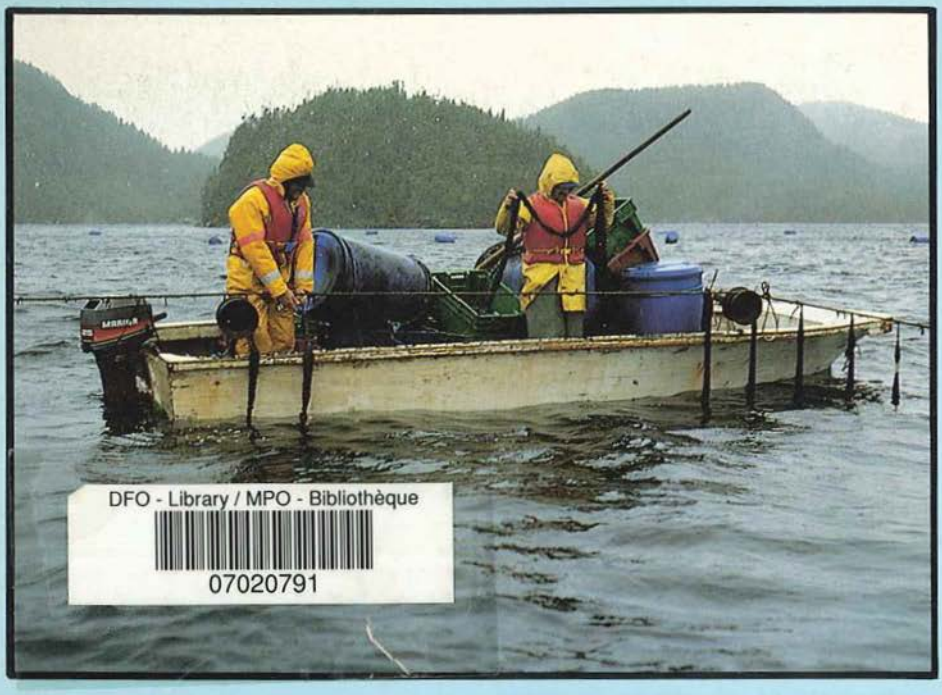


Aquaculture in Newfoundland — Publication No. 1

A GUIDE TO LONGLINE MUSSEL CULTURE IN NEWFOUNDLAND

Canada

Aquaculture in Newfoundland — Publication No. 1

A Guide to Longline Mussel Culture in Newfoundland

CONTENTS

This brochure was produced in response to a need for some basic information concerning techniques of longline mussel culture. Although primarily produced for the benefit of those interested in mussel farming in Newfoundland and Labrador, the information contained may also be applicable to aquaculturists in other regions of Canada.

The materials and methods used to culture mussels in Newfoundland and Labrador have been developed from existing technologies used elsewhere to suit local conditions.

Individuals requiring additional information on mussel culture or other types of aquacultural activity may contact the following:

Fisheries Development Division
Fisheries and Habitat Management Branch
Department of Fisheries and Oceans
Newfoundland Region
P. O. Box 5667
St. John's, NF
A1C 5X1
(709) 772-4438

LES TEXTES SONT
DISPONSIBLES EN FRANCAIS
SUR DEMANDE

March 1988

There are four distinct methods used throughout the world for farming mussels. They may be grown on protected areas of the seabed (**Bottom Culture**), on wooden poles sunk into the sea shore (**Pole or Bouchot Culture**), on ropes suspended either from floating rafts (**Raft Culture**) or from ropes attached to lines of floats (**Longline Culture**). Each method is adapted to suit particular coastal environments.

In Newfoundland, research and development conducted since the mid 1970's has centered on suspended culture methods. Early trials using rafts were generally less successful than those using longlines. The longline culture method is now used exclusively in the province and has been adapted to suit local conditions.

INTRODUCTION

Aquaculture, the farming of fish, shellfish and seaweed, is believed to have had its origins in China some 4000 years ago. Today it is an important component of the fisheries industries of many countries.

Although the cold waters off the Newfoundland and Labrador coasts limit the range of species which can be farmed, the province's long indented coastline and clean water provide favourable conditions for the farming of cold tolerant species.

Aquaculture is in its infancy in Newfoundland and Labrador. At present a number of species are either under investigation or in the early stages of commercial production. These species include Atlantic salmon, Arctic char, Rainbow trout, cod, scallop and mussels. Techniques for growing mussels are well established and sites for production are being developed at suitable locations all around the coast of the island portion of the province.

