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Copepods of the family Oncaeidae (Crustacea: Poecilostomatoida) in the northeast Pacific Ocean and inland coastal waters of Washington State

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Abstract.—Thirty species of the poecilostome copepod family Oncaeidae are recorded from zooplankton samples collected in deep water from the northeast Pacific Ocean and inland coastal waters of Washington State. Seven new species of *Oncaea* are described (*O. canadensis, O. thoresoni, O. insolita, O. rotata, O. grossa, O. rimula,* and *O. glabra*) and males of five species for which only females were previously described (three *Oncaea,* one *Epicalymma,* and one *Conaea*) are identified and characterized. Comparisons are made of several northeast Pacific species which have also been recorded from the Arctic Ocean, Antarctic Ocean, and waters around New Zealand. Keys are provided for the three Oncaeidae genera included in this study and for the 23 species of *Oncaea,* 4 species of *Epicalymma,* and 3 species of *Conaea.*

In many areas of the oceans, at subsurface depths, the marine zooplankton is dominated numerically by a diverse assemblage of species of the poecilostome copepod family Oncaeidae (Shmeleva 1966, 1968, 1969, Ferrari 1975, Boxshall 1977, Heron 1977, Heron et al. 1984, Heron & Bradford-Grieve 1995, Böttger-Schnack 1995, 1997, 1999).

In this study, 30 species of oncaeid copepods from the northeast Pacific Ocean and inland waters of Puget Sound, Washington, are recorded and discussed. Descriptions are provided for seven new species and for males of five species for which only the females were previously known. Distinguishing characters of similar species are presented and illustrated. Species of the oncaeids can be relatively difficult to identify and consequently considerable confusion exists in the literature about species diversity of the group. A number of sibling species and species groups have sometimes been designated as forms without sufficient definition for subsequent identification.

Several of the northeast Pacific area oncaeids treated here have also been recorded and studied in collections from other regions: southwest Pacific-Antarctic area (14 species: Heron 1977), Arctic Ocean, Canadian Basin, (8 species: Heron et al. 1984), and the New Zealand area (6 species: Heron & Bradford-Grieve 1995). These observations have considerable biogeographic significance.

Materials and Methods

The copepods discussed in this study were sorted from 80 zooplankton samples collected at oceanic and coastal sites in the northeast Pacific Ocean (Table 1). Oceanic samples were obtained from three areas. One large sample was collected at former Ocean Weather Station P (50°N, 145°W) in the central Gulf of Alaska by hauling a net (0.5-m mouth diameter, 216 μm mesh) vertically from 3000 m to the surface. Three additional zooplankton samples from the Gulf of Alaska were collected at a station to the northeast (Station Q: 51°N, 137°W); an opening-closing Tucker Trawl (Hovecamp 1989) fitted

with plankton nets of 333 μm mesh was used to sample between 360 and 480 m depth. Oceanic waters off Canada, Oregon, and Washington were sampled at various times using a zooplankton net (110 μm mesh) described by Heron & Damkaer (1978). These samples are designated OP (Open Pacific) in Table 1. Oncaeids were also studied from the Strait of Juan de Fuca, Dabob Bay, and Puget Sound, Washington, sorted from 29 zooplankton samples collected for other projects. These samples, designated IW (Inland Waters) in Table 1, were collected in vertical net hauls (1-m mouth diameter; mesh size 73 to 333 μm).

A few additional samples were employed in this study. Audun Fosshagen, Universitetet i Bergen, provided specimens of *Oncaea englishi* collected from Sognefjorden, Norway (61°08′27″N, 5°49′45″E), on 5 May 1966 (1250–0 m), and recently loaned us a sample containing *O. similis* and *Epicalymma vervoorti,* collected from Sognefjorden on 6 Dec 1982 (800–500 m). Specimens of two of the new species of *Oncaea* were also collected in a sample from Prince William Sound, Alaska, 10 Apr 1975, 735–520 m (provided by Douglas B. Dey, NOAA, NMFS, Seattle).

Copepod total length (TL), cephalosome anterior margin to the caudal ramus posterior margin, was measured on glycerine-mounted specimens; in many instances the urosome was flexed and the measurement of the prosome length (PL), anterior to posterior margin, is more useful for comparisons. If TL and PL measurements are not specified below, the size noted refers to the total length. As will be evident, in most instances the length of each sex of a particular species is similar throughout the geographical range of the species.

Figures were drawn with the aid of a Wild M20 drawing tube. In the figure legends, the capital letter following the explanation of each figure indicates the 0.1 mm scale at which the figure is shown; these scales are illustrated in Figs. 3, 4, 5, and 10. Specimens were stained by a solution of solophenyl blue 2RL dissolved in lactic acid, facilitating the observation of small or hyaline elements and sclerotized areas (English and Heron 1976). Details describing setule and spinule ornamentation of setae and spines, when obvious on figures, has not been included in the text. Type and reference specimens described in this report have been deposited in the National Museum of Natural History (USNM), Smithsonian Institution, Washington, D.C. and National Institute of Water and Atmospheric Research (NIWA), Wellington, New Zealand.

Swimming legs are illustrated in anterior view. Armature of the swimming legs is represented as: Arabic numerals (setae), Roman numerals (spines), Si, Se, St (seta or spine on the inner, outer, or terminal border of a segment). The phrase "spine set" of *Oncaea* species refers to the combination of the lengths, shapes, and position of the three or two terminal spines on the endopods of swimming legs 2–4.

Distribution records of other authors are not included unless sufficient description of specific identifying characteristics was provided.

Poecilostomatoida Thorell, 1859
Oncaeidae Giesbrecht, 1892

Based on a cladistic analysis, Huys & Böttger-Schnack (1997) concluded that the family Oncaeidae comprised only three of formerly described genera: *Oncaea* Philippi, 1843, *Conaea* Giesbrecht, 1891, and *Epicalymma* Heron, 1977, plus their new genus, *Archioncaea.* In the family Oncaeidae, the female urosome has five segments plus the caudal ramus while the male urosome has six segments plus the caudal ramus. The male rostral area and mouthparts are similar to those of the female, except for the first antenna and maxilliped, which typically are sexually dimorphic. In the male first antenna, segments corresponding to the terminal three of the female are fused into one segment; armature is similar to the cor-

responding segments of the female, except for absence of the distal seta on the third segment. The male maxilliped is three-segmented, lacking the small segment proximal to the claw of the female. Leg 6 is sexually dimorphic.

Conspicuous similarities and differences between species of the genera *Oncaea, Epicalymma,* and *Conaea,* considered in this study, are summarized in Table 2.

Key to genera of Oncaeidae in northeast Pacific and inland Washington waters

1a. Caudal ramus with expansion on dorsal surface, surrounding insertion of dorsal seta; leg 4 exopod with outer spine formula I, 0, I 2
1b. Caudal ramus without notable expansion on dorsal surface; leg 4 exopod with outer spine formula I, I, II; legs 1–3 exopod segment 3 with outer spine formula III, III, II ..... *Oncaea*
2a. Legs 1–3 exopod segment 3 with outer spine formula III, II, II ..... *Conaea*
2b. Legs 1–3 exopod segment 3 with outer spine formula II, III, III .... *Epicalymma*

Genus *Oncaea* Philippi, 1843

In some instances a number of species of *Oncaea* with distinctive characters, such as a dorsoposterior projection on pediger 2, an elongate leg 5, or a less than distinctive pattern of endopod terminal conical projections (cones) or spines for swimming legs 2–4, have caused confusion for discriminating the species from one another. Terminal spines on the endopods of swimming legs 2–4 are important diagnostic characters, usually when considered in addition to a combination of other distinguishing characters. Although the "spine set" may assist in making an identification, it can also cause confusion, when many species have a similar spine set, as shown by figures of terminal endopod spines of legs 2–4 for *Oncaea* species of the northeast Pacific and Washington waters (Figs. 1, 2).

Previously, females of eight *Oncaea* species were recognized as having both a dorsoposterior projection on pediger 2 plus a terminal cone on leg 4 endopod between the subterminal and terminal spines: *O. conifera* Giesbrecht, *O. borealis* Sars, *O. antarctica* Heron, *O. inflexa* Heron, *O. furcula* Farran, *O. quadrata* Heron & Bradford-Grieve, *O. derivata* Heron & Bradford-Grieve, and *O. redacta* Heron & Bradford-Grieve. Herein we describe two new species possessing these characters: *O. canadensis* and *O. thoresoni.*

Böttger-Schnack (1999) recently redescribed *Oncaea rufa* Boxshall & Böttger, 1987, with the female having a dorsoposterior projection on pediger 2, and she assigned the species to a new genus as *Triconia rufa.* She proposed that the new genus *Triconia* should include all *Oncaea* species where the legs 2–4 endopods of females and males have a conical projection between the terminal and subterminal spines; she also proposed incorporating all *Oncaea* females with a dorsoposterior projection on pediger 2, as well as several species without the projection, in the new genus. Undoubtedly the numerous species in the genus *Oncaea* should and will eventually be distributed among a number of new genera. We do not agree, however, that the generic definition of *Triconia* is sufficient to justify inclusion of all of the divergent species she assigned to the new genus.

Females of four *Oncaea* species with an elongate leg 5 were found in Antarctic samples (Heron 1977) and three of these species also occur in northeast Pacific-Washington waters (*O. damkaeri* Heron, *O. parila* Heron, and *O. prolata* Heron) in addition to the new species, which is a sibling species of *O. prolata.*

Closely related species with similar features must be separated by considering a combination of morphological characters, including size, lateral and dorsal profiles (including the angle of pediger 4 lateroposterior corner) labrum external form and ornamentation, and the shapes and sizes of the terminal endopod spines and cones of

Table 1.—Sample locations for Oncaeidae specimens (OP: open North Pacific; IW: inland coastal waters of Washington state).

Sample	Vessel	Cruise	Station	Date	Location	Depth (m)
P1	*Thompson*	TT082	P	8 Aug 73	49°56′N, 144°54′W	3000–0
Q 2	*Thompson*	TT091	Q	20 Jul 74	51°N, 137°W	420–360
Q 3	*Thompson*	TT091	Q	20 Jul 74	51°N, 137°W	480–420
Q 4	*Thompson*	TT091	Q	21 Jul 74	51°N, 137°W	480–420
OP5	*Brown Bear*	344	4	19 May 64	47°33′N, 126°48′W	1800–0
OP6	*Brown Bear*	344	5	20 May 64	47°33′N, 128°22′W	2128–0
OP7	*Brown Bear*	344	7	21 May 64	47°34′N, 130°12′W	2000–0
OP8	*Brown Bear*	344	9	22 May 64	47°44′N, 132°29′W	2000–0
OP9	*Brown Bear*	344	11	23 May 64	47°44′N, 134°55′W	2536–0
OP10	*Brown Bear*	344	17	26 May 64	49°17′N, 143°03′W	4650–0
OP11	*Brown Bear*	344	18	27 May 64	49°42′N, 144°16′W	1800–0
OP12	*Brown Bear*	344	19	27 May 64	49°56′N, 144°54′W	4014–0
OP13	*Brown Bear*	344	21	28 May 64	47°49′N, 144°57′W	4306–0
OP14	*Brown Bear*	344	25	30 May 64	45°17′N, 141°48′W	4500–0
OP15	*Brown Bear*	344	26	31 May 64	45°15′N, 132°44′W	2000–0
OP16	*Brown Bear*	344	29	1 Jun 64	45°23′N, 135°56′W	3500–0
OP17	*Brown Bear*	344	31	2 Jun 64	45°15′N, 132°44′W	3183–0
OP18	*Brown Bear*	344	35	4 Jun 64	45°29′N, 126°58′W	2750–0
OP19	*Brown Bear*	349	25	24 Aug 64	45°19′N, 132°26′W	1800–0
OP20	*Brown Bear*	349	26	24 Aug 64	45°21′N, 134°34′W	4000–0
OP21	*Brown Bear*	352	10	16 Jan 65	47°57′N, 135°33′W	2000–0
OP22	*Brown Bear*	352	12	17 Jan 65	48°29′N, 138°22′W	2000–0
OP23	*Brown Bear*	352	16	22 Jan 65	45°13′N, 136°04′W	3500–0
OP24	*Brown Bear*	352	16	22 Jan 65	45°13′N, 136°04′W	4150–0
OP25	*Brown Bear*	352	20	25 Jan 65	45°22′N, 128°10′W	2000–0
OP26	*Brown Bear*	352	21	26 Jan 65	45°27′N, 126°33′W	2750–0
OP27	*Brown Bear*	357	19	20 Apr 65	45°17′N, 138°34′W	4000–0
OP28	*Brown Bear*	357	19	20 Apr 65	45°17′N, 138°34′W	4150–0
OP29	*Brown Bear*	357	22	22 Apr 65	47°59′N, 139°58′W	4000–0
OP30	*Brown Bear*	368	20	10 Aug 65	45°22′N, 128°36′W	2700–0
OP31	*Brown Bear*	368	21	11 Aug 65	45°21′N, 129°53′W	2750–0
OP32	*Brown Bear*	368	23	12 Aug 65	45°20′N, 132°28′W	2000–0
OP33	*Brown Bear*	368	25	13 Aug 65	45°20′N, 134°56′W	2000–0
OP34	*Brown Bear*	368	28	14 Aug 65	45°17′N, 139°09′W	4250–0
OP35	*Brown Bear*	368	30	15 Aug 65	46°20′N, 139°50′W	4200–0
OP36	*Brown Bear*	368	31	16 Aug 65	47°05′N, 139°51′W	2000–0
OP37	*Brown Bear*	368	32	16 Aug 65	47°58′N, 139°44′W	4000–0
OP38	*Brown Bear*	368	33	17 Aug 65	47°58′N, 139°44′W	4000–0
OP39	*Brown Bear*	368	35	18 Aug 65	47°47′N, 137°28′W	2250–0
OP40	*Brown Bear*	368	36	18 Aug 65	47°47′N, 135°34′W	3700–0
OP41	*Brown Bear*	368	37	18 Aug 65	47°43′N, 134°17′W	2000–0
OP42	*Brown Bear*	368	38	19 Aug 65	47°33′N, 132°32′W	3000–0
OP43	*Brown Bear*	368	39	20 Aug 65	47°42′N, 131°02′W	2000–0
OP44	*Brown Bear*	368	40	20 Aug 65	47°55′N, 129°09′W	1967–0
OP45	*Brown Bear*	368	41	21 Aug 65	48°07′N, 127°25′W	2000–0
OP46	*Brown Bear*	380	11	9 Nov 65	47°37′N, 139°06′W	4100–0
OP47	*Brown Bear*	380	13	10 Nov 65	45°32′N, 139°48′W	4650–0
OP48	*Oshawa*	6	11	21 Oct 64	47°20′N, 139°12′W	700–0
OP49	*Oshawa*	6	11	21 Oct 64	47°20′N, 139°12′W	2500–0
OP50	*Oshawa*	6	12	22 Oct 64	45°20′N, 139°06′W	2250–0
OP51	*Oshawa*	6	12	22 Oct 64	45°20′N, 139°06′W	4200–0
IW52	*Commando*	J. de Fuca Strait		23 Feb 76	48°26′N, 124°30′W	102–50
IW53	*Commando*	J. de Fuca Strait		24 Feb 76	48°26′N, 124°30′W	176–100
IW54	*Commando*	J. de Fuca Strait		5 Apr 76	48°26′N, 124°30′W	250–100

Table 1.—Continued.

Sample	Vessel	Cruise	Station	Date	Location	Depth (m)
IW55	*Commando*	J. de Fuca Strait		6 Apr 76	48°26′N, 124°30′W	185–100
IW56	*Snow Goose*	J. de Fuca Strait		28 Jun 76	48°26′N, 124°30′W	50–25
IW57	*Snow Goose*	J. de Fuca Strait		11 Jan 77	48°26′N, 124°30′W	180–100
IW58	*Snow Goose*	J. de Fuca Strait		23 Feb 77	48°26′N, 124°30′W	180–100
IW59	*Snow Goose*	J. de Fuca Strait		6 Apr 77	48°26′N, 124°30′W	180–100
IW60	*Snow Goose*	J. de Fuca Strait		6 Apr 77	48°26′N, 124°30′W	230–100
IW61	*Snow Goose*	J. de Fuca Strait		26 Jul 77	48°26′N, 124°30′W	180–100
IW62	*Hoh*	Puget Sound		7 May 71	47°44′N, 122°25′W	200–0
IW63	*Hoh*	Puget Sound		10 Apr 72	47°44′N, 122°25′W	200–0
IW64	*Hoh*	Puget Sound		29 Mar 73	47°44′N, 122°25′W	200–0
IW65	*Hoh*	Puget Sound		2 Jul 73	47°44′N, 122°25′W	200–0
IW66	*Hoh*	Puget Sound		8 Jul 73	47°44′N, 122°25′W	200–0
IW67	*Hoh*	Puget Sound		16 Jul 73	47°44′N, 122°25′W	200–0
IW68	*Hoh*	Puget Sound		23 Jul 73	47°44′N, 122°25′W	200–0
IW69	*Hoh*	Puget Sound		13 Aug 73	47°44′N, 122°25′W	200–0
IW70	*Hoh*	Puget Sound		23 Aug 74	47°44′N, 122°25′W	250–0
IW71	*Hoh*	Puget Sound		24 Apr 75	47°44′N, 122°25′W	15–0
IW72	*Hoh*	Dabob Bay		21 Jul 76	47°45′N, 122°50′W	105–0
IW73	*Hoh*	Dabob Bay		7 Jul 77	47°45′N, 122°50′W	184–0
IW74	*Hoh*	Dabob Bay		16 Sep 82	47°45′N, 122°50′W	105–0
IW75	*Hoh*	Dabob Bay		25 Apr 85	47°45′N, 122°50′W	180–0
IW76	*Hoh*	Dabob Bay		26 Apr 85	47°45′N, 122°50′W	180–0
IW77	*Hoh*	Dabob Bay		20 Jun 85	47°45′N, 122°50′W	180–0
IW78	*Hoh*	Dabob Bay		24 Jun 85	47°45′N, 122°50′W	180–0
IW79	*Hoh*	Dabob Bay		22 Oct 85	47°45′N, 122°50′W	110–0
IW80	*Hoh*	Dabob Bay		5 Feb 91	47°45′N, 122°50′W	110–0

legs 2–4. *Oncaea* species characteristically have a cone between the terminal and subterminal spines on the endopods of legs 2 and 3, and, for some species, also leg 4. The size of these cones varies slightly among specimens of a species, while the relative shape and position of the spines remain constant. The cones are incompletely sclerotized at the terminal or subterminal region and support an integumental pore (Bersano & Boxshall 1994).

Recently some investigators have described and illustrated an *Oncaea* female gonopore with a small spiniform process, or minute spinule, in addition to the usual leg 6 setule or seta. There are several layers of overlapping chitinous bands surrounding the insertion of the leg 6 setule (or seta) which complicate interpretation of morphology. On some specimens the possibility of an additional thin spinule or small protuberance can be surmised, but it is never apparent on both right and left gonopores or consistently on other specimens of the same species for any of the *Oncaea* specimens in our collection.

Males of most species of *Oncaea* are difficult to identify. Several species with a distal cone on leg 4 endopod also have a pattern of very small cuticular pores on the lateral surfaces of the cephalosome, illustrated when visible, which may be useful to assist in preliminary identification of species; often the pores are difficult to discern and may be dissimilar on left and right sides.

Oncaea canadensis, new species
Figs. 1A, 3, 4, 5

Type material.—Holotype female, 1.52 mm, USNM 243731 (type locality, northeast Pacific Ocean); allotype male, 1.18 mm, USNM 243732; 20 paratypes, USNM

Table 2.—Relative characteristics of northeast Pacific Ocean genera of *Oncaea, Epicalymma,* and *Conaea* (Sp = spine; Se = seta).

Species	♀ Pediger 2 with dorsal projection	Antenna 2 with reduced inner seta	Labrum with at least one ventral tooth	Mandible with denticles	Mandible with setules	Maxilla 2 with elongate distal seta	♀ Maxilliped segment 2 with			Legs 2–4 endopod seg. 3 without cone	Leg 4 endopod seg. 3 with cone	Leg 4 endopod seg. 3 with			Leg 5			
															Segmented		Fused	
							SpSp	SeSp	SeSe			3 Sp	2 Sp	1 Sp	♀	♂	♀	♂
O. canadensis	+			+			+				+	+			+			+
O. thoresoni	+			+			+				+	+			+			+
O. derivata	+			+			+				+	+			+			+
O. redacta	+			+			+				+	+			+			+
O. borealis	+			+			+				+	+			+			+
O. similis				+			+				+	+			+			+
O. insolita		+		+			+				+	+			+			+
O. illgi				+			+					+					+	+
O. rotata				+			+					+			+			+
O. brocha			+	+			+					+					+	+
O. olsoni			+	+			+					+			+			+
O. damkaeri			+	+			+					+			+	+		
O. parila		+	+	+			+					+			+	+		
O. prolata		+	+	+			+					+			+	+		
O. grossa		+	+	+			+					+			+			+
O. rimula					+	+		+				+			+	+		
O. macilenta					+	+		+				+			+	+		
O. glabra					+	+		+				+			+	+		
O. lacinia					+	+		+				+					+	+
O. ovalis					+		+					+					+	+
O. ornata		+	+		+		+						+				+	+
O. englishi		+	+		+		+						+				+	+
O. subtilis			+		+		+						+				+	+
E. schmitti		+	+		+		+			+			+				+	+
E. umbonata		+	+		+				+	+			+				+	+
E. vervoorti		+	+		+		+			+			+				+	+
E. exigua		+	+		+		+			+			+				+	+
C. rapax		+	+		+			+		+				+			+	+
C. succurva		+	+		+			+		+				+			+	+
C. hispida		+	+		+			+		+				+			+	+

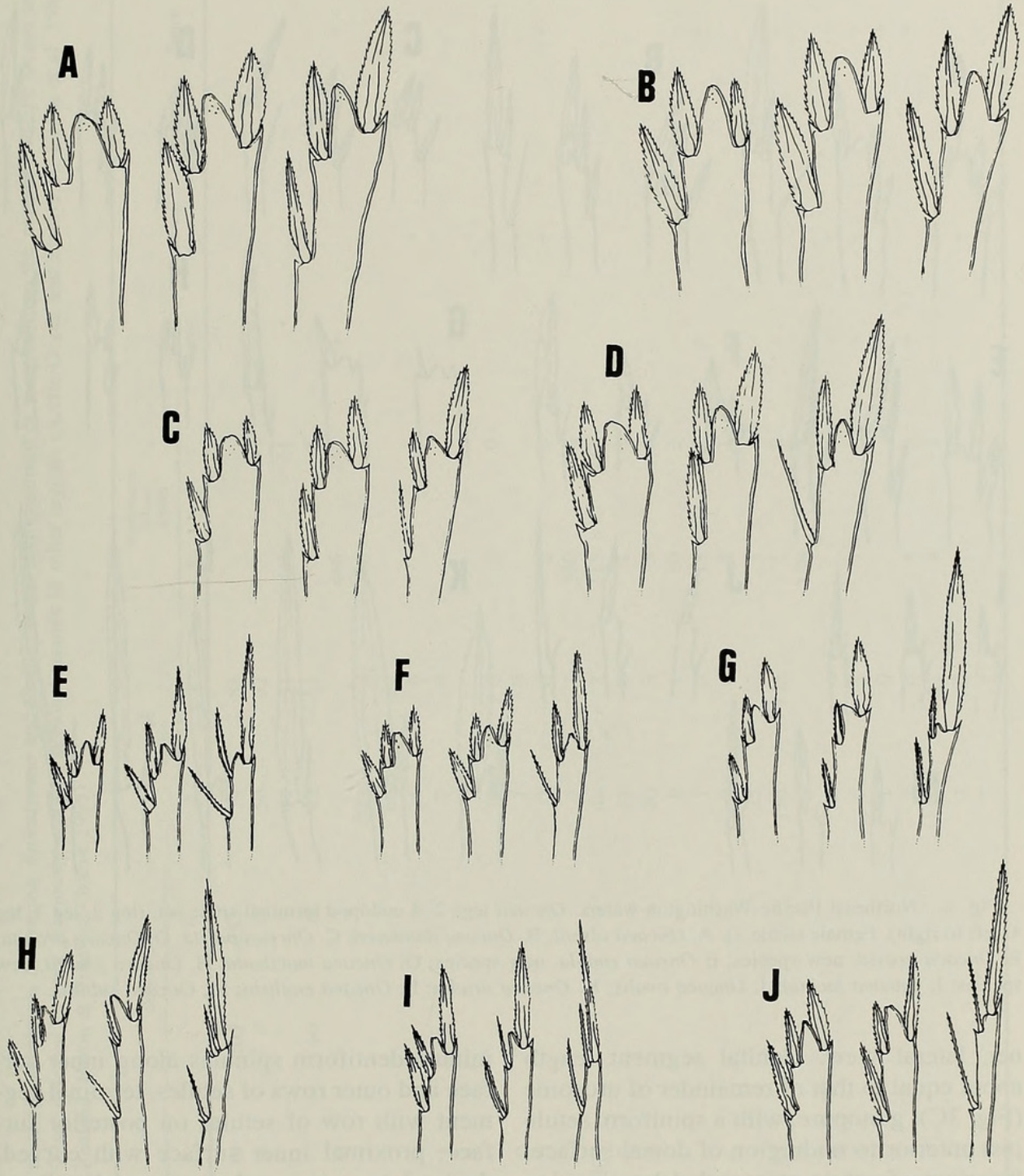

Fig. 1. Northeast Pacific-Washington waters: *Oncaea* legs 2–4 endopod terminal spine set, (leg 2, leg 3, leg 4, left to right). Female, (scale x): A, *Oncaea canadensis,* new species; B, *Oncaea thoresoni,* new species; C, *Oncaea derivata*; D, *Oncaea redacta*; E, *Oncaea borealis*; F, *Oncaea similis*; G, *Oncaea insolita,* new species; H, *Oncaea illgi*; I, *Oncaea rotata,* new species; J, *Oncaea brocha.*

243733 (10 females, 10 males): *Thompson* Sta P, 8 Aug 1973, 3000–0 m.

