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OCEAN QUAHAUG RESOURCES
OF SOUTHEASTERN NORTHUMBERLAND STRAIT

By Ross A. Chandler

INTRODUCTION

Ocean quahaugs, Arctica islandica (Linné), also called black quahaugs and mahogany quahaugs, are widely distributed in North Atlantic waters and in particular regions are abundant. They range from the Arctic to Long Island and, as they are a cold-water species, they are found only in deep water near the southern boundary of their range (Turner, 1953).

Most fishermen are not familiar with this species because it lives in deep water and only occasionally are shells washed ashore. However, fishermen living in areas around the eastern entrance of the Northumberland Strait have, for some years, been aware of the presence of ocean quahaugs in these waters since they are often captured in scallop drags. A commercial fishery for this species has never been established in Canada, although during World War II an extensive fishery was developed in the United States. With a decline in the availability of bay quahaugs (Mercenaria mercenaria) for market, an interest has been created in the ocean quahaug as a substitute product. The St. Andrews Biological Station of the Fisheries Research Board, with financial assistance from the Industrial Development Service of the Department of Fisheries, undertook fishing trials and explorations in 1958 to determine whether marketable quantities of ocean quahaugs were present in the Northumberland Strait. This was considered worth while because we had carried out some preliminary trial fishing in 1956.

PRELIMINARY TRIALS - 1956

In November 1956 this station chartered the fish dragger, Murray Harbour I, for one day's fishing trials. Two small dredges without hydraulic attachments were used and, although unsatisfactory due to the tough clayey bottom on which the dredging was done, samples of quahaugs from Pictou Island and Cape Bear were taken. Samples of these shellfish were eaten raw and canned and the flavour and texture of the meats compared favourably with those of the common quahaug.

These initial efforts indicated that if a dredge equipped with hydraulic attachments were used to dig the tough soil, there were likely marketable quantities of good quality quahaugs on these beds.

1958 TRIALS

During August 1958, the M.V. Paula Maria was chartered for explorations for ocean quahaugs and fishing demonstrations. She was equipped with a Long Island-type hydraulic dredge (Fig. 1) and a Fall River, Massachusetts, rocker-type, toothed dredge (Fig. 2). Mr. Earl Durkee was engaged as observer in charge of boat operations and to keep fishing records. Mr. Clifford Varin, Fire Island Sea Clam Company, Long Island, N.Y., was present (August 8-9) during preliminary trials and gave valuable technical assistance. His suggestions of a longer boom for easier handling of the gear, and the use of buoys to determine distance and speed of the boat were incorporated into our work. The program was planned and supervised by Dr. J. C. Medcof.

Long Island-type Hydraulic Dredge
Description and Operation

This hydraulic dredge (Fig. 1) was 6' long and weighed about 800 pounds. The cage portion of the dredge was 4' wide, made of 3/8" iron rods 1" apart and was large enough to hold about 10 bushels of shellfish and trash.

Three basic types of interchangeable cutting blades were used with this dredge. All blades measured 20" at the cutting edge.

(1) The horizontal lip blade (Fig. 3) was made of 3" x 2" x 3/8" angle iron, 3/8" flat iron, and 3/8" rods 19" long and 1" apart. Three blades of this type were made to cut 4", 6" and 8" into the bottom.

(2) The sloping lip blade was similar to the horizontal lip blade except the cutting edge followed the slope of the rods. Three blades of this type were also made to cut 4", 6" and 8" into the bottom.

(3) The comb blade (Fig. 4) was made of 16 flat iron teeth 8" long, 1" wide and ¼" thick. The teeth were spaced 1" by pieces of iron pipe. This blade was made to cut 4" into the bottom.

A manifold in front of the cutting blade had 6 flat spray nozzles, each capable of delivering 75 gallons of water per minute at 40 pounds pressure. There were also two ¾"-diameter "blow-backs" each directing a stream of water into the cage to help wash mud and debris away.

Water for the digging jets was supplied through 300 feet of 4-inch-diameter hose from a pump-motor assembly on deck. This unit consisted of a high-speed centrifugal force pump with a capacity of 750 gallons per minute at 40 pounds pressure powered by a 56 horse-power, air-cooled gasoline engine.

The dredge was set at full speed. As towing commenced the speed of the main engine was normally reduced to 3/4 throttle, although it varied due to tides and weather conditions. The pump engine was run at full throttle during the tow.

When hoisting, the pump engine was shut off after the dredge broke clear of the soil. The rope and hose remained in the water while the boat swung away to starboard to avoid fouling the hose and rope in the propeller.

The dredge was hoisted and boarded with a winch and wire rope but towed with a 5-inch-circumference manila rope. Experience has shown that the elasticity of manila rope prevents the dredge from being "jumped" out of the bottom soil by surges of the boat.

There were several "hook-ups" on the dredge for the towing rope (Fig. 5). In deep water an upper "hook-up" was used to allow the cutting blade to stay in the ground. The dredge fished satisfactorily to depths of 120 feet. With a longer hose it could probably be used at even greater depths but it would be difficult to accommodate more hose because deck space is limited on most vessels.

Fall River, Massachusetts,
<u>Rocker Dredge Description</u>

The rocker dredge (Fig. 2) lacked hydraulic attachments and could be used at any depth. It was a toothed dredge approximately 25" at the mouth. The teeth dug 5" into the bottom. The bag on the dredge was made of 2" inside diameter steel rings, 21 rings deep with a cod-end device at the free end to permit emptying. Lead weights could be placed in "shoes" on each side of the dredge to help it dig in on firm bottom. This dredge weighed about 200 pounds without the lead weights.

The rocker dredge fished efficiently only on a soft, muddy bottom. Although it was towed with a rope it was continually jumping out of its track on hard, clay bottom. The rocker dredge is sometimes aptly referred to as the "jumper" dredge in the United States.

<u>Hydraulic Dredge Performance Tests</u>

Trial hauls were conducted in various places off Cape Bear to acquaint the crew with the gear and to locate a suitable area for experimental fishing. Good catches were made in about 96 feet of water 1½ miles SE of Cape Bear Buoy and the crew practised with different gear and different water pressures (Table 1).

Thereafter a systematic series of 10-minute hauls was made in the area mentioned above (it was marked with buoys) using different pump pressures and volumes of flows and with various blades (mostly 4" horizontal lip blade) (Table 2).

It was apparent from these trials that a blade set to dig 4" into the bottom was as efficient as blades set to dig 6" and 8". The comb blade was responsible for more shell breakage than the horizontal and sloping lip blades.

With the blade set to dig 4", the catches rose as the water pressure and volume were increased to the limit of the pump assembly. From this relationship it appeared that the catches could have been doubled by using a force pump with a capacity of 1,500 gallons per minute at 100 pounds pressure. This is the sort of pump used by United States fishermen when harvesting these deep-water species (MacPhail, 1957).

Explorations

Originally it was proposed that the southern parts of Northumberland Strait should be explored. But the vessel charter was for only one month's duration and a good portion of this time was consumed in learning how to use the gear, in demonstrations to interested persons and in simulated commercial-fishing operations. Much enthusiasm was shown by fishermen and sea food processors, notably Mr. Bert Polley, Trenton, N.S. (a fisherman who had chartered his vessel for scallop explorations by our group and a strong advocate of the ocean quahaug exploration project), Mr. Horace Hewitt of James M. Hewitt & Sons, Sea Food Packers, Lower Montague, P.E.I., and Mr. Grant Graham, Gaspereaux, P.E.I. (a fisherman and sea food producer). The latter two were especially enthusiastic and continued to explore and fish for ocean quahaugs with our hydraulic dredge over the next few years. The "Charlottetown Guardian" and later the "Halifax Chronicle-Herald" covered the story of the explorations.

After completing the performance tests, demonstrations, and simulated commercial-fishing operations, there was little time left for extensive exploratory work. However, systematic explorations were conducted in areas where ocean quahaugs were suspected to be found from study of chart descriptions of bottom characteristics and from fishermen's reports (Fig. 6, Table 3).

Tows made in the Cape Bear and Livingstone Cove areas yielded good quantities of ocean quahaugs. The rocker dredge was used on the soft mud bottom at Livingstone Cove and catches of up to one bushel per 10-minute tow were recorded. Small catches were made southeast of Pictou Island with the hydraulic dredge but few quahaugs were found off Cape George (MacPhail and Medcof, 1959).

