A UNITED STATES DEPARTMENT OF COMMERCE PUBLICATION

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL MARINE FISHERIES SERVICE

Calico Scallops of the Southeastern United States, 1959-69

SPECIAL SCIENTIFIC REPORT—FISHERIES No. 627

UNITED STATES DEPARTMENT OF COMMERCE
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By

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Special Scientific Report—Fisheries No. 627

Seattle, Washington
June 1971

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ABSTRACT

The report summarizes developments concerning the calico scallop resource of the southeastern United States. A brief background is provided followed by a description of the fishery in North Carolina and subsequent expansion to the Florida grounds. Included are sections dealing with developments in the fishery, quality of the scallop and its parasites. A chronological review is made of the development of processing machinery; recent industry activity is summarized; and cooperative technical Bureau of Commercial Fisheries (now National Marine Fisheries Service) assistance is described.

INTRODUCTION

Calico scallops *(Argopecten gibbus)* occur in the western Atlantic from Cape Hatteras to Brazil including the Gulf of Mexico. Trawl fishermen have caught them sporadically but they have been regarded as a nuisance. Problems of handling, processing, and marketing were of little or no concern partly because these fishermen were primarily equipped for shrimp fishing in different areas and depths and partly because of the lack of an established fishery for calico scallops. Prior to 1960, concentration areas of calico scallops were unknown.

Early explorations indicated that the species was widely distributed along the southeast coast of North Carolina in 1959 and in the Gulf of Mexico in 1957. Subsequent explorations and preliminary resource assessment of calico scallops have been largely confined to three areas (fig. 1): North Carolina (Cummins, Rivers, and Struhsaker, 1962), the east coast of Florida (Bullis and Cummins, 1961; Drummond, 1969), and the east Gulf of Mexico (Bullis and Ingle, 1959; Carpenter, 1967). In addition to North Carolina and eastern Florida, small numbers have been reported off South Carolina and Georgia. Scallop explorations in these areas have been very limited.

As a continuing part of exploratory fishing, numerous scallop cruises were conducted which provided information on location, distribution, availability, catch rates, sizes, meat yield, gear, and methods. Dredging demonstrations at sea were given to fishermen, inventors, and prospective investors as well as assistance to commercial vessels in locating shell stock. Tests of scallop processing equipment were conducted at sea aboard the exploratory fishing vessel. Scallop meats were provided for study by the Bureau (Waters, 1964) and industry and for market development and shell stock for test purposes ashore. Information may be obtained from *Silver Bay* Cruise Report Nos. 18, 20 through 36, 39, 41, 42, 47, 51, 52, and 55; *Oregon* Cruise Report No's. 95, 97, 103, 108, 116, 117, 121, 122, 123, 124, 126, 128, 130, 132, 134 and 136; and *George M. Bowers* Cruise Report Nos. 85 and 90.[1]

Contribution No. 220.

[1] *Silver Bay, Oregon* and *George M. Bowers* cruise reports were published in *Commercial Fisheries Review* and are also available from the National Marine Fisheries Service Exploratory Fishing and Gear Research Station, Brunswick, Ga.

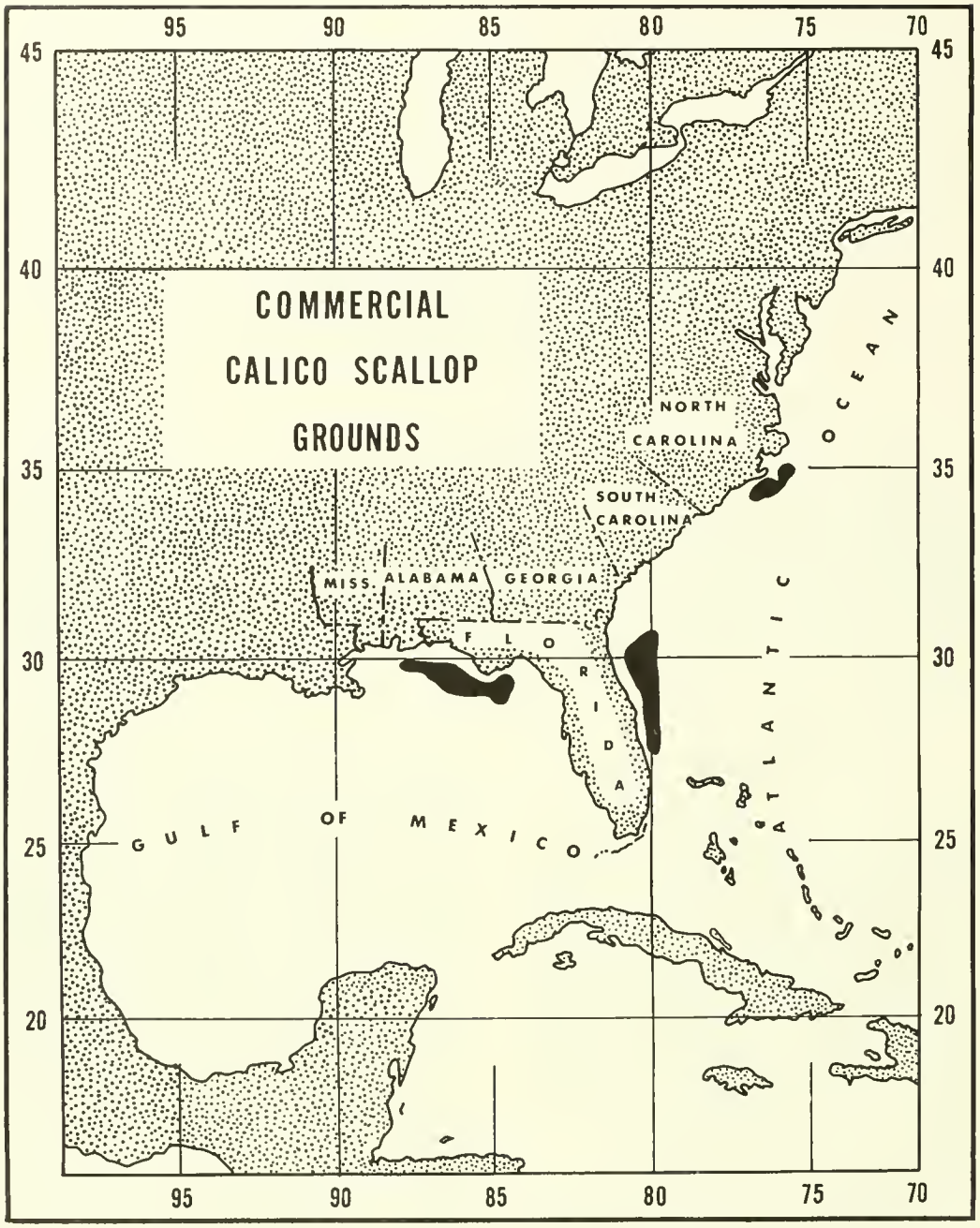

Figure 1.—Areas where commercial concentrations of calico scallops have been located by exploratory fishing vessels.

Because of their shape and small size, calico scallops cannot be hand-shucked economically, and a method was needed for mechanical shucking and evisceration. Lack of such equipment was a major factor inhibiting the development of a calico scallop fishery.

Numerous individuals, representing wide geographical areas of the United States, became interested in mechanical processing of scallops, which led to production trials for test purposes in Florida and North Carolina. The only successful fishery lasting for an extended period occurred in North Carolina. As shown below, this fishery used hand-shucking which was economical because of unusual circumstances. The many different and complicated

types of processing machinery are treated in a separate section. A wide variety of vessels and gear and extensive tests of processing equipment provided a broad background of knowledge and experience. Machinery improvement, the increasing market demand, and the ample stocks of calico scallops provided a valuable potential, and recent events point to the establishment of a fishery in eastern Florida.

THE NORTH CAROLINA FISHERY

Interest in the commercial potential of the North Carolina calico scallop grounds was stimulated by Bureau explorations in 1959 with the *Silver Bay* (Cruise Report No. 18). Soon after the Core Banks discovery in 1959, sporadic production of calico scallops began in Carteret County (fig. 2). A unique combination of aggressive fishermen, handling facilities, and suitable labor supply led to the development of a fishery and adjacent shore-based processing operations. Production has risen since 1959 when three boats produced 6,500 pounds of meats valued at $2,600 to 1,856,760 pounds of meats valued at $368,703 from 17 boats in 1966 (table 1).

With a minimum of handling at sea (little or no sorting is required), the catch is landed in the shell for shucking houses and hand processing.[2] Since 1959 the location of fishing grounds and availability have changed. While

[2] Only in Carteret County, N.C., has it been demonstrated economically feasible to schuck and eviscerate calico scallops by hand.

