Ecological Change and Resilience in Oregon's Salmon and Columbia River Estuaries

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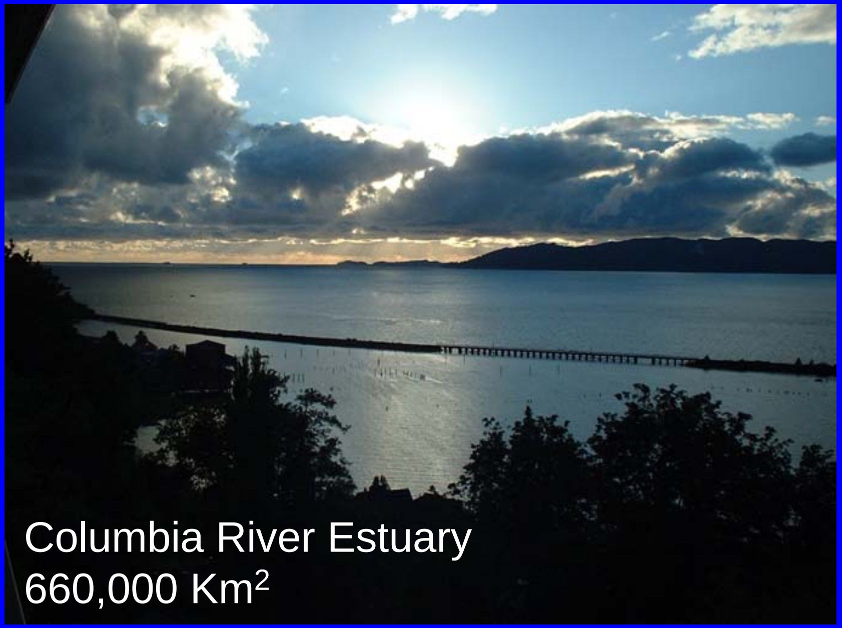
Salmon River Estuary
194 Km^2

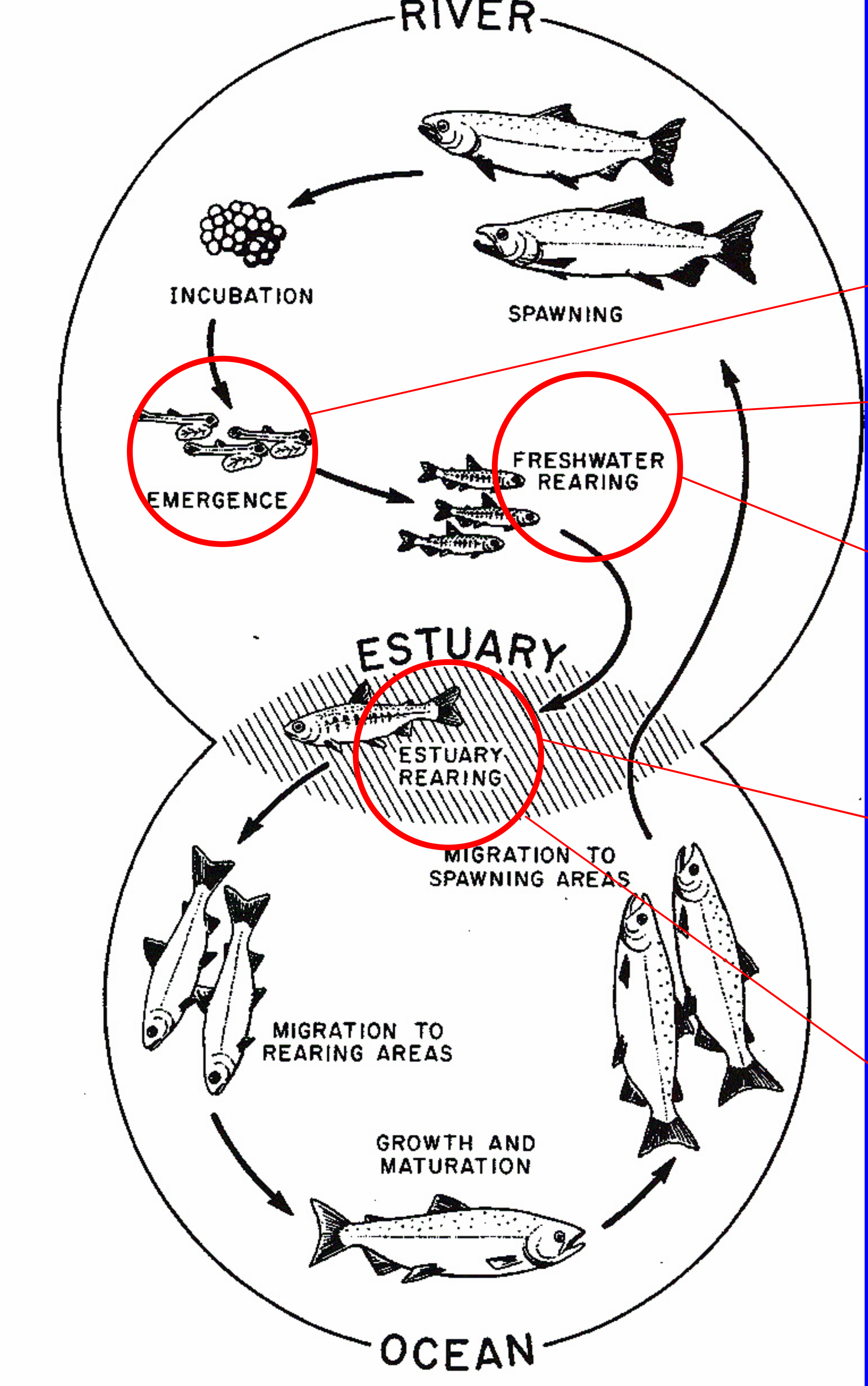


Columbia River Estuary
660,000 Km^2

- What changes have occurred?
- Are these systems (and their salmon populations) resilient to future disturbance?

Salmon Ecosystem

A system of organisms and environments linked to salmon populations or groups of populations

