

The Blue Mussel in Maine



Stanley Chenoweth

Benthic/Demersal Division
Bureau of Marine Sciences
Maine Department of Marine Resources
PO Box 8
West Boothbay Harbor Maine 04575-0008

RESEARCH REFERENCE DOCUMENT 95/17

INTRODUCTION

On the Atlantic coast, blue mussels are harvested commercially from Maine to Long Island, New York but Maine has historically ranked first in mussel landings. The resource is abundant in intertidal and shallow waters along much of the Maine coast and it is also adaptable to aquaculture, but market demand has fluctuated since the early 1970's (Figure 1). From 1975 to 1985 there was a surge in demand fueled by more shellfish consumption in the United States and a lower supply of clams. This increased the harvest of mussels in Maine dramatically and also stimulated the development of mussel culture. By 1988 the landings had reached a record 2846 mt of meats (over 400,000 bushels). Just as things were humming along, production turned downward as mussels harvested from deep water in the Nantucket Shoals area began to compete with the Maine product. As a result, Maine's mussel production dropped by 64% between 1988 and 1991.

Questions concerning the status of the mussel resource arose during the mid 1980's when both the harvest of wild mussels and mussel culture were at historic highs - What was the size of the marketable mussel population? What were prudent harvest levels? What was an equitable way to allow access to mussel seed for bottom culture without reducing recruitment to marketable wild beds? What was the impact of mussel dragging on the bottom community? These issues were hotly debated at the time and, in 1988, regulations were implemented by the Department of Marine Resources to address the seed mussel problem.

Although the heat from these issues has abated somewhat with the recent decline of the fishery, the issues have not gone away. The resource potential is still there and an improvement in the market could stimulate the industry, and bring up these resource questions once again.

THE RESOURCE

Blue mussels, (*Mytilus edulis*), are abundant, bivalve molluscs of the intertidal and shallow, subtidal zone. In Maine they are found in densely populated beds just above and below mean low water (MLW), but are restricted to the intertidal zone in many areas because of subtidal predation. They attach to the bottom substrate with strong string-like appendages called byssal threads, which, in dense beds, can create a thick mat of silt, mud and dead shells held

together by the collective byssal attachment of the colony. Within the bed is a rich community of benthic invertebrates including marine worms and crustaceans. These large beds go through natural cycles, increasing in size as silt and shell build up within the bed and then breaking up during major storms.

The commercial quality of mussel beds depend on the stress that the mussels encounter such as lack of food and exposure to air. The weight and flavor of the meats, absence of pearls and shell appearance are criteria that determine the quality of a bed.

The amount and quality of food that mussels get has much to do with their variation in growth and reproduction, and, therefore their marketability. They feed by filtering plankton, bacteria or bits of organic material from the water. The food that they get can depend on the density of the bed, their position within the bed, the strength of the currents just over the bed, or their position above mean low water. Mussels that live under the best combination of these conditions are the most valuable for commercial harvest.

The development of pearls in the meat is the mussel's response to foreign objects within the shell, usually trematode or flatworm parasites but sometimes physical objects such as sand grains. The presence of pearls obviously detract from the commercial value of the mussel. Younger, fast growing mussels are less likely to develop pearls.

Mussel quality also varies seasonally and is a function of the spawning cycle. Spawning, which occurs during the spring and summer, consumes a great deal of energy. In the late winter and early spring, just prior to spawning, mussels build up energy reserves which are stored in the body tissue. At this time the meats are best in terms of weight and taste and have the greatest market value. After spawning, the meat weight is down, it can taste bitter and the mussels are less desirable for harvest.

In Maine, the best commercial mussel beds are found a few feet above and below MLW between Casco Bay and Jonesport. The most recent survey of commercial beds (MARITEC, 1978) identified six of the most productive areas; Casco Bay, Muscongus Bay, Tenants Harbor to Vinalhaven, Stonington to Deer Isle, Sorrento

to Mt. Desert Narrows, and the Jonesport area. Most of the beds east of Schoodic Point were above MLW, while those west of Schoodic extended two to three feet above and below MLW.

There is no estimate of the standing crop of mussels in Maine that reflects the condition of the resource at the present time. Earlier surveys estimated the size of the marketable resource at 320,000 bushels (Scattergood and Taylor, 1949) and 544,000 bushels (MARITEC, 1978), but they probably underestimated the resource at the time and the results are now outdated.

