FINAL REPORT

on

DISTRIBUTION AND ABUNDANCE OF *Corophium tuberculatum* AND *Hydroides dianthus* IN RELATION TO THE THERMAL DISCHARGE FROM THE OYSTER CREEK GENERATING STATION

to

JERSEY CENTRAL POWER & LIGHT COMPANY

June 27, 1980

by

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MANAGEMENT SUMMARY

Artifical substrates were exposed for one-month or four-month cycles at six locations in Barnegat Bay, near the Jersey Central Power and Light Oyster Creek Generating Station. The distribution and abundances of the epibenthic gammaridean amphipods belonging to the genus *Corophium* and the serpulid polychaete, *Hydroides dianthus*, were studied in relation to the thermal discharge from the power plant.

Five species of *Corophium* were collected. Densities of all five species were low. *C. insidiosum* was the most abundant and widespread species, occurring at five of the six stations, and during all months except the first four of the study. *C. tuberculatum* occurred in low but equal densities at stations both within and beyond the heat dissipation area. *C. ascherusicum* was more common at stations within the heat dissipation area. *C. lacustre* and *C. acutum* occurred only at the station in Forked River.

Hydroides dianthus was collected only during four months of the study (July-October, 1979). It was equally abundant at all stations.

High variability within stations precluded the use of robust statistical tests, and also prevents definitive conclusions about power plant effects.

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INTRODUCTION

The gammaridean amphipod, *Corophium tuberculatum* and the serpulid polychaete, *Hydroides dianthus* were designated by the USEPA, Region II as representative important species in Oyster Creek and along the western shore of Barnegat Bay. Jersey Central Power and Light Company, which operates the Oyster Creek Generating Station, wished to determine the distribution and abundance of *C. tuberculatum* and *H. dianthus* in relation to the thermal discharge from the generating station, in order to demonstrate that the elevated temperatures in the area of the discharge do not interfere with the growth, reproduction or survival of these species.

Battelle's William F. Clapp Laboratories initiated a research program in January, 1979 to study the above question. This report presents the results of that study, which was conducted from January, 1979 through April, 1980.

METHODS AND MATERIALS

Field Methods

Six sampling stations (Figure 1, Table 1) were established in January, 1979. Three sites (Stations 2, 3, and 4) were established within the predicted heat dissipation area, and three sites (Stations 1, 5, and 6) outside this zone.

Exposure panel arrays (Figure 2) were submerged on January 10, 1979 at each of the six sites. Each panel consisted of two 10-inch (25.4 cm) by 3.5-inch (8.9 cm) pieces of transite attached to the face and back of a wood

