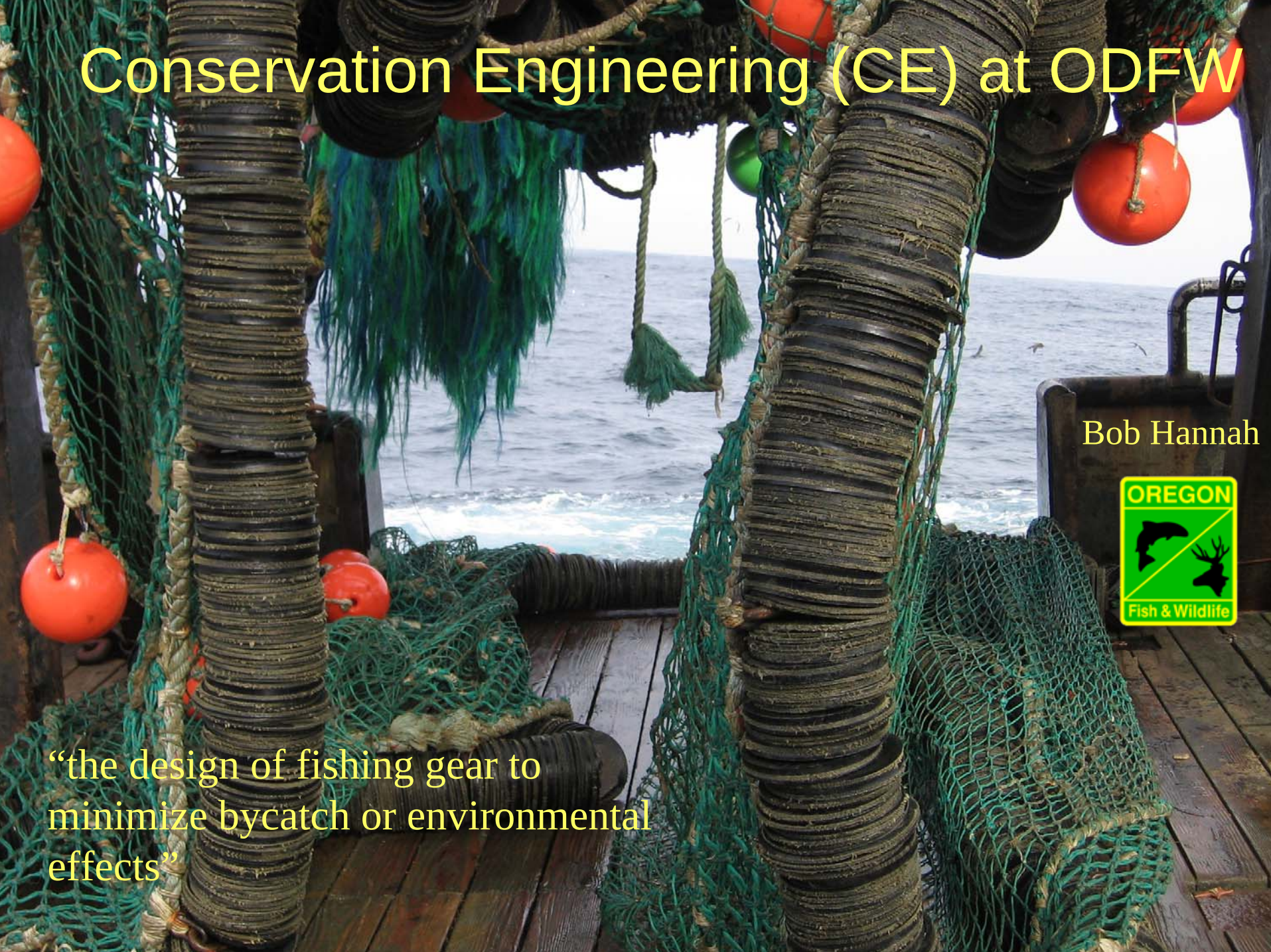
Conservation Engineering (CE) at ODFW

Bob Hannah



"the design of fishing gear to minimize bycatch or environmental effects"

Topics

- Some history of CE at ODFW
- Motivating resource concerns
- Pink shrimp trawl research
- Rockfish bycatch research
- Future directions

Research Program History

- No conservation engineers at ODFW
- Began with shrimp trawl BRD study (1994-95; SK-funded) and salmon “spreads” study
- Groundfish-related research expanded in 2000 – w/state legislative appropriation.
- Lot’s of assistance from NMFS conservation engineers (C. Rose, S. McEntire, W. Wakefield. M. Lomeli) and ODFW colleagues (Steve Jones, Polly Rankin, Matt Blume, Keith Matteson, Troy Buell)

Oregon bycatch issues and gear-based research

Time period	Bycatch concern	ODFW CE research
1990's	P. Halibut trawl discard mortality	Bycatch reduction devices (BRDs) in pink shrimp trawl fishery
2000's	Bycatch of overfished rockfish (canary, yelloweye, darkblotched, etc)	Selective flatfish trawl studies Long-leader rec. gear RF barotrauma and discard behavior/mortality Shrimp trawl footrope research to reduce juv. rf
Lately	Eulachon smelt bycatch in shrimp trawls (threatened under ESA)	More shrimp trawl BRD and footrope work Behavior/survival studies?

The culprits

Canary rockfish
(*Sebastes pinniger*)

Eulachon smelt (*Thalleichthys pacificus*)

Yelloweye rockfish
(*Sebastes ruberrimus*)

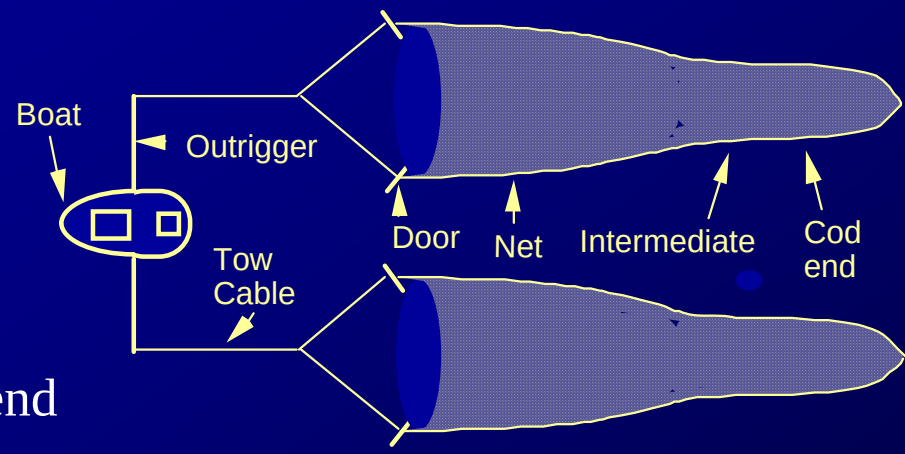
Other non-bycatch concerns

- Ecosystem effects of trawls (long term)
- Lack of stock assessments/survey tools for some rocky reef species

