FINAL RESEARCH REPORT TO

U.S.Department of Commerce
National Oceanographic and Atmospheric Administration

National Marine Fisheries Service
Middle Atlantic Coastal Fisheries Center
Sandy Hook Laboratory
Highlands, New Jersey 07732

<u>Institution</u>

University of Maryland
College Park, Maryland 20742

<u>Title of Research</u>

Analysis of the Ciliate Protozoa Associated with the Man Induced Change to the Sublittoral Environment of the New York Bight: June, 1973 to February, 1975.

<u>Contract Number</u>

03-3-043-48

<u>Principal Investigator</u>

Eugene B Small

Eugene B. Small
Associate Preofessor
Department of Zoology

Received
MAY 1 6 1975
Knee Mc Nulty
cc: Dr. Sindermann/Holston
Dr. Pearce

Sampling for the ciliated protozoa present in the planktonic and benthic environments of the New York Bight has been continued over the past eight months under contract number 03-3-043-48 for the U.S. Department of Commerce. Objectives for this study included: a) determining the feasibility of qualitative and quantitative marine ciliate sampling, b) establishing and monitoring the presence of the populations of marine ciliates throughout a yearly cycle, and, c) correlating the presence of small bactivorous ciliates with the presence of sewage pollution.

Samples were concentrated during the autumn and early winter months in order to give a more complete representation of the full seasonal cycle of planktonic ciliate populations. Data from the past two years of collections have been collated in the Appendix. This includes all data present in the six and twelve month reports, the report given last December, and the data presented herein for the first time.

The initial year established the feasibility and usefulness of some of the collection methods. Many extraction and concentration methods were attempted; several were abandoned. Marine ciliates were found in the planktonic as well as most benthic environments of the Bight throughout the year.

Definitive quantitative studies of the marine protozoa have only recently begun. Beers and Stewart (1969a, 1969b, 1971), working in the eastern Pacific, have perfected a large continuous peristaltic pump whereby samples of the water column are obtained throughout towed intervals. Their work is an exhaustive qualitative examination of the micro-zooplankton. Ciliated protozoa formed the greatest numerical fraction of the plankton, although, due to their small size, their biomass and volume fractions were less than half of the total. Protozoa consistently were greater in numbers within the euphotic zone than below it. This relationship may be changed by vertical movement within the water column at night; their samples were consistently obtained during mid day.

Ciliates, both tintinnids and others, were found to be important components in most plankton assemblages studied. A possible correlation was found between high numbers of protozoa and phytoplankton productivity. Beers and Stewart (1971) recognized that with the capacity of a rapid division rate, and the assumption that the increase of their predators would lag behind their own increase, the total protozoan food consumption could theoretically increase almost geometrically for a short period of time. The authors calculated during a coastal survey off of La Jolla (Beers and Stewart, 1970) that the standing stock of ciliates may have been cropping a larger amount of organic carbon per day than was being produced by the size class of phytoplankton upon which it was assumed that they feed.

The systems above are predominately open ocean assemblages based upon phytoplankton productivity. Quantitative studies involving bactivorous asseblages are relatively even more rare; cooperation between protozoan and microbial ecologists is a necessary factor. Lighthart (1971) performed a study of bactivorous protozoa in the Puget sound. His methods were not sufficient to adequately reflect the numbers of ciliates found; however,he did find bactivorous protozoa to be most numerous at the sediment-water interface.

Small, et al (International Estuarine Research Foundation Symposium,1973), working in a small subestuary of the Chesapeake Bay, has found a seasonal variability as well as a food source variability in ciliate assemblages. Predominant organisms in the summer encompass a diversity of trophic levels (herbivores, bacterivores, carnivores). The winter assemblage includes mostly tintinnid herbivores. Often in places of water stratification three distinct numerical peaks occur in the vertical column. These peaks correspond to: a) just below the water surface, b) just below the eupotic zone, and, c) just above the sediment-water interface. Ciliate numbers are highest when their predators are absent (spatially or temporally), and also during the summer months when species richness is high as well.

Psammobiotic ciliate populations are regulated by food source and climatic patterns as well as by substrate particle size. Fauré-Fremiet (1950) and Dragesco (1960) both observed that marine interstitial ciliates are least numerous in sediment that has a silt-clay fraction (particles ≤63 μm in size) greater than 10-14 %. Areas in the Bight in which the sediment is characterized as fine black muck are those sites of the greatest dredging spoils and sewage dumping. These areas would not be inimical to ciliates which live at the sediment-water interface since the ciliates would be unaffected by interstitial size.

Sampling was planned in order to attempt to take advantage of the previously reported trends in marine planktonic ciliate populations. At each station two samples of thirty liters were taken, one from three feet below the surface and one from three to ten feet above the bottom. Several stations were also sampled at a depth of from three to ten feet below the euphotic zone (three times the Secchi disk value). It must be understood that these values are most meaningful for vertical samples taken in relatively slow moving waters (e.g. a subestuary of the Chesapeake Bay) where vertical stratification is an important concept, and, that ciliates are easily transported by water currents. Diurnal vertical migration may have an affect on the data presented since several samples were obtained at night. Patchiness of predator distribution and short term reproductive responses of the ciliates to sudden "attractiveness" within the environment (e.g. a phytoplankton bloom or a sewage dump) are not examined within this study. Emphasis is placed upon seasonal population trends as reflected by quantitative data taken throughout a seasonal cycle.

Sediment sampling included material for immediate live examination as well as enrichment cultures. The enrichment culture data gives an indication of cyst forming bactivorous ciliates present in the plankton at some portion of the year.

Plankton samples that were obtained quantitatively were concentrated on 80, 35, and 20 µm Nytex nylon monofilament mesh filters. Aliquots of the concentrated plankton soup from each size class were preserved in Bouin's fixative and stored at University of Maryland until enumeration. Counts have been made by mixing 5 ml. aliquots from each size class vial and then taking measured portions of the well mixed combination sample. A sedimentation chamber of 5 ml. volume was used in conjunction with a Zeiss inverted compound microscope at magnifications of 160x to 200x. A 1 ml. Sedgewick-Rafter counting cell was also used, in conjunction with a Zeiss compound microscope at magnifications of 125x-200x. When the Sedgewick-Rafter cell was used, five samples were counted in order to obtain a sufficient sample. Statistical determination of the 95% range of the numbers of organisms has been done following the techniques of Lund, et al (1958). Individual phytoplankters were counted in the later samples in an effort to determine whether the ciliate and phytoplankton populations mutually influenced one another.

Identification and characterization of the psammobiotic ciliates was performed qualitatively. Live examination using a Zeiss compound microscope with Nomarski phase interference optics has been of utmost importance as an aid to the identification of these fragile forms.

Bactivorous scutico ciliates have continued to be found at the sewage site most notably during August. These ciliates are small voracious bactivores when bacteria are present in sufficient numbers. In the absence of bacteria, they are capable of forming cysts and waiting until the next bacterial bloom. Berk (1974) found that a species of Uronema isolated from the Chesapeake Bay was capable of sustained growth and reproduction at concentrations of bacteria on the order of 10^6 cells $ml.^{-1}$; lower concentrations were not adequate for growth or reproduction. Karakashian and Karakashian (1973) found that Paramecium bursaria does not form food vacuoles at bacterial concentrations of less than 3.5×10^4 cells $ml.^{-1}$ These reports suggest that bactivorous ciliates are physiologically limited to areas of high bacterial concentrations. Berk also found that Uronema is capable of feeding upon non-viable bacterial cells at the required concentration. When fed autoclaved cultures, the ciliates survived. This would indicate that ciliates are possibly feeding on non-marine bacteria which arrive in the sewage as well as marine forms that would decompose it.

The oceanic environment is notably low in bacterial concentration. Areas of high bacterial concentrations are usually localized to areas of high organic nutrient input. This type of situation is present at the sewage dump site in the Bight. Bacteria, like ciliates and most other plankton forms, are easily transported by water movement. Sewage outfall, transported and diluted by water currents, is limited by water stratification when present. Since planktonic bactivorous scutico ciliates are most likely limited to a locality in which sewage is present or has recently been present, the presence of these ciliates in large numbers is an indication of the probable presence of a recent sewage outfall. In times of stress these ciliates form resistant cysts which fall to the sediment. Presence of these cysts in the sediment indicates probable presence of a sewage outfall over or nearly over that sediment at some point in the recent past.

The scutico ciliates are most prevalent during the warm summer months. Data for the August cruises (1973 and 1974) gives the best illustration of the validity of the previous assumptions. In 1973, the initial collection coincided with a sewage dump approximately half a mile away from the collection site. Small visible pieces of black debris were present in the surface sample. Scutico ciliates were present in a range of from 170 to 250 ciliates per liter. In August, 1974, a surface oil slick was present over brownish colored water when the initial collection was made. Peritrich ciliates, 240 per liter, were present attached to the debris by their stalks (95% range: 211-280 ciliates per liter), giving a total value of over 390 bactivorous ciliates per liter. Four hours later nearly all bactivorous ciliates were absent from the protozoan assemblage within the plankton. A similar pattern is present for the silicoflagellates, many of which are facultative bacterivores.

Peritrich ciliates are important components of activated sludge sewage plants. Small (1973) reported them in a small sewage polluted stream in Illinois during the spring and fall months in extremely high numbers. Factors which seemed to be important in the presence of these sessile, stalked, voracious and efficient bacterivores were the high dissolved oxygen and low water temperatures found concommitently during the seasonal changes. Presence of the peritrichs at similar times in the plankton of the New York Bight could reflect a similar seasonality in oceanic peritrich distribution.

