THE OCEAN QUAHOG FISHERY OF MAINE

A MAINE DEPARTMENT OF MARINE RESOURCES/SEA GRANT/PUBLICATION

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Maine Department of Marine Resources/State House/Augusta, Maine 04333

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INTRODUCTION

As an introduction to this publication we would like to publish, in part, from an informative paper on ocean quahogs prepared by five persons of the National Marine Fisheries Service, Gloucester, Massachusetts - J. M. Mendelson; P. S. Parker; E. D. McRae, Jr.; F. J. King; and A. H. Joyce. They have been observing the east coast ocean quahog fishery since before World War II.

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At present, seafood processors in this country are looking for other available shellfish resources to supplement what remains of a once seemingly inexhaustible supply of hard clams (Mercenaria mercenaria), sea clams (Spisula solidissima), and soft shell clams (Mya arenaria) that is now being reduced by overfishing, pollution, predation and other forms of habitat disturbance. The industry realizes that future market demands can only hope to be met by making the remaining underutilized shellfish species acceptably available at the marketplace.

The ocean quahog is the only known living species of the family Arcitididae. This is only one of the families in the large group of bivalve mollusks characterized by having two opposed shells hinged together at the top. The ocean quahog is commonly referred to as mahogany quahog, mahogany clam or black quahog because of its black or chestnut colored exterior

which characterizes it from all other mollusks of a similar size and shape.

The National Marine Fisheries Service has considered the potential of the ocean quahog and has already undertaken investigative work to establish the extent of the ocean quahog resource by exploratory surveys, and to promote its acceptance as a food on a near par with other marine clams by developing new recipes and usages. While considerable work is already complete, much more remains to be done before the full food potential of the ocean quahog can be realized. Our main purpose here is to give an overall review of the completed work to acquaint you with the possible broad potential of the ocean quahog.

RESOURCE LOCATION AND YIELD

The ocean quahog was thought to be strictly a European species. Today, its known ranges also include the United States' side of the North Atlantic from the Arctic Ocean to Cape Hatteras in depths of about 6 to 90 fathoms. Results of exploratory sea clam surveys between 1963 and 1967 show that the ocean quahog inhabits extensive areas in the colder waters of the continental shelf between Gloucester, Massachusetts and Cape Hatteras, North Carolina. In all probability, its total range in the North Atlantic has not been defined.

Ocean quahogs generally occur in beds rather than in uniform distribution over the bottom although a scattering of quahogs is frequently found between the beds. The density and size of the ocean quahog beds were found to vary considerably within the areas surveyed. The best catches were made in depths ranging between 18 and 24 fathoms. Beyond, or inshore of these depths, the catch rates were much less. Some of the beds sampled yielded at a rate of 20 bushels per 4-minute tow using a 48" hydraulic sea clam dredge. Tows in other areas frequently produced only a few individuals. With the 20 bushels per 4-minute tow density occurring throughout a given area, a standing population of approximately 300,000 bushels of quahogs would be found in a square mile area whether as a single bed or as the sum of the areas of a number of beds. A bushel of ocean quahogs will yield approximately 10 pounds of meats which means a square mile of dense beds might provide 3,000,000 pounds of meats.

From the data compiled by NMFS, Gloucester, it seems reasonable to assume that a conservative estimate of the total crop of ocean quahogs between Cape Hatteras and Canada would be between 100 and 150 million bushels. While an accurate basis for determing the quahog population outside this area is not available, it seems that there could be at least an equal quantity in the remaining portion of its range making a total world standing crop of ocean quahogs of about 300,000,000 bushels or 3,000,000,000 pounds of meats. The U. S. production could grow to a sustained yield of about 150,000,000 pounds of meats per year.

PAST USE OF THE QUAHOG

Early in 1943, a small ocean quahog fishery was established in the waters off Rhode Island and southern Massachusetts. During that year, 461,000 pounds of meats were sold as fresh meats packaged in one-gallon metal containers or as frozen meats packaged in one-gallon cans or five-pound paper cartons. Production during this period reached its peak in 1946, after which the fishery started to decline.

The main reasons given for the decline in using ocean quahogs were their strong flavor and odor, dark color, high processing costs and storage instability. The strong flavor and odor concentrated in the liver was described as "iodine" or "medicinal" and its intensity increased with storage. The color of the meats varied from light brown to almost black depending on the harvesting area and method of processing and storage conditions (bay quahogs and surf clams are almost white). Another disadvantage is that the ocean quahog has an extremely hard shell and is completely closed with no easily accessible opening for a knife to penetrate. This requires a great amount of time and effort for shucking which means increased cost. Even opening this clam with steam under pressure as is used commercially to open other species of clams is not satisfactory and results in dark, rubbery meats having more concentrated unpleasant flavors and odors. Also, a large weight loss is sustained when the clams are subjected to steam even though the liquor can be recovered.

FACTORS AFFECTING QUAHOG UTILIZATION

Experiments were conducted at the NMFS Gloucester Technological Laboratory to confirm or reject the reason for underutilization of quahogs and to evaluate their potential in novel and in well established clam products.

The first objective was to investigate the iodine flavor and strong odor. Live quahogs were hand-shucked and the juice and meats collected, both of which were smelled by laboratory personnel who noticed no iodine odor. The odor of both meat and liquor was described as salty or "seaweedy." In the next test, both the clam meats and liquor were boiled separately. These two products were then smelled and tasted. Again, no iodine odor of flavor was noticed in the clam broth. In the clam meats a strong clamlike flavor and slight odor were observed, but not characterized as medicinal or iodine even though samples from different areas (New Jersey, Rhode Island, Maine and Massachusetts) were tasted at various times of the year. This clamlike flavor was not objectionable but stronger than found in the bland surf clam. Further experiments revealed that the clam flavor was water soluble and easily removed from the meats by repeated water washing. No odor was noticed in the washings. These results confirmed our previous findings that the substances responsible for the slightly strong flavor were not very volatile and are present in fresh clam meats in low concentrations. Any strong flavor observed in ocean quahogs may be due to isolated environmental

conditions or to poor handling, storage or processing. Since this flavor defect is not inherent in all ocean quahogs, it should not hinder development of the entire resource.

By transplanting ocean quahogs from one bed to another or by restricting the fishing area to those places known to produce quahogs with a good flavor, the strong flavor problem can be solved. There is a wide choice of bed locations. Also, shallow water relaying or transferring live ocean quahogs to different beds is feasible. Another possibility is to hold live ocean quahogs in chilled, filtered water tanks prior to shucking. This treatment gives the quahog an opportunity to clean itself. During this time its liver, the source of the strong taste, is atrophied thus resulting in a significant loss of the strong flavor in the meats.

To have a readily available supply of fresh ocean quahog meats, live quahogs were obtained and kept alive in refrigerated salt water tanks. Some quahogs have been held alive in the tanks for six months.

The fact that the color of the meats from ocean quahogs is darker than that from bay quahogs or surf clams is not considered serious. It was found that fresh ocean quahog meats, raw and cooked, vary from brown to gray, but are not unappealing. The chemical nature of this brownish color is unknown but is suggested to be a melamine. Addition of white ingredients or a bleaching process will lighten the color if desirable or by adding a colored ingredient, such as tomato,

the slightly darker color can be masked as in Manhattan clam chowder and in baked stuffed clams. Removal of the dark liver will not only lighten the product but will remove most of the robust clam flavor.

The next phase studied was the problem of shucking ocean quahogs. Two techniques have been used extensively. The first method, hand labor, is very slow and costly. The second method to open the shell uses steam under pressure. Although this method requires less hand labor, the resulting meats are very dry, hard, dark and have a very strong flavor. And the yield of meats from steaming open the shell is about 50 percent of the weight obtained from hand shucking (lost juices can be collected and concentrated). Both of these methods being quite poor, our laboratory investigated opening the shells with microwave energy.

Exploratory experiments have already shown that microwave opening of clams is feasible. A complete study of microwave opening of oysters, including economic and quality considerations, also has shown this technique is adaptable to various species of shellfish.

Finally, we concerned ourselves with the practical usage of ocean quahogs in recipes. Obviously, since the quahogs are darker in color and have a stronger flavor and odor than bay quahogs or surf clams, they should be used in recipes that take advantage of these characteristics. Therefore, we prepared new products by diluting the quahog meats with inexpensive

ingredients such as potato, vegetables, bread and starches to reduce the intensity of the strong clam flavor and also to provide a relatively inexpensive food product.

