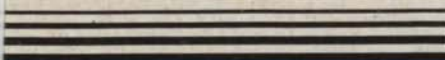





Fishing for Quality — Publication No. 3

HANDLING AND PROCESSING FEMALE CAPELIN IN NEWFOUNDLAND

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The Newfoundland fishery for roe-bearing capelin began on a commercial basis in the late 1970's. Many of the handling, holding and transporting practices in use are not the best, and have occasionally created problems for both fishermen and processors.

This brochure is designed to provide fishermen and others with information on the best methods for handling and holding female capelin to maintain top quality. It examines problems of product freshness, feed content, over-mature roe, etc. affecting the processor. The booklet attempts to give all those involved a broad overview of the capelin fishery.

Persons requiring further information on handling and processing female capelin, or having suggestions, should contact:

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

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DISPONIBLES EN FRANCAIS
SUR DEMANDE

April, 1986



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INTRODUCTION

The commercial capelin fishery in Newfoundland started in the early 1970's, and 1972 saw the first substantial foreign off-shore capelin fishery. By 1975 off-shore landings had climbed to a whopping 367,000 metric tonnes. Canada subsequently lowered foreign offshore capelin quotas dramatically; by 1985 the total quota had been reduced to 16,600 metric tonnes.

The Newfoundland inshore female capelin fishery for the Japanese market has grown tremendously in its short history. Frozen female capelin product sales have increased from 369 metric tonnes valued at less than one million dollars in 1977 to a record 18,500 metric tonnes valued at approximately \$30 million in 1984. By May of 1986 the province appeared headed for a record year, with production in the coming season predicted to reach or exceed 25,000 tonnes of female capelin valued at over (Cdn.) 50 million.

This fishery is unique in that it requires so many comprehensive checks prior to taking the catch onboard. Mistakes in checking can often lead to rejection of the catch.

There are five areas of concern:

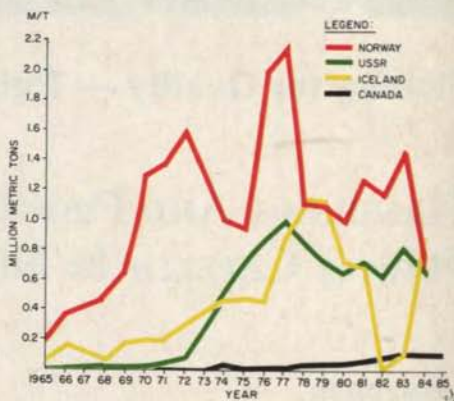
1. Checking the percentage of females, and their quality, prior to taking the catch on-

board.

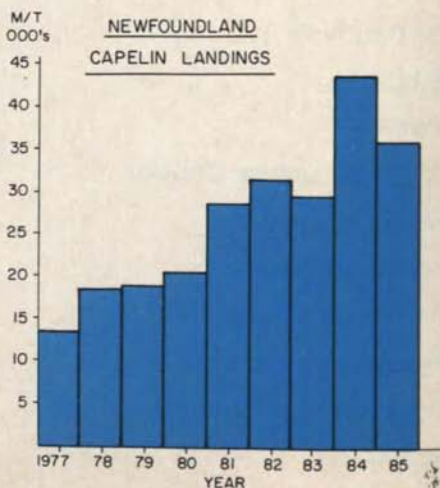
2. Loading and onboard holding.
3. Off-loading.
4. Handling and holding onshore.
5. Transportation.

Improper or careless procedures in any of these areas will likely result in inferior quality capelin arriving at the processing plant.

CAPELIN LANDINGS BY
MAJOR CAPELIN COUNTRIES



NEWFOUNDLAND
CAPELIN LANDINGS





Female Capelin (Top) Male Capelin (Bottom)

BIOLOGY

The capelin (*Mallotus villosus*) is a small silvery pelagic fish, 13-20 cm. long at maturity, found throughout Arctic and Sub-Arctic waters of the Pacific and Atlantic oceans. Widely distributed throughout the Northern Atlantic, they are found in great abundance off eastern Newfoundland and Labrador. Capelin are an important food source for many forms of marine life.