When water temperatures become low at the onset of winter, the algivorous tintinnid species begin to predominate in the micro-zooplankton. Throughout the winter months the tintinnids remain the most important ciliate plankton component numerically. Their numbers fluctuate wildly in response to weather, plankton blooms, and predators. The high count of between 137 and 200 tintinnids per liter on 20 February, 1975, was during a time of unusually calm and mild weather with large numbers of algae and other phytoplankton present, but relatively low numbers of zooplankters. It appears to hold true that the copepods in the Chesapeake Bay influence the numbers of tintinnids both by predation and competition. This would indicate that the times of high numbers of tintinnids would appear both spatially and temporally in "windows" of the copepod populations (Small et al, 1975, unpublished).

Most ciliates are capable of extremely rapid reproduction: from four to six hours in the case of some of the smaller scutico ciliates, and from twenty-four to thirty-six hours in the case of the tintinnids. Sampling with the frequency maintained within this study gives no indication of such short term population fluctuations nor the possible magnitude attained by these fluctuations. Indications of size of patchiness or movement of patches were also not included within the scope of the sampling program. It must be emphasized that this is a preliminary indication of the probable population fluctuations followed by the planktonic ciliates through the seasons.

Psammobiotic ciliate populations follow the basic trends reported by Fauré-Fremiet (1950) and Dragesco (1960). Interstitial ciliates are wholly absent from areas where the sediment tends to be mucky. All of the benthic ciliate populations appear to be high in both numbers and diversity in the summer and very low in numbers with lowered diversity in the winter. The Long Island coast has less species represented than the samples taken from the New Jersey coast as far south as was sampled. Most surprisingly, the acid waste dump site has the highest number of very fragile forms; this may reflect something of the nature of ionic requirements of these ciliates. Benthic communities tend to be somewhat more trophically balanced than the planktonic communties; this may reflect the dearth of well developed communities in the proximity of the sewage and dredging spoils dump areas. Other than the presence of cysts in the sediment, few indications of low diversity and stressed communities due to the extreme level of pollution exist.

SUMMARY

1. Sampling of planktonic and benthic ciliate populations in chosen areas of the New York Bight has been successful over a period of twenty months.

2. Large seasonal variations in numbers of populations have been observed quantitatively; this includes faunal as well as numerical variations.

3. Presence of large numbers of bactivorous ciliates have been observed to be associated with sewage dumps during the warm summer months.

4. Cysts of bactivorous ciliates (pollution associated species as well as "clean water" associated species) can be recovered from the sediments any season of the year; sewage associated species predominate in the areas proximal to the sewage and dredging spoils dump sites and clean water species in the areas designated as control areas (e.g. the Long Island and New Jersey shore stations).

5. Benthic ciliates are affected by climatic and substrate variabilities; lows occur during the winter and in areas proximal to the sewage and dredging spoils dump sites. Sewage sludge is made up of small particles which may account for the absence of ciliates in the dump site muds (rather than the "bacterial" pollution and/or biochemical saprobity).

Literature Cited:

Beers, J.R, and G.L.Stewart, 1969a. The vertical distribution of micro-zooplankton and some ecological observations. J.Cons.int.Explor.Mer.,33(1):30-44.

____________________ 1969b. Micro-zooplankton and its abundance relative to the larger zooplankton and other seston components. Mar.Biol. 4:182-189.

____________________ 1970. Numerical abundance and estimated biomass of micro-zooplankton. In: The ecology of the plankton of La Jolla, California, in the period April through September, 1967 (Part VI), J.D.H.Strickland, editor, Bull.Scripps Instn.Oceanogr., 17:67-87.

____________________ 1971. Micro-zooplankters in the plankton communities of the upper waters of the eastern tropical Pacific. Deep Sea Research, 18: 861-883.

Dragesco,J.,1960. Ciliés mésopsammiques littoraux. Trav.Stn.biol.Roscoff (NS), 12:1-356.

Fauré-Fremiet,E., 1950. Ecologie des ciliés psammophiles littoraux. Bull.Biol. France et Belg., 84:35-75.

Karakashian,M.W., and S.J.Karakashian, 1973. Intracellular digestion and sybiosis in Paramecium bursaria. Exp.Cell Res.,81:111-119.

Lighthart,B., 1969. Planktonic and benthic bactivorous Protozoa at eleven stations in Puget Sound andadjacent Pacific ocean. J.Fish Res. Bd. Canada, 26:299-304.

Small,E.B., 1973. A study of ciliate protozoa from a small polluted stream in east-central Illinois. Amer.Zool., 13(1):225-230.

Berk, S.G., 1974. Uptake and utilization of marine bacteria by ciliate Protozoa. Master's thesis. University of Maryland, College Park, Maryland.

APPENDIX

APPENDIX: PART A

Compendium of Cruises, Dates, and Samples
Taken, June, 1973 to February, 1975

Protozoology Sampling Cruises: June, 1973 to February, 1975

Dates	Research Vessel	Sampling Methods Sediment	Sampling Methods Water Column	Number of Stations
1. 18-20 June, 1973	Rorqual	L,S,U,W		5
2. 2-8 August	Albatross IV	L,S,M,U,W	N-CF	5
3. 14,27,29 August	Xiphias	L,S,M,U,W	N-CF	5
4. 18 September	Ferrel	L,U		4
5. 20-27 October	Oregon II	L,M,U	N-CF	7
6. 26-30 November	Ferrel	L,U		8
7. 23 January- 1 February, 1974	Albatross IV	L,M,U	N-CF	8
8. 21 March- 3 April	Oregon II	L,M,U	N-CF,PP	20
9. 27-30 August	Delaware II	L,U	N-CF,PP	13
0. 11 October	Xiphias	L,U	N-CF	6
1. 18-19 October	Commonwealth II	L,U	N-CF	7
2. 1 November	Xiphias	L,U	N-CF	2
3. 19-20 February	Rorqual	L,U	N-CF	5

Sediment methods:
- L -Lackey's 16 oz. jars, enrichment cultures
- M -Millipore filtering grab water
- S -Spoon's test tube extraction method
- U -Uhlig's seawater ice extraction columns
- W -Winogradsky column

Water Column methods:
- N-CF -Nisken water sample filtered through a cascade of graded filters
- PP -Peristaltic pump water sample filtered through graded filters

Table 1

Cruise: Boat and Dates:
1. R/V Albatros II, 2 - 8 August, 1973 (AII)
2. R/V Xiphias, 14 August, 1973

Station (Position)	Secchi EZ	Total Depth	Nisken Samples: Depth, Temp. Top 1. filt.	Mid 1. filt.	Bottom 1. filt.	Grab Sample Jars	Bag	Grab water	Uhlig Extraction	Phys. Parameters Sediment type
1.										
7-AII Long Island Control	21' 63'	30'	3 ft.		30 ft.	2	1	2 liters	2-80μ mesh 10" ice	clean fine sand
16-AII N.Y. Harbor Control	11' 33'	25'	3 ft.		25 ft.	2	1	2 liters	2-80μ mesh	clean fine sand dark sand at depth ~4"
32-AII Sewage	19' 57'	107'	3 ft.	60 ft.	107 ft.	2	1	4 liters	2-80μ mesh 35μ mesh	black muck
35-AII Dredge Site	5' 15'	70'	3 ft. 23.5°C	20 ft. 22.5°C	70 ft. 16°C	2	1	2 liters	2-80μ mesh 35μ mesh	black muck
51-AII Acid Waste			3 ft.			2	1	2 liters	2-80μ mesh	fine sand, reddi from iron flock
2.										
7-AII	33.5' 101.5'	70'	3' 15 l. 24°C		70' 10 lit. 12°C		1		2-80μ mesh	coarse sand some oil
8-AII	27' 60'	60'	3' 15 l. 24°C		60' 15 l. 16°C		1		2-80μ mesh	coarse sand some sludge
11-AII	32.5' 97.5'	52'	3' 15 l. 24°C		52' 5 l. 15°C		1		2-80μ mesh	clean fine sand
16-AII	13' 39'	30'	3' 15 l. 24°C		39' 15 l. 17°C		1		2-80μ mesh	coarse sand, mu covered by smal mussels

Table 2

Cruise; Boat and Dates: R/V Xiphias 27 August, 1973 and 29 August, 1973

Station (Position)	Secchi EZ	Depth	Nisken Samples Depth	Liters filt.	Temp. °C	Presence of Ciliates	DO
32-AIY							
	Secchi	110'	3'	6	24	+	2.40
Drift:	10'		10'	22	22.5	++	8.15
0.9 mile			20'	17	22	+	7.52
			30'	22	22	++	7.40
Sewage			40'	20.5	21	++	7.40
	EZ		50'	18	20		7.46
Tide coming	30'		60'	20	19	+	
in			70'	14	18		6.50
			80'	9	11		
			90'	16	10.5	++	5.25
			100'	17.5	9	++	
			110'	14	8.5	+	5.18

Station (Position)	Secchi EZ	Depth	Nisken Samples Depth	Liters filt.	Temp. °C	Presence of Ciliates	DO
32-AIY							
	Secchi	110'	3'	16	25	+	7.60
Drift:	21'		10'	13.5	24		7.65
0.4 mile			20'	20	23	+	7.72
			30'	14	22	+	7.44
Sewage			40'	21.5	21	++	6.64
	EZ		50'	18	21		7.45
	63'		60'	18.5	19		6.76
			70'	20	14	+	5.12
			80'	16	13	+	4.94
			90'	23	10	++	4.94
			100'	22	11	+	
			110'	21.5	10	+	5.12

Table 3

Cruise; Boat and Dates R/V Ferrel 18 September 1973 and R/V Oregon II 20-27 October 1973

