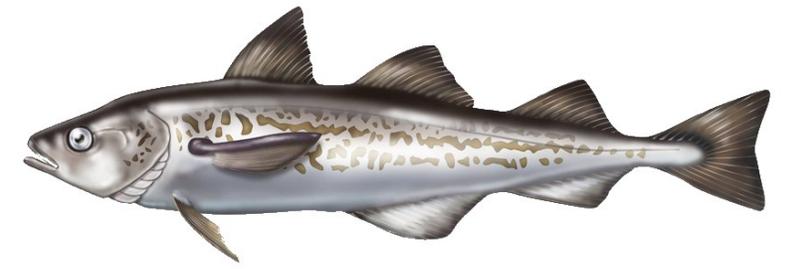


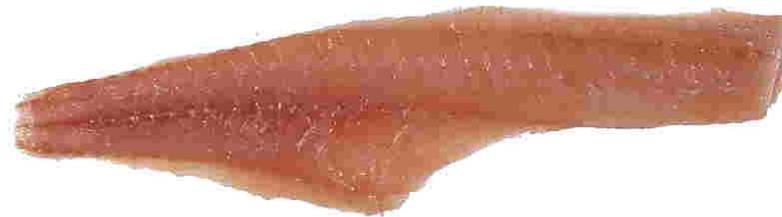
# The Salmon Excluder

Fishermen working with researchers to help ensure the sustainability of the North Pacific Pollock fishery and the health of Pacific salmon stocks

# Walleye Pollock (*Theragra chalcogrammus*)



- Most widely consumed fish on Earth
- Member of the cod family (Gadidae)
- Semipelagic schooling fish in North Pacific
- Fast growing, short-lived (up to 17 yrs)
- The average weight is between 4 and 15 pounds, and measures about 2 to 3 feet long
- Harvested at 3-5 years



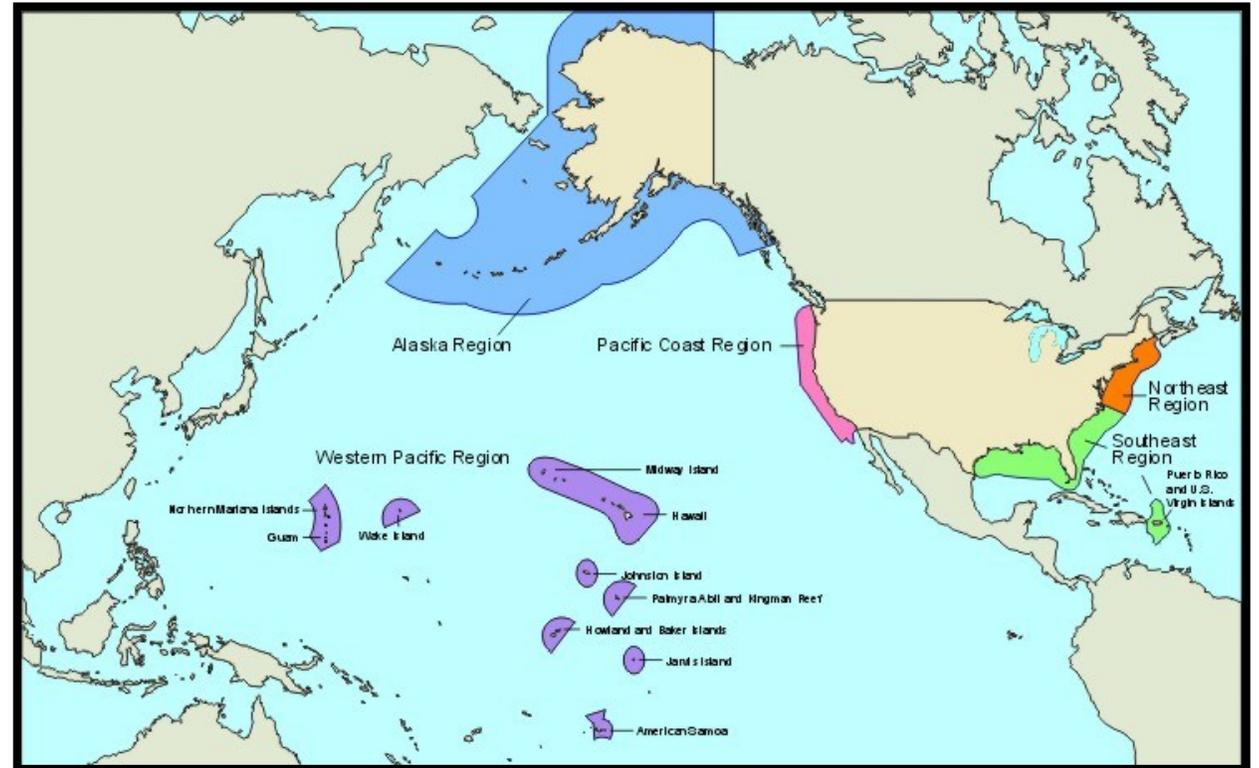
*Harvested Alaskan Pollock: Photo credit: Wikipedia.*

