NOAA FISHERIES

Northwest Fisheries Science Center

Eulachon in the Columbia River Estuary & Plume

Highlights of what is known,
what is unknown, what is needed for recovery planning

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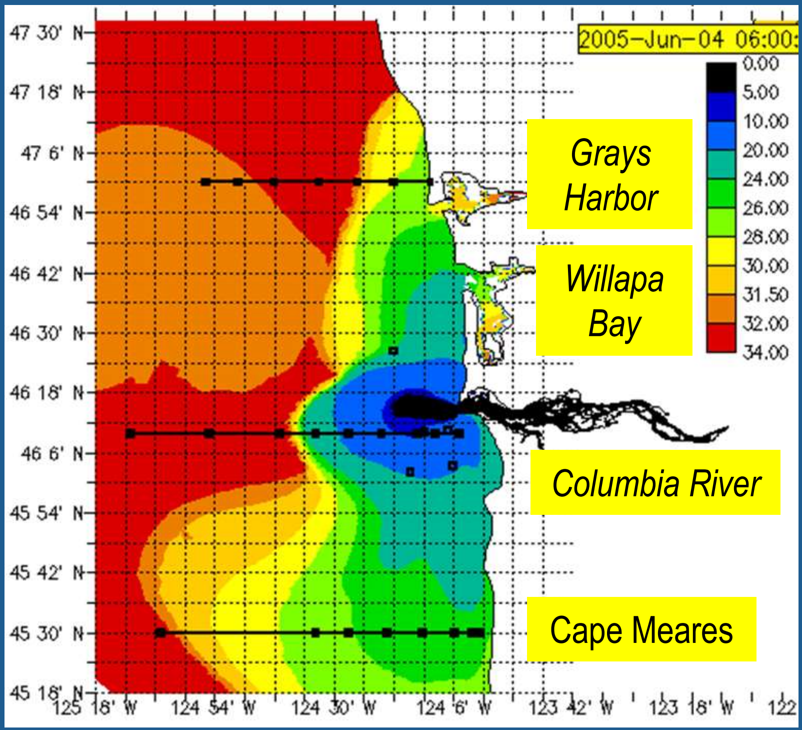
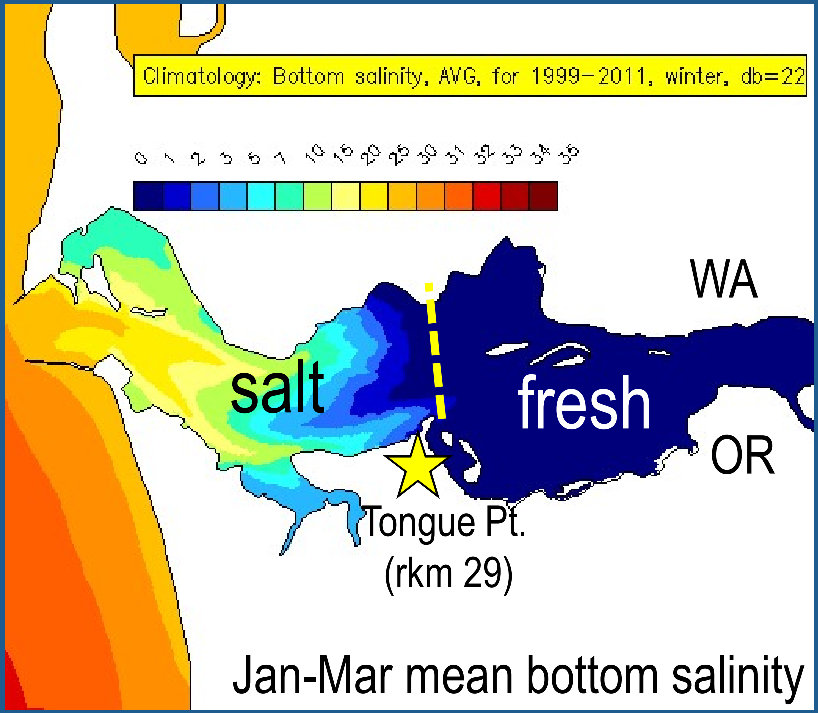
Jen's quick & dirty habitat definitions

