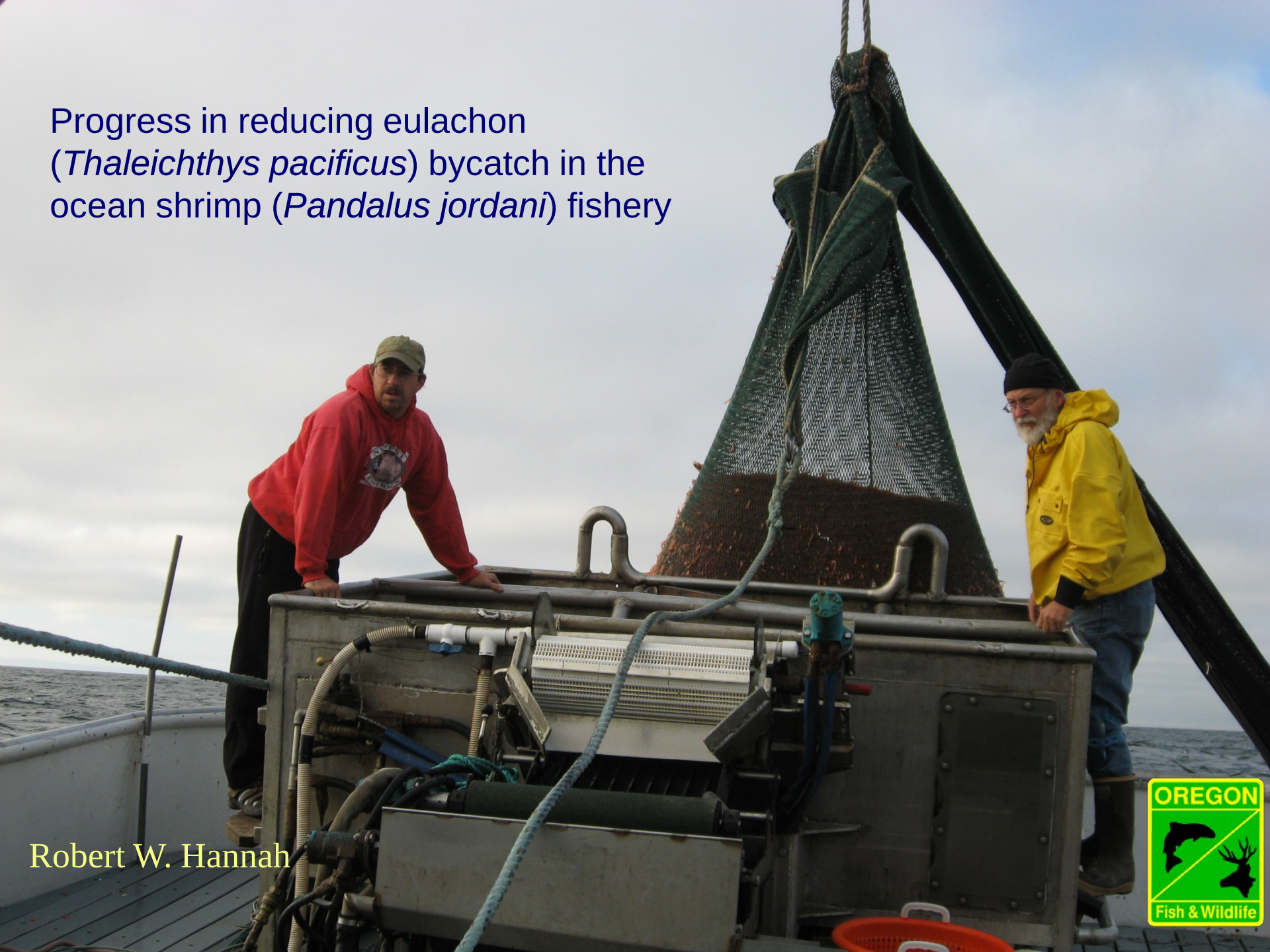

Progress in reducing eulachon (*Thaleichthys pacificus*) bycatch in the ocean shrimp (*Pandalus jordani*) fishery

