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Inventory of surf clams in nearshore waters from Cape Henlopen to the False Cape area : quarterly progress report, September 16, 1974 - December 15, 1974

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INVENTORY OF SURF CLAMS IN NEARSHORE WATERS FROM CAPE HENLOPEN TO THE FALSE CAPE AREA

Period covered: September 16, 1974 - December 15, 1974

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ABSTRACT

A survey of the surf clam (Spisula solidissima) in the nearshore area along the Delmarva Peninsula and further offshore from Cape Henry to upper North Carolina was conducted from 4 October, 1974 through 15 October, 1974. The project is a joint undertaking by the National Marine Fisheries Service (NMFS) and the Virginia Institute of Marine Science (VIMS). A total of 138 sites were sampled with a hydraulic tow dredge and, in addition, a benthic sample for juvenile clams were obtained at each site with a Smith-MacIntyre sampler.

Surf clams were encountered at six of 58 stations along the Delmarva Peninsula, but only one of the six samples indicated a high density. Two areas of heavy surf clam density were apparent in the overall area offshore of Cape Henry and south to upper North Carolina. The trend in the density distribution was in agreement with that found in an August, 1974, NMFS surf clam cruise. However, the catch data were significantly different and the implications of this are discussed herein.

The benthic grab samples are presently being examined, therefore, no juvenile clam data are reported.

INTRODUCTION

The main objectives of the study are to estimate distribution, relative abundance and recruitment of surf clams along the Delmarva Peninsula and in areas of intense harvesting off the Virginia coast.

Work during the first quarter of the project (previously reported) consisted of (1) obtaining the hydraulic tow dredge and its accessory equipment from the National Marine Fisheries Service (NMFS) at Sandy Hook, New Jersey; (2) installation of the equipment aboard the Virginia Institute of Marine Science (VIMS) research vessel Retriever; and (3) pilot tests of the equipment.

Sampling was conducted during the second quarter of the project, from 4 October, 1974 through 15 October, 1974, and the initial analyses of data begun.

The study is a joint NMFS-VIMS endeavor, but herein-after it is associated with the latter Institution to avoid confusion with an NMFS surf clam cruise in Virginia and North Carolina coastal waters in August, 1974.

MATERIALS AND METHODS

Surf clam samples for estimates of distribution and abundance were obtained with a hydraulic tow dredge operated from the VIMS research vessel Retriever. The dredge, supplied by the NMFS, is similar to those employed in the surf clam fishery, but smaller. It has a 30-inch (76.2 cm) blade versus industrial blades ranging up to

100 inches (254 cm). The dredge has a retention bag constructed of 2-inch rings (7.62 cm) versus 3-inch rings generally used throughout the industry. However, catch data and its size composition are applicable to surf clam fishery considerations. The relationships of sample catch and its size composition to the total population is unknown since the catch-efficiency of the dredge with respect to surf clams less than 2 inches is not known. Arbitrarily, a surf clam catch ≥ 45 was considered satisfactory in the sense that the immediate area would warrant replicate sampling to determine a reliable average catch and the extent of the local distribution. This figure (45) was derived in consideration of the necessity to maintain a constant sampling unit, whereas an experienced fisherman would make gear adjustments according to sea conditions, depth, bottom type, etc.

Sampling was standardized by taking a 5 minute tow at each station. It was estimated that vessel towing speed was, on the average, 1.5 knots. Thus, about 1900 ft^2 (176.5 m^2) of substrate was sampled in a standard tow.

Sampling stations along the coast of the Delmarva Peninsula were established along transect lines horizontal to lines of latitude at intervals of 1, 2 and 3 miles (nautical) offshore of the 1 fathom line indicated on the National Ocean Survey chart no. 1109. Transect lines were spaced at 5 mile intervals from just below Cape Henlopen (Rehoboth Beach area), Delaware, to Cape Charles, Virginia. An additional transect of three stations in a north to south direction was sampled inshore near Cape Henry, Virginia. Offshore of Cape Henry and further south,

sampling was conducted along a rectangular grid system constructed of six stations on each of 12 transects, in which both stations and transects were at 2.5 mile intervals. The grid duplicated one sampled by NMFS in August 1974. The purpose of the duplication was to obtain replicate samples in this area because of the active surf clam fishery there.