Station & Date	Secchi ft	EZ ft	Depth ft	Nisken Samples Depth	Nisken Samples Liters	Nisken Samples Temp°C	Grab Samples Jars	Grab Samples Bag	Grab Water	Uhlig	Bot. Temp	Sediment type
MESA grid 13 18 sept	43	128	98				2	1		2-35μ	11.8	black muck
MG 18 18 Sept	17	49	82				2	1		2-35μ	13.5	black muck
MG 23 18 Sept	22	66	160				2	1		2-80μ	11.04	clean sand, coarse
MG 22 18 Sept	22	66	68				2	1		2-80μ	15.37	clean sand, coarse
7-OII 3 L I Shore Control 20 Oct	15	45	52	3 52	13 27	14.0 12.5	2	1	2 1.	2-80μ		small starfish, coarse clean sand, broken shell
16 -OII NY Harbor Control 21 Oct			28	3 28	28.2 10.5	11.5 12.1	2	1	1 1.	2-80μ		fine clean sand, broken shells
35-OII-Sew. 22 Oct	32	96	108	3 108	29.9 13.5	14 11	2	1	2 1.			black muck
38-OII-Dredg. Spoils 22 Oct	15	45	70	3 50 70	28 29 12	14 16 12	2	1	2 1.			black muck
54-OII Acid 23 Oct	25	75	80	3 80	25 25.8	16 16.12	2	1	2 1.	2-80μ		fine graded sand, brown black at 1" depth
82-OII NJ Shore Control 25 Oct			42	3 42	25 29.8	16.0 15.0	2	1	1 1.	2-80μ		evenly mixed clean sand shell pieces

Table 4

Cruise; Boat and Dates: R/V Ferrel 26 - 30 November, 1973

Station: Water Sampling Grid Number	Depth	Temperature °C Top	Temperature °C Bottom	Sediment type
#1	43'	10.95	10.96	Coarse, clean sand with broken shells small, live mussels
#5	56'	10.62	10.60	Fine black sand, some muck near Nassau City sewage outfall
#12	77'	10.85	11.11	dark grey muck, some sand
#13	127'	10.98	11.40	Black, globby ugly muck, sulfurous
#19	87'	11.40	11.43	Very fine, grey black muck, Nereid poly-chaetes present.
#21	67'	11.50	11.56	Fine, clean sand
#23	170'	11.32	11.45	Fine, predominately clean sand; reddish as though some acid waste contamination
#25	103'	11.25	11.29	Fine, clean sand

Table 5

Cruise: Boat and Dates: R/V Albatross IV 23 January-1 February, 1974

Station & Date	Secchi EZ	Total Depth	Nisken Samples: Depth, Temp., Liters Filtered			Grab Sample			Uhlig Extraction	Sediment Type
			Top	Mid	Bottom	Jars	Bag	GrabWater		
St. 7 23 Jan.	14' 42'	52'	3' 5.5°C. 25 l.		47' 3.4°C 5 l.	2	1	1 l.	2-80 mesh	clean coarse sand, some pebbles
St. 16 24 Jan.	8' 24'	18'	3' 5.0° 5 l.		15' 5.2° 12.5 l.	2	1	.5 l.	2-80 mesh	fine grey clean sand
St. 32 25 Jan.	19' 57'	108'	3' 5.5° 7 l.	65' 6.8° 16 l.	105' 6.3° 5 l.	2	1	2 l.	-	black muck-top layer of grey-brown
St. 35 25 Jan.	11' 33'	75'	3' 4.5° 10 l.	40' 6.0° 7.5 l.	73' 6.3° 5 l.	2	1	1 l.	-	black muck-sand and rocks present
St. 51 26 Jan.	11' 33'	86'	3' 6.5° 28.5 l.	40' 6.8° 15 l.	84' 6.8° 15 l.	2	1	1 l.	2-80 mesh	fine sand
St. 82 28 Jan.	9' 27'	36'	3' 6.8° 9 l.		33' 6.4° 10 l.	2	1	2 l.	2-80 mesh	fine black sand, broken shells
St. 90 28 Jan.						2	1	4 l.	3-80 mesh	fine sand
St. 92 28 Jan.	16' 48'	210'	3' 6.7° 14 l.	60' 6.9° 27 l.	205' 7.5° 12.5 l.	2	1	.5 l.	2-80 mesh	grey silty sand

TABLE 6

Cruise: Boat and Dates: R/V Oregon II 21 March-3 April, 1974

Station & Date	Secchi EZ	Total Depth	Nisken Samples: Depth, Temp., Liters Filtered Top	Mid	Bottom	Grab Sample Jars	Bag	Grab Water	Uhlig Extraction	Sediment Type
St. 7 23 March	16' 48'	45'	3' 6.0°C 23 l.		42' 13	2		4 l.	2-80	very coarse clean sand
St. 16 23 March	9' 27'	23'	3' 9 l.		20' 7.0° 3 l.	2	1	2 l.	2-80	fine clean sand, grey-brown color
St. 31 24 March	16'	108'	3' 16 l.	53' 21 l.	105' 6.0° 5.5 l.	2		2 l.	2-T.K.S.	grey brown muck
St. 34 25 March	11.5' 33.5'	52'	3' 20 l.		45' 6.22° 14 l.	2		2 l.		black muck, grey-brown on top
St. 51 26 March	19.5' 58.5'	84'	3' 27 l.		75' 9 l.	2	1	4 l.	2-80 2-T.K.S.	fine grey-brown sand
St. 57 2 April		30'	Multiple Core Sample		5.6°	2				fine graded sand, some black muck on top
St. 82 28 March	15' 45'	51'	3' 7.0° 14 l.		45' 6.1° 4 l.	2		2 l.	2-80	coarse sand, some gravel
St. 90 29 March		190'	Sediment Grab Sample Only			2	1	1 l.	2-80	coarse sand, some pebbles, some silt
St. 92 30 March	13' 39'	200'	3' 5.5° 16 l.	50' 5.5° 17 l.	195' 6.0° 3 l.	2		0.5 l.		brown-black muck
St. 99 30 March		78'	Multiple Core Sample		5.5°	2				fine clean graded sand

Stations 21,22,23,29,30,32,33,43,44,45 had sediment samples taken via the Lackey jar method, two jars per station.

Table 7

Cruise: Boat and Dates: R/V Delaware II 26-31 August, 1974

Station & Date	Secchi EZ Depth	Nisken Samples: Depth, Temp., Liters Filtered Top	Mid	Bottom	Grab Sample Jars	Bag	Grab Water	Uhlig Extraction	Sediment Characteristics
		3'		18'					
St. 8 27 August					2	1	1 l.	2-80u	fine brown sand with shell debris mixed in
	22'	8.0 l.		9.0 l.					
		3'		45'					
St. 15 28 August				19.3°	2	1	1 l.	2-80u	coarse sand, some gravel, well aerated
	52'	18.0 l.		16.0 l.					
	a) 4'	3'							
St. 30 29 August	12'	23.9°							
	95'	5.0 l.			Plankton Tow- Vertical				
	b) 33'	3'		75'					
	99'	24.0°		15.5°	2	1	2 l.		black, unctuous muck
	80'	24.0 l.		18.0 l.					
	42'	3'		95'	Plankton Tow- Vertical				
St. 33 29 August	126'	23.5°		15.0°	2	1	1 l.		black muck, some sand and a little gravel
	100'	22.5 l.		10.0 l.					

Stations 21, 22, 23, 31, 32, 34, 42, and 43 had sediment samples taken via the Lackey Jar method, two jars per station.

Table 8

Cruise: Boat and Dates: R/V Xiphias 11 October and 1 November, 1974

Station & Date (Loran fix)	Secchi EZ Depth	Nisken Samples Depth, Temp., Liters Filtered Top	Mid	Bottom	Grab Sample Jars	Bag	Uhlig Extraction	Sediment Characteristics
3207x4587 Edge sewage 11 Oct.	95'				2			spaghetti mud, dark brown to black, worm tubes
3204x4609 Just out of sewage area 11 Oct.	90'				2	2 lge.		clean medium mixed sand, brown to tan color
3224x4615 Sewage 11 Oct.	28' 84' 120'	3' 17.0° 12.0 l.	80' 14.8° 21.5 l.	110' 11.5° 8.0 l.	2			black muck
3286x4576 Edge dredge 11 Oct.	65'				2	1	4-80 u	coarse sand with black muck present in the interstices
3290x4576 Edge dredge 11 Oct.	47'				2	1	4-80 u	medium, clean looking sand
3303x4571 Edge beach 11 Oct.	40'				2	1	4-80 u	medium to fine clean looking sand, many sand dollars present in sample
3219x4623 Sewage 1 Nov.	11' 33' 108'	3' 15.0° 18.0 l.	35' 10.0° 18.0 l.	100' 8.5° 25.0 l.	Plankton tow-vertical 2			black muck
3308x4566 Edge beach	40'				2	1	4-80 u	fine sand with some black muck in the interstices

Table 9

ruise: Boat and Dates: R/V Commonwealth 18-19 October, 1974

tation & Date	Secchi EZ Depth	Nisken Samples: Depth, Temp., Liters Filtered Top	Mid	Bottom	Grab Sample Jars	Bag	Uhlig Extraction	Sediment Characteristics
t. 35 redge 3 Oct.	11' 33' 64'	3' 24.0 l.	37' 15.3° 13.0 l.	61' 15.2° 7.0 l.	2			Black muck with greyish surface layer (5 cm.)
t. 37 dge dredge near beach 3 Oct.					2	1	2-80 u	fine sand, clean looking
t. 82 .J.shore,control 3 October					2			mucky sand and large gravel pieces
t. 16 ear N.Y.Harbor 9 October					2			medium sand, some black muck present
t. 92 udson canyon 3 October	180'	3' 14.65° 16.0 l.		175' 12.00° 8.0 l.	2			fine, somewhat mucky sand
t. 32 ewage 9 Oct.	28' 84' 110'	3' 15.37° 16.0 l.		95' 13.20° 15.0 l.	2			black muck
t. 51 cid waste 9 Oct.	73'	3' 15.40° 16.0 l.		60' 15.45° 16.0 l.	1	1	1-80 u	fine sand with a little muck in interstices

