



# 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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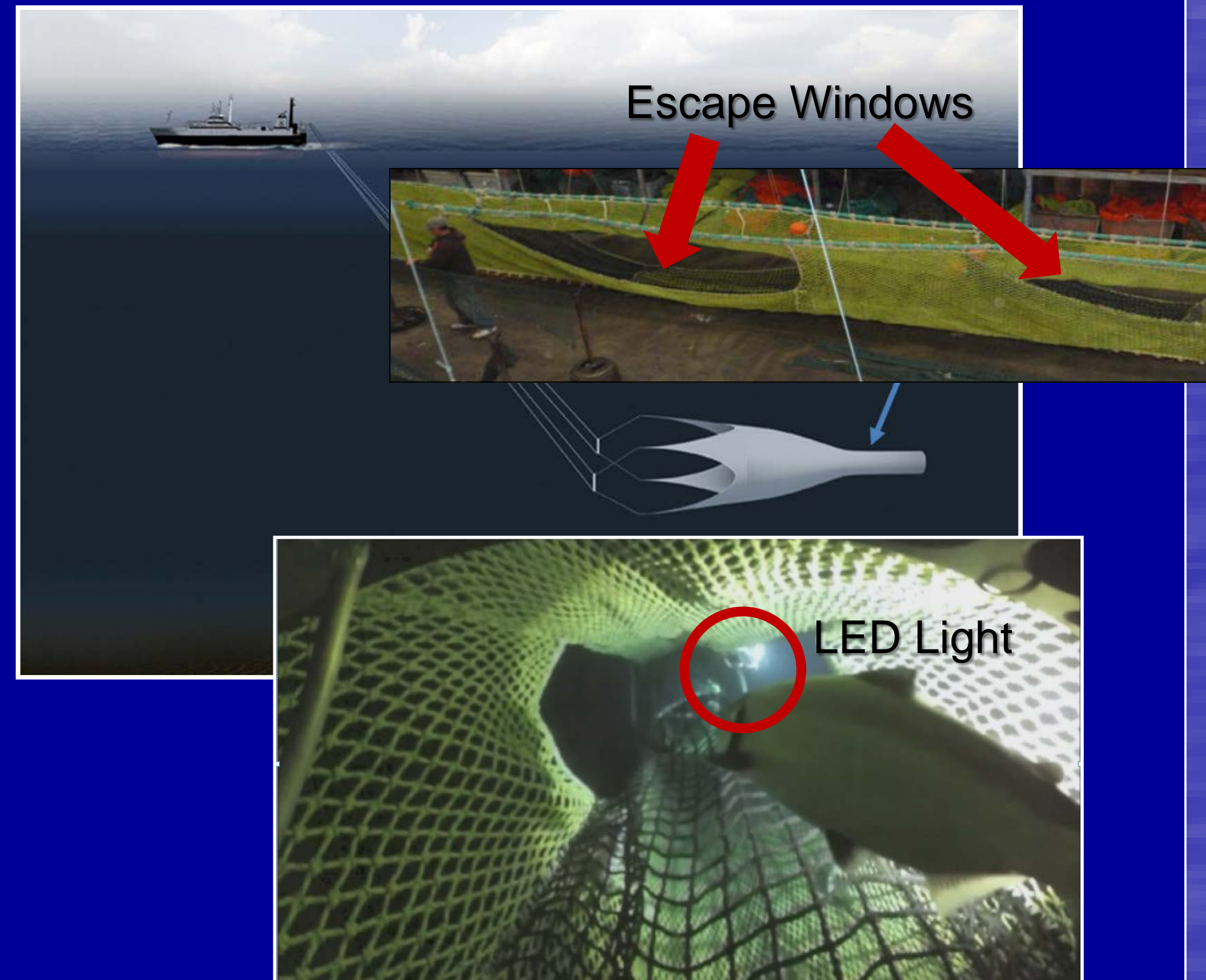


## Overview

Beginning in 2004, the NOAA Fisheries Northwest Fisheries Science Center (NWFS) initiated a fisheries conservation engineering program. 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 NWFS has been able to pursue a wide-ranging array of conservation engineering projects relevant to reducing bycatch and habitat impacts from mobile fishing gear. In the past two years, these projects included: 1) Reducing Chinook salmon, rockfish, and Pacific halibut bycatch in West Coast groundfish fisheries using bycatch reduction devices, 2) Bycatch reduction in the ocean shrimp fishery (juv. groundfishes, ESA-listed eulachon, megafaunal invertebrates), 3) Providing loaner video camera systems and BRD prototypes to the fishing industry, 4) Examining selectivity of codends that differ in mesh size and configuration in the bottom trawl fishery. Much of our current and projected work has been in response to rising needs for bycatch solutions that began in 2011 when the groundfish trawl fishery started management under a catch share program. Reducing bycatch has the potential to allow fishermen to more effectively utilize their catch share quotas, increase their net economic benefits, and potentially result in higher annual catch limits. This poster exhibits a portion of our recent and ongoing work.

