

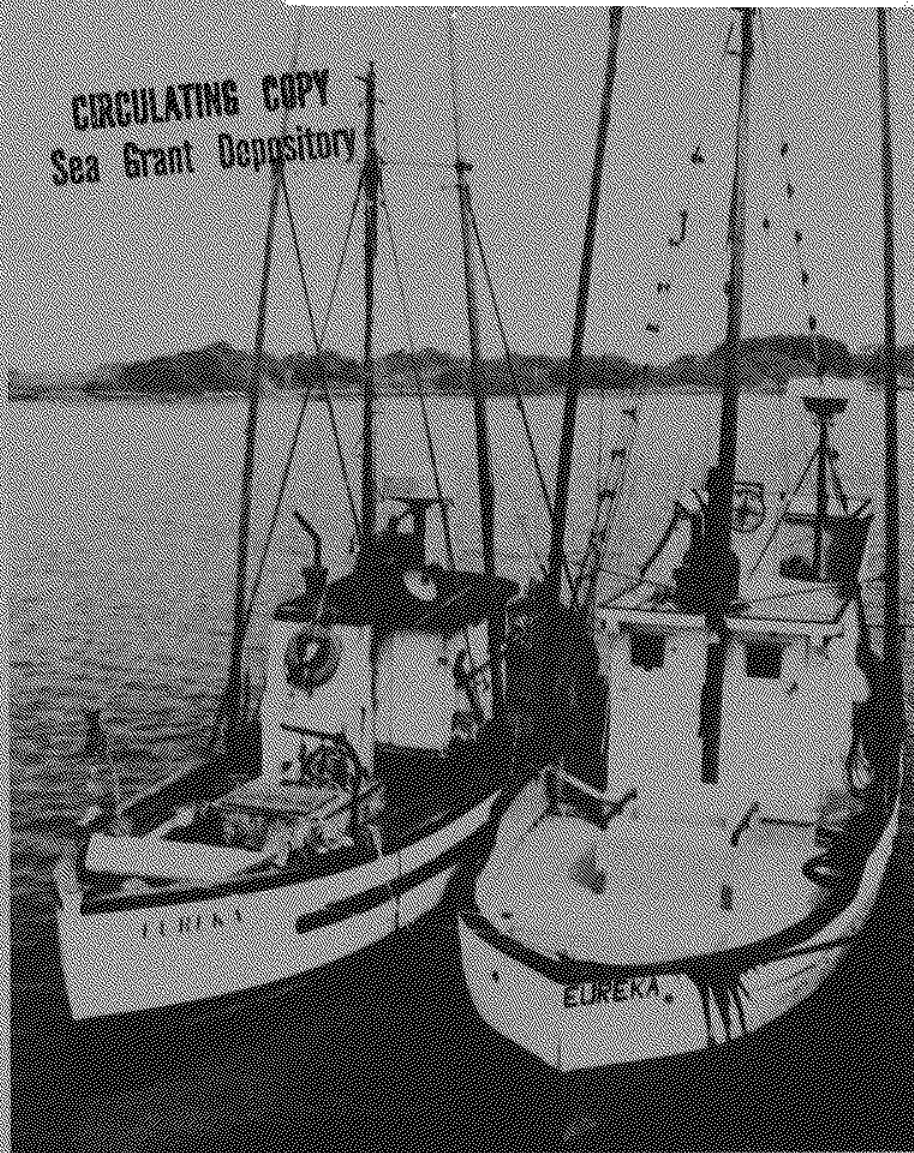


Recommended Procedures for Handling Troll-Caught Salmon

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**Recommended Procedures
for
Handling Troll-Caught Salmon**

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RECOMMENDED PROCEDURES FOR HANDLING TROLL-CAUGHT SALMON

INTRODUCTION

West Coast troll-caught salmon compete in the market place with Alaskan salmon and Scandinavian pen-reared salmon. It is imperative that West Coast trollers deliver high quality salmon to insure best market position and top price. Good handling procedures throughout the production cycle will yield quality salmon with a maximum shelf life.

SHELF LIFE OF A SALMON

Total shelf life is defined as the maximum number of days a salmon remains edible. Salmon and other fish begin to lose quality as soon as they die, but will retain high quality for about nine days at 32°F (Figure 1). After this time undesirable changes in flavor, odor and texture become apparent as quality decreases. The maximum edible shelf life for salmon at 32°F is about 14 to 16 days. Delayed chilling or dressing, or improper dressing or bleeding, result in a shorter shelf life and loss of quality.

