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NORTH AMERICAN HARPACTICOID COPEPODS II. NEW RECORDS AND SPECIES OF *ELAPHOIDELLA* (CANTHOCAMPTIDAE) FROM THE UNITED STATES AND CANADA

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The number of species of *Elaphoidella* known from North America is herein increased from two to five indicating that the genus is broadly distributed over the continent. The new species and records range eastward in the United States from Yosemite Park, California, to Florida, and northward to about 57°N latitude in Alaska and Canada.

I am indebted to the collectors mentioned in the text. Financial support from National Science Foundation grants G21643 to the Smithsonian Institution and GB7478 to the University of Alaska is acknowledged. Some equipment used in the work was loaned by the Arctic Health Research Center, U. S. Public Health Service, Fairbanks, Alaska. Sandra P. Roberts assisted in preparation of the final manuscript.

Elaphoidella bidens coronata (Sars, 1904)

Published North American records of this species are from the following states: Pennsylvania (Coker, 1934); Virginia (Carter, 1944); North Carolina (Coker, 1926, 1934; McKee & Coker, 1940); Georgia (Carter & Bradford, 1972); Minnesota (Cole, 1955).

New records from my collections include the following: NORTH CAROLINA: Lenore County, Skeet Club Pond draining into Neuse River, 16 January 1938, P. McKee collector, ♀. — FLORIDA: Leon County, ditch pond across road from Lake Jackson, 16 March 1953, Dr. Irene Boliek donor of collection, 2 ♀♀ with *Attheyella americana* Herrick; — spring fed stream in Meridian Estates, Tallahassee, 16 February 1959, Dr. Irene Boliek donor, 3 ♀♀ from mosses and liverworts; — running stream off West Thorpe Street on Damsey Street, Tallahassee, 29 January 1959, Dr. Irene Boliek donor, 1 ♀ from mosses. — LOUISIANA: Natchitoches Parish, Chestnut, spring fed pond, 22.28 cm deep, 31 March 1956, Lynn Blackwell collector, 1 ovigerous ♀ with *Canthocamptus assimilis* Kiefer. — OHIO: Lake County, mouth of Chagrin River, 11 November 1956, C. C. Davis collector, 1 ♀.

The paper on postembryonic development by Carter & Bradford (1972) is a publication of Carter's work and should be given attention. Leg 2 of the adult male, fig. 5M, is obviously abnormal; fig. 6K showing leg 4 of the adult male has no modified outer spine on exopod segment 3 and has a 1-segmented endopod.

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[1]) Mrs. M. S. Wilson died on 6 August 1973.

Elaphoidella subgracilis (Willey, 1934) (figs. 1-15)

Canthocamptus subgracilis Willey, 1934: 85, pl. 14 figs. 24-27 (original description).
Elaphoidella subgracilis: Chappuis, 1935: 283 (taxonomy); 1956: 63, 68 (in key); 1958: 148 (in list, distribution). — Lang, 1948: 912, table 19 (leg setation); p. 1163, fig. 462: 3 ,fig. from Willey, diagnosis emended from Willey). — Borutsky, 1952: 290, fig. 82.6-9 (description, fig. from Willey); 1960: 136 (in key), fig. 58.8-9 (from Willey). — Wilson, 1956: 294 (in list). — Wilson & Yeatman, 1959: 850, fig. 29.207 (in key, fig. from Willey, distribution).

Type locality. — A deep permanent pond near the Verdun asylum at a spot called Crawford Park, island of Montreal near city of Verdun, Quebec, Canada, about 45°27′N 73°35′W. Collected 24 April 1926 and 3 May 1927.

Types. — No statement made by Willey regarding deposition of type material. Not deposited in National Museum of Canada (personal correspondence, Dr. E. L. Bousfield).

Distribution. — Willey also records another Quebec collection made on 1 June 1926 indefinitely noted as the "St. Lawrence valley." The occurrence of the species in Saskatchewan noted in Wilson & Yeatman (1959) is based on the following records identified by Wilson.

Occurrence. — 3 ♀♀, 2 ovigerous with attached spermatophores, shallow lakelet in muskeg, vicinity of Department of Natural Resources laboratory, Lac la Ronge, about 55°07′N 105°25′W, 31 May 1956, E. B. Reed collector. Occurring with *Elaphoidella reedi* n. sp. (see below) and *Bryocamptus hutchinsoni* Kiefer, variant.