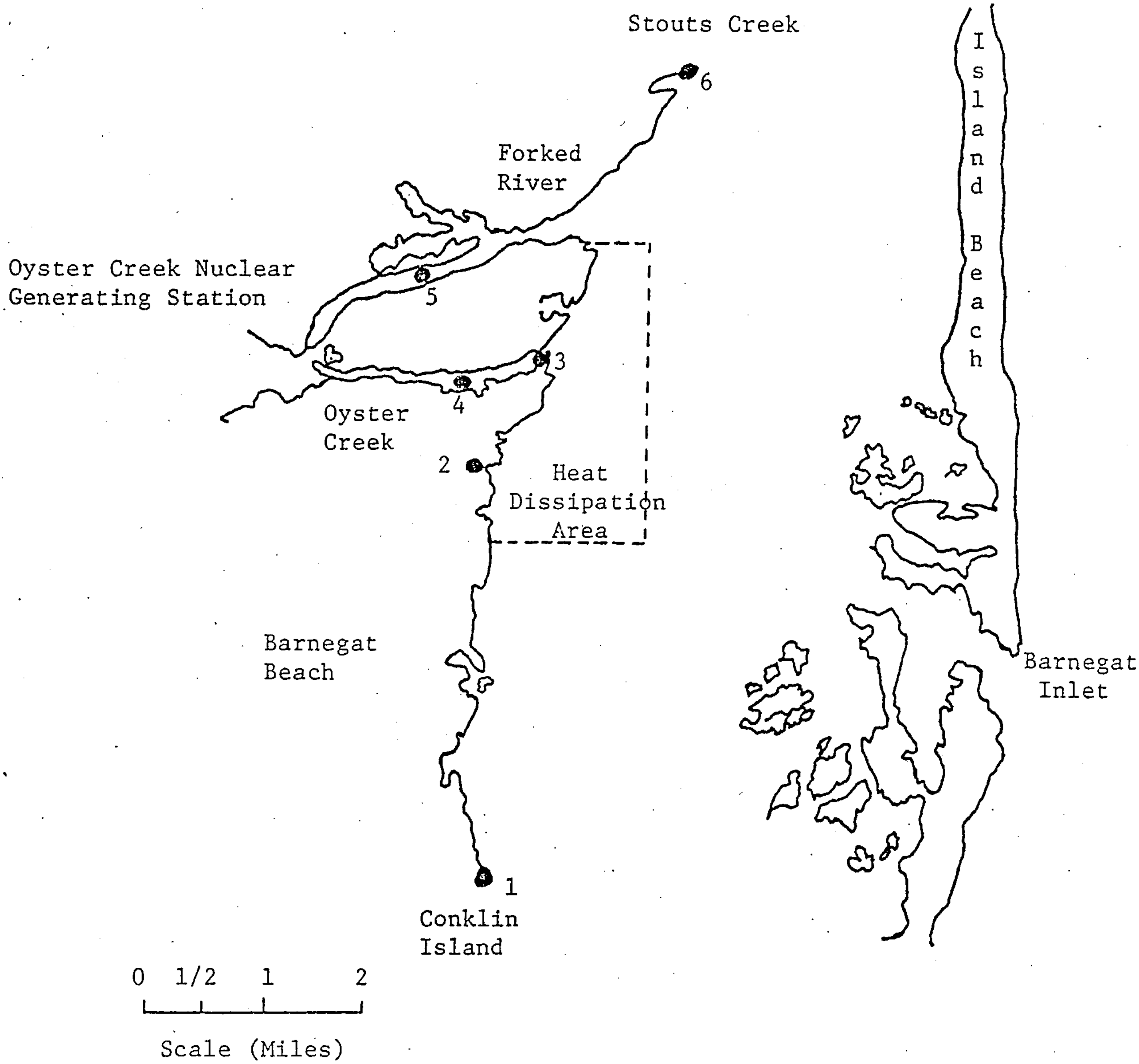

FIGURE 1. SITE LOCATIONS

TABLE 1. GEOGRAPHICAL LOCATIONS OF WFCL'S FOULING PANEL ARRAYS SUBMERGED JANUARY 10, 1979, BARNEGAT BAY, NEW JERSEY

Site No.	Location	Relation to Thermal Discharge
1.	Iggie's Marina East Bay Avenue Barnegat (Conklin Island)	Outside
2.	Liberty Harbor Marina Washington Avenue Waretown	Within
3.	Mouth of Oyster Creek Lot 4, Compass Road Offshore End	Within
4.	Private Dock Dock Avenue, Oyster Creek Waretown	Within
5.	Private Dock 519 N. Shore Drive Forked River	Outside
6.	Private Dock 1273 Capstan Drive Stouts Creek	Outside

