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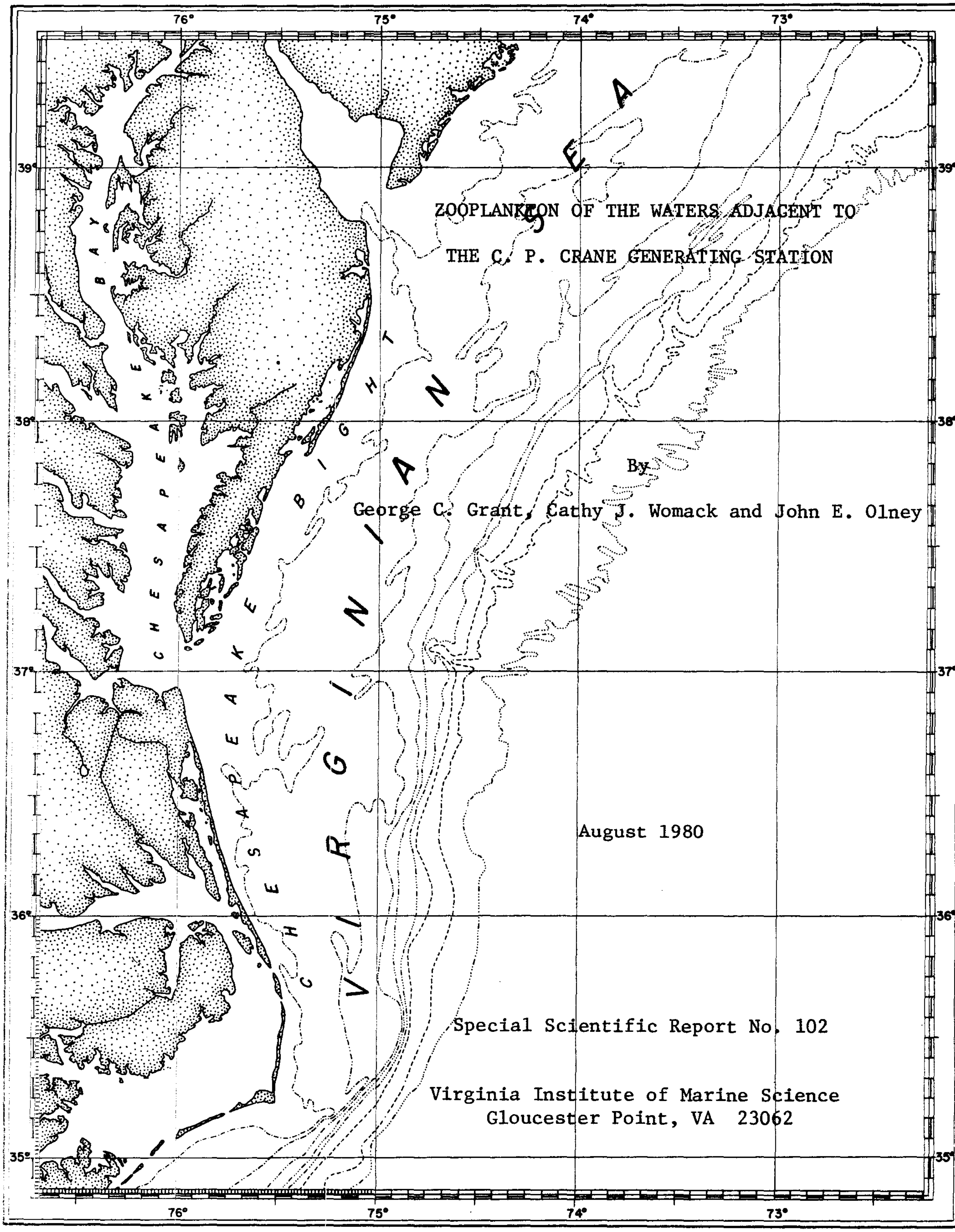

ZOOPLANKTON OF THE WATERS ADJACENT TO THE C. P. CRANE GENERATING STATION

By

George C. Grant, Cathy J. Womack and John E. Olney

August 1980

Special Scientific Report No. 102

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ABSTRACT

Zooplankton populations in the Gunpowder River and its tributaries were sampled monthly from July 1979 to March 1980 in a continuation of similar studies begun in March 1979. Fourteen stations were sampled for mesozooplankton (202 μm nets); six of these stations were also sampled for microzooplankton (concentration of pumped samples on 76 μm netting).

The sampling period was physically characterized by seasonally declining temperatures and salinities during fall months, but a reversal in salinity trends in winter months, when low runoff resulted in salinity ranges well above the winter norm for the upper Chesapeake Bay. The low water transparency observed in an earlier spring study was not repeated during this study, with Secchi disc readings ranging from 0.2-1.5 m and maximum water transparency occurring in January. Ice cover prevented regular sampling in February.

Summer dominance of mesozooplankton collections by *Acartia tonsa*, *Moina micrura* and barnacle larvae was altered in fall months to dominance by rotifers, cladocerans and *Eurytemora affinis*. Higher than normal winter salinities produced an early winter reappearance of *Acartia tonsa* and exceptionally high densities of *Eurytemora affinis* in March. Zooplankton volume in March 1980 exceeded any previous measurements of biomass in the study area.

Microzooplankton collections were seasonally dominated by the nauplii and copepodites of dominant copepods and by several species of rotifers. Nauplii of *Eurytemora affinis* occurred in all seasons, but in patterns of abundance that followed those of adults.

Cluster analyses of mesozooplankton collections revealed a principal division between a freshwater community at upper Gunpowder River, Dundee Creek and lower Saltpeter Creek sites, and remaining oligohaline collections from intake, discharge and lower Gunpowder River locations. Collections from the immediate discharge area only rarely clustered as a distinct sample group and typically are similar to assorted intake and lower river collections. This is a result of the large volume of water transferred by the power plant from intake to discharge creeks, relative to the small basin volume of the receiving body of water. Microzooplankton cluster analyses, performed on a smaller set of collections (six stations), were less informative because of their close similarity, especially in cooler seasons.

The principal effect of the C. P. Crane generating station on zooplankton of the area is believed to be a displacement of an original freshwater community through the pumping of cooling water from Seneca Creek to Saltpeter Creek. Unfortunately, this effect is now historical and, without benefit of preoperational surveys, cannot be documented. Present-day studies are restricted to examining acute and short-term plant effects within a community now common to both sides of the generating station.

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1. INTRODUCTION

1.1 General Remarks

This study completes zooplankton investigations at the C. P. Crane site and is a continuation of work initiated in summer months of 1978 (Grant and Berkowitz, 1979a) and repeated during spring months of 1979 (Grant and Berkowitz, 1979b). The present collections include months not previously sampled (October through February) and repeat sampling in March and in summer months. Phytoplankton measurements were deleted from this contract, so that the continuity in methodology and measurements applys only to micro- and mesozooplankton. This report, together with Grant and Berkowitz (1979b), provides information on identification and abundance of zooplankton over a continuous 13-month period. Indications of annual differences can be gained from comparisons of results from the summers of 1978 and 1979 and from March 1979 and 1980 collections.

1.2 Other Studies in the Vicinity

The numerous studies conducted at the C. P. Crane site, some of which are still in progress, have produced a unique body of data for a freshwater-oligohaline system under impact from a non-nuclear power plant. Earlier studies included some at the immediate site (Johns Hopkins Univ., 1973 and Davies, Hanson and Jensen, 1976) and several in nearby waters (Dovel, 1971a, 1971b; Johns Hopkins Univ., 1972; Seliger and Loftus, 1974; Allan, Kinsey and James, 1976). Intensive evaluation of the effects of the C. P. Crane plant on surrounding waters and their biota was begun in 1978 and thus far include studies on physical parameters (Binkerd, Johnston, and Comeau, 1978; Ecological Analysts, 1979a), on submerged aquatic vegetation (Nichols et al., 1979), on sediments, benthos and contained trace metals (Jordan, Sutton and Goodwin, 1979; Jordan et al., 1980; Ecological Analysts, 1980; Harris et al., 1980), on phytoplankton productivity and biomass (Grant and Berkowitz, 1979a,b; Sellner, 1979; Ecological Analysts, 1980) on community oxygen metabolism (Zubkoff, 1980), on microzooplankton and mesozooplankton (Ecological Analysts, 1980; Grant and Berkowitz, 1979a,b and the present report), and finfishes (Texas Instruments, 1979; Ecological Analysts, 1980).

A compendium of the above studies published under a single cover would provide future investigators of similar environments with a most useful reference, if funding can be found for the necessary efforts of condensation, rewriting, editing, interaction among the involved scientists, and for costs of publication.

1.3 Objectives of the Present Study

This study was designed to:

(1) Complete a year-round determination of the composition, abundance and diversity of microzooplankton and mesozooplankton, initiated in March 1979 by the Virginia Institute of Marine Science,

(2) Provide ancillary data on salinity, temperature, dissolved oxygen and water transparency, and

(3) Determine whether any of the above parameters are demonstrably affected by operation of the generating station.

2. METHODS AND MATERIALS

2.1 The Sampling Scheme

Zooplankton was sampled monthly from July 1979 through March 1980, with sampling dates selected so that phase of the tidal cycle was held constant from month to month. Sampling sites were located in waters of the Seneca, Saltpeter and Dundee creeks and in the Gunpowder River (Fig. 1), and were identical to the 14 locations sampled for zooplankton in a spring 1979 study (Grant and Berkowitz, 1979b). The number of stations sampled for microzooplankton was increased to six and included stations P02, P05, P06, P10, P15 and Z03.

2.2 Measurements and Methodology

2.2.1 Mesozooplankton

Netting of 202 μm mesh was employed in the capture and retention of mesozooplankton, as defined by the National Academy of Sciences (BMPCO, 1969). Nets were mounted on PVC bongo sampler frames having mouth openings of 18.5 cm and were towed obliquely through the water column at each of the 14 stations for periods of 15 minutes. Volume of water sampled was calculated from initial and final readings of calibrated General Oceanics flowmeters mounted in the mouth of the collection net. At Station P15 additional horizontal tows were made at near-surface, mid-depth and near-bottom, with flowmeters mounted in each of the paired bongo nets, and both collections retained for analysis.

Laboratory processing of collections included an initial measure of displacement volume (Kramer, 1972), quantitative sorting into major taxonomic categories (copepods, cladocerans, etc.), then identification of these groups to species, wherever possible. Initial sorting was performed on whole samples or half-splits for the rarer, generally larger organisms, then on successively smaller aliquots for the smaller, more abundant taxa. Resulting counts of identified taxa were entered on data processing cards, one for each species occurrence, for further analysis.

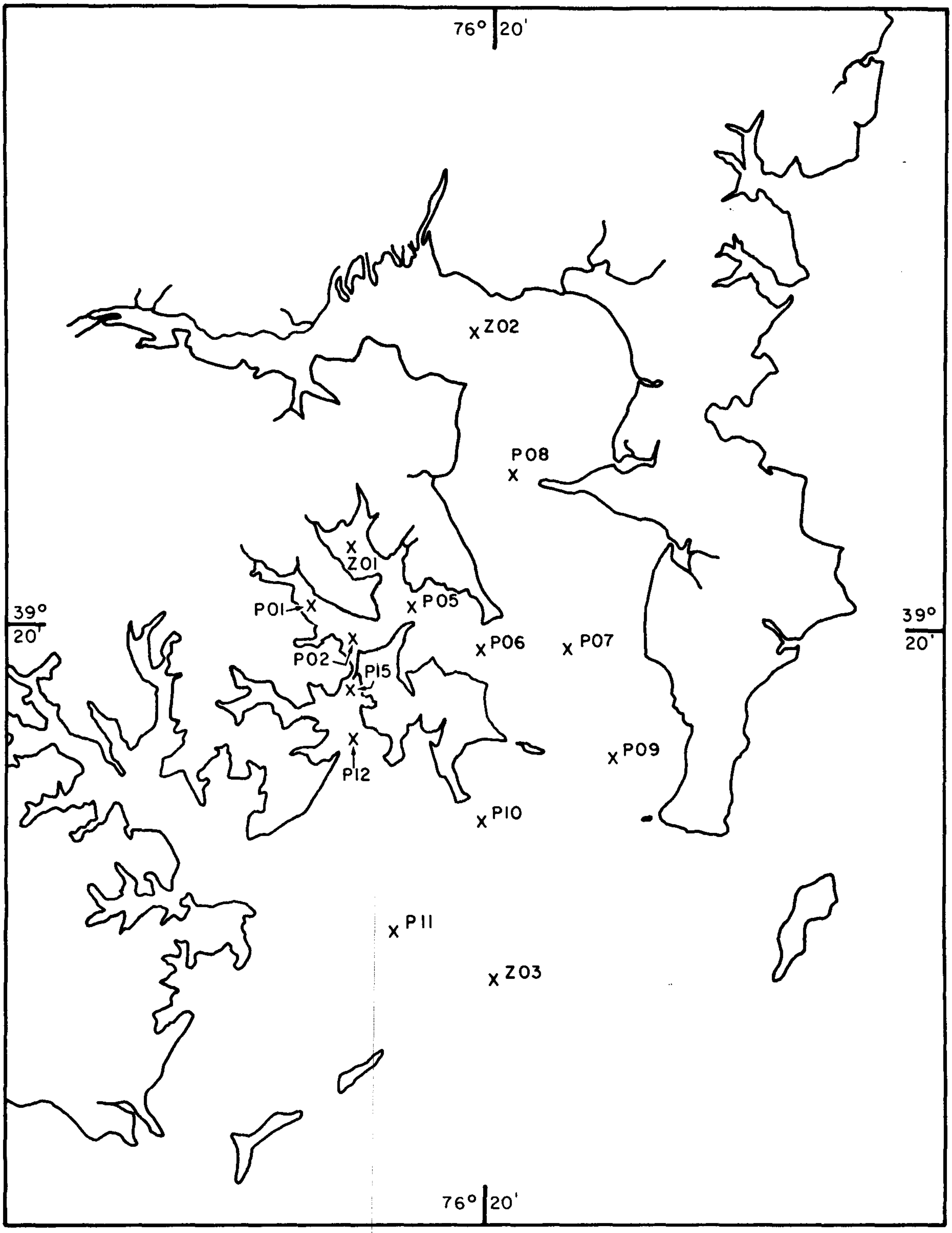

Figure 1 Location of stations sampled in the vicinity of the C.P. Crane generating station, July 1979-March 1980. Station P02 was located in the immediate discharge (Saltpeter Creek); P15 was in the immediate intake (Seneca Creek).

2.2.2 Microzooplankton

Smaller forms of zooplankton were sampled with a submersible pump (Flotec's Tempest Model S1400), moved obliquely through the water column to integrate samples. Water was pumped into carboys of known volume, then poured into a partially submerged net of 76 μm mesh to concentrate collections. At each station, two replicate samples of 0.1 m^3 each were obtained and preserved (5% formalin). Additional horizontal samples were collected at station P15 each month, including two replicate samples of 0.04 m^3 each from the near-surface, mid-depth and near-bottom.

In the laboratory, collections were initially stained with rose bengal to aid separation of organisms from detritus. Most counts and identifications were made at magnifications of 45-60X and 100-1000X, respectively. Counts of identified organisms, but with nauplii, copepodites and adults of dominant copepods tallied as individual "species", were entered on data processing cards as in mesozooplankton collections.

2.2.3 Ancillary Measurements

At each sampled station, water was collected by bucket for surface samples and by pump at depth for measurements of salinity, temperature and dissolved oxygen. Temperature and salinity was measured from surface to bottom at 1 m intervals; dissolved oxygen was measured only at surface and bottom. Temperature was measured by thermistor (YSI Model 43T), salinity with a Beckman RS-7B conductivity meter and dissolved oxygen using the modified Winkler titration method (Strickland and Parsons, 1972).

Surface incident radiation was measured with a hand-held solar meter (Dodge Products). Subsurface light penetration was measured with a Secchi disc and a submarine photometer (G. M. Mfg. and Instrument Corp. Model #268WA-310).

All obtained ancillary data are listed in Table A-1 (pp. 101-122).

2.3 Data Processing

Micro- and mesozooplankton collections from each month were clustered by samples and species (normal and inverse cluster analyses), and relationships of sample to species clusters examined by nodal analyses (Boesch, 1977; Grant and Berkowitz, 1979a). Nodal analyses were omitted when sample clusters were found to be poorly defined, which occurred among microzooplankton samples from November 1979-March 1980.

Descriptive analyses of both micro- and mesozooplankton collections included diversity (H'), evenness (J'), species richness (d) (Pielou, 1975; Margalef, 1961), frequency of occurrence, mean abundance and determinations of dominance.

3. THE PHYSICAL ENVIRONMENT (JULY, 1979-MARCH, 1980)

At each station sampled for zooplankton in this study, ancillary data were also collected on temperature, salinity, dissolved oxygen, incident radiation and light penetration. These data are provided in Table A-1 (pp. 101 to 122). Ranges of surface salinity, temperature and dissolved oxygen encountered in each sampling period are given in Table 1, together with field estimates of Δt, where available. In addition to these data, Baltimore Gas and Electric Co. provided us with their data on hourly generated load at the C. P. Crane stations for use in interpreting possible plant effects.

3.1 Temperature

Low temperatures and resulting ice formation in February prevented sampling during our scheduled tidal phase. An attempt to obtain at least some data in February (Feb. 29) was terminated on the third station when cold air temperatures froze and rendered inoperable both our flowmeters and submersible pump. The only other departure from scheduled sampling occurred in September as a result of a vessel breakdown.

Lowest temperatures in the ranges given in Table 1 are close to those considered ambient in field estimates of Δt, but not always identical since surface temperatures at stations P11 or P12 were utilized for this purpose. Surface temperatures nearest to the intake at P15 were not considered ambient because of leakage of heated water through the discharge canal wall. Low temperatures ranged from 1.0°C in December and February to 26.5°C in July. The high limit of temperature ranges was affected by operation of the C. P. Crane plant in every month except February, when no stations on the discharge side were sampled. The highest estimated ΔT was 8.0°C in December.

3.2 Salinity

With the passage of the winter snow belt well south of the upper Chesapeake Bay in the winter of 1979-1980* and resulting low runoff from the Susquehanna drainage, salinity increased in the study area in winter months. Surface salinities reached 5 o/oo in regularly

*Norfolk, Virginia received approximately 40 inches of snow, while more northerly locations in the Bay's drainage system received only scattered light precipitation.

Table 1. Ranges of surface temperature, salinity, and dissolved oxygen at the study site, July 1979-March 1980, with field estimated ΔT.

Sampling Dates	Temp (°C)	Salinity (o/oo)	DO (mg/1)	Estimated ΔT (°C)
July 24-25	26.5-31.2	0.28-2.84	6.0-7.8	3.4
Aug 22-23	22.0-27.0	1.02-5.46	6.9-9.0	2.5
Sept 21-22	19.5-22.0	0.71-2.43	7.3-9.4	*
Sept 29	20.5-23.5	0.53-1.93	7.8-11.1	*
Oct 22-23	15.5-23.0	0.11-0.62	8.5-12.5	4.0
Nov 21-22	9.5-15.0	0.13-1.58	10.0-11.4	4.0
Dec 18-19	1.0-9.0	0.22-0.81	10.8-12.1	8.0
Jan 17-18	3.5-9.5	0.67-5.16	11.1-12.5	5.0
Feb 29**	1.0-2.0	6.77-6.98	no data	**
Mar 18-19	5.5-10.1	1.56-4.97	9.9-11.9	4.6

*intake, discharge waters sampled 8 days apart
**sampling at 3 intake stations only

scheduled sampling periods of January and March, salinities normally seen only in summer months (as in August, 1979). Somewhat higher salinity on February 29, 1980 was due in part to the different tidal phase on that date.

Salinity during the first six months of sampling followed the expected pattern of a decrease from summer to fall months. Lowest salinities were measured in October and November, occurring at our uppermost Gunpowder River stations Z02 and P08. Essentially fresh water (<0.5 o/oo) was also sampled in July and December.

3.3 Dissolved Oxygen

There was no indication of dissolved oxygen depletion in the study area during our sampling, all of which occurred in daylight hours. The minimum surface oxygen content was 6.0 mg/l in July, coinciding as expected with highest seasonal temperatures. Oxygen content (Table 1) predictably increased with declining fall and winter temperatures.

3.4 Light Penetration

Secchi disk readings ranged from 0.25-0.5 m in July, 0.3-0.8 m in August, 0.4-0.7 m in September, 0.3-0.65 m in October, 0.4-0.7 m in November, 0.2-0.4 m in December, 0.5-1.5 m in January and 0.4-0.8 m in March. Measured by transmissometer, the sea cell/deck cell ratio at 1 meter (Appendix Table A-1) ranged from .010-.108 in August, .001-.025 in September, .004-.050 in October, .016-.070 in November, .001-.022 in December, .004-.175 in January and .014-.100 in March. No readings were obtained in July.

These two measures of water transparency agreed fairly well, showing increased clarity from July to August, a slight decline to moderate levels in September through November, a decrease in December followed by a sharp increase to maximum water clarity in January, then a slight decline in March. Water transparency in the immediate discharge stations (P01, P02, P05) was reduced in comparison with intake stations P12 and P15 in August, October, November, January and March (no comparison in February). Transparency was similar on the two sides of the plant in July, September and December.

3.5 Plant Operation

The C. P. Crane generating station has a gross-generating capacity of 400 Mw with both of its generating units operating. One unit is usually kept operating continuously, with the second unit brought online in response to power demand. With all cooling water pumps running and assuming about 85% efficiency, water flow is rated at 1,100 m^3/minute (Ecological Analysts, 1980).

Monthly, weekly and daily power production cycles at the plant have been well-described by Ecological Analysts (1980) and will not be repeated here. However, the operating levels during the days of our sampling and the week prior to sampling could be of importance to interpretation of sampling results. Figures 2-4 show the gross generated load of the plant at hourly intervals during days of sampling and averages of the prior week.

Sampling in July (Fig. 2) was conducted during two days of maximum power generation. The lower average of the prior week includes a typical reduction of power output during the weekend. Post-midnight shutdown of the plant's second unit is evident in the curves for the seven-day average and for July 24. August sampling, on the other hand, occurred after a week of low output, with both units in operation on only one of the seven days. Both units were being utilized during the first day of sampling. Initial sampling in

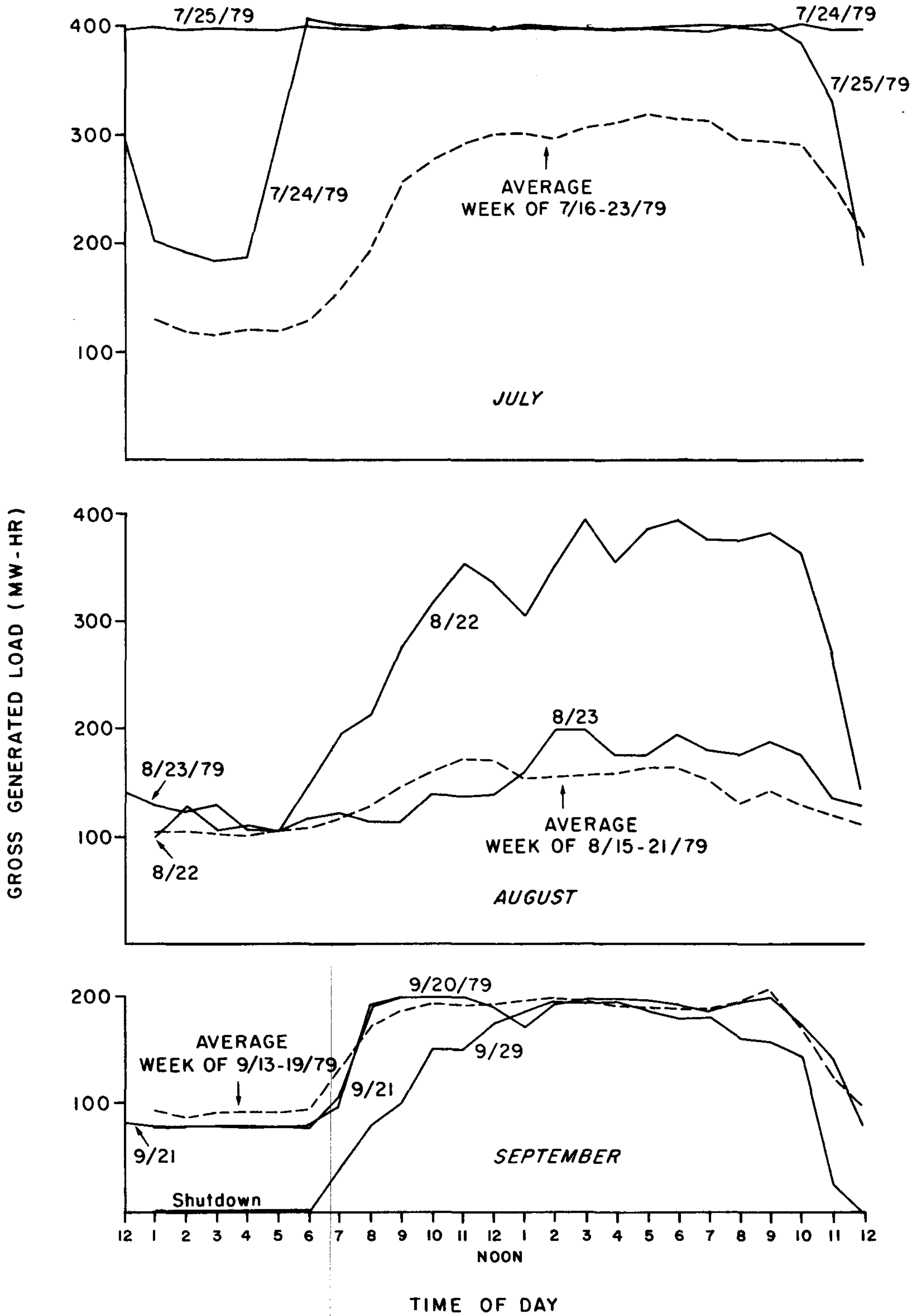

Figure 2. Plant operating load at the C. P. Crane generating station during sampling days, July-September 1979, and for the weeks prior to sampling.

September also occurred after a week in which both units were operated on only one day. Completion of interrupted sampling on September 29 followed a week of plant shutdowns: throughout the weekend and from midnight to 6 a.m. on other days, including our day of sampling (Fig. 2).

Sampling days in October were similar to average plant operation for the prior week (Fig. 3), with peak output in early evening at about 285 Mw and low output from midnight to 6 a.m. On November 21, both units were operating from 8 a.m. until 4 p.m., while output on Thanksgiving Day was considerably reduced. Sampling followed a week of high load. December sampling dates, similarly followed a week of high load (except for the weekend), and the plant was operating at, or near, capacity on both December 18 and 19.

The week prior to sampling in January saw operation of only one unit except for the first two days. One unit was in operation on January 17 and 18 (Fig. 4). On February 29, one unit was operated at near capacity, following a week of low power output. Plant shutdowns occurred earlier in the month (Feb. 9, 10, 13-18). Final sampling dates in March (18, 19) occurred after a week of one-unit operation and including shutdowns over nearly 60 hours within the period of March 12-15.

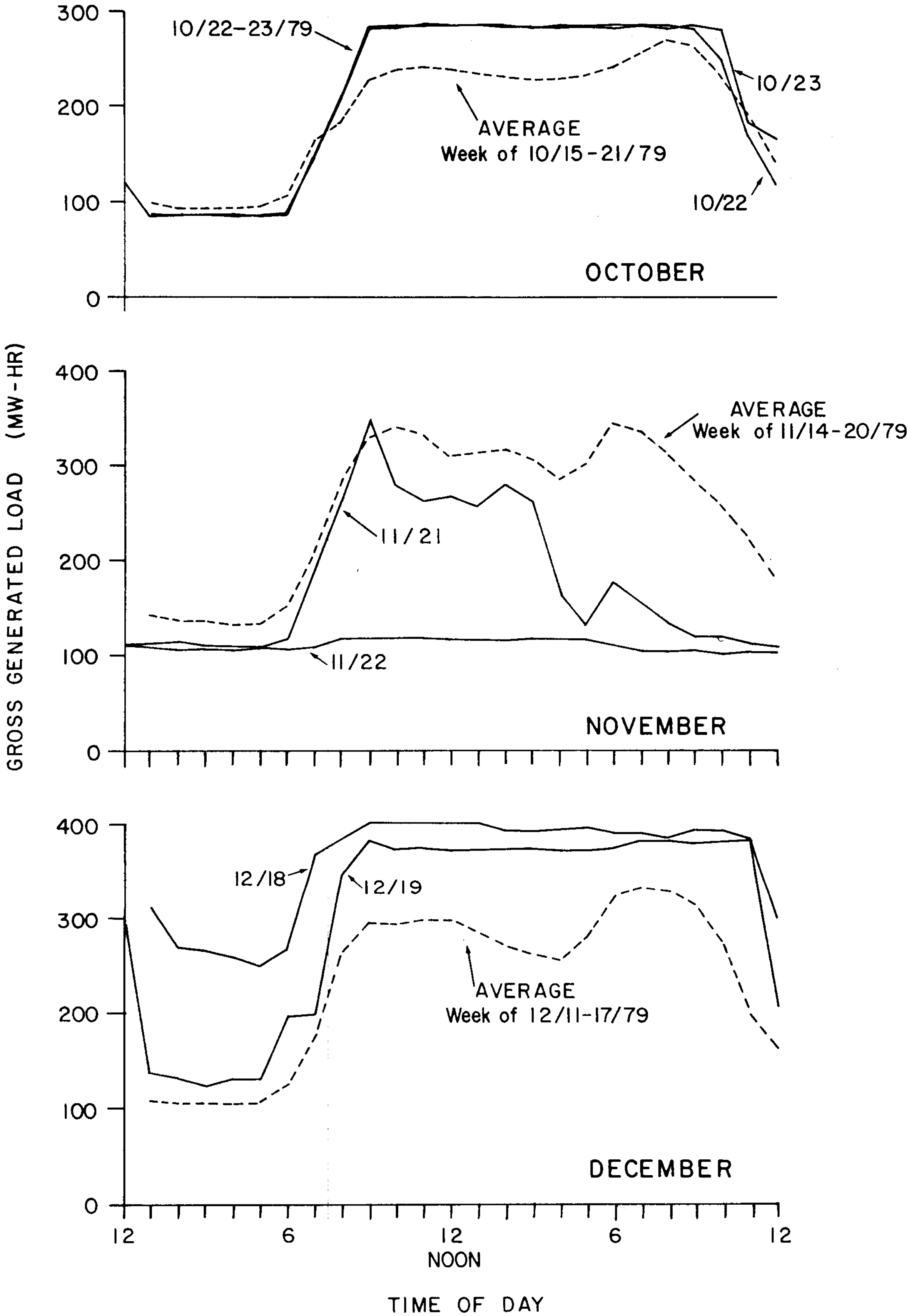

Figure 3. Plant operating load at the C. P. Crane generating station during sampling days, October-December 1979, and for the weeks prior to sampling.

