

Salmon Life Histories and Habitat Associations in the Columbia River Estuary, 2002 – 2011:

The Effects of Prior Rearing History on Estuary Habitat Use

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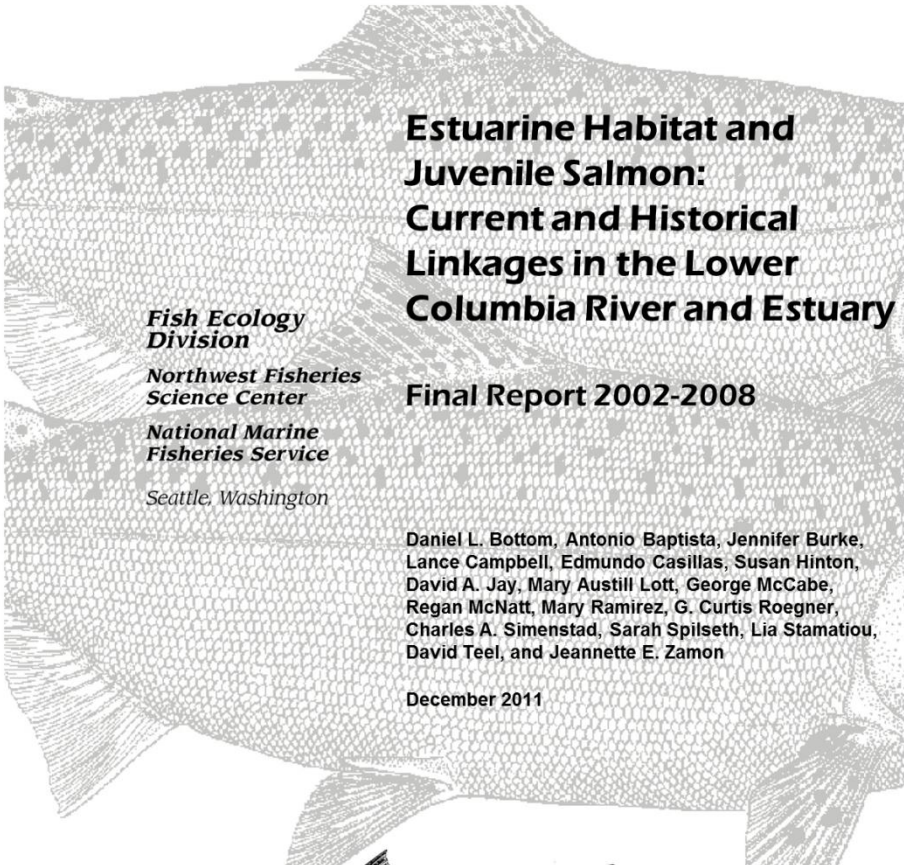
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**Estuarine Habitat and
Juvenile Salmon:
Current and Historical
Linkages in the Lower
Columbia River and Estuary**

*Fish Ecology
Division*

*Northwest Fisheries
Science Center*

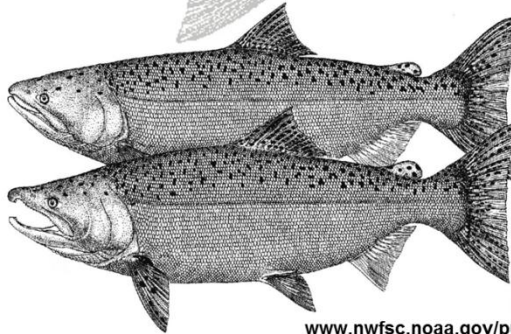
*National Marine
Fisheries Service*

Seattle, Washington

Final Report 2002-2008

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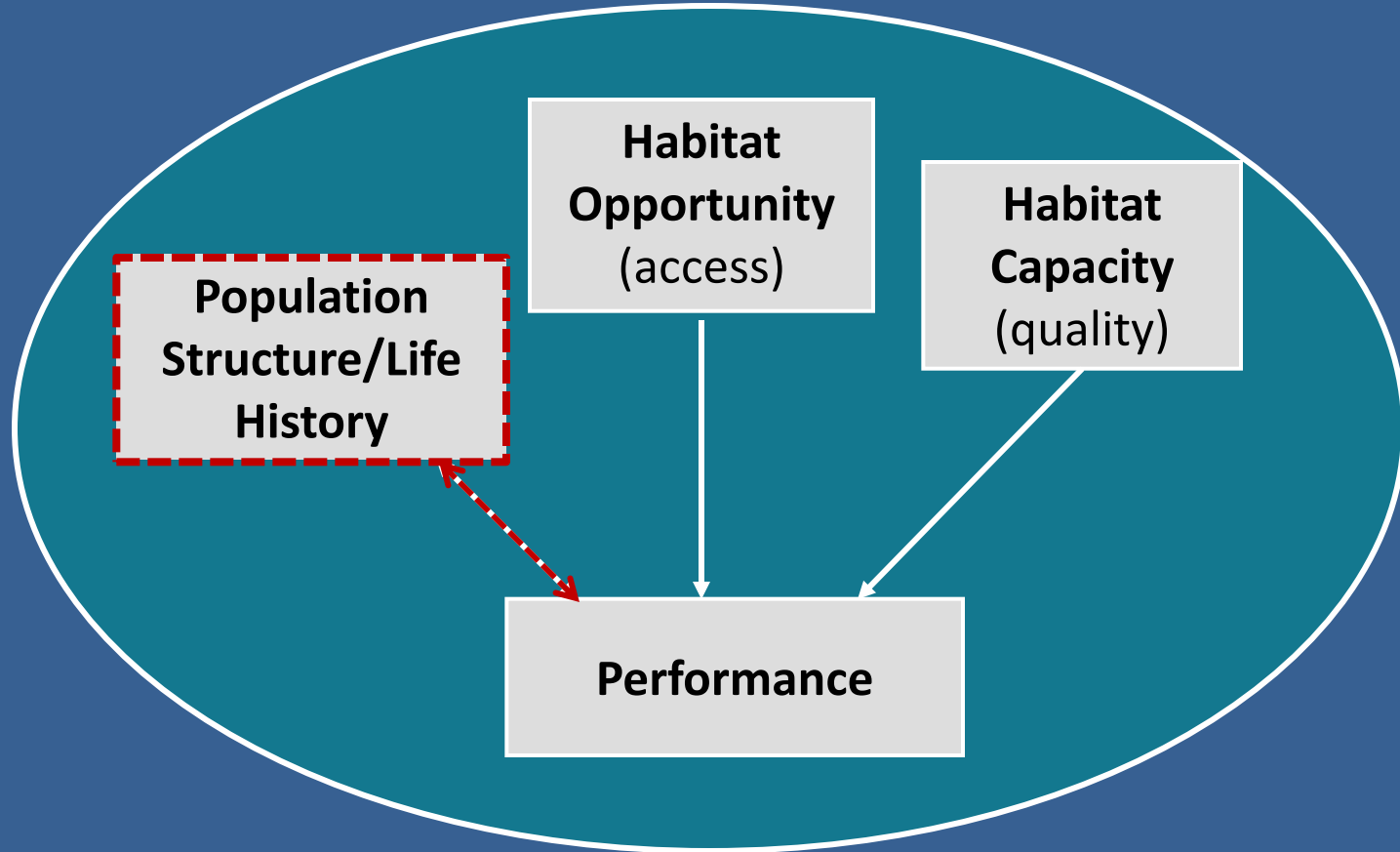
(contract reports, 2011)



