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# OCEAN CLAM SURVEY OFF U. S. MIDDLE ATLANTIC COAST--1963

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ABSTRACT

A cooperative clam survey was conducted during the summer of 1963 by the Eastern Sea Clam Packers Committee of the Oyster Institute of North America and the U. S. Bureau of Commercial Fisheries. The purpose was to locate and assess clam resources in the areas adjacent to those commercially fished. The surveyed areas are off the coast of New Jersey and Delaware on the seaward side of present fishing grounds. Additional concentrations of surf clams (Spisula solidissima) sufficient to sustain the commercial fishery at its present rate of production were not found. Many good catches of black quahogs (Arctica islandia) were made. The scope of the project has now been expanded, and the Bureau is continuing the survey of potential clam-producing areas in the Mid-Atlantic Bight.

## INTRODUCTION

The Atlantic surf clam is one of the largest bivalve mollusks known. It is the largest bivalve living on the Atlantic coast and reaches a maximum size of over 7 inches (Miner 1950). Differences in maximum size, however, occur between geographic regions throughout its range.

This clam is of ancient origin: the species has existed for over 10 million years along the east coast of North America (Chamberlin 1961). Its range is from Labrador to the Gulf of Mexico. To date, the surf clam has been found to occur, generally, from the beach to depths of about 150 feet with occasional specimens taken from deeper waters. Distribution is not homogeneous throughout the range; many areas are very sparsely populated while others have beds of heavy concentration. These beds, commonly called "streaks" or "patches," are of most interest to the industry.

In the various areas of the Atlantic coast where it commonly occurs, the surf clam is known locally by different names: "skimmer clam," "beach clam," "giant clam," "sea clam," "hen clam," "bar clam," and "surf clam." U. S. Bureau of Commercial Fisheries biologists have generally adopted the common name "surf clam" and the scientific name Spisula solidissima.

INDUSTRY DEVELOPMENT: From the late 1800's to 1943, the surf clam industry was located along the coasts of New Jersey and Long Island, N. Y. This industry did not become very important until 1943 when, under the stimulus of increased war-time demand, commercial research and subsequent large-scale production were started (Westman 1946). By 1946 catches from surf clam beds adjacent to Long Island's south shore totaled over a half-million bushels a year, yielding about 6.5 million pounds of meats (Ruggiero 1961).

The first signs that many exploited beds off Long Island were being depleted appeared in 1946: boats had to tow faster and work longer hours to maintain their daily catch; a sharp dropoff in the total catch for the area occurred in 1947 and 1948. The 1949 catch improved but since then the catch off Long Island has decreased to a level of less than 50,000 bushels a year.

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From 1947 through 1949 unused beds were found near Five-Fathom Banks off the coast of New Jersey and since then New Jersey has been the leading producer of surf clams. A tremendous increase in production has become possible because of (1) the discovery of the new beds, (2) the development of better processing methods, and (3) greatly improved harvesting methods.

GEAR DEVELOPMENTS: One of the factors limiting production during the early history of the clam industry was the harvesting gear used. The earliest methods were hand raking, tonging, or simply hand picking of the clams along the shore above the low-water mark where they were often stranded after storms. All of those methods are inefficient as they require a great amount of time and effort for the volume of clams produced.

To harvest clams in the areas lying beyond the low-water marks, other methods had to be devised. Small box-shaped steel-slatted dredges were the first power-hauled equipment used by fishermen. Those dredges were towed behind small boats and brought in over the stern by means of booms and winches. As the demand for clams increased, successively larger size dredges were built which required larger and more powerful boats. The early dredges had many drawbacks (many of the clams taken by them were either broken or had damaged meats) and attempts were made to improve them.

