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THE VARIETY AND ABUNDANCE OF ZOOPLANTON IN THE COASTAL WATERS OF PUERTO RICO

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ABSTRACT: During 1973-1974 a total of 160 zooplankton samples were collected in the uppermost 3 m at seven locations within 1 km of the coast of Puerto Rico. Total zooplankton densities ranged from 41 to 7568 organisms/m^3. Copepods formed 65-84% of all zooplankton caught; meroplankton constituted 2-17%.

Larger densities (2-21X) of zooplankton tended to be caught at night. Regional differences in the abundance of meroplankton were related to water circulation patterns, community development of benthic organisms, and recruitment from an embayment.

The total abundance of zooplankton around Puerto Rico was similar to densities of zooplankton near other Caribbean Islands.

The identity and abundance of zooplankton in oceanic regions of the Caribbean Sea and adjacent waters are fairly well defined (for reviews see Bjornberg, 1971; Moore and Sander, 1977). Comparatively few publications, however, have described zooplankton populations which occur in the coastal areas around Caribbean Islands (Coker and Gonzalez, 1960; Moore, 1967; Glynn, 1973; Moore and Sander, 1976; Grahame, 1976; Youngbluth, 1976, in press). To understand the trophic relations of zooplankton as predators and prey and to model their life histories in nearshore, tropical waters, basic information about the variety and quantity of these animals is needed. Data on zooplankton reported in this paper were collected during a program formed to survey, in a preliminary fashion, the marine flora and fauna inhabiting the shallow coastal waters of Puerto Rico at locations where power stations might be situated in the future.

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METHODS AND MATERIALS

Field Procedures

Zooplankton samples were collected with a bridled, 0.5-m diameter, cylinder-cone net towed from a 17-ft. boat. The net was designed to reduce clogging error (Smith *et al.*, 1968). Testing indicated that the net consistently filtered 90% or more of all water swept by the net mouth. The mesh size of the Nitex net was 202 μm. All hauls were made in a broad, circular path through the uppermost 3 m for ten minutes at speeds ranging from 2-3 kts. The towing path allowed the net to undulate through water undisturbed by propeller movements and permitted sampling to be conducted within a small (ca. 100 m diameter circle) area. After each tow the net was sprayed with seawater to wash all zooplankton into the cod end. The catch was preserved in buffered 4% seawater-formalin. The volume of water filtered through the net was estimated with a flowmeter (General Oceanics Model 2030) which was suspended about 10 cm off center in the mouth of the net to provide a representative measure of filtration performance (Tranter and Smith, 1968). The volume ranged from 100-150 m^3 per haul. The constancy of flowmeter revolutions was checked every two months.

The majority of collections were made during the daylight hours in six regions along the northern (except Islote), western, and southern coasts of Puerto Rico (Figure 1). On a few occasions samples were also gathered at midnight (Islote, Punta Verraco, Cabo Mala Pascua). In each region hauls were taken in five areas (in one region, Cabo Rojo, nine areas were sampled). A single tow was made in each area except the location nearest to where a power station might be situated. Three successive samples were collected at these sites. The areas sampled were about 0.5 to 1 km from shore and spaced at approximately 1 km intervals parallel to the coast on either side of a proposed location for a power station.

The manner of towing and the pattern of sampling in each region were consistent. Originally, collections were scheduled to be taken every three months for two years. In practice, foul weather, equipment failure, and proposed site location changes reduced the number of sampling periods. Consequently, the months when samples were collected and the total number of samples taken at each site varied.

The depth of the water in each area was about 10 m. Surface temperatures and salinities were measured before every tow.