This survey does not indicate the extent of the ocean quahaug resources of the southern parts of Northumberland Strait but it does show that there are areas of abundance sufficient to justify commercial fishing if market conditions warrant exploitation.

Simulated Commercial Fishing

The bed found off Cape Bear is large enough and the abundance of quahaugs seemed great enough to make commercial exploitation possible. One day of simulated commercial fishing was therefore undertaken on this bed on August 26 (Table 4). Twenty-five tows were made with the hydraulic dredge in 10 hours which resulted in 75 bushels being landed. This compares favourably to United States commercial landings of 25 to 60 bushels per 8- to 9-hour day (MacPhail, 1957). The average catch per 10-minute tow was 3 bushels.

During a day of commercial fishing in August 1959, Mr. Grant Graham got even better catches. He landed 161 bushels in the Cape Bear area. And in 27 fishing days he landed 2,205 bushels (G. Graham, personal communication).

EFFORT TO IMPROVE QUALITY OF OCEAN QUAHAUGS

Canned or cooked ocean quahaugs are characterized by a strong "iodine" flavour. At times a muddy flavour is also detected; this is due to mud entrapped between the shells as a result of the action of the dredge.

This muddy flavour can easily be overcome by washing and hand shucking (Turner, 1949); however, the elimination of the "iodine" flavour presents a greater problem. An attempt was made to correct this objectionable flavour by relaying the animal from deep water to an inshore area.

Mr. Grant Graham made a successful relay in September 1960 of 14 bushels of quahaugs. They were relaid 2 days after being fished. The relays were made in a lagoon which is sheltered from Northumberland Strait by Panmure Island on the east and a point of land jutting out into St. Mary Bay on the west.

Two months after relaying, samples were canned. Their flavour was compared with that of samples which were canned immediately after fishing without preliminary shoal-water relaying.

An appraisal of ocean quahaug packs according to standards generally used in rating shellfish packs of all kinds was undertaken by the Fish Inspection Laboratory at St. Andrews in April 1961. Four experimental lots were identified as follows:

Lot #1: Ocean quahaugs steamed immediately after fishing on July 1, 1960, and canned in their own bouillon.

Lot #2: Same as Lot #1, except that they were canned in prepared brine.

Lot #3: Ocean quahaugs steamed immediately after fishing on July 1, 1960, frozen and held in storage until March 29, 1961, then thawed and canned in prepared brine.

Lot #4: Ocean quahaugs fished in September 1960, then relaid at Panmure Island, refished November 26, 1960, and brought alive to St. Andrews where they were steamed and canned in their natural bouillon.

The results of the test were discouraging (Table 5). The Inspection Laboratory stated, "On account of the strong, objectionable odours and flavours in all cans and the very dark colour in a number of the cans we feel that this raw material canned in this way does not produce a satisfactory product. All cans would be assessed as unmerchantable."

It was noted, however, that holding these animals on an intertidal beach improved the appearance, flavour, odour, and colour of the pack.

MISCELLANEOUS STUDIES

Size Frequency Samples

Sampling shows that the majority of ocean quahaugs caught in both the hydraulic dredge and the rocker dredge were 50 to 70 mm in height (Figs. 7, 8, and 9; Tables 6, 7, and 8). The height is the diameter measured from the umbone to the ventral margin of the shell.

Direct tests with various-sized animals showed that quahaugs 49 mm in height went through some bar spaces and not others in the hydraulic dredge. These bars were spaced 1" apart. From this we assume that the 50% selector point was roughly 49-50 mm. No effort was made to estimate the 50% selection size for the rocker-type dredge.

Growth Rate

The ocean quahaug is known to be a slow grower (Turner, 1949). Annulus lengths were measured from a Cape Bear area sample to study growth rates (Fig. 10, Table 9). Annulus length was defined as the maximum distance from the posterior extremity to the anterior extremity of the annulus. In Fig.10 the average length of each annulus was plotted and the growth curve drawn by inspection.

Length-Height Ratio

This ratio was plotted from measurements of a mixed sample of half-shells from various sources (Fig. 11, Table 10). The line was drawn by inspection. Fig. 11 shows that the ratio, length-growth:height-growth, decreases with age.

Height-Thickness Ratio

A sample of ocean quahaugs fished from the L'Etang River in January 1958 was used to study this ratio (Fig. 12, Table 11). The line was drawn by inspection. Fig. 12 shows that the ratio, thickness-growth:height-growth, increases with age.

PROSPECTS

There appears to be a vast resource of ocean quahaugs in North Atlantic waters. Although the ocean quahaug is a slow-growing mollusc, the resource base is great enough to offset this disadvantage. At present it seems that it would never be worth culturing this species, so industry would have to depend upon wild stocks.

Until this species can be made suitable for market, further exploration will not be necessary. However, great resources could undoubtedly be made available to commercial fishing through exploration once a substantial market is opened up.

Before markets will be made available the source of the objectionable "iodine" flavour must be discovered and remedied. The Fisheries Research Board's Laboratory, Halifax, N.S., has recently discovered the cause of the so-called "blackberry" problem which refers to an offensive odour in fish fillets, and has suggested possible corrections for it. Conceivably this research group could explain and possibly find a cure for the "iodine" flavour of ocean quahaugs.

A comparative test could also be set up in the test kitchens at the Halifax Laboratory to determine the relative objectionable flavour in small and large quahaugs in the raw and canned state. It may be that canned small quahaugs would make a more agreeable pack than large quahaugs.

As an alternative to the canned product to Canadian consumers, raw quahaugs should be tested for the half-shell trade. So far as we can judge there is a less objectionable flavour in raw quahaugs than in the canned quahaugs. American consumers are very fond of small raw bay quahaugs and often eat "cherrystones" and "little-necks" on the half shell. The ocean quahaug could possibly compete with the bay quahaug in this market.

Consumption of raw ocean quahaugs would necessitate keeping the animals alive or the meats fresh long enough to market them. Keeping the animals alive may be difficult in summer months as their thermal death point is low, probably about 55-60°F (Turner, 1953). Commercial operators in the United States who bedded ocean quahaugs inshore to hold for market have reported high mortality rates when the temperature was 70°F or more. However, once the temperature dropped below 50°F, large numbers survived in good condition for several months (Turner, 1949). Facilities for artificial storage until consumption would have to be available to protect the stocks from heavy mortalities. And so far no attempts have been made to use raw shucked meats.

SUMMARY

The 1958 explorations of southeastern Northumberland Strait have indicated that there are commercial resources of ocean quahaugs but have not shown their extent. In one area in 1959 commercial catches of up to 160 bushels per day were recorded. If markets were available, a rewarding fishery could be established. Technological work should be initiated to discover the cause of and the remedy for the offensive "iodine" flavour which is the decisive factor in the marketability of this species.

ACKNOWLEDGMENTS

The 1958 ocean quahaug explorations were undertaken by the Fisheries Research Board under the direction of Dr. J. C. Medcof with financial assistance from the Industrial Development Service. Many thanks go to Mr. Clifford Varin for his technical advice during the initial trials, to Mr. Earl Durkee who supervised and recorded the work, and to Mr. Stuart MacPhail for his advice and assistance throughout the preparation of this report. Most of the work of table compilation was done by him.

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Table 1. Preliminary trials with Long Island-type hydraulic dredge off Cape Bear, August 4 to 8, 1958.

Date 1958	Length haul min.	Pump pressure psi	Main engine rpm	Gear	Catch bu.	Trash bu.	Broken	Depth ft	Distance towed ft	Remarks
Aug. 4	4	50	500	4" comb blade	½			90		1½ miles southeast Bear Reef Buoy - light winds - pump hose pulled apart - sandy soil
"	10	30	300	"	1½			102		Towing with tide - calm
"	10	30	300	"	¼	large quantity		102		Towing against tide
"	10	30	300	"	1¼			96		Towing with tide
"	10	30	300	"	1½			96		Towing across tide
"	10	40	300	"	1½			96		Towing with tide
"	10	40	300	"	½			102		Slack water
"	5	40	300	"	1½			96		NE wind and rain
Aug. 5	10	35	300	4" sloping lip	3¼			102		Towing with tide and east wind 10 mph
"	10	35	300	"	3			102		Towing with tide
"	5	40	300	"	2			102		Towing against tide
"	10	40	300	"	2½			102		Towing with tide
Aug. 6	10	50	300	4" sloping lip	-			78		ESE from Pictou Island light - soft mud
"	10	40	300	"	-			84		" " " "
"	10	30	300	"	-			87		" " " "
"	10	30	300	"	-			72		" " " "
"	10	30	300	"	-			60		" " " "
"	10	40	300	8" horizon. lip	-			72		" " " "
Aug. 7	10	40	300	6" horizon. lip	-			81		Soft mud
"	10	50	300	"	-			72		
"	10	45	300	"	-			72		NxE off east end Merigomish Island - soft mud
"	10	40	300	"	-			78		" " " "
Aug. 8	10	40	300	6" horizon. blade	1	1½		102		1½ miles SE Bear Reef Buoy
"	3	40	400	4" sloping blade	1	1		102		Towing against tide
"	10	40	400	"	1½	2		102		Towing with tide
"	10	40	400	"	½	3		102		Towing against tide
"	10	40	400	"	¾			90		
Aug. 8	10	40	400	"	8 clams	½ full mud		60		SE Pictou Island light
"	10	50	400	"	-			72		" " "

Table 2. Systematic trials off Cape Bear with Long Island-type hydraulic dredge to determine best pump and engine speed and best blade depth, August 11 to 14, 1958.