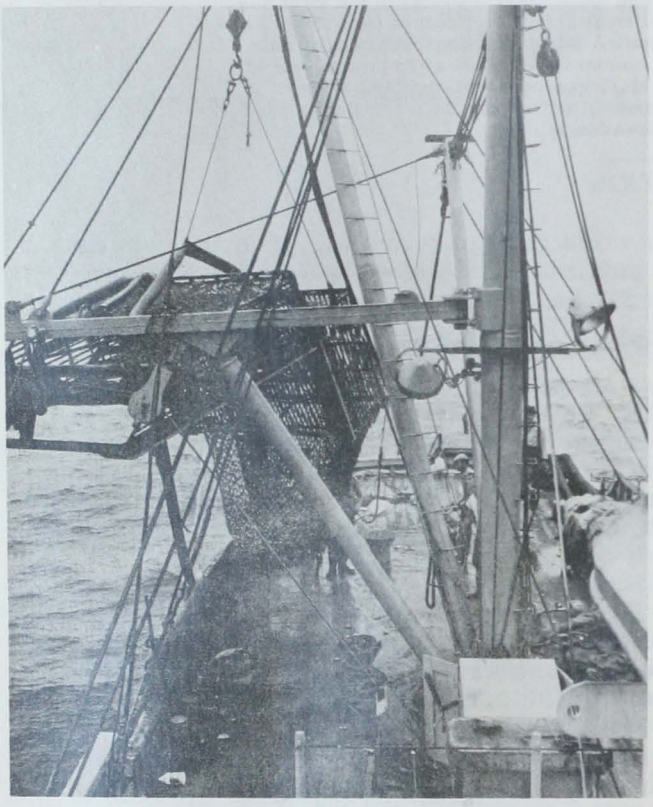

Fig. 1 - Experimental 84-inch wide dredge used on the vessel Gail Borden.

Late in 1945, industry experiments were begun to improve dredges by using hydraulic means for digging. This modification was rather simple: water, pumped under pressure, was used to wash out the clams in front of the dredge blade. After some experimentation, this technique was perfected and it is the principal method used today. The use of water jets made towing the dredge much easier and

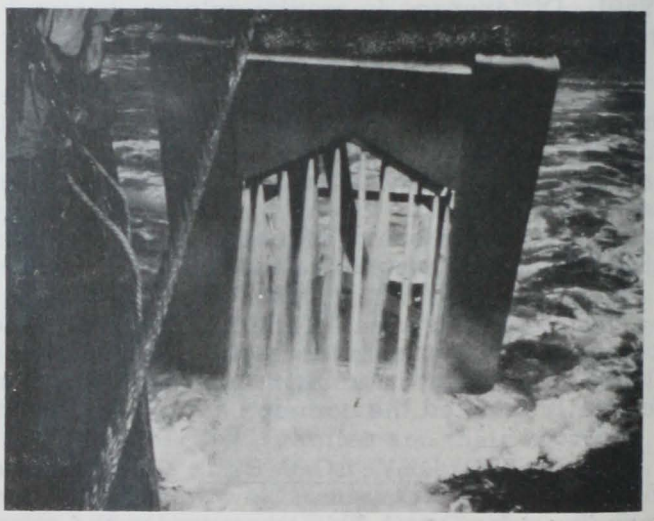

Fig. 2 - Hydraulic jet-dredge of the type used in the commercial fishery. A similar dredge was used for the survey.

greatly reduced injury to the clams. The present trend, as previously with the earlier non-hydraulic dredge, is toward building larger and more efficient dredges. The larger units have blades up to 84-inches wide (fig. 1) with jets supplied by pumps that deliver 3,500 gallons of water per minute at pressures exceeding 130 pounds per square inch. The standard "40-inch" (dimensions refer to the width of the dredge's blade) hydraulic dredge, however, is the one most commonly in use today (fig. 2). The 40-inch dredge also requires a considerable amount of water for efficient operation. To supply this a 1,500 g.p.m. centrifugal pump driven by diesel power is located below the fishing vessel's deck (early powered pumps were usually gasoline-driven units mounted on the deck of the fishing vessel) and connected to the clam

dredge by lengths of special 5-inch i.d. clam-jetting hose, the length of which depends upon the fishing depth. Doubled 5- or 6-inch hoses are used on some of the larger vessels to carry water to the dredges.

VESSELS: The present clam fleet is made up primarily of vessels from other fisheries that have been re-rigged for jet dredging. Included are conversions of Florida shrimp boats, oyster boats, trawlers, and naval-type craft. They range in size from 60 to 150 feet and most of them are powered with diesel engines. The size of the fleet varies because some vessels shift seasonally from clam dredging to other types of fishing. About 52 of them remain year-round in the clam fishery. Those boats can, in good production areas, each catch 500 to 600 bushels of clams a day, but during the past several years they have operated on industry-imposed quotas of 200 and 300 bushels a day. Today, because of depletion of the best producing areas, daily catches have decreased and most of the boats are bringing in all they can produce. The boats are generally operated by a crew of 3 or more men and are owned or controlled by individual packing companies. At the present time there are about 9 major packers or processors of surf clams on the east coast.

FISHING AREAS: The major fishing area now in use is off Point Pleasant, N. J. There appears to be enough large clams left in this area to keep the industry in operation for a few more years, but in order to maintain present production levels new equally productive beds must be located. The new beds must be productive enough to sustain a profitable fishery while younger clams on the old beds or from new "sets" grow to a commercial size.

The position and depth of any new beds located will have a bearing upon the ability of the clammers to continue with present modes of operation. If new beds are too far offshore and too deep many of the existing vessels will be unable to fish there; most of them, principally because of gear and equipment limitations, are able to dredge only in water less than 100-feet deep. It is possible now to hold harvested clams alive for the several hours required to land the catch from nearby fishing areas but an increase in the distance between the port and fishing area would necessitate either faster vessels or a method for keeping the clams alive for longer periods. A possible alternative might be to "shuck" the clams at sea as is done with scallops.