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Fish & Wildlife

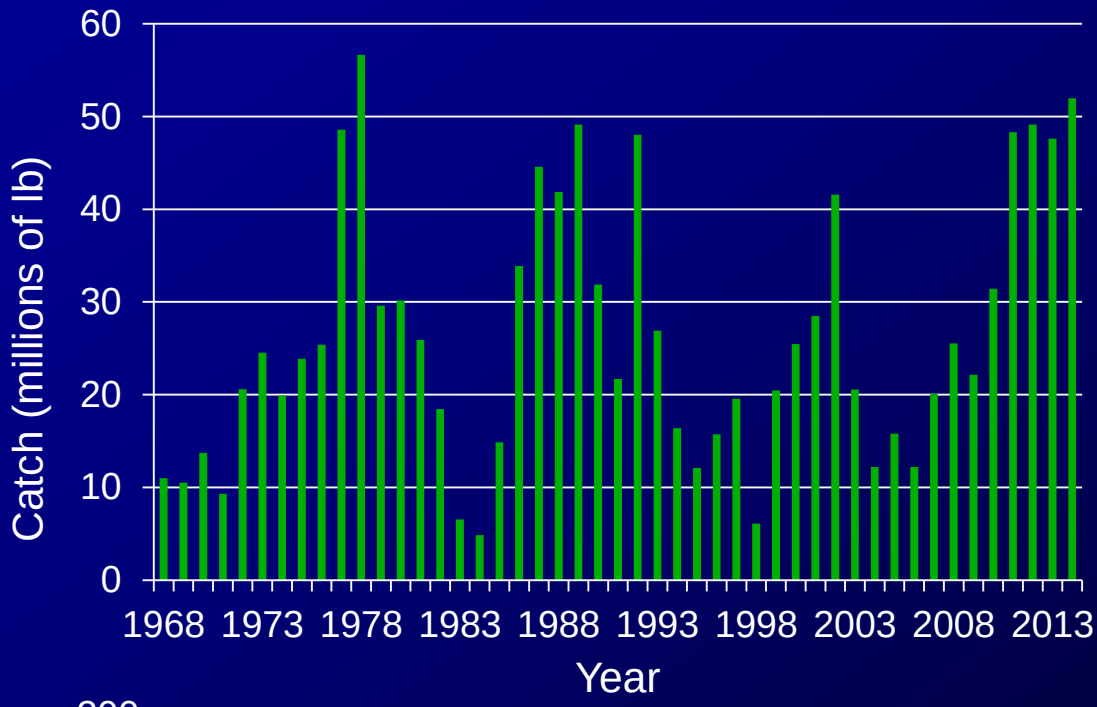
Topics

- The shrimp resource and fishery
- History of bycatch reduction technology

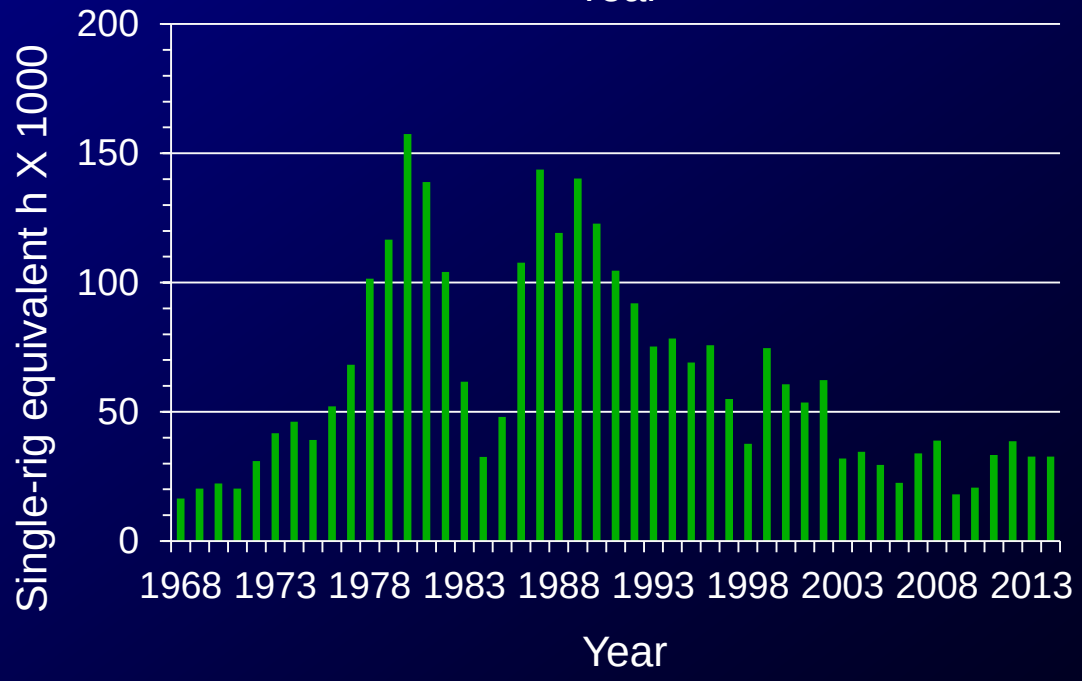
The resource and fishery

- Species *Pandalus jordani* – coldwater shrimp
- Small shrimp (80-170/lb) – low value ($0.70/lb at the dock)
- Machine cooked and peeled - Cocktail shrimp
- Caught at ages 1-3 (mostly 1-2)
- Highly variable annual recruitment
- Protandric hermaphrodites (male at age 1, then female)