Tidal freshwater - rkm 235-rkm 29

Estuary – rkm 29- rkm 0

- larvae, spawning adults





Plume – marine area directly influenced by river discharge

- larvae, juveniles, adults

Climatology & plume model courtesy www.stccmop.org

Columbia River Estuary & Tidal Freshwater

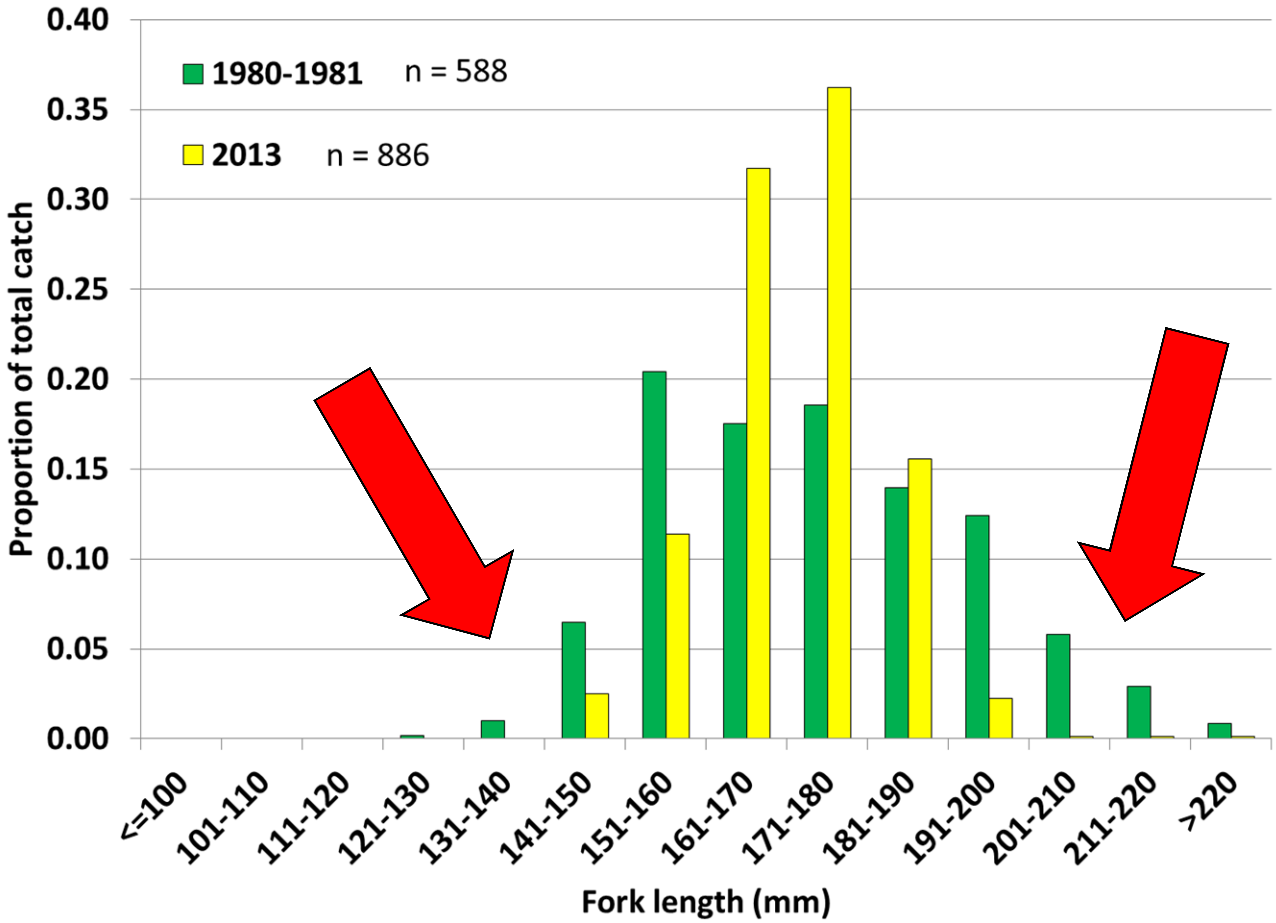
- Joint work NWFSC, WDFW; Jan-Mar 2013
- Proof of concept – research trawl + hydroacoustics
- Cost-effective, direct, fishery-independent sampling of spawning run: distribution, sex ratio, size, fecundity
- Potential work on run timing, age structure, acoustic biomass estimates, live specimens
- Compare w/historical estuary data from CREDDP 1980-81