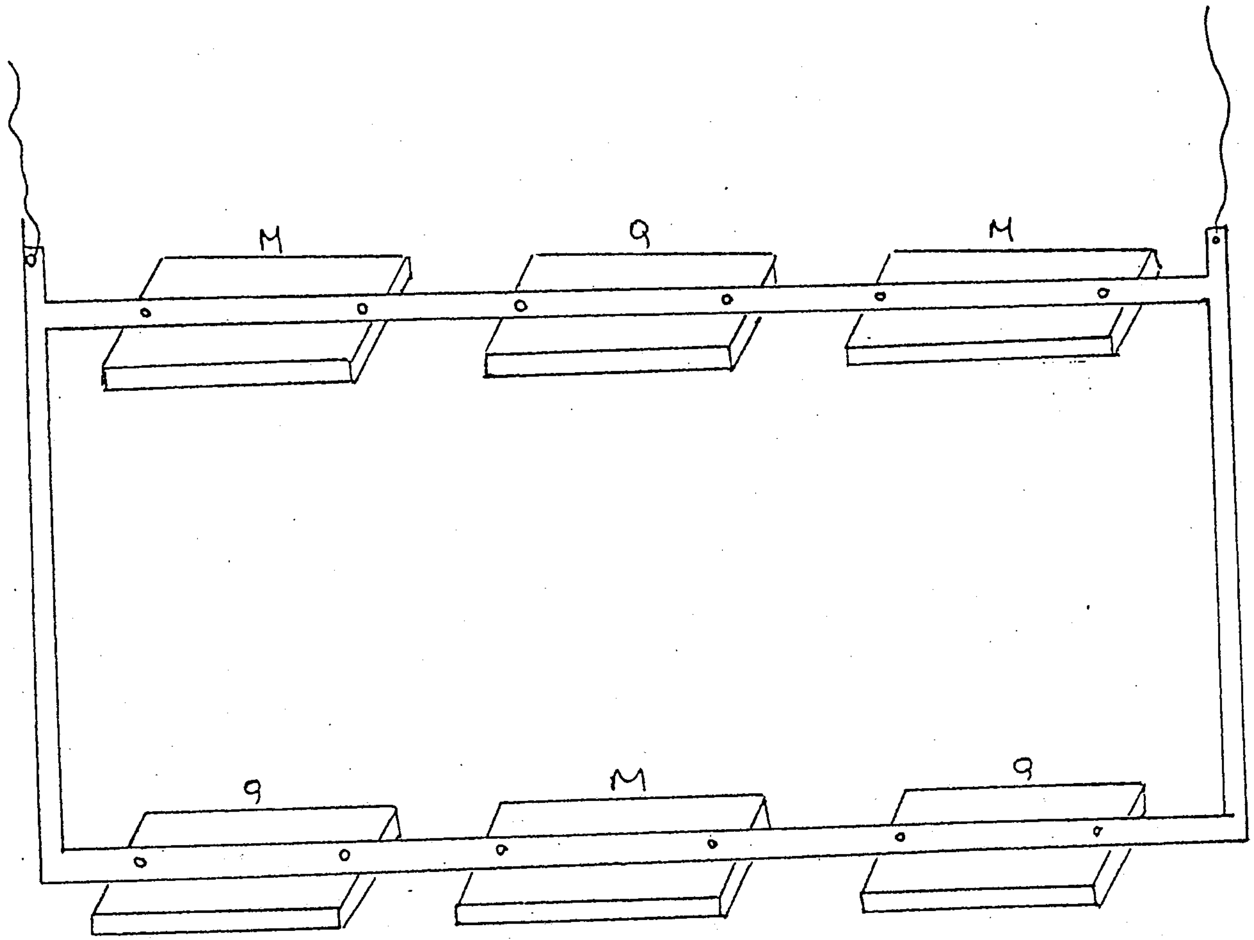

FIGURE 2. EXPOSURE PANEL RACK

M = Monthly Panel
Q = Triannual Panel

panel of the same size. Transite, a hard asbestos-like material, was chosen based on previous findings at Clapp Laboratories (Battelle, 1978, unpublished) and elsewhere (e.g. Pyefinch, 1950) that serpulid polychaetes such as *Hydroides* would readily settle on this substrate. Similarly, in a study to assess the variability of species on exposure panels (Battelle, 1978, unpublished data), it was found that as long as there was a fouling community present, there was no difference in substrate preference shown by *Corophium*. Therefore, transite was considered to be a good settling substrate for both species being investigated.

Panels were mounted horizontally on the iron frame so that the uppermost 25.4 cm x 8.9 cm surface would be parallel to and approximately 15 inches (40 cm) from the bottom.

The horizontal orientation was selected based on Young and Frame's (1976) rationale that *Corophium* is primarily an epibenthic organism and is usually found most abundantly on horizontal surfaces. Shafto (1974) observed that *Hydroides dianthus* is more prevalent on the lower surfaces of exposure panels.

Three panels were removed and replaced at each site monthly from February, 1979 through April, 1980. Three additional panels were removed and replaced triannually (May, 1979; September, 1979; and January, 1980), after an exposure of four months at each site. Before removal from the rack, a nytex bag (0.5 mm mesh) was placed around each panel in order to prevent loss of the motile amphipods. Each panel was then wrapped in newspaper and stored on ice until returned to the laboratory in Duxbury.

A Hydrolab (Model II B), calibrated before each day's use, was used to record temperature, pH, dissolved oxygen and conductivity at each site on each collection date. Conductivity readings were converted to salinity, and dissolved oxygen readings were converted for temperature/conductivity at the laboratory.

Laboratory Methods

All fouling organisms, including *Corophium* but excluding attached serpulid tubes, were transferred to a ten percent formalin solution. All specimens of *Corophium* were counted and identified to species where possible; some juvenile or damaged specimens could not be taken to species. The number of ovigerous females of each species was recorded. All specimens were retained for future reference.

The panels were then immersed in a neutral red dye solution, using the methods described by Dressel et al (1972) to aid in determining the percent of live serpulids. The number of serpulid tubes present, the percentage of tubes containing live individuals, and percent panel cover were recorded. All specimens were saved for future reference.

Voucher specimens of each species of *Corophium* found during this study were verified by Dr. E.L. Bousfield of the Department of Invertebrate Zoology, National Museums of Canada, Ottowa, Canada. Voucher specimens of the two species of serpulid polychaetes found on the panels were verified by N.J. Maciolek, William F. Clapp Laboratories.

Data Analysis

Counts of *Corophium* on each panel were multiplied by a factor of 67 to give estimated density per square meter. The use of this factor is based on a calculated 0.015 m^2 surface area (upper panel surface) available for settlement of *Corophium* spp. since no specimens were found on the underside of panels.

Counts of *Hydroides dianthus* on each panel were multiplied by a factor of 26.3 to give estimated density per square meter. The use of this factor is based on a calculated 0.038 m^2 surface area (both side of panel) available for settlement of *H. dianthus*.

Robust statistical tests were not performed on the data, according to the advice of Dr. Woollcott Smith, Woods Hole Oceanographic Institution. The variability in settlement of both *Corophium* spp. and *Hydroides dianthus*, which was often greater within a station than between stations, and the small numbers of organisms collected (see Results, below), made the use of statistical tests to determine power plant effects, impossible (Smith, pers. comm.). However, inspection of the data set does allow some points to be made about the species of interest.