Material examined.—See Table 3.

Female.—Mean lengths of 20 specimens: TL 1.47 mm (1.37–1.55 mm), PL 1.01 mm (0.93–1.07 mm). Body (Fig. 3A–B) robust, exoskeleton heavily sclerotized. Prosome about twice as long as urosome; pediger 2 with dorsoposterior projection in lateral view; pediger 4 with rounded posterior cor-

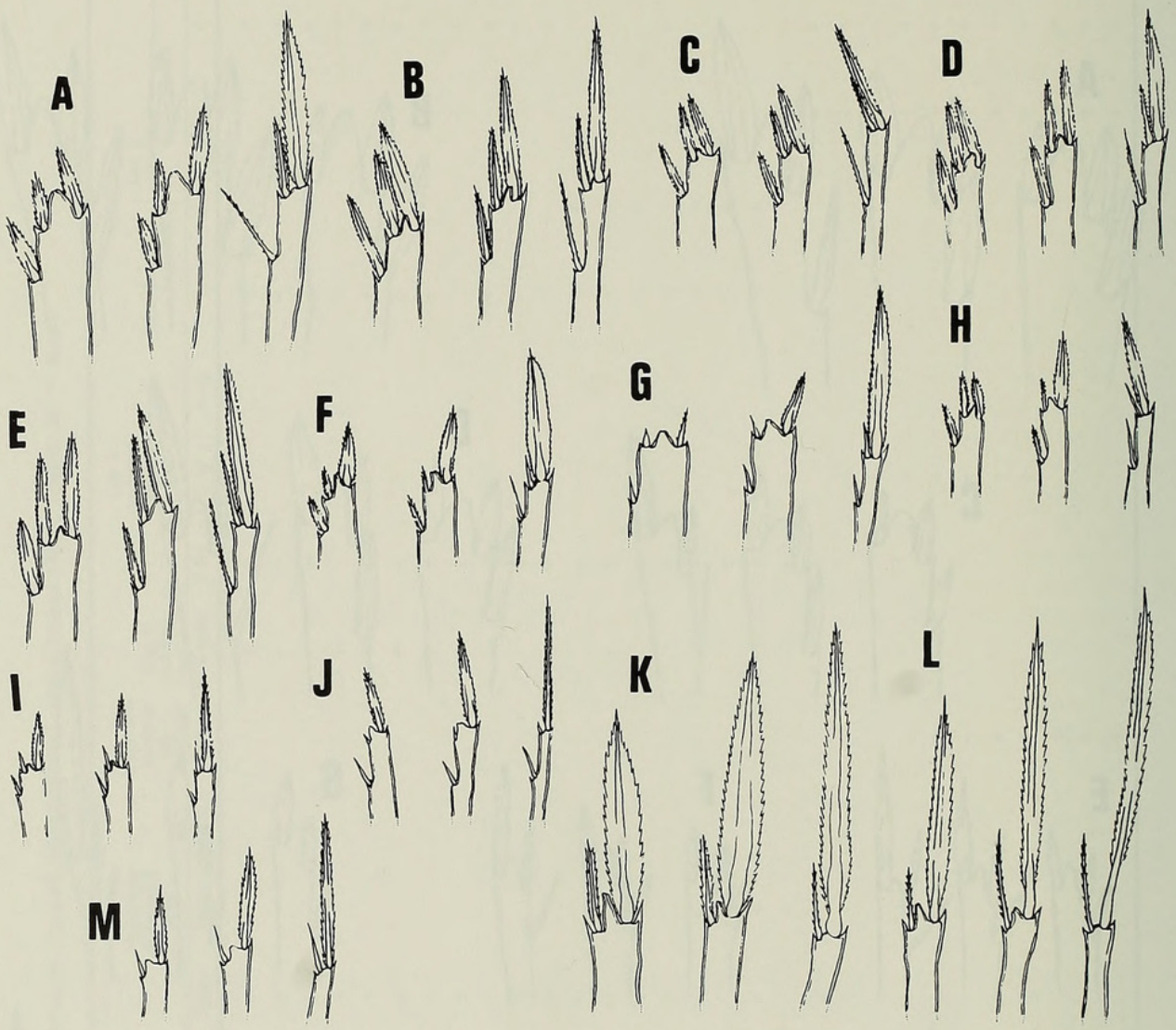

Fig. 2. Northeast Pacific-Washington waters: *Oncaea* legs 2–4 endopod terminal spine set, (leg 2, leg 3, leg 4, left to right). Female (scale x): A, *Oncaea olsoni*; B, *Oncaea damkaeri*; C, *Oncaea parila*; D, *Oncaea prolata*; E, *Oncaea grossa,* new species; F, *Oncaea rimula,* new species; G, *Oncaea macilenta*; H, *Oncaea glabra,* new species; I, *Oncaea lacinia*; J, *Oncaea ovalis*; K, *Oncaea ornata*; L, *Oncaea englishi*; M, *Oncaea subtilis.*

ner, lateral view. Genital segment length about equal to that of remainder of urosome (Fig. 3C); gonopore, with a spiniform setule just anterior to midregion of dorsal surface; insertion of setule surrounded by complex layers of overlapping chitinous layers. Caudal ramus 4 times as long as wide and longer than anal segment.

Rostral area with thickened, rounded posteroventral margin. First antenna 6-segmented (Fig. 3D) with armature formula 3, 8, 4+1 spinule, 3+1 esthete, 2+1 esthete, 7+1 esthete. Second antenna (Fig. 3E) 3-segmented; first segment with distal inner spinulose seta; second segment with row of minute dentiform spinules along inner surface and outer rows of setules; terminal segment with row of setules on posterior surface; proximal inner surface with curved, denticulate spine and 3 setae; distally 4 curved long spines and 3 setae.

Labrum (Fig. 3F) posteriorly protuberant; free margin divided into 2 rounded posteroventral lobes, each with a row of dentiform setules on undersurface; lobes separated by quadrate vertex; several thin lamellae extend posteriorly between the lobes; a semicircular ridge bears a row of spatulate setules anterior to the vertex; ovate protuberance anterior to labrum and

Table 3.—Adult female (♀) and male (♂) specimens of *Oncaea, Epicalymma* and *Conaea* found and examined in samples from the northeast Pacific Ocean and inland waters of Washington state. Also indicated (+) are previously reported personal records in other regions (Arctic Ocean and Station M, Heron et al. 1984; Southern Ocean, Heron 1977; New Zealand, Heron & Bradford-Grieve 1995).

Species	Station P		Station Q		Open NE Pacific		Washington inland waters		Arctic	Southern ocean	New Zealand	Station M
	♀	♂	♀	♂	♀	♂	♀	♂				
O. canadensis	20	39	103	253	74	85						
O. thoresoni	6	6	7	0	50	32						
O. derivata					44	51	36	41			+	
O. redacta			10	0	43	18	8	8			+	
O. borealis	334	0					446	242	+			+
O. similis	2	2			243	4	230	14		+		
O. insolita	5	1			66	59						
O. illgi					21	0				+		
O. rotata	0	1			7	0						
O. brocha	3	1								+		
O. olsoni	4	2			19	0	4	0		+		
O. damkaeri	7	0			1	0				+		
O. parila	16	0			2	0	2	4	+	+		+
O. prolata					1	3	200	48		+	+	
O. grossa	243	304			48	2	115	212				
O. rimula	2	0			11	0	1	3				
O. macilenta	32	1			20	3	5	0		+		
O. glabra					0	1	10	3				
O. lacinia					1	0	18	7	+		+	+
O. ovalis					2	0	5	1				
O. ornata					25	12	1	2				
O. englishi	38	34			196	155	1	0	+	+	+	+
O. subtilis							136	327				
E. schmitti	46	1			51	4			+	+		+
E. umbonata	0	1			6	1			+	+		+
E. vervoorti					1	0			+			+
E. exigua					2	0	4	3	+			+
C. rapax					18	21	3	3		+	+	
C. succurva					3	0				+		
C. hispida	1	0			7	1				+		

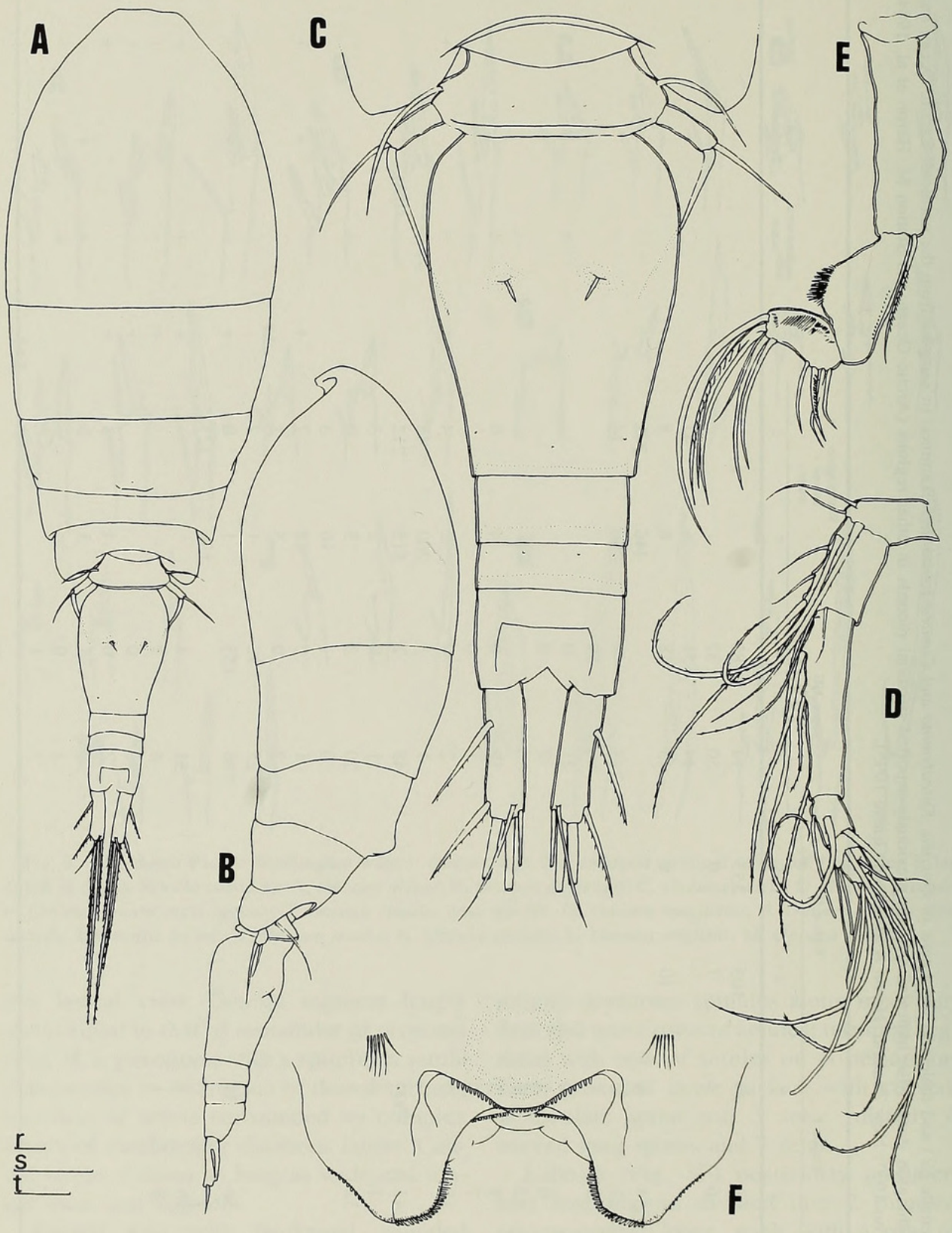

Fig. 3. *Oncaea canadensis,* new species. Female: A, dorsal (scale r); B, lateral (r); C, urosome, dorsal (s); D, first antenna, right (t); E, second antenna, left (s); F, labrum (u).

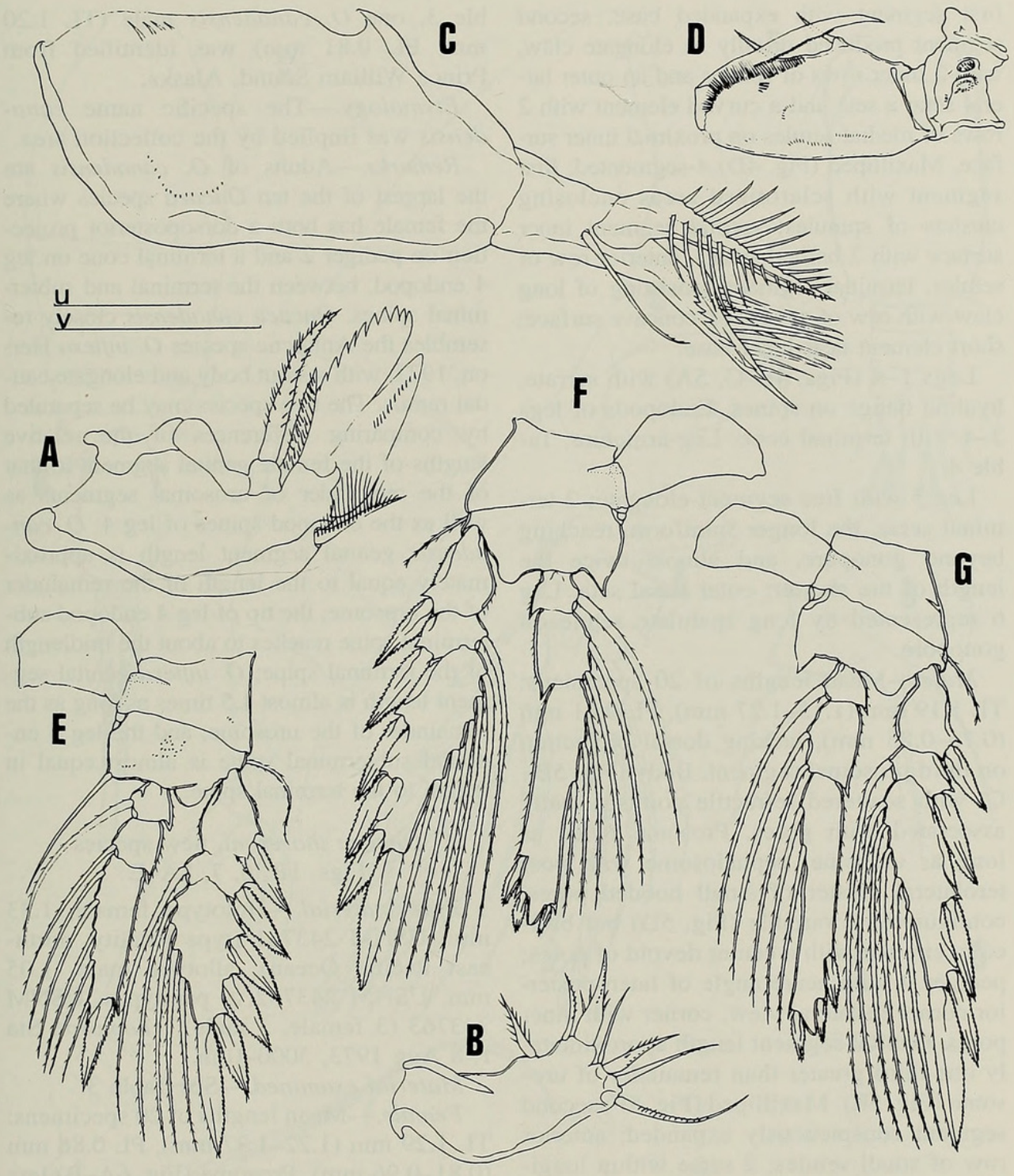

Fig. 4. *Oncaea canadensis,* new species. Female: A, mandible, left (scale v); B, first maxilla, right (u); C, second maxilla, left (v); D, maxilliped, left (t); E, leg 1 (t); F, leg 2 (t); G, leg 3 (t).

lateral setules. Mandible (Fig. 4A) with expanded, triangular base, terminally flattened, bearing 5 elements: outer stout seta with row of long setules; broad element with posterior row of setules and concave inner margin which cups outer basal edge of adjacent bladelike element with inner dentiform edge; 2 posterior spinulose setae, the shorter seta hyaline.

First maxilla (Fig. 4B) flat, bilobed; 2 setae and 1 spine on inner lobe; 4 setae on outer lobe. Second maxilla (Fig. 4C) 2-segmented;

first segment with expanded base; second segment produced distally as elongate claw, with 2 inner rows of setules and an outer lateral seta; a seta and a curved element with 2 rows of medial setules on proximal inner surface. Maxilliped (Fig. 4D) 4-segmented; first segment with sclerotized areas enclosing clusters of spinules; second segment inner surface with 2 barbed spines, anterior row of setules; terminal segment consisting of long claw with row of setules on concave surface; short element near inner base.

Legs 1–4 (Figs. 4E–G, 5A) with serrate, hyaline flange on spines. Endopods of legs 2–4 with terminal cone. Leg armature, Table 4.

Leg 5 with free segment elongate; 2 terminal setae, the longer spiniform, reaching beyond gonopore, and almost twice the length of the shorter; outer basal seta. Leg 6 represented by long spatulate setule on gonopore.

Male.—Mean lengths of 20 specimens: TL 1.19 mm (1.15–1.27 mm), PL 0.81 mm (0.76–0.85 mm), lacking dorsal projection on third prosomal segment. Body (Fig. 5B–C) with scattered refractile points, usually associated with pores. Prosome twice as long as urosome; cephalosome with posterolateral cluster of small hooded pores; configurations variable (Fig. 5D) but basically circular with a center devoid of pores; pediger 4 with acute angle of lateroposterior corner in lateral view; corner with inner pores. Genital segment length approximately one-third greater than remainder of urosome (Fig. 5E). Maxilliped (Fig. 5F) second segment conspicuously expanded; anterior row of small setules; 2 setae within longitudinal cleft; inner posterior rim with 3 rows of spatulate setules of graduated lengths; terminal claw with narrow element near inner base. Swimming legs as in female. Leg 5 (Fig. 5G) short, not delimited from thoracic segment; armament similar to that of female. Leg 6 represented by posterolateral point-tipped flap on ventral surface of genital segment.

In addition to the specimens listed on Table 3, one *O. canadensis* male (TL 1.20 mm, PL 0.81 mm) was identified from Prince William Sound, Alaska.

Etymology.—The specific name *canadensis* was implied by the collection area.

Remarks.—Adults of *O. canadensis* are the largest of the ten *Oncaea* species where the female has both a dorsoposterior projection on pediger 2 and a terminal cone on leg 4 endopod, between the terminal and subterminal spines. *Oncaea canadensis* closely resembles the Antarctic species *O. inflexa* Heron, 1977, with a stout body and elongate caudal ramus. The two species may be separated by comparing differences of the relative lengths of the female genital segment to that of the remainder of urosomal segments as well as the endopod spines of leg 4: *O. canadensis* genital segment length is approximately equal to the length of the remainder of the urosome; the tip of leg 4 endopod subterminal spine reaches to about the midlength of the terminal spine; *O. inflexa* genital segment length is almost 1.5 times as long as the remainder of the urosome, and the leg 4 endopod subterminal spine is almost equal in length to the terminal spine.

Oncaea thoresoni, new species
Figs. 1B, 6, 7, 8A–E

Type material.—Holotype female, 1.33 mm; USNM 243761 (type locality, northeast Pacific Ocean); allotype male, 1.05 mm, USNM 243762; 6 paratypes, USNM 243763 (3 female, 3 male): *Thompson* Sta P, 8 Aug 1973, 3000–0 m.

Material examined.—See Table 3.

Female.—Mean lengths of 20 specimens: TL 1.29 mm (1.22–1.37 mm), PL 0.86 mm (0.81–0.96 mm). Prosome (Fig. 6A–B) less than twice the length of urosome with a ratio of 1.86:1; pediger 2 with dorsoposterior projection, lateral view; pediger 4 with rounded posterior corner, lateral view. Genital segment length ratio to that of remainder of the urosome 1.11:1 (Fig. 6C); gonopore with spiniform setule. Caudal ramus about 3 times as long as wide and approximately same length as that of sum of the 2 segments posterior to genital segment.

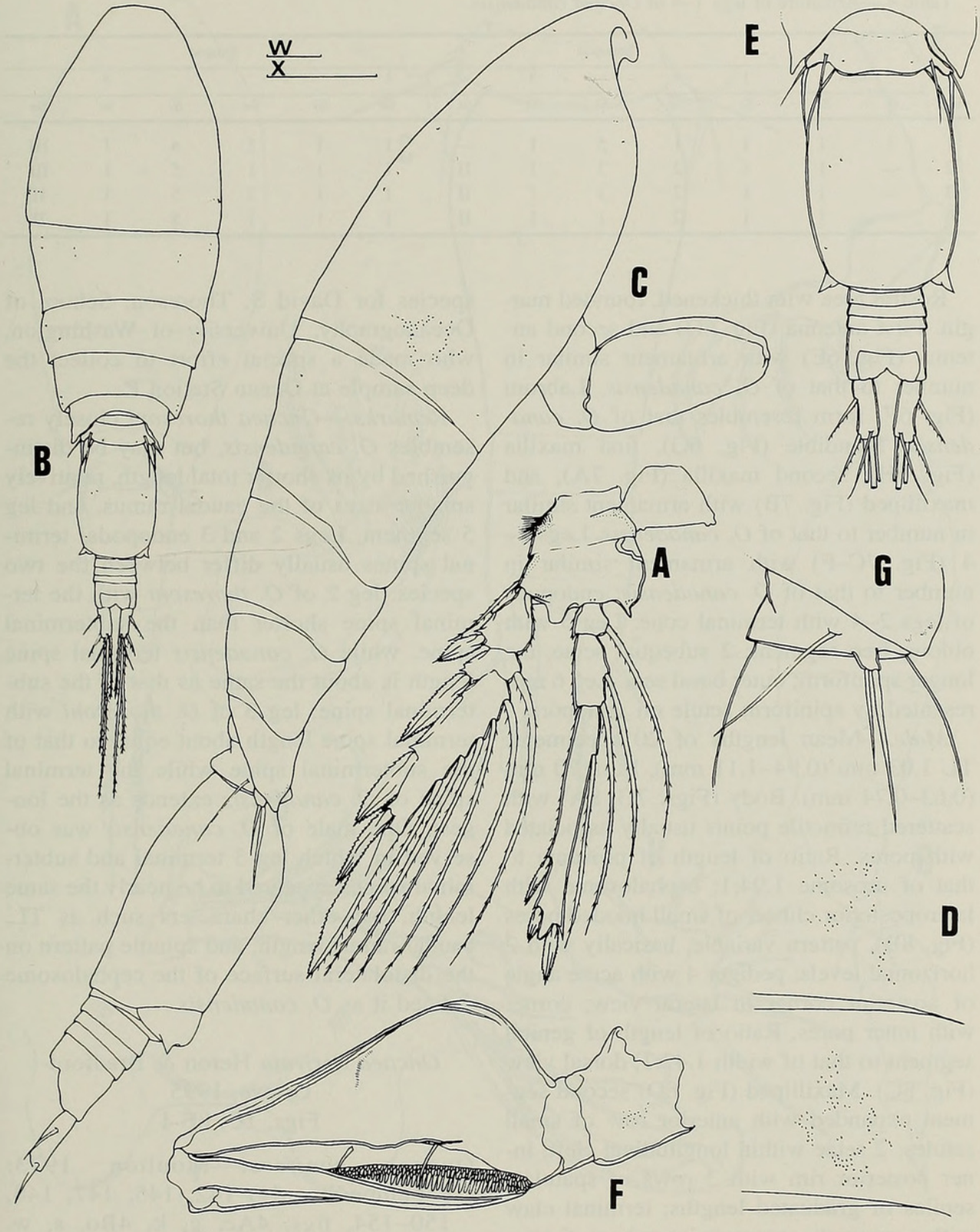

Fig. 5. *Oncaea canadensis,* new species. Female: A, Leg 4 (scale t). Male: B, dorsal (r); C, lateral (w); D, two posterolateral hooded pore clusters from two cephalosomes (x); E, urosome, dorsal (w); F, maxilliped, right (x); G, pediger 4 distal corner, segment of leg 5 (x).