Laboratory Procedures

Within 24 hours after samples were collected, the pH of the formalin-seawater solution was checked and adjusted, if necessary, to 7.6. If a sample contained a noticeable conglomerate of

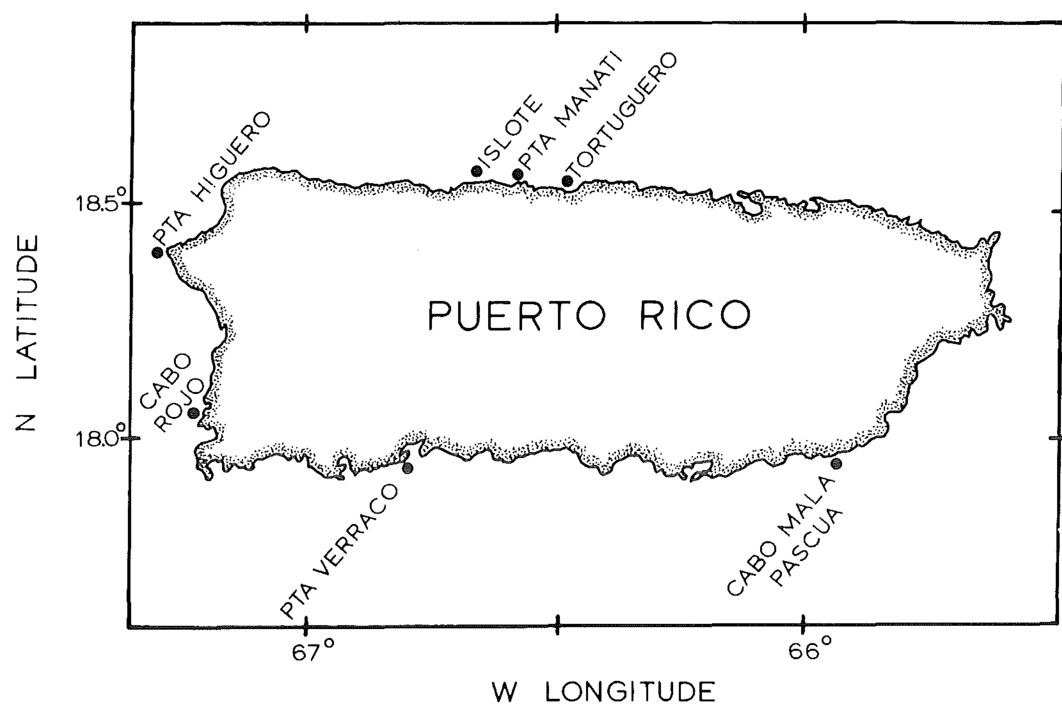

Figure 1. Locations of areas sampled around Puerto Rico.

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phytoplankton or detritus, this material was removed from the zooplankton fraction by gentle filtration through 202 μm mesh netting. Organisms larger than 1 cm (hydromedusae and fish larvae) were withdrawn before estimates of biomass and density were made.

Biomass was estimated as wet volume (Ahlstrom and Thraikill, 1963). These measurements were reproducible but are biased toward higher than actual values since some interstitial water and detritus were always present.

Densities of major zooplankton groups were determined by volumetric subsampling with replacement. The method consisted of diluting the catch in a known amount of seawater, pouring this volume back and forth between two graduated beakers, and when the sample was judged to be well mixed, quickly decanting a small portion, usually about 25 to 50 ml, into one beaker. The procedure was repeated until the final aliquot contained 400-600 organisms. Usually only two splits were required. The reliability of this subsampling technique is discussed in Brinton (1962) and Youngbluth (1976). The most common copepods, always the most numerous organisms, were identified to species from aliquots of 250-500 specimens. The entire sample was also scanned for rare species. Other organisms were recorded as members of broader taxonomic categories. Chaetognaths were identified to species.

RESULTS AND DISCUSSION

Temperature and Salinity

Surface temperatures varied from 25.5 to 29.0°C in all regions. The lowest values occurred from January to March and the highest during August. Surface salinites ranged from 31.96 to 36.04°/∞. The lowest levels were recorded in November, typically the middle of the wet season. The highest levels occurred in April and May.