Date 1958	Length haul min.	Pump pressure psi	Main engine rpm	Gear	Catch bu.	Trash bu.	Broken	Depth ft	Distance towed ft	Remarks
Aug. 11	10	30	400	Hydraulic L.I.	1¼	6½	30	102	700	Towing with wind and tide
"	10	30	400	4" horizontal lip	1½	1	25	102	750	Towing with wind, very little tide
"	10	30	400	"	1½	1¾	35	102	700	Towing with wind and tide
"	10	30	400	"	1½		35	102	800	Towing with wind and tide
				Means	1.44	2.3	31		737	
Aug. 11	10	40	400	Hydraulic L.I.	1¾	1¼	-	102	900	Towing against wind with tide
"	10	40	400	4" horizontal lip	2	1	-	102	800	Towing with wind against tide
"	10	40	400	"	2½	½	-	102	800	Towing against wind with tide
"	10	40	400	"	1¾	2½	-	102	850	Towing with wind against tide
				Means	2.0	1.31			838	
Aug. 11	10	50	450	4" horizontal lip	1¼	½	40	102	700	Towing against tide with wind
" 12	10	50	400	Hydraulic L.I.	½	-	49	102	1,050	Towing with tide against wind
"	10	50	400	4" horizontal lip	½	-	47	102	1,050	Towing with tide against wind
"	10	50	400	"	1¼	1	40	102	700	Towing against tide with wind
				Means	.875	.375	41		875	
Aug. 12	10	30	300	Hydraulic L.I.	1	1	few	102	600	Towing with tide against wind
"	10	30	300	4" horizontal lip	¾	4	-	102	600	Bottom contains much old shell - with tide and wind
"	10	30	300	"	1	1	-	102	550	Against tide - light breeze
"	10	30	300	"	¾	1	-	102	600	Against tide - light breeze
				Means	.875	1.75			587	
Aug. 12	10	40	300	Hydraulic L.I.	¾	-	55	102	400	Towing against strong tide and wind 15-18 mph
"	10	40	300	4" horizontal lip	1	2	57	102	675	Towing with wind and tide - wind 15-18 mph
"	10	40	300	"	¼	-	-	102	300	Towing against tide and wind 18 mph
"	10	40	300	"	1½	1	44	102	650	Towing with tide and wind 18 mph
				Means	.875	.75	39		506	

Table 2 (cont'd.)

Date 1958	Length haul min.	Pump pressure psi	Main engine rpm	Gear	Catch bu.	Trash bu.	Broken	Depth ft	Distance towed ft	Remarks
Aug. 12	10	50	300	Hydraulic L.I.	¼	-	-	102	250	Towing against tide and wind 18 mph
"	10	50	300	4" horizontal lip	1	3	25	102	700	Towing with tide and wind 18 mph
"	10	50	300	"	¼	-	-	102	200	Towing against tide and wind 18 mph
"	10	50	300	"	1½	1	61	102	600	Towing against tide and wind
				Means	.75	1	21	102	438	
Aug. 12	10	30	350	Hydraulic L.I.	1	1	-	102	600	Towing with wind and tide
"	10	30	350	4" horizontal lip	½	2	12	102	150	Towing against wind and tide - hose fouled
" 13	10	30	350	"	1	1¾	28	102	600	Towing against wind and tide
"	10	30	350	"	1	5	-	102	750	Towing with wind and tide
				Means	.875	2.4	10		525	
Aug. 13	10	40	350	Hydraulic L.I.	½	1	-	102	650	Towing against tide
"	10	40	350	4" horizontal lip	1¾	1½	42	102	650	Towing with tide
"	10	40	350	"	1¼	1	18	102	650	Towing with tide, light wind
				Means	1.17	1.17	20		650	
"	10	50	350	Hydraulic L.I.	1¼	1	75	102	650	Towing with tide - some breakage attributed to dumping on deck
	10	50	350	4" horizontal lip	1¾	1	30	102	600	Towing against tide
"	10	50	350	"	1	1	26	102	600	Towing against tide
"	10	50	350	"	1¾	1½	-	102	650	Towing with tide
				Means	1.44	1.12	33	102	625	
Aug. 13	10	50	350	Hydraulic L.I.	2½	1	58	102	600	Towing against tide and 10 mph wind
"	10	50	350	4" sloping lip	1½	1	40	102	650	Towing with tide and wind
"	10	50	350	"	1½	1	44	102	650	Towing against tide and wind
"	10	50	350	"	1½	1	-	102	-	Towing against tide and 20 mph wind
				Means	1.75	1	47		633	

Table 2 (cont'd.)

Date 1958	Length haul min.	Pump pressure psi	Main engine rpm	Gear	Catch bu.	Trash bu.	Broken	Depth ft	Distance towed ft	Remarks
Aug. 14	10	50	350	6" blade	1	1½	-	102	450	Towing against tide
"	10	50	350	"	1	1½	14	102	450	Towing against tide
"	10	50	350	"	¾	1	26	102	600	Towing with tide
"	10	50	350	"	½	1	14	102	650	Towing with tide
				Means	.812	1.25	13.5		538	
Aug. 14	10	50	350	8" blade	¼	1	17	102	200	Towing with tide
"	10	50	350	"	¼	1¾	7	102	125	Towing against tide
"	10	50	350	"	1/8	1/8	-	102	200	Towing with tide
"	10	50	350	"	¼	½	17	102	200	Towing against tide
				Means	.217	.842	10.2		181	(all tows brought up stone)
Aug. 14	10	50	350	4" comb blade	1½	2	57	102	1,000	Towing against tide - calm
"	10	50	350	"	2	1	122	102	1,250	Towing with tide
"	10	50	350	"	2½	1½	83	102	900	Towing against tide
"	10	50	350	"	2	1	-	102	1,250	Towing with tide
				Means	2.0	1.37	87		1,100	

Table 3. General exploratory hauls with hydraulic and rocker dredge for ocean quahaugs in eastern Northumberland Strait, August 15-27, 1958.

Date 1958	Length haul min.	Pump pressure psi	Main engine rpm	Gear	Catch bu.	Trash bu.	Broken	Depth ft	Distance towed ft	Remarks
Aug. 15	10		400	Rocker	1½	-	¾ bu.	102	1,500	Buoyed area off Cape Bear towing with tide
"	10		400	4" teeth, two 80-lb weights	1	-	1/3	102	600	Towing against tide
"	10		400	"	1	-	½	102	750	Towing against tide
"	10		400	"	1	-	1/3	102	1,200	Towing with tide
Aug. 15	10		400	Rocker 5" teeth	1	-	½	102	1,200	Slack tide
"	10		350	Two 80-lb weights	1	-	½	102	900	Slack tide
"	10		400	"	-	mud	-	160	-	4 miles SxE from marker buoy Cape Bear
"	10		400	"	6 clams	mud	6 clams	105	-	5 miles SxE from marker buoy Cape Bear
"	10		450	"	1	1¼	¼	98	-	
Aug. 16	10	50	350	Hydraulic L.I.	1	-	-	102		Buoyed area off Cape Bear - towing across tide
"	5	50	350	4" sloping blade	1¼	3½	15	102		Towing against tide
"	10	40	350	"	½	¾	42	102		Towing against tide
"	10	50	350	"	4½	4½	128	102		Towing with tide
"	10	50	350	"	2	3	-	96		
"	10	45	350	"	3¾	-	58	96		Towing against tide
"	10	50	350	"	4¼	3½	½	96		Towing with tide
"	10	50	350	"	3	2	½	96		Towing with tide
"	10	50	350	"	2½	½	-	96		Towing with tide
Aug. 18	10	40	350	Hydraulic L.I. 4" sloping blade	3	2½	100	96		Buoyed area off Cape Bear - towing against tide
"	10	50	350	"	1¼	1½	½	96		East against tide towards Fisherman's Bank
"	10	40	350	"	2	-	-	100		Towing against tide - dredge filled with rock and trash
"	5	40	350	"	½	2½	-	96		Towing against tide - parted hose
"	4	40	350	"	1¼	3½	58	94		Towing against tide - ¾ mile SExE from marker buoy
"	5	40	350	"	1¾	4	60	96		Towing with tide
"	5	40	350	"	1½	7	-	96		Towing with tide

Table 3 (cont'd.)

