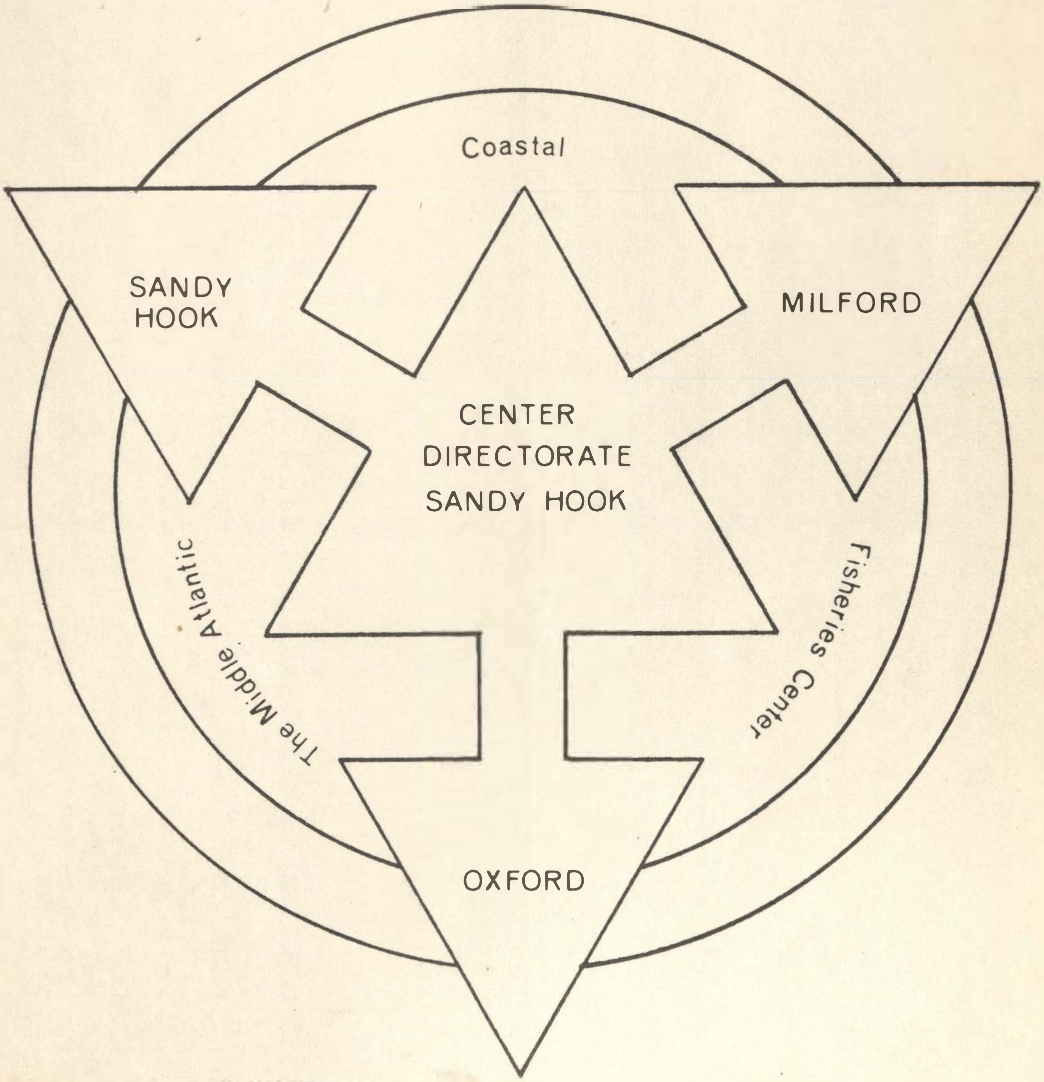
AN ENVIRONMENTAL SURVEY OF EFFECTS OF DREDGING AND SPOIL DISPOSAL, NEW LONDON, CONNECTICUT: 4th QUARTERLY REPORT

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northeast Region

MIDDLE ATLANTIC COASTAL FISHERIES CENTER



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15 August 1975

AN ENVIRONMENTAL SURVEY OF EFFECTS OF DREDGING AND SPOIL DISPOSAL NEW LONDON, CONNECTICUT: 4th QUARTERLY REPORT

Submitted by

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to

U.S. Navy, Northern Division, Naval Facilities Engineering Command

U.S. Army, Corps of Engineers

Interagency Scientific Advisory Subcommittee on
Ocean Dredging and Spoiling

15 August 1975

FOREWARD

This report deals with the fourth three-month period of studies monitoring effects of dredging in the Thames River and spoil disposal at the New London Dumping Ground. Activities and findings of the principal contractor, the Middle Atlantic Coastal Fisheries Center (MACFC), National Marine Fisheries Service, are discussed in detail. All subcontractors' quarterly reports were received by MACFC by 1 July 1975. These documents are summarized in the body of the report, and included as appendices thereto.

Overall goals, schedules and methodologies for the monitoring survey are contained in MACFC Informal Report No. 25-A, "A Proposal for an Environmental Survey of Dredging and Spoil Disposal in the Thames River and New London Dumping Ground" (21 May 1974), and will not be repeated in the quarterly reports. Changes or additions will be described in the pertinent quarterly report but not in subsequent reports.

A summary of the information concerning Phase I of the dredging-disposal operation itself has kindly been provided by Lt. F.P. Walcott, Assistant ROICC, Naval Submarine Base, New London. Some of the more pertinent facts are: the barges were of the bottom-discharging type, with a capacity of 1500-1600 cubic yards of spoils; the dredge had a 14 yd^3 bucket. Dredging and dumping operations were suspended between 4 October and 17 November 1974, and between 22 December 1974 and 6 January 1975. Other disruptions occurred but were less than three days in duration. On 20 December 1974 the dumpsite was shifted 600 feet SE of the original disposal point. Phase I dredging removed a maximum of 1,590,000 cubic yards of spoil. Information from other sources indicated dredging began on 19 August 1974 and ended early in July 1975. Readers should consider this information when considering the results presented in the quarterly and final reports. All parties to the operations are again reminded that the stipulation to immediately report any observed violations of the dumping criteria or other impacts judged significant is in effect and an extremely important component of the monitoring and research program.

This paper constitutes the 4th Quarterly Report on the results of studies of effects of dredging and spoiling in the Thames River Estuary, as well as an interim report in which certain comparisons are made of data collected during periods of investigations which covered the first year of study.

Reproduction or use of data from these reports must first be approved through the Director, MACFC (and through subcontractors if applicable).

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I. UNIVERSITY OF CONNECTICUT SUBTASKS

A. Suspended Material Transport in the Thames River (Appendix A).

Six cruises were conducted during the quarter, four of which included high-resolution sampling near the operating dredge to determine dredging effects on suspended materials. This completes the survey of dredging impacts. Data have been gathered for both ends and the middle of the Phase I dredging area. Dredging perturbations were found to be similar to those discussed in prior reports, i.e., increases in total and organic materials in suspension, but only within a small distance from the dredge-barge. A detailed analysis of this data will be undertaken in the next quarter to completely assess dispersion characteristics of the plume. Tidal cycle data from this quarter and from earlier sampling have been used to select what appears to be the most applicable hydraulic model of the lower river.

Collection and identification of geofungi continued, with the goal remaining to determine their suitability as indicators of sediment transport. The following findings are reported: numbers of fungal colonies produced were greater in surface than in bottom waters; both surface and bottom waters in the disposal area had low fungal counts; there is an apparent relationship between salinity and number of colonies at most stations, but this may simply reflect the fact that the fungi are introduced with the river water; no relationship between number of colonies and temperature or amounts of suspended sediment were found.

B. Effects of Dredging in the Thames River on Shellfish Resources and Phytoplankton (Appendix B).

Samples were collected to: a) continue characterization of temperature, salinity, dissolved oxygen, heavy metals and chlorophyll *a* at six transects across the Thames; b) analyse near-field effects of dredging on chlorophyll *a* and mercury concentrations - this was done in conjunction with the above study of dredging's effects on suspended materials; and c) study the bivalves *Mercenaria, Crassostrea* and *Pitar* for determination of pathology and heavy metals concentrations.

No abnormalities in the gills, palps or pericardial cavities were detected in any of the three bivalve species. Data on concentrations of zinc, copper, cadmium, nickel and mercury in these species in July and November 1974 and March and May 1975 are presented. The commonest pattern of metals levels observed was a seasonal variation, with higher values in July and May than during the cooler sampling periods. This was seen in *Mercenaria* and *Pitar* for copper, in *Crassostrea* for cadmium and zinc and perhaps in all three species for nickel. There were steady increases of cadmium in *Pitar* and zinc in *Mercenaria,* while decreases with time were found for copper in *Crassostrea* and mercury in *Mercenaria.*

Throughout the sampling, *Crassostrea* contained the highest concentrations of zinc, copper and cadmium; *Mercenaria* was highest in nickel and *Pitar* in lead. The only consistent differences in metals levels with location in the river were: higher copper and mercury, and lower nickel and cadmium, in *Mercenaria* from upriver stations; and lower cadmium upriver in *Pitar*.

Mercury in river water in February and April 1975 was 3-10 fold lower than concentrations measured in earlier samplings. It was thought possible that the lowered values in water (as in shellfish) were due to the removal of polluted sediments by the dredging operation. In the surveys of dredging impacts, at the southern boundary of the channel on 9 April and in the State Pier area on 14 May 1975, mercury concentrations were found to be lowered in waters near the dredging. This phenomenon had been noted in prior reports and in another dredging survey (Jeane and Pine, 1975). It is probably related to the selective loss of fine sediments which was previously documented in the above study on suspended material transport. The mercury is apparently being adsorbed onto the suspended sediments, which then quickly settle out of the water column.

Chlorophyll _a_ values were depressed near the dredge on April 9, but not on May 14. The high background levels of chlorophyll _a_ on the latter date may have masked any small decrease in productivity due to increased suspended load.

C. Lobster Monitoring and Related Dump Site SCUBA Studies (Appendix B).

On 28 May a 200 m transect study was conducted to the south of the disposal buoy. No obvious changes from earlier such surveys were reported. On the same day, a surveillance dive at North Hill, Fishers Island, revealed no excess sedimentation or obvious faunal impacts (compared to earlier North Hill surveys) from the spoil disposal at the New London site. Underwater observations of the dumping process were made on 30 April and 1 May 1975. The spoils were very cohesive in both cases, and turbidity increases were spatially and temporally limited. The sonic tagging experiments have been postponed because the number of lobsters colonizing the spoil pile are not sufficiently numerous to conduct these experiments now.

II. NEW YORK OCEAN SCIENCE LABORATORY SUBTASKS

A. Physical Oceanography of Dump Site Area (Appendix C).

A cruise on 20 May 1975 measured the effects of a dump on turbidity at a point 100 m downstream of the barge release. On 21 May water samples were taken at ten stations before a dump; immediately after the dump, the center and three downstream stations were intensively sampled, and turbidity at the center station was monitored. Current meters were in place for approximately 27 hours during this period.

On 20 May beam transmittance at the station 100 m downstream of the dump remained at ambient levels ($\approx$90%) for 12 minutes following the dump, then dropped to 0. Transmittance increased, in a fairly regular manner, to 80% by 40 minutes after the dump, and returned to 90% by an hour after dumping. The next day the turbidity cloud from another dump required six minutes to travel 50 m upstream of the release point. Transmittance was then low and variable for 28 minutes before returning to within 4% of ambient.

As in prior surveys, the current meter data indicated that easterly components of currents had greater speeds and durations than westerly components. Direction of net drift was computed as just south of east at the surface and ENE in near-bottom waters. Average bottom current velocities over half-tidal cycles were calculated as 23.7 cm/sec on a flooding tide and 25.6 cm/sec during ebb. Maximum recorded bottom speeds over 15 minute averages were 41.8 cm/sec (flooding) and 56.6 cm/sec (ebbing). A large lens of unusually warm and fresh water, originating in the river, was found to extend to within a mile of the NL buoy on an ebbing tide on 21 May.

B. <u>Chemical Oceanography of Dump Site Area</u> (Appendix D).

Water column measurements were made in conjunction with the 21 May monitoring of a dump plume (discussed in the preceding section). Samples taken throughout the study area before the dump revealed dissolved oxygen to be uniformly distributed at 79-85% saturation, levels similar to those found the previous July. Values for pH (8.58-8.79) were quite alkaline but comparable to levels NYOSL has found further west in Long Island Sound during this time of the year. Suspended solids were lower than for any other sampling period, and did not vary significantly with location. The contribution of volatile solids was highest along the transect to the north, perhaps due to the influence of the river discharge. After a dump estimated to be 50 yd east of the NL buoy (Station C), water samples were taken at station C and also stations one half mile to the N, S, W and E, as well as 1 mile east. No changes in oxygen saturation were observed. Other water column impacts were limited to the half-mile station to the east, where suspended solids increased by from approximately 4 x (surface waters) to 16 x (bottom). The suspended solids returned to ambient values within an hour.

Seston samples were collected for heavy metals analysis on 20 May. Data are presented for these as well as March 1975 samples. No consistent differences in metals concentrations with distance from the disposal site were detected. Information on metals in benthic organisms collected in January and in April is also reported. These data show no evidence of metals increasing between the two samplings. Heavy metals in sediments were higher in the proximity of the disposal site, but changes with time at a given station were considered random. Similar findings (elevated values in the spoils but only random changes at any station) were reported for chemical oxygen demand, Kjeldahl nitrogen and total phosphorus in the January and April samples. Since submission of the task's quarterly report, analysis of Kjeldahl nitrogen and total phosphorus in March and May seston samples and April benthic organisms has been completed. This information is included at the end of Appendix D. No noteworthy changes in nitrogen, phosphorus or N/P ratios are evident between these data and those discussed in the prior quarterly report for August-December 1974 samples.

C. Demersal Fish Distribution and Abundance.

No further collections have been made since the February 1975 survey. (A complete analysis of samples from that cruise was included in the third quarterly report). The post-disposal sampling has been scheduled for 4-6 August 1975.

III. MIDDLE ATLANTIC COASTAL FISHERIES CENTER SUBTASKS

A. Benthic Macrofauna Studies

1. Field Activities: The fourth quarterly field survey ended on 1 May 1975. The major portion of the fifth macrofauna cruise was carried out between 23 June and 11 July 1975. Eight of the 47 stations could not be sampled at that time; these stations were occupied on 28 - 30 July, in conjunction with diving surveys.

Smith-McIntyre grab samples have been routinely inspected for presence of spoil materials. The majority of Thames River spoils have a characteristically soft, grey and featureless appearance, easily distinguishable from that of the natural sediments at the disposal area. Thus visual inspection of the grabs is one means of determining spread of the spoil pile, perhaps adding to the effectiveness of the sediment analyses described below. Figure 1 shows the lateral extent of the spoil pile, based on inspection of the grabs, for each of the quarterly cruises completed to date. In September 1974, a month after the onset of dumping, spoils were evident only at the original disposal point, station C6.

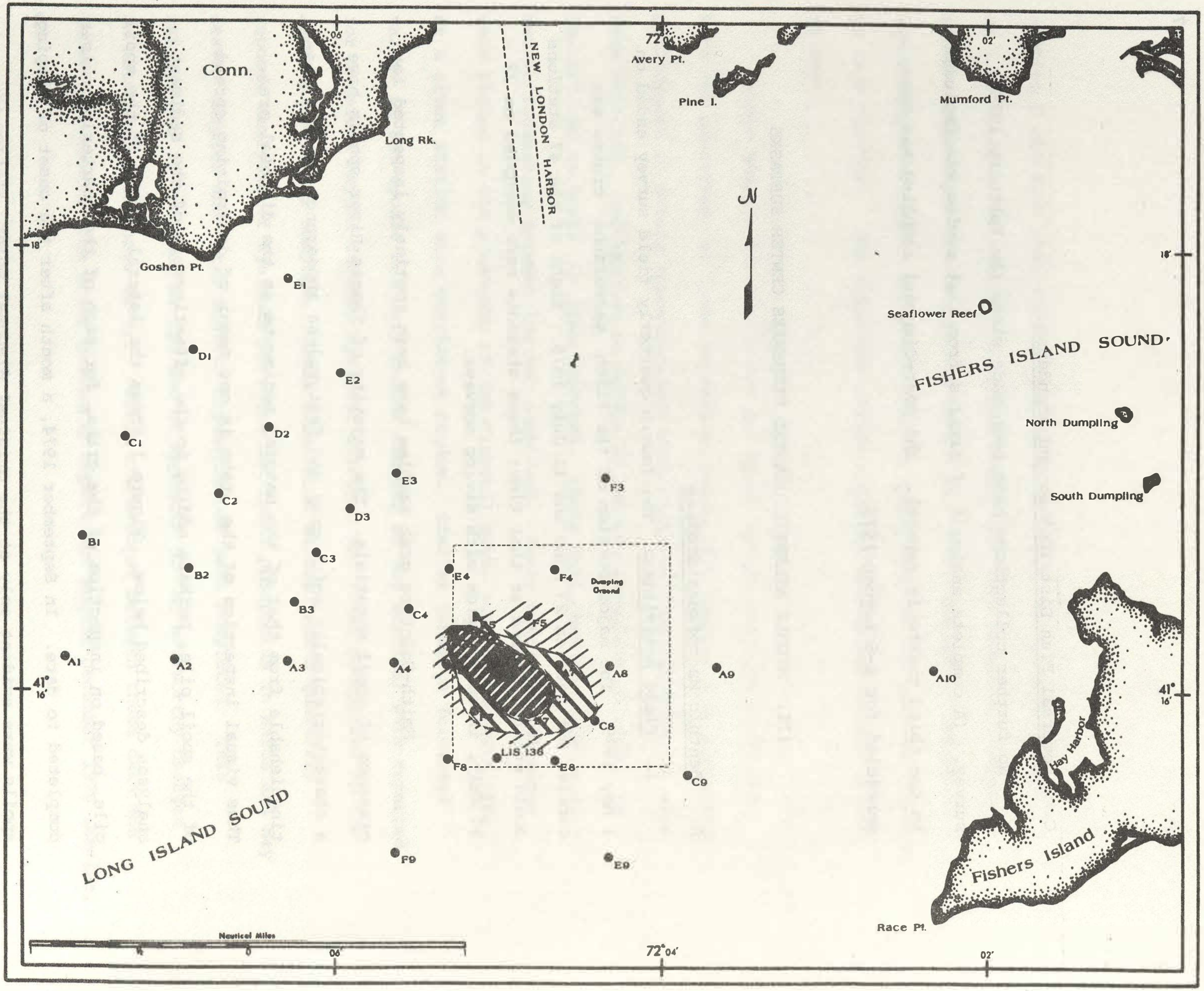

Figure 1. Extent of spoil material, from visual observations of grab samples.
- Sept. 1974 - Jan. 1975 - Apr. 1975 - June 1975

In January spoils were also detected at C7 and E7 (recall from the Foreward to this report that the disposal point was moved to halfway between C6 and C7 in December 1974) with a thin layer appearing at C5. In April 1975 spoils were thicker at C5, present at E7 and in lesser quantities at F7, and questionably present at C8. In June-July 1975 spoil material was apparent at A5, and possibly at F4 and F5, in addition to the previously named stations. Spoils were not seen at C8 in July.

Inspection of the grabs also revealed some recolonization of the spoils, as indicated by the presence of amphipod tubes. Further evidence of recolonization is discussed in section III D on dive studies.

2. <u>Laboratory Activities:</u> We are continuing to concentrate on sorting and identifying, each quarter, all five grabs from what are considered to be the "key" stations (A3, A9, C3, C4, C6), and then processing as many other selected grabs as time permits before the subsequent quarterly samples are returned to the laboratory. After the September 1975 post-disposal sampling, additional sample processing time will become available and a more complete picture of the effects of dredging and spoiling on macrofauna in the river and throughout the disposal area can be developed.

As in past reports, the macrofauna data are presented in terms of numbers of individuals (N) and species (S), Shannon-Weaver species diversity (H'), and equitability, or evenness of distribution of individuals among species (J'). Species composition will also be analysed in future reports. We have tentatively decided that the most appropriate means of analyzing effects of spoil disposal is to characterize the predisposal values in terms of N, S, H' and J', and then present data from subsequent samplings as changes relative to the "baseline" values. Obviously, the most meaningful comparisons will be between samples taken at comparable times of the year, i.e., June-July 1974 vs. June-July 1975, and September 1974 vs. September 1975. In the absence of these data from comparable seasons, however, comparison of predisposal samples to more recent collections can still give some indication of spoil effects.

Predisposal data for numbers of individuals are listed in Table 1, and represented symbolically in Figure 2. Mean densities ranged from 98 individuals /0.1 M^2 at station C5 to 1471 at Cl, a mussel bed.

Figure 3 and Table 2 show the percentage changes in faunal densities between the predisposal levels and samples taken in April 1975. The break points chosen to represent different levels of change are based on a statistical analysis of the dispersion of the predisposal figures from all stations. Thus in Figure 3, a change of 33.5% in faunal densities between June-July and April indicates that the April value would be within one standard deviation of the predisposal mean, assuming variability to be constant, between 33.5% and 66.8% would fall between one and two deviations, etc. This treatment incorporates the natural variability in the predisposal populations in assessing changes from those populations.

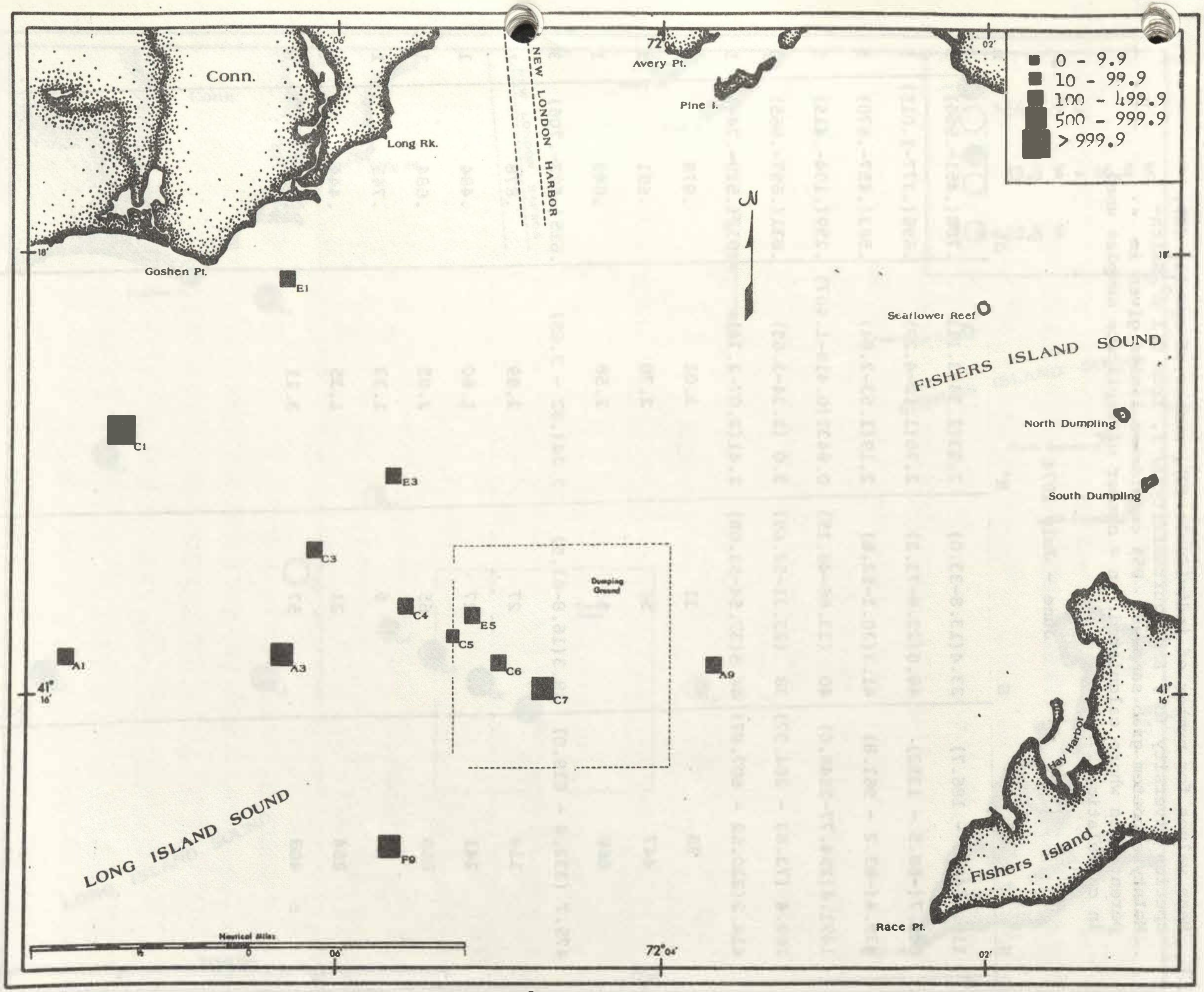

Figure 2. Mean numbers of individuals per 0.1 M^2 at selected stations, June - July 1974 (predisposal). See Table 1 for actual values.

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Table 1. Mean values for number of individuals (N), number of species (S), species diversity (H') and equitability (J'), from 0.1 m^2/Smith-McIntyre bottom grab samples. 95% confidence limits given in parentheses where calculated. n = number of replicate samples used in calculations.