RESULTS

The panels used in the study provided 0.023 m^2 area on each surface; however, the cross-bar of the frame to which the panels were attached obscured approximately one-third of the upper surface of each panel leaving 0.015 m^2 exposed. Three replicates provided a total of 0.045 m^2 upper surface area, 0.069 m^2 lower surface area, or 0.114 m^2 including both upper and lower surfaces.

Water Quality

Tables 2, 3, 4, and 5 give the values obtained monthly for temperature (°C), salinity (0/00), dissolved oxygen (mg/l), and pH at Stations 1 through 6. During the months of March, 1979 through December, 1979, temperatures at Oyster Creek Stations 3 and 4 appear elevated by 2-6°C over those recorded at the remaining stations. The generating station was not operating for several days in January and February, 1979, nor was it operating from January, 1980 through April, 1980 (Kennish, JCP&L, pers. comm.), so the similarity in water temperatures at all stations during those periods is not surprising.

Temperatures recorded at Station 2 during the course of the study more closely match those recorded at Station 1 than those at Stations 3 and 4. This suggests that Station 2, originally considered to lie within the heat dissipation area, actually is not affected by the thermal discharge.

TABLE 2. WATER TEMPERATURE (°C) AT *Corophium/Hydroides* PANEL STATIONS

	Station					
Month	1	2	3	4	5	6
Jan 79	0.3	2.5	4.5	4.5	*	1.5
Feb 79	-0.5	-0.5	-1.0	-1.0	-0.5	-0.7
Mar 79	6.0	5.9	11.1	12.0	6.8	5.7
Apr 79	8.5	8.0	11.0	10.5	11.5	10.0
May 79	15.9	15.4	19.4	20.3	17.6	18.1
Jun 79	20.8	19.6	24.3	25.0	21.0	20.7
Jul 79	23.2	23.4	30.7	27.6	23.2	24.6
Aug 79	27.0	27.5	31.0	31.5	27.5	27.5
Sep 79	22.0	23.0	25.7	26.6	22.9	22.7
Oct 79	13.2	14.2	18.2	17.4	13.3	12.4
Nov 79	11.3	12.5	15.5	16.0	11.7	11.6
Dec 79	6.3	8.0	11.7	13.4	9.6	7.5
Jan 80	2.0	2.5	2.0	2.5	2.0	2.5
Feb 80	-1.0	-0.5	0	0	0	1.0
Mar 80	-0.5	0.2	0.5	0.5	0	2.0
Apr 80	14.0	14.0	13.0	12.5	12.5	12.5

* - Hydrolab malfunctioning, reading not taken

TABLE 3. SALINITY (0/00) AT *Corophium/Hydroides* PANEL STATIONS

Month	Station 1	2	3	4	5	6
Jan 79	17.9	24.9	19.9	20.6	*	14.5
Feb 79	15.8	2.3	17.2	5.8	15.8	1.7
Mar 79	15.8	19.6	12.8	13.2	14.5	14.5
Apr 79	10.4	17.7	12.0	11.8	14.9	6.9
May 79	19.9	22.7	18.5	19.5	20.4	14.5
Jun 79	19.0	18.5	15.8	17.1	18.5	17.3
Jul 79	22.7	22.7	18.9	20.2	20.5	19.3
Aug 79	22.0	23.4	21.3	21.3	22.0	20.6
Sep 79	22.6	23.4	19.8	20.0	21.2	19.2
Oct 79	12.4	19.2	15.2	14.1	20.0	14.4
Nov 79	16.5	19.2	13.1	15.2	17.9	14.8
Dec 79	15.2	19.2	18.5	17.9	20.6	18.5
Jan 80	22.7	22.7	12.5	19.9	13.8	19.2
Feb 80	13.8	21.3	17.2	19.9	21.3	18.5
Mar 80	22.1	25.6	19.2	22.1	22.7	20.6
Apr 80	13.9	19.2	17.2	15.2	15.2	16.5

* - Hydrolab malfunctioning, reading not taken

TABLE 4. DISSOLVED OXYGEN (mg/l) AT *Corophium/Hydroides* PANEL STATIONS

	Station					
Month	1	2	3	4	5	6
Jan 79	*	*	*	*	*	*
Feb 79	14.6	16.1	14.8	14.6	15.1	16.1
Mar 79	11.9	7.9	11.0	11.2	11.4	10.9
Apr 79	10.3	8.0	10.2	10.4	9.9	11.6
May 79	8.9	9.1	7.9	8.9	8.9	10.3
Jun 79	7.2	5.1	6.8	7.7	7.9	7.0
Jul 79	7.1	8.0	7.4	6.8	7.6	8.3
Aug 79	*	*	*	*	*	*
Sep 79	*	*	*	*	*	*
Oct 79	9.0	8.9	9.0	9.1	10.2	10.2
Nov 79	8.9	9.2	9.2	8.6	8.9	9.6
Dec 79	10.0	10.9	8.9	9.9	10.0	10.7
Jan 80	10.5	11.2	10.8	12.2	12.9	11.2
Feb 80	12.7	12.6	10.6	12.4	13.4	13.6
Mar 80	11.8	11.8	11.4	11.9	11.4	12.1
Apr 80	9.1	9.0	9.1	8.2	8.9	8.9