INITIATION OF CLAM SURVEY: The U. S. Bureau of Commercial Fisheries has made several clam explorations. In 1958, as a result of an industry request at the 1957 Atlantic States Marine Fisheries Commission meeting, a short-term exploration for hard clams (Mercenaria mercenaria) and surf clams was made in Nantucket Sound (Ropes and Martin 1960). No additional survey work was attempted until 1963. In June 1963, a cooperative research project was agreed upon by the Bureau and the Eastern Sea Clam Packers Committee of the Oyster Institute of North America. The "committee" provided (1) a suitable vessel, (2) fishing equipment, and (3) a crew for exploratory work. The Bureau supplied technical personnel for the survey. A second agreement and a Congressional appropriation in fiscal year 1965 (July 1, 1964 to June 30, 1965) enabled the Bureau to continue that work.

Work accomplished under the first cooperative agreement is the subject of this report.

Three areas were originally picked for the survey and assigned priorities corresponding to the area number. As the survey progressed, a fourth area was picked and assigned top priority (fig. 3). The survey areas are described as follows:

Area I: A rectangular plot (about 40 by 12 miles) with the western boundary approximating the 100-foot depth contour and extending eastward 12 miles. The area is bounded on the north by the 40th parallel and on the south by lat. 39°20' N. (Mannasquan to Atlantic City, N.J.).

Area II: An area extending southwestward from Area I of about the same size and shape. The north boundary is adjacent to Area I; the south boundary approximates lat. 38°46' N. (opposite Cape May, N. J.).