# Distribution of Pollock in the Bering Sea and Gulf of Alaska



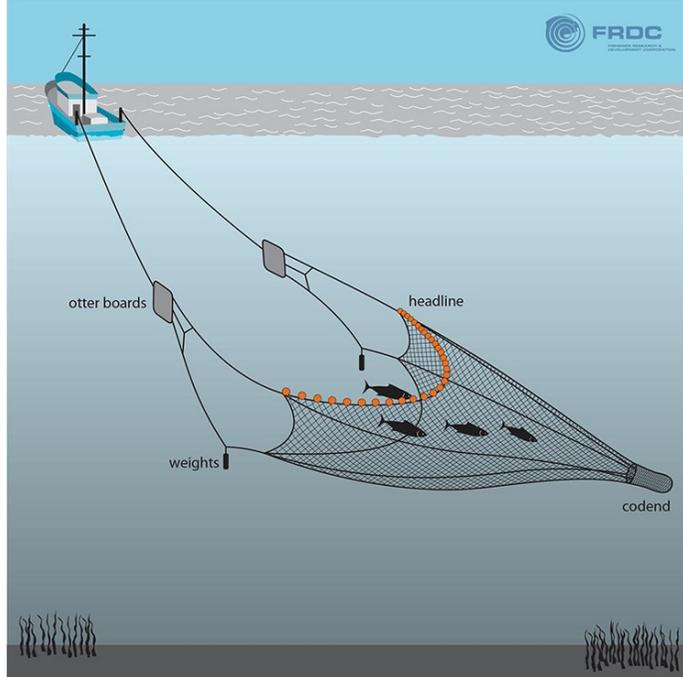
# The Pollock Fishery

- The largest catch of any single fish species in the US EEZ.
  - 2011, Pollock comprised 62% of total Alaska groundfish catch (2.8 billion pounds)
    - Why?
      - Large continental shelf off Alaska
      - Favorable ocean current that provide rich nutrients
  - Three stocks of Pollock are managed (Bering Sea, Aleutian Islands, and Gulf of Alaska)
  - One of the “cleanest” fisheries in the world (discard 0.5% of total catch compared with 25% for other fisheries)



The U.S. Exclusive Economic Zones (EEZ). Alaska Region is designated in blue.

Pollock are caught using mid-water trawlers. Some boats process the fish on-board.

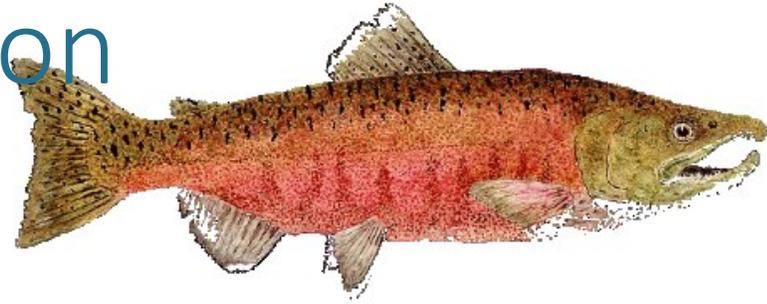


# Pollock Products

- Surimi seafood products\*
- Quick frozen fillets\*
- Roe\*
- Used in fast food and casual restaurants
- Consumer-ready meals
- Frozen breaded products such as fish sticks and fish sandwiches
- Kamoboko (a cured surimi)
- Child nutrition labeled products for schools
- Fishmeal
- Fish oil (burned as fuel in vessel boilers to provide clean energy)



