

Salmon Life Histories, Habitat, and Food Webs in the Columbia River Estuary, 2002-07



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Salmon at River's End:

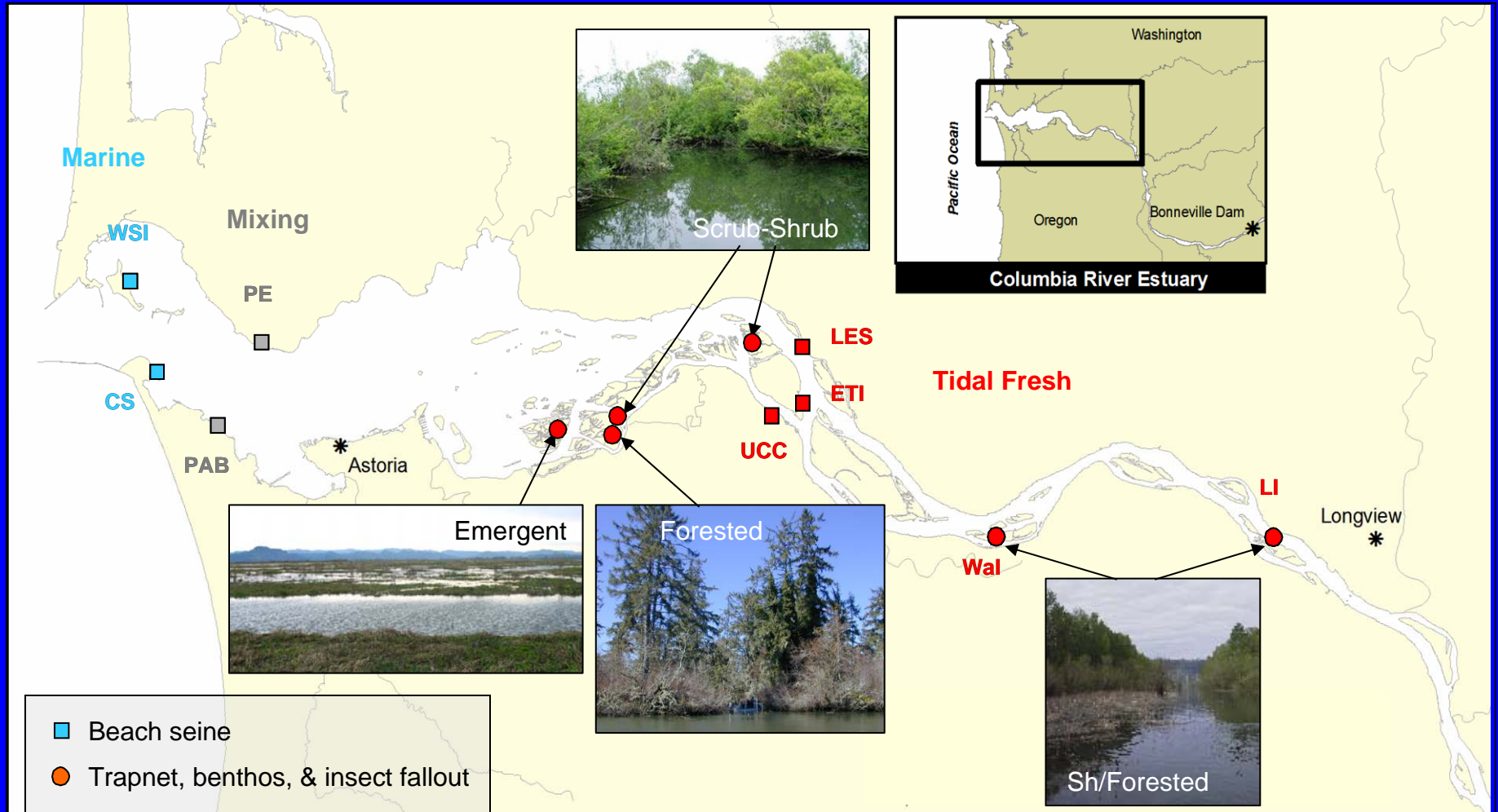
The Role of the Estuary in the Decline and Recovery of Columbia River Salmon



Changes in the estuary have contributed to salmon decline:

- Loss of estuarine habitat
- Reduced habitat opportunity and capacity (i.e., growth, foraging success, etc.) for salmon
- Reduced detrital sources for salmon food webs
- Reduced salmon life history diversity

Sample Sites, 2002-07

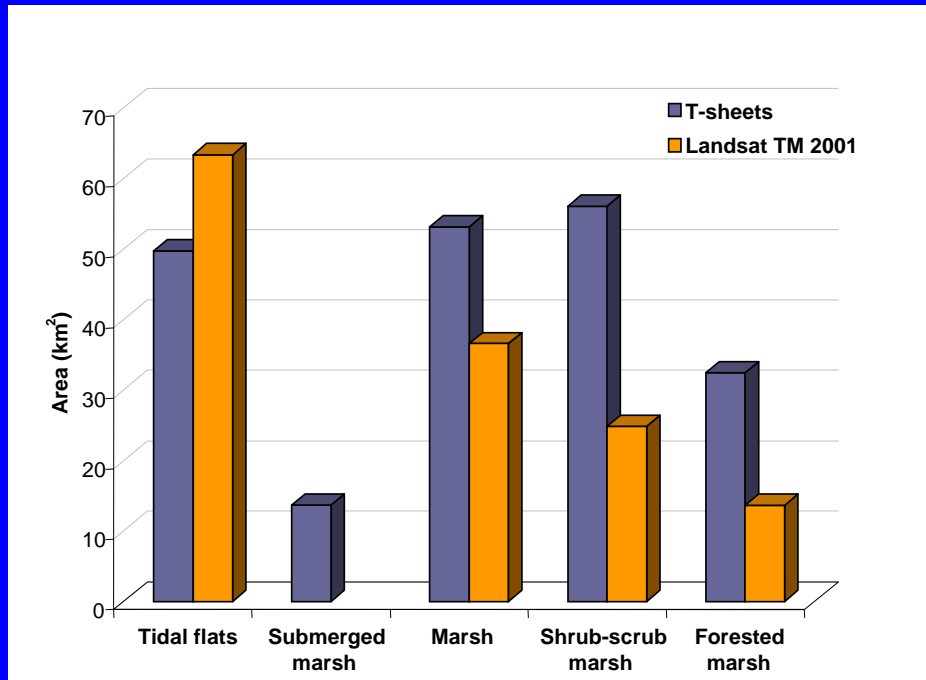


New tools:

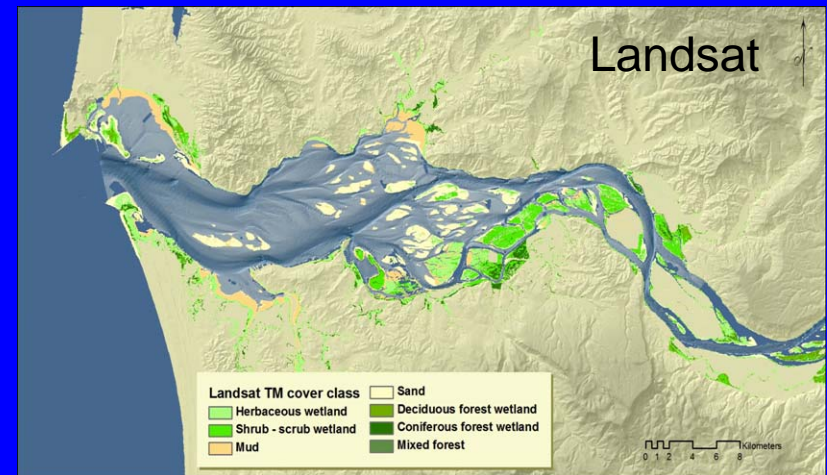
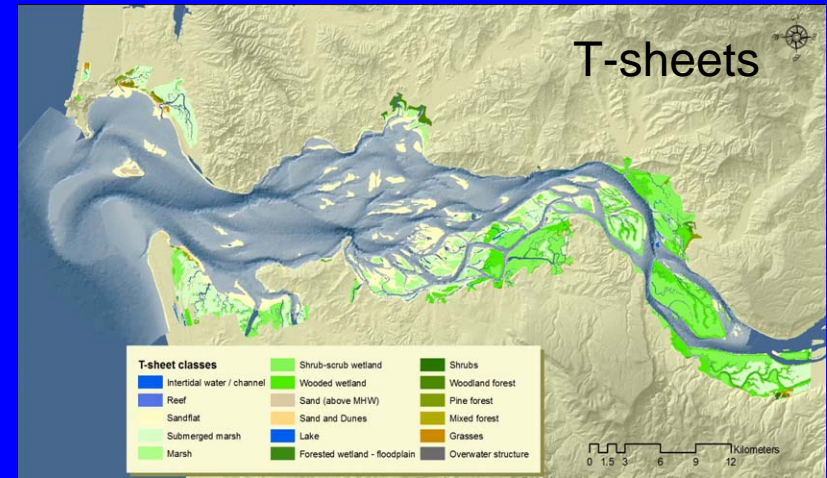
- GIS
- 3-D simulation model
- Otolith microchemistry
- PIT tag mark/recapture
- Stable isotope analyses
- Microsatellite DNA markers

Have estuarine habitats been lost?

Yes



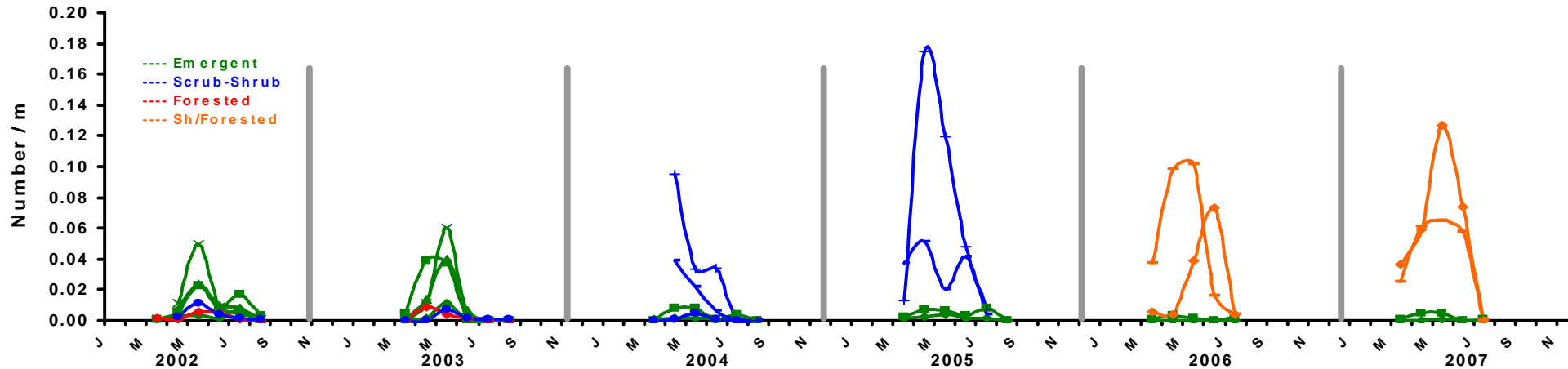
- Surface area of all wetland types has declined from 155 to 75 km² (>50%)
- Peripheral wetlands simplified or removed
- Loss of forested wetlands particularly high above Cathlamet Bay



