

# COMMERCIAL FISHERIES REVIEW

September 1949

Washington 25, D. C.

Vol. 11, No. 9

## THE MUSSEL RESOURCES OF THE NORTH ATLANTIC REGION

### PART I--THE SURVEY TO DISCOVER THE LOCATIONS AND AREAS OF THE NORTH ATLANTIC MUSSEL-PRODUCING BEDS

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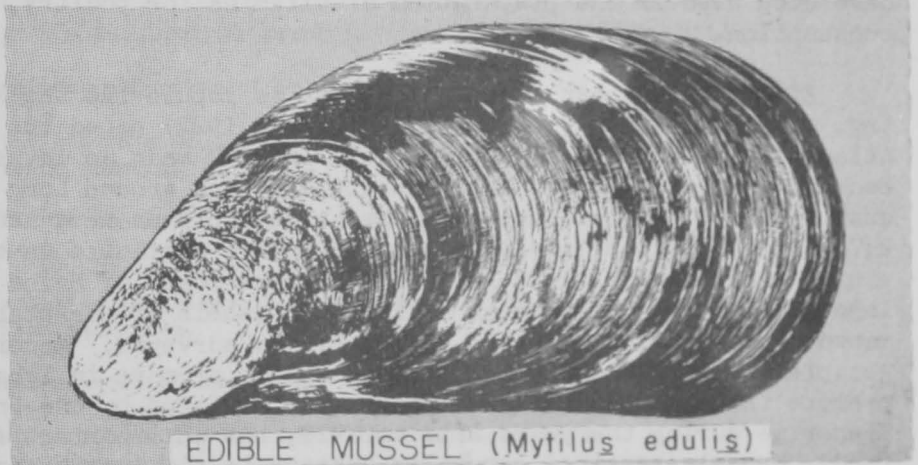
This is the first of three papers discussing the World War II promotion of the North Atlantic mussel fishery. The present article is primarily concerned with the quantitative results of a survey of the productivity of mussel areas.

#### INTRODUCTION

During the recent war, the fishing industry had the problem of increasing its production despite relative shortages of manpower, equipment, and materials. One of the ways of efficiently augmenting the catch of fish and shellfish was to utilize species ordinarily disregarded. One of the probable sources of sea food was the edible mussel

(*Mytilus edulis*), which is so common along the North Atlantic Coast of the United States. This species can be harvested during that time of the year when the small-boat fishery is least active.

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EDIBLE MUSSEL (*Mytilus edulis*)

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The mussel, although relatively unknown to the American public, has attained great popularity in Europe. Large quantities have been consumed in European countries for hundreds of years.

The annual English, Welsh, and Scotch production of this shellfish, as recorded in the statistical reports of the British Ministry of Agriculture and Fisheries, averaged about 19 million pounds ("in the shell" weight) for the 15-year period between 1924 and 1938. In addition, large quantities of the shellfish are imported or landed by foreign boats. For example, 10½ million pounds in 1930 and 12 million pounds in 1932 were brought into Great Britain. Considering the imports and local production, nearly 30 million pounds were used annually in Great

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Britain during these years. Most of the mussels are consumed as food; some are used as bait in the long-line fisheries.

France consumes much greater quantities of mussels, and so important is this shellfish that extensive artificial cultivation has been practiced for several centuries in that country. Lambert (1935) states that generally France consumes about 143.3 million pounds, of which about one-third comes from natural beds, one-third from mussel "farms", and the balance imported from Holland.

The mussel production for 1933 in Holland, which consumes only small quantities of this shellfish, was about 144.5 million pounds, of which 44.1 million pounds were used for duck food, 4.4 million pounds for fertilizer, and 90.4 million pounds were exported to Great Britain, Germany, Belgium, and France, according to Lambert. The latter two countries absorbed about 95 percent of the Dutch exports. During 1917 and 1918, Holland shipped over 2,204,600,000 pounds of mussels to Germany, according to estimates of some Dutch mussel culturists interviewed by Lambert.

In the United States, mussels have been utilized only slightly. The records of the United States Bureau of Fisheries and the Fish and Wildlife Service show that during the 10-year period (1929 to 1940), the annual production of the mussel fishery averaged 200,000 pounds of meats, or to make the figure comparable to those given for Great Britain, less than 1,000,000 pounds ("in the shell" weight). About 75 percent of the Atlantic Coast mussels were landed in New York City. As a result of the recent war, a fishery for the ribbed mussel (Modiolus demissus) has been prosecuted in the middle Atlantic and Chesapeake Bay areas, but these mussels have been used in the preparation of vitamins for poultry, rather than for human consumption.

Efforts have been made in the past to popularize the sea mussel in this country. Field (1910a, 1910b, 1911, 1913, and 1922) noted the potentialities of an Atlantic Coast mussel fishery. Field in 1917 made an investigation of the mussel beds at Plymouth Harbor, Narragansett Bay, and around Long Island, New York. An examination of 19 localities in the three sections revealed that an estimated 2,726,000 bushels of marketable mussels were available in these areas during the winter and spring of 1917-18. In 1918, the coast of Maine was surveyed from Portland to Eastport and a total of 127,000 bushels of marketable mussels were estimated to be available in the 32 localities surveyed. According to Field, a marketable mussel was one which was two inches or more in length. Some attempts to promote the use of mussels as food were initiated by the United States Bureau of Fisheries during the years 1917 to 1919, but an important fishery never materialized. Mussels remained generally unknown to the American public.