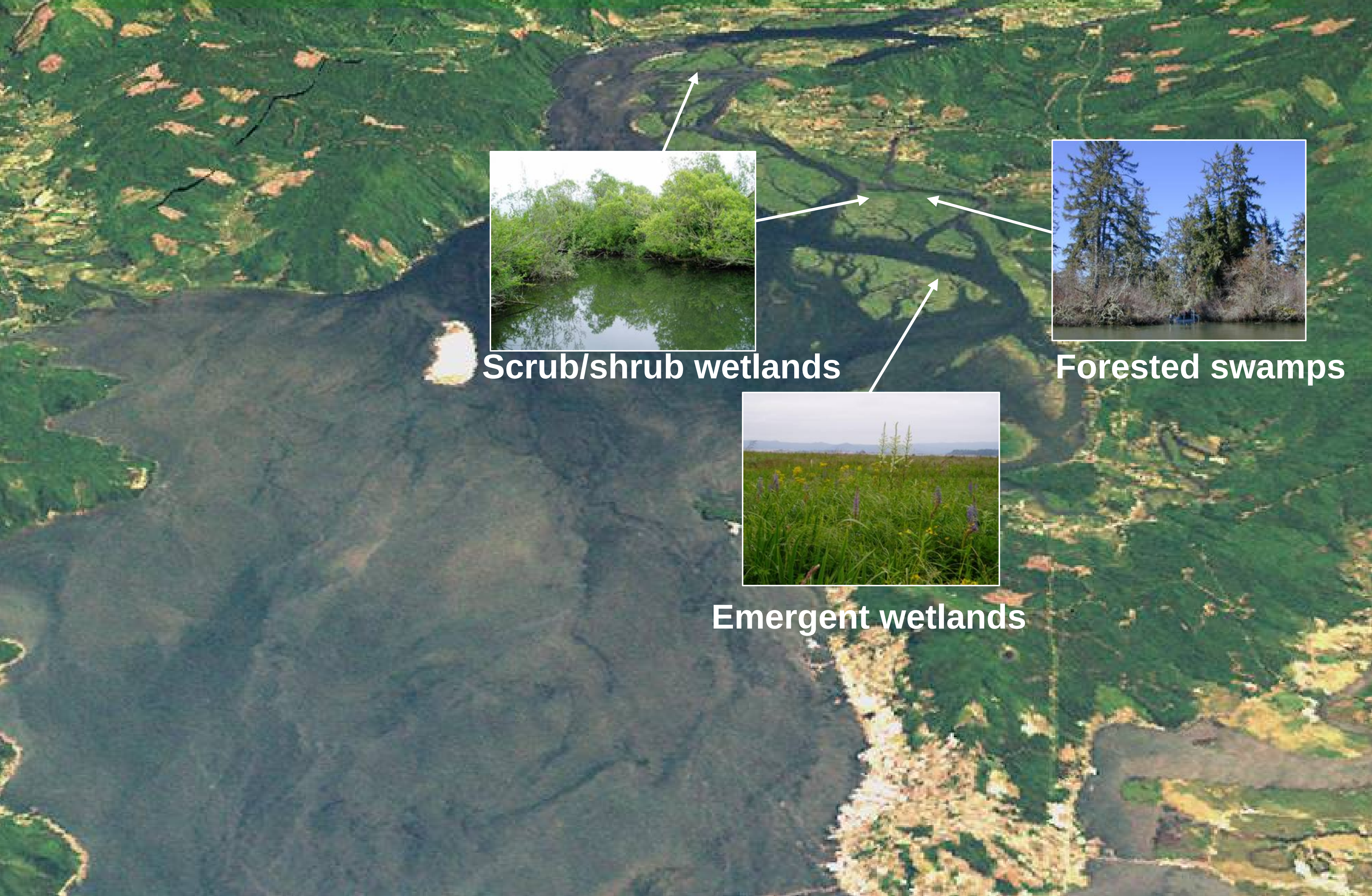


Life History Diversity

- Fry migrants
- Subyearling migrants
- Yearling migrants
- Subyearling migrants (mid summer)
- Subyearling migrants (late summer/fall)

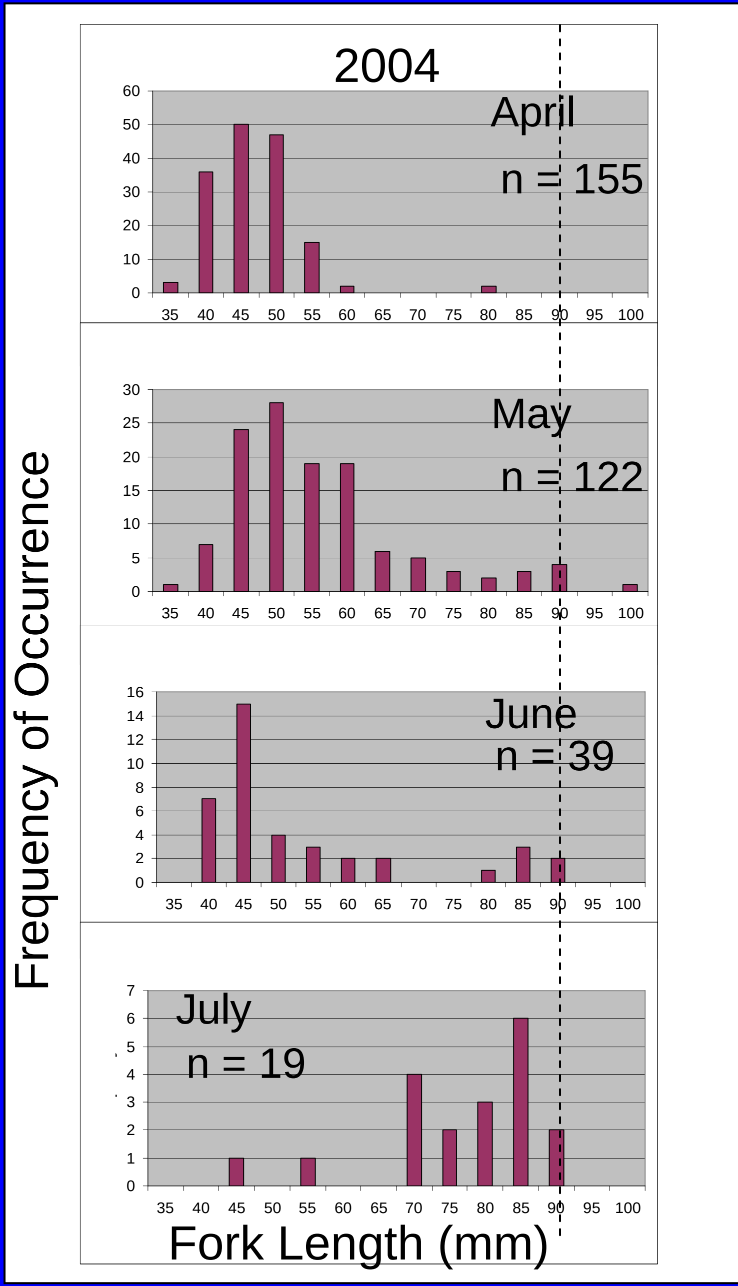
From Reimers 1973

Salmon with subyearling life histories use all wetland types along the tidal gradient



