Seattle, WA November 1974

Fishery Facts 7

National Oceanic and Atmospheric Administration / National Marine Fisheries Service

a trapping system for harvesting sablefish,

Anoplopoma fimbria

FRED W. HIPKINS

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COVER PHOTO—A tandem tunneled web trap with about 1,500 pounds of large sablefish.

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FISHERY FACTS-7

a trapping system for harvesting sablefish Anoplopoma fimbria

FRED W. HIPKINS

SEATTLE, WA
November 1974

CONTENTS

ABSTRACT

An improved method of commercial fishing for sablefish, commonly known as black cod (not related to the family of codfishes), is now used by commercial fishermen from California to Alaska. Fish are captured and impounded in lightly constructed, baited traps. The traps are collapsible (they fold down) but are rigid when set out to fish. They can be completely covered with webbing or steel wire mesh. Fish impounded in the traps, which are attached to groundlines, are alive and in excellent condition when brought aboard the fishing vessels. The traditional setline method for fishing sablefish requires considerably more bait, larger fishing crews, and many more hours of work per day to catch a comparable amount of sablefish.

Details of the trapping gear, setlines, and buoylines, plus the vessel equipment, fishing instructions, and locations of traditional fishing grounds are described.

A TRAPPING SYSTEM FOR HARVESTING SABLEFISH, *ANOPLOPOMA FIMBRIA*

FRED W. HIPKINS[1]

INTRODUCTION

Traps and pots were among the earliest types of fishing gear used by ancient man and are still used in many parts of the world to harvest fish and shellfish. Recently, as a result of a development project carried out by the National Marine Fisheries Service, traps are now used for harvesting sablefish (black cod), *Anoplopoma fimbria,* in the northeastern Pacific Ocean from central California northward to Alaska. The work has been a cooperative venture with fishermen in which both their and our ideas were tested from research and commercial fishing vessels. As a result of this work we can now provide a description of an economically feasible system for using traps to harvest sablefish.

Traps have several inherent advantages over setlines and otter trawls which are the traditional methods for harvesting sablefish. Since all fish captured in traps are alive when hauled aboard the vessel, the quality is superior. Also, traps will continue to collect fish and retain them alive for several days if a vessel is unable to haul the gear. In contrast, setlines must be hauled frequently to prevent fish from dying or being eaten by other marine animals. In some waters, sharks, sea lions, and other predators eat or mutilate fish on setlines when the gear is left in the water for only a short time. Traps provide protection from such predation. Fish caught in trawls often have many missing scales, punctures from spines of other fish, or are crushed by large loads in the net as it is lifted aboard the fishing vessel. Those in traps are generally of uniformly high quality.

Traps have several advantages, but also have some disadvantages.

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They are more easily lost or damaged than some other types of fishing gear and if lost can continue to collect and destroy fish for months or perhaps years before deteriorating unless suitable means for rendering them ineffective are incorporated. This problem can be reduced by inserting a "destruct panel" of natural fibre into steel mesh traps, or by constructing the traps in such a way that they will cease to fish if lost. Cotton deteriorates rather fast in salt water, and a panel constructed of cotton webbing ultimately provides for escape of fish entering lost traps.

Two types of trap systems were evaluated in our developmental work. The first was a modified Alaska king crab system where traps were fished from individual buoylines. The second was a lightweight trap of our own design fished from longlines. Advantages of the longline system compared to individual traps include: 1) lower costs since the traps are of lightweight construction; 2) up to 60% reduction in buoyline costs; and 3) higher daily catches because more traps can be hauled per day. A potential disadvantage is greater difficulty in accurately setting traps near submarine canyons where the sea floor is irregular.

The first lightweight traps tested were noncollapsible and included both cylindrical and rectangular designs. However, their shape and bulkiness made them impractical for handling and storing aboard the vessel. Consequently, development was concentrated on collapsible rectangular traps which have proved effective and feasible. The operation of the collapsible rectangular traps and the longline fishing technique is described in this publication.

Information most often requested by fishermen and vessel owners relate to details of trap and longline construction, fishing techniques, vessel gear needed, locations of sablefish concentrations, and the possibility of fishing other species with the gear. It is the intent of this article to provide such information.

THE FISHING GEAR

The trapping system includes a number of strings of gear and is set over a fishing area usually at different depths. The system is fished from 1 to 4 days between liftings. The time intervals are generally dictated by weather and sea conditions. Each string of gear, Figure 1, consists most often of 10 baited lightweight rectangular traps attached at 50-fathom intervals to a polypropylene setline. The string is anchored at each end. A buoyline running to the surface is attached to each anchor. The gear can be fished to any depth providing the length of buoyline exceeds the bottom depth by about 50-fathoms. The speed