Date 1958	Length haul min.	Pump pressure psi	Main engine rpm	Gear	Catch bu.	Trash bu.	Broken	Depth ft	Distance towed ft	Remarks
Aug. 18	10	40	350	Hydraulic L.I. 4" sloping blade	½	1½	60	96		½ mile from shore off white sands
"	10	40	350	"	-	-		72		½ mile or less SExE white sands
"	6	40	350	"	-	-		84		Off white sands
"	10	40	350	"	-	-		84		" " "
Aug. 21	2	40	350	"	-			48		Murray Hbr. buoy - towing west - rocky soil
"	10	40	350	"	-			78		2 miles ENE Murray Hbr. buoy
"	10	40	350	"	-			84		5 miles SExS Panmure Is. light
Aug. 22	10	40	350	"	4 quahaugs			48		SExS West Pt. light Pictou Island - hard sand, no rocks
"	10	30	300	"	-			54		" "
"	10	40	300	"	-			60		SSW lighthouse east end of Pictou Island
"	10	40	300	"	-			48		Towing in easterly direction
"	10	40	350	"	-			66		SSW lighthouse east end Pictou Island
Aug. 22	10		350	Rocker dredge	8 quahaugs			48		West Point light Pictou Island NNW - bottom rough ¼ bu. mussels
"	10		400	5" teeth	-			60		
"	10		400	"	-			48		NWxN from east end Merigomish Island
"	10		400	"	-			48		1½ miles N buoys Merigomish Hbr.
"	10		400	"	-			48		1 mile N buoys Merigomish Hbr.
Aug. 23	10		400	Rocker dredge	2 quahaugs			14		3½ miles NW from Lismore wharf in soft, muddy bottom
"	10		400	"	24 "			15		1/3 mile NW from Livingstone's wharf
"	10		400	"	¾	½	25	15		1/3 mile south Livingstone's wharf

Table 3 (cont'd.)

Date 1958	Length haul min.	Pump pressure psi	Main engine rpm	Gear	Catch bu.	Trash bu.	Broken	Depth ft	Distance towed ft	Remarks
Aug. 23	10	40	350	Hydraulic L.I.	½		7	16		1/3 mile NWxN Livingstone's wharf
"	5	40	300	4" sloping	1			15		¼ mile NxW Livingstone's wharf, very muddy
"	10	50	350	"	24 quahaugs			17		1/3 mile NxW Livingstone's wharf, sandy soil
"	10	50	350	"	½			15		1 mile ENE Livingstone's wharf
"	10		400	Rocker	-			11		¾ mile NxW Cape George lighthouse
"	10		400	"	12 quahaugs			10		1 mile NNE Cape George lighthouse
Aug. 27	4		350	Rocker	-			4		ESE Wood Is. lighthouse - Port Wood NxE
"	10		350	"	-			2		ESE Wood Island lighthouse - NNE Bone Creek
"	-		350	"	-			7		SxE Wood Island lighthouse - hard sand and gravel
Aug. 27	10		350	Rocker	-			5		SSE from Point Prim ENE from Pinette
"	-		350	"	-			10		" " " "

Table 4. Results of one day's simulated commercial fishing 4 3/4 miles SExE from Cape Bear Light, P.E.I.

Date 1958	Length haul min.	Pump pressure psi	Main engine rpm	Gear	Catch bu.	Trash bu.	Broken	Depth ft	Distance towed ft	Remarks
Aug. 26	10	40	350	Hydraulic L.I.	3	2	-	96		Towing against tide - little wind
"	2	40	350	4" sloping blade	-	-	-	96		
"	20	40	350	"	5 1/4	4	-	96		Towing against tide
"	20	40	350	"	4 3/4	4	-	96		Towing with tide
"	20	40	350	"	4 1/2	3	-	96		Towing against tide
"	20	40	350	"	4 1/2	4	-	96		Towing against tide
"	10	40	350	"	2 1/2	1 1/2	-	96		Towing with tide
"	20	40	350	"	4 1/4	3	-	96		Towing against tide
"	20	40	350	"	4 1/4	3	-	96		Towing against tide
"	20	50	350	"	4	2 1/2	-	96		Towing with tide
"	20	40	350	"	1 1/4	1	-	96		Towing against tide
"	20	40	350	"	2 1/2	2	-	96		Towing against tide
"	20	40	350	"	3/4	5	-	102		Towing against tide
"	20	50	350	"	1 1/2	3	-	96		Slack water
"	20	40	350	"	3 1/2	3	-	102		Towing against tide
"	20	50	350	"	5 1/4	2	-	96		Slack water
"	10	40	350	"	2	-	-	102		Towing against tide
"	20	50	350	"	3 3/4	-	-	102		Slack water
"	7	40	350	"	1	-	-	96		Towing with tide - dredge caught on bottom
"	17	50	350	"	2	4	-	96		
"	20	50	350	"	1	2 1/2	-	96		Little tide
"	20	50	350	"	5	3	-	96		Very little tide
"	20	50	350	"	4	-	-	96		Very little tide
"	20	50	350	"	5 1/4	-	-	96		Towing with tide
				Totals	75 3/4	52 1/2				
				Average	3 1/8					

Table 5. Summary of St. Andrews Fish Inspection Laboratory April 12, 1961, appraisals of canned ocean quahaug packs given various treatments in canning and storage.

Factors of assessment	Canned in bouillon immediately after fishing July 1960	Canned in brine immediately after fishing July 1960	Canned in brine after freezing for 8 months March 29, 1961	Canned in bouillon immediately after 2 months relay Dec. 6, 1960
Firmness	P	F - P	P	F
Appearance	2	3	1	4
Odour	Off 1	Off 3	Off 2	Off 3(4)
Flavour	Off 1 (muddy, iodine, very objectionable)	Off 2(3) (muddy, iodine, less pronounced)	Off 2 (muddy, iodine, burnt flavour)	Off 2(4) (muddy, iodine, less pronounced)
Colour	P - O (blue-black)	P (dark)	P (brownish)	F (somewhat natural)

F.I.L. gradings: Good (G), Fair (F), Poor (P), Unsalable (Off).

F.I.L. rating numbers: 1 is most objectionable and 4 least objectionable.

Table 6. Height frequency of ocean quahaug sample fished with the Long Island-type hydraulic dredge at Cape Bear buoy area, August 8, 1958.

Alive		Dead	
Height (mm)	Frequency	Height (mm)	Frequency
21	1	44	1
26	1	50	1
30	1	51	1
38	1	54	1
39	1	55	1
40	1	56	1
41	1	58	1
42	1	60	1
43	3	61	1
44	3	62	1
45	1	64	1
46	1	66	2
47	4	67	1
48	6	68	1
49	5	69	1
50	4	70	1
51	6	71	2
52	6	72	4
53	8	73	2
54	7	74	1
55	9	75	3
56	12	76	1
57	7	79	1
58	7	80	3
59	11	81	2
60	9	82	1
61	16	83	1
62	9	86	1
63	9	87	1
64	6	90	1
65	4	91	1
66	3		
67	9		
68	7		
69	6		
70	3		
71	10		
72	2		
73	5		
74	1		
75	1		
76	4		
77	2		
79	1		
80	2		
82	1		
85	1		

Table 7. Height frequency of ocean quahaug sample fished with Long Island-type hydraulic dredge at Cape Bear buoy area, August 11, 1958.