TABLE 10

CRUISE: Boat and Dates: R/V Rorqual 19, 20 February, 1975

Station Date	Secchi Depth EZ	Water Column: Nisken Samples, Depth Temp., Liters Filtered			Other Samples	Sediment Type
Station 35 Dredge 19 Feb.	12' 36' 68'	3' 6.0° 25.0 l.	40' 6.0° 27.0 l.	63' 6.0° 22.0 l.	none	
LORAN: 3296x4563					2 Lackey jars 1 bagful sediment	murky grey-black sand
LORAN: 3303x4558					2 Lackey jars 1 bagful sediment	fine sand, some muck under top layer of aerated sand
LORAN: 3308x4554					2 Lackey jars 1 bagful sediment	fine grained clean looking sand
Station 32 Sewage 20 Feb.	16' 48' 108'	3' 6.0° 29.0 l.	50' 6.0° 28.0 l.	100' 6.5 30.0 l.	Plankton tow taken vertically through the euphotic zone	

APPENDIX: PART B

Compendium of Ciliated Protozoa Found in Samples, Qualitative Data and Feeding Preferences

Table 1

Site: Tentative Genera/Species	Bacteria	Detritus	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
			Feeding Preference					
Sandy Hook Point St.	Sandy		Control			21 June 73		
Uronema marinum	+							
Euplotes crassus	+	+	+					
Loxophyllum sp.						+		
Litonotus sp.						+		
Tintinnid sp.(ord.)	+							
Hypotrich sp.(ord.)	+	+	+	+	+	+		
Trachelocercid sp.(fam.)			+	+	+	+		
Scutico sp.(ord.)	+							
St.36 (Alb.IV MESA Grid)	edge of dredge spoils, coarse sand					18 and 21 June 73		
Cyclidium dimacronucleatum	+							
Uronema nigricans	+							
Loxophyllum sp.						+		
Coleps sp				+				
Scutico sp.(ord.)	+							
Trachelocerca sp.			+	+	+	+		
Hypotrichs (ord.)	+	+	+	+	+	+		
Trachelocercid (fam.)			+	+	+	+		
St.35* (Alb.IV)	Black rubble, brick pieces			Dredge Spoils		18 June 73		
C.dimacronucleatum	+							
St. 35(Alb.IV)**	Black rubble, oil globs			Dredge Spoils		18 June 73		
U.nigricans	+							
C.dimacronucleatum	+							
St.23(Alb.IV)	Black muck,sand			Sewage edge		19 June 73		
C.dimacronucleatum	+							
Trachelocercid(fam.)			+	+	+	+		
St.32(Alb.IV)	Silty mud			Sewage		19 June 73		
Anophrys sp.	+							
Trachelocercid(fam.)			+	+	+	+		
Scutico sp.(ord.)	+							

Table 1 (cont'd.)

Site:Tentative Genera/Species	Bacteria	Detritus	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
				Feeding Preference				
St.32(Alb.IV),cont'd.								
Scutico sp.2 (ord.)	+							
Scutico sp.3 (ord.)	+							
Scutico sp.4 (ord.)	+							

* Old Station W-2, close to present Albatross IV Mesa Grid St.35.
**Old Station 67, close to present Albatross IV Mesa Grid St.23.

Table 2
Feeding Preference

Site: Tentative Genera/Species	Bacteria	Detritus	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
St. 7 (Alb.IV)	Coarse Sand, Gravel		Control			3 August 73		
Water col:								
Scutico (Ord.)	+							
Cyclidium polyschizonucleatum	+							
Sed/Water:								
Pseudoprorodon sp.			+	+				
Paraspathidium sp.			+	+	+	+	+	+
Metopus sp.	+							
Plagiopyla sp.	+							
Sediment:								
Lacrymaria sp. 1						+		
Lacrymaria sp. 2						+		
Metopus sp.	+							
Litonotus sp.						+		
Loxophyllum sp.						+		
Tracheloraphis sp. 1			+	+	+	+		
Tracheloraphis sp. 2			+	+	+	+		
Scuticos (order)								
St. 16 (Alb.IV)	Fine clean sand		Control			3 August 73		
Water column (bottom):								
Euplotes sp.	+		+					
Water column (top):								
Frontonia sp.			+	+				
Sed/Water:								
Euplotes sp.	+		+					
Sediment:								
Remanella sp.			+	+	+			
Loxophyllum sp.						+		
Amphileptus sp.					+	+		
Litonotus sp.						+		
Trachelocerca sp.			+	+	+	+		
Cyclidium sp.	+							
Euplotes n. sp. 1	+			+				

Table 2 (cont.)

Site: Tentative Genera/Species	Feeding Preference Bacteria	Detritus	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
<u>Euplotes</u> <u>sp</u>. 1	+		+					
<u>Euplotes</u> <u>sp</u>. 2	+		+					
<u>Pseudoprorodon</u> <u>sp</u>.			+	+				
<u>Paraspathidium</u> <u>sp</u>.			+	+	+	+	+	+
Metopids (family)	+							
St. 32 (Alb.IV)	Sewage			Black muck			4 August 73	
Water column:								
Scutico (order)	+							
<u>Pseudocohnilembus persalinis</u>	+							
<u>Cyclidium polyschizonucleatum</u>	+							
<u>Euplotes</u> <u>sp</u>.	+		+					
Sed/water:								
Scutico sp. (order)	+							
Sediment:								
diatoms (Rhizoselenis setigera)								
St. 35 (Alb.IV)	Dredge Spoils			Black rubble, muck			4 August 73	
Water column (bottom):								
<u>Euplotes</u> <u>sp</u>.	+		+					
Scutico sp. (order)	+							
Water column (7m):								
<u>Frontonia</u> <u>sp</u>.			+	+				
Scutico sp. (order)	+							
Water column (1m):								
<u>Euplotes</u> <u>sp</u>.	+		+					
Scutico sp. (order)	+							
<u>Cyclidium polyschizonucleatum</u>	+							
Sediment:								
<u>Cyclonema</u> <u>sp</u>.	+							
<u>Uronema elegans</u>	+							
<u>Euplotes</u> <u>sp</u>.	+		+					

Table 3

Site: Tentative Genera/Species	Bacteria	Detritus	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
				Feeding Preference				
St. 7	Coarse sand, some oil					14 August 73		
1 meter:	diverse phytoplankton, Gymnodinium bloom							
13 meter (bottom): dinoflagellates, radiolaria, diatoms								
Pseudoprorodon sp.			+	+	+	+		
hypotrich	+	+	+					
scuticociliate	+							
Bottom grab:								
hymenostome	+							
gymnostome sp. 1			+	+	+	+		
gymnostome sp. 2			+	+	+	+		
Uhlig:								
hymenostome	+							
Frontonia sp.			+	+				
Euplotes sp.	+		+					
Tracheloraphis sp.			+	+	+	+		
St. 8	Coarse sand, some oil sludge					14 August 73		
1 meter	diverse phytoplankton, some metazoa							
Tintinnids	+							
Cyclidium sp.	+							
scuticociliates	+							
10 meter (bottom):								
hypotrich	+	+	+					
Euplotes sp.	+		+					
Lacrymaria sp.						+		
Prorodon sp.	+		+	+				
Metopid	+							
scuticociliates	+							
Bottom grab:								
organic debris								
Uhlig:								
Trachelocerca sp. 1			+	+	+	+		
Trachelocerca sp. 2			+	+	+	+		
Tracheloraphis sp.			+	+	+	+		
Gruberia sp.	+		+					
Chlamydodon sp.			+					
Litonotus sp.						+		

Table 3 (cont.)

Site: Tentative Genera/Species	Feeding Preference Bacteria	Detritus	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
Paraspathidium sp.			+	+	+	+		
Loxophyllum sp.						+		
scuticociliates	+							
St. 11	Fine, clean sand					14 August 73		
1 meter:	organic debris, micrometazoa, diverse phytoplankton							
Tintinnids	+							
8 meter (bottom):	Ceratium, other dinoflagellates, micrometazoa							
scuticociliates	+							
Bottom grab:	Foraminifera, Radiolaria, Gymnodinium, diverse phytoplankton							
scuticociliates	+							
Uhlig:								
Litonotus sp.						+		
Tracheloraphis sp.			+	+	+	+		
Hemiophrys sp.						+		
Loxophyllum sp.						+		
Prorodon sp.			+	+				
Dileptus sp.						+		
Lacrymaria sp.						+		
St. 16	Coarse sand with clumps of small mussels overlying organic muck						14 August 73	
1 meter:	organic debris, phytoplankton							
scuticociliates	+							
10 meter (bottom):								
phytoplankton, micrometazoa								
Lacrymaria sp.						+		
scuticociliates	+							
hymenostome sp. 1	+							
hymenostome sp. 2	+							
Bottom grab:								
Euplotes sp. 1	+		+					
Euplotes sp. 2	+							
Aspidisca sp.	+							
Laerymaria sp.						+		
Paraspathidium sp.				+	+			
Trachelocerca sp.			+	+	+	+		
Uhlig:								
Frontonia sp.			+					

Table 3 (cont.)

