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Author(s): Gayle A. Heron

Source: *Crustaceana*, Vol. 7, No. 3 (Sep., 1964), pp. 199-211

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## SEVEN SPECIES OF *EURYTEMORA* (COPEPODA) FROM NORTHWESTERN NORTH AMERICA <sup>1)</sup>

BY

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Seven species of *Eurytemora* were collected close to the northwestern Alaskan coast during an oceanographic survey conducted by the Department of Oceanography, University of Washington, from 1 August to 2 September 1959. At least one of the seven species (*E. raboti* Richard, *E. herdmanni* Thompson & A. Scott, *E. americana* Williams, *E. pacifica* Sato, *E. gracilicauda* Akatova, *E. composita* Keiser, and *E. foveola* Johnson) occurred in nine of the ten samples (table I) collected from two lagoons and an inlet along the Alaskan coast; several of the species also occurred in offshore samples (fig. 1). Kivalina Lagoon and Marryatt Inlet had openings to the sea when collections were made by towing a net from a skiff; Krusenstern Lagoon was entirely enclosed when samples were taken by casting a net from shore.

*Eurytemora americana* was also collected from bays on San Juan Island, Washington, during July and August of 1958 and 1960.

### ***Eurytemora raboti* Richard (figs. 2-8)**

*Eurytemora affinis* Poppe var. *Raboti* Richard, 1897: 193, figs. 1-3.

*Eurytemora raboti*: Brehm, 1917: 609; Olofsson, 1918: 464, figs. 28, 29; Smirnov, 1930: 309, figs. 1-4, 1 map; Jashnov, 1935: 120, fig. 2; Jashnov, 1948: 199, pl. 48 fig. 6.

Female. — Body length of four specimens 1.53-1.77 mm (exclusive of caudal setae). Dissected specimen 1.53 mm (metasome 63%, urosome 37%); percentage of length of each metasomal segment: 1 - 46%; 2 - 15% 3 - 16%; 4 - 13%; 5 - 7%; 6 - 2%. Metasome possibly distorted; greatest width in dorsal view in segment 2, 0.53 mm; reduced to 0.44 mm for segment 5. Cephalic segment in lateral view showing no distal protuberance. Wings of sixth segment slightly asymmetrical, reaching to middle of genital segment; left wing barely larger than right.

Percentage of length of urosomal segments and caudal rami (fig. 2): 1 - 23%; 2 - 18%; 3 - 20%; CR - 38%. Genital segment with two lateral protrusions on either side, each bordered with three sensilla; operculum (fig. 3) rounded distally.

<sup>1)</sup> Contribution No. 278 from the Department of Oceanography, University of Washington, Seattle 5, Washington. This work was supported in part by the Office of Naval Research, Contract Nonr-477 (10), Project NR 083 012, and in part by the Atomic Energy Commission, Contract AT-45-1-540.

TABLE I  
Surface salinities and *Eurytemora* from two lagoons, one inlet, and four offshore stations, Alaska, 1959

Collection Location	Salinity ‰	<i>Eurytemora herdmani</i>		<i>Eurytemora pacifica</i>		<i>Eurytemora raboli</i>		<i>Eurytemora americana</i>		<i>Eurytemora gracilicanda</i>		<i>Eurytemora composita</i>		<i>Eurytemora foveola</i>	
		♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂
Krusenstern Lagoon August 19	5.6	wings none		—	—	—	—	—	—	—	—	2	—	—	—
		—	—	—	—	2*	—	—	—	—	—	—	—	—	—
Krusenstern Lagoon August 19	5.7	—	—	—	—	—	—	—	—	—	3	1	—	4	—
		—	—	—	—	—	—	—	—	—	—	—	—	—	—
Station 94 August 19	19.0	4	2	2	4	1	—	—	—	—	—	—	—	—	—
		—	—	—	—	—	—	—	—	—	—	—	—	—	—
Kivalina Lagoon August 22	12.6	4	2	17	10	1	—	—	—	—	—	1	—	—	—
		—	—	—	—	—	—	—	—	—	—	—	—	—	—
Kivalina Lagoon August 22	17.3	4	2	31	14	13	—	—	—	—	—	1	2	—	—
		—	—	—	—	—	—	—	—	—	—	—	—	—	—
Kivalina Lagoon August 22	16.5	—	1	2	1	2	—	—	—	—	—	1	2	—	—
		—	—	—	—	—	—	—	—	—	—	—	—	—	—
Kivalina Lagoon August 22	8.3	2	1	6	4	3	4	2	—	—	—	5	4	—	—
		—	—	—	—	—	—	—	—	—	—	—	—	—	—
Marryatt Inlet August 25	21.5	3	5	2	—	—	—	—	—	—	—	—	—	—	—
		—	—	—	—	—	—	—	—	—	—	—	—	—	—
Marryatt Inlet August 25	22.1	—	1	—	—	—	—	—	—	—	—	1	—	—	—
		—	—	—	—	—	—	—	—	—	—	—	—	—	—
Marryatt Inlet August 25	4.2	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		—	—	—	—	—	—	—	—	—	—	—	—	—	—
Marryatt Inlet August 25	29.7	6	22	2	—	1	—	—	—	—	—	—	—	—	—
		—	—	—	—	—	—	—	—	—	—	—	—	—	—
Station 158 August 29	23.6	2	—	2	4	2	—	—	—	—	—	—	—	—	—
		—	—	—	—	—	—	—	—	—	—	—	—	—	—
Station 159 August 29	23.2	3	1	1	2	2	—	—	—	—	—	—	—	—	—
		—	—	—	—	—	—	—	—	—	—	—	—	—	—
Station 176 September 1	29.5	3	3	2	3	4	—	—	—	—	—	—	—	—	—
		—	—	—	—	—	—	—	—	—	—	—	—	—	—

