Bycatch Reduction Devices in the Oregon Ocean Shrimp (*Pandalus jordani*) Fishery: Status of Current Knowledge

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Executive Summary

The status of bycatch reduction devices (BRD's) in the ocean shrimp (*Pandalus jordani*) fishery is a "good news-bad news" situation.

The Good News

1. The devices ODFW has tested are effective at reducing bycatch, especially bycatch of large rockfish, flatfish and hake.

2. These BRD's do a pretty good job of reducing unwanted bycatch, not just the large marketable fish.

3. The Nordmore grate has low shrimp loss rates and is the most efficient BRD.

The Bad News

1. All of the"user friendly" devices (fisheye and soft-panel excluders) cause variable and, sometimes high, rates of shrimp loss.

2. The soft-panel devices tend to collapse in many nets, causing high shrimp loss.

3. The Nordmore grate causes significant operational difficulties for most vessels (doors have to be loaded to steam even short distances or nets get twisted).

The Bottom Line

If a soft-panel BRD can be developed that maintains its shape in most nets, BRD's could be very effective in this fishery. Ideas that have been suggested for testing include incorporating rib lines, using a shorter intermediate, or moving the panel section up to the front of the intermediate. Flume tank experiments might be the quickest way to try and develop a truly effective soft-panel BRD. Using the field approach we've used at ODFW, and assuming level funding, the additional research will take about 2 years.

At best, this also leaves unaddressed the very real question as to survival of excluded fish.

This document attempts to summarize the current status of knowledge about the performance of "fish excluders" or bycatch reduction devices (BRD's) in Oregon's ocean shrimp trawl fishery. It is based primarily on fishing experiments conducted by ODFW staff since 1994. It is also based on field and underwater video observations, discussions with shrimp fishermen and net shop owners, and discussions with BRD experts from the Gulf of Mexico region.

History

Ocean shrimp fishermen began experimenting with BRD's in the early 1990's, in response to a large increase in the abundance of Pacific whiting (*Merluccius productus*) on the shrimp grounds (Hannah et al. 1996, Hannah and Jones, in press). The catches of Pacific whiting were so large that entire fishing grounds became unfishable without a BRD. The BRD's fishermen used were homemade or locally made soft-panel excluders (Figure 1) and produced high and variable shrimp loss, along with modest exclusion efficiency, that was generally below the performance of the Nordmore grate (Hannah et al. 1996, Isaksen et al. 1992). Voluntary use of BRD's continued to grow, with 33% of active Oregon shrimp vessels owning some type of BRD by 1994, although most used these devices less than 25% of the time (Jones et al. 1996). However, mandatory use of BRD's has not been implemented by any of the managing states or the Pacific Fishery Management Council and by 1998, BRD use had fallen again to virtually zero (ODFW, unpublished data).

The reasons for the decline in use of BRD's by Oregon shrimp fishermen are numerous. Resistance by fishermen to mandatory use of BRD's is based mostly on the value of the marketable bycatch, which has traditionally been retained and sold. Based on fish ticket data from 1987 to 1995 (see for example Lukas and Carter 1998), the ex-vessel value of marketable bycatch in the Oregon ocean shrimp fishery ranged from 2% to 5.5% of the total ex-vessel value from this fishery. Shrimp loss caused by the various BRD's, as well as net handling problems, contributed to the decline (Hannah et al. 1996). As in the past, fishermen also developed alternative, if not ecologically friendly, ways of handling the unwanted bycatch. Fishermen developed "shaker grates", vibrating grates with widely spaced bars, placed between the hopper conveyor belt and the sorting belt. These devices catch and divert larger fish, separating them mechanically from the shrimp, with marketable fish being removed manually and unwanted fish washing overboard. Some fishermen tied 23 kg weights to their codends and altered haul back procedures to allow the net to hang vertically in the water for several minutes to let fish, primarily Pacific whiting, float out the mouth of the net.

A variety of factors have contributed to the reluctance by managers to make BRD's mandatory in the ocean shrimp fishery. While concerns about enforcement and tri-state coordination probably top the list, concern over the survival of excluded fish has also been raised as an issue. At the present time, both voluntary BRD use and research into excluder performance are at very low levels. However, the fleet continues to innovate and develop technology for dealing with unmarketable

bycatch. A large portion of the fleet has adopted a ladder-roller style footrope (Figure 2), over the traditional "tickler chain"footrope, which has been shown to reduce the catch of small rockfish and small flatfish by 48% and 87%, respectively (Hannah and Jones, in press).