NWFSC trawl vessel *R/V Murrelet*

Numerical species composition of trawls

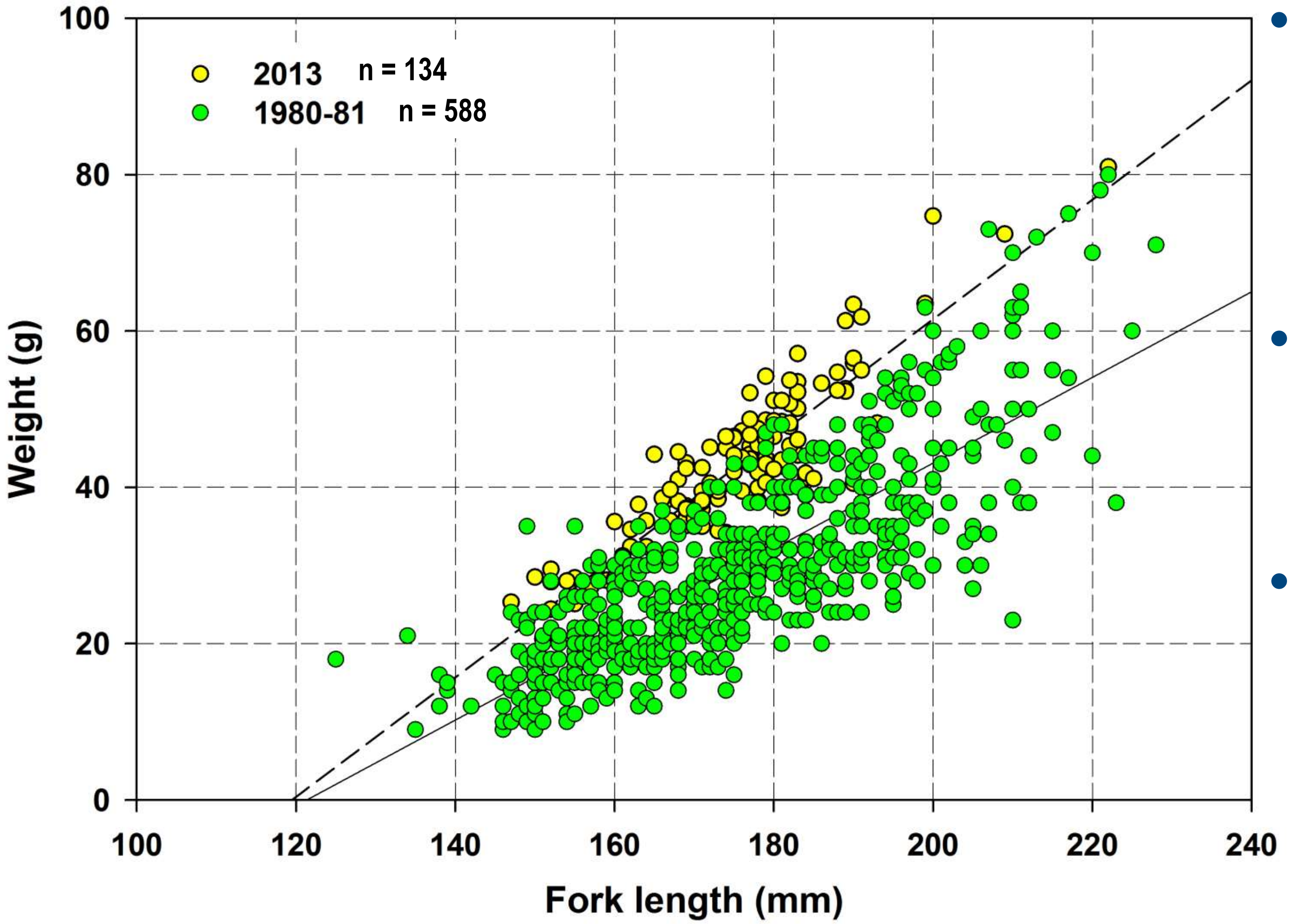
	ESTUARY (n = 38)			TIDAL FRESHWATER (n = 9)		
SPECIES	CATCH (n)	CATCH (%)	FO (%)	CATCH (n)	CATCH (%)	FO (%)
American shad	12,152	50.20	84.2	385	0.2	1.1
Longfin smelt	5,827	24.1	73.7	34	<0.1	22.2
Threespine stickleback	4,204	17.4	85.9	204,506	96.4	88.9
Eulachon	715	3.0	60.5	7,061	3.3	22.2
Dungeness crab	304	1.3	31.6	0	0	0
Starry flounder	256	1.1	65.8	72	<0.1	55.6
English sole	242	1.0	31.6	1	<0.1	11.1
Pacific staghorn sculpin	240	1.0	55.3	0	0	
Snake prickleback	64	0.3	26.3	0	0	
Sand sole	61	0.3	15.8	0	0	
Pacific tom cod	59	0.2	15.8	0	0	
Chinook salmon (juvenile)	36	0.1	26.3	12	0.1	11.1
Other, excluding bay shrimp	53	<0.1	-	1	<0.01	-