Table 4.—Armature of legs 1–4 of *Oncaea canadensis.*

			Endopod					Exopod					
	Basis		1	2	3			1	2		3		
Leg	Si	Se	Si	Se	Si	St	Se	Se	Si	Se	Si	St	Se
1	1	1	1	1	5	I	—	I	1	I	4	I	III
2	—	1	1	2	3	I	II	I	1	I	5	I	III
3	—	1	1	2	2	I	II	I	1	I	5	I	II
4	—	1	1	2	1	I	II	I	1	I	5	I	II

Rostral area with thickened, rounded margin. First antenna (Fig. 6D) and second antenna (Fig. 6E) with armament similar in number to that of *O. canadensis.* Labrum (Fig. 6F) form resembles that of *O. canadensis.* Mandible (Fig. 6G), first maxilla (Fig. 6H), second maxilla (Fig. 7A), and maxilliped (Fig. 7B) with armament similar in number to that of *O. canadensis.* Legs 1–4 (Fig. 7C–F) with armament similar in number to that of *O. canadensis*; endopods of legs 2–4 with terminal cone. Leg 5 with oblong free segment; 2 subequal setae, the longer spiniform; outer basal seta. Leg 6 represented by spiniform setule on gonopore.

Male.—Mean lengths of 20 specimens: TL 1.03 mm (0.94–1.11 mm), PL 0.70 mm (0.63–0.74 mm). Body (Figs. 7G, 8A) with scattered refractile points usually associated with pores. Ratio of length of prosome to that of urosome 1.94:1; cephalosome with lateroposterior cluster of small hooded pores (Fig. 8B), pattern variable, basically with 2 horizontal levels; pediger 4 with acute angle of posterior corner in lateral view; corner with inner pores. Ratio of length of genital segment to that of width 1.42:1, dorsal view (Fig. 8C). Maxilliped (Fig. 8D) second segment expanded with anterior row of small setules; 2 setae within longitudinal cleft; inner posterior rim with 3 rows of spatulate setules of graduated lengths; terminal claw with narrow element near inner base. Swimming legs as in female. Leg 5 (Fig. 8E) not delimited from thoracic segment; armament similar to that of female. Leg 6 represented by posterolateral point-tipped flap on ventral surface of genital segment.

Etymology.—It is a pleasure to name this species for David S. Thoreson, School of Oceanography, University of Washington, who made a special effort to collect the deep sample at Ocean Station P.

Remarks.—*Oncaea thoresoni* closely resembles *O. canadensis,* but may be distinguished by its shorter total length, relatively smaller sizes of the caudal ramus, and leg 5 segment. Legs 2 and 3 endopodal terminal spines usually differ between the two species: leg 2 of *O. thoresoni* with the terminal spine shorter than the subterminal spine, while *O. canadensis* terminal spine length is about the same as that of the subterminal spine; leg 3 of *O. thoresoni* with terminal spine length about equal to that of the subterminal spine while the terminal spine of *O. canadensis* extends as the longest. One male of *O. canadensis* was observed in which leg 3 terminal and subterminal spines appeared to be nearly the same length, but other characters such as TL, caudal ramus length, and spinule pattern on the distolateral surface of the cephalosome defined it as *O. canadensis.*

Oncaea derivata Heron & Bradford-Grieve, 1995
Figs. 1C, 8F–I

Oncaea conifera.—Moulton 1973: ("bumped" only) 142, 145, 147, 148, 150–154, figs. 4Ac, g, k, 4Bo, s, w. (Not *O. conifera* Giesbrecht, 1891.)

Oncaea derivata Heron & Bradford-Grieve, 1995:25, 29 (female), figs. 9h–j, 10, 11a, 25c.

Material examined.—See Table 3. Reference specimens: NIWA Z9390 (3 fe-

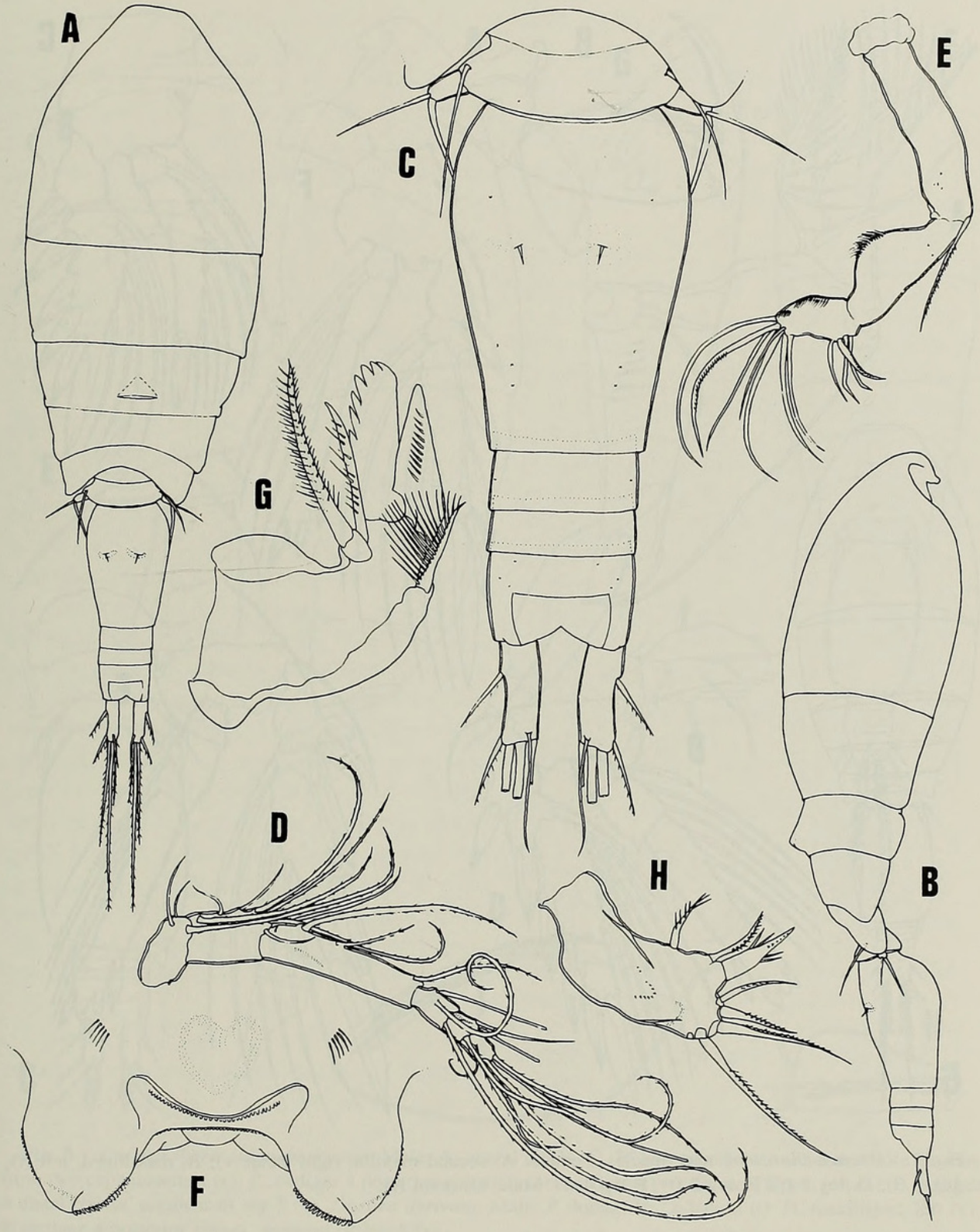

Fig. 6. *Oncaea thoresoni,* new species. Female: A, dorsal (scale r); B, lateral (r); C, urosome, dorsal (s); D, first antenna, left (t); E, second antenna, left (s); F, labrum (u); G, mandible, left (v); H, first maxilla, right (u).

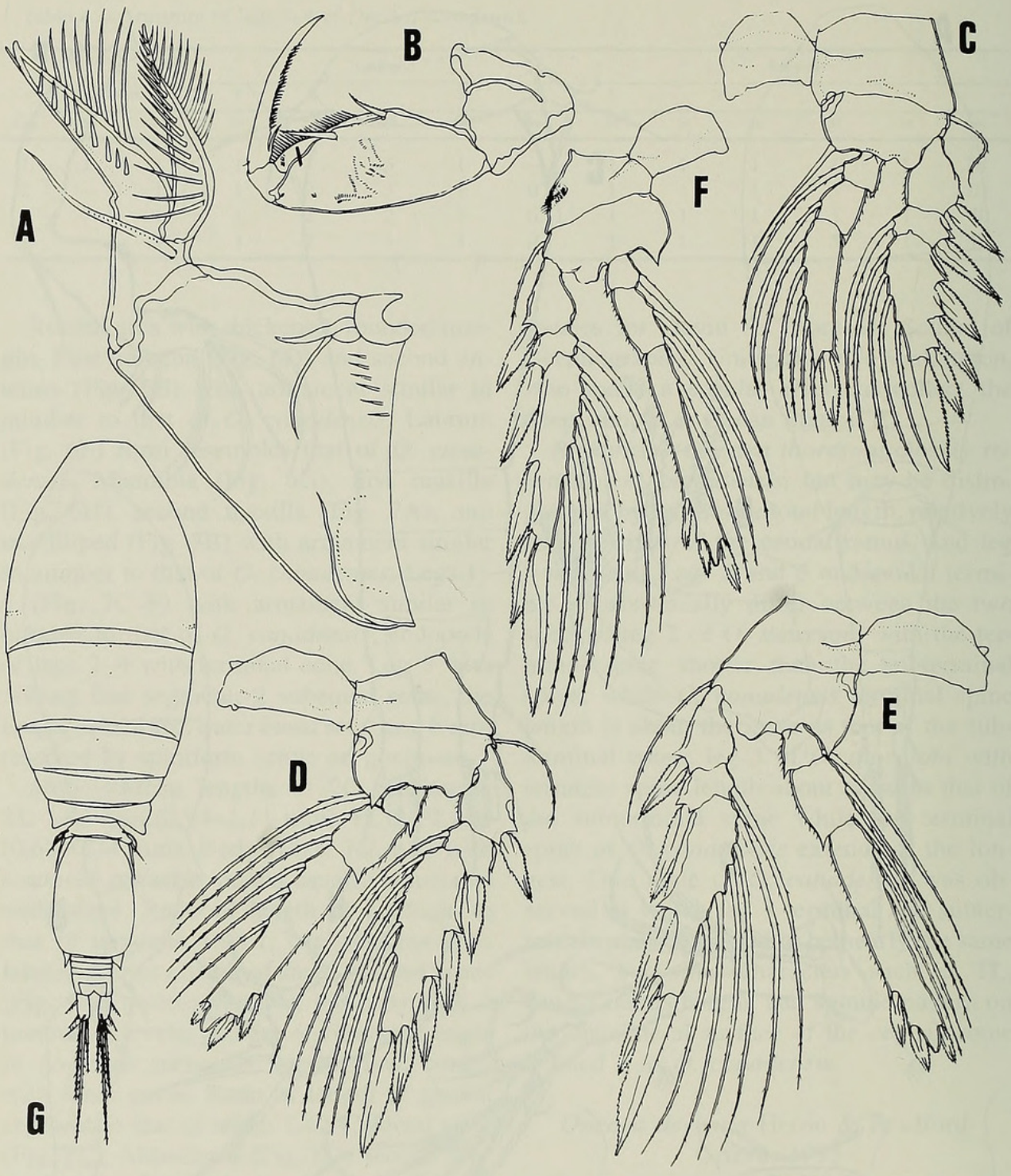

Fig. 7. *Oncaea thoresoni,* new species. Female: A, second maxilla, right (scale v); B, maxilliped, left (t); C, leg 1 (t); D, leg 2 (t); E, leg 3 (t); F, leg 4 (t). Male: G, doral (r).

males, 10 males); USNM 243734 (3 females, 10 males): Juan de Fuca Strait, 6 Apr 1977, 180–100 m.

Female.—Mean lengths of 20 specimens: TL 1.09 mm (1.05–1.15 mm), PL 0.73 mm (0.70–0.79 mm).

Male.—The male of *O. derivata* is described for the first time. Mean lengths of 15 specimens: TL 0.70 mm (0.67–0.74 mm), PL 0.47 mm (0.44–0.50 mm). Body (Fig. 8F–G) with scattered refractile points, usually associated with pores. Prosome

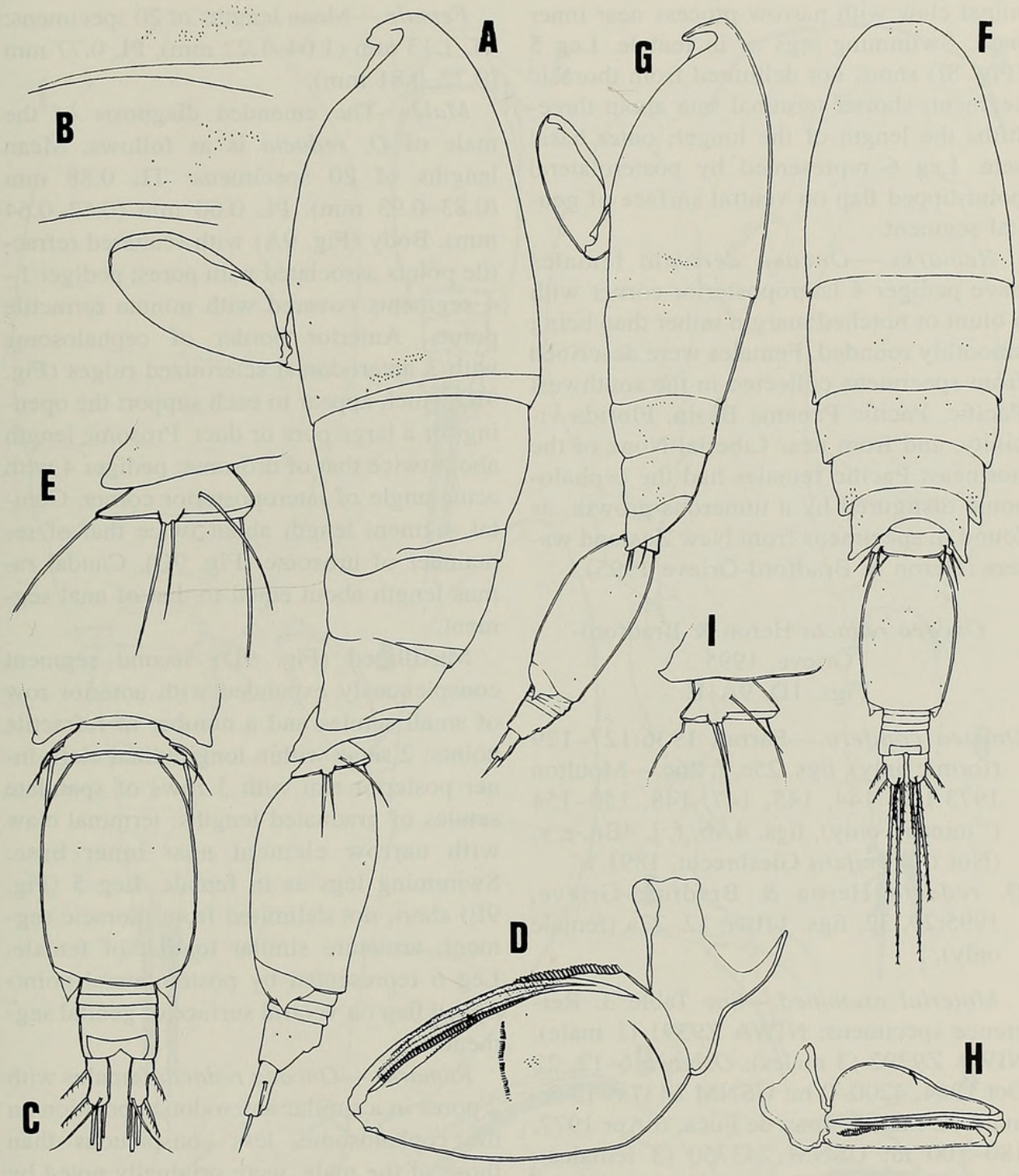

Fig. 8. *Oncaea thoresoni,* new species. Male: A, lateral (scale w); B, two posterolateral hooded pore clusters from two cephalosomes (x); C, pediger 4 posterior corner, urosome, dorsal (w); D, maxilliped, left (x); E, pediger 4 distal corner, segment of leg 5 (x). *Oncaea derivata,* Male: F, dorsal (t); G, lateral (t); H, maxilliped, left (x); I, pediger 4 posterior corner, segment of leg 5 (x).

length about twice that of urosome; cephalosome with posterolateral double slanting rows of hooded pores, pattern slightly variable; pediger 4 with acute angle of lateroposterior corner often tilted ventrally.

Maxilliped (Fig. 6J) second segment conspicuously expanded with anterior row of small setules; 2 setae within longitudinal cleft; inner posterior rim with 3 rows of spatulate setules of graduated lengths; ter-

minal claw with narrow process near inner base. Swimming legs as in female. Leg 5 (Fig. 8I) short, not delimited from thoracic segment; shorter terminal seta about three-fifths the length of the longer; outer basal seta. Leg 6 represented by posterolateral point-tipped flap on ventral surface of genital segment.

Remarks.—*Oncaea derivata* females have pediger 4 lateroposterior corner with a blunt or notched margin rather than being smoothly rounded. Females were described from specimens collected in the southwest Pacific, Pacific Panama Basin, Florida vicinity, and from near Liberia. None of the northeast Pacific females had the cephalosome disfigured by a tumerous growth, as found in specimens from New Zealand waters (Heron & Bradford-Grieve 1995).

Oncaea redacta Heron & Bradford-Grieve, 1995
Figs. 1D, 9A–E

Oncaea conifera.—Farran 1936:127–129 (form c only), figs. 25c, f, 26c.—Moulton 1973:142, 144, 145, 147, 148, 150–154 ("minus" only), figs. 4Ab, f, j, 4Bn, r, v. (Not *O. conifera* Giesbrecht, 1891.)

O. redacta Heron & Bradford-Grieve, 1995:29, 32, figs. 11b–i, 12, 27a (female only).

Material examined.—See Table 3. Reference specimens: NIWA Z9391 (1 male); NIWA Z9392 (3 males): *Oshawa* 6–12, 22 Oct 1964, 4200–0 m; USNM 243749 (3 females, 2 males): Juan de Fuca, 6 Apr 1977, 180–100 m; USNM 243750 (3 females): *Brown Bear* 368–36, 18 Aug 1965, 3700–0 m.

Females and males of *O. redacta* were described in 1995 based on 1 female collected from the southwest Pacific and 15 females and 2 males from northeast Pacific samples. After examination and study of additional samples and species, it has been determined that the male described as *O. redacta* in 1995 is actually the male of *O. similis* Sars, 1918, a closely related species.

Female.—Mean lengths of 20 specimens: TL 1.13 mm (1.04–1.22 mm), PL 0.77 mm (0.72–0.81 mm).

Male.—The emended diagnosis of the male of *O. redacta* is as follows. Mean lengths of 20 specimens: TL 0.88 mm (0.83–0.93 mm), PL 0.60 mm (0.53–0.64 mm). Body (Fig. 9A) with scattered refractile points associated with pores; pediger 1–4 segments covered with minute refractile points. Anterior border of cephalosome with 3 anterodorsal sclerotized ridges (Fig. 9B) which appear to each support the opening for a large pore or duct. Prosome length about twice that of urosome; pediger 4 with acute angle of lateroposterior corner. Genital segment length about twice that of remainder of urosome (Fig. 9C). Caudal ramus length about equal to that of anal segment.

Maxilliped (Fig. 9D) second segment conspicuously expanded with anterior row of small setules and a number of refractile points; 2 setae within longitudinal cleft; inner posterior rim with 3 rows of spatulate setules of graduated lengths; terminal claw with narrow element near inner base. Swimming legs as in female. Leg 5 (Fig. 9E) short, not delimited from thoracic segment; armature similar to that of female. Leg 6 represented by posterolateral point-tipped flap on ventral surface of genital segment.

Remarks.—*Oncaea redacta* females with 2 pores in a similar anterodorsal position on the cephalosome, less conspicuous than those of the male, were originally noted by Heron & Bradford-Grieve (1995: fig. 11c). The dorsal pores on the cephalosome and the numerous minute refractile points on pedigers 1–4 assist in the initial identification of *O. redacta* males. The males differ from those of *O. similis* by having a larger size, an acute rather than rounded angle of pediger 4 lateroposterior corner, and the basal seta of leg 5 shorter than the inner, longer of the two terminal setae.