A GLOBAL PERSPECTIVE

Mussels are farmed in Europe, Asia, America, Australia and New Zealand. The major producing countries are Spain, Netherlands, Denmark, France, Korea and China. Spain, the leading European producing country, harvests some 250,000 tonnes of farmed mussels annually.

Mussel farming is a recent development in Eastern Canada. Only within the last five years has the growing of mussels become a significant commercial operation. The first farms were established in Prince Edward Island followed by Nova Scotia. More recently, commercial operations have been started in New Brunswick and Newfoundland. Total sales from the Atlantic Provinces were an estimated 1845 tonnes in 1987, with a farm sale value of 3.4 million Canadian dollars. Production in Newfoundland has increased significantly from some 15 tonnes in 1984 to 140 tonnes in 1987.

FARMED MUSSEL PRODUCTION IN THE ATLANTIC REGION OF CANADA (Estimates for 1987)

	Tonnes
Prince Edward Island	1000
Nova Scotia	600
Newfoundland	140
Quebec	60
New Brunswick	45
TOTAL	**1845**

THE BLUE MUSSEL

The blue, or bay mussel, (**Mytilus edulis**), is the predominant mussel species cultivated world wide.

It is a bivalve (2-shelled mollusc) and is related to scallops, clams and oysters. Other molluscan relatives are the periwinkles, snails, whelks and squids. The blue mussel, like other bivalve molluscs, is a filter feeder. It pumps large volumes of water between its shells and filters organic matter for food. Food filtered from the water includes plant and animal plankton and other microscopic marine organisms.

Newfoundland is near the centre of the distribution range of the mussel on the east coast of North America. This range extends from South Carolina to Baffin Island. Extensive wild mussel beds are found in many Newfoundland coastal areas.

Growth rates of wild mussels vary greatly and are dependent on many factors including: water temperature, salinity, current, available food, location and competition. In Newfoundland waters growth occurs mainly from April to November. Water temperatures during the winter months and temperatures above 20°C appear detrimental to growth.

Growth rates are generally slow in wild mussel populations when compared with those of cultured mussels. Wild mussels, growing in the intertidal coastal zone may be six - eight years old before reaching a length of 50 - 70 mm.

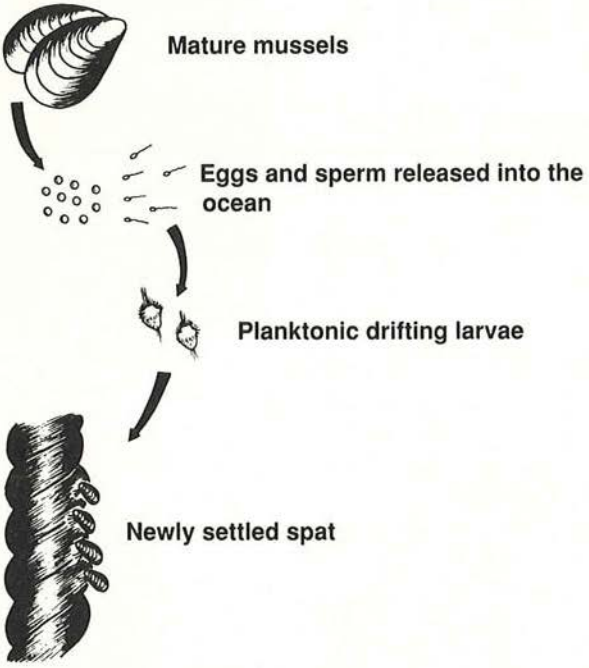
Mussels Growing on Socking

Cultured mussels achieve the same growth in 24 - 36 months.

In Newfoundland spawning usually occurs between June and September, however, the time may vary. Mussels usually spawn when they are two years old. Each female is capable of producing up to 25 million eggs. The eggs are fertilized by the sperm of the male and the resulting larvae are planktonic for approximately three weeks before they settle to the bottom. At this

stage the mussels (now called spat) are about 0.5 mm in length. The time of spawning is variable. Collection of these young mussels (spat) is the first step in mussel farming. Before taking this first step potential farmers should consider the other steps and requirements in the farming process.

Life Cycle of the Mussel



Site Requirements

To engage in mussel farming in Newfoundland a suitable, approved site is required.

Approval for mussel farm sites must be obtained from the provincial fisheries department. The mussel farm must not interfere with navigation, or with fixed or mobile gear fisheries. Additionally, the farm site must be inspected by the Environmental Protection Service, Environment Canada, to ensure the waters are clean and free of pollution.