What harvest levels the wild stocks will sustain over the long term is also not known, but the wild stocks were depleted in some areas after heavy harvests during World War II and the more recent expansion of the industry during the mid 1980's. The area between Casco Bay and Penobscot Bay was particularly heavily fished during the latter period.

MUSSEL LIFE CYCLE

Mussels reproduce by broadcasting their eggs and sperm into the water where fertilization takes place. Females can produce 5 to 12 million eggs. Although spawning generally occurs in the late spring or early summer, it is controlled by temperature and therefore specific spawning times vary from year to year and place to place. The duration and amount of spawning depends on the food supply, and mussels that have experienced optimum feeding conditions may spawn a second time in the fall.

After fertilization, mussels live as microscopic, planktonic larvae for about three weeks, most commonly during May, June and July. During this time they search for suitable bottom on which to settle. This is a difficult phase in the mussels life and very few survive. It is estimated that less than 1% live to become part of the bottom community.

When mussels first settle they become "spat" and attach themselves with newly developed byssal threads to some filamentous surface. Within a few weeks they move again. This time they settle on a hard, rough surface which may be gravel, shells, or sand, but many times is a bed of larger mussels. In this case they settle into the spaces between the larger mussels for refuge and if the spat

are thick enough, they can smother the older mussels by attaching to their shells. Young mussels attached to the bottom that are less than two inches in length are called "seed" mussels.

The growth rate of Maine mussels varies a great deal depending on circumstances within their immediate habitat. For instance, those in the intertidal zone tend to grow slower than those continually submerged because food is available only at intervals in the intertidal zone. Under good conditions, mussels can grow about 3/4 to 1-1/2 inches the first year but thereafter the growth rate slows. This is because as a mussel grows it must spend more energy to spawn and sustain itself and therefore there is less available for growth. In general, Maine mussels are relatively slow growing in the wild. It usually takes 7-12 years for them to obtain a length of 2-1/2 inches.

Normally, mussels live about 12 years, although individuals have been recorded over 24 years. Size, however, is not necessarily an indication of age. Winter mortality above MLW and a host of predators below MLW take a heavy toll of mussel populations.

THE INDUSTRY

WILD HARVESTING AND PROCESSING

Most of the landings in Maine are from wild mussel beds; cultured mussels, at the peak of production, accounted for about 18% of the total landings.

Wild mussels can be harvested all year, but most fishing is in the winter when the quality of the meat is best. They are taken by hand with a rake or from a boat with a drag. A license is required from the Department of Marine resources to harvest mussels by either method. In 1984, near the peak of production, there were 46 licensed hand rakers and 66 licensed boats. In 1991 there were 22 hand rakers and 25 licensed boats. As of February 20, 1992 there were 4 hand raker and 12 boat licenses issued.

A mussel drag is essentially a framed mouth with an attached bag. Across the bottom of the mouth is either a cutting bar or a chain sweep which loosens the mussels as the drag is pulled across the bottom. The mussels are then diverted into the bag. Department of Marine Resources regulations (Chapter 12),

prohibits fishing for mussels 1/2 hour after sunset to 1/2 hour before sunrise and restricts the size of mussel drags to an aggregate width of 6 feet 6 inches.

Wild mussels are usually harvested on demand, meaning the dealer usually has the mussels sold before they are harvested. After they are landed, the mussels may be soaked over night to clean the meat and then tumbled to separate them. Tumbling may also be done on board the boat. The mussels are then sorted by size, graded and bagged for shipment to market, or in some cases shucked and the fresh meats sold. There are 51 mussel dealers and 11 mussel processors in the state. Almost all of them handle other fish and shellfish as well. A detailed listing of mussel dealers and processors is given in the Department of Marine Resources publication: MAINE DIRECTORY OF WHOLESALE SEAFOOD DEALERS AND/OR PROCESSORS.

AQUACULTURE

Mussel aquaculture involves placing small mussels (3/4 to 2 inches long) in an area where growing conditions are optimum and where the culturist has exclusive rights to the harvest. Mussels can usually be grown to marketable size in 12 to 18 months. The product is of the highest quality and theoretically should command the highest price. Growth is rapid, the meats are sweet and without pearls and the shells are thin. The mussels can also be harvested over a longer season because, with good growth, meat quality remains high. The downside is that mussel aquaculture requires complying with a state permitting process, takes a commitment of time and money to acquire and grow the seed, and depends on successfully competing with product from wild beds.

