



Conservation Engineering Work in U.S. West Coast Groundfish Fisheries

(Scientists and Fishermen Collaborating to Reduce Bycatch in West Coast Fisheries)

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Overview

Through key regional collaborations with the Pacific States Marine Fisheries Commission, Oregon Department of Fish and Wildlife, Alaska Fisheries Science Center, and the fishing industry, the NWFSC has been able to pursue a wide-ranging array of conservation engineering projects relevant to reducing bycatch in the west coast groundfish and ocean shrimp trawl fisheries. In the past several years, these projects included: 1) Reducing Chinook salmon, eulachon, rockfish, and Pacific halibut bycatch in midwater and bottom trawl fisheries using BRDs, 2) Providing loaner video camera systems to the fishing industry, and 3) Examining selectivity characteristics of codends that differ in mesh size and configuration in the bottom trawl fishery. Much of our current work has been in response to the fishing industries concerns over catches of overfished rockfishes and Pacific halibut IBQ (Individual Bycatch Quota) allocated in the Pacific coast Groundfish Trawl Rationalization Catch Share Program. The trawl rationalization program, starting in January 2011, established formal Annual Catch Limits (ACLs) and individual catch share quotas. In addition to ACLs, fishing opportunities may also be limited by hard caps or IBQs for non-groundfish species (e.g., Pacific halibut). Bycatch of overfished and prohibited species in the west coast groundfish trawl fishery has the potential to constrain the fishery such that a substantial portion of available harvest may be left in the ocean.



Fishermen's Loaner Camera System

We provide loaner video camera systems to fishermen to support their evaluation of industry-designed approaches to reduce bycatch and reduce impacts to benthic habitats. Loaner camera systems greatly facilitate science and industry collaborations.



Custom designed systems



TrawlCam system, JT Electronics

<http://www.nwfsc.noaa.gov/research/divisions/fram/groundfish/habitat.cfm>

- Four systems currently available – loaner program started in November 2010
- Typical geographic range from Eureka, CA to Westport, WA
- PSMFC and NWFSC provide on site training for commercial fishermen
- No-fault loaner program
- Applications to date: Pacific hake fishery (ESA salmon & rockfishes), bottom trawl fishery (Pacific halibut), and ocean shrimp trawl fishery (juv. groundfish & ESA eulachon)