Alive	
Height (mm)	Frequency
29	1
30	1
33	1
35	4
36	2
37	1
39	3
40	1
41	2
42	3
43	2
45	3
46	1
47	5
48	2
49	2
50	1
51	1
52	4
53	5
54	8
55	8
56	5
57	6
58	1
59	4
60	5
61	9
62	4
63	4
64	10
65	3
67	5
68	5
69	4
70	2
72	1
74	1
77	1
78	2
79	1
80	1
81	1
86	1

Table 8. Height frequency of ocean quahaug sample fished with the Rocker dredge at Livingstone Cove, August 23, 1958.

Alive	
Height (mm)	Frequency
44	1
50	1
51	3
52	3
53	1
54	8
55	14
56	6
57	14
58	12
59	15
60	22
61	16
62	12
63	13
64	11
65	4
66	5
67	4
68	1
69	2
70	3
71	1
72	2
74	1
76	1
79	1
80	1

Table 9. Length of annulus of ocean quahaugs caught August 8, 1958, off Cape Bear, P.E.I.

Annulus no.	Annulus Length (mm) and Specimen No.								
	1	2	3	4	5	6	7	8	Av.
1	5.0	4.5	4.0	4.0	5.0	4.0	5.9	6.0	4.8
2	8.5	6.5	8.0	7.0	7.0	9.0	12.0	9.0	8.4
3	13.0	8.5	13.0	9.5	9.0	11.5	16.0	10.0	11.3
4	16.0	15.0	23.0	11.5	12.0	14.0	20.0	13.0	15.3
5	23.0	16.0	28.0	14.0	14.0	17.0	24.0	15.0	18.9
6	26.5	23.0	31.0	17.5	17.0	21.0	27.0	19.0	22.8
7	29.0	26.0	35.0	20.5	19.0	24.0	31.0	23.0	25.9
8			37.0	25.0	22.0	29.0	33.0	26.0	28.7
9			39.5	27.5		34.0	36.0	32.0	33.8
10				30.5		37.5	39.0	36.0	35.8
11				32.0		40.0	43.0	38.5	38.4
12				34.0		43.0	46.0	41.0	41.0
13				36.0		45.5	49.0	43.5	43.5
14				37.5		49.0	53.0	45.0	46.1
15				39.0			55.0	47.0	47.0
16								49.0	49.0
17								51.5	51.5
18								53.0	53.0
19								54.5	54.5
20								56.0	56.0
21								58.5	58.5

Table 10. Measurements of length and height of ocean quahaug half-shells. The origin of these shells is unknown.

Specimen no.	Length (mm)	Height (mm)
1	29	26
2	31	29
3	36	31
4	37	31
5	37	32
6	39	35
7	39	34
8	42	39
9	43	39
10	44	41
11	49	44
12	49	43
13	50	43
14	53	47
15	61	55
16	63	56
17	73	64
18	79	68
19	81	67
20	82	76
21	84	83
22	85	84
23	91	85

Table 11. Measurements of height and thickness of ocean quahaugs fished from the L'Etang River on January 23, 1958.

Specimen no.	Height (mm)	Thickness (mm)
1	54	33
2	54	30
3	56	33
4	56	32
5	57	32
6	58	34
7	58	34
8	58	33
9	58	34
10	58	34
11	59	33
12	59	35
13	59	36
14	60	34
15	60	35
16	60	34
17	60	35
18	60	35
19	61	35
20	61	34
21	61	36
22	62	34
23	62	34
24	62	36
25	62	33
26	63	33
27	63	36
28	63	36
29	64	38
30	64	39
31	65	37
32	66	38
33	68	40
34	69	42