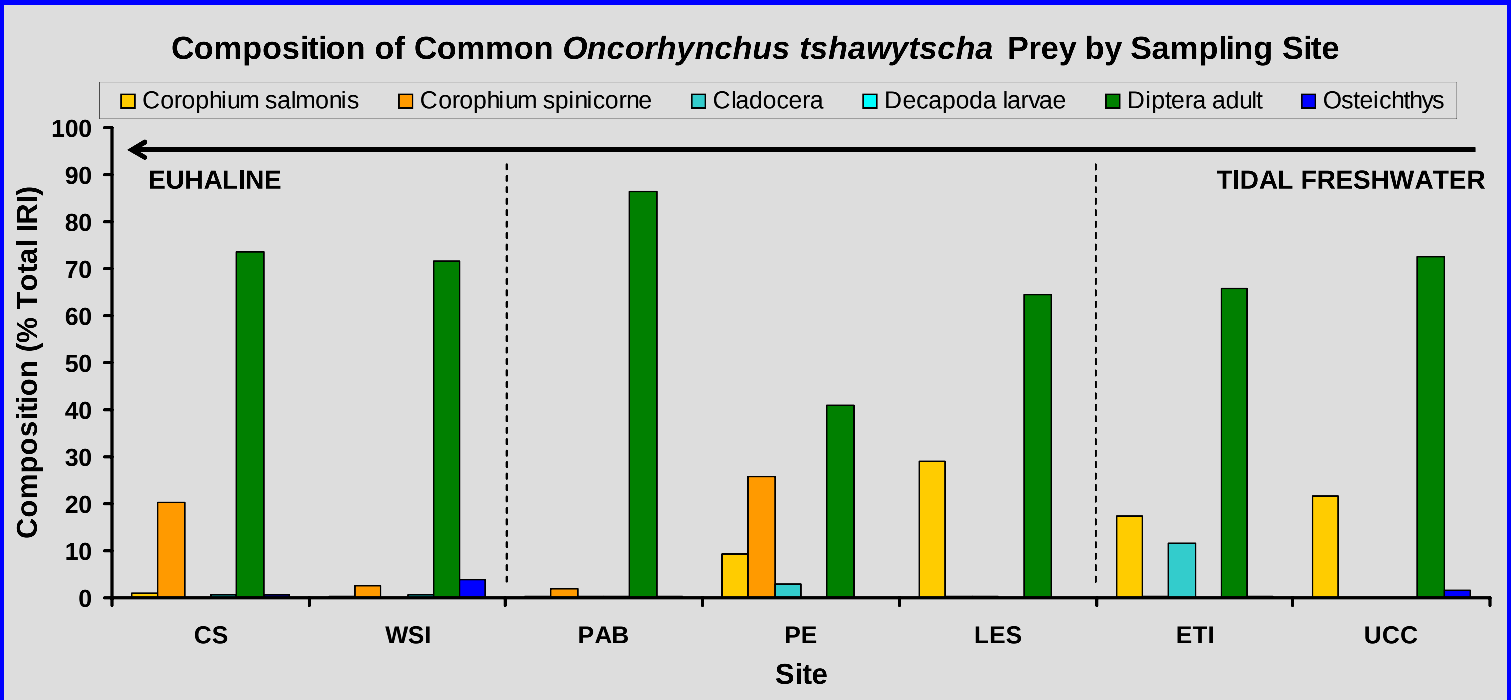
Estuarine habitat use by juvenile salmon is size-related

Chinook Length Frequency in Wetland Channels



Tidal wetlands provide food and support growth of juvenile salmon

- Salmon feed in wetland habitats on insects and amphipods produced in these habitats
- Insects from wetlands and other shallow habitats are also a major food source of fish throughout the Col R. estuary
- Mean growth in emergent wetlands ~0.6 mm/day