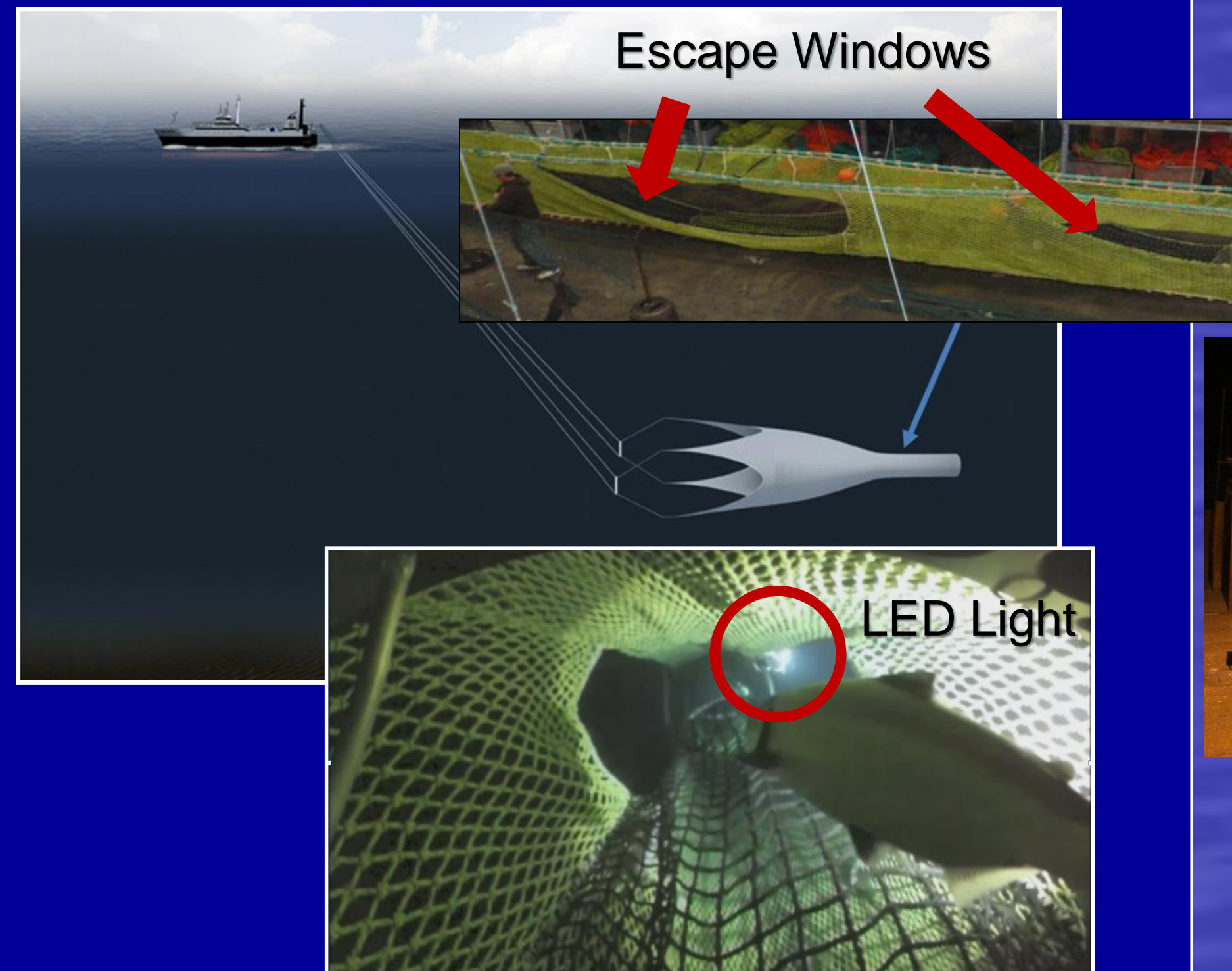
Frame grab from loaner video system (April 2011) aboard the F/V Last Straw during fishermen's evaluation of an industry-designed horizontal flexible grid halibut excluder.

F/V Last Straw Foulweather Trawl Excluder



Light stimulus to enhance Chinook salmon escapement in the Pacific hake fishery

Collaborative research in 2009 and 2010 suggested that there is potential for reducing Chinook salmon bycatch in the Pacific hake fishery using open escape window BRDs (Lomeli and Wakefield 2012). During this initial research, the use of artificial light was also noted to influence the behavior of Chinook salmon (82.4% of 34 salmon exited the escape window where the artificial light was directed [P<0.03]). In 2013, we conducted a dedicated study to further investigate light as a tool to enhance escapement. Six of 7 Chinook exited the illuminated escape window. Further work is needed to evaluate the efficacy of using artificial illumination (Lomeli and Wakefield 2014).



Escape Windows

LED Light

Frame grab from HD video: during June 2013 field work, 6 out of 7 Chinook salmon observed escaped through the illuminated escape window (a high-output LED light was randomly positioned on two of the BRD's escape windows, during each deployment).

Groundfish Bottom Trawl Fishery Codend Selectivity Research

- Examined the size selectivity characteristics of three codends that differed in mesh size and configuration
 - 4.5" diamond mesh, 4.5" and 5.5" T90 mesh
 - Manufacturer: NET Systems (Seattle)
- Objective was to reduce discards of juvenile and unmarketable-sized fish
- Collaborators: Daniel Erickson (ODFW) and Owen Hamel (NMFS NWFSC)
- Gear Testing / Sea Trials in 2012:
 - Fishing occurred aboard the *F/V Last Straw*
 - Codend selectivity was directly measured using a covered codend

Results

4.5" diamond mesh

- Pros:** relatively effective at reducing discards of small fishes
 - ✓ retained only 20% of all unmarketable-sized target spp.
- Cons:** relatively high loss of marketable-sized flatfishes
 - ✓ loss of 33% of Dover sole and 49% of rex sole



