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TAXONOMIC NOTES OF THE GENUS *ONCAEA*
(COPEPODA: CYCLOPOIDA) FROM THE
GULF OF MEXICO AND NORTHERN
CARIBBEAN SEA

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Copepods of the genus *Oncaea* are small cyclopoids between 0.2 mm and 1.4 mm long. They are abundant in the epipelagic zone of the tropical oceans and although they are often regarded as free-swimming members of the zooplankton community, the minute structure of the mouthparts (Sars, 1918), the reports of food procurement for some members of the genus (Wickstead, 1962; Heinrich (= Geinrich), 1957; Alldredge, 1972), and for the ecologically related genus *Sapphirina* (Heron, 1973), indicate that they probably maintain semi-parasitic relationships with other members of the zooplankton community. Because of their small size, the absence of obvious morphological differences, and the intra-specific size variability, the species are difficult to identify. In this paper the common larger species of the Gulf of Mexico and Northern Caribbean Sea are described and some of the variability encountered in these species is discussed.

Forty-one zooplankton samples were collected in July, 1969, September, 1971, and May-June, 1972, from the upper 500 m in the area beyond the continental shelf in the Gulf of Mexico and Northern Caribbean Sea (hereafter the Gulf area). The mesh width of the finest nets used was 216 microns. Problems with retention limited the study to the larger members of the genus *Oncaea* but a single Bongo-net tow (mesh width 183 microns) taken in March, 1973, from the northeastern Gulf

of Mexico, provided females of three small species. Much of the information given here, including comprehensive station details, were initially reported in a Ph. D. dissertation (Ferrari, 1973).

Specimens were measured and dissected in lactic acid and transferred to glycerol to be drawn with the aid of a camera lucida. Fixing with formaldehyde causes various degrees of flexation of the prosome and urosome and telescoping of the urosome segments in *Oncaea*. By positioning the animal for measurement, errors caused by flexation can be avoided. Adjustment for telescoping of segments is more tedious. The total length of a specimen was calculated simply as sum of the measurements of the prosome and urosome and was not adjusted for telescoping of segments. However measurements made for comparing the relative lengths of different abdominal segments were adjusted for the telescoping effect.

Oncaea conifera Giesbrecht 1891
Figures 1A-2G

Females of *Oncaea conifera* (length 1.01-1.26 mm) represent one of the four large species (total length greater than 0.70 mm) in the Gulf area. These females and those of *O. similis* can be distinguished from all other females by the distal conical projection of third segment of the endopod of the fourth swimming leg. Greater total length and, generally, some development of a dorsal projection on the second pedigerous segment separates *O. conifera* from *O. similis*. Males of *O. conifera* were the only males found in this study with a conical projection on the third segment of the endopod of the fourth swimming leg. Males of *O. similis* share this trait but were not collected. For purposes of identification, Olson (1949), who first described the males of *O. similis*, states that the terminal seta of the third endopodal segment of the second swimming leg is more prominent than the two external setae. In the males of *O. conifera* this terminal seta is less prominent.

O. conifera poses the most complex problem of variation of any species in the genus. Farran (1936) described size variation from the more limited area of the Great Barrier Reef. He divided 40 females into three groups one of which he called a variety. These three groups were often found in the same sample. Moulton (1973) described morphological variation of this species in the Indian Ocean. His study included a comprehensive numerical analysis of 23 females from two stations. From this analysis he recognized four groups, three of which were referable to those of Farran.