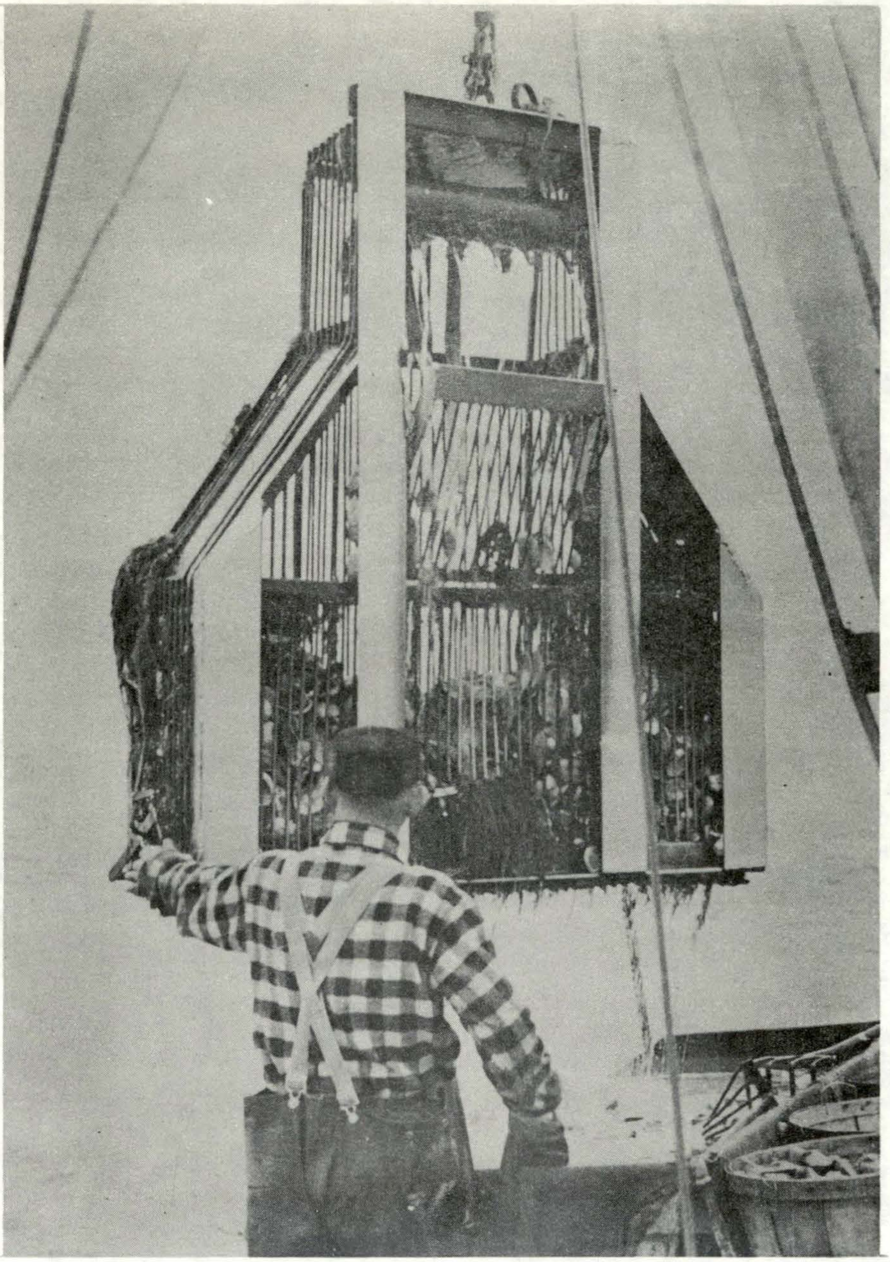


Fig. 1 The Long Island-type hydraulic quahaug dredge

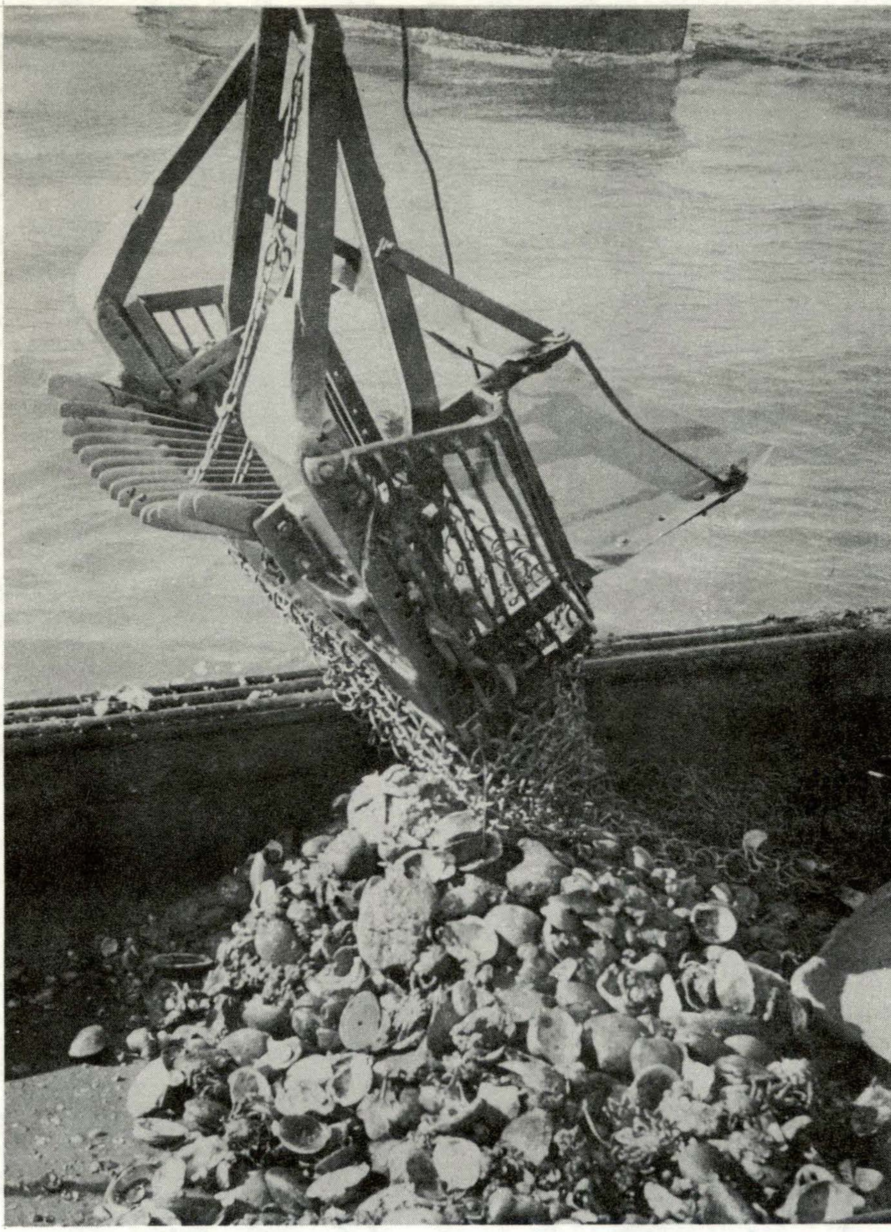


Fig. 2 The Fall River, Massachusetts, Rocker dredge

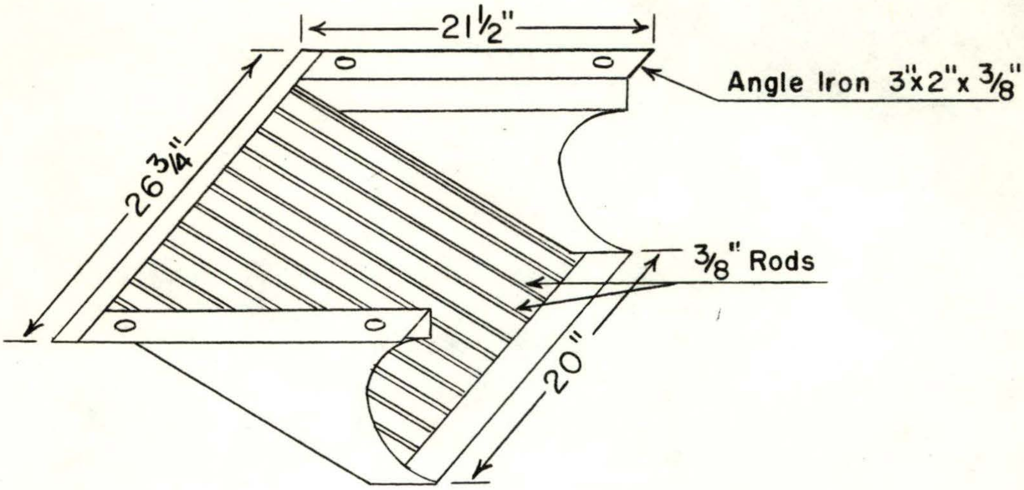


Fig. 3. The horizontal lip blade.

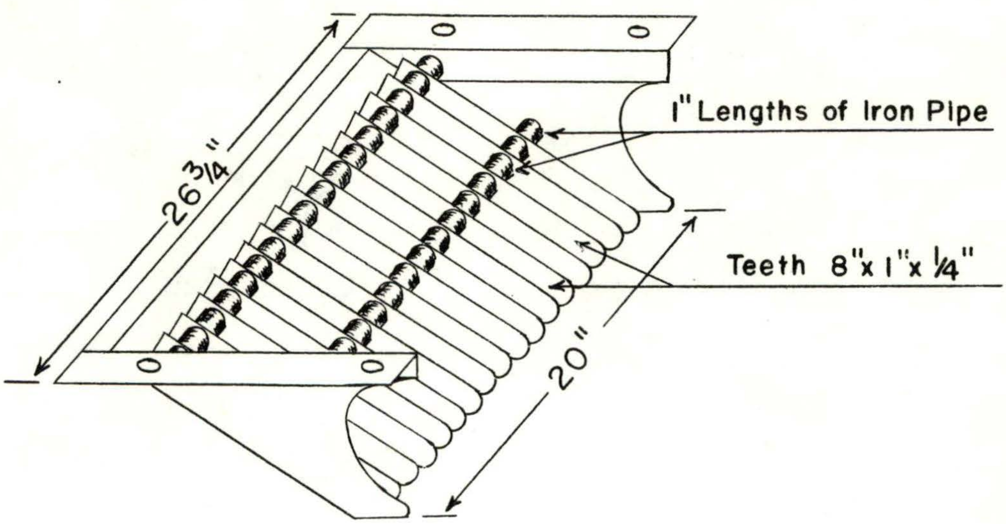


Fig. 4. The 4" comb blade.

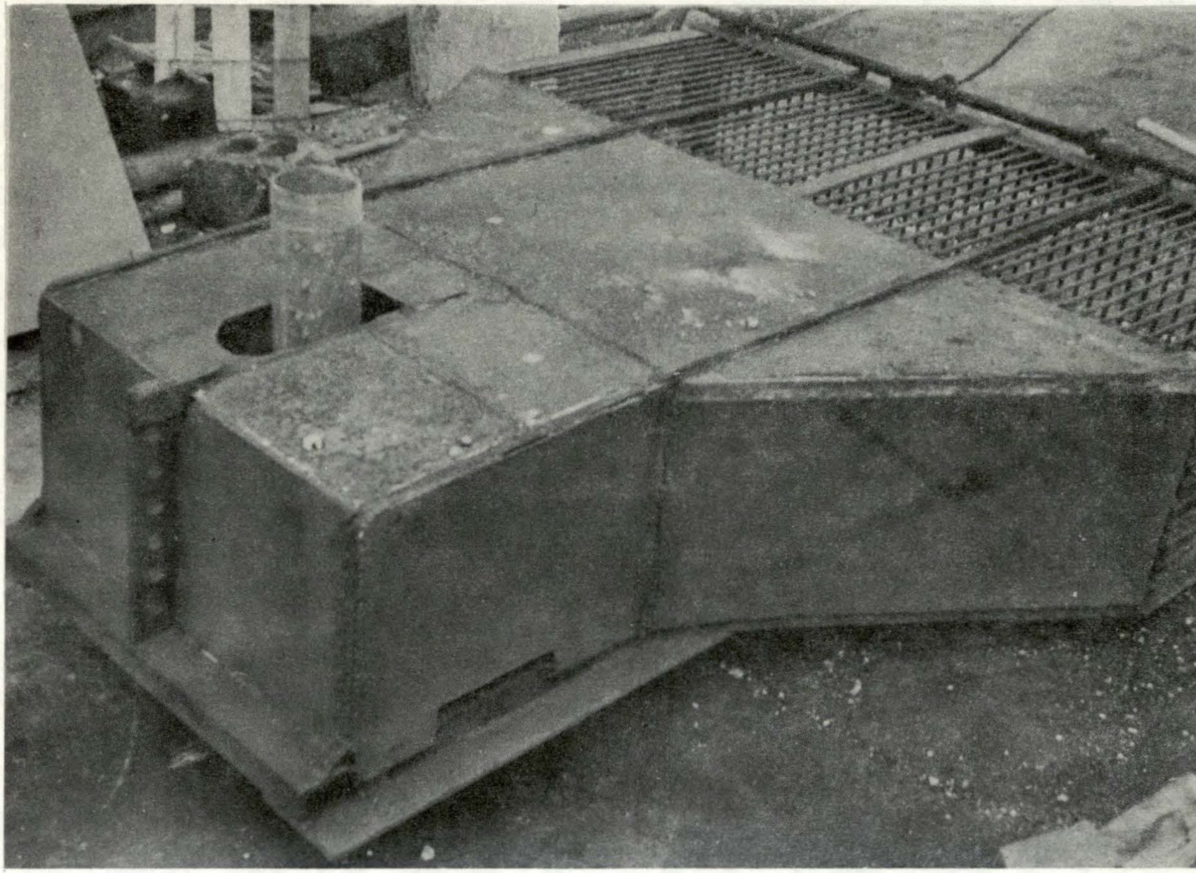


Fig. 5 The Long Island-type hydraulic dredge showing a series of six "hook-ups" for the towing rope

