You Are What You Eat: A Study of the Changing Age Demographics in Eulachon Smelt (*Thaleichthys pacificus*)

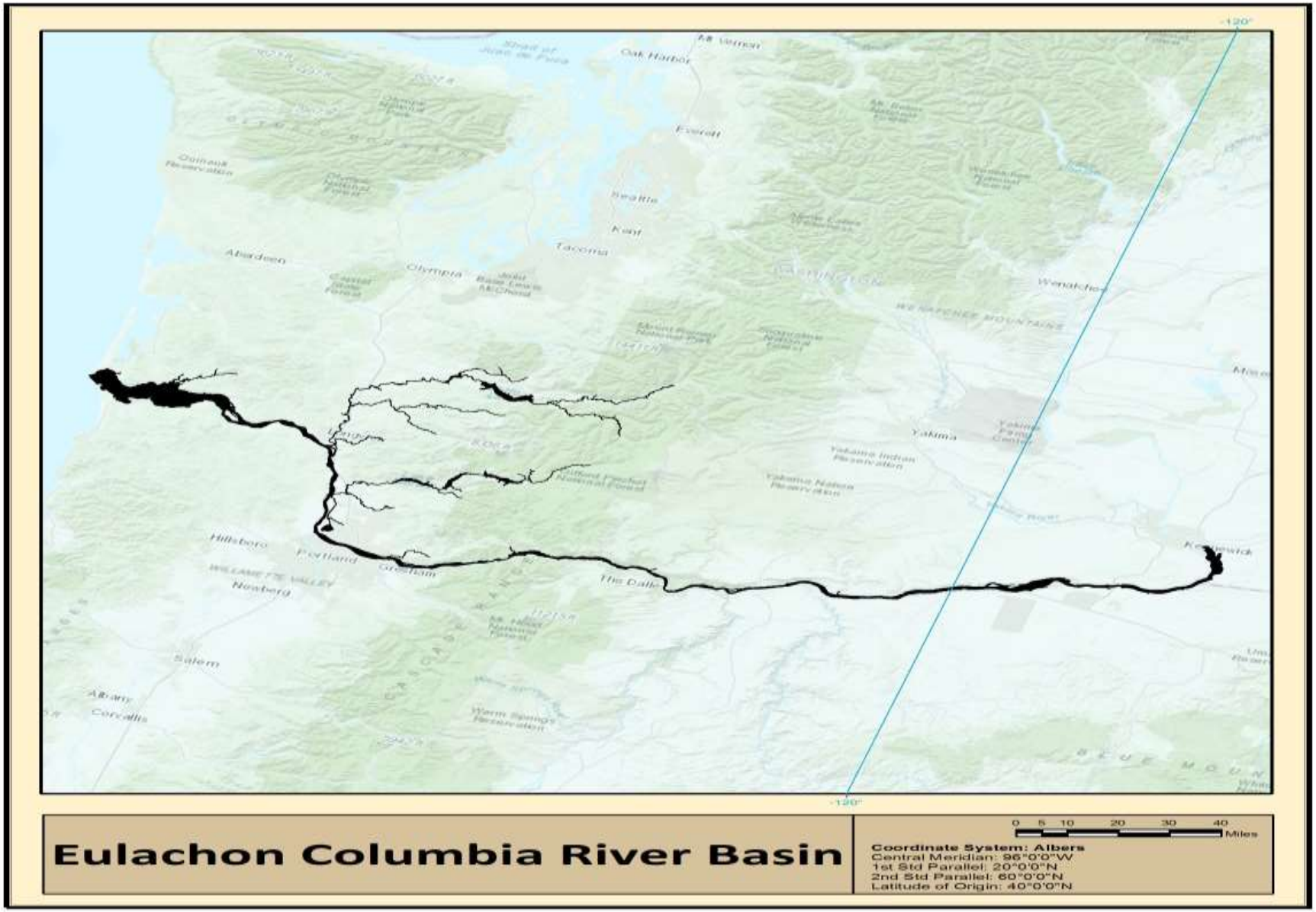
And Contributing Factors to Overall Run Decline

Laura Lloyd

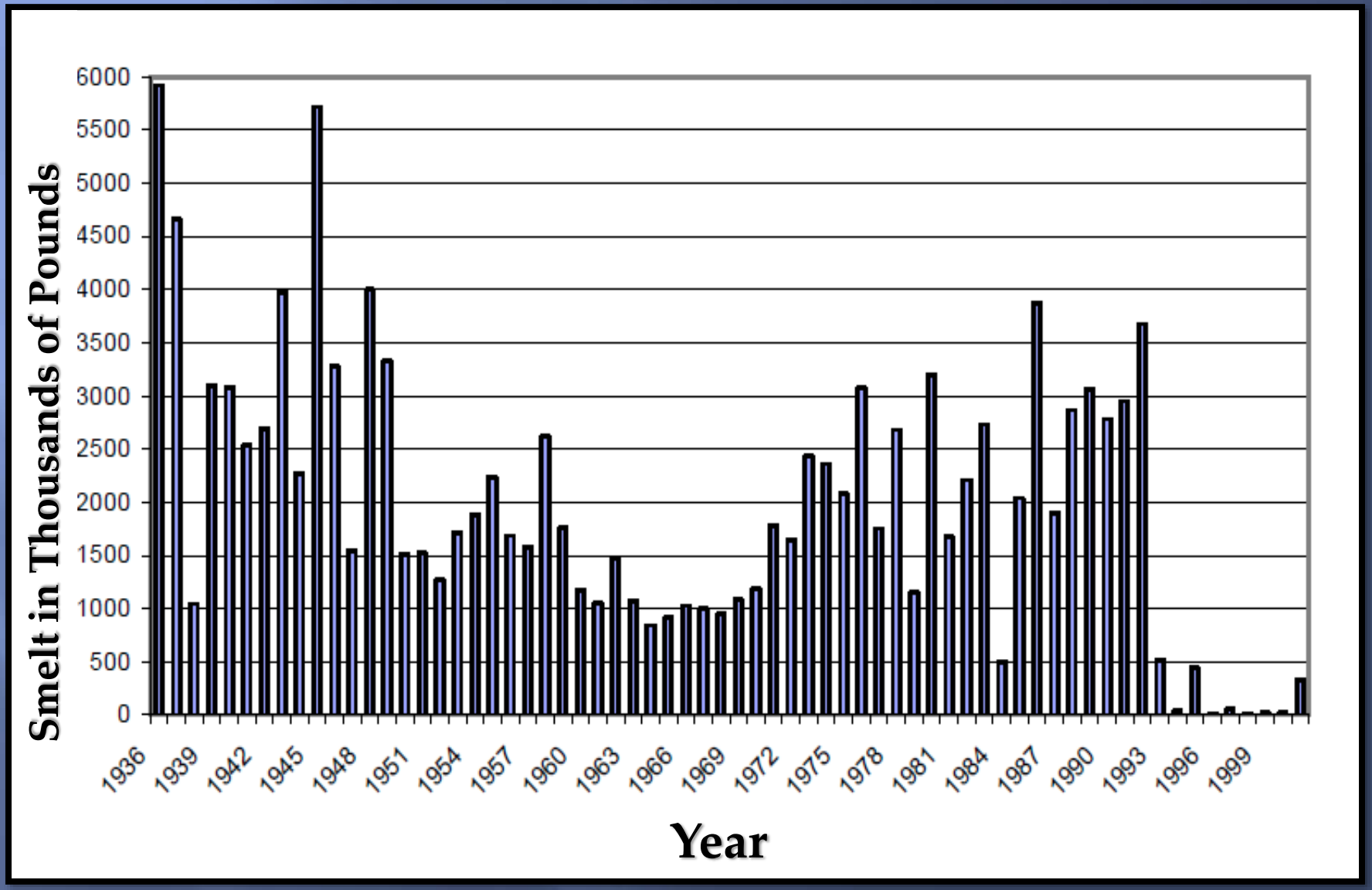
Eulachon Topics

- Introduction
- Recent Surveys
- Marine Conditions & Prey Availability
- Long Term Effects on Population Structure
- Causes for Population Decline
- Future Considerations

