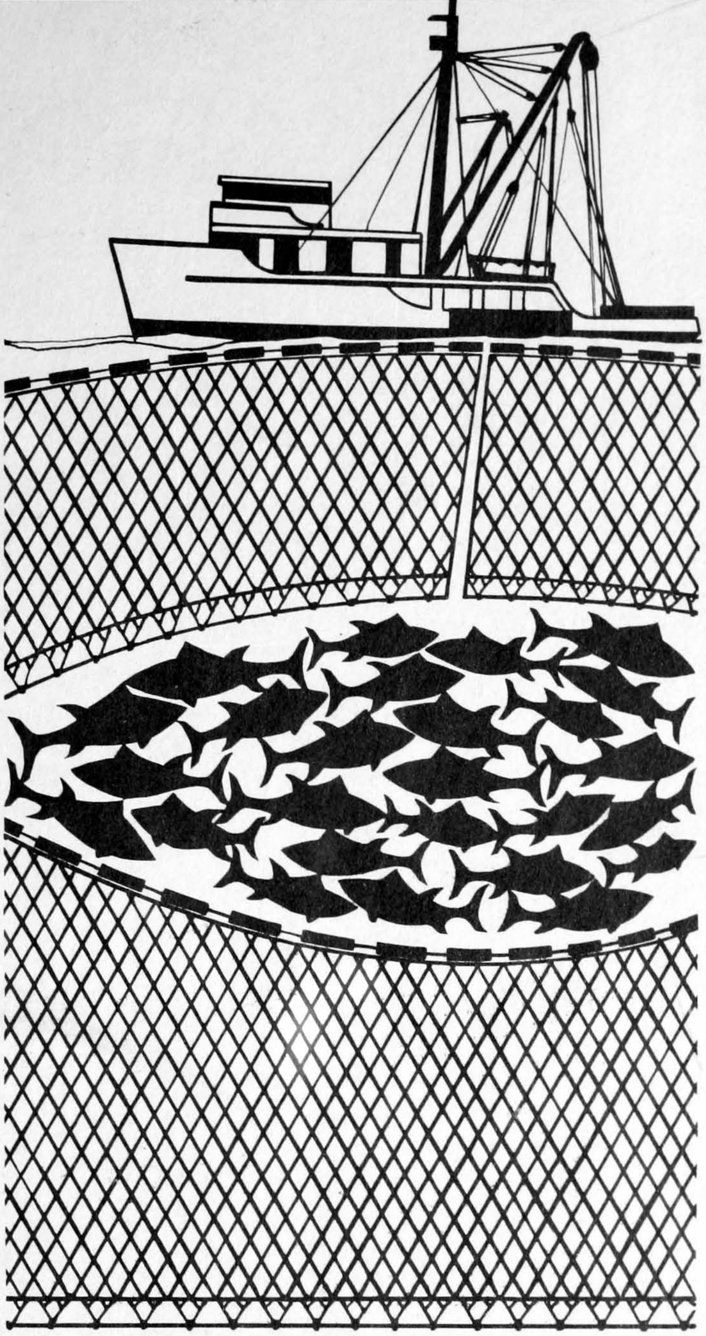

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VOLUME 6 NO. 2

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MACHINE FOR SEPARATING NORTHERN SHRIMP, *Pandalus borealis*, FROM FISH AND TRASH IN THE CATCH

by

Michael G. Corbett

ABSTRACT

Because of the labor required in separating northern shrimp from the unwanted components of the catch that are taken along with it, this valuable resource in the Gulf of Maine is not harvested to the extent possible. Consequently, a machine was developed to separate the shrimp from the bulk of groundfish and other species taken in trawl catches during exploratory and commercial fishing. Its use eliminates the laborious task of sorting the catch by hand, yet the separator recovers about 95 percent of the shrimp that are fed into it, while eliminating about 90 percent of the trash.

CONTENTS

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Published March 1970.

INTRODUCTION

Northern shrimp is a valuable resource in the Gulf of Maine. An estimated 14 million pounds were landed during the 1968 season, substantially more than the previous year. This resource is harvested by bottom trawling, much of it in areas inhabited by finfish and other species of shellfish.

Many of these areas, such as Stellwagen Bank (Figure 1) and that west of Jeffreys Ledge, having good commercial concentrations of shrimp are passed over at times because of the amounts of associated species likely in the catch. Tows often produce an equal weight of finfish.

The amount of associated species taken during a tow will vary depending on the time of year. During the peak of the shrimp season, January through March, catches are generally cleaner than at other times of the year. The relatively clean catches during this peak make hand picking, the current method of separating the shrimp from the associated species or "trash," possible. At other times of the year, hand picking is a time-consuming, laborious task that often is not economically feasible. If hand picking is not done, or is done in a haphazard manner, the buyer usually subtracts a percentage from the exvessel price paid as a trash allowance. Also, some vessels leave the shrimp fishery during the shrimp season and fish alternate resources mainly because of the relatively large amounts of trash present in the catch in the fall at the beginning of the season and in the spring near the end of the season.

Investigations and test fishing done prior to the exploratory shrimp fishing program undertaken by the Exploratory Fishing and Gear Research Base at Gloucester, Massachusetts, indicated that the program could be hampered and the work made more difficult without a suitable alternative to hand picking.

The need in exploratory and commercial fishing for a more efficient method led to the development of a shrimp separator (Figure 2). This machine mechanically separates shrimp from other components of the catch and thereby eliminates the need for hand picking.

Because of the potential value of the shrimp separator to the commercial fishing industry, the purpose of this report is to make information on the machine available.

I. DESCRIPTION OF SHRIMP SEPARATOR

This part of the report describes the operation of the separator and its design (Figure 3).

A. OPERATION

The shrimp separator, which was designed for use as shipboard equipment to be installed on the deck near the place where the net is emptied (Figures 4 and 5), is potentially usable as part of an automated system on deck or in a processing plant on shore, or it can be used independently.

We, the staff of the Exploratory Fishing and Gear Research Base at Gloucester, have not had the opportunity to use the shrimp separator in an automated system, so we use the machine as an independent entity.

The machine operates as follows. When the catch is shoveled into a hopper (Figure 6), an angle board inside the hopper forces the catch against a feed door, which, when lifted, allows the catch to tumble onto a separating platform. Two eccentric shafts, one supporting each end of the platform, provide: (1) the up-and-down movement necessary to cause the shrimp to be separated from the trash and (2) the throwing action needed to move the shrimp and the unwanted portion of the catch along the netting (Figure 7) until the shrimp fall through the netting and the unwanted portions fall over the end of the platform into a receiving box.

The shrimp, after passing through the netting, fall into the three wooden fish boxes of

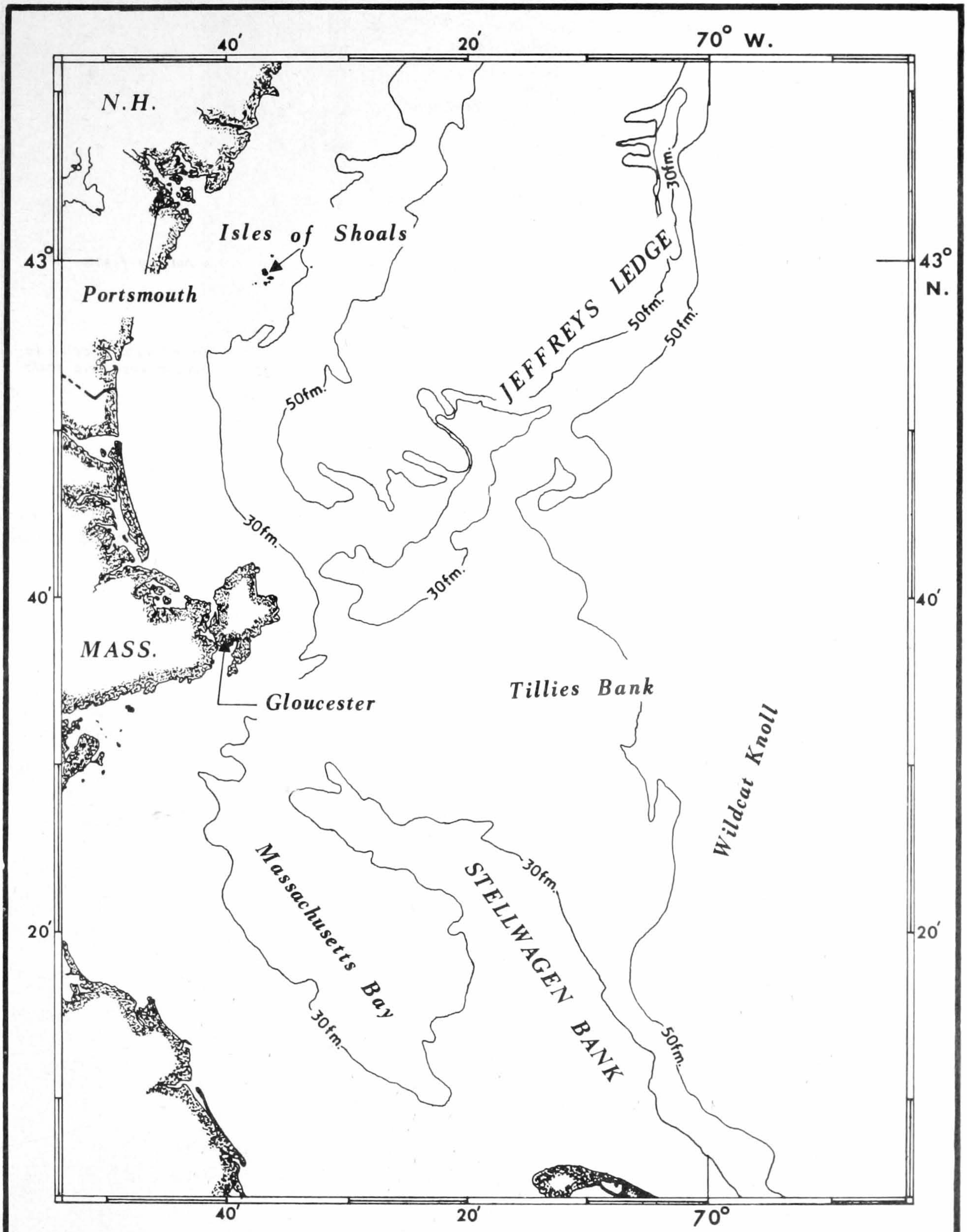

Figure 1.–Map of Gulf of Maine.

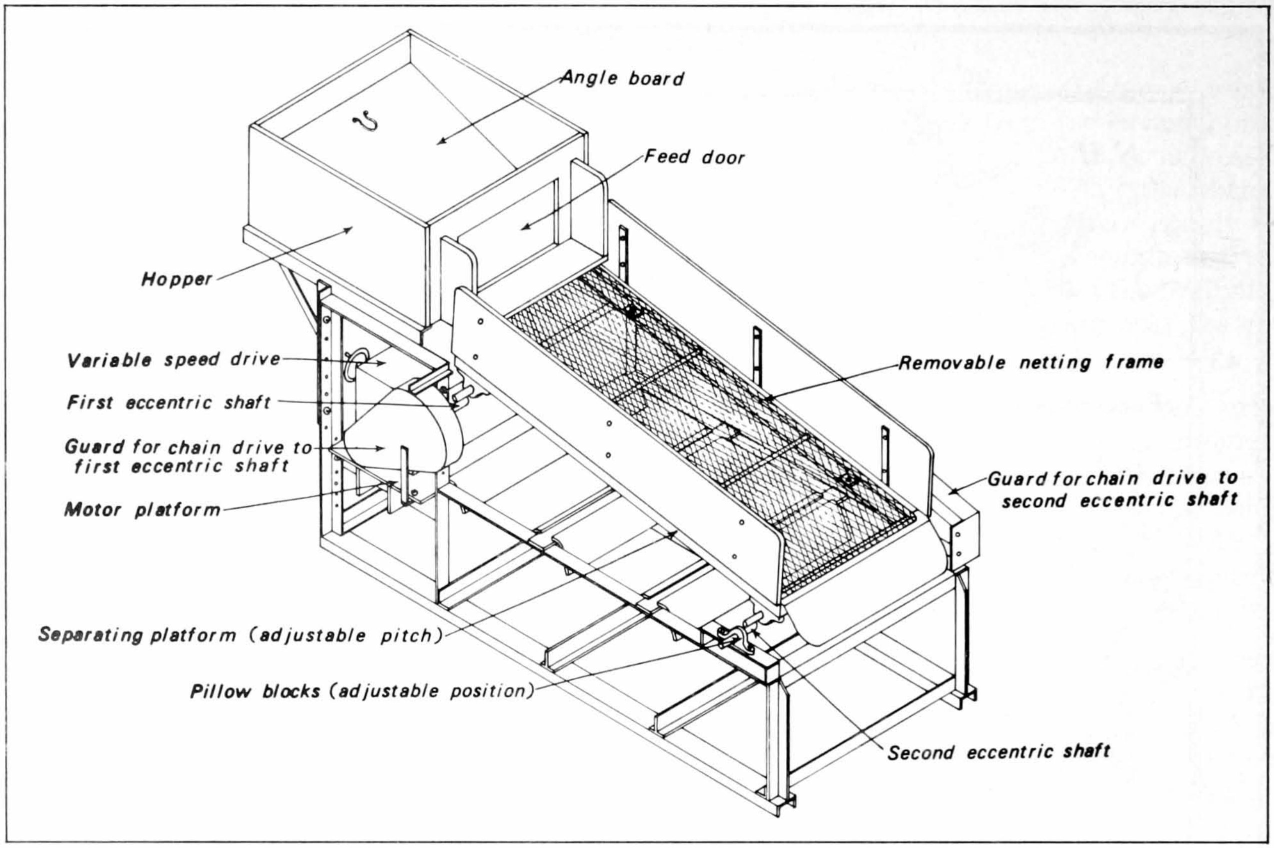

Figure 2.–Shrimp separator (isometric view).

