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A preliminary report to the Virginia Department of Highways on hard clam (Mercenaria mercenaria) populations in the vicinity of the Hampton Roads bridge-tunnel (I-64) (Segment 268-135D)

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Hard Clam (*Mercenaria mercenaria*) Populations in the Vicinity of the Hampton Roads Bridge-Tunnel (I-64).

(Segment 268-135D)

by

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INTRODUCTION

I-664 will be constructed in Hampton Roads in an area where the hard clam Mercenaria mercenaria is fished commercially. Because of this clam's economic value and because Hampton Roads is the major producing region for this species, it is worthwhile that every precaution be taken during construction of I-664 to minimize the possibility of damage to this resource.

To achieve this objective, we are evaluating the possible impact of construction activities around I-64 and adjacent areas on populations of the hard clam. The aim is that if damage or potential damage is noted around I-64, then construction techniques may be modified during I-664 construction so that the damage is minimized.

Sampling for this study was carried out during June, July and November, 1973. Additional work similar to that already accomplished is planned after construction activities have ended.

The objective of this segment (135D) has been to determine:

1. If the existing structures have influenced population of clams.
2. If activities associated with the present construction have had any adverse effects on populations.

These two objectives were evaluated in four types of areas.

1. The existing and new approaches.
2. The borrow pit off Fort Wool.
3. The Portal Islands.
4. The tunnel area in mid-channel.

In this preliminary study we have evaluated whether or not there has been any effect principally on the basis of differences in numbers

of living or dead hard clams per unit area of the bottom at varying distances from the four types of areas outlined in the preceding paragraph. The rationale behind this system follows.

A. If sediments associated with the construction or sediments deposited as a result of placement of islands or the approaches have accumulated to such depth as to kill hard clams, then there should be at these sites a decline in numbers of living clams and an increase in numbers of dead clams (boxes).* Moreover, mortalities would show a gradient. The highest values would be at or near areas of maximum deposition, with values decreasing with increasing distance.

A similar situation in respect to mortality would exist in areas where the bottom was being rapidly erroded.

B. Sublethal effects of abnormal sedimentation are evaluated on the basis of length studies. The rationale of this method is that hard clam larvae do not "set" or develop in soft mud, and prefer a firm bottom composed of sand, silts and clays. It is evident, therefore, that if an existing bottom which was favorable for setting were over lain by a thin cover of soft mud then there would be only marginal recruitment after this, but the larger animals would survive. Over a period of a year or two this would lead to a situation in which the population would contain mostly large individuals with few of the

* A box is composed of two valves still hinged at the ligament.

smaller size. To determine if this has occurred, we have used mean size, but in the final report we will show length frequency data. Again, the important aspect here is to look for gradients.

Locations of Stations.

To achieve the goals outlined under our objectives, we superimposed a grid over a hydrographic chart of lower Hampton Roads showing I-64 and the adjacent waters. This enabled us to locate stations on the grid in a series of parallel lines at varying distances from the approaches, the submerged tunnels, the Portal Islands and the borrow pit east of the South Portal Island.

The distances at which stations were located from the four areas varied as follows:

A. For the mid-channel tunnel area, stations were located on the area to be excavated, and about 250 feet on either side. Thereafter, distances were from 250 or 1000 feet.

B. In the vicinity of the borrow pit we attempted to locate stations within 150 to 600 feet of the edge, and thereafter at about 1000 to 1500 foot intervals.

C. Near the Portal Islands and the approach areas, station spacing was similar to that outlined in B.

Method of Sampling for Hard Clams

Sampling was done with a commercial hard clam harvesting rig under charter to VIMS. The rig consisted of a 37 foot boat with a boom and a pair of "patent tongs". This "rig" was operated by the owner, who is a commercial clammer and, therefore, experienced in the use of this gear.

Patent tongs were chosen as the sampling device since data obtained by using them may be analyzed quantiatively. That is, they cover the same area of bottom each time they are used. Those used in this study covered 1.2 yd^2 and retrieved everything over an inch in size.

A total of 290 stations were sampled (Figure 1). At each station the boat was anchored and 10 grabs or samples were taken. The boat was allowed to move slightly between grabs by letting out the anchor line; in this way, each grab sampled a new spot. Live hard clams taken in each grab were counted and average number per grab was calculated. Later, average number per 10 grabs along specific transects was calculated.

Total numbers of clam boxes in each grab were counted; later mean number per station was calculated.

Mean lengths of hard clams were determined for each station. In the final report, however, length frequency data will be presented.

VIMS personnel directed the positioning of the boat to the sampling locations and recorded and tabulated all data. Locations on the grid system were determined with the help of a sextant and a U. S. Coast and Geodetic Survey Chart 400[1]. Clams were measured to the nearest millimeter with calipers.

[1] The accuracy of the positioning was attested to when five stations were unitentionally sampled a second time. The second set of results was nearly identical to the first set.

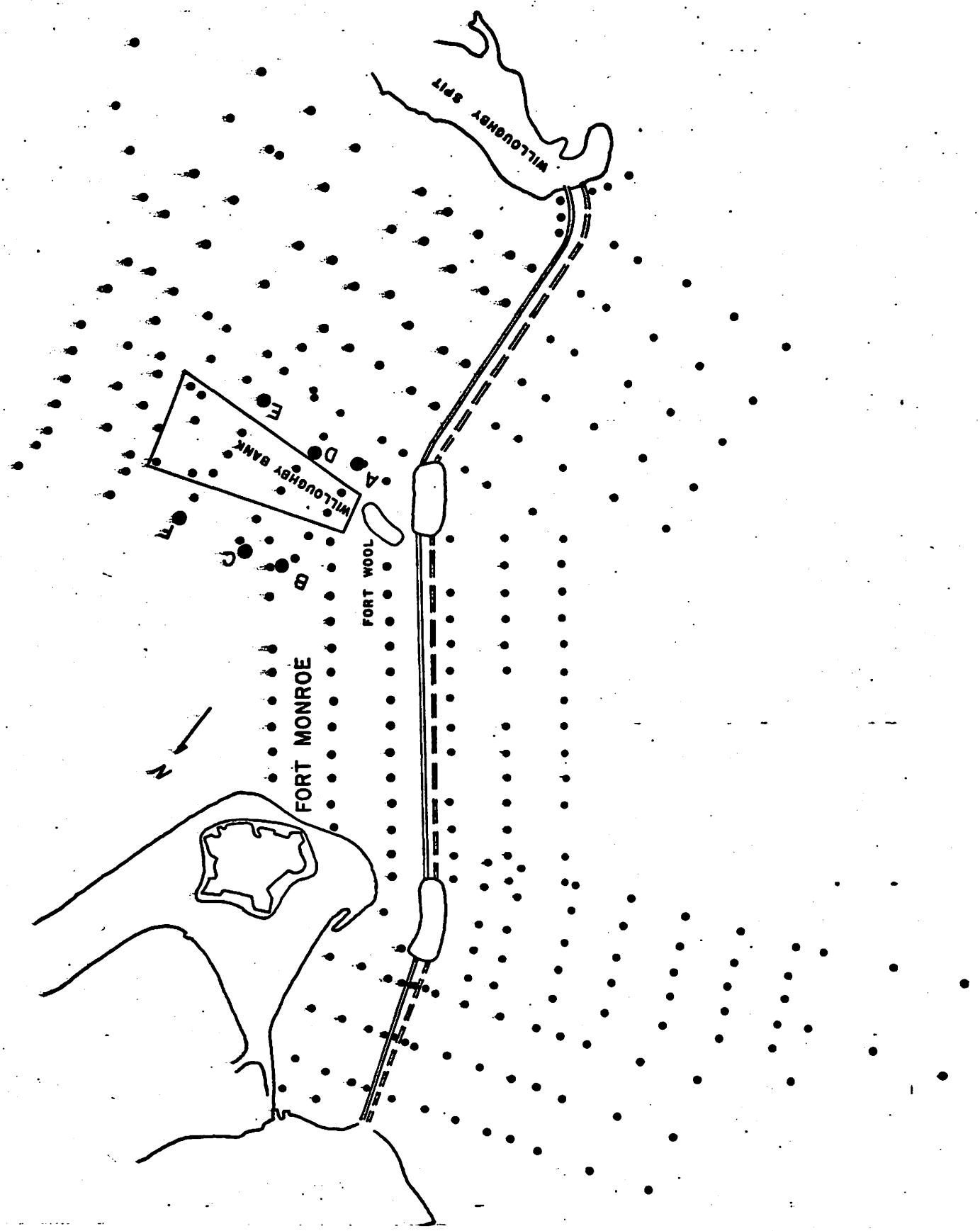


Figure 1. Chart of area around Hampton Roads Bridge-Tunnel showing location of sampling stations and transects across Willoughby Bank borrow pit.

