

ACOUSTIC TELEMETRY STUDY OF JUVENILE SALMONID DAM AND SPILLWAY SURVIVAL AT BONNEVILLE DAM IN 2008

- ▶ Sponsor: USACE District, Portland
- ▶ Oversight: Dennis Schwartz
- ▶ Collaboration:

PNNL / Battelle

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Problem Statement

- ▶ Historical data suggest that survival is higher for fish passing end bays (1-3 and 16-18) than for fish passing middle bays (4-15)
 - End bays 1-3 and 16-18 - flow deflectors at 7-ft above MSL
 - Middle bays 4-15 - flow deflectors at 14-ft above MSL
- ▶ Additional survival studies were needed to identify when survival differences might occur

Objectives

- ▶ Estimate survival of dam- and spillway-passed yearling Chinook salmon and steelhead in spring and fall Chinook salmon in summer
- ▶ Test whether survival of fish passing through end bays with deep flow deflectors was higher than that of fish passing through middle bays with shallow flow deflectors

Tagged Fish Releases

- ▶ PNNL tagged and released fish for the John Day Dam survival study, and made specific releases of fall Chinook below The Dalles Dam

Release Location	Spring Chinook		Spring Steelhead		Fall Chinook	
	Live	Dead	Live	Dead	Live	Dead
Arlington, OR	2,445	6	2,448	5	2,483	6
JDA Tailrace	980	14	979	14	982	14
TDA Tailrace					2,444	2
Treatment Totals	3,425	26	3,427	19	5,909	22

- ▶ NOAA Fisheries tagged and released juvenile Chinook salmon in the BON tailwater (reference releases) and B2CC each season

Release Location	Spring Chinook		Fall Chinook	
	Live	Dead	Live	Dead
Bonneville Tailrace	828	48	1,021	51
	826			



Photos provided by Jason Everett



Release Timing

- ▶ Treatment fish were released three times per day (early day, midday, and night)
 - 28 days consecutive days each season
 - Treatment fish passed BON or the spillway and tailwater
- ▶ Tailrace reference fish and B2CC fish were released at 0600, 1300, and 2100 hours
 - 34 consecutive days in spring and 38 consecutive days in summer
 - Reference fish passed the tailwater only (Chinook salmon only)

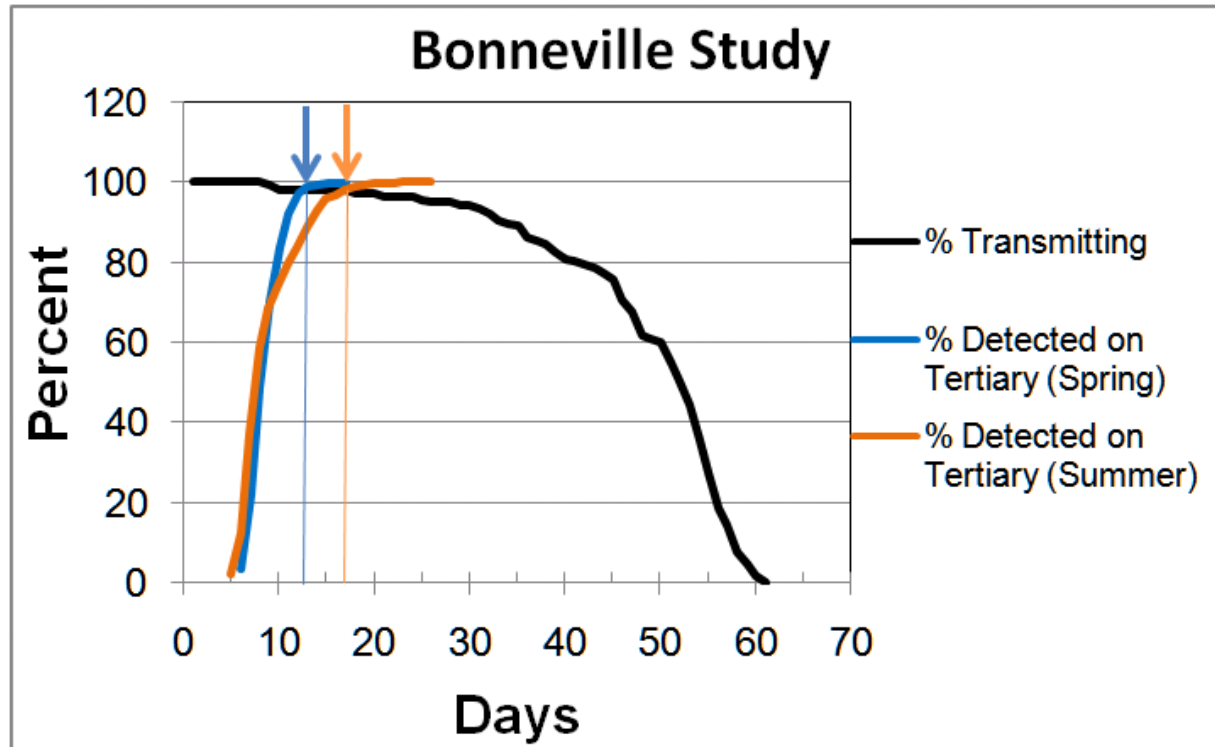
Detection Arrays = Groups of Autonomous Hydrophones Deployed to Listen for Tags at a River Cross Section