June - July 1974

STATION	N	S	H'	J'	n
A1	116.8(46.9 - 186.7)	23.4(13.8-33.0)	2.23(1.34-3.11)	.708(.451-.966)	5
A3	641.7(-68.5 - 1352)	48.0(22.8-73.2)	2.70(1.12-4.29)	.696(.377-1.015)	5
A9	439.4(-83.2 - 961.8)	41.3(30.1-52.6)	2.19(1.53-2.84)	.563(.457-.670)	5
C1	1471.4(294.77-2648.0)	40 (33.86-46.15)	0.9431(0.419-1.467)	.259(.104-.415)	5
C3	169.4 (73.83 - 264.97)	38 (23.31-52.69)	3.0 (2.34-3.65)	.831(.697-.965)	5
C4	414.2(220.52 - 607.87)	44.8(37.54-52.06)	2.41(2.07-2.74)	.637(.529-.744)	5
C5	98	31	3.02	.878	1
C6	447	50	2.70	.691	2
C7	660	53	2.58	.649	1
E1	475.7 (332.4 - 619.0)	39.3(16.8-61.9)	2.24(.82 - 3.65)	.615(.523-.706)	3
E3	114	27	2.89	.878	1
E5	241	27	1.60	.484	1
F9	866	65	2.85	.684	1
R4	57	6	1.33	.743	1
R5	254	21	1.35	.444	1
R7	408	57	3.11	.769	1

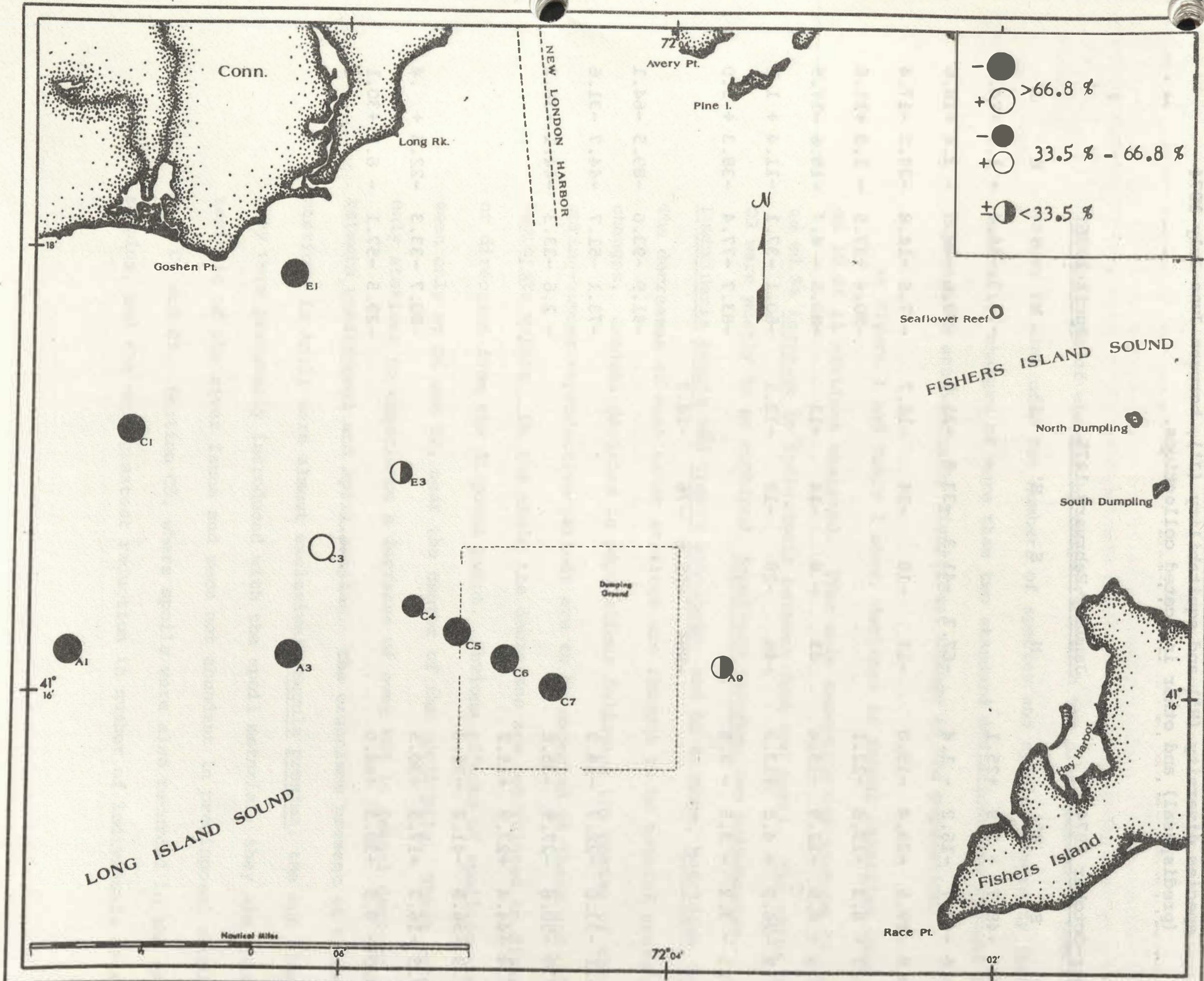

Figure 3. Changes in mean numbers of individuals per 0.1 M^2 between June-July 1974 and April 1975. Refer also to Tables 1 and 2.

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Table 2. Percent changes in number of individuals (N), number of species (S), species diversity (H') and equitability (J'), between June-July 1974 (predisposal) and other indicated collections.

	September-October 1974				January-February 1975				April 1975			
	N	S	H'	J'	N	S	H'	J'	N	S	H'	J'
A1	-78.9	-48.7	- 2.9	+25.1					-74.3	-44.4	+ 1.3	+24.1
A3	-72.6	-42.7	-16.2	- 1.4	-67.7	-41.3	-33.8	-21.6	-88.6	-48.5	- 3.4	+18.6
A9	+ 0.8	-19.5	-23.4	-15.0	-13	-18	-24	-16.7	- 7.6	-14.8	-24.2	-17.4
C1	-35.7	- 8.3	-13.6	-12.1					-80.4	-37.5	- 1.3	+11.6
C3	+116.8	+ 8.8	-12.9	-15.4	43	- 8	-14	-12	+80.5	- 4.7	-18.6	-17.9
C4	-62.2	-26.9	+ 4.5	+13.2	-46	-29	-19	-12.5	-60.1	-37.1	-11.4	+ 1.1
C5	- 7.1	- 3.2	- 3.5	- 2.5					-83.7	-77.4	-38.3	+ 9.0
C6					-99+	-95.6	-76	-14.7				
C7									-91.9	-93.6	-89.5	-64.1
E1	+ 6.1	-33.0	-22.7	-14.3					-73.1	-51.7	-44.7	-31.6
E3	+307.9	+50.6	-27.9	-35.8					- 2.6	-33.3	-44.1	-36.2
E5	+56.4	+44.4	+27.9	+15.2								
F9	-61.9	-56.9	-41.2	-26.3								
R4	-89.5	-16.7	+17.3	+30.5					-80.7	-33.3	-22.3	+ .4
R5	-28.0	- 9.5	+39.3	+44.0					-29.5	-57.1	- 6.1	+30.1

The analysis of changes by comparison with the distribution of predisposal values is also used for numbers of species and species diversity (below). Generally, changes of more than two standard deviations are thought to represent a statistically significant change in the population.

As Figure 3 and Table 2 show, declines in faunal densities were found at 10 of 11 stations analyzed. (The sole exception was station C3, with an 80.5% increase in individuals between June and April. The gains at C3 were mostly in an amphipod, *Ampelisca vadorum*; two polychaetes, *Lumbrineris tenuis* and *Tharyx annulosus*; and an anemone, *Metridium senile*). The decreases at most other stations are thought to be natural seasonal changes. Gradual declines in populations following the maxima of the spring-summer reproductive periods are to be expected in these and other temperate waters. On the whole the decreases are not related to distance or direction from the disposal point. Obvious effects of spoiling are seen only at C6 and C7, near the center of the spoil pile. These were the only stations to experience a decrease of over 90% in faunal density between predisposal and April samples. The organisms present at these stations in April were almost exclusively *Nucula proxima*, the nut clam. They were presumably introduced with the spoil material; they are characteristic of the river fauna and were not abundant in predisposal samples from C6 and C7. Station C5, where spoils were also recorded in the grab samples, had the next greatest reduction in number of individuals (84%).

Table 3: Observed values of temperature, salinity, and resultant σ_t obtained after the barge dump at 1204 EDST

Station	Time	Depth(meters)	T(°C)	S°/₀₀	σ_t(gm/cm^3)
C-4	1204	0	9.8	29.61	22.81
		15	9.3	29.88	23.10
C-5	1215	0	9.9	29.57	22.76
		15	9.3	29.86	23.08
C-6	1232	0	10.1	29.49	22.67
		15	9.3	29.82	23.05
S1-2	1204	0	10.5	29.44	22.56
		20	9.9	29.66	22.83
S1-3	1225	0	10.2	29.51	22.67
		20	9.7	29.84	23.00
S1-4	1238	0	10.2	29.53	22.68
		20	9.6	29.87	23.04
S1-5	1250	0	10.3	29.59	22.71
		20	9.6	29.90	23.06
S1-6	1304	0	10.2	29.57	22.71
		20	9.7	29.81	22.98
E1-2	1204	0	10.0	29.48	22.68
		15	9.3	29.89	23.10
E1-3	1230	0	10.5	29.49	22.60
		15	9.3	29.66	22.92
E1-4	1255	0	10.2	29.52	22.67
		15	9.3	29.86	23.08
E1-5	1320	0	10.5	29.50	22.61
		15	9.4	29.86	23.06
E2-2	1205	0	10.2	29.51	22.67
		10	9.4	29.89	23.09
E2-3	1228	0	9.8	29.48	22.71
		10	8.8	29.85	23.15

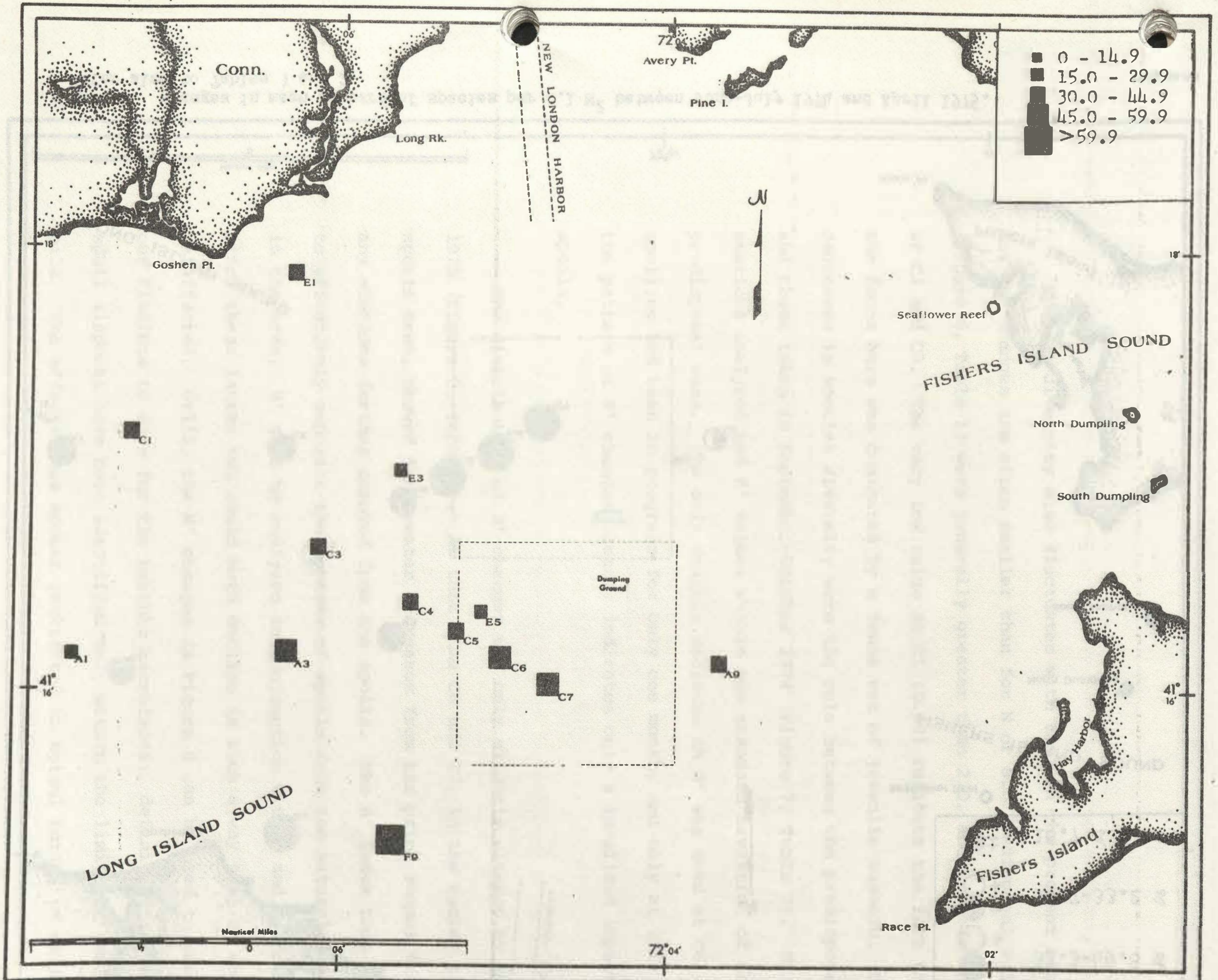

Figure 4. Mean numbers of species per 0.1 M^2 at selected stations, June - July 1974 (predisposal). See Table 1 for actual values.

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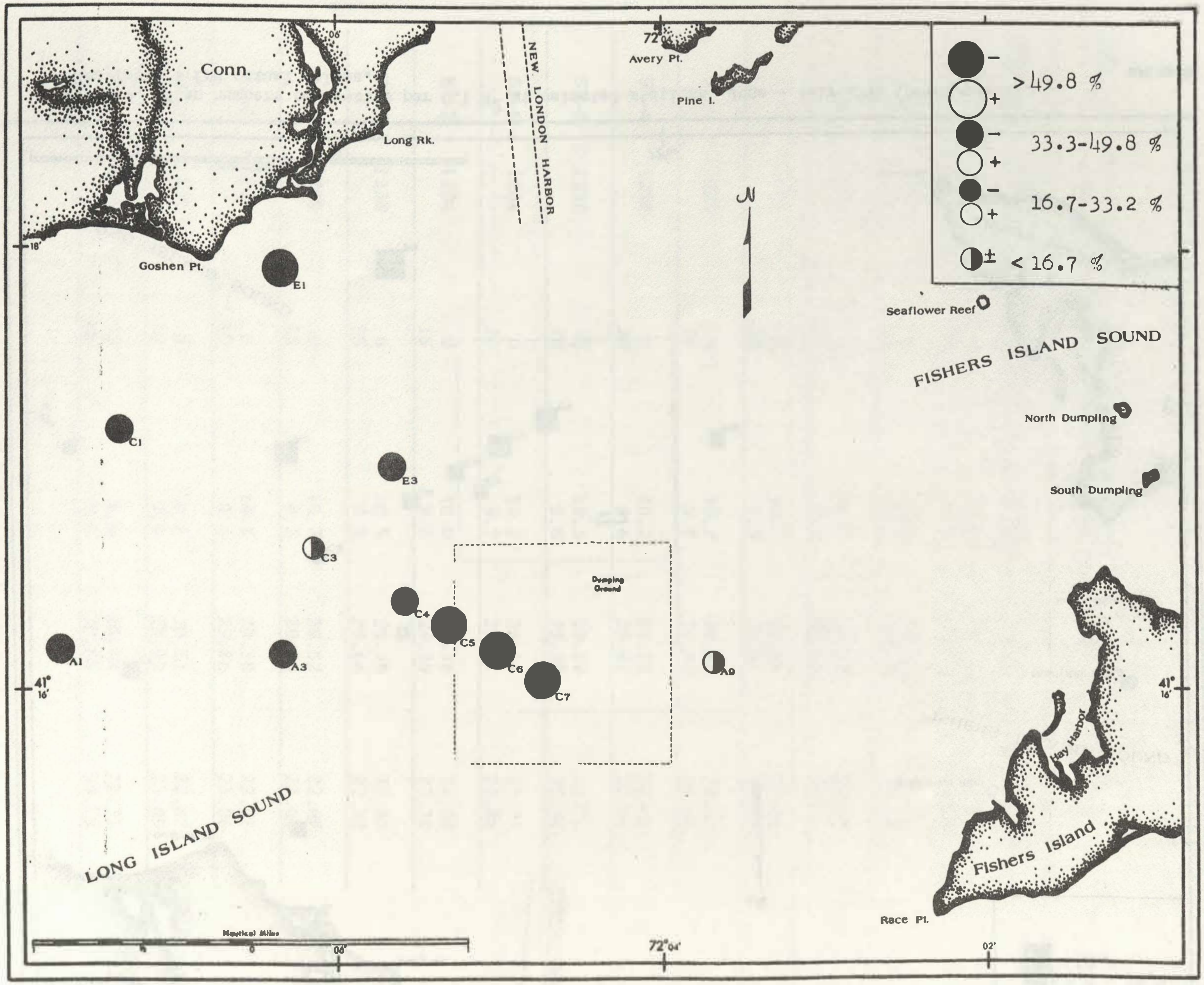

Figure 5. Changes in mean numbers of species per 0.1 M^2 between June-July 1974 and April 1975.
Refer also to Tables 1 and 2.

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Species diversity also fluctuates with time in the present study, but the changes are often smaller than for N or S. Predisposal values (Figure 6, Table 1) were generally greater than 2.0, and exceeded 3.0 at C3 and C5. The very low value at C1 (0.94) reflects the fact that the fauna here was dominated by a dense set of juvenile mussels. Small decreases in species diversity were the rule between the predisposal samples and those taken in September-October 1974 (Figure 7, Table 2). Half the stations analyzed had H' values within one standard deviation of the predisposal mean. The only drastic decrease in H' was seen at C6. Since spoiling had been in progress for only one month, and only at this station, the pattern of H' changes clearly indicates only a localized impact of the spoils.

The distribution of H' changes was only slightly altered by April 1975 (Figure 8, Table 2). At that time C6 and C7, in the center of the spoils area, showed far greater decreases from the prior summer than did any stations further removed from the spoils. The H' index thus appears to effectively separate the impacts of spoils from the natural seasonality in the area. H' must be analysed in conjunction with N and S, however, since these latter two could both decline in such a way that H' would not be affected. Still, the H' changes in Figure 8 can be used to summarize our findings to date for the benthic macrofauna: definite effects of spoil disposal have been identified only within the limits of the spoil pile. The effects thus appear restricted to actual burial of existing

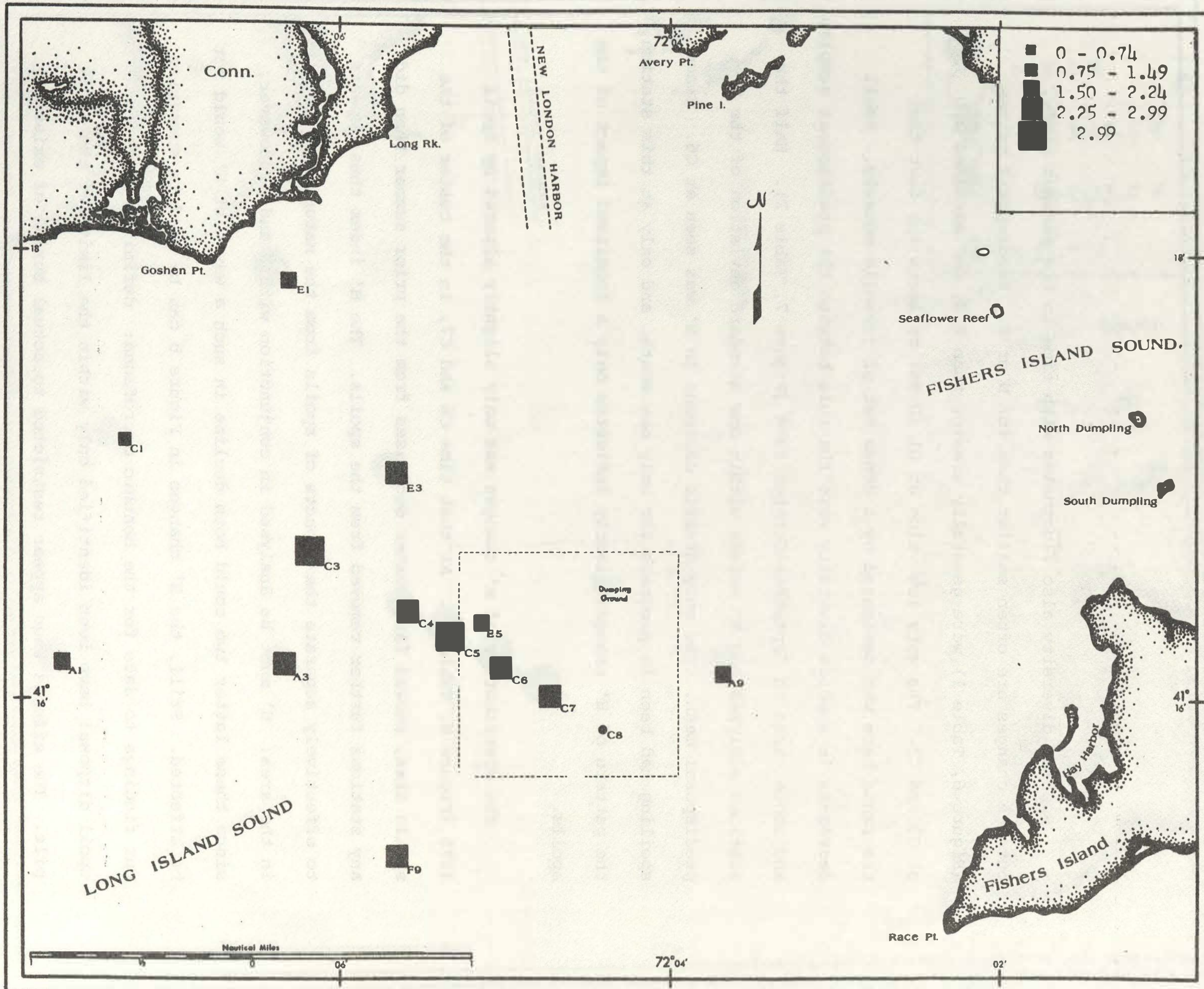

Figure 6. Mean values for Shannon-Weaver species diversity (H') at selected stations, June - July 1974 (predisposal). See Table 1 for actual values.

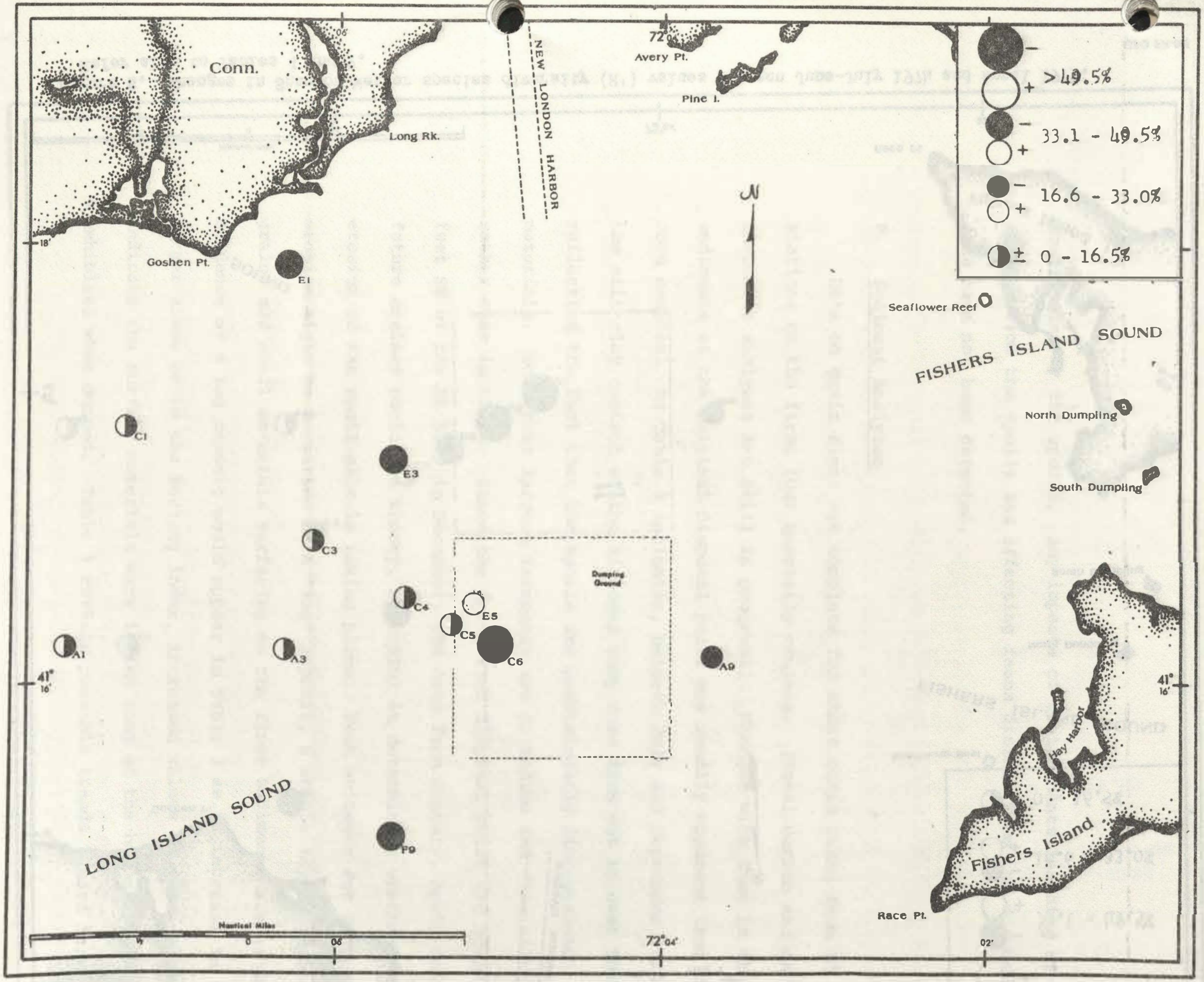

Figure 7. Changes in Shannon-Weaver species diversity (H') values between June-July and September-October 1974. Refer also to Tables 1 and 2.

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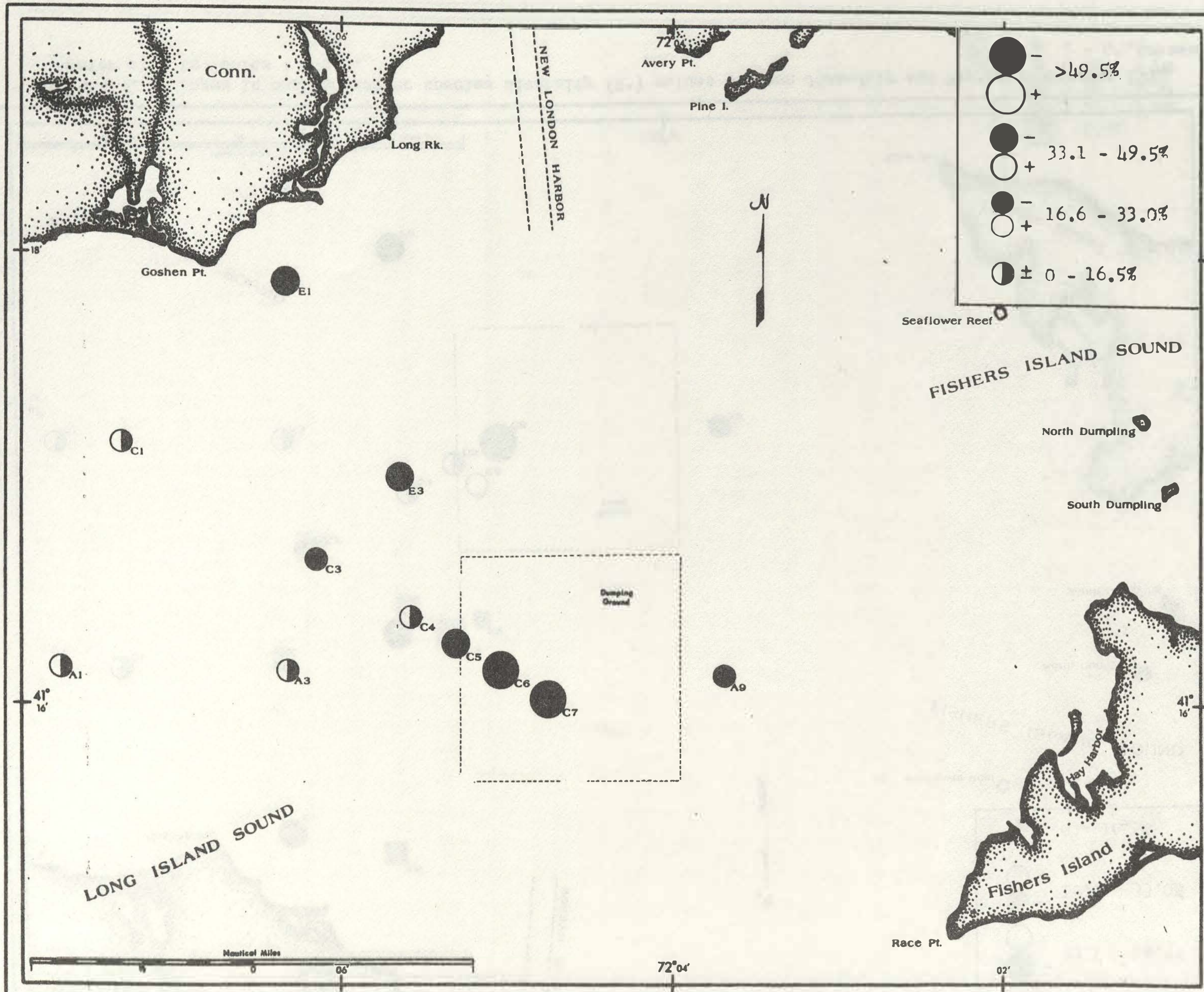

Figure 8. Changes in Shannon-Weaver species diversity (H') values between June-July 1974 and April 1975. Refer also to Tables 1 and 2.

