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Two new bathyal species of *Pseudotachidius* (Copepoda: Harpacticoida) from the Beaufort Sea (Alaska, U.S.A.)

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Introduction

During the summer of 1977, the Oregon State University Benthic Group participated in a USCGC GLACIER cruise off the northeastern coast of Alaska, U.S.A. Two new species of Harpacticoida (Copepoda) were found from several of the bathyal stations occupied. *Pseudotachidius brevisetosus* sp. nov. occurred in 15 samples from 4 stations. *Pseudotachidius bipartitus* sp. nov. co-occurred with *P. brevisetosus* in 5 samples from 3 stations. The areal extent was not great, but the depth ranged from 659–1144 m for the 3 stations where both species occurred. A single *P. brevisetosus* female was found at the fourth station, where the depth was 403 m.

Pseudotachidius bipartitus is most similar to *Pseudotachidius vikingus* Drzycimski, but differs from it and other members of the genus in that the endopod of the first leg is 2-segmented. *Pseudotachidius brevisetosus* is most nearly related to *Pseudotachidius coronatus* T. Scott, but differs from it in the setal arrangement of the fourth and fifth legs, and most importantly in the transformed endopod of the male second legs.

The setal arrangements of *P. coronatus* and *Pseudotachidius similis* T. Scott are in question, due to differing interpretations of the original descriptions. A re-examination of the literature is discussed so that the relationships of the new species are clearly defined.

All figures were made with the aid of a camera lucida. The nomenclature and descriptive terminology are adopted from Lang (1948, 1965) and Coull (1977). The following abbreviations are used throughout the text: R = rostrum, A₁ = antennule, A₂ = antennae, Md = mandible, Mx1 = maxillula, Mx = maxilla, Mxp = maxilliped, P₁–P₆ = legs 1–6, CR = caudal rami, GF = genital field, Bend. = baseoendopodite. Body length measurements are from the base of the R to the base of the CR, excluding both. CR L/W (=length to width ratio) is measured from the inner proximal edge to the inner distal edge for length, and at the widest points for width.

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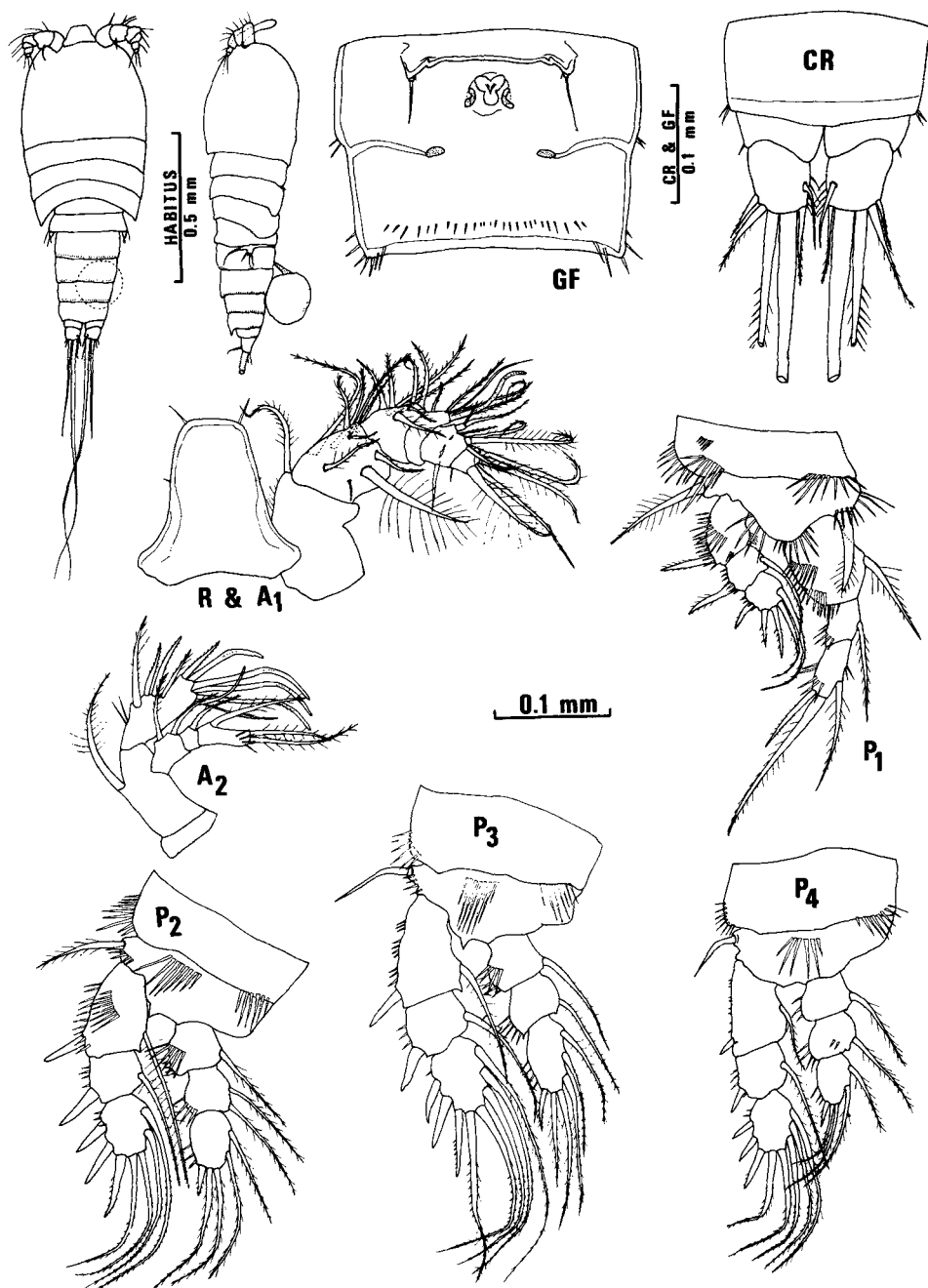


