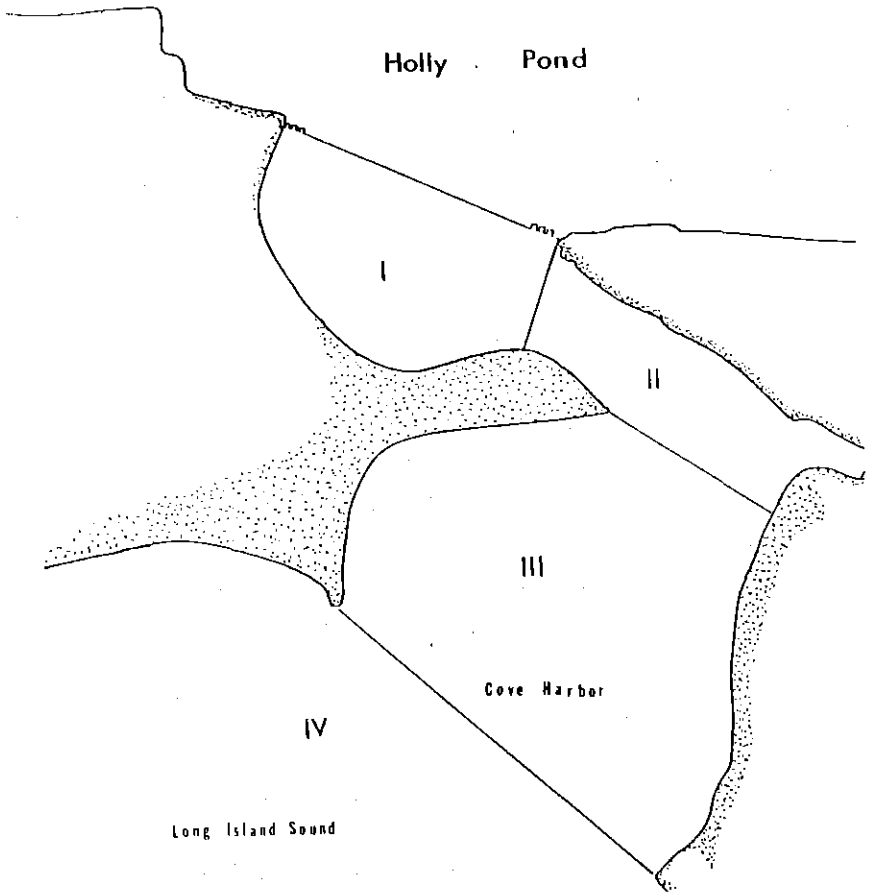
An Assessment of Coastal Resources in the Vicinity of Holly Pond (Stamford, CT) (Final Report)



Submitted to:

Environmental Protection Board
City of Stamford
Stamford, CT

This study was commissioned and funded through the Stamford Coastal Resources Mapping Project

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ENVIRONMENTAL PROTECTION BOARD

Submitted by:

Peter E. Pellegrino, Ph.D.
Southern Connecticut State University Foundation, Inc.
New Haven, Connecticut 06515

December, 1986

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I. Introduction

This project was designed to provide a comprehensive biological assessment of coastal resources in the vicinity of Holly Pond. Holly Pond (Figure 1) is a +/- 200 acre coastal embayment located on the border of Stamford and Darien. It is fed by the Noroton River and influenced by the tides of Long Island Sound.

The coastal resources of importance in the vicinity of Holly Pond are Beaches, Tidal Wetlands, Intertidal Flats, Shellfish Concentration Areas and Estuarine Embayment. The development of viable coastal management programs require a thorough scientific evaluation of the environment. It is impossible to properly manage coastal resources without conducting an accurate biological census. It is also impossible to detect future ecological change without a benchmark reference for comparison.

The purpose of this project was to census and map the shellfish populations and benthic species composition in the Cove Harbor area of the mouth of the Noroton River. The coastal environment was then arbitrarily divided into four major sampling regions (Figure 2).

II. Intertidal Shellfish Populations

Methods

Intertidal flat habitats within each region were inventoried using a line transect method. A total of eight transects were established in Region I; three in Region II; six in Region III

and five in Region IV (Figure 3). Sampling stations were located along these transects and involved the removal of all shellfish within a .25m^2 grid dug to a depth of 25 centimeters. Shellfish were identified, counted and measured (along maximum length axis). The general substrate type of each region was also evaluated (Figure 4).

The approximate area of intertidal habitat within each region was evaluated using appropriate planimetric methods from a 1 inch = 100 feet base map. Resource maps illustrating the general distribution and abundance patterns for each shellfish species can be found in Figures 5-7. The following general abundance categories were established:

Abundance Category	Number/m^2
Low	1-14
Moderate	15-29
High	30-44
Very High	45-Plus

Relative abundance relative among quadrats, and relative to this system. Comparison to other systems/habitats? What are ecological implications?

Region I

Region I consisted of a narrow band of intertidal habitat (Figure 8) with a total area of about 2,465m^2. The region, based upon substrate composition, can be divided into 3 general sub-regions: (1) a small mud dominated section (area = 240m^2) bordering a small Spartina Wetland (Transects A-C); (2) a larger sand dominated section with an area of 2,225m^2 (Transects D-G) and (3) a mussel bed (Mytilus Edulis) at the eastern end of the

region with an area of 1,038m^2. Another prominent mussel bed was located at the base of the dam (area = 1,407m^2) but was not inventoried during this study.

The muddy section bordering the Spartina wetland was characterized by abundant shell debris with scattered small boulders and cobble. The seaweeds Ulva and Fucus were present along with the ribbed mussel Geukensia demissus. Adult oyster drills, Urosalpinx cinerea along with their egg cases were abundant at scattered sites.

The Steamer clam, Mya arenaria, was the only shellfish species recovered from the mud section of Region I. It occurred at transect B (7 individuals/ .25m^2) and at transect C (1 individual/.25m^2). Steamers ranged in size from 4.0cm to 6.5cm with the mean length being 5.4cm. The mean density of Mya in the mud section is 2.7/.25m^2 or 10.8 per square meter. This section would therefore be placed in the Low Abundance Category for Mya. The total population of Mya in this mud section is estimated to be 2,592 individuals.

A total of 3 Mya and 2 Mercenaria were reported from a single transect (E) in the sand dominated section of Region I. Mya ranged in size from 6.0-7.5cm with the mean being 6.7cm while the two Mercenaria were 4.0 and 4.5cm with the mean being 4.3. Mya achieved a mean density of 0.75 individ./.25m^2 or 3.0/m^2. The total population of steamer clams in this section of Region I is estimated to be around 6,675. Mercenaria achieved a mean

density of 0.5 individ. /.25m^2 or 2.0 per m^2. The total hard clam population in this section is estimated to be around 4,450 clams.

This section of Region I is therefore placed into the Low Abundance Category for both Mya and Mercenaria.

The blue mussel and steamer clam both occurred in high numbers in the mussel bed section of Region I (Transect H). Mytilus achieved a density of 215 individuals/.25m^2 at Station 1 and 241/.25m^2 at Station 2. This translates into 860/m^2 and 964/m^2 respectively with the mean density being 912/m^2. The mean shell length for Mytilus was 3.9cm at Station 1 and 4.3cm at Station 2. The total population of Mytilus in this mussel bed is approximately 94,600.

Mya achieved a density of 45/.25m^2 at Station 1 and 37/.25m^2 at Station 2. This translates into 180 and 148 per m^2 respectively with the mean being 164/m^2. The mean shell length at Stations 1 and 2 was 4.2cm and 3.7cm respectively. The total Mya population of the mussel bed is estimated to be around 17,000.

The mussel bed section of Region I would be placed into the Very High Abundance Category for both Mya and Mytilus.

Region II

Region II (Figure 9) constituted a small but homogeneous area of intertidal habitat with a generalized substrate type of gravelly sand. Shellfish densities were low in this region with

the blue mussel being the numerical dominant. The total intertidal area for this region is only 588m^2.

The uppermost stations at all three transects were devoid of shellfish and were generally barren while the lower stations were dominated by the blue mussel. Mytilus achieved densities of 172/.25m^2 (688/m^2) at Transect H, 67/.25m^2 (268/m^2) at Transect B and 37/.25m^2 (148/m^2) at Transect C, with the mean being 368/m^2. Assuming that only 30% of the total area of Region II (167m^2) was occupied by Mytilus, the total mussel population is estimated to be around 61,600.

The lower intertidal portions of Region II would be placed in the Very High Abundance Category for Mytilus.

A single steamer clam and a single Oyster were recovered from Transect A (Station 2), thereby placing this area into the Low Abundance Category for Mya and Crassostrea.

Region III

Region III (Figure 10) constituted the largest portion of intertidal habitat with a total area of 15,934m^2. The substrate type (Figure 4) was generally gravelly-sand throughout most of the region (Transects A-D) with a shell-gravel substrate occurring at Transects E and F.

Mya (Table 3) achieved greatest numerical abundance (Figure 5) along Transects A and B. Mya was found at all three stations along Transect A with highest densities occurring at Station 1 (47/.25m^2) and lowest at Station 2 (31/.25m^2) with the mean being 39.3/.25m^2 or 157.3/m^2. The mean shell length of steamers along

Transect A was 4.3cm. This portion of Region III would be placed in the Very High Abundance category.

Mya was also found at all three stations along Transect B with highest densities occurring at Station 3 (37/.25m^2) and lowest at Station 2 (1/.25m^2) with the mean being 16.0/.25m^2 or 64/m^2. The mean shell length of 3.4cm was slightly smaller than that observed for Transect A.

No steamer clams were reported from the uppermost stations (1 and 2) along Transects C and D but the lower station (3) exhibited low densities (1/.25m^2) at C and very high densities (17/.25m^2) at D. The gravelly substrates of Transects E and F yielded no steamer clams.

Because of the large intertidal area of Region III, no meaningful estimate of total Mya population size can be made at this time. More transects need to be established before this can be accomplished.

The hard clam (Figure 6) was reported in moderate densities (6/.25m^2) at the middle station (2) of Transect B and in low densities at the upper two stations of Transect D. All hard clams recovered were juveniles with a mean shell length of 2.8cm.

The blue mussel (Figure 7) achieved a distribution pattern in Region III similar to that reported for Mya (Figure 5). Mytilus was found at all three stations along Transect A with highest densities occurring at Station 3 (581/.25m^2) and lowest at Station 2 (4/.25m^2) with the mean being 219/.25m^2 or 876/m^2. The mean shell length was 3.8cm.