Specimens separated and counted from the Gulf area exhibited a wide

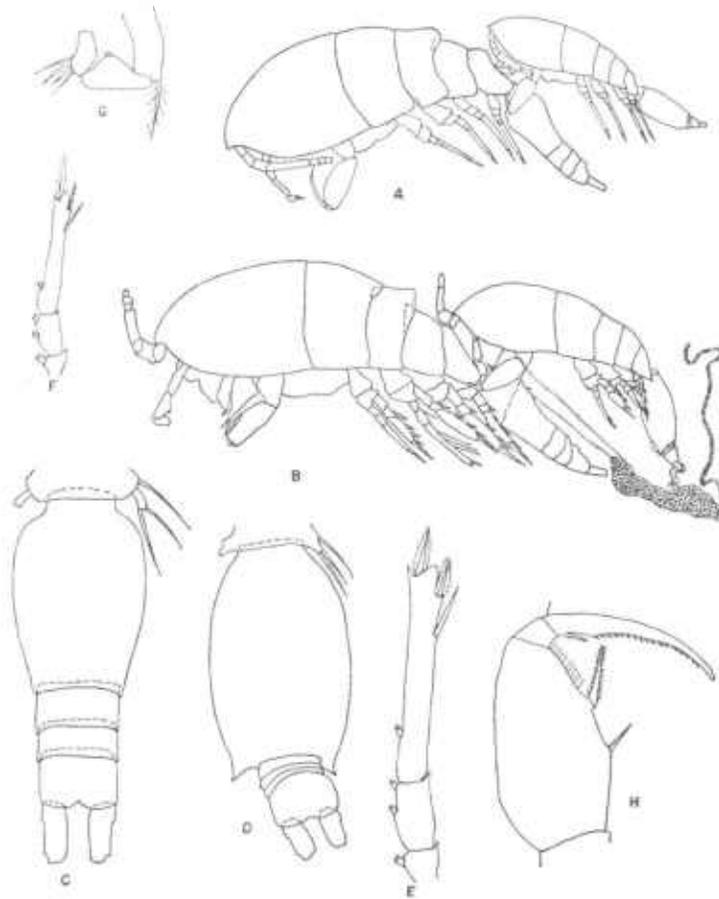


FIG. 1. *Oncaea confiera*: A, Small male-female pair, lateral; B, Large male-female pair, lateral; C, Female Ur, dorsal; D, Male Ur, dorsal; E, Female Enp3 P4; F, Male Enp3 P4; G, Male A2; H, Female, Mxpd.

degree of variation. Some individuals could be easily placed in either of Farran's groups, others could not; no systematic analysis by depth, water mass, or season was attempted. However, during the study, at seven different stations, seven male-female pairs of *O. confiera* were found in what is considered a mating posture (Fig. 1A, 1B). In these instances the male had grasped the female in the area of the articulation of the genital segment and the preceding urosomal segment. Grasping was done only with the large distal claws of the maxillipeds. In ad-

dition some accessory structures were found in one pair (Fig. 1B). The genital segment and the tip of the endopod of the fourth swimming leg of the female was encircled by a line composed of twisted strands. Both ends of this line passed outside and over the maxilliped of the male and into the area of the mouthparts. From this area both lines passed tautly back to an irregular mass of tubules or cells ventral to the male urosome. One small line, originating from this mass, seemed to wrap loosely around the caudal ramus and caudal setae of the male and terminate in the mass. Another thicker line dangled from the mass. As these two animals were collected with a net, held in a catch bucket for a period of time until the tow was completed and then exposed to the shock of fixation with formaldehyde, it is difficult to assess the significance of the position of these structures. Since they have not been recorded previously they have been included here.

Below is a list of the lengths (in mm) of the seven male-female pairs of *O. conifera*.

females	males
1.06*	0.60*
1.09	0.63
1.09	0.65
1.11	0.60
1.11	0.82
1.12	0.64
1.25+	0.79+

*Fig. 1A; +Fig. 1B

Had these 14 individuals occurred separated in a sample they could easily have been grouped into two size classes for both sexes (females: 1.06–1.12 and 1.25 mm; males: 0.60–0.65 and 0.79–0.82 mm). In six of the seven cases the data indicate that the females and males paired according to these size classes; the fifth pair is the exception. Incompatibility of size could be a premating isolation mechanism but caution should be exercised in extrapolating from this mating posture to actual reproduction.

The females of these pairs all have a well developed dorsal projection of the second pedigerous segment and the body is well sclerotized. The postero-lateral extensions of the last prosomal segment are parallel. The anal segment is not quite as long as the preceding two abdominal segments together and the caudal rami are set wide apart. Morphologically these females seem to belong to the "a" group of Farran (1936) although their total lengths lie outside the range reported by him. They also fit the "stocky" group of Moulton (1973) which, Moulton notes, is very similar to the "a" group of Farran.