FIG. 1. *Pseudotachidius brevisetosus* sp. nov. ♀.

Systematic account

Family THALESTRIDAE Sars, Lang
 Genus *PSEUDOTACHIDIUS* T. Scott
Pseudotachidius brevisetosus sp. nov.
 (Figs. 1-3)

MATERIAL: 55 ♀♀, 4 ♂♂, 2 copepodites. Holotype 1 ♀, USNM (United States National Museum of Natural History) 171404. Paratypes 13 ♀♀, USNM 171405. Paratype 1 ♂, USNM 171406. Paratypes 12 ♀♀, OSUBI (Oregon State University Benthic Invertebrate Reference Museum) 1685.

TYPE LOCALITY: Bathyal zone of the Beaufort Sea off northeastern Alaska, U.S.A. (70° 42·8' N, 147° 39·5' W), depth 659 m.

Description

FEMALE: Based on gravid ♀ 0·99 mm long. Body fusiform compressed (fig. 1), prosome broadened and urosome narrower. R broad, A₁ with many plumose setae. CR appear square. One large yolky egg was attached, but position (right of centre) suggests more may have been present.

A₁ (fig. 1): 6-segmented, aesthetasc on 4th-segment. 5th-segment appears indented on dorsal surface, giving appearance of an indistinctly 7-segmented A₁.

A₂ (fig. 1): 3-segmented with allobasis. Terminal segment bearing 11 setae. Exposed 3-segmented with 2.1.3 setae respectively.

Md (fig. 2): Precoxa with tridentate pars incisiva, tridentate lacina and associated spines. Coxa-basis with 4 inner setae. Endopod 1-segmented with 4 inner and 6 terminal setae. Exopod 1-segmented with 1 inner, 1 terminal, and 2 outer setae.

Mxl (fig. 2): Arthrite of precoxa with 8 inner spines, 2 slender setae on anterior surface, and a spine on posterior surface. Coxa with 5 setae, basis with 6. Exopod with 4 and endoped with 3 setae.

Mx (fig. 2): Syncoxa with 3 endites; proximal with 4 setae; middle with 1 claw, 2 setae; and distal with 2 spines and 1 seta. Basis transformed as a large claw with 3 slender setae. Endopod 1-segmented with 3 setae.

Mxp (fig. 2): Prehensile. Basis with 1 seta. Endopod 1-segmented with 1 seta and distal claw. Mxp greatly ornamented.

P₁-P₄ (fig. 1): Exopods and endopods 3-segmented, setation as listed and figured below.

	<i>Exopod</i>	<i>Endopod</i>
P ₁	0.1.023	1.1.111
P ₂	1.1.223	1.2.221
P ₃	1.1.323	1.1.321
P ₄	1.1.323	1.1.221

P₅ (fig. 2): Exopod distinctly segmented with 4 distal setae. Baseoendopodite with ornamentation on posterior surface, outer, and inner edge; 4 short setae on distal edge though 3 short setae are also found (as figured).

GF (fig. 1): Segments 6 and 7 fused ventrally. Ornamented medio-laterally with 1 seta. Genital pore tri-radiate, set in hyalinized area where cuticle is thickened and appears opaque.