Habitat Change Lower Columbia River Estuary

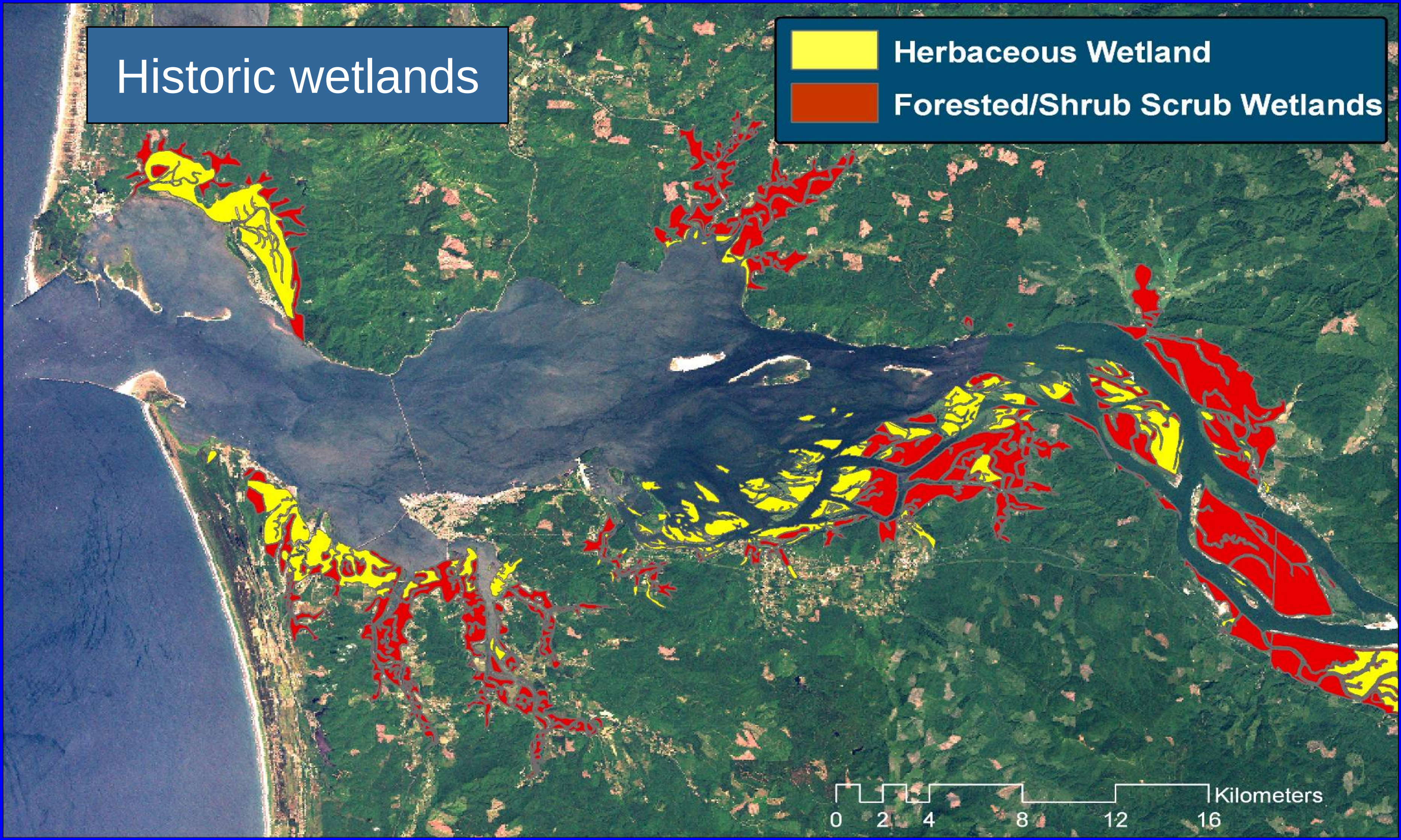


Image by: Jennifer Burke, UW

Habitat Change Lower Columbia River Estuary

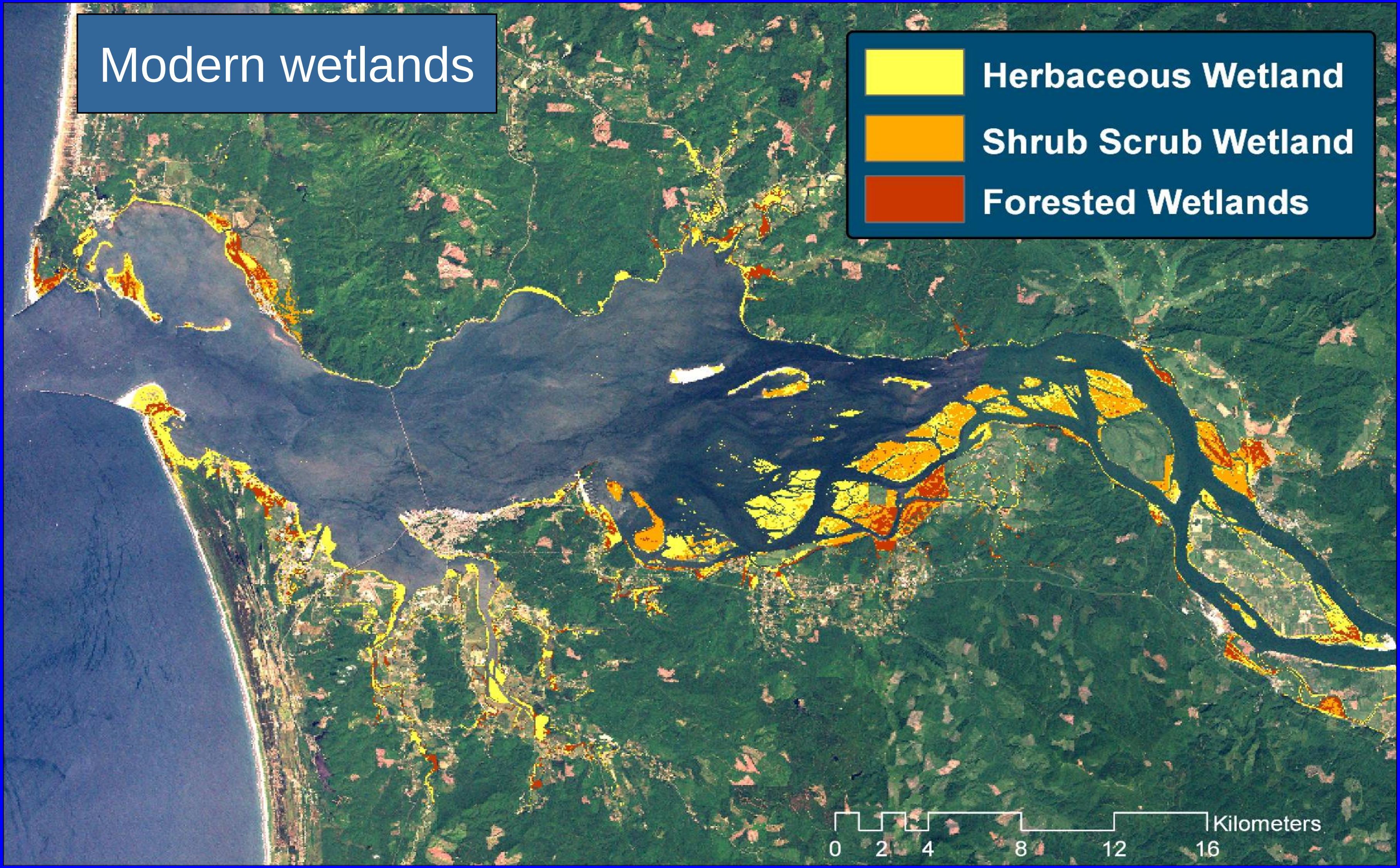
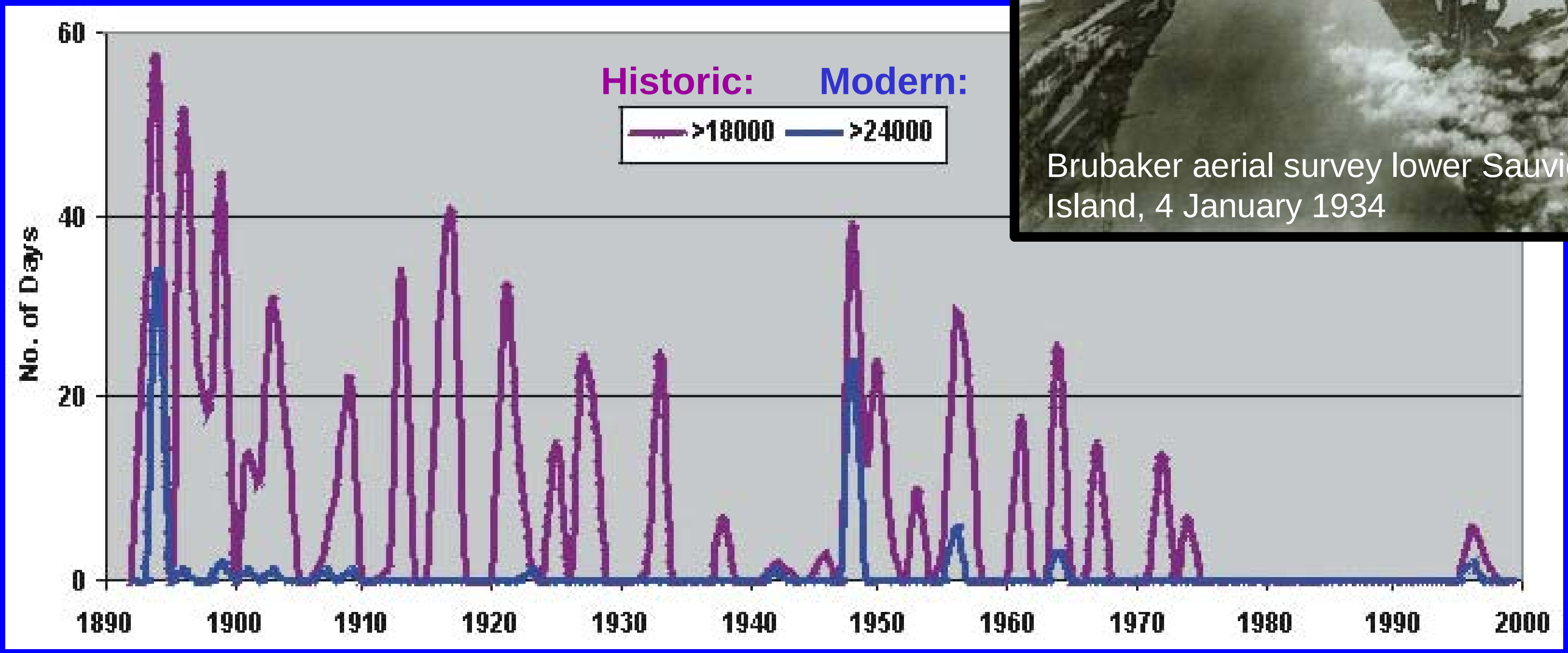