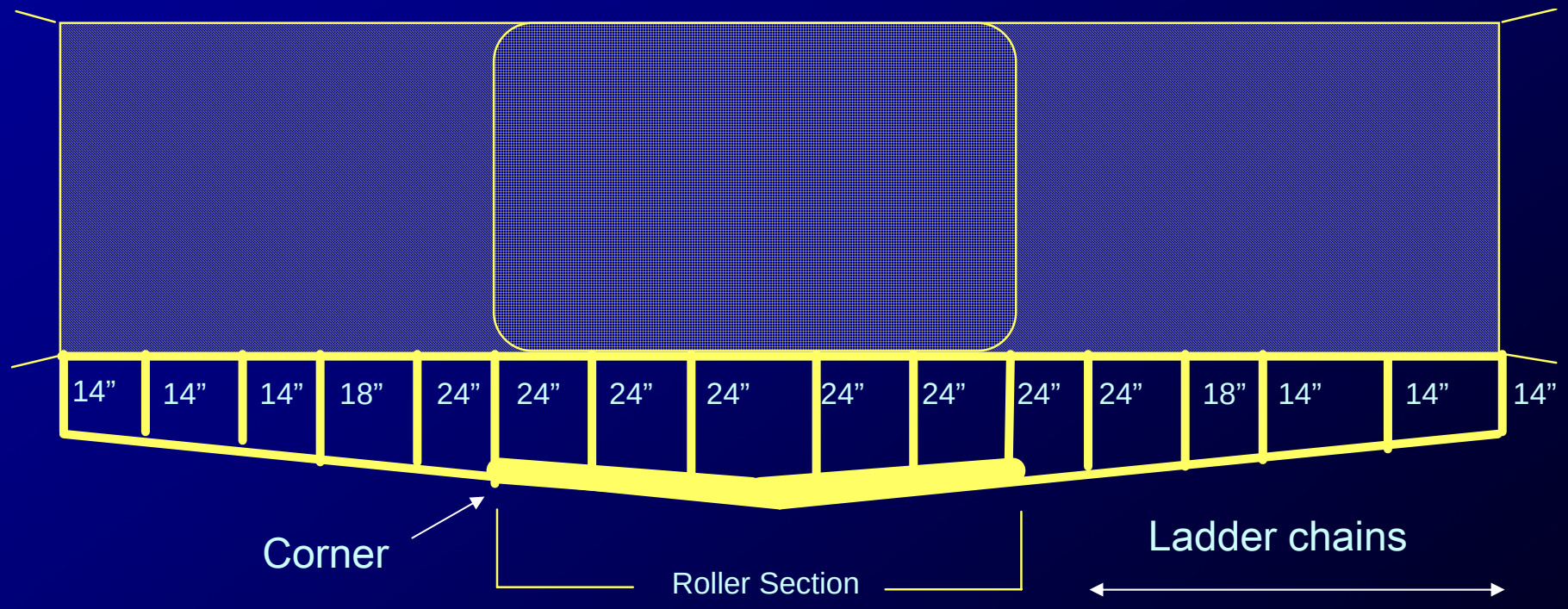
Pink shrimp trawls

Pink shrimp trawl basics

Double-rigged (mostly)



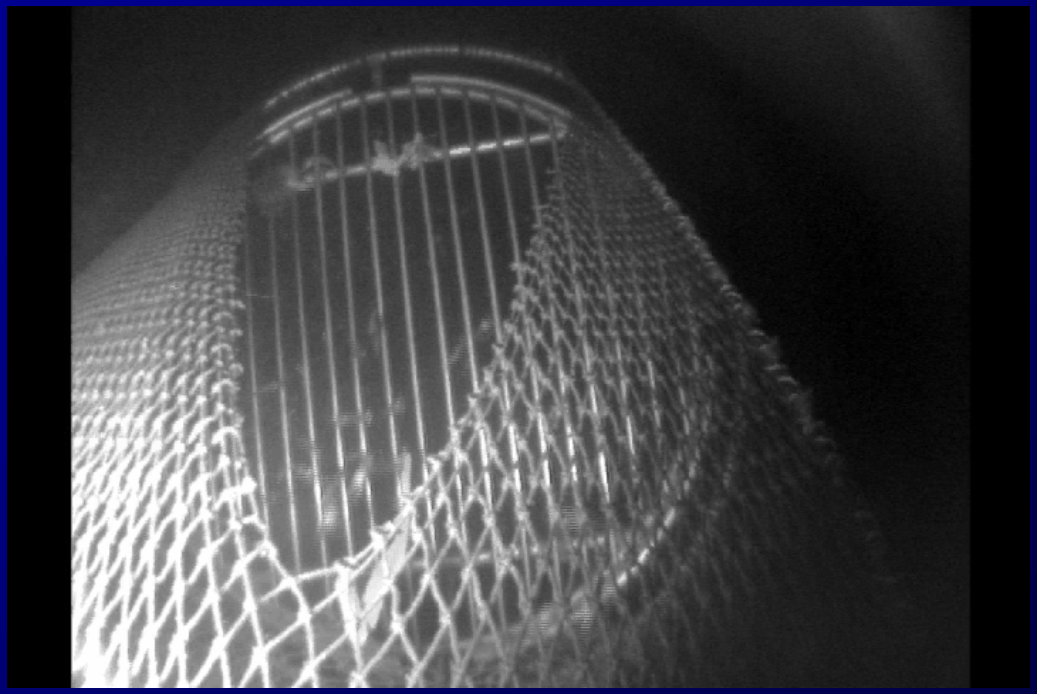
90 ft. headrope/footrope – semi-pelagic
1.75 in. mesh in body – 1.25 in. mesh in codend

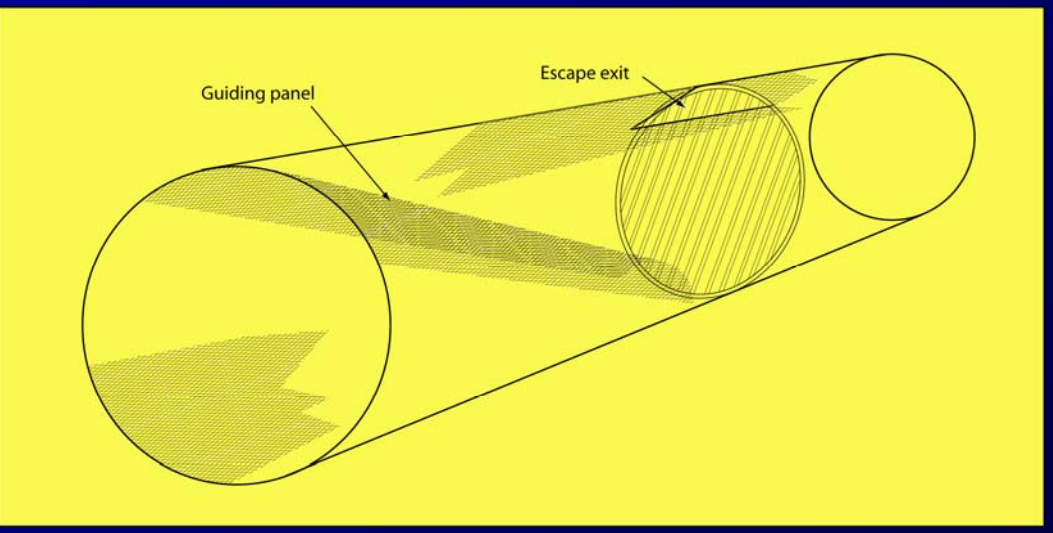


“Newport mud gear”

Shrimp BRDs

- Testing of Bycatch Reduction Devices (BRDs) for the pink shrimp trawl fishery (1994-present)
- Rigid-grate, soft-panel and Fisheye BRDs
- Early studies did not break out smelt to species
- Strong industry support



