PELAGIC COPEPODA COLLECTED OFF THE WEST COAST OF BARBADOS

by

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Submitted in partial fulfilment of
the requirements for the degree of
Master of Science in
Zoology.

McGill University, Montreal.

September 1958.

ACKNOWLEDGEMENTS

A summer grant from the National Research Council made this research possible. Most of the practical work was conducted in the Zoology Department of McGill University. I should like to thank Dr. Joan Marsden of the Zoology Department of McGill University for suggesting this research and for the collection of specimens from 1956. I am grateful, also, for the assistance of Dr. J. B. Lewis in providing laboratory space and equipment for me in Barbados at the Bellairs Research Institute, and for the collection of specimens after my departure from Barbados. I am indebted to Mr. J. W. Pollock for the photography of the plates used in this thesis.

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INTRODUCTION

This paper is a report of the planktonic Copepod material collected from Barbados, British West Indies, during 1956 - 1958. Only free-living and semi-parasitic copepods have been included. Wickstead (1956) has made a collection of copepods from the Barbados area consisting of 196 hauls over a period of two months, March and April. No previous study has attempted a collection of at least one year, or a plot of the population increase and decrease during the year, although considerable importance is attached to the decrease accompanying the hurricane season, which begins in July and continues until October.

Hall (1956) investigated the flying fish industry of Barbados; attempts were made to correlate statistically the concentration of plankton and the abundance of flying-fish, but a significant correlation between them could not be proved. That copepods are eaten by flying-fish has been known for some time. Breder (1938) stated, "Apparently they (flying-fish) feed entirely on planktonic organisms, mostly copepods". Dr. T.J. Hart in 1950, as reported by Hall in 1956, recorded copepods from a flying-fish stomach. Hall studied 441 specimens; the occurrence of copepods was relatively high; in 95 out of 425 stomachs, although their contribution to the diet was small. Preference for the larger copepods such as Miracia efferata seemed to be indicated.

Barbados is situated in the Lesser Antilles group of islands in the West Indies. It is the eastern-most island, being 92 miles east of St. Vincent and about 175 miles northeast of Trinidad. The island lies on the border line between two current systems (Parr, 1937 and 1938, and Brown, 1942). One is the Gulf Stream - North Atlantic Drift -

Canary Current - North Equatorial Drift System which forms the eddy enclosing the Sargasso Sea in the North Atlantic Ocean. This system passes through the Lesser Antilles and crosses the Caribbean Sea to emerge again from the Gulf of Mexico and the Florida Straits, as the Gulf Stream. The second is the South Atlantic Drift System coming from the Antarctic and running along the west coast of Africa. This current bears westward between 10° S. and the Equator, crossing the Atlantic and splitting at Cape San Roque, Brazil. The northern division passes along the coast of Brazil and approaches the Lesser Antilles from the southeast; it also contributes to the Gulf Stream water.

It is at this intersection of the two current systems that the flying-fish breeding area is located, and therefore a very valuable fishing industry has been established here. Spawning fish are taken from the end of November until the end of May, and fish occur in great enough numbers to produce a ten-month Barbadian flying-fish season, from October to July. The summer season, July to October, is, therefore, reasonably devoid of flying-fish. This period is the hurricane season. It is during this season that the Trade Winds, the predominant winds of Barbados, blow only intermittently. Thanks to the Fishery Department of Barbados, the catch data is available for the 1957 - 1958 season. Figures are in pounds of flying-fish landed at the Bridgetown market and can be taken as representative of the whole island.

Month	Year	
	1957	1958
May	44,969	
June	39,149	
July	33,140	
Aug.	2,040	
Sept.	1,570	
Oct.	667	
Nov.	3,060	
Dec.	48,065	
Jan.		56,453
Feb.		-----
March		52,265
April		59,295

These figures exemplify the productive winter season and the unproductive summer season.

Hall (1956) is of the opinion that flying-fish breed only when the strong westerly breezes, the Trade Winds, are blowing because drift is at a maximum at this time and consequently the distribution of eggs and larvae is more extensive and efficient. A second possibility is that the eggs which remain at the surface attached to seaweed require a high oxygen concentration which can only be obtained in an agitated rough sea. The third possibility, the one to be examined in this paper, is that the planktonic food for the larvae may be less abundant during the calm hurricane season.

MATERIALS AND METHODS

Collection: Copepods were collected from April to June of 1956 by Dr. Joan Marsden of the Zoology Department of McGill University. During the months from May to September of 1957, copepods were collected by the authour in Barbados. From September 1957 to March 1958, inclusive, the collections were made by Dr. J.B. Lewis, of the Bellairs Research Institute of McGill University. This represents a record of copepod hauls for a year beginning in late May 1957, and ending in March 1958. Samples were not taken in April or May of 1958. The information gained from the April to June hauls of 1956 has been incorporated into the histograms, but little information can be drawn from these hauls due to differences between seasons in various years.

The plankton hauls were all taken from one station about two to two and one half miles off the mid-western coast of the island. This position was chosen for its proximity to the Institute, and for the calmer seas off the western coast which make net hauling much easier. Conditions were kept as constant as possible by taking the hauls at the same time of day, and by hauling for a set length of time. Hauls were conducted in the evening from 8:00 to 8:30 p.m., on the surface of water of about 100 fathoms depth.

Nets and Tows: Horizontal towings were made with a fine mesh net of 18 inches in diameter and 48 meshes per inch, and with a coarse stramin net of one metre in diameter. Early in the season, only the stramin net was used, but later the fine net was used in addition. Both nets were lowered at the same time, the fine net withdrawn after ten minutes, and the stramin net after thirty minutes.

Specimens were taken from the plankton before the haul was concentrated or preserved. In the case of the stramin collections all copepods were withdrawn from the haul, and the haul concentrated and preserved in 5% formalin. The copepods were then separated into genera and preserved. The fine net collections yielded such large quantities of microplankton that this technique was impossible, so only a random sample was chosen. These techniques yielded specimens in very good condition; damage was confined to abrasion by the net itself.

The specimens, examined and identified as to genera, were shipped to McGill University, where they were re-examined and the species determined with the aid of literature in the collection of the Blacker - Wood Library of Zoology and Ornithology.

POPULATION HISTOGRAMS

Population histograms were drawn up for those copepods occuring most frequently in the hauls throughout the year. An account of each occurs under "Remarks" in the systematic account of the species. Fig. 36, Pl. 22, is a histogram using the total copepod population collected in the stramin net. It is characteristic in its bimodal distribution, shown also by the histograms drawn up for the individual species. The information on which Fig. 36 is based is given below.

Month	Collections		No. / Collection
April	1 in '56	12	12
May	2 in '56, 1 in '57	1026 ('56), 199 ('57)	199
June	2 in '56, 1 in '57	1521 ('56), 1279 ('57)	426
July	4 in '57	505	126
Aug.	3 "	159	53
Sept.	3 "	163	54
Oct.	0	0	0
Nov.	1 "	572	572
Dec.	1 "	543	542
Jan.	3 "	3083	1029
Feb.	1 "	828	828
March	1 "	500	500

In the histograms, the months of the year are along the abscissa, and the total number of copepods caught per collection are along the ordinate. When the histogram is drawn, the bimodal character of the distribution is apparent. There is a population increase reaching a climax in June, followed by a gradual decrease during the months of August and September. The population then increases again, reaching a peak greater than that of June, in January. The population then decreases again. As has been stated before, the decrease in population follows the hurricane season and the related decrease in the force and frequency of the Trade Winds.

LIST OF SPECIES

CALANOIDA

Family Calanidae

Genus Neocalanus Sars — Neocalanus gracilis Dana.

Genus Undinula A. Scott — Undinula vulgaris Dana.

Genus Rhincalanus Dana — Rhincalanus nasutus Giesbrecht.

Family Eucalanidae

Genus Eucalanus Dana — Eucalanus attenuatus Dana.

Family Paracalanidae

Genus Paracalanus Boeck — Paracalanus aculeatus Giesbrecht.

Genus Acrocalanus Giesbrecht — Acrocalanus longicornis Giesbrecht.

Family Pseudocalanidae

Genus Calocalanus Giesbrecht — Calocalanus pavo Dana.

Family Euchaetidae

Genus Euchaeta Philippi — Euchaeta marina (Prestandrea).

Family Scolecithricidae

Genus Scolecithrix Brady — Scolecithrix danae (Lubbock).

Family Centropagidae

Genus Centropages Kroyer — Centropages furcatus (Dana).

Family Temoridae

Genus Temora Baird — Temora stylifera (Dana).

Family Candaciidae

Genus Candacia Dana — Candacia pachydactyla (Dana).

Family Pontellidae

Genus Calanopia Dana — Calanopia americana F. Dahl.

Genus Labidocera Lubbock — Labidocera nerii (Kroyer).

Labidocera acutifrons (Dana).

Genus Pontellina Dana — Pontellina plumata (Dana).

Family Acartiidae

Genus Acartia Dana — Acartia longiremis (Lilljeborg).

Acartia negligens Dana.

Family Aetideidae

Genus Euchirella Giesbrecht — Euchirella amoena Giesbrecht.

Family Heterorhabdidae

Genus Hemicalanus Claus — Hemicalanus ornatus Giesbrecht.

Family Lucicutiidae

Genus Lucicutia Giesbrecht — Lucicutia flavicornis Giesbrecht.

Family Metridiidae

Genus Pleuromamma Giesbrecht — Pleuromamma abdominalis (Lubbock).

CYCLOPOIDA

Section GNATHOSTOMA

Family Oithonidae

Genus Oithona Baird — Oithona plumifera Baird.

Section POECILOSTOMA

Family Oncaeidae

Genus Oncaea Philippi — Oncaea venusta Philippi.

Genus Pachysoma Claus — Pachysoma punctatum Claus.

Family Sappharinidae

Genus Sappharina Thompson — Sappharina angusta Dana.

Sapphirina nigromaculata Claus.

Sapphirina ovatolanceolata Dana.

Genus Copilia Dana — Copilia mirabilis Dana.

Family Corycaeidae

Genus Corycaeus Dana

Sub-genus Corycaeus M. Dahl — Corycaeus speciosus Dana.

Sub-genus Agetus Kroyer — Corycaeus obtusus Dana.

Corycaeus elongatus Claus.

Sub-genus Corycella Farran — Corycella carinatus Giesbrecht.

HARPACTICOIDA

Family Ectinosomidae

Genus Microsetella Brady and Robertson — Microsetella rosea (Dana).

Family Macrosetellidae

Genus Macrosetella A. Scott — Macrosetella gracilis (Dana).

Genus Miracia Dana — Miracia efferata Dana.

MONSTRILLOIDA

Family Monstrillidae

Genus Monstrilla Dana — Monstrilla grandis Giesbrecht.

SYSTEMATIC ACCOUNT OF THE SPECIES

Family Calanidae

Genus Calanus Leach

Neocalanus gracilis Sars.

Calanus gracilis Dana, Proc. Amer. Acad. Arts and Sci., vol. 2, p. 18, 1849.

Megacalanus gracilis A. Scott, Siboga - Expeditie 29a, Copepoda, pt. 1, p. 12, 1909.

Neocalanus gracilis Sars, Resultats de compagnes scientifiques du Prince de Monaco, fasc. 69, p. 7, 1925.

Distribution: Tropical Atlantic (Dana, 1849); Mediterranean, tropical Atlantic, tropical Pacific (Giesbrecht, 1892); Gulf of Guinea (Lubbock, 1856); Messina (Claus, 1863); Philippines (Brady, 1883); Canary Islands and Malta (Thompson, 1888); Indian Ocean (van Breemen, 1908).

Colour: The body is on the whole colourless, transparent and very difficult to see in the water, but the appendages are more or less red or pinkish, and the overlapping margins of the four posterior thoracic segments form narrow transverse lines of deep vermillion, most pronounced dorsally, gradually fading out ventrally. Directly above the mouth and often at the posterior end of the thoracic cavity, there are internal blotches of blood - red colour mixed with yellow A few much smaller spots of the same colour are irregularly distributed along the sides and at the ventral edges of the segments. The eye is bright vermillion, (Wilson, 1932).

Remarks: This species can be recognised by the curved hook on the anterior surface of the first basipods, (Pl. 3, fig. 5A), and by the first antennae which are at least half as long again as the entire body, with one or more enlarged plumose setae near their distal end, (Pl. 3, fig. 5B).

This species is represented throughout the whole year, being well represented during the spring and early summer months, and again during the winter months, (Pl. 23, fig. 37).

The lengths are in mm:

Female:	Total	4.08	3.68	3.63	3.57	3.87
	Metasome	3.07	2.88	2.83	2.83	2.91
	Urosome	1.01	0.80	0.80	0.74	0.96

The total lengths exceed the range of 3.0 to 3.25 mm as given by Wilson.

Family Calanidae

Genus Undinula Scott

Undinula vulgaris (Dana).

Undina vulgaris Dana, Proc. Amer. Acad. Arts and Sci., vol. 2, p. 22, 1849.

Undinula vulgaris A. Scott, Siboga- Expeditie, 29a, Copepoda, pt. 1, p. 16, 1909.

Distribution: Tropical Atlantic, Samoa Islands, Sulu Sea, Banca Straits (Dana, 1849); Australia, New Guinea, Philippines, Hawaiian Islands, Fiji Islands, tropical Atlantic (Brady, 1883); Hong - Kong, Atlantic and Pacific Oceans (Giesbrecht, 1892); tropical Atlantic (Cleve, 1901); Red Sea, Indian Ocean (Thompson, 1903, Scott, 1902);

tropical Atlantic (Cleve, 1901); Red Sea and Indian Ocean (Thompson and Scott, 1902); Arabian Sea, Malay Arcipelago (Cleve, 1903); western Pacific, Bonin Islands (Anraku, 1953); Barbados (Wickstead, 1956).

Colour: The entire body is a uniform brick red, (Wilson, 1932).

Remarks: The highly modified fifth legs of the male, (Pl. 4, fig. 8), the elongated left fifth exopod of the female, (Pl. 2, fig. 3B), and the peculiar invagination of the second exopod, (Pl. 2, fig. 3A), in both sexes, furnish convenient characteristics for the identification of the species.

The female of this species was taken throughout the year in Barbados. It was the most abundant copepod, with a large spring peak in population which extended into July, and still larger peak in January, when on January 31, nine-hundred and seven females were taken, (Pl. 25, fig. 47).

Lengths in mm are:

Female:	Total	2.62	2.80	2.86	2.86	2.58	2.64
	Metasome	1.76	2.08	2.16	2.19	1.86	2.00
	Urosome	0.86	0.72	0.70	0.67	0.72	0.64

The male was also found throughout the year, but was not as numerous as the female. The spring and winter peaks are demonstrated with the greatest number of specimens being taken on January 31, when one-hundred and seven were taken, (Pl. 35, fig. 48).

Lengths in mm are:

Male: Total	2.48	3.10	3.23	3.07	2.72
Metasome	1.73	2.21	2.27	2.19	1.84
Urosome	0.75	0.89	0.96	0.88	0.88

The total length of the male exceeds the range given by Wilson (1932) as 2.25 to 2.50 mm.

Family Calanidae

Genus Rhincalanus Dana

Rhincalanus nasutus Giesbrecht

Rhincalanus nasutus Giesbrecht, Fauna und Flora des Golfes von Neapel, vol. 19, p. 152, pls. 3, 9, 12, 35, 1892.

Rhincalanus nasutus Sars, Crustacea of Norway, vol. 4, p. 15, pls. 6 - 7, 1901.

Distribution: Western Mediterranean, southern Pacific, Atlantic and Pacific Oceans (Giesbrecht, 1892); northern Atlantic (Cleve, 1900); Iceland, North Sea (Sars, 1901); California coast (Esterly, 1905); Indian Ocean (With, 1915); Chesapeake Bay (Wilson, 1932); Gulf of Maine (Bigelow, 1926); north - western Pacific, Bonin Islands (Anraku, 1953); Barbados (Wickstead, 1956).

Colour: Rathbun (1905) wrote of two females, " The larger specimen with such extremely long antennae was absolutely colourless." Sars (1901) also said of those species, "Body highly pellucid, and almost without any pigment." On the coloured plate of Giesbrecht's (1892)

monograph, (Pl. 3, fig. 6), the ovary and oviducts have a whitish tint; there is a large spot of faint reddish yellow above the mouth, while the third, fourth and fifth segments of the right antenna and the eye are bright ruby red. In the text, Giesbrecht (1892) says that the red in the antenna was sometimes entirely lacking, (Wilson, 1932).

Remarks: This species can be identified by the fifth legs of the male and female, (Pl. 6, figs. 14A,B). The female fifth leg differs from that drawn by Giesbrecht (1892), and Wilson (1932), in having two short spines on the second segment instead of one seta. The terminal spine is much shorter than that drawn by Giesbrecht or Wilson. Fig. 14C, Pl. 6 is the first leg, and fig. 14D, Pl. 6 the maxilliped of a female specimen.

Giesbrecht and Wilson show R. nasutus as having the frontal projections hidden from dorsal view. All the Barbados specimens were unlike this; their frontal projections were very obvious in dorsal view, the condition resembling that for R. cornutus. Also approaching the condition in R. cornutus is the arrangement of spines on the dorsal surface; spines occur on the second, third and fourth segments of the metasome in a dorsal position, and laterally on the same segments; the more posteriorly situated, the greater the size. The first antenna seems to resemble that of R. cornutus, with long cilia on segments 2 and 6, and longer cilia on segments 12, 14, 16, 19, 21, and 22 and four long cilia on segment 23 as well as one small one. R. nasutus has long cilia on segments 2, 12, 14, 16, 19, 21, 22 (2). Segment 23 has a number of small cilia.

This species appears in the plankton throughout the year. It shows a population peak in the spring (June), and another in the winter (January). It was represented during August, but not during September, (Pl. 25, fig. 45). Mostly females were taken; only one male was recognized.

Measurements in mm are as follows:

Female:	Total	3.28	3.49	3.26	3.39	3.39
	Metasome	2.85	2.91	2.76	2.88	2.85
	Urosome	0.43	0.58	0.50	0.51	0.54

The specimens from Barbados are all smaller than the size range given by Wilson (1932), which is 4 to 5.5mm.

Family Eucalanidae

Genus Eucalanus Dana

Eucalanus attenuatus Dana.

Eucalanus attenuatus Dana, Proc. Amer. Acad. Arts and Sci., vol. 2, p. 18, 1849.

Eucalanus attenuatus Giesbrecht and Schmeil, Das Tierreich, Lief. 6, Copepoda, p. 20, 1898.

Distribution: Western Mediterranean, tropical Atlantic and Pacific (Giesbrecht, 1892); Messina and Nizza (Claus, 1863); Red Sea, Indian Ocean (Thompson, 1903, and Scott, 1902); Malay Archipelago (Dana, 1849, Cleve, 1901); Kingsmill Island, China Sea (Dana, 1849); off Nova Scotia (Willey, 1919); Gulf of Maine (Bigelow, 1926).

Colour: The body is transparent with a variable degree of red pigment irregularly and often very asymmetrically distributed in the body; some

on the basal segments of the first antennae, and the terminal segments of the appendages. The plumes on the tips of the first antennae are usually bright orange with blue or violet iridescence, (Wilson, 1932).

Remarks: Identification drawings include the female second antennae, (Pl. 7, fig. 15B), with the proximal segment of the endopod four times as long as wide, and one-third longer than the distal segment. Included also are the female first and fourth legs, (Pl. 7, figs. 15A,D).

The lengths in mm are:

Female:	Total	4.08	4.22	4.35	4.16	4.24
	Metasome	3.52	3.68	3.84	3.65	3.71
	Urosome	0.56	0.54	0.51	0.51	0.53

The male fifth legs are used in identification, (Pl. 7, fig. 15C). The tip of the right leg scarcely reaches the centre of the second segment of the left leg.

This species was present throughout the whole year, showing the usual two peaks of population concentration. The spring peak is late June rather than in early June, as is the case with many other species. Adult specimens appeared throughout most of the summer months. The population rises again in the winter months, (Pl. 24, fig. 42).

Family Paracalanidae

Genus Paracalanus Boeck

Paracalanus aculeatus Giesbrecht.

Paracalanus aculeatus Giesbrecht, Fauna und Flora des Golfes von Neapel, vol. 19, p. 164, pl. 9, figs. 20,26, 30, 1892.

Paracalanus aculeatus Sewell, Copepoda of Indian Seas, p. 62,

figs. 20, 21, 1929.

Distribution: This species is widely distributed throughout the tropical and temperate regions of three oceans. In the Pacific, it has been recorded at several stations in the eastern area and on the western side between 10° N. and 10° S., Hong-Kong (Giesbrecht, 1892); the Australian Barrier Reefs (Farran, 1929); the Aru Archipelago (Fruchtl, 1924); and the Malay Archipelago (A. Scott, 1902); Indian Ocean off the coast of South Burma, the Andaman and Nicobar Islands and the Ceylon Pearl Banks (Sewell, 1929); the Maldive Archipelago (Wolfenden, 1906); the Arabian Sea (A. Scott, 1902); the Gulf of Aden, the Red Sea (Giesbrecht, 1892, A. Scott, 1902); and the east coast of Africa (T. Scott, 1897, as P. parvus); in the South Atlantic between 30° N. and 40° S. (Farran, 1929); in the tropical part of the Atlantic Ocean (Giesbrecht, 1892, Farran, 1929); and off the Cape Verde Islands (Sars, 1905); north-western Pacific, Bonin Islands, Oshoro Bay (Anraku, 1953); Barbados (Wickstead, 1956).

Remarks: Only females of this species were taken in the fine net hauls. The fifth leg, (Pl. 8, fig. 17B), and the fourth leg, (Pl. 8, fig. 17A), can be used in identification.

The lengths in mm are as follows:

Female:	Total	1.01	1.02	1.12	1.10	1.12
	Metasome	0.77	0.80	0.86	0.86	0.88
	Urosome	0.24	0.22	0.26	0.24	0.24

Family Paracalanidae

Genus Acrocalanus Giesbrecht

Acrocalanus longicornis Giesbrecht.

Acrocalanus longicornis Giesbrecht, Fauna und Flora des Golfes von Neapel, vol. 19, p. 171, pl. 10, figs. 25, 33, 1892.

Acrocalanus longicornis Sewell, Copepoda of Indian Seas, p. 82, fig. 33, 1929.

Distribution: The east and west Pacific Ocean between latitudes 15° N. and 10° S., the Arabian Sea (Giesbrecht, 1892); the Great Barrier Reefs of Australia (Farran, 1929); the Malay Archipelago (A. Scott, 1902); Indian Ocean, coast of South Burma and the Nicobar Islands (Sewell, 1929); the Madras coast (Menon, 1931); the Ceylon Pearl Banks (Thompson, 1903, and A. Scott, 1902, Sewell, 1929); the Maldive Archipelago (Wolfenden, 1906); the Persian Gulf (Pesta, 1913); the Red Sea (Thompson, 1903, and A. Scott, 1902); the east coast of Africa (Brady, 1883); the Atlantic Ocean in both tropical and temperate regions (Farran, 1929); Barbados (Wickstead, 1956).