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OCEAN QUAHOGS—THE MAINE STORY

In January of 1974 a number of Ogunquit area fishermen were interested in the possibility of harvesting the mahogany quahog as they were frequently found in bottom drags. They requested technical aid from the Department of Marine Resources. Extension Service agents and the Research Vessel DUCHESS were sent to the Ogunquit area with three objectives. First, to determine if commercially abundant amounts of quahogs were present in the area. Second, to develop efficient harvest methods through the use of various types of gear and operating procedures. And third, to demonstrate the equipment and its operation to interested fishermen. Extensive work was done in the Ogunquit area, and subsequently, with an increased interest in the mahogany quahog, similar work was done in Machias Bay, Dyers Bay, and more recently, Penobscot Bay.

The gear used to capture the mahogany quahog has undergone substantial changes as research was utilized to develop the most efficient gear practical for a small vessel. The operation began in the Ogunquit area with the rocking chair dredge which proved to be ineffective in the hard sand of the area. A hydraulic skimmer dredge was used with some success but due to its large size it was replaced by a much smaller hydraulic dredge which the Department had fabricated. The smaller dredge worked well in calm waters but proved extremely difficult to operate in the strong tidal currents of the Machias Bay area. The hydraulic skimmer dredge was modified to reduce

its size and to increase its capture efficiency. It was used with limited success in Machias and Dyer Bays. During the work in Penobscot Bay, additional modifications were made to the dredge which greatly increased its efficiency.

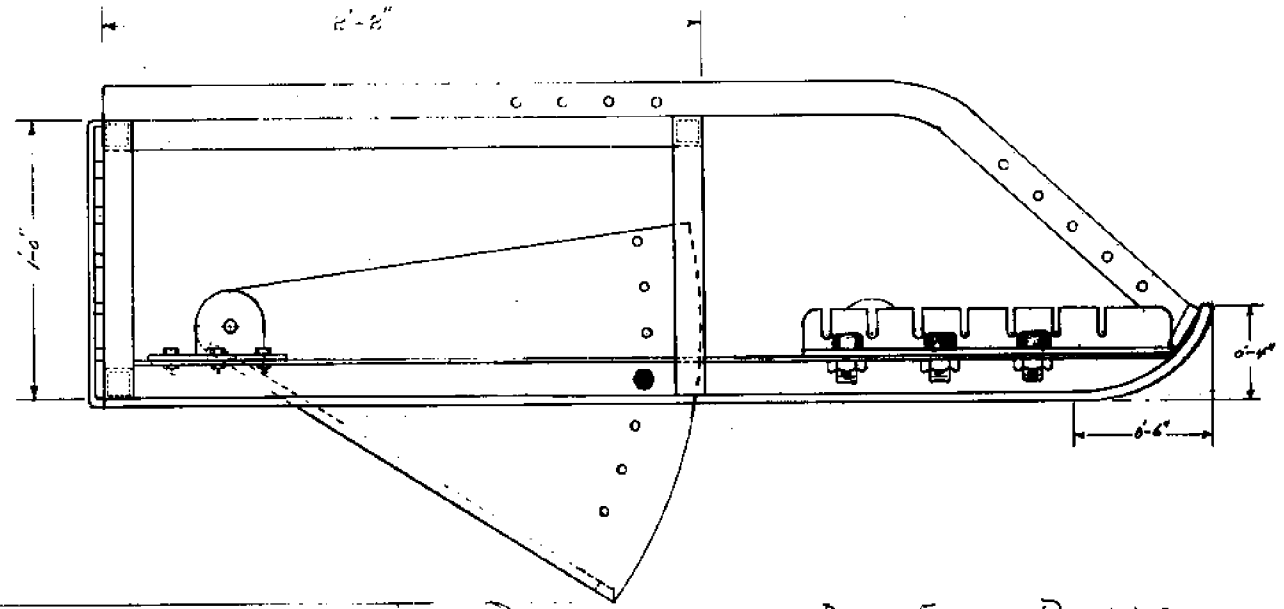
HYDRAULIC DREDGING

Since the mahogany quahog lies below the surface of the bottom it must be dug out in some manner to be captured. The most efficient way yet found is by the use of a hydraulic dredge; essentially a steel sled which is towed along the bottom. Attached to the front of the sled is a manifold with two sets of nozzles. The first set directs a stream of water at the bottom; the second set directs a stream backward into the dredge. The water is supplied by a pump aboard the towing vessel and fed to the dredge manifold by a long hose. The water stream from the first set of nozzles cuts away the bottom material dislodging the quahogs. The quahogs are then blown back against a cutter bar below and behind the nozzles. The water stream from the second set of nozzles moves the quahogs through the dredge into an attached ring bag. As the dredge is towed slowly along, the water jets loosen more bottom exposing more quahogs which are swept into the bag. The dredge is occasionally raised and the bag emptied.

THE GEAR

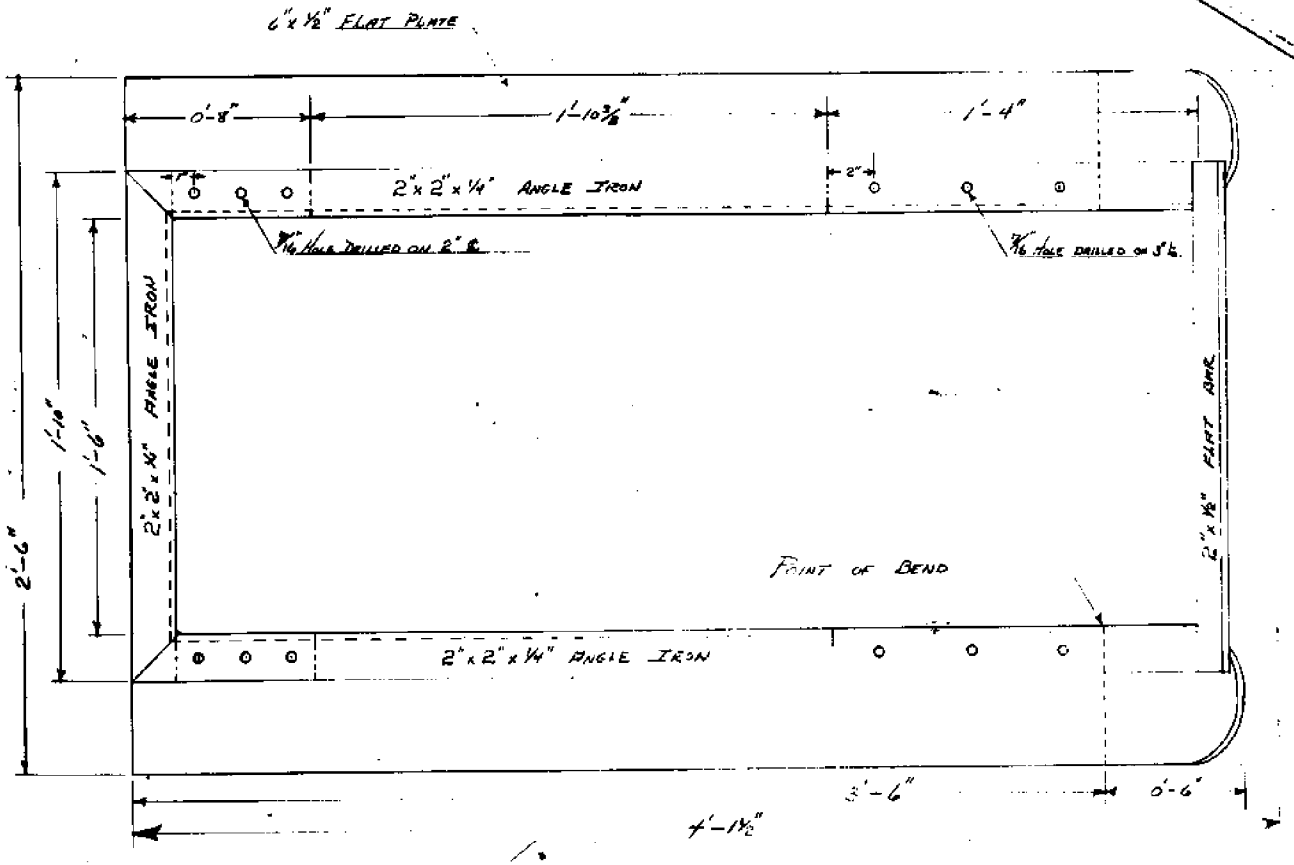
The hydraulic dredging gear used in this project consisted of three main parts: the water pump; the hose and reel; and the

hydraulic dredge. The water pump was a portable Hale fire pump powered by a 6 h.p. gasoline engine which produced a surface operating pressure of 70 lbs. The hose was three-inch nylon; one section 100 ft. and one smaller 50 ft. The reel was a fabricated steel drum driven by a hydraulic motor with chain and sprockets. The dredge was a modified skimmer hydraulic dredge 4' long, 2' wide with an 18" wide cutter bar. The three-inch manifold had five compressed nozzles.