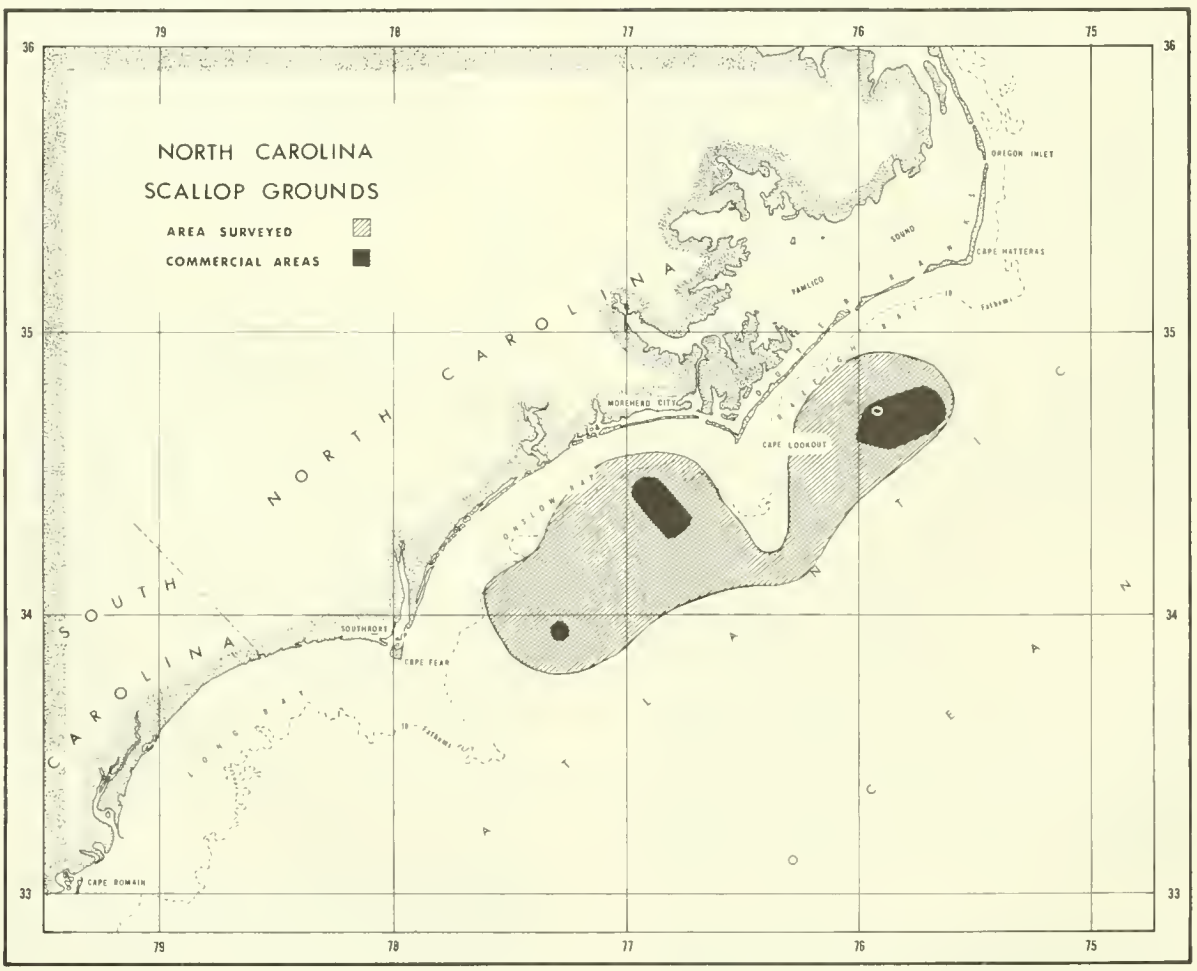

Figure 2.—Commercial scallop concentrations located in the Cape Lookout area of North Carolina.

Table 1.—North Carolina calico scallop production, 1959-67.[1]

Year	Meats	Value	Gear
	Pounds	*Dollars*	
1959	6,500	2,600	Dredge
1960	111,700	44,680	Trawl
1961	22,400	8,960	Trawl
1962	....	....	....
1963	....	....	....
1964	....	....	....
1965	871,164	244,709	Trawl
1966	1,856,760	[2]368,703	Trawl
1967	1,389,000	[2]309,000	Trawl

[1] Data supplied by the National Marine Fisheries Service Statistical Office, Beaufort, N.C.
[2] Computed as ex-vessel price in the shell.

no commercial production occurred during 1962, 1963, or 1964, production during 1965, 1966, and 1967 continued for about 18 months. Weather permitting, day trips are made with shrimp-type scallop vessels to grounds located only 2 to 4 hours from port. The vessels are outfitted with scallop trawls (Rivers, 1962) which can produce catches of up to 60 bushels per 5-minute drag. Despite high maintenance and repair costs, the all-synthetic trawls are very efficient and have replaced metal dredges and other gear in North Carolina. The scallops are piled on deck and catches per boat average 400 to 600 bushels (up to 900 bushels) per day. When the boats return by dark, the scallops are shoveled into fish boxes or wire baskets, loaded into covered van trucks, and transported to shucking houses nearby. The following day, hand-shucking is performed by local women; each woman can shuck about a gallon of meats per hour.[3] Meats are returned to the fish houses where they are ice packed in 1- and 4-gallon tins and bulk-shipped as fresh scallops or further processed and shipped as frozen scallops. Since shucking occurs the day following landing, there is no production on Saturday or Sunday and no processing on Sunday or Monday. When processed for freezing, the fresh meats are washed and individually quick frozen and glazed on a conveyor system with liquid nitrogen. When frozen, most scallops are packed and sealed in clear plastic 5-pound bags in 50-pound cases for restaurants, chain stores, and other processors. When available, the roe is sometimes used.[4]

"The production of calico scallops was an important factor in the economy of the fishing communities of Carteret County during 1967. . . . For Carteret County, calico scallops ranked only after menhaden and shrimp in total ex-vessel value. While only ten vessels engaged in this fishery, there were at various times as many as three hundred shore workers, who received over $199,000 for their labors. . . ." (Davis, 1965). Since 1965 some twenty vessels have engaged in the fishery, although they are also engaged in other fishing operations at various times during the year. Production rates during 1966 and early 1967 surpassed those of 1965. Table 2 shows production in Carteret County during February and March 1967, with minimum and maximum rates by week.

Table 2.—February-March 1967 calico scallop production, Cartaret County, N.C.[1]

	Meats		Shell stock	
	Bushels	*Pounds*	*Gallons*	*Pounds*
Minimum week	8,697	521,820	4,969	39,752
Maximum week	20,395	1,223,700	11,654	93,232
Feb-Mar total	120,302	7,218,120	68,744	549,957

[1] Data supplied by the National Marine Fisheries Service Statistical Office, Beaufort, N.C.

From this beginning, new markets are being established and demand for calico scallops is increasing. Quality control is important and nitrogen freezing for processing results in an improved product. Hand-shucking is feasible in North Carolina when large scallops are abundant nearby. Although there is no knowledge of the natural history of calico scallops, experience has shown great fluctuation in the abundance of a dominant size group or groups, and a given fishery may depend on a single group or year class.[5]

[3] Meat yields average about 1 gallon (8 pounds) per 1.75 bushels depending upon the size and condition of the scallops. One bushel in the shell weighs about 70 pounds, and meat counts of from 55 to 90 per pint (pound) are acceptable for hand-shucking.

[4] The bright orange gonad flesh, in demand for European markets, is used with scallop meat in casserole dishes. It makes an attractive pack which accounts for about 35 percent greater yield.

[5] Experience indicates that after scallops reach commercial size they die in less than 2 years. That is, they may be expected to remain as a fishable stock about 1 year.

Table 3.—Results of exploratory fishing with an 8-foot tumbler dredge (September to December 1967).

Florida east coast	Depth range	Catch rate-max.	Meat count	Meat yield
	Fathoms	*Bushels*	*Per pound*	*Lb/bushel*
East of New Smyrna Beach ...	23/27	45/76	50/82	5½/7¼
East of Cape Kennedy	21/26	33/64	68/106	4/7
East of Bethel Shoal	19/23	38/64	88/120	3/5

Availability, therefore, according to the requirements for hand-shucking in North Carolina, is subject to change. This assumption is supported by the North Carolina production statistics for 1959 to 1967 (table 1). It should be strongly recommended that the industry utilize calico scallops wherever they may occur, particularly in areas which have been delimited by exploratory fishing. Processing equipment, either mobile or located at various ports, would provide for utilizing scallops over a wider area thus enhancing the opportunity for continuous year-round production.