Remarks: Identification is based on the structure of the third and fourth legs, (Pl. 7, figs. 16A, B).

All specimens found were females with lengths in mm as follows:

Total	0.94	1.03	1.14	1.13	1.12
Metasome	0.67	0.77	0.90	0.86	0.88
Urosome	0.27	0.26	0.24	0.27	0.24

Family Paracalanidae

Genus Calocalanus Giesbrecht

Calocalanus pavo (Dana).

Calanus pavo Dana, Proc. Amer. Acad. Arts and Sci., vol. 2, p. 13, 1849.

Calocalanus pavo Giesbrecht, Fauna und Flora des Golfes von Neapel, vol. 19, p. 185, pls. 1, 4, 9, 36, 1892.

Distribution: Cape Verde Islands (Dana, 1849); tropical Atlantic and Pacific (Giesbrecht, 1892); Canary Islands, Malta (Thompson, 1888); northern Atlantic (Cleve, 1900); Adriatic (Steuer, 1910, Pesta, 1916); Mediterranean, Red Sea, Indian Ocean (Thompson, 1903, Scott, 1902); Woods Hole (Wheeler, 1901, Sharpe, 1911); Oshoro Bay (Anraku, 1953); Barbados (Wickstead, 1956).

Colour: The female is transparent, with a large orange or brick red spot in the posterior part of the thorax; the long bristles and the terminal segment of the first antennae are bright orange; the broad plumes at the base of the first antennae and on the caudal rami are brownish red, with a brilliant metallic iridescence. The eye is bright red, (Wilson, 1932).

Remarks: This copepod can be recognised by the peculiar position of the rami, and by the long bristles on the first antennae, (Pl. 5, fig. 13A). The female fifth legs, (Pl. 6, fig. 13B), are four-segmented, and the terminal segment has four or five plumose setae on the inner margin and at the tips a single spine on the outer distal corner. This segment also has two rows of spinules across its anterior surface

near the tip. Fig. 13C, Pl. 6 are male fifth legs.

Only females were taken, all in damaged condition.

The lengths in mm are:

Total	0.88	0.86	0.83
Metasome	0.77	0.74	0.75
Urosome	0.11	0.12	0.08

Family Euchaetidae

Genus Euchaeta Philippi

Euchaeta marina (Prestandrea).

Cyclops merinus Prestandrea, Effemeridi Sci. e. Lett. Sicilia, vol. 6, p. 12, 1833.

Euchaeta marina Giesbrecht, Fauna und Flora des Golfes von Neapel, vol. 19, p. 245, pls. 1, 15, 16, 1892.

Distribution: Messina (Philippi, 1840); tropical Atlantic (Dana, 1849); northern Atlantic (Cleve, 1900); Nizza (Claus, 1866); Australia, Mediterranean, South American coast (Giesbrecht, 1892); Canary Islands, Malta (Thompson, 1888); Red Sea, Indian Ocean (Thompson, 1903, Scott, 1902); Adriatic (Pesta, 1916); Gulf of Guinea (T. Scott, 1894); Arabian Sea, Malay Archipelago (Cleve, 1901); Gulf of Maine (Bigelow, 1926); north-western Pacific, Bonin Islands, Oshoro Bay (Anraku, 1953); Sundra Straits (Delsman, 1949); Barbados (Wickstead, 1956).

Colour: The general colour is a pale blueish grey, with blotches of dark red on the sides of the head opposite the mouth, at the bases of the mouth parts, and at the posterior corners of the thoracic

segments. In the female, there is a wide band of the same red across the posterior margin of the cephalothorax on the dorsal side, which is not continuous with the lateral spots, but whose end on each side is broken up into numerous branches very irregularly arranged. The eggs in the external ovisac are deeper blue than the body, and are spotted with white; those in the internal oviducts are also blue and show quite distinctly through the body wall. The eye is minute and a bright ruby red, (Wilson, 1932).

Remarks: This species is characterised by the pointed process on the forehead, by the asymmetry of the genital segment in the female, (Pl. 8, figs. 18C, D), by the maxilliped, (Pl. 8, fig. 18B), and by the first leg, (Pl. 8, fig. 18A).

The female of this species is well represented in the hauls throughout the year. The population peaks occur in early spring and during the winter, with the summer months nearly devoid of females, (Pl. 24, fig. 43).

The lengths of five specimens are:

Female:	Total	3.25	2.59	3.07	3.39	3.36
	Metasome	2.24	1.85	2.24	2.32	2.30
	Urosome	1.01	0.74	0.83	1.07	1.06

The males were found very rarely in the hauls. The greatest number, twenty, were taken during the December hauls, (Pl. 24, fig. 44).

The lengths of five specimens are:

Male:	Total	3.12	3.15	2.56	3.18	3.10
	Metasome	2.19	2.16	1.84	2.16	2.17
	Urosome	0.93	0.99	0.72	1.02	0.93

Family Scolecithricidae

Genus Scolecithrix Brady

Scolecithrix danae (Lubbock).

Undina danae Lubbock, Trans. Ent. Soc. London, new ser., vol. 4, p. 21, pl. 4, 1856.

Scolecithrix danae Giesbrecht, Fauna und Flora des Golfes von Neapel, vol. 19, p. 265, pls. 13, 37, 1892.

Distribution: North Atlantic (Lubbock, 1856, T. Scott, 1893, Cleve, 1900); New Holland, Japan (Brady, 1883); tropical Pacific, Mediterranean (Giesbrecht, 1892); Canary Islands, Malta (Thompson, 1888); Indian Ocean (Thompson, 1903, Scott, 1902); Malay Archipelago (A. Scott, 1902); California coast (Esterly, 1905); Gulf of Maine (Bigelow, 1926); Bonin Islands (Anraku, 1953); Sunda Strait (Delsman, 1949); Barbados (Wickstead, 1956.

Colour: The body is transparent and colourless except for the intestine which is yellowish or reddish brown with the same colour appearing in scattered spots on the swimming legs and genital segment. Flecks of red, irregularly arranged appear on the dorsal surface of the thoracic segments. The eye is bright ruby red, (Wilson, 1932).

Remarks: The distinguishing characteristics of this species are the shovel-shaped protuberance on the genital segment of the female, (Pl. 9, fig. 19B), and the form of the fifth legs in the male, (Pl. 9, fig. 19C). Fig. 19A, Pl. 9 is the female second leg.

The female of this species was present throughout the whole year. Its distribution shows the spring and winter peaks, (Pl. 25, fig. 46). The numbers of this species were very small, twenty-five

being the largest number taken in a haul.

The sizes in mm are as follows:

Female:	Total	2.83	3.49	2.05	1.97	1.98
	Metasome	2.24	2.80	1.68	1.60	1.63
	Urosome	0.59	0.69	0.37	0.37	0.35

The range given by Wilson (1932) is 2 to 2.25 mm.

The male of this species was present in the February haul only. Measurements from one specimen are:

Total 3.63

Metasome 2.72

Urosome 0.91

This specimen exceeds the range given by Wilson (1932) as 1.85 to 2.15 mm.

Family Centropagidae

Genus Centropages Kroyer

Centropages furcatus Dana

Catopia furcata Dana, Proc. Amer. Acad. Arts and Sci., vol. 2, p. 25, 1849

Distribution: Malay Archipelago (Cleve, 1901, A. Scott, 1902, Früchtl, 1920); Pearl Banks of Ceylon (Thompson, 1903, A. Scott, 1902, Sewell, 1929); Coast of Burma (Sewell, 1929); Maldive and Laccadive Archipelagoes (Wolfenden, 1906); Arabian Sea and Persian Gulf (Pesta, 1916); Durban Bay (Brady, 1883); Red Sea (A. Scott, 1902); tropical Atlantic (Farran, 1929); Barbados (Wickstead, 1956).

Remarks: The female of this species may be identified from the spines on the first, second and fifth joints of the anterior antennae, (Pl. 3, fig. 6B), and from the characteristic shape of the fifth legs, (Pl. 3, fig. 6A), which have a slightly serrated spine projecting down from the median joint. The second joint of the male right fifth foot has one uncinate process, and the last joint has one internal and two external marginal spines, (Pl. 5, fig. 10).

This species occurred in fine net hauls beginning in September, and continued to be represented sparsely until March.

The female lengths in mm are:			The male lengths in mm are:		
Total	1.84	1.70	Total	1.55	1.55
Metasome	1.20	1.12	Metasome	1.04	1.04
Urosome	0.64	0.58	Urosome	0.51	0.51

Family Temoridae

Genus Temora Baird

Temora stylifera (Dana).

Calanus stylifer Dana, Proc. Amer. Acad. Arts and Sci., vol. 2, p. 13, 1849.

Temora stylifera Giesbrecht, Fauna und Flora des Golfes von Neapel, vol. 19, p. 328, pls. 5, 17, 18, 1892.

Distribution: Sulu Sea, and off Rio de Janiero (Dana, 1849); Philippines, Fiji Islands (Brady, 1883); tropical Pacific, Red Sea, Mediterranean (Giesbrecht, 1892); Arabian Sea, Malay Archipelago (Cleve, 1901); tropical Atlantic (Brady, 1883, Cleve, 1901); Canary

Islands, Malta (Thompson, 1888); Azores (Barrois, from Wilson, 1932); Trieste (Car, from Wilson 1932); Gulf of Maine (Bigelow, 1926); Oshoro Bay, north-western Pacific, Bonin Islands (Anraku, 1953).

Colour: The body is fairly transparent, with yellow pigment in varying degrees on the metasome, especially at a large spot on either side of the head. The legs are also often yellow. The pigment is arranged in a network, and on the dorsal surface of the head, it is mixed with meshes of bright blue. Isolated flecks of orange-red are found around the mouth and between the bases of the legs. The anterior intestine is a muddy yellowish green. The ripe eggs are bluish green, and the vulva is a dull green, (Wilson, 1932).

Remarks: The sharp-pointed triangular process at the corners of the fifth segment, combined with the elongate and slender caudal rami, (Pl. 5, fig. 12A), are the distinguishing characteristics of this species. Fig. 12B, Pl. 5, shows the female fifth legs with the inner spine of the end segment much longer than the other two apical spines.

The female of this species occurred throughout the year in the plankton. It was never numerous, four being the greatest number taken at one time. Males were not taken.

The lengths are in mm:

Total	1.65	1.67	1.28	1.63	1.65
Metasome	1.07	1.06	0.88	0.99	1.04
Urosome	0.58	0.61	0.40	0.64	0.61

Family Candaciidae

Genus Candacia Dana

Candacia pachydactyla Dana.

Candacia pachydactyla Dana, Proc. Amer. Acad. Arts and Sci., vol. 2, p. 23, 1849.

Candacia pachydactyla Giesbrecht, Fauna und Flora des Golfes von Neapel, vol. 19, p. 424, pls. 21, 22, 39, 1892.

Distribution: China Sea, tropical Atlantic (Dana, 1849); Fiji Islands, Philippines (Brady, 1883); Malta (Thompson, 1903); tropical Atlantic (Kroyer, 1849, Giesbrecht, 1892, Cleve, 1900); Gulf of Guinea (T. Scott, 1894); South African coast (Cleve, 1900); Indian Ocean, Ceylon (Thompson, 1903, Scott, 1902); northern Atlantic (Wolfenden, 1906); Bay of Bengal (Sewell, 1929); eastern Atlantic (Lubbock, 1856); Malay Archipelago (A. Scott, 1902); Caribbean region, west of the Isthmus of Panama (Wilson, 1932); Barbados (Wickstead, 1956).

Colour: The body is moderately transparent and colourless, except for scattered red oil drops and reddish or yellowish oviducts. The chitin of the body and the appendages, especially the end segments of the second, third and fourth exopods and the stout spines on the fifth legs of the female, have a reddish-brown wash of varying intensity; no eye is visible, (Wilson, 1932).

Remarks: The finger-like processes on the genital segment, two in the female and one in the male, (Pl. 13, figs. 25B, D), and the form of the

fifth legs in both sexes, (Pl. 13, figs. 25A, C) furnish the best means of identification.

The female of this species was represented throughout the year, having population peaks in the early summer and in winter, (Pl. 23, fig. 38). The male shows the same sort of distribution, but did not appear during the summer months in the plankton, (Pl. 23, fig. 39).

Five females show the following lengths in mm:

Total	2.56	2.80	2.83	2.93	2.72
Metasome	2.08	2.13	2.00	2.16	2.05
Urosome	0.48	0.67	0.83	0.77	0.67

Four males show the following lengths in mm:

Total	2.64	2.96	3.20	2.66
Metasome	1.84	2.00	2.24	1.86
Urosome	0.80	0.96	0.96	0.80

Family Pontellidae

Genus Calanopia Dana

Calanopia americana F. Dahl.

Calanopia americana F. Dahl, Ber. Naturf, Ges. Greiburg, new ser., vol. 8, p. 21, pl. 1, figs. 23 - 36, 1849.

Calanopia americana Giesbrecht and Schmeil, Das Tierreiche: Copepoda, pl. 132, 1898.

Distribution: Lower Amazon River, Panay Island, Philippine Islands, Bermuda, Rio de Janiero, Caribbean region (Wilson, 1932); tropical Atlantic (Farran, 1929); Iceland (Jespersen, 1934); Barbados (Wickstead, 1956).

Remarks: The characteristic feature of the female is the fifth pair of feet, (Pl. 12, fig. 24B), with the one-jointed exopod; the apex of the joint terminates in three moderately strong spines, of which the middle spine is longest. Fig. 24A, Pl. 12, is the first leg of the female.

One female was taken in the February haul; the total length is 1.4 mm, with a metasome of 0.94 mm and a urosome of 0.46.

Family Pontellidae

Genus Labidocera Lubbock

Labidocera nerii (Kroyer).

Pontia nerii Kroyer, Naturh. Tidsskrift, ser. 2, vol. 2, p. 579, 1849.

Labidocera nerii Giesbrecht, Fauna und Flora des Golfes von Neapel, vol. 19, p. 446, pls. 23, 25, 1892.

Distribution: Cape Finisterre (Kroyer, 1849); tropical Atlantic (Lubbock, 1856; Giesbrecht 1892); Malay Archipelago (Cleve, 1901); Atlantic (Wolfenden, 1906); Gulf Stream, North Atlantic Drift, Canary Current, North Equatorial Current, California Current, west of Galapagos Islands (Wilson, 1932); Barbados (Wickstead, 1956).

Remarks: The chief identification features of L. nerii are the fifth legs of male and female, (Pl. 11, figs. 22D, F), and the appearance of the female urosome, (Pl. 11, fig. 22E).

One specimen of L. nerii appeared in the plankton in June and another in July. During September, all six hauls contained adult L. nerii and many immature forms. The numbers were very small, on September 11, seven females were taken. In November, one hundred and thirty-eight males and two hundred and ninety-six females were taken in the stramin net. During December, thirty-three females and nine males were taken, and in February only one female was collected. March yielded no mature forms.

Wilson (1932) states, "This is a rare species and does not occur anywhere except in very small numbers". In Barbados, L. nerii seems to be well represented during the autumn and winter months, and was one of the most common copepods during November and December.

The lengths of four females in mm are:

Total	3.20	3.28	3.20	3.30
Metasome	2.72	2.72	2.64	2.69
Urosome	0.48	0.56	0.56	0.61

The Barbados specimens exceed the size limits of Wilson's specimens, which are from 2.75 to 3.00 mm.

Two males have the following measurements in mm:

Total	2.83	3.12
Metasome	2.24	2.40
Urosome	0.59	0.72

The males also exceed the limits given by Wilson, which are 2.5 to 2.75 mm.

Labidocera acutifrons (Dana).

Pontella acutifrons Dana, Proc. Amer. Acad. Arts and Sci., vol. 2, p. 30, 1849.

Labidocera acutifrons Giesbrecht, Fauna und Flora des Golfes von Neapel, vol. 19, p. 455, pls. 23, 41, 1892.

Distribution: Pacific Islands (Dana, 1849); tropical Atlantic (Cleve, 1900); Gulf of Guinea (T. Scott, 1894); Mediterranean (Giesbrecht, 1892); Philippines, Australia (Brady, 1883); Atlantic and Antarctic Oceans (Wolfenden, 1906).

Colour: The body is a light transparent blue with a large area of dark in the posterior portion of the thorax. The eyes are large, separated from each other, and dark red, appearing black by transmitted light, (Wilson, 1932).

Remarks: The extraordinary asymmetry of the female urosome, (Pl. 11, fig. 22B), and the details of the fifth legs in both sexes, (Pl. 11, figs. 22A, C), are distinguishing characteristics.

Two females of L. acutifrons were taken on August 16. In September, one male and one female as well as many immature Labidocera were taken. On September 11, eight males and eight females were taken.

The lengths in mm of three females are:

Total	3.79	3.95	3.97
Metasome	3.07	3.15	3.23
Urosome	0.72	0.80	0.74

The lengths of four males in mm are:

Total	3.86	3.68	3.92	4.06
Metasome	2.90	2.72	2.96	3.10
Urosome	0.96	0.96	0.96	0.96

Both sexes are within the limits for total length as stated by Wilson (1932).

Family Pontellidae

Genus Pontellina Dana

Pontellina plumata (Dana).

Pontella plumata Dana, Proc. Amer. Acad. Arts and Sci., vol. 2, p. 27, 1849

Pontellina plumata Giesbrecht, Fauna und Flora des Golfes von Neapel, vol. 19, p. 497, pls. 25, 40, 1892

Distribution: Tropical Atlantic, Cape of Good Hope, Kingsmill Islands (Dana, 1849); East Indies (Lubbock, 1856); Messina (Claus, 1863); Fiji Islands, Philippines (Brady, 1883); Malta (Thompson, 1888); Atlantic and Indian Oceans (Wolfenden, 1906); Bay of Bengal (Sewell, 1929); Malay Archipelago (A. Scott, 1902); Gulf of Suez, Indian Ocean, Ceylon (Thompson, 1903, Scott, 1902); tropical Atlantic and Pacific, Mediterranean (Giesbrecht, 1892); northern Atlantic (Cleve, 1900); South African coast (Stebbing, 1910).

Colour: The body is a light violet-grey, deeper through the centre of the metasome and along the posterior margins of the first and second thoracic segments. A large spot of deep purple, surrounded by a margin of orange-red, occupies the centre of these two segments,

and extends forward onto the head, and backward onto the third segment. Setae of the appendages and of the caudal rami are also orange-red. Each eye is bordered on the inner side with a half-circle of ruby red, (Wilson, 1932).

Remarks: This species may be recognised by the comparative width of the body, the symmetry of the fifth segment and the urosome, and by the details of the fifth legs in both sexes, (Pl. 10, figs. 21B, D). The first leg of the female, (Pl. 10, fig. 21A), and the second leg of the male, (Pl. 10, fig. 21C), are included for further identification aids.

This species is constantly present in the fine net hauls from July to March. Its numbers are never great, one or two being the number in each haul.

The lengths in mm for five female specimens are:

Total	1.10	1.58	1.03	1.04	1.06
Metasome	0.83	1.23	0.77	0.78	0.82
Urosome	0.27	0.35	0.26	0.26	0.24

The Barbados specimens measured were all smaller than the range for the species given by Wilson (1932) as 1.6 to 2.75 mm.

Family Acartiidae

Genus Acartia Dana

Sub-genus Acartiura Steuer

Acartia longiremis (Lilljeborg).

Acartia longiremis Lilljeborg, De crustaceis ex ordinibus tribus; Claocera, Ostracoda et Copepoda, in Scania occurrentibus, p. 181, pl. 24, 1853.

Acartia longiremis Sars, Crustacea of Norway, vol. 4, p. 149, Pls. 99, 100, 1903.

Distribution: Faroe Islands, North Sea, Skager Rak, northern Atlantic (Cleve, 1900); Baltic Sea (Möbius, 1887); Gulf of Finland (Nordquist, as quoted by Wilson, 1932); English seas (Brady, 1872, T. Scott, 1897); Mediterranean (Thompson, 1903, Scott, 1902); Norwegian coast (Sars, 1901); North Sea (van Breemen, 1908); Greenland (Stephensen, as quoted by Wilson, 1932); Arctic Ocean (Mrazek, 1902, Willey, 1920); Keeler Fohrde (Giesbrecht, 1892); Chesapeake Bay, Sargasso and Carribean regions (Wilson, 1932); Gulf of Maine (Bigelow, 1926); Woods Hole (Fish, 1925); Barbados (Wickstead, 1956).

Colour: The body is extremely transparent, with a faint tinge of blue which is sufficient to make the animal visible over either a white or black background, (Wilson, 1932).

Remarks: Wickstead (1956) mentions that a single specimen of A. longiremis was taken in a haul. Four unidentified female Acartia were taken during the summer of 1957, all in damaged condition. Only one specimen was identified as a possible A. longiremis, although the spine on the inner margin of the fifth leg was much shorter than that shown in the drawing of Giesbrecht (1892).

Acartia negligens Dana.

Acartia negligens, Dana, Proc. Amer. Acad. Arts and Sci., vol. 2, p. 26, 1849.

Acartia negligens Giesbrecht, Fauna und Flora des Golfes von Neapel, p. 508, pls. 30, 43, 1892.

----- Giesbrecht, Schmeil, Das Tierreich: Copepoda, p. 154, 1898.

Distribution: Malay Archipelago (Cleve, 1901, A. Scott, 1902, Car, as quoted by Wilson, 1932); Ceylon Pearl Banks (Thompson, 1903, Scott, 1902, Sewell, 1929); Maldive and Laccadive Archipelagoes (Wolfenden, 1906); Red Sea (A. Scott, 1902); temperate and tropical Atlantic (Farran, 1936); Mediterranean, Arabian and Red Seas (Giesbrecht, 1892).

Remarks: A. negligens was taken in the plankton in February and March 1957. Only females were represented.

The species can be identified by the form of the fifth feet, (Pl. 12, fig. 23C), and the first and second antennae, (Pl. 12, figs. 23A, B).

Although the spine on the fifth foot of the female is similar to that on Acartia danae, the forms can be readily separated by the form of the last thoracic segment. In A. negligens, the posterior margins of the last thoracic segment are rounded, and the distal ends are each furnished with a very small spine. A strong spine projects on each side from the thoracic segment of Acartia danae.

Four specimens were measured in mm as:

Total	1.17	1.04	1.12	0.91
Metasome	0.88	0.82	0.82	0.70
Urosome	0.29	0.22	0.30	0.21

Family Aetideidae

Genus Euchirella Giesbrecht

Euchirella amoena Giesbrecht.

Euchirella amoena Giesbrecht, Fauna und Flora des Golfes von Neapel, vol. 19, p. 233, pl. 15, 1892.

