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THE PELAGIC COPEPODS OF THE IZU REGION, MIDDLE JAPAN
SYSTEMATIC ACCOUNT X
FAMILY HETERORHABDIDAE

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With 17 Text-figures

Family HETERORHABDIDAE

Genus *Heterorhabdus* (GIESBRECHT).

A. SCOTT recorded the occurrence of *Heterorhabdus clausi* (GIESBRECHT), *H. papilliger* (CLAUS) and *H. spinifrons* (CLAUS) from the Malay Archipelago. SEWELL (1932) recorded *H. clausi*, *H. papilliger*, *H. spinifrons* and *H. vipera* (GIESBRECHT) from the Indian seas. He (1947) further noted the occurrence of *H. abyssalis* (GIESBRECHT), *H. spinifrons* from the Arabian Sea. *H. tanneri* (GIESBRECHT) and *H. austrinus* (GIESBRECHT) have been reported by CLEVE (1905) from the Agulhas current. From the Japanese waters *H. papilliger* has been recorded by MORI. BRODSKY recorded the following species from the far-eastern seas of the USSR: *H. papilliger*, *H. robusticides* BRODSKY, *H. compactus*, SARS, *H. norvegicus* (BOECK), *H. spinifrons*, *H. clausi*, *H. abyssalis*, *H. pacificus* BRODSKY and *H. tanneri*. I have listed in my previous paper (1953) without description and figures the following species: *H. papilliger*, *H. abyssalis*, *H. spinifrons*, *H. vipera*, *H. compactus*, *H. robustus* FARRAN, *H. devius*, *H. dubius*, *H. vicinus*, *H. fistulosus*, *H. pilosus*, *H. sub-spinifrons* and *H. tenuis*.

There has been some confusion regarding the identification of the species allied to *H. abyssalis* (GIESBRECHT). *H. abyssalis*, *H. norvegicus*, *H. profundus* DAHL and *H. austrinus* (GIESBRECHT) resemble each other so closely that there is no remarkable structural differences among them. According to FARRAN (1929) *H. abyssalis* and *H. norvegicus* differ only in size. SEWELL (1947) described and figured specimens measuring from 3.08 to 3.1 mm under the name *H. abyssalis*. He is of opinion that *H. norvegicus* and *H. abyssalis* are size groups of one and

the same species. In the present collection there occurred several examples which resemble closely *H. abyssalis*, differing chiefly in size. They are *H. devius* and *H. dubius*. On closer examination *devius* and *dubius* are the size groups of *abyssalis*. *H. vicinus*, though closely allied to *abyssalis*, has characteristic features which distinguish it from the latter species.

Heterorhabus abyssalis (GIESBRECHT).

(Fig. 175, a-i)

Heterochaeta abyssalis GIESBRECHT, 1892, p. 273, pl. xix, fig. 4; pl. xx, figs. 29, 30.; *Heterorhabdus abyssalis* FARRAN, 1926, p. 280; SEWELL, 1947, p. 175, text-fig. 46, a-h; WILSON, 1949, p. 239; BRODSKY, 1950, p. 345, fig. 249; TANAKA, 1953, pl. 134; *H. dubius*, TANAKA, 1953, p. 134; *H. devius* TANAKA, 1953, p. 134; VERVOORT, 1957, p. 133.

There have several examples of *H. abyssalis* (GIESBRECHT) been reported. The original specimen described by GIESBRECHT measured 2.75 mm in the male. SEWELL'S specimens measured from 3.08 mm to 3.10 mm in the female, from 2.0 mm to 2.85 mm in the male. BRODSKY'S specimens from the far-eastern seas of the USSR measured 2.4 mm in the female, and 2.75 mm in the male. I have examples which resemble closely *H. abyssalis* (GIESBRECHT). These examples differ only in size and can be arranged into two size groups.

The first group measured 2.09 in the female, and 2.34 mm in the male; the 2nd group measured from 3.23 mm to 3.73 mm in the female, and from 2.92 mm to 3.08 mm in the male. These two groups have each the proportional lengths of the cephalothorax to abdomen, 70:30. The proportional lengths of the abdominal segments and furca are 48:13:10:7:22=100 in the first group, 48:13:10:8:21=100 in the second group. The genital segment slightly produced dorsally; the ventral surface swollen below; the anterior genital flap standing outward, sometimes depressed as shown in the figure.

The 1st antenna extends beyond the end of furca at least by 2 terminal segments; the segments have the following proportional lengths in the first and second groups respectively:

Segments.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	77	14	10	10	10	14	18	18	21	25	28	28	49	53	60	63
	17	17	18	19	20	21	22	23	24	25						
	67	67	67	70	56	53	56	56	53	54=1000						

Segments.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	80	11	11	11	11	13	15	15	17	22	30	28	52	58	60	65
	17	18	19	20	21	22	23	24	25							
	67	65	71	60	54	60	58	49	17=1000							

The proportional lengths of the segments of the 1st antenna are larger in the 2nd group in the segments 1st, 13th 20th and 22nd.

The 2nd antenna has the endopod about 1.3 times as long as the exopod.

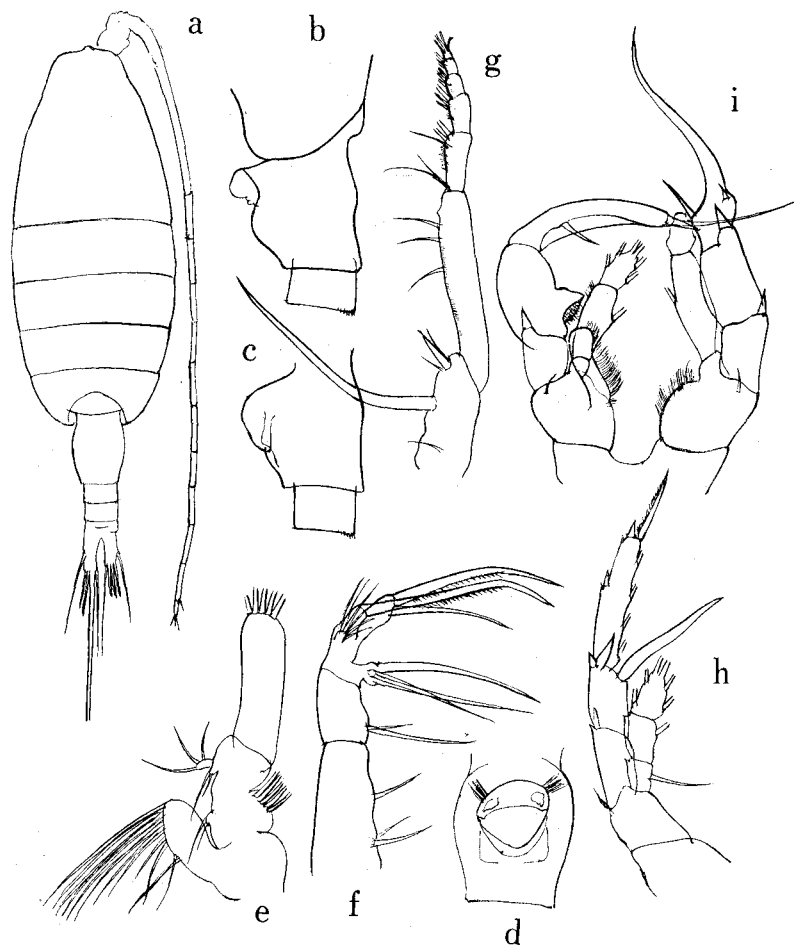


Fig. 175. *Heterorhabdus abyssalis* (GIESBRECHT).

Female : a, dorsal view aspect ; b, last thoracic segment and genital segment, lateral aspect ; c, genital segment, lateral aspect, other specimen ; d, genital segment, ventral aspect ; e, 1st maxilla ; f, 2nd maxilla ; g, maxilliped ; h, 5th leg. Male : i, 5th pair of legs.

The other mouth parts appear to be identical in these groups.

In the 1st leg the 2nd basal segment has a curved pointed claw on the outer margin.

In the 5th pair of legs the proportional lengths of the terminal spine of the 3rd segment of the exopod to the lengths of the 3rd to 1st segments of the exopod are as follows: 22:36:21:21 in the 1st group and 23:35:21:21 in the 2nd group. The distal inner marginal spine of the 2nd segment of the exopod is rather thick and are about as long as the 3rd segment of the exopod.

Male. Length, 2.34-3.08 mm. The abdomen is contained 2.4 times in the lengths of the cephalothorax. The proportional lengths of the abdominal segments and right furcal ramus are as follows: 24:17:16:12:7:24=100 in the 1st group: 22:17:15:13:9:24=100 in the 2nd group.

The 1st antenna extends to the distal end of the furca. The proportional lengths of the segments of the right antenna of the 1st and 2nd groups are as follows:

Segments.	1-2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
	117	12	12	14	17	23	26	26	31	31	31	49	57	60	63	63
	18	19-20-21	22-23	24	25											
	37	140	120	54	23=1000											
Segments.	1-2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
	97	13	10	15	15	20	23	25	28	30	30	46	56	67	69	67
	18	19-20-21	22-23	24	25											
	30	141	136	59	23=1000											

The proportional lengths are larger in the 2nd group in the segments 15th, 17th, 22-23rd and 24th.

There appears to be no differences between these two groups in the structure of the mouth parts and 1st to 5th legs.

Remarks. SEWELL (1947) is of opinion that the specimens of *abyssalis* from the Irish coast, that from the Indian Ocean and specimens of *norvegicus* from the Irish coast are races or forms of the same species. The present specimens, though differ in size, appear to be the size groups of one and the same species.

Occurrence. 4 females and 5 males of the small group, and 25 females and 10 males of the larger group from depths 1000 m to 0 m in the Izu region.

Distribution. The species has a wide distribution in the deep waters of the Pacific, Indian and Atlantic Oceans.

Heterorhabdus pacificus BRODSKY.

(Fig. 176, a-h)

Heterorhabdus pacificus BRODSKY, 1950, p. 355, text-fig. 250; *H. vicinus* TANAKA, 1953, p. 134.

Female. Length, 3.40-3.73 mm. The cephalothorax elongate ovate. The head separates from the 1st thoracic segment; the 4th and 5th thoracic segments are fused. The lateral corner of the last thoracic segment rounded but slightly

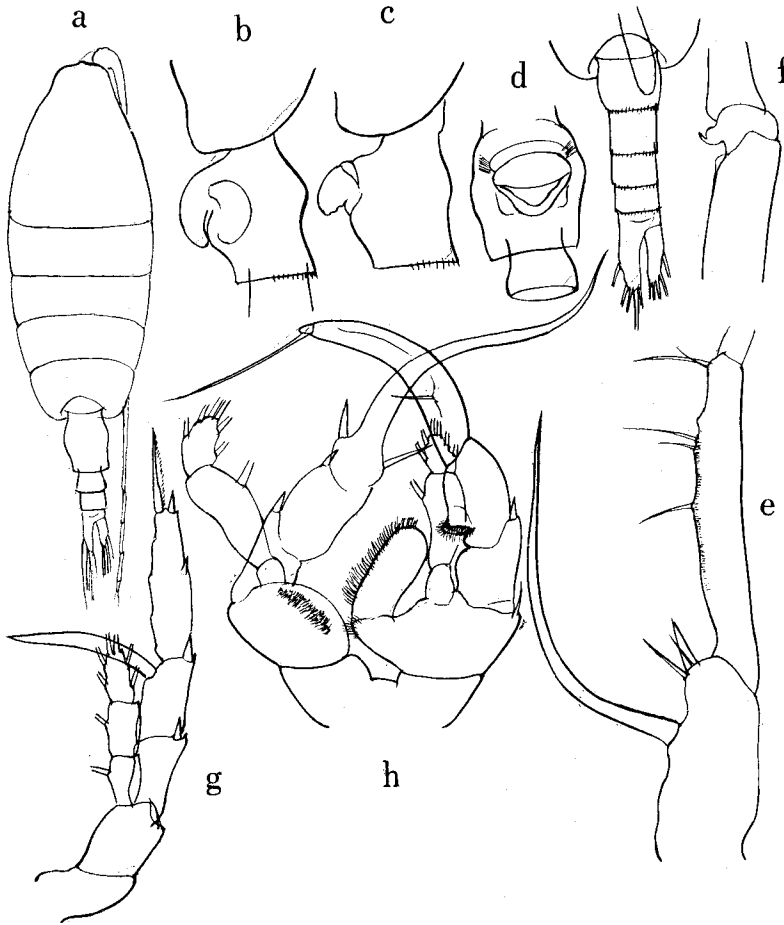


Fig. 176. *Heterorhabdus pacificus* BRODSKY.