* - Hydrolab malfunctioning, reading not taken

TABLE 5. pH AT *Corophium/Hydroides* PANEL STATIONS

Month	Station 1	2	3	4	5	6
Jan 79	*	*	*	*	*	*
Feb 79	7.8	7.8	7.4	7.3	7.5	7.4
Mar 79	9.2	8.0	8.2	8.5	9.1	8.7
Apr 79	7.9	7.1	8.5	8.7	9.0	8.6
May 79	8.0	8.1	7.9	7.8	8.0	8.2
Jun 79	8.0	7.5	7.6	7.9	8.3	7.7
Jul 79	8.7	8.8	8.5	8.5	9.1	9.1
Aug 79	8.4	8.5	8.5	8.4	8.6	8.5
Sep 79	*	*	*	*	*	*
Oct 79	7.1	6.7	7.0	6.9	7.1	6.5
Nov 79	*	*	*	*	*	*
Dec 79	8.1	8.0	7.9	7.8	8.0	8.1
Jan 80	7.4	7.2	6.5	7.0	7.1	7.2
Feb 80	7.7	7.8	7.4	8.0	8.0	7.9
Mar 80	8.1	8.1	7.9	8.1	8.2	8.0
Apr 80	7.8	7.9	7.8	7.7	7.7	7.7

* - Hydrolab malfunctioning, reading not taken

For the remainder of this report, Stations 3 and 4 are considered to be within the area affected by the thermal discharge, and Stations 1, 2, 5, and 6 are considered to lie outside the area affected by the discharge.

Corophium

The estimated densities (numbers per square meter) and species of *Corophium* collected on monthly panels are given in Table 6, and those found on panels exposed for four months are given in Table 7.

Five species of *Corophium* were collected: *C. tuberculatum*, *C. insidiosum*, *C. ascherusicum*, *C. acutum*, and *C. lacustre*. The species of interest, *C. tuberculatum*, was found on only three sampling dates: June, 1979 at Stations 4 and 5; July, 1979 at Station 1; and September, 1979 at Station 3. Abundances were low at each collection: a total of two specimens occurred at Station 1, one specimen at Station 3, 43 specimens at Station 4, and 57 individuals at Station 5. At Station 4, a total of 30 percent of the individuals collected were ovigerous and 39 percent of those at Station 5 (Table 8). None of the individuals collected at Stations 1 and 3 were ovigerous.

Corophium insidiosum was by far the most common and most abundant species collected, occurring at all locations except Station 6. This was the only species recorded from Station 2. Tables 7 and 8 give percent ovigerous specimens for those months in which gravid females were found. As late as December, 1979, an ovigerous female was found at Station 2, in spite of low water temperatures (8°C, Table 2).

Corophium ascherusicum was found at Stations 3, 4, and 6; but was reported only once from the latter two and more frequently from Station 3, where it occurred on both monthly and four-month panels (Tables 6 and 7). Ovigerous females were present only at Station 3, and were found as late as November and December, 1979 (Table 8).

TABLE 6. DENSITY OF *Corophium* ON PANELS EXPOSED FOR ONE MONTH

Numbers are estimated density per m^2 based on extrapolation from numbers of organisms per 0.015 m^2

t = *Corophium tuberculatum*, *i* = *C. insidiosum*, *a* = *C. ascherusicum*, *ac* = *C. acutum*, *l* = *C. lacustre*
sp = *juveniles not identified to species*

Month Removed	Station 1	2	3	4	5	6
Feb 79	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Mar 79	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Apr 79	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
May 79	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Jun 79	357*i* ± 139	6655*i* ± 3261	2814*i* ± 1047	960*t* ± 1165	1273*t* ± 639	22*sp* ± 39
Jul 79	916*i* ± 302 45*t* ± 77	2546*i* ± 725	0 ± 0	22*i* ± 39	335*i* ± 292	0 ± 0
Aug 79	0 ± 0	45*i* ± 77	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Sep 79	0 ± 0	625*i* ± 1083	89*i* ± 102 67*a* ± 116 22*t* ± 39	22*i* ± 39	22*i* ± 39 89*ac* ± 102 22*l* ± 39 22*sp* ± 39	0 ± 0
Oct 79	0 ± 0	45*sp* ± 77	514*i* ± 456 156*sp* ± 215	89*i* ± 39 67*sp* ± 67	45*i* ± 39	0 ± 0
Nov 79	0 ± 0	1653*i* ± 633 1027*sp* ± 915	804*l* ± 761 223*a* ± 279 223*sp* ± 102	134*i* ± 116 22*sp* ± 39	0 ± 0	0 ± 0
Dec 79	45*i* ± 78	625*i* ± 854 156*sp* ± 271	134*i* ± 116 1586*a* ± 2192 22*sp* ± 39	290*i* ± 393	67*i* ± 116	0 ± 0
Jan 80	0 ± 0	0 ± 0	45*a* ± 39	22*i* ± 39 22*a* ± 39	0 ± 0	0 ± 0
Feb 80	0 ± 0	0 ± 0	22*i* ± 39	0 ± 0	0 ± 0	0 ± 0
Mar 80	0 ± 0	22*i* ± 39	67*sp* ± 116	112*sp* ± 139	22*i* ± 39	22*a* ± 39 134*sp* ± 116
Apr 80	0 ± 0	246*i* ± 102	0 ± 0	0 ± 0	89*i* ± 102	0 ± 0

