12-1972

Survey of Leased Oyster Grounds Adjacent to the James River Bridge at Newport News, Virginia

Dexter Haven
Virginia Institute of Marine Science

Paul Kendall
Virginia Institute of Marine Science

Survey of Leased Oyster Grounds Adjacent to the James River Bridge at Newport News, Virginia

by

Dexter Haven and Paul Kendall

Virginia Institute of Marine Science
Gloucester Point, Virginia 23062

December, 1972

INTRODUCTION

Contents of This Report

This report describes the condition of leased oyster grounds in the area which is adjacent to the proposed construction site of the second James River Bridge. This survey was accomplished by taking numerous samples of the bottom with the aid of patent tongs and counting numbers of living oysters and hard clams. The quantity of shells taken was noted and observations were made on the nature of the bottom. During this study, which extended from 31 July to 11 August, 1972, nine individual tracts of leased bottom were investigated, and 222 samples of the bottom were collected (Table 1).

A second study was conducted during September and October, 1972 by an experienced diver who swam over all nine tracts to determine the density of exposed oyster shell, the character of the bottom and the number of living oysters.

A third study estimated dollar value of lands belonging to the Ballard Fish and Oyster Company adjacent to the present James River Bridge (See Appendix).

The James River - Its Productivity.

The area studied in this survey is in the lower James River adjacent to the James River Bridge. The James is the largest seed oyster producing area on the east coast. Here oysters set naturally on the shelly bottom, and in 1972 381,250 bushels of seed oysters were harvested from the extensive public rocks.

While the James is productive today, there has been a drastic decrease in production since 1960 which was severe in the lower part of the river starting in the vicinity of the James River Bridge and extending to the mouth of the system in Chesapeake Bay. This decline was part of a Bay wide decline in nearly all the high salinity regions (15 parts per thousand and over). The cause of this phenomenon was the oyster disease MSX which first appeared in Chesapeake Bay in 1960. In high salinity regions it often killed up to 70 percent of the oysters present each year. The disease, however, did not cause mortalities in mid to low salinity regions such as occur in the upper half of the James.

The Study Area

The leased bottoms investigated in this report are in the lower part of the James River seed area. Their exact location relative to the proposed bridge are shown on "Commonwealth of Virginia Department of Highways" chart dated May 16, 1972. (Sheet 9).

Several of the leases are in close proximity to Baylor Survey grounds (public oyster rocks). On the east side of the James, they

are close to Brown Shoals; on the south side they are near Ballard's Marsh and Naseway Shoals. Prior to 1960 these three public rocks were moderately productive. Exact information is lacking on the use of the adjacent private leases prior to 1960 but available information indicates that several were covered with oyster shells by the owners. These shells collected a "set" of oysters (seed). At intervals the small oysters were moved to other areas to grow to maturity. Certain growers, however, reportedly allowed the seed to grow to maturity in the area.

During the early and mid 1960's, MSX was especially destructive in the lower part of the James, and in the area covered by our study. Production from the public rocks dropped to almost zero. Several of the lease holders in the area reported that nearly all their oysters died.

Today MSX is still a major cause of oyster mortality in high salinity regions of Chesapeake Bay. However, during the past 2 or 3 years, there seems to have occured a major increase in the survival rates of oysters on the south side of the James River in the area beginning at the bridge and extending at least 1 mile down river. Our reasons for this statement follow:

1. In the mid 1960's few commercial tongers worked the public rocks in the area. Observations by the author, however, indicate that in October and November 1972, on several of the public rocks on the south side of the river (1/4 mile below the bridge) there were sufficient oysters to support operations by 5 to 10 boats daily.

2. As will be shown in the report which follows one of the private leases below the bridge has accumulated a large population of oysters which range in size from 1/2 to 3 inches long. Based on our knowledge of setting and rates of growth we believe that these oysters must have set during the 1969, 1970 and 1971 seasons.

On the east side of the James River at Brown Shoals production of oysters has not increased.

The probable reason for the increase survival of oysters on the south side of the James is a reduction in the severity of MSX in this area. This has allowed oyster populations to gradually accumulate over the past 2 or 3 years. How long this condition will continue is problematical. However, it is thought that in the future, low salinities similar to those experienced in the last 2 years will favor a continuation of the present situation. If salinities increase in the area due to low rain fall in the water shed area then mortalities due to MSX may again increase to levels observed in the early 1960's.

It is noted that oysters in the area surveyed on the east side of the James are polluted; those on the south side are not classed as polluted.

PRELIMINARY STUDY TO LOCATE GROUNDS PRIOR TO SURVEY

Prior to determining population of oysters, etc., it was necessary to first establish the location of the various leases. Therefore, on 31 July, 1972, Mr. Haven and Mr. Kendall from VIMS and Mr. Sinclair,

chief surveyor for the Virginia Marine Resourses Commission went to the James River to locate the grounds to be studied.

Ballard's ground was already staked in the following manner: the lower two corner stakes had cedar trees tied at the top; the upper off shore corner had four stakes in a clump with a white plastic bottle attached. The offshore and inshore lines were marked where they crossed the bridge by clumps of stakes on the downriver side of the bridge; the offshore clump had a cedar bush tied in it and the inshore one had an iron stake as one of the clump. Ballard's offshore, inshore and downriver lines were marked with single stakes at fairly regular intervals (Figure 1).

Lore's ground was easily located because all corner clumps of stakes had wooden tags tied to them with the initial "D.L." in yellow plus orange and red streamers (Figure 2). In addition all corner clumps of stakes had a bamboo stake among them. Besides these markings the upriver, offshore stake had a yellow piece of cloth on it. According to the stakes the offshore line was inshore of what is shown on the Highway Department drawing. Mr. Sinclair said that the stakes should correctly mark the ground because some VMRC engineers had just recently put them there.

Stroup's ground above the bridge was already marked by single stakes with red streamers attached (Figure 2). The stake near the bridge marked the offshore, downriver corner of the plot, and the stake upriver marked the offshore corner in that direction, according to Mr. Sinclair. Another plot below the bridge leased by Stroup was

already staked at its offshore, downriver corner; a white streamer was tied to the stake.

Melzer's ground was not staked. However, the stake marking Stroup's plot below the bridge was so close to the inshore, upriver corner of Melzer's big plot and the offshore, upriver corner of the smaller, adjacent plot that it was taken to mark those corners also. The offshore, upriver corner of Melzer's large plot coincided with the clump of Ballard's stakes containing the iron stake; so, that clump was used by Mr. Sinclair to locate Melzer's corner (Figure 2).

