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FATTY ACID ECOLOGY OF PLANKTON COMMUNITIES

Progress Report

for Period May 1, 1979 - April 30, 1980

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ABSTRACT

The principal hypothesis addressed in this study states that community variability is related to fatty acid structure. As a test of this idea, the zooplankton in three regimes of increasing physical severity (Block Island Sound, Narragansett Bay and Green Hill Pond) are being compared. A full year's sampling, begun in September 1978 and continued on a monthly basis through the present, is now complete. Measurements have been made on the physical environment, on standing crop and on fatty acid composition in both the phytoplankton-microzooplankton and macrozooplankton.

Fatty acid variation in these communities displays a unique trajectory in time at each location. Environmental change and biochemical variability are directly related. The resulting biochemical message is complex but apparently highly informative. Patterns of variation in some fatty acids are affected most strongly by physical environmental parameters whereas the variation of other fatty acids is more responsive to differences in species composition, diversity and food web relationships. Taken together, these two aspects of biochemical pattern appear to characterize complex species assemblages. The result offers a new strategem for convenient assessment of ever changing state in a natural community.

INTRODUCTION

1. Progress in field sampling.

Continuous monthly sampling began in September 1978. Three sampling locations, Block Island Sound, Narragansett Bay and Green Hill Pond were chosen to test the hypothesis that variability of fatty acid structure in plankton communities increases along a gradient of increasing physical severity (Fig. 1). Temperature and salinity vary the most in Green Hill Pond, less for Narragansett Bay and least for the comparatively stable Block Island Sound.

Figure 1. Study areas in Green Hill Pond (inset A)
Block Island Sound (*) and Narragansett Bay (+).

Two size fractions in the plankton have been collected every month. The phytoplankton-microzooplankton, consisting mainly of large phytoplankton and larval zooplankton (70 to 150 μ) has been sampled quantitatively with a calibrated pump that discharges into a suspended No. 20 mesh net. The macrozooplankton (copepods, fish, decapod larvae, medusae and ctenophores) is collected quantitatively with a No. 6 mesh net that retains organisms larger than 240 μ . Separate samples in each size fraction are taken for species enumeration and chemical analyses.

Green Hill Pond has been sampled exclusively from a small outboard skiff owned by the University of Rhode Island. During the warmer months, it has been possible to sample Narragansett Bay using this craft, but during the more severe months, both Narragansett Bay and Block Island Sound must be sampled from larger chartered vessels. In June 1979 an outboard powered, 20-foot Mako skiff was acquired and modified for field sampling. This vessel is used to sample Narragansett Bay and Block Island Sound whenever possible.

Throughout summer and early fall, 1979, the City of Providence discharged raw sewage into the Providence River at a rate of 60 million gallons per day. These circumstances provided us with an unexpected opportunity to study responses by the plankton. During June, July and August of 1979, we sampled biweekly along a transect extending from the Providence River through Narragansett Bay and well into Block Island Sound (Fig. 2). Our newly acquired Mako skiff made such extensive sampling possible. It is hoped that new insight into the effects of sewage enrichment on the state of the plankton can be

Figure 2. Transect stations: T₅ in the Providence River to T₀ off Block Island; T₁ in upper Point Judith Pond (Fig. 1, insert B) to T₀.

gained through an analysis of these data. We hope to do a follow up study next summer when Providence is processing wastes.

2. Laboratory Studies.

Taxonomic classification and enumeration of two size fractions in the plankton are complete through September of 1979. Successional patterns over an entire year have been worked out for the three primary stations.

Fatty acid composition has been determined with a Perkin-Elmer 900 gas chromatograph equipped with 2 m stainless steel columns, 3.1 mm o.d. packed with 10% SP-2330 on Chromosorb W-AW, 100/120 mesh. In June 1979, a Perkin-Elmer Sigma 1 chromatography system was installed and adapted for capillary chromatography. At present, the system has a 50 m, Silar 5-CP glass capillary column which permits separation and identification of isomeric fatty acids, a refinement not possible with packed columns. Work has also started on the identification and separation of biogenic hydrocarbons in plankton.

This past summer, significant progress was made in systematizing and cataloguing our data for computerized analysis. This task has been facilitated through the use of the Sigma 1 console which converses both with the Sigma 1 microprocessor for control of chromatography procedures and with the University's IBM-270 computer for data analysis.

RESULTS AND DISCUSSION

We are attempting to emphasize the dynamic nature of planktonic assemblages in relation to their ever changing environment. Accordingly, annual distributions are plotted graphically in the following text figures; accompanying values for these distributions and ancillary

data for statistical analysis are given in Appendix I, Tables 1-3 (physical environmental variables) and in Appendix II, Tables 1-6 (gravimetric and biochemical data for the plankton).

1. Physical Environment.

Figures 3 and 4 show the annual distributions of salinity, temperature and light extinction. Salinity is highest (~ 31 ‰) and least variable in Block Island Sound. Salinity in Narragansett Bay has been somewhat lower (~ 29 ‰) but varies more due to riverine input. Green Hill Pond, a shallow, brackish lagoon, displays the lowest and most variable salinity profile of the three areas.

Although temperature varies mainly as a function of season, water depth is a moderating influence. Thus, as is the case for salinity, Green Hill Pond shows the highest degree of thermal variability; Narragansett Bay is somewhat more variable than Block Island Sound. Green Hill Pond cools earlier in winter and warms sooner and faster than the other areas; Narragansett Bay and Block Island Sound are more similar due to their greater depths and correspondingly larger thermal mass.

A similar trend is evident in the extinction characteristics of the three environments (Fig. 4). Light extinction increases markedly from Block Island Sound (40 m) to the shallower waters of Narragansett Bay (20 m). Extinction is greatest in the yet shallower Green Hill Pond (2 m) but since the Secchi disc used to indicate extinction is usually visible on the Pond's bottom, a distribution is not given.

Figure 3. Salinity (S°/oo) and temperature ($T^{\circ}\text{C}$) in three contrasting environments: Block Island Sound (BIS), Narragansett Bay (NB) and Green Hill Pond (GHP), from September 1978 through September 1979.

Figure 4. Extinction coefficient (K') in Block Island Sound and Narragansett Bay. 1978-79.

2. Gross Biological Parameters.

Distributions of standing crop in the phytoplankton-microzooplankton and in the macrozooplankton are shown in Figure 5. In Green Hill Pond, the macrozooplankton decreased during the colder months when the pond froze periodically. The spring phytoplankton bloom stimulated zooplankton growth, and by mid-summer, the zooplankton biomass reached a maximum among the three areas compared here.