RECENT EXPANSION OF THE CALICO SCALLOP FISHERY TO FLORIDA GROUNDS

Bureau Explorations

Previous explorations have shown that the area off the Florida east coast shows the greatest potential for commercial exploitation of calico scallops. This area may be described as the portion of the continental shelf within 10 to 40 fathoms from Ft. Pierce northward to the St. Johns River and referred to as the Cape Kennedy beds (fig. 3). During dredging cruises with the exploratory vessels *Silver Bay* and *Oregon* since 1960, commercial concentrations of calico scallops were located every month in the year throughout the 9 year period. With this knowledge and new processing machinery, it was decided, following the decline of the North Carolina fishery in 1967, to provide the latest information for further industrial development. An intensive systematic resurvey of the east Florida grounds was scheduled with four cruises from September to December 1967 and additional cruises as would be required. Four standard transects were dredged between 10 and 40 fathoms during each cruise from Mayport to Ft. Pierce. Commercial concentrations of scallops were found during each cruise, and the results of catches made with 8-foot tumbler dredges (fig. 4) during the first four cruises are summarized in table 3.

In addition to commercial-size scallops, small "seed" scallops, amounting up to 14 bushels per hour, were found at scattered locations throughout the survey area. In September 1967 (*Oregon* Cruise No. 121) an observation dive made by the submersible DR/V Aluminaut in an area delimited by the *Oregon* provided information to supplement the *Oregon* findings. A Bureau observer confirmed intermittent distribution of scallops with individual "beds" oriented in north-south bands. Typical beds were observed to be 100 to 300 feet wide and up to 1,500 feet long. Average densities were of about 4 scallops per square foot with some exceeding 8 scallops per square foot. (For scallop density photos see figs. 5, 6 and 7.) During the cruises, vessels on the fishing grounds were assisted, dredging demonstrations were given, gear trials were conducted, and processing equipment was tested at sea. Shell stock was landed for test purposes. Also, numerous meetings were held with interested individuals or groups to make available a wide variety of information.

Commercial Production

Initial dredging results from the resurvey of the Cape Kennedy beds provided a basis for commercial fishing trials which began in October 1967. These have continued intermittently dependent on limitations by processing machinery, rough seas, hot weather, inadequate port facilities, and the availability of vessels engaged in other fishing activities.

From October to December 1967, shrimp-type scallop vessels landed 5,035 bushels (about 350,000 pounds) of shell stock from the Cape

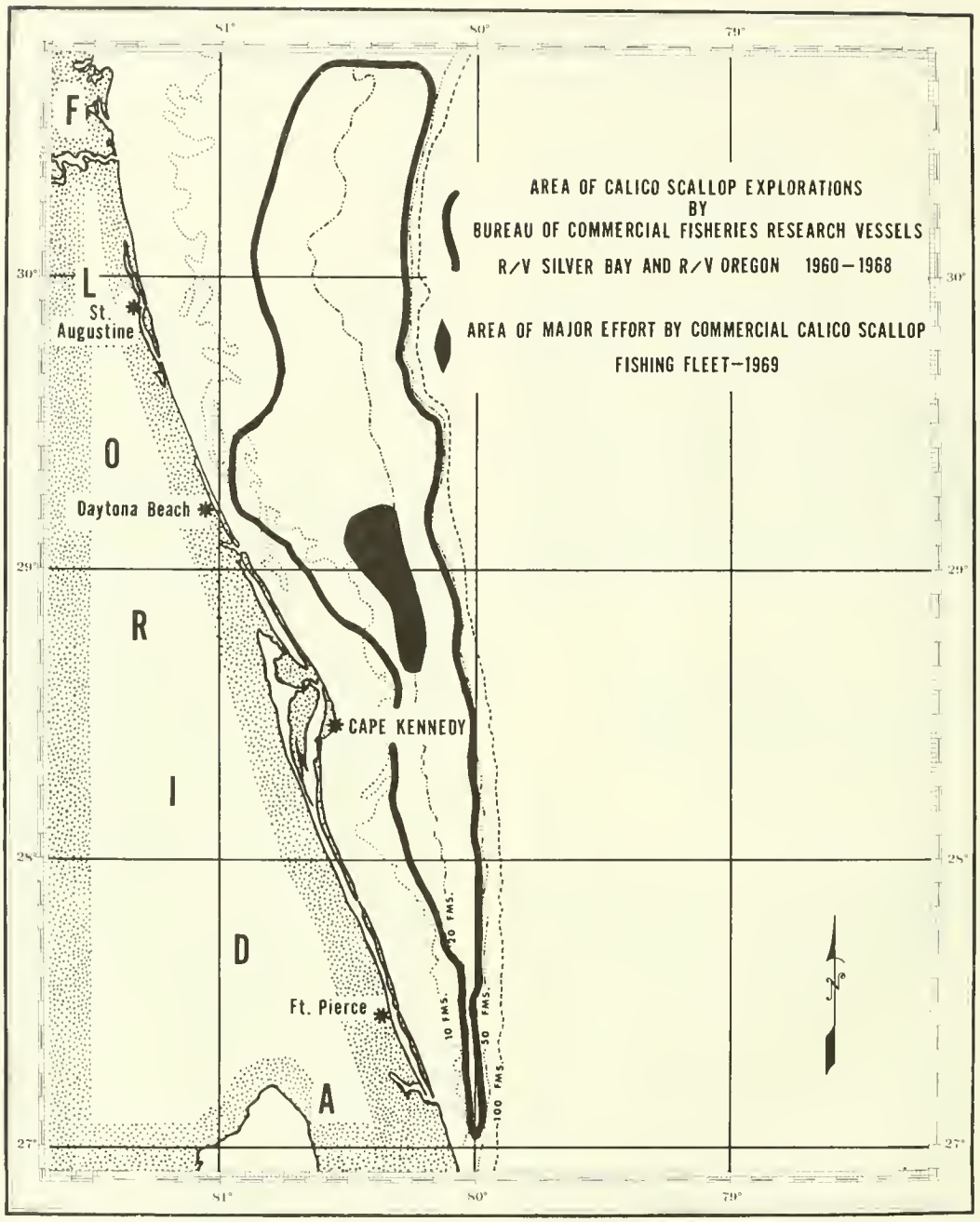

Figure 3.—Cape Kennedy beds showing area of scallop explorations from 1960 to 1968 and major commercial fishing location during 1969.

Kennedy beds. By May 1968 at least 16 vessels had landed calico scallop in Florida and Georgia ports. Of these, all but four were shrimp-type vessels. In January 1968 a 130-foot scallop vessel was equipped for ship-board processing and from Brunswick, Ga., as home port, began dredging on the Florida grounds. In March 1968 a scallop vessel from New Bedford, Mass., landed six trips in Brunswick, Ga., from the Florida grounds.[6]

In April 1968 two shallow draft dredgers from Chesapeake Bay made several landings

[6] Landings ranged from 735 to 1,500 bushels (about 51,450 to 105,000 pounds) of shell stock and each catch was obtained in about 24 hours of dredging with a single 8-foot tumbler dredge.