Ideal mussel farm sites are free from moving ice, water pollution, boat traffic and fishing activity. Narrow, deep protected inlets and bays are favoured locations. When considering a possible farm site the following factors should be checked:

- the ice movement in the area
- potential conflict with local fisheries
- possible sources of pollution
- tidal exchange
- water depth

The presence of a healthy wild mussel population is indicative of a favourable site. Personnel from federal and provincial fisheries departments are able to provide useful information of value in assessing a potential mussel farming site. Most farmers evaluate a site by starting small and measuring spat collection and mussel growth over a one to two year experimental period.

EQUIPMENT

Longline mussel culture requires four basic materials:

- Rope for mainlines and collectors.
- Mussel socking in which to sock the seed mussels.
- Floats to support collectors and socks.
- Anchoring system to anchor the farm in place.

The basic system consists of a longline (13-15 mm rope) anchored on both ends and supported by styrofoam or plastic floats. The longline may be anchored using bottom anchors or shore fastenings. Shore fastenings are less expensive and are accessible for inspection and maintenance. This system is similar for both the spat collection and the growout stages. The main difference is the use of rope collectors for spat collection and the use of mussel socking material for the growout stage.

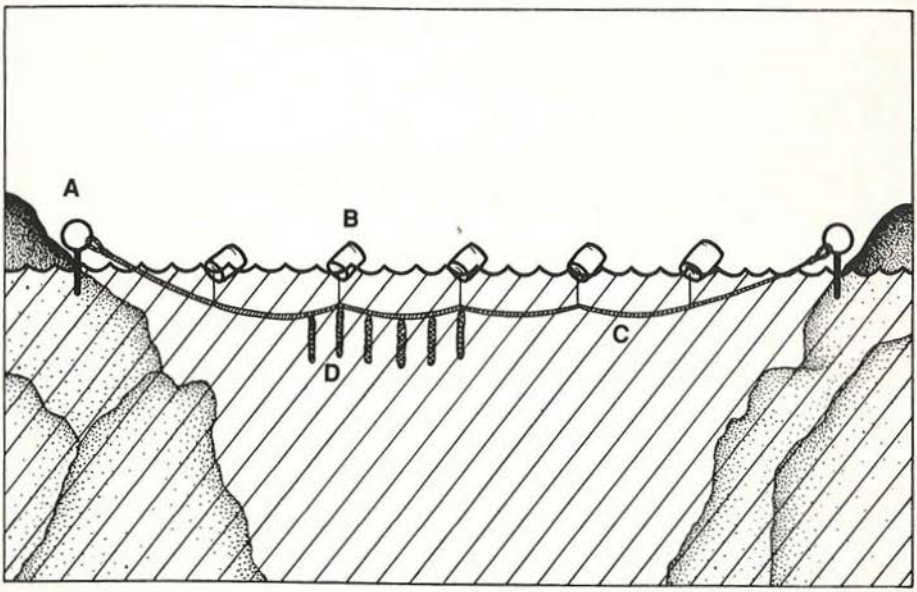
Pieces of used rope two to three meters long, weighted at the end, spaced at two to three per meter on the longline is the most common spat collecting material. Other materials have been developed but farmers in Newfoundland prefer ropes due mainly to performance and availability.

Mussel socking, used for growout, is available in a variety of mesh sizes. The mesh sizes most frequently used are 11 mm, 20 mm and 25 mm. The mesh size selected is dependent on the size of the available spat. Choice of mesh size is critical.

Installing a Shore Fastening

Types of Float

Mussel Longline



A - Shore mooring
B - Floats
C - Longline
D - Suspended mussel socks

Float Attached to Longline

Production Cycle

Longline mussel culture is a two stage operation. Firstly, spat (seed) is obtained by hanging collectors in the ocean prior to the time of spawning. After spat have settled and grown to a minimum size of 10 mm they may be stripped from the collector and placed into mussel socks. A simple socking table is used in this stage of the operation. After the sock is filled the spat must be able to migrate through the mesh for attachment and subsequent growth. The young mussels reattach by means of their byssal threads to the outside surface of the socking material. Experience in Newfoundland indicates that the optimal density for filling socks is within the range 800 - 1000 spat per meter.

The production cycle to a minimum market size of 50 mm shell length ranges from approximately 24-36 months in Newfoundland.

