An Assessment of Shellfish Resources in the Deep Water Areas of the Peconic Estuary

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Introduction

Hard clams, oysters, bay scallops, whelks, soft shell clams, and mussels have historically constituted a considerable fishery resource of the Peconic Estuary. Until the brown tide algae blooms of the mid-1980's, the Peconic Estuary (Figure 1) produced one-fourth of all bay scallops harvested in the United States and accounted for over 90% of the New York bay scallop harvest. The Peconic Estuary has supported a commercially important oyster industry both in the early 1900's and again during the 1950's. Hard clam production in the Peconic Estuary has increased since the mid-1980's because of the growth in New York's private transplant program (the Peconic Estuary is the receiving area for transplants and is recorded as the place of origin for these shellfish even though they originated from other water bodies).

With the exception of landings data, little information has been reported describing the distribution and abundance of these and other benthic species in the Peconic Estuary. The only shellfish survey in the deep waters of the Peconic Estuary was conducted by the New York State Department of Environmental Conservation (NYSDEC) in 1979 and 1980 (NYSDEC 1982). In their study, the NYSDEC collected hydraulic clam dredge tows at 246 stations distributed throughout Flanders Bay, Great Peconic Bay, Little Peconic Bay, Cutchogue Harbor and Hog Neck Bay in water depths between 1.2 and 9.1 meters. To our knowledge, no more recent information exists nor has there ever been comparable sampling east of Shelter Island. This represents an important information gap in our understanding of the natural resources of the Peconic Estuary. Distribution, abundance and size-frequency data for shellfish provides basic and necessary information for the effective management of estuarine resources.

In the present study, a survey of the shellfish resources in the deep waters of the Peconic Estuary was undertaken in the fall of 1995 as part of the natural resources assessment for the Peconic Estuary Program. The goals of the study were to assess the status of shellfish resources in the deep waters of the Peconic Estuary and to obtain information on bottom type, the distribution and abundance of shellfish, and the distribution of other species, particularly shellfish predators. This survey complements and extends the earlier deep water survey carried out in the western part of the Peconic Estuary by the New York State Department of Environmental Conservation in 1979 and 1980.

Methods

In the present survey, sampling was undertaken at 124 stations between October 23 and November 13, 1995 (Table 1). Because of gear limitations, the survey was restricted to water depths greater than 2 meters and less than 9.1 meters and to most areas outside the embayments and tributaries of the Peconic Estuary. The approximate grid scheme from the 1979/1980 NYSDEC survey was expanded in the present study to cover the previously unsurveyed areas eastward to a line extending between Orient Point and Cedar Point and stations were spaced approximately 0.5 nautical miles apart (Figure 2). Approximately one-quarter (63 of 246) of the 1979/1980 NYSDEC survey stations west of Shelter Island were resampled during 1995 (Table 2) in order to provide a representative comparison between the present and historic surveys.

Stations were located using onboard Loran C navigation equipment. If during sampling a station was found to be on privately owned bottom, the station was not sampled (stations 8 and 33). If the station was in shallower waters than appeared on the NOAA chart, it was sampled as near as possible to the original grid location (stations 48, 52, 53, 57, 59, 72 and 73). In all cases, the location of these stations was within 0.1 to 0.2 nautical miles of the original grid location.

Duplicate 61 meter (200 foot) tows were taken at each station using a hydraulic clam dredge towed from the NYDEC's boat *Seewanhaka*. A 61 m (200 foot) weighted line was released from the boat during the tow to determine the length of tow. This hydraulic clam dredge has an opening of 0.3 m (one foot), a bar spacing of 19 mm (3/4 inch) and the cutting edge, which determines the depth of dredge penetration, was set at 76 mm (three inches). The 1979/1980 NYSDEC survey used the same dredge and methods.

The bar spacing on the dredge (19 mm) is designed for harvesting large benthic organisms. Small organisms or highly mobile organisms, such as scallops, may have washed out, fallen through, or otherwise escaped the dredge. For this reason, values reported for scallops and smaller species probably underestimate absolute abundances. Despite the potential for underestimating these species, comparisons of distribution and abundance between surveys are considered valid since the two surveys used identical sampling methods.

All organisms collected during each tow were brought on board to be identified, measured, and counted. They were then returned as near as possible to the collection site. For abundant species such as slipper shell (*Crepidula fornicata*), subsamples were counted and measured. Total abundance was determined for these species by dividing the subsample abundance by the sampling fraction. Commercial shellfish species were classified according to market standards. Bay scallops (*Argopecten irradians*) were classified as legal or sublegal size (<57 mm length from mid-hinge to mid-bill). Oysters (*Crassostrea virginica*) were also classified as legal or sublegal size (< 127 mm added length and width); no oyster spat were collected. Hard clams (*Mercenaria mercenaria*) were sorted by racks into the following categories: sublegal (19 to 25 mm thick), littleneck (25 to 30 mm thick), cherry stone (30 to 41 mm thick), chowder (>41 mm thick). Length was measured for all other organisms.

Sediments were qualitatively characterized by material retained in the dredge with the organisms. The presence of plants, hydroids, worm tubes, shell or stone was also noted. Stations with no indication of sediment type were classified as "no sediment trace". This sediment characterization must be interpreted cautiously since the material recovered was subjected to substantial washing during towing and recovery of the dredge.

After all stations were sampled, abundance and size data were compiled in a computer spreadsheet. Abundances were plotted as both data and bubble plots. The data plots for each species showed average catch per 9.29 sq. meters (100 square feet) for each station location (including zero values). The bubble plots showed patterns in species abundance by plotting circles whose areas are proportional to catch. The data from the 1979/1980 NYSDEC survey corresponding to the stations in the present study were plotted in the same manner.

A paired comparisons ANOVA (Sokal and Rohlf, 1995) and a distribution-free sign test (Hollander and Wolfe, 1973) were used to compare the distribution and abundance data from the present study to the earlier NYSDEC survey. A total of 63 corresponding stations from the 1979/1980 NYSDEC survey were successfully reoccupied in the 1995 survey, and all comparisons were limited to these 63 stations. Comparisons were by survey year and station. Fourteen of the fifteen species reported in the 1979/1980 NYSDEC survey and found in 1995 were analyzed. Analysis of the remaining species, *Crepidula fornicata*, was not done as data were reported in bushels for 1979/1980 and as abundance in 1995.

Results

Environmental Characteristics

Station location, longitude and latitude, and environmental data are summarized in Appendix A. Depths at all sampling stations in the Peconic Estuary ranged from 1.8 to 8.5 meters (Figure 3). Depths in Flanders Bay ranged from 2.1 to 4.0 m. Great Peconic Bay had depths ranging from 1.8 to 8.5 m with 17 of the 41 stations $\geq$ 6.1 m. Depths in Little Peconic Bay varied from 1.8 to 8.8 m. Gardiners Bay was predominantly deeper water with only 2 stations shallower that 4.3 m. All stations that were between 1.8 and 3.0 m in depth were nearshore.

The stations in this study were representative of the very diverse bottom types found in the Peconic Estuary. Fine-grain sediment types ranged from mud to sand, with the predominant number of stations (Figure 4) being mud, muddy sand or sand (38 stations or 31%, 30 stations or 24%, 18 stations or 15%, respectively). Most of the muddy stations were deeper than 7.0 m. Many stations had shell and stone present as well, with the notable exception of lower Noyac Bay, lower Northwest Harbor and the center of Great Peconic Bay (Figure 5). Macroalgae were also recorded as a sediment characteristic (Figure 6). These included *Codium*, *Ulva*, and eelgrass, which were located predominantly east of Jessup Neck (see Figure 2 for the location of Jessup Neck). Brittle stars were dominate in the deep waters of Great Peconic Bay and hydroids were very abundant in the waters surrounding Shelter Island (Figure 7). The sediment surface at some stations had large quantities of invertebrate tubes (Figure 8). Amphipod tubes were found at three stations in Flanders Bay, while terrebellid worm tubes were found east of Flanders Bay.

Abundance and Distribution

In the 1995 Peconic Estuary survey, a total of 31 animal species were found and identified along with 4 algae species (Table 3). Abundance at each station varied from 0 to 6228 individuals per 9.29 sq. meters (Figure 9a,b). No shellfish or shellfish predators were found at 24 stations throughout the estuary, with 14 of the 24 being in Great Peconic Bay. Maximum abundance was found at station 110 in Gardiners Bay. *Crepidula fornicata* was, by far, the most abundant species in the survey area. Excluding *Crepidula spp.*, the abundance at each station (Figure 10a,b) ranged from 0 to 236 individuals per 9.29 sq. meters, with the maximum at station 4. In general, abundance tended to increase from offshore to onshore and from west to east in the estuary. Lowest abundances were often associated with deeper areas, fine-grained sediments, and the presence of terrebellid tubes. Highest abundances tended to occur in shallow, sandy areas, often characterized by the presence of shell or stone. Species richness throughout the Peconic Estuary ranged from 0 to 16 species per station. The highest value was at station 88 between Orient Harbor and Pipes Cove (Figure 11a,b). No animals were found at 17 of the 124 stations distributed throughout the estuary. Species richness generally followed the same pattern as abundance and increased from offshore to onshore and from west to east in the estuary. A tabular listing of sampling data for all species may be found in Appendix A and B. Size data collected for selected species are reported in Appendix C. No further analysis of abundance, species richness, and size data was performed in this study due to a lack of comparable data from the 1979/1980 NYSDEC survey.

Shellfish

Mercenaria mercenaria

The hard clam *Mercenaria mercenaria* occurs from the Gulf of St. Lawrence to Florida (Malouf and Bricelj, 1989). It can live in a temperature range of 1 to 21°C, and a salinity of 12 to

35 ppt (Malouf and Bricelj, 1989), although tolerance to salinities as low as 4 ppt has been reported (Eversole, 1987). *M. mercenaria* is generally found in estuarine intertidal to shallow subtidal habitats (Malouf and Bricelj, 1989) but can occur to a depth of 15 m or more (Eversole, 1987). Although hard clams are found in both sand or muddy substrates, they are most abundant in sand. It is a suspension feeder and active shallow burrower (Malouf, 1991) which shows a sensitivity to low dissolved oxygen. Shell length can be 135 mm (Malouf and Bricelj, 1989) and life span may reach 33 years (Eversole, 1987) or more (Cerrato, pers. com.). Predators on juveniles include bottom fish, hermit crabs, and mud and lady crabs (Malouf, 1991). Gulls, ducks, geese, moon shells, whelks, oyster drills and starfish prey on adults.

During the 1995 survey, *Mercenaria mercenaria* was distributed throughout the entire estuary with an increase in abundance toward nearshore areas (Figure 12a,b). Highest abundance was 40.5 individuals per 9.29 sq. meters at station 101. Hard clams were found at 61 of 124 stations (49%). The distribution of sublegal clams was limited to 6 stations in the eastern end of the estuary (Figure 12c,d). Littlenecks were limited to 14 stations, mostly east of Shelter Island (Figure 12e,f). Cherrystone abundance was low, and this size class was found at only 6 stations (Figure 12g,h). Chowders were the most abundant size class, and they were present at 60 stations (Figure 12i,j).

At the 63 stations sampled in the 1979/1980 (Figure 12k,l) and the present survey, hard clams were found at 38 stations (60%) in 1995, while in 1979/1980, hard clams were present at 35 stations (56%). Between 1979/1980 and 1995, hard clams increased in abundance at 10 stations and decreased at 28 stations. The remaining 25 stations had no hard clams during either survey. Statistical analysis indicated a significant decrease in total abundance from 1979/1980 to 1995 (Table 4). Additionally, abundance decreased at a significant number of stations between surveys (Table 5). The 1979/1980 survey did not include a listing of size class abundances, and therefore a separate analysis of each size class was not performed.

Argopecten irradians

The bay scallop is found from Massachusetts to South Carolina with subspecies extending to the Gulf of Mexico (Tettelbach and Wenczel, 1993). It can grow in temperatures greater than 7°C and may live in a salinity range of 15 to 36 ppt (NYSOL, 1970). The bay scallop is found in shallow bays with sandy or muddy substrates but may live in water depths up to 20 m. It is an epibenthic, suspension feeder (Fay, et al., 1983). Seagrass beds are preferred for settling of juveniles. Lengths may reach 7.5 cm (Watling and Maurer, 1973) and scallops live up to two years (Bricelj, et al., 1987). Predators of bay scallops include crabs, sea stars, oyster drills, fish, and gulls (NYSOL, 1970).

Argopecten irradians abundance was very low in the present study (Figure 13a,b). Legal sized bay scallops were found at only five locations in waters surrounding Shelter Island. Each of those stations had an abundance of 0.25 individuals per 9.29 sq. meters. No sublegal sized bay scallops were found in 1995 (Figure 13c). *Argopecten irradians* abundances in the 1979/1980 NYSDEC survey were considerably higher than in 1995 (Figure 13d,e). Bay scallops were found at 20 of the 63 coincident stations (32%) in 1979/1980, while none of the corresponding stations in 1995 had scallops present. Most of the bay scallops in 1979/1980 were found along the northern shore of the study area and in Flanders Bay. Statistical analysis indicates a significant decline in abundance from 1979/1980 to 1995 (Table 4). Abundance also decreased at a significant number of stations between surveys (Table 5).

Crassostrea virginica

The geographical range of the Eastern oyster, *Crassostrea virginica*, extends from the Gulf of St. Lawrence to the Yucatan Peninsula and beyond (Dove and Nyman, 1995). The oyster can live in salinities from 5 to 30 ppt and temperatures between 0 and 35°C. Oyster habitat includes many substrates such as gravel, sand and silt (NYSOL, 1970). In Long Island Sound, oysters may be found to a depth of 10 m. The Eastern oyster can reach up to 19 cm in length (Watling and Maurer, 1973). It is an epifaunal, filter feeding bivalve (NYSOL, 1970). Predators include flatworms, blue and mud crabs, starfish, herrings, oyster drills, and whelks.

Oysters were virtually absent in both the 1995 and the 1979/80 NYSDEC surveys. Only one Eastern oyster was found in the entire 1995 survey (Figure 14a,b). No Eastern oysters were collected during the 1979/1980 NYSDEC survey.

Busycon carica and Busycon canaliculatum

Busycon carica, the knobbed whelk, and *Busycon canaliculatum*, the channeled whelk, are found over a geographical range that includes the east coast from Cape Cod to Florida, the Gulf of Mexico, and the Caribbean (Magalhaes, 1948). The knobbed whelk lives in waters with a temperature range of 10 to 35°C while the channeled whelk's temperature range is 8.5 to 31.5°C. Channeled whelks are found in salinities greater than 20 ppt (Gosner, 1978). The channeled whelk lives in the lower intertidal to subtidal down to a depth of 18 m along bay and ocean beaches. Knobbed whelks can reach a maximum of 22 cm while channeled whelks can reach 17 cm (Watling and Maurer, 1973). Both species are predatory gastropods and their prey includes hard clams, oysters, and razor clams (Walker, 1988).

In the 1995 survey, both species were distributed throughout the entire estuary. While *B. carica* had no obvious west to east pattern (Figure 15a,b), *B. canaliculatum* increased in abundance to the east (Figure 15c,d). *B. carica* was found at 48 of 124 stations (39%) while *B. canaliculatum* was found at 28 of 124 stations (23%). Maximum abundance was 2 individuals per 9.29 sq. meters for *B. carica* at stations 42 and 70. *B. canaliculatum* had a maximum abundance of 0.75 individuals per 9.29 sq. meters at station 116. The 1979/1980 survey did not reported these species independently. Both whelk species were found at 53 of the 63 coincident stations (84%) in 1979/1980, and reached an abundance of 48 individuals per 9.29 sq. meters at station 7 (Figure 15e,f). Whelks were found at 32 of 63 coincident stations in 1995. Between 1979/1980 and 1995, abundance increased at 2 stations and decreased at 53 stations, while remaining the same at 8 stations. Statistical analysis indicates a significant decrease in total abundance from 1979/1980 to 1995 (Table 4). Abundance decreased at a significant number of stations (Table 5).

Shellfish Predators

Urosalpinx cinera

The oyster drill, *Urosalpinx cinera* is distributed from Nova Scotia to Florida (NYSOL, 1970; Shea, et al., 1980; Dove and Nyman, 1995). Oyster drills are active between 10 and 35°C but may survive in temperatures as low as 0°C. Their salinity range is from 10 to 26 ppt. Oyster drills live in shallow nearshore regions on sand, gravel and silt as well as the rocky intertidal zone (NYSOL, 1970; Katz, 1985). Oyster drills may be found to a depth of 15 m and may reach a length of 2.5 cm (Dove and Nyman, 1995). They are carnivores and their prey include barnacles, shellfish and other drills (NYSOL, 1970, Katz, 1985). One of its predators is the moon shell *Polinices duplicatus*.

In the current study, *Urosalpinx cinera* was present in all parts of the estuary, but increased in abundance from west to east (Figure 16a,b). Oyster drills were found at 22 of 124 stations (18%) and had an abundance as high as 1.5 individuals per 9.29 sq. meters at station 86 in Southold Bay. Because their maximum size is close to the bar spacing on the dredge, distribution and abundances are probably underestimated. Only one individual was found in the 1979/1980 NYSDEC survey, at station 13 in Great Peconic Bay (Figure 16c,d). Between 1979/80 and 1995, oyster drills increased at 7 stations, decreased at 1 station and remaining unchanged at 55 stations. Statistical analysis indicates a significant increase in total abundance from 1979/1980 to 1995 (Table 4).

Lunatia heros

The Northern moon shell's geographical range extends from Labrador to North Carolina (Gosner, 1978). This species lives in waters from the intertidal region to 360 m. It may grow to 10 cm in shell width. This gastropod is an important predator on molluscs.

Only two *Lunatia heros* were found in the entire 1995 survey (Figure 17a,b). Both were found at station 113 off Shelter Island. The 1979/1980 NYSDEC survey reported one individual at station 71 (Figure 17c,d). Statistical analysis indicates no change in distribution or abundance from 1979/1980 to 1995 (Tables 4, 5).

Pagurus longicarpus and *Pagurus pollicaris*

The long-clawed hermit crab, *Pagurus longicarpus*, is the most common shallow water hermit crab on the East coast (Gibbons, 1984). Its range extends from Nova Scotia to northern Florida and the Gulf of Mexico. It lives in temperatures up to 18.3°C and in salinities greater than 18 ppt (Gibbons, 1984; Williams and Wigley, 1977). This species lives in the shallow littoral zone on a variety of substrates to a depth of 45 m (Gibbons, 1984). There is also a report of long-clawed hermit crabs occurring to a depth of 200 m (Williams, 1984). Males may reach a carapace width of 7.5 mm and females 5 mm. Prey includes mussels, gastropods, and barnacles (Kuhlman, 1992). Predators are lobster, octopus, rock crab, blue crab, sea star, gastropods and flounder.

The flat-clawed hermit crab, *Pagurus pollicaris*, is the largest hermit crab (Williams, 1984). Its geographic range extends from New Brunswick to Florida and the Gulf of Mexico. This hermit crab can live in water temperatures up to 17.8° C (Williams and Wigley, 1977). It requires salinities greater than 9 ppt (Gosner, 1978). Flat-clawed hermit crabs inhabit subtidal regions of bays, estuaries and oceans (Gosner, 1978) and live to depths of 112 m (Williams, 1984). This species may reach 31 mm in carapace width (Gosner, 1978). Prey and predators are similar to those listed for long-clawed hermit crab.

In 1995, *Pagurus longicarpus* was found at 9 stations distributed throughout the entire estuary (Figure 18a,b). Abundance was uniformly low with a maximum of 0.75 individuals per 9.29 sq. meters at station 110. *Pagurus pollicaris* was restricted to the eastern portion of the estuary (Figure 18c,d). It was found at 15 of 124 stations (12%) with a maximum abundance of 1.00 individual per 9.29 sq. meters at stations 88 and 117. The 1979/1980 survey did not report these two species independently, and hermit crabs were reported at 20 of the coincident 63 stations. Hermit crabs reached a maximum abundance in 1979/1980 of 2.1 individuals per 9.29 sq. meters at station 7 (Figure 18e,f). Between 1979/80 and 1995, hermit crabs increased in abundance at 2 stations and decreased at 19 of the 63 coincident stations. At the remaining 42 stations, there was no change in abundance. Statistical analysis indicates a significant decrease in total abundance from 1979/1980 to 1995 (Table 4). Abundance also decreased at a significant number of stations (Table 5).

Cancer irroratus

Cancer irroratus, the rock crab, is one of the most common shallow water crabs in New England (Silbajoris, 1975). Its geographical range extends from Labrador to Florida. It is most active between 14 and 18°C (Silbajoris, 1975) and occurs in salinities greater than 20 ppt (Stone, et al., 1994). The rock crab is found to a depth of 575 m (Williams, 1984). Rock crabs generally live on flat sandy hard substrates as well as rock, gravel, and mud (Silbajoris, 1975; Stehlik, 1993; Stone, et al., 1994). Male rock crabs may reach 120 mm carapace width, while females may be 67 mm (Williams, 1984). Rock crabs prey on juvenile surf clams and hard clams, nut clams, polycheates and crustaceans (Stehlik, 1993).

The distribution of *Cancer irroratus* in the 1995 survey was limited to eight stations in Gardiners Bay (Figure 19a,b). Its maximum abundance was 0.75 individuals per 9.29 sq. meters at station 124. The 1979/1980 NYSDEC survey did not report the occurrence of *Cancer irroratus*.

Dyspanopeus sayi

Dyspanopeus sayi, the black-fingered mud crab, is found from New Brunswick to Florida (Gibbons, 1984). It is the most common mud crab species north of Delaware Bay. *Dyspanopeus sayi* lives in waters of salinity greater than 15 ppt. Generally these crabs prefer sand, gravel, and shell, although they may be found in sponge colonies, hydroids, and under rocks. Carapace width may be up to 22 mm. Prey include young oysters and clams.

Dyspanopeus sayi was a commonly collected predator in the 1995 study (Figure 20a,b). It was found at 52 of the 124 stations (42%) distributed throughout the estuary, and it increased in abundance in the eastern portion of the estuary. Its maximum abundance was 7.75 individuals per 9.29 sq. meters at station 110. Because its maximum size is similar to the bar spacing on the dredge, distribution and abundance values for this species were probably underestimated. The 1979/1980 NYSDEC survey reported *Dyspanopeus sayi* at 9 of the 63 coincident stations, with two of those stations (5 and 13) having greater than 10 individuals per 9.29 sq. meters (Figure 20c,d). Between 1979/1980 and 1995, mud crabs increased in abundance at 20 stations, decreased at 8 stations and remained unchanged at 35 stations. Statistical analysis indicates no significant change in abundance (Table 4). However, abundance increased at a significant number of stations from 1979/1980 to 1995 (Table 5).

Ovalipes ocellatus

The lady crab, *Ovalipes ocellatus*, has a geographical range from Cape Cod to the Gulf of Mexico (Gibbons, 1984). The lady crab lives in waters with temperatures up to 23.9°C (Williams and Wigley, 1977). It is a subtidal species preferring sandy bottoms and living to a depth of 95 m (Gibbons, 1984, Williams, 1984). This species may reach 87 mm carapace width (Gibbons, 1984 Stehlik, 1993). Prey includes juvenile hard and surf clams, polychaetes, and crustaceans.

Ovalipes ocellatus had the broadest distribution of any predator in 1995 (Figure 21a,b), being present at 63 of the 124 stations (51%). It was collected throughout the estuary at stations located inshore. Its maximum abundance was 4.0 individuals per 9.29 sq. meters at station 26. *Ovalipes ocellatus* was also widely distributed in the 1979/1980 NYSDEC survey (Figure 21c,d). It was present at 30 of the 63 coincident stations (48%) in 1979/1980. The maximum abundance of lady crabs in 1979/1980 was 8.0 individuals per 9.29 sq. meters. Between 1979/1980 and 1995, lady crabs increased in abudance at 23 of 63 coincident stations and decreased at 17 stations. Statistical analysis indicated no significant change in this species from 1979/1980 to 1995 (Table 4,5).

Libinia emarginata

Libinia emarginata, the common spider crab, has a geographic range from Nova Scotia to the Gulf of Mexico (Williams, 1984). The spider crab is common on all types of substrates (Gosner, 1978). It is found in oceans and highly saline portions of estuaries to 50 m depth (Williams and Wigley, 1977). Spider crabs have been reported living up to 125 m depth. It is a scavenger of plant and animal material (Conneticut DEP, 1989). Spider crabs may be an important prey item of Kemps Ridley turtles.

In 1995, *Libinia emarginata* was limited mainly to the eastern estuary, with presence reported at only seven stations west of Jessup Neck (Figure 22a,b). It was most common in Gardiners Bay, reaching an abundance of 6.75 individuals per 9.29 sq. meters at station 119. *Libinia emarginata* was also distributed throughout the survey area in the 1979/1980 survey, although it clearly increased in abundance to the east (Figure 22c,d). It was found at 20 of the 63 coincident stations in 1979/1980, with a maximum abundance of 2.25 individuals per 9.29 sq. meters. Between 1979/1980 and 1995, abundance increased at 3 stations and decreased at 18 of the 63 coincident stations. There was no change in abundance at the remaining 42 stations. Statistical analysis indicated a significant decrease in abundance from 1979/1980 to 1995 (Table 4). Abundance also decreased at a significant number of stations (Table 5).

Limulus polyphemus

The Atlantic horseshoe crab, *Limulus polyphemus*, has a geographical range from Maine to the Yucatan Peninsula (Botton and Ropes, 1987). Adults of this species have a salinity range of 18-32 ppt (Jegla and Costlow, 1982). Horseshoe crabs are found intertidally to the continental shelf with a reported maximum depth of 200 m (Gosner, 1978, Shuster, 1982). Females are larger than males and may reach a length of 60 cm (Gosner, 1978). Prey items include molluscs and polychaetes (Gosner, 1978, Botton and Ropes, 1989). One predator of the horseshoe crab is the gull (Botton and Loveland, 1993).

Few *Limulus polyphemus* were collected in the 1995 survey (Figure 23a,b). Four individuals were found at three stations west of Jessup Neck. The 1979/1980 survey found *Limulus polyphemus* at 11 of the 63 coincident stations (17%). The maximum abundance in 1979/1980 was 0.75 individuals per 9.29 sq. meters at station 7 (Figure 23c,d). Between 1979/1980 and 1995, abundance increased at 1 station and decreased at 9 of the 63 coincident stations. Statistical analysis indicated a significant decrease in total abundance from 1979/1980 to 1995 (Table 4). Abundance also decreased at a significant number of stations (Table 5).

Asterias forbesii

Asterias forbesii, the common sea star, has a range from Maine to Florida and the Gulf of Mexico (Loosenoff, 1961). The sea star is tolerant of water up to 33°C and salinities between 18 and 32 ppt (NYSOL, 1970; Gosner, 1978). Sea stars live on rock, sand, and other substrates in the littoral zone to a depth of 45 m (NYSOL, 1970). Average radius length is 12.5 cm. Prey items include shellfish such as mussels, oysters, and hard clams.

In 1995 only one sea star was found in the entire survey at station 2 (Figure 24a,b). In contrast, 12 of the 63 stations (19%) from the 1979/1980 NYSDEC survey had *Asterias forbesii* present. Its 1979/1980 abundance reached 30 individuals per 9.29 sq. meters at station 40 (Figure 24c,d). Between 1979/1980 and 1995, abundance increased at 1 of the 63 coincident stations and decreased at 12 stations. Statistical analysis indicated a significant decrease in abundance from 1979/1980 to 1995 (Table 4). Abundance also decreased at a significant number of stations (Table 5).

Other Species

Spisula solidissima

The distribution of surf clams extends from Nova Scotia to North Carolina (Keith, 1985). While surf clams live in salinities from 12 to 35 ppt, they prefer salinities around 35 ppt. Surf clams are thus more frequently a coastal oceanic species but may live in the mouths of estuaries. Surf clams have a sensitivity to low dissolved oxygen. Preferred substrates of this filter feeder include coarse sand and gravel (United States Department of the Interior Fish and Wildlife Service, 1968). Surf clams may be found to water depths of 150 m. They are infaunal, active burrowing, suspension feeders (Watling and Maurer, 1973). Maximum length reached is 17.5 cm (Watling and Maurer, 1973), and 31 years is the maximum reported lifespan (Keith, 1985). Surf clam predators include haddock, cod, moon shell, and oyster drill (NYSOL, 1970, Fay, et al., 1983).

In the 1995 survey, *Spisula solidissima* distribution was limited to Gardiners Bay except for one individual found off Robins Island at station 40 (Figure 25a,b). Surf clams were found at 11 of the 124 stations (9%) and reached a maximum abundance of 3 individuals per 9.29 sq. meters. *Spisula solidissima* abundance during the 1979/1980 survey was also low (Figure 25c,d), and this species was present at only 4 of the 63 coincident stations. In 1995, surf clams were found at only 1 of the 63 coincident stations. Statistical analysis indicates no significant change for this species from 1979/1980 to 1995 (Table 4,5).

Ensis directus

The razor clam's geographical range is from Labrador to Georgia (Gosner, 1978). Razor clams are found in the lower intertidal to subtidal and to a depth of 36 m. It is a suspension feeding bivalve that prefers sandy muds where it burrows. Razor clams can reach 25 cm in length. Predators include both knobbed and channeled whelks (Walker, 1988).

In the 1995 survey, razor clams were mainly limited to the eastern portion of the estuary (Figure 26a,b). They were found only in Northwest Harbor and Gardiners Bay, with the exception of three individuals, one in Great Peconic Bay and two in Little Peconic Bay. The highest abundance found was 8.75 individuals per 9.29 sq. meters at station 99. *Ensis directus* was collected at only 3 of the 63 coincident stations in the 1979/1980 survey, and their maximum abundance was 0.5 individuals per 9.29 sq. meters at station 3 (Figure 26c,d). Statistical analysis indicates no significant change in this species from 1979/1980 to 1995 (Table 4,5).

Anadara ovalis

The blood ark occurs from Cape Cod to the Gulf of Mexico (Gosner, 1978). It is an epibenthic suspension feeder, and lives mainly on muddy bottoms in the subtidal region where it attaches with byssal threads to shells and rocks. It may be found to a depth of 45 m. Blood arks may reach 6 cm in length (Watling and Maurer, 1973).

In the current study, *Anadara ovalis* was distributed throughout the inshore portions of the entire estuary, but showed an increasing trend from west to east (Figure 27a,b). It was collected at 56 of the 124 stations (45%). The highest abundance was 35 individuals per 9.29 sq. meters at station 107 in Gardiners Bay. In the 1979/1980 survey, *Anadara ovalis* was found at only 6 of the 63 coincident stations (9%). These were located mostly in Great Peconic Bay (Figure 27c,d). The maximum abundance in 1979/1980 was 2.25 individuals per 9.29 sq. meters at station 16. In 1995, blood arks were present at 24 of the 63 coincident stations. Between surveys, the abundance of blood arks increased at 24 of the 63 corresponding stations, decreased at 4 stations, and remained unchanged at 35 stations. Statistical analysis indicates a significant increase in abundance from 1979/1980 to 1995 (Table 4). Abundance also increased at a significant number of stations (Table 5).

Anomia simplex

The jingle shell's geographical range extends from Nova Scotia to the Caribbean (Gosner, 1978). Jingle shells live intertidally and subtidally to 18 m where they are found attached byssally to shells and rocks. It is a suspension feeding bivalve. The maximum reported length is 7.5 cm.

In 1995, *Anomia simplex* was found throughout the entire Peconic Estuary with no obvious trend in distribution (Figure 28a,b). It was found at 49 of 124 stations (40%) and had a maximum abundance of 207.5 individuals per 9.29 sq. meters at station 4 in Flanders Bay. *Anomia simplex* was not reported in the 1979/1980 survey.

Nucula proxima

The near nut shell, *Nucula proxima*, has a geographical range from Maine to Florida (Gosner, 1978). It can be found subtidally to 3 m or more. It is an infaunal, subsurface deposit feeder common on muddy bottoms of sounds and bays. Nut shells remain small throughout their lives and only grow to 9 mm. Predators include bottom feeding fish and diving ducks.

Nucula proxima was found at only three stations in 1995, one each in Gardeners Bay, Great Peconic Bay and Flanders Bay (Figure 29a,b). The maximum abundance was 104 individuals per 9.29 sq. meters at station 110. Because its maximum size is smaller than the bar spacing on the dredge, distribution and abundances are probably underestimated. The 1979/1980 survey did not report the presence of *Nucula proxima*.

Crepidula fornicata

Crepidula fornicata, the common slipper shell, and *Crepidula plana*, the flat slipper shell, are distributed from the Gulf of St. Lawrence to the Gulf of Mexico (Gosner, 1978). They are both suspension feeding gastropods (McGee and Targett, 1989). Slipper shells are common in benthic assemblages and colonize discrete hard substrates such as rocks, shells and other debris. *C. fornicata* prefer convex surfaces while *C. plana* prefer flat or concave surfaces (Hoagland, 1979). *C. fornicata* may reach lengths of 5 cm while *C. plana* may reach 3 cm (Watling and Maurer, 1973). Predators of slipper shells include sea stars and hermit crabs (McGee and Targett, 1989).

In 1995, *Crepidula fornicata* was widely distributed in nearshore areas and increased in abundance from west to east (Figure 30a,b). The distribution of *Crepidula plana* was very similar (Figure 30c,d), and the two species were often found together. Both species were collected at 60 of the 124 stations (48%). The maximum abundance of *C. fornicata* was 5840 individuals per 9.29 sq. meters at station 110, making it the most abundant species in the survey. *C. plana* had a maximum abundance of 200 individuals per 9.29 sq. meters at the same station. The 1979/1980 survey reported *C. fornicata* abundance in bushels per 100 sq. feet (9.29 sq. meters). It was found at 7 of the 63 1979/1980 NYSDEC stations (11%) and had a maximum abundance of 1.5 bushels per 9.29 sq. meters at stations 3 and 11 (Figure 30e,f). No *C. plana* were reported, but their presence is highly probable.

Nassarius trivittatus

The New England dog whelk, *Nassarius trivittatus*, is found from the Gulf of St. Lawrence to Florida (Gosner, 1978). This gastropod is a scavenger and is common subtidally in quiet water on sand or grassy flats. The maximum reported length is 2 cm for this species (Watling and Maurer, 1973).

Nassarius trivittatus was distributed at locations scattered throughout the Peconic Estuary in 1995 (Figure 31a,b) and was collected at about 15% (18 of 124) of the stations. Abundances in Flanders Bay were an order of magnitude larger than anywhere else in the estuary. Maximum abundance was 11.25 individuals per 9.29 sq. meters at station 2. Because its maximum size is smaller than the bar spacing on the dredge, distribution and abundance values are probably underestimated. The 1979/1980 survey did not report the presence of *Nassarius trivittatus.*

Ischnochiton ruber

The geographical range of *Ischnochiton ruber*, the red chiton, is from the Arctic to Long Island Sound (Gosner, 1978). It is a subtidal grazing mollusc which may reach 2.5 cm. Chitons are often found on hard substrates such as shell and rock.

Ischnochiton ruber was distributed throughout the eastern estuary in 1995, and was rarely found west of Jessup Neck (Figure 32a,b). It was present at 19 of 124 stations (15%), and reached an abundance of 14 individuals per 9.29 sq. meters at station 107. Red chiton was not reported in the 1979/1980 survey.

Sclerodactyla briareus

The hairy cucumber, *Sclerodactyla briareus*, has a geographical range from Cape Cod to the Gulf of Mexico (Gosner, 1978). It is a subtidal species living down to 18 m. The cucumber is abundant in soft mud and may reach a length of 15 cm.

In 1995, *Sclerodactyla briareus* was distributed throughout the entire estuary with no obvious trends in abundance (Figure 33a,b). It was present at 21 of 124 stations (17%) and reached abundances of 5 individuals per 9.29 sq. meters. The 1979/1980 survey did not report the presence of *Sclerodactyla briareus.*

Amphioplus abditus

The burrowing brittle star, *Amphioplus abditus*, has a geographical range from the Arctic to New Jersey (Gosner, 1978). It is common among stones and debris in tidal pools. This brittle star lives subtidally down to 300 m. Disc width may reach 1.2 cm while the arms may be up to 20 cm long.

Amphioplus abditus was found at 15 of 124 stations (12%) in the 1995 survey (Figure 34). At 6 of the locations, it was present in such large numbers that it was used as a sediment characteristic (Figure 6). The 1979/1980 survey did not report the presence of *Amphioplus abditus*.

Cliona celata

The boring sponge, *Cliona celata*, has a geographical range from the Gulf of St. Lawrence to the Gulf of Mexico (Gosner, 1978). This sponge is found in salinities above 15 ppt. Boring sponge live subtidally to a depth of 30 m or more on shells or alone. It often uses hard clams as substrate and may consume their host.

In the 1995 survey, *Cliona celata* was distributed throughout the entire estuary with no obvious trends in distribution (Figure 35). It was present at 15 of 124 stations (12%). The 1979/1980 survey did not report the presence of *Cliona celata*.

Halecium spp.

Hydroids, *Halecium spp.*, are found along the entire Atlantic coast (Gosner, 1978). These species are intertidal to subtidal at great depths. Colony stems may reach 7.5 cm in length.

Halecium spp. were distributed throughout the estuary except for Flanders Bay and were increasingly common to the east (Figure 36). They were found at 19 stations. At 8 of those locations, they were present in such a large quantity that they were used as a sediment characteristic (Figure 6). *Halecium spp.* were not reported in the 1979/1980 survey.

Discussion

According to the New York State Department of Environmental Conservation, the Peconic Estuary encompasses 121,390 acres of underwater lands available for the harvest of molluscan shellfish. Geographically as well as hydrographically there are, however, two very different types of shellfish lands in the estuary, the deep waters of open regions of the Peconic Estuary (Flanders Bay, Great Peconic Bay, Little Peconic Bay, Northwest Harbor, Noyack Bay, Orient Harbor, Southold Bay, Shelter Island Sound, and Gardiners Bay) which constitute approximately 113,480 acres and the shallow waters of the open regions, tributaries and enclosed embayments which constitute nearly 8,000 acres. Our survey of the commercially harvested molluscan shellfish population in the deep waters of the Peconic Estuary found very low abundances of shellfish. It thus appears that even though the deep waters makeup 94 percent of the Peconic Estuary, they contribute a relatively minor percentage to the Estuary's commercial shellfish harvest. It is worth noting that even though there are significant differences between the deep and shallow shellfish lands of the Peconic Estuary (which also includes ownership and shellfishing activity), no distinction is made in the landings data for the origin of the shellfish production and for this reason landing data cannot be used as indicators of shellfish abundance.

The low abundance of shellfish species makes it impossible to identify statistical trends in the distribution of abundance including the relationship between abundance and environmental parameters such as sediment type. It is, however, fairly evident that the central basin of Great Peconic Bay, which is comprised largely of muddy sediments, has a low abundance of shellfish and other species and that the fringes of the deep water have the greater abundance of shellfish and other species.

Even though their abundance was comparatively low, hard clams were the most abundant of the commercial shellfish species. Hard clams were present at 61 of the stations with an average baywide density at those stations of 0.16 hard clams per square meter and a maximum density of 4.3 hard clams per square meter. Hard clams tended to be found along the fringes of the deeper waters where the sediment was comprised of a mixture of sand and shell/stone. Flanders Bay had the greatest total abundance of hard clams. Sublegal and littleneck size hard clams were found in Northwest Harbor and off the west side of Shelter Island but most of the hard clams that were collected were of the larger chowder size which suggests that recruitment has been extremely low.

In 1979/80 the New York State Department of Environmental Conservation undertook a shellfish survey in Flanders Bay, Great Peconic Bay and Little Peconic Bay and sixty-three of those stations were reoccupied during the present survey. Of the stations having hard clams, the abundance of hard clams increased at 10 and decreased at 28 (Tables 4 and 5). The average hard clam abundance in 1979/80 was 0.26 individuals per square meter and decreased significantly to 0.13 hard clams per square meter in 1995.

In the 1995 survey, five bay scallops were found, one at each of five stations. This low level of abundance is not unexpected for three reasons: 1. most of the deep water areas did not contain suitable bay scallop habitat; 2. a towed hydraulic clam dredge does not efficiently sample for bay scallops; and, 3. the decline of bay scallops in the Peconic Estuary due to Brown Tide has been well documented.

No soft clams were collected during the survey. This was not unexpected because soft clams in the Peconic Estuary tend to occur intertidally and in the tributaries.

Knobbed whelks were found at 46 stations and had mean density of 0.03 whelks per square meter (maximum was 0.22 individuals per square meter) while channeled whelks were found at 28 stations and had a mean density of 0.01 individuals per square meter (maximum was 0.08 individuals per square meter). Knobbed and channel whelks co-occurred at 13 stations. At those stations surveyed in both 1979/80 and 1995, there was a significant decline in whelk abundance (0.42 individuals per square meter to 0.04 individuals).

The harvest of whelks from the Peconic Estuary increased significantly between 1993 (1,041 bushels) and 1994 (24,772 bushels). It is not known where in the Estuary the whelks are being harvested from so it is not known if the decline in whelk abundance reflects an increase in harvesting or a real decline in abundance. Additionally, the population density of whelks needed to support commercial fishing is not available so it is not possible to ascertain if the existing whelk population would be an attractive fishery resource.

Only one oyster was found during the survey. The deep waters of the Peconic Estuary were historically a major producer of oysters, although the production was based on the growout of seed oysters that had been transplanted into the Peconic Estuary as natural recruitment was low. Thus, it appears that the Peconic Estuary may provide a good habitat for oyster growout but not oyster recruitment.

Surf clams and razor clams are harvested commercially in many areas but no landings are reported for the Peconic Estuary. Surf clams were found at 11 of the 126 survey stations and had a maximum abundance of 0.32 individuals per square meter. Razor clams were found at 11 stations and had a maximum abundance of 0.94 individuals per square meter.

The results of the 1995 survey when viewed against the reported shellfish landings indicate that the deep waters of the Peconic Estuary is not currently productive for the commercially harvested species of shellfish. Although somewhat higher than in 1995, abundances of the various shellfish were also low in the 1979/80 survey which suggests that the deep waters of the Peconic Estuary are simply not naturally productive with respect to commercial shellfish. What factor or factors are preventing the deep waters from being more productive are not readily apparent, although Brown Tide and the areas of mud bottom which are unsuitable for suspension feeders offer a partial explanation.

Although the deep waters of the Peconic Estuary are not naturally productive of shellfish, they could probably still make a contribution to the Estuary's shellfish landings if mariculture technologies were to be employed. Over the past 10 years, for example, hard clam landings have increased primarily as a result of New York's hard clam transplant program in which hard clams that are harvested from uncertified waters are placed in racks located in certified waters for 21 days during which time they purge themselves of pathogens so they can be marketed. The planting of oyster seed for growout as was done in the past may still be viable. Other type of shellfish culture using racks, suspended trays and nets, and bottom planting may be feasible and would not interfere with natural shellfish production which is extremely low in the deep waters.

In addition to collecting the commercially important molluscan species, 23 other species were collected during the survey. As expected, the general distribution and abundance of these species was closely related to the distribution of sediment type. Abundance and species richness tended to be lower in the muddy sediments (which are not favorable to suspension feeders) that are located in the deep, mid-estuary areas. Higher abundances and species richness were associated with the sandy areas, particularly those containing shell or stone, occurring the shallower areas.

Changes in the abundance of nine noncommercial shellfish species can be compared at the stations that were sampled in both the 1979/80 and present survey (Table 4). Three (mud crab, lady crab, and moon snail) showed no change, two (blood ark and oyster drill) significantly increased and four (sea stars, horseshoe crabs, spider crabs, and hermit crabs) significantly decreased. Although the change cannot be quantified (because the data were recorded differently between the two surveys), it also appears that the abundance of slipper shells increased as well.

The findings of the shellfish survey thus also suggest that the deep waters of the Peconic Estuary are unique in several ways:

- The sediment surface of much of the deep water area consists of shell and stone which creates a unique type of habitat but one that is poorly documented or understood.
- Abundances decreased significantly between the 1979/80 survey and the 1995 survey for 7 of the 14 species that were compared (Table 4). Only 2 species, the blood ark and oyster drill, increased in abundance during the same period. While not compared because of methodological differences, it is also likely the slipper shell increased as well.
- The slipper shell is the most abundant suspension feeder and in several areas is extremely abundant and may thus be playing a major role in controlling the species composition and

abundance of phytoplankton. If a market can be developed, the slipper shell might be capable of supporting a commercial fishery.

- Brittle stars and hairy cucumbers are highly abundant in some locations and are a rather unique species assemblage not comparable to any other local system. It is not known how this assemblage affects critical processes (e.g., nutrient regeneration, sediment resuspension) in the Peconic Estuary.
- The shallow sandy areas that fringe deep waters are not dominated by commercially important suspension feeding shellfish but by noncommercial species, notably slipper shells, blood arks, and jingle shells.

In conclusion, the deep waters of the Peconic Estuary are not naturally productive shellfish areas but could support mariculture activities, the slipper shell is the dominant suspension feeder, and the bottom habitat is rather unique in terms of the sediment type and fauna. Further study is warranted in each instance.

Literature Cited

Botton, M. L., Loveland, R. E. 1993. Predation by herring gulls and great black-backed gulls on horseshoe crabs. Wilson Bulletin 105 (3): 518-521.

Botton, M.L., Ropes, J.W. 1987. Populations of Horseshoe crabs, *Limulus polyphemus*, on the northwestern Atlantic continental shelf. Fishery bulletin 85 (4): 805-812.

Botton, M. L., Ropes, J. W. 1989. Feeding ecology of horseshoe crabs on the continental shelf, New Jersey to North Carolina. Bulletin of Marine Sciences and Fisheries 45 (3): 637-647.

Bricelj, V. M., Epp, J., Malouf, R. E. 1987. Intraspecific variation in reproductive and somatic growth cycles of bay scallops *Argopecten irradians*. Marine Ecology Progress Series 36: 123-137.

Dove, L. E., Nyman, R. N., eds. 1995. Living resources of the Delaware Estuary. Delaware Estuary Program. 530 p.

Eversole, A. G. 1987. Species profiles: life histories and environmental requirement of coastal fishes and invertebrates (South Atlantic) - hard clam. U. S. Fish and Wildlife Service Biological Reprints 82 (11.75).

Fay, C. W., Neves, R. J., Pardue, G. B. 1983. Species profiles: life histories and environmental requirement of coastal fishes and invertebrates (Mid-Atlantic) - bay scallop. U. S. Fish and Wildlife Service Biological Reprints 82 (11.12).

Fay, C. W., Neves, R. J., Pardue, G. B. 1983. Species profiles: life histories and environmental requirement of coastal fishes and invertebrates (Mid-Atlantic) - surf clam. U. S. Fish and Wildlife Service Biological Reprints 82 (11.13).

Gibbons, M. C. 1984. Aspects of predation by the crabs *Neopanope sayi, Ovalipes oscellatus,* and *Paguris longicarpus* on the juvenile hard clam *Mercenaria mercenaria*. PhD. Dissertation, Marine Sciences Research Center, State University of New York at Stony Brook, 82 p.

Gosner, K. L. 1978. A field guide to the Atlantic seashore from the Bay of Fundy to Cape Hatteras. Houghton Mifflin, New York, 329 p.

Hoagland, K. F. 1979. The behavior of three sympatric species of *Crepidula* from the Atlantic, with implications for evolutionary ecology. Nautilus 74 (4): 143-149.

Jegla, T. C., Costlow, J. D. 1982. Temperature and salinity effects on developmental and early posthatch stages of Limulus. In: Bonaventura, J., Bonaventura, C., Tesh, S., eds. Physiology and biology of horseshoe crabs: studies on normal and environmentally stressed animals. Liss, New York, p. 103-113.

Katz, C. H. 1985. A nonequilibrium marine predator-prey interaction. Ecology 66 (5): 1426-1438.

Keith, D. L. 1985. Age, morphometric variation, and growth rate of the Atlantic surf clam, *Spisula solidissima*, from Long Island waters. M. S. Thesis, Marine Sciences Research Center, State University of New York at Stony Brook, 145 p.

Kuhlman, M. L. 1992. Behavioral avoidance of predation in an intertidal hermit crab. Journal of Experimental Marine Biology and Ecology 157 (2): 143-158.

Long Island Sound: an atlas of natural resources. 1989. Connecticut Department of Environmental Protection. 52p.

Loosenoff, V. L. 1961. Biology and methods of controlling the starfish. United States Department of the Interior, Fish and Wildlife Service, Leaflet 520.

Loosenoff, V. L. 1964. Variations in time and intensity of setting of the starfish, *Asterias forbesi*, in Long Island Sound during a twenty-five-year period. Biological Bulletin 126: 423-439.

McGee, B. L., Targett, N. M. 1989. Larval habitat selection in *Crepidula* (l.) and its effect on adult distribution patterns. Journal of Experimental Marine Biology and Ecology 131 (3): 195-214.

Magalhaes, H. 1948. An ecological study of snails of the genus *Busycon* at Beaufort, North Carolina. Ecological Monographs 18 (3): 377-409.

Malouf, R. E., Bricelj, V. M. 1989. Comparative biology of clams: environmental tolerances, feeding, and growth. In: Manzi, J. J., Castagna, M., eds. Clam Mariculture in North America. Elsivier, Amsterdam, p. 23-73.

Malouf, R. E. 1991. The hard clam: its biology and the natrual processes that affect its success. In: Schubel, J. R., Bell, T. M., Carter, H. H., eds. The Great South Bay. State University of New York Press, Albany. 43-54.

NYDEC. 1982. Assessment of New York 's shellfish resources. Completion report prepared by New York State Department of Environmental Conservation for the National Oceanic and Atmospheric Administration. 161 pp.

NYSOL. 1970. The state of knowledge with regard to the effects of physical and chemical environmental conditions of marine biota with emphasis on the Long Island situation. New York Ocean Science Laboratory technical report No. 0004. Center for the Environment of Man, Inc. Subcontract no. 3203.

Shea, G. B., Mackiernan, G. B., Athanas, L. C., Bliel, D. F. 1980. Chesapeake Bay low freshwater inflow study: biota assessment. Phase I: final report. Western Eco-Systems Technology, Inc. Laurel, Maryland for the U. S. Army Corps of Engineers Baltimore District, Chesapeake Bay Study Branch.

Shuster, C. N. Jr. 1982. A pictoral review of the nature and history of the horseshoe crab Limulus polyphemus, with reference to other Limulidae. In: Bonaventura, J., Bonaventura, C., Tesh, S., eds. Physiology and biology of horseshoe crabs: studies on normal and environmentally stressed animals. Liss, New York, p. 1-53.

Silbajoris, R. 1975. Underutilized fishery resources of New York State. M. S. Thesis, Marine Sciences Research Center, State University of New York at Stony Brook, 150 p.

Sokal, R. R., Rohlf, F. J. 1995. Biometery. W. H. Freeman and Comapny. New York. 887 p.

Stehlik, L. L. 1993. Diets of brachyuran crabs *Cancer irroratus*, *C. borealis*, and *Ovalipes ocellatus* in the New York Bight. Journal of Crustacean Biology 13 (40): 723-735.

Stone, S. L., Lowery, T. A., Field, J. D., Williams, C. D., Nelson, D. N., Jury, S. H., Monaco, M. E., Andreasen, L. 1994. Distribution and abundance of fishes and invertebrates in Mid-Atlantic estuaries. ELMR report no.12. NOAA/NOS Strategic Environmental Assessments Division, Silver Spring, Maryland. 280 p.

Tettelbach, S. T., Wenczel, P. 1993. Reseeding efforts and the status of bay scallop *Argopecten irradians* (Lamarck, 1819) populations in New York following the occurrence of "brown tide" algal blooms. Journal of Shellfish Research 12 (2): 423-431.

United States Department of the Interior, Fish and Wildlife Service, Circular 288. The Atlantic coast surf clam. 1968.

Walker, R. L. 1988. Observations on intertidal whelk (*Busycon* and *Busycrotypus*) populations in Wassaw Sound, Georgia. Journal of Shellfish Research 7 (3): 473-478.

Watling, L., Maurer, D. 1973. Guide to the macroscopic estuarine and marine invertebrates of the Delaware Bay region. Delaware Bay Report Series (5). College of Marine Studies, University of Delaware, Newark. 178 p.

Williams, A. B., Wigley, R. L. 1977. Distribution of decapod crustacea off the northeastern United States based on specimens of the Northeast Fisheries Center, Woods Hole, Massachusetts. United States Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. Circular no. 407. 44 p.

Williams, A. B. 1984. Shrimps, lobsters, and crabs of the Atlantic coast of the eastern United States, Maine to Florida. Smithsonian Inst. Press, Washington DC, 550 p.

Table 1

Station Locations

Station Number	Station Location	Latitude (Degrees)	Latitude (min.sec)	Longitude (Degrees)	Longitude (min.sec)
1	FB	40	55.49	-72	36.49
2	FB	40	55.60	-72	35.86
3	FB	40	54.99	-72	35.40
4	FB	40	54.69	-72	35.47
5	FB	40	55.74	-72	34.66
6	FB	40	55.08	-72	34.81
7	FB	40	55.78	-72	34.09
8	FB	40	54.63	-72	34.33
9	GPB	40	56.51	-72	33.33
10	GPB	40	55.95	-72	33.38
11	GPB	40	55.31	-72	33.58
12	GPB	40	58.05	-72	31.81
13	GPB	40	57.37	-72	31.97
14	GPB	40	56.78	-72	32.11
15	GPB	40	56.14	-72	32.25
16	GPB	40	55.51	-72	32.41
17	GPB	40	55.04	-72	32.50
18	GPB	40	58.25	-72	30.63
19	GPB	40	57.63	-72	30.74
20	GPB	40	56.98	-72	30.88
21	GPB	40	56.37	-72	30.99
22	GPB	40	55.72	-72	31.19
23	GPB	40	55.15	-72	31.33
24	GPB	40	54.51	-72	31.49
25	GPB	40	58.46	-72	29.44
26	GPB	40	57.84	-72	29.56
27	GPB	40	57.21	-72	29.70
28	GPB	40	56.56	-72	29.89
29	GPB	40	55.93	-72	30.00
30	GPB	40	55.28	-72	30.15
31	GPB	40	54.66	-72	30.29
32	GPB	40	54.05	-72	30.42
33	GPB	40	58.03	-72	28.83
34	GPB	40	57.41	-72	28.51
35	GPB	40	56.77	-72	28.65
36	GPB	40	56.15	-72	28.78
37	GPB	40	55.52	-72	28.92
38	GPB	40	54.85	-72	29.13
39	GPB	40	54.27	-72	29.21
40	GPB	40	56.98	-72	27.45
41	GPB	40	56.36	-72	27.59
42	GPB	40	55.75	-72	27.73

Table 1 (continued)

Station Locations

Station Number	Station Location	Latitude (Degrees)	Latitude (min.sec)	Longitude (Degrees)	Longitude (min.sec)
43	GPB	40	55.08	-72	27.89
44	CH	40	58.72	-72	28.20
45	CH	40	59.62	-72	28.25
46	CH	40	59.96	-72	27.92
47	CH	40	59.11	-72	27.53
48	CH	40	58.80	-72	26.72
49	LPB	40	57.27	-72	25.96
50	LPB	40	57.00	-72	25.73
51	LPB	40	57.23	-72	24.46
52	LPB	40	57.72	-72	24.49
53	LPB	40	58.03	-72	23.77
54	LPB	40	58.57	-72	23.62
55	LPB	40	59.35	-72	22.88
56	LPB	40	59.57	-72	23.40
57	LPB	41	0.46	-72	22.51
58	HNB	40	59.51	-72	25.44
59	HNB	41	0.21	-72	24.69
60	HNB	41	0.77	-72	23.72
61	HNB	41	0.32	-72	26.07
62	HNB	41	0.47	-72	25.20
63	HNB	41	0.84	-72	24.85
64	HNB	41	1.29	-72	24.15
65	HNB	41	1.80	-72	25.35
66	HNB	41	0.50	-72	26.64
67	HNB	41	0.93	-72	25.95
68	HNB	41	1.39	-72	25.24
69	HNB	41	1.74	-72	24.29
70	HNB	41	1.10	-72	26.77
71	HNB	41	1.59	-72	25.77
72	HNB	41	1.71	-72	26.01
73	HNB	40	58.81	-72	25.86
74	CH	40	57.93	-72	27.23
75	NYB	41	2.4	-72	22.90
76	NYB	41	1.1	-72	22.07
77	NYB	41	0.6	-72	21.40
78	NYB	41	0.6	-72	20.20
79	NYB	41	0.0	-72	19.60
80	NYB	41	1.2	-72	20.80
81	NYB	41	1.8	-72	20.20
82	NYB	41	1.8	-72	21.40
83	NYB	41	2.4	-72	20.80
84	SHB	41	3.0	-72	23.80

Table 1 (continued)

Station Locations

Station Number	Station Location	Latitude (Degrees)	Latitude (min.sec)	Longitude (Degrees)	Longitude (min.sec)
85	SHB	41	3.4	-72	24.40
86	SHB	41	4.2	-72	23.80
87	PC+	41	5.4	-72	22.60
88	PC+	41	6.6	-72	20.80
89	OH	41	6.6	-72	19.60
90	OH	41	7.2	-72	19.60
91	OH	41	7.2	-72	18.40
92	OH	41	7.8	-72	19.00
93	SMC	41	3.0	-72	18.40
94	SMC	41	2.4	-72	17.80
95	NWH	41	1.8	-72	17.22
96	NWH	41	0.6	-72	17.10
97	NWH	41	0.3	-72	16.62
98	NWH	41	1.2	-72	16.02
99	NWH	41	1.2	-72	15.12
100	NWH	41	1.8	-72	15.42
101	NWH	41	2.0	-72	14.80
102	NWH	41	2.4	-72	14.82
103	NWH	41	2.4	-72	16.60
104	GB	41	3.0	-72	13.60
105	GB	41	3.0	-72	14.20
106	GB	41	3.0	-72	15.40
107	GB	41	3.6	-72	14.80
108	GB	41	3.6	-72	16.00
109	GB	41	4.2	-72	14.20
110	GB	41	4.2	-72	15.40
111	GB	41	4.8	-72	14.80
112	GB	41	4.8	-72	16.00
113	GB	41	5.0	-72	17.20
114	GB	41	5.4	-72	15.40
115	GB	41	5.4	-72	16.60
116	GB	41	5.4	-72	17.80
117	GB	41	5.4	-72	19.00
118	GB	41	6.0	-72	14.80
119	GB	41	6.0	-72	18.40
120	GB	41	6.6	-72	15.40
121	GB	41	6.6	-72	16.60
122	GB	41	6.6	-72	17.80
123	GB	41	7.2	-72	16.00
124	GB	41	7.1	-72	17.20
125	GB	41	8.1	-72	14.80
126	GB	41	7.5	-72	14.80

Table 2

Relationship between station locations of 1995 and D.E.C. 1979, 1980 surveys.

Current Station #	D.E.C. Station #	Current Station #	D.E.C. Station #	Current Station #	D.E.C. Station #	Current Station #	D.E.C. Station #	Current Station #	D.E.C. Station #
1	E'-0' [1]	27	D-11 [1]	53 [4]	P19 [2]	79	-	105	-
2	E'-1 [1]	28	E-11 [1]	54	N19 [2,5]	80	-	106	-
3	F-2 [1]	29	F-11 [1]	55	L21 [2]	81	-	107	-
4	G'-2 [1]	30	G-11 [1]	56	K19 [2,5]	82	-	108	-
5	E-3 [1]	31	H-11 [1]	57 [4]	I22 [2,5]	83	-	109	-
6	F-3 [1]	32	I-11 [1]	58	J12 [2]	84	-	110	-
7	E-4 [1]	33 [3]	B-12 [1]	59 [4]	I14 [2]	85	-	111	-
8 [3]	G-4 [1]	34	D-13 [1]	60	G17 [2]	86	-	112	-
9	D-5 [1]	35	E-13 [1]	61	G9 [2]	87	-	113	-
10	E-5 [1]	36	F-13 [1]	62	G12 [2]	88	-	114	-
11	F-5 [1]	37	G-13 [1]	63	F13 [2]	89	-	115	-
12	B-7 [1]	38	H-13 [1]	64	E15 [2]	90	-	116	-
13	C-7 [1]	39	I-13 [1]	65	D17 [2]	91	-	117	-
14	D-7 [1]	40	E-15 [1]	66	F7 [2]	92	-	118	-
15	E-7 [1]	41	F-15 [1]	67	E9 [2]	93	-	119	-
16	F-7 [1]	42	G-15 [1]	68	D11 [2]	94	-	120	-
17	G-7 [1]	43	H-15 [1]	69	C12 [2]	95	-	121	-
18	B-9 [1]	44	K3 [2]	70	D6 [2]	96	-	122	-
19	C-9 [1]	45	H2 [2]	71	C9 [2]	97	-	123	-
20	D-9 [1]	46	G3 [2]	72 [4]	B8 [2]	98	-	124	-
21	E-9 [1]	47	J5 [2]	73 [4]	L10 [2]	99	-	125	-
22	F-9 [1]	48 [4]	L8 [2]	74	N7 [2]	100	-	126	-
23	G-9 [1]	49	Q12 [2]	75	-	101	-		
24	H-9 [1]	50	R13 [2]	76	-	102	-		
25	B-11 [1]	51	R17 [2]	77	-	103	-		
26	C-11 [1]	52 [4]	P16 [2]	78	-	104	-		

1 D.E.C. 1979 Survey. 2 D.E.C. 1980 Survey. 3 Private Bottom (no sample taken)
4 Station moved at sampling time due to depth restrictions. True location ranged from .1 to .2 nautical miles from D.E.C. location.
5 Gridpoint from D.E.C. study, but not sampled in D.E.C study.
- Stations in areas not previously sampled during DEC 1979 or 1980 surveys.