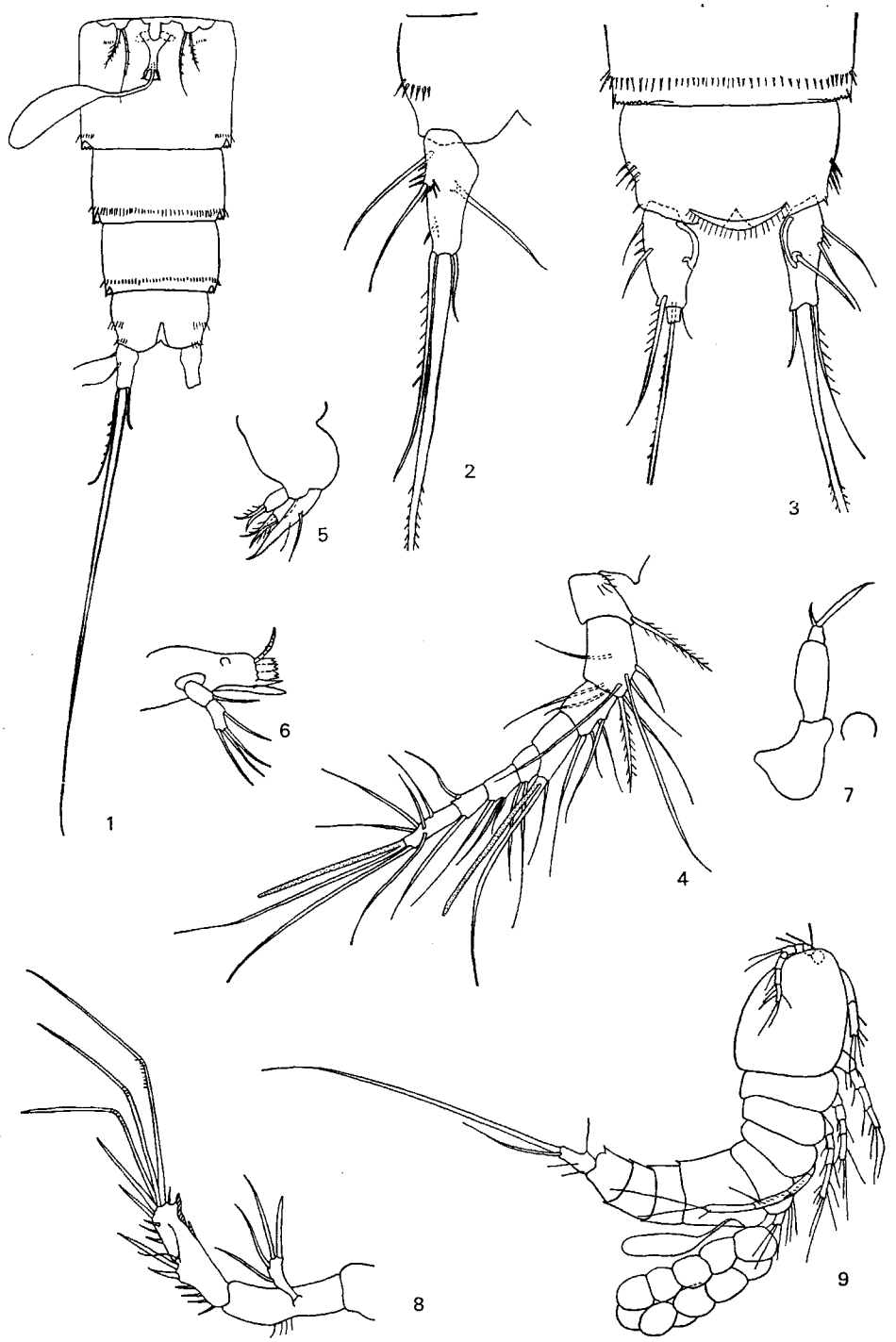
One ♀, nonovigerous, Crean Lake, Prince Albert Park, about 54°05′N 106°11′W, inshore surface tow, 30 May 1932, from Rawson collection, University of Saskatchewan.

Specimens deposited in U. S. National Museum.

Comments on literature. — The species is known from two provinces of Canada: Quebec (Willey, 1934) and Saskatchewan (Wilson & Yeatman, 1959). Copies of Willey's figures were used to illustrate the key of the latter publication since the Saskatchewan specimens were not identified in time to prepare new figures. There has thus been only Willey's description, which though incomplete, is sufficiently detailed and succinct so that the females of my collections can unquestionably be referred to the species.

The text of Willey's description is written in part as comparison with *E. gracilis*, apparently as redescribed by Gurney (1932). Only four figures of *E. subgracilis* are given: endopod of leg 2 and leg 5 of the male, and two views (ventral, lateral) of the caudal rami for which no sex is indicated in the captions. Unfortunately, in the text, it is not stated to which sex any habitus characters apply and whether any dimorphism exists. This may indicate that the caudal rami do not differ sexually, or like *E. gracilis*, are only more slender in the male. As my specimens are all female, this point still remains to be clarified, its importance being emphasized because of the striking dimorphism in some other species of the group.

Lang's diagnosis (1948) should be ignored because he writes into it many characters not described by Willey. He seems to have related the species closely to that of the European *E. gracilis*. Without critical comparison of various de-



Figs. 1-9. *Elaphoidella subgracilis* (Willey, 1934), female. 1, urosome, ventral; 2, last segment and caudal ramus, ventral; 3, last two urosome segments and caudal rami, dorsal, left caudal ramus abnormal, Crean Lake variant; 4, rostrum and antennule; 5, maxilla; 6, mandible; 7, maxilliped; 8, antenna; 9, habitus, lateral.