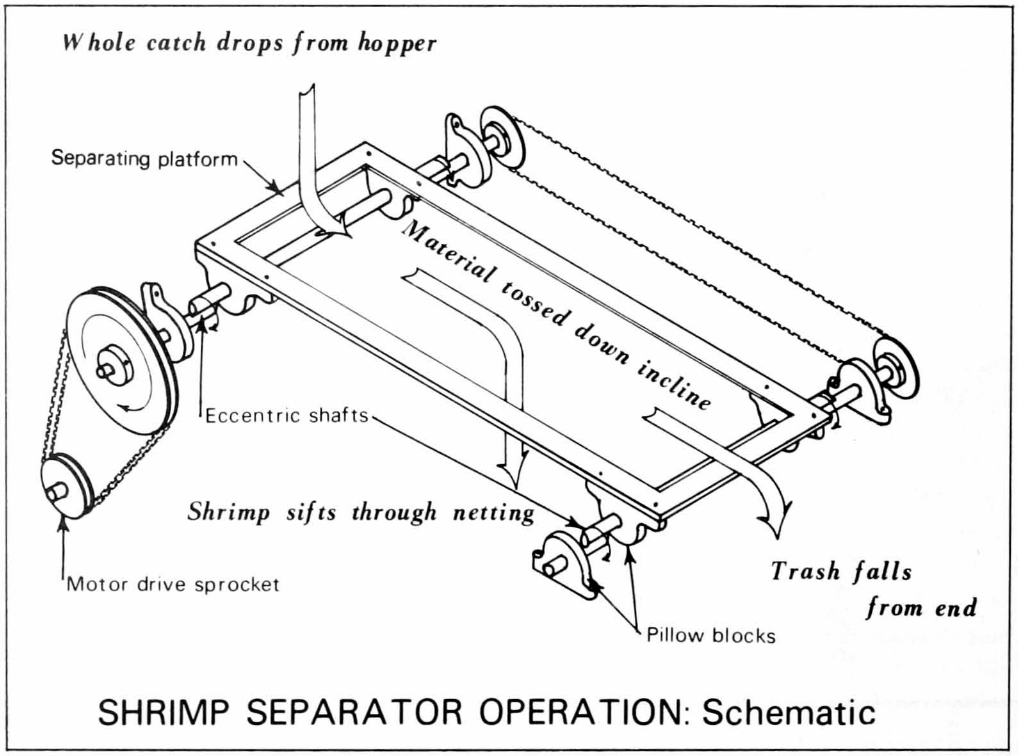

Figure 3.–Shrimp separator schematic.

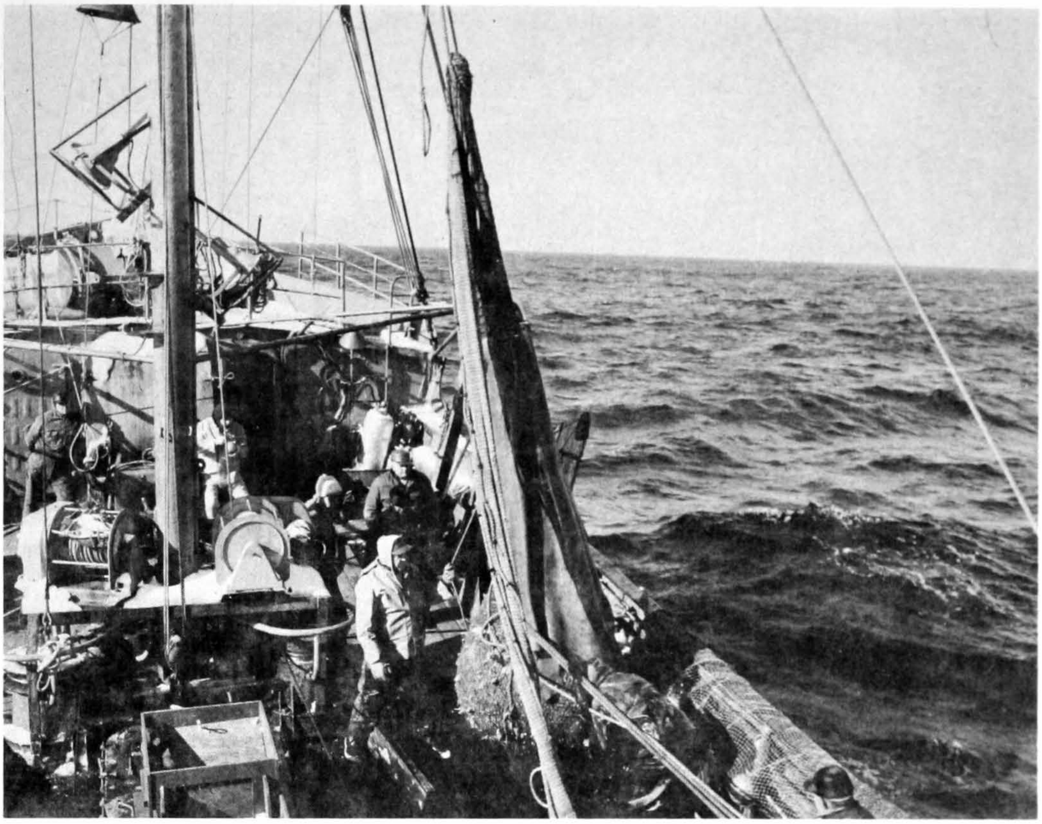

Figure 4.—Cod end being brought aboard.

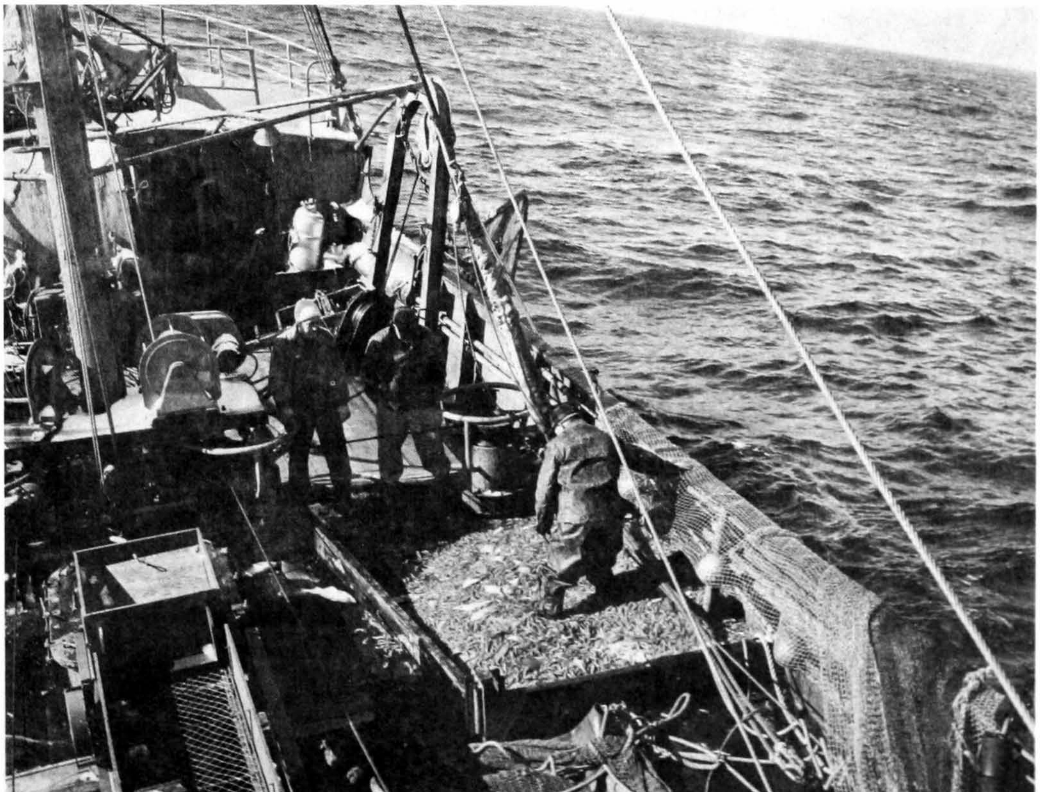

Figure 5.—Catch of shrimp in checker.

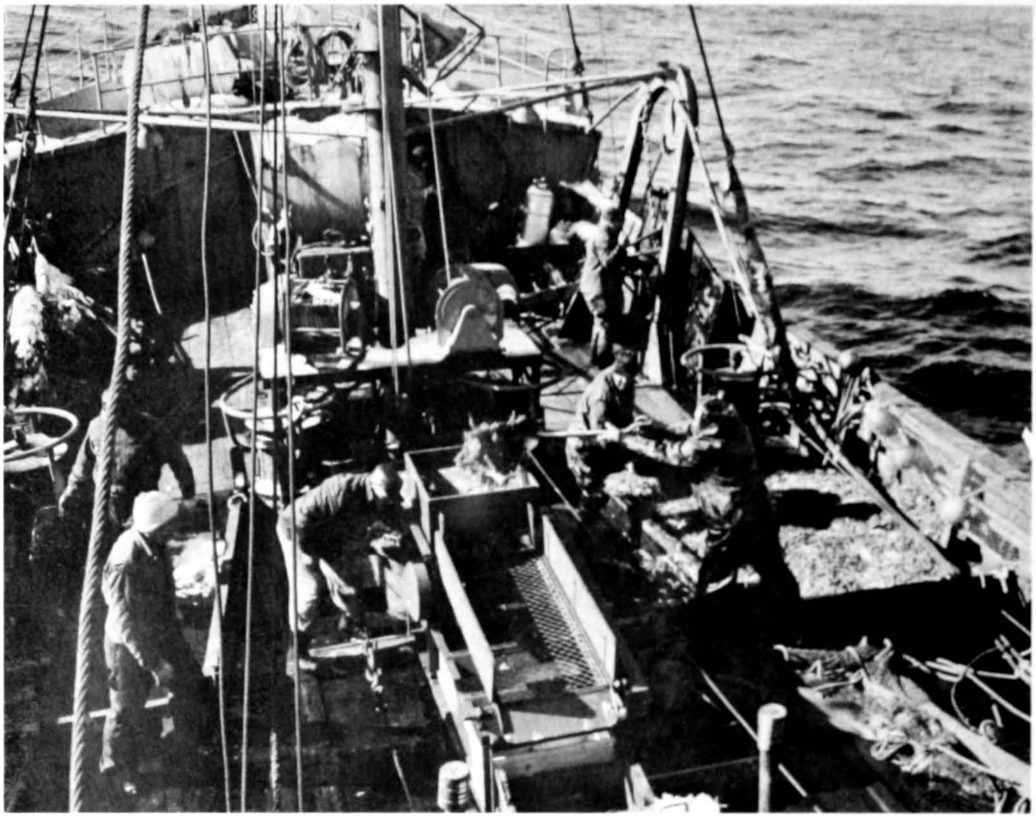

Figure 6.—First shovel full into separator.

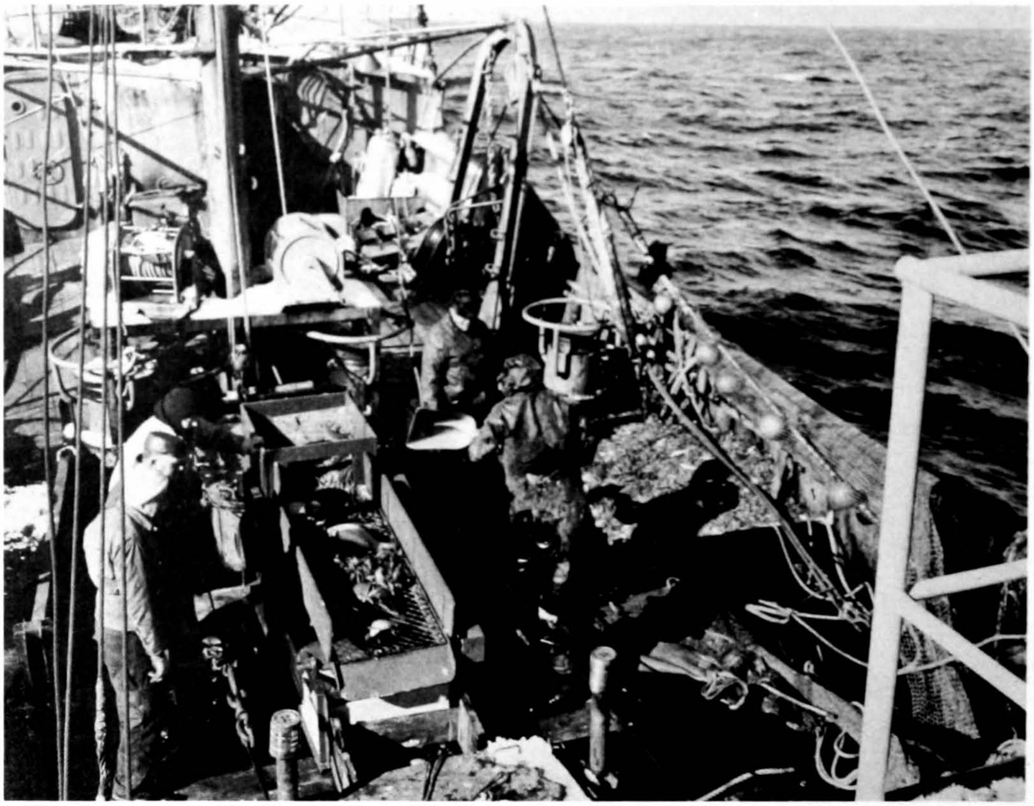

Figure 7.—Separator in operation.

standard size. Each box is 29 inches long, 17½ inches wide, and 12½ inches high, and each will hold 130 pounds of shrimp. The boxes can be inserted and removed from either side of the machine (Figure 8).