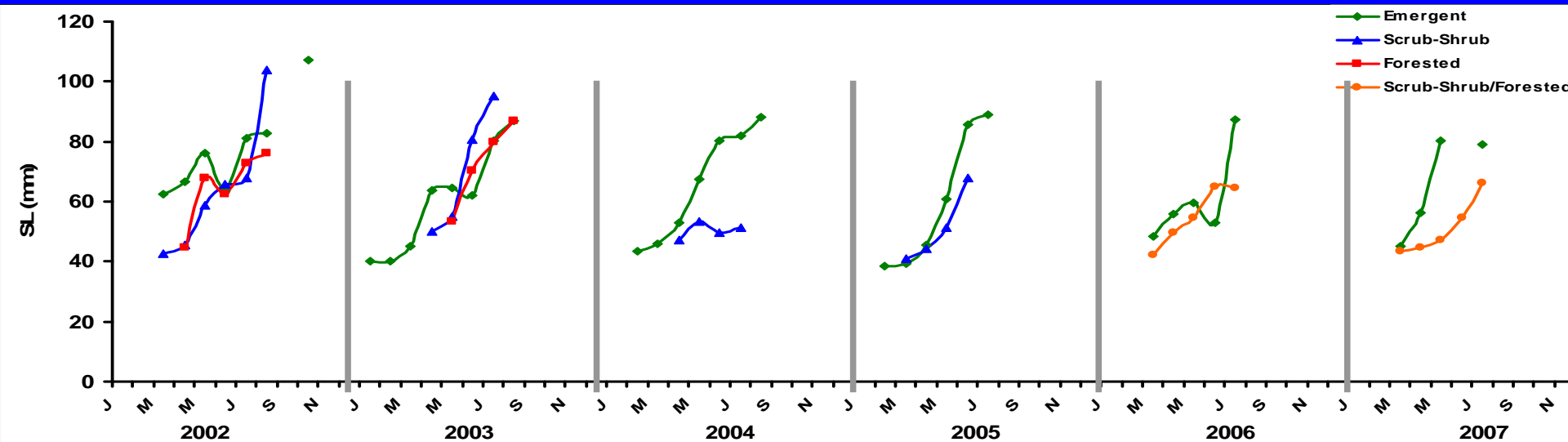
from Jennifer Burke

Have wetland losses reduced rearing opportunities for salmon? Yes

- Chinook salmon use all wetland types along the tidal gradient

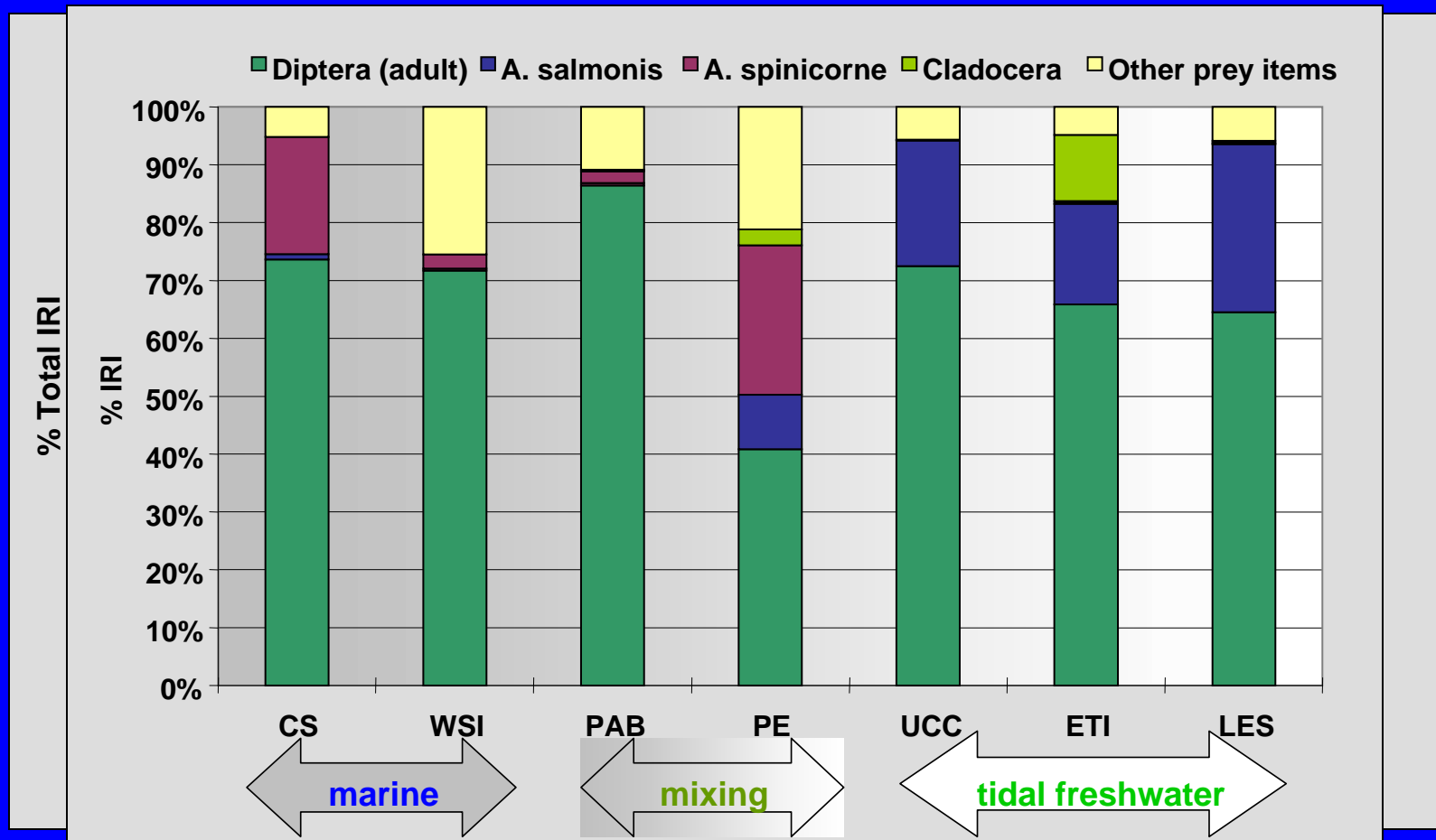


- Small Chinook with subyearling life histories favor wetlands

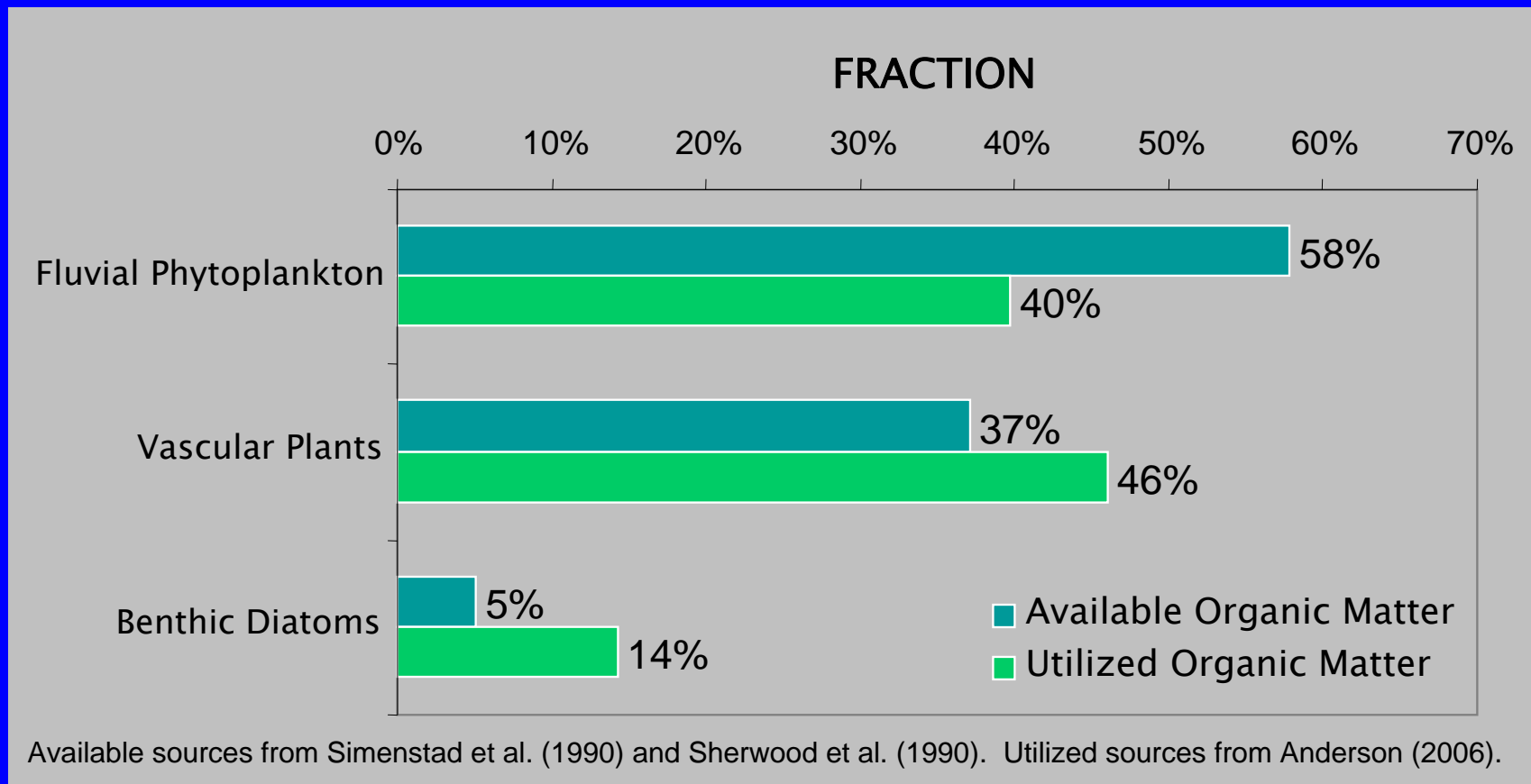


Estuarine wetlands provide food & support growth