Size distribution, Columbia estuary



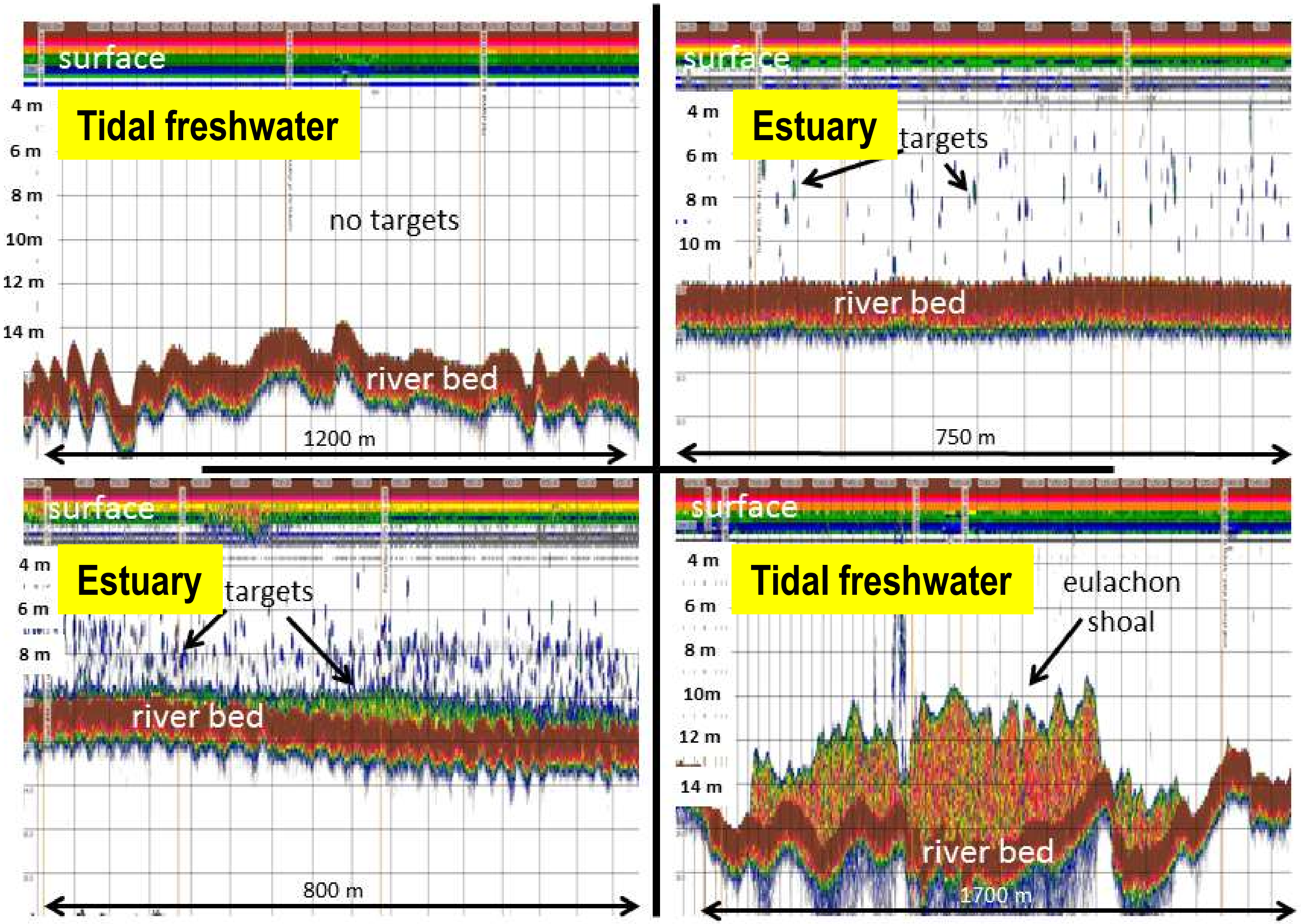
- 1:1 sex ratio
- Mean fork length, 2013 spawners:
  - males: 173.9 mm
  - females: 169.9 mm
- Size distribution changed, 1980-81 vs. 2013
- Is this a change in age distribution?

Length-weight distribution, Columbia estuary



- Apparent change in length-weight distribution, 1980-81 vs. 2013
- Less precise weights in 1980s: ±1.0g vs.±0.1g
- Inclusion of spawned out fish? Recent poor survival of smaller fish?

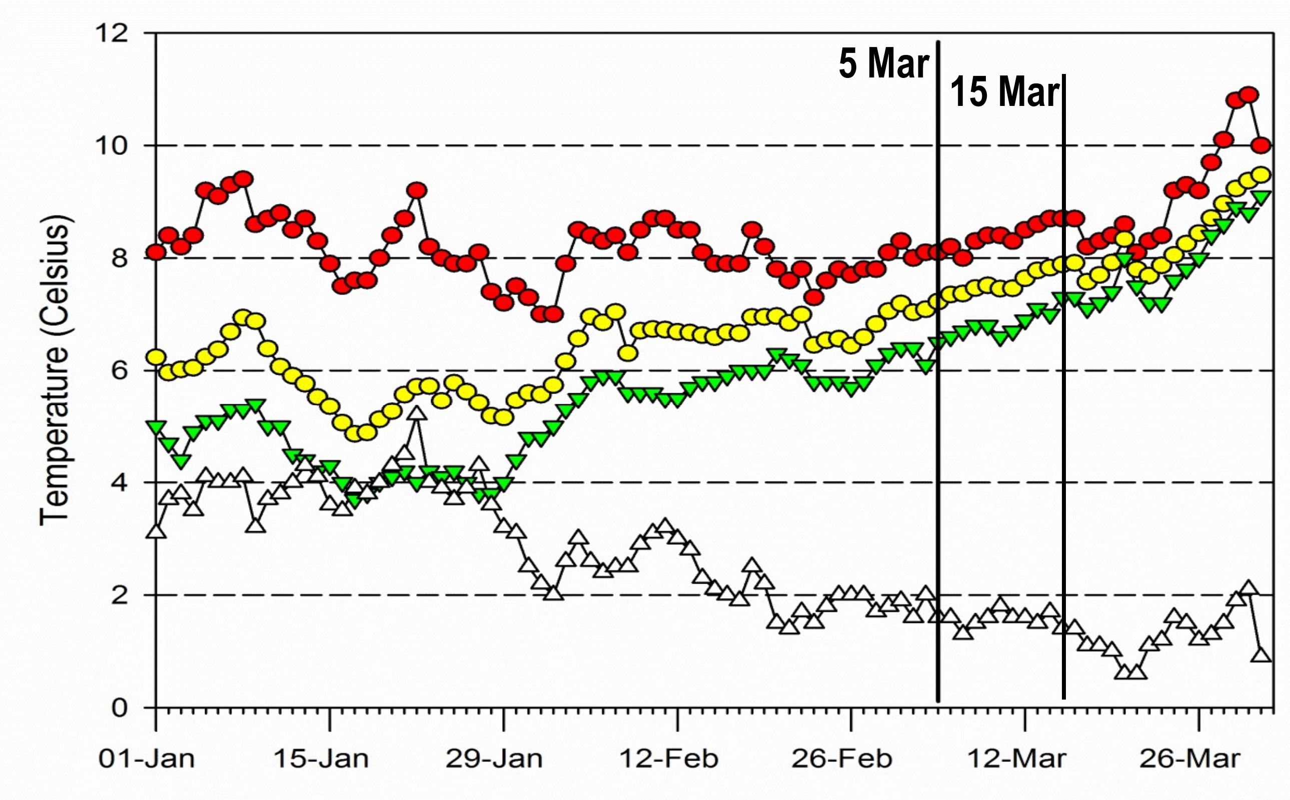
1st acoustic images of Columbia River eulachon shoals