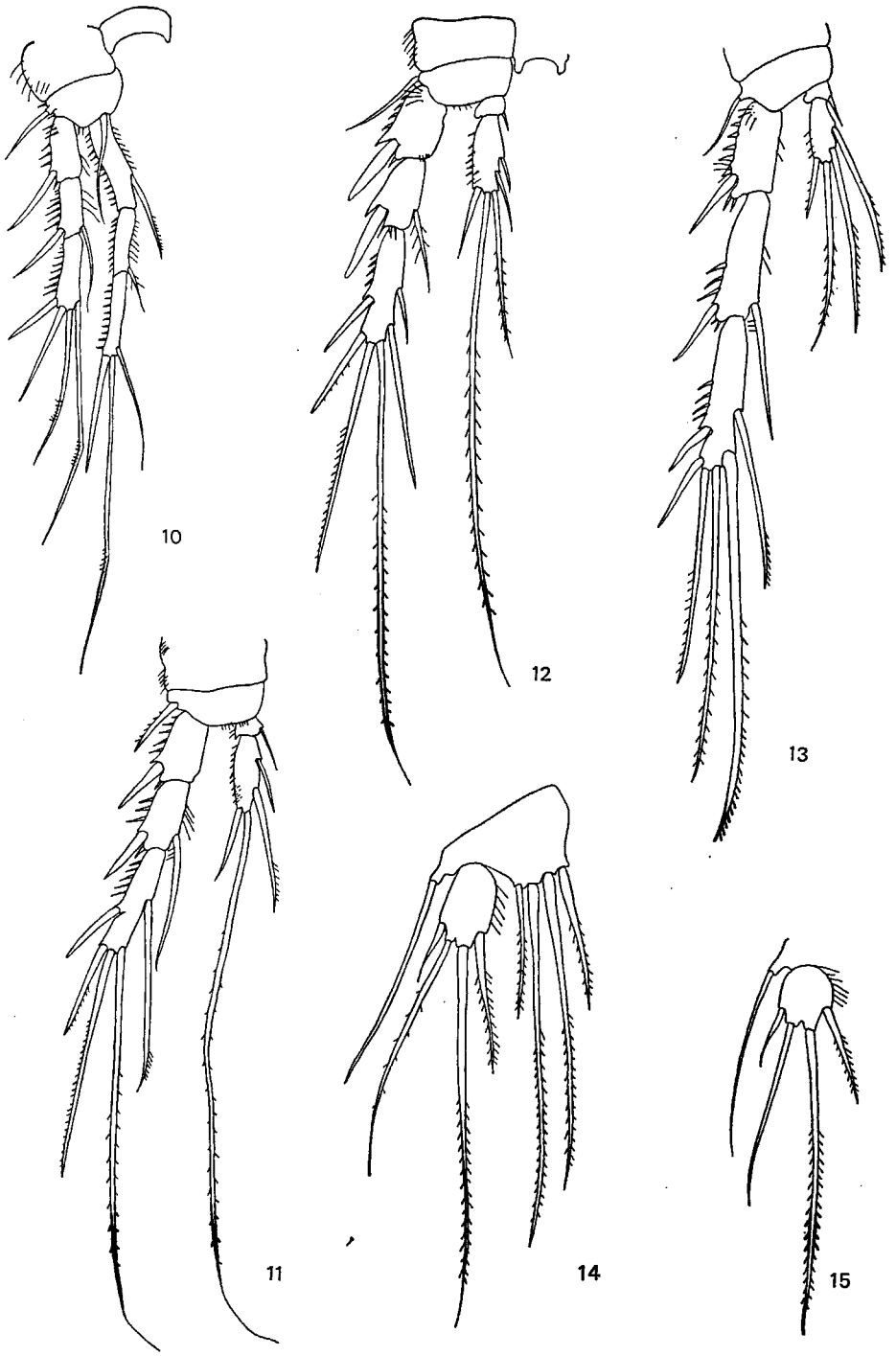
scriptions (*E. gracilis* and *E. subgracilis*), it is impossible to judge on what any particular statement is based.

Description of Saskatchewan specimens. — Most of the figures are based on specimens from the Lac la Ronge area with variations noted in the Crean Lake specimen interpolated in text and illustrated in some figures. Habitus (fig. 9): length of a normally expanded specimen 0.725 mm. Body form resembling known North American species of *Canthocamptus* except that in preserved specimens the long, slender leg 4 is carried appressed to body segments as shown in fig. 9. Distal segmental membrane weakly serrate dorsally (figs. 1, 3), carried laterally on to ventral side in Crean Lake specimen. Urosome spination: genital segment (counted here as segment 1) with lateral group of fine short spinules distally, external genital area with groups of spinules medially; ventrally, segments 2 and 3 with complete row of fine spinules distally, tending to be irregular and finer in center (not continuous on segment 2 of Crean Lake specimen); anal segment with lateral group of spinules at middle, distal edge of segment with lateral group of spinules partially overlying bases of caudal rami ventrally (fig. 1). Anal segment of characteristic shape, incurved below middle as shown in figs. 1-3; anal operculum narrow with numerous closely set fine spinules (fig. 3). Caudal ramus (fig. 2) having its outer margin subequal to that of anal segment; proximal half swollen dorso-laterally so that in dorsal view the inner margin appears as an expanded lobe (fig. 3), this area with thickened cuticle and bearing dorsal seta at end of sclerotized ridge which appears as sharp protrusion in lateral view (figs. 3, 9); lateral and dorsal setae long, equaling or surpassing a little the length of the ramus, set just above middle of ramus; proximal lateral seta arising on ventral side near base of ramus, distal lateral seta arising on lateral margin opposite placement of dorsal seta (fig. 2). Near distal fourth of ramus a tubelike glandular structure arising internally penetrates the cuticle and protrudes externally about half of its own total length (fig. 2). The three caudal setae set on slightly expanded apex of ramus; the middle caudal seta longer than urosome, much stouter basally than the others, tapering to hairlike end, armed with fine marginal spinules beginning about proximal fifth (figs. 1-2); outer caudal seta about two times length of ramus and about one-fifth length of middle seta, with a few outer marginal spinules; inner seta shorter than ramus (figs. 1-2).

Antennule (fig. 4) 8-segmented, both segments 1 and 2 with a plumose seta, that on segment 2 placed distally; aesthete of segment 4 reaching to near end of antennule, aesthete of apex subequal to that of segment 4. Armature of each segment (s = seta, a = aesthete):

1	2	3	4	5	6	7	8
1s	9s	4s	2s	2s	3s	2s	7s
			a				a

Antenna (fig. 8) lacking lateral setae on allobasis though hairs may be present; exopod with four setae; apical segment as figured with stout lateral spines, five apical setae and accessory lateral membranes.