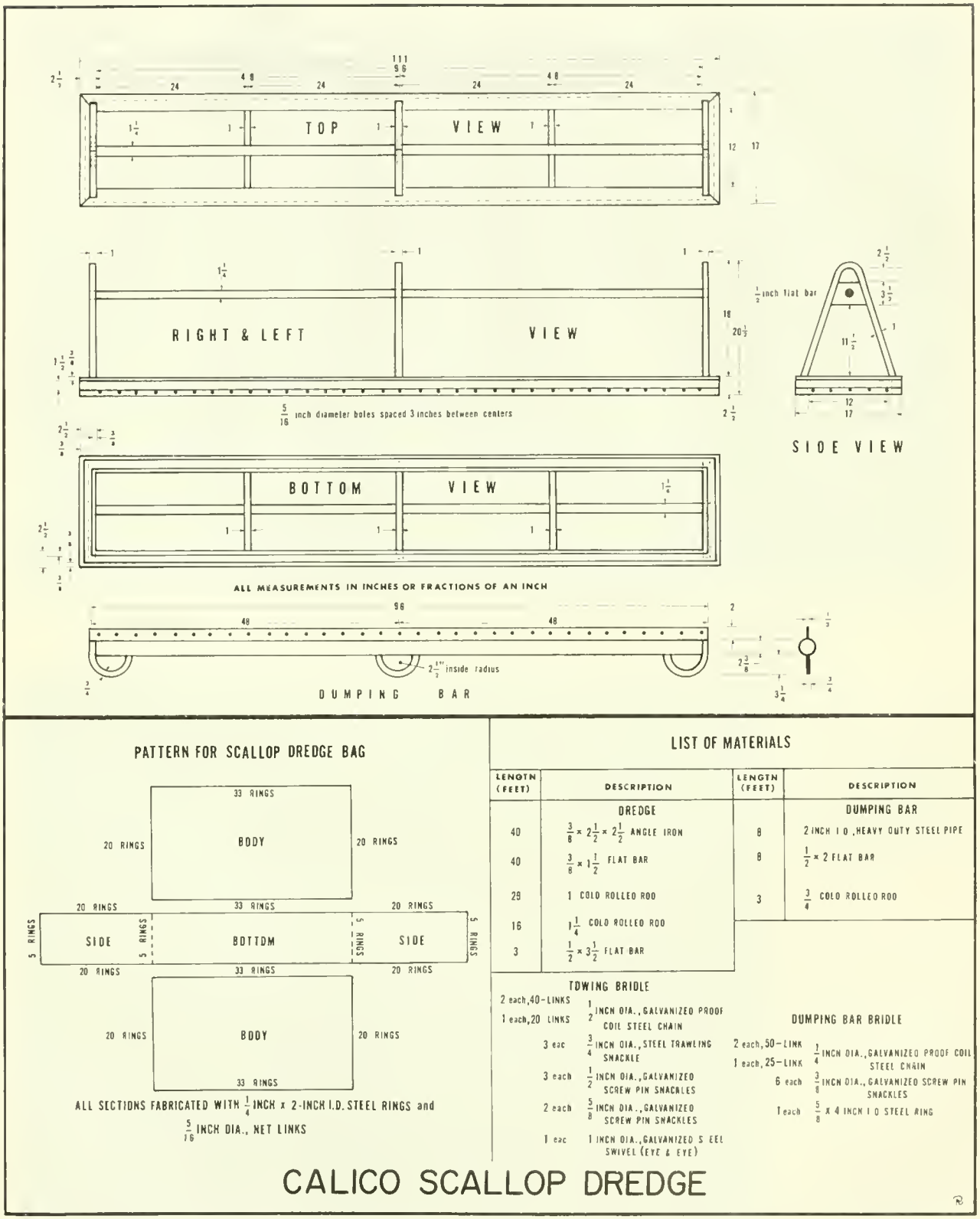

Figure 4.—Calico scallop dredge diagram.

Figure 5.—Example of low density commercial scallop concentrations—18 scallops.

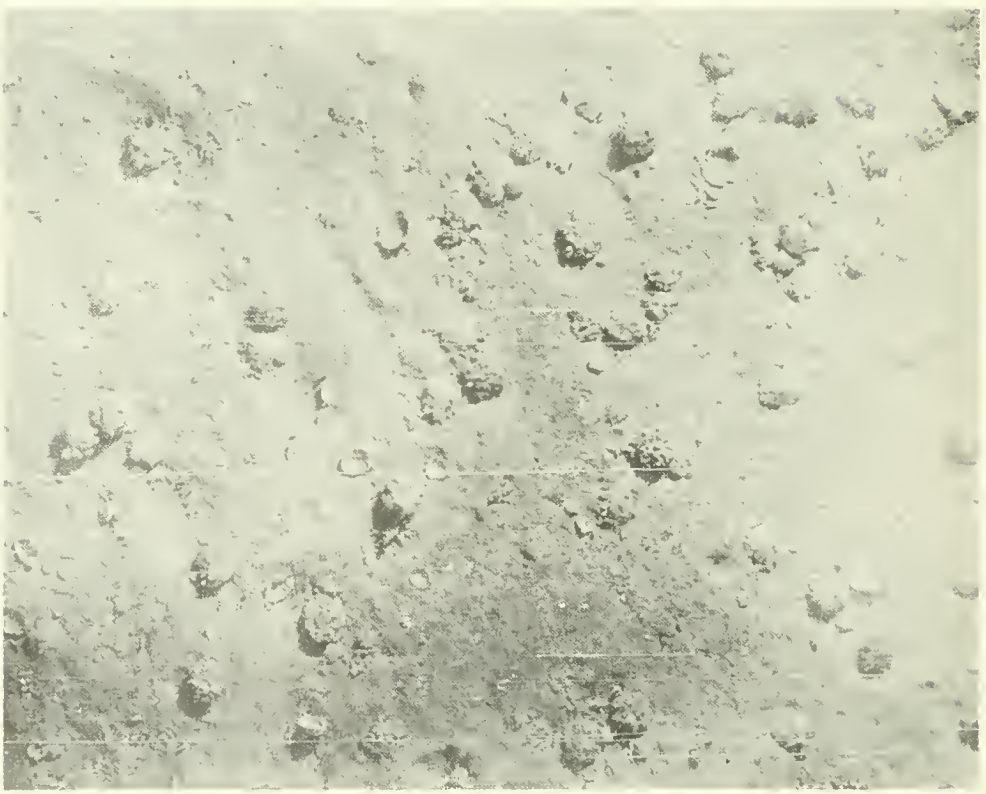

Figure 7.—Example of high density commercial scallop concentration—over 50 scallops.

in Florida at Port Canaveral and St. Augustine and continued intermittent operations for about 6 months. Since October 1967 all calico scallops appear to have been landed at Port Canaveral and St. Augustine in Florida and St. Marys, Brunswick, and Darien in Georgia. The Florida ports of Fernandina, Mayport, New Smyrna, and Ft. Pierce are being considered for future operations.

Quality

Calico scallops die soon after capture and spoil quickly during hot weather and in direct sunlight. Shell stock, even when kept in the shade and sprayed with fresh seawater, become "borderline" after 8 to 12 hours. When kept at iced temperatures (34° F.) scallop meats are organoleptically good for more than a week. When frozen, the quality is excellent and the shelf life is at least 1 year. When glazed to prevent dehydration, shelf life is much longer. Experience has shown that, except during cool weather, efficient mechanized handling and storage and complete or partial processing at sea are necessary to prevent spoilage. For additional information, Webb, Thomas, Carawan and Kerr (1969) report on the quality of machine-processed scallops. Waters (1964) reports on the storage life of iced scallops.

Figure 6.—Example of medium density commercial scallop concentration—about 30 scallops.

Parasites

Calico scallops are host to both commensal and parasitic organisms. At times an opaque yellowish parasite may be found encysted along the periphery of the adductor muscle. Although unidentified, it is probably a nematode, possibly *Porrocaecum pectinis*, (Carl J. Sindermann, personal communication, February 1969) which at room temperature emerges from a cyst about 2 millimeters in diameter, as a translucent hairlike worm less than 1 inch long. It remains dormant when refrigerated and apparently does not survive freezing. Washing and freezing are the best methods of treatment. It has no effect on either taste or

texture of the meat, and no organoleptic or visual detection is possible when cooked. Usually unnoticed, it is not likely to appeal to the aesthetic, but it is harmless when consumed after freezing or cooking.

DEVELOPMENT OF PROCESSING MACHINERY

Soon after the April 1960 discovery of the Florida grounds and subsequent dredging demonstrations in that year, several attempts to develop calico scallop shucking and eviscerating machines were initiated. In some instances the operational detail was not revealed, but the early developments, conducted independently of one another, utilized similar basic principles. That is, heat was used for shucking, and a combination of vacuum suction and cutting action was used for evisceration.

Evisceration

Figure 8 shows the first eviscerator developed (1960) being tested aboard the exploratory fishing vessel. From this pilot machine, two large vacuum cutting action type units were developed through shore based tests (Renfroe, 1964) and placed on a vessel for evisceration at sea. These original units were beset with frequent mechanical breakdowns and could not operate for more than brief, interrupted periods. Because of this and other costly factors, the venture was discontinued although a reasonably successful unit was developed.

In May 1961 a combination shucker and eviscerator was completed and tested aboard the exploratory vessel (fig. 9). The unit was a single, compact machine for use aboard shrimp-type scallop vessels. Heat was used for shucking and vacuum cutting action for evisceration. This machine did not perform well and it was therefore discontinued.

In January 1965 an eviscerator based on a somewhat different principle was tested at sea aboard the *Oregon* (fig. 10). Evisceration was done by a series of spring steel blades moving in continuous line over an extruded metal screen to provide a scraping or cutting action. The operation with a water-spray system attached

Figure 8.—Prototype experimental eviscerator being tested aboard the exploratory fishing vessel.

Figure 9.—Experimental combination shucker and eviscerator aboard the exploratory fishing vessel.