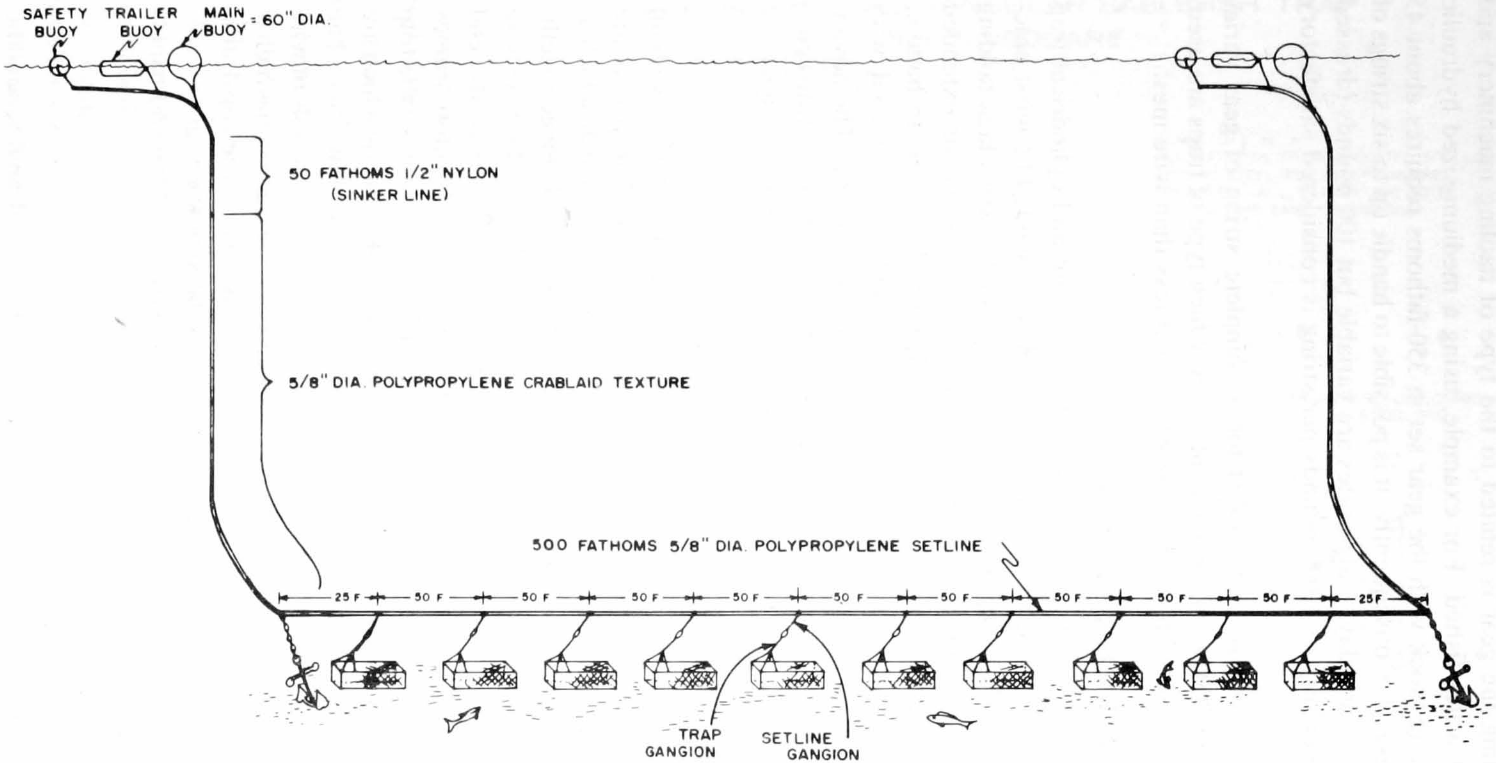

Figure 1.— A pictorial view of a string of sablefish trapping gear.

of handling the gear is related to the type of hauling machinery and depth of water fished. For example, using a medium-sized hydraulic line hauling block with the gear set in 350-fathoms requires about 45 min to reset it. Consequently, it is possible to handle up to six strings of gear per fishing day. Catch rates are variable but 100 pounds (dressed weight) per trap or 1,000 pounds per string is considered satisfactory fishing.

The cost of materials (1973) for a complete string of gear varies between $1,700 and $2,600 depending on which type of traps are used. Those covered with synthetic webbing cost less than wire mesh.

Collapsible Rectangular Traps

To overcome the disadvantages of the king crab and cylindrical trap designs, a rectangular collapsible trap was developed. The most practical size is 8 feet long by 34 inches square. Smaller sizes lack holding space which results in high fish mortality when fished for extended periods. Traps larger than 8 feet are awkward, dangerous to handle, and require more deck space. We have tested traps covered with welded wire mesh and nylon and polypropylene webbing. The advantage of steel mesh wire traps is stronger construction, while traps covered with synthetic webbing appear to produce larger catch rates.

Steel Wire Mesh Traps

The collapsible steel wire mesh trap shown in Figure 2 weighs about 130 pounds and is made from four identical panels. The panels are constructed with 2-inch square, 10-gage welded wire mesh which is machine welded to ⅜-inch diameter steel rod frames and hinged together with short sections of heavy gaged coiled wire (Fig. 3). Double wire clips (Fig. 3) are welded to the sides and bottom frames of the end locking panels. The clips are inserted into the sides and bottom frames and held in place with steel locking hooks (Fig. 3) which make the trap rigid. The locking hooks are attached to ends of rubber bands which are long enough to keep tension on the hooks, holding them in place. The emptying door (Fig. 3) is made with two equal size framed panels of wire mesh which are hinged with strap metal welded to the top panel which is shown in Figure 3. The locking panels are hinged to the top frame which allows them to remain intact when collapsing the trap. To collapse the trap, the steel locking hooks are removed and the end panels are laid over the top panel.

Web-Covered Traps

Collapsible frames for web-covered traps, Figures 4 and 5, are the

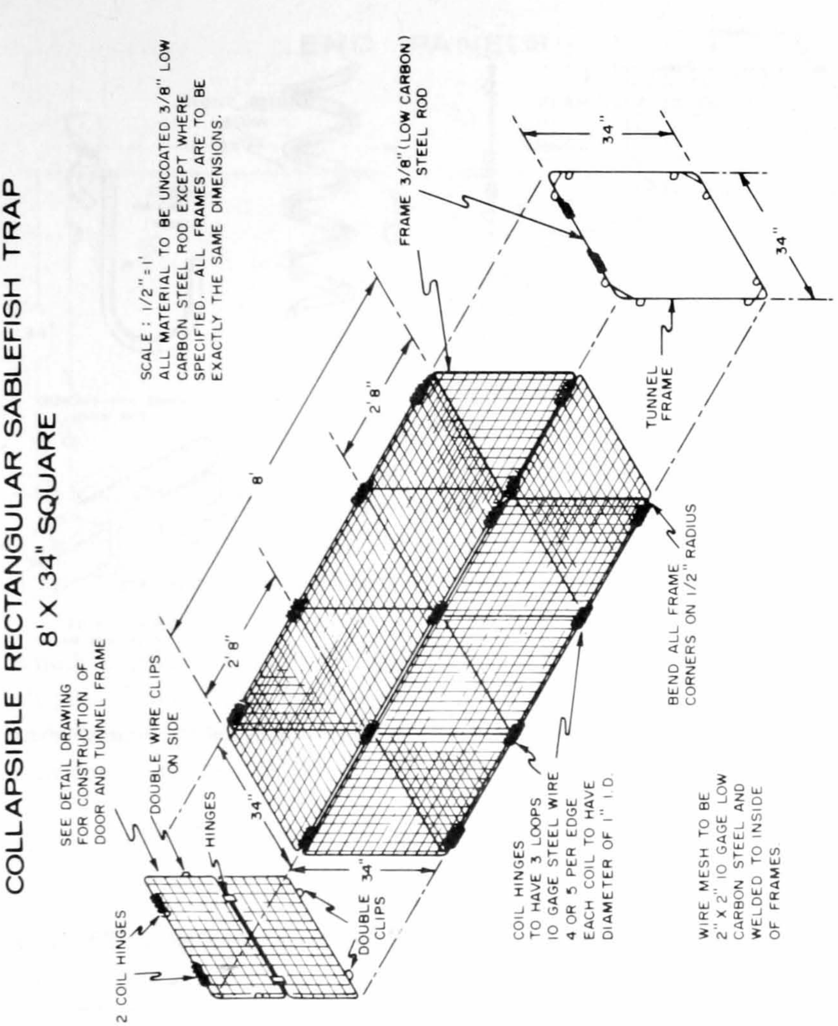

Figure 2.—Scale drawing of a collapsible rectangular steel mesh trap.

same as for the steel mesh traps except hanging rods for webbing are welded to the side frames. Thus, the inside dimensions for web-covered traps are 8 feet long by 34 inches wide by 32 inches deep. Short sections of ⅜-inch diameter rods are welded across the corners for additional strength. The frames are assembled in the same manner as the steel mesh traps using coiled wire hinges, steel locking hooks, and end frames with the double clips attached.