Distribution: Only two references to the distribution of this species were found. Giesbrecht (1892) found specimens at 115° W. and 5° N. at the 100 metre depth, and Esterly (1905) found one male at San Diego.

Remarks: Only one male was collected from Barbados. The chief feature of identification is the fifth pair of legs, (Pl. 9, fig. 20C). From the "John Murray" expedition, Sewell (1929) mentions that E. amoena can be included in the "Messinensis" group of the genus Euchirella, although the structure of the left fifth leg differs slightly from that of E. messinensis, E. bella, E. truncata, E. orientalis, E. propria, and E. pulchra, since the three segments of the exopod of the left leg are inserted distally on each other, whereas in all other species, the third segment is inserted a little proximally to the end of the second segment, so as to form a small pair of pincers. Fig. 20A, Pl. 9 is a lateral view of the male, The head is without a crest, like E. pulchra. Fig. 20B, Pl. 9 is the fourth leg.

The total length of the male is 3.63 mm, with metasome of 2.72 mm, and urosome of 0.91 mm.

Family Heterorhabdidae

Genus Hemicalanus Claus

Hemicalanus ornatus Giesbrecht.

Hemicalanus plumosus Giesbrecht, Fauna und Flora des Golfes von Neapel, vol. 19, p. 384, pls. 27, 42, 1892.

Distribution: Giesbrecht (1892) found this species in 1889 at 160° E. and 14° N. at a depth of 500 metres.

Remarks: The female of this species can be recognised by the first leg, (Pl. 3, fig. 4A), which has a proximal pointed spine on the second basipod and a large spine on the first exopod segment; and by the fifth leg, (Pl. 3, fig. 4B). Fig. 9, Pl. 4 is the male fifth leg.

This species occurred only three times in the Barbados plankton, once in June and July, with two females being taken, and once in January when two females were taken.

The total length for two specimens is 4.00 mm with a metasome of 3.68 mm in length, and a urosome length of 0.32 mm.

Family Lucicutiidae

Genus Lucicutia Giesbrecht

Lucicutia flavicornis (Claus).

Leukartia flavicornis Giesbrecht, Fauna und Flora des Golfes von Neapel, vol. 19, p. 358, pl. 5, fig. 4, pl. 19, figs. 2, 3, 15-17, 21, 23, 29, 38 Pl. 38, figs. 38, 40, 1892.

Lucicutia flavicornis Esterly, The Pelagic Copepoda of the San Diego Region, p. 180, fig. 36 a-c, 1905.

Lucicutia flavicornis Farran, British Antarctic ("Terra Nova") Expedition, p. 274, pl. 9, 1929.

Distribution: This species appears to be widely distributed throughout three great oceans. In the Pacific it has been recorded at San Francisco Bay and the San Diego region of the coast of California (Esterly, 1905); off New Zealand, and on the Australian Barrier Reefs (Farran, 1936); in the Malay Archipelago (A. Scott, 1902); in the Indian Ocean on the coast of South Burma, Mankauri Harbour, Nicobar Islands (Sewell, 1929); Ceylon Pearl Banks, Arabian Sea (Thompson, 1903, Scott, 1902) Ceylon Pearl Banks (Sewell, 1929); Maldive and Laccadive Archipelagoes (Wolfenden, 1906); in the tropical Atlantic (Giesbrecht, 1892, Wolfenden, 1906); in the Antilles and Florida Currents, the Sargasso Sea, Azores (Cleve, 1900); the temperate Atlantic (Sars, 1905, Rose, 1934); off the Canary Islands (Thompson, 1888); in the Bay of Biscay (Farran, 1926); off the west coast of Ireland (Farran, 1903, Pearson, 1906); and in the Mediterranean Sea (Claus, 1863, Steuer, 1910, Pesta, 1933).

Remarks: One female specimen was taken during the month of February. The female fifth leg, (Pl. 4, fig 7A), and the first antenna, (Pl. 4, fig. 7B), are both used in identification. The male fifth leg is drawn from Giesbrecht (1892), (Pl. 5, fig. 11).

The female total length was 1.39 mm, with metasome 0.83 mm, and urosome 0.56mm.

Family Metridiidae

Genus Pleuromamma Giesbrecht

Pleuromamma abdominalis (Lubbock).

Diaptomus abdominale Lubbock, Trans. Ent. Soc. London, new ser., vol. 4, p. 28, pl. 10, figs. 1 - 8, 1856.

Pleuromamma abdominalis Giesbrecht and Schmeil, Das Tierreich, Lief 6, Copepoda, p. 109, 1898.

Distribution: Northern Atlantic (Lubbock, 1856); Mediterranean (Claus, 1863, Giesbrecht, 1892; Hawaiian Islands (Brady, 1883); Canary Islands, Malta (Thompson, 1903); tropical Pacific (Giesbrecht, 1892); Malay Archipelago (A. Scott, 1902); Gulf of Maine (Bigelow, 1926).

Colour: The body is fairly transparent and colourless, with red pigment flecks in varying numbers, especially in the region of the mouth. The skin glands are often greenish yellow and the region of the genital opening is dark brown or even black. The eye is ruby red. The luminous organ is very dark and in preserved specimens nearly always turns black, (Wilson, 1932).

Remarks: The spot on the side of the metasome of Pleuromamma is a distinctive characteristic, (Pl. 2, fig. 2A), as are the fifth legs of the male and female, (Pl. 2, figs. 2B,C), as well as the male second leg, (Pl. 2, fig. 2D), with its invaginated second endopod on the left side of the body.

This species occurred only once in a May 8th collection from 1956. Five females and one male were taken on that occasion.

The lengths in mm are:

Female:	Total	2.75	2.72	2.64	Male:	5.36
	Metasome	1.95	1.86	1.84		3.92
	Urosome	0.80	0.86	0.80		1.44

The male taken at Barbados is much larger than those taken by Giesbrecht (1892) or Wilson (1932), who give a range in total length between 2.75 and 3.5 mm.

Family Oithonidae

Sub-family Oithoninae

Genus Oithona Baird

Oithona plumifera Baird.

Oithona plumifera Baird, The Zoologist (Newman), vol. 1, p. 59, 1843.

Oithona plumifera Giesbrecht, Fauna und Flora des Golfes von Neapel, vol. 19, p. 537, pls. 4, 34, 44, 1892.

Distribution: British seas (Baird, as quoted by Wilson, 1932); Mediterranean (Giesbrecht, 1892, Pesta, 1926, Thompson, 1903); North Atlantic North Sea, Arabian Sea (Cleve, 1900); California coast (Esterly, 1905); Malay Archipelago (A. Scott, 1902); tropical Atlantic (Dana, 1849); Red Sea, Indian Ocean (Thompson, 1903, Scott, 1902); Arctic Ocean (Mrazek, 1902); Adriatic (Car and Sraeffe, as quoted by Wilson, 1932, Steuer, 1895, Pesta, 1909); Cape of Good Hope, Naragansett Bay (Williams, as quoted by Wilson, 1932); Gulf Stream south of Martha's Vineyard (Wheeler, 1901); north-western Pacific, Bonin Islands, Oshoro Bay (Anraku, 1953); Barbados (Wickstead, 1956).

Colour: The body is very transparent, with ferruginous pigment variously distributed through the cephalic segment, especially in the region around the mouth. The same pigment sometimes forms spots symmetrically arranged in the thorax, abdomen, the long setae of the first antenna, the furca and the swimming legs. Other individuals are quite colourless except for the ruby red eyes (Wilson, 1932).

Remarks: This species may be recognised by the shape of the urosome, (Pl. 13, fig. 26C), with plumose setae on the outer margin and the tip of each ramus, by the second antenna (Pl. 13, fig. 26A), composed of three segments of which the terminal segment has three long setae with thick bases which taper off distally, and by the first leg, (Pl. 13, fig. 26B), with long setae on the outer margin of the second basipod.

Only females were taken in the hauls.

The length of four specimens measured in mm are:

Total	0.83	1.12	1.12	1.15
Metasome	0.48	0.56	0.56	0.61
Urosome	0.35	0.56	0.56	0.54

Family Oncaeidae

Genus Oncaea Philippi

Oncaea venusta Philippi.

Oncaea venusta Philippi, Arch. Nat., Wiegmann, vol. 1, Jahrg. 9, p. 63, fig. 3, text, 1843.

Oncaea venusta Giesbrecht, Fauna und Flora des Golfes von Neapel, vol. 19, p. 590, pl. 3, 47, 1892.

Distribution: Palermo (Philippi, 1843); South Atlantic (Lubbock, 1856); Nizza (Claus, 1863); New Guinea, Philippines, North Atlantic (Brady, 1883); Canary Islands, Malta (Thompson, 1903); North Atlantic (Cleve, 1900); Sulu Sea (Dana, 1849); Adriatic Sea (Pesta, 1909); Gulf Stream south of Martha's Vineyard (Wheeler, 1901); Chesapeake Bay, tropical Atlantic (Wilson, 1932); Barbados (Wickstead, 1956).

Colour: The body is rather opaque, tinged with carmine red which is deepest in the cephalic and genital segments. The chitin of the head and appendages is violet; the eggs are blue, increasing in colour with development, (Wilson, 1932).

Remarks: This species may be recognised by its body shape, (Pl. 14, fig. 27A), by the second antenna, (Pl. 14, fig. 27B), with its three segments, and by the fourth leg, (Pl. 14, fig. 27C).

Only females were taken in the hauls.

Measurements in mm of three specimens are:

Total	1.33	1.22	0.85
Metasome	0.85	0.70	0.58
Urosome	0.48	0.52	0.27

Family Oncaeidae

Genus Pachysoma Claus

Pachysoma punctatum Claus

Pachysoma punctatum Claus, Die freilebenden Copepoda, p. 163, pl. 25, figs. 6 - 11, 1863.

Distribution: Zamboanga (Suhm, as quoted by Sewell, 1929); Atlantic Ocean near the Equator (Lubbock, 1856); Messina (Claus, 1863).

Remarks: The characteristic shape of the body can be used to identify this species, (Pl. 17, fig. 29A). The second antenna, (Pl. 17, fig. 29B), has four segments; the second, third and fourth have toothed and wrinkled distentions. Fig. 29C, Pl. 17, is the female fourth pair of legs.

Female specimens only were taken during July and August, and again during December, February, and March.

The lengths in mm of three specimens are:

Total	2.40	2.54	2.64
Metasome	1.92	2.06	2.16
Urosome	0.48	0.48	0.48

These measurements are all less than those in the species's range given by Wilson (1932) as 3.25 to 4.0 mm.

Family Corycaeidae

Genus Sapphirina J.V. Thompson

Sapphirina angusta Dana.

Sapphirina angusta Dana, United States Exploring Expedition, 1838 - 1842, (Wilkes), vol. 14, Crustacea, p. 1240, 1853, pl. 87, fig. 3, 1855.

Sapphirina angusta Giesbrecht, Fauna und Flora des Golfes von Neapel, vol. 19, p. 619, pls. 52, 53, 54, 1892.

Distribution: Kerguelen Islands (Dana, 1843); tropical Atlantic (Lubbock, 1856); Messina, Madagascar, coast of Argentina (Brady, 1883); Malta (Thompson, 1903); Mediterranean, Hawaiian Islands (Giesbrecht, 1892); Adriatic (Steuer, 1895, Pesta 1909); California coast (Esterly,

1905); Malay Archipelago (A. Scott, 1902); Barbados (Wickstead, 1956).

Colour: The body of the female is almost colourless and semi-transparent. The ovaries, oviducts, and ovisacs are bluish. The digestive canal is faintly bluish, with the colour deeper in the anterior portion. Young females are almost perfectly transparent and colourless; the males brilliantly iridescent, (Wilson, 1932).

Remarks: This species is easily recognised by its exceptional length in comparison with its breadth, (Pl. 16, fig. 28N), and by the broad process at the inner corner of the caudal ramus, (Pl. 16, fig. 28Q). Figs. 28 O, P, Pl. 16, are the first and second antennae respectively. The third and fourth segments of the second antennae are shorter than the second segment.

Only two female specimens occured in hauls.

Their measurements in mm are:

Total	2.00	2.45
Metasome	1.44	1.65
Urosome	0.56	0.80

Sapphirina nigromaculata Claus.

Sapphirina nigromaculata Claus, Die frei lebenden Copepoden, p. 152, pl. 8, 1863.

Sapphirina nigromaculata Giesbrecht, Fauna und Flora des Golfes von Neapel, vol. 19, p. 619, pls. 52 - 54, 1892.

Distribution: Messina (Claus, 1863, Haeckel, 1893); Canary Isles, Malta (Thompson, 1888); Mediterranean, tropical Atlantic (Giesbrecht,

1892); Adriatic (Steuer, 1895, Pesta, 1909); North Atlantic (Cleve, 1900); Red Sea, Indian Ocean (Thompson, 1903, and Scott, 1902); Malay Archipelago (A. Scott, 1902); north-western Pacific, Bonin Islands, Oshoro Bay (Anraku, 1953); Barbados (Wickstead, 1956).

Colour: The body is transparent and almost colourless, but spotted on the dorsal surface with dark-brown pigment. The spots are arranged in rows of five across the center of each abdominal segment, two on each side, and one on the midline. In the genital segment, the one on the midline disappears. In the head and first four thoracic segments the colour spots are more numerous, but are irregularly arranged and of different sizes. In the female the spots on the urosome are lacking, (Wilson, 1932).

Remarks: This species may be recognised by its spots, and also by the great reduction in the size of the fourth endopods, (Pl. 14, fig. 28C). Figs. 28E, F, Pl. 15, are dorsal views of the male and female respectively. Figs. 28A, B, Pl. 14, are the female first and second antennae. The fourth segment of the second antenna is three times as long as the third segment. Fig. 28D, Pl. 14, is the second leg. The terminal segment of the exopod has two lanceolate flanged spines, one awl-shaped dentate spine, and two small spines around the apex.

This species occurs throughout the year in very small numbers. In February 1958, five females were taken, this number being the largest taken in a haul.

The lengths in mm are:

Female:	Total	1.74	1.73
	Metasome	1.05	1.04
	Urosome	0.69	0.69

The lengths in mm of two males are:

Total	2.50	2.35
Metasome	1.64	1.76
Urosome	0.86	0.59

Sapphirina ovatolanceolata Dana.

Sapphirina ovatolanceolata Dana, Unites States Exploring Expedition, 1833 - 1842 (Wilkes), vol. 14, Crustacea, p. 1855, pl. 87, figs. 15, 16, 1855.

Sapphirina ovatolanceolata Giesbrecht, Fauna und Flora des Golfes von Neapel, vol. 19, p. 618, pls. 1, 52 - 54, 1892.

Distribution: Rio de Janiero (Dana, 1855), Messina (Gagenbaur, from Wilson, 1932, Haeckel, 1893); Gulf of Guinea (Lubbock, 1856); Malay Archipelago (A. Scott, 1902); Nizza (Claus, 1863); Mediterranean, tropical Atlantic (Giesbrecht, 1892); South Atlantic (Cleve, 1900); Red Sea, Indian Ocean (Thompson, 1903, and Scott, 1902); Adriatic Sea (Pesta, 1916); Barbados (Wickstead, 1956).

Colour: The body of the female is colourless and semi-transparent, often with flecks of reddish brown pigment near the margin of the head, thoracic segments and caudal rami. The ovaries, oviducts, and ovisacs are blue, and the digestive canal, greyish blue. The dorsal surface of

male is reticulated and brilliantly iridescent, the meshes filled with all the colours of the rainbow indiscriminately arranged. In general, the head and middle of the thorax contain the reds and yellows, while the margins of the thorax and urosome contain the blues and greens. The caudal rami are not iridescent, but are either colourless or spotted with red, (Wilson, 1932).

Remarks: Figs. 28G, H, Pl. 15, are dorsal views of the female and male, with corneal lenses transferred to the ventral surface of both sexes. Figs. 28I, J, Pl. 15, are the female first and second antennae; the third and fourth segments of the second antenna are the same length and about half as long as the second segment. Figs. 28K, L, Pl. 16, are the male first and second antennae. The second antenna is longer and more slender in the male; the last two segments of the second antenna are nearly as long as the second segment. The terminal segment of the second endopod has three large lanceolate flanged spines, (Pl. 16, fig. 28M).

The total length of the female is 2.34 mm, with a metasome of 1.44 mm and urosome of 0.90 mm.

The length in mm of three males is:

Total	3.18	4.61	4.74
Metasome	2.14	3.01	3.22
Urosome	1.04	1.60	1.52

These lengths exceed the range given by Wilson (1932) for this species as 3.5 to 3.8 mm.

The males of this species occurred in both the fine and stramin nets throughout the year. Their numbers were very small, and the greatest number taken at one time was six. In July, 1957, only two females were taken.

Family Sappharinidae

Genus Copilia Dana

Copilia mirabilis Dana.

Copilia mirabilis Dana, United States Exploring Expedition, 1838 - 1842 (Wilkes), vol. 14, Crustacea, p. 1232, 1853, pl. 86, 1855.

Copilia mirabilis Brady, Voyage of H.M.S. Challenger, vol. 8, pt. 23, Copepoda, p. 117, pl. 53, 1883.

Distribution: Kingsmill Islands, Pacific (Dana, 1849); Cape Verde Islands (Lubbock, 1856); North Atlantic (Brady, 1883, Cleve, 1900); Canary Islands, Malta (Thompson, 1888); Indian Ocean, Pacific (Giesbrecht, 1892); Malay Archipelago (Cleve, 1901); Mediterranean, Gulf of Suez, Red Sea (Thompson, 1903, Scott, 1902); Oshoro Bay, northern Pacific, Bonin Islands (Anraku, 1953); Barbados (Wickstead, 1956).

Colour: The body is as transparent and colourless as glass, the only pigment appearing in the unpaired eye, which is ruby red, (Wilson, 1932).

Remarks: The female of this species can be recognised from its characteristic shape, (Pl. 17, fig. 30A). The urosome segments are denticulate, the anal segment twice as long as the rest of the urosome,

and the caudal rami divergent, with very short apical setae. The second antenna, (Pl. 17, fig. 30B), has a stout apical claw with a furcate spine on the second segment.

The male of the species has a very slender second antenna, (Pl. 18, fig. 30C), with a spine on the inner margin of the second segment which is falcate and unbranched. Fig. 30D, Pl. 18, is the fourth leg.

The male and female are represented in the plankton throughout the year, with the proportion of males being much higher, (Pl. 23, fig. 40, Pl. 24, fig. 41). In the case of the male, the two population peaks are well demonstrated, as is the summer decrease, although many were taken in the July hauls. Females showed no decrease during the summer months, (Pl. 24, fig. 41).

Three female specimens have measurements in mm as follows:

Total	2.13	2.43	2.29
Metasome	1.41	1.68	1.57
Urosome	0.72	0.75	0.72

These measurements are less than the range given by Wilson (1932), as 3.25 to 3.5 mm.

Four males have the following measurements, in mm:

Total	5.12	4.58	4.72	4.56
Metasome	3.04	2.55	2.88	2.80
Urosome	2.08	2.03	1.84	1.76

The male is smaller than Wilson's range, which is 5.25 to 5.5 mm.

Family Corycaeidae

Genus Corycaeus Dana

Corycaeus speciosus Dana.

Corycaeus speciosus Dana, Pro. Amer. Acad. Arts and Sci., vol. 2, p. 38, 1849.

Corycaeus speciosus Giesbrecht, Fauna und Flora des Golfes von Neapel, vol. 19, p. 660, pl. 51, 1892.

Distribution: Tropical Atlantic (Dana, 1849, Brady, 1883); Canary Islands, Malta (Thompson, 1888); Mediterranean, tropical Atlantic and Pacific (Giesbrecht, 1892); Red Sea, Indian Ocean, Arabian Sea (Thompson, 1903 and Scott, 1902); North Atlantic (Cleve, 1900); South Africa (Stebbing, 1920); Chesapeake Bay (Wilson, 1932); Oshoro Bay, north-western Pacific, Bonin Islands (Anraku, 1953); Barbados (Wickstead, 1956).

Colour: The body is rather opaque with pigment spots of red, yellow-red and yellow scattered through it irregularly. The eye is red, and the eggs yellowish, (Wilson, 1932).

Remarks: The female can be identified by the length of the caudal rami and the lappets on the third thoracic segment, (Pl. 18, fig. 31C). The fourth leg, (Pl. 18, fig. 31B), differs from that of C. obtusus in having a spine on the second basipod which is twice the length of the single seta of the knob-like endopod. In C. obtusus the spine equals the seta in length.

The male second antenna, (Pl. 18, fig. 31A), can be distinguished from that of C. elongatus by the serrated inner margin of the terminal

tooth of the second antenna.

Both males and females of this species were taken in the fine net hauls. This was the most abundant of the Corycaeus species. This species occurred in the plankton from August to March.

The lengths in mm of two females are:

Total	2.11	2.05
Metasome	1.21	1.17
Urosome	0.90	0.88

The lengths of four males are in mm:

Total	1.59	1.49	1.31	1.31
Metasome	0.58	0.58	0.77	0.83
Urosome	0.74	0.64	0.54	0.48

These measurements greatly exceed the range given by Wilson (1932) as 0.75 to 0.85 mm.

Corycaeus obtusus Dana.

Corycaeus obtusus Dana, Proc. Amer. Acad. Arts and Sci., vol. 2, p. 39, 1849.

Corycaeus obtusus Giesbrecht, Fauna und Flora des Golfes von Neapel, vol. 19, p. 659, pls. 4, 51, 1892.

Distribution: South Pacific, tropical Atlantic, Sulu Sea (Dana, 1849); Japan Sea, Philippines (Brady, 1883); Trieste (Car, as quoted by Wilson in 1932); Canary Islands, Malta (Thompson, 1888); French coast (Gourret, as quoted by Wilson, 1932); tropical Atlantic, Mediterranean (Giesbrecht, 1892); Arabian Sea, Indian Ocean, Malay Archipelago (Cleve, 1901); Adriatic Sea (Steuer, 1895, Pesta, 1916).

Colour: The female is greyish with red pigment plentifully scattered along the lateral margins, in the epimeral lappets of the metasome, and across the head anteriorly and posteriorly. The corneal lenses are brown with a grey spot in the center. The eye is red; the eggs are green with a blue center and a grey outer shell, (Wilson, 1932).

Remarks: Only females were taken in hauls. Fig. 31F, Pl. 19, is the second antenna. The urosome, (Pl. 19, fig. 31H), is a point of identification, being in the proportion of 24:9:10. The fourth leg, (Pl. 19, fig. 31G), is also a point of identification, the spine on the second basipod being the length of the seta of the knob-like endopod. This is in contrast to the condition in C. speciosus, where the spine is twice the size of the seta.

This species occurs in the fine net plankton hauls taken from August and September and again in the February and March hauls. A total of five hauls during this time yielded very few specimens.