Capelin spend most of their lives offshore. After a three to four-year growth period, four of the five major eastern Canadian stocks migrate inshore to spawn.

About a month before the spawning season, external sexual characteristics develop on the male. Spawning ridges down the sides and larger fins give the males a robust appearance compared to the more delicate silver coloured female. During the rest of the year, the sexes are almost indistinguishable. Capelin spawning inshore prefer water

temperatures of 5.5°C. to 8.5°C. Most capelin die after spawning and eggs start hatching in about 15 to 20 days.

During the June-July inshore spawning season, roe of the female is ripe and the brief but very valuable Newfoundland inshore fishery takes place. This fishery is directed towards supplying mature roe-bearing capelin for the Japanese market.

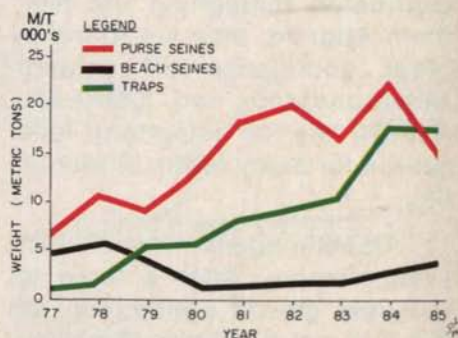
FISHING

Historically, capelin provided food for home consumption, fertilizer for farming, and bait for other fisheries.

A new inshore commercial fishery by Newfoundlanders has annual landings currently in the range of 30,000 to 40,000 metric tonnes. Harvesting is done mainly from trap boats, and a fleet of about 200 purse seiners under 20 m (65 ft.) long. A small number of larger purse seiners also fish capelin in western Newfoundland waters. Other fishing gears such as beach and bar seines are used to a limited degree.

The Department of Fisheries and Oceans is responsible for managing and regulating the capelin fishery, and as part of this mandate, DFO establishes quotas and season opening dates. Over the past few years attempts have been made to have the opening date coincide with acceptable market levels of roe and feed.

NEWFOUNDLAND
CAPELIN CATCH (METRIC TONS)
BY GEAR TYPE AND YEAR



Purse Seining Capelin



Trapping Capelin

SPOILAGE AND ITS CONTROL

When caught, female capelin have a firm elastic texture, mild characteristic odour, bright silvery sheen on the sides, and a glossy olive to bottle green colour on the back. After a few hours at 10°C. capelin pass through various stages of slow decay and become softer, tackier and less resilient in texture. They develop a stronger odour and a dull appearance with a loss of sheen.



Capelin on the left are of top quality, while those on the right have begun to lose their sheen.

There are three major causes of fish spoilage:

- 1. Digestive Enzymes:** After death digestive acids and enzymes attack the body cavity, causing a softer texture and discolouration in surrounding fish flesh. This is a problem most often seen in round, gut-in fish like capelin.
- 2. Micro-organisms:** Found in the surface slime, the gills, and intestines of healthy fish, spoilage bacteria multiply and cause deterioration soon after the fish die. It is these micro-organisms that cause the strong odour and poor taste of low quality fish.
- 3. Fat Oxidation:** Rancidity occurs when air mixes with the fish's unsaturated fatty acids over a period of time, leading to poor flavour and appearance.

Temperature is the best weapon in the battle to reduce these three major causes of spoilage; chilling is the best method to prolong high quality. Avoid exposure to the elements and quickly chill the catch.