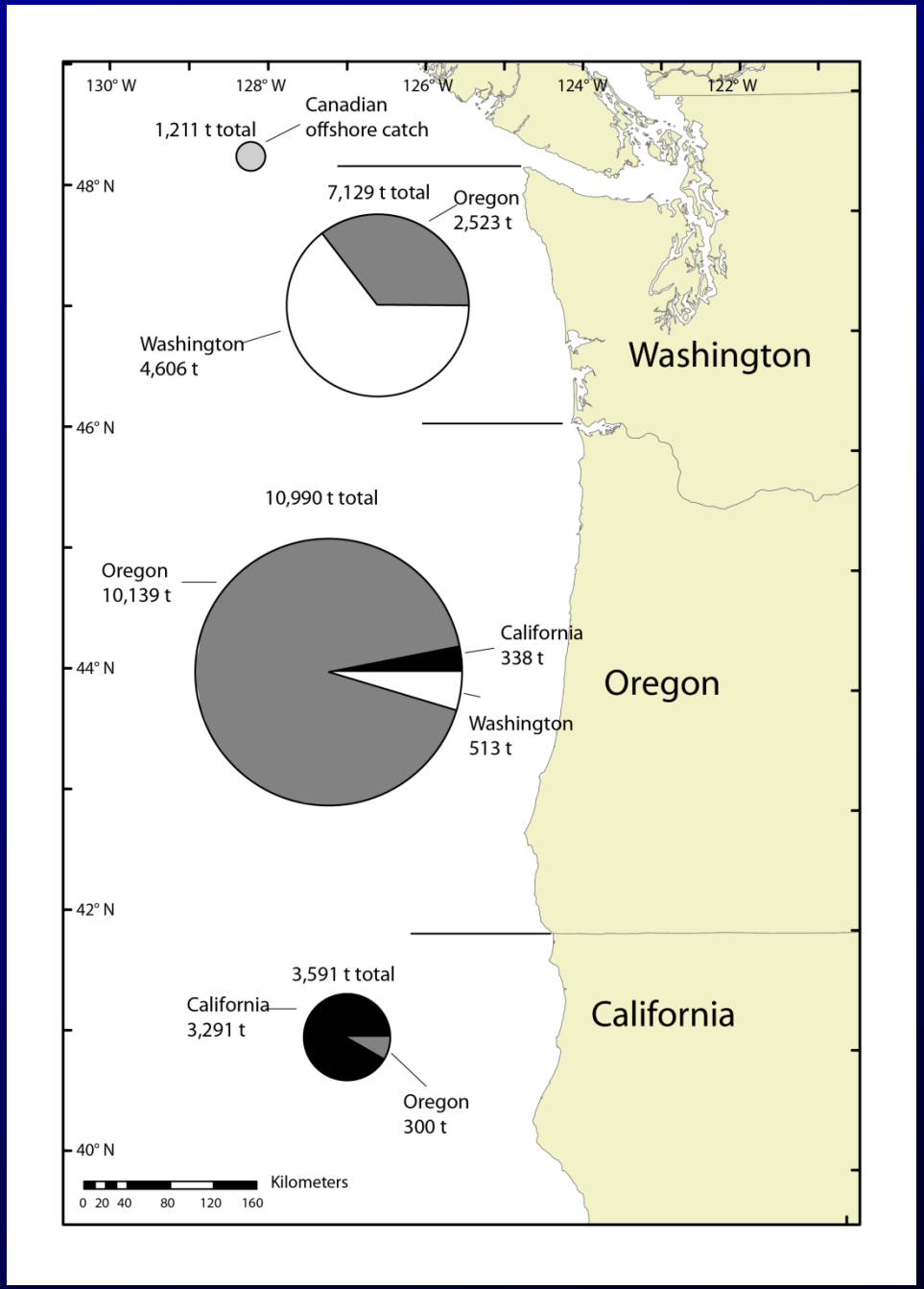
- Catch is highly variable
- Ex-vessel Value – $3-30 million (Oregon)