Collection	Year 1 (April-June) Place collectors into ocean
Transfer	Year 1 (Oct.-Nov.) (or) Year 2 (April-May) Strip Collectors Fill Mussel Socks
Grow Out	18-24 months
Harvest	Year 3 (Spring) 24 Month Cycle (or) Year 3 (Fall) 30 Month Cycle (or) Year 4 (Spring) 36 Month Cycle

Spat Growing on Rope Collectors

HARVESTING

Mussels may be harvested when they reach the minimum market size of 50 mm and minimum meat yield of 40 percent. A marketable product is reached in approximately 24-36 months in Newfoundland.

Harvesting is difficult, hard work. A mussel sock, at harvest can weigh 10 kg or more per meter when lifted. This means a standard three meter mussel sock will weigh 30 kg or more. These heavy socks must be pulled from the water, placed into a fish box and transported to a processing facility. Individual farmers have designed and developed specialized machinery to facilitate winter or summer harvesting. A continuation of these development efforts will hopefully lead to increased mechanization of harvesting.

Harvesting is dependent, not only on size, but also on the meat yield of the mussels. The highest meat yields are obtained in the six months prior to spawning. After spawning, mussels can lose as much as 50 percent of their meat content.

A practical estimate of the market meat yield from mussels may be determined by steaming a sample of 25 mussels for a period of five minutes, (until the shells open and the meat is cooked). Meats are then removed from the shells, drained and weighed. The drained shells are also weighed. Market meat yield is calculated from the following equation:

$$\text{Percent Market Meat Yield} = \frac{\text{Weight of Steamed Meats}}{\text{Weight of Steamed Meats plus Weight of Shells.}} \times 100$$

Mussels Ready for Harvesting

Harvesting Mussels in Winter

Stripping Spat off Rope Collectors

Experience has shown that farmers can:

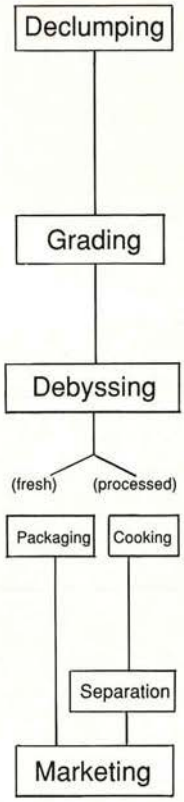
- expect one growout sock from one rope collector (minimum)
- expect to harvest five - six kg of marketable mussels per meter of mussel sock, after undersize mussels are removed
- expect growth rates to vary considerably on different farm sites in different parts of the province.

Attaching Socks to Longline

PROCESSING

When harvested, each mussel sock contains a variety of sizes of mussels, empty mussel shells, and a combination of other marine plants and animals. Extraneous material and undersized mussels (less than 50 mm shell length) must be removed and the marketable mussels washed, cleaned, debyssed and packaged prior to marketing.

Processing stages are very similar for mussels marketed as a live fresh product or as a cooked processed product. The additional steps of cooking and shell removal are required for a processed product. A flow chart illustrates the steps involved in processing:



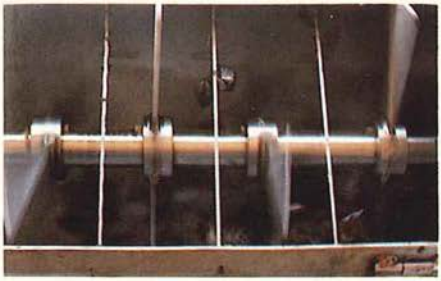
Mussels are hand stripped from socks, washed and drum-rotated to break up clumps.

Mussels are size separated through a bar grader.

Mussels are debyssed by rolling bars.

Mussels are cooked using high pressure steam.