HANDLING ONBOARD

1. Quality Considerations:

Prior to the start of the in-shore capelin fishery, fishermen should learn the exact buyer specifications. Once the fishery is opened and a successful set is made, certain tests can be performed onboard the vessel to see if the catch meets these specifications. The catch is tested for:

A. Percentage of Female Capelin:

Accuracy in determining the percentage of females in a mixed catch can only be achieved by weighing. However, a rough indication of the percentage of females may be determined onboard without weighing. Fill a bucket completely with capelin, then dump and sort into male and female. The females are then returned to the bucket. A half full bucket indicates 50 percent female. Accuracy can be increased by repeating this procedure several times. Remember, the higher the percentage of females, the more valuable the catch.

B. Spent Female Capelin:

Spent capelin are those that have spawned and contain no eggs; they are most common towards the end of the season. Spent females are very thin compared to the

plump, full, roe-bearing capelin. To determine the percentage, count the number of spent capelin in a representative sample of 100 females. Fishermen should be aware, however, that buyers may determine percentage of spent capelin by weight rather than number.



Fisherman Checking Catch

C. Feed in Female Capelin:

There are several types of feed found in female capelin, including red feed (the most common), consumed roe, digested feed, and black feed. Japanese specifications will usually tolerate 10% feed. To determine the feed percentage in a catch, take 100 roe-bearing capelin and separate the heads by pinching through the neck area. The stomach comes out attached to the head. If the stomachs of more than 10 females contain feed, the whole catch

may be rejected. Very small amounts of feed may be overlooked by the Japanese depending on buyer, capelin freshness, and market conditions for the year. The red feed problem is generally more pronounced at the beginning of the season.

D. Maturity of Roe:

The Japanese prefer Newfoundland female capelin to contain a minimum of 15 percent mature roe by weight; 15 to 25 percent mature roe may normally be found in capelin prior to spawning. However, one or two days before spawning the roe becomes soft and watery. This is a condition common towards the end of the season.

To determine the maturity of the roe, use the 100 capelin tested in the feed check. Force the roe through the belly opening in the head area. If the roe is granular and can be picked up in one piece it is considered mature. If the roe is watery it is over-mature. On extraction, separate the mature roe from the over-mature roe so that a percentage judgment can be made. Accuracy can be determined only by weight.

2. Loading the Capelin Vessels:

Capelin are usually removed from the seines or traps with a large dip net known as a brailer. The use of fish pumps for food capelin is not recommended, as pumps that



Capelin with No Feed



Capelin with Feed



Mature Roe (Top): Over-Mature Roe (Bottom)

operate poorly can bruise and damage the catch. However, the large mobile fleet (vessels over 20 m) on the west coast of Newfoundland are using large fish pumps successfully.

3. Holding Onboard:

Newfoundland capelin fishermen are fortunate; they can often secure and unload at nearby processing plants quickly (under 3 hours), thereby ensuring the highest possibility of top quality landings. But there can sometimes be long, and costly, delays. Deep bulk storage should be avoided whenever possible, as it causes compression, bruising, increased spoilage and higher drip loss. This could result in a catch being rejected, especially when it has not been chilled. Most small vessels are unsuited to immersion chilling methods. In these vessels, ice should be spread on the bottom of the hold, and some ice kept to lightly mix with, and cover, the catch.

With open boats, ice should be spread on the catch prior to covering to retain top quality. Careful onboard handling protects the value of your catch.

Onboard immersion cooling of the catch in cold sea water takes two forms:

- (a) The refrigerated sea water (R.S.W.) technique involves chilling and holding the catch near the freezing point. These systems are designed mainly for large vessels. Insulated tanks containing cool sea water are fitted with a refrigeration system consisting of sea water circulating pumps with filters and tank dividers.

- (b) Chilled sea water (C.S.W.) systems are very popular in some pelagic fisheries involving small seiners and use a sea water/ice combination. Chilled sea water is prepared by using one part ice plus one part sea water. One part C.S.W. to 2 to 3 parts fish makes an excellent cooling medium. Ideally, flaked ice and sea water should be mixed together onboard. The fish holds of small vessels should be divided, water tight, and insulated for maximum effect.

Pressurized air pumped into the R.S.W. or C.S.W. fish holding units agitates the water or ice/water mix around the fish and enhances uniform chilling throughout.