Northern and Southern DPS Range



Columbia Basin Commercial Smelt Harvest 1936-2001



So Why Are Eulachon Important

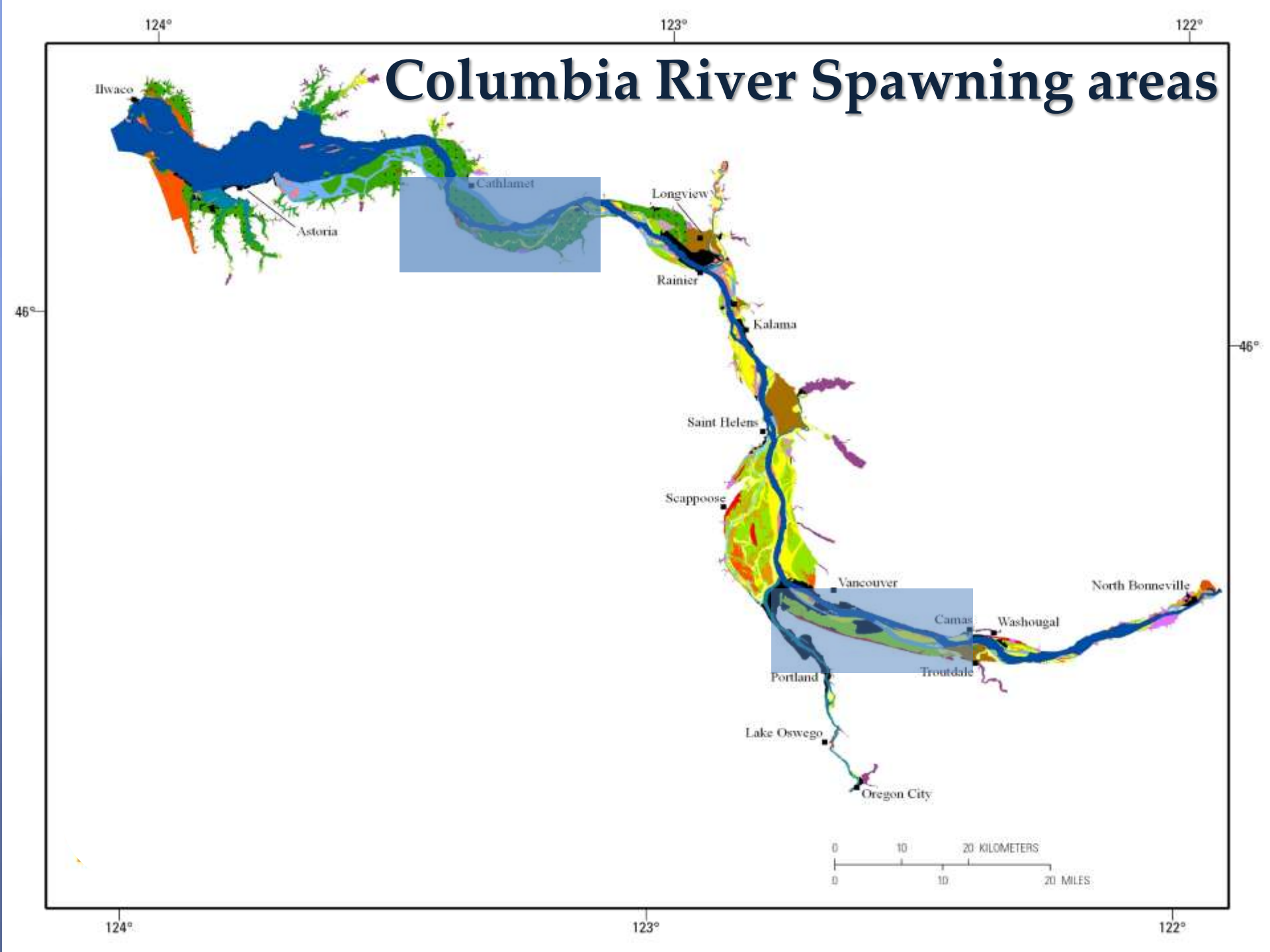
So Why Are Eulachon Important?

SOME USER GROUPS HAVE HIGH COMMERCIAL VALUE

SOME ARE JUST WORTH A LOT…

So Why are Eulachon Important?

Columbia River Spawning areas



Non Natal and non Heterogenetic

- Low stream fidelity
- Minimal time in fresh water
- Response to environmental cues
- Tooth absorption prior to spawning

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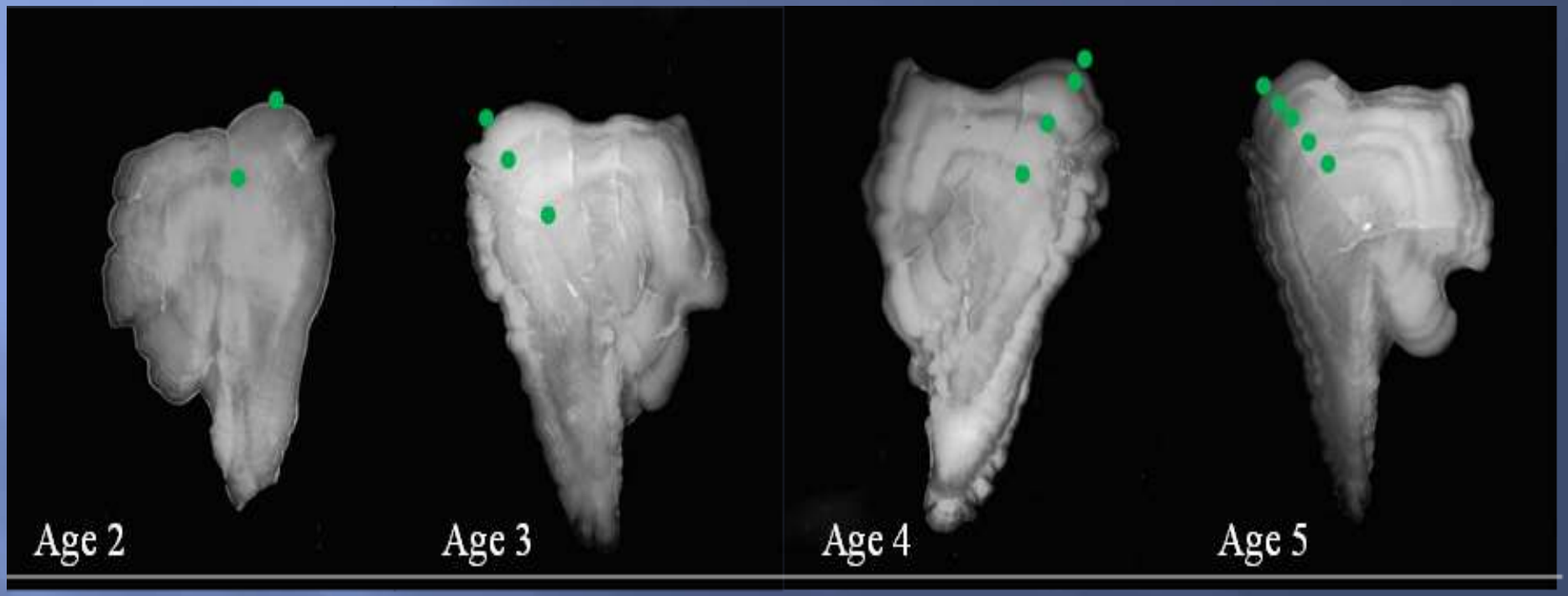
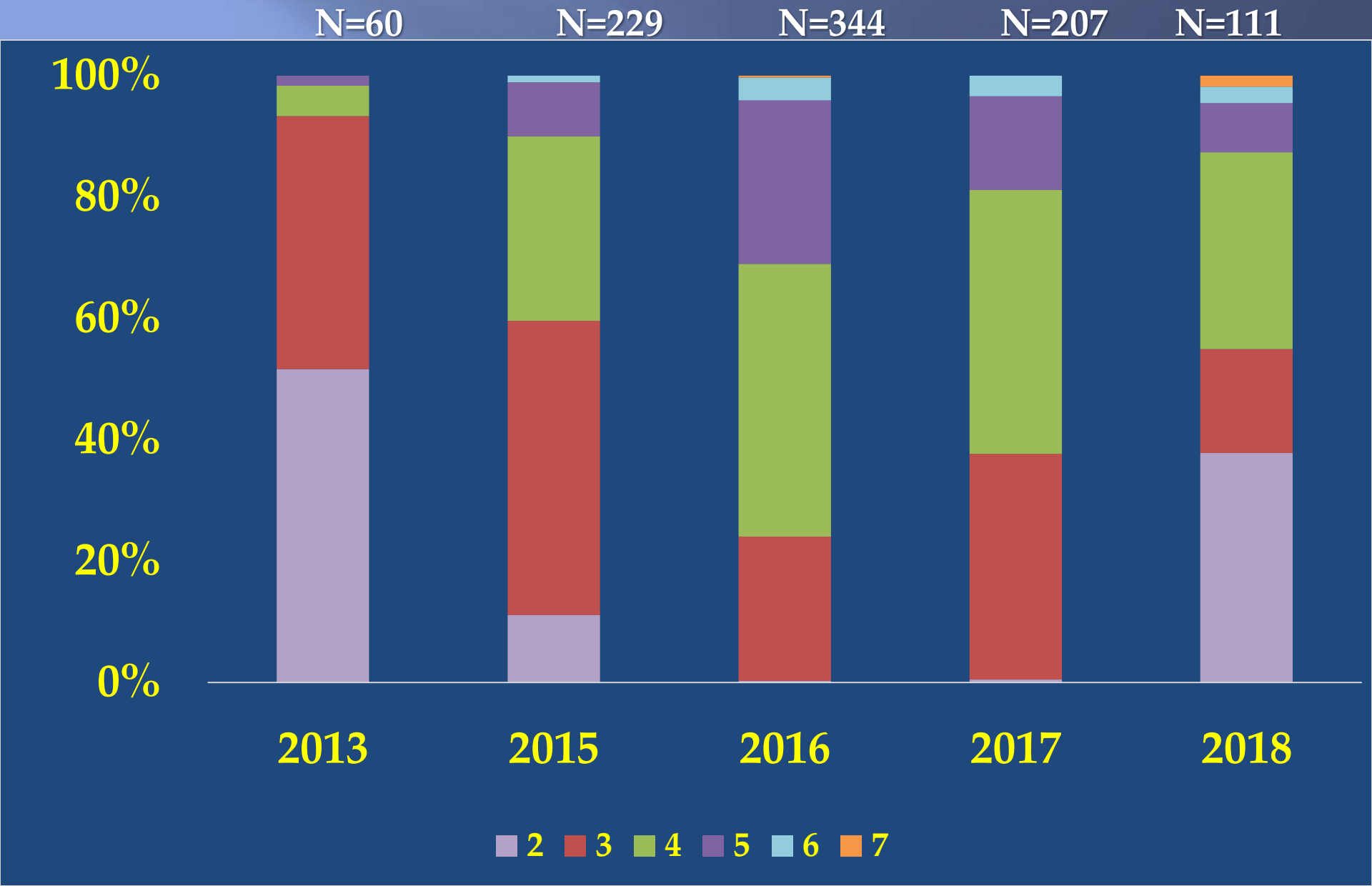
Larval Smelt