Types of Excluders

Since 1994, ODFW has evaluated how 10 different shrimp trawl modifications influence bycatch and shrimp catch. We've tested a modified trawl footrope (Hannah and Jones, in press), eliminated parts of the trawl belly, evaluated square mesh escapement panels in the codend and tested 6 configurations of codend devices. The codend devices tested include the Nordmore grate (Figure 1), the "fisheye" (Figure 3) and a variety of soft panel devices (Figure 1). Most of the evaluations involved comparative fishing experiments on double-rigged shrimp vessels. In some cases, underwater video was also used to evaluate trawl configuration and to see how a device might be working.

Performance

Table 1 summarizes the performance of each type of excluder device tested. The "fisheye" is the easiest to install and use, but has higher shrimp loss, and is very sensitive to the installation location. The Nordmore grate is the most efficient device, with high exclusion rates and low shrimp loss. In some experiments we actually saw an increase in shrimp retention with the Nordmore grate. Underwater video studies suggest this may be due to the fact that contact with fish causes increased escapement of shrimp through the codend meshes; eliminate the fish and more shrimp are retained. The soft-panel devices are intermediate in efficiency (Table 1) and have performance that is highly variable between individual nets (see below).

Operational Problems

All of the rigid devices (the Nordmore grate and fisheye) cause serious operational problems for some shrimpers. Most vessels are double-rigged, and leave their nets in the water (at the surface) while relocating the vessel over short distances. The Nordmore grate tends to spin in the water during steaming, making a tangled mess of the net. So to use the Nordmore grate effectively, most shrimpers need to fully load their gear, including the doors, before relocating the boat. This can have a major impact on the vessel's time actually fishing and, in rough weather, can create a safety hazard for the crew.

The fisheye also causes operational problems for some vessels. For vessesl that use a seine block to load their gear, a fisheye cannot be used. Since a fisheye needs to be near the rear of the codend to be effective, in high volume fishing shrimp loss can be extreme. To use a fisheye effectively in this fishery, fishermen would need to be able to legally disable the device when shrimp volume was high.

Additional Research Needed

Soft-panel excluders will probably ultimately prove to be the best excluder device for this fishery. They can be hauled through a seine block and they probably can be positioned further forward to minimize shrimp loss in high volume fishing. They also can be very efficient at excluding large fish, such as rockfish. The principal problem with these devices is that in some nets they tend to "collapse", causing a very low panel angle and excessive shrimp loss. This has been verified by fishing experiments and underwater video.

The next step in the development of "soft-panel" devices is to test some modifications that are aimed at keeping the devices from collapsing. Some of the ideas that have been suggested are rib lines in the excluder, rib lines in the whole net, shortening the "intermediate", and moving the excluder forward, where the spreading force of the net is greater. Within the next few years, we hope to test some of these suggested modifications, if sufficient funding is available.

References

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Table 1. Percent reduction in catch (lbs), for selected species groups, caused by various BRD's in comparative fishing experiments in the ocean shrimp trawl fishery, 1994-98.

BRD	Shrimp	Large Rockfish	Large* Flatfish	Pacific Whiting
Nordmore grate (6/95)	Increase	100.0	97.0	100.0
Nordmore grate (7/95)	10.0	100.0	90.0	99.0
Nordmore grate (9/95)	Increase	95.0	93.0	100.0
Nordmore grate (6/98)	Increase	100.0	78.4	99.5
Nordmore grate (6/98)	5.7	100.0	97.5	99.4
5" Soft-panel	7.0	100.0	89.5	80.0
5" Soft-panel	15.0	97.0	97.5	67.0
8" Soft-panel	6.0	44.0	77.5	41.0
8" Soft-panel	Increase	100.0	93.0	70.0
8" Soft-panel	31.0	100.0	100.0	81.0
8" Soft-panel (modified)	2.0	87.0	--	62.0
3" Soft-panel	7.0	100.0	98.0	97.0
Fisheye at 76 meshes	22.6	72.0	69.5	79.4
Fisheye at 82 meshes	9.6	82.8	51.6	73.2

*Average of estimates for large and medium flatfish from Hannah et al. (1996)
"--" = Insufficient data.