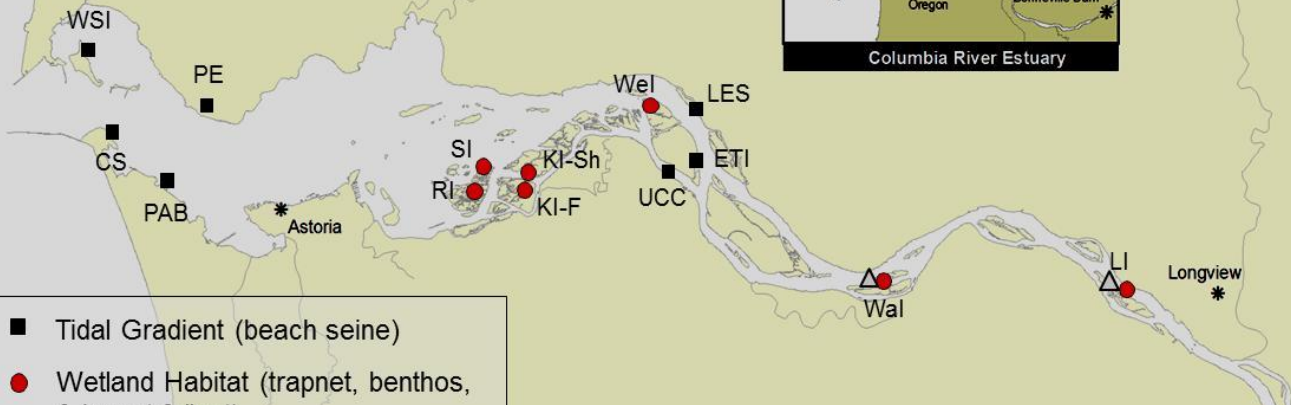
Criteria for Evaluating Estuarine Rearing Conditions for Salmon

Upriver Connections to the Estuary:

- Effects of prior rearing on estuary habitat use (D. Bottom)
- Estuary life histories in adult returns (L. Campbell)
- Stock-specific patterns of estuary habitat use (D. Teel)



Lower Estuary Studies 2002-08

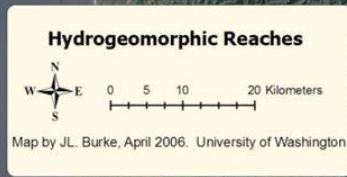
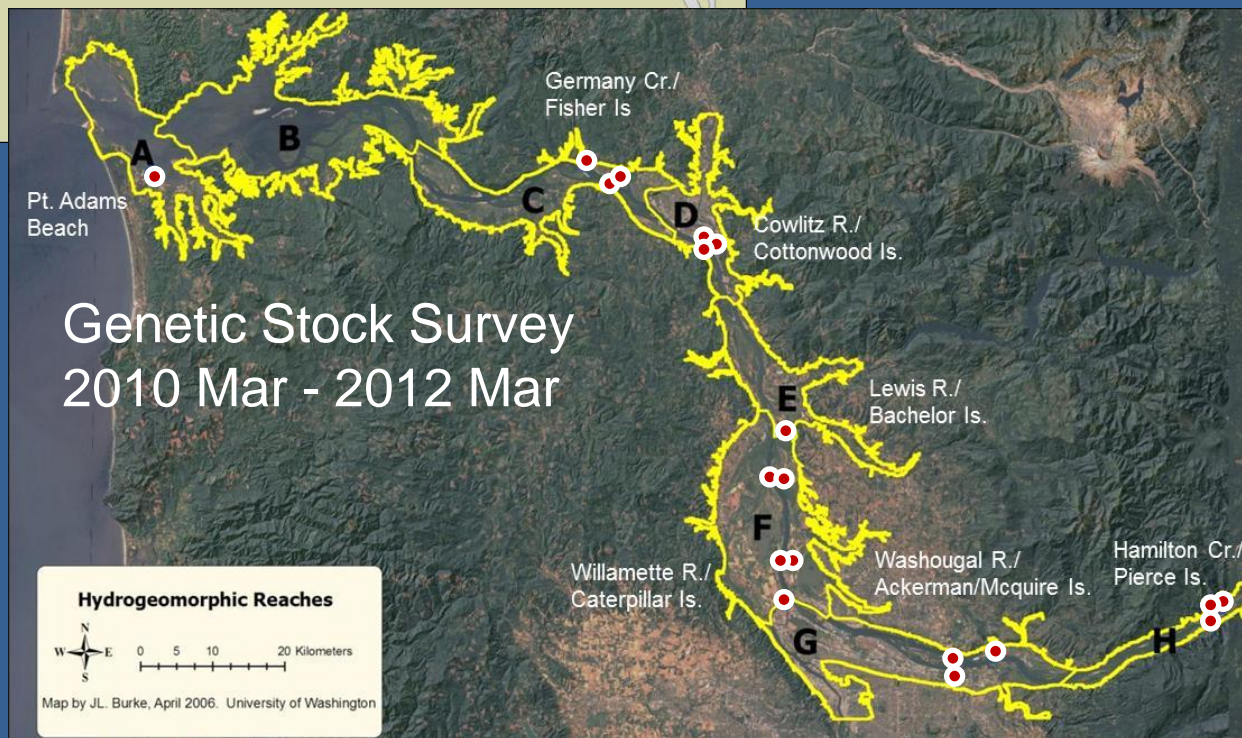