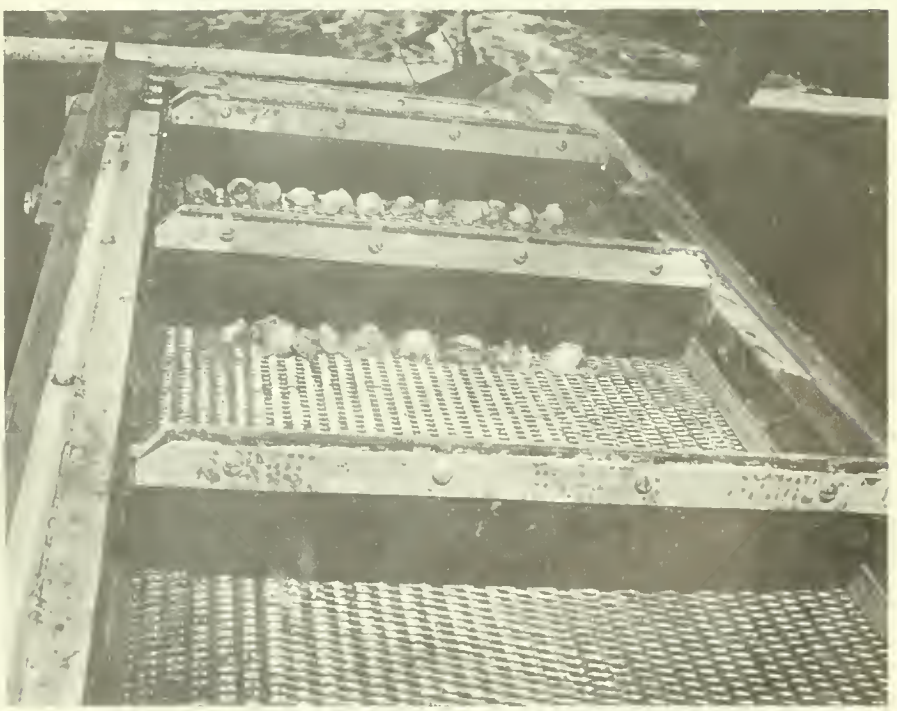

Figure 10.—Prototype experimental eviscerator being tested aboard the exploratory fishing vessel.

is shown in figure 11. This machine required a large volume of water, and although it functioned well, evisceration was incomplete and it was also discontinued.

Figure 12 shows a prototype of the most successful eviscerator, which has been in limited commercial use both ashore and at sea, undergoing tests at dock side in 1965. Evisceration is performed by a series of rotating rollers and the action is similar to that of a washing machine wringer. Each roll rotates in the opposite direction of the adjacent roll for about one revolution and then reverses direction. Every other roll therefore rotates in the same direction. The roller surface is critical because it controls the cleaning action by squeezing off the viscera between two adjacent rolls. The rolls are on an inclined frame, and the individual scallop meats flip down to the next roll with each rotation of adjacent rolls away from one another. Water is continuously sprayed over and underneath the rollers during evisceration. Numerous variations in size, length of rolls, number of rolls, surface type, and number and speed of rotation have been tested; this evisceration has provided the best results.

Two additional methods for eviscerating calico scallops have been described by Bullis and Love (1961) and by Williams (1966). Both these methods require partial hand-shucking and utilize vacuum suction to speed up the operation. Neither of the two methods has been used commercially.

Shucking

Efforts to develop a suitable method to automatically shuck calico scallops have not been as varied nor so much a problem as evisceration. For the most part, inventors have utilized

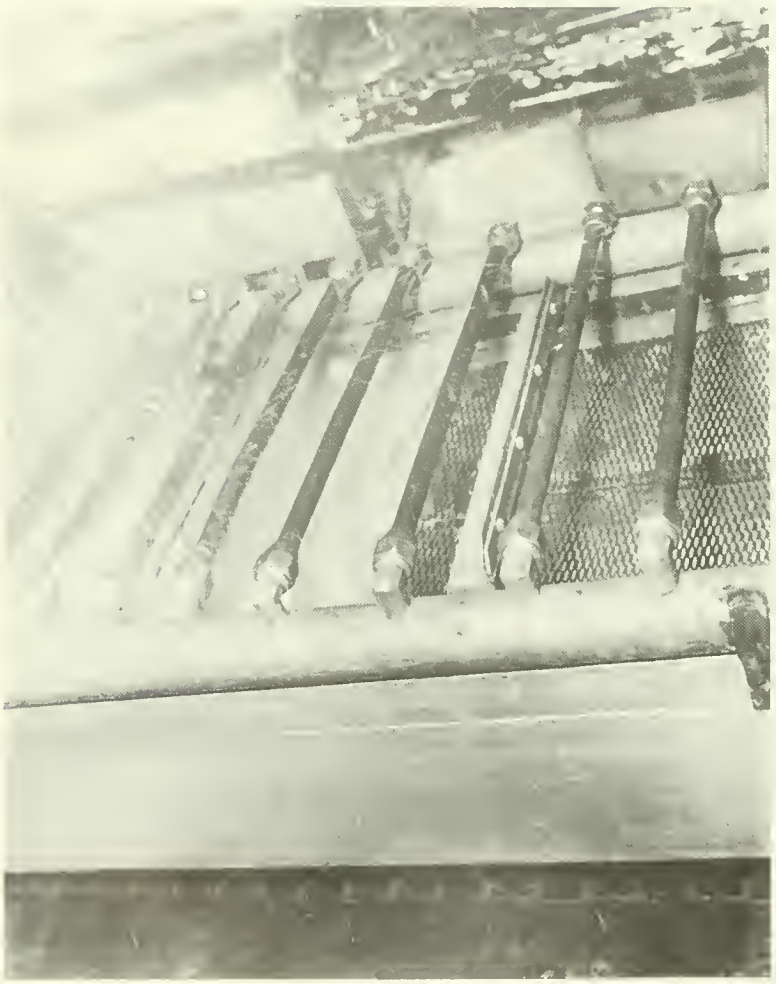

Figure 11.—Eviscerator shown in figure 10 with water jacket attached.

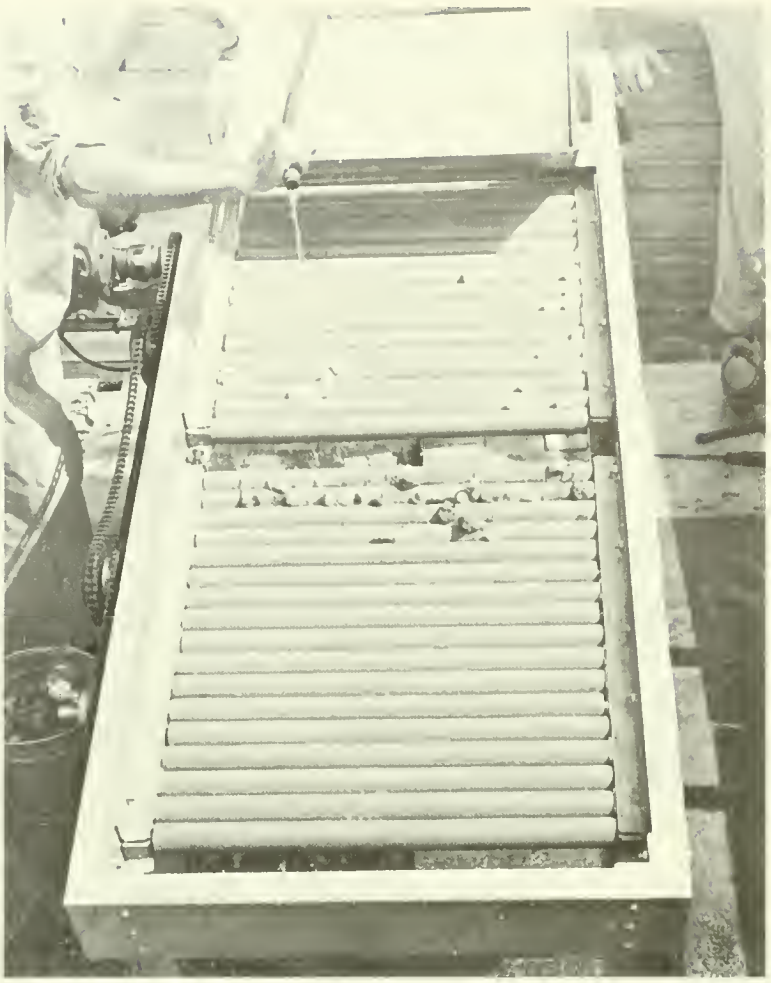

Figure 12.—Testing an early model eviscerator similar to units now in commercial operation.

some variation of a heat-shock method. The principle is not new and is used in other segments of the food processing industry. Heat, usually hot water, provides a blanching effect and mechanical shock frees the whole animal from the shell prior to evisceration. The meat should not be overheated so that it remains a "fresh" product. In calico scallop the top shell is commonly heavily encrusted with barnacles which insulate that shell. Thus, in providing adequate heat to the top shell, the bottom one is likely to be overheated. The viscera, however, insulates the adductor muscle, and by subjecting scallops to mechanical shock both before and after a brief period of heat, shucking is satisfactorily effected. It is much more difficult to shuck live scallops than dead iced scallops because the adductor muscle of live animals is more firmly attached to the shell. The shore-based shucking operation is therefore easier but with added quality problems. The proper combination of heat and mechanical shock works well with live scallops at sea.