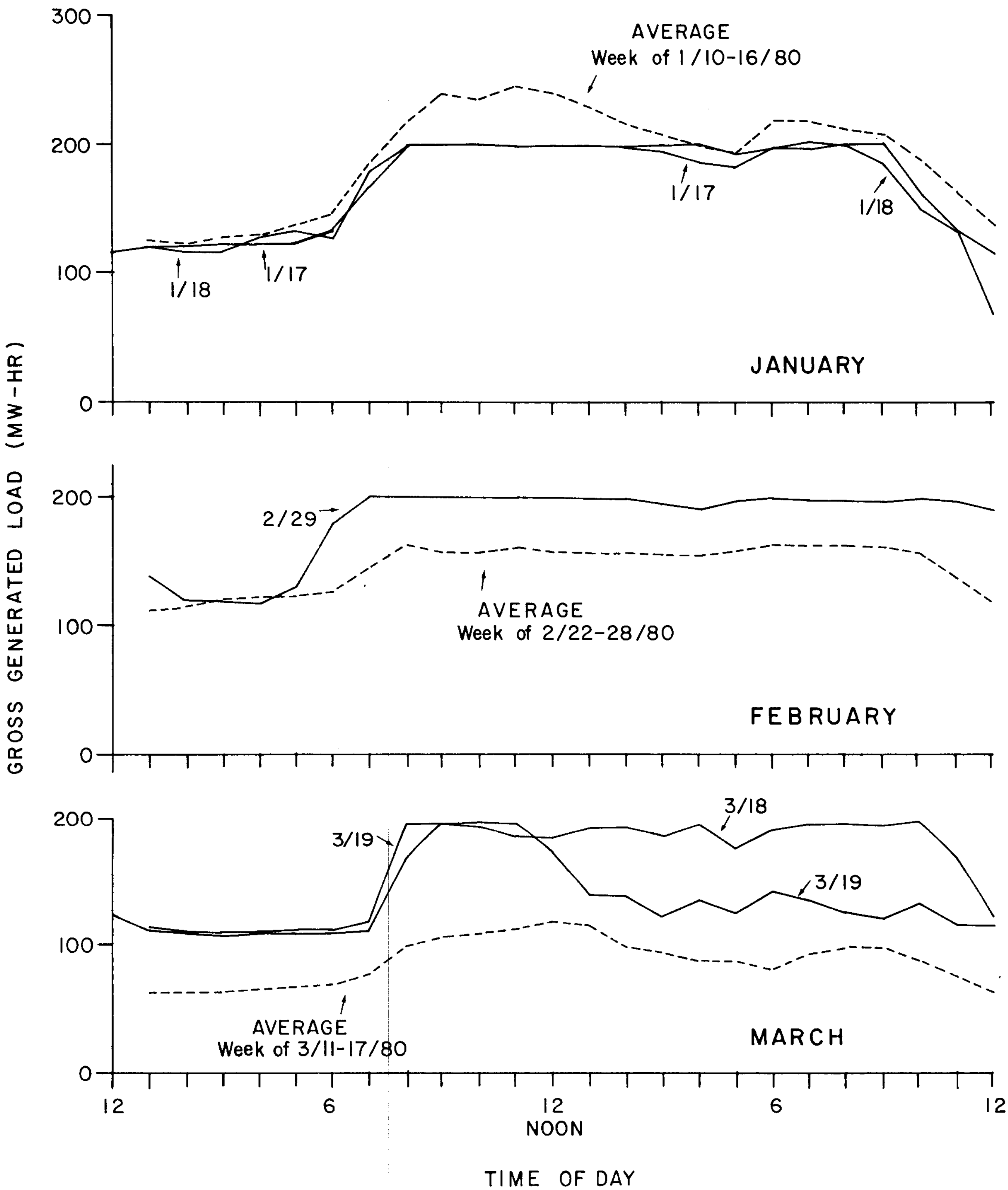

Figure 4. Plant operating load at the C. P. Crane generating station during sampling days, January-March 1980, and for the weeks prior to sampling.

4. MESOZOOPLANKTON (JULY 1979-MARCH 1980)

4.1 Biomass

Biomass estimates of mesozooplankton (those organisms retained on 202 μm mesh netting) were obtained for all collected samples by simple, non-destructive measurement of displacement volume (Kramer, 1972). Results of biomass measurement are given in Table 2.

Zooplankton volume decreased from the initial sampling in July 1979 to very low levels in late summer and early fall, increased somewhat in December, then very sharply in March. Volumes exceeded 2.0 ml/m^3 at all but one station in March, and were greater than 5.0 ml/m^3 at eight stations. Zooplankton volumes from stations on the discharge side of the C. P. Crane plant were generally smaller than those on the bay side in warm months and larger in fall and winter months, considering only the oblique collections. Among the horizontal collections obtained at Station P15, near-bottom tows usually yielded higher zooplankton volumes than mid-depth or near-surface tows.

Mean zooplankton volume (total volume collected per total volume of water sampled) for all 14 mesozooplankton stations ranged from a low of 0.09 ml/m^3 in August to 4.95 ml/m^3 in March.

4.2 Species Occurrence, Dominance and Relative Abundance

4.2.1 Summer 1979

A checklist of species occurring in mesozooplankton collections during the summer months of July-September is provided in Table 3. Found in all or nearly all summer collections were *Acartia tonsa*, *Argulus alosae*, nauplii and cypris larvae of barnacles, larvae of *Rhithropanopeus harrisii*, and water mites (Hydracarina). Rotifers, especially *Brachionus plicatilis*, become more frequent in late summer,

Table 2. Displacement volume (ml/m^3) of 18.5 cm bongo, 202 μm mesh net, collections at the C. P. Crane generating station, July 1979-March 1980.

Station	July	August	September	October	November	December	January	February	March
Z01	3.97*	0.13	0.02	0.24	0.05	0.58	0.95	-	7.10
Z02	0.36	0.07	0.12	0.12	0.17	1.12	0.75	-	1.94
P08	1.01	0.06	0.05	0.22	0.57	0.86	1.42	-	5.27
P01	0.20	0.03	0.26	0.02	0.28	0.72	1.00	-	3.83
P02	0.16	0.03	0.18	0.03	0.15	0.81	0.73	-	7.91
P05	0.35	0.09	0.10	0.07	0.03	2.28	2.19	-	5.33
P06	0.11	0.01	0.06	0.04	0.34	0.81	0.33	-	5.09
P07	1.11	0.08	0.06	0.18	0.60	0.70	0.48	-	2.99
P09	1.61	0.09	0.24	0.08	0.07	0.46	1.28	-	6.10
P10	1.19	0.14	0.16	0.11	0.11	0.64	0.07	-	2.50
P11	0.52	0.12	0.04	0.07	0.02	0.14	0.80	1.06	7.39
P12	0.30	0.03	0.12	0.14	0.03	0.42	1.27	0.88	6.73
P15	0.08	0.03	0.16	0.08	0.03	0.34	1.92	0.60	4.52
sfc	0.04	0.02	#	0.05	0.08	0.34	0.19	0.76	5.84
	#	0.01	#	0.13	0.19	0.33	0.37	1.09	7.83
mid	0.39	0.01	0.04	0.10	0.06	0.43	2.59	1.25	13.37
	0.17	-	#	0.01	0.04	0.18	1.99	1.32	8.83
bot	0.45	0.01	0.37	0.45	0.08	0.51	1.75	0.65	14.57
	-	0.01	0.20	0.42	0.04	0.27	3.14	-	9.16
Z03	1.50	0.37	0.15	0.19	0.13	0.21	0.65	-	2.94

*biomass mostly vegetation
#sample too small for measurement

Table 3. Checklist of zooplankton identified from mesozooplankton collections, vicinity of C. P. Crane generating station, summer 1979. Order of stations each month is P09, P10, P11, Z03, P15 oblique, near-surface (2), mid-depth (2), near-bottom (2), P12, Z02, P08, P07, P06, P01, P02, P05, Z01.

Taxa	July	August	September
	No Sample	No Sample	
TINTINNIDA		X X X	
COELENTERATA			
unid. coelenterates	X		
Dipurena sp.		X	
Hydra sp.			X X X
ROTIFERA			
unid. rotifers	XXXX XXX	XXX XXX XXXXXXX	XXXXXXXXXXXXXXXXXXXX
Brachionus angularis		X	
Brachionus calyciflorus	XXXX X	X XX X	XX X X XXXXXXXXX
Brachionus caudatus			X X
Brachionus plicatilis	X	XX X XXX XXXXX	XX XXXXXXX XXX XXXXX
Brachionus quadridentata	X	X	
Platyias palulus	X		
ANNELIDA			
unid. oligochaetes	X		X
unid. polychaetes	X	X	X X X X
Polydora sp.		XX X	XX X XX
MOLLUSCA			
Physa sp.	X		
Hydrobia sp.	X		
ARTHROPODA			
Cladocera			
unid. cladocerans	X X		
unid. chydorids	X		
Alona diaphana		X XX	XXX

Table 3 (continued)

Taxa	July	August	September
ARTHROPODA (continued)			
Cladocera (continued)			
Bosmina longirostris			X XX X
Ceriodaphnia lacustris			X
Ceriodaphnia reticulata			X
Chydorus sp.			X
Daphnia spp.			XX
Diaphanosoma brachyurum	X XXXX	X X	X XX XX
Ilyocryptus sp.			X X
Leptodora kindti	XXX XXXXXXX XXXXXX X	X	
Moina micrura	XXXXXXXXXXX XXXXXXXXXX	XX XXXXXXXXXXXX	XXXXXXXXXXXX XXX
Pleuroxus denticulatus	X		
Scapholeberis sp.			X
Scapholeberis mucronatus			X
Sida crystallina		XX	X X XXXXXX
Simocephalus exspinosus			X
Ostracoda (unid.)	X X XXX	XXX X	X XXXX XXX X
Copepoda			
unid. copepod nauplii			XXX X
Acartia tonsa	XXXXXXXXXXX XXXXXXXXXXX	XXXXXXXXX XXXXXXXXXXXX	XXXXXXXXXXXXXXXXXX
Diaptomus sp.	X		X X
Eurytemora affinis	XXXXXXXXXXX XXXXXXXXXX		X X XXX XXX
Cyclops bicuspidatus	XX X X		
Ergasilus sp.	X		
Ergasilus cerastes	XX X	X X X	X
Ergasilus chatauquaensis	XX X X X	X X X	X X
Ergasilus lizae		X X	X X XX

No Sample (July); No Sample (August)

Table 3 (continued)

Taxa	July					August					September			
			No Sample					No Sample						
ARTHROPODA (continued)														
Copepoda (continued)														
Eucyclops agilis					X					X				
Macrocyclops olbidus					X								X	X
Unid. harpacticoid				X										
Scottolana canadensis											XX	X		
Argulus alosae	XXXXX	XXXXX		XXXX	XXXXX	XXXXX	XXX		XXXXXX	XXXXX	XXXXX	XXXXX	XXXXX	XXXXX
Argulus laticauda				X										
Cirripedia														
unid. nauplii	XXXXX	XXXXX		XXXX	XXXXX	XXXXX	XXX		XXXXXX	XXXXX	XXXXX	XXXXX	XXX X	XXXX
unid. cypris larvae	XXXXX	XXXXX		XXXX	XXXXX	XXXXX	X X		XXXXXX	XXXXX	XXXXX	XXXXX	XX	X XX
Mysidacea														
Neomysis americana	XXXXX	X				X X					X X		X	
Isopoda														
Aegathoa oculata												X	X	
Amphipoda														
unid. gammarid											X			
Corophium sp.	XX	X									XX			
Corophium lacustre					X									
Gammarus sp.						X			X					
Gammarus tigrinus					X									
Leptocheirus plumulosus				X	X	X								
Decapoda														
Palaemonetes sp.				X	XX X	X			X	XXX	X X	X	X	X
Rhithropanopeus harrisii	XXXXX	XXXXX		XXXX	XXXXX	XXXXX	XXX		X XXXX	XXXXX	XX X	XXXXX	XXX X	X XXX
Arachnida														
Hydracarina	XXXXX	XXXXX		XXXX	XXXXX	XXXXX	XX		X XXXX	XXXXX	XXXXX	X XXX	XXX X	XXXX

Table 3 (concluded)

Taxa	July	August	September
ARTHROPODA (continued)			
Insecta			
unid. insect larvae	X	X	X
chironomid larvae	XX X XX X	X X XX	X X X
~~dipteran larvae~~	XX X		
Zygopteran larvae		X	
PISCES			
unid. fish larvae	X		
Anchoa mitchilli	X X X X	XXXXX X X XXX XX	
Gobiosoma bosci	X	X X	X X XX
Menidia beryllina	X XX	XXX XX	X
Pomoxis sp.	X		XX

No sample (one sampling date in July and one in August)

B. calyciflorus in September. Among the Cladocera, Leptodora kindti was common only in July, Moina micrura was excluded only from the higher salinity stations in August, and the remainder of the numerous, less frequent, cladocerans appeared mostly in September. Eurytemora affinis was ubiquitous in July, absent from August collections and limited in September to upstream Saltpeter Creek and Gunpowder River stations. Neomysis americana was present in all months, but mostly at stations around the mouth of Gunpowder River. The bay anchovy, Anchoa mitchilli, occurred most commonly in August and was absent in September. Other species not mentioned above occurred sporadically or in no discernable pattern.

Acartia tonsa numerically dominated mesozooplankton collections at most July stations and all August and September stations (Table 4). This species, dominant in summer throughout the Chesapeake Bay, was outnumbered by Moina micrura at six (lower-salinity) July stations. Other important subdominants included barnacle nauplii in all three months, larvae of Rhithropanopeus harrisii in August and Brachionus calyciflorus in August and September. Eurytemora affinis was not ranked among the subdominant species until September when it was third most abundant at two upper Saltpeter Creek stations.

The most frequent and abundant mesozooplankton species taken in summer months are listed within months in Table 5, where percent occurrence and average abundance at the 14 stations are given. All listed species were reduced in abundance in August, in agreement with observations on biomass. Completion of sampling in September late in the month affected the mean calculated abundance by reducing mean densities of Acartia tonsa, barnacle nauplii and cypris larvae, while

Table 4. Rank of numerical dominance of zooplankton species in 18.5 cm bongo, 202 μm mesh nets, summer 1979. First, second, third most abundant taxa listed for each oblique collection.

Month		Z01	Z02	P08	P07	P06	P05	P01	P02	P15	P12	P09	P10	P11	Z03
July	*Acartia tonsa*			3	1	2	2	1	1	1	2	1	1	1	1
	Moina micrura	1	1	1	2	1	1	2	2	2	1	2	2	2	2
	barnacle nauplii	2			3	3	3		3	3		3	3	3	3
	Diaphanosoma brachyurum		2	2											
	Rhithropanopeus harrisii										3				
	Leptodora kindti		3												
	Unid. rotifers							3							
	Gammarus tigrinus	3													
Aug	*Acartia tonsa*	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	barnacle nauplii	2	3	3	2	2	2	2	2	2	2	2	2	2	2
	Rhithropanopeus harrisii				3		3	3					3	3	3
	Brachionus calyciflorus		2	2											
	Brachionus plicatilis										3				
	unid. rotifers					3			3						
	Brachionus spp.									3		3			
	Sida crystallina	3													
Sept	*Acartia tonsa*	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	barnacle nauplii						2		2	2	2	2	2	2	2
	Brachionus calyciflorus		2	2	2						3	3			
	unid. rotifers	3	3		3	3	3						3	3	3
	unid. copepod nauplii	2		3		2									
	Sida crystallina							2							
	Eurytemora affinis							3	3						
	Moina micrura									3					

Table 5. Frequency of occurrence (%) and average abundance (total numbers per total sampled volume in m^3) of the more common mesozooplankton occurring near the C. P. Crane generating station, summer 1979. Based on oblique tows with an 18.5 cm bongo sampler (202 μm nets). Horizontal collections omitted.

	July		August		September	
	%	no./m^3	%	no./m^3	%	no./m^3
Acartia tonsa	100	6384.4	100	1014.6	100	874.1
Moina micrura	100	5063.8	57	0.3	93	6.7
barnacle nauplii	100	733.4	100	88.7	86	54.6
barnacle cypris	100	144.7	100	0.8	64	1.7
Eurytemora affinis	100	136.1	0	0	50	6.3
Rhithropanopeus harrisii	100	86.2	100	4.2	79	0.2
Hydracarina	100	5.7	100	0.9	86	0.1
Argulus alosae	100	0.9	100	0.3	100	0.6
Leptodora kindti	79	39.7	14	<0.1	0	0

increasing the average for Eurytemora affinis. A seasonal shift toward dominance by the latter species had begun by September 29.

4.2.2 Fall 1979

Mesozooplankton collected during the months of October-December are checklisted in Table 6. Found in nearly all collections throughout the 3-month period were Brachionus calyciflorus, Bosmina longirostris and Eurytemora affinis. Asplanchna sp., a soft-bodied rotifer, was identified from nearly all November and December collections and may be included among those previously tabulated as unidentified rotifers, in which case it would also be considered a ubiquitous species. Brachionus caudatus, B. plicatilis, unidentified nematodes, unidentified chydorids, Diaphanosoma brachyurum, Moina micrura, Acartia tonsa, Diaptomus sp., Cyclops bicuspidatus, Ergasilus spp., Argulus alosae, and Hydracarina were all limited generally to the early part of the season. Occurring later were Notholca marina, polychaete larvae, Chydorus sphaericus, Cyclops sp. and chironomid larvae. Other species were sporadic in occurrence.

October was a month of transition in dominance by Acartia tonsa and Eurytemora affinis (Table 7). A tonsa was still the numerically dominant species in mesozooplankton collections from immediate intake and discharge stations, while E. affinis had assumed dominance at most Gunpowder River stations. E. affinis was dominant at most November stations and in all December collections. Brachionus plicatilis and Cyclops bicuspidatus were predominate in upriver locations in October (Z01 and Z02). Brachionus calyciflorus and Asplanchna sp. were the most abundant species in several November collections. Other important subdominants included Bosmina longirostris,

Table 6. Checklist of zooplankton identified from mesozooplankton collections, vicinity of C. P. Crane generating station, fall 1979. Order of stations for each month is P09, P10, P11, Z03, P15 oblique, near-surface (2), mid-depth (2), near-bottom (2), P12, Z02, P08, P07, P06, P01, P02, P05, Z01.

October

Taxa	P09	P10	P11	Z03	P15 oblique	near-surface	near-surface	mid-depth	mid-depth	near-bottom	near-bottom	P12	Z02	P08	P07	P06	P01	P02	P05	Z01
COELENTERATA																				
unid. hydrozoans																				
Hydra sp.												X								X
PLATYHELMINTHES																				
unid. flatworms																				
ROTIFERA																				
unid. rotifers	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X		
Asplanchna sp.																				
Brachionus sp.	X																			
Brachionus calyciflorus	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Brachionus caudatus						X	X	X	X	X							X	X	X	X
Brachionus plicatilis	X	X			X	X	X	X	X	X	X	X					X	X	X	
Notholca marina																				
NEMATODA																				
unid. nematodes		X					X				X		X	X		X			X	
ANNELIDA																				
unid. trochophore																				
unid. polychaete larvae										X										
spionid larvae	X											X						X		
unid. oligochaetes	X												X	X	X	X	X	X	X	X
MOLLUSCA																				
unid. gastropod																				
Hydrobia sp.																				
unid. bivalve																				
Mulinia lateralis		X	X								X	X				X				
Mya arenaria																				

November

Taxa	P09	P10	P11	Z03	P15 oblique	near-surface	near-surface	mid-depth	mid-depth	near-bottom	near-bottom	P12	Z02	P08	P07	P06	P01	P02	P05	Z01
COELENTERATA																				
unid. hydrozoans																	X			
Hydra sp.																				
PLATYHELMINTHES																				
unid. flatworms													X	X						
ROTIFERA																				
unid. rotifers																				
Asplanchna sp.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Brachionus sp.																				
Brachionus calyciflorus	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Brachionus caudatus																				
Brachionus plicatilis																		X		X
Notholca marina						X	X		X	X					X	X				X
NEMATODA																				
unid. nematodes																				
ANNELIDA																				
unid. trochophore																				
unid. polychaete larvae	X	X	X	X			X	X	X	X	X								X	X
spionid larvae																				
unid. oligochaetes	X		X									X	X	X	X	X	X	X	X	X
MOLLUSCA																				
unid. gastropod																				
Hydrobia sp.																				
unid. bivalve																				
Mulinia lateralis																				
Mya arenaria																				

December

Taxa	P09	P10	P11	Z03	P15 oblique	near-surface	near-surface	mid-depth	mid-depth	near-bottom	near-bottom	P12	Z02	P08	P07	P06	P01	P02	P05	Z01
COELENTERATA																				
unid. hydrozoans																				X
Hydra sp.																				
PLATYHELMINTHES																				
unid. flatworms																				
ROTIFERA																				
unid. rotifers																				
Asplanchna sp.	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X
Brachionus sp.																				
Brachionus calyciflorus	X	X		X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
Brachionus caudatus																				
Brachionus plicatilis																				
Notholca marina																				
NEMATODA																				
unid. nematodes		X																		
ANNELIDA																				
unid. trochophore		X																		
unid. polychaete larvae		X	X	X		X		X	X					X	X			X		
spionid larvae																				
unid. oligochaetes		X			X	X		X	X	X					X		X	X	X	X
MOLLUSCA																				
unid. gastropod		X																		
Hydrobia sp.		X	X			X														
unid. bivalve		X																		
Mulinia lateralis			X	X		X														
Mya arenaria		X																		

Table 6 (continued).

Taxa	October				November				December			
ARTHROPODA												
Cladocera												
unid. cladocerans			X	X X						X		
unid. chydorids		X	XX	X								
~~unid. daphnids~~	XXXXX	X X	XXXX	X	XXXXX	XXXX	XXX		XX X	X X	X	X
unid. bosminids			X									
Alona diaphana				XX								
Bosmina sp.					XXXXX	XXXXX	X XX	XX XX	XX		XX	X X
Bosmina longirostris	XXXXX	XXXXX	XXXXX	XXXX	XXXXX	XXXXX	XXXXX	XXXXX	XX XX	XXXXX	XXXXX	XXX X
Camptocercus rectirostris				X								
Ceriodaphnia sp.	X											
Chydorus sphaericus				XXX	X XXX	XXXXX	X	XX XX	XXXXX	XXXX	XXXXX	XXXXX
Diaphanosoma brachyurum	X	XX										
Disparalona rostrata							XXX					
Eubosmina coregoni			X				X					
Ilyocryptus sordidus									X			X
Leptodora kindti			X									
Moina micrura	X X	XXXX	XX XX	XX X	X	X	X					
Sida crystallina				XX								
Simocephalus vetulus				X								
Ostracoda												
unid. ostracods	X		XXXXX	XX XX	X		X		XXXXX	XXXXX	XXXXX	XXX
Halocypris sp.											X	
Halocypris brevirostris									X			

Table 6 (continued)

Taxa	October				November				December			
ARTHROPODA (continued)												
Copepoda												
unid. copepod nauplii		X						X	X	X X	XX	X X
Acartia tonsa	XXXXX	XXXXX	XX	XXXXX	X X X	XXXXX	XX	XXXX	XXX			
Centropages hamatus					X							
Diaptomus sp.	XXX		XXXX	XXXX	XXXXX	XXXXX	X XXX	XXXXX	X		X	
Eurytemora affinis	XXXXX	X XXX	XXXXX	XXXXX	XXXXX	XXXXX	XXXXX	XXXXX	XXXXX	XXXXX	XXXXX	XXXXX
unid. cyclopoid		X		XX	XXX X	XXXX	XXXXX	XX XX			XXXX	X XXX
Cyclopidae							X	X	X			
Cyclops sp.					XXXXX	XXXXX	X XXX	XXX	XXXXX	XXXXX	XXXXX	XXXXX
Cylops bicuspidatus	XXXX		XXX	X		X X	X	X				
Ergasilus sp.				X	X	XXXXX	X	XXX				
Ergasilus cerastes		X										
Ergasilus chatauguaensis	X	X X										
Ergasilus lizae	X X	XXXXX	XXX	XXX								
Eucyclops agilis			X	X								
Macrocyclops albidus	X											
Bryocamptus sp.		X	XX									
Scottolana canadensis	X		XX	X					X			
Argulus alosae	X XXX	XX X	XXXXX	XX X		X						
Cirripedia												
unid. barnacle nauplii				XX								
unid. barnacle cypris	X											
Mysidacea												
Neomysis americana	X								X X	X	X	
Mysidopsis bigelowi												X X

Table 6 (concluded)

Taxa	October				November				December			
ARTHROPODA (continued)												
Amphipoda												
Corophium lacustre			X						X			X
Gammarus fasciatus												X
Leptocheirus plumulosus		X	X						X X			
Monoculodes edwardsi												X
Decapoda												
Palaemonetes sp.			X									X
Arachnida												
Hydracarina	XXX X	XX		XX X			X		X			
Insecta												
Chaoborus sp.			X									
chironomid larvae			X	X					XXXXX	XXXXX	XXXXX	XXXXX
Isotomorus sp.									X			
unid. insects								X X				

Table 7. Rank of numerical dominance of zooplankton species in 18.5 cm bongo, 202 μm mesh nets, fall 1979. First, second, third most abundant taxa listed for each oblique collection.

Month		Z01	Z02	P08	P07	P06	P05	P01	P02	P15	P12	P09	P10	P11	Z03
Oct	*Eurytemora affinis*		2	1	1	2				2	2	1	1	1	1
	Acartia tonsa	2				1	1	1	1	1	1	2	2	3	2
	Bosmina longirostris				3				2	3	3	3	3	2	3
	Cyclops bicuspidatus		1	3											
	Diaptomus sp.		3	2	2	3									
	Brachionus plicatilis	1					3	2							
	unid. rotifers							3							
	Ergasilus lizae?								3						
	Chydorus sphaericus						2								
	unid. oligochaetes	3													
Nov	*Eurytemora affinis*		1	1	1	1			3		1	1	1	3	1
	Asplanchna sp.	3				3	2	2	2	1	2	3	2	1	
	Brachionus calyciflorus	1		2	2	2	1	1	1	2	3	2	3	2	3
	Acartia tonsa									3					
	Diaptomus sp.		3												2
	Cyclops sp.		2		3										
	unid. cyclopoid			3											
	Bosmina longirostris						3	3							
	Notholca marina	2													
Dec	*Eurytemora affinis*	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Cyclops sp.		2		3	3	3		3	3	2	2	2	3	2
	Asplanchna sp.	3	3	2	2	2		3	2	2	3	3	3	2	
	Bosmina longirostris			3											3
	Brachionus calyciflorus							2							
	Chydorus sphaericus	2					2								

Diaptomus sp., Cyclops sp. (probably C. bicuspidatus) and Chydorus sphaericus.

Eurytemora affinis, the most abundant species of mesozooplankton through the fall months increased in abundance from a mean of 285/m^3 in October to 4530/m^3 in December. It was present in all 42 fall collections. A similar seasonal increase is evident with catches of Asplanchna sp., Cyclops bicuspidatus and Chydorus sphaericus. Seasonal decreases in abundance occurred among Acartia tonsa, Brachionus plicatilis and Moina micrura (Table 8). Brachionus calyciflorus appeared to reach a peak of abundance in November.

4.2.3 Winter 1980

A checklist of mesozooplankton organisms collected in the months of January-March is provided in Table 9. The list is noticeably shorter than those for summer and fall months (Tables 3 and 6), largely a result of a reduction in the diversity of Cladocera and Copepoda, and also due to the absence of molluscs, barnacles, decapod crustacean larvae and fishes. Essentially ubiquitous taxa included polychaete larvae, Eurytemora affinis, Cyclops bicuspidatus (less so in March) and chironomid larvae. Brachionus calyciflorus, having peaked in the fall, was absent after January, and Bosmina longirostris was very common in January and infrequent in March. Eubosmina coregoni did not appear in collections until March. Acartia tonsa, infrequent in January, was ubiquitous in February and March collections. Other species occurred sporadically.

Eurytemora affinis numerically dominated every winter 1980 collection (Table 10). Cyclops bicuspidatus was an important sub-dominant in January and March when full surveys were conducted,

Table 8. Frequency of occurrence (%) and average abundance (total numbers per total volume in m^3) of the more common mesozooplankton occurring near the C. P. Crane generating station, fall 1979. Based on oblique tows with an 18.5 cm bongo sampler (202 μm nets). Horizontal tows omitted.

	October		November		December	
	%	no./m^3	%	no./m^3	%	no./m^3
Eurytemora affinis	100	284.9	100	642.2	100	4530.6
Bosmina longirostris	93	63.2	100	21.4	93	236.5
Brachionus calyciflorus	86	1.1	100	404.1	93	172.3
Acartia tonsa	79	140.6	57	5.0	21	2.0
Diaptomus sp.	79	15.2	93	30.3	7	0.2
Asplanchna sp.	79	1.7	100	139.0	100	682.4
Daphnia spp.	71	13.2	57	10.6	29	31.4
Cyclops bicuspidatus	57	14.5	86	75.5	100	605.1
Brachionus plicatilis	57	4.4	14	3.1	0	0
Moina micrura	57	1.4	7	<0.1	0	0
Chydorus sphaericus	21	3.6	64	6.0	100	379.7

Table 9. Checklist of zooplankton identified from mesozooplankton collections, vicinity of C. P. Crane generating station, winter 1980. Order of stations each month is P09, P10, P11, Z03, P15 oblique, near-surface (2), mid-depth (2), near-bottom (2), P12, Z02, P08, P07, P06, P01, P02, P05, Z01.

Taxa	January	February	March
ROTIFERA		** * *********	
unid. rotifers	X	X XX X	
Asplanchna sp.	X X		
Brachionus sp.			X
Brachionus calyciflorus	XXXXXXXXXXXXXXXXXXXX		
Brachionus plicatilis	X		
Keratella cochlearis			X X
Notholca marina	XX X	X XXXXXXX	XXXX
Tetramastix opoliensis	X X		
NEMATODA			
unid. nematodes			X
ANNELIDA			
polychaete larvae	XXXXXXXXXXXXX X XXXX	X XXXXXXXX	XXX XXXXXXXXXXXXXXXX
unid. oligochaetes	X	X	X X
ARTHROPODA			
Cladocera			
Bosmina sp.	X		
Bosmina longirostris	XXXXXX XXXXXXXXXXXXX		XX X
unid. chydorids			XXXX XXXXX X
Chydorus sphaericus	XXXXXXXX XXXXX X XXX	X X	XXX XXXX X XXXX
unid. daphnids	X X XXX XXX		XX
Eubosmina coregoni			XX XX X
Ilyocryptus sp.			X
Scapholeberis mucronatus	X		

Table 9 (concluded)

Taxa	January				February				March			
ARTHROPODA (continued)												
Ostracoda												
unid. ostracods	X X	X X		X		X	X		XX X	XXX X	XXX X	X XX
Copepoda												
unid. copepod nauplii												X
Acartia tonsa	XX		X X	X	X X	XXXXX	XX		XXXXX	XXXXX	XXXX	XXXXX
Diaptomus sp.		X	X	X								
Eurytemora affinis	XXXXX	XXXXX	XXXXX	XXXXX	X X	XXXXX	XX	XXXXX	XXXXX	XXXXX	XXXXX	XXXXX
unid. cyclopoid	X				X		XX					
Cyclopidae	X X	XXXXX	X XX	X XX						X		
Cyclops bicuspidatus	XXXXX	XXXXX	XXXXX	XXXXX		XXXXX	X		X X	X X	XXXX	XX XX
Mysidacea												
Neomysis americana									X		X	
Amphipoda												
Corophium lacustre				X			X					
Leptocheirus plumulosus							XX					
Insecta												
unid. insect larvae	X X		X									X
Chaoborus sp.											X	
chironomid larvae	X X	XXX	X XX	XXXXX		X XX	XX		XXX X	XXXXX	XXX X	XX XX
Isotomerus palustris			X									

(* - not sampled)

Table 10. Rank of numerical dominance of zooplankton species in 18.5 cm bongo, 202 μm mesh nets, winter 1980. First, second, third most abundant taxa listed for each oblique collection.