Eulachon Otoliths



Age Structure By Return Year



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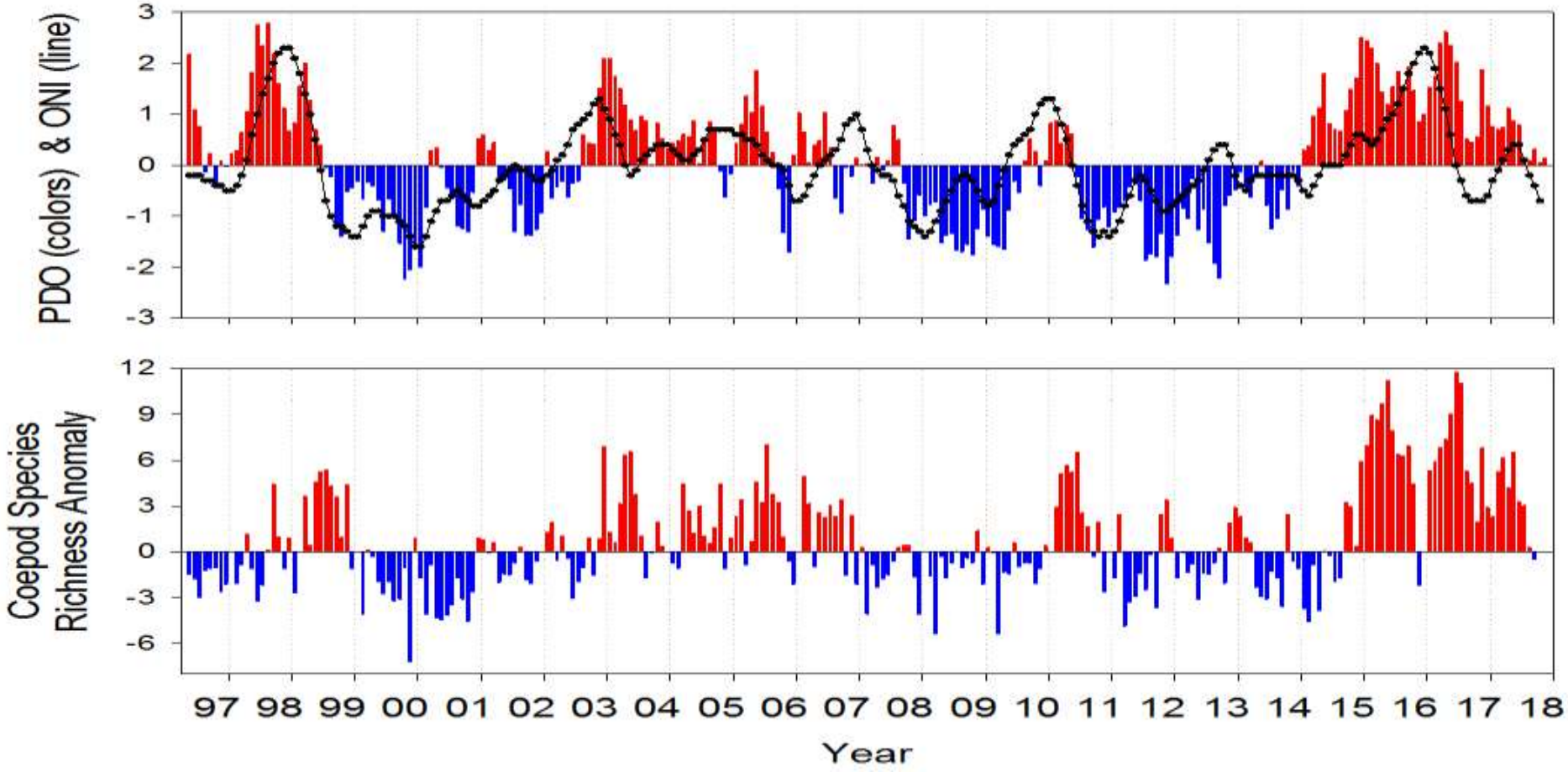
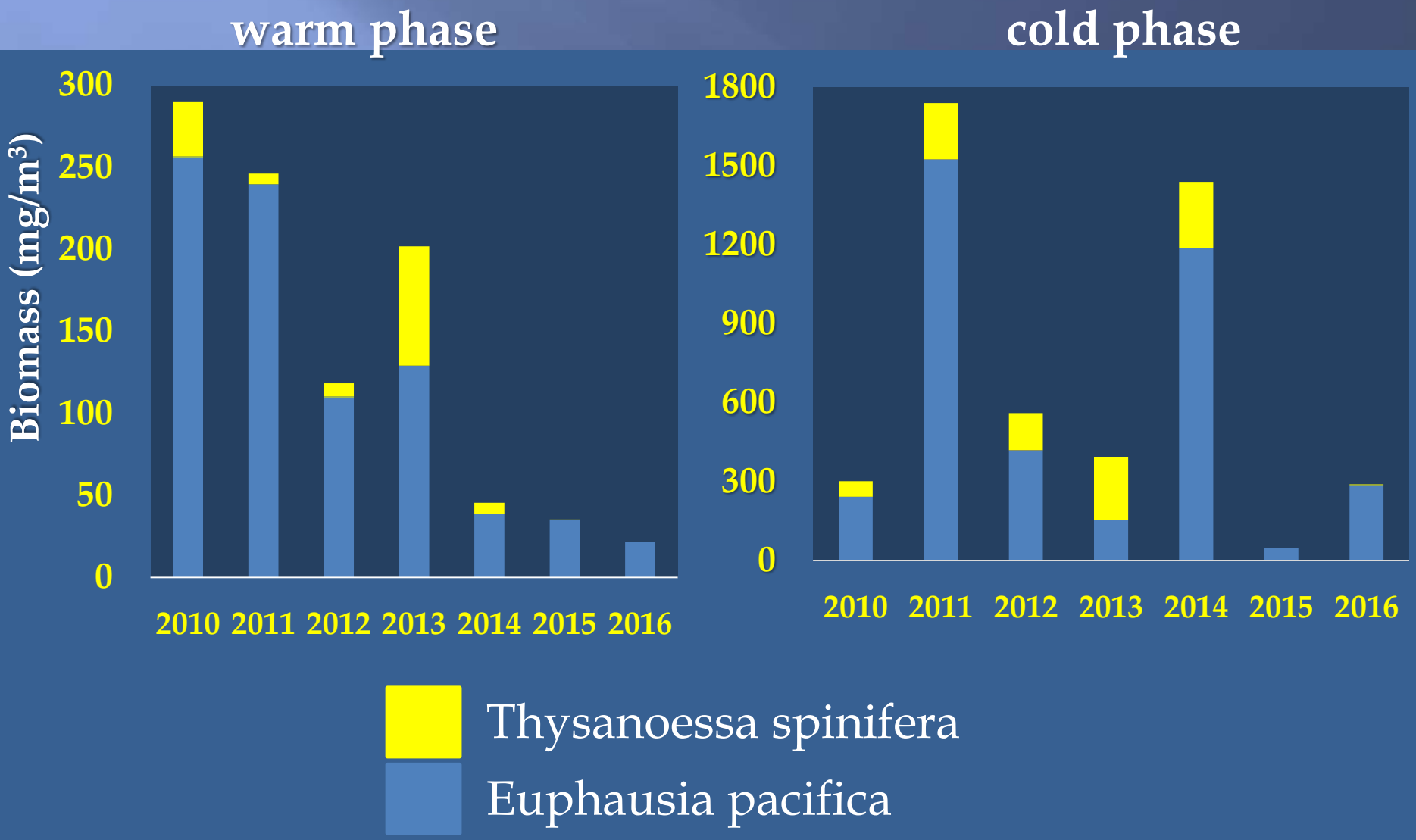
A Twenty Year Look at Temperature and Copepods