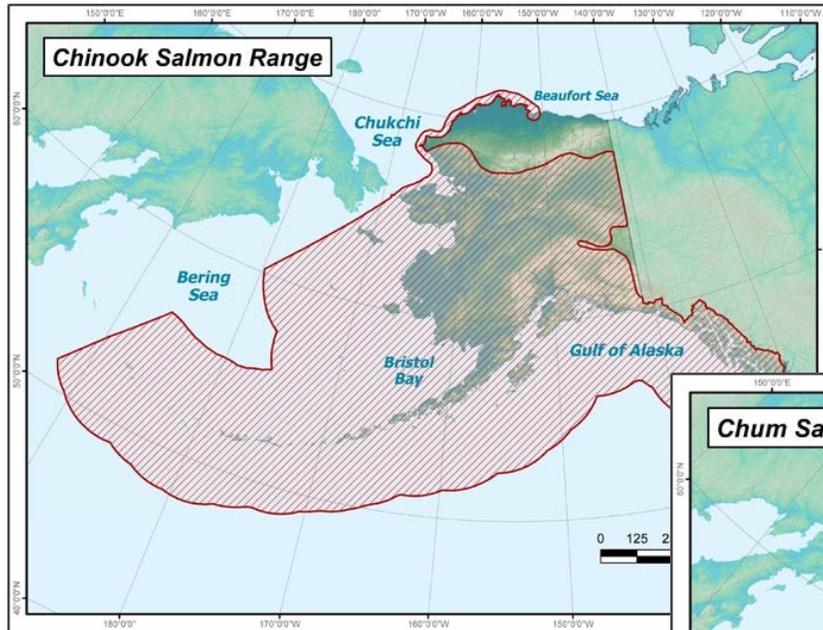
# Salmon



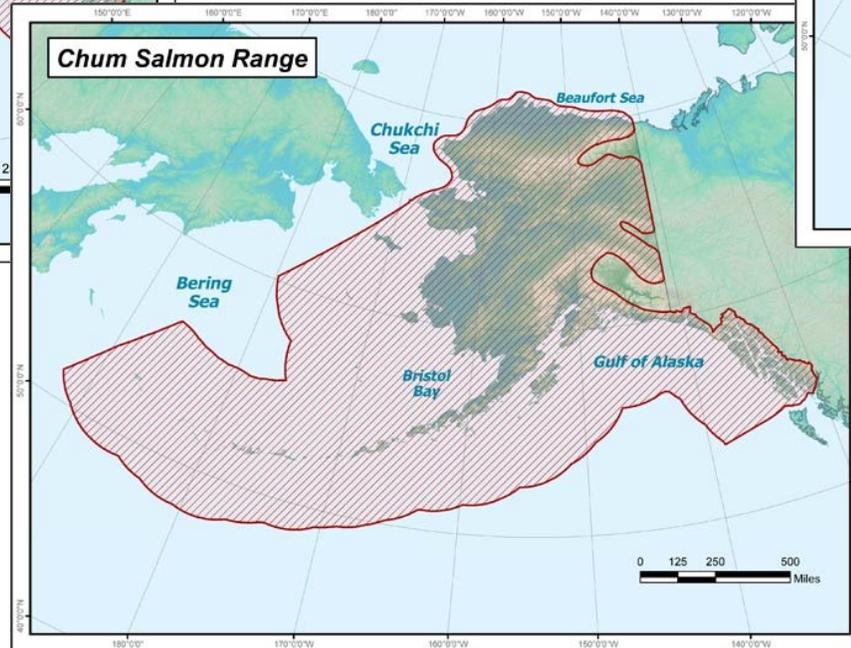
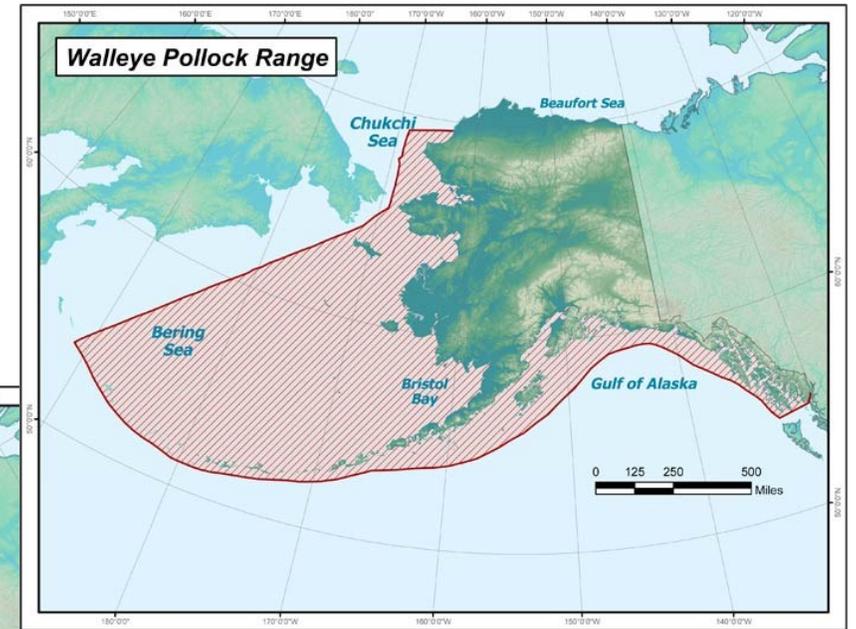
- |
  - Biological foundation of coastal ecosystems and human economies.
  - Symbol for building support for conservation of northern Pacific Rim coastal ecosystems.
- Culture
  - Integral part of tribal religion, culture and physical sustenance.
- Recreation
- Commercial
- Food source
- Regional economic health
- Social/historical importance