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



Have habitat losses diminished salmonid food webs? Yes

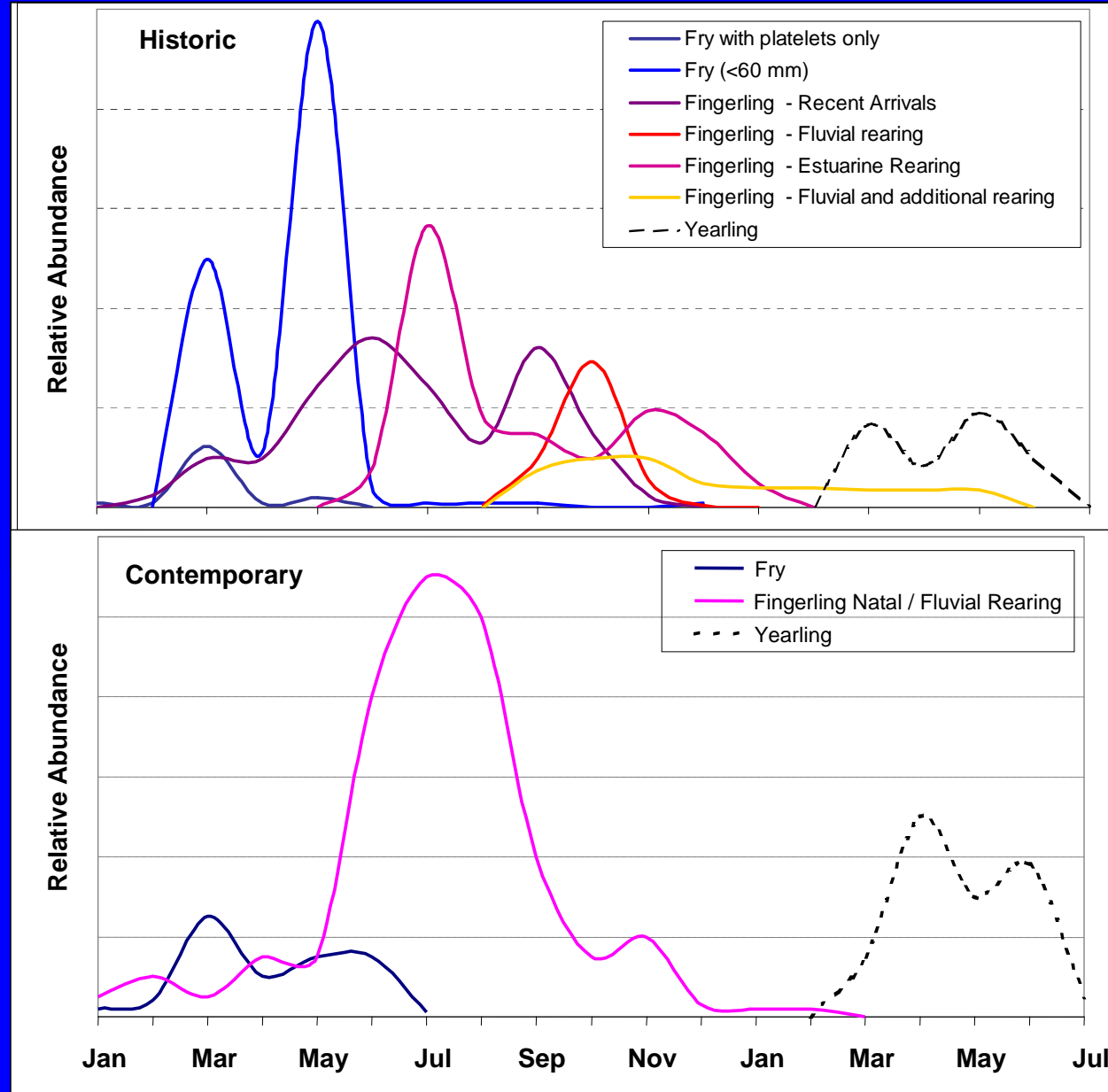


- Salmon disproportionately select wetland-derived food webs
- Enhanced fluvial food web may not make up for wetland losses
- Salmon interact substantially with marsh food webs and on average for weeks to months

Have Chinook salmon life histories been simplified?