Image by: Jennifer Burke, UW

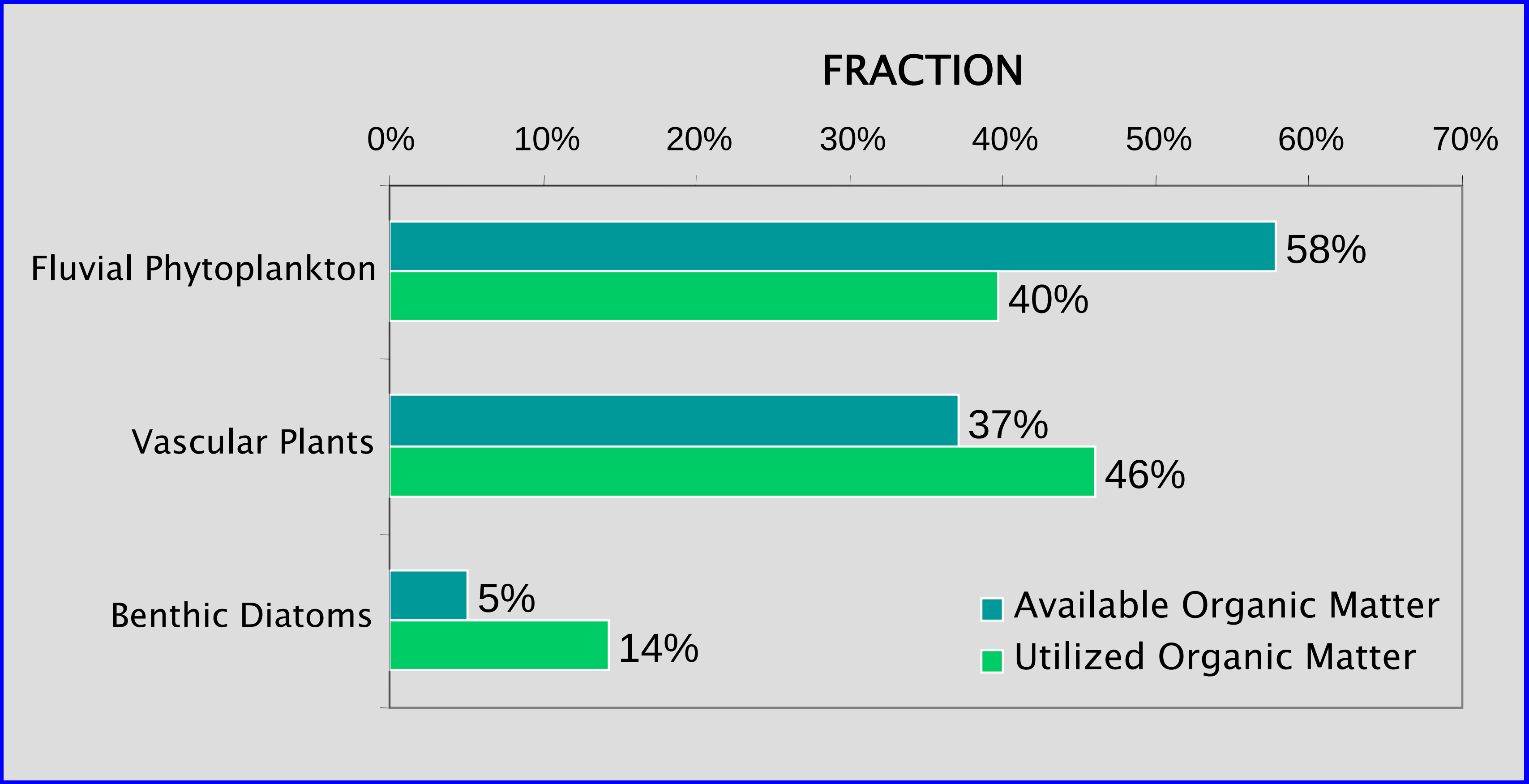
The tidal river has been disconnected from its floodplain



Brubaker aerial survey lower Sauvies Island, 4 January 1934

- Overbank flows now rare and floodplain inaccessible to fish
- Reduced delivery of nutrients, organic matter, salmon prey, and structure (large wood)
- Impact on food webs

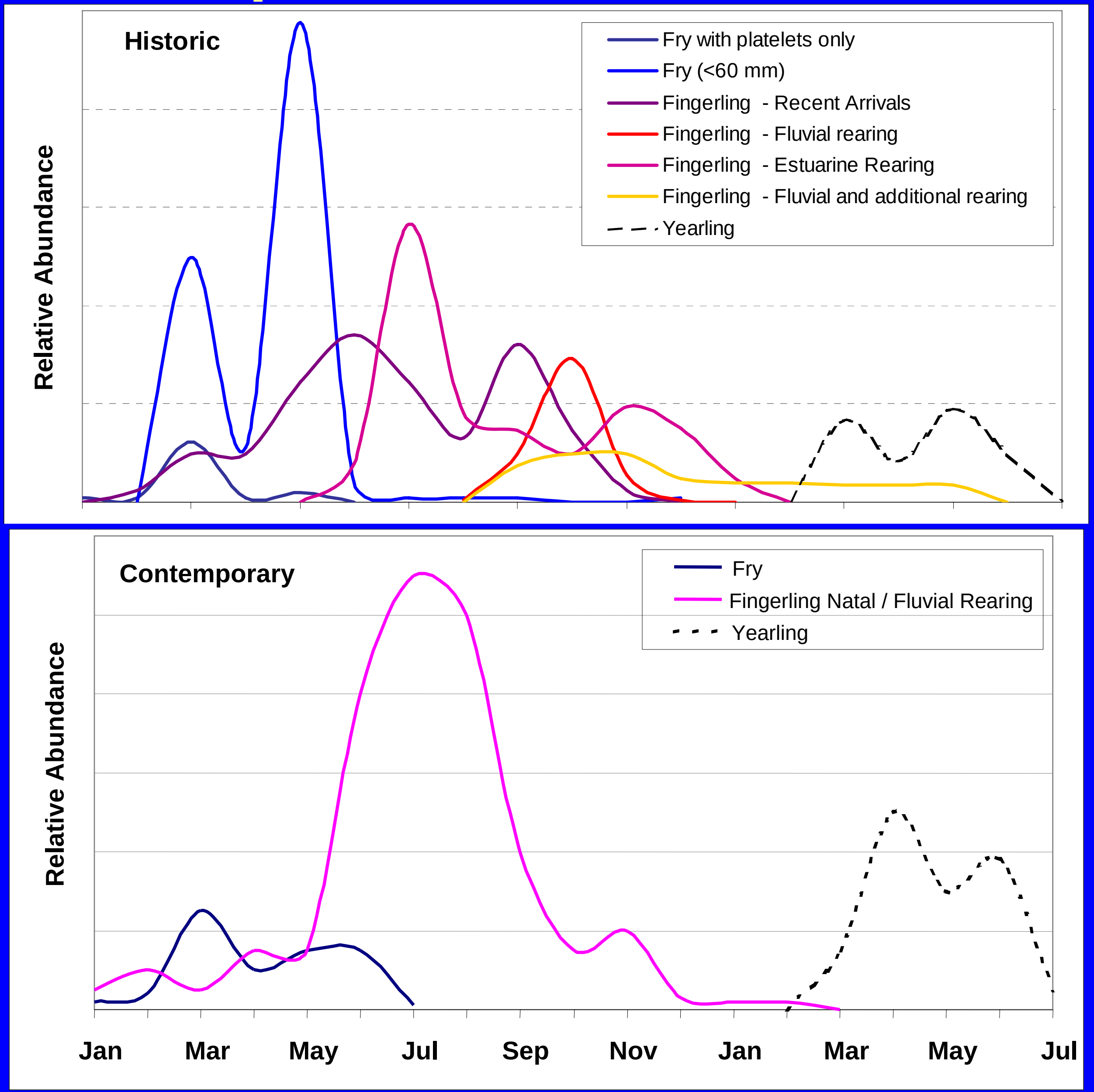
Salmon use wetland-derived food sources in greater proportion than their estuarine abundance



