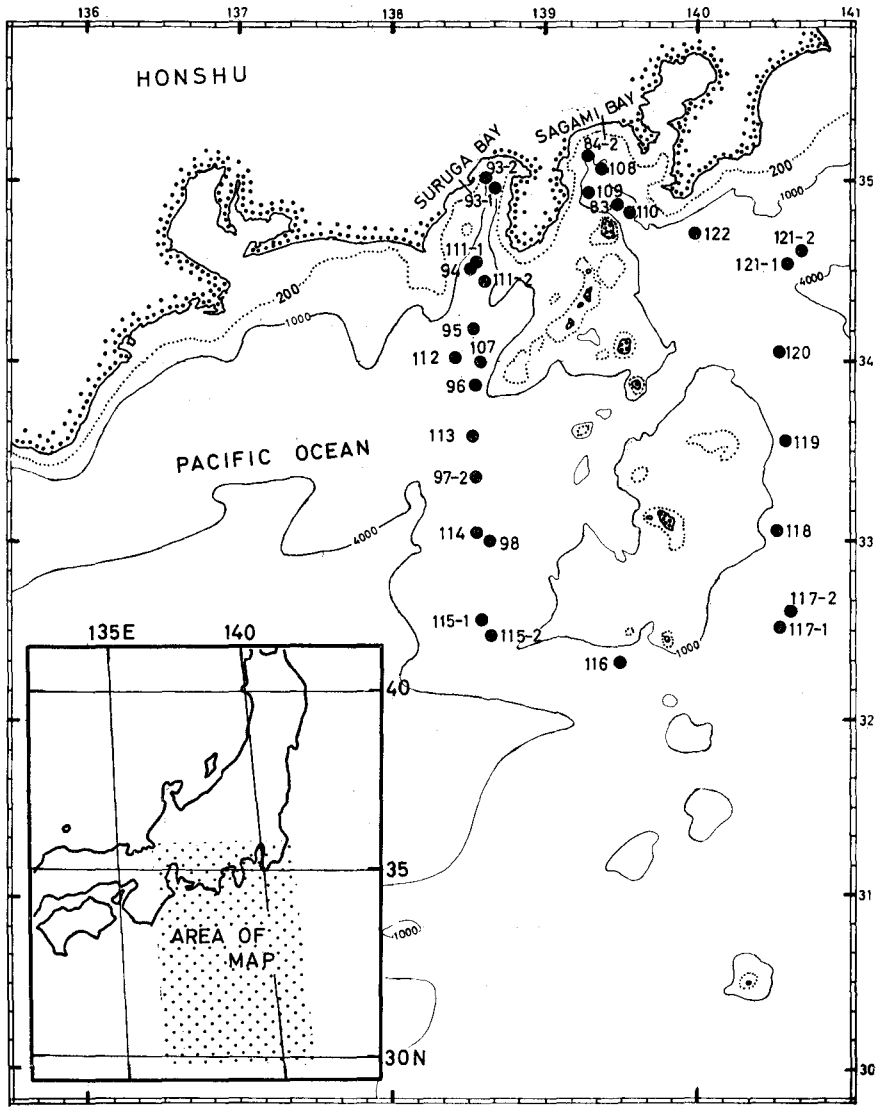

Fig. 1. Position of zooplankton sampling stations in the Izu region.

The ventral surface of the oral region is much swollen. The frontal margin of the head is produced when viewed dorsally. The lateral distal margin of the last thoracic segment is narrowly rounded.

The abdominal segments and furca are in the following proportional lengths:

segment	1–2	3	4	5	furca	
	42	9	8	13	28	=100

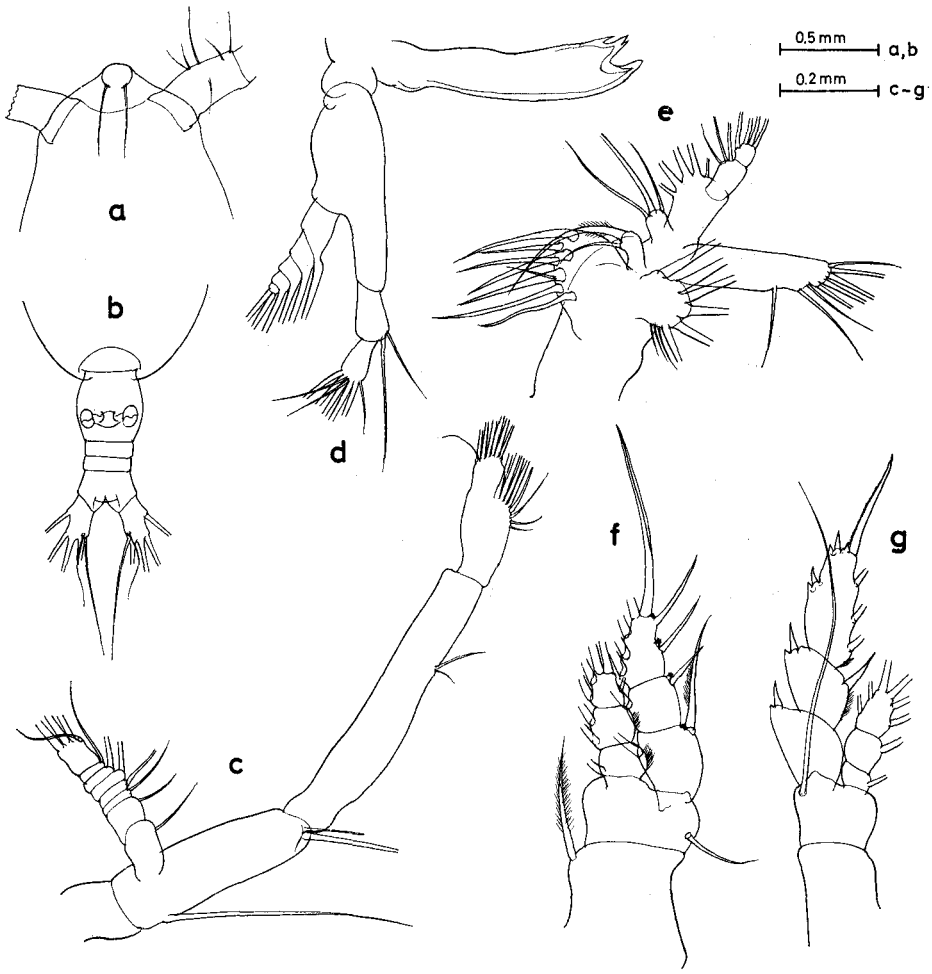

Fig. 2. *Haloptilus chierchiae* (GIESBRECHT), female: a, head, ventral view; b, last thoracic segment and abdomen, ventral view; c, 2nd antenna; d, mandible; e, 1st maxilla; f, 1st leg; g, 5th leg.