- Tidal Gradient (beach seine)
- Wetland Habitat (trapnet, benthos, & insect fallout)
- △ Exposure Gradient (main stem, backside, & interior channel)



- Salmon habitat use, life histories, & prey resources
- Limited to shallow-water habitats

- Stock composition by reach and habitat type

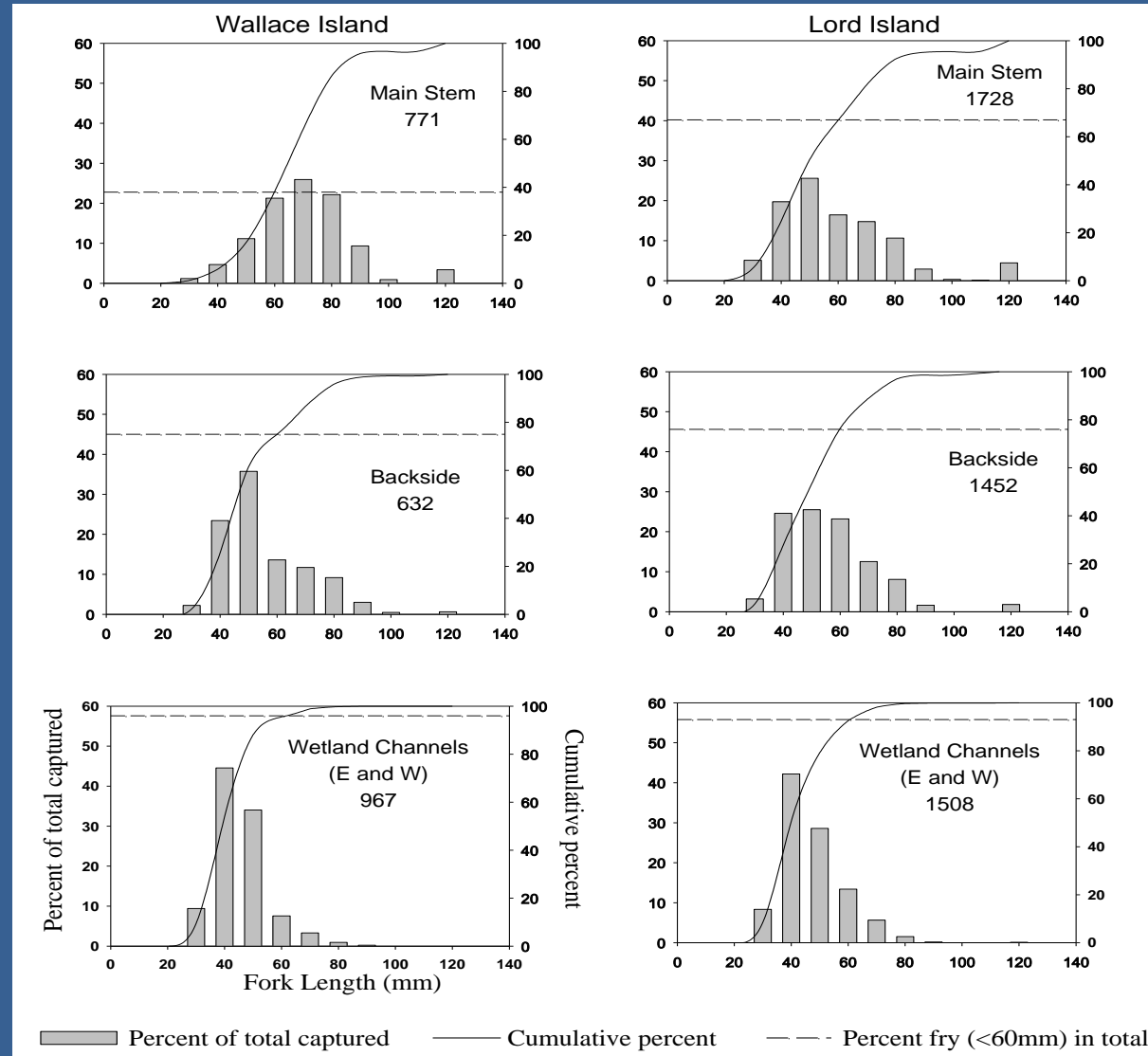


Estuarine habitat use by juvenile Chinook is size-related

Lord Island, Rkm 101



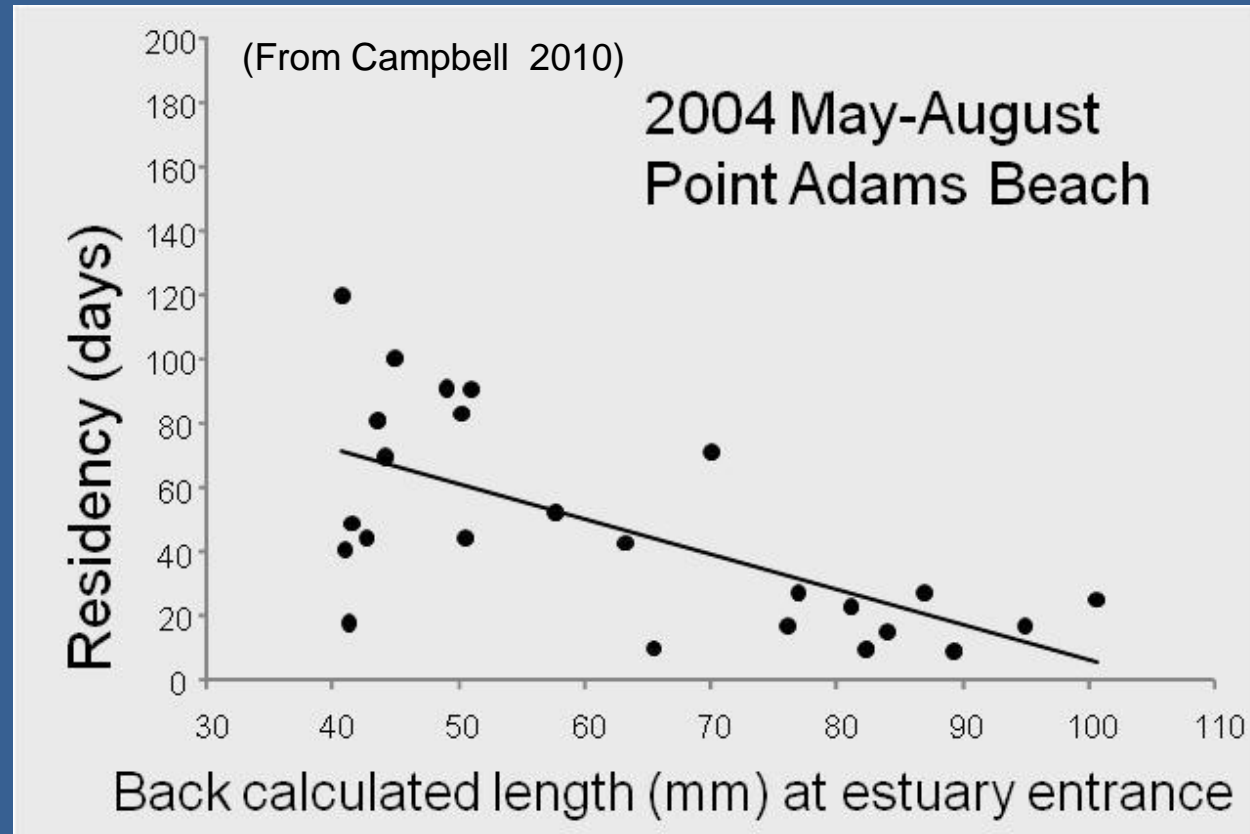