# Distribution of Chinook, chum salmon and Pollock

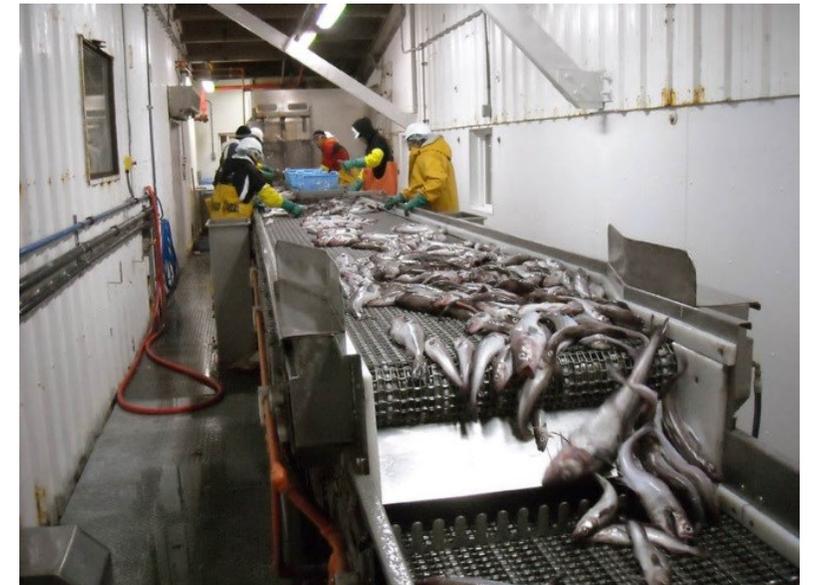


*The distribution of Chinook, chum salmon and Pollock. Overlap in the distribution of these species creates unwanted opportunities for fishermen to catch salmon incidental to catching Pollock. Map credits: Alaska Department of Fish and Game.*



# Bycatch

- Fishermen do not want to catch non-target fish, or bycatch, while harvesting Pollock
  - Some species of bycatch cannot be sold or kept for personal use, while fishermen are required to keep other species.
  - Chinook salmon bycatch cannot be kept by Pollock fishermen – the salmon are reserved for small boat fisheries and subsistence fisheries.
  - Currently, salmon runs in Alaska are at low abundance levels due to natural cycles in North Pacific productivity. The challenge is for Pollock fishermen to conduct a high volume fishery that is good for the nation's interest without affecting the native and small boat fisheries that existed long before pollock fishing began.
- Two ways to address bycatch:
  - Set a limit for the amount of bycatch that can be caught, and when that threshold is reached, the fishery closes.
  - Reduce/avoid bycatch



Top photo: Salmon bycatch. Photo credit: akmarine.org.  
Bottom photo: A Pollock processing line. Photo credit: NOAA.