There are two methods of mussel culture practiced in Maine - suspended culture and bottom culture. With suspended culture, mussel spat is collected on short ropes hung in the water. Later they are transferred to plastic mesh tubing suspended from floats where they grow until reaching marketable size. These mussels grow very fast and are of the highest quality, but the process is labor intensive and the mussels are vulnerable to storms and ice damage. With bottom culture, seed mussels (1 1/4 to 2 inches long) are collected from dense, wild beds and thinly spread over the lease site. This allows the mussels to increase

their growth rate and double their size within a year. This process is less labor intensive than suspended culture, but the mussels are more subject to predation and the harvest is less predictable.

Because marine resources are public property, the right to exclusive access to a resource on any site has to be obtained through a lease. The State of Maine, through the authority of the Commissioner of the Department of Marine Resources, grants aquaculture leases for a period up to 10 years and up to 200 acres in area. Lease proposals are subject to an adjudicatory hearing, which considers the impact of an aquaculture operation on navigation, fishing, access for riparian owners and coastal zoning statutes. At the end of 1991, there were 21 mussel leases in Maine that farmed a total area of 399 acres. This is down from 32 leases over 696 acres in 1986.

MANAGEMENT

Mussel regulations were implemented in 1988 by the Department of Marine Resources in response to concerns within the industry and legislature that the intensity of the fishery that existed at that time was leading towards resource problems and conflicts between users. After much debate and compromise, the final regulations defined seed mussels and their use, set up seed mussel conservation areas, established size limits of mussel drags and prohibited nighttime harvesting.

By regulation, seed mussels are defined as those that number no less than 106 in a 2 qt container. This corresponds to an average length of two inches or less. There is a 10% tolerance applied to the 106 mussel count. It is the intent of the regulations that seed mussels not be landed and placed in the channels of trade, but they can be collected and transported to lease sites as seed for culture operations. By regulation only mussels that meet the definition of seed mussels can be placed on a lease site.

One of the major problems at the time was the significant demand for seed mussels by the aquaculture industry. There was a fear that recruitment to the prime wild beds might be impaired if the seed was heavily harvested and transferred to lease sites. The solution was to find an alternate source of seed

for the aquaculture industry. To this end, the regulations established four "seed mussel conservation areas". These unique areas had dense populations of small mussels that were fine for transport to a lease site, but unsuitable for market. The four conservation areas, located in eastern Maine (Figures 2-4), are:

- .Jordan River, Trenton/Lamoine
- .West Bay, Gouldsboro
- .Narraquagus Bay, Milbridge
- .Harrington River, Milbridge/Harrington.

The biomass of the mussel population is estimated annually for each area by the Department of Marine Resources using aerial photography and on-site sampling. The areal extent of the beds is estimated from the photographs. The average density of the beds and size of the mussels are estimated by counting and measuring the mussels in a series of random 0.1 square meter samples. The result is an estimate of the standing crop of mussels in each conservation area. In addition to the annual assessment, which is made early in the spring, an assessment is made after any removal of seed. When approximately 50% of the mussels have been removed, the area is closed and the beds are allowed to reseed. Table 1 gives the average length and the volume of mussels in each area since they were established in 1988.

A permit is required to remove any mussels from the conservation areas. The permits are issued by the Department of Marine Resources at no cost and on a first-come-first-serve basis and removals are monitored through bi-weekly reporting forms. For further information on the seed mussel conservation areas or the process involved in removing seed from them, contact Stanley Chenoweth, Department of Marine Resources, Biological Laboratory, West Boothbay Harbor, Maine 04575, Tel. (207) 633-5572.

REFERENCES CITED

- Maritec. 1978. An inventory of the blue mussel (*Mytilus edulis*) stocks from the Damariscotta River estuary to Jonesport, Maine. Report produced by Maritec, South Bristol, Maine under contract No. 03-7-043-35192 for the New England Fisheries Development Program, NMFS, Gloucester, MA.
- Scattergood, L. W. and C. C. Taylor, 1949. 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. Fishery Leaflet No. 364, U. S. Dept. Interior.
- Thayer, P.E. 1991. Maine seed mussel conservation areas-mussel count/volume/standing crop. Unpublished data file. Department of Marine Resources, West Boothbay Harbor, Maine.

