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Sole Trawling in the Bering Sea: Some Practical Guidelines for Operation and Reducing By-Catch of Prohibited Species

by R. Barry Fisher

Introduction

In the fall of 1983, the North Pacific Fishery Management Council appointed a work study group to address prohibited species by-catch in the sole trawl fisheries of the Eastern Bering Sea. It was hoped that this panel's work could be used to suggest allowable rates of incidental catch and/or a season maximum. Included on the panel were fishermen from the concerned fisheries: sole trawlermen, crabbers and halibut longliners; as well as agency observers.

The group was to investigate what could be done to lower incidental catches of prohibited species and/or to lower human predation on crab, halibut, salmon, and other non-targeted species of commercial value. In this Sea Gram, committee member R. Barry Fisher describes his experience with the trawling tactics and practices used by Marine Resources Company International (MRCI) trawlers in the Bering Sea that seemed helpful in avoiding these species.

Fisher was the first U.S. joint venture fisherman to work with MRCI on joint ventures, beginning in the 1978 whiting fishery off Oregon. The relationship continued in 1979 with Fisher as a senior U.S. fleet captain. In 1980, he helped plan and led the first MRCI and U.S. joint venture for yellowfin sole in the Bering Sea. His vessel Excalibur has fished in the yellowfin sole fishery yearly since 1981.

In 1982, Fisher was senior captain of the Joint Venture Fisheries Company in Shelikof Strait for pollock. Joint Venture Fisheries Company is a wholly-owned subsidiary of Bellingham Cold Storage Co., which is in turn MRCI's U.S. partner. Fisher used a new vessel, the Excalibur II, in the 1982 pollock fishery. Both vessels have subsequently been dedicated to the MRCI yellowfin joint venture.

The group had divided opinions over the catch rate concept discussed here as a way to monitor and reduce by-catch. Fishermen immediately noted that seasonal quotas would allow people to fish up to the "quota". Using tow-by-tow conservation however,

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would inhibit "dirty fishing" and, if MRCI's results are any indication, would bring the fleet in well below the proposed catch caps. The work study group endorsed the rate concept for 1985 with no cap quotas specified. The 1985 season figures were then to be used to set caps for 1986.

The group was concerned not only with the welfare of the respective fisheries involved, but also with fisheries in general. Ways to balance development and general conservation were discussed; respect for and appreciation of each other's viewpoints grew. Above all else, Fisher believes that the politics of total entrance or total exclusion that were bandied about in 1980 and 1981 serve no useful purpose.

Left to right, Alaska plaice, starry flounder, and yellowfin sole are but three of the groundfish species teeming in the Bering Sea. Yellowfin sole joint venture boats landed 37,787.4 mt in 1984 and they have a 1985 allocation of 82,200 . Photo by Leslie Watson

Summary

A rich fishery for soles and flounders exists in the Bering Sea. Some fishery biologists feel that a sustained yield of 400,000 to 500,00 mt can be achieved. The Bering Sea areas where these soles are concentrated also have high concentrations of king crab, tanner crab and halibut that move over time around the area. These species are often taken as a minor catch component along with the target sole species.

The unit values of these crab and halibut fisheries are quite high. The crab and halibut fisheries represent fully utilized fisheries that are important components of the overall fishery. Uncontrolled removal of these species by bottom trawlers targeting on soles or flounders could well affect the biological mass of crab and halibut. In five years of intensive sole trawling, there have been only rare incidental by-catch of salmon; therefore salmon by-catch is not addressed.

This paper does address some trawling tactics and techniques that have been proven to reduce unwanted incidental catches of crab and halibut, which are prohibited species for trawlers.

The Sole and Flounder Fisheries

The sole and flounder fisheries in the Bering Sea are well-known and were dominated by the U.S.S.R. and Japan beginning in the 1950s, with some later Korean exploitation. Sole and flounder stocks were heavily overfished by these foreigners in the late 1950s and early 1960s (catches of yellowfin sole alone averaged 400,000 mt from 1959 through 1962). These stocks are once again plentiful and growing, thanks to tightened U.S. management controls established in bilateral fisheries agreements preceding the Fishery Management and Conservation Act (FMCA) of 1976, and because of active and concerned fisheries management by the North Pacific Fishery Management Council (NPFMC) since 1976.