NOAA 45° N



Krill Populations



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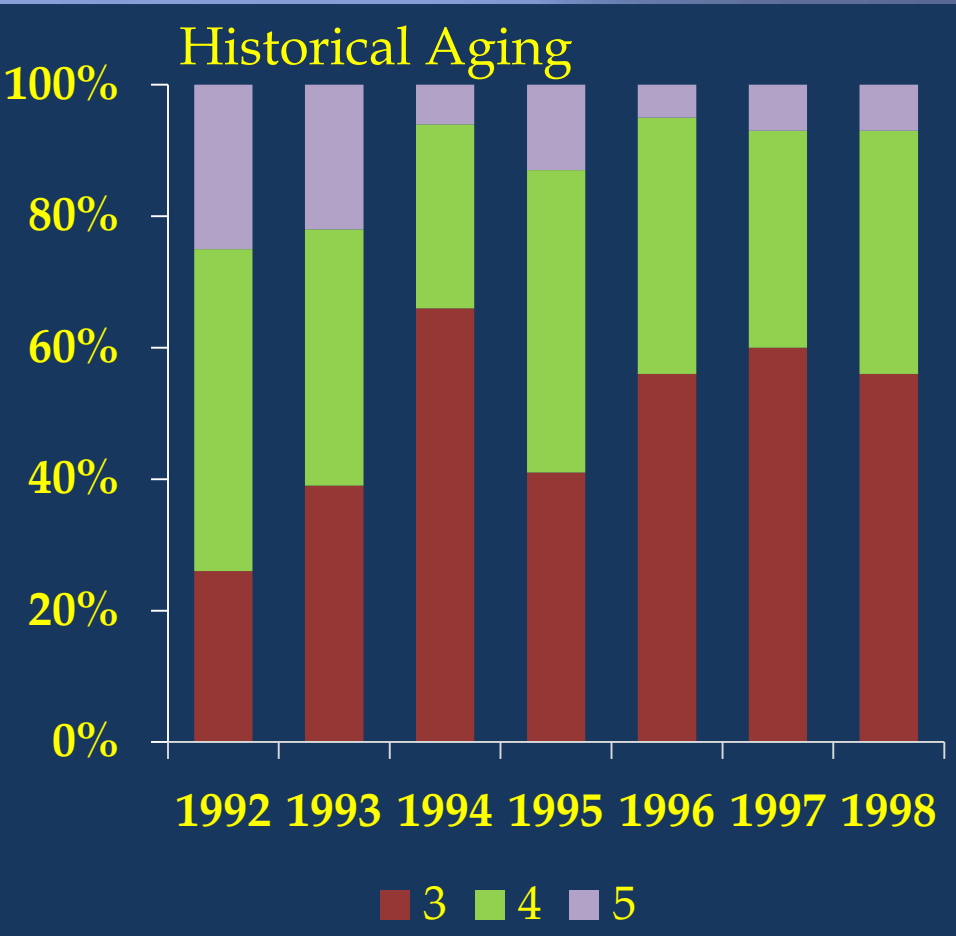
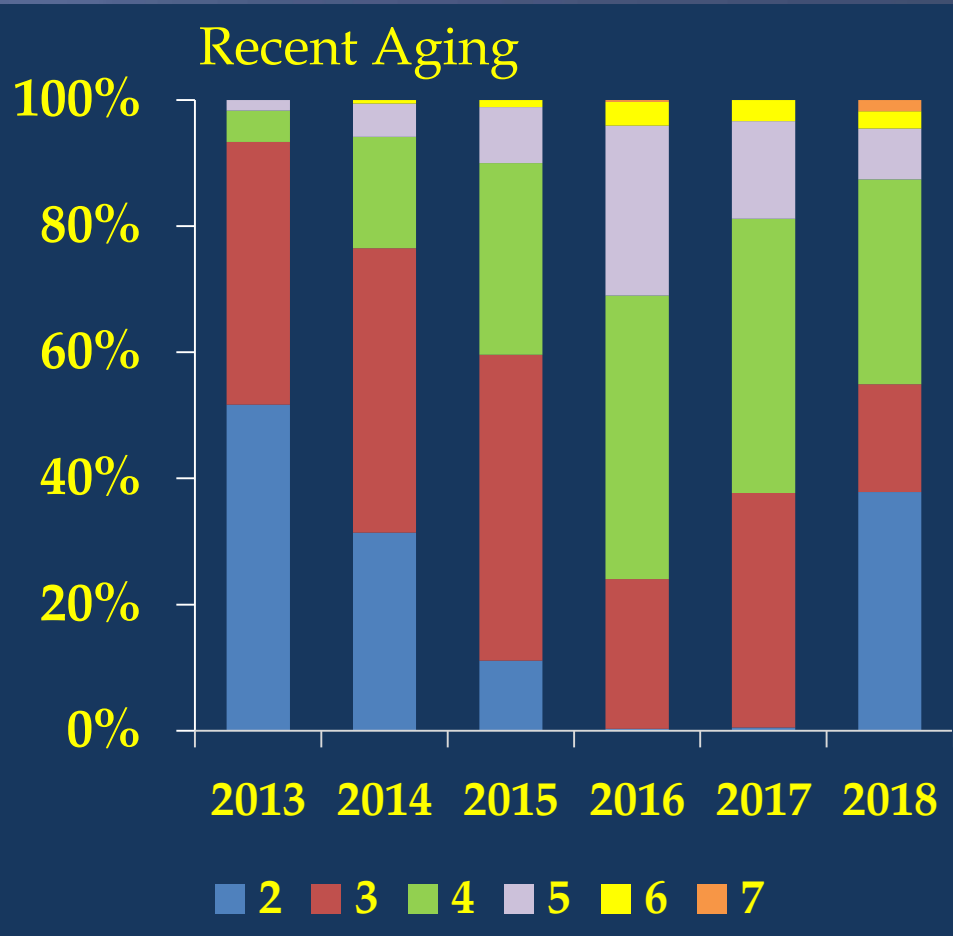
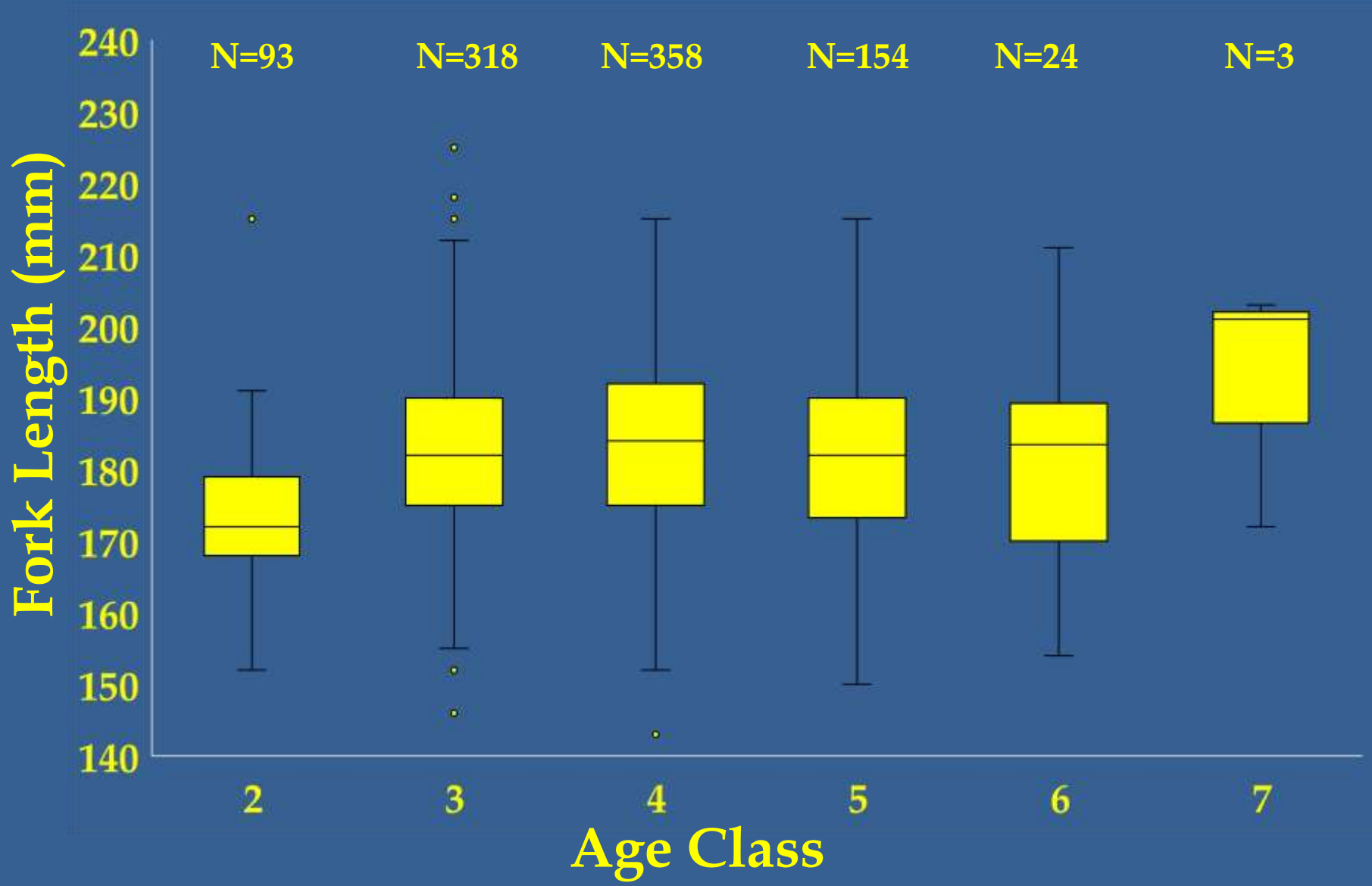
Age Comparison