In Narragansett Bay, the winter zooplankton community was dominated by Acartia clausi. Contrary to expectation, no phytoplankton bloom occurred during the spring. Thus, the zooplankton declined into the summer. The usually abundant Acartia tonsa population never became established, presumably due to the absence of the spring diatom bloom.

In Block Island Sound, the macrozooplankton tracked the phytoplankton-microzooplankton biomass until spring when the zooplankton increased significantly. Zooplankton production appeared closely linked to phytoplankton-microzooplankton abundance which became depressed through grazing. As the summer progressed, an increase in ctenophores (*Mnemiopsis leidyi*) led to a reduction in zooplankton biomass and a consequent reduction in predation on the phytoplankton-macrozooplankton, which responded with increased abundance. The decrease in zooplankton biomass in the late summer in Green Hill Pond may also be attributed to ctenophore predation.

Figure 5. Standing crop (mg m⁻³ dry wt.) in Green Hill Pond, Narragansett Bay and Block Island Sound. Phytoplankton-microzooplankton (#20) and macrozooplankton (#6).

Table 1 gives the coefficients of variation for the macrozooplankton and phytoplankton-microzooplankton biomass distributions in the three areas. This index is used to compare variability because the mean biomass is significantly different between locations.

Table 1. Relative variation in biomass for an annual cycle, expressed as coefficient of variation.^{a,b}

	Macrozooplankton	Phytoplankton-microzooplankton
Block Island Sound	103.1	97.9
Narragansett Bay	60.7	93.4
Green Hill Pond	140.8	74.2

^a (standard deviation/mean) x 100

^b It is assumed that values for biomass are normally distributed.

Variation is greatest for Green Hill Pond macrozooplankton biomass; this is a significant factor in the development of our general hypothesis. Although contrary to expectation, minimum variation is found in Narragansett Bay. Green Hill Pond phytoplankton-microzooplankton biomass varies least due to continuous contribution of larval stages during the spring, summer and fall period.

Standing crop is related to the nature of food web interactions, nutrient dynamics and the physiological capacities for production in the phytoplankton and zooplankton. Although standing stock estimates may be physically mediated to some extent, the data do not support any

significant conclusions in this respect. As we expected, however, responses of individual species in relation to the pool of fatty acid monomers reveal an entirely different pattern, one that is delicately attuned to environmental vicissitudes in a highly complex manner.

3. Species Composition.

Green Hill Pond (Fig. 6) displays the most symmetrical annual cycle and also has the largest range of densities ($44/\text{m}^3$ to $44,428/\text{m}^3$). The annual low in January suggests that physical conditions become too harsh in the Pond to allow even boreal species to survive. In contrast, the phytoplankton-microzooplankton, dominated by the rotifer Synchaeta sp., maintains a high population level.

Compared with the Pond, the range of densities is smaller in Narragansett Bay ($1,900$ - $16,902/\text{m}^3$) and the pattern is less symmetrical. The seasonal low occurs in September, coinciding with the annual invasion of the carnivorous ctenophore, Mnemiopsis leidyi. The winter levels in the bay are maintained by the boreal copepod Acartia clausi (Fig. 7) in contrast to the disjunctive distribution of A. clausi in Green Hill Pond (Fig. 7). Severe environmental conditions in the Pond delay development of the boreal component until April.

In estuarine systems along the East Coast, zooplankton communities tend to be dominated by the genus Acartia (Jeffries 1962). The winter boreal species A. clausi is replaced by its congener A. tonsa during the summer months. The succession of the two species along an estuarine gradient is related to temperature-salinity interactions. With the quick warming of Green Hill Pond in spring, A. tonsa develops about

Figure 6. Seasonal abundance, no. individuals m^{-3} , in the macrozooplankton (No. 6 fraction) and phytoplankton-microzooplankton (No. 20 fraction) of three habitats.

Figure 7. Seasonal abundance, no. individuals m^{-3} , of the copepods *Acartia tonsa* and *A. clausi* (No. 6 fraction) in three habitats.

30 days sooner than in Narragansett Bay (Fig. 7). Bay stocks are preyed upon by Mnemiopsis leidyi, which may account for low densities in September; but in Green Hill Pond, ctenophores delayed their appearance in sizeable numbers until October. Thus the summer A. tonsa population does not appear to be controlled by predation in the Pond.

Block Island Sound has the smallest range in zooplankton densities (490-15,072/m³) but it also has the lowest average densities. The annual cycle (Fig. 6) shows a low of 490/m³ in February and high in June. Figure 7 shows that neither Acartia species attains densities reaching those found in the Bay, although the annual cycles are similar in both locales. A one month lag in the appearance of A. tonsa in Block Island Sound probably results from temperature-salinity interactions involved in succession.

A major copepod species in Block Island Sound is Pseudocalanus minutus (Fig. 8), which displays a comparatively stable population from January through July. This species dominates the Sound (Frolander 1955), but seasonally it may become an important member of the Bay assemblage (Fig. 8). In general though, P. minutus in the Bay is shorter lived than in the Sound and tends to be outnumbered by A. clausi. The appearance of P. minutus in Green Hill Pond is insignificant; here it is an adventitious species transported in from the Sound, unable to reproduce at the low salinity characterizing this habitat.

The question that must be answered is: how does species composition affect the fatty acid pattern at each station and how might this relate to our hypothesis? Block Island Sound has the most diverse plankton population whereas Green Hill Pond plankton is the least diverse.

Figure 8. Seasonal abundance, no. individuals m^{-3} , of the copepod Pseudocalanus minutus (No. 6 fraction) in three habitats.

Another consideration affecting biochemical pattern is species similarity among habitats. We used a simple matching coefficient based on presence or absence of species to determine similarity. Two main clusters originating in Narragansett Bay and Green Hill resulted, but even consecutive monthly samples from the Sound showed little similarity.

In terms of species composition, Block Island Sound is the most variable station. It also has the most diverse plankton community. How this variability affects the fatty acid trajectories will be discussed in a later section.

4. Fatty Acid Variation.

a) Macrozooplankton

We have proposed that the fatty acid structure of an entire plankton community is a meaningful descriptor of ecological state and that changes in this structure over time result both from taxonomic variation and functional interactions between the plankton and their physical environment.

Correspondence analysis is a means for portraying complex multivariate relations. It allows us to visualize a plankton community over time as a pattern of successive samples in a space defined by variables. This technique simultaneously indicates the relation of each fatty acid to the pattern of sample change throughout the year.