B. DESIGN

This section of the report describes the present design of the shrimp separator and then indicates how the design might be made more economical.

1. Present Design

Described here are the source of power, the variable-speed drive, the chain and eccentric shafts, and the separating platform.

a. Source of power.—The shrimp separator can be driven by almost any source of power delivering about 1 horsepower. Our model, because of the particular source of power that was readily available to us, is driven by a reversible hydraulic motor mounted below the hopper (Figure 8).

b. Variable-speed drive.—A mechanical variable-speed drive, which allows adjustment for catches of different composition, is directly connected to the motor with a flexible coupling. Because the speed is variable, the best speed can be selected for the maximum separation of shrimp with the minimum amount of small trash passing through the netting.

c. Chain and eccentric shafts.—Power is transferred by a chain to a sprocket attached to an eccentric shaft at one end of the separating platform. This shaft, with a 1-inch eccentric, turns, by means of another chain, a second shaft, also with a 1-inch eccentric, at the other end of the platform. Together they impart the rotary motion that, as was indicated earlier, gives (1) the up-and-down movement necessary for separation and (2)

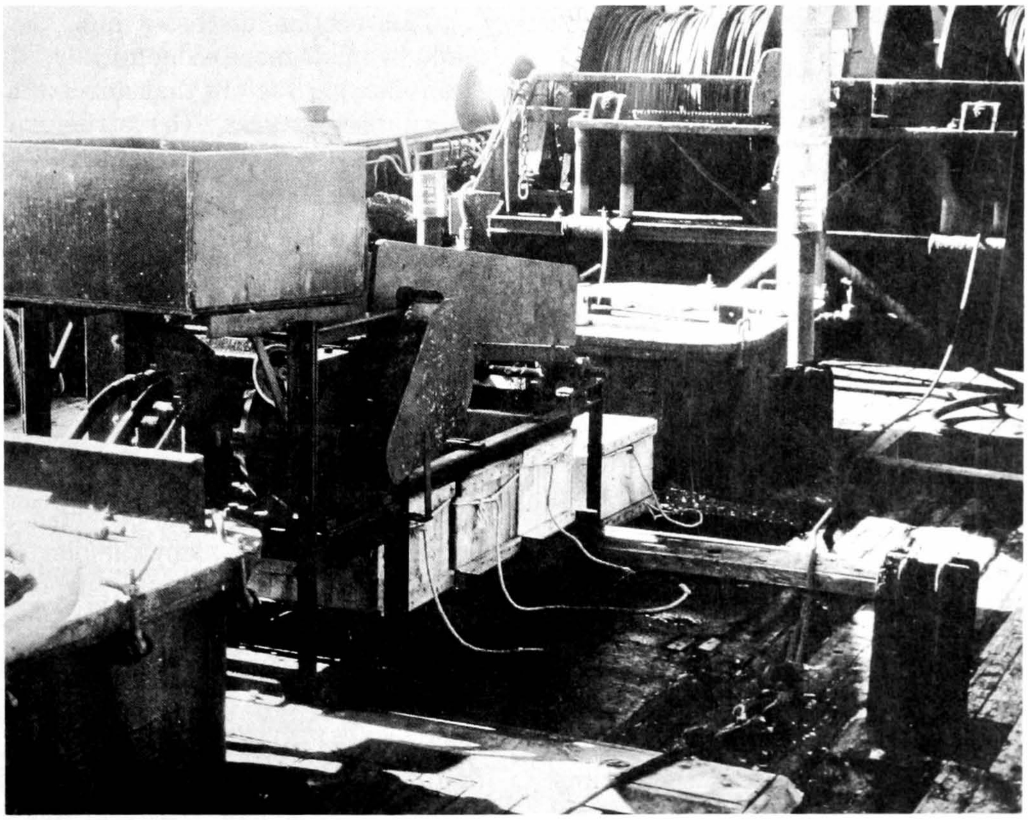

Figure 8.–View of separator showing hydraulic motor and wood fish boxes in place.

the throwing action necessary to move the catch along the platform.

d. Separating platform.—Described in this subsection are (1) the pitch of the separating platform, (2) its dimensions, and (3) its openings.

(1) Pitch.—The pitch of the separating platform is adjustable through five positions between 0° and 12° to the horizontal. These positions allow the operator to change the speed at which the catch moves along the platform, without altering the movement up and down that is necessary to separate the shrimp. The effectiveness of the lateral motion for moving material along the platform is controlled by the angle of slope.

(2) Dimensions.—The separating platform is 57 inches long and 24 inches wide and is fitted with sideboards to contain the catch. This size handles the amount that two men can shovel into the hopper and allows easy movement of the catch along the platform with maximum separation of unwanted fish and trash and minimum loss of shrimp over the end.

(3) Openings.—The shrimp can be separated from the unwanted material by means of netting with mesh of suitable size or by means of steel rods suitably spaced.

(a) *Netting.*—The separating platform has a quick-release netting frame that allows the size of mesh and the configuration of the mesh to be changed to accommodate shrimp of different sizes. The shrimp can be graded to size by the use of mesh of smaller size in the first sections of the netting frame. Experiments have shown, however, that even when only one size of mesh is used, some grading occurs, because the small shrimp tend to fall through the net sooner than the large shrimp do. A 2-inch square mesh was most satisfactory, effectively separating out from the catch about 95 percent of the shrimp that have an average count of 30 to 60 per pound, heads on. The other 5 percent of the shrimp fell over the end of the platform into a box for trash.

The fish boxes are not filled at a uniform rate. The first box, which is the one nearest to the hopper, fills about five times as fast as the third box does, and the second box fills about three times as fast as the third box. This difference in the rate of fill could undoubtedly be narrowed considerably by varying the size of mesh as described above. We have not as yet had the opportunity to investigate the best combination of mesh size.

(b) *Steel rods.*—As an alternative to the netting, $^{3}/_{16}$-inch diameter steel rods, which ran the length of the platform, were welded to the netting frame. The rods were spaced 1 inch on center and then plastic-coated to a maximum thickness of $^{1}/_{16}$ inch. The rods were equally as effective as the netting was and did not require periodic adjustment as did the netting. After observing the rods in use, we feel, however, that a longer platform than the existing 57-inch one would have improved the performance of the rods.

2. Future Design

This section discusses how the separator could be made more economically. It considers the following factors that affect the cost: (a) adjustable features, (b) structural strength, (c) power, and (d) size and configuration.

a. Adjustable features.—Because anticipating design requirements was difficult with a machine of this type, we incorporated several adjustable features. These features include reversible rotation, adjustable platform angle, variable speed, and interchangeable screens having different sizes of mesh and rods.

(1) Reversible rotation.—The reversible rotation, which was provided to slow the descent of the catch along the platform, proved to be unnecessary for our purposes but may be useful in other fisheries for the separation of different species.

(2) Adjustable platform angle.—For the platform angles tested, a fixed inclination of 10° to 12° for the platform was satisfactory. Thus, an adjustable platform angle could be eliminated in future models.

(3) Variable speed.—The wide range of 50 to 300 revolutions per minute for the rotation of the eccentric shaft at the separating platform is more than adequate because the optimum speed of operation was found to be about midrange (175 revolutions per minute plus or minus 25 revolutions per minute). This range of 150 to 200 revolutions per minute is necessary to compensate for the variable amount of trash and size of shrimp in the catch.

(4) Variable-mesh screens. — Because the size of the shrimp will vary, interchangeable screens with mesh of varying size are desirable. Some of our best results were obtained with 2-inch square mesh, but various combinations of mesh size could be tried (between 1½-inch to 2½-inch square mesh). Equally as effective were the plastic-coated steel rods that were described earlier.

b. Structural strength.—Structurally, the machine is stronger than is necessary because the working loads are lighter than we anticipated they would be. Construction is primarily of 2 by 2 by ⅜-inch steel angle iron. A marked reduction in the size of stock is not advisable, however, unless tolerances can be held during construction. The reason for not reducing the size of stock is that stresses due to the possible misalignment of rotating components could cause their deformation and the failure of welds. Furthermore, structural overdesign helps to ensure constant operation under the rigorous conditions of commercial fishing.

c. Power.—Operating experience indicates that a motor of 1 horsepower would provide sufficient power. We used a much higher horsepower hydraulic motor because it was readily available to us.

d. Size and configuration.—The size and general configuration of the separator were determined by the space available aboard our particular vessel. Overall dimensions are: length - 98 inches, width - 40½ inches, height - 52 inches. Changing the size would alter the characteristics of the operation. Shortening the separating platform less than the present 57 inches would not be advised unless the rate of descent of the catch is slowed.

II. EVALUATION OF SHRIMP SEPARATOR

As was indicated, the separator described here was constructed to meet our own needs. For this purpose, it performed better than we expected, demonstrating its usefulness and effectiveness in trial use and subsequently in three shrimp-survey cruises. To perform the quantitative testing required to give a complete report of performance under a comprehensive range of catch conditions, we would have had to use our vessel longer than it could have been spared, so we were unable to evaluate the separator under all conditions. Based, however, on observations made in the three survey cruises, where the separator was used for over 100 tows, we estimate that about 95 percent of the shrimp and 10 percent of the trash passed through the screen. This 10 percent of the trash consisted primarily of small starfish with a few small flatfish and herring mixed in.

The rate of separation by the experimental model was limited by the speed at which two men shoveled the shrimp into the hopper and by the slope of the screen. The separator generally processed an average catch of 20 bushels in less than 15 minutes. The rate of separation, of course, varied according to the amount and type of trash in the catch.

The shrimp separator has the potential of general use. If, for example, it were made in several sizes, the separator would be usable on vessels of various sizes. Because it is essentially a piece of processing equipment, it could also have applications in processing plants onshore.

SUMMARY

Northern shrimp are not harvested to the extent possible, because too much time and labor are required in separating the shrimp from the unwanted components of the catch. The purpose of this article is to report on a machine that separates the shrimp rapidly and efficiently.

In the operation of the separator, the catch is shoveled into a hopper, which feeds the shrimp onto a vibrating separatory platform. This platform is made up of netting or rods with openings sufficiently large to allow the shrimp to fall through into boxes below but sufficiently small to retain most of the other materials in the catch. The platform is set at such an angle and is given sufficient motion that the shrimp are separated out and the materials that do not fall through the net move along to where they fall over the edge of the platform into a receiving box.

The design of the separator is simple and straightforward. It can be driven by any motor capable of delivering 1 horsepower. The motor is directly coupled to a mechanical variable-speed drive. Power is transferred to the separating platform by means of a chain to an eccentric shaft at the upper end of the platform. The eccentric shaft at the lower end of the platform is linked by chain to the upper shaft to ensure a coordinated pattern of motion. The pitch of the platform is adjustable between 0° and 12° to the horizontal. The platform has a quick-release netting frame that allows the size of mesh or rods and their spacing to be changed to accommodate shrimp of various sizes.

The separator described here was made from mechanical parts that were readily available to us and that would fit our particular use. A commercially designed separator, however, could be made more cheaply than ours was by using more economical parts and by eliminating unnecessary features. Reversible rotation, for example, is not required for northern shrimp. The platform angle need not be adjustable but can be fixed at an inclination of 10° to 12°. The range of variable speed can be narrowed considerably to 175 revolutions per minute plus or minus 25 revolutions per minute. The machine is stronger than is necessary, because the weights of the working loads are less than we anticipated that they would be. The machine also is overpowered, so a smaller power unit of about 1 horsepower could be used.

In trials at sea, the shrimp separator worked well. It generally processed an average catch of 20 bushels in less than 15 minutes, and it satisfactorily separated out about 95 percent of all the shrimp able to pass through the size of mesh used, while eliminating about 90 percent of the trash. The separator could have application not only aboard ship but in processing plants on shore.

