1975

Inventory of surf clams in nearshore waters from Cape Henlopen to the False Cape area : quarterly progress report, December 16, 1974 - March 15, 1975

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Virginia

Contract 03-4-043-357

Quarterly Progress Report

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

Period covered: December 16, 1974 - March 15, 1975

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ABSTRACT

The following pertinent considerations are developed and discussed in this report.

1. Standing Crop

A commercial density of surf clams is not present in the inshore waters along the Delmarva Peninsula. In the Virginia fishery area sampled offshore of Cape Henry south to upper North Carolina, the estimated standing crop was 10 million bushels.

2. Growth

A growth function for Virginia surf clams was derived by reevaluation of the data of Welch. The resulting length-age relationship indicates that surf clam recruitment to the fishery probably accurs between ages 2 and 3.

3. Length Frequency

A cummulative length frequency curve was construted and in conjunction with the growth function, it is estimated that 40.5% of the clams sampled were age 5 or younger. This infers an average recruitment of 8% a year since 1969.

4. Juveniles

To date, 20 Smith-MacIntyre sediment samples have been examined and only four juvenile surf clams recorded. This low density and the small percentage of age 2 clams in the dredge samples indicates that surf clam stocks may be dependent upon occassional successful year classes.

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. The project is a joint undertaking by the National Marine Fisheries Service (NMFS), and the Virginia Institute of Marine Science (VIMS). 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.

Work during the first quarter of the project consisted of (1) obtainment of a hydraulic tow dredge and its accessory equipment from the NMFS; (2) installation of the equipment aboard the VIMS research vessel Retriever; and (3) pilot tests of the equipment.

During the second quarter of the project, 138 sites were sampled with the hydraulic tow dredge and, in addition, a benthic sample for juvenile surf clams was taken at each site with a Smith-MacIntyre sampler. Examination of the samples and the initial analysis of the data were begun, and a preliminary report submitted.

In this report for the third quarter, standing crop, growth, and juvenile abundance are considered.

MATERIALS AND METHODS

A thorough presentation of material and methods employed in this study were presented in the previous quarterly report. It is suffic-

ient, with one exception noted below, at this time to simply reiterate the following: (1) twenty transects horizontal to lines of latitude and spaced at 5 mile intervals from Cape Henlopen to Cape Charles were each sampled at 1, 2 and 3 nautical miles offshore of the Delmarva Peninsula; (2) 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 the NMFS in August, 1974; (3) a 1.08 ft^2 (0.1 m^2) benthic grab sample was taken at every station; and (4) a station is referred to by its transect number followed by its offshore position, e.g., T29(5) is the fifth station, counting from inshore to offshore, on transect 29.

Harold Nix, captain of the R/V Retriever during the cruise, estimated vessel speed while towing the dredge to be 0.5 knot. Accordingly, the standard sampling unit was adjusted to 632.9 ft^2 (58.8 m^2). The statistical contrasts between the NMFS and VIMS catches presented in the previous Quarterly Progress Report are invalid and such analysis must be delayed until an estimate of the standard sampling unit used on the NMFS cruise is available.

RESULTS AND DISCUSSION

Catch and Standing Crop Estimates

Surf clams were obtained at only six of 58 stations sampled in the nearshore waters ($\leq$ 3 miles) along the Delmarva Peninsula (Figures 1 and 2). The total catch was 271 and the average catch was 4.7 clams