When renewed efforts to develop a mussel fishery were under consideration in 1942, it was thought that the consumer's reaction to the product should first be evaluated. Fresh, frozen, and canned mussels, prepared in a variety of ways were served to a considerable number of people by members of the Fish and Wildlife Service. The mussels, with the exception of several frozen lots, were judged to be excellent when served in chowder, fried, or eaten raw as a cocktail. The first general test of the public's reaction to mussels was sponsored by the Massachusetts Division of Marine Fisheries. At the 1942 annual fair in Brockton, Massachusetts, steamed mussels on the half shell were served at the marine fisheries booth. The consumption of over two tons of mussels at the fair indicated that the public found the shellfish acceptable. In addition, representatives of the Massachusetts Division of Marine Fisheries prepared mussel chowders which were served in the commissaries of several Massachusetts defense plants. The enthusiastic acceptance of the mussels was most encouraging. The Division representatives

reported that the few individuals who did not enjoy mussels were those who did not like shellfish in general. It was felt that once consumers were acquainted with the excellent flavor of the mussels a demand for this new product would soon be established.

Mussels are an excellent source of protein, are rich in vitamins (riboflavin and Vitamin A), iron, copper, and iodine, and contain magnesium, phosphorus, and calcium; therefore, they would be a valuable addition to the diet. The possibilities of increased use of mussels in this country were recently stated by Herrington and Scattergood (1942, 1943) and Loosanoff (1942, 1943a, and 1943b).

As the mussel resources had been but slightly utilized along the North Atlantic coast, there was little recent available information concerning the supply of the species. Data from Field's survey of 1917-18 were available, but it was not known whether his estimates of productivity were applicable to the 1942 supplies, or whether the beds which he examined still existed. In order to determine the extent of the supply and the possibility of developing a fishery, it was necessary to make a preliminary survey of the mussel resources and the factors affecting their utilization. No attempt was made to make a complete survey.

Because of the limitations in time, it was not possible to cover the entire North Atlantic region. However, the principal mussel-producing areas between Point Lepreau, New Brunswick, and Rockland, Maine were examined. Parts of the New Hampshire and Massachusetts coastlines also were examined. Available data indicated that these areas included the most productive beds along the coast at that time.

The mussel survey was planned to provide the following information:

1. The locations and sizes of the principal mussel beds.
2. The total contents of the beds in terms of quantity and size of mussels.
3. The yield in pounds of meat per bushel for each area and season.
4. The quantities and sizes of pearls found in mussels taken from each area.
5. Practical methods of harvesting mussels.
6. Information concerning available canning facilities, boats, and manpower.

The mussel surveys of 1942 and 1943 were made possible by the active cooperation of the Maine Department of Sea and Shore Fisheries, Maine Development Commission, New Hampshire Fish and Game Department, Massachusetts Division of Marine Fisheries, Fisheries Research Board of Canada, Canadian Department of Fisheries, and interested cannery operators and fishermen. Without this assistance much less ground could have been covered with the time and personnel available.

An examination of the mussel resources of Southern New England was carried on by the United States Fish and Wildlife Service in cooperation with the Rhode Island Department of Conservation, and the Connecticut State Board of Fish and Game. The preliminary results of the survey in southern New England are given by Loosanoff (1943c).

## MUSSEL SURVEY

The object of the survey was to locate and examine the most important mussel beds in the various sections. In many localities, small areas which might possess enough mussels to be worthy of a fisherman's attention were not covered; therefore, the survey represents the very minimum extent of the supply.

Local information from fishermen and fishery wardens was of great assistance in locating the mussel beds in many localities, although in general the mussel was not of any interest among the residents along the East Coast. The best information was obtained in those regions where mussels are used as fish bait or are considered to compete with soft clams (Mya arenaria) for space on some tidal flats.

## SURVEY METHODS

The New Brunswick, Maine, New Hampshire, and some Massachusetts mussel beds were located near the low-tide mark; consequently, examination was relatively simple. Inspection of the bed at low tide was made either by rowing around it in a dory or by walking over it, if conditions permitted. The location, shape, and dimensions of the bed were plotted on a U. S. Coast and Geodetic Survey chart of that region and from such information, the area was determined by planimeter measurements. The variations in mussel sizes and population densities were noted, for these vary considerably on most beds, particularly where the bed extends from several feet below to several feet above the mean low-water mark. One or more samples were taken from what were considered to be characteristic parts of the bed to determine the weights of the meats and the average sizes of the mussels. In some cases, a sample from one square yard of the bed was removed. With this information it was possible to estimate roughly the total number of bushels of marketable mussels on the beds. It was not possible to determine how accurate the estimates were, but it was felt that the error was small and that the quantities were representative of the abundance of the shellfish.

In the Nantucket Island region the mussel beds were not completely exposed at low tide, but were in depths of about one to two fathoms. Here, due to the clearness of the water, most of the beds were easily seen and the examination of the remaining beds was completed by using a boat and a long-handled rake. In the Cape Cod Bay region, the mussels were located by dredging.

All mussel samples were washed free of mud and the dead mussels and shells were separated from the live mussels. The ratio of live mussels to dead mussels and shells was recorded. The live mussels were measured for individual lengths and the ratio of the volume of mussels over two inches in length to those under two inches was ascertained. The meats were removed from those mussels above two inches to obtain the yield per bushel.