Analysis of the fatty acid data in this manner revealed two interesting trends based upon the major (>5% each) fatty acids (16:0, 16:1, 18:1, 18:4, 20:5, 22:6); and the minor (<5% each) fatty acids (18:2, 18:3, 18:4, 20:2, 20:3, 20:4, 22:3, 22:5). Stearidonic acid (18:4)

is usually intermediate in percent concentration and is included in both groups. This division scheme is meaningful in light of the manner in which fatty acids are elongated and desaturated, as follows according to two main patterns involving double bond positioning (Gunstone 1967).

Series

Unsaturations help to maintain membrane permeability and protoplasmic viscosity at low temperatures, thereby being a factor in determining osmoregulatory capacity at less than optimal salinity conditions. In general, then, variation of the minor fatty acids is integrally related to environmental variability.

Figures 9-11, lower, are the results of a correspondence analysis on the minor fatty acids in macrozooplankton samples taken from September 1978 through September 1979. Each of the three trajectories has a distinctive shape, indicating differences in the three zooplankton communities. These differences are in accordance with our

principal hypothesis. Overall variation is related to the spread between sample points. Tight clusters indicate little variation. The Block Island Sound community (allowing for the exclusion of the February sample) has the most tightly clustered trajectory, having grown in physically the most stable location. It follows, according to our hypothesis, that those fatty acids whose activity is physically mediated should be the least variable in the plankton. A comparison of Green Hill Pond and Narragansett Bay shows the latter to have a more streamlined profile, with less spread along the third axis. If the area along a contoured surface drawn between sample points were measured, we might be able to compare the respective variations quite accurately. Further statistical work is necessary, however, because distances are not equal within the entire field of representation. We believe, however, that the patterns defined by these trajectories are commensurate with our hypothesis: the zooplankton of Block Island Sound is less variable biochemically than that in Green Hill Pond; Narragansett Bay zooplankton is probably intermediate.

Summer samples are biochemically distinct from those collected during winter. In each trajectory, the winter grouping is above and to the left of the summer group. Winter (boreal) and summer (temperate) species display characteristically different fatty acid affinities. The 18 carbon series becomes more desaturated, i.e., $18:2 \rightarrow 18:3 \rightarrow 18:4$, from right to left in Figs. 9-11, lower, from summer to winter, along a gradient of decreasing temperature. Thus, arachidonic acid (20:4) lies to the left of 20:2 and 20:3 in these diagrams. Although the

Figure 9. Correspondence analysis of fatty acid distributions in the Block Island Sound macrozooplankton (No. 6 fraction). Positions of consecutive monthly samples (9 = Sept. 1978, 9' = Sept. 1979) are connected with a solid line forming the sample pattern. Positions of fatty acid variables are indicated by the broken lines. Lower: sample pattern based on minor fatty acids. Upper: sample pattern based on major fatty acids.

Figure 10. Annual sample pattern of Narragansett Bay macro-zooplankton (No. 6 fraction) in fatty acid space. Lower, minor fatty acids; upper, major fatty acids. See Figure 9 for explanation of sample pattern, points 1-12.

Figure 11. Annual sample pattern of Green Hill Pond macrozooplankton (No. 6 fraction) in fatty acid space. Lower, minor fatty acids; upper, major fatty acids. See Figure 9 for explanation of sample pattern, points 1-12.

positions of 22:5 and 22:3 do not fit the picture, we must remember that fatty acid distributions are controlled by a multiplicity of factors and not simply by temperature.

One last point to note is the proximity of consecutive September samples in each area. These are fairly close on the Green Hill Pond and Block Island Sound trajectories but somewhat more separated in Narragansett Bay. This represents our first insight into year-to-year variation demonstrated in the biochemical dynamics of zooplankton communities.

Community trajectory based upon the major fatty acids is shown in Figs. 9-11, upper. Trajectories are plotted separately on the first three principal axes, which account for about 90% of the original variation in the data. The shapes of these trajectories indicate different patterns for the zooplankton community development in each location. Temporal variability appears least in Green Hill Pond. This is contrary to our hypothesis and findings for the minor fatty acids. Narragansett Bay is the most variable and Block Island Sound is intermediate.

Why are the above patterns different from those displayed by the minor fatty acids? Apparently, distributions of the major fatty acids are not strongly dictated by physical environmental factors; rather, they are genetically controlled. Zooplankton species are high in saturated and monounsaturated 16 and 18 carbon fatty acids. These components are predominantly bound in triglycerides as energy reserves. Thus, compared to the minor fatty acids, distributions of major acids vary more with nutritional state and phylogenetic diversity than with

physical environmental factors.

In an earlier section on species composition, we indicated that Block Island Sound displayed the greatest species complexity, whereas Green Hill Pond had the smallest throughout the year. This pattern is commensurate with the trends revealed in the biochemical trajectories based on major fatty acids. If the distribution of these fatty acids is most strongly correlated with species composition, then greater biochemical variability should occur in areas displaying the greatest species complexity. This is, in fact, what we have found. In terms of the major fatty acids, Green Hill Pond plankton displays the tightest biochemical trajectory. Block Island Sound, whose species diversity was highest, reveals the most variable chemical trajectory.

Both the major and minor fatty acid patterns are significant in the structural and functional development of zooplankton communities over time. Biochemical variability is inexorably intertwined with environmental conditions as well as with taxonomic structure and population dynamics, but each factor's contribution to the whole appears to be decipherable. We hope to define further these biochemical relations through continued sampling and data analysis.

b) Phytoplankton-microzooplankton

An analysis of the fatty acid profiles in the #20 size fraction reveals trends similar to those seen for the macrozooplankton. Shapes of the trajectories are, of course, unique for each size fraction and location. In terms of the minor fatty acids, Green Hill Pond phytoplankton-microzooplankton have the largest and most variable yearly trajectory. Block Island Sound phytoplankton-microzooplankton are

least variable in terms of these fatty acids, and the Narragansett Bay community is intermediate. The trend in desaturation along the 18 and 20 carbon fatty acid series is the same as that described for the macrozooplankton. Desaturation increases from the summer to winter months except for 22:3 and 22:5. Summer and winter groups separate clearly on the first three principal axes of variation, which account for 82% of the original variation.

The major fatty acids produce the largest and most variable trajectories in Narragansett Bay and Block Island Sound, the smallest in Green Hill Pond. As expected, summer and winter phytoplankton-microzooplankton assemblages are distinct. Three principal axes retain 90% of the original variation.