# Tools Fishermen Use to Avoid Bycatch

- Fishing Cooperatives

- Fishermen manage the share of Pollock catch among themselves
- Develop strategies to reduce bycatch

- Incentives

- The Chinook Salmon Bycatch Reduction Incentive Plan

- Limits access to local areas of relatively high Chinook bycatch
  - Avoiding “hot spots” reduces operating costs and increases profits
- Gives flexibility in years with high Chinook salmon encounters
- Ensures fishery does not exceed bycatch limits over a 2-year period

- Timing of Season Closures

- Fishing seasons are closed when Chinook salmon are abundant

- Adaptive Management

- Harvest is adjusted based on populations levels

The salmon  
excluder is  
the  
*“last line of  
defense”* to  
avoid salmon  
bycatch

# The Partners

- *North Pacific Fisheries Research Foundation*
- Pollock Conservation Cooperative
- Alaska Fisheries Science Center
- NOAA Fisheries Alaska Region
- Pacific States Marine Fisheries Commission
- North Pacific Fishery Management Council
- Pollock captains, vessel crews, vessel owners
- Pollock fishermen
- Swan Nets, Dantrawl, Hampidjan Nets, NET Systems
- Alaska Groundfish Databank
- United Catcher Boats Association
- The Nature Conservancy



# North Pacific Fisheries Research Foundation

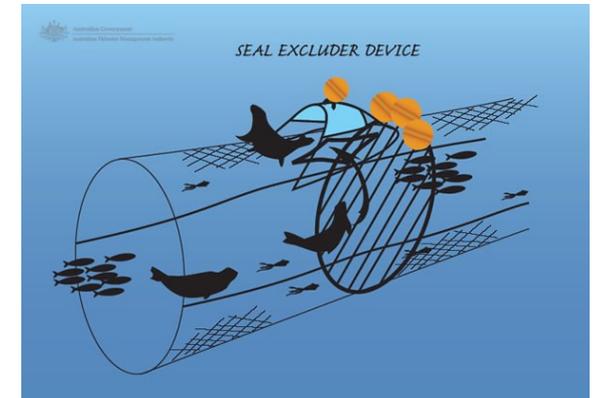
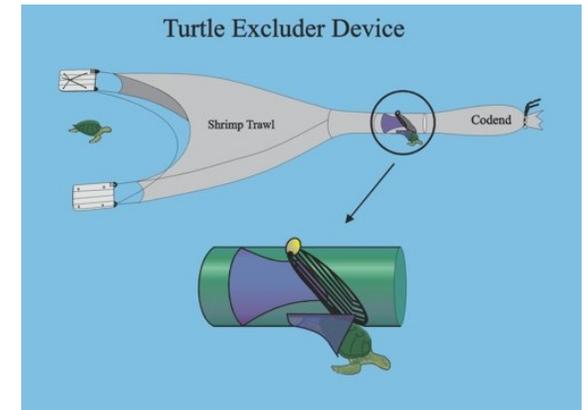
- Formed in 1998
- Established by the Bering Sea trawl fishery to fund, direct and oversee applied scientific research on fisheries of the North Pacific
- In 2003, the Bering Sea Pollock fishery launched research on trawl net technology to allow salmon to escape unharmed from Pollock mid-winter trawl nets



*The Pacific Prince is one of several boats that has participated in testing salmon excluders. Photo credit: Bob Dooley.*

# The Solution: Excluder Device

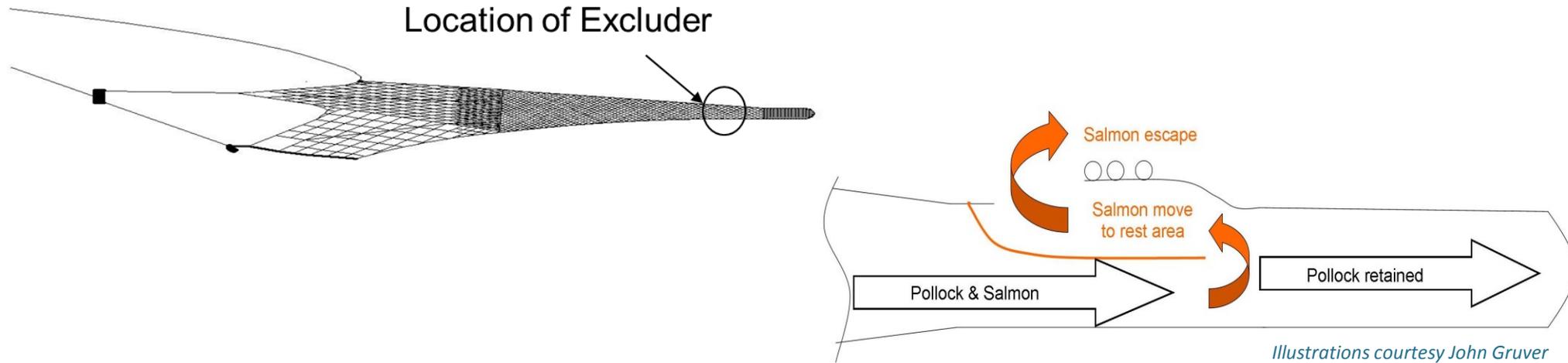
- Excluder devices have been developed for decades to sort out catches of different-sized species
  - Turtles, salmon, halibut, seals, etc.
  - The principles are the same
    - Target species stay in the net
    - Non-target species escape through a well-designed opening