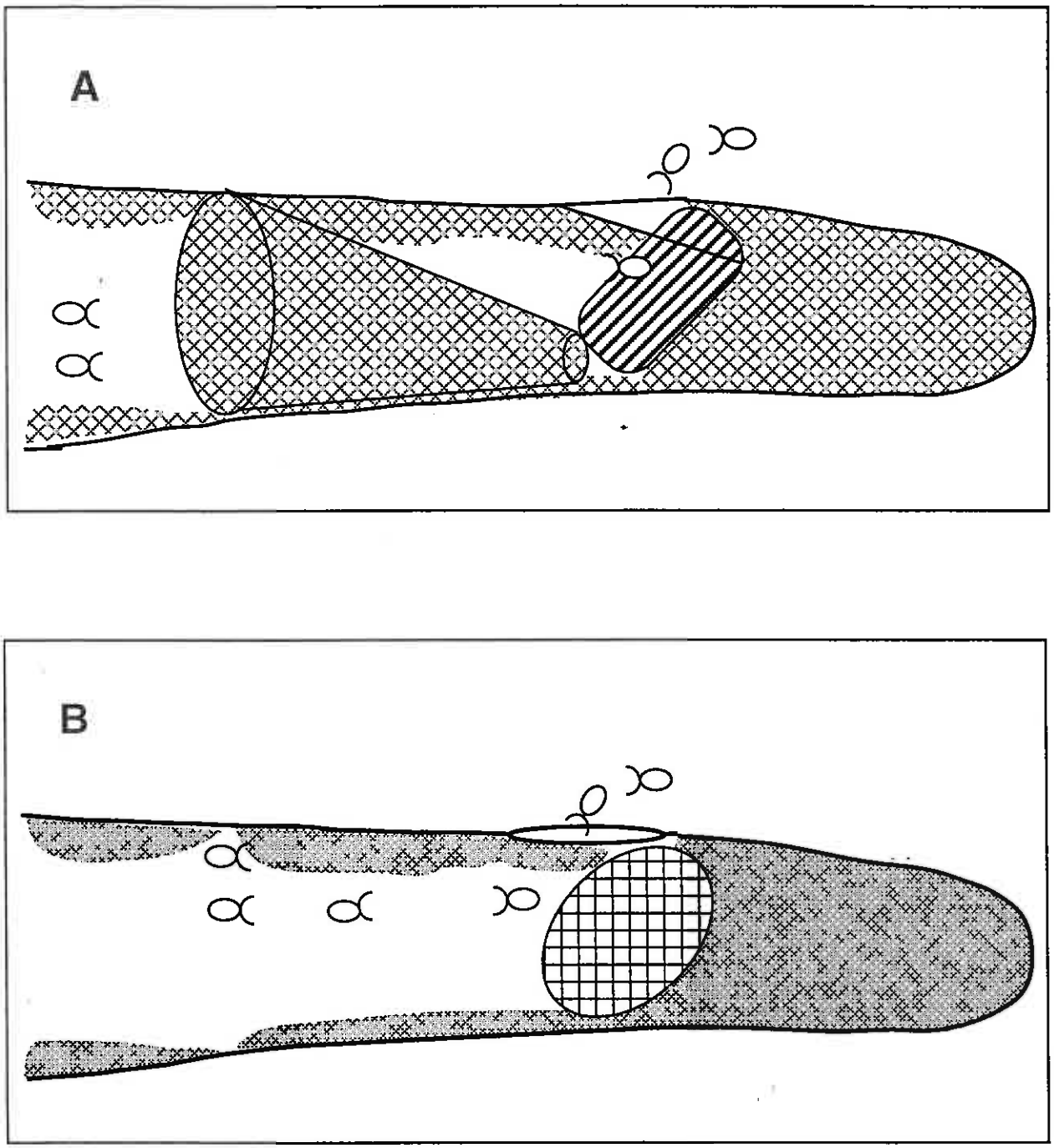