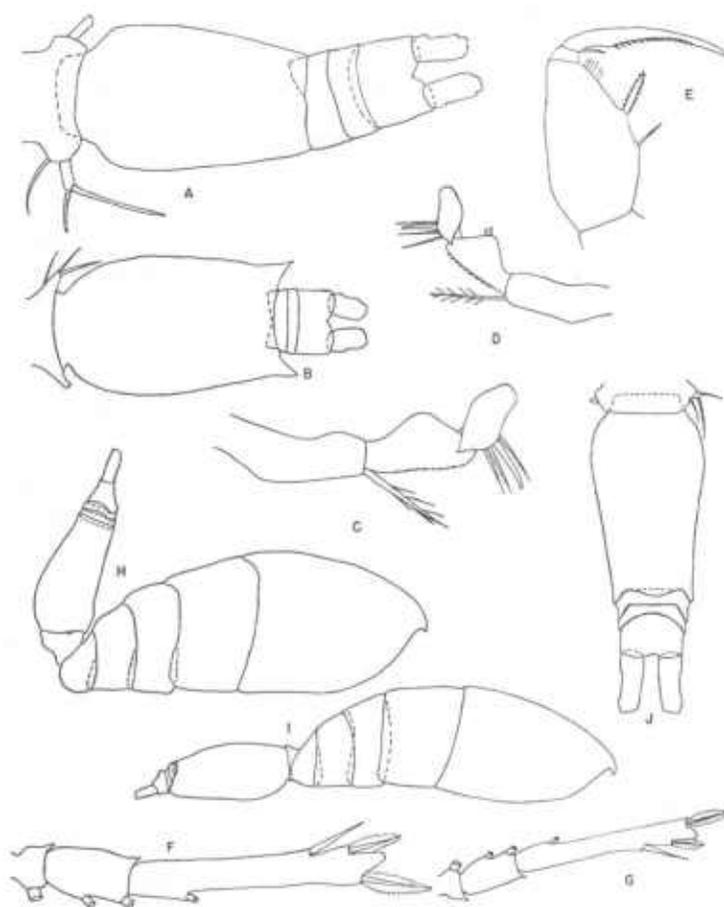


FIG. 2. *Oncaea conifera*: A, Female Ur, dorsal; B, Male Ur, dorsal; C, Female A2; D, Male A2; E, Female Mxpd; F, Female Enp P4; G, Male Enp P4; *Oncaea media*: H, Female, lateral; I, Male, lateral; J, Female Ur, dorsal, flexed dorsally.

Two male-female pairs were dissected and certain structures drawn. Fig. 1C-H is the small female-small male pair illustrated in Fig. 1A; Fig. 2A-G is the large male-large female of Fig. 1B. The only notable difference between these two pairs is the slight serration on the second segment of A2 in both male and female of the large female-large male pair.

Oncaea media Giesbrecht 1891

Figures 2H-3D

In the Gulf area the females of this species are easily separated from all others encountered by their deep blue coloration in reflected light. Farran (1929) remarks that females found around New Zealand were crimson while Sewell (1947) notes an orange-red color for some of his specimens from the northern Arabian Sea. The males are characterized, as are those of *O. venusta*, by the short curved spine in the proximal group of spines and setae of the third segment of second antenna (Fig. 3B). The males are separated from those of *O. venusta* by their smaller size and smaller length of the caudal ramus relative to the anal segment (compare Fig. 3A with Fig. 6B).

Females of *O. media* were collected extensively in the Gulf area in July, 1969. The individuals were referable to the major form of Sewell (1947) on the basis of length range, 0.72-0.81 mm. The species was not found in September, 1971, or May-June, 1972, but was found again in the single sample collected in March, 1973. The length range of these specimens, 0.73-0.93 mm, exceeded that of the specimens collected in July, 1969. Below is a list of lengths for a sample of 30 females from each year.

Length (mm)	.72	.73	.74	.75	.76	.77	.78	.79	.80	.81	.82
1969	2	2	2	-	3	5	7	5	1	3	-
1973	-	-	-	1	2	-	1	-	1	2	3
Length (mm)	.83	.84	.85	.86	.87	.88	.89	.90	.91	.92	.93
1969	-	-	-	-	-	-	-	-	-	-	-
1973	2	-	3	1	1	1	1	1	1	8	2

Small individuals which could be ascribed to Sewell's minor form, length range 0.58-0.65 mm, were not collected from the Gulf area at any time. The nets of the 1969 survey, mesh width 333 microns, may not have retained specimens of this size but if present, they should have been found in the sample of 1973, mesh width 183 microns, because smaller specimens of the genus were collected. A single male 0.63 mm long was found in the 1969 samples; the length range of 10 males from the sample of 1973 was 0.56-0.62 mm.