\* copepodids

Lateral and dorsal surfaces of segment 3 and caudal rami thickly covered with spinules. Caudal rami length about 4 times width. Caudal setae stout, shorter than caudal rami.

Antennules robust, 24-segmented, reaching to end of metasomal segment 3.

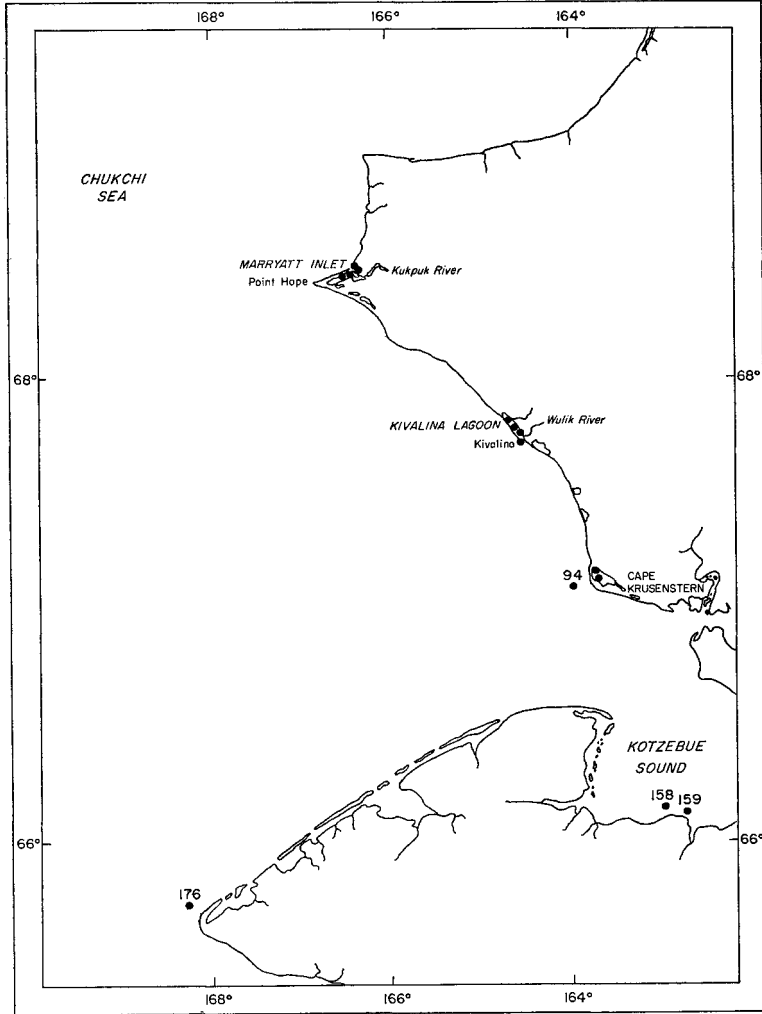
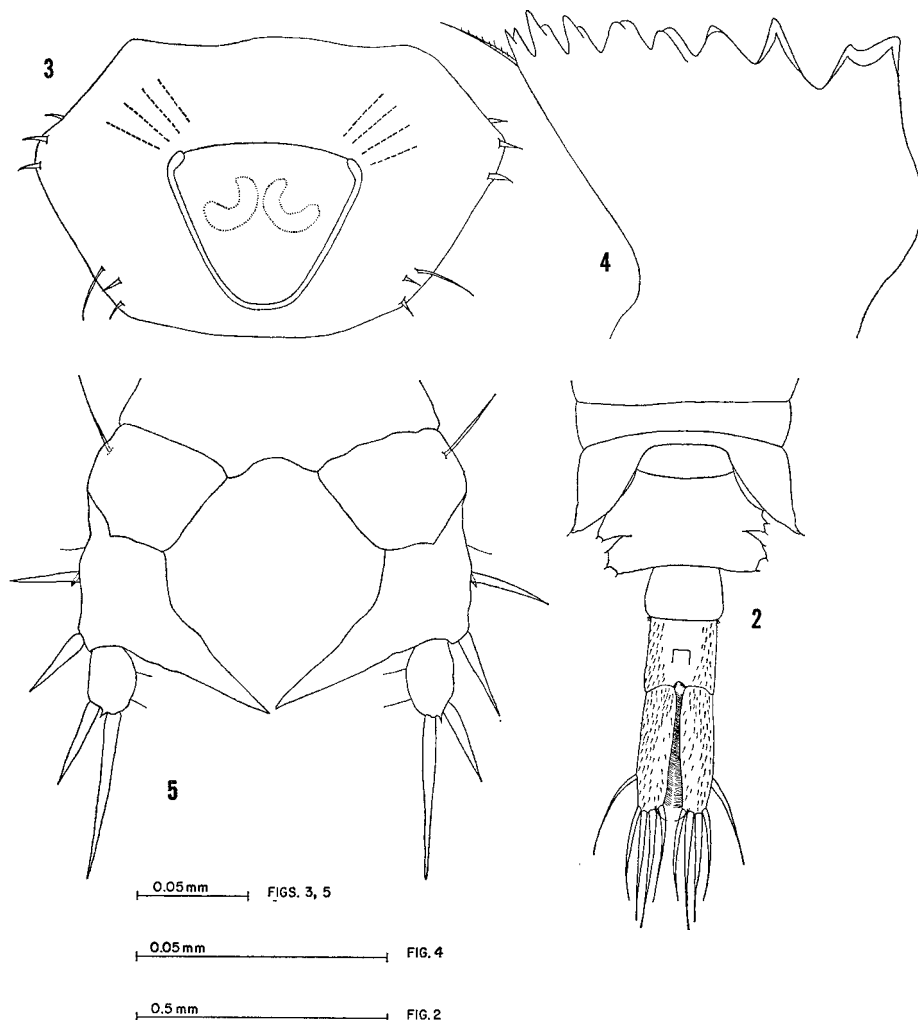