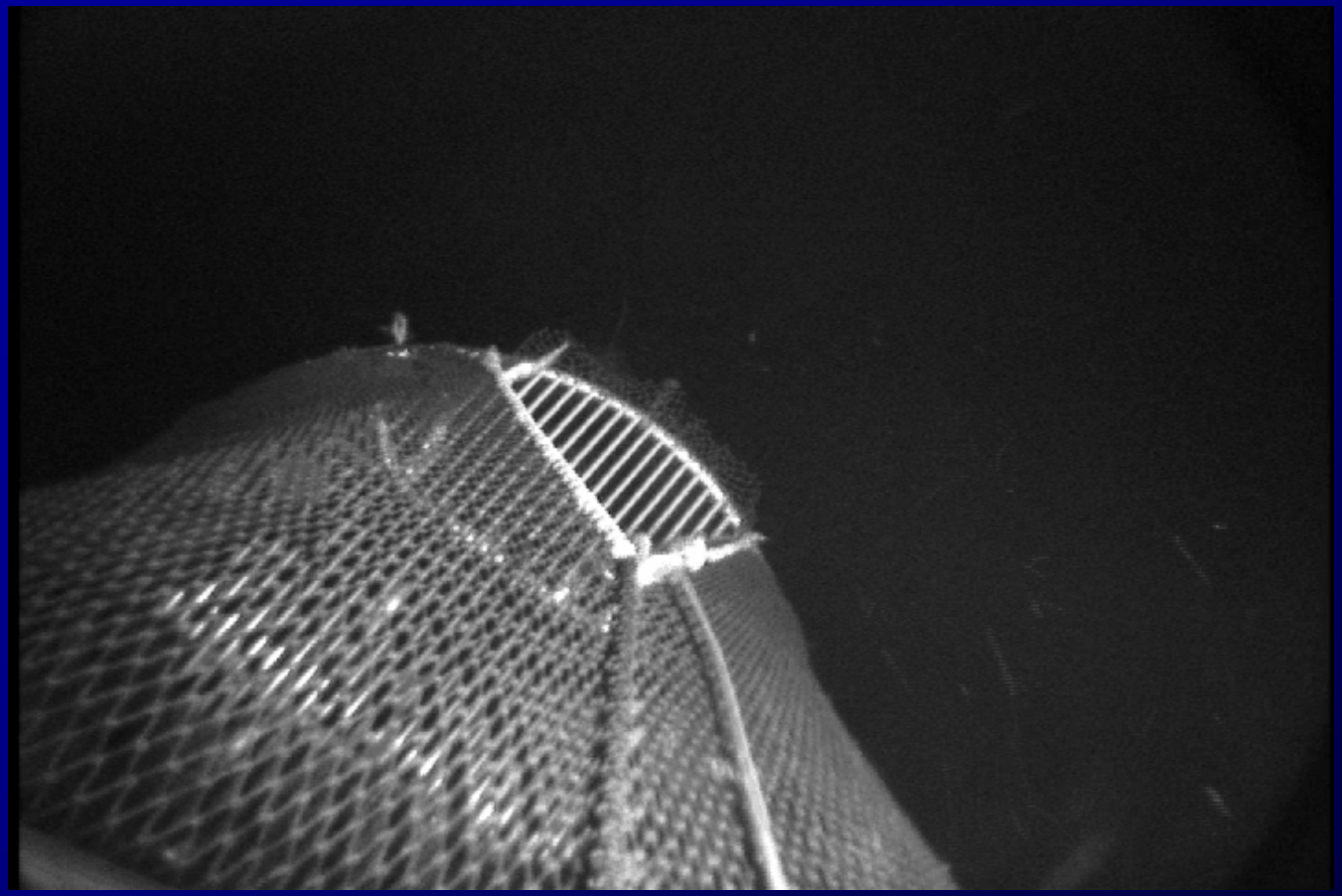


•As of 2005, bycatch reduction of 66-88% by weight had been achieved

•Even better now due to fishers responding to YOY P. hake

• Fishery is MSC certified

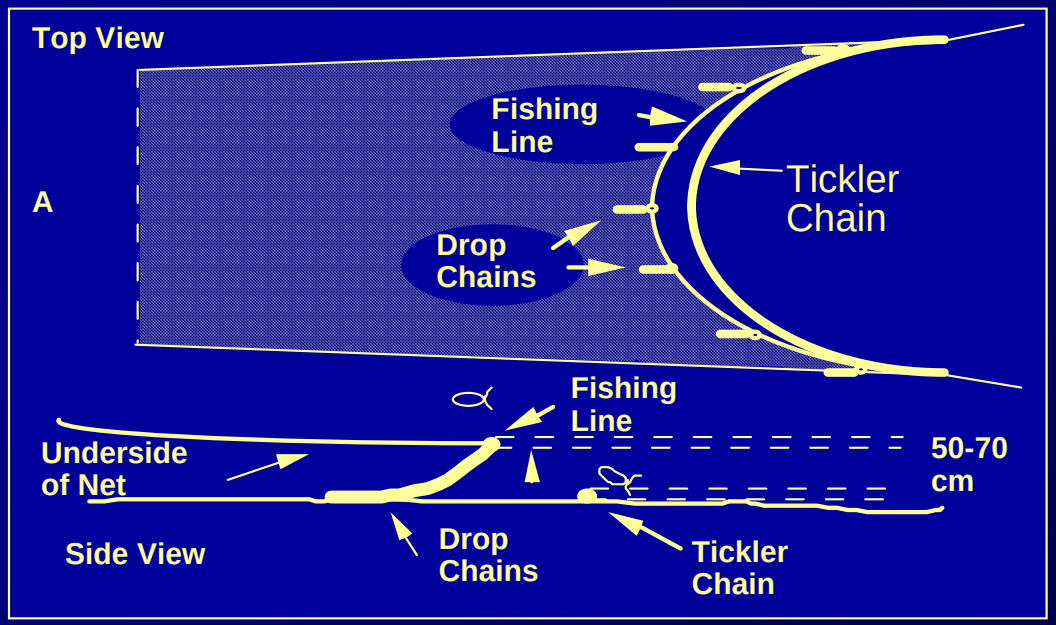
•Typical BRD in 2010 is rigid-grate BRD w/vert bar spacing of 1-1.25 inches

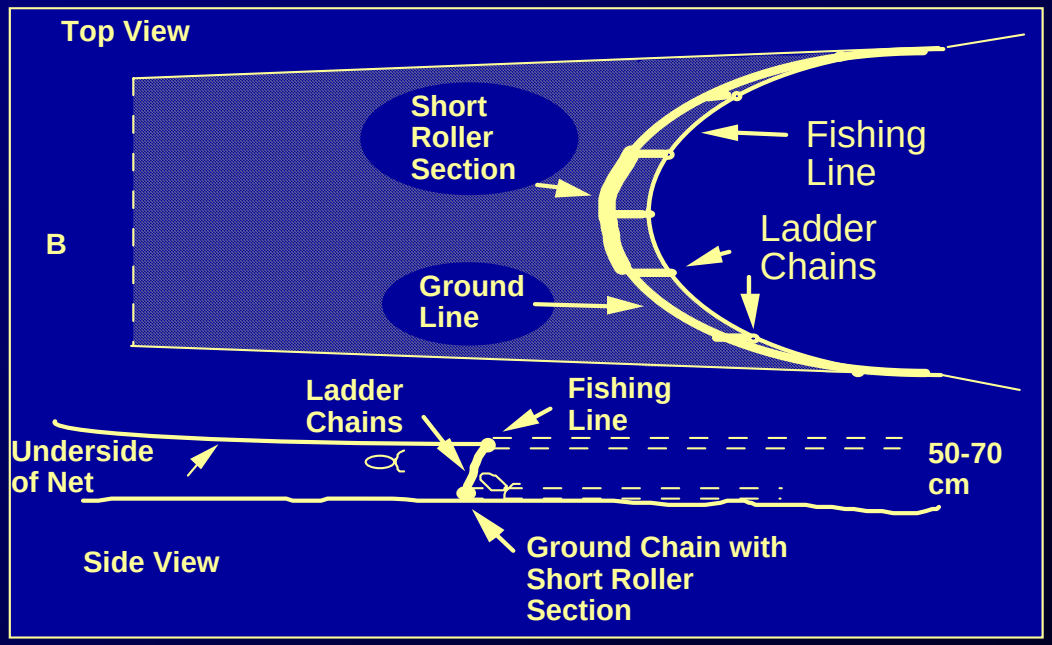


- In December 2010 the OFWC will be considering rule changes to allow only rigid-grate BRDs with 0.75 inch bar spacing to reduce bycatch of eulachon smelt
- 10% of fleet already fishing 0.75 inch BRDs
- Studies are in progress to measure additional reduction in bycatch of eulachon

Shrimp trawl footropes

- Reducing shrimp trawl bycatch through footrope modifications
- Large effect on juv. rf, small flatfish – maybe eulachon?