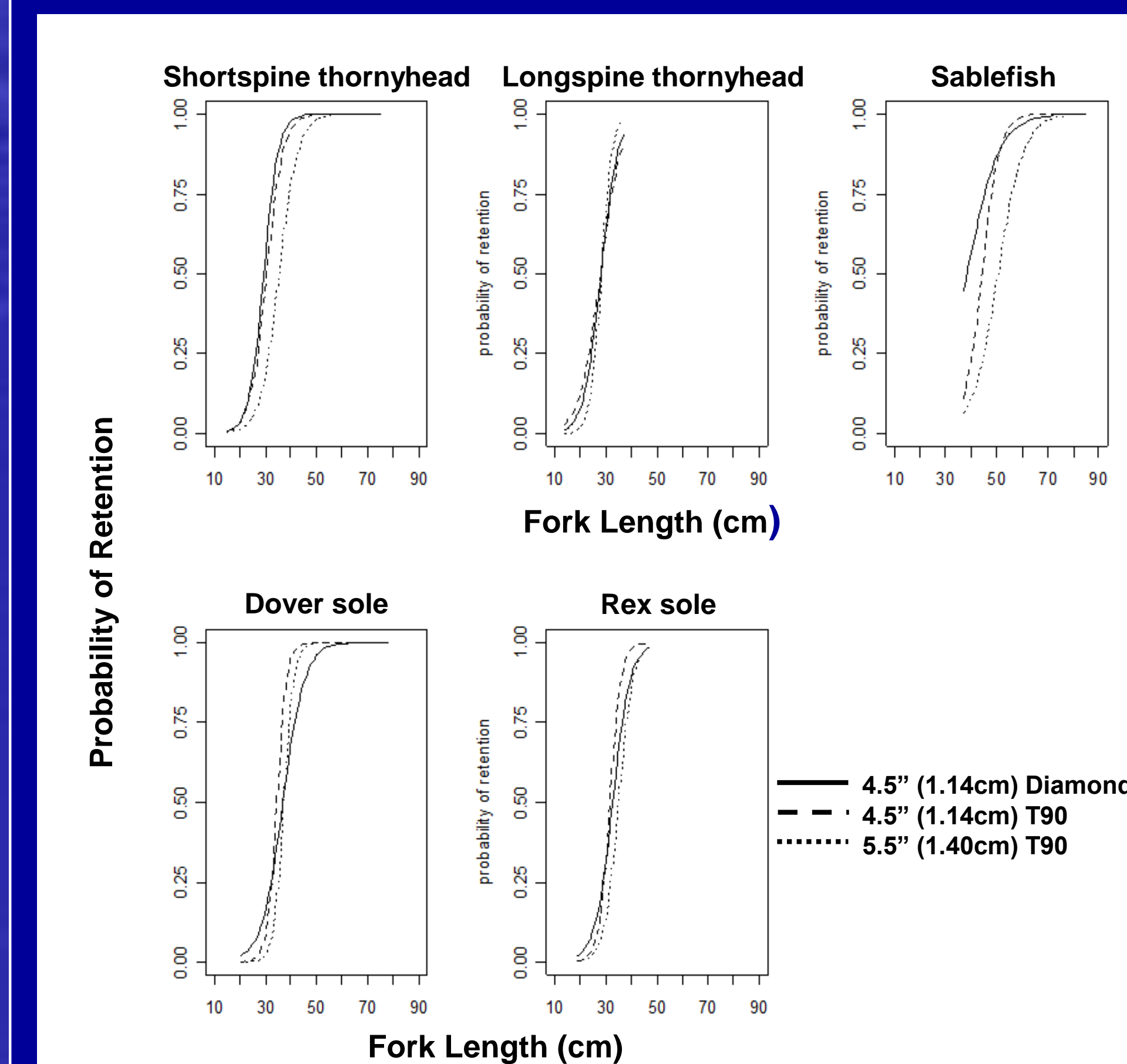
4.5" T90 mesh

- Pros:** retained the highest % of marketable fishes
 - ✓ retained 86% of all marketable-sized target spp.
- Cons:** least effective at reducing discards of small fishes
 - ✓ retained 55% of unmarketable-sized target spp.