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communities by the spoils. Any impacts of contaminants leaching or eroding from the spoils and affecting fauna distant from the disposal site have not been detected.

B. Sediment Analyses

Data on grain sizes are complete for short cores taken from 20 stations on the first four quarterly cruises. (Total carbon and calcium carbonate analyses are still in progress). Changes with time in the sediments at the original disposal point are readily apparent from the core samples. As Table 3 indicates, between July and September 1974 the silt-clay content at the disposal buoy rose from 65% to over 99%, reflecting the fact that the spoils are predominantly fine-grained materials. Note that largest increases are in medium and fine silts, rather than in clays. Since the designated disposal point was moved 600 feet SE of the NL buoy in December, the data from January, April and future cruises could, in theory, be useful in determining whether erosion of the spoil pile is taking place. Best evidence for such erosion might be formation of a "lag" deposit, a stable layer of coarser grains and shell materials surfacing as the finer sediments are eroded. Evidence of a lag deposit could appear in Table 3 as an increase in the larger sizes or in the sorting index, increased values of which would indicate the surface materials were losing some of the homogeneity they exhibited when dumped. Table 3 reveals possible trends toward increases

Table 3. CHARACTERISTICS OF SURFACE SEDIMENTS AT ORIGINAL NEW LONDON DISPOSAL POINT

DATE	DIAMETER, MM		SORTING INDEX	WEIGHT PERCENT RETAINED ON MESH SIZE IN MM									
				GRANULE	SAND					SILT			CLAY
	MEAN	MEDIAN		4.0mm	2.0	1.0	0.5	0.25	0.125	0.0625	0.0156	0.004	< 0.004mm.
3 Jul. 74	.055	.078	2.50	-	1.75	1.65	3.65	9.47	18.29	19.57	23.40	13.68	8.53
26 Sep. 74	.016	.019	1.58	-	-	-	.15	.25	.27	1.04	56.28	29.59	12.42
24 Jan. 75	.018	.022	1.60	-	-	.33	.58	.56	.73	3.13	59.41	23.87	11.39
23 Apr. 75	.016	.020	1.71	-	.14	.03	.41	.70	.70	3.72	54.60	24.78	14.91

in both large grain sizes and sorting index, but samples from further cruises must be analysed to determine the persistence of these trends. When the calcium carbonate data become available, they will indicate whether surficial shell material is increasing and contributing to a lag deposit.

As Table 3 indicates, presence of spoils at the disposal buoy is easily detected by the increase in fine sediments, specifically those $\angle$ 63u. Changes in these size classes between June-July 1974 and April 1975 were therefore plotted in an attempt to measure the extent of the spoil pile (Figure 9). The large increases in fines at C6 and C7 are unquestionably due to the appearance of spoils. Changes at other stations are, however, erratic and difficult to interpret. It appears that the natural spatial sediment variability, combined with our inability to exactly reoccupy a given station, reduce the effectiveness of this method for charting extent or spread of the spoil pile. We will nevertheless continue the sediment analyses, to follow changes at the disposal buoy and to make the necessary correlations with heavy metals and macrofauna data.

C. Sedimentation Rate Studies

Sediment traps were again set and retrieved by divers at A3, A4 and E3 on 19 - 23 May and 28 - 31 July 1975. Data on amounts of material collected and total and organic carbon content are complete for the first three quarterly cruises (Table 4). Principal findings are: 1) the station closest to the disposal buoy (A4) has had the least material collected on each of the two cruises for which comparative data are available; and

TABLE 4. AMOUNTS AND CARBON CONTENTS OF MATERIALS COLLECTED IN SEDIMENTATION TRAPS

July & October 1974, March 1975

STATION	HEIGHT ABOVE SEDIMENT (cm)	TOTAL MATERIAL COLLECTED (gm/cm^2 of trap/da) July	Oct.	Mar.	DEPTH IN SAMPLE	TOTAL CARBON, % July	Oct.	Mar.	ORGANIC CARBON, % Oct.	Mar.
A2	15	0.12 1/	0.033		TOP	1.62	3.64		1.58	
					BOTTOM	0.79	3.78		3.47	
	55									
A3	15	0.133	0.051	0.225	TOP	2.43	3.57	2.47	3.21	2.29
					BOTTOM	0.36	3.13	2.41	2.42	2.01
	55			0.182	TOP			1.59		1.54
					BOTTOM			1.93		1.86
A4	15		0.023	0.214	TOP		3.55	2.53	2.61	2.26
					BOTTOM		3.40	2.93	3.33	2.59
	55			0.125	TOP			1.54		1.48
					BOTTOM			3.05		2.05
E3	15		0.12 1/	0.270	TOP		2.49	2.90	2.19	2.52
					BOTTOM		2.96	2.92	1.16	2.46
	55			0.130	TOP			1.58		1.09
					BOTTOM			3.76		3.93

1/ Based on weight recovered and volume observed in trap prior to spillage during sampler recovery.

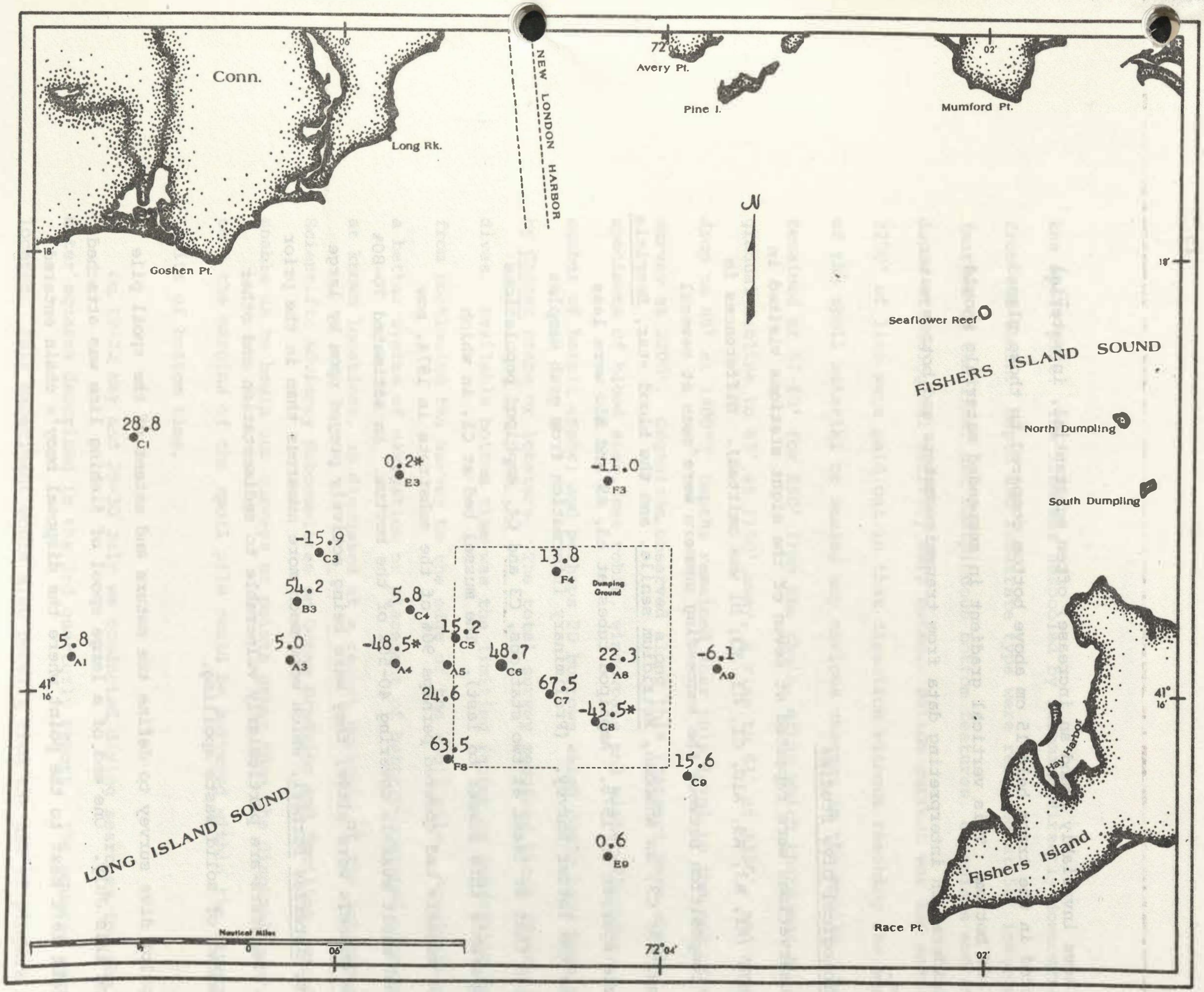

Figure 9. Changes in percent of sediments < .0625mm (by pipette analysis), June-July 1974 to April 1975.
* - Changes are September 1974 to April 1975 where no predisposal samples available.

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2) we have invariably found an increase, often substantial, in material collected in the traps held 15 cm above bottom compared to those placed 55 cm off bottom. This vertical gradient in suspended materials should be considered in interpreting data from transmissometers and bottom water samples.

D. Biological Dive Studies

Observations were repeated at seven of the eight stations visited in July 1974 (A1, A3, A9, A10, C1, C3, E3; D1 was omitted). Differences in faunal composition between the succeeding summers were seen at several stations. At C3, an anemone, Metridium senile, and the blood star, Henricia sp., were sparser in 1975. Amphipod tubes at A3, A9 and A10 were less dense in the latter survey. (Preliminary information from grab samples indicates that at least at two stations, C3 and C4, amphipod populations are comparable this summer to last). The mussel bed at C1, in which juvenile mussels had covered perhaps 90% of the substrate in 1974, now contained adult mussels covering 40-50% of the bottom. An estimated 70-80% of these mussels were alive; they were being actively preyed upon by large seastars, Asterias forbesi, which were much more numerous than in the prior summer. Seastars are particularly vulnerable to sedimentation and other consequences of solid waste spoiling.

A pilot dive survey to define the nature and extent of the spoil pile was begun this July. One end of a large spool of fishing line was attached to a weight left next to the point where the disposal buoy's chain entered the spoil pile. The line was unspooled by swimming directly downcurrent from the chain. Depth and substrate type were recorded at 50' intervals (marked on the line) and conspicuous bottom features, organisms and evidence of biological activity were noted. Bottom current was due east; 2200' of line were paid out in that direction without reaching the end of the spoil material or seeing any obvious changes in the spoils. Depths remained at 57-60' for 650' from the chain, after which there was a gradual decline to 67' at 1150' away, a rise to 61' at 1350', and another drop to 65' at 1400'. Depths remained near this level to the end of the survey at 2200'. Organisms observed along this transect were single specimens of blood star, sea robin, windowpane and winter flounder; a number of hermit crabs; and perhaps 20 burrows which could have been made by Cancer crabs or lobsters. The total survey required three 20-minute dives. Available bottom time was the limiting factor in preventing us from continuing the survey to the edge of the spoil pile. Acquisition of a better system of navigation or placement of battery-operated pingers at known locations, as discussed at a recent workship of the Interagency Scientific Advisory Subcommittee on Ocean Dredging and Spoiling, would enable us to begin our surveys at points other than the disposal buoy, so that the margins of the spoil pile could be surveyed within the divers' limits of bottom time.

On 19-22 May and 29-30 July we conducted diving searches for the meter squares described in the 3rd quarterly report. The squares were not located. This experiment would also benefit from the use of pingers or other sonic locating devices, if the squares are to be used in further studies of the dumping ground.

E. Bacteriology

Extensive sampling in river and disposal areas was conducted from 21-24 July 1975. Analysis of these samples will permit comparisons with data collected in July 1974, and thus enable an assessment of impacts of Phase I dredging and spoiling on distributions of fecal coliform and other bacteria in the study area. Results of the recent survey will be presented in a forthcoming annual report, which will be submitted in lieu of this quarter's report.

LITERATURE CITED

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Jeane, G.S.II and R.E. Pine. 1975. Environmental effects of dredging and spoil disposal. J.W.P.C.F. 47(3): 553-561.

IV. ACKNOWLEDGMENTS

This work is supported by the U.S. Navy through contract #74-0001 with MACFC. MACFC has subsequently subcontracted portions of the study to UCONN and NYOSL. Principal investigators for the various subprojects are:

UCONN - Dr. W.F. Bohlen (Suspended Material Transport, Thames River); Dr. S.Y. Feng (Dredging Effects on Shellfish Resources and Phytoplankton, Thames River); Dr. L. Stewart (Dump Site Lobster and Related SCUBA Studies); Mr. J. Cooke (Geofungi).

NYOSL - Mr. T. White (Chemical Oceanography of Dump Site); Dr. R. Valenti (Fish Distribution and Abundance); Dr. R. Hollman (Physical Oceanography of Dump Site).

MACFC - Mr. A. Draxler (Sediment Trap Experiments); Dr. J. Graikoski (Microbiology); Mr. R. McGrath (Benthic Macrofauna); Mr. R. Reid (SCUBA Surveys, Cage Experiments, Contract Representative).

Thanks for the acknowledgment AD

Appendix A

To: Dr. Robert Reid, Monitoring Project Leader

From: Dr. W. Frank Bohlen, Principal Investigator

Subject: The Investigation of Suspended Material Transport in the Thames River Estuary: Progress Report for the quarter ending June 30, 1975.

During the past quarter primary emphasis has been placed on a variety of field observations required to complete selected data sets prior to the completion of the dredging project scheduled for June 1975. Monthly sampling of suspended material concentrations and concurrent hydrographic conditions was supplemented by special purpose surveys designed to determine the variability of the suspended material field over a tidal cycle and the impacts produced by the operating dredge (Table 1).

The above sampling has served to complete the proposed high resolution surveying in the vicinity of the operating dredge and barge. Data have been obtained at each of three locations within the project area (Fig. 1). Detailed sampling in the vicinity of the northern project boundary was limited by the short time the dredge remained on station. This is not considered a major data shortage. A sufficient variety of hydrographic and geological conditions were sampled to permit a comprehensive examination of the dispersion characteristics of the plume of materials produced by the dredging operation. Particular emphasis during the next quarter will be placed on the evaluation of these characteristics.

Tidal cycle data obtained during this quarter have been combined with those obtained during December 1974. The resultant comparisons have been used to select an optimum hydraulic modelling scheme applicable to the lower Thames River. These efforts suggest that the model prepared by Festa and Hansen (1975) best suits the purpose of this investigation. The subject computer program has been obtained and is at present being modified to satisfy local computer requirements. First runs of this program are expected during the next quarter.

The identification of marine fungi associated with suspended sediments is continuing (Appendix A). An initial evaluation of the utility of these data as indicators of sediment transport is expected to be completed prior to the workshop scheduled for July 1975.

Data evaluation was limited by the intensive field sampling conducted during the past quarter. Routine review of the monthly survey data fails to indicate any dredging impacts other than those noted in the previous quarterly reports.

References:

Festa, J.F. and D.V. Hansen, 1975. Effects of Dredging and River Flow Diversion on Estuarine Circulation. Submitted for Publication in Estuarine and Coastal Marine Science.

FIG.1

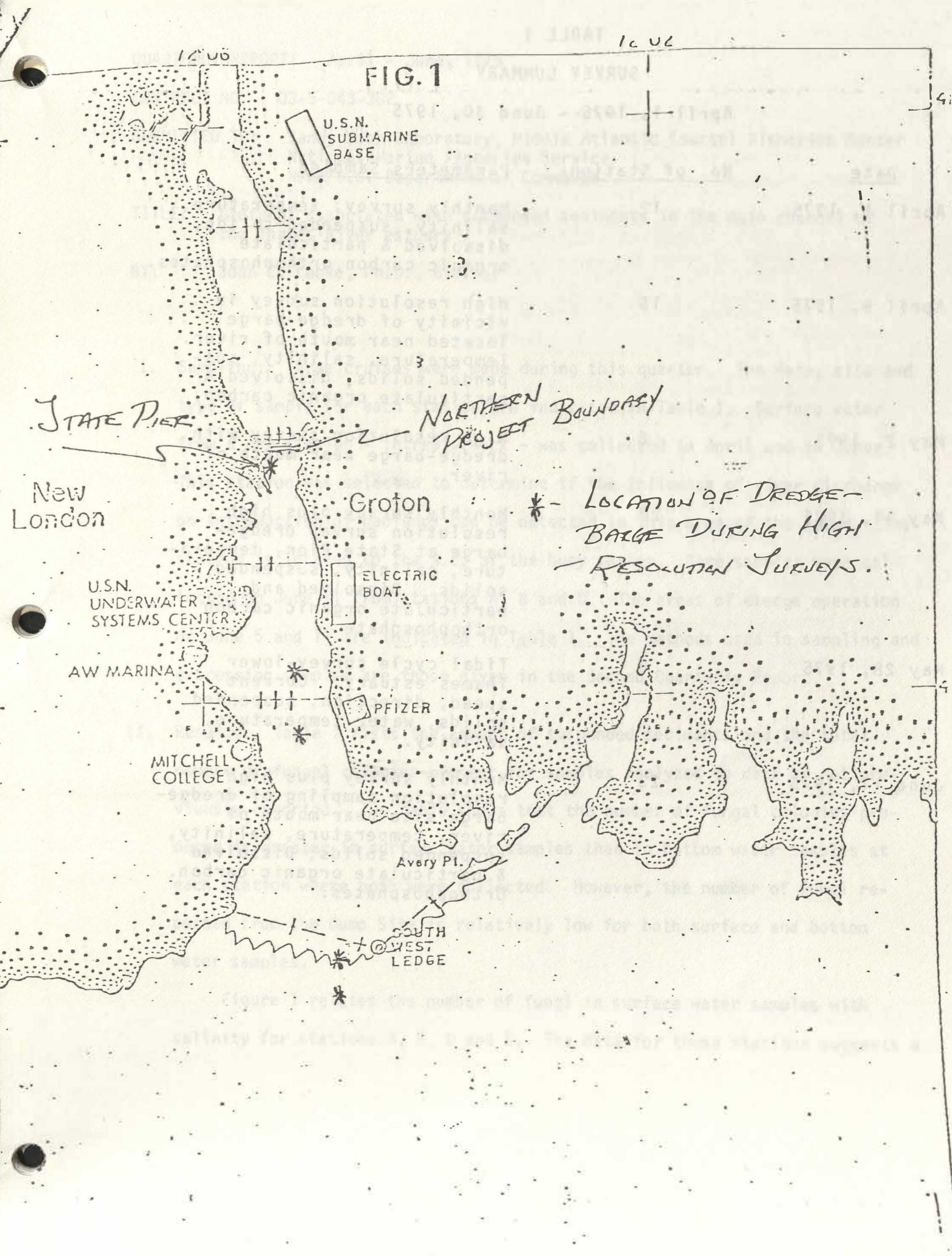

U.S.N.
SUBMARINE
BASE
STATE PIER
NORTHERN PROJECT BOUNDARY
New
London
Groton
*- LOCATION OF DREDGE-BARGE DURING HIGH RESOLUTION SURVEYS.
ELECTRIC
BOAT
U.S.N.
UNDERWATER
SYSTEMS CENTER
AW MARINA
PFIZER
MITCHELL
COLLEGE
Avery Pt.
SOUTH
WEST
LEDGE

TABLE 1

SURVEY SUMMARY

April 1, 1975 - June 30, 1975

Date	No. of Stations	Parameters Sampled
April 1, 1975	12	Monthly survey, temperature, salinity, suspended solids, dissolved & particulate organic carbon, orthophosphates.
April 9, 1975	15	High resolution survey in vicinity of dredge-barge located near mouth of river. Temperature, salinity, suspended solids, dissolved & particulate organic carbon.
May 2, 1975	8	High resolution survey with dredge-barge near mouth of river.
May 14, 1975	22	Monthly survey plus high resolution survey dredge-barge at State Pier, temperature, salinity, suspended solids. Dissolved and particulate organic carbon orthophosphate
May 28, 1975	8	Tidal cycle survey-lower Thames estuary. Current speed, direction, suspended solids, water temperature, salinity.
June 11, 1975	23	Monthly survey plus high resolution sampling of dredge-barge site near mouth of river, temperature, salinity, suspended solids, Dissolved & particulate organic carbon. Orthophosphates.

QUARTERLY REPORT: April - June, 1975

CONTRACT NO. 03-5-043-302

SUBMITTED TO: Sandy Hook Laboratory, Middle Atlantic Coastal Fisheries Center
National Marine Fisheries Service
NOAA/U.S. Department of Commerce

TITLE: Geofungi associated with suspended sediments in the main channel of the Thames River estuary

BY: John C. Cooke, Ph.D., Biology

I. Sampling: Three cruises were made during this quarter. The date, site and type of sample for each station are indicated in Table I. Surface water from a new station - Intrepid Rock - was collected in April and in June. This station was selected to determine if the influence of river discharge on introduction of geofungi can be detected in this area of the sound. The station is located to the S.E. of the buoy marker. Core samples were collected on June 11 from stations A, B and D. The areas of dredge operation on June 5 and 11 are indicated in Table 1. The methods used in sampling and processing samples are those given in the Second Quarterly Report.

II. Results: Table I lists the amount of suspended sediments and the total number of fungal colonies present for samples analyzed to date or not previously reported. The table shows that the number of fungal colonies produced is greater in surface water samples than in bottom water samples at each station where both were collected. However, the number of fungi reported from the Dump Site is relatively low for both surface and bottom water samples.

Figure 1 relates the number of fungi in surface water samples with salinity for stations A, B, D and E. The data for these stations suggests a correlation between these two measurements in the river channel and at station E (Vixen Ledge), an area affected by river discharge. Figure 2 suggests no correlation between salinity and colony number at station F (Mumford Cove) although the range in salinity is as great as at station E. Station F is not affected directly by river discharge. The essential lack of characteristic geo-fungal populations with any of the stations suggests that the fungi are introduced with the river water and that the relationship with salinity indicates only a mixing process.

No relationship of fungal colonies with temperature or amount of suspended sediments has been found.

III. Future Work: Analysis of the sample plates from June is being completed. Two additional collections of samples will be made from the river during the summer.

TABLE I.

Number of fungi and amount of suspended sediment from each station.

DATE	mg/l SEDIMENT Surface	Bottom		TOTAL # OF COLONIES/SAMPLE Surface	Bottom	
STATION A:	BUOY #2 - New London Harbor					
3-20-75	4.31	31.98		59/6 plates	19/6 plates	
4-24-75	10.38	6.40		15/6 plates	5/6 plates	
6-5-75	0.96	2.63		To be examined		(south of dredge)
6-11-75		not sampled		To be examined		(area of dredge)
STATION B:	BUOY #6 - New London Harbor					
3-20-75	3.65	5.18		60/6 plates	9/6 plates	
4-24-75	12.22	7.79		46/6 plates	6/6 plates	
6-5-75	1.89	468.94	(collected at bottom surface)	To be examined		
6-11-75		not sampled		To be examined		
STATION C:	Below dredge in channel - NEW LONDON HARBOR					
4-24-75	10.52	9.72		39/6 plates	3/6 plates	(1/3 mi.north of N. L. Light)
6-5-75	1.59	1.25				(North of dredge See STATION A 6-5-75)
STATION D:	Thames River BUOY #2 (North of Gold Star Memorial Bridge)					
3-20-75	3.30	4.17		38/6 plates	15/6 plates	
4-26-75	10.66	10.70		41/6 plates	21/6 plates	
6-5-75	7.35	7.56		To be examined		
6-11-75		not sampled		To be examined		
STATION E:	Vixen Ledge (Red Buoy Marker)					
3-20-75	7.61	---		11/6 plates		
4-24-75	9.90	---		8/6 plates		
6-5-75	1.16	---		To be examined		

Table I. - continued

STATION F: Mumford Cove (West of Channel Marker #5)

DATE	mg/l SEDIMENT Surface	Bottom	TOTAL # OF COLONIES/SAMPLE Surface	Bottom
3-20-75	5.13	---	45/6 plates	
6-5-75	1.48	---	To be examined	

STATION DUMP SITE: (Vicinity of marker buoy)

3-20-75	6.34	29.60	10/6 plates	3/6 plates
4-24-75	7.99	9.71	12/6 plates	7/6 plates
6-5-75	0.63	18.96	To be examined	

STATION INTREPID ROCK: (East of Buoy Marker)

4-26-75	11.16	---	5/6 plates	
6-5-75	1.68	---	To be examined	

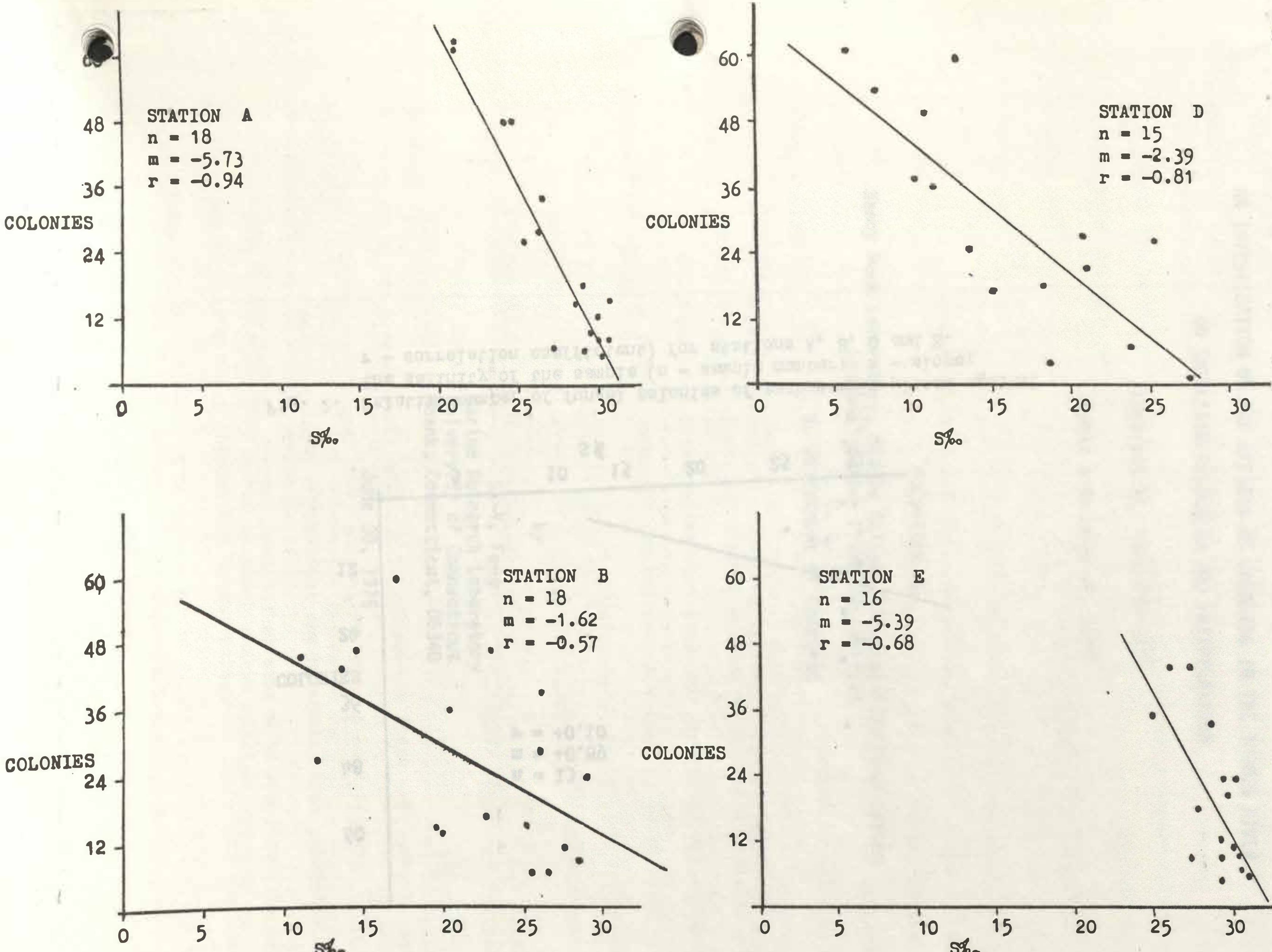


Fig.1. Relative number of fungal colonies of each sample ploted against the salinity of the sample (n - sample number; m - slope; r - correlation coefficient) for stations A, B, D and E.