5. Progress in Capillary Chromatography.

Our analytical capabilities now include glass capillary gas chromatography. We are able to achieve extraordinary resolution with a 50 m Silar 5-CP column (>100,000 theoretical plates). This resolution is particularly relevant to understanding fatty acid variability in nature. For example, the capillary column separates the ω 3 and ω 6 isomers of 18:3 and 20:3, as well as the ω 7 and ω 9 isomers of 18:1 fatty acids. Figure 12 compares capillary column (Silar 5-CP) and packed column (SP-2330) chromatographs of a typical zooplankton sample. We will continue to analyze zooplankton fatty acids by both methods.

6. Progress in Biogenic Hydrocarbon Analysis.

Work has begun on the determination of biogenic hydrocarbons in plankton samples. A suitable extraction and purification procedure is being refined. Chromatographic analyses will be made with the

Figure 12. Comparison of resolution between packed (top) and capillary (lower) chromatography of macrozooplankton, (T-5, 8-17-79) fatty acids.

Sigma 1 system and a 50 m SE-52 glass capillary column.

7. Summer Transect.

During summer 1979, the City of Providence experienced a breakdown in its sewage treatment facility at Fields Point and was forced to discharge raw sewage into the Providence River at a rate of 60 million gallons per day. We took this as an opportunity for practical application of our biochemical response program and established a biweekly sampling program at the stations shown in Fig. 2. Stations T-5, T-4, T-3, T-2 and T-0 represent a gradient of decreasing sewage pollution from the Providence River into Block Island Sound; stations T-0, T-1 and T-P form a gradient on increasing rural development. Sampling procedures and measurements are similar to those used in our monthly sampling program. Laboratory work is complete, but the data analyses are not. Appendix II, Table 6 lists fatty acid composition for the macrozooplankton collected along the transect in mid-August, 1979. The data collected this past summer may provide insight into the effects of the sewage discharge episode. We hope to continue this program next summer and compare the condition of the plankton under impacted and non-impacted circumstances.

8. Biogeographic comparison of Chemical Domains.

Although not discussed here in detail, a Spanish plankton program identical to the one described above has been in operation since September 1978 (Jeffries and Corral 1979). Two rias (estuaries) on the Atlantic coast of northern Spain are being compared. Biochemical characteristics of the plankton in each ria seem to reflect markedly different species patterns and physical environment.

Particularly significant is the dominating influence of mussel culture in one ria (Ria de Arosa). A raft technique for suspending ropes laden with mussels is so successful that usual trophic relations have become modified. Mussels rather than copepods are chiefly responsible for converting plant to animal tissue in this ria. Mussels produce mucous in huge amounts while feeding, whereas copepods do not. The consequence for Ria de Arosa is a unique detrital network that is under study by a group of Spanish and American investigators working on a "Cooperative investigation of Spanish coastal waters."

Just to the north in Ria de Muros y Noya, where mussel culture is far less intensive than in the Arosa, a typically estuarine species pattern prevails in the zooplankton. Comparisons between these two areas define a field experiment that compliments our three-habitat comparison in Rhode Island waters.

A sample suite from both rias was analyzed for plankton fatty acids by Jose Manuel Cabanas, a visiting investigator from the La Coruña laboratory of the Instituto Español de Oceanografía. During a six-week visit, he became proficient in gas chromatography and computer-assisted data analysis.

A full year's data collected at monthly intervals must be obtained before statistical comparisons can be made, but from the period examined so far (September 1978-February 1979), the aforementioned mussel-dominated influence on trophic relations in Ria de Arosa appears in the zooplankton fatty acid pattern. Fatty acid patterns portrayed by correspondence analysis show a sharp divergence in the mussel raft area.

The effect may be much more noticeable than any accompanying alteration in species distribution along the ria's axis. The significance of these results, for purposes of this report, is that our approach to studying the dynamics of community structure through fatty acid patterns seems to have credibility. This test, in a general sense, is our most important task.

SUMMARY-PROGRESS ON SPECIFIC TASKS

Task 1: Biochemical patterns under varying regimes of environmental severity.

A comparison of biochemical trajectories in plankton communities subjected to increasingly severe environmental regimes has been completed for an annual cycle. Sampling is continuing in an effort to define successional cycles for the second year ending September 1980. These trajectories are required for estimation of year-to-year variation.

Analysis by high performance gas chromatography (glass capillary columns) has been initiated. This approach -- to include positional isomers of fatty acids -- should refine our understanding of biochemical variability in natural communities. The components probably vary in more subtle and meaningful ways than the mixtures separated by packed columns.

We are also working on a procedure to analyze biogenic hydrocarbons with glass capillary columns. These constituents should compliment our understanding of biochemical state in plankton.

To date our knowledge has been based solely on the generally more active fatty acids.

Task 2. Biographic comparison of chemical domains.

Biographic comparisons are being made between two estuaries in northern Spain (Ria de Arosa and Ria de y Muros Noya). Not only is the comparison helpful for testing hypotheses advanced here, but also for relating food production to environmental gradients. From comparisons of ubiquitous biochemical monomers common to all plankton communities, cooperative aspects take on operational meaning. Species lists differ, to be sure, but the same fatty acids are represented on both sides of the Atlantic, and it is their quantitative variation in time and space that we are using to characterize structural behavior at the food web's productive base.

Task 3. Responses of community pattern to controlled stressors.

Although samples were collected during an oil addition experiment at the Marine Ecosystems Research Laboratory (MERL), we have discontinued efforts to obtain zooplankton community trajectories at this facility. We believe that the experiment designed by MERL, involving the recovery of benthic communities in polluted sediments underlying non-polluted Narragansett Bay waters, would not adequately fulfill our objectives. Furthermore, the MERL microcosms may not provide an adequate experimental system for our purposes due to logistical uncertainties over which we have no control. Rather than invest heavily in the MERL system, we decided that more useful information would be obtained from a field experiment on raw sewage

discharge in the Providence River. We hope to continue this experiment next summer.

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Appendix I. Physical environmental variables for Green Hill Pond (GHP),

Narragansett Bay (NB) and Block Island Sound (BIS), 1978-1979.

Table 1. Temperature distributions, surface (S) and bottom (B);
sampling day is given in parenthesis for each month.