Fig. 1. Locations of plankton collections containing *Eurytemora*, near the western Alaskan coastline. The numbers refer to the stations of the Research Vessel "Brown Bear".

Aesthetes and setae stout; setation of one dissected specimen not typical of genus as described by Gurney (1931: 183); segments 13, 15, 17, and 18 of one antennule each with two setae and one aesthete; segments 15 and 18 of other antennule with two setae and one aesthete. Second dissected specimen typical except for segments 18 of both antennules, each with two setae and one aesthete.

Mandibular blade (fig. 4) with small gap between double-cusped anterior denticle and succeeding denticles.

Setation of legs 1 to 4 normal, except leg 3 of the dissected specimen anomalous having exopod 2 of one side with two inner setae, the other with the typical single inner seta.



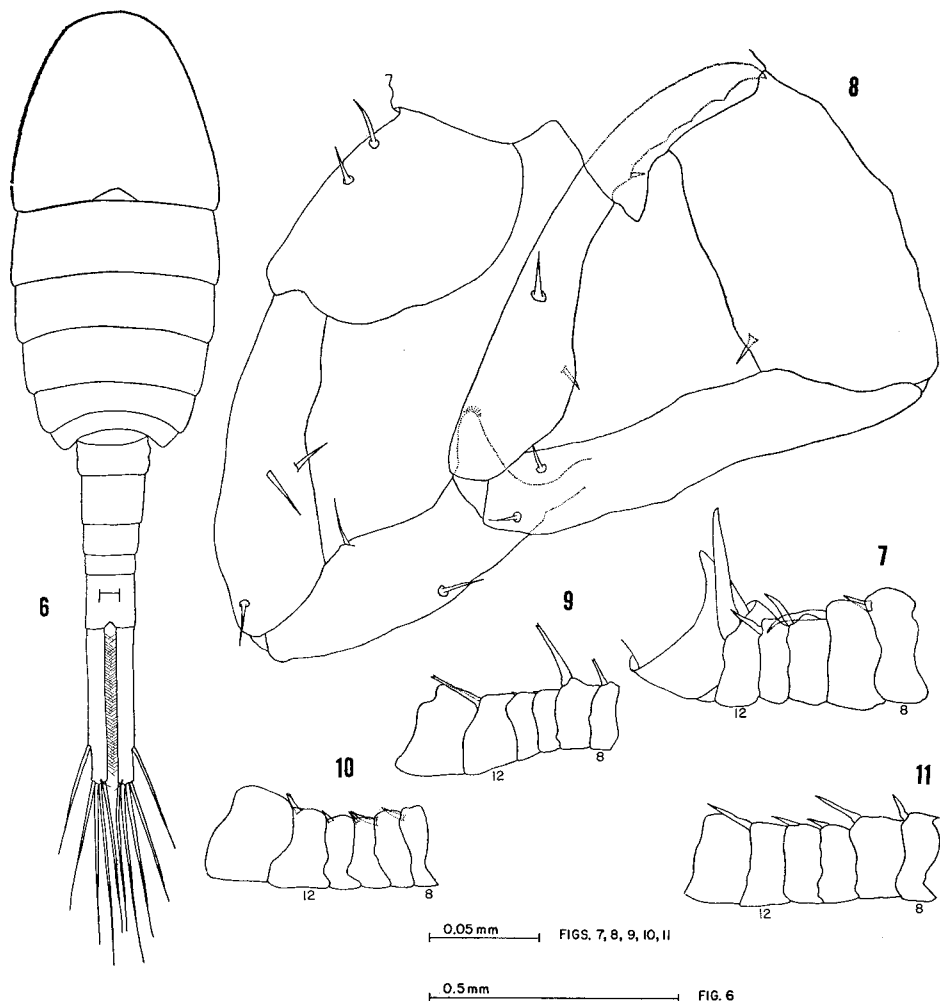
Figs. 2-5. *Eurytemora raboti* Richard. 2, metasomal segments 5 and 6 and urosome, dorsal view ♀; 3, genital segment, ventral view ♀; 4, apex of mandible blade ♀; 5, leg 5 ♀.