Mytilus occurred at Stations 2 and 3 along Transect B but in lower numbers. Highest densities were reported at Station 2 ($28/.25m^2$) with the mean for Transect B being $10.7/.25m^2$ or $42.7/m^2$. The mean shell length for Transect B was 4.2cm. *Mytilus* also occurred at Station 1 ($43/.25m^2$) and Station 3 ($51/.25m^2$) at Transect C, and at Station 3 ($53/.25m^2$) at Transect D.

Mytilus like *Mya* and *Mercenaria* was not reported from any stations along Transects E and F.

Region IV

The intertidal habitat of Region IV (Figure 4) consisted of a well drained sand beach that was barren and devoid of any shellfish.

III. Subtidal Shellfish Populations

Subtidal shellfish populations were inventoried using a standard clam rake. Each major region was divided into three subregions (Figure 11) with a total of ten clam rake samples taken in each subregion. The area sampled per clam rake tow was estimated to be $.056m^2$. The total subtidal area for each sampling region was determined using appropriate planimetric methods from a 1 inch = 100 foot base map. The general substrate type (Figure 12) and area for each subregion can be found in Table 4.

Shellfish were identified, inventoried and measured (maximum length axis). These data are summarized in Table 5 and in the

resource maps (Figures 13-14). The most important subtidal shellfish species was the hard clam, Mercenaria mercenaria. Hard clams were divided into the following size categories: Juveniles (up to 4.8cm), Littlenecks (4.9-7.0cm), Cherrystones (7.1-9.2cm) and Chowders (greater than 9.3cm). The same general abundance categories used for intertidal populations were used for subtidal:

Abundance Category	Number/m^2
Low	1-14
Moderate	15-29
High	30-44
Very High	44 Plus

The general distribution and abundance of hard clams throughout the four regions is summarized in Figure 13. It can be seen that the greatest density of hard clams is located in a continuous area occupied by Region II-C and III-A. These areas supported Mercenaria densities of 46.4 clams/m^2 and 53.6 clams/m^2 respectively.

Region I

Region I comprised a total subtidal area of about 14,944m^2 and was dominated by silt-clay substrates in the western portion (Subregion A) and sandy-silt substrates in the central (B) and eastern portions (C). Mercenaria was not reported from Subregion A but occurred in low densities in the sandy-silt substrates of Subregion B (X=14.3 clams/m^2) and C (X=12.5 clams/m^2).

Littleneck and Cherrystone size classes dominated the population in B (87.5%) while accounting for only 57.2% in Subregion C.

Region II

Region II constituted a total subtidal area of about 10,886m^2 and was dominated by a sandy-silt substrate type combined with Mytilus shell in Subregion B. Subregion A, comprising an area of 3,592m^2, exhibited moderate densities of Mercenaria (X=17.7 clams/m^2) with the population being dominated by Juvenile and Littleneck size classes (100.0%) (X length=4.0cm). The blue mussel, Mytilus, also occurred in moderate numbers especially in the eastern portion of the subregion (X=26.8 mussels/m^2).

Subregion B, comprising an area of 2,470m^2, was characterized by an extensive subtidal population of Mytilus. The region averaged 363.1 mussels/m^2 which translates into a total population of 87,870.

Subregion C, comprising an area of 4,874m^2, exhibited very high densities of hard clams (X=46.4 clams/m^2). Juvenile and Littleneck size classes dominated the subregion accounting for 84.6% of the total population. This region exhibited a "healthy" mixture of all size (age) classes.

Region III

Region III constituted a total subtidal area of 40,446m^2 and was characterized by gradation of substrate type from the inner to outer subregions (Figure 12). The innermost subregion (A) exhibited a sandy-silt substrate type; the central or middle

portion (B) exhibited a silty-sand substrate in its northern portion and a gravelly-sand substrate in its southern portion; the outermost subregion (C) exhibited a gravelly-sand substrate with shell.

Subregion A, comprising a total area of 6,354m^2, represented a contiguous band of silty-sand substrate with II-C and was also characterized by very high densities of hard clams (53.6 clams/m^2). The size class distribution for III-A was also similar to II-C with Juveniles and Littlenecks accounting for 73.3% of the total.

It is apparent that II-C and III-A exhibit the most favorable substrate and environmental conditons for Mercenaria. These combined subregions support the highest densities of Mercenaria and a healthy mixture of size (age) classes: Juveniles, 26.8%; Litlenecks, 51.8%; Cherrystones, 16.1%; and Chowders, 5.4%.

Subregion B, comprising an area of 13,511m^2, exhibited a transition in substrate type from silty-sand in the northern portion to gravelly-sand in the southern. The three clam rake tows in the silty-sand portion yielded moderate densities of hard clams (X=23.2 clams/m^2). No clams were taken in the seven tows in the sandy portion of Subregion B.

Subregion C, comprising an area of 20,581m^2, was characterized by a gravelly-sand-shell substrate and exhibited low densities of Mercenaria (X=3.8 clams/m^2). Cherrystone (50.0%) and Chowders (50.0%) dominated the population. Because

the southern portion of III-B was so similar in substrate composition to III-C, it was assumed to also have low densities of Mercenaria ($3.8/m^2$) even though none were collected.

Region IV

The shallow subtidal areas of Region IV constituted a relatively homogeneous zone of sandy-shell substrate (Figure 12). Leased oyster bed areas can be found in the deeper portions of Region IV. No attempt was made to estimate bottom area since this region is not semi-enclosed. Since only a single hard clam and oyster were taken in the 30 clam rake tows, the sampled areas of Region IV should be placed in the low abundance category for both.

IV. Subtidal Benthos

The benthos (bottom invertebrates) are of major ecological significance as energy converters and storage units and are, therefore, vital links in estuarine food chains. The benthos can also be useful tools in the long-term monitoring of environmental changes. This survey has established a preliminary historic benchmark against which future change can be detected.

Benthic invertebrate distribution and abundance was monitored for each region with two sampling stations established per region (Figure 15). Samples were obtained with a $0.04m^2$ Van Veen Grab with a single replicate taken at each station. Samples were washed through a 0.5mm mesh screen, stained with rose bengal and fixed in 10% buffered formalin. All organisms were sorted in

the laboratory, counted and identified to the lowest possible taxon. The following aspects of benthic community structure were examined: species richness, species diversity (Shannon-Wiener Index), abundance and dominance (Biotic Index). Temperature, salinity, dissolved oxygen and substrate type were documented at each station (Table 8).

A total of 28 invertebrate species (Table 7) was recovered from the 8 grab samples with polychaetes accounting for 60.7% of the total; crustaceans, 21.4%; bivalves, 10.7%; and gastropods, 7.1%. By pooling the two grab samples a generalized profile of each region can be obtained. Species richness values ranged from a high of 16 in Region II to a low of 10 in Region I with the mean being 13.8. Density values ranged from a high of 379 in Region II to a low of 45 in Region I with the mean being 155. Species diversity values (H') ranged from a high of 3.514 in Region II to a low of 1.939 in Region I with the mean being 2.869.

The Biotic Index revealed the four regions to be dominated by the following benthic species (decreasing order of importance): (1) *Heteromastus filiformis*; (2) *Phyllodoce arenae*; (3) *Lumbrineris tenuis*; (4) *Haploscoloplos robustus*; (5) *Tellina agilis*; (6) *Glycera dibranchiata* and (7) *Melita nitida*. This suggests a stable (mature) invertebrate assemblage and not a community dominated by short-lived opportunistic species that thrive in stressed (disturbed) environments.

Region I

Region I exhibited the lowest mean richness (X=6.0 species/.04m^2), mean density (X=45 individuals/.04m^2) and mean diversity (X[H']=2.303) values. The dominant invertebrate species were: Heteromastus filiformis, Phyllodoce arenae, Lumbrineris tenuis and Tellina agilis. Station A exhibited a total of 5 species and 27 individuals and Station B a total of 7 and 18. H' values were highest at Station B (H'=2.667) and lowest at Station A (H'=1.939).

Polychaetes accounted for 60.0% and bivalves 30.0% of the total species in Region I with Lumbrineris, Glycera and Heteromastus dominating at Station A and Tellina, Gemma and Phyllodoce dominating at Station B.

Region II

Region II exhibited the highest mean richness (X=11.0 species/.04m^2) and mean density (X=189.5 individuals/.04m^2) values. Station A exhibited a total of 12 species and 114 individuals and Station B 10 species and 64 individuals. Species diversity values were highest (H'=3.514) at Station A and lowest at Station B (H'=2.916)(Value with Cirratulus weighted). The mean diversity value for Region II was 3.215.

Polychaetes were again the dominant group accounting for 75% of the total species number with the dominants being: Heteromastus, Cirratulis, Mediomastus, Haploscoloplos, Amphitoe and Melita. Station A was dominated by the polychaetes Mediomastus and Heteromastus and the amphipod Melita while

Station B was strongly dominated by the polychaete Cirratulus cirratus. This single species accounted for 81.5% of all organisms at Station B.

Region III

Region III exhibited mean species richness and density values of 9.0 and 65.5 respectively. Both stations showed similar values with Station A reporting 8 species and 67 individuals and Station B 10 species and 64 individuals. The mean species diversity value (H') was 2.766 with similar values reported for Station A (2.6740) and Station B (2.857).

Polychaetes again were the dominant taxonomic group (80.0%) with the numerical dominants being: Cirratulus, Phyllodoce, Heteromastus, Lumbrineris and Melita. Cirratulus was the numerical dominant at Station A while Station B was dominated by Lumbrineris and Melita.

Region IV

The shelly-sand habitats of Region IV exhibited mean species richness and density values of 9.5 and 32.5 respectively. A total of 11 species and 34 individuals were reported from Station A and 8 species and 31 individuals from Station B. The mean diversity value for Region IV was 2.985 with Station A exhibiting the highest value (H'=3.182) and Station B the lowest (H'=2.787).

The numerical importance of polychaetes declined to 50.0% with crustaceans accounting for 21.4% and bivalves and gastropods, 14.3%. The numerical dominants for Region IV were Phylladoce arenae, Tellina agilis and Lumbrineris tenuis with

Station A being dominated by Lumbrineris and Heteromostus and Station B by Phyllodoce, Tellina and Haploscolaplos.

V. Ecological Health

The Cove Harbor System supports a diverse and productive assemblage of invertebrate life. The community is dominated by a stable mature assemblage and not by a community dominated by short-lived opportunistic species which thrive in stressed (disturbed) environments.

Pellegrino (1983) established the following general categories relative to H' values:

H' Value	Category
0.000-1.499	Low
1.500-2.499	Moderate
Greater than 2.500	High

Low diversity values are usually found in areas receiving high levels of environmental stresses. The mean H' value of 2.817 for the 8 Cove Harbor Stations places the system in the High Category. This suggests an area whose Ecological Health is High and an area that is not being subjected to high levels of environmental stresses.