Female: a, dorsal aspect; b, last thoracic segment and genital segment, lateral aspect; c, genital segment, lateral aspect, other specimen; d, genital segment, ventral aspect; e, maxilliped; f, curved spine on the 2nd basal segment of 1st leg; g, 5th leg. Male: h, abdomen, dorsal aspect; i, 5th pair of legs.

produced postero-ventrally. The abdomen is contained about 2.5 times in the length of the cephalothorax (71:29).

The abdominal segments and furca are in the proportional length as 47:14:10:8:21 (right furcal ramus)=100. The genital segment slightly asymmetrical;

the left side is more inflated about the middle; the dorsal surface of the segment is considerably produced; the ventral surface is swollen below; the anterior flap standing outwards and sometimes depressed. The 2nd segment is bowl-shaped, contracts at the proximal when viewed from the dorsal. The furcal rami asymmetrical; the left side is longer than the right; the 2nd inner seta of the left ramus is longer than the total length of the body.

The 1st antenna exceeds the end of the furca by 2 terminal segments; the segments are in the proportional lengths:

Segments.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	87	11	11	11	13	15	19	17	19	21	30	28	49	51	58	62
	17	18	19	20	21	22	23	24	25							
	62	64	75	62	56	56	53	51	19=1000							

The 2nd antenna has the exopod about as long as the endopod (45:47). The mandibular blade has 4 teeth and a seta on the right, and 3 teeth and a seta on the left side. In the 1st maxilla the 2nd and 3rd inner lobes bear each a single seta. The 2nd maxilla as that of the other species of the genus. The maxilliped has a long sigmoid spine on the 1st basal segment; the 2nd basal segment is slender and is furnished with 3 marginal setae, 2 distal setae and a row of hair-like spines on the middle section of the anterior margin, and a small process or something like cutaneous pore on the anterior distal 1/4 of the segment.

The 1st to 5th legs have each 3-jointed exopod and endopod. In the 1st leg the 2nd basal has a curved claw on the outer margin. In the 3rd leg the terminal segment of the exopod is broad and has a short curved endspine.

In the 5th pair of legs the 2nd segment of the exopod has an inner marginal spine which is about as long as the distal segment of the exopod; the endspine is shorter than the segment itself. The proportional lengths of the segments of the exopod to the endspine of the 1st to 5th legs are as follows:

	Endspine	Re 3	Re 2	Re 1
1st leg	47	17	15	21 (=100)
2nd leg	13	48	20	19
3rd leg	7	54	21	18
4th leg	15	48	20	17
5th leg	23	35	21	21

Male. Length, 3.07-3.35 mm. The abdomen is contained 2.45 times in the length of the cephalothorax. The abdominal segments and right furcal ramus are in the proportional lengths as 21:17:15:13:6:28=100.

The 1st antenna exceeds the end of the furca by one terminal segment; the proportional lengths of the segments of the grasping antenna are as follows:

Segments.	1-2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
	107	13	10	13	18	23	28	28	33	33	33	43	53	60	60	65
	18	19-20-21	22-23	24	25											
	43	143	118	53	23=1000											

The 2nd antenna has the endopod 1.5 times as long as the exopod. In the mandible the exopod slightly longer than the endopod. The maxillae and maxilliped as those of the female.

The 1st to 4th legs as in the female. In the right 5th leg the 2nd basal segment has a sausage-shaped process on the inner margin; the 2nd segment of the exopod carries a process on the inner margin, which is not so sharp as is seen in *H. abyssalis*; the sub-apical spine on the distal segment of the exopod is about as long as the 3rd segment of the exopod. In the left leg the 2nd basal segment has a brush of hair-like spines on the middle portion of the segment; the outer edge spine of the segment of the exopod is about equal in size to that of the 1st segment of the exopod; the distal segment of the exopod is long and slender.

Remarks. The present species comes near to *H. norvegicus* (BOECK) in its large size but differs from it in the proportional lengths of the abdominal segments and furca. The present species is characterized by the peculiar shape of the 2nd abdominal segment. The species is also closely allied to *H. abyssalis* (GIESBRECHT) but can be distinguished from the former by its large size and by the shape of the 2nd abdominal segment of the female. The present species may be identical with *H. pacificus* BRODSKY taken from the far-eastern seas of the USSR. His specimen measured 3.5 mm in the female 3.2 mm in the male.

Occurrence. 25 females and 36 males in vertical hauls from depths 1000-0 m in the Izu region.

Distribution. The species appears to be distributed in deep waters of the North-west Pacific.

Heterorhabdus fistulosus sp. nov.

(Fig. 177, a-g)

Female. Length, 3.39-3.60 mm. General appearance as in *H. abyssalis* (GIESBRECHT). The abdomen is contained 2.3 times in the length of the cephalothorax. The abdominal segments and furca (right side) are in the proportional lengths as 44:14:10:7:25 (=100). The genital segment is slightly asymmetrical; the right lateral margin of the left side is more produced when viewed from the dorsal; the ventral surface swollen considerably below; the anterior flap standing; the posterior margin of the segment is striated with denticles. The 2nd and 3rd segments are each furnished along the posterior margin with

denticles. The furcal rami asymmetrical; the right ramus is 3 times as long as wide; the outer margin of the both rami bear each a minute spine near the

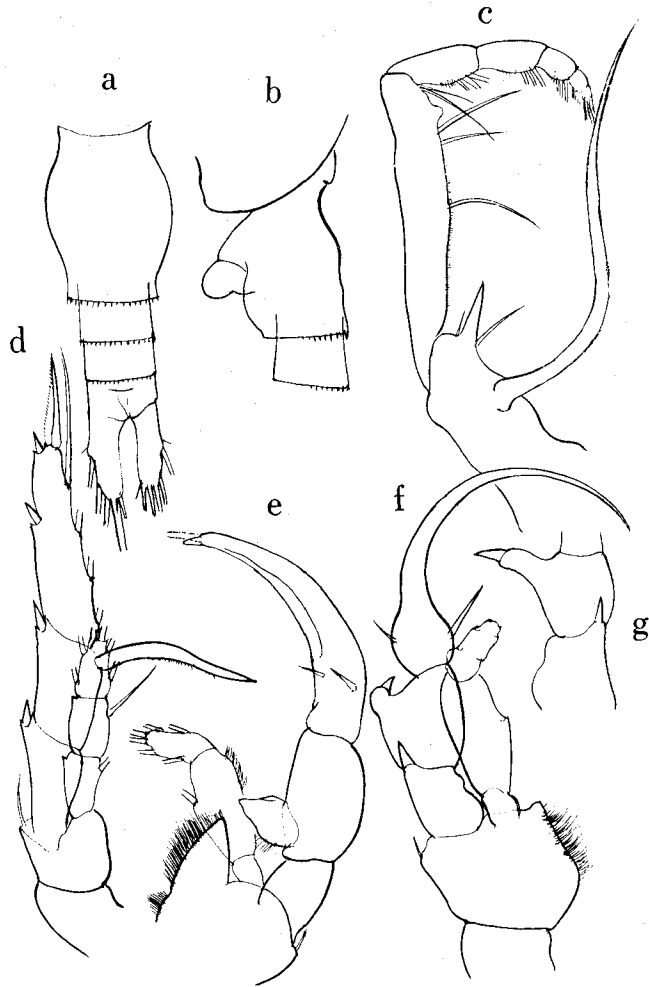


Fig. 177. *Heterorhabdus fistulosus* sp. nov.

Female : a, abdomen, dorsal aspect ; b, last thoracic segment and genital segment, lateral aspect ; c, maxilliped ; d, 5th leg.
Male : e, right 5th leg ; f, left 5th leg ; g, 1st and 2nd segment of exopod left 5th leg.

base of the outer-most seta; the distal margin of the rami has, beside 3 long setae, a short seta on the dorsal surface at the base of the inner-most seta; the 2nd inner seta of the left ramus is very long.

The 1st antenna over-reaches the furcal rami by 2 terminal segments; the segments are in the following proportional lengths:

Segments.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	72	14	14	11	11	14	18	16	21	23	29	25	51	56	53	51
	17	18	19	20	21	22	23	24	25							
	67	70	74	60	53	58	58	58	23=1000							

The segments 15 and 16 are much shorter in proportions than those of *H. abyssalis*.

The 2nd antenna has the endopod 1.6 times as long as the exopod; the 2nd segment of the endopod is furnished with hair-like spines on the distal half of the outer margin. In the mandible the right side has the biting blade furnished with 4 teeth and a seta, and the left side has 3 teeth and a seta; the exopod 1.6 times as long as the endopod; the 1st segment of the endopod has 3 marginal setae; the 2nd segment has 7 setae on the distal margin. In the 1st maxilla the 1st and 2nd inner lobes have each a single seta; the endopod bears 3 setae; the masticatory lobe bears 13 setae. In the 2nd maxilla the terminal spine of the 6th lobe is longer than the rest spines; the proximal spine on the 5th lobe is about 4/5 the length of the terminal spine of the 6th lobe. The maxilliped has the basal segments and the endopod in the following proportional lengths: 35:50:36 (endopod); the 1st basal has a long curved spine which is of about equal in length to the 2 basal segments taken together; the anterior distal margin of the segment is furnished with a strong spine and 2 short setae; the 2nd basal has 3 setae and a row of hair-like spines on the anterior margin, and 2 setae on the distal corner; there is a moderately large protuberance or cutaneous pore on the distal anterior margin near the base of the 3rd marginal seta; this protuberance is small in the foregoing species; the 1st to 4th segments of the endopod are each furnished with hair-like spines and 3 marginal setae on the anterior margin; the terminal segment has 3 distal setae and a short marginal seta.

In the 1st leg the 2nd basal segment has a curved pointed claw on the outer margin; the 1st segment of the exopod has an outer edge spine extending to the proximal 1/3 of the 3rd segment of the exopod. The 2nd to 4th legs resemble those of the preceding species; the proportional lengths of the endspine to the segments of the exopod of the 1st to 5th legs are as follows:

	Endspine	Re 3	Re 2	Re 1
1st leg	46	16	14	24=100
2nd leg	16	48	17	19
3rd leg	8	56	17	17
4th leg	16	51	17	16
5th leg	22	38	21	19

In the 5th pair of legs the inner marginal spine of the 2nd segment of the exopod is shorter than the 3rd segment of the exopod, and extends to the base of the distal inner marginal seta of the 3rd segment. The inner marginal spine is rather slender.

Male. Length, 3.45 mm. General appearance as in the female. The abdomen is contained 2.4 times in the length of the cephalothorax. The abdominal segments and right furcal ramus are in the proportional lengths as 22:17:16:12:9:24=100.

The 1st antenna extends to the distal margin of the anal segments; the proportional lengths of the segments of the grasping antenna are in the main similar to those of the foregoing species but the segments 22-23 are shorter:

Segments.	1-2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
	114	11	9	14	16	23	25	25	29	32	29	50	55	64	68	68
	18	19-20-21	22-23	24	25											
	34	140	114	57	23=1000											

The mouth parts and 1st to 4th swimming legs as those of the female.

In the right 5th leg the inner marginal process of the 2nd basal segment of the exopod is situated near the base of the segment and pointed at the apex; the subapical seta of the 3rd segment of the exopod broken off in the present specimen. In the left leg the 2nd basal segment is furnished with a brush of hair-like spines on the distal 2/3 of the inner margin; the 2nd segment of the exopod has a strong outer edge spine based on the long projection of the segment; the distal segment is prolonged into a slender spine which is 3.5 times as long as the 2nd segment of the exopod.

Remarks. The present species is characterized by the large protuberance on the anterior margin of the 2nd basal segment of the maxilliped in both sexes. The male is distinguished from any other males of the genus by the shape of the inner marginal process of the 2nd basal segment and the protuberance on the inner margin of the 2nd segment of the exopod of the right 5th leg.

Occurrence. 2 females and one male in vertical hauls from 1000-0 m in the Izu region.