Sediment Type - Quantity of Shell

Samples of sediment were collected at most stations. These are now being analyzed for percent sand, silt and clay. Observations at the time of collection, however, enable us to state the general composition at each station. The depth of the water at each station was recorded with a portable fathometer. The volume of shell collected in the patent tongs was measured in a ten-quart bucket. Data on shell are not presented, but will be in the final report.

Profiles of the bottom in the Willoughby Bank borrow pit area were made with a portable fathometer. The three profiles (B-A, C-D, F-E) were traced by the fathometer while the boat was run in a North-South direction (Figure 1).

Final Report

A final report will be submitted at the termination of this study.

The conclusions reached in this preliminary report seem reasonable; they may be modified slightly when data on sediment type and length frequency are analyzed.

1. North of Channel (East and West of Approach and Island)

This area is shown in Figure 2. It includes the shallow water station off Phoebus and to the West of Fort Monroe.

Table 1

A summary of numbers and lengths of clams and number of clam boxes at varying distances from the North Portal Island and Approach.
(Area North of the Channel)

Direction	Distance (ft)	Range of Depth (ft)	Number of Stations Sampled	Average Number/ Station (10 grabs)*	Mean Length (mm)	Average Number Boxes/ Station* (10 grabs)
West	15	9 -10	3	16	77	0.3
	50	10	2	23	82	0
	400	3.5-10	3	14	76	0.7
	1,050	5.5-30	8	17	75	0.1
	1,620	4.5-27	8	7	77	0.2
	2,340	8.5-12	3	24	74	0.7
	2,550	5 -38	5	9	76	0.4
	3,050	9 -13	3	22	75	2.7
	3,550	5 -32	8	14	74	0.1
	4,550	5 -21	8	12	66	0.4
	5,550	5 -21	8	16	78	0.1
	6,550	6 -21	5	27	75	0.4
	7,250	8.5-19	3	24	76	0
	9,250	9 -11	2	22	76	0
	11,350	12 -14	2	12	73	0
	13,750	14	2	23	75	0
East	50	6 -16	3	10	65	0
	375	8 -19	4	12	77	0.2
	930	4 -20	5	6	79	0.2
	1,500	10 -22	4	38	74	0.8

* Covered 12 sq. yds.

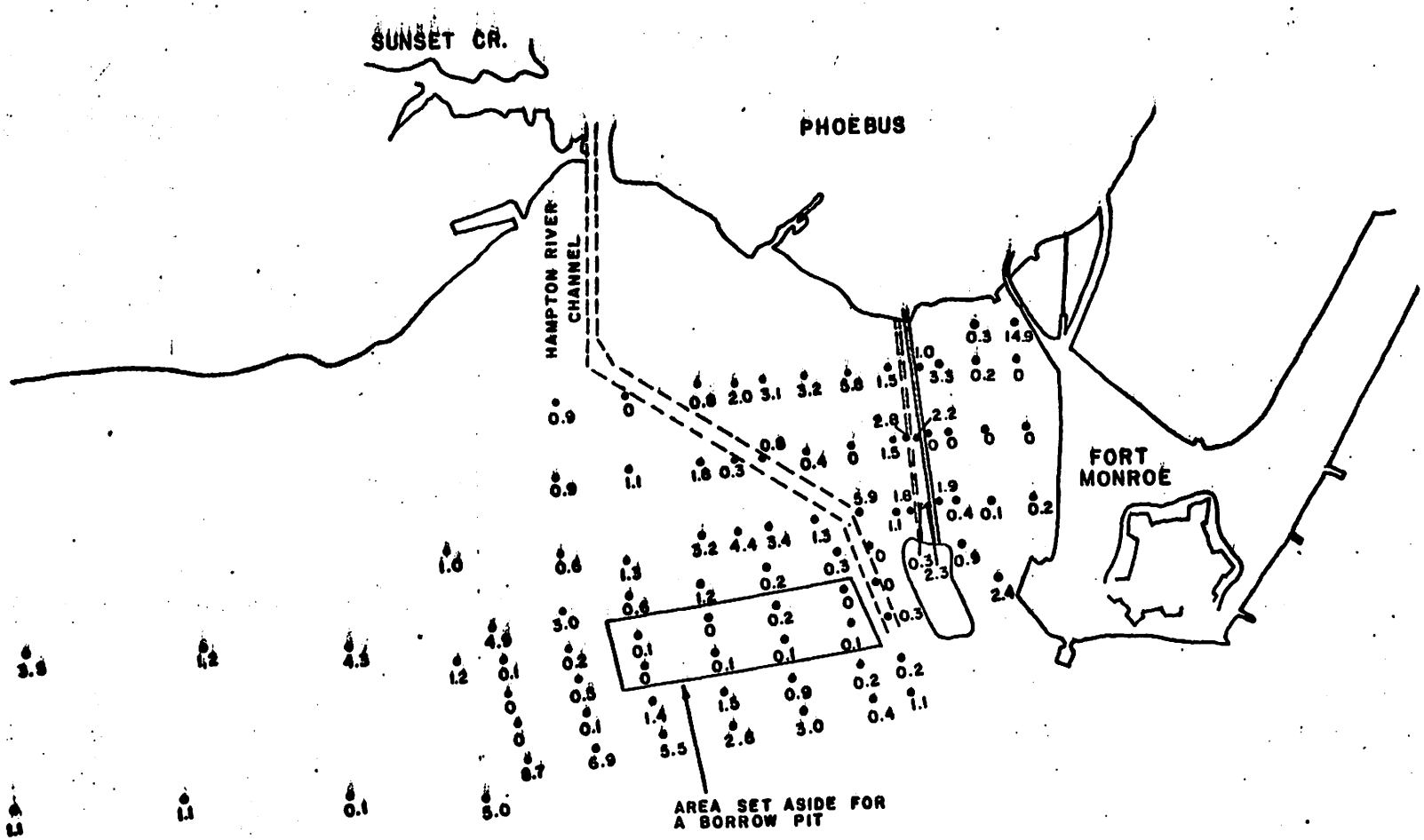


Figure 2. Mean numbers of living hard clams per grab (1.2 yd^2) at stations North of the channel.

Eighty-nine stations were sampled in this area and hard clams were found at 84% of the stations. The stations were located on 20 transects, parallel to the approach. Four of the transects were East of the approach toward Fort Monroe; 16 were on the other side on the West. Stations in the area were almost all in shallow water with a depth range from about 3.5 to 22 feet. Four stations, however, were in deeper water ranging from 30 to 38 feet. Sediments were predominately a mixture of sand and mud which formed a firm bottom favorable for good recruitment and rapid growth.

The mean numbers of live clams at each of the 89 stations are shown in Figure 2. From this source was calculated the mean numbers of clams (per 10 grabs) in a series of rows parallel to the approach (Table 1).

These data show no evidence of a change in mean numbers of living hard clams with increasing distance from the North Approach or from the North Portal Island (Figure 3A). Average per 10 grabs ranged from 7 to 27 to the west and from 6 to 38 to the east. The mean number of boxes was quite low (0-2.7) per 10 grabs. Analysis suggests no trend in numbers of living oysters or boxes with increasing distance from the approach or the island.

Average size of clams ramained about the same and showed no trend with increasing distances from the approach or island (Figure 4A).

Channel

Samples collected in the channel, on either side of the tunnel, show no evidence of adverse effects on clams from construction. There is a pattern in the variation of numbers of living clams and of mean

lengths. However, this pattern did not appear to be centered in the vicinity of the tunnel (Table 2, Figure 5).