*A seal excluder device, awaiting testing in a flume tank.  
Photo credit: Mercator Media 2013.*

# Understanding *Fish Behavior* . . .

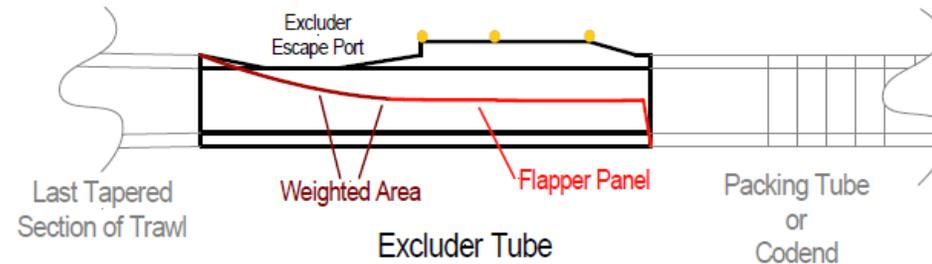
## Designing the Excluder



The excluder is a flapper weighted in the tapered portion of the net. During capture, Pollock continuously move toward the back of the trawl net, with relatively infrequent, brief efforts to hold position or move slightly forward.

Salmon react to changes in water flow, and make forward progress in the net. The escapement tunnel allows them to pass through the net.

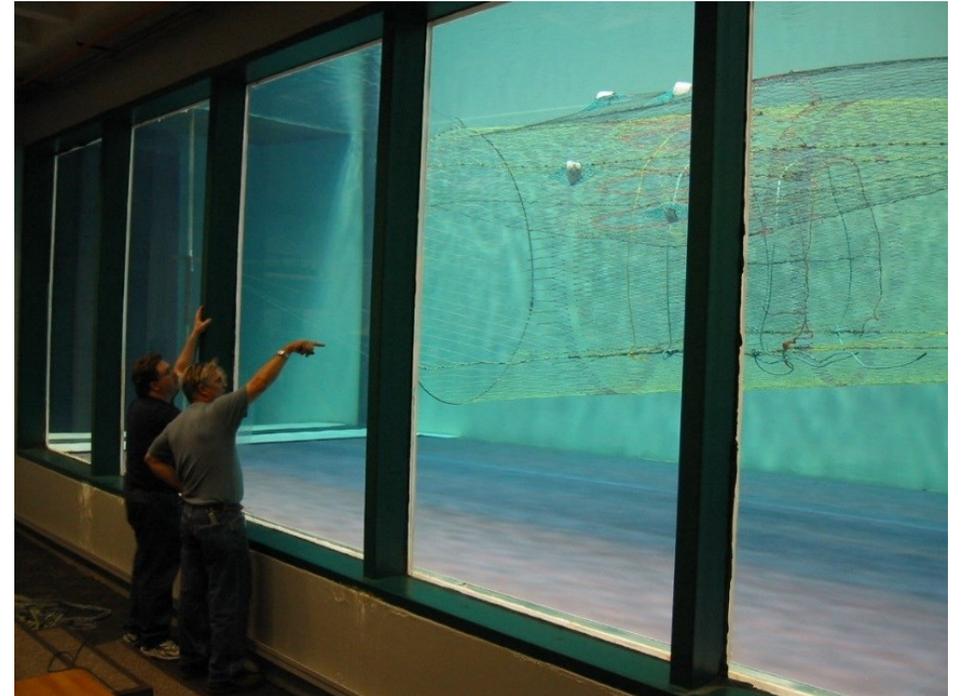
# Excluder Design Modifications



- Flapper panels in excluder tubes, lighting, weights, and other modifications have been tested on trawl nets in flume tanks to:
  - Determine success in allowing for escapement of non-target species
  - Prevent escapement of Pollock
  - Minimize modifications to gear based on the type of net or size of vessel