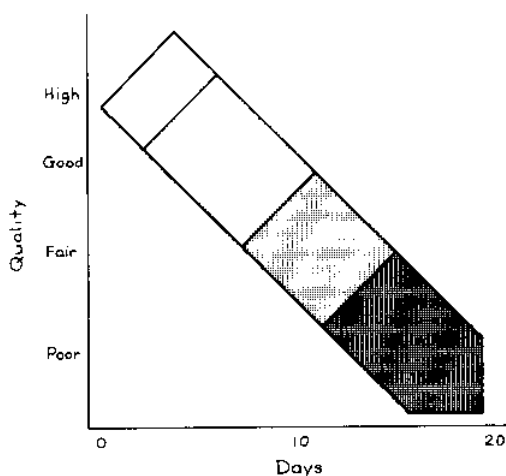


Figure 1. Quality Changes in Salmon Held at 32° F

Why Fish Spoil

As soon as fish die, spoilage begins. Spoilage is the result of a series of changes that take place in the dead fish. These changes are caused by the fish's own enzymes, by bacteria, and by chemical action.

Bacterial spoilage: Bacteria are the most important cause of fish spoilage. Millions of bacteria are present in the surface slime, on the gills, and in the gut of living fish. These bacteria do not harm the live fish, but soon after the fish dies, bacteria invade the tissues through the gills, along blood vessels, and directly through the skin and belly cavity lining. When this happens, the fish begins to lose quality.

Enzymatic breakdown: When the fish dies, its natural chemicals called enzymes, break down or digest the fish flesh. This causes softening and lowers the quality. It also produces more food for bacteria to feed on, increasing the rate of decay.

Oxidation: The action of air on the fat in fish can cause off-flavors and rancidity. This is important in fatty fish such as salmon, mackerel and herring.

Temperature and Spoilage

The shelf life of fish varies directly with storage temperatures (Figure 2). The rate of fish spoilage increases as the temperature rises. Ice or refrigeration slows bacterial growth, enzymatic breakdown, and oxidation. Fish held for 14 days at 32°F are equal in quality to fish held for only 2.5 days at 60°F. For each hour fish are held at 60°F (not refrigerated on-board), about six hours of refrigerated shelf life are lost.

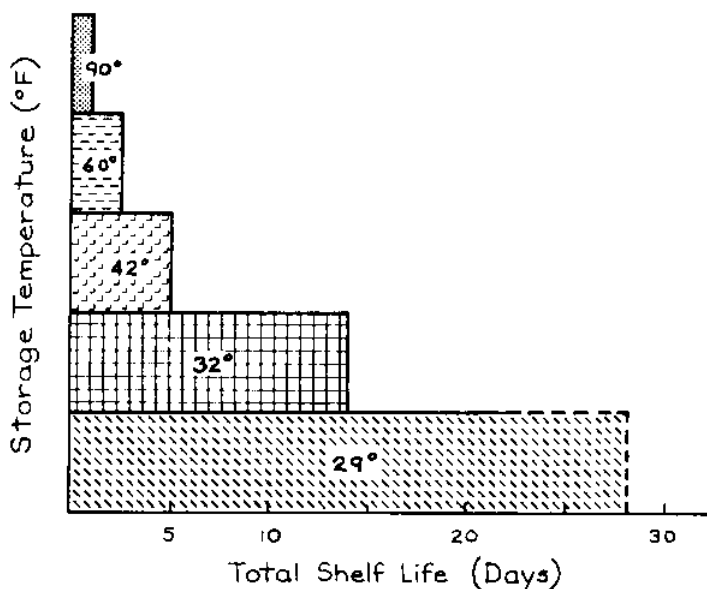


Figure 2. Salmon Shelf Life vs. Storage Temperature

Trip Time

The maximum time fish should be held refrigerated at sea is five to seven days. Liquid chilling systems do not increase total shelf life, and cannot justify increased trip time. Fish held in most liquid chilling systems at 32°F for five to seven days can be of equal quality to those held an equivalent time on ice. Refrigerated sea water (RSW) is the exception because significant salt uptake and shrinkage can occur in as few as four days.