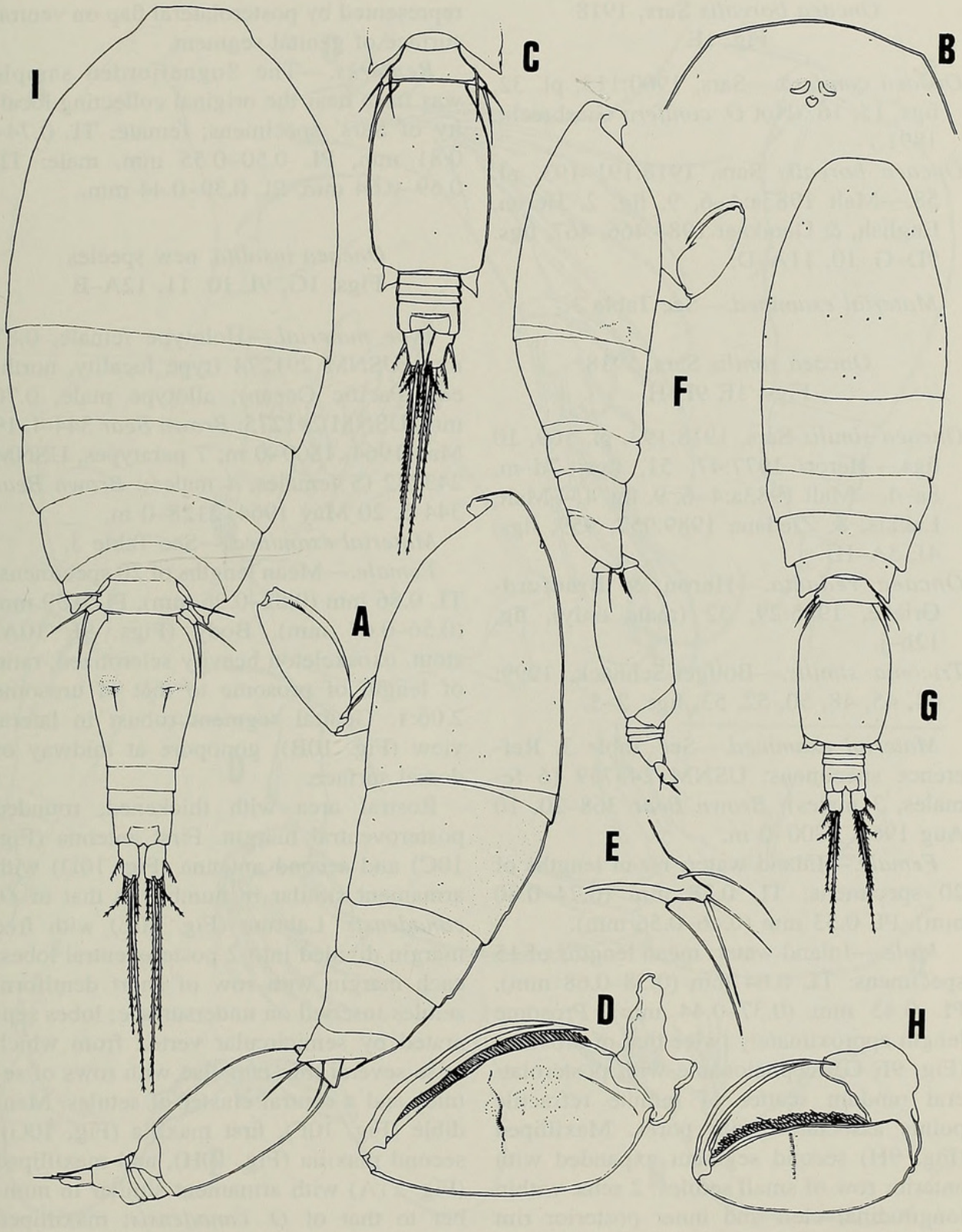

Fig. 9. *Oncaea redacta,* Male: A, lateral (scale t); B, anterior border of cephalosome, dorsoanterior (x); C, pediger 4 posterior corner, urosome, dorsal (t); D, maxilliped, left (x); E, leg 5 (x). *Oncaea similis,* Male: 0.64mm (Sognofjordan specimen); F, lateral (t); G, dorsal (t); H, maxilliped, left (t). *Oncaea insolita,* new species. Female: I, dorsal (t).

Oncaea borealis Sars, 1918
Fig. 1E

Oncaea conifera.—Sars, 1900:113, pl. 32, figs. 15, 16. (Not *O. conifera* Giesbrecht, 1891.)

Oncaea borealis Sars, 1918:191–193, pl. 58.—Malt 1983a:4–6, 9, fig. 2. Heron, English, & Damkaer 1984:466, 467, figs. 9D–G, 10, 11A–D.

Material examined.—See Table 3.

Oncaea similis Sars, 1918
Figs. 1F, 9F–H

Oncaea similis Sars, 1918:193, pl. 109, 10 figs.—Heron 1977:47, 51, figs. 7d–m, 8a–d.—Malt 1983a:4–6, 9, fig. 4.—Malt, Lakkis, & Ziedane 1989:957, 959, figs. 4J, 5A–H.

Oncaea redacta.—Heron & Bradford-Grieve, 1995:29, 32 (male only), fig. 12h–j.

Triconia similis.—Böttger-Schnack, 1999: 44, 45, 48, 50, 52, 53, figs. 2–5.

Material examined.—See Table 3. Reference specimens: USNM 243759 (6 females, 3 males): *Brown Bear* 368–20, 10 Aug 1965, 2700–0 m.

Female.—Inland water: mean lengths of 20 specimens: TL 0.78 mm (0.74–0.80 mm), PL 0.53 mm (0.46–0.56 mm).

Male.—Inland water: mean lengths of 15 specimens: TL 0.64 mm (0.58–0.68 mm), PL 0.43 mm (0.37–0.44 mm). Prosome length approximately twice that of urosome (Fig. 9F, G); cephalosome with posterolateral random scatter of minute refractile points associated with pores. Maxilliped (Fig. 9H) second segment expanded with anterior row of small setules; 2 setae within longitudinal cleft and inner posterior rim with 3 rows of spatulate setules of graduated lengths; terminal claw with narrow process near inner base. Swimming legs as in female. Leg 5 not delimited from thoracic segment; general shape of segment and armature similar to that of female; outer basal seta longer than setae of leg 5. Leg 6 represented by posterolateral flap on ventral surface of genital segment.

Remarks.—The Sognefjorden sample was from near the original collecting locality of Sars' specimens; female: TL 0.74–0.81 mm, PL 0.50–0.55 mm, male: TL 0.59–0.64 mm, PL 0.39–0.44 mm.

Oncaea insolita, new species
Figs. 1G, 9I, 10, 11, 12A–B

Type material.—Holotype female, 0.87 mm; USNM 291274 (type locality, northeast Pacific Ocean); allotype male, 0.70 mm, USNM 291275: *Brown Bear* 344-4, 19 May 1964, 1800–0 m; 7 paratypes, USNM 243742 (5 females, 4 males): *Brown Bear* 344-5, 20 May 1964, 2128–0 m.

Material examined.—See Table 3.

Female.—Mean lengths of 20 specimens: TL 0.86 mm (0.82–0.96 mm), PL 0.59 mm (0.56–0.67 mm). Body (Figs. 9I, 10A) stout, exoskeleton heavily sclerotized; ratio of length of prosome to that of urosome 2.06:1. Genital segment robust in lateral view (Fig. 10B); gonopore at midway of dorsal surface.

Rostral area with thickened, rounded posteroventral margin. First antenna (Fig. 10C) and second antenna (Fig. 10D) with armament similar in number to that of *O. canadensis.* Labrum (Fig. 10E) with free margin divided into 2 posteroventral lobes; each margin with row of short dentiform setules inserted on undersurface; lobes separated by semicircular vertex from which arise several thin lamellae with rows of setules and a central cluster of setules. Mandible (Fig. 10F), first maxilla (Fig. 10G), second maxilla (Fig. 10H), and maxilliped (Fig. 11A) with armament similar in number to that of *O. canadensis*; maxilliped with relatively conspicuous areas of sclerotization on first segment.

Legs 1–4 (Fig. 11B–E) with armament similar in number to that of *O. canadensis*; legs 2–4 endopods with terminal cone. Leg 5 a free segment with 2 subequal terminal setae, the longer slightly spiniform; outer

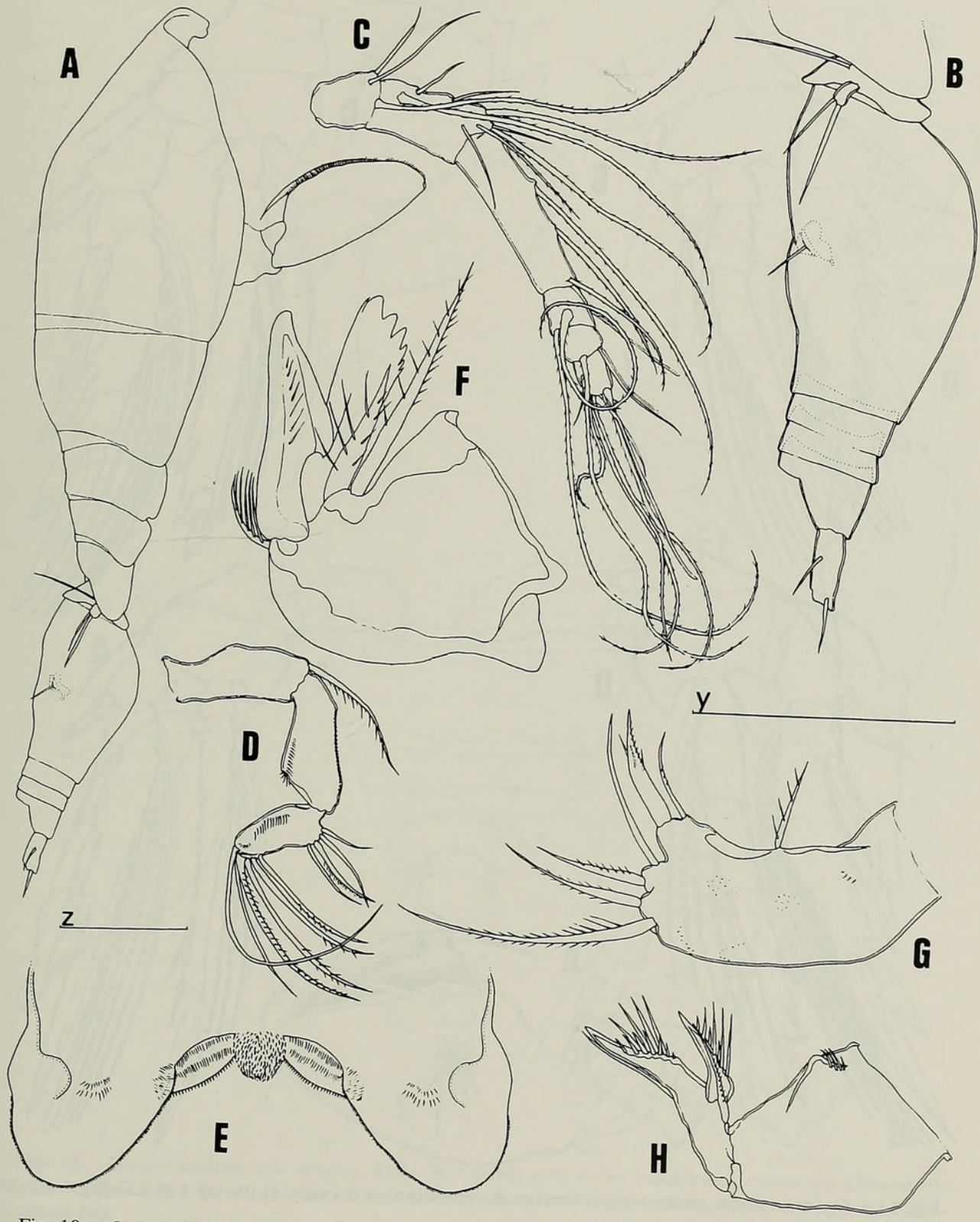

Fig. 10. *Oncaea insolita,* new species. Female: A, lateral (scale x); B, pediger 4 posterior corner, urosome, lateral (x); C, first antenna, left (x); D, second antenna, left (x); E, labrum (v); F, mandible, right (y); G, first maxilla, left (y); H, second maxilla, right (z).

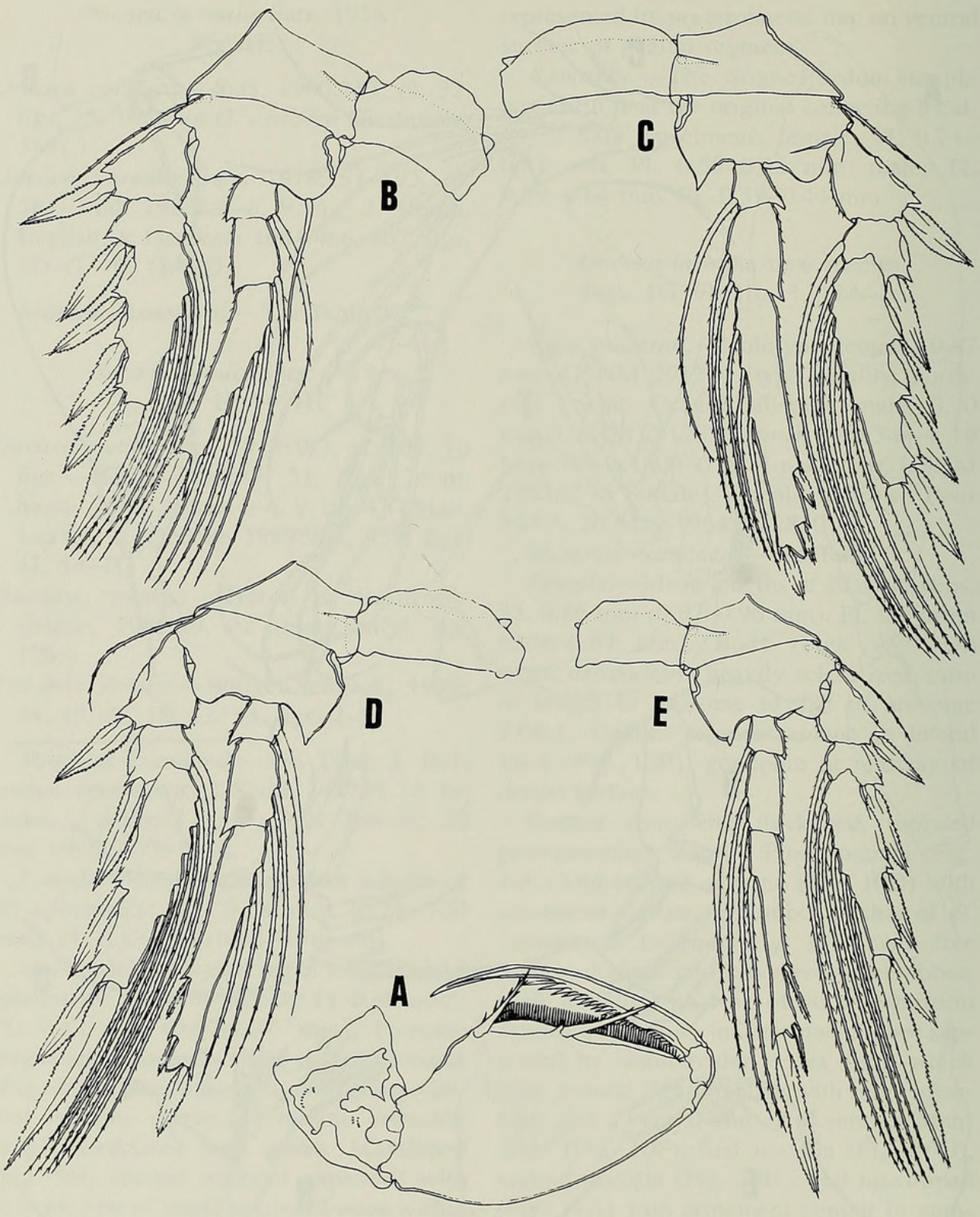

Fig. 11. *Oncaea insolita,* new species. Female: A, maxilliped, left (scale x); B, leg 1 (x); C, leg 2 (x); D, leg 3 (x); E, leg 4 (x).

basal seta. Leg 6 represented by spiniform setule on gonopore.

Male.—Mean lengths of 20 specimens: TL 0.74 mm (0.70–0.81 mm, PL 0.50 mm (0.45–0.56 mm). Body (Fig. 12A) stout, exoskeleton heavily sclerotized. Maxilliped (Fig. 12B) second segment with outer row of setules and posterior surface with cluster of small spinules followed by prominent protrusion with 2 rows of denticles, each

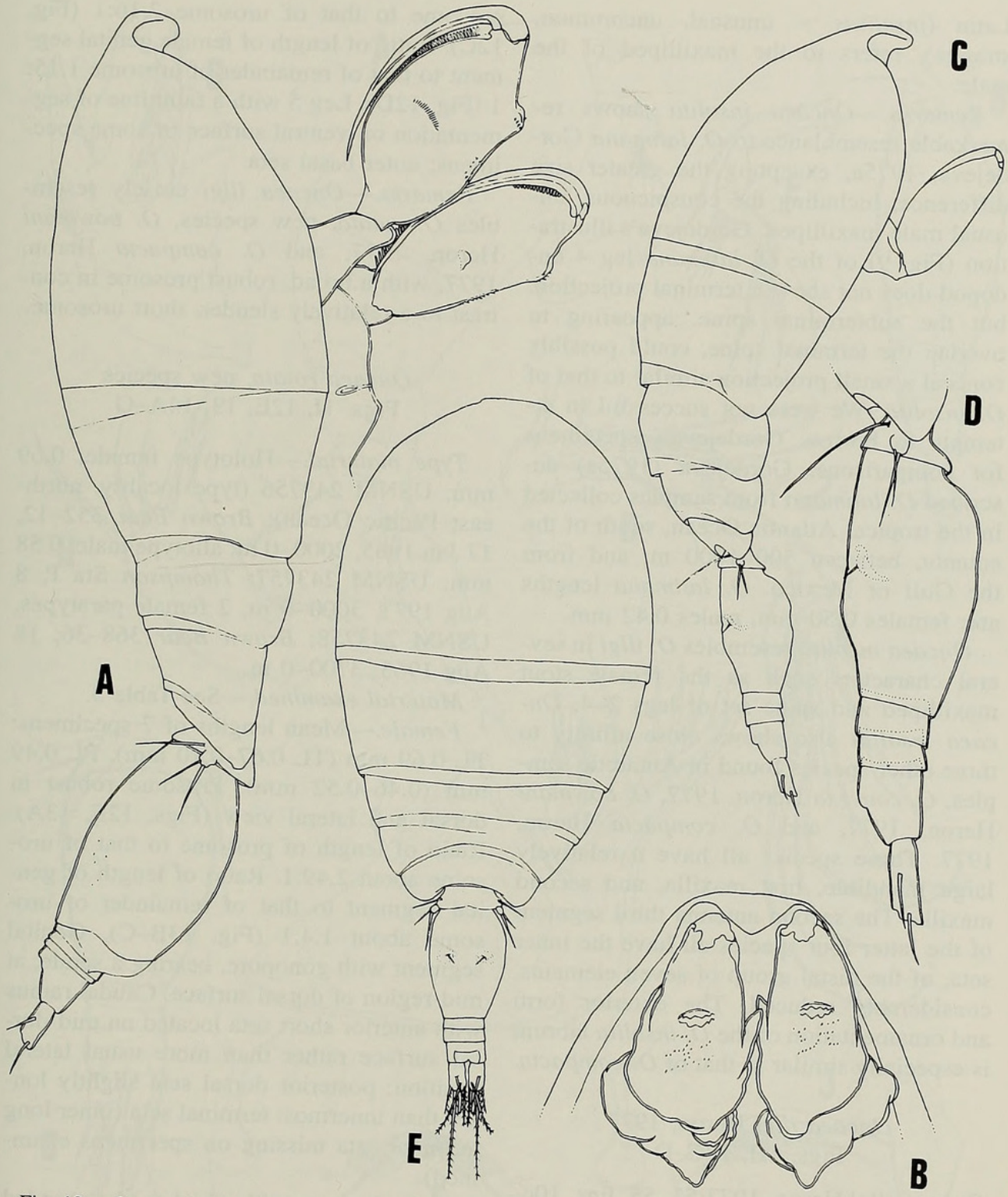

Fig. 12. *Oncaea insolita,* new species. Male: A, lateral (scale s); B, maxillipeds, ventral (s). *Oncaea illgi,* Female: C, lateral (w); D, pediger 4 posterior corner, urosome, lateral (x). *Oncaea rotata,* new species. Female: E, dorsal (w).

associated with small pore; inner surface with stout digitiform outgrowth with inner pore. Swimming legs as in female. Leg 5 not delimited from thoracic segment; armament similar to that of female. Leg 6 represented by posterolateral flap on ventral surface of genital segment.

Etymology.—The specific name, from

Latin (*insolitus* = unusual, uncommon, strange), refers to the maxilliped of the male.

Remarks.—*Oncaea insolita* shows remarkable resemblance to *O. latimana* Gordejeva, 1975a, excepting the greater size difference, including the conspicuous, unusual male maxilliped. Gordejeva's illustration (Fig. 9) of the *O. latimana* leg 4 endopod does not show a terminal projection, but the subterminal spine, appearing to overlap the terminal spine, could possibly conceal a small projection similar to that of *O. insolita.* We were not successful in attempts to borrow Gordejeva's specimens for comparisons. Gordejeva (1975a) described *O. latimana* from samples collected in the tropical Atlantic Ocean, south of the equator, between 500–1000 m, and from the Gulf of Mexico. *O. latimana* lengths are: females 0.50 mm, males 0.42 mm.

Oncaea insolita resembles *O. illgi* in several characters such as the female stout maxilliped and spine set of legs 2–4. *Oncaea insolita* also shows close affinity to three other species found in Antarctic samples, *O. convexa* Heron, 1977, *O. bowmani* Heron, 1977, and *O. compacta* Heron, 1977. These species all have a relatively large mandible, first maxilla, and second maxilla. The second antenna third segment of the latter four species all have the inner seta, of the distal group of seven elements, considerably reduced. The exterior form and ornamentation of the *O. insolita* labrum is especially similar to that of *O. compacta.*

Oncaea illgi Heron, 1977
Figs. 1H, 12C–D

Oncaea illgi Heron, 1977:51, 55, figs. 10c–k, 11a–k.

Material examined.—See Table 3. Reference specimens: USNM 243764 (4 females): *Brown Bear* 380–13, 10 Nov 1965, 4650–0 m.

Female.—Mean lengths of 20 specimens: TL 0.78 mm (0.76–0.79 mm), PL 0.54 mm (0.48–0.58 mm). Ratio of length of female prosome to that of urosome 2.16:1 (Fig. 12C). Ratio of length of female genital segment to that of remainder of urosome 1.15:1 (Fig. 12D). Leg 5 with a faint line of segmentation on ventral surface of some specimens; outer basal seta.

Remarks.—*Oncaea illgi* closely resembles *O. rotata,* new species, *O. bowmani* Heron, 1977, and *O. compacta* Heron, 1977, with a broad, robust prosome in contrast to a relatively slender, short urosome.

Oncaea rotata, new species
Figs. 1I, 12E, 13, 14A–G

Type material.—Holotype female, 0.69 mm, USNM 243756 (type locality, northeast Pacific Ocean): *Brown Bear* 352–12, 17 Jan 1965, 2000–0 m; allotype male, 0.58 mm, USNM 243757: *Thompson* Sta P, 8 Aug 1973, 3000–0 m; 2 female paratypes, USNM 243758: *Brown Bear* 368–36, 18 Aug 1965, 3700–0 m.

Material examined.—See Table 3.

Female.—Mean lengths of 7 specimens: TL 0.69 mm (TL 0.67–0.70 mm), PL 0.49 mm (0.46–0.52 mm). Prosome robust in dorsal and lateral view (Figs. 12E, 13A). Ratio of length of prosome to that of urosome about 2.49:1. Ratio of length of genital segment to that of remainder of urosome about 1.4:1 (Fig. 13B–C). Genital segment with gonopore, bearing a setule, at mid-region of dorsal surface. Caudal ramus with anterior short seta located on mid-dorsal surface rather than more usual lateral position; posterior dorsal seta slightly longer than innermost terminal seta (inner long terminal seta missing on specimens examined).