Table 1. Mussel count, size and standing crop for seed mussel conservation area, 1988-1991. (after Thayer 1991)

JORDAN RIVER, TRENTON/LAMOINE

SAMPLE DATE	MUS BU/SQ M	AVE LENGTH	MUS CT/2 QT	PHOTO DATE	AREA SQ M	MUS TOT BU
10/25/88	.6	1.45	255	10/27/88	33,546	20,128
03/26/90	.7	1.41	277	04/24/90	17,942	12,560
04/24/91	1.07	1.53	220	05/17/91	25,179	26,942

WEST BAY, GOULDSBORO

SAMPLE DATE	MUS BU/SQ M	AVE LENGTH	MUS CT/2 QT	PHOTO DATE	AREA SQ M	MUS TOT BU
11/21/88	.57	1.46	253	10/27/88	34,940	19,916
04/27/90	.4	1.36	303	04/24/90	74,927	29,971
05/01/91	.43	1.41	278	05/17/91	91,824	39,484

NARRAGAUGUS BAY, MILBRIDGE/HARRINGTON

SAMPLE DATE	MUS BU/SQ M	AVE LENGTH	MUS CT/2 QT	PHOTO DATE	AREA SQ M	MUS TOT BU
11/21/88	.5	0.99	733	10/27/88	79,894	39,947
03/27/90	.47	1.11	532	04/24/90	96,088	45,161
04/25/91	.48	1.20	433	04/17/91	71,388	34,266

HARRINGTON RIVER, MILBRIDGE/HARRINGTON

SAMPLE DATE	MUS BU/SQ M	AVE LENGTH	MUS CT/2 QT	PHOTO DATE	AREA SQ M	MUS TOT BU
11/22/88	.81	1.33	325	10/27/88	43,455	35,199
04/26/90	.62	1.36	307	04/24/90	76,284	47,296
05/02/91	.51	1.22	413	05/17/91	107,950	55,055

NOTES: MUS = Mussels
MUS CT/2QT = Mussel count per 2 quarts (liquid measure)
PHOTO DATE = Date area aerially photographed for bed size assessment.
AREA SQ M = Total area of mussel beds within conservation area
TOT BU = Total bushels
AVE LENGTH = Average shell length in inches