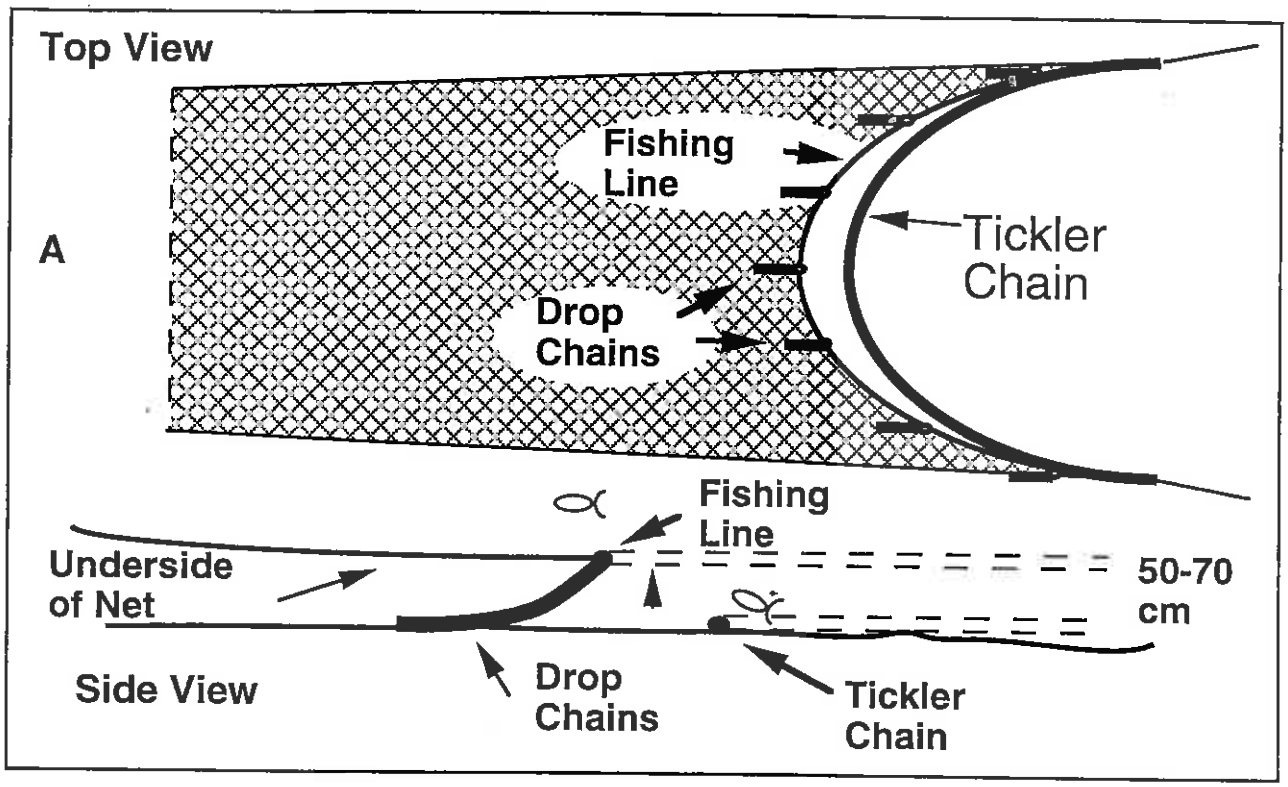