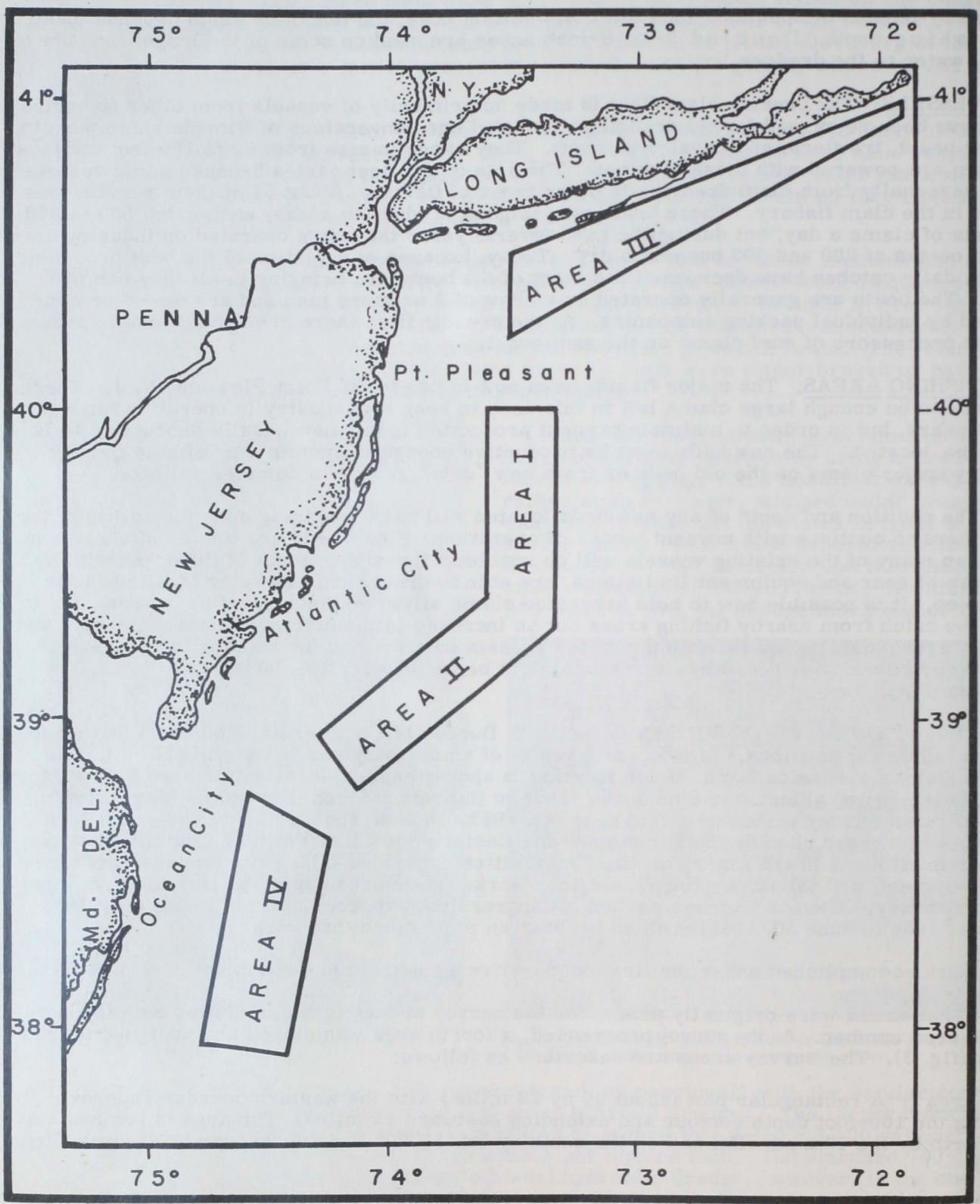


Fig. 3 - Clam survey areas off the middle Atlantic coast; Areas I, II, and III are those areas originally suggested by the Sea Clam Committee members and agreed to by the Bureau. The numbers are arranged according to the priority originally assigned each. The Committee requested that Area IV be surveyed during the last 6 weeks of the survey.

Area III: Waters adjacent to the south shore of Long Island, N. Y., between the 10- and 20-fathom depth contours.

Area IV: The north boundary is lat. 38°47' N., the latitude of Cape Henlopen, Dela.; the south boundary is lat. 37°55' N., near Winter Quarter Light. East and west boundaries were set about 8 miles on each side of a straight line approximating the 120-foot contour.

## SURVEY PROCEDURE

VESSEL AND DREDGE EQUIPMENT: In early July 1963, a chartered vessel was readied for the survey. Originally it was planned to use a medium (one-half cubic yard) industrial earth-moving clam-shell type bucket for sampling purposes. It was believed that this unit might be a more efficient piece of gear for sampling than the clam dredge because all material on the bottom encompassed by the bucket would be retained, and an accurate assessment of all material within the area sampled could thus be made. Early trials, however, showed that this unit could not be satisfactorily operated from the vessel and the bucket was replaced by a small 20-inch nonhydraulic dredge of a type originally used by the industry.

The nonhydraulic dredge was likewise discarded early in the survey and replaced with a 30-inch wide hydraulic jet-dredge similar to those in use by the industry (fig. 2). The sides of that dredge were lined with one-half inch hardware cloth and the distance between the knife grids was reduced by adding extra slats to the blade to retain the smaller sizes of clams. Also, the chain bag was replaced by a small nylon-mesh cod-end bag, but despite those changes some of the smaller clams were lost. Compared to the "dry" dredge, the jet-dredge reduced breakage of the clams, increased the numbers caught, and improved the size range of the clams taken.

Clam-Sounder: A "clam-sounder" was used experimentally throughout the survey. This was similar to a prototype that had been built and used by an industry vessel during limited earlier survey work. During the first period of the 1963 survey, an enlarged model of the unit was used (fig. 4). This sounder was towed separately from the dredge.

The main component of the sounder is a hollow waterproof tube inside of which small microphones are attached to a wooden panel. The tube body is attached to a sled-like carriage so that the unit will slide along the surface of the bottom. Welded in a row along one side of the tube (fig. 4) are many steel fingers. When one or more of the fingers strikes any object the sound produced is picked up by the microphones, amplified, and reproduced in the pilothouse. The sound of the fingers striking upon surf clams can readily be distinguished, by an experienced operator, from extraneous sounds so that a general indication of the relative abundance of clams in the path of the sounder can be obtained.

Fig. 4 - Clam sounder (at rail of vessel) used during survey operations. Note "teeth" mounted on pipe. Telephone microphones which transmit the sounds of clams being struck by the teeth are secured inside the pipe.

A log of the sounds transmitted by the sounder, while being towed between stations, was kept and those data were correlated with the sample collected at each sampling station.

During the last period of the survey, a shorter clam-sounder was attached directly to the dredge just in front of the jet manifold so that the dredge acted as a sled for the sounder.

The clam-sounder was of less use during the 1963 operations than was anticipated because of frequent flooding of the sounding tube and the enclosed microphones. The effective-

ness of the principle of sounding for clams in this manner, however, was established; Bureau electronic specialists designed a more dependable model with specially designed submersible hydrophones for underwater sound detection for use during succeeding survey work.

SAMPLING STATIONS: It was not possible in a limited time to completely investigate any of the four survey areas. The survey began in the southern section of Area I and was shifted to Area IV for the last 6 weeks. Sampling stations were established 1 mile apart on a grid pattern within each area arranged to coincide with LORAN lines. Unsurveyed portions of any area can thus be located and completed at a later date without difficulty.

A sample was taken at each station by a 5-minute tow of the jet dredge. Elapsed time of the tow included only the period when the water was flowing at maximum volume through the jets of the dredge.

The surf clams and black quahogs in each sample were measured and weighed, and additional pertinent data, such as bottom type and other organisms present, were recorded for the remaining material in the catch.