Yellowfin sole is the predominant sole species in the Eastern Bering Sea. This fish is primarily concentrated in shallow water, 20 to 40 fathoms, and in an area bounded roughly by lat. 55 degrees 50'N to lat. 58 degrees 50' N, and long. 169 degrees W to long. 159 degrees W.

There are also lesser, but good, concentrations of such flounder species as Alaska plaice, lemon sole, flathead sole, rock sole, turbot, and starry flounder in this same huge general area. (There are no true soles, Soleidae, in the Eastern Pacific. The species commonly referred to as soles here are actually Pacific flounders.)

U.S. trawlers targeting flounders use bottom or demersal trawls fishing "hard on bottom," using long mud lines or ground cables and bridles between the trawl doors and trawl to herd the fish into the path of the trawl.

At certain times of the year and in certain areas in the Eastern Bering Sea, the soles and flounders coexist with other bottom creatures such as halibut, king crab and tanner crab. These other species are fully utilized by domestic U.S. fleets, have a high unit value and are important components of the U.S. fisheries. Uncontrolled removal of crab and halibut by trawlers targeting soles could well affect the allowed quotas in the halibut and crab fisheries. Crab and halibut by-catches in the yellowfin sole fishery, for example, have been relatively small as a percentage of the total catches of targeted species (yellowfin sole, rock sole, plaice, and lemon sole), but by-catches of as little as 2 to 3 percent of crab and halibut are felt to be quite high by most fishermen in the concerned fisheries.

Sole trawler fleets practicing certain tactics and techniques have substantially reduced incidental catch of crab and halibut. However, this lowered by-catch is not yet universal in the fleet. As the fishery grows, it is imperative that by-catch be kept to a minimum. Much of what follows about rigging trawl gear, avoiding concentrations of prohibited species and trawling tactics will be adjudged as "basic, well-known and just plain common sense" by experienced trawlermen. But every effort must be expended to reduce by-catch. Use of the tactics discussed in this paper will significantly lower this incidental catch.

Sole Gear in the Bering Sea

A sole trawl is a conically-shaped otter trawl that is fished "hard on bottom": the full footrope of the trawl makes constant contact from one wing tip to the other on the sea bed. Soles and flounders are true demersal or bottom-dwelling species, and sole trawls are generally designed to permit little or no escapement under the trawl's footrope or through gaps between the trawl footrope and the fishing line at the bottom of the trawl mouth.

Usually the soles are herded by long, rubber disc-covered ground cables (or mud lines) and trawl bridles that run from the trawl doors back to the mouth of the trawl. The doors keep the mouth of the trawl spread open horizontally by their shearing action and by their weight, keep the mud lines, bridles and trawl in contact with the bottom.

An initial "mud cloud" is stirred up by the trawl doors. This "mud cloud", or trails of sand and mud in the water column, is carried back toward the trawl and added to by the action of the mud lines and bridles, producing a mud cloud along the entire span of the gear, back to the mouth of the trawl.

The soles on bottom respond to approaching gear and to the mud clouds by making short runs of only a few feet directly away from the doors, mud lines and bridles at roughly a 90 degree angle. The fish then settle to the bottom again. The ever-approaching mud line will root the soles out again for continued short runs until the fish are in the mouth of the trawl. Figure 1 is a graphic illustration of this behavior.

Once the soles are concentrated in the mouth of the trawl, the approaching footrope constantly pushes them. They swim rapidly to stay in front of the footrope. The speed of the oncoming trawl is greater than the fish's sustained capacity to swim. Remember, any fish has a very low sustained rate of speed. For soles, this sustained rate of speed is as low as 1 to 1.75 knots. Forcing the fish to swim faster than its sustained rate of speed will rapidly deplete its oxygen. The fish then lose their capacity to outswim the trawl. Maintaining a trawling speed of 2.5 to 3.3 knots causes the sole to exhaust itself, and the fish will then be "caught" by the footrope passing under it. Captured fish move down the body of the trawl to the cod end by the sustained speed of the trawl net advancing across the sea bed.

The soles will often try to escape when swimming just in front of the footrope. If fish perceive a lessening of the mud cloud in the mouth of the trawl, they will make for the gap and attempt to escape .

For this reason, sole trawls in areas of good, smooth bottom usually have footropes of 3 to 6 inch diameter rubber discs hung on chain or cable. Such a footrope prevents gaps in the mud cloud; the entire footrope generates its own mud cloud, and all animals on the bottom in the path of the trawl are subject to capture.