Month		Z01	Z02	P08	P07	P06	P05	P01	P02	P15	P12	P09	P10	P11	Z03
Jan	*Eurytemora affinis*	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Cyclops bicuspidatus	2	2	2	2	2	2	2	2	2	2	2	2	2	3
	unid. cyclopoid			3						3		3			
	Brachionus calyciflorus				3				3		3		3	3	
	Acartia tonsa														2
	Bosmina longirostris	3	3			3	3	3							
Feb	*Eurytemora affinis*	*	*	*	*	*	*	*	*	1	1	*	*	1	*
	Acartia tonsa									3	2			2	
	unid. cyclopoid										3			3	
	Notholca marina									2					
Mar	*Eurytemora affinis*	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Cyclops bicuspidatus		2	2	2	2	3	2		3	2		2		
	Acartia tonsa	2		3	3	3	2	3	2	2	3	2	3	2	2
	Eubosmina coregoni		3												
	polychaete larvae								3						
	Chydorus sphaericus	3										3		3	
	Keratella cochlearis														3

*no sample

probably also in February when an unidentified cyclopoid was subdominant at the few intake stations sampled. Acartia tonsa was subdominant in nearly all February and March collections.

Eurytemora affinis, which had increased in abundance through the fall months, continued to do so through the winter. The slight decrease indicated for February in Table 11 is likely a result of a lack of any sampling in Saltpeter Creek and Gunpowder River. The mean calculated abundance for the 14 stations in March reached nearly $71{,}000/m^3$. Acartia tonsa also increased during the winter although its abundance was two orders of magnitude below that attained by E. affinis. Bosmina longirostris decreased from its peak abundance in December and was absent or scarce after January. Brachionus calyciflorus also was absent from 202 μm collections after January. Cyclops bicuspidatus and Chydorus sphaericus, while not recorded in the few February collections, appeared to maintain fairly constant abundance through the winter.

4.3 Diversity

Calculated diversity (H'), evenness (J') and species richness (d) for all bongo net collections are listed in Table 12. Stations in this table are in approximate order of a transect extending from intake waters off the mouth of Seneca Creek, through the plant to Saltpeter Creek, then from station Z02 at the head of Gunpowder River to station Z03 at its mouth.

In July, diversity increased up Seneca Creek to relatively high indices on the discharge side. Maximum diversity occurred in the collection from Dundee Creek (station Z01). The lowest diversity

Table 11. Frequency of occurrence (%) and average abundance (total numbers per total volume in m^3) of the more common meso-zooplankton occurring near the C. P. Crane generating station, winter 1980. Based on oblique tows with an 18.5 cm bongo sampler (202 μm nets). Horizontal tows omitted.

	January		February*		March	
	%	no./m^3	%	no./m^3	%	no./m^3
Eurytemora affinis	100	14746.6	100	8322.0	100	70844.5
Cyclops bicuspidatus	100	883.0	0	-	71	806.8
Acartia tonsa	29	212.5	100	172.2	100	701.7
Bosmina longirostris	100	85.7	0	-	21	1.0
Brachionus calyciflorus	100	76.8	0	-	0	-
Chydorus sphaericus	86	55.3	0	-	93	48.8
polychaete larvae	86	4.6	100	3.0	86	1.0
unid. cyclopoid	50	104.3	67	23.5	0	-
chironomid larvae	64	2.7	33	<0.1	76	1.0
Eubosmina coregoni	0	-	0	-	36	65.6

Table 12. Diversity (H'), evenness (J') and species richness (d) of mesozooplankton collections obtained with 18.5 cm bongo nets (202 μm mesh) at the C. P. Crane generating station, July 1979-March 1980. All collections from 15 min. oblique tows except those replicated, horizontal tows indicated under P15 (5 min. tows).

	JULY			AUG			SEPT		
Station	H'	J'	d	H'	J'	d	H'	J'	d
P11	1.1588	0.3350	0.8397	0.4853	0.1531	0.7340	0.9451	0.2482	1.3240
P12	1.4597	0.4394	0.7469	0.3180	0.0835	1.2825	0.4632	0.1292	0.9869
P15	1.5372	0.4288	0.9859	0.5230	0.1650	0.8030	0.8241	0.2299	1.0148
surface	2.2669	0.6126	1.6100	1.1456	0.3819	0.9951	1.6435	0.4948	1.1375
surface	2.4755	0.6336	1.9673	1.9665	0.7005	1.4321	2.1452	0.5634	1.6168
mid-depth	1.4727	0.3868	1.2989	0.4468	0.1345	1.1871	0.6487	0.1953	1.0076
mid-depth	1.5896	0.4296	1.2187	*	*	*	0.8996	0.2600	1.1463
bottom	1.6369	0.4299	1.3870	0.4764	0.1503	0.7820	0.5048	0.1262	1.3466
bottom	*	*	*	0.4014	0.1729	0.6989	1.3968	0.3775	1.1530
P01	2.2312	0.5711	1.4397	0.8688	0.2348	1.2088	1.5183	0.3796	1.5873
P02	1.6538	0.4613	0.9690	0.9071	0.2451	1.3523	0.6687	0.1756	1.3730
P05	1.5115	0.4369	0.9005	1.0984	0.2746	1.5911	1.2785	0.3455	1.2793
Z01	2.5328	0.5388	2.8139	0.5713	0.1462	1.4909	0.9673	0.2614	1.2181
P06	1.4875	0.4020	0.9418	1.2216	0.3531	1.2671	1.7487	0.4476	1.4710
Z02	0.3168	0.0760	1.5073	0.5952	0.1563	1.2901	1.4056	0.3514	1.4580
P08	1.1014	0.2976	0.9942	0.6111	0.1766	0.9774	2.5970	0.6353	1.5995
P07	1.7066	0.4368	1.0187	0.5623	0.1477	1.1737	1.5745	0.3936	1.4736
P09	1.0468	0.3026	0.7628	0.5837	0.1577	1.1500	0.3374	0.0886	1.1775
P10	1.1868	0.3573	0.7110	0.4684	0.1478	0.6492	0.4818	0.1233	1.2848
Z03	1.1866	0.3430	0.7624	0.6190	0.1789	1.0895	0.4845	0.1352	1.0129

	OCT			NOV			DEC		
	H'	J'	d	H'	J'	d	H'	J'	d
P11	1.9352	0.5594	0.9529	1.0289	0.2781	1.3178	1.2736	0.3682	0.9085
P12	0.7442	0.1785	2.0831	1.8325	0.6108	0.7692	1.8802	0.5440	0.8597
P15	1.7389	0.4699	1.5654	2.0355	0.5678	1.1755	1.6105	0.5081	0.6752
surface	2.9944	0.8353	2.4327	1.9046	0.5003	1.5058	1.7434	0.4863	1.0153
surface	2.6183	0.7304	2.2745	1.2223	0.3210	1.3987	1.7853	0.5951	0.6753
mid-depth	1.8213	0.5483	1.6700	1.2806	0.3363	1.5069	1.8990	0.5297	1.0127
mid-depth	1.8126	0.4640	2.5828	1.2810	0.3279	1.4531	1.7662	0.5106	0.9049
bottom	1.3626	0.3488	1.8706	1.9223	0.5195	1.3011	1.9392	0.5838	0.8084
bottom	1.5025	0.3846	1.8669	2.5782	0.7453	1.7308	1.2022	0.3619	0.7994
P01	0.4781	0.1195	1.8921	1.3160	0.3556	1.3014	1.4188	0.3834	0.9154
P02	1.7706	0.4785	1.6404	1.5358	0.4034	1.4329	1.3378	0.3732	0.9234
P05	2.1928	0.5074	2.3505	1.2708	0.3545	1.1199	1.4999	0.4184	0.8620
Z01	2.9995	0.7499	1.7824	1.4968	0.3931	1.1596	1.7935	0.5184	0.8340
P06	0.8645	0.2115	1.8941	1.8267	0.5095	1.0236	1.9103	0.5522	0.7756
Z02	2.2042	0.5338	1.8117	1.5713	0.4246	1.1474	1.5979	0.4810	0.7229
P08	1.7218	0.4522	1.4028	2.0847	0.5634	1.0409	1.3448	0.4048	0.7216
P07	1.8105	0.5050	1.1952	1.8799	0.4812	1.1547	1.2996	0.3625	0.8845
P09	1.8847	0.4824	1.5109	2.1178	0.5562	1.3169	1.7301	0.4826	0.9448
P10	2.0442	0.5111	1.6449	2.0278	0.6104	0.8707	2.4012	0.4995	2.5875
Z03	1.2283	0.3875	0.6978	1.1211	0.3241	0.9426	1.1649	0.3060	1.1742

Table 12 (continued).

Station	JAN H'	JAN J'	JAN d	FEB H'	FEB J'	FEB d	MAR H'	MAR J'	MAR d
P11	0.1543	0.0514	0.5841	0.2594	0.1003	0.4306	0.0255	0.0110	0.2777
P12	0.3575	0.1273	0.4446	0.2299	0.0766	0.5542	0.1021	0.0364	0.4040
P15	0.5765	0.1608	0.7948	0.1598	0.0688	0.3368	0.0755	0.0258	0.4752
surface	1.3122	0.4374	0.7733	0.3517	0.1253	0.5268	0.1268	0.0423	0.5344
surface	0.9227	0.2667	1.0291	0.0316	0.0112	0.4257	0.1295	0.0408	0.5934
mid-depth	0.5968	0.1989	0.5658	0.1995	0.0859	0.3783	0.1154	0.0385	0.5092
mid-depth	0.6906	0.2460	0.4538	0.3783	0.1463	0.4371	0.0945	0.0407	0.2978
bottom	1.2195	0.3402	0.9133	0.3019	0.1168	0.4317	0.0782	0.0302	0.3653
bottom	1.0833	0.3261	0.7155	0.4317	0.1167	1.0286	0.0021	0.0009	0.2951
P01	0.3436	0.1145	0.5464	-	-	-	0.1145	0.0361	0.5819
P02	0.8615	0.2718	0.6668	-	-	-	0.0587	0.0293	0.2141
P05	0.5960	0.1880	0.6073	-	-	-	0.1297	0.0432	0.4778
Z01	0.5794	0.1566	0.8776	-	-	-	0.2653	0.0837	0.5466
P06	0.9263	0.3300	0.5272	-	-	-	0.2172	0.0724	0.4952
Z01	1.2730	0.4016	0.6708	-	-	-	0.7777	0.2169	0.8475
P08	0.5269	0.1586	0.6691	-	-	-	0.3894	0.1387	0.4173
P07	0.5022	0.1943	0.4121	-	-	-	0.1606	0.0507	0.6105
P09	0.5401	0.1626	0.7094	-	-	-	0.0982	0.0310	0.5936
P10	0.3497	0.1353	0.4891	-	-	-	0.1501	0.0452	0.6700
Z03	0.5275	0.1664	0.5739	-	-	-	0.0451	0.0226	0.2575

(*) collection lost or non-quantitative
(-) not sampled

was found at the head of Gunpowder River (0.3168), which increased to 1.7066 at station P07, the maximum for Gunpowder River stations. Diversity in August was reduced at most stations, ranging from 0.3180 to 1.2216 in oblique collections. It was increased in Saltpeter Creek, compared with intake waters, to a maximum at P06. Diversity at all August Gunpowder River stations was uniformly low. September saw an increase in diversity, with H' ranging from 0.3374 to 2.5970. Indices were low in intake waters and the immediate discharge (P02), reaching a maximum in Saltpeter Creek of 1.7487 at P06. The extremes in the range of diversity in September both occurred in the Gunpowder River, with high indices upstream, low indices off Carroll Island and at the river mouth.

Fall diversity was generally higher than that calculated for summer collections. In October, diversity ranged from a low 0.4781 at P01, above the immediate discharge, to 2.9995 in Dundee Creek. Intake diversities were moderately high, but variable, and somewhat lower than those at the immediate discharge (P02, P05). Gunpowder River collections were all of relatively high diversity. Intake diversity increased to P15 in November then decreased in discharge waters. Except for Z03, the farthest downstream site, Gunpowder River collections were all relatively diverse. The range of November diversities in oblique collection was 1.0289 at P11 to 2.1178 at P09. Diversity at most stations increased again in December, with a range of 1.1649 at Z03 to 2.4012 at P10. Immediate discharge diversity was lower than that at intake sites.

Diversity was noticeably lower in winter months with ranges in oblique collections of 0.1543-1.2730 in January and 0.0451-0.7777 in March. The three intake stations sampled in February were all of low diversity. Highest diversities in both January and March occurred at the head of Gunpowder River (Z02), with sharp decreases in indices toward the river mouth. Diversity in the immediate discharge was somewhat higher than intake waters in both January and March.

The relationship of faunal similarity within monthly collections and measures of diversity and species richness is shown in Figure 5. Samples clustered according to faunal similarity are separated in this figure by lines into the sample groups described in the next section of this report. It is evident that the dissimilarity of sample groups found in cluster analyses based on compositions and abundance of fauna is sometimes, but not always, mirrored by dissimilarity in diversity. In July, sample groups II and III, except for two outliers, included a group of samples with very similar diversity and species richness. Separation was better in August and September with the two indicated sample groups separated into low and high diversity collections. Separation of clustered sample groups by diversity was again poor in fall months. January sample groups were separated into high and low diversity. This was also the case in March, but the range of diversity was too small for this to be evident.

4.4 Cluster and Nodal Analyses

Each month's mesozooplankton collections, except for the few collections available from February, were submitted to a cluster analysis. These analyses used the Bray-Curtis coefficient of similarity as elements in the data matrix and a flexible beta = -0.25 to avoid

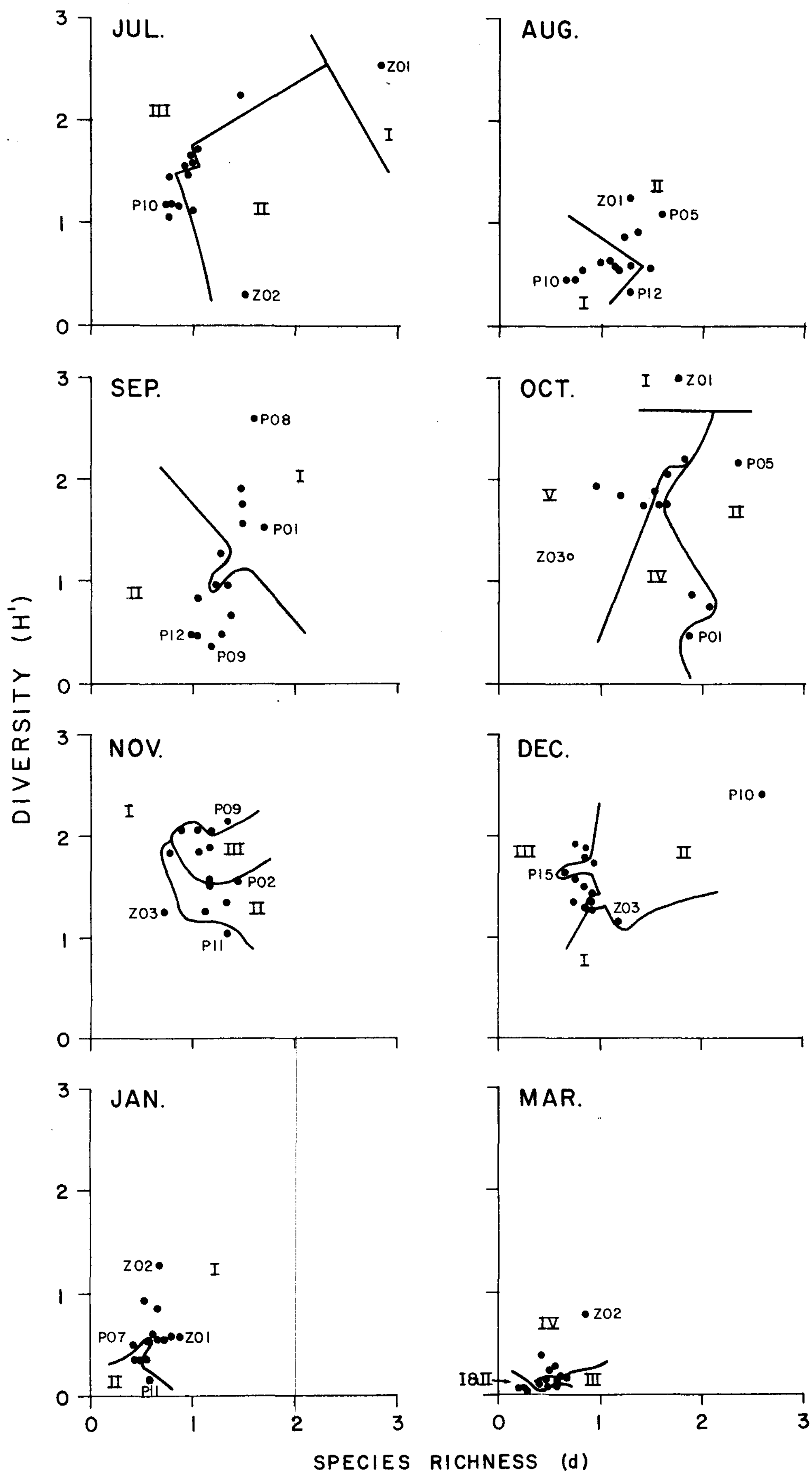

Figure 5. Relationship of diversity (H') to species richness (d) as calculated from 18.5 cm bongo collections, July 1979-March 1980. Groups of samples separated by cluster analyses are indicated by Roman numerals. Stations with extreme values labelled.

chaining. Those species occurring in less than two collections were omitted from inverse cluster analyses. Normal and inverse clusters of samples and species were related by nodal analysis, employing an index of fidelity (Boesch, 1977). Results of these analyses are included below within seasons.

4.4.1 Summer 1979

The normal cluster analysis of July collections, with 19 samples and 26 taxa occurring in at least two samples, divided samples into three clusters:

I: Dundee Creek (Z01) and the two surface horizontal collections at P15.

II: Upper Gunpowder River (Z02, P08, P07) and lower Saltpeter Creek (P06)

III: The remaining study area, including all lower stations, intake and discharge waters.

Sample group I collections were those with highest calculated diversity in July. Sample groups II and III, as mentioned earlier, were not well separated by diversity, but were faunistically distinct. Collections in sample group II were obtained from stations having lower salinity ($\bar{x}$0.99 o/oo) than those in group III ($\bar{x}$2.24 o/oo), and contained more freshwater organisms. Because of their location and general circulation in the area, stations in Group II are likely to be least affected by discharged cooling water.

Dominant species were clustered together in species group A, a group showing no particular fidelity toward any of the sample groups (fidelity indices near 1.0, Figure 6). The highest indices for both sample groups I and II were in species group B, a group of freshwater

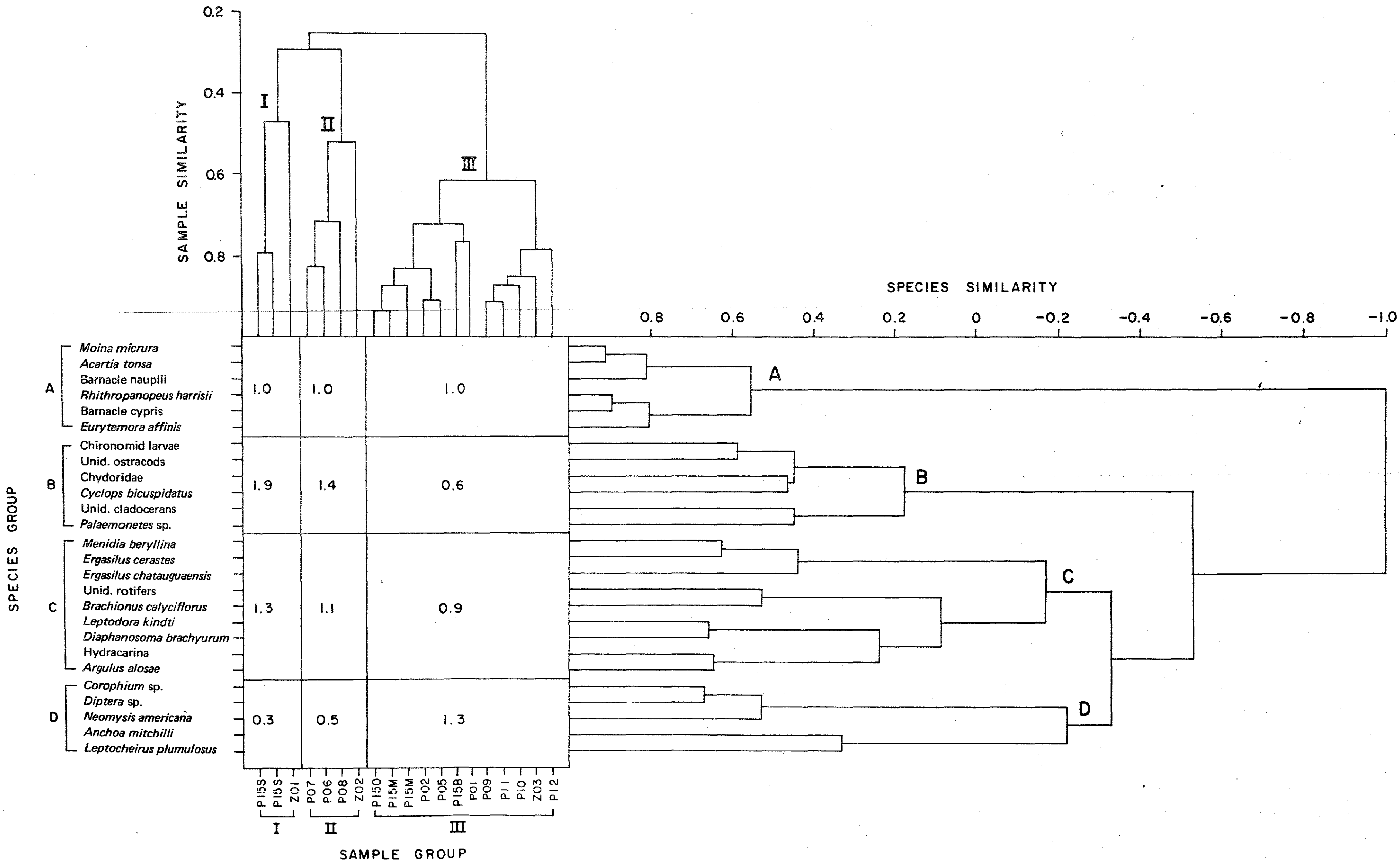

Figure 6. Sample and species clusters from July 1979 bongo collections, with the relationship of species groups to sample groups shown by indices of fidelity.

organisms including *Cyclops bicuspidatus* and chironomid larvae. Species group C, which included the parasitic copepods, also showed some preference for sample groups I and II. The cladoceran, *Diaphanosoma brachyurum*, and a member of that group was subdominant at stations Z02 and P08 (sample group II). Species group D, containing amphipods, mysids and the bay anchovy showed highest affinity for the lower group of stations, sample group III.

August collections, with 19 samples and 25 taxa included in the cluster analyses, were split into three groups:

I: Gunpowder River, from head to mouth and two P15 collections

II: Saltpeter Creek, Dundee Creek, plus station P12 and two horizontal P15 collections

III: Two horizontal collections from P15

P15 collections were, therefore, distributed through all three sample groups. Sample group I consisted of collections having uniformly low diversity (H' = 0.4684-0.6190). Diversity was generally higher in collections comprising sample group II. Salinity differences were greater within than between groups in August, since lowest salinity stations at upriver Gunpowder River stations were clustered with high salinity stations at the river mouth. Primary differences between sample groups I and II were faunistic (Figure 7), with rare species in species group A occurring in Gunpowder River collections, but not in sample group II. There was a greater affinity for sample group II evident in species groups B and C, which included parasitic copepods (*Ergasilus* spp.), freshwater cladocerans, gobies and tidewater silver-

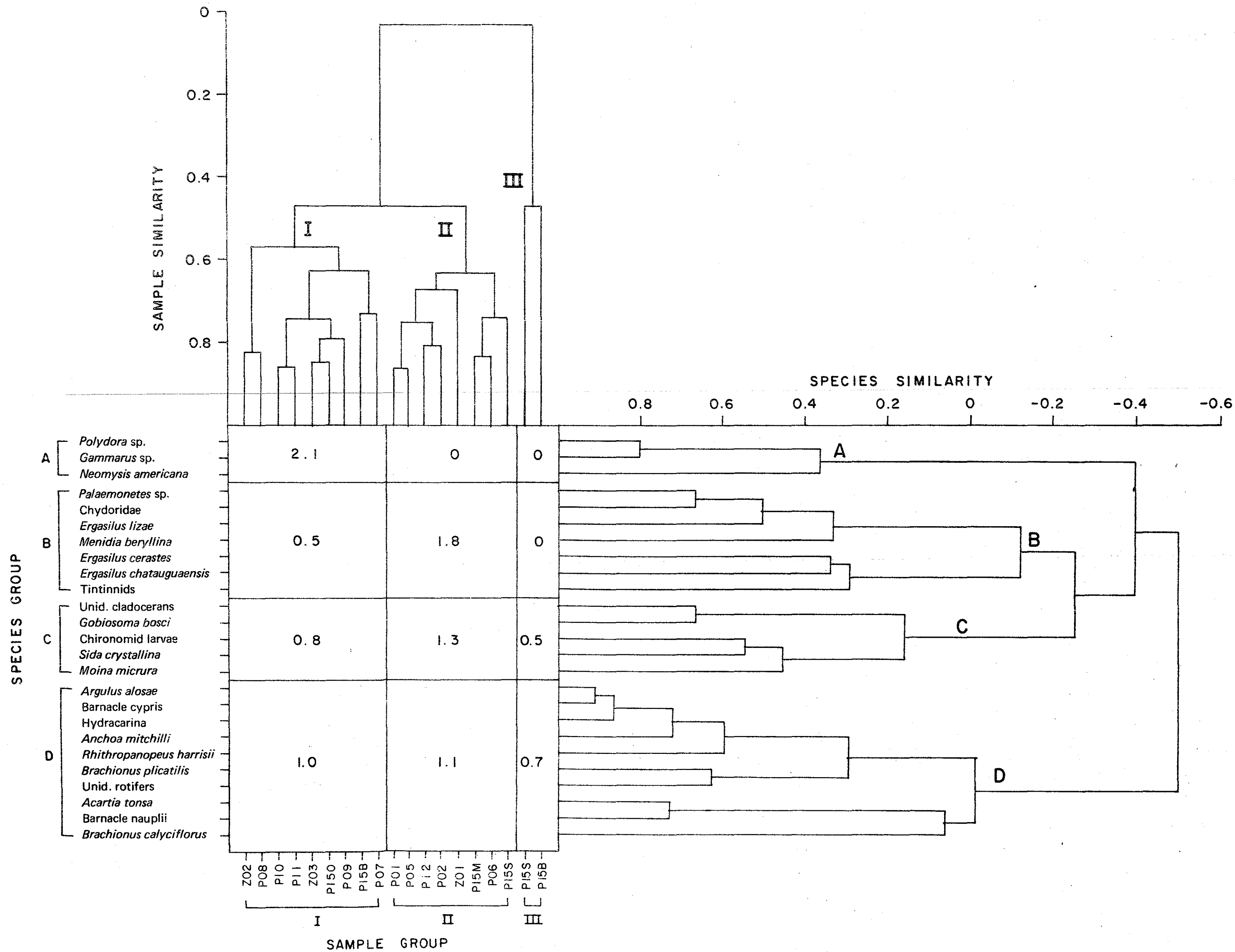

Figure 7. Sample and species clusters from August 1979 bongo collections, with the relationship of species groups to sample groups shown by indices of fidelity.

sides. Sample group III was characterized mainly by absence of species groups A and B. Dominant species were included in species group D, with fidelity indices near 1.0.

September bongo collections were clearly clustered into two groups in the normal analysis (Figure 8):

I: Upstream stations of the Gunpowder River, Saltpeter Creek (P01) and Dundee Creek (Z01) and P06

II: All remaining downriver, intake and near-discharge stations.

Sample group I consisted of stations with lower salinity ($\bar{x}$1.12 o/oo) and generally higher diversity than those of sample group II (mean salinity of 2.11 o/oo). Low salinity collections of sample group I showed, by nodal analyses, a preference for those sites by species in groups A, F and G, containing freshwater cladocerans, rotifers, chironomid larvae, and copepods. Preference for sample group II sites was evident for species groups B, C and D and to some extent species group E, which contained the principle dominants Acartia tonsa and barnacle nauplii.

4.4.2 Fall 1979

The normal cluster analysis of October bongo collections, based on 20 samples and 33 taxa occurring in at least two collections, split samples into five clusters at similarity levels below 0.5 (Figure 9):

I: The single collection from Dundee Creek (Z01),

II: Immediate discharge stations (P01, P02, P05),

III: Mid-depth and surface horizontal collections at P15,

IV: Remaining Seneca Creek collections (intake) and stations P06 and P10,

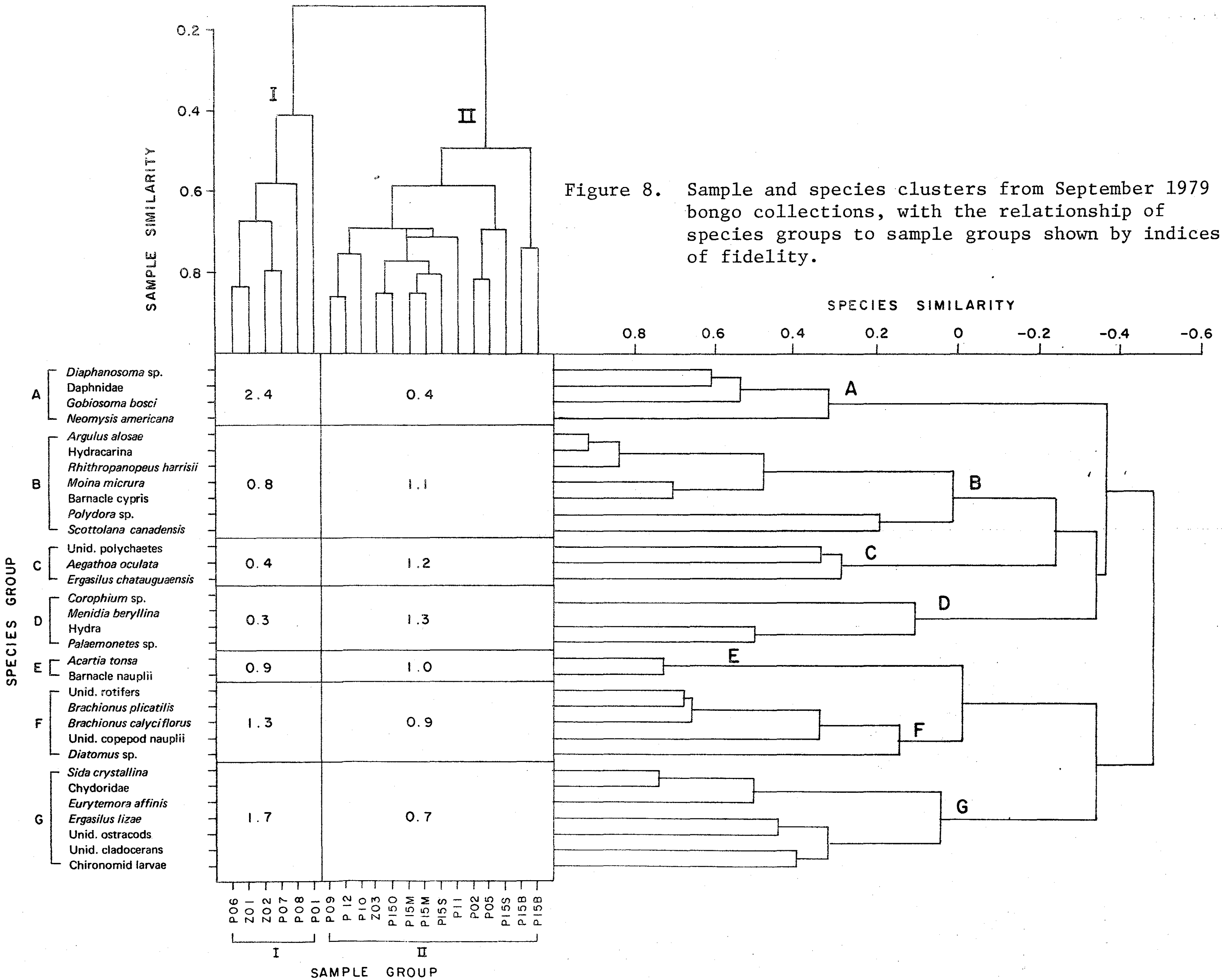

Figure 8. Sample and species clusters from September 1979 bongo collections, with the relationship of species groups to sample groups shown by indices of fidelity.