Rostral area with thickened, rounded posteroventral margin. First antenna (Fig. 13D) and second antenna (Fig. 13E) with armament similar in number to that of *O. canadensis*; second antenna with comparatively slender segments, third segment longer than the second. Labrum (Fig. 13F) with free margin divided into 2 lobes, each margin with an underlying row of setules;

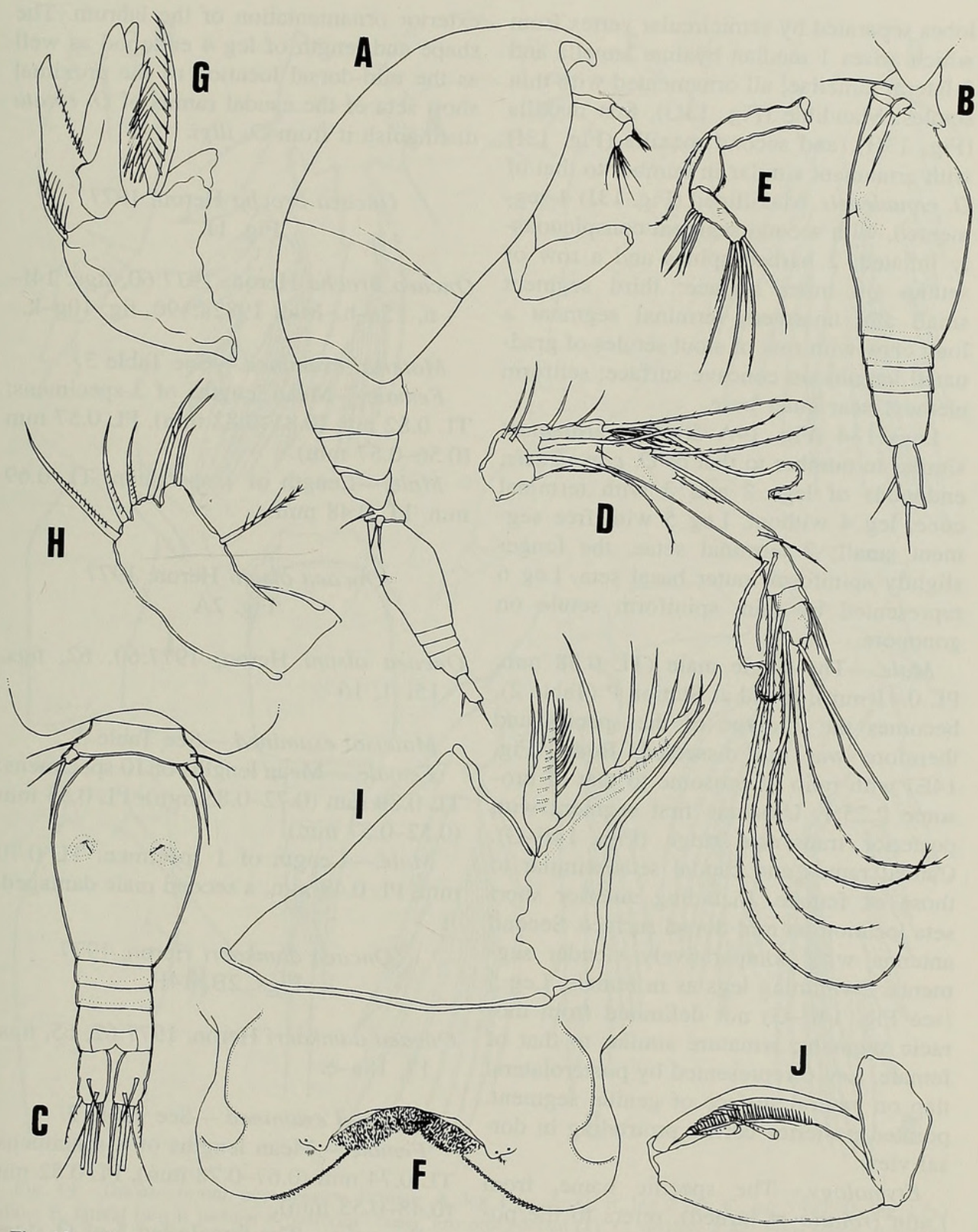

Fig. 13. *Oncaea rotata,* new species. Female: A, lateral (scale w); B, pediger 4 posterior corner, urosome, lateral (x); C, pediger 4 posterior corner, urosome, dorsal (x); D, first antenna, left (x); E, second antenna, left (x); F, labrum (v); G, mandible, right (y); H, first maxilla, left (y); I, second maxilla, right (y); J, maxilliped, right (x).

lobes separated by semicircular vertex from which arises 1 median hyaline lamella and 2 lateral lamellae, all ornamented with thin setules. Mandible (Fig. 13G), first maxilla (Fig. 13H), and second maxilla (Fig. 13I) with armament similar in number to that of *O. canadensis*. Maxilliped (Fig. 13J) 4-segmented, with second segment conspicuously inflated; 2 barbed spines and a row of setules on inner surface; third segment small and unarmed; terminal segment a long claw with row of stout setules of graduated lengths on concave surface; setiform element near inner base.

Legs 1–4 (Fig. 14A–D) with armament similar in number to that of *O. canadensis*; endopods of legs 2 and 3 with terminal cone, leg 4 without. Leg 5 with free segment small; 2 terminal setae, the longer slightly spiniform; outer basal seta. Leg 6 represented by thin, spiniform setule on gonopore.

Male.—The single male (TL 0.58 mm, PL 0.41 mm), found at Station P (Table 2), becomes the allotype of the species and therefore was not dissected. Body (Fig. 14E) with ratio of prosome to that of urosome 2.25:1. Urosome first segment with posterior transverse ridge (Fig. 14F–G). Caudal ramus and caudal setae similar to those of female, including anterior short seta location on mid-dorsal surface. Second antenna with comparatively slender segments. Swimming legs as in female. Leg 5 (see Fig. 14F–G) not delimited from thoracic segment; armature similar to that of female. Leg 6 represented by posterolateral flap on ventral surface of genital segment, pointed posterior corner protruding in dorsal view.

Etymology.—The specific name, from Latin (*rotatio* = turned), refers to the position of the short anterior seta of the caudal ramus, which is located on the mid-dorsal surface, rather than the usual lateral margin.

Remarks.—*Oncaea rotata* appears to have an affinity to *O. illgi* with similar characters such as robust appearance of prosome, diminutive second antenna, and the exterior ornamentation of the labrum. The shape and length of leg 4 endopod as well as the mid-dorsal location of the proximal short seta of the caudal ramus of *O. rotata* distinguish it from *O. illgi*.

Oncaea brocha Heron, 1977
Fig. 1J

Oncaea brocha Heron, 1977:60, figs. 14f–n, 15a–h.–Malt 1982a:190, fig. 10g–k.

Material examined.—See Table 3.

Female.—Mean lengths of 3 specimens: TL 0.82 mm (0.81–0.83 mm), PL 0.57 mm (0.56–0.57 mm).

Male.—Length of 1 specimen: TL 0.69 mm, PL 0.48 mm.

Oncaea olsoni Heron, 1977
Fig. 2A

Oncaea olsoni Heron, 1977:60, 62, figs. 15i–l, 16.

Material examined.—See Table 3.

Female.—Mean lengths of 10 specimens: TL 0.80 mm (0.72–0.85 mm), PL 0.55 mm (0.52–0.57 mm).

Male.—Length of 1 specimen: TL 0.70 mm, PL 0.48 mm; a second male damaged.

Oncaea damkaeri Heron, 1977
Figs. 2B, 14H

Oncaea damkaeri Heron, 1977:62, 65, figs. 17, 18a–e.

Material examined.—See Table 3.

Female.—Mean lengths of 8 specimens: TL 0.74 mm (0.67–0.78 mm), PL 0.52 mm (0.48–0.53 mm).

Remarks.—The female leg 5 of *O. damkaeri* distinguishes it from other similar species, with the length of the terminal, longer spiniform seta exceeding the length of the leg 5 segment and measuring more than twice the length of the shorter seta (Fig. 14H).

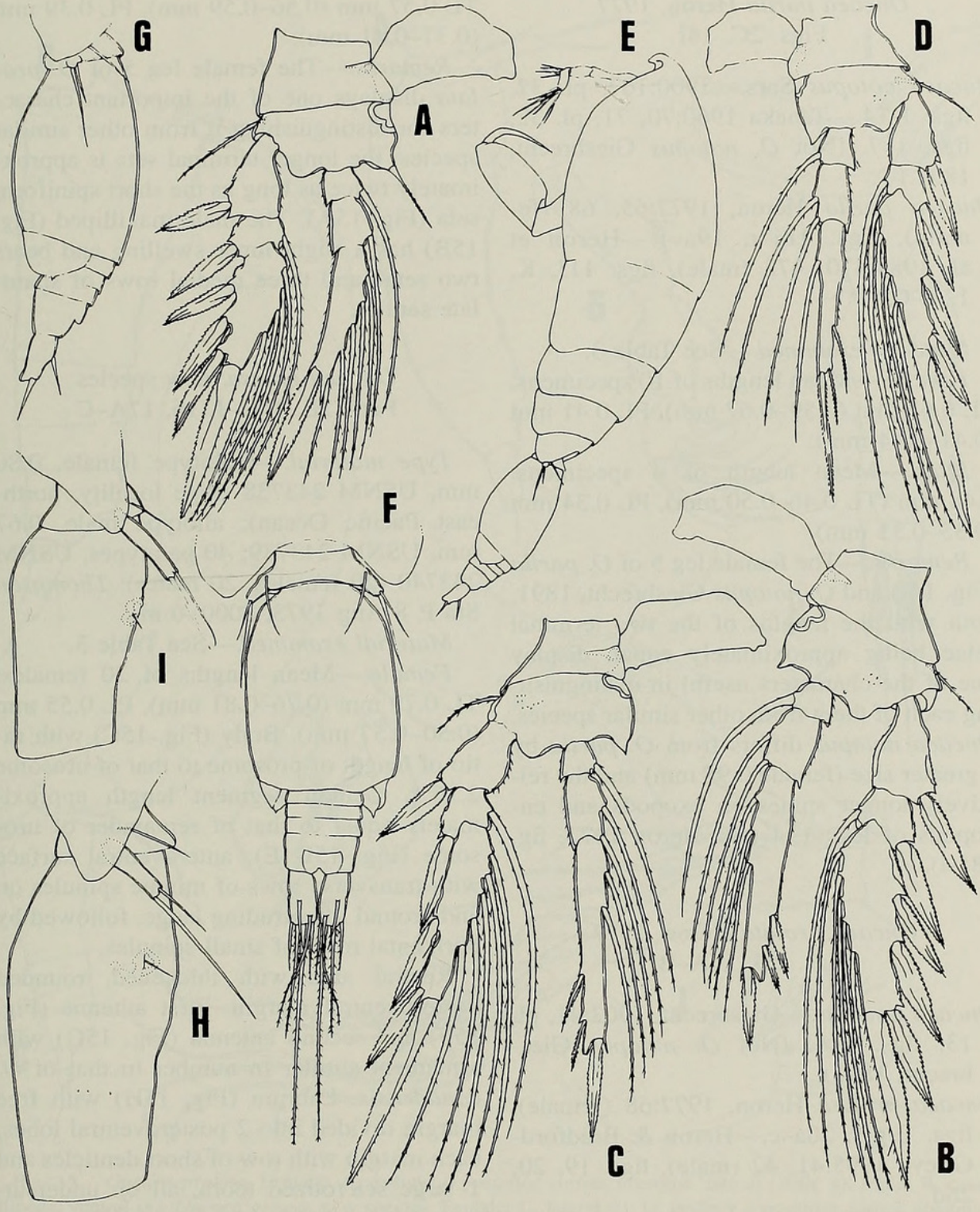

Fig. 14. *Oncaea rotata,* new species. Female: A, leg 1 (scale x); B, leg 2 (x); C, leg 3 (x); D, leg 4 (x). Male: E, lateral (w); F, pediger 4 posterior corner, urosome, dorsal (x); G, pediger 4 posterior corner, urosome, lateral (x). *Oncaea damkaeri,* Female: H, pediger 4 posterior corner, segment of leg 5, genital segment, lateral (x). *Oncaea parila.* Female: I, pediger 4 posterior corner, segment of leg 5, genital segment, lateral (x).

Oncaea parila Heron, 1977
Figs. 2C, 14I

Oncaea notopus Sars.—1900:107, pl. 32, figs. 1-14.—Tanaka 1960:70, 71, pl. 32, figs. 1–7. (Not *O. notopus* Giesbrecht, 1891.)

Oncaea parila Heron, 1977:65, 68 (female), figs. 18j–r, 19a–f.—Heron et al. 1984:470, 472 (male), figs. 11J, K, 12A–C.

Material examined.—See Table 3.

Female.—Mean lengths of 10 specimens: TL 0.62 mm (0.59–0.67 mm), PL 0.41 mm (0.41–0.44 mm).

Male.—Mean length of 4 specimens: 0.48 mm (TL 0.46–0.50 mm), PL 0.34 mm (0.33–0.35 mm).

Remarks.—The female leg 5 of *O. parila* (Fig. 14I) and *O. notopus* Giesbrecht, 1891, both with the lengths of the two terminal setae being approximately equal, display one of the characters useful in distinguishing each of them from other similar species. *Oncaea notopus* differs from *O. parila* by a greater size (female 0.95 mm) and the relatively longer spines on exopods and endopods of legs 1–4 (see Heron 1977, fig. 18f–i).

Oncaea prolata Heron, 1977
Figs. 2D, 15A–B

Oncaea notopus.—Giesbrecht, 1902:41, pl. 13, figs. 1–6. (Not *O. notopus* Giesbrecht, 1891).

Oncaea prolata Heron, 1977:68 (female), figs. 19g–r, 20a–c.—Heron & Bradford-Grieve 1995:41, 42 (male), figs. 19, 20, 26d.

Material examined.—See Table 3. Reference specimens: USNM 243748 (10 females, 10 males): *Hoh* Dabob Bay, 24 Jun 1985, 180–0 m.

Female.—Mean lengths of 10 specimens: TL 0.68 mm (0.64–0.70 mm, PL 0.47 mm (0.44–0.48 mm).

Male.—Mean lengths of 10 specimens: TL 0.57 mm (0.56–0.59 mm), PL 0.39 mm (0.37–0.41 mm).

Remarks.—The female leg 5 of *O. prolata* displays one of the important characters for distinguishing it from other similar species: the longer terminal seta is approximately twice as long as the short spiniform seta (Fig. 15A). The male maxilliped (Fig. 15B) has a slight inner swelling and bears two setae and three medial rows of spatulate setules.

Oncaea grossa. new species
Figs. 2E, 15C–J, 16, 17A–C

Type material.—Holotype female, 0.80 mm, USNM 243738 (type locality, northeast Pacific Ocean); allotype male, 0.67 mm, USNM 243739; 40 paratypes, USNM 243740 (20 females, 20 males): *Thompson* Sta P, 8 Aug 1973, 3000–0 m.

Material examined.—See Table 3.

Female.—Mean lengths of 20 females: TL 0.79 mm (0.76–0.81 mm), PL 0.55 mm (0.50–0.57 mm). Body (Fig. 15C) with ratio of length of prosome to that of urosome 2.16:1. Genital segment length approximately equal to that of remainder of urosome (Fig. 15D–E); anteroventral surface with transverse rows of minute spinules on and around a protruding ledge, followed by horizontal rows of small spinules.

Rostral area with thickened, rounded posteroventral margin. First antenna (Fig. 15F) and second antenna (Fig. 15G) with armament similar in number to that of *O. canadensis*. Labrum (Fig. 15H) with free margin divided into 2 posteroventral lobes; each margin with row of short denticles and 1 large sclerotized tooth, all on undersurface; lobes separated by semicircular vertex from which arise several thin lamellae and a medial tuft with thin setules. Mandible (Fig. 15I), first maxilla (Fig. 15J), second maxilla (Fig. 16A), and maxilliped (Fig. 16B) with armament similar in number to that of *O. canadensis*.

Legs 1–4 (Fig. 16C–F) with armament similar in number to that of *O. canadensis*;

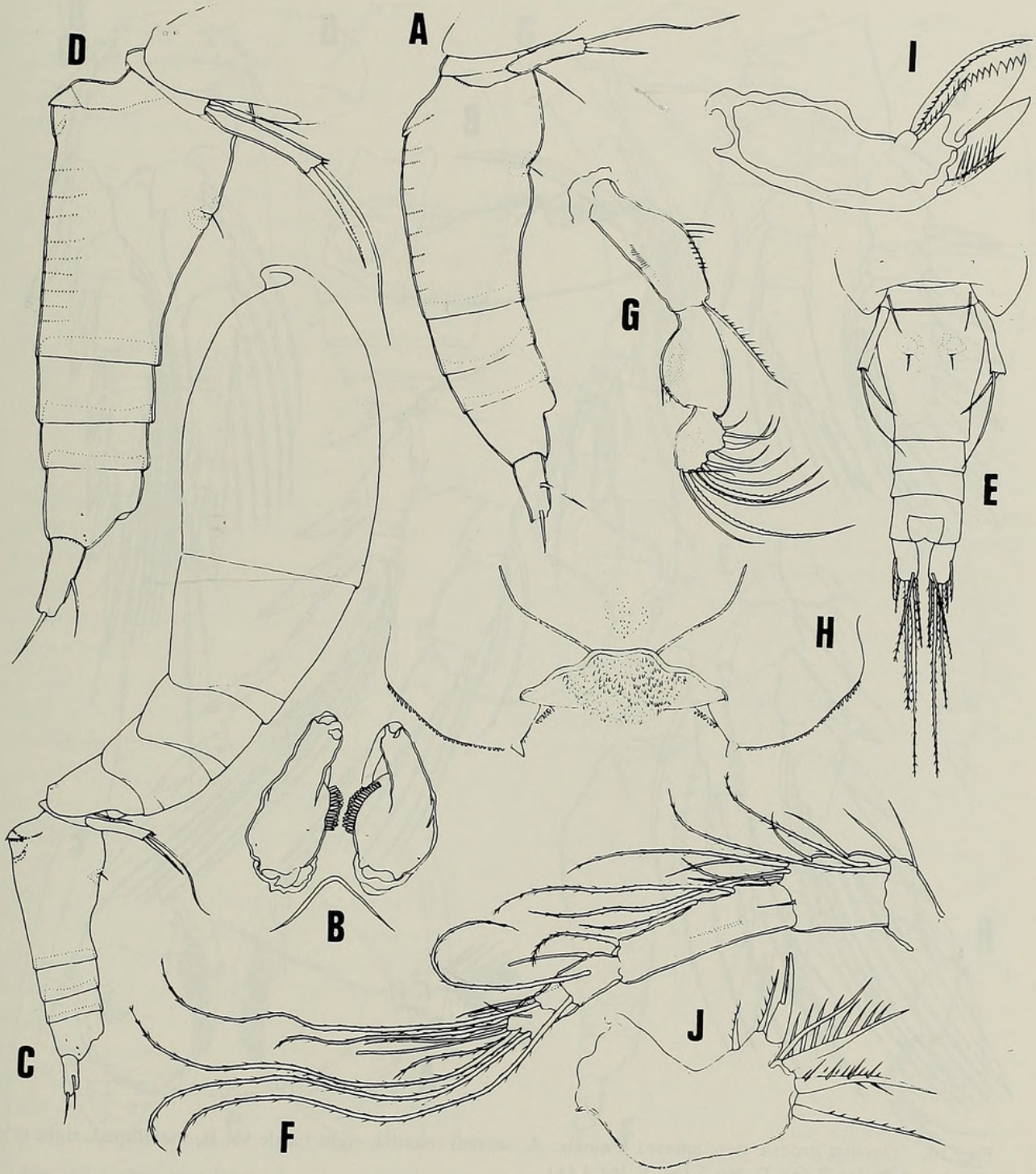

Fig. 15. *Oncaea prolata.* Female: A, pediger 4 posterior corner, urosome, lateral (scale x). Male: B, maxillipeds, ventral (x). *Oncaea grossa,* new species. Female: C, lateral (t); D, pediger 4 posterior corner, urosome, lateral (x); E, pediger 4 posterior corner, urosome, dorsal (t); F, first antenna, right (x); G, second antenna, right (x); H, labrum (y); I, mandible, left (y); J, first maxilla, right (y).

endopods of legs 2 and 3 with a small terminal cone, leg 4 without. Leg 5 with elongate free segment; 2 terminal setae, the longer less than twice the length of the shorter, which is dentiform; outer basal seta. Leg 6 represented by spiniform setule on gonopore.

Male.—Mean length of 20 males: TL 0.69 mm (0.63–0.70 mm), PL 0.47 mm (0.41–0.48 mm). Body (Fig. 17A) with ra-

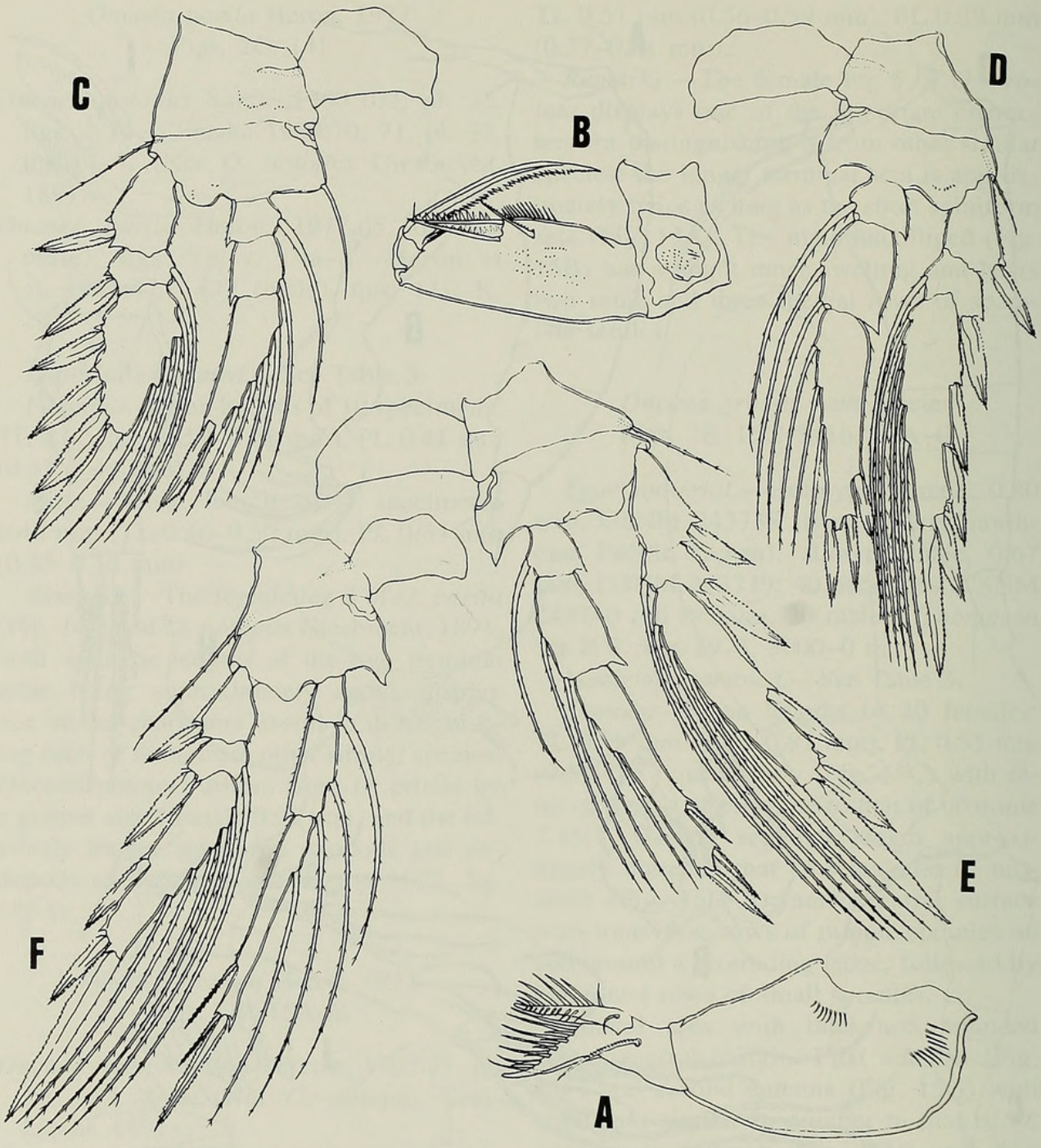

Fig. 16. *Oncaea grossa,* new species. Female: A, second maxilla, right (scale v); B, maxilliped, right (x); C, leg 1 (x); D, leg 2 (x); E, leg 3 (x); F, leg 4 (x).

tio of length of prosome to that of urosome 1.97:1. Urosome (Fig. 17B) with caudal setae proportional lengths as in female. Maxilliped (Fig. 17C) second segment proximally enlarged with 3 rows of wide, lamellate setules on inner posterior rim and conspicuous areas of sclerotization proximally; tip of claw with terminal lamella. Swimming legs as in female. Leg 5 (see Fig. 17B) not delimited from thoracic segment; armament similar to that of female. Leg 6 represented by posterolateral flap on ventral surface of genital segment.

Etymology.—The specific name, from Latin (*grossa* = big, thick), refers to the conspicuously large size of the male maxilliped.