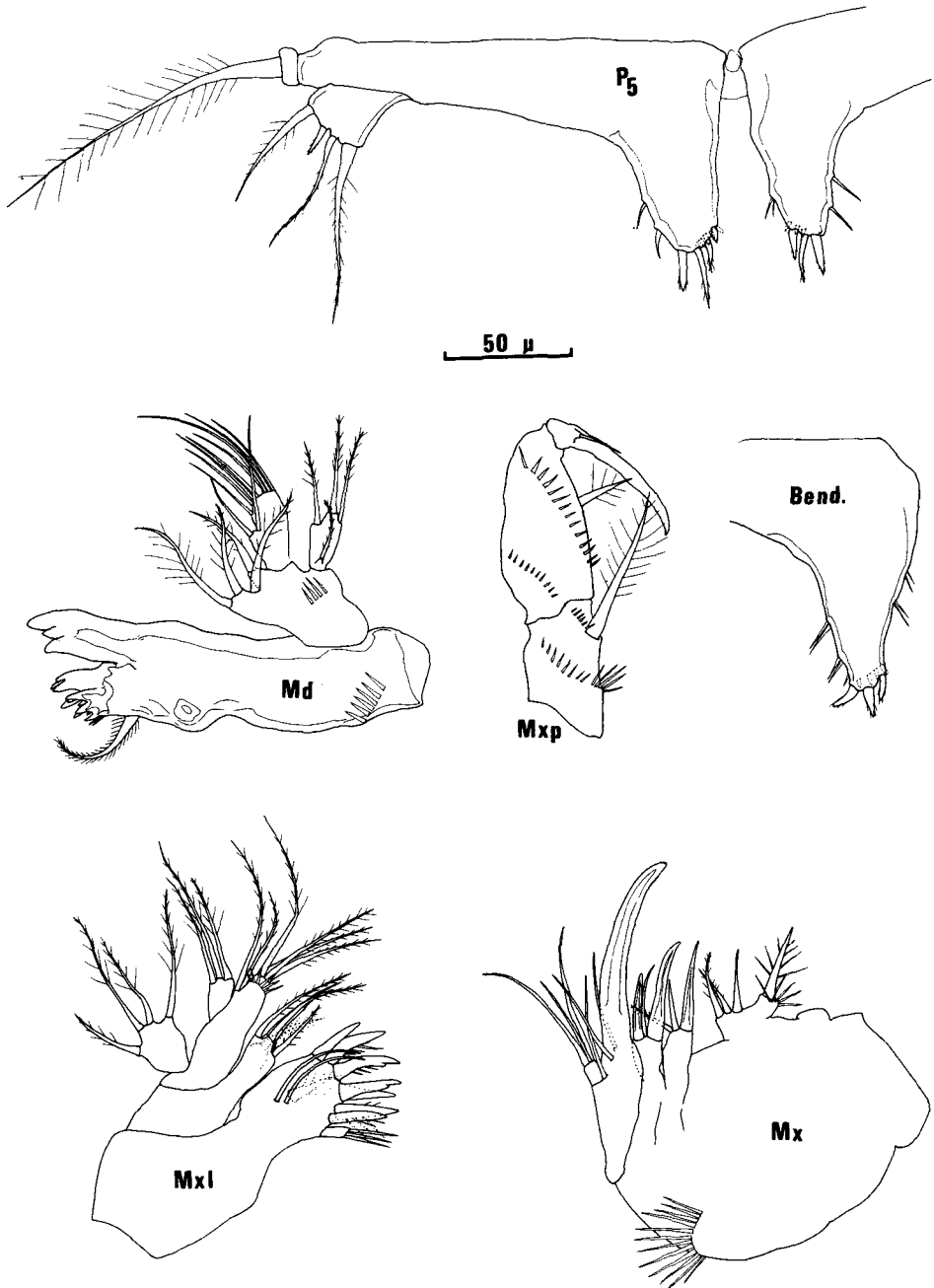


FIG. 2. *Pseudotachidius brevisetosus* sp. nov. ♀.