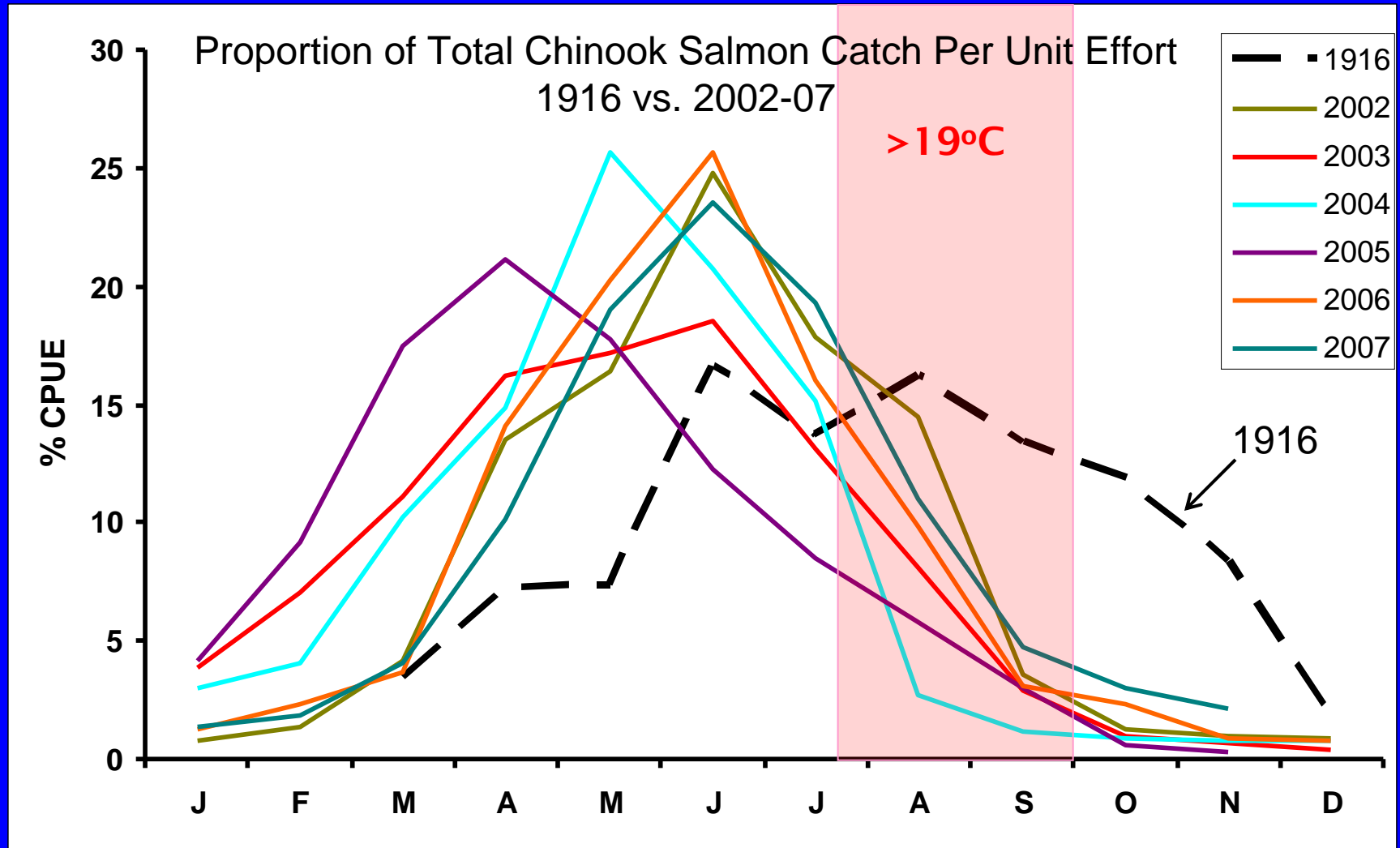
Estimated changes in the relative proportions of juvenile salmon life histories (SARE report)

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



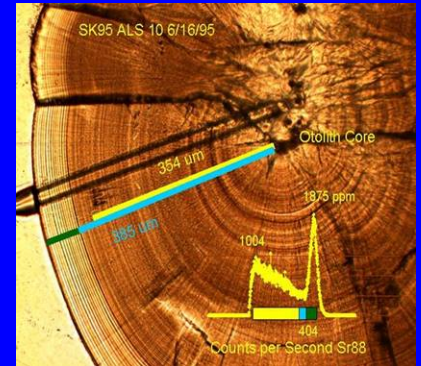
Have Chinook life histories been simplified? YES