The fishing lines from which the bottom webbing of the traditional sole trawl is hung are, and must be, fastened close to the footrope to prevent any large gaps through which the soles can escape.

Such a trawl used indiscriminantly will also capture crab and halibut in the mouth of the trawl. If these species are present in large numbers, an unwarranted number will be captured as by-product. When faced with such a problem the trawlerman has only two alternatives:

1. **Leave that particular fishing area immediately and search for an area with lower concentrations of prohibited species and a high abundance of the target species, sole.**

2. **Modify the trawl gear or trawling tactics to permit easy capture of the free-swimming sole and yet allow crab to escape.**

Sole trawling experience in the Bering Sea dictates that when high concentrations of halibut are present with the soles, leaving that trawl track is the only real solution to minimize halibut by-catches.

However, experience has also dictated that radical or long distance moves are often not necessary. Halibut have a preference for certain, often very limited, pieces of ground. In general, halibut seem to prefer low domes or ridges of a somewhat "harder" bottom than the prevalent black volcanic sand of the Bering Sea. These slight domes or harder bottom areas should be pinpointed and avoided in order to minimize halibut by-catch.

These domes or ridges are often discernible on echo sounders. Echo sounder markings will reveal a slight rise in the sea bottom as the trawler traverses a dome. Usually the bottom