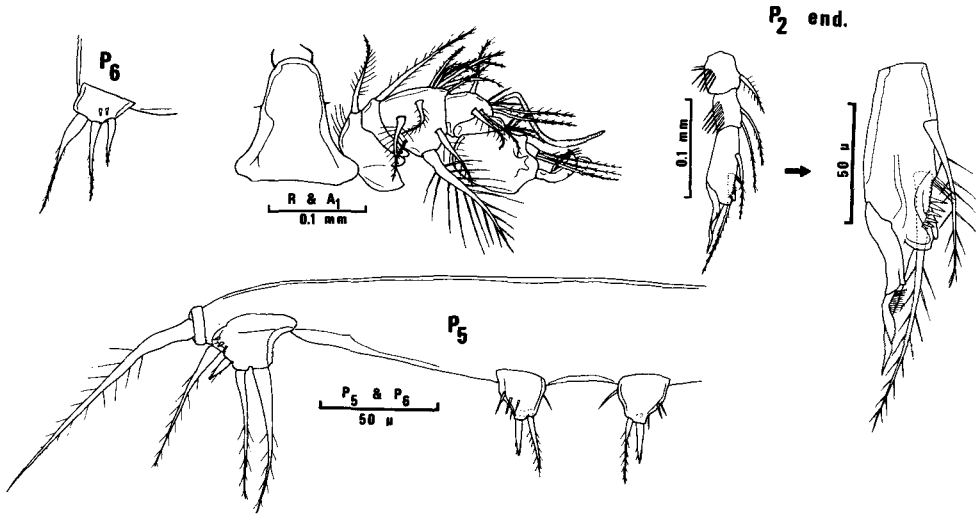


FIG. 3. *Pseudotachidius brevisetosus* sp. nov. ♂.

CR (fig. 1): 1 inner-dorsal seta, 2 lateral setae, and 2 principal caudal setae. CR $L/W=0.8$.

MALE: Based on mature male 0.95 mm long. The male exhibits typical sexual dimorphism; the A_1 is haplocer, the P_2 endopod is transformed, P_5 and P_6 also differ from the female. All other appendages agree with the female.

A_1 (fig. 3): Plumose, 7-segmented. Modified for grasping, terminal segment hook-shaped.

P_2 (fig. 3): Both rami 3-segmented, exopod and first 2 endopod segments same as female. Terminal endopodite; outer and terminal setae transformed, combine to appear screw-like; 2 inner setae normal; inner distal edge equipped with a row of spinules.

P_5 (fig. 3): Basis fused across forming plate, exopod and endopod distinctly separate. Exopod with 4 and endopod with 2 setae.

P_6 (fig. 3): Represented by 3 setae.

VARIABILITY: Mean size of 24 adult ♀♀ = 0.95 mm ($s = \pm 0.05$). Five animals dissected; 1 found with 4 setae on terminal P_1 exopods; for baseoendopodite pairs of 4 ♀♀, 5 with 4 setae and 3 with 3 setae.

ETYMOLOGY: The specific name *brevisetosus* (L. 'brevis' = short, L. 'seta' = bristle) refers to the short setae found on the baseoendopodite of the female.

Pseudotachidius bipartitus sp. nov.

(Figs 4–6)

MATERIAL: 4 ♀♀, 1 ♂, 1 copepodites. Holotype 1 ♀ USNM 171407. Paratypes 2 ♀♀, USNM 171408. Paratypes 1 ♀ OSUBI 1686.

TYPE LOCALITY: Bathyal zone of the Beaufort Sea off northeastern Alaska, U.S.A. ($70^\circ 42' 8''$ N, $141^\circ 39' 5''$ W), depth 659 m.

