GROUND TRUTH VERIFICATION OF A REMOTS® SURVEY OF BUZZARDS BAY

By

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Introduction

The Woods Hole Oceanographic Institution and Science Applications International Corporation (SAIC) conducted a joint sediment quality survey in Buzzards Bay estuary in August 1987 as part of the U.S. Environmental Protection Agency's (EPA) Buzzards Bay Project. The purpose of the reconnaissance survey was two-fold. First the study utilized SAIC's REMOTS® System (Remote Ecological Monitoring of the Seafloor) to define gradients in the benthic environment. This remote sensing tool allows in situ imaging of the upper 20 cm of the sediment column. Sediment profile images are analyzed by computer image analysis and up to 20 parameters are available for the purpose of rapidly mapping and identifying organic enrichment gradients in sediments. Secondly, the REMOTS® results are evaluated in this report with traditional benthic habitat surveys based on actual samples obtained with a quantitative grab sampler. The benthic habitat results are the subject of this report, and the REMOTS® data was provided to EPA Region I under separate cover (Rhoads, 1987).

Fifteen stations ranging in depth from 20'-60' below mean low water were occupied and sampled (Figure 1) by REMOTS®, followed by 2 biological cruises reoccupying these stations to conduct the benthic survey (Table 1). Stations were positioned along a transect extending between New Bedford Harbor (a major organic enrichment site) and Station R (Sanders, 1960). Station R was selected as a reference station based on its historical significance, having been sampled periodically over the past 30 plus years. Station R is considered a "pristine" (i.e., not enriched) station as Station R is located 6.5 nautical miles south-southwest from the New Bedford Harbor outfall.

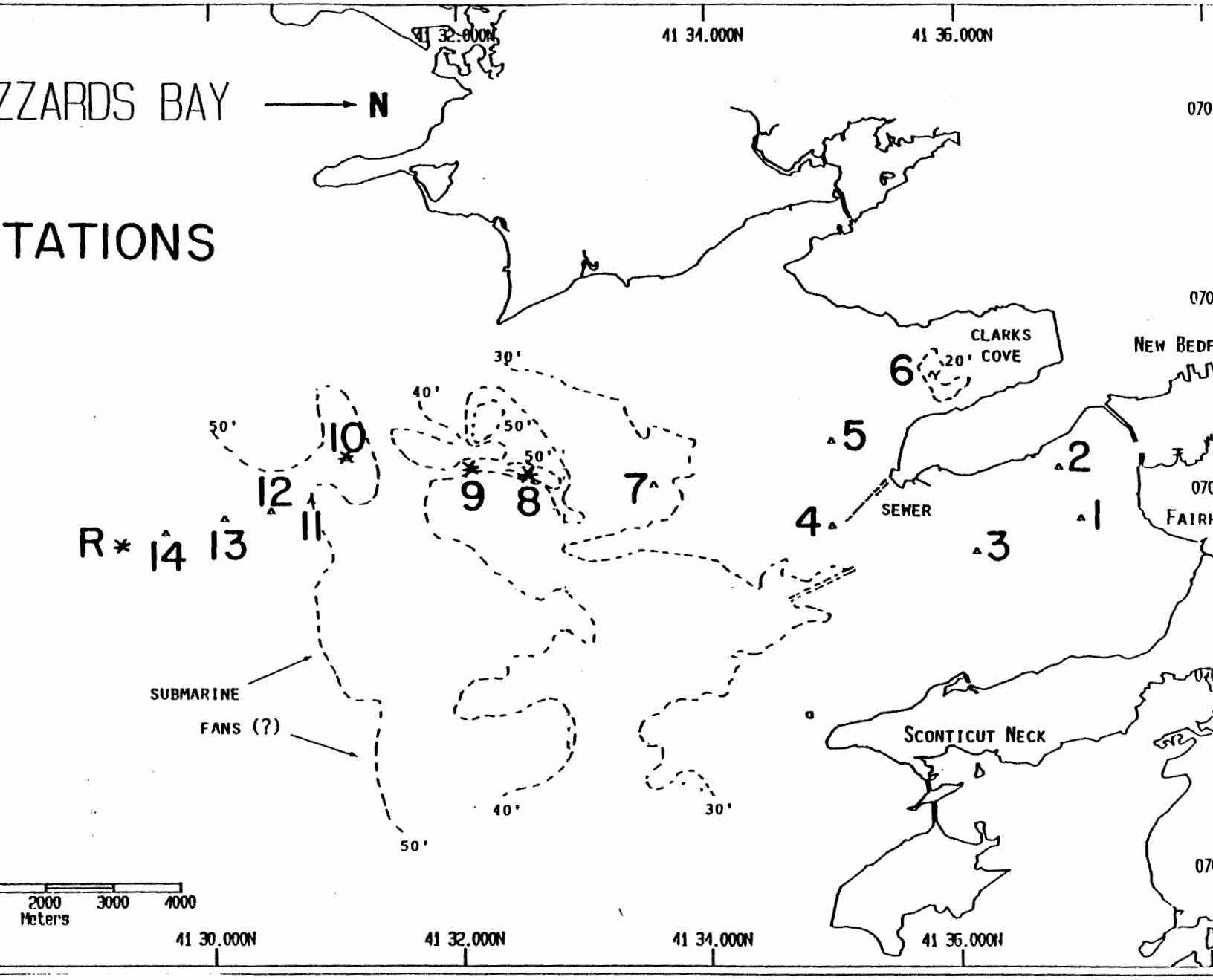
Methods

a) Sampling Stations

A total of 7 biological stations were initially sampled in triplicate on August 10, 1987 (Table 1) reoccupying REMOTS® stations previously sampled on August 4, 1987 by SAIC (Rhoads 1987). Some of these replicates were collected but not sorted, being retained as reference material for any future REMOTS®-benthic studies that might be undertaken within the New Bedford-Station "R" transect.

Interpretation of preliminary sediment profile images from Rhoads' initial REMOTS® survey for the Buzzards Bay EPA (Aug. 1987), suggested that an additional benthic ground truth station (Sta. 9) be added and processed together with the initial 7 benthic sites. This station appeared to have an exceedingly high REMOTS Organism-Sediment Index (high benthic habitat quality) relative to all other stations and therefore required additional documentation for testing this OSI index. A second cruise was initiated on Sept. 10, 1987 to sample this station.

Operating within the fiscal constraints of our original proposal, initially only three primary stations were initially selected to be sampled and processed and only one of the replicates from each station was intended to be completely sorted. The other two replicates were intended to be screened and sorted only to the 1 mm size fraction with a smaller aliquot to be subsampled and processed for the fine fraction. After sorting time was fully evaluated, it was decided to sort, identify, and enumerate the entire sample to ensure maximum accuracy. In summary, all replicates from four primary sites 15, 10, 9, and 8



e -1. REMOTS® Stations 1 through 14 and Station R-(15) in Buzzards Bay. Benthic Stations R(15), 14, 13, 12, 10, 9, 8, 3. * = primary sites.

have been processed and secondary Stations 14, 13, 12, and 3 have been processed for one replicate only.

In consideration of the expansion of the project requirements, a no cost extension was requested and granted from the Environmental Protection Agency to allow completion of this more comprehensive study.

b) Field Sampling and Field Processing

Table 1 shows the LORAN time delays for each station sampled, with dates and depths indicated for each cruise. Stations were located by LORAN-C (North Star 6000) using time delays obtained from the REMOTS® survey of August 4, 1987 when the first cruise was completed and stations established. Stations were also located by reference to bathymetry and bottom topography.

When these stations were reoccupied for the biology infaunal sampling, a float marker with anchor was deployed over the side of the vessel when each LORAN station was positioned and marked. All replicates were obtained adjacent to the marker float to insure close positioning of each replicate.

As the samples were recovered on deck, the condition of the samples was qualitatively noted in a deck log. This log is included as Appendix 1.

Core subsamples: One core sample was taken for C-H-N analysis and sediment grain size analyses from each third infaunal grab sample immediately after collection. A plastic syringe with an inside diameter of 2.54 cm was used to collect these cores. Cores were frozen in labelled Whirlpak® bags immediately after returning to port in Woods Hole. Removal of these cores therefore reduced the surface area of the faunal grab. C-H-N data is shown in Table 2, and sediment grain size analysis is provided in Table 3.

Table 1.