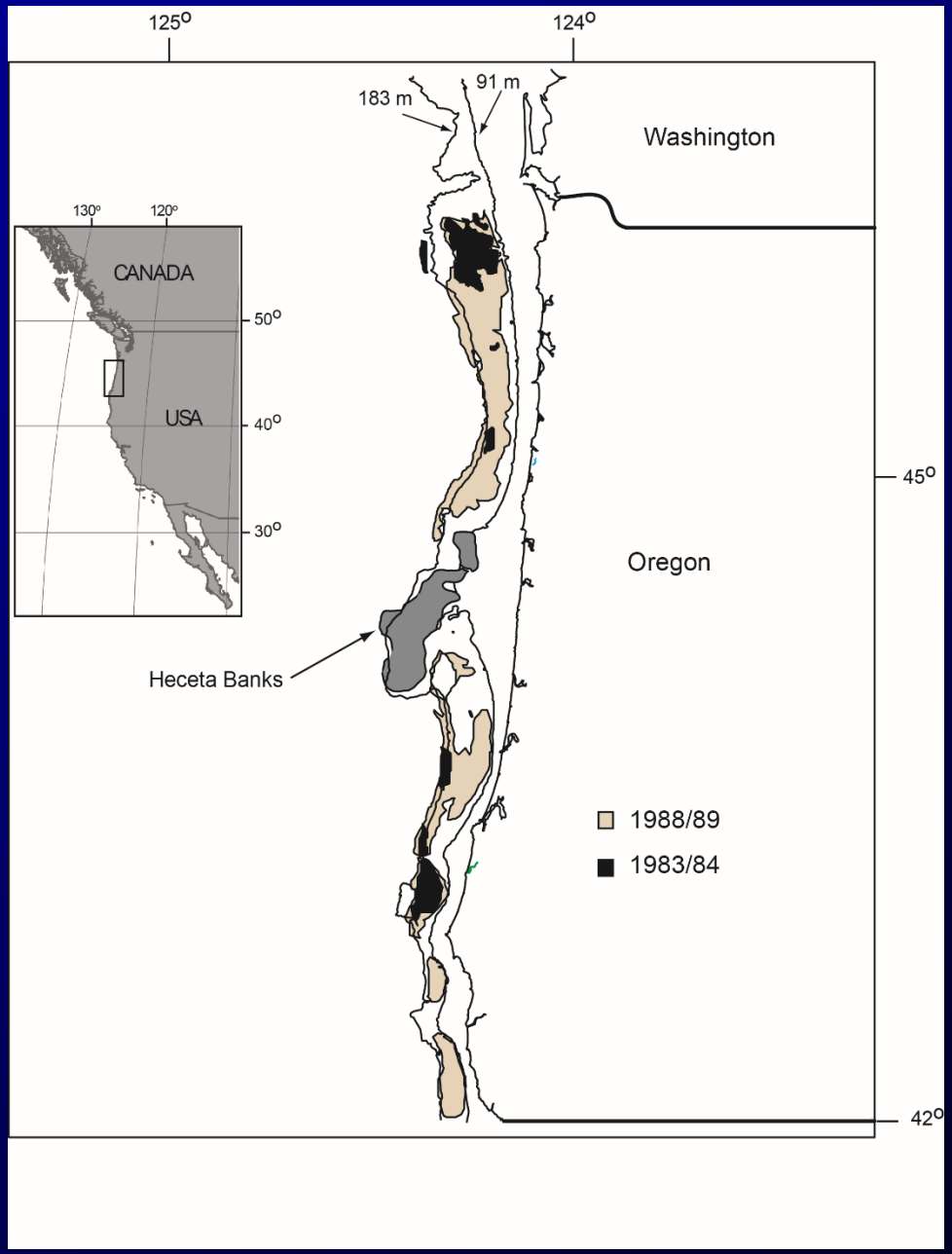
- Effort is down from historical levels
- State limited entry program and federal vessel buyback (2003)



- Oregon shrimp grounds and catches are the largest component of the fishery
- Based on 1980-92 logbook data
- Circles proportional to total average catch by area
- Shading shows state of landing

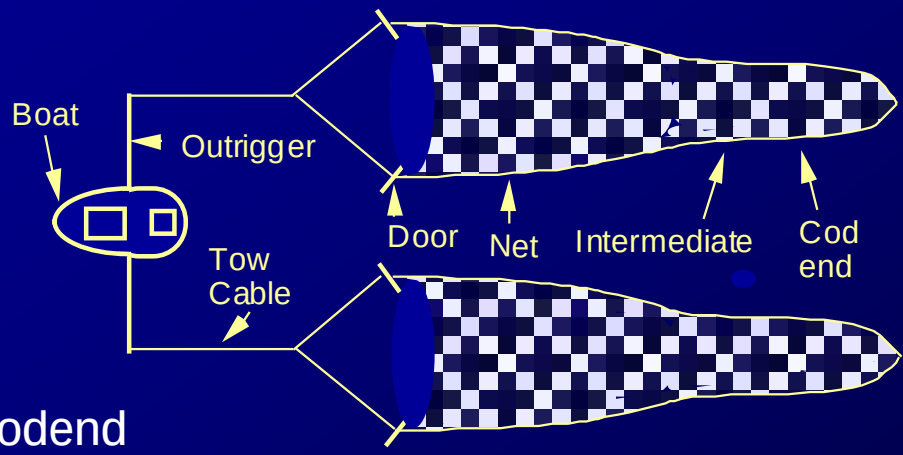


- The size and location of the shrimp “grounds” (geographic stock area) varies widely from year to year
- Recruitment can shift from statewide, to mostly north or mostly south each year
- Typically between 60 and 125 fathoms depth
- Green mud and muddy sand substrates