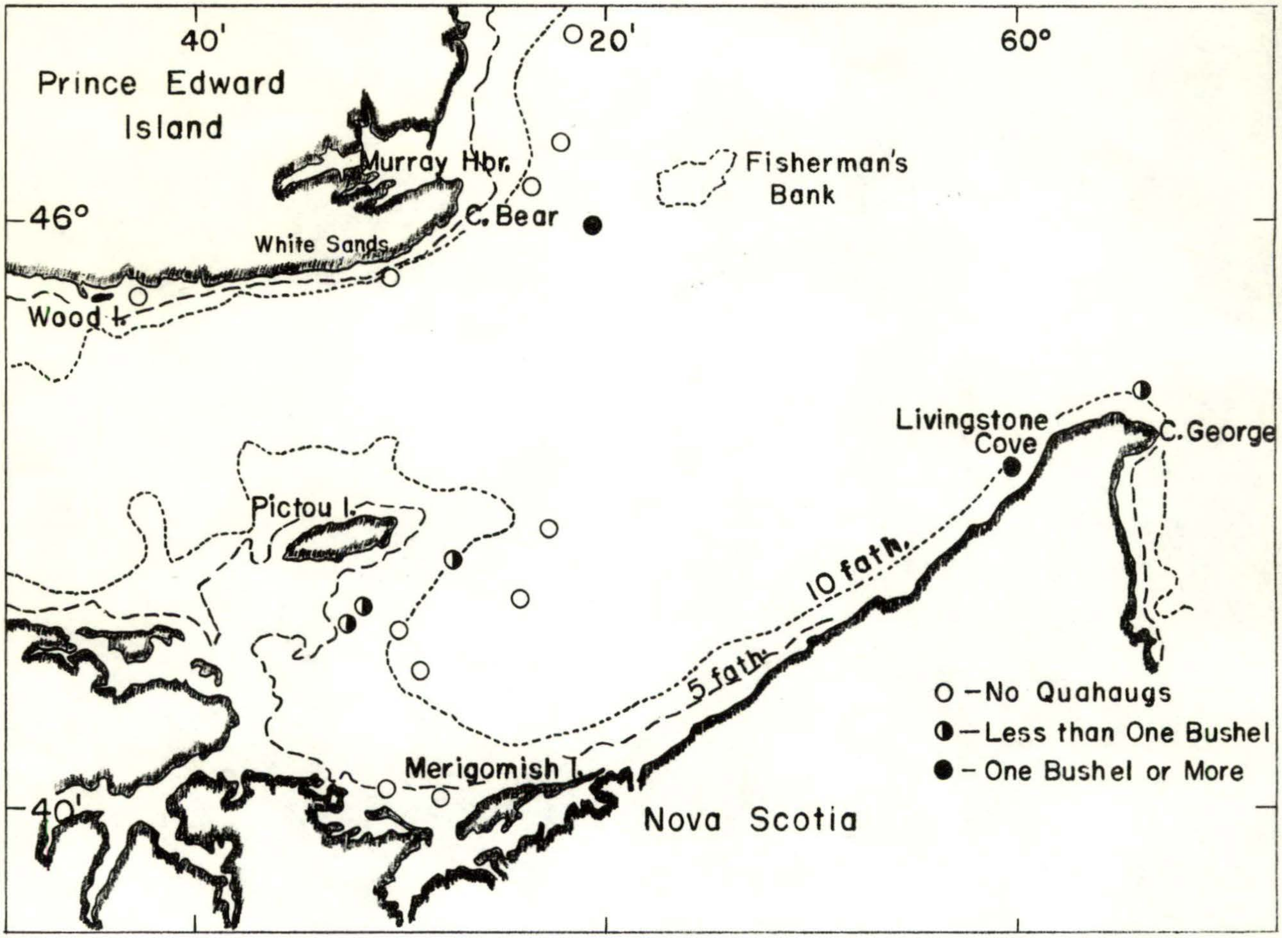


Fig. 6. Areas explored and catches per 10-minute haul of ocean quahaugs made in southern Northumberland Strait in 1958. (Reproduced from June, 1959, issue of "Trade News")

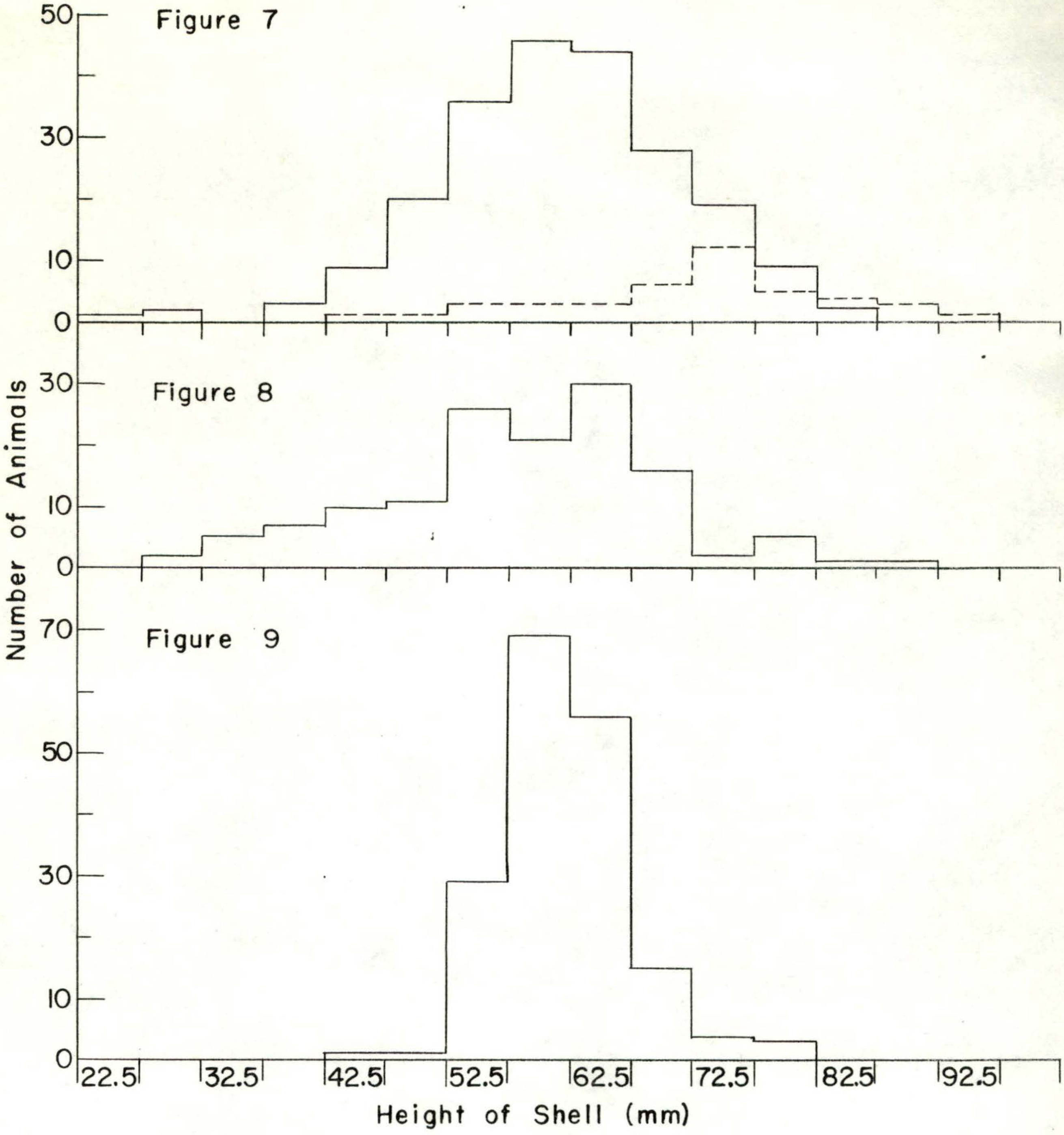


Fig. 7. Height frequency of ocean quahaug sample fished with the Long Island-type hydraulic dredge at Cape Bear buoy area, August 8, 1958. The dotted area indicates the height frequency of dead ocean quahaugs.