Three stakes with white streamers attached were placed along what Mr. Sinclair determined to be the downriver line of Melzer's two plots. Mr. Sinclair stood on a small point of land which he determined to be the point shown on the Highway Department drawing as being adjacent to Melzer's downriver, inshore corner. From there he directed VIMS personnel to stick the stakes in a line from him to the towers on the James River Bridge. At that time, he stated that the point which he had stood on may actually have been a short distance upriver from the point shown on the drawing; in that case the line of stakes would be upriver of the lower boundary of Melzer's plots. Later, when we were measuring off the stations on the plots we determined that this was the case, i.e., that the line of three stakes was upriver of where they should be.

Hines' ground was unmarked. The line of three stakes stuck at the lower end of Melzer's plots were used to locate the upper line of Hines' plot. Since the offshore, downriver corner of Hines' plot is the same as the inshore, downriver corner of Ballard's plot, Ballard's

stake at that point was used. A single stake with a white streamer attached was stuch at Mr. Sinclair's direction to mark the inshore, downriver corner of Hines' plot. Mr. Sinclair determined the location by lining up the point of land (shown on the Highway Department drawing as being adjacent to Melzer's lower line) with the rip rap at the end of the bridge and, at the same time, lining up the two cedar bushes marking Ballard's downriver corners (Figure 2).

Miles' ground on the south side of the river was marked with a clump of stakes at the offshore, downriver corner; a white streamer was tied to this clump. The upriver line of this plot corresponds to the downriver line of Ballard's plot which is marked with two cedar bushes.

Miles' plot on the north side of the river was marked at the upper corners by clumps of stakes; white streamers were added. The long leg of the offshore line was marked with single stakes at fairly regular intervals. At the point where this offshore leg bends there was a clump of two or three stakes; a white streamer was tied to the stakes (Figure 3).

Michaux's ground was unmarked; therefore, we stuck two stakes with white streamers attached at the offshore corner at Mr. Sinclair's direction. Both stakes were stuck when the two offshore legs of the electric tower nearest the river bank were in line. The upper stake may have been put closer than 400 ft. to the bridge; it seemed so when we went there later to take samples (Figure 3).

PROCEDURE

Locating Stations - The corners of the tracts were already marked (as previously described). These were used for reference. Stations where samples were collected were first located on charts of the area in west to east lines across each tract and were spaced at regular intervals. Stations were designated by a system of letters and numbers (Figure 4 and 5). On the river the stations were located with reference to the corner stakes using appropriate landmarks; a plastic line marked at 50 foot intervals was then used to measure distances. When a station was located, a wooden stake was placed there to mark the spot.

Taking Samples of the Bottom Substrate - This study was conducted using a 37 foot boat designed and rigged to harvest hard clams. The bottom samples were obtained with a pair of heavy "patent tongs" which were raised and lowered by a power winch. These "tongs" equipped with teeth penetrated soft mud and hard shelly bottom to a depth of about 4-5 inches and brought to the surface a section of bottom covering about 1.2 square yards. This was deep enough to collect all living oysters and hard clams, and surface shells. It was not deep enough, however, to collect all buried shells which may have been in the area.

At each station, two grabs were made with the tongs, therefore, each station represented 2.4 square yards sampled. After each single grab, however, the boat was moved slightly so that the tongs did not fall twice in the same place.

At each station the following data was collected: water depth, date, time, vegetation (if any), bottom type, quantity of shells (buried or surface), numbers of living oysters and their length, and

numbers of hard clams. Observations were also made on fouling of shells and on the number of boxes (hinged but empty shells). This latter parameter was useful in estimating mortality.

Analyzing the Samples - The contents of the two grabs of the patent tongs at each station was analyzed separately for numbers of oysters and clams and for the quantity of oyster shells. The length of live oysters and clams was measured. Shell material was tabulated according to whether it had been buried beneath the surface of the bottom or had been resting above the bottom. The difference was readily apparent since shells buried in the bottom were black from anerobic conditions; shells not buried in sand or mud were light brown. Small numbers of shells were counted individually; larger quantities were measured in a plastic pail marked in quarts. (Count of 10 quarts of shell showed that, on the average, one quart contained 17 shells).

Using the area sampled by the dredge (1.2 sq/yd) we calculated mean numbers of oysters and shells per grab and per acre. Table 2 shows how these calculations were made.

RESULTS

There were variations in the tracts surveyed. Those differences will become apparent from the following summary.

Ballard's Ground - For analysis, Ballard's grounds were divided into the smaller portion up-river from the bridge and that part below the bridge (Figure 1).

The larger part of Ballard's ground (about 238 acres) is located downriver from the bridge and our study showed that the major part of

this area must now be classed as good oyster bottom, which is now supporting a fair to good crop of marketable oysters. Our reason for these statements follow: 1) Most of the areas sampled showed exposed oyster shells, and locations not having exposed shells had shells buried in the substrate; 2) Average density of oysters here was 198 bushels per acre. Natural mortality was low and few boxes (dead oysters) were seen. The oysters were natural strike (not planted) and this indicates that the area was naturally productive and had produced a crop of marketable oysters without the expense of planting seed.

The portion above the bridge is about 44 acres in size and has exposed shell in about half the areas sampled; all stations, however, showed shell material in the subsurface deposits (Table 3, Figure 4). The density of oysters was 54 bushels per acre which is too low to be of much value commercially. Most oysters ranged from 1 to 3 inches long. These oysters were not planted but originated from larvae which set on the exposed shells. Few boxes (dead oysters) were seen. Although the density of oysters is not too high, the area must now be considered as potentially productive because of its firm bottom containing shells, and the existence of the large populations of oysters growing on the same type of bottom downriver.

Lore's Ground - The bottom on this tract had no exposed shell and was not producing oysters when it was sampled since our study indicated a density of only 3.4 bushels per acre (Table 4, Figures 2 and 4). The bottom contained little exposed shell (shell which had been resting above the bottom) and our estimate of 51 bushels of shell per acre indicated that total quantity was not large. The bottom of the tract

appeared to be "patchy"; i.e., at most of the stations the bottom was a mixture of sand and mud. It is possible that this bottom could be made productive if planted with seed oysters or if it was shelled at the rate of about 5,000 bushels of shell per acre.

Stroup's Ground - This tract had a hard sandy bottom. It had no shell available for cultch. No oysters were found (Table 5, Figures 2 and 4). This bottom could be made productive only if planted to seed oysters or shell as outlined for Lore's ground.

Melzer's Ground - Both of Melzer's tracts will be discussed together since they are adjacent and since similar results were found on both. No shell was present to provide cultch and the tract was not producing oysters. The bottom at almost all stations was hard, packed sand mixed with some clay; at a few stations it was mud and sand. Therefore, the bottom seemed suitable for oyster culture. It was, however, located in shallow water (4 feet MLW) and if planted with shells or seed, the sandy bottom might shift during storms thus killing those living in the area. On the entire 182 acres, 2 live oysters and a negligible amount of shell (most of it buried) were found (Table 6, Figures 2 and 4).