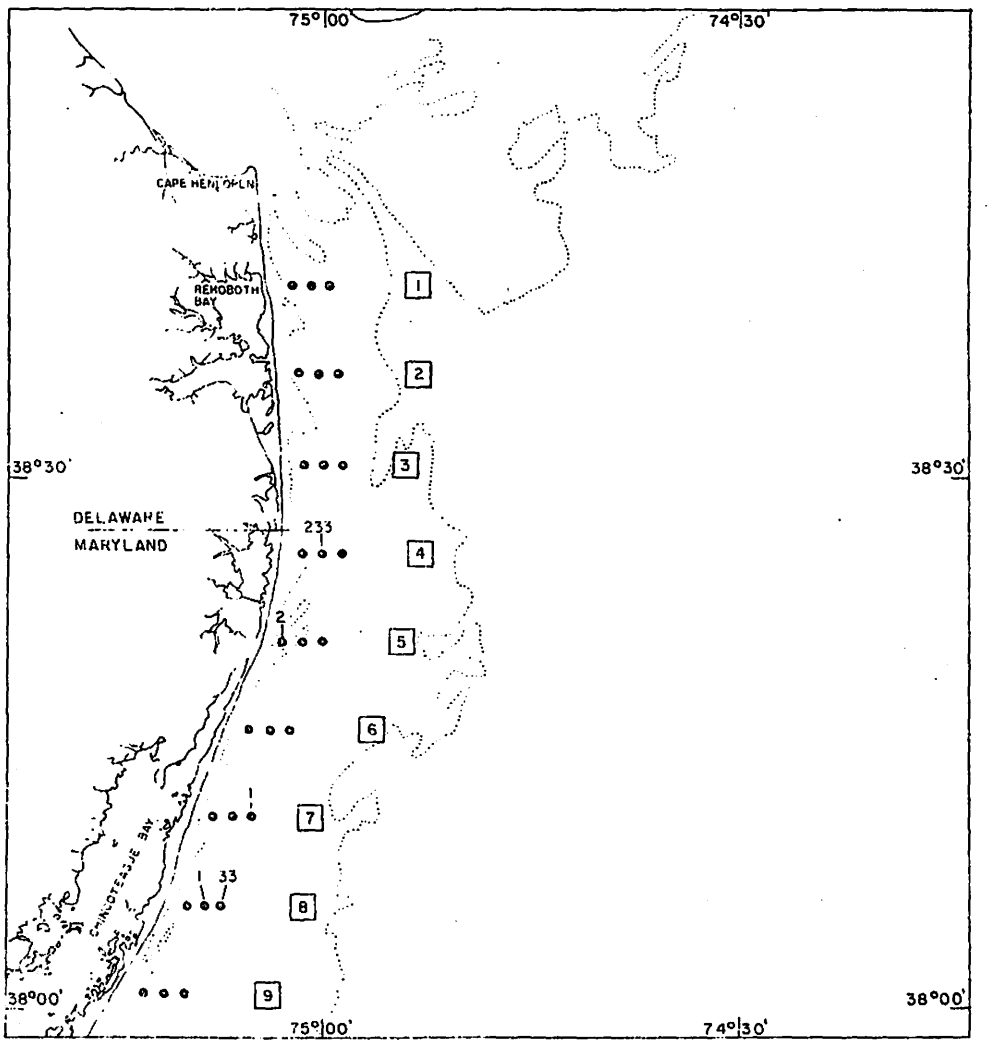

Figure 1. Transects (squares) and sampling stations (closed circles) at 1, 2 and 3 miles offshore of the Delaware and Maryland coast of the Delmarva Peninsula. Number above stations indicate catch of surf clams. VIMS surf clam cruise, October, 1974.