Wallace and Lord islands, 2006-08



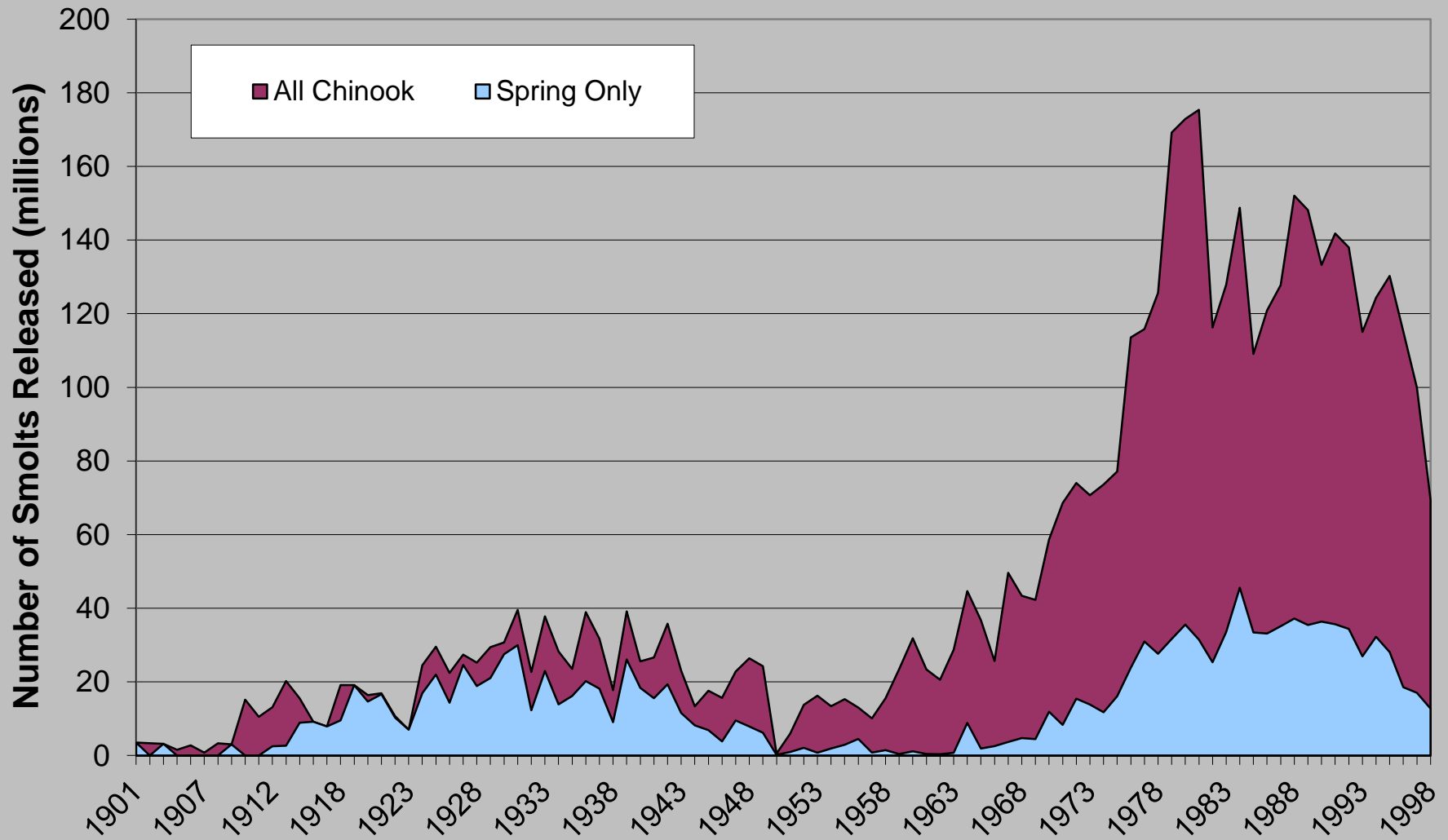
- Few fish in wetland channels > 70mm
- % fry decreases with depth and exposure:
 - Main stem: 38-67%
 - Back side: 75-76%
 - Interior: >93%

Mean estuary residence time varies with fish size

- Subyearling Chinook enter the estuary over a wide range of sizes
- Residence time decreases with size at estuary entry
- In 2003-05 >50% of hatchery fish released at sizes >90mm FL