A general biological comparison of the Cove Harbor System can be made with two shallow water habitats in Mystic and Clinton. Pellegrino (1986) monitored the shallow water areas off the Mystic Whaler Dock in the Mystic River and found the area to be dominated by a mature assemblage of invertebrates. The area

exhibited a mean diversity value (H' = 2.438) similar to the Cove Harbor System. The community was dominated by several species which were also important components of Cove Harbor, Lumbrineris tenuis; Haploscoloplos robustus, Nereis succinea; Heteromastus filiformis and Melita nitida.

Pellegrino (1985) using identical sampling methods inventoried shallow water environments off Cedar Island Marina in Clinton. He found the mean diversity index value (H' = 2.170) to be lower than the Cove Harbor System but again found a relatively stable, mature invertebrate assemblage. The polychaetes Haploscoloplos and Lumbrineris and the bivalve Tellina agilis were dominant components common to both systems.

This preliminary survey has shown the Cove Harbor System to be comparable in its overall "Ecological Health" to typical shallow water habitats of "non-urban" coastal areas.

VI. Glossary

Ampelisca vadorum - Small tube building amphipod

Amphitoe sp. - Amphipod

Arabella irricolor - opal worm (Polychaete)

Benthos - Invertebrates larger than 1 millimeter which live on or within the sediments.

Biotic Index - A mathematical method of determining which species are dominant.

Capitella capitata - polychaete of the family capitellidae.

Cirratulus cirratus - Polychaete commonly known as a fringed worm.

Clymenella torquata - Bamboo worm.

Corophium sp. - Amphipod

Crepidula fornicata - Slipper shell (Gastropod).

Diopatra cuprea - Plumed worm (Polychaete).

Ensis directus - Razor clam (Bivalve).

Eteone heteropoda - Paddle worm (Polychaete)

Gemma gemma - Gem clam (Bivalve).

Glycera dibranchiata - Blood worm (Polychaete)

Haploscoloplos robustus - Polychaete of the family Orbiniidae.

Heteromastus filiformis Polychaete of the family Capitellidae.

Lumbrineris tenuis - Thread worm (Polychaete).

Mediomastus ambiseta - Polychaete of the family Capitellidae.

Nassarius obsoletus - Mud snail.

Neopanope texana - Mud crab.

Nereis succinea - Sand worm.

Pectinaria gouldii - Trumpet worm.

Phyllodoce arenae - Paddle worm.

Polydora ligni - Polychaete of the family Spioniidae.

Tellina agilis - Bivalve commonly called Tellins.

Upogebia affinis - Mud shrimp.

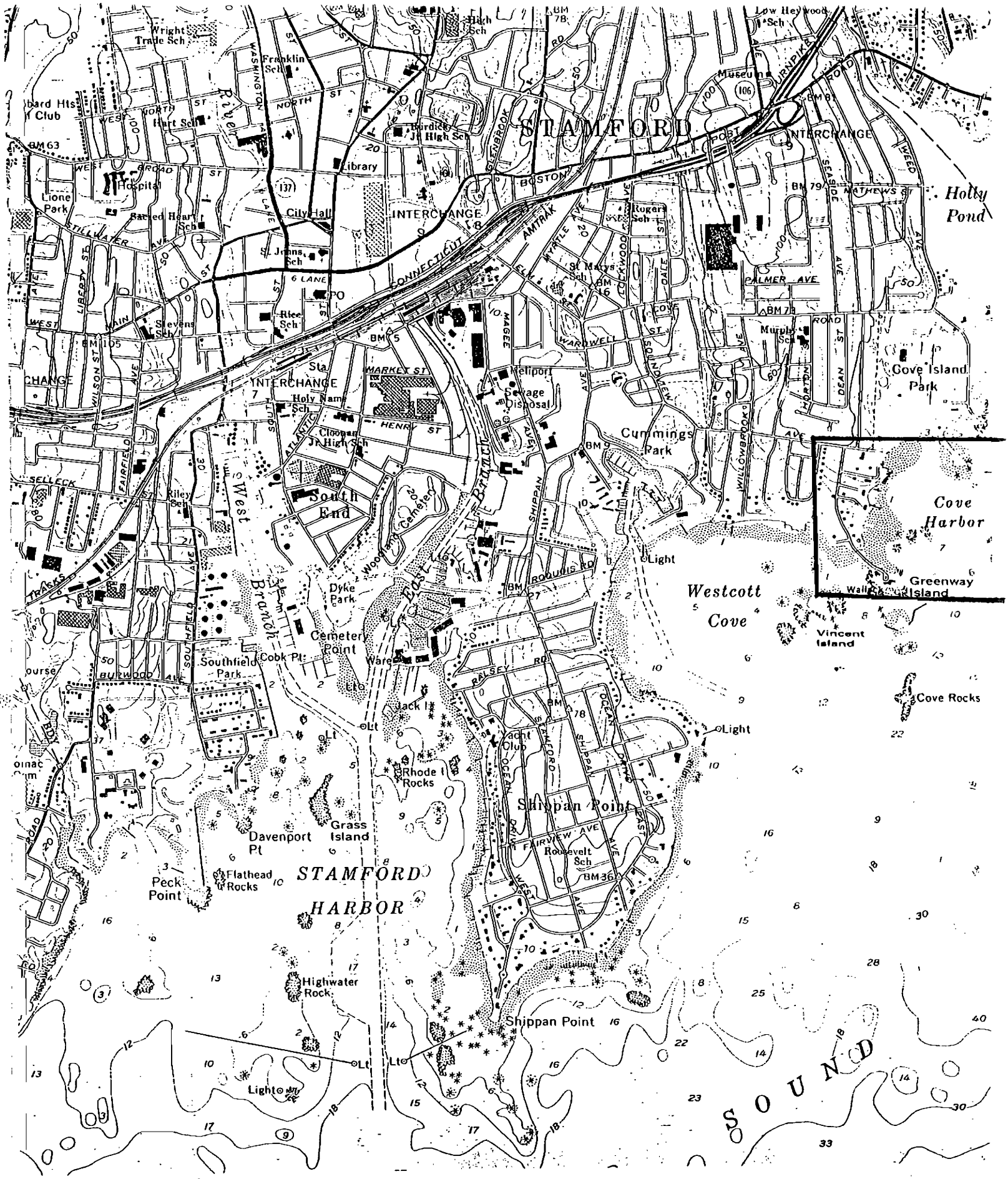

Figure 1. Geographic Location of Holly Pond and Cove Harbor
U.S. Dept. of Interior, Geological Survey