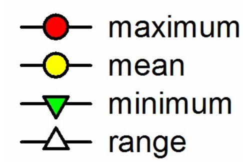
- 5-7 Mar 2013
- Tidal freshwater
- Blanketed ~2 km section of river
- Single species, bottom-oriented, well-defined edges, densely packed
- Unique echo signatures

Hull-mounted 38 kHz Simrad split-beam system, 12° beam-width

Run timing & Columbia estuary conditions



Estuary temperatures, Tansy Point, rkm 16

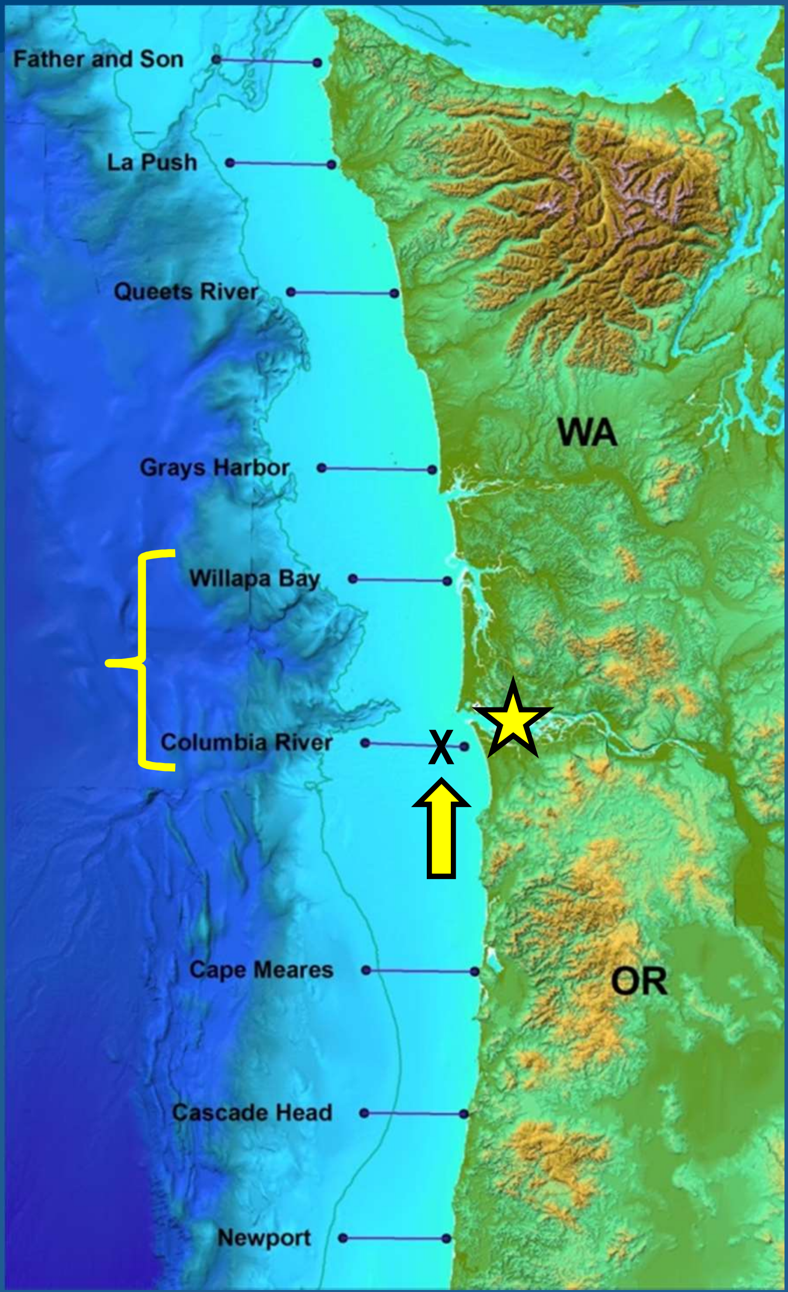


Temperature data courtesy www.stccmop.org

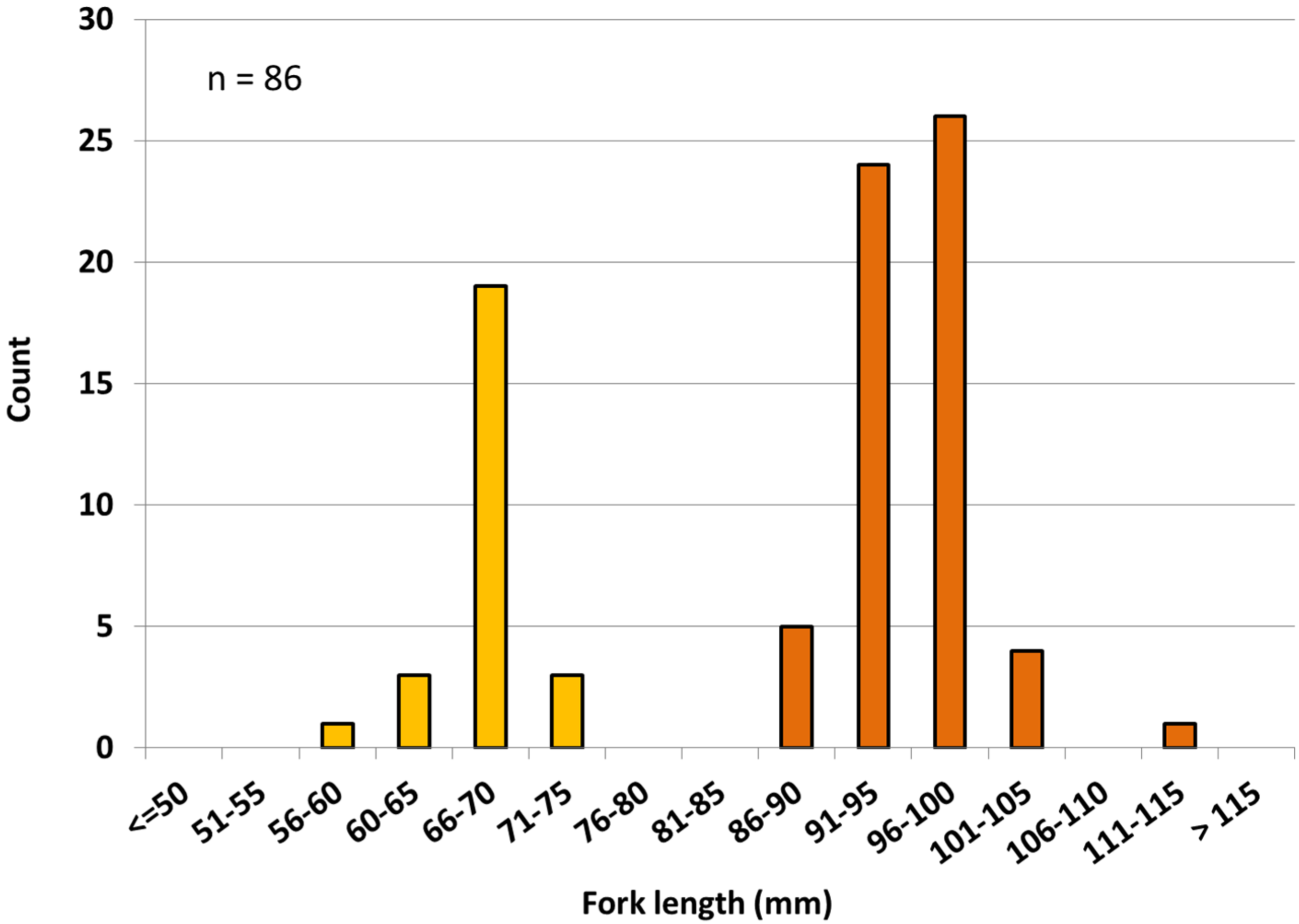
- 5-7 Mar: eulachon shoal 1st seen in tidal freshwater near Wauna, OR (rkm 64-66)
- 15 Mar: eulachon enter Cowlitz River (rkm 109)
- Is 6°C a critical estuary minimum temperature trigger for upstream migration? Is it the transition from tide-dominated to flow-dominated temperature?

Columbia River Plume

- NOAA-led work
- Emmett et al. legacy
- At-sea surveys to understand mechanisms governing early marine distribution, growth, & survival of juvenile salmon