Distribution. The species is known at present time only from the North-west Pacific.

Heterorhabdus papilliger (CLAUS).

Heterochaeta papilliger, GIESBRECHT, 1892, p. 372, t. 20, figs. 4, 7, 10, 15, 17, 23, 35, 36; t. 39, figs. 39, figs. 40, 53; *Heterorhabdus papilliger*, ESTERLY, 1905, p. 184; A. SCOTT, 1909, p. 132; WOLFENDEN, 1911, p. 302; SEWELL, 1913, p. 354; SARS, 1925, p. 229; FARRAN, 1926, p. 282; 1929, p.p. 265; SEWELL, 1932, p. 300; FARRAN, 1936, p. 112; MORI, 1937, p. 73, pl. 37, figs. 7-13; pl. 38, figs. 1-4; BRODSKY, 1950, p. 353, text-fig. 247; WILSON, 1950, p. 240; TANAKA, 1953, p. 134.

Female. Length, 1.88-2.04 mm. The 1st antenna extends to the distal margin of the 2nd abdominal segment. The 5th pair of legs has an inner edge spine on the 2nd segment of the exopod which is longer than the 3rd segment of the exopod; the inner distal corner of the 2nd basal segment is triangularly produced.

Male. Length, 1.88 mm. In the right 5th leg the 2nd basal segment has a large process; the 2nd segment of the exopod carries proximally a large process furnished with a small spine on the middle of the inner margin; the subapical spine of the 3rd segment of the exopod is short.

Occurrence. Very common in the surface layer.

Distribution. The species has a wide distribution in the great oceans.

Heterorhabdus tanneri (GIESBRECHT).

(Fig. 178, a-i)

Heterochaeta tanneri GIESBRECHT, 1895, p. 259, pl. 4, figs. 5, 6; *Heterorhabdus tanneri* BRODSKY, 1950, p. 357, text-fig. 251; *Heterorhabdus pilosus* TANAKA, 1953, p. 134.

Female. Length 4.01 mm: cephalothorax 2.75 mm; abdomen, 1.26 mm. The cephalothorax elongate ovate in outline, 2.2 times as long as it is wide at the 1st thoracic segment. The lateral corner of the last thoracic segment is furnished with 3 small spines on the distal margin when viewed from the lateral. The abdominal segments and furca are in the proportional lengths as 49:11:10:7:23=100 (left ramus). The genital segment long and slightly asymmetrical; the lateral margin of the left side slightly sinuate and is furnished with minute spines on the distal 1/3 of the lateral margin; the ventral surface of the segment just below the genital flap is furnished with a blunt process when viewed from the lateral.

The 1st antenna extends to the end of the furca; it over-reaches the furca by 2 or 3 segments when fully reflexed; the segments are in the following proportional lengths:

Segments.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	66	8	8	8	9	11	18	18	18	22	33	29	53	57	62	68
	17	18	19	20	21	22	23	24	25							
	69	69	75	62	55	60	57	47	18=1000							

The 2nd maxilla and maxilliped as those of *H. papilliger*.

In the 5th pair of legs the inner marginal spine on the 2nd segment of the exopod is short, about 2/3 the length of the 3rd segment of the exopod; the end-spine of the exopod is about 2/5 the length of the 3rd segment of the exopod.

Male. Length, 3.75-3.85 mm. General appearance as in the female. The abdomen is contained 2 times in the length of the cephalothorax. The abdominal

segments and furca are in the proportional lengths as 22:20:19:12:7:20=100.

The 1st antenna exceeds the end of the furca by 2 terminal segments; the clasping antenna has the segments in the following proportional lengths:

Segments.	1-2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
	110	14	12	14	18	23	23	23	29	31	27	47	55	61	67	65
	18	19-20-21	22-23	24	25											
	47	134	128	53	19=1000											

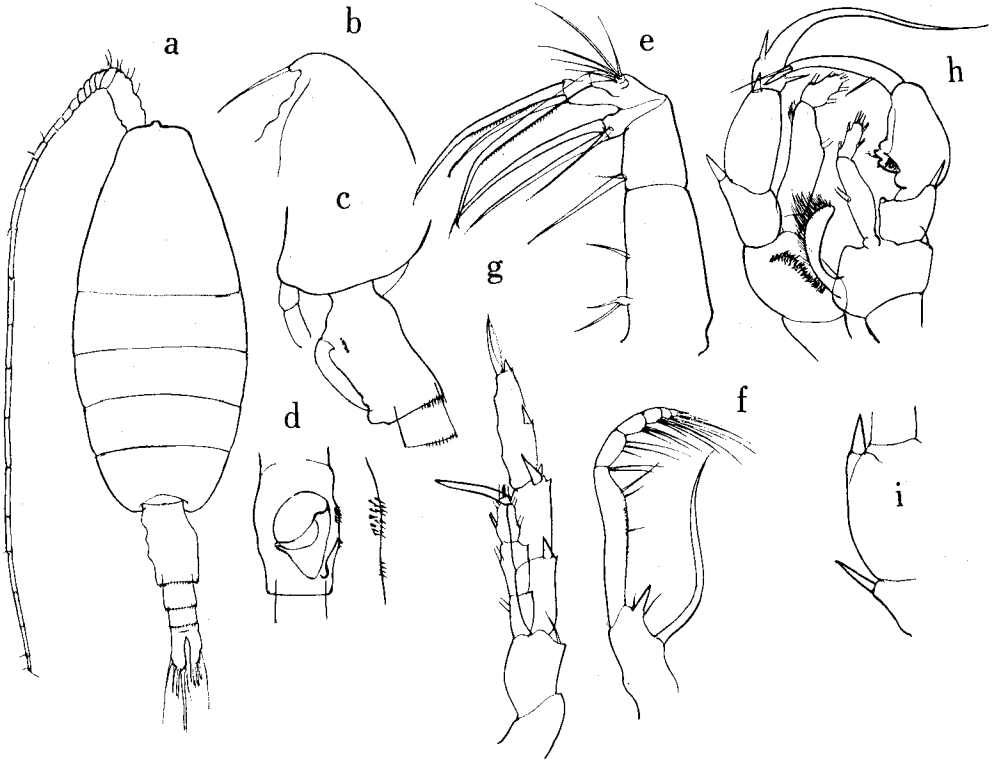


Fig. 178. *Heterorhabdus tanneri* (GIESBRECHT).

Female: a, dorsal aspect; b, head, lateral aspect; c, last thoracic segment and genital segment, lateral aspect; d, genital segment, ventral aspect; e, 2nd maxilla; f, maxilliped; g, 5th leg. Male: h, 5th pair of legs; i, 1st and 2nd segment of exopod of left 5th leg.

The mouth parts and the 1st to 4th swimming legs as in the female.

The right 5th leg has a long and narrow process on the inner margin of the 2nd basal segment; the 2nd segment of the exopod is furnished along its inner margin with a process which resembles in shape to that found in the same segment of *H. papilliger*; the 3rd segment of the exopod is rather short; the

subapical spine is about one-half the length of the segment itself. The left leg is furnished with a brush of hair-like spines on the inner margin of the 2nd basal segment; the outer edge spine on the 2nd segment of the exopod is strong but slightly shorter than that on the 1st segment of the exopod; the 3rd segment of the exopod is prolonged into a slender whip-like spine about 2.3 times as long as the 2nd segment of the exopod.

Remarks. The species is easily distinguished from the other members of the genus by the peculiar shape of the genital segment in the female and by the characteristic feature of the right 5th leg in the male.

Occurrence. 4 females and 4 males in the vertical hauls from depth 1000 m to the surface in Sagami Bay.

Distribution. The species has been recorded from the Pacific by GIESBRECHT and from the Okhotsk Sea and Bering Sea by BRODSKY.

Heterorhabdus spinifrons (CLAUS).

(Fig. 179, a-e)

Heterochaeta spinifrons, GIESBRECHT, 1892, p. 372, t. 20, figs. 1, 3, 11, 16, 19, 31; t. 39, figs. 42, 43, 51, 52, 54; *Heterorhabdus spinifrons*, A. SCOTT, 1909, p. 130; SARS, 1925, p. 227; FARRAN, 1926, p. 282; 1929, p. 264; SEWELL, 1932, p. 300; 1947, p. 179; BRODSKY, 1950, p. 246, 352, text-fig. 246; WILSON, 1950, p. 240; TANAKA, 1953, p. 134; VERVOORT, 1957, p. 133.

Female. Length 3.49 mm: cephalothorax, 2.33 mm; abdomen, 1.16 mm. The frontal margin of the head produced into a small spine. The 1st antenna exceeds the end of the furca by distal 2 segments. The 1st antenna has the segments in the following proportional lengths:

Segments.	1	2	3	4	5	6	7	8	6	10	11	12	13	14	15	16
	51	10	10	8	10	12	17	17	17	23	31	27	55	59	66	68
	17	18	19	20	21	22	23	24	25							
	70	66	74	61	55	61	59	55	18=1000							

In the 5th pair of legs the inner marginal spine of the 2nd segment of the exopod is about as long as the 3rd segment of the exopod; the endspine about 1/3 the length of the 3rd segment of the exopod.

Male. Length, 2.95 mm–3.19 mm: cephalothorax, 2.05 mm; abdomen, 0.90 mm,

In the right 5th leg the 2nd basal segment has rather a small process on the 2nd segment of the exopod furnished with a small spine at the apex; the 3rd segment of the exopod is long, about twice as long as the 2nd segment of the exopod; the sub-apical spine on the 3rd segment of the exopod short. In the left 5th leg the outer edge spine of the 2nd segment of the exopod larger than that of the 1st segment of the exopod; the 3rd segment terminates into a long spine; the proximal part of the spine not thickened.

Occurrence. 10 females and 13 males from deep layers of Sagami Bay.

Distribution. The species has a wide distribution in the great oceans.

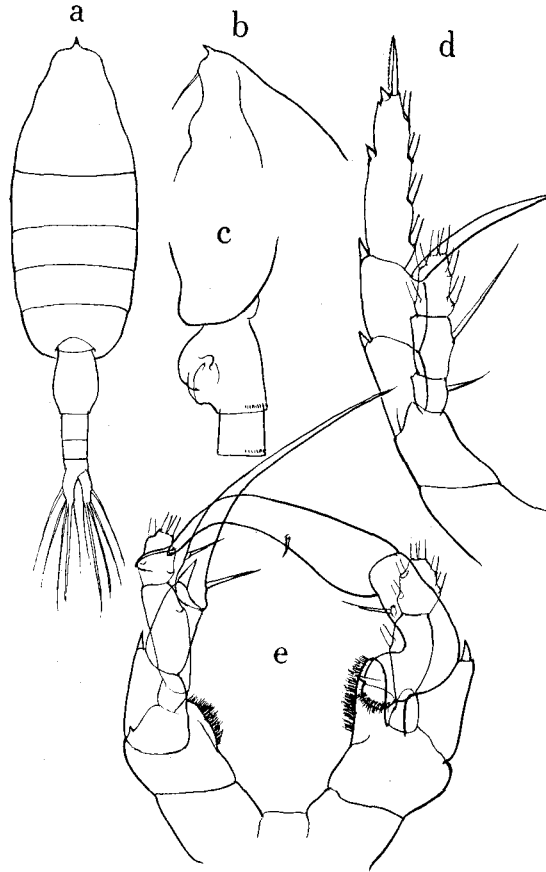


Fig. 179. *Heterorhabdus spinifrons* (CLAUS).

Female: a, dorsal aspect; b, head, lateral aspect; c, last thoracic segment and genital segment, lateral aspect; d, 5th leg. Male: e, 5th pair of legs.

Heterorhabdus sub-spinifrons sp. nov.

(Fig. 180, e-j)

Female. Length, 2.27 mm: cephalothorax, 1.88 mm; abdomen, 0.89 mm. General appearance as in *H. spinifrons* (CLAUS). The papilla is prolonged into a sharp spine. The abdominal segments and furca are in the proportional lengths as 40:16:12:12:20 (left ramus)=100. The genital segment has a small

process on each side above the genital opening; the ventral surface of the segment is fringed with a row of small denticles on each side around the genital opening as shown in the figure.