The holding of any pelagic species in chilled sea water has major advantages over bulk icing methods. There is faster cooling due to complete contact of fish with C.S.W. Other advantages include reduced pressure on the fish, lower holding temperatures, less ice pitting and cleaner fish.

4. Sanitation:

All vessels and holding containers should be maintained

to high standards of cleanliness. Thorough cleaning is essential after each use. The provision of an acceptable water supply, and the hygiene of fishermen are also important factors affecting catch quality.



Capelin Held in Chilled Sea Water (C.S.W.)

HANDLING ONSHORE

1. Quality Concerns Onshore:

In recent years representatives of Japanese trading companies have become actively involved with onshore quality control.

Representative samples of female capelin are taken to determine freshness, percentage feed, roe content, mature roe, count per kilogram, damaged catch and undersized and spent females. Based on these findings, a decision is made to purchase or reject the catch.



Japanese Technician

2. Determining Female Percentage Onshore:

Most plants take several samples and average the results, as a greater number of samples insures higher accuracy. Samples are taken throughout the catch using a consistent sampling pattern to determine female percentages.



Checking Percentage Female Onshore

3. Unloading:

All the capelin from the small mobile fleet and open boats are unloaded using the brailer. The smaller the load and mesh size in each brailer, the less chance of pressure on the fish, and the better the opportunity to ice the catch.



Unloading

4. Holding Onshore:

Most capelin landed in Newfoundland are processed with little delay, and the high quality characteristics are locked in on freezing. Occasionally, during heavy landings, decisions are made to hold some catches onshore for several hours prior to processing. In certain operations, the current icing procedure is inadequate to prolong optimum quality.



Capelin in Boxes on Wharf

Landings are containerized onshore using covered, insulated containers with drainage plugs. When processing delays do occur the catch can be properly chilled while unloading.

Ice is most effective while melting and should be spread thinly throughout the catch to draw out the capelin's body heat. This, in turn, lowers the temperature quickly and slows the spoilage process. Using heavy layers of ice chips may cause the ice to fuse together, reducing its ability to melt properly.

Some plants first weigh the container of capelin without ice to avoid weighing problems. A deduction is then made for container weight and drip. Immediately after weighing, ice is placed over the top capelin, and the container is topped up with sea water. This practice has proven to be inadequate. A complete mixing of ice with capelin after weighing can be accomplished while dumping from one container to another, but this practice damages some of the delicate female capelin, reducing product value.

Ideally, chilling of a capelin catch should occur during unloading. A pre-measured weight of ice should be lightly spread among the capelin as each container is filled.

Approximately 90 kg (200 pounds) of ice lightly mixed through 450 kg (1000 pounds) of mixed capelin, weighed and quickly topped with sea water will fill a 27 cubic foot covered insulated container. This is sufficient to lower the temperature of the capelin and sea water from 10°C. (50°F.) to 0°C. (32°F.) and maintain that temperature for several hours. Thus, if 450 kg (1000 pounds) of ice in an insulated container is located near the landing site just prior to unloading, it will adequately ice 2270 kg (5000 pounds) of mixed capelin, or 5 containers. A standard pan, holding a given weight of ice when filled, can be used as a measuring guide. On the weighing scales, 90 kg of ice is deducted from each container. Immediately after weighing, the container is filled with sea water. The mixed capelin uniformly experience the chilled sea water effect throughout. Use new ice to avoid fusing; both fresh and salt water flaked ice give excellent results.

capelin long distances by flatbed trucks results in a severe quality loss and is not recommended. Chilled sea water tanker trucks are also used to a limited extent.

5. Trucking:

Containerized trucking is a popular method of transporting capelin in Newfoundland. Covered, insulated containers are generally prepared to receive a catch by filling them 1/3 full with ice and sea water (slush ice mix). Transporting un-iced



PROCESSING IN NEWFOUNDLAND

The objective of plant management is to produce, at capacity, marketable top quality frozen female capelin packs quickly and efficiently.