MS. #1907

RECOMMENDATIONS FOR THE SANITARY OPERATION OF PLANTS THAT PROCESS FRESH AND FROZEN FISH

by

J. Perry Lane

ABSTRACT

The problem of sanitation in food-processing plants is receiving increasing attention from Federal and State regulatory agencies, as well as private industry. This article covers recommended guidelines that can assist the processors of fresh and frozen fish in evaluating their existing sanitation practices or in establishing new ones.

CONTENTS

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CONTENTS—Con.

INTRODUCTION

In recent years, the spotlight of public attention has focused on the operations of food processors. This spotlight has shown on fish processors, as is evidenced by the succession of bills on compulsory inspection and regulation of the seafood industry that have recently been introduced in the Congress of the United States. These bills are concerned primarily with protecting the consumer from health hazards and aesthetically undesirable practices. For the most part, the need for protection results from problems in sanitation.

The guidelines presented here represent an attempt to assemble the existing requirements for food plants in general and to relate them to fish plants in particular. A processor of fresh fish may find that many of the suggestions are difficult to put into practice without rebuilding his plant. These suggestions or closely related ones, however, are actual requirements for some food processors, such as packers of meat and poultry and producers of dairy products. So, similar types of regulations are likely to be forthcoming for the fishing industry. These guidelines thus can serve as a preview of some of the things that may be required.

Apart from any regulatory activities, another powerful factor now at work suggests that the fish processor should take a lively interest in sanitation. This factor is the consumer's increased awareness of quality factors and processing conditions. With the elimination of the captive Friday market for fishery products, seafoods have to compete on their own merits for the consumer's food dollar. The fishing industry, therefore, is fortunate in having a product that is both nutritious and flavorful when it is handled properly.

The purpose of these guidelines is to provide the processor with suggestions that will help him to give the consumer the quality that makes fish a desirable food. Some of the suggestions can be put into practice immediately, whereas others, such as those that involve building construction, can aid in long-range planning for expansion or remodeling. Every segment in the chain of distribution from the sea to the consumer must ensure that it delivers fish that is as close as possible to the quality that it received. By paying proper attention to sanitation in his plant, the processor will contribute greatly toward maintaining the quality of the fish.

The first part of the guidelines presented here gives recommendations for the plant; the second part gives recommendations for the processing of the fish.

I. PLANT RECOMMENDATIONS

In this part of the guidelines, we are concerned with plant premises and plant construction.

A. PLANT PREMISES

Both the location of the plant and the plant surroundings are important factors in a sanitary food-processing operation.

1. Location

a. If possible, locate the plant away from such sources of odors, dust, and air contamination as refineries, chemical plants, and dumps. [See Thompson and Farragut (1969) for an example of a problem that can be encountered at certain plant locations.]

b. Locate the plant where it will be accessible to a supply of potable (here potable means that the water supply meets the criteria in the current edition of the "U.S. Public Health Service Drinking Water Standards") water and to a sewage system.

c. Locate the plant in a well-drained area.

d. Pave the entrance roadways.

e. Physically separate the plant from any plants that process nonhuman food.

2. Surroundings

a. Keep the surroundings free of unkempt vegetation capable of harboring insects or vermin.

b. Keep the grass and shrubs trimmed and neat.

c. Keep refuse areas separate from the processing plant.

d. Do not pile waste containers and fish boxes, for example, in the open area outside of the plant.

B. PLANT CONSTRUCTION

In the construction of the plant, we are concerned with both the facilities for processing the fish and the facilities for the employees.

1. Processing Facilities

We can divide the processing facilities into what we might call the basic facilities and the equipment used in the processing operations.

a. Basic facilities.—What do we mean by basic facilities? We consider the basic facilities to be building construction, water supply and waste disposal, refrigeration, and lighting and ventilation.

(1) Building construction.

Construct the buildings large enough to accommodate the operation without hampering sanitary cleanup.

In areas where food is processed or stored, use building materials that are impervious to water, easily cleanable, and resistant to wear and corrosion.

Keep all exterior openings such as doors, windows, and vents in good repair, and equip them with screens or other devices, such as air curtains, to prevent the entrance of insects, rodents, and other animals.

In this section, we consider the following subjects specifically: floors, walls, ceilings, and entrances.

(*a*) *Floors.*—Two aspects of floor construction are of concern: the floors themselves and their drains.

[1] Floor construction.

Construct the floors of hard material such as waterproof concrete or tile. Do not make the floors extremely smooth. To prevent the workers' slipping on the floors, give the concrete a rough finish or use embedded abrasive particles.

Apply an approved latex synthetic resin base on concrete or mortar floors to increase resistance to corrosion.

Install drainage coves at the junctures of floors and walls.

[2] Floor drains.

In any area where water is used, install at least one drainage outlet for each 400 square feet of floor space.

Give floors a slope of $\frac{1}{4}$ inch per foot to drainage outlets.

Make the slope uniform with no dead spots.

Provide drains with traps.

In areas where the water seal in the traps is likely to evaporate unless replenished, provide the drains with removable metal screw plugs.

Construct drainage lines of galvanized iron or steel.

Use drainage lines with an inside diameter of at least 4 inches.

Vent drainage lines to outside air.

Screen the vents to prevent rodents from entering the plant.

Do not connect drainage lines from toilets to other drainage lines; be sure that the drainage lines from toilets discharge directly into a sewage system.

(*b*) *Walls.*

Make interior walls smooth and flat.

Maintain the walls in good repair.

Construct the walls of water-impervious materials, such as glazed brick, glazed tile, smooth-surfaced portland-cement plaster, or other nontoxic, nonabsorbent material. [Poured concrete walls are satisfactory if they are troweled to a smooth finish. Marine plywood or metal walls (stainless steel, aluminum, or galvanized iron or steel) also are satisfactory if seams, nail holes, and junctions of floors, walls, and ceilings are watertight.]

Do not allow the supporting structures of walls to be exposed.

(*c*) *Ceilings.*

Place ceilings in work areas in such a way as to prevent foreign material from falling from overhead pipes, machinery, and beams onto exposed fishery products.

Make ceilings 10 feet high or higher in work areas.
Construct ceilings of portland-cement plaster, large-size asbestos boards with joints sealed with a flexible sealing compound, or other suitable material impervious to moisture.

(*d*) *Entrances.*—In this section, we are concerned with the construction of doorways and doors and with pest control.

[1] Construction of doorways and doors.

Make doorways through which products are transferred on handtrucks, dollies, or forklifts at least 5 feet wide.

Make the doors and frames of rust-resistant metal or of wood sheathed completely with rust-resistant metal having tightly soldered or welded seams.

[2] Pest control.—Both insects and rodents need to be controlled to prevent contamination and destruction of food products.

[a] Insect control.

Screen and maintain in good repair all windows, doorways, and other openings that would admit flies and other insects.

[a] Insect control—Continued

Provide "fly-chaser" fans and ducts over outside doorways in the food-handling area.

Limit the use of insecticides to those that are approved by the U.S. Food and Drug Administration.

In the application of insecticides, take care to prevent their contact with fish or other food products and with any working surfaces that come in contact with food products.

[b] Rodent control.

Provide all exterior openings with screens that are rodentproof as well as insectproof.

Except for solid masonry walls constructed or lined with such materials as glazed tile or brick, imbed expanded metal or wire of ½-inch mesh or less in the junction of walls and floors.

Routinely inspect beams and storage areas for evidence of rat runways and nests.

If you find signs of rodents, call in a professional exterminator. Exercise extreme care so as not to contaminate fish or work surfaces with rodenticides.

(2) Water supply and waste disposal.

(*a*) *Water supply.*

Use only potable water for cleaning fish in any form or for cleaning any surface that could come in contact with food products or that could contribute to their contamination. Sea water may be used for the fluming of whole or dressed fish if the source meets local health requirements and if the water itself meets the microbiological requirements of the "Drinking Water Standards."

If water from public water supplies is used, test it against the "Drinking Water Standards" at least every 6 months to ensure that no in-plant contamination has occurred.

If water from a private well is used, make sure that the source is free of contamination. Test the water for purity monthly.

If chlorinators are required to ensure a continuous supply of potable water, use an automatic type equipped with warning devices to signal when it is not functioning properly.

Throughout the plant, provide both hot and cold water under adequate pressure and in quantities sufficient for all operating needs.

Install all equipment so that liquids will not be back syphoned into lines carrying potable water.

In general, except as provided above, do not use nonpotable waters in the plant. If such water is used for fire protection, steam lines, and the like, supply it in separate lines with no cross connections with potable-water lines. Clearly mark nonpotable water lines and outlets, and instruct all plant personnel that nonpotable water is a deadly hazard if it comes in contact with food products.

(*b*) *Waste disposal.*

Ensure that waste-disposal systems meet the pertinent requirements given under the section on "Floor drains," page 66.

If permitted by local ordinances, discharge plant wastes into the municipal sewer system.

If you use a private septic tank or sewage disposal system, ensure that it is efficiently designed and operated so as not to produce objectionable conditions.

Do not discharge gurry and processing waste or plant sewage directly into harbors or other water areas without explicit written permission of Municipal or State Public Health Authorities.

Have any sewage-disposal facilities approved by the appropriate health authorities. Get the approval in writing, indicating when the facilities were inspected last.

Store gurry and other fish waste that cannot be carried by a sewage-disposal system in insectproof and rodentproof containers outside the plant or in physically segregated refrigerated rooms that are not used for any food products. Empty or remove unrefrigerated gurry from the plant premises at least once every 8 hours. If the containers are to be reused, wash and sanitize them before using them again. Do not store gurry in refrigerated rooms above freezing (32° F.) for more than 48 hours. Dispose of frozen gurry as expeditiously as possible, and do not keep it on the premises for more than a week.

(3) Refrigeration.

Make the refrigeration adequate to handle raw materials as will be discussed under the section on "Receiving raw materials," page 78.

Provide a temperature of 50° F. or less in work areas where fresh fish are processed.

Maintain freezer rooms at −10° F. or lower for the storage of the finished product.

For the initial freezing of finished products, use plate freezers or blast-freezing tunnels that provide contact temperatures of −20° F. or lower.

If refrigeration wall coils are used in chilling rooms, provide, beneath the coils, a drip gutter of concrete or other moisture-impervious material properly connected with the drainage system.

Provide overhead refrigeration coils or plates in chilling rooms with insulated drip pans connected to drains placed beneath.

Use potable water in making ice used for holding fresh fish or other food products. Store, transport, and handle the ice in a sanitary manner. Do

(3) Refrigeration—Continued.

not reuse ice after it has been in contact with fish or fish products or with contaminated work surfaces or holding areas.

(4) Lighting and ventilation.—Both proper light and ventilation are important in maintaining sanitary surroundings and comfortable employee working conditions.

(*a*) *Lighting.*

Provide unrefrigerated workrooms with direct natural light where possible. In windows and skylights, use uncolored glass having a high transmissibility of light.

Use heat-absorbing (blue) glass to reduce glare in windows and skylights that are exposed to considerable sunshine.

In a workroom, make the glass area at least one-fourth the size of the floor area.

Provide well-distributed artificial lighting of good quality where natural lighting is not available or sufficient. In work areas, make the overall intensity of artificial illumination not less than 20 foot-candles.

Lights over processing areas should be covered by clear shields to prevent glass from falling into the food products if a light bulb should break.

In candling for parasites, use lights that provide at least 50 foot-candles of illumination. Cover the light by a clean glass surface so arranged as to prevent any moisture from seeping down to the light fixture.

(*b*) *Ventilation.*

Provide sufficient natural or mechanical ventilation to control visible molds, objectionable odors, or excessive condensates.

Provide ventilation by means of windows, skylights, mechanical air conditioning, or a fan-and-duct system.

Supply mechanical ventilation in refrigerated workrooms where natural ventilation is lacking.

Locate fresh-air intakes so that the air is not contaminated with odor, dust, or smoke.

Where mechanical systems are used as the sole means of ventilating nonrefrigerated workrooms and employee welfare rooms, use systems that can provide at least six complete changes of air per hour.

Install the ventilation systems so that air does not move from raw material or preparation rooms into processing or packaging rooms.

b. Processing equipment.—Having considered the basic processing facilities, we shall now consider processing equipment. Design all equipment and utensils of such material and construction that they are smooth, easily cleanable, and durable, and that any surfaces in contact with the product are free from pits, cracks, and scale. In addition, design and construct the equipment and utensils to prevent contamination of fish and fishery products with fuel, lubricants, metal, and other extraneous material.

(1) New equipment.—Ensure that new equipment conforms to the applicable standards cited in the AFDOUS Food Code (Association of Food and Drug Officials of the United States, 1962) and with any more recent revisions of these standards.

(2) Materials.

Use stainless steel as far as possible in all metal equipment that will come in contact with seafood.

In general, do not use galvanized metal, because it is not sufficiently resistant to the corrosive action of food products and cleaning compounds. If you must use galvanized metal for economic reasons, use it for such purposes as the construction of waste containers. If galvanized metal is used, make sure that it has the smoothness of high-quality commercial dip.

Where fish are handled, make cutting boards or table tops of synthetic rubber-thermoplastic or of other hard, nonporous, moisture-resistant, synthetic material. If you use hardwood cutting boards, be sure that the surfaces are smooth and intact.

Do not use copper, cadmium, lead, painted surfaces, enamelware, or porcelain on surfaces in contact with the product. (The first three materials are toxic, and the last three may chip or flake off into the product.)