This pattern is such that numbers of clams increased from nearly zero at 2500 feet East of the Tunnel to an average of almost 15 per station on the far western transect (2500 feet West). The fact that this trend is not interrupted or modified at the tunnel (Figure 3B) suggests that activities associated with tunnel construction were not the cause of the variation. Possibly, the observed variation is associated with a natural change in sediment type or depths. However, data on sediments must be analyzed prior to making a more positive statement. Box counts were very low adjacent to the tunnel site which supported our conclusions that there appears to have been no abnormal mortality.

Mean length of clams on the transects in the channel area were highest 2500 feet East of the Tunnel (99 mm); then they declined steadily to 70 mm on the 2500 foot West transect (Table 2). This pattern is the reverse of the numbers found. However, the trend is not interrupted or modified at the tunnel (Figure 4B), again suggesting that factors other than the tunnel are responsible.

The majority of the channel stations had depths of 50 to 70 feet which is about four times greater than in the area to the North and South. As is expected of deep channel bottoms, the sediment was largely soft mud as contrasted to sandy mud in areas outside of the channel. Mud bottoms are not favorable for hard clam recruitment or growth.

Table 2

A summary of numbers and lengths of clams and number of clam boxes in the channel of Hampton Roads compared to distance from the tunnel.
(Area in the Channel)

Direction	Distance (ft)	Range of Depth (ft)	Number of Stations Sampled	Average Number/ Station (10 grabs)*	Mean Length (mm)	Average Number Boxes/ Station (10 grabs)*
East	500	12-70	14	3.5	72	1.0
	1,500	20-76	11	0.1	85	0.1
	2,500	30-83	10	0.2	99	0.1
West	250	55-83	4	0.0	--	0
	500	11-72	12	3.1	71	0.6
	1,500	16-66	13	6.1	73	1.7
	2,500	12-64	13	14.8	70	3.4

* Covered 12 sq. yds.

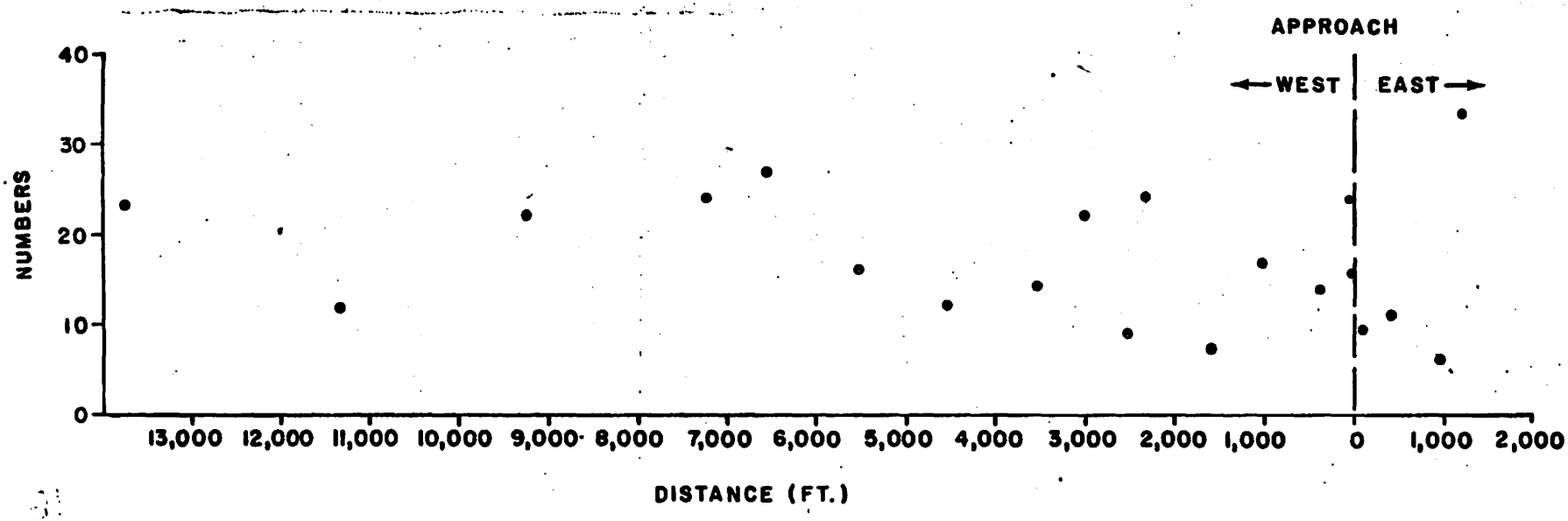


Figure 3A. Numbers of living hard clams per station compared to distance from the existing bridge-tunnel area North of channel.

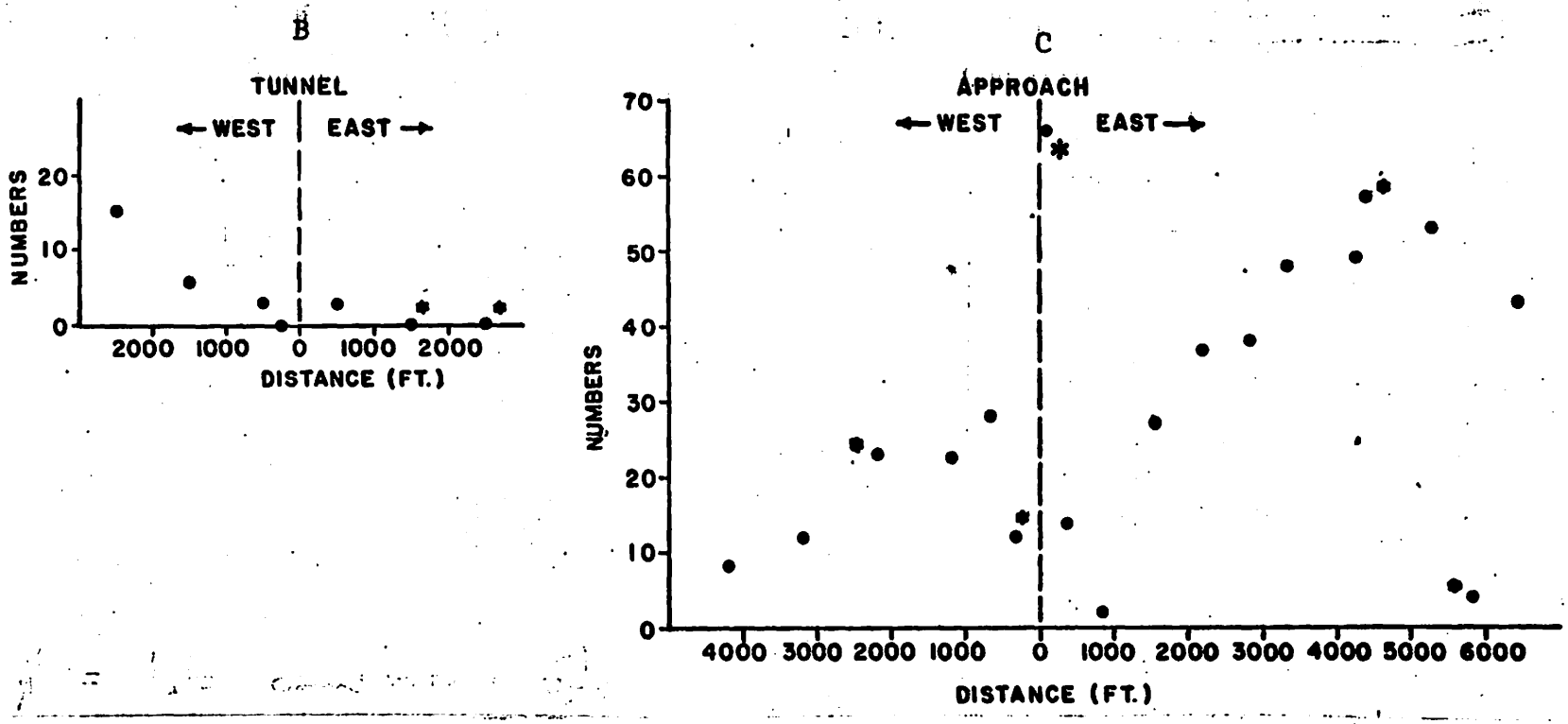


Figure 3B &C. Numbers of living hard clams per station compared to distance from the existing bridge-tunnel.

B: Area in channel.
C. Area South of channel.

* Data came from one station only.