Figs. 10-15. *Elaphoidella subgracilis* (Willey, 1934), female. 10, leg 1; 11, leg 2; 12, leg 3; 13, leg 4; 14, leg 5; 15, leg 5, Crean Lake variant.

Mandible (fig. 6) blade with stout lateral seta, three indistinctly divided teeth of "lightweight cuticle" and two distinct sclerotized teeth at apex; palp 2-segmented, segment 1 with seta, segment 2 with four setae. Maxilla (fig. 5) with three endites of which the apical has two separately inserted setae. Maxilliped (fig. 7) 3-segmented; with apical claw and seta; sternal plate present between bases.

Leg 1 (fig. 10) with 3-segmented endopod; legs 2-4 (figs. 11-13) with 2-segmented endopod. Setation of endopods of legs 2-4 as in Table I. Leg 2 (fig. 11) endopod with extremely long apical seta, reaching to near apex of inner apical seta of exopod. Leg 3 (fig. 12) with similar long setae in these positions. Leg 4 (fig. 13) exopod exceedingly elongate; segment 1 the shortest; segment 3 a little longer than segment 2 with inner distal seta greatly enlarged, as long as exopod; endopod less than length of segment 1 of exopod with four apical setae as in leg 2. Leg 5 exopod a little longer than greatest width in Lac la Ronge specimen (fig. 14), shorter in Crean Lake specimen (fig. 15), with four setae of different lengths, the third seta the longest; of the setae on inner basal expansion, the two middle about two times the length of the innermost and outermost setae.

Elaphoidella californica n. sp. (figs. 16-23)

Type locality. — Small pond about 1 m deep, in Yosemite Field School research plot 6, off Tioga Road at 2400 m elevation, Yosemite National Park, Mariposa County, California, U.S.A., about 37°48'N 119°30'W.

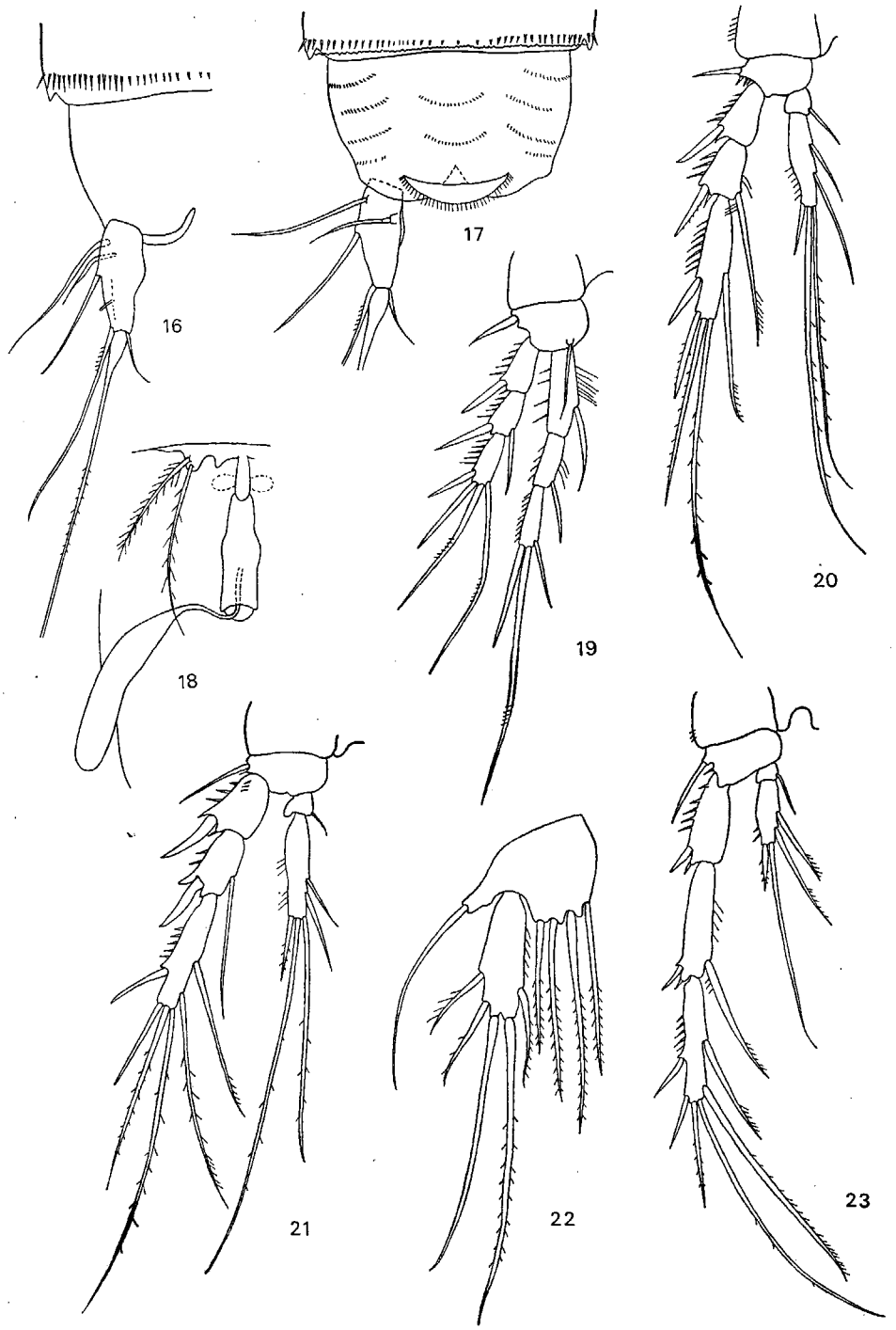
Type. — U. S. National Museum Catalog No. 141766, 1 slide, dissected appendages and urosome.