REMOTS®/Ground Truth Verification:
Benthic Samples Processed and Identified

Sampler: 1/25 m^2 Van Veen Grab

Station Name	Date	Depth	Location LORAN-C Slaves	
R-15-1*	8/10/87	64.6'	14221.3	43956.2
15-2*	8/10/87	"	"	"
15-3*	8/10/87	"	"	"
14-1	8/10/87	62.4	14220.6	43957.7
13-1	8/10/87	54.4	14218.9	43962.7
12-1	8/12/87	53.5	14217.8	43966.6
10-1*	8/10/87	55.0	14220.8	43969.9
10-2*	8/10/87	"	"	"
10-3*	8/10/87	"	"	"
9-1*	9/10/87	54.0	14214.6	43976.6
9-2*	9/10/87	"	"	"
9-3*	9/10/87	"	"	"
8-1*	8/10/87	66.0	14212.0	43978.9
8-2*	8/10/87	"	"	"
8-3*	8/10/87	"	"	"
3-1	8/10/87	28.5	14193.2	44001.1

Secondary benthic sample collected and achieved - future analysis:

14-2
14-3
13-2
13-3
12-2
12-3
3-2
3-3

*Primary sites

Table 2

C-H-N

Sample	Date	%N	%C	%H	C/N Ratio
EPA	8/10/87				
Sta. 3	"	0.32	3.37	0.70	10.5
Sta. 8	"	0.17	1.52	0.40	8.9
Sta. 9	9/10/87	0.03	0.39	0.10	13.0
Sta. 10	8/10/87	0.25	2.02	0.50	8.1
Sta. 12	"	0.27	2.18	0.60	8.1
Sta. 13	"	0.25	2.21	0.50	8.8
Sta. 14	"	0.20	1.66	0.40	8.3
Sta. 15	"	0.22	1.88	0.50	8.5
Sta. 15 (R) Boxcore	5/14/86	0.05	0.76	0.60	15.2

Table 3

Location		%Sand	%Silt	%Clay	%H_2O
EPA 8/10/1987	STA 3	21.8	44.6	33.5	55.5
"	STA 8	21.2	49.6	29.1	52.1
"	STA 9	89.7	5.4	4.8	23.3
"	STA 10	11.6	52.5	35.9	58.2
"	STA 12	9.0	53.7	37.2	57.4
"	STA 15	16.0	50.9	33.1	54.2

Each Van Veen grab sample (area - 0.04 m^2) was washed into a 9.5 liter plastic bucket containing a pour spout for ease of decanting and transferring. Filtered seawater was used to wash and decant the sample as the excess fine sediments passed through a 30.5 cm diameter screen with a 0.3 mm mesh opening. Most of the samples consisted of a fine soft, silty-clay sediment allowing most of the excess sediment to pass through the screen. Samples were then preserved with 10% buffered formalin in filtered seawater and labelled both inside and outside the containers.

c) Laboratory Processing: Benthic Analysis

Each grab sample was logged onto a master sheet upon arriving in Woods Hole. Each sample was resieved before sorting and separated into two size classes (> 1.0 mm) and fine (<1.0 mm) fraction using a nested set of a 1.0 mm and 0.3 mm sieves.

Samples were then stained with a solution of Rose Bengal for a duration of 3-24 hours, after which the samples were rinsed with fresh water to remove excess stain. The organisms were picked and sorted under a dissecting microscope. Initial sorting involved 8 high level taxonomic categories: polychaetes, amphipods, crustacea, gastropods, pelecypods, *Mediomastus*, oligochaetes and miscellaneous.

Additional identifications were made to the lowest possible taxonomic level, usually to species level with the help of taxonomic experts at the Biology Department of the Woods Hole Oceanographic Institution. Ms. Susan Brown-Leger assisted with the more difficult polychaete groups and amphipod identifications and Ms. Linda Morse-Porteous completed the gastropod taxonomy. Most of the other groups were more easily identified from the author's past experience with the local benthic fauna from Buzzards Bay.

d) Data Processing

Counts of individual species per 0.04 m^2 were recorded for each replicate and appear in Appendix 2 both by major taxonomic groups and also accumulative percent basis.

Due to excessive numbers of small polychaete species encountered at Stations 9 and 3, the fine fraction component (<1.0 mm) collected from these stations required subsampling to reduce excessive sorting time.

Two replicates from Station 9 were picked and sorted in their entirety. Only the third replicate (Sta. 9-3) was placed in a Kahlsico plankton splitter. All specimens were picked from one-half of the split sample and individual counts multiplied by two for totals.

Station 3 (secondary site) also required subsampling for one replicate due to the presence of an excessive abundance of *Mediomastus ambiseta* (polychaete). This was accomplished with the aid of a 40 cm x 40 cm clear plastic tray subdivided into 100 4 cm x 4 cm quadrates. The fine fraction of the sample (3-1) was equally distributed across the surface of the tray and then subsampled by removing 5 randomly selected quadrates (4 cm^2) within the tray (table of random numbers used). Individual species counts obtained from five cores were combined and multiplied by 20 to provide final counts.

Background

Organic enrichment associated with eutrophication of coastal ponds and embayments is a worldwide problem, especially in coastal areas adjacent to densely populated towns and cities. Sewage discharges, agricultural runoff and street drainage increase sedimentation rates and introduce nutrients, pollutants, and other organic matter collectively; these are the major contributing sources of overfertilization of our harbors. The coastline of Buzzards

Bay, with its explosive land development in the last 10-15 years, shows evidence of this nutrient overloading within nearshore ponds and harbors of the Bay. The initial results of our 1987 REMOTS survey revealed some evidence of enrichment especially near the New Bedford outfall site and nutrient overloading was apparently affecting some of our deeper offshore stations within the Bay.

Pearson and Rosenberg (1978) summarized a number of studies related to the effect of organic enrichment on spatial and temporal trends in macrofaunal species abundance, species richness, and biomass. The relative changes in the above three parameters with increasing distance away from a point source of organic loading was found to produce a predictable and repeatable pattern. A generic form of this enrichment-response graph is shown in Fig. 2. We will use this model to evaluate both the faunal and REMOTS data in the discussion section of this report.

Immediately adjacent to an organic effluent, azoic or nearly azoic conditions may exist caused by excessive organic loading rates which produce anoxic sulphidic, or methanogenic conditions. Farther from the effluent, "enrichment" opportunists (mainly spionid and capitellid polychaetes) attain peak densities (PO-peak of opportunists). Species richness is low as only a few opportunistic species dominate these very dense assemblages. Because the individual biomass of these small worms is low, the population biomass is low compared to the very high densities that can be attained (ca. 10^4-$10^5/m^2$).

Continuing away from the enrichment source, the density of opportunists decreases and other species appear. This results in a lower overall population density but species richness increases. Where the decreasing abundance curve and increasing species richness curves cross, Pearson and Rosenberg identify this as the ecotone (E). Within the

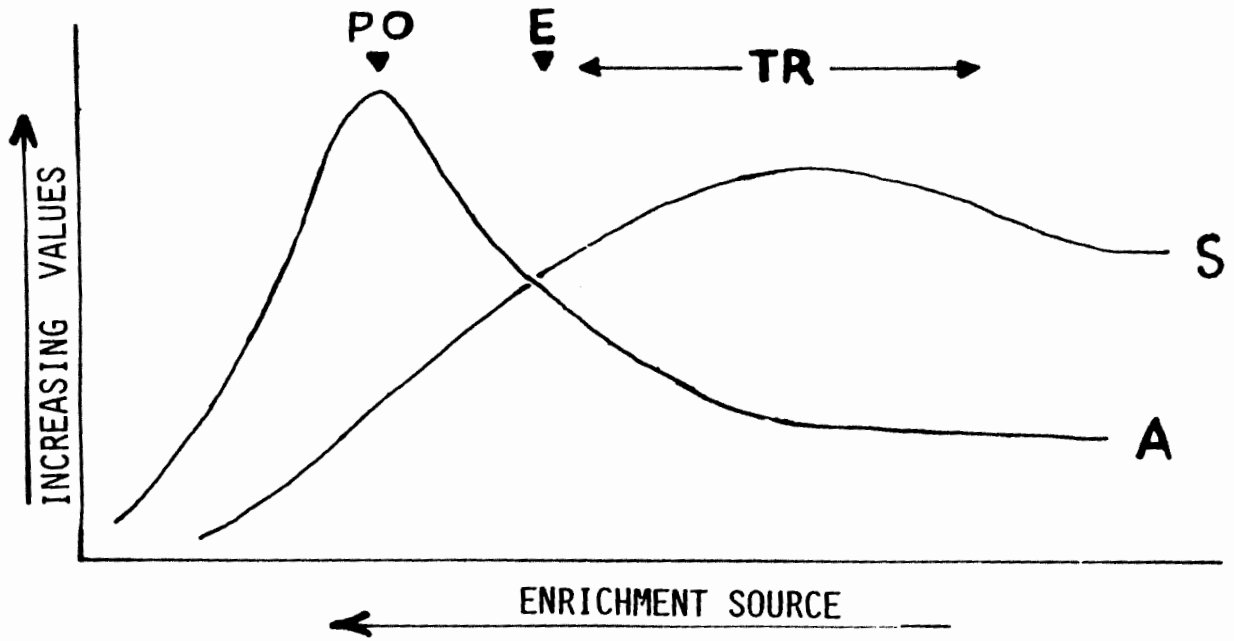


FIG. 2. Generalized SAB diagram (Pearson & Rosenberg, 1978), changes along a gradient of organic enrichment: S, species numbers; A, total abundance; PO, peak of opportunists; E, ecotone point, TR, transition zone.

Transition Zone, species richness tends to increase. Population biomass also increases because colonizing species within this zone tend to be larger in mean body size and have greater individual biomass values.

At the extreme right-hand side of the enrichment axis, the ambient infauna tends to be nutrient limited, therefore, the diminished carrying capacity of the bottom is reflected in decreased abundance and biomass. Species richness also falls off as species typical of intermediate successional seres or stages are lost. Typically, the ambient infauna tends to be dominated by a few head-down deposit-feeders. These trophic types appear to be adapted to relatively oligotrophic sediments (Rice and Rhoads, in press).