Webbing can be of either number 36 nylon or number 42 polypropylene and the mesh size should be about 3½- (3.5) to 3¾-inch (3.75) stretched mesh. These sizes have sufficient strength for holding large catches and retain commercial sizes of sablefish without excess gilling of smaller sizes.

The assembled trap is usually covered with a single piece of webbing

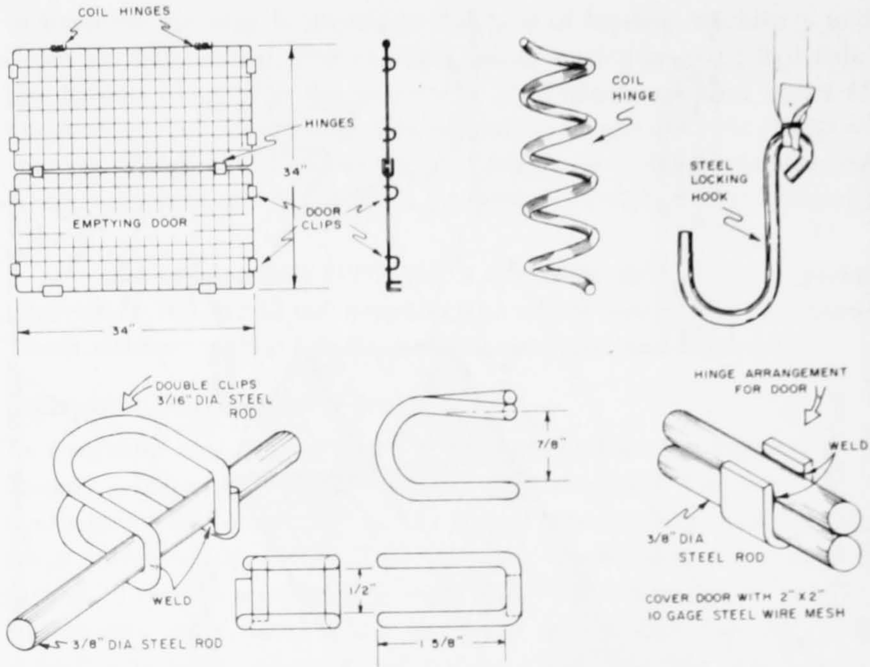

Figure 3.—End locking panel with hinged emptying door and details of various assembling components.

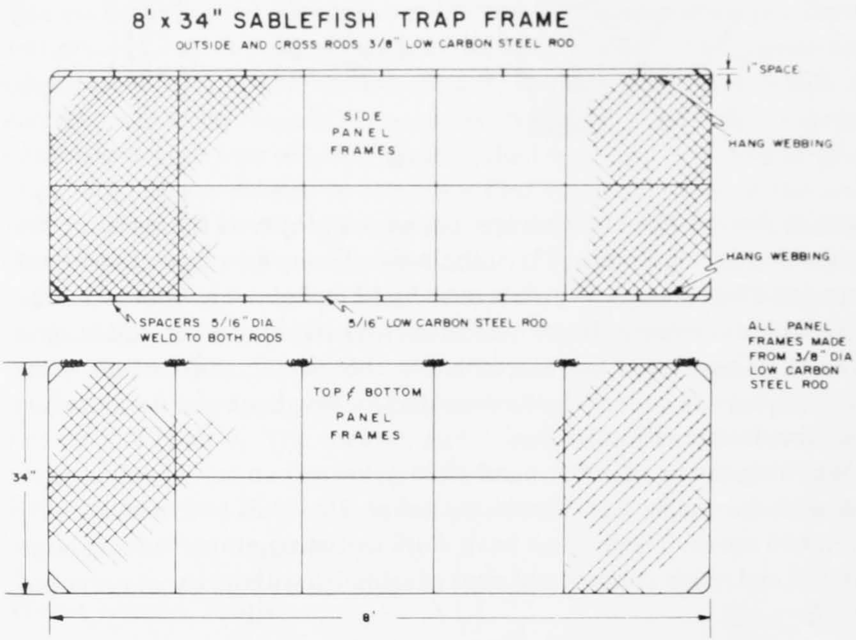

Figure 4.—Collapsible trap frames for webbing.

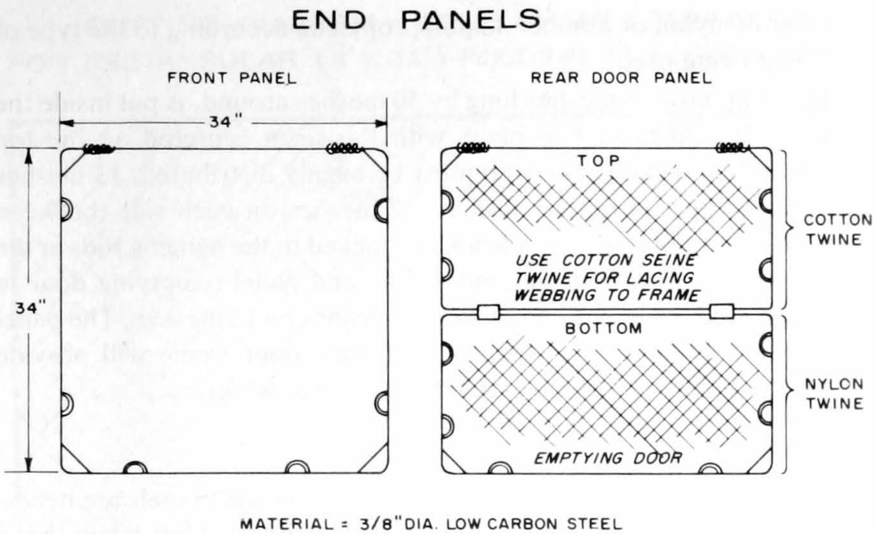

Figure 5.—End locking panels for webbing frames.

which should be hung to the frame with square-, rather than diamond-shaped meshes. This is the most efficient shape and is also the easiest to calculate. The following formula can be used for calculating the number of meshes required to cover a given area:

$$\text{Number of meshes} = \frac{\text{Length of frame (inches)}}{\text{Mesh size (inches)} \times 0.707}$$

For a frame 8 feet long by 34 inches wide by 32 inches deep (Fig. 4) the calculations are:

$$\text{Meshes long} = \frac{96}{3.75 \times 0.707} = 36.2 \text{ or } 36 \text{ M}$$

$$\text{Meshes deep (top \& bottom)} = \frac{34}{3.75 \times 0.707} = 12.8 \text{ or } 13 \text{ M} \times 2 = 26 \text{ M}$$

$$\text{Meshes deep (sides)} = \frac{32}{3.75 \times 0.707} = 12.1 \text{ or } 12 \text{ M} \times 2 = 24 \text{ M.}$$

The panel of web 36 meshes long by 50 meshes deep is laced together lengthwise producing a cylindrical shape. About 2 feet of this seam should be laced with number 27 cotton seine twine (for "destruct" purposes) while the balance of lacing and hanging twine should be number 36 nylon or number 42 polypropylene according to the type of webbing being used.