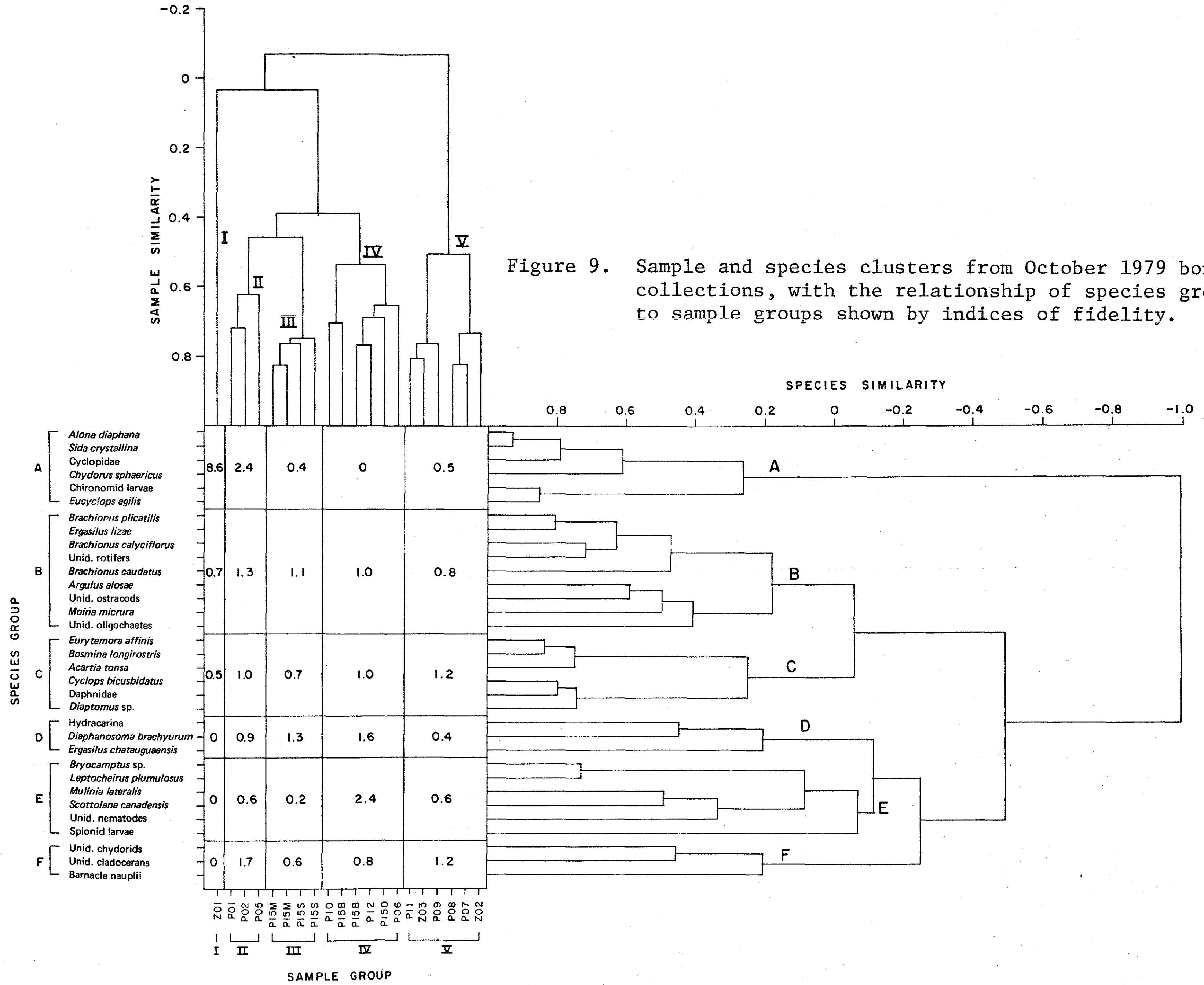

Figure 9. Sample and species clusters from October 1979 bongo collections, with the relationship of species groups to sample groups shown by indices of fidelity.

V: Gunpowder River collections from the head of the river (Z02) to the mouth (P11 and Z03).

The Dundee Creek collection was the most diverse of October collections (H' = 2.9995), in salinities slightly higher than other sites ($\bar{x} = 0.93$ °/oo). A high affinity (fidelity index of 8.6) of species group A for this site was evident, as well as for sample group II, the immediate discharge stations of upper Saltpeter Creek. Species group A consisted of several freshwater cladocerans, cyclopoid copepods and chironomid larvae. Species groups D, E and F were absent from Z01, while species groups B and C, showed relatively low fidelity to Z01. The immediate discharge stations were also of somewhat higher salinity ($\bar{x} = 0.71$ o/oo) but lower diversity than other sample sites and were in a region of elevated temperatures due to discharged cooling water. Slightly higher affinity for these sites was evident for species group B (including rotifers, certain parasitic copepods and remnants of the summer populations of Moina micrura) and species group F (unidentified cladocerans and barnacle nauplii). The sites included representatives of all species groups. Sample group III included only horizontal collections, surface and mid-depth, from station P15. Sample group IV consisted of a group of collections, disjunct except for stations P12 and P15. Species group A was absent, while species group E displayed relatively high affinity for these stations (fidelity index of 2.4). Species group E included several typically oligohaline species, although the mean salinity of these stations was a relatively low 0.62 o/oo. The Gunpowder River stations of sample group V were characterized by low salinity ($\bar{x} = 0.42$ °/oo) and included representatives of all species groups, with species groups C and F showing slightly higher affinity.

The occurrence of Mulinia lateralis in the plankton is of interest in that the species is not among the molluscs identified from benthic collections obtained in other studies conducted in the area.

The November normal analysis, including 20 collections and 22 taxa, resulted in three sample groups (Figure 10):

I: Immediate intake (P15) and three lower river collections (P09, P11 and Z03)

II: Immediate discharge (P01, P02 and P05), Dundee Creek (Z01) and mouth of Seneca Creek (P12)

III: Upper and middle Gunpowder River stations.

The first group of samples was taken at sites with relatively high salinity ($\bar{x}$1.15 o/oo). There was no distinct separation of sample groups according to diversity of collections. The second group of samples (II) from immediate discharge sites were from stations of somewhat lower average salinity ($\bar{x}$0.87 o/oo) and of elevated temperature. Sample group III consisted of low salinity ($\bar{x}$0.62 o/oo) stations in the Gunpowder River. The group of species containing dominant forms (group A) showed little preference for any of the sample groups (fidelity indices 0.9-1.1). Species group B was found preferentially in the higher salinity sites of sample group I, while species group C seemed to prefer lower salinity stations (groups II and III).

December samples were divided by cluster analysis into three groups (Figure 11):

I: Station P11 at the river mouth,

II: Remaining lower Gunpowder River stations, the immediate intake (P15) and immediate discharge (P02)

III: Remaining Saltpeter Creek stations, upper Gunpowder River stations, Dundee Creek and the mouth of Seneca Creek (P12)

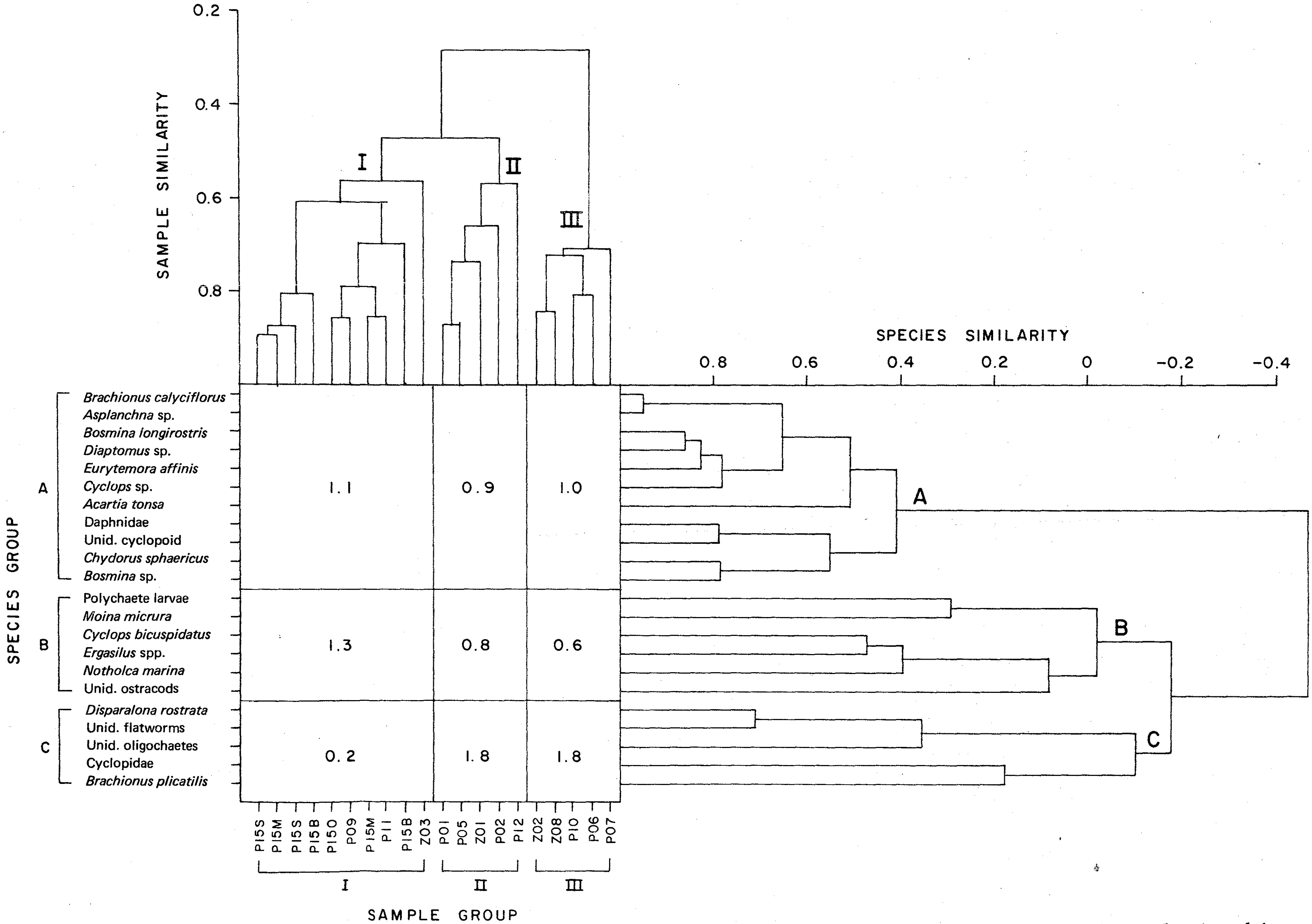

Figure 10. Sample and species clusters from November 1979 bongo collections, with the relationship of species groups to sample groups shown by indices of fidelity.

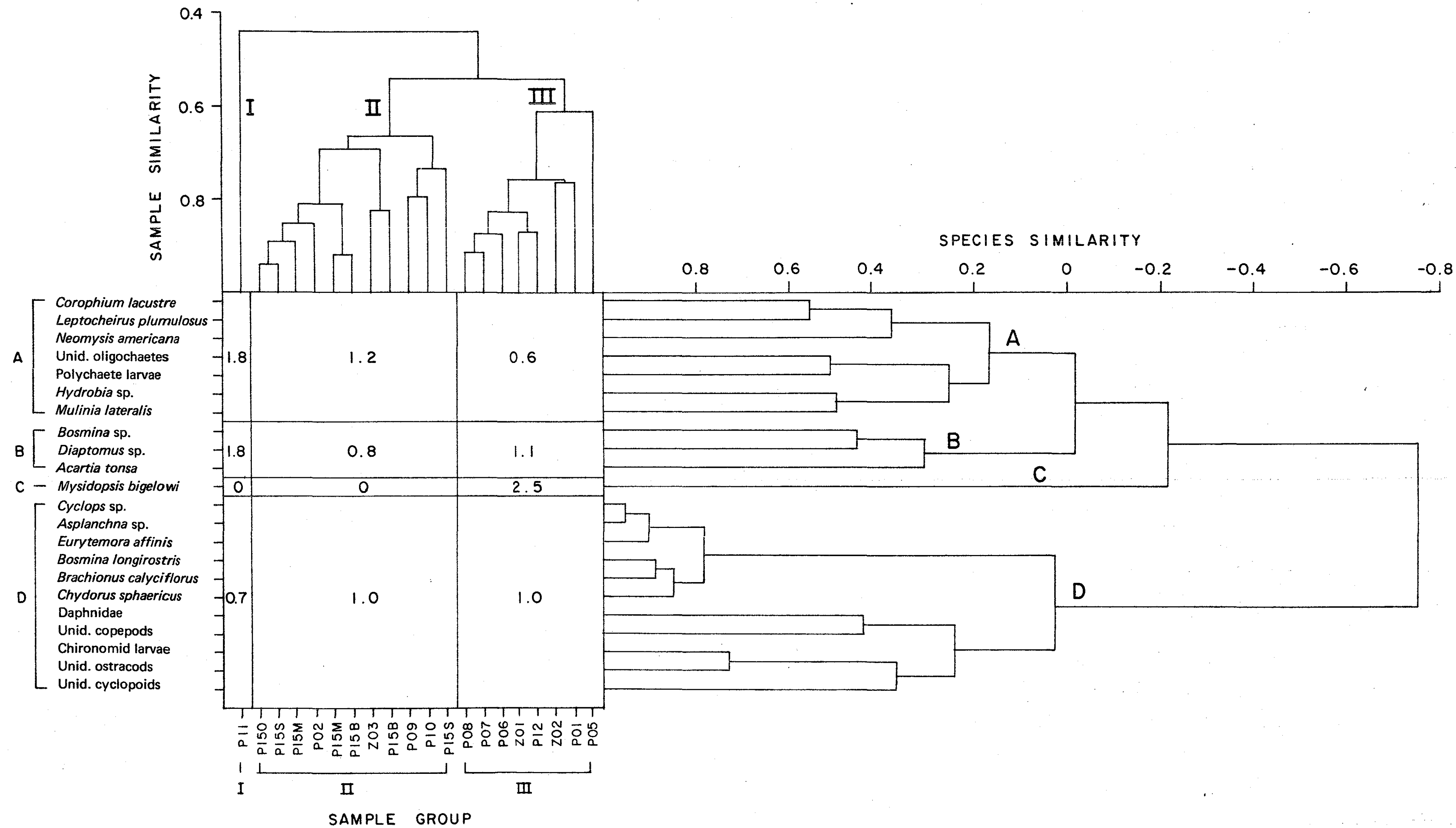

Figure 11. Sample and species clusters from December 1979 bongo collections, with the relationship of species groups to sample groups shown by indices of fidelity.

Average salinities were similarly low in all three groups: I - 0.58 o/oo, II - 0.46 o/oo, III - 0.38 o/oo. Groups were not distinguishable by diversity of collections. Stations with higher than ambient temperatures were divided between sample groups.

Station P11 appeared to differ from others principally in the greater affinity shown for it by species groups A and B, which contained certain typically oligohaline species and common warm-water species such as *Diaptomus* sp. and *Acartia tonsa*. Sample groups II and III, marginally separated by cluster analysis (similarity coefficient of ca. 0.54), differed in the presence of *Mysidopsis bigelowi* in sample group III, a slight preference of species group B for sample group III and some preference for group II by species group A. The dominant species in December were included in species group D, which was neutral for sample groups II and III.

4.4.3 Winter 1980

Again in January, separation of samples by cluster analysis was marginal. Two groups of samples were separated at a similarity level just over 0.52 (Figure 12):

I: Gunpowder River stations Z02, P08, P07 and P09; oblique, mid-depth and bottom collections at P15; Saltpeter Creek stations; and Dundee Creek (Z01)

II: River-mouth stations P10, P11, Z03 and P12; surface horizontal tows at P15

Although salinity had increased throughout the study area by January in response to lack of freshwater inflow, sample group I was on the average comprised of stations having lower salinity ($\bar{x}$2.63 o/oo) than stations in sample group II ($\bar{x}$4.38 o/oo). Except for one surface sample at P15, samples in group II were of lower diversity, generally, than those in group I. This is also reflected in the fidelity indices,

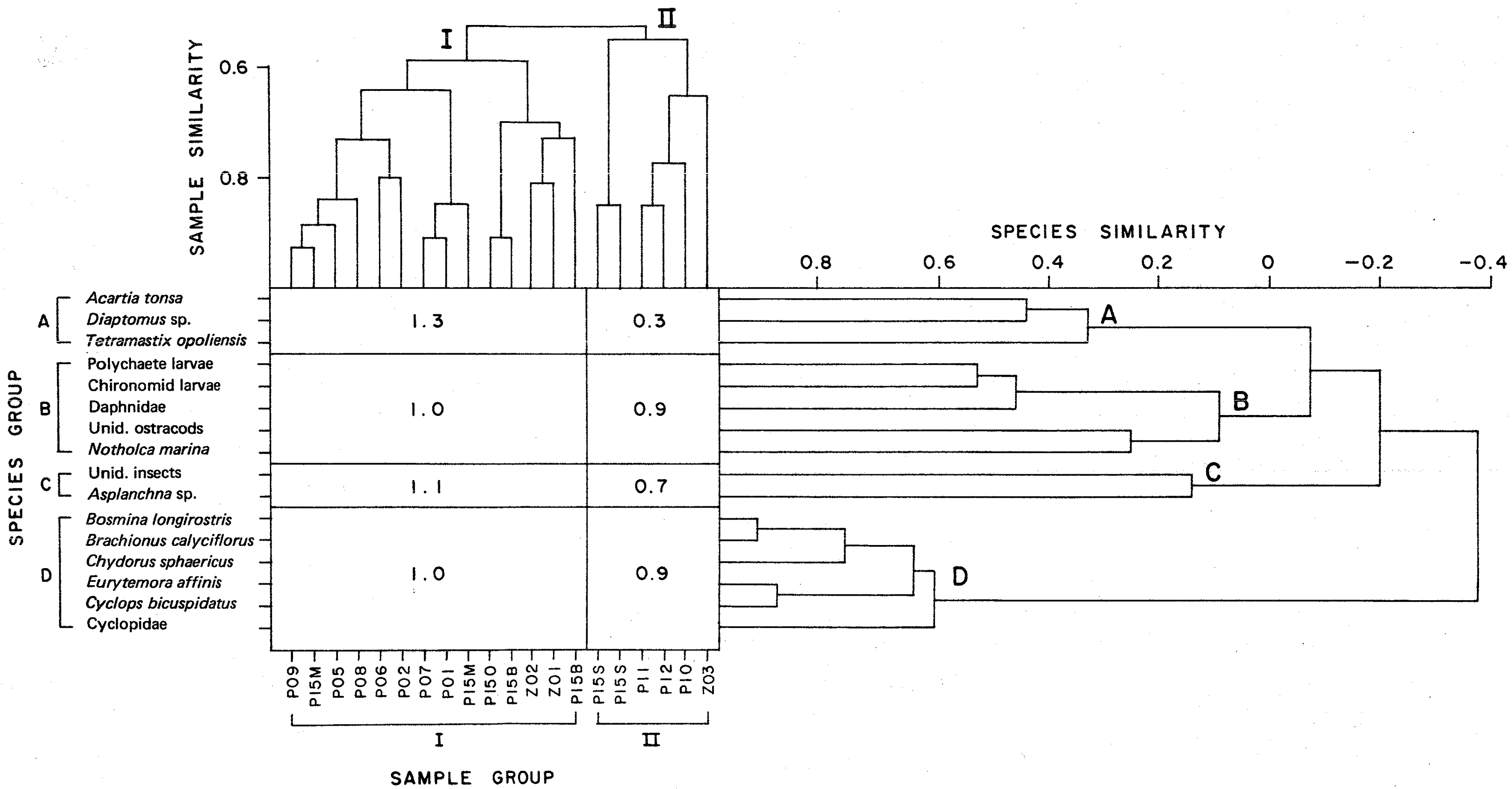

Figure 12. Sample and species clusters from January 1980 bongo collections, with the relationship of species groups to sample groups shown by indices of fidelity.

lower for sample group II in each comparison (species groups A-D). The greatest difference in preference for sample groups occurred with species group A, including _Acartia tonsa_, with a fidelity index of 1.3 for group I and 0.3 for group II. This may have been due to temperature, since all stations with elevated temperatures were included in sample group I.

No cluster analyses were carried out on the limited number of collections obtained in February.

The normal cluster analysis of March 1980 bongo collections yielded four sample groups, with groups II and III only marginally separable at a similarity level just over 0.6 (Figure 13):

I: Station Z03

II: Immediate discharge (P02), two lower Gunpowder River stations (P09, P11) and a surface horizontal sample at P15

III: A mix of intake, near-discharge and lower Gunpowder River samples

IV: Upper Gunpowder River (Z02, P08, P07), lower Saltpeter Creek (P06), Dundee Creek (Z01), and the four mid-depth and bottom horizontal collections at P15.

Average salinity in the first three sample groups was similar ($\bar{x}$ 4.46-4.67 o/oo), somewhat lower in sample group IV (3.35 o/oo). Diversity was exceptionally low throughout the study area in March due to the strong dominance exhibited by _Eurytemora affinis_. However, the lowest indices of diversity appeared among stations in sample groups I and II, the highest in sample group IV.

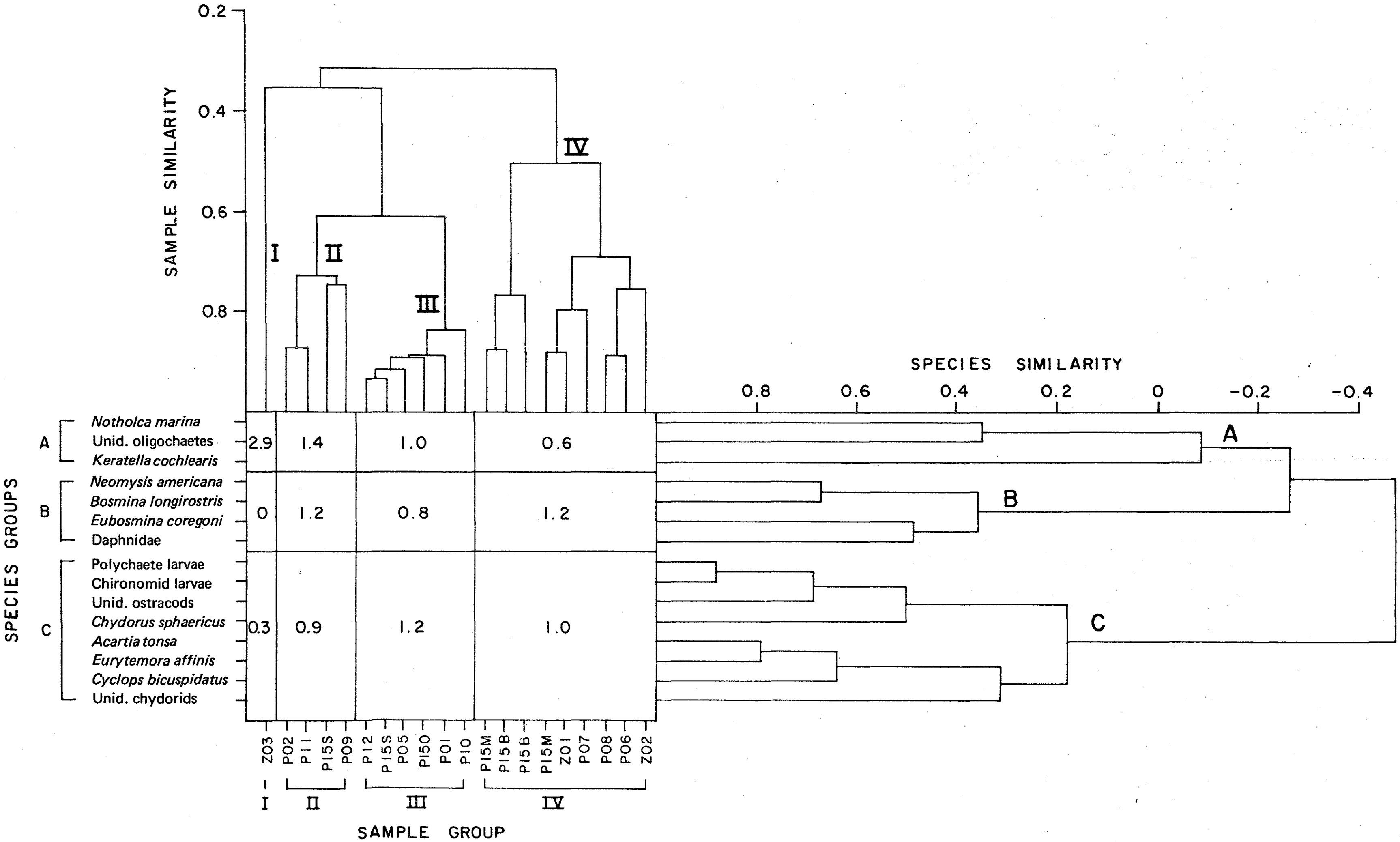

Figure 13. Sample and species clusters from March 1980 bongo collections, with the relationship of species groups to sample groups shown by indices of fidelity.

Station Z03 differed from others primarily in the affinity shown for it by species group A (Figure 13) and the absence at that site of species group B with its bosminids and daphnids. Sample group II also was preferred by species group A. Other indices were close to neutrality, with dominant species all occurring in species group C.

4.5 Vertical Distribution at Station P15

Horizontal collections of mesozooplankton were obtained in each month from near-surface, mid-depth and near-bottom waters at station P15, close to the intake pumps of the C. P. Crane generating station. Biomass and diversity in these replicated tows have previously been listed in Tables 2 and 12, and horizontal collections were included in the cluster and nodal analyses presented above. Counts of selected zooplankters from individual horizontal collections, are given in Table 13, along with those from the oblique tows taken at the immediate discharge station P02.

In July, biomass was lower and diversity higher in surface samples, which were linked with the Dundee Creek collection in the cluster analysis. Mid-depth and bottom collections were more similar to those in discharge stations. In Table 13, it is evident that abundance of dominant species was considerably higher in deeper horizontal collections and that these densities more nearly matched those from station P02. August horizontal collections were all of low biomass, with surface collections more diverse. These collections were distributed among the three separated sample groups in cluster analyses; one of the surface samples and a mid-depth collection was included with samples from discharge stations. Replication in bottom tows was poor in August (Table 13). Calculated densities for the

Table 13. Density of mesozooplankton in replicated horizontal and oblique collections at station P15 and in oblique tows in the immediate discharge (P02), July 1979-March 1980. Numbers per m^3.

	Station P15						oblique tows	
	surface		mid-depth		bottom			
	1	2	1	2	1	2	P15	P02
JULY								
Moina micrura	94.2	96.5	1800.0	1368.3	1280.0	*	1569.0	1476.0
Acartia tonsa	48.2	16.8	1390.0	1533.8	564.4	*	1858.1	1649.0
Eurytemora affinis	3.0	0.3	50.0	33.1	8.7	*	82.6	23.1
barnacle nauplii	11.0	18.8	160.0	231.7	58.2	*	123.9	622.7
barnacle cypris larvae	6.8	7.4	25.3	27.4	18.2	*	48.2	26.7
Rhithropanopeus harrisii	61.4	10.9	26.2	20.7	13.5	*	68.8	17.3
AUGUST								
Acartia tonsa	77.4	2.7	143.3	*	1915.2	20.8	596.9	169.2
barnacle nauplii	19.1	1.7	2.5	*	105.1	1.1	27.4	26.6
barnacle cypris larvae	0.1	0	0.1	*	0.6	0.1	0.2	0.3
Rhithropanopeus harrisii	0.3	0.1	0.2	*	0.4	0	0.5	1.3
Hydracarina	0	0.2	0.8	*	0.4	0	0.3	0.6
SEPTEMBER								
Moina micrura	1.0	0.5	3.9	5.7	1.6	2.5	23.9	0.2
Acartia tonsa	116.1	58.5	581.1	440.3	4642.4	7645.6	1343.6	516.3
Eurytemora affinis	0	0.3	0	0	0	0	0	4.3
Argulus alosae	0.5	0.6	0.8	0.8	0.4	0.6	0.7	1.1
barnacle nauplii	93.5	103.9	73.0	57.4	458.5	1254.2	178.9	39.8
barnacle cypris larvae	1.3	1.0	1.8	1.5	7.9	7.9	3.9	0
OCTOBER								
Bosmina longirostris	1.3	1.3	1.2	1.8	2.0	7.5	7.9	5.7
Daphnia spp.	0.1	0	0	0	0.2	0	2.8	0
Acartia tonsa	2.3	0.9	9.9	10.1	108.6	98.3	48.8	34.7
Cyclops bicuspidatus	0	0	0	0	0	0	0	0.3
Diaptomus sp.	0	0	0	0	0	0	0	0.5
Eurytemora affinis	0.7	0	0.4	0.2	39.3	38.6	20.8	0.8

Table 13 (continued).

	Station P15						oblique tows	
	surface		mid-depth		bottom			
	1	2	1	2	1	2	P15	P02
NOVEMBER								
Asplanchna sp.	238.4	585.1	220.5	722.6	225.6	3.0	123.5	101.1
Brachionus calyciflorus	194.5	414.5	231.3	454.2	439.3	4.8	74.1	160.0
Bosmina longirostris	5.3	6.8	2.4	4.9	11.8	2.5	12.9	4.6
Daphnia spp.	0.4	0.5	0.5	0.5	0	0	2.5	0
Cyclops bicuspidatus	0.1	0	0	0.1	0	0	0	<0.1
Diaptomus sp.	37.6	0.2	1.8	2.1	5.2	0.6	6.7	1.2
Eurytemora affinis	0.7	0.3	2.5	2.9	45.9	6.3	10.9	5.6
DECEMBER								
Asplanchna sp.	644.4	469.3	562.0	713.7	771.5	0?	617.1	625.8
Brachionus calyciflorus	296.1	51.2	281.0	232.7	315.6	263.0	166.8	56.9
Bosmina longirostris	26.1	93.9	85.9	93.1	140.3	140.3	150.1	189.6
Chydorus sphaericus	0	8.5	31.2	31.0	52.6	87.7	66.7	75.9
Cyclops bicuspidatus	507.1	384.0	483.9	465.5	420.8	578.6	600.4	474.1
Eurytemora affinis	1950.5	1109.3	1717.1	2249.7	2717.8	4155.6	2951.9	4077.0
JANUARY								
Brachionus calyciflorus	18.5	17.9	161.3	15.4	1056.5	779.1	49.6	125.3
Bosmina longirostris	12.3	0	30.2	11.6	84.6	118.0	47.4	53.7
Chydorus sphaericus	30.8	53.8	15.1	0	1.0	3.0	15.1	71.6
Acartia tonsa	0	0	0	0	0	445.3	137.9	0
Cyclops bicuspidatus	92.3	137.6	1466.5	3331.1	1462.9	3784.3	2482.4	644.5
Eurytemora affinis	627.7	1309.9	16665.3	28745.7	10321.4	25154.3	31168.3	4761.9
FEBRUARY								
polychaete larvae	4.3	7.2	4.4	5.9	5.2	6.3	1.5	*
Acartia tonsa	195.8	62.1	32.1	396.9	116.6	480.2	41.3	*
Eurytemora affinis	7155.8	16632.2	4785.9	13653.3	7814.1	12845.0	5698.1	*
Cyclops bicuspidatus	43.5	124.1	16.1	158.8	77.8	120.0	0	*

Table 13 (continued).