Figure 1. Nordmore grate (A) and soft-panel (B) bycatch reduction devices.



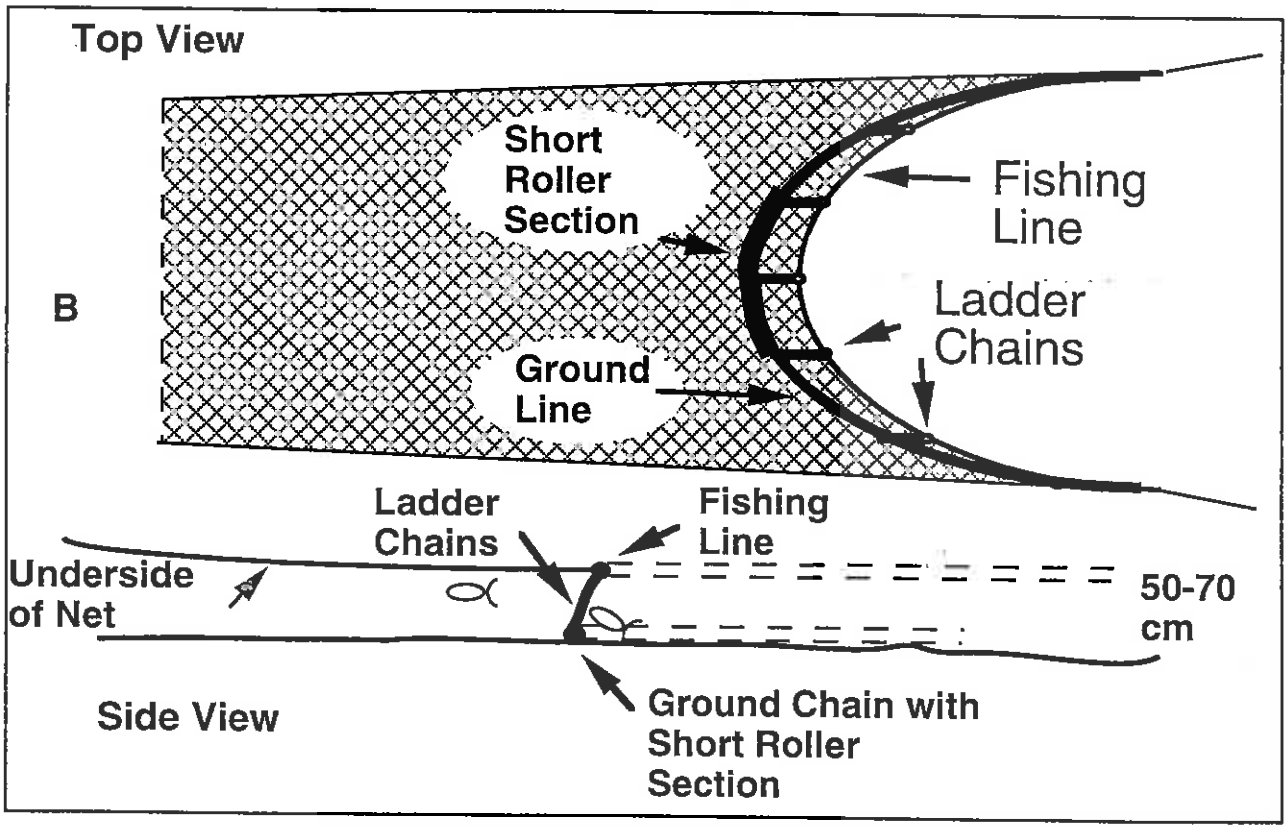


Figure 2. Schematic of trawl footrope with tickler and dropper chains (A) and with ladder/roller footrope (B).

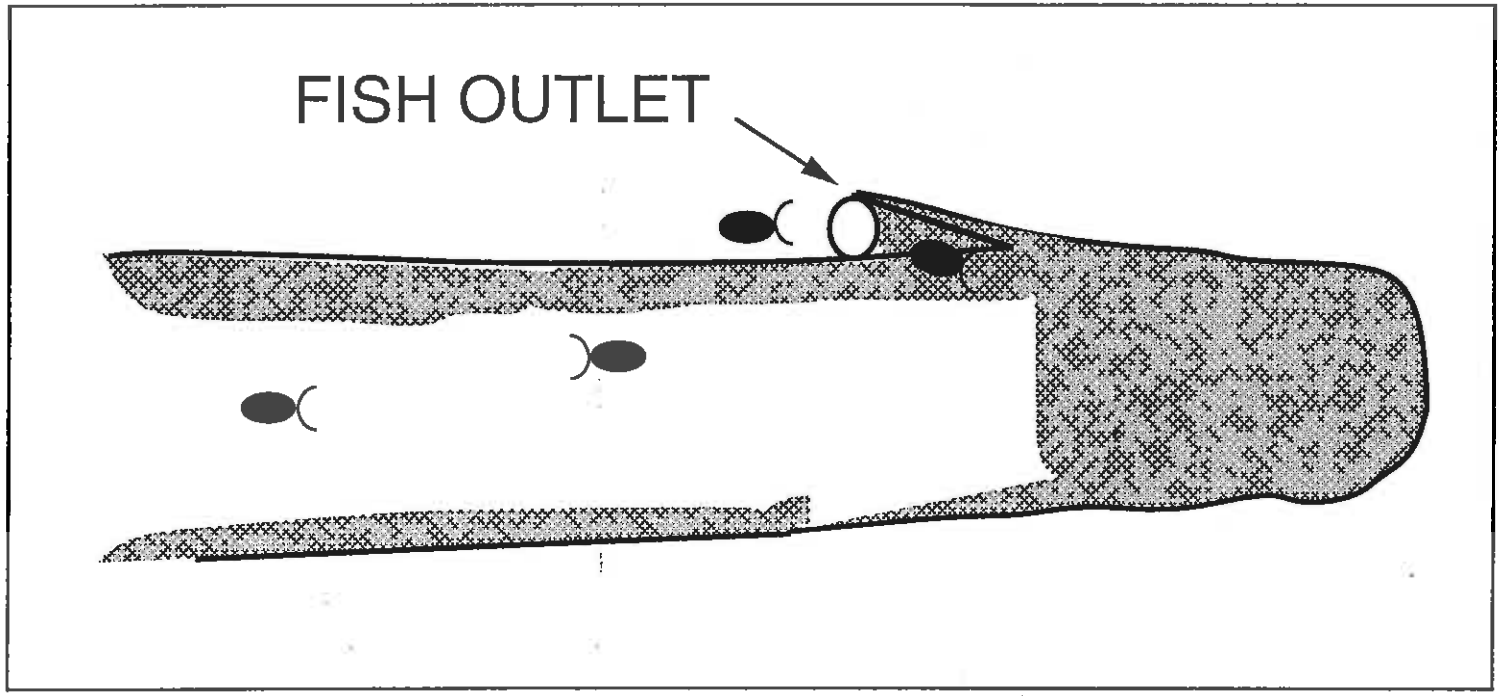


Figure 3. Diagram of the "fisheye" bycatch reduction device.