Oncaea mediterranea Claus (1863)

Figures 3E-5D

Females of *Oncaea mediterranea* can be separated with *O. venusta* from other oncaeids by the length of the caudal ramus, more than 2.5 times longer than wide (Fig. 3G). Females can be separated from those of *O. venusta* by their longer fifth leg (Fig. 3G) which is reduced in *O. venusta* (Fig. 5J), and by the structure of the maxilliped, especially the distal spine on the second basipod segment, which is

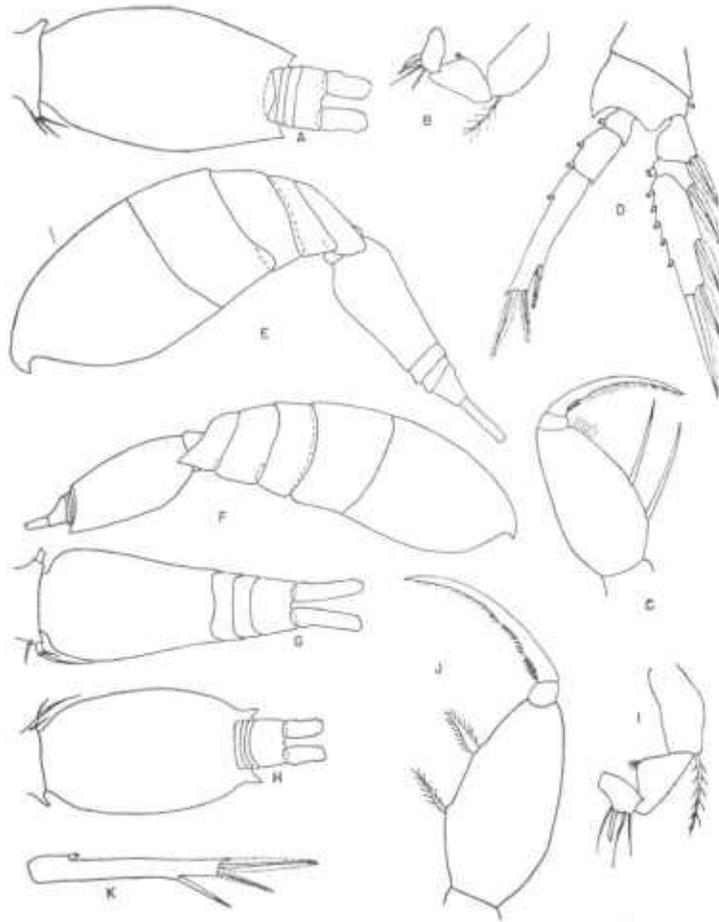


FIG. 3. *Oncaea media*: A, Male Ur, dorsal; B, Male A2; C, Female Mxpd; D, Female P4; *Oncaea mediterranea* typical group: E, Female, lateral; F, Male, lateral; G, Female Ur, dorsal; H, Male Ur, dorsal; I, Male A2; J, Female Mxpd; K, Female, Enp3 P4.

toothed on *O. mediterranea* (Fig. 3J) but setose on *O. venusta* (Fig. 6C). Males of *O. mediterranea* and *O. venusta* have distinctive caudal rami that are more than 3 times longer than wide and longer than the anal segment. The two species can be separated by the presence of a seta instead of a curved spine on the third segment of the second antenna in *O. mediterranea* (compare Fig. 3I with 6D).

There are three distinct size groups of both males and females of *O. mediterranea* from the Gulf area. The length range of the typical group, females 1.07–1.22 mm and males 0.76–0.89 mm, falls within the range for females reported by other authors (Giesbrecht, 1892; Rose, 1933; Farran, 1936). In samples from the Gulf area this group always makes up a relatively greater number of individuals than the large group. The length range of the larger group, females 1.29–1.37 mm and males 1.06–1.12 mm, exceeds the upper limit usually reported for the females, although Olson (1949) reported the length of *O. mediterranea* from the east coast of the Pacific Ocean as 1.38 mm. There are no morphological differences in the appendages of these two groups but the larger group is easily distinguished by its greater total length, more heavily sclerotized exoskeleton, and greater amount of orange pigment on the extremities of the body and appendages.