	GHP		NB			BIS		
	S	Day	S	B	Day	S	B	Day
<u>1978</u>								
Sept	19.2	(13)	18.5	- ^a	(15)	17.9	17.3	(25)
Oct	16.5	(13)	14.2	14.2	(11)	14.5	--	(23)
Nov	9.7	(15)	11.4	11.3	(10)			
Dec	-0.5	(20)	4.7	4.7	(13)	10.0	9.8	(1)
<u>1979</u>								
Jan	5.4	(29)	1.2	1.0	(18)	6.3	6.0	(5)
Feb						2.0	3.5	(13)
Mar	5.8	(6)	7.0	1.5	(1)			
			5.0	5.0	(29)			
Apr	8.5	(3)				5.8	--	(17)
May	20.9	(11)	14.9	13.0	(10)	12.2	10.1	(21)
Jun	22.5	(11)	17.5	17.0	(12)	14.5	12.5	(14)
Jul	24.0	(9)	19.5	18.8	(10)	20.2	15.1	(17)
Aug	19.8	(14)	20.7	20.3	(14)	18.1	14.0	(17)
Sept	19.7	(20)	20.5	20.7	(18)	19.2	18.8	(18)

^a No sample.

Appendix I. Table 2. Salinity distribution, surface (S) and bottom (B);
sampling days are given in Table 1.

	GHP	NB		BIS	
	S	S	B	S	B
<u>1978</u>					
Sept	15.55	29.14	-- ^a	30.16	--
Oct	22.53	29.39	29.46	30.57	--
Nov	24.86	28.72	28.99		
Dec	20.14	29.93	29.96	32.09	--
<u>1979</u>					
Jan	25.87	27.45	27.59	32.01	32.03
Feb				32.33	32.40
Mar	11.70	28.36	29.18		
		30.07	30.06		
Apr	18.59			30.96	--
May	20.67	28.96	29.75	31.17	31.79
Jun	6.56	28.18	28.47	30.97	31.44
Jul	19.07	30.19	30.27	31.46	--
Aug	22.88	29.33	29.48	31.67	32.32
Sept	24.22	30.03	30.08	31.67	31.73

^aNo sample.

Appendix I. Table 3. Extinction coefficients, k' (M^{-1}) calculated from Secchi disc measurements; sampling days are given in Table 1.^{a,b}

	NB	BIS
<u>1978</u>		
Sept	0.68	0.14
Oct	0.85	0.26
Nov	0.68	
Dec	0.68	0.34
<u>1979</u>		
Jan	0.57	0.34
Feb		0.28
Mar	0.52	
	0.34	
Apr		0.28
May	0.57	0.34
Jun	0.68	0.21
Jul	0.85	0.18
Aug	0.68	0.19
Sept	0.85	0.31

^a $k' = 1.7/D_s$, where D_s is the depth (m)

at which Secchi disc is no longer visible.

^bSecchi disc visible on bottom in GHP.

Appendix II. Gravimetric and biochemical data for the plankton in Green Hill Pond (GHP), Narragansett Bay (NB) and Block Island Sound (BIS). Actual dates of sampling each month are given in Appendix I, Table 1, 1978-1979.

Table 1. Standing crop (biomass) mg dry wt. m^{-3} , collected by towing a No. 6 mesh net obliquely from bottom to surface (Macro); phytoplankton-microzooplankton pumped from 0.5 m through a No. 20 mesh net (Micro).

	Macro (#6)			Micro (#20)		
	GHP	NB	BIS	GHP	NB	BIS
<u>1978</u>						
Sept	34.9	21.1	141.5	-- ^a	--	--
Oct	37.9	130.0	--	73.9	61.6	--
Nov	5.2	63.5		62.9	84.8	
Dec	--	103.8	13.6	30.1	84.8	
<u>1979</u>						
Jan	1.6	108.8	14.9	24.6	16.4	28.4
Feb			4.1			3.7
Mar		66.4			14.4	
	3.3	110.0		54.7	16.4	
Apr	5.8		7.3	49.3		32.8
May	19.8	139.9	5.4	160.1	26.0	35.6
Jun	30.0	69.4	136.6	30.1	51.0	9.6
Jul	184.3	21.5	119.5	79.4	164.7	38.3
Aug	246.0	17.7	103.9	79.3	24.6	82.1
Sept	67.0	28.6	30.3	28.7	142.3	60.2

^a No sample.

Appendix II, Table 2. Surface chlorophyll a, $\mu\text{g l}^{-1}$; day of sampling given in Appendix I, Table 1.

	GHP	NB	BIS
<u>1978</u>			
Sept	3.4	5.4	0.3
Oct	1.3	2.6	1.4
Nov	1.3	16.2	
Dec	3.6	1.4	1.6
<u>1979</u>			
Jan	2.0	1.2	1.1
Feb			3.8
Mar	1.9	0.7	
		1.9	
Apr	1.3		0.3
May	5.9	0.8	1.3
Jun	1.4	3.7	0.4
Jul	4.3	2.2	0.9
Aug	11.5	0.6	1.8
Sept	5.3	3.4	2.1

Appendix II, Table 3. Fatty acid composition of the macrozooplankton and phytoplankton-microzooplankton in Green Hill Pond; percent of total fatty acid methyl esters^{a,b}.

STAT=GMP MESH=6													
DATE	F140	F141	F150	F151	F160	F161	F170	F171	F180	F181	F164	F182	F183
780913	3.5	0.6	1.6	0.1	14.5	3.9	2.0	0.9	6.8	4.3	0.300	1.7	1.8
781013	3.8	0.9	0.8	0.2	19.7	2.5	1.3	0.7	3.8	7.0	0.200	2.6	1.7
781115	3.4	0.8	0.6	0.3	20.6	3.4	0.9	0.8	4.4	3.4	0.200	2.2	2.7
781220	3.4	0.8	1.3	0.9	26.1	1.3	1.3	1.8	3.3	3.4	0.500	1.4	2.3
790129	3.5	0.6	0.7	0.9	14.9	3.4	0.8	2.5	2.6	6.8	1.500	1.7	2.5
790306	6.0	1.9	0.5	0.7	21.6	5.0	0.9	1.2	2.8	4.9	0.400	4.4	2.5
790403	4.1	1.1	0.9	0.4	17.6	12.3	0.4	0.5	3.2	3.2	0.005	1.4	1.9
790611	4.9	0.7	1.6	0.2	18.9	3.8	2.0	0.8	4.6	8.3	0.005	2.6	1.7
790709	5.4	0.9	1.8	0.4	18.8	6.5	2.1	1.0	4.7	5.7	0.500	2.0	1.7
790814	5.7	0.3	1.1	0.1	15.9	6.2	2.1	1.7	4.3	5.2	0.700	1.7	1.7
790920	5.0	1.3	2.1	0.3	13.8	4.6	2.1	1.5	4.6	4.7	0.100	1.8	1.8
DATE	F201	F184	F202	F203	F221	F204	F205	F240	F223	F241	F225	F226	
780913	0.400	1.4	1.1	2.0	0.008	0.9	15.8	0.7	0.600	1.700	1.5	31.4	
781013	0.200	6.8	0.7	1.4	0.005	0.8	15.2	1.0	0.400	1.100	0.8	22.2	
781115	0.200	3.9	0.4	1.0	0.400	0.6	14.5	0.4	0.300	0.400	0.5	27.4	
781220	0.700	3.8	0.6	1.9	0.000	0.4	15.1	0.4	0.005	0.005	0.1	8.3	
790129	0.500	8.0	0.5	1.3	0.005	0.9	17.2	0.2	0.800	0.300	0.9	20.2	
790306	0.600	4.7	0.7	1.7	0.005	1.0	15.2	0.0	0.700	0.005	3.4	17.2	
790403	0.400	3.2	0.8	1.2	0.000	0.8	14.9	0.0	0.500	0.500	1.2	19.8	
790511	0.005	3.9	0.3	0.9	0.500	0.5	15.7	0.4	0.400	1.100	1.0	25.0	
790611	0.100	4.1	0.5	1.4	0.005	1.4	11.5	0.9	0.300	1.600	0.6	20.2	
790709	0.100	2.7	0.6	1.7	0.300	0.6	11.4	0.9	0.400	1.500	0.8	24.0	
790814	0.100	1.6	1.1	1.6	0.300	0.9	13.4	0.1	0.400	1.400	0.8	18.5	
790920	0.300	1.6	1.8	1.2	0.600	0.5	14.2	0.3	0.200	0.800	0.5	27.9	