Although more experience has been gained from heat shock, other methods have been tried. A method for shucking scallops electronically was described by Carpenter (1963), but the cost was prohibitive and it was not attempted commercially. It has been reported that the adductor muscle of live scallops placed in seawater and subjected to low voltage direct current contracts sufficiently free from the shell to effect shucking. Other developments concern the use of live steam (Meyer, 1969) and gas flame (Matzer, 1965) for heat.

The most successful heat shock shucker is shown in figures 13, 14, and 15, and its operation may be described as follows:

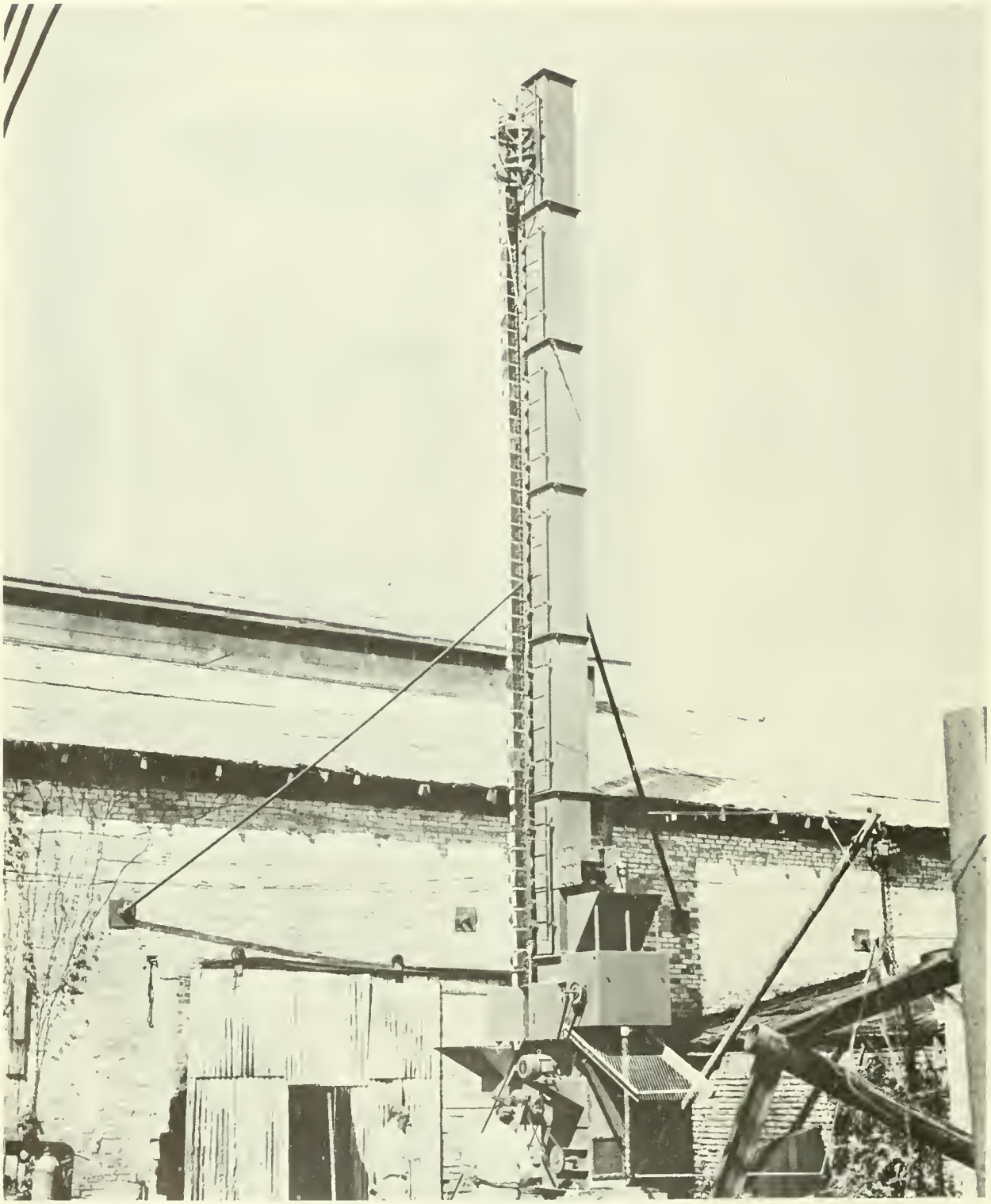

Figure 13.—An early commercial size shock-heat-shock shucker with high free-fall and separator screen.

Figure 15.—External view of completely automated shock-heat-shock shucker installed aboard 86-foot factory-type scallop vessel.

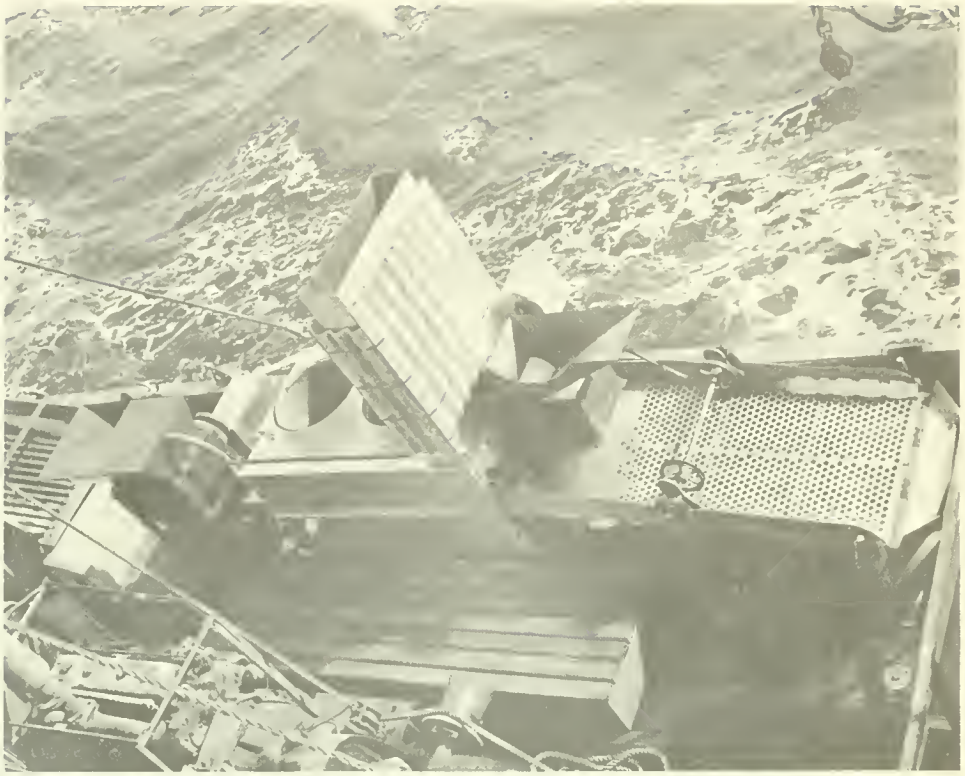

Figure 14.—Commercial size shock-heat-shocker shucker installed aboard 136-foot fishing vessel.

1. Shock—referred to as the first "knock out box." Scallops are placed in a hopper, which is above two large flexible rollers, rotating in opposite direction which slam the scallops against a baffle plate.

2. Heat—hot water into which scallops are placed for several seconds and then removed.

3. Shock—a second duplicate "knock out box" and thence to a "shaker screen" through which the shucked animal falls prior to evisceration and the shells are vibrated off in another direction.

Culling

Throughout the Florida east coast grounds there is continuous evidence of calico scallops in different stages of their life cycle. Catches, therefore, may be composed entirely of live scallops, or of shell, or any ratio in between.

An important shipboard labor-saving device is the culler, or separating machine, which sorts out live scallops from shell and debris. Figure 16 shows a successful culler being tested aboard the *Oregon*. It is a simple device consisting of a series of pipes placed longitudinally on an inclined frame. The lower portion of the frame is on springs and is vibrated by an eccentric weight. The unsorted catch is fed onto the top

Figure 16.—Culling machine for separating live scallops from shells and debris being tested aboard the exploratory fishing vessel.

of the frame and the adjustable pipes are spaced so that the empty shells fall through. Except for large objects such as conchs and occasional flotsam, the scallops and all other material thus separated go through the shucker. An improved model is a 2-way separator with an extension to the lower end of the frame with the pipe spacings widened to permit live scallops to pass through, while larger objects continue in another direction. Another simplified version, utilizing the same general principle, has a series of spaced pipes built into an inclined rotating cylinder called a "squirrel cage" that sorts out shells and debris. When equipped with cleansing seawater spray and made to function as a screw-type conveyor, this version has proved best (figs. 17 and 18).