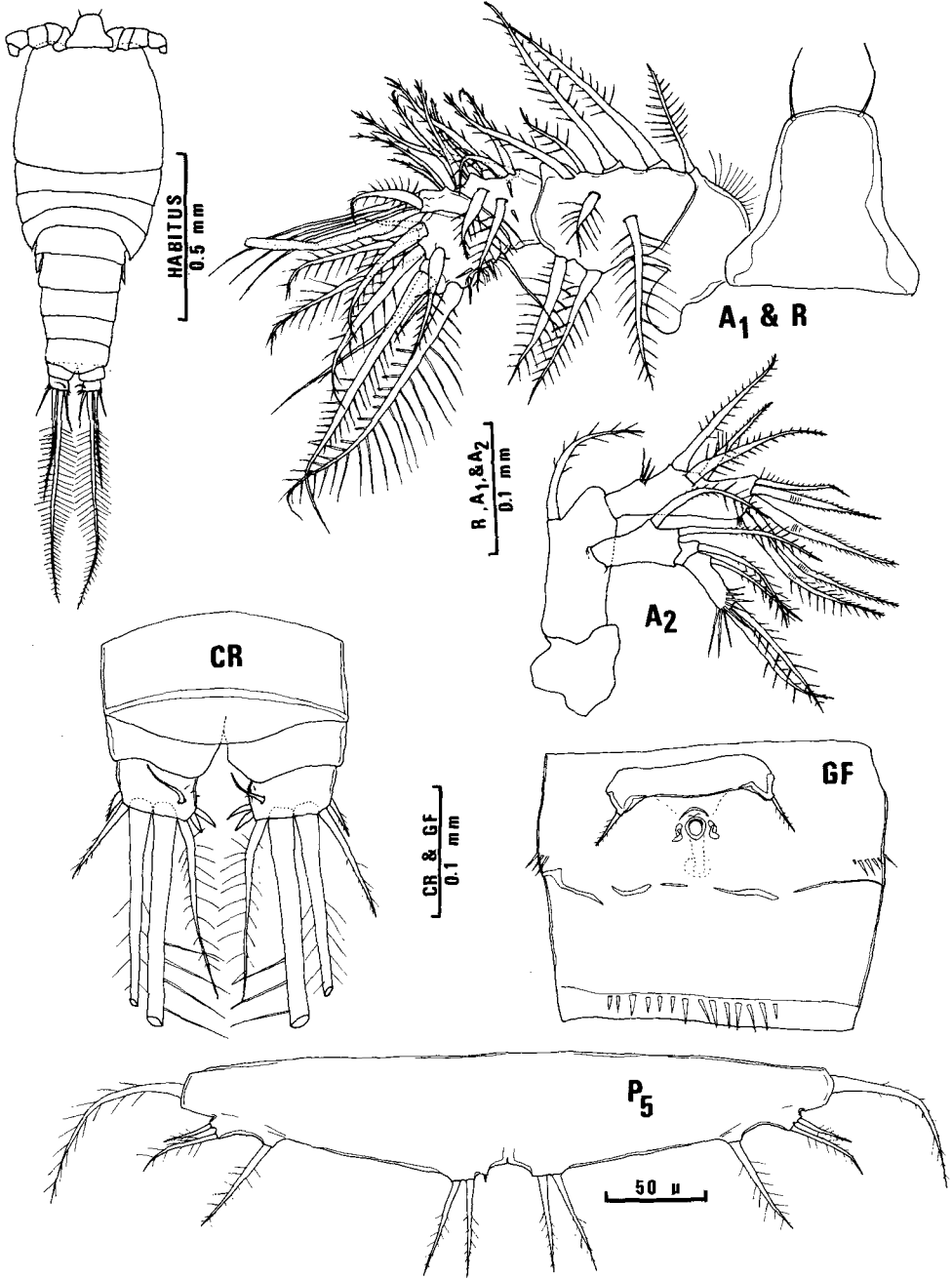


FIG. 4. *Pseudotachidius bipartitus* sp. nov. ♀.