DRAG FOUNDATION

DRAG FRAME PROFILE

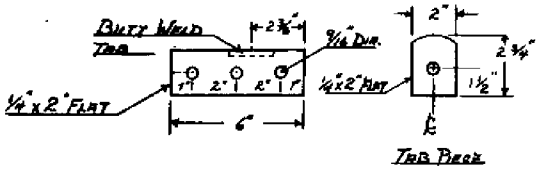


"18" QUAHOG DRAG

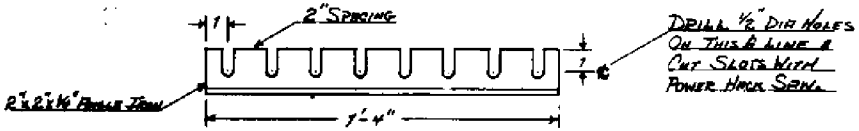
DEPARTMENT OF MARINE RESOURCES

SCALE 3:1 DATE: 7-21-76

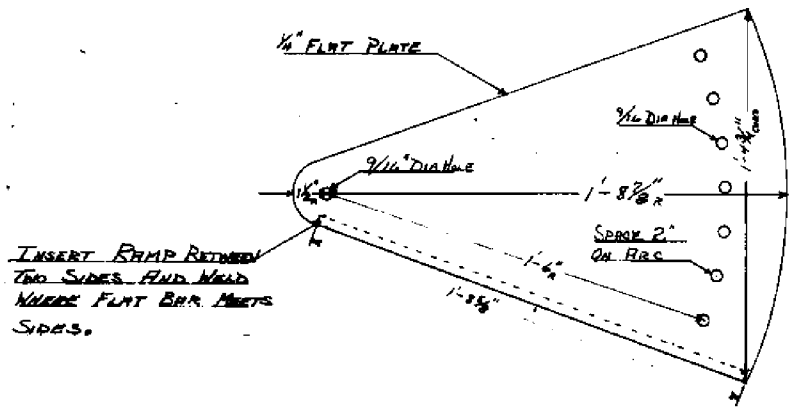
DRAWING 1 OF 4 ENG: JOHN MATHIESON



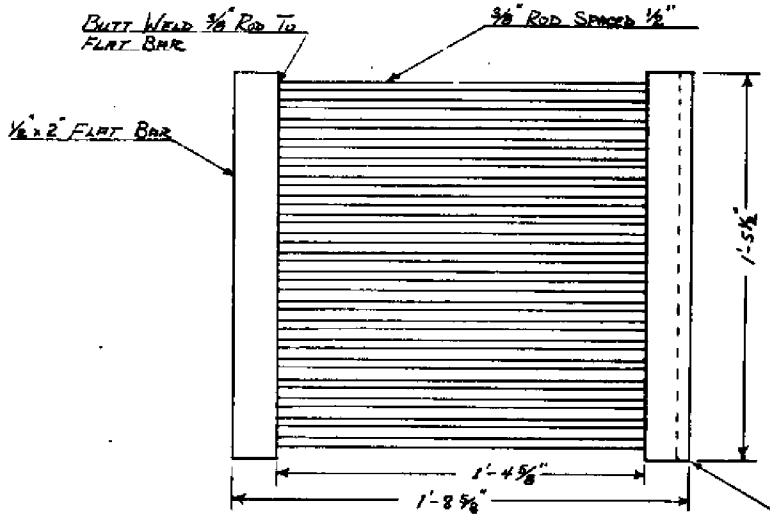
Ramp Pivot Piece
Make One For Right & Left Sides



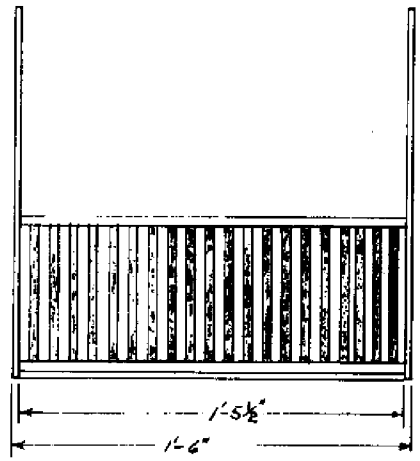
Manifold Bracket
Make One For Right & Left Sides.



Side View Ramp
One Of Two Pieces



Flat View Of Ramp



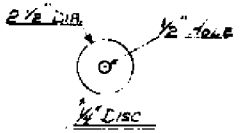
Front View Ramp

18" Quahog Drag

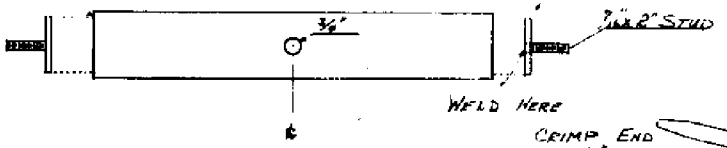
Department Of Marine Resources

Scale 3:1 Date 7-21-76

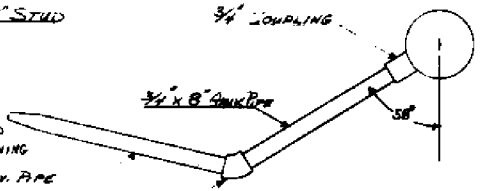
Drawing 4 of 4 Eng. J. K. Mathieson



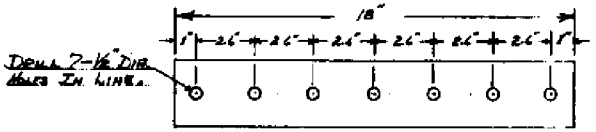
WELD DISC FLUSH WITH END OF PIPE.



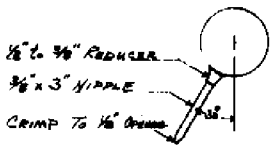
MANIFOLD FLUSHING VIEW



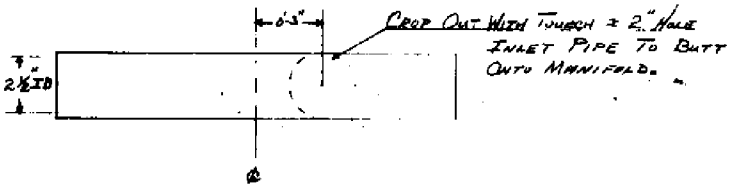
FLUSHING PIPE



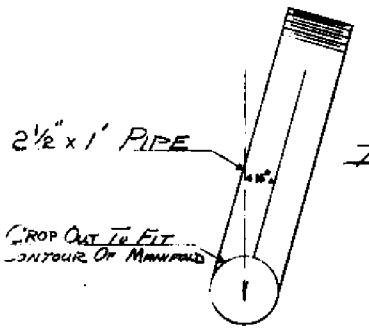
MANIFOLD NOZZLE VIEW



NOZZLES



MANIFOLD INLET VIEW



INLET PIPE

18" QUAHOG DREDGE

DEPARTMENT OF MARINE RESOURCES

SCALE 3:1 DATE 7-21-76

DRAWING 3 OF 4 ENG. J.K. MATHIESON

THE VESSEL

The vessel used for dredging was the R/V DUCHESS, a 47' double-ended dragger with a 14' beam, 4½' draft and powered by a GM 3-71 diesel with a 2:1 reduction gear. The lifting gear consisted of a 20' mast with 14' boom and a hydraulically driven double-drum Hathaway winch with 5/16" cable. The vessel had approximately 150 sq. ft. of rear deck working space and 2' of free board.

OPERATIONAL PROCEDURE

The development of a correct operating procedure involved a considerable amount of trial and error especially when a modification was made on the dredge. The correct procedure was found to be critical to dredge efficiency, therefore, a step-by-step procedure follows:

Preparation of equipment - When the area to be dredged was reached, the vessel was slowed to two knots and the dredge lowered over the side just into the water. One end of the hose was attached to the dredge and the hose was fed from the reel into the water to trail behind the vessel until the other end of the hose was reached and attached to the pump. The pump was started and brought up to pressure to check flow and then set to idle.

Lowering the dredge - The vessel's course was adjusted either perpendicular away from shore or into the current depending on water conditions.* The dredge was lowered slowly and once on bottom the winch was allowed to freewheel until enough wire was out to provide for a scope of 3:1. The pump pressure was increased to 75 lbs. and the boom lowered to its towing position.**

Towing the dredge - The engine RPM was increased to 1000 or enough throttle to provide a steady pull without causing the cable to jerk. The vessel's course was maintained straight, away from shore, or into the current. The dredge was towed

from 10 to 20 minutes.

Hauling the dredge - The boom was placed in hauling position and the winch engaged slowly with pump pressure and vessel RPM being maintained. During hauling, the vessel was kept as straight as possible. When the dredge left the bottom, the pump was shut down and the vessel speed decreased. The winch was stopped when the dredge broke the surface to allow for washing of the bag contents.