The 1st antenna exceeds the end of the furca by distal 2 segments; the segments are in the following proportional lengths:

Segments.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	72	12	12	12	12	14	17	17	19	23	32	29	57	63	13	69
	17	18	19	20	21	22	23	24	25							
	67	63	67	55	49	52	52	52	20	=1000						

The segments 14 and 15 are of equal lengths in the present specimen, whereas, in *spinifrons* the segment 15 is longer than the segment 14; the segment 16 is the longest in the present specimen while it is the segment 19 which is the longest in *spinifrons*; the segment 24 is less than 3 times the length of the segment 25 in the present specimen, whereas it is just 3 times in *spinifrons*.

The mouth parts and swimming legs as those of *spinifrons*.

In the 5th pair of legs the inner marginal spine on the 2nd segment of the exopod slightly shorter than the 3rd segment of the exopod; the terminal spine of the exopod $\frac{3}{8}$ the length of the 3rd segment of the exopod.

Male. Length, 2.11 mm: cephalothorax, 1.52 mm; abdomen, 0.59 mm. The abdominal segments and furca are in the propornal lengths as 22:18:15:12:9:24=100. The genital segment 1.7 times as wide as long; the right furcal ramus 2.3 times as long as wide.

The right 1st antenna extends to the end of the 3rd abdominal segment; the segments are in the following proportional lengths:

Segments.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	108	18	14	14	14	18	18	18	23	23	32	32	45	49	54	63
	17	18	19	20	21	22	23	24	25							
	63	63	67	54	45	49	49	49	18	=1000						

The left antenna is modified into a grasping organ; the segments are in the following proportional lengths:

Segments.	1-2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
	130	14	14	14	19	23	23	27	27	32	23	46	56	60	56	56
	18	19-20	21	22-23	24	25										
	32	148	125	56	19	=1000										

The 2nd antenna has the exopod about as long as the endopod. The mandible has the exopod 1.6 times as long as the endopod; the left cutting edge has 3 teeth. The 1st maxilla as that of the other member of the genus; the numbers

of the setae on the endopod reduced. The 2nd maxilla and maxilliped as those of *H. spinifrons*.

The 1st leg has 3-jointed exopod and endopod; the outer edge spine of the

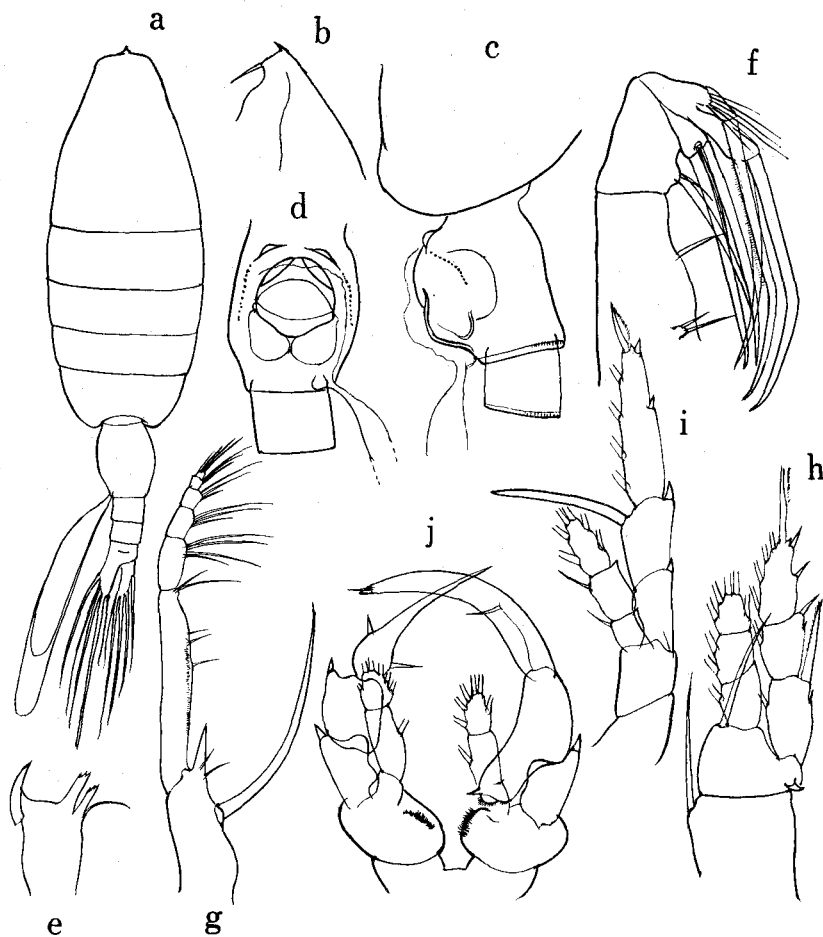


Fig. 180. *Heterorhabdus sub-spinifrons* sp. nov.

Female : a, dorsal aspect ; b, head, lateral aspect ; c, last thoracic segment and genital segment, lateral aspect ; d, genital segment, ventral aspect ; e, biting blade of mandible ; f, 2nd maxilla ; g, maxilliped ; h, 1st leg ; i, 5th leg. Male : 5th pair of legs.

1st segment of the exopod is long exceeding the base of the outer edge spine of the 2nd segment of the exopod ; the outer margin of the 1st and 2nd segments of the exopod are each furnished with a small spine at the base of the outer edge spine ; the 2nd basal segment has a curved claw on the outer proximal

margin. The 2nd to 4th legs as those of the foregoing species; the numbers of setae on the segments of the 2nd to 4th legs as follows: 1, 2, 7; 1, 2, 8; 1, 2, 7.

The 5th pair of legs resembles that of *H. spinifrons*. In the right leg the 2nd segment of the exopod has a large inner marginal protuberance furnished with a small spine, extending about to the base of the 1st segment of the exopod; the sub-apical spine on the 3rd segment of the exopod small; the 2nd basal segment has no remarkable protuberance on the inner margin. In the left leg the distal segment of the exopod terminates into rather a short spine.

Remarks. The specimen closely resembles *H. spinifrons* (CLAUS) but can be easily distinguished from it by its small size, the processes on the ventral surface of the genital segment, the proportional lengths of the segments of the 1st antenna and by the structure of the 5th pair of legs in the female. In the male the inner marginal process on the 2nd basal segment of the right 5th leg is small, and the inner margin of the 2nd segment of the exopod is stright.

Occurrence. 9 females and one male from deep layers of Sagami Bay.

Distribution. The species is known only from the North-west Pacific.

Heterorhabdus vipera (GIESBRECHT).

(Fig. 181, a-g)

Heterochaeta vipera, GIESBRECHT, 1892, p. 373, t. 20, figs. 5, 6, 12, 13, 18, 20, 27, 32, 33; t. 39, fig. 41; *Heterorhabdus vipera*, WOLFENDEN, 1911, p. 303; FARRAN, 1926, p. 284; SEWELL, 1932, p. 300; TANAKA, 1953, p. 134.

Female. Length, 2.16 mm: cephalothorax, 1.68 mm; abdomen, 0.93 mm. The frontal margin of the head truncate. The abdominal segments and furca are in the proportional lengths as 39:16:14:8:23 (left)=100. The genital segment about 1.5 times as long as wide; the genital flap depressed.

The 1st antenna extends to the end of the anal segment when fully reflexed. The mandible has a long ventral tooth on the cutting edge of the left side. In the 2nd maxilla the spines on the terminal segments and the distal lobes are more slender than those of *papilliger* section. The maxilliped has a slender normal seta on the 1st basal segment about the middle of the anterior margin.

In the 5th pair of legs the inner marginal spine of the 2nd segment of the exopod is rather straight and is longer than the 3rd segment of the exopod.

Occurrence. One female from deep layers of Sagami Bay.

Distribution. The species has been recorded from the Pacific, Atlantic and Indian Oceans.

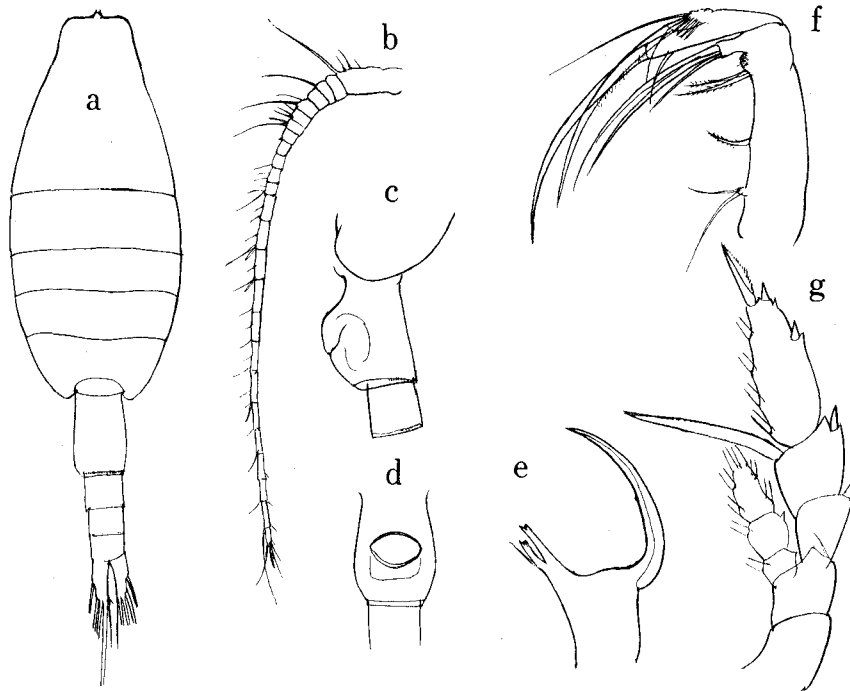


Fig. 181. *Heterorhabdus vipera* (GIESBRECHT).

Female: a, dorsal aspect; b, 1st antenna; c, last thoracic segment and genital segment, lateral aspect; d, genital segment, ventral aspect; e, biting blade of mandible; f, 2nd maxilla; g, 5th leg.

Heterorhabdus robustus FARRAN.

(Fig. 182, a-h)

Heterorhabdus robustus, FARRAN, 1929, p. 266; WILSON, 1950, p. 240; TANAKA, 1953, p. 134.

Female. Length, 3.83–4.75 mm: cephalothorax 3.06 mm; abdomen, 1.69 mm. The cephalothorax robust. The abdominal segments and furca are in the proportional lengths as 34:15:13:12:26=100. The genital segment about as wide as long; there is a row of small denticles on the periphery of the genital opening when viewed from the lateral. The furcal rami are slender and slightly asymmetrical.

The 1st antenna reaches back when fully extended to the end of the 2nd abdominal segment. The cutting edge of the mandible has a long ventral tooth on the left side. In the maxilliped the posterior margin of the 2nd basal segment is bluntly produced proximally.

The swimming legs as described and figured by FARRAN. In the 5th pair

of legs the inner edge spine of the 2nd segment of the exopod is about as long as the 3rd segment of the exopod.

Male. Length, 3.45–4.90 mm : cephalothorax, 3.06 mm ; abdomen 1.84 mm. The abdominal segments and furca are in the proportional lengths as 19:15:15:17:8:28 (left)=100. The genital segments 2 times as long as wide. The furcal rami well defined.

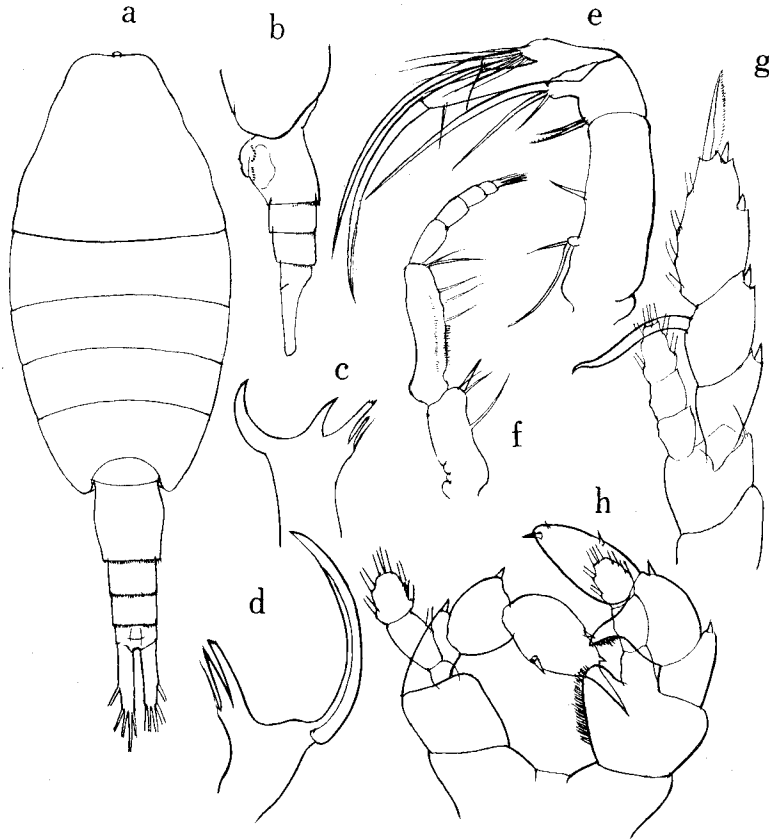


Fig. 182. *Heterorhabdus robustus* FARRAN.