Site: Tentative Genera/Species	Feeding Preference: Bacteria	Detritus	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
Prorodon *sp*.	+		+	+				
Hemiophrys *sp*.						+		
Trachelocerca *sp*. 1			+	+	+	+		
Trachelocerca *sp*. 2			+	+	+	+		
hypotrich	+	+	+					

Table 4

Feeding Preference

Site: Tentative Genera/Species	Bacteria	Detritus	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
St. 32	Sewage sludge 110' deep low tide 27 August 73							
3 feet:	algal strands, micrometazoa, diatoms, Gymnodinium							
1 ciliate (Colpoda sp.)	+							
10 feet:	micrometazoa, algae diatoms, dinoflagellates, euglenoids, Gymnodinium							
Metopid sp.	+							
scuticociliate sp. 1	+							
scuticociliate sp. 2	+							
scuticociliate sp. 3	+							
20 feet:	much organic debris, diatoms, algae, Gymnodinium, Peradinium, euglenoids, micrometazoa							
Cyclidium sp.	+							
scuticociliate sp. 1	+							
scuticociliate sp. 2	+							
scuticociliate sp. 3	+							
30 feet:	mostly organic debris, diatoms, algae, Peradinium, euglenoids							
scuticociliate sp. 1	+							
scuticociliate sp. 2	+							
hymenostome sp. 1	+							
hymenostome sp. 2	+							
Tintinnid sp.	+							
40 feet:	organic debris, algae, diatoms, Ceratium, Peradinium, Radiolaria, micrometazoa							
Tintinnid sp. 1	+							
scuticociliate sp.	+							
50 feet:	sand, organic debris, algae, dinoflagellates, metazoan larval forms							
scuticociliate sp.	+							
60 feet:	algae, diatoms, dinoflagellates, molluscan larvae							
no ciliates								
70 feet:	algae, dinoflagellates, metazoan larvae							
scuticociliate sp.	+							
80 feet:	sand, oil, organic debris, algae							
no ciliates seen								
90 feet:	algae, organic debris, diatoms							
scuticociliate sp.	+							
Euplotes sp.	+		+					
hypotrich sp.	+	+	+					
100 feet:	diatoms, algae, organic debris, dinoflagellates							
Tintinnid sp.	+							
hymenostome sp.	+							
scuticociliate sp. 1	+							

Table 4 (cont.)

Site: Tentative Genera/Species	Feeding Preference: Bacteria	Detritus	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
scuticociliate sp. 2	+							
110 feet:	organic debris, sludge, oil, sand, algae							
scuticociliate sp. 1	+							
scuticociliate sp. 2	+							
St. 32	Sewage sludge 110' deep outgoing tide 29 August 73							
3 feet:	organic debris, algae, oil globs, diatoms, dinoflagellates, euglenoids							
Tintinnid sp.	+							
hymenostome sp.	+							
scuticociliate sp.	+							
10 feet:	organic debris, fibers, sand, *Ceratium*, algae, diatoms, *Gymnodinium*, *Peridinium*							
no ciliates								
20 feet:	sand, organic debris, euglenoids, algae, *Ceratium*							
scuticociliate sp.	+							
30 feet:	organic debris, *Ceratium*, sand, fibers, oil, micrometazoa, algae, *Peridinium*, *Gymnodinium*, euglenoids							
Tintinnid sp.	+							
scuticociliate sp. 1	+							
scuticociliate sp. 2	+							
scuticociliate sp. 3	+							
40 feet:	large oil globs, organic debris, diatoms, algae, micrometazoa, *Peridinium*, *Ceratium*, *Gymnodinium*, euglenoids							
hypotrich sp.	+	+	+					
scuticociliate sp.	+							
50 feet:	organic debris, oil globs, sand grains, euglenoids *Polykrikos*, *Gymnodinium*, metazoan larval forms							
no ciliates								
60 feet:	organic debris, fibers, algae, diatoms, *Peradinium*, euglenoids							
no ciliates								
70 feet:	organic debris, diatoms, metazoan larval forms, sand dinoflagellates, algae, tissue debris							
Colpoda sp.	+							
80 feet:	organic debris, larvae, sand, oil, fibers, diatoms, algae, euglenoids, dinoflagellates							
scuticociliate sp.	+							
90 feet:	oil, diatoms, fibers, algae, debris, dinoflagellates, euglenoids							
scuticociliate sp.	+							
100 feet:	organic debris, oil, sand, algae, diatoms, euglenoids							
scuticociliate sp.	+							

Table 4 (cont.)

Feeding Preference

Site: Tentative Genera/Species	Bacteria	Detritus	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
110 feet:	oil, sand, sludge, fibers, algae, organic debris							
scuticociliate sp.	+							

Table 5

Site: Tentative Genera/Species	Bacteria	Detritus	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
				Feeding Preference				
R/V Ferrel cruise		Sediment samples only				18 September 73		
St.13 (water sampling cruise)			Sewage sludge					
nothing seen- no phytoplankton or zooplankton, mostly oil globs and dirty debris.								
St.22 (water sampling cruise)			Clean sand					
Euplotes sp.	+		+					
Tracheloraphis sp.			+	+	+	+		
Coleps sp.				+				
Loxophyllum sp.						+		
Trachelocerca sp.1			+	+	+	+		
Trachelocerca sp.2			+	+	+	+		
Trachelocerca sp. 3			+	+	+	+		
St.23 (water sampling cruise)			Clean sand, some sludge					
oil globs and a Foraminifera								

Table 6

Site:Tentative Genera/Species	Bacteria	Detritus	Diatoms	Feeding Preference Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
R/V Oregon II cruise 19-26 October 73								
St.7(Or.II)Long Island Coast Control Clean sand 52' depth								
Top water column: diatoms,algal stands,debris								
Bottom water column:diatoms,sand grains,algal strands								
Grab water:debris,algal strands								
Uhlig extraction:								
<u>Trachelocerca</u> sp.1			+	+	+	+		
<u>Trachelocerca</u> sp.2			+	+	+	+		
<u>Lacrymaria</u> sp.						+		
Hypotrich sp.(ord.)	+	+	+	+	+	+		
<u>Prorodon</u> sp.1	+		+					
<u>Prorodon</u> sp.2	+		+					
<u>Euplotes</u> sp.	+		+					
<u>Loxophyllum</u> sp.						+		
St, 16(Or.II)N.Y.Harbor Control Clean sand 28' depth								
Top water column:algal strands,fibers,<u>Gymnodinium</u>								
Bottom water column:algal strands,debris,sand,oil,diatoms,Euglenoids								
Scutico sp.(ord.)	+							
Grab water:debris,diatoms,fibers,<u>Gymnodinium</u>,<u>Polykrikos</u>								
Uhlig extraction:								
<u>Loxophyllum</u> sp.1						+		
<u>Loxophyllum</u> sp.2						+		
<u>Remanella</u> sp.			+	+	+			
<u>Trcheloraphis</u> sp.			+	+	+	+		
<u>Euplotes</u> sp.	+		+					
<u>Frontonia</u> sp.		+	+					
<u>Sonderia</u> sp.	+	+	+					
<u>Spirostomum</u> sp.	+							
<u>Geleia</u> sp.					+	+		
<u>Lacrymaria</u> sp.						+		
Scutico sp.1(ord.)	+							
Scutico sp.2(ord.)	+							
St.35(Or.II)Sewage dumping site Black muck 108' depth								
Top water column:diatoms,algal strands,fibers,oil								

Table 6 (cont'd.)

Site:Tentative Genera/Species	Feeding Preference Bacteria	Detritus	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
St.35(Or.II),cont'd.								
<u>Plagiopyla</u> sp.	+	+	+					
Bottom water column:algal strands,debris,oil,diatoms,sand								
Scutico sp.1(ord.)	+							
Scutico sp.2(ord.)	+							
Hypotrich sp.(ord.)	+	+	+	+	+	+		
Grab water:debris,diatoms,algal strands								
Uhlig extraction:sand,fibers,debris,diatoms								
St.38(Or.II)Dredge spoils Black muck 70' depth								
Top water column:algal strands,debris,<u>Gymnodinium</u>,<u>Peradinium</u>								
Scutico sp.1(ord.)	+							
Scutico sp.2(ord.)	+							
Mid water column:algal strands,diatoms,debris,dinoflagellates,euglenoids								
Scutico sp.(ord.)	+							
Bottom water column:algal strands,diatoms,dinoflagellate,euglenoids								
<u>Plagiopyla</u> sp.	+	+	+					
Grab water:debris								
Uhlig extraction:debris,sediment								
St.54(Or.II)Acid waste Fine sand, reddish color 80' depth								
Top water:algal strands, diatoms,sand,debris,fibers,dinoflagellates,euglenoids								
Bottom water column:algal strands,diatoms,sand,fibers								
Grab water:algal strands,diatoms,sand								
Uhlig extraction:sand,fibers,iron flock								
<u>Trachelocerca</u> sp.1			+	+	+	+		
<u>Trachelonema</u> sp.			+	+	+	+		
<u>Loxophyllum</u> <u>vermiforme</u>						+		
<u>Centrophorella</u> sp.						+		
<u>Remanella</u> sp.1			+	+	+			
<u>Remanella</u> sp.2			+	+	+			
<u>Trachelocerca</u> sp.2			+	+	+	+		
<u>Trachelocerca</u> sp.3			+	+	+	+		
<u>Lacrymaria</u> sp.1						+		
<u>Lacrymaria</u> sp.2						+		
<u>Prorodon</u> sp.	+	-	+	+				

Table 6 (cont'd.)