Make certain that any plastic materials and resinous coatings that you use are abrasion- and heat-resistant, shatterproof, and nontoxic, and that they do not contain any material that will contaminate the fish or fishery products.

(3) Conveyor belts.—Make conveyor belts of moisture resistant material that is easy to clean, such as nylon, hard-finished rubber, or stainless steel.

(4) Equipment design.—Design the equipment in such a way as to eliminate dirt-catching corners and inaccessible areas. Install equipment capable of rapid and complete breakdown for cleaning. To facilitate cleaning, use steel tubing rather than angle or channel iron.

(5) Motors, bearings, and switches.

On food-handling equipment, locate all motors and oiled bearings in such a way as to prevent oil or grease from contacting the product.

Protect motors and switches from contact with water.

Raise motor mounts high enough to permit you to clean under them and between them.

Protect drivebelts and pulleys with guard shields that can be readily removed for cleaning.

(6) Welding.—Make all welding within the product area continuous, smooth, even, and as nearly flush with adjacent surfaces as possible.

(7) Stationary equipment.

Install all parts of stationary, or not readily movable, equipment at least 1 foot from walls and ceilings to provide access for cleaning.

Mount this type of equipment at least 1 foot above the floor, or else have a watertight seal with the floor.

(8) Water-wasting equipment.—Install water-wasting equipment--such as flumes, brining tanks, and wash tanks--in such a way that waste water from the equipment is delivered through an uninterrupted connection into the drainage system without flowing over the floor.

(9) Cutting tables.—Turn up the edges, at least 1 inch, of cutting tables or other equipment having water on the working surface.

2. Employee Facilities

Having considered the processing facilities, we now consider the facilities for the employees. To get plant personnel to recognize the importance of sanitary practices and to obtain their full cooperation, make proper provision for their personal needs. Considered here are the dressing rooms, toilet facilities, hand-washing units, and eating facilities.

a. Dressing rooms.

Provide separate dressing rooms for employees of each sex.

Separate the dressing rooms from the toilet and work areas.

Ventilate the dressing rooms, and provide receptacles for the disposal of cigarette stubs and other waste.

Provide each employee with a metal locker that is at least 15 by 18 by 60 inches. Place the lockers on legs 16 inches high to enable you to clean all areas of the floor.

b. Toilet facilities.

Separate toilet rooms from dressing rooms by tight, full-height walls or partitions.

Do not permit toilet rooms to open directly into food-processing areas; instead, separate them by a ventilated vestibule with two sets of self-closing doors.

Provide elongated water closets with open split seats, in the following ratios:

Persons employed	Toilets provided
Number	*Minimum number*
1 to 9	1
10 to 24	2
25 to 49	3
50 to 100	5
Each additional 30	1

c. Hand-washing units.

Locate hand-washing unit (lavatory) conveniently and make sure that they meet the appropriate requirements discussed under the section on "Plant sanitation and cleaning provisions," page 75.

Make the minimum size of bowl 16 by 16 by 9 inches, and supply each lavatory with hot and cold water delivered through a mixing faucet fixed at least 12 inches above the rim of the bowl so that an employee may wash his arms.

Locate liquid soap and sanitary towels in suitable containers at each wash basin.

d. Eating facilities.

Provide clean, well-lighted, and ventilated eating facilities that are separate from work areas and toilet areas.

If eating facilities are provided in the dressing room, set the space aside separate from the immediate locker area.

Provide tables and chairs or benches, washing facilities, and drinking fountains.

Clean the area after regularly scheduled work breaks and lunch periods to prevent food particles from attracting vermin and insects.

II. PROCESSING RECOMMENDATIONS

We now have given detailed consideration to the guidelines on the plant--both its premises and its construction, including the processing facilities and the employee facilities. We turn next to the guidelines on the processing itself. In so doing, we consider methods of guarding against microbial contamination of the plant and product and then give attention to the handling of the product.

A. GUARDING AGAINST MICROBIAL CONTAMINATION

In guarding against microbial contamination, we are aided by a knowledge of certain procedures for testing for the presence of microbial contamination and of sanitation principles involved in microbial control.

1. Bacteriological Testing Procedures

Have the microbiological tests listed below (under "Microbial tests to be performed") made periodically on samples of the finished products from all processing lines. These tests will serve as a guide in determining whether you have a sanitation problem in your plant. Do not consider the numbers as being an absolute standard of product quality, but rather as being levels that, if exceeded, indicate that a more thorough microbiological survey of raw material, processing equipment, and personnel should be made. This survey will help you decide whether you do have an area that is a source of serious contamination or that could become one.

Here we are concerned specifically with five subjects:

a. Directions for microbial tests.

b. Microbial tests to be performed.

c. Sampling.

d. Corrective action.

e. Resurvey.

a. Directions for microbial tests.—Have the microbiological tests carried out according to the procedures given in "Standard Methods for the Examination of Dairy Products": current edition, prepared by the American Public Health Association (1967). These procedures are suggested for fishery products but are not standardized for such products. There are still no generally recognized methods for testing fishery products, but the procedures given in Standard Methods for Dairy Products will prove generally satisfactory for the type of microbiological survey recommended in this section.

b. Microbiological tests to be performed.—The microbial tests to be performed include the following: (1) total plate count, (2) coliforms, (3) Salmonella, (4) E. coli, and (5) coagulase positive staphylococcus.

(1) Total plate count.—Take remedial action if the total plate count exceeds 200,000 organisms per gram. Consider that the total plate count indicates the entire bacterial exposure of the product. Furthermore, consider that it also indicates the level of spoilage organisms present. Although a direct relation between total plate counts and organoleptic quality or storage life has not been established, excessive counts do indicate that the storage life of fresh fish with such counts will be reduced materially.

(2) Coliforms.—Take immediate remedial action if the MPN (most probable number) is more than 360 per gram. The presence of coliform organisms indicates contact of the product with water and soil contaminants and warns that the product may possibly be polluted with sewage.

(3) Salmonella.—Take immediate remedial action if the sample is not free of this organism. Salmonella is a bacteria that causes food poisoning. The presence of this organism indicates human or animal contamination.

(4) E. coli.—Take immediate remedial action if the MPN is greater than 50 per gram. This organism is one of the coliform group and is a specific indicator of fecal contamination. Although this organism does not cause disease, it indicates that the product probably has been contaminated with organisms that are pathogenic.

(5) Coagulase positive staphylococcus.—Take immediate remedial action if the MPN is more than 5 per gram. The test for this organism should be the confirmed test. The presence of the organism indicates human, infectious contamination. It is a toxin-producing organism that causes food poisoning. The organism is readily killed by heat, but the toxin is quite heat stable.

c. Sampling.

Make the initial survey of the finished fresh or frozen product at the point where it is ready to leave the plant.

Sample precooked products before they enter the cooker. Cooking will destroy many organisms but not all toxins; for this reason, microbial tests on cooked products give a misleading indication of their microbial exposure.

Take samples separately and place them in sterile containers.

Store fresh samples at 33° F.

Store frozen samples at 0° F. or lower.

Test all samples as soon as possible after they are taken.

If the results of any of the bacteriological tests exceed the suggested limits, make a complete microbiological survey of the plant.

Take samples of all raw material.

Take samples of the product after each stage of processing (that is, after initial washing, filleting, skinning, brining, tempering, and cutting of frozen blocks; after applying batter and breading; and after packing).

Take swabs of all equipment during processing and after cleaning up.

d. Corrective action.—From the results of the complete survey, take corrective action if any trouble spots were identified. Corrective action may range from a general cleanup of the entire plant to something as specific as cleaning up a single piece of equipment, discarding certain raw material, or having one of the employees change his personal habits.

e. Resurvey. — To determine the effectiveness of the corrective action, repeat the product survey after the corrective sanitizing and cleanup measure have been instituted. Make periodic surveys to determine if the plant-sanitation program is continuing to be effective or if new problems in sanitation have developed.

2. Plant and Personnel Sanitation

Having outlined the bacteriological testing procedures, we now consider plant and personnel sanitation. In so doing, we consider provisions relating to plant sanitation and cleaning and those relating to personnel practices.

a. Plant sanitation and cleaning provisions.—Keep in mind that, although proper sanitation is the direct responsibility of the plant manager, an effective sanitation program can be obtained only when every employee in the plant is instructed in proper sanitary precautions and is fully impressed with the reason for proper sanitation in terms of product quality and protection of the product from public-health hazards.

Plant sanitation requires the services of a sanitarian and adequate cleaning methods and facilities.

(1) Sanitarian.—Assign one person as a sanitarian for the plant. The sanitarian must be tactful and have good judgement. If the plant is large, assign one or more assistant sanitarians for specific work areas. Make the sanitarian responsible for supervision of all plant-cleaning operations. Have him thoroughly inspect all processing areas and equipment before each day's operation, and see that any deficiencies are corrected before operations are started.

(2) Cleaning and cleaning facilities.

(*a*) *Cleaning.*—To clean adequately, adopt a schedule and carry out the cleaning steps in proper sequence.

[1] Cleaning schedule.

Adopt a cleaning schedule for each area in the plant, and adhere to it unless conditions warrant more frequent cleaning or sanitizing

[1] Cleaning schedule—Continued

operations. Thoroughly clean continuous-use equipment such as conveyors, filleting machines, flumes, batter and breading machines, cookers, and tunnel freezers at the end of each working shift, or oftener, if conditions indicate the need.

Clean batter machines and other equipment in contact with milk or egg products more frequently, depending on the temperature at which the batter is maintained, the type of material going into the batter (fresh or frozen), the ambient temperature of the work area, and the microbiological level of the raw materials and fish. Ascertain these factors, and design the cleaning schedule accordingly.

Clean and sanitize portable equipment and utensils after they are used, and store them above the floor in a clean, dry location so that they are protected from splash water, dust, and other contaminants.

[2] Cleaning sequence.

Mechanically or manually remove loose dirt by scraping and brushing floors and equipment.

Rinse with cold or warm water. Because fish residues and other proteins coagulate at high temperature and may become baked onto the contact surface, remove these materials at temperatures below 100° F. early in the cleaning process.

Wash with an acceptable detergent.

Rinse twice with hot water at a temperature of at least 170° F. Hot water is more effective than cold water in removing fats, oils, and inorganic material.

Sanitize with an acceptable bactericidal agent. Chlorine compounds are the most widely used--recommended strengths are given later. Other sanitizing agents approved for use in food-processing plants are also effective.

Rinse twice with hot water. A thorough rinse with potable water should follow any operation involving a chemical sanitizing agent.

(b) *Cleaning facilities.*—Here are considered detergents, chlorine solutions, single-service articles, and hand-sanitizing units.

[1] Detergents.—In using detergents, we are concerned about their characteristics and about which of them are approved for use with food products.

[a] Characteristics of detergents.

Keep in mind that the desirability of a detergent usually is determined by the degree to which it exhibits the following characteristics (Somers, 1949).

High wetting or penetrating action, which causes rapid washing away of the soil.

Good rinsibility, which results in the detergent and soil being rinsed from the equipment freely and rapidly after the desired cleaning has been accomplished.

High emulsifying power for oils.

High deflocculating or dispersing power, to bring deposits of precipitates into suspension so that they can be washed away.

Water conditioning or sequestering properties in alkaline solutions, to prevent deposits on equipment of any calcium and magnesium compounds from the water.

Dissolving and neutralizing power, for the purpose of dissolving or neutralizing tenacious deposits and saponifying fats to make them soluble in water.

Low corrosiveness to the surfaces on which they are used.

[b] Approved compounds.—Detergents and sanitizing compounds approved for use in food processing plants may be found in the current edition of "List of Chemical Compounds - Authorized for Use under USDA Poultry, Meat, Rabbit, and Egg Products Inspection Programs," U.S. Department of Agriculture (1968).

[2] Chlorine solutions.

Use the following suggested concentrations of chlorine solutions in fish processing plants:

Use	Available chlorine
	Parts per million
Wash water	2 to 10
Rinse water on hands	100
Clean smooth surfaces (wash basin, urinals, glassware)	50 to 300
Clean smooth wood, metal, or synthetic surfaces (new boxes, new table tops, conveyor belts, machines)	300 to 500
Rough surfaces (worn tables, old boxes, concrete floors, and walls)	1,000 to 5,000

Keep in mind that it is important to rinse with clear potable water after using any sanitizing agent and that, to prevent corrosion, it is especially important to rinse metal surfaces after chlorine solutions are used.

[3] Single-service articles.

Store materials intended for one-time use, such as paper cups or towels, in closed containers, and dispense them singly and in such a manner as to prevent their being contaminated.

Provide closed containers for the disposal of such articles.

[4] Hand-sanitizing units.

Locate wash sinks and sanitizing hand dips outside of lavatories and adjacent to work areas, such as filleting lines or packing tables, where fish are handled.

Supply sanitizing dips with 100 parts per million available chlorine. Keep filleting knives and steels in sanitizing solutions when not in use, and have each filleter rinse his hands and change knives frequently.

b. Personnel provisions.—Employee health and employee practices are important in controlling microbial contamination.

(1) Employee health.