Female : a, dorsal aspect ; b, last thoracic segment and abdomen, lateral aspect ; c, biting blade of mandible ; e, 2nd maxilla ; f, maxilliped ; g, 5th leg. Male : 5th pair of legs.

The right 1st antenna reaches back to the end of the anal segment; the left antenna is modified into a grasping organ

In the 5th pair of legs the 2nd segment of the exopod of the right leg has a large pointed process on the inner margin; the inner marginal process on the 2nd basal segment is small. In the left leg the 2nd basal segment has no brush

of hair-like spines on the inner margin.

Remarks. There are two size groups in the present species; the small one measured 3.83 mm in the female; 4.09 mm in the male; the larger one measured 4.75 mm in the female and 4.90 mm in the male. BRODSKYS' *H. robustoides* may perhaps be identical with the present species. His specimens measured 4.8–5.0 mm in the female 4.6–4.8 mm in the male.

Occurrence. 12 females and 4 males from deep layers of Sagami Bay.

Distribution. The species has been recorded from the temperate Atlantic and from the Antarctic.

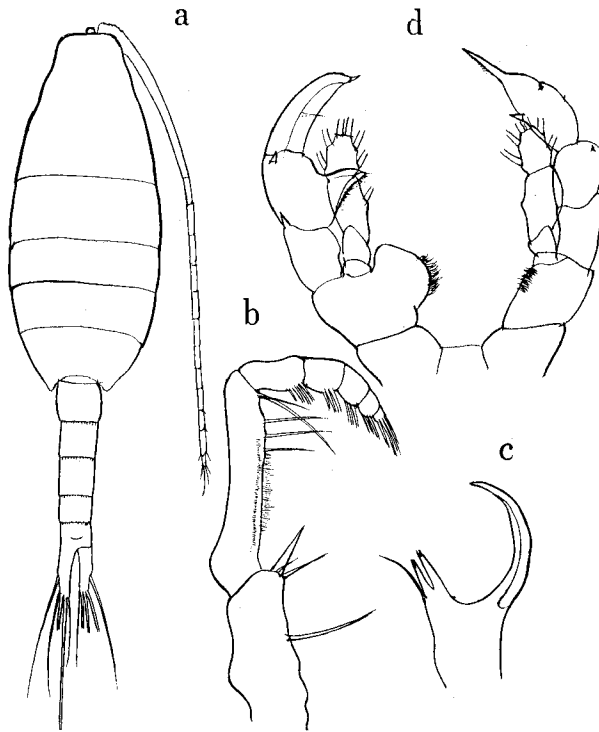


Fig. 183. *Heterorhabdus tenuis* sp. nov.

Male: dorsal aspect; b, maxilliped; c, biting blade of mandible, d, 5th pair of legs.

Heterorhabdus tenuis sp. nov.

(Fig. 183, a-d)

Male. Length, 2.52 mm: cephalothorax, 1.59 mm; abdomen, 0.93 mm. The cephalothorax elongate ovate in outline, 2.4 times as wide as long. The lateral corner of the last thoracic segment bluntly produced. The abdominal segments

and furca are in the proportional lengths as 15:17:18:15:10:25=100. The furcal rami slightly asymmetrical; the left ramus is longer.

The right 1st antenna extends about to the end of the 2nd abdominal segment; the distal segments of the grasping antenna has the following proportional lengths:

Segments.	18	19-20-21	22-23	24	25
	8	29	21	11	6

The mouth parts as those of *H. robustus* FARRAN.

The 5th pair of legs resembles that of *H. robustus*, but the inner margin of the 2nd basal segment of the right leg much swollen. In the left leg the 2nd basal segment is furnished coarsely with hair-like spines on the inner margin.

Remarks. The specimen has the appendages quite similar in structure to those of *H. robustus* FARRAN but differs from it in its slender cephalothorax and in some minute points of structure in the 5th pair of legs. The specimen is also closely allied to *H. vipera* but the slender furcal rami and the shape of the distal segment of the right 5th leg are the main characteristics which distinguish the present specimen from *vipera*.

Occurrence. One male from deep layers of Suruga Bay.

Distribution. The species is known from the North-west Pacific.

Heterorhabdus compactus SARS.

(Fig. 184, a-g)

Heterorhabdus compactus, SARS, 1925, p. 226, pl. LXII; FARRAN, 1929, p. 267; BRODSKY, 1950, p. 348, text-fig. 244; TANAKA, 1953, p. 134.

Female. Length, 2.43 mm: cephalothorax, 1.84 mm; abdomen, 0.59 mm. The cephalothorax very robust, the greatest width measured 1.04 mm. The lateral corner of the last thoracic segment narrowly rounded. The abdominal segments and furca are in the proportional lengths as 47:9:9:13:22=100. The genital segment tumified laterally and produced below. The furcal rami symmetrical, 2 times as long as wide.

The 1st antenna extends to the middle of the last thoracic segment. The 2nd maxilla as that of *H. vipera*. The maxilliped is furnished with an usual short seta on the anterior margin of the 1st basal segment about the middle.

In the 5th pair of legs the inner edge spine of the 2nd segment of the exopod is slightly longer than the 3rd segment of the exopod; the spine is furnished with minute spinules on the distal half of the posterior margin.

Male. Length, 2.59 mm: cephalothorax, 1.93 mm; abdomen 0.66 mm. General appearance as in the female. The lateral margin of the 2nd abdominal segment is furnished with two groups of short hairs on the right side.

In the right 5th leg the inner marginal process on the 2nd basal segment is not much produced; the inner margin of the 2nd segment of the exopod is furnished with a large acute process arising from the middle of the segment; the sub-apical spine of the distal segment is short. In the left leg the distal segment of the exopod broad and terminates into a strong spine which is shorter than the 3rd segment itself.

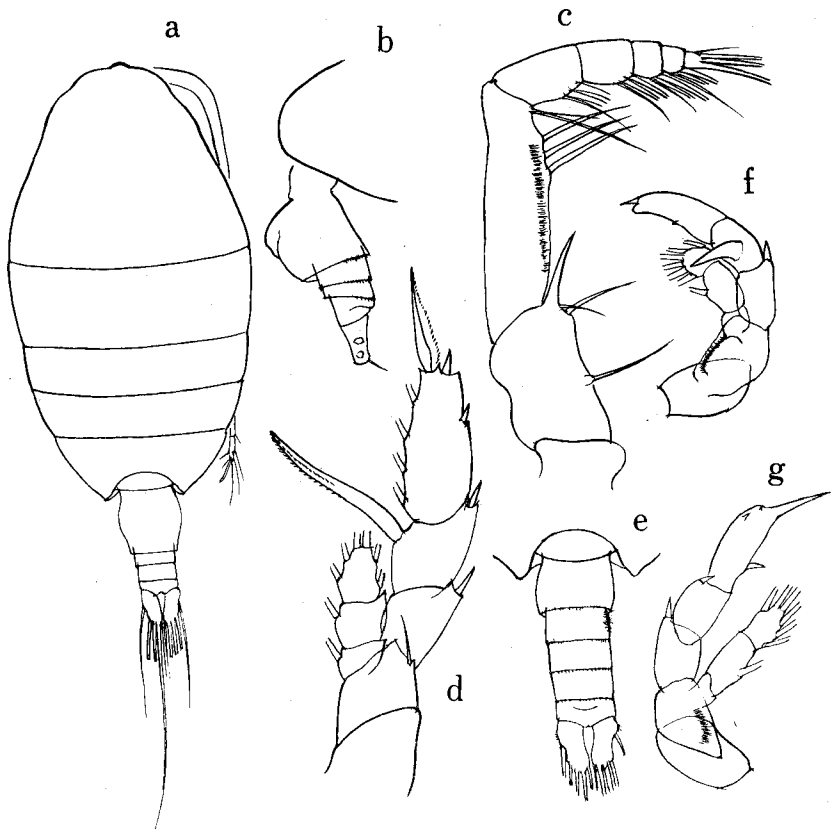


Fig. 184. *Heterorhabdus compactus* Sars.

Female: a, dorsal aspect; b, last thoracic segment and abdomen, lateral aspect; c, maxilliped; d, 5th leg. Male: e, abdomen, dorsal aspect; f, right 5th leg; g, left 5th leg.

Remarks. The specimens recorded by BRODSKY from the far-eastern seas of the USSR are larger in size, and measured 3.0–3.4 mm in the female, 2.9–3.4 mm in the male. According to FARRAN (1929) there are two size groups; the larger one from the Antarctic measured 3.35 mm and the small one from the North Atlantic 2.3 mm

Occurrence. 9 females and 2 males from deep layers of the Izu region.

Distribution. The species has been recorded from the temperate Atlantic and from the Antarctic, also from the far-eastern seas of the USSR.

Genus *Heterostylites* SARS.

The genus was created by SARS in 1920 to accommodate two species which had been included in the genus *Heterorhabdus*. The genus differs from *Heterorhabdus* in the structure of the teeth of the cutting edge of the mandible and in the structure of the 2nd maxilla. The maxilliped as in *Heterorhabdus vipera*. The genus comprises at present two species *Heterostylites longicornis* (GIESBRECHT) and *H. major* DAHL. SEWELL recorded the occurrence of these two species from the Indian seas and from the Arabian Sea. The same species have been recorded by BRODSKY from the far-eastern seas of the USSR. VERVOORT recorded the same two species from the Antarctic. From the Izu region I have been able to find the female and immature specimens of *H. longicornis* and the male specimen of *H. major*.

Heterostylites longicornis (GIESBRECHT).

(Fig. 185, a-g)

Heterochaeta longicornis, GIESBRECHT, 1892, p. 373, t. 20, figs. 4, 21, 25, 26; t. 39, fig. 44; *Heterorhabdus longicornis*, ESTERLY, 1905, p. 186, fig. 40; A. SCOTT, 1909, p. 302; SEWELL, 1913, p. 354; *Heterostylites longicornis*, SARS, 1925, p. 238, pl. LXVII, figs. 1-6; FARRAN, 1926, p. 293; 1929, p. 267; SEWELL, 1932, p. 301; 1947, p. 181; WILSON, 1950, p. 241; BRODSKY, 1950, p. 235; VERVOORT, 1957, p. 135.

Female. Length, 3.05 mm: cephalothorax, 2.05 mm: abdomen, 1.00 mm. The cephalothorax robust. The frontal margin of the head broad. The abdomen 4-jointed; the furcal rami asymmetrical. The segments and furca are in the proportional lengths as 38:16:13:11:22 (right side)=100. The genital segment not swollen below; an oval protuberance projects from the genital orifice; the ventral surface of the segment is furnished with short hairs near the distal margin when viewed from the lateral. The left furcal ramus about 3 times as long as wide.

The 1st antenna over-reaches the furca by 7 terminal segments; the distal segments are in the following proportions:

Segments.	20	21	22	23	24	25
	32	29	30	30	26	8

The 2nd antenna has the exopod about as long as the exopod; the 1st segment of the exopod has no inner marginal seta. In the mandible the tooth-plate as in *Heterorhabdus*; the ventral tooth is not strong. The 1st maxilla as in *Heterorhabdus*; the endopod bears 4 setae. The 2nd maxilla has the lobes

more developed than those of *Heterorhabdus*; the seta on the 5th lobe is the longest. In the maxilliped the median seta on the anterior margin of the 1st basal segment is normal; the endopod about as long as the 2nd basal segment.