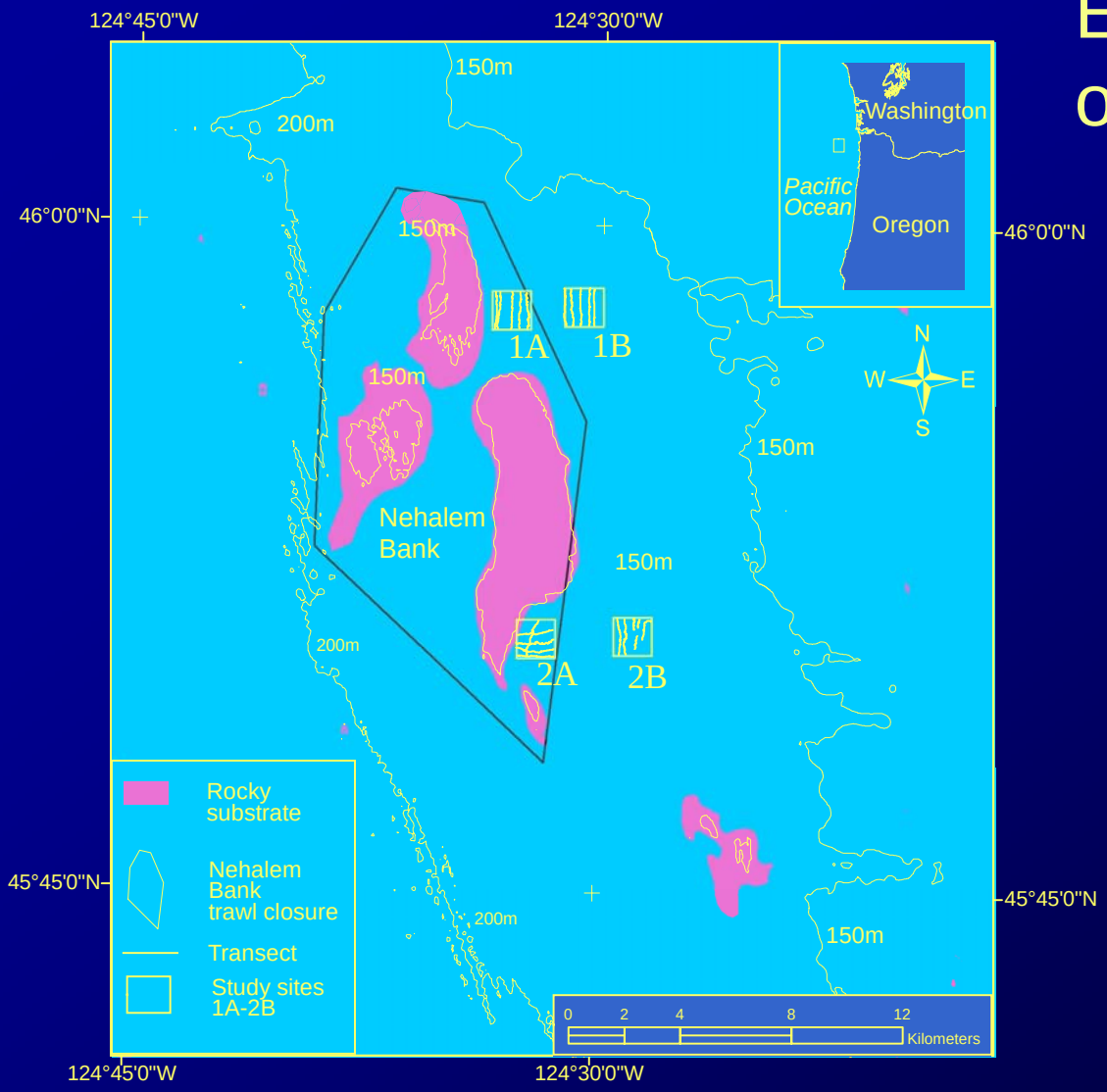


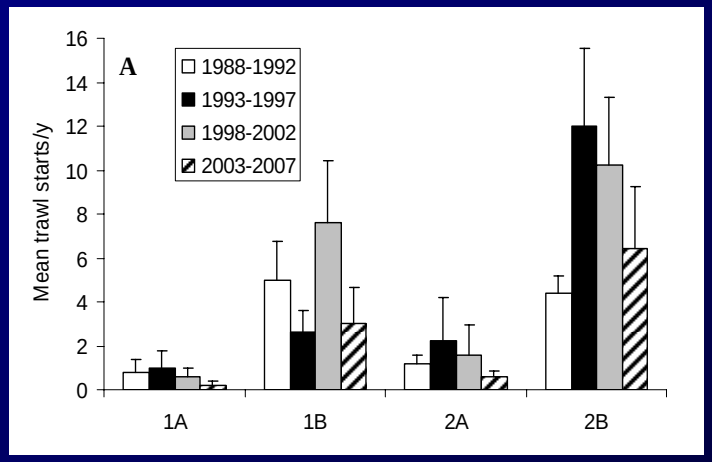
Configuration and FLH both important

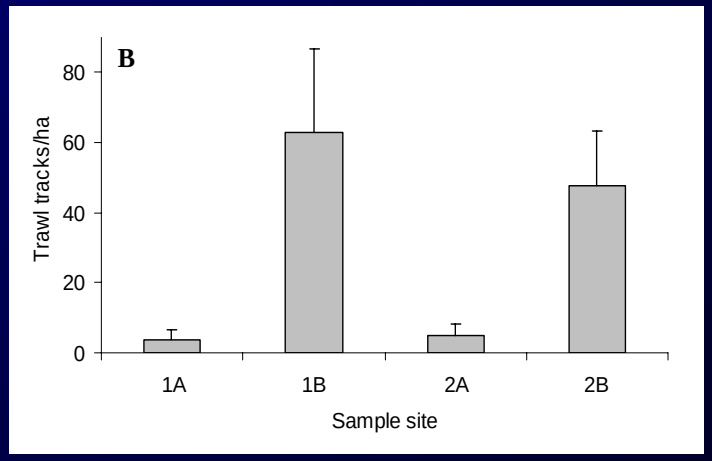
June 2010 results with eulachon

- Removed center section of groundline – compared "Newport mud gear" with "absence of groundline"
- Good abundance of eulachon in 2010
- Equalized height of the fishing line (FLH)
- Rigid-grate BRDs with 0.75 inch vertical bar spacing on both nets
- 25% reduction in resid. eulachon catch by weight
- 17% reduction in shrimp catch
- Next step is to reduce FLH with absent groundline to increase shrimp catch
- Will also remove BRDs to measure true effect on trawl entrainment

Effects of shrimp trawls on macroinvertebrates







Results

- Dominant structural feature in this soft mud habitat was hagfish burrows – more in HT areas
- Reduced diversity of macroinverts in HT areas
- Reductions in sea whips, orange sea pens, sea stars, squat lobsters, sea cucumbers in HT areas
- Heterogeneity between northern and southern sites – unclear what majority of shrimp grounds are like

2010 study of benthic effects of groundlines (BREP funded, Waldo W. and Mark L.)

Evaluate physical effects of shrimp groundlines on sessile invertebrates (sea whips)

Develop “kinder-gentler” groundline designs

Typical “Newport” shrimp groundline

Elevated/PVC groundline

Next questions

- Can we just do away with most of the groundline?
- Do kinder-gentler groundlines catch enough shrimp?
- How do materials change with use?
- Are they durable enough?
- Work has just begun - eulachon smelt will dominate our research near-term.

Rockfish bycatch

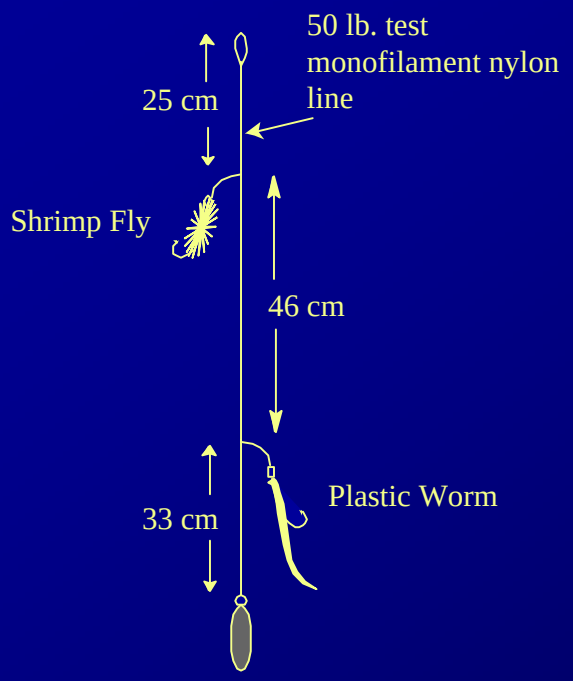
Selective flatfish trawl (2000-2003, collaboration with NMFS-NWFSC, OSU)

Since 2005 - required gear for nearshore (inside 50-100 f) trawling on U.S west coast (north of 40° 10’ N. Lat.)