Total Zooplankton

A total of 160 tows from seven locations was collected during the two year period (1973-1974). The means, medians, and ranges of wet volumes and densities of the zooplankton groups observed in each region appear in Table 1. The relative abundances of the most common holoplanktonic and meroplanktonic groups were computed and listed along with similar data in Table 2. The average number and total range for all zooplankton were similar to the abundances reported in other comparable studies (refer to Tables 2 & 3), i.e., 818/m^3 (41-7568/m^3) [this study], 1113/m^3 (510-2055) [Nutt and Yeaman, 1975], 1602/m^3 (507-3587/m^3) [Moore, 1976; Moore and Sander, 1976], 345/m^3 (80-1070/m^3) [Moore and Sander, 1976], and 368/m^3 (41-2320/m^3) [Moore and Sander, 1977]. These data indicate that the quantity of total zooplankton in the surface waters around Caribbean Islands can be expected to vary by only 1 to 2 orders of magnitude (10^1 to 10^3) during an annual period.

Copepods

Copepods were always the most abundant animals, comprising 65% or more of all zooplankton collected, and accounted for the largest portion of the regional differences. A total of 69 copepod species was identified but only a few species were abundant. The total number of species is similar to previous studies of copepods in surface waters around Jamaica, Puerto Rico, and Barbados (Table 3). In each study, however, a few different species were reported and when all these data are considered about 112

TABLE 1. Means, medians, and ranges (no./m^3) of zooplankton groups collected in shallow, coastal waters of Puerto Rico. The numbers in brackets below the name of eacn site refer to the total number of samples, the months and the year(s) when samples were collected.

Sites	Wet volume biomass (ml)	Total zooplankton	Holoplankton	Copepods	Larvaceans	Chaetognaths	Meroplankton	Gastropod larvae	Cirripede nauplii	Natantian larvae	Reptantian larvae	Fish eggs
North Coast												
	.066	349	280	226	18	23	41	23	3	10	4	13
Tortuguero	.063	294	250	200	16	23	40	21	3	6	4	14
[18-1,5,8-73]	(.032-.149)	(71-642)	(62-580)	(48-470)	(4-49)	(1-56)	(6-123)	(1-52)	(+-14)	(+-39)	(+-10)	(2-27)
	.108	385	301	260	13	12	39	27	1	6	3	25
Punta Manati	.102	413	322	297	8	11	40	25	1	4	2	25
[15-1,5,8-73]	(.036-.201)	(138-709)	(89-574)	(80-493)	(2-35)	(1-35)	(24-99)	(6-52)	(+-2)	(+-31)	(+-11)	(3-47)
West Coast												
	.090	1322	1242	1117	45	22	27	5	12	7	2	40
Punta Higuero	.061	485	456	424	34	15	32	19	6	5	2	40
[15-5,8,12-73]	(.004-.249)	(49-7568)	(28-7210)	(26-6869)	(+-171)	(1-100)	(5-55)	(1-78)	(+-54)	(+-19)	(+-5)	(15-49)
	.068	808	722	651	28	34	73	26	2	35	7	6
Cabo Rojo	.063	665	601	553	20	19	61	19	2	30	4	3
[36-1,4,8,11-74]	(.023-.207)	(41-1776)	(32-1698)	25-1523)	(+-81)	(+-243)	(8-174)	(2-102)	(+-8)	(+-97)	(+-31)	(+-34)
South Coast												
Punta Verraco	.112	1465	1175	1068	26	17	250	56	85	94	14	39
[15-2,5,11-73]	.107	942	835	733	16	9	173	29	53	36	11	16
[20-2,4,8,11-74]	(.041-.192)	(227-5462)	(101-5319)	(82-5067)	(1-113)	(2-88)	(15-1089)	(5-196)	(+-487)	(5-510)	(+-45)	(2-148)
Cabo Mala Pascua	.070	580	460	410	26	15	64	32	4	19	4	52
[10-2,5-73]	.070	626	492	438	23	10	72	29	3	10	3	35
[15-2,4,8-74]	(.046-.101)	(219-840)	(84-710)	(69-683)	(3-139)	(1-51)	(6-148)	(6-98)	(+-19)	(+-91)	(+-23)	(4-197)
Arithmetic Mean	.086	818	697	622	26	21	85	28	18	29	6	29
Median Average	.078	571	493	441	20	15	70	24	11	15	4	22