The web, now 36 meshes long by 50 meshes around, is put inside the trap frame and tacked in place with the seam centered on the top frame. When tacking, the web must be evenly distributed, 13 meshes across the top and bottom frames, 12 meshes on each side (between hanging rods). The web should also be tacked to the hanging rods at the center (18 meshes from the ends). The end panel (emptying door in Fig. 5) is covered by a panel of web 12 meshes by 12 meshes. The panel should be on the inside so that the hinged door frame will provide support when large catches are lifted from the water.

Tunnels

Proper webbing, construction and installation of the tunnels are necessary if the trap is to fish effectively. Best results for sablefish have been obtained with 2½-inch number 21 knotted nylon which has been treated with a netting preservative. The treatment gives a springlike action which apparently facilitates entry and is effective in preventing escape. Construction is from two identical panels, cut as shown in Figure 6. These are laced together along the 24 bar sides to form a completed tunnel. It is installed in the trap as shown in Figure 7. The 14 bar edges are laced to the vertical corner rods and the longer forward edges to the horizontal top and bottom rods. Support for the tunnel eye is by large rubber bands which are made for commercial fishing attached to the lacing twine at each side of the eye and to the center of the side frame. The tunnel should not be stretched too tight but left flexible to allow the web to spread when fish enter.

Traps have been tested with single and tandem tunnels. The latter is shown in Figure 7. Results suggest that the tandem design is more effective when the traps are fished from 2 to 4 days between liftings while single tunnels are best for shorter fishing times (1 to 2 days). For example, in one test both single and tandem tunneled traps were fished in the same area for 4 days. The tandem tunneled traps averaged 59 sablefish per trap while the single tunneled traps averaged 26. In view of this we recommend tandem tunneled traps whenever longer soaking periods are anticipated.

Trap Bridle and Gangion

The trap bridle shown in Figure 8 is a four legged harness designed to tilt the trap 40 to 50 degrees. This allows the trap to rest on the bottom in an upright position (Fig. 1) and forces the fish near the emptying

CUTTING DIAGRAM – CONE SHAPED TUNNELS'
FOR RECTANGULAR (8' X 34") FOLDING BLACKCOD TRAPS

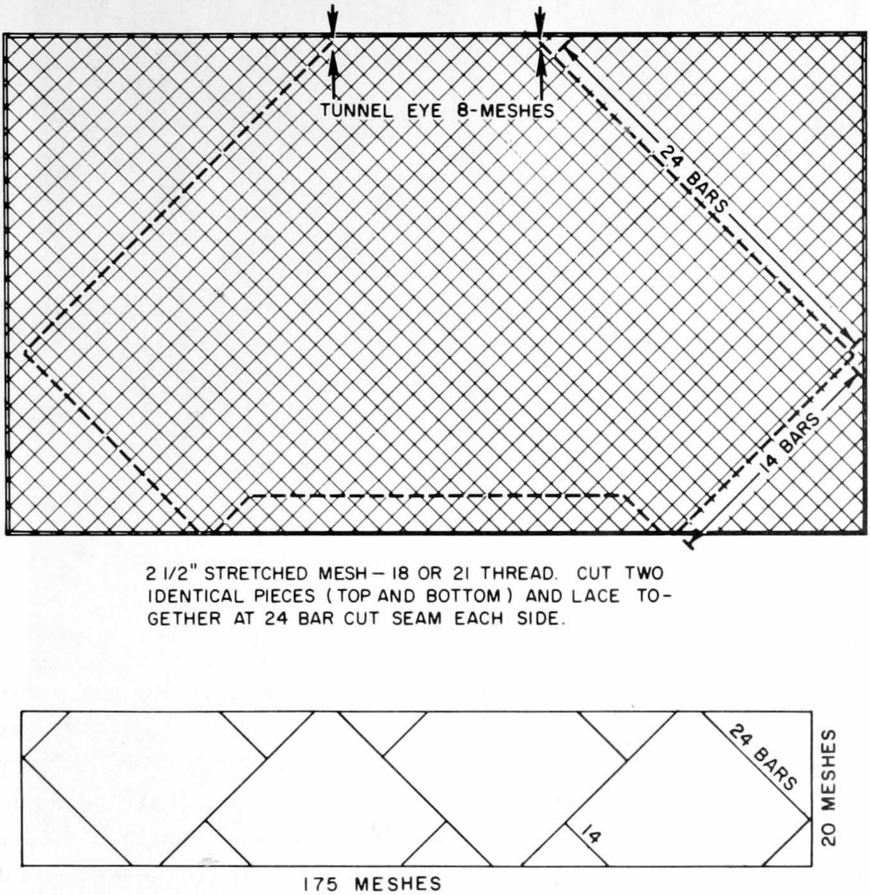

Figure 6.—Web cutting diagram for tunnels. If larger eye opening desired extend it one more mesh to 9 meshes.

door when hauling. The bridle is made with two pieces of ½-inch diameter soft laid polypropylene, 13 feet long. The lines are tied to each front corner, crossed, and tied just forward of center to each side of the frame. They are adjusted to about 15 inches above the front center of the trap with long loops extended and an overhand knot tied in the loops. The double loops provide the beckett for attaching the trap gangion. The gangion is a 5-foot piece of ½-inch diameter soft laid polypropylene which is secured to the backett with the opposing end secured to a snap hook (Fig. 9). In 2 yr of test fishing no trap losses occured from using the snap hook and connection shown.

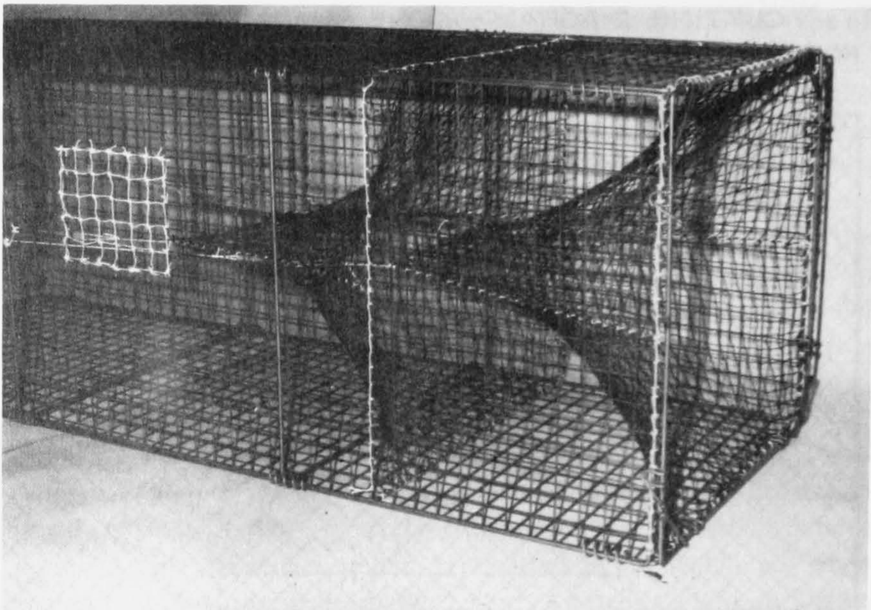

Figure 7.—A tandem tunnel trap showing a cotton destruct panel.