- ▶ **TDA Forebay Entrance array** -- 2 km upstream of TDA Powerhouse
- ▶ **BON Forebay Entrance array** -- 2 km upstream of B2 Powerhouse
- ▶ **BON Spillway dam-face array**
 - 36 hydrophones (two per pier at El 40 and 60 ft above MSL)
 - Time synchronized to within 150 nanoseconds
- ▶ **Primary Array** -- 33 km below BON
- ▶ **Secondary Array** -- 42 km below BON
- ▶ **Tertiary Array** -- 149 km below BON
 - These data were provided by the Post-FCRPS (Estuary) Survival Study

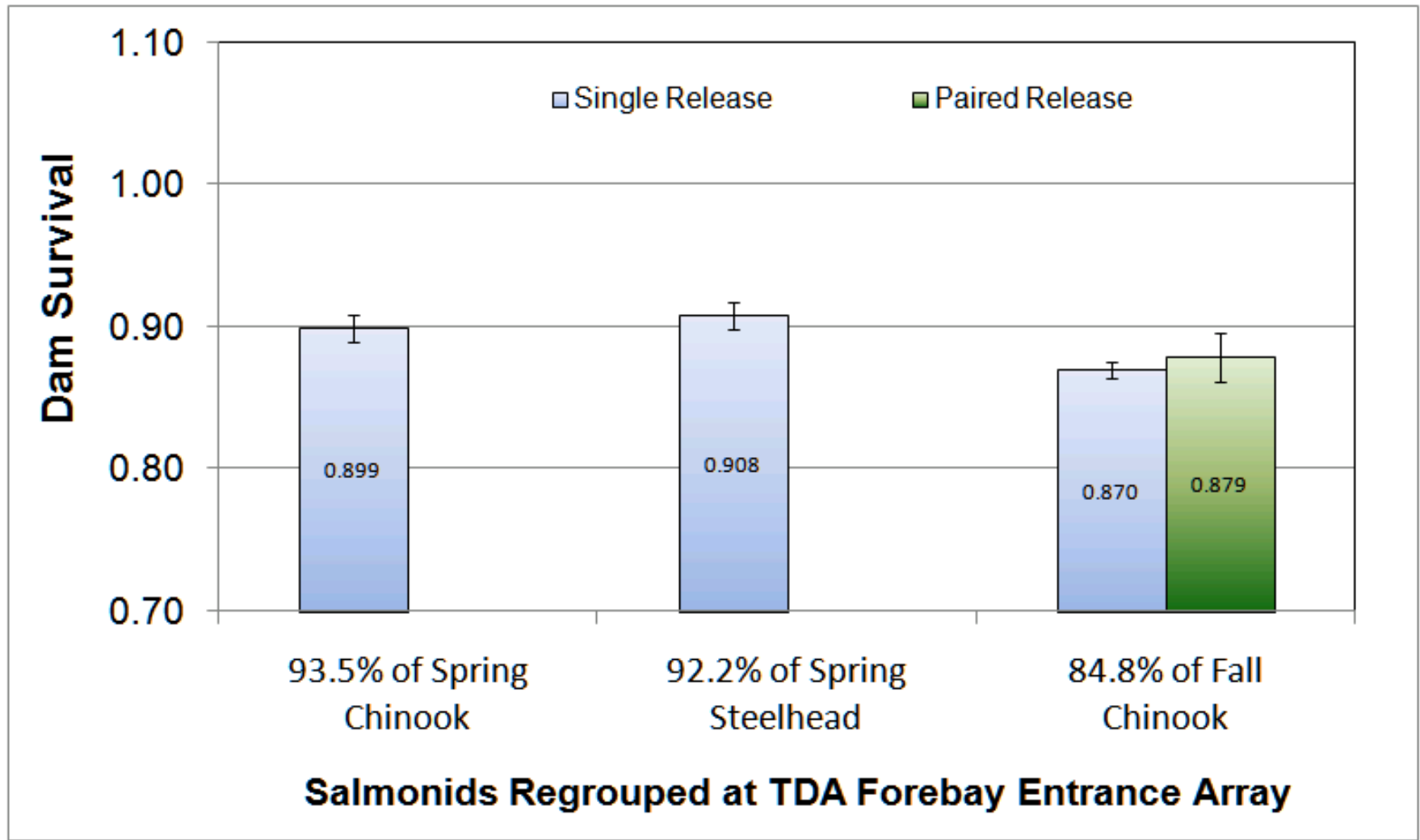
Results

- ▶ Present virtual-release dam survival estimates for spring and summer runs
- ▶ Present spillway passage and survival for juvenile fall Chinook salmon in summer

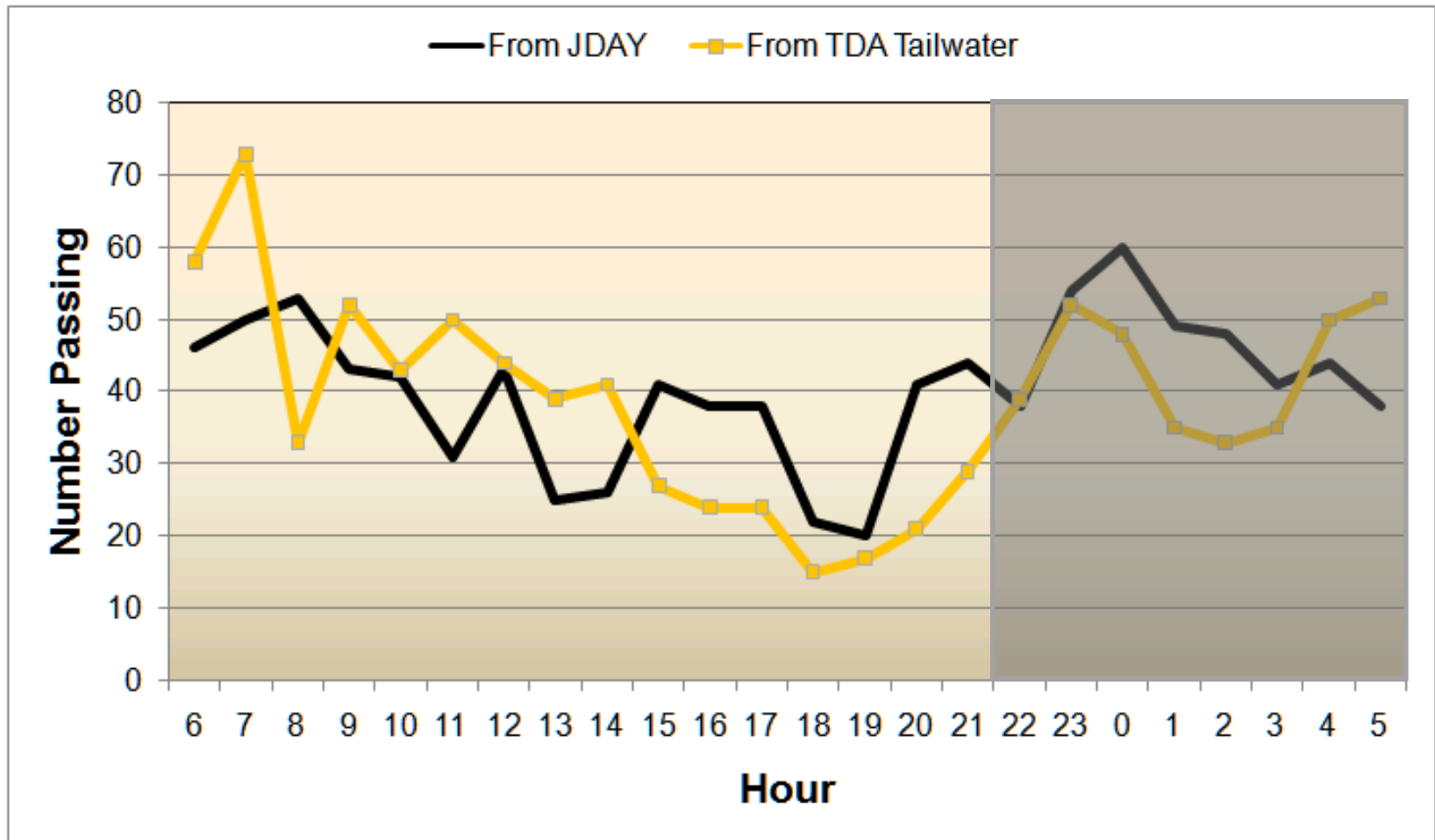
Most Fish Passed the Last Survival Array Before Tag Failure was Significant