Have all food-handling employees examined physically prior to their starting work at the plant and at least annually thereafter. Comply with local health requirements regarding the physical examination and see that each employee has a current and valid health certificate showing no evidence of any communicable disease. Have the employee take a physical examination before returning to work after any contagious illness.

Do not allow employees with open sores and lesions into food-processing areas.

(2) Employee practices.

Prohibit employees from eating, using tobacco in any form, and spitting in food-handling areas.

Do not allow employees to wear jewelry, except plain wedding bands and unadorned pierced earrings (not screw-on type), in food areas.

Have all food handlers wear clean outer garments, preferably white, that cover personal clothing. Have fish filleters wear easily cleanable rubber or plastic aprons or coveralls and boots. Such garb should be worn by personnel working with fresh fish or on cleanup crews using large amounts of water. Require that all clothing worn during working hours be clean, and maintain an adequate supply of replacement garments.

Have all employees wear clean head coverings (caps or hairnets) that cover or hold the hair in place.

Require that each employee wash and sanitize his hands after each absence from a work station. When rubber gloves are worn, have them washed and sanitized in the same manner.

B. PRODUCT HANDLING

In our guidelines on processing, we now have completed our suggestions for guarding against microbial contamination. We turn now to our guidelines on how to handle the product. Here, we consider the receiving of the raw material and the processing of it.

1. Receiving Raw Materials

By raw materials, we mean both the fish and any other raw materials used in processing.

a. **Fish.**—We consider first the fresh fish and then the frozen fishery products.

(1) Fresh fish.

Check fresh fish for signs of spoilage, off odors, and damage upon their arrival at your plant. Discard any spoiled fish.

If the fish are to be scaled, scale them before you wash them.

Unload the fish immediately into a washing tank. Use potable, nonrecirculated water containing 20 parts per million of available chlorine and chill to 40° F. or lower. Spray wash the fish with chlorinated water after taking them from the wash tank.

If incoming fresh fish cannot be processed immediately, inspect them, cull out the spoiled fish, and re-ice the acceptable fish in clean boxes; then store them preferably in a cold room at 32° to 40° F. or, at least, in an area protected from the sun and weather and from insects and vermin.

Wash, rinse, and steam-clean carts, boxes, barrels, and trucks used to transport the fresh fish to the plant if any of these are to be used again. If disposable-type containers are used, rinse them off and store them in a screened area until you remove them from the premises.

(2) Frozen fishery products.

Use a loading zone that provides direct access to a refrigerated room.

Check the temperature of the product at several areas in the load. When the product arrives, it should be 0° F. or lower.

Place the product on pallets and assign a freezer lot number to it to ensure that the rule of "first-in, first-out" is observed.

Keep the freezer storage at −10° F. or lower, and use a separate blast freezer capable of rapidly lowering to −20° F. any product that arrives at a temperature higher than 0° F.

b. **Other raw material (dry).**

Unload other raw material in an area separate from the fresh or frozen products.

Store the material in a dry, ventilated area on pallets or shelves that will keep the material away from the floors and the walls.

Screen the storage area adequately to prevent entrance of insects during loading or unloading operations.

2. Processing Raw Material

Keep in mind that fish is a highly perishable food. The primary cause of deterioration of fish flesh and the resulting loss of quality is bacterial contamination. Every step in the recommendations for sanitary plant operation and fish-handling procedures is designed to reduce this contamination and thereby protect the health of the consumer and maintain the quality of the product. The basic rules for handling a fishery product are:

Keep the product cool, as near 32° F. as possible for fresh fish and below 0° F. for frozen fish.

Keep it clean.

Keep it moving. It is the combination of time and temperature that permits bacteria to grow and build up. Even under optimum conditions, quality will be lost, so you should get the product into the consumer's hands as rapidly as possible.

a. Fresh fish.

Handle incoming fresh fish as was described in the section on "Receiving raw materials," page 78.

Cool the filleting room to 50° F. or lower. If the room is not cooled, then ice the fish so as to maintain their internal temperature of 40° F. or lower.

During hand-filleting operations, scrub the filleting boards at least twice a day. Use water containing 2 to 5 parts per million available chlorine to flush continuously the filleting boards and conveyors used to transport whole fish.

When cutting fillets by hand, handle them so that the cut surface does not come in contact with the filleting board; then immediately place them on a fillet conveyor or in a container.

Furnish filleting machines with a continuous supply of water on the surfaces in contact with the fish.

Have the fillets discharged directly onto a conveyor into a container.

Use a machine to prepare skinless fillets and spray water on the skinning machinery.

Complete all trimming operations before sending the fillets to the final wash.

Because certain species of fish (such as cod, ocean perch, and some Pacific rockfish) may contain parasites, candle the fillets from these fish before brining them in the final wash. Do the candling on a clean glass surface well illuminated from below. Because heat from the lights may cause bacteria to grow rapidly on the surface of the candling table, clean the surface thoroughly and sanitize it frequently. Continuously flush it with chlorinated water.

A brining tank, to be effective, must be used correctly. Use brine as a final wash in order to help reduce the loss of moisture. Chill the brine to 35° F. or lower, chlorinate it, and change it at least once an hour, so that it will decrease bacterial contamination. Convey the fillets through the tank so as to regulate their time of exposure to the brine; after they leave the tank, pass them through a multijet mist spray. Keep in mind that the strength of brine and exposure time should depend on the species of fish being handled. Only mildly brine the fillets of fatty fish, especially those fillets that are to be frozen; otherwise, the residual salt on the fillets will accelerate the development of rancidity during storage.

See that fresh fillets that are to be packed in bulk have an internal temperature no higher than 35° F. before the fillets are packed in a bulk container. If need be, use an adequately refrigerated brining tank as a prechiller. Promptly pack and ice well the prechilled fillets, or place them in a cold-storage room at 30° to 35° F.

Promptly pack fillets that are to be frozen, and place them in a freezer in less than 30 minutes after they are packed. If it be necessary to transport the fillets to another building for freezing, transport them under refrigerated conditions if the elapsed time from packing to entering the freezer exceeds 30 minutes. Do not expose the packaged fillets to sun and dirt.

b. Frozen fishery products.

Handle incoming frozen fish as was described in the section on "Receiving raw materials," page 78.

Where frozen fishery products such as fish blocks must be tempered (brought up to a higher temperature) before being processed, temper them in a refrigerated room under controlled conditions. (Uncontrolled tempering in work areas causes blocks on the outside of the load to become excessively warm while the blocks at the center of the load remain too cold for efficient processing.) Once the blocks are tempered to the desired temperature (not higher than 20° F.), process them as soon as possible. Slake out, in refrigerated water, blocks or bulk packs of fillets or whole fish that must be thawed and separated for further processing. Prechill the water to below 40° F. Remove the fish or fillets as soon as they are thawed sufficiently to be processed. Change the water and clean and sanitize the tanks before you put more fish in them.

Good product handling practices require that breading lines be given particular attention. Maintain the temperature of the batter below 50° F. Discard all unused batter at the meal break and at the end of each work shift, and clean and sanitize the batter container before reloading it. Discard unused breading at the end of each work shift. Place drip pans and dust shields around breading and batter machines. Remove any spillage from the floors at once.

When processing precooked products, pass cooking oil through a continuous filter to remove any food particles in the oil. Locate adequate exhaust fans in the working areas to remove smoke, odors, and excess heat. Pass precooked products directly from the cooker to a freezer before packing them. Maintain temperature-control charts for all cookers.

Handle all frozen products as expeditiously as possible to prevent them from thawing. Do not allow the time between bringing the frozen blocks to the processing area and placing the finished product in the freezer to exceed 1 hour. (In a well laid-out plant, this time will be less than 30 minutes.) Because of this short time interval, the work area need not be refrigerated, but prevent it from becoming warmer than 75° F.

Show the date of packing on the primary code containers of all finished products.

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MS. 1968

TOW-BAR SYSTEM FOR SEINING FARM PONDS

by

Kenneth L. Coon and James E. Ellis

ABSTRACT

The farm-pond fish-raising industry has needed mechanized methods to lower the cost of harvesting the fish. This report describes equipment and its operation for hauling a small seine with farm tractors or trucks if the pond has levees or a shore that can accommodate these vehicles. The equipment works well with ponds up to 450 feet wide and of any length.

INTRODUCTION

Gordon (1965) and Coon, Larsen, and Ellis (1968) of the Bureau of Commercial Fisheries have developed and described mechanized seining equipment and techniques for use in lakes and large ponds. Prior to this mechanization, the fish farmer was restricted to using harvesting methods that involved the draining of a pond, the use of a large crew of men, and usually a considerable amount of time to seine even the smallest of ponds.

The critical need for mechanization in the farm-pond fish-producing industry has now led us to develop tow bars for hauling seines with standard farm equipment under certain fish-harvesting conditions. By means of tow bars attached to tractors or trucks, two men can harvest fish from ponds up to 450 feet wide and of any length, providing the levees or shore can accommodate the vehicles (Figures 1 and 2). The tow bars are simple to make and are relatively inexpensive. They cost about $200 for two bars plus $65 for an added seine reel.

Described here are the equipment needed and the method of operating it.

I. EQUIPMENT

The seine tow bar has three sections—one length of square steel tube and two sections of round iron pipe (Figure 3). The square tube is attached to a three-point tractor hitch or to a truck bumper by means of mounting brackets. This tube is 3½ inches square by 7 feet long and is made of ¼-inch-thick steel plate (American Society for Testing Materials Alloy 1025, or the equivalent). The square tube extends 2 to 3 feet beyond one side of the vehicle and is connected to the first section of pipe by a self-aligning bearing pivot joint. The first section of pipe is 3-inch inside diameter (iron-pipe standard) and 6 feet long. The second section of pipe is 2½-inch inside diameter and also 6 feet long. The pipe of smaller diameter slides into the one of larger diameter to provide for varying the length of

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Figure 1.--Tractor-mounted tow bar attached to a seine in a commercial catfish pond.

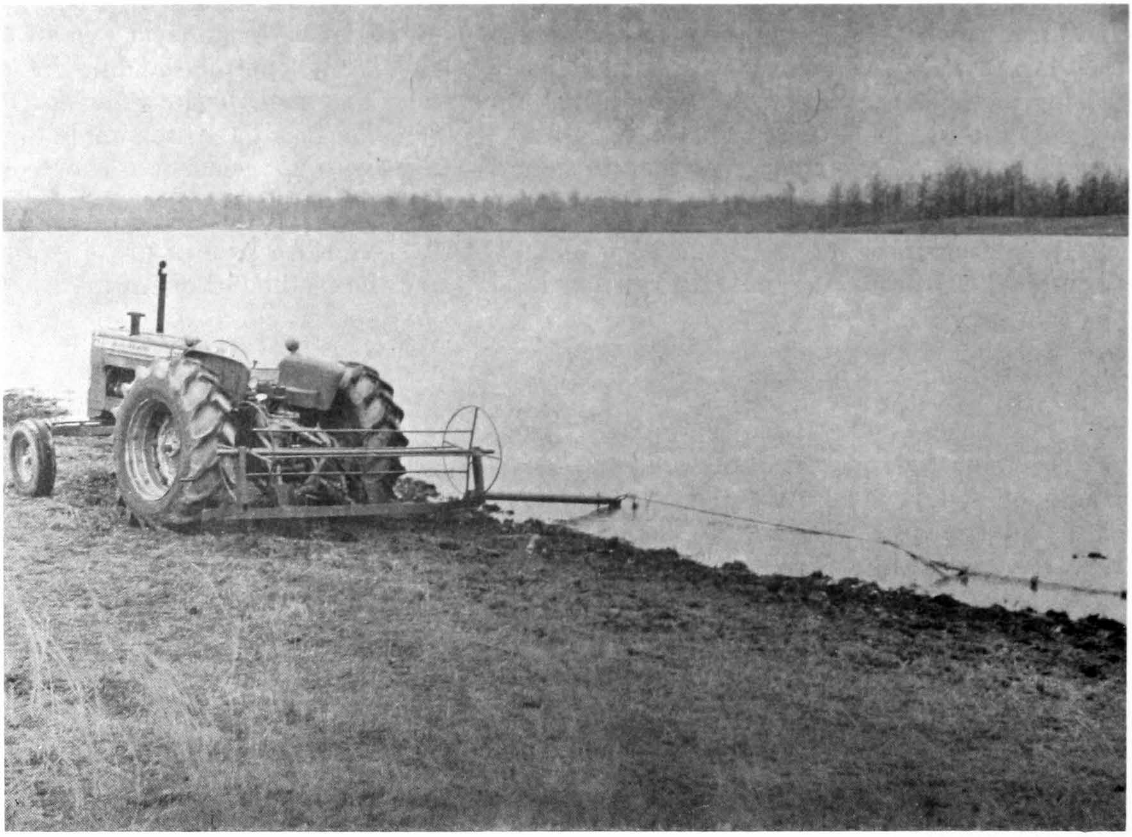

Figure 2.--Tractor mounted tow bar (with net reel) attached to a seine in a commercial catfish pond.