Bait Containers and Bait

Bait containers are 2- or 3-quart, wide mouth, plastic food jars perforated with numerous 1/32-inch diameter holes (Fig. 10). They are loosely filled with about 1¼ pounds of bait. It is important that they are not packed too tightly because it is necessary to have adequate circulation of water through the container to obtain adequate bait odor dispersal. Herring has been found to be an effective bait as it has good attraction qualities, is in ready supply, and can be conveniently stored aboard the vessel.

Buoylines and Buoys

A buoyline is constructed with a 50-fathom length of ½-inch diameter nylon rope at the surface end and the balance of 50-fathom lengths of ⅝-inch diameter polypropylene rope. The purpose of the nylon length (the sinker line) is to hold the buoyline down so as to reduce the possibility of it being cut or tangled by propellors of passing vessels. Use of 50-fathom lengths is for ease of handling aboard the vessel. For security reasons buoyline assemblies are used at both ends of a string of gear. Figure 1 describes the relationship of the buoylines to a string of traps.

The length of buoyline is a function of the water depth being worked. In depths to about 200-fathoms 25% excess buoyline is used. In greater

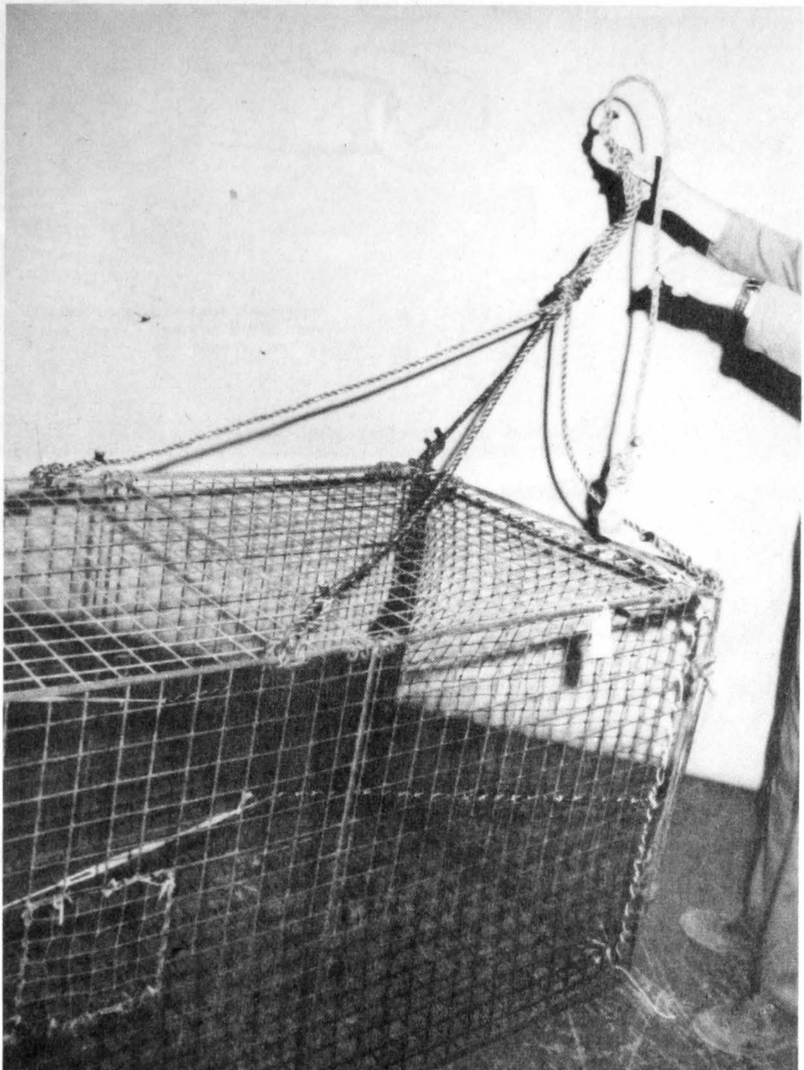

Figure 8.—Four legged trap bridle with gangion attached.

depths 50-fathoms of excess buoyline is adequate. When fishing in areas near steep drop-offs additional buoyline should be used to ensure gear retrieval in the event the traps are carried into the deeper water. Surface buoy assemblies are constructed with a 5-fathom section of ⅝-inch diameter polypropylene and three floats (Fig. 11). The inflatable main and trailer buoys are secured to the float line using plastic thimbles and are restricted from sliding along it by knots placed at 18-inch intervals. These features ensure that the buoys will not be

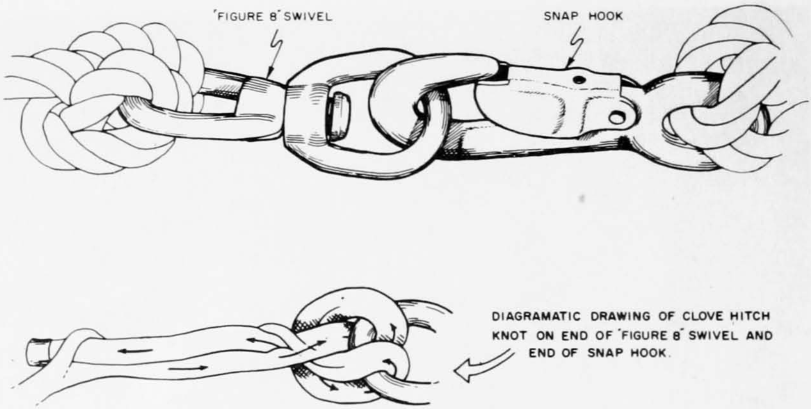

Figure 9.—Method for connecting setline and trap gangions.