Table 3

Species list

Hard Clam	*Mercenaria mercenaria*
Bay Scallop	*Argopecten irradians*
Surf Clam	*Spisula solidissima*
American Oyster	*Crassostrea virginica*
Common Razor Clam	*Ensis directus*
Near Nut Clams	*Nucula proxima*
Blood Ark	*Anadara ovalis*
Jingles	*Anomia simplex*
Chestnut Astarte Clam	*Astarte castanea*
Common Shipworm	*Teredo navalis*
Knobbed Whelk	*Busycon carica*
Channeled Whelk	*Busycon canaliculatum*
Oyster Drill	*Urosalpinx cinerea*
New England Dog Whelk	*Nassarius trivittatus*
Common Slipper Shell	*Crepidula fornicata*
Flat Slipper Shell	*Crepidula plana*
Northern Moon Shell	*Lunatia heros*
Red Chiton	*Ischnochiton ruber*
Long-Clawed Hermit Crab	*Pagurus longicarpus*
Flat-Clawed Hermit Crab	*Pagurus pollicaris*
Common Spider Crab	*Libinia emarginata*
Black-Fingered Mud Crab	*Panopeus herbstii*
Lady Crab	*Ovalipes ocellatus*
Rock Crab	*Cancer irroratus*
Atlantic Horseshoe Crab	*Limulus polyphemus*
Plumed Worm	*Diopatra cuprea*
Hairy Cucumbers	*Sclerodactyla briarus*
Boring Sponges	*Cliona celata*
Burrowing Brittle Stars	*Amphioplus abditus*
Forbes' Asterias (Common Sea Star)	*Asterias forbesii*
Hydroid	*Halecium spp.*
Sea Lettuce	*Ulva lactuca*
Green Fleece	*Codium fragile*
Gulfweed	*Sargassum filipendula*
Eelgrass	*Zostera marina*

Other Species

Red sponge (possibly immature red beard sponge)	*Microciona prolifera ?*
Yellow encrusting algae (possibly Sea Potato)	*Leathesia difformis ?*
Red leafy algae (possibly Ribbbed Lace Weed or Sea Oak)	*Membranoptera spp.* or *Phycodrys spp. ?*

Table 4

Change in Abundance
(Mean number of individuals per 9.29 sq. meters)

	1979/80 Abundance	1995 Abundance	Probability and Trend
Hard Clam	2.38	1.17	.0002(-)
Scallop	1.37	0	.0022(-)
Surf Clam	0.03	0.01	.1094
Razor Clam	0.02	0.01	.7418
Blood Ark	0.08	0.62	.0022(+)
Whelks	3.91	0.34	.0001(-)
Sea Star	1.06	0.004	.0498(-)
Horseshoe Crab	0.06	0.02	.0131(-)
Hermit Crabs	0.16	0.02	.0028(-)
Mud Crab	0.43	0.41	.9258
Lady Crab	0.78	0.81	.8788
Spider Crab	0.18	0.04	.0052(-)
Oyster Drill	0.004	0.05	.0436(+)
Moon Shell	0.004	0	.3212

Table 5

Frequency of Occurrence
14 compared species between 1979/1980 and 1995

Number of stations where abundance:

	Increased	Decreased	Remained the same
Hard Clam	10	29	24
Scallop	0	20	43
Surf Clam	1	4	58
Razor Clam	3	3	57
Blood Ark	24	4	35
Whelks	2	53	8
Sea Star	1	12	50
Horseshoe Crab	1	9	53
Hermit Crabs	2	19	42
Mud Crab	20	8	35
Lady Crab	23	17	23
Spider Crab	3	18	42
Oyster Drill	7	1	55
Moon Shell	0	1	62

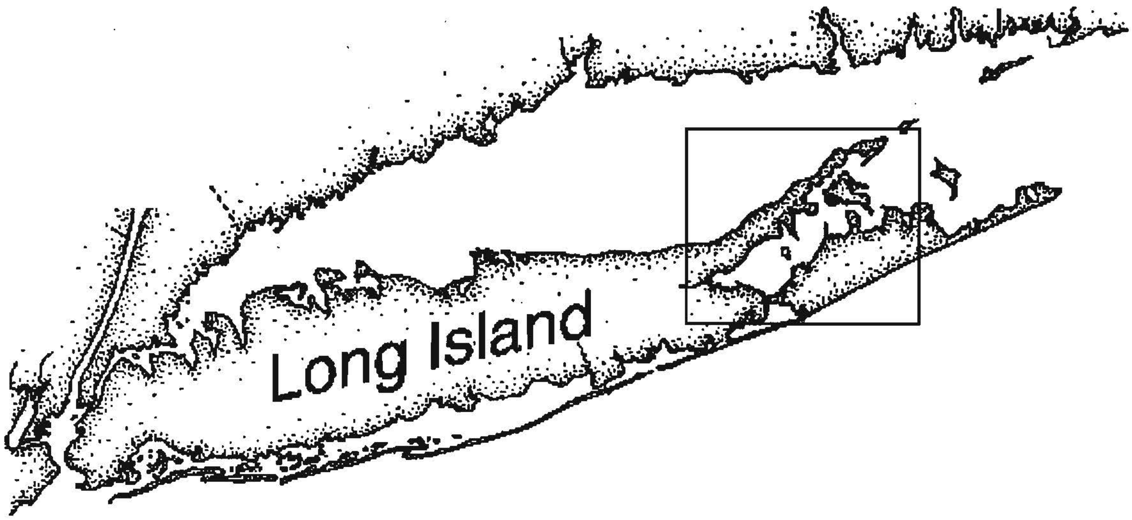

Figure 1 Study Area

Peconic Estuary
1995 Deep Water Shellfish Survey

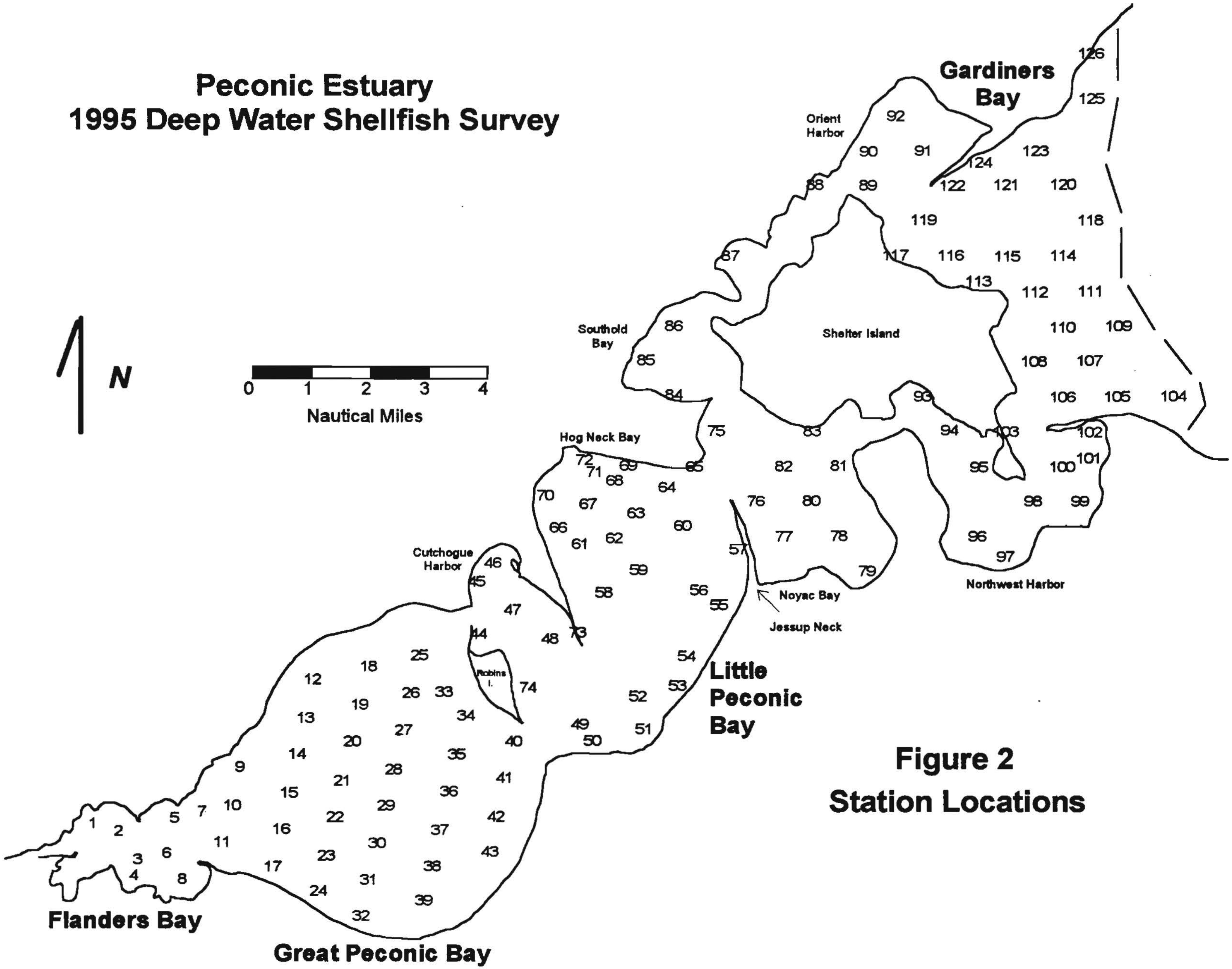

Figure 2
Station Locations

Peconic Estuary
1995 Deep Water Shellfish Survey

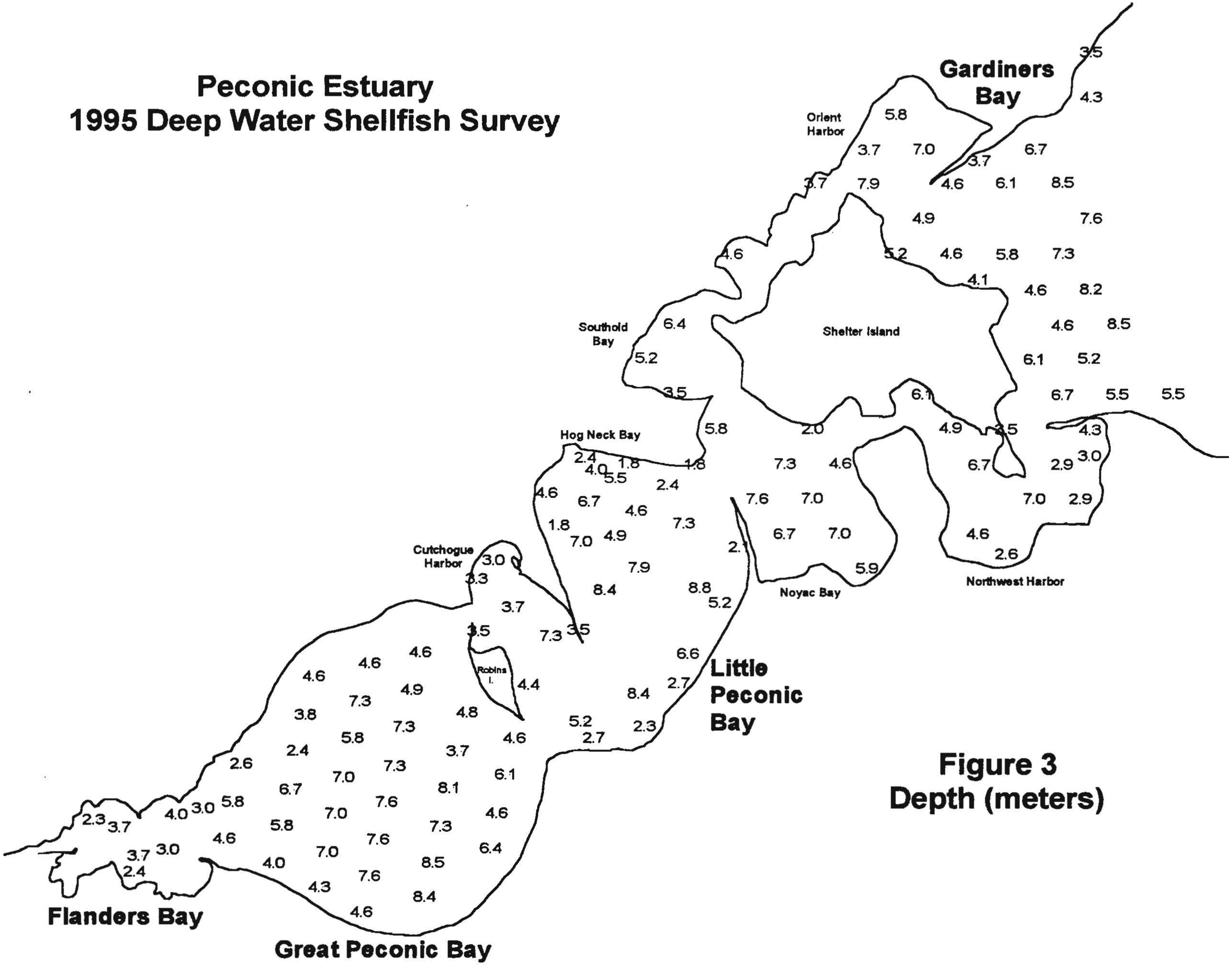

Figure 3
Depth (meters)

Peconic Estuary
1995 Deep Water Shellfish Survey

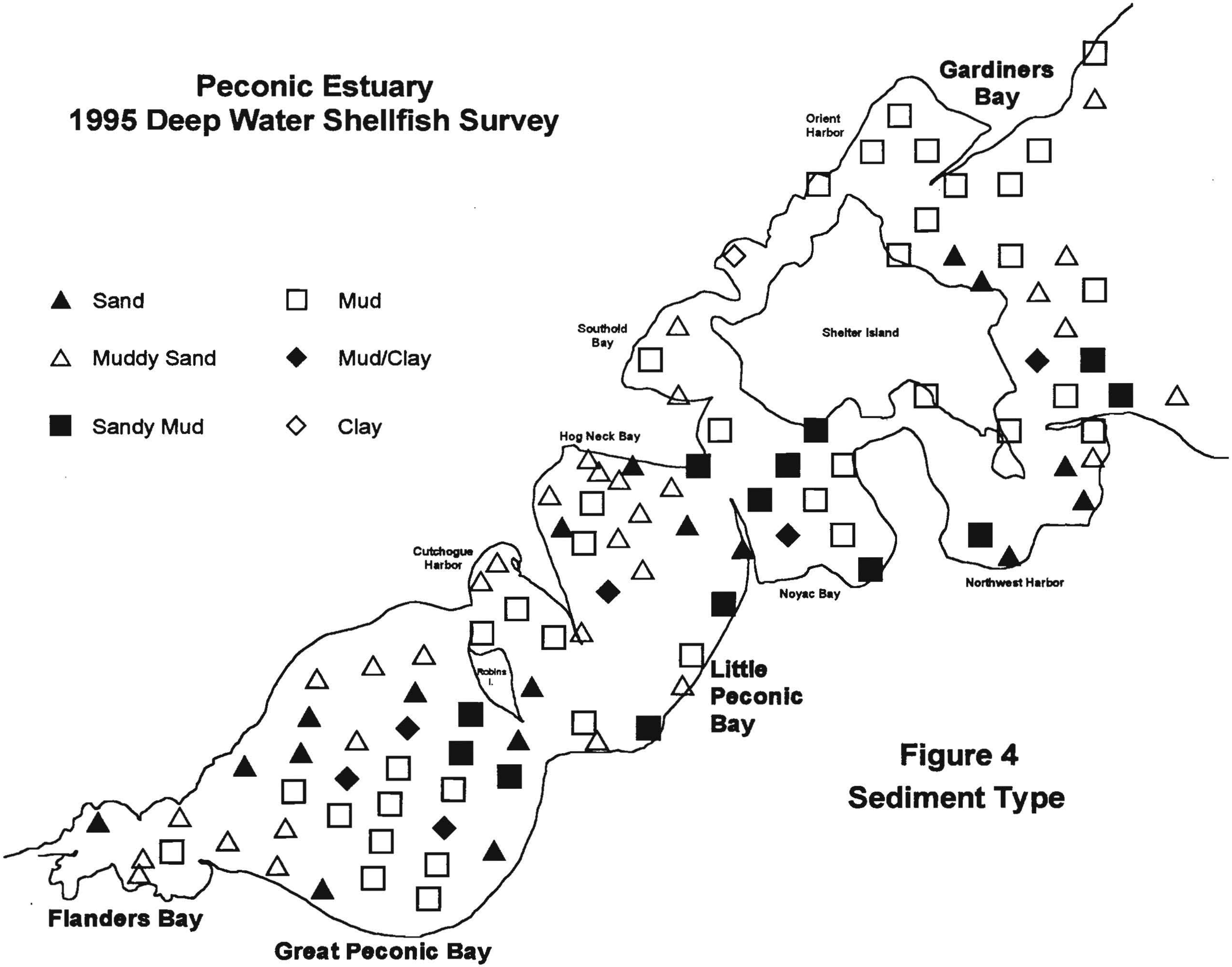

Figure 4
Sediment Type

Peconic Estuary
1995 Deep Water Shellfish Survey

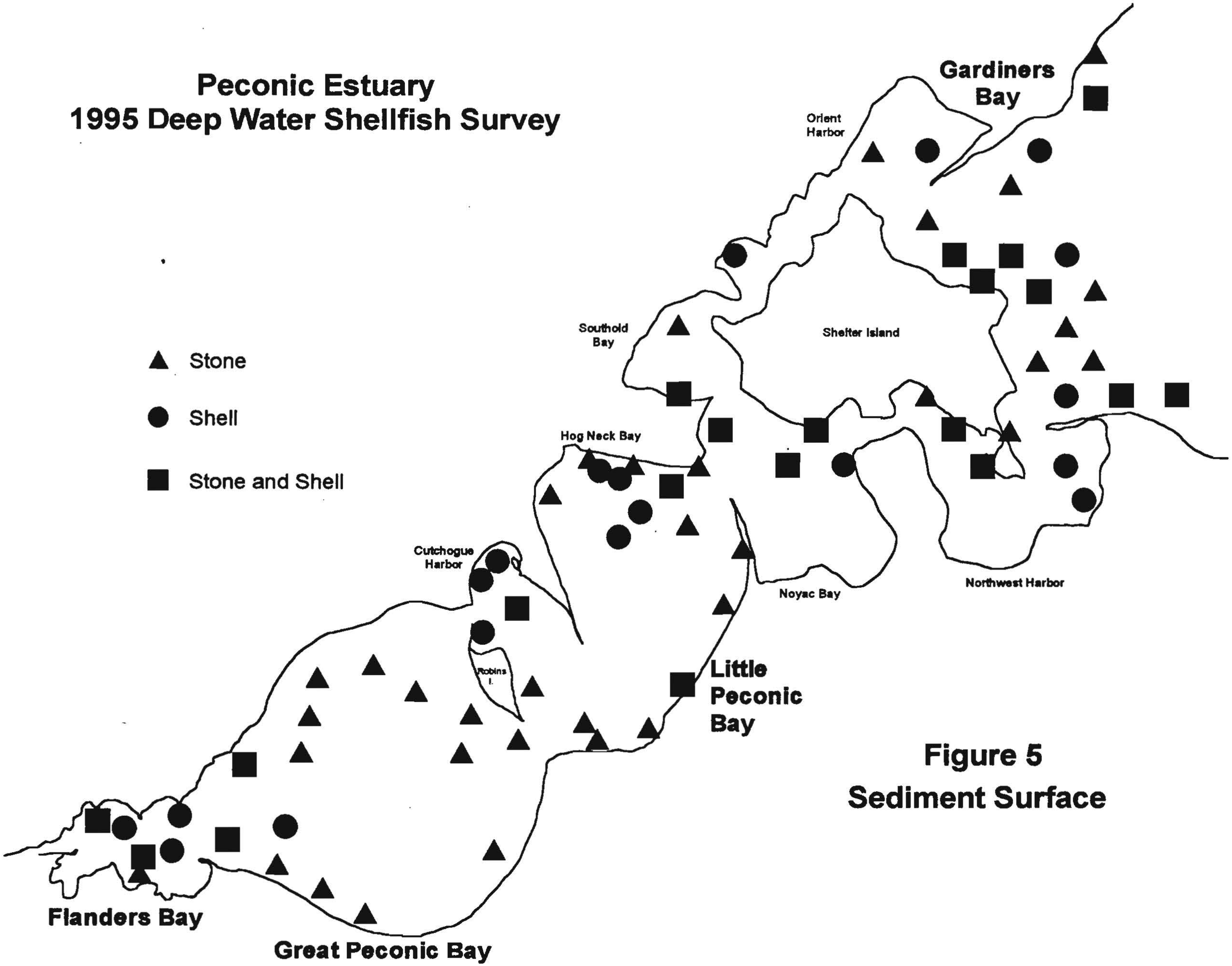

Figure 5
Sediment Surface

Peconic Estuary
1995 Deep Water Shellfish Survey

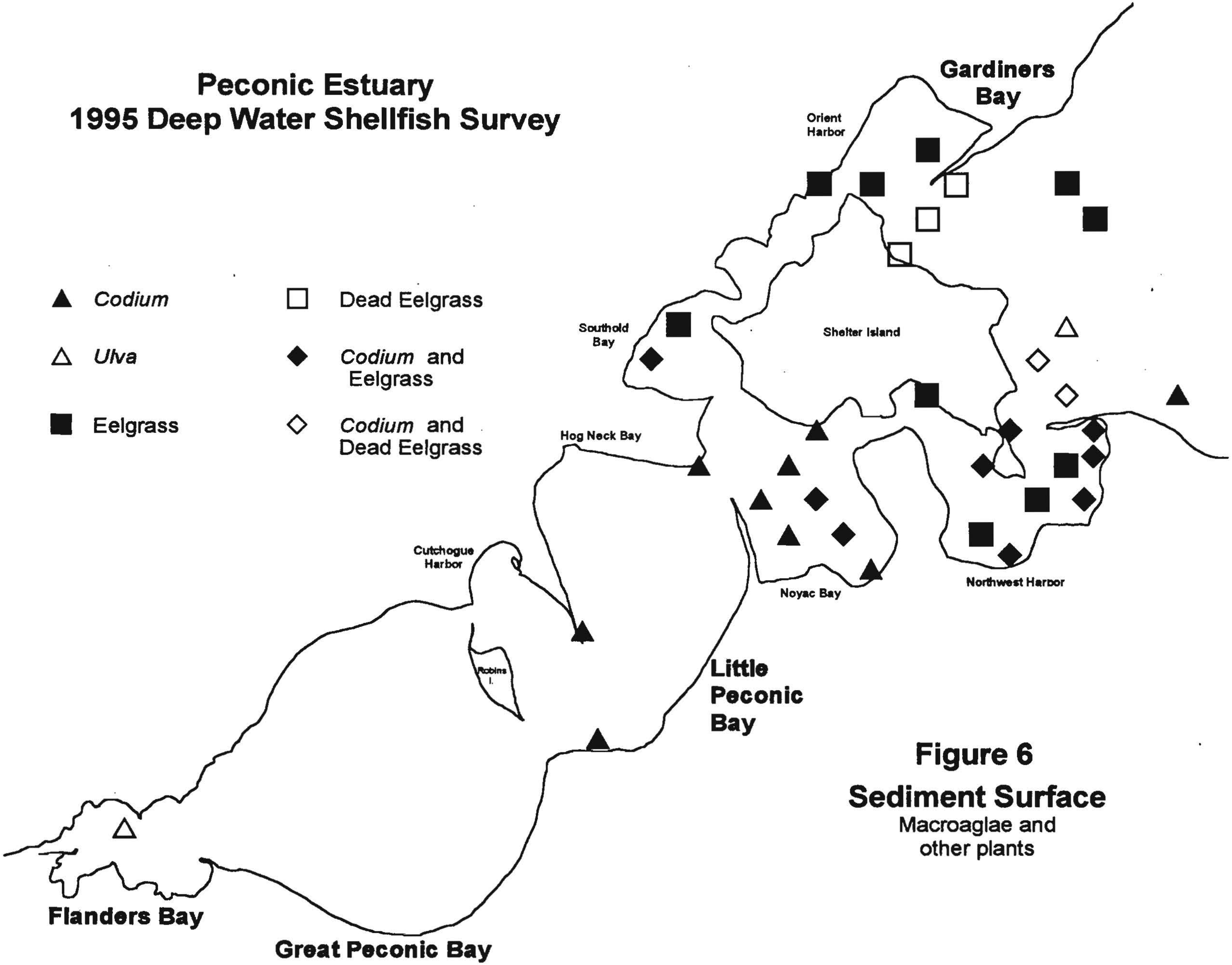

Figure 6

Sediment Surface

Macroaglae and other plants

Peconic Estuary
1995 Deep Water Shellfish Survey

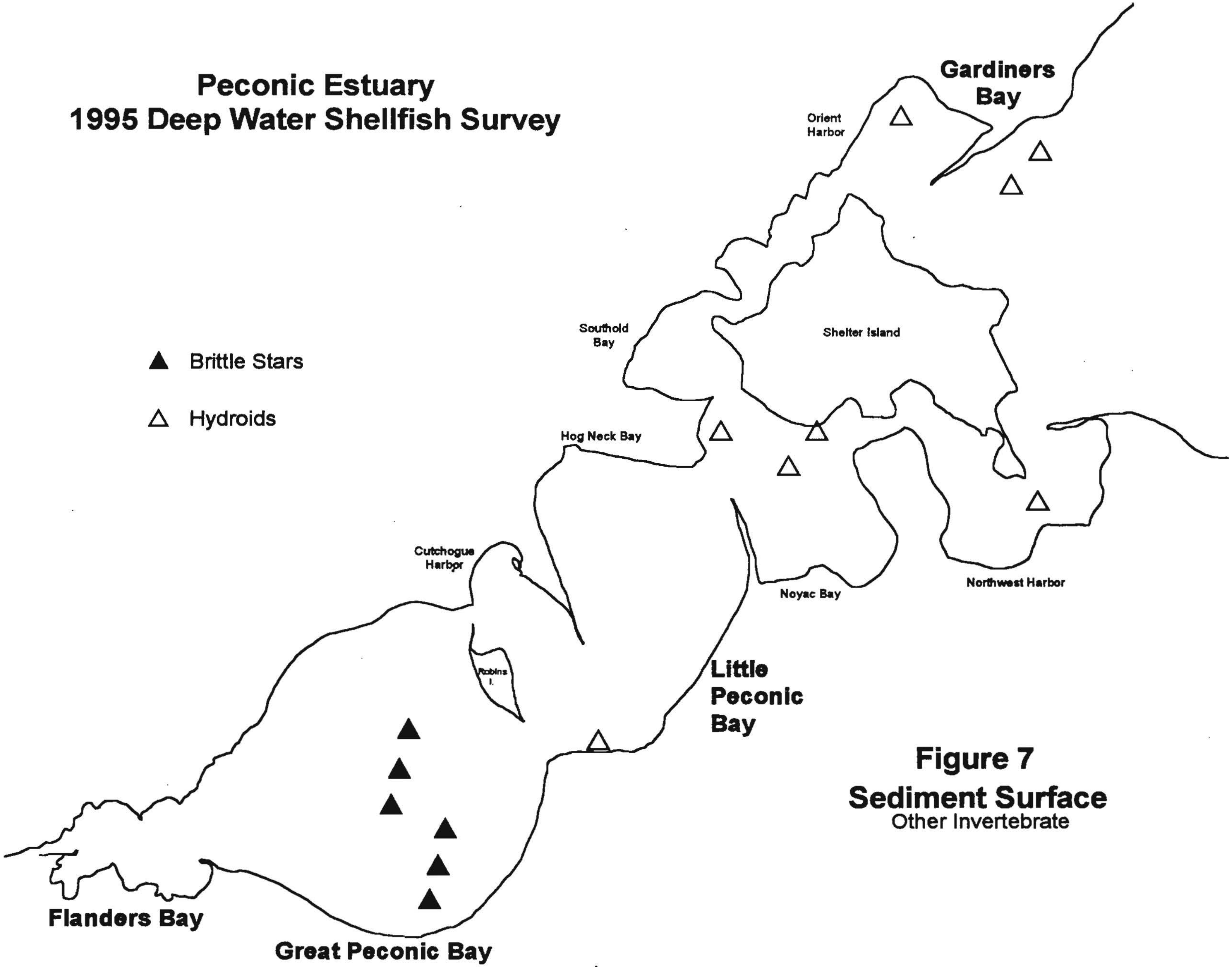

Figure 7
Sediment Surface
Other Invertebrate

Peconic Estuary
1995 Deep Water Shellfish Survey

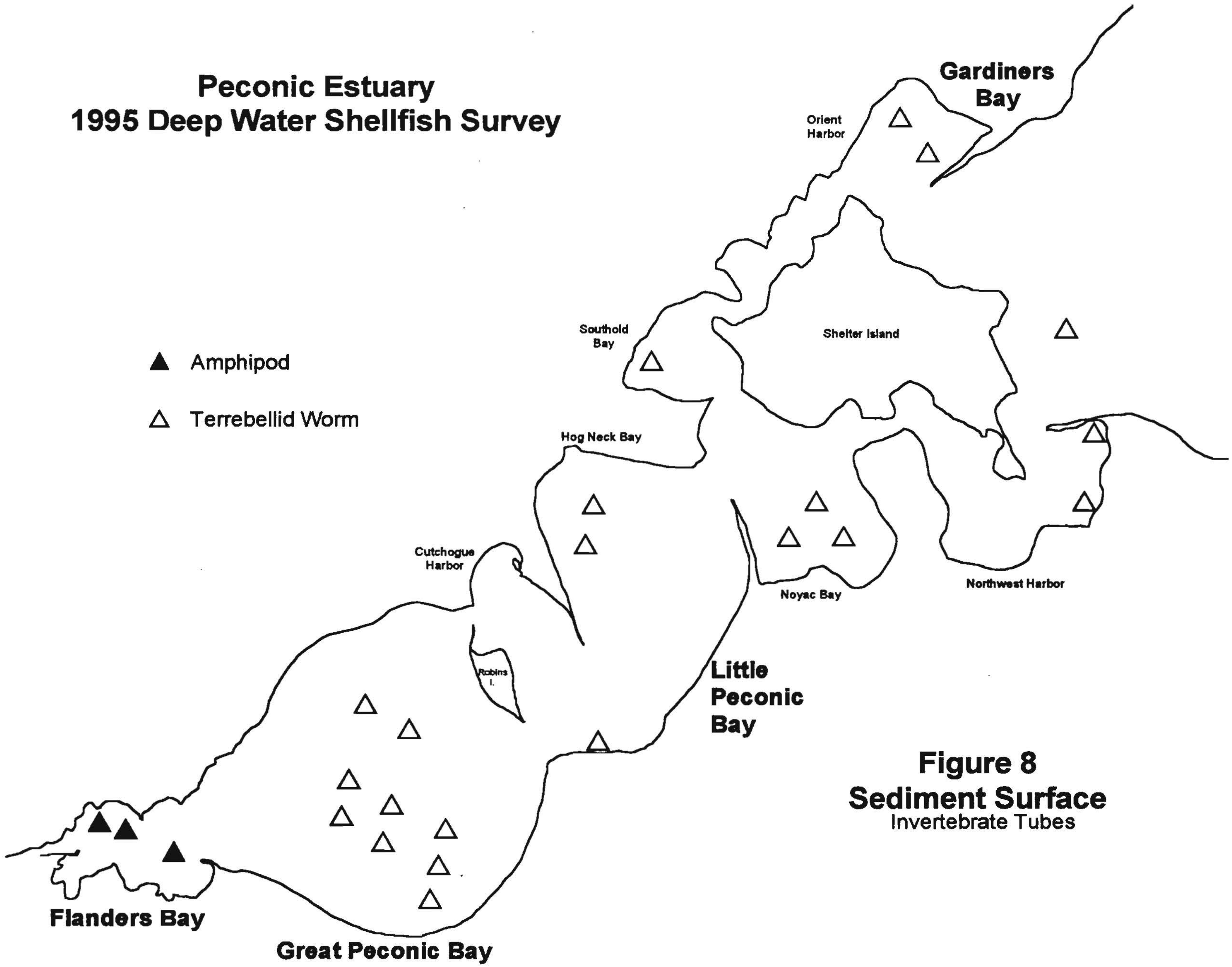

Figure 8
Sediment Surface
Invertebrate Tubes

Peconic Estuary
1995 Deep Water Shellfish Survey

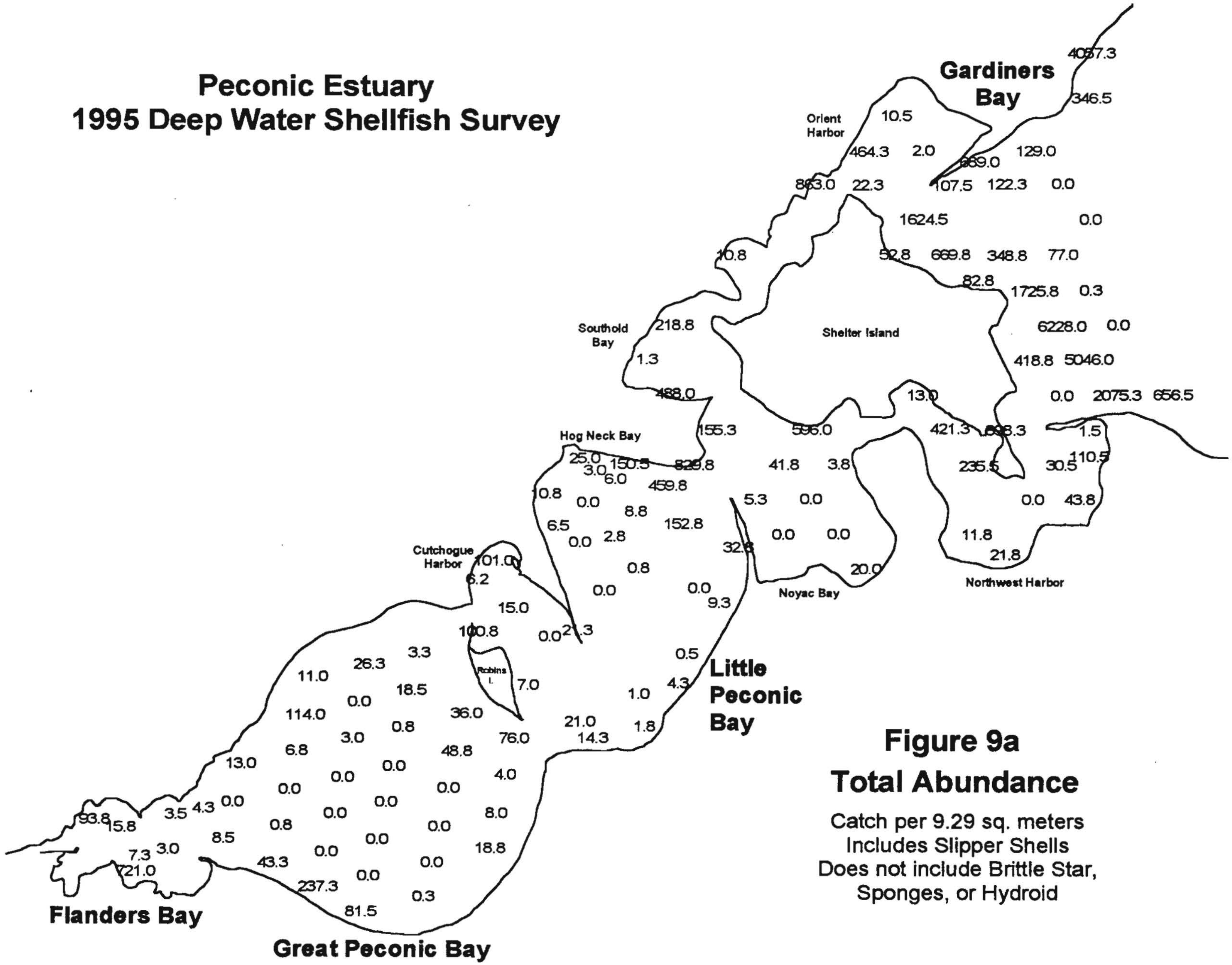

Figure 9a
Total Abundance

Catch per 9.29 sq. meters
Includes Slipper Shells
Does not include Brittle Star,
Sponges, or Hydroid

Peconic Estuary
1995 Deep Water Shellfish Survey

Symbol area proportional to total abundance

● = 6000 ind. per 9.29 sq. meters

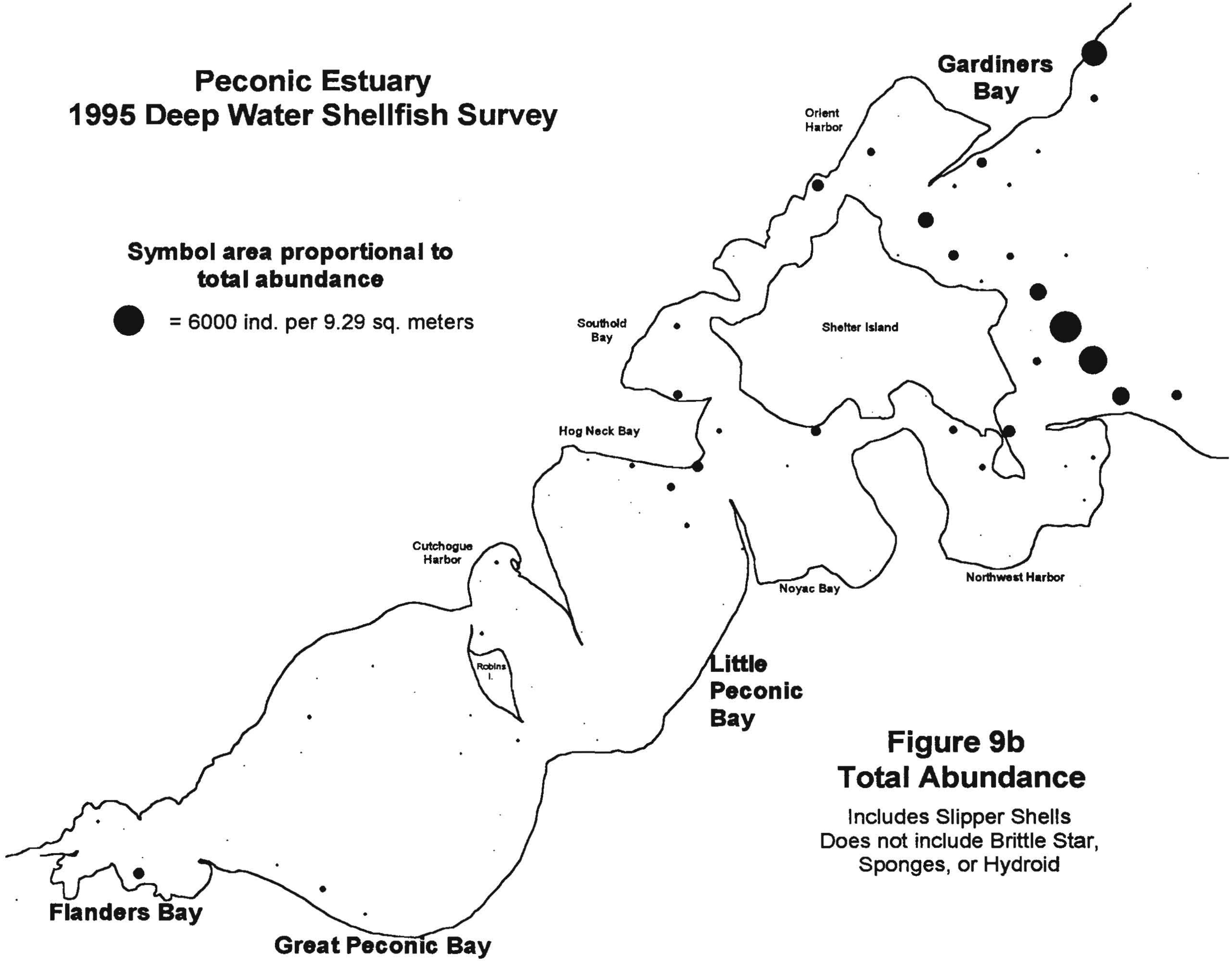

Figure 9b
Total Abundance

Includes Slipper Shells
Does not include Brittle Star,
Sponges, or Hydroid

Peconic Estuary
1995 Deep Water Shellfish Survey

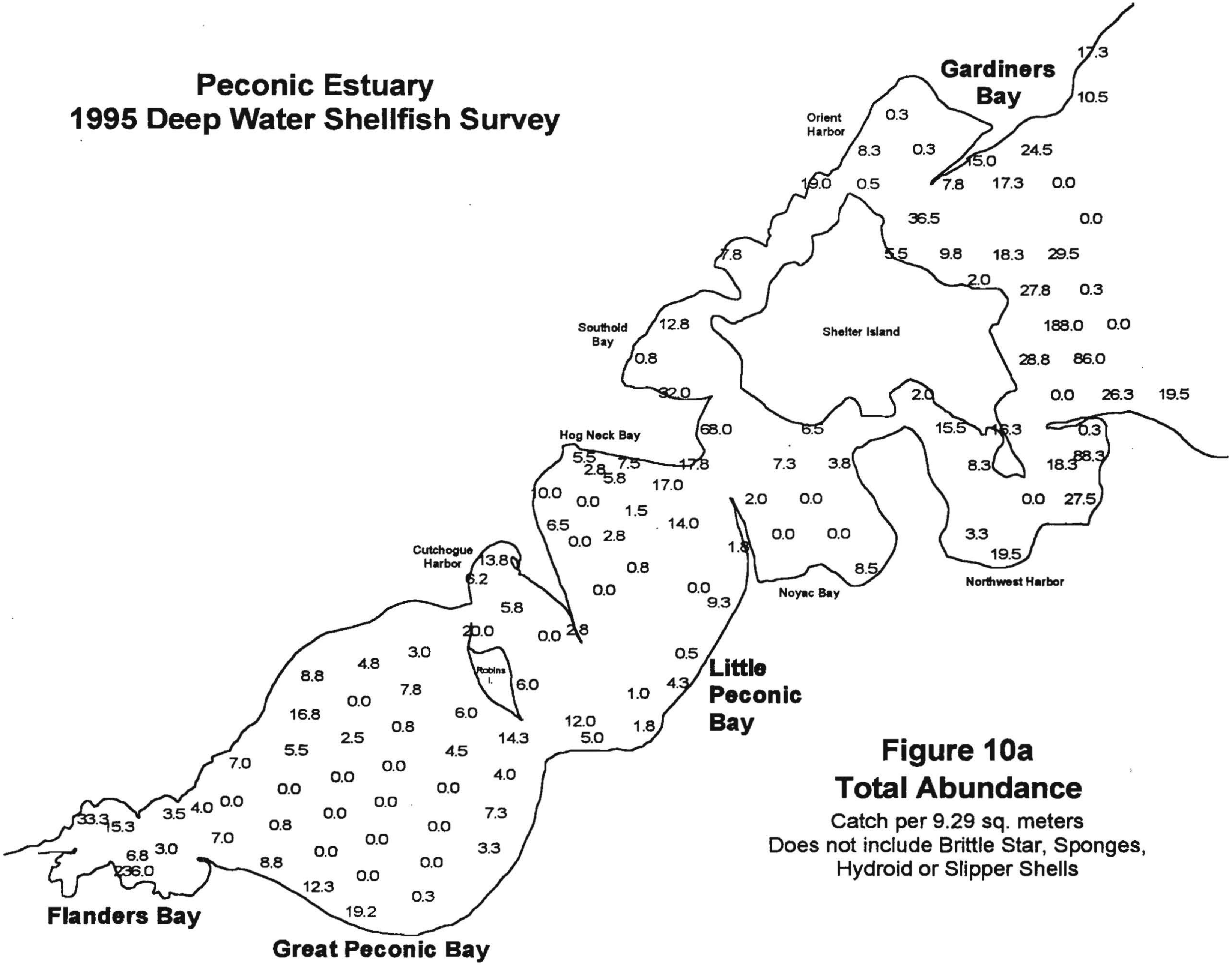

Figure 10a
Total Abundance
Catch per 9.29 sq. meters
Does not include Brittle Star, Sponges,
Hydroid or Slipper Shells

Peconic Estuary
1995 Deep Water Shellfish Survey

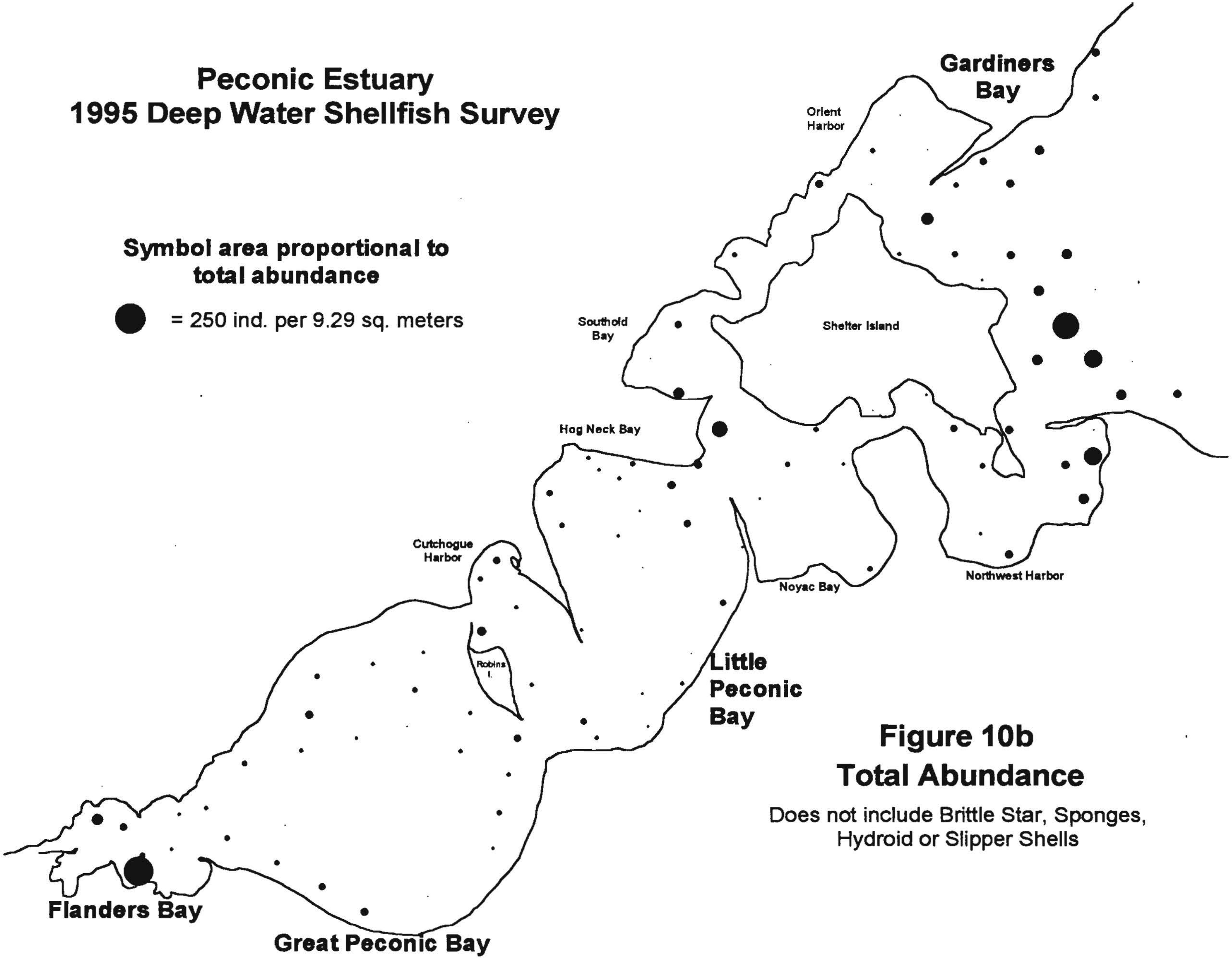

Figure 10b
Total Abundance

Does not include Brittle Star, Sponges, Hydroid or Slipper Shells

Peconic Estuary
1995 Deep Water Shellfish Survey

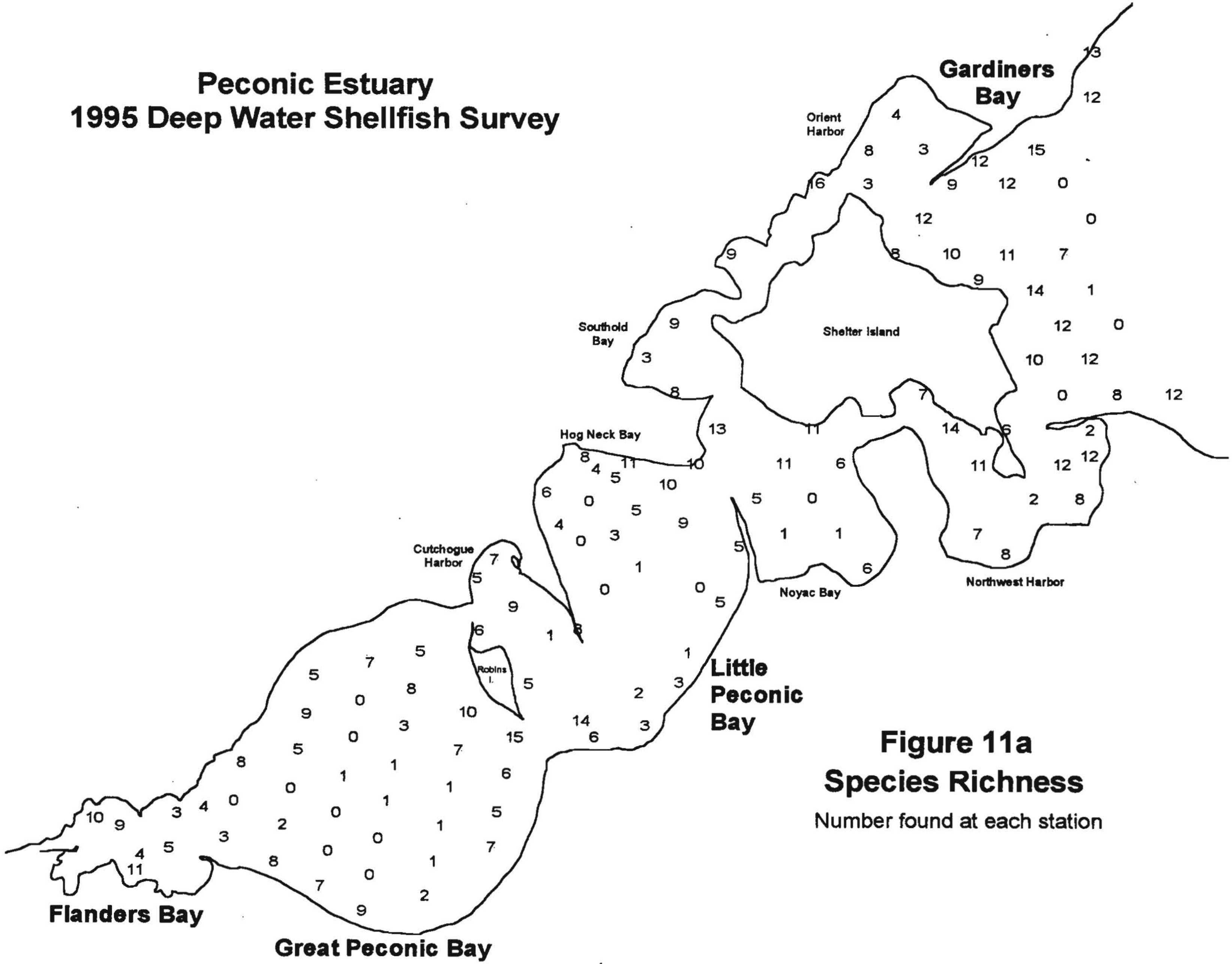

Figure 11a
Species Richness
Number found at each station

Peconic Estuary
1995 Deep Water Shellfish Survey

Symbol diameter proportional to species richness

● = 16 species per station

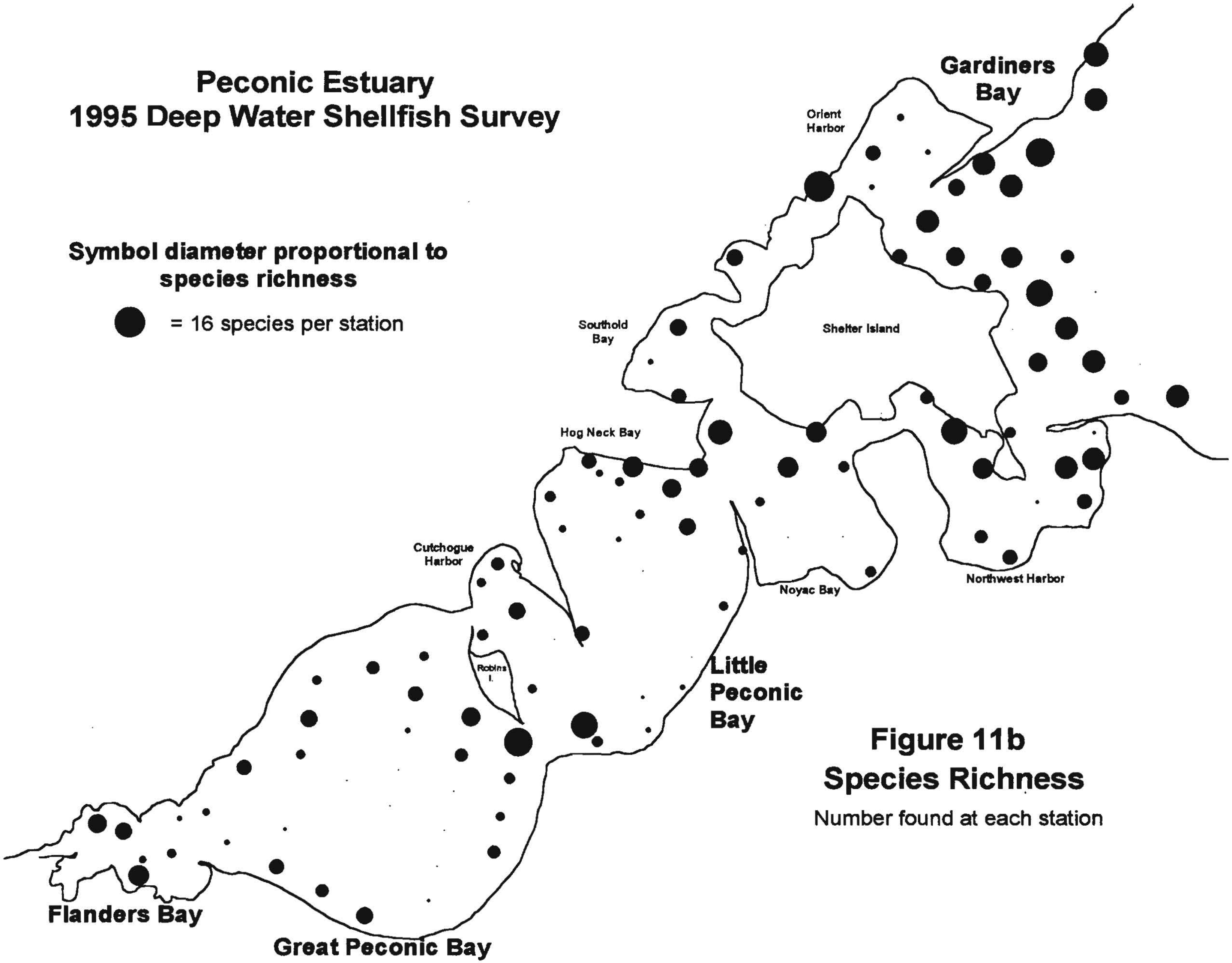

Figure 11b
Species Richness
Number found at each station

Peconic Estuary
1995 Deep Water Shellfish Survey

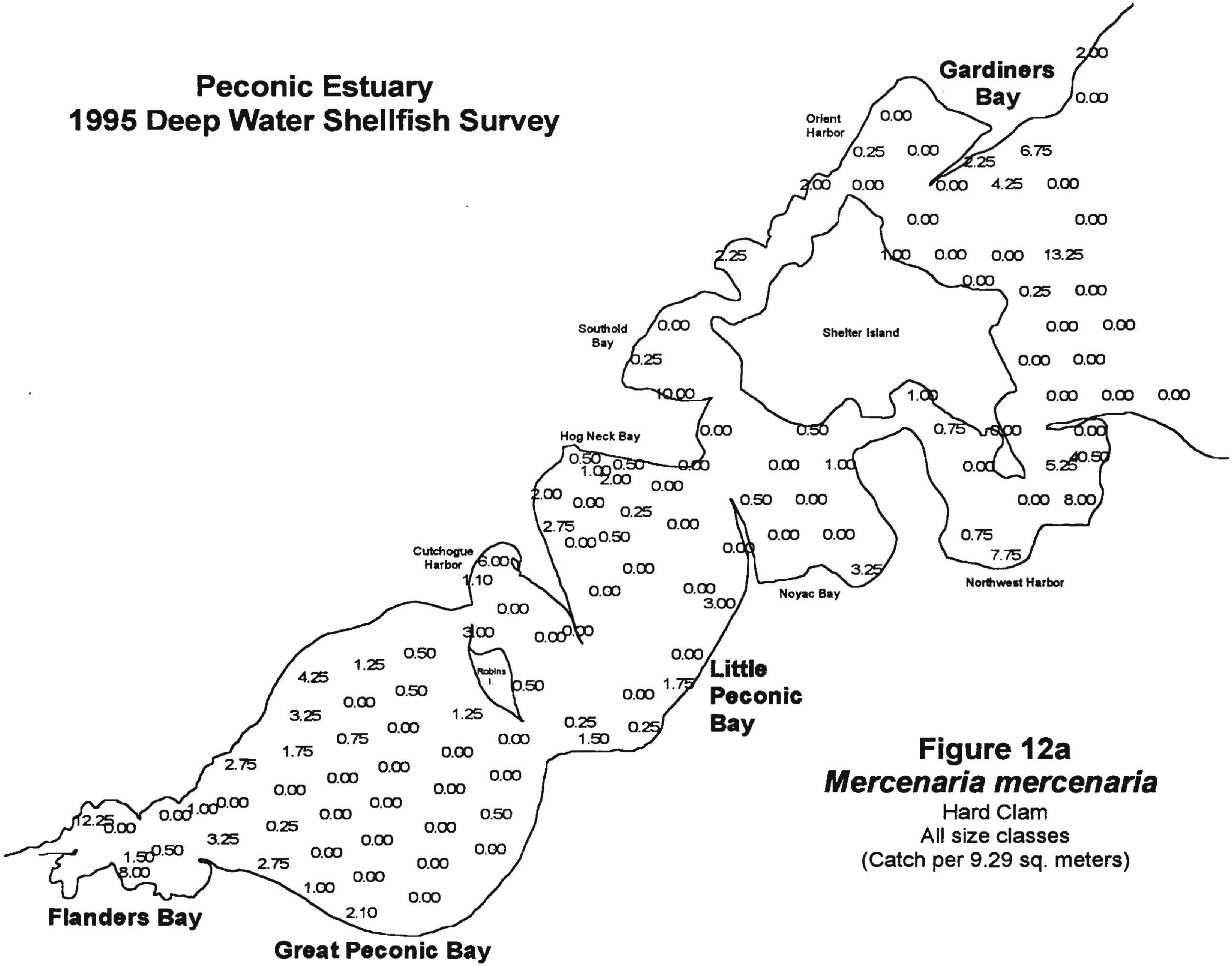

Figure 12a
Mercenaria mercenaria
Hard Clam
All size classes
(Catch per 9.29 sq. meters)

Peconic Estuary
1995 Deep Water Shellfish Survey

Symbol area proportional to catch

● = 50 ind. per 9.29 sq. meters

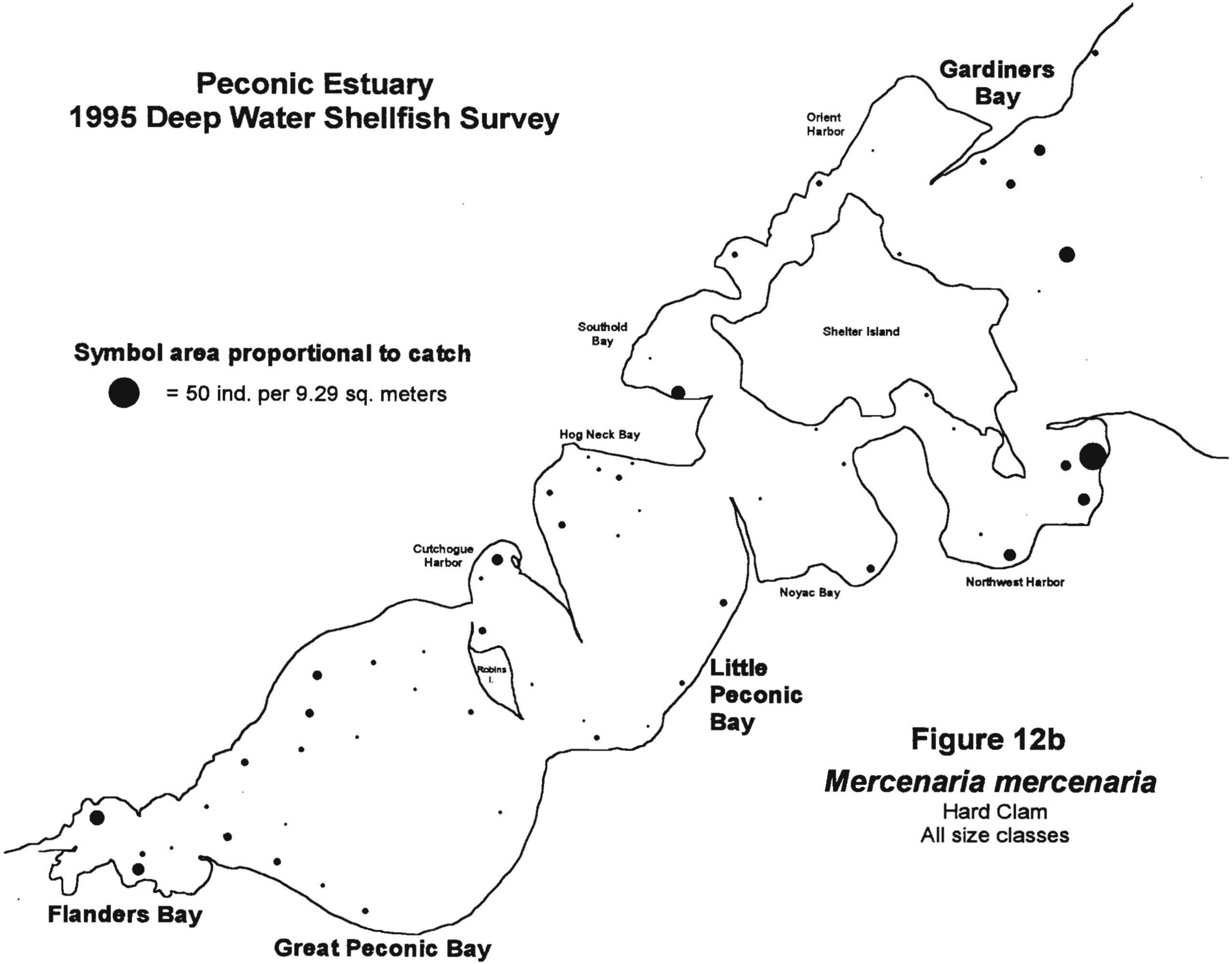

Figure 12b

Mercenaria mercenaria

Hard Clam

All size classes

Peconic Estuary
1995 Deep Water Shellfish Survey

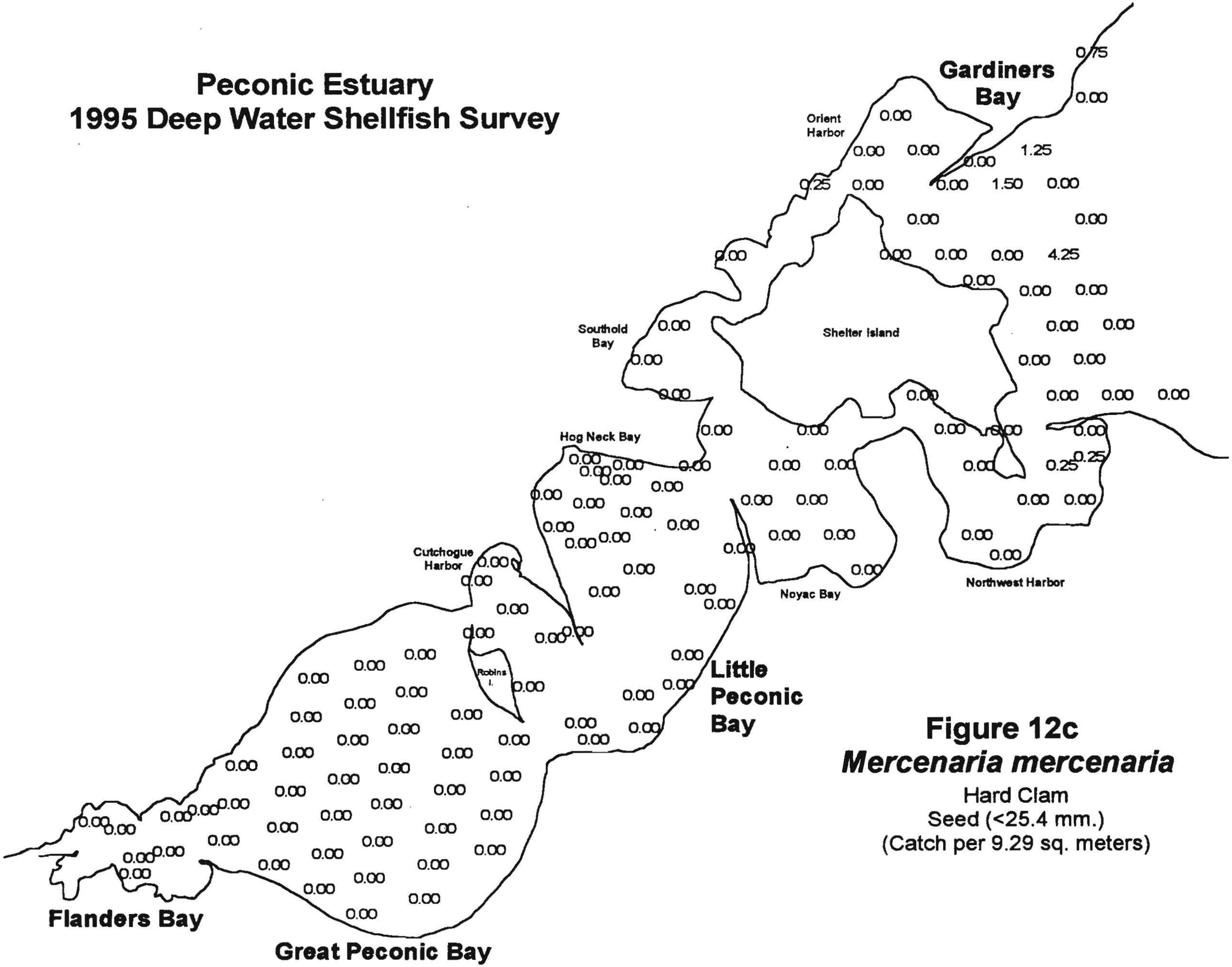

Figure 12c
Mercenaria mercenaria
Hard Clam
Seed (<25.4 mm.)
(Catch per 9.29 sq. meters)

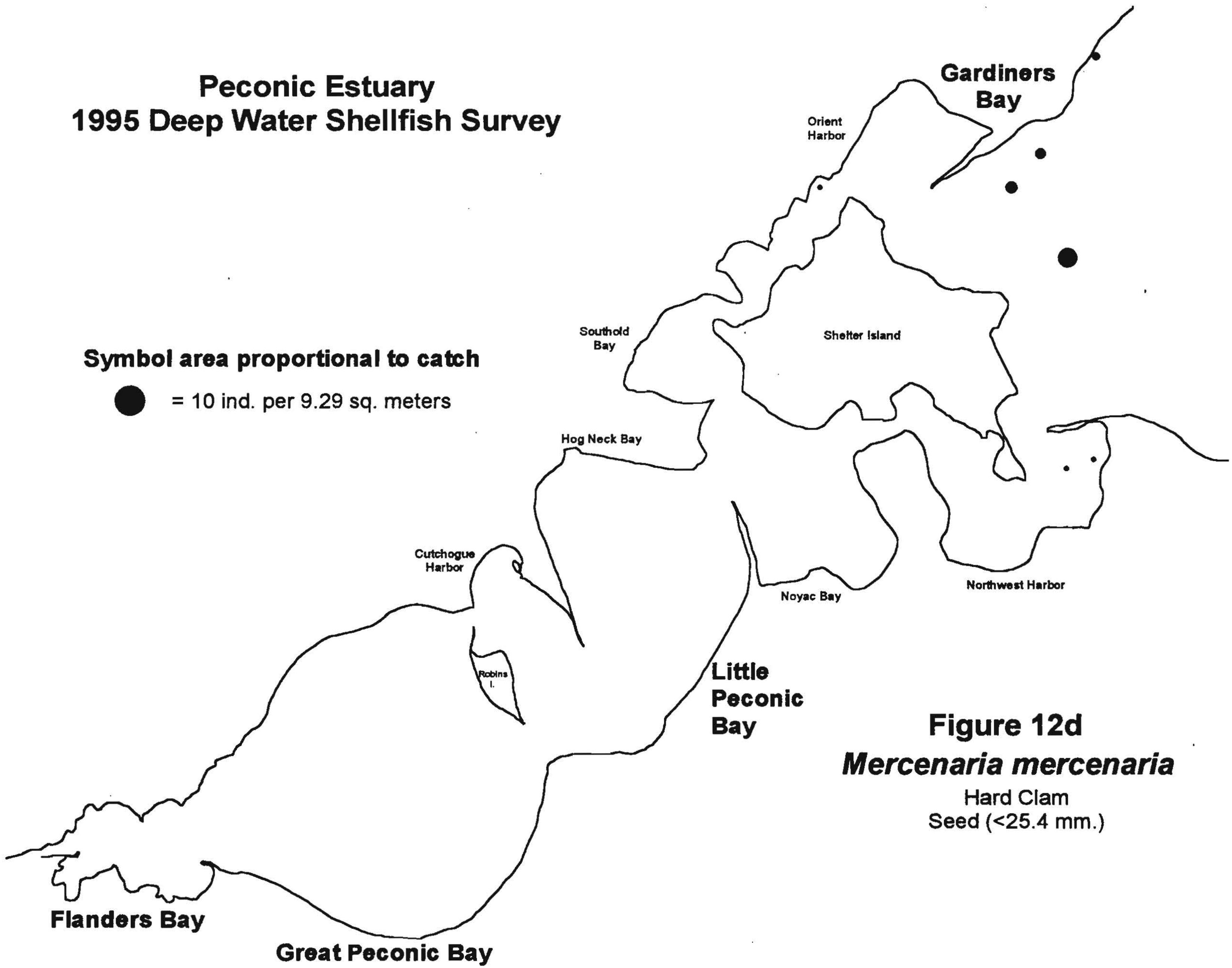

Figure 12d
Mercenaria mercenaria
Hard Clam
Seed (<25.4 mm.)