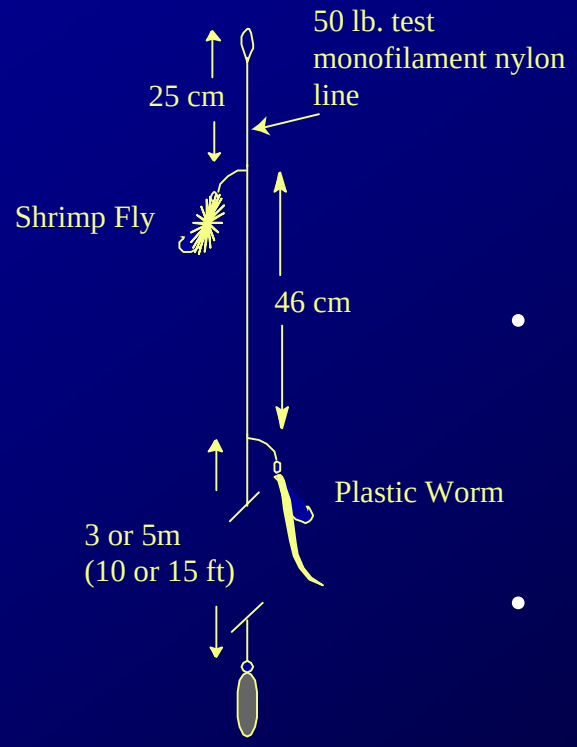
Canary RF -76%
Flatfish - increase

Recreational “long-leader” gear (2006-2008)

Elevate H&L baits 15 ft. above bottom



Control Configuration

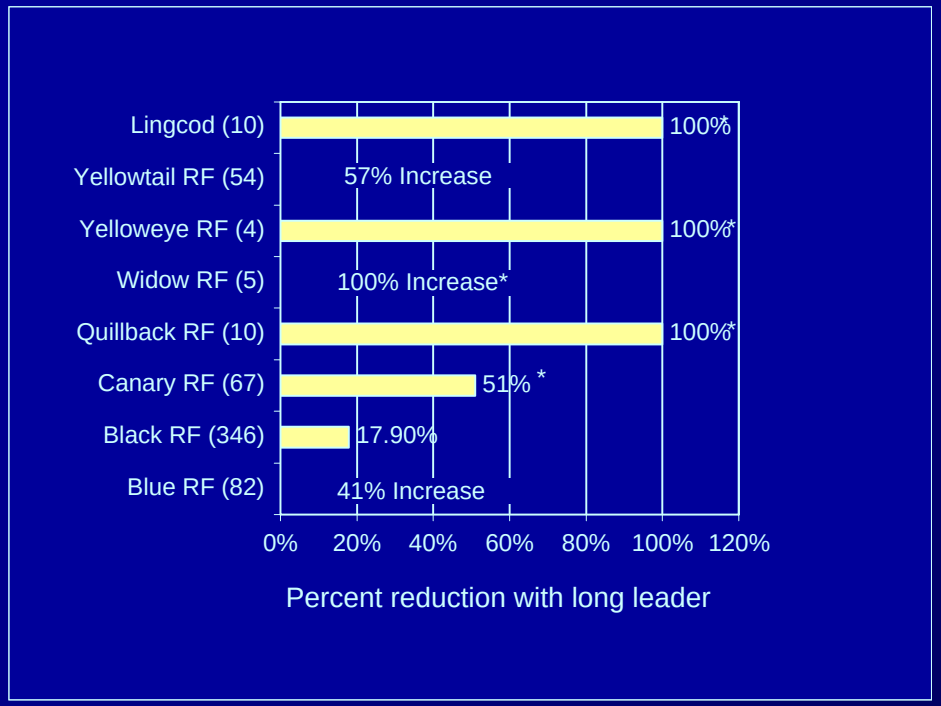


Long Leader Configuration

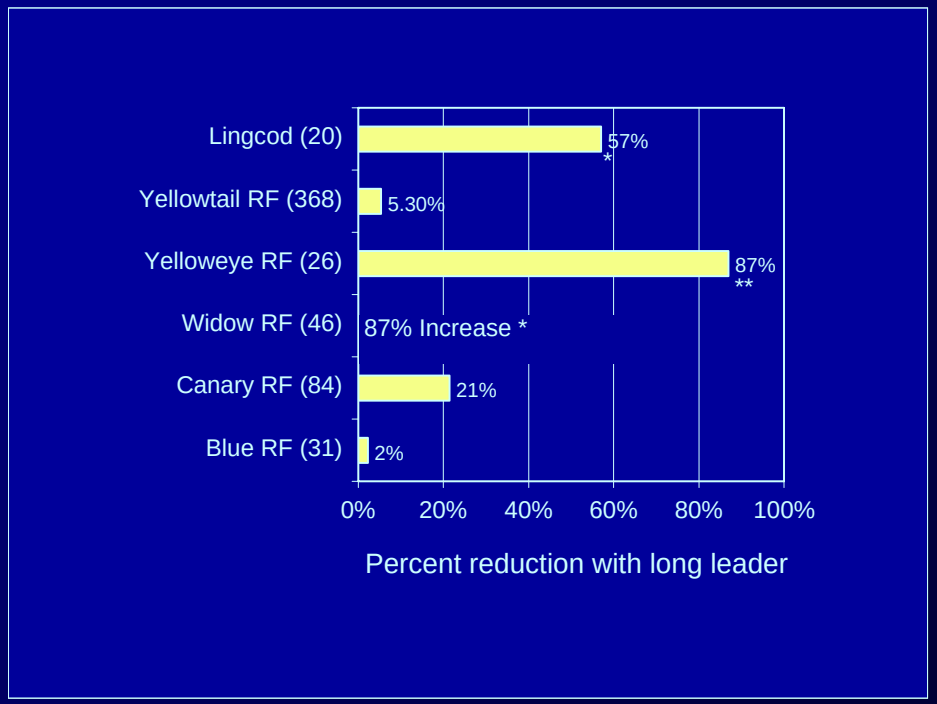
- Concept – avoid catching demersal RF (canary, yelloweye) while catching semi-pelagic species (black, blue, yellowtail, widow)
- Many demersal species very long-lived (150 y), late-maturing, some overfished
- Fished these gears side-by-side and alternately

Results

Nearshore



Offshore



Long-leader gear is currently being used in an EFP fishery targeting yellowtail RF in offshore waters

Rockfish discard mortality in hook and line fisheries

- Discard mandated by PFMC for yelloweye, canary RF – targeting concerns
- Physoclists - barotrauma raises questions about survival
- Studies –
  - Submergence success of released fish
  - Behavior of fish released at depth
  - Internal injuries from barotrauma in relation to external signs
  - Survival of released (recompressed) fish
  - Effect of venting

Submergence success

1) Released RF into a floating, bottomless pen
2) Timed how long it took them to submerge (5 minute maximum)
3) 10 rockfish species (429 fish)
4) Modeled submergence success vs. depth using logistic regression

Most fish submerged quickly, but we found big differences related to depth and species – in turn related to retention of swimbladder gas (anatomy)

Results – submergence success vs. injuries and anatomy

Tend to retain gas – poor submergence success, success drops off with depth, more severe internal injuries