Site:Tentative Genera/Species	Bacteria	Detritus	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
St.85(Or.II)N.J.coast control Fine,clean sand 42' depth								
Top water column:algal strands,diatoms,sand								
Bottom water column:algal strands,diatoms,euglenoids,*Gymnodinium*								
Grab water:diatoms,sand,debris								
Uhlig extraction:								
Lacrymaria sp.						+		
Remanella sp.			+	+	+			
Loxophyllum sp.						+		
Tracheloraphis sp.			+	+	+	+		
Condylostoma clarissimum			+		+	+		
Euplotes sp.	+		+					
Trachelocercid sp.(fam.)			+	+	+	+		
St.91(Or.II)Deep water Hudson River canyon control Fine,clean sand 100' depth								
Grab water:sand, debris								
Uhlig extraction:sand,diatoms,algal strands,debris								
unidentified Trachelocercid and trachelocercid type ciliates								
Trachelocerca sp.			+	+	+	+		

Table 7

Feeding Preference

Sites:Tentative Genera/Species	Bacteria	Detritus	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
R/V Ferrel cruise		Sediment samples only			26-30 November 73			
St.1(water sampling cruise)L.I.shore control								
Loxophyllum sp.						+		
Euplotes sp.	+		+					
Scutico sp.(ord.)	+							
St.5(water sampling cruise)L.I.shore control								
Trachelocerca sp.			+	+	+	+		
Loxophyllum sp.						+		
Litonotus sp.						+		
Tracheloraphis sp.			+	+	+	+		
Lacrymaria sp.						+		
Hypotrich sp.(ord.)	+	+	+	+	+	+		
Condylostoma clarissimum			+		+	+		
St.12(water sampling cruise)Sewage								
data pending results from Lackey's (1961) modified live aquarium extraction method								
St.13(water sampling cruise)Dredge spoils								
data pending results from Lackey's (1961) modified live aquarium extraction method								
St.19(water sampling cruise)Acid waste								
Geleia sp.					+	+		
Lacrymaria sp.						+		
Hypotrich sp.(ord.)	+	+	+	+	+	+		
Euplotes sp.	+		+					
Dileptus sp.						+		
Trachelocercid sp.(fam.)			+	+	+	+		
St.21(water sampling cruise)N.J.shore control								
Condylostoma sp.			+		+	+		
Condylostoma clarissima			+		+	+		
Trachelocerca sp.			+	+	+	+		
Tracheloraphis sp.1			+	+	+	+		

Table 7 (cont'd.)

Sites: Tentative Genera/Species	Feeding Preference: Bacteria	Detritus	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
St.21(cont'd.)								
Tracheloraphis sp.2			+	+	+	+		
Frontonia sp.		+	+					
St.23(water sampling cruise)Control								
Trachelocercid sp.(fam.)			+	+	+	+		
Tracheloraphis sp.1			+	+	+	+		
Tracheloraphis sp.2			+	+	+	+		
St.25(water sampling cruise)Control								
Condylostoma clarissimum			+		+	+		
Hypotrich sp.(ord.)	+	+	+	+	+	+		
Prorodon sp.	+		+					
Paraspathidium sp.				+	+			
Gruberia sp.	+		+					
Heterotrich sp.(ord.)	+		+					
Trachelocerca sp.			+	+	+	+		
Loxophyllum sp.						+		
Geleia sp.					+	+		
Euplotes sp.	+		+					
Tracheloraphis sp.			+	+	+	+		
Condylostoma enigmatica			+		+	+		
Lacrymaria sp.						+		

Table 8

Feeding Preference

Sites: Tentative Genera/Species	Bacteria	Detritus or Algae a or d	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
R/V Albatross IV								
23 Jan. to 1 Feb., 1974								
St. 7 40°31'N 73°38'W								
Water col:								
Top: algae, diatoms, *Ceratium*, *Peradinium*								
Tintinnid sp.1	+	a	+	+	+			
Bottom: algae, diatoms, *Ceratium*, *Peradinium*								
Tintinnid sp.1	+	a	+	+	+			
Sed/Water:								
Metopids	+							
Scuticociliate	+							
Sediment:								
Hypotrichs	+	a,d	+	+	+	+	+	
Condylostoma			+		+	+		
Trachelonema			+	+	+	+		
Lacrymaria					+	+		
St.16 40°31'N 73°38'W								
Water col:								
Top: dense algae, diatoms, *Ceratium*, *Polykrikos*, copepods								
Tintinnid sp.1	+	a	+	+	+			
Tintinnid sp.2	+	a	+	+	+			
Tintinnid sp.3	+	a	+	+	+			
Tintinnid sp.4	+	a	+	+	+			
Bottom: algae, diatoms, foraminifera, *Ceratium*, *Peradinium*								
Tintinnid sp.1	+	a	+	+	+			
Sed/Water:								
Euplotes	+			+				
Sediment:								
Condylostoma			+		+	+		
Litonotus						+		
Nassula		a						
Lacrymaria						+		
Euplotes	+			+				
Trachelocercid sp.1			+	+	+	+		
Trachelocercid sp.2			+	+	+	+		
Scuticociliate	+							

Table 8 (cont'd.)

Site:Tentative Genera/Species	Feeding Preference: Bacteria	Detritus or Algae a or d	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
St. 32 $40^o25'N$ $73^o48'W$								
Water col:								
Top:algae, Ceratium								
Tintinnid sp.1	+	a	+	+	+			
Tintinnid sp.2	+	a	+	+	+			
Tintinnid sp.3	+	a	+	+	+			
Mid:algae, diatoms								
Tintinnid sp.1	+	a	+	+	+			
Tintinnid sp.2	+	a	+	+	+			
Bottom: all present seem dead								
Sed/Water:--								
Sediment:--								
St. 35 $40^o25'N$ $73^o54'W$								
Water col:								
Top:very dense with algae and diatoms, Ceratium								
Tintinnid sp.1	+	a	+	+	+			
Tintinnid sp.2	+	a	+	+	+			
Mid:very dense with algae and diatoms, Ceratium, Peradinium, Gymnodinium								
Tintinnid sp.1	+	a	+	+	+			
Bottom:algae and other phytoplankton seem dead								
Tintinnid sp.1	+	a	+	+	+			
Scuticociliate	+							
Sed/Water:--								
Sediment:--								
St. 51 $40^o19'N$ $73^o42'W$								
Water col:								
Top:algae,diatoms, Ceratium,Peradinium, Gymnodinium								
Tintinnid sp.1								
Mid:algae, diatoms, Ceratium, Gymnodinium								
Bottom:algae, few diatoms								
Sed/Water:--								
Sediment:								
Loxophyllum						+		
Teleia					+	+		
Helicoprorodon			+	+	+	+		
Frontonia			+	+				
Lacrymaria sp.1						+		
Lacrymaria sp.2						+		

Table 8 (cont'd.)

Feeding Preferences

ites:Tentative enera/Species	Bacteria	Detritus or Algae a or d	Diatoms	Dino- flagellates	Euglenoids	Ciliates	Micro- metazoa	Histophages
t. 51 (cont'd.)								
ediment (cont'd.):								
ondylostoma			+		+	+		
uplotes	+		+					
rachelocercid sp.1			+	+	+	+		
cuticociliate	+							
t. 82 40°13'N 73°59'W								
ater col:								
op:extremely dense algae, diatoms, Ceratium								
intinnid sp.1	+	a	+	+	+			
ottom:algae, copepods, Ceratium								
ed/Water:								
uplotes	+		+					
acrymaria						+		
etopid	+							
ediment:								
oxophyllum sp.1						+		
oxophyllum sp.2						+		
rachelocerca sp.1			+	+	+	+		
rachelocerca sp.2			+	+	+	+		
racheloraphis			+	+	+	+		
acrymaria						+		
etopid sp.1	+							
etopid sp.2	+							
rachelonema			+	+	+	+		
uplotes	+		+					
eleia					+	+		
cuticociliate	+							
t. 90 40°10'N 73°44'W								
ediment:								
oxophyllum						+		
acrymaria						+		
rachelocerca sp.1			+	+	+	+		
rachelocerca sp.2			+	+	+	+		
uplotes	+		+					
cuticociliate	+							

Table 8 (cont'd)

Feeding Preference

tes:Tentative nera/Species	Bacteria	Detritus or Algae a or d	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
. 92 40°10'N 73°42'W								
ter col:								
p:algae, Ceratium, Peradinium								
ntinnid sp.1	+	a	+	+	+			
d:algae, diatoms, Ceratium, Peradinium								
ntinnid sp.1	+	a	+	+	+			
ntinnid sp.3	+	a	+	+	+			
ttom:diatoms, Ceratium								
d/Water:very silty								
plotes	+		+					
diment:								
plotes	+		+					
achelocercid sp.1			+	+	+	+		

Table 9

Sites:Tentative Genera/Species	Bacteria	Detritus or Algae a or d	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
/V Oregon II								
1 March-3 April, 1974								
t. 7 40°31'N 73°38'W 23 March Long Island Shore Control								
ater Column:								
op: algal strands, sand, Ceratium, Peridinium, copepods, rotifer								
intinnid sp.1	+	a						
ottom: algae, Ceratium, Gymnodinium, diatoms, nauplii								
intinnid sp.1	+	a						
ed/Water: Ceratium, Peridinium, algae, nauplii								
ediment: nematodes, debris, Peridinium, flatworm								
potrich	+	a,d	+	+	+	+	+	+
rachelocercid			+	+	+	+		
leps spiralis			+					
acrymaria					+	+		
intinnid sp.1	+	a,d						
t. 16 40°31'N 73°38'W 23 March New York Harbor Control								
ater column:								
op: algae, Ceratium, diatoms, nauplii								
intinnid sp.1	+	aaa						
intinnid sp.2	+	a						
ottom: algae, sand, Ceratium, Gymnodinium, rotifers								
ed/Water: algae, debris, Gymnodinium, Ceratium, gelatinous zooflagellates								
cutico siliate	+							
ediment:								
rachelocercid sp.1			+	+	+	+		
rachelocercid sp.2			+	+	+	+		
rachelocercid sp.3			+	+	+	+		
acheloraphis			+	+	+	+		
oxophyllum sp.1						+		
oxophyllum sp.2						+		
xophyllum sp.3						+		
enanella						+		
acrymaria sp.1						+		
acrymaria sp.2						+		
elicoprorodon			+	+	+	+		
urlotes	+		+					
ondylostoma			+		+	+		
ypotrichs	+	a,d	+	+	+	+	+	+
etopids	+							
cutico ciliates	+							