	Station P15						oblique tows	
	surface		mid-depth		bottom			
	1	2	1	2	1	2	P15	P02
MARCH								
polychaete larvae	1.8	1.1	4.2	0.5	4.0	3.7	0.1	0.8
Chydorus sphaericus	15.8	10.3	0	0	0	0	3.7	0.4
Acartia tonsa	315.1	1007.2	787.7	1037.0	1820.4	0	397.7	424.4
Cyclops bicuspidatus	787.7	0	1575.4	0	0	0	265.1	0
Eurytemora affinis	74042.9	15829.2	77230.2	85289.7	93877.3	89540.5	80064.5	62606.1

*no sample

first replicate appear more reasonable when compared with the oblique collection at P15. September bottom collections were higher in biomass, while surface collections again were the most diverse. In the cluster analysis, all horizontal and oblique tows in intake waters were included in the same cluster with near-discharge collections. The higher biomass of bottom collections was evidently due to greater abundance of *Acartia tonsa* and barnacle nauplii (Table 13).

In October, biomass was higher in bottom horizontal collections and, as in all summer collections, diversity was higher at the surface. Mid-depth and surface collections at P15 were clustered as a separate sample group, but most closely similar to near-discharge collections. The oblique and bottom horizontal collections were included in a third sample cluster. The higher biomass of bottom samples from P15 was reflected in increased densities of *Acartia tonsa* and *Eurytemora affinis*. Sample measurements of biomass in November horizontal collections were all low, although slightly higher at the surface. Diversity was higher at the bottom, rather than the surface as seen in all previous months. The reduced biomass appeared related to a shift in dominance toward small rotifers (Table 13) and a reduction in copepods, which were somewhat more abundant in bottom layers at P15. All P15 collections were clustered together in November and were distinctly dissimilar to near-discharge stations. Replication of counts in bottom samples was poor. December biomass and diversity were uniform throughout the water column at P15, and all collections at that site were clustered together in a single sample group by cluster analysis. The immediate discharge station P02 was also included in that sample group (Fig. 11), with a similarity to intake plankton that is evidenced in density calculations presented in Table 13.

Biomass in January horizontal collections was low at the surface; diversity was low at mid-depth, somewhat higher at both surface and bottom. Density of the dominant species (Table 13) reflects that distribution of biomass. Surface collections were combined with oblique collections from the river mouth in the cluster analysis, while other P15 collections were more similar to a much larger sample group that included all discharge creek sites and upper Gunpowder River stations. Collections from discharge stations were lacking in February, but all samples from P15 were taken. Highest biomass was measured at mid-depth and diversity was variable, but slightly higher at the bottom. Cluster analyses were not performed on these limited data. In March, very high densities of *Eurytemora affinis* were recorded, exceeding 90,000/m^3 in a bottom collection (Table 13). Biomass was higher in mid-depth and bottom collections which were clustered with upper Gunpowder River, Dundee Creek and lower Saltpeter Creek collections (Fig. 13). One surface tow with relatively few *E. affinis* clustered with river mouth collections and the discharge station, while the remaining surface collections and the oblique collection were included in a third group.

5. MICROZOOPLANKTON

Pumped collections of microzooplankton, those forms of zooplankton retained on meshes of a #20 net (76 μm mesh), were obtained from six stations (P15, P02, P05, P06, P10 and Z03) in every month except February. Added to the resulting 12 monthly oblique collections (2 replicates each station) were discrete-depth collections, also replicated, from surface, mid-depth and bottom at station P15. Counts of identified organisms from all collections are provided in the Appendix Table A-2 (p. 123).

5.1 Diversity

The nauplii, copepodites and adults of dominant copepods and the nauplii and cypris larvae of barnacles were treated as separate taxa in analyses of microzooplankton collections. These developmental stages were, therefore, included as separate "species" in calculations of diversity (H'), evenness (J') and species richness (d) presented in Table 14. A certain monotony of composition and abundance of collected microzooplankton throughout the study period resulted in indices of diversity (H') that showed less variation between stations and months than in mesozooplankton collections. Although the diversity of winter collections was reduced compared with earlier months, the extremely low indices associated with the dominance of mesozooplankton collections by *Eurytemora affinis* were not found in pumped samples.

In most of the warmer months (exception August), diversity was reduced at discharge stations P02 and/or P05. In December, January and March, however, there was little change in calculated indices from one side of the plant to the other. Diversity on the discharge side increased somewhat in August. Diversity at downstream stations P10

Table 14. Diversity (H'), evenness (J') and species richness (d) of microzooplankton collections obtained by submersible pump and concentration with #20 netting (76 μm mesh). "Species" include developmental stages of copepods and barnacles.

Station	JULY H'	JULY J'	JULY d	AUG H'	AUG J'	AUG d	SEPT H'	SEPT J'	SEPT d
P15			Discrete-depth Collections						
surface	2.3513	0.7418	1.0065	1.8090	0.5229	1.4698	2.4667	0.7425	1.1604
surface	2.1327	0.7597	0.7863	1.7936	0.5399	1.2735	2.5773	0.7450	1.3818
mid-depth	2.2309	0.6449	1.1651	2.1814	0.7271	0.9914	2.3323	0.6506	1.2595
mid-depth	2.3124	0.6450	1.2833	1.8516	0.6596	0.8850	2.2128	0.6396	1.1888
bottom	2.4384	0.6802	1.1776	1.5521	0.5174	0.8581	2.6822	0.7482	1.2285
bottom	2.7067	0.6928	1.4864	1.7291	0.4998	1.2000	2.6880	0.7498	1.2383
			Oblique Collections						
P15	2.3972	0.6478	1.3661	1.6468	0.4760	1.2383	2.5793	0.7195	1.2372
P15	2.1194	0.5912	1.2231	1.8594	0.7193	0.7001	2.7214	0.7591	1.2860
P02	1.8402	0.6134	0.7626	2.1705	0.6847	1.0679	2.3364	0.7370	1.0337
P02	1.9320	0.6095	0.8499	1.6898	0.6019	0.7706	2.2130	0.7377	0.9144
P05	1.7813	0.5149	1.0567	1.9335	0.5820	1.1711	2.2538	0.6785	1.0691
P05	2.0257	0.5856	1.1124	1.7927	0.5976	0.8803	2.0856	0.6579	0.9405
P06	2.5866	0.6621	1.4663	2.0147	0.6065	1.2366	2.4986	0.7223	1.2773
P06	2.6457	0.7648	1.0997	1.9748	0.6583	0.8673	2.1771	0.6554	1.1260
P10	2.5820	0.6977	1.3841	1.5528	0.4489	1.1477	1.8060	0.5220	1.1610
P10	2.1297	0.6156	1.1641	1.1816	0.3728	0.9007	1.7727	0.5592	0.9391
Z03	2.5413	0.7089	1.3225	1.4145	0.6092	0.4793	1.5597	0.4509	1.1397
Z03	2.4568	0.6639	1.4191	1.5744	0.6091	0.5982	1.4965	0.4174	1.2509

Station	OCT H'	OCT J'	OCT d	NOV H'	NOV J'	NOV d	DEC H'	DEC J'	DEC d
P15			Discrete-depth Collections						
surface	2.4029	0.6311	1.6158	2.5604	0.6919	1.1394	2.6336	0.6917	1.2652
surface	2.2184	0.5995	1.5112	2.5973	0.7245	1.0428	2.2204	0.5683	1.3275
mid-depth	1.7189	0.4515	1.5344	2.4145	0.6525	1.1282	2.5897	0.6628	1.3681
mid-depth	2.0034	0.5128	1.6963	2.4822	0.6206	1.4700	2.7560	0.6743	1.5568
bottom	2.5605	0.6554	1.6500	2.8782	0.7367	1.4459	2.4036	0.5880	1.4835
bottom	2.4240	0.6551	1.4050	2.8439	0.7279	1.5339	2.5167	0.6442	1.3202
			Oblique Collections						
P15	2.6260	0.6722	1.7934	2.7370	0.6231	2.0541	2.4276	0.5822	1.6244
P15	2.5613	0.6727	1.7177	2.6745	0.6543	1.6915	2.8238	0.6647	1.7771
P02	2.4780	0.6062	2.0974	2.6280	0.6302	1.6529	2.3765	0.5814	1.5812
P02	2.4579	0.5786	2.0815	2.6885	0.6447	1.5854	2.4233	0.5929	1.4482
P05	1.7519	0.3989	2.2319	1.9765	0.4836	1.5797	2.6341	0.5997	1.7417
P05	1.7749	0.4257	1.9105	1.6465	0.4125	1.4234	2.5616	0.6404	1.3056
P06	1.6023	0.3707	2.0357	2.5883	0.6798	1.2646	0.5020	0.5890	1.6758
P06	1.3853	0.3864	1.2537	2.5225	0.6625	1.2874	2.2858	0.5714	1.4027
P10	2.9554	0.6148	3.2491	2.9938	0.7324	1.6581	2.8013	0.6378	1.9339
P10	2.4671	0.5313	2.9179	2.8589	0.7509	1.3463	2.7620	0.6757	1.6414
Z03	3.5431	0.7152	3.4860	3.1133	0.7783	1.6285	2.7172	0.6793	1.6193
Z03	3.0449	0.6557	2.9179	3.0342	0.7586	1.6389	2.6076	0.6519	1.6115

Table 14 (continued).

Station	JAN H'	JAN J'	JAN d	FEB H'	FEB J'	FEB d	MAR H'	MAR J'	MAR d
P15	Discrete-depth Collections								
surface	2.3517	0.6560	1.1293	1.4189	0.6111	0.3600	1.5252	0.5900	0.4236
surface	2.1998	0.5945	1.1790	1.5837	0.6127	0.4476	1.5055	0.6484	0.3402
mid-depth	0.9794	0.2647	0.9964	*	*	*	1.4202	0.6116	0.3374
mid-depth	1.3738	0.3832	0.9579	*	*	*	1.6175	0.6257	0.4245
bottom	1.8734	0.4920	1.3563	*	*	*	1.5699	0.6761	0.3367
bottom	1.8709	0.5219	1.0459	*	*	*	1.5289	0.6585	0.3301
	Oblique Collections								
P15	1.7182	0.4793	1.0185	1.0941	0.4712	0.3594	1.5593	0.6032	0.4254
P15	1.4266	0.4124	0.9266	1.4999	0.6460	0.3596	1.5868	0.6139	0.4253
P02	1.2248	0.3540	0.8936	-	-	-	1.6561	0.7132	0.3560
P02	1.5595	0.4350	1.0252	-	-	-	1.5529	0.6688	0.3604
P05	1.6217	0.4259	1.1163	-	-	-	1.4142	0.7071	0.2663
P05	1.4456	0.4179	0.8922	-	-	-	1.6518	0.7114	0.3499
P06	1.7177	0.4965	1.0844	-	-	-	0.5427	0.2337	0.3109
P06	1.7991	0.4725	1.3095	-	-	-	0.5869	0.2527	0.3154
P10	1.8368	0.5124	1.0872	-	-	-	0.8754	0.3770	0.3435
P10	2.1797	0.6562	0.8761	-	-	-	1.1393	0.4907	0.3414
Z03	2.2418	0.5888	1.3676	-	-	-	1.2231	0.5267	0.3619
Z03	1.9744	0.5054	1.3957	-	-	-	1.0671	0.3557	0.6035

(*) pump frozen at station P15 after initial sampling
(-) not sampled

and Z03 was higher than at other sites during the colder months October-January and in July, lower in August, September and March. Distribution of diversity in the study area seen in pumped and bongo net collections showed little agreement, either in intake-discharge comparisons or in trends through discharge waters to the river mouth. The small range of calculated diversity in pumped collections also precluded presentation of data in bivariate plots such as the previous Figure 5 for mesozooplankton.

Vertical differences in diversity at station P15, within the small ranges of calculated indices (H'), were most often evident as slightly higher diversity in bottom collections (July, September, October, November). Diversity was somewhat higher at mid-depths in August and December and at the surface in January. Diversity was uniform through the water column in March. In February only oblique and surface horizontal microzooplankton collections were obtained.

5.2 Occurrence, Dominance and Relative Abundance of Microzooplankton

Since all identified microzooplankton organisms are listed in Table A-2, checklists of their occurrence will not be repeated here. Ubiquitous taxa, i.e. those occurring in pump samples from every station in a given sampling period included a long list of identified species. However, most of these were ubiquitous only within certain seasons. An exception was found in nauplii of *Eurytemora affinis*, caught at every station (not always both replicates at a station) in every month from July through March. Developmental stages of *Acartia tonsa* were at every station in summer months, along with barnacle nauplii. *Notholca marina* was ubiquitous in every month except August, while most rotifers were spread throughout the area in cooler months, September through January.

Table 15 lists the three most abundant microzooplankters from each pumped collection taken during the study. Summer dominance by first, Notholca marina, then nauplii of Acartia tonsa was replaced in October by an abundance of unidentified rotifers and Scottolana nauplii. Assorted rotifers continued to dominate collections in fall months, with one of them, Notholca marina remaining dominant through the winter. Eurytemora affinis nauplii increased in importance in January and remained second in abundance throughout the winter.

The frequency of occurrence and average abundance of some of the more common microzooplankters are given for each month in Table 16. Abundance in this table is presented as average numbers per 0.1 m^3, rather than numbers per m^3 as in mesozooplankton, to avoid expanding estimates beyond actual sampled volume (each oblique pump collection sampled exactly 0.1 m^3). The density estimates in this table must, therefore, be multiplied by 10 in any comparison with mesozooplankton results. The most strikingly abundant organism sampled by pump was the rotifer Notholca marina, which increased from lows in August-October to over 100,000/0.1 m^3 ($1x10^6/m^3$). The nauplii of Eurytemora affinis were present throughout the study period and increased steadily through fall and winter months to nearly 24,000/ 0.1 m^3 in March. The copepodid stage of this dominant copepod also increased in pump collections over this period. Most rotifers, including Filinia sp., Brachionus calyciflorus, Tetramastix opoliensis, Asplanchna sp. and Keratella sp. peaked in abundance earlier in the season, usually November or December. Acartia tonsa nauplii, although dominant in pump collections of August and September, never attained the densities reached by E. affinis.

Table 15. Rank of numerical dominance of microzooplankton in pumped collections (76 μm), July 1979-March 1980. First, second, third most abundant taxa listed for each collection.

		P15																			
		surface		mid-depth		bottom		oblique		P02		P05		P06		P10		Z03	
MONTH	TAXA replicate:	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
JULY	Notholca marina	1	1	1	1	1	2	1	1	1	1	1	1	1	1		3		
	Acartia tonsa(N)	3		2	2	2	1	2	2			3	3	3		1	1	1	1
	Eurytemora affinis(N)	2	2		3	3	3	3			2	2	2	2	2				
	unid. cladoceran														3	2	2	3	3
	A. tonsa(C)															3		2	2
	Brachionus calyciflorus		3	3					3	3									
	unid. barnacle(N)										3								
AUG	Acartia tonsa(N)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Eurytemora affinis(N)	2	2	2	2	2	3	2	2	2	2	3	3	2	3	3	3	2	2
	A. tonsa					3	2	3								2	2		
	unid. barnacle(N)	3		3					3	3								3	
	Brachionus plicatilis				3						3	2	2						
	Brachionus calyciflorus													3	2				
	Notholca marina		3																
	unid. oligochaete																		3
SEPT	Acartia tonsa(N)	2	2	1	1	1	1	1	2	2	2	1	1	1	2	1	1	1	1
	Eurytemora affinis(N)	1	1	2	2	2	2	2	1	1	1	2	2	3	1	3	2	3	2
	Notholca marina	3	3	3		3	3	3	3					2	3				
	Brachionus calyciflorus										3	3	3			2	3		
	A. tonsa(C)																	2	3
	Unid. barnacle(N)				3					3									
OCT	unid. rotifer	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Scottolana canadensis(N)	2	2	3	3	2	2	2	2	2	2	2	2	2	2	2	2		2
	Acartia tonsa(N)	3	3				3	3	3	3	3		3	3	3				
	Eurytemora affinis(N)											3				3	3	3	3
	polychaete larvae																	2	
	Brachionus calyciflorus			2															
	unid. ciliate				2														
	unid. copepod(N)					3													

Table 15 (continued).

MONTH	TAXA replicate:	P15 surface 1	P15 surface 2	P15 mid-depth 1	P15 mid-depth 2	P15 bottom 1	P15 bottom 2	P15 oblique 1	P15 oblique 2	P02 1	P02 2	P05 1	P05 2	P06 1	P06 2	P10 1	P10 2	Z03 1	Z03 2
NOV	*Notholca marina*			1	1	3		1	1	1	1	1	1	1	1	3	2		2
	unid. rotifers	1	2	2	3	1	1	3		3	2	3		3	3	2	1	1	1
	Brachionus calyciflorus	2	1					2	2		3	2	2	2	2				
	Filinia sp.	3	3	3	2	2							3			1	3	3	3
	Eurytemora affinis(N)						2		3	2								2	
	Keratella sp.						3												
DEC	*Notholca marina*	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	2	2
	Filinia sp.	1	1	1	1	1	1	1	1	1	2	2	2	2	2	3	2	1	1
	unid. rotifers	3	3	3	3	3	3	3								2	3	3	
	Eurytemora affinis(N)								3			3	3	3	3				3
	Tetramastix opoliensis									3									
	Brachionus calyciflorus										3								
JAN	*Notholca marina*	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Eurytemora affinis(N)	2	2	2	2	3		2	2	2	2	2	2	2	2	3	3	3	3
	unid. rotifers		3	3					3		3	3			3	2	2	2	2
	Filinia sp.	3			3		2						3	3					
	unid. copepod(N)					2	3	3											
	Tetramastix opoliensis									3									
FEB	*Notholca marina*	1	1	*		*		1	1	*		*		*		*		*	
	Eurytemora affinis(N)	2	2					2	2										
	unid. rotifers	3	3						3										
	E. affinis (C)							3											
MAR	*Notholca marina*	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Eurytemora affinis(N)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	E. affinis(C)	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

*no collections

Table 16. Frequency of occurrence (%) and average abundance (total numbers per total sampled volume in 0.1 m^3) of the more common microzooplankters occurring near the C. P. Crane generating station, July 1979-March 1980. Based on oblique tows with a submersible pump, filtered through a #20 (76 μm) net. Horizontal collections omitted. N = nauplii, C = copepodites, A = adults

	Summer Months					
	July		Aug		Sept	
	%	$N/0.1m^3$	%	$N/0.1m^3$	%	$N/0.1m^3$
Acartia tonsa (N)	100	1552.0	100	2144.7	100	2345.7
Eurtytemora affinis(N)	100	889.3	100	466.0	100	922.7
Unid. cladocerans	100	624.0	0	0	17	2.7
Brachionus calciflorus	100	548.7	67	127.3	100	399.3
Barnacle nauplii	100	385.3	92	163.3	100	203.0
A. tonsa(C)	83	294.7	100	194.7	100	180.0
Notholca marina	92	3606.7	67	31.3	92	277.7

	Fall Months					
	Oct		Nov		Dec	
	%	$N/0.1m^3$	%	$N/0.1m^3$	%	$N/0.1m^3$
Notholca marina	92	38.7	100	8546.7	100	15010.2
Unid. rotifers	100	3458.0	100	3242.7	92	1989.7
Filinia sp.	75	24.7	100	476.0	100	12604.9
Eurytemora affinis(N)	100	143.1	100	859.7	100	2772.6
Brachionus calyciflorus	100	142.7	100	4278.7	100	1787.1
Tetramastix opoliensis	42	11.7	92	2490.7	100	2703.1
Unid. cyclopoid(N)	83	21.0	100	60.3	100	425.7
Asplanchna sp.	67	14.3	92	626.7	100	2360.9
Keratella sp.	75	23.3	100	1205.3	92	241.3
Unid. calanoid(N)	100	117.5	92	109.3	83	265.3
E. affinis(C)	67	75.7	92	158.0	100	581.7
E. affinis(A)	17	4.7	17	1.7	100	162.2
Scottolana canadensis(N)	100	781.3	50	12.0	0	0

	Winter Months					
	Jan		Feb*		Mar	
	%	$N/0.1m^3$	%	$N/0.1m^3$	%	$N/0.1m^3$
Notholca marina	100	29157.3	*	45120.0	100	103477.3
Eurytemora affinis(N)	100	7653.3	*	16000.0	100	23872.3
Unid. rotifers	100	2226.7	*	3520.0	75	764.7
Filinia sp.	100	1357.3	*	256.0	0	-
E. affinis(C)	100	794.7	*	3316.0	100	11232.0
Unid. cyclopoid(N)	100	602.7		-	25	53.3
E. affinis(A)	58	93.3	*	256.0	92	960.0

*Only station P15 sampled due to icing conditions during week scheduled for sampling

5.3 Cluster and Nodal Analyses

Except for the limited February data, each month's pump collections were submitted to a cluster analysis, with the same technique as employed in treatment of bongo net collections. Those analyses of data from November through March failed to separate collections into groups sufficiently distinct to warrant a nodal analysis. This was caused by a close similarity of collections throughout the study area in those months, as demonstrated below.

The normal cluster analysis of July samples, including 18 samples and 21 taxa, divided the collections into three dissimilar groups:

I: The replicate samples from P06,

II: Lower stations, P10 and Z03; oblique, bottom and one mid-depth sample from P15; and one replicate from P05,

III: Near-discharge samples from P02 and P05, and surface and one mid-depth collection from P15.

Station P06 was most different from other sites, with collections characterized by presence of species group A (fidelity index of 7.0), and absence of the adult copepods and barnacle cypris larvae of species groups C and D (Fig. 14). This station was clustered with upper Gunpowder River stations in analysis of bongo net collections. The more abundant taxa were included in species group B, with little preference for any sample group in evidence (fidelity indices 0.9-1.1). Adult A. tonsa and barnacle cypris larvae were more common among samples in Group II, while absence of these and presence of adult E. affinis, Diaphanosoma and unidentified cyclopoids characterized sample group III.

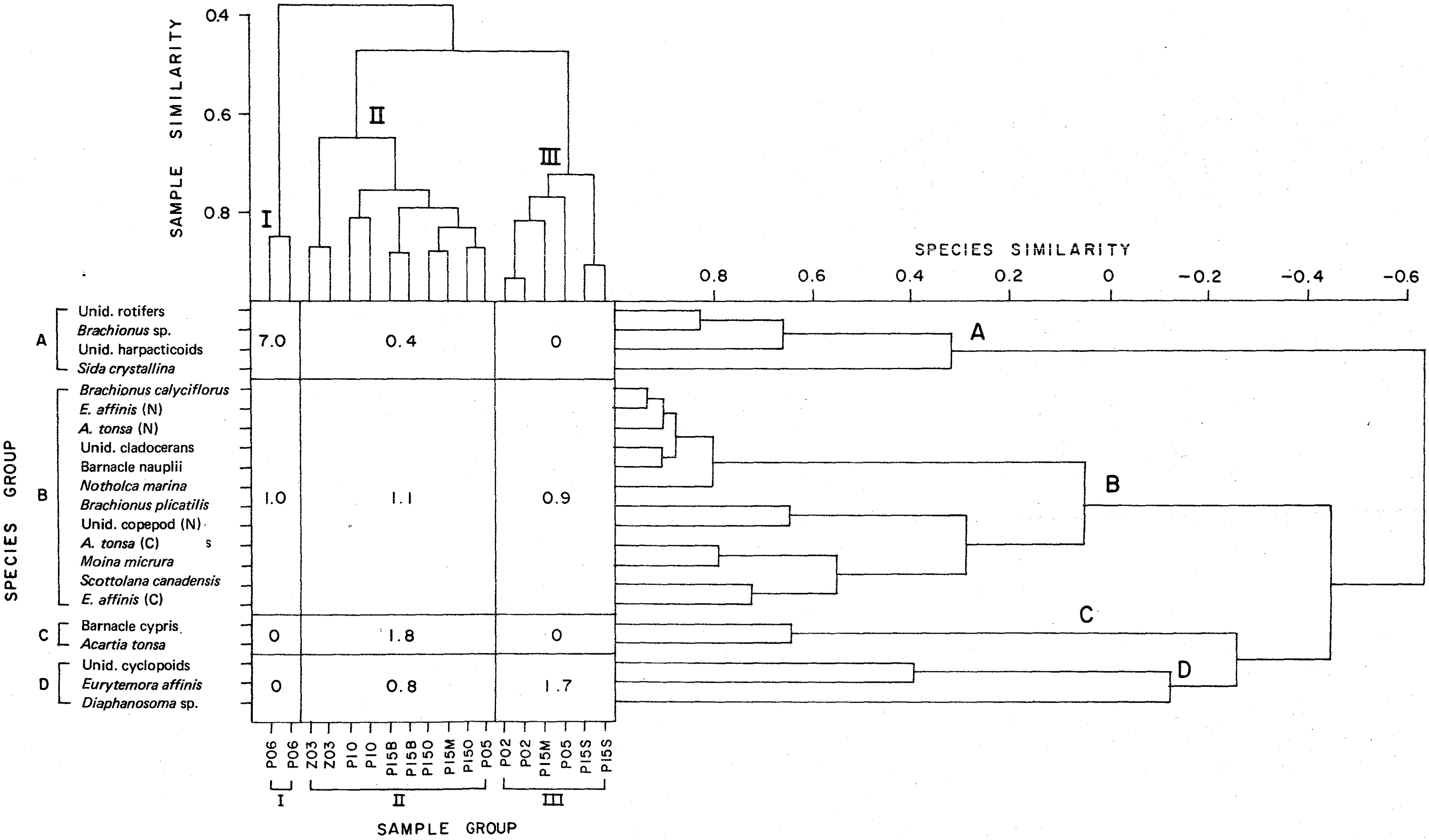

Figure 14. Sample and species clusters from July 1979 pump collections, with the relationship of species groups to sample groups shown by indices of fidelity.

August collections, with 18 samples and a much reduced 11 taxa, were again divided into three sample groups (Fig. 15), although groups I and II were separated at a similarity level just below 0.6:

I: Immediate discharge P02 and one replicate from P05; one replicate each of oblique and bottom samples from P15, and the P10 samples,

II: Remaining P15 and P05 samples and those from P06,

III: Z03 samples.

The dissimilarity of Z03 collections was apparently due to a reduction in occurrence and abundance of the taxa dominating other collections, rather than occurrence of a unique fauna. Sample groups I and II differed primarily in a slight preference by species group A for sample group I. Species group A included adults of A. tonsa and Scottolana canadensis, while species group B included the dominant nauplii and copepodites of copepods, barnacle nauplii and rotifers.

Pump collections in September were increasingly similar, with separation of only two groups effected at a similarity level just below 0.6 (Fig. 16):

I: Lower stations P10 and Z03 plus oblique, mid-depth and bottom collections from P15,

II: Discharge stations in Saltpeter Creek (P02, P05 and P06) plus surface P15 samples.

This cluster analysis included 18 samples and 15 taxa and resulted in three species groups. Species groups A and B showed some preference for sample group I and included the less frequent and abundant taxa. Fidelity indices for the third species group, which contained the dominant taxa showed no preference for either sample

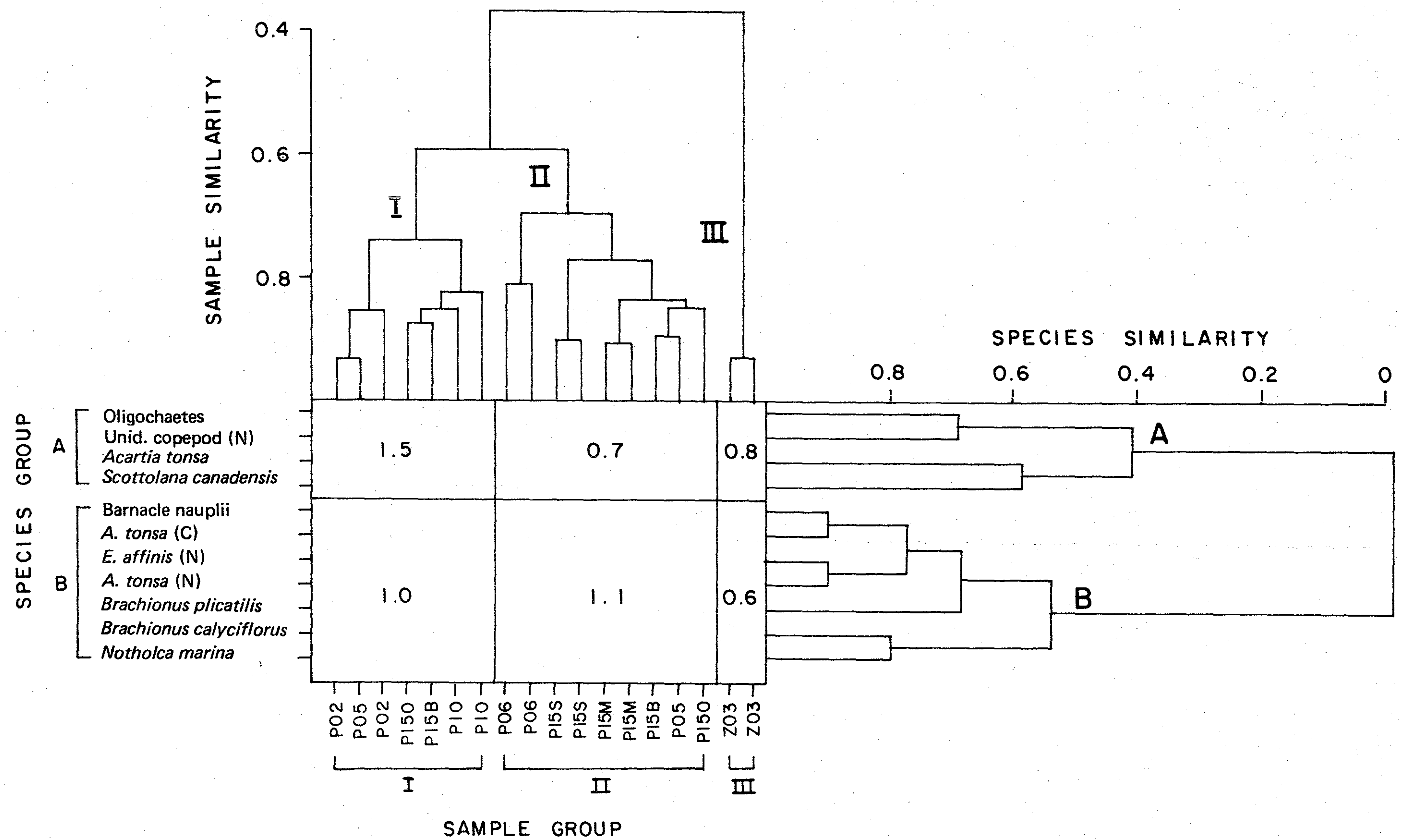

Figure 15. Sample and species clusters from August 1979 pump collections, with the relationship of species groups to sample groups shown by indices of fidelity.