* Stations on this transect not randomly chosen and were on shallower and sand bottom.

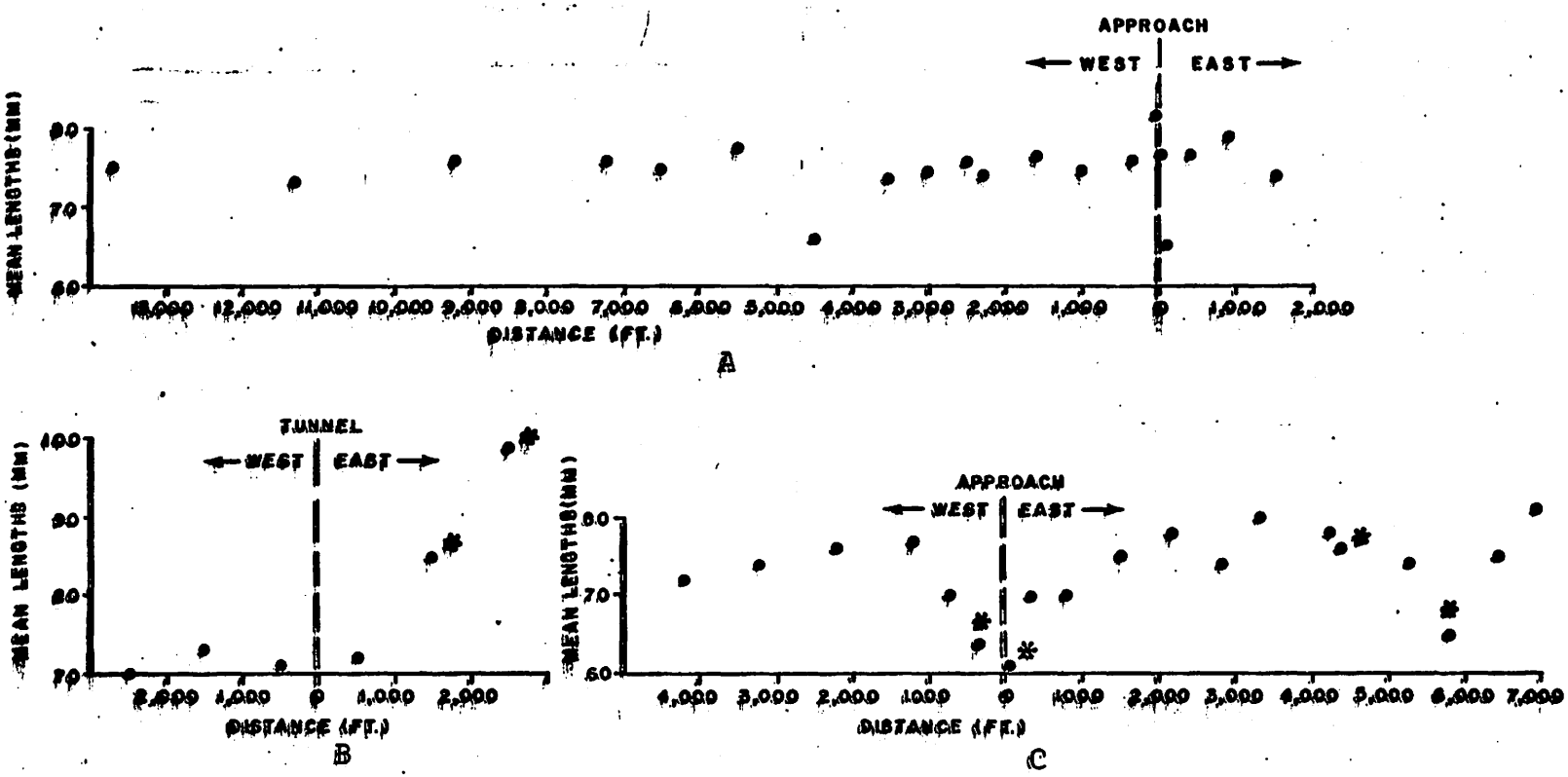


Figure 4. Mean lengths of living hard clams compared to distance from the existing Bridge-Tunnel.

A. Area North of channel.
B. Area in channel.
C. Area South of channel.

* Data from one station only.

★ Stations on this transect were not randomly chosen, and were on shallower and sand bottom.

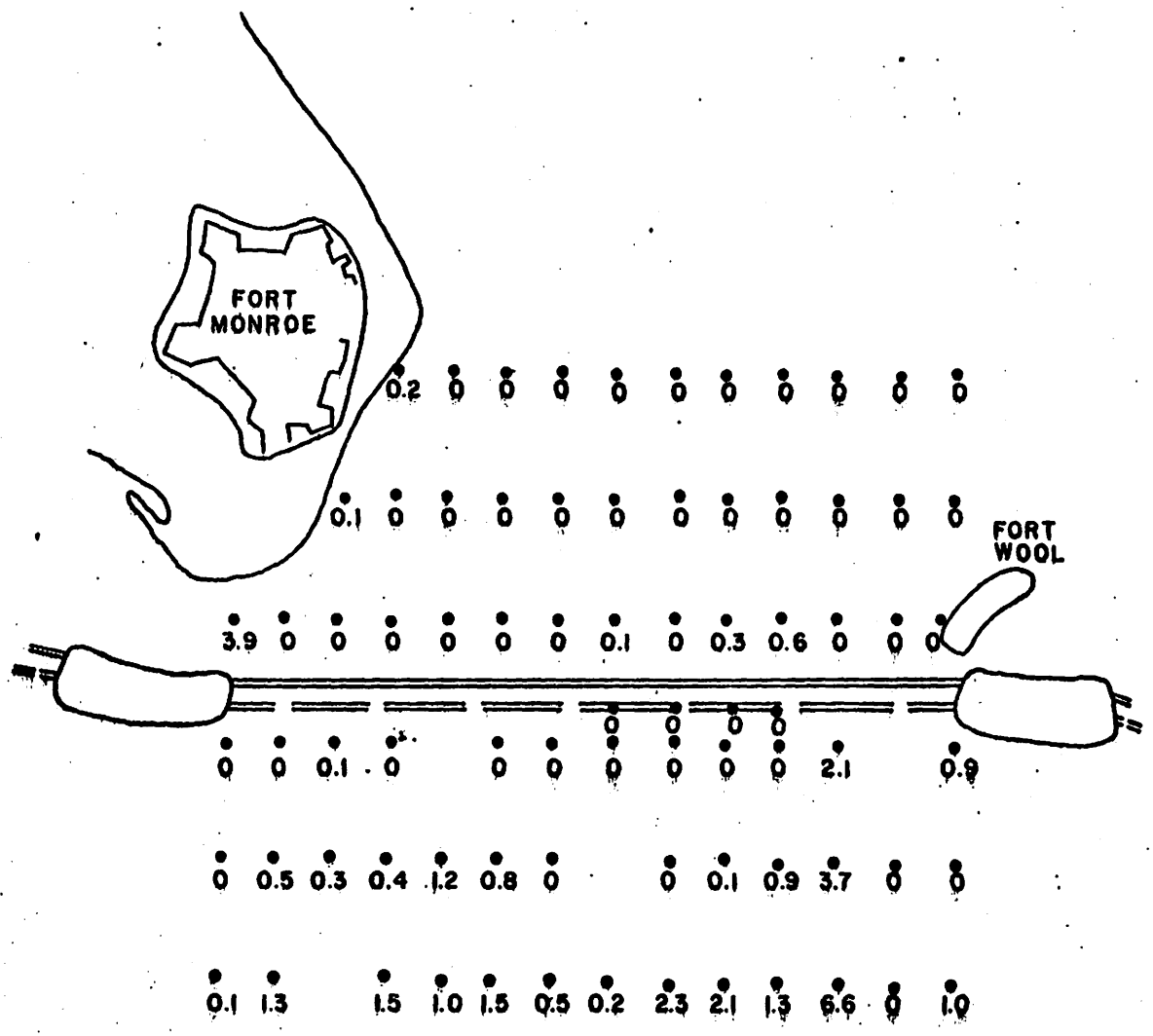


Figure 5. Numbers of living hard clams per grab (1.2 yd^2) at stations in the channel.