Results

Carbon-Nitrogen Values (C-H-N)

The percentage composition of the sediment in the form of carbon (C), nitrogen (N), and hydrogen (H) is given for each station in Table 1. Graphs of carbon, nitrogen, and the C/N ratio along the New Bedford transect are shown in Fig. 3.

The highest carbon:nitrogen ratio was measured at Station 3 near the sewer outfall. A high inventory of fresh carbon is responsible for this high ratio. Ratios of C:N are also relatively high at Stations 8 and 9 but the weight percents of both carbon and nitrogen are lower at these stations than at any other stations on the transect. The distal part of the transect (Stations 10 to 15) are comparable in C:N ratios and inventories of C and N.

Distribution of infaunal species

Gradients in species richness, species abundance, and densities of known enrichment species along the New Bedford Harbor transect are shown in Fig. 4. Starting at Station 3,

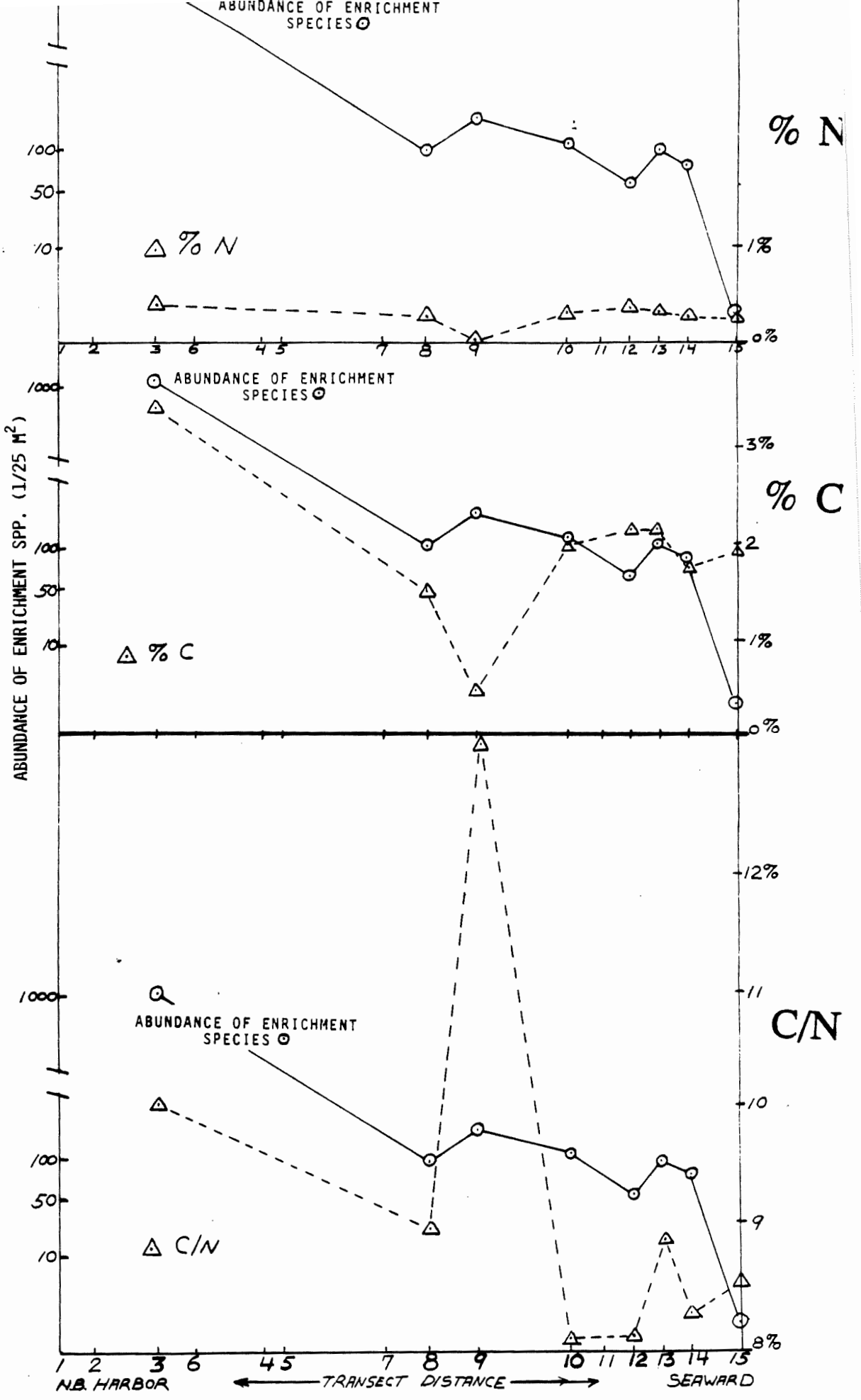

ABUNDANCE OF ENRICHMENT SPECIES
% N
△ % N
ABUNDANCE OF ENRICHMENT SPECIES
% C
△ % C
ABUNDANCE OF ENRICHMENT SPP. (1/25 M²)
ABUNDANCE OF ENRICHMENT SPECIES
C/N
△ C/N
N.B. HARBOR
TRANSECT DISTANCE
SEAWARD

FIG. 3

the infauna is dominated by high densities of a few species, mainly the enrichment species *Mediomastus ambiseta* (Capitellid polychaete), and the mactrid bivalve, *Mulinia lateralis*. These two taxa comprise 75% (by number) of the infauna and represent a Stage I as mapped by REMOTS.

At Station 8, densities of enrichment species decline to 25% of the total abundance (still dominated by spionid polychaetes) and species richness increases. Station 8 is populated by some Stage III taxa (REMOTS designation) as represented by *Nucula annulata* and *Nephtys incisa*.

Station 9 represents an apex in specie richness along the transect. Total abundance also increased at this station with 23% of the fauna being represented by enrichment species (mainly *Mediomastus ambiseta*). Stage III taxa are also represented by the maldanid polychaete *Asychis elongata*; *Nucula delphinodonta* and *Nephtys incisa* are also present. This station represents a mixture of both Stage I and III taxa.

Total abundance continued to increase at Station 10 but the proportion of enrichment species (*Mediomastus ambiseta*) declines to 4% of the total population density. Total species richness also declined. However, approximately 70% of the infauna are represented by Stage III taxa (*Nucula annulata, Nephtys incisa, Yoldia limatula,* and *Asychis elongata*).

Station 12 continued to show the decline in overall species richness and abundance of enrichment specie. However, total abundance increased to peak densities due mainly to a high standing stock of *Nucula annulata* (84% of the fauna by abundance). *Mediomastus ambiseta* represents 4% of the total infaunal population (by number). Other Stage III taxa are also present (*Yoldia limatula* and *Asychis elongata*). Station 13 is comparable to Station 12 as it is dominated by *Nucula annulata* (75%). However, *Mediomastus ambiseta*

increased slightly to represent 7% of the fauna. Station 14 similarly is dominated by *Nucula annulata* (80%) and *Mediomastus ambiseta* declines to 4% of the total infaunal population. Station 15 ("R") has the lowest abundance of enrichment species (<0.5%) and is dominated by Stage III seres species (*Nucula annulata*, 80%), *Nephtys incisa*, *Yoldia limatula*, and *Asychys elongata*). The low abundance and species richness (particularly of enrichment species) at this station may reflect limiting trophic conditions in terms of food quantity and lability. Trophic group amensalism may also be operating at this station to exclude suspension-feeders and tubicolous species (Rhoads and Young, 1970).