Remarks.—In addition, 11 females (TL

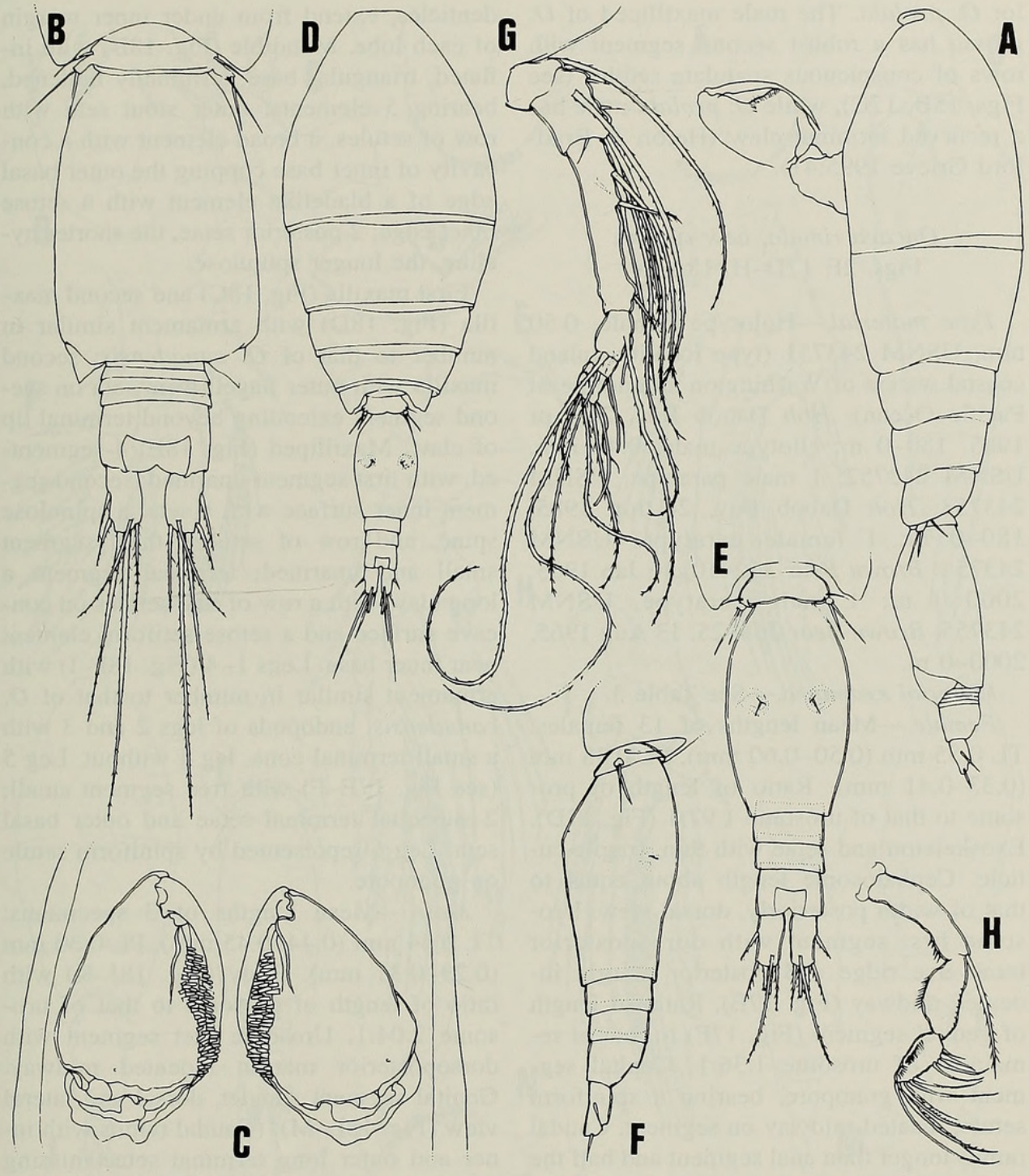

Fig. 17. *Oncaea grossa,* new species. Male: A, lateral (scale t); B, pediger 4 posterior corner, urosome, dorsal (x); C, maxillipeds, ventral (x). *Oncaea rimula,* new species. Female: D, dorsal (w); E, pediger 4 posterior corner, urosome, dorsal (x); F, pediger 4 posterior corner, urosome, lateral (x); G, first antenna, left (x); H, second antenna, left (x).

0.76–0.81 mm, PL 0.56–0.58 mm) and five males (TL 0.63–0.70 mm, PL 0.45–0.48 mm) of *O. grossa* were identified from Prince William Sound, Alaska. *Oncaea grossa* closely resembles *O. prolata* in many characters, but may be separated by noting the larger size of *O. grossa* and the more robust appearance of the female genital segment in lateral view. The shorter terminal seta of the female leg 5 for both species has a denticulate margin, but denticles are conspicuous for *O. grossa* and obscure

for *O. prolata*. The male maxilliped of *O. grossa* has a robust second segment with rows of conspicuous spatulate setules (see Figs. 15B, 17C), while *O. prolata* male has a recurved terminal claw (Heron & Bradford Grieve 1995:41).

Oncaea rimula, new species
Figs. 2F, 17D–H, 18A–N

Type material.—Holotype female, 0.50 mm, USNM 243751 (type locality, inland coastal waters of Washington and northeast Pacific Ocean): *Hoh* Dabob Bay, 25 Apr 1985, 180–0 m; allotype male, 0.44 mm, USNM 243752; 1 male paratype, USNM 243753: *Hoh* Dabob Bay, 24 Jun 1985, 180–0 m; 1 female paratype, USNM 243754: *Brown Bear* 352–10, 16 Jan 1965, 2000–0 m; 1 male paratype, USNM 243755: *Brown Bear* 368–25, 13 Aug 1965, 2000–0 m.

Material examined.—See Table 3.

Female.—Mean lengths of 13 females: TL 0.55 mm (0.50–0.60 mm), PL 0.38 mm (0.33–0.41 mm). Ratio of length of prosome to that of urosome 1.97:1 (Fig. 17D). Exoskeleton and setae with thin, fragile cuticle. Cephalosome length about equal to that of width posteriorly, dorsal view. Urosome first segment with dorsoposterior transverse ridge and posterior margin indented midway (Fig. 17E). Ratio of length of genital segment (Fig. 17F) to that of remainder of urosome 1.36:1. Genital segment with gonopore, bearing a spiniform setule, located midway on segment. Caudal ramus longer than anal segment and half the length of dorsal seta (inner long terminal seta missing on specimens examined).

Rostral area with thickened, rounded margin. First antenna (Fig. 17G) and second antenna (Fig. 17H) with armament similar in number to that of *O. canadensis*. Labrum (Fig. 18A) with posterior free margin divided into 2 posteroventral lobes and separated by a semicircular vertex from which arises a thin lamella ornamented with fine setules; imbricated flanges, bearing small denticles, extend from under inner margin of each lobe. Mandible (Fig. 18B) with inflated, triangular base, terminally flattened, bearing 5 elements: outer stout seta with row of setules, a broad element with a concavity of inner base cupping the outer basal edge of a bladelike element with a setose inner edge; 2 posterior setae, the shorter hyaline, the longer spinulose.

First maxilla (Fig. 18C) and second maxilla (Fig. 18D) with armament similar in number to that of *O. canadensis*; second maxilla with outer flagelliform seta on second segment extending beyond terminal tip of claw. Maxilliped (Fig. 18E) 4-segmented, with first segment unarmed; second segment inner surface with a seta, a spinulose spine, and row of setules; third segment small and unarmed; terminal segment a long claw with a row of fine setules on concave surface and a setose setiform element near inner base. Legs 1–4 (Fig. 18F–I) with armament similar in number to that of *O. canadensis*; endopods of legs 2 and 3 with a small terminal cone, leg 4 without. Leg 5 (see Fig. 17E–F) with free segment small; 2 subequal terminal setae and outer basal seta. Leg 6 represented by spiniform setule on gonopore.

Male.—Mean lengths of 3 specimens: TL 0.44 mm (0.44–0.45 mm), PL 0.30 mm (0.29–0.31 mm). Body (Fig. 18J–K) with ratio of length of prosome to that of urosome 2.04:1. Urosome first segment with dorsoposterior margin indented midway. Genital segment slender, dorsal and lateral view (Fig. 18L–M). (Caudal ramus with inner and outer long terminal setae missing on specimens examined.) Maxilliped (Fig. 18N) second segment with 3 rows of spatulate setules on inner surface, and a seta replacing the spinulose spine. Swimming legs and leg 5 as in female. Leg 6 represented by posterolateral point-tipped flap on ventral surface of genital segment.

Etymology.—The specific name, from Latin (*rima* = cleft), refers to the small indentation on the dorsoposterior margin of the first segment of the urosome.

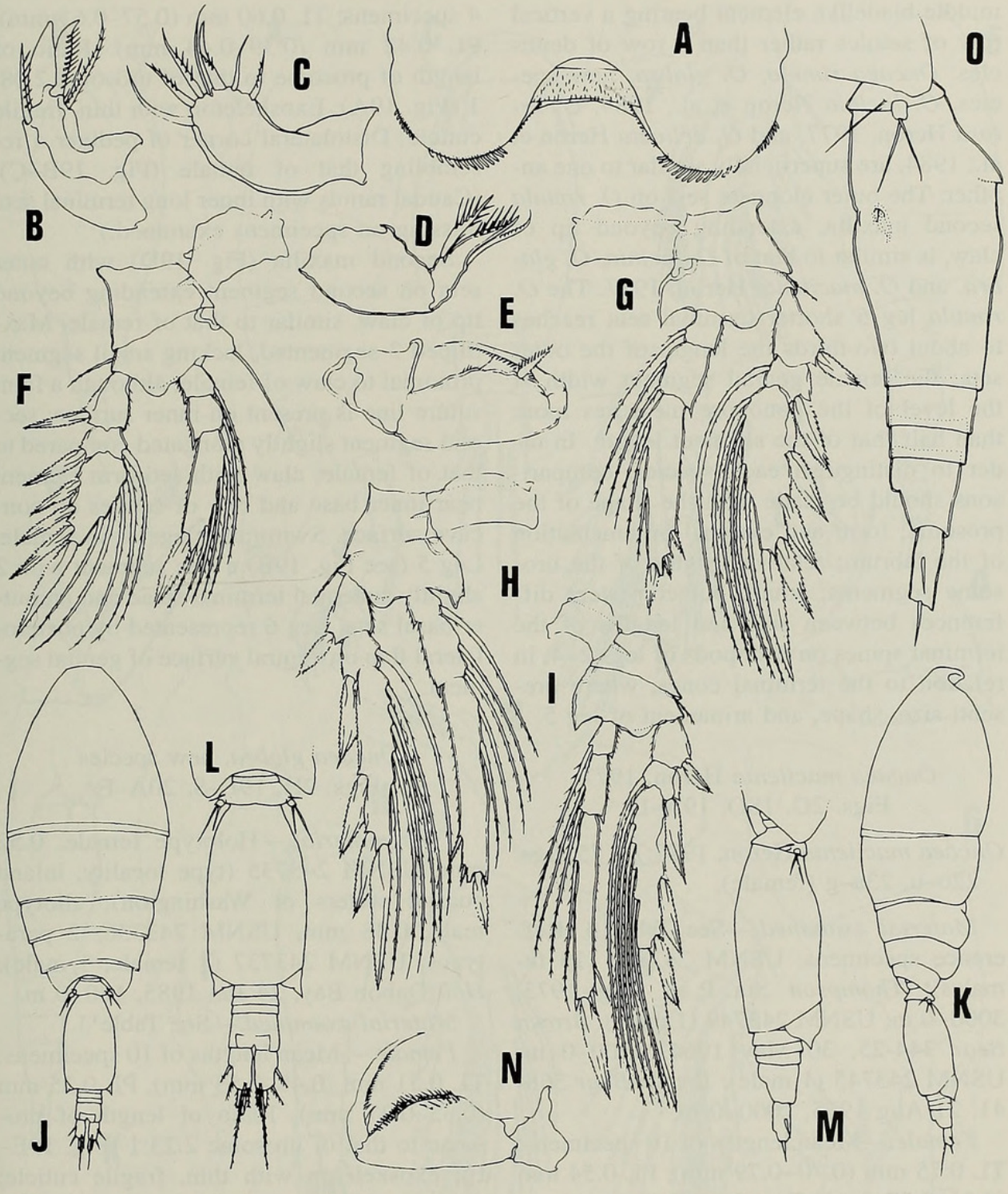

Fig. 18. *Oncaea rimula,* new species. Female: A, labrum (scale y); B, mandible, left (y); C, first maxilla, right (y); D, second maxilla, left (z); E, maxilliped, left (x); F, leg 1 (x); G, leg 2 (x); H, leg 3 (x); I, leg 4 (x). Male: J, dorsal (t); K, lateral (t); L, pediger 4 posterior corner, urosome, dorsal (x); M, pediger 4 posterior corner, urosome, lateral (x); N, maxilliped, left (z). *Oncaea macilenta.* Female: O, pediger 4 posterior corner, urosome, lateral (x).

Remarks.—Oncaea rimula, with a thin exoskeleton, is exceedingly fragile. The long caudal setae, when not broken, taper to a very fine distal half of a seta; contrarily, the dentate flange of the swimming legs is prominent. The mandible of *O. rimula* and those of all of the succeeding species differ from the preceding species by the

middle bladelike element bearing a vertical row of setules rather than a row of denticles. *Oncaea rimula, O. glabra,* new species, *O. lacinia* Heron et al., 1984, *O. setosa* Heron, 1977, and *O. delicata* Heron et al., 1984, are superficially similar to one another. The outer elongate seta on *O. rimula* second maxilla, extending beyond tip of claw, is similar to that of *O. lacinia, O. glabra,* and *O. macilenta* Heron, 1977. The *O. rimula* leg 5 shorter terminal seta reaches to about two-thirds the length of the outer seta; the female genital segment width at the level of the gonopore measures more than half that of the segment length. In order to distinguish each species, comparisons should be made with the shape of the prosome; form and external ornamentation of the labrum; relative lengths of the urosome segments; small, but consistent differences between size and lengths of the terminal spines on endopods of legs 2–4, in relation to the terminal cones, where present; size, shape, and armament of leg 5.

Oncaea macilenta Heron, 1977
Figs. 2G, 18O, 19A–D

Oncaea macilenta Heron, 1977:73, 75, figs. 22o–u, 23a–g (female).

Material examined.—See Table 3. Reference specimens: USNM 243743 (15 females): *Thompson* Sta P, 8 Aug 1973, 3000–0 m; USNM 243749 (1 male): *Brown Bear* 344-25, 30 May 1964, 4500–0 m; USNM 243745 (1 male): *Brown Bear* 368-41, 21 Aug 1965, 2000–0 m.

Female.—Mean lengths of 10 specimens: TL 0.75 mm (0.70–0.79 mm), PL 0.54 mm (0.51–0.57 mm). Females of *O. macilenta* show a squared distolateral corner of pediger 4 with a slight dorsal indentation (Fig. 18O). Genital segment bears a conspicuous anteroventral transverse ridge lined with minute denticles. (Caudal ramus with inner long terminal seta missing on specimens examined.)

Male.—The male of *O. macilenta* is described for the first time. Mean lengths of 4 specimens: TL 0.60 mm (0.57–0.63 mm), PL 0.42 mm (0.39–0.44 mm). Ratio of length of prosome to that of urosome 2.08:1 (Fig. 19A). Exoskeleton with thin, fragile cuticle. Distolateral corner of pediger 4 resembling that of female (Fig. 19B–C). (Caudal ramus with inner long terminal seta missing on specimens examined.)

Second maxilla (Fig. 19D) with outer seta on second segment extending beyond tip of claw, similar to that of female. Maxilliped 3-segmented, lacking small segment proximal to claw of female, although a faint suture line is present on inner surface; second segment slightly elongated compared to that of female; claw with setiform element near inner base and row of setules on concave surface. Swimming legs as in female. Leg 5 (see Fig. 19B) a free segment with 2 slightly subequal terminal setae and an outer basal seta. Leg 6 represented by posterolateral flap on ventral surface of genital segment.

Oncaea glabra, new species
Figs. 2H, 19E–S, 20A–E

Type material.—Holotype female, 0.52 mm, USNM 243735 (type locality, inland coastal waters of Washington); allotype male, 0.48 mm, USNM 243736; 2 paratypes, USNM 243737 (1 female, 1 male): *Hoh* Dabob Bay, 24 Jun 1985, 180–0 m.

Material examined.—See Table 3.

Female.—Mean lengths of 10 specimens: TL 0.51 mm (0.48–0.53 mm), PL 0.35 mm (0.33–0.37 mm). Ratio of length of prosome to that of urosome 2.23:1 (Fig. 19E–F); exoskeleton with thin, fragile cuticle; cephalosome slender, with width posteriorly about same as that of pediger 1, widest point for normal specimens, dorsal view (prosome occasionally expanded abnormally (Fig. 19G) when invaded by unidentified microorganisms). Ratio of genital segment length to that of remainder of urosome 1.11:1 (Fig. 19H). Genital segment with ledge protruding on anteroventral surface, conspicuous in lateral view (Fig. 19I); gon-

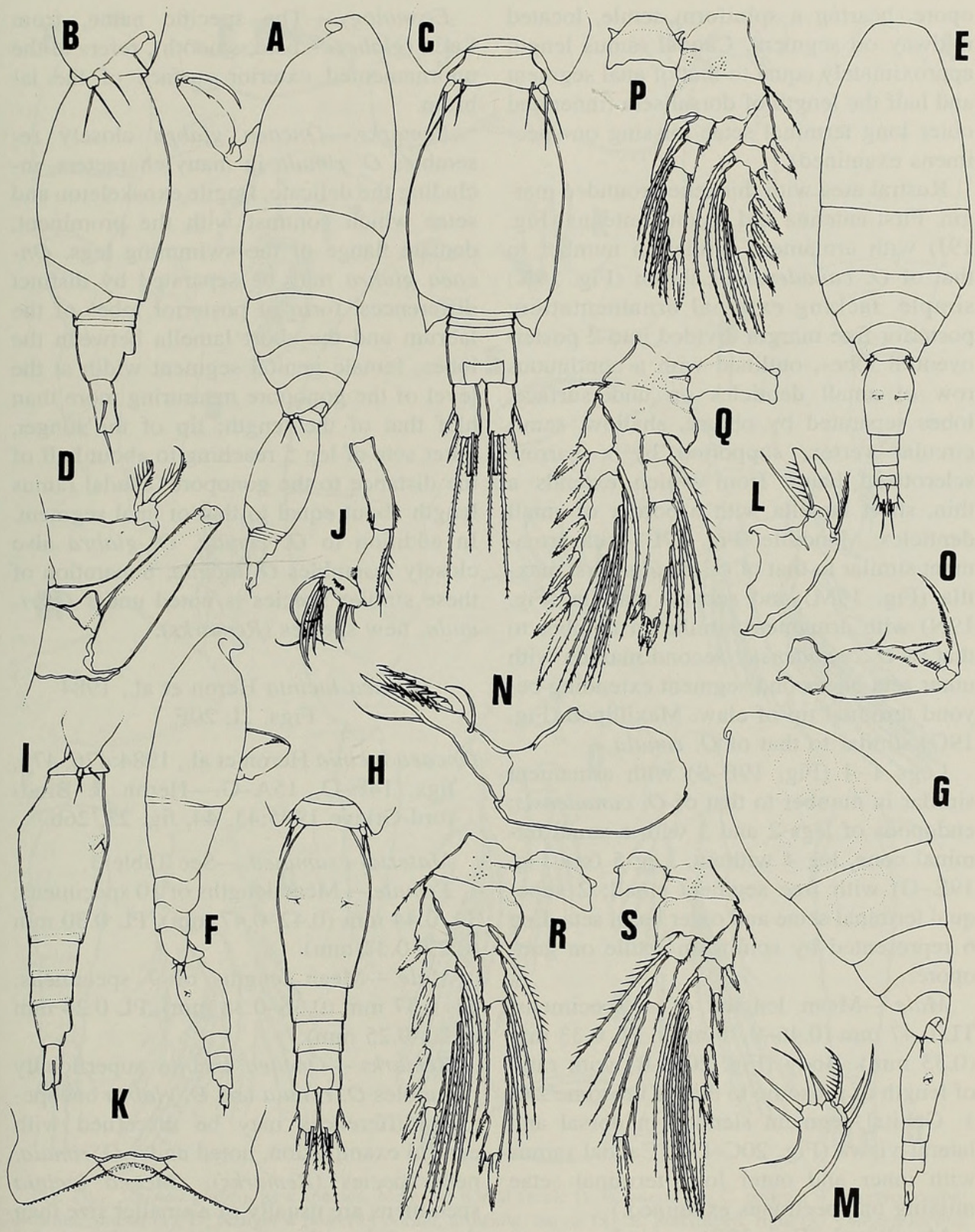

Fig. 19. *Oncaea macilenta.* Male: A, lateral (scale w); B, pediger 4 posterior corner, urosome, lateral (x); C, pediger 4 posterior corner, urosome, dorsal (x); D, second maxilla, maxilliped, lateral (in situ) (x). *Oncaea glabra,* new species. Female: E, dorsal (w); F, lateral (w); G, lateral, abnormally expanded prosome (w); H, pediger 4 posterior corner, urosome, dorsal (x); I, pediger 4 posterior corner, urosome, lateral (x); J, second antenna, left (x); K, labrum (y); L, mandible, left (y); M, first maxilla, left (y); N, second maxilla, right (y); O, maxilliped, right (x); P, leg 1 (x); Q, leg 2 (x); R, leg 3 (x); S, leg 4 (x).

opore, bearing a spiniform setule, located midway on segment. Caudal ramus length approximately equal to that of anal segment and half the length of dorsal seta (inner and outer long terminal setae missing on specimens examined).

Rostral area with thickened rounded margin. First antenna and second antenna (Fig. 19J) with armament similar in number to that of *O. canadensis.* Labrum (Fig. 19K) simple, lacking external ornamentation; posterior free margin divided into 2 posteroventral lobes, outlined with a continuous row of small denticles on undersurface; lobes separated by obtuse, shallow, semicircular vertex, supported by a narrow sclerotized band, from which extends a thin, short lamella with a border of small denticles. Mandible (Fig. 19L) with armament similar to that of *O. rimula.* First maxilla (Fig. 19M) and second maxilla (Fig. 19N) with armament similar in number to that of *O. canadensis:* second maxilla with outer seta on second segment extending beyond terminal tip of claw. Maxilliped (Fig. 19O) similar to that of *O. rimula.*

Legs 1–4 (Fig. 19P–S) with armament similar in number to that of *O. canadensis*; endopods of legs 2 and 3 with a small terminal cone, leg 4 without. Leg 5 (see Fig. 19E–G) with free segment small; 2 subequal terminal setae and outer basal seta. Leg 6 represented by spiniform setule on gonopore.

Male.—Mean lengths of 4 specimens: TL 0.47 mm (0.46–0.48 mm), PL 0.33 mm (0.33 mm). Body (Fig. 20A–B) with ratio of length of prosome to that of urosome 2.0: 1. Genital segment slender, in dorsal and lateral views (Fig. 20C–D). (Caudal ramus with inner and outer long terminal setae missing on specimens examined.)

Maxilliped (Fig. 20E) second segment elongate with rows of spatulate setules on inner surface, and a seta replacing the spinulose spine. Swimming legs and leg 5 as in female. Leg 6 represented by posterolateral point-tipped flap on ventral surface of genital segment.

Etymology.—The specific name, from Latin (*glaber* = bald, smooth), refers to the unornamented exterior surface of the labrum.

Remarks.—*Oncaea glabra* closely resembles *O. rimula* in many characters, including the delicate, fragile exoskeleton and setae which contrast with the prominent, dentate flange of the swimming legs. *Oncaea glabra* may be separated by distinct differences: form of posterior lobes of the labrum and the short lamella between the lobes; female genital segment width at the level of the gonopore measuring more than half that of the length; tip of the longer, outer seta of leg 5 reaching to about half of the distance to the gonopore; caudal ramus length about equal to that of anal segment. In addition to *O. rimula, O. glabra* also closely resembles *O. lacinia.* Separation of these similar species is noted under *O. rimula,* new species (*Remarks*).

Oncaea lacinia Heron et al., 1984
Figs. 2I, 20F

Oncaea lacinia Heron et al., 1984:476, 478, figs. 14F–O, 15A–G.—Heron & Bradford-Grieve 1995:43, 44, fig. 23, 26b.

Material examined.—See Table 3.

Female.—Mean lengths of 10 specimens: TL 0.44 mm (0.42–0.47 mm), PL 0.30 mm (0.29–0.34 mm).

Male.—Mean lengths of 7 specimens: TL 0.37 mm (0.36–0.38 mm), PL 0.24 mm (0.23–0.25 mm).

