To be presented at the 6th Annual Ocean Thermal Energy Conversion Conference, Washington, D.C., June 19-22, 1979

LBL-9053 C.2

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ZOOPLANKTON FROM OTEC SITES IN THE GULF OF MEXICO AND THE CARIBBEAN

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Abstract

The spatial and temporal variations in the abundance of major classes of zooplankton were measured using standard methods, between June and October 1978, at two OTEC sites in the Gulf of Mexico and in the Caribbean near Puerto Rico. The usual oceanic patterns were found with highest numbers near the surface, especially at night, and lowest numbers at 800 - 1000 m. Absolute numbers varied considerably from site to site. As expected, copepods (usually divided between calanoids and cyclopoids) dominated the zooplankton at all sites.

Introduction

Zooplankton are small, relatively slow-moving aquatic animals. They are widely distributed even in oligotrophic oceans and link marine plants (phytoplankton) with small fish in the overall trophic structure of the marine community. Zooplankton samples have been collected at three OTEC sites off Tampa and Mobile in the Gulf of Mexico and in the Caribbean off Puerto Rico. Studies on distribution and taxonomy at specific OTEC sites are lacking although various general surveys have been made.[1,2,3,4]

Samples for OTEC zooplankton were collected using standard methods employing 202 μ mesh net with a 0.75 m diameter and a 5:1 cone. This type of net adequately samples the majority of zooplankton but some small organisms pass through the net. Very large zooplankton may avoid the net or be so uncommon that they are rarely captured by this diameter net. At present logistic problems have prevented uniform methodology. This will presumably be overcome in the future but may have contributed to between-site differences in the data presented here.

This report presents part of the information obtained so that comparisons can be made between OTEC sites. We present data from at least two sites collected in June, August, and October 1978. This accommodates seasonal variation in zooplankton which occurs in the Gulf of Mexico.

Temporal and Spatial Variation in Zooplankton Abundance

Maximum zooplankton number in the Gulf of Mexico at the Tampa site for the 5-month period was 1110.0 individual organisms per m^3. This peak occurred in October during the day at a depth of 25 m. The minimum number for the Tampa site was 2.2 individuals per m^3 in June at 1000 - 800 m. Populations at 800 - 1000 m are unlikely to be significantly influenced by the day-night light regime although we have not made measurements at these sites (Table 1). Zooplankton abundance for the Gulf of Mexico Mobile site ranged from 3995.6 per m^3 collected during the nighttime 25 m tow in June to a low of 7.6 per m^3 at 1000 - 800 m in August (Table 2).

Table 1. Zooplankton abundance (# per m^3) and percent copepods, Tampa site.

	Jun	Aug	Oct
25 m Horizontal Night			
Total	512.7	896.2	1106.9
% copepods	75	46	86
25 m Horizontal Day			
Total	953.7	582.1	1110.0
% copepods	84	49	81
200 m - 0 m			
Total	408.0	332.7	213.6
% copepods	68	70	70
800 m - 200 m			
Total	26.7	16.8	9.0
% copepods	86	84	76
1000 m - 800 m			
Total	2.2	2.5	--
% copepods	93	92	--

Table 2. Zooplankton abundance (# per m^3) and percent copepods, Mobile site

	Jun	Aug	Oct
25 m Horizontal Night			
Total	3995.6	1962.1	1340.1
% copepods	62	29	59
25 m Horizontal Day			
Total	1049.6	1137.3	1370.5
% copepods	79	29	48
200 m - 0 m			
Total	--	685.3	414.0
% copepods	--	57	56
800 m - 200 m			
Total	102.7	62.8	58.9
% copepods	84	84	78
1000 m - 800 m			
Total	11.8	7.6	--
% copepods	78	72	--

Over the same time period in the Caribbean off Puerto Rico samples are only available from August. Here the zooplankton abundance peak was 858 per m^3 at 25 m during the day (Table 3). Equipment failure prevented collection of deep samples, including 1000 - 800 m so no useful comparisons about minimum numbers can be made with the Gulf of Mexico.