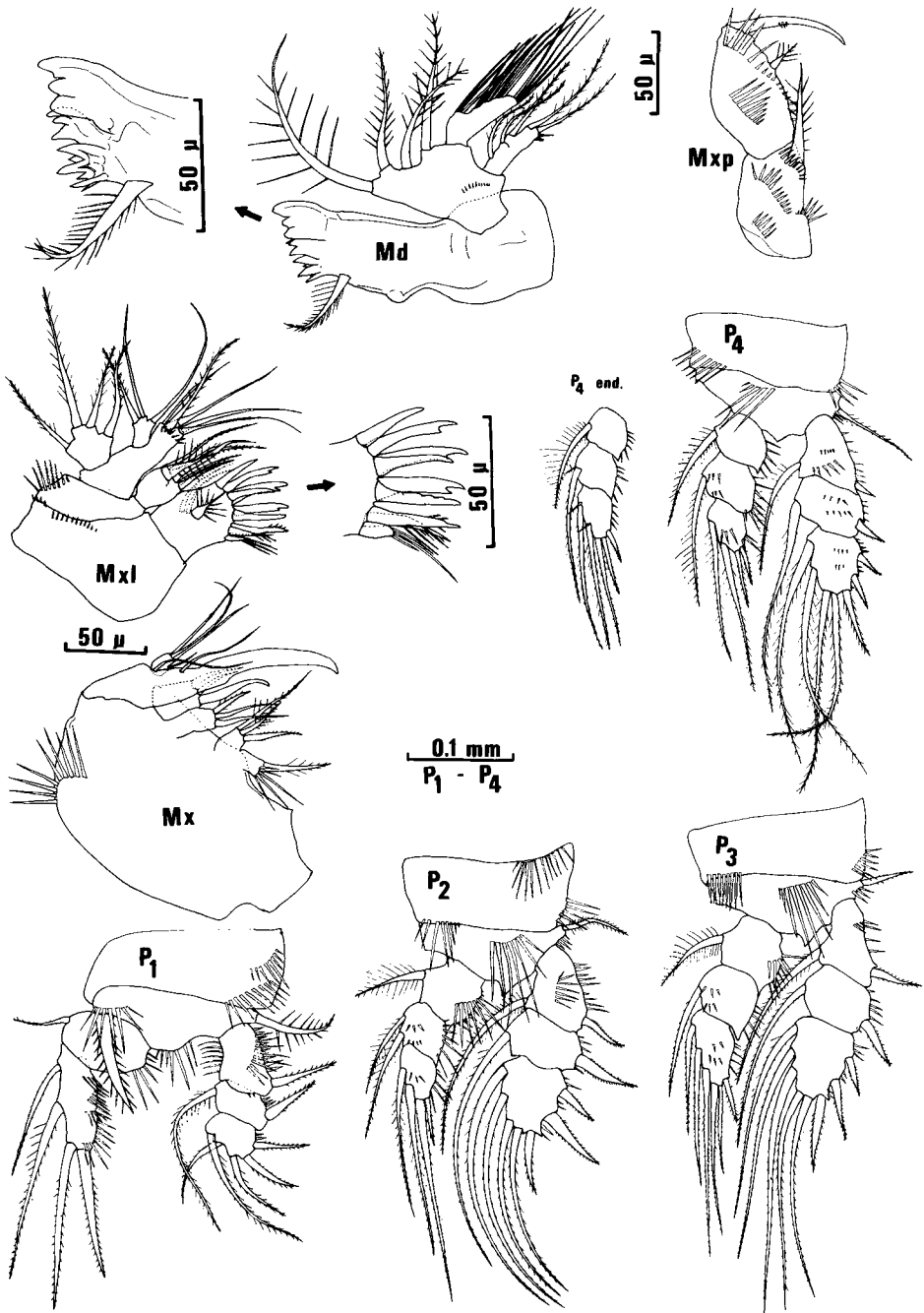


FIG. 5. *Pseudotachidius bipartitus* sp. nov. ♀.

Description

FEMALE: Based on an adult female 1.03 mm long. Body fusiform compressed, R broad, A_1 with plumose setae. CR appear squat (shorter than broad). Principal caudal setae with many plumose setules.

A_1 (fig. 4): Plumose, 5-segmented, aesthetasc on fourth segment. Setae with exaggerated ornamentation.

A_2 (fig. 4): Allobasis type, with 3 inner and 5 terminal setae on end segment. Exopod 3-segmented with 2.1.3 setae respectively.

Md (fig. 5): Precoxa with tridentate pars incisiva, tridentate lacina and 6 additional spines. Coxa-basis with 4 setae. Endopod 1-segmented with 13 slender setae, exopod 1-segmented with 3 inner and 2 terminal setae.

Mxl (fig. 5): Arthrite of precoxa with 9 claw-like spines; 3 bifid, 1 glandular; 1 seta on anterior surface and 2 slender setae on posterior surface. Coxa with 6 inner setae. Basis with 5 inner setae. Endopod 1-segmented with 3 setae, exopod 1-segmented with 4 setae.

Mx (fig. 5): Syncoxa with 3 endites, proximal bi-lobed with 4 setae, middle and distal endites with 3 setae each. Basis with claw and two surface setae. Endopod with three terminal, 1 small inner setae.

Mxp (fig. 5): Prehensile. Endopod 1-segment with 1 inner seta and a terminal claw. Basis with 1 seta. Basis and endopod with ornamentation.

P_1 (fig. 5): Exopod 3-segmented, endopod 2-segmented. Inner seta of terminal exopod segment appearing prehensile as figured. This condition found in all specimens examined. Setation as listed below.

P_2, P_3 (fig. 5): Exopod 3-segmented, endopod 3-segmented, setation as figured and listed below.

P_4 (fig. 5): Exopod 3-segmented, endopod 3-segmented. For all 4 ♀♀ and 1 ♂ examined, terminal endopodite bore 221 setae respectively. The 211 condition figured for this specimen considered a variant. Setation listed below.

	<i>Exopod</i>	<i>Endopod</i>
P_1	0.1.023	1.211
P_2	1.1.223	1.2.211
P_3	1.1.323	1.1.321
P_4	1.1.223	1.1.221 (211)

P_5 (fig. 4): Exopods and baseoendopodites fused into plate. Exopod and baseoendopodite with 3 and 2 setae respectively.

GF (fig. 4): Medio-laterally with 1 seta. 6th and 7th urosomal segments fused. GF with a round genital pore and hyalinized area located medially.

CR (fig. 4): Shorter than broad, CR L/W=0.5. One inner-dorsal seta, 2 inner-medial spines, 1 long inner-ventral seta, two terminal principal setae plumose in appearance, 2 outer setae.

MALE (fig. 6): Based on mature adult 0.93 mm long, mouth parts and P_1 - P_5 as in female. P_6 with 1 seta, urosome segments 6 and 7 distinct. A_1 transformed.

A_1 (fig. 6): Plumose, 6-segmented. Modified as grasping organ, terminal segment hook-shaped. One aesthetasc on third segment, 2 on fifth segment.

ETYMOLOGY: The specific name *bipartitus* (L. 'bi' = two and L. 'partis' = a part) refers to the P_1 endopod which is 2-segmented.