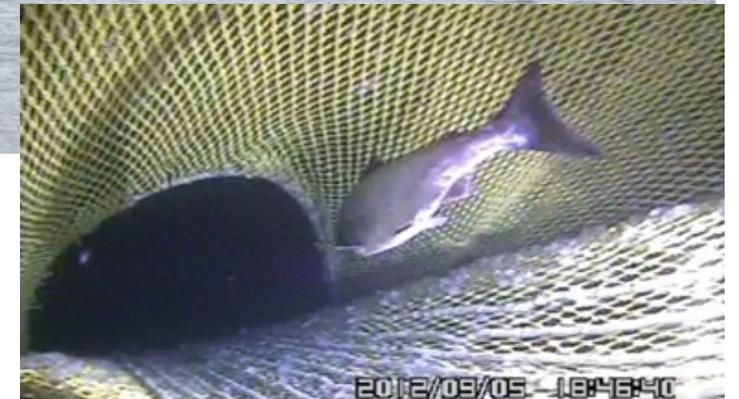
# Testing the Salmon Excluder

- Testing the excluder in a flume tank allows researchers to test design modifications to improve release of salmon
  - Using and adjusting weights
  - Adding flotation to portions of the escapement hole



# Taking the New Design to the Field

- Once designs are tested in the flume tank, the critical next step is taking it the Gulf of Alaska, where fishermen work with researchers to test the performance of the excluder in real-world fall and winter situations.



# Not all Pollock fisheries are the same

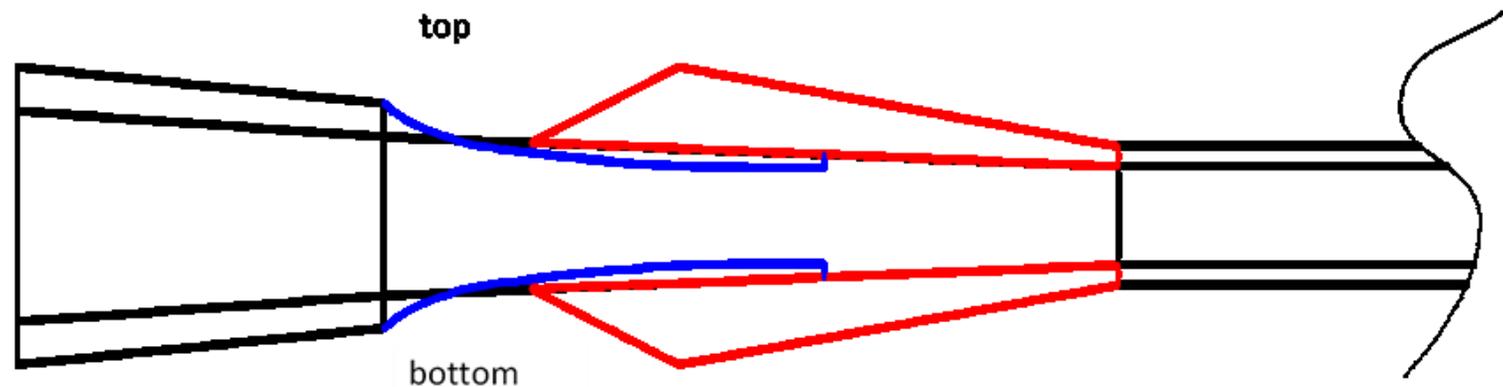
- The salmon excluder was originally designed for the Bering Sea Pollock fishery – vessels with more horsepower, which can tow fast and hard
- Gulf of Alaska trawlers have relatively low horsepower, tow at slower speeds and use smaller boats (less than 60 feet to 125 feet)
- The challenge - modify the excluder to:
  - Minimize bycatch.
  - Ensure Pollock remain in the net.
  - Retain the shape of the net to allow salmon to swim against the flow and escape.