## SURVEY RESULTS

AREA I: Surf Clams: In Area I, 148 of the 181 stations surveyed yielded small quantities of surf clams, usually mixed with black quahogs (fig. 5). As the survey progressed northward from the southern boundary of the Area, the number of stations producing surf clams increased but at no time were they found in sufficient concentrations to be of commercial interest in the surveyed portion of Area I. To support commercial fishing operations a minimum catch rate of about $\frac{1}{4}$ bushel per minute of towing time is required. (Catches of one-half bushel or more of surf clams per 5-minute tow are listed in the appendix.)

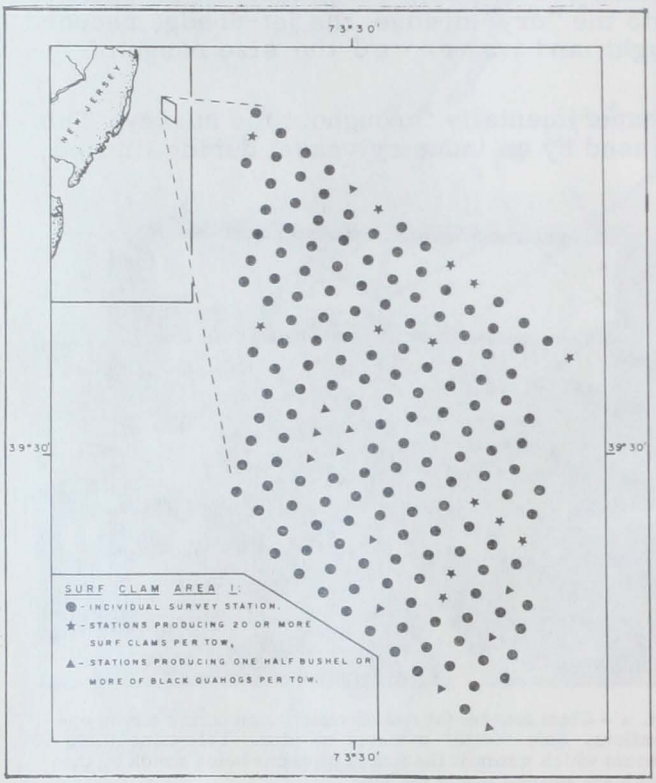


Fig. 5 - Location of survey stations in Area I.

Table 1 - Size Distribution of Surf Clams Taken at Selected Sampling Stations in Areas I and IV

| Length of Clams | | Number of Clams |
|---|---|---|
| Millimeters | Inches | Individuals |
| 0-19 | 0- .7 | 1 |
| 20-39 | .8-1.5 | 11 |
| 40-59 | 1.6-2.3 | 25 |
| 60-79 | 2.4-3.1 | 6 |
| 80-99 | 3.1-3.9 | 8 |
| 100-119 | 3.9-4.7 | 34 |
| 120-139 | 4.7-5.5 | 95 |
| 140-159 | 5.5-6.3 | 391 |
| 160-179 | 6.3-7.0 | 77 |

Surf clams of all sizes, except those below three-quarters of an inch long which were too small for the gear to retain, were found in the Area (table 1). This wide variation indicates that populations of various size and age occur in the area. Surf-clam shells in various amounts were taken in almost every tow along with shells of other mollusks.

Black Quahogs: Black quahogs were found with the surf clams in almost all of the tows in which the latter were taken. In Area I they were more abundant than the surf clam, occurring in 170 of the 181 station samples with a maximum catch of over 300 pounds (3.7 bushels) per 5-minute tow. In general, that clam was more concentrated in the southern part of the Area.

AREA IV: Surf Clams: In Area IV, 312 stations were sampled (fig. 6) with much better results than in Area I. Up to 2.8 bushels of surf clams were taken per 5-minute tow; 15 tows produced 1 bushel or more. A catch of 2.8 bushels in five minutes of fishing with a 30-inch dredge would indicate a possible catch of of about 15 bushels per 20-minute tow with a regular 40-inch dredge. Such a yield equals