The genital segment is a little longer than wide; it is swollen laterally; the genital protuberance is not remarkable. The furca is twice as long as wide.

The 1st antenna exceeds the furca by distal 7 segments; it measures 6.46 mm in length; the segments are in the following proportional lengths:

segment	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	58	14	13	19	26	27	26	27	30	33	35	43	49	51

15	16	17	18	19	20	21	22	23	24	25
51	54	59	59	48	42	46	45	56	54	35=1000

Segments 3, 4, 7, 9, 12, 14, 18, 21, 23, 24, and 25 each have a long seta; the setae are more than 8 times the length of the 25th segment.

The 2nd antenna with endopod 2.4 times the length of the exopod; the exopod is 8-segmented; the 1st to 7th segments each have a seta; the endopod has 8 setae on the inner lobe and 7 setae on the outer lobe. The mandible is well-developed; the exopod has 6 setae; the endopod has 6+2 setae on the distal segment; the cutting blade consists of 2 large teeth and 1 small tooth. The 1st maxilla has the following number of setae on the various lobes: 6 large and 3 small setae on the outer lobe, 7 setae on the exopod, 4 setae on the distal segment of the endopod, 3 setae on the 1st segment of the endopod, 5 setae on the 2nd basal segment, 3 setae on the 3rd inner lobe, 2 setae on the 2nd inner lobe, and 8 setae on the 1st inner lobe; the distal seta on the 2nd inner lobe is very strong. The 2nd maxilla has the following number of setae on the various lobes and endopod:

lobe	1	2	3	4	5	6	Ri
setae	3	3	3	2	2	3	6

In the maxilliped the 1st and 2nd basal segments are equal in length; the number of setae on the lobes and endopod is as follows:

	B1			B2			Ri				
lobe	1	2	3	1	2	segment	1	2	3	4	5
setae	2	3	3	2	2		4	4	4	3	4

The distal setae are fringed with fine spinules.

In the 1st leg the 2nd basal segment has a retroverted seta; the outer marginal spine on the 1st segment of the exopod is long, and extends to the distal margin of the 3rd segment; the 2nd segment of the exopod has 1 spine; the 3rd segment of the exopod has fairly long 2 spines. In the 5th leg the 2nd basal segment has a long seta which exceeds the distal margin of the exopod; the 2nd segment of the exopod has an inner marginal spine which extends to the base of the proximal inner marginal seta on the 3rd segment of the exopod.

Remarks: This is the first record of occurrence of the species from the surrounding waters of Japan.

Distribution and size variation:

Author	Locality	Depth (m)	Length (mm) ♀	♂
GIESBRECHT, 1889	99°W, 3°S	0–1800	4.8	—
WOLFENDEN, 1911	Equatorial Atlantic	0–300	—	—
SARS, 1925	Off Canary Is.	0–1000	5.10	—
SEWELL, 1947	Arabian Sea	0–1500	4.6–4.8	4.05
WILSON, 1950	Off Peru	0–550	—	—
GRICE and HULSEMANN, 1967	Arabian Sea	1000–2000	—	—
Present record	Izu region	0–2500	5.25	—

Haloptilus longicornis (CLAUS, 1863)

Hemicalanus longicornis CLAUS, 1863, p. 179, pl. 29 fig. 1; BRADY, 1883, p. 44, pl. 9 figs. 1–7; GIESBRECHT, 1892, p. 384, pl. 1 fig. 4, pl. 2 fig. 13, pl. 27 figs. 3, 8–10 23, 27, 29, 33, pl. 42 figs. 15, 29.
Haloptilus longicornis (CLAUS).—SARS, 1902, p. 121, pl. 82, pl. 83 fig. 1; MORI, 1937, p. 75, pl. 38 figs. 5–14; TANAKA, 1964b, p. 39, fig. 192; Park, 1970, p. 535, figs. 325–329.

Occurrence: Sta. 94, 2♀; Sta. 97–2, 1♀; Sta. 98, 1♀; Sta. 107, 1♀; Sta. 115–1, 3♀; Sta. 115–2, 2♀.

Remarks: The species has been recorded from many localities in the Atlantic, Indian, and Pacific Oceans. The species is abundant both in deep and surface layers in the Izu region.

Distribution and size variation:

Author	Locality	Depth (m)	Length (mm) ♀	♂
BRADY, 1883	South Pacific	—	2.5	—
GIESBRECHT, 1892	Temperate Atlantic	—	2.1–2.5	1.18
SARS, 1902	Norwegian waters	—	2.15	—
A. SCOTT, 1909	Malay Archipelago	0–200	—	—
FARRAN, 1926	Bay of Biscay	0–1830	1.98–2.07	—
FARRAN, 1929	Off New Zealand	0–3	2.04–2.16	—
FARRAN, 1936	Great Barrier Reef	0–600	1.98–2.45	—
MORI, 1937	Off Kii Peninsula	0–100	2.3	—
GRICE, 1962	Equatorial Pacific	63–119	1.77–1.90	—
BJORNBERG, 1963	Off Brazil	0–85	2.1	—
TANAKA, 1964b	Izu region	0	2.14–2.25	1.16
VERVOORT, 1965	Gulf of Guinea	0–175	1.94–2.23	—
OWRE and FOYO, 1967	Florida Current	0–318	—	—
PARK, 1968	Central North Pacific	0–140	2.00–2.44	—
PARK, 1970	Caribbean Sea	0–100	2.00–2.16	1.24
Present record	Izu region	0–1800	2.10–2.63	—

Haloptilus ornatus (GIESBRECHT, 1892)

Hemicalanus ornatus GIESBRECHT, 1892, p. 384, pl. 27 figs. 1, 6, 7. 14, 15, 21, 24, 38, pl. 42, figs. 1, 9, 17, 19, 22, 24.