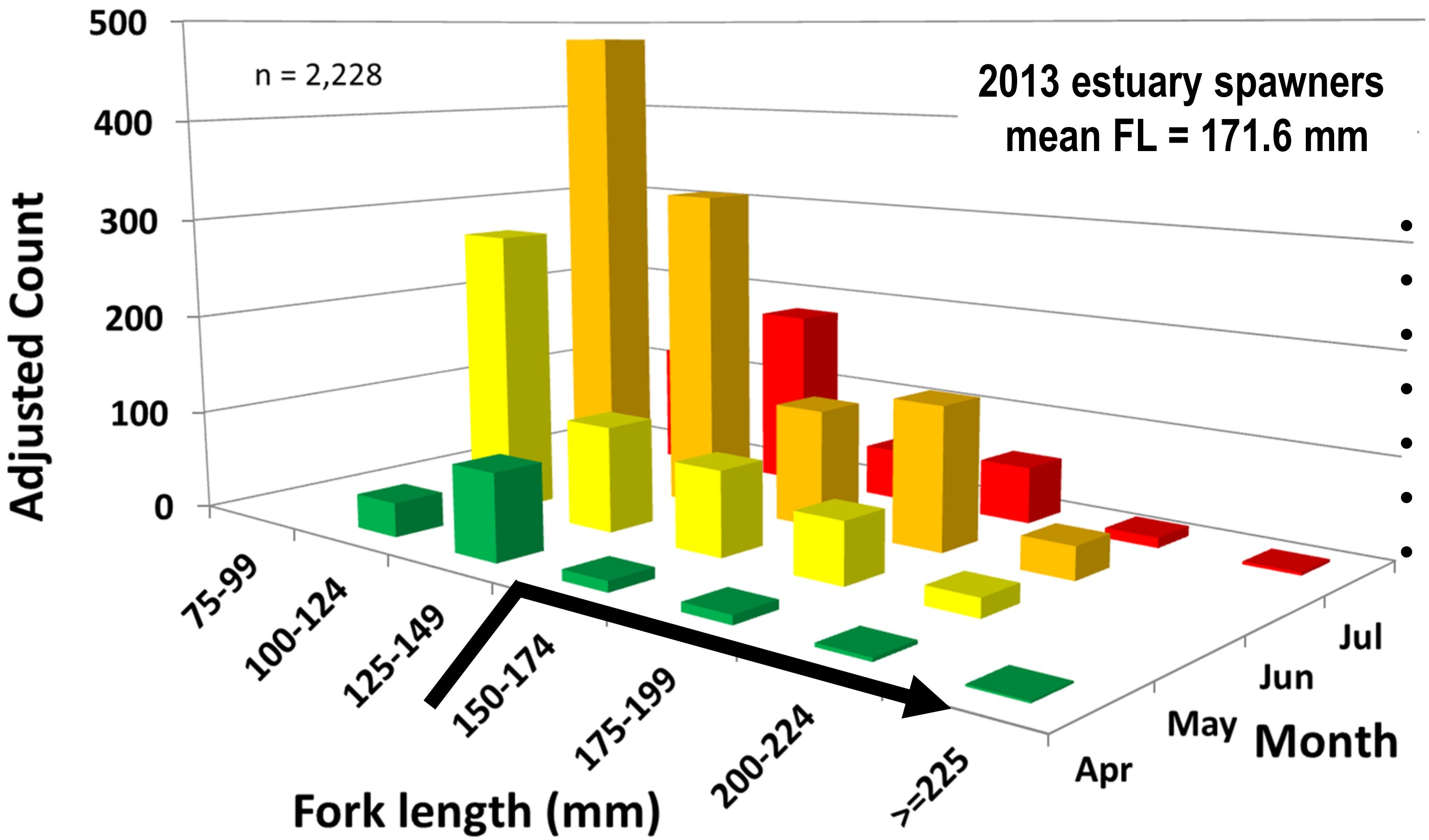
Size distribution, Columbia plume



- 21-22 Jun 2000
- 28 x 12 rope trawl
- 8 mm mesh liner
- 12-24 m depth
- 13 km offshore
- 8-10°C
- > 31 salinity

- Emmett et al. 2004, occur w/herring, whitebait smelt, juvenile salmon
- Two size classes = two age classes? two spawning events? two growth conditions?

Seasonal size distribution, Columbia plume



- 2003-2011
- Night only
- 28 x 12 rope trawl
- 8 mm mesh liner
- 0-12 m depth
- 7.4-55.6 km offshore
- 12 stations

- Emmett et al., unpublished data
- 85% captured in < 100 m, overlap w/juvenile salmon & nearshore predators
- Growth into spawner size classes between Apr-Jun? Multiple age classes?

Filling data gaps for recovery planning

- Bringing existing NWFSC resources into play
- Coordinating work with state, tribal, academic resources

Adult spawner, estuary 2013

Acoustics vessel *R/V Magister*

Eulachon in Columbia estuary/tidal freshwater

- KNOWN
  - Spawners occupy estuary habitat weeks before peak spawning
  - Size distribution of spawners has changed
  - Daytime eulachon are bottom-oriented
  - Research trawl captures fish w/greater size range, lower mortality (<0.1%), better condition than commercial gear
  - Acoustics can map, target, & enumerate spawners
  - Spawning run attracts large numbers of predators (e.g. seabirds, pinnipeds, sturgeon)
- UNKNOWN and NEEDED
  - Size-at-age structure of spawners
  - Sex ratio of spawners
  - Variation in run magnitude, timing
  - Direct estimate of spawner biomass
  - Mechanisms triggering upriver movement of spawners: temperature, flow, etc.
  - Larval density/size/condition/timing at ocean entry w/r/t flow, tides, other estuary conditions (present larval sampling in tidal freshwater, rkm 55-65)