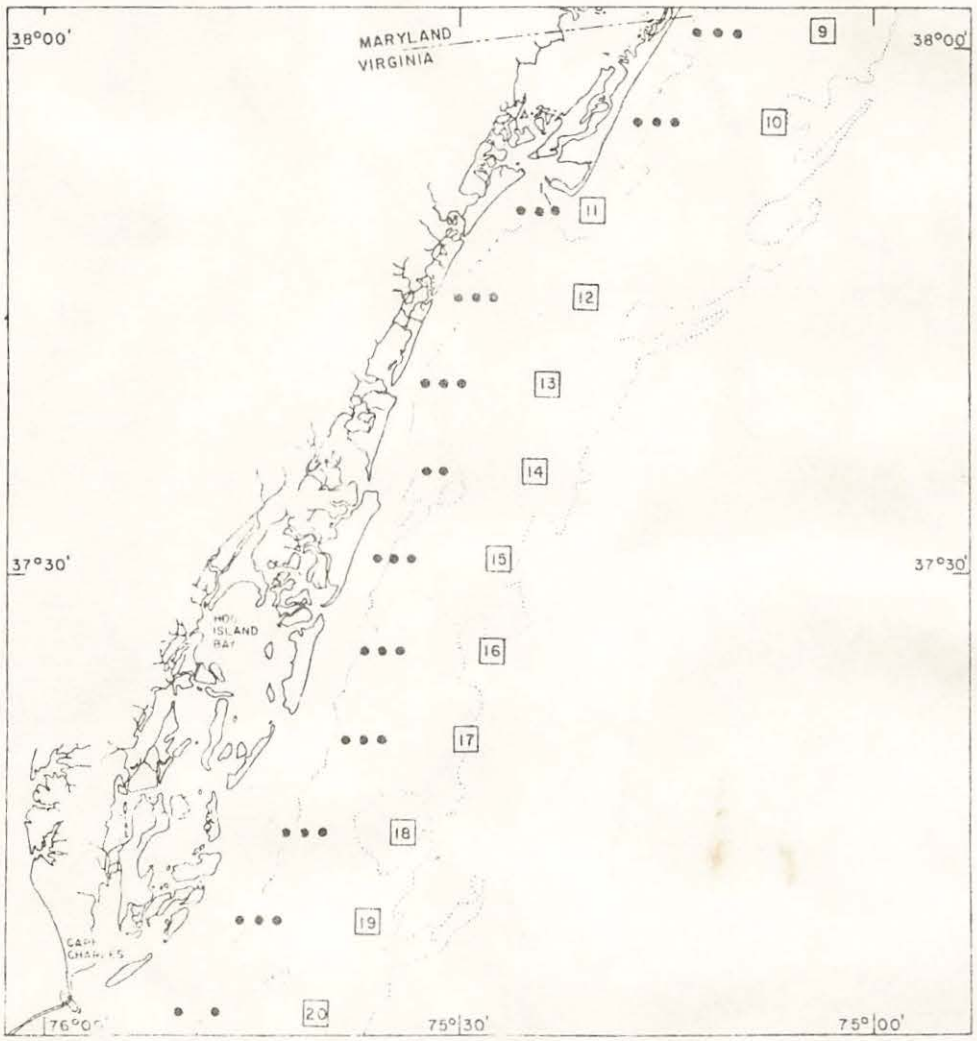

Figure 2. Transects (squares) and sampling stations (closed circles) at 1, 2 and 3 miles offshore of the Virginia coast of the Delmarva Peninsula. Number above stations indicates catch of surf clams. VIMS surf clam cruise, October, 1974.

per standard tow. Commercial abundance was indicated at only one site, T4(2) where the catch, 233 clams, was about 87% of the total catch along this Peninsula. This concentration of surf clams is probably very limited in its distribution since no clams were taken at the adjacent sites T4(1) and T4(3), nor along transect T3, and only two clams were taken along transect T5. It is obvious that a commercial density of surf clams is not present in the inshore waters along the Delmarva Peninsula, thus, no further considerations of the data are made.

Standing crop estimates are presented in Table 1 for the entire area sampled offshore of Cape Henry south to upper North Carolina (Figure 3), transects T22 through T33 (343.75 nautical miles^2), and also for the areas between T23 and T29 (187.5 nautical miles^2), the north-south boundries of the highest observed densities for both the NMFS and VIMS cruises. Approximately 89% of the estimated standing crop of surf clams occurred within the T23-T29 boundries. Additions to the total estimate of about 10 million bushels would include density estimates offshore of T24 and T25 and south of T33, areas sampled by NMFS.

Estimation of Growth

Yancey and Welch (1968) presented four different growth curves for the surf clam. One for clams in Nova Scotia and another for a narrow age range of clams in Massachusetts waters are not considered. The other two curves pertain to surf clams off Long Island, New York (Westman and Bidwell, 1946. Unpublished) and off New Jersey (Welch, 1963. Unpublished). The age-length relationship for the Long Island clams was ascertained from the growth curve, and check mark-length data for

Table I. Standing crop estimates for surf clams in the Virginia fishery area south of Cape Henry. VIMS cruise, October, 1974.