Farran (1929) reported "a small colorless form" of *O. mediterranea* in a sample taken south of New Zealand but gave no further description of the specimen. A similar group of *O. mediterranea* was collected abundantly throughout the Gulf area during the four years studied. Individuals of this third group are smaller, females 0.85–0.91 mm and males 0.69–0.75 mm, than previously reported for *O. mediterranea*. This small group differs from the preceding two in its lack of pigment and its more weakly sclerotized exoskeleton. Its caudal rami are parallel to one another, not divergent as in the other two groups (compare Fig. 3C with Fig. 5C). The caudal ramus length to width ratio is 3.0 to 3.5 while for the other two groups it is greater than 4.0; the ratio of caudal ramus length to anal length is 1.0 in the small group and 1.6 in the other two groups. In Fig. 4 measurements of 30 females, randomly selected from a general collection of *O. mediterranea*, are used to indicate these three separate groups. Males of the small group can be distinguished most easily by the shorter total length, lack of pigment and minimal sclerotization of the exoskeleton.

The small group was tentatively treated as a new species by Ferrari (1973) because it differed in relative lengths of the body segments as well as in total body length, whereas the large and typical groups differed only in total body length. However, other species of *Oncaea*, specifically *O. conifera*, also exhibit a great degree of relative size variation. Since this variation in *O. mediterranea* is not accompanied by structural differences in the appendages, it is not considered great enough to warrant recognition as a species.

Oncaea similis Sars 1918

Figures 5E–H

Due to its very small size *Oncaea similis* was collected only in the March, 1973, sample (mesh width 183 microns) and only females of this species were found. Separation of these females has been discussed under *O. conifera*.

ONCAEA MEDITERRANEA ♀♀

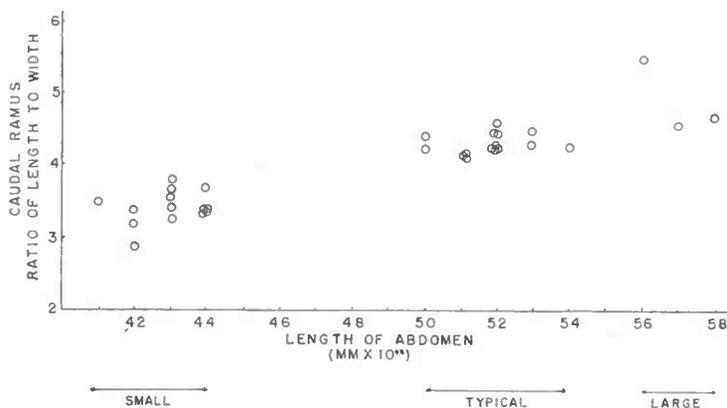


FIG. 4. Length of the abdomen plotted against length-width ratio from 30 females randomly selected from a general collection of *Oncaea mediterranea* from the Gulf area.

Specimens from the Gulf area differ slightly from those described by Sars (1918) but agree well with the description of Olson (1949) for *O. similis* from the coastal waters of the eastern Pacific Ocean. Sars lists the total length of the adult females as 0.78 mm while those from the Gulf area are 0.62–0.65 mm. The genital segment does not gradually taper posteriorly from its widest to narrowest width; rather the anterior area is more rounded and the posterior portion distinctly cylindrical (Fig. 5F) as in Olson (1949). The second abdominal segment is longer than the third; the medial spine of P5 is much thicker than the lateral. The spines on the second basipodal segment of the maxilliped are dissimilar, the distal one being longer, stouter, and toothed.

Oncaea venusta Philippi 1843

Figures 5I–6D

The separation of *Oncaea venusta* has been discussed with *O. media* and *O. mediterranea*. Males of the former species and females of the latter are the only ones which might cause confusion. Two size groups were found in the Gulf area, females 0.92–0.99 mm, males 0.57–0.63 mm and females 1.10–1.20 mm, males 0.76–0.86 mm, throughout the period sampled. These correspond respectively to forma *venella* and forma *typica* described by Farran (1929) and noted by Sewell (1947). Although there are slight differences in the length ranges reported in all three cases, the presence of distinct size groups is consistent. On page