The 5th pair of legs has a row of spines on the 2nd segment of the exopod near the base of the outer edge spine. The inner marginal setae of the exopod of the 1st to 4th legs are coloured.

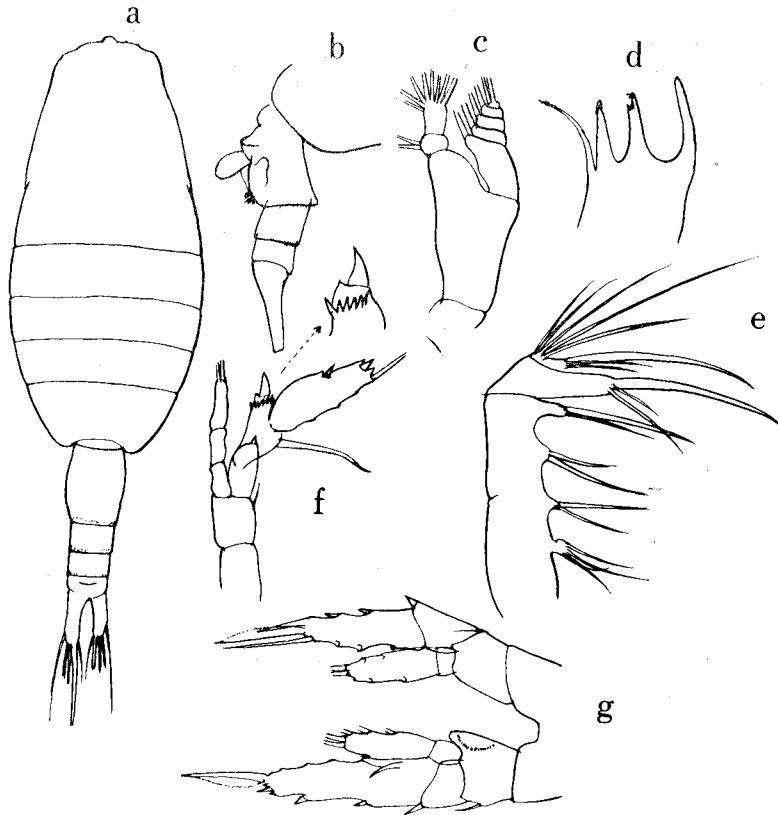


Fig. 185. *Heterostylites longicornis* (GIESBRECHT).

Female: a, dorsal aspect; b, last thoracic segment and abdomen, lateral aspect; c, mandible palp; d, biting blade of mandible; e, 2nd maxilla; f, 5th leg. Immature male: g, 5th pair of legs.

Immature male. Length, 3.25 mm. The abdomen 4-jointed. The 1st antenna exceeds the end of the furca by distal 7 segments. The 5th pair of legs undeveloped as shown in the figure.

Occurrence. 4 females and an immature male from Sagami Bay in vertical hauls from depths 300–100 m.

Distribution. The species has been recorded from the Atlantic, Pacific, Malay

Archipelago, Arabian Sea and from the far-eastern seas of the USSR, and also from the Antarctic.

Heterostylites major (DAHL).

(Fig. 186, a-f)

Heterochaeta major DAHL, 1898, p. 79; *Heterorhabdus major*, WOLFENDEN, 1911, p. 306; *Heterostylites major*, SARS, 1925, p. 239, pl. LXVII, figs. 17, 18; FARRAN, 1929, p. 267; SEWELL, 1932, p. 302; WILSON, 1950, p. 241; BRODSKY, 1950, p. 353, text-fig. 252; VERVOORT, 1957, p. 135.

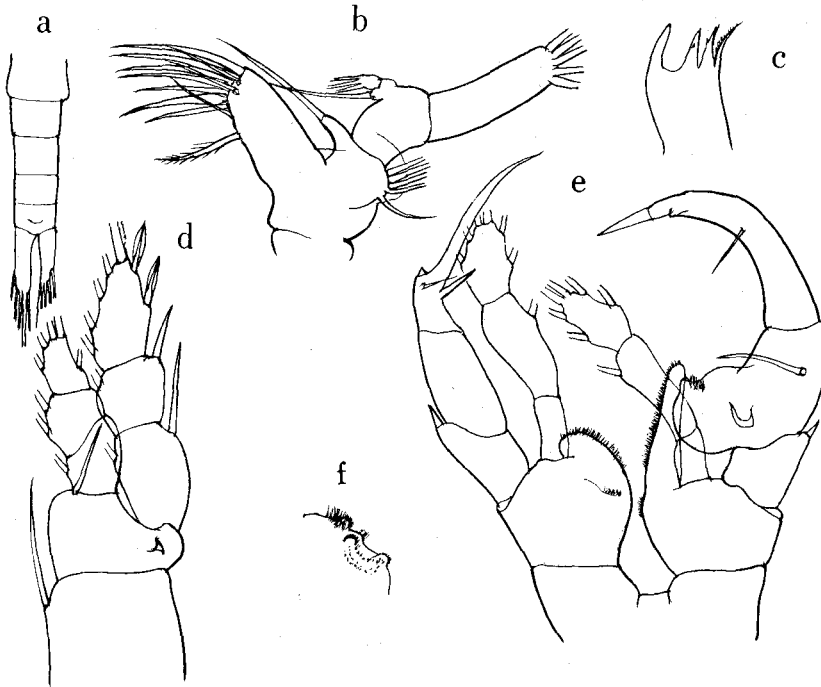


Fig. 186. *Heterostylites major* (DAHL).

Male: a, abdomen, dorsal aspect; b, 1st maxilla; c, biting blade of mandible; d, 1st leg; e, 5th pair of legs; f, inner margin of 2nd joint of exopod of right 5th leg.

Male. Length, 5.38 mm: cephalothorax, 3.44 mm; abdomen, 1.94 mm. The cephalothorax elongate ovate. The abdomen 5-jointed; the furcal rami asymmetrical. The abdominal segments and furca are in the proportional lengths as 17:15:17:12:12:27 (left)=100.

The left 1st antenna exceeds the end of the furca by distal 7 segments; the right antenna forms a grasping organ; the segments are in the following proportional lengths:

Segments.	1-2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
	63	24	27	31	29	29	24	22	27	29	29	45	56	63	65	67
	18	19-20-21		22	23	24	25									
	24	143	69	74	60	?										

The 2nd antenna has the exopod as long as the endopod. The mandible has the cutting edge furnished with 4 teeth on the left side. The maxillae and maxilliped as those of *H. longicornis*.

The 1st leg has a long outer edge spine on the 1st segment of the exopod reaching the middle of the outer edge spine of the 2nd segment. The 2nd to 4th legs as those of *H. longicornis*.

In the 5th pair of legs the 2nd segment of the exopod of the right leg has a large process furnished with denticles near the apex as shown in the figure; the inner marginal process of the 2nd basal segment slender and long. In the left 5th leg the inner distal margin of the 2nd basal segment is produced anteriorly, and is furnished with a brush of hair-like spines.

Remarks. *H. major* and *H. longicornis* resemble each other so closely that SEWELL doubts the validity of the former species. *H. major* may be a major form of *H. longicornis*. SARS' female specimen measured 4.70 mm; SEWELL's measured 5.00 mm in the male.

Occurrence. 4 males from deep waters of Sagami Bay.

Distribution. The species has a wide distribution in the Atlantic and Indian Oceans, also from the Antarctic and from the far-eastern seas of the USSR.

Hemirhabdus WOLFENDEN.

The genus was created by WOLFENDEN (1911) to accommodate *Hemirhabdus grimaldii* (RICHARD) and *H. palciiformis* WOLFENDEN taken by the "Gauss". SARS created a genus *Macrorhabdus* and accommodated *Macrorhabdus grimaldii* (RICHARD) and *M. latus* but he, afterward, acknowledged the priority of WOLFENDEN's genus. A. SCOTT recorded *Mesorhabdus truncatus* A. SCOTT from the Malay Archipelago which belongs to the present genus. SEWELL (1932) recorded the occurrence of *H. grimaldii* and *H. truncatus* from the Indian seas, and the same two species from the Arabian Sea. Up to the present time *H. grimaldii* and *H. latus* have been taken from the Izu region.

The genus differs from *Heterostylites* in the structure of the tooth plate of the mandible and also in the structure of the 2nd maxilla.

Hemirhabdus grimaldii (RICHARD).

(Fig. 187, a-d)

Heterorhabdus grimaldii, FARRAN, 1908, p. 66; WOLFENDEN, 1911, p. 309; SEWELL, 1913, p. 354; *Hemirhabdus grimaldii*, SARS, 1925, pl. LXIII, figs. 1-15; FARRAN, 1926, p. 284; SEWELL, 1932, p. 3004; 1947, p. 181; WILSON, 1950, p. 238.

Male. Length, 10.05 mm: cephalothorax, 7.05 mm; abdomen, 3.00 mm. The cephalothorax elongate ovate; the lateral corner of the last thoracic segment rounded. The rostral filaments slender.

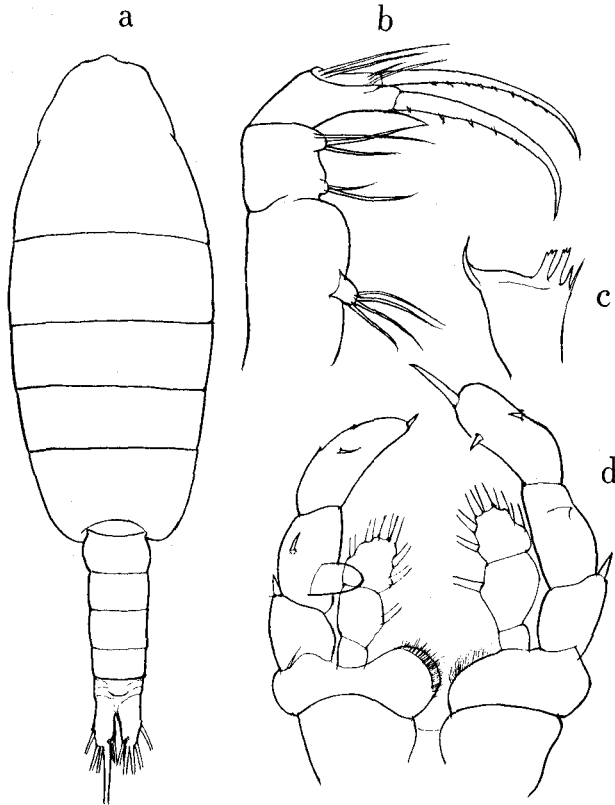


Fig. 187. *Hemirhabdus grimaldii* (J. RICHARD).
Male: a, dorsal aspect; b, 2nd maxilla; c, biting blade of mandible; d, 5th pair of legs.

The abdomen 5-jointed; the segments and furca are in the proportional lengths as 17:17:17:15:17:17=100. The furcal rami symmetrical, 1.6 times as long as wide; the inner distal margin of the ramus carries a small dorsal seta.

The right 1st antenna extends at least to the end of the furca. The 2nd antenna as in *Heterorhabdus*, but the exopod is smaller than the endopod. In the mandible the tooth plate as that of *Heterorhabdus*, but the ventral tooth is

not so strong. The 1st maxilla has 6 setae on the endopod. The 2nd maxilla is provided with each a strong spine on the 4th and 5th lobes; these spines are furnished with denticles along the posterior margin.

The endopod of the 1st to 4th legs have each the following numbers of the marginal setae:

	Ri 1	Ri 2	Ri 3
1st leg	1	2	5
2nd leg	1	2	7
3rd leg	1	2	8
4th leg	1	2	7

In the right 5th leg the inner marginal process of the 2nd segment of the exopod rather small and simple; the inner margin of the 2nd basal segment has a rounded process furnished with a brush of hair-like spines.

Remarks. The female specimen from the Indian seas measured 9.21 mm. The specimen reported by Sars from the Atlantic measured 10.30 mm.

Occurrence. One male from depths 1000-0 m in Sagami Bay.

Distribution. The species has a wide distribution and has been recorded from the Atlantic, Indian, and Pacific Oceans, also from the Arabian Sea.

Hemirhabdus latus Sars.