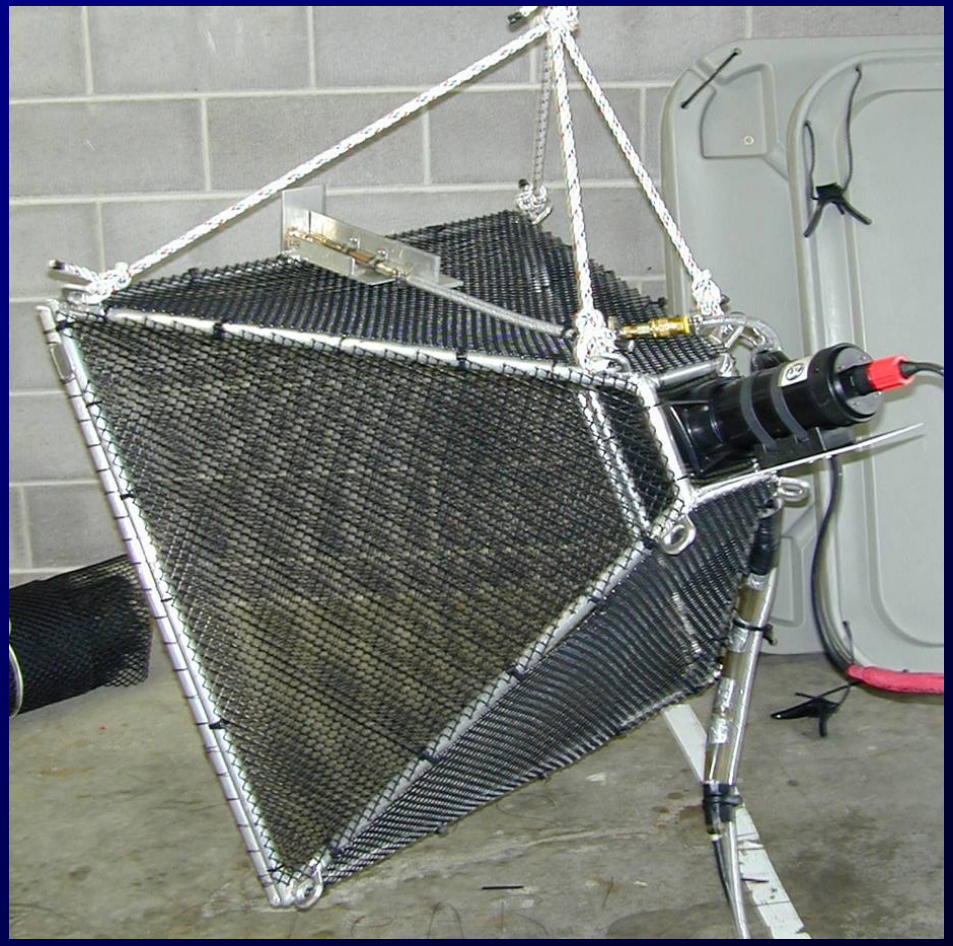
Yelloweye RF

Tend to lose gas during ascent through tears in post-cleithral membrane – good submergence success, less depth effect, less internal damage

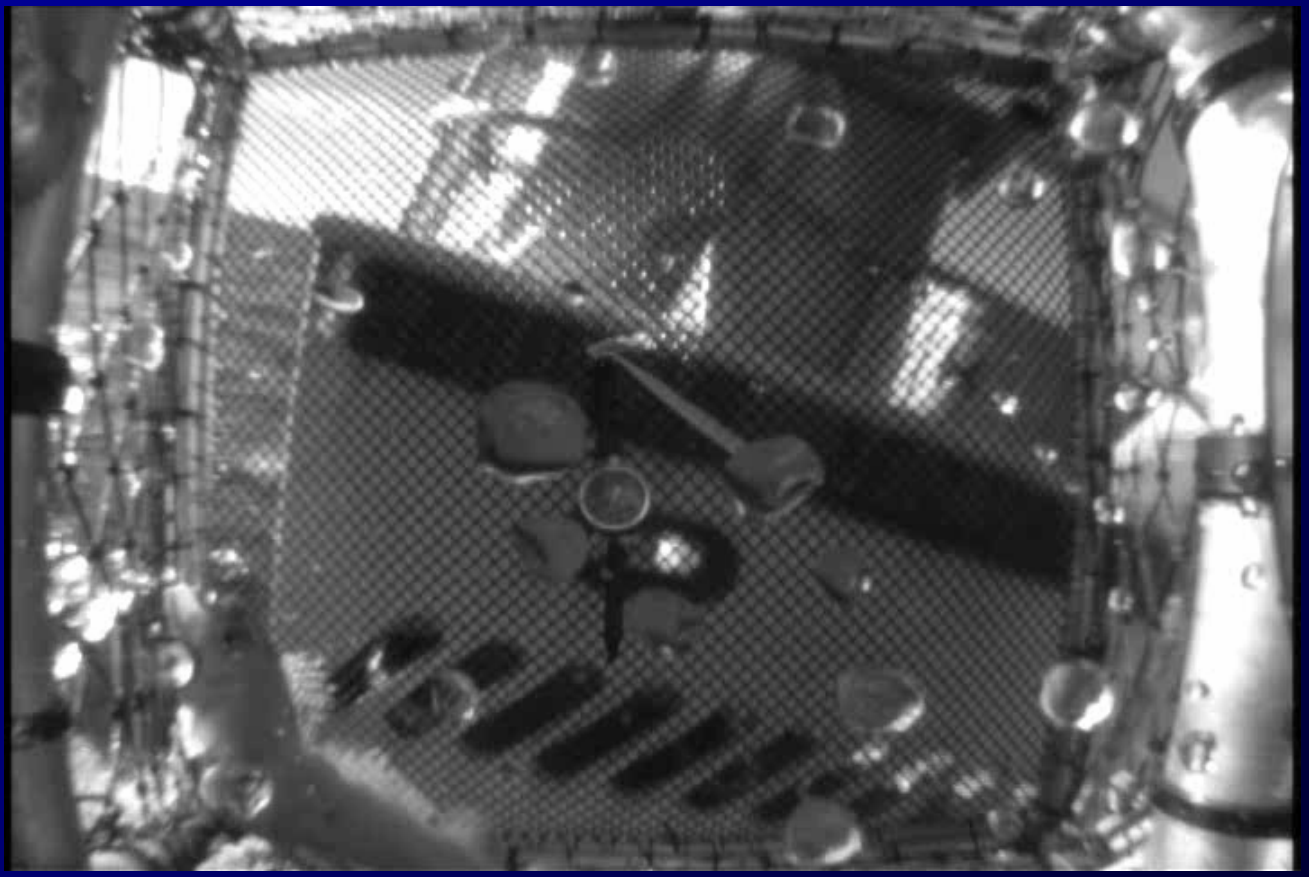
Quillback RF

Release behavior

- Ambient light video
- Observe in real-time at the surface
- Remote release
- Recompress in the field to 50 m quickly
- Captured 9 rockfish species across a wide depth range (hook and line) and examined their behavior upon release at depth.