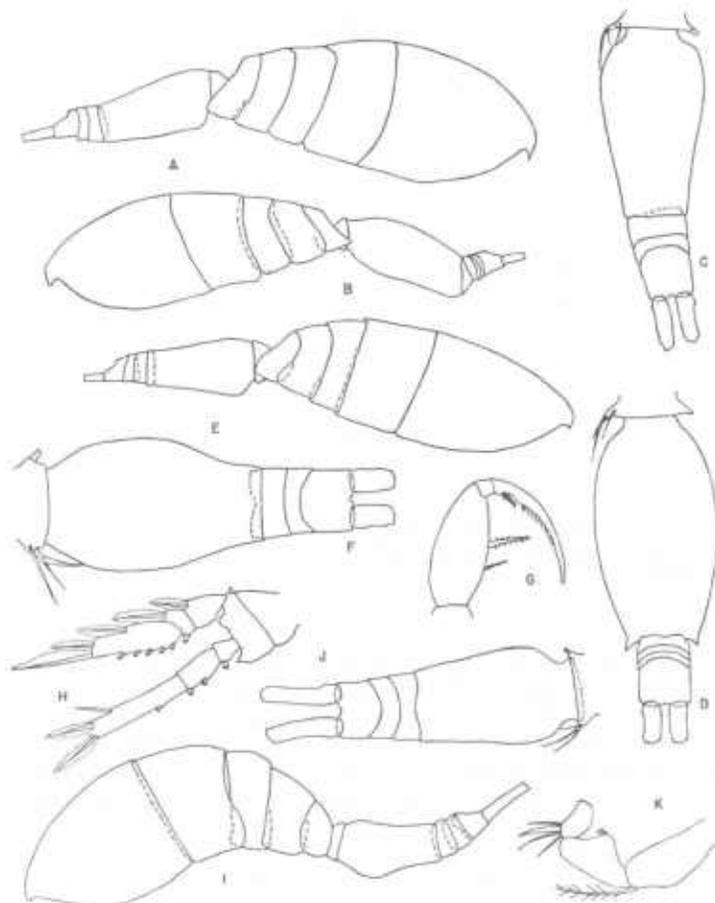


FIG. 5. *Oncaea mediterranea* new group: A, Female, lateral; B, Male, lateral; C, female Ur, dorsal; D, Male Ur, dorsal; *Oncaea similis*: E, female, lateral; F, Female Ur, dorsal; G, Female Mxd; H, Female, P4; *Oncaea venusta* typical group: I, Female, lateral; J, Female Ur, dorsal; K, Female A2.

228 is a list of the lengths of 30 females and 30 males randomly selected from a general collection of the species.

Both groups were present in the Gulf area during all four years studied. In all stations the smaller group was by far the more abundant, which contradicts the findings of Farran (1929) from New Zealand and Sewell (1943) from the Arabian Sea. Both groups from the Gulf area,