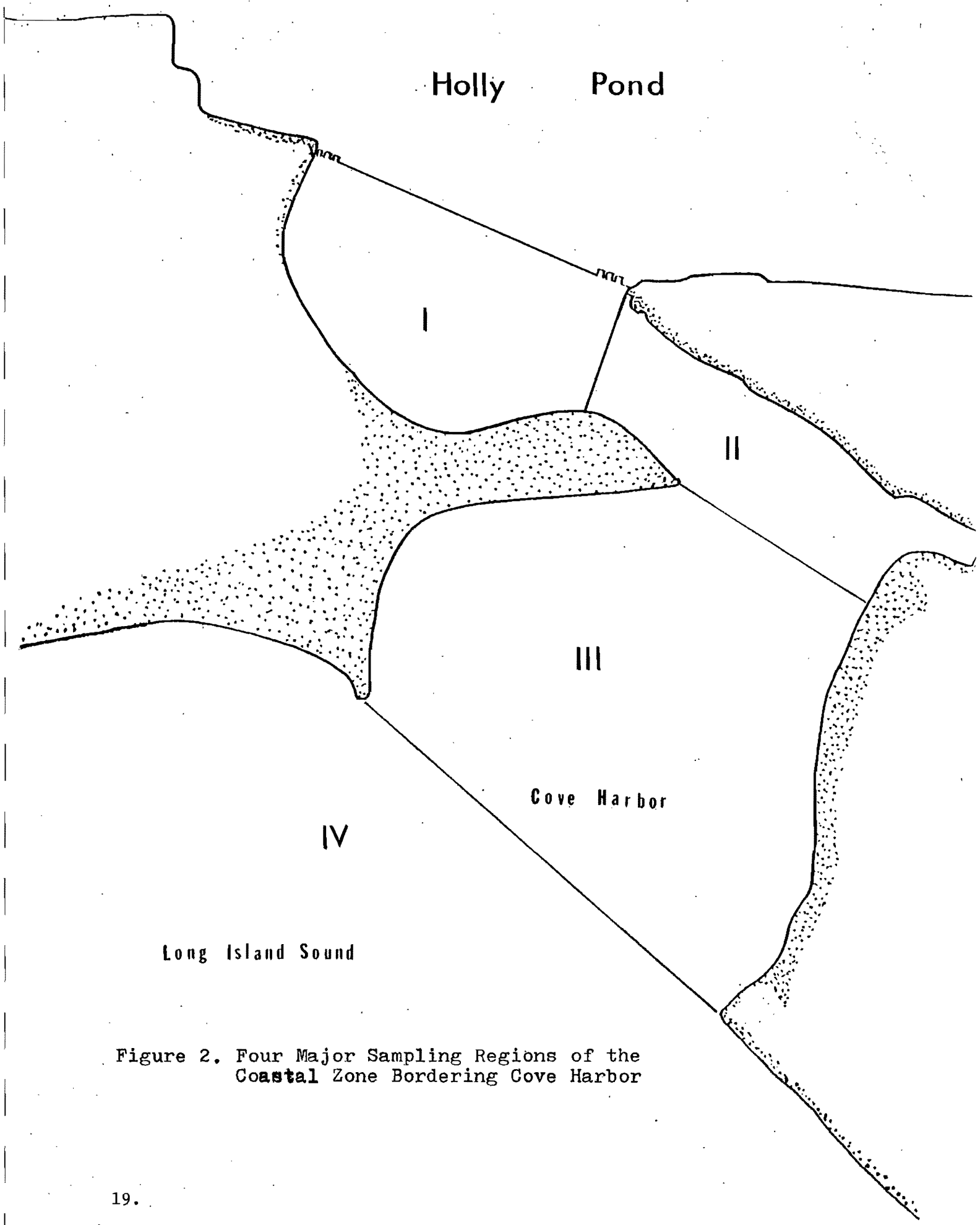

Figure 2. Four Major Sampling Regions of the Coastal Zone Bordering Cove Harbor

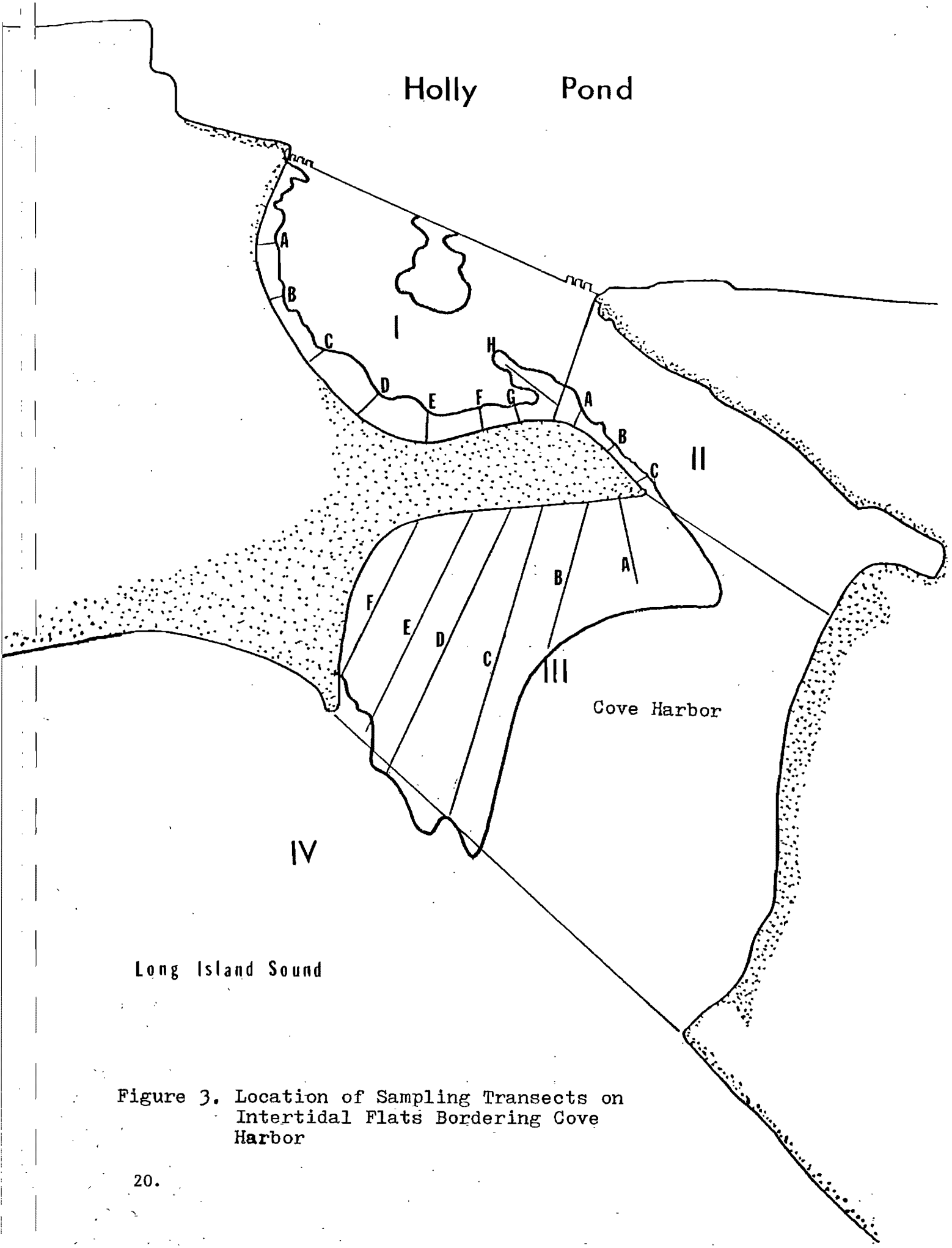

Figure 3. Location of Sampling Transects on Intertidal Flats Bordering Cove Harbor