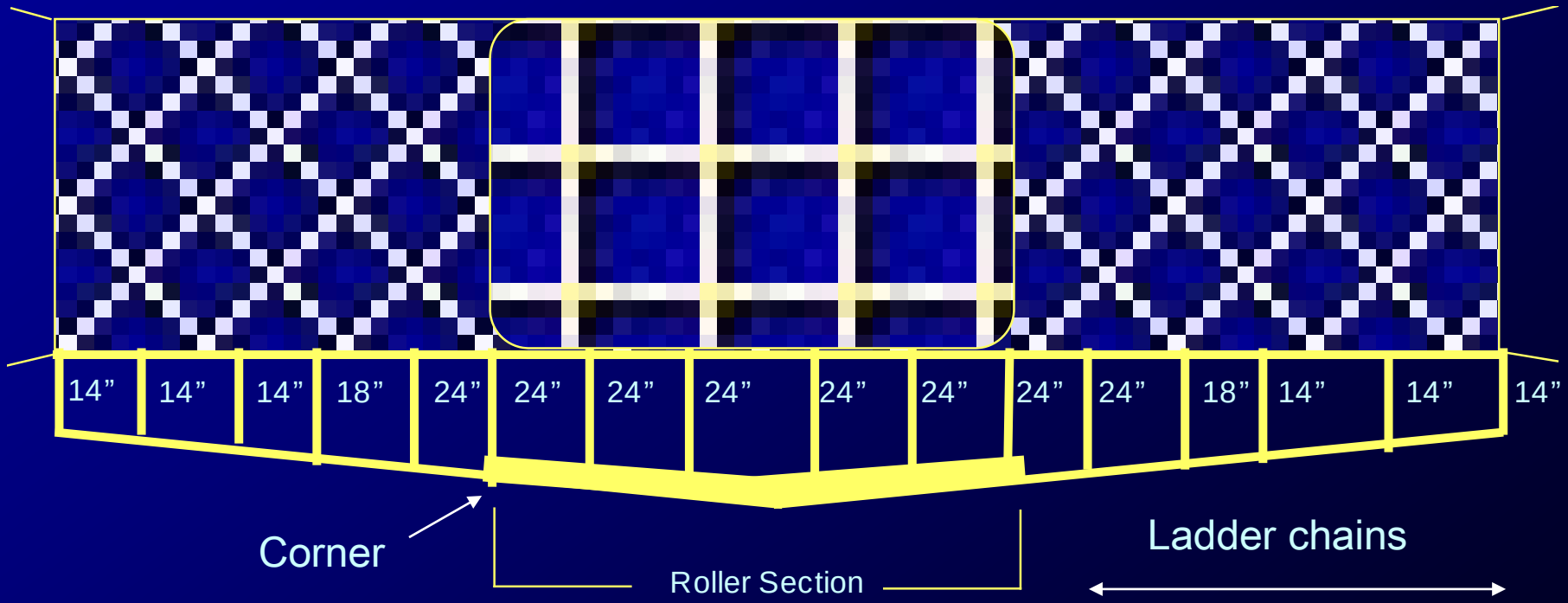


Pink shrimp trawl basics

Double-rigged (mostly)



- 90 ft. headrope/footrope – semi-pelagic
- 1.75 in. mesh in body – 1.25 in. mesh in codend