## LOCATION, AREAS, AND TOTAL CONTENTS OF BEDS

Table 1 presents the data on the locations, areas, and total contents of the mussel beds.

In New Brunswick, the region between Point Lepreau and Saint Andrews was examined during November 1943. Musquash, Beaver, L'Etang, and Bocabec Harbors were not surveyed because information from representatives of the Fisheries Research Board of Canada and the Canadian Department of Fisheries indicated that few mussels were present in those areas. Very limited supplies of mussels were found at

Lepreau Point, Lepreau Harbor, Mill Cove, Midjik Bluff, Digdequash Inlet, Parker, Jameson, and McMaster Islands (Figure 1). This region was examined by Mossop (1921) during 1917 and her observations agree with those of the 1942 survey. The mussels were so small that they were considered to be of no commercial importance. To be commercially important mussels should be at least two inches long and in great enough quantities to make their harvesting profitable.

In the Eastport-Lubec region, which was surveyed during October 1943, mussel beds were not abundant. Jim Island, Spectacle Island, Pennamaquan River near West Pembroke, Scrub Island, and Long Island had small patches of mussels. The largest bed was located in Lubec Narrows at Leadurny Point. Less than 26 acres of mussel flats were discovered in the entire Eastport-Lubec section and mussels of over two inches in length were so scarce that the beds were not commercially important.

Information from fishery wardens and fishermen indicated that mussels were not abundant enough to warrant a fishery in the region extending eastward from Jonesboro, Maine, to Lubec, Maine. In order to avoid the expenditure of time on areas offering little prospects of a commercial fishery, the survey was not extended to that region.

The principal mussel areas of eastern Maine were surveyed in October and November 1942, with the exceptions of Pattens Bay, Morgans Bay, and Allen's Cove, which were examined during October 1943. Figures 2, 3, and 4 show the locations of the beds. In the Jonesport area (Jonesboro to Gouldsboro Bay) a total of 620 acres of mussel beds contained about 182,000 bushels of marketable mussels; the

Table 1 - Locations, Areas and Estimated Quantities of Mussels on Some Surveyed Beds			
Locality	Estimated Bushels Per Acre of Marketable-size Mussels (2" or more in length)	Approximate Area of Bed Containing Marketable Mussels	
		Acres	Total Bushels
<b>New Brunswick:</b>			
Lepreau Point .....	1/	-	-
Lepreau Harbor .....	1/	-	-
Letite Harbor, Mill Cove .....	1/	-	-
Little Letite Passage .....	1/	-	-
Midjik Bluff .....	300	1	300
Digdequash Inlet .....	1/	-	-
<b>Total .....</b>	<b>-</b>	<b>1</b>	<b>300</b>
<b>Maine, Eastport-Lubec Section:</b>			
Moose Island Bridge .....	1/	-	-
Spectacle Island .....	1/	-	-
Jim Island .....	1/	-	-
Leadurny Point .....	1/	-	-
Long Island .....	1/	-	-
Scrub Island .....	1/	-	-
Pennamaquan River .....	1/	-	-
<b>Total .....</b>	<b>-</b>	<b>-</b>	<b>-</b>
<b>Maine, Jonesport Section:</b>			
Chandler River .....	1/	-	-
Mason Bay .....	1/	-	-
Indian River .....	15	134	2,010
West River, Goose Islands .....	75	75	5,625
Cape Split Harbor .....	600	84	50,400
Pleasant River, Reef Point .....	70	134	9,380
Harrington River, Ripley Islands .....	10	26	260
Narraguagus Bay, Back Bay .....	310	26	8,680
Narraguagus River, Long Point .....	65	8	520
Pigeon Hill Cove, Bar Island .....	1/	-	-
Dyer Harbor .....	1,210	41	49,610
Pinkham Bay .....	685	44	30,140
Joy Bay .....	570	44	25,080
<b>Total .....</b>	<b>-</b>	<b>620</b>	<b>181,725</b>
<b>Maine, Frenchman Bay Section:</b>			
Winter Harbor .....	500	2	1,000
Stave Island Harbor .....	380	65	24,700
Hog Island .....	100	3	300
Soward's Island .....	75	36	2,700
Ingall's Island .....	195	10	1,950
Sullivan Harbor, Moon Ledge .....	145	7	1,015
Raccoon Cove .....	180	225	40,500
Skillings River .....	100	10	1,000
Jordan River .....	1/	-	-
<b>Total .....</b>	<b>-</b>	<b>358</b>	<b>73,165</b>
<b>Maine, East Penobscot Bay Section:</b>			
Pattens Bay .....	1/	-	-
Morgans Bay .....	1/	-	-
Blue Hill Harbor .....	1/	-	-
Allen's Cove .....	1/	-	-
Herrick Bay .....	150	248	39,680
Centre Harbor .....	335	3	1,005
Deer Isle, Fish Creek .....	80	129	10,320
Deer Isle, Greenlaw's Cove .....	75	100	7,500
Deer Isle, Webb Cove .....	1/	-	-
White Island .....	500	1	500
Jim's Island .....	100	1	100
John Island .....	575	5	2,875
Opechee Island .....	50	3	400
Swans Island, Mackerel Cove .....	10	39	390
Swans Island, Atlantic Harbor .....	40	13	520
Isle au Haut Harbor .....	375	4	1,500
<b>Total .....</b>	<b>-</b>	<b>551</b>	<b>64,780</b>
<b>New Hampshire:</b>			
Hampton River .....	1/	-	-
<b>Massachusetts:</b>			
Duxbury Bay .....	1/	-	-
Chatham .....	1/	-	-
Nantucket, Muskeget Island .....	2	125	250
Nantucket, Maddaket Harbor .....	600	21	12,600
<b>Total .....</b>	<b>-</b>	<b>146</b>	<b>12,850</b>