Haloptilus ornatus (GIESBRECHT).—GIESBRECHT and SCHMEIL, 1898, p. 120, fig. 28; SARS, 1925, p. 247, pl. 73 figs. 1–5, MORI, 1937, p. 75, pl. 39 figs. 5–8, GRICE, 1962, p. 223, pl. 25 figs. 12–16.

Occurrence: Sta. 84–2, 1♀; Sta. 97–2, 1♀; Sta. 98, 5♀; Sta. 110, 1♀; Sta. 113, 1♀; Sta. 114, 3♀; Sta. 115–1, 3♀; Sta. 115–2, 5♀; Sta. 116, 1♀; Sta. 118, 1♀.

Remarks: The body length of a specimen from Sta. 98 is 2.88 mm, but that of others ranges from 4.04 to 4.96 mm. The small specimen differs from the larger ones in the number of setae on various lobes of the 1st maxilla: the exopod with 4 long and 2 small setae, the endopod with 2 setae, the 2nd basal segment with 4 setae, and the 3rd inner lobe with 2 setae. In the larger specimens the exopod with 9 setae, the endopod with 2 setae, the 2nd basal segment with 5 setae, and the 3rd inner lobe with 3 setae; this arrangement of the setae agrees exactly with the figure given by SARS (1925). According to SARS (1925), the rostral filaments are absent in this species. However, 2 small filaments are observed on the rostrum in the specimens from the Izu region.

Distribution and size variation:

Author	Locality	Depth (m)	Length (mm) ♀	♂
GIESBRECHT, 1982	Western Mediterranean	—	4.6–4.8	2.75–3.05
A. SCOTT, 1909	Celebes Sea	0–700	—	—
SARS, 1925	Temperate Atlantic	0	5.0	—
MORI, 1937	Off Kii Peninsula	0–100	3.0–5.0	—
SEWELL, 1947	Arabian Sea	0–500	4.4–4.5	—
WILSON, 1950	Off Hawaii	0–183	—	—
CHIBA, 1956	Equatorial Pacific	—	3.0–4.2	—
GRICE, 1962	Equatorial Pacific	0–169	4.56	—
TANAKA, 1964b	Sagami Bay	0	4.54	—
VERVOORT, 1965	Gulf of Guinea	130–600	4.30–4.80	—
Present record	Izu region	0–520	2.88–4.94	—

Haloptilus oxycephalus (GIESBRECHT, 1889)

Hemicalanus oxycephalus GIESBRECHT, 1889, p. 813; GIESBRECHT, 1892, p. 384, pl. 42 figs. 7, 16, 23.
Haloptilus oxycephalus (GIESBRECHT).—Sars, 1925, p. 252, pl. 74 figs. 12–16; MORI, 1937, p. 77, pl. 40 figs. 1, 2; VERVOORT, 1957, p. 136, figs. 128–130; BRODSKY, 1962, p. 132, fig. 34; BRADFORD, 1971, p. 27, figs. 120–124.

Occurrence: Sta. 84–2, 1♀; Sta. 108, 1♀; Sta. 110, 1♀; Sta. 115–2, 1♀; Sta. 122, 2♀.

Distribution and size variation:

Author	Locality	Depth (m)	Length (mm) ♀	♂
SARS, 1925	Bay of Biscay	0–2000	3.50	—
FARRAN, 1929	Off New Zealand	4	4.02–4.08	—
MORI, 1937	Off Hachijo Is.	0–60	3.0	—
SEWELL, 1947	Arabian Sea	0–500	—	—

WILSON, 1950	Off Hawaii	0–183	—	—
VERVOORT, 1957	Antarctic waters	100–250	3.38–4.95	2.57
BRODSKY, 1962	Northwestern Pacific	0	3.25	—
TANAKA, 1964b	Suruga Bay	0–1000	3.56	—
VERVOORT, 1965	Gulf of Guinea	0–100	3.30–3.70	2.50
BRADFORD, 1971	Ross Sea	0–1000	3.1	2.85
Present record	Izu region	0–740	3.64–5.00	—

Haloptilus spiniceps (GIESBRECHT, 1892)

Hemicalanus spiniceps GIESBRECHT, 1892, p. 384, pl. 27 figs. 5, 20, 35, 40, pl. 42 figs. 3, 8, 10, 11, 21, 25.
Haloptilus spiniceps (GIESBRECHT).—SARS, 1925, p. 249, pl. 73 figs. 6–10; MORI, 1937, p. 76, pl. 39 figs. 9–14; GRICE, 1962, p. 223, pl. 25 figs. 17–20, pl. 26. figs. 1–5.

Occurrence: Sta. 114, 1♀.

Distribution and size variation:

Author	Locality	Depth (m)	Length (mm) ♀	♂
GIESBRECHT, 1892	Western Mediterranean	—	3.8–4.3	2.55
A. SCOTT, 1909	Banda Sea	0–200	—	—
SARS, 1925	South Off Azores	0–500	4.10	—
FARRAN, 1929	Off New Zealand	2	4.56	—
FARRAN, 1936	Off Great Barrier Reef	0–180	4.02	—
MORI, 1937	Kii Channel	0–150	—	2.3(V)
GRICE, 1962	Equatorial Pacific	72–146	3.70–3.99	—
TANAKA, 1964b	Sagami Bay	0–1000	2.29(V)	—
VERVOORT, 1965	Gulf of Guinea	0–600	3.95–5.45	—
PARK, 1968	Central North Pacific	0–140	4.12–4.99	—
Present record	Izu region	0–930	4.07	—

Haloptilus validus SARS, 1920

(Fig. 3, a-k)

Haloptilus validus SARS, 1920, p. 11; SARS, 1925, p. 241, pl. 98; SEWELL, 1947, p. 194, fig. 50a-g.

Occurrence: Sta. 116, 1♀.

Descriptive notes: Female, 6.09 mm. The body is elongate ovate, and 3 times as long as wide. The cephalothorax and abdomen are in the proportional lengths 87:13. The frontal margin of the head is produced in a small spinous projection when viewed dorsally. The head is separated from the 1st thoracic segment: the 4th segment is fused with the 5th. The distal lateral margin of the last thoracic segment is rounded. The rostrum is composed of 2 small filaments.

The abdominal segments and furca are in the following proportional lengths:

segment	1–2	3	4	5	furca	
	51	12	6	6	25	=100

The genital segment is as long as wide; the genital protuberance is considerably produced ventrally: the furca is a little longer than wide.