In this report a station is referred to by the transect number followed by its offshore position, e.g., T4(3) is the third station, counting from inshore to offshore, on transect 4 (Figure 1); similarly, T29(5) is the fifth offshore station on transect 29 (Figure 3). Three stations, T14(1), T20(2) and T33(5) were not sampled.

At each station, the catch of surf clams was recorded, and a random subsample of up to 1 bushel of clams was measured for length (longest linear dimension). Other major (or obvious) benthic species were identified and counted.

A Smith-MacIntrye benthic sampler was employed at each station to sample for juvenile clams. It sampled an area of 1.08 ft^2 (0.1 m^2). A single grab sample was taken at each station and wet sieved on a 0.04 inch (1 mm) mesh screen. The portion retained was preserved in 5% formalin and returned to the laboratory. These samples are presently being examined.

Bottom and surface water temperatures were recorded at each station and accompanying water samples were later titrated to determine salinities. Mean low water depth at each station was recorded from the navigation chart.

RESULTS

Distribution and Abundance

A total of 58 stations were sampled in the nearshore waters ($\leq$ 3 miles) along the Delmarva Peninsula. No surf clams were obtained at the nine stations off the Delaware coast. Surf clams were present in five of 15 samples off the Maryland coast; however, commercial abundance was indicated at only one site, T4(2), where 233 clams were taken in a standard tow (Figure 1). Only one surf clam was obtained in 34 samples off the Virginia section of the Delmarva Peninsula (Figure 2).

No surf clams were captured at the three inshore stations (T21) off Cape Henry (Figure 3).

In the 2.5 X 2.5 mile grid offshore of Cape Henry and south to upper North Carolina, 71 stations were sampled (Figure 3). A total of 2,474 surf clams were taken from 39 stations. Two areas of heavy surf clam density were apparent. One was along T23 and T24 where 8 of 12 catches ranged from satisfactory ($\geq$45 clams) to the highest recorded (394 clams). Another group of five spatialy associated high catches occurred along T26 and T27. Only four other stations had catches $\geq$45 [T25(6); T28(5); and T29(2&4)].

The average catch for the 71 stations sampled in the grid area was 34.8 clams per standard tow. However, this is an arithmetic average and, as such, greatly influenced by the several high catches. A standing crop estimated from it would be exaggerated. The catch data are discrete observations and their distribution sharply skewed right; this, in conjunction with a variance which greatly exceeds the mean