Emptying the dredge - The vessel was oriented into any sea that existed to minimize rolling. The dredge was brought aboard as quickly as possible and emptied and reset quickly for the sake of safety. The dredge was then lowered for another tow.

Securing the equipment - At the end of the last tow the dredge was lowered to the deck and secured. The manifold end of the hose was released and allowed to trail behind the vessel as it proceeded at two knots. The pump end of the hose was then attached to the reel and the reel engaged to bring in the hose.

Since the vessel used for dredging was double-ended, it was necessary to lower and raise the dredge over the side. This was time consuming and somewhat difficult in rough weather.

Future dredging will be done with a square stern vessel. The dredge will be raised, lowered and towed from an A-frame extending over the stern. The use of an A-frame, particularly in emptying the dredge, should simplify the operation.

The aforementioned procedure, however, in all aspects but boom positioning, would be applicable to dredging from a square stern vessel.

* The tows were made perpendicularly away from shore (shallow to deep) so that the forward progress of the vessel could be monitored on its depth recorder. In strong currents or wind, however, it was found necessary to tow into these elements to maintain adequate control of the vessel.

** The dredge was towed from the vessel's boom which was hydraulically raised and lowered. The boom was stayed in such a way that when in the raised position (approximately 45 degrees) it extended over the starboard side of the vessel for ease in getting the dredge in and out of the water, and when the boom was lowered until horizontal with the deck, it extended toward the stern for ease in maneuvering the vessel.

WHERE TO DREDGE

Mahogany quahog beds were found extensively in the sand bottom from Portsmouth to Kennebunkport. Beds were found in the mud bottom of Machias Bay off Bucks Harbor entrance. A small bed was also found in the gravel bottom of Dyer Bay. Recently, a bed was located in Penobscot Bay at Ducktrap. The mahogany quahogs were found in these areas of depths of 40 to 60 feet. The sand bottoms proved easier to dredge

with better results. It is believed that mahogany quahogs may be found in many more areas in dredgeable bottoms at the appropriate depths but discovering the location of other beds will depend mainly upon fishermen exploration.

ANTICIPATED YIELD

Prior to the work in Penobscot Bay, different gear was used and modified to try and increase capture efficiency. The maximum yield realized in any of the areas did not exceed one bushel per 10-minute tow.

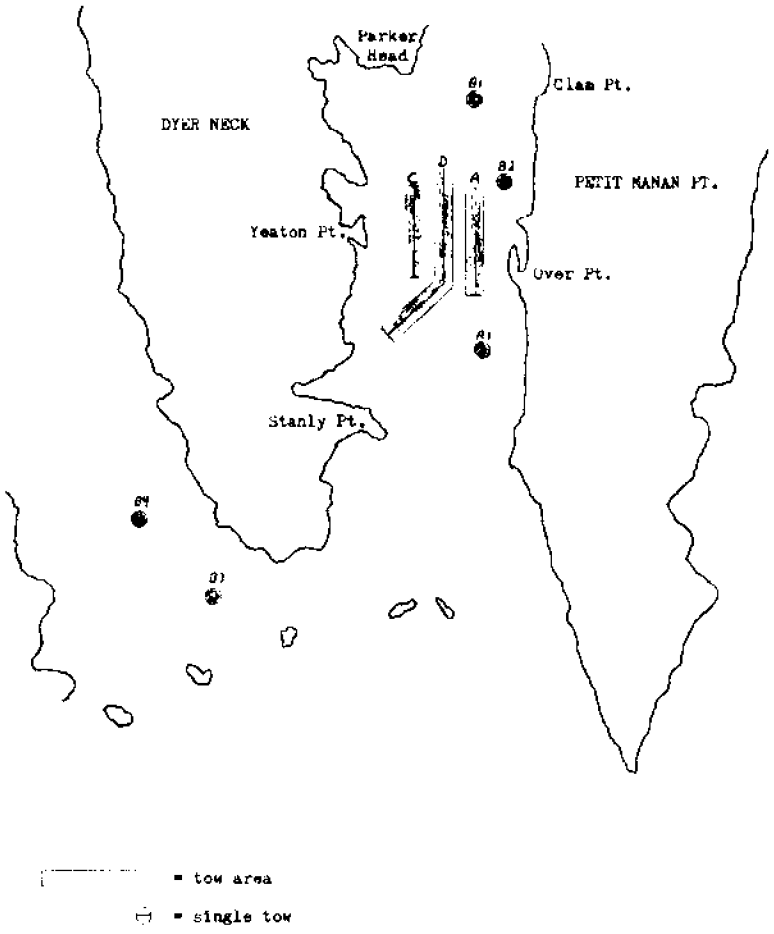
Fortunately, with a relatively simple modification of the already greatly modified hydraulic skimmer dredge - the addition of two nozzles directed backwards into the dredge - the maximum yield for the size bag was obtained. At Ducktrap in Penobscot Bay, 8 bushels per 10-minute tow was realized.

With similar results as at Ducktrap, a projected daily yield can be computed: Allowing for 10 minutes handling time per tow and making 10-minute tows, three tows could be made per hour. If an average of 5 bushels per tow were captured, a yield of approximately 120 bushels per 8-hour day could be expected.

COASTAL AREAS SURVEYED

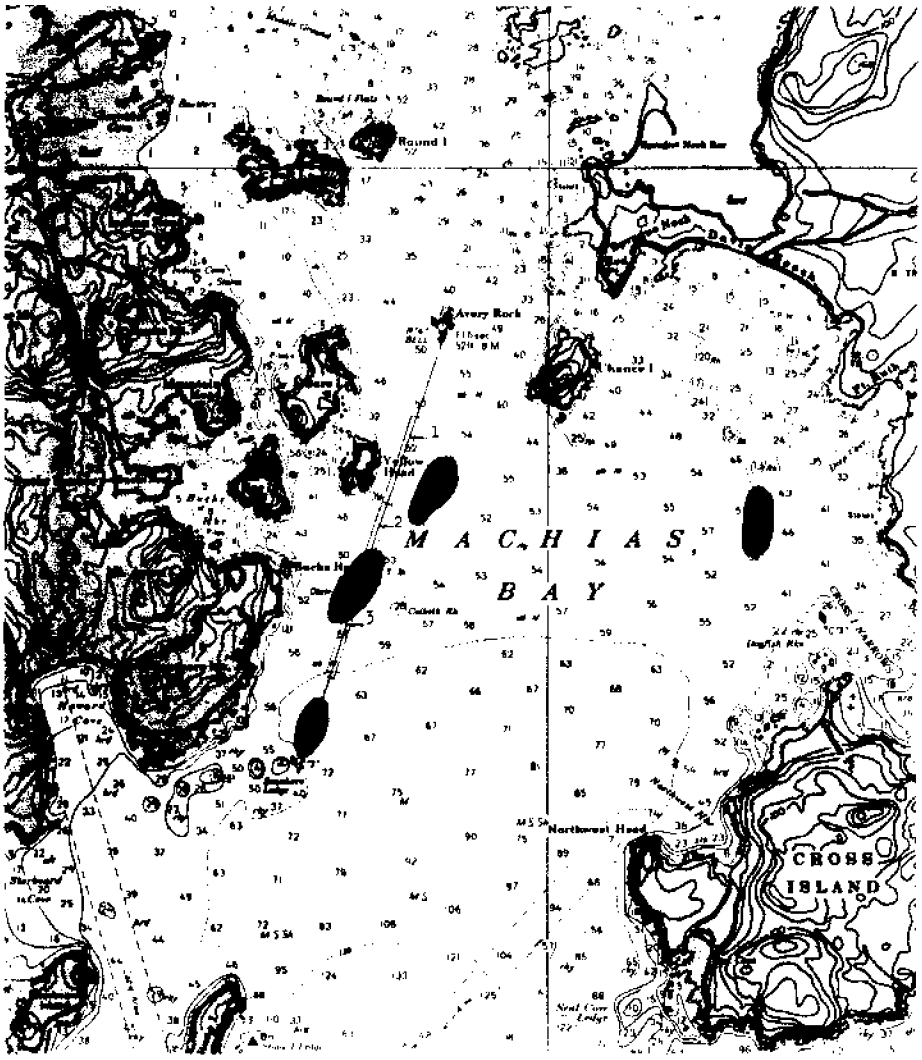
The following locations along the Maine coast have been surveyed by marine extension agents aboard the R/V DUCHESS. A brief explanation of these surveys accompanies the chart locations.