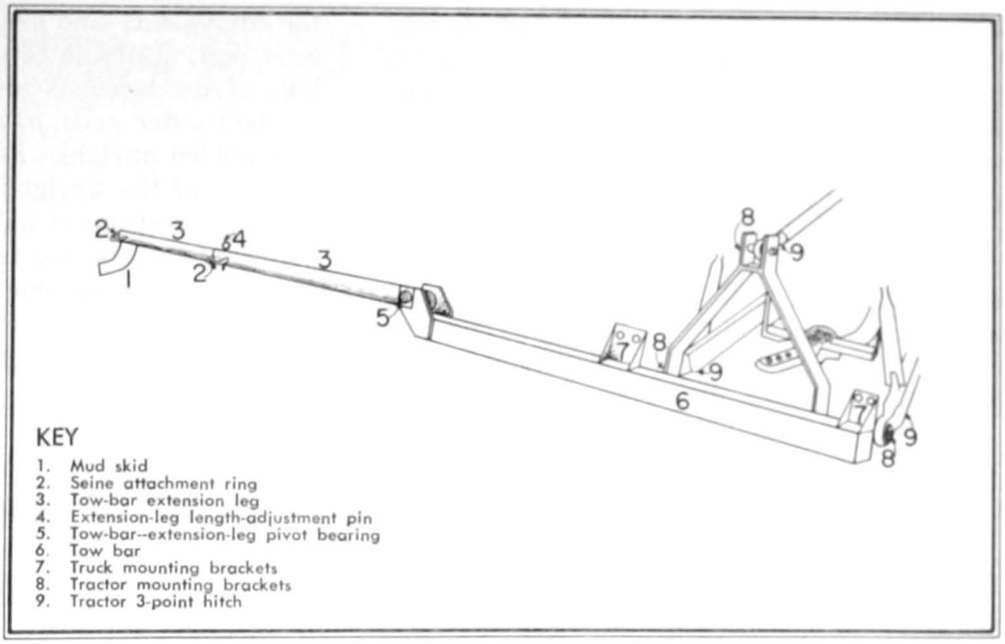

Figure 3.–Tow bar for pulling seines to harvest fish in certain farm ponds.

the tow bar 6 to 10 feet beyond the pivot. A pin through matching holes in the overlapping portion of the pipes keeps the pipes at the length wanted. Rings for attaching the seine are welded to the outer end of each pipe, and a 1/4-inch, by 6-inch, by 18-inch curved mud skid is welded to the outer end of the pipe having the smaller diameter.

Additional convenience and efficiency can be gained by adding a net reel to one of the tow-bar units (Figure 4). The 8-foot-long

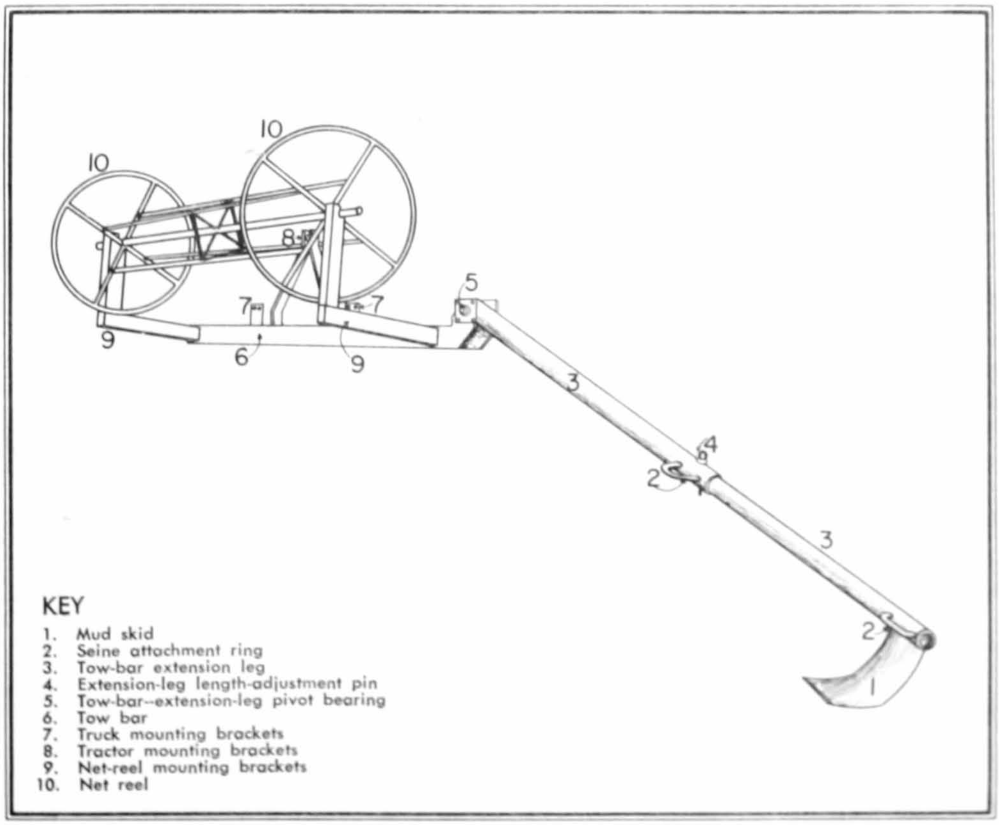

Figure 4.–Farm-pond-seine tow bar fitted with a net reel for stowing, transporting, and setting the seine.

net reel tested by the Bureau of Commercial Fisheries has core bars spaced 16 inches apart, has end flanges 32 inches in diameter, and has an axle that is 10 feet long. This reel, which will hold a seine of up to 500 feet in length, is of $\frac{3}{4}$-inch inside diameter pipe (iron-pipe standard). The square-steel-tube section behind the vehicle has to be $9\frac{5}{6}$ feet long to accommodate a reel 8 feet long. Support brackets for the reel are 3-inch square tubes made of $\frac{1}{4}$-inch-thick steel plate (American Society for Testing Materials Alloy 1025, or the equivalent) and are welded to the square-tube section of the tow bar. The horizontal legs of the brackets are 18 inches long and, on their outer ends, have 15-inch-long vertical legs welded upright. Semicircular cuts, in the top end of the upright legs, accommodate 3-inch-long sections of half-round, 2-inch inside-diameter pipe used as friction bearings for the $1\frac{1}{2}$-inch inside-diameter pipe axle of the reel. A removable crank handle at one end of the axle facilitates your turning the reel as you wind in the seine.

II. METHOD OF SEINING WITH TOW BARS

Two vehicles, with a tow bar attached to each, are positioned back-to-back at one corner of the pond. The vehicle with the seine reel lays the net along the end of the pond while the other vehicle anchors one end of the net (Figure 5).

The self-aligning bearing pivot permits the skid on the tip of the tow bar to rest on the ground regardless of how the levee slopes or of how irregular the levee is. The tip of the tow bar does not need to be exactly at the edge of the water. It operates satisfactorily at any location from a few feet into the water to a few feet up on the bank.

After the net has been laid along the end of the pond, the two vehicles proceed along the opposite levees at a rate of up to 50 feet per minute.

The vehicles must meet near the site where you intend to remove the fish whether it be at a corner of the pond or at someplace in between the two levees. To get at the fish, you can dry them up either by hand or by attaching both ends of the net to one of the vehicles and slowly pulling it up onto the shore.

In actual tests, the equipment illustrated in Figures 1 and 2 worked well.

SUMMARY AND CONCLUSIONS

A simple, relatively inexpensive, tractor or truck tow-bar system was developed and tested to remove farm-cultured fish from ponds up to 450 feet wide and of any length.

The advantages of the system over manual methods include: (1) when the system is used, draining the pond is unnecessary, (2) seining is more convenient and faster, and (3) increasing the efficiency in this manner reduces the cost per acre of water seined and per pound of fish handled.

The main limiting factor is the adequacy of the levees or shore of the pond to accommodate the tractors or trucks.

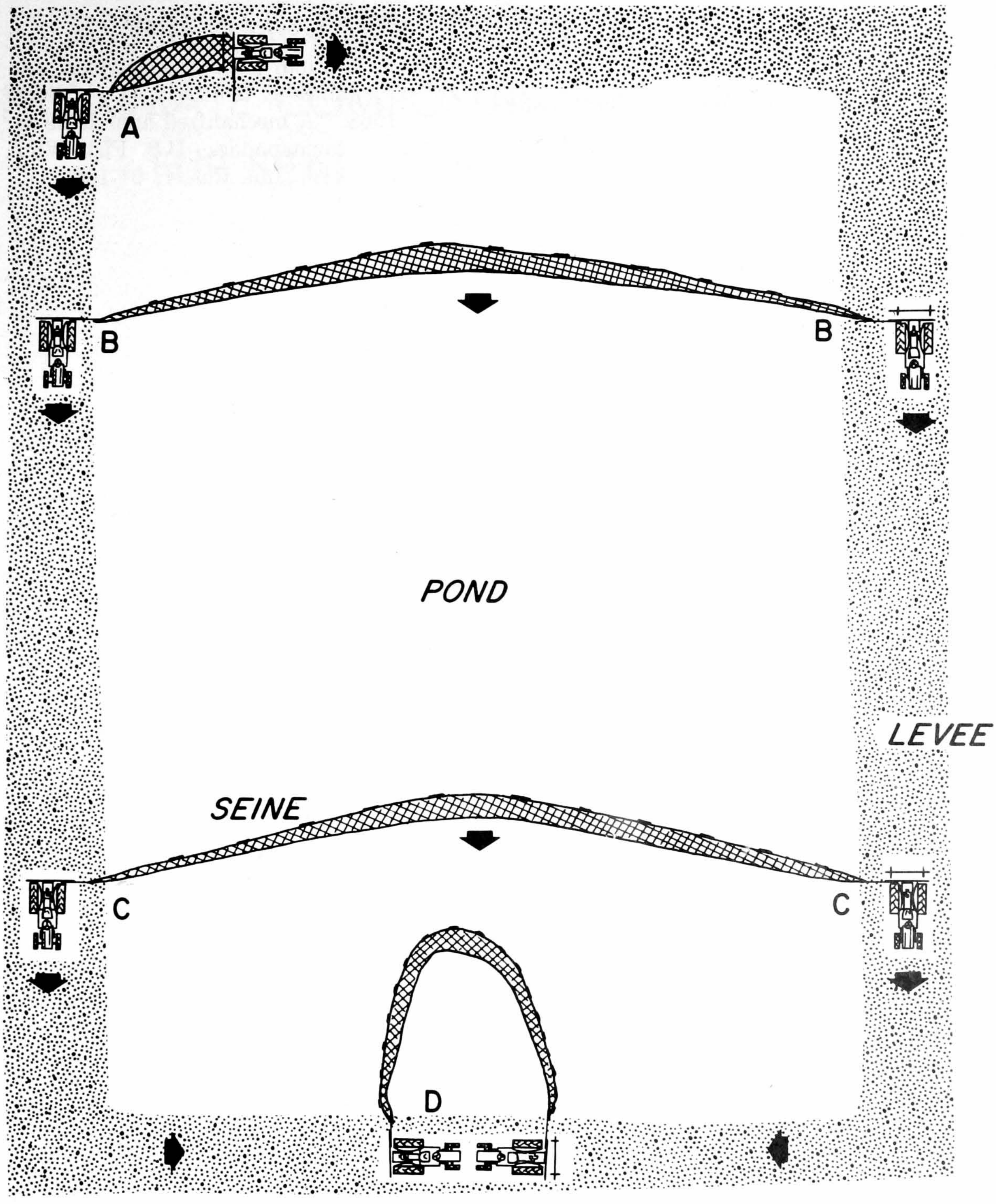

Figure 5.—Major steps in operating a farm-pond seine with tractor-mounted tow bars. A—setting the seine. B and C—pulling the seine. D—pocketing the fish at the site of removal.

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PRELIMINARY STUDY OF THE PROXIMATE COMPOSITION OF MEAT OF FUR SEAL, *Callorhinus ursinus*

by

Richard W. Nelson and Harold J. Barnett

ABSTRACT

Finding profitable uses for the carcasses of fur seal has presented a problem to the Bureau of Commercial Fisheries. As a part of an effort to encourage use of the carcasses, several separate lots of meat and ground eviscerated carcasses were analyzed to determine proximate chemical composition. In this preliminary study, individual carcasses and samples from lots of ground carcasses were high in protein content and variable in oil content. Analyses of small samples of male and female seals taken at different times during the harvesting season indicated that variation in composition did not correlate with the time of sampling nor with the sex of the animal.

CONTENTS

INTRODUCTION

Fur seals harvested annually on the Pribilof Islands in the Bering Sea provide the world's largest source of sealskin furs. This harvest is administered by the Bureau of Commercial Fisheries. During 1956 through 1963, the Bureau took an annual average of 81,600 sealskins[1] from St. Paul and St. George Islands, the two largest islands in the Pribilofs.

[1] Personal communication from the Bureau of Commercial Fisheries Marine Mammal Biological Laboratory, Seattle, Washington.

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On St. Paul Island, the carcasses that remained after being skinned were formerly processed into meal and oil in a reduction plant located on the island. However, after 1961, the reduction plant was not operated, owing to the low market prices for meal and oil.

The Bureau therefore investigated other methods of using the carcasses to prevent waste of the more than 2 million pounds available and to get income from them. The most promising result of efforts to use the carcasses has been the production of ground meat for mink feed. The carcasses are purchased by private contractors and are processed into a ground, frozen product in a plant located on St. Paul Island.