Hines' Ground - At all stations sampled there was a hard sand bottom (Table 7, Figures 2 and 4). A negligible quantity of shell and no live oysters were found. It could be made productive as outlined for Lore's ground, but the fact that it is located in shallow water means that oysters or shells planted there might be covered by shifting sands during storms.

Miles' Ground - There are two tracts leased by Miles and Co. on opposite sides of the James River.

The tract on the south side of the river appeared suitable for oyster culture over most of the area and was producing a small quantity of oysters which was estimated at 40 bushels per acre (Table 8, Figures 3 and 4). The bottom varied from hard sand with plenty of shell to exposed oyster shell over mud, to a mud bottom with no shells. Density of shell was estimated at 260 bushels per acre.

Miles' tract on the north or Newport News side of the James River also appeared to be suitable for oyster culture because of the thick layer of exposed shells which covered most of it. We found, however, only 9 bushels of oysters per acre and this was too few to call it commercially productive. At most stations, about half the shells brought up were surface shells (Table 9, Figures 3 and 5).

Three cherrystone size hard clams were recovered from two stations at the lower, offshore corner.

Michaux's Ground - This bottom was suitable for oyster culture, since it was of hard sand and it was located in 8 to 10 feet of water. No oysters and no shell was found (Table 10, Figures 3 and 5).

Two cherrystone size hard clams were found in one sample.

HARD CLAM DISTRIBUTION ON LEASED BOTTOMS

The five hard clams obtained by the patent tongs from Miles' ground on the east side of the James and from Michaux's ground were the only ones recovered by the grab in the entire study on both sides of the river. It was concluded that hard clams are very scarce or

absent on the leased bottoms surveyed in this study.

DIVER SURVEY OF LEASED BOTTOM

The patent tong survey of leased bottoms was designed to provide quantitative data on numbers of oysters, shells and hard clams at known locations so that present distribution might be defined and results compared with similar data collected at a future date. This technique obviously did not sample bottoms between the stations, therefore, we supplemented this study with a diver survey to determine if the densities between stations were the same as revealed by our single station analysis. To determine this, a trained diver swam over all leased plots sampled by patent tongs and observed the bottom for oysters and surface shells. This survey confirmed the data obtained by the patent tong study. That is, where the patent tong showed living oysters and exposed shells, the diver reported a similar situation over a wide area; when the patent tongs reported no oysters or shells, the diver showed a similar condition over a much wider area.

There follows the report submitted by Mr. Lynch, the diver who made the survey, (see appendix for the letter of transmittal).

REPORT OF THE CONDITION OF SELECTED OYSTER BOTTOMS

IN THE

JAMES RIVER, VIRGINIA

On 23 and 24 September 1972 and 9 and 14 October 1972, I examined certain oyster grounds in the James River in close proximity to the James River Bridge. These grounds were examined by diving either in selected spots or by being towed over the grounds behind a small boat. My findings are listed below.

Michaux Grounds: Firm bottom, no oysters.

J. H. Miles Ground (East Side): Shell bottom, some scattered live oysters 2 1/2-3" long. Scattered patches of clear bottom and buried shell.

Melzer Grounds (Both Sets): Hard, sand bottom, no oysters or shell.

Ballard Ground (Above Bridge): Shell and some oysters on area towards bridge, remainder of ground soft with some scattered shell.

Other ground above Bridge (West Side): A few small patches of shell and oysters next to bridge, remainder of ground firm, no shell or oysters.

Ballard Ground (Below Bridge): In area adjacent to pipeline, mud and mud over shell. Most of remainder of ground, good shell bottom, many oysters 2 1/2-3" long.

J. H. Miles Ground (Below Bridge - West Side): Primarily shell bottom, some oysters, some areas covered with mud.

Overall, only the grounds belonging to Ballard, and to a lesser extent, Miles below the bridge on the west side appeared to be active, viable oyster grounds.

M. P. Lynch

SUMMARY

Our study showed a most significant aspect concerning the leased bottoms near the site of the new bridge. That is, there was an area of about 238 acres of bottom immediately adjacent and to the south of the bridge (Ballard's Ground) which during the past 2 or 3 years has produced a crop of oysters of commercial size. We believe that there are three principal reasons for the existence of this crop.

1. Ballard's ground had during 1969, 1970 and 1971 a large quantity of exposed shell for oyster larvae to attach.
2. Mature oyster larvae were in the water in that area during those years and they did in fact attach to the shells.
3. MSX, which has plagued the area in the early 1960's for some reason (probably low salinity), has not caused appreciable mortalities in the past 2 to 3 years and, therefore, there has been an accumulation of oysters on these grounds. It is impossible to say how long this latter condition will persist.

It is of interest to calculate the maximum value of the oysters on Ballard's lease on the basis of 198 bushels per acre and a size of 238 acres. Assuming a value of $3.50 per bushel (See letter dated 18 October in Appendix) we may calculate: 238 X 198 X $3.50 = $164,934. This, of course, is maximal and assumes complete harvest.

It is of interest to determine value of shells in the area. As we stated previously, our estimate of shell abundance does not give a true picture of quantity of buried shells and the quantity shown in this study are all too low. However, oystermen often plant 5,000

bushels of shell per acre, and it is our estimate that there was at least this amount on Ballard's ground. The value of this shell planted is 25 cents per bushel. Consequently, the value of the shells in the area is:

25¢ X 282 X 5000 = $352,500

Miles' leased bottom on the sourth side of the James contained only 40 bushels of oysters per acre and it is doubtful that they would be dense enough to harvest at the present time. However, if they were those present would have a maximal value of:

40 X 94 X $3.50 = $13,160

Shells are estimated to have been planted at the rate of at least 5000 bushels per acre: Therefore, these would have a value of:

94 X 5000 X 25¢ = $117,500

Miles' bottom on the east side of the James contained no oysters but large quantities of shell which would have an estimated value if they were to be replaced of:

43 X 5000 X 25¢ = $53,750

The remaining oyster grounds belong to Hines, Lore, Stroup, Melzer and Michaux contained no oysters and it was evident that shells had not been planted in the area. Therefore, no value may be placed on shells or oysters on their grounds. Their only value is their basic value, which may be about $400 per acre (see letter in appendix). It is pointed out, however, that while these bottoms do not have shell or oysters now, there is the possibility that they may be shelled or planted with seed oysters at some future date with some expectation of obtaining a "crop".

It is concluded that companies engaged in construction activities at or near the bridge site should observe caution so that their activities do not damage the existing oyster and shell resources on Ballard's and Miles' grounds.