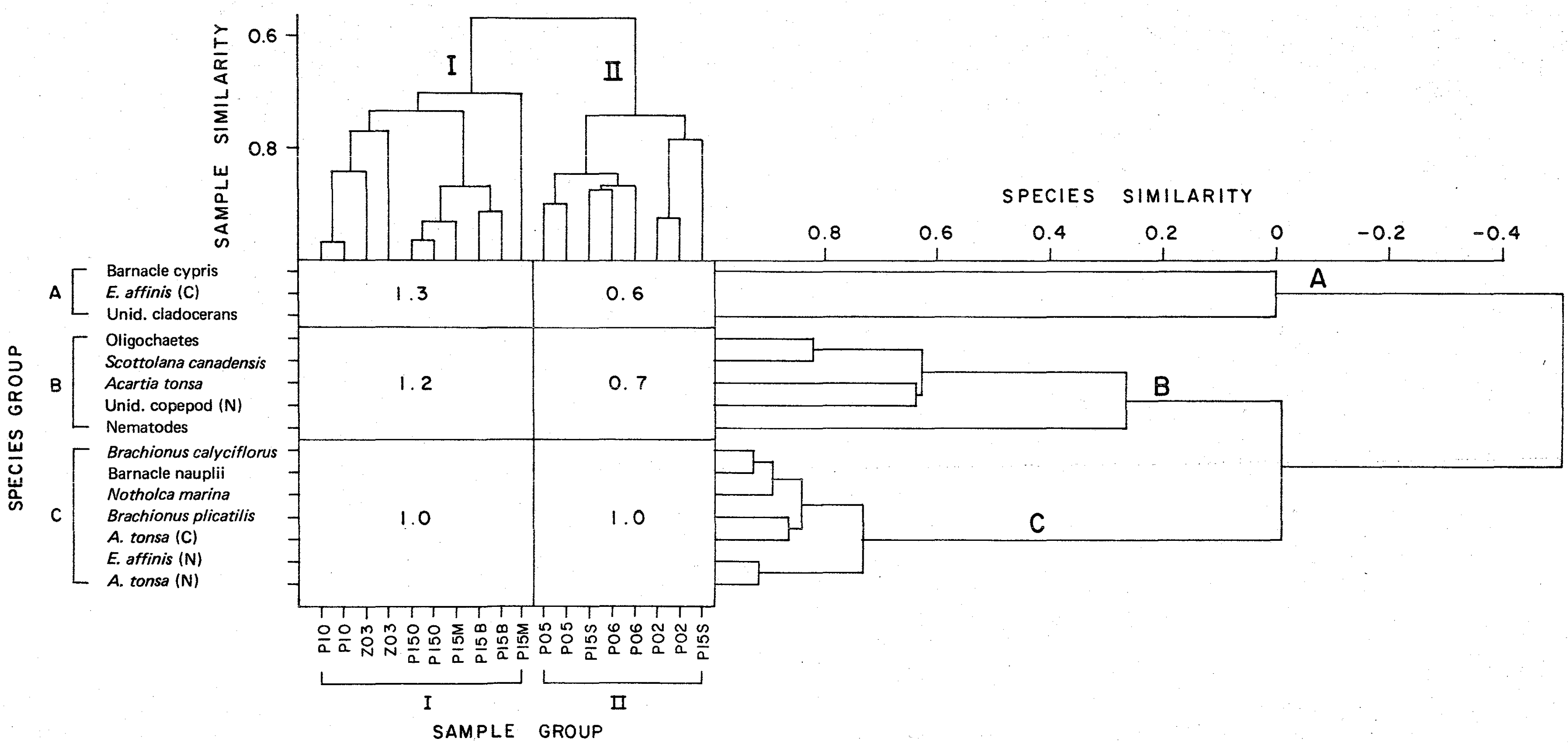

Figure 16. Sample and species clusters from September 1979 pump collections, with the relationship of species groups to sample groups shown by indices of fidelity.

group. Separation of samples, except for the inclusion of P15 surface samples with Saltpeter Creek collections, was similar to that obtained in cluster analysis of bongo collections (p. 39).

October pump collections were more dissimilar, with the cluster analysis based on 18 samples and a much expanded 30 taxa yielding three sample groups (Fig. 17):

I: Lower stations P10 and Z03,

II: Station P05 plus one repicate each from P02, P06 and bottom collections at P15,

III: Most P15 collections and remaining replicates at P02 and P06.

The more abundant rotifers and copepod nauplii were included in species group C, which showed no preference for any of the sample groups. Neutrality in preference was apparent for all species groups toward the collections in sample group II, while group III differed from II in occurrence and abundance of species groups A and B. The most different group of samples (I) included the downstream sites preferentially inhabited by taxa of species groups A and B (fidelity indices of 2.2 and 2.1, respectively).

None of the remaining sets of monthly pump collections were clustered at reasonably low similarity levels and in meaningful locations. November pump samples were all combined at a similarity of 0.6 and all but one Z03 replicate at 0.665. In December all samples were combined at a similarity of 0.687, with both Z03 replicates separated at 0.718. January collections united at a similarity level of 0.625, with the last remaining cluster consisting of Z03 samples and three of the eight P15 collections. March samples were all linked

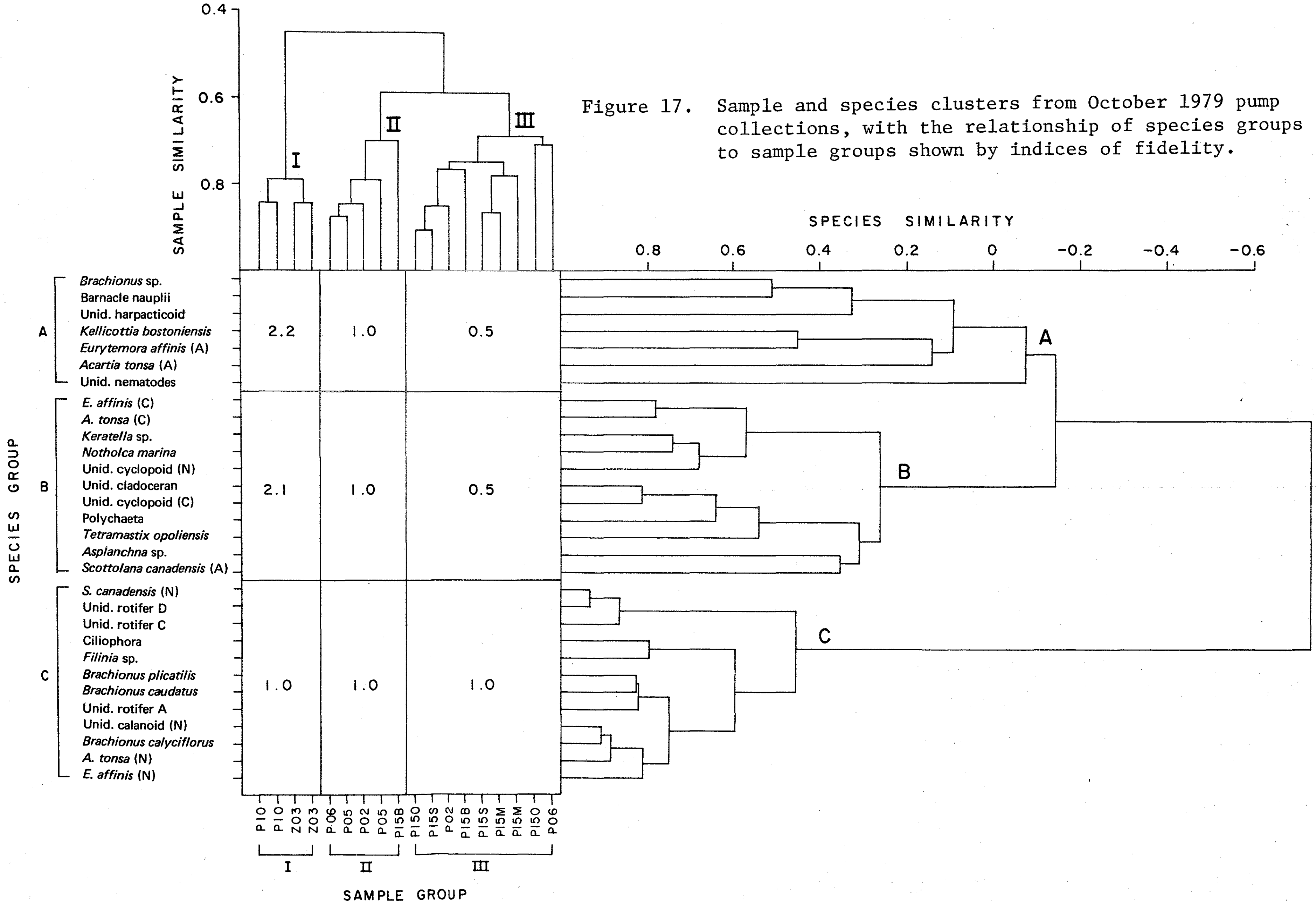

Figure 17. Sample and species clusters from October 1979 pump collections, with the relationship of species groups to sample groups shown by indices of fidelity.

together at a similarity of 0.660, with the last cluster a meaningless group of single replicates from P15, P02, P06, P10 and Z03.

6. DISCUSSION

6.1 An Annual Cycle of Zooplankton at C. P. Crane

6.1.1 Mesozooplankton

Together with the study of spring zooplankton by Grant and Berkowitz (1979b), the present results allow an examination of seasonal succession over a continuous 13-month period. In any discussion of species abundance over time the often striking differences between years should be kept in mind and examples of these will be pointed out below. However, populations of dominant zooplankton species tend to be resistant to major modifications in successional patterns. Thus, use of percentage composition as in Figure 18 has predictive value. While certain of the less abundant species may occur or not occur in different years, the principal species (although varying in absolute abundance) can be expected to follow the same seasonal trends in relative importance.

Percentages of the 12 species included in Figure 18 are based on total counts of collected mesozooplankton organisms and cumulatively total over 93% of all collected individuals in every month except May 1979. The 12 species include four copepods, five cladocerans, two rotifers, and barnacle nauplii. The community is characterized by a seasonal alternation of dominance by *Acartia tonsa* and *Eurytemora affinis*. Warm-season associates of *Acartia tonsa* include, in particular, *Moina micrura* and barnacle nauplii. Cooler months are strongly dominated by *Eurytemora affinis*, with lesser contributions (but similar seasonal distribution) from *Cyclops bicuspidatus* and the cladoceran *Chydrous sphaericus*. As might be expected in any temperate estuary, the most rapid change in fauna

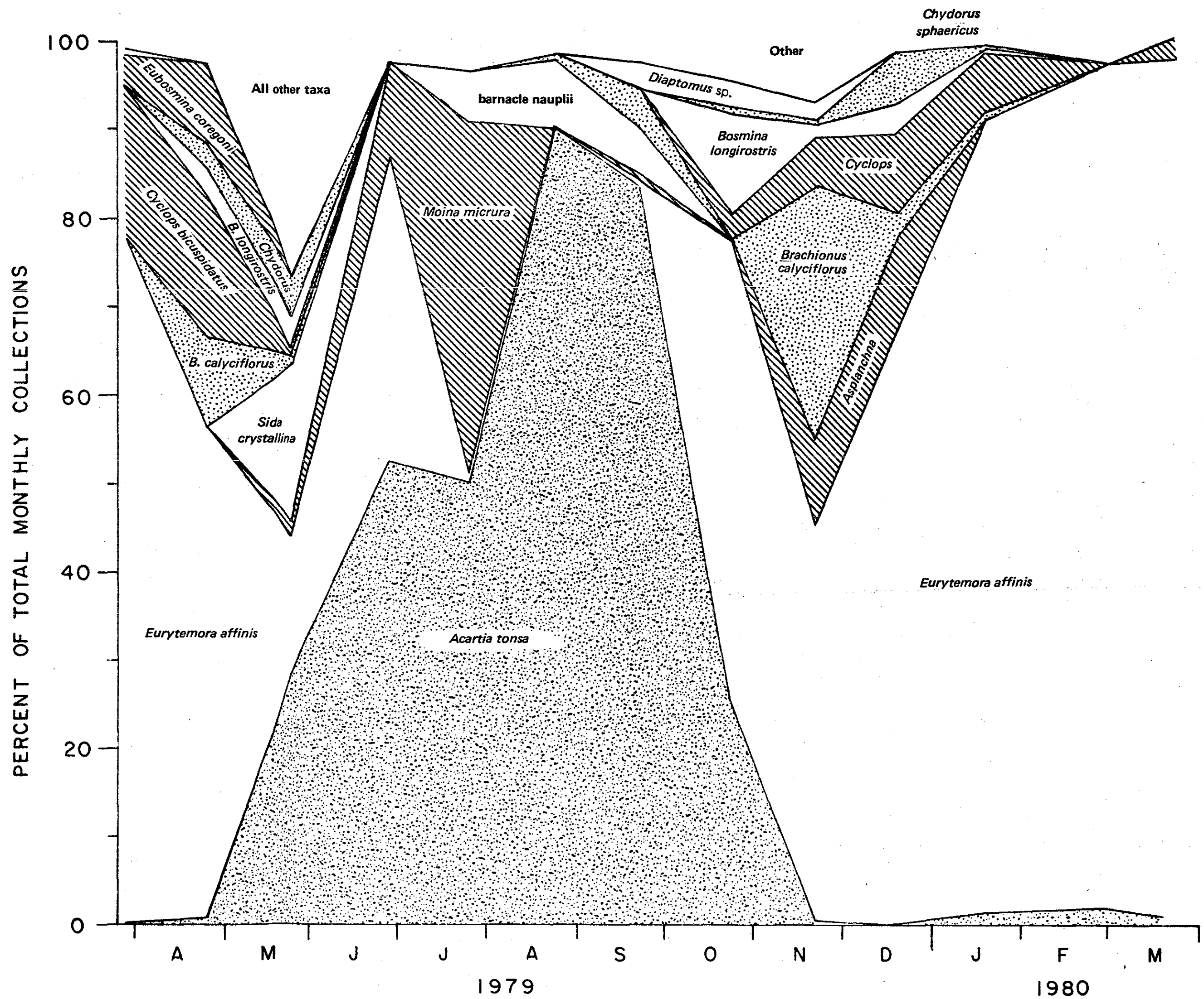

Figure 18. Percent composition of mesozooplankton collections from waters near the C. P. Crane station, March 1979–March 1980. Spring 1979 data from Grant and Berkowitz, 1979b.

occurs during spring and fall. Evidence of this in Figure 18 is found in the increased diversity centered in May and November 1979. Several cladocerans and rotifers peak in abundance during spring and fall during the shifts in dominance by A. tonsa and E. affinis.

Certain species of mesozooplankton appear for relatively brief periods of the year. Eubosmina coregoni, a prominent subdominant of spring 1979 collections, did not occur again until March of the following year. Asplanchna, although perhaps among unidentified rotifers in earlier fall months, contributed significantly to collections only in November and December. Inclusion of Sida crystallina in Figure 18 was the result, mainly, of a single, very large upper Gunpowder R. collection in May 1979. These briefly occurring species are among those that might be expected to change in importance in other years with differing environmental conditions.

Although differing somewhat in season of sampling (January-December 1979) and mesh size of sampling nets (153 μm), the study conducted for Baltimore Gas and Electric Company (Ecological Analysts, 1980) provides the best comparison of our results with others. Their winter season, although one year removed from ours, was perhaps quite similar in that Ecological Analysts was also prevented by ice from sampling in February. Their seven stations, sampled night and day each month, were at sites similar to one-half of our day stations, as follows:

EA Stations	Comparable VIMS Stations
1	P11
2	P12
3	P05
4	P06
5	P09
6	P08
7	Z01

On a seasonal basis, Ecological Analysts' results were similar to ours, with dominance evident by Eurytemora affinis in winter, spring and fall, and by Acartia tonsa in summer. Other warmer water occurrences also agreed: Moina micrura, Leptodora kindti, Rhithropanopeus harrisii larvae and Brachionus calyciflorus, the latter more abundant in spring and fall months. A primary difference in seasonal results of the two studies lies in absence of mention of the presence of barnacle larvae by Ecological Analysts (1980), one of the summer dominants in our collections and possibly a result of the presence of the power plant (Grant and Berkowitz, 1979a).

6.1.2 Microzooplankton

The most common microzooplankton, as in the larger sized mesozooplankton, included copepods and rotifers. The most abundant copepods included nauplii of both Eurytemora affinis and Acartia tonsa, seasonally alternating in dominance (Figure 19). This pattern reflects seasonal abundance of adults and later stage copepodites seen in mesozooplankton collections. Densities of E. affinis nauplii reached nearly 24,000/0.1 m^3 (or 240,000/m^3) in March 1980, after a low of 143/0.1 m^3 in October. A. tonsa nauplii, on the other hand peaked at about 2300/0.1 m^3 in September and were absent from collections in cooler months (January-May). These seasonal patterns were generally repeated by the more advanced copepodid and adult stages.

The #20 net used to concentrate pumped microzooplankton collections was considerably more efficient than 202 μm nets in

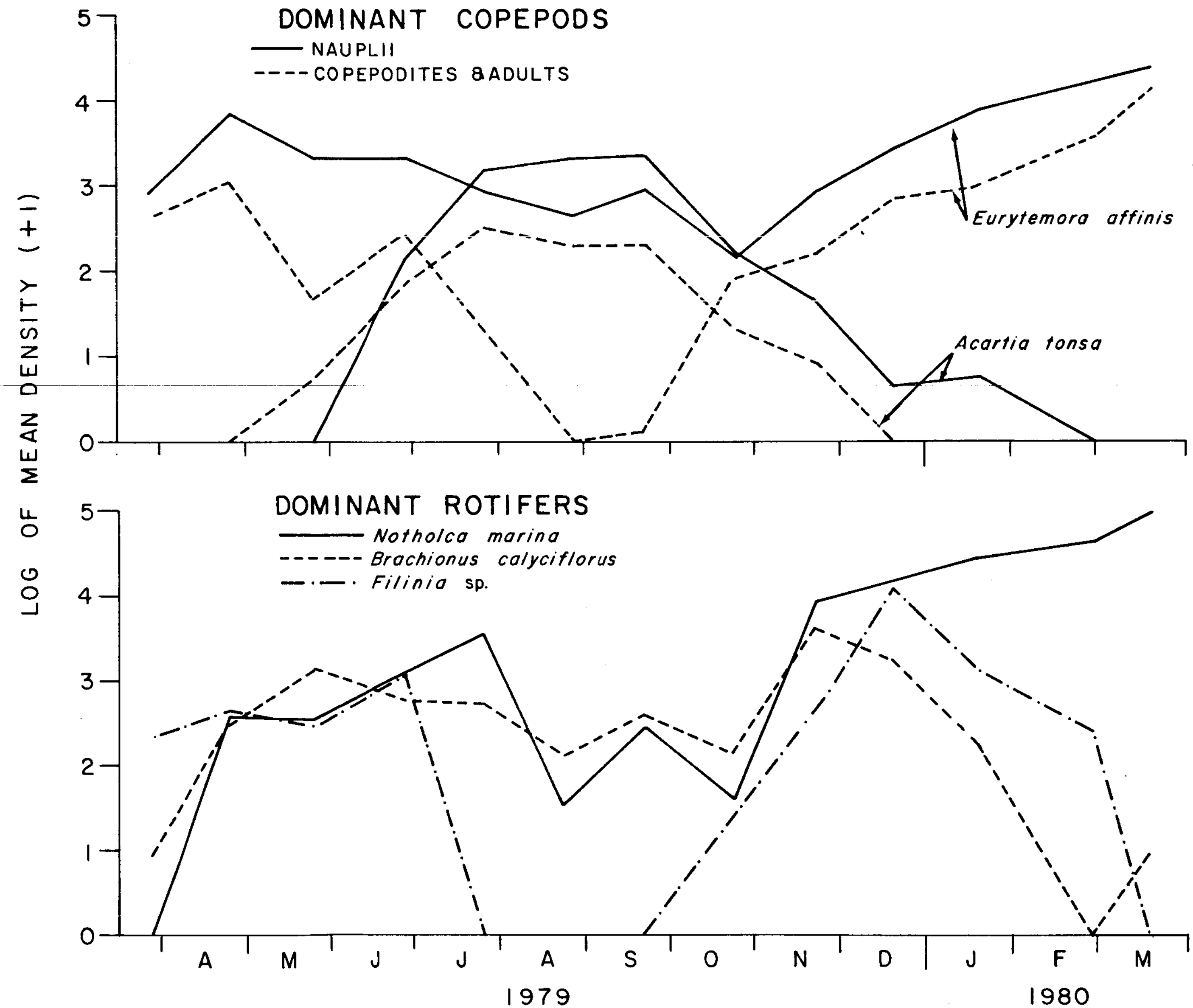

Figure 19. Seasonal abundance of dominant microzooplankters in waters adjacent to the C. P. Crane generating station (top: copepods, bottom: rotifers). Spring 1979 data from Grant and Berkowitz, 1979b.

retaining the rotifers. The more abundant of these often exceeded copepod nauplii in abundance, especially in spring and fall months (bottom, Figure 19). Average density of Notholca marina exceeded 100,000/0.1 m^3 ($1x10^6/m^3$) in March 1980, also the month of greatest biomass and E. affinis abundance. Brachionus calyciflorus was bimodally distributed through the seasons, with peaks of about 1400/0.1 m^3 and 4300/0.1 m^3 in May and November, respectively. Filinia sp. peaked in June and December but was absent from summer and March collections.

Although the mesh size used by Ecological Analysts (1980) in their collections of microzooplankton (80 μm) matched ours, they employed towed nets as opposed to our pumped collections. They found Synchaeta the most abundant microzooplankton, followed by combined counts of copepod nauplii. Ranking of the rotifer (not identified in our collections) was primarily due to high abundance in January 1979, prior to our initial sampling. It is possible that our failure to identify this soft-bodied rotifer in the fall of 1979, when Ecological Analysts again collected it from Crane waters, was a result of pump damage. The April peak for copepod nauplii in their study matches our spring peak for E. affinis nauplii, but the summer peak for Brachionus angularis (another rotifer not included among our identifications) was unlike anything in our data except for Notholca marina, which displayed a minor July peak of about 3600/0.1 m^3. Confusion between these two species is possible but unlikely due to their different morphology and the further fact that Ecological Analysts has also identified Notholca in their collections. Instead, it might be that we have disagreed in identification of the more similar Brachionus plicatilis and B. angularis. However, B. plicatilis never occurred in our collections in the abundances reported for _B. angularis_ (Ecological Analysts, 1980).

Density estimates for _Brachionus calyciflorus_ also differed between the studies, with our collections showing peaks in May and November, Ecological Analysts with peaks in April, July and November. The magnitude of the major peak of November, however, was very similar - over 4,000/0.1 m^3 in both studies. The studies also agreed in showing a peak of _Filinia_ sp. in December and a peak for _Keratella_ in November.

6.2 Annual Differences in Populations

Collections reported on in Grant and Berkowitz (1979a,b) provide data for examples of annual differences where sampling months were repeated in the present study. These include both summer months (July- September 1978 and 1979) and the month of March (1979 and 1980).

6.2.1 The Summers of 1978 and 1979

Since only three of the four stations sampled for microzooplankton by Grant and Berkowitz (1979a) were comparable in location to stations sampled in the present study, comparisons of annual differences will be limited to those three sites:

1978	1979
A08	P15
B01	P02
C30	P06

A comparison of physical characteristics and features of the microzooplankton collections at these three pairs of stations is provided in Table 17. Temperatures and salinities at these-three stations were remarkably close during July sampling in the two years, but densities of the listed taxa were generally higher in 1979. _Brachionus calyciflorus_ was particularly more prominent in 1979 collections.

Table 17. A comparison of selected microzooplankton at three locations in summers of 1978 and 1979. The 1978 data are taken from Grant and Berkowitz (1979a). Counts are averages of replicate samples at each station in numbers per 0.1 m^3.

	Intake		Discharge		Lower Saltpeter	
	1978	1979	1978	1979	1978	1979
Station:	A08	P15	B01	P02	C30	P06
JULY						
Surface temperature °C	27.4	27.3	32.4	31.2	27.9	27.0
Surface salinity o/oo	1.63	1.85	1.38	1.72	1.24	1.24
Acartia tonsa nauplii	220	1864	15	544	997	1648
A. tonsa copepodites	63	168	45	48	84	32
Eurytemora affinis nauplii	119	584	19	904	437	2096
E. affinis copepodites	62	8	44	0	52	0
Moina micrura	46	152	444	48	33	32
Barnacle nauplii	73	272	22	1056	61	32
Brachionus calyciflorus	2	1088	0	976	0	832
AUGUST						
Surface temperature °C	30.4	25.0	>36.0	27.0	31.4	24.5
Surface salinity o/oo	2.31	3.40	2.32	3.35	2.12	2.73
Acartia tonsa nauplii	443	1496	1457	1132	1735	1040
A. tonsa copepodites	57	136	65	44	216	40
Eurytemora affinis nauplii	247	288	313	440	428	496
E. affinis copepodites	3	0	3	0	65	0
Barnacle nauplii	77	120	227	192	47	12
Brachionus calyciflorus	0	64	0	12	0	576
SEPTEMBER						
Surface temperature °C	23.9	21.5	27.6	23.5	26.0	22.0
Surface salinity o/oo	3.06	2.37	3.06	1.93	2.64	1.44
Acartia tonsa nauplii	531	2168	251	674	255	792
A. tonsa copepodites	60	312	48	12	46	36
Eurytemora affinis nauplii	301	1680	154	728	29	816
E. affinis copepodites	1	0	0	2	24	0
Barnacle nauplii	89	320	393	290	22	80
Brachionus calyciflorus	7	328	1	304	2	364

The nauplii of both copepods and of barnacles were also more abundant in the second year. August sampling in 1979 was conducted in considerable lower temperatures and higher salinities than the previous year, yet densities of *E. affinis* nauplii were quite close from one year to the next. Copepodites of this species were not taken in 1979. *Brachionus calyciflorus* was absent in 1978. Both temperature and salinity were lower in the second year of September sampling when densities of all listed taxa were generally higher.

The area sampled for mesozooplankton was expanded in 1979 both upstream and downstream in the Gunpowder River, but the majority of stations were identical to those sampled in the summer of 1978. Mean density of the more common zooplankton in bongo collections over the entire sampled area is compared for the summers of 1978 and 1979 in the following table, with densities presented as numbers per m^3:

	July		August		September	
	1978	1979	1978	1979	1978	1979
Acartia tonsa	855	6384	701	1015	395	874
Moina micrura	1644	5064	37	<1	<1	7
barnacle larvae	23	878	272	89	141	55
Eurytemora affinis	74	136	18	0	<1	6
Rhithropanopeus harrisii	17	86	10	4	3	<1
Leptodora kindti	31	40	<1	<1	0	0

Acartia tonsa was more abundant throughout the second summer, largely through its dominance of collections at the added lower river stations (see Table 4 of this report). Most of the common taxa, despite differences in abundance, follow the same trend in the two years from July through September: *A. tonsa* decreasing in abundance, *Moina micrura* sharply decreasing after July, *Eurytemora affinis* and *Rhithropanopeus* larvae in low and generally decreasing abundance through the summer, and *Leptodora kindti* essentially disappearing after July. An exception to this similarity was evident with barnacle larvae (nauplii + cypris larvae) which did not peak in abundance in 1978 until August, when it dominated collections in the near-discharge.

6.2.2 March of 1979 and 1980

In contrast to the similarity of fauna in the summers of 1978 and 1979, collections from the succeeding months of March in 1979 and 1980 show little in common beyond the dominance of collections by *Eurytemora affinis*. March microzooplankton collections in 1979 contained *E. affinis* nauplii in densities of about 100/0.1 m^3 at most stations; those in 1980 averaged about 35,000/0.1 m^3. Other abundant taxa in 1979 (*Keratella cochlearis*, *Ectinosoma curicorne*, *Cyclops bicuspidatus*, *Bryocamptus* sp.) were absent or in very low abundance in 1980.

Bongo net collections averaged 5166 *Eurytemora affinis*/m^3 in 1979, but over 70,000/m^3 in 1980. Averages for *Cyclops bicuspidatus* were 1134/m^3 in 1979, 807/m^3 in 1980. *Acartia tonsa* were found only in the immediate discharge in 1979 (7/m^3 overall area mean), but were 100X more abundant in 1980 (702/m^3). Temperatures in 1980 were considerably lower (average 6.9°C) than in 1979 (10.3°C), a result of the later dates of sampling (March 29-30, 1979 vs. March 18-19, 1980), but the most likely contributing factor for greatly increased density of *Eurytemora affinis* and *Acartia tonsa* in 1980 is the increased salinity: area mean of 4.163 o/oo in March 1980 *vs.* 0.297 o/oo in 1979.

6.3 Cluster Analyses and Plant Effects

As pointed out by Ecological Analysts (1980), cause and effect relationships between power plant operations and faunal changes are difficult to establish. It is particularly difficult in the case of the C. P. Crane power plant because of the small volume of water in the creek on the discharge side of the plant, relative to the volume of water pumped through the plant from the intake creek. Any mass alteration of the fauna must therefore embrace most of Saltpeter and Dundee creeks and is now historical, dating from initial plant operation. Major changes in fauna related to plant operation are not detectable in studies limited spatially to intake and near-discharge waters due to the similarity of fauna on either side of the plant imposed by such large transfers of water. Without benefit of pre-operational data, original faunal assemblages can only be conjectured from collections made in waters relatively close to the immediate plant area, but unaffected by the plant.

The cluster analyses throughout the months of our present and past studies have consistently separated two basic zooplankton communities, a low-salinity estuarine one, and one of freshwater origin. With a preoperational lack of water exchange between Seneca and Saltpeter Creeks, one can reasonably assume that fresher water was characteristic of Saltpeter and Dundee creeks and perhaps of lower Gunpowder River as well. Thus, the freshwater fauna presently limited to the upper Gunpowder River and occasionally to certain stations in the Saltpeter-Dundee tributary probably inhabited most of the present discharge waters, except in very dry seasons. This faunal change, which we consider to be the major effect of plant operation, cannot be demonstrated in present-day studies.

The only effects left to examine are those acute changes in entrained fauna produced by passage through the plant. Thus, we are looking at alterations (due to elevated temperature, mechanical damage or production of larvae from sessile organisms) within a zooplankton community already altered by a relocation of low salinity water into fresh water. In results of cluster analyses, we must look for distinctive clusters of near-discharge samples as indications of such changes, recognizing that operation of the plant's pumps and transfer of water from Seneca Creek to the discharge side will tend to diminish differences through the transfer of entrained fauna. In the present study, near-discharge samples (from stations P02, P01 and P05) were linked with certain of those from intake locations (P15, P12) or Dundee Creek until October, when a unique cluster of samples from P01, P02 and P05 was formed. The near-discharge samples were similar to the Dundee Creek sample again in November, but later cluster analyses (December-March) reflected a lack of faunal effect. In colder months, near-discharge stations showed similarity in fauna with a mix of samples from the lower Gunpowder and intake stations.

The discharge collections in October yielded fidelity indices over 1.0 for three of the six species groups. This was a result of higher abundances in discharge waters of Brachionus plicatilis, B. candatus, Chydorus sphaericus, Alona diaphana, Sida crystallina and barnacle larvae; absence of Daphnia spp. and bivalve larvae; and lower abundance of Eurytemora affinis, Cyclops bicuspidatus and Bosmina longirostris. The November discharge cluster, which also included the Dundee Creek sample and one intake (P12) collection, was distinguished by a lower abundance of dominant copepods and Bosmina longirostris, absence of *Daphnia* spp. and *Notholca marina*, and higher occurrence of several rarer taxa including oligochaetes and *Brachionus plicatilis*.