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TABLE 2. The relative abundance of zooplankton groups collected in surface tows from shallow coastal waters of Puerto Rico and offshore waters of Barbados and Jamaica. Values are means and medians (in parentheses). A dash (-) indicates no estimates of relative abundance could be calculated.

Sites	Holoplankton	Copepods	Larvaceans	Chaetognaths	Meroplankton	Gastropod larvae	Cirripede nauplii	Natanian larvae	Reptantian larvae	Fish eggs
Puerto Rico										
(this study)										
North Coast										
Tortuguero	80 (85)	65 (68)	5 (5)	7 (5)	12 (14)	7 (7)	1 (1)	3 (2)	1 (1)	4 (5)
Punta Manati	78 (78)	68 (72)	3 (2)	3 (3)	10 (10)	7 (6)	<1 (<1)	2 (1)	1 (<1)	6 (6)
West Coast										
Punta Higuero	94 (94)	84 (87)	3 (7)	2 (3)	2 (7)	<1 (4)	1 (1)	1 (1)	<1 (<1)	3 (8)
Cabo Rojo	89 (90)	81 (83)	3 (3)	4 (3)	9 (9)	3 (3)	<1 (<1)	4 (5)	1 (1)	1 (<1)
South Coast										
Punta Verraco	80 (89)	73 (78)	2 (2)	1 (1)	17 (18)	4 (3)	6 (6)	6 (4)	1 (1)	3 (2)
Cabo Mala Pascua	79 (79)	71 (70)	4 (2)	3 (2)	11 (12)	4 (5)	1 (<1)	3 (2)	1 (<1)	9 (1)
Mean	83 (86)	74 (76)	3 (4)	3 (3)	11 (12)	4 (5)	3 (2)	2 (2)	1 (1)	4 (3)
Puerto Rico										
(Nutt and Yeaman 1975)	86	73	3	3	8	4	<1	2*	—	6
Jamaica										
(Moore and Sander 1976)	91	76	12	1	4	—	—	—	—	5
Barbados										
(Moore and Sander 1976)	90	84	1	4	5	—	—	—	—	5
(Moore and Sander 1977)	78	62	2	3	2	—	—	—	—	20

*malacostracan larvae

species have been observed (Table 4). This total represents about 28% of all copepods collected in shallow and deep waters of the Caribbean area (Michel and Foyo, 1976). The copepod species which consistently occurred in densities greater than $5/m^3$ and constituted 75% or more of all copepod species collected in each area around Puerto Rico included: *Undinula vulgaris, Paracalanus aculeatus, Paracalanus quasimodo, Clausocalanus furcatus, Temora turbinata, Acartia spinata, Oithona plumifera, Oithona setigera, Farranula gracilis.* The rank order of these species was significantly similar among replicate samples but not between samples from different areas, regions, or sampling periods ($p = 0.05$, Kendall Concordance Test). These data probably represent patch size differences formed by tidal and wind mixing processes. In other studies near Jamaica and Barbados (Moore and Sander, 1976, 1977) these species were also among the numerous copepods observed.