On grounds not planted with shells or containing oysters, the potential danger is that a future crop might be endangered or that silt accumulation might make the ground unsuitable for oyster culture.

APPENDIX

1. Letter to Mr. R. R. Chapman submitted 18 October 1972 giving dollar value of oyster grounds which belong to Ballard, adjacent to the bridge.

2. Report of Mr. M. P. Lynch submitted 17 November 1972 giving results of survey of the bottom.

MEMO

TO: Dexter Haven

FROM: M. P. Lynch

SUBJECT: Survey of oyster grounds in the vicinity of the James River Bridge. September - October 1972.

DATE: 17 November 1972

1. Attached you will find a report of a survey made by me on designated oyster leases in the vicinity of the James River Bridge during September and October 1972.
2. A bill for expenses and fees is being submitted under separate cover to the State Highway Department.

M. P. Lynch

Attachment

cc: Mr. R. R. Chapman (without attachment)

COMMONWEALTH OF VIRGINIA

VIRGINIA INSTITUTE OF MARINE SCIENCE
GLOUCESTER POINT, VIRGINIA 23062

October 18, 1972

Mr. R. R. Chapman
Assistant District Right-of-Way Engineer
Deparmtent of Highways
Suffolk, Virginia 23434

Dear Mr. Chapman:

We have completed our survey of the oyster grounds in the vicinity of the New James River Bridge. A complete report on the project will be forwarded to your department shortly.

As you requested, prior to the submission of the completed report, we have summarized data on the oyster grounds leased by the Ballard Fish and Oyster Company and have estimated the value of the oysters and shells in the 22 acres which will be occupied by the bridge right-of-way. We have enclosed a chart of this area on which is entered the density of living oysters per square yard as shown by our study. Also data are given showing quantity of shell material obtained at each station.

Our estimate of the area we surveyed is that at present it is a naturally productive oyster ground. The bottom has been "shelled" and the oysters on the bottom came from a natural strike and were not planted. At the present time the living oysters average from 2-1/2 to 3-1/2 inches long.

We have not surveyed the 22 acres in the Restricted area but have assumed, as you suggested, that its productivity and basic value per acre is the same as that which we did examine. In respect to the number of oysters there per acre, we (in the absence of a survey there) have assumed a density equal to that in the area we did examine.

We have arrived at our estimate by averaging the density of oysters below the bridge, and find that there are about 198 bushels per acre. We did not include the area above the bridge since the oysters there had apparently been harvested. Other values used in our calculations

are shown below. We have assumed a value of $3.50 per bushel which is the price they would bring as soups.

1. Value of shells on the bottom was estimated by assuming that about 5,000 bushels per acre is the usual quantity planted. Value of shells planted per bushel is 25¢.

5000 X 25¢ X 22 acres = $27,500

2. Value of oysters on the bottom was estimated using our estimate that there are 198 bushels per acre and that each bushel is worth $3.50. Note: this assumes complete recovery of the oysters when harvested, which is seldom achieved. Therefore, this value is maximal.

198 X $3.50 X 22 acres = $15,246

3. Basic value of grounds - this is a difficult figure to arrive at. I understand, however, that the appraisers for the State has set its value at $400 per acre (without shells). I agree that this value is not excessive.

$400 X 22 acres = $8,800

TOTAL = $51,546

The preceding values are, of course, maximal for values of oysters since it is seldom possible to recover all from the bottom.

If you need further information, please let us know.

Sincerely,

Dexter Haven
Head, Department of Applied Biology

DH/gjb

Enclosures (2)

Table 1

Tracts of Leased Oyster Ground Surveyed and Number of Samples Taken

Lessee	VMRC Plat No.	Acreage Surveyed*	Number Samples	Number Stations
Ballard Co.	1,438	282	76	38
Lore, D.H. & Sons	7,899	37	12	6
Stroup, J. G.	2,136	4	4	2
Melzer, W.D.	7,898	122	32	16
Melzer, W.D.	11,080	60	20	10
Hines, Evelyn		59	18	9
Miles, J.H. & Co.	7,988	43	28	14
Miles, J.H. & Co.		94	26	13
Michaux, L.	8,113	8	6	3
	Total	708	222	111

* This is the unrestricted acreage.

Table 2

Methods of Calculating Average Density of
Live Oysters and Shells

1. There are 44.8 quarts in a Virginia bushel.
2. There are 4,840 square yards in an acre.
3. The oysters of the size recovered from the area counted on the average 400 to the bushel.
4. The shells we recovered, on the average, counted 17 to the quart, or 762 per bushel.
5. Each grab of the patent tong covered 1.2 square yards of surface area.
6. Average penetration of the grab on soft and hard bottom was about 4-5 inches.

Example of typical calculations taken from Table 4 D.H. Lore & Sons.

Oysters

Average No. Live Oysters/Yd^2 (.27) X 4,840 (sq. yds/acre) = 1307 oysters. Therefore, 1307 ÷ 400 (number of oysters in a bushel)= 3.4 bushels per acre.

Shells

Average number of qts. per grab (note this is not per sq/yd)
.51 qts ÷ 1.2 yd^2/grab X 4840 yd^2/acre ÷ 44.8 qts/bu = 51 bu/acre.

9 59/66

Table 3

Density of live oysters and of shell found in August, 1972 on a tract located in the James River and leased by Ballard F&O Co.

Tract	Station Number	Sediment Type	Live Oysters Recovered: Mean Grab	Live Oysters Recovered: No. Yd^2	Buried & Clean Oyster Shell Recovered: Total (qts)	Buried & Clean Oyster Shell Recovered: Mean Grab (qts)
Ballard	A 1	SH-BS	61.0	50.8	9.0	4.5
	A 2	SH-BS	40.0	33.3	14.0	7.0
	A 3	SH-BS	28.5	23.8	9.0	4.5
	B 1	SM-BS	0	0	2.6	1.3
	B 2	SH-BS	33.5	27.9	8.0	4.0
	B 3	SH-BS	27.0	22.5	15.0	7.5
	B 4	SH-BS	23.0	19.2	4.0	2.0
	B 5	SH-BS	7.5	6.2	4.0	2.0
	B 6	SH-BS	26.5	22.1	8.0	4.0
	C 1	M-BS	0	0	0.2	0.1
	C 2	SH-BS	49.0	40.8	5.5	2.8
	C 3	M-BS	0	0	3.2	1.6
	C 4	SH-BS	18.5	15.4	2.8	1.4
	C 5	SH-BS	19.0	15.8	4.0	2.0
	C 6	SH-BS	22.0	18.3	6.0	3.0
	C 7	S-BS	37.5	31.2	6.0	3.0
	C 8	SH-BS	30.5	25.4	9.0	4.5
	C 9	SH-BS	17.0	14.2	3.0	1.5
	D 1	M-BS	0	0	0.4	0.2
	D 2	M-BS	0	0	1.1	0.6
	D 3	M-BS	35.0	29.2	11.0	5.5
	D 4	SS-BS	7.5	6.2	2.2	1.1
	D 5	SH-BS	27.5	22.9	4.9	2.4
	D 6	SH-BS	34.0	28.3	3.0	1.5
	D 7	SH-BS	13.0	10.8	2.5	1.2
	D 8	SH-BS	24.5	20.4	3.0	1.5
	D 9	SH-BS	21.5	17.9	8.0	4.0
	D10	SH-BS	27.5	22.9	11.0	5.5
	E 1	M-BS	0	0	0.9	0.4
	E 2	M-BS	0	0	1.4	0.7
	E 3	M-BS	0	0	4.2	2.1
	E 4	S-BS	3.0	2.5	1.1	0.6
	E 5	S-BS	1.5	1.2	1.0	0.5
	E 6	M-BS	0.5	0.4	1.3	0.6
	E 7	M-BS	1.0	0.8	3.1	1.6
	E 8	M-BS	1.0	0.8	2.0	1.0
	E 9	S-BS	5.5	4.6	2.1	1.0
	E10	S+SH-BS	9.0	7.5	4.0	2.0