1/Commercially unimportant because of comparative absence of mussels over two inches in length

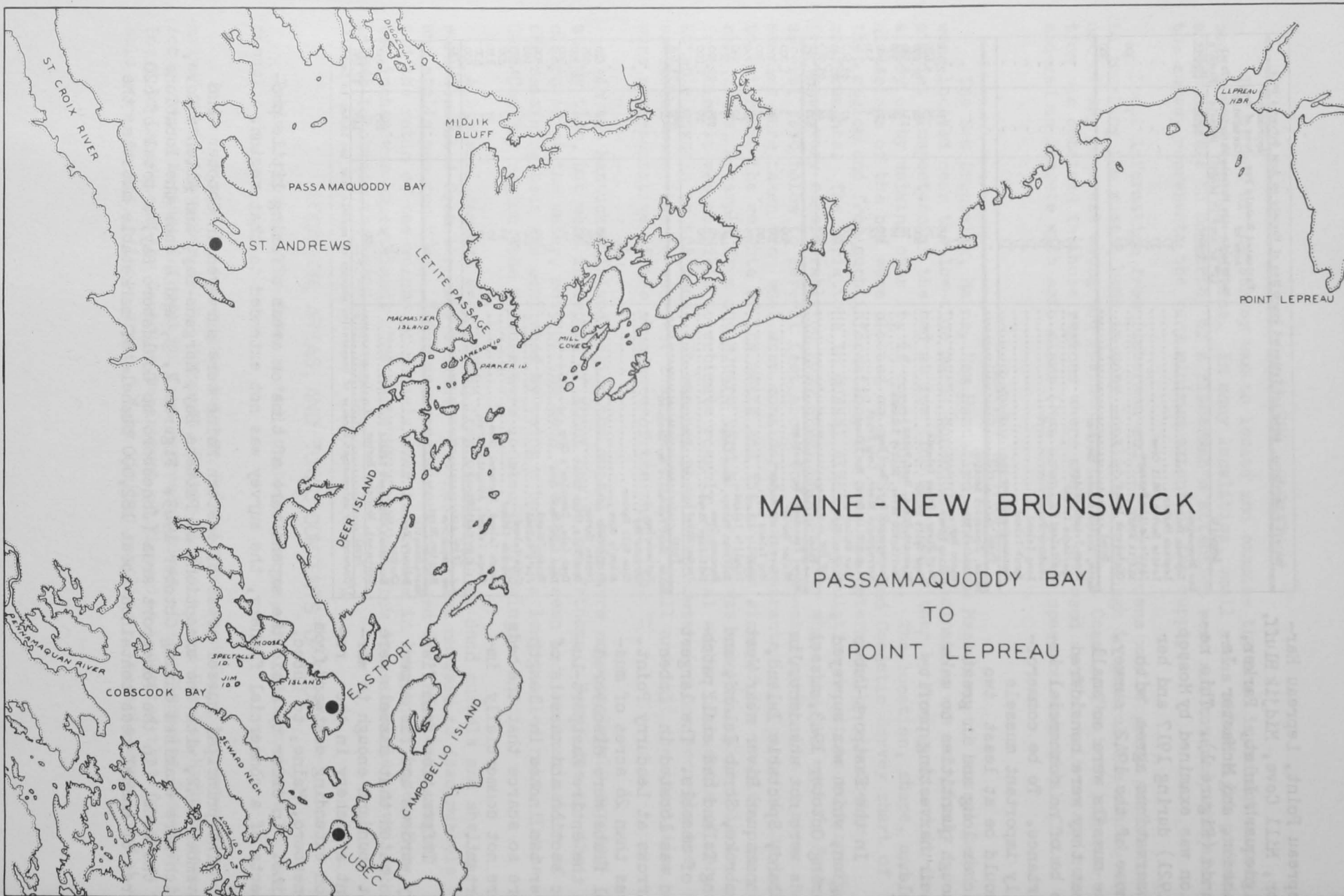


FIGURE 1 - REGIONS SURVEYED BUT IN WHICH MUSSELS WERE NOT FOUND TO BE PRESENT IN COMMERCIALY IMPORTANT QUANTITIES

Frenchman Bay section had 358 acres of beds and 73,000 bushels of mussels; and the East Penobscot Bay region had 551 acres of beds and about 65,000 bushels.

The survey did not investigate thoroughly the entire coastline even of any one section. The Maine coast has a very large number of islands, rocks, bays, and inlets, many of which offer favorable conditions for the growth of mussels. Most of the beds reported by fishermen, wardens, etc., were examined; however, many small beds were undoubtedly not visited, consequently, the estimated available supplies must be considered as a minimum. Furthermore, the survey of the Jonesport region was more intensive than that of Frenchman Bay, while East Penobscot Bay received the least attention. The