The lengths in mm of two specimens are:

Female:	Total	1.06	1.15
	Metasome	0.68	0.72
	Urosome	0.38	0.43

Corycaeus elongatus Claus.

Corycaeus elongatus Claus, Die frei-lebenden Copepoden, p. 157, pl. 24, figs. 3 - 4, 1863.

Corycaeus elongatus Giesbrecht, Fauna und Flora des Golfes von Neapel, vol. 19, p. 657, pls. 4, 49, 51, 1892.

Distribution: Gulf Stream south of Martha's Vineyard (Wheeler, 1901); Malay Archipelago, North Atlantic (Cleve, 1900-1901); Messina, Nizaa (Claus, 1863); French coast (Gourret, as quoted by Wilson, 1932); South Atlantic, Mediterranean (Giesbrecht, 1892); Red Sea, Indian Ocean (Thompson, 1903, Scott, 1902); Adriatic Sea (Steuer, 1895, Pesta, 1916); Chesapeake Bay (Wilson, 1932).

Colour: The body is opaque, with a variable extent of red, yellowish-red and yellow pigment, especially in the region of the mouth, in the wing-like extensions of the posterior metasome segment and in the genital segment. The eye is dark red, and the eggs are yellowish, turning red with development, (Wilson, 1932).

Remarks: Only males of this species were identified from the Barbados plankton. Characteristic features are the shape of the urosome, (Pl. 19, fig. 31E), with the caudal rami half as long as the urosome, and the posterior antenna with minute spinules on the inner margin of the terminal tooth, (Pl. 19, fig. 31D).

This species occurred more often in the fine net hauls than did C. obtusus. It was taken each month beginning in August and continuing until March.

The measurements in mm of four specimens are:

Total	1.50	1.74	1.63	1.76
Metasome	0.83	0.96	0.93	0.96
Urosome	0.67	0.78	0.70	0.80

These specimens exceed the limits given by Wilson (1932) as 1.3 to 1.4 mm.

Family Corycaeidae

Genus Corycella Farran

Corycella carinata (Giesbrecht).

Corycella carinata Giesbrecht, Fauna und Flora des Golfes von Neapel, vol. 19, p. 661, pl. 51, 1892.

Corycella carinata Farran, Proc. Zool. Soc. London, p. 286, pl. 11, fig. 10, 1911.

Distribution: Tropical Pacific (Giesbrecht, 1892); Mediterranean, Indian Ocean (Thompson, 1903, Scott, 1902); California coast (Esterly, 1905); Chesapeake Bay (Wilson, 1932); Gulf Stream south of Martha's Vineyard (Wheeler, 1901); Christmas Island, Indian Ocean (Farran, 1911); tropical Atlantic, Woods Hole region, Red Sea, Australia - Great Barrier Reef (as quoted by Wickstead, 1956); Barbados (Wickstead, 1956).

Colour: The body is opaque with a variable extent of red, orange and yellow pigment distributed very irregularly, but usually concentrated around the mouth on the ventral surface, in the epimeral lappets, and on the dorsal surface of the genital segment. The eye is dark red and the eggs are orange, (Wilson, 1932).

Remarks: This form can be recognised by its characteristic shape, (Pl. 20, fig. 32A). In the female, the corneal lenses appear in dorsal view and the lappets on the third segment reach the centre of the one-segmented urosome. The caudal rami are half as long as the urosome. The second antenna, (Pl. 20, fig. 32B), is in contrast to that found in any of the Corycaeus species found in this collection.

This species occurred on four occasions in the fine net hauls,

twice in September and once in February and March. The numbers were very small on each occasion. Only females were taken.

Three specimens measured in mm have the following measurements:

Total	0.98	0.98	0.98
Metasome	0.67	0.69	0.67
Urosome	0.31	0.29	0.31

These specimens exceed the range of Wilson (1932), given as 0.86 to 0.92 mm.

Family Ectinosomidae

Genus Microsetella Brady and Robertson

Microsetella rosea Dana.

Canthocamptus roseus Dana, United States Exploring Expedition, 1838 - 1842 (Wilkes), vol. 14, Crustacea, p. 1189, 1853, pl. 83, fig. 10, 1855.

Microsetella rosea Giesbrecht, Fauna und Flora des Golfes von Neapel, vol. 19, p. 554, pl. 44, 1892.

Distribution: Sulu Sea (Dana, 1849); Naples (Giesbrecht, 1892); English seas (Brady, 1883); Woods Hole (Fish, 1925); Oshoro Bay, Bonin Islands (Anraku, 1953); South Atlantic as far as lat. 50° S., New Zealand, tropical Atlantic (Farran, 1926); temperate South Atlantic at lat. 26° 25' S., long. 42° W. (T. Scott, 1914); north temperate Atlantic (Rose, 1924 - 1925, T. Scott, 1897, van Breemen, 1908); Mediterranean Sea (Giesbrecht, 1892, Cleve, 1901, Thompson, 1903, A. Scott, 1902, Pesta, 1916, Rose, 1924); San Diege region (Esterly, 1905); Malay Archipelago (A. Scott, 1902); Indian Ocean off the coast

of Madras (Menon, 1931); Ceylon Pearl Banks, Laccadive and Maldive Archipelagoes (Thompson, 1903, Scott, 1902); Arabian Sea (Cleve, 1901, Thompson, 1903, A. Scott, 19020; Red Sea (Cleve, 1901, Thompson, 1903, A. Scott, 1902); Barbados (Wickstead, 1956).

Colour: The body is transparent, with a decided rosy or reddish tinge which is deepest anteriorly and gradually fades away posteriorly, (Wilson, 1932).

Remarks: This species may be recognised from the shape of the first antenna, (Pl. 20, fig. 33A), which has large projections from segments three and six, the fifth legs, (Pl 20, fig. 33B), with basal and distal segments in which the inner expansion of the basal segment reaches the tip of the distal segment, and the shape of the caudal rami, (Pl. 20, fig. 33C), with the second inner apical seta nearly twice the body length.

Measurement of two specimens in mm is:

Total	0.64	0.53
Metasome	0.32	0.27
Urosome	0.32	0.26

Family Macrosetellidae

Genus Macrosetella A. Scott

Macrosetella gracilis Dana.

Setella gracilis Dana, United States Exploring Expedition, 1838 - 1842 (Wilkes), vol. 14, Crustacea, p. 1198, 1853, pl. 84, fig. 3, 1855.

Setella gracilis Giesbrecht, Fauna und Flora des Golfes von Neapel, vol. 19, p. 559, pls. 1, 45, 1892.

Distribution: Mediterranean (Giesbrecht, 1892); Atlantic Ocean (Cleve, 1900); Malay Archipelago (A. Scott, 1902); Messina (Claus, 1863); Gulf of Guinea (T. Scott, 1894); Papua, Philippines, Sandwich Islands, Atlantic and Pacific (Brady, 1883); Indian Ocean (Thompson, 1903, Scott, 1902); North Sea (van Breemen, 1908); Gulf of Genoa (Brian, 1938); Gulf of Maine (Bigelow, 1926); Gulf Stream south of Martha's Vineyard (Wheeler, 1901); Oshoro Bay, north-western Pacific, Bonin Islands (Anraku, 1953); Barbados (Wickstead, 1956).

Colour: In general, the body is very transparent. The chitin covering and the proximal portions of all the appendages is pinkish violet. The digestive canal is ferruginous red, and surrounded by oil drops, which are usually yellow and darker in colour anteriorly. The eye is bright ruby red, (Wilson, 1932).

Remarks: This species may be identified in the female from the first antenna, (Pl. 21, fig. 34A), which is very long and reaches the genital segment. The anterior and posterior maxillipeds, (Pl. 21, fig. 34B), are well developed. The fifth legs, (Pl. 21, fig. 34C), have a basal segment with four apical setae which does not reach the centre of the distal segment. The distal segment is five times as long as wide, with three apical setae.

Measurements in mm for three specimens are:

Total	1.25	1.46	1.31
Metasome	0.59	0.64	0.62
Urosome	0.66	0.82	0.69

In the male, on the fifth legs, (Pl. 21, fig. 34D), the basal expansion is very short and is tipped with two setae. The distal segment is four times as long as wide, with three apical and one outer setae.

Family Macrosetellidae

Genus Miracia Dana

Miracia efferata Dana.

Miracia efferata Dana, Proc. Amer. Acad. Arts and Sci., vol. 2, p. 53, 1849.

Miracia efferata Brady, Voyage of H.M.S. Challenger, vol. 8, pt. 23, Copepoda, p. 102, pl. 43, figs. 1 - 16, 1883.

Distribution: North Atlantic and South Pacific (Brady, 1883); tropical Atlantic (Dana, 1849); Gulf Stream south of Martha's Vineyard (Wheeler, 1901); New Zealand (Farran, 1926); southeast part of Indian Ocean (Mrazek, 1894); Arabian Sea (Thompson, 1903); Nicobar Islands (Sewell, 1929); Bay of Bengal (Thompson, 1903, Mrazek, 1894); temperate North Atlantic (Giesbrecht, 1892, Mrazek, 1894, Farran, 1926); Barbados (Wickstead, 1956).

Colour: The female is dark greenish blue, becoming yellowish along the margins of the segments. A. large spot on the dorsal surface of the head, extending from the anterior margin back to the centre of the cephalic segment, is blue above the eyes and black behind them. The entire dorsal surface of the body has a glistening metallic lustre

deepest on the head and gradually fading posteriorly. The digestive canal is reddish yellow and surrounded with small red oil globules; the sides of the body are also usually tinged with red, and this colour spreads onto the dorsal and ventral surfaces of the penultimate abdominal segment. The basal segments of the first antennae are tinged with blue; the rest of these appendages, the mouth parts, the swimming legs, the anal segment and the caudal rami are yellow. The eggs are blue at first and turn red as they mature. The male is much paler than the female in colour, (Wilson, 1932).

Remarks:This species can be recognised in the female by the body shape, (Pl. 21, fig. 35A), with its cuticular lenses on the front of the head, the very short caudal setae, and the appearance of the fifth legs, (Pl. 21, fig. 35B).

The lengths of four specimens in mm are:

Total	1.83	1.83	1.76	1.83
Metasome	1.09	1.09	1.04	1.09
Urosome	0.74	0.74	0.72	0.74

In the male, the second antenna, (Pl. 21, fig. 35C), is two-jointed; attached at the middle of the first segment is a one-jointed branch with two pectinated setae.

Family Monstrillidae

Genus Monstrilla Dana

Monstrilla grandis Giesbrecht.

Monstrilla grandis Giesbrecht, Fauna und Flora des Golfes von Neapel, vol. 19, p. 586, pl. 46, 1892.

Distribution: Giesbrecht (1892) found this species in 1891 at 65° W. and 40° S.

Remarks: Fig. 1A, Pl. 1 is a lateral view of a female M. grandis drawn after Giesbrecht (1892), with a metasome length of 2.9 mm, and urosome of length 0.85 mm. Only two specimens were measured from the Barbados collection, a female of metasome length 3.4 mm and urosome of 0.72 mm, and a male with metasome length 1.39 mm and urosome of 0.38 mm. This specimen does not approach the size range given by Giesbrecht (1892) as metasome length 2.3 to 2.55 mm and urosome length 0.45 to 0.50 mm.

Fig. 1B, Pl. 1 is the female first antenna. This drawing corresponds favourably with that from Giesbrecht, except that only two short spines can be found at the proximal end of the structure instead of three. The female fifth leg, (Pl. 1, fig. 1C), also differs slightly from those drawn by Giesbrecht. The inner margin has only one seta instead of two. The outer margin has three which is the case in Giesbrecht's drawings. Fig. 1D, Pl. 1 is the male first antenna, and differs as did the female first antenna by having only two short spines at its proximal end instead of three.

This species was not common the the waters of Barbados, although specimens were taken from August to December, 1957, in fine net hauls.

DISCUSSION

Farran (1920) has divided the Copepoda into a series of groups according the the frequency of their occurrence and the number of individuals present in different habitats. The first are the Neritic species that are usually taken near the coast in large numbers. Second are the Oceanic species that are usually taken in open waters of the ocean. Third are the Euryhaline species, having a wide tolerance to differences in salinity which may be present in any locality. Fourth are the Benthic species, which live on or close to the bottom of the sea. The specimens identified from Barbados would probably fall mostly in the second category, the Oceanic species. The geographic position of Barbados, at the intersection of the North and South Equatorial Currents, makes this assumption plausible. Sewell (1947) has compiled records of 134 species from the North Equatorial System, all of which fall into the Oceanic category. From this listing the species identified from Barbados have been chosen and are listed below:

Undinula vulgaris (Lubbock).

Paracalanus aculeatus Giesbrecht.

Acrocalanus longicornis Giesbrecht.

Calocalanus pavo (Dana).

Euchaeta marina (Prestandrea).

Scolecithrix danae (Lubbock).

Centropages furcatus (Dana).

Temora stylifera (Dana).

Lucicutia flavicornis (Claus).

Candacia pachydactyla Dana.

Labidocera acutifrons (Dana).

Pontellina plumata Dana.

Acartia negligens Dana.

Oithona plumifera Baird.

Oncaea venusta Philippi.

Corycaeus obtusus (Claus).

C. speciosus Dana.

Corycella carinatus Giesbrecht.

Sappharina angusta Dana.

S. nigromaculata Claus.

S. ovatolanceolata Dana.

Copilia mirabilis Dana.

Microsetella rosea Dana.

Macrosetella gracilis (Dana).

Miracia efferata Dana.

Sewell's list includes the majority of the species found at Barbados. Wheeler (1901) and Wilson (1933 and 1942) list the species found in the Gulf Stream, a part of the North Equatorial Current System. Many are present in the Barbados fauna. After passing the Lesser Antilles, this water system is then swept northwards and eastwards into the North Atlantic Ocean and on towards the coasts of Europe.

The South Equatorial Current is formed from the Benguela Current which flows up the west coast of Africa, crosses the Atlantic to the north-east corner of South America, and divides into two main streams. This current is responsible for bringing the Indian Ocean copepod

fauna into the Atlantic Ocean. Sewell (1947) lists 138 warm water species from the south temperate and tropical Atlantic regions of the South Atlantic Ocean which are also present in the Indo-Pacific fauna. Of these species those present in the Barbados area are listed below:

Undinula vulgaris (Dana).

Paracalanus aculeatus Giesbrecht.

Acrocalanus longicornis Giesbrecht.

Calocalanus pavo (Dana).

Euchaeta marina (Prestandrea).

Scolecithrix danae (Lubbock).

Centropages furcatus (Dana).

Temora stylifera (Dana).

Lucicutia flavicornis (Claus).

Candacia pachydactyla Dana.

Labidocera acutifrons (Dana).

Pontellina plumata Dana.

Acartia negligens Dana.

Oithona plumifera Baird.

Corycaeus obtusus Dana.

C. speciosus Dana.

Sappharina angusta Dana.

S. nigromaculata Claus.

S. ovatolanceolata Dana.

Microsetella rosea Dana.

Macrosetella gracilis (Dana).

Miracia efferata Dana.

Species known from the western side of the South Atlantic Ocean

also include many species common in Barbados, of which two are not mentioned in the above list. These are Calanopia americana F. Dahl and Labidocera nerii (Kroyer). Calanopia americana has a distribution confined to the east coast of South America, although it has been reported as far north as Bermuda and Iceland, (Sewell, 1947).

The deep-living or bathy-planktonic species also appear in the fauna of Barbados. These groups of species are also oceanic and are affected by the North Atlantic Intermediate water currents at depths of 1500 to 4000 metres. These currents sweep south-west across the North Atlantic. Sewell (1947) lists 357 species of deep sea Copepoda. Those appearing in the Barbados plankton are:

Neocalanus gracilis (Dana).

Eucalanus attenuatus (Dana).

Rhincalanus nasutus Giesbrecht.

Euchirella amoena Giesbrecht.

Pleuromamma abdominalis (Lubbock).

Microsetella rosea Dana.

Surging waters in the Barbados area due to the convergence of currents may bring these specimens to the surface, and thus account for the fact that Neocalanus gracilis, Eucalanus attenuatus, and Rhincalanus nasutus are common species in the Barbados area.

During the period of June to September of 1957, the total volume of dry plankton was recorded and a graph drawn, (Pl. 26, fig. 49). Information for this graph is given below.

Month	Date	Volume of Dry Plankton (cc)
June	6	20
	25	50
July	18	60
	26	25
Aug.	2	15
	16	15
Sept.	2	20
	16	40

This graph shows an increase in the total amount of plankton during June and the first part of July. On the 18th of July, 60 cc of dry plankton were recorded. The amount falls off steadily, reaching a low in August, with only 15 cc being obtained. The volume rises again during the middle of September. This decrease during August and September may be seen in the histogram of total copepod catches, and in the histograms of individual species. Such evidence would indicate a general decrease in the food supply during this time of year.

Smith (1950) determined plankton volumes from eleven stations in Biscayne Bay, Florida. Plankton from the northern part of this bay shows two concentration maxima, one in July and a smaller one in December and January. One station in the southern part of the bay also showed maxima in July and December. The results in Barbados follow closely these from Florida. It seems possible from the population maximum demonstrated by the copepods in January that the total plankton also reaches a maximum during this period, although no figures are available. Smith found that the Copepoda are a minor part of the plankton except at Chicken Key, where in October, 1949, 48.5% of the

organisms were copepods. In June, 1946, 16.5% were copepods. The June peak of copepods from Biscayne Bay corresponds favourably with what is found in Barbados, but the October peak is almost three months earlier, in Florida, than in Barbados.

Davis (1955) generalised the results found by Smith, showing that the total plankton volume sets a pattern which is entirely different from the conventional pattern established for temperate waters. The southern plankton has a massive midwinter maximum with a secondary spring maximum. The temperate regions show a massive spring maximum with a secondary autumn maximum. Attempts have been made to explain these seasonal variations on the basis of simple physical, chemical, or biological factors. The factors used to explain these variations in temperate waters, the temperature of the water, and an increasing solar radiation, will, however, be of lesser importance in tropical waters.

The correlation of phytoplankton to zooplankton is perhaps more important. Marshall (1933) states that in several instances phytoplankton bloom begins when the strong Trade Winds begin. In the Great Barrier Reef region, the most extensive phytoplankton maximum appears during the season of the Trade Winds. Winds may stir up shallower areas and bring an increased nutrient content to the surface as well as oxygenate the waters. Winds may also be responsible for the transport of food material by causing surface currents and thus bring nutrients from one area into a secondary one. The flow of large South American rivers probably brings down rich supplies of nutrients from the interior, which cause the bloom during certain seasons of the year. Nutrients from the tropical rainy season of summer would reach the Barbados area

by early winter.

Accompanying a phytoplankton peak, one would expect a zooplankton peak. The zooplankton would increase and consume the phytoplankton faster than the phytoplankton can reproduce itself, with a resulting reduction of both phyto- and zooplankton.

How accurate these theories are and how much the maxima and minima of population are dependent on physical, chemical and biological factors still needs much further investigation.

SUMMARY

Collections of copepods were taken from Barbados during April to June of 1956 and from May to March of 1957 - 58. The samples were taken with a fine mesh net (48mpi) and a coarse stramin net.

Thirty-six species of copepods were taken from this area. All species are oceanic in distribution and could be carried to the area by the North and South Equatorial Currents and the North Atlantic Intermediate water currents. A systematic account is given for each species including its distribution, colour and characteristics for identification. These latter characteristics are illustrated.

Population histograms were drawn up for the total number of copepods caught per month, and for certain individual copepods which occur frequently in the Barbados plankton. The histogram for the total number of copepods and the individual histograms all show the bimodal type of distribution, with a spring peak, summer decrease and winter peak. An attempt has been made to explain the peaks and decrease of plankton with reference to the correlation between phyto-plankton and zooplankton.

A key to the separation of the Barbados plankton has been designed using the keys of Wilson (1932) and Davis (1955) as models.