Borrow Pit Area (Willoughby Bank)

For the construction of the portal islands, bottom materials were excavated from an area east of Fort Wool on Willoughby Bar. This activity resulted in the "hole" ranging from about 250 to 500 yards wide and about 1,250 yards long. During excavation of the tunnel for I-64, sand was relaid in the pit. Much effort went into studying the area within and adjacent to this pit. The reason being that we wished to determine if the taking of fill material from the pit or relaying material had deposited sediments in adjacent areas to such an extent that it had killed or reduced in numbers existing populations.

The contours of the pit and the surrounding bottom were measured along three transects with a fathometer (Figures 1, 6, 7 and 8). These measurements showed an irregular bottom with numerous peaks representing either piles of deposited materials from the tube area or indicative of an uneven removal of bottom materials. The depth of the original bottom seemed to have been about 15 feet; excavations had extended depths to 25 feet.

In determining clam distribution, 12 stations were occupied in the pit and 86 were sampled outside (Figure 9). These data were used to obtain average number of clams per 10 grabs in a series of transects parallel to the North, East and South edges of the borrow pit (Table 3)

An examination of Figure 9 shows that within the pit, hard clam density varied from a mean of zero to 4.2 clams per grab. The fact that clams occurred within the pit area was unexpected. There are two probable explanations. 1) These clams were taken from unexcavated

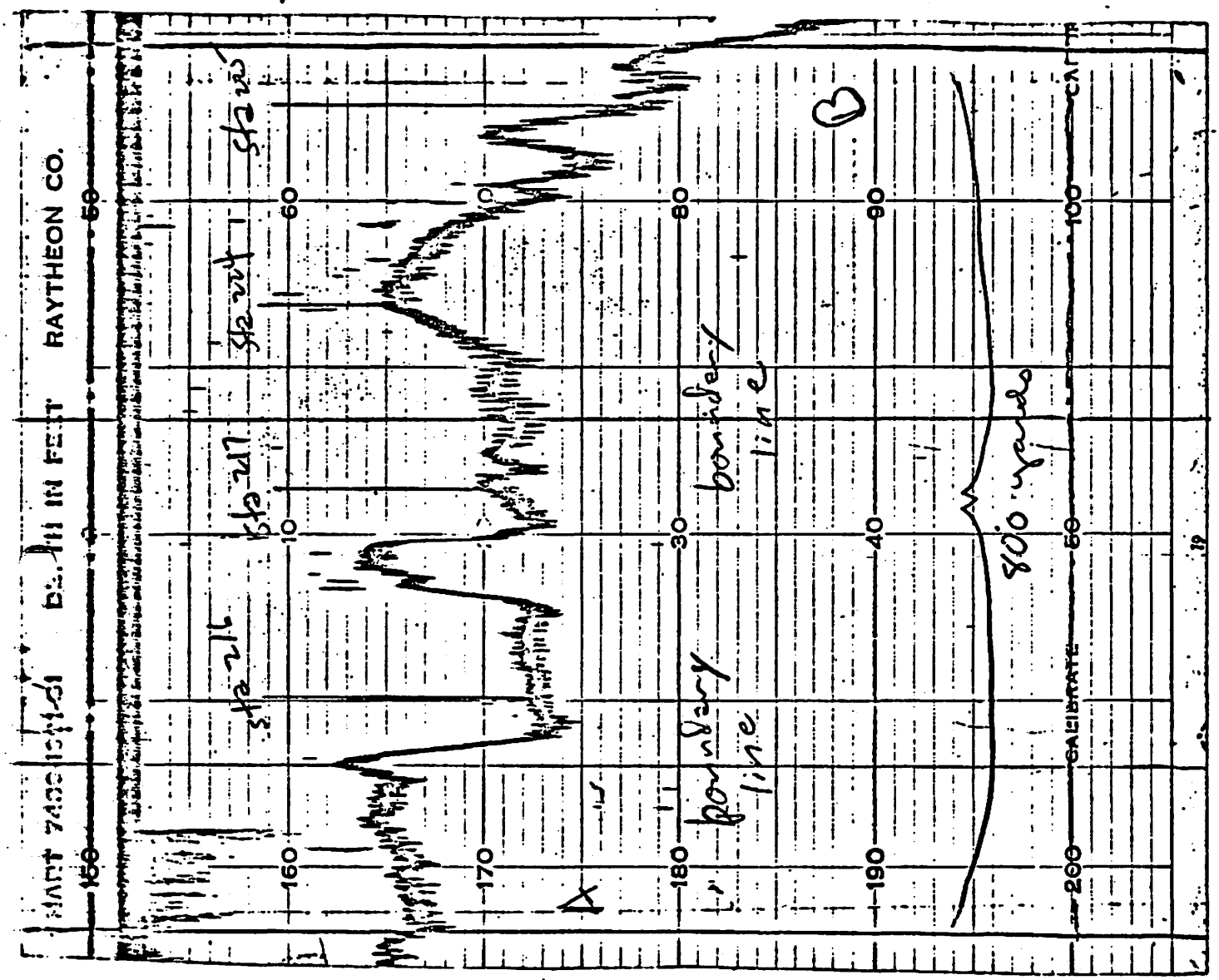


Figure 6. Fathometer tracing across Willoughby Bank borrow pit.
A-B

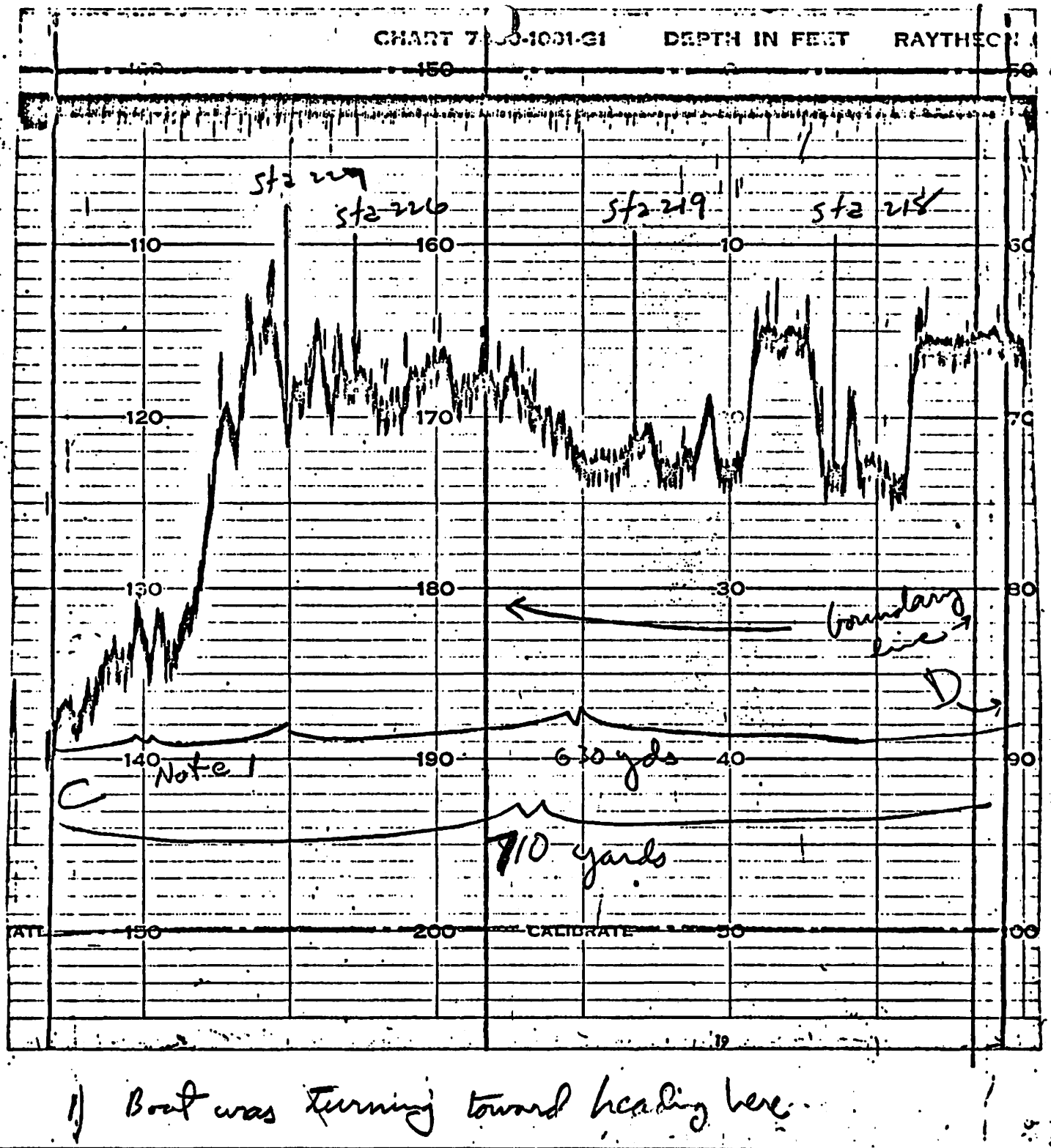


Figure 7. Fathometer tracing across Willoughby Bank borrow pit.