MAINE MUSSELS Landings and Value

1960 - 1993

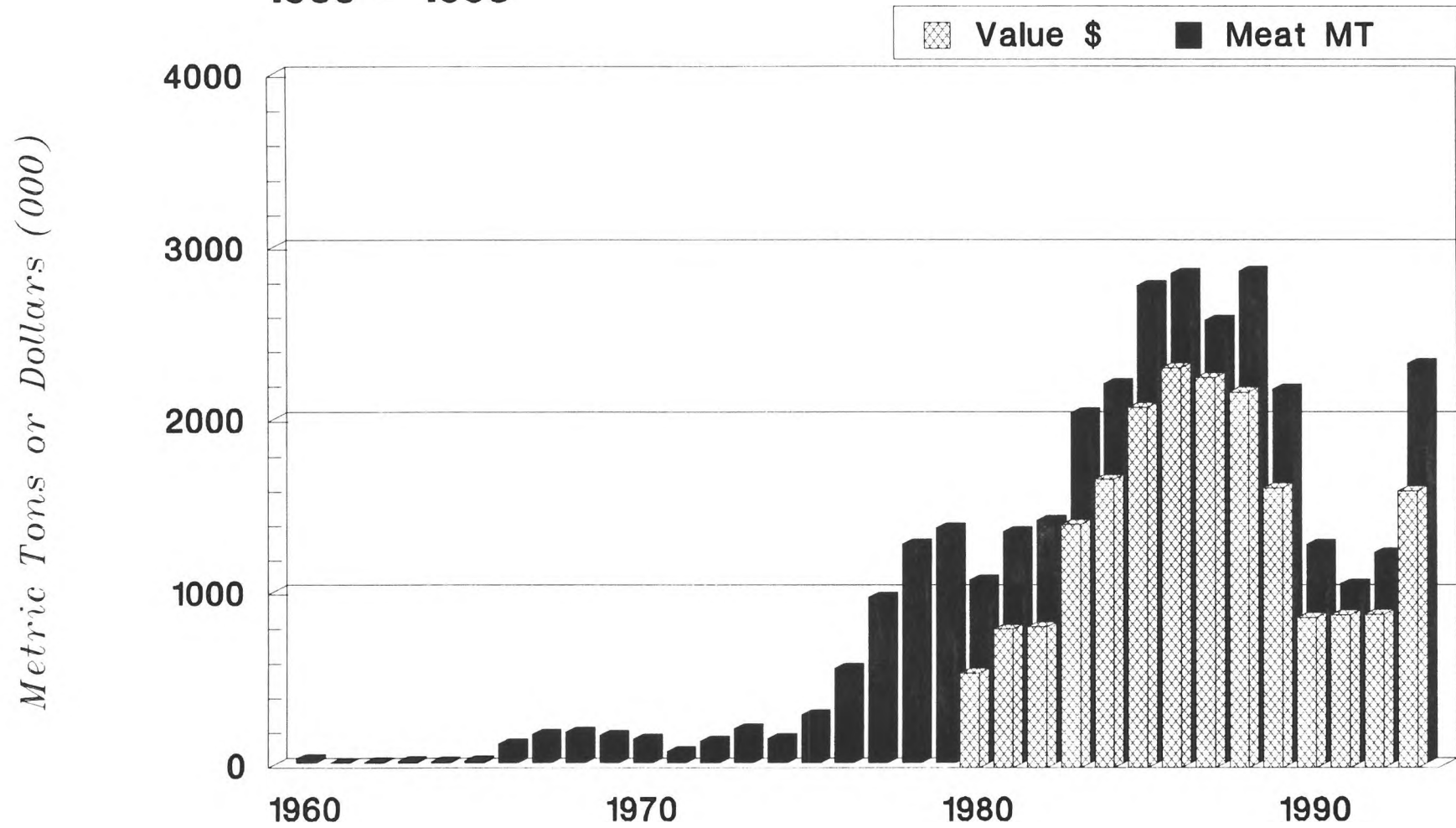


Figure 1.