The 1st antenna, 7.08 mm in length, exceeds the end of the furca by distal 5 segments; the segments are in the following proportional lengths:

Fig. 3. *Haloptilus validus* SARS, female: a, whole body, dorsal view; b, head, lateral view; c, last thoracic segment and abdomen, lateral view; d, 2nd antenna; e, mandible; f, 1st maxilla; g, 2nd maxilla; h, maxilliped; i, 1st leg; j, 2nd leg; k, 5th leg.

segment	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	73	13	15	13	20	20	26	23	35	31	39	47	52	55

15	16	17	18	19	20	21	22	23	24	25
60	63	67	66	58	48	44	38	38	33	23=1000

In the 2nd antenna the endopod is 3 times the length of the exopod; the exopod is 8-segmented, and each of the 1st to 7th segments carries a seta; the endopod has 8 setae on the inner lobe and 5 setae on the outer lobe. The mandibular palp is devoid of setae; the endopod has 2 setae on the 1st segment and 8 setae on the 2nd segment; the cutting blade has 4 teeth. The 1st maxilla is well-developed; the various lobes have the following number of setae: 6+3 setae on the outer lobe, 11 setae on the elongated exopod, of which the apical 4 are small, 2 setae on the endopod, 5 setae on the 2nd basal segment, 3 setae on the 3rd inner lobe, 1 seta on the 2nd inner lobe, and 7 setae on the 1st inner lobe. The 2nd maxilla is large and carries 3 setae on the 1st lobe and 2 setae on each of the 2nd to 4th lobes; the 5th lobe bears a strong serrated spine and a small seta; the 6th lobe has a stout serrated spine and 2 setae; the endopod bears 2+2+3 setae, of which the distal setae are fringed coarsely with strong spinules. In the maxilliped the 1st basal segment is about twice the length of the 2nd basal segment; the number of setae on the various lobes and endopod is as follows:

	B1			B2			Ri				
lobe	1	2	3	1	2	segment	1	2	3	4	5
setae	2	3	3	2	2		4	4	3	3	2

The large setae on the distal 4 segments of the endopod are fringed coarsely with strong spinules.

The 1st leg has a 3-segmented exopod and endopod; the 2nd basal segment has a retroverted seta; the 1st segment of the exopod has a long marginal spine which extends to the base of the 1st marginal spine on the 3rd segment of the exopod. The 2nd to 4th legs each have a 3-segmented exopod and endopod. In the 5th leg the 2nd basal segment has a long seta; the 2nd segment of the exopod has a minute spine on the inner margin.

Remarks: The species is easily recognized by the structure of the 2nd maxilla and maxilliped. This is the first record of occurrence of the species from the Pacific Ocean.

Distribution and size variation:

Author	Locality	Depth (m)	Length (mm) ♀	♂
Sars, 1925	North Atlantic	0–1000	6.30	—
Sewell, 1947	Arabian Sea	400–645	6.00	—
Grice and Hulsemann, 1967	Arabian Sea	350–940	—	—
Present record	Izu region	0–1200	6.09	—

Haloptilus species

(Fig. 4, a-g)

Occurrence: Sta. 108, 1♀ (juv.)

Descriptive notes: Copepodite IV stage female, 4.33 mm. The cephalothorax and abdomen are in the proportional lengths 84:16. The frontal margin of the head is highly vaulted when viewed dorsally. The lateral distal margins of the last thoracic segment are narrowly rounded. The rostrum is represented by a small knob.

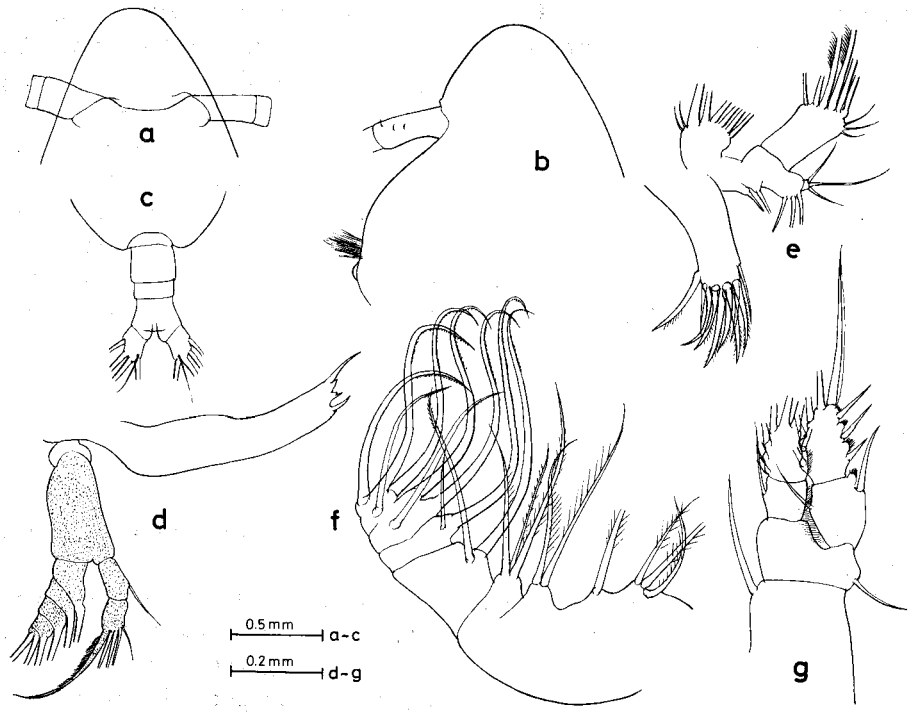

Fig. 4. *Haloptilus* species, immature female: a, head, dorsal view; b, the same, lateral view; c, last thoracic segment and abdomen, dorsal view; d, mandible; e, 1st maxilla; f, 2nd maxilla; g, 1st leg.

The abdomen is 3-segmented; the segments and furca are in the following proportional lengths:

segment	1	2	3	furca	
	35	14	26	25	=100

The furca is 1.3 times as long as wide.