C-D

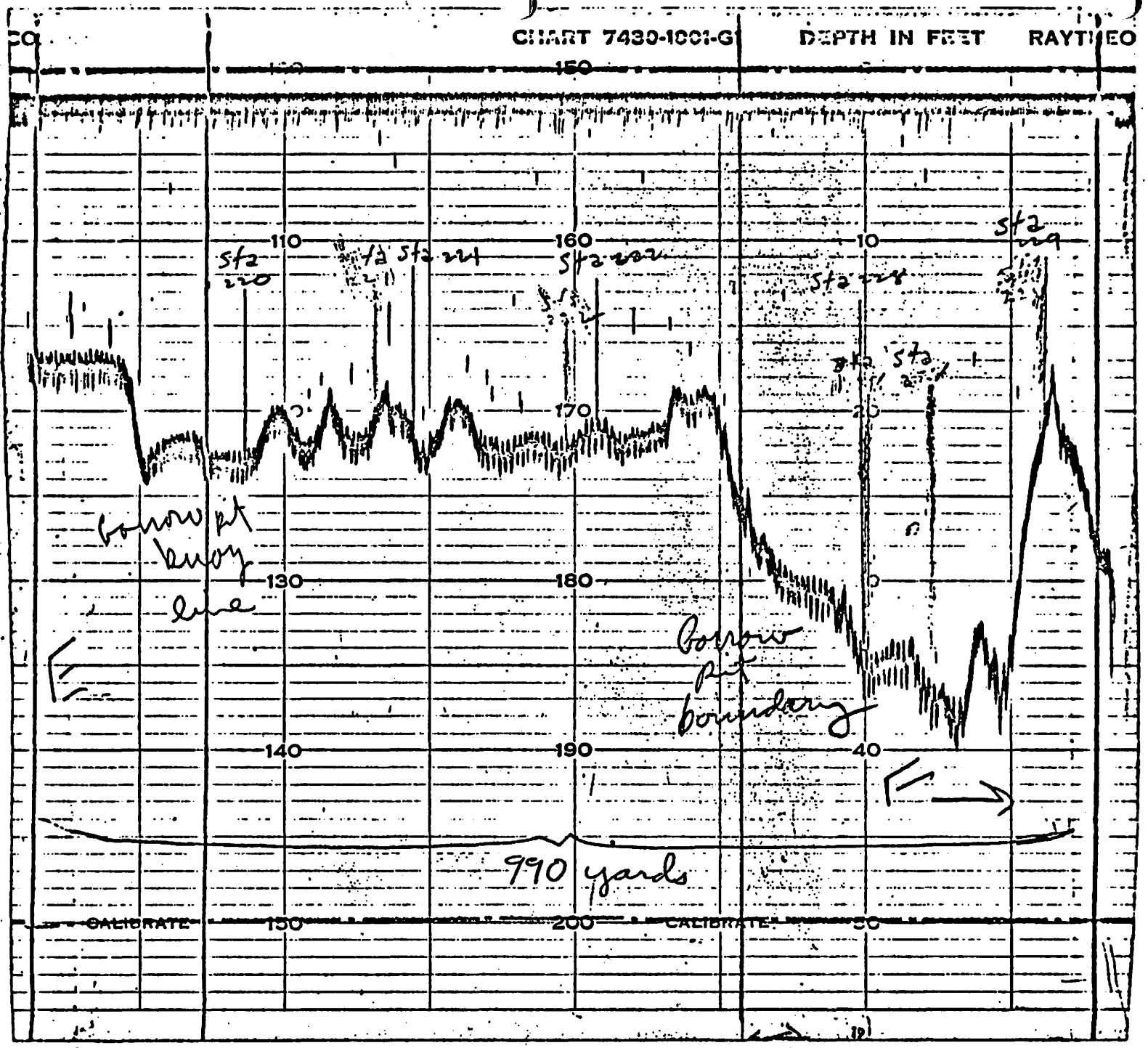


Figure 8. Fathometer tracing across Willoughby Bank borrow pit.

E-F

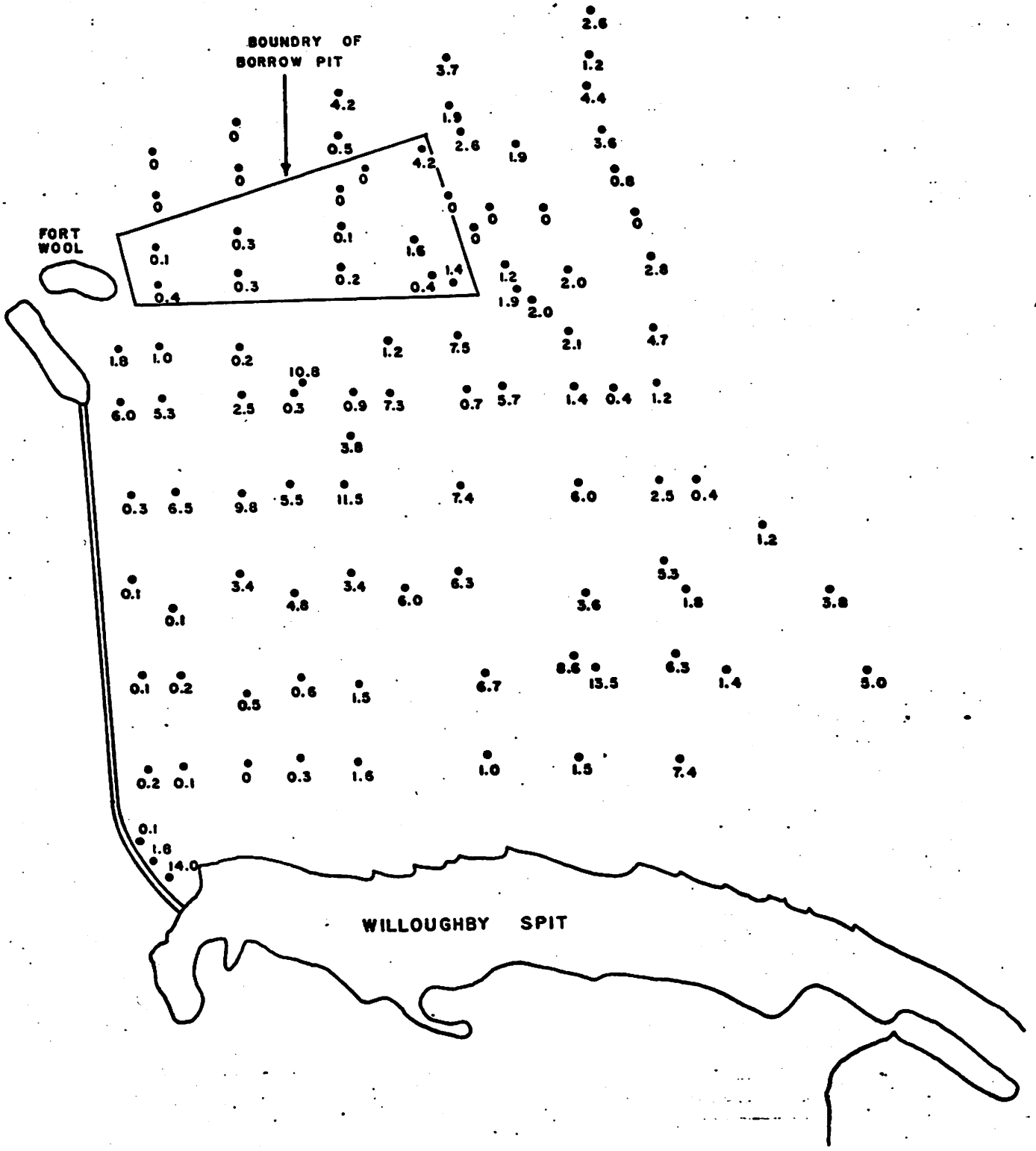


Figure 9. Mean numbers of living hard clams per grab (1.2 yd^2) at stations South of the channel and East of the approach.