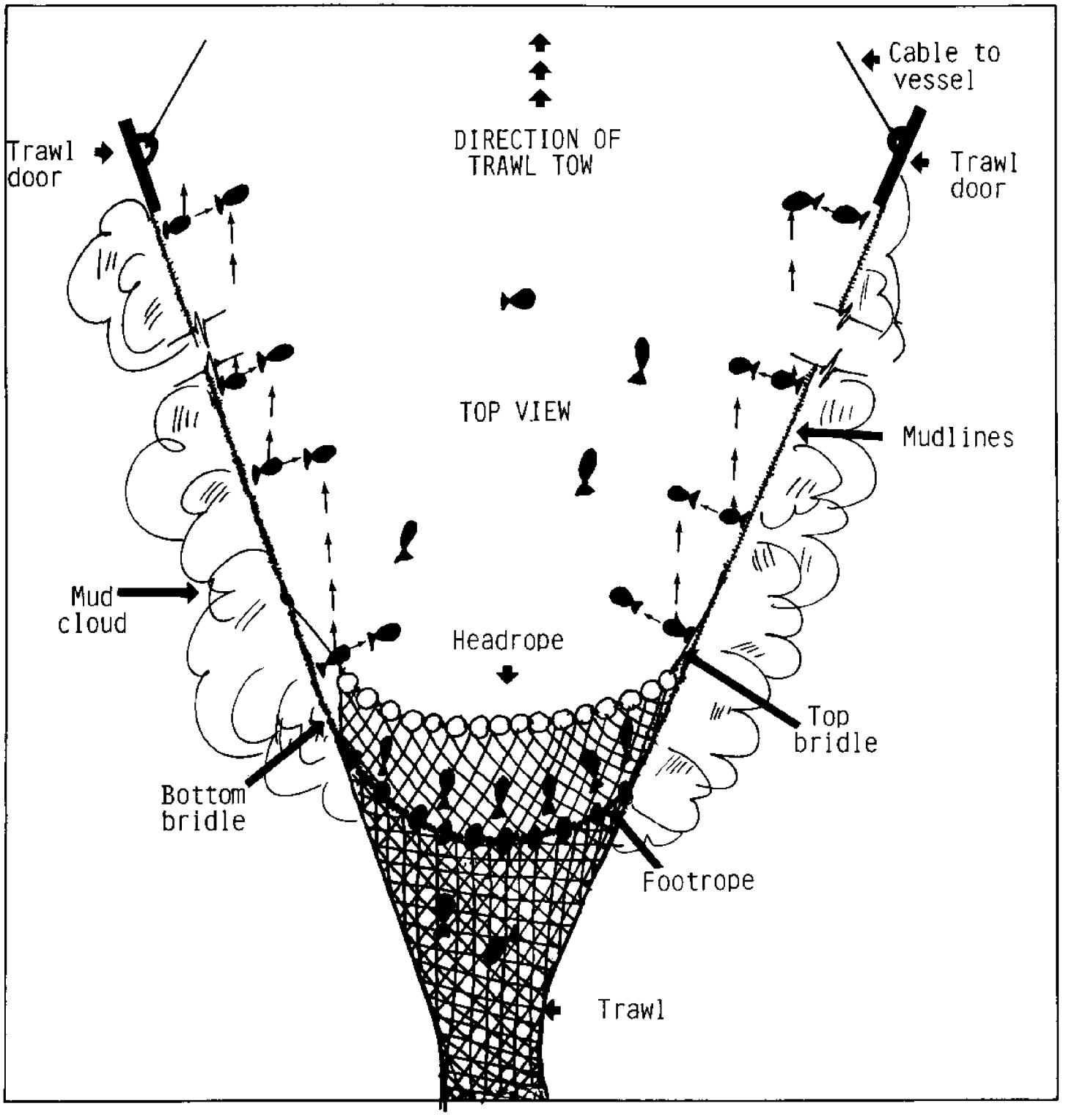


Figure 1. Sole behavior toward an approaching trawl net.

markings on a sounder show a "harder echo": increased red and brownish hues on a video sounder and a darker, deeper bottom echo return on a paper sounder. Track plotters can further define these domes and harder bottom and are also indispensable for remaining on the fish in the long, flat stretches of the Bering Sea. Finally, careful notation of catch composition when correlated to echo sounder markings can often lead to a slight shift of trawl track to avoid harder bottom and domes and still maintain good catches of sole.

Remember that halibut may be encountered in concentrations that preclude any such slight shifts. In this instance, there is little else that can be done besides moving to another general area. However, halibut are notorious travelers and an area that yields high concentrations of halibut by-catches at one time may yield a much lower or almost non-existent by-catch a few weeks later.

The broad general movements or migratory patterns of halibut behavior in the Eastern Bering Sea are thought to be understood, but little accurate data exists of movement within the area over a year. For this reason, keeping an accurate log of trawl tracks in areas where by-catch composition is important information for establishing a data base that can serve to reduce halibut by-catch.

Crabs can be more vulnerable to trawl capture than halibut. These animals crawl, and lack the instant if limited ability of fin fish to swim rapidly away from the trawl. Unfortunately there are no films or reported observations of how crabs respond to an oncoming trawl. Such data could lead to improved ways to avoid crabs while trawling. However, there are proven trawl gear modifications that will reduce incidental crab catch.

Earlier, a typical sole trawl footrope was described: 3 to 6 inch diameter rubber discs hung on a chain or cable across the bottom of the trawl mouth. When approached by the trawl footrope and its attendant noise and vibration, it is suspected that crabs "hunker" down or attempt to immerse themselves in the bottom sediment. Sole species also display characteristic behavior when approached by trawl footropes. The general behavior has already been described as moving away from mud lines and into the mouth of the trawl. But different species of sole exhibit different behaviors. Some, such as Dover or rex sole, will tend bottom and try to bury themselves. When fishing such species, the footrope must maintain a consistent bottom contact that roots out these soles. Fortunately, most soles in the Eastern Bering will free-swim away from approaching gear when "tickled" by a mud line, bridle or footrope, rather than trying to bury themselves.

The action of the trawl footrope can be modified to capitalize on these different behaviors. The footrope does not have to dig much to effectively capture these soles. A footrope that tends bottom lightly will still effectively capture sole while allowing the footrope to pass lightly over the crab. The mechanics involved in lessening or intensifying footrope contact are well understood by experienced sole fishermen. These modifications are listed for other trawl fishermen who may not be sole specialists.

A trawl, when properly rigged, is a balance of physical forces. Trawl doors operate to keep the mouth of the trawl spread horizontally and to keep the trawl mouth down on the bottom. The mud lines and bridles herd the fish as previously described. Trawl floats keep the mouth open. Weight on the footrope keeps the bottom of the trawl mouth down and in good contact with the sea bed.

However, a complete trawl is kept open and fishing by a subtler set of physical forces. The passage of water through the trawl also causes the net to stay open and down. This pressure, or hydrodynamic force, can also be used to lessen incidental by-catches of crab.