RECENT DEVELOPMENTS

Stimulated by the potential of this latent resource, vigorous activity of many industry

Figure 17.—Bucket conveyor and rotary "squirrel cage" type culling machine, for sorting live scallops from the catch, installed aboard 86-foot factory-type scallop vessel.

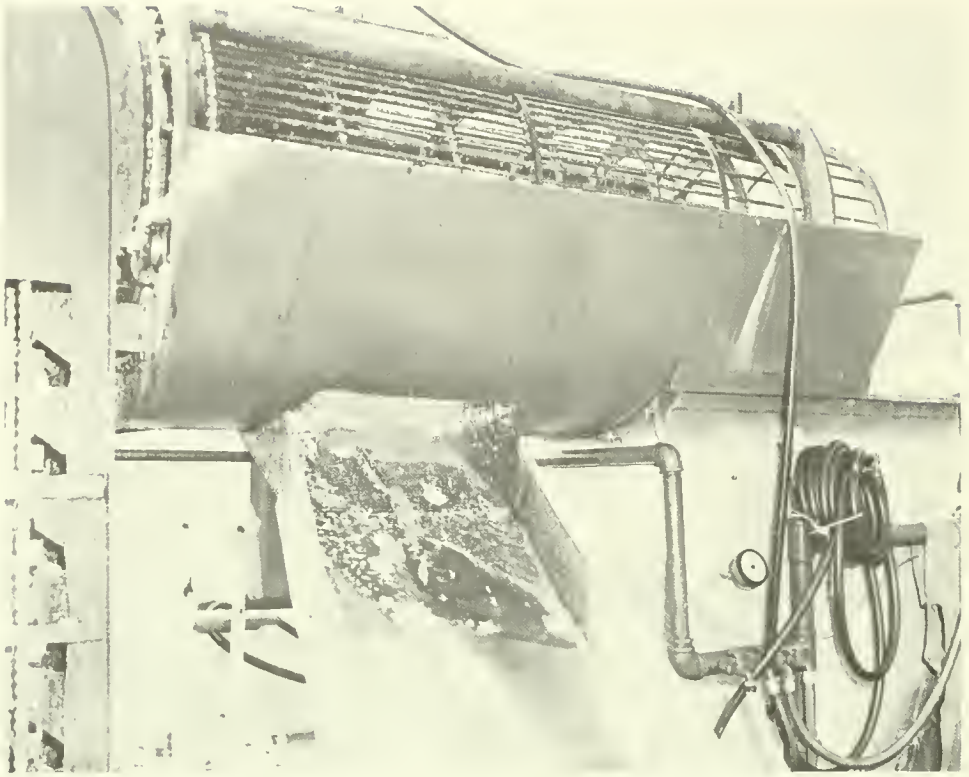

Figure 18.—Side view of rotary culling machine for sorting live scallops from the catch, installed aboard 86-foot factory-type scallop vessel.

segments is constantly changing. Negotiations involve risk capital ranging from individuals to large corporations. The trend toward larger, more efficient vessels has resulted from trial and effort with shrimp-type boats.

Vessels

Construction of four new factory-type scallop vessels was initiated in 1968. The vessels were to be equipped with onboard culling and shucking and eviscerating machines. Concurrently, the acquisition of other vessels suitable for factory-type modification is constantly under negotiation.

The four new factory-type vessels entered the fishery in early 1969. Initially, operations consisted primarily of fishing gear and processing trials with modifications required on a continuing basis. Due to labor problems, the largest vessel left the fishery for combination shrimp and scallop fishing in Central America with two small catcher vessels.

The more successful vessels worked a 24-hour day, and by September maximum production had reached 4,000 pounds of processed meats per day (fig. 19). For a description of processing see Cummins and Rivers (1970). The largest single vessel landing of 12,000 pounds occurred in October. In November two vessels working together landed about 20,000 pounds of processed meats during four fishing days (exclusive of 2 days running time) for an average of 2,500 pounds per vessel day.

RUFAS

Technical assistance was provided by the Bureau to reduce search time and thereby provide maximum sea time for processing equipment repair and development. To accomplish this a survey cruise utilizing RUFAS (Remote Underwater Fishery Assessment System) (fig. 20) was conducted off the Florida east coast during July and August. Motion pictures of the bottom were taken along 7 transects covering a distance of 70 miles from northeast of Flagler Beach to northeast of Cape Kennedy. The results of the survey were presented in graphic form showing areas of scallop concen-

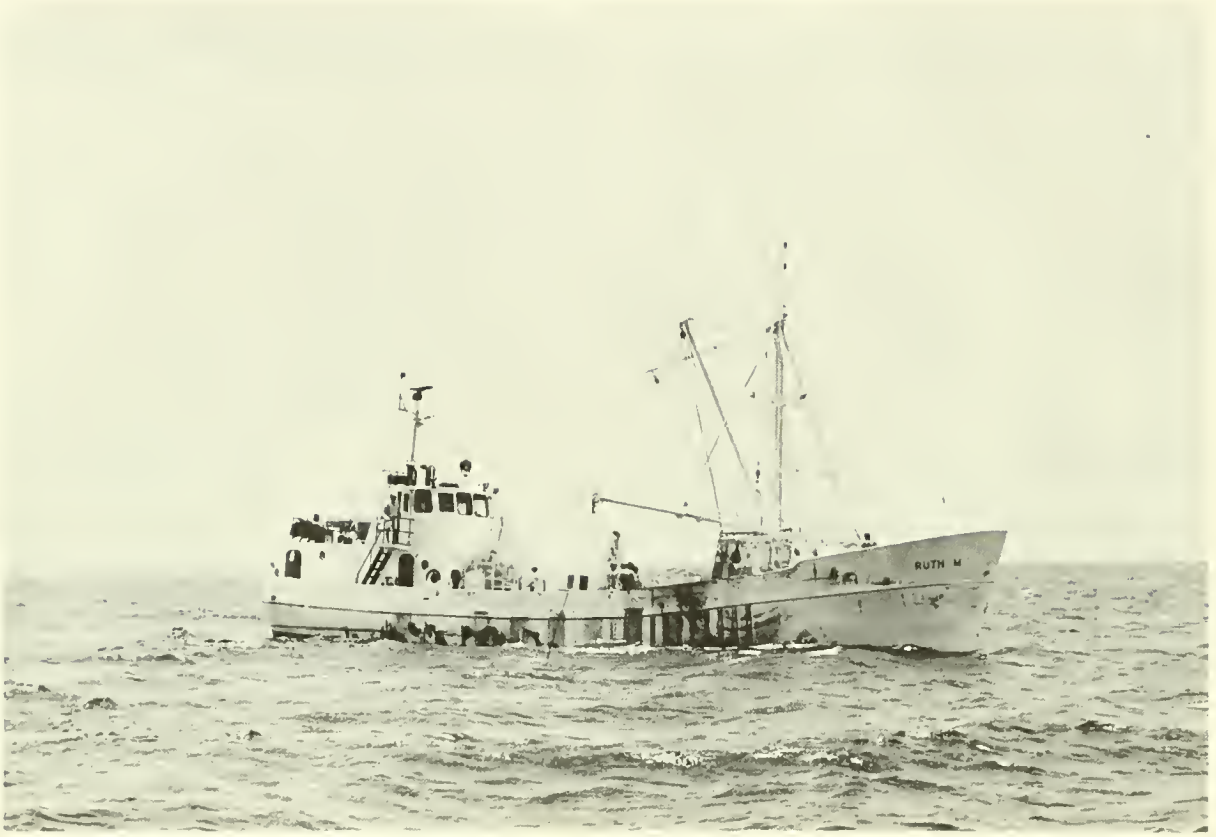

Figure 19.—*Ruth M,* 86-4-foot factory-type scallop vessel, in operation on the Cape Kennedy grounds.