Peconic Estuary
1995 Deep Water Shellfish Survey

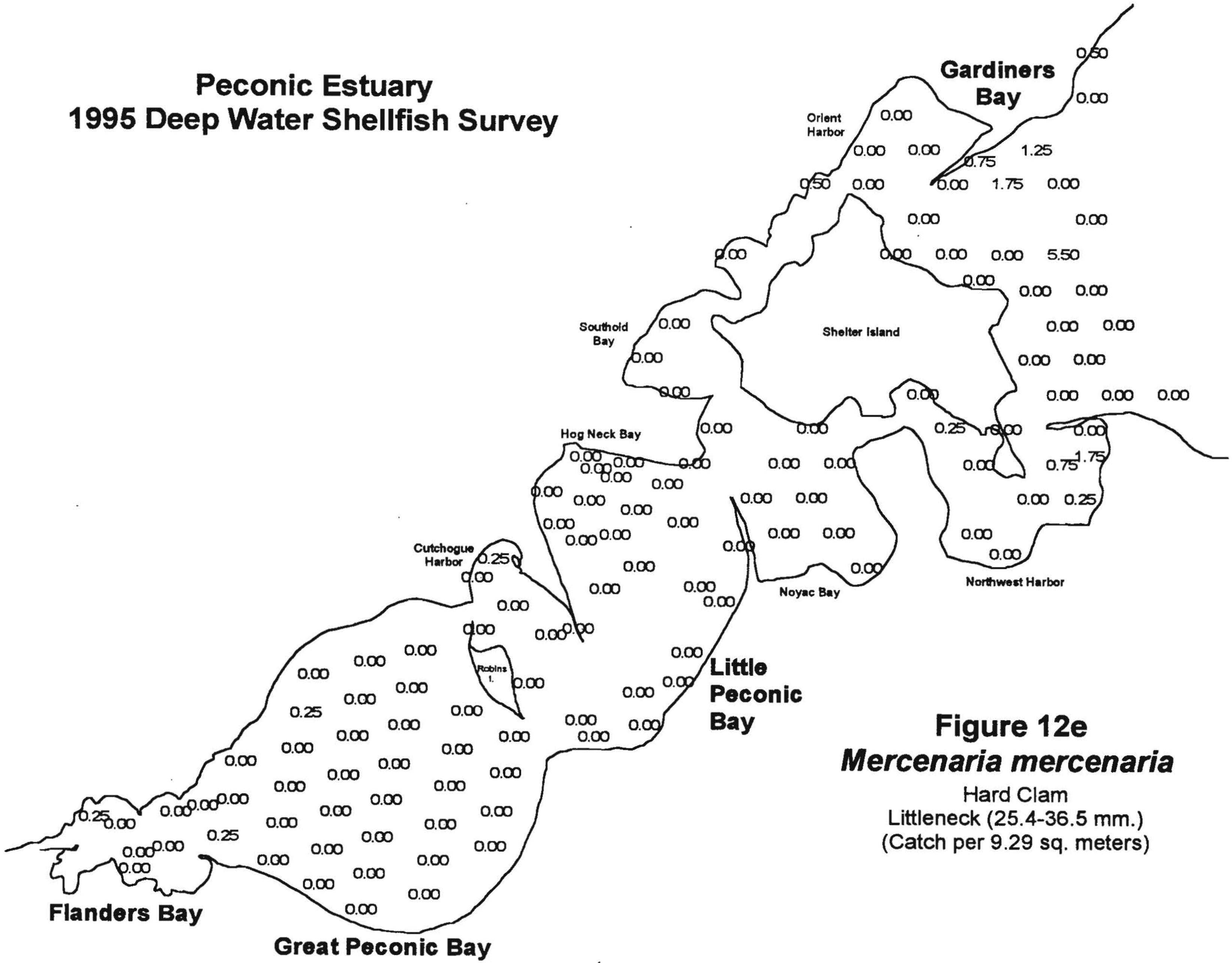

Figure 12e
Mercenaria mercenaria
Hard Clam
Littleneck (25.4-36.5 mm.)
(Catch per 9.29 sq. meters)

Peconic Estuary
1995 Deep Water Shellfish Survey

Symbol area proportional to catch

● = 10 ind. per 9.29 sq. meters

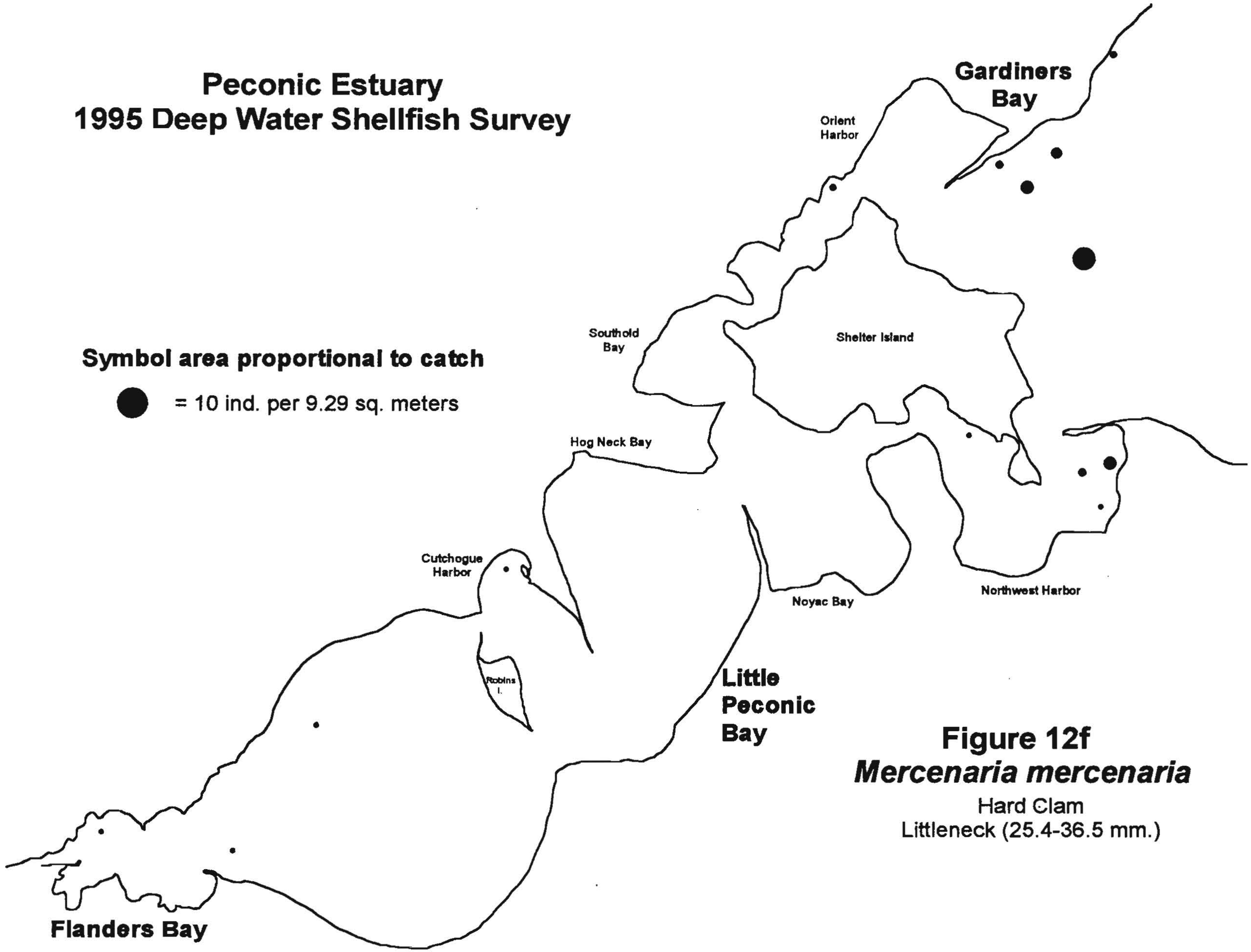

Figure 12f
Mercenaria mercenaria
Hard Clam
Littleneck (25.4-36.5 mm.)

Peconic Estuary
1995 Deep Water Shellfish Survey

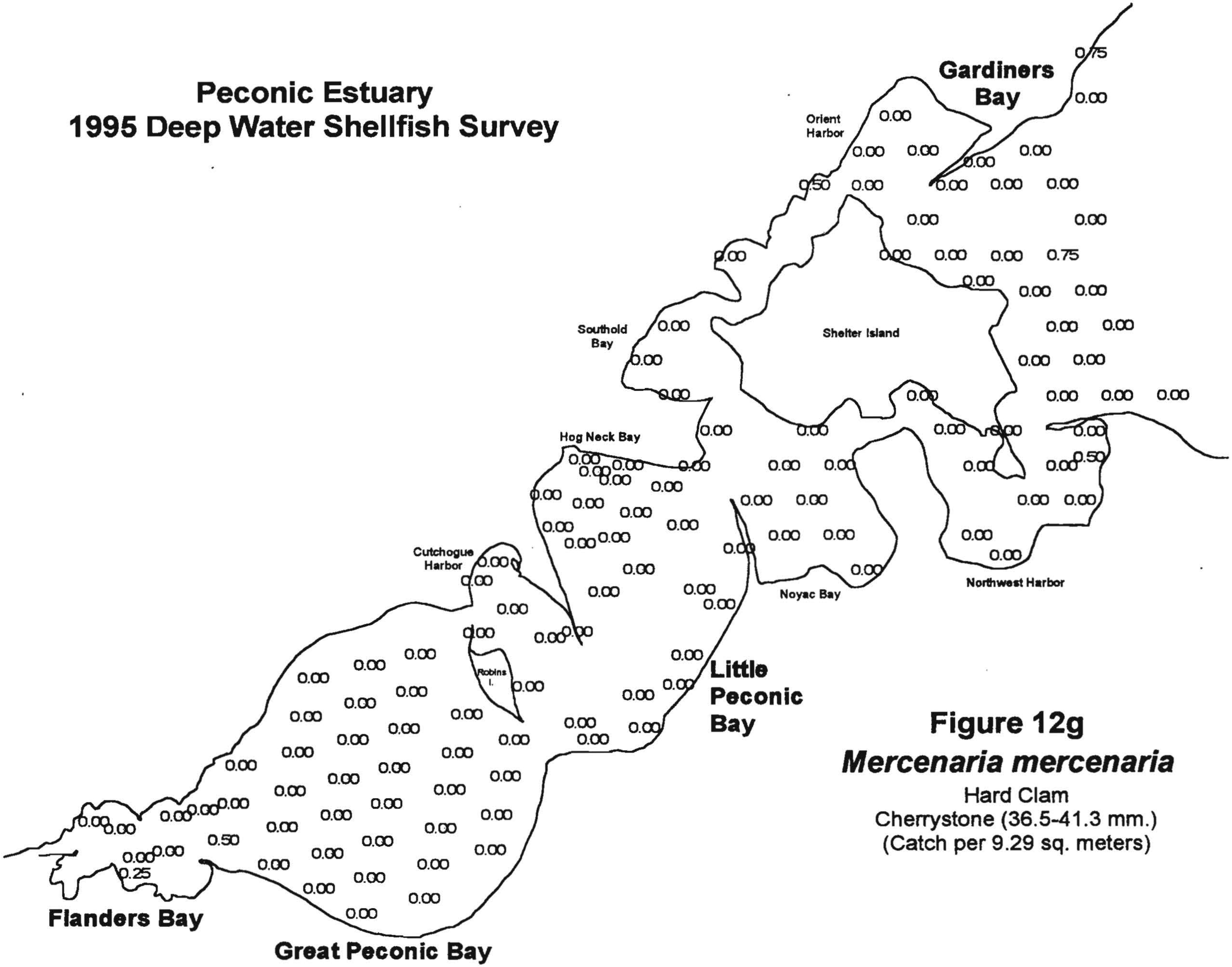

Figure 12g
Mercenaria mercenaria
Hard Clam
Cherrystone (36.5-41.3 mm.)
(Catch per 9.29 sq. meters)

Peconic Estuary
1995 Deep Water Shellfish Survey

Symbol area proportional to catch

● = 1 ind. per 9.29 sq. meters

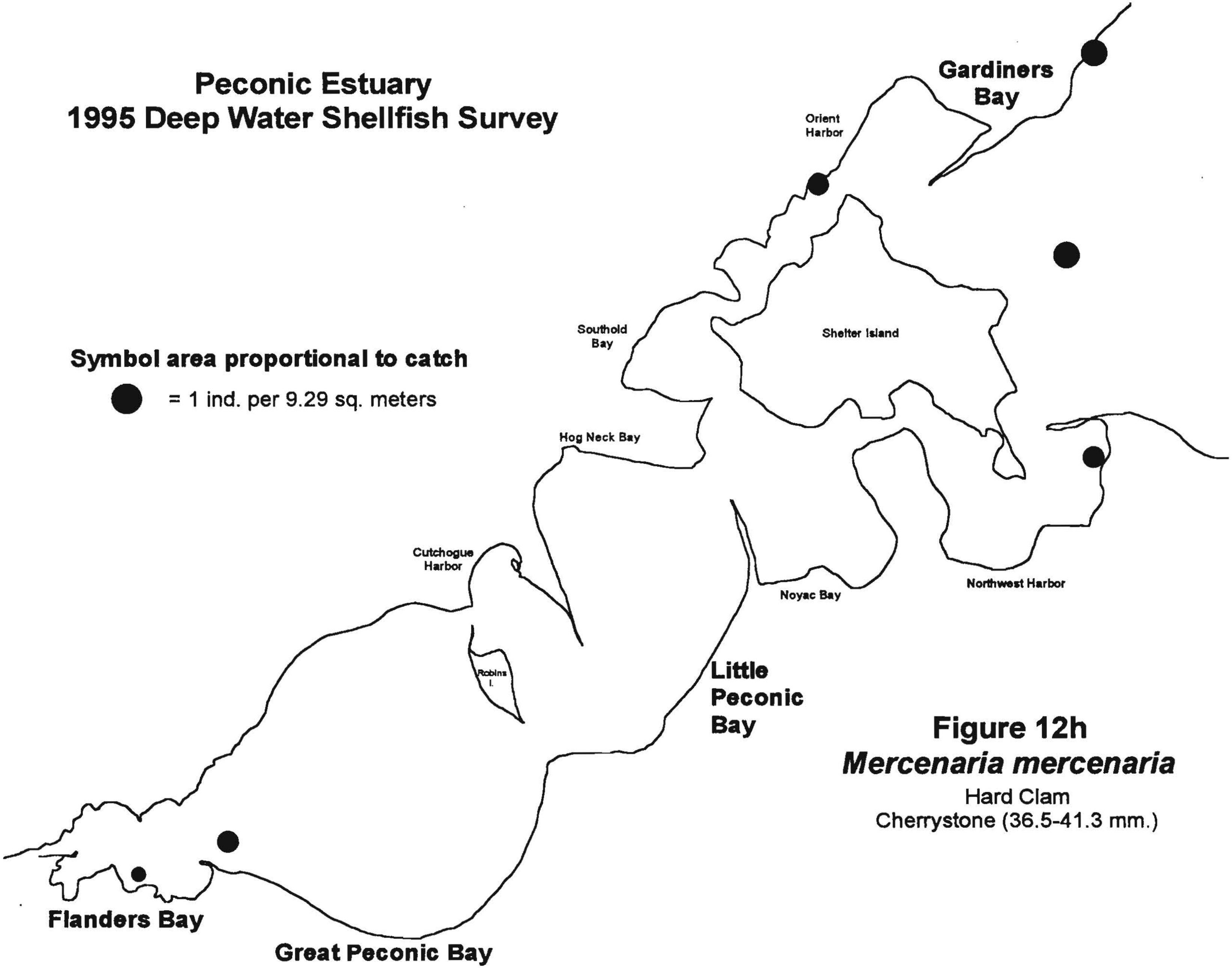

Figure 12h
Mercenaria mercenaria
Hard Clam
Cherrystone (36.5-41.3 mm.)

Peconic Estuary
1995 Deep Water Shellfish Survey

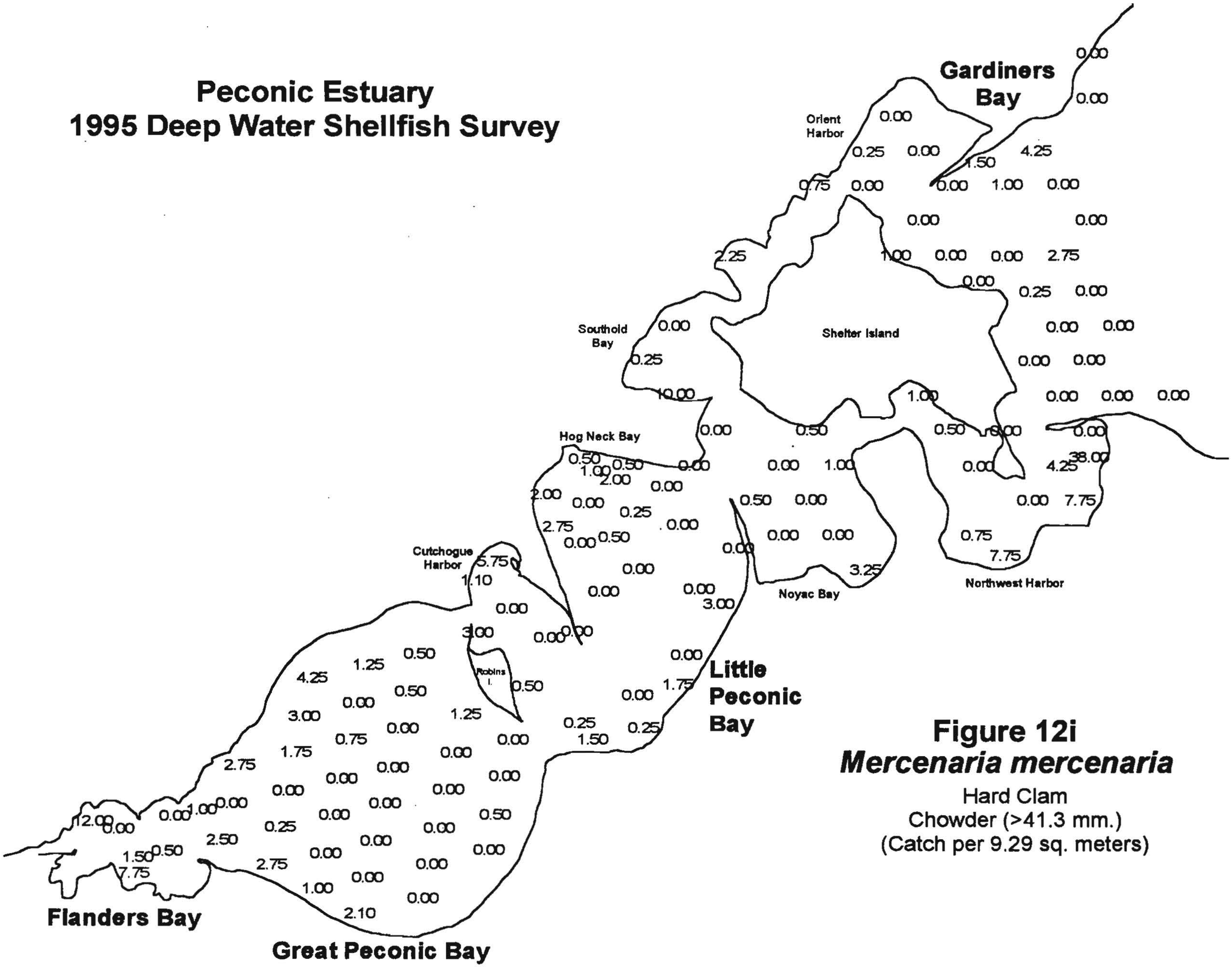

Figure 12i
Mercenaria mercenaria
Hard Clam
Chowder (>41.3 mm.)
(Catch per 9.29 sq. meters)

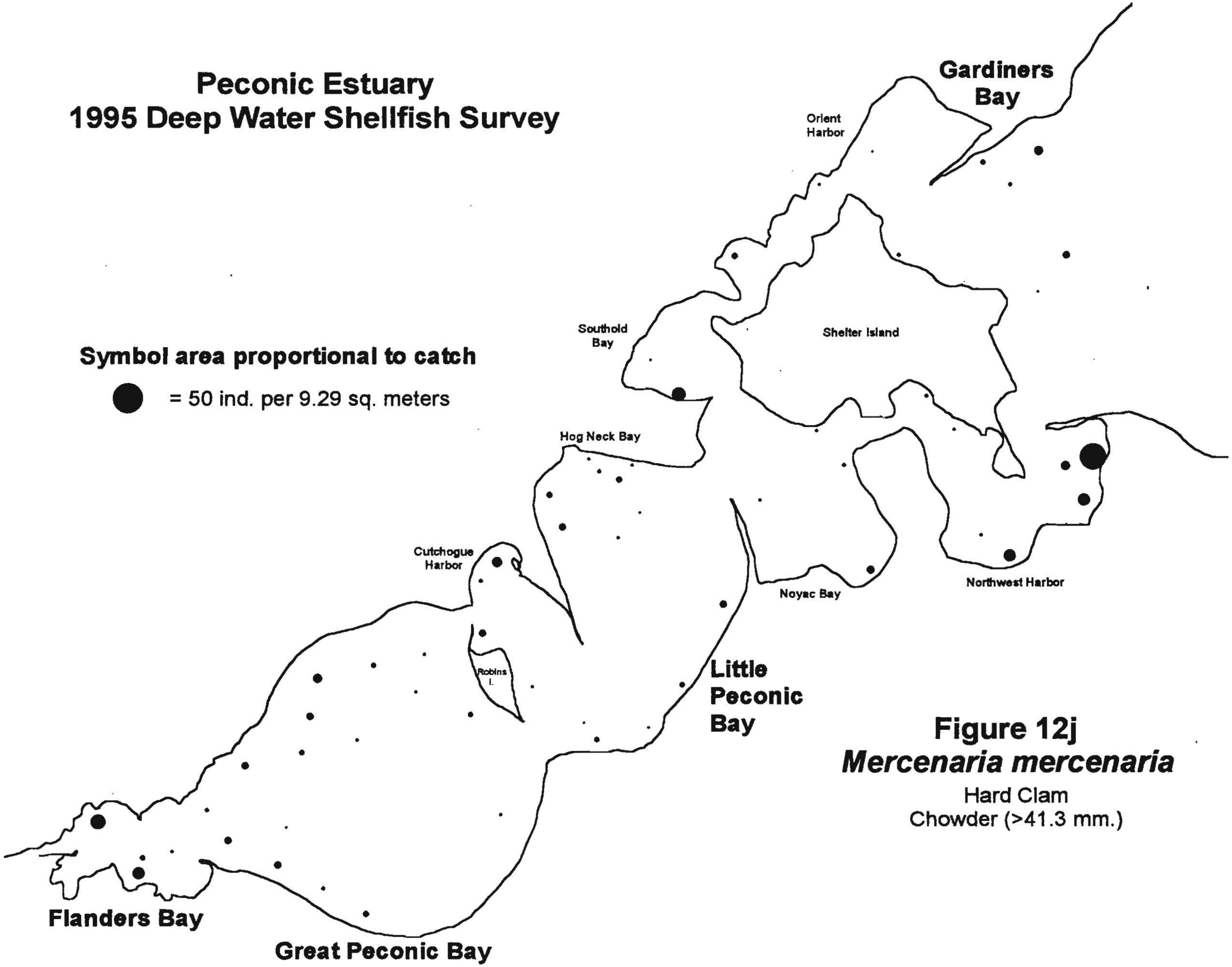

Figure 12j
Mercenaria mercenaria
Hard Clam
Chowder (>41.3 mm.)

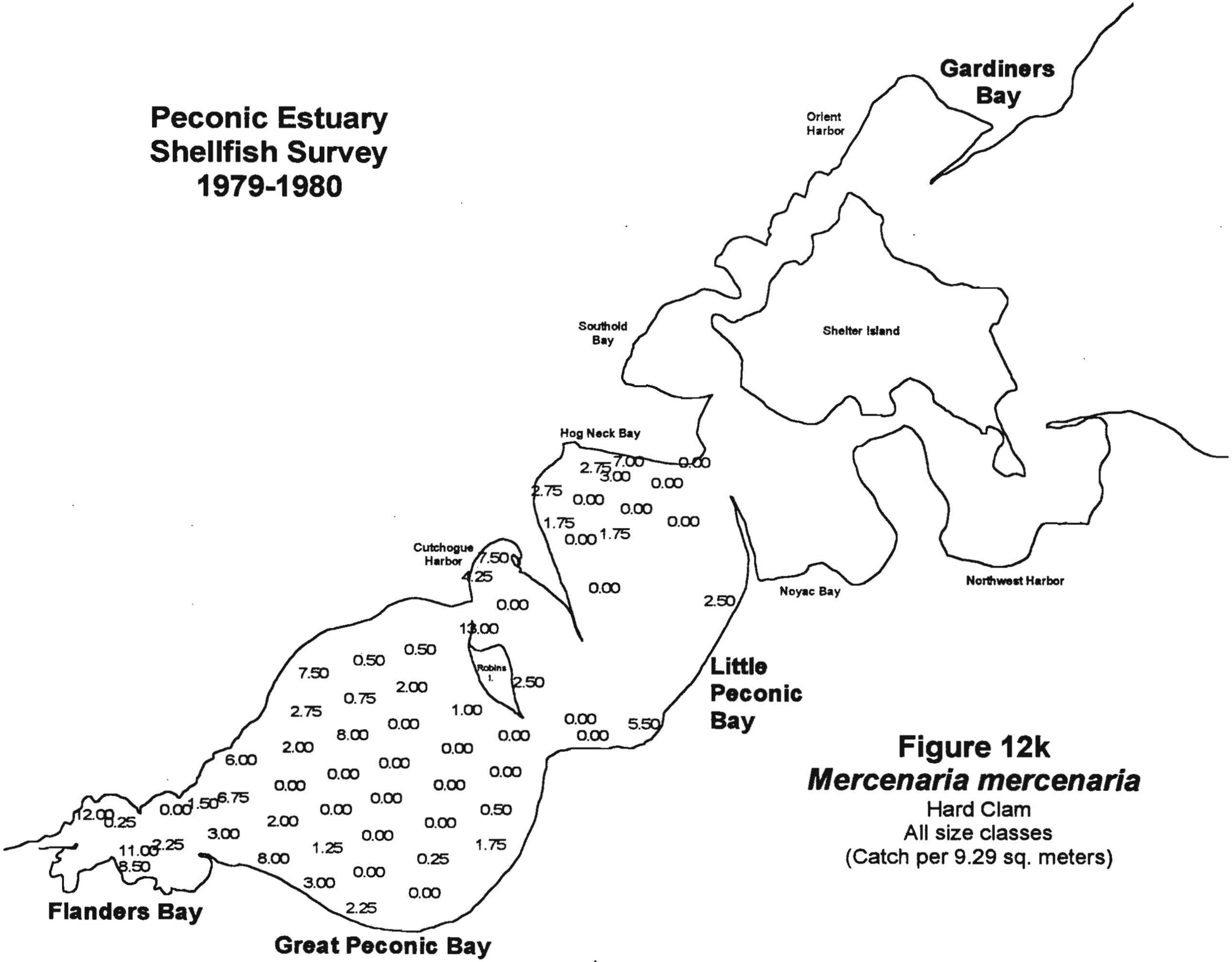

Figure 12k
Mercenaria mercenaria
Hard Clam
All size classes
(Catch per 9.29 sq. meters)

Peconic Estuary
Shellfish Survey
1979-1980

Symbol area proportional to catch

● = 20 ind. per 9.29 sq. meters

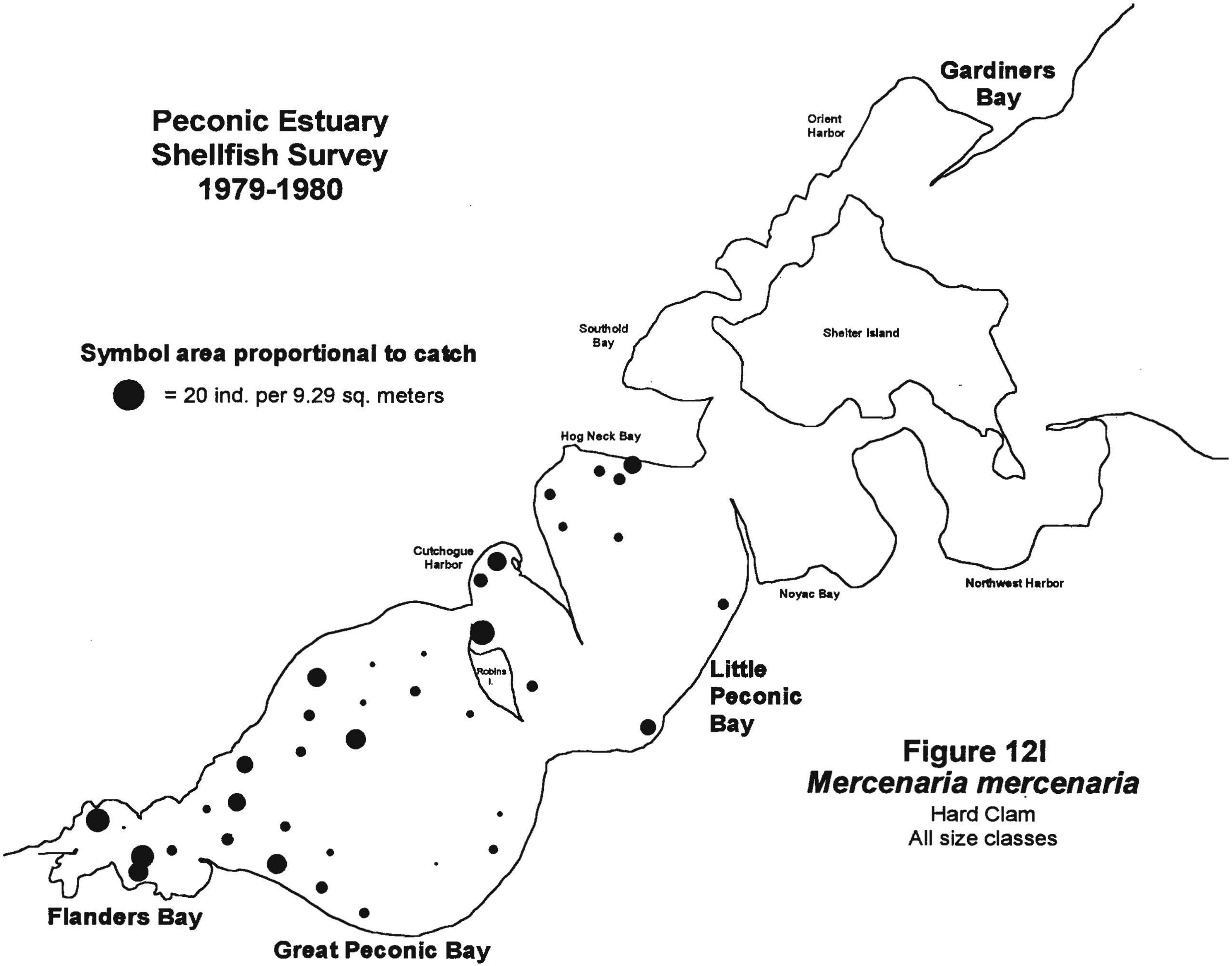

Figure 12I
Mercenaria mercenaria
Hard Clam
All size classes

Peconic Estuary
1995 Deep Water Shellfish Survey

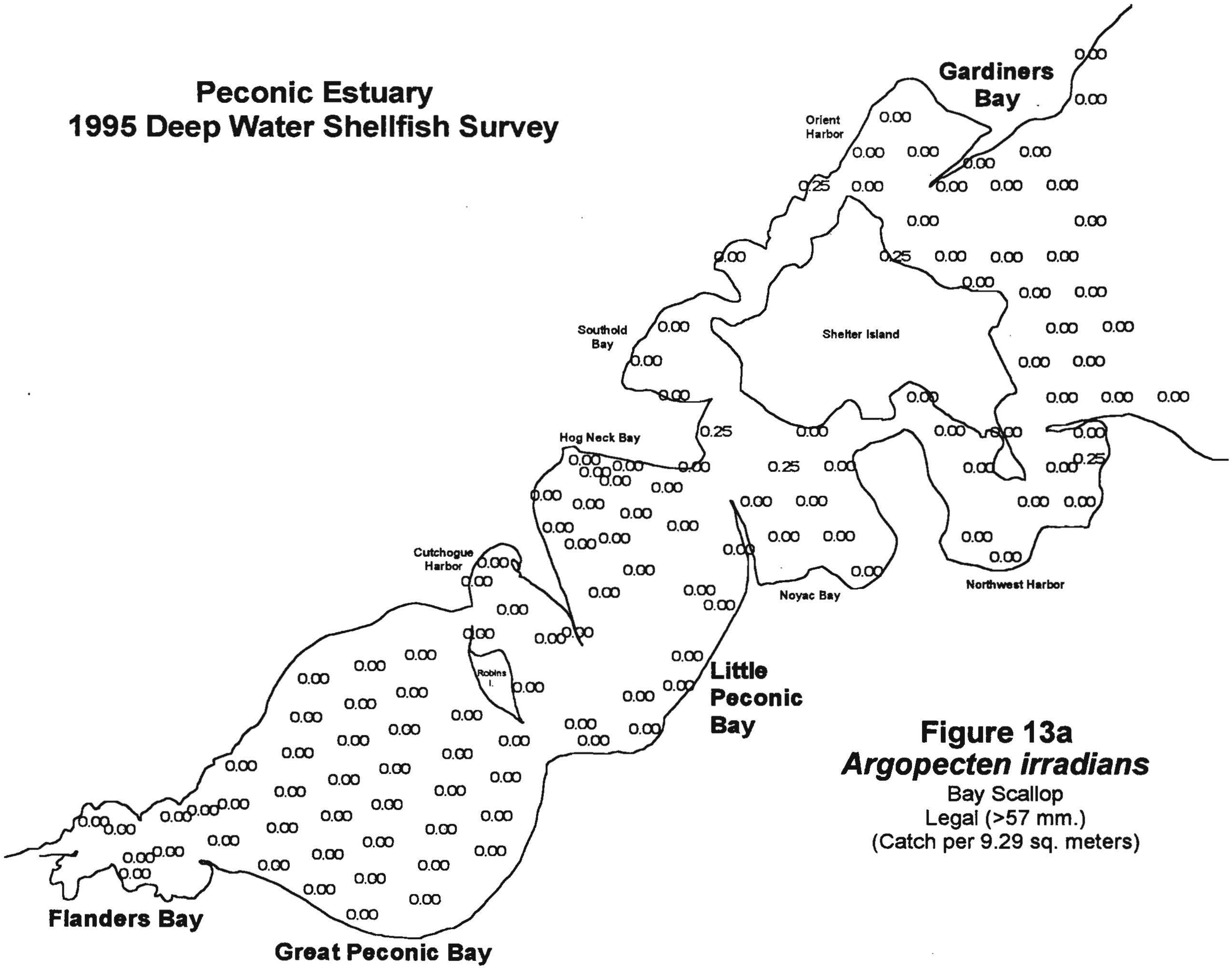

Figure 13a
Argopecten irradians
Bay Scallop
Legal (>57 mm.)
(Catch per 9.29 sq. meters)

Peconic Estuary
1995 Deep Water Shellfish Survey

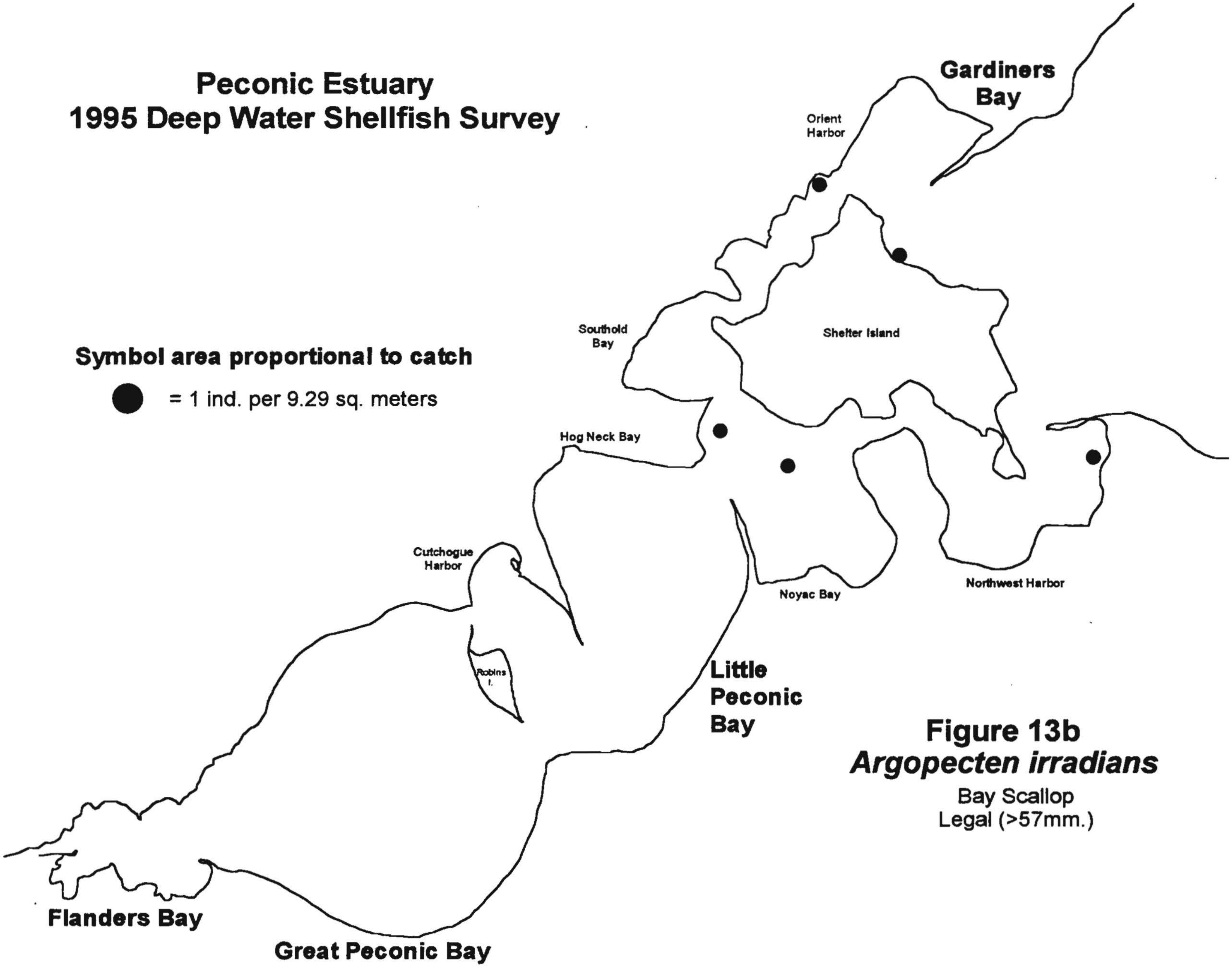

Figure 13b
Argopecten irradians
Bay Scallop
Legal (>57mm.)

Peconic Estuary
1995 Deep Water Shellfish Survey

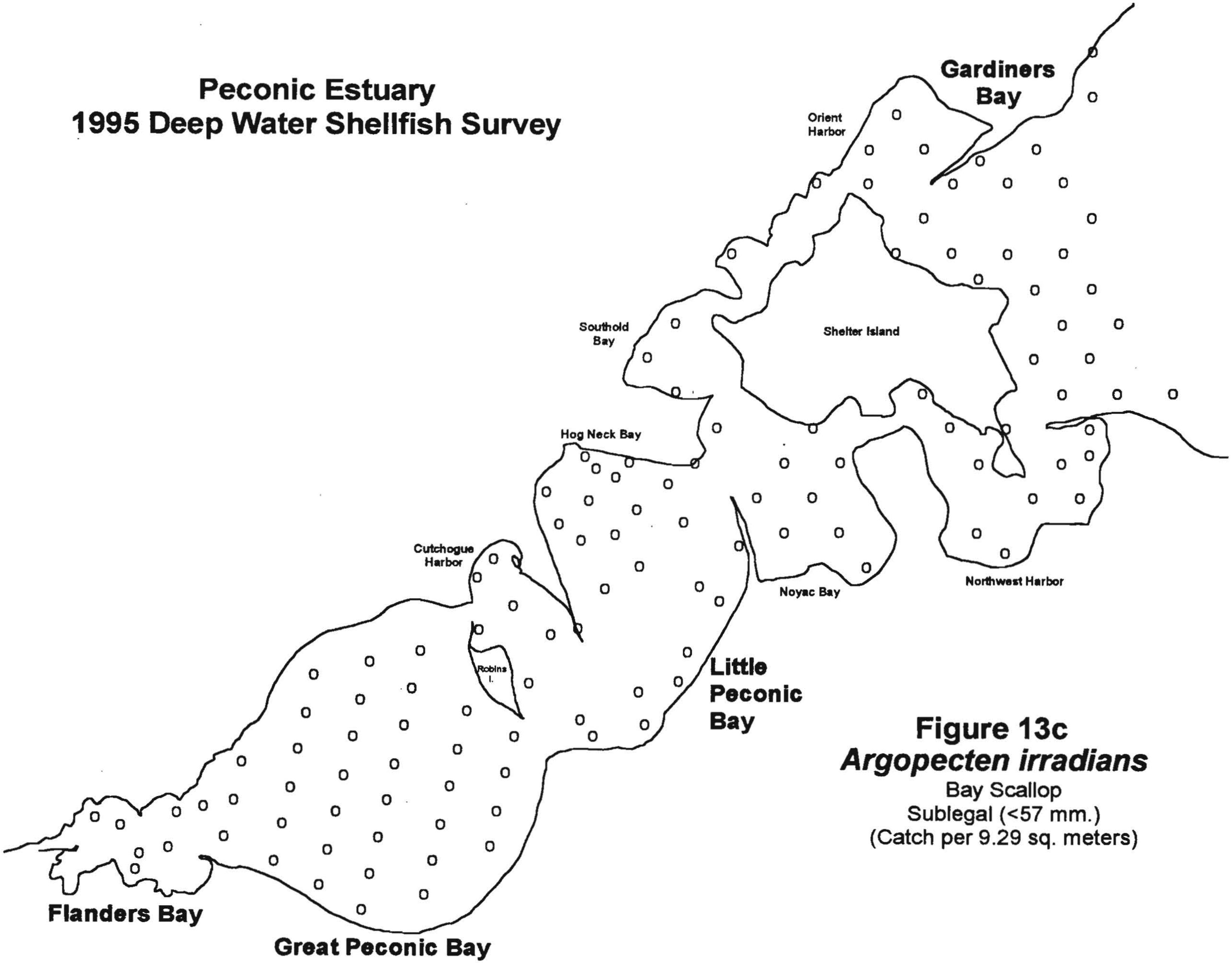

Figure 13c
Argopecten irradians
Bay Scallop
Sublegal (<57 mm.)
(Catch per 9.29 sq. meters)

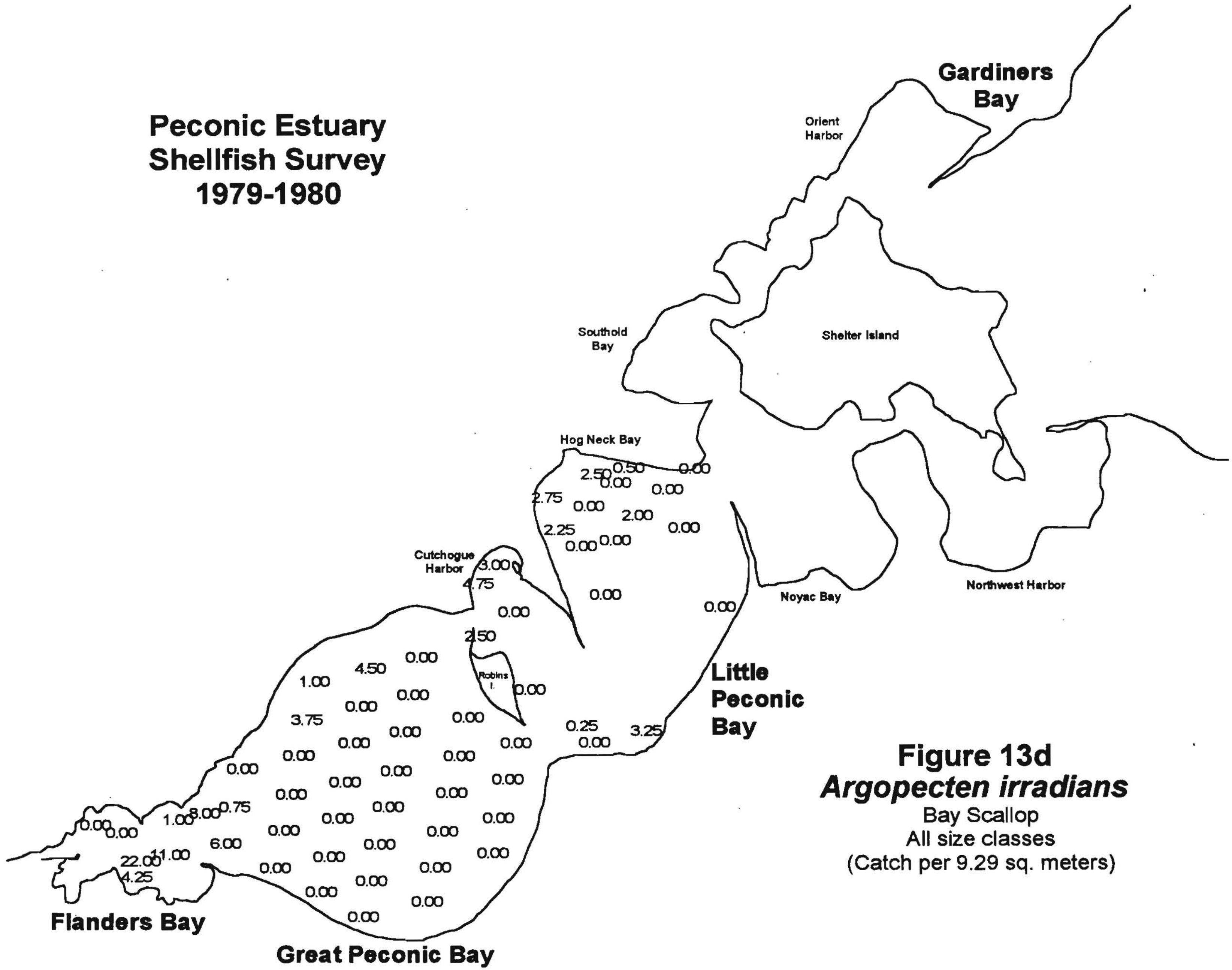

Figure 13d
Argopecten irradians
Bay Scallop
All size classes
(Catch per 9.29 sq. meters)

Peconic Estuary Shellfish Survey 1979-1980

Symbol area proportional to catch

● = 20 ind. per 9.29 sq. meters

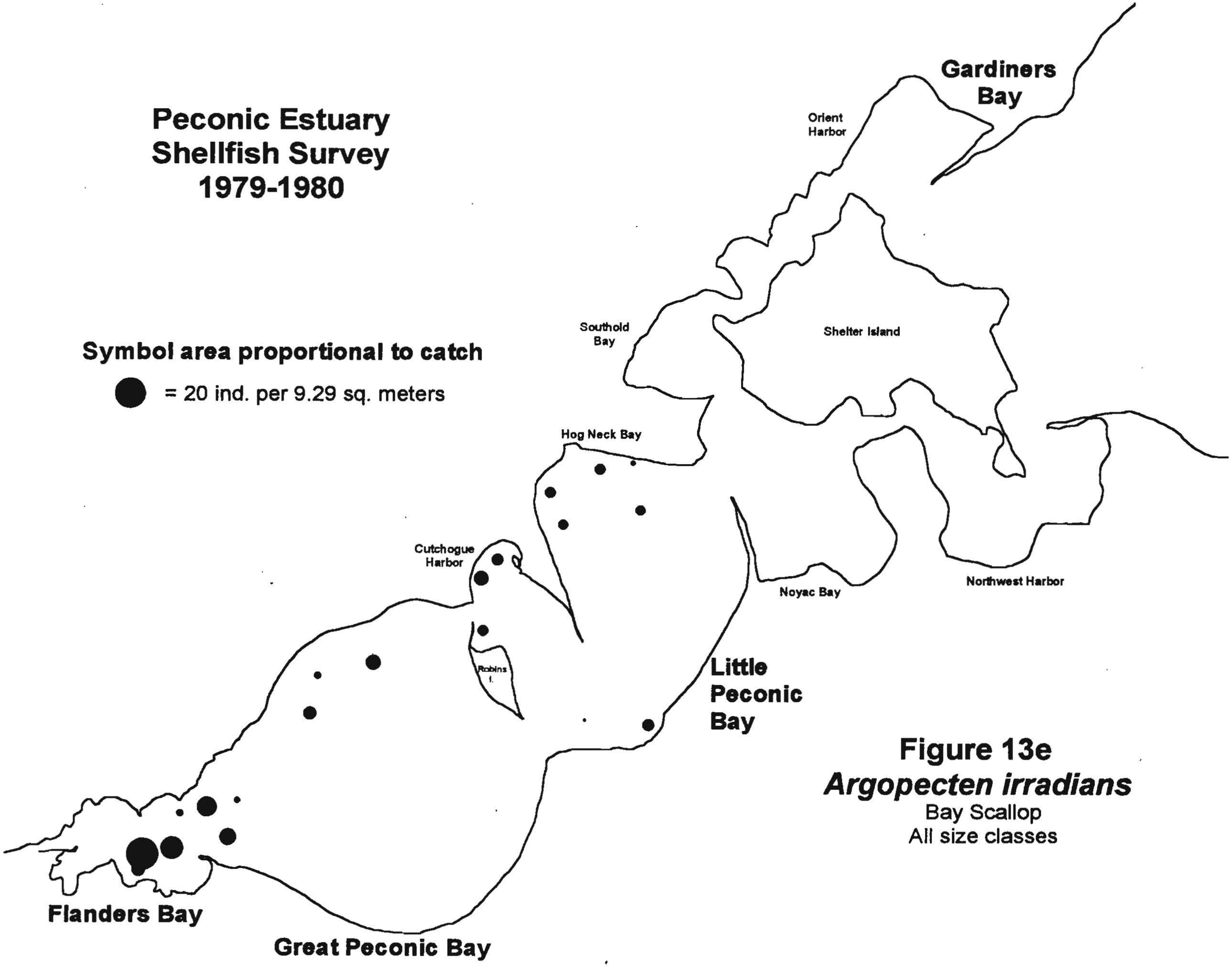

Figure 13e
Argopecten irradians
Bay Scallop
All size classes

Peconic Estuary
1995 Deep Water Shellfish Survey

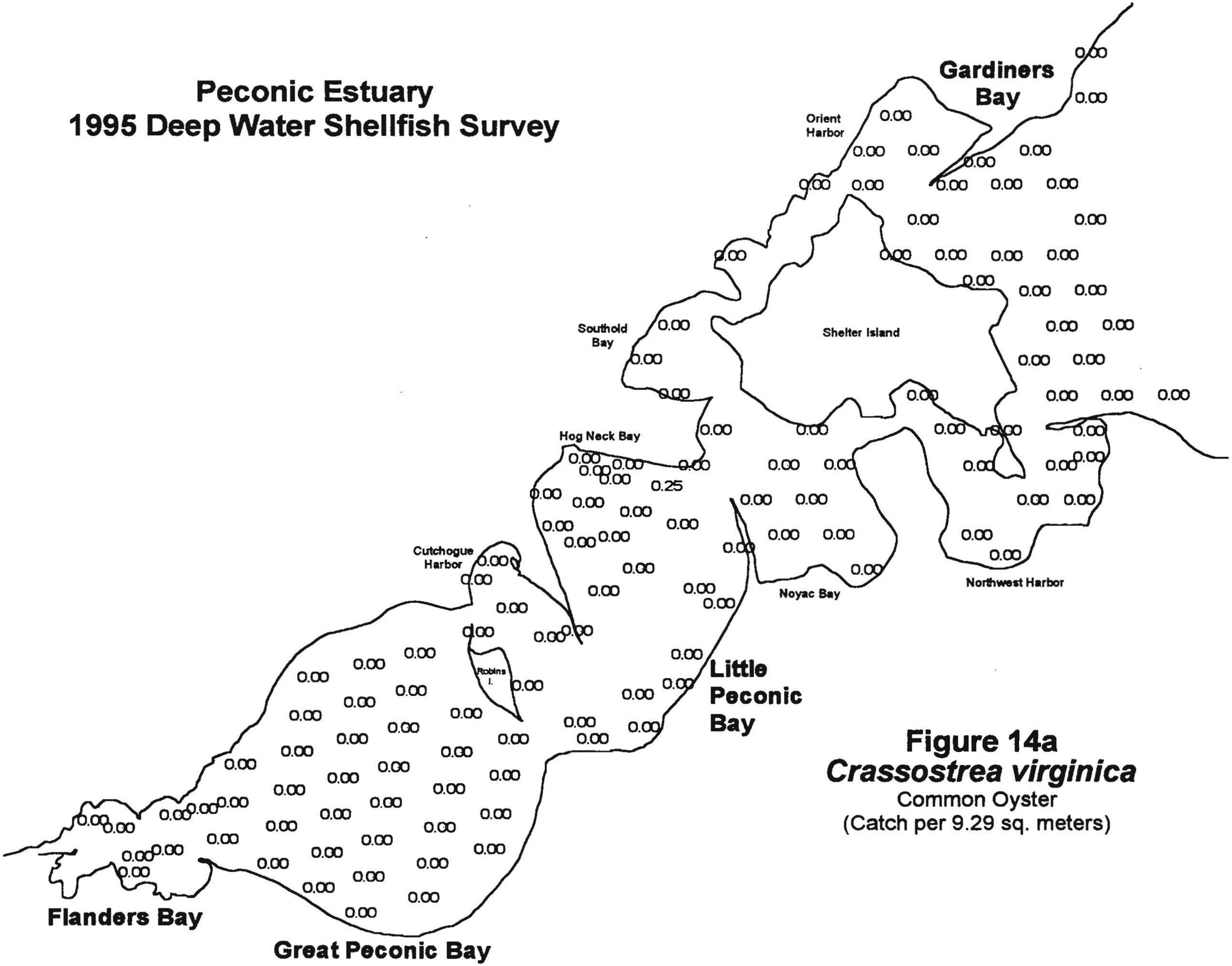

Figure 14a
Crassostrea virginica
Common Oyster
(Catch per 9.29 sq. meters)

F-33

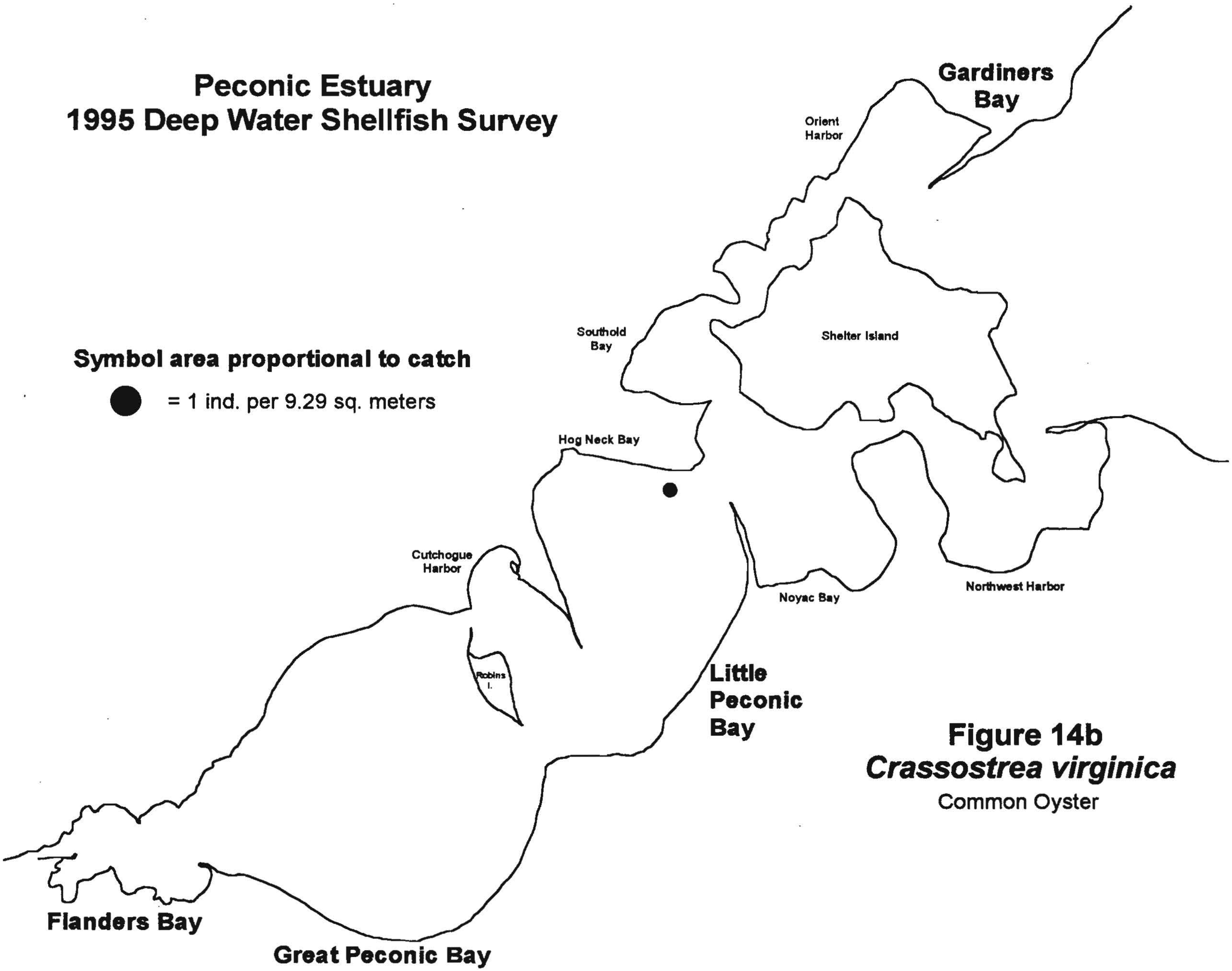

Figure 14b
Crassostrea virginica
Common Oyster

Peconic Estuary
1995 Deep Water Shellfish Survey

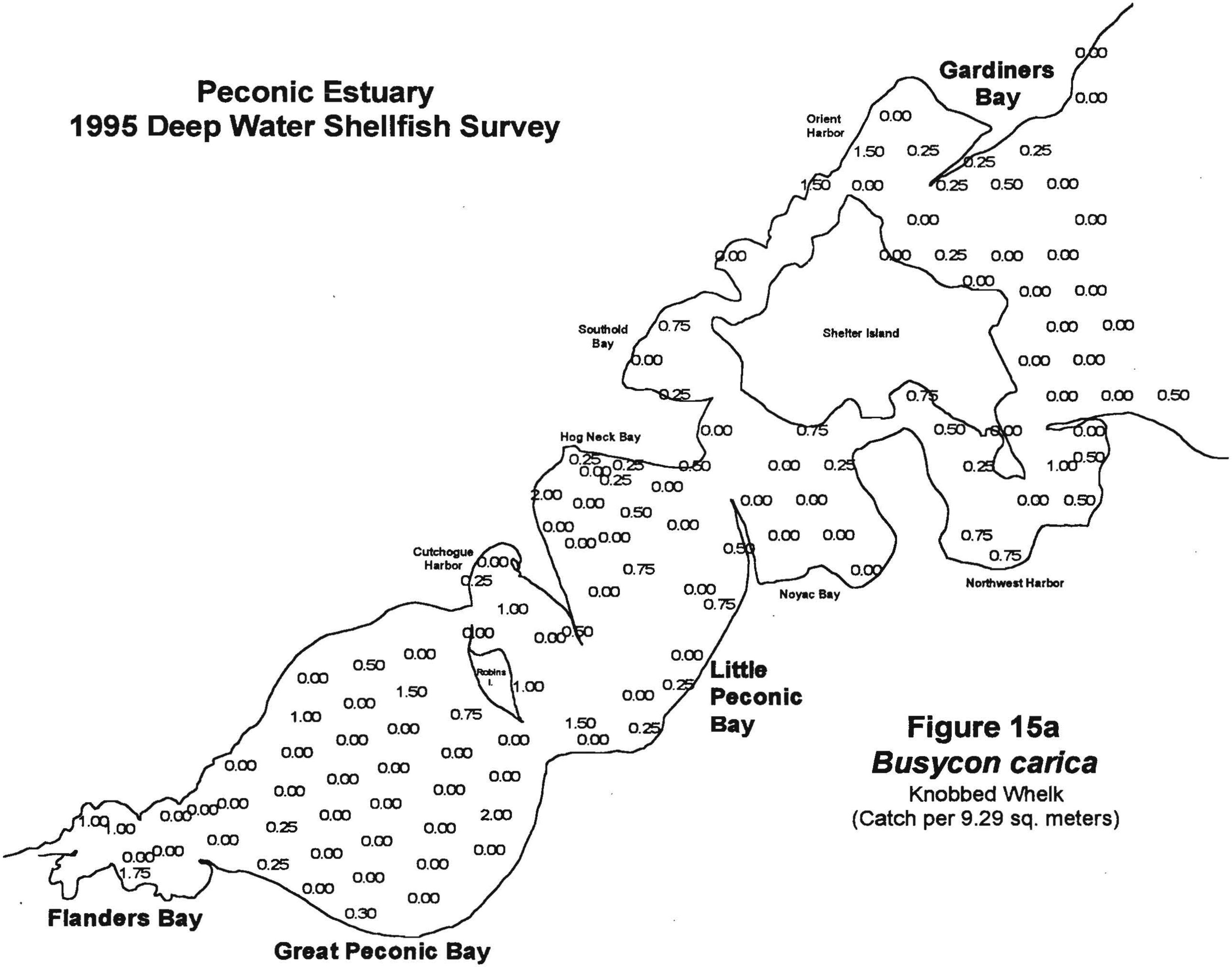

Figure 15a
Busycon carica
Knobbed Whelk
(Catch per 9.29 sq. meters)