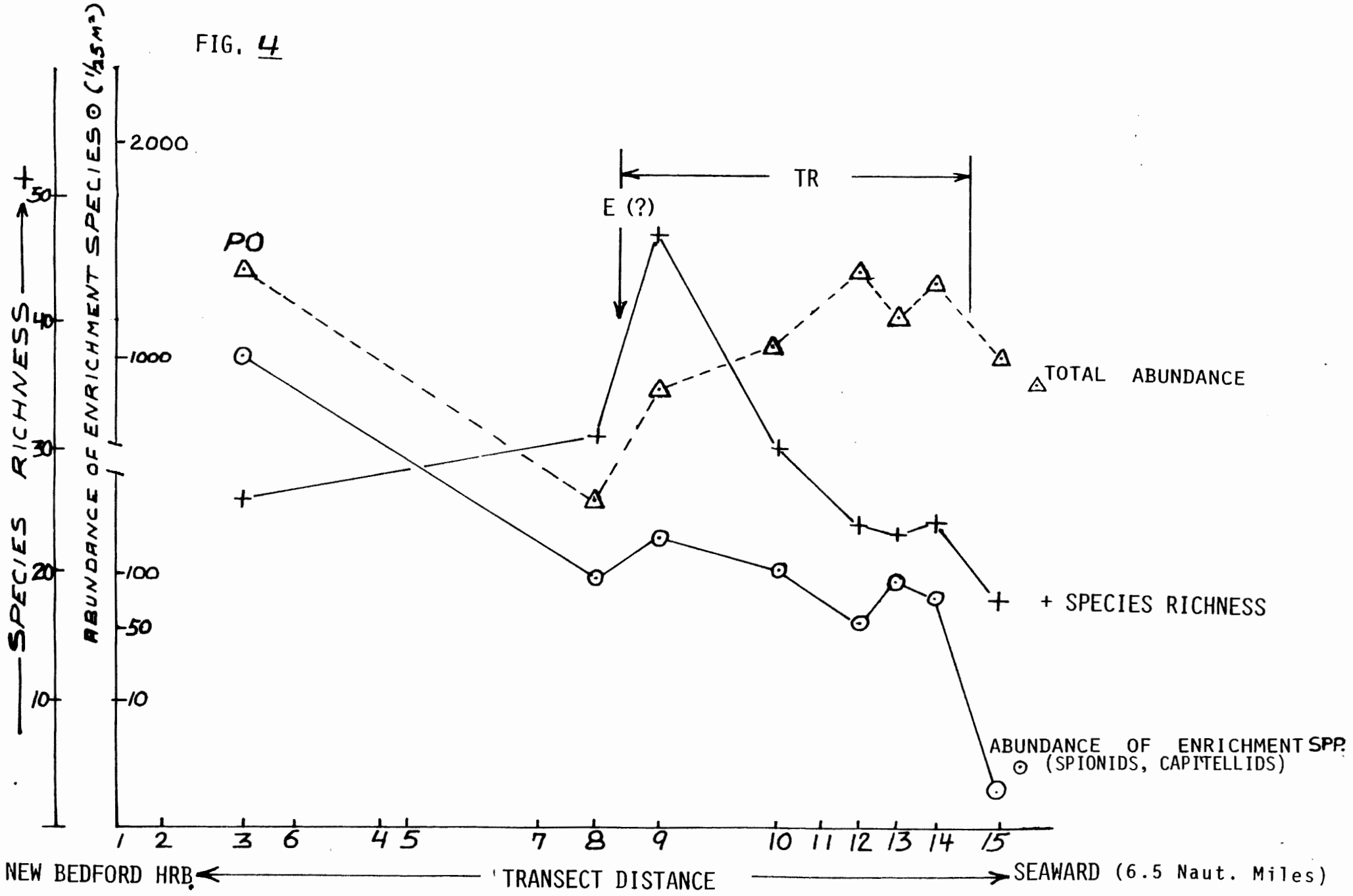
Discussion

The Pearson and Rosenberg enrichment model (Fig. 2) will be used to interpret the New Bedford transect data (Fig. 4).

The dominance of spionid polychaetes and mactrid bivalves at Station 3 apparently corresponds to the "Peak of Opportunists" in the Pearson and Rosenberg diagram. At Station 8, farther removed from the enrichment source, species abundance decreases and species richness increases as predicted by the model. However, between Station 8 and Station 9, a steep ecological gradient exists where both the richness curve raises dramatically and the faunal abundance curve declines from its peak value at Station 3. Within this region lies the Ecotonal region; a boundary between enriched biotopes (harbor) and Station 9 which is located in a drowned stream valley on the western slope of the bay.

Between Stations 10-14, the observed trends in species richness and faunal abundance deviate significantly from the Pearson and Rosenberg diagram. This is because the Pearson and Rosenberg curves reflect a smooth gradient away from a point source of enrichment.

FIG. 4


ABUNDANCE OF ENRICHMENT SPECIES (1/45m²)
SPECIES RICHNESS
2000
1000
100
50
10
50
40
30
20
10
PO
E (?)
TR
TOTAL ABUNDANCE
+ SPECIES RICHNESS
ABUNDANCE OF ENRICHMENT SPP.
(SPIONIDS, CAPITELLIDS)
1 2 3 6 4 5 7 8 9 10 11 12 13 14 15
NEW BEDFORD HRB.
TRANSECT DISTANCE
SEAWARD (6.5 Naut. Miles)

Stations 10-14 may represent a second organic loading site at the base of the slope off New Bedford. A possible mechanism for this "far-field" enrichment was proposed in the SAIC (1987) report. Sediment in the vicinity of the sewage effluent may be resuspended during storms and move down-slope within the drowned channel as a density current. The turbidity flows may largely bypass Stations 8 and 9 and be deposited near the base of the slope.

Station 15 ("R"), the furthest station from New Bedford Harbor, is apparently far enough away from the base of the slope so that nearshore organic inputs do not affect this station. Species richness is low (especially of enrichment species) and faunal density also declines (reflecting possible lower carrying capacity. Station 15 ("R") represents conditions at the extreme right-hand side of the Pearson and Rosenberg diagram (ambient conditions) reflecting there normal "non-polluted communities".

The carbon and nitrogen values are used as independent measurements of organic enrichment and compared with the distribution of enrichment species along the transect (Fig. 3). While carbon and nitrogen can be used as crude measures of organic inputs, these parameters do not reflect the lability (reactivity) of the organic matter and hence its availability to benthic consumers. The changing ratio of carbon to nitrogen has been used in the literature as a measure of the microbial "aging" of detritus. Fresh carbon substrates are typically low in particulate nitrogen. As organic substrates are colonized by bacteria, the carbon-rich substrate is digested by microbial enzymes and the protein fraction is increased as populations of bacteria grow on the detritus. This mineralization process results in a decrease in the C:N ratio over time. However, organic detritus in the form of vascular plant tissue, may experience an increase in its nitrogen content in the absence of

bacterial activity. The plant detritus may undergo condensation reactions with inorganic nitrogen. These condensed phenols can actually inhibit microbial breakdown. In this case, the decrease in the C:N ratio is not a measure of substrate lability but rather reflects the formation of refractory detritus (Rice, 1982).

With the limitations discussed above, some cautious observations can be made about the gradient in carbon and nitrogen along the sampling transect. The percent composition of particulate nitrogen is not very interesting as most stations have about the same percent composition. Station 9 appears to have the smallest percentage of nitrogen. The percentage of carbon in the sediment is highest at Station 3 and declines to a minimum at Stations 8 and 9. The low inventory of organic matter at Stations 8 and 9 is interesting as Stations 8 and 9 support a relatively high number of species and individuals. This Ecotonal region may represent a balance between organic inputs and consumer utilization. This idea is consistent with the hypothesis that the bulk of the organic matter moving down the axis of the drowned channel from upslope may largely bypass these two stations.

The percent carbon content of the sediment increases in the region of Stations 10, 12, 13. This is the area postulated to be a depositional site for tubidity currents moving down the drowned channel axis. The apparent decline in the percentage carbon at Stations 14 and 15 relative to "upslope" stations is very slight. The biological parameters strongly suggest that Station 15 ("R") is oligotrophic relative to all other stations. However, there is not strong support for this hypothesis from the C-N data. Again, the reason may be that the C and N data alone are insufficient to identify the lability of the organic detritus along this transect segment.

Comparison with REMOTS: Conclusions

The conclusions of the faunal and sediment sampling are that Station 3 is a highly enriched station. Moving downslope, the area between Stations 8 and 9 represents a sharp ecological transition. Station 9 has the highest species richness as both enrichment species and head-down deposit feeders are present. This station also has a low inventory of carbon and nitrogen. Stations 10-14 represent a transition zone. Along this segment of the transect, the bottom appears to represent a second area of enrichment, albeit less enriched than Station 3 (based on the density of enrichment species and percent carbon content). Station 15 ("R") is populated by a low density and low diversity assemblage of head-down feeders.

Figure 5 shows the REMOTS Organism-Sediment Index (OSI) along this transect. The index indicates that Stations 1-4 represent the lowest quality benthic habitats and that between Station 5 and 7 benthic enrichment decreases markedly. The REMOTS data agree that Station 9 is of very high quality. The decline in the OSI between Stations 9 and 10 is mirrored by a declining species richness and maintenance of populations of enrichment species. The clinal gradient in improving OSI values toward Station 15 ("R") is supported by the faunal data as virtually all enrichment species drop out at Station 15. The faunal list confirms the REMOTS interpretation that Station 15 is dominated by Stage III head-down feeders and that upslope stations (8-14) are represented by mixtures of Stage I and Stage III seres.