Table 3

A summary of numbers and lengths of clams and numbers of clam boxes in the area east of Fort Wool in relation to distances away from the Willoughby Bank borrow pit.

Direction	Distance (ft)	Range of Depth (ft)	Number of Stations Sampled	Average Number/ Station (10 grabs)*	Mean Length (mm)	Average Number Boxes/ Station (10 grabs)*
In the pit area	-----	16 -23.5	12	8	74	0.5
North	300	16 -37	5	7	80	0.6
	800	20 -27	5	21	80	3.2
East	150	13	1	0	--	0
	300	12	1	0	--	1.0
	500	9 -18	4	14	69	0.2
	650	15	1	20	73	5.0
	1,000	9 -17	4	20	79	0.5
	2,070	13 -18	5	23	73	1.4
South	600	13.5-15	7	34	76	0.7
	1,125	14 -17	12	35	75	3.2
	1,650	13	1	38	78	1.0
	2,150	14.5-21	9	56	75	4.3
	2,700	18	1	12	72	0
	3,000	6 -15	5	37	78	1.0
	3,300	8 -19	6	34	79	1.5
	4,200	6 -20	5	32	74	1.8
	4,400	8 -20	6	48	78	0.5
	5,325	6 -13	8	15	67	0.6

* Covered 12 sq.yds.

areas within the pit; or 2) They fell into the pit from outside, as the sides of the pit slumped or collapsed.

The samples collected outside the pit area showed the following (Table 3 and Figures 10 & 11).

1. South of Pit - There was no well defined trend in abundance starting 600 feet south of the pit and extending to 5,325 feet south toward Willoughby Spit. Also number of boxes remained constant over this distance indicating no recent mortalities.
2. East of Pit - Distribution indicated a gradient. Clams were less abundant at 150-300 and 500 feet than they were at greater distances. Dead clams as shown by box counts were in most instances very low and showed no gradient with increasing distance from the pit. This suggested no recent mortality. No gradient in average size was noted.
3. North of Pit - The fact that only two parallel rows of stations were occupied on this narrow ridge between the pit and the channel precluded the establishment of a possible gradient with any degree of reliability. However, the two series suggested that at 800 feet clams were as abundant as they were in the wide areas to the south and east at a similar distance. No gradient in size was noted.

Sediments in areas 1, 2 and 3 were predominantly a sand-mud mixture where clams were present and sand with little mud where they were scarce.

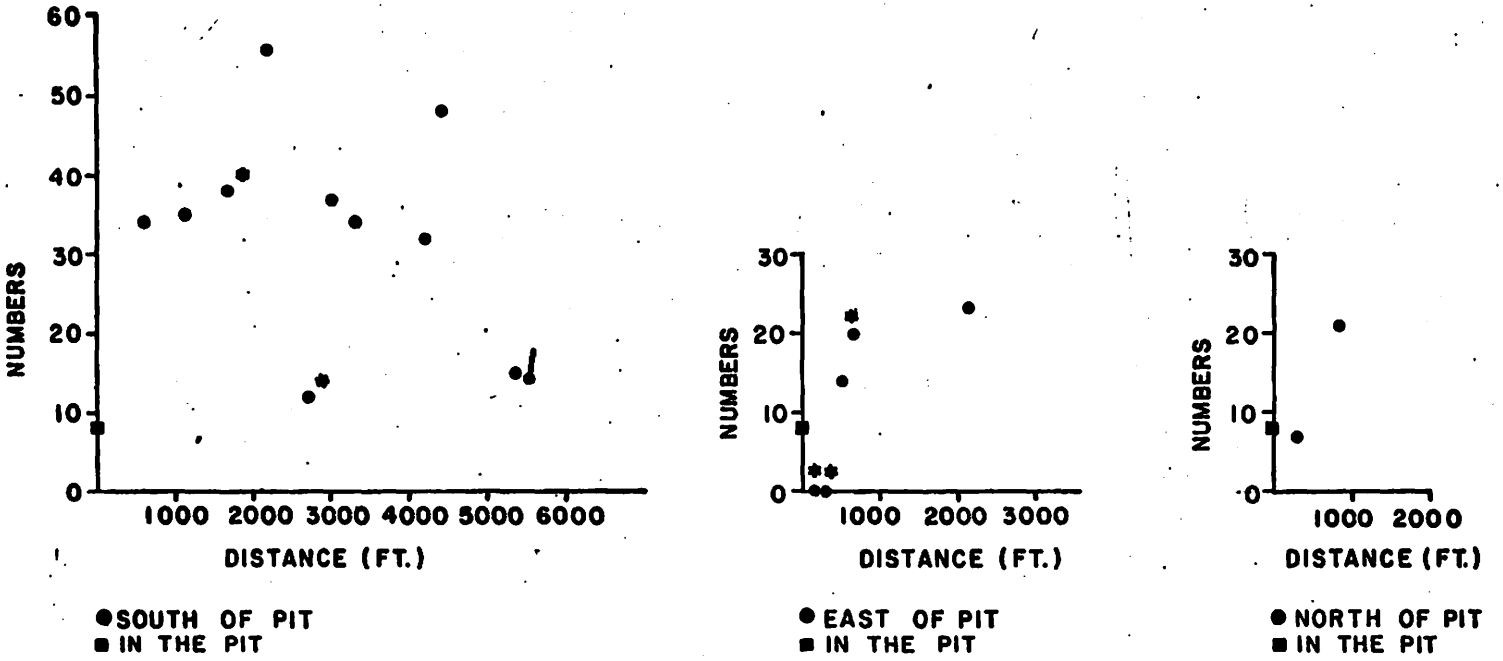


Figure 10. Numbers of living hard clams per station compared to distance from the Willoughby Bank borrow pit in three directions.

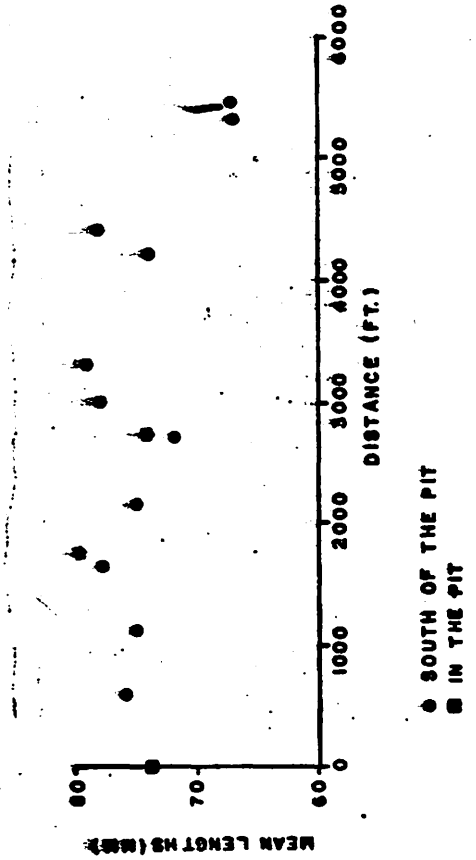
* Data from one station only.

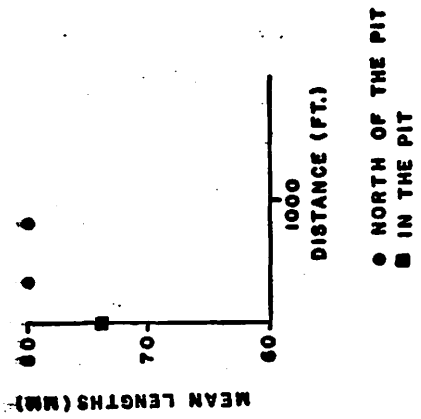
! Stations on this transect close to beach, on shallower and sand bottom.