During the two to three-week capelin spawning season, good communications between fishermen and processors is crucial to regulate capelin landings. If a plant purchases more capelin than it can effectively freeze, low and reject quality product results.

The sorting of the reject capelin (including males) from the prime roe-bearing capelin in

the mixed lot is the most crucial step in this process. When processing top quality capelin usually male capelin only are removed on sorting. Towards the end of the season, however, sorting becomes more difficult as undersized and spent females become more common in the catch. If low quality capelin were allowed to be processed, sorting would slow considerably with higher instances of broken and blemished females, and females with ruptured bellies.



Mechanically Sorting Capelin

IN-PLANT PROCESSING

In Newfoundland, capelin processing involves six steps: weighing mixed catch, sorting, weighing and packaging females, freezing, strapping and coding and cold storage.

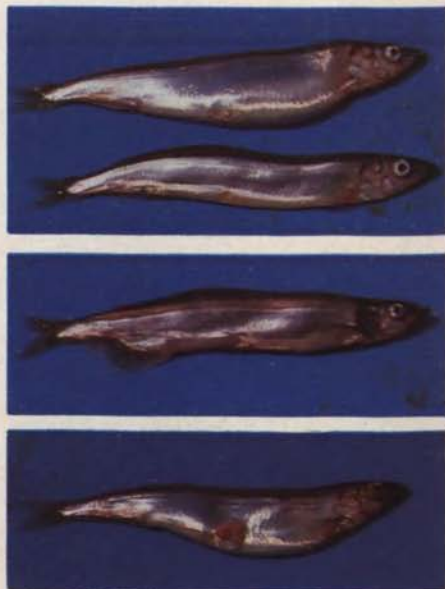
When processing starts, the main task facing the plant is the separation of males and reject females from the roe-bearing capelin. Ten-kilo cartons of 100 percent roe-bearing female capelin are the most popular pack. In each poly-lined carton, extra weight or an over-pack of 5 percent is included. If otherwise, top quality capelin are processed with feed and over-mature roe exceeding set standards, heavier over-packs are requested resulting in longer freezing times. Packaged capelin are frozen in either air-blast or multi-plate freezers. After strapping and coding the product is placed in cold storage.

MALE CAPELIN

In Newfoundland, male capelin have little commercial value. Landed weight may exceed 20,000 metric tonnes per year and represent 50 to 60 percent of the total landings. Currently, most male capelin are processed into fish meal, or dumped on land or at sea. A small percent gets used for fertilizer. Some is frozen for zoo food; very small amounts are dried, smoked or canned. A strong potential market exists for frozen male capelin in China and a potential exists for the use of

capelin as fish food in aquaculture.

In future, surimi research work will be conducted on fresh male capelin in Newfoundland to study the potential of making a satisfactory surimi paste from this abundant resource. If high quality surimi paste can be successfully produced, it has great potential in the production of a variety of surimi-based products, including imitations of crab, scallops, shrimp, etc.



Prime Female (top); Spent Female; Male; Female with busted gut

PROCESSING IN JAPAN

In Japan, there are approximately one hundred plants processing roe-bearing female capelin. These labour intensive plants produce a semi-dried final product. Nine steps are involved: weighing, thawing, brining, skewering, drying, size sorting, packaging, labelling, and carton-ing/storage.

Thawing often takes place in a weak brine solution, followed by an additional brine treatment to enhance the flavour. In skewer-

ing, the capelin are hung from fibreglass rods, and quality is once again checked before the capelin are placed in the drying rooms. After this final process, the fish are size sorted, packaged and labelled for market, then held in cold storage rooms until they are shipped.

A high percentage of the female capelin produced in Newfoundland meet Japanese quality requirements. However, capelin of low overall quality or having unacceptable levels of feed and over-mature roe, may sometimes find their way into the market and create special problems for the Japanese secondary processor; especially during the semi-drying process. The lower quality capelin are more prone to physical damage (e.g. busted gut).