This "ground-truth" study of the REMOTS survey gives strong support to the interpretation and conclusions contained in the SAIC (1987) REMOTS report. It is clear that the REMOTS technique can be used to rapidly and accurately map benthic enrichment

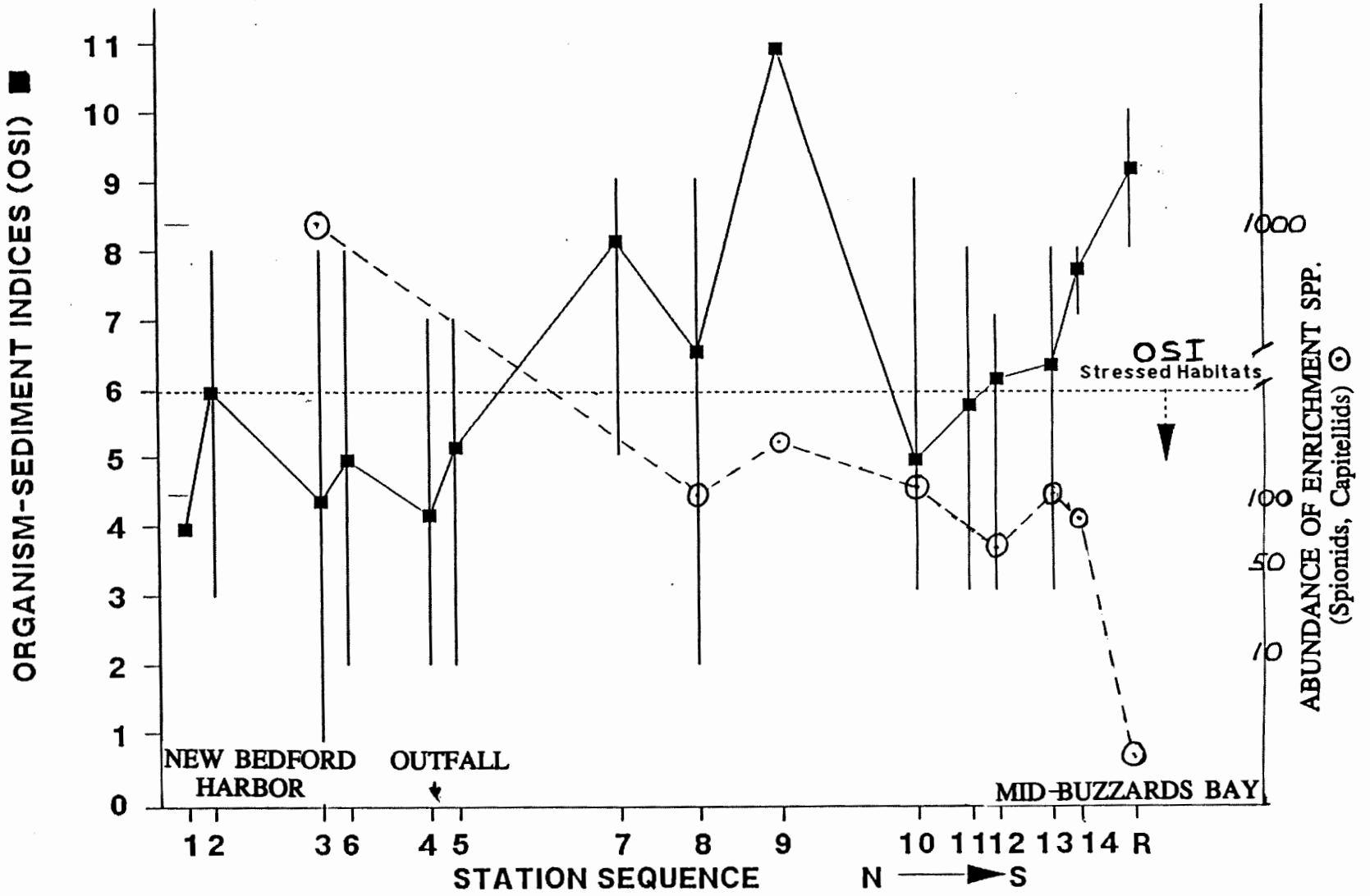


Figure 5. Means and ranges of OSI values along the surveyed transect. Values at, or below +6 may (indicated by the dashed line) represent those stations or replicates which are the most organically loaded or otherwise stressed. Abundance of enrichment species plotted for comparions: Note - High OSI values associated with low densities of enrichment polychaetes.

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gradients. This technique can be used to define gradients prior to establishment of a fixed sampling grid for the purposes of efficiently sampling both sediments and organisms. Because the REMOTS method is rapid and data can be turned around in 60 to 90 days, this technique is efficient for defining spatial and temporal changes in a system. If significant changes are detected, this may trigger a decision to do further sediment sampling to quantify the observed change. If no change is detected with REMOTS, further sediment sampling may not be warranted.

Our REMOTS®-Benthic Ground Truth Survey, transecting from inner New Bedford Harbor and Clark's Cove; locations near the sewage effluent, and extending to the middle part of the Bay, marks the first attempt in Buzzards Bay to closely document the effects of nutrient overloading on spatial gradients in benthic assemblages.

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Appendix 1.

Field Log
Ground Truth Verification Cruise - General Field Observations
ASTERIAS, August 10, 1987

Field Team: George Hampson, Hovey Clifford, Kim Allsup

Stations Sampled:

15, Sta. R 15-1, 2, 3	*Nephtys incisa-Nucula annulata (Nephtys-Nucula* community) Organic rich surface - light tan brown. Appears to be well oxygenated surface. *Mulinia* shell hash present; few living *Mulinia* noted, however. (Depth - 64.5')
14-1, 2, 3	*Nephtys, Nucula, Mulinia* shells present. Light tan brown surface; fauna similar to Sta. R (#15). (Depth - 62')
13-1, 2, 3	*Nephtys, Nucula,* surface sediment seems well oxygenated and associated fauna similar to Sta. R (#15). At Sta. #13-2 took 2 photographs there. (Depth - 55')
12-1	Surface - tan color, well oxygenated. However, sediment just below surface, blackened. Appears to be higher levels of sulfide sediments showing just below surface. *Nephtys* and *Nucula* present here also. During washing of sediment, blackened nature of sediment was very apparent. (Depth - 53')
12-2	Same as above except *Cerianthus* a. present in this grab. (Depth - 53')
12-3	Sediment more cohesive here, mud balls, *Cerianthus* tubes. (Depth - 50')
11-1, 2, 3	Same sediment type as above. Tan, well oxygenated surface layer with *Nephtys, Nucula,* etc. (Depth 50')
10-1	*Nephtys, Yoldia limatula*; reduction in species noted. Other bivalves common to Sta. R appear not to be as obvious here. (Depth - 55.5')
10-2	Bits of eelgrass noted on surface and mixed in sediment below surface; *Cerianthus* tube present.

Ground Truth Verification Cruise - General Field Observations
ASTERIAS, August 10, 1987 (continued):

Stations Sampled:

10-3	Seems *Yoldia* more common here than *Nucula*. Soft sediment as found in all previous stations.
8-1	Top surface of sediment flocculent zone (tan color) appears to be somewhat deeper than Rhoad's REMOTS® suggest; however, surface doesn't appear to be as light a tan color as all previous stations. *Nephtys* present, small bits of shells, *Pitar* m. (bivalve) present. Shell hash, lots of broken bits and pieces of shells here (*Pitar* shells). Frames #7, #6 (GRH's camera showing grab sample taken at Sta. 9 including shot of washing shell hash). (Depth - 66')
8-3	Noted increase in general biomass here, medium and larger *Nephthys* more common here. Vegetation - eelgrass present, mixed with sediment. Camera shots here - frames #10 and #11 (GRH's camera). Blackened surface noted on grab sampler when sample was dumped.
3-1 (Outer New Bedford Harbor)	*Mulinia* community here - mostly dead *Mulinia* shells, hash, sediment soft as other stations. However, very black (sulfuric H_2S
3-2	odor. Living moon snail taken here, some few living *Melina* seen.
3-3	H_2S odor in sediment. Sampling one living *Mercenaria* bivalve in grab -- approx. 3-3.5 inches in length; returned it to sea. Black sediment even at surface here, absence of light tan color as noted in previous stations. Sediment smells of H_2S. All dead *Crepidula* shells here - shell hash again. A few living moon snail (smaller individuals). *Mulinia* hash not as common at this replicate.

APPENDIX 2

Taxonomic Groups

Buzzards Bay Survey	Stations								
Species	15-1	15-2	15-3	14-1	13-1	12-1	10-1	10-2	10-3
Polychaeta									
Mediomastus ambiseta	1	3		50	83	52	114	134	50
Capitella capitata					1				
Melinna cristata	1	11	1	5	7	8	10	2	9
Spiochaetopterus oculans									
Tharyx acutus					3	1	2	1	
Chaetozone sp									
Meiodorvillea minuta									
Pherusa affinis				1	2	2			1
Microphthalmus sczelkowii									
Ninoe nigripes	4	4	7	14	21	6	2	6	6
Asychis elongata	1	3	1	2	19	22		3	4
Nephtys incisa	37	36	36	53	33	40	53	96	68
Nereis sp									
Owenia fusiformis							4	2	2
Ancistrosyllis groenlandica									
Aricidea catherinae			1	11	28	16	19	32	31
Pectinaria gouldii									
Phyllodoce arenae									
Paranaitis speciosa									
Eteone heteropoda									
Scalibregma inflatum									
Parapionosyllis longicirrata									
Brania wellfleetensis									
Carazziella hobsonae									
Polydora cornuta				8	1				
Polydora socialis									
Prionospio perkinsi	1			16				1	5
Prionospio steenstrupi			1	1		1	3	7	
Scolelepis texana		2		3	1		7	3	8
Spiophanes bombyx									
Exogone dispar									
Sphaerosyllis taylori								1	
Sphaerosyllis erinaceus									
Tauberia gracilis	54	61	63	58	64	32	31	61	63
Polycirrus eximius									1
Pholoe minuta		1	1	1	4	1	1		
Bivalves									
Nucula annulata	635	1109	865	1089	916	1198	746	702	551
Nucula proxima									
Nucula delphinodonta									
Yoldia limatula	1	4	5	12		8	16	23	12
Mytilis edulis									
Astarte borealis	1	1							
Bochefortia cuneata							1		
Cerastoderma pinnulatum								4	5
Pitar morrhuana		3	8	3	15	4	6	12	11
Petricola pholadiformis							1		
Mulinia lateralis		1	3	3					
Macoma tenta					1	1		2	2
Tellina agilis									