Table 3. Zooplankton abundance (# per m^3) and percent copepods, Puerto Rico site

	August
25 m Horizontal Night	
Total	407
% copepods	86
25 m Horizontal Day	
Total	858
% copepods	87
1200 m - 0 m	
Total	141
% copepods	72

The vertical distribution of zooplankton is shown in Fig. 1. At both the Mobile and the Tampa sites approximately 98% of the zooplankton occurred in the upper 200 m of water with over half occurring near the surface. The 200 to 1000 m region was sparsely populated. Increased zooplankton numbers in near-surface waters is due to their need to feed on algae which only grow in the photic zone. Normally some daily vertical migration by zooplankton out of the photic zone in the daylight hours occurs to avoid predation by fish and squid. Detailed studies on diel migration are in progress for the Gulf of Mexico.

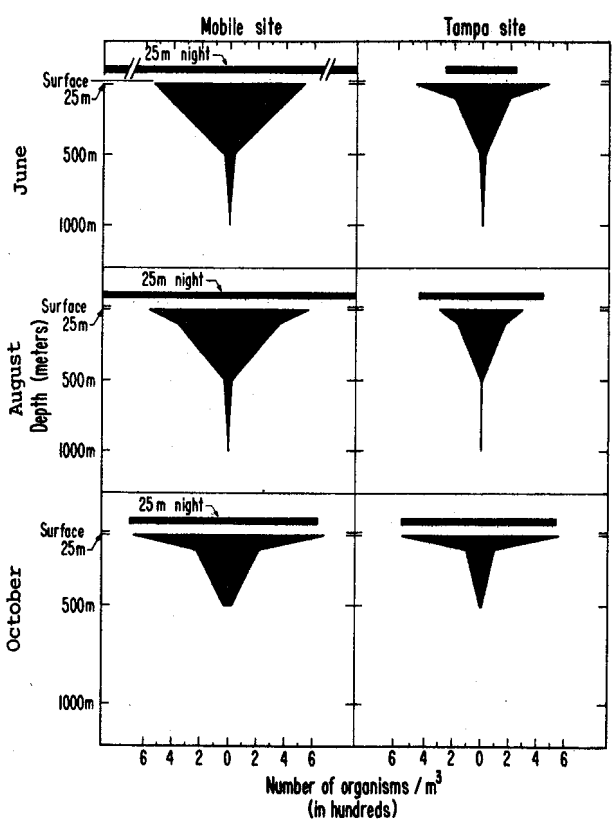

Fig. 1 Daytime vertical distribution of zooplankton during June, August, and October, 1978.

Major Taxonomic Groups

In general environmental surveys of the type carried out for OTEC by LBL, it is desirable to subdivide the zooplankton into their major functional groups in the food chain. This is not possible in detail but some idea of the importance of each type of organism can be gained from a breakdown of total numbers into the main taxonomic groups and also by division into size classes.

As usual in ocean waters, copepods comprised a major portion of the total plankton, ranging from 46% to 93% at the Tampa site, 29% to 84% at the Mobile site, and 72% to 87% at Puerto Rico (Tables 1-3). The copepods were quite evenly divided between the two major free-living oceanic taxonomic groups, the calanoids and the cyclopoids. Usually only a small number of the third group, the harpacticoids, occurred at both the Tampa and Mobile sites. In contrast, although the data are somewhat limited, at the Puerto Rico site the calanoids were approximately three times more numerous than the cyclopoids.