In summary, cluster analysis shows that the contrast between freshwater and more saline communities of zooplankton is much sharper than differences between intake and discharge collections. Upper Gunpowder River stations Z02 and P08 were distinctively separated in seven of the eight bongo cluster analyses, and linked closely with P07 and P06 in six and five analyses, respectively. Discharge collections, on the other hand, were typically clustered with intake and lower river samples. Reduced abundances in discharge collections of dominant copepods, as noted by Ecological Analysts (1980), were evident in our 1979 collections, but are minor differences compared with the faunal changes in freshwater communities. The major effect of plant operations - the dislocation of the freshwater community - is missed in contrasts of intake and discharge waters.

7. SUMMARY

7.1 General Results

a) Water temperatures at the C. P. Crane site varied from <1.0°C in February 1980, when icing prevented sampling, to 31.2°C in discharge waters in July 1979.

b) Salinity in the area ranged from 0.11 to 5.46 o/oo during regularly scheduled sampling dates, to 6.98 o/oo in off-tidal phase sampling conducted late in February. Seasonally declining salinities were reversed in January, when lack of freshwater runoff resulted in persistently high winter salinity.

c) There was no evidence of oxygen depletion at any time during our nine months of daytime sampling.

d) Sampling was conducted in each month while the generating station was in operation, but followed weeks of low power output in August, September, February and March. Plant shutdowns were frequent during the latter three months.

e) Mesozooplankton biomass decreased to seasonal lows in late summer and early fall, increased in December, then very sharply in March, when exceptional volumes greater than 5.0 ml/m^3 were observed. At Station P15, near-bottom horizontal tows yielded higher zooplankton volumes than similar collections from mid-depth and the surface.

f) Ubiquitous summer species included *Acartia tonsa*, *Argulus alosae*, barnacle larvae, mud crab larvae, and water mites. *Moina micrura*, abundant only in July, shared dominance of collections in that month with *A. tonsa*. *A. tonsa* numerically dominated all mesozooplankton collections in August and September. Important summer subdominants included barnacle larvae, larvae of *Rhithropanopeus harrisii* and *Brachionus calyciflorus*.

g) Nearly all fall mesozooplankton collections contained Brachionus calyciflorus, Bosmina longirostris and Eurytemora affinis. Rapidly changing environmental conditions were reflected in appearances of numerous species of rotifers and cladocerans. E. affinis had become the dominant species at all stations by December. Brachionus calyciflorus and Asplanchna sp. dominated several collections in November.

h) Found in nearly all mesozooplankton collections in winter months were polychaete larvae (probably Scolecolepides), Eurytemora affinis, Cyclops bicuspidatus and chironomid larvae. E. affinis dominated every winter collection and in March 1980 reached a remarkable average density of over 70,000 per m^3. Diversity was particularly low in winter collections strongly dominated by E. affinis.

i) Twelve species of mesozooplankton account for over 93% of the total numbers of collected organisms in every month except May. The community is characterized by alternation of dominance by Acartia tonsa and Eurytemora affinis.

j) Cluster analyses in most months clearly separated those mesozooplankton samples obtained at freshwater sites from intake and discharge samples taken at locations affected by plant operation.

k) Microzooplankton collections in any given month were very similar throughout much of the sampling period, particularly during the months of November through March. Diversity indices throughout the sampling period all fell within a relatively narrow range.

l) Nauplii of Eurytemora affinis were ubiquitous throughout the period of July 1979-March 1980, but not often the dominant species in microzooplankton collections. Important dominants included Notholca marina in July and November-March, and Acartia tonsa nauplii in summer months.

7.2 Observed Plant Effects

a) Field-estimated ΔT's at the C. P. Crane site ranged from 2.5 to 8.0°C during the summer, fall and winter of 1979-1980.

b) Water transparency tended to be reduced at near-discharge stations.

c) Zooplankton volume on the discharge side of the plant was lower than at the intake during warm months, but higher in fall and winter months.

d) *Acartia tonsa* remained dominant at stations near C. P. Crane in October, while other locations saw a shift in dominance to *Eurytemora affinis*.

e) Diversity of mesozooplankton collections from discharge stations usually increased relative to intake collections, but was lower in both November and December.

f) The principal division by similarity of collections in the study area was not between intake and discharge locations, but between freshwater-influenced stations and those of the intake and discharge rendered similar by the pumping of large volumes of water.

g) Comparison of densities in horizontal tows at P15 with those from oblique collections at P15 and P02 do not demonstrate any consistent depth source for pumped intake water. There is usually a reduction in densities, however, from intake to discharge.

h) Diversity of microzooplankton increased on the discharge side only in August, decreased in other warm months through November, and showed little change in winter months.

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In this, the final segment of our reports on C. P. Crane zooplankton, it is fitting that we also extend our thanks to Randy A. Roig and Fred Jacobs for their continued support, assistance and constructive criticism in our mutual efforts.

A P P E N D I X

Table A-1. Ancillary physical data from the July 1979 - March 1980 zooplankton study for waters around the C. P. Crane generating station.

CRUISE CPC-10 (July 24, 1979)

Station	Depth (m)	Time	Surface Incident Radiation (ly/hr)	Secchi (m)	Deck Cell Lux	Sea Cell Lux	Sea/Deck Ratio	Temp (°C)	Sal. (°/oo)	D.O. (mg/l)
P-09	surf	0810	20	.35				26.5	2.413	7.06
	1.0							27.0	2.274	
	2.0							26.5	2.389	
	3.0							26.5	2.428	
	4.0							26.5	2.443	6.67
P-10	surf	0930	13	.35				27.0	2.199	7.46
	1.0							26.8	2.220	
	2.0							26.6	2.368	
	3.0							26.6	2.470	
	4.0							26.6	2.676	6.77
P-11	surf	1025	23	.45				27.0	2.362	7.82
	1.0							26.9	2.359	
	2.0							26.7	2.452	
	3.0							26.5	2.826	
	4.0							26.3	2.442	6.61
Z-03	surf	1105	20	.40				27.0	2.844	7.58
	1.0							26.8	2.868	
	2.0							26.8	3.061	
	3.0							26.5	3.234	
	4.0							26.5	3.342	
	5.0							26.3	3.413	6.17

Table A-1 (continued).

CRUISE CPC-10 (July 24, 1979) (continued)

Station	Depth (m)	Time	Surface Incident Radiation (ly/hr)	Secchi (m)	Deck Cell Lux	Sea Cell Lux	Sea/Deck Ratio	Temp (°C)	Sal. (°/oo)	D.O. (mg/l)
P-15	surf	1215	15	.40				27.3	1.851	6.93
	1.0							27.3	1.780	
	2.0							27.3	1.783	
	3.0							27.0	1.798	
	4.0							26.8	1.806	6.29
P-12	surf	1428	30	.45				27.8	1.753	7.36
	1.0							27.2	1.783	
	2.0							26.5	1.792	
	3.0							26.0	1.806	8.36

CRUISE CPC-10 (July 25, 1979)

Station	Depth (m)	Time	Surface Incident Radiation (ly/hr)	Secchi (m)	Deck Cell Lux	Sea Cell Lux	Sea/Deck Ratio	Temp (°C)	Sal. (°/oo)	D.O. (mg/l)
Z-02	surf	0830	15	.3				27.1	0.282	6.45
	1.0							27.0	0.258	
	2.0							27.0	0.248	6.61
P-08	surf	0904	12	.25				26.7	0.745	
	1.0							26.7	0.759	
	2.0							26.7	0.756	5.97
P-07	surf	0935	20	.30				26.7	1.694	6.27
	1.0							26.7	1.745	
	2.0							26.7	1.759	6.07

Table A-1 (continued)

CRUISE CPC-10 (July 25, 1979) (continued)

Station	Depth (m)	Time	Surface Incident Radiation (ly/hr)	Secchi (m)	Deck Cell Lux	Sea Cell Lux	Sea/Deck Ratio	Temp (°C)	Sal. (°/oo)	D.O. (mg/l)
P-06	surf	1012	18	.30				27.0	1.238	
	1.0							27.0	1.235	
	2.0							26.8	1.206	5.97
P-01	0.0	1105	18	.45				29.8	1.668	6.69
	1.0							29.8	1.668	6.27
P-02	0.0	1135	15	.40				31.2	1.724	6.01
	1.0							32.0	1.715	6.05
P-05	surf	1235	38	.40				30.5	1.680	6.39
	1.0							30.0	1.665	
	2.0							29.3	1.642	6.05
Z-01	surf	1328	30	.50				28.0	1.298	6.37
	1.0							27.8	1.281	6.23

CRUISE CPC-11 (August 22, 1979)

Station	Depth (m)	Time	Surface Incident Radiation (ly/hr)	Secchi (m)	Deck Cell Lux	Sea Cell Lux	Sea/Deck Ratio	Temp (°C)	Sal. (°/oo)	D.O. (mg/l)
P-09	surf	0820	25	.50	22425	4933.5	0.220	22.0	4.064	7.28
	1.0				22425	426.1	0.019	22.0	3.655	
	2.0				22425	76.24	0.003	22.0	3.689	
	3.0				22425	6.73	0.0003	22.0	3.711	
	4.0							22.0	3.842	
	5.0							22.5	3.989	6.28

Table A-1 (continued)

CRUISE CPC-11 (August 22, 1979) (continued)

Station	Depth (m)	Time	Surface Incident Radiation (ly/hr)	Secchi (m)	Deck Cell Lux	Sea Cell Lux	Sea/Deck Ratio	Temp (°C)	Sal. (°/oo)	D.O. (mg/l)
P-10	surf	0905	27	.60	35880.0	8745.75	0.244	22.0	3.723	7.00
	1.0				35880.0	986.7	0.027	22.0	3.908	
	2.0				35880.0	17.94	0.0005	22.0	4.366	
	3.0							22.0	4.581	
	4.0							22.5	5.074	6.64
P-11	surf	1015	45	.70	58305.0	12558.0	0.215	22.0	3.886	8.48
	1.0				58305.0	2915.25	0.050	22.0	3.876	
	2.0				58305.0	426.075	0.007	22.0	4.171	
	3.0				58305.0	20.1825	0.0003	22.5	4.600	
	4.0							22.5	4.740	6.42
Z-03	surf	1055	65	.60	58305.0	8970.0	0.154	23.0	5.458	9.00
	1.0				58305.0	2242.5	0.038	23.0	6.052	
	2.0				58305.0	246.675	0.004	22.5	6.091	
	3.0				58305.0	22.425	0.0003	22.5	6.142	
	4.0							22.5	6.078	
	5.0							22.5	6.139	6.34
P-15	surf	1340	65	.60	74002.5	19734.0	0.2667	25.0	3.400	7.76
	1.0				74002.5	5157.75	0.06970	24.0	3.305	
	2.0				74002.5	538.2	0.00727	23.0	3.320	
	3.0				74002.5	35.88	0.00048	22.5	3.354	
	4.0				74002.5	4.485	0.00006	22.0	3.373	6.68

Table A-1 (continued)

CRUISE CPC-11 (August 22, 1979) (continued)

Station	Depth (m)	Time	Surface Incident Radiation (ly/hr)	Secchi (m)	Deck Cell Lux	Sea Cell Lux	Sea/Deck Ratio	Temp (°C)	Sal. (°/oo)	D.O. (mg/1)
P-12	surf	1550	65	.80	58305.0	16146.0	0.27692	24.5	3.376	8.30
	1.0				58305.0	6279.0	0.10769	24.0	3.438	
	2.0				58305.0	560.625	0.00961	22.5	3.500	
	3.0							22.0	3.630	5.16

CRUISE CPC-11 (August 23, 1979)

Station	Depth (m)	Time	Surface Incident Radiation (ly/hr)	Secchi (m)	Deck Cell Lux	Sea Cell Lux	Sea/Deck Ratio	Temp (°C)	Sal. (°/oo)	D.O. (mg/1)
Z-02	surf	0810	15	.30	22425.0	2018.25	0.09	23.0	1.023	6.94
	1.0				22425.0	224.25	0.01	22.5	0.967	
	2.0				22425.0	4.485	0.0002	23.0	1.018	6.56
P-08	surf	0850	25	.40	26910.0	2691.0	0.100	23.5	1.562	7.40
	1.0				26910.0	493.35	0.018	23.0	1.747	
	2.0				26910.0	20.1825	0.0007	23.0	1.804	6.82
P-07	surf	0930	35	.50	38122.5	4709.25	0.124	23.0	3.144	7.56
	1.0				38122.5	807.30	0.021	23.0	3.397	
	2.0				38122.5	47.09	0.001	23.0	3.397	
	3.0							23.0	3.366	7.12
P-06	surf	1000	60	.50	49335.0	6727.5	0.136	24.5	2.731	--
	1.0				53820.0	1569.75	0.029	24.0	2.695	
	2.0				53820.0	112.125	0.002	23.5	2.649	6.22

Table A-1 (continued)

CRUISE CPC-11 (August 23, 1979) (continued)

Station	Depth (m)	Time	Surface Incident Radiation (ly/hr)	Secchi (m)	Deck Cell Lux	Sea Cell Lux	Sea/Deck Ratio	Temp (°C)	Sal. (°/oo)	D.O. (mg/l)
P-01	surf	1055	55	.50	65032.5	9867.0	0.152	27.0	3.028	7.26
	1.0				60547.5	2466.75	0.041	27.0	3.240	7.24
P-02	surf	1202	70	.50	74002.5	8970.0	0.121	27.0	3.305	7.34
	1.0				74002.5	2242.5	0.030	26.5	3.271	7.24
P-05	surf	1253	45	.50	67275.0	11661.0	0.173	27.0	3.268	7.36
	1.0				67275.0	2691.0	0.040	27.0	3.194	
	2.0				67275.0	269.1	0.004	27.0	2.755	7.08
Z-01	surf	1342	20	.60	35880.0	6279.0	0.175	26.0	2.670	7.42
	1.0				35880.0	2018.25	0.056	26.0	--	7.52

CRUISE CPC-12 (September 20, 1979)

Station	Depth (m)	Time	Surface Incident Radiation (ly/hr)	Secchi (m)	Deck Cell Lux	Sea Cell Lux	Sea/Deck Ratio	Temp (°C)	Sal. (°/oo)	D.O. (mg/l)
P-09	surf	0742	--	.40	8970.0	897.0	0.10	19.5	2.289	7.58
	1.0				8970.0	112.125	0.0125	20.0	1.650	
	2.0							20.0	1.639	
	3.0							20.0	1.636	
	4.0							20.5	1.656	7.70
P-10	surf	0830	15	.50	20182.5	2242.5	0.111	21.0	1.990	7.94
	1.0				20182.5	224.25	0.011	21.0	1.961	
	2.0				20182.5	8.97	0.0004	21.0	1.961	
	3.0							21.0	1.955	7.90

Table A-1 (continued)

CRUISE CPC-12 (September 20, 1979) (continued)

Station	Depth (m)	Time	Surface Incident Radiation (ly/hr)	Secchi (m)	Deck Cell Lux	Sea Cell Lux	Sea/Deck Ratio	Temp (°C)	Sal. (°/oo)	D.O. (mg/l)
P-11	surf	0945	45	.60	42607.5	5606.25	0.132	21.0	2.005	7.50
	1.0				42607.5	852.15	0.020	21.0	2.035	
	2.0				42607.5	35.88	0.008	21.0	2.077	
	3.0							21.0	2.142	7.48
Z-03	surf	1028	50	.60	49335.0	8073.0	0.16	21.5	2.428	7.68
	1.0				49335.0	1121.25	0.023	21.5	2.428	
	2.0				49335.0	44.85	0.0009	21.0	2.413	
	3.0							21.0	2.410	
	4.0							21.0	2.443	7.54
P-15	surf	1218	70	.60	67275.0	8073.0	0.12	21.5	2.368	7.34
	1.0				67275.0	964.275	0.014	21.0	2.362	
	2.0				67275.0	22.425	0.0003	21.0	2.359	
	3.0							21.0	2.359	
	4.0							21.0	2.389	7.10
P-12	surf	1449	40	.70	44850.0	4485.0	0.1	22.0	2.283	9.38
	1.0				44850.0	986.7	0.022	22.0	2.277	
	2.0				44850.0	56.0625	0.00125	21.5	2.338	
	3.0				44850.0	11.2125	0.00025	21.0	2.377	6.36

Table A-1 (continued)

CRUISE CPC-12 (September 21, 1979)

Station	Depth (m)	Time	Surface Incident Radiation (ly/hr)	Secchi (m)	Deck Cell Lux	Sea Cell Lux	Sea/Deck Ratio	Temp (°C)	Sal. (°/oo)	D.O. (mg/l)
Z-02	surf	0757	0	.5	2242.5	33.6375	0.015	20.5	0.712	8.0
	1.0				2242.5	8.97	0.004	20.5	0.745	
	2.0							20.5	0.986	7.8

CRUISE CPC-12 (September 29, 1979)

Station	Depth (m)	Time	Surface Incident Radiation (ly/hr)	Secchi (m)	Deck Cell Lux	Sea Cell Lux	Sea/Deck Ratio	Temp (°C)	Sal. (°/oo)	D.O. (mg/l)
P-01	surf	0815	<5	.70	4485.0	650.325	0.145	23.0	1.922	7.98
	1.0				4485.0	96.4275	0.0215	22.5	1.910	7.90
P-02	surf	0858	8	.70	13455.0	2691.0	0.20	23.5	1.934	8.22
	1.0				13455.0	85.215	0.0063	22.0	1.904	7.86
P-05	surf	0945	20	.60	26910.0	3139.5	0.1167	22.5	1.715	8.24
	1.0				26910.0	583.05	0.0217	22.5	1.809	
	2.0				26910.0	42.6075	0.00158	22.0	1.806	7.46
P-06	surf	1032	20	.60	31395.0	2915.25	0.02929	22.0	1.440	9.65
	1.0				31395.0	605.475	0.0193	22.0	1.431	
	2.0							22.0	1.475	8.99
P-08	surf	1215	15	.40	22425.0	627.9	0.028	20.5	0.531	9.67
	1.0				22425.0	31.395	0.0014	20.0	0.526	
	2.0					8.97	0.0004	20.0	0.616	
	3.0							20.0	0.657	8.28

Table A-1 (continued)

CRUISE CPC-12 (September 29, 1979) (continued)

Station	Depth (m)	Time	Surface Incident Radiation (ly/hr)	Secchi (m)	Deck Cell Lux	Sea Cell Lux	Sea/Deck Ratio	Temp (°C)	Sal. (°/oo)	D.O. (mg/l)
P-07	surf	1250	35	.50	53820.0	3588.0	0.067	21.0	0.865	11.12
	1.0				53820.0	336.375	0.00625	20.0	1.026	
	2.0				53820.0	11.2125	0.00021	20.0	1.069	8.82
Z-01	surf	1325	20	.50	29152.5	4260.75	0.146	22.0	1.522	9.87
	1.0				29152.5	717.6	0.0246	21.5	1.671	8.84

CRUISE CPC-13 (October 22, 1979)

Station	Depth (m)	Time	Surface Incident Radiation (ly/hr)	Secchi (m)	Deck Cell Lux	Sea Cell Lux	Sea/Deck Ratio	Temp (°C)	Sal. (°/oo)	D.O. (mg/l)
P-09	surf	0813	5	.45	6727.5	538.2	0.08	16.0	0.461	9.92
	1.0				6727.5	58.3	0.009	16.0	0.456	
	2.0				6727.5	13.5	0.002	16.0	0.471	
	3.0							16.0	0.471	
	4.0							16.0	0.496	9.60
P-10	surf	0906	15	.50	17940.0	2691.0	0.15	16.0	0.418	9.90
	1.0				17940.0	493.35	0.03	16.0	0.418	
	2.0				17940.0	71.8	0.004	16.0	0.504	
	3.0				17940.0	58.3	0.00325	15.5	0.640	
	4.0							15.5	0.654	9.33
P-11	surf	1005	30	.50	33637.5	5606.25	0.167	15.5	0.509	9.58
	1.0				33637.5	874.575	0.027	15.5	0.550	
	2.0				33637.5	56.0625	0.00167	15.5	0.561	
	3.0							15.5	0.547	9.31

Table A-1 (continued)

CRUISE CPC-13 (October 22, 1979) (continued)

Station	Depth (m)	Time	Surface Incident Radiation (ly/hr)	Secchi (m)	Deck Cell Lux	Sea Cell Lux	Sea/Deck Ratio	Temp (°C)	Sal. (°/oo)	D.O. (mg/l)
Z-03	surf	1048	30	.50	42607.5	6951.75	0.163	15.5	0.545	9.35
	1.0				42607.5	1794.0	0.042	15.5	0.537	
	2.0				42607.5	58.305	0.0014	15.0	0.534	
	3.0				42607.5	20.1825	0.00047	15.0	0.594	
	4.0							14.5	0.936	
	5.0							14.5	0.978	8.35
P-15	surf	1225	45	.55	56062.5	8970.0	0.16	20.5	0.594	11.96
	1.0				56062.5	2242.5	0.04	18.5	0.610	
	2.0				56062.5	201.825	0.0036	18.0	0.589	
	3.0				56062.5	17.94	0.00032	18.0	0.610	
	4.0							17.5	0.646	9.88
P-12	surf	1445	35	.60	44850.0	10764.0	0.24	19.0	0.621	12.52
	1.0				44850.0	2018.25	0.045	18.5	0.616	
	2.0				44850.0	269.1	0.006	18.5	0.610	
	3.0				44850.0	15.697	0.00035	17.5	0.627	10.05

CRUISE CPC-13 (October 23, 1979)

Station	Depth (m)	Time	Surface Incident Radiation (ly/hr)	Secchi (m)	Deck Cell Lux	Sea Cell Lux	Sea/Deck Ratio	Temp (°C)	Sal. (°/oo)	D.O. (mg/l)
Z-02	surf	0807	10	.30	6727.5	560.625	0.083	18.5	0.110	8.72
	1.0				6727.5	246.675	0.037	18.0	0.096	
	2.0				6727.5	65.0325	0.00967	18.0	0.096	8.84

Table A-1 (continued)

CRUISE CPC-13 (October 23, 1979) (continued)

Station	Depth (m)	Time	Surface Incident Radiation (ly/hr)	Secchi (m)	Deck Cell Lux	Sea Cell Lux	Sea/Deck Ratio	Temp (°C)	Sal. (°/oo)	D.O. (mg/l)
P-08	surf	0928	25	.35	26910.0	2018.25	0.075	18.0	0.261	9.19
	1.0				26910.0	224.25	0.0083	17.5	0.167	
	2.0				26910.0	17.94	0.00067	17.5	0.156	9.53
P-07	surf	1015	35	.35	40365.0	2018.25	0.05	17.5	0.190	9.07
	1.0				42607.5	2018.25	0.0047	17.0	0.185	
	2.0				42607.5	8.97	0.00021	17.0	0.185	8.96
P-06	surf	1055	40	.45	53820.0	4933.5	0.197	19.0	0.751	8.49
	1.0				51577.5	762.45	0.015	19.0	0.767	
	2.0				51577.5	35.88	0.00069	19.0	0.765	8.76
P-01	surf	1225	35	.65	44850.0	7176.0	0.16	21.3	0.779	10.96
	1.0				44850.0	2242.5	0.05	21.1	0.781	9.70
P-02	surf	1255	55	.4	58305.0	6727.5	0.115	23.0	0.635	11.80
	1.0				58305.0	2018.25	0.035	23.0	0.657	10.39
P-05	surf	1345	25	.55	35880.0	4036.5	0.1125	21.5	0.706	10.12
	1.0				35880.0	897.0	0.025	21.5	0.715	
	2.0				35880.0	80.73	0.00225	21.5	0.726	9.58
Z-01	surf	1432	25	.60	31395.0	4709.25	0.15	21.0	0.933	10.35
	1.0				31395.0	941.85	0.03	20.5	0.924	9.49

Table A-1 (continued)

CRUISE CPC-14 (November 21, 1979)

Station	Depth (m)	Time	Surface Incident Radiation (ly/hr)	Secchi (m)	Deck Cell Lux	Sea Cell Lux	Sea/Deck Ratio	Temp (°C)	Sal. (^{o}/oo)	D.O. (mg/l)
P-15	surf	1255	35	.60	26910.0	4036.5	0.150	12.0	0.773	10.47
	1.0				26910.0	1794.0	0.067	10.5	0.734	
	2.0				26910.0	246.7	0.0092	10.0	0.829	
	3.0							10.0	0.851	
	4.0							9.5	0.851	8.75
Z-03	surf	1520	17.0	.60	11212.5	2466.7	0.220	10.0	1.583	9.98
	1.0				11212.5	672.75	0.060	10.0	1.580	
	2.0				11212.5	89.7	0.008	10.0	1.612	
	3.0				11212.5	11.21	0.0004	10.0	1.589	
	4.0							10.0	1.589	9.72
P-11	surf	1612	10	.6	2242.5	179.4	0.08	10.0	1.189	10.16
	1.0				2242.5	35.88	0.016	10.0	1.177	
	2.0							9.5	1.212	
	3.0							9.5	1.238	9.44

CRUISE CPC-14 (November 22, 1979)

Station	Depth (m)	Time	Surface Incident Radiation (ly/hr)	Secchi (m)	Deck Cell Lux	Sea Cell Lux	Sea/Deck Ratio	Temp (°C)	Sal. (^{o}/oo)	D.O. (mg/l)
P-10	surf	0730	5	.50	2242.5	538.2	0.24	9.5	0.921	10.20
	1.0				4485.0	179.4	0.04	9.5	0.989	
	2.0				4485.0	17.94	0.004	9.5	1.037	
	3.0				4485.0	6.73	0.0015	10.0	1.417	
	4.0							10.0	1.437	9.37

Table A-1 (continued)

CRUISE CPC-14 (November 22, 1979) (continued)

Station	Depth (m)	Time	Surface Incident Radiation (ly/hr)	Secchi (m)	Deck Cell Lux	Sea Cell Lux	Sea/Deck Ratio	Temp (°C)	Sal. (°/oo)	D.O. (mg/l)
P-09	surf	0830	15	.60	13455.0	1345.5	0.10	10.0	0.986	10.34
	1.0				13455.0	403.65	0.03	10.0	0.981	
	2.0				13455.0	33.63	0.0025	10.0	0.981	
	3.0				13455.0	8.97	0.000667	10.0	0.998	
	4.0				13455.0	4.485	0.000333	10.0	1.012	10.14
Z-02	surf	0925	50	.70	29152.5	4485.0	0.1538	10.0	0.210	10.30
	1.0				29152.5	1794.0	0.0615	10.0	0.101	
	2.0				29152.5	426.075	0.0146	9.5	0.099	10.18
P-08	surf	1000	40	.50	31395.0	5382.0	0.1714	10.0	0.135	11.14
	1.0				29152.5	1009.125	0.03214	9.5	0.133	
	2.0				29152.5	49.3	0.00157	9.0	0.133	11.11
P-07	surf	1035	40	.50	38122.5	4485.0	0.11764	10.0	0.308	10.65
	1.0				38122.5	897.0	0.0235	9.5	0.331	
	2.0				38122.5	44.85	0.00118	9.5	0.347	10.59
P-06	surf	1110	35	.40	42607.5	4933.5	0.1158	12.5	1.318	10.45
	1.0				42607.5	1121.25	0.0263	12.0	0.809	
	2.0				42607.5	134.55	0.00316	12.0	0.795	9.84
P-01	surf	1200	45	.40	44850.0	6503.25	0.145	12.0	0.773	10.02

Table A-1 (continued)

CRUISE CPC-14 (November 22, 1979) (continued)

Station	Depth (m)	Time	Surface Incident Radiation (ly/hr)	Secchi (m)	Deck Cell Lux	Sea Cell Lux	Sea/Deck Ratio	Temp (°C)	Sal. (°/oo)	D.O. (mg/1)
P-02	surf	1230	45	.50	44850.0	7400.25	0.165	15.0	0.784	10.26
	1.0				42607.5	2242.5	0.05			
P-05	surf	1320	40	.50	35880.0	7624.5	0.2125	13.5	0.795	10.65
Z-01	surf	1405	35	.60	29152.5	4036.5	0.1385	11.0	0.851	10.26
P-12	surf	1455	30	.60	11212.5	1345.5	0.12	11.0	0.831	10.65
	1.0				11212.5	784.875	0.07	11.0	0.820	
	2.0				11212.5	134.55	0.012	11.0	0.950	
	3.0				11212.5	8.97	0.0008	11.0	1.137	10.73

CRUISE CPC-15 (December 18, 1979)

Station	Depth (m)	Time	Surface Incident Radiation (ly/hr)	Secchi (m)	Deck Cell Lux	Sea Cell Lux	Sea/Deck Ratio	Temp (°C)	Sal. (°/oo)	D.O. (mg/1)
P-09	surf	0845	20	.3	134550.0	25116.0	0.187	3.0	0.501	11.72
	1.0				13455.0	201.825	0.0015	2.0	0.424	
	2.0				13455.0	17.94	0.000133	2.0	0.408	
	3.0							2.0	0.416	
	4.0							3.0	0.426	11.16
P-10	surf	1020	30	.30	29152.5	2018.25	0.06923	3.0	0.410	10.96
	1.0				29152.5	224.25	0.00769	3.0	0.464	
	2.0				29152.5	29.1525	0.001	3.0	0.403	
	3.0							2.5	0.469	
	4.0							3.0	0.426	11.00

Table A-1 (continued)

CRUISE CPC-15 (December 18, 1979) (continued)

Station	Depth (m)	Time	Surface Incident Radiation (ly/hr)	Secchi (m)	Deck Cell Lux	Sea Cell Lux	Sea/Deck Ratio	Temp (°C)	Sal. (°/oo)	D.O. (mg/1)
Z-03	surf	1150	25	.30	22425.0	672.75	0.03	3.5	0.583	11.44
	1.0				22425.0	112.125	0.005	3.5	0.564	
	2.0				22425.0	29.1525	0.0013	3.5	0.561	
	3.0							4.0	0.558	
	4.0							4.0	0.591	
	5.0							4.0	--	11.3
P-11	surf	1307	20	.40	24667.5	672.75	0.2727	3.0	0.809	11.92
	1.0				24667.5	179.4	0.00727	3.5	0.501	
	2.0				24667.5	40.365	0.001636	3.5	0.501	
	3.0							4.0	0.518	11.24
P-15	surf	1355	25	.30	17940.0	897.0	0.05	2.5	0.434	11.86
	1.0				17940.0	179.4	0.01	2.5	0.429	
	2.0				17940.0	60.5475	0.003375	2.5	0.429	
	3.0							2.5	0.429	
	4.0							2.5	0.424	11.64

CRUISE CPC-15 (December 19, 1979)

Station	Depth (m)	Time	Surface Incident Radiation (ly/hr)	Secchi (m)	Deck Cell Lux	Sea Cell Lux	Sea/Deck Ratio	Temp (°C)	Sal. (°/oo)	D.O. (mg/1)
Z-02	surf	0855	<5	.30	4485.0	67.275	0.015	1.0	0.222	12.0
	1.0				4485.0	33.88	0.008	1.0	0.167	
	2.0							1.0	0.162	12.0

Table A-1 (continued)

CRUISE CPC-15 (December 19, 1979) (continued)