KEY TO SEPARATION OF COPEPOD GENERA

1. With no appendages between the first antennae and the first swimming legs. Oral tubule near the centre of the ventral surface of the cephalothorax; fifth legs present in the male; caudal rami with five or six setae. . . . . ♀♂ Monstrilla, Pl. 1, fig. 1A

   With appendages between the first antennae and the first swimming legs. 2

2. Fifth thoracic segment and fifth legs if present, form the posterior portion of the metasome. 3

   The fifth thoracic segment is first segment of the urosome. 26

3. Endopods of third and fourth legs three-segmented. 4

   Endopods of third and fourth legs two-segmented. 22

4. Endopods of first legs with three segments 5

   Endopods of first legs with two segments 15

   Endopods of first legs with one segment. 20

5. With small brown luminescent organ on right or left side of first segment; fifth legs uniramose, 2- to 4- segmented in female, 5-segmented in male, asymmetrical. . . . . ♀♂ Pleuromamma, Pl. 2, fig. 2A

No circular brown spot on either side of first segment. 6

6. Female with swollen genital segment. 7

Male genital segment not swollen. 11

7. Fifth legs similar to other legs. 8

Fifth legs unlike other legs. 10

8. Outer margin of second segment of second exopod with a deep notch at its proximal corner. . . . . ♀ Undinula, Pl. 2, fig. 3A

Second segment of second exopod not thus. 9

9. Distal segment of basipod of first legs with a spine; first basipod of the fifth legs has a long seta on the outer margin. . . . . ♀ Hemicalanus, Pl. 3, fig. 4A,B

Distal segment of basipod of first legs has a strong hook on anterior margin; third segment of exopod terminates in a hooked spine. . . . . ♀ Neocalanus, Pl. 3, fig. 5A

10. Middle segment of fifth exopod with a large inner spine; end segment with denticulate terminal spine; segments one, two and five of first antenna with short spines. ♀ Centropages, Pl. 3, fig. 6A,B

Fourth and fifth metasome segment fused and rounded; fifth legs biramose. Exopods 3-segmented, endopods 2- or 3-segmented. Terminal segment of fifth endopod with five plumose setae. . . . . ♀ Lucicutia, Pl. 4, fig. 7A

11. Rami of fifth legs segmented alike, endopods subsymmetrical or missing, exopods asymmetrical. 12

Rami of fifth legs not segmented alike. 14

12. Basipod of right fifth leg biramose, very short; left leg very long, uniramose or biramose. Middle segment of second exopod invaginated. . . . . ♂ Undinula, Pl. 4, fig. 8

Condition not thus. 13

13. Basipods of first and second segments of left exopods lengthened, end segments short; end segments of second, third and fourth exopods have toothed margins. . . . . ♂ Neocalanus

13. (Cont.) Third segment of left fifth leg with bristle on outer margin, terminates in spine which is longer than that of right leg. . . . . ♂ Hemicalanus, Pl. 4, fig. 9

14. Left fifth exopod 2-segmented, right 3-segmented, with two end segments forming a strong chela, endopods symmetrical, 3-segmented; exopod of second antenna 6-segmented, its basal segment exceptionally short. . . ♂ Centropages, Pl. 5, fig. 10

Rami of left fifth legs 3-segmented, right leg 2-segmented, distal segment of right exopod shutting down against the proximal, forming a chela. . . . . ♂ Lucicutia, Pl. 5, fig. 11

15. Caudal rami at least six times as long as wide, fifth legs uniramose, 3-segmented in female; in male, left leg 4-segmented, chelate; right 3-segmented . ♀♂ Temora, Pl. 5, fig. 12A,B

Caudal rami at most three times as long as wide. 16

16. Middle segment of third and fourth endopods with two setae and terminal segment with seven setae. 17

Middle segment with one seta, and terminal segment with five setae. 18

17. Outer margin of second, third and fourth exopods not toothed; fifth legs uniramose, 3- or 4-segmented in female; in male, right leg 4-segmented, left 5-segmented. . . ♀♂ Calocalanus, Pls. 5-6, figs. 13A-C

Outer margin of exopods toothed. 19

18. Exopod of first legs with two segments; fifth legs uniramose in female, 3-segmented; left leg biramose in male, right leg uniramose, with only one segment. . . . ♀♂ Rhincalanus, Pl. 6, figs. 14A-D

Exopod of first legs with three segments; end spines of second to fourth exopods with smooth margins; fifth legs uniramose in male. . . . . ♀♂ Eucalanus, Pl. 7, figs. 15A-D

19. Fifth legs of female lacking or reduced to knobs; left leg only present in male; exopod of second antenna as long as endopod, 1-segmented. . . . . ♀♂ Acrocalanus, Pl. 7, fig. 6A,B

Fifth legs 2-segmented, uniramose in female, in male right leg 2-segmented; exopod of second antenna shorter than endopod, 7-segmented. . ♀♂ Paracalanus, Pl. 8, fig. 17A

20. Posterior surfaces of rami of third and/or fourth legs with transverse rows of spines or at least with a row of spines on the inner border of the first basipod segment of the fourth legs. 21

    Posterior surfaces of rami unarmed and smooth. Posterior corners of metasome rounded, hairless; inner seta on caudal rami lengthened and geniculate. . . . . ♀♂ Euchaeta, Pl. 8, figs. 18A-D

21. Head fused with first thoracic segment; no spines on inner border of the first segment of the fourth basipod; urosome as wide as metasome. . . . . ♀ Scolecithrix, Pl.9, figs. 19A-C

    Head separate from first thoracic segment, with a row of spines on the inner border of the first segment of the fourth basipod. . . . . ♀ Euchirella, Pl. 9, figs. 20A-C

22. Endopod of first legs with three segments; fifth legs in female biramose, 1-segmented, exopod four times as long as endopod; in male uniramose and 4-segmented . . . . ♀♂ Pontellina, Pl. 10, figs. 21A-D

22. (cont.) Endopod of first two legs
with two segments. 23

23. Head with a pair of conspicuous dorsal lenses; fifth legs biramose in female, rami 1-segmented and unequal; right leg uniramose in male, with chela. . . . . ♀♂ Labidocera, Pl. 11, fig. 22

Head without such lenses. 24

24. Exopod of second antenna less than half as long as endopod. Fifth legs in female 3-segmented, each tipped with a long seta; in male 4-segmented and somewhat asymmetrical, the right leg the longer. . . . . ♀♂ Acartia, Pl. 12, fig. 23

Exopod of the second antenna as long as the endopod. 25

25. Urosome symmetrical; fifth legs in female 3- or 4-segmented, the two distal segments of the right leg forming a stout chela. . . . . ♀ Calanopia, Pl. 12, figs. 24A,B

Urosome asymmetrical; male fifth legs without a chela; fifth legs of female 3-segmented, very small and symmetrical; left leg in male

25. (cont.) 4-segmented, right 3-
segmented, the two end segments
scissor-like. . . . . ♀♂ Candacia, Pl. 13, figs. 25A-D

26. Metasome much wider than urosome. 27

Urosome nearly as wide as the
metasome or tapering into it. 33

27. Exopod and endopod of first to
fourth legs with three segments. 28

Same unevenly segmented. 31

28. Second antenna with two segments,
six setae; fifth leg conical, with
one seta, caudal rami twice as
long as wide, and setose. . . . . ♀ Oithona, Pl. 13, figs. 26A-C

Second antenna with more than two
segments. 29

29. Second antenna with three segments,
first antenna 6-segmented; rami of
first to fourth pairs of legs, 3-
segmented, end segments elongated,
exopods with coarse dagger-like
spines; fifth legs minute, 1-seg-
mented with two subequal apical setae. ♀ Oncaea, Pl. 14, figs. 27A-C

Second antenna with four segments. 30

30. Second antenna having a short spine mid-way along second basipod segment, third segment with three or fewer short cilia, fourth segment terminating in a coarse spine; fifth legs uniramose, 1-segmented, each with two minute apical spines; caudal rami broadly laminate, with no elongated setae. . . . . ♀♂ Sappharina, Pls. 14-16, Figs. 28A-Q

Second antenna having haired knobs on second segment, third segment with three long cilia, fourth segment terminates in four long, two short cilia; fifth legs at sides of fifth thoracic segment, uniramose, with two basal, two terminal spines; caudal rami narrow, twice as long as wide, with one long outer marginal seta, three long terminal setae, two shorter ones. . . . . ♀ Pachysoma, Pl. 17, figs. 29A-C

31. Head squarely truncated anteriorly; second antenna 4-segmented; urosome 4-segmented in female, 5-segmented in male, caudal rami long and divergent. . . ♀♂ Copilia, Pls. 17-18 figs. 30A-D

Conditions not thus. 32

32. Urosome 2-segmented or fused; second antenna 3-segmented; rami of first to third legs and exopod of fourth leg 3-segmented; endopod of fourth legs 1-segmented; fifth legs represented by two setae, unequal in length. . . . . ♀♂ Corycaeus, Pls. 18-19, figs. 31A-H

Urosome 1- segmented; second antenna 4-segmented, inner margin of second segment not toothed; rami of first to third legs and exopod of fourth leg 3-segmented; endopod of fourth leg missing; fifth legs lacking. . . . . ♀ Corycella, Pl. 20, figs. 32A,B

33. First four pairs of legs with three rami; middle apical seta of caudal rami as long as the body; inner seta of end segment of fifth leg very short, weak and rudimentary. . . . . ♀ Microsetella, Pl. 20, figs. 33A-C

Condition not thus. 34

34. First antenna 8-segmented; geniculate in male; exopod of second antenna lacking; caudal rami slender, cylindrical, longer than last two abdominal segments; apical cilia longer than entire body; fifth legs 2-segmented. . . . ♀♂ Macrosetella, Pl. 21, figs. 34A-D

First antenna 8-segmented; geniculate in male; exopod of second antenna small, 1-segmented and attached to the side of the basal endopod segment; caudal rami long, slender; apical setae scarcely longer than rami. . . ♀♂ Miracia, Pl. 21, figs. 35A-C

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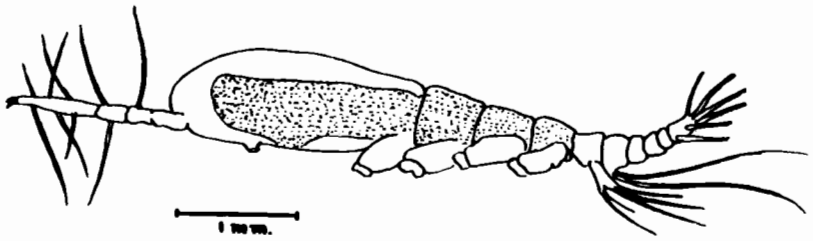
PLATES 1 - 26



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B

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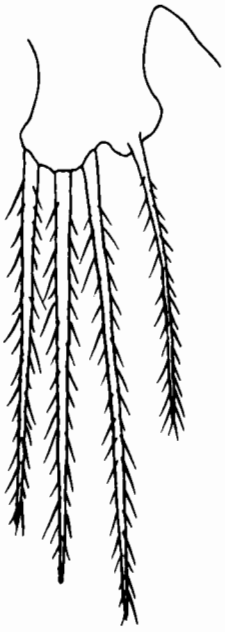

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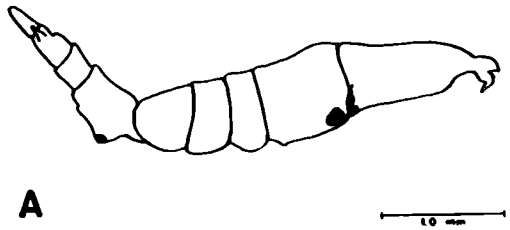

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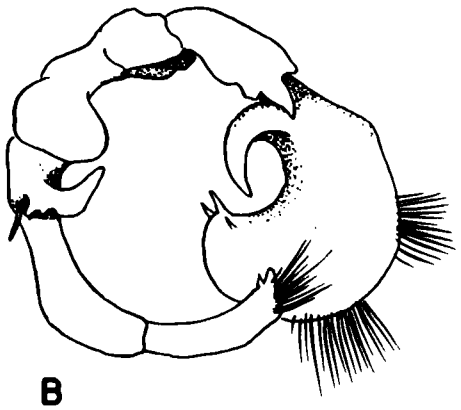

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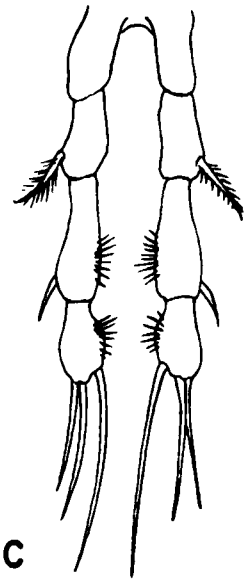

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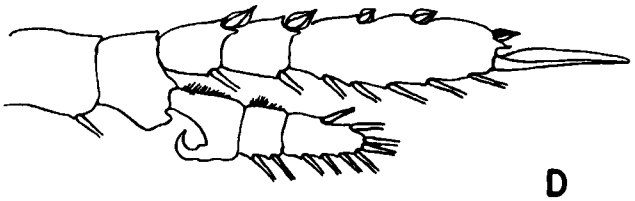

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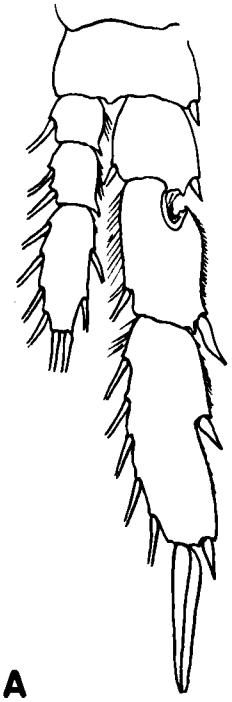

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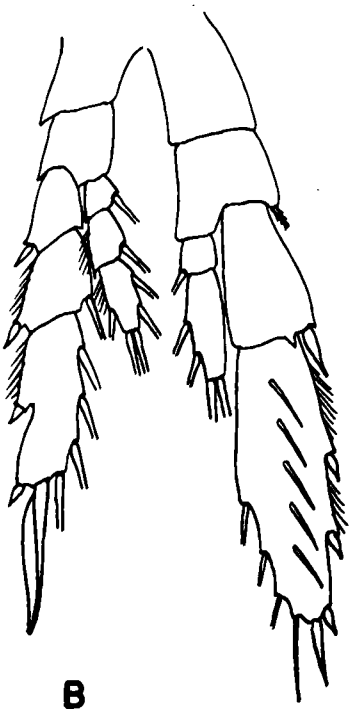

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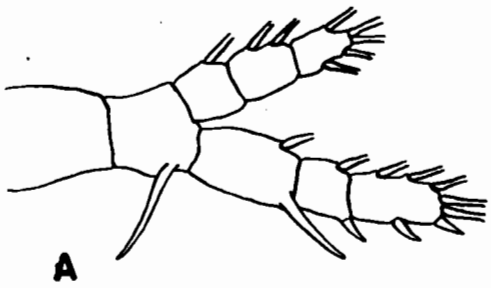

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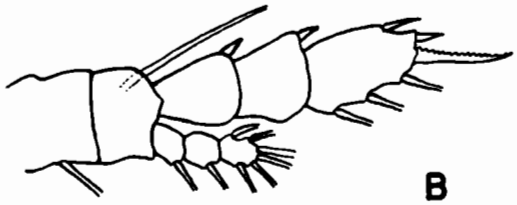

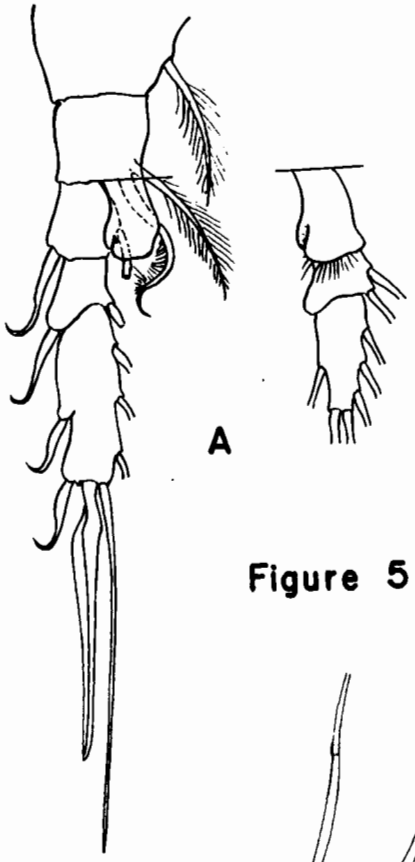

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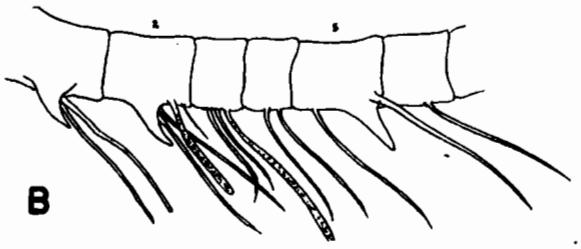

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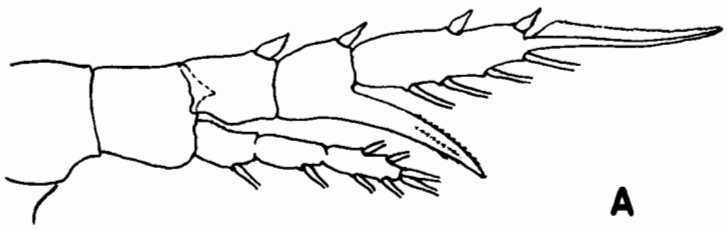

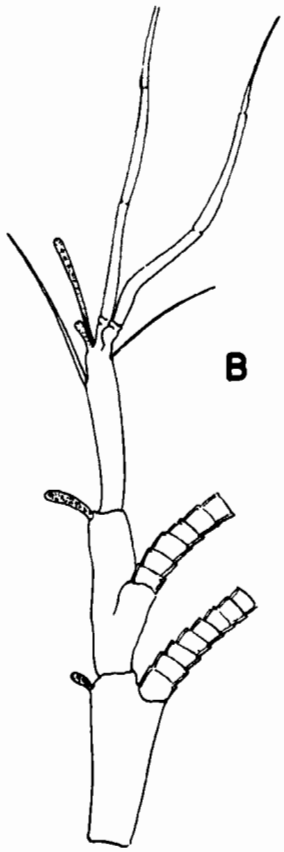

Plate 3

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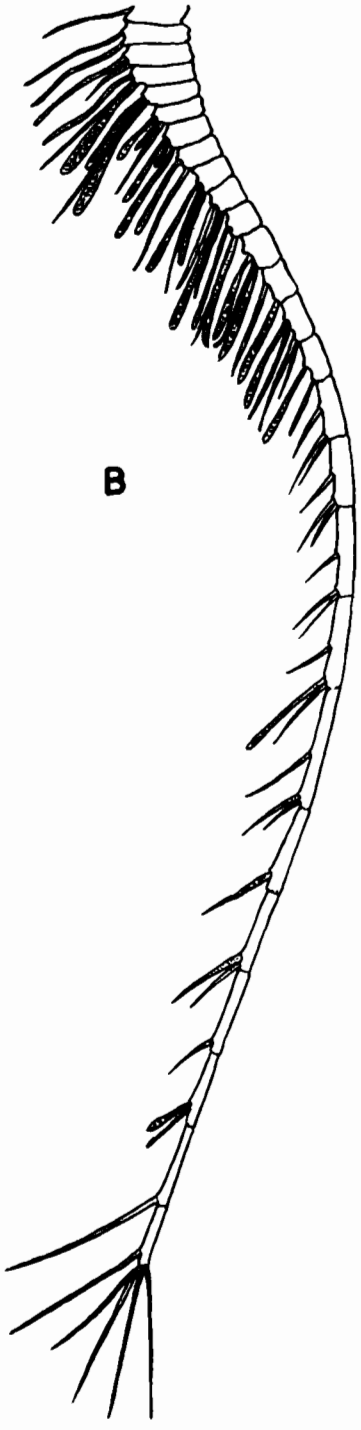

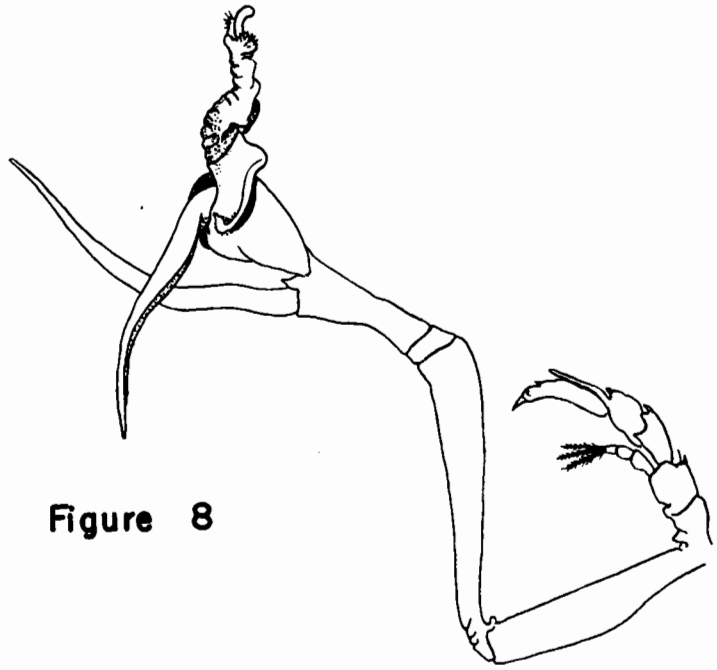

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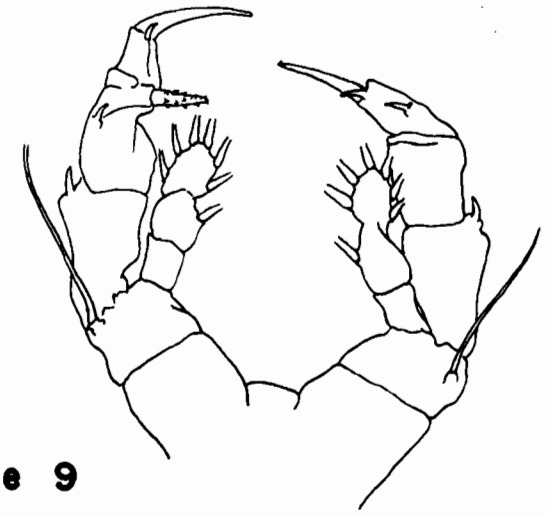

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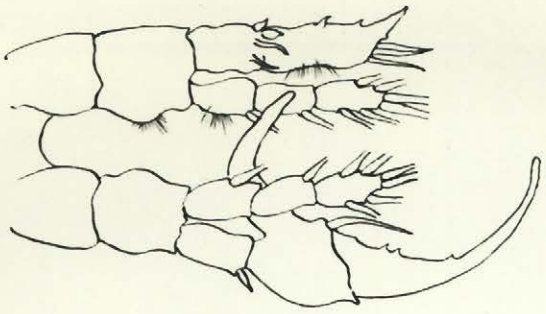

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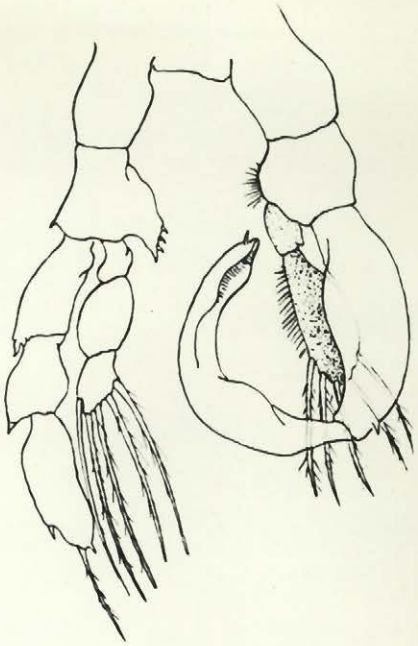

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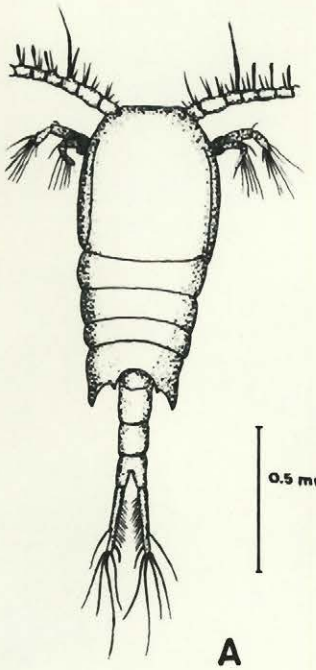

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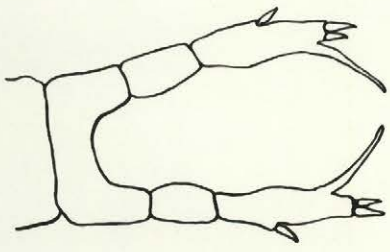

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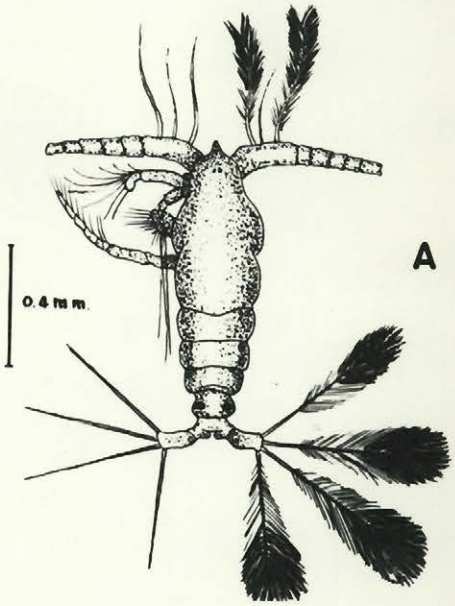