Table 9 (cont'd.)

ites: Tentative enera/Species	Bacteria	Detritus or Algae a or d	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micrometazoa	Histophages
t. 31 40°25'N 73°48'W 24 March Sewage Dump Site								
ater column:								
op: algae, Ceratium, nauplii, copepods, polychaete larvae, diatoms, Peridinium								
intinnid sp.1	+	a						
assula		a						
iddle: algae, nauplii, copepods, Ceratium, Gymnodinium, Polykrikos, other dinoflagellates								
ottom: algae, Ceratium, foraminifers, debris								
ed/Water: silt								
t. 34 40°25'N 73°54'W 25 March Dredging Spoils Dump Site								
ater column:								
op: algae, sand, Ceratium, nauplii, copepods								
intinnid sp.1	+	a						
ypotrich	+	a,d	+	+	+	+	+	+
ottom: debris, Ceratium, Peridinium, nauplii, diatoms								
intinnid sp.1	+	a						
ed/Water: debris, dead amphipods								
t. 51 40°19'N 73°42'W 26 March Acid Waste Dump Site								
ater column:								
op: algae, Ceratium, Gymnodinium, Peridinium, other dinoflagellates, zooflagellates, euglenoids, rotifers								
ottom: debris, algae, Ceratium, Peridinium, nauplii								
intinnid sp.1	+	a						
ed/Water: debris, algae, sand, Ceratium, other dinoflagellates								
diment:								
entrophorella sp.1						+		
entrophorella sp.2						+		
emanella sp.1						+		
emanella sp.2						+		
emanella sp.3						+		
emanella sp.4						+		
rorodon		a	+	+	+			
rachelocercid sp.1			+	+	+	+		
rachelocercid sp.2			+	+	+	+		
rachelocercid sp.3			+	+	+	+		
aenia						+		
oxophyllum						+		
acryaria						+		
oxodid sp.						+		

Table 9 (cont'd.)

Sites: Tentative Genera/Species	Bacteria	Detritus or Algae a or d	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micrometazoa	Histophages
Station 57 40°19' 73°52'W 2 April New Jersey Shore Control A								
Multiple Core Station								
Sediment: sand, oil, rotifers								
Trachelocercid			+	+	+	+		
St. 82 40°13'N 73°59'W 28 March New Jersey Shore Control B								
Water column:								
Top: algae, diatoms, Ceratium, Cryptomonas, Peridinium								
Tintinnid sp.1	+	a						
Bottom: algae, Ceratium, Peridinium								
Tintinnid sp.1	+	a						
Sed/Water: algae, dinoflagellates, diatoms								
Euplotes	+		+					
Sediment:								
Trachelocercid			+	+	+	+		
Centrophorella						+		
Lacrymaria						+		
St. 90 40°10'N 73°44'W 29 March Deep Water Sediment Station								
Sediment: Cryptomonas								
Euplotes	+		+					
St. 92 40°10'N 73°42'W 29 March Deep Water Control								
Water column:								
Top: algae, Ceratium, polychaete larvae, Peridinium								
Tintinnid sp.1	+	a						
Middle: algae, Ceratium, nauplii, copepods, diatoms								
Bottom: Debris, algae, diatoms, Ceratium, nauplii								
St. 99 40°22'N 73°36'W 2 April Outer Control Station								
Multiple Core Station								
Sediment: Euglenoid, flatworms, flagellates								
Tintinnid sp.1	+	a						
Trachelocercid sp.1			+	+	+	+		
Trachelocercid sp.2			+	+	+	+		
Trachelocercid sp.3			+	+	+	+		
Pseudoprorodon			+	+	+			
Ketopid	+							
Loxophyllum						+		
Hemionotus						+		
Centrophorella						+		

Table 10
Feeding Preference

Sites: Tentative Genera/Species	Bacteria	Detritus or Algae a or d	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
R/V Delaware II								
26-31 August, 1974								
St. 8								
Water col:								
Top: heliozoa, acantharian, desmid, ctenophores, polychaete larvae, diatoms, *Gymnodinium*, euglenoid								
Tintinnid	+	a						
Oligotrich	+	a						
Bottom: acantharia, polychaete larvae, diatoms, copepods, radiolarian								
Tintinnid	+	a						
Scutico ciliate	+							
St. 15								
Water col:								
Top: acantharia, diatoms, *Gymnodinium*, euglenoid								
Bottom: diatoms, copepods, rotifers, hydroid, *Cryptomonas*, *Chromulina*, *Ceratium*								
Tintinnid sp.1	+	a						
Tintinnid sp.2	+	a						
Sediment;								
Metopid	+							
Litonotus						+		
Prorodon		a	+	+	+			
Euplotes								
Remanella						+		
St. 30								
Water col:								
Top AM: many ciliates (peritrichs, tintinnids, scuticos)								
Vorticella	+							
Philasterid	+							
Uronema	+							
Uronema nigricans	+							
Top PM: copepods, ctenophores with *Trichophrya salparum*, *ceratium*, daphnia, pelecypod larva, chaetognath larvae, dinoflagellates rotifer								
Pseudocohnilembus	+							
Euplotes	+	a,d	+	+	+			
Oligotrich	+							
Tintinnid	+	a						
Cyclidium	+							
Uronema nigricans	+							

Table 11
FEEDING PREFERENCE

Site:Tentative Genera/Species	Bacteria	Detritus or Algae a or d	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
R/V Xiphias								
11 October, 1974								
Sewage dump site								
Water column:								
Top: diatoms, *Ceratium*, copepods, rotifer								
Peritrichs	+							
Vorticella	+							
Mid: *Ceratium*, *Gymnodinium*, copepods, flagellates								
Bottom:								
Uronema nigricans	+							
Dredge edge(a)								
Sediment: nematodes								
Dredge edge(b)								
Sediment:								
Keronopsis			+		+			
Uronema	+							
Cyclidium	+							
Pleuronema	+							
Condylostoma			+		+	+		
Spirostomum								
Metopids	+							
Trachelocerca sp.1			+	+	+	+		
Trachelocerca sp.2			+	+	+	+		
Dredge edge(c)								
Sediment: nematodes, copepods								
Remanella						+		
Pleuronema	+							
Coleps			+					

Table 12
Feeding Preference

Site:Tentative Genera/Species	Bacteria	Detritus or Algae a or d	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
R/V Commonwealth								
18-19 October, 1974								
Station 35 Dredge								
Water column :								
Top: copepods, pelecypod larvae, Ceratium, radiolaria								
Hypotrich	+		+	+	+			
Mid: copepods, organic debris, oil blobs, Ceratium								
Bottom: chaetognath larva, sand, debris								
Station 92 Hudson canyon								
Water column:								
Top: copepods, sand, debris								
Bottom: diatoms, copepods, sand, debris								
Station 32 Sewage								
Water column:								
Top: diatoms, salps, copepods, debris, flagellates, hydroid								
Bottom: copepods, pelecypod larvae, debris								
Station 51 Acid waste								
Water column:								
Top: hydroid medusa, copepods, fish and pelecypod larvae, debris								
Hypotrich	+		+	+	+			
Bottom: copepods, euglenoids, pelecypod larvae, sand								

Table 13
Feeding Preference

Sites: Tentative Genera/Species	Bacteria	Detritus or Algae a or d	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
R/V Xiphias								
1 November, 1974								
Sewage								
Water column:								
Top: copepods, silicoflagellates, Ceratium								
Mid: Ceratium, silicoflagellates, debris								
Tintinnids	+	a						
Bottom: copepods, flagellates								
Uronema	+							
Station 37 Beach edge								
Sediment: nematodes								
Coleps			+					
Pleuronema	+							
Plagiopyla	+	a	+					
Prorodon		a	+	+	+			
Centrophorella						+		
Loxophyllum						+ o		
Frontonia			+					
Helicoprorodon			+	+	+	+		
Remanella						+		
Lacrymaria						+		
Litonotus						+		
Trachelocerca sp.1			+	+	+	+		
Trachelocerca sp.2			+	+	+	+		