Available sources from Simenstad et al. (1990) and Sherwood et al. (1990). Utilized sources from Anderson (2006).

Juvenile Chinook life histories in the Columbia River been simplified

Estimated proportions of juvenile salmon life histories from historic and contemporary surveys



From Burke, 2005.
Data from Rich (1920)
& Dawley et al. (1985)

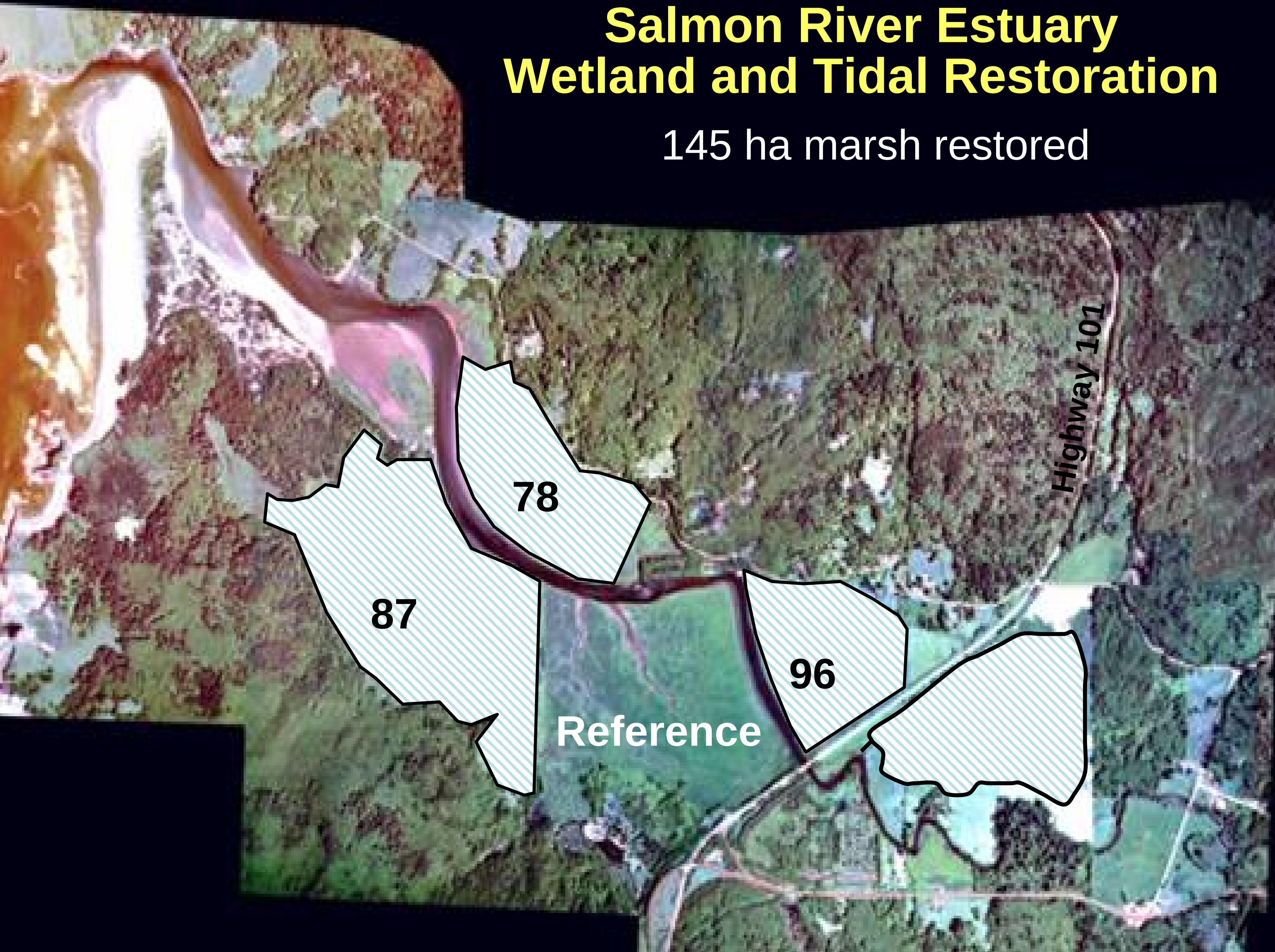