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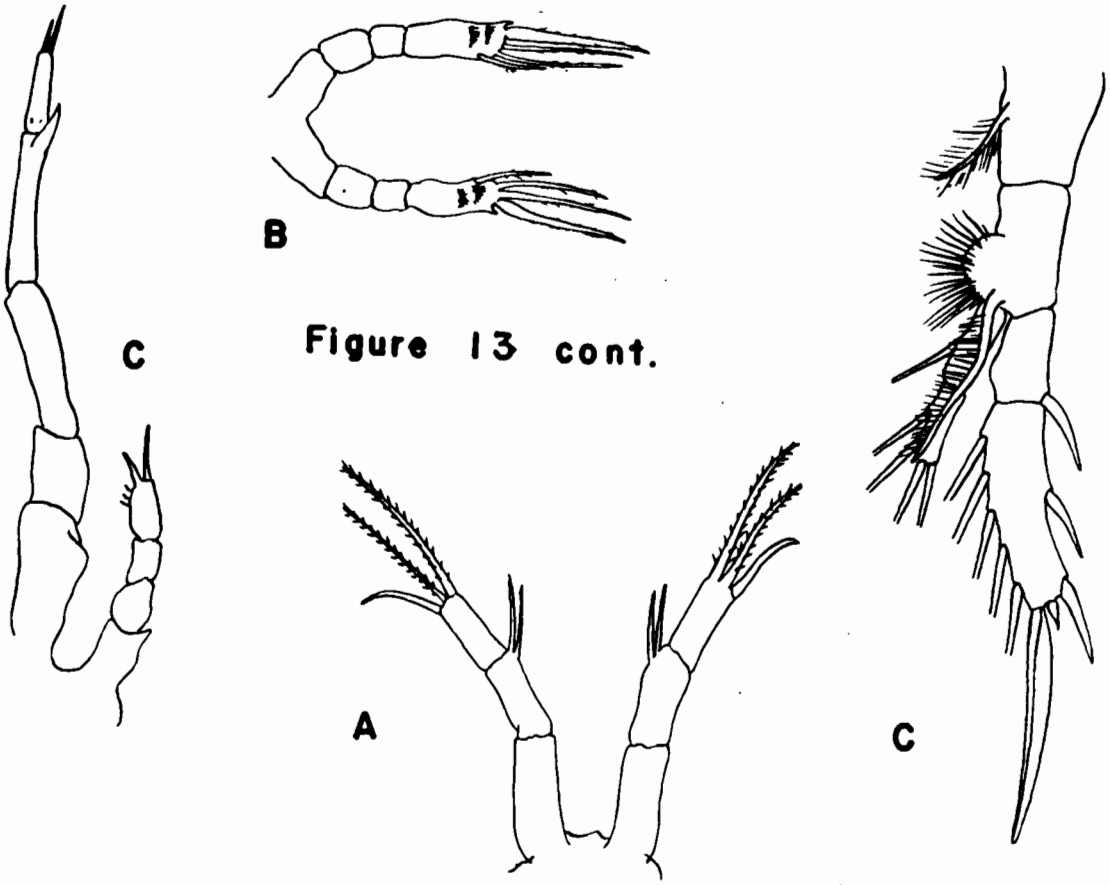
Figure 13

Plate 5



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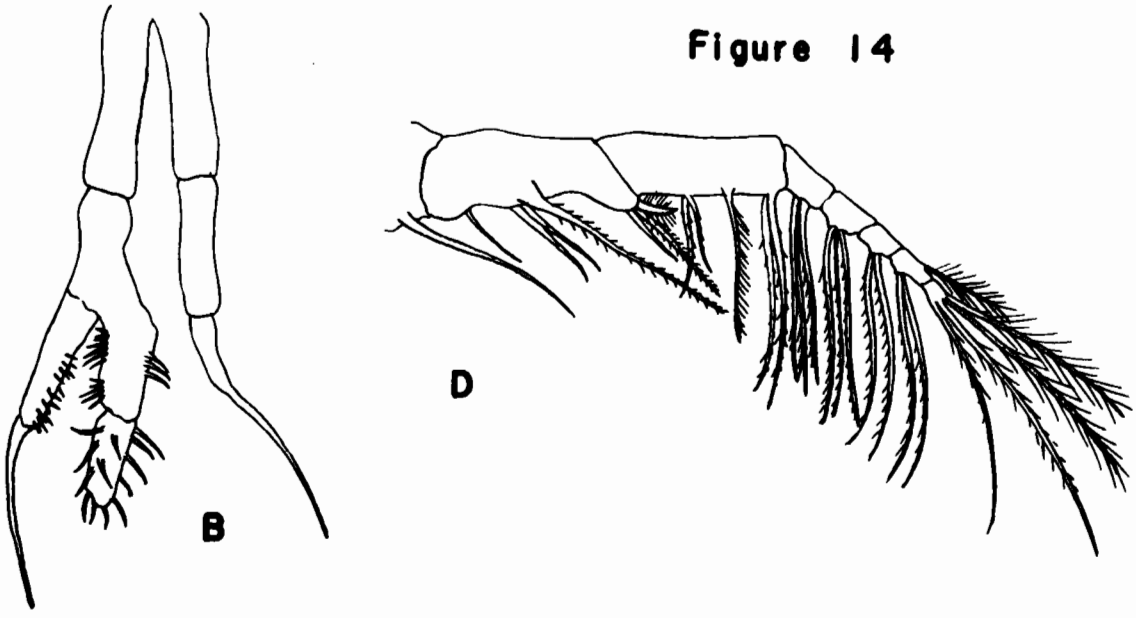

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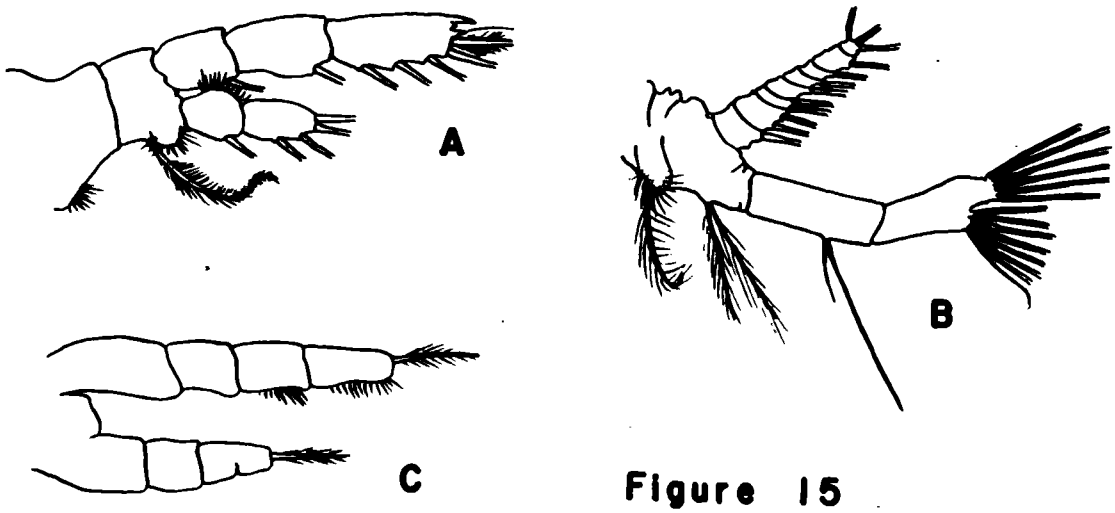

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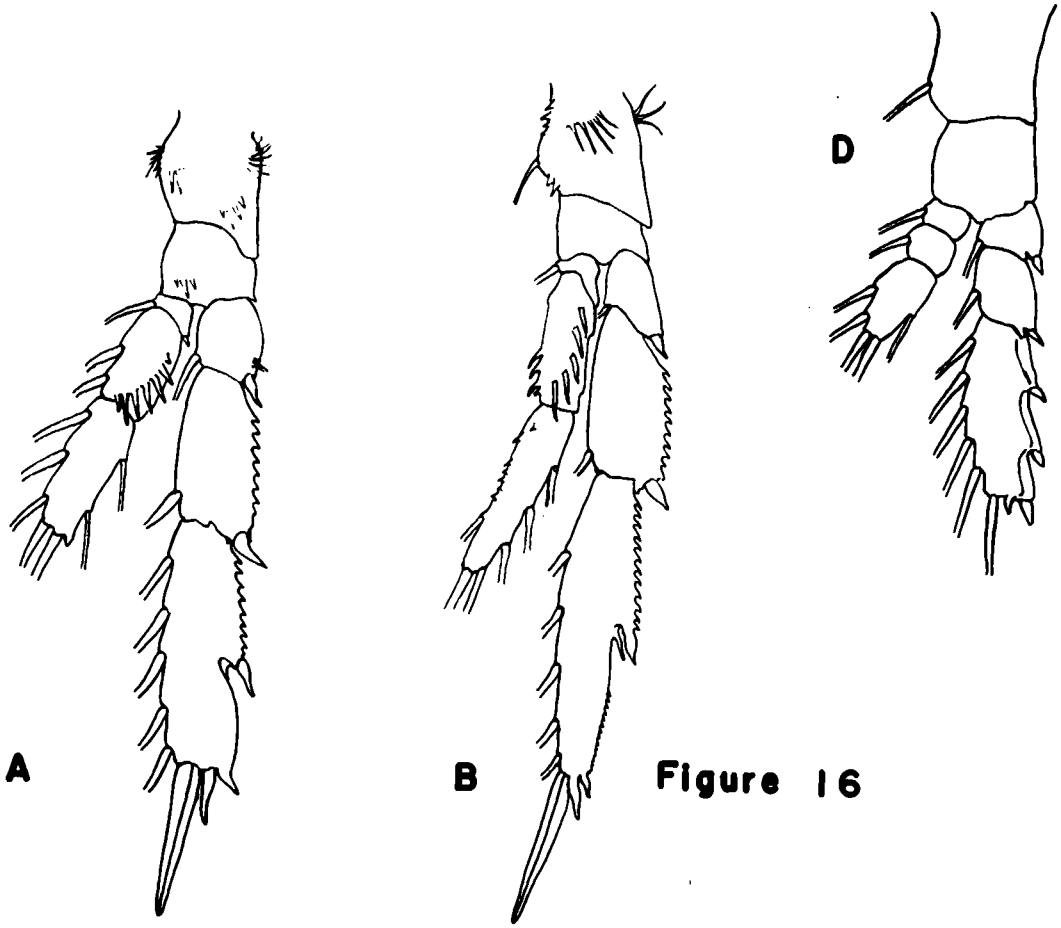
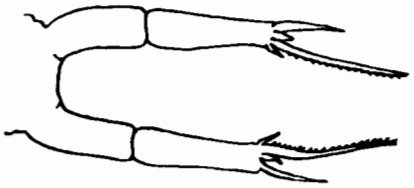


Figure 16

Plate 7

Figure 17



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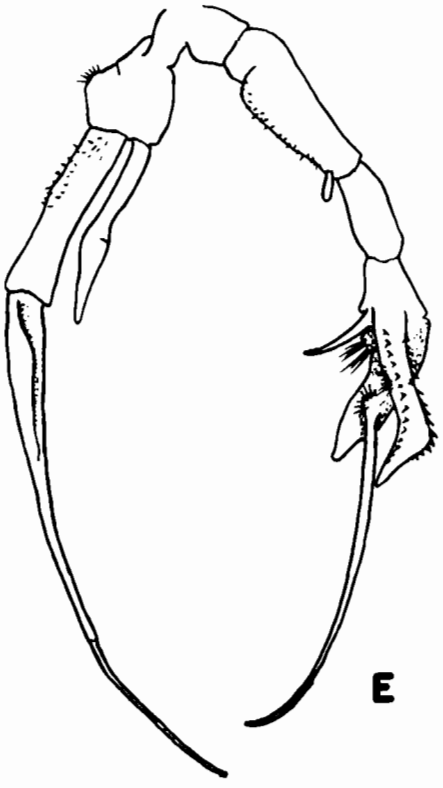

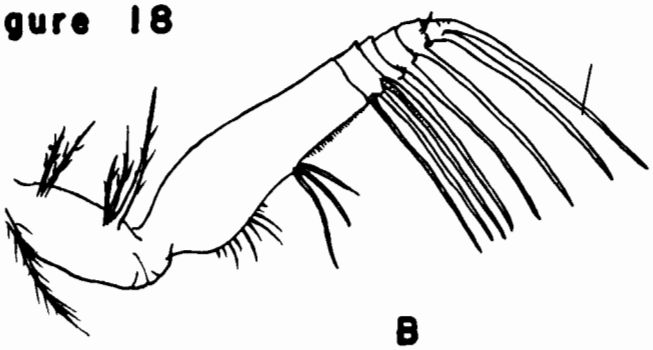

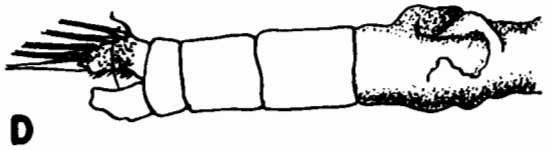

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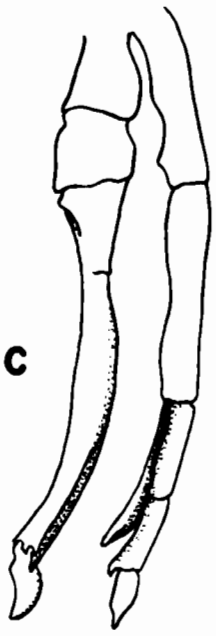

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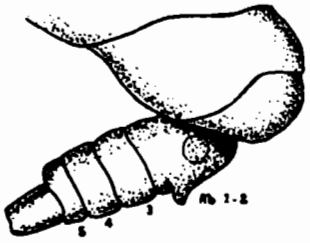

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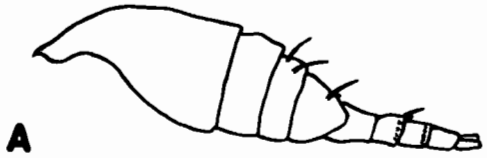

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Figure 20

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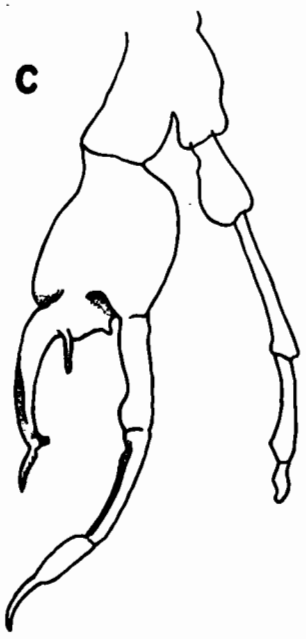

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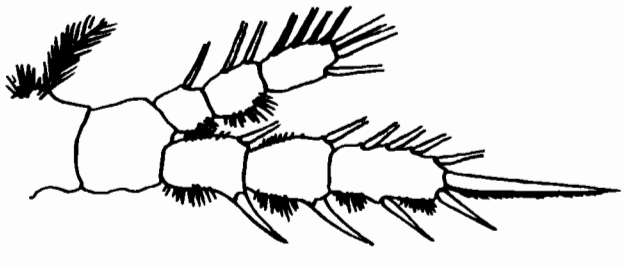
Plate 9



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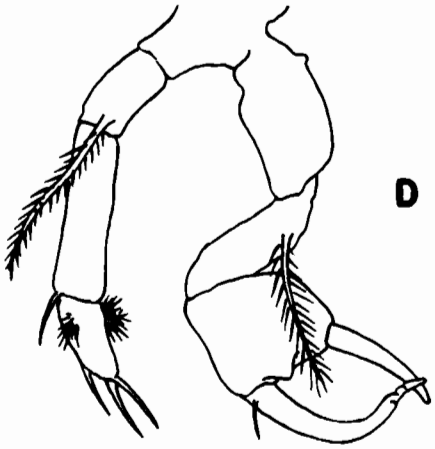

D

B

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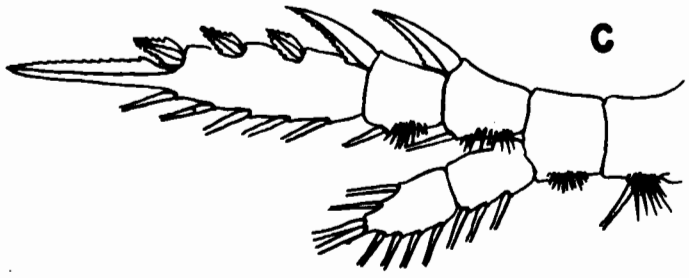

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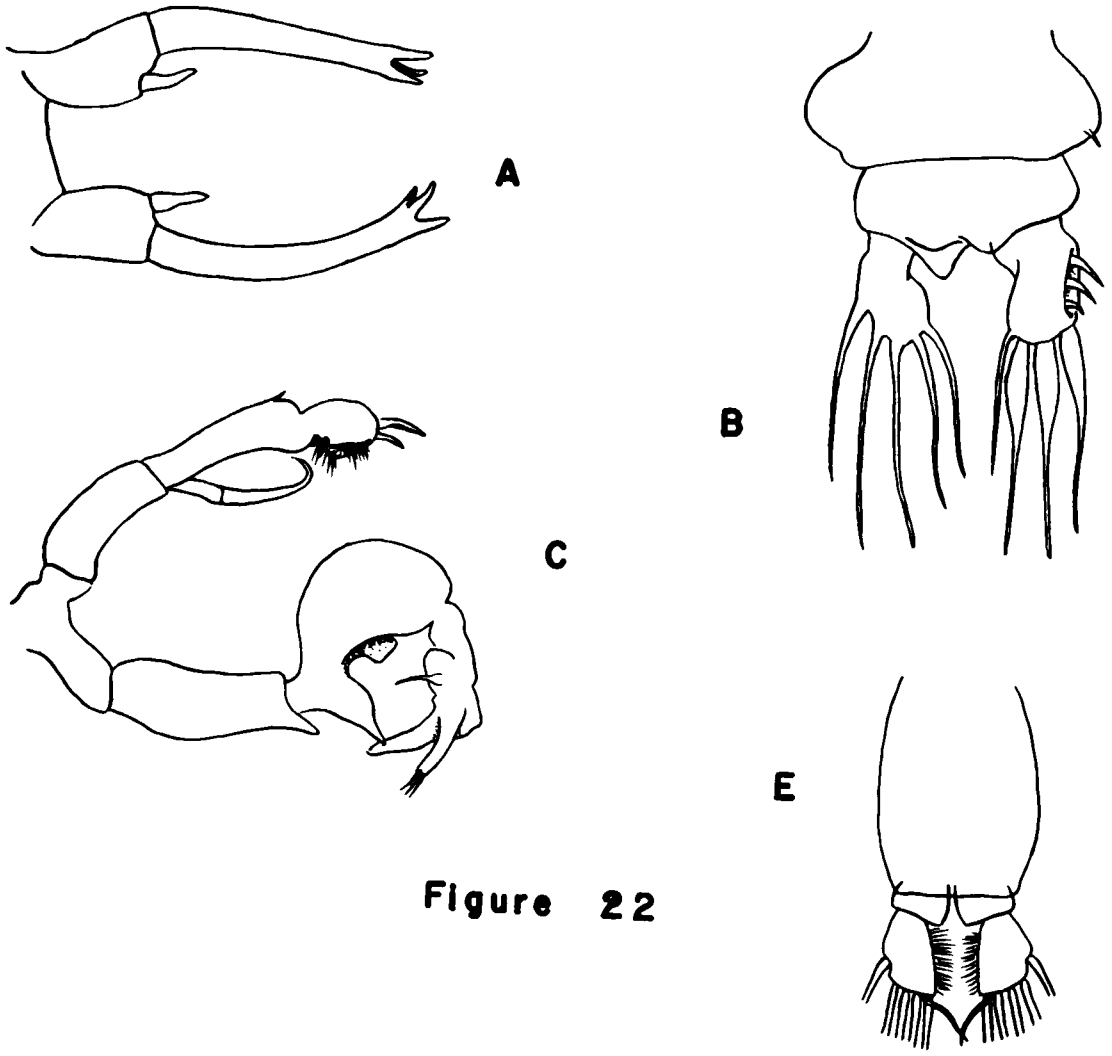

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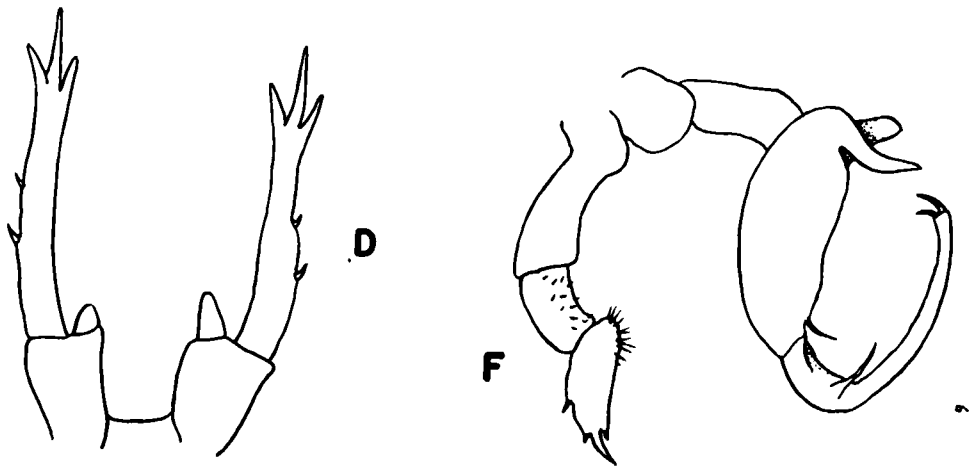

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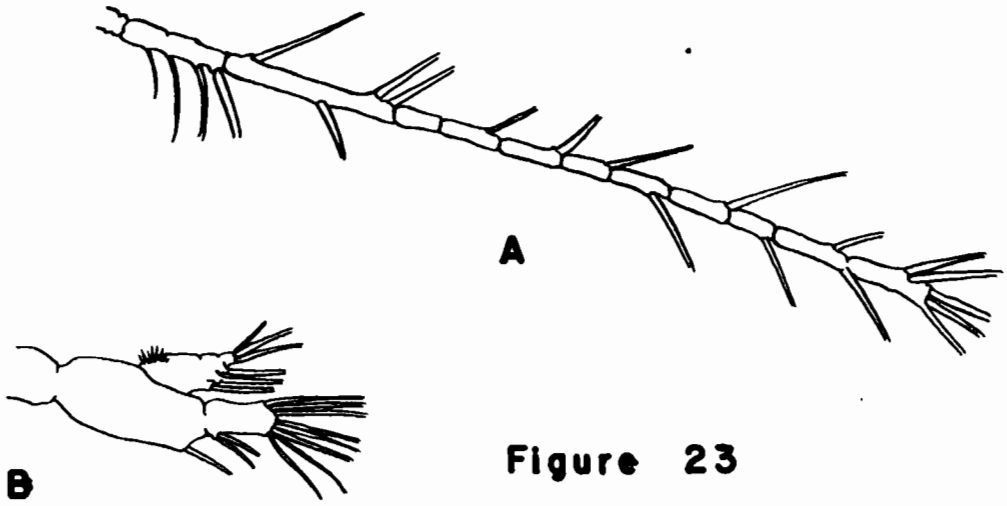