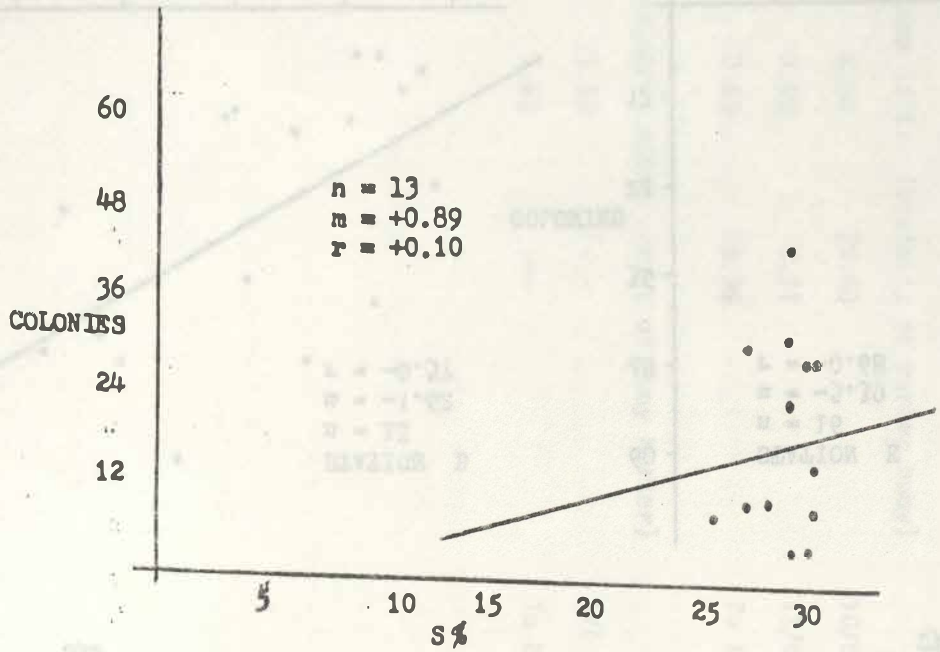


Fig. 2. Relative number of fungal colonies of each sample ploted against the salinity of the sample (n - sample number; m - slope; r - correlation coefficient) for stations A, B, D and E.

APPENDIX B

QUARTERLY REPORT

AN INVESTIGATION ON THE EFFECTS OF DREDGING IN THE THAMES RIVER ON SHELLFISH RESOURCES AND PHYTOPLANKTON

(Contract No. 03-5-043-301)

April 1 to June 30, 1975

Submitted to

Sandy Hook Laboratory, Middle Atlantic Coastal Fisheries Center
National Marine Fisheries Service
N. O. A. A.
U. S. Department of Commerce

by

S. Y. Feng
Marine Research Laboratory
University of Connecticut
Noank, Connecticut, 06340

June 30, 1975

Introduction

During this quarter field sampling has been continued to determine the concentrations of zinc, copper, cadmium, nickle and mercury in shellfish as well as in water samples. In cooperation with Dr. W. F. Bohlen we have also completed a study of chlorophyll a and mercury concentrations in the vicinity of the dredge-barge. At the dump site, lobster and related SCUBA studies were carried out by Drs. W.A. Lund and L.L. Stewart.

Field Accomplishments. Five cruises were made in April and May 1975. On April 22, 24 water samples for heavy metal determinations and 64 samples for chlorophyll analyses were obtained from the six transects in Thames River. Concurrently temperature, salinity and dissolved oxygen were also measured at each station.

The cruises to monitor the concentration of chlorophyll a and mercury in the vicinity of the dredge-barge were conducted concurrently with Dr. Bohlen's suspended load studies on April 9 and May 14 when the dredge-barge was located at the mouth of the Thames and the State Pier respectively. During the two cruises, a total of 22 stations was occupied and 126 water samples were collected for chlorophyll a and mercury determinations.

Thirteen samples of *Mercenaria mercenaria* (104 clams), 7 samples of *Pitar morrhuana* (105 individuals) and 4 samples of *Crassostrea virginica* (32 oysters) were collected from Thames River on May 17-19.

Sonic tagging of lobsters at the dump site was attempted on April 30 and May 1, 1975. On May 28 a SCUBA observation of the dump site was also conducted.

Laboratory Accomplishement. Before the shellfish samples were prepared for heavy metal analyses, each individual was examined for gross pathological conditions. The analyses of the 24 shellfish samples for zinc, copper, cadmium, nickle and mercury have been completed. Concentrations of chlorophyll a and mercury in the 126 samples collected in the vicinity of the dredge-barge as well as the 24 water samples from the six transects have also been analyzed. Analyses of heavy metals other than mercury in the water samples are in progress.

Methods

The procedures for gross examination of pathological conditions and determination of heavy metals in shellfish samples were detailed in our original proposal and also in the previous quarterly reports. Chlorophyll a, b, and c were determined spectrophotometrically according to the method outlined in Strickland and Parsons (1968). The mercury levels of the water samples were obtained by the method of Fitzgerald et al. (1974). Other metals: zinc, copper, cadmium and nickle are being determined by the APDC-MIBK extraction method (Brewer et al. 1969). Where appropriate water sample treated with NH_4NO_3 have also been analyzed for the above mentioned metals by the newly developed graphite flameless atomizer technique (Ediger et al. 1974).

Results and Discussions

A. Gross Pathological Examination of Shellfish

Inspections of the inner and outer aspects of gills and palps, as well as the pericardial cavity revealed no discernible abnormalities.

B. Heavy Metal Concentrations in *Mercenaria mercenaria*, *Crassostrea virginica* and *Pitar morrhuana*

There appeared to be a slow but steady accumulation of zinc in *M. mercenaria* and *P. morrhuana.* In *C. virginica,* the results suggested the presence of seasonal variations of this metal (Table I).

Copper concentrations varied seasonally within narrow limits in *M. mercenaria* and *P. morrhuana;* the concentrations were lower in the November and March than in the July and May samples (Table II). Continuous attrition of copper was evident in the *C. virginica* samples.

TABLE I. Zinc Concentrations in Shellfish (ug/gm freeze dry weight).

Station	July '74	November '74	March '75	May '75
		Mercenaria mercenaria		
A				
B	182	---	268	---
C	122	138	181	259
D	164	368	222	237
E	147	231	212	203
F	226	144	226	278
G	144	168	239	256
H	236	87	184	244
O-VII	---	---	---	---
Avg.	174	189	219	246
		Pitar morrhuana		
A	201	178	206	306
B	---	---	284	375
C	634	412	390	362
D	281	546	487	430
E	---	706	426	468
F	306	437	---	---
Avg.	356	456	359	388
		Crassostrea virginica		
O-II	19,700	14,700	18,600	13,700
O-III	16,900	14,700	12,800	14,400
O-VI	21,200	14,400	11,900	20,900
O-VII	18,100	13,100	14,700	15,900
Avg.	19,000	14,200	14,500	16,200

TABLE II. Copper Concentrations in Shellfish (ug/gm freeze dry weight).

Station	July '74	November '74	March '75	May '75
		Mercenaria mercenaria		
B	25.6	---	36.8	---
C	25.0	18.1	15.6	21.5
D	25.2	17.2	17.5	24.4
E	27.5	24.4	20.3	23.4
F	33.7	22.5	22.5	29.6
G	29.6	25.6	26.5	24.6
H	37.9	27.5	26.8	24.3
Avg.	29.2	22.6	23.7	24.6
		Pitar morrhuana		
A	22.3	11.9	12.2	26.8
B	---	---	14.4	26.2
C	19.4	15.9	13.7	20.4
D	21.2	13.7	14.7	15.0
E	---	23.7	16.2	14.4
F	18.1	27.5	---	---
Avg.	20.2	18.5	14.2	20.6
		Crassostrea virginica		
O-II	1500	750	1203	703
O-III	1218	768	748	656
O-VI	1405	731	796	1060
O-VII	1275	712	937	795
	1350	740	921	804

The lowest level of cadmium was observed in the November samples of M. mercenaria and C. virginica, which showed a 50% decrease from that of the July sample (Table III). This trend was reversed in the subsequent March sample. Pitar morrohuana, however, showed accumulation of cadmium at a slow rate.

The variations of nickle concentrations among the July, November and May samples of the three bivalve molluscs were small (Table IV). However, there were noticable reductions of nickle levels during the month of March in all the shellfish examined.

There were two discernible patterns of variation in mercury concentrations: a slow steady and a fluctuating decrease pattern. Mercenaria mercenaria represents the former, while P. morrhuana and C. virginica examplify the latter (Table V).

Analysis of the data collected to date revealed a definite pattern of species specific affinity for certain metals. Zinc, copper and cadmium were most avidly taken up by C. virginica, while M. mercenaria exhibited a special preference for nickle. Pitar morrhuana on the other hand contained the highest level of lead among the three bivalves examined. Although the reasons for the apparent specificity of metal uptake by these molluscs still remain obscure, such information, from a practical point of view, could conceivably improve the sensitivity of monitoring particular metals in the environment by selecting a organism which concentrates a given metal or metals most efficiently.

In most of the shellfish examined, there was no consistent relationship between the location on the river and the concentration of metals in the organisms. However, in the upriver stations, the concentrations of copper and mercury in M. mercenaria tended to be higher, while those of nickle and cadmium inclined to be lower (Tables II, III, IV and V). Cadmium concentrations in P. morrhuana were also lower in the upriver stations as compared with that of the lower river stations.

TABLE III. Cadmium Concentrations in Shellfish (ug/gm freeze dry weight).

Station	July '74	November '74	March '75	May '75
		Mercenaria mercenaria		
B	1.34	---	1.12	---
C	1.25	1.16	0.97	1.72
D	1.16	0.56	1.25	1.91
E	1.19	0.84	1.88	2.16
F	0.92	0.37	1.09	1.34
G	0.92	0.69	1.06	1.62
H	0.94	0.31	1.00	1.56
Avg.	1.10	0.66	1.20	1.72
		Pitar morrhuana		
A	4.48	4.15	4.15	4.56
B	---	---	---	5.00
C	2.38	3.40	3.40	3.22
D	3.12	2.47	2.47	3.37
E	---	3.00	3.00	3.37
F	1.62	2.37	2.37	---
Avg.	2.90	3.08	3.08	3.90
		Crassostrea virginica		
O-II	5.75	2.56	5.69	5.68
O-III	5.31	3.00	4.37	5.12
O-VI	---	3.06	6.18	6.36
O-VII	8.31	3.81	5.68	6.42
Avg.	6.46	3.11	5.48	5.90

TABLE IV. Nickle Concentrations in Shellfish (ug/gm freeze dry weight)

Station	July '74	November '74	March '75	May '75
		Mercenaria mercenaria		
B	10.24	---	10.24	---
C	10.50	8.12	5.62	8.74
D	8.82	11.49	6.00	8.75
E	8.37	9.62	5.75	9.06
F	9.12	7.74	4.62	8.74
G	6.16	6.24	4.62	6.50
H	6.16	7.00	4.24	6.87
Avg.	8.51	8.37	5.87	8.11
		Pitar morrhuana		
A	7.66	7.12	5.75	9.37
B	---	---	5.24	8.12
C	7.00	7.37	5.74	7.50
D	8.00	8.37	5.12	9.37
E	---	8.49	4.25	7.50
F	8.00	---	---	---
Avg.	7.66	7.84	5.22	8.37
		Crassostrea virginica		
O-II	6.50	7.00	4.75	5.00
O-III	5.75	4.75	4.74	6.25
O-VI	5.74	5.00	4.50	6.86
O-VII	4.25	4.75	6.75	6.24
Avg.	5.56	5.38	5.18	6.09

TABLE V. Mercury Concentrations in Shellfish (ug/gm freeze dry weight).

Station	July '74	November '74	March '75	May '75
		Mercenaria mercenaria		
B	.304	---	.185	---
C	.219	.242	.146	.139
D	.277	.221	.195	.159
E	.468	.286	.202	.210
F	.280	.372	.212	.182
G	.307	.254	.320	.220
H	.482	.584	.314	.344
Avg.	.334	.326	.225	.210
		Pitar morrhuana		
A	.260	.206	.204	.113
B	---	---	.261	.110
C	.203	.183	.233	.109
D	.205	.234	.224	.136
E	---	.302	.212	.145
F	---	.118	---	---
Avg.	.223	.204	.227	.123
		Crassostrea virginica		
O-II	.381	.185	.374	.300
O-III	.368	.233	.356	.215
O-VI	.396	.128	.344	.311
O-VII	.424	.281	.381	.289
Avg.	.392	.207	.364	.279

C. Mercury Concentrations in Thames River Water Samples

The distribution of mercury in the surface and bottom at high and low water is depicted in Figure 1 and Table VI which summarizes all available information to date. There was a 3- to 10- fold decrease in the mercury concentration of the February and April 1975 samples as contrasted with that of the November and July 1974 samples. The range of mercury concentrations during this quarter varied from 2 to 12 ng/L, which approximates the range of February 1975 samples (2 to 10 ng/L).

Such reduction of mercury concentrations in the water could be ascribed to the gradual removal of polluted spoils from the channel. However, final confirmation of this tentative interpretation awaits the completion of all metal determinations. It is also tempting to associate the general decline of mercury levels in the three species of shellfish (Table V) with the significant lowering of mercury in the environment.

D. The Distribution of Chlorophyll a and Mercury Concentration in the Vicinity of the Dredge-Barge

Results of chlorophyll a and mercury concentrations obtained on April 9 are shown in Figures 2 and 3. The dredge-barge was located at the southern most boundary of the channel. In general the levels of chlorophyll a and mercury were significantly lower than that of the background in an area south of the dredge-barge.

The investigation carried out on May 14 was conducted approximately 500 yd. south of the draw bridge (D.B.) in the State Pier (S.P.) area. The data are presented graphically in Figures 4 and 5. The concentrations of chlorophyll a were slightly higher in the immediate vicinity of the dredge-barge at all three depths and quickly dissipated into the background levels within 250 yd. from the site of dredging.

TABLE VI. Mercruy Concentrations in Thames River Water (expressed in ng/L or parts per trillion)

Transect	7/2/74	7/18/74	11/4/74	2/2/75	4/22/75
I-LW-S		23	12	8	6
-B		80	48	10	2
HW-S	12	15	17	5	10
-B	12	62	9	5	5
II-LW-S		254	32	5	6
-B		410	20	8	2
HW-S	12	12	14	6	10
-B	15	11	12	3	6
III-LW-S		15	26	5	3
-B		7	20	4	2
HW-S		6	8	4	6
-B	10	7	7	4	3
VI-LW-S	30	13	11	4	3
-B		33	9	3	5
HW-S	14	46	16	5	8
-B	15	41	16	5	5
V-LW-S		16	11	3	6
-B		12	9	3	4
HW-S	6	4	12	4	9
-B	16	132	13	7	6
VI-LW-S		31	11	2	4
-B		17	18	5	5
HW-S	28	11	15	6	6
-B	10	18	15	8	12
Avg.	15	53	16	5	6

Figure 1. Mercury Concentrations in Thames River (4/22/75).

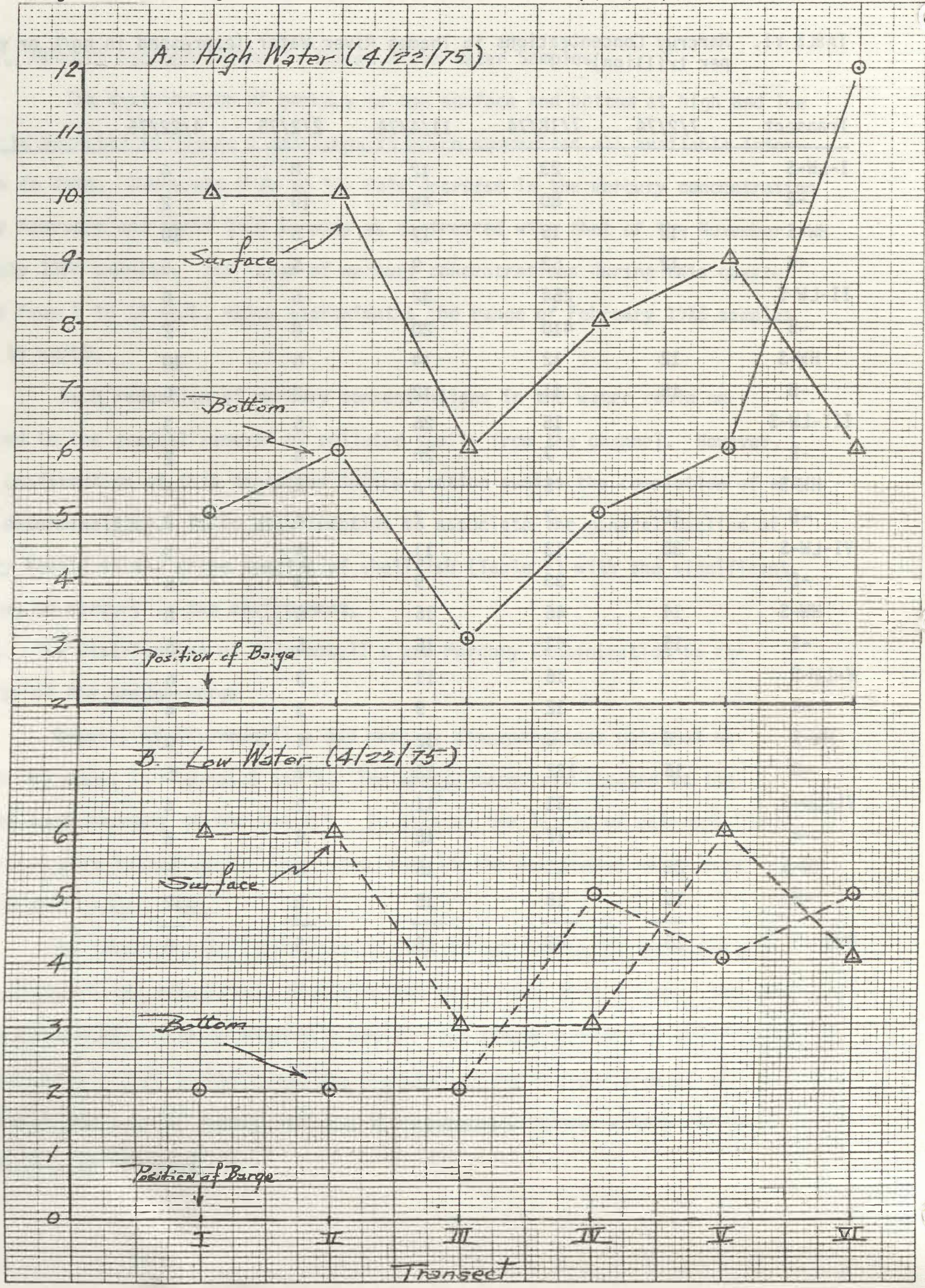


Figure 2. The distribution of Chlorophyll a concentrations in the vicinity of the dredge-barge (4/9/75).

C-Bottom

E.B. 2.2
Pfizer 2.5

B. Mid-depth (4 m.)

E.B. 2.4
Pfizer 2.0

A. Surface

E.B. 2.0
Pfizer 1.8

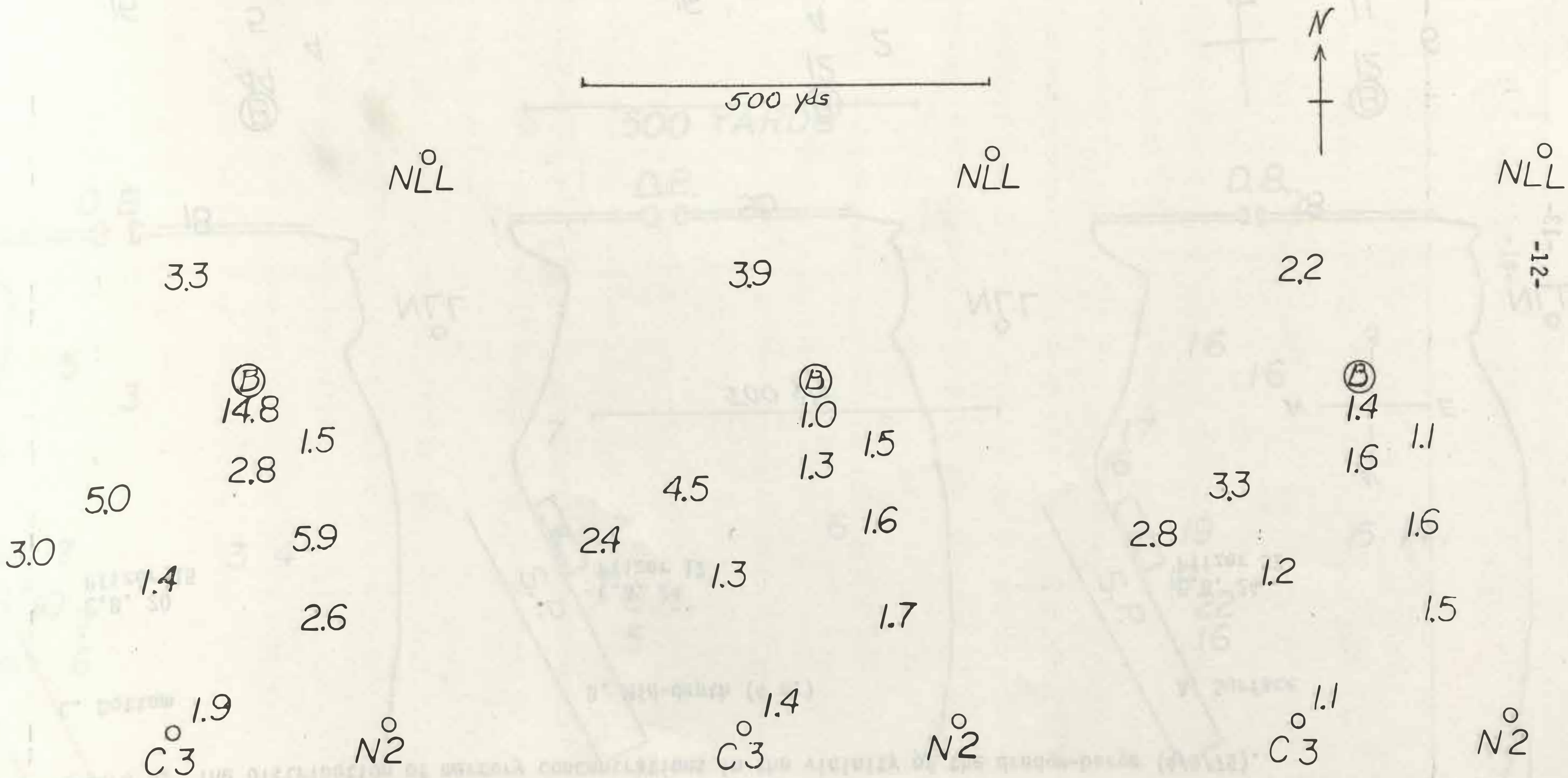


Figure 3. The distribution of mercury concentrations in the vicinity of the dredge-barge (4/9/75).