The Salmon River Estuary
Diked in 1960s

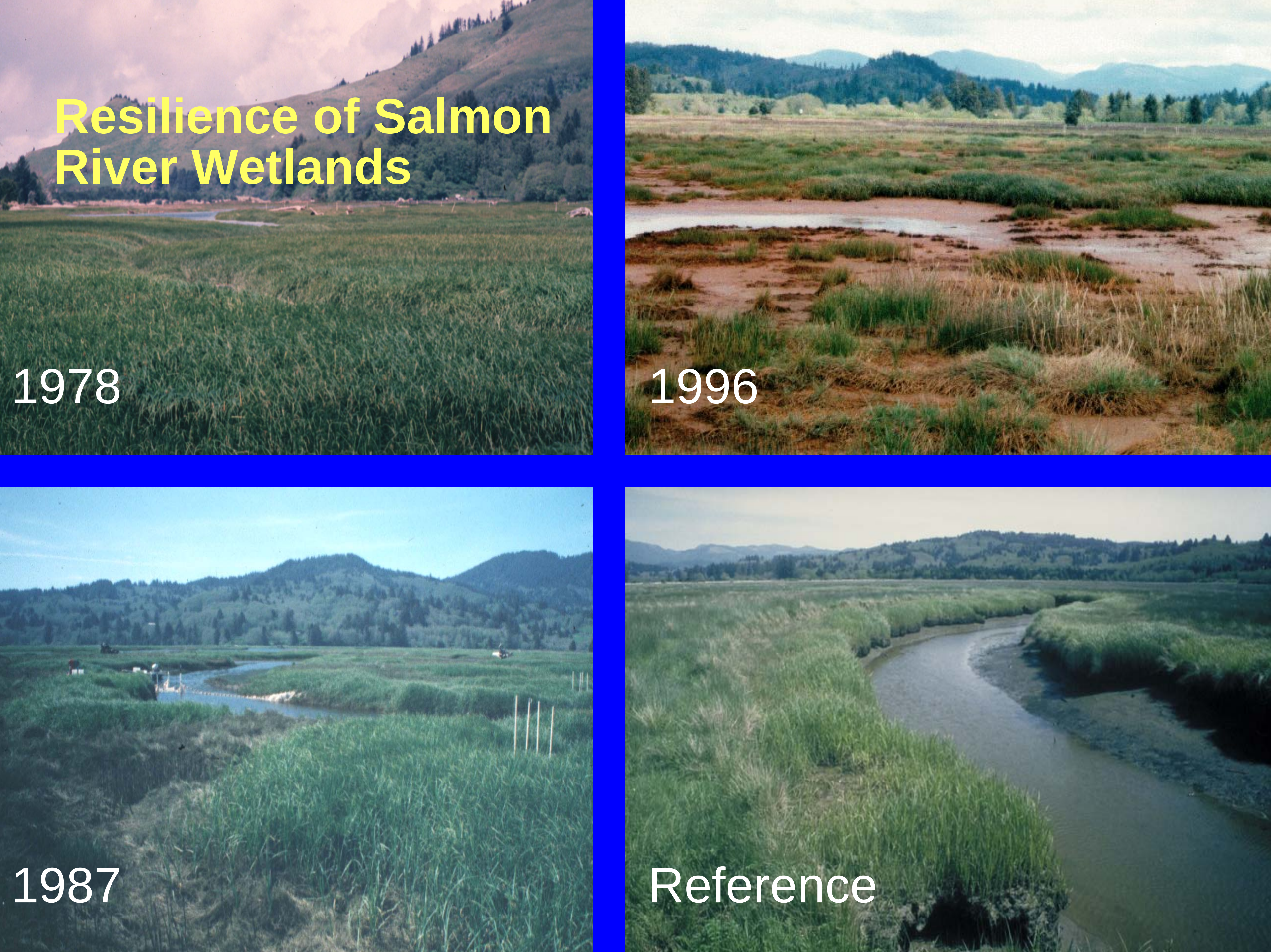
Pre-diking

Diked

Salmon River Estuary Wetland and Tidal Restoration

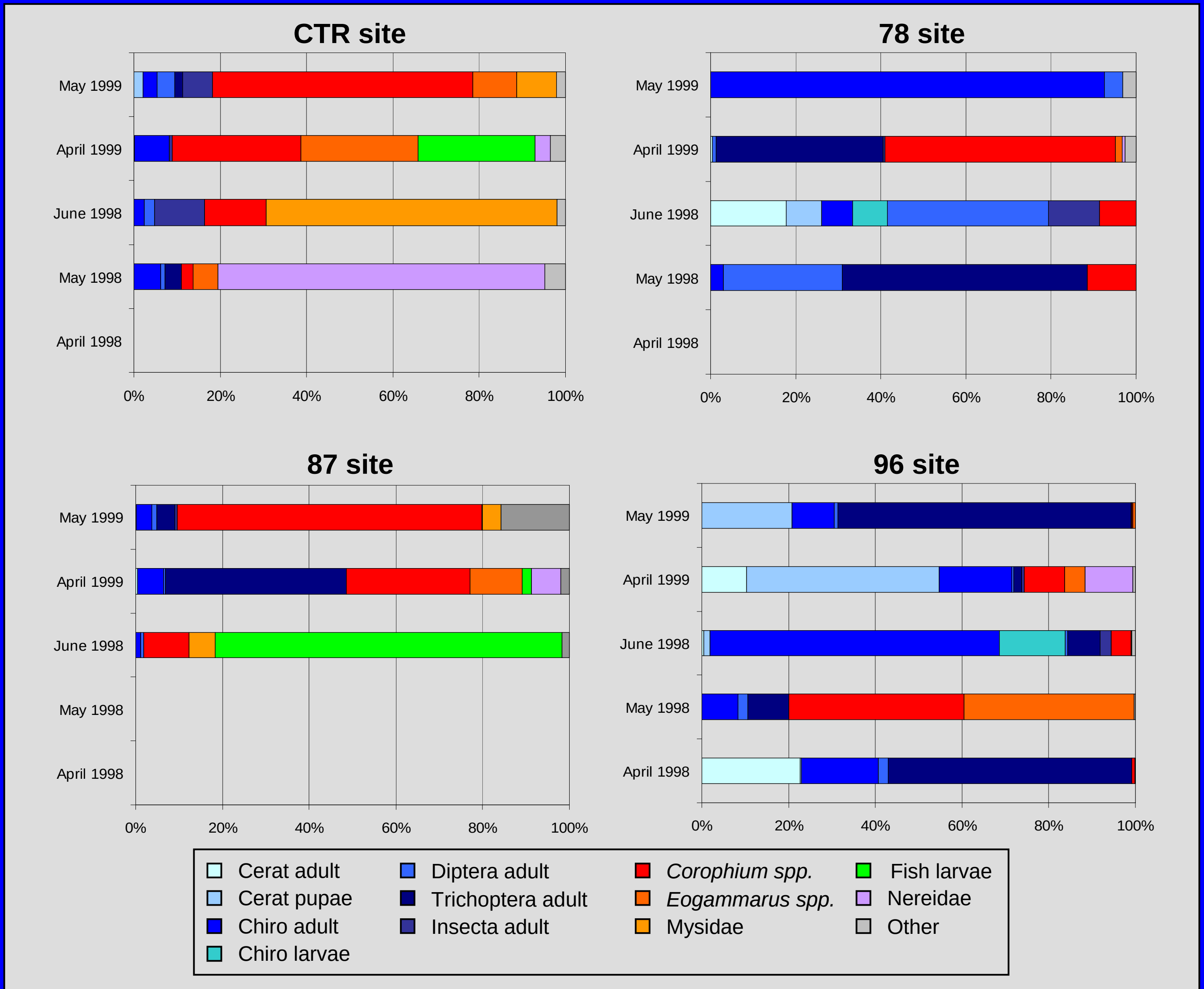
145 ha marsh restored




Resilience of Salmon River Wetlands
1978
1996
1987
Reference

Food webs supporting Salmon River Chinook are closely linked to emergent wetland sources