The "tilt" of the trawl mouth, or angle of attack of the trawl as it is towed across the bottom, can be increased or decreased. An upward tilt can lessen bottom contact of the footrope. Conversely, a downward tilt of the trawl mouth will increase bottom contact. A careful balance must be struck to maximize the sole catch and minimize the incidental crab catch. To achieve these results, the following rules should be constantly employed:

To decrease footrope digging:

A. **Simple modifications**

1. **Add floats to the headrope and/or**
2. **lighten footrope weight.**

B. **Modify the angle or attack of the trawl mouth**

1. **Slack the headrope back by adding increments of shackles, chain, or wire between the top wing end and top bridle or**
2. **take up incremental amounts of footrope by shortening footrope length on each side.**

To increase footrope digging:

A. **Simple modifications**

1. **Take floats off the headrope and/or**
2. **add weight (chains) to the footrope.**

B. **Modify the angle of attack of the trawl mouth**

1. **Shorten the headrope by taking out shackles, chain or wire increments or**
2. **lengthen the footrope by adding shackles, chain or cable increments.**

During fishing operations the trawl footrope and the catch composition must be constantly observed for signs of excessive digging by the trawl.

High crab by-catches in themselves are often a symptom of excessive digging by the trawl. Another sign is the appearance of large numbers of starfish, shells, bottom debris, and traces of sand and/or mud in the cod end and the catch. Under these conditions, modifications to reduce bottom contact and footrope digging should be undertaken.

Excessive bottom contact is indicated when sand or mud clings to the net meshes close to the footrope. If these residues are found several meshes up from the bottom on the trailing bottom edges of the wings or well into the bottom belly webbing, then the trawl is digging excessively and should be modified to reduce the force of bottom contact. Utilization of these tactics should significantly lower incidental crab catches.

Sole trawl gear can be further modified to lower crab by-catch. These modifications again capitalize on the free-swimming behavior of the target sole species. Most sole trawls used throughout the world have vertical wing ends between headrope and footrope, or fish tail or "V" cuts in the wing ends. A wall of webbing is provided in the trawl to prevent the escape of sole over the footrope along the wings.

Five years of sole fishing in the Bering Sea have shown that the wing ends of the trawl do not require this wall of webbing. Virtually all sole trawls used in the Bering Sea feature a flying wing design. In this design, much of the bottom webbing of the wing is cut away and not used. The terminal point of the wing is fastened to the trawl headrope. The wing webbing is then tailored or cut on a taper that is 45 degrees or greater along the wall of the vertical wing webbing, so that at the end of the taper, the wing terminates on the

footrope much farther back than the wing terminated on the headrope. (See Figure 2.) This tailored design still retains high sole capture as the herding action, and attendant mud cloud, of the mud line and bridle is carried on to the footrope end pieces. The crabs are afforded an extra opportunity to escape over the now-bared footrope end pieces, just as they do over the mud lines and bottom bridles.

Marine Resources Company International (MRCI) has tested a number of trawl gear modifications in its yellowfin sole joint ventures. Among these modifications has been the use of various configurations with bobbins spaced intermittently along the footrope. In this type of footrope, only the bobbins are in contact with the sea bed if the trawl is properly rigged. The remainder of the footrope is built of 4 inch diameter rubber discs on a chain or cable footrope. Nine inch diameter bunt bobbins in the wings and 9 or 12 inch bosom bobbins in the bosom or belly part of the trawl can provide good bottom contact. However, the major portion of the footrope is suspended off bottom. The resulting gap of 3 to 6 inches between the disc portion of the footrope and the sea bed will permit escape for crab that are attempting to bury themselves, and still not cause an appreciable loss of the target soles since they are free-swimming and not heading for the bottom. A sufficiently dense mud cloud is still produced by the footrope and no gaps are perceived by the soles. MRCI trawlers using such bobbin/disc footropes have consistently fished cleaner, with lower by-catches of crab, than vessels employing a straight disc footrope.

This bobbin/disc footrope's utility can perhaps be increased by the judicious action of a tickler chain suspended from the footrope wing tips. Tickler chains are widely used throughout the world in sole fisheries. Such a chain lightly touches, or "tickles," soles resting on or buried in the bottom, forcing them up slightly to permit easy capture as the footrope approaches.