Larvaceans and Chaetognaths

Larvaceans and chaetognaths, each averaging about 3% of the total, were commonly the only other abundant holoplankton. Larvaceans, belonging to the genera *Oikopleura* and *Fritillaria,* were present but species were not defined. Nine species of chaetognaths were identified: *Sagitta bipunctata, Sagitta enflata, Sagitta helena, Sagitta hexaptera, Sagitta hispida, Sagitta serratodentata, Sagitta tenuis, Khronitta mutabbii,* and *Pterosagitta draco.* Of these species, only *Sagitta helena,* represents a population previously unreported from nearshore waters around Caribbean Islands (Suarez-Caabro, 1955). One or more of four populations were relatively abundant, i.e., *Sagitta hispida, Sagitta serratodentata, Sagitta tenuis,* and *Khronitta mutabbii.* The other species appeared infrequently and in small concentrations ($<0.1/m^3$).

Meroplankton

Meroplankton formed about 11% of

all zooplankton collected. Gastropod veligers, cirripede nauplii, and decapod (=natantian and reptantian) larvae constituted the bulk of this group. Other young invertebrates noted included the larvae of echinoderms, polychaetes, bivalves, stomatopods, palinurids, and ascidians. The largest mean densities of meroplankton, 64 to 250/m^3, occurred at Cabo Rojo and the south coast regions, where shelf areas are broadest; the smallest, 27 to 41/m^3, in Punta Higuero and the north coast sites, where deep water is close to shore. Water movement and community development of benthic invertebrates in these regions suggest at least two reasons why concentrations might be expected to differ. Physical oceanographic surveys indicated that local gyres, formed by wind and tidal action, may be regular features of the nearshore current flow around Cabo Rojo and Punta Verraco (Wood, 1975a, b). These eddies may serve to retain meroplankton nearshore (Emery, 1972). It is also known that many benthic invertebrate larvae can regulate their vertical distribution. Small differences in their position within a water column can result in different directions of transport by nearshore current processes. Some evidence for diurnal vertical movement is mentioned in a subsequent section.

Benthic surveys at each site showed that exposure to swell and surge action effects the development and persistence of benthic invertebrate communities (Yoshioka, 1975). Gorgonians, corals, and sponges were abundant at protected locales (Cabo Rojo and Punta Verraco) and macroalgae covered the bottom at exposed sites (Punta Manati and Punta Higuero). Both community types occurred in the other regions. The larger mean densities of natantian larvae, 35 and 94/m^3, at Cabo Rojo and Punta Verraco may be related to the greater diversity of benthic habitats. The large average density of barnacle nauplii at Punta Verraco (85/m^3), however, may represent recruitment from stocks developed in nearby Guayanilla Bay (Youngbluth, 1976).

Fish Eggs

The majority of the fish eggs observed were round and clear; oblong eggs were common but never noted to be abundant. The eggs ranged in size from 0.5 to 2 mm in diameter. Identification of preserved fish eggs is unreliable and consequently

TABLE 3. A review of sampling statistics from papers reporting zooplankton groups caught by surface net tows in nearshore waters around Caribbean Islands.

Author and Location	Net Mesh (μm)	Type of Net	Mouth Diameter of Net (m)	Manner of Towing	Duration of Tow (min)	Speed of Tow (kt)	Depth of Tow (m)	Depth of Water (m)	Number and Time of Tows	Frequency and Year of Sampling
Wickstead (1956) [0-17 km west of Barbados]	324	Hi-Speed Sheard	?	horizontal	10	5	2	?	7 (Day)	1 week (March, 1953)
	324	Hi-Speed Hardy Plankton	0.04	horizontal	20	6	5-10	?	189 (Day)	? ?
Fish (1962) [3 km west of Barbados]	417	simple cone	0.5	horizontal	10	?	surface	?	21 (2000-2030 hrs)	monthly (1957-1958)
	?	Stramin	1.0	horizontal	30	?	surface	?		
Moore and Sander (1977) [9 km west of Barbados]	239	simple cone	0.5	horizontal	?	1-2	surface	460	94 (0800-1000 hrs)	1-2 week intervals (1967-1969)
Moore and Sander (1976) [2 km west of Barbados]	239	simple cone	0.5	oblique	?	?	0-5	25	24 (0900-1000 hrs)	semi-monthly (1974-1975)
[1 km south of Jamaica]	203	simple cone	0.5	oblique	15	?	0.5	30-35	18 (0900-1200 hrs)	monthly (1962-1964)
Nutt and Yeaman (1975) [0.5-1 km north of Puerto Rico]	202	cylinder cone	0.5	oblique	10	1-2	0-20	20	110 (Day)	biweekly (1974-1975)
This paper [0.5-1 km north, west, and south of Puerto Rico]	202	cylinder cone	0.5	oblique	10	2-3	0-3	10-20	144 (Day) 16 (Night)	ca. 3 month intervals (1973-1974)