Leg 5 (fig. 5) with exopods (exclusive of spines) of approximately same length as basal segments. Lateral spines of exopod 1 equal in length to width of proximal part of segment; accessory spine at base of proximal spine. Inner spinous process of exopod 1, measured from inner base of exopod 2, longer than its segment (1.5 : 1); directed distally, tapering to point from broad base.

Exopod 2 with lateral spine one-half length of terminal spine; spinous point between the two spines; two hairs on inner margin.

Male. — Body length of two specimens 1.52 and 1.60 mm (exclusive of caudal setae). Dissected specimen 1.52 mm (metasome 55%, urosome 45%). Cephalic segment with medial distal protuberance. Length of caudal rami 8 times greatest width, 44% of total urosome length; inner margin with fine hairs (fig. 6). Longest caudal setae longer than caudal rami (1.13 : 1).

Antennules stout, reaching to end of metasome; setation typical, one seta and one aesthete on segment 11. Right antennule with segments 13 to 18 enlarged, pro-



Figs. 6-8. *Eurytemora raboti* Richard. 6, habitus, dorsal view ♂; 7, right antennule, segments 8-13, with detail of spines ♂; 8, leg 5, posterior view ♂. Fig. 9. *E. pacifica* Sato, right antennule, segments 8-13, with detail of spines ♂. Fig. 10. *E. gracilicauda* Akatova, right antennule, segments 8-13, with detail of spines ♂. Fig. 11. *E. foveola* Johnson, right antennule, segments 8-13, with detail of spines ♂.

portional lengths of spines on segments 8 to 12 (fig. 7): 1.0 : 2.1 : 1.5 : 1.4 : 4.2; thick spine on segment 12, as long as width of segment; proximal area of segment 19 concave, bearing row of spinules with short spine on either side.

Mandibular blade as in female.

Leg 2 of dissected specimen anomalous, with four inner setae on one exopod 3 and the typical five on the other.

Leg 5 (fig. 8) with right basal portion having a prominent distally directed triangular protuberance. Exopod 2 of right leg with spine on rounded prominence at base; inner margin irregular. Left leg with second basal segment shorter and more swollen than that of right leg. Distal portion of left exopod 2 dilated and broadly bifurcated, with each of the two lobes extending laterally to form an obtuse apex; inner portion with fine hairs; short spine on outer margin.

Remarks. — The genital segment of females from Kivalina Lagoon conforms with Richard's (1897) description. Leg 5 resembles Smirnov's (1930) supplement to Richard's description. The sample containing *Eurytemora raboti* was the one of four from the lagoon obtained closest to the Wulik River (within 100 meters).

Two copepodids in the Krusenstern sample measured: 1 female, copepodid stage IV, 0.99 mm; 1 male, copepodid stage V, 1.45 mm.

Distribution. — Spitzbergen, Novaya Zemlya, White Sea coast, Chukchi Peninsula, and north-western Alaskan coast.