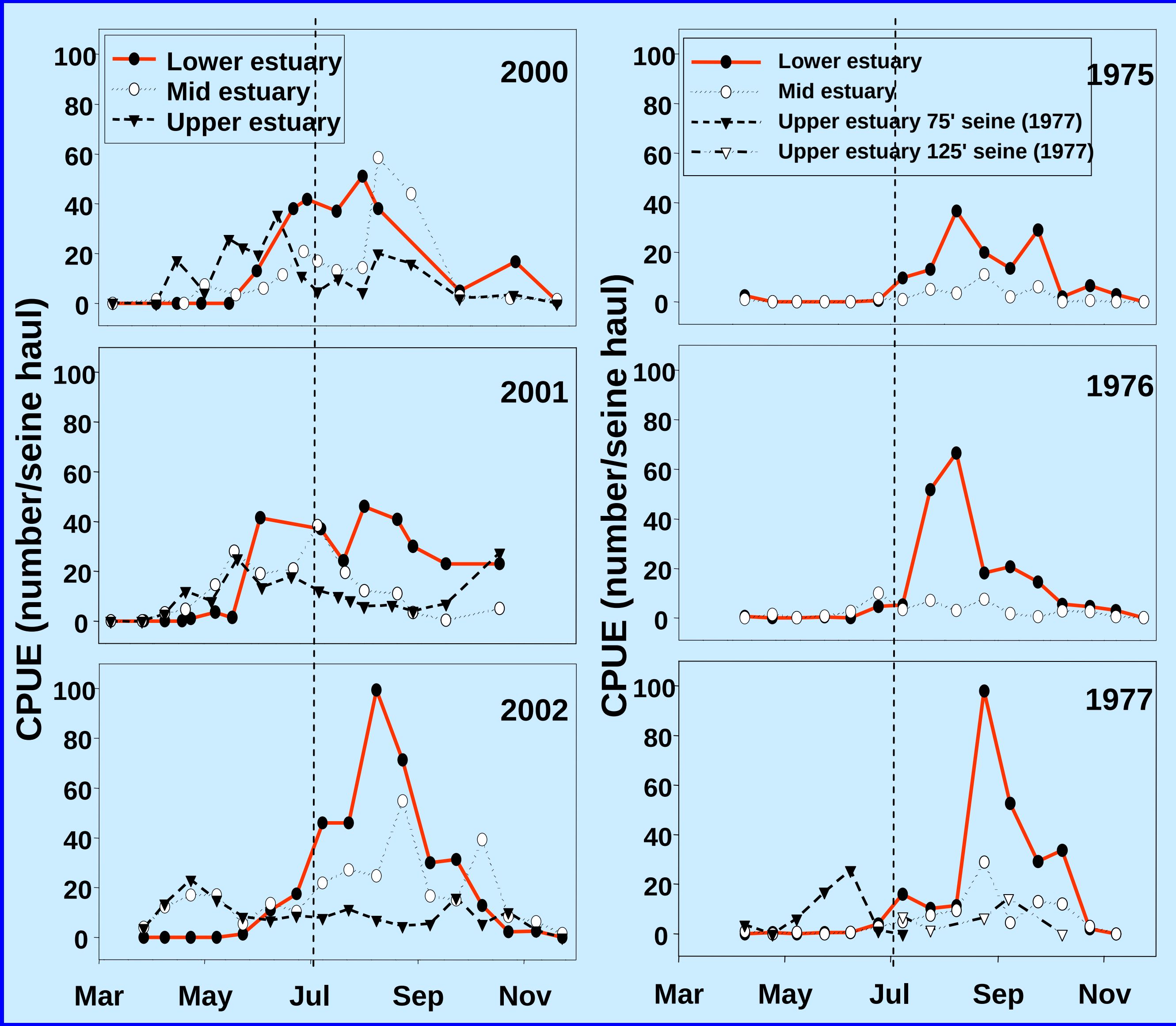
Juvenile Chinook Diet Composition



Can Life History Diversity be Restored?

Chinook Catch Salmon River Estuary

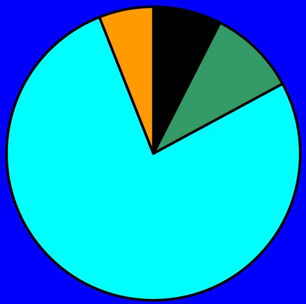
Life history diversity has expanded with increased wetland opportunity



All juvenile life histories contribute to adult returns at Salmon River

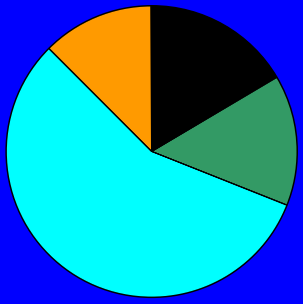
Life histories of juvenile outmigrants (BY 2001 & 02)

Emergent Fry	< 45mm	7%
Spring (MAM)	47 – 64 mm	10%
Summer (JJA)	55 – 96 mm	77%
Fall (SON)	97 – 109 mm	6%



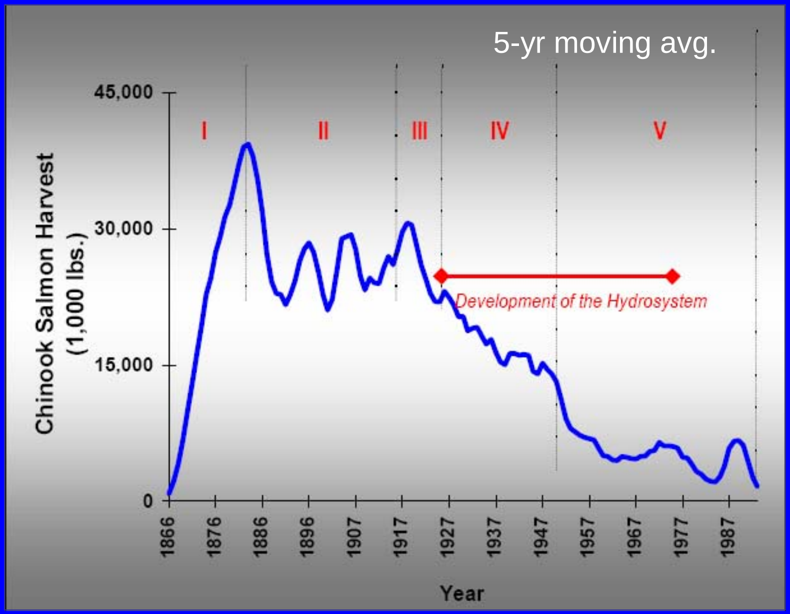
Juvenile life histories of returning adults (2004 RY; n=145)

Emergent Fry	<45 mm	17%
Spring (MAM)	45-60 mm	14%
Summer (JJA)	61-95 mm	57%
Fall (SON)	>95 mm	12%



Salmon and Estuary Resilience

- Management controls (dams, hatcheries, dikes) in the Columbia River have reduced the natural range of variability, modified food webs, and eroded estuary and salmon population resilience



From Mundy (2005)

- Dike removal in Salmon River estuary has reinforced population and ecosystem resilience by restoring wetland functions, terrestrial and epibenthic food webs, and diversity of salmon life histories

- It is unclear whether ecosystem processes in the Columbia River Basin are so altered that it has crossed a threshold to a persistent low-productivity regime that will be resistant to recovery