Eulachon in the Columbia plume

KNOWN

- Juveniles, sub-adults, adults definitely present Apr-Jul
- Length-frequencies suggest
  - Critical marine growth Apr-Jun
  - Recruitment to spawner size classes
- Not caught in daytime surface trawls or estuary seines

UNKNOWN and NEEDED

- Variation in size-at-age composition
- Larval, juvenile marine distribution - hydrography
- Marine growth/survival – hydrography, food, predators
- Eulachon function as alternative prey for salmon predators

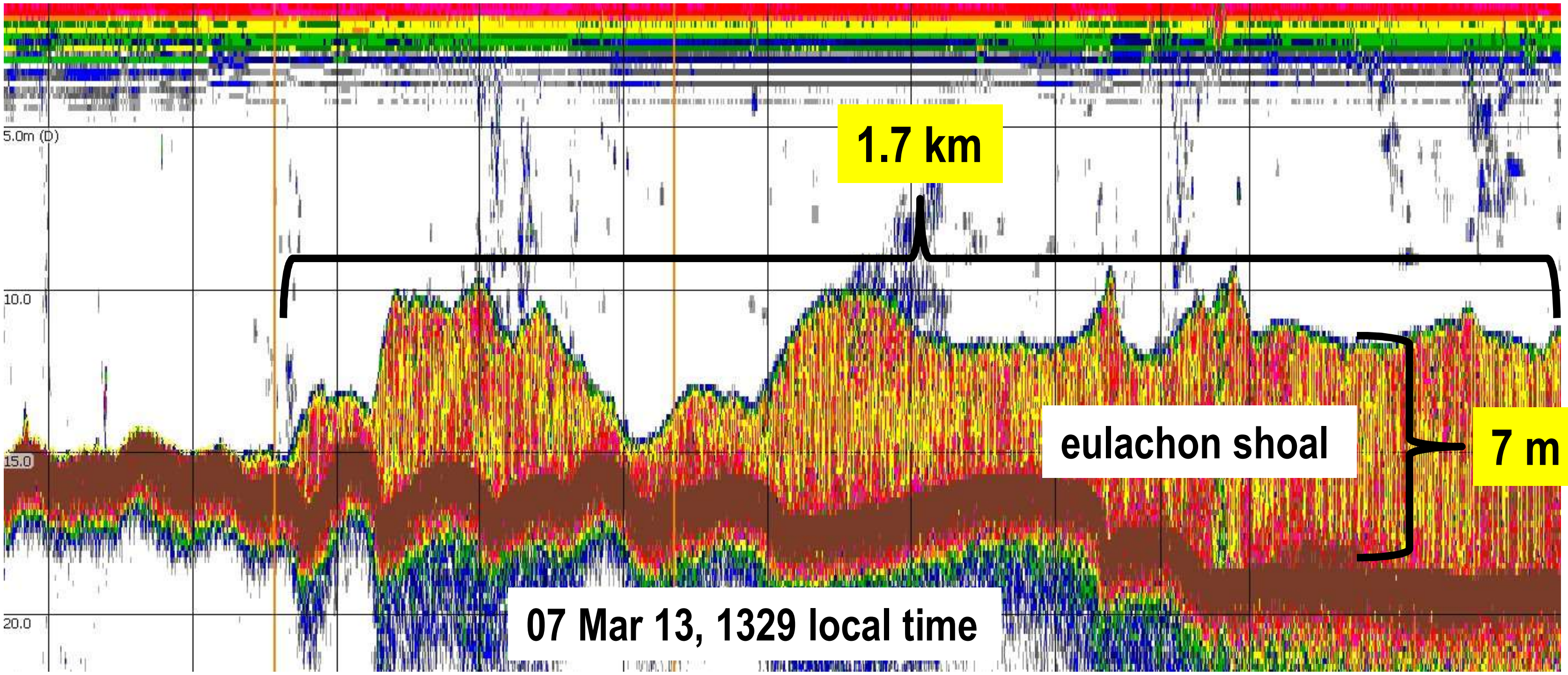
“Low-hanging fruit” - critical uncertainties we could resolve with high probability of success

- Tidal freshwater & estuary
  - Adult spawning stock biomass, run timing (direct, indirect)
  - Age, size, genetic structure of estuary spawners & larvae
  - Spawning migration timing vs. flow, temperature, other estuary/ocean conditions
  - Ocean entry timing, size, condition for larvae w/r/t temp, flow
- Plume
  - Synthesize/analyze existing ocean eulachon data w/physical & biological ocean ecology data
  - Marine distribution, age, size structure of larvae
  - Juvenile/adult age, size structure

Acoustic spawning stock biomass estimate: a sound investment in recovery planning

- Direct estimate of run timing, biomass in estuary, tidal freshwater
- Ground-truth size, age distribution w/net sampling
- Proven technique in fisheries management, used in Alaska, Canada***
- Strong conceptual framework from which to launch other studies

***Stables et al. 2005, Sigler et al. 2004



Acknowledgements, questions

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Dedicated to the memory of

Dr. Robert Emmett

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