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

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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 endoped 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 reexamination 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,  $A_1 = antennule$ ,  $A_2 = antennae$ , Md = mandible, Mxl = maxillula, Mx = maxilla, Mxp = maxilliped,  $P_1-P_6 = legs 1-6$ , 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.  $\mathcal{Q}$ .

#### Systematic account

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

MATERIAL: 55  $\Im$ , 4  $\Im$ , 2 copepodites. Holotype 1  $\Im$ , USNM (United States National Museum of Natural History) 171404. Paratypes 13  $\Im$ , USNM 171405. Paratype 1  $\Im$ , USNM 171406. Paratypes 12  $\Im$ , 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  $\bigcirc$  0.99 mm long. Body fusiform compressed (fig. 1), prosome broadened and urosome narrower. R broad, A<sub>1</sub> with many plumose setae. CR appear square. One large yolky egg was attached, but position (right of centre) suggests more may have been present.

 $A_1$  (fig. 1): 6-segmented, aesthetase on 4th-segment. 5th-segment appears indented on dorsal surface, giving appearance of an indistinctly 7-segmented  $A_1$ .

 $A_2$  (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.

 $P_1-P_4$  (fig. 1): Exopods and endopods 3-segmented, setation as listed and figured below.

	Exopod	Endopod
$P_1$	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

 $P_5$  (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.  $\mathcal{Q}$ .



FIG. 3. Pseudotachidius brevisetosus sp. nov. 3.

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  $P_2$  endoped 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 endoped distinctly separate. Exopod with 4 and endoped with 2 setae.

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

VARIABILITY: Mean size of 24 adult  $\Im = 0.95 \text{ mm}$  (s =  $\pm 0.05$ ). Five animals dissected; 1 found with 4 setae on terminal P<sub>1</sub> exopods; for baseoendopodite pairs of  $4 \Im \Im$ , 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:  $4 \Im \Im$ , 1 d, 1 copepodites. Holotype  $1 \Im$  USNM 171407. Paratypes  $2 \Im \Im$ , USNM 171408. Paratypes  $1 \Im$  OSUBI 1686.

TYPE LOCALITY: Bathyal zone of the Beaufont Sea off northeastern Alaska, U.S.A. (70°42.8' N, 141°39.5' W), depth 659 m.



FIG. 4. Pseudotachidius bipartitus sp. nov.  $\mathcal{Q}$ .



FIG. 5. Pseudotachidius bipartitus sp. nov.  $\mathcal{Q}$ .

#### 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, aesthetase 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 setate. 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, endoped 3-segmented, setation as figured and listed below.

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

	Exopod	Endopod		
$\mathbf{P}_{1}$	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 innermedial 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  $P_1$  endoped which is 2-segmented.

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females.
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Table 1.

$\mathbf{CR}$	L/W		1.0	0.8	0.5	0.7	1.0	0.5	0.8	
	5	Bend.	3	4(3)	67	-	က	'n	ŝ	
	_	exp.§	3f	4d	3f	4d	3f	5d	3f	
	<b>^</b> 4	end.	1.1.021	1.1.221	1.1.221	1.1.221	1.1.021	1.1.221	1.1.121	
	щ	exp.	1.1.023	1.1.323	1.1.223	1.1.223	1.1.023	1.1.323	1.1.123	
rmula	<b>_</b> E	end.	1.1.021	1.1.321	1.1.321	uwot		1.1.321	1.1.121	
Setal for	щ	exp.	1.1.123	1.1.323	1.1.323	unkr	uwou	1.1.323	1.1.123	
	2	end.	1.1.021	1.2.221	1.2.211	1.1.221	unkı	1.2.221	1.1.121	
	Ч	exp.	1.1.123	1.1.223	1.1.223	1.1.223		1.1.223	1.1.123	
	~-	end.	1.1.021	1.1.111	1.211	1.1.111	1.1.011	1.1.121	1.1.021	
	H	exp.	0.1.023	0.1.023	0.1.023	0.1.023	0.1.023	0.1.023	0.1.023	
$\mathbf{A_1}$	No.	segments	4†	9	ũ	9	ũ	ţ9	5	
			abyssalis Bockor 1074	brevisetosus	sp. nov. bipartitus	sp. nov. coronatus	T. Scott 1897 similis	T. Scott 1903 peruanus	Becker 1974 vikingus	Drzycimksi 1968

†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  $A_2$ , Mxl, 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<sub>3</sub>, 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 P2 and P3 are the same as P4, 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 baseoendopodite is short showing no inner expansion. The  $P_5$  of P. coronatus is more normal; the exopod is distinctly segmented, and the baseoendopodite 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.