Area	Number Samples	Average Catch	Bushels Per Acre	Total Bushels ($X 10^6$)	Meat Wts (lbs) ($X 10^6$)
T22-T33	71	34.8	34.2	9.96	169.38
T23-T29	42	56.6	55.5	8.84	150.27

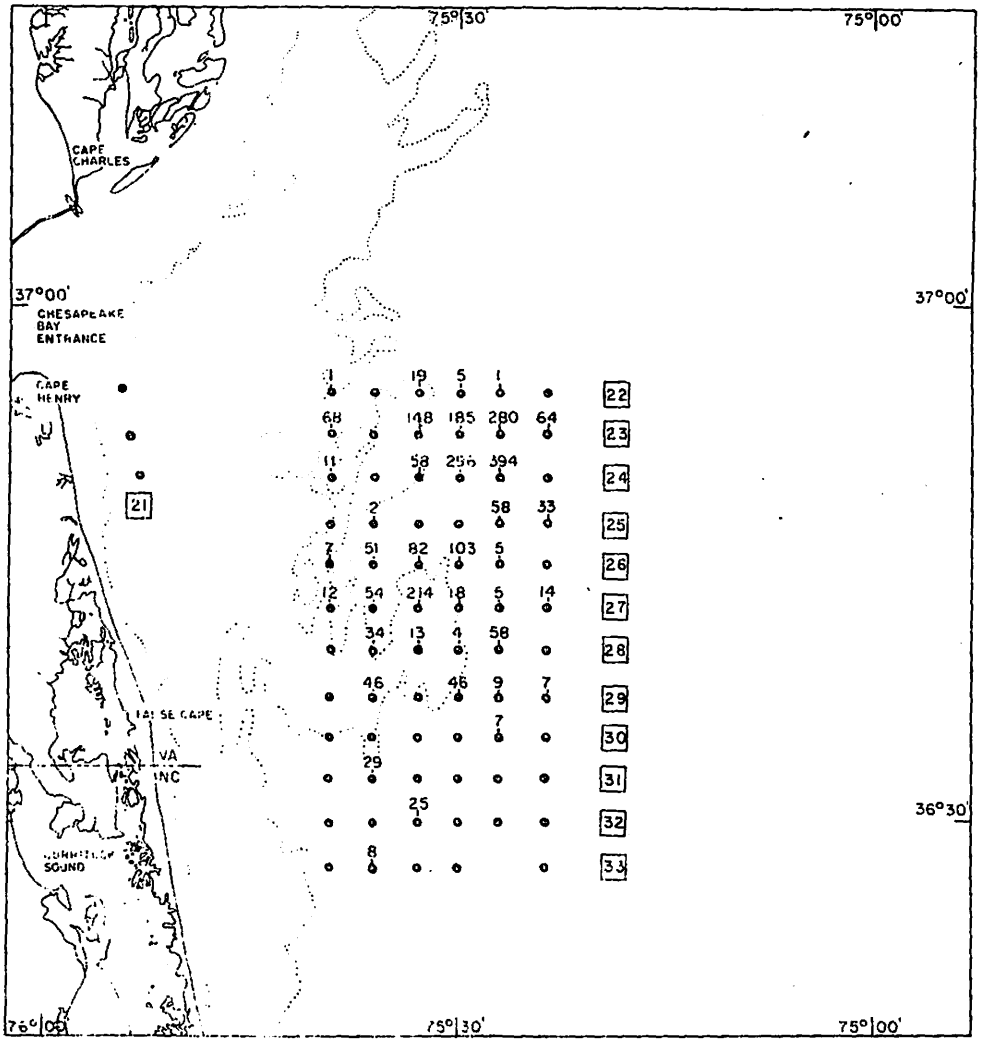

Figure 3. Transects (squares) and sampling stations (closed circles) off the coast of lower Virginia and upper North Carolina. Number above stations indicates catch of surf clams. VIMS surf clam cruise, October, 1974.

the New Jersey clams was supplied by Welch (personal communication). The Walford "transformation" (Walford, 1946) was applied to both data to estimate growth functions. This analysis tranforms an asymptotic growth curve to the linear form:

$$L_{t+1} = L_\infty(1-k) + kL_t$$

where L_t = length a time t; L_{t+1} = length at the end of a constant time interval (one year in the present cases); $L_\infty(1-k)$ = regression line intercept; k = the regression coefficient; and L_∞ is the asymptotic size, i. e., the average maximum size.