During the period of investigation into the possibilities of using the seal meat for mink food, the Bureau of Commercial Fisheries Technological Laboratory at Seattle analyzed several different small lots of fur-seal samples to determine their proximate chemical composition. The purpose of this paper is to report on the analyses made in this limited study.

For the analyses, samples of carcasses and meat were obtained from several sources during the years 1962 and 1963. The samples were from (I) eviscerated carcasses and (II) commercially ground seal meat.

I. EVISCERATED CARCASSES

One lot of eight, frozen, eviscerated seals was obtained in 1962 from St. Paul Island, and the heads and flippers were removed. Each carcass in this lot was analyzed separately. Six of these carcasses were ground entirely, so the ground samples contained blubber and bone. The remaining two were trimmed of blubber and bone, and only the meat was analayzed.

A. SAMPLES CONTAINING BLUBBER AND BONE

1. Procedure

During the 1963 killing season, the staff on St. Paul Island prepared and froze six carcasses from each week's harvest and held them in frozen storage on the island until they could be shipped to Seattle. Samples were taken between July 11 and August 29. The collection of samples conformed to the normal pattern of killing, which consists of taking only males during the early part of the season and taking only females during the latter part of the season.

Carcasses to be analyzed were sawed into sections about 2 inches thick and then were allowed to thaw slightly to facilitate their being ground. A 25-horsepower Autio grinder equipped with a ½-inch grinding plate was used for grinding.[2]

Representative portions from each sample were reground in a Hobart food cutter to reduce the size of the particles of meat further. The samples were packed in metal cans and stored at −20° F. until needed for analysis.

Each sample was analyzed, in duplicate, for moisture, protein, oil, and ash by the use of standard procedures (Horwitz, 1955).

2. Results

Analyses of individual carcasses (Table 1) show that the concentration of oil varied con-

Table 1.—Proximate composition of six individual eviscerated carcasses of fur seal

Sample	Proximate composition			
	Moisture	Oil	Protein	Ash
	Percent	*Percent*	*Percent*	*Percent*
Carcass 1	61.9	17.4	18.5	3.0
Carcass 2	61.4	15.3	19.9	3.7
Carcass 3	63.7	12.8	20.2	4.2
Carcass 4	66.4	8.7	21.2	4.2
Carcass 5	64.0	12.6	20.1	4.8
Carcass 6	62.1	12.9	19.9	5.5
Average	63.2	13.3	20.0	4.2

Note: The carcasses included bones and some blubber but did not include heads, viscera, hides, or flippers.

[2] Use of trade names is only to facilitate descriptions; no endorsement is implied.

siderably from one carcass to another. This variation may be due to inherent differences between animals or, more likely, may be due to the fact that different amounts of blubber, or fat, were left on the carcass during skinning.

B. SAMPLES WITH BLUBBER AND BONE REMOVED

A comparison of the data on oil concentration in Table 2 with those in Table 1 shows the effect of blubber. Where the whole carcass was ground, with the blubber left on the carcass, the average concentration of oil in the meat was 13 percent, whereas with the blubber removed from the carcass, the concentration of oil in the meat was only 3 percent.

Table 2.—Proximate composition of fur seal (meat only)

Sample	Proximate composition			
	Moisture	Oil	Protein	Ash
	Percent	*Percent*	*Percent*	*Percent*
Carcass 7	71.7	3.7	24.6	1.4
Carcass 8	72.7	2.7	24.6	1.3
Average	72.2	3.2	24.6	1.3

Note: The samples were prepared from blubber-free, lean meat trimmed from the whole carcass and then blended in a laboratory grinder.

A comparison of the data on ash content in the two tables shows the effect of bone. Where the whole carcass was ground, with the bone left in, the average concentration of ash was 4.2 percent, whereas with the bone removed, the concentration of ash was only 1.3 percent.

C. SAMPLES OBTAINED AT INTERVALS DURING HARVEST SEASON

Samples of carcasses taken at various times during the 1963 killing season were analyzed to determine whether significant changes in composition occur as the killing season progresses. During this season, which coincides with the mating season, the harem bulls establish their territory, the female seals (mated from previous year) have pups, and mating takes place. The feeding habits are abnormal during this period. Samples of male and female carcasses, taken over the span of the entire killing season, were analyzed to determine whether composition changes during this period. Twenty-four carcasses were examined. Six males were obtained on July 11; another six, on August 1. Six females were obtained on August 15; another six, on August 29.

The results (Table 3) from this small sample do not indicate any marked differences in composition due to season or sex. These samples were all lower in concentration of moisture than were those analyzed previously. This difference in moisture concentration (compare with the average of six carcasses in Table 1) may be due to a loss of moisture during frozen storage.

Table 3.—Proximate composition of male and female eviscerated fur-seal carcasses, period from July 11, 1963, to August 29, 1963

Sample description			Proximate composition			
Date taken	Sex of seal	Carcasses in sample	Moisture	Oil	Protein	Ash
		Number	*Percent*	*Percent*	*Percent*	*Percent*
7-11	Male	6	61.0	12.9	23.0	3.9
8- 1	Male	6	61.6	12.6	23.3	4.7
8-15	Female	6	62.1	9.1	23.7	5.2
8-29	Female	6	60.5	12.5	23.5	5.0

Note: The carcasses included bones, flippers, and some blubber but did not include heads, viscera, or hides. All carcasses were frozen in burlap bags on St. Paul Island. Each sample lot analyzed consisted of the six carcasses combined to form a single sample.

II. COMMERCIALLY GROUND SEAL MEAT

A. PROCEDURE

Samples of ground carcass meat were obtained during a trial grinding and freezing operation by a firm in Vancouver, British Columbia. The lot sampled was part of a commercial experiment in which carcasses were shipped from St. Paul to Vancouver, iced in the hold of a fishing vessel (*Mina C.*). The product was used for ranch mink feed. About 150 tons of carcasses that had been held from 12 to 18 days on ice at the time of arrival in Vancouver were used in the trial.

The carcasses were unloaded from the vessel and ground in an Autio grinder using a

½-inch grinding plate. Three samples were obtained from the material as it was discharged from the grinder, and each sample consisted of about 12 aliquots taken at random and combined to form 5-pound portions. The samples were stored at −20° F. at the laboratory. At the time that the samples were prepared for chemical analyses, each portion was reground in a Hobart food cutter to reduce the size of the particles of meat.

B. RESULTS

The average concentration of oil in this large composite of ground fur seal was 9.8 percent (Table 4). Each of the three samples was taken at random and consisted of about 12 aliquots totaling 5 pounds. The aliquots were taken from the ground material as it left the grinder. Even with this attempt at obtaining representative material, the concentrations of oil in the three lots ranged from 8.7 percent to 11.2 percent.

It should be noted, however, that the carcasses were shipped from St. Paul Island to Vancouver, British Columbia, packed in crushed ice. Contact with melting ice during the voyage may have affected the content of moisture in the carcasses and hence may have affected the relative content of oil.

Table 4.–Proximate composition of fur seal commercially ground

Sample	Proximate composition			
	Moisture	Oil	Protein	Ash
	Percent	*Percent*	*Percent*	*Percent*
A	67.3	8.7	21.3	3.4
B	66.6	9.6	21.6	3.1
C	64.8	11.2	21.3	3.3
Average	66.3	9.8	21.4	3.3

Note: Commercially ground samples included bones, flippers, and some blubber but did not include heads, viscera, or hides.

SUMMARY AND CONCLUSIONS

In a preliminary study, analyses of samples of fur-seal carcass indicate that the fur seal contains a high amount of protein, a moderately high amount of oil--due primarily to the presence of blubber, and a high amount of ash--due primarily to the presence of bone.

Analyses of samples of fur-seal meat only show that the meat is very high in protein and low in oil.

Although the data indicate that fur seal varies considerably in composition, the variability did not correlate with sex or time of sampling within the killing season between mid July and late August--at least in the small size of samples tested.

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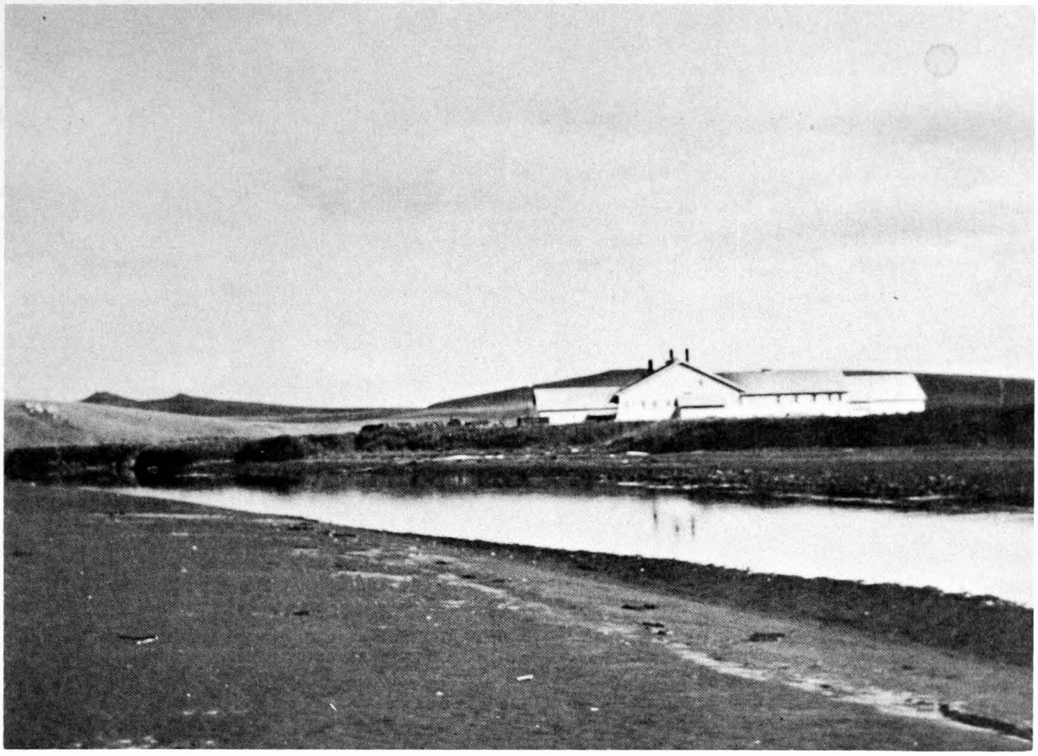
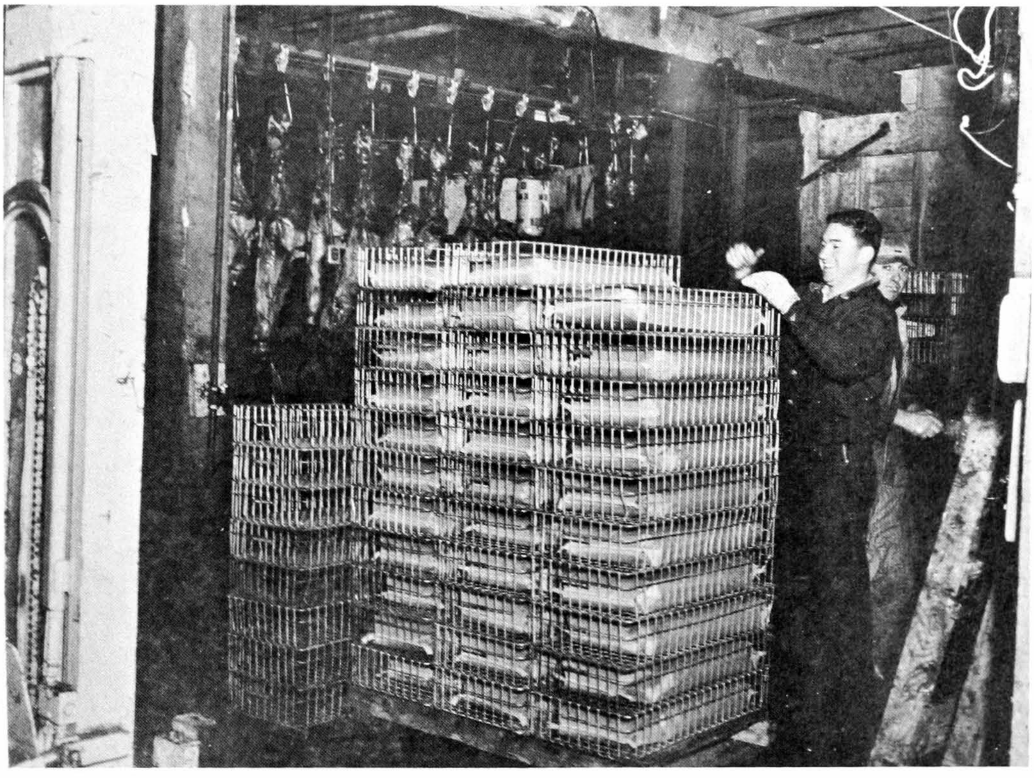


Byproducts plant on St. Paul Island.



Loading ground, packaged seal meat onto a pallet for transportation into the freezer.

The Pribilof Islands in Bering Sea are the homeland of the largest fur seal herd in the world. Here the fur seals come ashore to bear their young on the rocks and sands above tidewater.

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