DYER BAY AREA



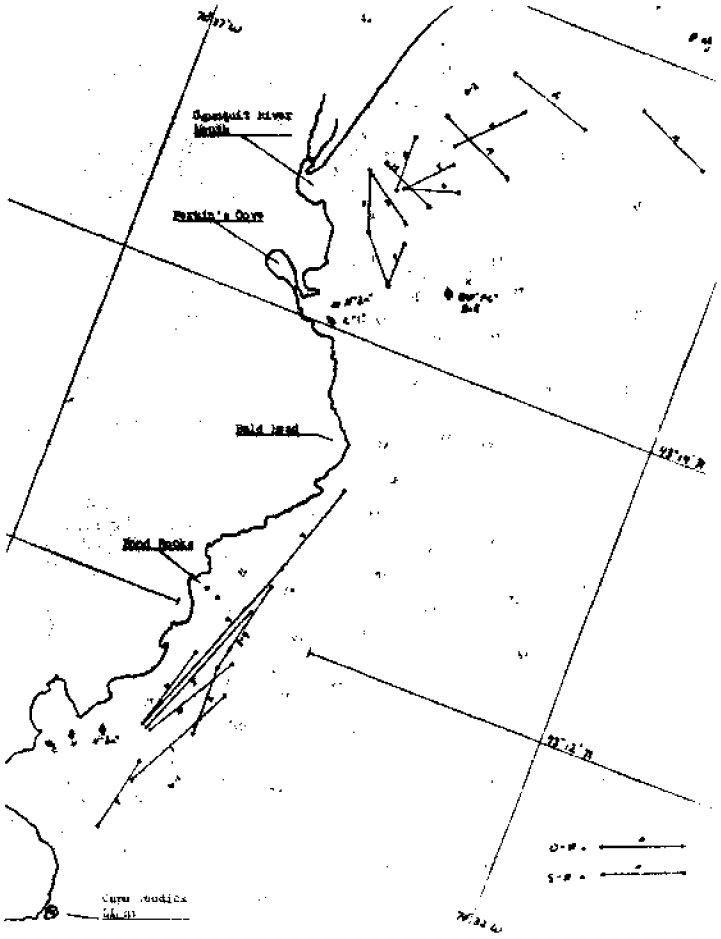
Experimental tows were made in Dyer Bay at the suggestion of local fishermen who had dredged up live mahogany quahogs in scallop dredges. In the area surveyed, however, the best tow was one bushel for a 20-minute tow in 50' of water. The bottom was gravel-rocky and the hydraulic dredge was obviously not performing well. The beds were concentrated and two tows made parallel but 20' from each other produced very contrasting results.

MACHIAS BAY AREA



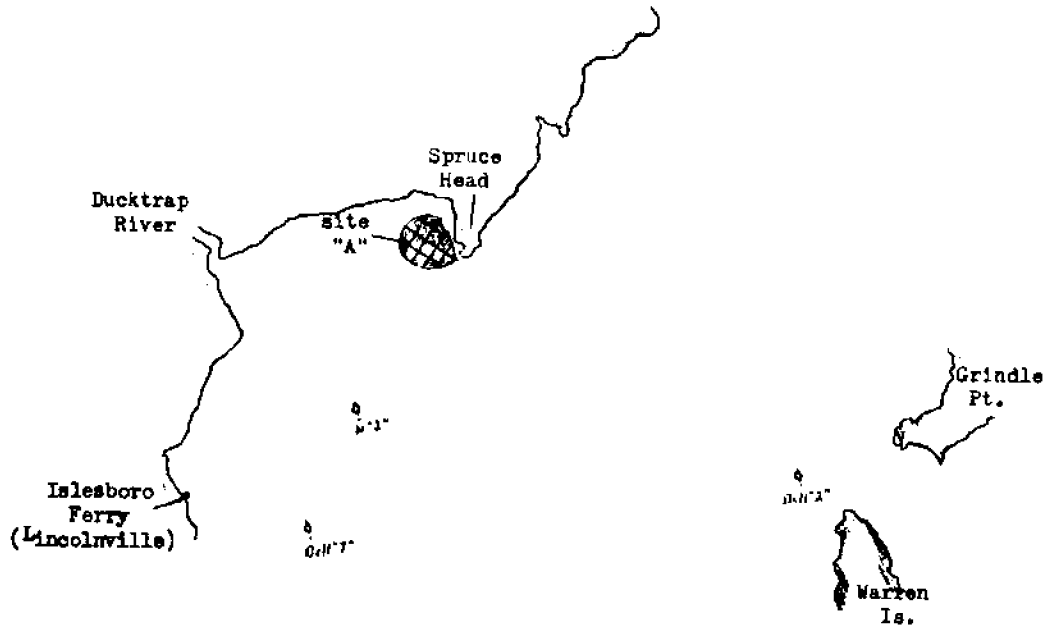
This survey area was one of the first and throughout the period working at this site many modifications of gear were attempted for maximum efficiency of the dredge. Mahogany quahogs were found in areas shown shaded in the above chart. However, the largest number taken during any 10-minute tow was 3/4 bushel.

OGUNQUIT AREA



In the Ogunquit area, as shown by tow lines on the chart, the surveyed area yielded an average of 1.2 bushels per mile. The quahogs were most abundant at depths between 40-65' and were not found in areas less than 25' or more than 90' in depth. They were three times more abundant north of Perkins Cove than south of Bald Head. The size was almost totally (95%) between 3-3¼".

PENOBSCOT BAY (DUCKTRAP) AREA



This was one of the last sites surveyed and proved to be the most rewarding. A full bag - eight bushels - was realized during a 10-minute tow. The final modifications of the dredge were done at this site (shown as Site A on the chart) with many scuba observations. The depth towed for the quahogs was generally 50-60' and 75% of the quahogs were 3-3½" in size. Bottom water temperature was 37 degrees, salinity 21 ppm.

SCUBA OBSERVATIONS

Invaluable information was gained throughout the ocean quahog project by utilizing the use of divers and scuba gear.

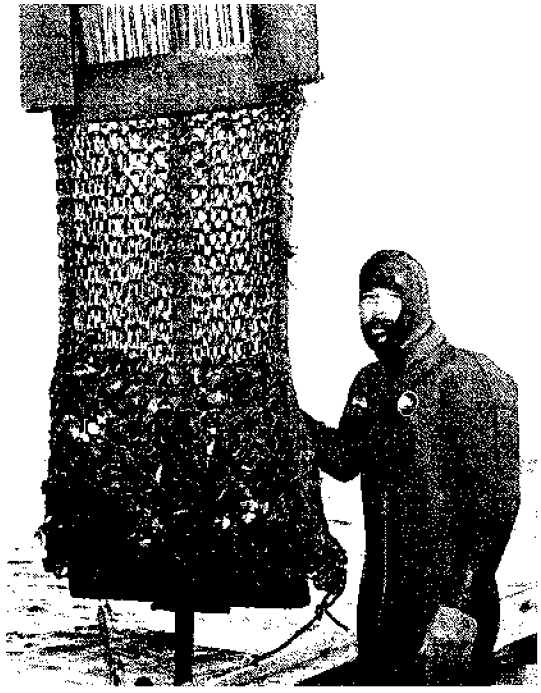
In probable areas of quahog beds, the diver would first explore the area, digging the suspected beds with a small clam hoe. Sometimes only dead shells were found, but in other instances, considerable beds of quahogs were defined. Once an area was determined as live quahog producing, then the hydraulic gear would be lowered. However, the use of scuba observation greatly increased the number of areas covered in the suvey.

Scuba observation was also valuable in viewing the actual operation of the hydraulic dredge on the ocean floor. The diver not only observed this operation personally but underwater photographs were made showing the dredge harvesting the live quahogs.