Skewering Female Capelin (left); Packaged Semi-Dried Product



Semi-dried capelin showing red feed damage (left) and distortion due to over-mature roe (center); prime semi-dried female capelin



Barbecuing Semi-Dried Female Capelin

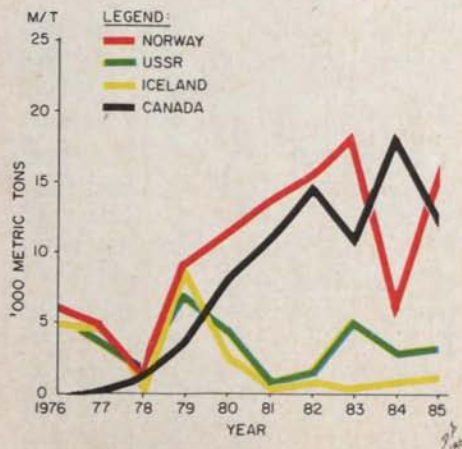
THE JAPANESE MARKET

Japan is the world's leading fishing nation, with an annual fishery production in 1985 of more than eleven million metric tonnes. Canada has about a three

and one half percent share of the approximately (Cdn.) \$9 billion Japanese seafood import market.

Japan consumes approximately 30,000 metric tonnes of roe-bearing female capelin per year. The domestic capelin catch in Japan continues to decline each year, with the 1984 catch of 1800 metric tonnes being about 1/10 the catch of 1980. Most of Japan's imported frozen female capelin comes from Canada and Norway, with smaller amounts from the U.S.S.R. and Iceland. The United States entered the market in 1985, and Greenland is expected to produce female capelin in the future. Most of these countries are struggling to get a larger slice of a stable but limited market; international competition should be stronger in the future.

JAPANESE IMPORTS OF FROZEN
FEMALE CAPELIN



Newfoundland currently produces nearly 100 percent of the Canadian output. Canada's two major advantages over her competitors are:

1. A high percentage of Canadian female capelin are of large size (fewer than 40 pieces per kilo), resulting in a lower labour cost in the Japanese secondary processing plants, and higher sale value of the packaged product.

2. A higher roe content in Newfoundland female capelin, averaging over 20 percent.

Semi-dried capelin are not used in regular meals in Japan, but if they were, consumption would probably double or triple. Found in consumer packs in supermarkets and in larger retail packs in bars and Japanese style restaurants, the capelin are usually broiled or barbecued and eaten as snacks with beer or sake (rice wine).

SUMMARY

Although Canada is the sole supplier of **large** roe-bearing female capelin to Japan, we can gain a stronger reputation for delivering a consistently high quality product to this very specialized market.

Many Japanese buyers are of the opinion that Canada is disadvantaged by the warmer temperatures of a summer fishery producing female capelin of inconsistent quality; which is not considered a problem with the European winter fishery. The Newfoundland fishing industry currently has tremendous icing facilities available. All that is needed is a greater effort in quickly chilling the catch, both onboard and onshore.

Canada produces the world's largest average size female capelin with the highest percentage of roe. Once a strong reputation for consistent quality is gained, stable prices should result, with new doors opening for Canadian Seafood in the world's number one seafood consuming and importing nation — Japan.

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female capelin in...
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Other informational brochures produced by the Fisheries Development Branch, Newfoundland Region, include:

FISHING FOR QUALITY

1. An Onboard Handling System — Gillnetters.
2. Handling, Holding and Transporting Live Snow Crab in Newfoundland.

FISHING FOR PROFIT

1. Cutting the Cost.
2. Picking a Prop.
3. Engine Efficiency.

FISHING GEAR AND EQUIPMENT

1. The Newfoundland Longline Fishery.
2. Development of the Cod Trap.

OTHERS

1. The Newfoundland Crab Fishery.
2. The Newfoundland Scallop Fishery.