Table 1. Salient morphological characters of *Pseudotachidius* females.

A ₁ No. segments	P ₁		P ₂		P ₃		P ₄		P ₅		CR L/W
	exp.	end.	exp.	end.	exp.	end.	exp.	end.	exp.	Bend.	
4†	0.1.023	1.1.021	1.1.123	1.1.021	1.1.123	1.1.021	1.1.023	1.1.021	3f	3	1.0
Becker 1974 <i>brevisetosus</i> sp. nov.	0.1.023	1.1.111	1.1.223	1.2.221	1.1.323	1.1.321	1.1.323	1.1.221	4d	4(3)	0.8
5 <i>bipartitus</i> sp. nov.	0.1.023	1.211	1.1.223	1.2.211	1.1.323	1.1.321	1.1.223	1.1.221	3f	2	0.5
6 T. Scott 1897 <i>coronatus</i>	0.1.023	1.1.111	1.1.223	1.1.221	unknown	unknown	1.1.223	1.1.221	4d	1	0.7
5 T. Scott 1903 <i>similis</i>	0.1.023	1.1.011	---	unknown---	---	---	1.1.023	1.1.021	3f	3	1.0
6‡	0.1.023	1.1.121	1.1.223	1.2.221	1.1.323	1.1.321	1.1.323	1.1.221	5d	5	0.5
Becker 1974 <i>vikingus</i> Drzycimski 1968	0.1.023	1.1.021	1.1.123	1.1.121	1.1.123	1.1.121	1.1.123	1.1.121	3f	3	0.8

† 4 segments are figured, but the text reports 5.

‡ 6 segments are figured, but the text reports 5.

§ f=fused to basis, d=distinctly segmented.

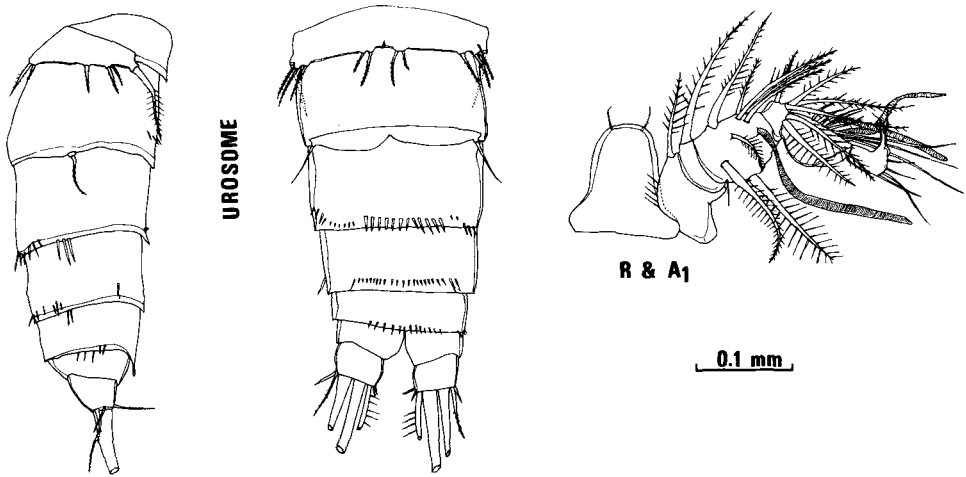


FIG. 6. *Pseudotachidius bipartitus* sp. nov. ♂.

Discussion

All the species in the genus *Pseudotachidius* share the following characteristics: Fusiform compressed body shape; broad R; plumose A_1 ; and similar structure and setation of the A_2 , Mx_1 , Mx and P_1 exopod. The basal segment of the P_1 endopod is also characteristic, being short and having one medially located inner seta.

A survey of the species' salient morphological characters (table 1) shows that setal arrangement varies considerably. The table was constructed from the original descriptions of each species. However, the descriptions of *P. coronatus* and *P. similis* were incomplete and this has led to some confusion over their setal formulae. Scott (1897) figures only P_1 and P_4 for *P. coronatus*, in addition Sars (1911) figures P_2 . Neither author mentions setation of P_3 , therefore it is unknown. Yet, Drzycimski (1968) gives a setal formula for P_3 , and an incorrect formula for the terminal P_4 exopodite. He states these formulae come from the literature, but my examination of the same literature results in the setal arrangements listed in tables 1 and 2. Scott (1903) again figures only P_1 and P_4 for *P. similis* and states, 'The second, third, and fourth pairs are somewhat similar to the same appendages in *Pseudotachidius coronatus*; fig. 7 represents the fourth pair, and the second and third do not appear to differ greatly from this.' The implication of this statement is that the arrangements for P_2 and P_3 are the same as P_4 , and that this is the same as in *P. coronatus*. But from table 1 it is clear that the arrangements for P_4 in *P. coronatus* and *P. similis* are quite different. This contradiction obscures the meaning of the description, and it is not clear what 'appear to differ greatly' means. I conclude that there is no information in this description which will yield the setal formula of P_2 and P_3 for *P. similis*.