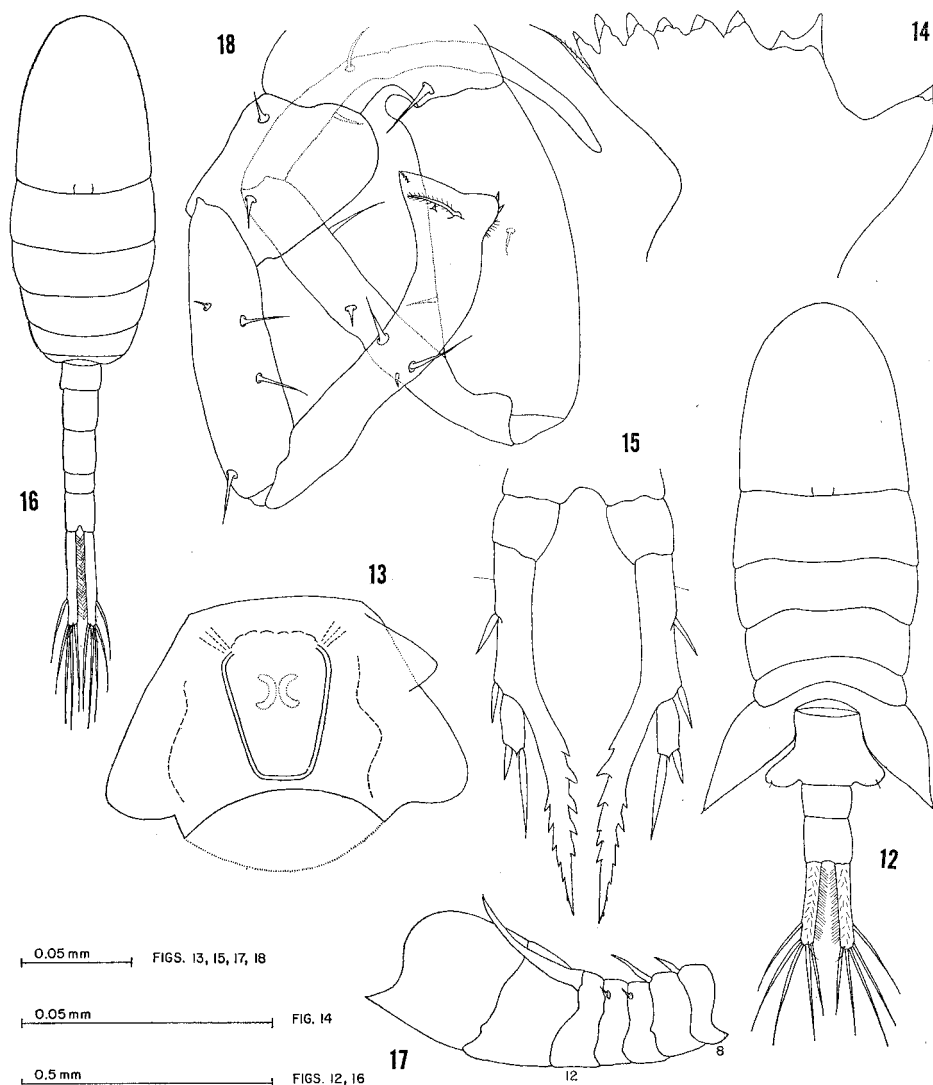
### ***Eurytemora herdmani* Thompson & A. Scott (figs. 12-18)**

*Eurytemora herdmani* Thompson & A. Scott, 1897: 78, pl. 5 figs. 1-11; Giesbrecht & Schmeil, 1898: 102; Sato, 1913: 34, pl. 6 figs. 83-86; C. B. Wilson, 1932: 112, fig. 75; Marsh, 1933: 14, pl. 8 figs. 1-3; Mori, 1937: 66, pl. 33 figs. 3-13; Brodsky, 1948: 56, pl. 13 figs. 5, 6; Jashnov, 1948: 199-200, pl. 48; Brodsky, 1950: 282, fig. 191.

Specimens examined. — Sixteen females and 21 males from the northwest coast of Alaska, and 3 females and 4 males (U.S.N.M. No. 59705, C. B. Wilson, 1923) from Woods Hole. The body length (excluding the caudal setae) of the Alaska specimens is for the females 1.05-1.36 mm (mean 1.15 mm) and for the males 1.16-1.46 mm (mean 1.23 mm); these figures are for the Woods Hole specimens, females 1.09-1.26 mm (mean 1.15 mm), males 1.19-1.26 mm (mean 1.20 mm).

Female. — Percentage of total length of each metasomal segment of an Alaskan specimen (fig. 12) 1.28 mm (metasome 62%, urosome 38%): 1 - 48%; 2 - 16%; 3 - 13%; 4 - 12%; 5 - 6%; 6 - 4%. Greatest width of metasome in segment 2, 0.37 mm; reduced to 0.30 mm in segment 5. First segment with cephalic depression and medial dorsal protuberance. Broad transparent wings, flaring out laterally from sixth segment, tapering to a point extending as far as second segment of urosome.

Percentage of total length of each urosomal segment and caudal rami: 1 - 29%; 2 - 12%; 3 - 21%; CR - 38%. Genital segment with rounded, transparent lateral



Figs. 12-18. *Eurytemora herdmani* Thompson & A. Scott. 12, habitus, dorsal view ♀; 13, genital segment, ventral view ♀; 14, apex of mandible blade ♀; 15, leg 5 ♀; 16, habitus, dorsal view ♂; 17, right antennule, segments 8-14, with details of spines ♂; 18, leg 5, posterior view ♂.

protrusions in distal portion; operculum (fig. 13) with squared apex extending distally.

Length of caudal rami 6 times width at base; dorsal surface hirsute; inner margins with long fine hairs.

Antennules 24-segmented, reaching to metasomal segment 6; order of aesthetes and setae typical for genus as described by Gurney (1931: 183); segment 11 with one seta and one aesthete.



Mandibular blade (fig. 14) with anterior denticle separated by deep groove from succeeding double-cusped denticle.

Leg 5 (fig. 15) with inner process on exopod 1 directed distally, parallel with axis of leg; process longer than total length of exopod 2 and terminal spine (1.61 : 1), measured from inner base of exopod 2; margins with stout serrations. Two lateral spines of exopod 1 as long as width of segment; one lateral hair. Exopod 2 with terminal inner spine more than twice length of lateral spine (2.27 : 1), produced to spinous point between two spines.