Buzzards Bay Survey	Stations								
Species	15-1	15-2	15-3	14-1	13-1	12-1	10-1	10-2	10-3
Ensis directus						1		1	
Corbula contracta									
Pandora gouldiana	1	7	5	8	5	1		4	3
Anadara transversa									
Lyonsia hyalina				3					1
Solemya velum							1		
Bivalve sp.1							1		
Bivalve sp.2									
Gastropods									
Mitrella lunata	1	1			11	3	3	16	3
Nassarius trivitatus									1
Nassarius vibex							1		
Eupleura caudata					1		1		
Cylichna sp.							2		
Naticid juv.							1		
Turbonilla sumneri							2	28	
T. interrupta									
T. aereolata						7			
T. sp.									
Cylichna oryza								1	
Odostomia dealbata								3	
Odostomia winkleyi									
Odostomia sp.									
Crepidula sp.							1		
Lacuna sp.									
Skeneopsis sp.									
Natica pusilla						4			
Anachis translirata		2							
Acteocina canaliculata	2					2	5	4	1
nr. Oenopota sp.									
Gastropoda sp.								1	
Polinices sp.									
Amphipoda									
Ampelisca vadorum		1	1			3	3	5	
Ampelisca verrilli							1	1	3
Aoridae sp.									
Caprellid sp.									
Cerapus tubularis									
Byblis serrata									
Leptocheirus pinguis									
Paraphoxus spinosus									
Photis pollex	2		2	2		1	3		
Unciola irrorata								1	
Cephalocarida									
Hutchinsoniella macracantha	11	4	2	7	2		9	7	29
Mysidacea									
Mysid sp.		1							

Buzzards Bay Survey	Stations								
Species	15-1	15-2	15-3	14-1	13-1	12-1	10-1	10-2	10-3
Cumacea									
Diastylis polita	1								
Leptocuma minor									
Oxyurostylis smithi									
Isopoda									
Edotea montosa							1		1
Cyatnura polita									
Decapoda									
Panopeus herbsti									
Pinnixa chaetopterana				2					
Pagurus longicarpus									
Crangon septemspinosus								1	1
Upogebia affinis					1				
Miscellaneous groups									
Phascolion strombi									
Pycnogonid sp.									
Cerianthus americanus	3				1				
Coelenterata sp.					1				
Tunicata sp.				2					
Turbellaria sp.									
Acoela sp. a									
Nemertina sp.	1			4					1
Oligochaeta sp. 1						1	3	29	
total animals/sample =	758	1255	1004	1358	1220	1415	1054	1214	873
number species present	18	19	16	24	23	24	32	32	27
animals/meter square	18950	31375	25100	33950	30500	35375	26350	30350	21825

Buzzards Bay Survey	Stations						
Species	9-1	9-2	9-3	8-1	8-2	8-3	3-1
Polychaeta							
Mediomastus ambiseta	164	194	186	33	129	91	1001
Capitella capitata						2	
Melinna cristata	4	9	3	9	29	48	1
Spiochaetopterus oculans		1					
Tharyx acutus	4	36	3	1	3	2	
Chaetozone sp					1		
Meiodorvillea minuta		2					
Pherusa affinis		1	1	1	2	3	
Microphthalmus sczelkowii	3	2	4	3	4		
Ninoe nigripes	32	15	18	1	3		
Asychis elongata	1	8	2	2	1	5	
Nephtys incisa		1	5	45	72	67	17
Nereis sp							1
Owenia fusiformis					3	7	
Ancistrosyllis groenlandica		2	4				
Aricidea catherinae	13	28	16				
Pectinaria gouldii	1	1	3				
Phyllodoce arenae							1
Paranaitis speciosa						1	
Eteone heteropoda			2				1
Scalibregma inflatum	2	3	2				
Parapionosyllis longicirrat	2	63	1				
Brania wellfleetensis		20	8				
Carazziella hobsonae			2				
Polydora cornuta	22	18	48				
Polydora socialis			1				
Prionospio perkinsi		7	19	1		4	1
Prionospio steenstrupi	1	8					
Scolelepis texana		3		2	5	8	2
Spiophanes bombyx		1					
Exogone dispar	1		11	9			
Sphaerosyllis taylori	5	3	5	1	2		
Sphaerosyllis erinaceus			1				
Tauberia gracilis		2		1	1		
Polycirrus eximius	12	14	12	10			
Pholoe minuta				12			
Bivalves							
Nucula annulata				17	53	72	
Nucula proxima							241
Nucula delphinodonta	27	7	53				
Yoldia limatula	1			3	17	9	7
Mytilis edulis						1	
Astarte borealis							
Bochefortia cuneata	1						8
Cerastoderma pinnulatum	3	5	3		1	3	
Pitar morrhuana	1			7		4	5
Petricola pholadiformis							
Mulinia lateralis					3	1	67
Macoma tenta	2	3			2	3	43
Tellina agilis		1	8				1

Buzzards Bay Survey	Stations						
Species	9-1	9-2	9-3	8-1	8-2	8-3	3-1
Ensis directus							
Corbula contracta				1			
Pandora gouldiana	1	6	4	1	4	4	1
Anadara transversa		2	2				
Cyonsia hyalina	1	1			1	3	
Solemya velum							
Bivalve sp.1				2			
Bivalve sp.2					2		
Gastropods							
Mitrella lunata	15	12	9			2	1
Nassarius trivitatus	6	1	4	3	9		8
Nassarius vibex							
Eupleura caudata					1		1
Cylichna sp.					1		
Naticid juv.	1				1		
Turbonilla sumneri		1					
T. interrupta					1		
T. aereolata							
T. sp.		1					
Cylichna oryza					1		1
Odostomia dealbata	4	5	6				
Odostomia winkleyi					4	1	
Odostomia sp.	20		28		1		
Crepidula sp.						1	
Lacuna sp.						1	
Skeneopsis sp.	1						
Natica pusilla	1						
Anachis translirata			1				
Acteocina canaliculata					2	1	5
nr. Oenopota sp.	1						
Gastropoda sp.							
Polinices sp.							1
Amphipoda							
Ampelisca vadorum	140	57	116	10	22	22	3
Ampelisca verrilli	26	14	24				
Aoridae sp.			1				
Caprellid sp.	1	1	1				
Cerapus tubularis			2				
Byblis serrata		8	3				
Leptocheirus pinguis	90	37	28				
Paraphoxus spinosus		7					
Photis pollex							
Unciola irrorata	7	1	7				
Cephalocarida							
Hutchinsoniella macracantha					16	6	
Mysidacea							
Mysid sp.							

Buzzards Bay Survey	Stations						
Species	9-1	9-2	9-3	8-1	8-2	8-3	3-1
Cumacea							
Diastylis polita						4	
Leptocuma minor							1
Oxyurostylis smithi			1	1			
Isopoda							
Edotea montosa		2					
Cyathura polita	1		1				
Decapoda							
Panopeus herbsti				1			
Pinnixa chaetopterana		3	7				
Pagurus longicarpus		1	12	1			
Crangon septemspinosus		2	1			1	
Upogebia affinis	2	10	3				
Miscellaneous groups							
Phascolion strombi		1			2	1	2
Pycnogonid sp.			1			1	
Cerianthus americanus		1					
Coelenterata sp.							
Tunicata sp.							
Turbellaria sp.							
Acoela sp. a			2				
Nemertina sp.							
Oligochaeta sp. 1	295	172	192	15	5	7	
total animals/sample =	915	804	877	193	404	386	1421
number species present	39	52	53	27	34	32	25
animals/meter square	22875	20100	21925	4825	10100	9650	35525