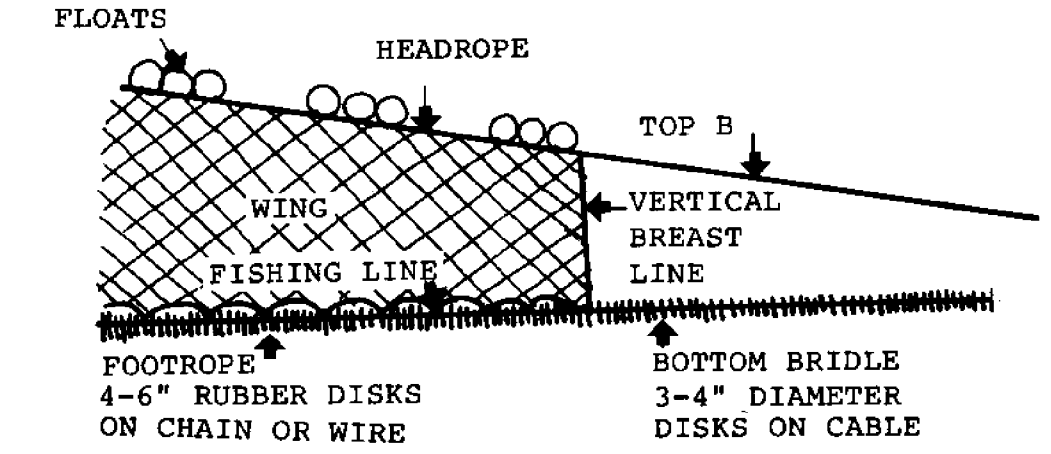
Tickler chains should be rigged so that the chain rides some 3 to 6 ft in front of the center portion of the footrope. To achieve this position, tickler chains are generally made up 10 to 12 percent shorter than the length of the footrope to which they are attached. Some trawlermen believe that the tickler chain should be used over the entire footrope length. Others argue that a tickler chain should be fastened farther back from the bottom wing ends on each side.

In any event, tickler chain use should be encouraged with careful observation of results as the gear is discretely modified. It is believed that the correct use of tickler chains with footropes made up of bobbins and discs will alleviate by-catches of crab since the sole are constantly tickled by the chain, which continues to produce a mud cloud. The sole will be captured because they will exhaust themselves and cannot perceive a gap or break in the mud cloud. Crabs, on the other hand, will be tickled off bottom by a light tickler chain and then immediately drop back on bottom. As they hug the ground, the footrope will pass over them.

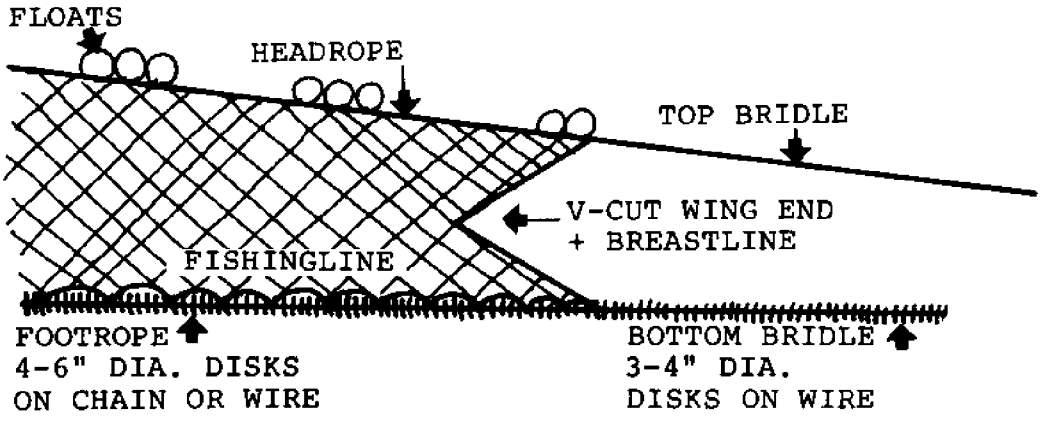
Tickler chains need not be heavy to be effective. Tickler chains of 5/16 inch or 3/8 inch diameter are of sufficient weight to work well.

Critics claim that such tactics are not "sure-fire" solutions that allow every crab to escape. There are no such "sure-fire" solutions. There is by-catch in virtually every fishery in Alaska. The objective of this paper is to suggest ways to markedly lower the rate of incidental by-catch of crab and other species in order to minimize overall removals of these species by a trawl fishery.