Male. — Body length of an Alaskan specimen (fig. 16) 1.19 mm (metasome 56%, urosome 44%). First metasomal segment with cephalic depression and medial dorsal protuberance. Caudal rami 37% of total length of urosome, length 10 times greatest width.

Antennules reaching to third segment of urosome. Right antennule 21-segmented, segments 13 to 17 enlarged; proportional lengths of spines on segments 8 to 12 (fig. 17): 3.3 : 5.3 : 1 : 1 : 14.3.

Leg 5 (fig. 18) with right second basal segment longer than left (1.91 : 1); prominent thumb-like process on proximal part of segment directed mesially. Right exopod 1 same length as and half width of basal segment 2; exopod 2 crescent-shaped, not separated into two segments but with indentations at midpoint, indicating the possibility of fused segments in specimens examined. Left exopod 2 longer than exopod 1 (1.21 : 1). Apex of exopod 2 spatulate with straight edge, both corners projected anteriorly; plumose seta and small spine on posterior surface of apex; anterior surface with two rows of fine hairs in central area, two small spines near outside margin.

Remarks. — Woods Hole and Alaskan specimens, and also Sato's (1913) description and illustrations, conform with original description, but not with C. B. Wilson's (1932) definition of the species. Brodsky's (1950) illustrations were from C. B. Wilson. Slides made of seven specimens from northwestern Alaskan coast were examined and a distinct fifth segment could not be discerned in the male fifth leg, although several specimens had indentations about midpoint on the segment similar to Sato's illustration.

Distribution. — Narragansett Bay north to Gulf of St. Lawrence; Dolphin and Union Strait, Beaufort Sea Coast; Chukchi Sea, Bering Sea; Okhotsk Sea; Sea of Japan.

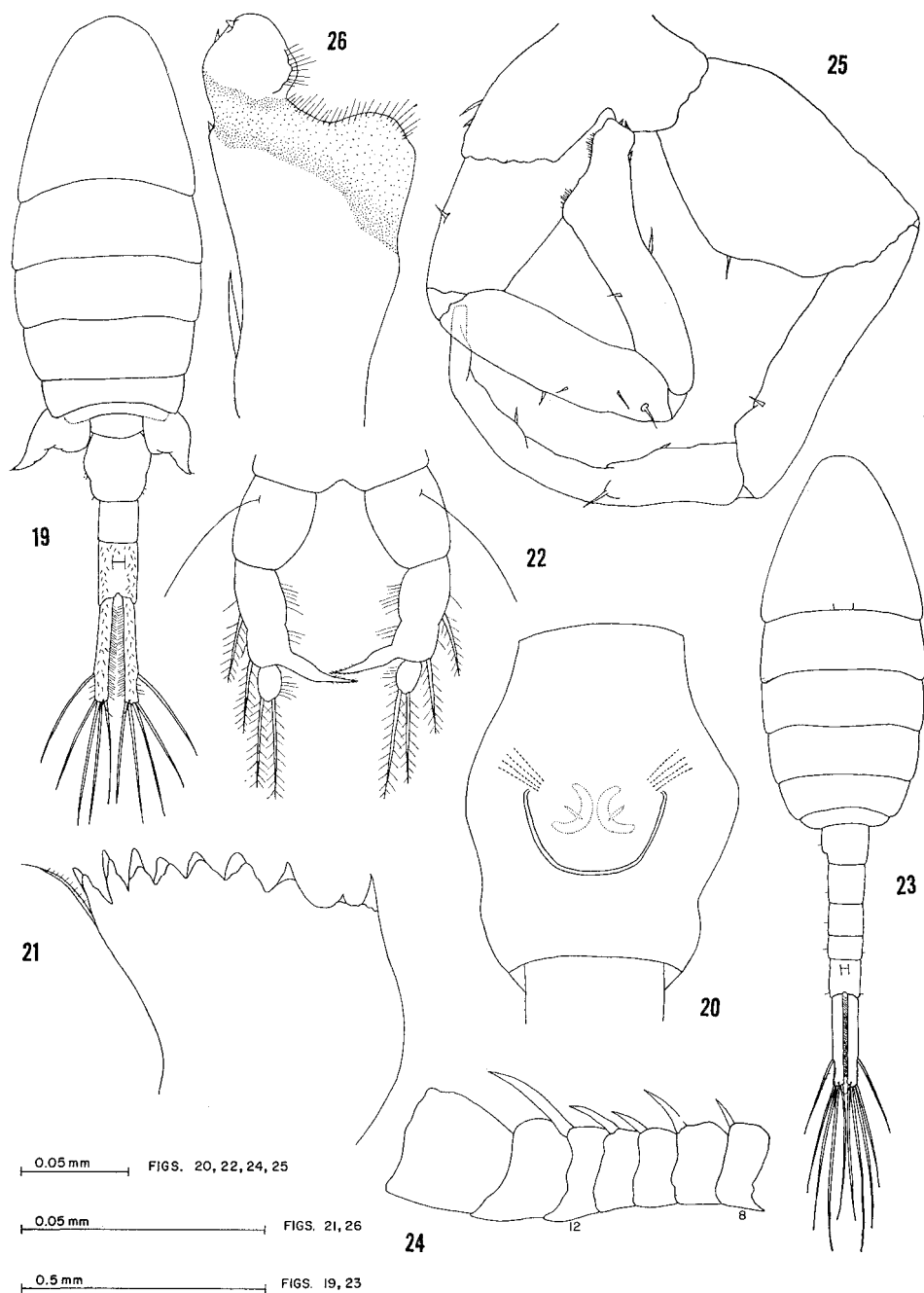
### ***Eurytemora americana* Williams (figs. 19-26)**