Remarks.—*Oncaea lacinia* superficially resembles *O. rimula* and *O. glabra* but specific differences may be discerned with careful examination, noted under *O. rimula,* new species (*Remarks*). *Oncaea lacinia* specimens are usually of a smaller size than those of the other two species; the caudal ramus is slightly longer than the anal segment (Fig. 20F); the width of the female genital segment at the level of the gonopore is close to half that of the length; the length of the shorter terminal seta of leg 5 is half or less than that of the outer seta; the tip of

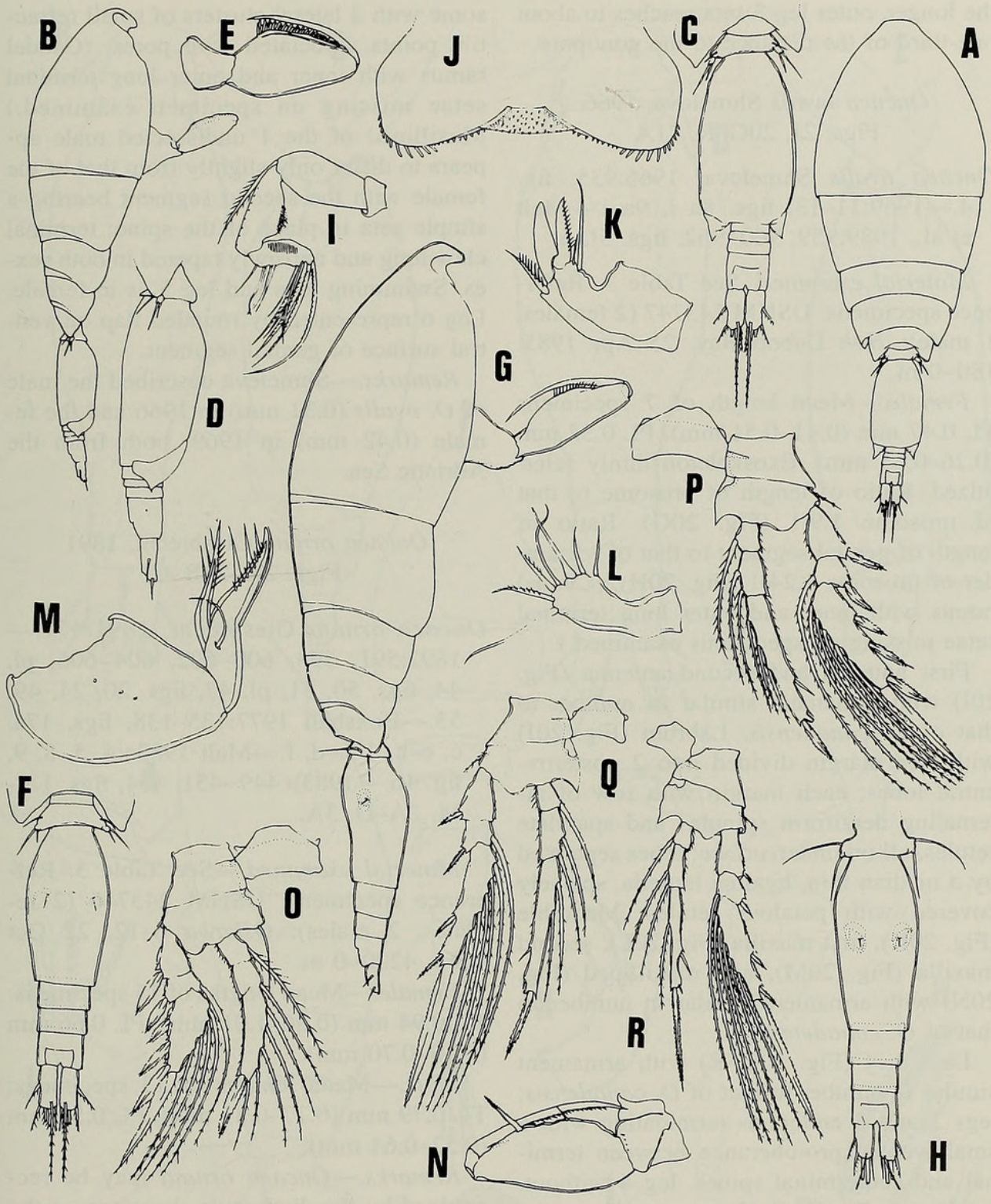

Fig. 20. *Oncaea glabra,* new species. Male: A, dorsal (scale t); B, lateral (t); C, pediger 4 posterior corner, urosome, dorsal (x); D, pediger 4 posterior corner, urosome, lateral (x); E, maxilliped, right (x). *Oncaea lacinia.* Female: F, pediger 4 posterior corner, urosome, dorsal (x). *Oncaea ovalis.* Female: G, lateral (s); H, urosome, dorsal (x); I, second antenna, right (z); J, labrum (y); K, mandible, right (y); L, first maxilla, left (y); M, second maxilla, left (y); N, maxilliped, right (x); O, leg 1 (x); P, leg 2 (x); Q, leg 3 (x); R, leg 4 (x).

the longer, outer leg 5 seta reaches to about one-third of the distance to the gonopore.

Oncaea ovalis Shmeleva, 1966
Figs. 2J, 20G–R, 21A

Oncaea ovalis Shmeleva, 1966:935, fig. 4.—1969:11–13, figs. 8a–i, 9a–i.—Malt et al., 1989:959, 960–962, figs. 5I, 6.

Material examined. See Table 3. Reference specimens: USNM 243747 (2 females, 1 male): *Hoh* Dabob Bay, 25 Apr 1985, 180–0 m.

Female.—Mean length of 7 specimens TL 0.47 mm (0.41–0.51 mm), PL 0.32 mm (0.26–0.35 mm). Exoskeleton thinly sclerotized. Ratio of length of prosome to that of urosome 1.9:1 (Fig. 20G). Ratio of length of genital segment to that of remainder of urosome 1.24:1 (Fig. 20H). (Caudal ramus with inner and outer long terminal setae missing on specimens examined.)

First antenna and second antenna (Fig. 20I) with armament similar in number to that of *O. canadensis*. Labrum (Fig. 20J) with free margin divided into 2 posteroventral lobes; each margin with row of alternating dentiform spinules and spatulate setules, all on undersurface; lobes separated by a median thin, hyaline lamella, sparsely covered with petaloid setules. Mandible (Fig. 20K), first maxilla (Fig. 20L), second maxilla (Fig. 20M), and maxilliped (Fig. 20N) with armament similar in number to that of *O. canadensis*.

Legs 1–4 (Fig. 20O–R) with armament similar in number to that of *O. canadensis*; legs 2 and 3 endopods terminating with a small vented protuberance between terminal and subterminal spines, leg 4 without. Leg 5 (see Fig. 20G–H) as a small papilla, not delimited from thoracic segment, with 1 terminal seta and an outer long basal seta. Leg 6 represented by spiniform setule on gonopore.

Male.—Length of 1 specimen: TL 0.41 mm, PL 0.27 mm. Ratio of length of prosome to that of urosome 2.22:1 (Fig. 21A). Exoskeleton thinly sclerotized. Cephalosome with 2 lateral clusters of small refractile points associated with pores. (Caudal ramus with inner and outer long terminal setae missing on specimen examined.) Maxilliped of the 1 undissected male appears to differ only slightly from that of the female with the second segment bearing a simple seta in place of the spine; terminal claw long and narrowly tapered in both sexes. Swimming legs and leg 5 as in female. Leg 6 represented by rounded flap on ventral surface of genital segment.

Remarks.—Shmeleva described the male of *O. ovalis* (0.31 mm) in 1966 and the female (0.42 mm) in 1969, both from the Adriatic Sea.

Oncaea ornata Giesbrecht, 1891
Figs. 2K, 21B–C

Oncaea ornata Giesbrecht, 1891:477.—1892:591, 593, 600–602, 604–606, pl. 44, figs. 50, 51, pl. 47, figs. 20, 24, 49, 53.—Boxshall 1977:135–138, figs. 17a, c, e–h, 18a–d, f.—Malt 1983a:4, 5, 8, 9, fig. 16.—1983b:449–451, 454, figs. 1A–M, 2A–D, 3A.

Material examined.—See Table 3. Reference specimens: USNM 243746 (2 females, 2 males): *Oshawa* 6–12, 22 Oct 1964, 4200–0 m.

Female.—Mean lengths of 15 specimens: TL 0.94 mm (0.86–1.01 mm), PL 0.66 mm (0.60–0.70 mm).

Male.—Mean lengths of 13 specimens: TL 0.79 mm (0.77–0.81 mm), PL 0.55 mm (0.52–0.64 mm).

Remarks.—*Oncaea ornata* may be recognized by the distinctive characters of the urosome for both sexes including the ratio of the length of the genital segment to that of remainder of urosome: female 2.15:1 (Fig. 21B); male 2.8:1 (Fig. 21C). There were only two instances in the northeast Pacific samples where *O. ornata* occurred without the co-occurrence of *O. englishi* Heron, 1977, which it closely resembles.

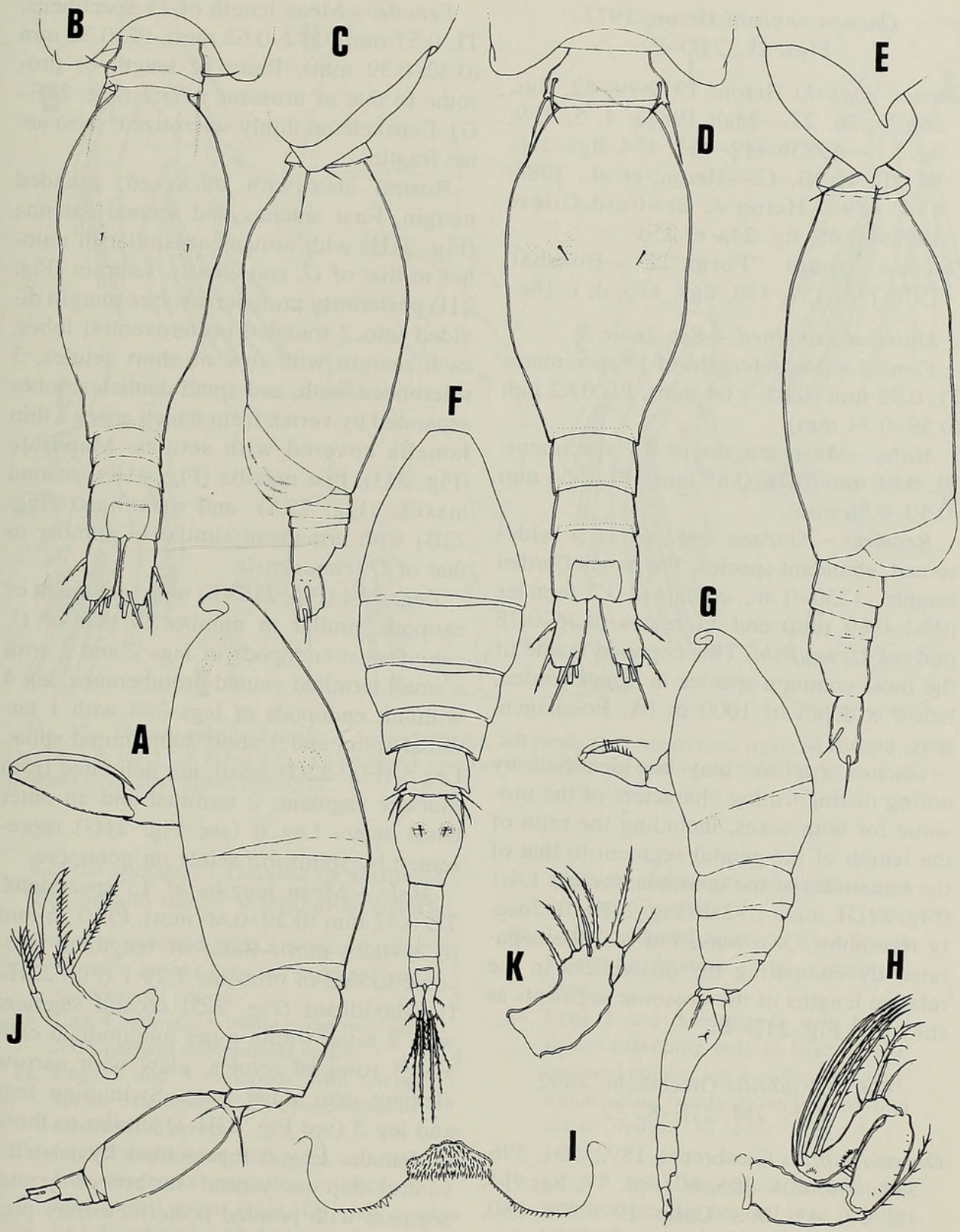

Fig. 21. *Oncaea ovalis.* Male: A, lateral (scale x). *Oncaea ornata.* Female: B, pediger 4 posterior corner, urosome, dorsal (x). Male: C, pediger 3 posterior corner, pediger 4, urosome, lateral (x). *Oncaea englishi.* Female: D, pediger 4 posterior corner, urosome, dorsal (x). Male: E, pediger 3 posterior corner, pediger 4, urosome, lateral (x). *Oncaea subtilis.* Female: F, dorsal (w); G, lateral (w); H, second antenna, right (z); I, labrum (y); J, mandible, right (y); K, first maxilla, left (y).

Oncaea englishi Heron, 1977
Figs. 2L, 21D–E

Oncaea englishi Heron, 1977:79, 82, figs. 25n, o, 26, 27.—Malt 1983a: 4, 5, 8, 9, fig. 17.—1983b:449–451, 454, figs. 1N–W, 2E, F, 3B, C.—Heron, et al., 1984: 478, 479.—Heron & Bradford-Grieve 1995:44, 45, fig. 24a–e, 25d.

Oncaea ornata "Form 2".—Boxshall 1977:135, 137, 138, figs. 17b, d, i, 18e.

Material examined.—See Table 3.

Female.—Mean lengths of 15 specimens: TL 0.92 mm (0.85–1.04 mm), PL 0.62 mm (0.59–0.74 mm).

Male.—Mean lengths of 15 specimens: TL 0.81 mm (0.76–0.85 mm), PL 0.54 mm (0.50–0.56 mm).

Remarks.—*Oncaea englishi* is a widespread, abundant species. The Sognefjorden sample, 1250–0 m, contained 12 females (0.81–0.89 mm) and 11 males (0.76–0.78 mm) of *O. englishi.* This copepod is one of the most common species in Sognefjorden, below a depth of 1000 m (A. Fosshagen, pers. comm.).

Oncaea englishi may be identified by noting distinguishing characters of the urosome for both sexes, including the ratio of the length of the genital segment to that of the remainder of the urosome: female 1.4:1 (Fig. 21D); male 1.92:1 (Fig. 21E). It closely resembles *O. ornata,* but may be separated by comparing the differences in the relative lengths of the urosome segments as shown in Fig. 21B–E.

Oncaea subtilis Giesbrecht, 1892
Figs. 2M, 21F–K, 22

Oncaea subtilis Giesbrecht, 1892: 591, 596, 598, 599, 601–603, 605, pl. 47, figs. 14, 18, 25, 43, 60.—Gallo 1976:275–280, fig. 1A–I.—Malt 1982b: 134–141, figs. 6–9.—1983a:4, 5, 7, 9, fig. 12.

Material examined.—See Table 3. Reference specimens: USNM 243760 (10 females, 10 males): *Hoh* Dabob Bay, 24 Jun 1985, 180–0 m.

Female.—Mean length of 15 specimens: TL 0.57 mm (0.52–0.63 mm), PL 0.35 mm (0.32–0.39 mm). Ratio of length of prosome to that of urosome 1.53:1 (Fig. 21F–G). Exoskeleton thinly sclerotized; most setae fragile.

Rostral area with thickened, rounded margin. First antenna and second antenna (Fig. 21H) with armament similar in number to that of *O. canadensis.* Labrum (Fig. 21I) posteriorly protuberant; free margin divided into 2 rounded posteroventral lobes, each margin with row of short setules, 3 sclerotized teeth, and small denticles; lobes separated by vertex from which arises a thin lamella covered with setules. Mandible (Fig. 21J), first maxilla (Fig. 21K), second maxilla (Fig. 22A), and maxilliped (Fig. 22B) with armament similar in number to that of *O. canadensis.*

Legs 1–4 (Fig. 22C–F) with armament of exopods similar in number to that of *O. canadensis*; endopods of legs 2 and 3 with a small terminal vented protuberance, leg 4 without; endopods of legs 2–4 with 1 terminal spine and 1 short subterminal spine. Leg 5 (Fig. 22G) small, not delimited from thoracic segment; 2 terminal and an outer basal setae. Leg 6 (see Fig. 21G) represented by spiniform setule on gonopore.

Male.—Mean lengths of 15 specimens: TL 0.42 mm (0.39–0.46 mm), PL 0.26 mm (0.24–0.29 mm). Ratio of length of prosome to that of urosome 1.79:1 (Fig. 22H–I). Maxilliped (Fig. 22J) second segment with 2 setae within inner longitudinal cleft and 3 rows of setules; claw with narrow element near inner base. Swimming legs and leg 5 (see Fig. 22H–I) similar to those of female. Leg 6 represented by posteroventral flap on ventral surface of genital segment with pointed posterior corner protruding in dorsal view.

Remarks.—*Oncaea subtilis* third endopodal segment of swimming legs 2–4, with two rather than three terminal spines, is similar to the formula for *O. ornata* and *O. englishi.*

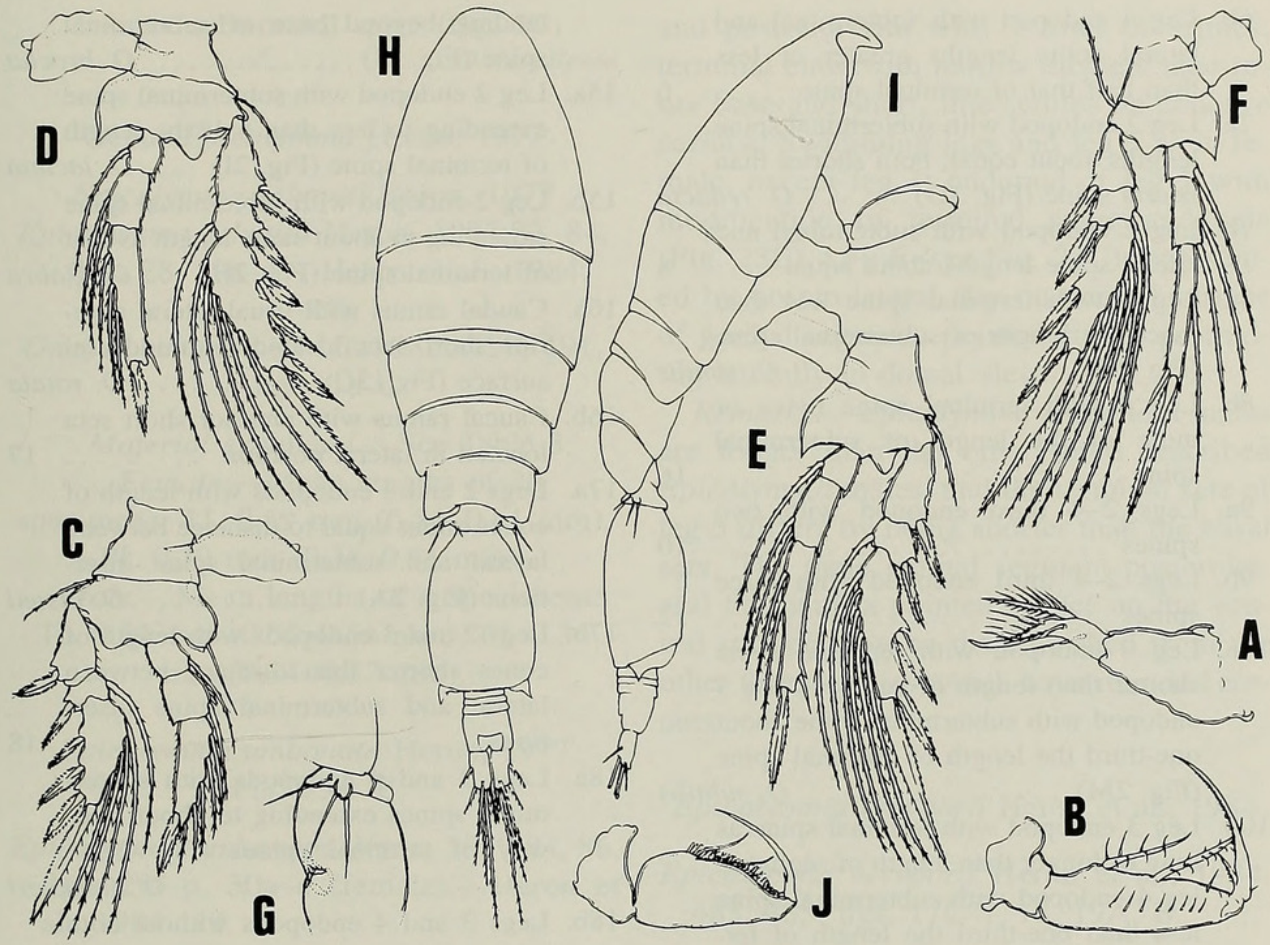

Fig. 22. *Oncaea subtilis*. Female: A, second maxilla, left (scale z); B, maxilliped, right (x); C, leg 1 (x); D, leg 2 (x); E, leg 3 (x); F, leg 4 (x); G, pediger 4 posterior corner and segment of leg 5 (x). Male: H, dorsal (s); I, lateral (s); J, maxilliped, right (x).

Key to species of *Oncaea* in northeast Pacific and inland Washington waters

1a. Leg 4 endopod with a conical protuberance (cone) between terminal and subterminal spines 2
1b. Leg 4 endopod without cone between terminal and subterminal spines 8
2a. Legs 2 and 3 endopods with lateral spines extending to or beyond bases of subterminal spines 3
2b. Legs 2 and 3 endopod spines with lateral spines not extending to base of subterminal spines (Fig. 1G) *O. insolita*
3a. Leg 4 endopod with lateral spine extending just to subterminal spine base (Fig. 1A) ..... *O. canadensis*
3b. Leg 4 endopod with lateral spine extending beyond subterminal spine base 4
4a. Leg 2 endopod terminal spine length reaching about as far as distal margin of cone (Fig. 1B) ..... *O. thoresoni*
4b. Leg 2 endopod terminal spine length extending beyond distal margin of cone 5
5a. Legs 2 and 3 endopods with lateral spines extending only to base of subterminal spines; leg 4 endopod subterminal spine barely extending beyond distal margin of cone (Fig. 1C) ..... *O. derivata*
5b. Legs 2 and 3 endopods with lateral spines extending beyond base of subterminal spines; leg 4 endopod subterminal spine is twice or more the length of the cone 6
6a. Leg 4 endopod with subterminal and lateral spine lengths both about half that of terminal spine (Fig. 1E) ..... *O. borealis*

6b. Leg 4 endopod with subterminal and lateral spine lengths greater or less than half that of terminal spine 6

7a. Leg 2 endopod with subterminal spine lengths about equal, both shorter than lateral spine (Fig. 1D) ..... *O. redacta*

7b. Leg 2 endopod with subterminal and lateral spine lengths about equal 8

8a. Leg 4 with terminal spine less than twice the length of subterminal spine (Fig. 1F) ..... *O. similis*

8b. Leg 4 with terminal spine twice or more of the length of subterminal spine 16

9a. Legs 2–4 third endopod with two spines 10

9b. Legs 2–4 third endopod with three spines 12

10a. Leg 3 endopod with terminal spine shorter than length of segment, leg 4 endopod with subterminal spine about one-third the length of terminal spine (Fig. 2M) ..... *O. subtilis*

10b. Leg 3 endopod with terminal spine as long or longer than length of segment; leg 4 endopod with subterminal spine less than one-third the length of terminal spine 11

11a. Leg 2 endopod terminal spine length about twice that of subterminal spine; leg 4 endopod segment about three-fifths the length of terminal spine and more than two times that of subterminal spine (Fig. 2K) ..... *O. ornata*

11b. Leg 2 endopod with terminal spine length more than three times that of subterminal spine; leg 4 endopod segment length about two-thirds that of terminal spine and about twice that of subterminal spine (Fig. 2L) .. *O. englishi*

12a. Mandible middle bladelike element with inner row of setules (Fig. 20K) 13

12b. Mandible middle bladelike element with inner dentiform margin 14

13a. Leg 5 with one terminal seta and one basal seta (Fig. 20G) ..... *O. ovalis*

13b. Leg 5 with two terminal setae and one basal seta 15

14a. Leg 3 endopod with lateral spine not extending as far as base of subterminal spine (Fig. 1H) ..... *O. illgi*

14b. Leg 3 endopod with lateral spine extending beyond base of subterminal spine (Fig. 1J) ..... *O. brocha*

15a. Leg 2 endopod with subterminal spine extending to less than half the length of terminal spine (Fig. 2I) ... *O. lacinia*

15b. Leg 2 endopod with subterminal spine extending to about same length as that of terminal spine (Fig. 2H) ... *O. glabra*

16a. Caudal ramus with usual lateral anterior short seta located on middorsal surface (Fig.13C) ..... *O. rotata*

16b. Caucal ramus with anterior short seta located in lateral position 17

17a. Legs 2 and 3 endopods with length of cones about equal to distance between lateral and subterminal spine insertions (Fig. 2A) ..... *O. olsoni*

17b. Legs 2 and 3 endopods with length of cones shorter than distance between lateral and subterminal spine insertions 18

18a. Legs 3 and 4 endopods with subterminal spines extending to about midway of terminal spines (Fig. 2B) ..... *O. damkaeri*

18b. Legs 3 and 4 endopods without both subterminal spines extending to about midway of terminal spines 19

19a. Leg 4 endopod with subterminal spine half the length of terminal spine and lateral spine longer than leg 3 terminal spine (Fig. 2C) ..... *O. parila*

19b. Leg 4 endopod with subterminal spine less than half the length of terminal spine and lateral spine shorter than leg 3 terminal spine 20

20a. Leg 3 endopod with lateral spine extending about as distal margin of cone (Fig. 2D) ..... *O. prolata*

20b. Leg 3 endopod with lateral spine not extending as far as distal margin of cone 21

21a. Leg 2 with lateral spine extending beyond distal margin of cone (Fig. 2E) ..... *O. grossa*

21b. Leg 2 with lateral spine not extending to base of cone 22

22a. Legs 2 and 3 endopod with lateral spine extending to base of subterminal spine (Fig. 2F) ..... *O. rimula*

22b. Legs 2 and 3 endopod with lateral spine extending about half as far as

base of subterminal spine (Fig. 2G) ..... *O. macilenta*

Genus *Epicalymma* Heron, 1977

Epicalymma schmitti Heron, 1977

Epicalymma schmitti Heron, 1977:82, 84, figs. 28, 29a–e.—Heron et al., 1984: 488.