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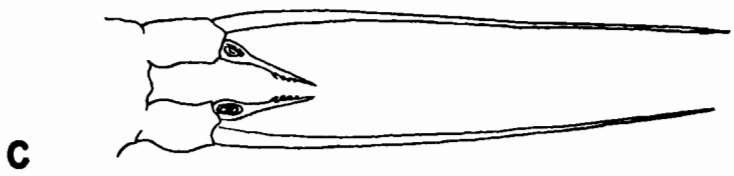

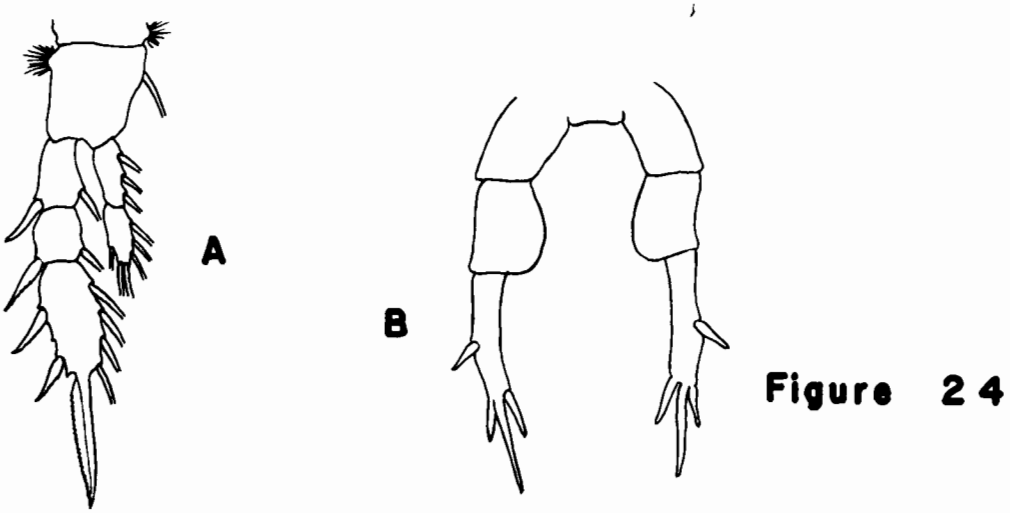

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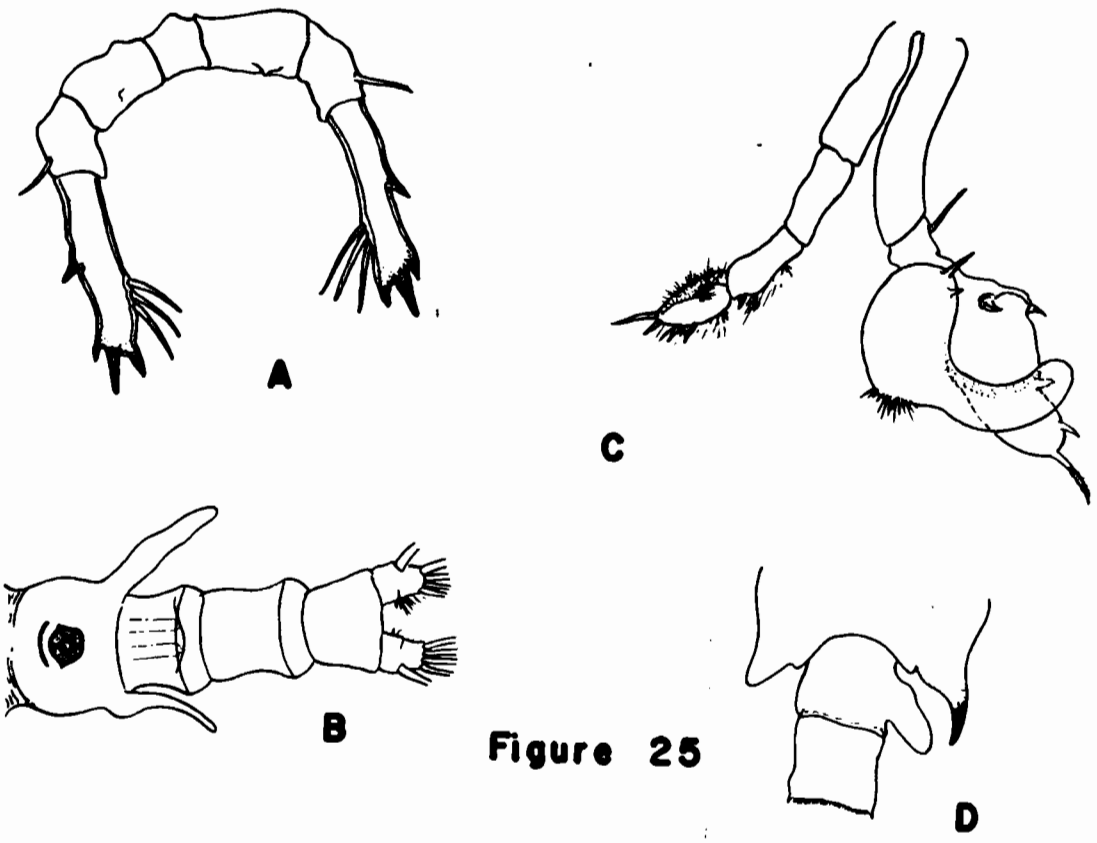

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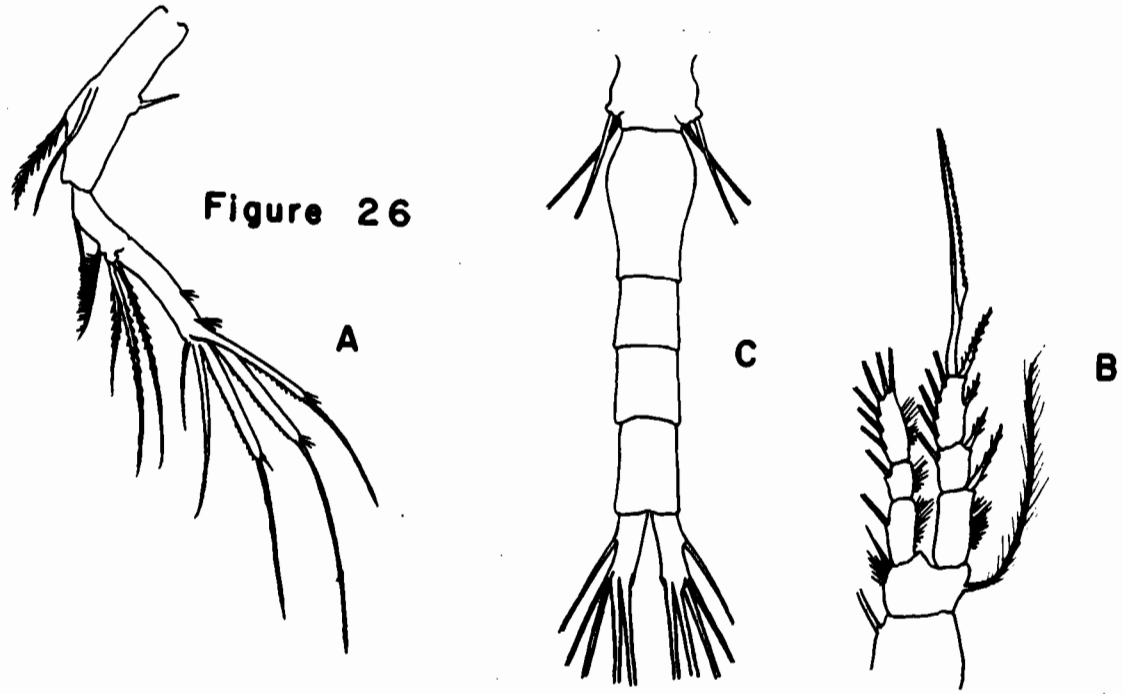

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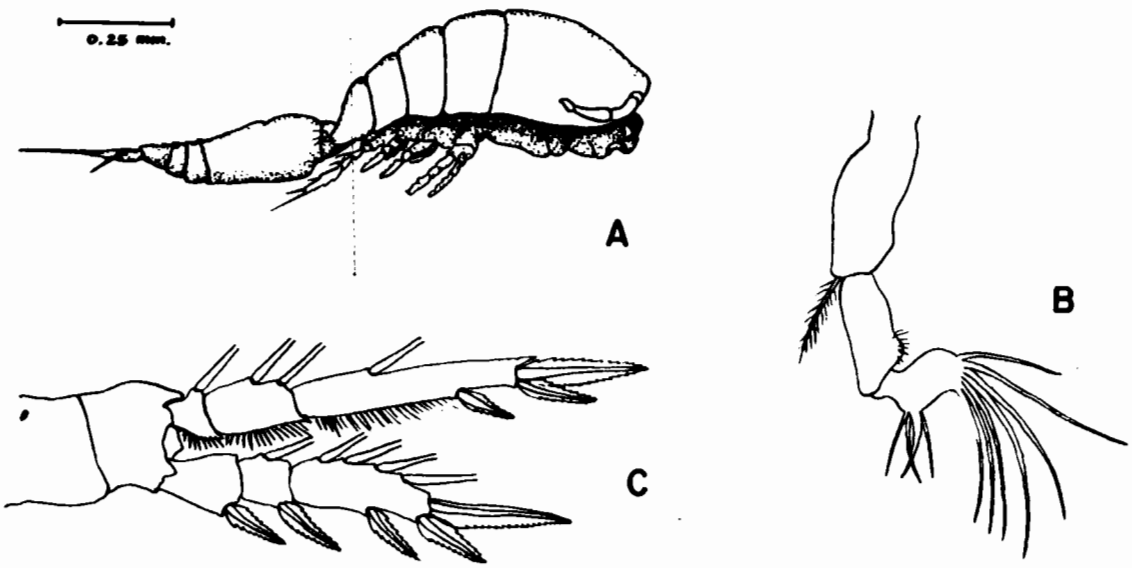

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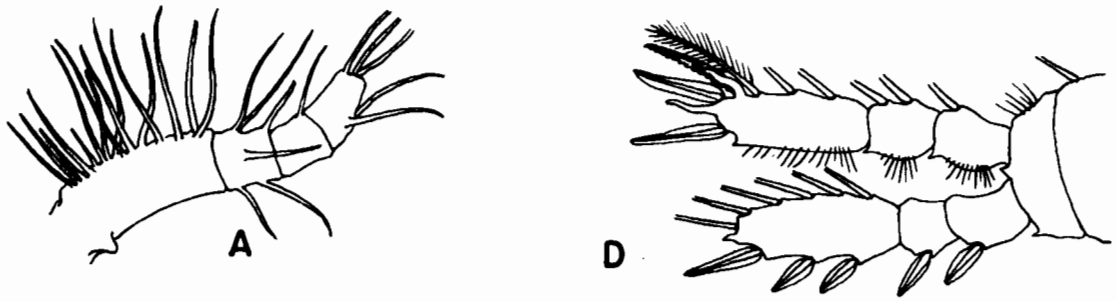

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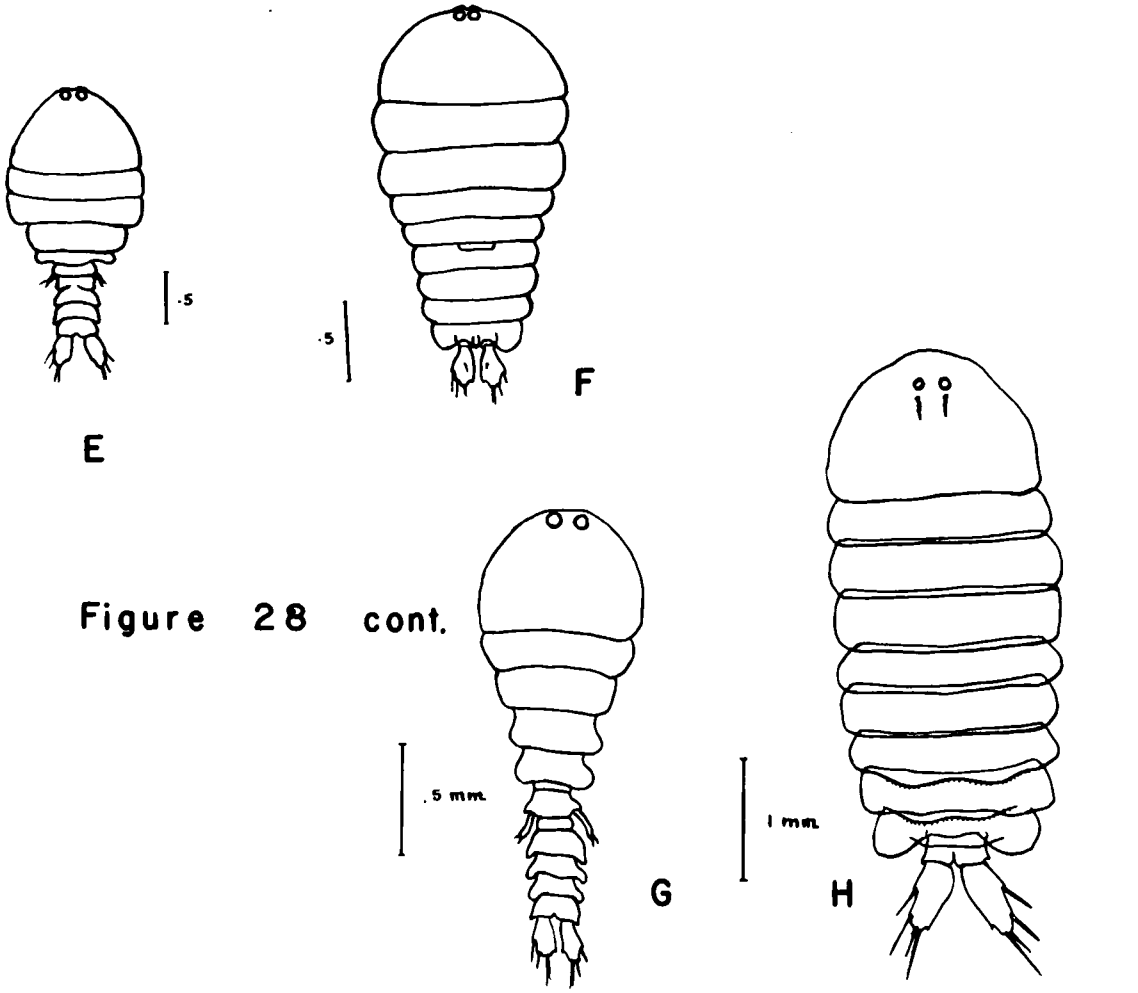

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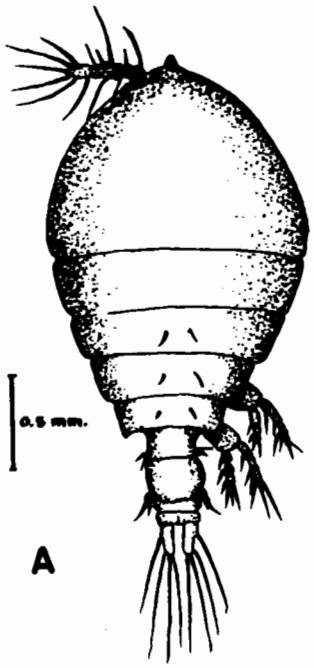
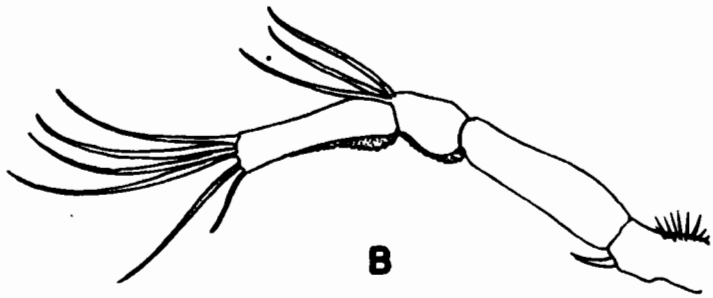




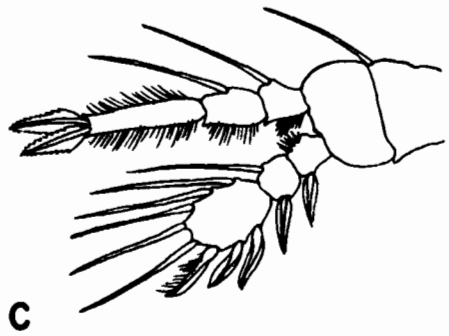
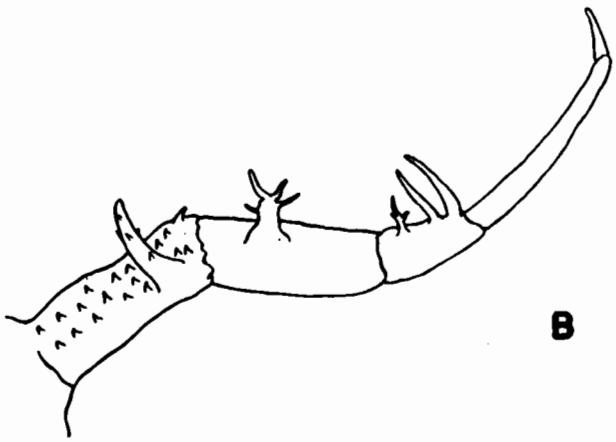
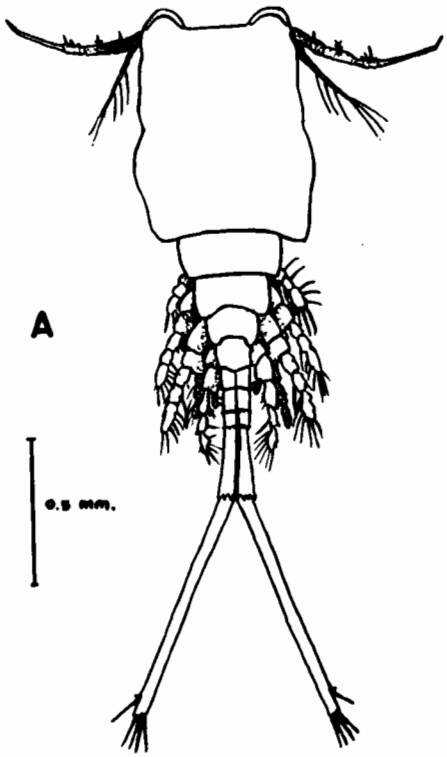


Figure 29

Figure 30





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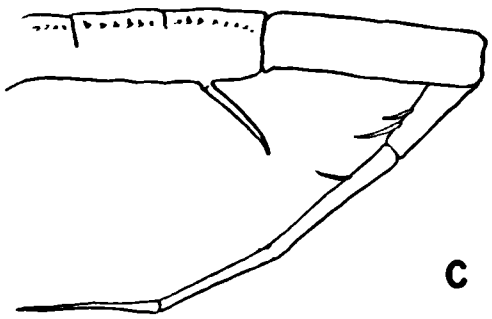

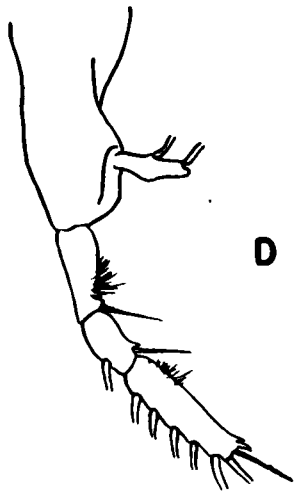

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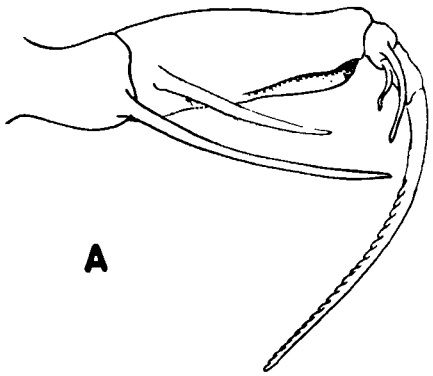

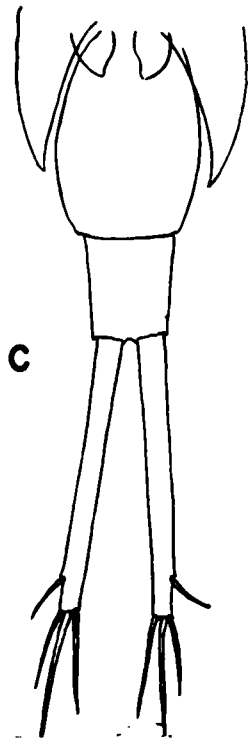

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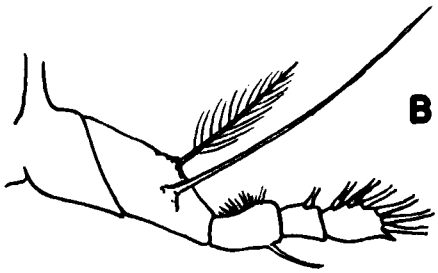
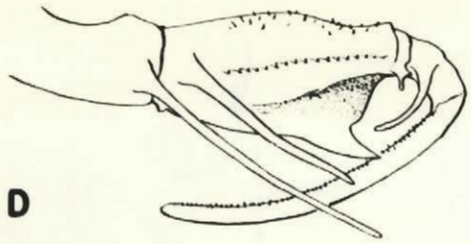


Plate 18



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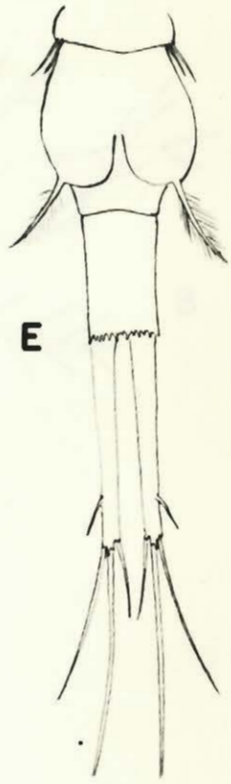
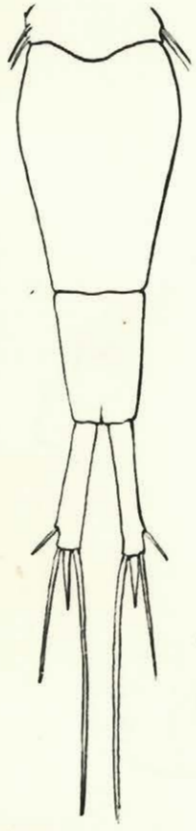


E

Figure 31 cont.