*Eurytemora americana* Williams, 1906: 645, figs. 8-11; Lowndes, 1932: 541, figs. 1-11; C. B. Wilson, 1932: 109, fig. 72; Gurney, 1933: 369, figs. 2048-2061; Brodsky, 1950: 284, fig. 193. *Eurytemora thompsoni* Willey, 1923: 303, fig. 7; Lowndes, 1931: 501, figs. 1-16; Brodsky, 1950: 287, fig. 195.

*Eurytemora transversalis* Campbell, 1930: 179, pl. 1 figs. 4-6; Brodsky, 1950: 288, fig. 197.

*Eurytemora kieferi* Smirnov, 1931: 194, figs. 1-6; Brodsky, 1950: 287, fig. 196.

Specimens examined. — Two females from Kivalina Lagoon and numerous specimens collected from Garrison Bay, False Bay, and Argyle Lagoon on San



Figs. 19-26. *Eurytemora americana* Williams. 19, habitus, dorsal view ♀; 20, genital segment, ventral view ♀; 21, apex of mandible blade ♀; 22, leg 5 ♀; 23, habitus, dorsal view ♂; 24, right antennule, segments 8-14, with detail of spines ♂; 25, leg 5, posterior view ♂; 26, detail of apex of left exopod of leg 5, anterior view ♂.

Juan Island, Washington. Description based on Washington specimens.

Female. — Body length of 23 specimens 1.35-1.58 mm; mean 1.43 mm (excluding caudal setae). Cephalic segment without dorsal protuberance; metasome 59%, urosome 41% of total length. Percentage of length of metasomal segments of a specimen (fig. 19) of 1.37 mm: 1 - 40%; 2 - 19%; 3 - 16%; 4 - 15%; 5 - 7%; 6 - 2%.

Wings of sixth segment with inner rounded lobe slightly dorsal to acutely pointed tip. Left wing slightly larger than right; wing angle varying between right and left as well as between individuals, extending beyond middle of genital segment.

Percentage of total length of segments of urosome and caudal rami: 1 - 24%; 2 - 16%; 3 - 21%; CR - 38%. Genital segment with slight asymmetrical constriction in posterior third; considerable variability between individuals; operculum (fig. 20) with short rounded flap overlying area of receptacula. Closely set spinules on dorsal surface of segment 3, except in medial portion. Dorsal surface of caudal rami spinulose; fine hairs on inner margin; length about 7 times width.

Antennules 24-segmented, reaching to middle of metasomal wing; setation typical for the genus as described by Gurney (1931: 183); segment 11 with one seta, and segment: 2.9 : 2.6 : 1.

Mandibular blade (fig. 21) with two translucent sharp cusps on first denticle, small gap followed by second denticle with translucent cap.

Leg 5 (fig. 22) with second basal segment with fine seta longer than segment (1.5 : 1). Exopod 1 elongated, constriction about midway on segment; two lateral, flexible, plumose setae, longer than width of segment (1.38 : 1); two lateral hairs; inner margin with fine long hairs. Inner process curved, shorter than exopod (0.70 : 1) measured from inner margin of segment; distal half of process setose, tapering to fine point. Terminal segment bearing two long, flexible, plumose setae; fine hairs on inner margin. Relative lengths of terminal seta, lateral seta, and segment: 2.9 : 2.6 : 1.

Male. — Body length of 30 male specimens 1.22-1.43 mm (exclusive of caudal setae), mean 1.26 mm; cephalic segment with medial distal protuberance. Relative lengths of metasome, urosome, and caudal rami of specimen (fig. 23) 1.30 mm: 3.4 : 1.7 : 1.

Length of caudal rami 7 times width; fine hairs on inner margins; caudal setae longer than caudal rami (1.78 : 1).

Antennules reach to urosomal segment 4. Right antennule stout, segments 13 to 16 enlarged; relative length of spines on segments 8 to 12 (fig. 24): 1 : 1.7 : 1.2 : 1.6 : 3.1, each shorter than width of segment except 12, which is slightly longer.

Mandibular blade as in female.