Trips of a maximum of five to seven days are recommended because it may take an additional six days for the product to move from the buyer, through a retail chain store, to the consumer. If fish are destined for a chain store after being held on board for seven days, only three days of edible shelf life may remain for the consumer. In this case, the highest quality shelf life is spent at sea and during distribution.

HANDLING AND DRESSING

Careful handling and proper dressing are essential to the delivery of high quality salmon. Before landing salmon, wet the surfaces the fish may contact, including the cleaning trough. This precaution will help keep the fish moist and prevent excessive scale loss, which damages their appearance.

Handling

- 1) Immediately stun the fish to reduce bruising and to ease hook removal.
- 2) Sever the gills to allow the heart to pump out most of the blood.
- 3) Handle the fish by the head, or the head and body (Figure 3). **NEVER PICK UP A FISH BY THE TAIL.** Handling fish by the tail often breaks the backbone, resulting in blood spots and flesh separations (mushy areas) near the break.

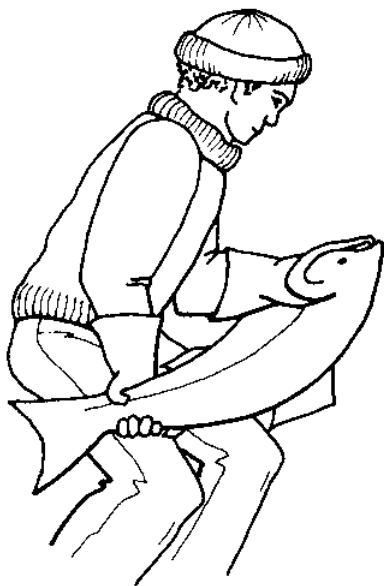


Figure 3. Handle Salmon Carefully.

Dressing

Always gut a fish as soon as possible to avoid decomposition of the belly wall (belly burn) by digestive enzymes present in the gut. Belly burn softens the belly walls and causes an objectionable red-brown discoloration of the belly cavity, resulting in a sour odor and a bitter flavor. In extreme cases, the belly walls will burst and rib bones will protrude. Belly burn can occur within ten minutes, if fish have been feeding heavily.

Sharp knives are essential for proper dressing. To open the belly, insert a knife at the vent at an angle almost flush with the belly (Figure 4). Maintaining this angle, make a smooth, shallow cut along the center line to the base of the pectoral fins, or about 1 ½ inches behind the "V" of the neck (Figure 5). Prevent injury by cutting away from yourself.

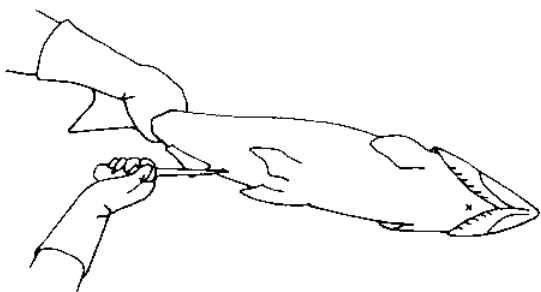


Figure 4. Insert knife without puncturing viscera.

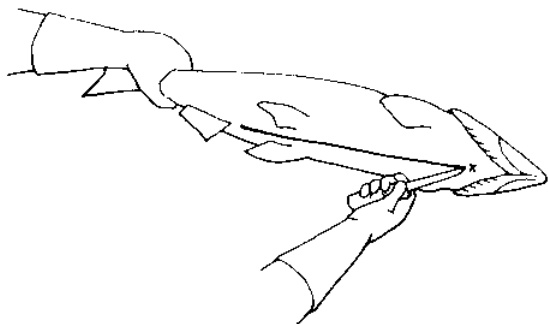


Figure 5. The shallow belly cut should end 1-1½ inches behind the "V" of the neck.

A shallow cut at the correct angle prevents slashing of the belly wall (Figure 6) and puncturing of the viscera, which would release spoilage agents onto the flesh.