STAT=GMP MESH=20													
DATE	F140	F141	F150	F151	F160	F161	F170	F171	F180	F181	F164	F182	F183
780913	4.5	0.6	2.5	0.1	14.6	3.7	2.9	1.8	5.8	4.7	0.200	1.6	1.9
781013	3.2	0.3	3.4	0.2	13.7	2.4	1.1	2.4	6.3	4.7	0.100	1.4	2.2
781115	1.1	0.3	1.1	0.3	17.2	1.1	0.8	1.5	3.5	4.0	0.005	1.7	2.7
781220	11.2	0.9	1.3	1.3	20.0	1.8	2.0	1.0	4.0	3.9	0.700	1.8	1.3
790129	6.9	1.0	0.8	0.3	17.4	5.9	1.4	1.1	3.4	4.2	0.800	1.4	2.1
790306	5.3	0.5	0.8	0.5	21.2	11.5	2.4	0.4	7.4	10.2	1.400	2.5	2.7
790403	3.3	0.9	0.5	0.5	13.6	5.8	1.6	0.6	4.6	4.4	0.005	2.5	1.8
790511	3.2	0.9	0.4	0.4	13.6	4.9	2.1	0.6	6.4	5.6	0.000	1.4	1.4
790611	7.7	1.5	0.0	0.1	27.7	6.4	1.1	0.8	3.0	6.8	0.008	2.5	5.9
790709	4.7	0.9	0.4	0.3	17.9	4.4	1.1	0.8	6.0	6.0	0.100	2.0	2.8
790814	5.6	0.7	0.4	0.1	18.0	3.4	2.7	1.4	4.1	4.9	0.100	1.5	1.8
790920	4.6	1.4	3.2	0.3	19.1	4.2	2.8	1.5	6.0	5.8	0.000	2.0	1.8
DATE	F201	F184	F202	F203	F221	F204	F205	F240	F223	F241	F225	F226	
780913	2.10	2.000	2.600	2.5	0.400	1.0	13.5	0.600	1.400	1.200	2.100	21.6	
781013	3.90	3.000	1.300	1.5	0.200	0.7	19.0	0.000	1.900	1.200	2.300	15.8	
781115	0.90	9.000	0.000	1.9	0.300	0.6	15.9	0.300	0.300	0.300	0.700	18.0	
781220	0.40	4.400	0.005	1.0	0.005	0.5	10.6	0.500	0.005	0.005	0.005	5.9	
790129	1.10	8.600	0.500	2.8	0.000	2.2	17.8	0.005	0.005	0.005	1.200	19.2	
790306	1.00	2.000	0.600	0.8	0.005	1.1	7.1	0.005	0.005	0.005	0.200	6.1	
790403	1.00	2.200	1.600	1.4	0.005	0.6	20.3	0.005	0.700	0.300	2.100	16.7	
790511	7.10	0.005	1.900	2.2	0.005	0.3	18.6	0.005	1.800	0.800	3.400	10.4	
790611	0.04	4.088	0.300	0.8	0.005	0.8	9.6	0.400	0.300	1.800	0.400	13.7	
790709	2.10	2.000	1.300	2.8	0.100	0.8	12.0	0.200	1.300	1.200	2.300	17.7	
790814	0.00	4.400	1.100	1.4	0.400	0.9	11.0	0.300	1.000	1.200	2.000	17.6	
790920	1.20	2.200	1.800	1.3	0.900	0.7	12.6	0.100	0.500	0.400	1.900	18.4	

^aDate: shorthand notation for yr/mo/day.

^bFatty acid shorthand notation for number of carbon atoms:
number of double bonds.

Appendix II, Table 4. Fatty acid composition of the macrozooplankton and phytoplankton-microzooplankton in Narragansett Bay, percent of total fatty acid methyl esters^{a,b}.