At the Tampa site the most frequently occurring copepods genera in the upper 200 m were the cyclopoids, *Oithona* and *Oncaea* and the calanoid, *Clausocalanus*. The most common genera at deeper levels were the calanoids *Eucalanus*, *Rhincalanus*, and *Mormonilla* and the cyclopoid *Conaea*. In the upper 200 m at Mobile the most common genera of copepods were the same as those at Tampa, *Clausocalanus Oithona*, and *Oncaea*. A fourth copepod, the calanoid genus *Temora*, not abundant at Tampa, was quite common at the Mobile site. The deeper samples were also similar to the Tampa site in having *Conaea*, *Mormonilla*, and *Eucalanus* occurring most frequently, in addition to *Oithona* and *Oncaea*. The most numerous copepod genera in the 25 m samples from Puerto Rico were the calanoids *Clausocalanus*, *Acartia*, and *Calocalanus* and the cyclopoid *Oithona*.

Size Frequency Distribution

Unlike their algal or bacterial food most zooplankton pass through a variety of distinct stages before becoming reproductive adults. In general, adult reproduction and survival of very early stages are most prone to environmental disturbances such as may be caused by full-scale OTEC plants. Thus size-frequency distribution of correctly identified organisms may enable prediction of future effects on the most sensitive section of each functional unit of the ecosystem. At present a size class distribution is all that can be obtained for each data set.

The size class distribution of the zooplankton collected at the Tampa site is shown in Fig. 2. Most of the organisms in the upper waters fell in the 0.5 - 1.9 mm size range. There was an increased frequency of the larger sizes in deeper samples. Zooplankton in the 2.0 - 2.9 mm range were almost as numerous at 800 - 200 m and more numerous at 1000 - 800 m than the 0.5 - 1.9 mm organisms. Organisms in the 0.5 - 1.9 mm size range were also the most frequently occurring in the upper waters at Mobile (Fig. 3). There was a slight increase in larger size ranges in deeper waters but this was not so pronouced an increase as that found at the Tampa site.

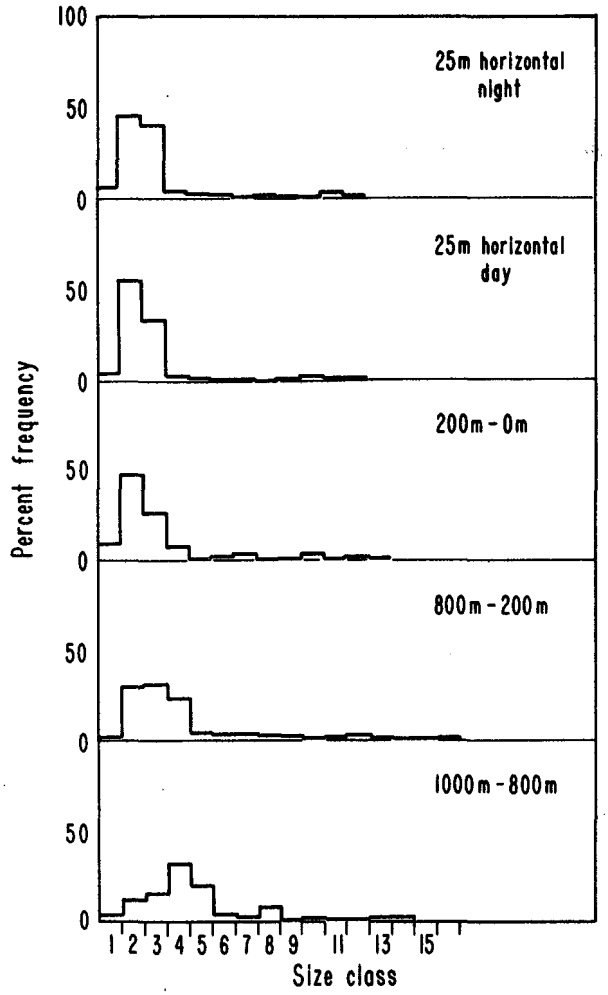

Fig. 2 Zooplankton size distribution for the Tampa site during June, August, and October, 1978. Actual size range of size classes are (in mm): 1 = <0.5; 2 = 0.5-0.9; 3 = 1.0-1.9; 4 = 2.0-2.9; 5 = 3.0-3.9; 6 = 4.0-4.9; 7 = 5.0-5.9; 8 = 6.0-6.9; 9 = 7.0-7.9; 10 = 8.0-8.9; 11 = 9.0-9.9; 12 = 10.0-19.9; 13 = 20.0-29.9; 14 = 30.0-39.9; 15 = 40.0-49.9; 16 = >50.0.