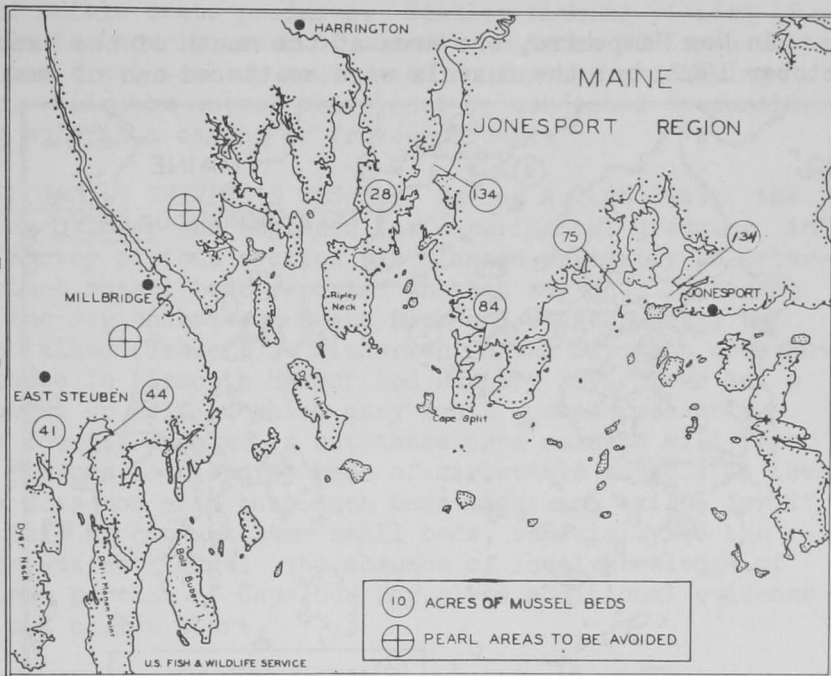


FIGURE 2 - PRINCIPAL MUSSEL BEDS OF THE JONESPORT, ME., REGION.

reason for this difference was that there was insufficient time to examine the latter two areas as thoroughly as the first; therefore, a comparison of the relative productivity of the three regions cannot be made from the survey. As the fishery developed, the mussel gatherers found many more small beds, particularly in Hancock County.

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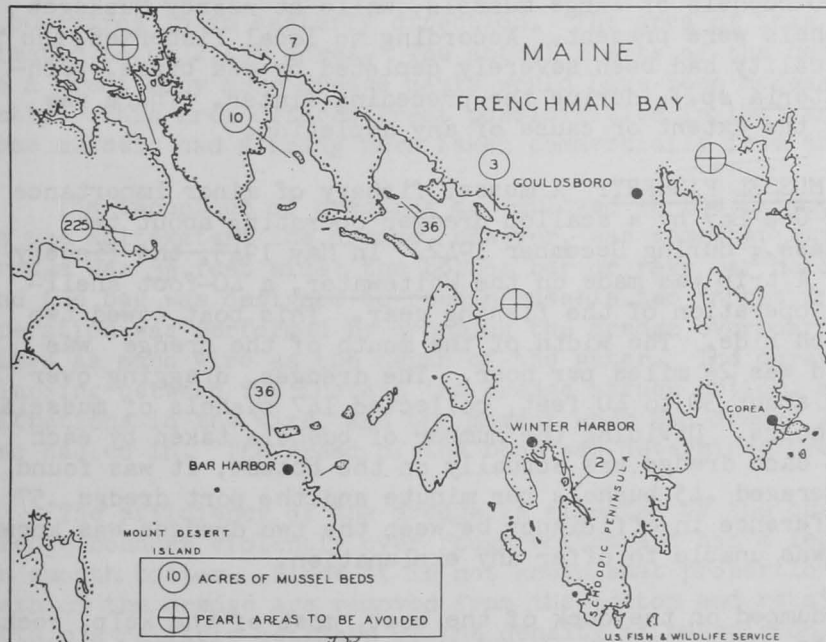


FIGURE 3 - PRINCIPAL MUSSEL BEDS OF THE FRENCHMAN BAY, ME., REGION.

The areas around Mount Desert, Vinalhaven, and North Haven Islands, and West Penobscot Bay, were not surveyed. Wardens of the Maine Department of Sea and Shore Fisheries reported that a good supply of mussels was present around Mount Desert Island; however there was little available information about the other three sections. The remaining sections of the Maine coast between Rockland and Portland were not examined, but fisher-

men who were familiar with both the sizes of the beds and mussels reported large quantities. No beds of commercial importance were reported by wardens or fishermen in the coastal area between Portland and Kittery, Maine.

In New Hampshire, the area at the mouth of the Hampton River was examined in October 1942, but the mussels were scattered and of small size. Fishermen and