*Spring-run Chinook salmon, photographed in Butte Creek, California, demonstrate their instinctive behavior to swim upstream against the water flow. Photo credit: Allen Harthorn, Friends of Butte Creek)*

# Excluder Test Results

- Latest “over and under” excluder design allows Chinook salmon to escape from both the top and bottom portion of the net:
  - Reduces Chinook bycatch by 40%
  - Reduces chum bycatch by 20%
  - Results in a loss of target Pollock of 1-3%



GOA = Gulf of Alaska  
BS = Bering Sea

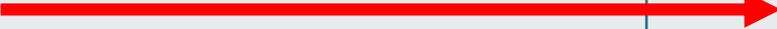
**Tunnel Era Excluder  
(2003-2004)**

**Flapper Excluder Version  
1 (2010-2011)**

**Flapper Excluder Version 2  
(2012)**

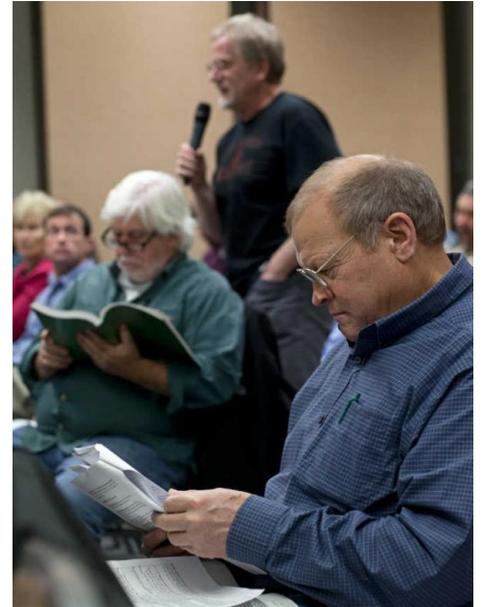
**Over and Under Design  
with Weights and Floats  
(2012-2013)**

<b>Design</b>	Square mesh creates tunnel shape	Panel drops down to allow escapement during slowdowns	Flapper panel weighted; floated hood allows escapement; panel pushes up for surge of Pollock through net	Allows salmon to escape from both the top and bottom of the net using weights and floats
<b>Challenges</b>	Nets may clog; square mesh caused rigidity; occasional damage to nets	Net spends more time in part of water column with higher salmon catch rates	Weights must be tuned; not effective for chum salmon bycatch reduction	Few – no signs of negative effects on nets; potentially easier to tune
<b>Chinook Escapement</b>	13%	12-20%	25-24%	40% GOA
<b>Chum Escapement</b>	-	-	minimal	20% BS
<b>Pollock Escapement</b>	Poor; Pollock pinned at excluder entrance	~1%	<1%	<0.1% BS ~3% GOA



# Next Steps

- Focus future efforts on refining the “over-under” excluder design
  - Install a recapture net on the bottom of the trawl net to identify salmon species.
  - Identify potential for this new design to be as effective for Chinook salmon exclusion while lessening customization for different nets and vessels.
- Spread the word - Voluntary use of salmon excluder devices by Pollock skippers is increasing. Increased use lessens bycatch to help ensure the long-term sustainability of the fishery as well as salmon stocks.



# Summary

- There are different types of excluders that release bycatch from targeted fisheries
- These excluders have evolved over time, from basic devices that sorted fish based on size, to sophisticated devices based on fish behavior
- The North Pacific Fisheries Research Foundation is productively and proactively participating in research to reduce bycatch
- Fishermen and their nonprofit industries are part of the solution – and part of their communities
  - Community Catch Program/SeaShare – The Generosity of the Seafood Industry Working with Food Banks
    - At Sea Processors Association provides more than 1 million seafood meals annually to local and national food banks.



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ANSWER TO HUNGER.

180 MILLION MEALS  
AND COUNTING.

# The Future

- Management of economical, cultural, societal, recreational, and commercial fisheries is and will become increasingly complex. Advances in technology will help address those complexities.
- Having a diversity of tools to manage fisheries will be important.
- The excluder design can potentially be used to reduce bycatch in other fisheries.
- The fishing industry, fishermen, nonprofit organizations, and others working collaboratively with researchers and scientists are reducing bycatch, ensuring healthy, productive sustainable fisheries well into the future, and preserving a way of life for existing and future generations.