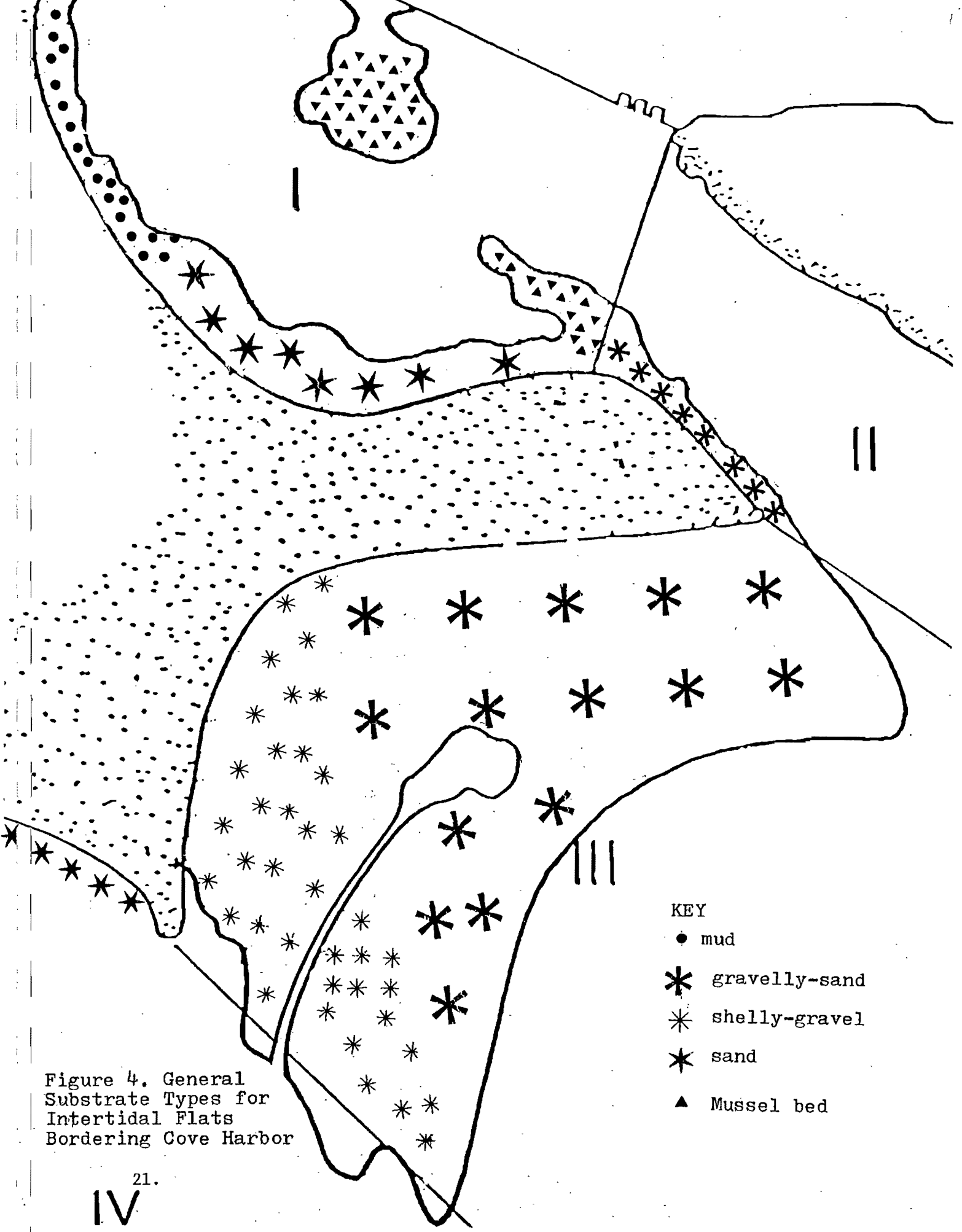

Figure 4. General Substrate Types for Intertidal Flats Bordering Cove Harbor

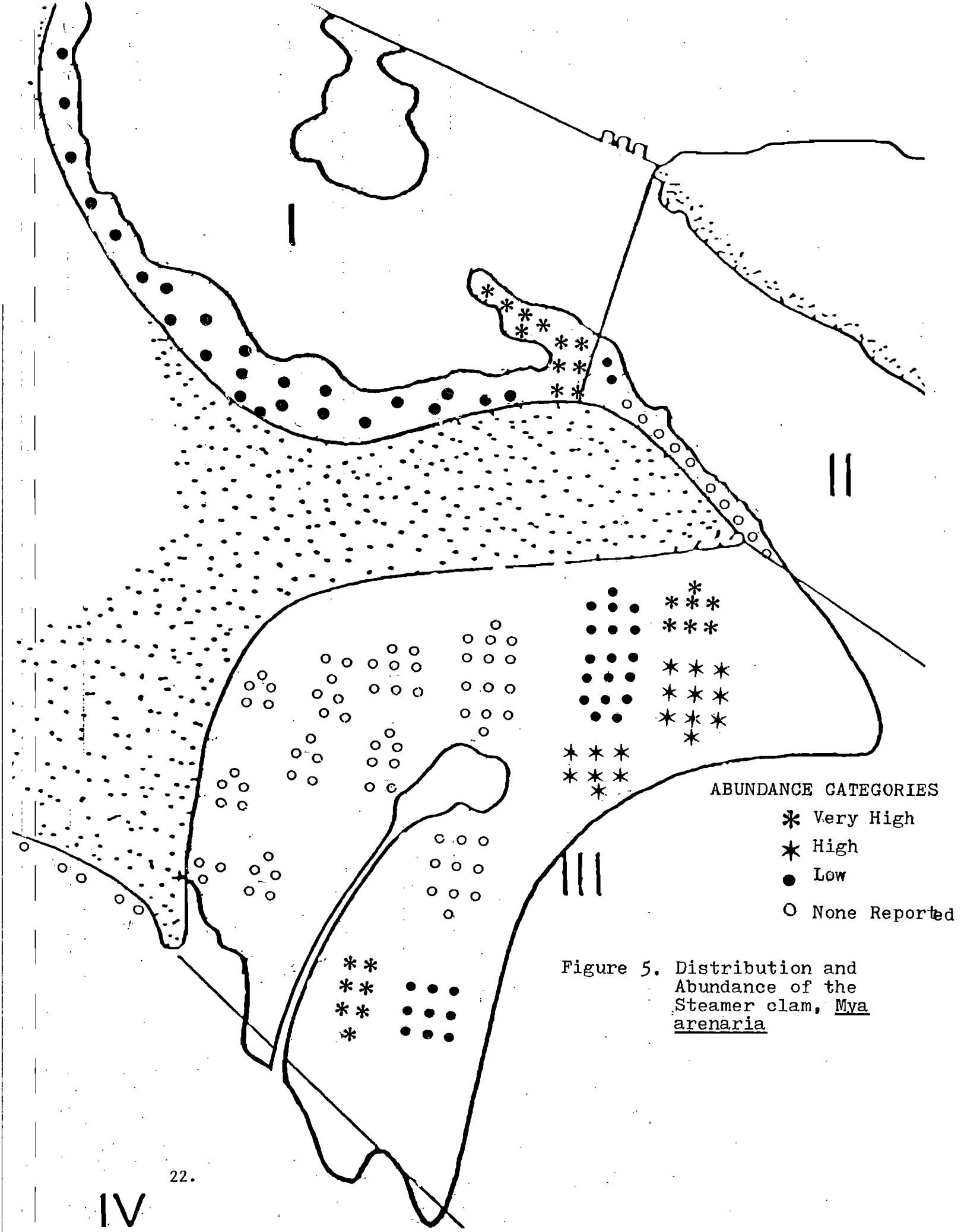

Figure 5. Distribution and Abundance of the Steamer clam, Mya arenaria

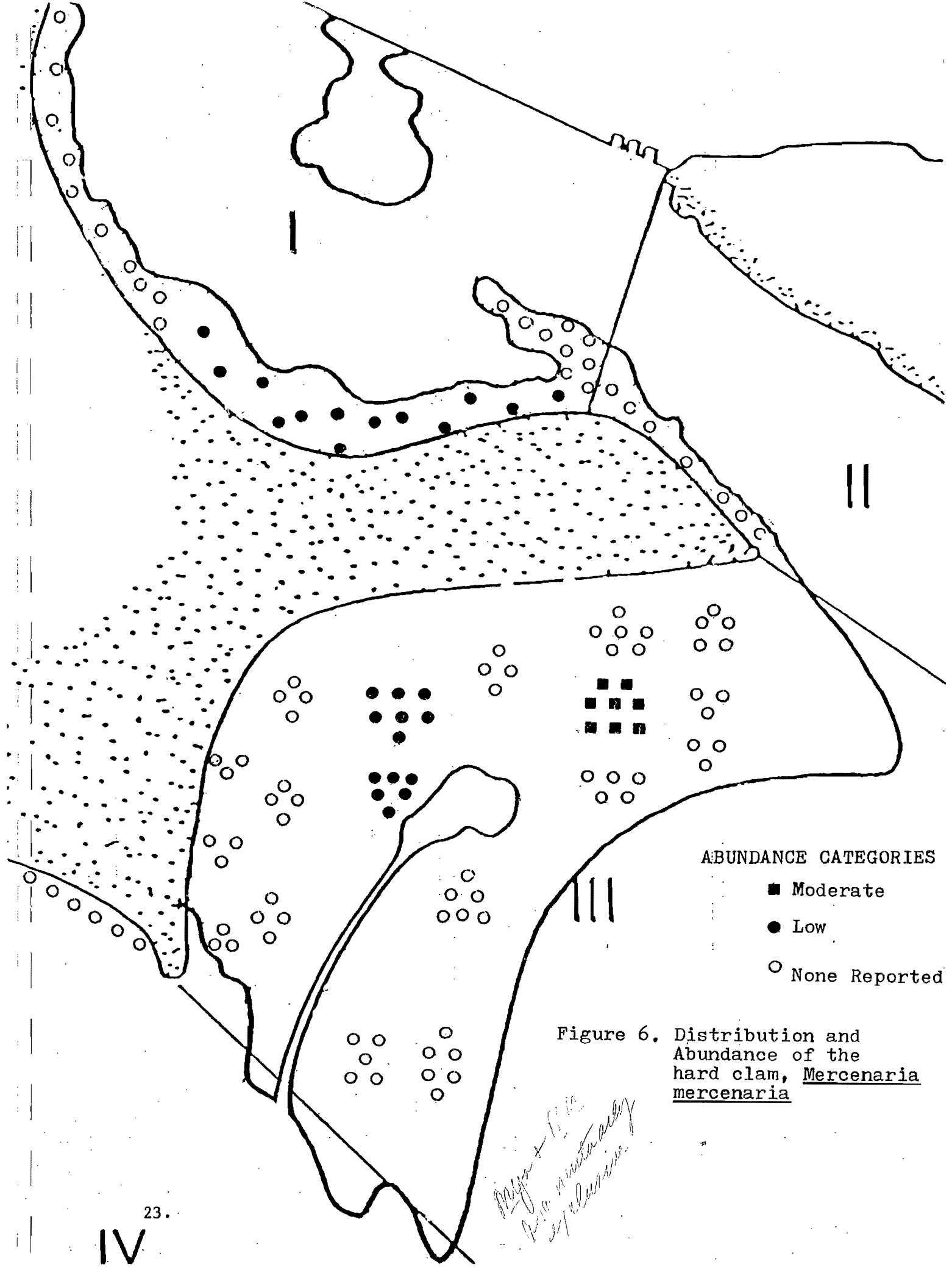

Figure 6. Distribution and Abundance of the hard clam, Mercenaria mercenaria

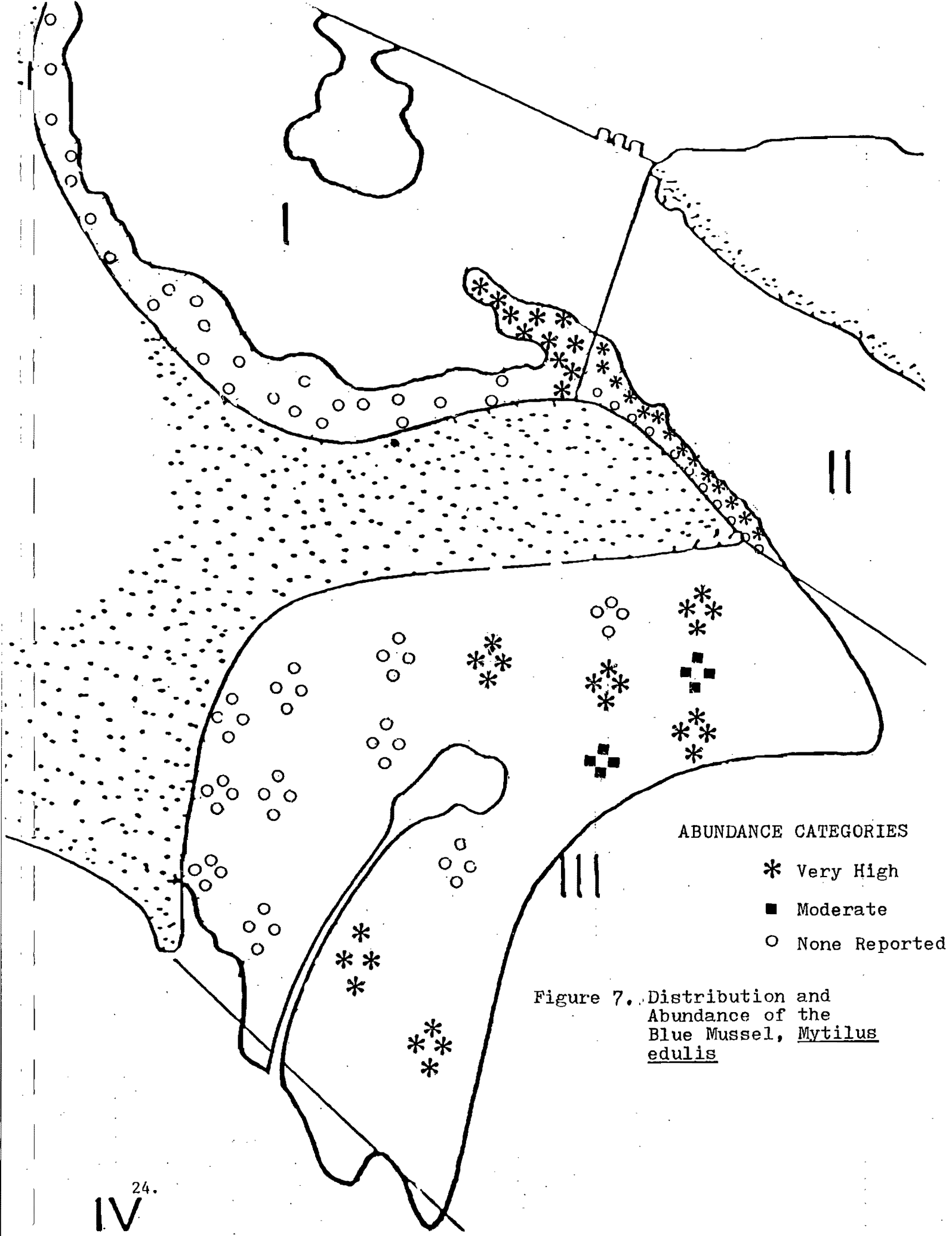