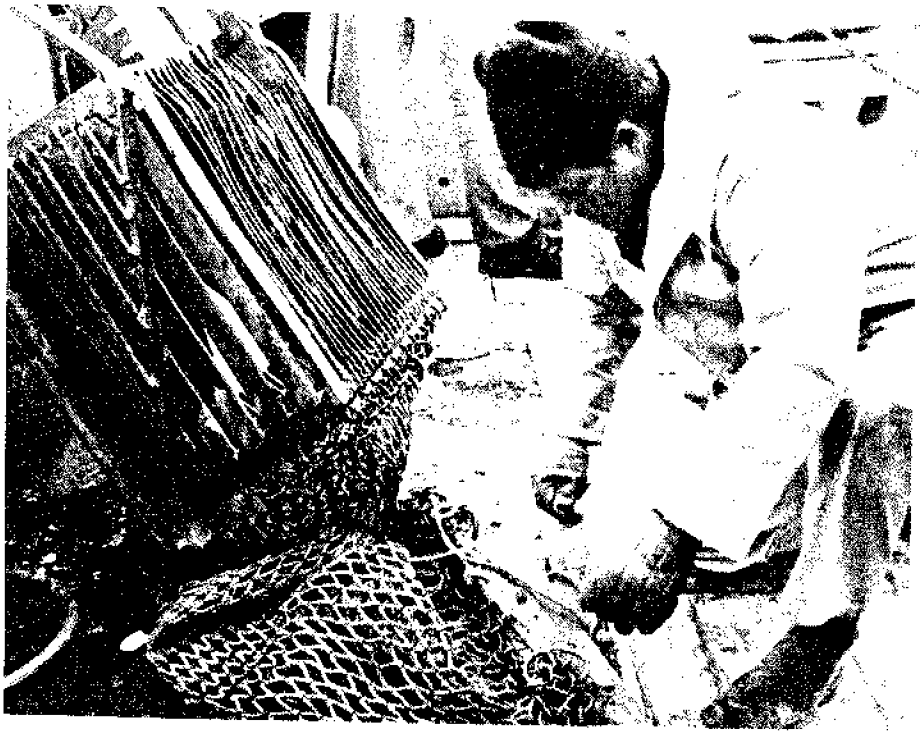
In the modification of the dredge from its questionable initial yield to maximum efficiency at the Ducktrap site, most changes came about as the result of scuba observation. The angle of the manifold nozzles, the second set of nozzles blowing the quahogs into the bag and the speed of the dredge were all determined through the use of the diver.

The habitat of the quahogs was seen by the diver who discovered the clams were in horizontal layers from 1" to 12" deep as observed by examining the walls of the trench made by the dredge.

Above, left, diver extension agent reports observation of hydraulic dredge operation to boat crew member resulting in a correction, right, to the angle of the manifold nozzles. This method of modifying gear saved immeasurable time.



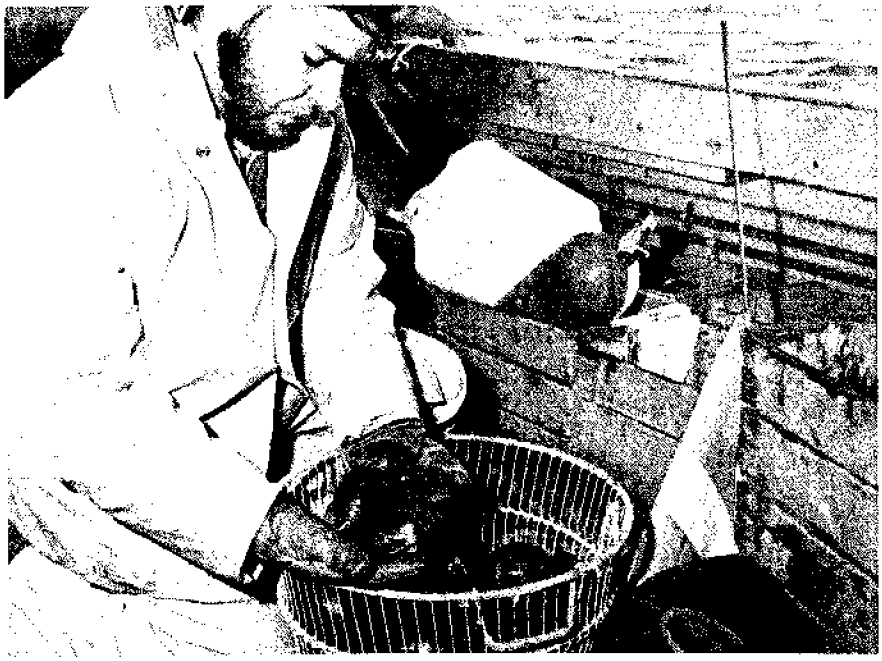
Below, left, scuba diver could spend considerable time underwater in winter temperature using a "dry suit." Below, right, shows one of the first 10-minute tows yielding about two bushel. Subsequent dredge modifications resulted in a full bag - 8 bushel in 10 minutes.



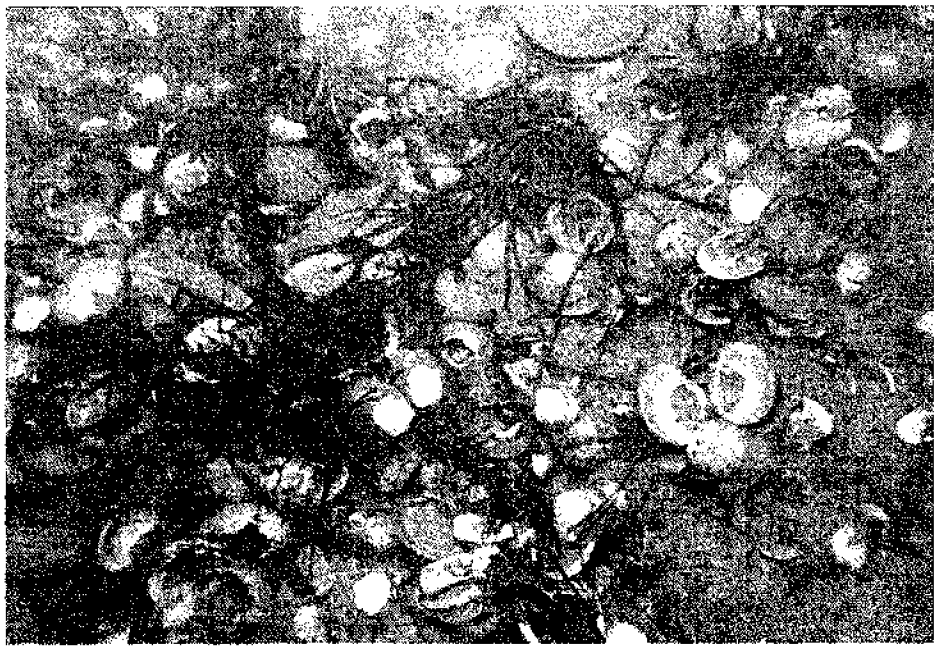
Tying the club of the mahogany dredge. This too was modified using a pin release similar to that of scallop dredges.

Eight bushels of quahogs dredged off Ducktrap in a 10-minute tow.

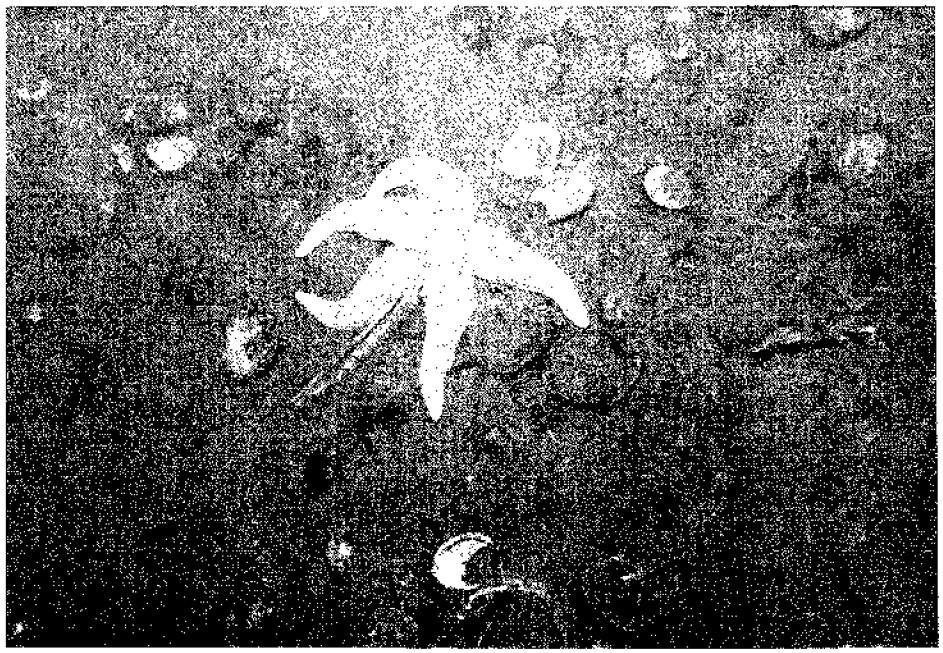
New quahog beds are relatively free of culch. Dead shells, sea urchins, starfish and sand dollars are found in the same quahog bed areas. However, some tows get them in considerable numbers.