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the fish groups represented were not determined.

The average density of fish eggs observed in this study, ca. 30/m^3, was within ± 2X that of similar data from Puerto Rico and Barbados (Nutt and Yeaman, 1975; Moore and Sander, 1976, 1977). Mean concentrations near Jamaica and in the offshore waters of Barbados were about 2.5X larger. Whether this range in mean densities represents differences in fish stocks or sampling variability is not known.

Diel and Seasonal Variation

Studies of zooplankton in other, shallow tropical waters have shown that nighttime catches, collected with nets towed through the uppermost 3 m or with emergence traps placed just above the bottom, are often larger and the variety of zooplankton noted is usually greater (Kuenzel, 1972; Alldredge and King, 1977; Porter *et al.*, 1977; Youngbluth, in press). On four occasions at three of the sites replicate (n = 3-5) net samples were collected at midnight and midday to determine if differences in the density and variety of zooplankton were likely to occur. In most instances larger numbers of nearly all organisms were captured at night (Table 5). On the average, the total biomass and number of zooplankton doubled. The densities of chaetognaths, larvaceans, decapod larvae, and cirripede nauplii were 5-21X more abundant. It is likely that these changes in density are related to several factors, i.e., avoidance of sampling gear, diel vertical migration, differences in the diversity of benthic communities, and seasonal spawning patterns among benthic invertebrates. More rigorous sampling would be required to judge the relative importance of these factors. These data, however, indicate the magnitude of bias that can occur when sampling is conducted only during the daylight hours in the upper portion of a shallow water column nearshore.

In regions where samples were gathered throughout a year, i.e., Punta Higuero, Cabo Rojo, and Punta Verraco, the largest densities of total zooplankton, often 3-10X greater than the abundances recorded at other times of a year, were collected during November and December. These larger standing stocks may represent seasonal production since their appearance coincided with low salinity waters which are indicative of dilution by seasonally heavy precipitation and concomitant freshwater runoff (Wood, 1975a, b, c). Data from Nutt and Yeaman (1975) indicated that populations of small, herbivorous copepods, *Paracalanus* spp. and *Clausocalanus furcatus*, tended to be about 2X more numerous during the wet season. Other examples of zooplankton population growth coincident with periods of greater rainfalls are not evident in the studies cited in Table 3. One explanation may be that sampling, except near Jamaica, was conducted 2-17 km from the coast where the effects of land drainage processes may not be as influential. Moore and Sander (1976, 1977) reported that zooplankton densities frequently fluctuated through the range of values observed. They suggested, from a review of their data and previous investigations around Barbados, that local hydrographic variables, such as upwelling and water mass movements, were likely to be the primary factors responsible for changes in abundance.

Future Studies

This and other surveys of the abundance and species composition of zooplankton communities in the Caribbean area serve to describe standing stocks but do not provide information relative

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TABLE 4. Copepod species collected in the surface waters of nearshore regions around Barbados, Jamaica, and Puerto Rico.