(Fig. 188, a-g)

Hemirhabdus latus, Sars, 1925, p. 232, pl. LXIV, figs. 1-16; Wilson, 1950, p. 238.

Immature female in the copepodid stage V: Length, 5.94 mm. The cephalothorax very robust. The last thoracic segment rounded laterally. The rostral filaments slender arising from a papilla. The abdomen 4-jointed. The furcal rami slightly asymmetrical; the left ramus is slightly longer than the right; a small seta arises from the dorsal distal margin of the ramus.

The 1st antenna 25-jointed, extends about to the distal margin of the furca. The 2nd antenna has the endopod 1.4 times as long as the exopod (38:27). The mandible has the exopod about as long as the endopod; the cutting edge has 3 teeth on the left side. The 1st maxilla small: the 2nd and 3rd inner lobes are devoid of setae; the endopod has 5 setae; the 2nd basal segment has 2 setae; the exopod has 4 long setae; these numbers of the setae are different from those given by Sars in his figure 8, pl. lxiv. The 2nd maxilla is simple in structure; there are 2 strong spines on the distal lobes; the seta on the proximal lobe is coarsely serrated. The maxilliped is slender; the combined length of the segments of the endopod is 1.4 times as long as the 2nd basal segment.

In the 1st leg the outer edge spine of the 1st segment of the exopod extends beyond the base of the spine of the 2nd segment of the exopod; the outer

marginal spines of the 2nd and 3rd segments of the exopod are of about equal lengths. The 5th pair of legs undeveloped, and has 2-jointed exopod and endopod.

Remarks. The specimen, though immature, agrees well with some exceptions with *H. latus* described and figured by Sars. SEWELL considers *H. latus* is identical *H. truncatus* (A. SCOTT). But the present specimen, though immature, differs from *H. truncatus* in the asymmetry of the furcal ramus, in the shape of the last thoracic segment in dorsal aspect, and in having a longer 1st antenna which extends to the distal margin of the furca.

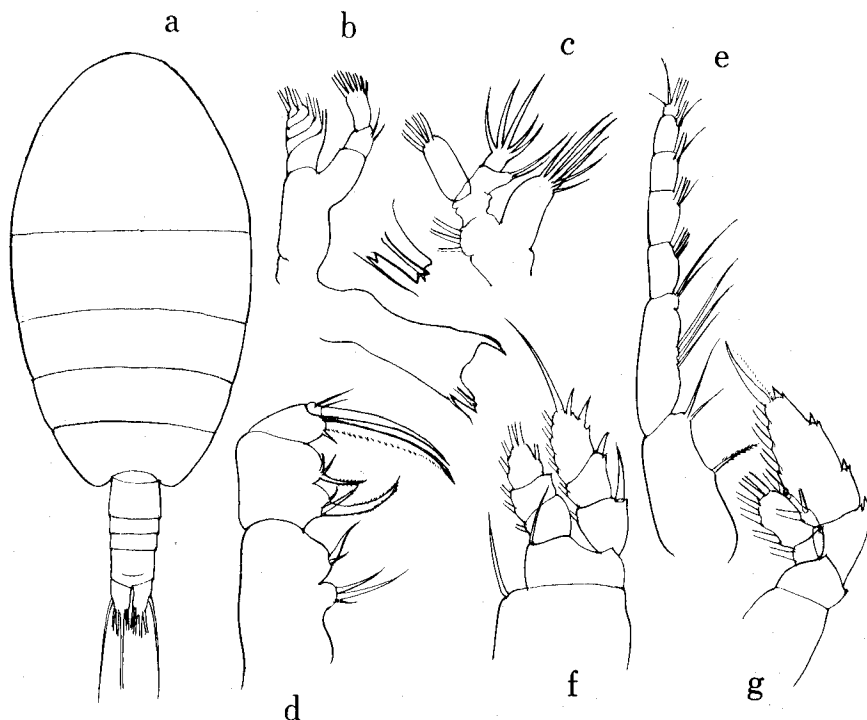


Fig. 188. *Hemirhabdus latus* Sars.

Immature female: a, dorsal aspect; b, mandible, c, 1st maxilla; d, 2nd maxilla; e, maxilliped; f, 1st leg; g, 5th leg.

Occurrence. One immature female from deep waters of Sagami Bay.

Distribution. The species has been recorded from the temperate Pacific Ocean.

Genus *Mesorhabdus* Sars.

Sars (1905) created the genus to accommodate *Mesorhabdus annectens* and

indicated that the species forms a transition between *Heterorhabdus* and *Disseta*. In 1907 he described two more species *Mesorhabdus gracilis* and *M. angustus*. WOLFENDEN (1995) described a species under the name *Heterorhabdus brevicaudatus* which is identical with *M. annectens*, but WOLFENDEN'S name has a priority. SEWELL recorded the occurrence of *M. angustens* from the Indian seas and from the Arabian Sea. From the Izu region only *M. brevicaudatus* (WOLFENDEN) has been recorded.

The genus differs from *Heterorhabdus* in the structure of the tooth plate of the mandible and in the structure of the 2nd maxilla.

Mesorhabdus brevicaudatus (WOLFENDEN).

(Fig. 189, a-e)

Heterorhabdus brevicadatus, WOLFENDEN, 1905, p. 12; *Mesorhabdus annectenus*, SARS, p. 9;
Mesorhabdus brevicaudatus, SARS, 1925, p. 234, p. lxxv, figs. 1-15.

Female. Length, 3.38 mm: cephalothorax, 2.63 mm: abdomen, 1.24 mm. The cephalothorax ovate. The lateral corner of the last thoracic segment narrowly rounded in lateral aspect. The abdomen 4-jointed; the segments and furca are in the proportional lengths as 35:15:13:14:23 (left)=100. The genital segment a little longer than wide, swollen considerably below; the anterior flap depressed or sometimes standing with a projection from the orifice; cutaneous pores were observed on the genital segment and on the right furcal ramus. The furcal rami asymmetrical; left ramus is longer than the right.

The 1st antenna reaches back when fully extended to the end of the anal segment. The mouth parts and swimming legs agree with the description and figures given by SARS. In the 5th pair of legs the inner marginal spine of the 2nd segment of the exopod slender, about as long as the 3rd segment of the exopod; the inner margin of the 2nd segment of the exopod haired.

Male. Length, 3.62 mm: cephalothorax 2.50 mm; abdomen, 1.12 mm; the greatest width of the cephalothorax, 1.12 mm. The abdominal segments and furca are in the proportional lengths as 17:13:16:13:17:24=100. The genital segment wider than long. The furcal rami about 3 times as long as wide.

The right 1st antenna extends about to the end of the 4th abdominal segment; the left antenna forming a grasping organ, has the segments in the following proportional lengths:

Segments.	1-2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
	83	14	25	33	36	36	36	30	39	36	33	39	44	55	61	58
	18	19-20-21	22-23	24	25											
	44	127	94	55	25=1000											

The 2nd antenna has the endopod 1.4 times as long as the exopod. The mandible blade is furnished with 4 slender teeth, a bifurcated one and a slender spine; the exopod a little longer than the endopod. The maxillae as in the female. The maxilliped has a slender 2nd basal segment, 1.8 times as long the 1st basal segment.

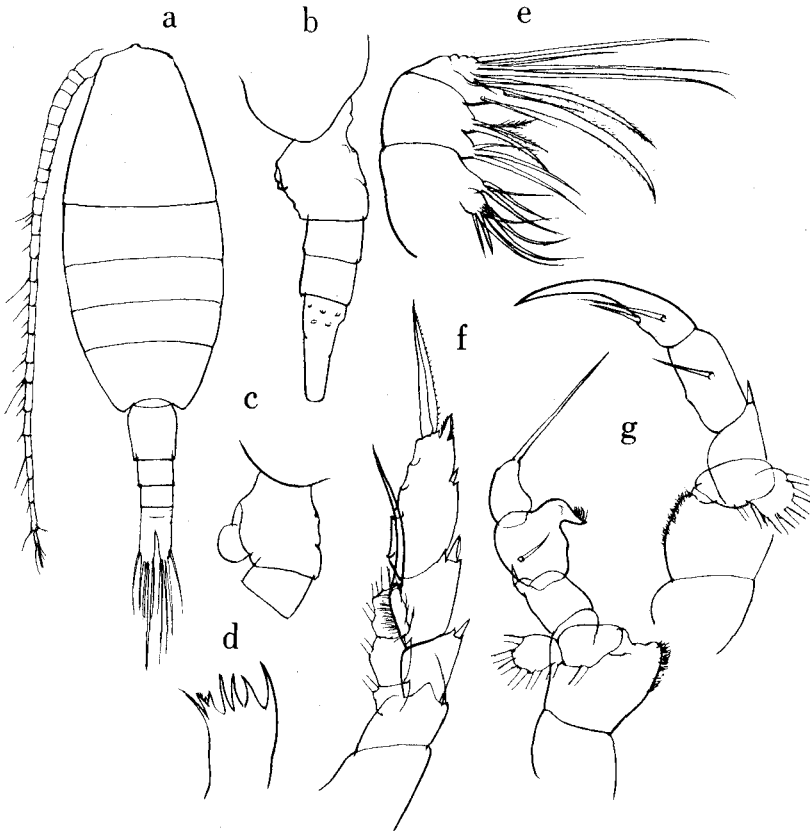


Fig. 189. *Mesorhabdus brevicaudatus* WOLFENDEN.

Female : a, dorsal aspect ; b, last thoracic segment and abdomen, lateral aspect ; c, genital segment, lateral aspect, other specimen ; d, biting blade of mandible ; e, 2nd maxilla ; f, 5th leg. Male : g, 5th pair of legs.

The 1st to 4th legs as in the female. The 5th pair of legs as figured by Sars. The right leg has a curved and pointed process on the 2nd segment of the exopod ; the inner distal margin of the 2nd basal segment not produced much.

Remarks. According to Sars' figure the 2nd maxilla has only 4 setae on the 1st lobe but in the present specimen the lobe 1 has, beside 3 long setae, 2 spine and a pointed process. Sars' specimen measured 3.5 mm in the female.

Occurrence. 2 females and 3 males from deep layers of Sagami Bay.

Distribution. The species has been recorded from the Atlantic.

Genus *Disseta* GIESBRECHT.

WOLFENDEN (1905) recorded *Heterorhabdus grandis* which is in reality belongs to the genus *Disseta* from the west coast of Ireland. He (1911) further recorded a species under the name *D. atlantica*. But his specimen is, according to SARS or SEWELL, identical with *D. palumboi*. ESTERLY (1906) recorded a species, *D. grandis*, a form which he took to be different from GIESBRECHT's *D. palumboi*. He also (1911) described a form under the name *D. sp.* which he too to be identical with WOLFENDEN's *Heterorhabdus grandis*. In the same paper he described a large form under the name *D. maxima* taken from the San Diego region. The species is, as has been suggested by SEWELL, synonymous with *Leuckartia scopularis* BRADY. SEWELL recorded the occurrence of *D. palumboi* and *D. scopularis* (BRADY) from the Indian seas and the former from the Arabian Sea I have recorded *D. palumboi* and *D. scopularis* from the Izu region. These two species differ each other in the minute points of structure in the 5th pair of legs in both sexes.

The genus differs from *Heterorhabdus* in the structure of the tooth plate of the mandible and in the structure of the 2nd maxilla.

Disseta palumboi GIESBRECHT.

(Fig. 196, a-d)

Disseta palumboi, GIESBRECHT, 1892, p. 369, t. xxix, figs. 2, 8, 14, 19, 23-25, 27; t. xxxviii, fig. 44; *Disseta grandis*, WOLFENDEN, 1904, p. 120; ESTERLY, 1906, p. 72, pl. ix, fig. 21, pl. xi, figs. 45, 46; pl. xiii, fig. 69; pl. xiv, figs. 88, 94; *Disseta palumboi*, A. SCOTT, 1909, p. 133; *Disseta atlantica*, WOLFENDEN, 1911, p. 313; *Disseta sp.*, ESTERLY, 1911, p. 331, pl. xxviii, figs. 40, 41; pl. xxv, figs. 76, 80; pl. xxxi, fig. 100; pl. xxxii, figs. 107, 108; SARS, 1925, p. 221, pl. ix, figs. 1-14; *Disseta palumboi*, FARRAN, 1926, p. 279; SEWELL, 1932, p. 309; 1947, p. 185, text-fig. 48, A-I; WILSON, 1950, p. 198.