Figure 7. Distribution and Abundance of the Blue Mussel, *Mytilus edulis*

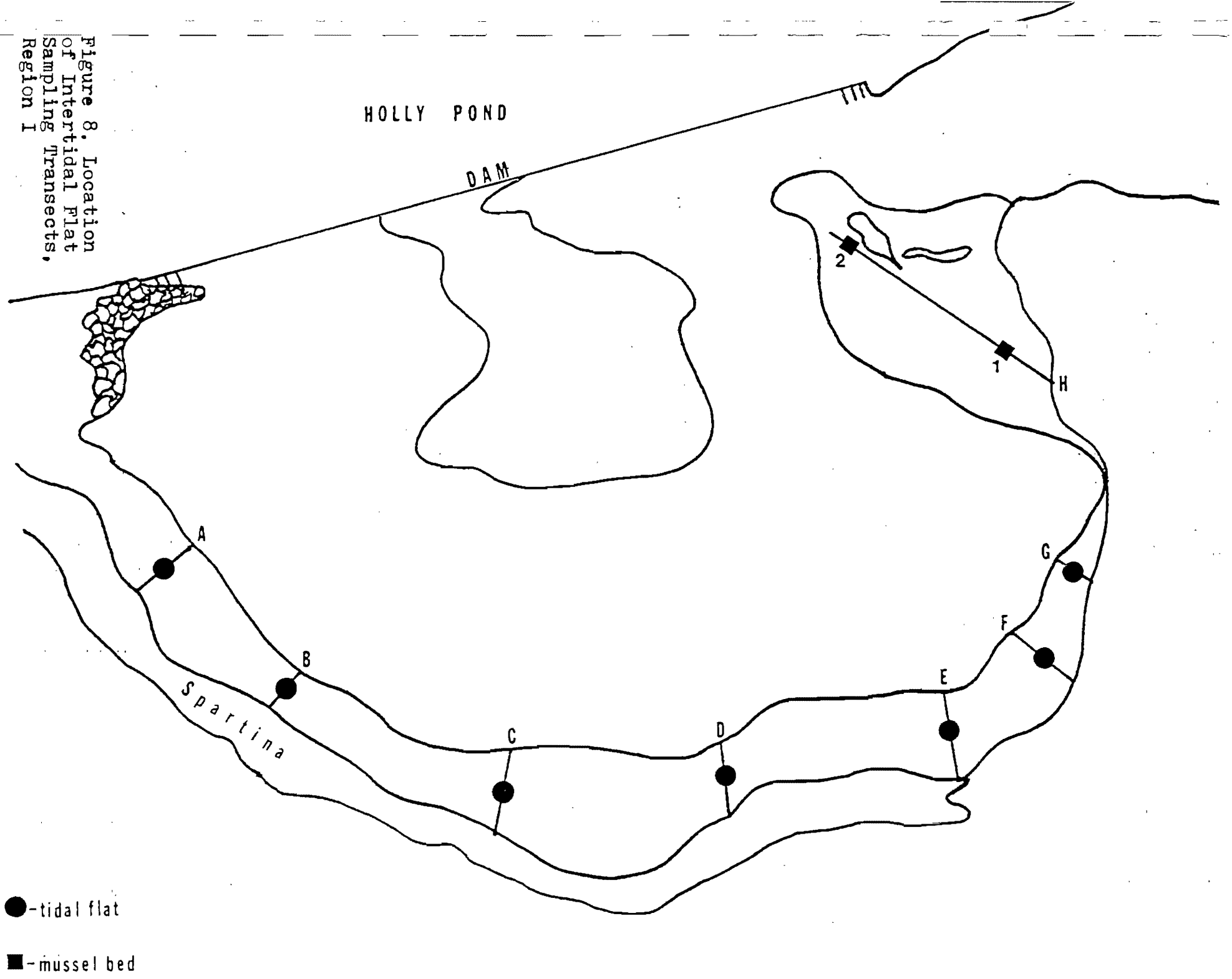

Figure 8. Location of Intertidal Flat Sampling Transects, Region I

Figure 9. Location of Intertidal Flat Sampling Transects, Region II

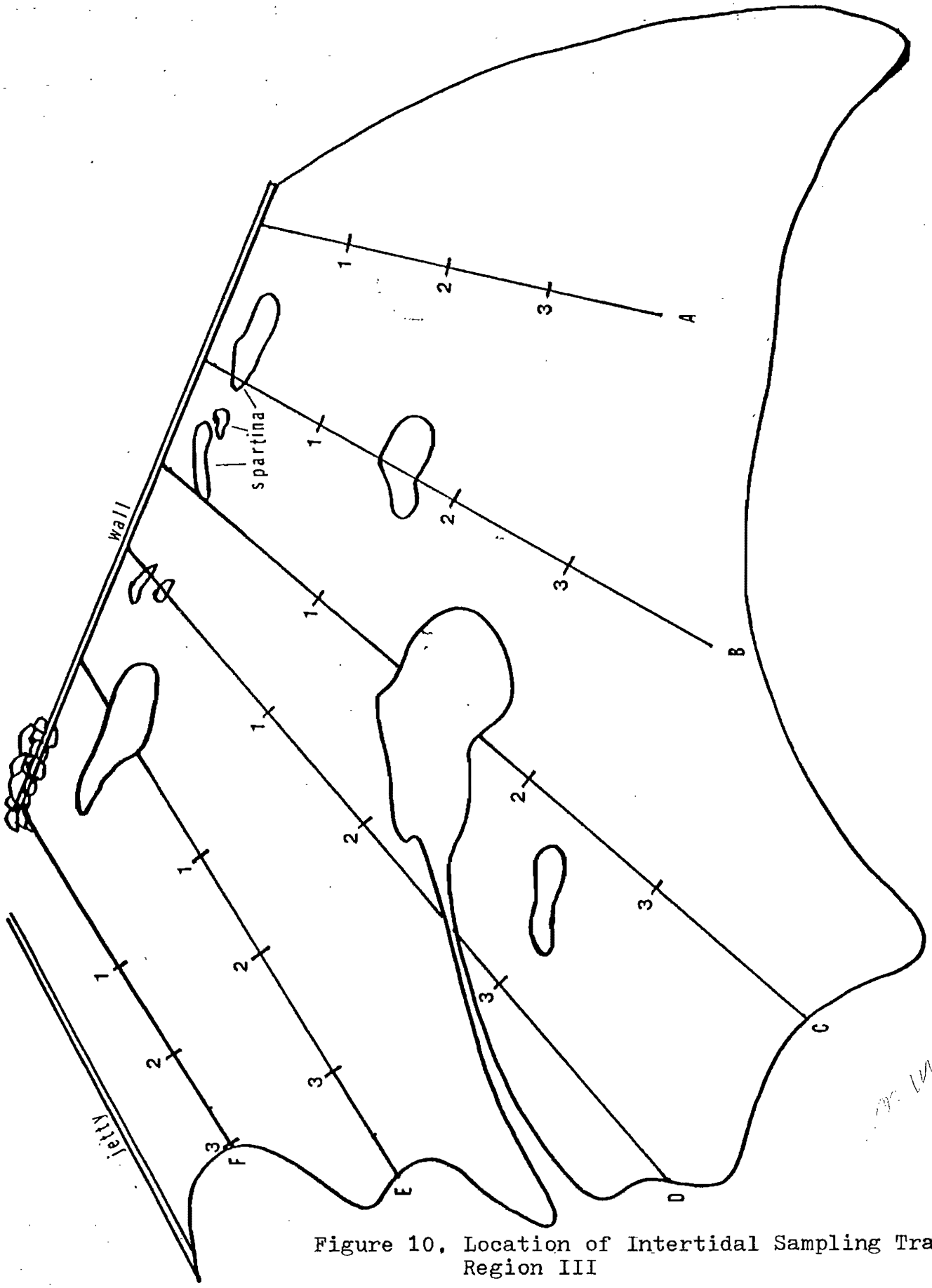

Figure 10. Location of Intertidal Sampling Transects, Region III

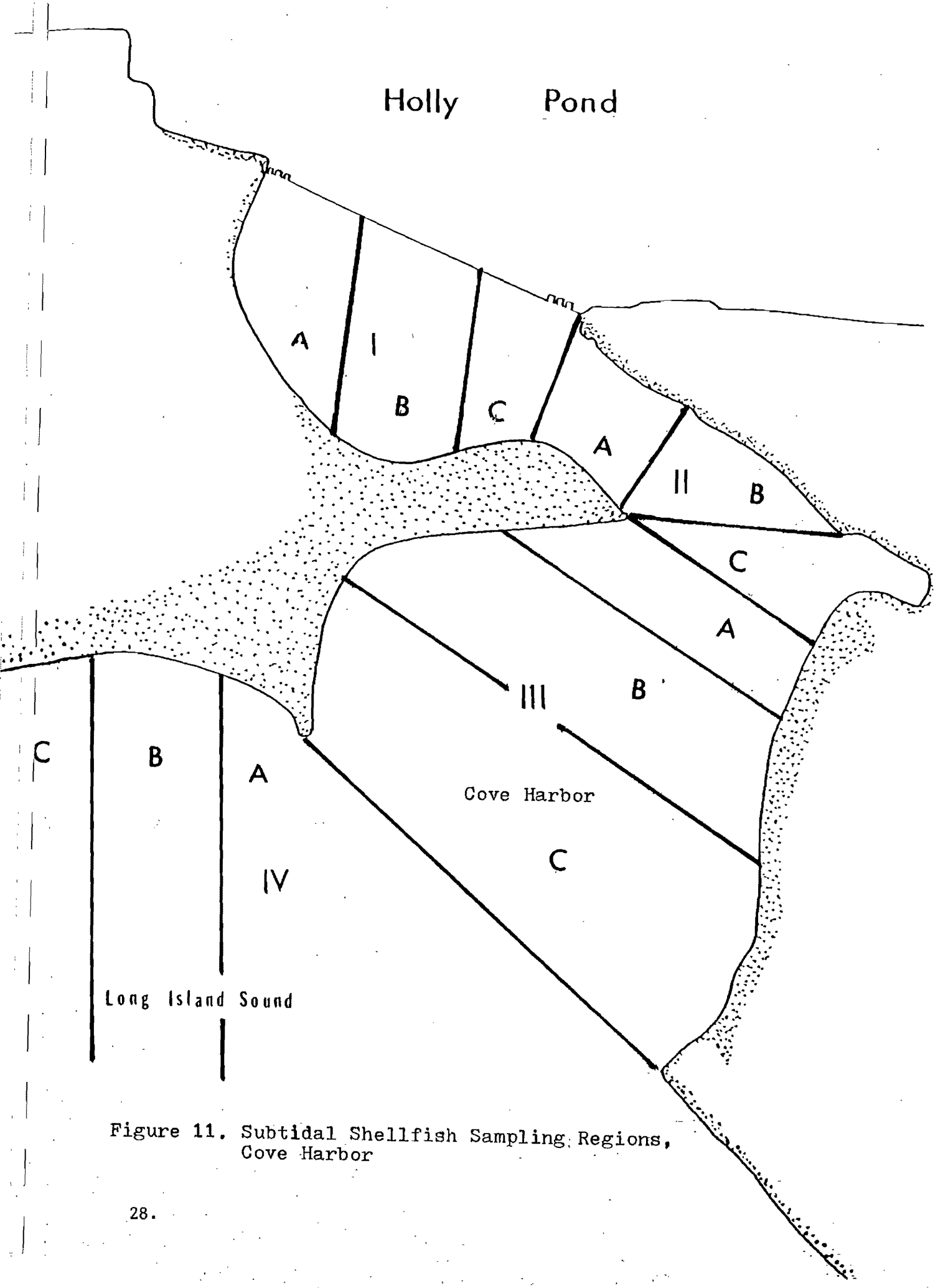

Figure 11. Subtidal Shellfish Sampling Regions, Cove Harbor