5.5" T90 mesh

- Pros:** extremely effective at reducing discards of small fishes
 - ✓ retained only 18% of all unmarketable-sized target spp.
- Cons:** exhibited a high loss of marketable-sized fishes
 - ✓ loss of 58% of flatfishes and 33% of roundfishes



Testing Pacific Halibut Excluders

To address fishermen's concerns about reaching their Individual Bycatch Quota (IBQ) for Pacific halibut before reaching their groundfish catch share quotas, we tested a series of flexible sorting grid excluders (e.g., Lomeli and Wakefield 2013). Most recently, (June 2013), we tested two excluders (designed to be inserted between the intermediate and the codend): 1) a simple downward flexible ramp or horizontal grid excluder in common use in the Pacific NW with 5.5" X 6" (14.0cmX15.2cm) rectangular openings, and 2) a novel design for a vertical flexible grid constructed of two vertical panels where the grid openings are vertical narrow slots (1.75" high X 8" wide, 4.4cmX20.3cm) rather than rectangles. Results for both excluders are shown below (preliminary for the vertical flexible grid). The vertical grid specifically addresses fishermen's expressed need for a halibut excluder that would also exclude roundfishes (e.g., sablefish and rockfishes) while retaining flatfishes (e.g., Dover and petrale soles).

Retained catch from vertical grid excluder, note large proportion of flatfishes (petrale and Dover soles)

Excluded catch (halibut, sablefish, and rockfishes from recapture bag) from vertical grid excluder



Results

Species	% Retention (marketable-sized fish) Vertical Flexible Grid 1.75" X 8" "slots" Nearshore Fishery	% Retention (marketable-sized fish) Horizontal Flexible Grid 5.5"X6" "rectangles" DTS Fishery*
Pacific halibut	6% by weight 12% by numbers	16% by weight 26% by numbers
Dover sole	89	99
Petrale sole	93	97
English sole	88	97
Arrowtooth flounder	75	93
Sablefish	7	90
Lingcod	1	90
Canary rockfish	4	100
Shortspine thornyhead	-	97
Other roundfishes	30	96

*Dover sole/thornyhead/sablefish

Recent Relevant Papers and Reports:

- Hannah, R.W. S.A. Jones, M.J.M. Lomeli, W.W. Wakefield. 2012. Tests of trawl net modifications to reduce the bycatch of eulachon (*Thaleichthys pacificus*) in the ocean shrimp (*Pandalus jordani*) trawl fishery. *Fish. Res.* 110:277-282.
- Lomeli, M.J.M. and W.W. Wakefield. 2012. Reducing Chinook salmon (*Oncorhynchus tshawytscha*) and rockfish (*Sebastes* spp.) bycatch in the U.S. west coast Pacific hake (*Merluccius productus*) fishery using an open escape window bycatch reduction device. *Fish. Res.* 119-120:128-132.
- Lomeli, M.J.M. and W.W. Wakefield. 2013. A flexible sorting grid to reduce Pacific halibut (*Hippoglossus stenolepis*) bycatch in the U.S. west coast groundfish bottom trawl fishery. *Fish. Res.* 143:102-108.
- Lomeli, M.J.M. and W.W. Wakefield. 2013. A pilot study testing the efficacy of a flexible sorting grid rockfish excluder in the U.S. Pacific hake fishery: Outcome of a collaborative workshop. NOAA Fisheries, Northwest Fisheries Science Center Report, 23p.
- Hannah, R.W., M.J.M. Lomeli, and S.A. Jones. 2013. Direct estimation of disturbance rates of benthic macroinvertebrates from contact with standard and modified ocean shrimp (*Pandalus jordani*) trawl footropes. *J. Shellfish Res.* 32:551-557.
- Lomeli, M.J.M. and W.W. Wakefield. 2014. Examining the potential use of artificial illumination to enhance Chinook salmon escapement out a bycatch reduction device in a Pacific hake midwater trawl. Northwest Fisheries Science Center Report, 15p.
- Lomeli, M.J.M. and W.W. Wakefield. 2014. Testing of an industry-designed bycatch reduction device to reduce the incidental catch of Pacific halibut in a groundfish bottom trawl fishery. NMFS Northwest Fisheries Science Center Report, 23 pp.

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