The surf clam growth curve by Westman and Bidwell does not appear realistic. By the 17th year the curve still does not tend toward an asymptotic size (L_∞) and the Walford analysis indicates that L_∞ would not be attained until about age 38. Thus, one would have to assume the surf clam lived for well over 40 years. Surf clam longevity is not known but about 17 years has been suggested (Ropes et al. 1969).

The Welch growth curve has a more general appearance of an asymptotic growth curve and tends toward L_∞ about the 10th year. However, Welch apparently missed the 1st year class, his growth curve indicated an average 1-year old is about 2.5 inches (63.5 mm). This estimate is 0.75 inch (19 mm) larger than reported for age 1 in a mark and recapture study (Ropes et al. 1969). Welch (unpublished report and personal communication) suspects that the first winter check mark may have been missed in his and the other growth studies reported by Yancey and Welch (1968).

The growth function ascertained by the Walford transformation of Welch's length data for successive check marks is:

$$L_{t+1} = 1.85 + 0.68\ L_t$$

This expression is independent of age, but the age-length relationship

was estimated by using 0.01 inch (0.24 mm), the midpoint of the general size range of newly settled surf clam spat (Loosanoff et al. 1966). At this time when the larvae leave the planktonic environment and become members of the benthic community, I considered them to be age zero. Substitution of the length at age zero into the growth function produced an estimate of length at age 1. A growth curve was generated by continuing this process until arbitrarily terminated at age 17 (Figure 4). The curve appears to be a reasonable approximation of surf clam growth in the Virginia fishery area, given the limitations of the data. This contention is supported by the reported size of juvenile surf clams off Chincoteague, Virginia (Ropes et al. 1969). There is a need for a more refined growth study if long term management of the fishery is considered, since Figure 4 is derived from the data of Welch, who made 90 check-mark measurements from only 10 surf clams (Welch, personal communication).

The average maximum lenght (L_{∞}), not attained by some individuals but exceeded by others, is estimated at 5.8 inches (147.3 mm) and theoretically reached at age 13. Of more practical importance are the estimates that 95% of L_{∞} occurrs at age 8 and 50% by age 5. The growth curve indicates that recruitment to the Virginia surf clam fishery occurs between age 2 and 3, since 3-inch rings (76.2 mm) are used in the commercial dredge bags. Thus, there are not several unexploited year classes which would tend to stabilize a fishery (assuming constant effort) when years of poor setting occur. In addition, potential future recruitment is further reduced by some retention of smaller sizes in the