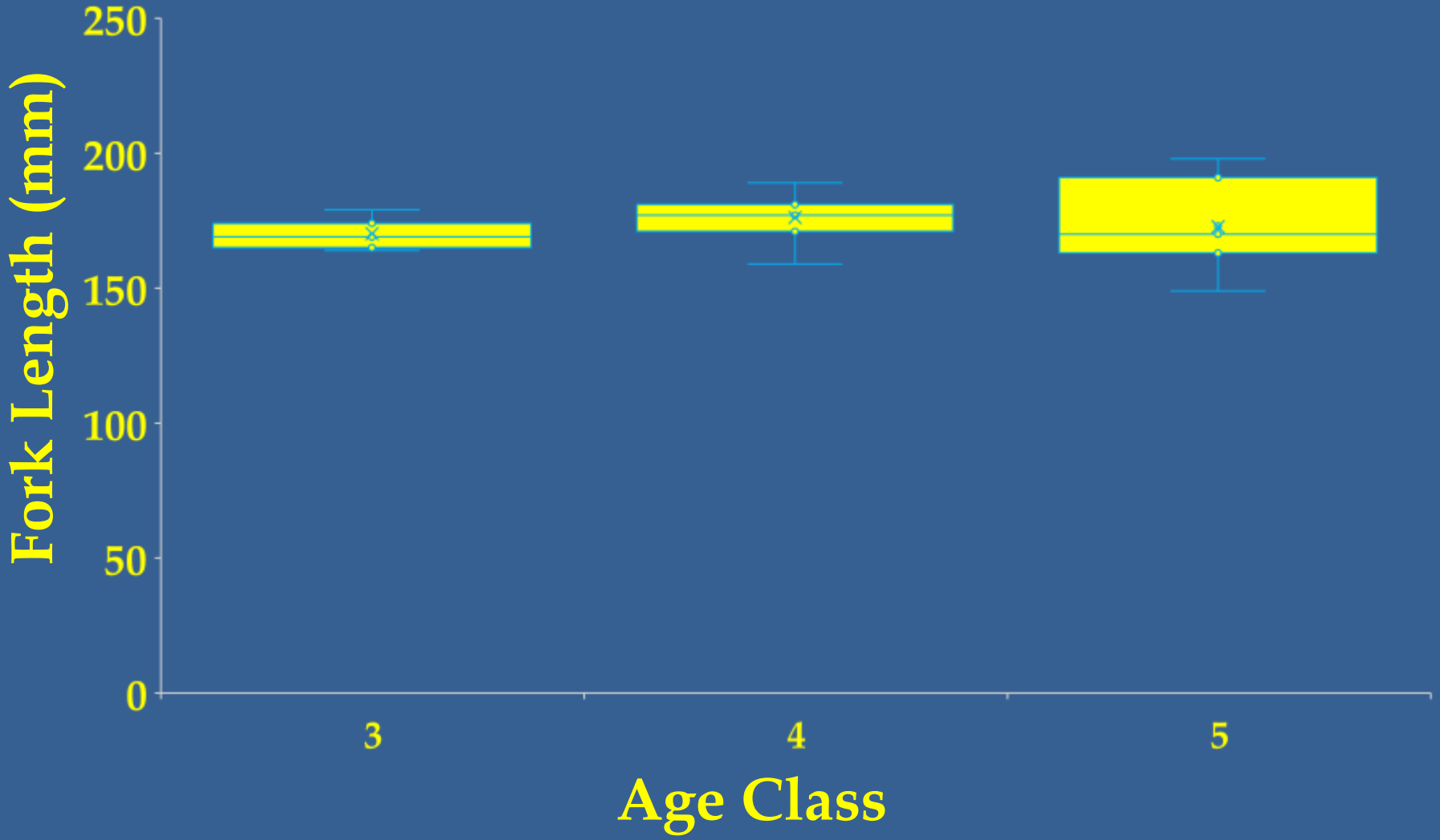




2013-18 Age and Length Comparison



1993-98 Age and Length Comparison



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Reasons For Population Decline

Ocean Conditions

Reasons for Population Decline

Bycatch

…"It seems probable most eulachon captured offshore of Vancouver Island spawn in the Columbia River" (Hay et al 1999)

Reasons for Population Decline

Predation

Reasons for Population Decline

River Conditions

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What Have We Learned?