Water temperatures could contribute to reduced habitat opportunities

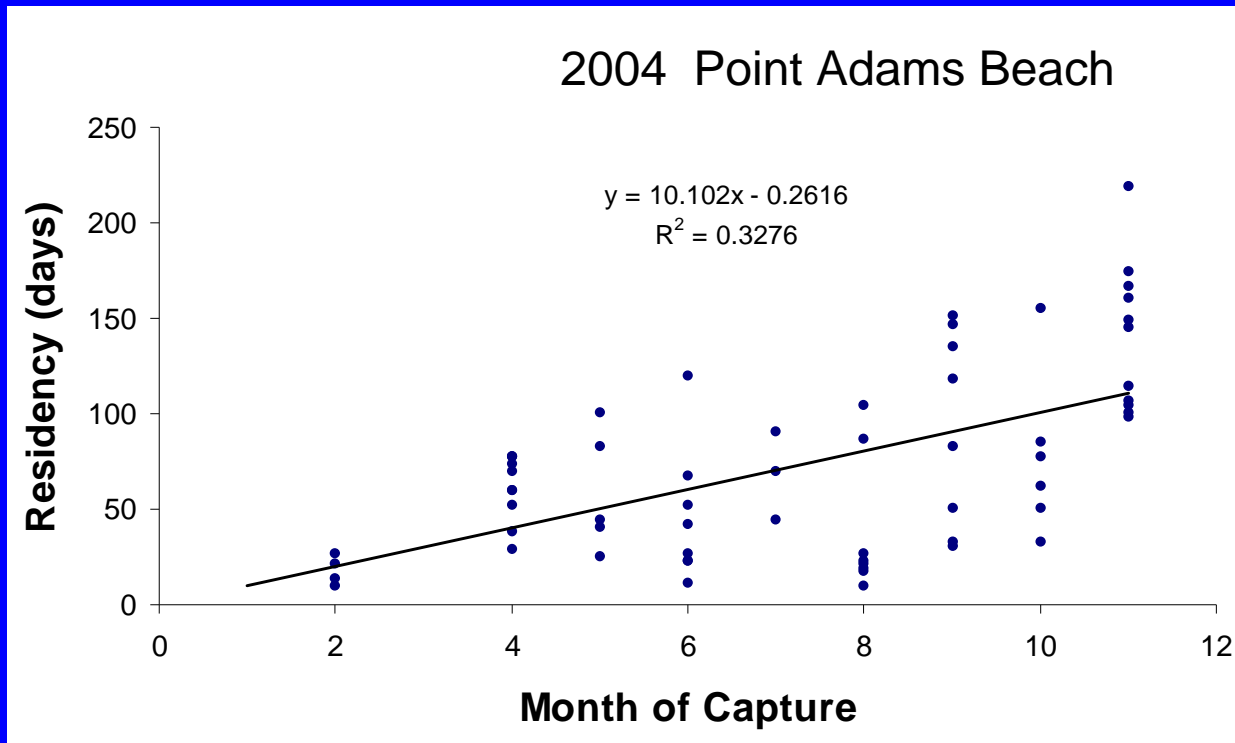


But estuary residency for many fish is much longer than previously reported

- 71% of samples at PAB showed salt water residency (n = 94)
- Mean residence time 73 d (10 – 219 d)
- Minimal estimate (salt water residency only)



Otolith analyses
Data from Lance Campbell

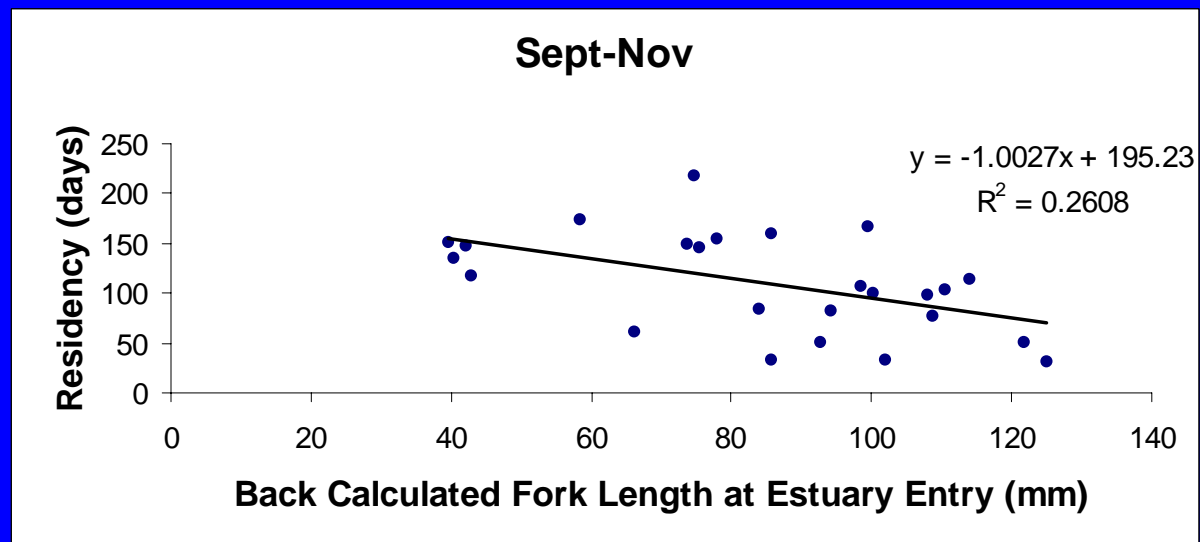
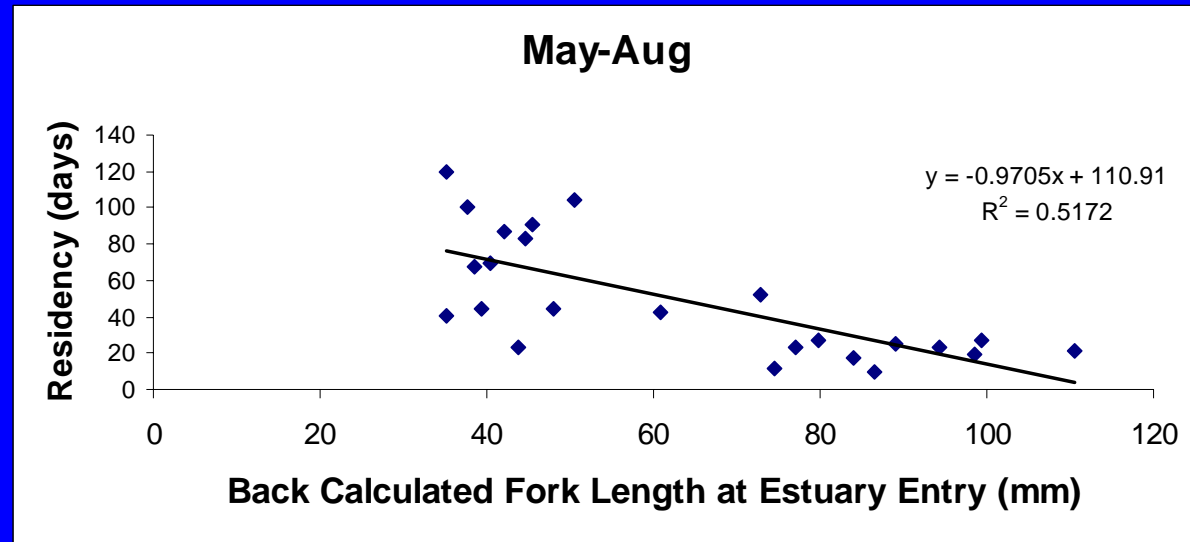