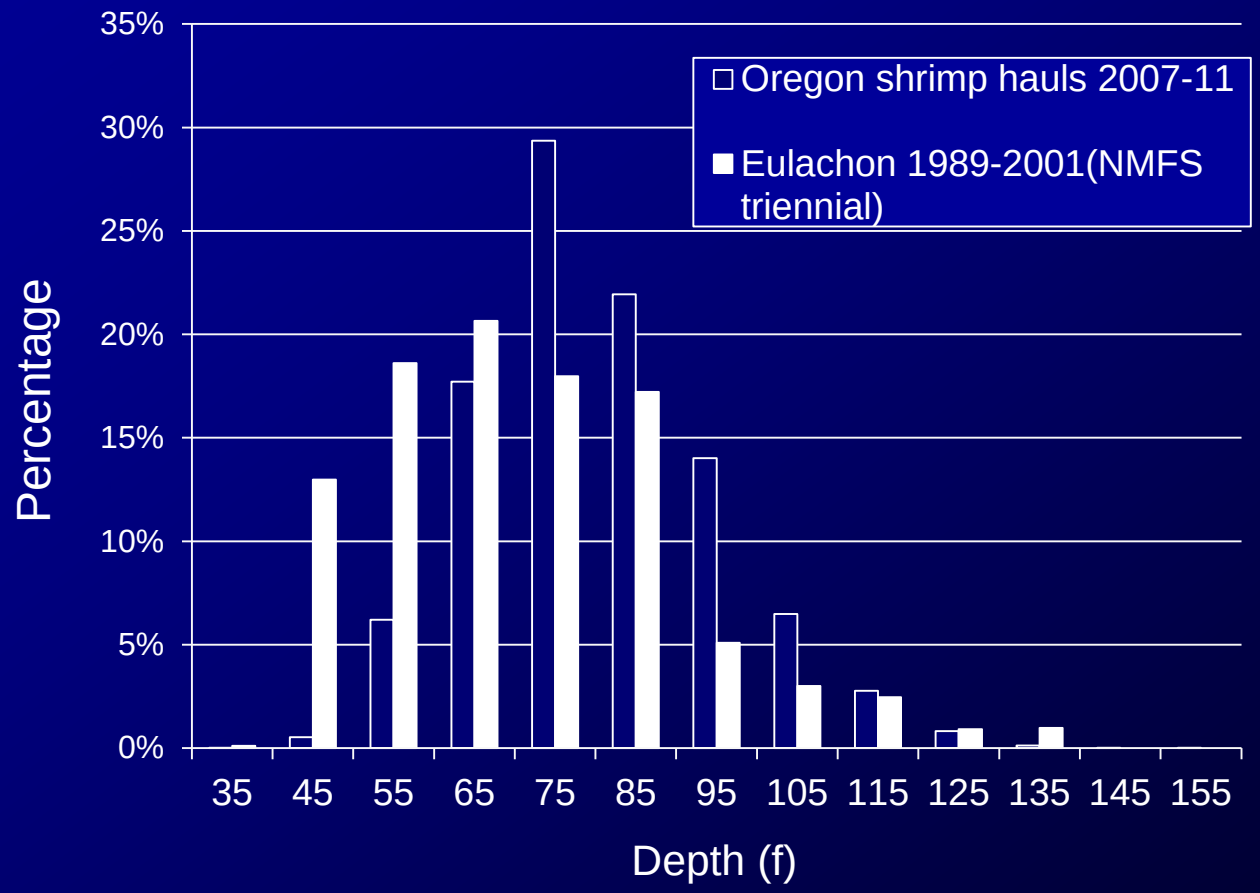
“Newport mud gear”


History of bycatch reduction

Eulachon (*Thalleichthys pacificus*) consistently part of the bycatch

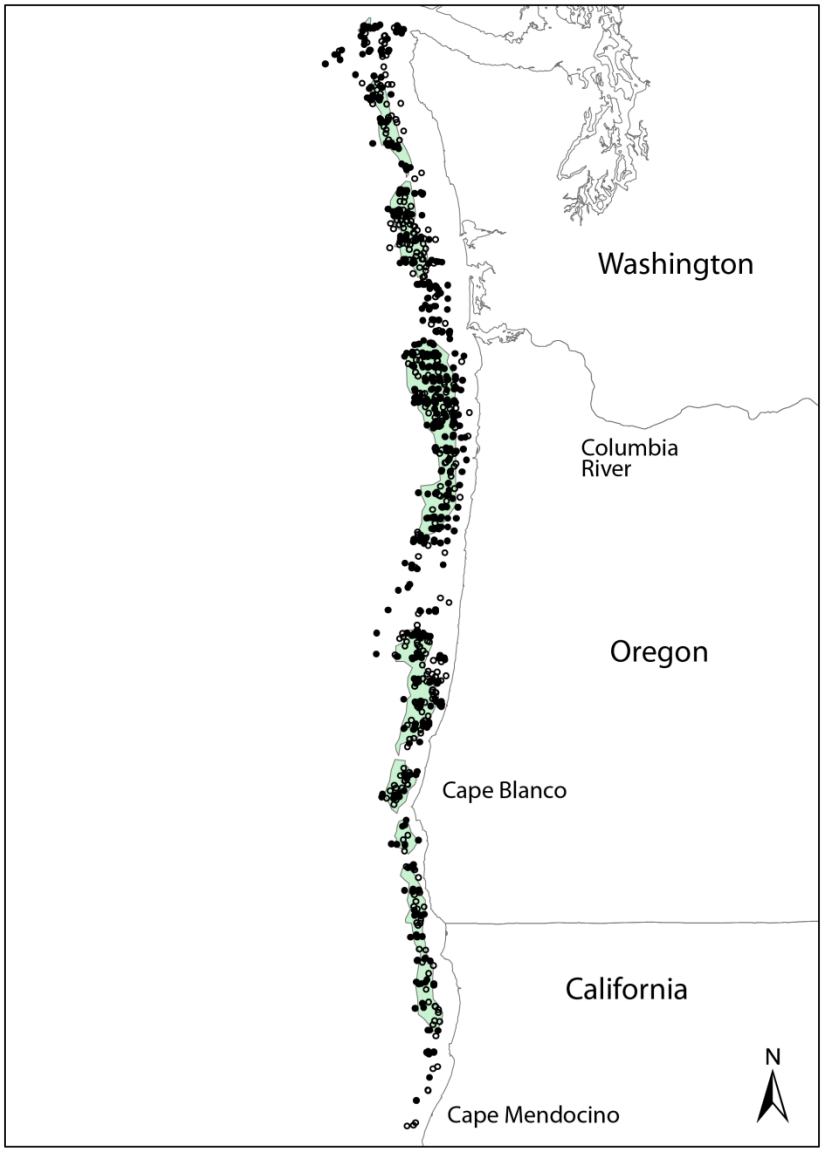
"Smelt belts" were developed early on to help sort out the eulachon