Occurrence. — 1 ♀, ovigerous with attached spermatophore, 4 July 1954, D. R. Zuckswert collector. Occurring with *Canthocamptus assimilis* Kiefer and *C. oregonensis* M. S. Wilson.

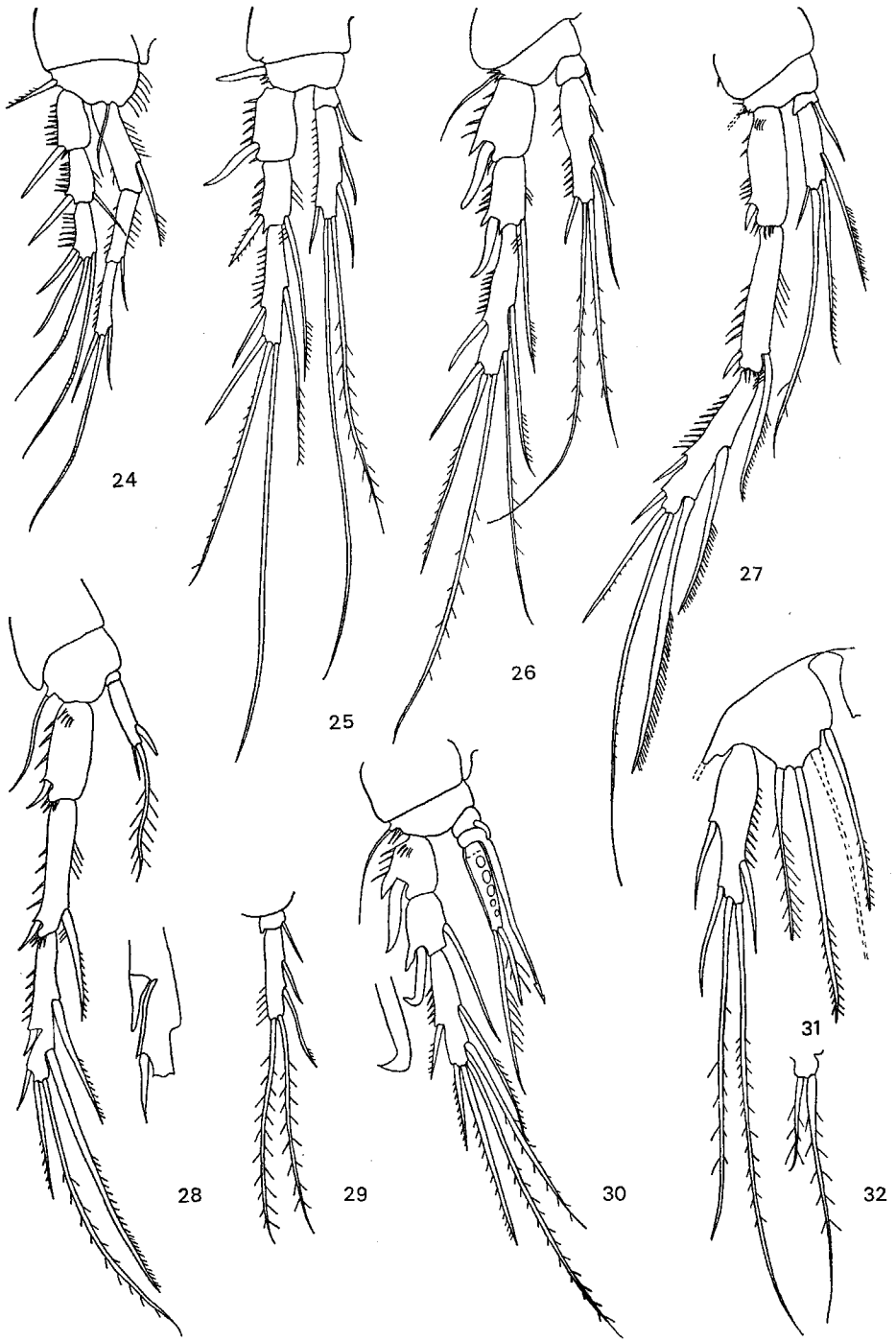
Description. — Habitus: length 0.7 mm. Body form as in *E. subgracilis*. Distal segmental membrane weakly serrate dorsally. Urosome spination: genital and second segment with lateral group of spinules distally (figs. 16-17); segment 3 with complete row of spines dorsally and ventrally, center spines on each side reduced in size, with gaps on dorsal side (fig. 17); anal segment (fig. 17) incurved below middle, dorsally with many short, curved rows of fine spinules. Operculum a narrow membrane, armed with numerous fine setules. Caudal ramus (figs. 16-17) shaped as in *E. subgracilis* with sclerotized dorsal ridge, a little shorter than outer margin of anal segment; lateral setae set above middle of ramus, both longer than ramus; ventrally a tubelike gland below distal seta (fig. 16); caudal setae as in *E. subgracilis*.

Antennule setation as in *E. subgracilis* except that distal seta of segment 2 not plumose.

Leg 1 (fig. 19) as in *E. subgracilis*. Leg 2 (fig. 20) with two elongate, subequal apical setae on endopod. Leg 3 (fig. 21) endopod with two inner setae both placed below the middle of segment, apical setae like those of leg 2 in length; exopod abnormal on one side, distal inner seta absent. Leg 4 (fig. 23) exopod not as elongate as in *E. subgracilis* or other species described herein, segments 2 and 3



Figs. 16-23. *Elaphoidella californica* n. sp. female. 16, anal segment and caudal ramus, ventral; 17, anal segment and caudal ramus, dorsal; 18, genital area with spermatophore; 19, leg 1; 20, leg 2; 21, leg 3; 22, leg 5; 23, leg 4.