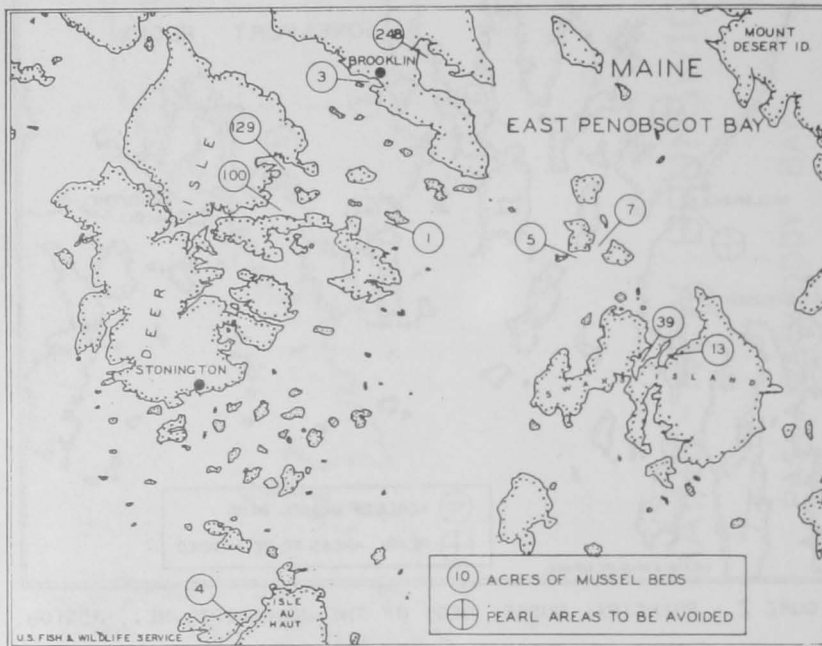


FIGURE 4 - PRINCIPAL MUSSEL BEDS OF THE EAST PENOBSCOT BAY, ME., REGION.

conservation officers did not believe that a mussel fishery was possible in that State, due to the scarcity of large mussels. The Great Bay area was not surveyed because of lack of any information on possible mussel beds.

Some regions in Massachusetts also were visited. In December 1942, Plymouth Harbor and Duxbury Bay in Massachusetts were examined. Although there were 36 acres of mussels present in the intertidal zone, the mussels were generally so small that a fishery would be impractical. Chatham Harbor, also examined at this time, contained only

mussels under two inches in length. In April 1943, Maddaket Harbor at Nantucket Island contained about 16,000 bushels of large mussels, while at nearby Muskeget Island, an estimated 250 bushels were present. According to local fishermen, the mussel beds at the latter locality had been severely depleted by sea birds, principally the eider duck (*Somateria* sp.), during the preceding winter. There was no definite evidence to show the extent or cause of any depletion.

**OBSERVATION OF A SMALL MUSSEL FISHERY:** A mussel fishery of minor importance was being carried on in Cape Cod Bay by a scallop dredger operating about two miles northeast of Dennis, Mass., during December 1942. In May 1943, the fishery was resumed by three boats. A trip was made on the *Whitewater*, a 40-foot shellfish dredger, to observe the operation of the fishing gear. This boat towed two scallop dredges, one from each side. The width of the mouth of the dredge was seven feet. The towing speed was  $2\frac{1}{2}$  miles per hour. The dredges, dragging over a muddy bottom at a depth of about 30 to 40 feet, collected 147 bushels of mussels in slightly less than three hours. Dividing the number of bushels taken by each dredge by the length of time each dredge was actually on the bottom, it was found that the starboard dredge averaged .45 bushels per minute and the port dredge .57 bushels per minute. The difference in efficiency between the two dredges was known to the boat operator but he was unable to offer any explanation.

After the mussels were dumped on the deck of the boat, most of the kelp, rocks, whelks (*Buccinum undatum*), etc. were culled out and the mussels were shoveled into burlap bags. Examination of the contents of the bags revealed that about 80 percent of the volume was live mussels, the remaining 20 percent being empty shells, rocks, sand dollars (*Echinarachinus parma*), and other debris.



On the same trip, the Whitewater dredged for scallops and caught 96 pounds of meats in over 5 hours. While the scallop fishing may not have been particularly productive in that region, some comparison can be made between the productivity of the two fisheries in terms of edible meats produced. Scallop fishing yielded 18.8 pounds of meats per hour while the hourly catch of mussels in terms of fresh meats was 645.7 pounds. However, the fresh scallop meats need no further processing before reaching the consumer, while the mussel meats must be subjected to considerable handling before being sold as a canned or frozen product.

EXPERIMENTAL MUSSEL DREDGING BY SERVICE'S VESSEL: During August 1943, the Fish and Wildlife Service boat Skimmer was employed for experimental dredging in the Cape Cod Bay area. The survey of this section was planned primarily to determine the extent of the important mussel beds reported in that region. Thirteen dredging hauls were made in the region between Brant Rock and Scorton Neck, but no marketable mussels were obtained (Table 2). Fishermen in the Plymouth area were unaware of any beds except those in Plymouth Harbor and Duxbury Bay. Tows No. 6 and 7, off Plymouth Bay, brought up kelp on which many small mussels measuring 1/16 to 5/16 of an inch were found. Whether or not these seed mussels will form a bed is questionable. The failure to discover beds of marketable mussels in the Brant Rock-Scorton Neck area does not mean that such beds might not exist, for it would be relatively easy to fail to contact some small beds, especially as the number of dredging operations was not large. The absence of local knowledge of mussel beds in the northwestern portion of Cape Cod Bay gives additional evidence that marketable mussels are not common there.

Mussels were dredged in the area between Billingsgate Shoal and the Brewster-Dennis shores. From the results of the Skimmer's dredge hauls as shown in Table 2, a rough idea may be obtained of the size of this mussel-producing section. The probable center of the mussel bed or beds, is about 2,700 yards southwest of the Billingsgate Shoal buoys, which mark its northern limits, and its southern limit is about 3,300 yards north of the Sesuit Harbor breakwater. Its greatest length is 6,000 yards in a north northeast half east direction and its greatest width 3,600 yards in an easterly direction. The area of this bed has been roughly estimated to be 2,450 acres. The actual limits of the bed are not known exactly, as a great many more dredge hauls would have been necessary to plot the area exactly. This area offered great possibilities in 1943 and, as mentioned before, some mussels had already been taken commercially from the region.

