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# Cultured Mussels of the Northeast

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## Introduction

Since the mid-1970s, blue mussels have been farmed first in Maine and then in Rhode Island, and into New Hampshire. Over the years mussels have gained in popularity as a seafood choice in fish markets and a menu item in restaurants throughout the region. The growing popularity of mussels as a tasty seafood choice is growing throughout the country, suggesting that the culture of mussels in the Northeast will increase to meet expanding markets. The purpose of this fact sheet is to provide an overview of the species of mussels being cultured in the region and to provide a summary of the nutritional aspects and the biology of these mussels.

## Mussels as Food

One of the factors contributing to the growing popularity of mussels as a food throughout the United States is their excellent nutritional value (Figure 1). Table 1 provides a guide of the relative composition of nutrients in a 100g (3.5 oz) portion of mussel meats, or the amount of mussel meat in about 0.45 kg (1 lb) of unshucked mussels. Mussels are relatively high in protein and low in fat, and the fat that they do have are of the omega-3 and omega-6 polyunsaturated type Essential Fatty Acids (EFAs) that are known to be healthy. For instance mussels have a relatively high ratio of omega-3 to omega-6 EFAs, which has been shown to be associated with lower incidence of cardiovascular diseases. They are also a very rich source of vitamin B-12, with a 3.5 oz. serving providing 200% of the recommended daily requirement for an average adult. However, mussels are also relatively high in cholesterol with a single portion providing nearly 10% of the adult daily requirement.

**Figure 1. Delicious and nutritious blue mussels, *Mytilus edulis.* Photo credit: American Mussel Harvesters, Inc.**

**Table 1. The nutritional composition of 100g (3.5 oz.) portion of raw mussel meats**

(Source: USDA Food nutrition tables (http://www.nal.usda.gov/fnic/foodcomp/search/).

| Nutritional component | Content in blue mussel |
|---|---|
| Calories | 86 |
| Protein | 14.4g |
| Total Fats | 2.3g |
| Omega-3 EFAs | 0.7g |
| Omega-6 EFAs | 0.03g |
| Cholesterol | 28mg |
| Carbohydrates | 3.3g |
| Calcium | 88mg |
| Magnesium | 37mg |
| Phosphorus | 236mg |
| Iron | 3.4mg |
| Thiamin | 0.16mg |
| Riboflavin | 0.21mg |
| B-12 | 12 mcg |

## Species of Mussels in the Northeast

Two species of blue mussel can be found in the water of the Northeastern United States, the locally native blue mussel *Mytilus edulis* and *Mytilus trossulus* that originated in the Northern Pacific Ocean. *M. trossulus* has been recently shown by genetic analysis to have entered the Atlantic most likely through the arctic some 20,000 years ago and is currently found alongside *Mytlus edulis* in Canada, and as far south as the Gulf of Maine (Rawson, 2009). Genetic researchers have found that the two species will readily form hybrids.

Although the two species of mussels are similar in appearance, there are some differences between the species of note. First, the shells of *M. trossulus* are reportedly thinner and more brittle than the shells of their *M. edulis* counterparts, making for greater breakage loss when mechanical processing equipment is used. Furthermore, the meat yields of *M. trossulus* is about 30% less than *M. edulis* cultured under identical conditions (Mallett and Carver, 1995). A combination of lower meat yield and the tendency of shell breakage considerably lower the economic value of *M. trossulus* mussels.

A 2001 study has shown that the percentage of *M. trossulus* in comparison to *M. edulis* declines the farther south one travels in the Gulf of Maine. The highest percentages of *M. trossulus* in the wild in the northeastern United States are found in the Pasamaquoddy Bay region of Northeastern Maine, and very low percentages are found south of the Jonesport region of the Maine coast and in the states further south (Rawson *et.al.*, 2001).

## Anatomy and Physiology of Mussels

An adult mussel may reach a maximum shell length of about 15 centimeters (about 6 inches) in undisturbed populations. They more typically reach shell lengths of about 10 centimeters (4 inches) in most areas as they grow while attached to surfaces in gregarious clumps (Figure 1) (Dolmer, 1998). Mussels attach themselves to hard surfaces or other mussels via a series of thin threads known as byssal threads (Figure 2). These byssal threads are synthesized by a byssal gland that is associated with the foot of the mussel, and they can be no longer than the length that the mussel's foot can extend outside the shell. The entire clump of byssal threads is known collectively as the byssus (Figure 3).