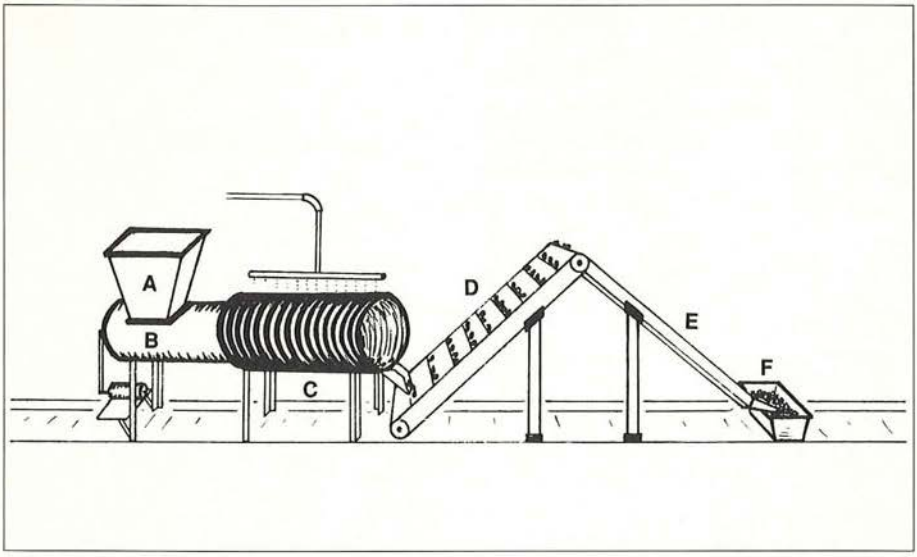
Meats are separated from their shells



Declumper

Debysser

Mussel Processing Line



(A) Hopper, (B) Declumper, (C) Washer and Grader, (D) Conveyor Belt, (E) Debysser, (F) Washed, Graded, Debyssed Mussels.

MARKETS

Mussels may be marketed live, fresh or as a processed product. Mussels sold outside Newfoundland must be processed in an approved, licensed fish processing facility.

Local mussel growers may be able to market a small quantity of live, fresh mussels in their local area. The large percentage of mussels farmed will likely be sold to other companies for cleaning, grading, packaging and marketing.

Existing markets for live, fresh Newfoundland mussels include Central and Western Canada. Future opportunities exist to export live, fresh and processed mussels into the United States and possibly Europe.

A variety of processed mussel products are available in the marketplace. These include; bottled and canned marinated mussels, canned mussels in oils or sauces, frozen shucked mussels and mussels frozen in the shell. New product developments will likely see microwavable packaging and a variety of convenience vacuum packaged products.

Considerable product development work needs to be undertaken to ensure Newfoundland grown mussels obtain an appropriate share of Canadian, United States and European mussel sales.

Shucked Mussel Meats

NOTE

The sale of mussels and mussel products are subject to several government rules and regulations. Producers, buyers and sellers of these products should ensure that these requirements are met. Information concerning current requirements can be obtained from the appropriate Federal and Provincial Departments.

Economic Considerations

Production costs will vary greatly for individual mussel farmers. Farmers should prepare a thorough business plan for their specific farm operation. Mussel farming should be viewed as a serious business venture and time taken to carefully assess capital costs, operating costs and sales outlets before investing time and money.

Capital and operating costs will be lower if the selected site is ice free or has shore fast ice. These sites will avoid additional costs for submerging gear in winter and will permit the use of the more economic shore to shore production system.

An estimation of capital costs and a five year income projection for a 5000 sock farm (75,000 kg. annual production) is provided.

Assumptions used to arrive at the estimation below are that:

- The farm is family run, thus labour and other operating costs are not accounted.
- Floats are 200 L plastic containers.
- One collector provides spat for one growout sock.
- A boat and motor is available from the farm owners.
- The mussels are sold for 65 cents per kilogram.
- The farm produces 15 kg of marketable mussels per sock.
- Growing cycle is 36 months.

	Year 1	Year 2	Year 3	Year 4	Year 5
Floats	2000	4500	4500	—	—
Ropes	2500	1350	1350	—	—
Stocking Material	—	1500	1500	1600	1700
Anchorage	500	500	500	—	—
Contingencies	500	650	650	700	800
Total Capital Cost	5500	8500	8500	2300	2500
Income (Sales)	—	—	50000	50000	50000

(ALL VALUES ARE IN CANADIAN DOLLARS)

SUMMARY

Potential exists for the establishment of new mussel farming enterprises in Newfoundland. There are numerous suitable sites and appropriate methods for growing mussels have been successfully developed. Blue mussels are an ideal species to be grown in the province. Farmed mussels have clean, thin shells and are generally free from grit, sand and pearls. They may be selectively harvested when meat yields are high. These features combine to make the farmed mussel an attractive and superior product when compared with wild or bottom cultured mussels.

Traditions of consuming mussels are not well established in North America. The future success of mussel culture as a viable fisheries operation will undoubtedly rest on the development of new mussel products and their successful promotion in a competitive market place.

— Notes —

Fisheries and Oceans

Peches et Oceans

Prepared by:

Boyd Smith and Stephen Goddard
Department of Fisheries Technology
Marine Institute
St. John's
Newfoundland
A1C 5R3