Station	Depth (m)	Time	Surface Incident Radiation (ly/hr)	Secchi (m)	Deck Cell Lux	Sea Cell Lux	Sea/Deck Ratio	Temp (°C)	Sal. (°/oo)	D.O. (mg/l)
P-08	surf	1010	<5	.30	4485.0	44.85	0.01	1.5	0.284	12.1
	1.0				4485.0	31.395	0.007	1.0	0.279	
	2.0							1.0	0.323	12.08
P-07	surf	1050	<5	.20	8970.0	583.05	0.065	1.0	0.389	12.08
	1.0				8970.0	201.825	0.0225	1.0	0.389	
	2.0							1.0	0.389	11.94
P-06	surf	1122	5	.20	8970.0	112.125	0.0125	1.0	0.426	11.82
	1.0				8970.0	31.395	0.0035	1.0	0.429	
	2.0							1.0	0.424	11.86
P-01	surf	1228	5	.20	11212.5	426.075	0.038	4.0	0.453	11.26
	1.0							4.0	0.453	11.18
P-02	surf	1305	5	.20	11212.5	134.55	0.012	9.0	0.450	10.84
	1.0							9.0	0.429	10.56
P-05	surf	1400	5	.20	13455.0	89.7	0.0067	3.0	0.509	11.56
	1.0				13455.0	35.88	0.0027	3.0	0.509	11.04
Z-01	surf	1500	5	.20	6727.5	426.075	0.0633	2.0	0.556	11.70

Table A-1 (continued)

CRUISE CPC-15 (December 19, 1979) (continued)

Station	Depth (m)	Time	Surface Incident Radiation (ly/hr)	Secchi (m)	Deck Cell Lux	Sea Cell Lux	Sea/Deck Ratio	Temp (°C)	Sal. (°/oo)	D.O. (mg/l)
P-12	surf	1550	5	.20	4485.0	134.55	0.03	1.0	0.424	11.54
		pump broken			4485.0	42.6075	0.0095			
	3.0							1.0	0.424	11.60

CRUISE CPC-16 (January 17, 1980)

Station	Depth (m)	Time	Surface Incident Radiation (ly/hr)	Secchi (m)	Deck Cell Lux	Sea Cell Lux	Sea/Deck Ratio	Temp (°C)	Sal. (°/oo)	D.O. (mg/l)
P-09	surf	0800	5	1.5	4485.0	1121.25	0.25	3.5	3.845	12.55
	1.0				4485.0	515.775	0.115	3.0	3.864	
	2.0				4485.0	269.1	0.06	4.0	3.652	
	3.0				4485.0	58.305	0.013	4.0	3.892	
	4.0							4.0	4.347	11.98
P-10	surf	0850	7	1.2	8970.0	2242.5	0.25	3.5	3.546	12.55
	1.0				8970.0	1569.75	0.175	3.5	3.531	
	2.0				8970.0	493.35	0.055	3.5	3.889	
	3.0				8970.0	336.375	0.0375	3.5	4.177	12.08
P-11	surf	1000	30	1.3	24667.5	3588.0	0.1454	3.5	4.259	11.09
	1.0				24667.5	2466.75	0.10	4.0	4.225	
	2.0				24667.5	852.15	0.034	4.0	4.256	
	3.0				24667.5	21.182	0.00086	4.0	4.464	
	3.5							4.0	4.632	11.92

Table A-1 (continued)

CRUISE CPC-16 (January 17, 1980) (continued)

Station	Depth (m)	Time	Surface Incident Radiation (ly/hr)	Secchi (m)	Deck Cell Lux	Sea Cell Lux	Sea/Deck Ratio	Temp (°C)	Sal. (°/oo)	D.O. (mg/l)
Z-03	surf	1040	25	1.4	24667.5	4485.0	0.1818	4.0	5.157	11.98
	1.0				24667.5	3139.5	0.1273	4.0	5.176	
	2.0				24667.5	1031.55	0.0419	4.0	5.215	
	3.0				24667.5	457.47	0.0185	4.0	5.346	
	4.0				24667.5	313.95	0.0127	4.0	5.417	
	5.0				24667.5	76.245	0.0031	4.0	5.420	11.31
P-15	surf	1240	10	1.2	20182.5	2242.5	0.1111	6.0	3.407	11.74
	1.0				20182.5	2242.5	0.1111	5.5	3.370	
	2.0				20182.5	897.0	0.0444	5.5	3.521	
	3.0				20182.5	403.65	0.0200	4.5	4.146	
	4.0				20182.5	246.675	0.0122	3.5	4.363	11.68
P-12	surf	1445	5	1.2	11212.5	1121.25	0.10	4.5	3.191	12.27
	1.0				11212.5	717.6	0.064	4.0	3.311	
	2.0				11212.5	381.225	0.034	4.0	3.590	
	3.0				11212.5	201.825	0.018	3.5	4.486	12.06

CRUISE CPC-16 (January 18, 1980)

Station	Depth (m)	Time	Surface Incident Radiation (ly/hr)	Secchi (m)	Deck Cell Lux	Sea Cell Lux	Sea/Deck Ratio	Temp (°C)	Sal. (°/oo)	D.O. (mg/l)
Z-02	surf	0815	2	.70	2242.5	22.425	0.01	4.0	0.673	12.51
	1.0				2242.5	8.97	0.004	4.0	0.936	
	2.0							4.0	1.750	11.98

Table A-1 (continued)

CRUISE CPC-16 (January 18, 1980) (continued)

Station	Depth (m)	Time	Surface Incident Radiation (ly/hr)	Secchi (m)	Deck Cell Lux	Sea Cell Lux	Sea/Deck Ratio	Temp (°C)	Sal. (°/oo)	D.O. (mg/l)
P-08	surf	0850	2	1	2242.5	381.225	0.17	4.0	1.984	12.17
	1.0				2242.5	201.825	0.09	4.0	1.827	
	2.0				2242.5	44.85	0.02	4.0	1.919	12.37
P-07	surf	0925	2	0.9	2242.5	426.075	0.19	4.0	2.119	12.14
	1.0				2242.5	269.1	0.12	4.0	2.874	
	2.0				2242.5	56.06	0.025	4.0	3.271	11.96
P-06	surf	0955	2	1.0	2242.5	784.875	0.35	4.9	1.809	12.04
	1.0				2242.5	358.8	0.16	4.5	1.827	
	2.0				2242.5	179.4	0.08	6.9	2.220	10.97
P-01	surf	1055	5	0.9	4485.0	448.5	0.10	6.0	2.362	11.31
	1.0				4485.0	269.1	0.06	6.4	2.356	11.07
P-02	surf	1207	5	1.0	6727.5	1794.0	0.267	7.0	2.283	11.49
	1.0				6727.5	717.6	0.107	9.5	2.902	11.33
P-05	surf	1300	5	0.50	4485.0	695.175	0.155	6.0	1.833	11.09
	1.0				4485.0	246.675	0.055	--	1.833	11.33
Z-01	surf	1340	5	0.80	2242.5	269.1	0.12	6.0	1.830	11.27
	1.0				2242.5	112.125	0.05	6.0	1.830	10.85

Table A-1 (continued)

CRUISE CPC-17 (February 29, 1980)

Station	Depth (m)	Time	Surface Incident Radiation (ly/hr)	Secchi (m)	Deck Cell Lux	Sea Cell Lux	Sea/Deck Ratio	Temp (°C)	Sal. (°/oo)	D.O. (mg/l)
P-12	surf	1050	60	1.25	60547.5	18837.0	0.3111	1.5	6.872	--
	1.0				60547.5	11661.0	0.1926	1.0	6.826	
	2.0				60547.5	897.0	0.0148	1.0	6.817	
P-11	surf	1130	60	--	49335.0	23322.0	0.4727	1.0	6.980	--
	1.0				49335.0	16863.6	0.3418	1.5	6.961	--
	2.0				49335.0	3363.75	0.0682	1.5	6.967	
	3.0				49335.0	1121.25	0.0227	1.2	6.934	--
P-15	surf	1200	15	1.25	20182.5	6951.75	0.3444	2.0	6.774	
	1.0				20182.5	3588.0	0.1778	2.0	6.718	--
	2.0				20182.5	874.575	0.0433	2.0	6.764	
	3.0				20182.5	426.075	0.0211	2.0	6.686	
	4.0				20182.5	336.375	0.0167	2.0	--	--

CRUISE CPC-18 (March 18, 1980)

Station	Depth (m)	Time	Surface Incident Radiation (ly/hr)	Secchi (m)	Deck Cell Lux	Sea Cell Lux	Sea/Deck Ratio	Temp (°C)	Sal. (°/oo)	D.O. (mg/l)
P-12	surf	0950	17	0.80	26910.0	3812.25	0.1417	5.5	4.800	11.46
	1.0				26910.0	919.425	0.0347	5.5	--	
	2.0				26910.0	201.825	0.0075	5.5	4.857	
	3.0							5.5	4.810	11.04
P-15	surf	1102	60	0.80	74002.5	18837.0	0.0255	8.0	4.969	10.82
	1.0				74002.5	5382.0	0.0727	--	--	
	2.0				74002.5	672.75	0.0091	7.8	4.969	
	3.0							7.5	4.937	10.44

Table A-1 (continued)

CRUISE CPC-18 (March 19, 1980)

Station	Depth (m)	Time	Surface Incident Radiation (ly/hr)	Secchi (m)	Deck Cell Lux	Sea Cell Lux	Sea/Deck Ratio	Temp (°C)	Sal. (°/oo)	D.O. (mg/l)
Z-02	surf	0805	40	--	29152.5	3139.5	0.1077	7.8	1.557	10.54
	1.0				29152.5	426.075	0.0146	7.0	1.501	
	2.0				29152.5	35.88	0.0012	7.0	1.557	11.00
P-08	surf	0842	45	0.40	35880.0	19734.0	0.55	6.8	2.939	11.82
	1.0				35880.0	1121.25	0.0313	6.8	3.037	
	2.0				35880.0	89.7	0.0025	6.7	3.037	11.18
P-07	surf	0915	50	0.50	48707.1	8073.0	0.1658	6.6	4.127	10.86
	1.0				48707.1	2018.25	0.0414	6.6	4.146	
	2.0				48707.1	179.4	0.0037	6.4	4.177	11.36
P-06	surf	0944	55	0.50	56062.5	5382.0	0.096	6.9	3.702	11.00
	1.0				56062.5	1569.75	0.028	6.9	3.692	
	2.0				56062.5	269.1	0.0048	6.8	3.808	11.48
P-01	surf	1026	60	0.60	69517.5	24219.0	0.3484	10.1	4.803	9.94
	1.0				69517.5	2018.25	0.0290	10.1	4.905	9.76
P-02	surf	1055	50	0.70	58305.0	9867.0	0.1692	10.0	--	10.62
	1.0				58305.0	2242.5	0.0385	9.9	--	10.90
P-05	surf	1135	55	0.50	69517.5	8073.0	0.1161	8.7	4.565	11.0
	1.0				69517.5	1794.0	0.0258	8.3	4.518	10.66

Table A-1 (concluded)

CRUISE CPC-18 (March 19, 1980) (continued)

Station	Depth (m)	Time	Surface Incident Radiation (ly/hr)	Secchi (m)	Deck Cell Lux	Sea Cell Lux	Sea/Deck Ratio	Temp (°C)	Sal. (°/oo)	D.O. (mg/l)
Z-01	surf	1215	55	0.50	67275.0	9418.5	0.14	9.8	4.841	10.06
	1.0				67275.0	2242.5	0.0333	9.6	4.841	10.00
P-09	surf	1300	55	0.60	62790.0	8970.0	0.1429	6.5	4.310	11.30
	1.0				62790.0	3812.25	0.0607	6.4	4.303	
	2.0				62790.0	560.625	0.0089	6.4	4.303	11.10
P-10	surf	1345	50	0.60	60099.0	17043.0	0.2836	6.6	4.316	11.50
	1.0				60099.0	3991.65	0.0664	6.5	4.306	
	2.0				60099.0	609.96	0.0102	6.7	4.313	
	3.0				60099.0	165.945	0.0028	--	--	
	4.0							6.5	4.332	10.50
Z-03	surf	1440	30	0.80	40365.0	15249.0	0.3778	6.1	4.474	11.88
	1.0				33637.5	3363.75	0.100	6.1	4.470	
	2.0				33637.5	941.85	0.028	6.1	4.483	
	3.0				33637.5	300.495	0.0089			
	4.0				33637.5	56.511	0.0017	6.0	4.743	
	5.0							5.8	4.762	11.78
P-11	surf	1525	20	0.70	30049.5	21528.0	0.7164	6.2	4.527	11.62
	1.0				30049.5	2242.5	0.0746	6.1	4.524	
	2.0				30049.5	461.955	0.0153	6.1	4.518	
	3.0				30049.5	98.222	0.0033	6.0	4.740	11.20

Table A-2 . Identity and counts (per 0.1 m^3) of microzooplankton sampled by pump at the C. P. Crane generating station, July 1979 - March 1980. N = nauplii, C = copepodites, A = adults.

	Station																	
	P15								P02		P05		P06		P10		Z03	
	OBL		SURF		MID		BOT											
Taxa/Replicate	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
									July									
ROTIFERA																		
unid. rotifers													448	128		32		
Brachionus sp.													512	320				
Brachionus calyciflorus	416	672	360	280	590	560	200	140	768	1184	624	480	896	768	192	64	80	32
Brachionus plicatilis	48				10	40		20					32	96	32			
Notholca marina	2678	4096	1120	1020	2530	2320	3880	3380	6048	7280	8640	4544	5856	3200	480	352		16
NEMATODA																		
unid. nematodes		32																
CLADOCERA																		
unid. cladoceran	224	80	160	110	220	120	320	440	352	688	432	160	1248	1248	1216	1184	352	384
Diaphanosoma brachyurum			10								16							
Moina micrura	144	160			10	60	120	72	32	64	384	160	64			32	160	224
Sida crystallina												32	64					
COPEPODA																		
unid. nauplii					40	20	40	60			16		288	512	96		48	
Acartia tonsa (N)	1760	1968	470	230	980	1160	3360	3560	672	416	1008	960	1856	896	2368	2912	1792	2016
" " (C)	144	192	10	10	40	20	400	400	32	64		32	64		576	320	912	1200
" " (A)	16						40										208	192
Eurytemora affinis (N)	624	544	520	310	680	680	1680	1640	736	1072	1296	1216	2528	1664	224	192	208	256
" " (C)	16					20	40	40				32			32	32	32	112
" " (A)					10			20										
unid. cyclopoid		16						40		16	64							
unid. harpacticoid													32	32				
Ectinosoma curticorne																		32
Scottolana canadensis	32	48	10			20	120	40			144	32	96		32	64	32	16

Table A-2 (continued)

Taxa/Replicate	Station OBL 1	OBL 2	SURF 1	SURF 2	MID 1	MID 2	BOT 1	BOT 2	P02 1	P02 2	P05 1	P05 2	P06 1	P06 2	P10 1	P10 2	Z03 1	Z03 2
July (continued)																		
CIRRIPEDIA																		
unid. barnacle nauplii	304	240	170	100	230	260	1200	1080	1056	1056	256	448	32	32	512	288	192	208
unid. barnacle cypris	32														32		80	16
ARACHNIDA																		
Hydracarina															32			
August																		
ROTIFERA																		
Brachionus calyciflorus	80	48	7	20	50	10	20	50	24		48	32	328	824	32			
Brachionus plicatilis	112	32	7	15	95	95	160	180	224	248	440	496	24	48	16	64		
Notholca marina	48		35	85	40	40	20	10	32		8	8	40	168	48	16		
ANNELIDA																		
unid. oligochaetes	16							10	8	8	16		8		80	16	240	304
COPEPODA																		
unid. nauplii	16			2	5			30	16	24	16		8	8	48	16		
Acartia tonsa (N)	2288	704	502	542	605	515	2430	2720	800	1464	1216	1632	664	1416	4240	5632	3024	1328
" " (C)	192	80	32	15	80	15	300	650	40	48	80	104	32	48	672	672	256	56
" " (A)	16		2	2				10					8		16			8
Eurytemora affinis (N)	320	256	245	450	185	155	380	300	416	464	272	456	328	664	656	480	352	464
unid. cyclopoid			2									8						
Scottolana canadensis	32		5	2			20	50					8			16		
CIRRIPEDIA																		
unid. barnacle nauplius	96	144	62	40	105	50	160	150	232	152	72	104		24	256	288	336	128

Table A-2 (continued)

Taxa/Replicate		P15 OBL 1	P15 OBL 2	P15 SURF 1	P15 SURF 2	P15 MID 1	P15 MID 2	P15 BOT 1	P15 BOT 2	P02 1	P02 2	P05 1	P05 2	P06 1	P06 2	P10 1	P10 2	Z03 1	Z03 2
September																			
ROTIFERA																			
Brachionus calyciflorus		256	400	185	65	250	230	260	200	344	264	752	480	392	336	688	496	112	64
Brachionus plicatilis		512	512	125	165	290	190	340	150	100	96	208	128	88	16	48	32	208	96
Keratella cochlearis												16							
Notholca marina		576	544	400	305	430	220	820	690	84	96	224	208	552	552	240	176	80	
NEMATODA																			
unid. nematodes		128	32	10	55	10													
ANNELIDA																			
unid. oligochaetes		96	80			30	10	180	90						16	16	32	32	80
unid. polychaetes					5														
CLADOCERA																			
unid. cladoceran														16					16
unid. chydorid										4									
COPEPODA																			
unid. nauplii		64	48	5	15	10	10	40	60		8	16	48	16	8	64			16
Acartia tonsa	(N)	2880	1456	620	305	2890	2220	2700	2730	668	680	1936	2528	760	824	3584	3248	4720	4864
" "	(C)	480	144	35	10	340	210	380	750	16	8	64	112	48	24	208	272	528	256
" "	(A)	32	32		5	50		20	60					8				96	96
Eurytemora affinis	(N)	1824	1536	755	415	1460	1030	1940	1360	688	768	1104	1152	536	1096	480	592	496	800
" "	(C)						10		20	4									
" "	(A)																		
unid. cyclopoid																			32
Ergasilus chatauguaensis																16			
Scottolana canadensis		96	80	15		60	20	480	650			48	16	16	8	16	32	32	64
CIRRIPEDIA																			
unid. barnacle nauplii		320	320	155	45	390	370	560	450	388	192	160	272	80	80	144	128	144	208
unid. barnacle cypris								20										16	

Table A-2 (continued)

Taxa/Replicate	P15 OBL 1	P15 OBL 2	P15 SURF 1	P15 SURF 2	P15 MID 1	P15 MID 2	P15 BOT 1	P15 BOT 2	P02 1	P02 2	P05 1	P05 2	P06 1	P06 2	P10 1	P10 2	Z03 1	Z03 2
October																		
PROTOZOA																		
unid. ciliate	40		20	70	60	150	180	140	16	48	64	48	8	32		20	8	
ROTIFERA																		
unid. rotifers	1496	936	2220	1930	4150	3050	2380	2720	1312	3800	6152	5688	9192	5312	1716	2292	1328	1396
<u>Asplanchna</u> sp.	16	24	20			20					8	8		32	44	20	24	4
<u>Brachionus</u> sp.															28			4
<u>Brachionus caudatus</u>	32	40	40	60	90	90		40	32	64	24	8	64		80	96	24	60
<u>Brachionus calyciflorus</u>	72	80	60	30	150	130	80	160	16	88	160	120	200	144	172	288		196
<u>Brachionus plicatilis</u>	16	24		40	60	40	40		96	200	48	144	64		96	80		48
<u>Filinia</u> sp.					20		20						8			28	72	8
<u>Kellicottia bostoniensis</u>																		4
<u>Kellicottia longispina</u>																4	8	
<u>Keratella</u> sp.	8		20			10	20		8	8	8		16		40	40	80	64
<u>Keratella cochlearis</u>					50													
<u>Notholca marina</u>	8		20		10				8	40	24	104	32	80	28	48	56	36
<u>Tetramastix opoliensis</u>			20	30		10	20	100	16	16	40	56	32		20	36	8	24
NEMATODA																		
unid. nematodes		8									8	8						
ANNELIDA																		
unid. polychaete larvae											16				12	8	552	156
CLADOCERA																		
unid. cladoceran															12	8	72	12

Table A-2 (continued)

Taxa/Replicate		P15 OBL 1	P15 OBL 2	P15 SURF 1	P15 SURF 2	P15 MID 1	P15 MID 2	P15 BOT 1	P15 BOT 2	P02 1	P02 2	P05 1	P05 2	P06 1	P06 2	P10 1	P10 2	Z03 1	Z03 2
									October (continued)										
COPEPODA																			
unid. nauplii		64	88	140	40	10	30	320	160	88	192	112	144	96	48	128	1696	200	
Acartia tonsa	(N)	144	128	180	160	70	110		520	128	296	128	128	352	304	124		8	
" "	(C)								20		24	8	32	56		12	12		8
" "	(A)						50				48				16				
Eurytemora affinis	(N)	16	8	40		10	30	80	60	16	24	160	88	80	32	284		424	(?)
" "	(C)								20		16	16	16	40		64	76	384	296
" "	(A)													8				48	
Pseudodiaptomus coronatus	(C)																4		
unid. cyclopoid	(N)															12			
" "	(C)															12	4	32	
Cyclops bicuspidatus	(C)																	16	
" "	(A)																	8	
Oithona colcarva																	4		
unid. harpacticoid										8			8			4		8	
Scottolana canadensis	(N)	480	424	340	390	100	130	1480	1160	312	584	792	672	1056	464	1132			(?)
" "	(C)															24			
" "	(A)		8						20										
CIRRIPEDIA																			
unid. barnacle nauplii											8								

Table A-2 (continued)

Taxa/Replicate	P15 OBL 1	P15 OBL 2	P15 SURF 1	P15 SURF 2	P15 MID 1	P15 MID 2	P15 BOT 1	P15 BOT 2	P02 1	P02 2	P05 1	P05 2	P06 1	P06 2	P10 1	P10 2	Z03 1	Z03 2
November																		
PROTOZOA																		
unid. ciliate	32		160						64					32				
ROTIFERA																		
unid. rotifers	2496	960	10,880	6320	9200	5440	4260	2200	4608	8704	1472	1120	4128	2880	3360	3808	2816	2816
Asplanchna sp.	288	480	352	1120	840	240	100	220	768	2368	736	832	608	448	448	384		160
Brachionus calyciflorus	4368	3264	3744	7440	6320	2720	1840	1520	3072	8064	5728	5376	8448	6976	2032	2368	736	912
Brachionus caudatus					40					192				96				16
Brachionus plicatilis	32		32		40	80	60	20	384		128	288	128		80			48
Filinia sp.	1728	992	2400	5040	7600	5520	2440	1080	3968	7808	1184	2016	2208	1696	3440	2976	1600	1264
Kellicottia bostoniensis								20										
Kellicottia longispina	48											32			64	80		
Keratella sp.	1232	704	2640	2320	2560	1360	1680	1640	2176	2688	768	1280	1184	1696	896	544	704	592
Keratella quadrata											32							
Notholca marina	5152	4800	5840	4000	14,080	10,080	2360	1240	12,416	13,184	14,240	25,984	9152	8544	2992	3360	864	1872
Platyias quadricornis	16																	
Tetramastix opoliensis	368	576	1280	1120	560	240	240	80	512	1280	288	480	448	448	448	352	352	160
NEMATODA																		
unid. nematodes	16	64	32															
ANNELIDA																		
unid. polychaetes	64	32		80			80		256		32	32	32		160	64	384	400
MOLLUSCA																		
unid. bivalve larvae						80												
CLADOCERA																		
unid. cladocerans	48	8						40									8	

Table A-2 (continued)

Taxa/Replicate		P15 OBL 1	P15 OBL 2	P15 SURF 1	P15 SURF 2	P15 MID 1	P15 MID 2	P15 BOT 1	P15 BOT 2	P02 1	P02 2	P05 1	P05 2	P06 1	P06 2	P10 1	P10 2	Z03 1	Z03 2
November (continued)																			
OSTRACODA																			
unid. ostracods		16																	
COPEPODA																			
unid. nauplii		208	112		10		100	300	420	144	152	48	28	256	256	288	320	24	128
Acartia tonsa	(N)		8	20	30	60				48	8		20				80	176	160
" "	(C)																	32	
" "	(A)						80						8					32	
Eurytemora affinis	(N)	720	600	250	140	200	760	2420	2060	792	480	264	188	2272	1120	912	1072	408	576
" "	(C)	64	56			20	60	220	40	16	192	32		256	64	352	208	320	336
" "	(A)															16			
unid. cyclopoid		16						20	20	64						16			
Cyclops sp.																16			
Cyclops bicuspidatus												32						32	
unid. harpacticoid														32					
Scottolana canadensis	(N)	16	8		10	40	100			48	8	32			32				
" "	(A)							20											
CIRRIPEDIA																			
unid. barnacle nauplii																		8	

Table A-2 (continued)

Taxa/Replicate	P15 OBL 1	P15 OBL 2	P15 SURF 1	P15 SURF 2	P15 MID 1	P15 MID 2	P15 BOT 1	P15 BOT 2	P02 1	P02 2	P05 1	P05 2	P06 1	P06 2	P10 1	P10 2	Z03 1	Z03 2
December																		
ROTIFERA																		
unid. rotifers	2944	1664	3320	4760	3160	3000	5280	5440	1280	1280	1472	1280	704		5728	2880	1360	2432
Asplanchna sp.	320	480	320	240	520	560	640	560	192	768	384	320	832	512	448	192	32	64
Brachionus calyciflorus	1280	1408	1080	960	720	1160	1840	1360	1184	3456	1920	2816	1408	1216	1344	1120	448	48
Brachionus caudatus				40					32									
Brachionus plicatilis	160	96	80		160	120		240	256	768	384		320	320	352	96		
Filinia sp.	15,136	8800	10,800	19,320	10,200	9080	21,600	16,560	21,312	17,088	24,128	14,464	12,672	13,248	3200	3296	736	2608
Kellicottia sp.	32																	
Kellicottia bostoniensis						40				128		64	128	192	32		16	16
Kellicottia longispina	64	32				40								128	64			
Keratella sp.	192	448	360	640	320	360	240	480	160	256	384	192	192	64	640		128	112
Notholca marina	9056	5568	7400	7480	7560	8240	10,800	9360	13,728	26,944	29,504	17,152	20,608	20,416	11,936	5888	4688	3200
Tetramastix opoliensis	2752	2560	2080	2400	2280	2680	4160	2720	2592	6464	4032	2624	1728	1792	2752	1248	1040	1104
NEMATODA																		
unid. nematodes		32							128	128		64				64		
ANNELIDA																		
unid. polychaetes				40			80		64	64	128	128	192			32		
MOLLUSCA																		
unid. bivalve larvae															64			
CLADOCERA																		
unid. cladocerans	64	32	80	40	40	80	80	160	32		384	768	448	128	32	128	48	32
OSTRACODA																		
unid. ostracods											384							

Table A-2 (continued)

Taxa/Replicate		P15 OBL 1	P15 OBL 2	P15 SURF 1	P15 SURF 2	P15 MID 1	P15 MID 2	P15 BOT 1	P15 BOT 2	P02 1	P02 2	P05 1	P05 2	P06 1	P06 2	P10 1	P10 2	Z03 1	Z03 2
December (continued)																			
COPEPODA																			
unid. nauplii		416	608	600	560	680	600	560	320	416	576	576	320	1472	1792	416	352	720	160
Acartia tonsa	(N)															32			
Diaptomus sp.																		16	
Eurytemora affinis	(N)	2016	2432	1840	1280	1320	2240	2160	2080	1760	3200	5760	3712	3584	5440	3072	1440	896	896
" "	(C)	384	640	640	240	240	640	640	800	576	896	1088	320	1088	832	320	160	288	176
" "	(A)	128	128			80	80			32	384	320	64	320	320	128	32	32	16
unid. cyclopoid		96	32	400	40	120	160		160		320	320	128	320	512	320	32	48	48
Cyclops sp.									80										
Cyclops bicuspidatus														64	64	96			
unid. harpacticoid		32	64													32	160		
Scottolana canadensis	(N)							80											
" "	(A)		32					80				64							
January																			
ROTIFERA																			
unid. rotifers		1408	1792	1720	3720	3200	4480	520	960	896	2176	2944	1536	320	864	3584	5376	2944	2880
Asplanchna sp.						160		60			128			64		64		256	1216
Brachionus calyciflorus		768	384	80	160	160	160	140	320		384	128	128	64	64		128	64	128
Brachionus plicatilis									160			128							128
Filinia sp.		1536	1536	3160	2600	1760	4640	660	2400	896	1152	2816	2176	576	736	960	2944	576	384

Table A-2 (continued)

	Station																	
	P15								P02		P05		P06		P10		Z03	
	OBL		SURF		MID		BOT											
Taxa/Replicate	1	2	1	2	1	2	1	2	1	2	1	22	11	22	11	22	1	2
January (continued)																		
ROTIFERA (continued)																		
Keratella sp.				80														
Notholca marina	33,920	36,352	5480	9520	142,720	73,600	9660	25,120	56,448	32,384	69,120	53,120	6400	12,672	15,104	13,952	6272	14,144
Tetramastix opoliensis		128	480	360	480		80		1408	1024	1664	1280	64	192	64	256		
ANNELIDA - MOLLUSCA																		
unid. trochophore		640	320	160	480	480	20	480	512	128	256		64	64			320	320
CLADOCERA																		
unid. cladoceran	128										128			64				
COPEPODA																		
unid. nauplii	2688	1792	160	280	1760	1600	1600	2240	1280	1024	1536	2048	128	448	512	768	256	192
Acartia tonsa (N)							20								64			
Eurytemora affinis (N)	6272	5632	5160	8920	15,840	10,080	1020	2080	9856	6656	32,384	11,904	2112	4480	3456	4224	2368	2432
" " (C)	1024	256	280	360	2720	1120	180	640	768	512	2560	1280	320	576	768	1152	128	192
" " (A)	128	128	40	40	480	320	60	160			256			32		128	64	384
unid. cyclopoid	1024		80	80	160	480	500	1760	128	128	256	128		160	64		64	128
Cyclops bicuspidatus	128					160	20	640	256			128		64	128		64	64
unid. harpacticoid																		64
Scottolana canadensis																		64

Table A-2 (continued)

	Station P15								P02		P05		P06		P10		Z03	
	OBL		SURF		MID		BOT											
Taxa/Replicate	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
February																		
ROTIFERA					*	*	*	*	*	*	*	*	*	*	*	*	*	*
unid. rotifers		7040	8000	9920														
Filinia sp.	512																	
Notholca marina	48,896	41,344	42,080	40,640														
COPEPODA																		
Diaptomus sp.				320														
Eurytemora affinis (N)	15,872	16,128	15,200	17,600														
" " (C)	2560	3072	1280	2240														
" " (A)	256	256	320	320														
March																		
ROTIFERA																		
unid. rotifers	768	1792	2240	1600	1280	1600	2800	4880	256		768	512		512		1280	768	2304
Brachionus calyciflorus			320															
Notholca marina	69,376	70,656	74,240	71,360	86,080	69,120	78,080	111,040	32,256	31,232	44,032	42,240	351,488	289,280	93,440	92,672	41,728	83,328
ANNELIDA																		
unid. polychaete						320												
COPEPODA																		
unid. nauplii		256													256			128
Diaptomus sp.										256								128
Eurytemora affinis (N)	33,536	31,488	41,920	36,800	35,840	37,120	42,240	41,600	28,856	23,296	24,320	29,952	26,112	22,784	14,080	17,920	17,408	19,712

Table A-2 (concluded)

Taxa/Replicate	Station P15 OBL 1	2	SURF 1	2	MID 1	2	BOT 1	2	P02 1	2	P05 1	2	P06 1	2	P10 1	2	Z03 1	2
									March (continued)									
COPEPODA (continued)																		
<u>Eurytemora affinis</u> (C)	21,760	21,760	13,440	16,960	16,320	20,160	18,880	22,720	16,128	10,752	8960	17,664	8704	7936	6144	9216	2944	2816
" " (A)	1536	1536	1600	960	1280	2240	640	2880	1280	512		1792	1024	1280	256	1536	128	512
<u>Cyclops</u> sp.													256					
<u>Cyclops bicuspidatus</u>	256																	

* no samples due to icing

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