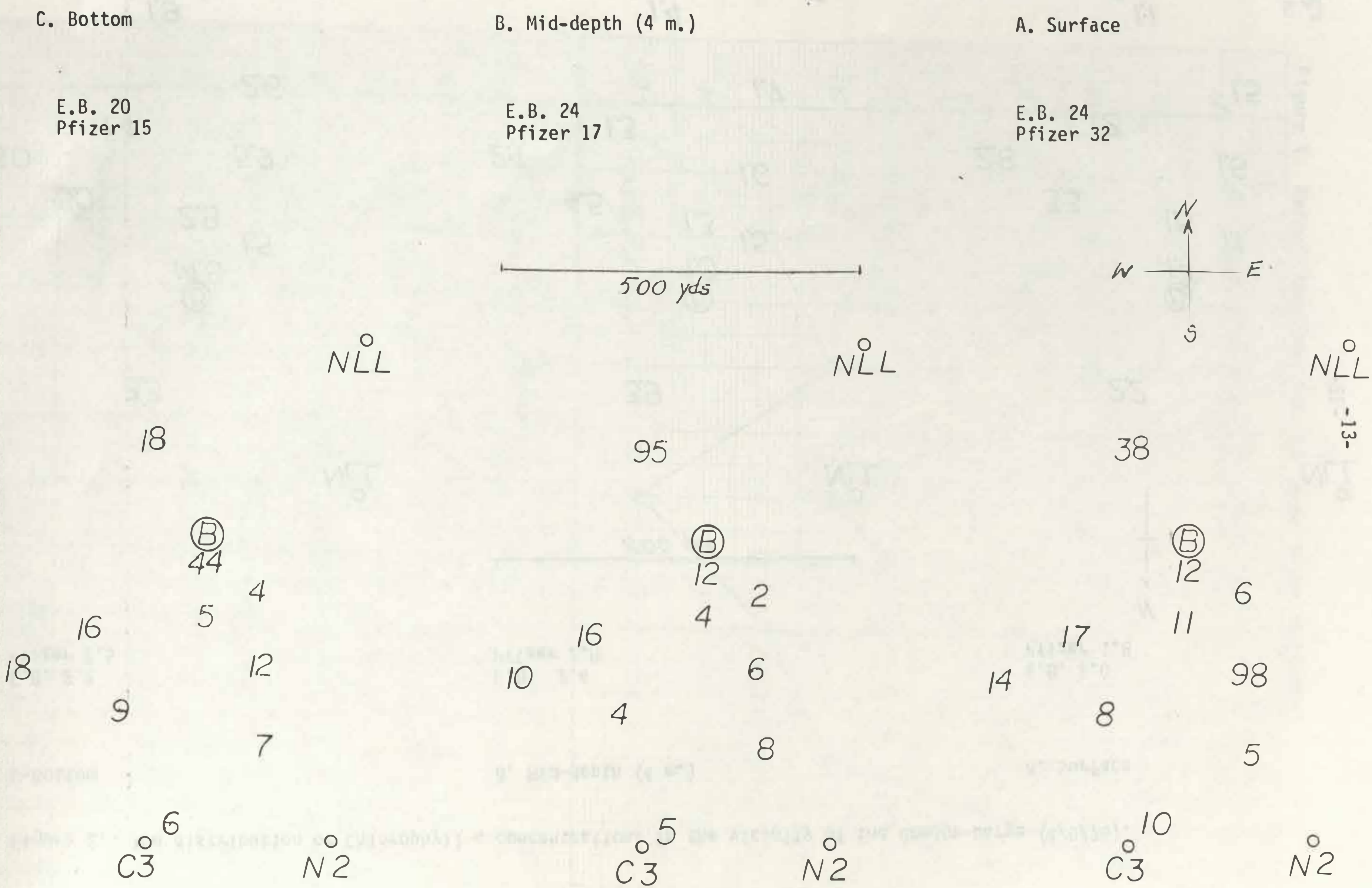


Figure 4. The distribution of chlorophyll a concentrations in the vicinity of the dredge-barge (5/14/75)

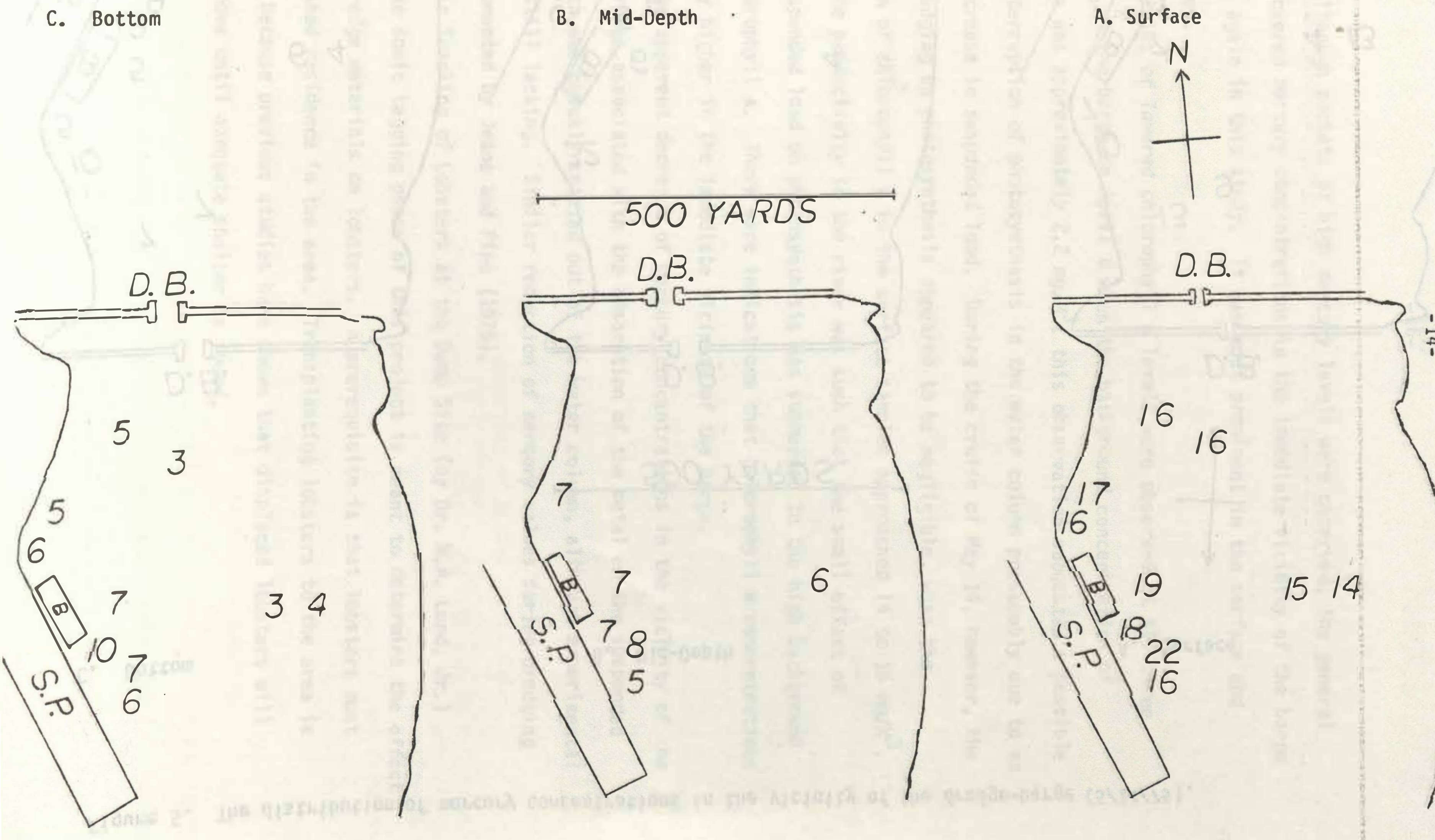
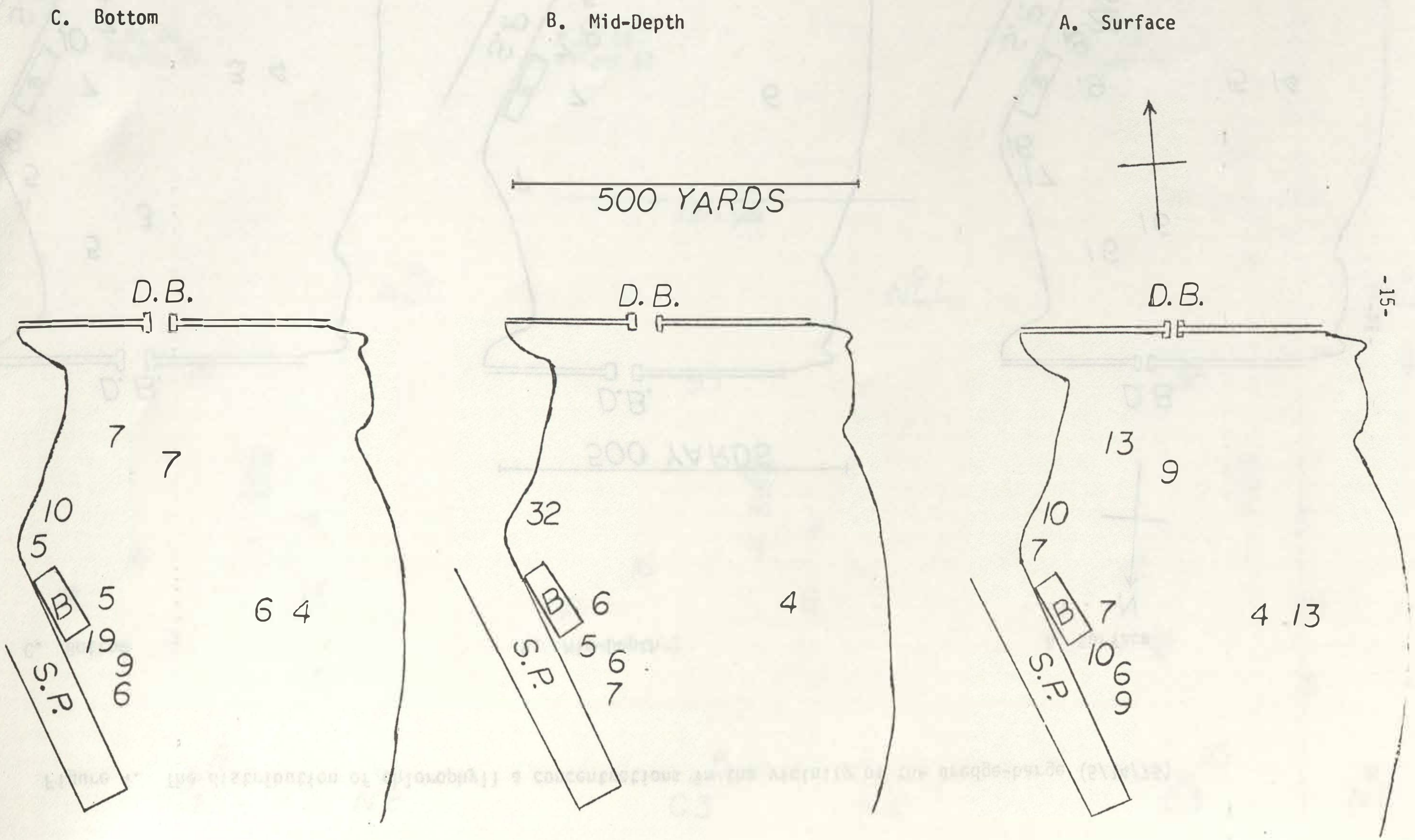


Figure 5. The distribution of mercury concentrations in the vicinity of the dredge-barge (5/14/75).



Although pockets of high mercury levels were observed, the general pattern of lowered mercury concentrations in the immediate vicinity of the barge was detected again in this study. It was most prominent in the surface and bottom samples.

Fields of lowered chlorophyll a levels were observed at all three depths south of the barge on April 9 when the background concentration of chlorophyll a was approximately 2.2 mg/M^3; this observation suggested a possible transient interruption of photosynthesis in the water column presumably due to an temporary increase in suspended load. During the cruise of May 14, however, the effect of dredging on photosynthesis appeared to be negligible, when the concentration of chlorophyll a in the surface samples approached 14 to 16 mg/M^3. Apparently the productivity in the river was such that the small effect of increased suspended load on photosynthesis was submerged in the high background level of chlorophyll a. There were indications that chlorophyll a concentrations were slightly higher in the immediate vicinity of the barge.

The apparent decrease of mercury concentrations in the vicinity of the barge was perhaps associated with the adsorption of the metal on the suspended sediment which was quickly settled out of the water column, although experimental evidence is still lacking. Similar reduction of mercury values during dredging has been documented by Jeane and Pine (1975).

E. Sonic Tracking of Lobsters at the Dump Site (by Dr. W.A. Lund, Jr.)

The sonic tagging phase of this project is meant to determine the effect of dumping dredge materials on lobsters. A prerequisite is that lobsters must have established residence in the area. Transplanting lobsters to the area is not possible because previous studies have shown that displaced lobsters will continue to move until adequate shelter is found.

Lobsters have recently established themselves on the dump site so an attempt was made to determine their reactions to the dumping. On April 30 a diver tried to locate lobsters in the area of the dump site where the barge had been unloading. However, this area had a featureless, hard bottom devoid of most animals. The diver then went into that part of the dump site where earlier dumping had been done, but he was only able to locate one lobster. A sonic tag was attached to the lobster and it was returned to its burrow. The barge coming from New London arrived and dumped its load, and we were at the exact site of dumping. The load was very cohesive, and no visible siltation could be seen outside the exact area of dump; and within minutes no siltation could be seen in the water. The area of the dump site where the tagged lobster was located had no visible changes in turbidity. The next day the site was revisited and another dumping was observed. The material was still very cohesive and practically no siltation resulted.

Sonic tagging has been postponed until either resident lobsters are available in the direct area of the dump or the composition of the materials is such that other areas with lobsters are directly affected. If this does not occur, the sonic tagging phase should be eliminated.

F. SCUBA Survey of the Dump Site (by Dr. L.L. Stewart)

Dive survey and 16 mm photography of disposal site conditions were conducted on May 28. A 200 meter SE transect (south of the NL buoy) was covered. All film is processed and available for review. On the same date, a one hour general surveillance dive was made at North Hill, Fishers Island, one mile east of the disposal site. Visual comparison revealed no excess sedimentation and "normal" composition and density of hard surface fouling organisms.

Numerous observations during the last two quarters have been recurrent, thus, observation and filming efforts have been reduced until the post dredging period. At this time, more static conditions will be condusive to recolonization and more meaningful results can be recorded by our survey techniques.

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APPENDIX C

QUARTERLY REPORT

Physical Oceanography of the New
London Dump Site Area
April through June, 1975

Submitted to

Sandy Hook Laboratory, Middle Atlantic Coastal
Fisheries Center, National Marine Fisheries Service
NOAA/U.S. Dept. Commerce
under Contract No. 03-5-043-305

by

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TABLE OF CONTENTS

A. Definitions:

u: east/west velocity component in cm/sec

v: north/south velocity component in cm/sec

R: speed of the current in cm/sec,

$$R = [u^2 + v^2]^{1/2}$$

θ: direction of the current relative to geographic north,

$$\theta = \arctan v/u.$$

D(R): virtual distance in kilometers of a half-tidal cycle,

$$D(R) = \int_{1/2 \text{ tidal cycle}} R(t)\, dt$$

t: duration of half-tidal cycle in hours

Beam Attenuation coefficient (β): sum of the absorption coefficient and total scattering coefficient and calculated from

$$\beta = (^{-1}/L) \ln (T/100)$$

where T is the beam transmittance in percent and L is the path length in centimeters.

"Extinction" coefficient (k): is defined by the equation:

$$I(z) = I(z=0) \exp -kz$$

where I(z=0) is the total visible light energy (irradiance) incident to the air-sea interface, I(z), is the remaining light energy at the depth z (meters), and -k is the mean total "extinction" coefficient (m^{-1}) for the entire water column.

"Transmission": the degree of daylight penetration in the water (transmission of downwelling irradiance over the visible spectrum) and calculated from:

$$\% \text{ Transmission} = [I(z)/I(z=0)] \times 100\%$$

B. Instrumentation

Current meters used to obtain these data were film recording General Oceanics Model 2010. Temperatures were measured by bathythermograph and surface bucket thermometers (mercurial). Beam transmittance measurements were obtained with a Hydro-Products Transmissometer.

C. Cruise Descriptions

1. 20 May 1975

Fog kept visibility generally below 100 yards until approximately 1100 hours. When the fog lifted, a 3 current sub-surface array was installed next to the Center Station, C (Figure 1). Transmissometer measurements were then started from a position approximately 100 m downstream of barge release point. Sampling frequency was 1 minute from the time of the dump at 1128 EDST until 1239 EDST. The current meter array was left in until the end of the cruise on 21 May.

2. 21 May 1975

Fog was again a problem with visibility generally below 200 yards for most of the day. An additional bottom current meter was installed as close as practical to the barge release point. Ten stations were systematically sampled using 4 boats, so that 4 stations were synoptically sampled at a time; one vessel was anchored at the Center Station and was sampled almost hourly. After the barge release, at 1204, 3 downstream stations, E1, E2, and S1, as well as the Center Station, were sampled every 15 minutes. Transmissivity readings were taken from the anchored vessel at the Center Station, closest to the release point. Increased fog caused the experiment to be terminated at 1530 EDST. The current meters were up at approximately 1600 hours.

D. Discussion and Comments

The temperatures and salinities encountered on 21 May are, in general, normal for that time of year. The average surface and near-bottom values for all stations are tabulated in Table 1. The exception to the general temperature and salinity regime can be seen at Stations N3, at the entrance to the Thames River to the north, and at N1, one mile north of Center Buoy. These temperatures are almost 5°C above those of the surrounding stations and 9% less saline; these values were all double checked in the field and are reliable. The source of this unusually warm and fresher water is the Thames River since the flow was ebbing, and was not in the area to the west or south at the start of the sampling effort at 0900 (see Tables 2a through 2e). The tide was already on the flood by 1400 hours which would explain the presence of some of this water at station W1 at 1500. A lens of warm and fresh water such as this leads to a very strongly stratified fluid as can be seen in the accompanying σ_t distributions.

The beam transmittance values as a function of time obtained from fixed locations both upstream and downstream of discharge positions are shown in Figures 2 and 3 and tabulated in Tables 4 and 5. For the downstream case on the 20th of May, it took 48 minutes for the cloud of suspended material to pass a point approximately 100 m away from the discharge point in the downstream direction. On the following day, the recording position was approximately 50 m away from the discharge point in the upstream direction. In this case, the cloud lasted for 28 minutes. These data are still being analyzed.

Maximum current speeds encountered over 15 minute averaging during the sampling interval are listed in Table 7. The mid-depth current meter malfunctioned so that no mid-depth values can be reported. The moon was in perigee and about mid-way between quadrature and full. Resultant current velocities, tidal excursions, and durations are tabulated in Tables 6a through c.

Continuous vectors for the surface and bottom are shown in Figure 7. The net-drift is very apparent. The corresponding u and v components are shown in Figure 8. An interesting reversal (nearly 180°) is observed in the v-component during the ebb cycle.

Analysis of the data are progressing as planned.

Table 1: Average temperature, salinity, and σ_t for stations in the New London Dump Site, 21 May 1975

Station	N*	Depth (meters)	T(°C)	S°/oo	σ_t (gm/cm^3)
N3	1	0	15.1	20.04	14.51
		10	11.8	29.75	22.58
N2	1	0	9.8	29.55	22.76
		10	9.3	29.78	23.02
N1	3	0	12.9	26.36	19.77
		15	10.8	29.84	22.82
C	8	0	10.0	29.58	22.75
		15	9.2	29.90	23.13
S1	6	0	10.2	29.41	22.59
		20	9.6	29.88	23.05
E1	7	0	10.4	29.45	22.59
		15	9.3	29.82	23.05
E2	3	0	10.0	29.47	22.67
		10	9.5	29.81	23.01
E3	1	0	9.9	29.56	22.75
		15	9.8	29.71	22.89
W1	3	0	11.0	29.09	22.21
		20	10.0	29.97	23.06
W2	1	0	10.0	29.72	22.86
		30	10.0	30.32	23.33
W3	1	0	10.0	29.54	22.72
		20	9.6	29.70	22.91

*Number of observations

Table 2a: Observed values of temperature, salinity, and resultant σ_t obtained during synoptic sampling routine performed on 21 May 1975

Station	Time	Depth(meters)	T(°C)	S°/oo	σ_t(gm/cm^3)
N1-1	0900	0	9.8	29.48	22.71
		5	9.7	29.58	22.80
		10	9.6	29.68	22.89
		15	9.5	29.79	23.00
C-1	0845	0	9.4	29.78	23.00
		5	9.3	29.80	23.03
		10	9.3	29.82	23.05
		15	9.2	29.95	23.16
W1-1	0847	0	9.6	29.79	22.98
		5	9.6	29.82	23.00
		10	9.5	29.91	23.09
		15	9.5	30.27	23.37
		20	9.1	30.55	23.65
E1-1	0845	0	9.7	29.40	22.66
		5	10.0	29.52	22.71
		10	10.0	29.64	22.80
		15	9.8	29.66	22.85
		20	*9.7	29.68	22.88

*Extrapolated

Table 2b: Observed values of temperature, salinity, and resultant σ_t obtained during synoptic sampling routine performed on 21 May 1975

Station	Time	Depth (meters)	T(°C)	S°/°°	σ_t (gm/cm^3)
N2-1	0955	0	9.8	29.55	22.76
		5	9.5	29.72	22.94
		10	9.3	29.78	23.02
C-2	0954	0	9.4	29.83	23.04
		5	9.2	29.94	23.16
		10	9.1	30.05	23.26
		15	8.9	30.26	23.45
W2-1	0958	0	10.0	29.72	22.86
		5	10.0	29.81	22.93
		10	10.0	29.89	22.99
		15	10.0	30.00	23.08
		20	10.0	30.10	23.16
		25	10.0	30.21	23.24
		30	10.0	30.32	23.33
E2-1	0947	0	10.0	29.41	22.62
		5	10.0	29.55	22.73
		10	10.2	29.68	22.80
		15	10.1	29.70	22.83

Table 2c: Observed values of temperature, salinity, and resultant σ_t obtained during synoptic sampling routine performed on 21 May 1975

Station	Time	Depth (meters)	T(°C)	S°/∘∘	σ_t(gm/cm^3)
N3-1	1055	0	15.1	20.04	14.51
		5	12.2	29.70	22.47
		10	11.8	29.75	22.58
C-3	1100	0	9.7	29.64	22.85
		5	9.5	29.66	22.89
		10	9.3	29.67	22.93
		15	9.2	29.85	23.09
W3-1	1058	0	10.0	29.54	22.72
		5	9.9	29.54	22.74
		10	9.8	29.53	22.75
		15	9.7	29.60	22.82
		20	9.6	29.70	22.91
E3-1	1058	0	9.9	29.56	22.75
		5	9.9	29.60	22.78
		10	9.8	29.66	22.85
		15	9.8	29.71	22.89

Table 2d: Observed values of temperature, salinity, and resultant σ_t obtained during synoptic sampling routine performed on 21 May 1975

Station	Time	Depth(meters)	T(°C)	S°/oo	σ_t(gm/cm^3)
N1-2	1357	0	14.2	24.65	18.21
		5	13.3	27.56	20.62
		10	12.6	29.65	22.36
		15	12.1	29.85	22.60
C-7	1400	0	10.8	29.36	22.45
		5	9.9	29.42	22.64
		10	9.5	29.49	22.76
		15	9.3	29.70	22.96
W1-2	1358	0	11.0	29.34	22.40
		5	10.5	29.37	22.51
		10	10.2	29.42	22.60
		15	10.0	29.60	22.77
		20	9.8	*29.77	22.93
E1-6	1400	0	11.0	29.37	22.43
		5	10.0	29.63	22.79
		10	9.5	29.84	23.03
		15	9.4	29.90	23.10
		20	9.4	-	-

*Extrapolated

Table 2e: Observed values of temperature, salinity, and resultant σ_t obtained during synoptic sampling routine performed on 21 May 1975

Station	Time	Depth (meters)	T(°C)	S°/₀₀	σ_t (gm/cm^3)
N1-3	1455	0	14.6	24.95	18.36
		5	12.4	27.88	21.03
		10	11.5	29.71	22.60
		15	10.8	29.88	22.86
C-8	1500	0	11.2	29.36	22.38
		5	10.1	29.56	22.72
		10	9.4	29.75	22.98
		15	9.3	29.84	23.06
W1-3	1500	0	12.3	28.15	21.26
		5	11.4	28.84	21.95
		10	11.0	29.53	22.55
		15	11.0	29.56	22.57
		20	11.0	29.60	22.60
E1-7	1500	0	11.2	29.36	22.38
		5	9.4	29.63	22.89
		10	9.0	29.87	23.13
		15	9.0	29.90	23.16
		20	8.9	-	-

Numbers of species also showed a general decline between predisposal and April collections, although the changes were generally smaller than for numbers of individuals. Figure 4 and Table 1 give the predisposal data; the range was from 23 species/0.1 m^2 at A1 to 65 at F9, with the majority of stations containing means of 30 to 45 species. Changes from these values between June-July and April are shown in Table 2 and Figure 5. Although reductions are seen at all stations, the largest decreases are clearly in the vicinity of disposal operations. Stations C5, C6 and C7 had losses of 77, 99 and 94% respectively. The next largest decrease was 52% at E1, which also showed the greatest decrease in faunal density of any station outside the immediate spoiling area. This station may be anomalous due to its shallowness ($<$ 4m) and proximity to land; winter wave action, temperature stresses, etc., may be greater here than at the other stations under study.

On the whole, it is believed that changes in numbers of species will be of more value in determining effects of spoil disposal than will changes in faunal density. The former should be more conservative than the latter; our data to date do indicate that fluctuations in individuals are greater than in species. Buchanan, Kingston and Sheader (1974), in a 4 year study of the benthic macrofauna of the Northumberland coast, have found that number of species remained relatively constant over the study period, while faunal densities showed large natural fluctuations, as was also true for species diversity.

Table 4 . Beam transmittance (T) and attenuation coefficient (β) as a function of time, 1 meter off the bottom, approximately 100 m downstream from the barge release point. The barge dump took place at 1128 EDST, 20 May 1975.

Time	T(%)	β(m^{-1})	Time	T(%)	β(m^{-1})	Time	T(%)	β(m^{-1})
1128	91	0.94	1152	22	15.14	1216	83	1.86
1129	91	0.94	1153	16	18.32	1217	82	1.98
1130	91	0.94	1154	18	17.15	1218	81	2.11
1131	91	0.94	1155	30	12.04	1219	82	1.98
1132	91	0.94	1156	40	9.16	1220	85	1.63
1133	91	0.94	1157	40	9.16	1221	86	1.51
1134	91	0.94	1158	48	7.34	1222	85	1.63
1135	91	0.94	1159	51	6.73	1223	85	1.63
1136	91	0.94	1200	52	6.54	1224	87	1.39
1137	91	0.94	1201	57	5.62	1225	88	1.28
1138	91	0.94	1202	60	5.11	1226	89	1.17
1139	90	1.05	1203	68	3.86	1227	89	1.17
1140	0	∞	1204	63	4.62	1228	90	1.05
1141	01	46.05	1205	74	3.01	1229	90	1.05
1142	0	∞	1206	-	-	1230	90	1.05
1143	07	26.59	1207	74	3.01	1231	-	-
1144	17	17.72	1208	80	2.23	1232	-	-
1145	27	13.09	1209	80	2.23	1233	90	1.05
1146	24	14.27	1210	82	1.98	1234	-	-
1147	50	6.93	1211	80	2.23	1235	90	1.05
1148	50	6.93	1212	83	1.86	1236	90	1.05
1149	27	13.09	1213	83	1.86	1237	-	-
1150	19	16.61	1214	82	1.98	1238	-	-
1151	14	19.66	1215	84	1.74	1239	90	1.05

Table 5. Beam transmittance (T) and attenuation coefficient (β) as a function of time at the Center Station, at an average height of 2.2 m from the bottom. The barge release took place approximately 50 m downstream of Center Station at 1204 EDST, 21 May 1975.

Time	T(%)	$\beta(m^{-1})$	Time	T(%)	$\beta(m^{-1})$
0938	90.5	1.00	1215	2	39.12
1000	90.5	1.00	1219	42	8.68
1043	91	0.94	1219:30	2	39.12
1110	90.5	1.00	1220	1	46.05
1145	90	1.05	1221	1	46.05
1207	90	1.05	1222	2	39.12
1209	90	1.05	1231	1	46.05
1210	89	1.16	1235	1	46.05
1210:45	3	35.06	1236	66	4.16
1211:00	50	6.93	1238	86	1.51
1211:15	10	23.02	1239	89	1.16
1211:30	1	46.05	1300	88	1.28
1211:45	10	23.02	1457	88	1.28
1212	2	39.12			

Table 6a. Average velocities for flood & ebb tidal cycles calculated from the half tidal cycle data.

Depth	Flood		Ebb	
	R (cm/sec)	θ (°T)	R (cm/sec)	θ (°T)
Surface	27.6	304	38.9	119
Bottom	23.7	288	25.6	104

Table 6b. Average effective distances and duration calculated from the half tidal cycle data.

Depth	Flood		Ebb	
	$\overline{D}$ (Km)	$\overline{t}$ (Hrs)	$\overline{D}$ (Km)	$\overline{t}$ (Hrs)
Surface	5.1	4.1	13.9	8.5
Bottom	3.3	3.8	8.5	8.6

Table 6c. The net average tidal cycle flow for each depth from the average velocities.