The 1st antenna extends beyond the end of the furca by distal 4 segments; the segments are in the following proportional lengths:

segment	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	73	13	18	16	22	24	24	28	29	33	35	51	51	51

15	16	17	18	19	20	21	22	23	24	25
49	47	57	53	59	47	49	51	53	41	26=1000

In the 2nd antenna the exopod and endopod are about equal in length; the endopod carries 6 setae on the outer lobe and 6 setae on the inner lobe. The mandible is characteristic: the 2nd basal segment is finely granulated; the endopod has 1 seta on the 1st segment; the 2nd segment bears 5 setae on the distal margin, of which the outer one is very long and is furnished with short bristles on the anterior margin; the cutting blade is oblique and has 4 teeth, of which the inner marginal one is slender. The 1st maxilla has the following number of setae on the various lobes: 6 long and 2 small setae on the outer lobe, 6 long and 3 small setae on the exopod, 3 setae on the endopod, 3 setae on the 2nd basal segment, 1 seta on each of the 2nd and 3rd inner lobes, and 10 setae on the 1st inner lobe. The 2nd maxilla has the following number of setae on the various lobes and endopod:

lobe	1	2	3	4	5	6	Ri
setae	3	1	2	3	2	2	7

In the maxilliped the 1st and 2nd basal segments and endopod are in the proportional lengths 36:33:31; the number of setae on the various lobes is as follows:

	B1			B2			Ri				
lobe	1	2	3	1	2	segment	1	2	3	4	5
setae	1	3	3	3	2		2	2	1	1	3

The distal setae are furnished with button-like organs.

The 1st leg has a 2-segmented exopod and endopod; the 1st basal segment has a retroverted seta. The 2nd to 4th legs each have a 2-segmented exopod and endopod. The 5th pair of legs has an 1-segmented exopod and endopod.

Remarks: The present immature specimen appears to be referable the genus *Haloptilus*, but not to either of the preceding 6 species.

AUGAPTILUS GIESBRECHT, 1892

Augaptilus glacialis SARS, 1900

(Fig. 5, a)

Augaptilus glacialis SARS, 1900, p. 88, pls. 26, 27; SARS, 1925 p. 254, pl. 76 figs. 1–16; BRODSKY, 1950, p. 367, fig. 258; VERVOORT, 1951, p. 144, figs. 80, 81; TANAKA. 1964b, p. 77, fig. 212; VERVOORT, 1965, p. 130.

Augaptilus zetosios WOLFENDEN, 1902, p. 369, pl. 3.

Occurrence: Sta. 83, 1♀; Sta. 107, 1♀; Sta. 110, 2♀; Sta. 115–2, 4♀; Sta. 116, 1♀.

Distribution and size variation:

Author	Locality	Depth (m)	Length (mm) ♀	♂
WOLFENDEN, 1902	Faroe Channel	—	4.71	—
SARS, 1925	North Atlantic	0–1800	5.3	—
BRODSKY, 1950	Arctic Ocean	200–2500	4.6–5.3	4.4–5.1
VERVOORT, 1951	Antarctic Ocean	0–900	—	4.43
VERVOORT, 1957	Southern Indian Ocean	250–500	5.72	—
Johnson, 1963	Arctic Ocean	200–1000	—	—
TANAKA, 1964b	Sagami Bay	0–1000	5.88	5.19
VERVOORT, 1965	Gulf of Guinea	0–600	4.10–4.90	3.70–3.80
Present record	Izu region	0–1200	4.03–5.90	—

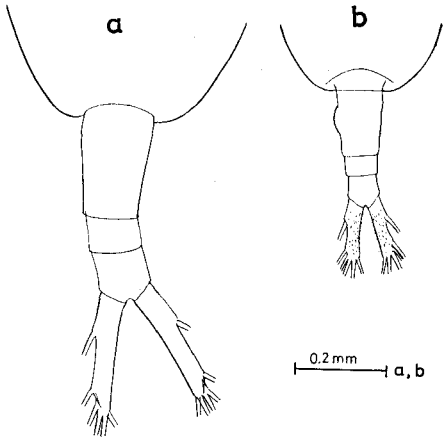

Fig. 5. a, *Augaptilus glacialis* SARS, female, last thoracic segment and abdomen, dorsal view; b, *Augaptilus longicaudatus* (Claus), female, the same, dorsal view.

Augaptilus longicaudatus (CLAUS, 1863)

(Fig. 5, b)

Hemicalanus longicaudatus CLAUS, 1863, p. 179, pl. 29.

Augaptilus longicaudatus (CLAUS).—GIESBRECHT, 1892, p. 400, pl. 27 fig. 31, pl. 28 figs. 2, 8, 11, 19, 23, 31, 32, 35, 38, 39, pl. 29 fig. 22, pl. 39 figs. 37, 48; SARS, 1925, p. 256, pl. 76 figs. 17, 18; GRICE, 1962, p. 226, pl. 26, figs. 6–14;

Occurrence: Sta. 83, 1♀; Sta. 98, 2♀; Sta. 108, 1♀; Sta. 115–2, 1♀; Sta. 117–1, 1♀; Sta. 118, 1♀; Sta. 121–1, 1♀.

Remarks: Female specimens of *Augaptilus longicaudatus* and *A. glacialis* resemble each other not only in the general appearance but also in the structure of the mouth appendages and swimming legs. The former species is characterized by remarkable

swellings on the lateral margins of the genital segment and by possessing small spiniform hairs on the furca. The latter has less remarkable swellings on the lateral margins of the genital segment. However, as discussed by VERVOORT (1965), it is not easy to separate *A. longicaudatus* from *A. glacialis* so far as the female is concerned. The great variablity in length of the species shown by Farran (1908) is incredible. The species has been recorded from various localities of the Atlantic, Indian, and Pacific Oceans.

Distribution and size variation:

Author	Locality	Depth (m)	Length (mm) ♀	♂
GIESBRECHT, 1892	Central Pacific	0–1000	3.7–3.85	3.2–3.35
ESTERLY, 1905	San Diego region	—	—	3.39
FARRAN, 1908	Irish Atlantic slope	180–2070	3.6–6.1	—
A. SCOTT, 1909	Malay Archipelago	0–750	—	—
SARS, 1925	North Atlantic	0–1000	3.60	—
FARRAN, 1926	Bay of Biscay	0–590	3.7–4.3	3.6–3.76
FARRAN, 1929	Off New Zealand	0–100	2.04–2.16	—
FARRAN, 1936	Off Great Barrier Reef	0–600	3.72	—
SEWELL, 1947	Arabian Sea	0–500	3.67	—
TANAKA, 1964b	Sagami Bay	0–1000	3.82	—
VERVOORT, 1965	Gulf of Guinea	0–35	3.50–4.03	3.45–3.80
OWRE and FOYO, 1967	Florida Current	525	—	—
Present record	Izu region	0–850	3.22–4.07	—

Augaptilus megalurus GIESBRECHT, 1889

Augaptilus megalurus GIESBRECHT, 1889, p. 814; GIESBRECHT, 1892, p. 400, pl. 27 fig. 28, pl. 28 fig. 7, pl. 29 fig. 20, pl. 39 fig. 47; SARS, 1925, p. 257, pl. 77 figs. 1–9.
Augaptilus anceps TANAKA, 1964b, p. 75, fig. 211.