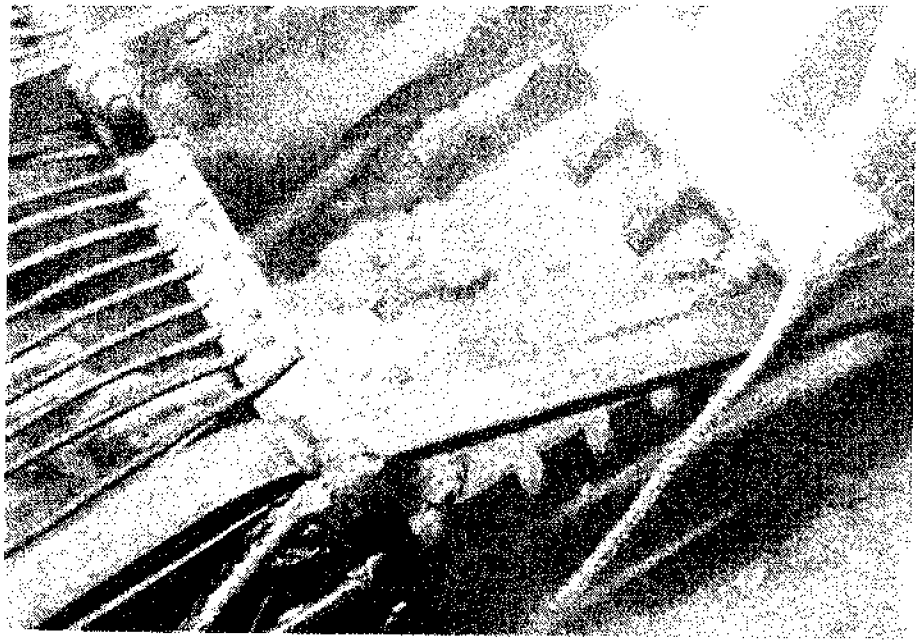
A sample of size distribution from one bed. Generally a tow would produce almost all of the same size although a second tow on the same bed would produce a different size.



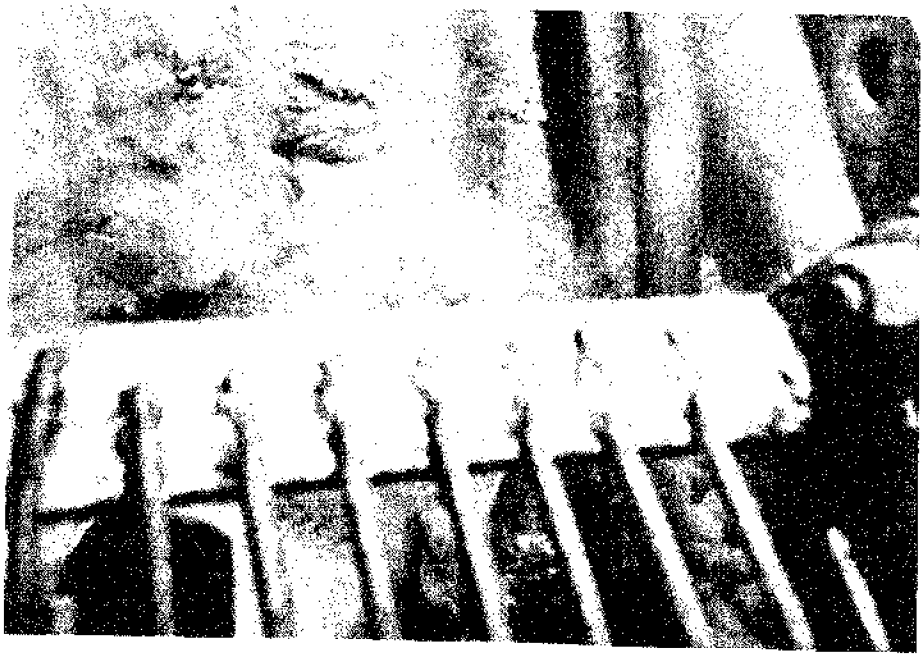
This underwater photo was taken at 60' and shows the top of a virgin quahog bed. Dead shells are usually a good indication that there are live quahogs beneath them.



Another underwater photo showing one of the main predators of ocean quahogs, the starfish.



The hydraulic dredge at work 60' underwater. Note the trench being dug by the force of the water being pumped through the manifold nozzles. The water pressure digs about 8" and the steady advance of the dredge, plus a second nozzle, drives the quahogs into the dredge ring bag.



This underwater close-up shows the quahogs being dug from the bottom. The scuba diver took this photo from directly atop the dredge cage looking down into the trench back of the manifold nozzles.

OCEAN QUAHOG PROCESSING

There are only a couple of Maine seafood firms who have processed the ocean quahog. Obviously, they are reluctant to share processing information. However, a method has been suggested by the National Marine Fisheries Service. The following information was supplied by John A. Peters, Robert J. Learson and Joseph M. Mendelson of the Technology Laboratory at Gloucester, Massachusetts.

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We have used as a base, landings of 200, 85-pound bushels per day by one vessel. The yield of whole raw meats will be 11 to 12 pounds per bushel. Removing the bellies will reduce this to roughly 9 to 10 pounds. One gallon of raw meats will weigh about 8 pounds.

For processing, we consider it essential to use microwave energy to cause the quahogs to gape. Labor costs for shucking would otherwise be prohibitive. We have found that the quahogs can be gaped at a rate of three bushels per hour per kilowatt of applied microwave energy. In our calculations we have used 10 kilowatts per 200 bushels per 8-hour day.

We have also been extremely conservative in our estimates of shucking capacity per man. We know that one inexperienced person can shuck two bushels of gaped quahogs per hour and indications are that this can be doubled, if not even tripled,

with experienced help. Particularly, if an incentive bonus-pay system was instituted.

The process would be somewhat as follows:

The shellstock is taken from the cooler and washed in a conveyorized washer which leads directly to the conveyor for the microwave oven. On emerging from the oven, the gaped quahogs are transferred to a conveyor running down the center of the shucking table (rough handling at this point might cause the quahogs to close again). The quahogs are shucked continuously by about twelve shuckers (six on each side of the table). The empty shells are carried away by another conveyor and the meats are put into one-gallon cans.

The filled cans are then taken to a separate room and emptied into a blowing tank where the meats are washed for about 30 minutes. They are then run through the "belly squeezer" (a pair of rollers similar to washing machine wringers) and then onto a skimming table where they are washed again to free them of viscera remnant.

The cleaned meats may be packed directly from the skimming table into 10-pound size waxed cartons or transferred to a separate packing table. The filled cartons are then frozen and packed in master cartons.

The necessary equipment with approximate size and cost:

Washing Conveyor - 5 ft. x 3 ft.	$ 1,500.00
Microwave Tunnel - 10 KW - 18 ft. x 3 ½ ft.	22,000.00
Shucking Table (12 shuckers) - 18 ft. x 3 ½ ft.	2,500.00
Blowing Tank - 5 ft. x 5 ft.	1,300.00
Air Compressor for Tank - 3 ft. x 2 ft.	400.00
Belly Squeezer - 5 ft. x 5 ft.	500.00
Skimming Table - 5 ft. x 2 ½ ft.	600.00
Packing & Weighing Table - 3 ft. x 3 ft.	200.00
	$29,000.00

These are 1971 prices.

If the shells are to be cleaned and sold, a separate room and special tanks will be needed. We have no idea of costs involved in this process. There will, however, be about 15,000 pounds of shells (80,000 individual shells) to dispose of each day. If they were cleaned, they could be sold for as much as 5 cents each.

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MARKET POTENTIAL

A considerable amount of market investigative work on the ocean quahog has already been done by the National Marine Fisheries Service.

From data compiled by them, it is conservatively estimated that the total crop of ocean quahogs between Cape Hatteras and Canada would be between 100 and 150 million bushels.

The potential of ocean quahogs, canned and frozen for retail and institutional use, should be of considerable interest to the Maine industry in view of the declining stocks of traditional species.

REPORT FROM CREATIVE FOOD SERVICE, INC.

In exploring the marketing potentials for ocean clams (which is the term suggested rather than quahog) and for some other underutilized fish species, one problem is the lack of know-how. The fishermen don't communicate to the trade what is available and processors don't know how to use anything other than a few traditional species. With the increased need for fish materials, and the development of more "snack food" or small meal products, particularly in the frozen area, this is the time to make known the availability of these species and tell processors how to use them.

In the case of the ocean clams with which we worked, we find that the clams are largely unknown in the trade and that the few manufacturers who heard of them had some adverse experience with attempts to use whole clams. Ocean clams should be treated as the sea equivalent of a tougher grade of meat. They are best used ground or diced or cut forms where the meat is, in effect, tenderized by being cut into small pieces (as tough meat is ground for hamburgers).

The ground or cut meat of ocean clams is appropriate for canning or for freezing or for institutional preparation of dishes. Since the flavor is fairly "gutsy" they are best used in dishes with a good degree of seasoning. They are very compatible with tomato.

In canned processing, there is Manhattan Clam Chowder. In addition; Clam Spaghetti Sauce, Clam Spread, Clam Pattie Mix, Clam Creole with Rice and Clam Asopoa for the Spanish market.