Leg 5 (fig. 25) with swelling on inner right second basal segment; right exopod 1 long and slender. Exopod 2 falcate; inner margin irregular, with small spines. Left leg having inner second basal segment with proximal swelling; exopod 1

slender. Apical portion of exopod 2 slightly dilated; bulbous expansion with two small spines and fine hairs, projecting at distal outer margin of concavity on anterior surface (fig. 26).

Remarks. — *Eurytemora americana* specimens from North American west coast are similar to Gurney's (1933) description of *E. americana*. Gurney placed *E. thompsoni* Willey, *E. transversalis* Campbell, and *E. kieferi* Smirnov in synonymy with *E. americana*. This synonymy was substantiated by Jespersen (1940) and Fontaine (1955). Washington and Alaskan specimens agree with Campbell's (1930) description of *E. transversalis*; they correspond with descriptions by Smirnov (1931) and Lowndes (1931), except for hairs on setae and exopods of female leg 5. The hairs were not visible to the author without a stain or with methyl blue; they were distinguishable when stained with acid fuchsin and mounted in euparal. Williams (1906) described male leg 5 of *E. americana* with both rami 5-segmented, but all of his illustrations of *E. americana* suggest the possibility of inaccuracy.

Distribution. — Narragansett Bay to Ungava Bay; northern Icelandic coast; southern British coast; San Juan Island, Washington northward to Point Barrow area; western Bering Sea; Sea of Okhotsk.

### ***Eurytemora pacifica* Sato (fig. 9)**

*Eurytemora pacifica* Sato, 1913: 34, pl. 7 figs. 87-89; Smirnov, 1931: 199, fig. 7; Brodsky, 1948: 55, pl. 12 fig. 7, pl. 13 figs. 1-4; Brodsky, 1950: 281, fig. 190; Chiba, 1952: 63, figs. 1-10; Johnson, 1961: 317, figs. 7-10.

*Eurytemora johanseni* Willey, 1920: 13, figs. 5-7, 9, 11-13; Marsh, 1933: 16, pl. 8 figs. 4, 7.

Specimens of adult female *Eurytemora pacifica* varied considerably in the development of metasomal wings (Johnson, 1961). A complete examination of all characters was made and no difference was observed. Specimens without wings appeared more robust, with left metasomal lobe slightly larger; none was ovigerous; about one-fourth had spermatophores. The only ovigerous females were a few of the winged females in the lagoons. Body length (excluding caudal setae) of 29 males 0.99-1.16 mm. Of the females the length is as follows: offshore stations, 7 specimens with wings 0.99-1.19 mm, 13 specimens without wings 1.05-1.29 mm; Kivalina Lagoon, Marryatt Inlet, 60 specimens with wings 1.06-1.46 mm, 29 specimens without wings 1.12-1.33 mm.

### ***Eurytemora gracilicauda* Akatova (fig. 10)**

*Eurytemora gracilicauda* Akatova, 1949: 341, fig. 5 a-d.

Total length (excluding caudal setae) of three males 1.16-1.33 mm.

Akatova described only the female from lakes of the Kolyma River watershed in northeastern Siberia.

The males from Krusenstern Lagoon have been identified by M. S. Wilson. She states (personal communication) that the species is widely distributed in western Alaska and that a description of both sexes is being prepared.

**Eurytemora foveola** Johnson (fig. 11)

*Eurytemora foveola* Johnson, 1961: 317, figs. 3-6, 11-18.

Total length (excluding caudal setae) of four females 1.12-1.22 mm.

In correspondence, Dr. Johnson stated that the outer spine on exopod 3 of female leg 1 was inadvertently omitted when his original drawing was traced for publication. He agreed that exopod 3 of female leg 1 should have four inner setae, that female leg 4 should have five setae on exopod 3 and five setae on endopod 2, as is normal for the genus.

## ACKNOWLEDGEMENTS

I am particularly indebted to Mrs. Mildred S. Wilson, Arctic Health Research Center, Anchorage, Alaska, for critical reading and discussion of the manuscript; Dr. Paul Illg, Department of Zoology, University of Washington, Seattle, provided one of the San Juan Island samples and offered helpful suggestions; Dr. Thomas E. Bowman, U. S. National Museum, Washington, D.C., arranged the loan of specimens from the National Museum. Assistance of members of the Department of Oceanography, University of Washington, is gratefully acknowledged; Robert W. Owen collected the plankton samples in Alaska, David M. Damkaer translated several Russian references, and Dr. Karl Banse gave encouragement during preparation of the manuscript.

## ZUSAMMENFASSUNG

*Eurytemora herdmani* Thompson & A. Scott und *E. pacifica* Sato, bekannt aus dem Ozean und dem Brackwasser, werden aus Nordwest-Alaska aus offener See, Haffen und Strandseen gemeldet. Die Brackwasserarten *E. raboti* Richard (neu für Nordamerika), *E. americana* Williams, *E. composita* Keiser, *E. gracilicauda* Akatova und *E. foveola* Johnson sind in Strandseen Alaskas gefunden worden. *E. herdmani*, *E. raboti* und *E. americana* werden nachbeschrieben. *E. americana* ist neu für die San Juan Insel, Washington.

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