46

Estimated average density of live oysters downriver side of bridge 197 bushels/acre.
Estimated average density of live oysters upriver side of bridge 54 bushels/acre.

Estimated average density shells in whole area 214 bushels/acre.
SH = exposed surface shell; BS = buried shell; S = hard sand bottom; M = soft mud.

Table 4

Density of live oysters and of shell found August 1972, and the estimated average density of each (bu/acre) on a tract located in the James River, Virginia and leased by D. H. Lore & Sons.

		Live Oysters Recovered		Buried & Clean Oyster Shell Recovered	
Station Number	Sediment Type	Mean Grab	No. Yd^2	Total (qts)	Mean Grab (qts)
P 1	M-BS	0	0	1.0	0.5
P 2	M-BS	0.5	0.4	1.2	0.6
P 3	M-BS	0.5	0.4	1.4	0.7
Q 1	M-BS	0	0	0.4	0.2
Q 2	M-BS	1.0	0.8	1.4	0.7
Q 3	S-BS	0	0	0.9	0.4
Average			.27		.51

Estimated average density of live oysters - 3.4 bushels/acre.

Estimated average density of shell - 51.0 bushels/acre.

SH = Exposed shell hard bottom; BS = buried shell; S = hard sand; M = soft mud.

Table 5

Density of live oysters and of shell found August 1972, on a tract located in the James River, Virginia, and leased by J. G. Stroup.

Station Number	Sediment Type	Live Oysters Recovered: Mean Grab	Live Oysters Recovered: No./Yd^2	Buried & Clean Oyster Shell Recovered: Total (qts)	Buried & Clean Oyster Shell Recovered: Mean Grab (qts)
Y 1	S	0	0	0	0
Y 2	S	0	0	0	0
Total				0	

SH = Exposed shell hard bottom; S = hard sand; M = soft mud.

Table 6

Density of live oysters and of shell found August 1972, and the estimated average density of each (bu/acre) on two adjacent tracts located in the James River, Virginia, leased by W. D. Melzer.

			Live Oysters Recovered		Buried & Clean Oyster Shell Recovered	
Tract	Station Number	Sediment Type	Mean Grab	No. Yd^2	Total (qts)	Mean Grab (qts)
Inshore	X 1	S-BS	0	0	0.12	0.06
	X 2	S-BS	0	0	0.06	0.03
	X 3	MR	0	0	0	0
	X 4	S	0	0	0	0
	X 5	S	0	0	0	0
	X 6	S	0	0	0	0
	X 7	S-BS	0	0	0.06	0.03
	X 8	S	0	0	0	0
	X 9	MR	0	0	0	0
	X10	MR-BS	0	0	0.06	0.03
Offshore	R 1	S-M-BS	0	0	0.35	0.18
	R 2	S-M-BS	0	0	0.18	0.09
	R 3	S-M-BS	0	0	0.18	0.09
	R 4	S-BS	0	0	0.12	0.06
	R 5	S	0	0	0	0
	S 1	S-BS	0	0	0.18	0.09
	S 2	S-BS	0	0	0.06	0.03
	S 3	S-BS	0.5	0.4	0.06	0.03
	S 4	S	0	0	0	0
	S 5	S	0	0	0	0
	T 1	S-BS	0.5	0.4	0.12	0.06
	T 2	S-BS	0	0	0.06	0.03
	T 3	S	0	0	0	0
	T 4	S	0	0	0	0
	T 5	S-BS	0	0	0.35	0.18
	T 6	S-BS	0	0	0.06	0.03
	Total				2.02	

Estimated average density of live oysters - .39 bushels/acre.

Estimated average density of shell - 3.6 bushels/acre.

SH = Exposed shell hard bottom; BS = Buried shell; S = hard sand; M = soft mud; MR = marl sand.

Table 7

Density of live oysters and of shell found August 1972, and the estimated average density of shell (bu/acre) on a tract located in the James River, Virginia, and leased by Evelyn Hines.

		Live Oysters Recovered		Buried & Clean Oyster Shell Recovered	
Station Number	Sediment Type	Mean Grab	No. Yd^2	Total (qts)	Mean Grab (qts)
U 1	S-BS	0	0	0.06	0.03
U 2	S-BS	0	0	0.06	0.03
U 3	S-BS	0	0	0.12	0.06
U 4	S	0	0	0	0
V 1	S-BS	0	0	0.06	0.03
V 2	S-BS	0	0	0.41	0.20
V 3	S-BS	0	0	0.12	0.06
V 4	S-BS	0	0	0	0
W 1	S	0	0	0.29	0.14
Total				1.12	

Estimated average density of shell - 5.4 bushels/acre.

SH = Exposed shell hard bottom; BS = Buried Shell; S = Hard sand; M = Soft mud; MR = Marl sand.

Table 8

Density of live oysters and of shell found August 1972, and the estimated average density of each (bu/acre) on a tract located on the south side of the James River, Virginia, and leased by J. H. Miles & Co.