Occurrence: Sta. 111–1, 1♀; Sta. 112, 1♀; Sta. 114, 1♀; Sta. 115–1, 1♀; Sta. 117–2, 1♀.

Remarks: The species previously described by Tanaka (1964b) as *Augaptilus anceps* is *A. megalurus*. The geographical distribution of the species has been discussed by VERVOORT (1965).

Distribution and size variation:

Author	Locality	Depth (m)	Length (mm) ♀	♂
GIESBRECHT, 1892	Central Pacific	0–1000	4.5	4.0
FARRAN, 1908	Irish Atlantic slope	1080–1260	5.7–6.1	5.0
SARS, 1926	North Atlantic	0–500	4.50	—
TANAKA, 1964b	Sagami Bay	0–1000	5.0	4.23
VERVOORT, 1965	Gulf of Guinea	0–600	4.30–4.60	—
Present record	Izu region	0–921	4.64–5.40	—

CENTRAUGAPTILUS SARS, 1920

Centraugaptilus cuculatus (SARS, 1905)

(Fig. 6, a-c)

Augaptilus cuculatus SARS, 1905, p. 17.
Centraugaptilus cuculatus (SARS).—Sars, 1925, p. 306, pl. 107 figs. 1–10, TANAKA and OMORI, 1967, p. 258.

Occurrence: Sta. 111–2, 1♀.

Remarks: The present specimen is unusually large in size (10.20 mm), but a specimen taken by the horizontal tow at a depth of 750 m in Suruga Bay is 7.60 mm

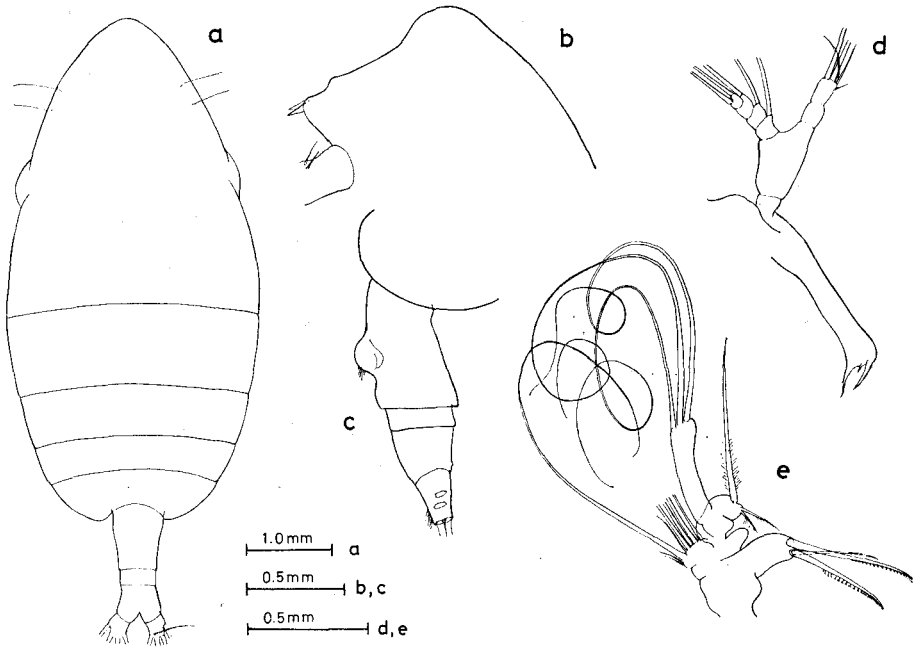

Fig. 6. *Centraugaptilus cuculatus* (SARS), female: a, whole body; b, head, lateral view; c, last thoracic segment and abdomen, lateral view; d, mandible; e, 1st maxilla.

in length. As noted previously (TANAKA and OMORI, 1967), there are no structural differences between the large and small specimens. The mandible has 5 setae on the distal segment of the endopod. In the 1st maxilla the various lobes have the following number of setae: 8 setae on the outer lobe, of which the proximal 2 are very small; 3 large setae on the exopod; a strong seta on the endopod, 2 small setae on the 2nd basal segment, 3 setae on the 1st inner lobe; the 2nd and 3rd inner lobes lack the seta. Distribution and size variation are summarized by TANAKA and OMORI (1967).

Centraugaptilus horridus (FARRAN, 1908)

Augaptilus horridus FARRAN, 1908, p. 78, pl. 8 fig. 20.
Centraugaptilus horridus (FARRAN).—SARS, 1925, p. 307, pl. 107 figs. 11–18; SEWELL, 1932, p. 326, fig. 107; TANAKA, 1964b, p. 83, fig. 215.
Augaptilus pyramidalis ESTERLY, 1911, p. 334, pl. 26 figs. 1, 9, pl. 30 fig. 69, pl. 32 fig. 106.
Centraugaptilus pyramidalis (ESTERLY).—BRODSKY, 1950, p. 389, fig. 276.

Occurrence: Sta. 94, 1♀; Sta. 107, 1♀; Sta. 108, 1♀; Sta. 111–2, 2♀; Sta. 114, 1♀; Sta. 122, 1♀.