TABLE 7. DENSITY ($\#/m^2$) OF *Corophium* ON PANELS EXPOSED FOR FOUR MONTHS

Numbers are extrapolated from raw counts. Date shown is date of collection. Numbers in parenthesis indicate percent ovigerous females.

i = *Corophium insidiosum*, *a* = *C. ascherusicum*, *l* = *C. lacustre*
sp = *juveniles not identified to species*

MAY 1979

	Station 1	2	3	4	5	6
Replicate 1	0	0	0	0	0	0
Replicate 2	0	0	0	0	0	0
Replicate 3	0	0	0	0	0	0
$\bar{X} \pm$ S.D.	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0

SEPTEMBER 1979

	Station 1	2	3	4	5	6
Replicate 1	0	3082*i* (22%)	134*i* 67*a* (100%) 67*sp*	0	201*l* (33%)	0
Replicate 2	0	67*i*	0	0	0	0
Replicate 3	0	603*i* (22%)	0	0	0	0
$\bar{X} \pm$ S.D.	0 ± 0	1251*i* ± 1608 223*sp* ± 387	44*i* ± 77 22*a* ± 39 22*sp* ± 39	0 ± 0	67*l* ± 116	0 ± 0

TABLE 7. CONTINUED

JANUARY 1980

	Station 1	2	3	4	5	6
Replicate 1	134*i*	10117*i* 603*sp*	0	0	0	0
Replicate 2	67*i*	6365 (1%)	67*i* 134*a*	134*i*	67*i*	0
Replicate 3	871*i* (8%)	0	67*a*	0	0	67*i*
$\overline{X}$ ± S.D.	357*i* ± 446	5494*i* ± 5114 201*sp* ± 348	22*i* ± 39 45*a* ± 77	45*i* ± 77	22*i* ± 39	22*i* ± 39

TABLE 8. PERCENT OVIGEROUS COROPHIUM COLLECTED ON MONTHLY EXPOSURE PANELS AT SIX STATIONS IN BARNEGAT BAY

Months are not included in which no ovigerous specimens were collected.* Numbers in parenthesis refer to actual numbers collected per replicate panels.

A. *Corophium tuberculatum*

Month	Station 1	2	3	4	5	6
Jun 79				26.5 (9/34)	62.5 (5/8)	
				100 (1/1)	28.0 (7/25)	
				37.5 (3/8)	41.7 (10/24)	
Total				30.0 (13/43)	38.6 (22/57)	

B. *Corophium insidiosum*

Month	Station 1	2	3	4	5	6
Jun 79	42.9 (3/7)	21.0 (32/152)	20.8 (5/24)			
	16.7 (1/6)	12.5 (7/56)	9.6 (5/52)			
	33.3 (1/3)	24.4 (22/90)	24.0 (12/50)			
Total	31.2 (5/16)	20.5 (61/298)	17.5 (22/126)			
Jul 79	11.1 (1/9)	19.2 (5/26)			14.3 (1/7)	
	27.8 (5/18)	29.8 (14/47)				
	7.1 (1/14)	7.3 (3/41)				
Total	17.1 (7/41)	19.3 (22/114)				
Sep 79		7.1 (2/28)			100 (1/1)	

(B. *Corophium insidiosum*)

Month	Station 1	2	3	4	5	6
Oct 79			38.5 (5/13)			
			20.0 (2/10)			
Total			30.4 (7/23)			
Nov 79		1.6 (1/63)	28.0 (7/25)			
		15.6 (5/32)				
		5.0 (1/20)				
Total		6.1 (7/115)				
Dec 79		4.2 (1/24)				
Apr 80		60.0 (3/5)				
		50.0 (1/2)				
		50.0 (2/4				
Total		54.6 (6/11)				

C. *Corophium acherusicum*

Month	Station 1	2	3	4	5	6
Sep 79			66.7 (2/3)			
Nov 79			62.5 (5/8)			
			50.0 (1/2)			
Total			60.0 (6/10)			
Dec 79			6.6 (4/61)			
			30.0 (3/10)			
Total			9.9 (7/71)			

* - No ovigerous specimens of *Corophium lacustre* or *C. acutum* were collected from panels exposed for one month

Corophium lacustre and *C. acutum* both were reported only from Station 5 in September, 1979. *C. lacustre* occurred on both one-month and four-month exposure panels, but gravid females were found only on a four-month panel (Tables 6 and 7). *C. acutum* occurred only on the one-month panels and no ovigerous specimens were found.