The technique of dredging as employed on the Skimmer varied little from that on the Whitewater; the dredge, however, was somewhat smaller. The mouth of the dredge was 3½ feet wide; the bottom bar or rake bar held 11 one-inch square teeth; and the bag was designed to retain mussels two inches in length. The dredging operation was performed by dropping the dredge overboard and paying out about three times as much wire as the depth of the water. The duration of the tow was the time elapsing between the instant the dredge struck bottom, which was determined by the vibrations in the wire, and the moment when the dredge left the bottom as the wire was hauled in. The speed of the boat was determined frequently by ship logs.

The efficiency of the dredge is affected by the character of the bottom. The dredge bounces violently over rough bottom and has a less marked jumping effect on smooth bottom. Since it is not known what proportion of the mussels in the path of the dredge are removed from the bottom and retained, it is not possible to obtain a reliable estimate of the density of mussels on the beds, unless a considerable number of data are accumulated concerning the efficiency of the dredge. Frey

Table 2 - Record of Mussel Dredging in Cape Cod Bay by the Service's Vessel "Skianer"

Tow No.	Date 1943	Position		Locality	Depth Feet	Duration of Tow Minutes	Direction of Tow	Length of Tow Feet	Catch <sup>1/</sup>
		Latitude, N.	Longitude, W.						
1	Aug. 26	41° 58' 51"	70° 35' 0"	Plymouth Bay	44	10	N	2,050	Sand dollars
2	Aug. 27	42° 2' 43"	70° 37' 34"	Off Duxbury Beach	48	13	N 1/2 E	2,653	do
3	do	42° 3' 14"	70° 38' 9"	do	25	10	N 1/2 E	2,050	Kelp
4	do	42° 3' 39"	70° 38' 13"	do	34	3	NE by E	2,050	Nothing
5	do	41° 58' 2"	70° 34' 57"	Plymouth Bay	45	10	W by N	2,050	Sand dollars
6	do	41° 59' 3"	70° 35' 35"	do	36	10	S by E	2,050	Sand dollars, kelp, many seed mussels
7	do	41° 59' 25"	70° 35' 35"	do	22	10	SW	2,050	do
8	Aug. 29	41° 49' 51"	70° 30' 21"	Off Sagamore Beach	28	10	SW by S 1/2 S	2,050	Kelp
9	do	41° 59' 16"	70° 30' 35"	do	29	10	SW by S 1/2 S	2,050	Sand dollars
10	do	41° 59' 6"	70° 29' 41"	do	40	10	S by W 1/2 W	2,050	do
11	do	41° 48' 29"	70° 29' 38"	do	38	10	E by S 1/2 S	2,050	2 scallops, sand dollars
12	do	41° 46' 32"	70° 26' 56"	Off Spring Hill Beach	40	10	SE by E 1/2 E	2,050	1 horse mussel, sand dollars
13	do	41° 46' 1"	70° 23' 52"	Off Scorton Neck	59	10	SE by E 1/2 E	2,050	Nothing
14	Aug. 30	41° 49' 45"	70° 9' 18"	Brewster to Billingsgate Shoal	42	10	E	2,050	12 quarts mussels
15	do	41° 49' 50"	70° 9' 0"	do	41	10	E	2,050	1 quart mussels
16	do	41° 45' 52"	70° 8' 48"	do	39	10	E	2,050	Kelp
17	Aug. 31	41° 46' 6"	70° 15' 48"	Off Barnstable Bar	47	10	N by E 1/2 E	2,050	Sand dollars
18	do	41° 46' 58"	70° 15' 12"	do	52	10	N by W 1/2 W	2,050	do
19	do	41° 46' 47"	70° 15' 8"	do	45	10	S by E 1/2 E	2,050	do
20	do	41° 45' 33"	70° 15' 49"	do	39	10	N by W 1/2 W	2,050	do
21	do	41° 45' 33"	70° 15' 38"	do	39	10	N by E 1/2 E	2,050	do
22	do	41° 46' 32"	70° 16' 51"	do	51	10	N by E 1/2 E	2,050	2 scallops, whelks
23	do	41° 47' 29"	70° 16' 59"	do	57	10	Y by E 1/2 E	2,050	7 scallops, sea urchins
24	do	41° 47' 50"	70° 17' 51"	Off Sandy Neck	64	10	W by W 1/2 W	2,050	Sand dollars, starfish
25	do	41° 47' 10"	70° 18' 32"	do	59	10	S by W 1/2 W	2,050	Sand dollars, sea urchins
26	do	41° 46' 12"	70° 18' 36"	do	54	10	S by W 1/2 W	2,050	Sand dollars
27	Sept. 2	41° 45' 42"	70° 11' 22"	Dennis to Billingsgate Shoal	41	10	E	2,050	Kelp
28	do	41° 46' 48"	70° 10' 53"	do	41	10	E	2,050	5 quarts mussels
29	do	41° 46' 53"	70° 10' 23"	do	41	10	E	2,050	Kelp
30	do	41° 46' 58"	70° 9' 57"	do	40	10	E	2,050	do