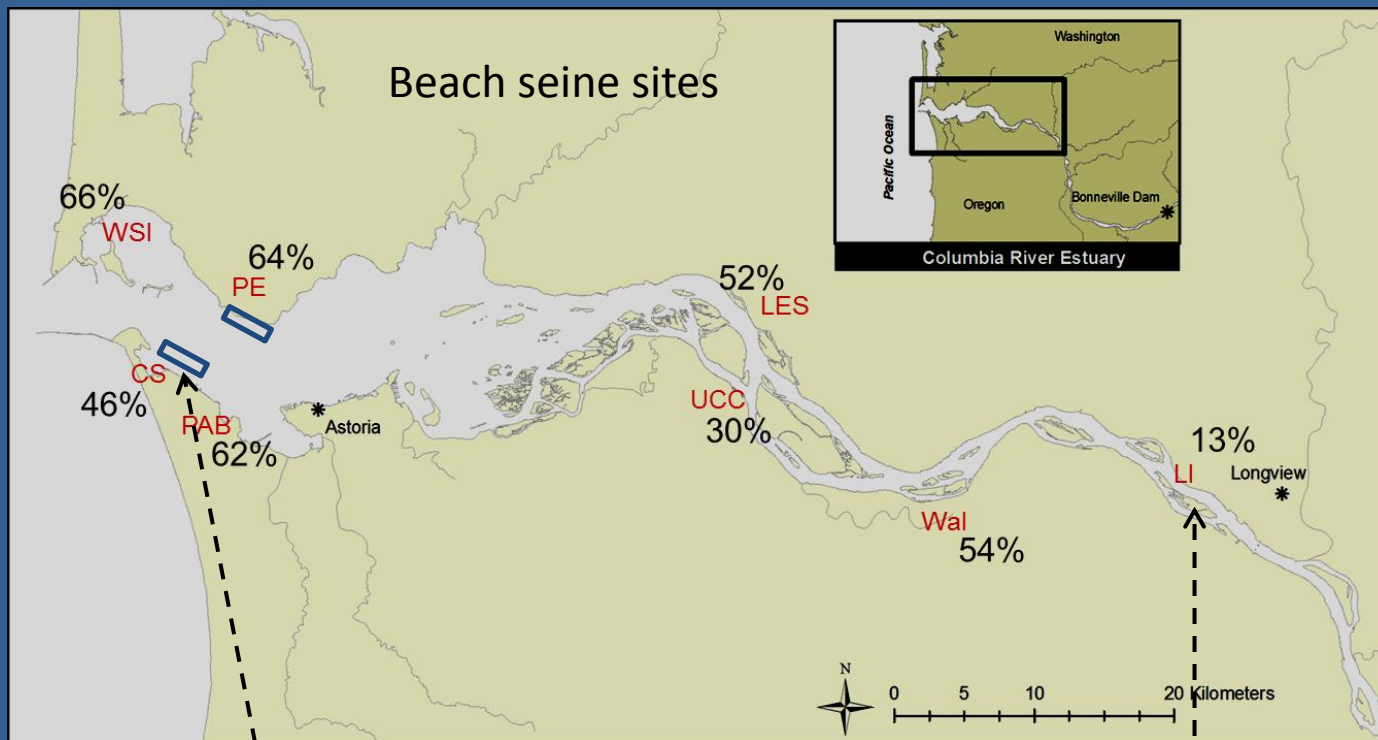


Total Releases Columbia River Hatchery Chinook Salmon



Data Source: Streamnet, provided by Phil Levin, NOAA/NMFS

Percent Hatchery Clipped Chinook 2007-2008



Hatchery fish distribution varies by river mile and depth

% Hatchery Marked 2007-10 Purse Seine Catches (L. Weitkamp)