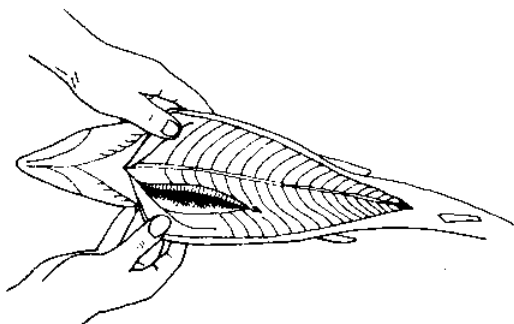


Figure 6. Careless cutting can result in a slashed belly wall.

Remove the viscera intact by severing the organs which extend into the head, and the connecting tissue on either side. Grasp the viscera firmly, pull them up and toward the tail of the fish, and toss overboard.

The kidney is the deep red mass which runs along the backbone. Carefully slit open the kidney with the tip of the knife, and scrape the kidney out with a spoon (Figure 7). Avoid cutting into the flesh along the backbone, particularly toward the tail, because the flesh below the kidney is soft and very susceptible to bacterial spoilage.

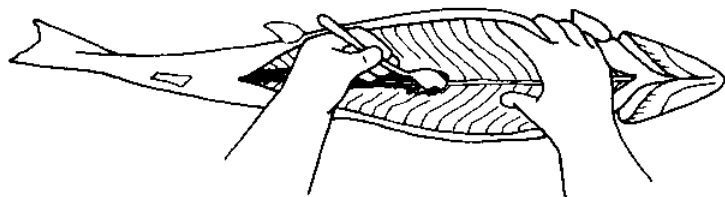


Figure 7. Carefully scrape out the kidney with a spoon.

Completely remove the gill arches because this is an area where bacteria and spoilage enzymes are concentrated. Remove the gill arches in such a way as to leave the throat firmly attached to the lower jaw. The attached throat will prevent the head from breaking off during later handling. Some fishermen prefer removing the gill arches before gutting the fish.

Cleaning

Wash the gutted fish thoroughly with clean, running water. Loosen and wash off all the slime, blood and attached shreds of viscera. Be careful not to remove scales.

Remove the blood in the veins which run down the sides of the belly cavity by gently sliding the back of the spoon (or your fingers) along the veins to the backbone. Never use the spoon roughly because it can easily cut the flesh of the belly and loosen the rib bones. Attempts to remove discolored flesh by hard scraping will only cause more damage.

Remove any residual slime which remains on the body of the fish after washing. Slime contains many bacteria which will accelerate fish spoilage.

Wash Boxes

Wash boxes should only be used to wash fish and not for fish storage. Prolonged wash box storage results in reduced shelf life. For each hour a fish is held in an unrefrigerated wash box, about six hours of shelf life are lost.

CHILLING THE CATCH

Proper handling and storage of fish at sea insures that the catch stays as fresh as possible until it is landed. The important requirements are to:

- 1) chill the fish rapidly as soon as they are caught;
- 2) keep them chilled;
- 3) maintain a good standard of cleanliness on deck and in the fishroom or stowage area.

The importance of good practice at sea cannot be over-emphasized because fish begin to spoil the minute they die. Neglect on board, even on short fishing trips, can sometimes result in poor quality fish after only a few hours. The time the fish is on board the vessel is often longer than the time on shore between landing and consumption. Therefore, the fisherman bears much of the responsibility for the freshness of fish reaching the consumer.

Ice

Ice has the unique characteristic of removing large amounts of heat as it melts without changing its temperature of 32° F. This makes ice an effective "heat mop." It is the act of ice melting that preserves fish. As ice surrounding fish melts, cold water runs over the fish, continuously draining toward the bilge. It is this cold meltwater that reduces the temperature of the fish rapidly.

Generally, one ton of ice is required to cool two tons of fish, but the actual quantity of ice necessary to properly store fish varies among vessels. Sea and air temperature, the amount of insulation of the fish room or container, the size and temperature of the fish caught, and the length of the voyage all affect the amount of ice required. To judge the amount of ice needed, examine the catch when off-loading. Check to see if adequate ice remains to cover the fish completely, paying particular attention to vulnerable parts of the fish hold such as the bulkhead, bin boards and top ice. Make adjustments as necessary.

Fish room temperature should be 34° to 35° F. This allows the ice to melt slowly. If the air temperature is maintained too low with refrigeration (for example 29° to 30° F), uncontrolled slow freezing of the outermost fish may occur, while fish in the middle of the bin may receive inadequate meltwater resulting in insufficient cooling.