Hydroides dianthus

The estimated densities (number per square meter) of living *Hydroides dianthus* found on panels exposed for one month are given in Table 9. Densities on panels exposed for four months are found in Table 10.

No living individuals were recorded from monthly panels collected from February, 1979 through June, 1979, or from November, 1979 through April, 1980, indicating no settlement during those months. Therefore, only during the four months of July, August, September, and October, 1979 did this species settle and survive at our stations. As expected, the heaviest settlement was on the underside of the exposure panels, although some individuals did settle on the upper surfaces.

DISCUSSION

Corophium

In the study conducted by Young and Frame (1976) at two stations near the Oyster Creek Generating Station, *Corophium tuberculatum* was most abundant at the station in the intake canal. In the present study, Station 5, in the south branch of Forked River, is situated most similarly to their intake canal station, and is the station at which the highest counts of *C. tuberculatum* were obtained. The second highest counts were at Station 4, at the mouth of Oyster Creek, which is within the influence of the thermal discharge from the power plant.

TABLE 9. DENSITY OF *Hydroides dianthus* ON PANELS EXPOSED FOR ONE MONTH

Numbers are estimated density per m^2 based on extrapolation from numbers of organisms per 0.038 m^2

	Station					
Month Removed	1	2	3	4	5	6
Feb 79	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Mar 79	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Apr 79	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
May 79	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Jun 79	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Jul 79	0 ± 0	0 ± 0	9 ± 15	1402 ± 1217	308 ± 329	0 ± 0
Aug 79	158 ± 229	1920 ± 1740	1043 ± 367	2455 ± 425	4103 ± 632	2762 ± 1409
Sep 79	693 ± 402	2753 ± 2175	1990 ± 1027	771 ± 404	3612 ± 3227	4904 ± 1632
Oct 79	114 ± 154	345 ± 411	1359 ± 762	3296 ± 1057	5137 ± 2393	0 ± 0
Nov 79	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Dec 79	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Jan 80	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Feb 80	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Mar 80	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0
Apr 80	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0

TABLE 10. DENSITY (#/m^2) OF *Hydroides dianthus* ON PANELS EXPOSED FOR FOUR MONTHS

Date shown is date of collection. Numbers are extrapolated from numbers of *Hydroides* alive at time of collection.

MAY 1979

	Station 1	2	3	4	5	6
Replicate 1	0	0	0	0	0	0
Replicate 2	0	0	0	0	0	0
Replicate 3	0	0	0	0	0	0
$\bar{X} \pm$ S.D.	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0

SEPTEMBER 1979

	Station 1	2	3	4	5	6
Replicate 1	0	1524	79	210	3583	1065
Replicate 2	316	26	526	79	156	1924
Replicate 3	355	3708	663	0	105	2236
$\bar{X} \pm$ S.D.	224 ± 195	1753 ± 1852	423 ± 305	96 ± 106	1281 ± 1993	1742 ± 606

JANUARY 1980

	Station 1	2	3	4	5	6
Replicate 1	53	350*	367	4048	79	0*
Replicate 2	184	158	1129*	2695	304*	0*
Replicate 3	497	294*	1150*	2275	0	0*
$\bar{X} \pm$ S.D.	245 ± 228	267 ± 99	882 ± 446	3006 ± 926	128 ± 158	0 ± 0

* - *Ficopomatus enigmaticus* present on panels

However, the densities reported by Young and Frame are one to two orders of magnitude larger than those obtained in the present study, and they recorded the species during more than one month. For instance, they report "about 17,000 individuals in July and 12,000 in August" (1976, p. 47). These densities, which are numbers per 0.10 m^2, are very much larger than our estimated density of 1,273 $\pm$ 639 per square meter at Station 5 or 960 $\pm$ 1,165 at Station 4 in June, 1979.

One possible reason for this discrepancy might be the amount of surface area exposed for settlement of the amphipods. The discs used by Young and Frame provided a total surface area of 0.10 m^2, each side being 0.05 m^2. Our panels provided an upper surface area of 0.015 m^2 and lower surface area of 0.023 m^2. Since *Corophium* were not observed on the lower side of any panel, it is concluded that only 0.015 m^2 per panel, or a total of 0.045 m^2 per station/date was potential space for settlement by *Corophium*. This amount of surface area is, therefore, comparable to one side of the one disc per station/date used by Young and Frame; hence, a lack of exposed surface area cannot completely account for the low numbers recorded.

It is also possible that the natural population density of this species was low in the study area during 1979-1980. The study design does not allow evaluation of this, since only individuals which moved and settled on our panels were sampled. However, all other species of *Corophium* were recorded in equally low numbers: either populations of all species were low, or our experimental design was inadequate to detect real population densities.