Depth	R(cm/sec)	θ(°T)
Surface	11.7	106
Bottom	2.7	61

Table 7. The maximum observed speeds over 15 minute averages.

Date	Depth	Flood		Ebb	
		R(cm/sec)	θ(°T)	R(cm/sec)	θ(°T)
20/V/75	Surface	49.1	312	92.0	105
	Bottom	41.8	285	50.3	107
21/V/75	Surface	56.4	292	-	-
	Bottom	40.5	281	56.6	102

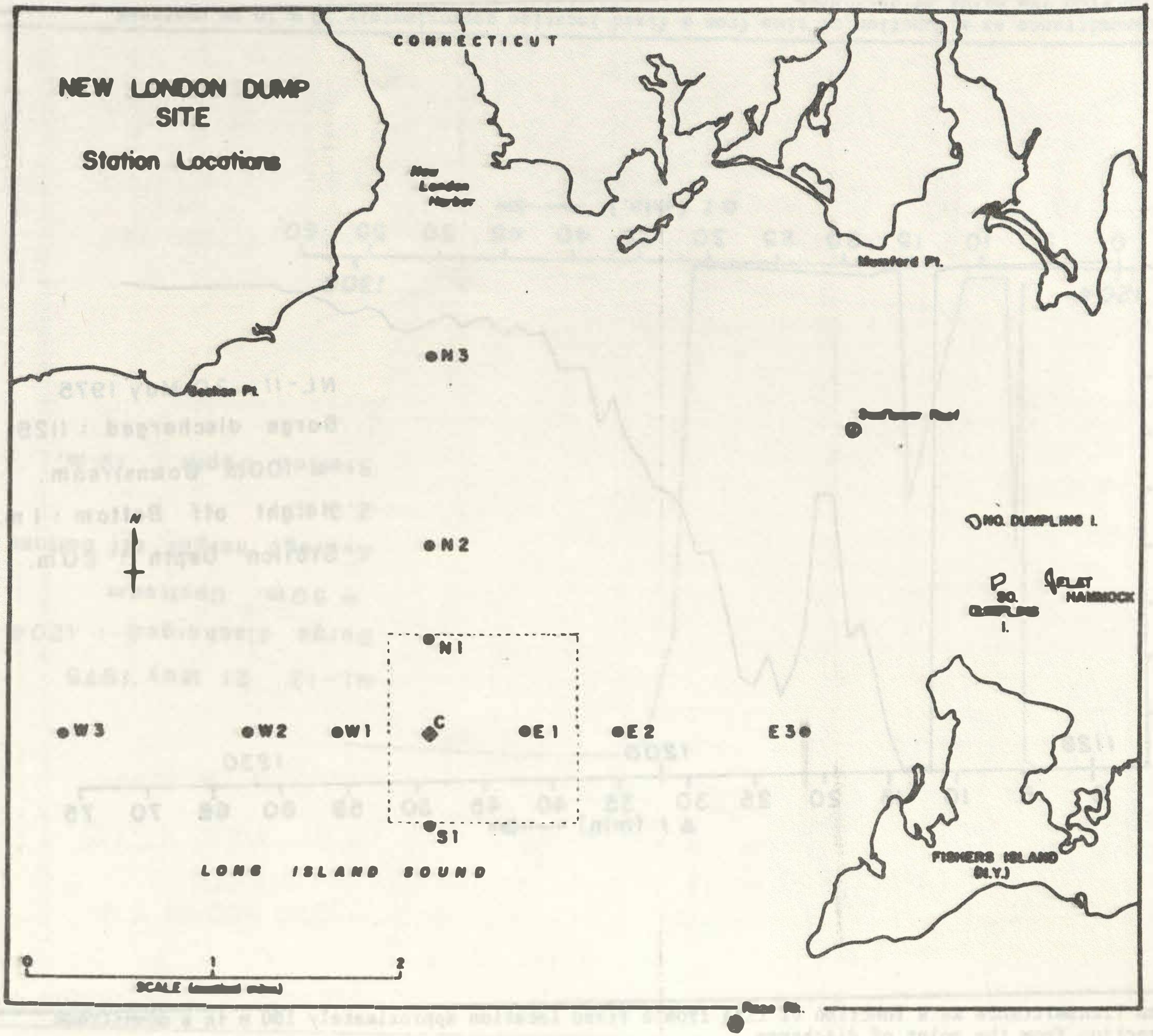

Figure 1. Map of Dump Site (dotted square) and Station Locations

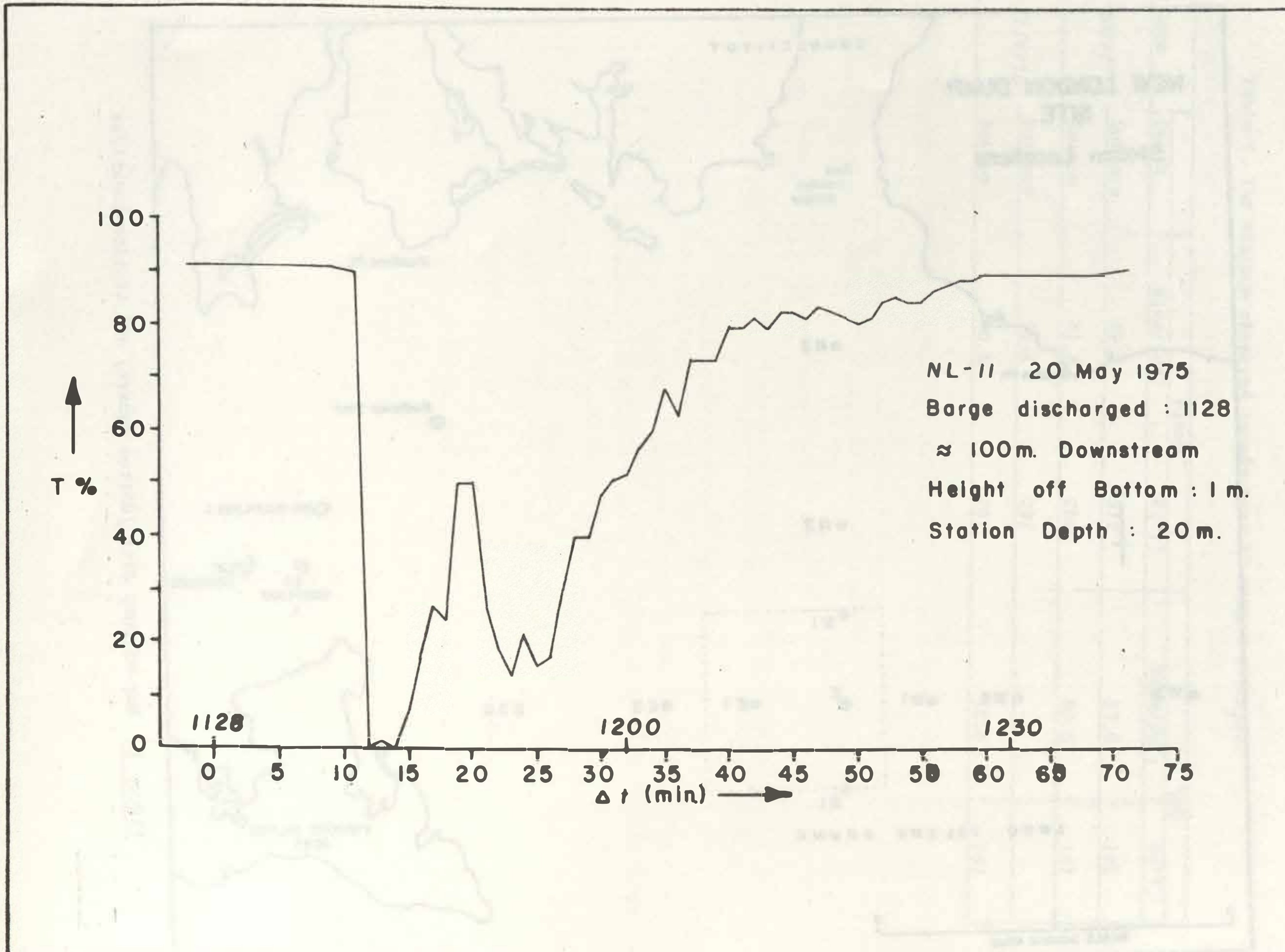

Figure 2. Beam Transmittance as a function of time from a fixed location approximately 100 m in a downstream direction from the point of discharge.

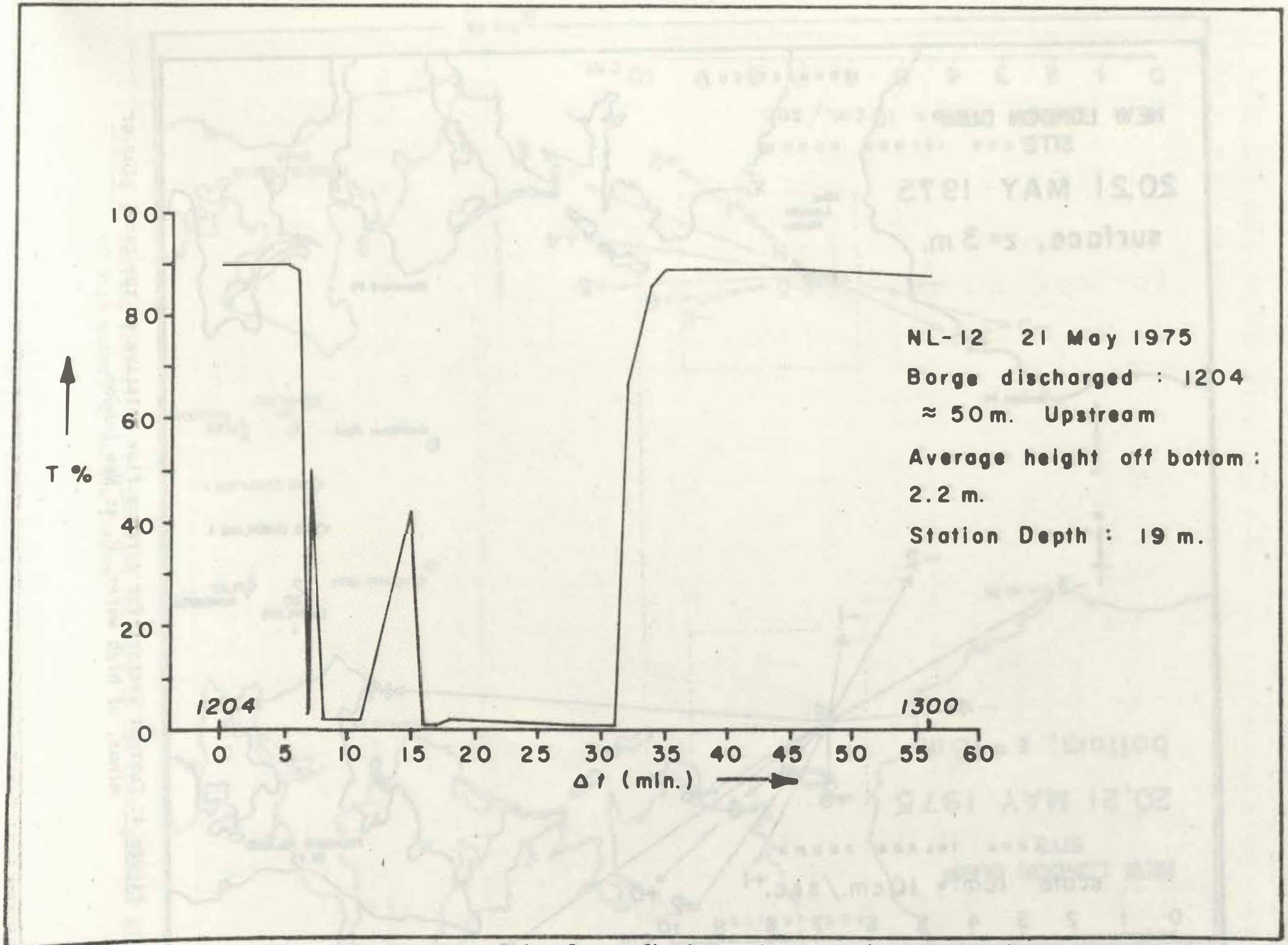

Figure 3. Beam Transmittance as a function of time from a fixed location approximately 50 m in an upstream direction from the point of discharge.

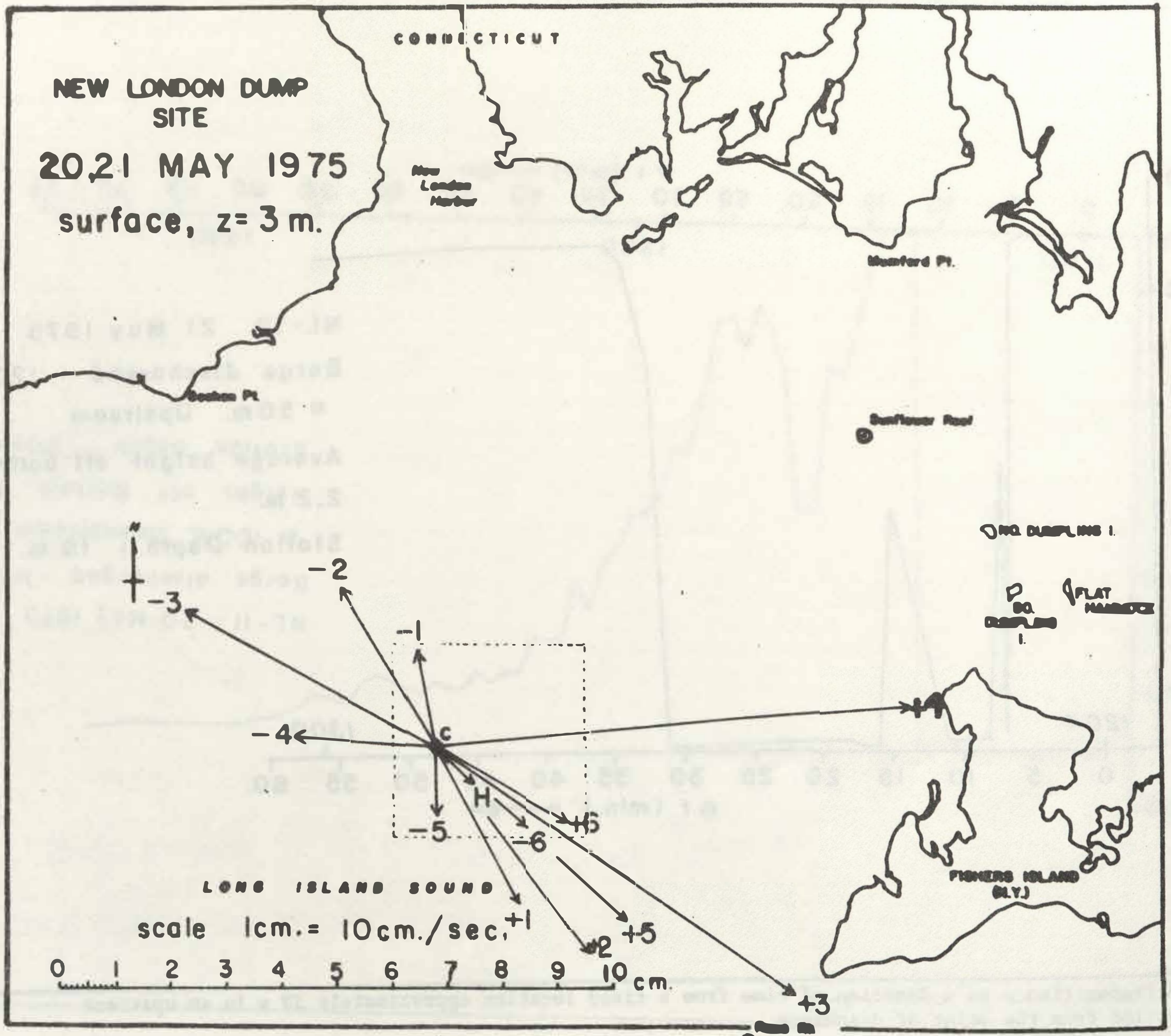

Figure 4. Current Vectors for surface flow relative to the time, plus or minus, of high water, H, at New London.

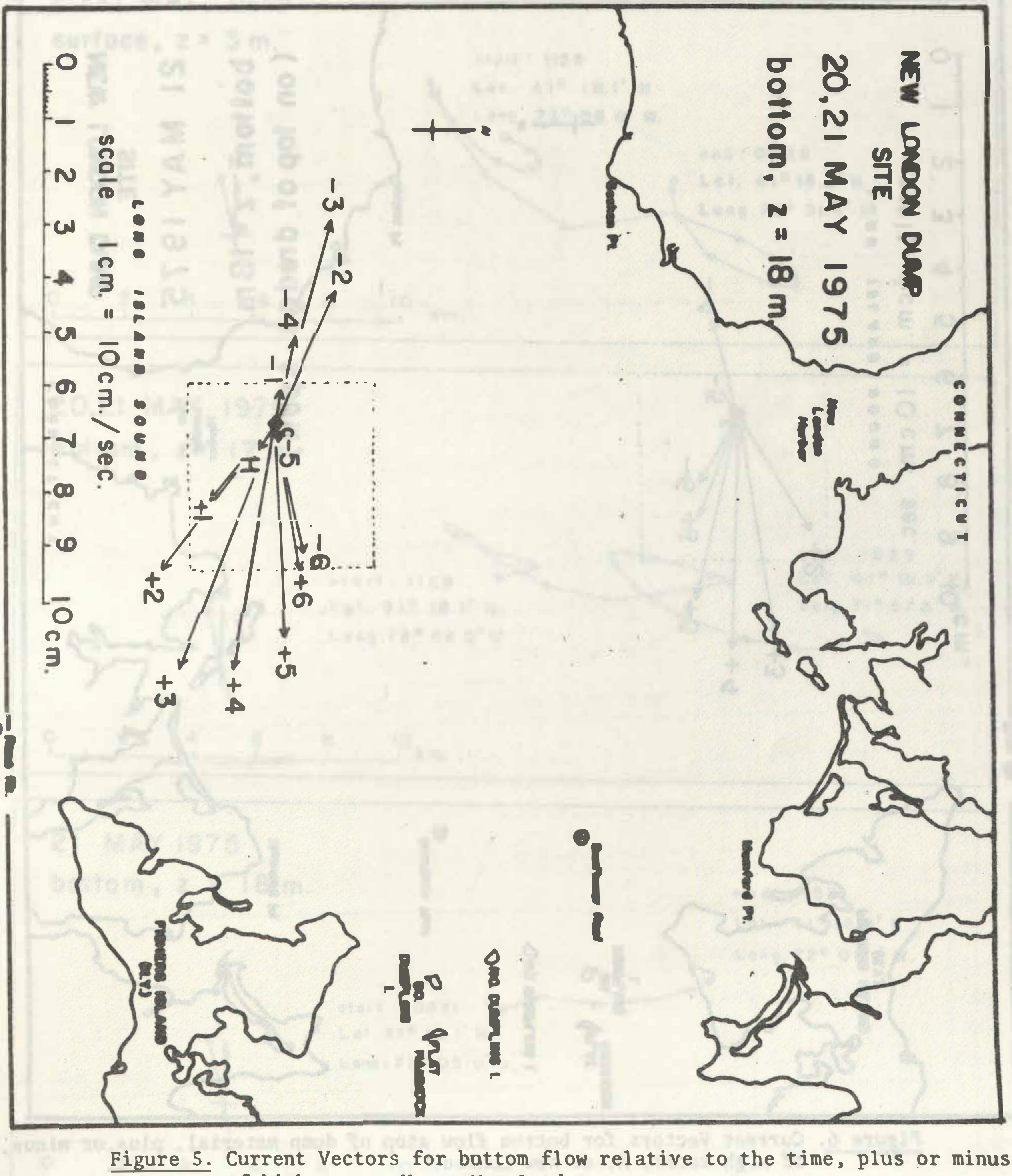

Figure 5. Current Vectors for bottom flow relative to the time, plus or minus, of high water, H, at New London.

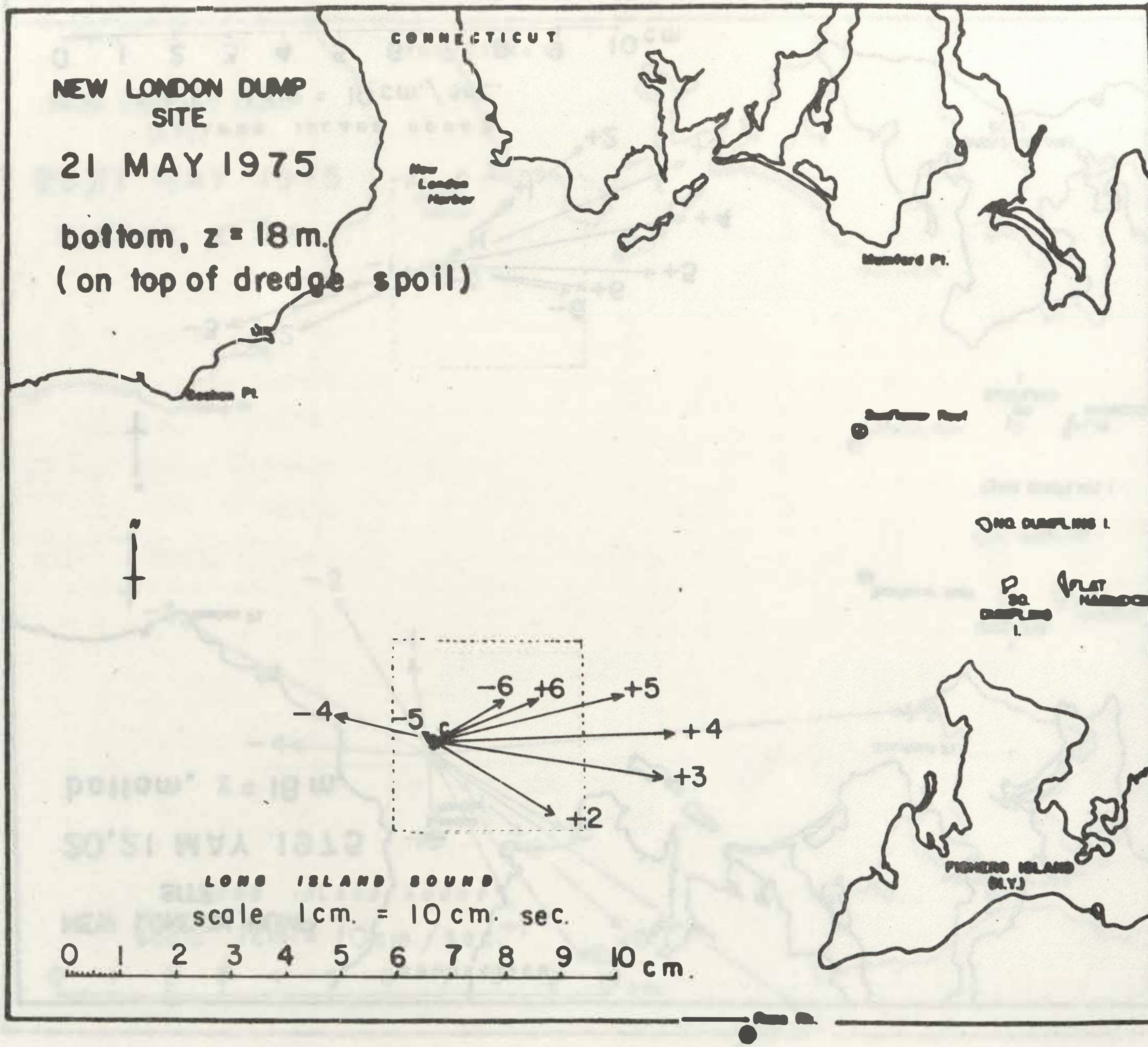

Figure 6. Current Vectors for bottom flow atop of dump material, plus or minus, of high water, H, at New London.

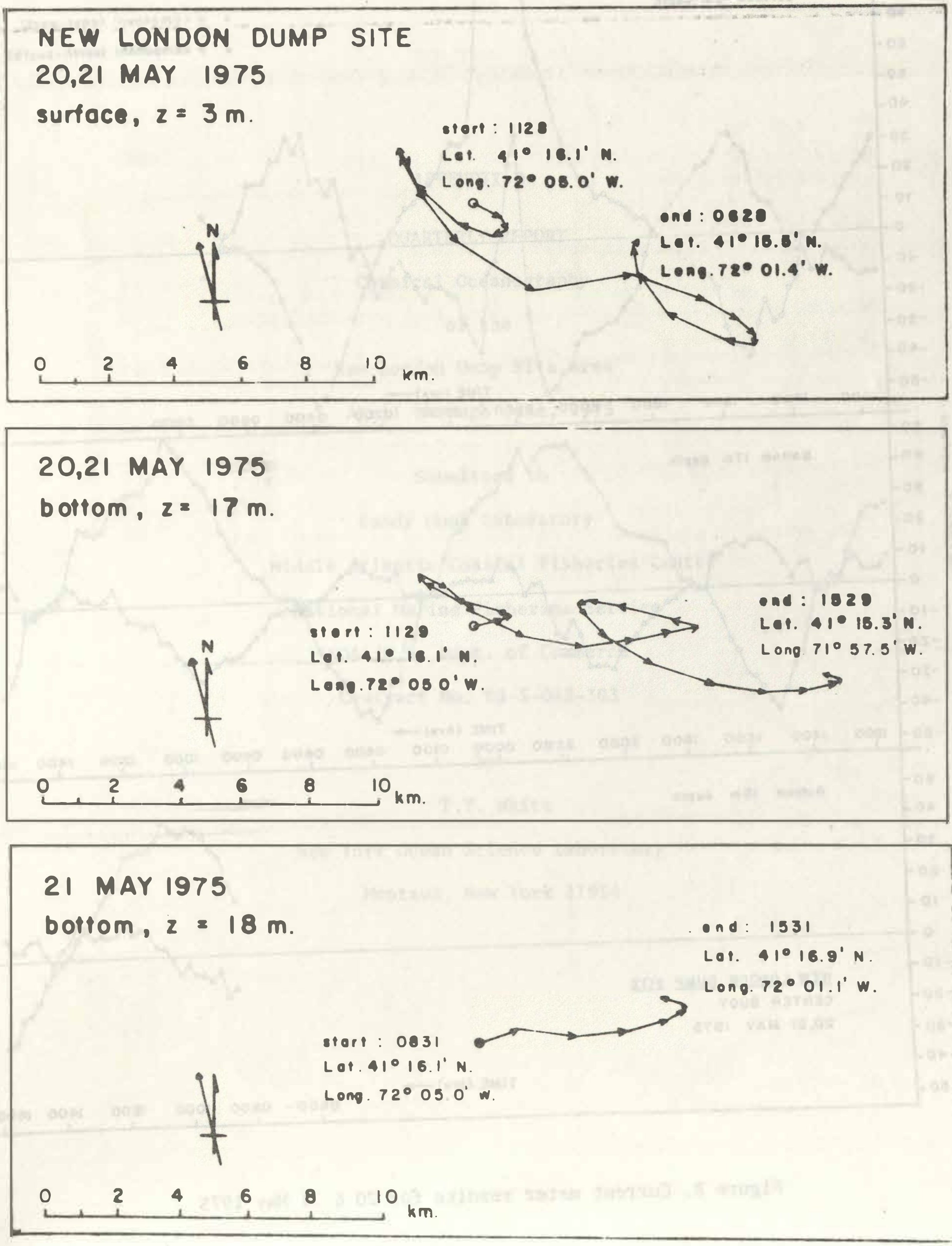

Figure 7. Progressive vector diagram for surface and bottom flows for 20 and 21 May, 1975.