Bulk Stowage

This method of icing is the most common and allows maximum use of available space in the fish room. The following recommendations are designed to insure efficient cooling, and to prevent damage and weight loss:

- 1) Place a layer of ice eight to 12 inches deep, depending on the amount of insulation, in the bottom of a clean bin. Make it smooth and level, breaking up lumps which could damage fish.
- 2) Place the fish on the ice bed facing the same direction, side by side loosely, with some space between each fish for ice. It is common practice to place fish belly up. However, seafood scientists recommend that dressed fish be placed belly down to prevent dirty meltwater from puddling in the belly cavity. Keep fish from touching the bin surfaces.
- 3) Shovel broken ice gently over the entire layer of fish. Pack the belly cavities loosely with ice, and work ice between the fish and along the sides of the bin. Do not overfill the belly cavities or damage may result. Use enough ice so that the layer of fish is barely visible. Smooth off the ice layer. If available, use an ice blanket (an easily cleaned piece of insulation) as a temporary cover to conserve top ice.
- 4) Place another layer of fish on the ice, nose to tail and over the spaces left between the fish in the first layer. Surround the second row of fish with ice as above. Continue to a maximum of three layers. The top layer of ice should cover the fish completely. Again, an ice blanket will conserve ice and keep fish moist. Check the top ice periodically, and replenish as necessary.
- 5) If fish are bulked more than three layers, considerable weight loss and/or gaping of the belly cavity may occur due to compression. If more than three layers are necessary, shelves which do not bear directly on the lower bin are recommended.
- 6) At the end of a trip, discard ice which has been in contact with fish, especially

the bottom ice. The fish hold should be scrubbed with warm water and detergent, and then sanitized with a chlorine solution and rinsed. Household bleach mixed at one teaspoon per gallon of water is an effective sanitizer.

Liquid Chilling Systems

Liquid chilling systems use water chilled by refrigeration to store fish. In recent years, liquid chilling systems have become increasingly popular among West Coast salmon trollers. These systems are popular because less work is required to chill the catch, and this frequently results in the catch being chilled sooner. Also, the expense for ice is eliminated or reduced, and the crushing and related weight loss usually experienced with improper icing is avoided.

Temperature control is the most important factor affecting the quality of salmon using liquid systems. A system must be capable of maintaining water at 31° to 32°F with a minimum of temperature fluctuation. The following sources of temperature fluctuation must be considered in designing and maintaining a liquid chilling system:

- 1) The system should be insulated to minimize heat gain when the refrigeration is turned off at night. If heat gain becomes a problem, ice should be added in the evening.
- 2) Fish should be introduced to chilled water throughout the day, and divided evenly among containers. Too many fish placed in a single container (barrel) at one time will warm the chilling water, resulting in slower chilling rates.
- 3) Avoid freezing fish. Fish start to freeze between 29° and 30°F. Partial freezing and thawing causes cells to burst and bacteria to infiltrate, resulting in soft flesh and reduced quality.
- 4) Mix water when possible to avoid hot pockets and temperature stratification. This can be done manually using a clean plastic paddle, or automatically using air or water pumps.
- 5) Measure the temperature of the system periodically to identify possible problems, especially in the morning before starting.

Clean freshwater, or a combination of 1/3 sea water and 2/3 freshwater, are recommended as chilling media in preference to sea water. This is because fish absorb salt to objectionable levels and shrink significantly in 100% refrigerated sea water. Available information indicates that fish chilled in clean freshwater (or ice) do not shrink.

A solution of 1/3 sea water and 2/3 freshwater can be used to achieve lower holding temperatures. This solution will freeze at 30°-31°F, resulting in a colder storage temperature. Some salt is absorbed by the flesh using 1/3 sea water, but less than in 100% sea water. Some fishermen have indicated that a sea water/freshwater mixture may preserve the true color of salmon flesh better than freshwater alone.

Fish held in any liquid system absorb water rapidly. This can lead to a 3% weight increase after four days, and up to 5% after seven to nine days. All of this increased weight may be lost when fish are later stored on ice.

At the end of each trip, the water containers used for liquid cooling should be scrubbed with warm water and detergent, sanitized with a chlorine solution (one teaspoon bleach per gallon of water), and rinsed.



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