31	do	41° 46' 14"	70° 11' 12"	do	33	10	E	2,050	1 quart mussels
32	do	41° 46' 18"	70° 10' 42"	do	38	10	E	2,050	1 mussel
33	Sept. 5	41° 47' 5"	70° 9' 34"	do	34	10	N	2,050	32 quarts mussels
34	do	41° 47' 23"	70° 9' 41"	do	34	10	N	2,050	12 quarts mussels
35	do	41° 47' 41"	70° 9' 48"	do	34	10	E	2,050	5 mussels
36	do	41° 47' 45"	70° 9' 22"	do	27	5	E	1,025	Nothing
37	do	41° 47' 48"	70° 9' 12"	do	28	10	E	2,050	12 mussels
38	do	41° 47' 53"	70° 8' 47"	do	28	10	E	2,050	42 quarts mussels
39	do	41° 47' 58"	70° 8' 24"	Brewster to Billingsgate Shoal	27	10	E	2,050	16 quarts mussels
40	do	41° 48' 4"	70° 8' 0"	do	29	10	E	2,050	11 quarts mussels
41	do	41° 48' 9"	70° 7' 36"	do	28	10	E	2,050	Many small mussels
42	do	41° 48' 14"	70° 7' 11"	do	28	10	E	2,050	do
43	do	41° 48' 19"	70° 6' 47"	do	27	10	E	2,050	do
44	do	41° 48' 24"	70° 6' 23"	do	26	10	E	2,050	Kelp
45	do	41° 48' 30"	70° 6' 0"	do	26	10	S	2,050	do
46	do	41° 47' 24"	70° 8' 22"	do	23	10	S	2,050	Nothing
47	do	41° 48' 3"	70° 8' 37"	do	26	10	N	2,050	1 quart mussels
48	do	41° 48' 20"	70° 8' 44"	do	29	10	N	2,050	19 quarts mussels
49	do	41° 48' 38"	70° 8' 52"	do	35	10	N	1,500	42 quarts mussels
50	do	41° 48' 51"	70° 8' 56"	do	36	10	N	1,500	31 quarts mussels
51	do	41° 49' 6"	70° 9' 1"	do	36	10	N	1,500	26 quarts mussels
52	do	41° 49' 19"	70° 9' 6"	do	42	10	N	1,500	2 mussels, 7 horse mussels
53	do	41° 49' 33"	70° 9' 12"	do	46	10	N	1,500	57 quarts mussels
54	Sept. 6	41° 49' 15"	70° 10' 18"	Dennis to Billingsgate Shoal	31	10	S	2,050	Sand dollars
55	do	41° 48' 56"	70° 10' 13"	do	46	10	S	2,050	do
56	do	41° 48' 38"	70° 10' 9"	do	41	10	S	2,050	do
57	do	41° 48' 15"	70° 10' 5"	do	41	10	S	2,050	5 mussels
58	do	41° 47' 57"	70° 9' 57"	do	37	5	S	1,025	Nothing
59	do	41° 47' 44"	70° 9' 54"	do	35	7	S	1,435	1 quart mussels
60	do	41° 47' 26"	70° 9' 51"	do	32	10	S	2,050	2 horse mussels
61	do	41° 46' 59"	70° 9' 43"	do	32	10	S	1,800	2 mussels, 3 horse mussels
62	do	41° 46' 42"	70° 9' 40"	do	32	10	S	1,800	1 horse mussel, many seed mussels
63	do	41° 46' 26"	70° 9' 37"	do	32	10	S	1,800	2 mussels, many seed mussels
64	do	41° 46' 3"	70° 9' 57"	do	28	10	N	2,050	3 horse mussels, many seed mussels
65	do	41° 46' 21"	70° 10' 5"	do	32	10	N	2,050	2 horse mussels
66	do	41° 46' 42"	70° 10' 12"	do	36	10	N	2,050	2 horse mussels
67	do	41° 47' 0"	70° 10' 19"	do	32	10	N	2,050	1 horse mussel
68	do	41° 47' 19"	70° 10' 26"	do	36	10	N	2,050	6 mussels
69	do	41° 47' 38"	70° 10' 32"	do	42	10	N	2,050	4 mussels, 1 horse mussel
70	do	41° 48' 20"	70° 11' 33"	do	46	10	S 1/2 W	2,050	Scallops
71	do	41° 48' 20"	70° 11' 31"	do	48	7	N 1/2 E	1,435	do
72	do	41° 48' 16"	70° 11' 32"	do	47	7	S 1/2 W	1,435	do
73	do	41° 48' 2"	70° 11' 31"	do	47	5	S 1/2 W	1,025	do
74	do	41° 47' 36"	70° 11' 30"	do	37	10	S 1/2 W	2,050	8 mussels, 3 scallops
75	do	41° 47' 16"	70° 11' 27"	do	40	8	S 1/2 W	1,540	3 mussels, 3 scallops
76	do	41° 47' 0"	70° 11' 26"	do	36	10	S 1/2 W	2,050	Sand dollars
77	do	41° 46' 42"	70° 11' 24"	do	36	10	S 1/2 W	2,050	2 horse mussels

<sup>1/</sup> Common and scientific names: Sand dollar (*Echinarrhynchus parma*); Sea urchin (*Strongylocentrotus drobachiensis*); Starfish (*Asterias vulgaris* and *A. forbesii*); Whelk (*Euccinum undatum*); Mussel (*Mytilus edulis*); Horse mussel (*Modiolus modiolus*); Scallop (*Pecten magellanicus*); Kelp - Principally members of the LAMINARIAEAE.

(1946) cites similar difficulties with dredging operations in oyster population studies. In view of such difficulties, no attempt has been made to estimate the abundance of mussels in the Cape Cod Bay area.

(This article will be continued in the October 1949 issue of this periodical)