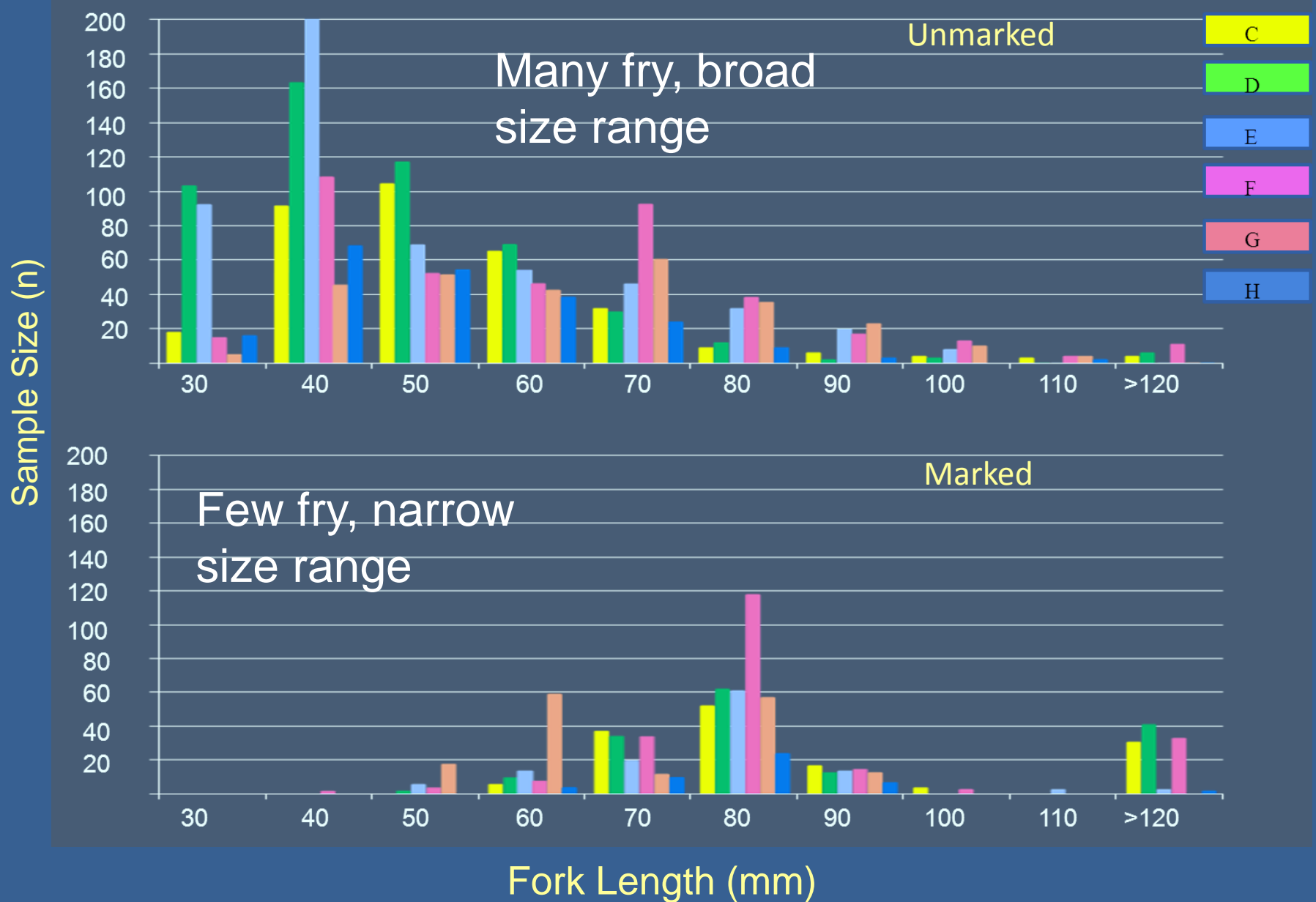
Subyearlings	85.5%
Yearlings	94.4%

% Hatchery Lord Island

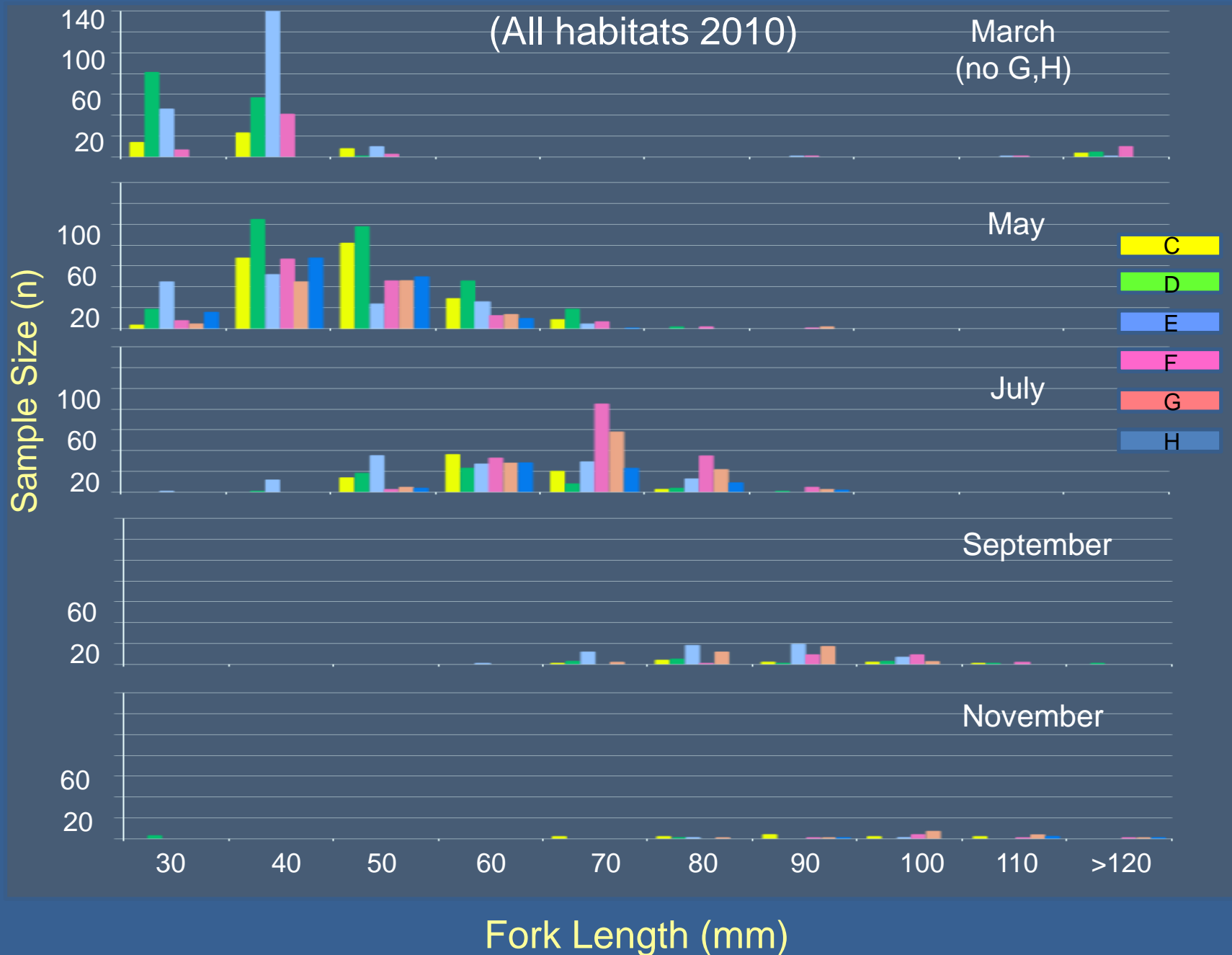
Lord Island	2007	2008
Main stem	11.7	22
Back side	10.4	11.0
Wetland Channel	1.0	7.0

Chinook Length Frequency

(All months and habitats 2010)