## 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.



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).



## West Coast Catch Shares Program

- NOAA Fisheries implemented an Annual Catch Share program for the Pacific coast groundfish limited entry trawl fisheries in 2011
- Complex fishery management measures created an increased demand for bycatch solutions across sectors of the fishing industry
- All catch retained and discarded goes against quotas
- Catch share program mandates 100% observer coverage



## Fishermen's Loaner Camera System

The loaner video camera systems are provided to fishermen to support their evaluation of industry-designed approaches to reduce bycatch and reduce impacts to benthic habitats. The loaner camera systems have greatly facilitated science and industry collaborations.

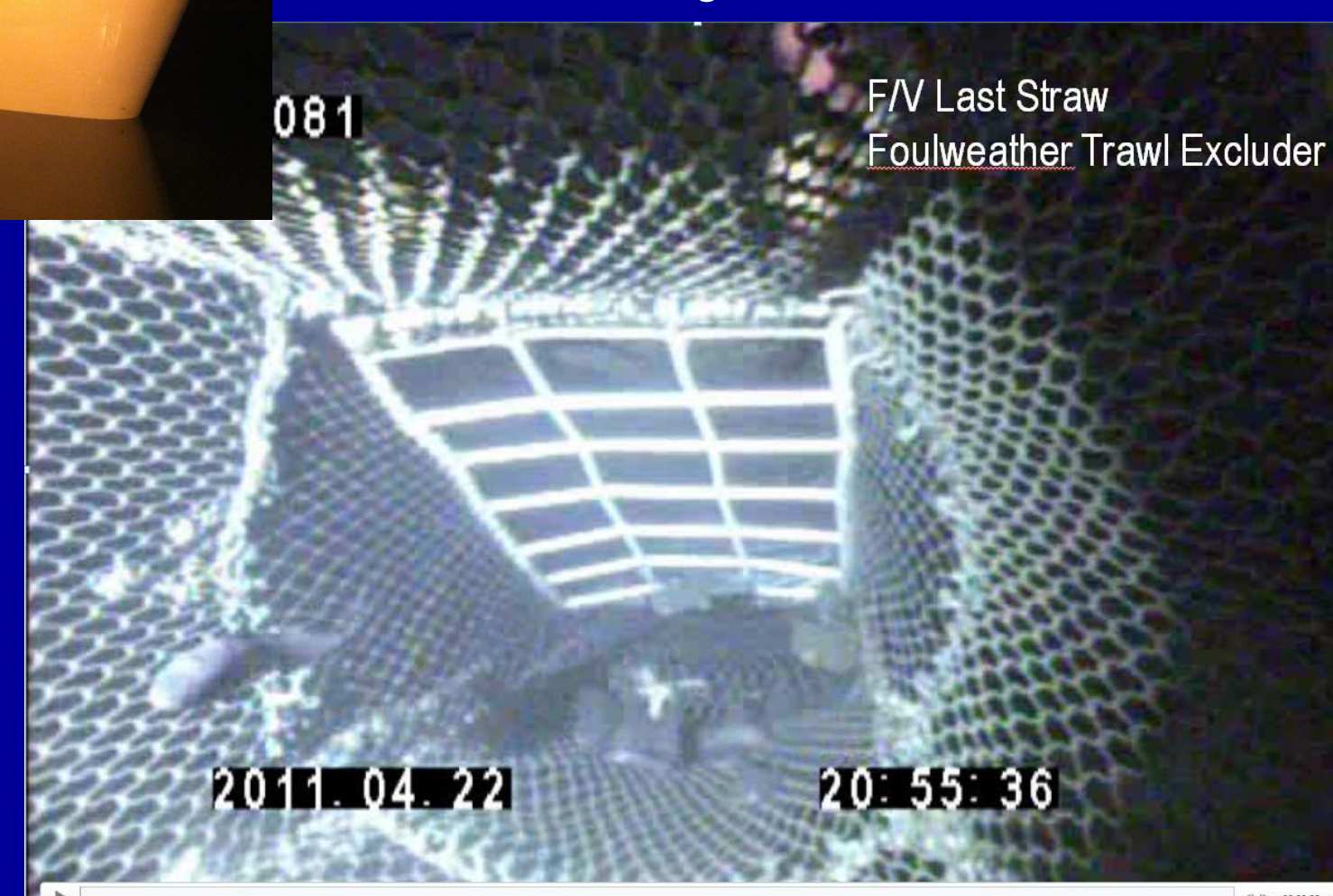


<http://www.nwfsc.noaa.gov/research/divisions/fram/groundfish/habitat.cfm>