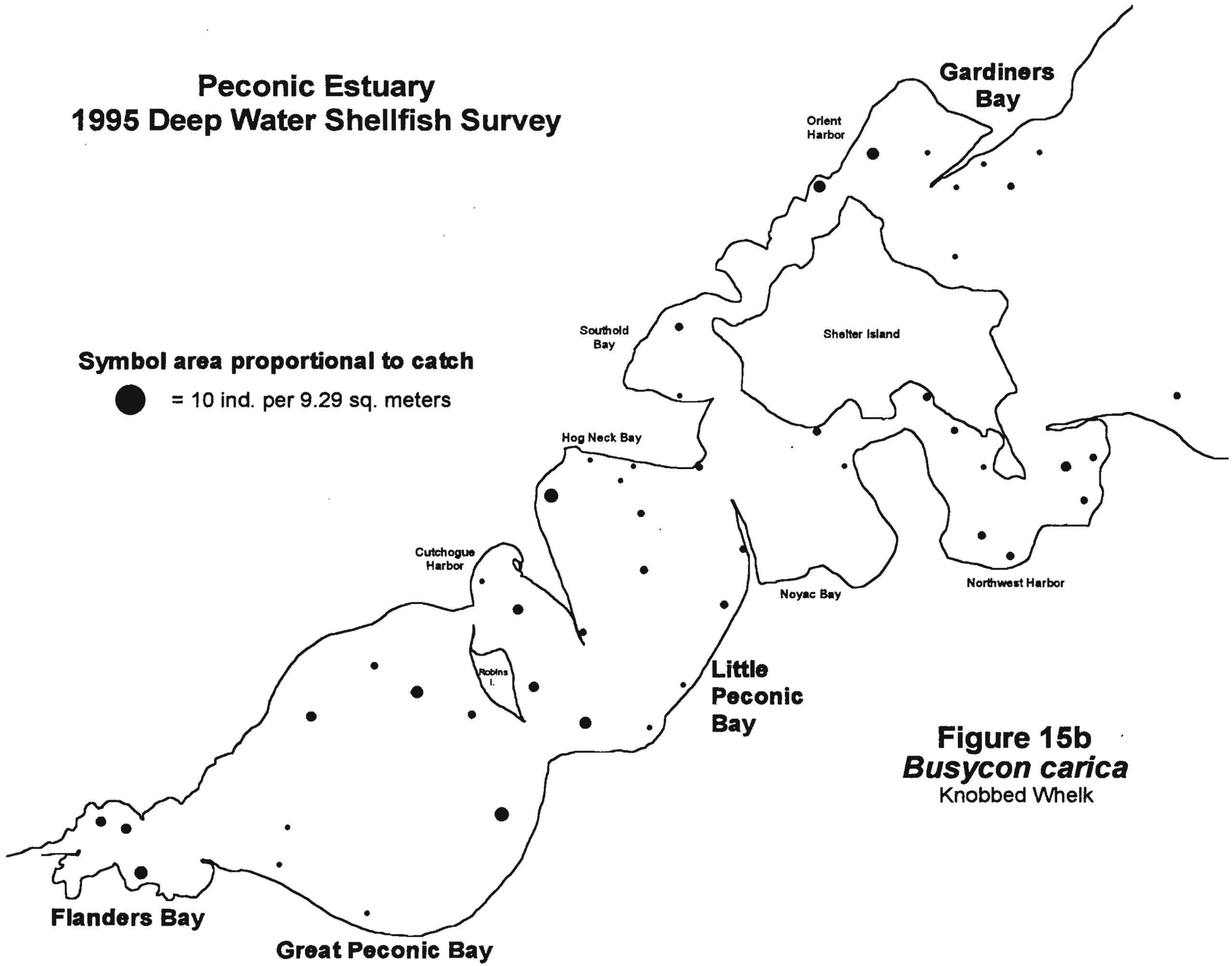

Figure 15b
Busycon carica
Knobbed Whelk

Peconic Estuary
1995 Deep Water Shellfish Survey

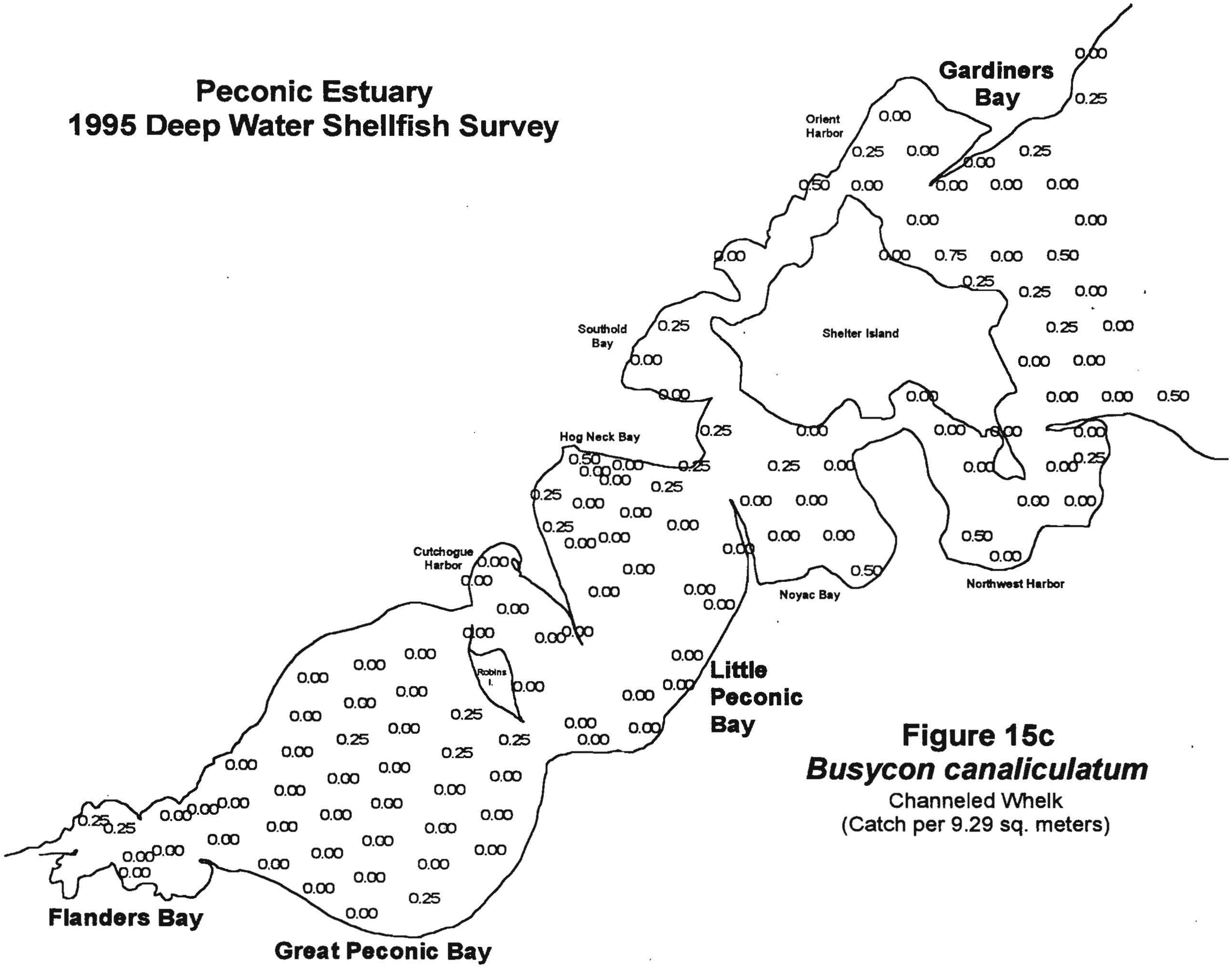

Figure 15c
Busycon canaliculatum
Channeled Whelk
(Catch per 9.29 sq. meters)

Peconic Estuary
1995 Deep Water Shellfish Survey

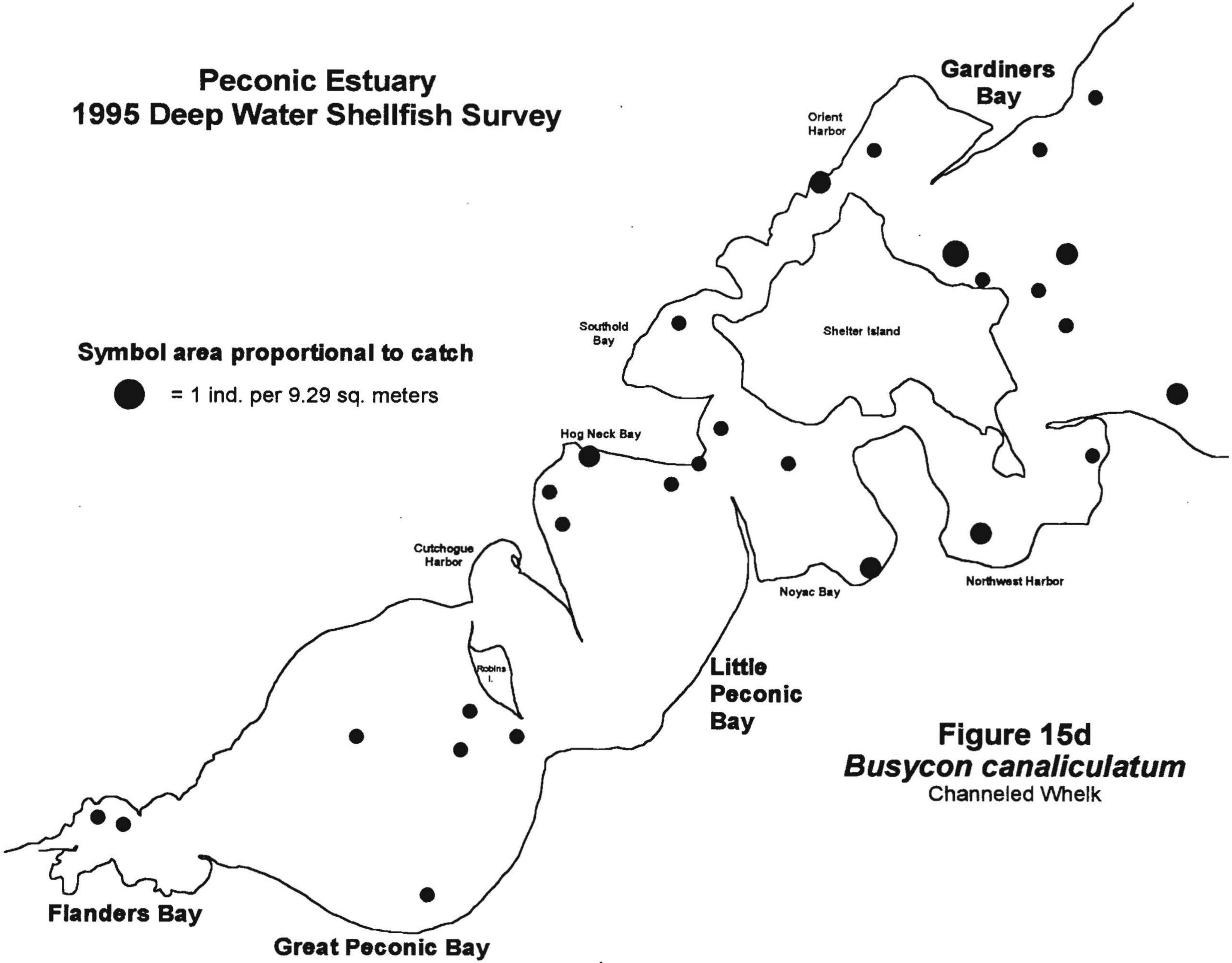

Figure 15d
Busycon canaliculatum
Channeled Whelk

Peconic Estuary Shellfish Survey 1979-1980

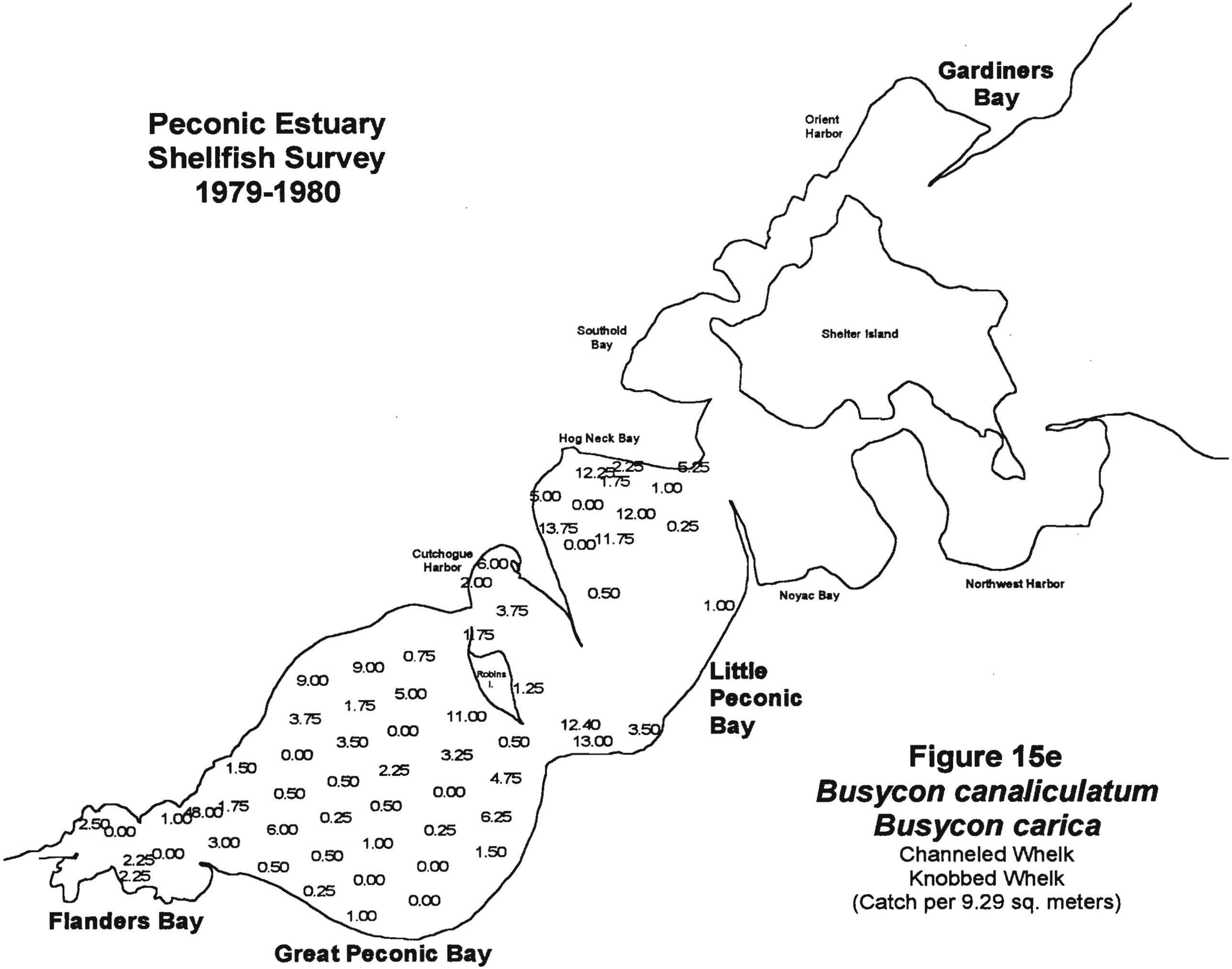

Figure 15e
Busycon canaliculatum
Busycon carica
Channeled Whelk
Knobbed Whelk
(Catch per 9.29 sq. meters)

Peconic Estuary Shellfish Survey 1979-1980

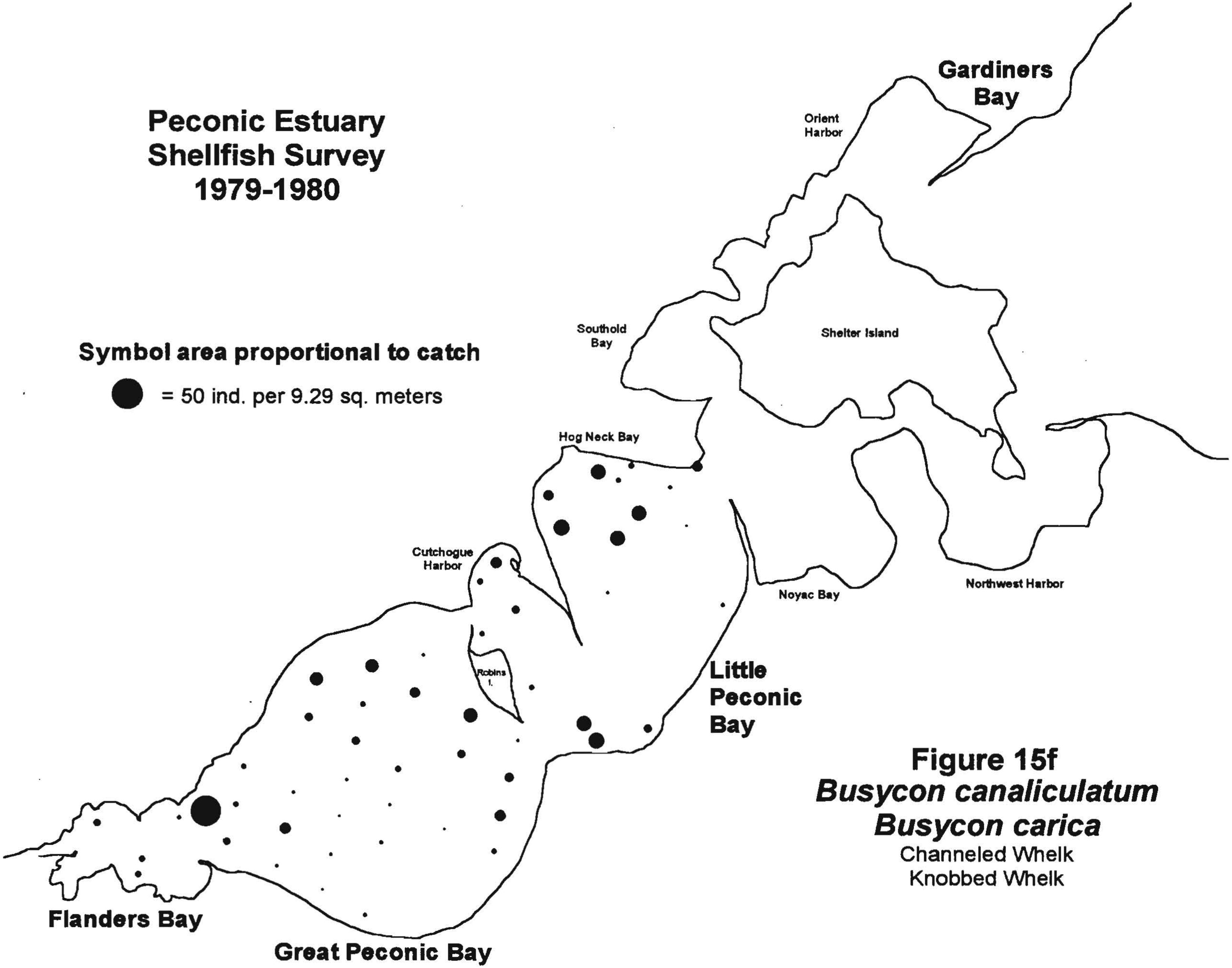

Figure 15f
Busycon canaliculatum
Busycon carica
Channeled Whelk
Knobbed Whelk

Peconic Estuary
1995 Deep Water Shellfish Survey

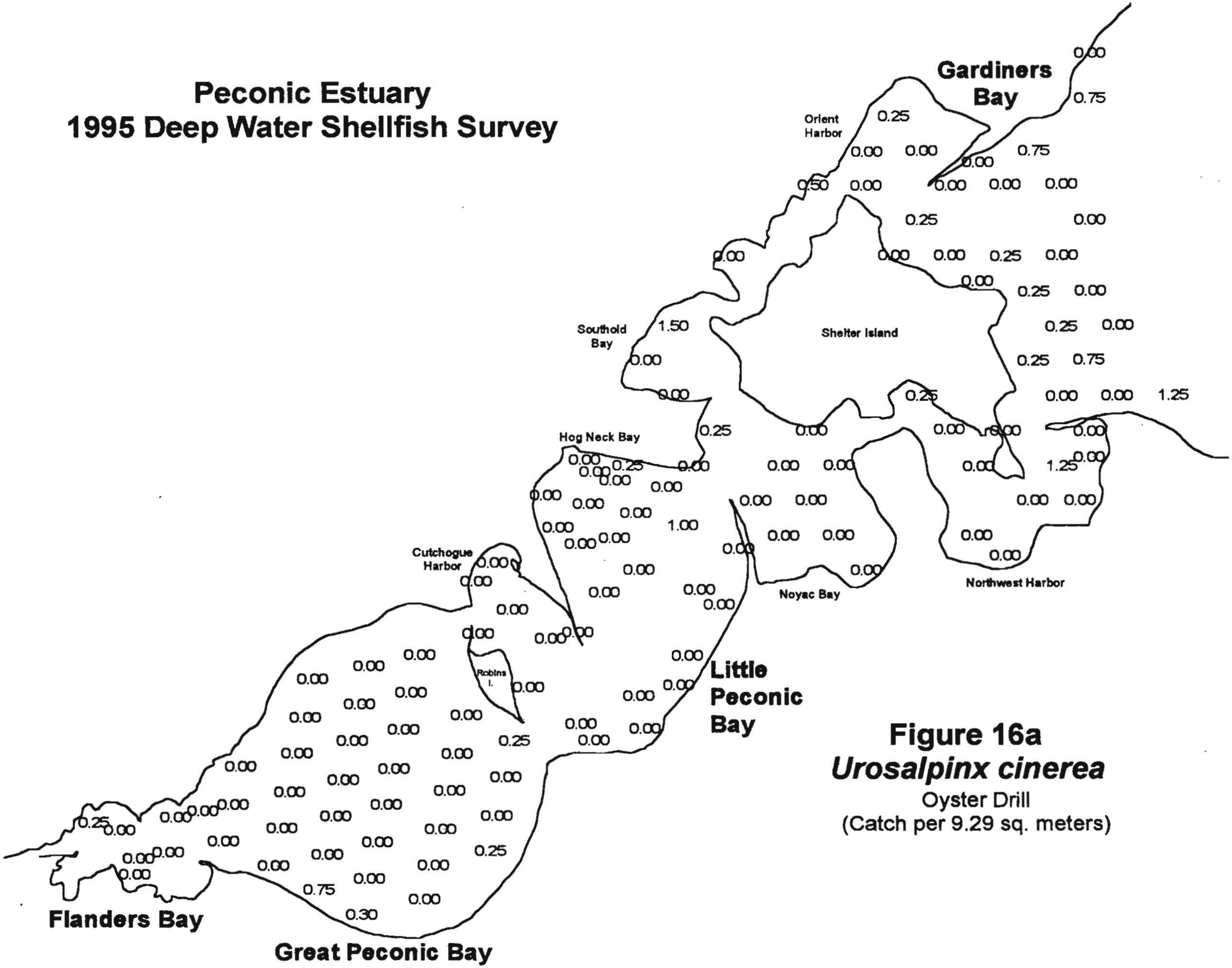

Figure 16a
Urosalpinx cinerea
Oyster Drill
(Catch per 9.29 sq. meters)

Peconic Estuary
1995 Deep Water Shellfish Survey

Symbol area proportional to catch

● = 2 ind. per 9.29 sq. meters

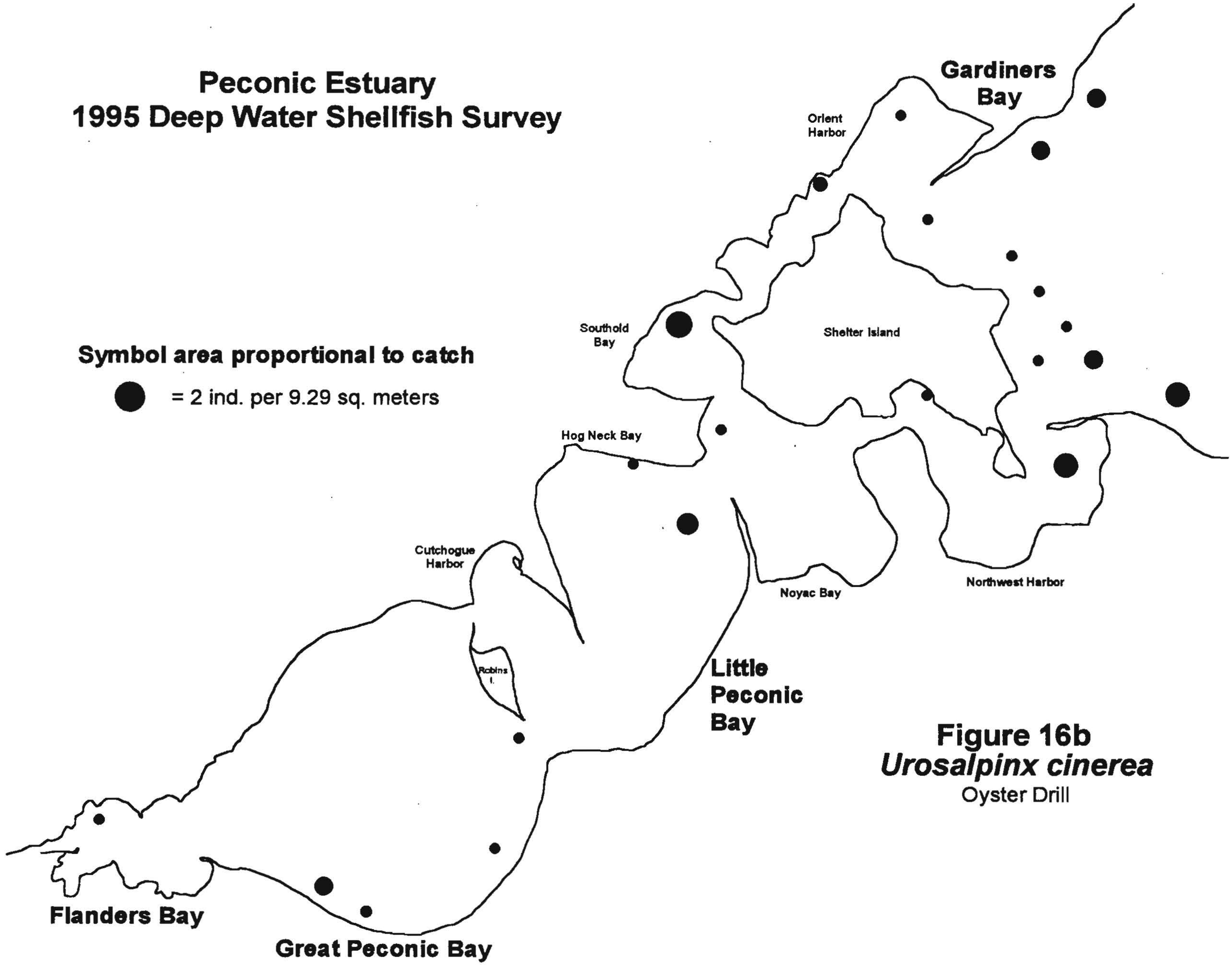

Figure 16b
Urosalpinx cinerea
Oyster Drill

Peconic Estuary Shellfish Survey 1979-1980

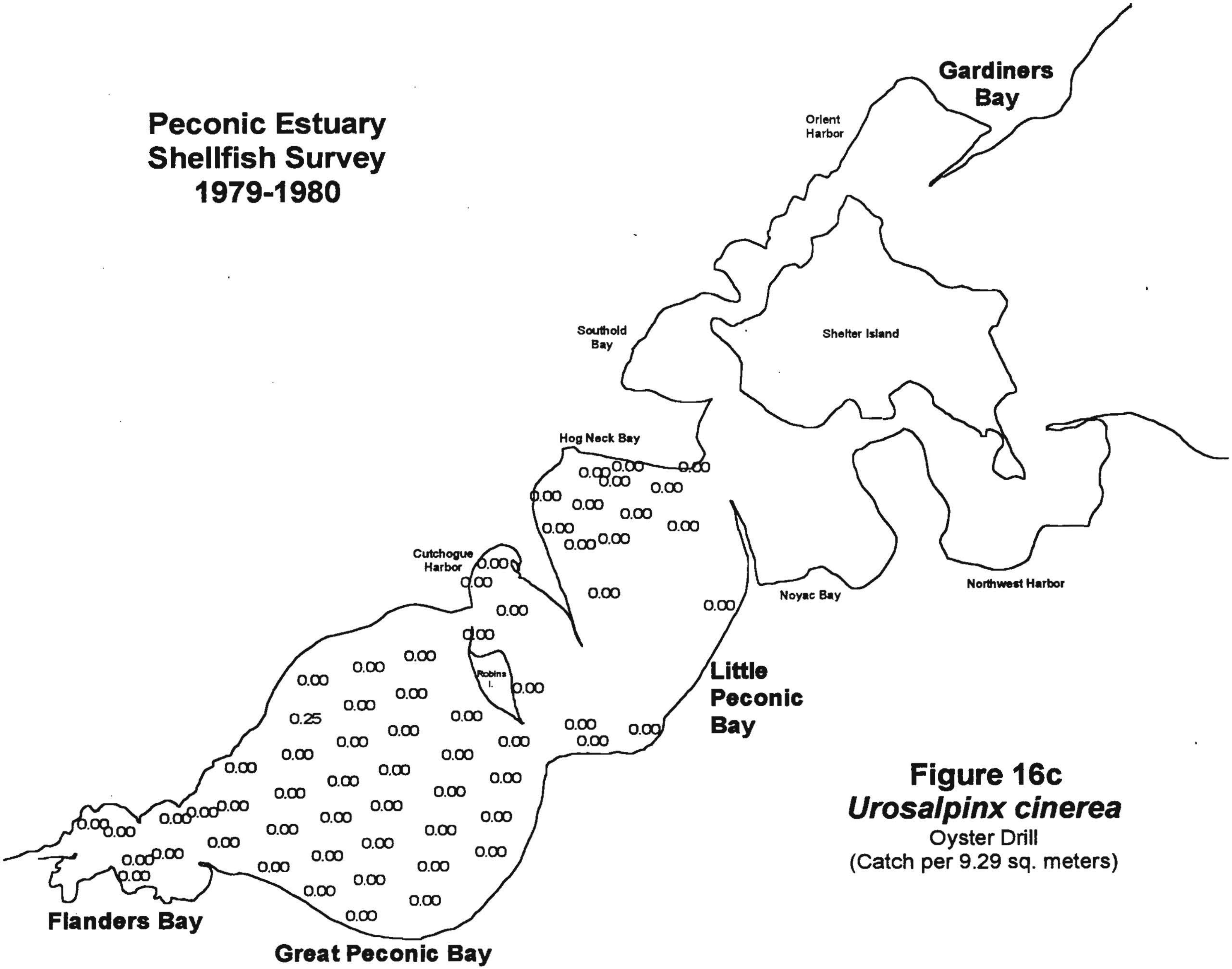

Figure 16c
Urosalpinx cinerea
Oyster Drill
(Catch per 9.29 sq. meters)

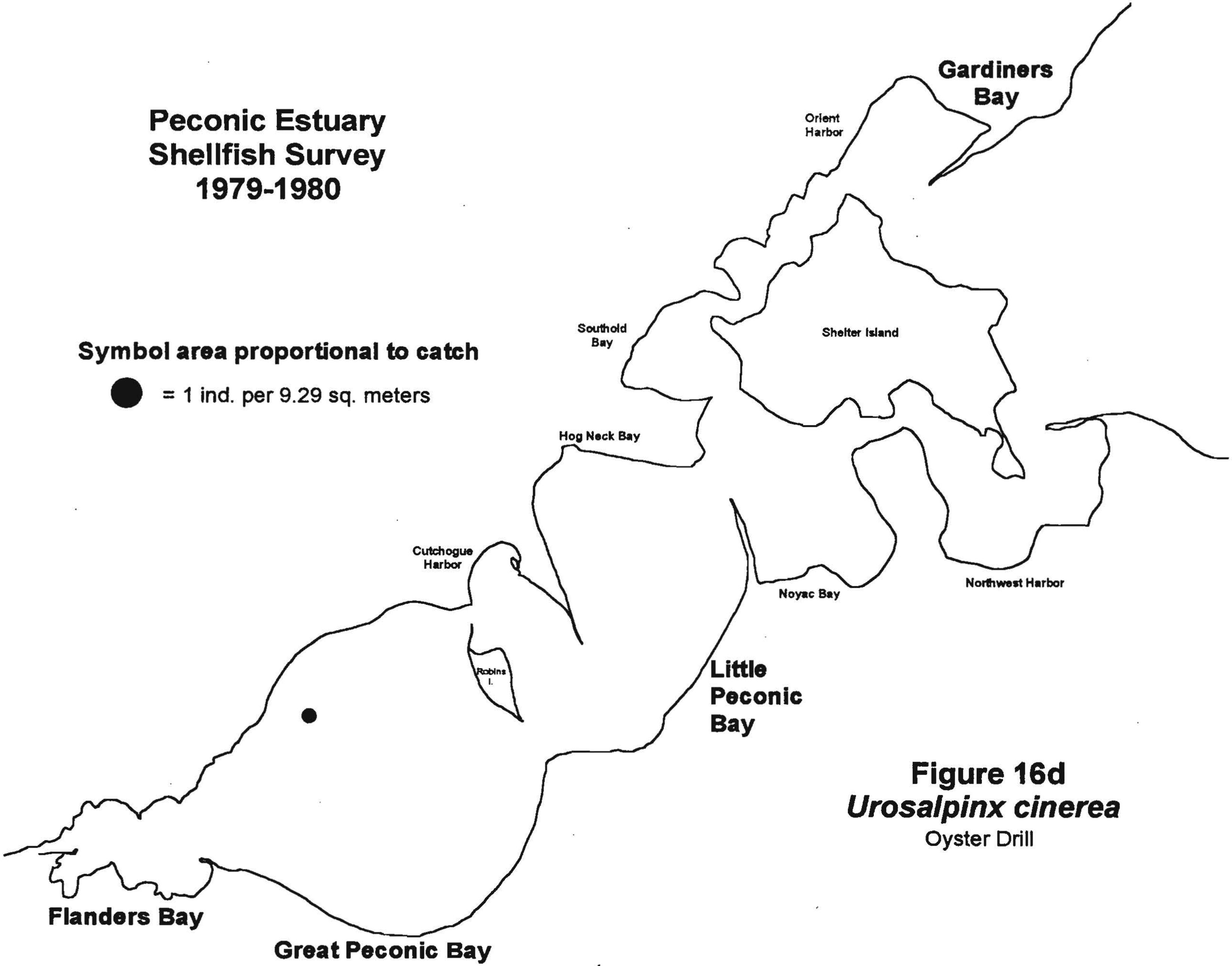

Figure 16d
Urosalpinx cinerea
Oyster Drill

Peconic Estuary
1995 Deep Water Shellfish Survey

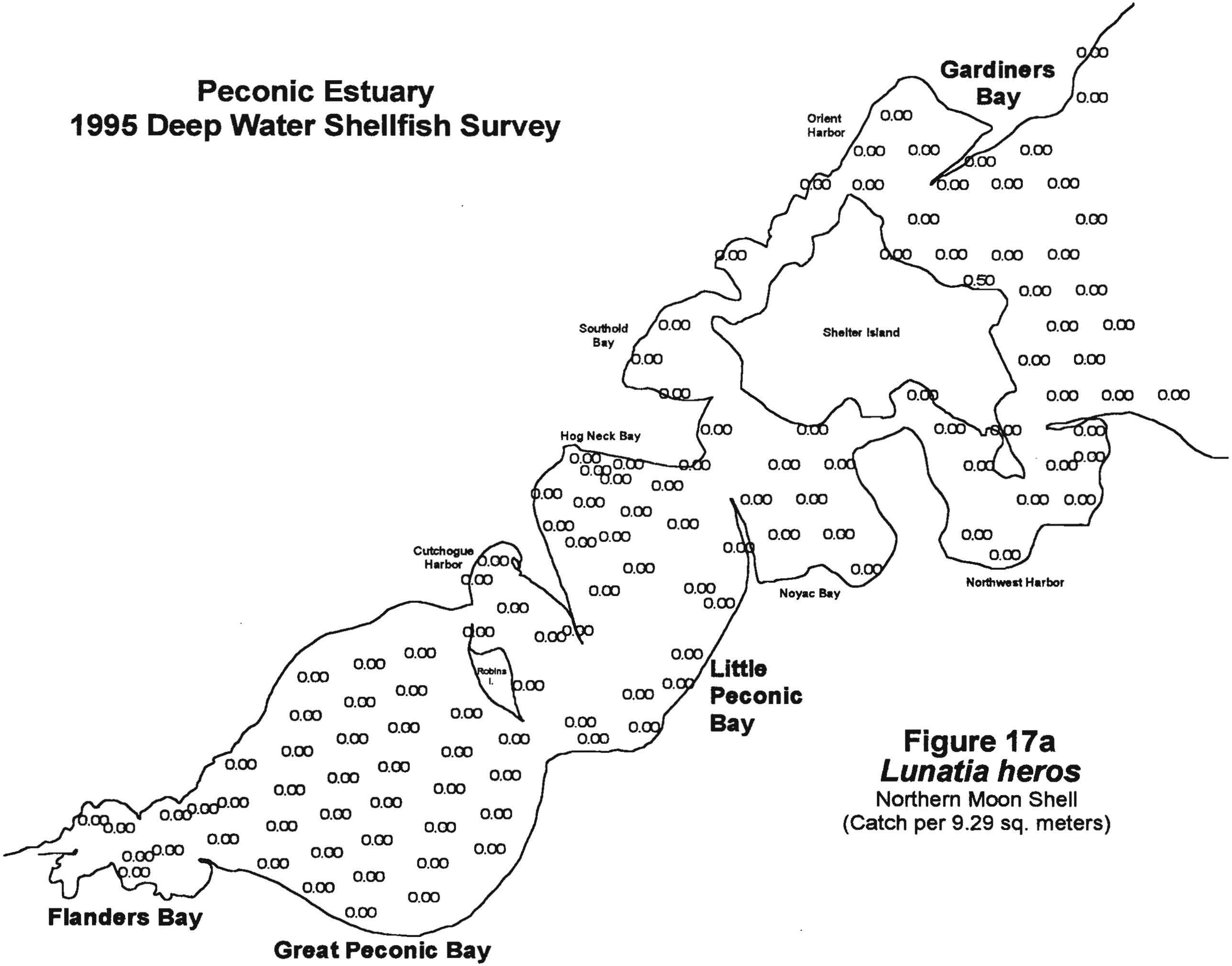

Figure 17a
Lunatia heros
Northern Moon Shell
(Catch per 9.29 sq. meters)

Peconic Estuary
1995 Deep Water Shellfish Survey

Symbol area proportional to catch

● = 1 ind. per 9.29 sq. meters

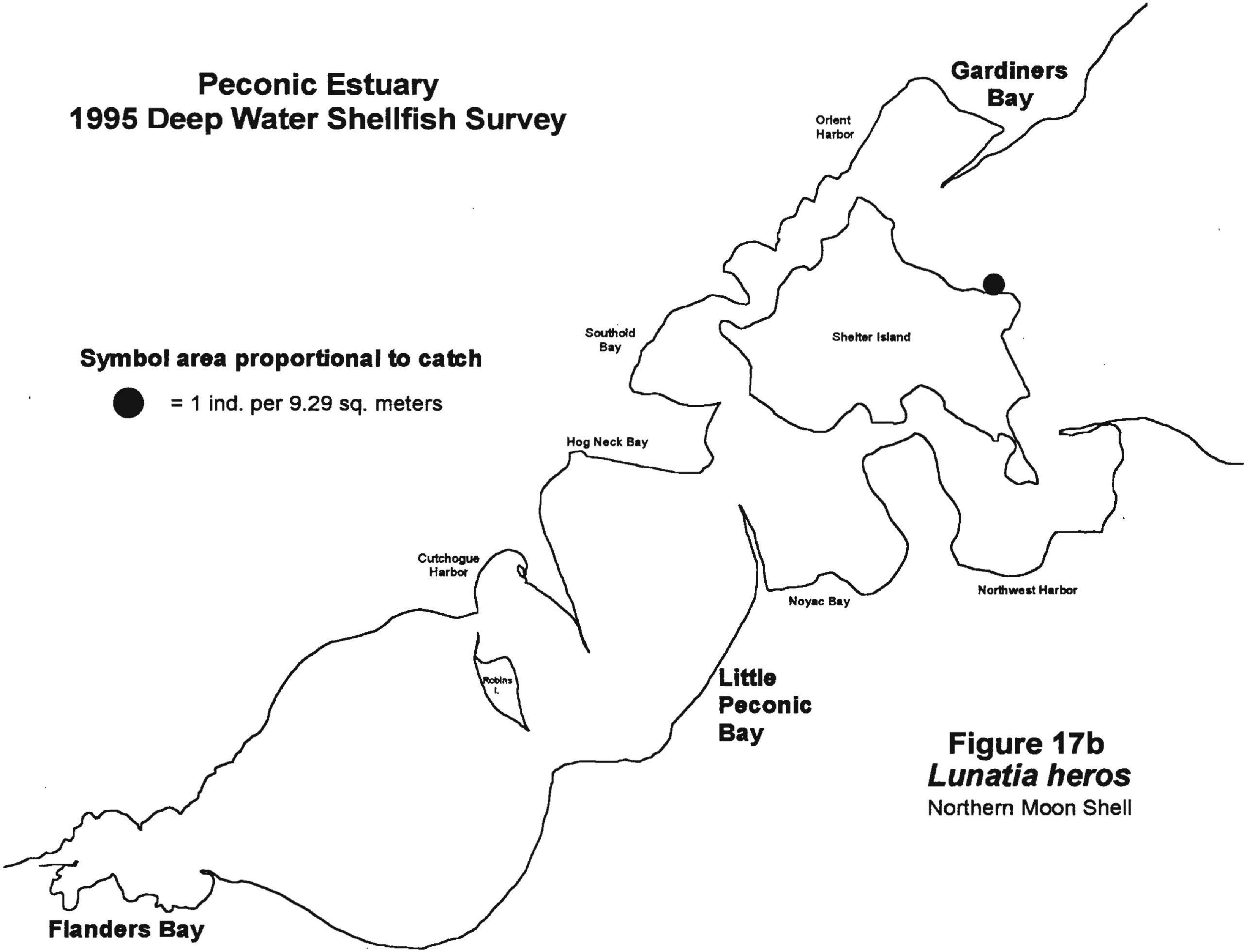

Figure 17b
Lunatia heros
Northern Moon Shell

Peconic Estuary Shellfish Survey 1979-1980

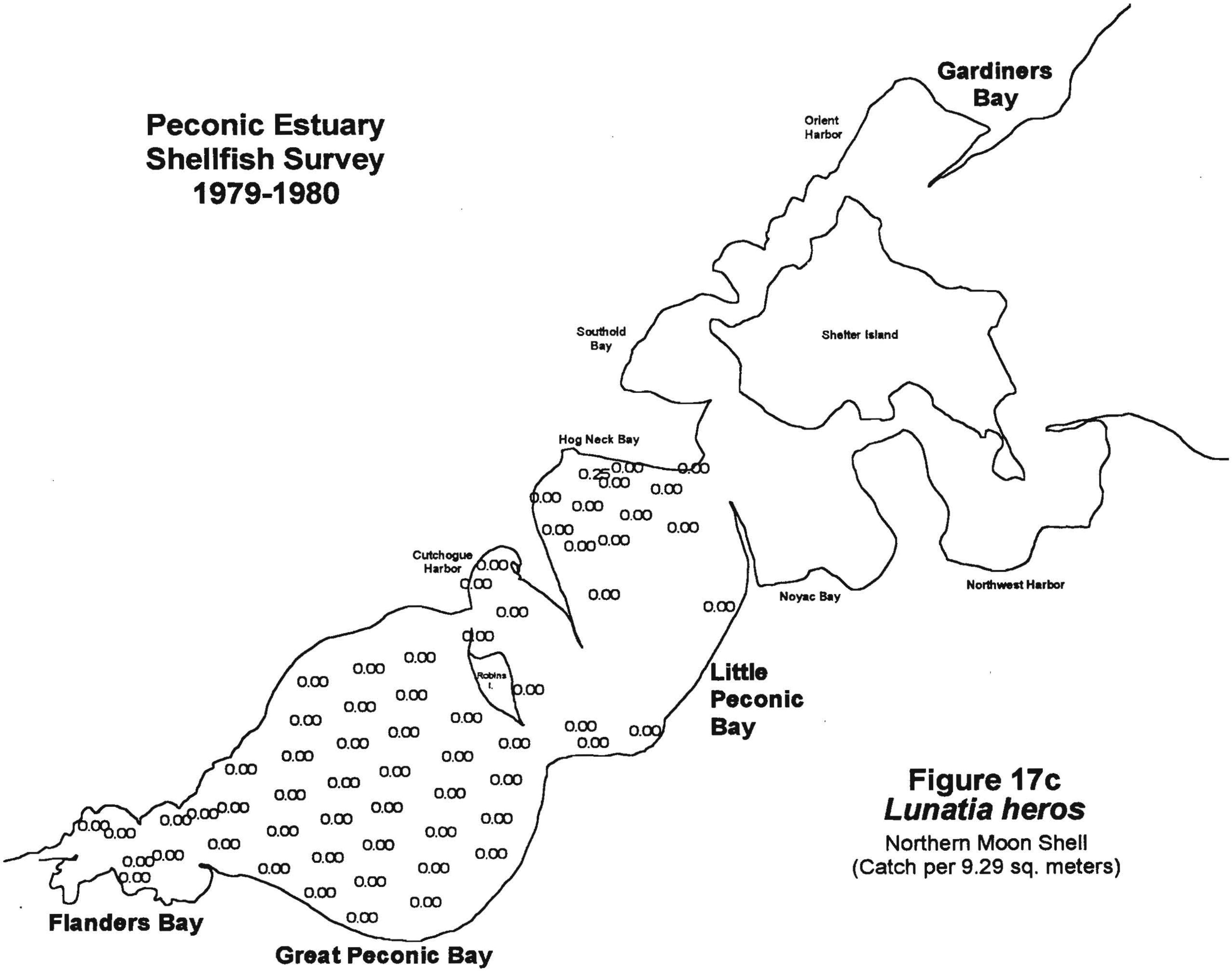

Figure 17c
Lunatia heros
Northern Moon Shell
(Catch per 9.29 sq. meters)

Peconic Estuary Shellfish Survey 1979-1980

Symbol area proportional to catch

● = 1 ind. per 9.29 sq. meters

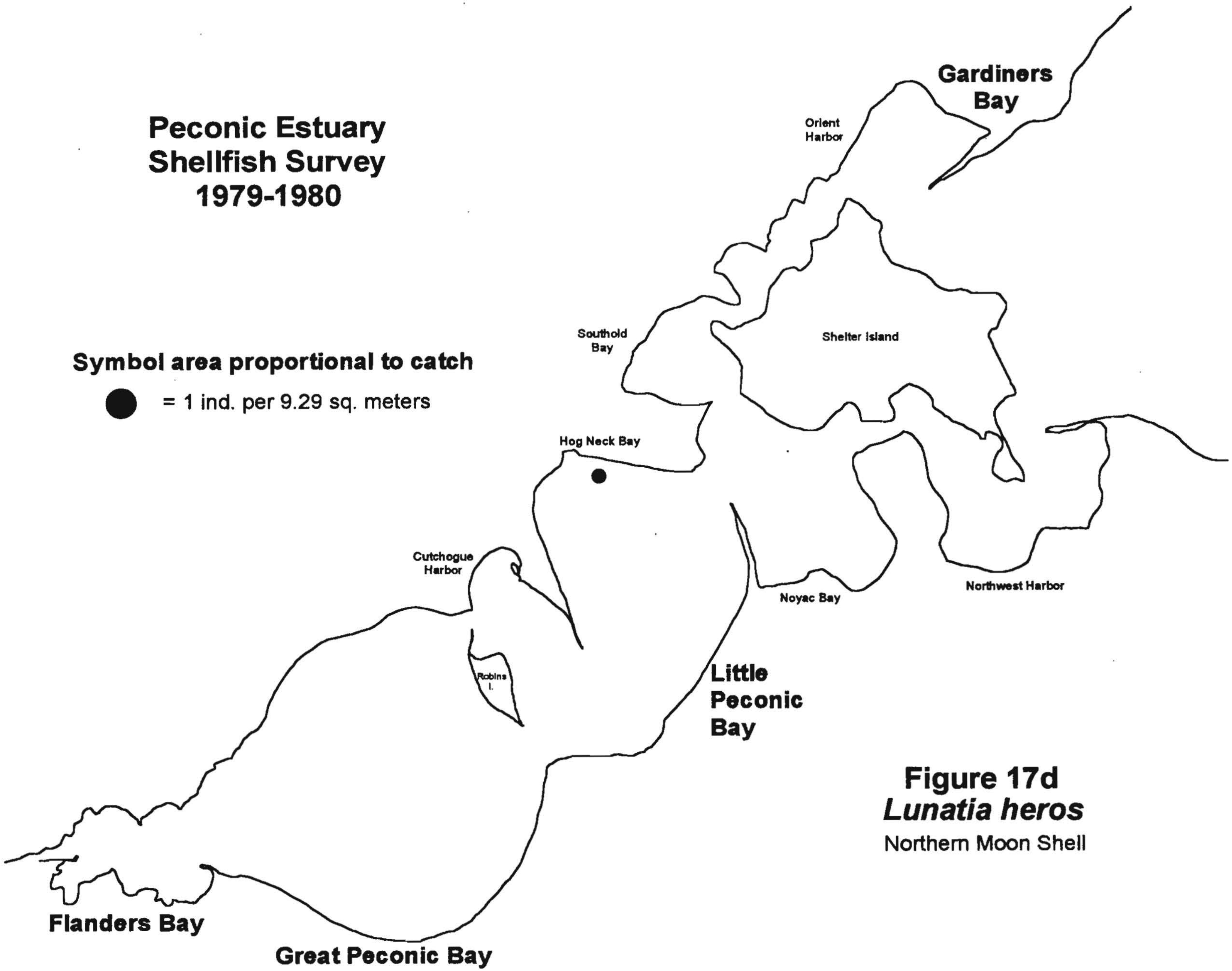

Figure 17d
Lunatia heros
Northern Moon Shell

Peconic Estuary
1995 Deep Water Shellfish Survey

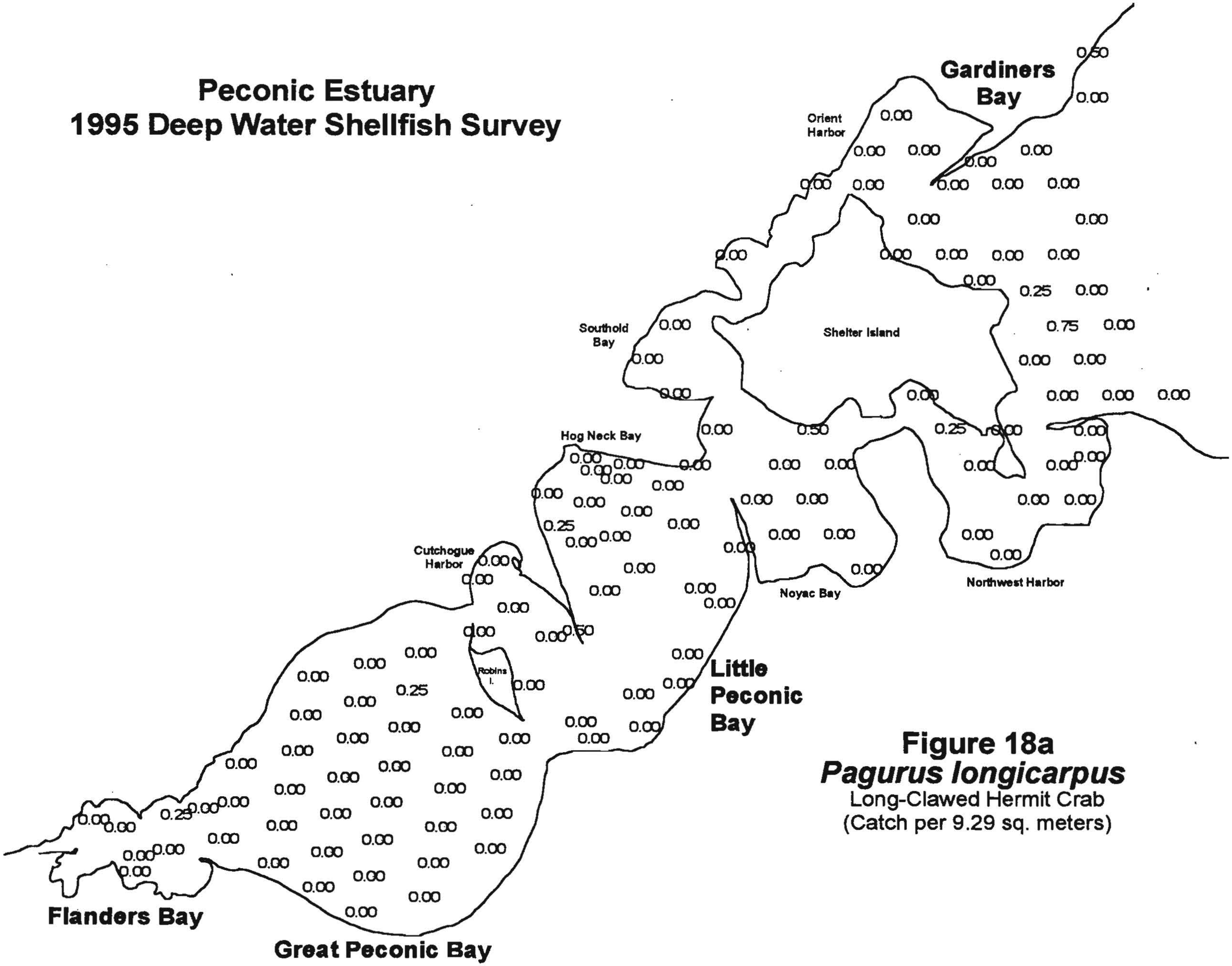

Figure 18a
Pagurus longicarpus
Long-Clawed Hermit Crab
(Catch per 9.29 sq. meters)

Peconic Estuary
1995 Deep Water Shellfish Survey

Symbol area proportional to catch

● = 1 ind. per 9.29 sq. meters

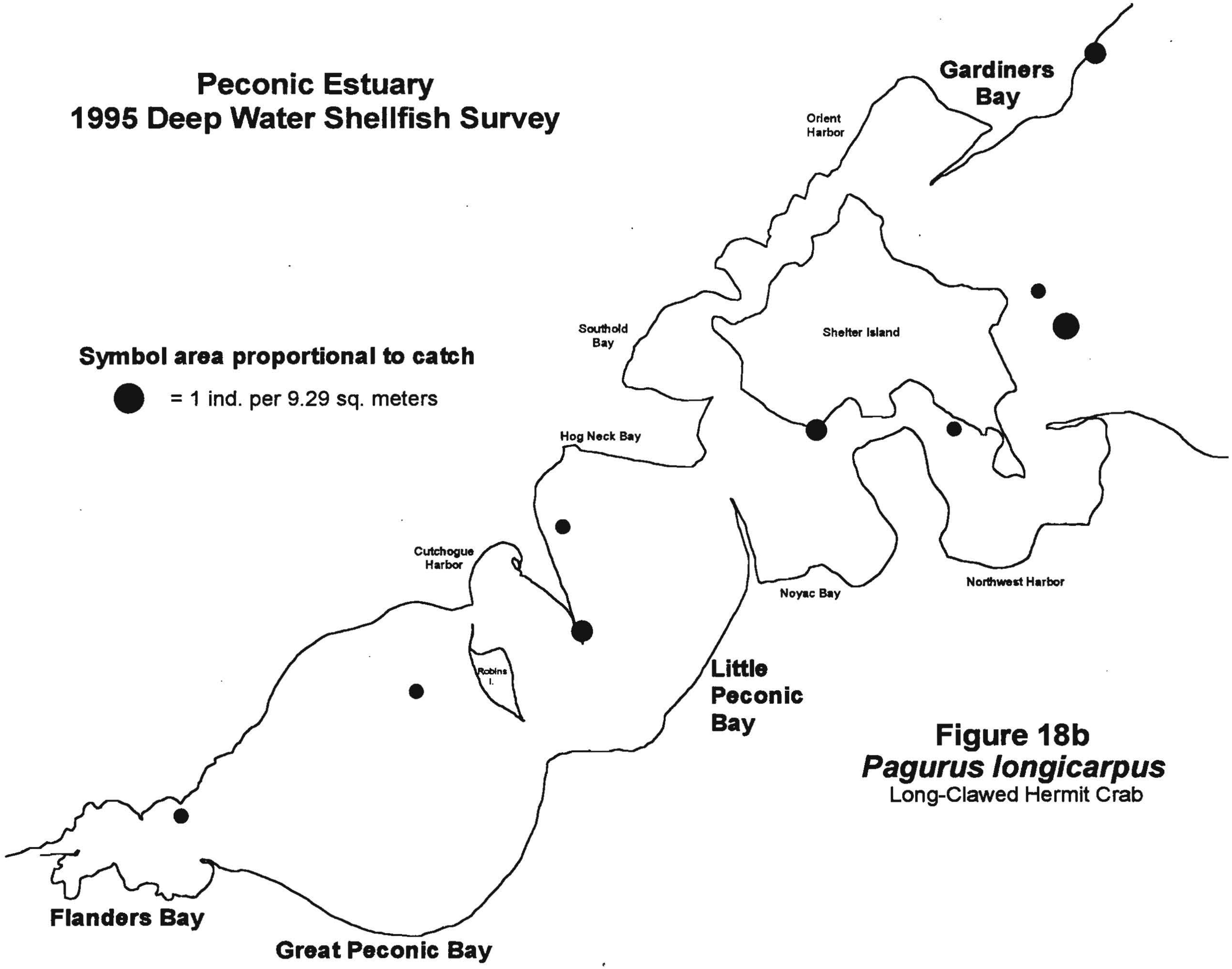

Figure 18b
Pagurus longicarpus
Long-Clawed Hermit Crab

Peconic Estuary
1995 Deep Water Shellfish Survey

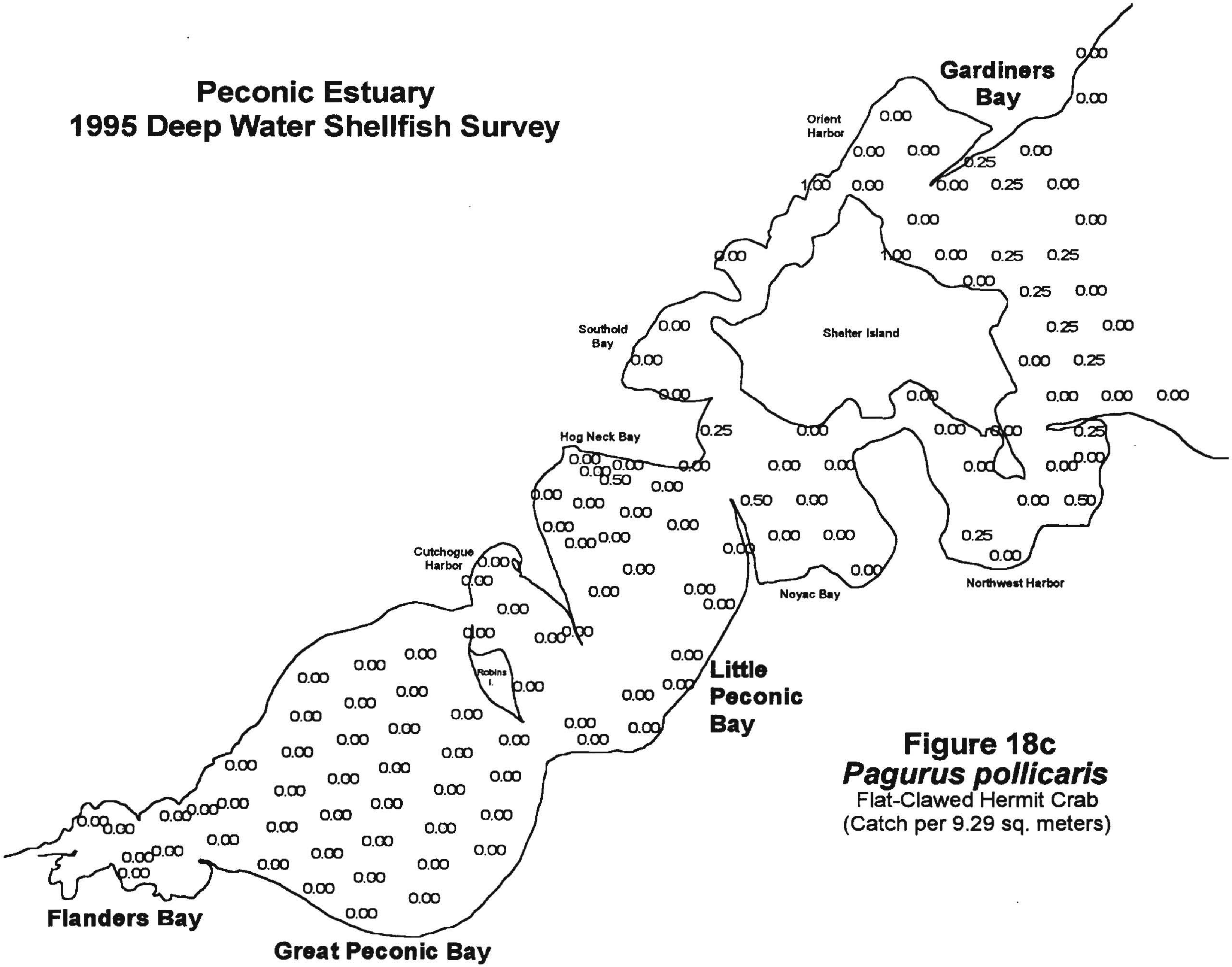

Figure 18c
Pagurus pollicaris
Flat-Clawed Hermit Crab
(Catch per 9.29 sq. meters)

Peconic Estuary
1995 Deep Water Shellfish Survey

Symbol area proportional to catch

● = 1 ind. per 9.29 sq. meters

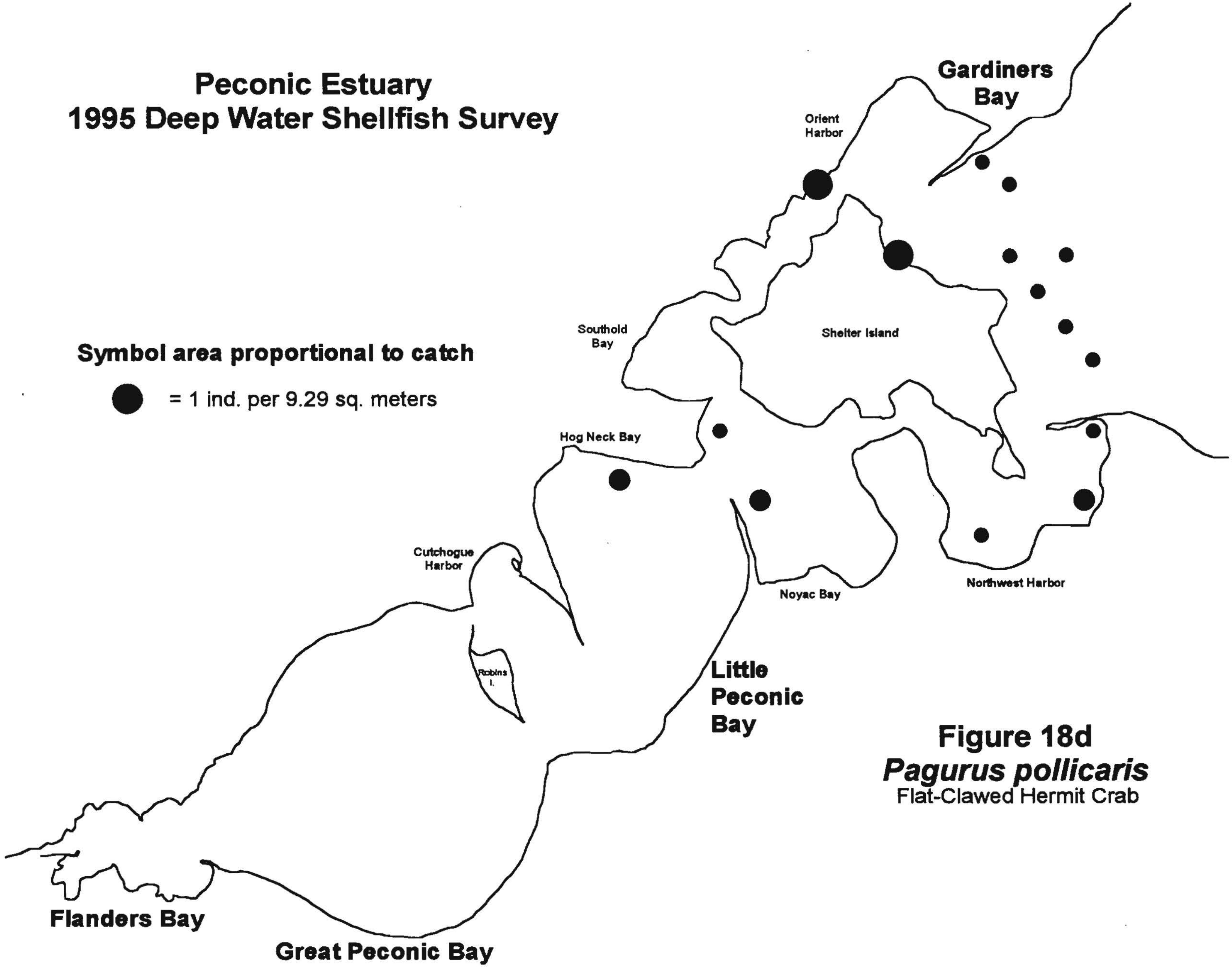

Figure 18d
Pagurus pollicaris
Flat-Clawed Hermit Crab

Peconic Estuary Shellfish Survey 1979-1980

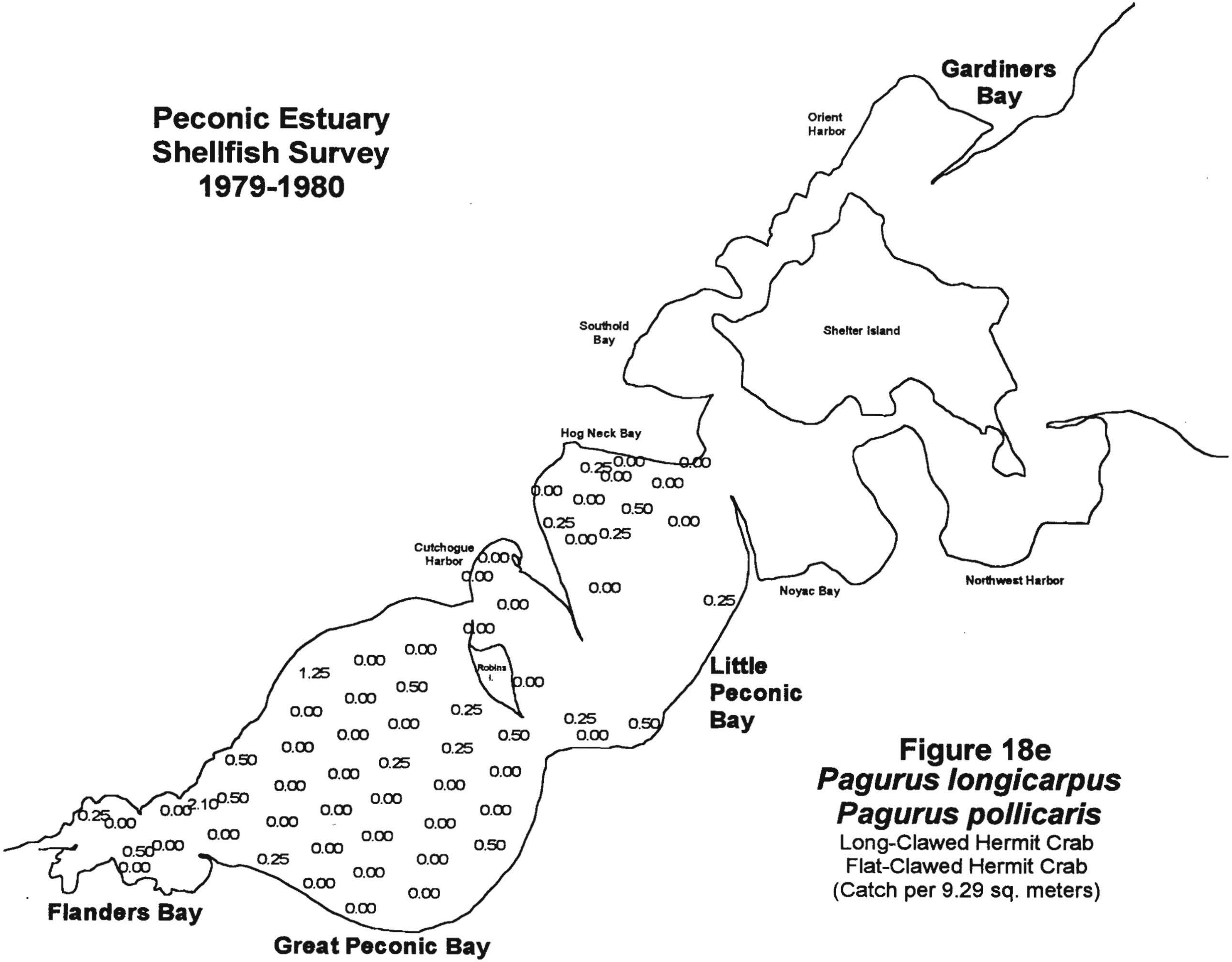

Figure 18e
Pagurus longicarpus
Pagurus pollicaris
Long-Clawed Hermit Crab
Flat-Clawed Hermit Crab
(Catch per 9.29 sq. meters)