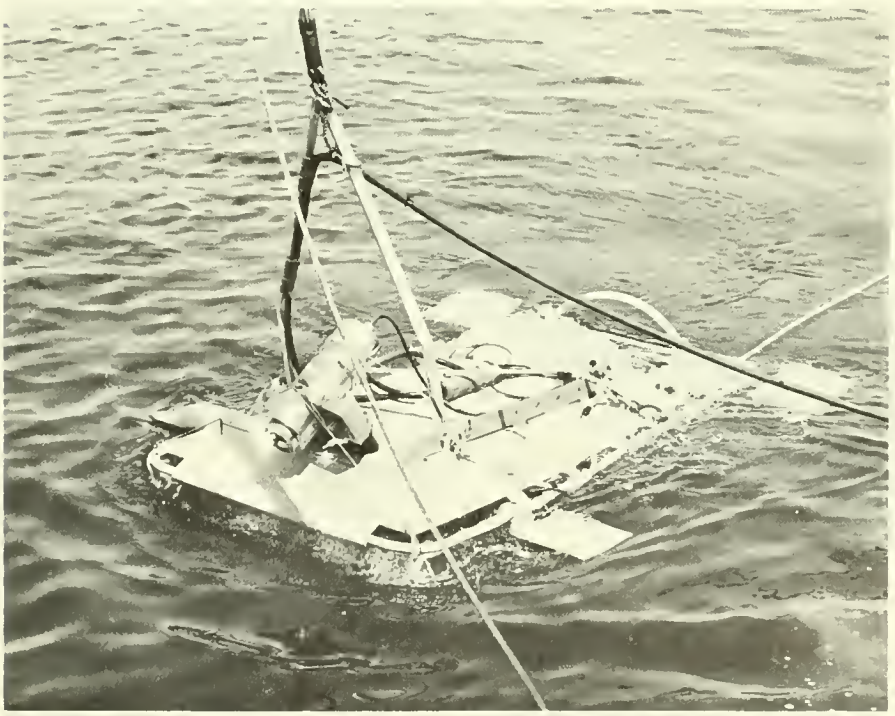

Figure 20.—Remote Underwriter Fishery Assessment System (RUFAS) vehicle.

trations and predicted catch rates for the fall season (fig. 21). The report was prepared exclusively for fishing captains whose primary need is for real-time information (Cummins, Maurer, May, and Rivers, 1969[7]). As follow up and verification of the RUFAS survey, a 10-day submarine survey cruise was conducted in September (fig. 22). During the cruise scallop vessel captains had the opportunity to make observations in their fishing area (Cruise Report Calico Scallop Submarine Survey, 9/21-10/1/1969).

Shore Facilities

The construction of facilities for processing shell stock ashore was initiated at Brunswick, Ga., and at Apalachicola and Port Canaveral, Fla. (fig. 23). At each location different machinery will be used.

[7] Cummins, Robert, Jr., Ray Maurer, Leonard May, and Jack Rivers. 1969. Summary log of scallop locations with predicted catch rates of Cape Kennedy grounds—fall 1969. Unpublished manuscript, 17 p.; filed at the National Marine Fisheries Service Exploratory Fishing and Gear Research Station, Brunswick, Ga. 31520.

Software and hardware problems in dealing with local and public health officials, court actions, and patent right will likely be substantial as the fishery develops. It is expected, however, that as the processing equipment is improved and more readily available, a valuable new fishery will be established in the southeastern United States.

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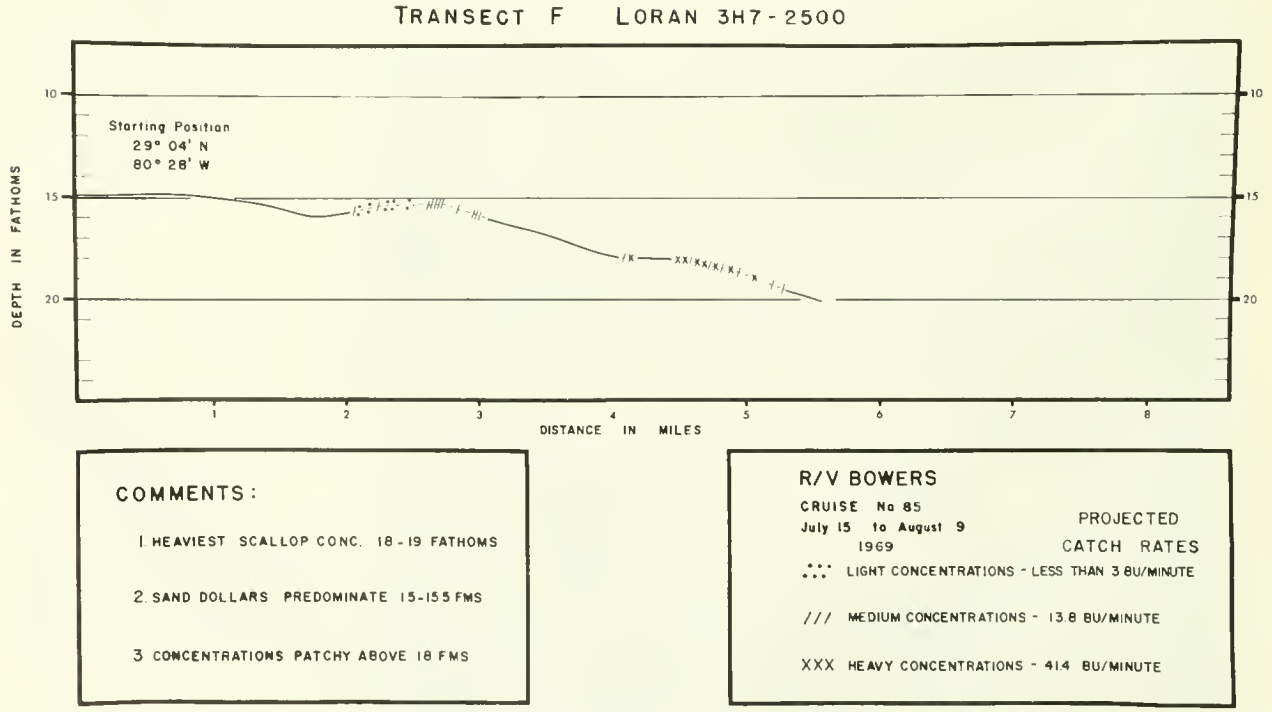

Figure 21.—Example of RUFAS transect summary showing scallop locations and predicted catch rates, prepared for fishing captains.

Figure 22.—Chartered two-man submarine utilized for survey of the Cape Kennedy scallop beds.

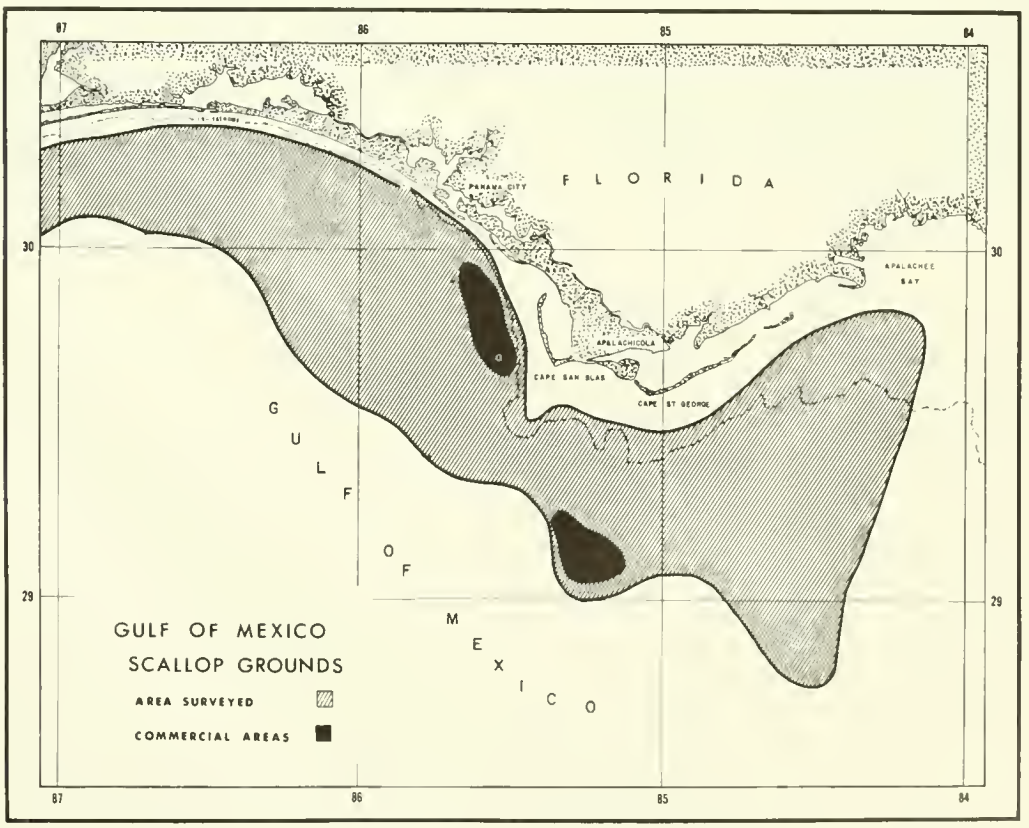

Figure 23.—Commercial scallop concentrations located in the Cape San Blas area in the Gulf of Mexico.

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