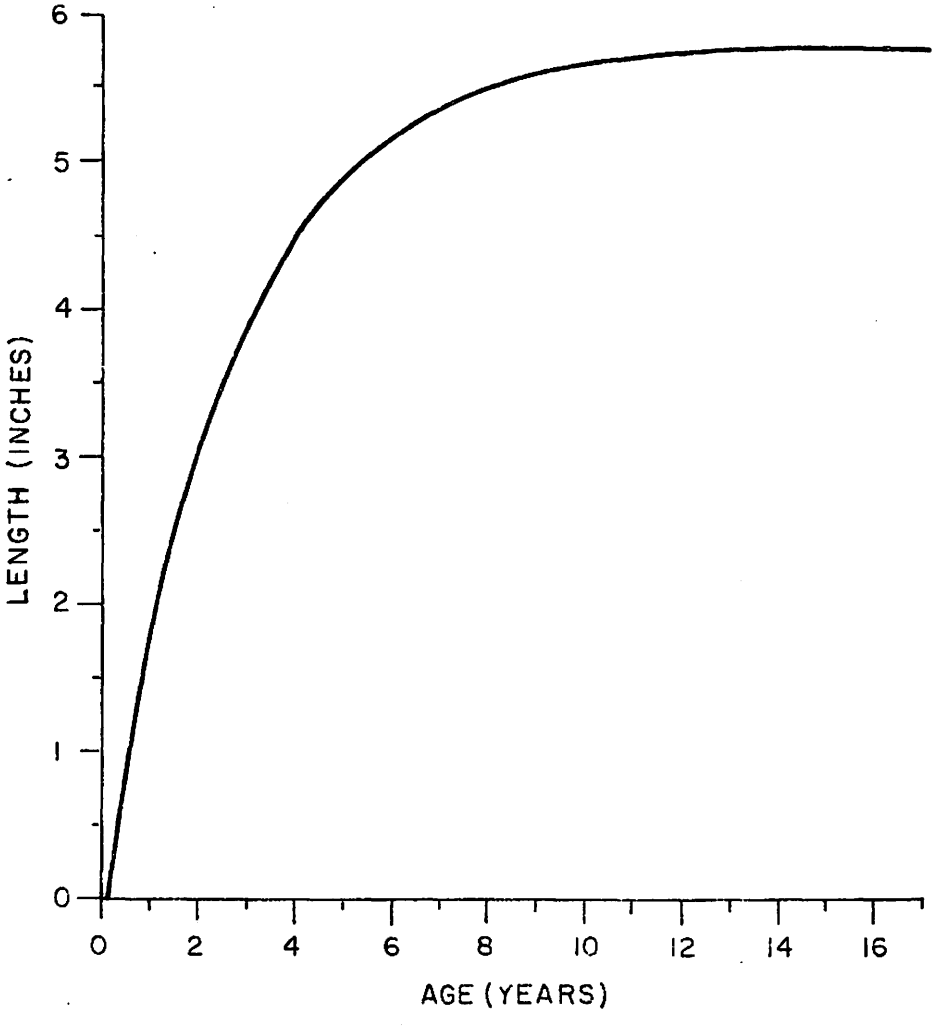

Figure 4. The length-age relationship for Virginia surf clams derived from the data of Welch.

bag, and the suspected near total mortality of clams which passed through the rings but have the mantel cavity packed with sand due to the hydraulic jet harvesting process.

Length Frequencies

An average surf clam length of 5.2 inches (133.5 mm) was estimate from 1,273 measurements of individuals obtained in the Virginia fishery area with the NMFS dredge. Approximately 95% of the measurements were within the interval from 3.8 to 6.6 inches (98.0 to 169.1 mm). It is estimated from the growth curve (Figure 4) that this dredge with its 2 inch rings (50.8 mm) was 100% efficient in sampling surf clams age 2 or older. The cumulative length frequency curve (Figure 5) indicates that only 0.7% of the sample was age 2. This estimate arbitrarily assumes a maximum age 2 length of about 3.5 inches (89.9 mm), the point midway between ages 2 and 3 in the growth curve. By the same rationale, 7.8% of the catch was age 3 or younger, 23.9% was age 4 or younger, and 40.5% was age 5 or younger. The latter percentage infers an average recruitment rate (relative to the 2-inch rings) of about 8% a year since 1969 when (prior to 1974) the area was last surveyed by NMFS. However, the low percentage of age 2 surf clams in the samples and the scarcity of juveniles clams in the Smith-MacIntyre grabs (below), indicates that surf clam stocks may be dependent upon occasional successful year classes.