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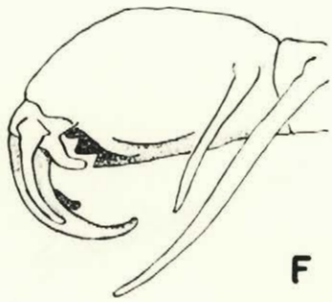

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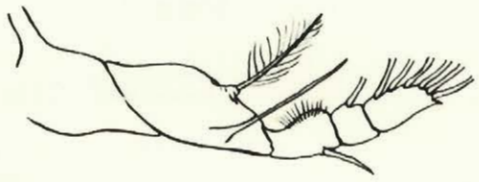
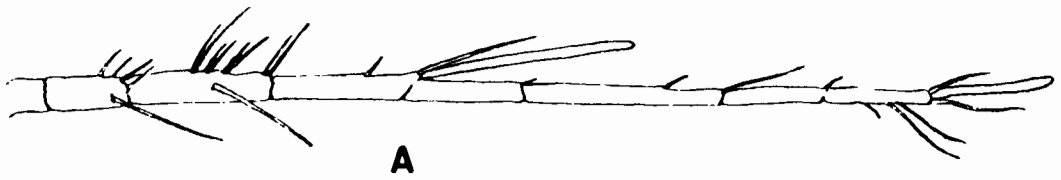
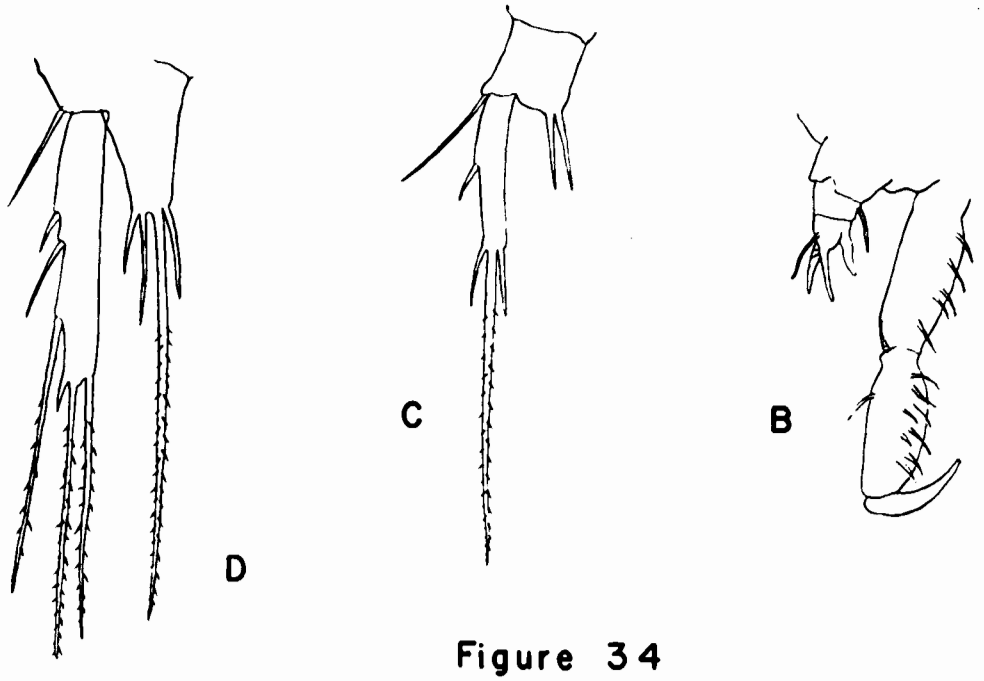


G

Plate 19



A

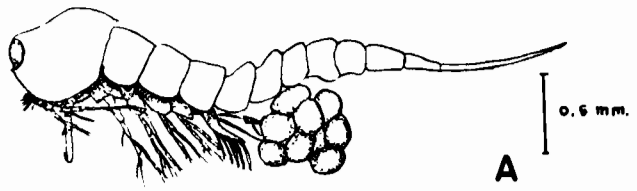


D

C

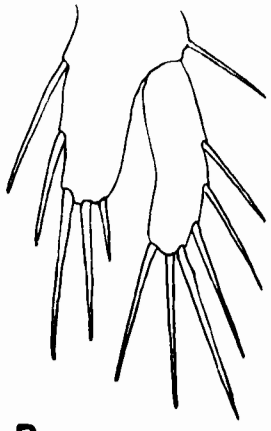
B

Figure 34



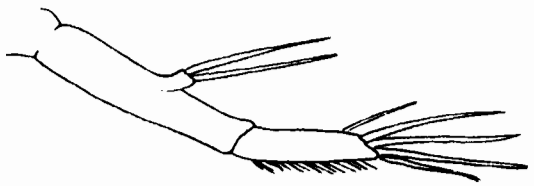
0.6 mm.

A



B

Figure 35



C

Plate 21

Figure 36

Histogram showing the relationship between Total Copepods collected and Month of Year

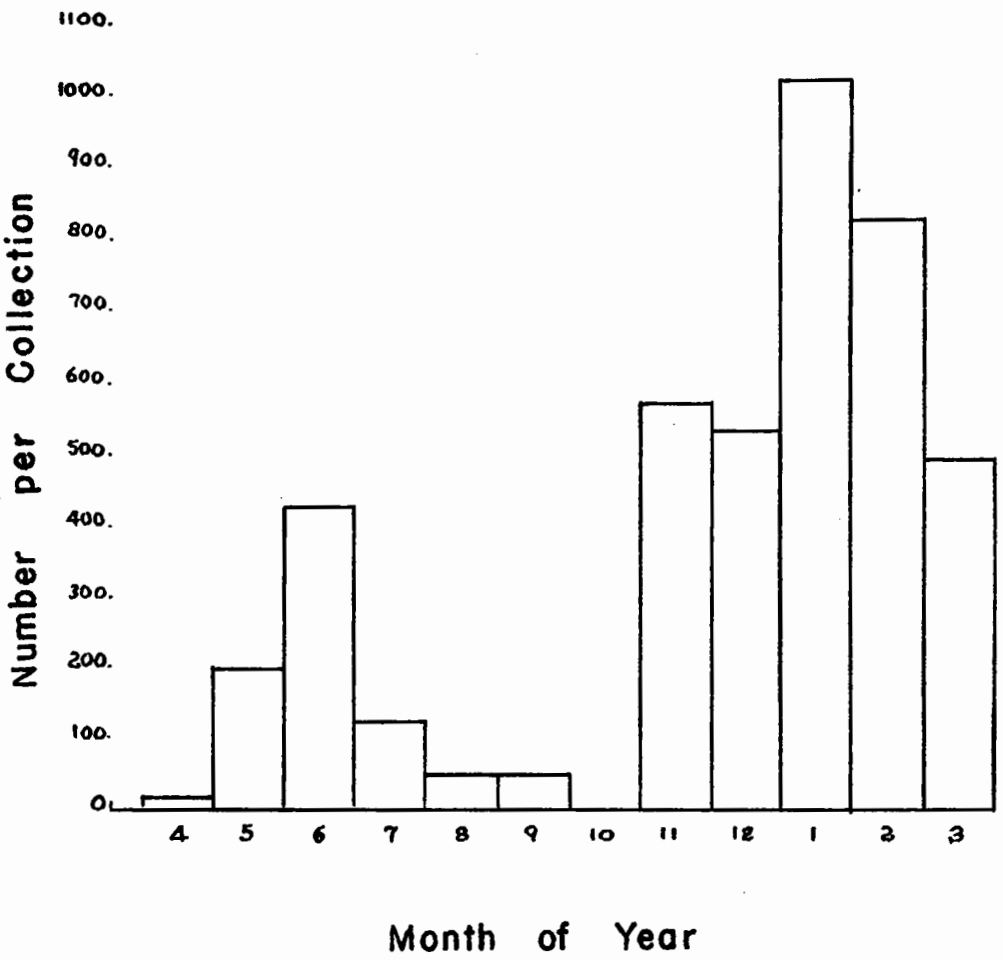


Plate 22

Figure 37 Neocalanus gracilis ♀

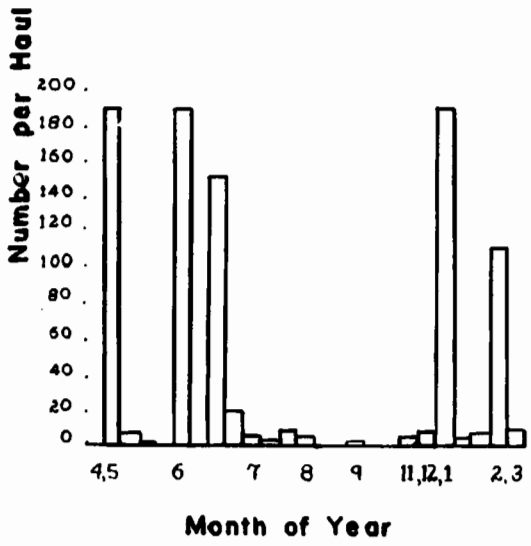


Figure 38 Candacia pachydactyla ♀

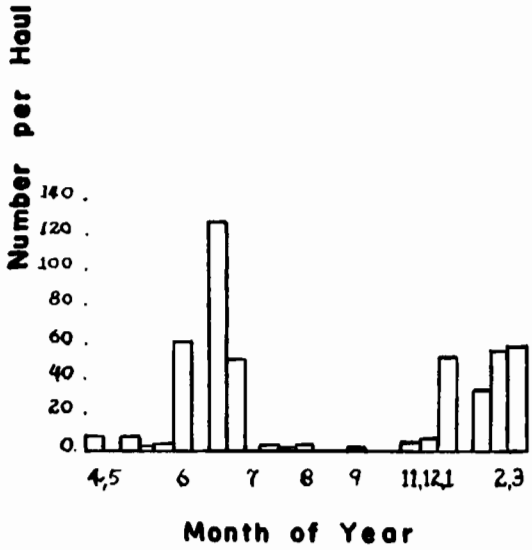


Figure 39 Candacia pachydactyla ♂

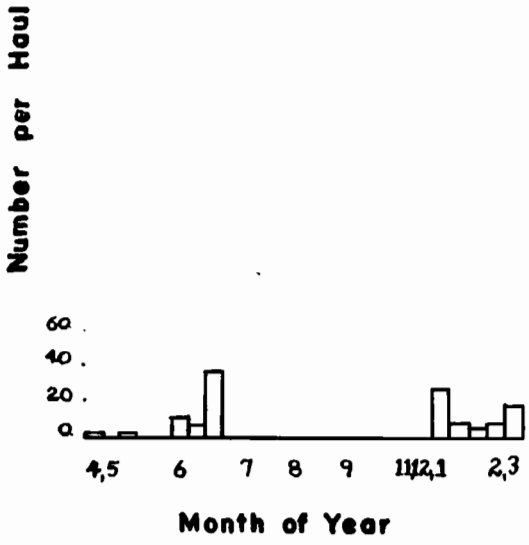


Figure 40 Copilia mirabilis ♂

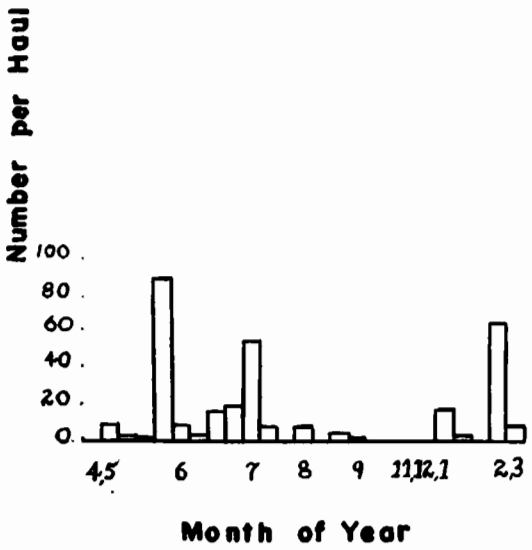


Plate 23

Figure 41 Copilia mirabilis ♀

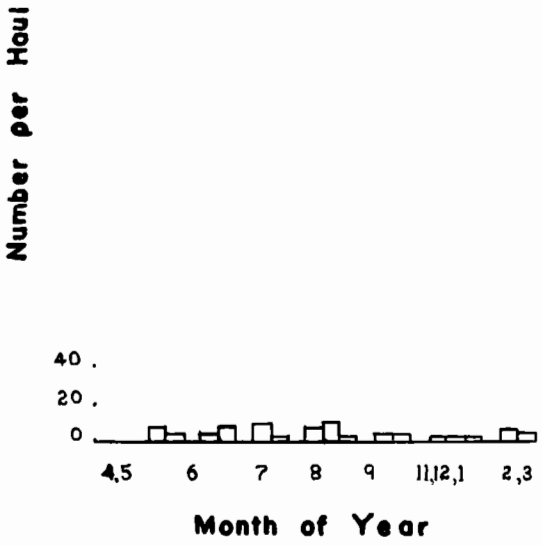


Figure 42 Eucalanus attenuatus ♀

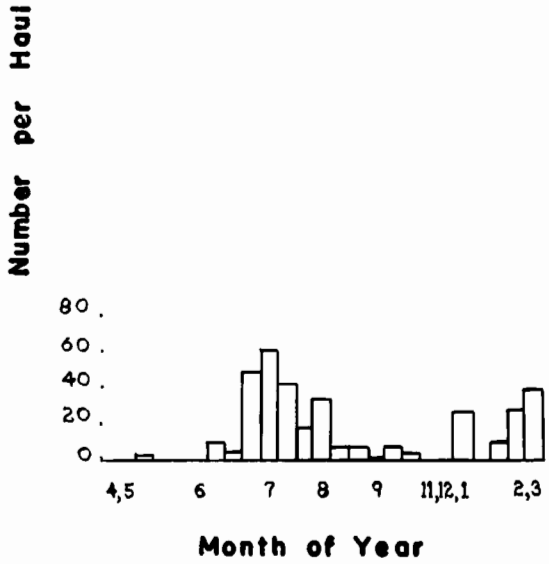


Figure 43 Euchaeta marina ♀

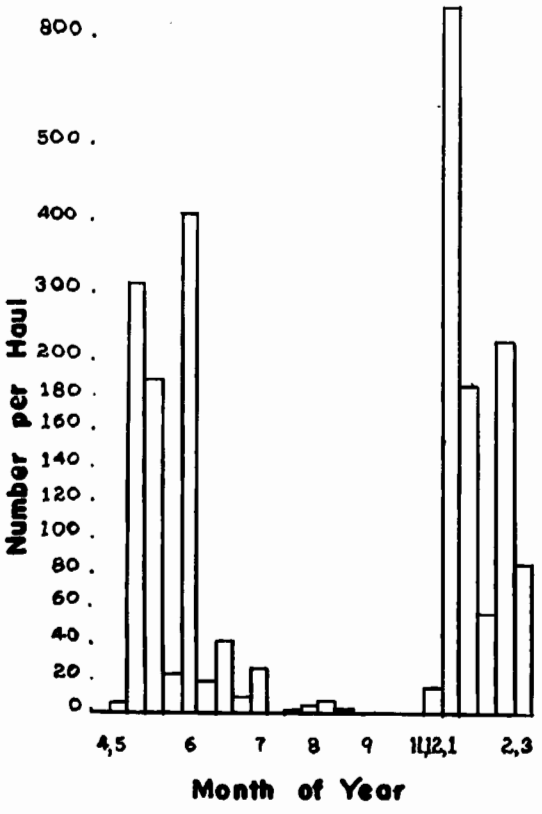


Figure 44 Euchaeta marina ♂

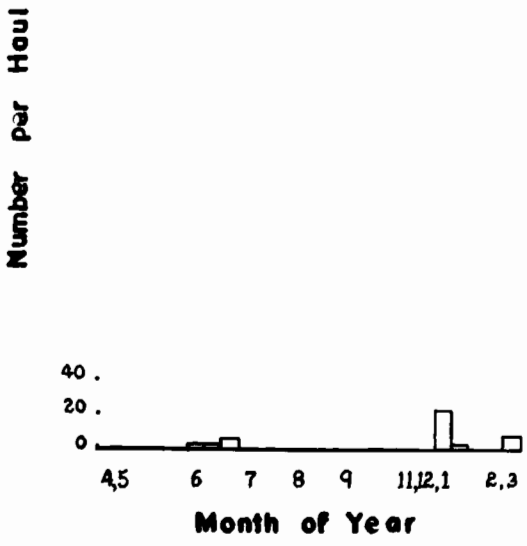


Plate 24

Figure 45 Rhincalanus nasutus ♀

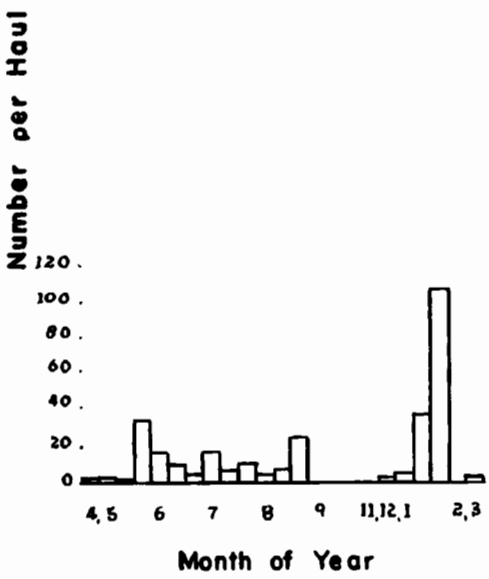


Figure 46 Scolecithrix danae ♀

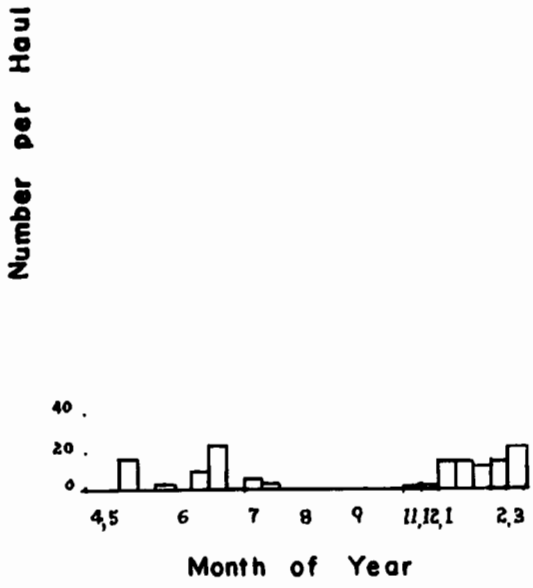


Figure 47 Undinula vulgaris ♀

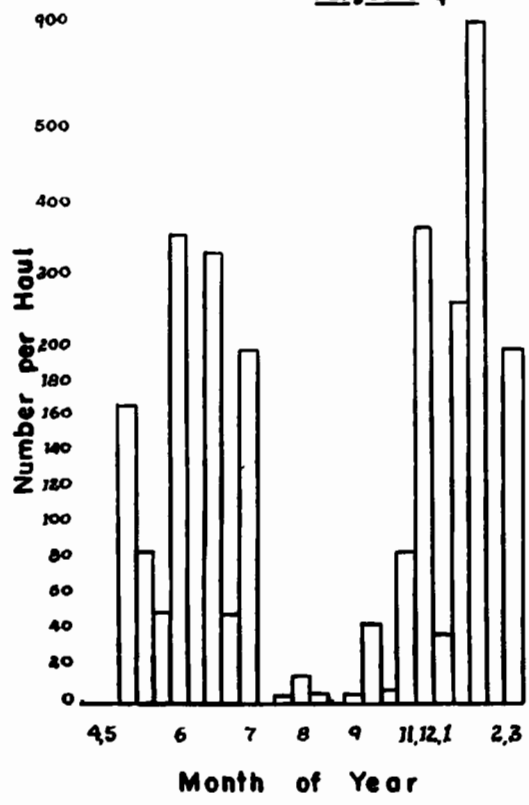


Figure 48 Undinula vulgaris ♂

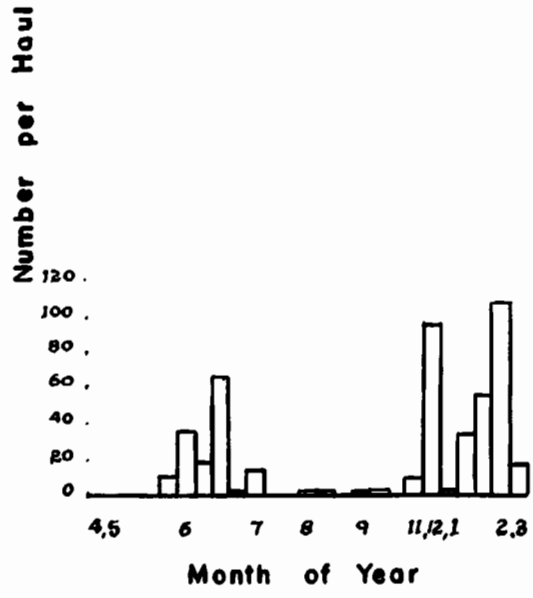


Plate 25

Figure 49

Graph showing relationship between

Dry Volume of Planton and Date of Haul

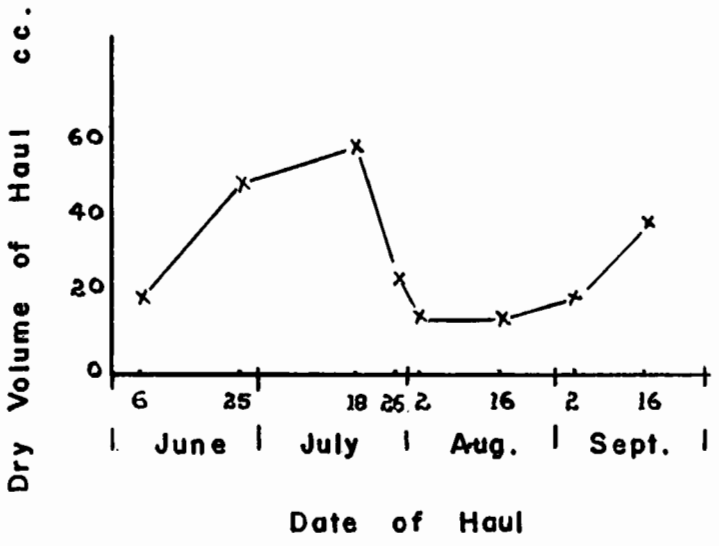


Plate 26