1. Smelt will drive you crazy!

2 .We have a better understanding of how biological data ties to ocean conditions.

3 We have improved run forecasting.

4. We have determined some spawning parameters.

5. We need funding for monitoring and research

Future Considerations

1. Improved run forecasting

- Oceanic monitoring
- Prey Resources
- Run return monitoring

2. Research spawning parameters

- Spatial and temporal distribution (eDNA?)
- Hydroacoustics

3. Population structure

- Age structure
- Fecundity

I would like to thank the following people for their help and support;

Andrew Claiborne; for awesome otolith work

Greg Lippert; my IT and historical data guru

NOAA; for all their wonderful Ocean data

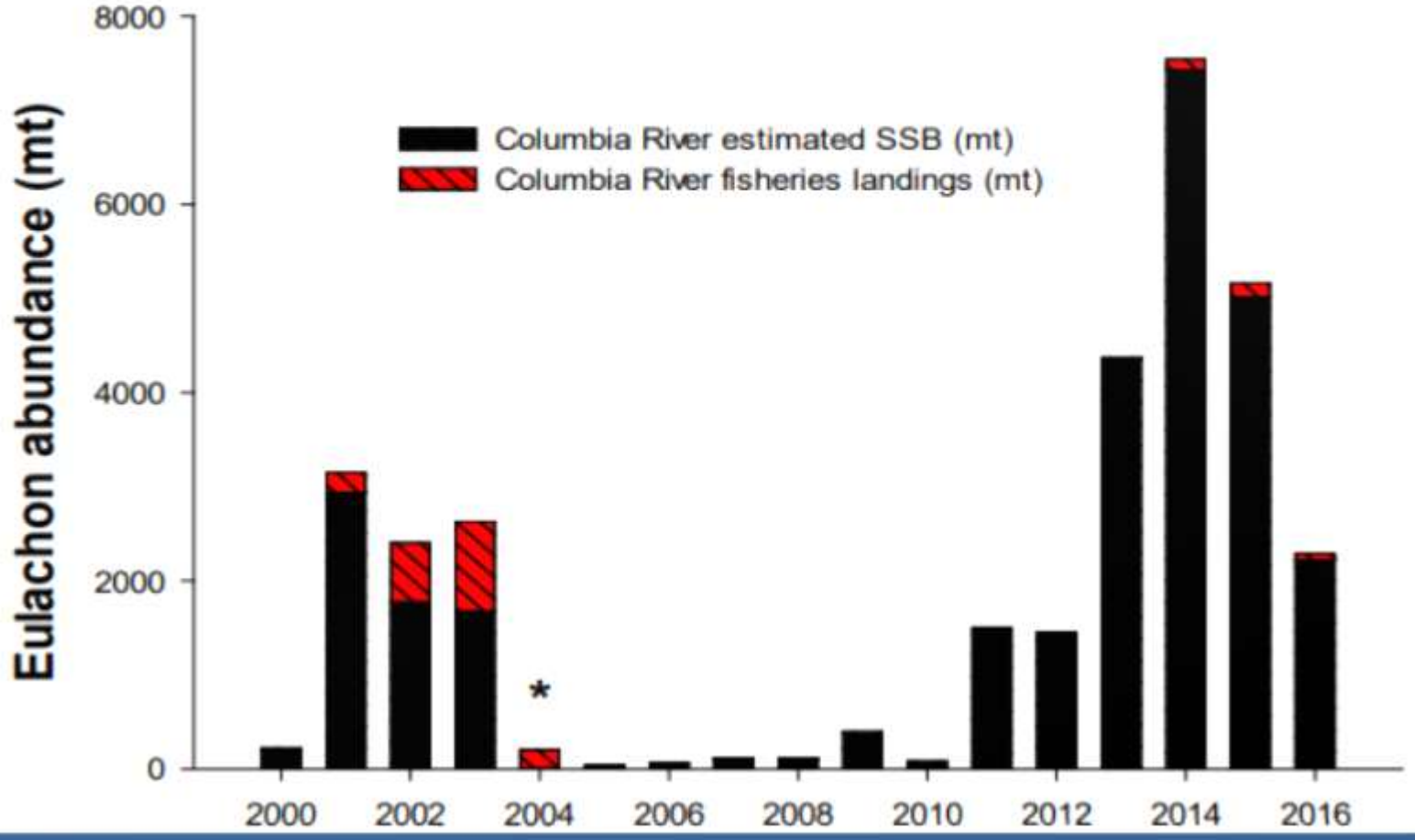
Olaf Langness; my boss and the eulachon master