MAINE MUSSELS Landings and Value

1960 - 1994

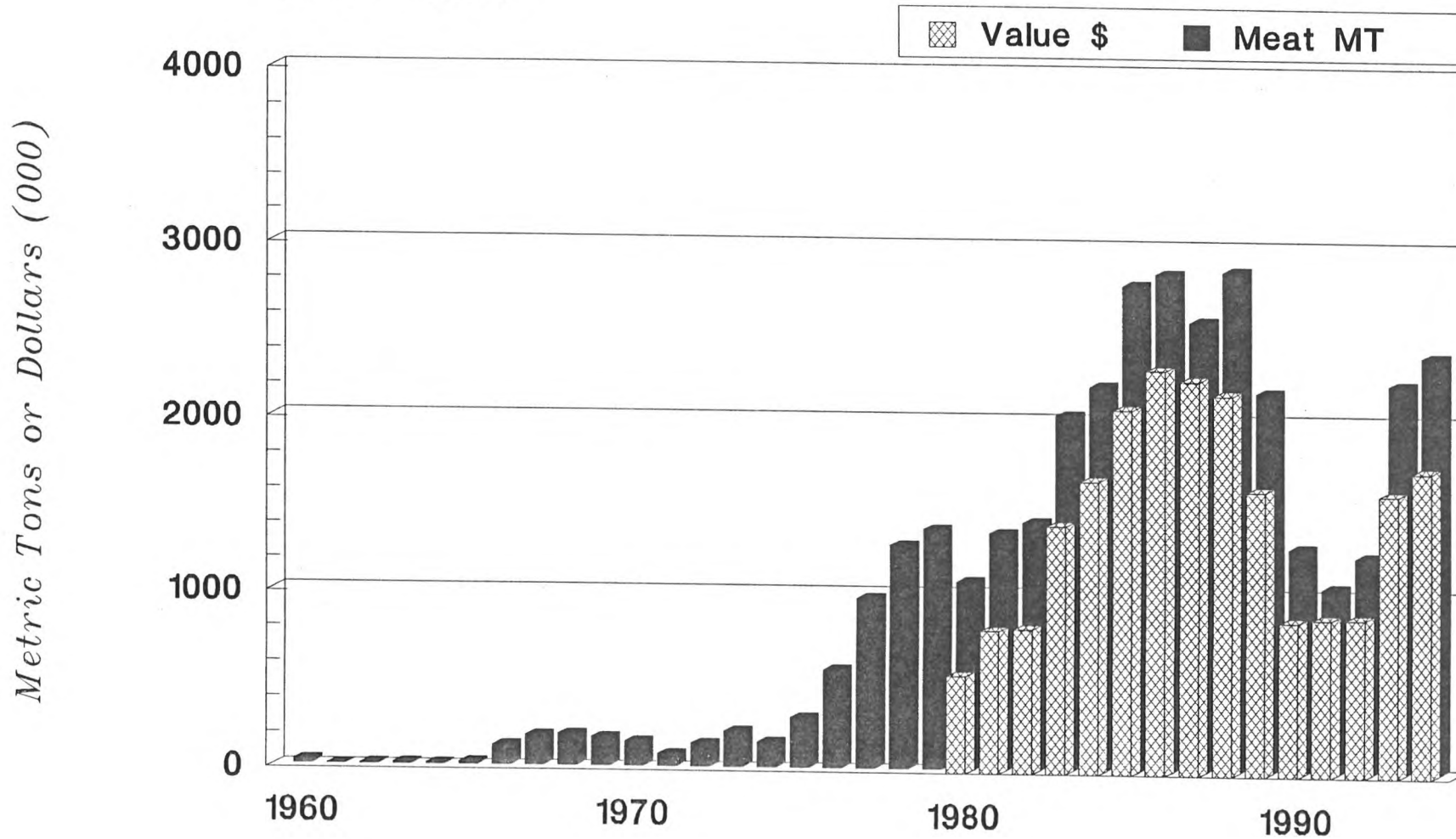


Figure 1.