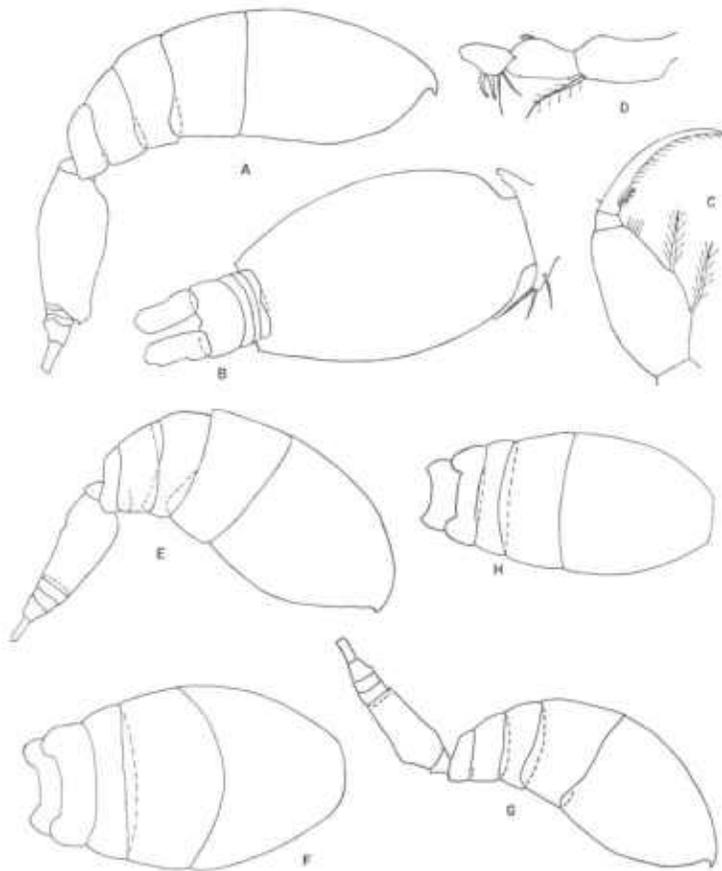


FIG. 6. *Oncaea venusta* typical group: A, Male, lateral; B, Male Ur, dorsal; C, Female Mxpd; D, Male, A2; *Oncaea* sp. 1: E, Female, lateral; F, Female Pr, dorsal; *Oncaea* sp. 2: G, Female, lateral; H, Female Pr, dorsal.

when viewed under reflected light, are tinged with red on the extremities of the body and appendages. This coloration agrees with specimens described by Farran (1929) from the Great Barrier Reef but Giesbrecht (1891), Rose (1933), and Owre and Foyo (1967) describe this species as purple.

The following two females were recovered from the sample collected in the net with mesh width of 183 microns. In the keys of Rose (1933) and Shmeleva (1969), *Oncaea* sp. 1 and *Oncaea* sp. 2 fall between *O. media* and *O. curta*.

Length (mm)	.93	.94	.95	.96	.97	.98	.99	—	1.10	1.11
females	3	3	5	6	3	2	1		—	2
Length (mm)		1.12	1.13	1.14	1.15	1.16	1.17	1.18	1.19	1.20
females		1	—	1	1	1	—	1	—	—
Length (mm)	.57	.58	.59	.60	.61	.62	.63	—	.76	.77
males	—	—	1	5	12	8	—		—	—
Length (mm)		.78	.79	.80	.81	.82	.83	.84	.85	.86
males		1	—	2	—	—	1	—	1	—

Oncaea sp. 1

Figures 6E, F and 7A-D

Length 0.68 to 0.71 mm. Prosome 68% of total length. Third segment of second antenna shorter than second. Spines of second basipodal segment equal; both spines with a row of short, fine hairs. Fine hairs on medial margin of terminal hook of maxilliped. First three swimming legs as figured for *O. curta* in Sars (1916); fourth without terminal cone on endopod; third segment of its endopod with two lanceolate setae; the proximal external seta naked. Genital segment longer than rest of urosome; caudal ramus longer than anal segment. Urosome formula 8,53,8,6,8,17 = 100.

This female resembles *O. curta* Sars (1916). Third segment of second antenna is proportionally shorter than second, as compared to Sars' drawing. Other differences: the setae on second basipod of maxilliped are unequal, genital segment proportionally wider, genital segment longer than rest of urosome. In the description of *O. curta* Sars states "... tail does not exceed half the length of the anterior division and having a shorter genital segment than *O. media* being in length equal to the rest of the tail." However, Olson (1949) figures *O. curta* with the genital segment longer than the rest of the urosome. Until the males can be found and described no decision can be made as to whether this is a new species or another size group of *O. curta*.

Oncaea sp. 2

Figures 6G, H and 7E-H

Total length range of these females, 0.54-0.58 mm. Prosome twice urosome. Caudal ramus slightly longer than anal segment which is longer than third abdominal segment. Genital segment longer than rest of urosome. Urosome formula 6,53,10,7,10,14 = 100. Appendages similar to those of *Oncaea* sp. 1 but smaller and narrower. These females are easily separated from those of *Oncaea* sp. 1 by the shorter total length, narrower prosome and urosome, and the less arched aspect of the prosome.

DISCUSSION

Due to their small size, variation in the species of the genus *Oncaea* is often overlooked. Several types of variation have been observed or