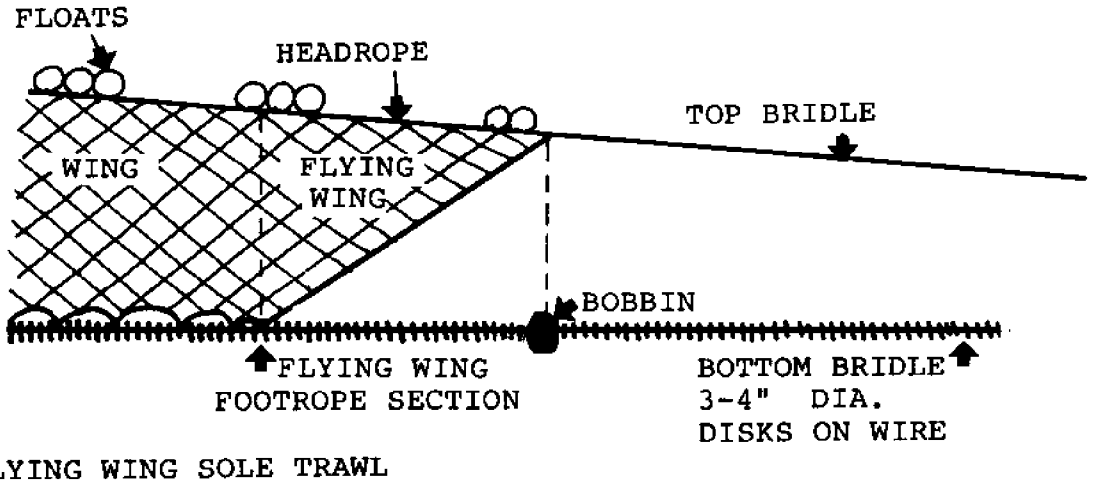
There are other details of trawl rigging that deserve mention. Sole trawls used in the Bering Sea fisheries are by necessity heavily constructed and robust. Huge volumes of sole exist and catches of 15 to 45 mt are not uncommon. MRCI's fleet has



A TRADITIONAL SOLE TRAWL - VERTICAL BREAST LINE AND WING END



A TRADITIONAL SOLE TRAWL- V CUT WING END



A FLYING WING SOLE TRAWL

Figure 2. Three types of sole trawls.

consistently averaged 14 to 17 mt per tow from 1980 to 1984. As these catches build up in the cod end, drag increases. The fish and any bottom debris in the trawl are of negative buoyancy, and when their drag is added to that caused by increased trawl weight, the cod end will tend to drag on the bottom and the trawl will dig more. Keeping the cod end off the bottom sill reduce drag and thereby reduce cod end wear. The reduced drag will also lower incidental by-catch of crab. These greater drag tendencies can be offset by:

1. **Using positive bouyancy chafing gear of the polypropylene "hula" skirt type. Do not use nylon chafing gear. Nylon has a negative bouyancy and will also absorb sand and mud.**

2. **Attaching effective amounts of flotation to the cod end top panel rib lines and lower intermediate top panel rib lines. The MRCI fleet uses 8 inch diameter spherical trawl floats. About 70 or 80 of these are spread evenly along the cod end, and four to six such floats are placed on each lower intermediate top panel rib line.**

There is another naturally-occurring phenomenon in the Eastern Bering Sea that will induce drag and decrease trawl effectiveness. These waters are inhabited by a profusion of plant-like bottom dwelling creatures. Among the less scatalogical tags sole fishermen have for them are "sea onions", "rhino nuts", and "elephant turds", a fair indication of their usefulness to fishermen.

In areas where these animals are abundant, a large number of them are picked up by the trawl and lodge in the webbing. When trawl meshes are festooned with these creatures the trawl is heavier, harder to tow and, because of induced extra drag, will tend to catch more crab. When such conditions are encountered, the trawl must be laboriously picked clean of these animals. There have been times when sole fleet nets had to be picked clean after every tow to keep the trawl working efficiently.

Tactics and Strategy to Reduce Incidental By-Catch

We have discussed avoiding prohibited species as a viable tactic when trawling for sole in the Eastern Bering Sea. Gear modifications have also been described that will lower incidental catches of crab and halibut. Reducing drag has been discussed because increased drag causes the trawl to dig excessively and hence increase crab by-catch.

A separate set of strategies can also be employed to further lower incidental catch rates. Avoidance and lowered drag can be combined by using some common sense practices.

Long tows or sets of the trawl should be avoided for a number of reasons. Heavy trawl catches, with increased induced drag, seem to increase the chances of prohibited species catch. Rather than attempting too much at one time, the tows should be shortened to avoid induced drag. This is particularly beneficial in joint venture or "floater" operations where catcher vessels usually have long periods of wait-time because they can catch faster than the factory ships can process.