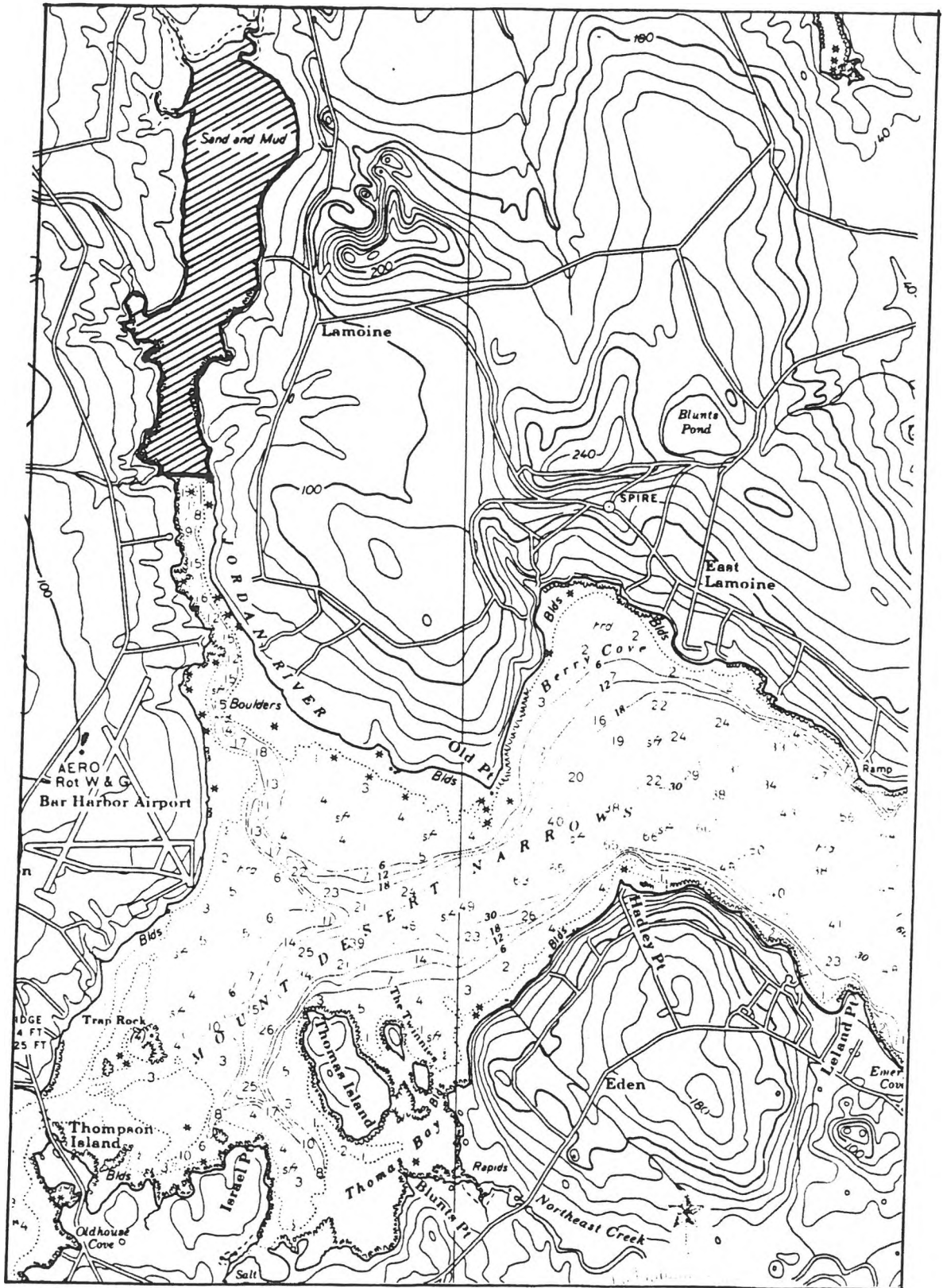


Figure 2. Jordan River seed mussel conservation area.

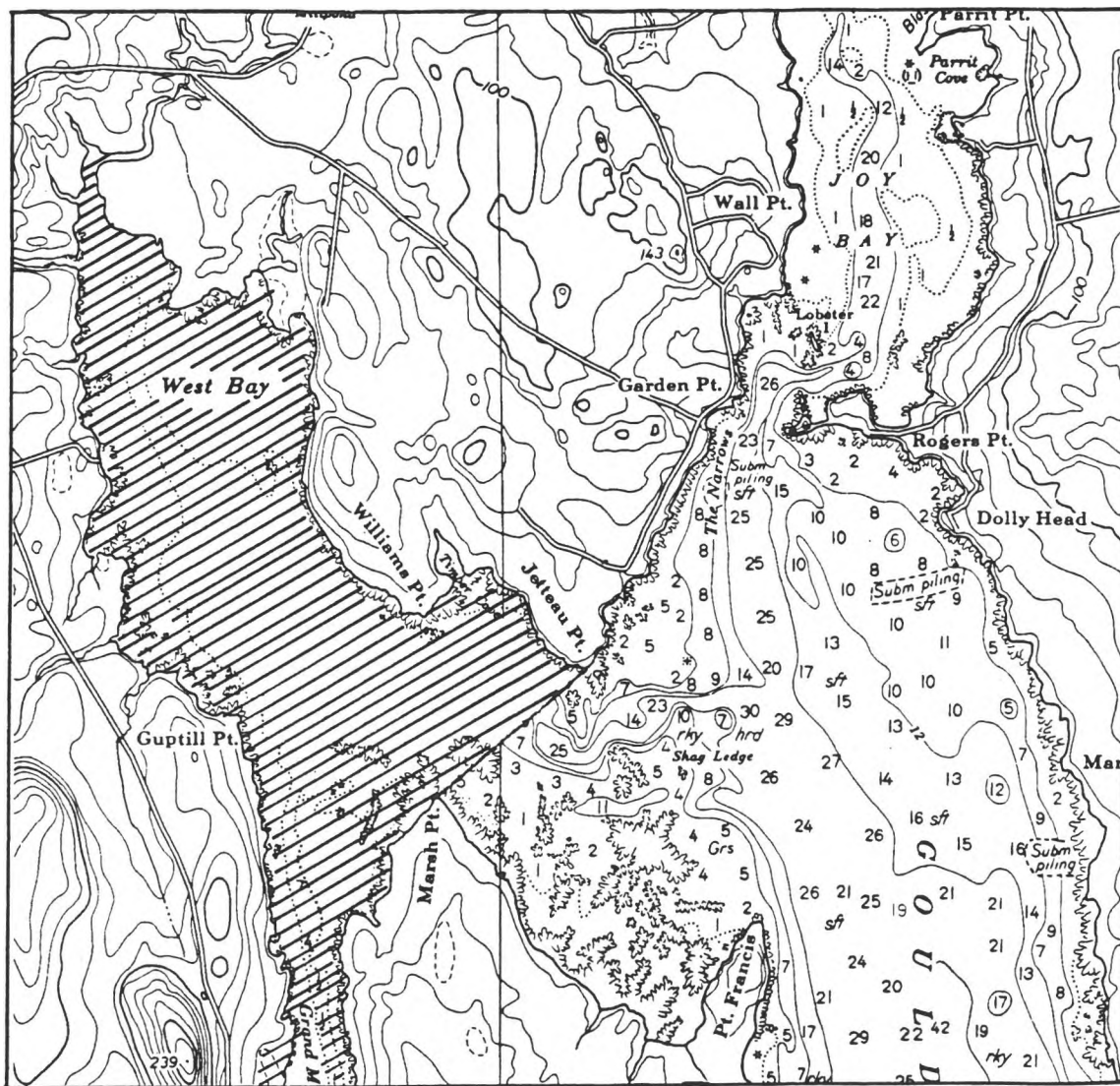


Figure 3. West Bay seed mussel conservation area.