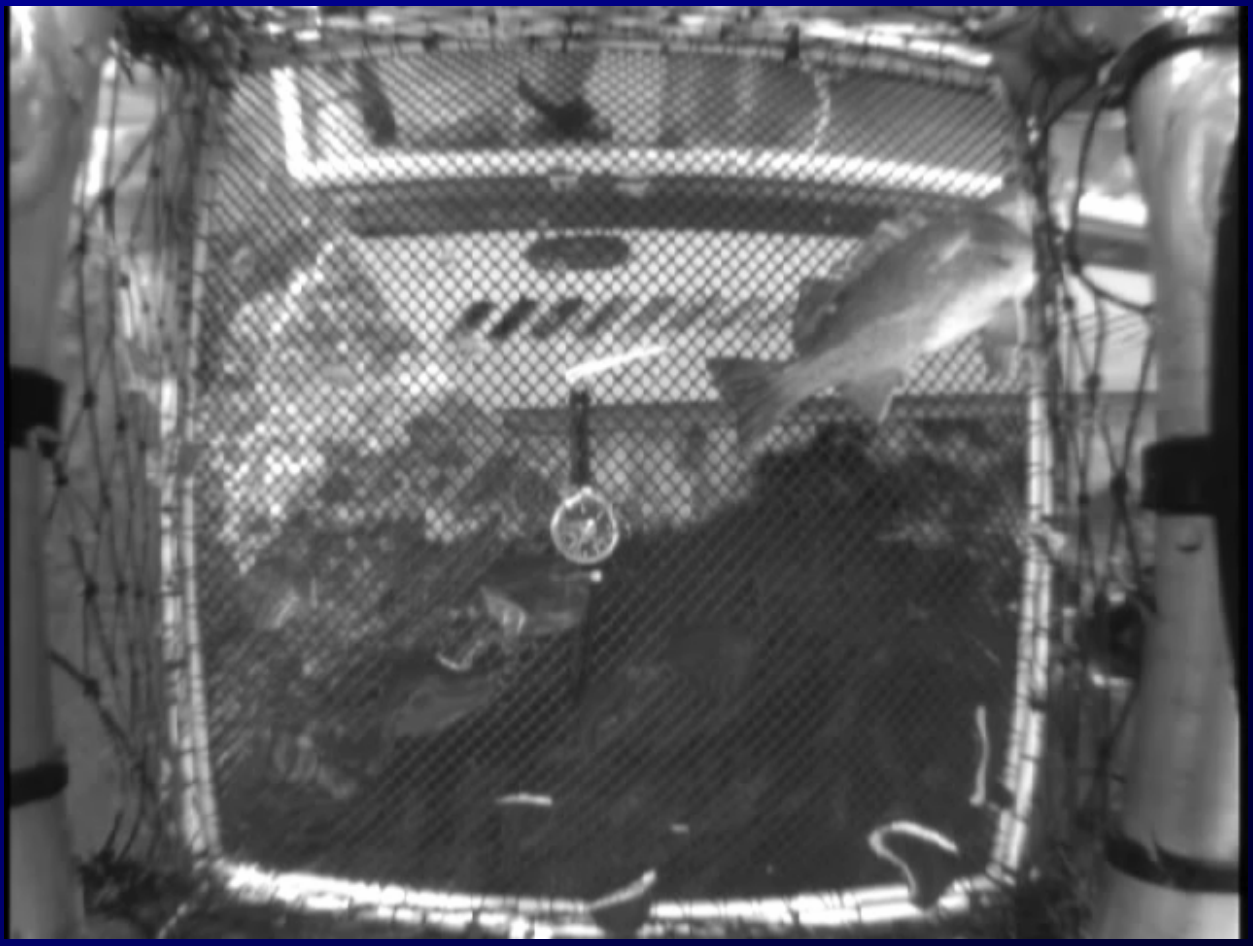


Yelloweye and canary



Many species that looked terrible at surface, looked pretty good at release (yelloweye) and some that looked okay at surface (blue rf) looked terrible at release (no ability to orient vertically) – probable bottom line; species-specific and random nature of barotrauma injuries

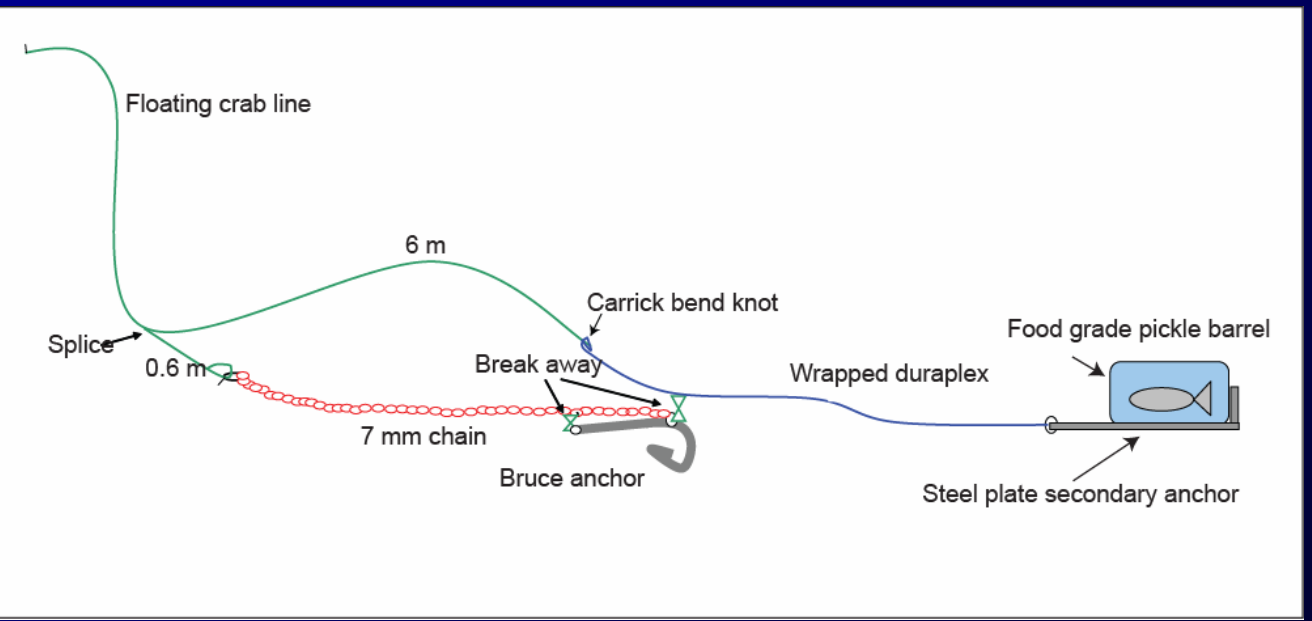
Blue rockfish often look good at the surface and swim down quickly



Venting Study

- Venting – the release of expanded swimbladder gas via hypodermic needle to facilitate re-submergence
- Pit-tagged 1500 black rf; 500 in each of 3 groups
- Every 3rd fish captured was either vented and released, recompressed in an underwater release cage, or simply tossed over the side.
- Tags were recovered in carcasses scanned in the rec landings since 2005
- Recoveries to date – Tossed over 59; vented 43; caged 35 ($p<0.05$)
- Probably just shows mortality effect of increased handling.