Nicole Czarnomski; For her invitation and support

Laura Heironimus; For her input and computer skills

Commercial Smelt Dipping

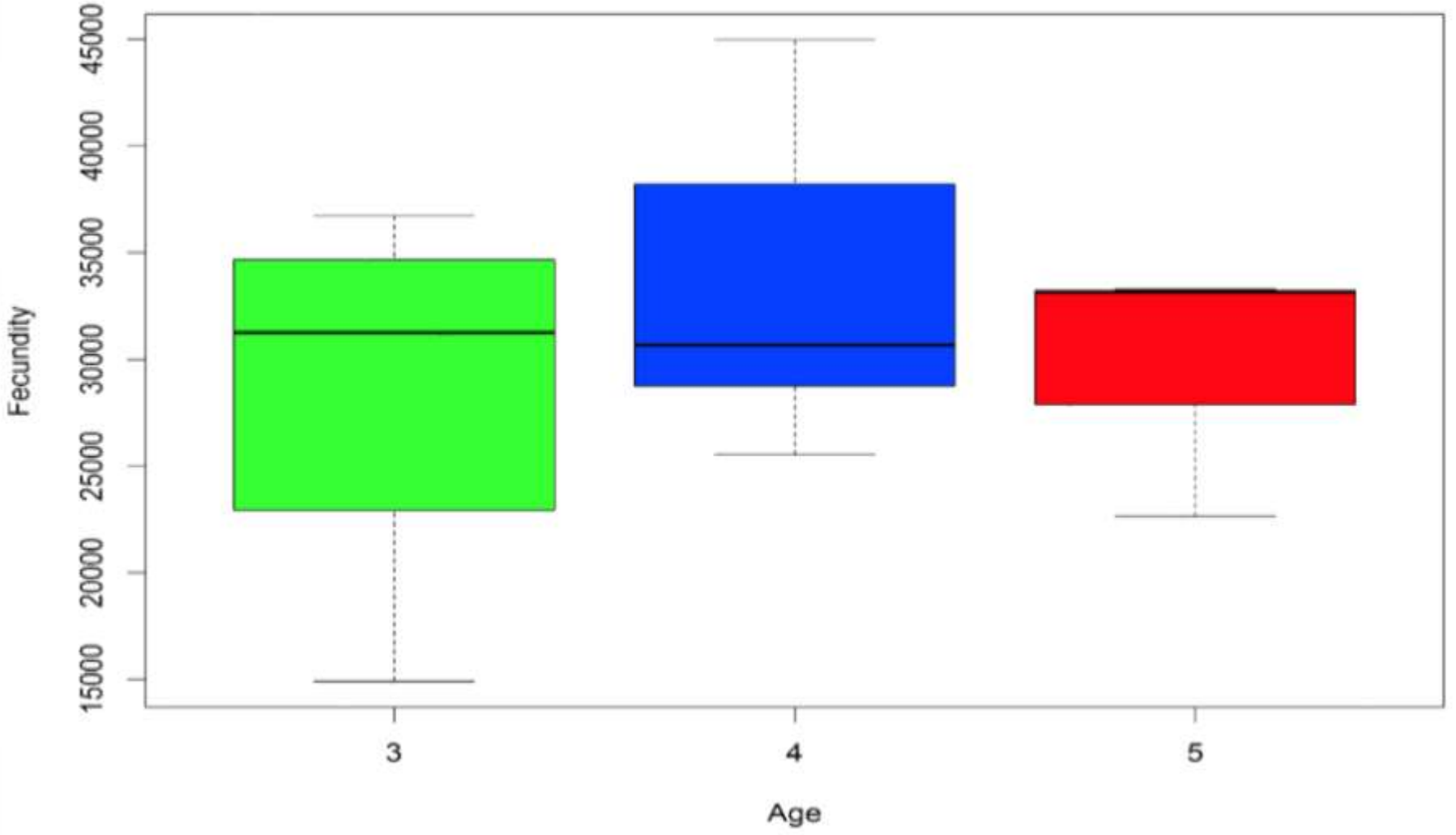
Columbia River SSB



Shrimp Boat Bycatch

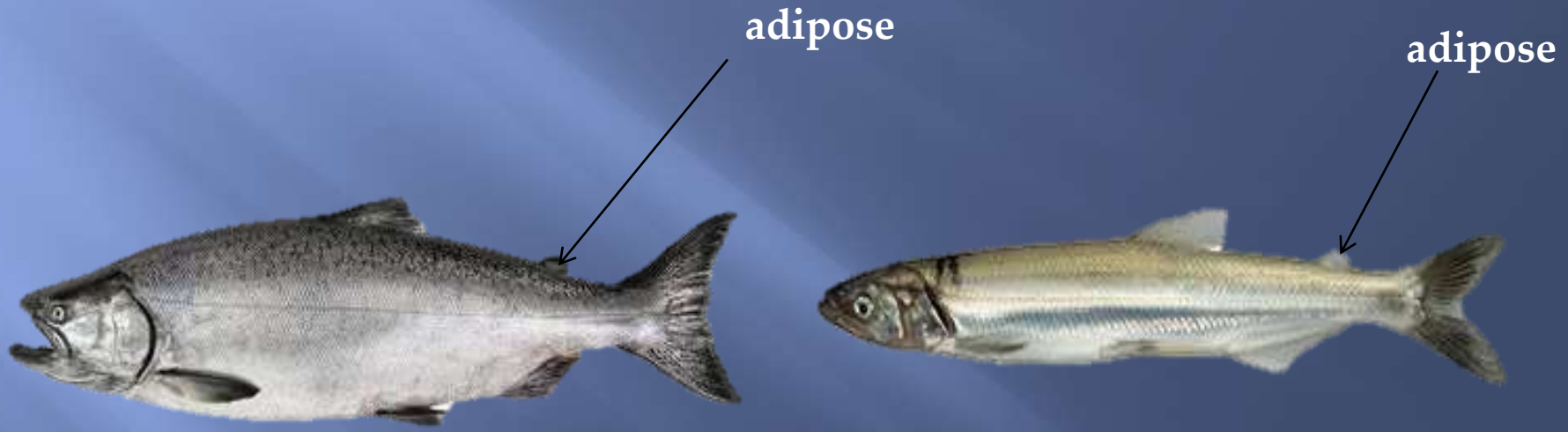
	Eulachon bycatch (mt)					Eulachon bycatch (numbers of fish)				
Year	Washington	Oregon	California	Coastwide bycatch	95% CI	Washington	Oregon	California	Coastwide bycatch	95% CI
2004	--	2.88	0.31	3.19	0.33 8.97	--	146,388	11,442	157,780	11,642 498,887
2005	--	4.95	0.23	5.18	2.65 16.19	--	207,362	9,848	217,210	21,542 453,326
2006	--	--	--	--	-- --	--	--	--	--	-- --
2007	--	3.90	0.17	4.07	0.73 11.99	--	197,807	11,450	209,257	15,062 549,978
2008	--	10.33	0.25	10.58	5.68 14.22	--	389,604	24,793	414,397	114,334 796,455
2009	--	8.71	0.74	9.45	3.87 24.65	--	845,081	113,815	958,896	237,377 2,169,745
2010	2.06	13.70	2.45	18.22	10.73 22.90	64,735	748,501	267,057	1,072,294	540,065 1,899,846
2011	5.68	20.45	0.03	26.16	20.44 29.78	123,543	480,907	471	604,921	397,957 876,346
2012	156.69	427.95	6.88	591.52	507.83 704.84	14,218,507	28,065,308	337,344	42,621,159	26,830,708 58,828,252
2013	202.83	540.06	0.72	743.61	603.07 967.13	17,095,225	34,686,116	16,684	51,798,025	31,753,502 73,944,039
2014	142.22	636.37	6.56	785.15	589.14 965.66	13,417,079	54,735,346	611,152	68,763,577	45,201,130 96,974,077
2015	219.78	361.23	32.34	613.36	482.83 716.84	22,389,318	35,310,975	2,050,791	59,751,084	40,883,332 82,986,695