Peconic Estuary
Shellfish Survey
1979-1980

Symbol area proportional to catch

● = 5 ind. per 9.29 sq. meters

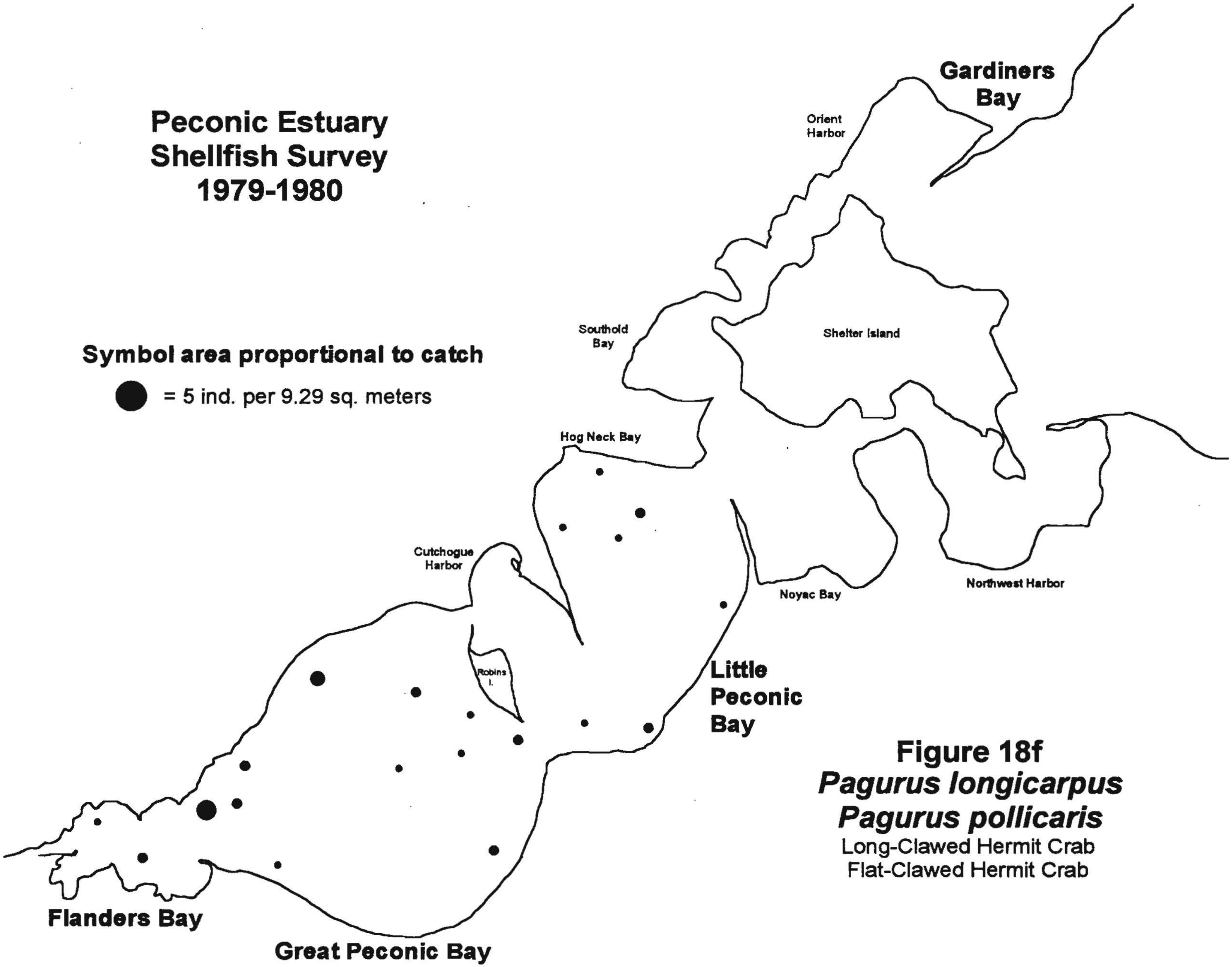

Figure 18f
Pagurus longicarpus
Pagurus pollicaris
Long-Clawed Hermit Crab
Flat-Clawed Hermit Crab

Peconic Estuary
1995 Deep Water Shellfish Survey

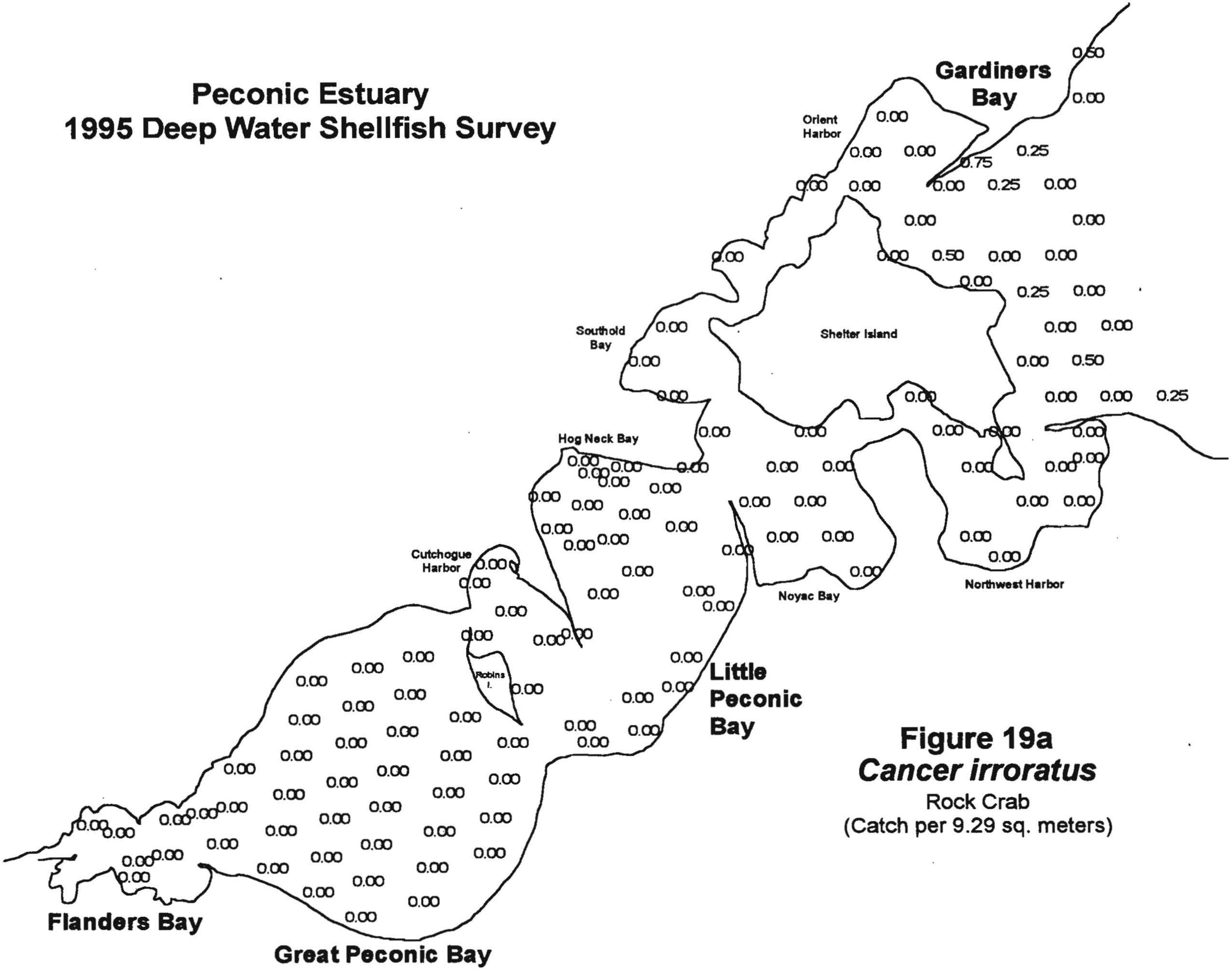

Figure 19a
Cancer irroratus
Rock Crab
(Catch per 9.29 sq. meters)

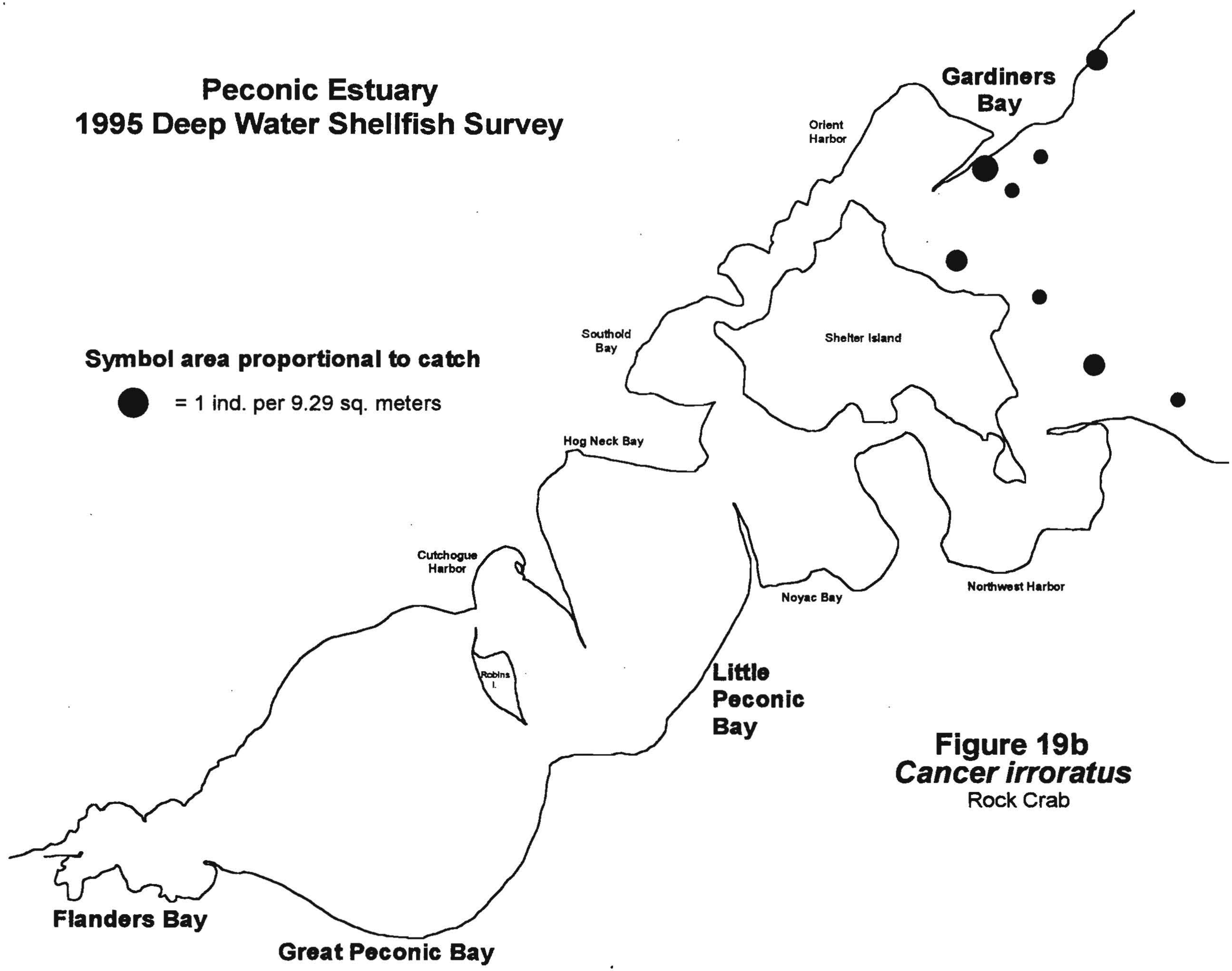

Figure 19b
Cancer irroratus
Rock Crab

Peconic Estuary
1995 Deep Water Shellfish Survey

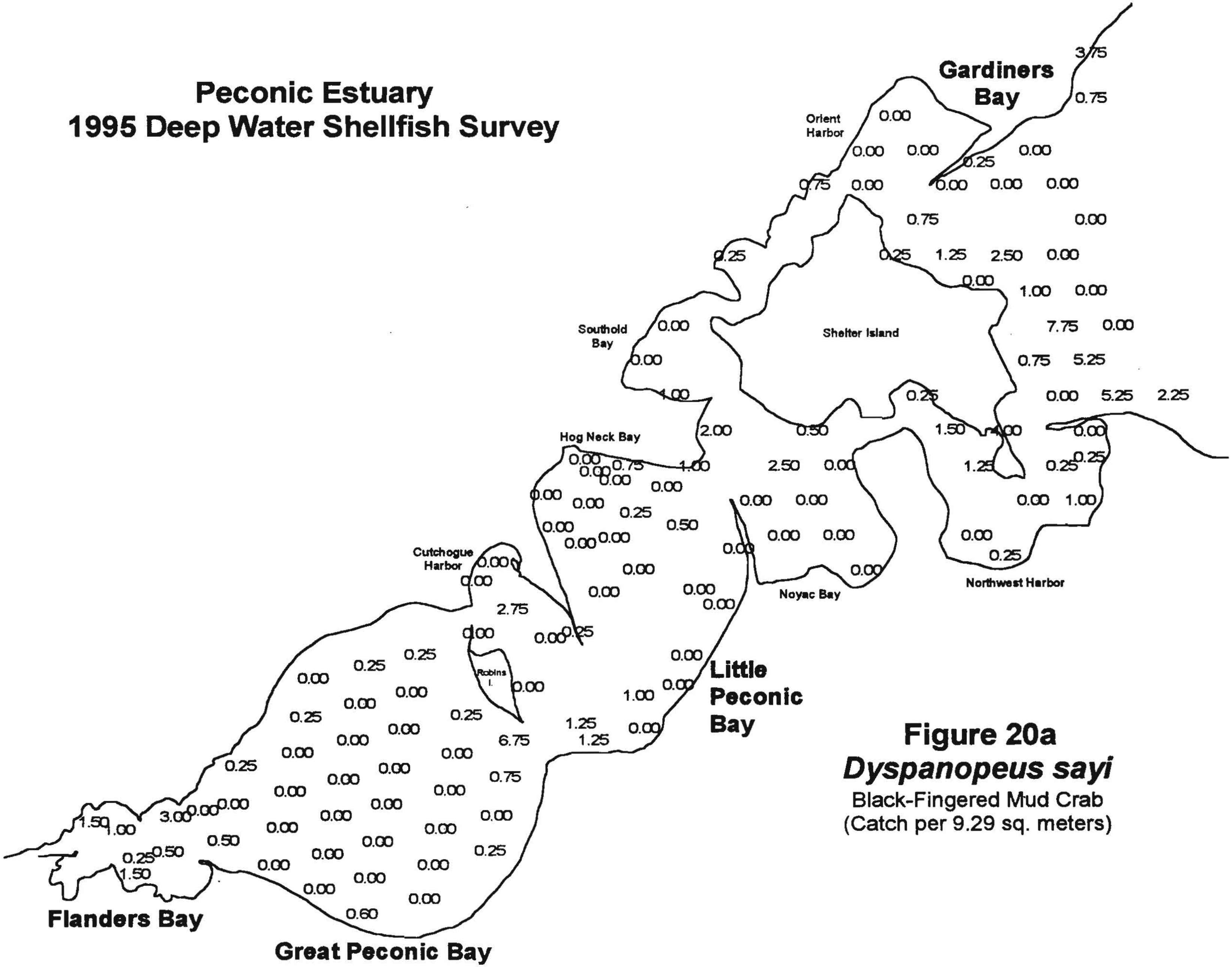

Figure 20a
Dyspanopeus sayi
Black-Fingered Mud Crab
(Catch per 9.29 sq. meters)

Peconic Estuary
1995 Deep Water Shellfish Survey

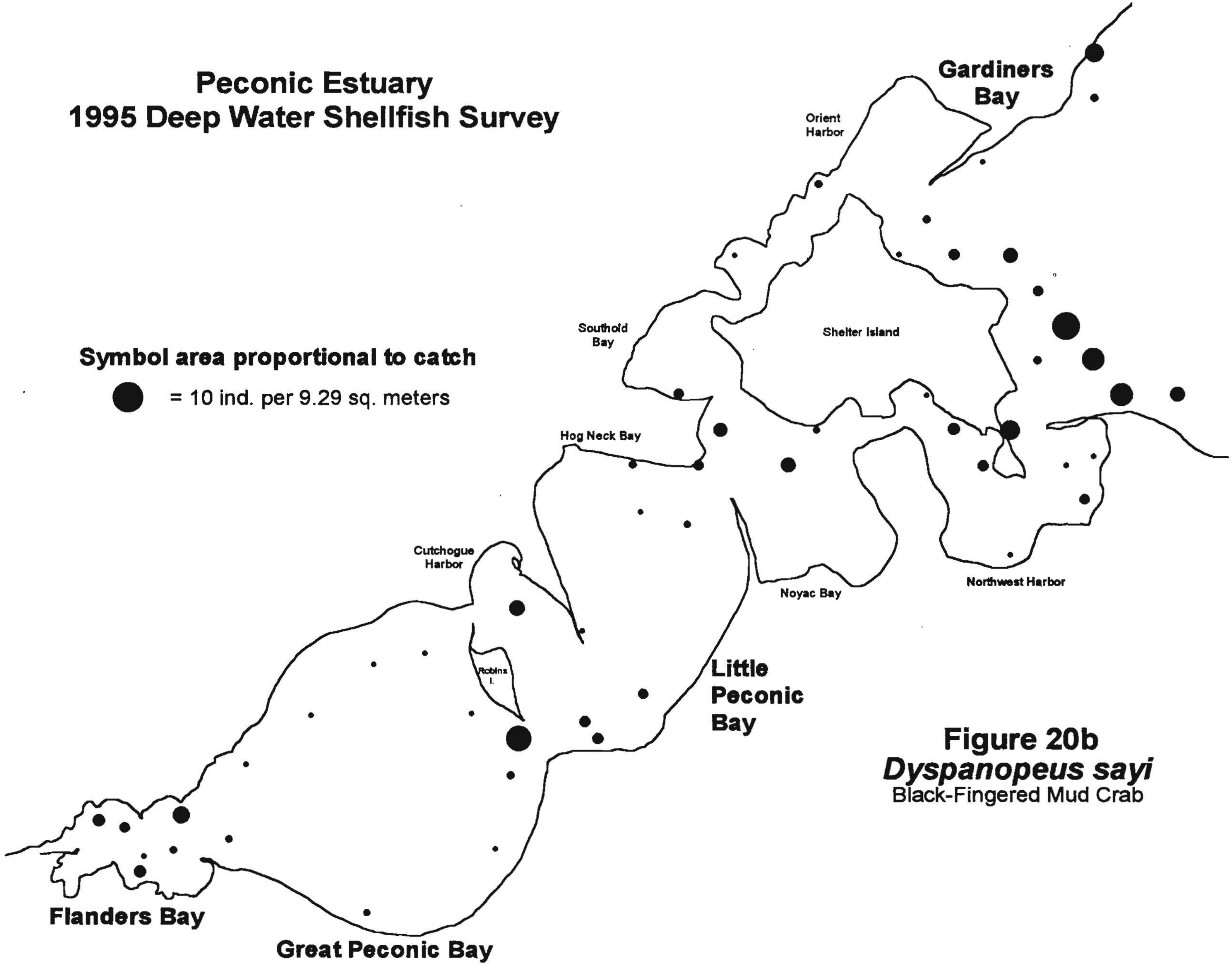

Figure 20b
Dyspanopeus sayi
Black-Fingered Mud Crab

Peconic Estuary Shellfish Survey 1979-1980

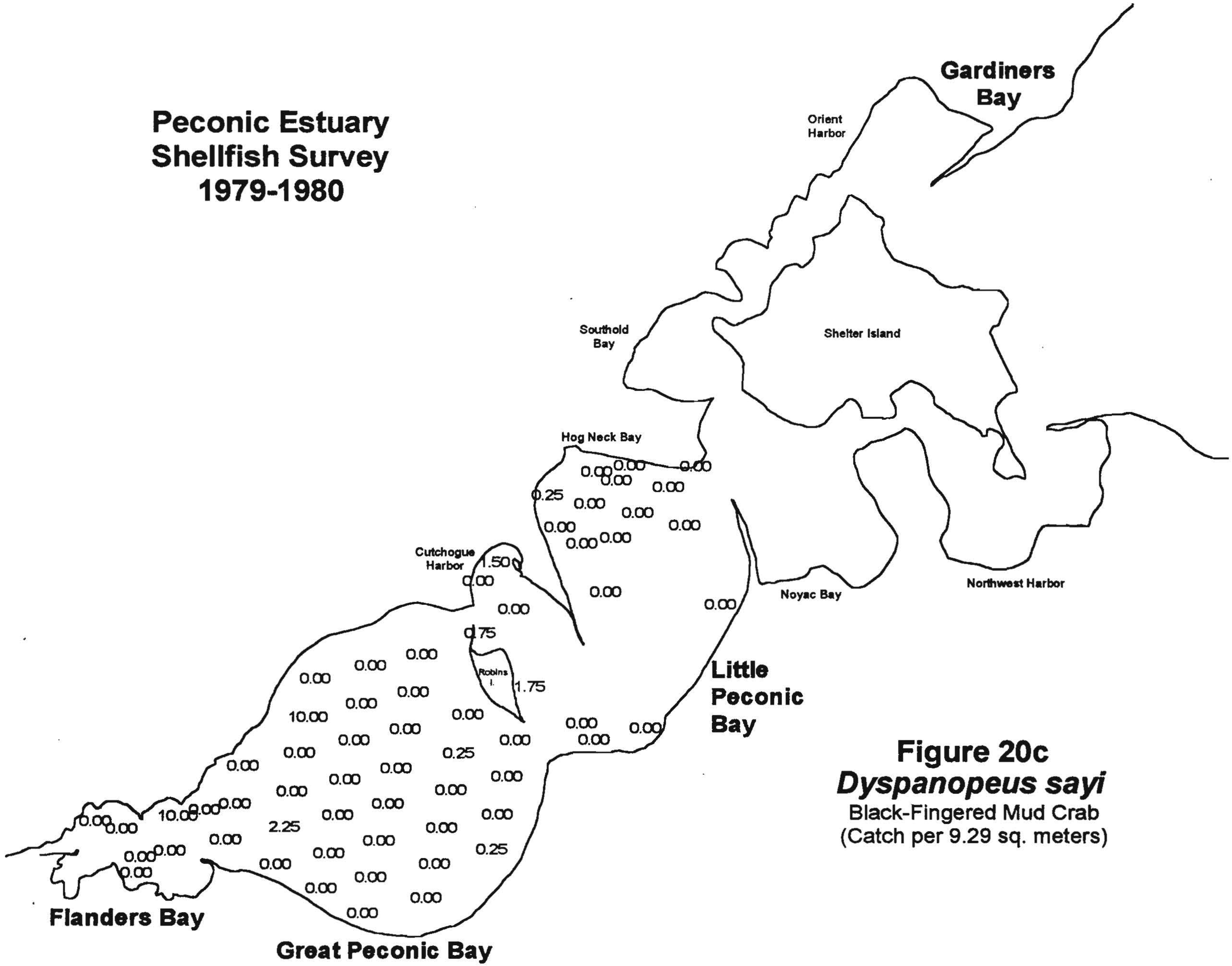

Figure 20c
Dyspanopeus sayi
Black-Fingered Mud Crab
(Catch per 9.29 sq. meters)

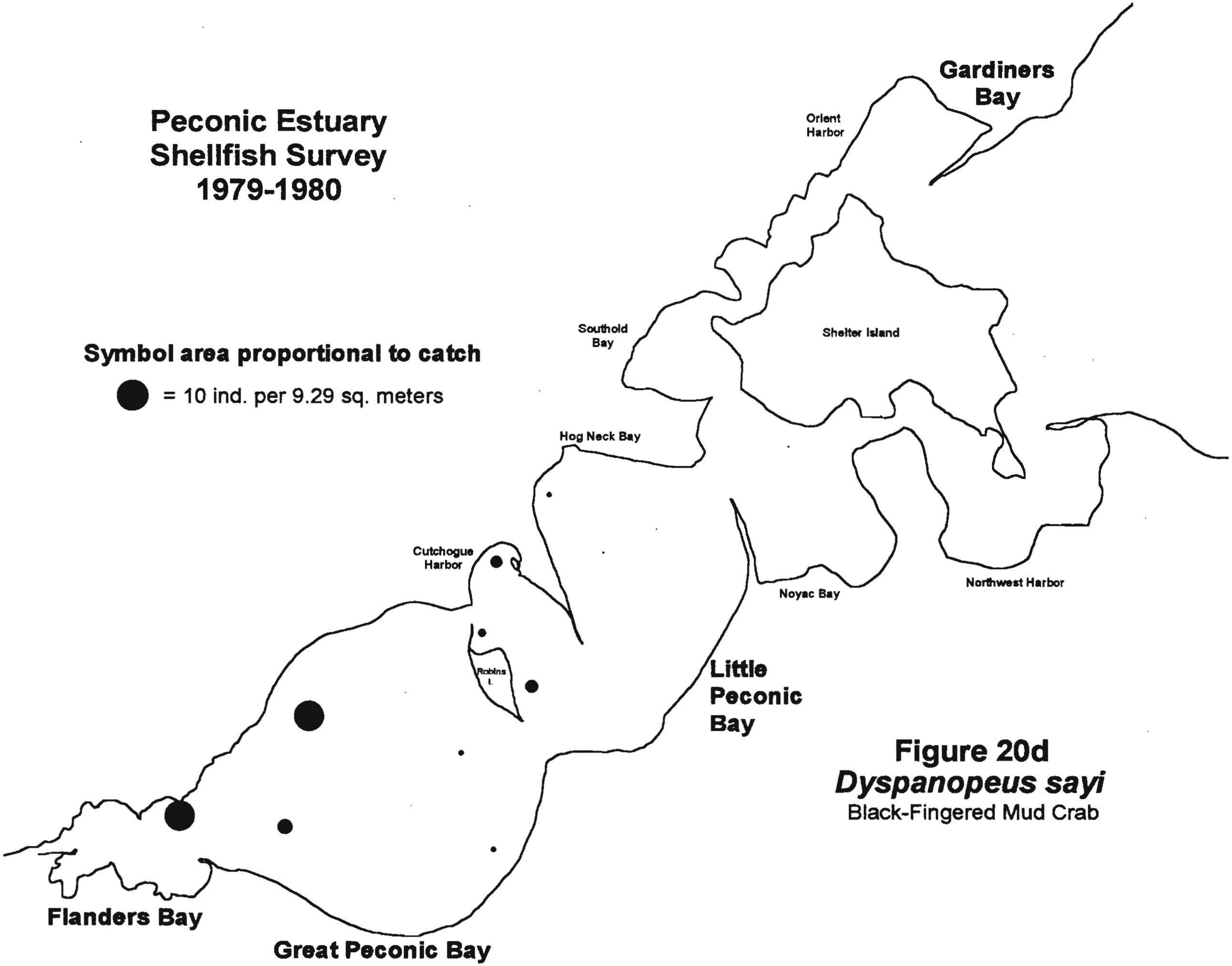

Figure 20d
Dyspanopeus sayi
Black-Fingered Mud Crab

Peconic Estuary
1995 Deep Water Shellfish Survey

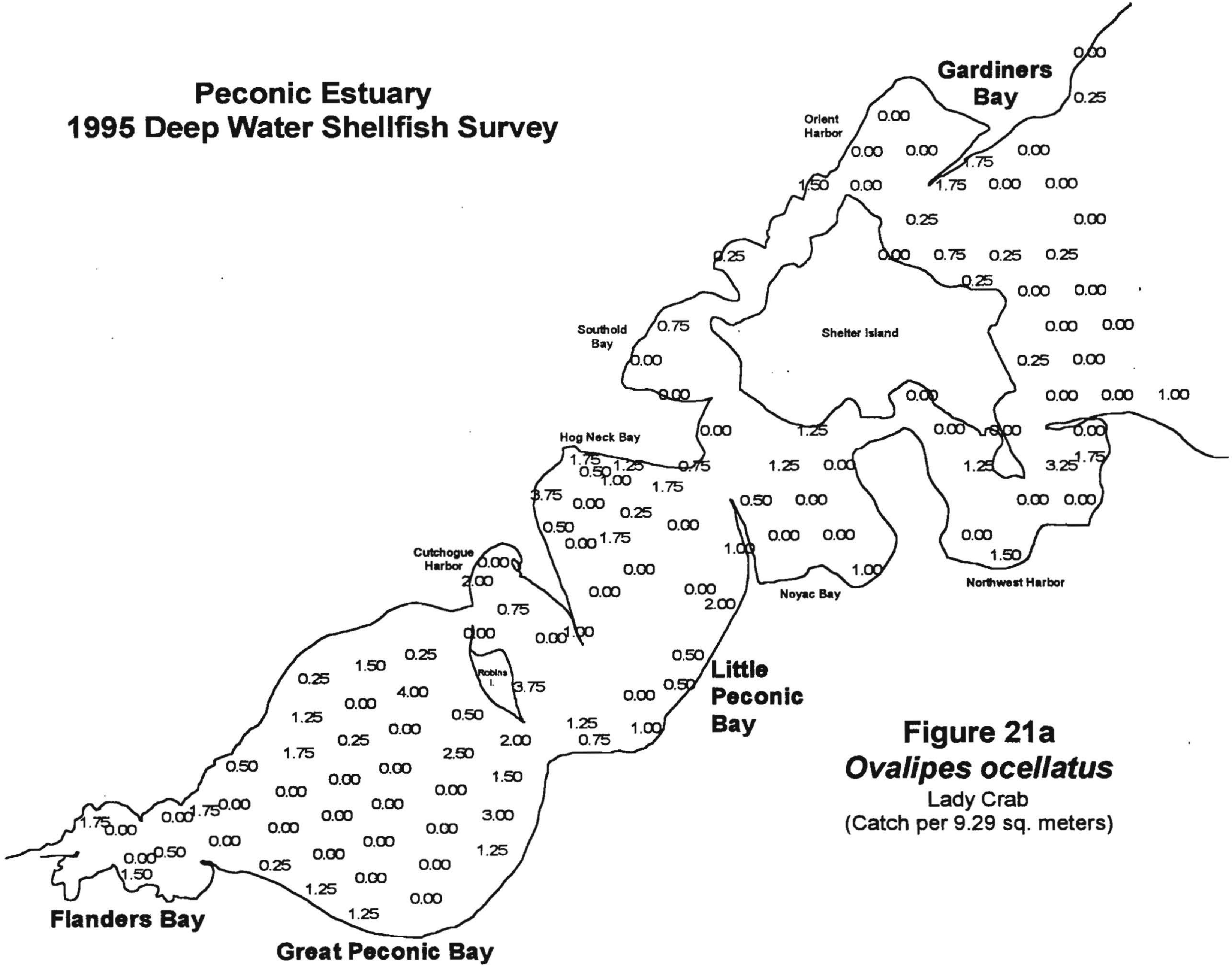

Figure 21a
Ovalipes ocellatus
Lady Crab
(Catch per 9.29 sq. meters)

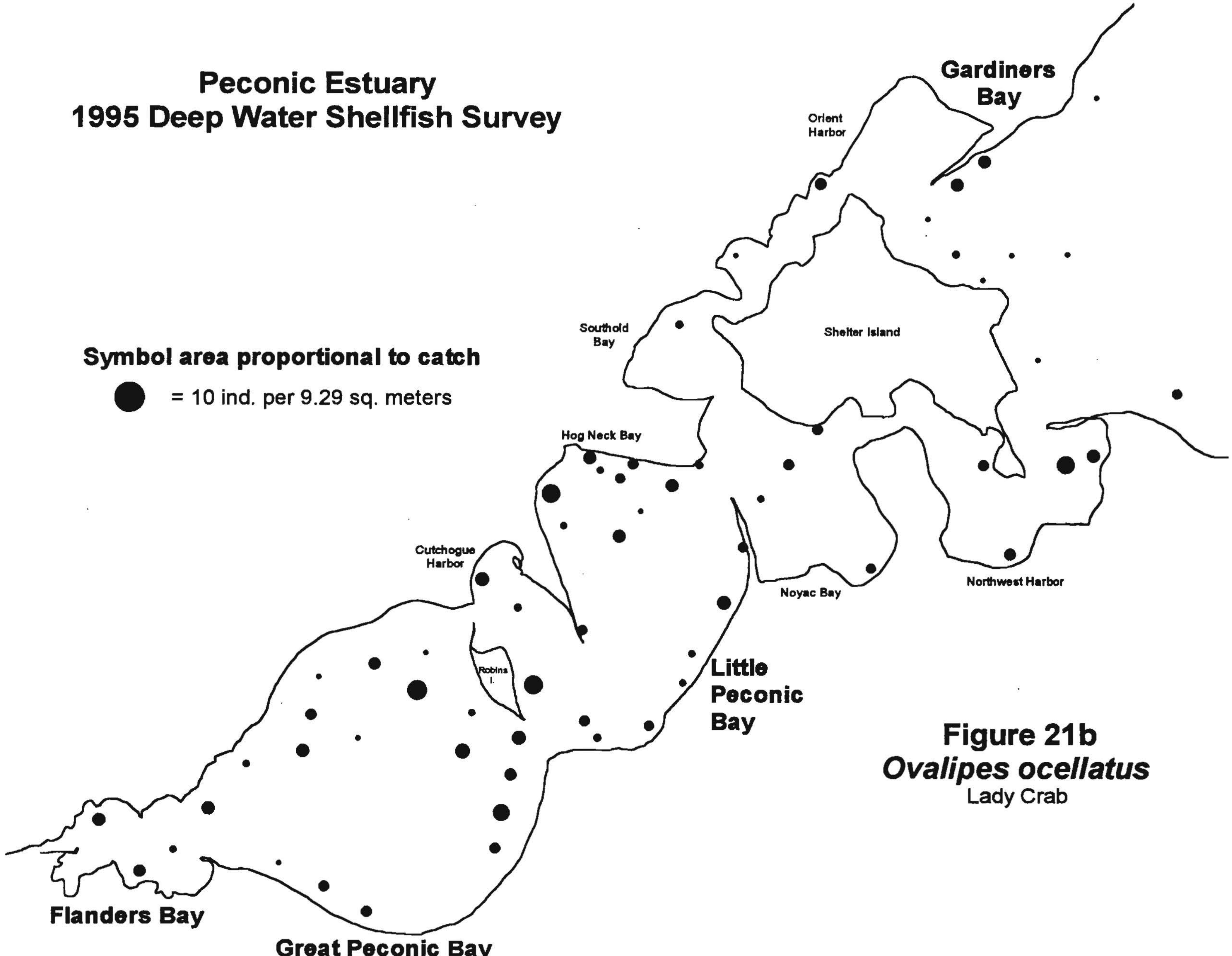

Figure 21b
Ovalipes ocellatus
Lady Crab

Peconic Estuary Shellfish Survey 1979-1980

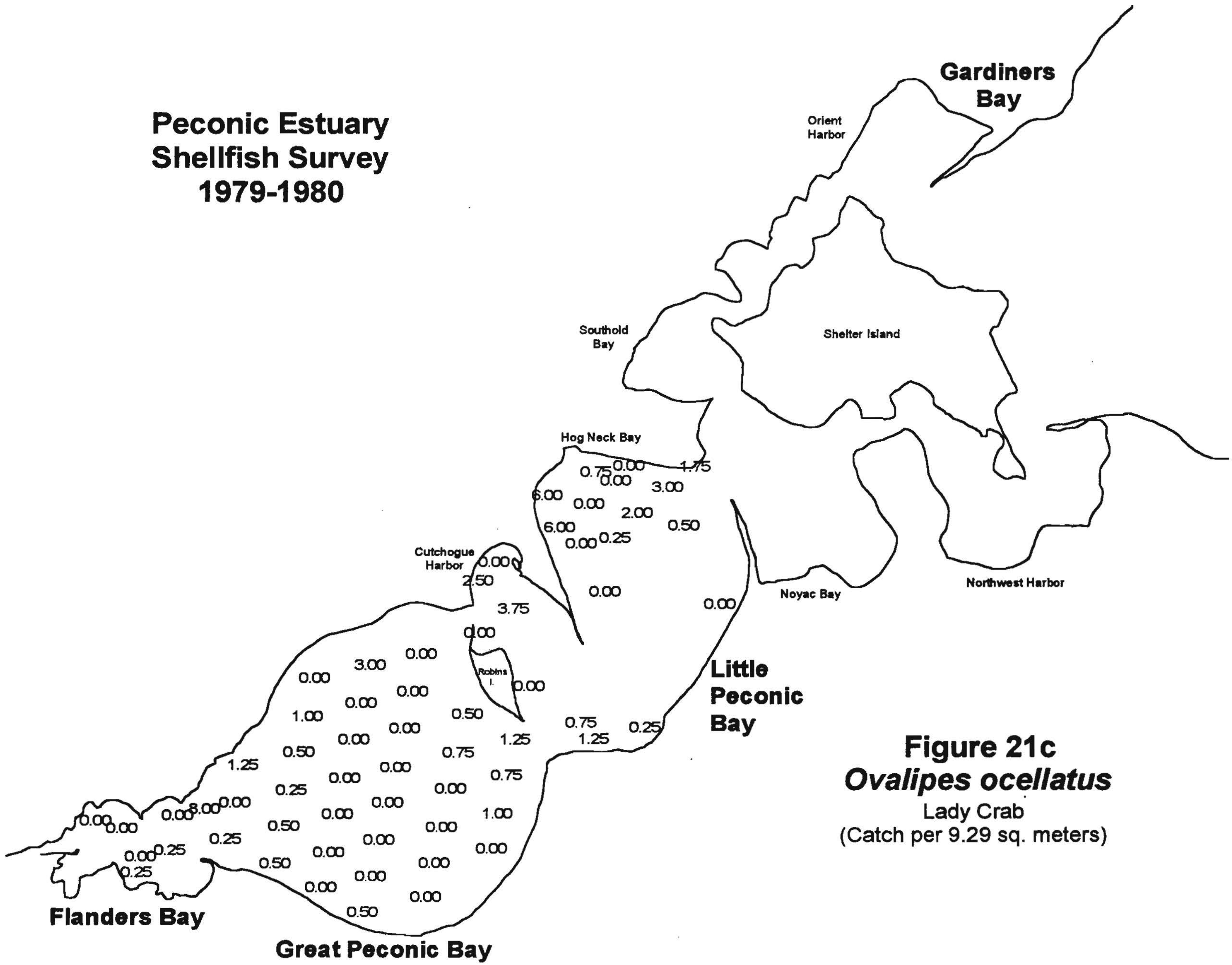

Figure 21c
Ovalipes ocellatus
Lady Crab
(Catch per 9.29 sq. meters)

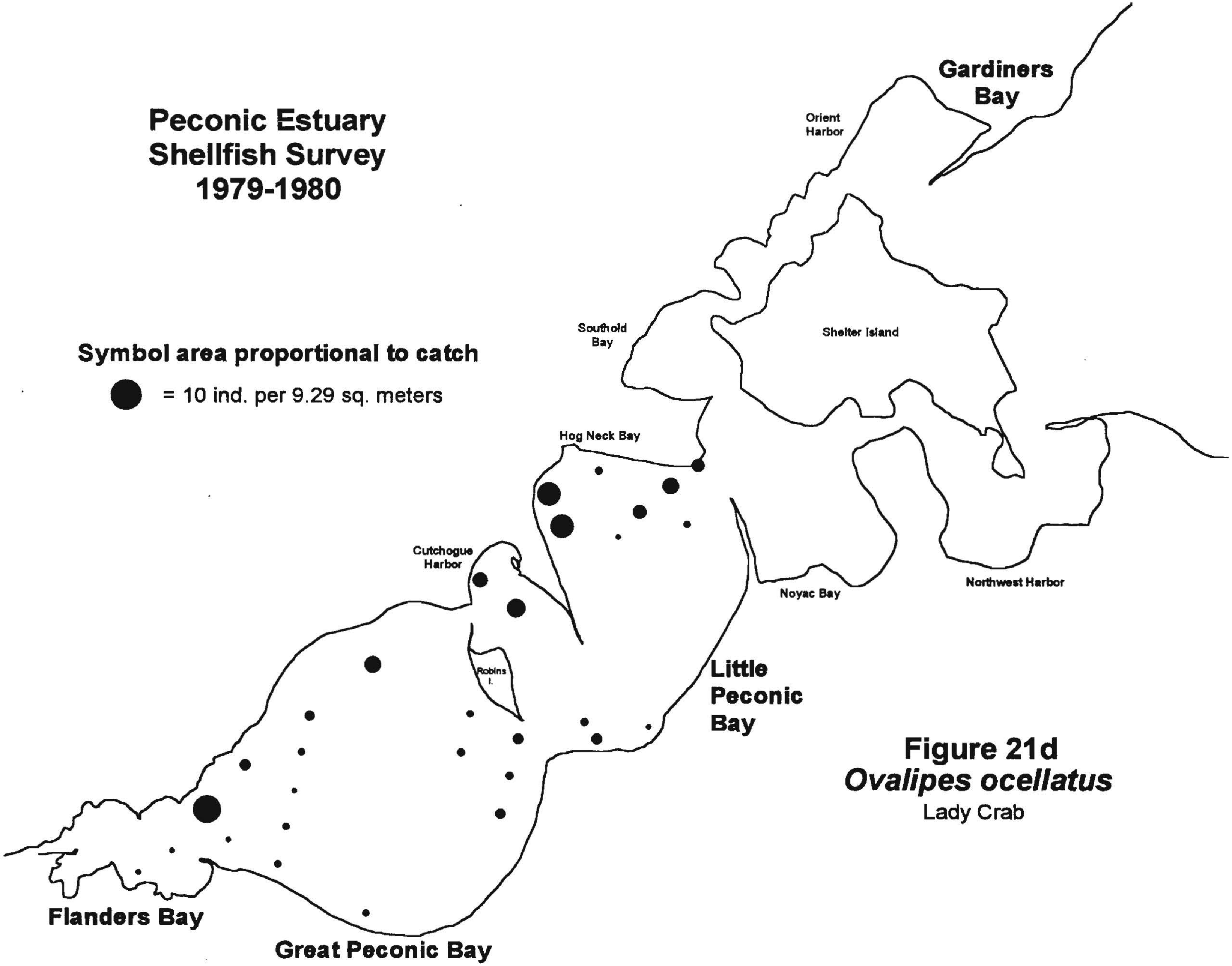

Figure 21d
Ovalipes ocellatus
Lady Crab

Peconic Estuary
1995 Deep Water Shellfish Survey

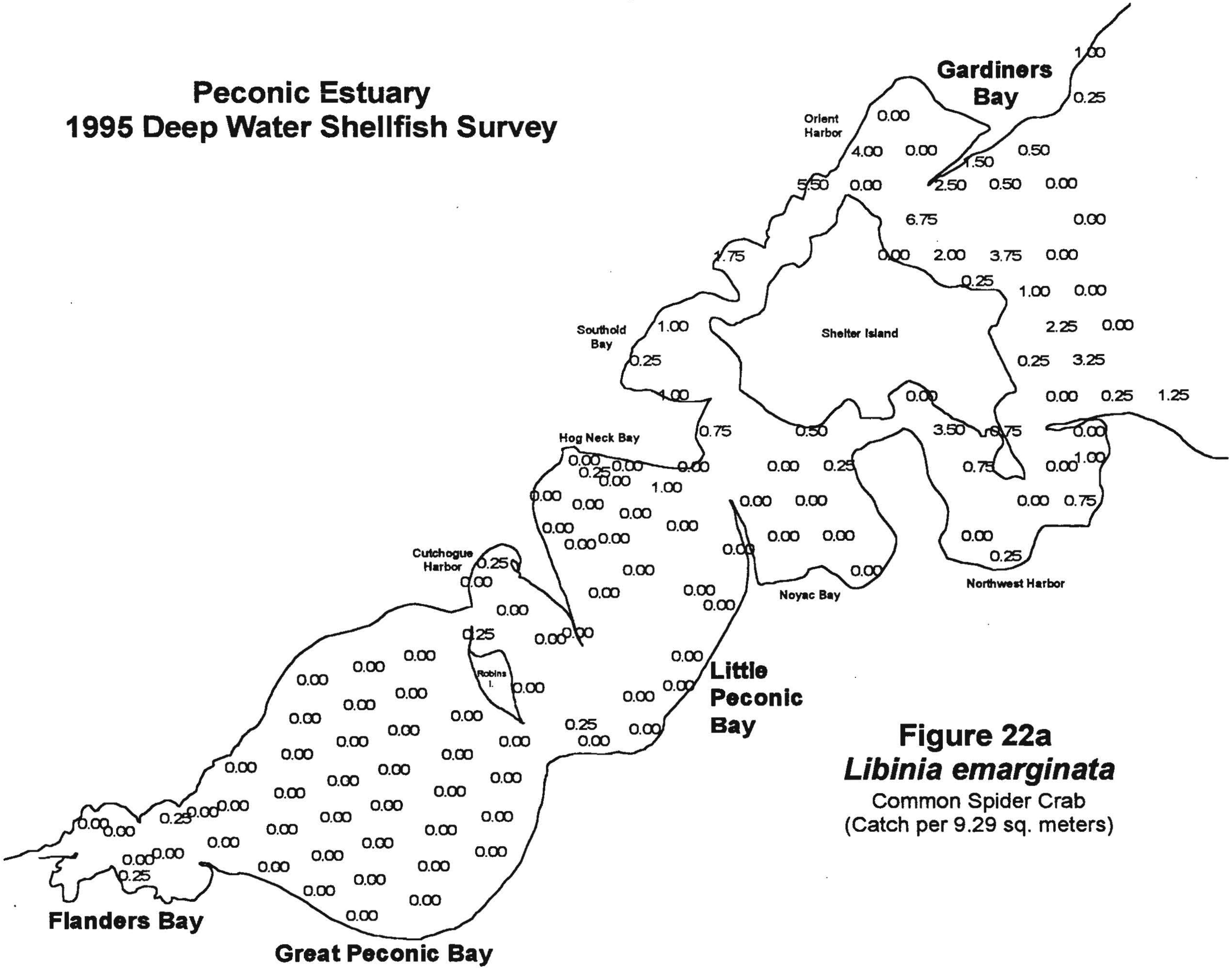

Figure 22a
Libinia emarginata
Common Spider Crab
(Catch per 9.29 sq. meters)

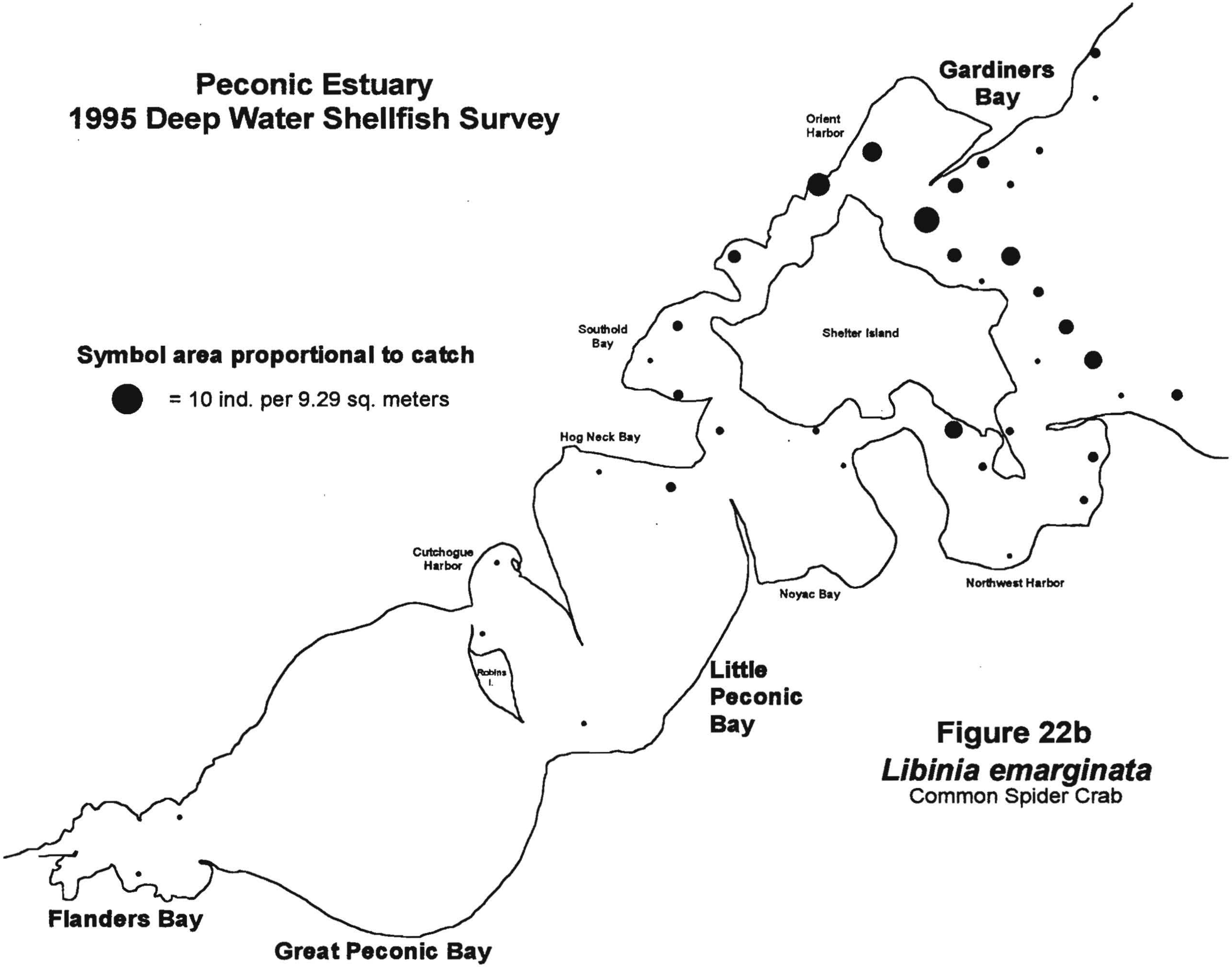

Figure 22b
Libinia emarginata
Common Spider Crab

Peconic Estuary
Shellfish Survey
1979-1980

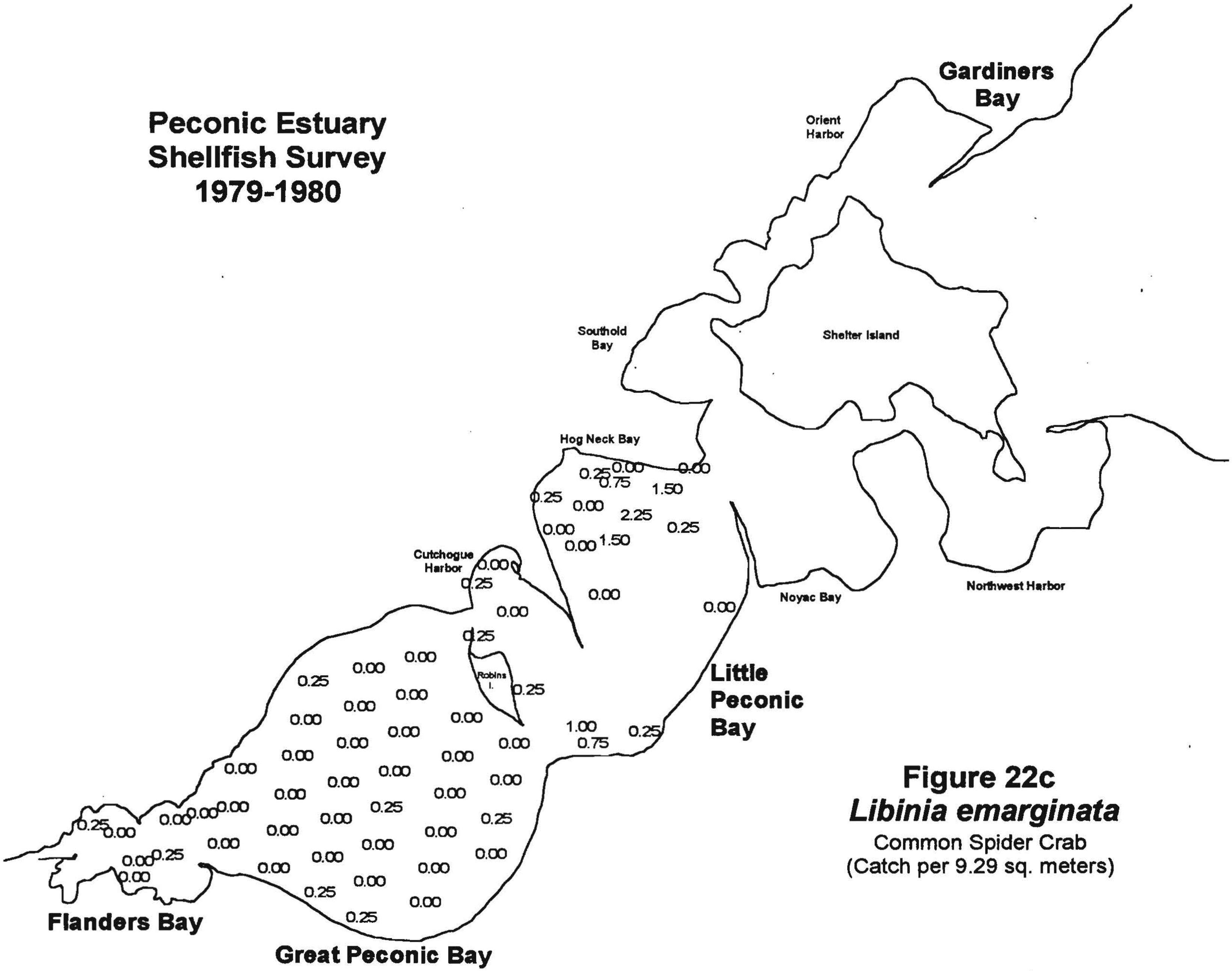

Figure 22c
Libinia emarginata
Common Spider Crab
(Catch per 9.29 sq. meters)

Peconic Estuary Shellfish Survey 1979-1980

Symbol area proportional to catch

● = 5 ind. per 9.29 sq. meters

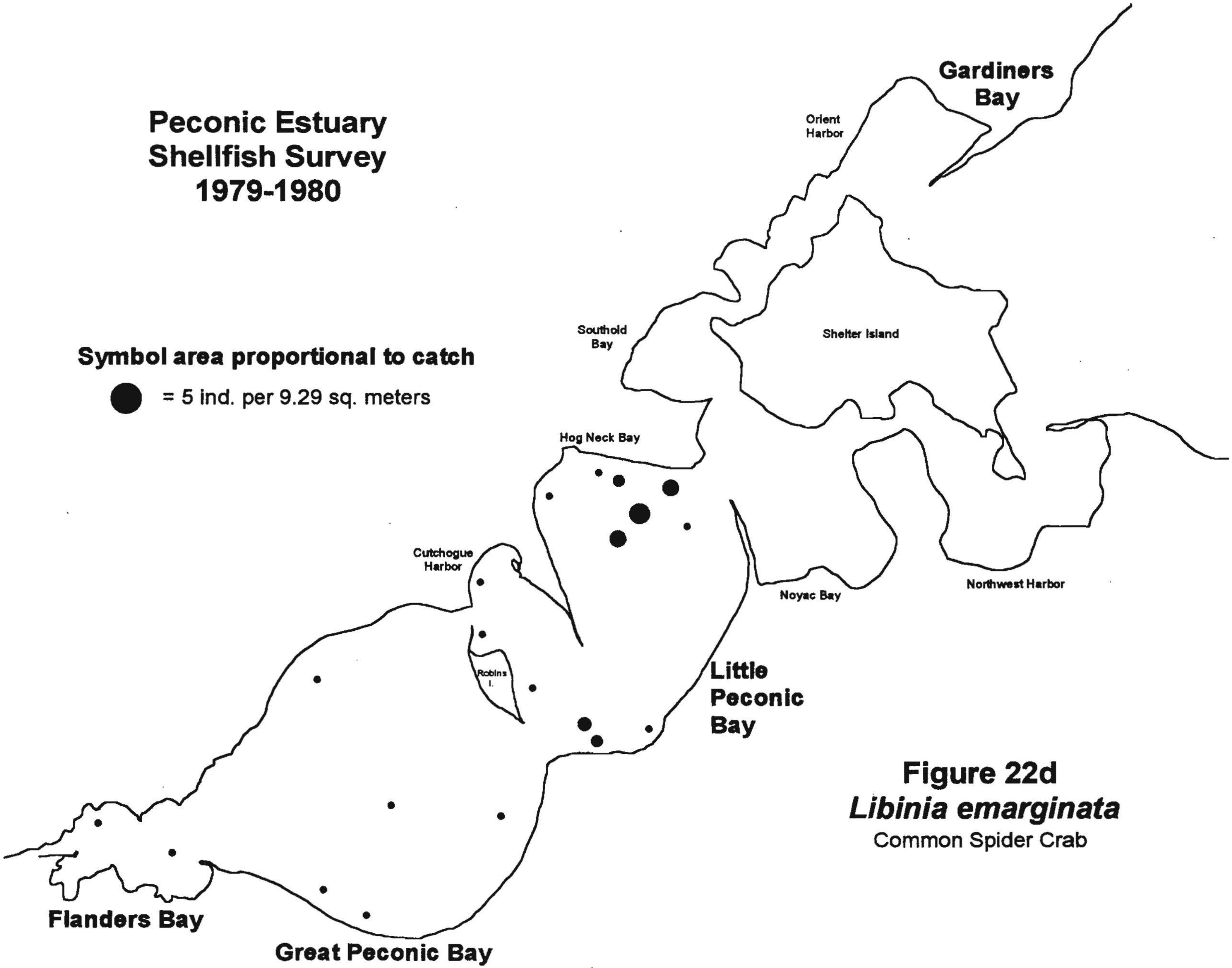

Figure 22d
Libinia emarginata
Common Spider Crab

Peconic Estuary
1995 Deep Water Shellfish Survey

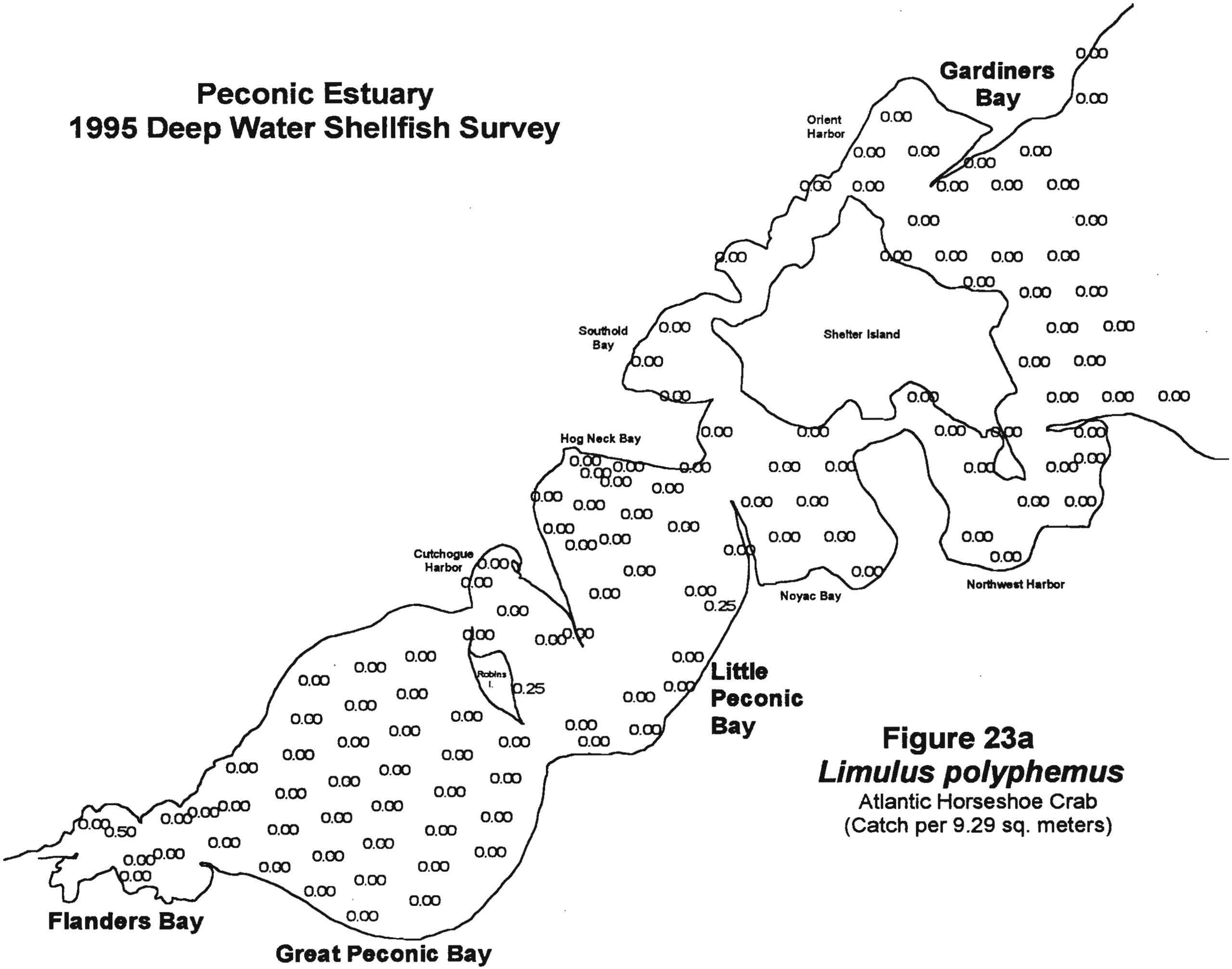

Figure 23a
Limulus polyphemus
Atlantic Horseshoe Crab
(Catch per 9.29 sq. meters)