······································	P2		P_		P_4		P.5	
	exp.	end.	exp.	end.	exp.	end.	exp.‡	Bend.
brevisetosus sp. nov.	1.1.223	1.2.211†	1.1.323	1.1.321	1.1.323	1.1.221	4d	2
bipartitus sp. nov.	1.1.223	1.2.211	1.1.323	1.1.321	1.1.223	1.1.221	3f	<b>2</b>
coronatus T. Scott	unknown	1.2.211	unknown	1.1.321	unkr	юwn	4d	1
vikingus Drzycimski	1.1.223	1.1.221	1.1.323	1.1.321	1.1.323	1.1.221	3f	<b>2</b>

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

†Transformed.

 $\ddagger f = fused$  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  $P_1$  endoped,  $P_5$  exoped, and the CR. However, P. brevisetosus is distinct from P. coronatus in the setal arrangement of the  $P_4$  exoped,  $P_5$  baseoendopedite, and more significantly the  $P_2$  endoped of the male. In fact, P. brevisetosus is the only known male of the genus which shows the usual dimorphic transformation of the male  $P_2$  endoped.

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  $P_1$  endopod is 2-segmented. However, the shape of the  $P_1$  endopod is suggestive of the 'coronatus'-group, as is the setal arrangement and structure of  $P_2$  and  $P_3$ . 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	$P_5$ exopod distinctly separate, baseoendopodite with inner expansion, ( <i>'coronatus'</i>
	$\cdots$
	P <sub>5</sub> exopod fused to basis, baseoendopodites not expanded ('similis' group) 4
<b>2</b>	P <sub>5</sub> exopod and baseoendopodite each with 5 setae peruanus Becker
_	$P_5$ exopod with 4 setae, baseoendopodite with less than 5 setae $\ldots$ $3$
3	$P_5$ baseoendopodite with 1 long seta, a variable number of short setae also present
	coronatus T. Scott
_	$P_5$ 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
<b>5</b>	Terminal endopod segments of $P_1$ and $P_4$ with 3 setae each abyssalis Becker
-	Terminal endopod segments of $P_1$ and $P_4$ with 2 and 3 setae respectively
	similis T. Scott
-	Terminal endopod segments of $P_1$ and $P_4$ with 3 and 4 setae respectively
	vikingus Dryzeimski

#### 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  $\bigcirc$  P<sub>5</sub> and the  $\circlearrowleft$  P<sub>2</sub> endopod. Pseudotachidius bipartitus, with a 2-segmented P<sub>1</sub> endoped 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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### References

- BECKER, K. 1974, Eidonomie und Taxonomie abyssaler Harpacticoidea (Crustacea, Copepoda) Teil I. Cerviniidae-Ameridae, 'Meteor' Forschungsergebnisse, Ser. D, 18:1-28.
- COULL, B. C., 1973, Meiobenthic Harpacticoida (Crustacea, Copepoda) from the deep sea off North Carolina III. The families Tisbidae Stebbing emend. Lang, Thalestridae Sars emend. Lang, and Diosaccidae Sars, *Transactions of the American Microscopical Society*, 92 (4):592–603.
- ---- 1977, Marine flora and fauna of the northeastern United States, Copepoda: Harpacticoida, NOAA Technical Report, NMFS Circular, 399.
- DRZYCIMSKI, I., 1968, Drei neue Harpacticoida aus Westnorwegen, Sarsia, 36: 55-64.
- LANG, K., 1948, Monographie der Harpacticiden, I & II, Hakan Ohlsson, Lund, 1682 pp.
  1965, Copepoda Harpacticoida from the California Pacific coast, Kunglica Svenska Vetenskapsakademiens Handlingar, Ser. 4, 10 (2): 1–560.
- SARS, G. O., 1911, An account of the Crustacea of Norway, 5. Copepoda, Harpacticoida. Bergen Museum, Norway, 499 pp.
- SCOTT, T., 1897, Some additions to the invertebrate fauna of Loch Fyne, 16th Annual Report of the Fishery Board for Scotland, Part III: 261–282.
- 1903, Notes on some Copepoda from the Faroe channel, Zoological Journal of the Linnean Society, 29:1–11.