2015 Fecundity Graph



So Why Are Eulachon Important

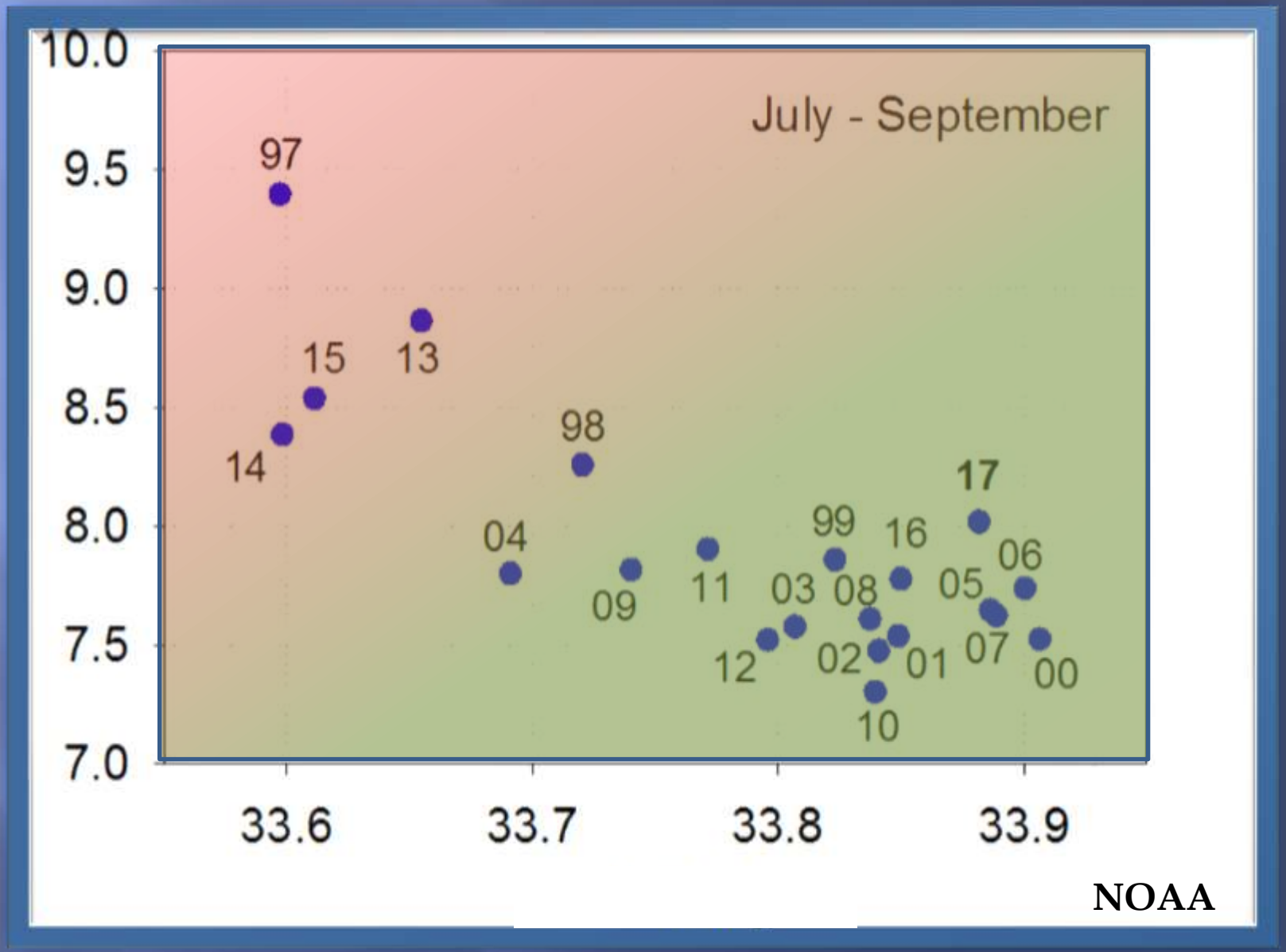
Smelt Through a Salmon Lens



Semelparous

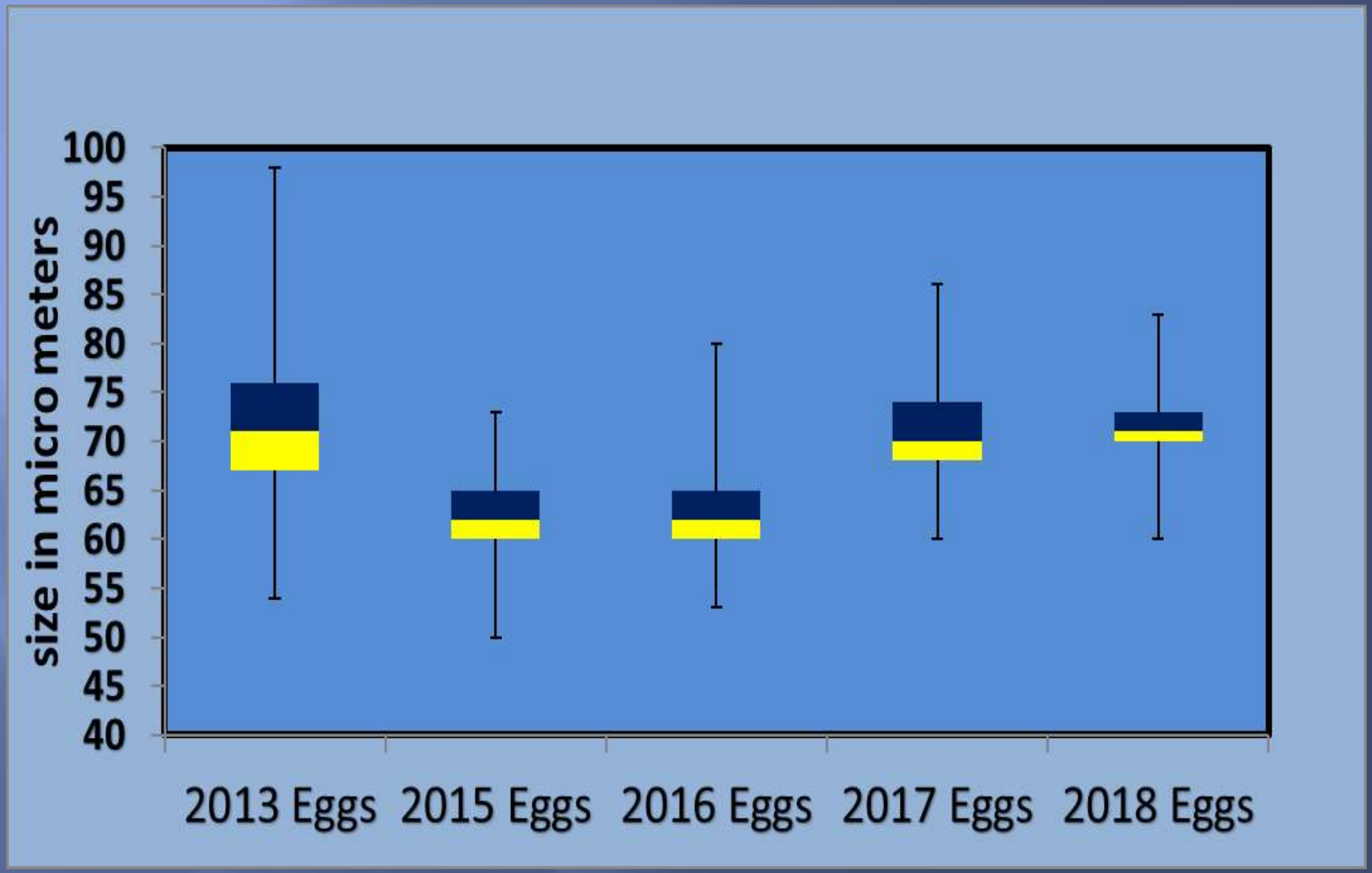
Anadromous

Ocean Conditions



Salinity

Egg Diameter by Year

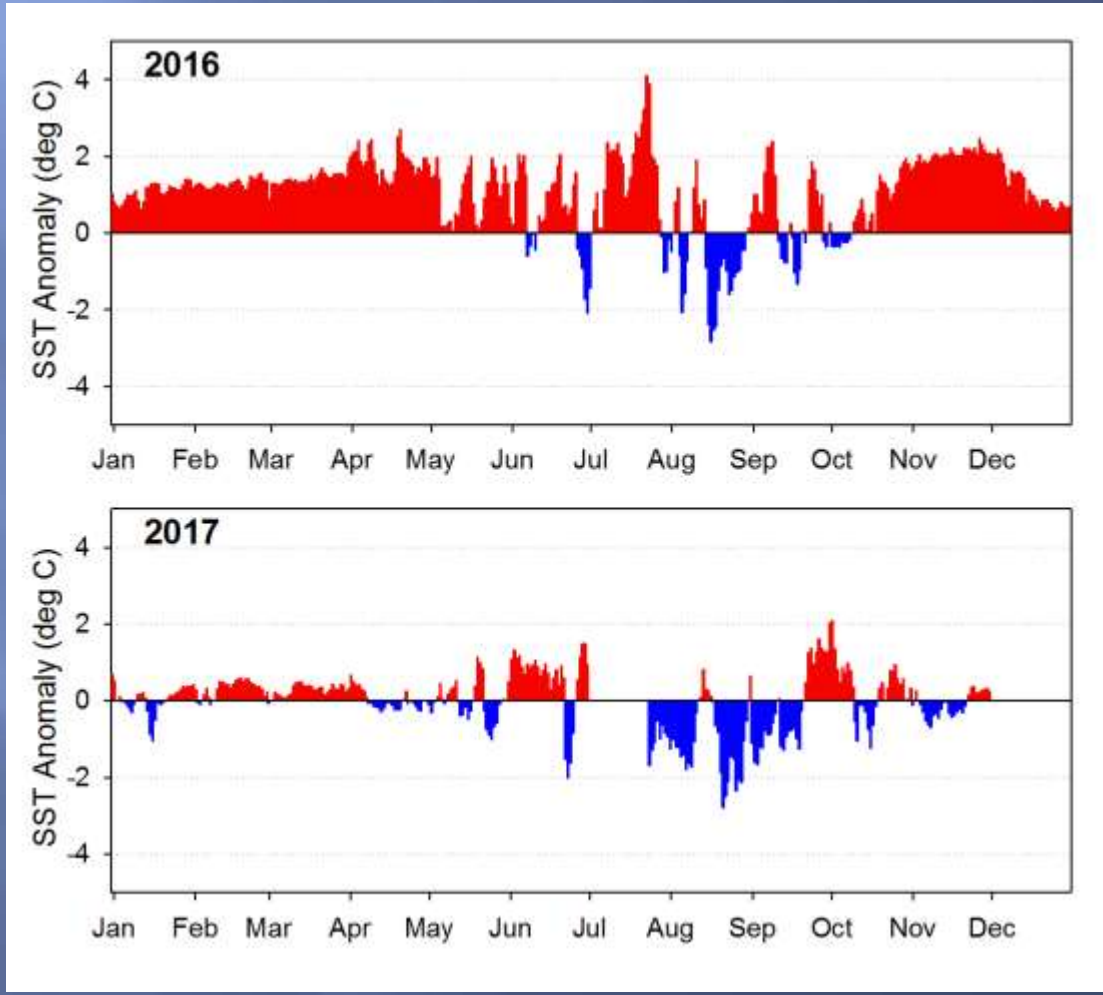


Age composition of Columbia River eulachon, 1992-1998

Age Composition				Average Length (mm) by Age		
Year	3	4	5	3	4	5
1992	26%	49%	25%	169	189	191
1993	39%	39%	22%	164	159	149
1994	66%	28%	6%	179	177	165
1995	41%	46%	13%	171	181	198
1996	56%	39%	5%	169	179	170
1997	60%	33%	7%	165	171	163
1998	56%	37%	7%	174	182	176
Average	***49%***	***39%***	***12%***	***170***	***177***	***173***

(WDFW 2001)

A Closer Look at 2016-17



So Why Are Eulachon Important

80% of large hake(>500mm) diet is comprised of eulachon (2011 Gustafson et al)

Reasons for Population Decline

Over Harvest

Historic Issue