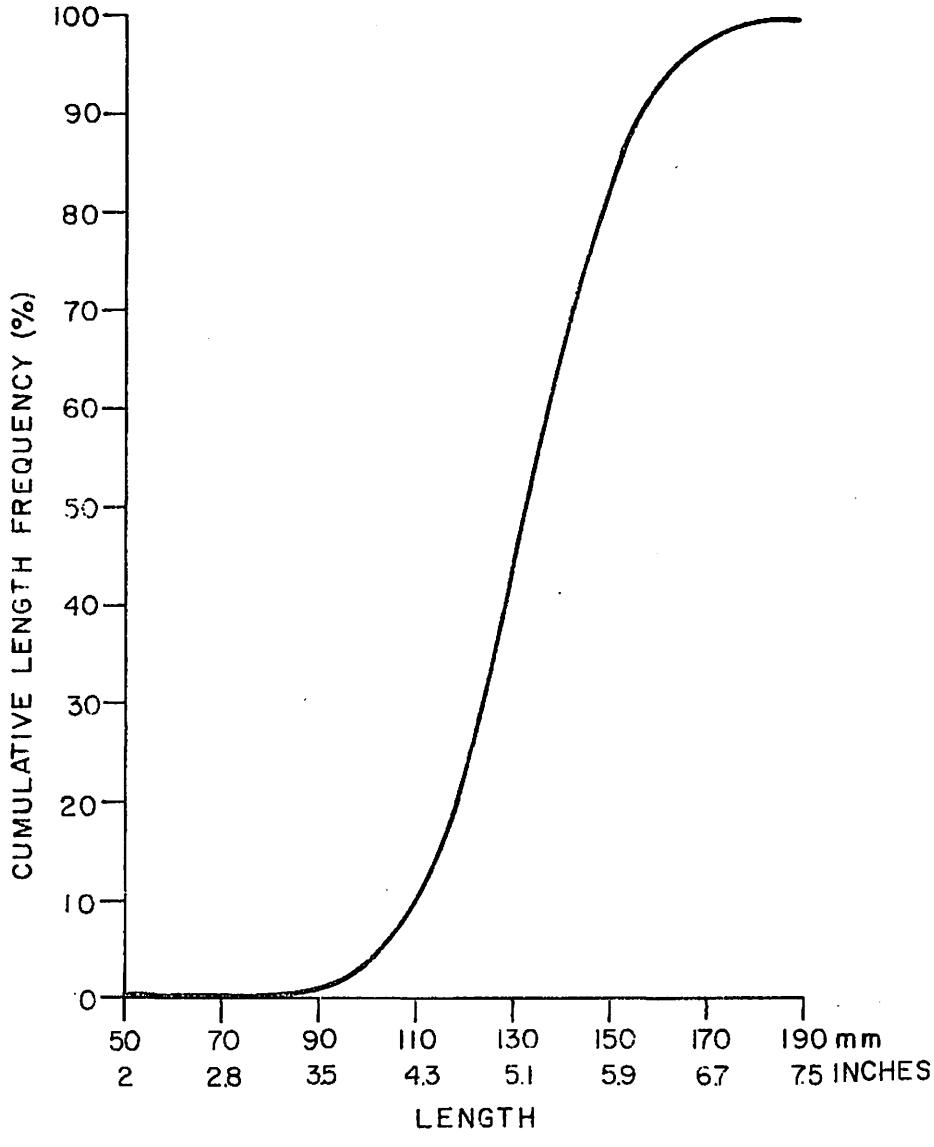

Figure 5. Cumulative length frequency percentages of surf clams sampled in the Virginia fishery area south of Cape Henry.

Juvenile Surf Clams

To date, 20 Smith-MacIntyre samples corresponding to the stations exhibiting high densities of surf clam in the Virginia fishery area have been examined. Only four young-of-the-year surf clams were found. This indicates an average of 0.2 clams per 1.08 ft^2 (0.1 m^2). Accompanying them were 50 young "clappers" (empty shells with valves attached) indicating about a 93% mortality. However, this is probably a gross underestimation of mortality since separation of valves by turbulence and young clams crushed by crabs cannot be accounted for.

The lengths of the four young clams were two of 0.09 inch (2.2 mm), and one each of 0.16 inch (4.2 mm) and 0.46 inch (11.6 mm). From linear interpolations between the estimated lengths at ages 0 and 1, the smaller clams were less than 1 month old and the largest about 3 months old. The duration of spawning in Virginia waters is not known, but Ropes et al. (1969) reported a major spawning period in summer and a minor spawning period in fall in New Jersey waters.

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