Peconic Estuary
1995 Deep Water Shellfish Survey

Symbol area proportional to catch

● = 1 ind. per 9.29 sq. meters

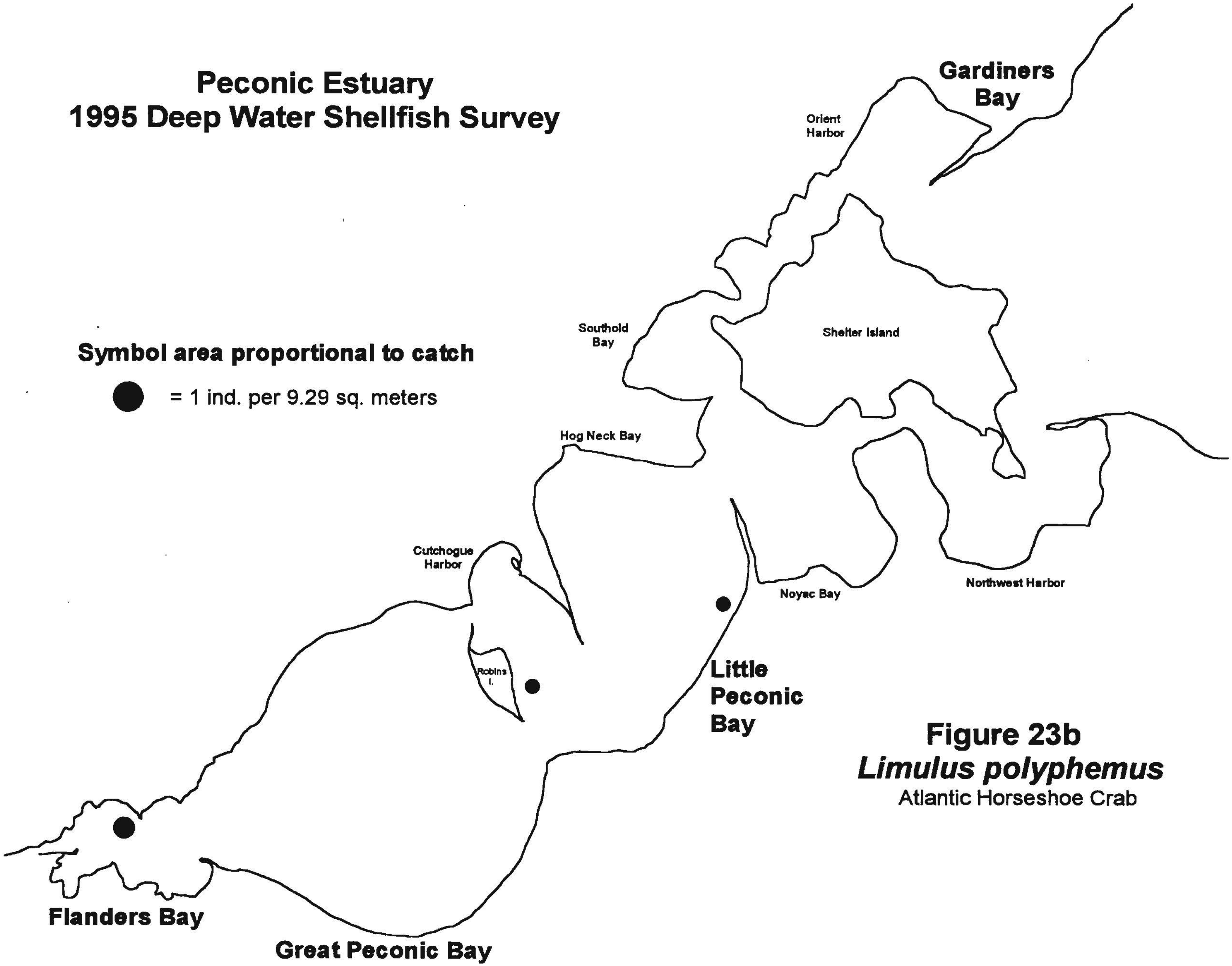

Figure 23b
Limulus polyphemus
Atlantic Horseshoe Crab

Peconic Estuary Shellfish Survey 1979-1980

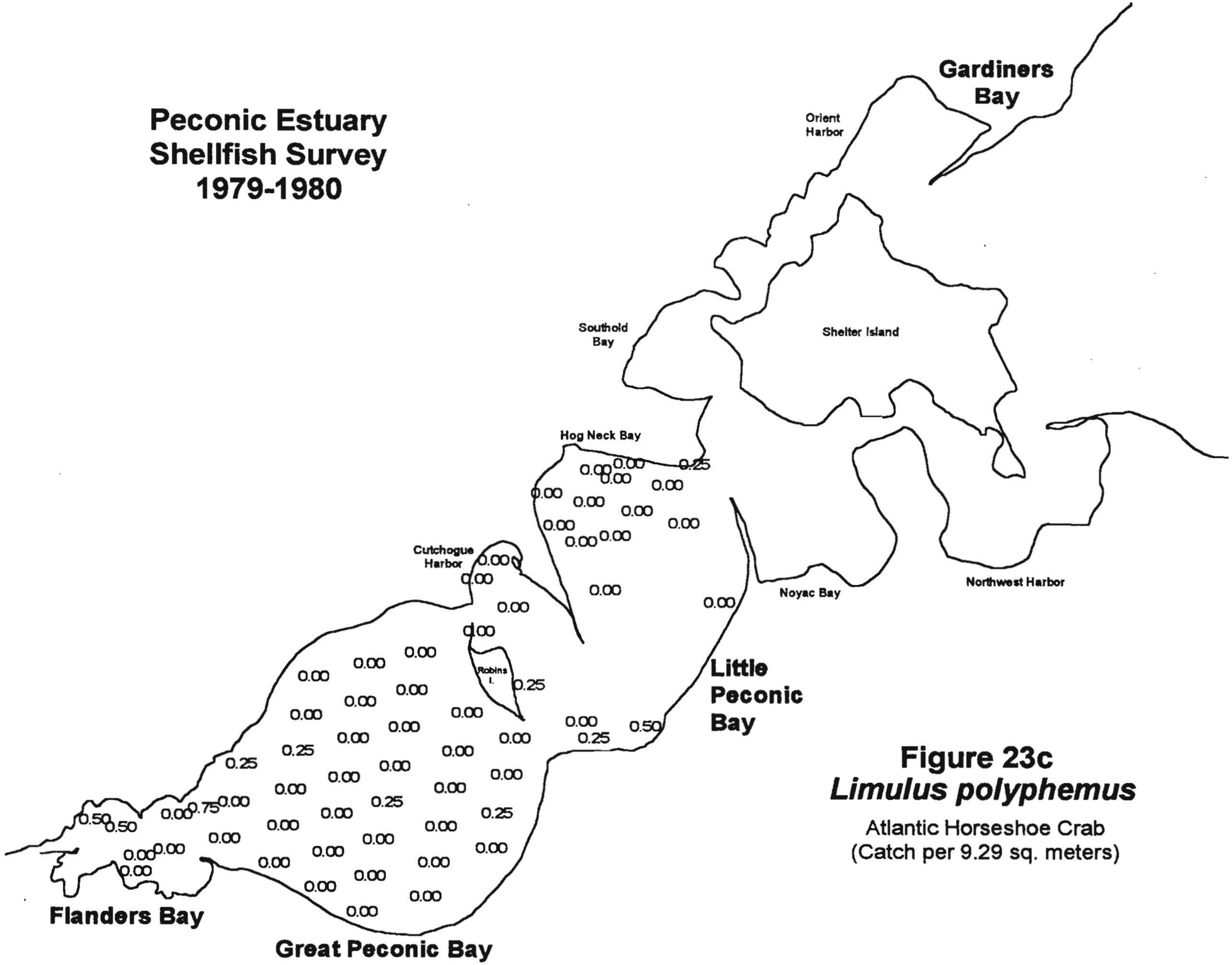

Figure 23c
Limulus polyphemus
Atlantic Horseshoe Crab
(Catch per 9.29 sq. meters)

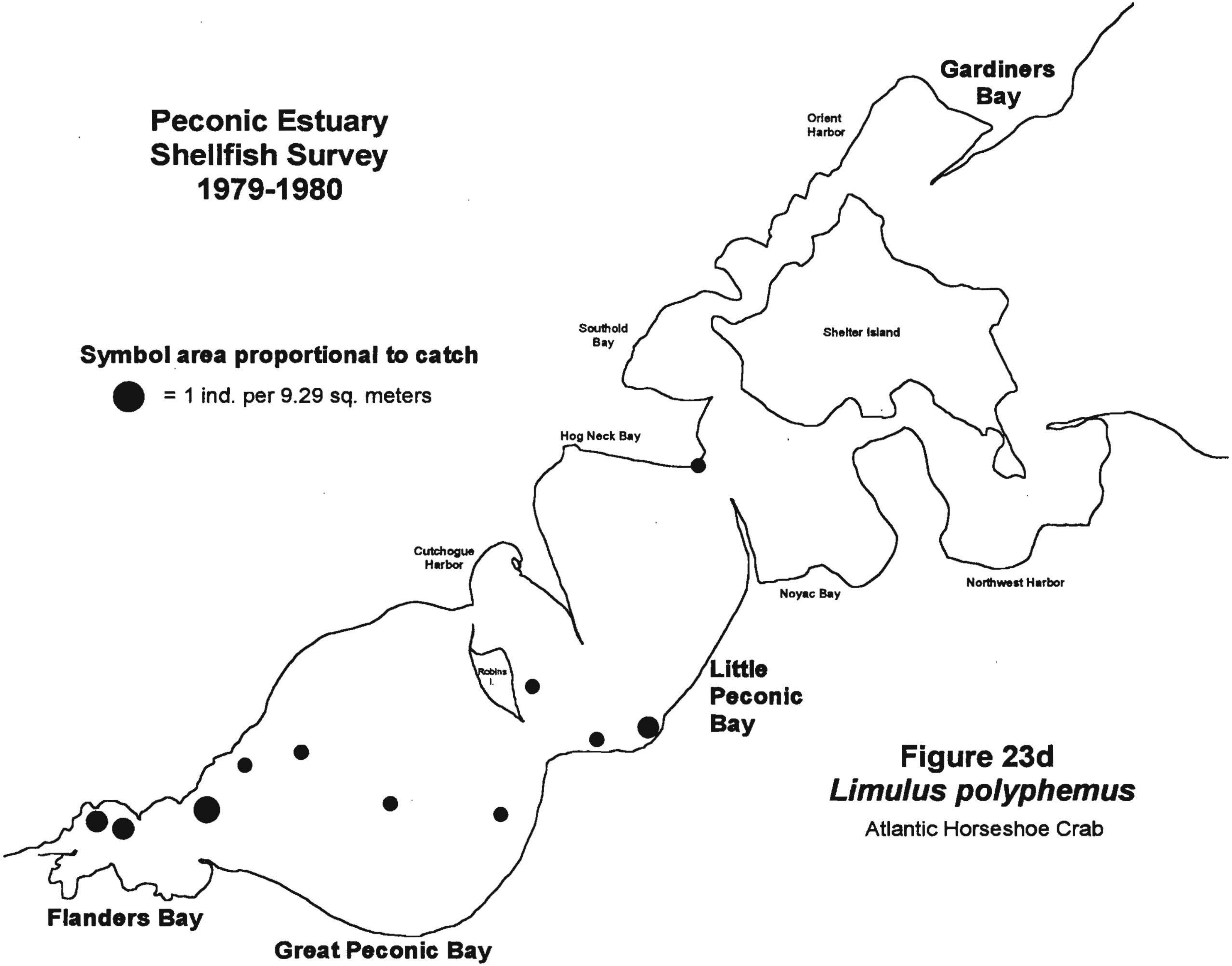

Figure 23d
Limulus polyphemus
Atlantic Horseshoe Crab

Peconic Estuary
1995 Deep Water Shellfish Survey

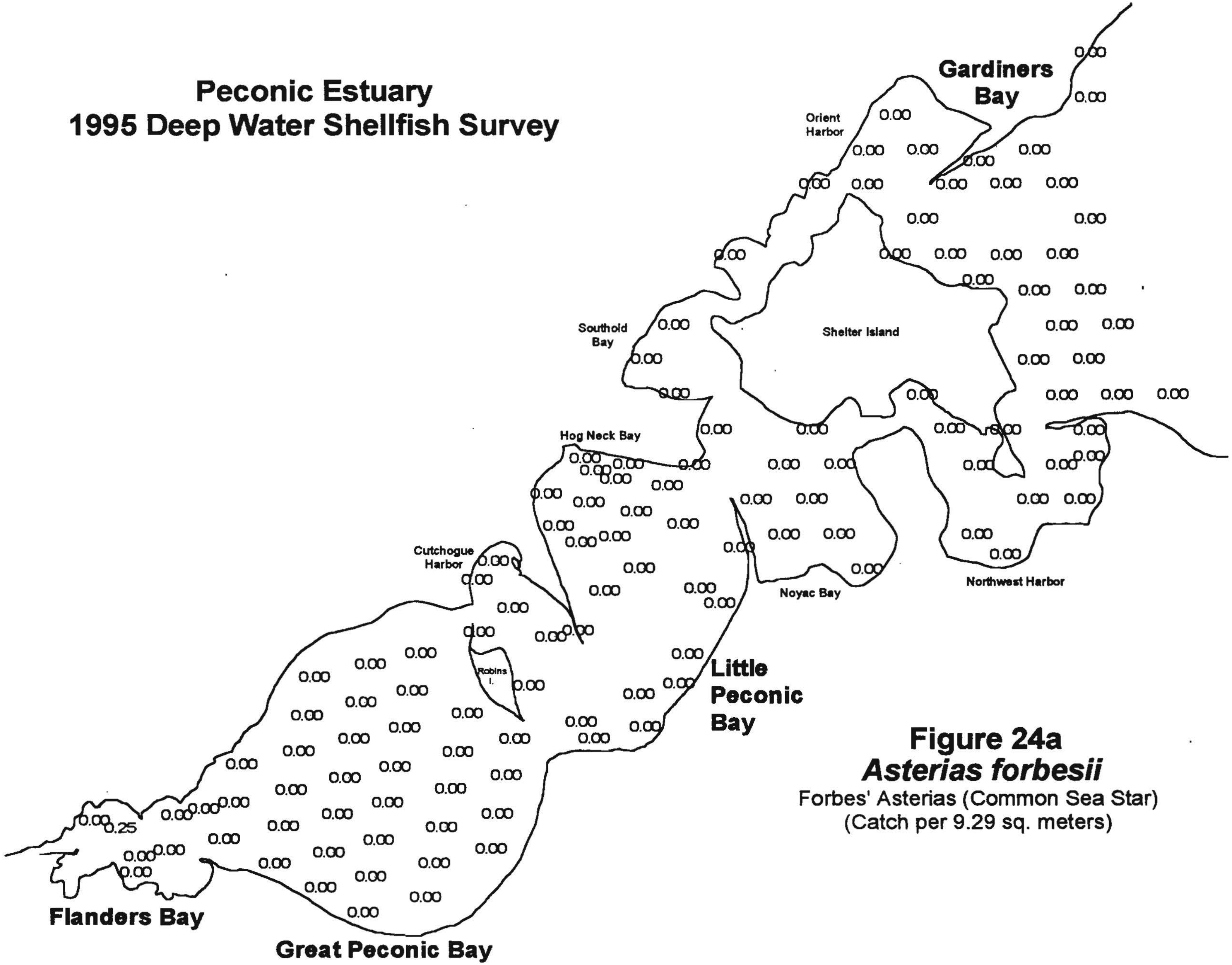

Figure 24a
Asterias forbesii
Forbes' Asterias (Common Sea Star)
(Catch per 9.29 sq. meters)

Peconic Estuary
1995 Deep Water Shellfish Survey

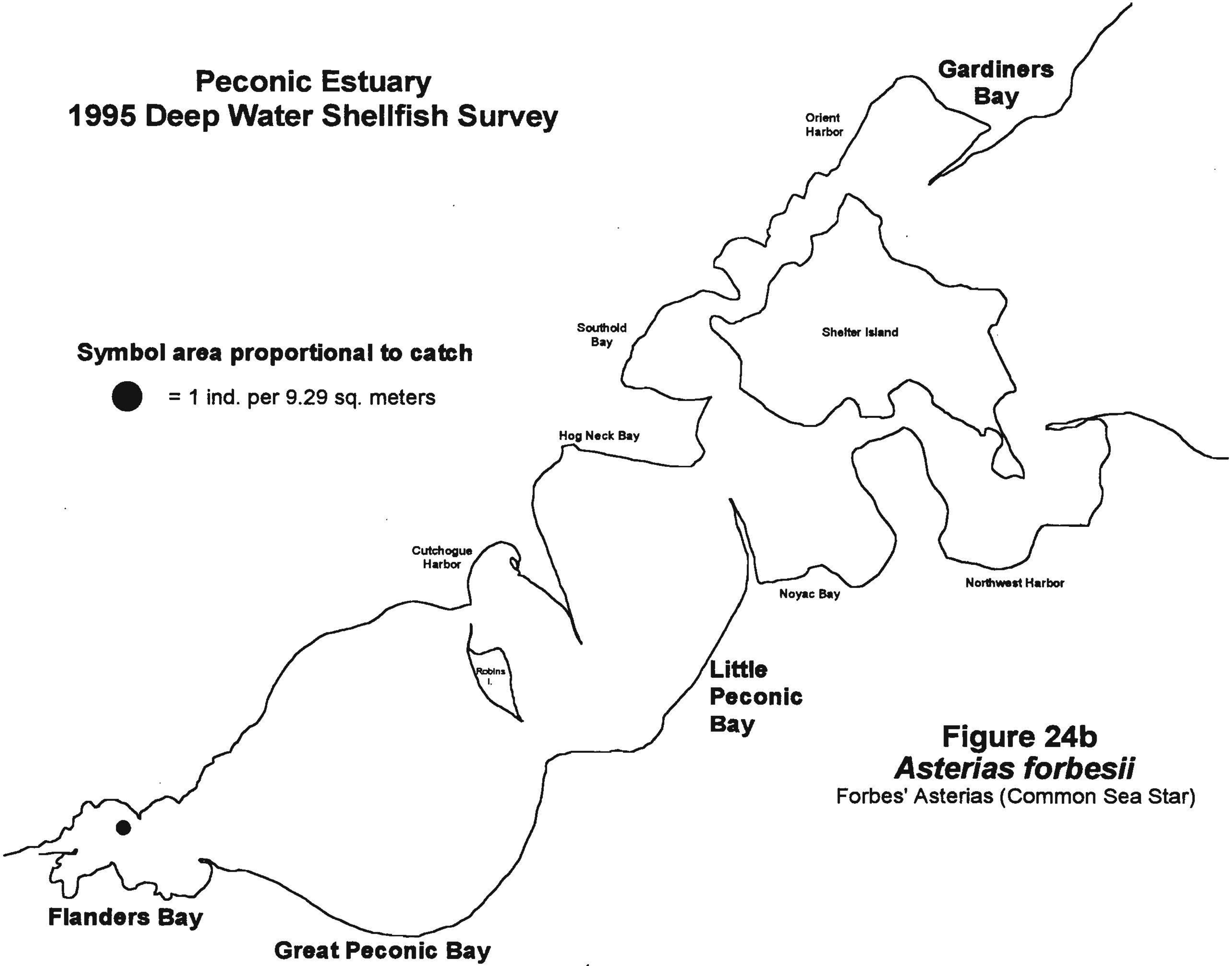

Figure 24b
Asterias forbesii
Forbes' Asterias (Common Sea Star)

Peconic Estuary Shellfish Survey 1979-1980

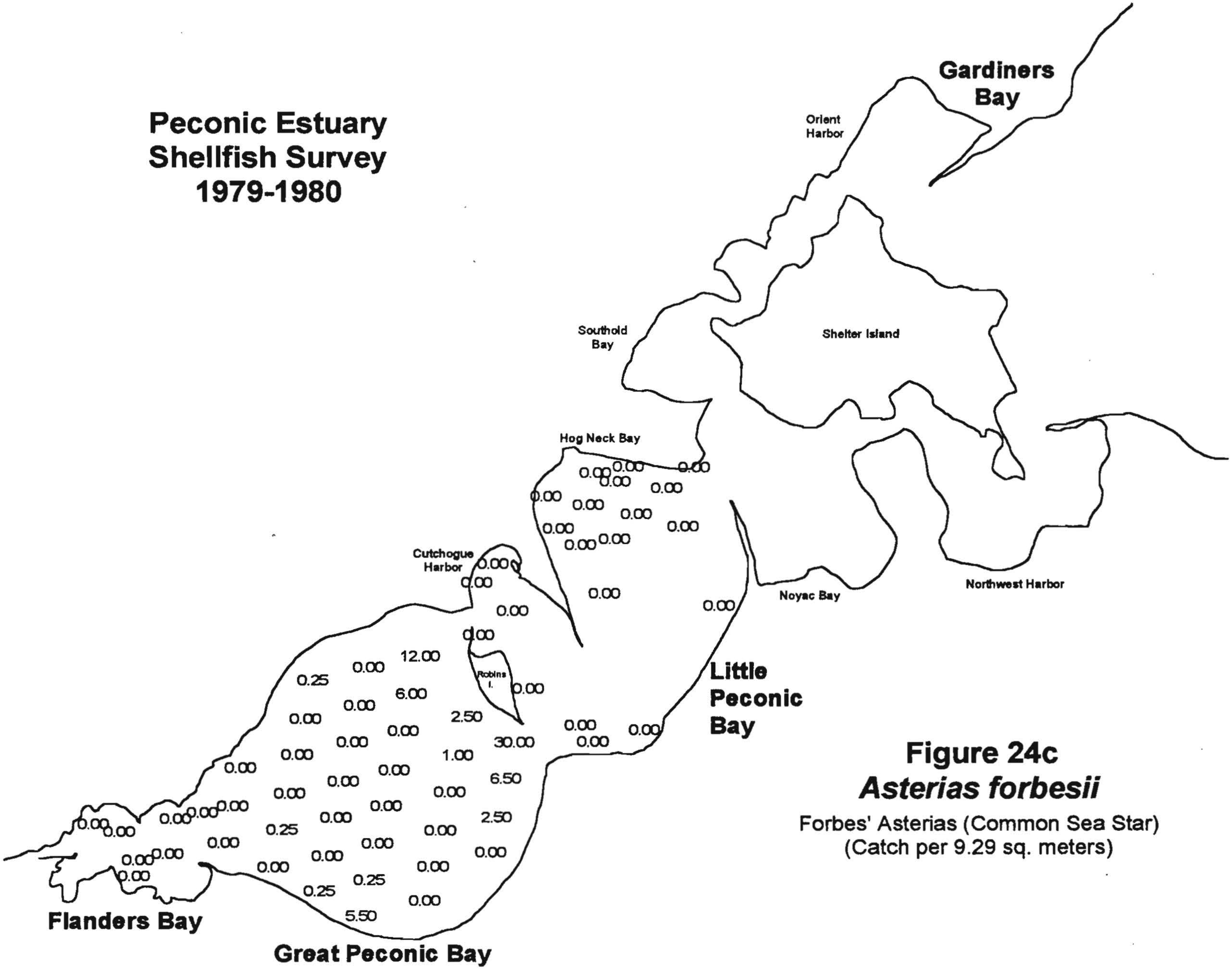

Figure 24c
Asterias forbesii

Forbes' Asterias (Common Sea Star)
(Catch per 9.29 sq. meters)

Peconic Estuary Shellfish Survey 1979-1980

Symbol area proportional to catch

● = 50 ind. per 9.29 sq. meters

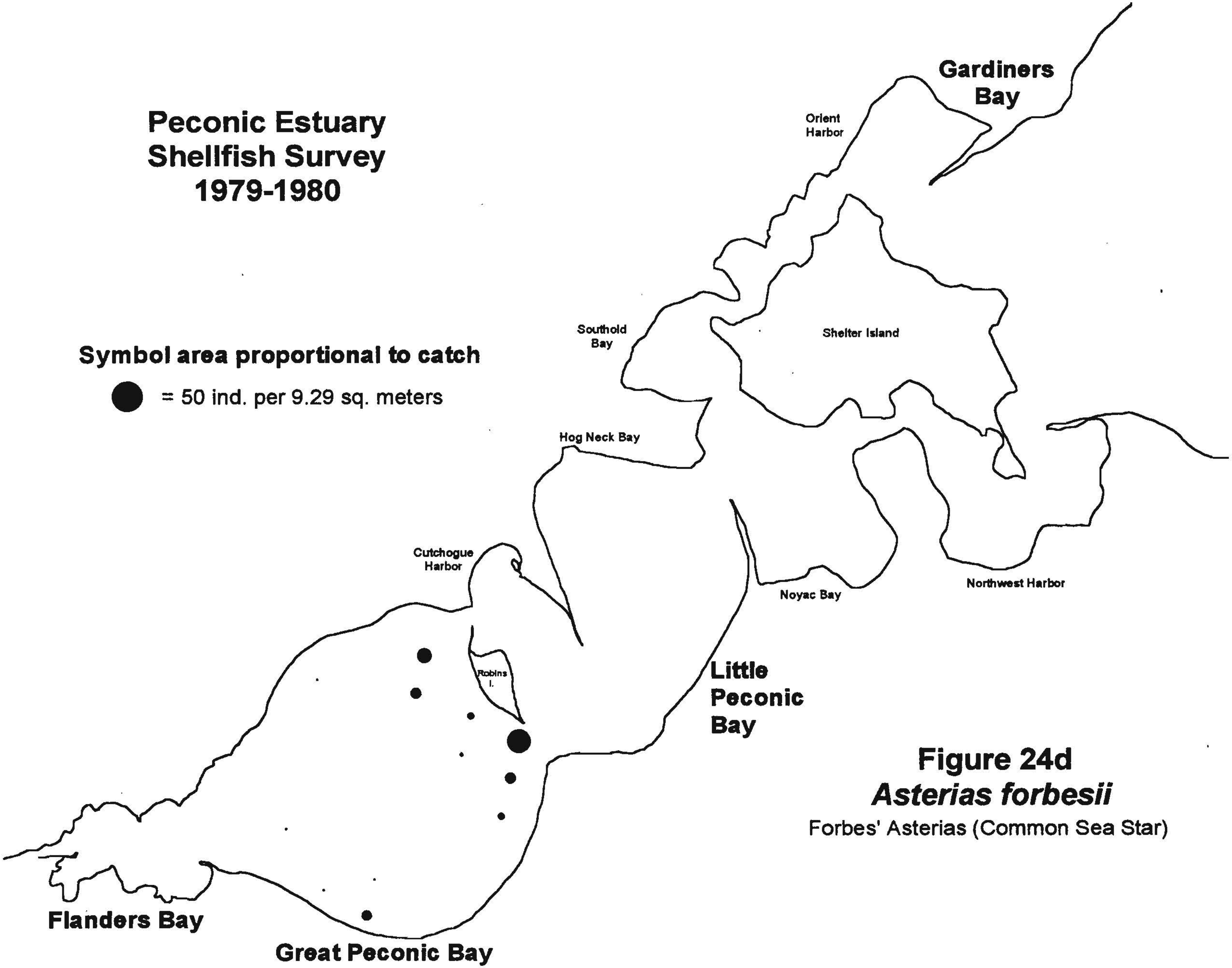

Figure 24d
Asterias forbesii
Forbes' Asterias (Common Sea Star)

Peconic Estuary
1995 Deep Water Shellfish Survey

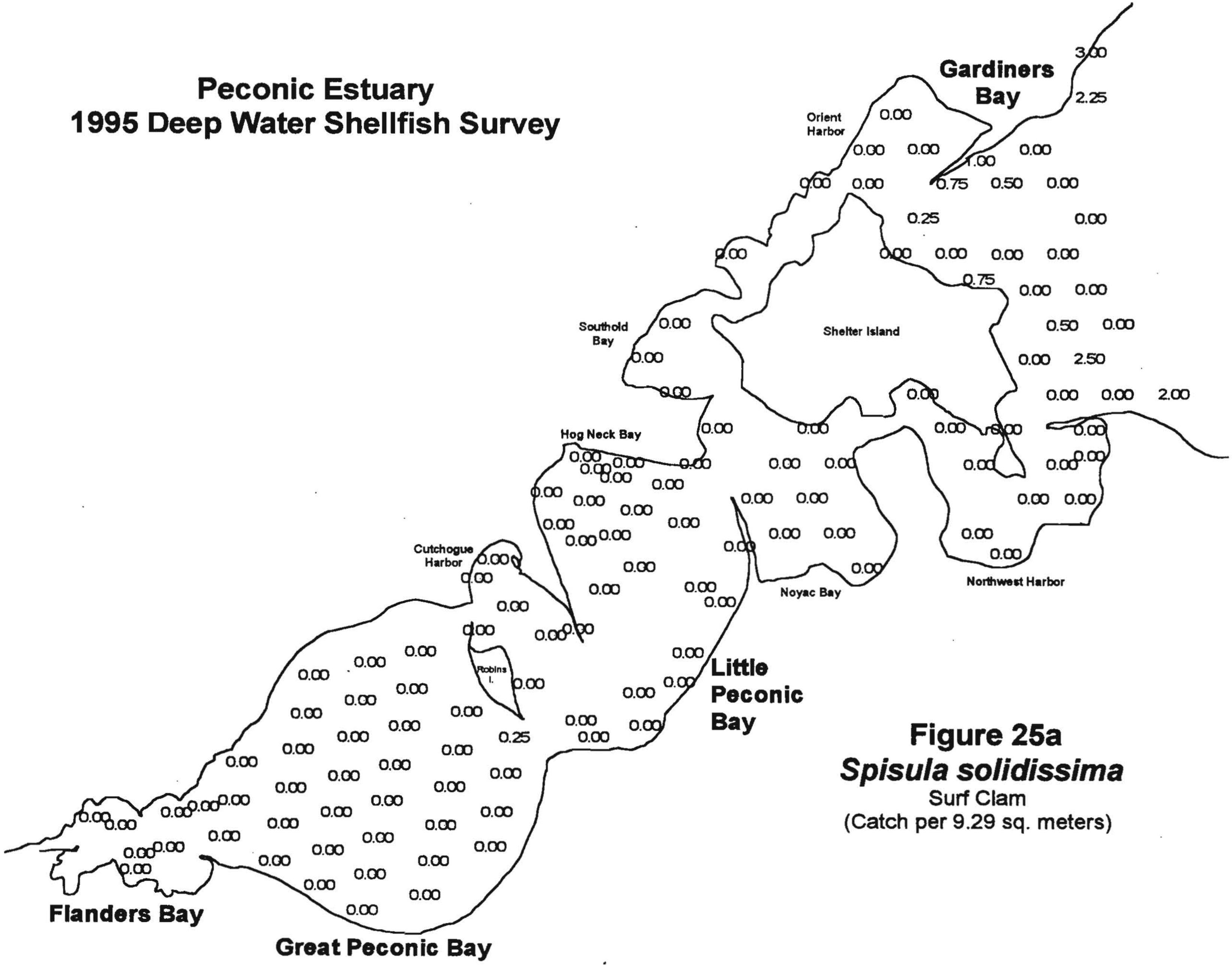

Figure 25a
Spisula solidissima
Surf Clam
(Catch per 9.29 sq. meters)

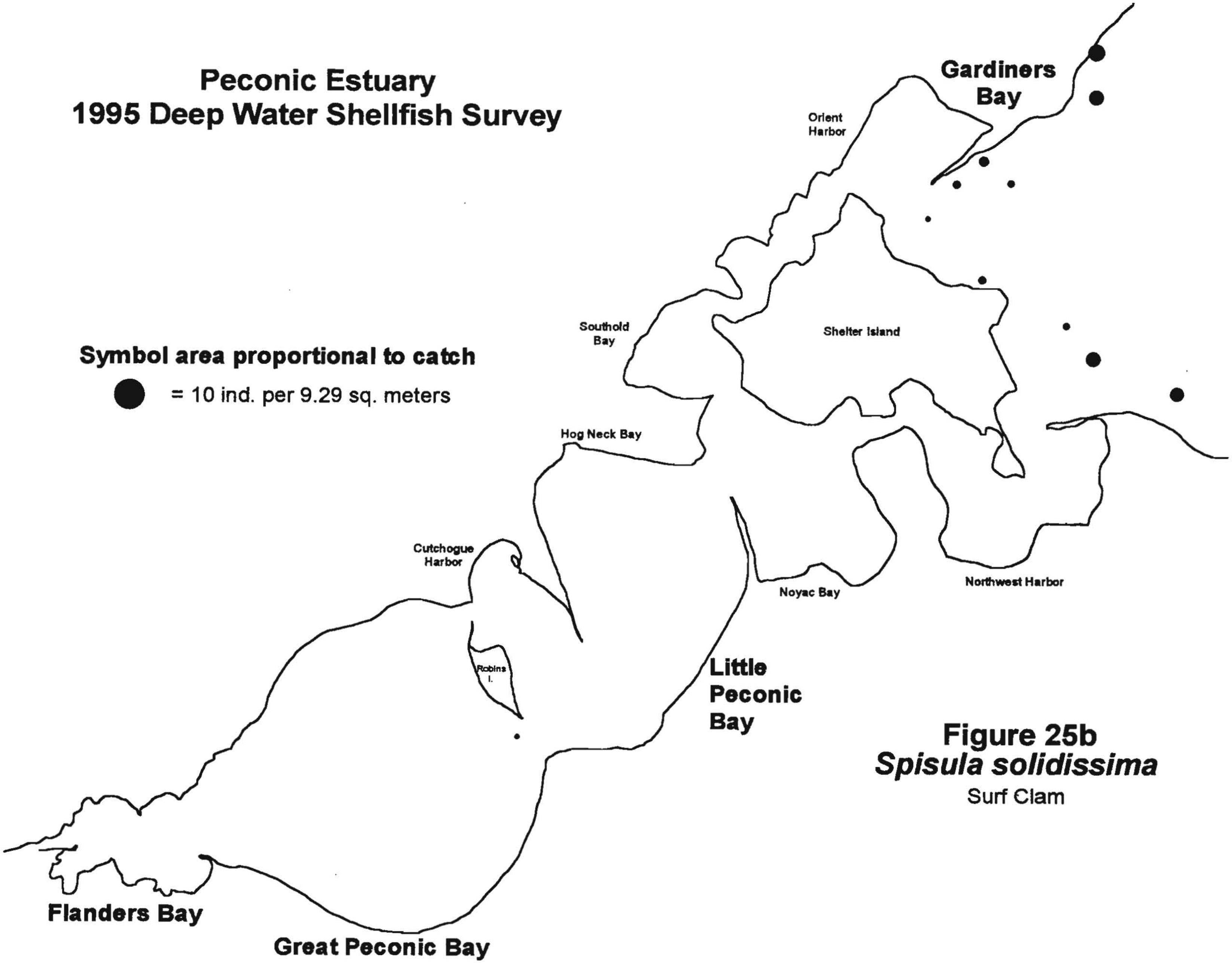

Figure 25b
Spisula solidissima
Surf Clam

Peconic Estuary Shellfish Survey 1979-1980

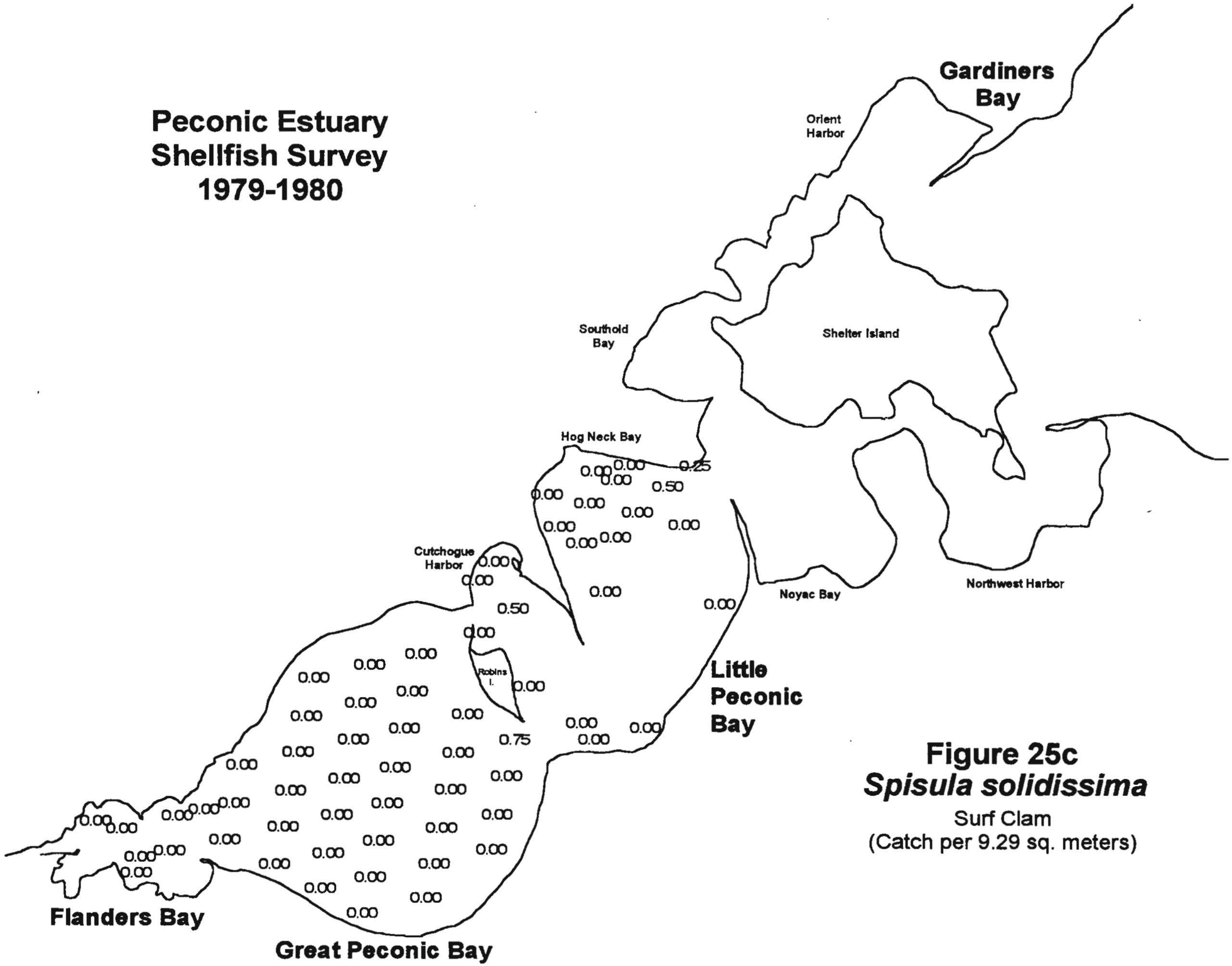

Figure 25c
Spisula solidissima
Surf Clam
(Catch per 9.29 sq. meters)

Peconic Estuary Shellfish Survey 1979-1980

Symbol area proportional to catch

● = 1 ind. per 9.29 sq. meters

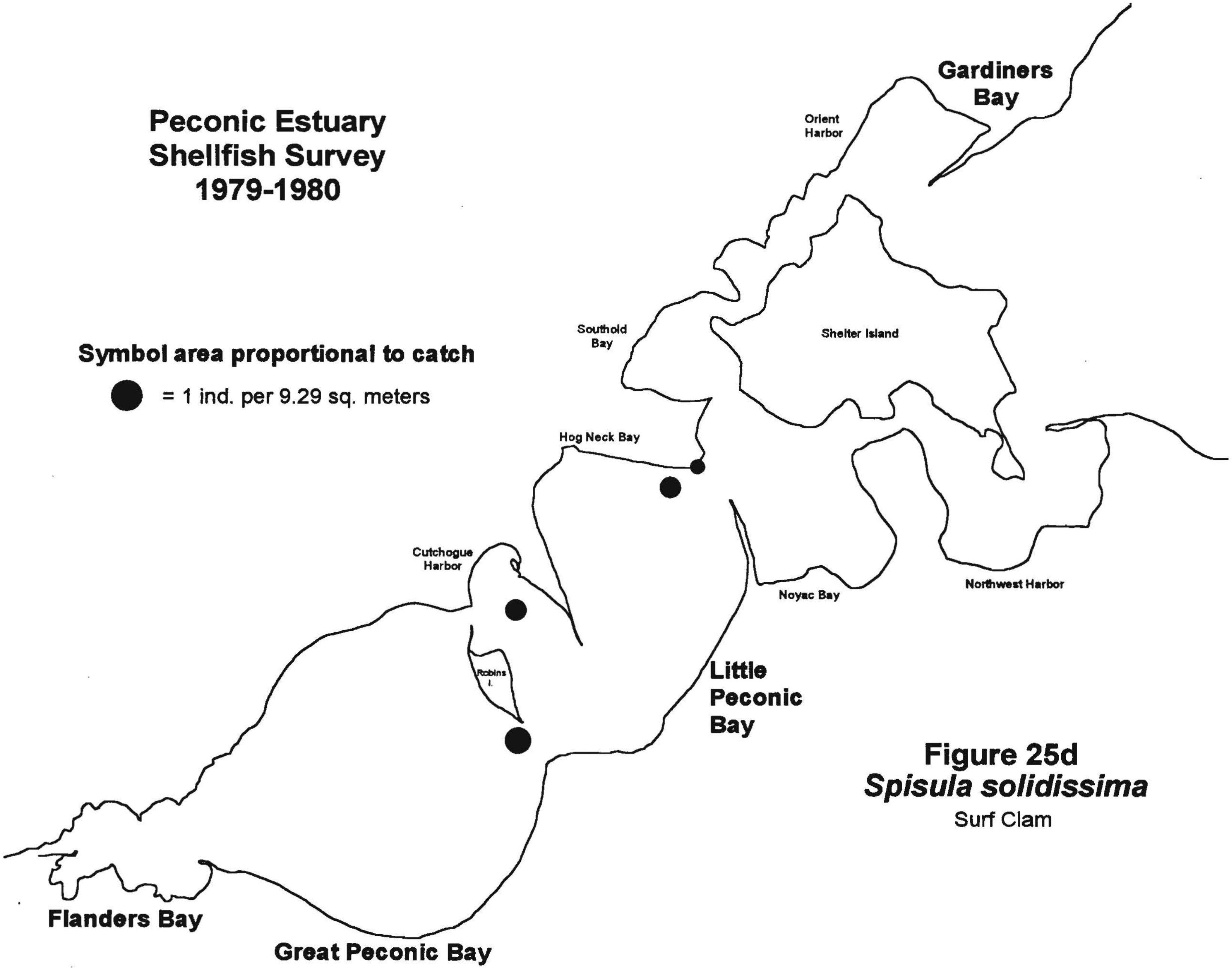

Figure 25d
Spisula solidissima
Surf Clam

Peconic Estuary
1995 Deep Water Shellfish Survey

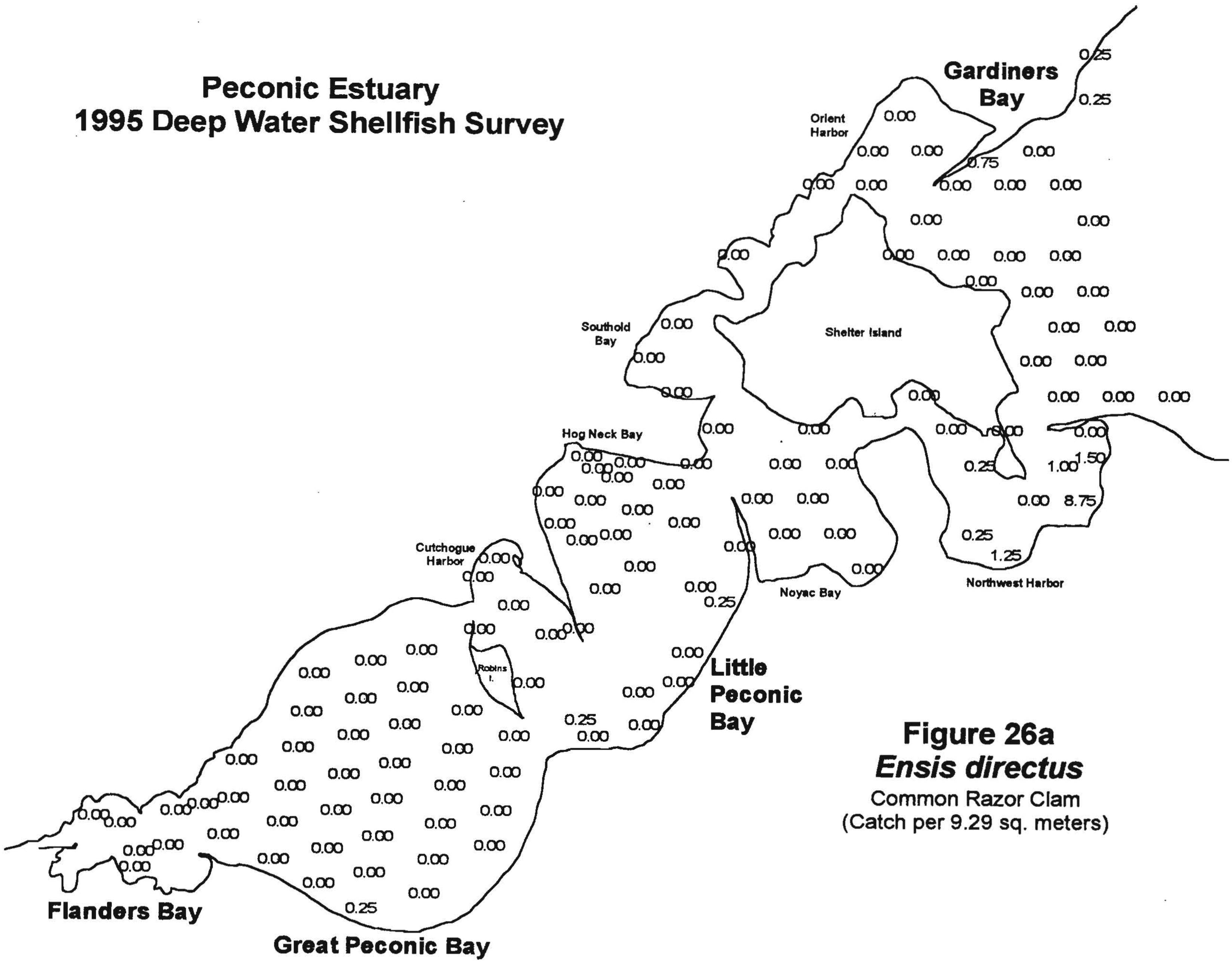

Figure 26a
Ensis directus
Common Razor Clam
(Catch per 9.29 sq. meters)

Peconic Estuary
1995 Deep Water Shellfish Survey

Symbol area proportional to catch

● = 10 ind. per 9.29 sq. meters

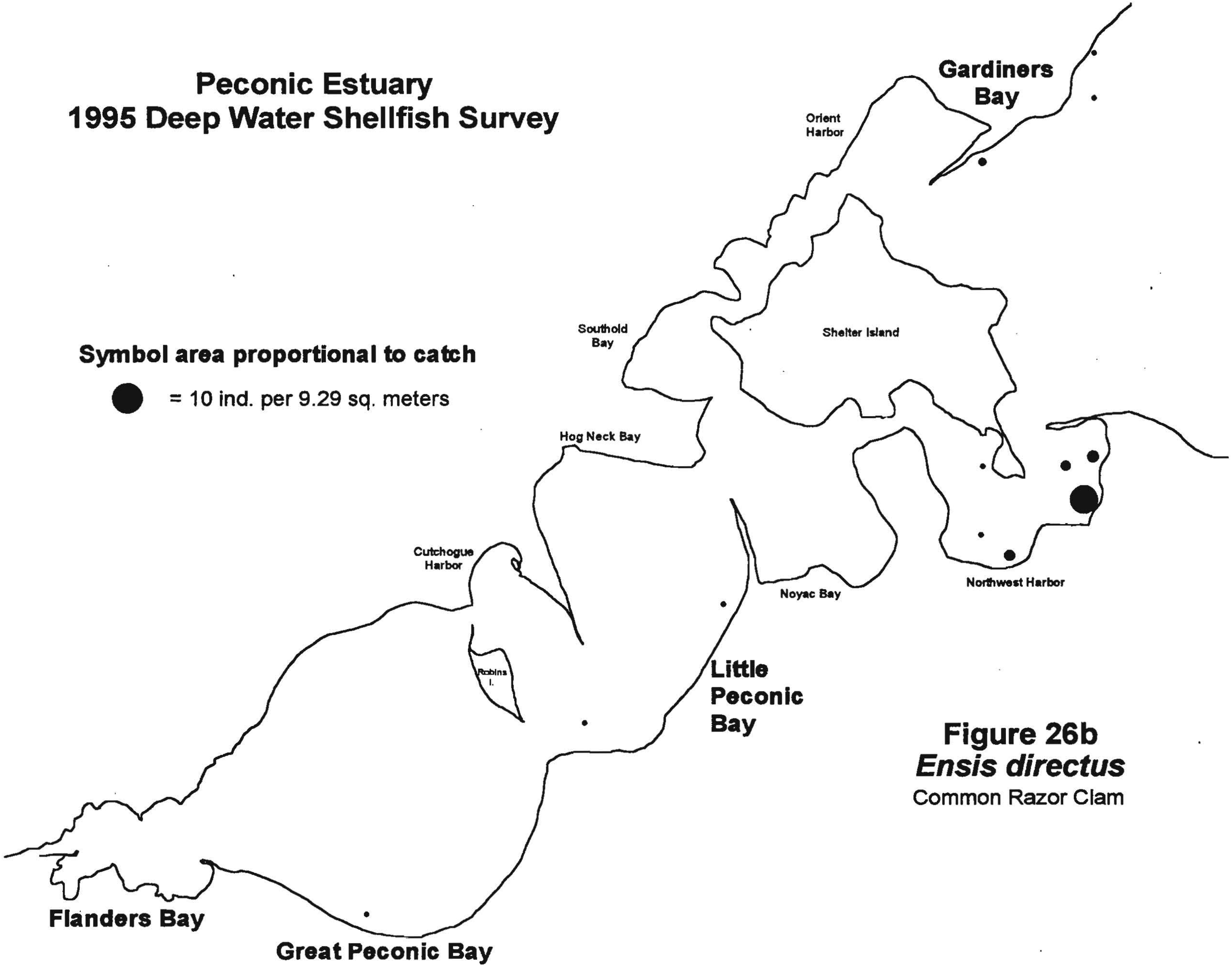

Figure 26b
Ensis directus
Common Razor Clam

Peconic Estuary Shellfish Survey 1979-1980

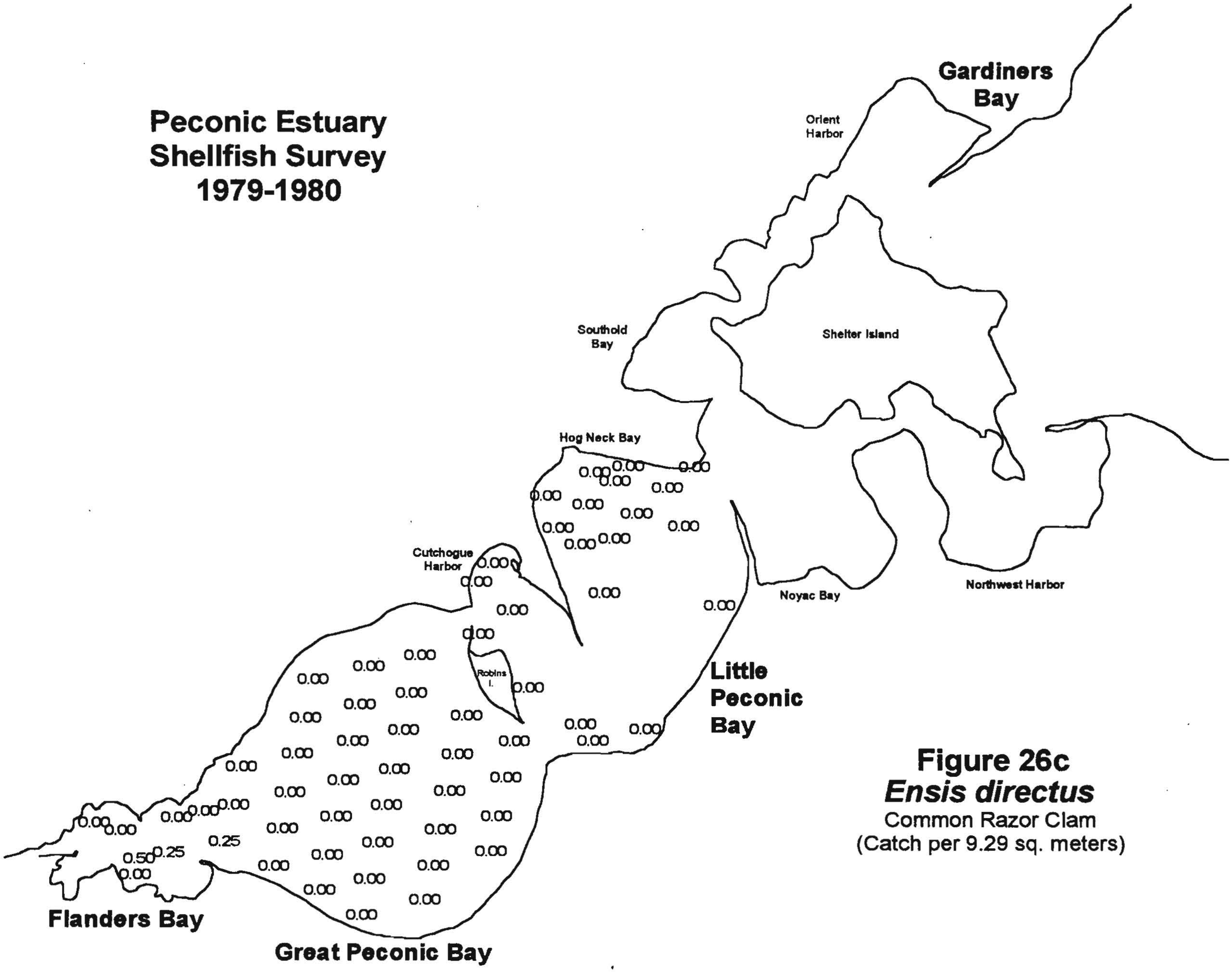

Figure 26c
Ensis directus
Common Razor Clam
(Catch per 9.29 sq. meters)

Peconic Estuary
Shellfish Survey
1979-1980

Symbol area proportional to catch

● = 1 ind. per 9.29 sq. meters

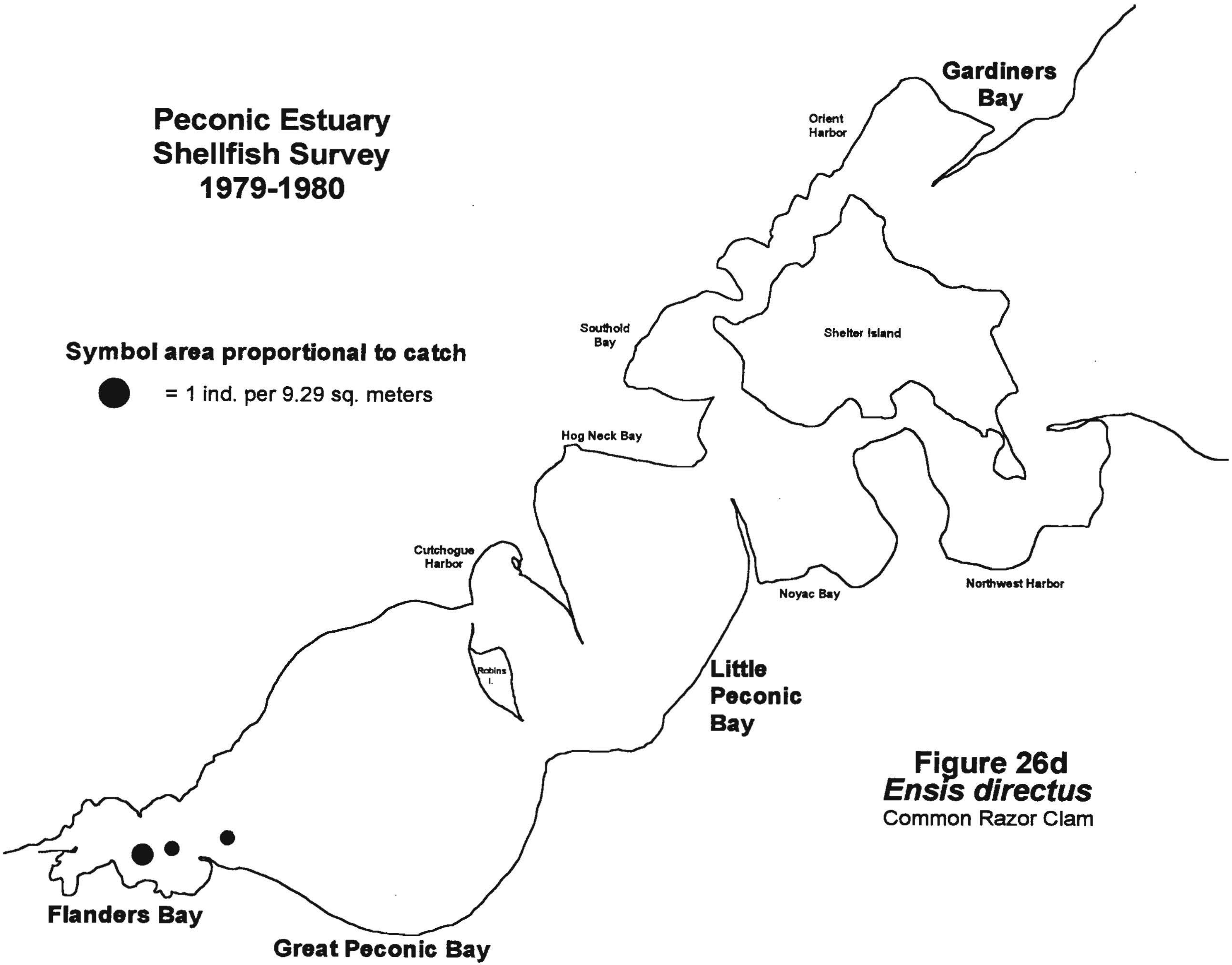

Figure 26d
Ensis directus
Common Razor Clam

Peconic Estuary
1995 Deep Water Shellfish Survey

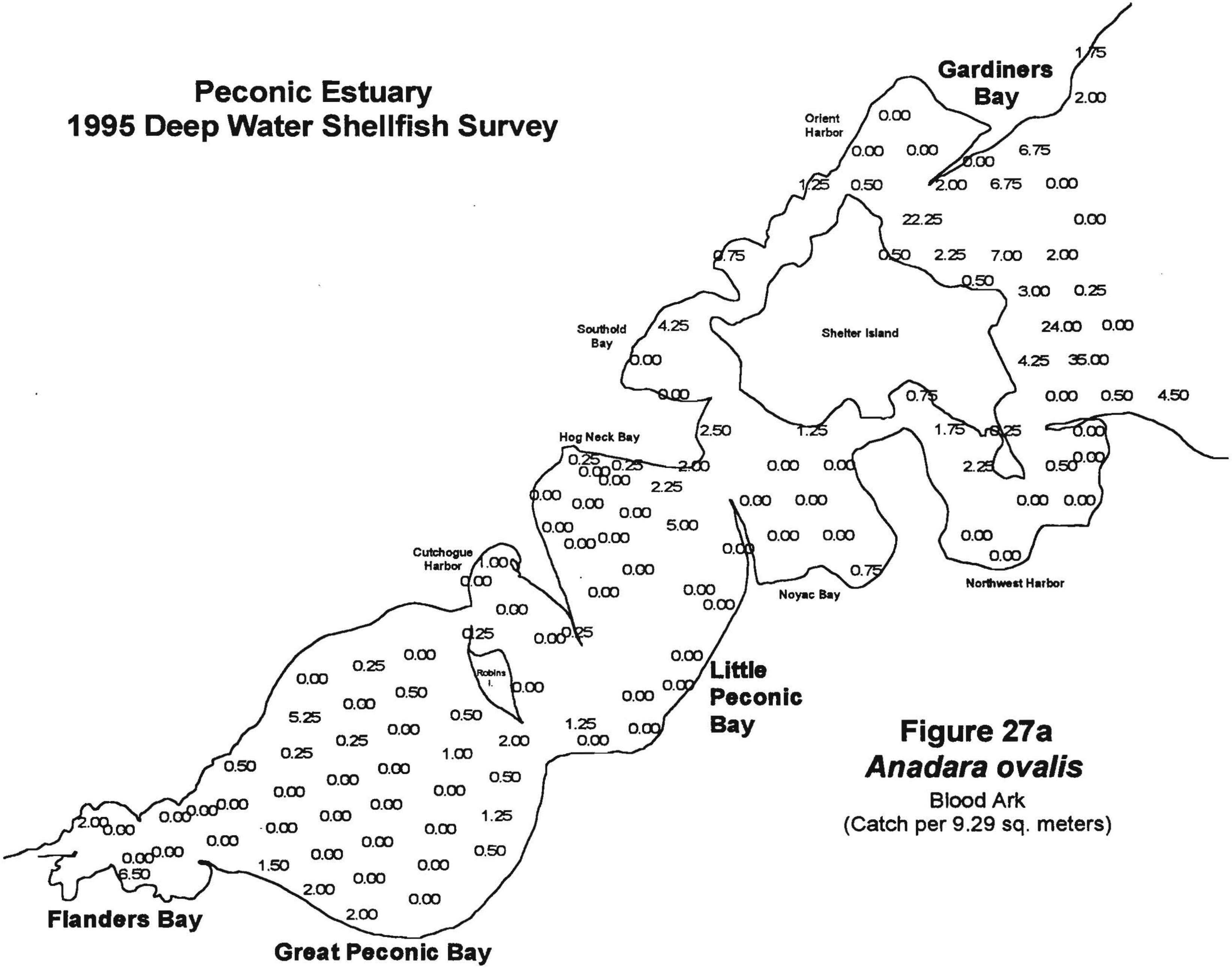

Figure 27a
Anadara ovalis
Blood Ark
(Catch per 9.29 sq. meters)

Peconic Estuary
1995 Deep Water Shellfish Survey

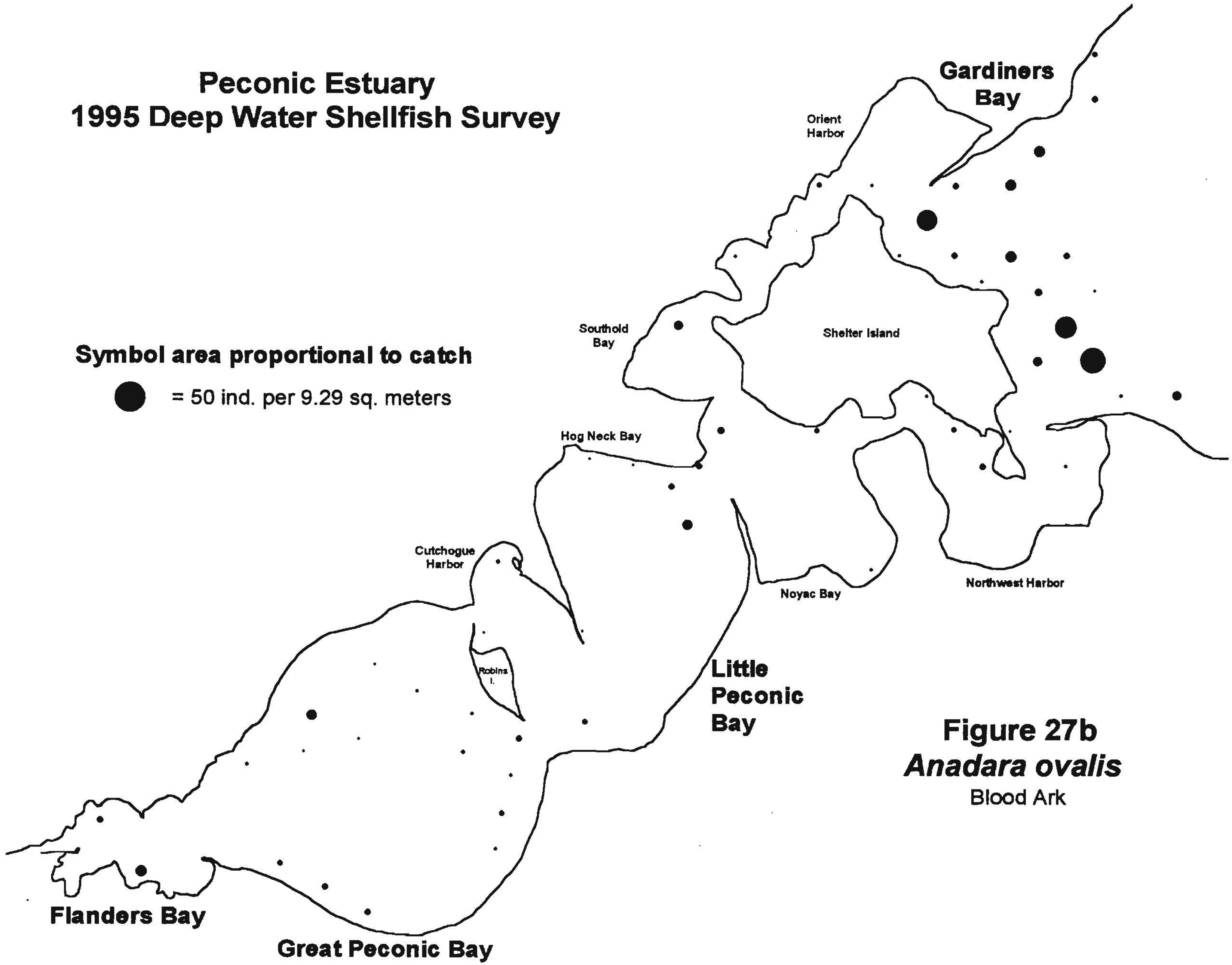

Figure 27b
Anadara ovalis
Blood Ark

Peconic Estuary Shellfish Survey 1979-1980

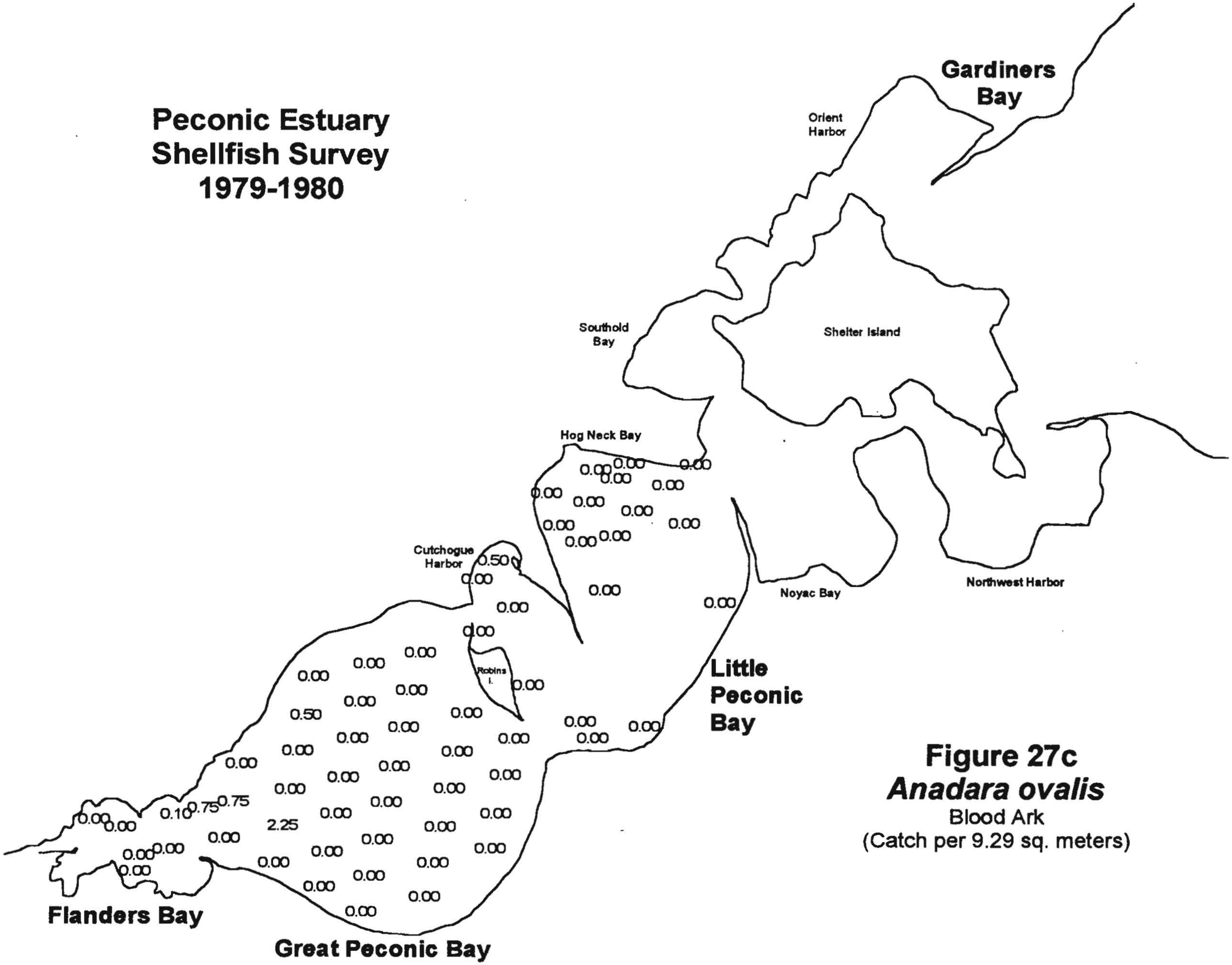

Figure 27c
Anadara ovalis
Blood Ark
(Catch per 9.29 sq. meters)