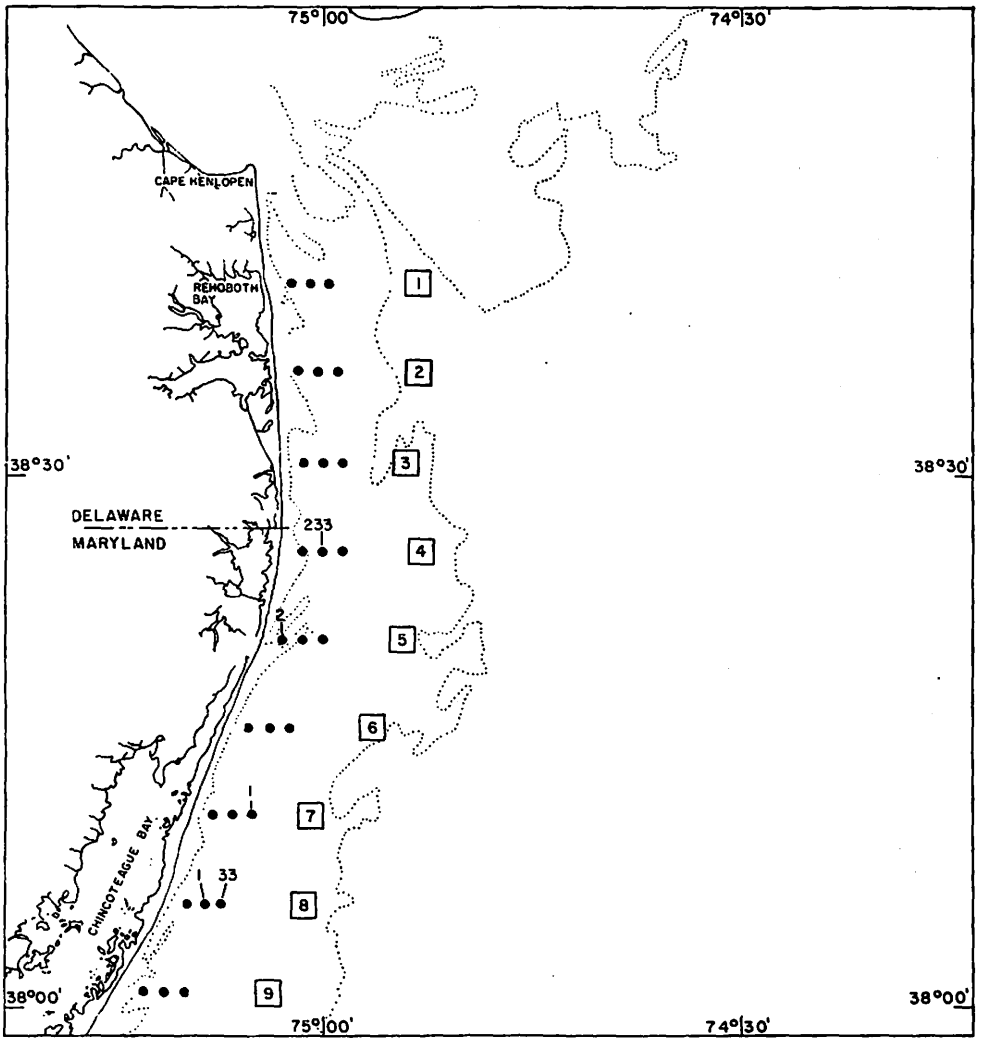

Figure 1. Transects (squares) and sampling stations (closed circles) at 1, 2 and 3 miles offshore of the Delaware and Maryland coast of the Delmarva Peninsula. Number above stations indicate catch of surf clams. VIMS surf clam cruise, October, 1974.