		Live Oysters Recovered		Shell Recovered	
Station Number	Sediment Type	Mean / Grab	No. / Yd^2	Total (qts)	Mean / Grab (qts)
F1	S-BS	11.5	9.6	12.0	6.0
F2	SH-M-BS	4.0	3.3	13.0	6.5
G1	SH-BS	7.5	6.2	8.0	4.0
G2	SH-M-BS	7.0	5.8	12.0	6.0
G3	M-BS	0	0	9.0	4.5
H1	SH-BS	4.0	3.3	4.0	2.0
H2	SH-BS	4.0	3.3	6.0	3.0
H3	SH-M-BS	0.5	0.4	1.5	0.8
I1	SH-S-BS	2.0	1.7	2.0	1.0
I2	SH-M-BS	0.5	0.4	2.0	1.0
I3	SH-BS	10.0	8.3	2.0	1.0
J1	S-BS	0	0	2.0	1.0
J2	SH-M-BS	1.0	0.8	2.1	1.0
Total				75.6	

Estimated average density of live oysters - 39.9 bushels/acre.
Estimated average density of shell-260 bushels/acre.
SH = Exposed shell, hard bottom; BS = buried shell; S = hard sand; M = soft mud; MR = marl sand. SH-M = Thin crust of shells over mud.

Table 9

Density of live oysters and of shell found August 1972, and the estimated average density of each (bu/acre) on a tract located on the north side of the James River, Virginia, and leased by J. H. Miles & Co.

		Live Oysters Recovered		Shell Recovered	
Station Number	Sediment Type	Mean / Grab	No. / Yd^2	Total (qts)	Mean / Grab (qts)
L1	M	0	0	1.7	0.8
M1	SH-BS	2.5	2.1	20.0	10.0
M2	SH-BS	0	0	10.0	5.0
M3	SH-BS	2.5	2.1	10.0	5.0
M4	SH-BS	2.0	1.7	14.0	7.0
M5	SH-BS	1.5	1.2	12.0	6.0
M6	SH-BS	0.5	0.4	8.0	4.0
N1	S-BS	0	0	2.0	1.0
N2	S-BS	0.5	0.4	16.0	8.0
N3	SH-BS	0.5	0.4	12.0	6.0
N4	SH-BS	2.5	2.1	9.0	4.5
N5	SH-BS	0	0	7.0	3.5
N6	SH-BS	0	0	7.0	3.5
O1	SH-M-BS	0	0	18.0	9.0
Total				146.7	

Estimated average density of live oysters - 9.1 bushels/acre.
Estimated average density of shell - 475.4 bushels/acre.
SH= exposed surface shell; S = hard sand bottom; M = soft mud; BS = buried shells.

Table 10

Density of live oysters and of shell found August 1972, on a tract located in the James River, Virginia, and leased by L. Michaux.

Station Number	Sediment Type	Live Oysters Recovered: Mean / Grab	Live Oysters Recovered: No. / Yd^2	Buried & Clean Oyster Shell Recovered: Total (qts)	Buried & Clean Oyster Shell Recovered: Mean / Grab (qts)
K1	S	0	0	0	0
K2	S	0	0	0	0
K3	S	0	0	0	0

S = hard sand.

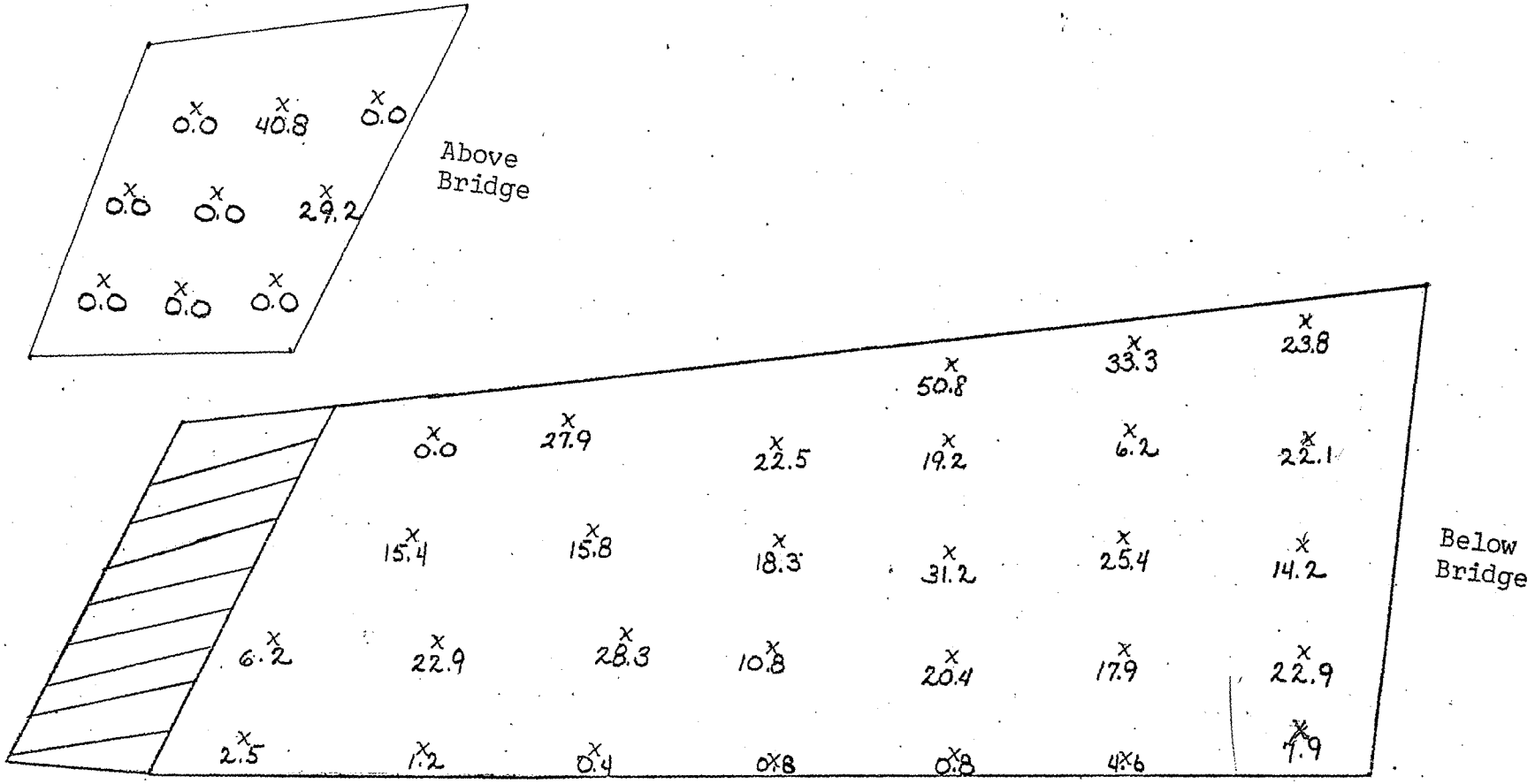

Figure 1

Density of Live Oysters (Oysters/yd^2) Found August 1972 on Ballards Oyster Grounds in the James River, Virginia.