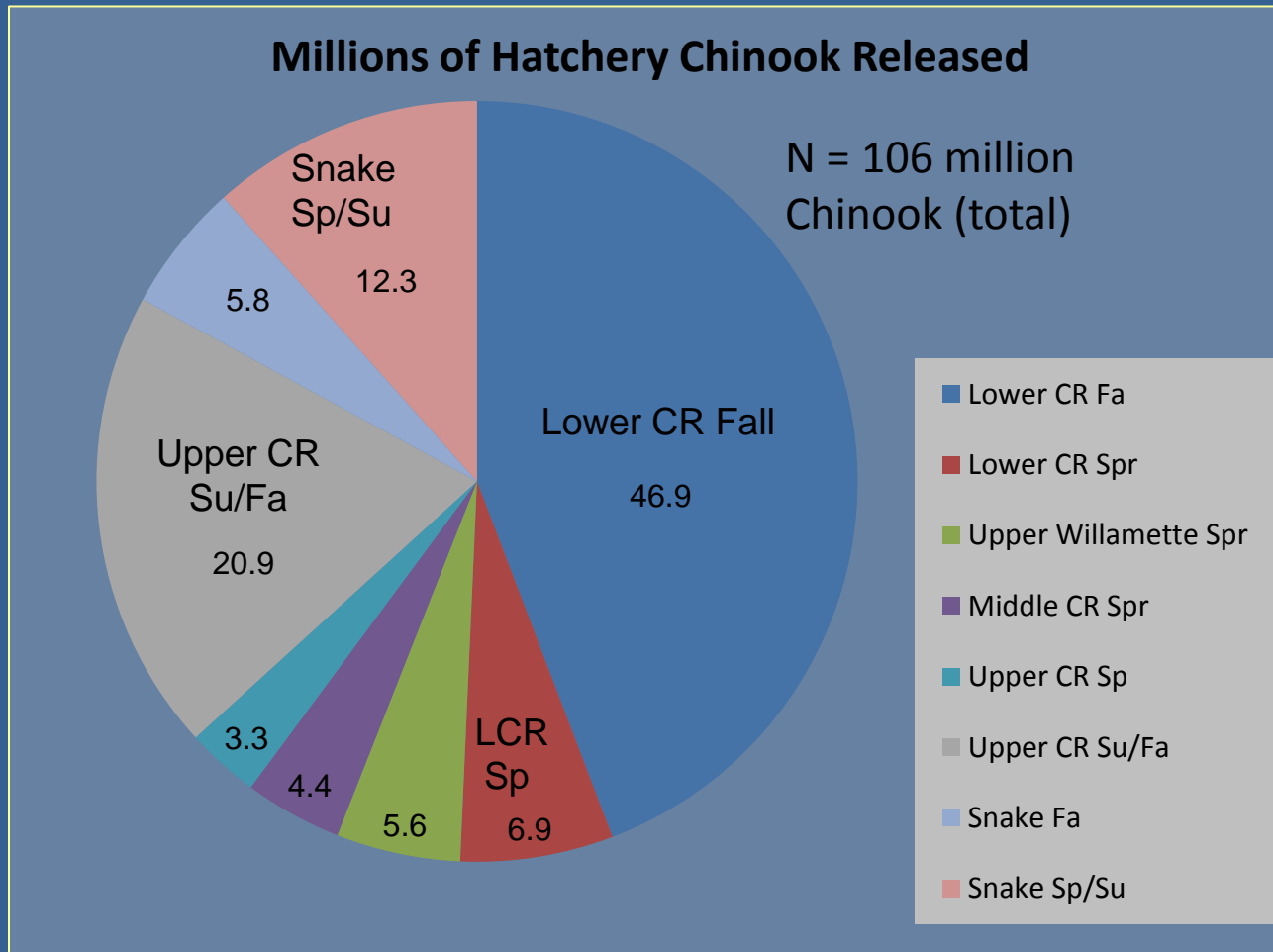


Chinook Length Frequency (unmarked)



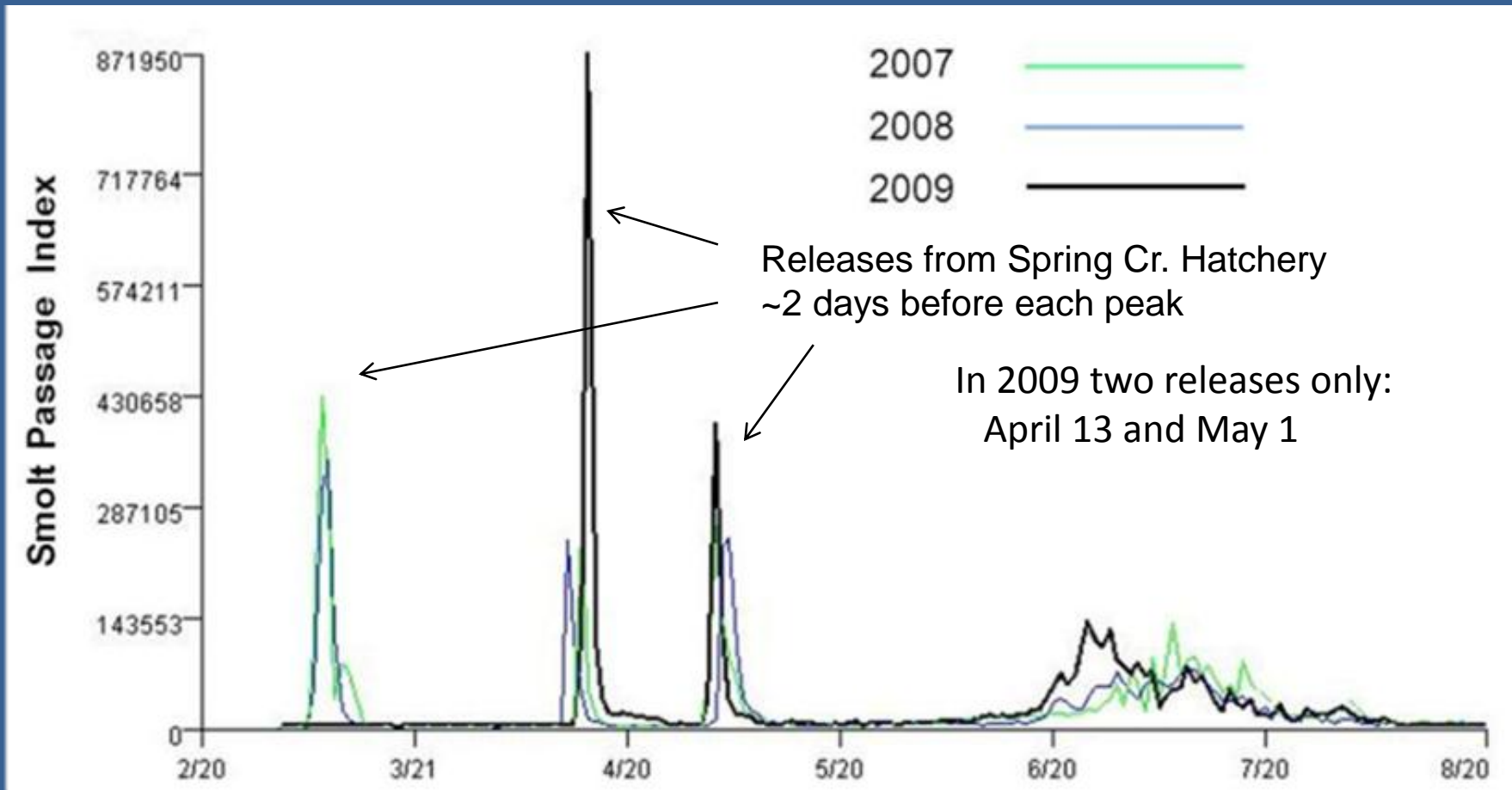
Chinook Salmon Hatchery Releases by ESU

Hatchery Scientific Research Group (2009)