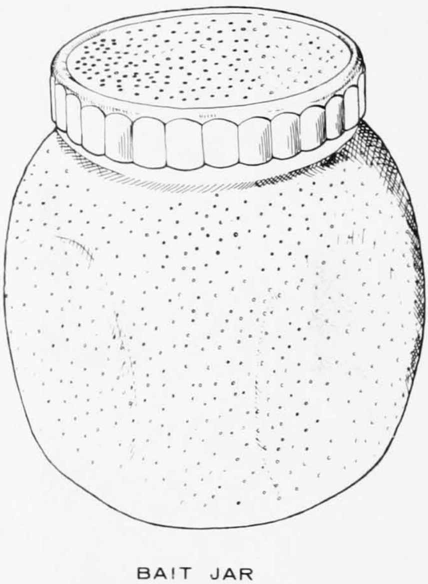

Figure 10.—A bait container constructed from a 2- or 3-quart size, plastic, wide-mouth food jar and perforated with 1/32-inch diameter holes.

twisted together due to the natural twisting of the buoyline during fishing. The safety buoy is secured to the end of the floatline. It is of solid plastic material for keeping the buoyline at the surface in the event the main and trailer buoys are deflated. Several states require the fishing license number be shown on the buoys and that they should be numbered for identification purposes.

Setline

The setline is a 500-fathom length of ⅝-inch diameter polypropylene rope with ten 30-inch setline gangions secured to it at 50-fathom intervals (see Figs. 1 and 12). The setline gangions are of ½-inch diameter polypropylene. Gangions may also be used at each end of the setline

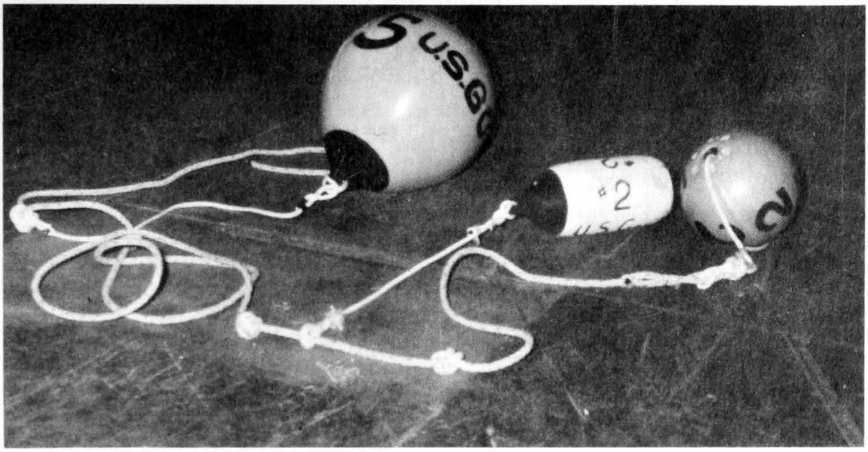

Figure 11.—One set of surface buoys. Each buoy is separately connected to a 5-fathom length of ⅝-inch diameter polypropylene line.

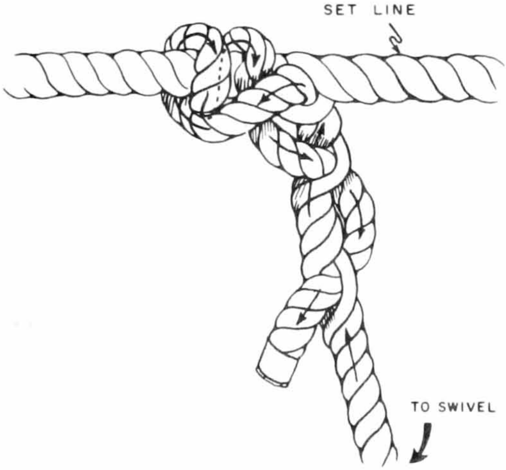

Figure 12.—Attaching the gangion to the setline.

for connecting the anchors. This technique permits more rapid handling during setting and hauling. The anchors are the 30- or 35-pound dory-type with 6 feet of ⅜-inch chain.

Carrick Bend Knot

The carrick bend is used for connecting the shots (sections) of buoyline and may also be used for adjoining the setline unless the setline is spliced. It is a strong knot that cannot jam and unties easily. Under strain it always draws up tight which is important because knots cannot be fully tightened by hand. Another feature is that it comes through the sheaves of the hauling block without slipping. For maximum security the ends should be long and seized together. A detailed description of it is shown in Figure 13.

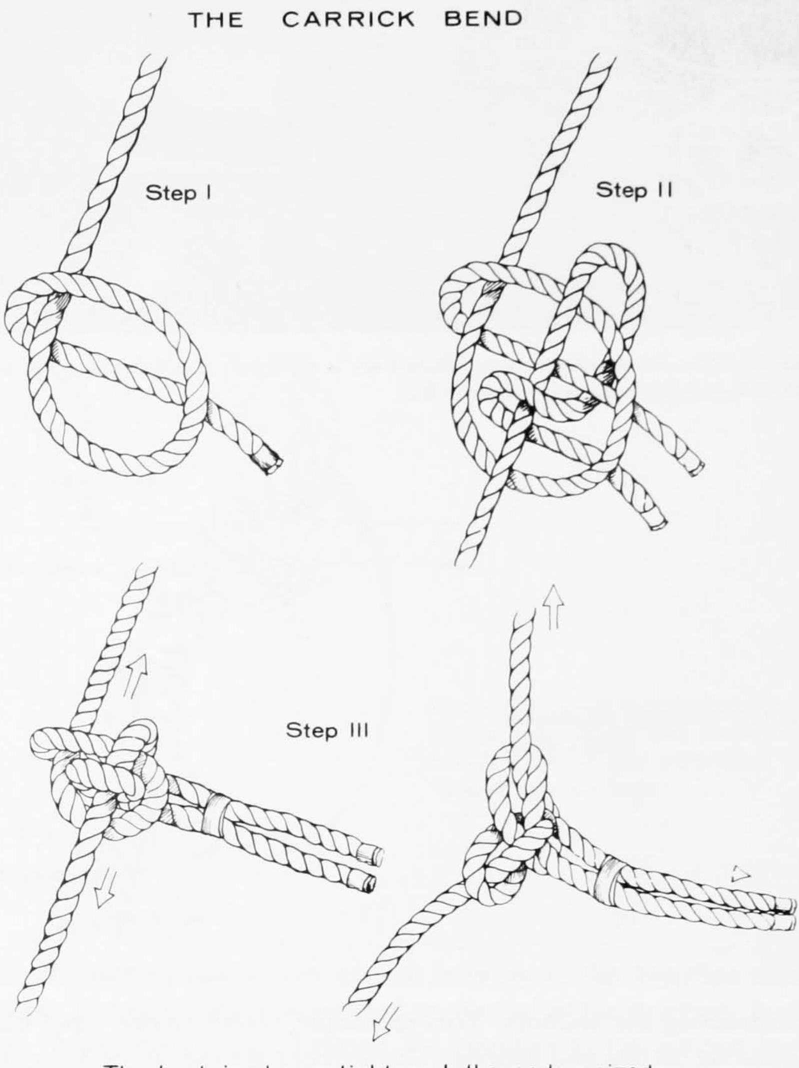

Figure 13.—The carrick bend knot.