Figs. 24-32. *Elaphoidella reedi* n. sp. female, male. 24, leg 1 female; 25, leg 2 female; 26, leg 3 female; 27, leg 4 female; 28, leg 4 male, with enlargement of apex of exopod segment 3; 29, leg 2, endopod male; 30, leg 3 male; 31, leg 5 female; 32, leg 6 female.

subequal to one another. Leg 5 (fig. 22) exopod elongate, length about three times the greatest width, with straight inner margin, outer margin slightly incurved distally, all setae inserted below middle of segment; none of the setae of basal expansion much longer than the other, all reaching a little beyond exopod.

Elaphoidella reedi n. sp. (figs 24-37)

Type locality. — Shallow lakelet in muskeg, vicinity of Department of Natural Resources laboratory, Lac la Ronge, Saskatchewan, Canada, about 55°07'N 105°25'W.

Types. — U. S. National Museum Catalog Nos. 141763 and 141765, 2 slides, dissected appendages and urosome of each sex.

Occurrence. — 1 ♀, 1 ♂ in tandem, 31 May 1956, E. B. Reed collector. Occurring with *E. subgracilis* (Willey) and *Bryocamptus hutchinsoni* Kiefer, variant.

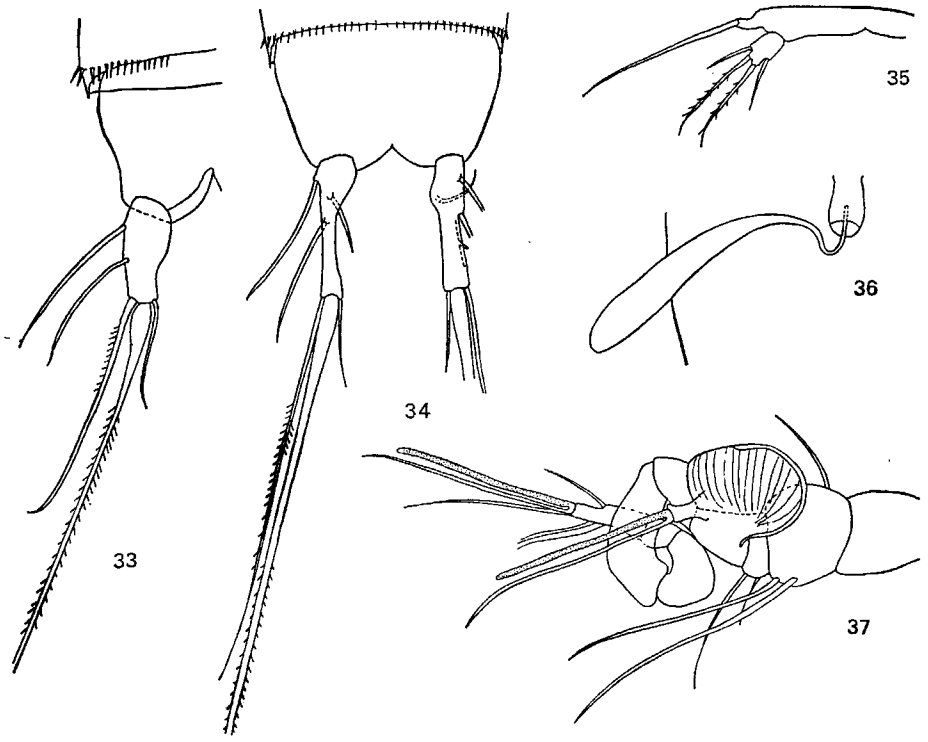
Description of female. — Habitus: length 0.665 mm. Body form similar to and leg 4 carried as in *E. subgracilis*. Urosome ventral spination: genital segment lacking spinules; segment 2 with few lateral hairlike spinules; about one-third of each side of segment 3 with fine spinules (fig. 33); anal segment lacking spinules. Proximal part of anal segment outcurved, distal incurved; operculum a narrow membrane with serrate edge. Caudal ramus shorter than outer margin of anal segment (about 4:5); lateral setae longer than ramus; dorsal seta at end of curved sclerotized ridge. Caudal setae as in *E. subgracilis*, outer and middle setae with fine marginal spinulation. Glandular process not present.

Antennule with setation as in *E. subgracilis*, seta of segment 1 plumose, not determined if distal seta of segment 2 also plumose; aesthetes of similar length. Antenna and oral appendages also comparable to *E. subgracilis*.

Leg 1 as in fig. 24. Setation of legs 2-4 as in Table I and as shown in figs. 25-27. Leg 3 differing from *E. subgracilis* in having three inner setae on endopod segment 2, regularly spaced, the first seta about the same length as that of endopod segment 1. Leg 4 with all inner setae of exopod segments 2 and 3 enlarged basally; endopod shorter than exopod segment 1, with setae as shown in fig. 27. Leg 5 (fig. 31) exopod elongate, greatest width about middle, equal to about one-fourth total length (4:15), two apical setae very long, more than two times length of exopod; of the four setae of basal expansion, the third broken on both sides; of the other setae, the second the longest. Leg 6 with the usual two long setae, the innermost the longer.

Description of male. — Habitus: length 0.62 mm. Anal segment not shaped as in female, rounded and not incurved at middle (fig. 34). Caudal rami slender, in dorsal view greatly incurved on inner margin; fig. 34 shows right caudal ramus turned in ventral position with glandular process distad to second lateral seta; caudal setae resembling those of female but longer, middle seta enlarged a little more than two times length of outer slender seta.