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

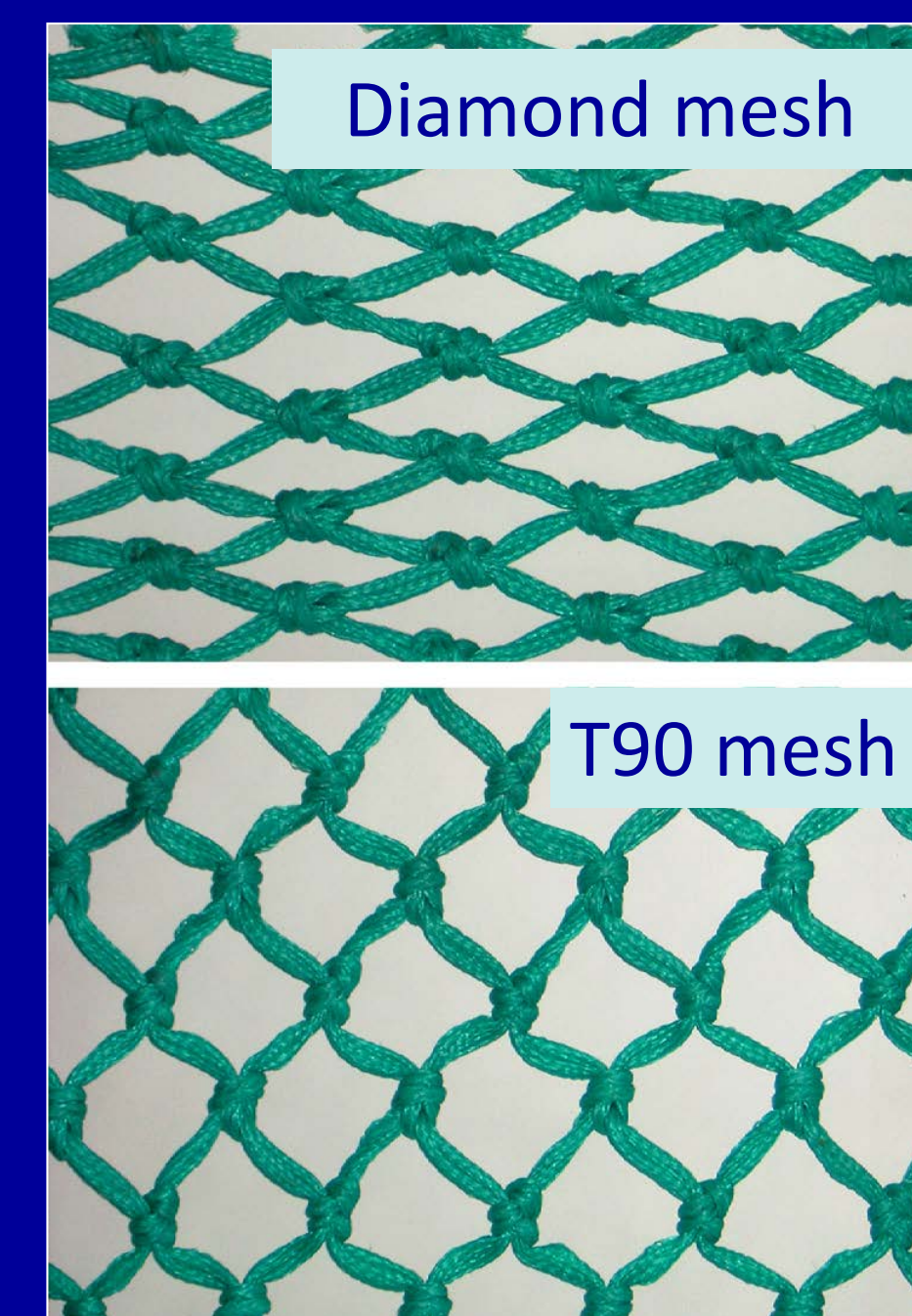


Frame grab from loaner video system (April 2011) aboard the F/V Last Straw during fishermen's evaluation of an industry-designed horizontal flexible grid halibut excluder.



## 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 NWFS)
- Gear Testing / Sea Trials in 2012:
  - Fishing occurred aboard the F/V Last Straw
  - Codend selectivity was directly measured using a covered codend



- Diamond mesh Issues:**
- With the accumulation of catch, the codend takes on a bulbous shape
  - Only a few rows of mesh forward of the catch bulge are open to allow for escape of small fishes
  - Further forward in the codend, the meshes are stretched and reduced in opening
- T90 benefits:**
- Meshes remain open over the whole codend throughout the entire tow
  - Easy to build and repair
  - Low in price compared to other netting (i.e. knotless square mesh)