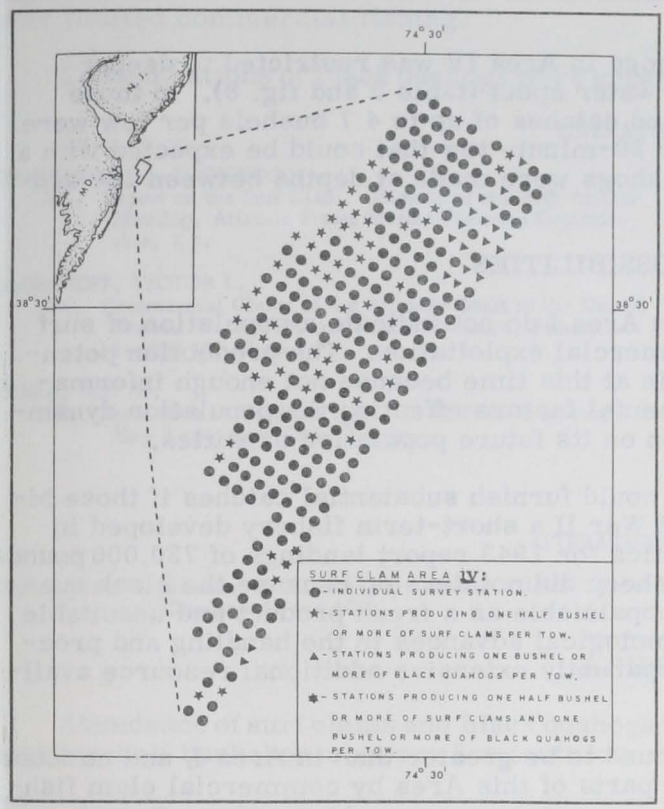


Fig. 6 - Locations of survey stations in Area IV.

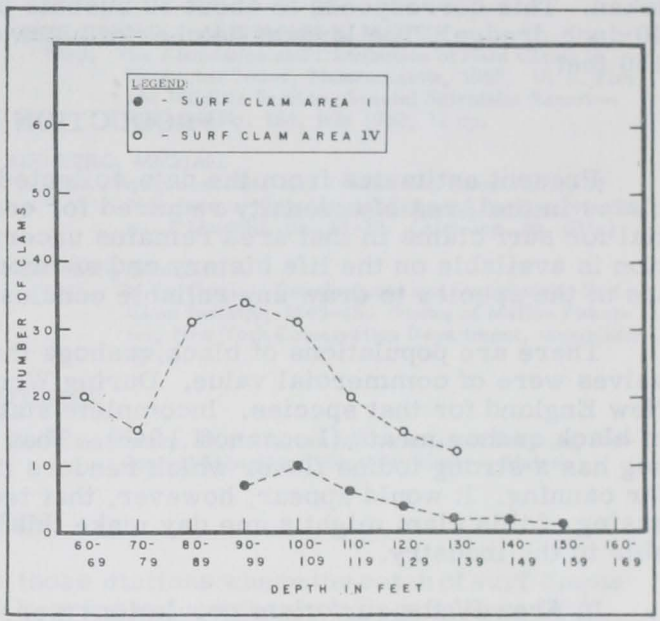


Fig. 7 - Abundance distribution of surf clams in Areas I and IV plotted by 10-foot depth intervals for those stations where this species was caught.

good commercial catches. In this Area, as in Area I, surf clams of all sizes were found within the fishing capabilities of the gear. Best catches were made in depths of 80 to 119 feet but no surf clams were found in depths of over 135 feet (fig. 7 and table 2).

The percentage of sampling stations where surf clams, unmixed with black quahogs, were taken was much greater in Area IV than in Area I. This difference may partly reflect the concentration of sampling effort in

Table 2 - Bottom-Depth Distribution of Surf Clam and Black Quahog Catches in Areas I and IV, Based on 5-Minute Tows and Averaged by 10-Foot Increments

| Depth of Water | Number of Surf Clams | | Number of Black Quahogs | |
|---|---|---|---|---|
| | Area I 1/ | Area IV 2/ | Area I | Area IV |
| Feet | | | | |
| 60-69 | - | 20 | - | - |
| 70-79 | - | 15 | - | - |
| 80-89 | - | 31 | - | - |
| 90-99 | 7 | 33 | 4 | 2 |
| 100-109 | 10 | 31 | 7 | 12 |
| 110-119 | 6 | 21 | 16 | 26 |
| 120-129 | 4 | 15 | 37 | 108 |
| 130-139 | 2 | 12 | 116 | 193 |
| 140-149 | 2 | - | 61 | 314 |
| 150-159 | 1 | - | 43 | - |
| 160-169 | - | - | 53 | - |

1/Area I fished with 20-inch dredge.
2/Area IV fished with 30-inch dredge.