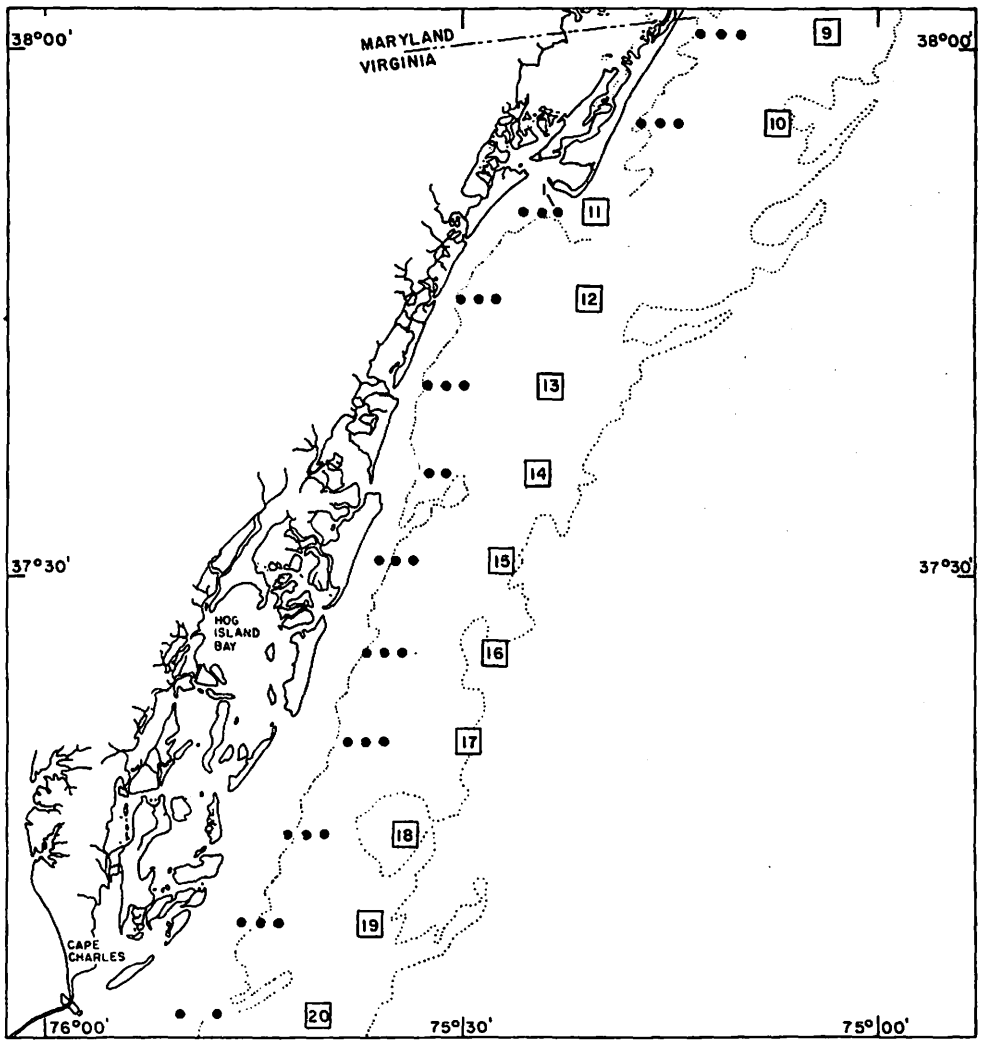

Figure 2. Transects (squares) and sampling stations (closed circles) at 1, 2 and 3 miles offshore of the Virginia coast of the Delmarva Peninsula. Number above stations indicates catch of surf clams. VIMS surf clam cruise, October, 1974.