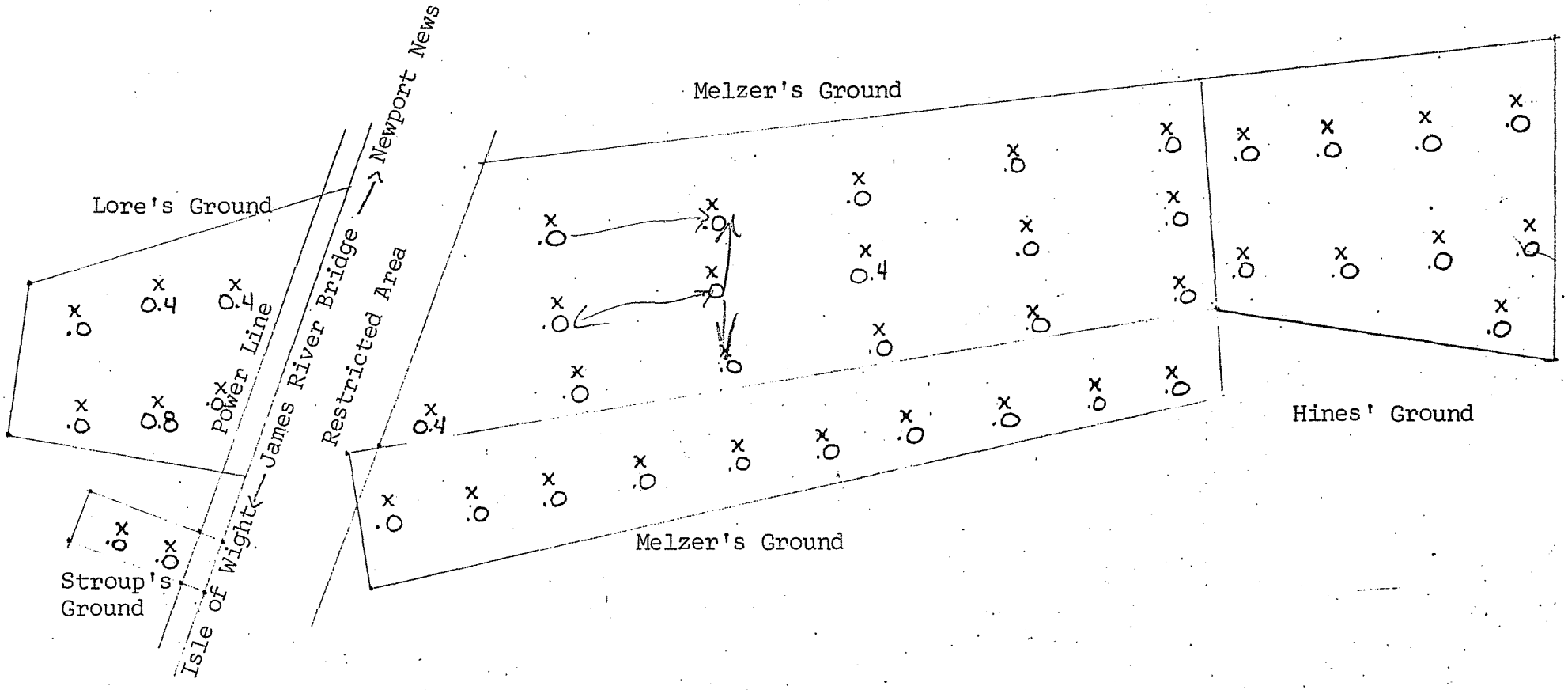

Figure 2

Density of Live Oysters (oysters/yd^2) Found August 1972, on Several Tracts of Oyster Ground Located in the James River, Virginia, and Leased by Several Individuals.

Drawn by Paul Kendall

Virginia Institute of Marine Science

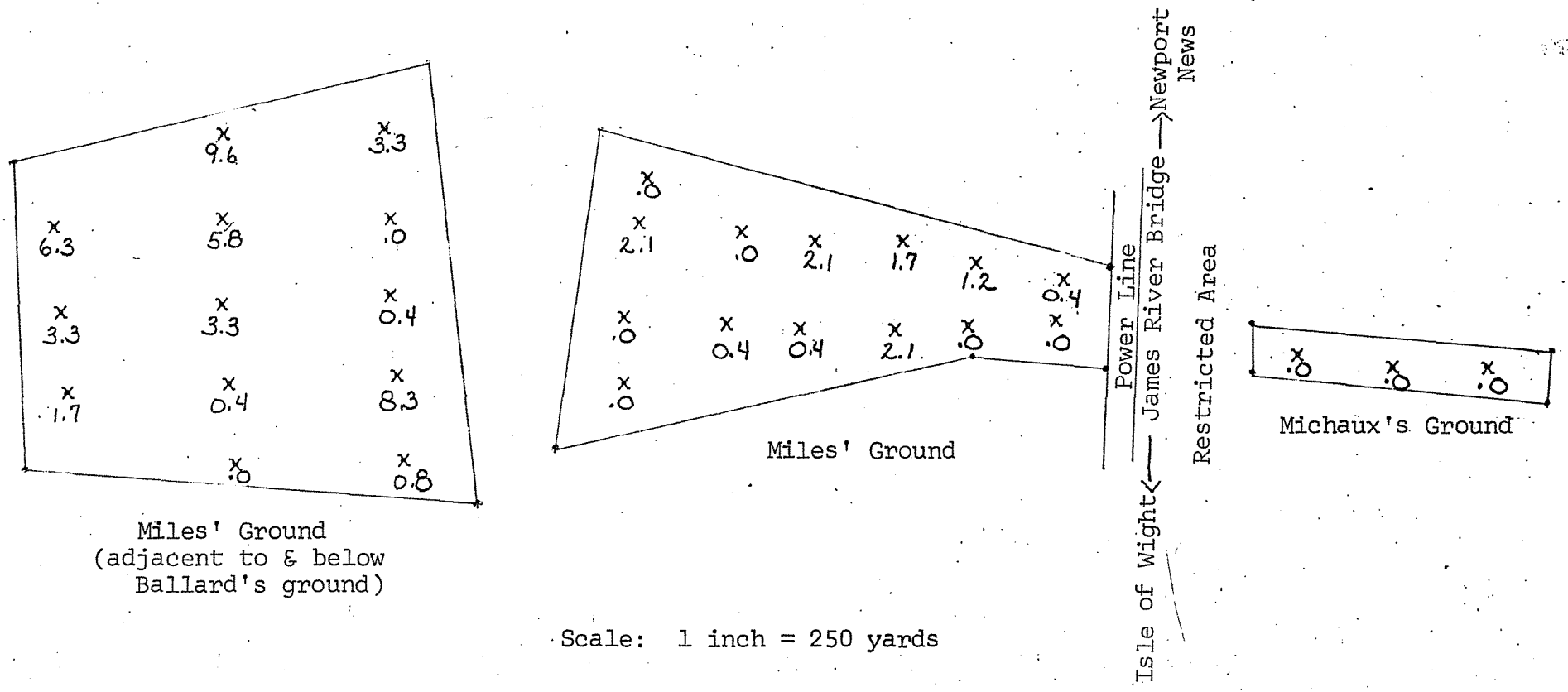

Figure 3

Density of Live Oysters (oysters/yd^2) Found August 1972, on Several Tracts of Oyster Ground Located in the James River, Virginia, and Leased by Two Individuals.