Depth distribution of shrimping and eulachon



Spatial overlap of shrimp trawling[1] and eulachon habitat[2] is substantial

Both distributions will be highly variable year to year

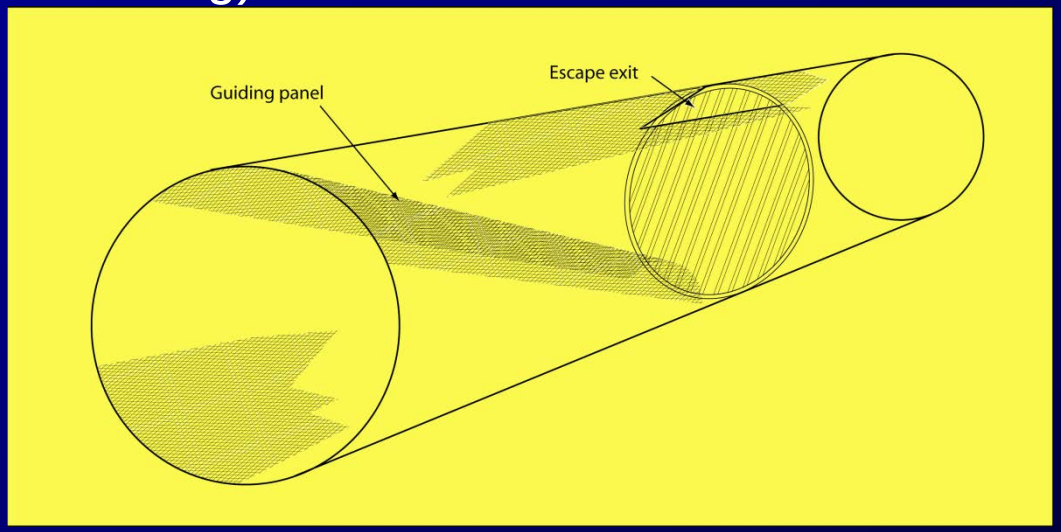


[1]shaded green, 2009-2014 Oregon logbooks

[2] circles, 1989-2001 triennial survey and 2003-2012 annual NWFSC survey positive eulachon hauls

Shrimp BRDs

- Modern development of BRDs began in 1994
- Originally mostly “soft-panel” BRDs
- BRDs made mandatory in 2003 (canary rf)
- Rigid-grates BRDs with 19.1 mm bar spacing made mandatory in 2012 (eulachon listing)



- As of 2005, bycatch reduction of 66-88% by weight had been achieved, leaving fish bycatch at 7.5% of total catch
- 2011 observer data showed fish bycatch just under 2% of total catch (NMFS/NWFSC)

Typical bycatch from a few years ago

- Some fish being “excluded”

Sometimes, especially recently, a shrimp haul can look like this, even with a high efficiency BRD

Occasionally, it can even look like this, even though studies showed that about 55-70% of the eulachon were being excluded by BRDs.

So, more bycatch reduction was needed:
in 2014 we decided to study the effect of artificial lights.

- Ambient seafloor light on the shrimp grounds is minimal
- Underwater video studies of eulachon behavior as they interacted with BRDs showed that eulachon were:
  - Actively swimming in front of the BRD
  - Avoiding contact with the BRD
  - Sometimes swimming back directly through the BRD

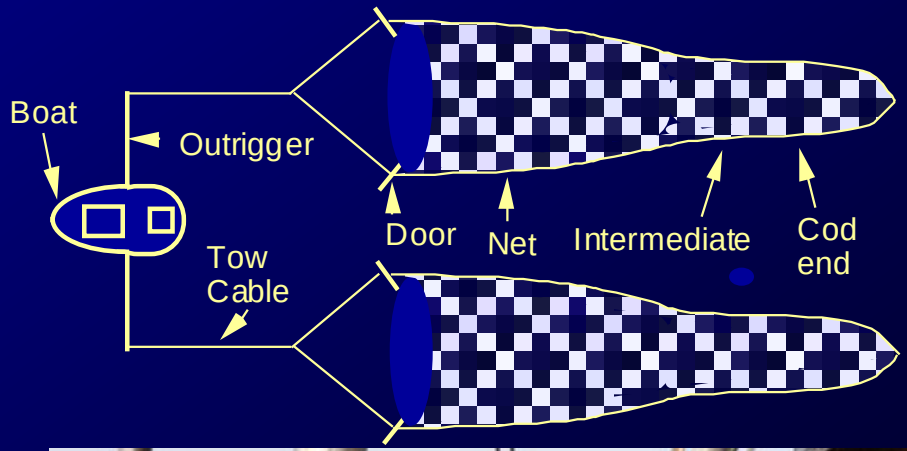
So, we hypothesized that:

1) Making the BRD more visible might improve exclusion efficiency

2) Making the fishing line more visible might increase escapement under the net

Our research question was:

Can artificial lights be used to increase escapement of eulachon in either of these two locations (by making the BRD or the fishing line more visible)?