Parenthetically, remember that huge catches also can lower product quality, which is not in the best interests of fishermen. Tows in excess of 15 mt heighten the risk of extra prohibited species catch. Tow time and length should be planned to keep volumes at a reasonable level.

A further reason for shortening tow time or extent is to practice avoidance. Often, prohibited species are encountered in pockets along the trawl track. Bottom type preference for halibut has been cited. Higher or lower crab concentrations are also often encountered along the trawl track. Shortening the tow or laying out a grid of various shorter trawl tracks on a plotter can yield dividends in lower

catches of prohibited species. The relatively higher concentrations of prohibited species can be pinpointed and avoided.

Evidence to support this theory comes from the 1984 yellowfin sole fishery in the Eastern Bering Sea. One company fleet had a much higher incidental catch rate of crab than did the other company's fleet. In both fleets, the gear was much the same and there was a high overlap among trawl tracks during the season. The only significant variables between the two fleets were trawl catch volumes and length of tows. Predictably, the vessels with higher average catch volume and longer tows also had greatly increased catches of prohibited species of crabs.

Another strategy that can lower crab by-catch focuses upon the behavior of crab. Crab feeding behavior is scavenger-like. Crabs are attracted to dead bait whether it be in bait boxes in traps, in lost traps that "ghost fish", or in areas where large amounts of dead bait are found on the bottom.

In joint venture or floater-type operations where a factory ship processes the catch, it has been noted that the incidental catch of crab seems to rise as trawlers prosecute a sole fishery in a discrete area. Everyone loves a "free lunch" and crabs are no exception. If the processor ships, which of necessity must stand close to their catcher vessels, remain directly on the trawl tracks while processing and discharging offal, then a constant banquet of dead bait is provided which can and does attract crab. Processors should make every effort to pick up cod ends from the catcher vessels, then move immediately off the trawl tracks some 4 to 8 miles distant while processing that catch.

Conversely, the catcher vessels should refrain from trawling immediately adjacent to processor vessels. Coordination of these activities and a resulting separation of trawling area and processing area should lead to diminished crab by-catch.

Finally, a tow-by-tow rather than seasonal prohibited species limit effectively lowered by-catches in the MRCI fleet in 1983 and 1984. This experience has shown that conservation efforts must be practiced consistently on each tow for optimum success. Setting a seasonal rate or volume or percentage of the catch does not necessarily lower incidental by-catch rates or prohibited species on any given tow.

Worse, using seasonal rates often leads individual fishermen to unconsciously fish against a set "quota" of allowable by-catch and/or forces fishermen to think only about the season total catch of prohibited species. Here's a good hypothetical example of this mentality: "Our quota (or allowed limit) of halibut is 1 percent of the target species tonnage, or x thousand animals. In June, we caught only 3/4 of 1 percent, or minus x thousand animals. Therefore, we can fish a little dirtier during the rest of the season and still come out OK on the season's percentage or total animals allowed."

MRCI fishermen and others have demonstrated that this rate of catch limit concept did indeed help lead to considerably lowered catches of prohibited species in 1984. The allowable rates of by-catch on a per tow basis in the MRCI fleet are:

1. **No more than three halibut per ton of target species**
2. **No more than five king crab per ton of target species**
3. **No more than seven tanner crab per ton of target species**

These limits allow an incidental by-catch of prohibited species lower than the levels of removal that fishery biologists consider safe and equitable for the maintenance and building of the crab and halibut stocks.

Another MRCI policy that can lead to reduced by-catch of prohibited species is giving the senior U.S. captain authority to order the entire fleet to move if the incidental catch rates of prohibited species surpass the com-

pany's established catch rate limits on a tow-by-tow basis. Further, individual catcher boats that exceed the prohibited species rate limits of their colleagues are punished. Senior company representatives and the senior U.S. captain order the offending boats to take time off "to modify your gear and lower your individual by-catch of prohibited species."

Individual and collective discipline voluntarily accepted in the sole fleet will probably prove to be the most potent technique for minimizing incidental by-catches of prohibited species in the Eastern Bering Sea sole fishery.

Acknowledgement

I would like to express my deep gratitude to the North Pacific Fishery Management Council for having the foresight, patience, and courage to convene a user's group to begin the task of limiting the incidental by-catch of prohibited species.

UNIVERSITY OF ALASKA
ALASKA SEA GRANT COLLEGE PROGRAM
590 UNIVERSITY AVE., SUITE 102
FAIRBANKS, AK 99701