Distribution and size variation:

Author	Locality	Depth (m)	Length (mm) ♀	♂
FARRAN, 1908	Irish Atlantic slope	1134–2070	10.0	—
ESTERLY. 1911	San Diego region	0–450	6.68	—
SARS, 1925	North Atlantic	0–1500	9.6	—
SEWELL, 1932	Bay of Bengal	0–720	—	8.4
SEWELL, 1947	Arabian Sea	0–1500	6.0–7.0	—
TANAKA, 1964b	Sagami Bay	0–1000	9.45	8.33
VERVOORT, 1965	Gulf of Guinea	0–600	5.60–8.55	—
TANAKA and OMORI, 1967	Northwestern Pacific	0–1430	8.8–10.1	—
Present record	Izu region	0–900	7.21–9.68	—

Centraugaptilus rattrayi (T. SCOTT, 1894)

Augaptilus rattrayi T. SCOTT, 1894, p. 36, pl. 2, figs. 25–37; FARRAN, 1908, p. 78, pl. 8 fig. 21.
Centraugaptilus rattrayi (T. SCOTT).—SARS, 1925, p. 304, pl. 106; TANAKA, 1964b, p. 81, fig. 214.
Augaptilus macrodus ESTERLY, 1911, p. 332, pl. 27 fig. 18, pl. 29 fig. 44, pl. 30 figs. 72, 74, pl. 31 fig. 87, pl. 32 fig. 112.
Centraugaptilus macrodus (ESTERLY).—BRODSKY, 1950, p. 388, fig. 275.

Occurrence: Sta. 94, 1♀; Sta. 107, 1♀; Sta. 108, 1♀; Sta. 109, 2♀; Sta. 110, 1♀; Sta. 111–2, 1♀; Sta. 115–1, 1♀; Sta. 115–2, 1♂; Sta. 118, 1♀; Sta. 120, 1♀; Sta. 121–2, 1♂.

Distribution and size variation:

Author	Locality	Depth (m)	Length (mm) ♀	♂
T. SCOTT, 1898	Gulf of Guinea	0–183	4.9	—
ESTERLY, 1911	San Diego region	0–595	5.31	—
SARS, 1925	North Atlantic	0–1000	6.0	—
FARRAN, 1926	Bay of Biscay	135–540	5.52–6.18	—
SEWELL, 1932	Laccadive Sea	0–1260	4.8	—
TANAKA, 1964b	Sagami Bay	0–1000	5.80	—
VERVOORT, 1965	Gulf of Guinea	0–600	4.70–5.70	4.98
Present record	Izu region	0–680	5.15–5.87	4.80, 4.85

PSEUDAUGAPTILUS SARS, 1907

Pseudaugaptilus polaris BRODSKY, 1950

(Fig. 7, a-k)

Pseudaugaptilus polaris BRODSKY, 1950, p. 391, fig. 278; MORRIS, 1970, p. 2316, fig. 11.

Occurrence: Sta. 84–2, 1♀; Sta. 110, 1♀.

Descriptive notes: Female, 5.77 mm. The cephalothorax and abdomen are in the proportional lengths 78:22. The head is separated from the 1st thoracic segment; the 4th and 5th thoracic segments are fused. The frontal margin of the head is produced when viewed dorsally. The lateral margin of the last thoracic segment is bluntly rounded. The rostral filaments are very long.

The abdominal segments and furca are in the following proportional lengths:

segment	1–2	3	4	5	furca	
	43	14	10	9	24	=100

The ventral surface of the genital segment is produced. The furca is 1.7 times as long as wide; the outer marginal seta is the largest, and the accessory seta is small.

The 1st antenna exceeds a little the end of the furca; it measures 6.27 mm in length. The segments are in the following proportional lengths:

segment	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	95	27	35	35	35	35	32	32	33	33	37	43	46	48

15	16	17	18	19	20	21	22	23	24	25	
49	51	51	48	40	27	27	19	21	49	52	=1000

In the 2nd antenna the endopod is 1.2 times the length of the exopod; the exopod is 7-segmented; the 1st and 2nd segments are partially fused; the 7th segment is elongated, and is nearly as long as the combined lengths of the 1st to 6th segments; the endopod has 6 long setae on the inner lobe, and 5 long and 2 small setae on the outer lobe. The mandibular palp is well-developed; the exopod and endopod are equal in length; the exopod has 6 setae; the endopod has 1 seta on the 1st segment and 5 setae on the distal margin of the 2nd segment; the cutting blade is small and has 3 groups of complicated teeth. In the 1st maxilla the outer lobe is devoid of any setae; the exopod has 2 long setae; the endopod has 2 setae, of which the distal one is long; the 2nd basal segment has 1 long seta; the 2nd and 3rd inner lobes each have 1 seta; the 1st inner lobe has 7 setae. In BRODSKY's (1950) specimen the 2nd and 3rd inner lobes each have 2 setae. The 2nd maxilla resembles that of *Pseudaugaptilus longiremis* SARS; the number of setae on the various lobes and endopod is as follows:

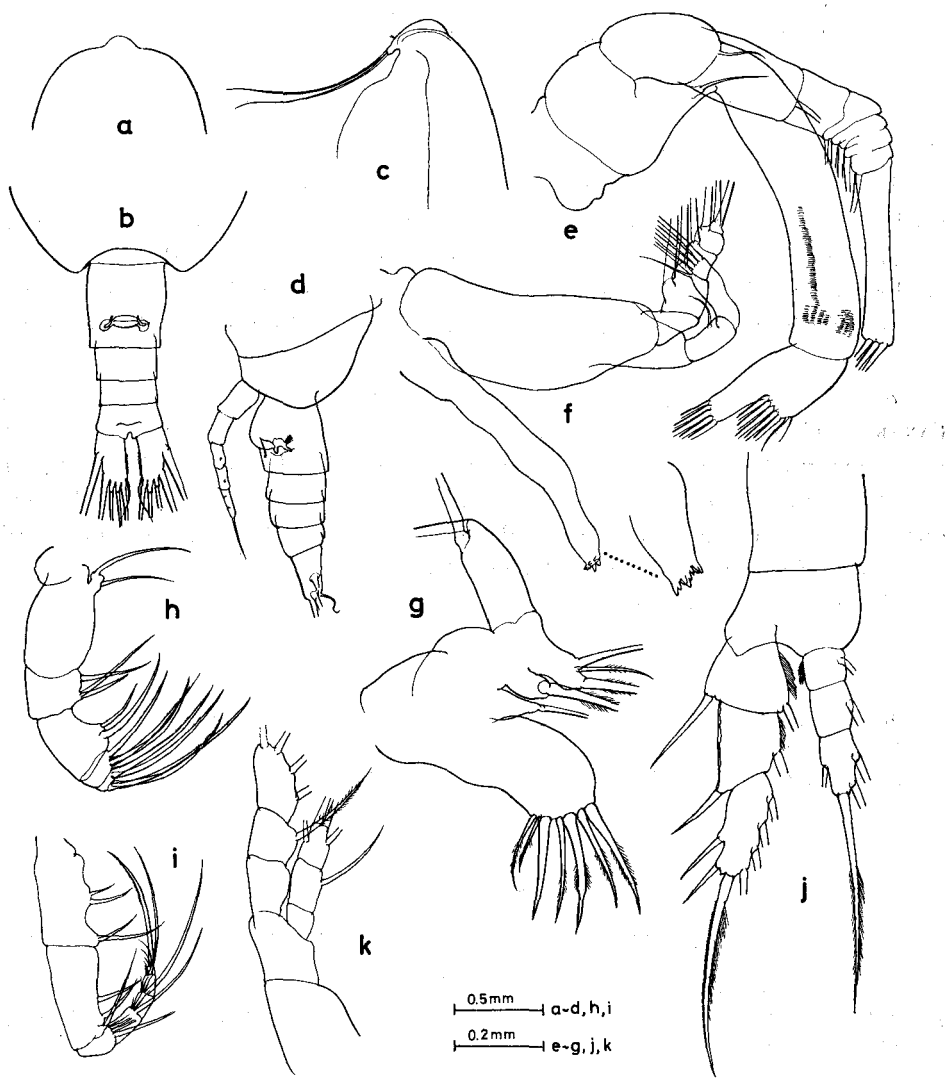

Fig. 7. *Pseudaugaptilus polaris* BRODSKY, female: a, head, dorsal view; b, the same, lateral view; c, last thoracic segment, dorsal view; d, the same, lateral view; e, 2nd antenna; f, mandible; g, 1st maxilla; h, 2nd maxilla; i, maxilliped; j, 1st leg; k, 5th leg.

lobe	1	2	3	4	5	6	Ri
setae	2	0	1	2	1	1	7

The distal setae are fringed with fine spinules. The maxilliped has the following number of setae on the various lobes:

	B1			B2			Ri				
lobe	1	2	3	1	2	segment	1	2	3	4	5
setae	0	2	2	2	1		4	4	4	4	4

The distal setae are fringed with fine spinules.

In the 1st leg the 1st segment of the exopod has a marginal spine which extends nearly to the base of the marginal spine on the 2nd segment; the spines on the 2nd and 3rd segments of the exopod are slender; there is no retroverted seta on the 2nd basal segment. In the 5th leg the inner marginal spine on the 2nd segment of the exopod is fairly long, extending to the base of the inner distal seta on the 3rd segment of exopod.

Remarks: *Pseudaugaptilus polaris* resembles *P. longiremis* SARS or *P. orientalis* TANAKA. However, it differs from *P. longiremis* in having the 1st leg which is provided with a marginal spine on the 2nd segment of exopod. The species is distinguished from *P. orientalis* by the following characters; larger in size, longer furca, shorter 1st antenna, and 7-segmented exopod in the 2nd antenna. This is the second record of occurrence of the species from the Pacific Ocean.

Distribution and size variation:

Author	Locality	Depth (m)	Length (mm) ♀
BRODSKY, 1950	Central Arctic Ocean	400–1000	6.2
MORRIS 1970	South of Alaska Peninsula	0–500	5.80
Present record	Izu region	0–740	5.70, 5.77

PACHYPTILUS (SARS, 1905)

Pachyptilus abbreviatus (SARS, 1905)

Pontoptilus abbreviatus SARS, 1905, p. 19.

Pachyptilus abbreviatus (SARS).—SARS, 1925, p. 319, pl. 113; TANAKA, 1964b, p. 87, fig. 217; VERVOORT, 1965, p. 149; GRICE and HULSEMANN, 1967, p. 37, figs. 241–247.

Occurrence: Sta. 107, 1♀; Sta. 114, 1♀.

Distribution and size variation:

Author	Locality	Depth (m)	Length (mm) ♀
SARS, 1925	Off Azores Is.	0–3000	3.9
JESPERSEN, 1934	Baffin Bay	0–1000	6.1
WILSON, 1950	Off Peru	0–540	—
TANAKA, 1964b	Sagami Bay	0–1000	4.06
VERVOORT, 1965	Gulf of Guinea	0–600	4.10–4.55
GRICE and HULSEMANN, 1967	Arabian Sea	350–2850	5.52
Present record	Izu region	0–930	4.01, 5.90

Pachyptilus eurygnathus SARS, 1920

Pachyptilus eurygnathus SARS, 1920, p. 18; SARS, 1925, p. 321, pl. 114; TANAKA, 1964b, p. 90, fig. 219.

Occurrence: Sta. 83, 1♀; Sta. 107, 1♀; Sta. 108, 1♀; Sta. 111–2, 1♀; Sta. 114, 1♀.

Distribution and size variation:

Author	Locality	Depth (m)	Length (mm) ♀
SARS, 1925	Off Lisbon	0–1550	4.80
JESPERSEN, 1934	Baffin Bay	0–1000	5.3–5.9
WILSON, 1950	Off Galapagos Is.	0–540	—
TANAKA, 1964b	Sagami Bay	0–1000	5.00
GRICE and HULSEMANN, 1967	Western Indian Ocean	350–1470	—
Present record	Izu region	0–930	4.74–5.05

Pachyptilus pacificus JOHNSON, 1936

Pachyptilus pacificus JOHNSON, 1936, p. 65, fig. a 4, 5, b 1–10; BRODSKY, 1950, p. 391, fig. 279; TANAKA, 1964b, p. 88, fig. 218.
Pachyptilus eurygnathus.—SEWELL, 1947, p 239, fig. 65.

Remarks: GRICE and HULSEMANN (1967) note that the specimens recorded by SEWELL (1947) as *Pachyptilus eurygnathus* are referable to *P. pacificus*.

Occurrence: Sta. 84–2, 1♀; Sta. 108, 2♀.

Distribution and size variation:

Author	Locality	Depth (m)	Length (mm) ♀
JOHNSON, 1936	South of Aleutian Is.	—	6.25
SEWELL, 1947	Arabian Sea	0–1000	—
BRODSKY, 1950	Bering Sea	200–4000	5.80–6.25
TANAKA, 1964b	Sagami Bay	0–1000	5.50
GRICE and HULSEMANN, 1967	Equatorial Indian Ocean	275–2600	—
PARK, 1970	Caribbean Sea	1004–1058	—
Present record	Izu region	0–740	5.97–6.18

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