- Residency increased through the survey period
- Few fish entered after August

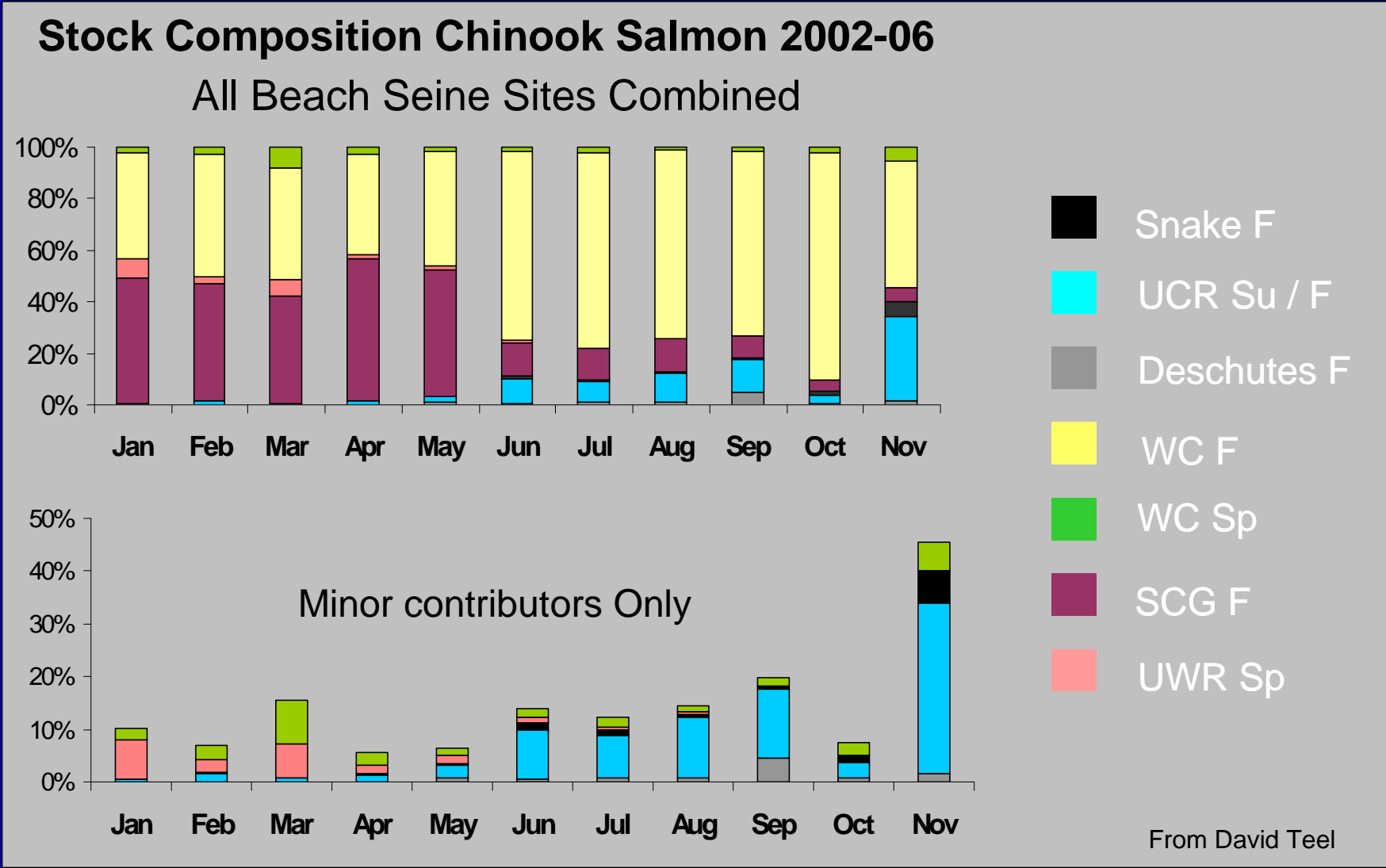
Estuary residency is size-related

- Subyearlings enter the estuary over a wide range of sizes
- Residence time decreases with size at estuary entry