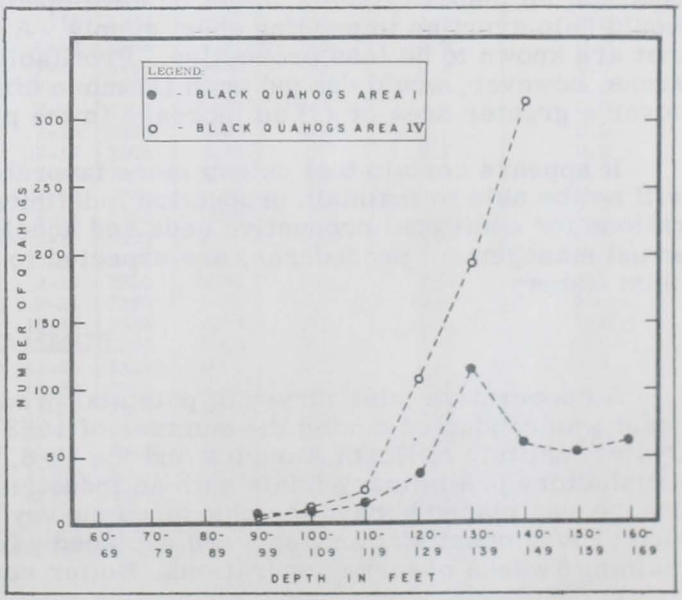


Fig. 8 - Abundance distribution of black quahogs in Areas I and IV plotted by 10-foot depth intervals for those stations where this species was caught.

depths of 110 feet or less. During the survey no black quahogs were found in depths of less than 89 feet; conclusions concerning relative abundance of black quahogs within the two areas, therefore, should not be drawn from these data.

Black Quahogs: The range of the black quahogs in Area IV was restricted to deeper areas in the northeast section and isolated deep-water spots (table 2 and fig. 8). In those spots their concentration was frequently heavy and catches of up to 4.7 bushels per tow were taken. This corresponds to about 30 bushels per 20-minute tow that could be expected with a 40-inch dredge. The largest catches of black quahogs were made at depths between 120 and 150 feet.

## PRODUCTION POSSIBILITIES

Present estimates from the data collected in Area I do not indicate a population of surf clams in the Area of a density required for commercial exploitation. The production potential for surf clams in that area remains uncertain at this time because not enough information is available on the life history and environmental factors effecting the population dynamics of the species to draw any reliable conclusion on its future population densities.

There are populations of black quahogs that could furnish substantial catches if those bivalves were of commercial value. During World War II a short-term fishery developed in New England for that species. Incomplete statistics for 1943 report landings of 720,000 pounds of black quahog meats (Loosanoff 1946). That fishery did not develop because the black quahog has a strong iodine flavor which renders it unpalatable as a fresh product and unsuitable for canning. It would appear, however, that technological advances in the handling and processing of this clam might some day make this apparently extensive additional resource available to the industry.

In Area IV the surf clam populations were found to be greater than in Area I, and no doubt good catches of that species could be taken from parts of this Area by commercial clam fishermen.

Two possibilities appear to exist for increasing production from the resources now known or being used. At present the packers prefer clams which measure 5 inches in length but if a suitable process were developed to handle the smaller clams that are found close to the beaches, an inshore fishery might be developed with existing vessels. Such a development would help avert an impending short supply. A second possibility is the harvesting of beds that are known to be less productive. Profitable harvesting of the more sparsely populated areas, however, would depend upon (1) more efficient dredging equipment that can rapidly cover a greater area or (2) an increase in the price of raw clams.

It appears certain that unless more favorable developments are forthcoming the industry will not be able to maintain production indefinitely at or near 1963 levels. Continuing explorations for additional productive beds and accelerated biological research, as a basis for sound management procedures, are expected to assist materially in stabilization of the surf clam fishery.

## SUMMARY

A cooperative joint survey of potential production areas for sea clams off the New Jersey coast was conducted during the summer of 1963 by the Sea Clam Packers Association of the Oyster Institute of North America and the U. S. Bureau of Commercial Fisheries. After unsatisfactory preliminary trials with an industrial clam-shell bucket, a small non-hydraulic dredge was placed aboard the chartered survey vessel for sampling purposes. This dredge also proved unsatisfactory and was replaced with a 30-inch hydraulic-jet dredge for the remaining 6 weeks of survey operations. Better results were obtained with the latter equipment.

Throughout the survey a clam-sounder was used. Because of breakdowns during early trials, little information of value was obtained; however, results of considerable potential are indicated, and a redesigned sounder is planned for future work.

Concentrations of surf clams in Area I, off the coast of central New Jersey, were found to be below the level required for commercial utilization; however, the population of surf clams found to date in Area IV, off the Delaware-Maryland coast, appears sufficient to support limited commercial fishing.

Concentrations of black quahogs were greater than surf clam concentrations in both areas.