Copepod Species	Barbados (Wickstead 1956)	Barbados (Fish 1962)	Barbados (Moore & Sander 1977)	Barbados (Moore & Sander 1976)	Jamaica (Moore & Sander 1976)	Puerto Rico (Nutt & Yeaman 1975)	Puerto Rico (this study)
Calanoida							
Calanus tenuicornis			X	X			
Nannocalanus minor	X			X		X	X
Neocalanus gracilis		X	X	X			
N. robustior			X	X			
Undinula vulgaris	X	X	X	X	X	X	X
Eucalanus sewelli[a]		X	X	X		X	X
E. crassus			X	X			X
E. monachus			X				
E. mucronatus				X			X
E. subcrassus	X		X	X	X		
Rhincalanus cornutus			X	X		X	X
R. nasutus	X	X					
Mecynocera clausi	X		X	X		X	X
M. gracilis				X			
M. sp.			X	X			
Acrocalanus andersoni							X
A. longicornis	X	X	X	X		X	X
Calocalanus pavo	X	X	X	X	X	X	X
C. pavoninus			X			X	X
Parvocalanus crassirostris[a]						X	X
Paracalanus aculeatus	X	X	X	X	X	X	X
P. indicus							X
P. parvus			X			X	
P. quasimodo							X
Clausocalanus arcuicornis	X		X	X			
C. furcatus	X		X	X		X	X
Monacilla typica			X				
Euaetideus giesbrechti						X	
Chiridiella sp.				X			
Euchaeta marina	X	X	X	X	X	X	X
Euchirella amoena		X					
E. venusta			X				
Valdiviella brevicornis			X				
V. insignis			X				
Phaenna spinifera			X	X			X
Scottocalanus persecans			X				
Scolecithrix danae	X	X	X	X	X	X	X
S. minor			X				
Temora stylifera	X	X	X	X	X	X	X
T. turbinata			X	X	X	X	X
Metridia princeps			X				
Pseudodiaptomus cokeri							X
P. acutus[b]							X
Pleuromamma abdominalis		X	X				X
P. gracilis							X
P. piseki			X				
P. quadrungulata			X				
P. xiphias			X				
Centropages caribbeanensis						X	X
C. velificatus[a]	X	X	X	X	X	X	X
C. violaceus	X		X	X			X
Lucicutia flavicornis		X				X	X
Heterorhabdus spinifrons			X				
Haloptilus acutifrons			X				
H. longicornis						X	
H. ornatus		X	X				
Phyllopus sp.				X			
Candacia pachydactyla	X	X	X	X	X	X	X
C. paenelongimana			X				
Paracandacia bispinosa						X	
P. simplex			X				
Calanopia americana	X	X	X	X	X	X	X
Labidocera acutifrons		X	X	X	X		
L. aestiva			X		X		
L. nerii	X	X	X	X		X	X
L. scotti					X	X	X
L. sp.				X			
Pontellopsis perspicax			X				
P. regalis			X				

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TABLE 4. - (cont.)