Drawn by Paul Kendall

Virginia Institute of Marine Science

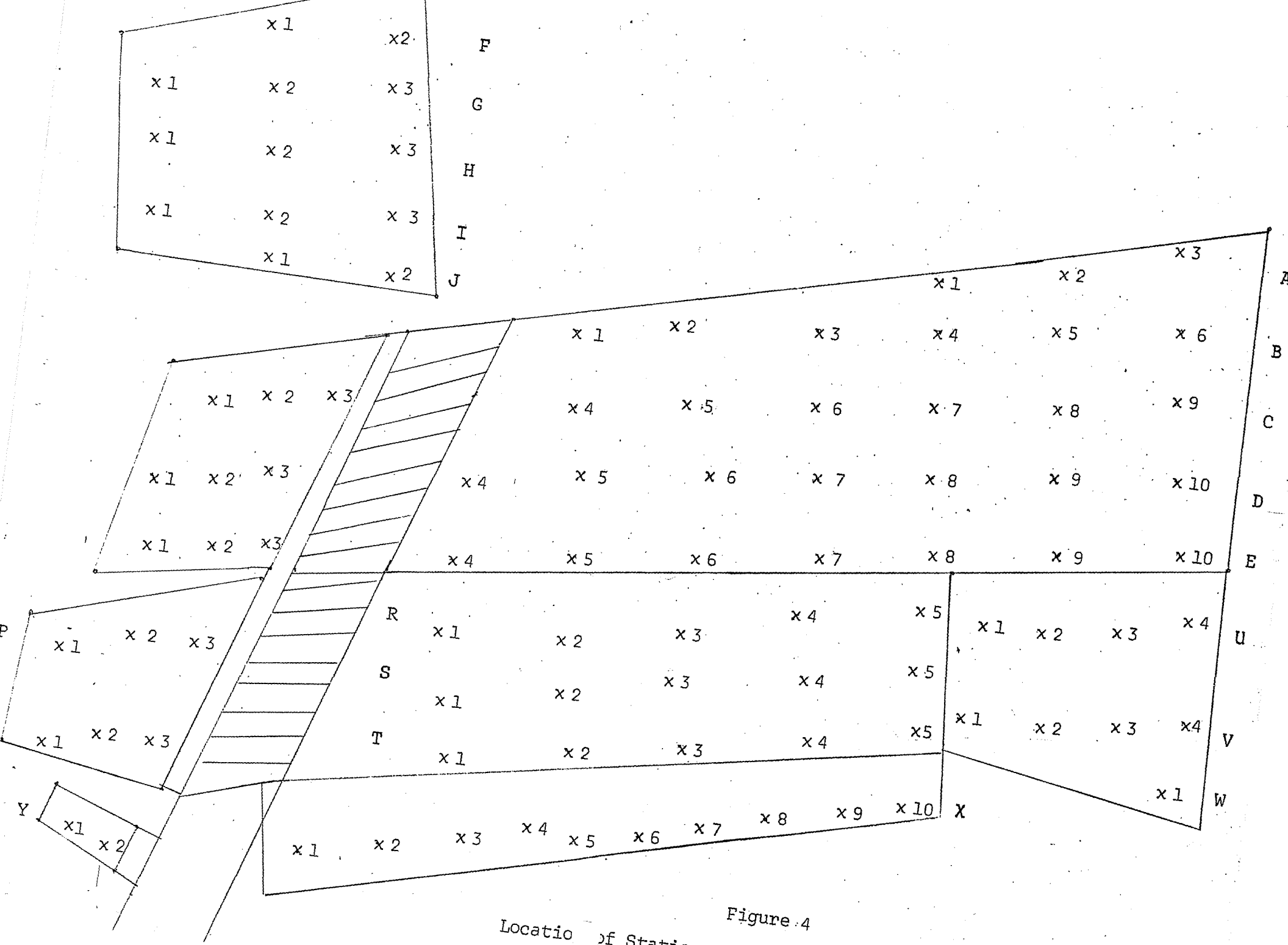

Figure 4

Location of Stations South Side James River - 1972

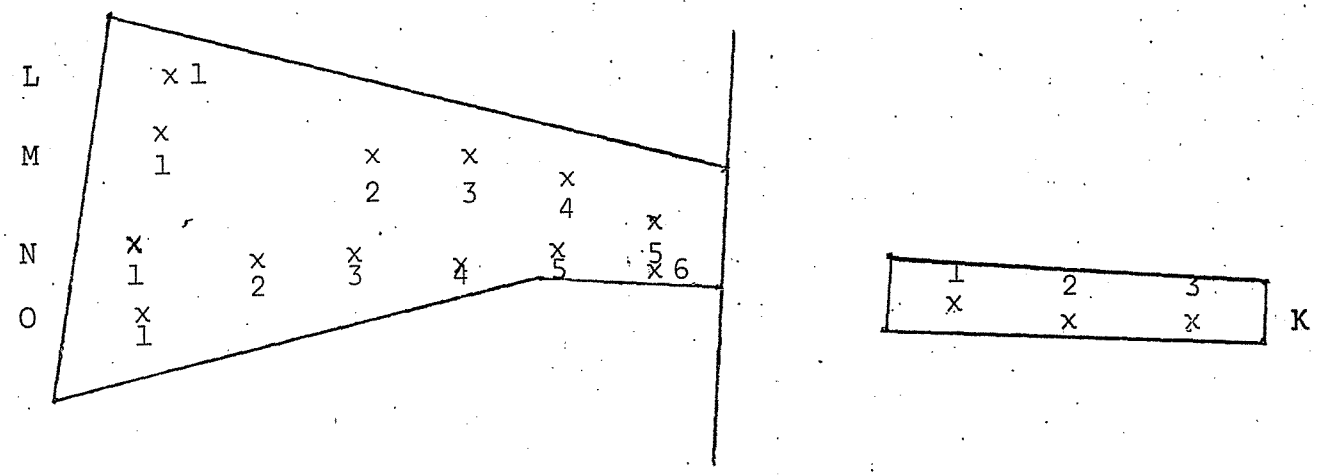

Figure 5

Location of Stations on the North Side of the James River - 1972.