Antennule (fig. 37) 9-segmented, segment 4 with large, ribbed membranous section from which aesthete and seta arise on projection of section; figure does not show all the setae which are numerous. Antenna and oral appendages as in female.



Figs. 33-37. *Elaphoidella reedi* n. sp. female, male. 33, anal segment and caudal ramus, ventral, female; 34, anal segment and caudal rami, rami in different positions, ventral, male; 35, leg 5 male; 36, spermatophore male; 37, antennule male.

Leg 1 as in female; leg 2 endopod segment 2 with four setae (fig. 29); leg 3 as in fig. 30, spines of exopod segments 1 and 2 exceedingly stout, that of segment 2 outcurved at tip. Leg 4 with first outer spine of exopod segment 3 transformed as shown in fig. 28; endopod exceedingly reduced with three apical setae, that of inner margin thick and spinelike. Leg 5 (fig. 35) exopod short, length hardly two times the width, the four setae short but all a little longer than exopod; basal expansion not produced, without inner seta.

This species is named in honor of Dr. E. B. Reed, Colorado State University, Fort Collins, not only in acknowledgement of his collections upon which this paper is largely based but also in recognition of his contribution to the knowledge of North American Copepoda.

Elaphoidella kodiakensis n. sp. (figs. 38-43)

Type locality. — Pothole near outlet of Karluk Lake, Kodiak Island, Alaska, U.S.A., about 57°28'N 154°09'W.

Type. — U. S. National Museum Catalog No. 141767, 1 slide, legs and urosome; cephalic segment not dissected, in alcohol.

Occurrence. — 1 ♀, nonovigerous, 27 July, 1956, Seawright and Safsten collectors, U. S. Fish and Wildlife Service donor.

Description. — Habitus: length 0.81 mm (body segments of single specimen expanded). Body form like that of *E. reedi* except that anal segment narrower than preceding segments and not incurved. Distal membranes of body segments smooth. Urosome spination: genital and second segment without spinules; segment 3 ventrally with lateral spinules and a center group (fig. 42), dorsally with gap in center (fig. 43); segment 4 with two long setules in distal part dorsally (fig. 43). Anal operculum a narrow membrane, armed with numerous fine setules. Caudal ramus a little shorter than outer margin of anal segment (14:18); length a little more than two times greatest width (14:6); not laterally compressed, with narrow dorsal ridge; lateral setae longer than ramus, the proximal set near base of ramus, the distal at its mid-point; dorsal seta on lobelike swelling above middle of ramus between two lateral setae. Apex of ramus broad; with three processes, one a continuation of the outer margin and heavily sclerotized, the other two (stippled in fig. 43) digitiform and flexible, arising just above insertion of middle caudal seta on the ventral and dorsal sides (assumed to be non-glandular, not connected to internal tissue). Of three caudal setae, the outer was broken on each side but appears from the remnant to be longer than the inner seta, armed with spinules; middle seta very stout at base, attenuated, spinulose; inner seta a little shorter than ramus.

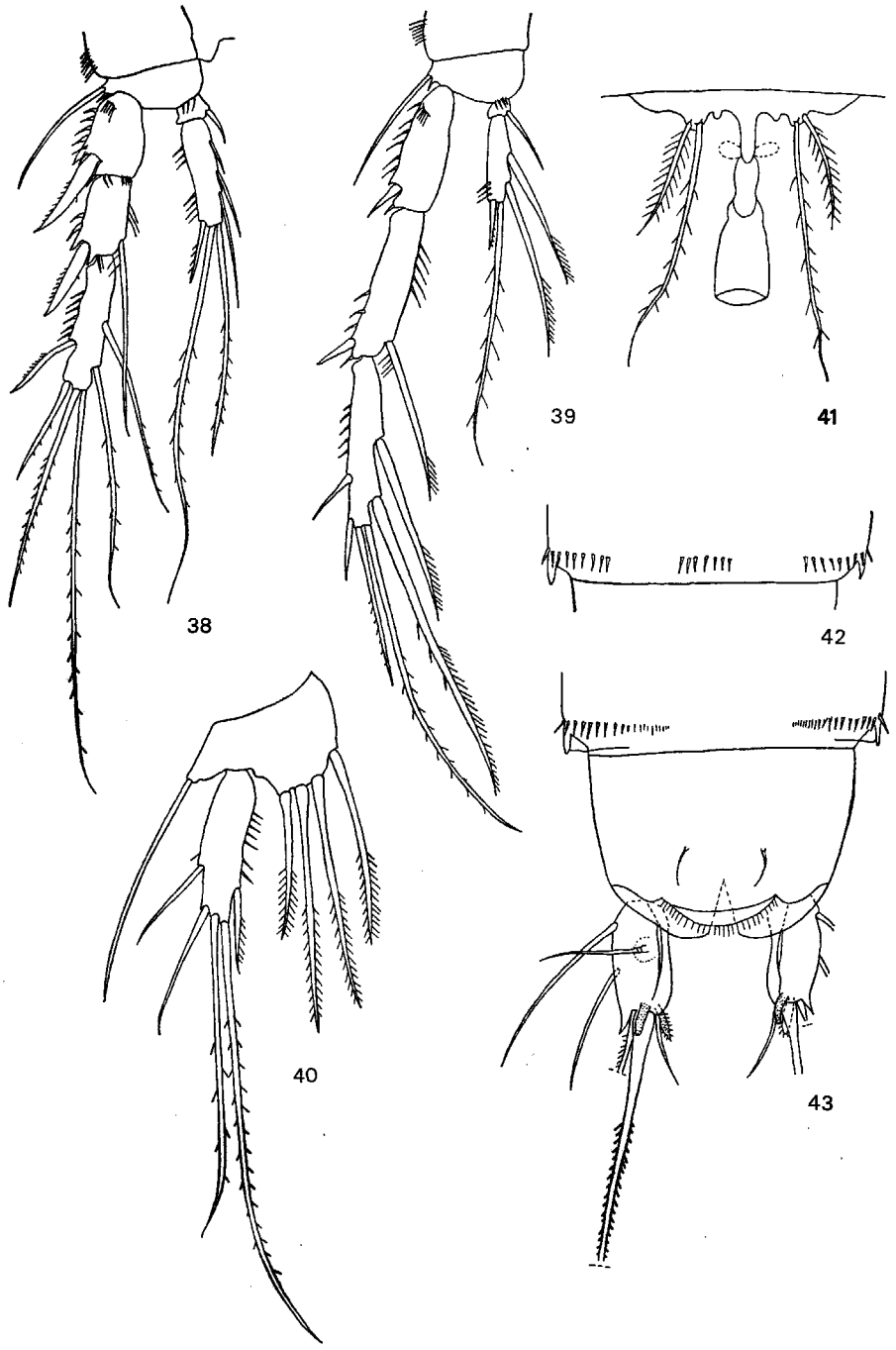
Antennule 8-segmented.