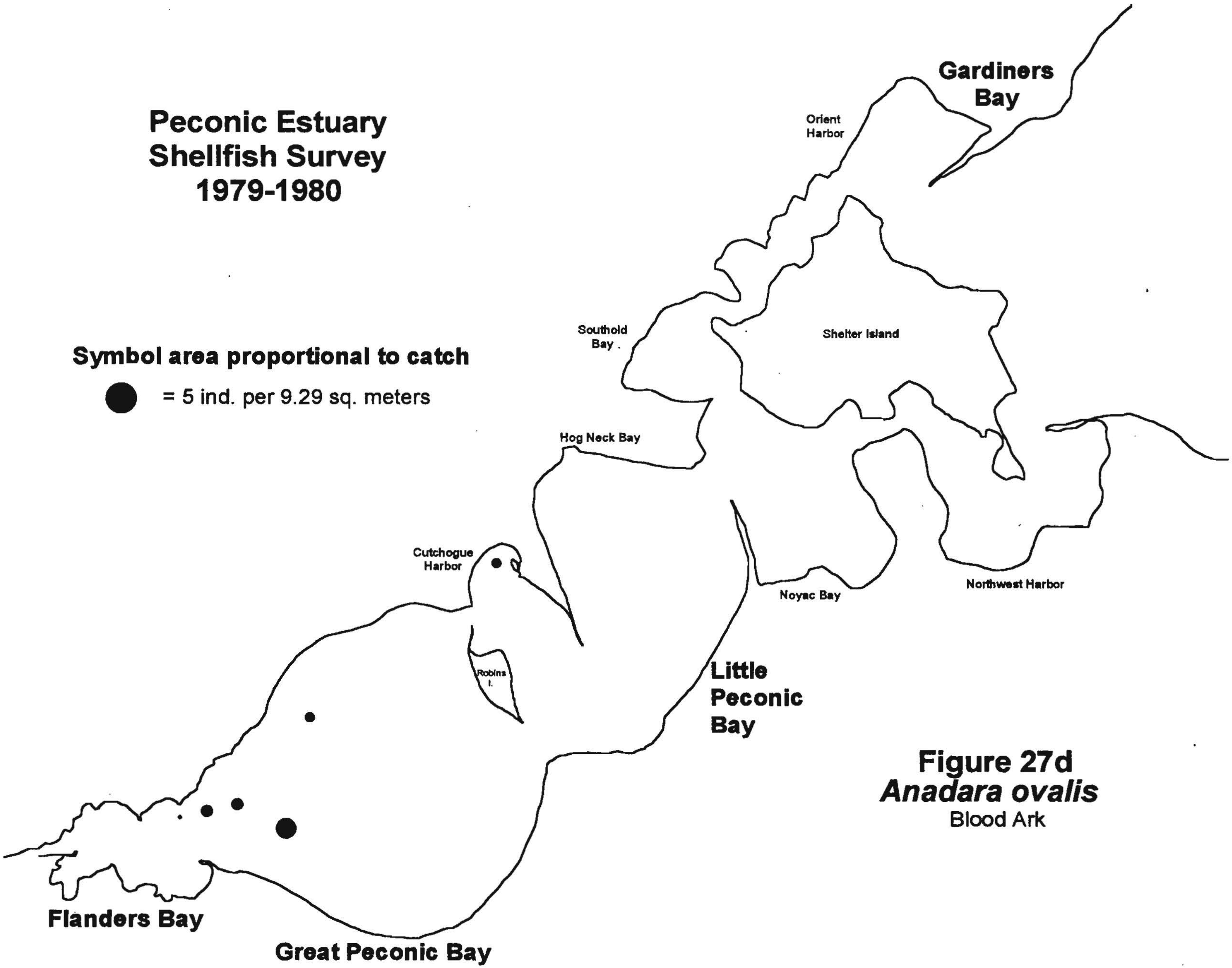

Figure 27d
Anadara ovalis
Blood Ark

Peconic Estuary
1995 Deep Water Shellfish Survey

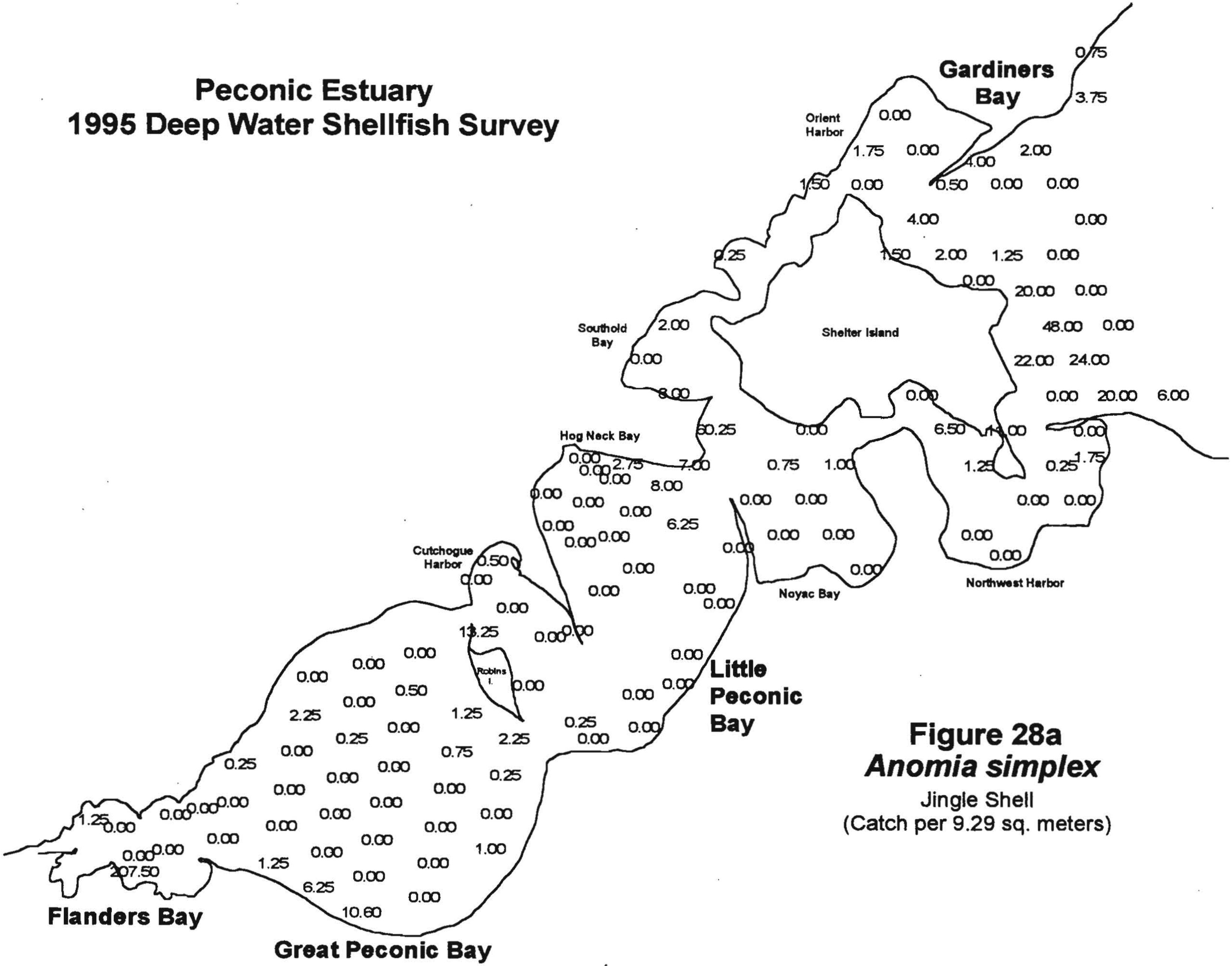

Figure 28a
Anomia simplex
Jingle Shell
(Catch per 9.29 sq. meters)

Peconic Estuary
1995 Deep Water Shellfish Survey

Symbol area proportional to catch

● = 200 ind. per 9.29 sq. meters

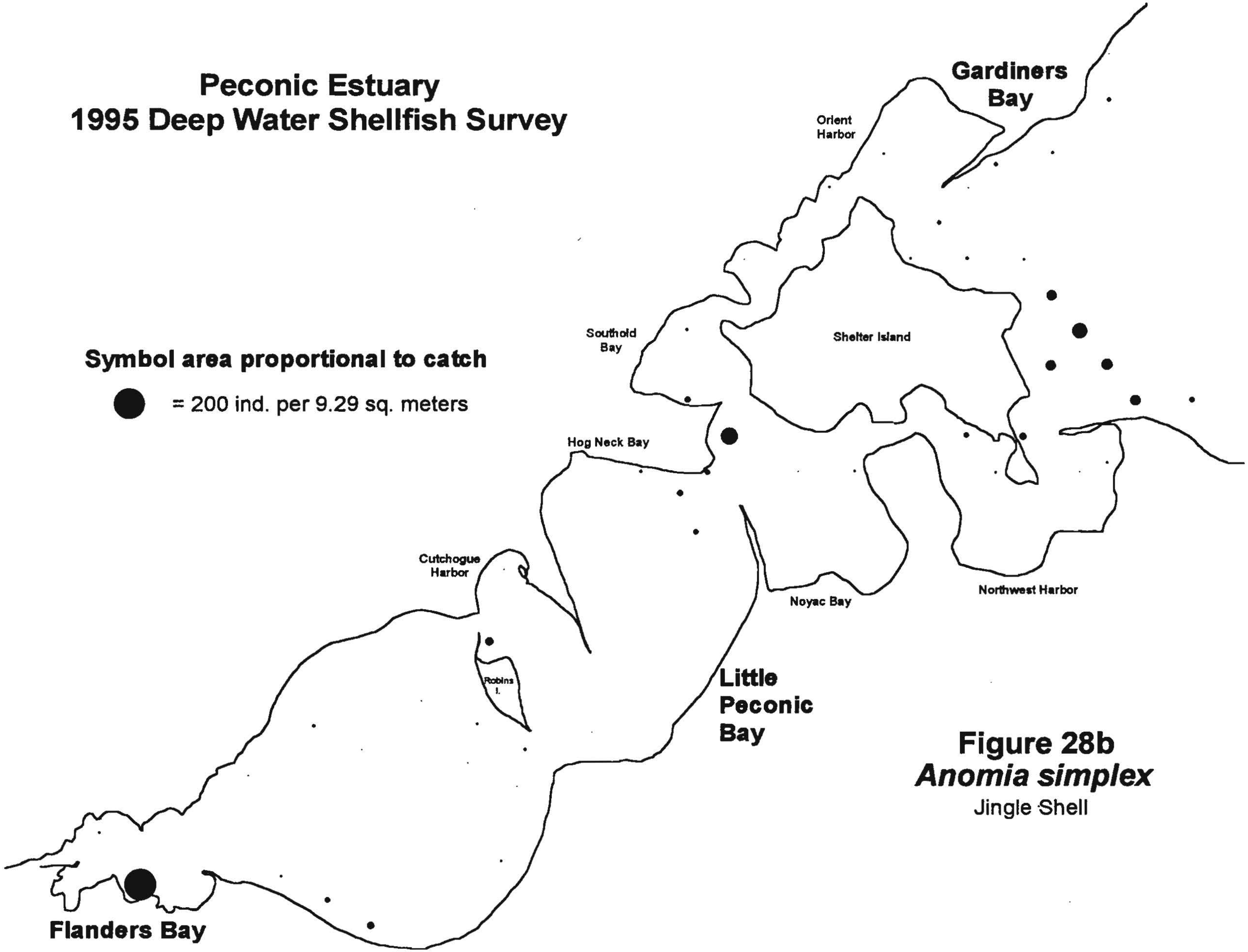

Figure 28b
Anomia simplex
Jingle Shell

Peconic Estuary
1995 Deep Water Shellfish Survey

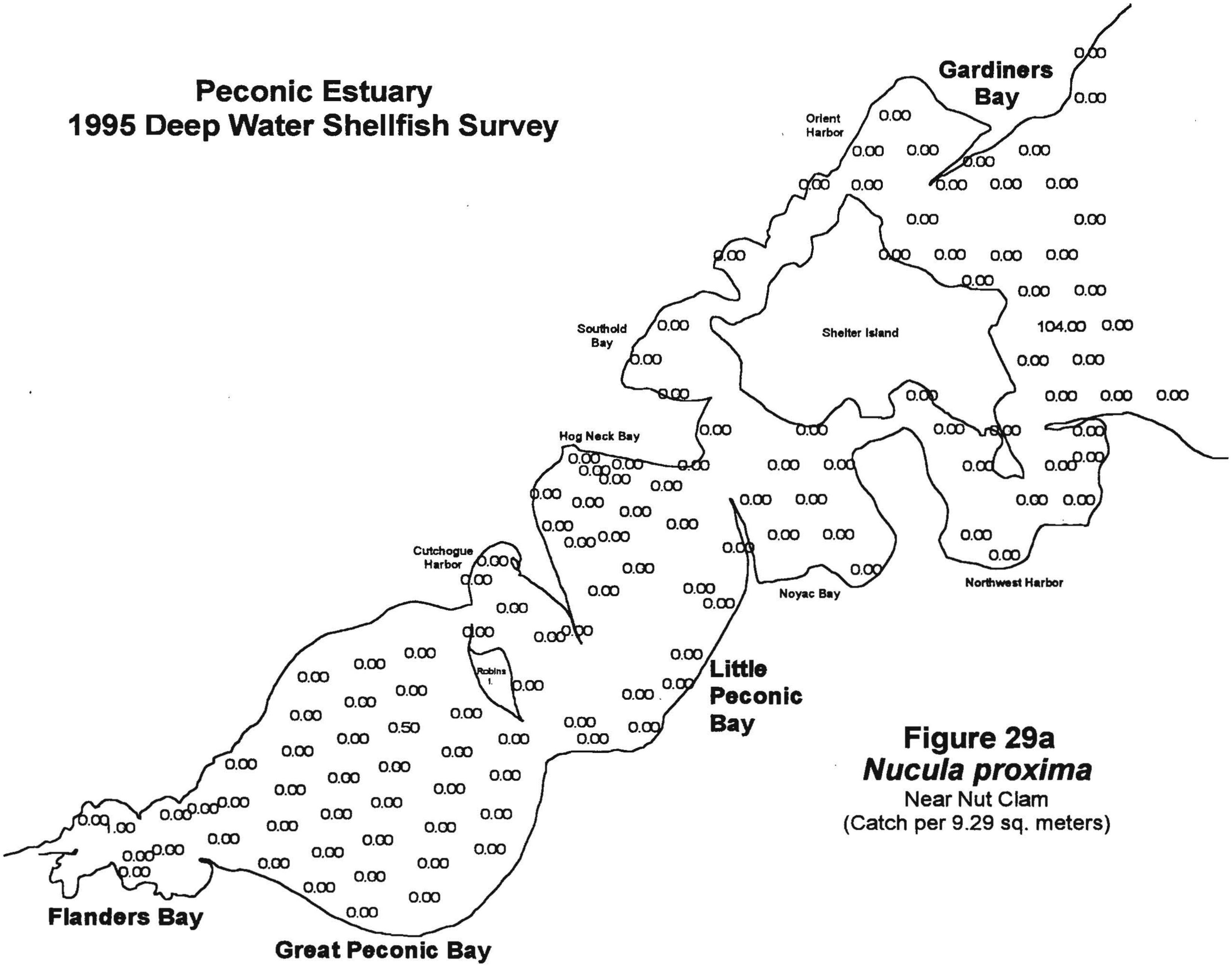

Figure 29a
Nucula proxima
Near Nut Clam
(Catch per 9.29 sq. meters)

Peconic Estuary
1995 Deep Water Shellfish Survey

Symbol area proportional to catch

● = 100 ind. per 9.29 sq. meters

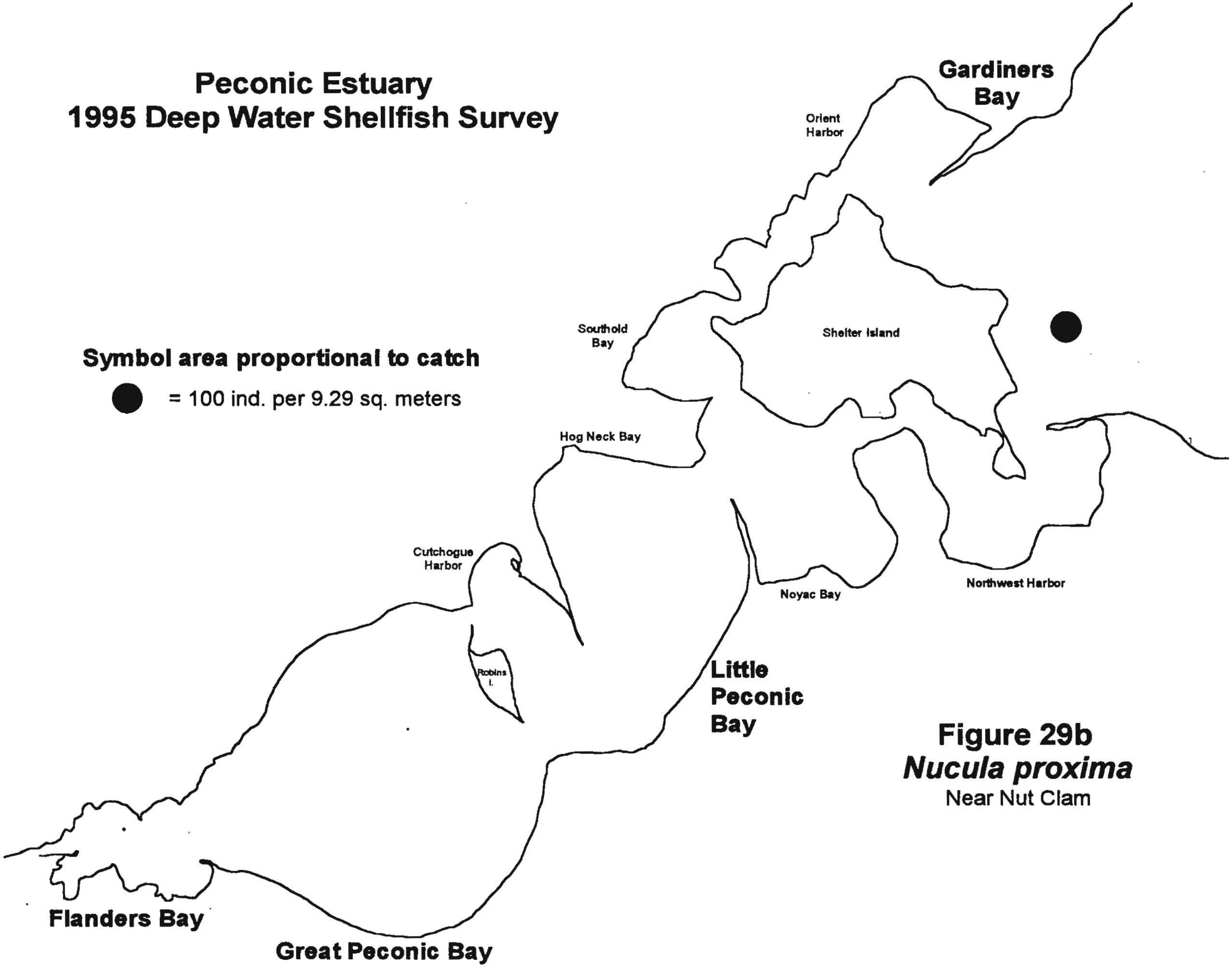

Figure 29b
Nucula proxima
Near Nut Clam

Peconic Estuary
1995 Deep Water Shellfish Survey

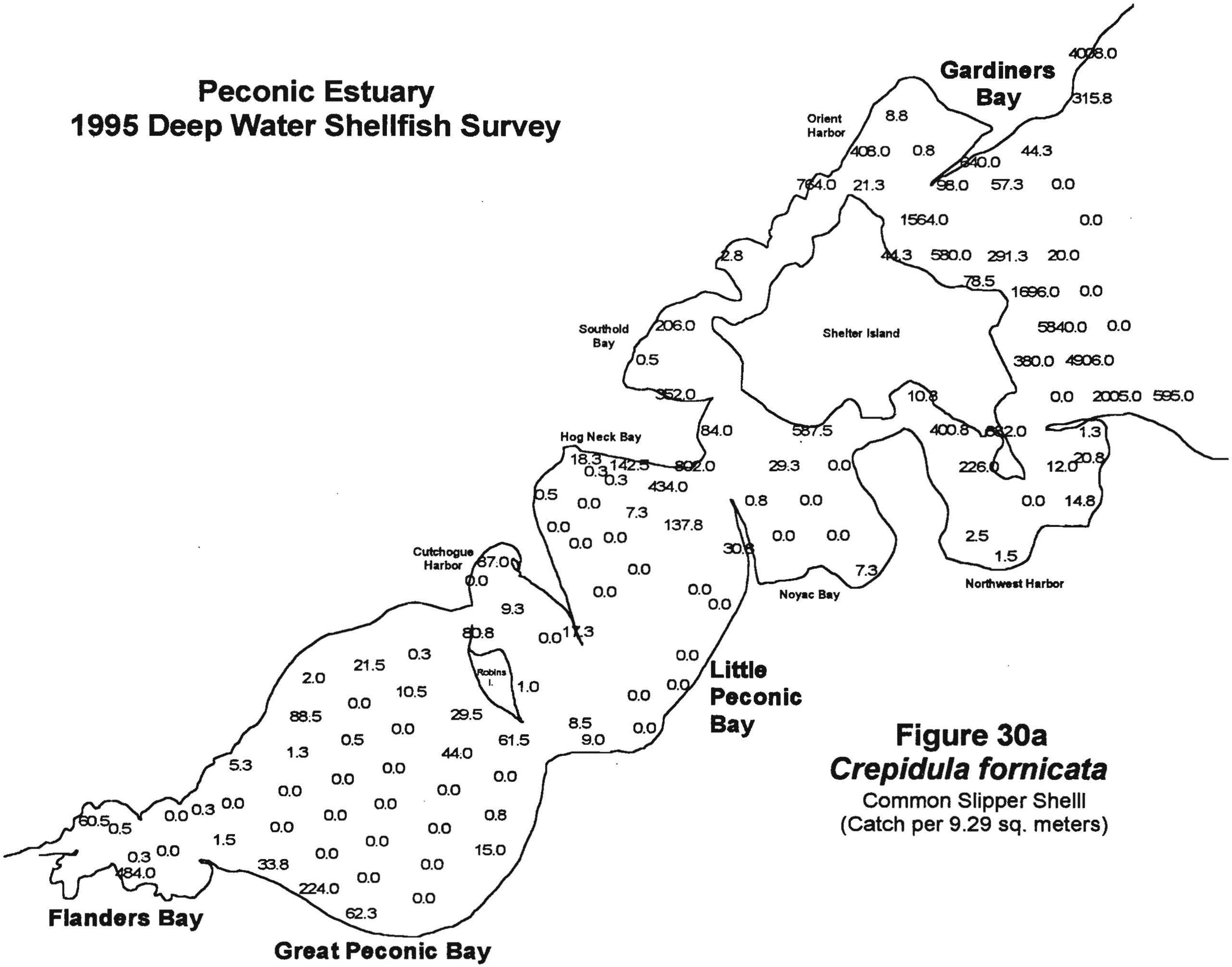

Figure 30a
Crepidula fornicata
Common Slipper Shelll
(Catch per 9.29 sq. meters)

Peconic Estuary
1995 Deep Water Shellfish Survey

Symbol area proportional to catch

● = 6000 ind. per 9.29 sq. meters

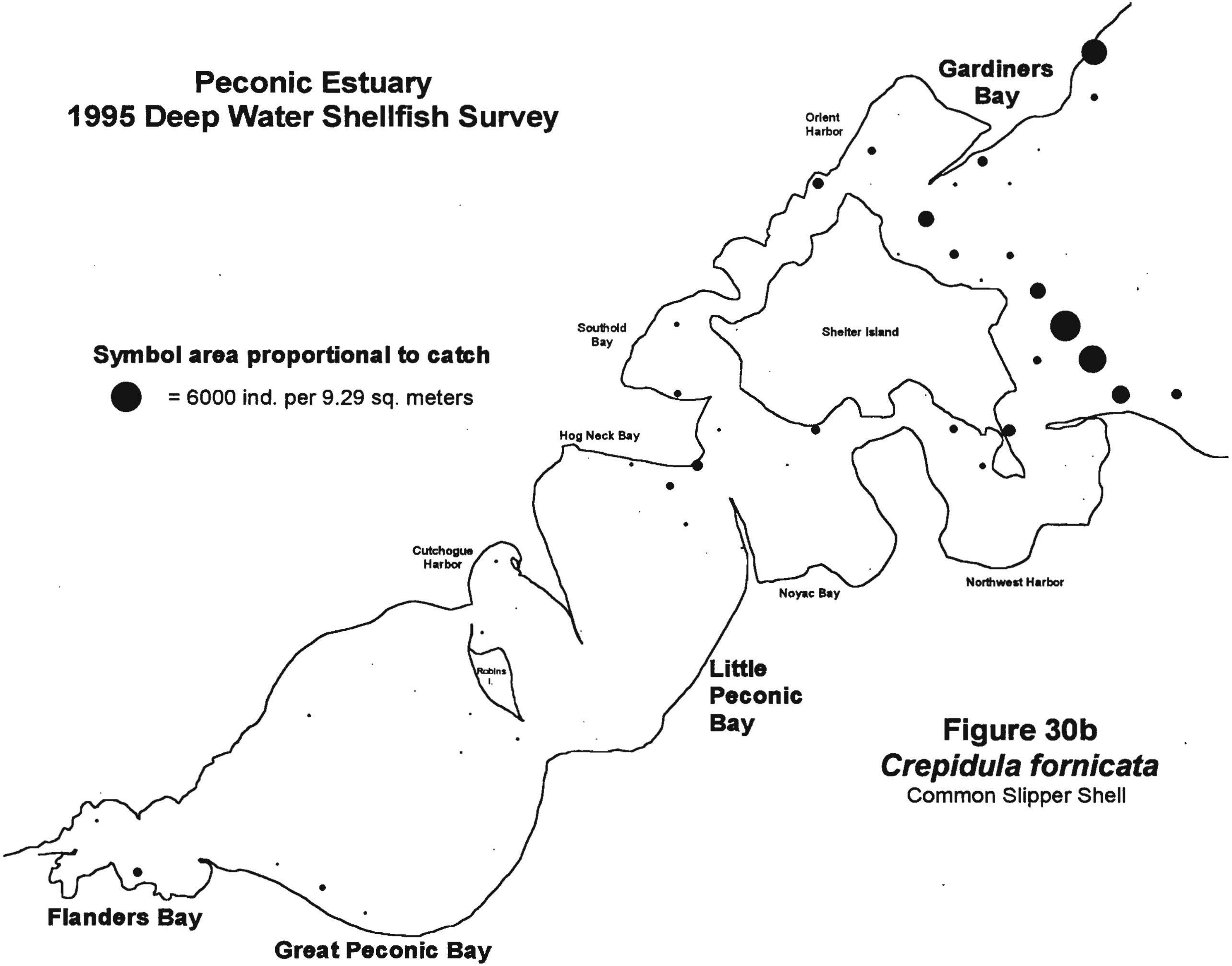

Figure 30b
Crepidula fornicata
Common Slipper Shell

Peconic Estuary
1995 Deep Water Shellfish Survey

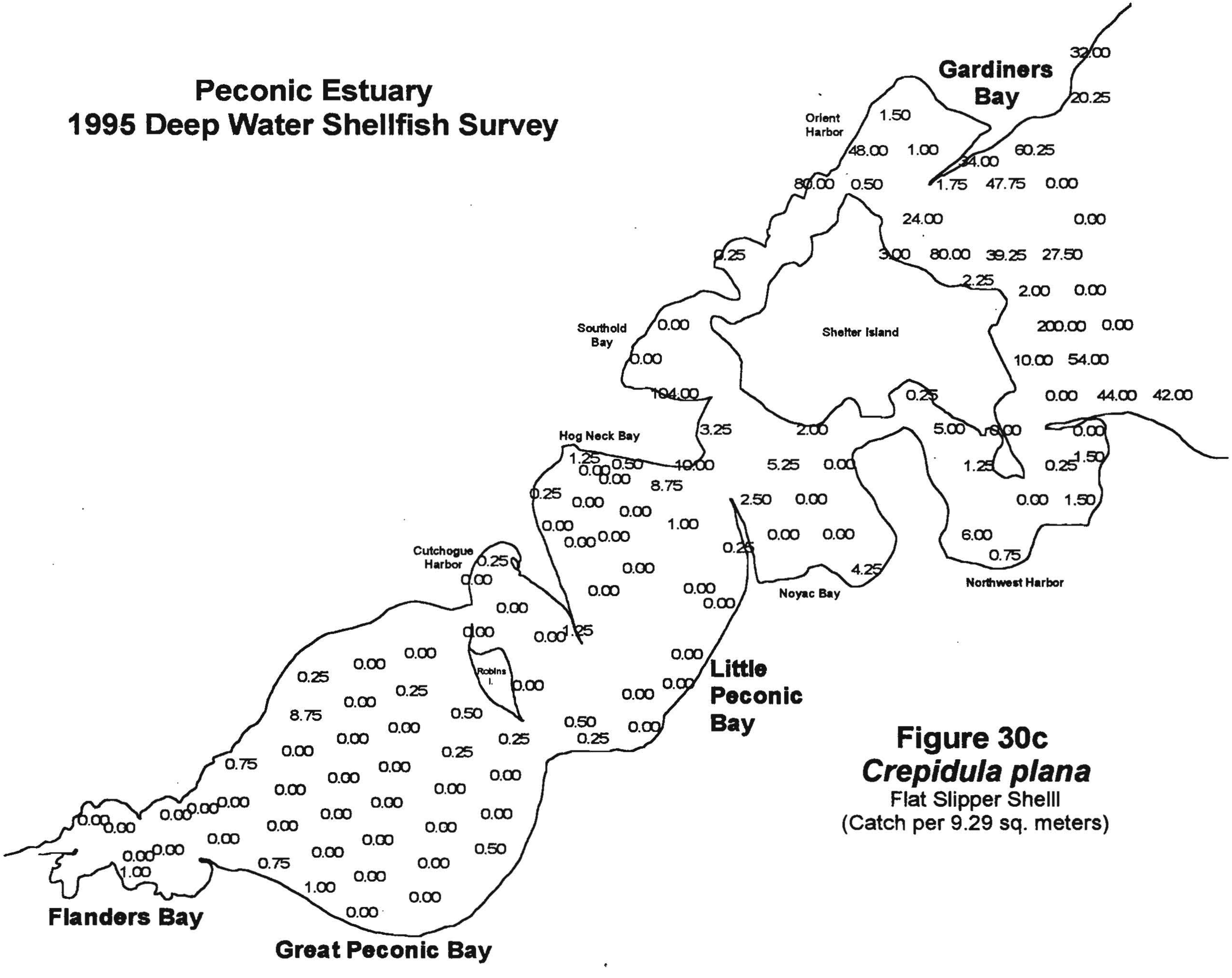

Figure 30c
Crepidula plana
Flat Slipper Shelll
(Catch per 9.29 sq. meters)

Peconic Estuary
1995 Deep Water Shellfish Survey

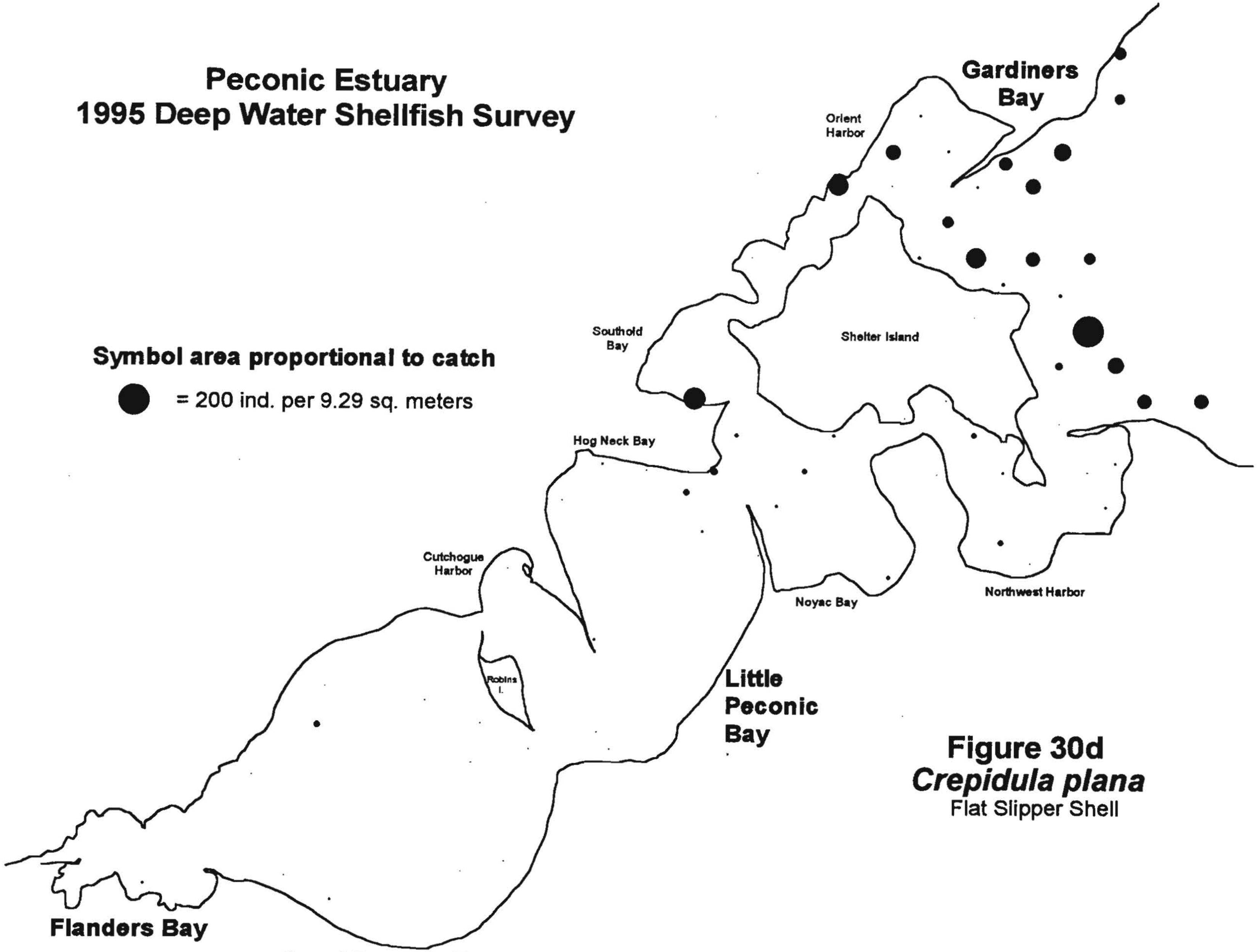

Figure 30d
Crepidula plana
Flat Slipper Shell

Peconic Estuary Shellfish Survey 1979-1980

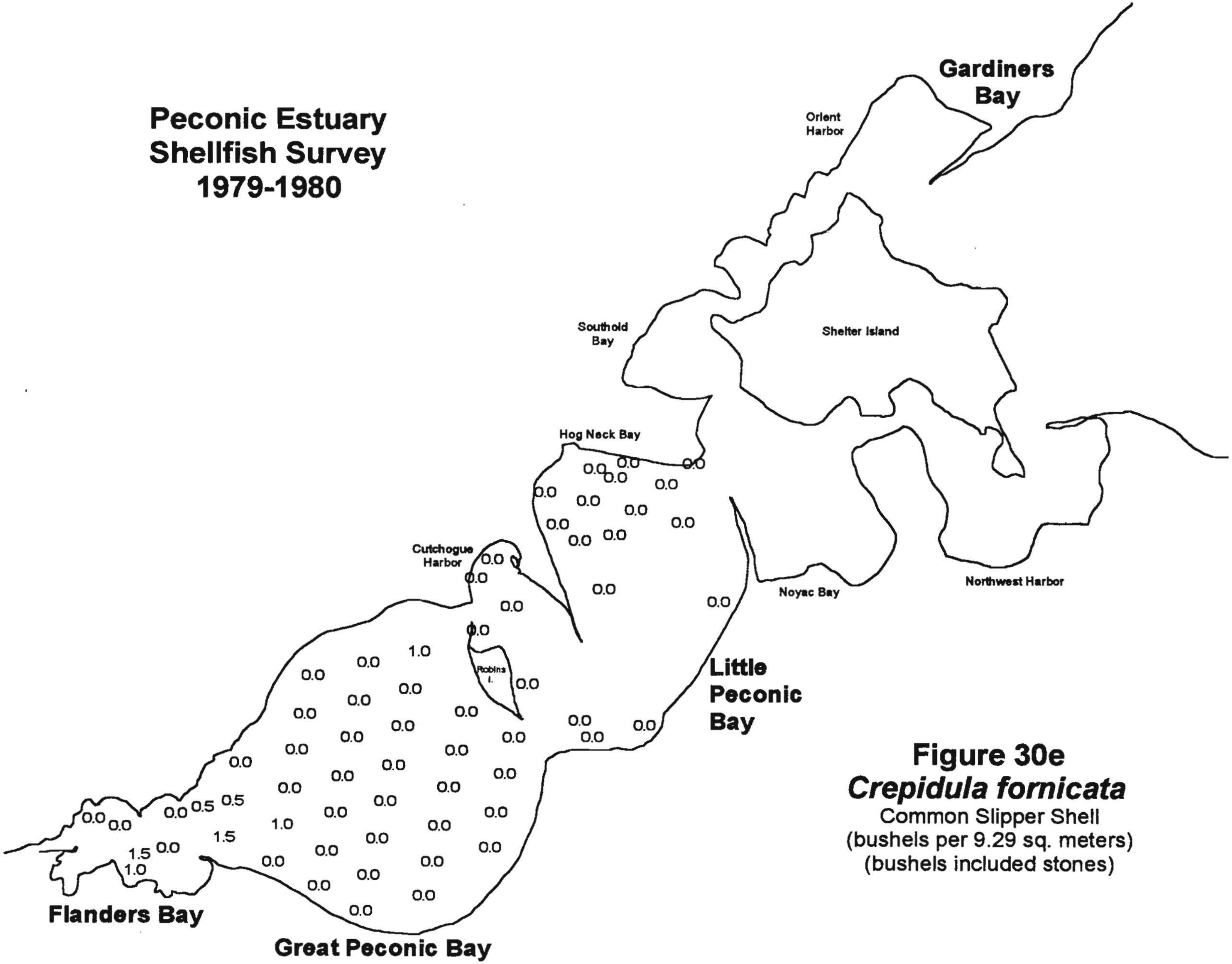

Figure 30e
Crepidula fornicata
Common Slipper Shell
(bushels per 9.29 sq. meters)
(bushels included stones)

Peconic Estuary Shellfish Survey 1979-1980

Symbol area proportional to catch

● = 2 bushels per 9.29 sq. meters
(bushels also included stones)

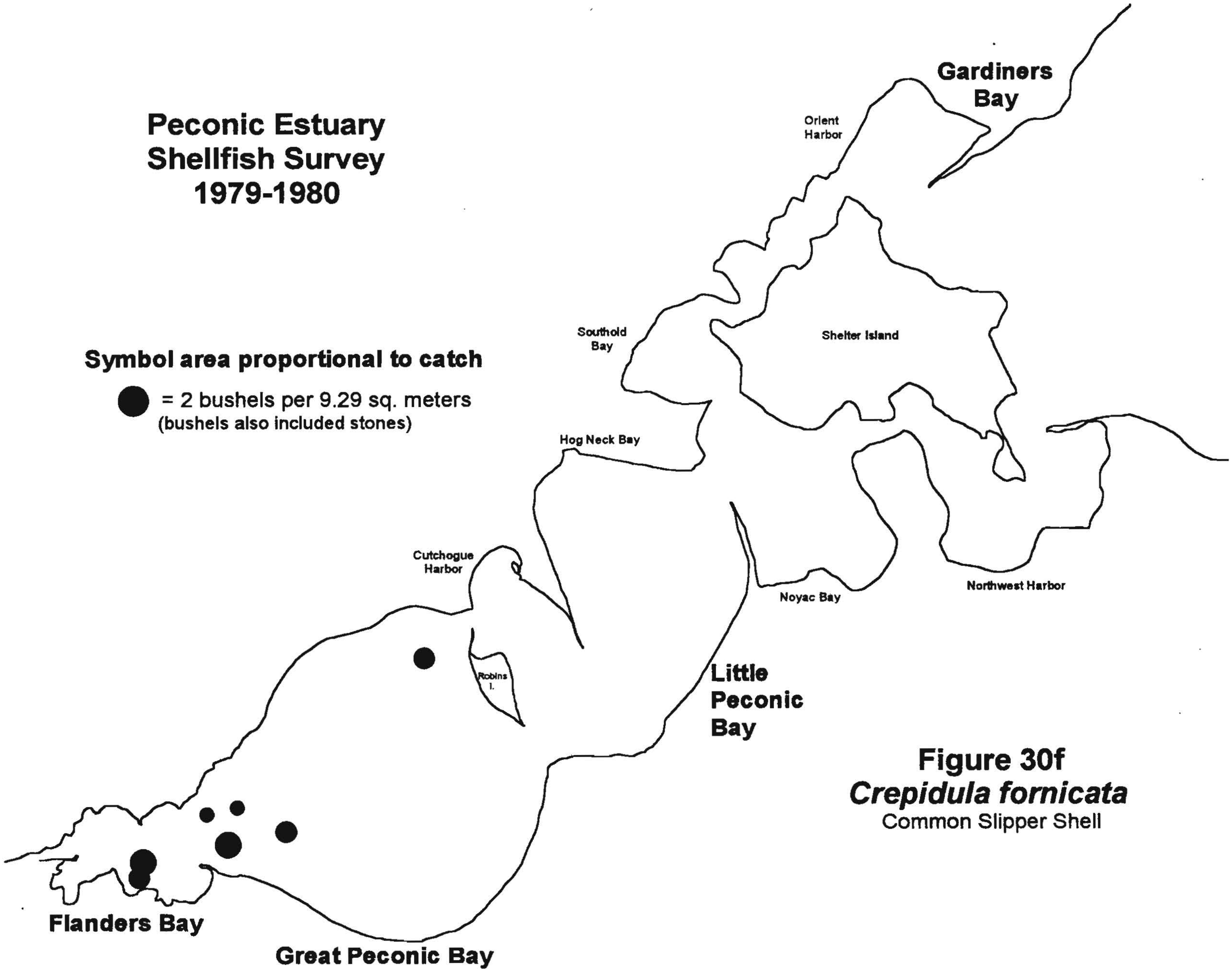

Figure 30f
Crepidula fornicata
Common Slipper Shell

Peconic Estuary
1995 Deep Water Shellfish Survey

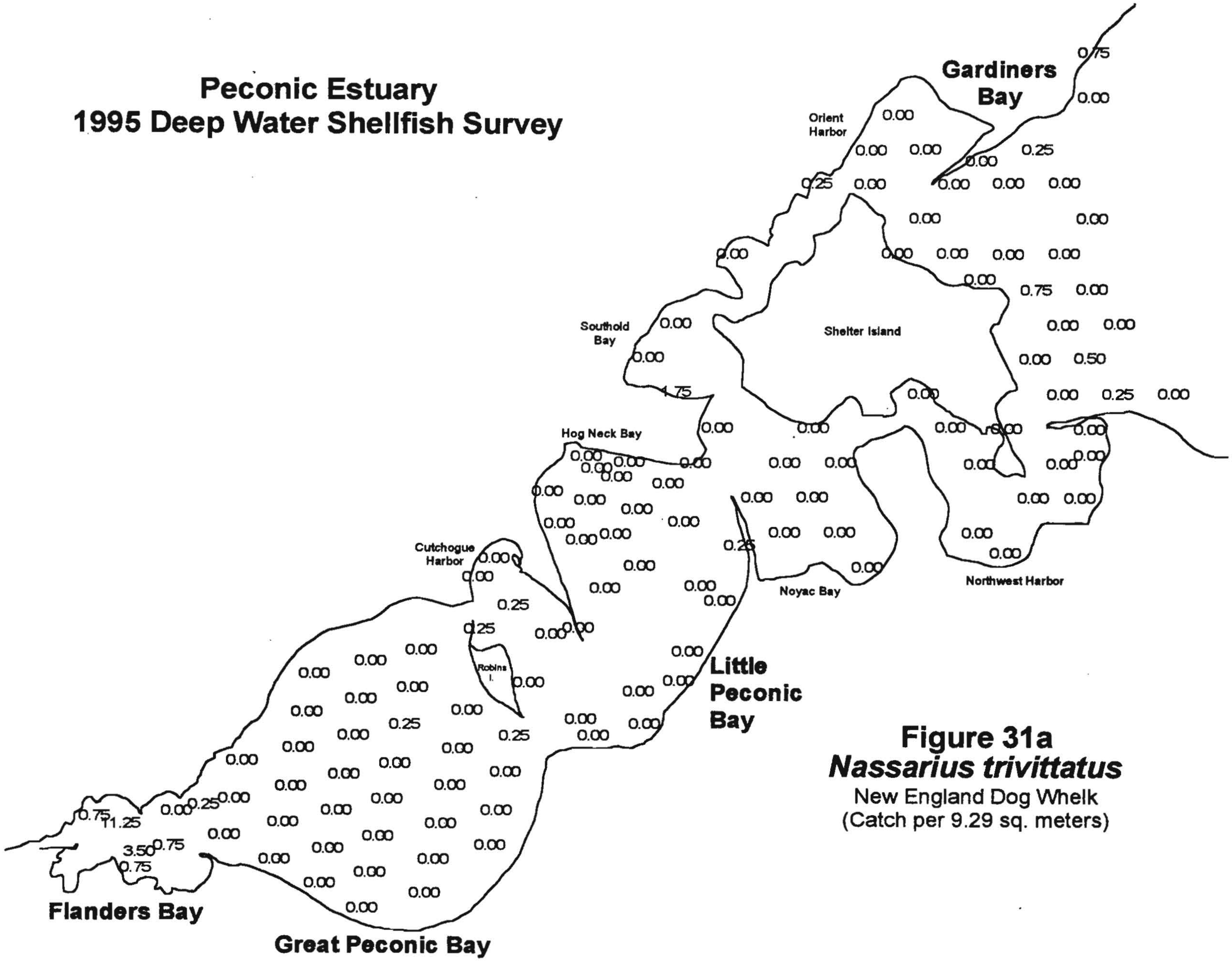

Figure 31a
Nassarius trivittatus
New England Dog Whelk
(Catch per 9.29 sq. meters)

Peconic Estuary
1995 Deep Water Shellfish Survey

Symbol area proportional to catch

● = 20 ind. per 9.29 sq. meters

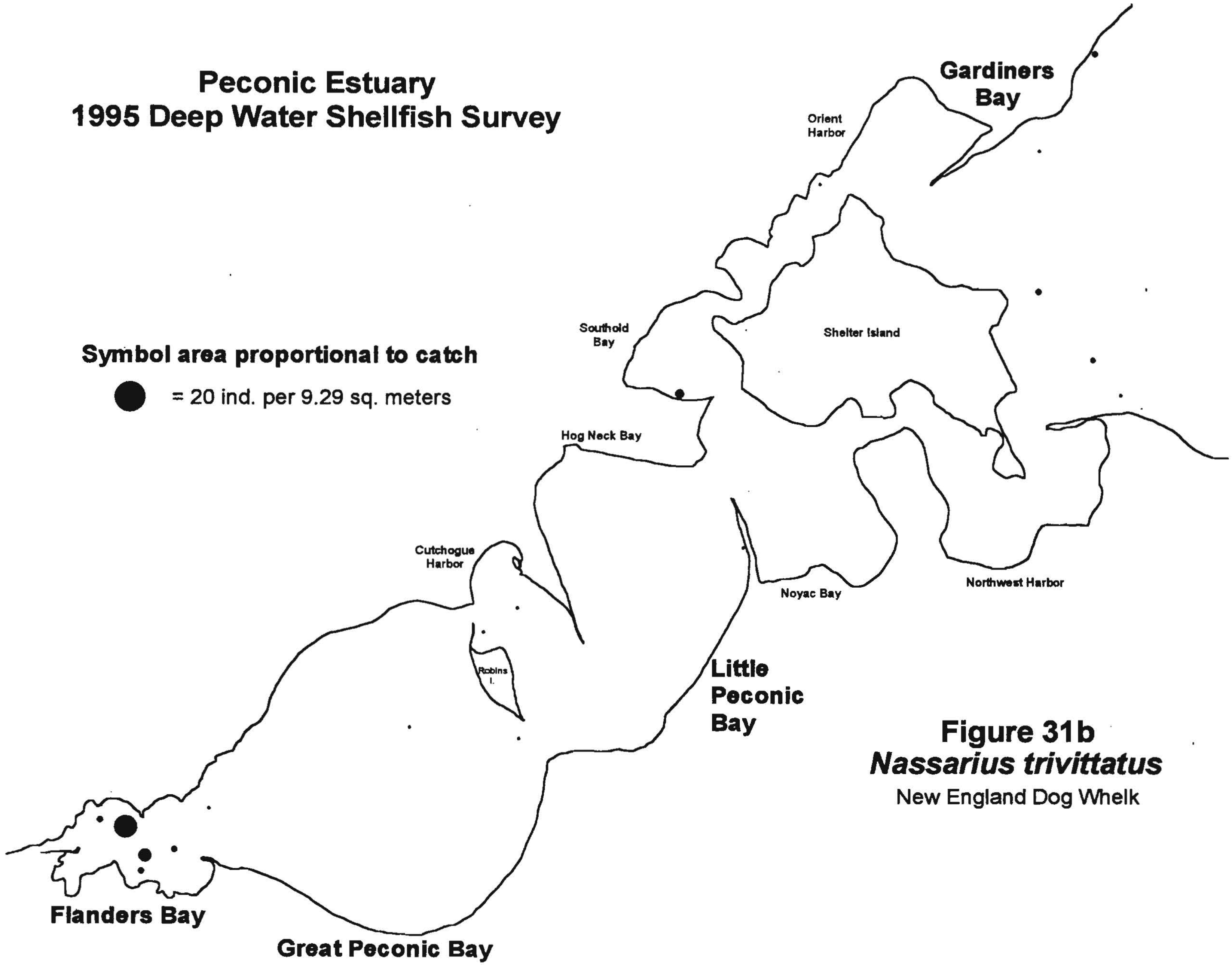

Figure 31b
Nassarius trivittatus
New England Dog Whelk

Peconic Estuary
1995 Deep Water Shellfish Survey

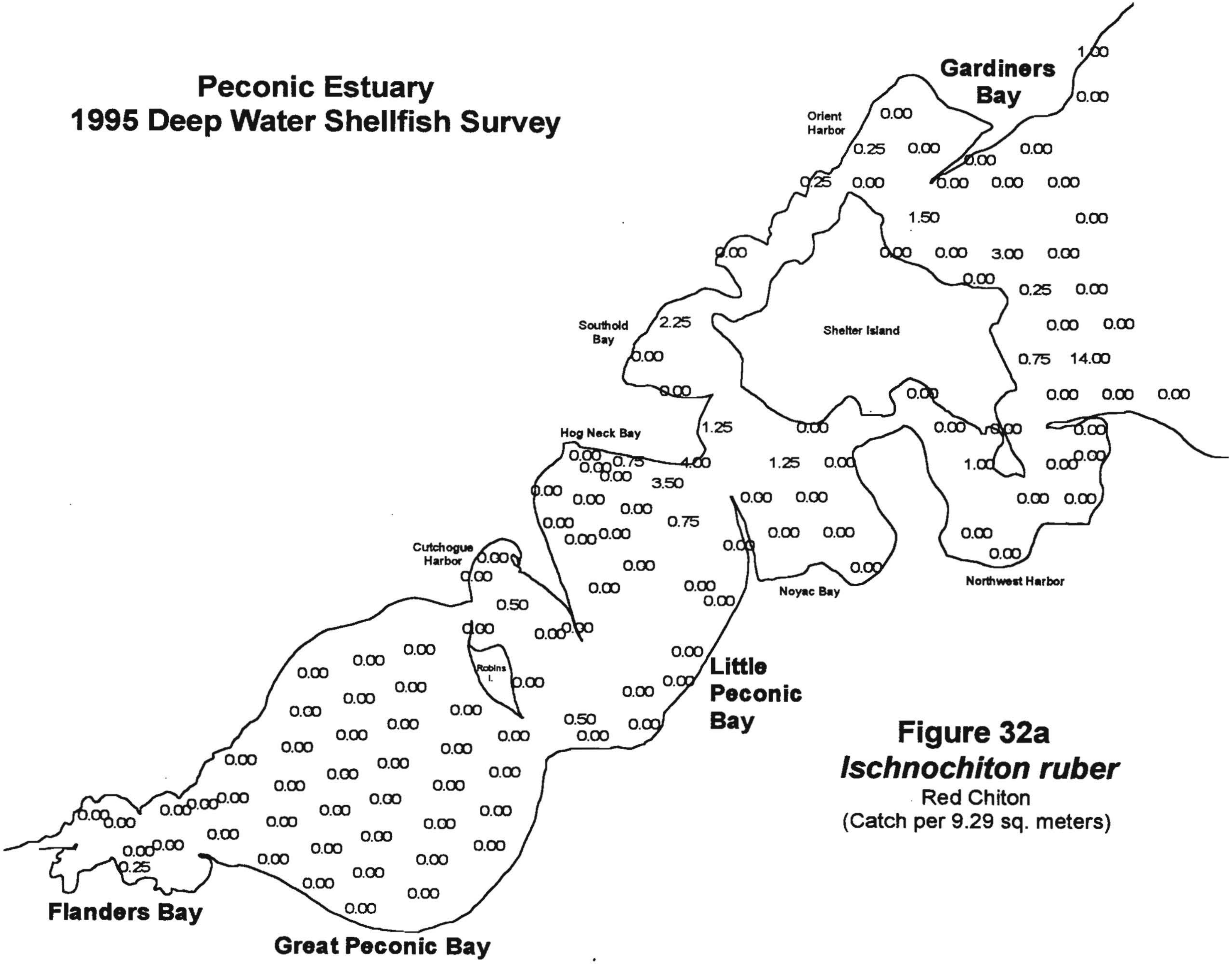

Figure 32a
Ischnochiton ruber
Red Chiton
(Catch per 9.29 sq. meters)

Peconic Estuary
1995 Deep Water Shellfish Survey

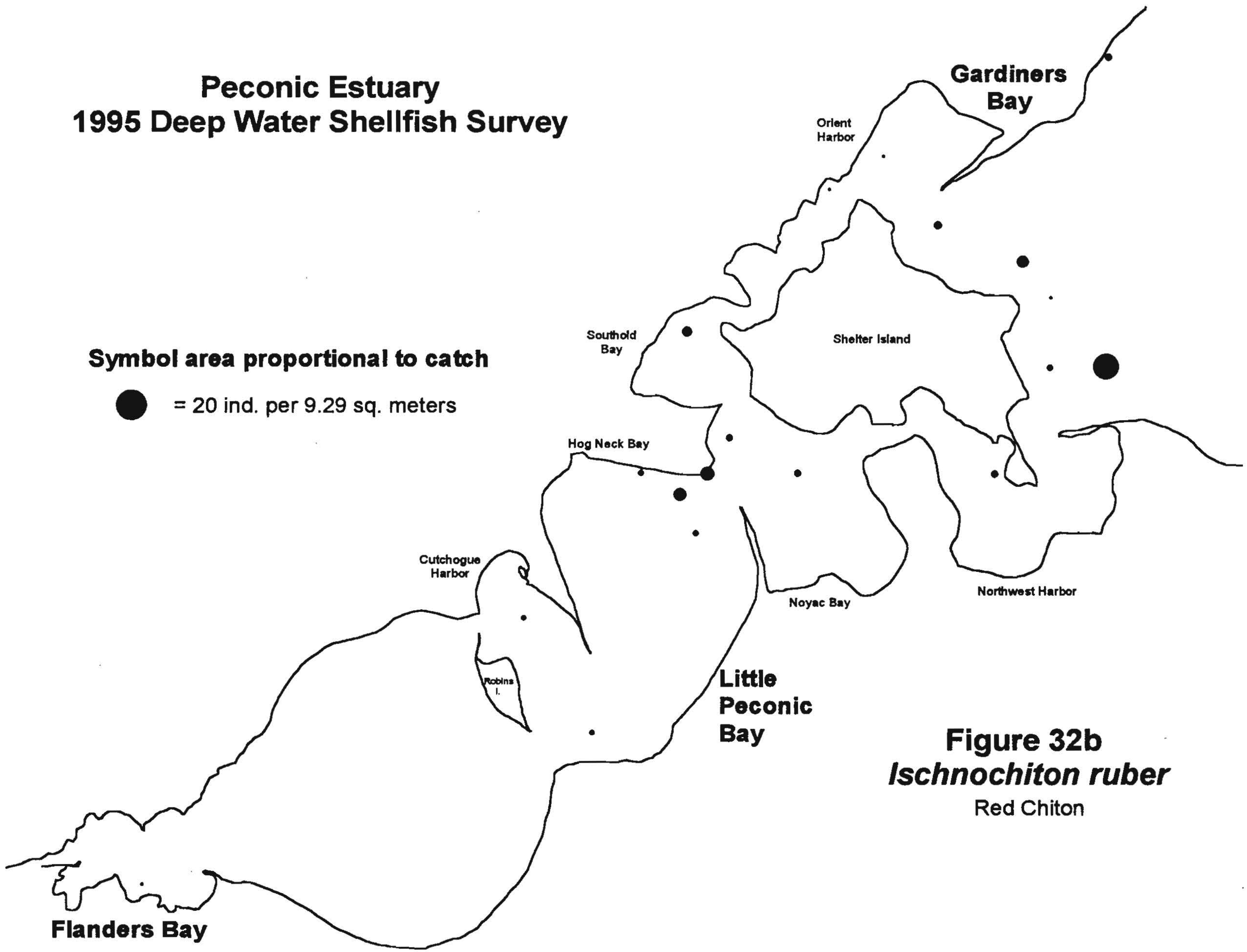

Figure 32b
Ischnochiton ruber
Red Chiton

Peconic Estuary
1995 Deep Water Shellfish Survey

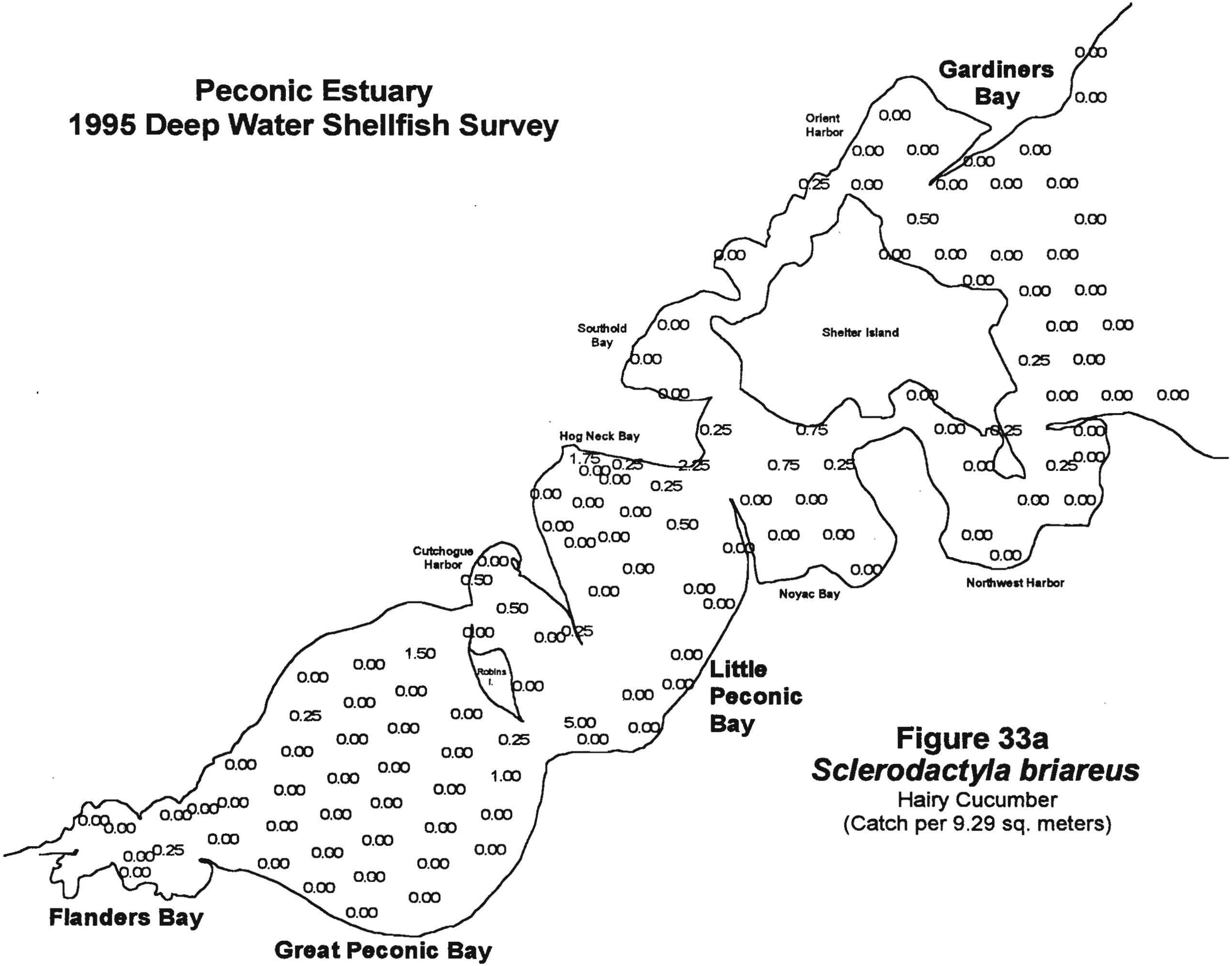

Figure 33a
Sclerodactyla briareus
Hairy Cucumber
(Catch per 9.29 sq. meters)