We varied the effect of interest from side to side versus control (no lights), and using a divided hopper, weighed all catch, by species, from each net.

Rigid-grate 19mm BRDS in both nets

To generate artificial light we used green or blue Lindgren-Pitman lights (used for some types of longline fishing)

Experiment 1- We attached 1-4 green or blue Lindgren-Pitman lights to the BRD and in nearby locations

Result was the opposite of expectation (N=12) – eulachon bycatch doubled (data are catch in weight)

The presence of light anywhere near the BRD interfered with the behavioral escapement response of eulachon and small flatfish – they went right through the grate. We stopped testing this after 12 hauls.

Species or group	Percent change in catch weight with lights near BRD	P-value
Ocean shrimp	0.0%	ns
Eulachon	+104%	0.0005
Slender sole	+77%	0.0082
Other flatfish	+1.3%	ns
Darkblotched rockfish	-9.0%	ns
Other rockfish	-34.6%	ns

Experiment 2 - We attached 10 green Lindgren-Pitman lights to the central 1/3 of the fishing line (about 4 feet apart).

When the first tow was dumped, this is about what we saw when we looked in the hopper

This continued through 42 hauls

Lighted fishing line

In some cases this was all of the bycatch from an 80 foot net towed for an hour

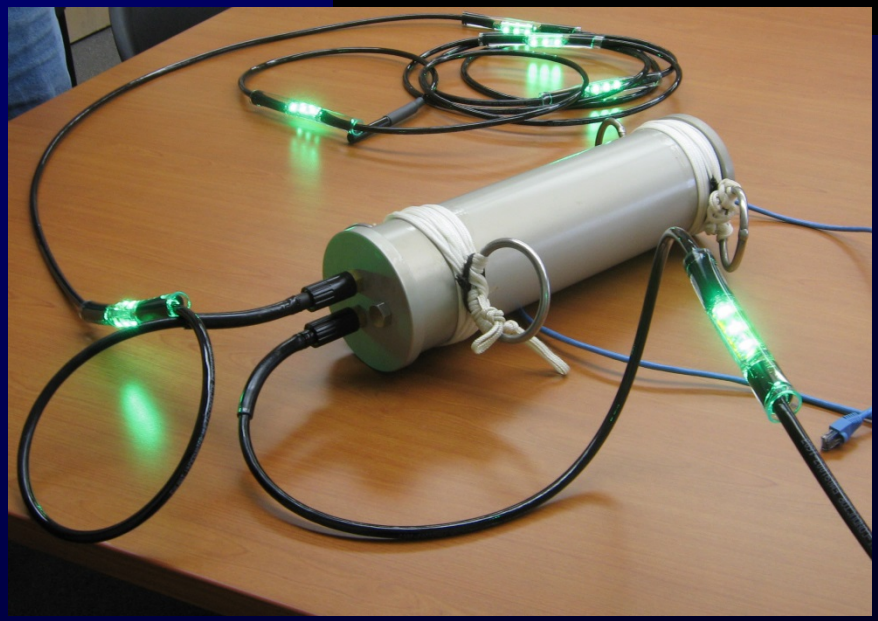
Result (N=42) – Bycatch of everything was greatly reduced and shrimp catch was not reduced.

Hypothesis - The presence of light facilitated escapement of fish under the fishing line.

Species or group	Percent change in catch weight with lights on the fishing line	P-value
Ocean shrimp	-0.7%	ns
Eulachon	-90.5%	0.0001
Slender sole	-68.6%	0.0001
Other flatfish	-69.4%	0.0001
Darkblotched rockfish	-82.2%	0.0001
Other rockfish	-56.3%	0.0004

Technology Transfer

- After 7 hauls, the skipper steamed in to cell phone range and ordered 50 green Lindgren-Pitman lights (about $2k)
- Outreach was provided to industry via a newsletter
- Fall 2014 fleet survey showed nearly complete adoption of this technology by vessels within just over 2 months
- Vessels are reporting excellent results; additional technology is being developed



Other thoughts:

- First successful application of artificial light for bycatch reduction?
- For some species, passing through a restricted space is modulated by light (some lab studies are consistent with this)
- Many fish may completely avoid trawl entrainment; less concern about post-exclusion survival
- May have applications in other trawl fisheries
- Lindgren-Pitman company is now receiving orders for these lights from many countries


The End – Questions?