Vessel Equipment

Due to the fishing conditions on the sablefish grounds, certain navigational, safety and gear handling equipment is necessary. These include radio transceivers, radar, depth sounder, and loran. Deck equipment should include a hydraulic line hauling block and a boom mounted hoist for lifting traps from the water.

FISHING METHOD

Results of our experimental work indicate a number of practices which will facilitate successful fishing operations. Execution of these will of course depend upon conditions existing on the grounds. They should thus be viewed as being for the "average" or "normal" situation. Catch rates as related to the length of trap soaking time appear to be dependent upon fish density. In heavy fishing a 24-hr soak will produce large catches; however, when fish are not as plentiful, soaks up to 72 hr may be required to produce good results. Under most conditions little additional catch is realized by soaking the gear more than 48 hr. For most vessels optimum fishing can best be accomplished by fishing 12 strings of gear and working 6 of them each day.

Commercial concentrations of sablefish occur in water depths ranging between 200 and 400 fathoms, and they are very mobile within this range (Heyamoto and Alton, 1964). Consequently, in order to maintain optimum catch rates it is necessary to monitor depths and geographic location by varying the locations of the strings when catch rates fall off.

Losses of gear will reduce the profitability of fishing and must be minimized. In this regard it is necessary that the position of the gear (depth and position) be recorded as accurately as possible so that if the vessel must leave the area, it will be possible to return to it. Gear should not be set in shipping lanes where passing ships may cut buoylines, nor on trawling grounds where losses would occur due to entanglement with trawling gear.

Setting a String of Gear

The gear is set with the drift of the vessel. Before setting, all buoy and setlines of a string are connected. Then with the vessel moving slowly ahead, the first buoy assembly is set and the buoyline played out by hand until the setline is reached. The setline is then put into the hauling block, the anchor connected, and set. With the vessel moving ahead the block is operated in the setting direction at a speed that will keep the setline and buoylines tight. The baited traps are connected after the setline gangion has passed through the block (Fig. 14). When the second anchor has been set, the buoyline is set through the block, keeping it taut until the sinker line is reached. This is then removed and the buoys set. Keeping the line taut while setting is important because it reduces the tendency of the string to sag while settling to the bottom. Sagging results in the traps being grouped relatively close together, thereby reducing the total effective area fished by the strings.

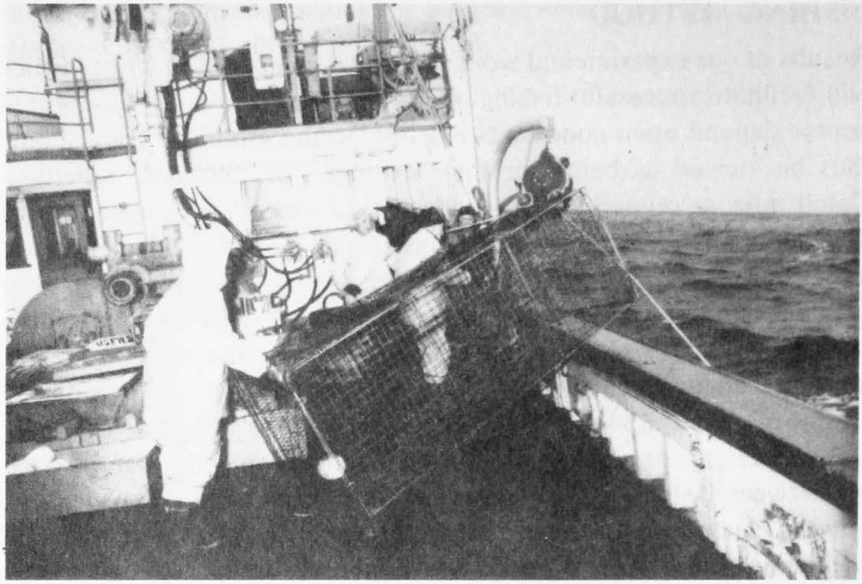

Figure 14.—A trap is connected to the setline.

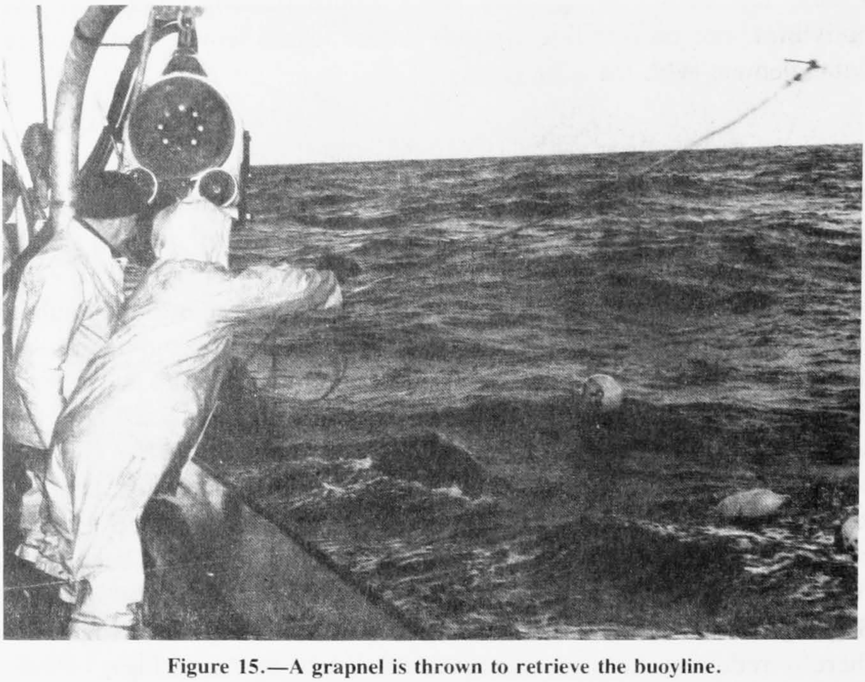

Figure 15.—A grapnel is thrown to retrieve the buoyline.