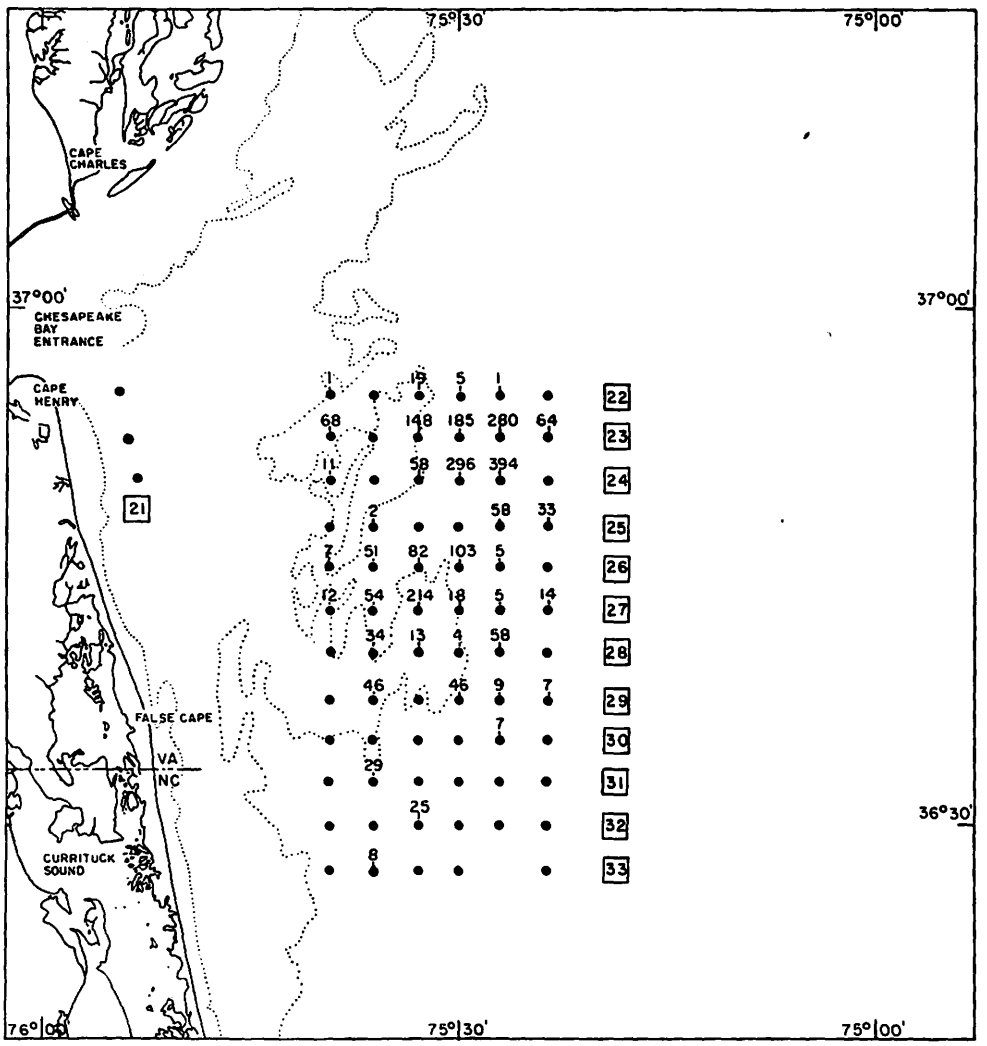

Figure 3. Transects (squares) and sampling stations (closed) circles) off the coast of lower Virginia and upper North Carolina. Number above stations indicates catch of surf clams. VIMS surf clam cruise, October, 1974.

(5,546.84 and 34.8, respectively) implies a negative binomial distribution of the catch data. Assuming the transformation of the data by $X_i = \ln(X_i + 1)$ reasonably approximates normality, the resulting geometric average catch is 5.1 clams per standard tow. A 90% interval estimate ranges from 3.1 to 7.9 clams per tow (an interval cannot properly by placed about the arithmetic average because it would imply a normal distribution of the untransformed catch data). The dramatic difference between the arithmetic and geometric averages is, with respect to the entire area sampled, academic. The fishery is not conducted over the entire area sampled, but rather, is limited to specific sites of high density. When only sample catches ≥ 45 in transects T23 and T24 are considered and each sample site is considered to be centered in a grid square of 2.5 mile sides, the standing crop is estimated at about 4,300 clams per acre based on an arithmetic mean of 186 clams per tow. Based on a geometric mean of 147 clams per tow, the estimated standing crop is approximately 3,400 clams per acre. If the omitted samples (< 45) in the two transects and their respective areas are considered, the standing crop estimate will be reduced. Conversely, if only the area between the two transects is considered, the standing crop estimates will greatly increase. A similar rationale applies to the observed concentration of surf clams in transects T26 and T27 where an arithmetic estimate of 101 clams per tow indicated a standing crop of approximately 2,300 clams per acre and the geometric estimate of 87 clams per tow indicated about 2,000 clams per acre. It is obvious from the distribution of the

catches that surf clams have a contagious distribution. Until the contagion areas are reasonably defined, estimates of standing crop, no matter how derived, are suspect.