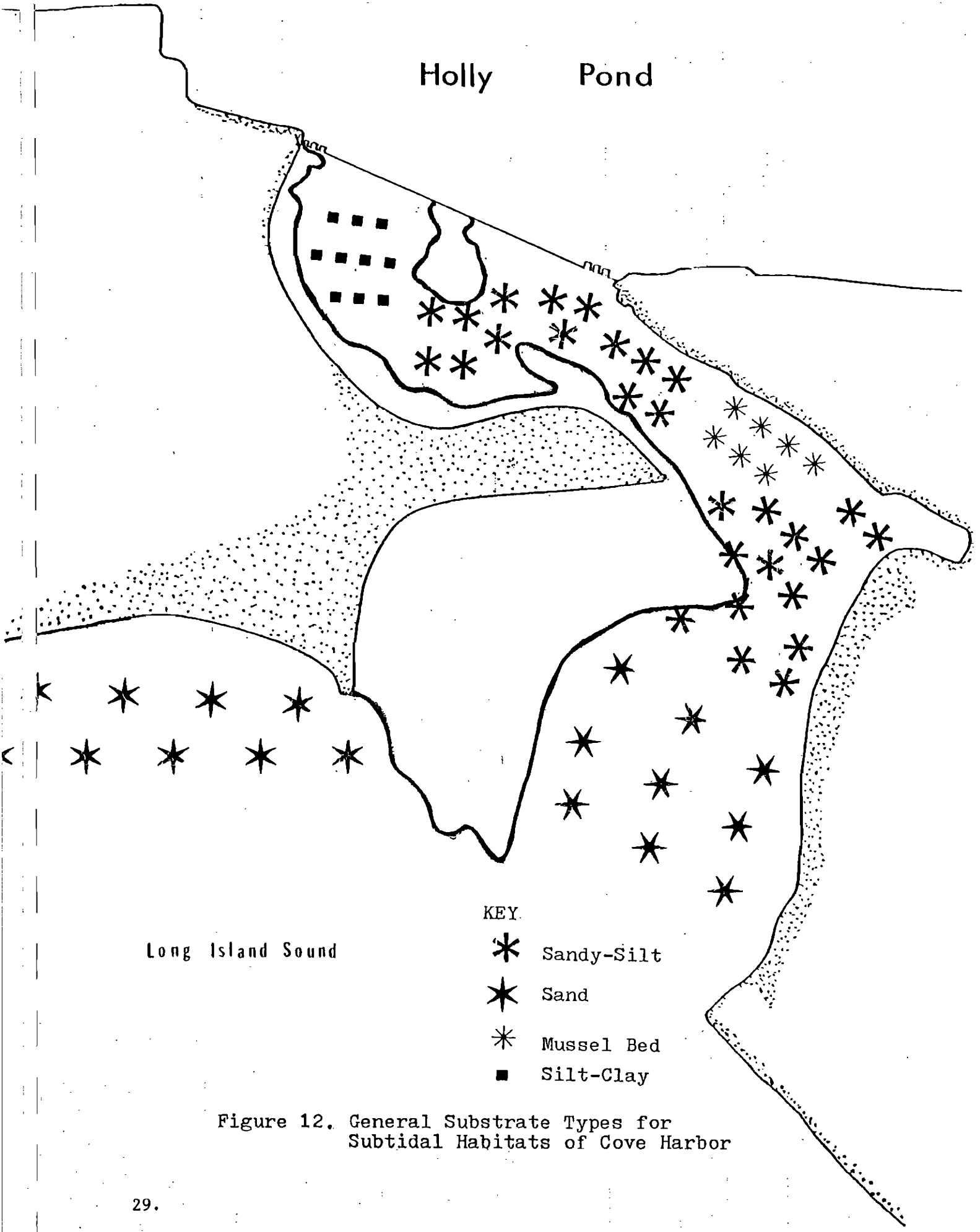

Figure 12. General Substrate Types for Subtidal Habitats of Cove Harbor

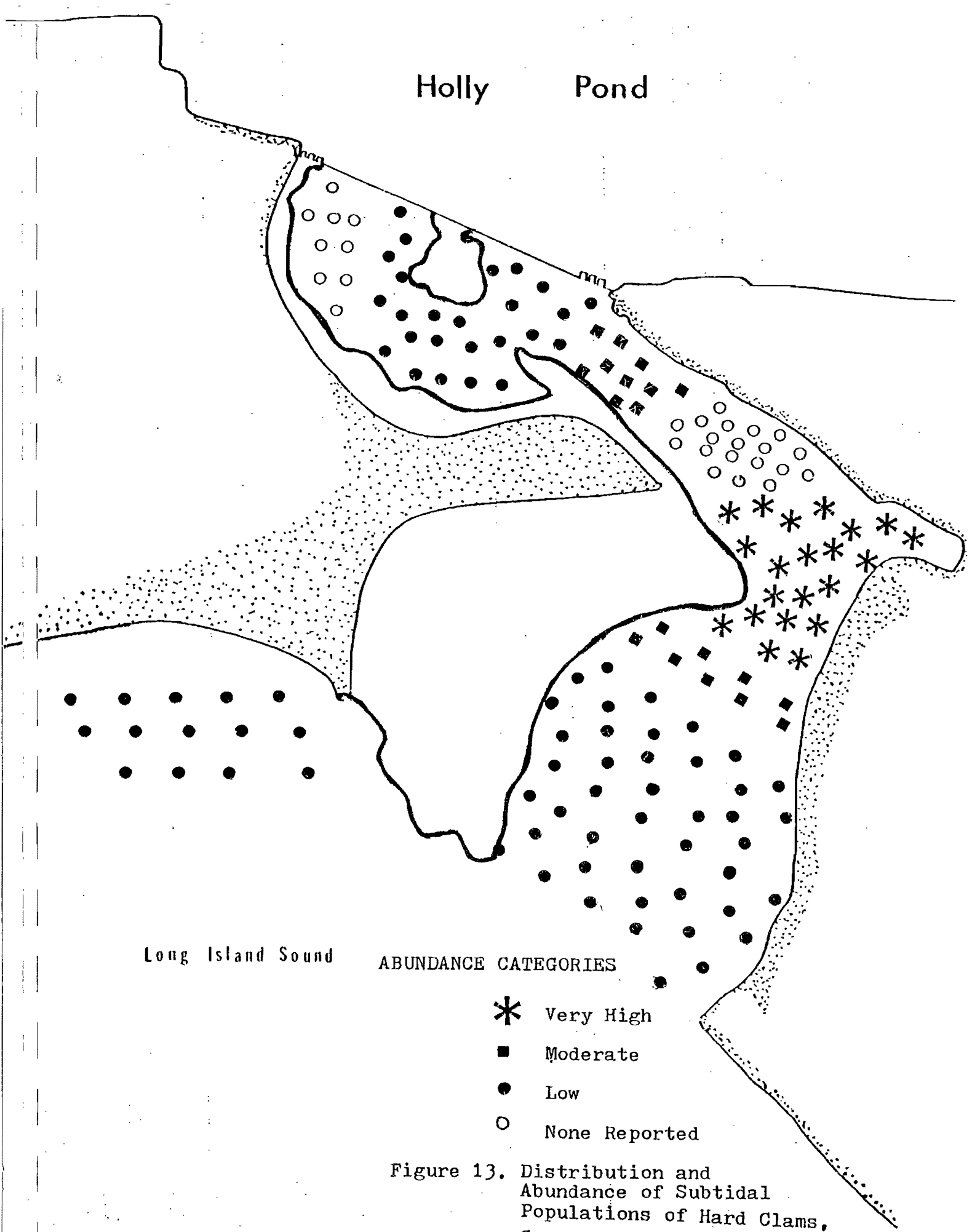

Figure 13. Distribution and Abundance of Subtidal Populations of Hard Clams, Cove Harbor

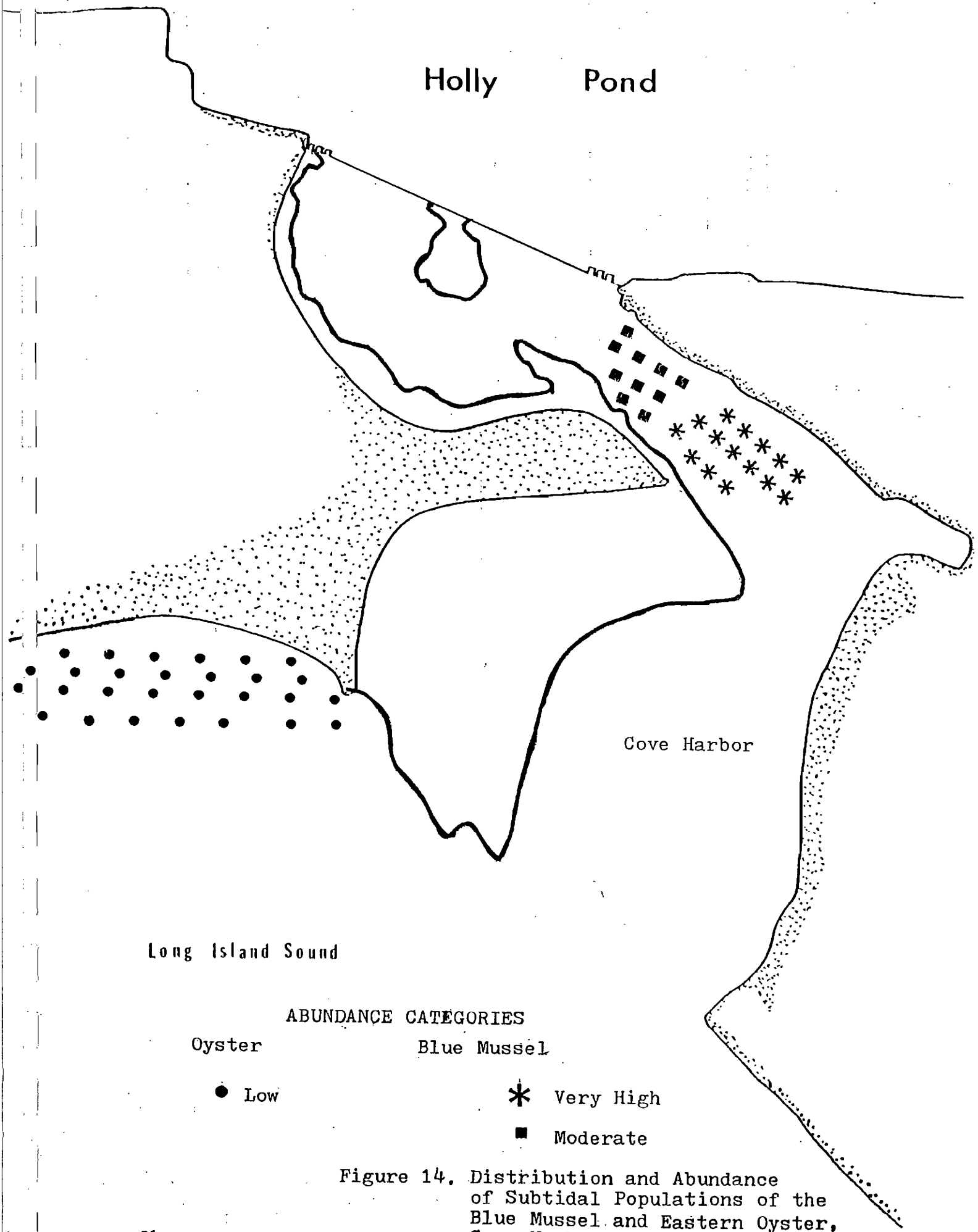

Figure 14. Distribution and Abundance of Subtidal Populations of the Blue Mussel and Eastern Oyster, Cove Harbor