Peconic Estuary
1995 Deep Water Shellfish Survey

Symbol area proportional to catch

● = 10 ind. per 9.29 sq. meters

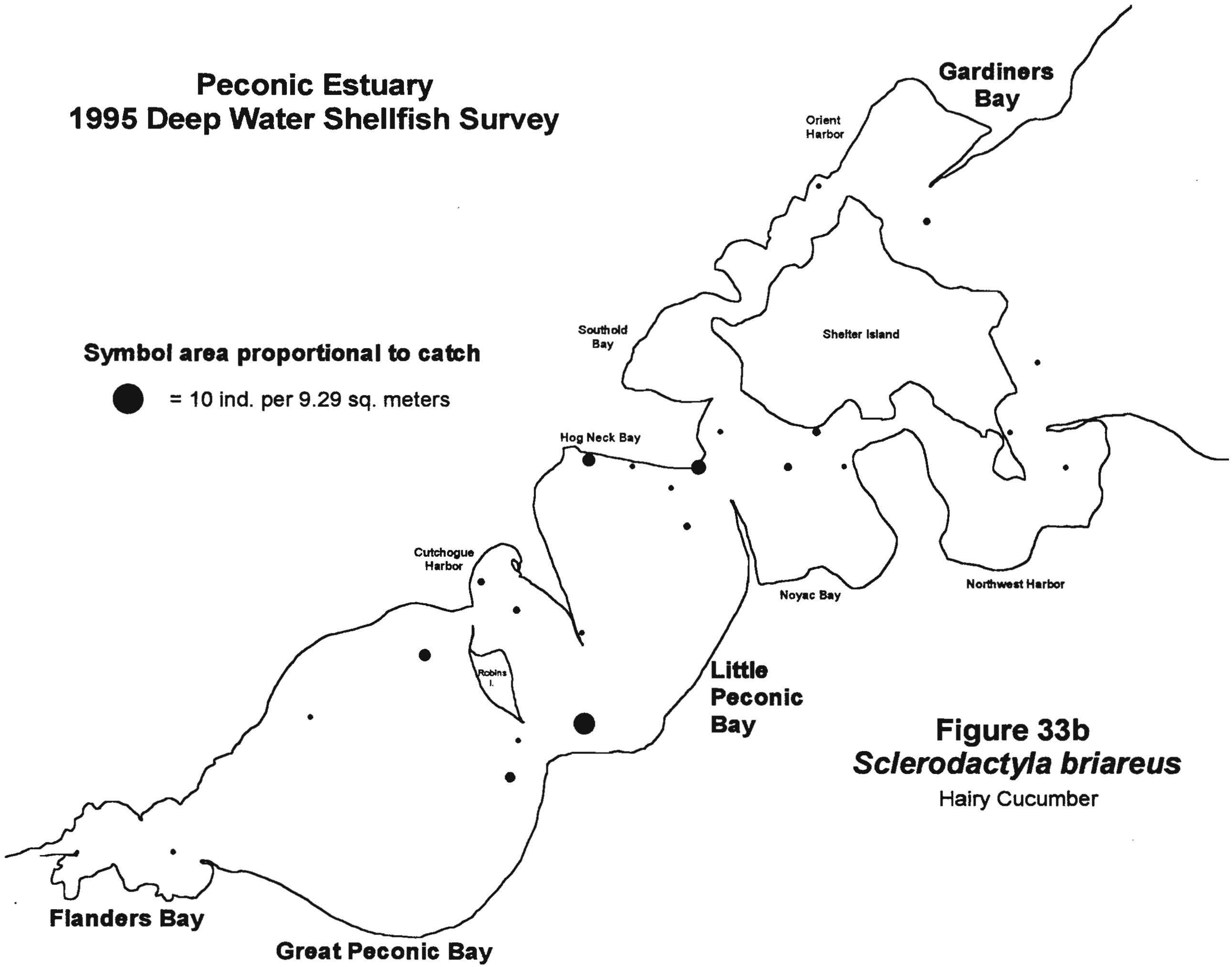

Figure 33b
Sclerodactyla briareus
Hairy Cucumber

Peconic Estuary
1995 Deep Water Shellfish Survey

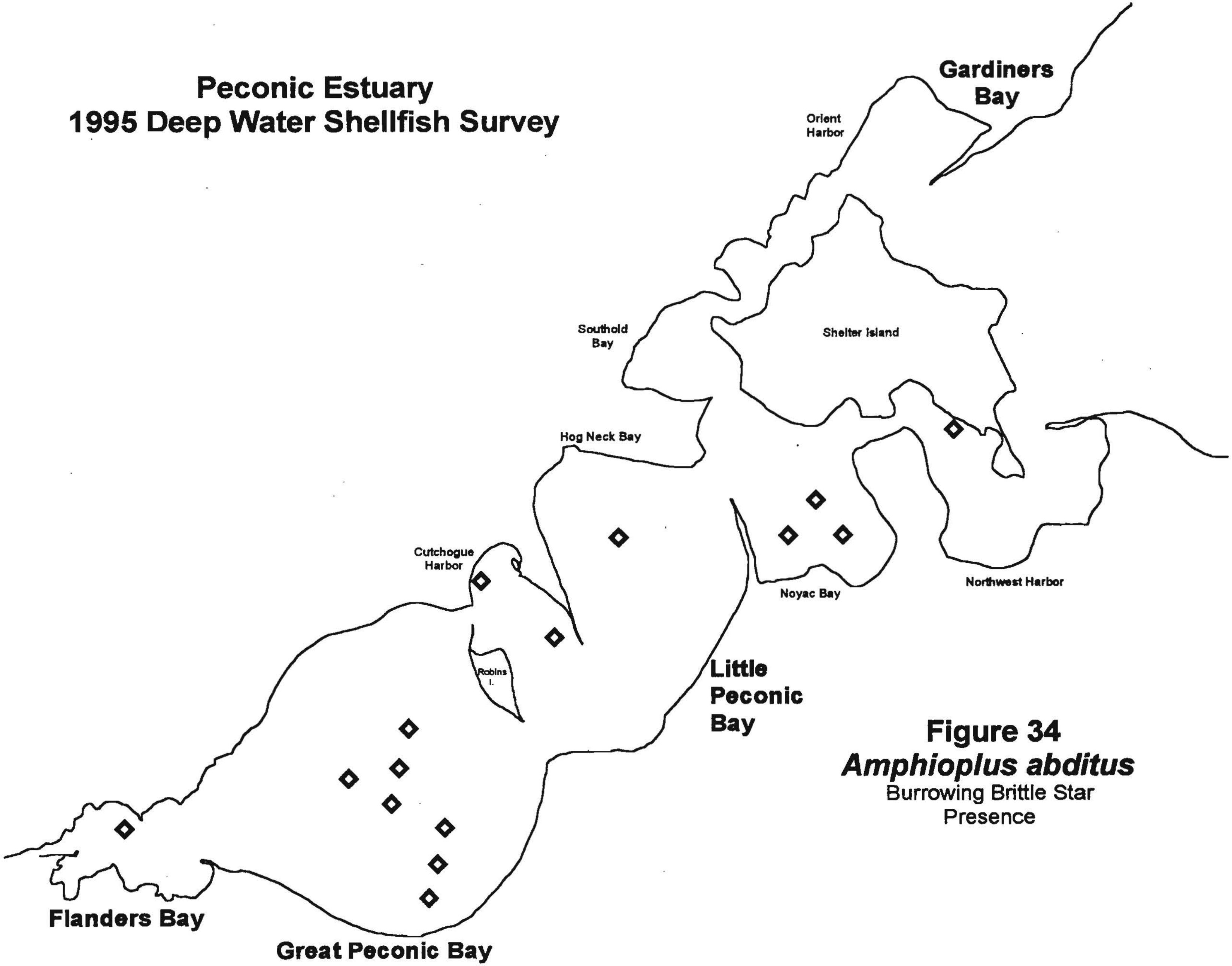

Figure 34
Amphioplus abditus
Burrowing Brittle Star
Presence

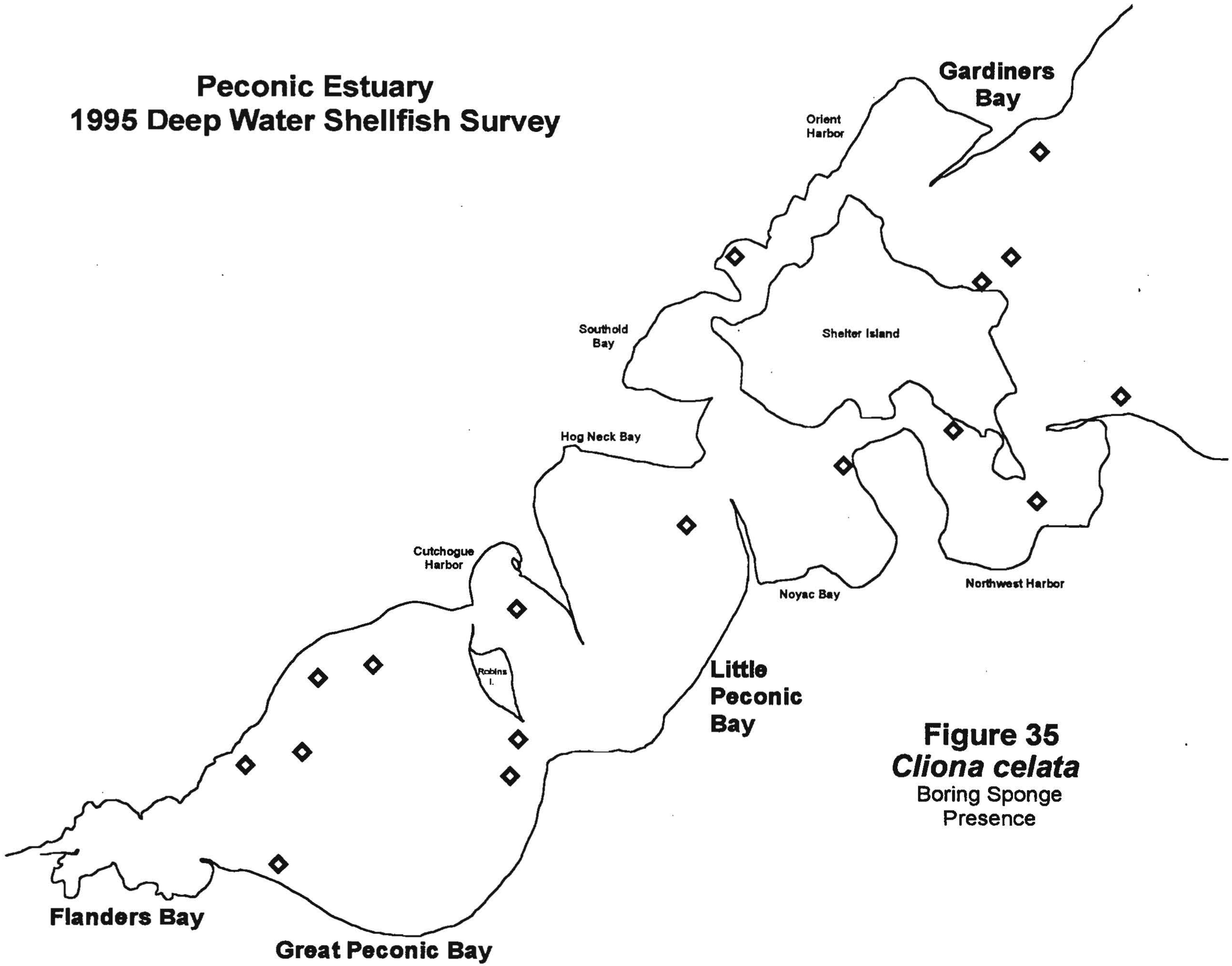

Figure 35
Cliona celata
Boring Sponge
Presence

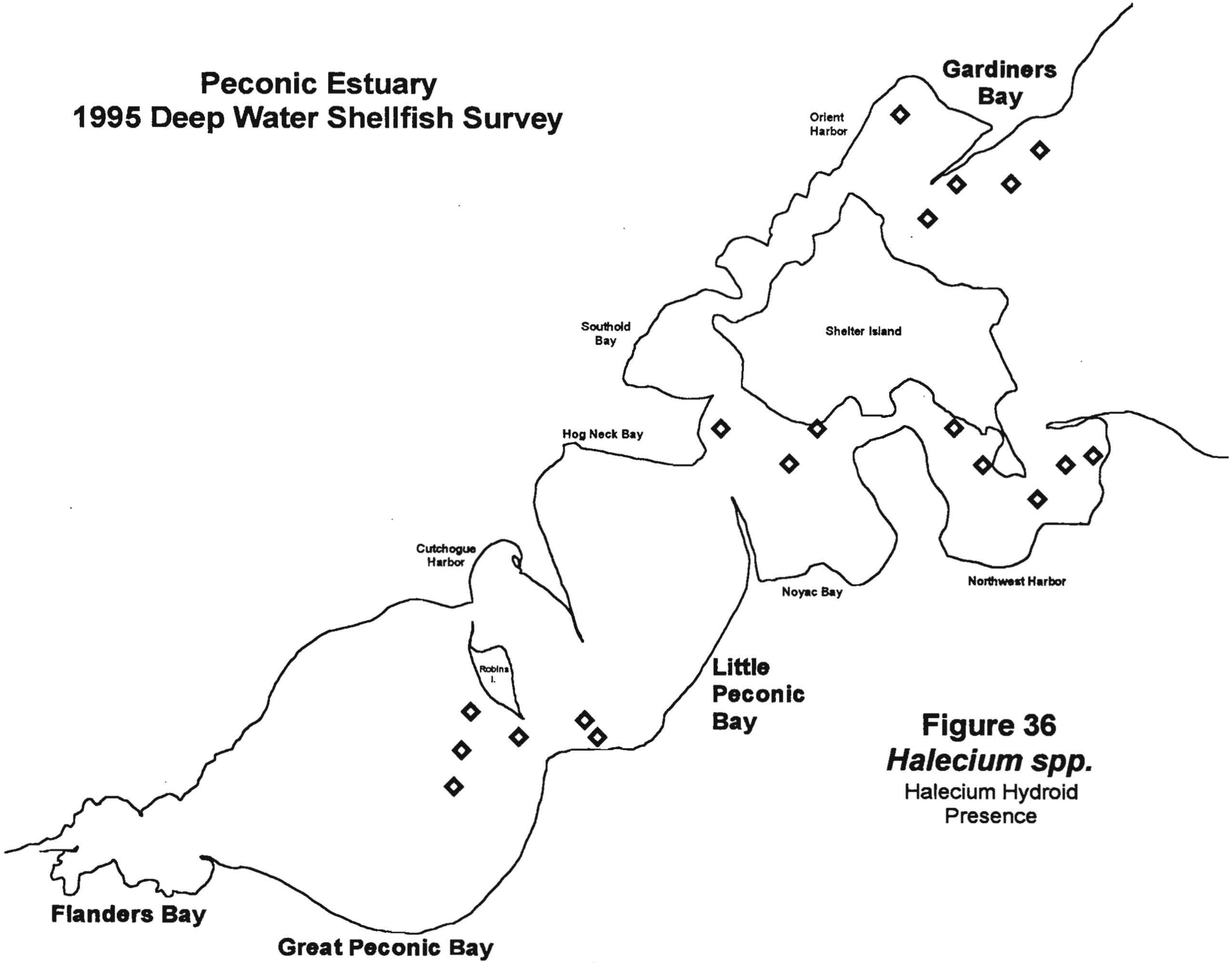

Figure 36
Halecium spp.
Halecium Hydroid
Presence

Appendix A

Data Tabulation by Station.

Key

Location:

FB	Flanders Bay
GPB	Great Peconic Bay
CH	Cutchogue Harbor
LPB	Little Peconic Bay
HNB	Hog Neck Bay
NYB	Noyac Bay
SHB	Southold Bay
PC+	Pipes Cove (and surrounding waters)
OH	Orient Harbor
SMC	Smith Cove
NWH	Northwest Harbor
GB	Gardiners Bay

Sediment:

Sa	Sand
Ms	Muddy sand
Sm	Sandy Mud
Mu	Mud
Mc	Mud/Clay
Cl	Clay
St	Stone
Sh	Shell
nst	No sediment trace in sample. (Likely thin mud.)
PB	Private Bottom (No sample taken.)
Co	*Codium*
Ul	*Ulva*
Gr	Eelgrass
De	Dead Eelgrass
Hy	Hydroids
Bs	Brittle Stars

Values are average catch per 9.29 sq. meters.

Station	1	2	3	4	5	6	7	8	9	10	11	12
Location	FB	FB	FB	FB	FB	FB	FB	FB	GPB	GPB	GPB	GPB
Latitude (degrees)	40	40	40	40	40	40	40	40	40	40	40	40
Latitude (min.sec)	55.49	55.6	54.99	54.69	55.74	55.08	55.78	54.63	56.51	55.95	55.31	58.05
Longitude (degrees)	-72	-72	-72	-72	-72	-72	-72	-72	-72	-72	-72	-72
Longitude (min.sec)	36.49	35.86	35.4	35.47	34.66	34.81	34.09	34.33	33.33	33.38	33.58	31.81
Depth (feet)	7.4	12	12	8	13	10	10		8.6	19	15.2	15
Sediment	SaSh StAt	ShUI At	StSh Ms	MsSt	ShMs	MuAt Sh	n/a	PL	ShSt Sa	n/a	StSh Ms	StMs
Hard Clam Seed												
Hard Clam Littleneck	0.25										0.25	
Hard Clam Cherrystone				0.25							0.5	
Hard Clam Chowder	12		1.5	7.75		0.5	1		2.75		2.5	4.25
Hard Clam Total	12.25		1.5	8		0.5	1		2.75		3.25	4.25
Scallop (Sublegal)												
Scallop (Legal)												
Knobbed Whelk	1	1		1.75								
Channelled Whelk	0.25	0.25										
Oyster Drill	0.25											
Crepidula fornicata	60.5	0.5	0.5	484			0.25		5.25		1.5	2
Crepidula plana				1					0.75			0.25
Sea Star		0.25										
LongClawed Hermit Crab					0.25							
FlatClawed Hermit Crab												
Spider Crab				0.25	0.25							
Mud Crab	1.5	1	0.25	1.5	3	0.5			0.25		0.5	
Lady Crab	1.75			1.5		0.5	1.75		0.5			0.25
Rock Crab												
Horseshoe Crab		0.5										
Blood Ark	2			6.5					0.5			
Jingles	1.25			207.5					0.25			
Dog Whelk	0.75	11.25	3.5	0.75		0.75	0.25					
Hairy Cucumbers						0.25						
Sponges									Yes			Yes
Brittle Stars		Yes										
Razor Clam												
Chiton				0.25								
Nut Clams		1										
Hydroid												
Surf clam												

Station	13	14	15	16	17	18	19	20	21	22	23	24
Location	GPB	GPB	GPB	GPB	GPB	GPB	GPB	GPB	GPB	GPB	GPB	GPB
Latitude (degrees)	40	40	40	40	40	40	40	40	40	40	40	40
Latitude (min.sec)	57.37	56.78	56.14	55.51	55.04	58.25	57.63	56.98	56.37	55.72	55.15	54.51
Longitude (degrees)	-72	-72	-72	-72	-72	-72	-72	-72	-72	-72	-72	-72
Longitude (min.sec)	31.97	32.11	32.25	32.41	32.5	30.63	30.74	30.88	30.99	31.19	31.33	31.49
Depth (feet)	12.5	8	22	19	13	15	24	19	23	23	23	14
Sediment	StSa	StSa	Mu	ShMs	StMs	MsSt	Wt	Ms	McWt	MuWt	n/a	StSa
Hard Clam Seed												
Hard Clam Littleneck	0.25											
Hard Clam Cherrystone												
Hard Clam Chowder	3	1.75		0.25	2.75	1.25		0.75				1
Hard Clam Total	3.25	1.75		0.25	2.75	1.25		0.75				1
Scallop (Sublegal)												
Scallop (Legal)												
Knobbed Whelk	1			0.25	0.25	0.5						
Channelled Whelk								0.25				
Oyster Drill												0.75
Crepidula fornicata	88.5	1.25			33.75	21.5		0.5				224
Crepidula plana	8.75				0.75							1
Sea Star												
LongClawed Hermit Crab												
FlatClawed Hermit Crab												
Spider Crab												
Mud Crab	0.25					0.25						
Lady Crab	1.25	1.75			0.25	1.25		0.25				1.25
Rock Crab												
Horseshoe Crab												
Blood Ark	5.25	0.25			1.5	0.25		0.25				2
Jingles	2.25				1.25			0.25				6.25
Dog Whelk												
Hairy Cucumbers	0.25											
Sponges		Yes			Yes	Yes						
Brittle Stars									Yes			
Razor Clam												
Chiton												
Nut Clams												
Hydroid												
Surf clam												

Station	25	26	27	28	29	30	31	32	33	34	35	36
Location	GPB	GPB	GPB	GPB	GPB	GPB	GPB	GPB	GPB	GPB	GPB	GPB
Latitude (degrees)	40	40	40	40	40	40	40	40	40	40	40	40
Latitude (min.sec)	58.46	57.84	57.21	56.56	55.93	55.28	54.66	54.05	58.03	57.41	56.77	56.15
Longitude (degrees)	-72	-72	-72	-72	-72	-72	-72	-72	-72	-72	-72	-72
Longitude (min.sec)	29.44	29.56	29.7	29.89	30	30.15	30.29	30.42	28.83	28.51	28.65	28.78
Depth (feet)	15	16	24	24	25	25	25	15		15.6	12	26.5
Sediment	Ms	StSa	MuCl BsWt	MuBs	MuWt Bs	MuWt	Mu	St	PL	SmSt	SmSt	Mu
Hard Clam Seed												
Hard Clam Littleneck												
Hard Clam Cherrystone												
Hard Clam Chowder	0.5	0.5						2.1		1.25		
Hard Clam Total	0.5	0.5						2.1		1.25		
Scallop (Sublegal)												
Scallop (Legal)												
Knobbed Whelk		1.5						0.33		0.75		
Channelled Whelk										0.25	0.25	
Oyster Drill								0.33				
Crepidula fornicata	0.25	10.5						62.25		29.5	44	
Crepidula plana		0.25								0.5	0.25	
Sea Star												
LongClawed Hermit Crab		0.25										
FlatClawed Hermit Crab												
Spider Crab												
Mud Crab	0.25							0.6		0.25		
Lady Crab	0.25	4						0.9		0.5	2.5	
Rock Crab												
Horseshoe Crab												
Blood Ark		0.5						2		0.5	1	
Jingles		0.5						10.6		1.25	0.75	
Dog Whelk			0.25									
Hairy Cucumbers	1.5											
Sponges												
Brittle Stars			Yes	Yes	Yes							
Razor Clam								0.25				
Chiton												
Nut Clams			0.5									
Hydroid										Yes	Yes	Yes
Surf clam												

Station	37	38	39	40	41	42	43	44	45	46	47	48
Location	GPB	GPB	GPB	GPB	GPB	GPB	GPB	CH	CH	CH	CH	CH
Latitude (degrees)	40	40	40	40	40	40	40	40	40	40	40	40
Latitude (min.sec)	55.52	54.85	54.27	56.98	56.36	55.75	55.08	58.72	59.62	59.96	59.11	58.8
Longitude (degrees)	-72	-72	-72	-72	-72	-72	-72	-72	-72	-72	-72	-72
Longitude (min.sec)	28.92	29.13	29.21	27.45	27.59	27.73	27.89	28.2	28.25	27.92	27.53	26.72
Depth (feet)	24	28	27.5	15	20	15	20.9	11.5	10.8	10	12	24
Sediment	McWt Bs	WtBs Mu	MuWt Bs	StSa	Sc	n/a	StSa	ShMu	ShMs	MsSh	StSh Mu	Mu
Hard Clam Seed												
Hard Clam Littleneck										0.25		
Hard Clam Cherrystone												
Hard Clam Chowder						0.5		3	1.1	5.75		
Hard Clam Total						0.5		3	1.1	6		
Scallop (Sublegal)												
Scallop (Legal)												
Knobbed Whelk						2			0.25		1	
Channelled Whelk			0.25	0.25								
Oyster Drill				0.25			0.25					
Crepidula fornicata				61.5		0.75	15	80.75		87	9.25	
Crepidula plana				0.25			0.5			0.25		
Sea Star												
LongClawed Hermit Crab												
FlatClawed Hermit Crab												
Spider Crab								0.25		0.25		
Mud Crab				6.75	0.75		0.25				2.75	
Lady Crab				2	1.5	3	1.25		2		0.75	
Rock Crab												
Horseshoe Crab												
Blood Ark				2	0.5	1.25	0.5	0.25		1		
Jingles				2.25	0.25		1	13.25		0.5		
Dog Whelk				0.25				0.25			0.25	
Hairy Cucumbers				0.25	1				0.5		0.5	
Sponges				Yes	Yes						Yes	
Brittle Stars	Yes	Yes	Yes						1.25			
Razor Clam												
Chiton											0.5	
Nut Clams												
Hydroid				Yes								
Surf clam				0.25								

Station	49	50	51	52	53	54	55	56	57	58	59	60
Location	LPB	LPB	LPB	LPB	LPB	LPB	LPB	LPB	LPB	HNB	HNB	HNB
Latitude (degrees)	40	40	40	40	40	40	40	40	41	40	41	41
Latitude (min.sec)	57.3	57	57.2	57.7	58	58.6	59.4	59.6	0.46	59.5	0.21	0.77
Longitude (degrees)	-72	-72	-72	-72	-72	-72	-72	-72	-72	-72	-72	-72
Longitude (min.sec)	26	25.73	24.5	24.5	23.8	23.6	22.9	23.4	22.5	25.4	24.7	23.7
Depth (feet)	17	8.7	7.5	27.5	9	21.5	17	29	7	27.5	26	24
Sediment	StWt Mu	StSaSm WtHyCo	SmSt	n/a	MsSt Sh	Mu	SmSt	n/a	SaSt	Mc	Ms	SaSt
Hard Clam Seed												
Hard Clam Littleneck												
Hard Clam Cherrystone												
Hard Clam Chowder	0.25	1.5	0.25		1.75		3					
Hard Clam Total	0.25	1.5	0.25		1.75		3					
Scallop (Sublegal)												
Scallop (Legal)												
Knobbed Whelk	1.5		0.25		0.25		0.75		0.5		0.75	
Channelled Whelk												
Oyster Drill												1
Crepidula fornicata	8.5	9							30.8			138
Crepidula plana	0.5	0.25							0.25			1
Sea Star												
LongClawed Hermit Crab												
FlatClawed Hermit Crab												
Spider Crab	0.25											
Mud Crab	1.25	1.25		1								0.5
Lady Crab	1.25	0.75	1		0.5	0.5	2		1			
Rock Crab												
Horseshoe Crab							0.25					
Blood Ark	1.25											5
Jingles	0.25											6.25
Dog Whelk									0.25			
Hairy Cucumbers	5											0.5
Sponges												Yes
Brittle Stars												
Razor Clam							0.25					
Chiton	0.5											0.75
Nut Clams												
Hydroid	Yes	Yes										
Surf clam	0.25											

Station	61	62	63	64	65	66	67	68	69	70	71	72
Location	HNB	HNB	HNB	HNB	HNB	HNB	HNB	HNB	HNB	HNB	HNB	HNB
Latitude (degrees)	41	41	41	41	41	41	41	41	41	41	41	41
Latitude (min.sec)	0.32	0.47	0.84	1.29	1.8	0.5	0.93	1.39	1.74	1.1	1.59	1.71
Longitude (degrees)	-72	-72	-72	-72	-72	-72	-72	-72	-72	-72	-72	-72
Longitude (min.sec)	26.07	25.2	24.85	24.15	25.35	26.64	25.95	25.24	24.29	26.77	25.77	26.01
Depth (feet)	23	16	15	8	6	6	22	18	5.8	15	13	8
Sediment	MuWt	MsSh	MsSh	MsSt Sh	CoSt Sm	Sa	MuWt	MsSh	SaSt	MsSt	MsSh	MsSt
Hard Clam Seed												
Hard Clam Littleneck												
Hard Clam Cherrystone												
Hard Clam Chowder		0.5	0.25			2.75		2	0.5	2	1	0.5
Hard Clam Total		0.5	0.25			2.75		2	0.5	2	1	0.5
Scallop (Sublegal)												
Scallop (Legal)												
Knobbed Whelk			0.5		0.5			0.25	0.25	2		0.25
Channelled Whelk				0.25	0.25	0.25				0.25		0.5
Oyster Drill									0.25			
Crepidula fornicata			7.25	434	802			0.25	142.5	0.5	0.25	18.25
Crepidula plana				8.75	10				0.5	0.25		1.25
Sea Star												
LongClawed Hermit Crab						0.25						
FlatClawed Hermit Crab								0.5				
Spider Crab				1							0.25	
Mud Crab			0.25		1				0.75			
Lady Crab		1.75	0.25	1.75	0.75	0.5		1	1.25	3.75	0.5	1.75
Rock Crab												
Horseshoe Crab												
Blood Ark				2.25	2				0.25			0.25
Jingles				8	7				2.75			
Dog Whelk												
Hairy Cucumbers				0.25	2.25				0.25			1.75
Sponges												
Brittle Stars		Yes										
Razor Clam												
Chiton				3.5	4				0.75			
Nut Clams												
Hydroid												
Surf clam												

Station	73	74	75	76	77	78	79	80	81	82	83	84
Location	HNB	CH	NYB	NYB	NYB	NYB	NYB	NYB	NYB	NYB	NYB	SHB
Latitude (degrees)	40	40	41	41	41	41	41	41	41	41	41	41
Latitude (min.sec)	58.8	57.9	2.4	1.1	0.6	0.6		1.2	1.8	1.8	2.4	3
Longitude (degrees)	-72	-72	-72	-72	-72	-72	-72	-72	-72	-72	-72	-72
Longitude (min.sec)	25.9	27.2	22.9	22.1	21.4	20.2	19.6	20.8	20.2	21.4	20.8	23.8
Depth (feet)	11.5	14.5	19	25	22	23	19.5	23	15	24	6.5	11.4
Sediment	MsSt	SaSt	MuSt ShHy	CoSm	McCo Wt	MuWt CoGr	SmCo	CoGr WtMu	MuSh	SmCoHy StSh	StShCo HySm	MsSh St
Hard Clam Seed												
Hard Clam Littleneck												
Hard Clam Cherrystone												
Hard Clam Chowder		0.5		0.5			3.25		1		0.5	10
Hard Clam Total		0.5		0.5			3.25		1		0.5	10
Scallop (Sublegal)												
Scallop (Legal)			0.25							0.25		
Knobbed Whelk	0.5	1							0.25		0.75	0.25
Channelled Whelk			0.25				0.25			0.25		
Oyster Drill			0.25							0.25		
Crepidula fornicata	17.3	1	84	0.75			7.25			29.25	587.5	352
Crepidula plana	1.25		3.25	2.5			4.25			5.25	2	104
Sea Star												
LongClawed Hermit Crab	0.5										0.5	
FlatClawed Hermit Crab			0.25	0.5								
Spider Crab			0.75						0.25		0.5	1
Mud Crab	0.25		2							2.5	0.5	1
Lady Crab	1	3.75		0.5			1			1.25	1.25	
Rock Crab												
Horseshoe Crab		0.25										
Blood Ark	0.25		2.5				0.75				1.25	
Jingles			60.3						1	0.75		8
Dog Whelk												1.75
Hairy Cucumbers	0.25		0.25						0.25	0.75	0.75	
Sponges									Yes			
Brittle Stars					Yes	Yes		Yes				
Razor Clam												
Chiton			1.25							1.25		
Nut Clams												
Hydroid			Yes							Yes	Yes	
Surf clam												

Station	85	86	87	88	89	90	91	92	93	94	95	96
Location	SHB	SHB	PC+	PC+	OH	OH	OH	OH	SMC	SMC	NWH	NWH
Latitude (degrees)	41	41	41	41	41	41	41	41	41	41	41	41
Latitude (min.sec)	3.4	4.2	5.4	6.6	6.6	7.2	7.2	7.8	3	2.4	1.8	0.6
Longitude (degrees)	-72	-72	-72	-72	-72	-72	-72	-72	-72	-72	-72	-72
Longitude (min.sec)	24.4	23.8	22.6	20.8	19.6	19.6	18.4	19	18.4	17.8	17.22	17.1
Depth (feet)	17	21	15	12	26	12	23	19	20	16	22	15
Sediment	CoGr WtMu	StGr Ms	ClMs Sh	MuGr	Gr	MuSt	MuSh GrWt	MuWt Hy	MuGr St	StSh	StSh GrCo	SmGr
Hard Clam Seed				0.25								
Hard Clam Littleneck				0.5						0.25		
Hard Clam Cherrystone				0.5								
Hard Clam Chowder	0.25		2.25	0.75		0.25				0.5		0.75
Hard Clam Total	0.25		2.25	2		0.25				0.75		0.75
Scallop (Sublegal)												
Scallop (Legal)				0.25								
Knobbed Whelk		0.75		1.5		1.5	0.25		0.75	0.5	0.25	0.75
Channelled Whelk		0.25		0.5		0.25						0.5
Oyster Drill		1.5		0.5				0.25	0.25			
Crepidula fornicata	0.5	206	2.75	764	21.25	408	0.75	8.75	10.75	400.8	226	2.5
Crepidula plana			0.25	80	0.5	48	1	1.5	0.25	5	1.25	6
Sea Star												
LongClawed Hermit Crab										0.25		
FlatClawed Hermit Crab				1								0.25
Spider Crab	0.25	1	1.75	5.5		4				3.5	0.75	
Mud Crab			0.25	0.75					0.25	1.5	1.25	
Lady Crab		0.75	0.25	1.5							1.25	
Rock Crab												
Horseshoe Crab												
Blood Ark		4.25	0.75	1.25	0.5				0.75	1.75	2.25	
Jingles		2	0.25	1.5		1.75				6.5	1.25	
Dog Whelk				0.25								
Hairy Cucumbers				0.25								
Sponges			Yes							Yes		
Brittle Stars										Yes		
Razor Clam											0.25	0.25
Chiton		2.25		0.25		0.25					1	
Nut Clams												
Hydroid								Yes		Yes	Yes	
Surf clam												

Station	97	98	99	100	101	102	103	104	105	106	107	108
Location	NWH	NWH	NWH	NWH	NWH	NWH	NWH	GB	GB	GB	GB	GB
Latitude (degrees)	41	41	41	41	41	41	41	41	41	41	41	41
Latitude (min.sec)	0.3	1.2	1.2	1.8	1.95	2.4	2.4	3	3	3	3.6	3.6
Longitude (degrees)	-72	-72	-72	-72	-72	-72	-72	-72	-72	-72	-72	-72
Longitude (min.sec)	16.6	16	15.12	15.4	14.8	14.8	16.6	13.6	14.2	15.4	14.8	16
Depth (feet)	8.5	23	9.6	9.6	10	14	11.6	18	18	22	17	20
Sediment	GrCo Sa	HyGr	ShGrSa WtCo	GrSa Sh	MsGr Co	MuWt CoGr	CoGr MuSt	StSh MsCo	StSm Sh	CoSh MuDe	SmSt	McCo StDe
Hard Clam Seed				0.25	0.25							
Hard Clam Littleneck			0.25	0.75	1.75							
Hard Clam Cherrystone					0.5							
Hard Clam Chowder	7.75		7.75	4.25	38							
Hard Clam Total	7.75		8	5.25	40.5							
Scallop (Sublegal)												
Scallop (Legal)					0.25							
Knobbed Whelk	0.75		0.5	1	0.5			0.5				
Channelled Whelk					0.25			0.5				
Oyster Drill				1.25				1.25			0.75	0.25
Crepidula fornicata	1.5		14.75	12	20.8	1.25	882	595	2005		4906	380
Crepidula plana	0.75		1.5	0.25	1.5			42	44		54	10
Sea Star												
LongClawed Hermit Crab												
FlatClawed Hermit Crab			0.5			0.25					0.25	
Spider Crab	0.25		0.75		1		0.75	1.25	0.25		3.25	0.25
Mud Crab	0.25		1	0.25	0.25		4	2.25	5.25		5.25	0.75
Lady Crab	1.5			3.25	1.75			1				0.25
Rock Crab								0.25			0.5	
Horseshoe Crab												
Blood Ark				0.5			0.25	4.5	0.5		35	4.25
Jingles				0.25	1.75		11	6	20		24	22
Dog Whelk									0.25		0.5	
Hairy Cucumbers				0.25			0.25					0.25
Sponges		Yes							Yes			
Brittle Stars												
Razor Clam	1.25		8.75	1	1.5							
Chiton											14	0.75
Nut Clams												
Hydroid		Yes		Yes	Yes							
Surf clam								2			2.5	

Station	109	110	111	112	113	114	115	116	117	118	119	120
Location	GB	GB	GB	GB	GB	GB	GB	GB	GB	GB	GB	GB
Latitude (degrees)	41	41	41	41	41	41	41	41	41	41	41	41
Latitude (min.sec)	4.2	4.2	4.8	4.8	5	5.4	5.4	5.4	5.4	6	6	6.6
Longitude (degrees)	-72	-72	-72	-72	-72	-72	-72	-72	-72	-72	-72	-72
Longitude (min.sec)	14.2	15.4	14.8	16	17.2	15.4	16.6	17.8	19	14.8	18.4	15.4
Depth (feet)	28	15	27	15	13.5	24	19	15	17	25	16	28
Sediment	n/a	MsSt WtUl	StMu	MsSt Sh	SaSt Sh	MsSh	MuSt Sh	SaSh St	DeMu	Gr	MuSt De	Gr
Hard Clam Seed						4.25						
Hard Clam Littleneck						5.5						
Hard Clam Cherrystone						0.75						
Hard Clam Chowder				0.25		2.75			1			
Hard Clam Total				0.25		13.25			1			
Scallop (Sublegal)												
Scallop (Legal)									0.25			
Knobbed Whelk								0.25				
Channelled Whelk		0.25		0.25	0.25	0.5		0.75				
Oyster Drill		0.25		0.25			0.25				0.25	
Crepidula fornicata		5840		1696	78.5	20	291.3	580	44.25		1564	
Crepidula plana		200		2	2.25	27.5	39.25	80	3		24	
Sea Star												
LongClawed Hermit Crab		0.75		0.25								
FlatClawed Hermit Crab		0.25		0.25		0.25	0.25		1			
Spider Crab		2.25		1	0.25		3.75	2			6.75	
Mud Crab		7.75		1			2.5	1.25	0.25		0.75	
Lady Crab					0.25	0.25	0.25	0.75			0.25	
Rock Crab				0.25				0.5				
Horseshoe Crab												
Blood Ark		24	0.25	3	0.5	2	7	2.25	0.5		22.25	
Jingles		48		20			1.25	2	1.5		4	
Dog Whelk				0.75								
Hairy Cucumbers											0.5	
Sponges					Yes		Yes					
Brittle Stars												
Razor Clam												
Chiton				0.25			3				1.5	
Nut Clams		104										
Hydroid											Yes	
Surf clam		0.5			0.75						0.25	

Station	121	122	123	124	125	126
Location	GB	GB	GB	GB	GB	GB
Latitude (degrees)	41	41	41	41	41	41
Latitude (min.sec)	6.6	6.6	7.2	7.1	8.1	7.5
Longitude (degrees)	-72	-72	-72	-72	-72	-72
Longitude (min.sec)	16.6	17.8	16	17.2	14.8	14.8
Depth (feet)	20	15	22	12	14	11.4
Sediment	HySt Mu	MuDe	MuSh Hy	n/a	StSh Ms	MuSt
Hard Clam Seed	1.5		1.25			0.75
Hard Clam Littleneck	1.75		1.25	0.75		0.5
Hard Clam Cherrystone						0.75
Hard Clam Chowder	1		4.25	1.5		
Hard Clam Total	4.25		6.75	2.25		2
Scallop (Sublegal)						
Scallop (Legal)						
Knobbed Whelk	0.5	0.25	0.25	0.25		
Channelled Whelk			0.25		0.25	
Oyster Drill			0.75		0.75	
Crepidula fornicata	57.25	98	44.25	640	315.8	4008
Crepidula plana	47.75	1.75	60.25	34	20.25	32
Sea Star						
LongClawed Hermit Crab						0.5
FlatClawed Hermit Crab	0.25			0.25		
Spider Crab	0.5	2.5	0.5	1.5	0.25	1
Mud Crab				0.25	0.75	3.75
Lady Crab		1.75		1.75	0.25	
Rock Crab	0.25		0.25	0.75		0.5
Horseshoe Crab						
Blood Ark	6.75	2	6.75		2	1.75
Jingles		0.5	2	4	3.75	0.75
Dog Whelk			0.25			0.75
Hairy Cucumbers						
Sponges			Yes			
Brittle Stars						
Razor Clam				0.75	0.25	0.25
Chiton						1
Nut Clams						
Hydroid	Yes	Yes	Yes			
Surf clam	0.5	0.75		1	2.25	3

Appendix B

Miscellaneous Organisms by Station

Station	Miscellaneous Organisms
1	1 Whelk egg cases
34	.25 Whelk egg case
40	.25 Chestnut Astarte Clam
	Red sponge
47	Red sponge
49	Red sponge
	.25 Whelk egg case
52	.5 Shipworms
64	.25 Common Oyster
81	*Sargassum filipendula.*
	Yellow encrusting algae
82	.5 Plum Worms
86	Red leafy algae
	Yellow encrusting algae
90	Red leafy algae
94	Red leafy algae
	Red sponge
97	.25 Whelk egg case
100	Red leafy algae
107	Red leafy algae
113	.5 Northern Moon Shells
125	Red sponge

Values are average catch per 9.29 sq. meters.

Appendix C

Length Data Tabulation by Species
and Station.

Hard Clam (Width x Length in mm)

Station	1										3		4								6	
	w	l	w	l	w	l	w	l	w	l	w	l	w	l	w	l	w	l	w	l	w	l
	28	52	57	82	54	99	53	95	56	114	51	96	42	92	64	97	57	107	51	99	60	113
	66	112	55	104	57	97	58	93	57	115	58	105	61	109	57	93	66	110			64	119
	53	93	56	94	59	101	57	99	66	104	56	92	52	96	62	94	65	109				
	54	94	53	94	55	92	52	102	53	96	58	107	50	84	63	103	58	102				
	53	94	49	86	56	95	60	108	53	104	62	113	55	95	67	105	56	94				
	62	115	53	89	53	91	54	93	57	96	60	94	65	108	52	93	53	96				
	55	116	59	112	58	101	50	98	53	89			58	103	53	91	58	108				
	64	105	47	84	58	106	46	84					57	94	56	97	60	102				
	55	92	58	92	58	103	55	97					57	101	45	84	61	104				
	57	91	60	99	58	98	54	103					57	97	65	106	54	102				

Station	7		9				11				12				13				14		16	
	w	l	w	l	w	l	w	l	w	l	w	l	w	l	w	l	w	l	w	l	w	l
	66	114	64	107	70	107	37	51	62	113	57	97	65	97	30	61	62	101	71	111	57	115
	71	113	66	113			44	84	61	107	69	107	62	117	63	117	72	110	72	124		
	65	112	53	97			44	82	61	108	61	104	66	111	55	97	71	117	63	110		
	70	110	72	117			58	102			69	103	67	106	52	92			69	116		
			66	116			58	91			66	103	66	116	53	100			69	118		
			68	112			47	87			70	113	67	107	63	111			69	127		
			53	95			47	92			67	107	65	111	71	114			70	117		
			63	106			46	78			72	116			53	100						
			60	114			53	93			62	100			65	112						
			67	119			56	107			56	98			60	96						

Station	17				18		20		24		25		26		32		34		42	
	w	l	w	l	w	l	w	l	w	l	w	l	w	l	w	l	w	l	w	l
	57	115	63	107	66	111	56	95	70	114	66	117	62	119	53	108	56	100	48	85
	58	115			65	100	57	113	62	111	56	100	64	115	59	108	57	102	54	86
	53	97			65	117	58	111	50	90					49	82	60	112		
	56	98			60	112			44	87					62	118	56	96		
	65	114													55	105	59	100		
	46	79													47	84				
	53	98													55	97				
	54	92																		
	47	92																		
	69	118																		

Station	44				45		46						49		50		51		53	
	w	l	w	l	w	l	w	l	w	l	w	l	w	l	w	l	w	l	w	l
	62	105	59	100	64	105	29	54	52	98	58	108	65	120	61	114	55	91	56	103
	57	92	49	82	64	102	65	105	59	94	66	113			60	106			62	111
	61	93			64	109	61	105	53	95	55	101			57	102			63	109
	59	102					61	103	63	116	64	104			57	96			62	111
	53	101					59	105	65	112					62	109			53	96
	55	102					59	100	64	104					80	129			63	108
	60	92					46	86	56	94									57	100
	55	97					59	101	54	94										
	60	102					62	94	70	109										
	64	102					54	101	66	106										

Hard Clam (Width x Length in mm)

Station	55				62		63		66				68		69		70		71		72	
	w	l	w	l	w	l	w	l	w	l	w	l	w	l	w	l	w	l	w	l	w	l
	63	110	57	96	58	100	60	102	64	119	72	101	50	100	69	123	58	107	52	97	64	116
	56	94	65	111	55	92			67	119			65	112	60	116	67	111	59	100	64	112
	47	80							62	122			65	112			56	93	63	105		
	59	94							72	123			65	117			64	112	64	114		
	53	90							59	93			66	113			62	112				
	58	88							69	112			65	112			72	110				
	53	90							71	107			52	89			68	113				
	58	93							64	112			65	114			68	120				
	53	95							77	122												
	55	93							71	122												

Station	74		76		79				81		83		84								85	
	w	l	w	l	w	l	w	l	w	l	w	l	w	l	w	l	w	l	w	l	w	l
	56	96	63	98	67	100	61	92	67	110	63	102	52	92	58	94	48	91	54	92	48	80
	59	104	64	106	60	97	67	99	64	108	53	91	52	83	62	102	58	92	47	81		
					60	100	57	90	59	109			65	109	52	92	59	93	55	94		
					61	105			55	91			57	98	49	72	57	95	53	91		
					57	93							58	98	44	80	58	95	61	103		
					55	95							63	102	53	91	67	104	53	84		
					60	101							64	102	47	86	62	94	49	83		
					60	100							62	105	47	84	56	93	55	92		
					52	87							60	100	47	84	58	106	54	91		
					60	94							60	97	54	92	54	85	52	78		

Station	87		88		90		93		94		96		97							
	w	l	w	l	w	l	w	l	w	l	w	l	w	l	w	l	w	l	w	l
	45	85	13	22	66	102	51	93	33	62	68	109	43	83	38	76	44	73	50	84
	54	98	27	52			49	86	67	102	44	83	48	88	48	101	53	94		
	57	91	32	60			56	103	59	101	62	100	48	91	48	94	53	97		
	52	85	39	74			52	96					43	73	55	92	57	101		
	52	90	37	73									37	76	50	94	62	105		
	60	100	51	80									58	94	50	85	58	112		
	54	94	49	72									57	104	54	92	47	82		
	55	103	47	91									54	95	53	101	48	83		
	52	98											55	100	52	89	49	93		
													35	70	46	90	37	74		

Station	99								100					
	w	l	w	l	w	l	w	l	w	l	w	l	w	l
	25	47	54	104	39	79	56	106	22	40	67	101	52	96
	53	100	61	106	52	77	46	104	32	65	52	102		
	67	102	46	82	55	110			30	59	58	89		
	54	104	50	90	57	100			31	63	38	79		
	63	105	49	88	57	102			46	94	54	92		
	56	105	44	81	39	79			60	105	53	100		
	48	96	52	96	54	91			67	115	61	103		
	57	97	40	81	58	98			69	120	53	99		
	60	97	46	83	53	88			73	109	54	102		
	38	77	42	78	51	104			62	113	57	92		

Hard Clam (Width x Length in mm)

Station 101

w	l	w	l	w	l	w	l	w	l	w	l	w	l	w	l	w	l	w	l	w	l
22	41	52	95	54	97	54	97	59	102	57	97	52	97	49	93	46	89	56	104	62	111
26	52	55	84	48	87	49	91	41	79	50	99	46	90	50	97	48	85	57	99	56	101
36	74	55	102	52	90	48	82	53	88	62	97	49	92	47	87	62	114	57	99	54	100
32	64	57	99	56	93	46	81	40	83	44	91	47	92	52	80	48	90	49	91	56	102
31	63	53	100	52	107	52	98	53	102	43	89	53	96	56	87	60	93	53	95	57	100
24	46	57	97	54	90	57	99	50	91	46	79	41	81	36	77	52	90	53	91	42	81
30	62	50	93	59	103	56	92	49	94	43	88	54	94	45	90	55	110	55	91	45	80
32	64	49	86	52	98	47	95	48	84	48	89	43	83	44	89	62	108	56	99	48	96
40	83	57	102	55	99	55	98	53	92	50	89	53	102	45	103	53	92	55	89	50	91
39	75	52	92	52	91	36	71	43	81	55	91	48	95	64	103	47	84	54	96	53	98

Station 101 continued												112	
w	l	w	l	w	l	w	l	w	l	w	l	w	l
49	96	53	93	41	80	43	85	50	90	61	90	53	84
46	86	57	103	48	85	49	89	61	102				
48	96	44	89	47	91	56	93	43	83				
47	82	56	99	50	100	46	92	47	88				
59	99	47	90	41	77	50	91	47	90				
47	83	49	93	52	88	51	94	44	78				
52	92	41	80	48	92	46	89	47	85				
38	79	57	97	57	91	46	81	48	91				
58	102	42	83	50	94	48	85	53	92				
52	100	50	97	52	92	55	97	43	85				

Station 114												117		121			
w	l	w	l	w	l	w	l	w	l	w	l	w	l	w	l	w	l
22	41	18	31	27	55	36	72	39	71	58	97	52	91	18	33	27	53
23	42	20	36	28	55	28	54	44	85	50	77	58	91	21	40	23	48
19	35	23	41	28	51	30	56	42	79	58	92	60	90	17	34	24	53
21	40	21	37	29	54	32	60	58	99					16	34	62	109
20	37	21	38	25	47	33	64	49	87					17	32	56	99
20	37	21	40	32	60	34	64	47	76					17	35	57	97
24	37	25	46	29	55	31	58	50	90					30	59	58	100
18	35	29	53	26	45	28	55	51	89					28	54		
22	41	25	49	32	58	31	54	54	86					23	58		
21	38	27	49	32	63	40	81	60	102					25	49		

Station 123						124		126	
w	l	w	l	w	l	w	l	w	l
19	38	43	83	48	91	27	52	19	37
16	35	58	99	57	102	33	65	18	33
18	36	50	92	49	87	35	62	20	40
18	38	57	101	45	83	54	84	30	62
15	31	44	82	58	95	47	89	27	52
24	49	53	88	52	97	48	89	37	65
26	55	44	78	47	83	54	94	37	70
33	66	60	113			53	95	41	73
22	45	49	87						
20	37	54	92						

Oyster (Width x Length in mm)

Station	64	
	w	l
	55	85

Scallop (Length in mm)

Station	75	82	88	101	117
	57	72	69	64	71

Razor Clam (Length in mm)

Station	32	49	55	95	97	99	101	124	125
	100	57	53	40	117	60	105	40	103
					92	100	121	75	
						129	82	48	
						109			
						93			
						102			

Surf Clam (Length in mm)

Station	40	104		107	110	113	119	121	122	124	125		126	
	100	94	104	95	72	115	75	98	90	80	95	89	100	93
		107	99	92	89	100		112	64	75	75	96	96	102
		115		92		90			62	105	48	100	95	93
		68		89						114	75		97	
		67		91							60		69	
		83		89							47		94	

Crepidula fornicata (Length in mm)

Station 1	2	3	4	7	9		11	12	13			14	17			34				
22	23	2	35	12	7	27	16	34	19	21	30	6	22	30	33	14	30	36	12	16
17	25		38		10	28	4	9	32	8	48	9	40	12	39	12	30	13	23	32
29			23		32	31	16	12	17	6	18	18	43	26	45	8	9	10	24	26
13			35		34	37	43	5	26	30	29	26	29	5	43	15	13	10	12	27
12			12		38	38	28	8	10	37	36	22	42	45	17	39	27	19	10	
10			5		5		45	26	24	32	39		24	43	20	38	8	14	13	
13			30		4			38	15	41	18		12	14	42	8	14	22	9	
24			27		11			48	21	36	42		14	28	48	12	9	11	22	
31			37		31				14	27	35		43	39		14	34	9	12	
37					32				27	16	12		42	26		12	37	13	18	

Station 35				40				42	43		44			46			47		
16	30	14	10	6	36	11	4	11	34	39	23	33	22	45	32	37	10	8	27
12	17	15	32	8	9	10	9	14	37	5	33	19	46	29	33	37	11	13	7
12	36	16	37	9	28	35	36	29	7	13	31	32	18	34	18	42	35	10	10
18	15	21	43	12	15	24	9		12	36	19	33	14	36	17	30	9	9	7
9	11	36	43	35	39	38	22		18	40	32	13	19	26	39	31	10	7	7
10	15	34	35	6	15	20	36		11	42	35	17	17	23	42	43	19	8	11
18	16	26	30	6	26	36			9		27	34	28	36	15		9	9	18
40	34	33	17	12	16	40			17		33	12	40	39	18		8	8	10
40	40	38	27	33	23	37			31		34	18	46	14	41		12	10	13
29	8	39	34	28	23	32			7		13	28		35	48		11	11	

Station 49			50			57		60		63			64				65			
34	36	33	11	26	27	16	28	42	5	35	41	19	25	16	32	11	24	13	16	21
32	30	9	13	11	32	32	36	30	3	28	37	21	11	9	12	10	29	25	26	11
29	40		30	41		10		17		24	31	31	10	27	10	15	11	31	22	30
32	35		19	9		12		28		24	33	33	26	13	23	27	33	30	27	7
31	38		7	4		35		9		6	18	27	30	12	29	24	26	29	12	32
31	41		11	35		12		10		32	44	22	15	11	12	8	26	29	26	28
36	46		34	36		11		26		11	40	36	25	29	22	30	33	31	13	27
32	11		39	13		12		12		31	38	34	26	13	36	15	18	32	26	12
39	11		13	27		9		23		22	26		10	28	18		34	15	10	
41	33		16	11		27		22		31	34		19	15	22		31	19	10	

Station 68	69		70	71	72		73		74	76	79	82			
10	30	38	11	6	22	13	11	24	17	8	11	11	27	6	9
	35	5	9		11	7	11	31	12		20	9	9	16	14
	13	7			10	10	27		32			12	8	16	
	13	7			11	12	20		31			27	11	8	
	27	40			24	5	8					8	8	23	
	29	20			32	11	9					10	5	8	
	37	27			10	10	12					12	12	10	
	37	33			7	17	25					15	8	11	
	37	38			29	14	9					5	12	6	
	38				10	14	30					5	11	13	

Crepidula fornicata (Length in mm)

Station 83							84		85	86			87	93	94					
13	10	9	11	31	25	7	28	30	21	10	25	14	42	9	19	35	38	26	21	5
23	33	29	29	31	27	27	28	37	28	8	9	8	34	33	11	29	37	11	40	16
42	38	32	28	7	26		27	36		14	8		30	25	17	4	7	15	15	27
11	42	12	29	15	34		11	29		32	7		27	9	31	9	33	34	19	21
7	41	9	33	10	8		37	34		9	12		30	34	45	10	22	18	36	8
14	38	6	4	16	20		41	37		14	9		35	8	9	25	20	36	10	27
13	31	29	31	8	23		39	16		9	9		10	8	36	37	11	41	10	34
11	24	31	11	8	7		34	12		20	19		28	7	36	25	8	35	32	
11	12	9	11	10	11		17	26		22	25		19	12	8	20	36	9	34	
8	18	10	8	10	10		16	37		26	25		28	19	43	22	4	13	34	

Station 95				96	97	99		100		101				102	103			
13	12	12	37	18	9	24	35	8	29	8	27	22	20	34	7	27	23	20
10	11	8	6	8	13	31	34	27	37	7	8	31	27	19	8	22	7	17
7	10	9	41	24	9	33	21	32		27	32	22	34	15	16	29	6	16
38	28	15		35	17	10	18	12		31	27	28	10	29	20	29	17	29
34	24	10		21	10	12	32	27		43	6	33	8	8	16	18	22	25
12	27	11		33	13	9	8	38		9	29	6			16	5	36	22
6	19	9		38		12	22	37		38	30	26			17	6	12	27
33	33	29		30		5	29	39		11	19	31			7	9	29	
11	6	29		39		27	27	37		43	23	10			20	21	9	
16	8	21		37		43	4	23		29	8	34			33	30	29	

Station 104				105						107				110				115	
5	10	27	28	24	16	18	15	28	4	7	7	6	39	12	17	9	37	8	15
3	23	12	29	21	14	15	18	19	14	8	7	8	38	8	23	9		8	18
4	24	10	26	10	27	7	16	18	22	7	8	9	23	11	18	16		9	34
6	9	12	6	17	15	18	18	30	28	21	8	32	9	8	8	10		6	40
26	6	11	12	21	22	24	15	32	14	4	6	5	6	7	7	30		8	36
22	6	9	9	6	29	33	15	48	23	8	4	10	8	6	9	37		7	
28	9	6		28	17	23	25	25	12	29	8	6	11	9	20	37		8	
6	25	9		28	17	40	15	19		17	9	5		26	11	39		9	
30	6	6		17	34	20	14	14		6	6	3		29	6	6		17	
20	4	6		22	18	24	14	17		29	8	3		7	40	9		7	

Station 117		123	125			126			
14	18	10	16	7	21	8	10	28	24
20	20	16	18	6	30	6	7	27	6
10	27	12	16	11	36	5	12	8	23
42	31	30	14	17	6	6	11	30	
15		13	16	9		10	14	18	
17		25	21	9		30	25	8	
18		35	17	17		16	29	12	
36		37	20	8		8	6	12	
12			20	7		25	9	19	
14			16	13		37	11	24	

Jingle (Length in mm)

Station	9	34	35	40		41	43	49	81	82	84	95	100	101	105	125
	16	19	28	24	29	18	16	12	35	31	25	34	33	39	32	16
		34	22	22	37		34		31	30		32		36	36	14
		36	32	42	7				33			30		34		8
		35		33					27					37		
		29		30												

Crepidula plana (Length in mm)

Station	9	12	13	17	34	35	40	43	50	70	76	79	82			84		87	95
	8	19	23	26	15	27	6	14	19	20	18	5	4	18	3	20	5	13	14
	8		28	30	15						22	3	5	13	3	6	22		
	20			6							21	5	27	5	3	8	6		
											21	7	26	4		7	22		
											19	8	20	19		18			
												22	19	3		3			

Station	96	97	104	115	117	123		125	
	25	8	17	4	13	6	8	9	13
	5	21		15	19	21	15	4	15
	3	25		12	8	8	7	3	4
	3			3		19	7	19	6
				5		9	22	3	15

Blood ark (Length in mm)

Station	1	4	9	13	17	18	24	32	34	35	40	41	42	43	44	46	49
	12	18	13	21	22	15	20	9	15	16	12	27	28	14	28	27	21
	22	21	15	28	31		32	14	17	11	24	29	30	9		29	14
	23	15		31	16			15		11	15		20			26	15
	13	17		28	21			29		13	14		15				16
	15	15		13	20						23		8				20
	19	15		22	17						16						
	17	19									20						
	20	18															

Station	60	64	65	69	72	73	75		79	86	93	94	95		100	103	104
	24	19	29	17	10	16	12	26	22	17	21	20	38	34	22	30	20
	23	22	26				18	27	21	17	25	35	25		29		30
	19		16				24		20	19	19	38	37				20
	17		15				24			12		34	33				25
			19				27					39	39				
			28				29					28	14				
			21				22					43	22				
			8				24						32				

Station	105	107	108	114	115			119									125
	25	21	20	23	22	13	28	23	25	15	12	22	29	20	28	18	20
	33	32	20	33	30	20		28	21	15	15	23	23	22	29	25	16
		10	22	32	22	14		18	25	20	15	18	29	21	20	14	20
			20	23	23	18		21	30	17	14	21	22	15	24	12	
			16		31	23		25	19	17	30	24	12	18	29		
					30	22		15	30	25	27	23	25	23	22		
					25	27		14	13	19	24	13	17	17	15		

Station	126
	20

Chiton (Length in mm.)

Station	47	49	60	64	65			69	75	82	86		95	107	108	119	126
	7	14	11	13	17	16	11	9	9	12	11	11	12	10	20	12	15
	17	15	11	17	17	8	10	8	15	12	9	14	11	12	22	12	23
			16	12	15	6		13	4	8	5		11			17	20
				7	14	15			10	9	5		16			9	
				13	13	12			11	5	5					9	
				13	13	11					11					11	
				16	14	9					14						

New England Dog Whelk (Length in mm)

Station	1	2			3		40	44	47	57	84	105
	12	7	10	13	15	12	18	11	12	10	16	13
	15	16	10	14	17	15					10	
		13	12	12	16	12					11	
		10	11		14	15						
		10	10		16							

Moon Shell (Longest diameter in mm)

Station	113
	65
	58

Sea Star (Radius in mm)

Station	2
	85

Knobbed Whelk (Length in mm.)

Station	1	2	4	13	16	17	18	26	32	34	42	45	47	49	51	53	55	57	59
	122	99	131	162	120	132	131	110	130	51	141	124	150	110	129	130	126	138	60
	116	101	119	161			123	112		125	136		130	130			117	111	67
	155	107	116	155				135		127	132		110	140			76		67
	85	140	157	132				142			151		112	123					
			114					115			128			120					
			132					121			137			81					
			132								126								
											131								

Station	63	65	68	69	70	72	73	74	81	83	84	86	88	90	91	93	94	95	96
	153	137	74	130	72	73	120	131	110	139	136	136	139	69	121	85	93	106	143
	110	147			80		116	112		102		113	137	66		75	154		93
					102			124		103		105	119	69		77			86
					103			132					104	64					
					108								166	58					
					107								152	56					
					75														
					99														

Station	97	99	100	101	104	116	121	122	123	124
	167	122	174	130	138	160	111	127	155	170
	104	139	174	87	147		121			
	90		151							
			102							

Channeled Whelk (Length in mm.)

Station	1	2	20	34	35	40	64	65	66	70	72	75	79	82	86	88	90	96	101
	82	109	125	136	113	95	132	141	107	124	117	144	101	100	119	54	132	147	161
											127		109			41		132	

Station	104	110	112	113	114	116	123	125
	69	99	100	108	109	75	122	170
	150				66	120		
						120		

Oyster Drill (Length in mm.)

Station	43	60	69	75	86	88	92	93	100	104	107	108	115	119	125
	23	23	26	23	5	8	3	20	3	20	4	20	20	23	20
		19			4	2			3	19	4				4
		20			10				4	18	4				3
		18			2				4	20					
					2				3.5	19					
					2										

Spider Crab (Length in mm.)

Station	4	5	44	46	49	64	71	75	81	83	84	85	86	87	88		
	56	51	83	61	73	60	77	80	51	50	82	69	51	87	80	47	58
						48		57		37	54		49	47	52	53	45
						64		65			46		78	77	55	56	50
						55					71		48	57	52	53	64
														73	48	83	
														40	52	63	
														74	58	55	

Station	90			94		95	97	99	101	103	104	105	107		108	110		112	113
	90	48	52	72	65	54	78	77	49	51	65	82	74	49	47	61	60	48	58
	67	59	50	56	64	87		51	55	55	62		54	59		75	21	41	
	60	55		50	46	46		70	59	48	64		52	50		55		40	
	44	48		51	63						49		56	58		58		56	
	65	46		58	59						66		54	60		48			
	57	48		49	53								50	74		52			
	42	50		59	70								64			44			

Station	115		116		117	119				121	122		123	124	125	126
	60	55	85	34	90	33	47	55	67	59	45	74	36	66	21	79
	50	61	50		45	41	58	42	35	47	50	40	49	36		25
	75	51	46		56	38	52	45	30		48	55		53		26
	40		20			37	42	50	38		54			59		32
	58		55			56	62	40	52		38			32		
	45		48			48	43	47	45		36			47		
	52		50			80	57	45			79					

Mud Crab (Length in mm.)

Station	1	2	3	4	5		6	9	11	13	18	25	32	34	40				41
	9	13	14	20	7	10	14	11	12	9	11	12	8	5	9	4	15	4	14
	10	15		15	24	11	12		11				4		6	7	7	5	12
	14	8		12	31	12									7	18	9	10	12
	13	9		15	19	13									4	12	6	9	
	14			12	10										6	7	5	3	
				10	14										6	12	4	3	
					9										3	4	4		

Station	43	47		49	50	52	60	63	65	69	73	75		82		83	84	87	88
	15	16	7	11	15	7	16	8	12	22	5	4	14	8	14	12	15	15	16
		11	11	5	10	3	10		11	16		6		12	4	12	13		11
		4	12	6	3	11			9	6		10		15	12		3		9
		5	5	11	11	5			3			12		8			3		
		4		7	12							14		3					
		5										9		4					
		8										4		5					

Station	93	94	95	97	99	100	101	103			104		105			107		108
	9	12	20	12	8	6	12	6	6	3	4	5	4	3	2	6	13	13
		14	10		14			7	4	4	7	5	3	9	3	13		10
		10	5		11			4	3	14	13		5	12	3	11		11
		11	11		5			8	11		15		5	14	6	10		
		17	4					4	10		11		6	19	11	3		
		16						4	8		8		2	20	12	3		
								4	9		10		2	4	11	5		

Station	110		112	115		116	119	124	125	126
	26	4	8	2	10	15	5	15	8	16
	16	4	19	6	12	10	16		3	10
	10	3	17	11	12	7	8		15	20
	5	3	11	5		16				11
	15			6		6				2
	20			15						6
	12			10						

Lady Crab (Length in mm.)

Station	1	4	6	7	9	12	13	14	17	18	20	24	25	26		32	34	35	40
	59	76	55	52	62	62	54	61	56	55	69	69	58	64	76	60	66	63	57
	52	46	42	56	68		52	62		60		54		57	67	80		64	59
	58	68		51			71	67		56		50		66	53	80		56	57
	57	54		53			51	69		58		56		61	60	56		56	74
	64	52		80			60	56		51		46		61	54			62	79
	61	58		57				55						54	53			59	60
	55							63						55	58			63	52
														55				63	56
																		69	

Station	41	42		43	45	47	49	50	51	53	54	55	57	62	63	64	65	66	68
	55	56	58	63	68	52	58	55	58	71	41	58	73	69	54	71	58	59	62
	50	60	59	68	58	58	58	72	75	71	57	58	55	52		72	73	60	57
	64	56	52	53	71	61	52		63			57	75	53		58	64		55
	52	84	73	55	56		56		76			49	57	56		59			48
	63	63		54	49		52					55		60		51			
	54	53			58							55		54		90			
		54			55							63		70		73			
		59										47							

Station	69	70		71	72	73	74		76	79	82	83	86	87	88	95	97	100	
	62	72	54	60	60	56	53	60	55	48	55	59	64	47	51	56	50	58	68
	54	57	57	55	56	67	56	50	62	60	66	55	69		80	57	52	60	75
	62	58	58		57	74	58	63		56	67	55	74		53	75	55	63	58
	63	57	58		62	77	54	61		63	54	70			55	71	62	67	72
	52	57	52		56		55	49			58	56			71	60	63	53	64
		54	55		58		54	54							65		62	58	
		52	57		61		62	54										62	
		56					60											53	

Station	101	104	108	113	114	115	116	117	119	122	124	125
	55	65	68	70	66	64	50	58	67	72	50	82
	59	58					66			55	56	
	56	58					60			69	71	
	63	55								67	66	
	54									68	45	
	53									63	57	
	53									64	76	

Rock Crab (Length in mm.)

Station	104	107	112	116	121	123	124	126
	55	59	44	64	67	52	59	62
		66		71			55	40
							53	

Horseshoe Crab (Length in mm.)

Station	2	55	74
	270	450	580
	340		