The National Marine Fisheries Service conducted a surf clam survey off the Virginia and North Carolina coast in August 1974. The VIMS survey in October 1974, essentially duplicated 65 stations as indicated by the similarity of the Loran bearings (Table 1). The catch distribution of the NMFS data (Ropes, unpublished) shows the same trend as stated above for the VIMS cruise. The greatest density was encountered along T24 and T25 (vs T23 and T24 in VIMS data) and, again, a second concentration along T27 and T28 (vs T26 and T27 in VIMS data. Ropes also found, contrary to the VIMS data, a high density of surf clams at T33(2&3); in addition, he found a dense concentration at T34(2&3), a transect not sampled during the VIMS cruise.

Although the density distribution trend was similar, catch data (obtained with the same dredge) are different, and imply, in the dense surf clam areas which are actively fished, a reduction in standing crop between the NMFS August 1974 cruise and the VIMS October 1974 cruise. A total of 4,876 surf clams were taken during the NMFS sampling of the 65 common stations versus 2,398 total for the VIMS samples. The difference in the two catch totals was highly significant when χ^2 was used to test a hypothesis of a 1:1 catch ratio ($\chi^2 = 844$; $P < 0.001$, i.e., the probability that the observed difference was due to chance is <1 in a 1000). The number of times in which the NMFS catch exceeded the VIMS catch was not significant ($\chi^2 = 0.17$; $P > 0.50$).

Table 1. Selected Loran bearings for NMFS and VIMS surf clam surveys off the Virginia-North Carolina coast, 1974.

Station	Loran Bearings NMFS 3H4	NMFS 3H5	VIMS 3H4	VIMS 3H5
T22 (4)	2111	3047	2110	3046
T23 (4)	2085	3044	2080	3043
T24 (4)	2055	3040	2057	3040
T25 (4)	2031	3036	2028	3036
T26 (4)	2004	3033	2003	3033
T27 (4)	1978	3030	1976	3030
T28 (4)	1950	3026	1950	3027
T29 (4)	1925	3024	1920	3023
T30 (4)	1895	3020	1896	3020
T31 (4)	1870	3017	1870	3017
T32 (4)	1844	3014	1842	3014
T33 (4)	1813	3011	1815	3011

The arbitrary separation of the higher catches ($\geq$ 45 clams per station for either cruise sample) from the lesser ones also reveals that the NMFS catch (4,721 clams) in the higher density areas was significantly greater than the VIMS catch (2,229 clams) (χ^2 = 893; $P \leq 0.001$), and, again, there was no significant difference in the occurrence of higher catches (χ^2 = 0.3; $P > 0.50$). In the areas of apparent less density ($\leq$ 45 clams per station for both cruise samples) the difference between the NMFS catch (155 clams) and the VIMS catch (169 clams) was not significant (χ^2 = 0.52; $P > 0.30$); nor, was the difference in the occurrence of higher catches (χ^2 = 0.19; $P > 0.50$). Thus, no significant change in standing crop could be detected in the areas of lesser surf clam density which are subject to little or no fishing pressure.

A conclusion that a reduction in surf clam density is the result of fishing mortality is valid only if the implicit assumptions for the two cruises of an equal fishing efficiency and standard fishing effort (i.e., a standard sample tow) are valid. A 5 minute standard tow was also used in the NMFS cruise, but if towing speed and/or weather and sea conditions were different, it would result in a different standard sampling unit. Differences in fishing efficiency cannot, from the practical aspect, be readily determined; however, fishing effort could be adjusted to a standard effort by employment of an odometer.