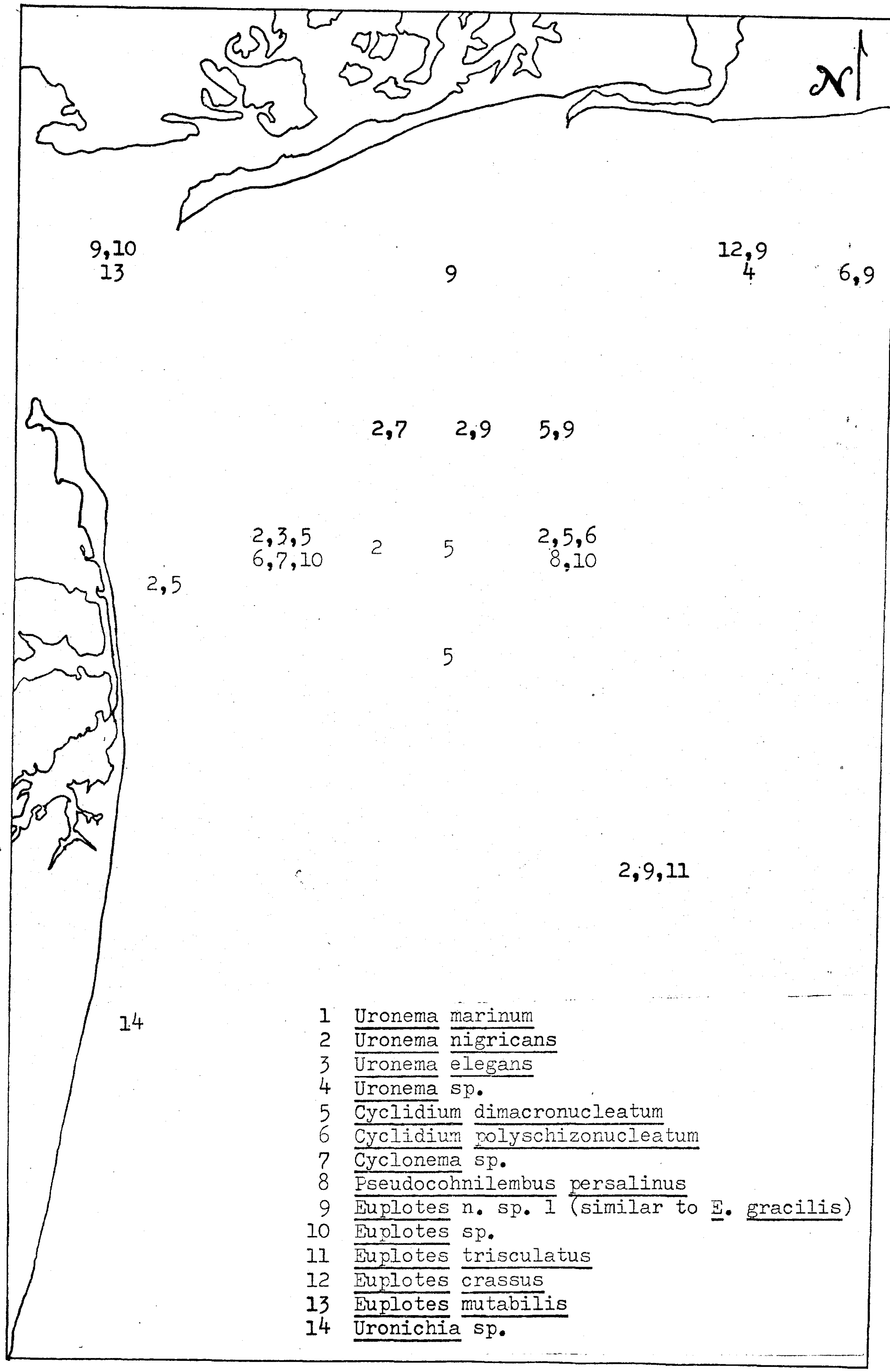
Table 14
Feeding Preference

Sites:Tentative Genera/Species	Bacteria	Detritus or Algae a or d	Diatoms	Dino-flagellates	Euglenoids	Ciliates	Micro-metazoa	Histophages
R/V Rorqual								
19,20 February, 1975								
Dredge Water column:								
Top: algae, fibers								
Tintinnid sp.1		a						
Tintinnid sp.2		a						
Tintinnid sp.3		a						
Mid: algae, diatoms, organic debris								
Tintinnids, 3 spp.		aa						
Bottom: algae, diatoms, sand, debris								
Tintinnids, 5 spp.		aa						
Sediment:								
Scuticociliates, 2 spp.	+							
Sewage Water column:								
Top: algae, phytoplankton								
Bot: algae, phytoplankton								
Dredge edge								
Sediment:								
Metopid sp.	+							
Hypotrichs, 2 spp.	+	a,d	+	+	+			
Trachelocerca sp.			+	+	+	+	+	
Tracheloraphis sp.			+	+	+	+	+	
Centrophorella sp.						+		
Plagiopyla sp.	+	a	+	+	+			
Scuticociliates	+							

APPENDIX: PART C

1. Updated distributional map
2. Abstract for Society of Protozoologists Meetings, August, 1975

Figure 1: Distribution of indicator organisms in the New York Bight



Seasonal fluctuations of planktonic ciliate protozoa from a polluted marine environment

CADY A. SOUKUP, SUZANNE J. SUCHARD, EUGENE B. SMALL
Dept. of Zoology, University of Maryland, College Park, Maryland, 20742

Plankton from the water column over the major sewage dump site in the New York Bight has been sampled over a period of twenty one months. Quantitative counts of the ciliates present indicate seasonal fluctuation in the ciliate plankton population.
Samples were collected from depths of (a) 1 m., (b) 1m. below the euphotic zone (range:3-30 m.), (c) 1 m. above the bottom (range:25-33 m.). The samples were gravity filtered through 80μ, 35μ, and 20μ mesh Nytex monofilament nylon net filters as soon as possible. Filters were placed in a 20 ml. aliquot of filtered seawater and swirled to suspend the filtrate. Ten ml. of the resulting concentrated plankton soup were examined for live material and ten ml. were fixed in ten ml. of Bouin's preservative for later counting.
Data analysis indicates that there are three major population peaks corresponding roughly to the summer, autumn, and winter seasons. Bactivorous scutico ciliates predominate in the relatively large summer population peak; bactivorous peritrichs outnumber the scutico ciliates in the large autumn peak; algivorous tintinnids predominate in the smaller winter peak and are also present in low numbers during the spring phytoplankton blooms. (Supported by U.S.Department of Commerce contract 03-3-043-48 in conjunction with the NOAA Marine Ecosystems Analysis Program).

APPENDIX: PART D

Quantitative Data for the
Sewage Dump Site:

August, 1973 to February, 1975

TABLE I.

QUANTITATIVE DATA:

SEWAGE SITE 40°25'N x 73°48'W

Date	Depth Secchi EZ	Sample Depth	Liters Filtered	Temp.	DO	Direct Observ.	Ciliates Raw Count	95% Range	Ciliates Liter	95% Range
27 August	110'	3'	6	24°C	2.40	+	105	85-125	210.0	170-250
1973		10'	22	22.5	8.15	++	30	21-43	16.4	11-23
	10'	20'	17	22	7.52	+	38	27-53	26.8	19-37
		30'	22	22	7.40	++	40	29-55	21.8	16-30
	30'	40'	20.5	21	7.40	++	95	78-118	55.6	46-69
		50'	18	20	7.46		28	19-41	18.6	13-27
		60'	20	19		+	28	19-41	16.8	11-25
		70'	14	18	6.50		28	19-41	24.0	16-35
		80'	9	11			42	31-57	56.0	41-76
		90'	16	10.5	5.25	++	54	41-71	40.5	31-53
		100'	17.5	9		++	27	18-40	18.5	12-27
		110'	14		5.18	+	42	31-57	36.0	27-49
29 August	110'	3'	16	25	7.60	+	163	135-190	122.2	101-142
		10'	13.5	24	7.65		22	14-34	26.0	17-40
	21'	20'	20	23	7.72	+	44	32-60	35.2	26-48
		30'	14	22	7.44	+	32	22-46	27.4	19-39
	63'	40'	21.5	21	6.64	++	52	39-69	38.7	22-51
		50'	18	21	7.45		32	22-46	21.3	15-31
		60'	18.5	19	6.76		34	24-48	29.4	21-41
		70'	20	14	5.12	+	119	96-133	71.4	58-80
		80'	16	13	4.94	+	14	8-24	10.5	6-19
		90'	23	11	4.94	++	20	13-32	13.9	9-22
		100'	22	10		+	35	25-49	25.4	18-36
		110'	21.5		5.12	+	13	7-19	7.2	4-11
22 October	108'	3'	29.9	14		+	48	36-64	19.2	14-26
	32'	105'	13.5	11		+	40	29-55	47.4	34-65
	96'									
25 January	108'	3'	7	5.5		+	70*	55-89	30.0	21-43
1974	19'	65'	16	6.8		+	49*	37-54	9.2	5-18
	57'	105'	5	6.3			35*	25-49	21.0	13-33
24 March	108'	3'	16			+	29*	20-42	5.4	2-13
	16'	53'	21				16*	9-27	2.2	0.4-8
	48'	105'	5.5	6.0			22*	14-34	12.0	7-22

TABLE 2 QUANTITATIVE DATA: SEWAGE SITE $40^{\circ}25'$ N x $73^{\circ}48'$ W

Date	Depth Secchi EZ	Sample Depth	Liters Filtered	Temp.	Hypo-trichs	Peri-trichs	Tin-tinnids	Ciliates	Total Ciliates	Silico-flagellates	Cera-tium	Dino-physis	Gymno-dinium
29 Aug. 1974	[a] 95' 4.5' 13.5'	5'	5.0	23.9°		240.0	9.6	153.6	403.2	432.0	24.0		144.0
	[b] 80' 35' 105'	3'	24.0	24.0°		2.0	4.0		6.0	2.5		2.5	22.4
		75'	18.0	15.5°			34.6		34.6	23.3		30.0	
11 Oct.	120'	3'	12.0	17.0°	4.0				4.0	105.0	55.0	5.0	5.0
	28'	80'	21.5	14.8°		8.9	8.9		17.8	239.0	273.4	69.7	2.8
	84'	110'	8.0	11.5°			42.0	6.0	48.0	7.5	7.5	7.5	
19 Oct.	110' 30' 90'	3'	16.0	15.4°			21.0		21.0	90.0	21.0	15.0	
		100'	15.0	13.2°		3.2	22.4		25.6	92.8	38.4		
1 Nov.	108'	3'	18.0	15.0°			10.0		10.0	39.3	4.7	40.7	4.0
	11'	35'	18.0	10.0°	0.67		16.7	1.3	18.67		11.3	5.3	
	33'	100'	25.0	8.5°	1.2		30.0	2.4	33.6		16.8	9.8	
20 Feb. 1975	108'	3'	29.0	6.0°			137.9		137.9	45.1	21.7	9.3	25.5
	16'	50'	28.0	6.0°			199.3		199.3	40.0	11.8	8.6	11.8
	48'	100'	30.0	6.5°			188.0		188.0	3.0	10.0	8.6	