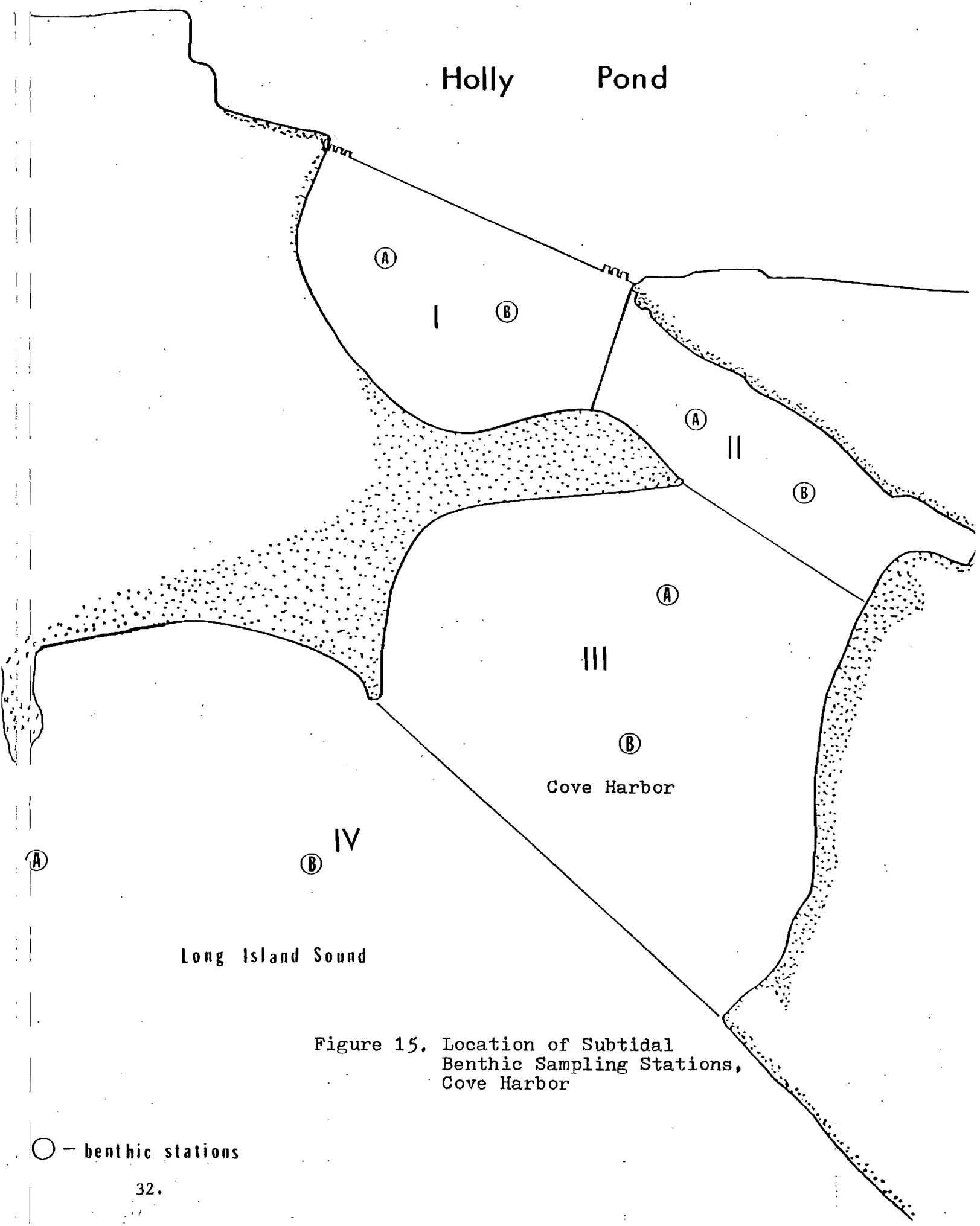

Figure 15. Location of Subtidal Benthic Sampling Stations, Cove Harbor

TABLES

TABLE 1 Abundance of Intertidal Shellfish Populations, Inner Cove Harbor (Region I) (Number/.25m^2) (Summer, 1986)

Transect	Mya arenaria	Mytilus edulis	Mercenaria mercenaria
A)	-	-	-
) M			
B) U	7	-	-
) D			
C)	1	-	-
D)	-	-	-
)S			
E)A	3	-	2
)N			
F)D	-	-	-
)			
G)	-	-	-
H (Mussel Bed)			
Station 1	45	215	-
Station 2	37	241	-

TABLE 2. Abundance of Intertidal Shellfish Populations, Inner Cove Harbor (Region II) (Numbers/.25m^2)(Summer, 1986)

Transect	Mya	Mytilus	Mercenaria	Crassostrea
A				
Station 1	-	-	-	-
Station 2	1	172	-	1
B				
Station 1	-	-	-	-
Station 2	-	67	-	-
C				
Station 1	-	-	-	-
Station 2	-	37	-	-

TABLE 3. Abundance of Intertidal Shellfish Populations, Inner Cove Harbor (Region III) (Number/.25m^2)(Summer, 1986)

Transect	Mya	Mytilus	Mercenaria
A			
Station 1	47	72	-
Station 2	31	4	-
Station 3	40	581	-
B			
Station 1	10	-	-
Station 2	1	28	6
Station 3	37	4	-
C			
Station 1	-	43	-
Station 2	-	-	-
Station 3	1	51	-
D			
Station 1	-	-	1
Station 2	-	-	2
Station 3	17	53	-
E			
Station 1	-	-	-
Station 2	-	-	-
Station 3	-	-	-
F			
Station 1	-	-	-
Station 2	-	-	-
Station 3	-	-	-

TABLE 4 Physical Characteristics of Subtidal Habitat Regions, Inner Cove Harbor

Region	Subregion	Substrate	Area(m^2)
I.			
	A	Silt-Clay	3,606
	B	Sandy-Silt	4,978
	C	Sandy-Silt	6,360
II.	A	Sandy-Silt	3,592
	B	Sandy-Silty Shell	2,420
	C	Sandy-Silt	4,874
III.	A	Sandy-Silt	6,354
	B	Muddy-sand to Gravelly-Sand	13,511
	C	Gravelly-Sand with Shell	20,581
IV.	A	Sandy-Shell	
	B.	Sandy-Shell	
	C.	Sandy-Shell	

TABLE 5. Abundance of Subtidal Shellfish Populations (Inner Cove Harbor) Summer, 1986 (Total Number per 10 Clam Tows)

Region	Subregion	Mercenaria	Mytilus	Crassostrea
I.				
	A	-	-	-
	B	8	-	-
	C	7	-	-
II.				
	A	10	15	-
	B	-	610	-
	C	26	-	-
III.				
	A	30	-	-
	B	4	-	-
	C	2	-	-
IV.				
	A	-	-	-
	B	1	-	1
	C	-	-	-

TABLE 6. Size-Class Distribution of Hard Clam Populations, Inner Cove Harbor (Summer, 1986) (Percent Frequency)

Region	Subregion	Juveniles (Up to 4.8cm)	Littlenecks (4.9-7.0cm)	Cherrystones (7.1-9.2cm)	Chowders (Greater than 9.3cm)
I.					
	A	-	-	-	-
	B	-	62.5	25.0	12.5
	C	-	28.6	28.6	42.8
II.					
	A	60.0	40.0	-	-
	B	-	-	-	-
	C	34.6	50.0	7.7	7.7
III.					
	A	20.0	53.3	23.3	3.4
	B	25.0	-	75.0	-
	C	-	-	50.0	50.0
IV.					
	A	-	-	-	-
	B	-	-	-	100.0
	C	-	-	-	-

TABLE 7. Benthic Community Structure of Inner Cove Harbor (Numbers/.04m^2) Summer, 1986

Species	I. A	I. B	II. A	II. B	III. A	III. B	IV. A	IV. B
Polychaetes								
Nereis succinea	-	-	2	3	-	7	4	-
Lumbrineris tenuis	12	-	-	-	-	22	7	-
Glycera dibrunchiata	6	-	-	-	-	7	3	2
Haploscoloplos robustus	-	2	2	9	5	-	-	5
Phyllodoce arenae	2	3	-	-	9	3	4	7
Eteone heteropoda	-	-	1	2	-	-	-	3
Cirratulus cirratus	-	-	3	216	29	3	-	-
Arabella irricolor	-	-	-	4	5	-	-	-
Polydora ligni	1	-	2	3	-	-	-	-
Capitella capitata	-	-	-	2	-	-	-	-
Stauroneris caecus	-	-	-	6	-	2	-	-
Diopatra cuprea	-	-	-	-	-	2	-	-
Mediomastus ambiseta	-	-	64	-	3	-	-	-
Spiochaetopterus oculatus	-	-	-	-	5	-	-	-
Pectinaria gouldii	-	-	2	-	-	-	-	-
Heteromastus filiformis	6	2	28	9	7	7	6	-
Clymenella torquata	-	-	2	-	-	-	-	-
Crustacea								
Melita nitida	-	-	6	-	-	9	2	3
Ampelisca vadorum	-	2	-	-	-	-	-	-
Amphitoe	-	-	-	11	-	2	-	-
Corophium	-	-	1	-	-	-	-	-
Neopanope texana	-	-	1	-	-	-	1	-
Upogebia affinus	-	-	-	-	-	-	1	-
Bivalves								
Gemma gemma	-	3	-	-	-	-	-	3
Tellina agilis	-	5	-	-	-	-	2	7
Ensisdirectus	-	1	-	-	-	-	-	-
Gastropods								
Crepidula fornicata	-	-	-	-	-	-	3	1
Nassarius obsoletus	-	-	-	-	4	-	1	-
TOTALS								
# Species	5	7	12	10	8	10	11	8
# Individuals	27	18	114	265	67	64	34	31

TABLE 8. A Biotic Parameters for Subtidal Stations of Inner Cove Harbor (September 15, 1986) (12:30 P.M.)

Region	Temperature OC	Salinity 0/00	Dissolved Oxygen mg/L
I.			
A	19.0	23.5	7.5
B	19.0	24.0	7.8
II.			
A	19.0	24.0	6.9
B	19.0	24.5	7.1
III.			
A	19.0	24.5	7.2
B	19.0	24.5	7.0
IV.			
A	19.0	25.0	7.1
B	19.0	25.0	7.3