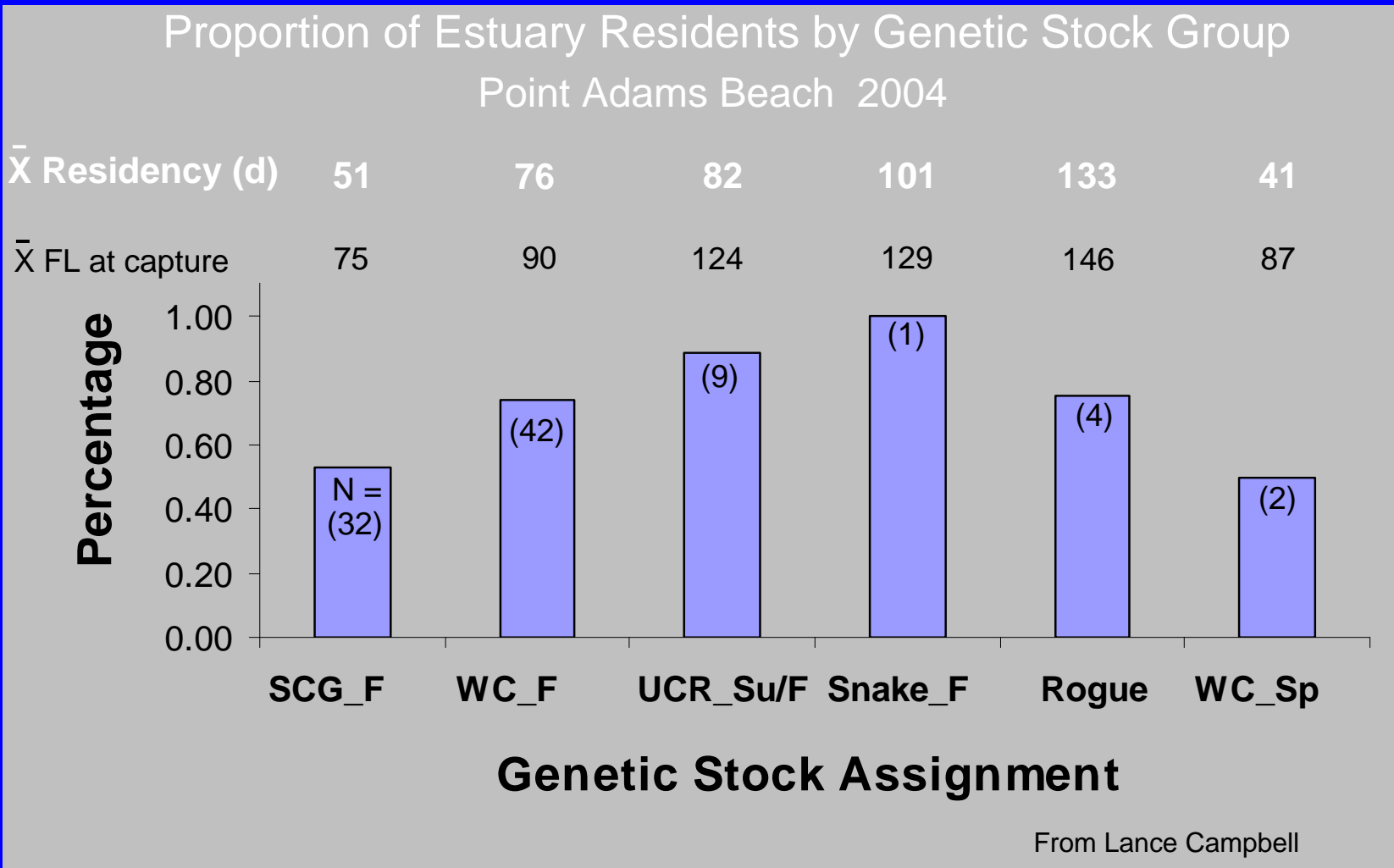
Point Adams Beach 2004



Individuals from all ESUs utilize estuarine habitats; stock composition varies through the year



Individuals from diverse genetic stock groups rear in the estuary for weeks or months



Conclusions

Recent estuary studies support key SARE hypotheses:

- Considerable wetland habitat has been lost
- Wetland loss has decreased habitat opportunities for subyearling salmon
- Habitat loss has reduced detrital sources for salmon food webs
- Life history diversity of Chinook salmon has declined

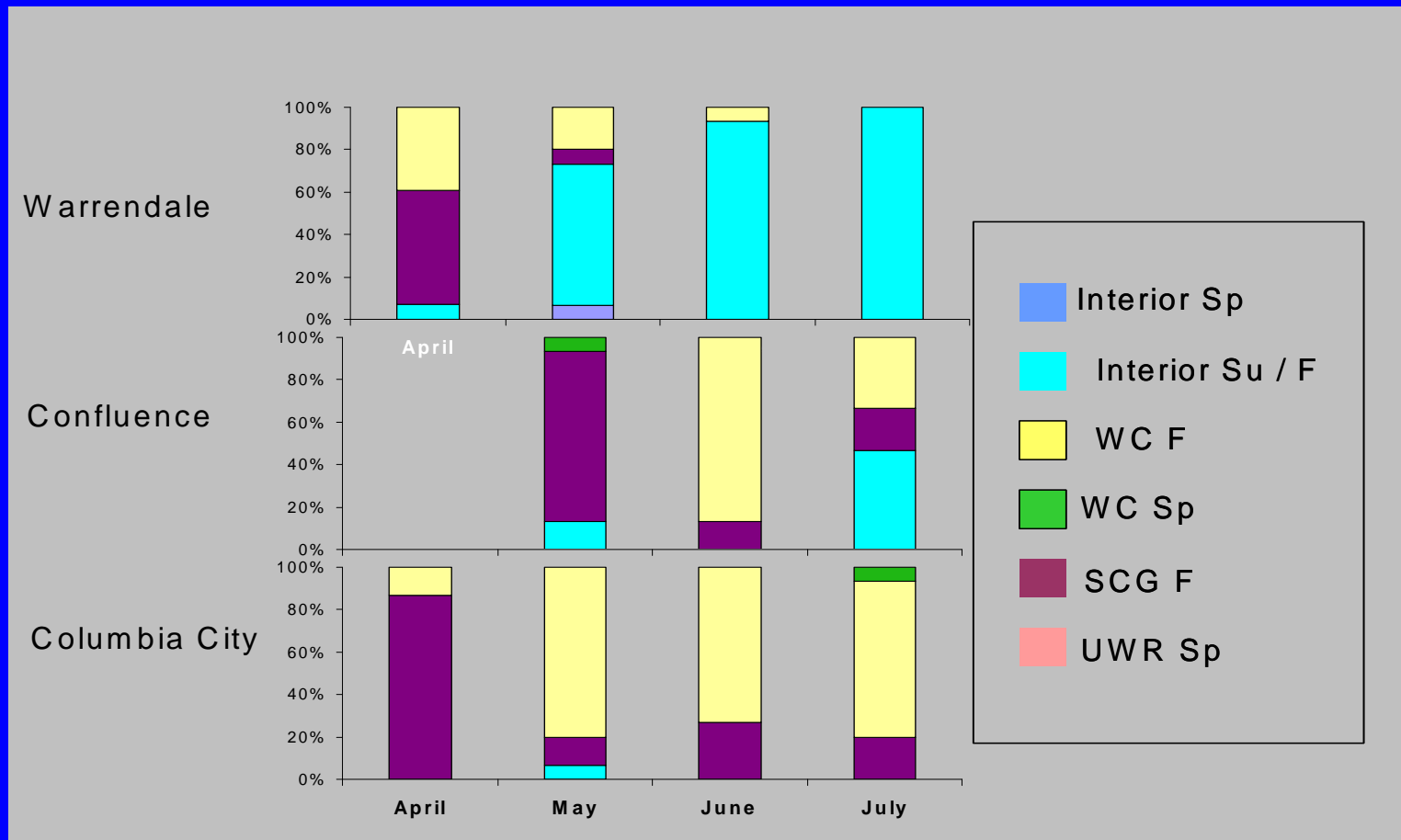
Conclusions

Results provide new information for recovery planning:

- All ESUs express subyearling life histories
- Diverse ESUs use wetland channels
- Even fish that do not enter wetlands depend on wetland-based food webs
- Even upper basin stocks use the estuary for extended periods
- Large releases of similarly-sized hatchery fish likely alter estuarine life histories (migration, habitat use, residency, etc.)
- Decreased summer/fall use of the estuary may reflect reduced habitat opportunities and upriver stock declines
- Habitat restoration above Bonneville alone is insufficient to maintain LH diversity or restore at-risk stocks

Do stock-specific habitat-use patterns differ in the upper estuary?

What estuary restoration strategies will benefit multiple ESUs, including at risk stocks?



Data from David Teel