STATION# NESH#6												
DATE	F140	F141	F150	F151	F160	F161	F170	F171	F180	F181	F182	F183
780915	6.40	0.5	1.0	0.3	17.1	9.7	1.4	1.7	5.3	4.5	0.9	1.0
781011	3.00	0.4	0.4	0.1	20.2	0.5	1.4	0.7	4.4	4.4	0.2	1.2
781110	0.00	0.0	0.0	0.0	18.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
781213	0.0	0.0	0.0	0.0	13.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
790118	4.38	0.1	0.5	0.7	13.4	0.4	0.8	1.1	4.5	1.5	1.0	0.9
790301	2.00	0.1	0.2	0.9	9.7	0.6	0.8	1.2	0.0	1.6	0.4	0.9
790329	0.60	1.2	0.3	2.1	11.9	0.0	0.2	0.3	0.9	4.1	0.7	1.1
790510	6.30	0.5	0.9	1.5	12.4	0.0	0.2	0.5	0.0	3.5	1.3	0.0
790612	4.81	0.6	1.0	0.6	17.0	4.5	1.1	0.0	2.2	3.1	0.1	1.1
790710	7.20	0.4	0.6	0.6	19.0	2.4	0.9	0.0	0.4	3.4	0.0	0.7
790814	1.40	1.7	1.7	0.0	19.1	0.4	0.4	0.0	0.0	0.0	1.3	0.0
790912	7.80	0.4	1.0	0.5	19.0	9.2	0.5	1.7	4.7	4.2	0.7	1.0
STATION# NESH#6												
DATE	F201	F184	F202	F203	F221	F204	F205	F240	F223	F241	F225	F226
780915	2.2	4.4	0.7	1.1	0.000	0.9	19.4	0.005	1.1	0.200	1.1	16.3
781011	0.2	7.7	0.7	1.1	0.000	0.5	13.1	0.000	0.0	0.000	0.0	27.6
781110	0.0	0.0	0.0	0.0	0.000	0.0	0.0	0.000	0.0	0.000	0.0	0.0
781213	0.3	11.3	0.5	1.3	0.000	0.7	18.5	0.000	1.1	0.700	0.0	23.4
790118	0.4	12.4	0.7	1.4	0.200	0.6	16.9	0.200	0.0	0.600	0.6	34.8
790301	0.6	6.8	1.1	0.6	0.200	0.9	17.3	0.200	0.9	0.700	0.3	12.6
790329	0.7	4.5	0.8	0.5	0.005	0.9	15.1	0.005	1.1	0.005	0.0	10.7
790510	0.5	0.0	0.4	1.0	0.000	1.5	21.2	0.000	0.6	0.700	0.7	11.1
790612	0.6	0.0	0.6	1.4	0.000	0.6	17.0	0.000	0.7	0.700	0.8	23.9
790710	0.7	9.6	0.6	0.0	0.000	0.0	12.9	0.000	0.0	0.000	0.0	19.0
790814	1.1	1.9	1.2	0.0	0.400	0.5	12.4	0.000	0.5	0.000	1.0	15.1
790912	0.6	2.5	0.6	1.3	0.400	0.6	21.6	0.200	0.8	0.500	1.0	15.1
STATION# NESH#20												
DATE	F140	F141	F150	F151	F160	F161	F170	F171	F180	F181	F182	F183
780915	6.8	1.100	1.5	0.6	19.8	8.3	1.8	1.8	5.6	5.1	0.7	1.5
781011	12.3	0.000	0.7	0.6	19.3	10.2	1.9	2.7	3.7	2.4	0.0	1.9
781110	11.6	0.000	0.5	0.5	18.6	13.5	0.5	2.6	2.4	1.9	0.9	1.2
781213	4.8	0.000	0.0	0.0	14.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
790118	9.7	0.005	0.1	1.1	14.4	14.9	0.2	4.4	4.4	2.9	1.1	0.4
790301	17.6	0.000	0.6	0.8	20.8	11.4	0.3	1.7	2.2	6.1	0.0	1.7
790329	17.4	0.200	0.5	0.9	19.0	28.6	0.1	2.8	2.8	2.6	2.9	0.9
790510	11.8	0.300	1.6	0.6	18.9	7.8	1.4	1.4	3.6	3.1	1.7	1.7
790612	18.3	0.100	0.8	0.2	19.6	13.7	0.4	1.4	2.5	2.0	1.7	1.0
790710	3.8	1.000	2.2	0.7	15.4	4.2	2.6	2.6	6.9	4.8	1.0	1.9
790814	16.7	0.300	0.7	0.8	19.9	15.6	0.3	0.6	3.1	2.4	1.5	1.5
STATION# NESH#20												
DATE	F201	F184	F202	F203	F221	F204	F205	F240	F223	F241	F225	F226
780915	1.700	5.1	0.400	1.2	0.005	0.7	15.4	0.100	0.6	0.100	1.2	14.8
781011	0.200	4.6	0.200	0.7	0.000	0.4	17.8	0.100	0.4	0.200	1.0	10.4
781110	0.005	0.000	0.000	0.0	0.000	0.5	23.2	0.005	0.6	0.000	0.5	8.1
781213	0.005	0.000	0.000	0.0	0.000	1.0	19.1	0.005	1.0	0.700	0.0	22.7
790118	0.400	11.3	0.600	1.4	0.305	0.3	16.4	0.000	0.6	0.400	0.0	21.5
790301	0.100	3.2	0.400	3.3	0.000	0.4	23.4	0.005	0.1	0.005	0.0	2.6
790329	0.400	5.1	0.005	1.6	0.000	0.5	18.1	0.100	0.3	0.000	0.0	9.2
790510	0.305	2.6	0.200	1.3	0.100	0.3	18.9	0.100	0.4	0.000	0.0	12.2
790612	1.200	0.4	0.600	2.1	0.000	0.7	13.6	0.000	0.8	0.400	0.6	6.7
790710	0.700	2.7	0.400	1.1	0.300	0.6	14.7	0.200	0.8	1.100	0.6	23.9
790814	1.200	2.3	1.300	2.8	0.400	1.0	13.7	0.200	1.1	1.500	2.9	6.3
790912	0.400	4.4	0.200	0.9	0.300	0.8	16.8	0.100	0.3	0.400	0.0	6.3

^a Date: shorthand notation for yr/mo/day.

^b Fatty acid shorthand notation for number of carbon atoms: numbers of double bonds.

Appendix II, Table 5. Fatty acid composition for the macrozooplankton and phytoplankton-microzooplankton in Block Island Sound; percent of total fatty acid methyl esters^{a,b}.