Legs 1-5 similar to *E. reedi*; setal formula the same (Table I). Legs 1-2 very similar in proportion of segments and setal lengths to *E. reedi*; other legs differing slightly. Leg 3 (fig. 38) endopod shorter than in *E. reedi*, with three inner setae similarly placed, except the distal closer to the middle seta. Leg 4 (fig. 39) similar to *E. reedi* except the proximal inner seta of endopod placed at middle rather than below middle and distal seta further from apex. Leg 5 (fig. 40) exopod with length similar to *E. reedi*, differing in shape, distal part not incurved, proximal outer seta set below middle; inner basal expansion with four setae, the two middle the longer and subequal to one another.

TAXONOMY

All of the North American species of *Elaphoidella* fall into group II as defined by Lang (1948). Of the five species, *E. bidens coronata* does not seem to belong to the same subgroup as the other four species and will not be considered in the discussion. Probably the term *gracilis* group is appropriate for the North American subgroup.

The North American species of the *gracilis* group, as exemplified by the four species described above, show several distinct characters that may or may not occur in other groups. These characters are: Caudal ramus modified; with both lateral setae very long and placed in proximal part of ramus. Antennule 8-segmented, segment 1 with plumose seta, sometimes distal seta plumose on segment 2. Antenna with no setae on allobasis; apex ornamented with lateral membrane. Leg 1 exopod segment 2 with inner seta; endopod 3-segmented, segments 1 and



Figs. 38-43. *Elaphoidella kodiakensis* n. sp. female. 38, leg 3; 39, leg 4; 40, leg 5; 41, genital area and leg 6; 42, urosome segment 3, ventral; 43, urosome posterior segments and caudal rami, rami turned in slightly different positions, dorsal.

2 each with inner seta, segment 3 with three setae. Legs 2-4: exopod segment 3 with two outer spines, total spines and setae 5, 6, 6; endopod 2-segmented, not reaching beyond exopod segment 2, that of leg 4 shorter than exopod segment 1; setation as in Table I. Leg 2: setation of endopod segment 2 variable as shown in Table I. Leg 3: outer spines of exopod segments 1 and 2 enlarged, that of exopod segment 2 exceedingly stout in both sexes. Leg 4 with slender elongate exopod, the segments increasing in length distally; inner distal seta or setae of exopod segment 3 enlarged in female and where known in male. Leg 5 exopod in female with five setae except in *E. subgracilis* which has four, male where known with four setae; basal expansion with four setae in female, none in male where known.

TABLE I

Setation of endopods, legs 2-4 ♀ of North American species of *gracilis* subgroup (Setae counted from outer to inner margins)

Leg	2		3		4		Total endo.
segment	1	2	1	2	1	2	2
subgracilis	0-1	1-1-2	0-1	1-2-2	0-1	1-1-2	4,5,4
californica	0-1	1-2-2	0-1	1-2-2	0-1	1-1-2	5,5,4
reedi	0-1	1-2-2	0-1	1-2-3	0-1	1-1-2	5,6,4
kodiakensis	0-1	1-2-2	0-1	1-2-3	0-1	1-1-2	5,6,4

E. subgracilis differs most noticeably from other species of the group, not only in leg 5 but in having four setae on the endopod of leg 2. It will be necessary to know more about the male before *E. subgracilis* can be considered a well-known species. *E. californica* shows some similarity to *E. subgracilis* in the shape of the female caudal ramus and in having only two inner setae on endopod segment 2. Otherwise, this species may represent a more primitive form than *E. subgracilis* and be related to the two remaining species. *E. reedi* and *E. kodiakensis* seem to be related through leg 5 of the female and the presence of three inner setae on the endopod of leg 3 of the female. The two species are distinct from one another, however, through the strikingly different caudal rami of the females.

ZUSAMMENFASSUNG

Nordamerikanische Angaben von *Elaphoidella bidens coronata* Sars werden hier zusammengefasst und neue werden aufgezeichnet. Das Weibchen von *E. subgracilis* (Willey) aus Saskatchewan, Kanada, wird wiederbeschrieben. Drei neue nordamerikanische Arten werden beschrieben: *E. reedi*, das Weibchen und das Männchen; *E. californica*, nur das Weibchen; und *E. kodiakensis*, nur das Weibchen.

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