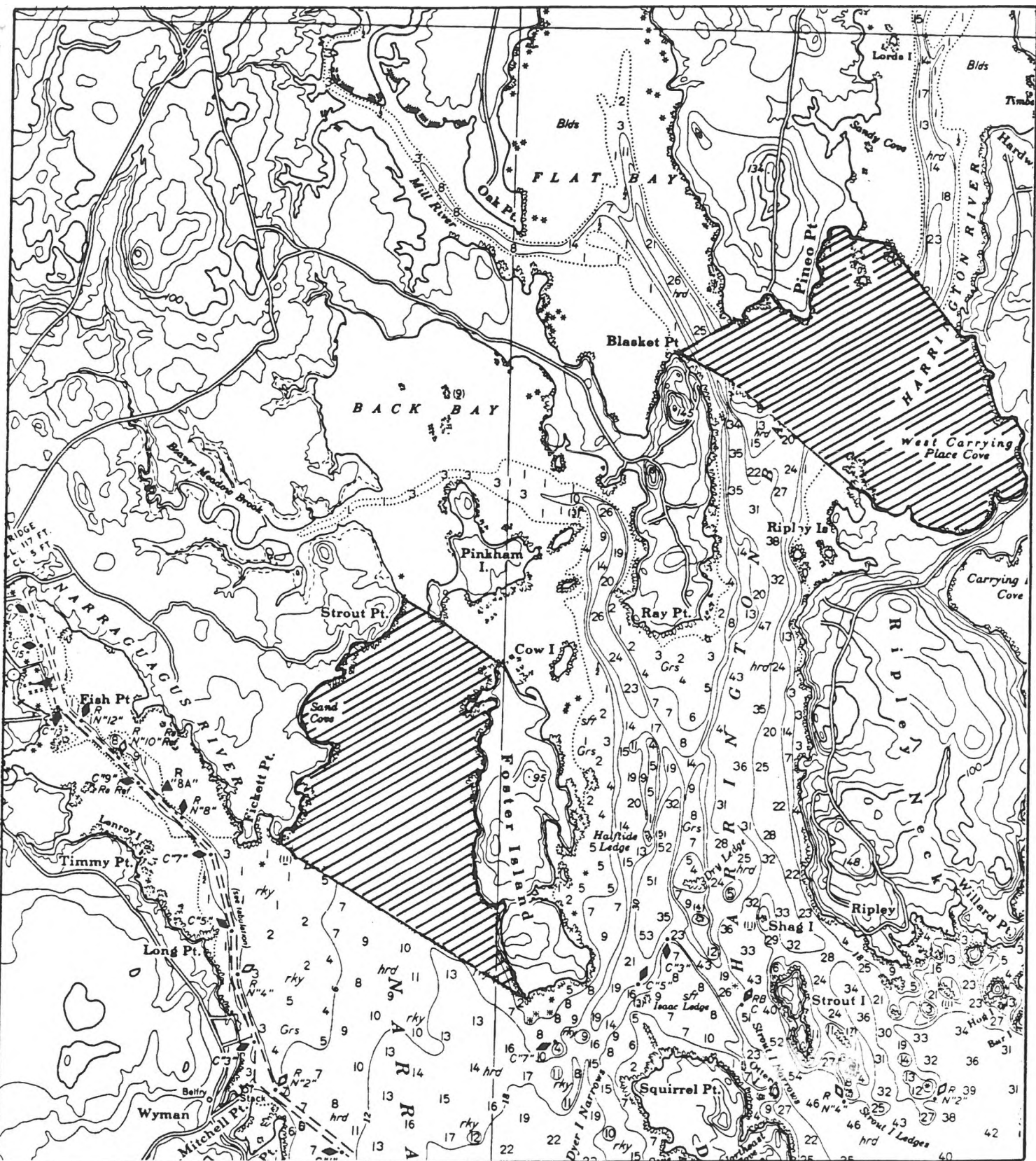


Figure 4. Narraguagus Bay and Harrington River seed mussel conservation area.