Female. Length, 6.57 mm: cephalothorax, 4.45 mm; abdomen, 2.12 mm. The abdominal segments and furca (left side) are in the proportional lengths as 37:16:13:8:26=100. The genital segment asymmetrical; the genital area produced slightly below. The furca asymmetrical; the left ramus 4 times as long as it is wide at the distal. The abdominal segments and furca are covered with fine short hairs.

The 1st antenna exceeds the end of the furca by distal 3 segments. In the 2nd antenna the 1st basal segment bears a long seta; the exopod a little shorter than the endopod. The other mouth parts and swimming legs as described by

GIESBRECHT. In the 5th pair of legs the segments of the exopod are broad; the inner marginal spine of the 2nd segment of the exopod slender, about as long as the 3rd segment of the exopod; the outer edge spine of the 2nd segment of the exopod reaches halfway between the proximal outer marginal spine and the junction of the 3rd segment with the 2nd segment of the exopod.

Immature male. Length, 6.90 mm. The abdomen 4-jointed. The grasping antenna undeveloped, exceeds the end of the furca by distal 3 segment. The 5th pair of legs has 2-jointed exopod and endopod.

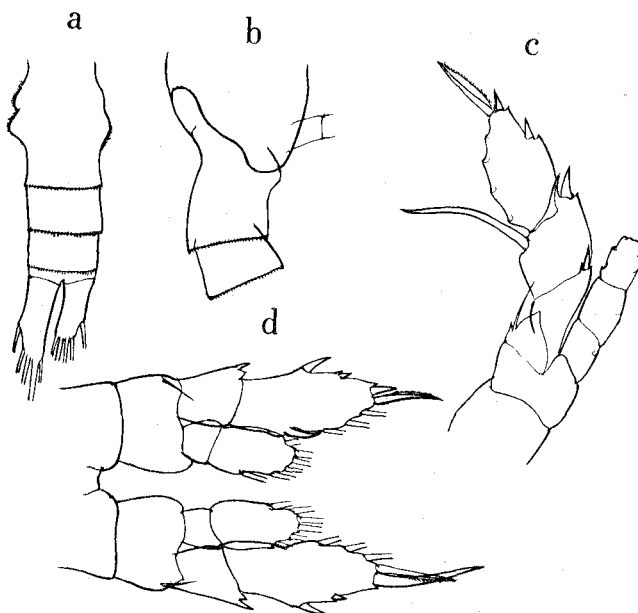


Fig. 190. *Disseta palumboi* (GIESBRECHT).

Female : a, abdomen, dorsal aspect ; b, last thoracic segment and genital segment, lateral aspect ; c, 5th leg. Immature male : d, 5th pair of legs.

Remarks. SEWELL's specimen from the Arabian Sea has the genital segment provided with a pronounced swelling on the dorso-lateral region of the right margin. (SEWELL, 1947, text-fig. 48, A). This swelling is not remarkable in the present specimen or in his specimen from the Indian seas (SEWELL, 1932, text-fig. 102).

Remarks. Several examples of *palumboi* have been recorded from the Pacific, Atlantic and Indian Oceans. SEWELL's specimens from the Arabian Sea measured 7.33-7.45 mm, and that from the Indian seas 7.0 mm in the female. ESTERLY's *D. grandis* from the Pacific measured 8.3 mm in the female and 7.6 mm in the

male. The smallest specimen is that of GIESBRECHT taken from the Pacific; it measured 5.7 mm in the female. SEWELL is opinion that there is no grounds for separating the various females into the Pacific and Atlantic forms or species. The present specimen is intermediate in size between the GIESBRECHT's and ESTERLY's specimens.

Occurrence. 3 females and 1 immature male from Sagami from depths 1000-0 m.

Distribution. The species has a wide distribution and has been recorded from the North Atlantic and Indian Oceans, also from the Malay Archipelago.

Disseta scopularis (BRADY).

(Fig. 191, a-g)

Leuckartia scopularis, BRADY, 1883, p. 51, pl. xiv, figs. 1-5; *Disseta maxima*, ESTERLY, 1911, p. 330, pl. 29, 30; WILSON, 1950, p. 198, pl. 6, figs. 47-50.

Female. Length, 9.60 mm: cephalothorax, 5.75 mm; abdomen, 3.85 mm. The cephalothorax elongate ovate. The last thoracic segment produced at the posterolateral corner. The abdominal segments and left furcal ramus are in the proportional lengths as 31:15:13:10:31=100. The genital segment produced below; the dorsal surface of the segment is slightly swollen; in dorsal aspect the lateral margin of the segment is slightly inflated on the proximal part of the right side; the left side is sinuate. The furca asymmetrical; the left ramus is much longer and wider than the right, 1.3 times as long as the right and 6 times as long as it is wide at the distal; the 2nd furcal seta of the left ramus much elongated. The furcal rami well defined from the anal segment; several cutaneous pores were observed on the abdominal segments and furcal rami.

The 1st antenna exceed the end of the furca by distal 5 segments; the segments are in the following proportional lengths:

Segments.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	46	16	19	18	19	18	18	16	18	20	24	26	36	41	48	58
	17	18	19	20	21	22	23	24	25							
	65	74	77	63	56	64	70	64	26	=1000						

In the 2nd antenna the 1st basal segment bears a single seta; the 2nd basal is voluminous, bears 2 setae; the endopod about 1.2 times as long as the exopod (48:42); the 1st segment of the exopod has a seta on the inner distal margin; the 2nd segment of the endopod has 5 long setae on the 2nd lobe, 8 setae on the 1st lobe. The mandible has the exopod 1.2 times as long as the endopod; the cutting edge normal. The 1st maxilla has 9 setae on the outer lobe, 11 setae on the exopod, 11 setae on the endopod, 3 setae on the 2nd basal

segment, 2 setae on the 3rd inner lobe, 1 seta on the 2nd inner lobe, and 13 setae on the 1st inner lobe. In the 2nd maxilla the 1st lobe has 4 setae and a small spine; the 2nd to 4th lobes have each 3 setae; the 5th lobe has 4 setae;

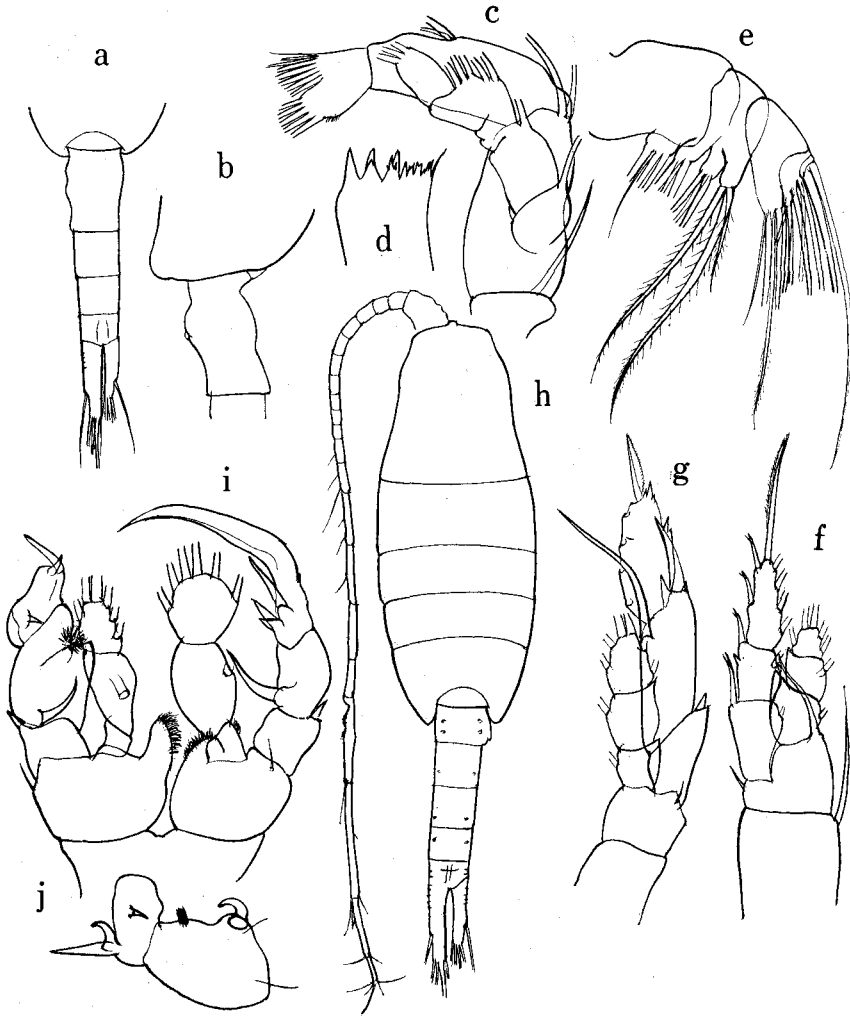


Fig. 191. *Disseta scopularis* BRADY.

Female : a, abdomen, dorsal aspect ; b, last thoracic segment and genital segment, lateral aspect ; c, 2nd antenna ; d, biting blade of mandible ; e, 2nd maxilla ; f, 1st leg ; g, 5th leg. Male : h, dorsal aspect ; i, 5th pair of leg ; j, 2nd and 3rd joints of exopod right 5th leg.

distal segment have 10 setae in all. In the maxilliped the 1st and 2nd basals are of about equal lengths; in other respects it is as that of *D. palumboi* described by SEWELL.

The 1st leg as figured by ESTERLY; the outer marginal spines on the segments of the exopod are branched at the distal end. In the 2nd leg the terminal spine of the exopod is $\frac{3}{4}$ as long as the 3rd segment of the exopod. The 3rd leg has the terminal spine of the exopod which is $\frac{1}{4}$ as long as the 3rd segment of the exopod.

The 5th pair of legs has a long outer edge spine on the 2nd segment of the exopod reaching the distal end of the proximal outer marginal spine of the 3rd segment of the exopod; the inner edge spine of the 2nd segment of the exopod slender, exceeding the distal end of the 3rd segment of the exopod.

Male. Length, 8.76 mm : cephalothorax, 5.81 mm ; abdomen, 3.95 mm. General appearance as in *D. palumboi*. The abdominal segments and furca (left) are in the proportional lengths as 13:16:16:13:11:31=100. The furcal ramus 4.2 times as long as wide on the left side; cutaneous pores clearly observed on the abdominal segments and furcal rami; the 1st to 4th segments are fringed with fine spinules on the posterior margin.

The right 1st antenna exceeds the end of the furca by distal 2 segments; the left antenna forming a grasping organ; the segments have the following proportional lengths :

Segments.	1-2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
	72	11	21	23	26	26	23	19	21	19	19	27	50	66	81	74
	18	19-20-21	22-23	24	25											
	48	115	151	76	32=1000											

The 2nd antenna has the endopod 1.2 times as long as the exopod; the terminal segment of the exopod is short. The mandible has the exopod a little longer than the endopod (23/19). The 1st maxilla and maxilliped as in the female.

The 1st to 4th legs as in the female. The 5th pair of legs resembles, in general appearance, that of *D. palumboi*. In the left leg the terminal spine of the 3rd segment of the exopod terminates into a long sickle-shaped spine; the inner margin of the same segment bears 2 long and one short spines on the inner proximal margin; the 2nd segment carries a strong curved spine near the inner proximal margin. In the right leg the 3rd segment of the exopod is produced rectangularly on the inner margin; the apex of the segment carries 2 spines of which the apical one is straight and strong; the 2nd segment of the exopod has a strong curved spine on the proximal inner margin, and a tuft of fine hairs near the inner distal margin.

Remarks. The present species is much larger in size than *D. palumboi* GIESBRECHT. The female specimen differs from the former in the shape of the 5th pair of legs in its long outer edge spine on the 2nd segment of the exopod, and also in the shape of the genital segment. In the male the 5th pair of legs

differs from that of *D. palumboi* in the structure of the 3rd segment of the exopod. The present specimen is identical with *D. maxima* ESTERLY which is synonymous with *D. scopularis* (BRADY).

Occurrence. 1 female and 2 males from deep layers of Sagami Bay.

Distribution. The species has been recorded from deep layers of the Pacific.