Accumulative %

Species	15-1	percent	15-2	percent	15-3	percent	14-1	percent
Nucula annulata	635	83.773%	1109	88.367%	865	86.155%	1089	80.191%
Mediomastus ambiseta	1	0.132%	3	0.239%			50	3.682%
Nephthys incisa	37	4.881%	36	2.869%	36	3.586%	53	3.903%
Oligochaeta sp. 1								
Tauberia gracilis	54	7.124%	61	4.861%	63	6.275%	58	4.271%
Ampelisca vadorum			1	0.080%	1	0.100%		
Melinna cristata	1	0.132%	11	0.876%	1	0.100%	5	0.368%
Yoldia limatula	1	0.132%	4	0.319%	5	0.498%	12	0.884%
Aricidea catherinae					1	0.100%	11	0.810%
Nucula proxima								
Hutchinsoniella macracantha	11	1.451%	4	0.319%	2	0.199%	7	0.515%
Leptocheirus pinguis								
Ninoe nigripes	4	0.528%	4	0.319%	9	0.896%	14	1.031%
Pitar morrhuana			3	0.239%	8	0.797%	3	0.221%
Asychis elongata	1	0.132%	3	0.239%	1	0.100%	2	0.147%
Scolelepis texana			2	0.159%			3	0.221%
Polycirrus eximius								
Paraonosyllis longicirrata								
Tharyx acutus								
Mitrella lunata	1	0.132%	1	0.080%				
Pandora gouldiana	1	0.132%	7	0.558%	5	0.498%	8	0.589%
Pholoe minuta			1	0.080%	1	0.100%	1	0.074%
Mulinia lateralis			1	0.080%	3	0.299%	3	0.221%
Macoma tenta								
Prionospio perkinsi	1	0.132%					16	1.178%
Polydora cornuta							8	0.589%
Nassarius trivitatus								
Owenia fusiformis								
Ampelisca verrilli								
Exogone dispar								
Nucula delphinodonta								
Cerastoderma pinnulatum								
Pherusa affinis							1	0.074%
Microphthalmus sczelkowii								
Acteocina canaliculata	2	0.264%						
Turbonilla sumneri								
Brania wellfleetensis								
Odostomia sp.								
Lyonsia hyalina							3	0.221%
Diastylis polita	1	0.132%						
Prionospio steenstrupi					1	0.100%	1	0.074%
Sphaerosyllis taylori								
Upogebia affinis								
Odostomia winkleyi								
Odostomia dealbata								
Phascolion strombi								
Bivalve sp.1								
Capitella capitata								
Byblis serrata								
Unciola irrorata								
Photis pollex	2	0.264%			2	0.199%	2	0.147%
Crangon septemspinosus								
Paraphoxus spinosus								
Bochefortia cuneata								
Pagurus longicarpus								
Crepidula sp.								
Cerianthus americanus	3	0.396%						
Scalibregma inflatum								
Nemertina sp.	1	0.132%					4	0.295%

Species	15-1	percent	15-2	percent	15-3	percent	14-1	percent
Pinnixa chaetopterana							2	0.147%
Mytilis edulis								
Pycnogonid sp.								
Lacuna sp.								
Oxyurostylis smithi								
Corbula contracta								
Panopeus herbsti								
Bivalve sp.2								
Eupleura caudata								
T. aereolata								
Edotea montosa								
Naticid juv.								
Cylichna sp.								
Cylichna oryza								
Natica pusilla								
Anadara transversa								
Meiodorvillea minuta								
Ancistrosyllis groenlandica								
T. interrupta								
Chaetozone sp								
Caprellid sp.								
Pectinaria gouldii								
Astarte borealis	1	0.132%	1	0.080%				
Tellina agilis								
Anachis translirata			2	0.159%				
Ensis directus								
Tunicata sp.							2	0.147%
Spiophanes bombyx								
T. sp.								
Spiochaetopterus oculans								
Skeneopsis sp.								
Cyathura polita								
nr. Oenopota sp.								
Petricola pholadiformis								
Solemya velum								
Nassarius vibex								
Gastropoda sp.								
Coelenterata sp.								
Mysid sp.			1	0.080%				
Nereis sp								
Phyllodoce arenae								
Eteone heteropoda								
Polinices sp.								
Leptocuma minor								
Sphaerosyllis erinaceus								
Cerapus tubularis								
Carazziella hobsonae								
Aoridae sp.								
Paranaitis speciosa								
Polydora socialis								
Turbellaria sp.								
Acoela sp. a								

station #	15-1	15-2	15-3	14-1
Station total all species	758	1255	1004	1358
total species with counts	18	19	16	24

Species	13-1	percent	12-1	percent	10-1	percent	10-2	percent
Nucula annulata	916	75.082%	1198	84.664%	746	70.778%	702	57.825%
Mediomastus ambiseta	83	6.803%	52	3.675%	114	10.816%	154	12.685%
Nephthys incisa	33	2.705%	40	2.827%	53	5.028%	96	7.908%
Oligochaeta sp. 1			1	0.071%	3	0.285%	29	2.389%
Tauberia gracilis	64	5.246%	32	2.261%	31	2.941%	61	5.025%
Ampelisca vadorum			3	0.212%	3	0.285%	5	0.412%
Melinna cristata	7	0.574%	8	0.565%	10	0.949%	2	0.165%
Yoldia limatula			8	0.565%	16	1.518%	23	1.895%
Aricidea catherinae	28	2.295%	16	1.131%	19	1.803%	32	2.636%
Nucula proxima								
Hutchinsoniella macracantha	2	0.164%			9	0.854%	7	0.577%
Leptocheirus pinguis								
Ninoe nigripes	21	1.721%	6	0.424%	2	0.190%	6	0.494%
Pitar morrhuana	15	1.230%	4	0.283%	6	0.569%	12	0.988%
Asychis elongata	19	1.557%	22	1.555%			3	0.247%
Scoletepis texana	1	0.082%			7	0.664%	3	0.247%
Polycirrus eximius								
Paraonosyllis longicirrata								
Tharyx acutus	2	0.164%	1	0.071%	2	0.190%	1	0.082%
Mitrella lunata	11	0.902%	3	0.212%	3	0.285%	16	1.318%
Pandora gouldiana	5	0.410%	1	0.071%			4	0.329%
Pholoe minuta	4	0.328%	1	0.071%	1	0.095%		
Mulinia lateralis								
Macoma tenta	1	0.082%	1	0.071%			2	0.165%
Prionospio perkinsi							1	0.082%
Polydora cornuta	1	0.082%						
Nassarius trivitatus								
Owenia fusiformis					4	0.380%	2	0.165%
Ampelisca verrilli					1	0.095%	1	0.082%
Exogone dispar								
Nucula delphinodonta								
Cerastoderma pinnulatum							4	0.329%
Pherusa affinis	2	0.164%	2	0.141%				
Microphthalmus sczelkowii								
Acteocina canaliculata			2	0.141%	5	0.474%	4	0.329%
Turbonilla sumneri					2	0.190%	28	2.306%
Brania wellfleetensis								
Odostomia sp.								
Lyonsia hyalina								
Diastylis polita								
Prionospio steenstrupi			1	0.071%	3	0.285%	7	0.577%
Sphaerosyllis taylori							1	0.082%
Upogebia affinis	1	0.082%						
Odostomia winkleyi								
Odostomia dealbata							3	0.247%
Phascolion strombi								
Bivalve sp.1					1	0.095%		
Capitella capitata	1	0.082%						
Byblis serrata								
Unciola irrorata							1	0.082%
Photis pollex			1	0.071%	3	0.285%		
Crangon septemspinosus							1	0.082%
Paraphoxus spinosus								
Bochefortia cuneata					1	0.095%		
Pagurus longicarpus								
Crepidula sp.					1	0.095%		
Cerianthus americanus	1	0.082%						
Scalibregma inflatum								
Nemertina sp.								

Species	13-1	percent	12-1	percent	10-1	percent	10-2	percent
Pinnixa chaetopterana								
Mytilis edulis								
Pycnogonid sp.								
Lacuna sp.								
Oxyurostylis smithi								
Corbula contracta								
Panopeus herbsti								
Bivalve sp.2								
Eupleura caudata	1	0.082%			1	0.095%		
T. aereolata			7	0.495%				
Edotea montosa					1	0.095%		
Naticid juv.					1	0.095%		
Cylichna sp.					2	0.190%		
Cylichna oryza							1	0.082%
Natica pusilla			4	0.283%				
Anadara transversa								
Meiodorvillea minuta								
Ancistrosyllis groenlandica								
T. interrupta								
Chaetozone sp								
Caprellid sp.								
Pectinaria gouldii								
Astarte borealis								
Tellina agilis								
Anachis translirata								
Ensis directus			1	0.071%			1	0.082%
Tunicata sp.								
Spiophanes bombyx								
T. sp.								
Spiochaetopterus oculans								
Skeneopsis sp.								
Cyathura polita								
nr. Oenopota sp.								
Petricola pholadiformis					1	0.095%		
Solemya velum					1	0.095%		
Nassarius vibex					1	0.095%		
Gastropoda sp.							1	0.082%
Coelenterata sp.	1	0.082%						
Mysid sp.								
Nereis sp								
Phyllodoce arenae								
Eteone heteropoda								
Polinices sp.								
Leptocuma minor								
Sphaerosyllis erinaceus								
Cerapus tubularis								
Carazziella hobsonae								
Aoridae sp.								
Paranaitis speciosa								
Polydora socialis								
Turbellaria sp.								
Acoela sp. a								
station #	13-1		12-1		10-1		10-2	
Station total all species	1220		1415		1054		1214	
total species with counts	23		24		32		32	