The clams would also be appropriate for patties, fritters, sauces, casseroles and chowders for institutional preparation.

Since the large increases in seafood product sales are for frozen products, both for consumer and institutional use, we have prepared five formulations for products which can be readily produced and marketed in frozen form. For this purpose, we suggest that ocean clams be provided in bulk pack, fully cleaned and precut or ground in 1/8", 3/8", and 1/2" cuts, and in strips. If clam juice is developed in this production, it should be filtered and either frozen or bottled for resale. Tougher portions and trims and culls can be sold for pet food manufacture, or dried and powdered for "instant" products.

The availability and prices of the cuts of ocean clams should be announced widely to the trade and further assistance offered for research and development of specific products.

MANHATTAN CLAM CHOWDER

Ingredients and Procedure	Percentages
Salt pork, chopped	1.665
Onion, fresh, finely chopped	3.750
Carrots, fresh, coarsely chopped	5.415
Celery, coarsely chopped	3.750
Parsley, finely chopped	.005
Canned tomato pieces with liquor	32.940
Water	18.750
Clam juice	14.170
Salt	.375
Pepper	.005
Bay leaf	.005
Dehydrated thyme	.005
Pared potatoes, fresh, diced 1/3" x 1/3"	11.665
Ocean clams, chopped (1/4" cut)	7.500
	100.000%

In steam jacketed kettle, saute pork until crisp. Add onion, saute 5 minutes. Add carrots, celery and parsley; cook ten minutes. Add tomato pieces with liquor, water, clam juice, salt, pepper, bay leaf and thyme. Cover; bring to 212°. Add potatoes and clams. Agitate and fill in cans. Seal and process 40 minutes at 240°.

WHITE CLAM SAUCE (FROZEN)

Ingredients and Procedure	Percentages
Olive oil	11.165
Vegetable oil	11.560
Minced garlic cloves or equivalent in dry garlic powder	.920
Chopped parsley	.400
Salt	1.195
Clam juice	30.900
Chopped ocean clams (1/4" cut)	43.860
	100.000%

Heat oils in steam jacketed kettle. Saute garlic 5 minutes. Add remaining ingredients except clams. Simmer uncovered 10 minutes. Add clams. Heat through. Pouch pack, and freeze if desired.

RED CLAM SAUCE (FROZEN)

Ingredients and Procedure	Percentages
Olive oil	3.345
Crushed garlic	.180
Chopped parsley	.010
Oregano	.003
Basil	.001
Salt	.210
Pepper	.106
Canned tomatoes	39.440
Tomato sauce	19.725
Clam juice	17.610
Ocean clams (1/4" cut)	19.370
	100.000%

In steam jacketed kettle, heat oil. Add garlic. saute 3 minutes. Add remaining ingredients except clams. Simmer uncovered, 45 minutes, stirring occasionally. Add clams, heat through. Pack and freeze.

ESCALLOPED CLAMS (FROZEN)

Ingredients and Procedures	Percentages
Melted butter	13.560
Bread crumbs	9.685
Cracker crumbs	9.685
Salt	.360
Pepper	.005
Minced ocean clams (1/8" cut)	53.270
Minced onion	2.665
Chopped parsley	.360
Half & Half	10.410
	100.000%

Combine melted butter, bread crumbs, cracker crumbs, salt and pepper. Reserve 25% of the mixture. Add clams, onion, and parsley to remaining mixture. Mix well. Pour into oiled pans or foil shells and top with reserved crumbs. Pour Half and Half over top. Cover and freeze. To serve, bake in preheated 400° F. oven 20 to 40 minutes. (Time will depend on size of unit).

CLAM PATTIE (FROZEN)

Ingredients and Procedures	Percentages
Butter or margarine	7.010
Chopped onion	4.920
Bread crumbs	24.600
Chopped ocean clams (3/8" cut)	41.820
Whole egg	13.520
Dry mustard	.120
Salt	.370
Paprika	.250
Milk	3.445
Mayonnaise	3.935
	100.000%

Heat deep fat in fryer to 375° F. Melt butter, saute onions about 3 minutes. Add to remaining ingredients. Form into patties. Dip in flour. Fry until golden. Pack and freeze.

CLAM FRITTERS (FROZEN - HIGH QUALITY RESTAURANT USE)

Ingredients and Procedure	Percentages
Flour	24.090
Baking powder	.795
Salt	.705
Egg whites	8.790
Egg yolks	6.235
Milk	25.510
Oil	3.685
Grated lemon peel	.145
Chopped onion	1.700
Chopped ocean clams (1/4" cut)	28.345
	100.000%

Heat deep fat in fryer to 375° F. Sift flour, baking powder and salt. Beat egg whites until stiff. Beat egg yolks, milk and oil. Add flour mixture; beat until smooth. Fold in egg whites, lemon peel, chopped onions and clams. Let stand 10 minutes. Drop about 1 oz. per fritter into deep fat. Fry until golden, about 3 minutes. Serve warm, or pack and freeze.

CLAM FRITTERS (FROZEN - INSTITUTIONAL)

Ingredients and Procedures	Percentages
Buttermilk pancake mix	31.710
Milk	33.610
Beaten whole egg	10.570
Salt	.210
Pepper	.005
Chopped onion	1.480
Grated lemon rind	.005
Chopped ocean clams (1/4" cut)	22.410
	100.000%

Heat deep fat in fryer to 375° F. In Hobart mixer, combine all ingredients except clams. Mix until just smooth (do not overbeat). Stir in clams. Drop about 1 oz. per fritter into deep fat at 375° F. Fry until golden. For freezer product, scale into aluminum trays, wrap, freeze. Oven reheat.

NEW PRODUCTS MADE WITH OCEAN QUAHOGS

Several types of specialty products were prepared in the NMFS Technological Laboratory, Gloucester, that took full advantage of the specific characteristics of ocean quahogs. These products were deep-fat and pan-fried clam patties and puffs, stuffed clams, poultry stuffing, clam sausage and clam roll. The recipes used were very simple and intended as guidelines for commercial uses. In all these products, bland inexpensive ingredients were mixed with the quahogs.

Results of taste tests for flavor and texture show that the deep-fat and pan-fried clam patties and puffs were considered good. The stuffed and deviled clams were also graded as good with comments that the stuffed product was far superior to the commercially prepared stuffed clams that were taste-tested simultaneously. The poultry stuffing and clam sausage were also liked by the panel. The stuffing received a good score while the sausage was scored fairly good with comments that improvements could be made. Comments varied from too little clam flavor to lack of good texture. Although these criticisms are noted, it is obvious that quahogs can be incorporated into a sausage, after further formulation work, to achieve an excellent product.

The quahog roll was so different it had no basis for comparison to any existing product. It was made with quahogs and a slurry of ground bland fish (any species of fish can be used)

and formed into a roll (in a can) and cooked. The steamed product was cooled and then sliced into convenient sized portions. These were battered, breaded and deep-fat fried until golden brown and served hot. The taste panel scores showed that this is an acceptable product, but that it needs more work to improve its flavor and texture.

The ocean quahog is a versatile resource for preparation of clam products and any major expansion of the clam fishery in the Northwestern Atlantic will probably result from increased use of the unexploited quahog resource.

CONCLUSION

The ocean or mahogany quahog has been around for thousands of years. This member of the hard shell clam family has been harvested successfully for fifty years in the waters of New Jersey, New York, Rhode Island and Massachusetts. And yet, at the beginning of 1977, there was not one Maine fisherman engaged in this fishery on a full-time basis.

The preliminary survey work completed by the Maine Department of Marine Resources indicates a large potential for the ocean quahog fishery in Maine. Only a few locations were surveyed but they revealed the presence of considerable numbers of quahogs. Inquiries and discussions within the trade also indicated that a viable commercial market is available once processors are assured of a constant supply. Past market research clearly documents consumer acceptance of the ocean quahog prepared in numerous seafood products.

As a prime example of an underutilized ocean product, and with the technical small vessel gear problems largely solved over the past three years by DMR, it appears that the Maine fisherman has an alternative untapped resource to supplement his declining catches of traditional species of Maine seafood.

ACKNOWLEDGEMENTS

The Extension Division of the Maine Department of Marine Resources wishes to thank the many persons who aided and encouraged our ocean quahog survey over the past three years. Considerable help and suggestions were received from personnel of the National Marine Fisheries Service, notably the NMFS Northeast Utilization Research Center at Gloucester, Massachusetts.

Maine seafood processors were especially cordial in discussing specific problems in evaluating a new product. Maine fishermen worked aboard DMR vessels and extension agents were guests aboard vessels owned by Maine fishermen. The mutual exchange of ideas and observations was most beneficial to the project.