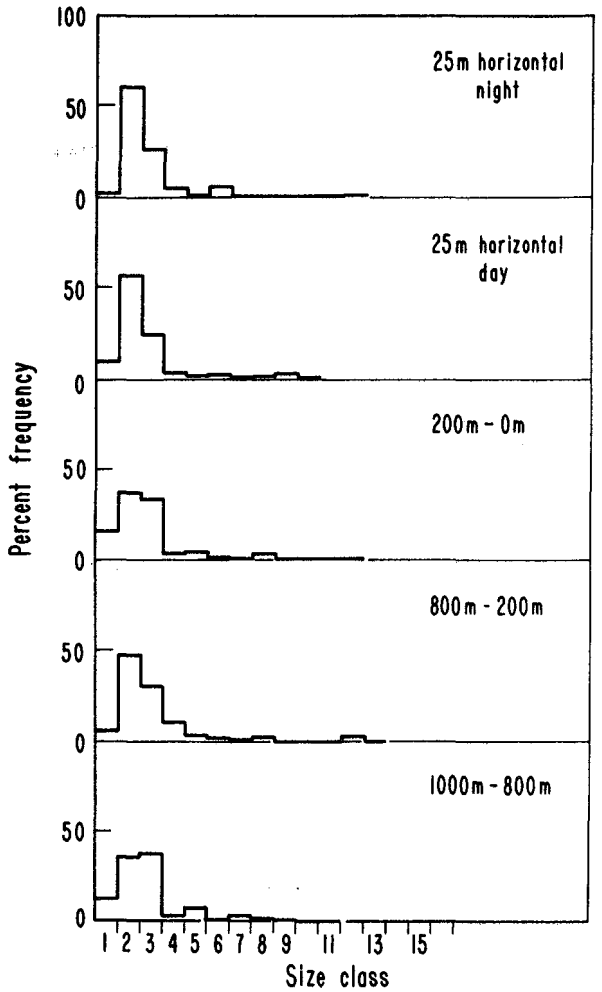

Fig. 3 Zooplankton size distribution for the Mobile site during June, August, and October, 1978. Actual size range of size classes are (in mm): 1 = < 0.5; 2 = 0.5-0.9; 3 = 1.0-1.9; 4 = 2.0-2.9; 5 = 3.0-3.9; 6 = 4.0-4.9; 7 = 5.0-5.9; 8 = 6.0-6.9; 9 = 7.0-7.9; 10 = 8.0-8.9; 11 = 9.0-9.9; 12 = 10.0-19.9; 13 = 20.0-29.9; 14 = 30.0-39.9; 15 = 40.0-49.9; 16 = >50.0.

References

1. Khromov, N.S. 1965. Distribution of plankton in the Gulf of Mexico and some aspects of its seasonal dynamics. In: Soviety-Cuban Fishery Research. A.S. Bogdanov, ed.

2. _____. 1965. Distribution of plankton in the Caribbean Sea. In: Soviet-Cuban Fishery Research. A.S. Bogdanov, ed.

3. Hopkins, T.L. 1973. Zooplankton. In: A summary of knowledge of the Eastern Gulf of Mexico. J.I. Jones, ed. State University of Florida Institute of Oceanography.

4. Michel, H and M. Foyo. 1976. Caribbean zooplankton. Part I. Siphonophora, Heteropoda, Copepoda, Euphausiacea, Chaetognatha, and Salpidae. Office of Naval Research. Dept. of Navy. 549 pp.

This report was supported by the U. S. Department of Energy under Contract W-7405-ENG-48.