Copepod Species	Barbados (Wickstead 1956)	Barbados (Fish 1962)	Barbados (Moore & Sander 1977)	Barbados (Moore & Sander 1976)	Jamaica (Moore & Sander 1976)	Puerto Rico (Nutt & Yeoman 1975)	Puerto Rico (this study)
Pontella securifer					X		
P. sp.				X			
Pontellina plumata		X	X	X		X	X
P. plumifera					X		
Acartia lilljeborgii			X		X	X	X
A. longiremis	X	X					
A. negligens		X	X	X			
A. sp.			X				
A. spinata			X	X		X	X
A. tonsa							X
Harpacticoida							
Microsetella norvegica					X	X	X
M. rosea	X	X	X	X			
M. sp.				X			
Miracia efferata	X	X	X	X	X	X	X
Macrosetella gracilis	X	X	X	X	X	X	X
Euterpina acutifrons					X	X	X
Clytemnestra scutellata			X	X			
Harpacticus gurneyi			X		X		
Longipedia helgolandica						X	X
Cyclopoida							
Oithona nana			X	X	X	X	X
O. oculata			X	X		X	X
O. plumifera	X	X	X	X	X	X	X
O. setigera			X	X			X
Saphirella tropica			X	X			X
Oncaea curta	X						
O. media f. major	X					X	
O. mediterranea			X	X	X	X	X
O. notopus				X			
O. venusta	X	X	X	X	X	X	X
Pachysoma punctatum		X					
Lubbockia aculeata				X			
L. squillimana			X	X		X	X
Sapphirina angusta	X	X		X			
S. auronitens	X		X				
S. intesticulata			X	X	X		
S. nigromaculata	X	X	X	X			X
S. opalina			X	X			
S. ovatolanceolata	X	X	X	X			X
S. sali	X						
S. stellata			X				
Copilia mediterranea			X				
C. mirabilis	X	X	X	X	X	X	X
C. quadrata			X	X		X	X
Corycaeus agilis						X	X
C. anglicus						X	X
C. amazonicus			X		X		X
C. catus			X	X			
C. clausi			X			X	X
C. elongatus		X					
C. flaccus			X	X			X
C. giesbrechti						X	X
C. latus	X		X	X	X	X	X
C. lautus	X		X	X		X	X
C. limbatus	X		X	X			X
C. obtusus		X					
C. pacificus							X
C. speciosus	X	X	X	X	X	X	X
C. subulatus			X		X	X	X
C. typicus			X			X	X
Farranula carinata	X	X		X			
F. gracilis			X	X	X	X	X
Monstrilloida							
Monstrilla grandis		X				X	X
Total number of copepod species	37	37	86	66	33	54	69

a) In previous studies in the Caribbean Sea *Eucalanus sewelii* was probably identified as *E. attenuatus* (see Fleminger 1973). *Parvocalanus crassirostris* was formerly called *Paracalanus crassirostris* (see Andronox 1970; Lonsdale and Coull 1977). *Centropages velificatus* is the Atlantic cognate of *C. furacatus* (see Fleminger and Hulsemann 1973).

b) Subsequent to this study *Pseudodiaptomus acutus* (see Marsh 1933; Bowman 1978) was collected near the Cabo Rojo site (=Punta Guanajibo).

TABLE 5. Midnight (MN) /Midday (MD) densities/m^3 of zooplankton groups in three nearshore locations around Puerto Rico. All values are means of replicate collections (n=3-5 samples/period).

Category	Islote (30 Aug 73)	Punta Verraco (21 Aug 74)	Cabo Mala Pascua (13 Feb 74)	Cabo Mala Pascua (22 Aug 74)	Mean Ratio of MN/MD Density
Total Biomass (ml)	.074/.042	.184/.048	.083/.038	.047/.080	2.1
Total Zooplankton	583/376	2631/592	646/219	532/577	2.5
Holoplankton	360/270	1080/377	402/84	400/453	2.5
Copepods	210/91	955/368	320/69	345/426	2.6
Chaetognaths	46/5	12/3	11/1	3/10	6.1
Larvaceans	4/1	62/5	38/3	50/8	8.9
Meroplankton	175/24	1515/199	62/6	91/93	6.5
Gastropod Larvae	65/42	55/26	26/8	44/29	2.1
Natantian Larvae	70/2	928/86	35/1	20/19	20.5
Reptantian Larvae	35/7	97/11	13/1	14/17	6.9
Cirripede Nauplii	—	399/63	5/1	7/3	4.5
Fish Eggs	48/48	15/11	170/130	42/35	1.2

to understanding the physical and biological factors that can regulate the development and persistence of zooplankton communities. Future research in shallow, tropical waters should be designed to examine such topics as lethal and sublethal effects of physical and chemical changes in the preferred environment(s) of zooplankton, the reproductive biology of holoplanktonic and meroplanktonic populations, and predator-prey interactions among zooplankton, benthic invertebrates, and fishes.

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