Oncaea schmitti.—Malt 1982b:190, 191, fig. 11a–d.

Material examined.—See Table 3.

Female.—Mean lengths of 20 specimens: TL 0.59 mm (0.56–0.61 mm), PL 0.39 mm (0.36–0.41 mm).

Male.—Mean lengths of 4 specimens: TL 0.54 mm (0.52–0.56 mm), PL 0.36 mm (0.34–0.37 mm).

Epicalymma umbonata Heron, 1977
Fig. 23A–E

Epicalymma umbonata Heron, 1977:84, 86, figs. 29f–p, 30a–c (female).—Heron et al., 1984:489.

Oncaea umbonata.—Malt 1982b:191, 193, fig. 11e–h.

Material examined.—See Table 3.

Female.—Mean lengths of 4 specimens: TL 0.70 mm (0.65–0.72 mm), PL 0.47 mm (0.44–0.48 m).

Male.—The male of *E. umbonata* is described for the first time. Lengths of 2 specimens: TL 0.64, 0.67 mm, PL 0.41, 0.44 mm. Body (Fig. 23A, B) with comparatively compact appearance, similar to that of female; ratio of length of prosome to that of urosome 1.77:1. Exoskeleton thinly sclerotized. Genital segment (Fig. 23C) with robust appearance in lateral and dorsal view; caudal ramus with conspicuous expansion on dorsal surface surrounding base of dorsal seta; dorsal seta almost as long as outer long terminal seta; all caudal setae long and resilient.

Rostral area with thickened triangular posteroventral margin. Maxilliped (Fig. 23D) second segment with anterior row of setules; inner longitudinal cleft with 2 setae and posterior rim with 3 rows of setules; terminal claw with narrow element near inner base and short, fine setules on concave surface. Swimming legs and leg 5 as in female, except leg 1: endopod of leg 1 with modification of terminal spine and seta (Fig. 23E). Leg 6 (see Fig. 23C) represented by posterolateral flap on ventral surface of genital segment, pointed corner protruding laterally in dorsal view.

Remarks.—*Epicalymma umbonata* males are longer than the other three described *Epicalymma* males, and the terminal seta of leg 5 differs by being shorter than the basal seta. The male genital segment posterolateral flap with a pointed corner on the ventral surface may be distinguished from the other three species which have rounded corners.

Epicalymma vervoorti Heron et al., 1984

Epicalymma vervoorti Heron et al., 1984: 483, 485, figs. 17C–I, 18, 19A, B.

Material examined.—See Table 3.

Female.—Lengths of 1 specimen: TL 0.48 mm, PL 0.33 mm.

Remarks.—The one female was also identified from the Sognefjorden, Norway sample, 6 Dec 1982, 800–500 m, loaned by Audun Fosshagen.

Epicalymma exigua (Farran, 1908)

Oncaea exigua Farran, 1908:93, 94, pl. 10, figs. 25–30; pl. 11, figs. 9–11 (female).—Razouls 1974:241, fig. 15.—Gordejeva 1975b:778, figs. 21–27.

Epicalymma exigua (Farran, 1908).—Heron et al., 1984:485, 488, figs. 19C–J, 20.

Material examined.—See Table 3.

Female.—Mean lengths of 6 specimens: TL 0.45 mm (0.43–0.48 mm, PL 0.30 mm (0.29–0.33 mm).

Male.—Mean lengths of 3 specimens: TL 0.40 mm (0.39–0.41 mm), PL 0.26 mm (0.25–0.27 mm).

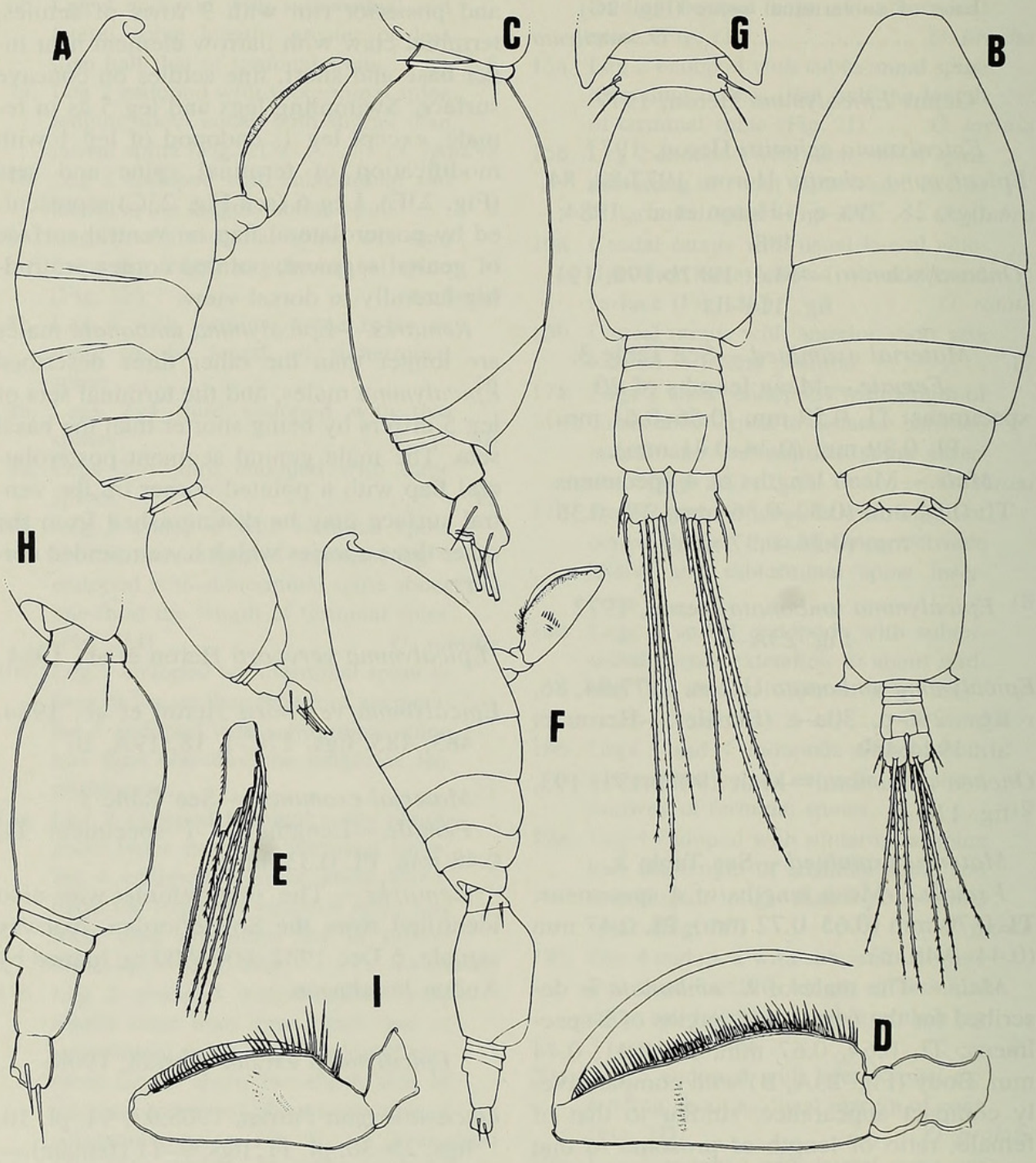

Fig. 23. *Epicalymma umbonata.* Male: A, lateral (scale w); B, dorsal (w); C, pediger 4 posterior corner, urosome, lateral (x); D, maxilliped, right, posterior (x); E, leg 1, third endopod segment (x). *Conaea hispida.* Male: F, lateral (w); G, pediger 4 posterior corner, urosome, dorsal (x); H, pediger 4 posterior corner, urosome, lateral (x); I, maxilliped, right, posterior (x).

Key to species of *Epicalymma* females in northeast Pacific and inland Washington waters

1a. Genital segment with gonopore located approximately at midregion of dorsal surface ..... *E. umbonata*

1b. Genital segment with gonopore located on anterior third of dorsal surface ... 2

2a. Anal segment with operculum margin basically straight 3

2b. Anal segment with operculum margin medially distended ..... *E. exigua*

3a. Urosome, lateral view, with caudal ra-

mus width as wide at midpoint as that of anal segment (posterior to operculum) ..... *E. schmitti*

3b. Urosome, lateral view, with caudal ramus width less than that of anal segment ..... *E. vervoorti*

Key to species of *Epicalymma* males in northeast Pacific and inland Washington waters

1a. Anal segment with operculum margin straight 2

1b. Anal segment with operculum margin medially distended ..... *E. exigua*

2a. Pediger 4 posterior corner rounded ... 3

2b. Pediger 4 posterior corner squared and leg 5 distal seta longer than basal seta ..... *E. vervoorti*

3a. Leg 5 terminal seta length about same as that of basal seta ..... *E. schmitti*

3b. Leg 5 terminal seta length shorter than that of basal seta ..... *E. umbonata*

Genus *Conaea* Giesbrecht, 1891

Conaea rapax Giesbrecht, 1891

Conaea rapax Giesbrecht, 1891:477.—1892:82, 605, pl. 48, figs. 50–59.—Heron 1977:86, 88, 90, figs. 30d–j, 31, 32a–d.—Heron & Bradford-Grieve 1995:45, 46, figs. 24f–i, 27c.

Oncaea gracilis (Dana).—Scott 1894:116, pl. 13, figs. 4–12.—Malt 1983a:4, 5, 7, 9, fig. 14.

Conaea gracilis (Dana).—Wilson 1950: 191, pl. 5, figs. 36–46 (illustrated and identified as *C. rapax* by G. O. Sars).—Boxshall 1977:145–148, figs. 22, 23.

Material examined.—See Table 3.

Female.—Mean lengths of 12 specimens: TL 1.02 mm (0.97–1.14 mm), PL 0.63 mm (0.60–0.67 mm).

Male.—Mean lengths of 8 specimens: TL 0.92 mm (0.87–1.00 mm), PL 0.59 mm (0.56–0.63 mm).

Conaea succurva Heron, 1977

Conaea succurva Heron, 1977:90, figs. 32e–k, 33a–g.

Material examined.—See Table 3.

Female.—Mean lengths of 3 specimens: TL 0.71 mm (0.70–0.72), PL 0.47 mm (0.45–0.48 mm).

Conaea hispida Heron, 1977
Fig. 23F–I

Conaea hispida Heron, 1977:90, 95, figs. 33h–j, 34.

Oncaea hispida.—Malt 1982a:187, 188, 192, 193, figs. 5, 6.

Material examined.—See Table 3. Reference specimens: USNM 243741 (2 females, 1 male): *Brown Bear* 357–22, 22 Apr 1965, 4000–0 m.

Female.—Mean lengths of 8 specimens: TL 0.60 mm (0.56–0.63 mm), PL 0.40 mm (0.37–0.44 mm).

Male.—The male of *C. hispida* is described for the first time. The single male found was not dissected, except for the right maxilliped. Body with ratio of length of prosome to that of urosome 1.54:1 (Fig. 23F). Lengths of the 1 specimen: TL 0.56 mm, PL 0.37 mm. Exoskeleton thinly sclerotized. Genital segment with slight constriction of lateral margins at midregion, dorsal view (Fig. 23G), similar to that of female. Caudal ramus with slight expansion on dorsal surface surrounding base of dorsal seta (Fig. 23H); dorsal seta nearly as long as outer long terminal seta; all caudal setae long and resilient.

Rostral area with thickened, rounded posterior margin. Maxilliped (Fig. 23I) second segment elongate with anterior setules; inner longitudinal cleft with 2 setae; posterior rim with rows of setules, proximally long. Swimming legs and leg 5 appear to be as in female. Leg 6 represented by posterolateral rounded flap on ventral surface of genital segment.

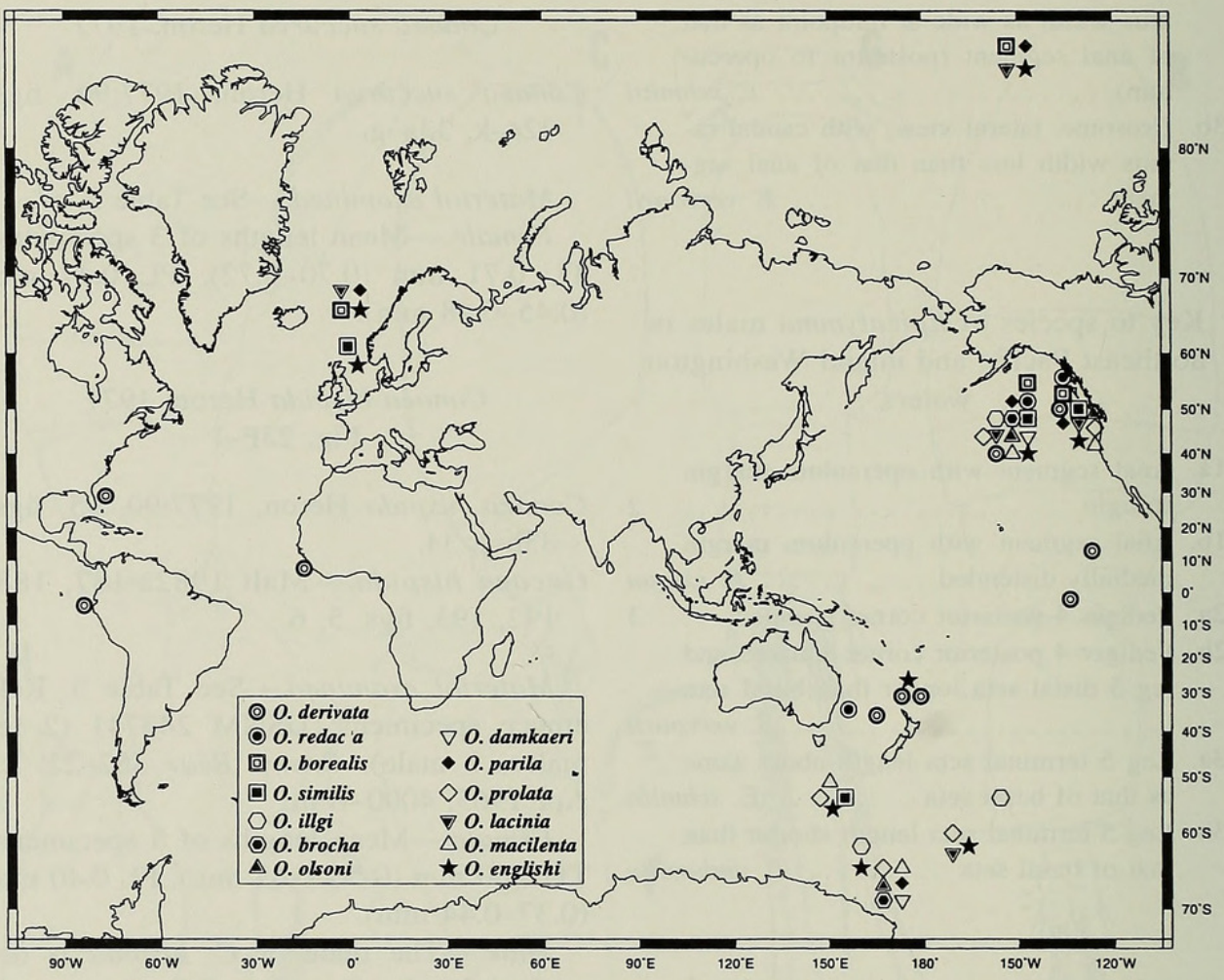

Fig. 24. Locality records for selected species of *Oncaea*. Records include previously published personal observations and data presented in this study (Table 3).

Key to species of *Conaea* in northeast Pacific and inland Washington waters

1a. Leg 2 with third endopod bearing three setae and one spine ..... *C. rapax*
1b. Leg 2 with third endopod bearing three setae and two spines 2
2a. Leg 2 with outer spine of third endopod approximately one-third the length of inner spine ..... *C. succurva*
2b. Leg 2 with outer spine of third endopod approximately half the length of inner spine ..... *C. hispida*

Discussion

Two significant patterns in our results are noteworthy. First, while the seven new species of *Oncaea* described here were found only in our samples from the eastern Pacific, many of the previously described species that were also collected have much more extensive geographical distributions, occurring in both the northern and southern hemispheres (Table 3, Figs. 24 and 25). In particular, the five most widely distributed species, *O. parila, O. englishi, O. lacinia, Epicalymma umbonata,* and *E. exigua,* occur in polar and subpolar regions of both hemispheres. Bipolar or subpolar amphitropical distributions are well known in planktonic protozoans (e.g., foraminiferans: Bé & Tolderlund 1971; tintinnid ciliates: Pierce & Turner 1993, fig. 18), but not among planktonic metazoa. One of the few remaining cases of a putative bipolar or subpolar amphitropical species of epipelagic crustacean zooplankton was, upon closer scrutiny, ascribed to different spe-

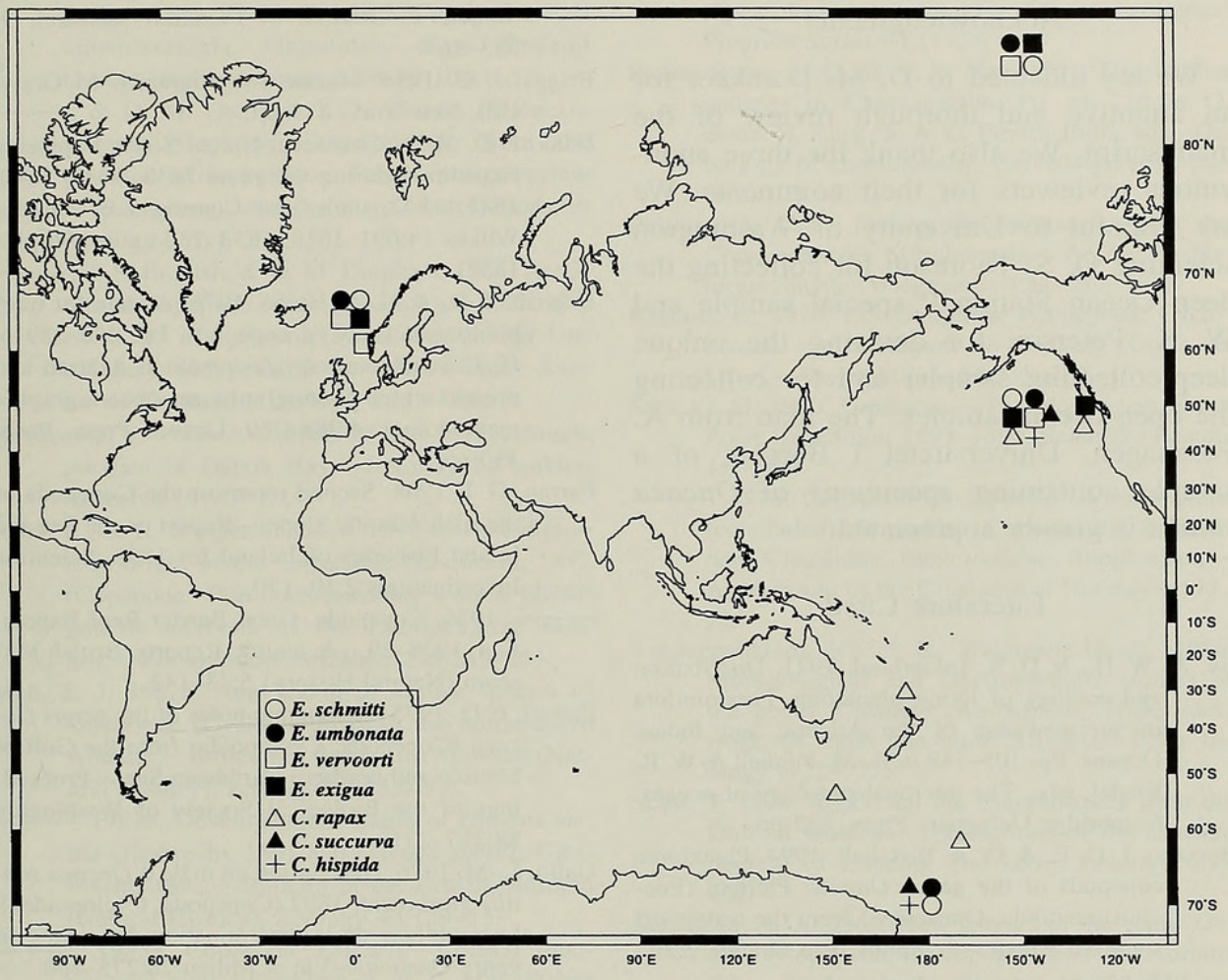

Fig. 25. Locality records for species of *Epicalymma* and *Conaea*. Records include previously published personal observations and data presented in this study (Table 3).

cies in the two hemispheres based on morphological and electrophoretic analyses (e.g., Schneppenheim & Weigmann-Haass 1986).

Second, we found no evidence of morphological divergence between any of the geographically widely separated, apparently disjunct, species of Oncaeidae that occur in the northern and southern polar and subpolar regions and even in different oceans. Thus our morphological evidence suggests that populations in different ocean basins either share a common gene pool or have not diverged genetically if indeed their distributions are disjunct today. With the advent of DNA sequencing, this is a testable hypothesis.

Possibly the extensive geographical ranges of many oncaeid species reflects their broad depth ranges, often extending into the meso- to bathypelagic zones (Heron 1977, Heron et al. 1984, Heron & Bradford-Grieve 1995; fig. 28; Böttger-Schnack 1996, table IV). Such species tend to have much wider latitudinal ranges than oceanic epipelagic species, perhaps by "isothermic submergence" through the subtropical and tropical regions (Briggs 1974, Pierrot-Bults & Nair 1991). It should be noted that the ranges depicted in Figs. 24 and 25 are conservative, being based only on our limited previous observations. We expect that careful analysis of deep samples from subtropical and tropical latitudes will reveal occurrences of many of the polar and subpolar species treated here.

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