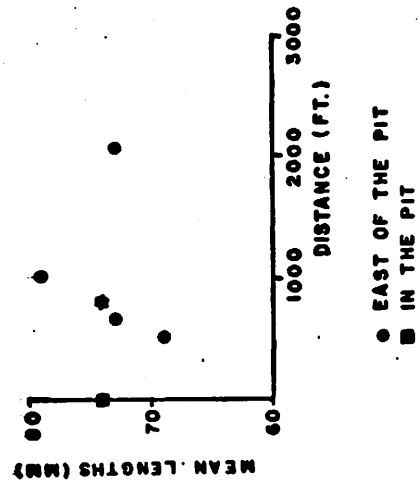
Figure 11. Mean lengths of living hard clams compared to distance from the Willoughby Bank borrow pit in three directions.

* Data from one station only.

! Stations on this transect close to beach, on shallower and sand bottom.







We concluded that in the borrow pit area there is some evidence of limited damage within 500 feet of the pit but that the evidence is not conclusive. There was no detectable effect at distances exceeding 500 feet.

South of Channel - East and West of Approach and Island

Results obtained in the area around the South Portal Island and approach based on number of clams per unit area and number of boxes indicate that the construction off Willoughby Spit has had no detectable effect on hard clam populations.

This is shown by referring to data on number of clams per unit area in Figure 9 which shows distribution to the east of the approach and to Figure 12 showing distribution to the west. These data are averaged in Table 4 to show average number per station along a transect. It is noted here that information in Figure 9 was recalculated for Table 4 so that the values shown are for transects parallel to the approach.

While there is a trend in numbers from a high catch to the East of the approach to a low one on the West side, the decline appears regular and is not interrupted by the approach (Figure 11).

The declining numbers of clams (going from East to West) may be due, in part, to a variation in the sediment type. However, confirmation of this hypothesis must await analysis of all sediment samples. In the area West of the approach, according to preliminary examinations, 18 of 31 stations (58%) had sediments which were mixtures of mud and sand, East of the approach 42 of 60 stations (70% had the

Table 4

A summary of numbers and mean lengths of clams and numbers of clam boxes in the area South of Channel compared to distance from the South Portal Island and Approach.
(Area South of the Channel)

Direction	Distance (ft)	Range of Depth (ft)	Number of Stations Sampled	Average Number/ Station (10 grabs)*	Mean Length (mm)	Average Number Boxes/ Station (10 grabs)*
East**	20	9	3	66	61	1.3
	330	6 -15.5	6	14	70	1.0
	800	7 - 8	2	2	70	0
	1,000	8 -17	4	32	74	2.8
	1,500	6 -16	6	27	75	1.3
	2,150	6.5-16	6	37	78	1.0
	2,800	7 -18	6	38	74	1.5
	3,300	13.5-14.5	3	48	80	2.7
	4,230	10 -21	6	49	78	2.3
	4,350	16	1	57	76	7.0
	5,250	10 -20	7	53	74	2.1
	5,800	14	1	4	65	0
	6,400	13 -21	7	43	75	1.9
	6,900	17 -18	2	10	81	0
West	375	8	1	12	64	0
	725	7 -13.5	7	28	70	1.0
	1,225	6 - 9.5	7	22	77	0.6
	2,225	7 -16	6	23	76	0.2
	3,225	12 -13.5	5	12	74	0.6
	4,225	10 -13	5	8	72	0.4

* Covered 12 sq. yds.

** The data tabulated here is shown as average density at individual stations in Figure 9. However, in Table 4, the data are tabulated in a series of transects parallel to the tressel instead of parallel to the borrow pit as they appear in (Table 3 - South).

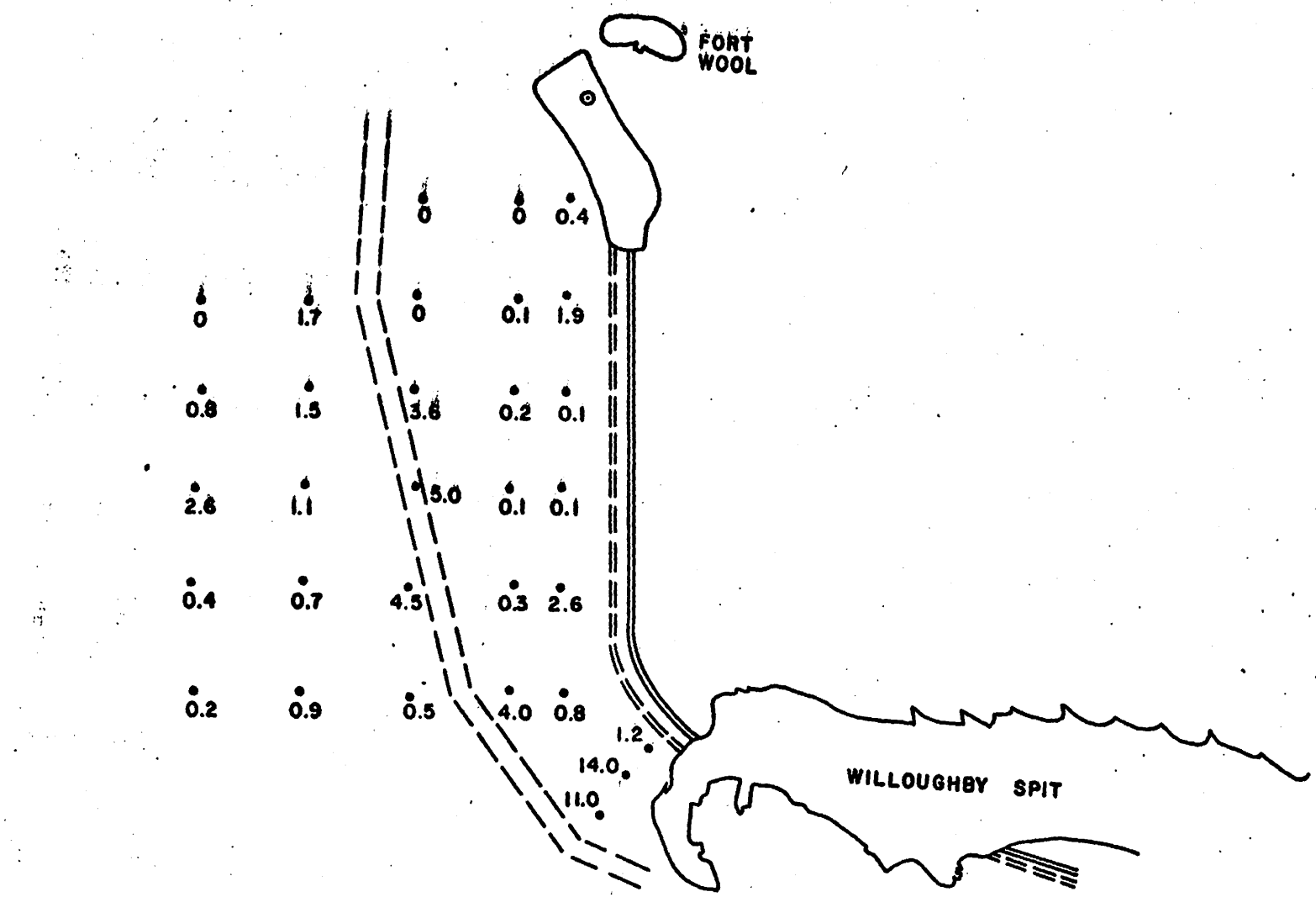


Figure 12. Numbens of living hard clams per grab (1.2 yd^2) at stations South of the channel and West of the approach.

same mixture. At the remaining stations on both sides of the approach a sand bottom was found which is unfavorable for hard clam growth and recruitment. Ninety-seven percent of the stations occupied had depths between 5 and 20 feet.

Box counts were low especially near the island and approach further substantiating our observations that there was no condition causing mortalities which seem associated with construction.

Analysis of mean length of hard clams showed a decrease in mean length as one got closer to the approach (Figure 4C). The significance of this aspect cannot be determined until length data is analyzed.

CONCLUSIONS

With one minor exception, there is no evidence that the existing structures, or the construction activities have adversely influenced hard clam populations. The single exception is to the east of the borrow pit where "damage" may have extended about 500 feet.

Data on length frequency and sediment type are still being analyzed.