STAT=81S MESH=6													
DATE	F140	F141	F150	F151	F150	F161	F170	F171	F180	F181	F164	F182	F183
780925	6.2	0.7	0.9	0.1	15.3	5.3	1.0	0.9	3.5	6.0	0.005	1.1	1.0
781023	6.1	0.6	1.2	0.3	18.8	4.9	1.3	0.7	1.4	7.6	0.100	3.1	4.9
781201	6.5	0.6	0.8	0.2	16.5	9.4	1.3	2.7	1.7	4.8	1.800	0.7	1.0
790105	3.7	0.4	0.7	0.6	15.8	4.8	1.4	2.3	3.4	9.0	1.500	3.2	1.4
790213	3.0	0.1	0.3	3.2	9.1	8.6	1.1	12.9	3.4	12.1	4.700	0.5	1.6
790417	3.1	0.6	0.8	3.4	13.4	7.4	1.2	6.8	2.6	13.2	0.005	2.6	1.3
790521	4.9	0.8	1.1	1.1	16.2	6.4	1.5	1.8	4.8	10.7	0.100	1.7	1.2
790614	4.5	0.1	0.6	2.2	13.9	3.8	0.8	6.5	2.5	8.9	0.000	2.4	2.6
790717	7.1	0.2	0.9	1.2	16.0	8.0	0.9	1.6	3.2	6.6	1.200	1.7	1.3
790817	11.2	0.3	1.2	0.5	19.3	10.4	1.6	1.9	1.6	5.1	1.800	2.3	1.4
790918	10.3	0.1	0.5	0.8	17.6	11.0	1.5	2.3	3.1	3.1	2.800	2.0	1.2
DATE	F201	F184	F202	F203	F221	F204	F205	F240	F223	F241	F225	F226	
780925	0.4	1.9	0.7	2.2	0.500	0.3	20.1	0.300	0.8	1.000	0.8	26.9	
781023	0.1	12.2	1.6	1.3	0.000	0.4	9.3	0.000	0.7	0.400	1.1	17.6	
781201	0.4	3.5	0.3	0.9	0.500	0.4	20.7	0.200	0.6	0.800	0.9	19.4	
790105	1.4	2.4	0.7	0.8	0.700	0.6	15.4	0.105	1.1	0.600	0.7	23.4	
790213	0.4	4.6	1.1	0.8	0.100	0.8	19.0	0.000	1.4	0.005	0.5	19.7	
790417	0.6	4.3	0.3	0.8	0.005	0.8	14.4	0.100	0.5	0.600	0.4	16.2	
790521	0.9	3.7	0.6	2.6	0.005	1.3	15.1	0.100	0.5	0.900	0.7	22.6	
790614	0.7	6.2	0.5	1.3	0.700	1.0	14.4	1.400	0.0	0.800	0.4	19.4	
790717	0.5	3.2	0.6	1.1	0.600	0.7	17.7	0.300	1.2	0.500	0.6	16.8	
790817	0.6	2.7	0.4	1.3	0.500	0.6	14.8	0.100	0.9	0.200	0.5	10.8	
790918	0.3	2.3	0.3	1.4	0.030	0.6	25.6	0.100	0.3	0.400	0.4	10.7	
STAT=81S MESH=20													
DATE	F140	F141	F150	F151	F160	F161	F170	F171	F180	F181	F164	F182	F183
780925	6.3	0.8	0.9	0.2	18.3	5.4	1.2	1.2	4.4	6.1	0.7	1.5	1.0
781201	10.7	0.8	0.9	0.5	19.5	8.9	1.5	1.2	3.2	7.1	3.5	0.8	1.1
790105	12.3	0.4	0.8	0.9	16.6	15.1	1.7	3.4	3.4	3.9	7.5	0.7	0.3
790213	12.8	0.2	0.9	0.9	19.8	15.5	0.8	3.9	4.5	3.7	6.8	1.0	0.2
790417	13.6	0.5	0.8	1.9	22.2	24.7	0.2	3.2	3.2	3.1	4.6	1.8	0.6
790521	11.1	2.7	1.8	1.0	24.7	6.5	1.6	1.5	3.2	3.1	0.9	1.8	1.5
790614	12.4	1.1	1.2	0.7	32.9	3.5	1.3	1.3	2.8	6.9	0.1	1.4	1.4
790717	12.1	0.1	1.0	0.9	19.0	21.8	0.1	1.5	2.1	4.6	1.0	2.0	2.9
790817	17.2	0.1	1.0	0.9	19.0	21.8	0.1	1.5	2.1	4.6	1.0	2.0	2.9
790918	11.1	0.6	1.3	0.7	18.7	15.4	0.5	2.7	3.4	4.4	2.5	2.1	1.8
DATE	F201	F184	F202	F203	F221	F204	F205	F240	F223	F241	F225	F226	
780925	0.8	2.2	0.400	1.8	0.000	0.600	15.5	0.000	0.900	0.900	0.800	24.4	
781201	0.2	4.5	0.005	1.1	0.000	1.000	15.8	0.005	0.400	0.100	0.600	13.0	
790105	0.2	2.5	0.005	1.1	0.000	0.300	19.6	0.005	0.005	0.005	0.005	8.8	
790213	0.4	1.4	0.300	1.1	0.005	0.200	15.6	0.100	0.100	0.005	0.200	5.6	
790417	0.2	3.4	0.005	1.9	0.005	0.600	7.9	0.005	0.200	0.200	0.100	13.6	
790521	0.2	3.4	0.005	1.1	0.000	1.100	11.9	0.000	3.400	0.200	0.300	14.1	
790614	0.2	3.4	0.005	1.3	0.000	0.005	11.9	0.100	0.200	0.200	0.400	14.1	
790717	0.4	3.2	0.400	1.6	0.500	0.000	10.0	0.200	0.400	0.200	0.400	14.1	
790817	0.1	1.9	0.400	1.7	0.010	0.900	13.3	0.300	0.300	0.100	0.200	8.0	
790918	0.8	3.5	0.400	1.5	0.000	0.700	15.0	0.100	0.300	0.200	0.300	9.1	

^a Date: shorthand notation for yr/mo/day.

^b Fatty acid shorthand for number of carbon atoms: number of double bonds.

Appendix II, Table 6. Relative concentrations of selected fatty acids in the macrozooplankton collected August 15-17, 1979 along the Providence River-Block Island Sound transect (T-5, T-0) and the Block Island Sound-Point Judith Pond transect (T-0, T-P); percent of total fatty acid methyl esters.

Fatty acid ^a	Station						
	T-5	T-4	T-3	T-2	T-0	T-1	T-P
16:0	19.5	18.4	20.8	22.4	17.2	19.3	18.4
16:1	4.4	4.5	3.8	8.3	12.3	10.5	5.9
18:0	8.6	5.6	6.5	4.7	3.3	3.6	6.8
18:1	6.8	4.3	4.8	8.1	6.2	5.3	7.5
18:2	2.4	1.5	1.1	2.0	2.3	2.3	2.3
18:3	2.3	1.1	1.2	1.4	1.8	1.5	3.8
18:4	0.04	2.4	1.6	1.5	2.3	2.7	3.8
20:2	1.4	0.5	0.6	0.8	0.7	0.4	1.0
20:3	2.1	1.2	1.2	1.8	1.7	1.5	2.3
20:4	1.8	0.4	0.3	0.5	0.7	0.6	1.0
20:5	9.2	17.2	15.4	16.8	18.1	14.8	16.9
22:3	1.7	0.5	0.4	0.4	0.6	0.7	0.8
22:5	0.9	1.0	0.8	0.4	0.4	0.3	2.3
22:6	14.1	25.8	27.7	8.6	10.2	10.8	12.2

^aShorthand notation for number of carbon atoms:number of double bonds.