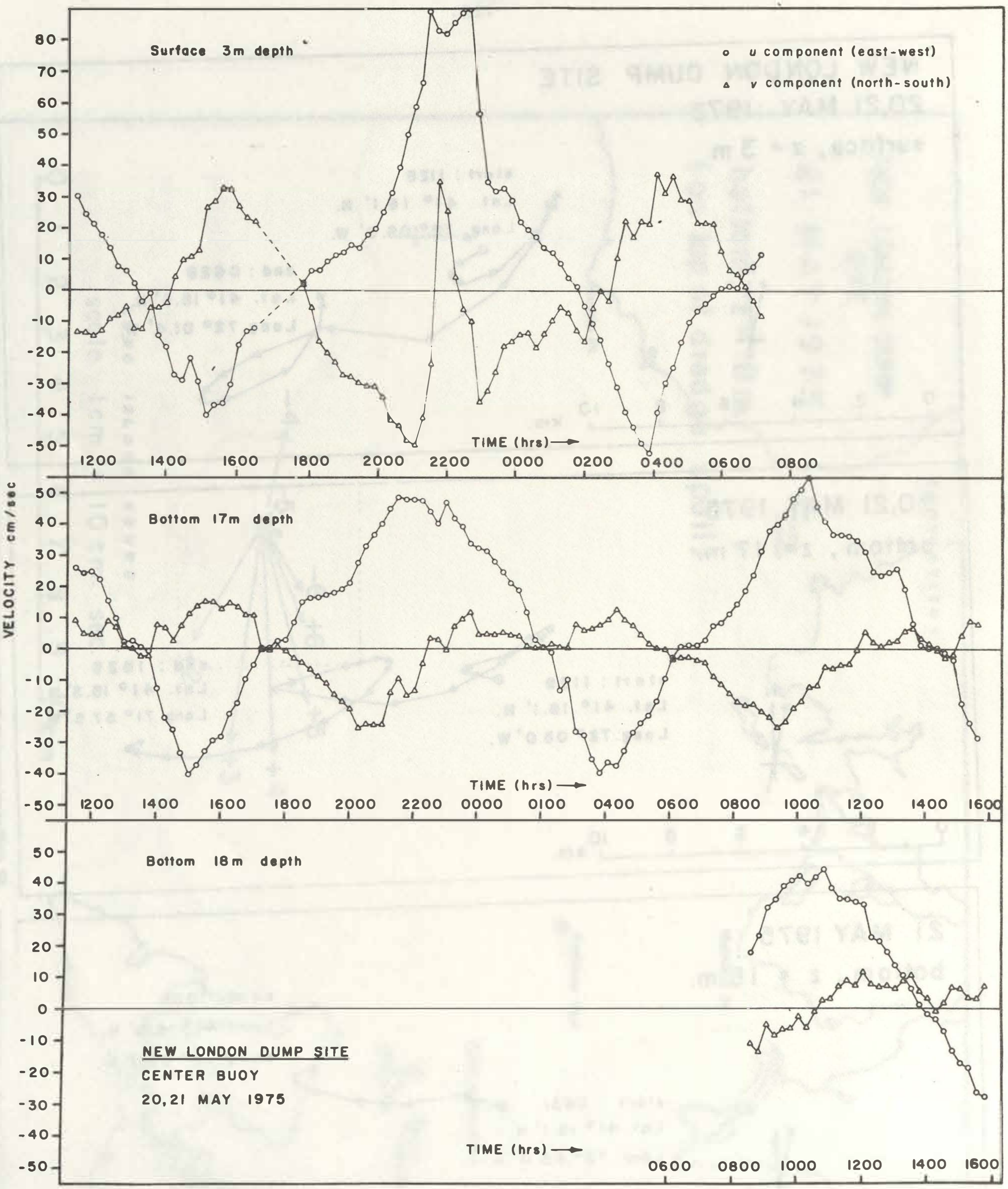

Figure 8. Current meter results for 20 & 21 May 1975

APPENDIX D

QUARTERLY REPORT

Chemical Oceanography

of the

New London Dump Site Area

April through June, 1975

Submitted to

Sandy Hook Laboratory

Middle Atlantic Coastal Fisheries Center

National Marine Fisheries Service

NOAA/U.S. Dept. of Commerce

Contract No. 03-5-043-303

by

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Introduction

The rationale behind these studies has been presented in previous reports. In this report we present the results of the quarterly areal survey and a study made to determine the time necessary for a perturbation resulting from a dump of dredged material to pass a given point downstream of the dump.

Additional results from our monitoring program for the heavy metals in both sediments and biota are also presented.

This report presents the results of work accomplished through June, 1975.

Methods

Detailed descriptions of field and laboratory procedures employed for the collection, on board processing and subsequent laboratory analysis are contained in our October through December, 1974 Quarterly Report.

All sampling efforts required for our water column and seston studies were completed in this quarter. Cruise reports are appended. The benthic sampling efforts were conducted in conjunction with the Sandy Hook Laboratory.

Station locations for the water column and seston work are shown in Figure 1, while Figure 2 shows the station locations for benthic samples.

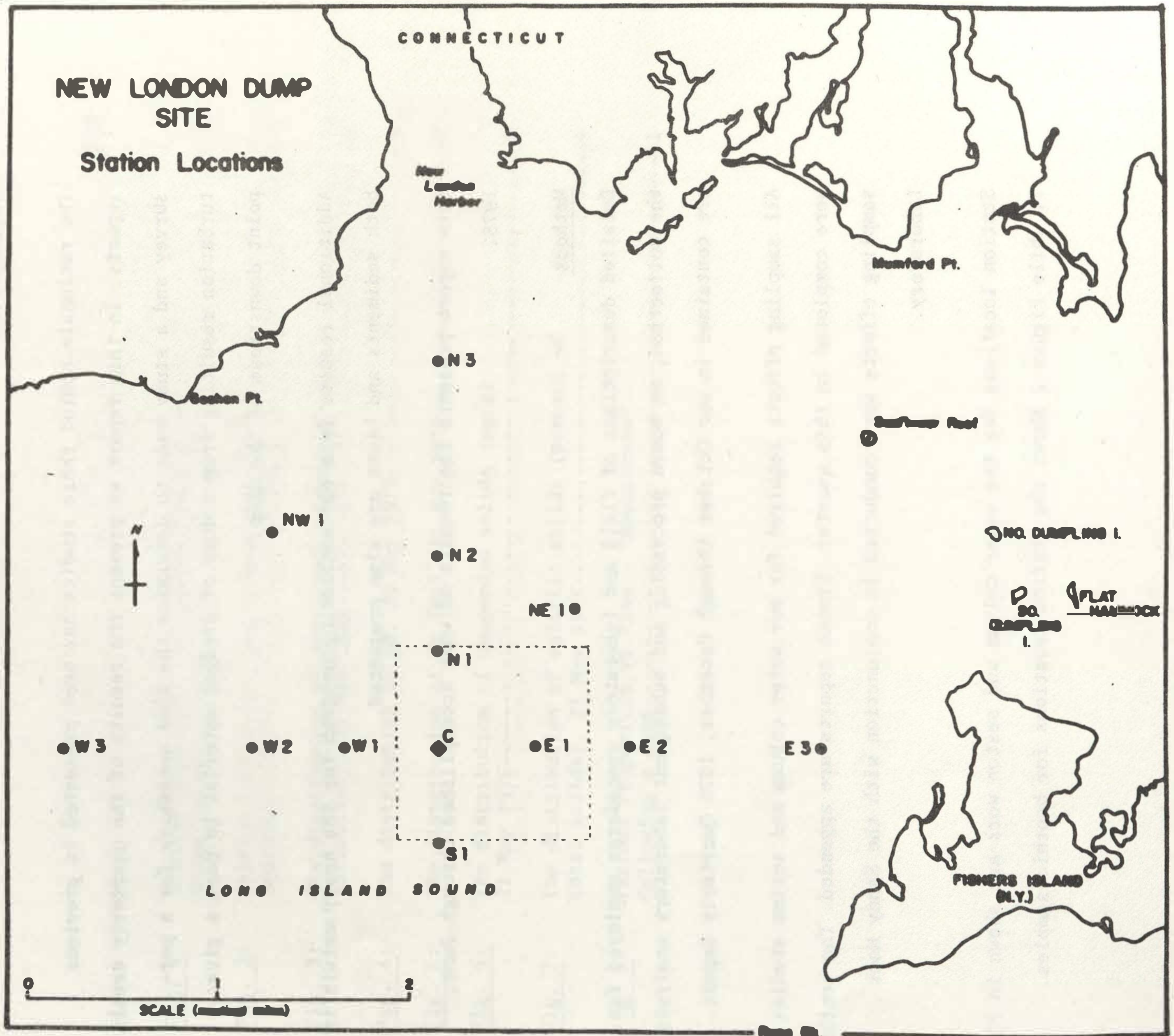

Fig. 1. Station Locations - New London Dump Site - Water Column

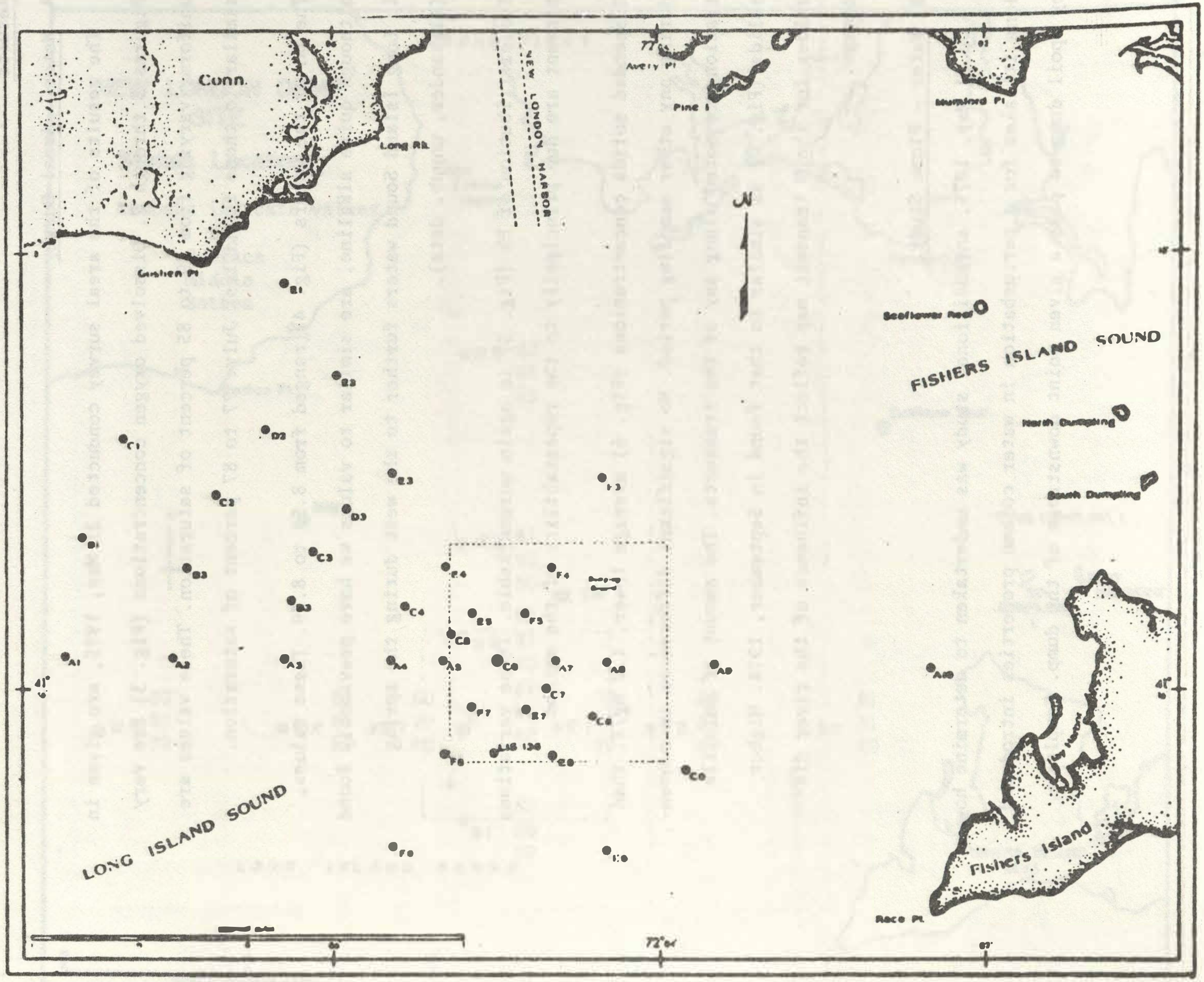

Fig. 2. Station Locations - New London Dump Site - Benthic

Results

A. Water - Areal Survey

The results of the areal survey conducted 21 May, 1975, are given in Figures 3 through 7. Dissolved oxygen concentrations (Fig. 3) are very uniform, varying from 79 to 85 percent of saturation. These values are similar to those found last July: 77 to 87 percent of saturation.

The pH of the waters (Fig. 4) ranged from 8.58 to 8.79. These values, although quite alkaline, are similar to values we have previously found in Long Island Sound waters further to the west during the spring (Alexander, unpub. data).

The distribution of Eh (Fig. 5) is again unremarkable. Those variations present are due principally to the repeatability of the method.

Suspended solids concentrations (Fig. 6) average lower, 1.2 mg/ℓ, than during any other sampling period. No significant differences in concentration are noted along any of the transects. The amount of volatile solids (Fig. 7) is similar to that found in September, 1974. Higher values for the N transect may reflect the influence of the river discharge.

B. Water - Plume Study

On 21 May, 1975, an additional study was undertaken to determine how long it takes for a perturbation in water column properties introduced by spoil dump to pass a given point downstream of the dump. Samples