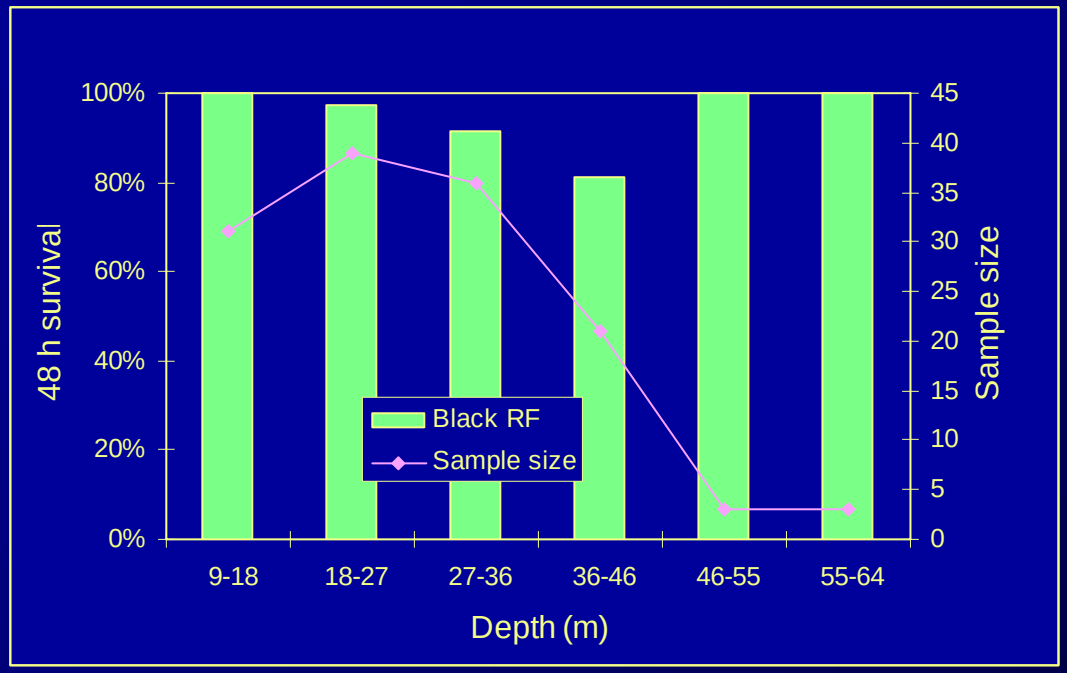
Survival



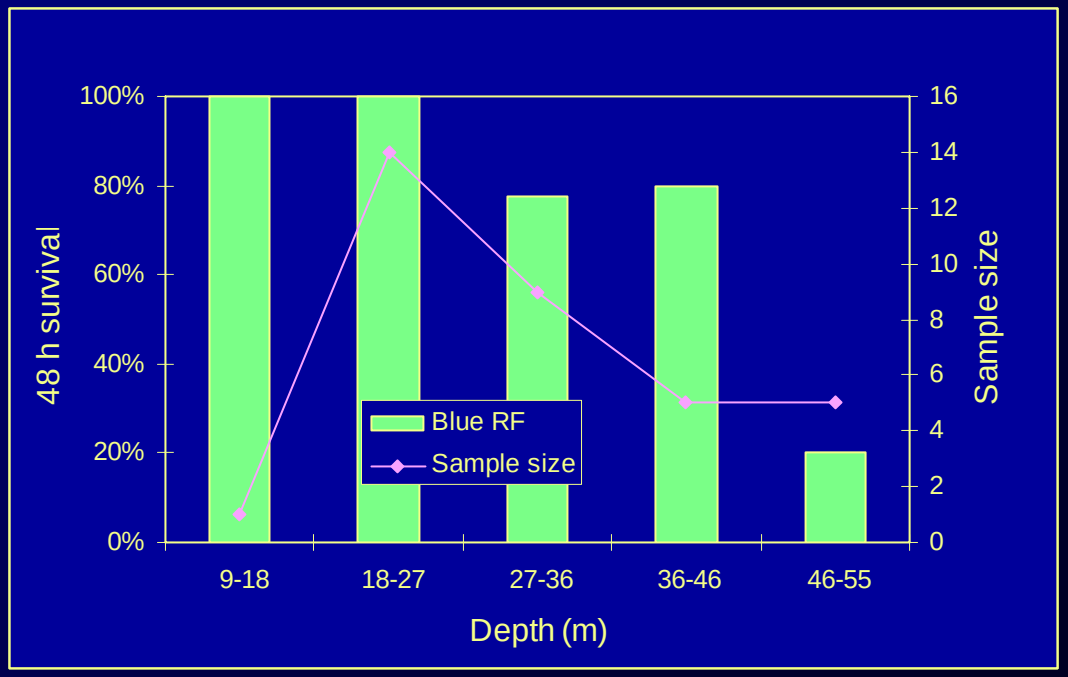
- Focus - demersal rf vs depth of capture
- 48h survival is surprisingly high
- Cage design overcomes cage-effect issues with surge also time on deck, amphipods

Preliminary results

Black RF



Blue RF



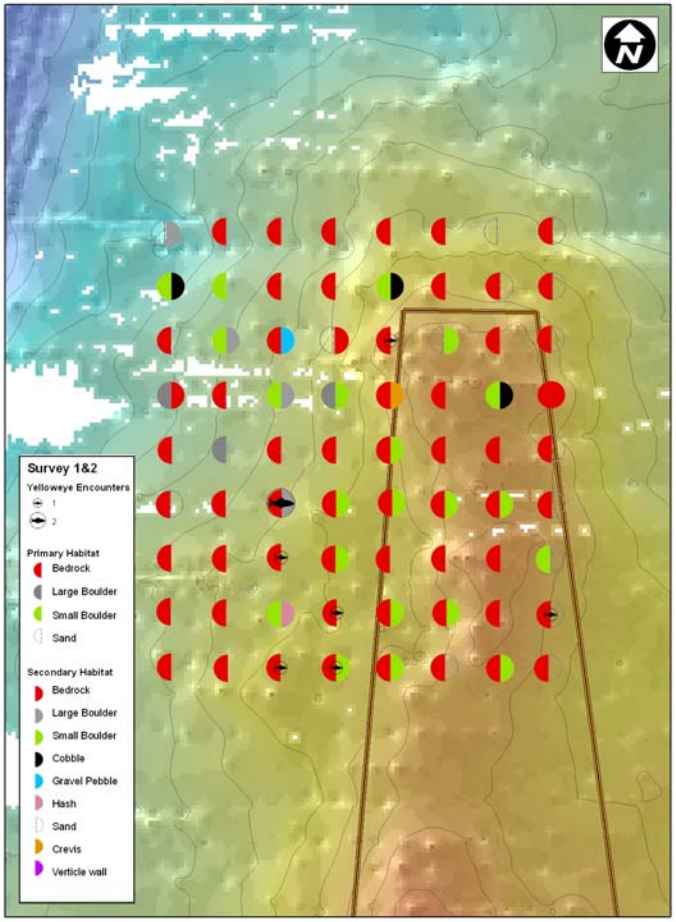
RF Discard and barotrauma – “bottom line”

- Submergence and severity of barotrauma related to depth of capture, and tendency to retain SB gas
- Outward signs BT caused by forward travel of expanding SB gas – injuries to kidney, liver, venous embolism, bleed out, infection in rete mirable
- However, many fish appear competent when released at depth and have high 48-h survival (not blue or widow)
- Tagging studies suggest multi-year survival (cnrf, yeye, quill, verm, black)
- Recompression devices may help reduce discard mortality for some species

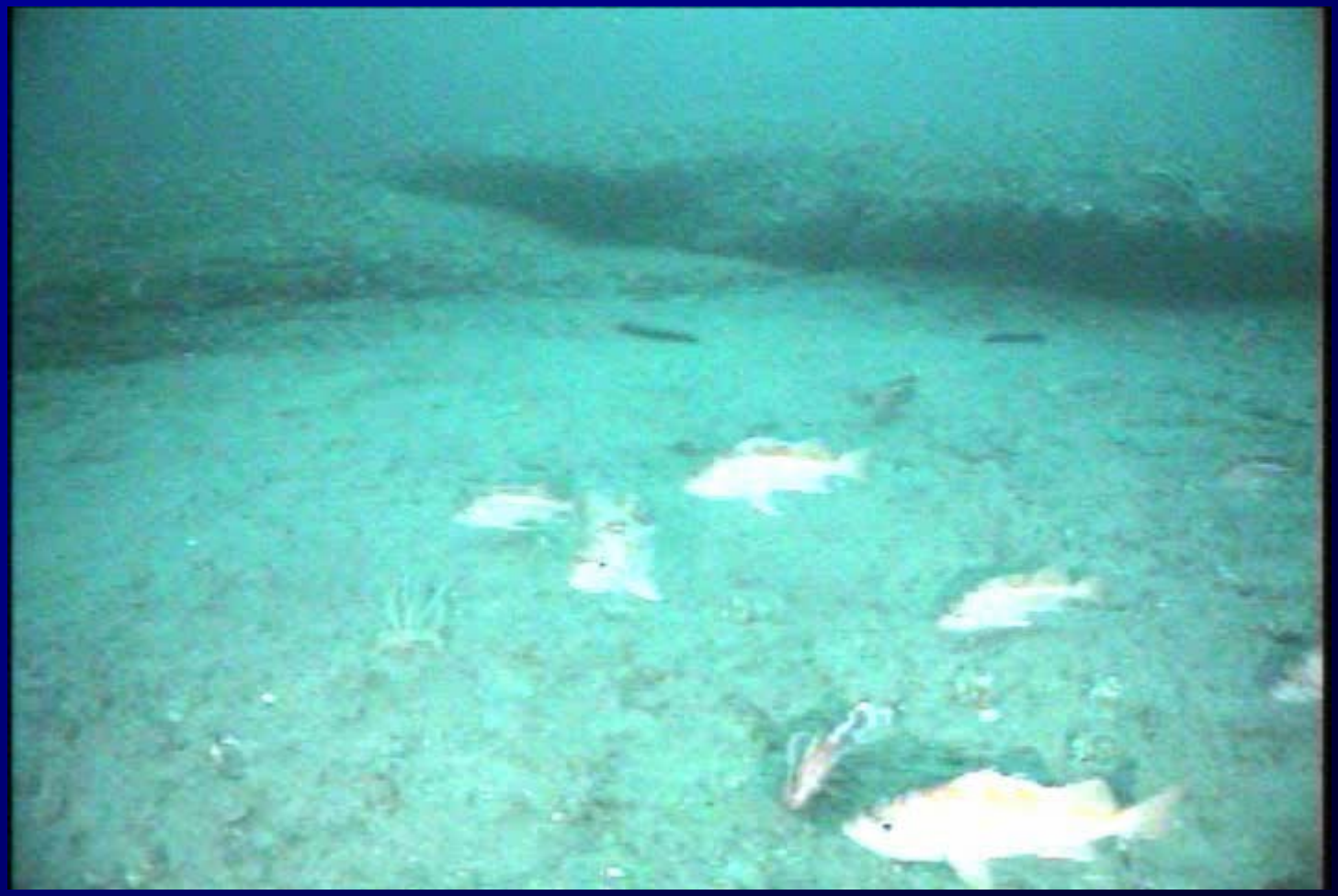
Future directions

- Finish rockfish discard mortality studies
- Benthic effects of different shrimp trawl groundline configurations
- Effect of shrimp trawl footrope configurations on eulachon smelt bycatch
- Behavior of eulachon smelt interacting with BRDs (attempt to get at survival) – develop HD UW camera systems
- Rocky reef survey issues

Develop non-lethal survey methods at ODFW – untrawlable areas



Video lander footage – Stonewall Bank



The End - Questions on Anything

Polly Rankin

The people who actually do this work

Matt Blume

Steve Jones

Keith Matteson