Average Length

Average lengths are presented in Figure 4 for those samples in which 10 or more clams were measured. The overall average for the

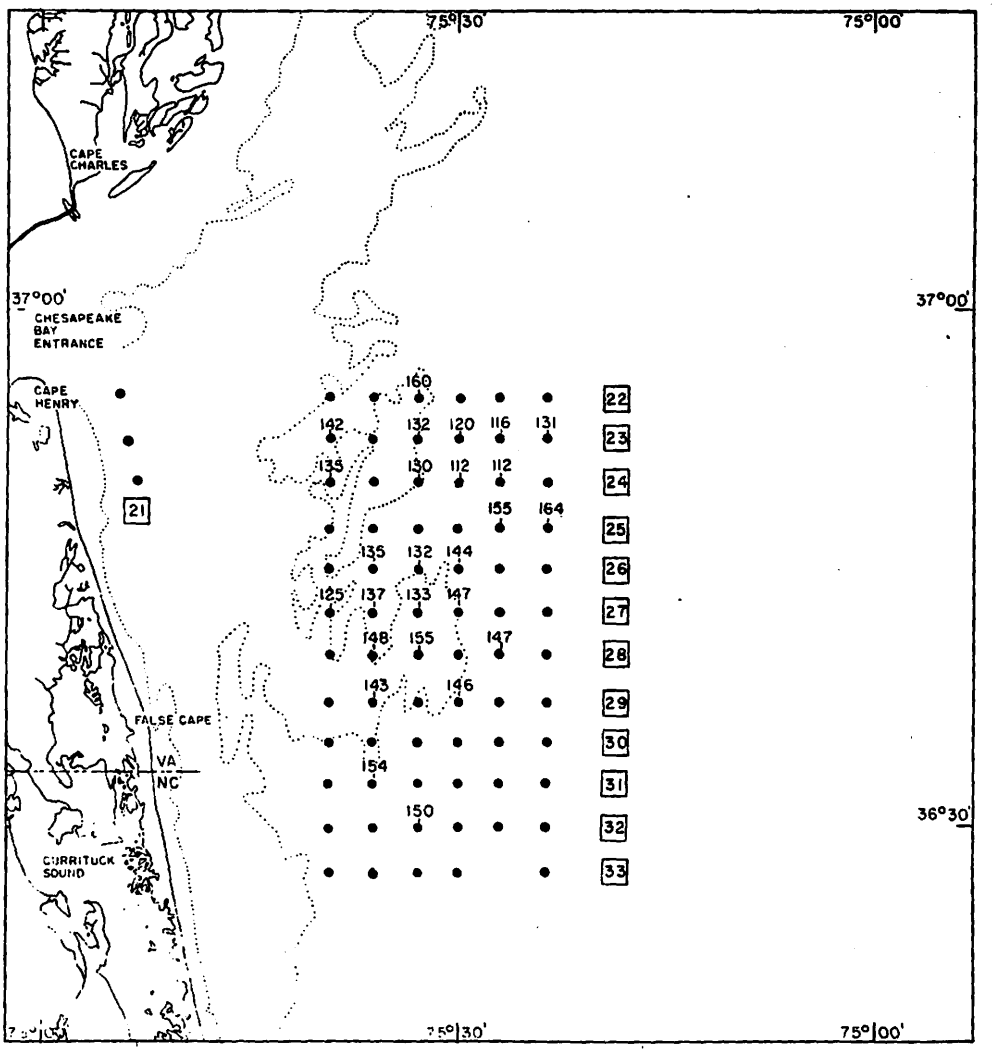

Figure 4. Distribution of average surf clam lengths (number above station). VIMS surf clam cruise, October, 1974.

pooled length measurements of all samples (1,295 clams) was 131 mm, with a 90% interval estimate from 130 mm to 132 mm. The estimated average surf clam length for the eight stations in the dense population along T23 and T24 was 122 mm with a 90% interval estimate from 121 mm to 123 mm. This smaller average length may be due the heavier fishing pressure in this area because of the high density of clams and its relative nearness to the shucking houses on the Eastern Shore. Overall, the correlation between catch and average length was extremely weak, $r = -0.16$ when samples ≥ 10 were considered. This correlation rose to -0.82 when only samples ≥ 45 were considered. This higher r value implies a smaller average length in higher densities because of recruitment and/or fishing mortality. This is a common fisheries phemomenon.

Recruitment

The Smith-MacIntyre samples are being sorted and no data is presently available.