Hauling a String of Gear

The gear is hauled either against the wind or current—whichever affects the vessel the most. The vessel moves alongside the buoys at a slow speed and the surface line retrieved with a grapnel (Fig. 15). The buoys are pulled aboard and the buoyline is put into the hauling block and coiled as it comes aboard (Fig. 16). When the anchor gangion is reached, the block is stopped. The anchor is pulled aboard, disconnected, and stowed; then hauling is resumed. When a trap approaches, the bridle is snagged with a hook from the boom mounted hoist. With the strain taken and the hoist attached to the trap bridle, the gangions are disconnected and the trap lifted aboard the vessel (Fig. 17). The same procedure follows until all traps and the end anchor are aboard. If

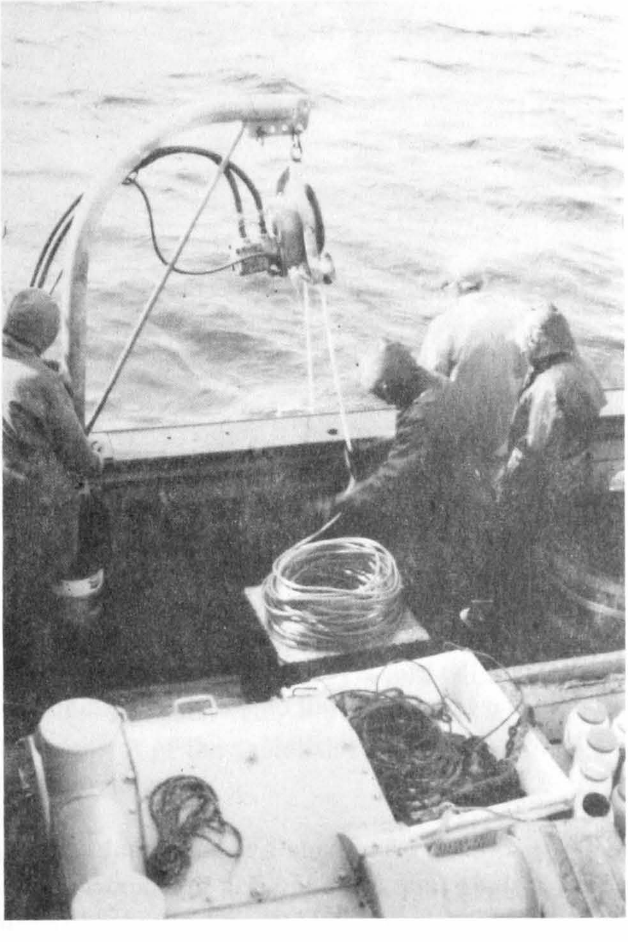

Figure 16.—The buoyline is coiled as it comes through the hauling block.

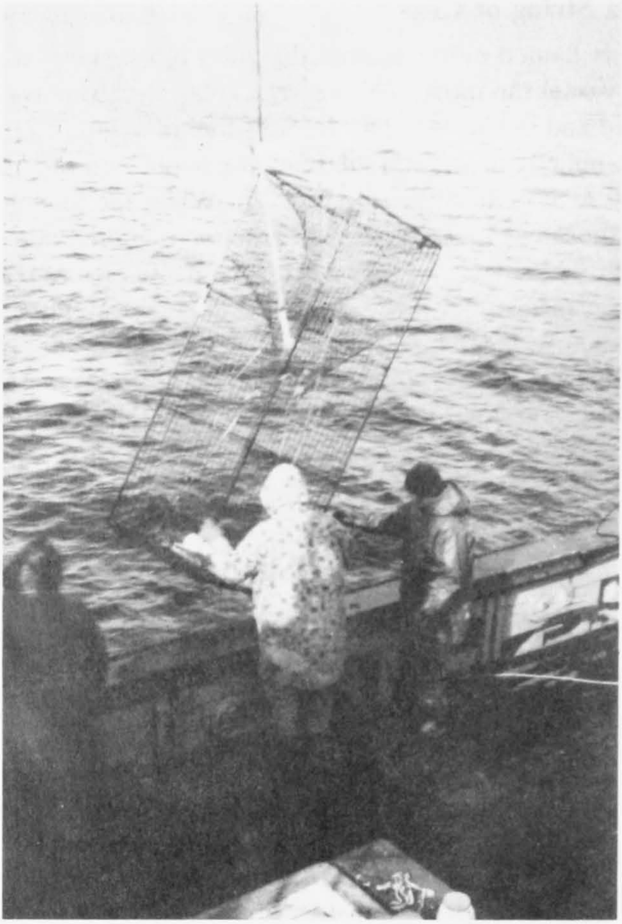

Figure 17.—Lifting a trap from the water with a boom mounted hoist.

fishing is productive, the gear is reset without having to bring in the end buoyline. Should the gear be moved only a short distance the buoyline can be towed.

Care of the Catch

Trap caught fish are of prime quality and should be dressed and cleaned within a short time after the fish are landed. After cleaning they are packed with ice, inside and out, and stored in fish bins between layers of ice. The fish should not be held in ice aboard the vessel for more than 12 days. Care in handling should be exercised to prevent bruising of the flesh which causes discoloration.

TRADITIONAL FISHING GROUNDS

Traditionally, sablefish were taken by setline at depths shallower than 200 fathoms; however, they are more abundant at depths between 200 and 400 fathoms (Alverson, Pruter, and Ronholt, 1964; Heyamoto and Alton, 1964; Parrish, 1973). According to Alverson et al. (1964), sablefish also favor blue clay and mud bottoms near submarine canyons and gullies and are less abundant over sandy and rocky bottoms. In this regard, fishing grounds are as follows: 1) California-off-shore near Santa Cruz, Fort Bragg, Eureka, and Crescent City; 2) off Oregon on Hecata Bank, off Newport, and off the Columbia River; 3) off Washington from Destruction Island to Cape Flattery; 4) off British Columbia near Barkley Sound, in Queen Charlotte Sound, and along the west coast of Queen Charlotte Islands; 5) in Alaska, off Cape Ommaney, off Prince of Wales Island, off Baranoff Island, from Cape Cross to Cape Fairweather, and from Middleton Island to Portlock Bank. Major fishing areas in the inside waters of southeastern Alaska are those of Clarence Strait, Frederick Sound, and Chatham Strait.

INCIDENTAL CATCHES

The traps described here are designed for capturing sablefish. We did, however, have incidental catches of other species which generally occurred at various depth levels. For example, at depths less than 225 fathoms we often had incidental catches of red rockfish, ling cod, true or grey cod, and various flatfish species. At depths between 225 and 450 fathoms—in addition to sablefish—we occasionally caught a large red snapper, idiot rockfish, and Tanner crabs. The reduced number of species taken in the deeper water is probably a reflection of the fewer species occurring there (Alton, 1972).

ACKNOWLEDGMENTS

Valuable inputs have been provided by many individuals. It would be impossible to identify each one. Nevertheless, anyone who profits from our development of the sablefish trapping system owes a vote of thanks to the following:

Sig Jaeger, Alaska Community College, Kodiak, and former owner and skipper of the *Seattle,* who for 1 yr conducted cooperative research with the National Marine Fisheries Service, keeping data and catch records and volunteering many useful suggestions which contributed to the successful development of the setline trapping system.

William White, owner of White Metal Fabricators, who built the modified king crab-type traps and offered many suggestions which aided the program.

Konrad Uri, owner and skipper of the *Seaview*, and his crew, who were involved in the first full-scale operations in which traps were fished from groundlines.

John Hefferman and Bob Olson, Northwest Wire Works, who worked with us in the development of the collapsible traps.

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