**Figure 2. Blue mussels attached in clumps to an aquaculture line. Photo credit: New Hampshire Cooperative Extension.**

A strong waterproof cement at the end of the byssal thread cements each of the threads to the attachment surface (Moesner and Carrington, 2006).

Like other economically important bivalve mollusks, mussels derive their nutrition by filter-feeding upon phytoplankton and particulate detritus from the water. Mussels filter particle sizes in the range of one to three micrometers (Bayne *et.al.,* 1987). Cells located on the gills of mussels have hair-like extensions called cilia that beat and create the water current that flows through the mussels, delivering food and oxygen. There is also evidence that mussels derive at least a part of their nutritional needs by direct absorption of small organic molecules directly from seawater as they pump seawater through their bodies (Manahan *et.al.,* 1987). Typically adult mussels will filter approximately two to three liters of water per hour while they filter feed and respire.

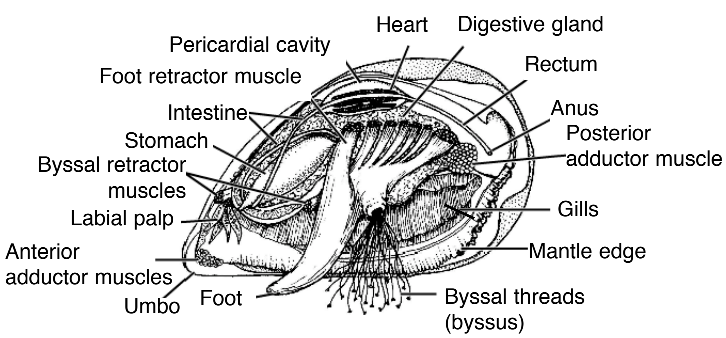


**Figure 3. Anatomy of the blue mussel, *Mytilus edulis*, showing the proximity relationship of byssal threads with the mussel foot. Diagram source: BIODIDAC (biodidac.bio.uottawa.ca)**

Because mussels are adapted to filter their food from low concentrations in the water, there are implications for aquaculturists interested in culturing these bivalves. Much of the entire farm production cycle must occur in coastal and estuarine waters where they can graze on natural phytoplankton and other naturally occurring particulate foods. The artificial production of live algal feeds for mussels in quantities to make indoor production feasible would be excessively cost prohibitive.

Details of farming mussels will be provided in the subsequent NRAC Fact Sheet in this series entitled *Mussel Aquaculture in the Northeast,* number 211-2010.

## Reproduction and Larval Biology of Mussels

Blue mussels exhibit separate sexes and spawn by broadcasting eggs and sperm into the water that join on fertilization to form planktonic embryos and larvae (Nelson, 1928). Mussels commence gonad ripening ranges from March to May when water temperatures reaches 6.5 to 8 degrees Celsius (44-47 degrees Fahrenheit), and they commence spawning in May or June when water temperatures are between 10 and 15 degrees Celsius (50-59 degrees Farenheit) (Chipperfield, 1953). Depending upon water temperature, mussel embryos and the subsequent larval stages remain in the water column from 10 to 14 days as they develop and disperse by action of tidal and wind-driven currents. Once the larvae pass through their trochophore and veliger larval stages, they develop a larval foot (pediveliger stage) and their swimming behavior changes such that they begin swimming toward the bottom and begin substrate-seeking behavior. Knowledge of the timing of mussel spawning and the duration of the pelagic larval stages can allow aquaculturists to collect spatfall or seed mussels as the larvae are setting and metamorphosing into attached juvenile mussels.

## Natural Predators of Mussels

Natural predators of mussels include birds such as loons and Eider ducks, starfish, crabs and various species of fish. In some locations where mussels are grown, considerable effort and expense is taken to prevent predation losses. Refer to NRAC Fact Sheets #180 and #00-007 for a more complete treatment of mussel predators and means to mitigate their impact.

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