Fig. 8. Height frequency of a second ocean quahaug sample fished with the Long Island-type hydraulic dredge at Cape Bear buoy area, August 8, 1958.

Fig. 9. Height frequency of ocean quahaug sample fished with the Rocker dredge at Livingstone Cove, August 23, 1958.

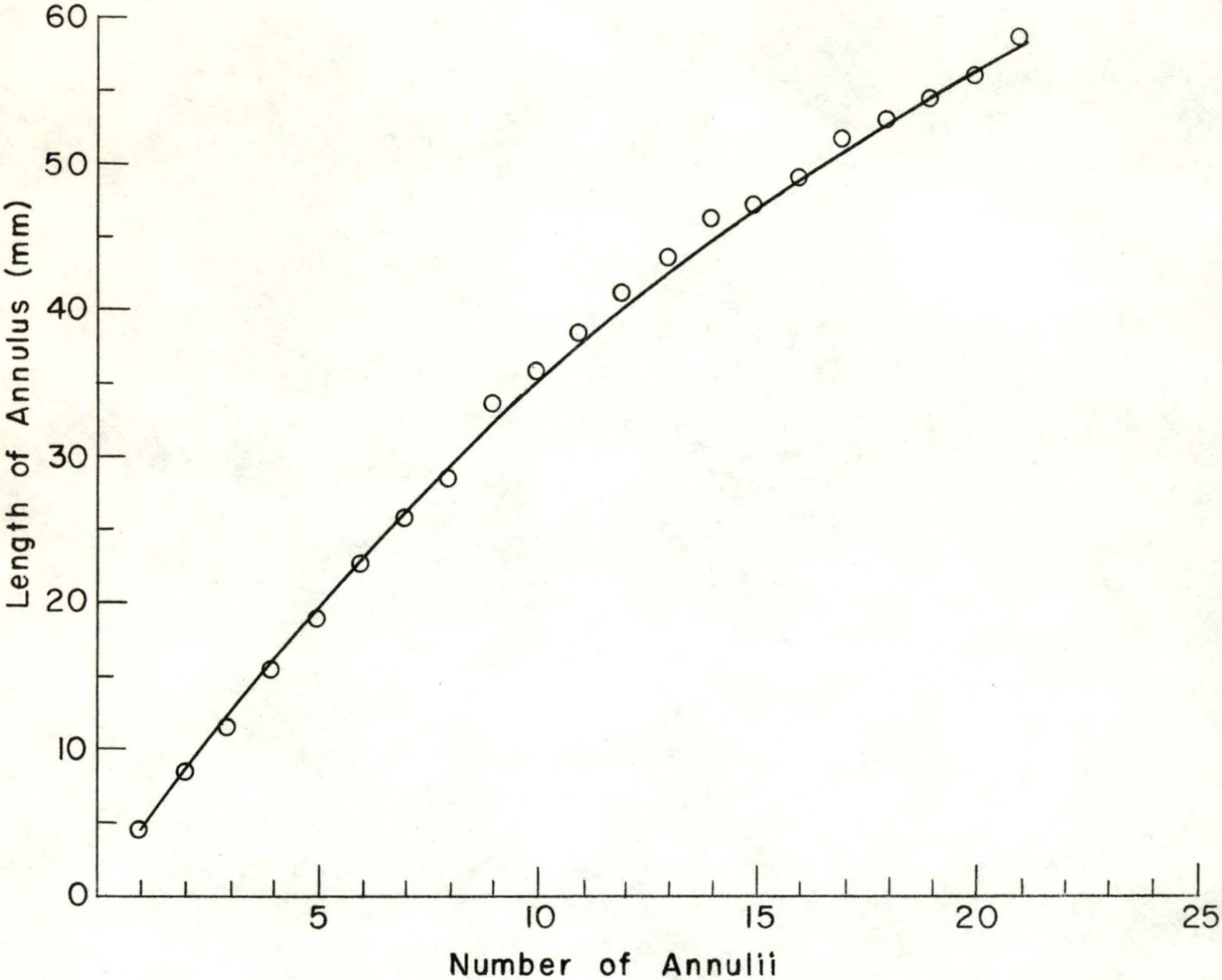
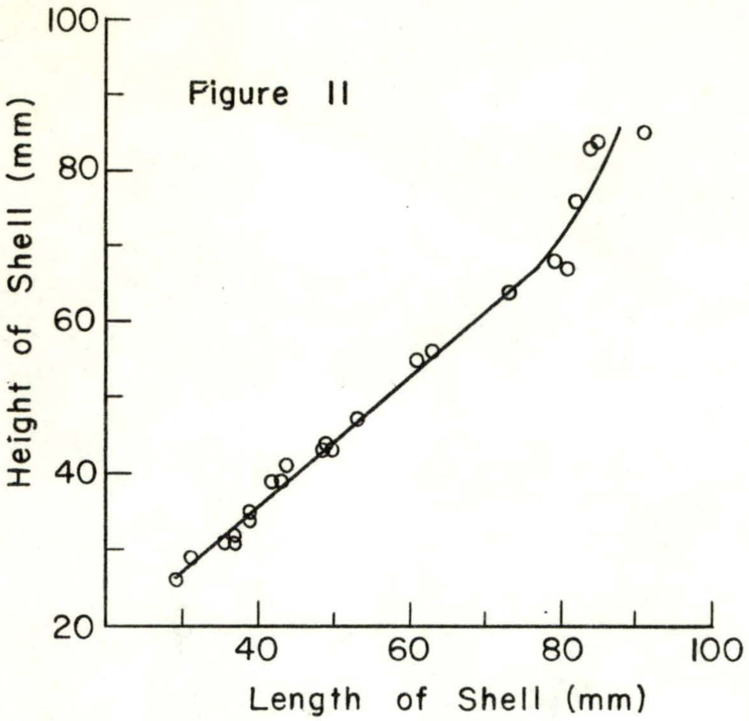


Fig. 10. Growth rate of ocean quahaugs caught
August 8, 1958, off Cape Bear, P.E.I.



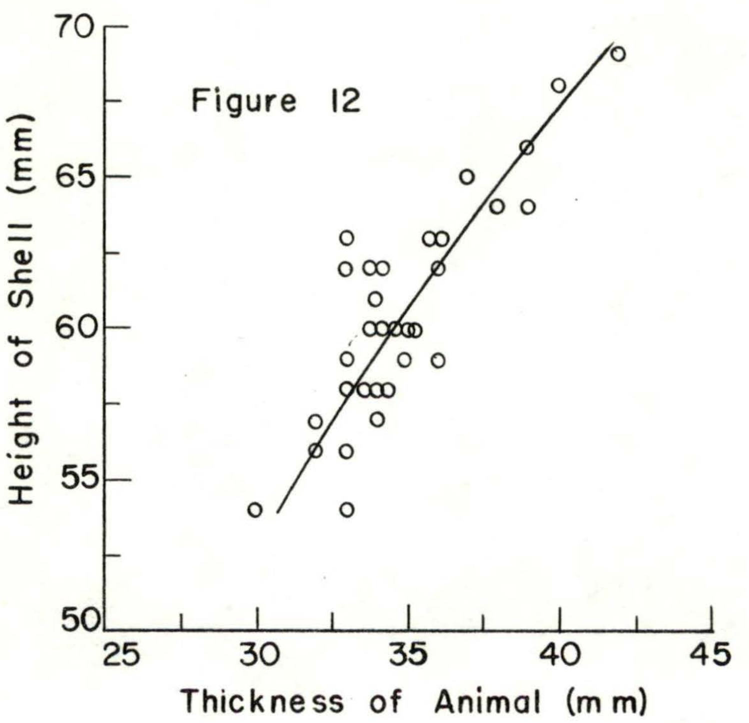


Fig. 11. Length-height ratio of ocean quahaug half-shells. The origin of these shells is unknown.

Fig. 12. Height-thickness ratio of ocean quahaugs fished from the L'Etang River, January 23, 1958.