The abundances of *C. tuberculatum* recorded in June, 1979 at Station 4, within the influence of the thermal discharge, and at Station 5, in Forked River, are of equal and comparable magnitude, as are the percent ovigerous specimens at each station. These results might lead one to conclude that the condition of *C. tuberculatum* is the same in areas both under the influence of the thermal discharge and outside this influence. However, a firm conclusion is not warranted, since the species was collected in such low numbers and on only one sampling date. The most that can be stated based on present data is that the species was present and reproducing in both the Forked River and Oyster Creek areas in June, 1979.

Young and Frame (1976, p. 47) reported that *Corophium ascherusicum* occurred primarily at their station in the discharge canal, where ovigerous females and juveniles were found during most months of their study. In the present study, Station 3 is closest to Young and Frame's discharge canal station, and it was at this station that *C. ascherusicum* was most abundant. Similarly, our Station 3 was the only one at which ovigerous females of this species were found, and these occurred as late in the year as December, 1979 where water temperatures were probably influenced by thermal discharges from the generating station. However, although our data suggest a pattern similar to that reported by Young and Frame, as with *C. tuberculatum*, recorded densities are one to two orders of magnitude lower in the present study. As with *C. tuberculatum*, there is no conclusive explanation for this.

The five species of *Corophium* collected in this study are all reported by Bousfield (1973) as common along the American Atlantic coast, mostly in protected bays and estuaries. *C. acutum* is more common in very lotic areas or open surf coasts. All are annual species, reproducing during the months of April or May through September.

Hydroides dianthus

The low numbers of individuals collected, and the high variability among replicates from any one station precludes an extensive discussion concerning the possible effects of the generating station on the distribution of this species.

However, a tendency may be seen (Tables 9 and 10) for higher counts of individuals at Stations 4, 5 and 6 over Stations 1, 2 and 3. In particular, the cumulative panels collected in January, 1980 show Station 4 to have the highest densities of any of the stations, suggesting a better winter survival at this station.

Other reports of *Hydroides dianthus* in Barnegat Bay include Shafto (1974), Young and Frame (1976), and Hoagland et al (e.g. 1977, 1979 a and b). Shafto (1974) concluded that *H. dianthus* has a narrow salinity range (≥17-24 0/00), a moderate temperature range (17.5-33°C) and an affinity for areas of high wave action. She recorded high densities at her stations in Waretown (similar to our Station 2), at the mouth of the Forked River, and to a lesser extent, at the mouth of Stouts Creek (similar to our Station 6). Densities per square meter calculated from data recorded by Shafto (1974) at Waretown and the mouth of Forked River were an order of magnitude larger than those recorded in the present study (e.g. 60,295 vs. 1,920 at Waretown in a particular month). Densities at the mouth of Stouts Creek were similar in both studies.

Shafto (1974) did not record the species from her Oyster Creek stations, which are comparable to our Stations 3 and 4, and only minimal densities at her stations near the intake and outfall of the generating station. Young and Frame (1976) found low densities of *H. dianthus* at their station in the intake canal, and recorded the species only once from the discharge canal station. In the present study, there is no clear-cut difference in densities of *H. dianthus* at thermally-impacted stations (3 and 4) versus Station 5 in the intake canal. However, densities at Station 4 (discharge canal station) were high in July, 1979, a month before equivalent densities were found at other stations, suggestive of an earlier start of reproduction for that population. Also, data from the cumulative panels collected in January suggest a higher survival at Station 4, possibly due to the elevated temperatures.

Hoagland et al (e.g. 1977) reported presence or absence of *H. dianthus* from stations similar to those monitored in the present study. The general conclusion reached by Hoagland et al is that healthy, reproductive populations of *H. dianthus* exist at Waretown (similar to our Station 2), and at several stations south of Waretown. This conclusion is similar to Shafto's, but in the present study, recorded densities were very low in this area of Barnegat Bay (Stations 1 and 2; Tables 9 and 10).

Also in contrast to our findings, Hoagland et al reported that *H. dianthus* was consistently absent from the Stouts Creek area. Shafto (1974) and the present study recorded fairly high densities from that area.

Hoagland et al reported settlement patterns at the Forked River and Oyster Creek stations which are consistent with our data: with the occasional exception of Stations 7 and 8, larvae were found to settle at the same stations during approximately the same months of 1976 and 1977 as found in the present study during 1979. Hoagland's data from 1978 showed settlement only at three stations in the Forked River area.

A second serpulid, *Ficopomatus enigmaticus*, was observed on both monthly and four-month panels. *F. enigmaticus*, which was recorded as *Mercierella enigmaticus* until the taxonomic revision by ten Hove and Weerdenburg (1978), is typically a circumsubtropical species occasionally found in temperate areas (ten Hove, 1979). Its occurrence in Barnegat Bay, as noted earlier by Hoagland and Turner (manuscript in press, pers. comm.) and verified by ten Hove (pers. comm.), is the first and only report of this species from the east coast of North America. This species was possibly introduced to this coast from a European location, perhaps via trans-Atlantic ship traffic (J. Carlton, WHOI, pers. comm.). It has the potential for constructing large reefs which have been known to clog large diameter pipes within short periods of time (Tebble, 1953).

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