Species	10-3	percent	9-1	percent	9-2	percent	9-3	percent
Nucula annulata	551	63.116%						
Mediomastus ambiseta	50	5.727%	164	17.923%	194	24.129%	186	21.209%
Nephthys incisa	68	7.789%			1	0.124%	5	0.570%
Oligochaeta sp. 1			295	32.240%	172	21.393%	192	21.893%
Tauberia gracilis	63	7.216%			2	0.249%		
Ampelisca vadorum			140	15.301%	57	7.090%	116	13.227%
Melinna cristata	9	1.031%	4	0.437%	9	1.119%	3	0.342%
Yoldia limatula	12	1.375%	1	0.109%				
Aricidea catherinae	31	3.551%	13	1.421%	28	3.483%	16	1.824%
Nucula proxima								
Hutchinsoniella macracantha	29	3.322%						
Leptocheirus pinguis			90	9.836%	37	4.602%	28	3.193%
Ninoe nigripes	6	0.687%	32	3.497%	15	1.866%	18	2.052%
Pitar morrhuana	11	1.260%	1	0.109%				
Asychis elongata	4	0.458%	1	0.109%	8	0.995%	2	0.228%
Scolelepis texana	8	0.916%			3	0.373%		
Polycirrus eximius	1	0.115%	12	1.311%	14	1.741%	12	1.368%
Parapionosyllis longicirrata			2	0.219%	63	7.836%	1	0.114%
Tharyx acutus			4	0.437%	36	4.478%	3	0.342%
Mitrella lunata	3	0.344%	15	1.639%	12	1.493%	9	1.026%
Pandora gouldiana	3	0.344%	1	0.109%	6	0.746%	4	0.456%
Pholoe minuta								
Mulinia lateralis								
Macoma tenta	2	0.229%	2	0.219%	3	0.373%		
Prionospio perkinsi	5	0.573%			7	0.871%	19	2.166%
Polydora cornuta			22	2.404%	18	2.239%	48	5.473%
Nassarius trivitatus	1	0.115%	6	0.656%	1	0.124%	4	0.456%
Owenia fusiformis	2	0.229%						
Ampelisca verrilli	3	0.344%	26	2.842%	14	1.741%	24	2.737%
Exogone dispar			1	0.109%			11	1.254%
Nucula delphinodonta			27	2.951%	7	0.871%	53	6.043%
Cerastoderma pinnulatum	5	0.573%	3	0.328%	5	0.622%	3	0.342%
Pherusa affinis	1	0.115%			1	0.124%	1	0.114%
Microphthalmus sczelkowii			3	0.328%	2	0.249%	4	0.456%
Acteocina canaliculata	1	0.115%						
Turbonilla sumneri					1	0.124%		
Brania wellfleetensis					20	2.488%	8	0.912%
Odostomia sp.			20	2.186%			28	3.193%
Lyonsia hyalina	1	0.115%	1	0.109%	1	0.124%		
Diastylis polita								
Prionospio steenstrupi			1	0.109%	8	0.995%		
Sphaerosyllis taylori			5	0.546%	3	0.373%	5	0.570%
Upogebia affinis			2	0.219%	10	1.244%	3	0.342%
Odostomia winkleyi								
Odostomia dealbata			4	0.437%	5	0.622%	6	0.684%
Phascolion strombi					1	0.124%		
Bivalve sp.1								
Capitella capitata								
Byblis serrata					8	0.995%	3	0.342%
Unciola irrorata			7	0.765%	1	0.124%	7	0.798%
Photis pollex								
Crangon septemspinosus	1	0.115%			2	0.249%	1	0.114%
Paraphoxus spinosus					7	0.871%		
Bochefortia cuneata			1	0.109%				
Pagurus longicarpus					1	0.124%	12	1.368%
Crepidula sp.								
Cerianthus americanus					1	0.124%		
Scalibregma inflatum			2	0.219%	3	0.373%	2	0.228%
Nemertina sp.	1	0.115%						

Species	10-3	percent	9-1	percent	9-2	percent	9-3	percent
Pinnixa chaetopterana					3	0.373%	7	0.798%
Mytilis edulis								
Pycnogonid sp.							1	0.114%
Lacuna sp.								
Oxyurostylis smithi							1	0.114%
Corbula contracta								
Panopeus herbsti								
Bivalve so.2								
Eupleura caudata								
T. aereolata								
Edotea montosa	1	0.115%			2	0.249%		
Naticid juv.			1	0.109%				
Cylichna sp.								
Cylichna oryza								
Natica pusilla			1	0.109%				
Anadara transversa					2	0.249%	2	0.228%
Meiodorvillea minuta					2	0.249%		
Ancistrosyllis groenlandica					2	0.249%	4	0.456%
T. interrupta								
Chaetozone sp								
Caprellid sp.			1	0.109%	1	0.124%	1	0.114%
Pectinaria gouldii			1	0.109%	1	0.124%	3	0.342%
Astarte borealis								
Tellina agilis					1	0.124%	8	0.912%
Anachis translirata							1	0.114%
Ensis directus								
Tunicata sp.								
Spiophanes bombyx					1	0.124%		
T. sp.					1	0.124%		
Spiochaetopterus oculans					1	0.124%		
Skeneopsis sp.			1	0.109%				
Cyathura polita			1	0.109%			1	0.114%
nr. Oenopota sp.			1	0.109%				
Petricola pholadiformis								
Solemya velum								
Nassarius vibex								
Gastropoda sp.								
Coelenterata sp.								
Mysid sp.								
Nereis sp								
Phyllodoce arenae								
Eteone heteropoda							2	0.228%
Polinices sp.								
Leptocuma minor								
Sphaerosyllis erinaceus							1	0.114%
Cerapus tubularis							2	0.228%
Carazziella hobsonae							2	0.228%
Aoridae sp.							1	0.114%
Paranaitis speciosa								
Polydora socialis							1	0.114%
Turbellaria sp.								
Acoela sp. a							2	0.228%
station #	10-3		9-1		9-2		9-3	
Station total all species	873		915		804		877	
total species with counts	27		39		51		50	

Species	8-1	percent	8-2	percent	8-3	percent	3-1	percent	avg. pct.
Nucula annulata	17	8.808%	53	13.119%	72	18.701%			46.83%
Mediomastus ambiseta	33	17.098%	129	31.931%	91	23.636%	1001	70.443%	15.78%
Nephthys incisa	45	23.316%	72	17.822%	67	17.403%	17	1.196%	7.42%
Oligochaeta sp. 1	15	7.772%	5	1.238%	7	1.818%			4.31%
Tauberia gracilis	1	0.518%	1	0.248%					2.89%
Ampelisca vadorum	10	5.181%	22	5.446%	22	5.714%	3	0.211%	2.86%
Melinna cristata	9	4.663%	29	7.178%	48	12.468%	1	0.070%	2.70%
Yoldia limatula	3	1.554%	17	4.208%	9	2.338%	7	0.493%	1.14%
Aricidea catherinae									1.09%
Nucula proxima							241	16.960%	1.06%
Hutchinsoniella macracantha			16	3.960%	6	1.558%			0.90%
Leptocheirus pinguis									0.90%
Ninoe nigripes	1	0.518%	3	0.743%					0.81%
Pitar morrhuana	7	3.627%			4	1.039%	5	0.352%	0.73%
Asychis elongata	2	1.036%	1	0.248%	5	1.299%			0.59%
Scoletepis texana	2	1.036%	5	1.238%	8	2.078%	2	0.141%	0.58%
Polycirrus eximius	10	5.181%							0.52%
Parapionosyllis longicirrata									0.50%
Tharyx acutus	1	0.518%	3	0.743%	2	0.519%			0.48%
Mitrella lunata					2	0.519%	1	0.070%	0.47%
Pandora gouldiana	1	0.518%	4	0.990%	4	1.039%	1	0.070%	0.47%
Pholoe minuta	12	6.218%							0.44%
Mulinia lateralis			3	0.743%	1	0.260%	67	4.715%	0.41%
Macoma tenta			2	0.495%	3	0.779%	43	3.026%	0.39%
Prionospio perkinsi	1	0.518%			4	1.039%	1	0.070%	0.34%
Polydora cornuta									0.33%
Nassarius trivitatus	3	1.554%	9	2.228%			8	0.563%	0.33%
Owenia fusiformis			3	0.743%	7	1.818%			0.32%
Ampelisca verrilli									0.32%
Exogone dispar	9	4.663%							0.30%
Nucula delphinodonta									0.24%
Cerastoderma pinnulatum			1	0.248%	3	0.779%			0.23%
Pherusa affinis	1	0.518%	2	0.495%	3	0.779%			0.20%
Microphthalmus sczelkowii	3	1.554%	4	0.990%					0.20%
Acteocina canaliculata			2	0.495%	1	0.260%	5	0.352%	0.17%
Turbonilla sumneri									0.16%
Brania wellfleetensis									0.16%
Odostomia sp.			1	0.248%					0.15%
Lyonsia hyalina			1	0.248%	3	0.779%			0.15%
Diastylis polita					4	1.039%			0.14%
Prionospio steenstrupi									0.14%
Sphaerosyllis taylori	1	0.518%	2	0.495%					0.13%
Upogebia affinis									0.10%
Odostomia winkleyi			4	0.990%	1	0.260%			0.09%
Odostomia dealbata									0.08%
Phascolion strombi			2	0.495%	1	0.260%	2	0.141%	0.08%
Bivalve sp.1	2	1.036%							0.07%
Capitella capitata					2	0.519%			0.07%
Byblis serrata									0.06%
Unciola irrorata									0.06%
Photis pollex									0.06%
Crangon septemspinosus					1	0.260%			0.06%
Paraphoxus spinosus									0.05%
Bochefortia cuneata							8	0.563%	0.05%
Pagurus longicarpus	1	0.518%							0.04%
Crepidula sp.					1	0.260%			0.04%
Cerianthus americanus									0.04%
Scalibregma inflatum									0.04%
Nemertina sp.									0.03%