Images from H. Herrmann et al. Fisheries Research 109 (2007) 222-232

## 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



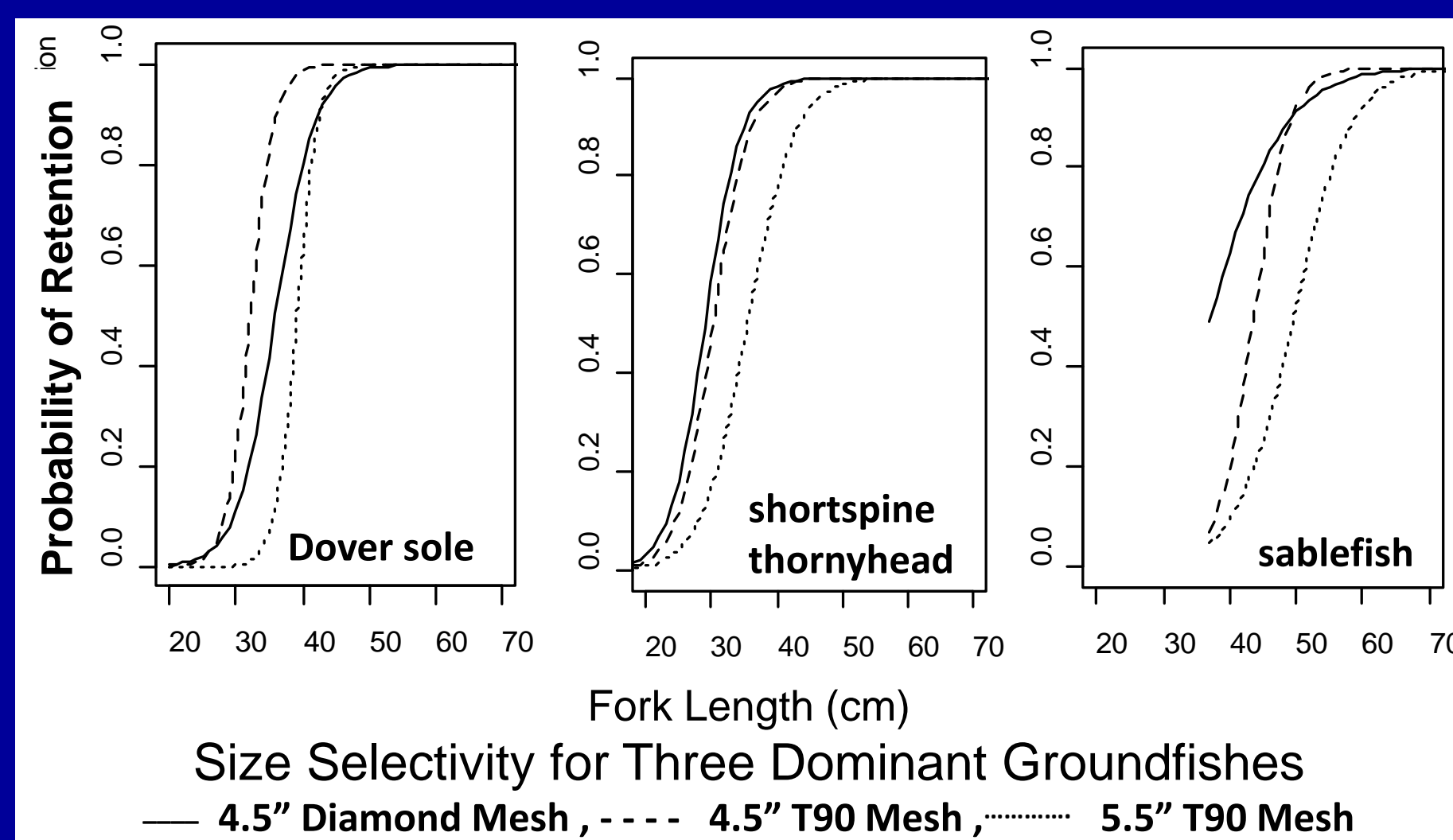
### 4.5" T90 mesh

- 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 have 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" rectangular openings, and 2) a novel design for a vertical flexible grid constructed of two vertical panels where the grid openings are vertically narrow slots (1.75" high X 8" wide) rather than rectangles. Preliminary results from the vertical flexible grid are shown below. This design specifically addresses the 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



## Preliminary Results

Species	% Retention Vertical Flexible Grid 1.75" X 8" "slots" (NWFS/PSMFC design)	% Retention Horizontal Flexible Grid 5.5"X6" "rectangles" (Industry design)
Pacific halibut	6% by weight 12% by numbers	21% by weight 27% by numbers
Dover sole	89	99
Petrale sole	92	97
English sole	88	97
Arrowtooth flounder	75	93
Sablefish	7	90
Lingcod	1	92
Canary rockfish	4	100
Shortspine thornyhead	-	97
Other roundfishes	30	96

## 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.

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