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## APPENDIX

Abundance of surf clams and black quahogs for those stations where the catch of surf clams was one-half bushel or more per 5-minute tow with bearing and depth recordings in Area IV.[1]

| Station | Loran Bearing | | Depth of Water | Amount of Clams | | Station | Loran Bearing | | Depth of Water | Amount of Clams | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1H4 | 1H5 | | Surf Clams | Black Quahogs | | 1H4 | 1H5 | | Surf Clams | Black Quahogs |
| | | | Feet | (Bushels) | | | | | Feet | (Bushel) | |
| 1-12 | 3368 | 3104 | 105 | 2.0 | 0.0 | 5-20 | 3272 | 3088 | 100 | 0.7 | 0.0 |
| 1-14 | 3344 | 3104 | 75 | 1.0 | 0.0 | 5-24 | 3224 | 3088 | 87 | 0.7 | 0.0 |
| 1-16 | 3320 | 3104 | 65 | 0.5 | 0.0 | 5-25 | 3212 | 3088 | 82 | 0.7 | 0.0 |
| 1-17 | 3308 | 3104 | 90 | 0.9 | 0.0 | 6-8 | 3416 | 3084 | 105 | 0.6 | 0.1 |
| 1-18 | 3296 | 3104 | 95 | 1.3 | 0.0 | 6-14 | 3344 | 3084 | 100 | 1.8 | 0.0 |
| 2-6 | 3440 | 3100 | 115 | 0.5 | 0.0 | 6-17 | 3308 | 3084 | 75 | 0.5 | 0.0 |
| 2-8 | 3416 | 3100 | 115 | 2.1 | 0.0 | 7-6 | 3440 | 3080 | 95 | 0.6 | 0.0 |
| 2-9 | 3404 | 3100 | 105 | 0.7 | 0.0 | 7-7 | 3428 | 3080 | 105 | 0.6 | 0.0 |
| 2-10 | 3392 | 3100 | 100 | 0.5 | 0.0 | 7-13 | 3356 | 3080 | 100 | 1.6 | 0.0 |
| 2-11 | 3380 | 3100 | 100 | 1.7 | 0.0 | 7-16 | 3320 | 3080 | 100 | 0.5 | 0.0 |
| 2-12 | 3368 | 3100 | 95 | 1.8 | 0.0 | 7-17 | 3308 | 3080 | 97 | 0.7 | 0.0 |
| 3-6 | 3440 | 3096 | 110 | 0.5 | 0.0 | 7-18 | 3296 | 3080 | 95 | 0.9 | 0.0 |
| 3-9 | 3404 | 3096 | 95 | 2.1 | 0.0 | 7-19 | 3284 | 3080 | 87 | 0.6 | 0.0 |
| 3-10 | 3392 | 3096 | 80 | 0.6 | 0.0 | 8-11 | 3380 | 3076 | 95 | 0.8 | 0.0 |
| 3-13 | 3356 | 3096 | 100 | 1.7 | 0.0 | 9-1 | 3500 | 3072 | 90 | 0.6 | 0.0 |
| 3-17 | 3308 | 3096 | 80 | 1.5 | 0.0 | 9-2 | 3488 | 3072 | 95 | 0.7 | 0.0 |
| 3-18 | 3296 | 3096 | 100 | 0.7 | 0.0 | 9-13 | 3356 | 3072 | 105 | 1.2 | 0.0 |
| 4-4 | 3464 | 3092 | 105 | 0.5 | 0.2 | 9-21 | 3260 | 3072 | 80 | 0.9 | 0.0 |
| 4-7 | 3428 | 3092 | 115 | 1.2 | 0.1 | 10-15 | 3332 | 3068 | 122 | 0.6 | 0.0 |
| 4-9 | 3404 | 3092 | 110 | 2.8 | 0.0 | 10-18 | 3296 | 3068 | 105 | 0.5 | 0.0 |
| 4-10 | 3392 | 3092 | 110 | 0.7 | 0.0 | 11-16 | 3320 | 3064 | 120 | 0.7 | 0.2 |
| 4-12 | 3368 | 3092 | 105 | 0.8 | 0.0 | 11-20 | 3272 | 3064 | 110 | 0.8 | 0.0 |
| 4-13 | 3356 | 3092 | 95 | 0.6 | 0.0 | 11-28 | 3176 | 3064 | 95 | 0.9 | 0.0 |
| 4-20 | 3272 | 3092 | 90 | 0.7 | 0.0 | 12-27 | 3188 | 3060 | 130 | 0.8 | 1.6 |
| 5-1 | 3500 | 3088 | 105 | 0.7 | 0.0 | 12-28 | 3176 | 3060 | 125 | 0.6 | 1.8 |
| 5-10 | 3392 | 3088 | 105 | 0.5 | 0.0 | 12-29 | 3164 | 3060 | 125 | 0.8 | 0.0 |
| 5-11 | 3380 | 3088 | 105 | 1.0 | 0.0 | 12-37 | 3068 | 3060 | 105 | 0.8 | 0.0 |
| 5-19 | 3284 | 3088 | 65 | 0.5 | 0.0 | 13-36 | 3080 | 3056 | 120 | 0.6 | 0.0 |

[1] There were no stations in Area I where the catch came to or exceeded one-half bushel of surf clams per tow.