A significant difference occurs between the fifth legs. The exopod is fused to the basis in *P. similis*, and the baseopodite is short showing no inner expansion. The P_5 of *P. coronatus* is more normal; the exopod is distinctly segmented, and the baseopodite has an inner expansion. In fact all the species in the genus can be grouped as either 'coronatus'-like or 'similis'-like based on the differences in the P_5 . In addition to the P_5 structure the 'coronatus'-group also shares similarities in the P_2 and shape of the P_1 endopod.

Table 2. Setal formulae of *Pseudotachidius* males (unknown for *P. abyssalis*, *similis*, and *peruanus*).

	P ₂		P ₃		P ₄		P ₅	
	exp.	end.	exp.	end.	exp.	end.	exp.‡	Bend.
<i>brevisetosus</i> sp. nov.	1.1.223	1.2.211†	1.1.323	1.1.321	1.1.323	1.1.221	4d	2
<i>bipartitus</i> sp. nov.	1.1.223	1.2.211	1.1.323	1.1.321	1.1.223	1.1.221	3f	2
<i>coronatus</i> T. Scott	unknown	1.2.211	unknown	1.1.321	unknown		4d	1
<i>vikingus</i> Drzycimski	1.1.223	1.1.221	1.1.323	1.1.321	1.1.323	1.1.221	3f	2

† Transformed.

‡ f = fused to basis, d = distinctly segmented.

The new species *P. brevisetosus* belongs to the 'coronatus' complex. Within the group it is most closely related to *P. coronatus*. It shares similarities in the shape and setal arrangement of the P₁ endopod, P₅ exopod, and the CR. However, *P. brevisetosus* is distinct from *P. coronatus* in the setal arrangement of the P₄ exopod, P₅ baseoendopodite, and more significantly the P₂ endopod of the male. In fact, *P. brevisetosus* is the only known male of the genus which shows the usual dimorphic transformation of the male P₂ endopod.

Pseudotachidius bipartitus belongs to the 'similis' complex, but it appears to differ from the other species of the group in many ways, and show some affinities to the 'coronatus'-group. Primarily, *P. bipartitus* is distinct in that the P₁ endopod is 2-segmented. However, the shape of the P₁ endopod is suggestive of the 'coronatus'-group, as is the setal arrangement and structure of P₂ and P₃. Within the 'similis' complex, *P. bipartitus* is most nearly related to *P. vikingus*. The pediger setal arrangements of the females show many differences (table 1), but the males are nearly identical (table 2).

A key to the species of *Pseudotachidius* follows below.

Key to the species of *Pseudotachidius*

Based on females, adapted from Coull (1973).

- 1 P₅ exopod distinctly separate, baseoendopodite with inner expansion, ('coronatus' group) 2
- P₅ exopod fused to basis, baseoendopodites not expanded ('similis' group) 4
- 2 P₅ exopod and baseoendopodite each with 5 setae *peruanus* Becker
- P₅ exopod with 4 setae, baseoendopodite with less than 5 setae 3
- 3 P₅ baseoendopodite with 1 long seta, a variable number of short setae also present *coronatus* T. Scott
- P₅ baseoendopodite with short setae only, 4 is usual but 3 also found *brevisetosus* sp. nov.
- 4 P₁ endopod 2-segmented *bipartitus* sp. nov.
- P₁ endopod 3-segmented 5
- 5 Terminal endopod segments of P₁ and P₄ with 3 setae each *abyssalis* Becker
- Terminal endopod segments of P₁ and P₄ with 2 and 3 setae respectively *similis* T. Scott
- Terminal endopod segments of P₁ and P₄ with 3 and 4 setae respectively *vikingus* Drzycimski

Summary

Two new species of harpacticoid copepods are described from the northeastern coast of Alaska, U.S.A. *Pseudotachidius brevisetosus* sp. nov. and *Pseudotachidius bipartitus* sp. nov. co-occurred at depths from 659–1144 m. *Pseudotachidius*

brevisetosus is unique in the armature of the ♀ P₅ and the ♂ P₂ endopod. *Pseudotachidius bipartitus*, with a 2-segmented P₁ endopod is also unique. The setal arrangements of *Pseudotachidius coronatus* T. Scott and *Pseudotachidius similis* T. Scott are discussed. The correct setal formulae for all species and a key to the genus are given.

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