- ~2/3 of all hatchery releases in the basin come from two ESUs
- ~1/2 of all hatchery Chinook are released into the Lower CR ESU
- Since 2000 one hatchery (Spring Creek) accounted for ~24% (15-47%) of all subyearlings released annually

Smolt Passage Index Bonneville Dam 2007-09



(Data from CR DART and Fish Passage Center)

Genetic Stock Composition

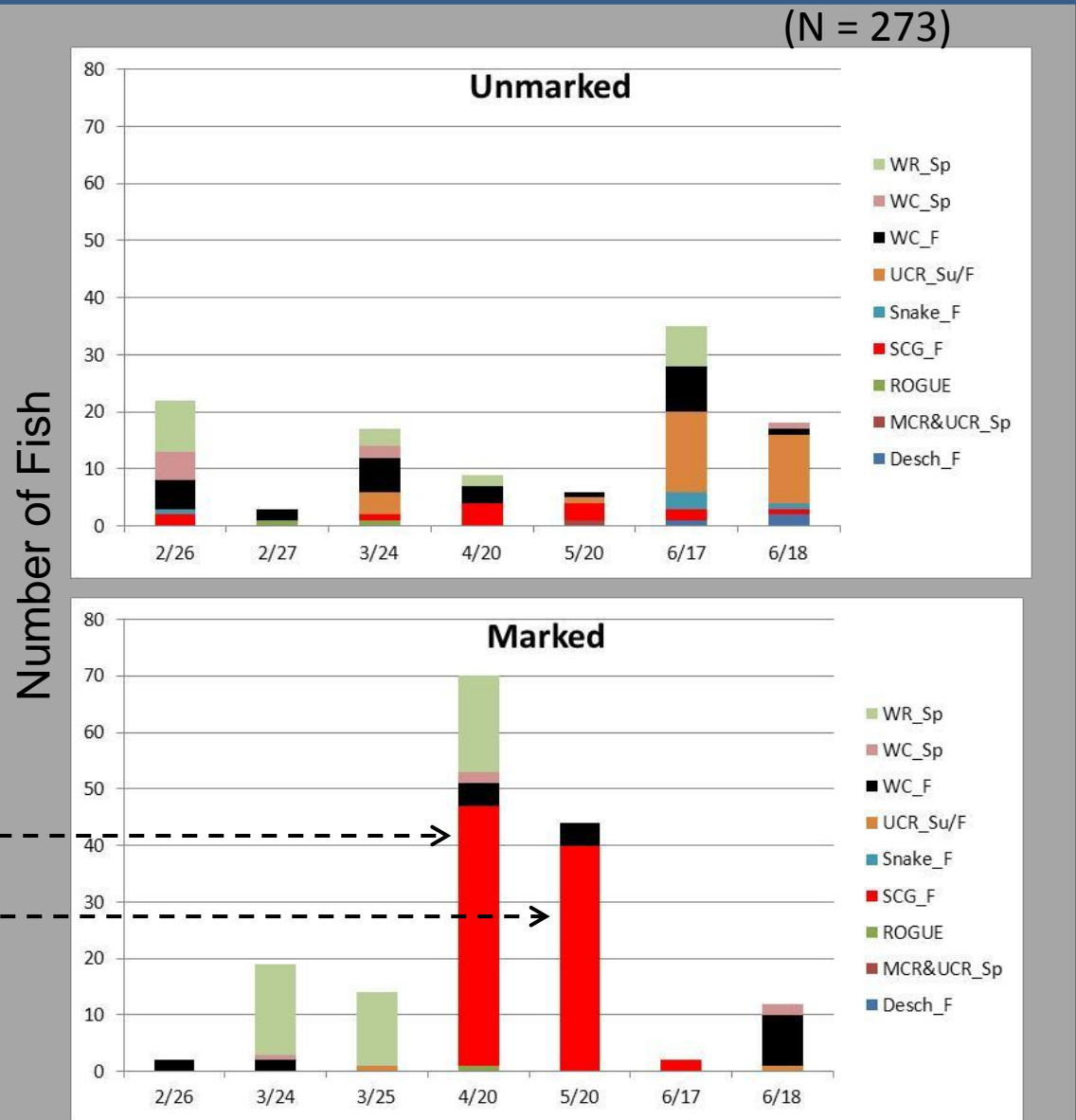
2009 Hayden Island (~Rkm 169)

- Beach-seine sampling, City of Portland
- Collected by Lyndal Johnson

Spring Cr. Hatchery Releases

- April 13: 13 million
- May 1: 9.5 million

(D. Teel, NWFSC)



The phenotypic behavior of salmon in the estuary are largely a downstream expression of hatchery practices

- Hatcheries account for the majority of Chinook salmon produced in the Columbia R. basin
- Hatchery location → time of estuary arrival
- Timing and number of fish released → temporal patterns of abundance and stock composition in the estuary, particularly in spring/summer
- Size at release → estuary residence times, estuary habitat selection, and time/size at ocean entry
- Prior rearing histories constrain life history expression in the estuary

Conclusions

- Hatcheries have replaced the dispersed distributions and emergence times of natural populations with “point sources” of similarly-sized individuals released in concentrated pulses (April – July)
- Hatchery-reared salmon tend to enter the estuary at a larger mean size (and a narrower size range), select deeper habitats further from shore, and reside shorter periods than many naturally-produced juveniles
- But hatchery and wild salmon distributions overlap in the estuary; not all hatchery fish migrate rapidly
- Contemporary abundance patterns, stock composition, habitat use, and residency in the estuary are largely driven by hatchery programs

Some Key Management Questions

- Does intensive hatchery production limit the use or effectiveness of estuary restoration projects for at-risk populations?
- How do naturally-produced and hatchery-reared salmon interact in the estuary?
- Do intensive hatchery releases alter estuarine food webs, predation pressure, or the estuary's capacity to support naturally-produced salmon?
- Based on present release levels and methods, are hatchery production and estuary restoration compatible management strategies ?

Thanks!

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