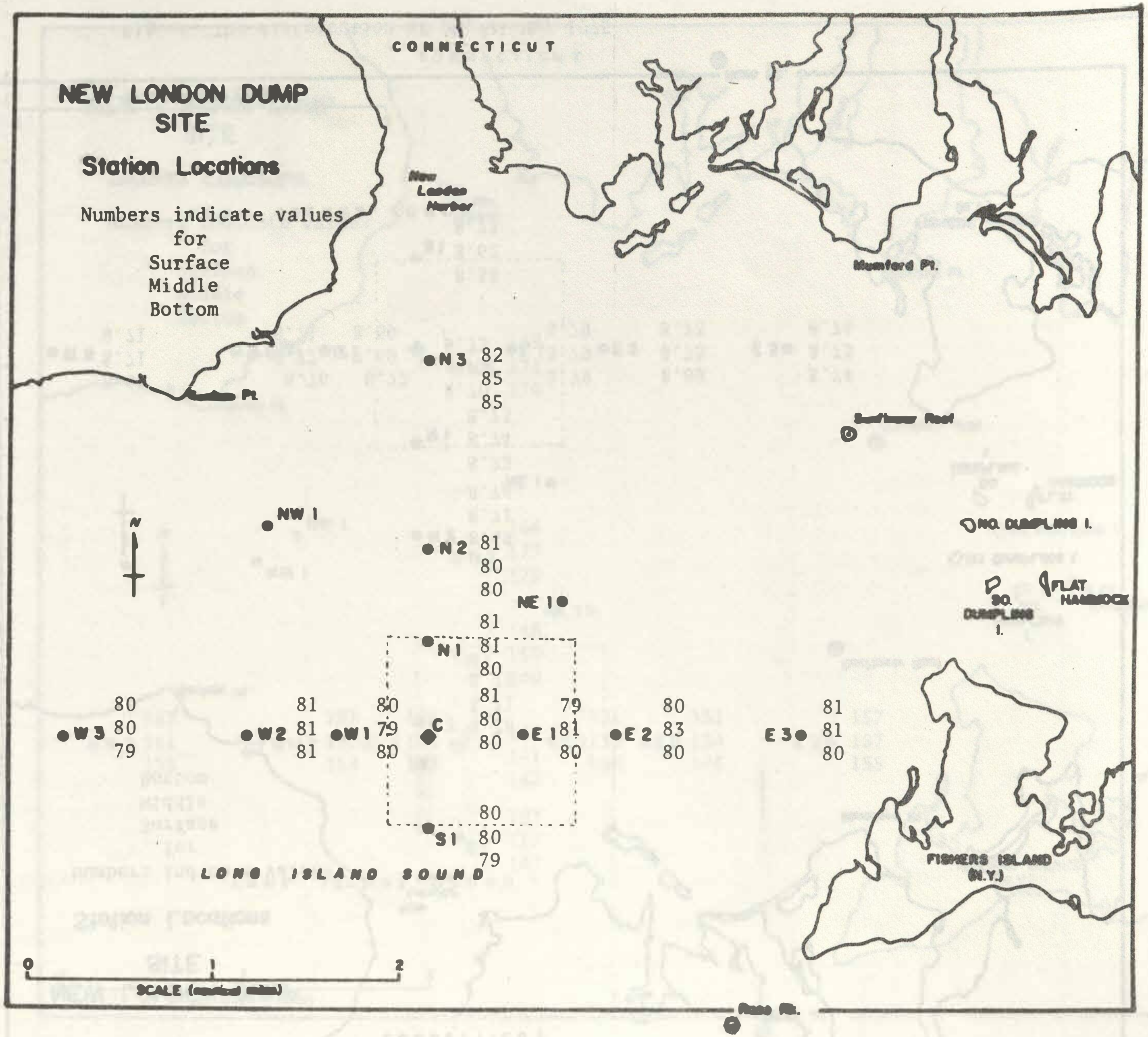

Fig. 3. The distribution of dissolved oxygen (percent saturation), 21 May 1975

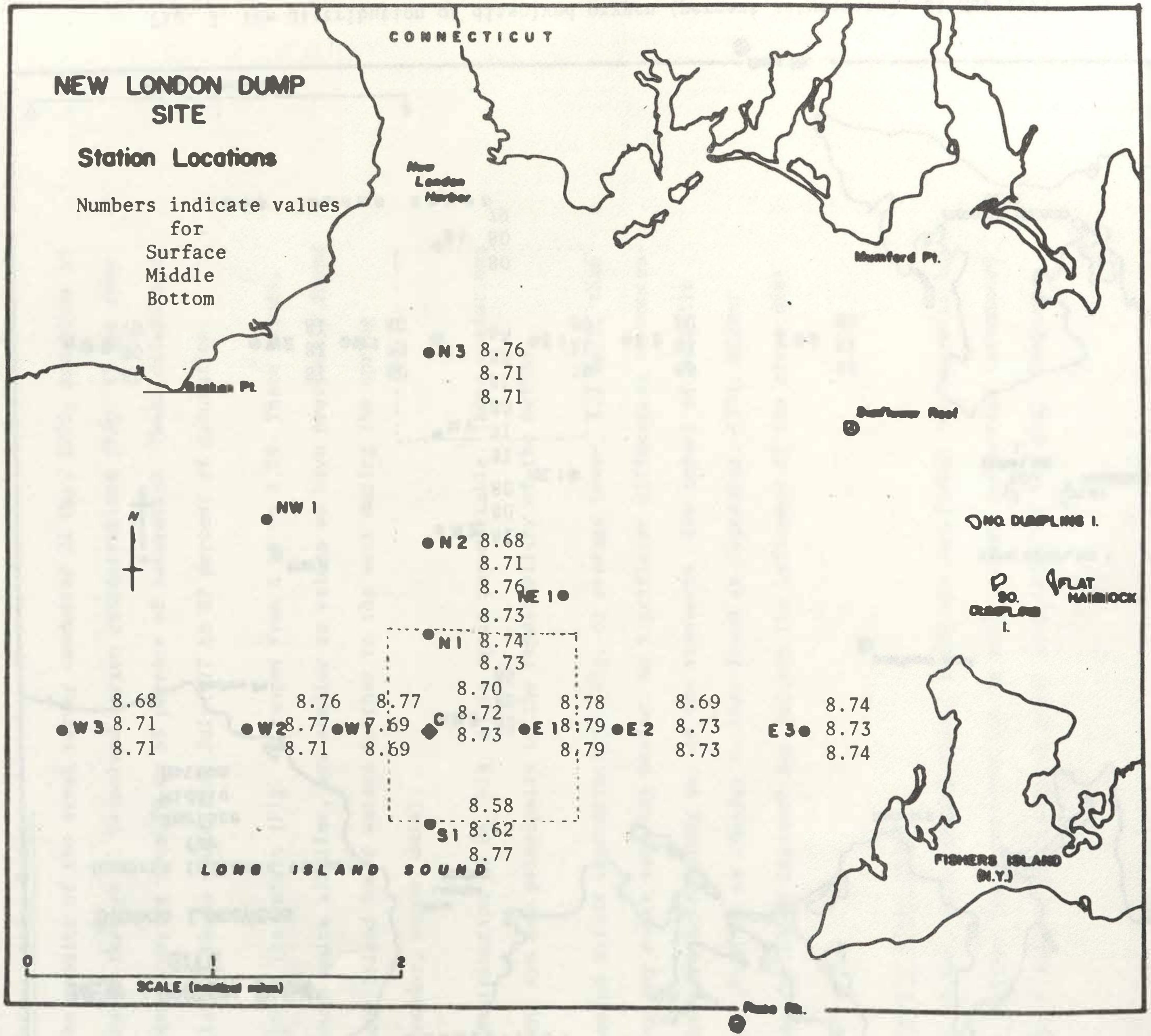

Fig. 4. The distribution of pH, 21 May 1975

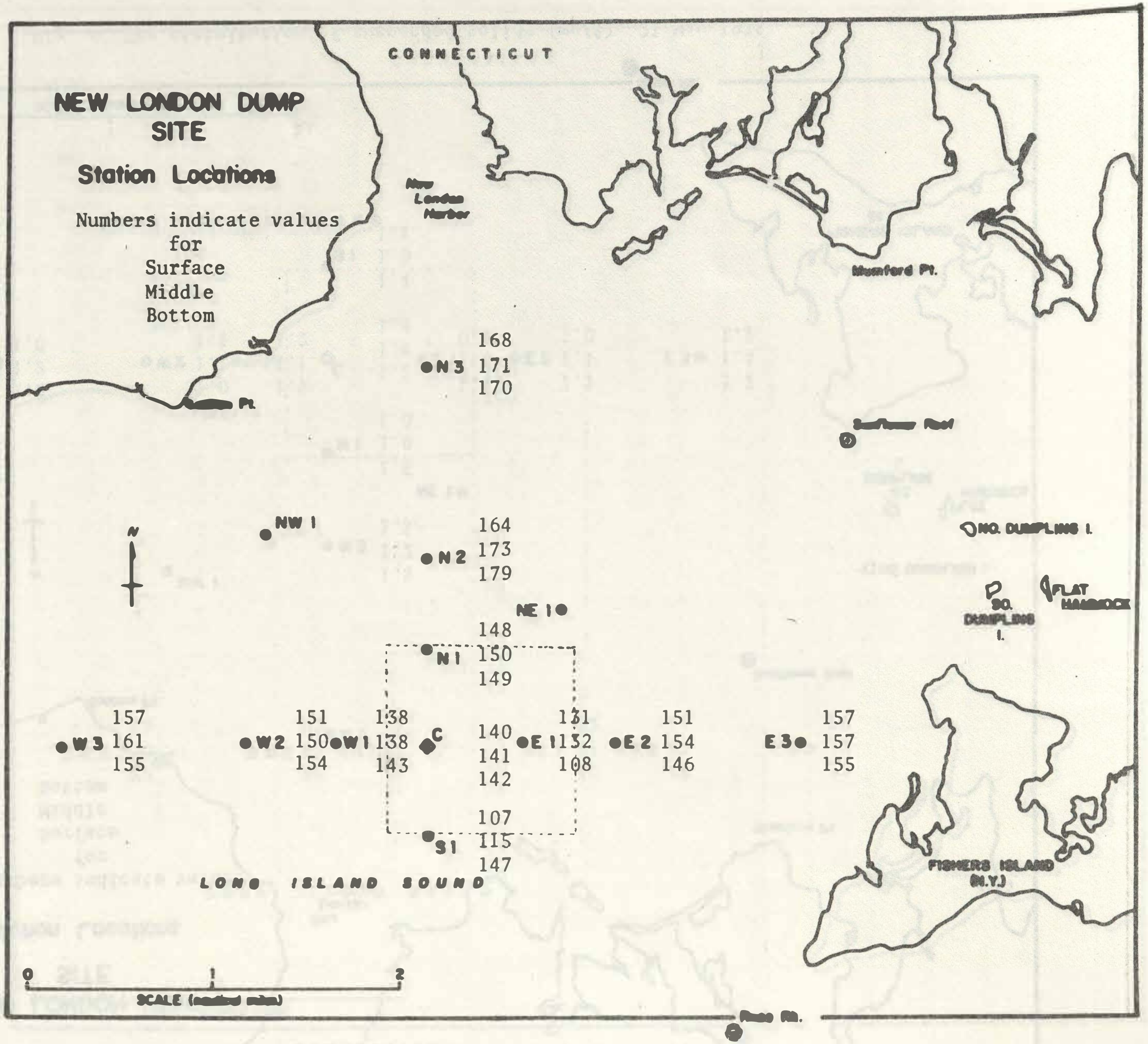

Fig. 5. The distribution of Eh (mv), 21 May, 1975

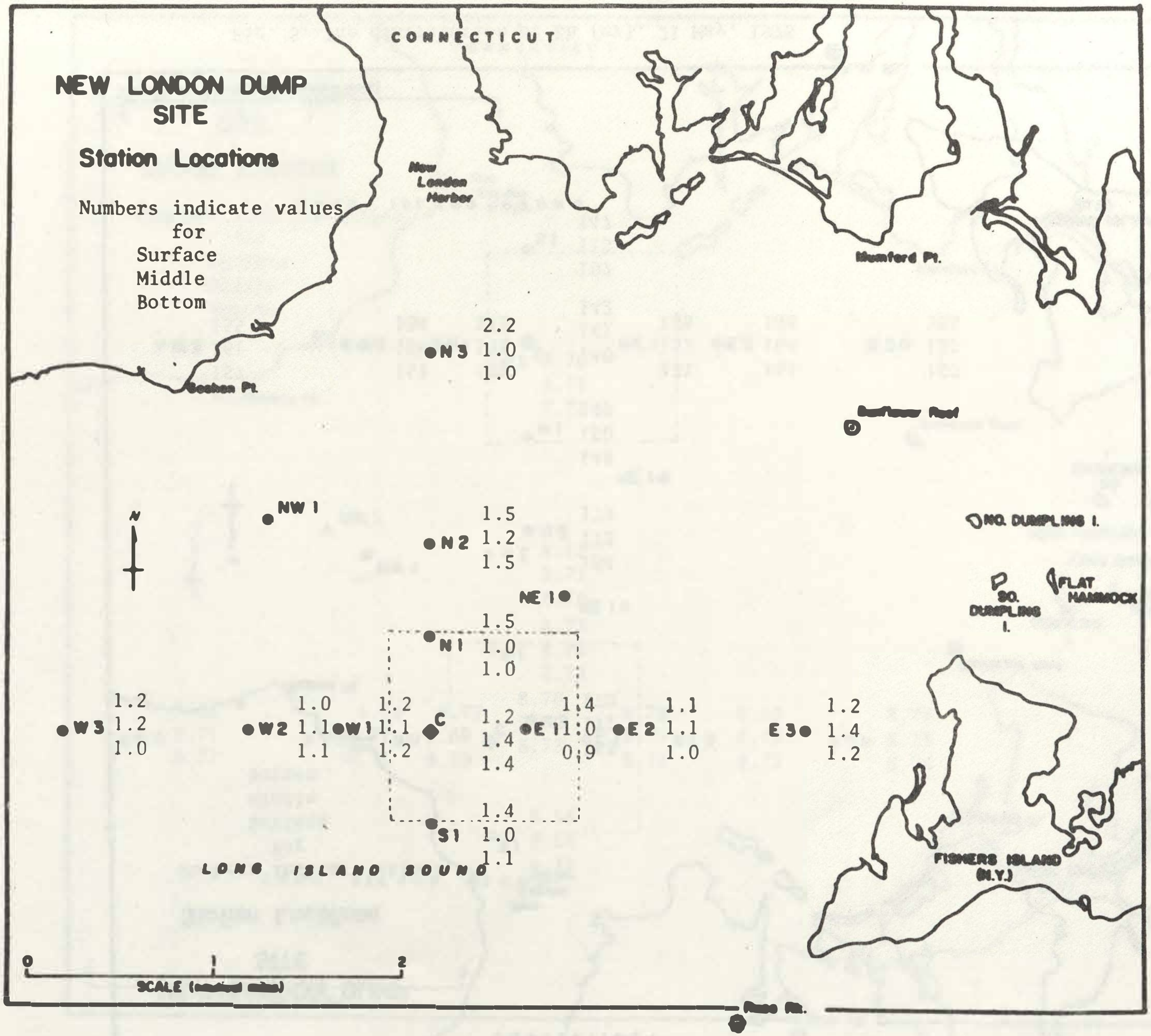

Fig. 6. The distribution of suspended solids (mg/ℓ), 21 May 1975

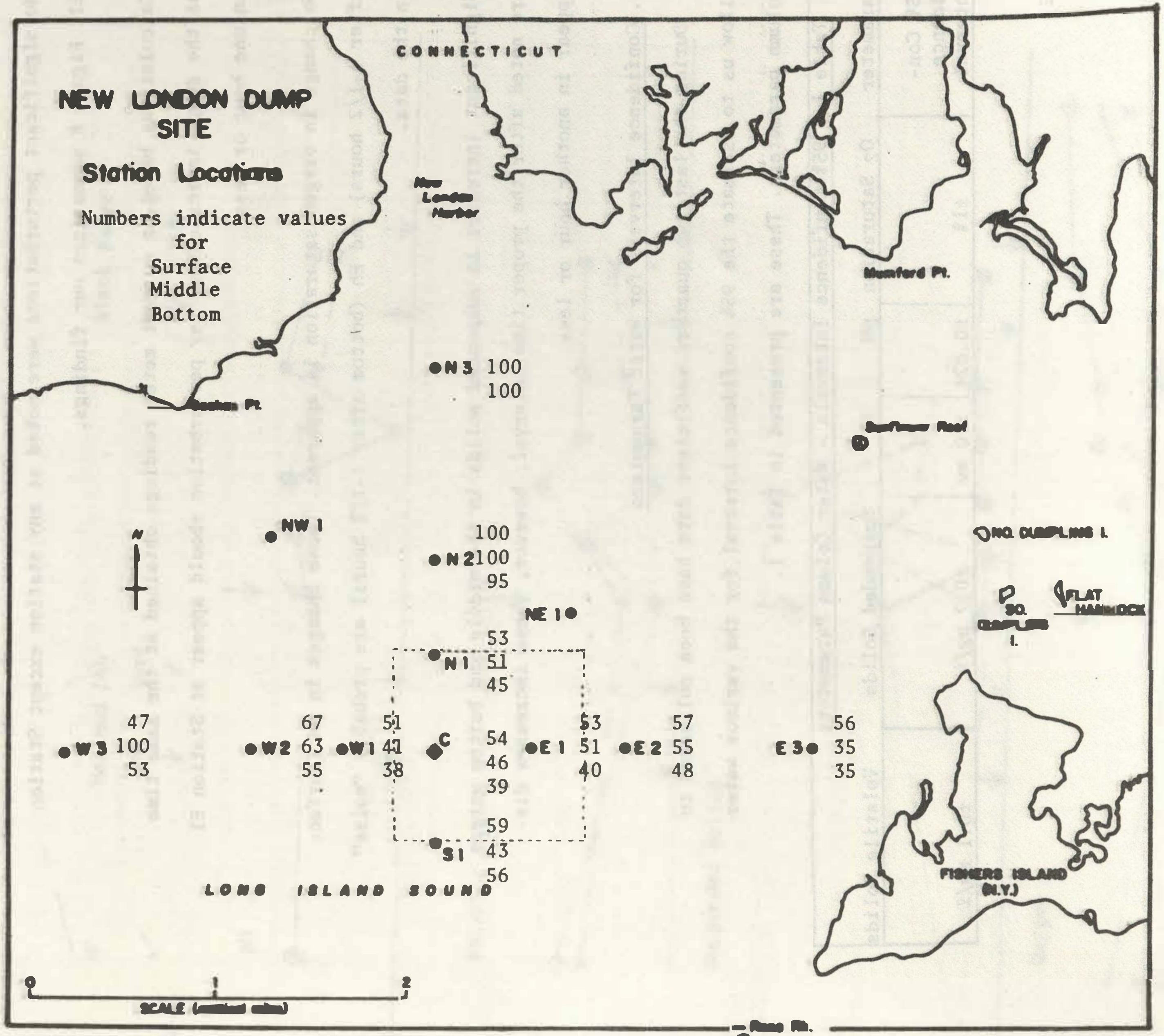

Fig. 7. The distribution of volatile solids (percent of total solids), 21 May 1975

were taken at Stations C, E1, E2, S1, N1 and W1 (see Fig. 1) on an ebbing tide. The dump occurred approximately 50 yards east of Station C. No significant perturbations were noted at any station except Station E1. Figure 8 summarizes our findings.

Calculations based on current meter readings obtained at the same time as the dump, indicate that any perturbation should appear at Station E1 in one hour or less.

No change in oxygen saturation is apparent. Those changes in pH (surface after 1-1/2 hours) and Eh (bottom after 1-1/2 hours) are probably "noise" in the data.

Significant increases in suspended solids in the middle and bottom waters are noted after the proper time interval; however, these increases disappear in another hour or less.

C. Confidence Intervals for Water Parameters

During the last two quarters sufficient data have been collected to allow us to estimate the 95% confidence interval for the various water column parameters. These are presented in Table I.

Table I. 95% Confidence Intervals - Water Column Parameters

Parameter	O_2 Saturation	pH	Eh	Suspended Solids	Volatile Solids
95% Confidence Interval	±1%	±0.024	±10 mv	±0.7 mg/ℓ	±0.1 mg/ℓ

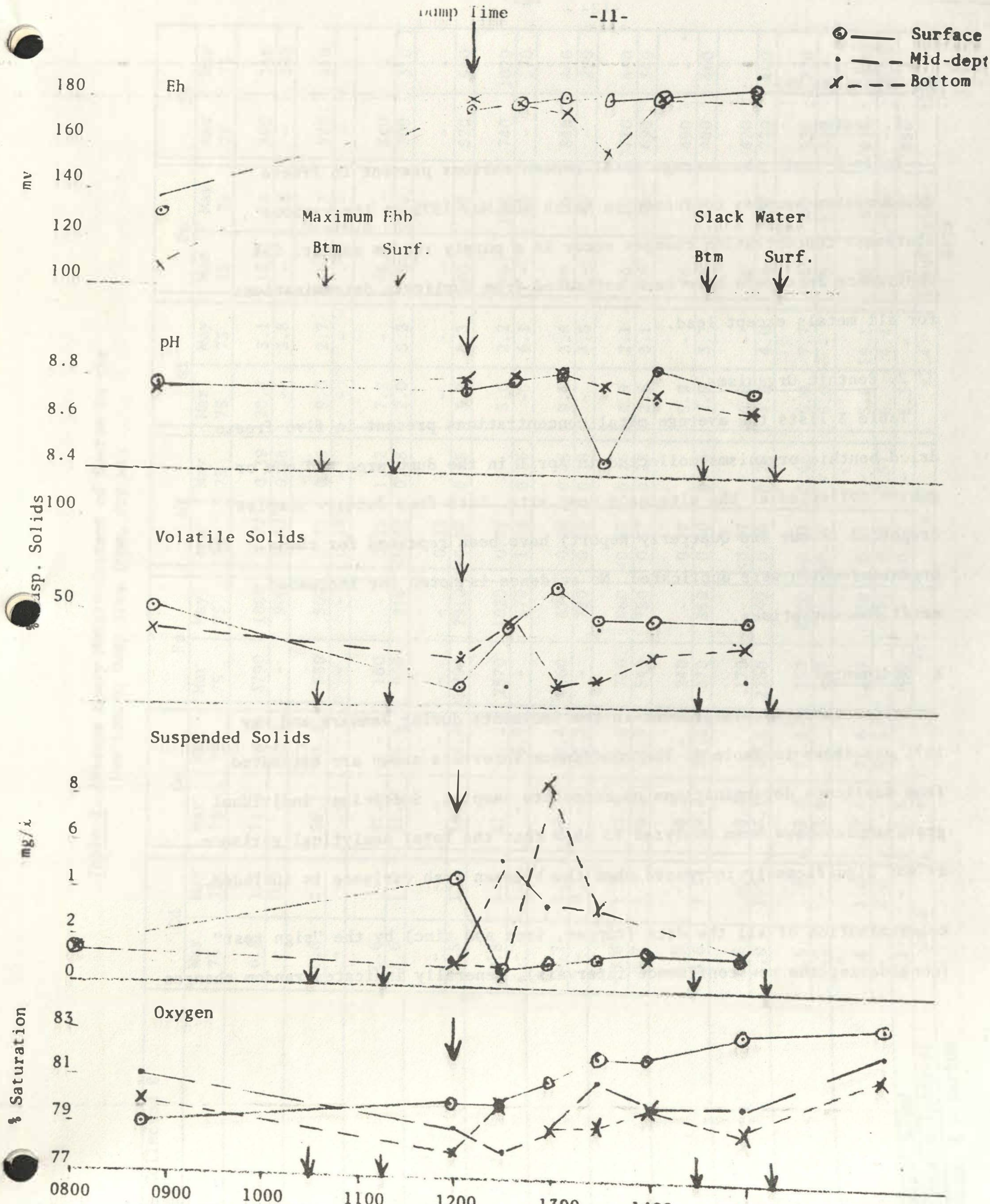

Fig. 8. Various Properties vs Time - "downstream" following a dump.

D. Organisms

1. Seston

Table 2 lists the average metal concentrations present in freeze dried seston samples collected in March and May 1975 at the various stations. Concentration changes occur in a purely random manner. 95% confidence intervals have been estimated from duplicate determinations for all metals except lead.

2. Benthic Organisms

Table 3 lists the average metal concentrations present in five freeze dried benthic organisms collected in April in the dump area and one organism collected at the alternate dump site. Data from January samples (reported in our 3rd Quarterly Report) have been repeated for those organisms which were duplicated. No evidence is noted for increased metal concentrations.

E. Sediments

Acid soluble metals present in the sediments during January and May 1975 are shown in Table 4. The confidence intervals shown are estimated from duplicate determinations on composite samples. Sufficient individual grab samples have been analyzed to show that the total analytical variance is not significantly increased when the between grab variance is included.

Re-examination of all the data (copper, iron and zinc) by the "sign test" (considering the new confidence intervals), generally indicates random changes

Table 2. Average Heavy Metals Content of Seston in the New London Dump Area (ppm, dry wt)

Sample Collected @ Station	Cd		Cu		Fe		Hg		Ni		Pb		Zn	
	Mar 75	May 75	Mar 75	May 75	Mar 75	May 75	Mar 75	May 75	Mar 75	May 75	Mar 75	May 75	Mar 75	May 75
W-3 S	0.8	1.5	71.8	16.3	3790	1080	0.22	0.39	20.4	3.1	15	<6	800	380
W-3 B	-	0.9	-	46.9	-	900	0.37	0.38	-	3.8	-	<6	-	330
W-2 S	0.6	2.5	56.1	45.3	530	500	0.23	0.26	9.0	2.7	<6	7	520	410
W-2 B	-	-	-	-	-	-	0.18	-	-	-	-	-	-	-
W-1 S	0.6	-	41.6	-	160	-	0.21	1.12	7.2	-	<6	-	320	-
W-1 B	1.6	1.9	51.1	56.4	960	210	<0.07	0.08	2.0	5.3	<6	<6	700	310
C S	-	-	-	-	-	-	0.23	-	-	-	-	-	-	-
C B	1.5	1.2	58.3	84.4	290	2910	<0.07	0.95	3.9	8.3	<6	20	520	580
E-1 S	0.8	1.5	51.8	66.0	2570	1020	0.21	-	5.6	2.2	<6	100	740	1020
E-1 B	-	1.5	-	45.6	-	570	1.04	0.35	-	6.1	-	<6	-	570
E-2 S	0.7	1.3	68.3	29.4	4560	670	0.26	0.43	9.6	3.6	<6	<6	840	440
E-2 B	-	0.7	-	40.2	-	780	0.56	0.18	-	4.6	-	<6	-	290
E-3 S	<0.6	1.3	44.8	37.0	710	560	<0.07	0.26	8.9	2.1	<6	10	710	440
E-3 B	0.7	1.3	46.3	44.9	540	750	0.57	0.23	2.8	3.1	<6	<6	690	340
N-1 S	1.5	-	56.2	-	240	-	0.29	-	5.9	-	<6	-	490	-
N-1 B	<0.6	1.5	39.4	56.2	870	850	0.30	0.35	7.9	3.7	<6	<6	480	460
N-2 S	0.8	-	48.4	-	170	-	<0.07	-	6.6	-	<6	-	420	-
N-2 B	1.0	1.8	55.1	61.5	2260	990	0.08	0.28	4.9	4.0	<6	20	720	490
N-3 S	0.6	1.8	45.8	72.1	350	8200	<0.07	0.66	5.0	7.7	<6	40	520	720
N-3 B	0.7	-	46.6	-	540	-	<0.07	-	6.0	-	<6	-	620	-
S-1 S	1.4	1.6	52.6	71.6	1210	4380	0.15	-	5.8	19.1	<6	80	910	490
S-1 B	-	2.2	-	57.6	-	620	0.46	0.57	0	4.4	-	<6	-	330
Block Island Sound	4.2	-	48.5	-	880	-	<0.77	-	8.3	-	<6	-	850	-
95% Confidence Interval	±0.6		±1.7		±57		±.07		±2.4		Insufficient data		±27	

S = Surface, B = Bottom

Table 3. Heavy Metals in Benthic Organisms
New London Dump Site - April 1975 Samples
ppm (dry wt)

Organism	Cd		Cu		Fe		Hg		Ni		Pb		Zn	
	Jan	Apr	Jan	Apr	Jan	Apr	Jan	Apr	Jan	Apr	Jan	Apr	Jan	Apr
Mercenaria														
Average	0.8	3.2	16	20	460	800	<0.3	0.4	14	11	<5	8	289	271
Range	0.4-1.1	0.8-6.6	10-19	17-21	280-560	500-1100	-	-	11-16	8-12	<5-5	<8-9	202-414	226-309
Astarte (composite sample)														
Average	<1	1.0	38	39	1100	490	<0.3	0.7	10	3	<10	<8	170	100
Polychaeta (comp. sample)														
Average	0.6	0.5	16	26	7070	2300	<0.3	0.4	7	6	10	<8	158	172
Modiolus (1 individual)														
Average	-	0.8	-	12	-	1440	-	0.3	-	5	-	<8	-	200
Nemertean (1 individual)														
Average	-	0.7	-	60	-	460	-	0.1	-	4	-	<8	-	230
Collected at alternate Dump Site:														
Artica														
Average	-	1.8	-	31		1470		0.4	-	18	-	18	-	183
Range		0.8-3.4		22-42		980-2180		0.2-0.6		10-27		6-25		87-288

Table 4. Acid Soluble Metals in Sediments, Composite Samples
New London Dump Site January & May 1975 Samples
(All values in mg/kg dry wt)

	Cd		Cu		Fe		Hg		Ni		Pb		Zn	
95% Confidence Interval	±1.4		±6.3		$\pm 1.6 \times 10^3$		±.09		±2.7		±10		±13.4	
Minimum Detectable Limit	2		2		-		0.1[1]		2		20		2	
	Jan	May	Jan	May	Jan	May	Jan	May	Jan	May	Jan	May	Jan	May
Station					$\times 10^3$									
A1	↑	↑	<2	4	7.1	6.1	<.1	.04	8	<9	<20	↑	34	34
2			3	15	7.2	8.2	05[2]	.05	<8	17	<20	<20	29	57
3			14	15	11.8	10.6	.02[2]	<.02	<8	<9	<20	↓	59	75
4			19	25	14.0	9.6	.05[2]	.02	15	17	<20	130	63	200
5			40	15	14.2	10.3	.03[2]	.03	15	13	<20	↑	64	56
7	<2		15	18	8.3	16.6	.16	.03	16	17	20	<20	58	60
8			23	19	15.4	9.6	.16	.09	20	17	50	↓	68	52
9			13	8	8.1	8.8	.20	.10	8	<9	<20	30	54	47
10	↓	<2	2	2	6.4	6.1	<.1	.03	3	<9	<20	<20	37	35
B1	3		7	7	7.8	9.0	.13	.03	44	13	30	30	148	47
2	↑		7	7	7.8	7.2	.23	.17	8	13	20	↑	52	41
3			16	9	10.5	8.7	.23	.02	8	<9	20		65	49
C1			3	6	4.4	5.4	.01[2]	.06	<8	<9	<20	<20	17	34
2			6	4	19.6	3.4	.08[2]	.08	11	<9	<20		85	21
3	<2		9	5	16.2	12.6	.04[2]	.09	<8	13	<20		54	52
4			14	12	10.8	8.3	.08[2]	.04	11	13	<20		54	49
5			17	15	13.7	18.6	.01[2]	.06	<8	17	<20		62	60
6	↓		45	19	29.6	22.0	<.01[2]	<.02	23	22	<20		79	53
7	3		28	14	11.6	16.6	.16	.08	12	17	<20		75	45
8	<2		15	12	8.8	7.7	.91	<.02	15	<9	20		55	45
9	↓	↓	8	13	8.7	8.3	.11	.11	12	13	<20	↓	57	51

[1] Based on 0.2 g sample.

[2] 2.0 g sample.

Table 4 (cont.)

Station	Cd Jan	Cd May	Cu Jan	Cu May	Fe Jan	Fe May	Hg Jan	Hg May	Ni Jan	Ni May	Pb Jan	Pb May	Zn Jan	Zn May
D1			2	NS	3.1	NS	<.1	NS	<8	NS	<20	NS	22	NS
2			3	2	1.9	1.3	<.1[2]	.04	<8	<9	<20		11	11
3			8	4	18.4	19.1	.06[2]	.03	11	<9	<20		64	63
E1			<2	<2	2.9	1.5	.04[2]	.02	<8	<9	<20		11	8
2			-	9	-	7.5	-	.06	-	<9	-		-	40
3			8	12	14.8	12.0	.13[2]	.09	<8	13	<20	<20	50	36
4	<2	<2	12	51	8.4	10.0	.10[2]	.08	<8	17	<20		46	53
5			8	14	7.0	12.4	.04[2]	.13	11	13	<20		10	60
7			14	19	20.1	20.2	1.35	<.02	20	17	20		54	61
8			13	11	9.2	8.2	-	.03	12	13	20		54	44
9			6	5	6.1	6.2	.13	.06	11	<9	<20		32	33
F3			10	17	9.8	10.7	.12	.03	7	13	30		50	109
4			9	13	15.9	21.8	1.73	<.02	12	22	<20		37	57
5			40	30	12.9	18.0	.60	<.02	16	13	20		106	69
7			31	24	21.0	14.0	2.44	.04	24	17	<20		135	92
8			8	26	6.2	14.8	.21	<.02	12	17	50		34	88
9			13	5	10.0	6.0	.30	.04	12	<9	<20		69	43
Alternate Site														
ANL 4	-		-	3	-	12.8	-	.02	-	<9	-		-	43
5	-		-	6	-	11.1	-	.10	-	13	-		-	45
6	-		-	10	-	13.4	-	.07	-	13	-		-	53

[1] Based on 0.2 g sample

[2] 2.0 g sample

NS = No sample

in concentration regardless of the time interval in July/October, October/January and January/May. However, a preponderance of increases are still to be found in an irregular area around the dump buoy during July/October and October/January. During January/May 1975, the concentrations generally decreased around the dump buoy. This decrease could be due to winter dispersal of the spoil pile or the spoil pile is being covered with dredged material containing lower concentrations of metals.

The chemical oxygen demand, Kjeldahl nitrogen and total phosphorus values found in January and April samples of the sediments are shown in Table 5. 95% confidence intervals for these properties are also listed. Increases or decreases for any property at any station occur randomly. In general, though, higher values for any property occur toward the center of the dump.

Table 5. The Chemical Oxygen Demand, Kjeldahl Nitrogen and Total Phosphorus Concentrations of Sediments - January 1975 and April 1975 Samples (all values in mg/kg dry wt)

Station	Chemical Oxygen Demand		Kjeldahl Nitrogen		Total Phosphorus	
	Jan. 75	Apr. 75	Jan. 75	Apr.75	Jan.75	Apr.75
A1	4300	4690	190	160	250	350
2	7580	29400	200	960	290	590
3	26800	24500	1280	950	170	500
4	24900	9660	1410	1100	420	540
5	28400	32400	1450	860	540	540
7	27400	56900	680	1050	390	560
8	53800	20300	1420	850	690	600
9	23400	42800	820	730	540	500
10	8280	8780	280	420	500	580
B1	13800	11700	500	310	470	630
2	13700	12400	440	360	790	550
3	28600	19400	1210	660	590	520
C1	3300	12300	760	670	130	500
2	8900	7650	720	380	660	260
3	13800	11900	440	470	460	410
4	24600	28500	1550	720	640	470
5	32500	55300	1640	1320	540	590
6	82700	62900	4660	1450	740	580
7	32900	52800	1040	1060	580	620
8	27800	24300	1090	720	480	480
9	15000	22400	360	720	500	570
D1	4610	NS	300	NS	140	NS
2	1120	2350	50	180	190	120
3	17500	10200	760	360	690	570
E1	3220	3370	120	70	210	100
2	NS	17100	NS	710	-	670
3	10800	25400	520	720	450	610
4	18700	25700	670	770	560	540
5	11900	47700	440	1060	380	540
7	46100	40800	1100	1040	610	610
8	24000	23300	870	770	500	570
9	27600	15500	360	480	350	370
F3	16800	30900	640	710	450	500
4	48600	83100	850	1640	460	570
5	58100	78800	1320	1440	510	590
7	51000	48400	1950	1710	650	650
8	15200	45200	570	1500	350	560
9	24100	16100	1140	620	380	340
95% Confidence Interval	±552		±34		± 22	

NEW YORK OCEAN SCIENCE LABORATORY
Cruise Report NL-11
Project SR74-48D
Tuesday 20 May 1975

I. OBJECTIVES

To continue zooplankton sampling and water quality studies associated with Project SR74-48D.

II. ACTUAL SCHEDULE

20 May 1975 (Tuesday)	0500	- Departed Lake Montauk
	0730	- Arrived New London Dump Site area Anchored vessel and waited for fog to lift
	1115	- Deployed current meter array near center buoy
	1125	- Commenced plankton tows
	1128	- Barge release - commenced transmissometer studies on Whaler 19
	1350	- Terminated transmissometer studies
	1515	- Arrived Lake Montauk with Whaler 19
	1900	- Terminated plankton sampling
	2100	- Arrived Lake Montauk with *R/V Louise*

III. VESSELS

R/V Louise
Whaler 19

IV. PROBLEMS

Presence of dense fog until 1100 hours. Set back sampling operations. One plankton net was lost during sampling period.

V. PERSONNEL

D. Uttley	Captain, *R/V Louise*
T. Chiuchiolo	Chief Scientist
H. Dubois	Marine Technician
T. Condit	" "
S. Gill	" "
T. Chico	" "

NEW YORK OCEAN SCIENCE LABORATORY
Cruise Report NL-12
Project SR74-48
Wednesday 21 May 1975

I. OBJECTIVES

To continue sampling program associated with water quality studies of the New London Dump Site.

II. ACTUAL SCHEDULE

21 May 1975
(Wednesday)

- 0600- Departed Lake Montauk
- 0805 - Arrived New London Dump Site and commenced synoptic sampling of water quality stations
- 0830 - Deployed bottom current meter on top of dredged spoils
- 1120 - Terminated synoptic sampling and proceeded to stations for barge release study
- 1204 - Barge release - commenced sampling stations C, E1, E2 and S1
- 1330 - Terminated barge release sampling
- 1440 - Continued synoptic sampling of stations C, N1, E1, W1
- 1515 - Terminated synoptic sampling
- 1550 - Retrieved bottom current meter
- 1555 - Retrieved current meter array deployed on 20 May
- 1600 - Departed New London Dump Site
- 1815 - Arrived Lake Montauk

III. VESSELS

R/V Swordfish
R/V Louise
Whaler 19'
Whaler 17'

CRUISE REPORT NL-12 (cont.)

IV. OPERATIONS

Sampling Procedure

Time	Stations
0805	S1
0845	C, W1, E1, N1
0958	C, W2, E2, N2
1058	C, W3, E3, N3
1204 to 1330	Barge release. C, E1, E2, S1
1400	C, W1, E1, N1
1500	C, W1, E1, N1

V. PROBLEMS

Poor visibility (1/2 mile) throughout the day due to fog and haze hampered the placing of small craft on station locations. *R/V Swordfish* radar is not able to pick up small craft well at 1-1/2 mile range. Radio communications with Whaler 17' hampered by lack of antenna.

VI. PERSONNEL

H. DeCastro	Captain, *R/V Swordfish*
D. Uttley	Captain, *R/V Louise*
S. Gill	Chief Scientist
T. Condit	Marine Technician
T. Chico	" "
T. Chiuchiolo	" "
H. Dubois	" "
J. Schneidmuller	Technical Aide
J. Gish	Marine Technician
T. Croce	" "
S. Roschke	Research Fellow
C. Mamay	Photographer

Kjeldahl Nitrogen and Phosphorus in Seston
and Benthic Organisms - New London Dump Area

Sample	Sample Date	Kjeldahl Nitrogen, %w		Phosphorus, %w		N/P Ratio	
		Average	Range[a]	Average	Range[a]	Average	Range[a]
Seston	Mar. 75	10.6	2.9-19.7	0.56	0.35-0.76	19	8-26
Seston	May 75	14.1	6.3-21.4	0.60	0.36-0.95	24	7-52
Artica	Apr. 75	15.9	6.4-25.9	.56	0.41-0.69	28	9-63
Modiolus	Apr. 75	8.7	-	0.79	-	11	-
Nemertean	Apr. 75	5.9	-	0.56	-	11	-
Mercenaria	Apr. 75	16.4	14.2-18.6	0.70	0.60-0.81	23	17-31
95% Confidence Interval Seston		±2.0		±0.04			

[a] When no range is given, the average = the value found for a single sample.