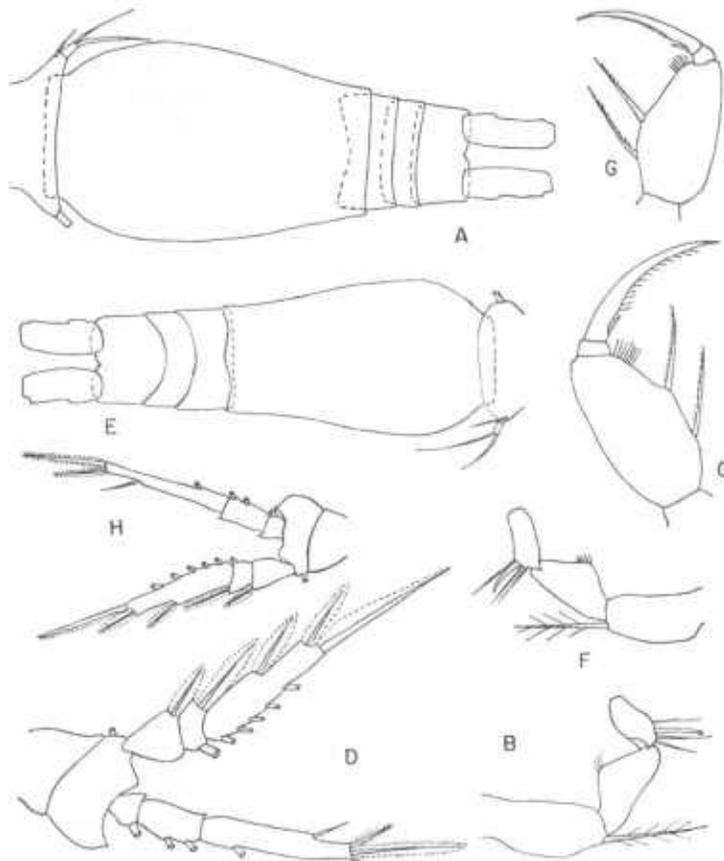


FIG. 7. *Oncaea* sp. 1: A, Female Ur, dorsal; B, Female, A2; C, Female Mxpd; D, Female P4; *Oncaea* sp. 2: E, Female Ur, dorsal; F, Female A2; G, Female Mxpd; H, Female P4.

cited here. Color variation within the same species from different geographic regions is noted in *O. media* and *O. venusta*. Simple size variation, in which only the total length of the specimens varies, is found in *O. media*, *O. mediterranea*, and *O. venusta* from the Gulf area and reported for *O. venusta* by Farran (1929) and Sewell (1947) and for *O. media* by Sewell (1947). Relative size variation, in which the size of certain body segments varies in relation to one another, is demonstrated for *O. mediterranea* from the Gulf area and reported for *O. conifera* by Farran (1936) and Moulton (1973). Both kinds of size variation can produce definite size groups of specimens; these size

groups can be consistent over space and time, e.g., *O. mediterranea* and *O. venusta*, or change temporally, e.g. *O. media*. If these groups are different species, distinctions in appendage morphology should be noticeable, especially in those appendages of the male involved in reproductive behavior. However, distinctions in the male maxillipeds have not been noted so far. It is possible that the behavior of the male in securing the female with accessory reproductive structures (noted in *O. conifera*) may act as a premating isolation mechanism. Finally it should be noted that variation in seven male-female pairs of *O. conifera*, captured in what is believed to be a mating posture, is not broad as the variation in the rest of the population in the Gulf area. These seven females fit into only one of the several previously described groups of *O. conifera*. It is possible in this species that only certain females are actually capable of attracting males for the purpose of reproduction.

KEY TO THE SPECIES OF *ONCAEA*

- Ur 5 segmented females
Ur 6 segmented males

Females

1. Enp3 of P4 with a distal conical projection 2
Enp3 of P4 without projection 3
2. Th2 usually with pronounced hump at the dorsal midline; total length greater than 0.90 mm *O. conifera*
Th2 without this hump; total length less than 0.80 mm *O. similis*
3. Caudal ramus less than 3 times as long as wide *O. media*
Caudal ramus 3-5 times as long as wide 4
4. Body heavily sclerotized; Pr strongly arched; P5 short *O. venusta*
Body not as sclerotized; Pr not arched; P5 elongated
..... *O. mediterranea*

Males

1. Enp3 of P4 with a terminal rounded projection *O. conifera*
Enp3 of P4 without this projection 2
2. Seg3 of A2, proximal set of spines and setae with 2 thick spines and 2 thin setae 3
Seg3 of A2, proximal set of spines and setae with 1 thin seta, 1 thick spine, and 2 thin setae *O. mediterranea*
3. Ratio, caudal ramus length to Ansg length, less than 2 ... *O. media*
This ratio greater than 2 *O. venusta*

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