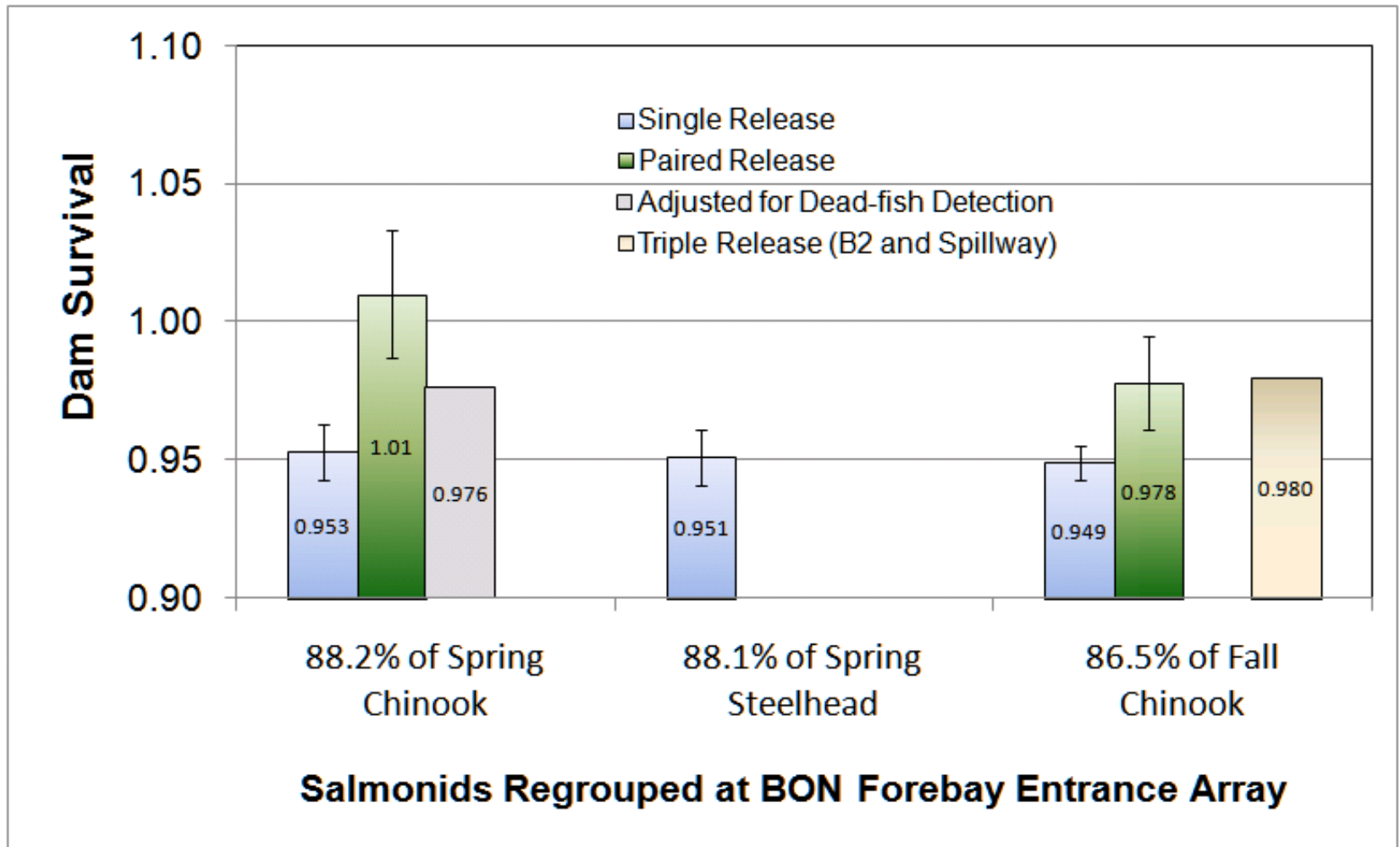
TDA Dam Survivals from Virtual Releases



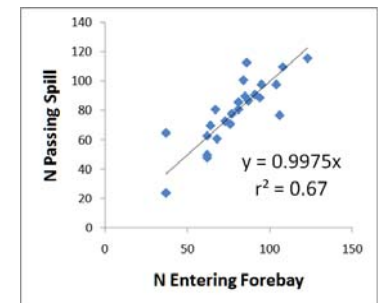
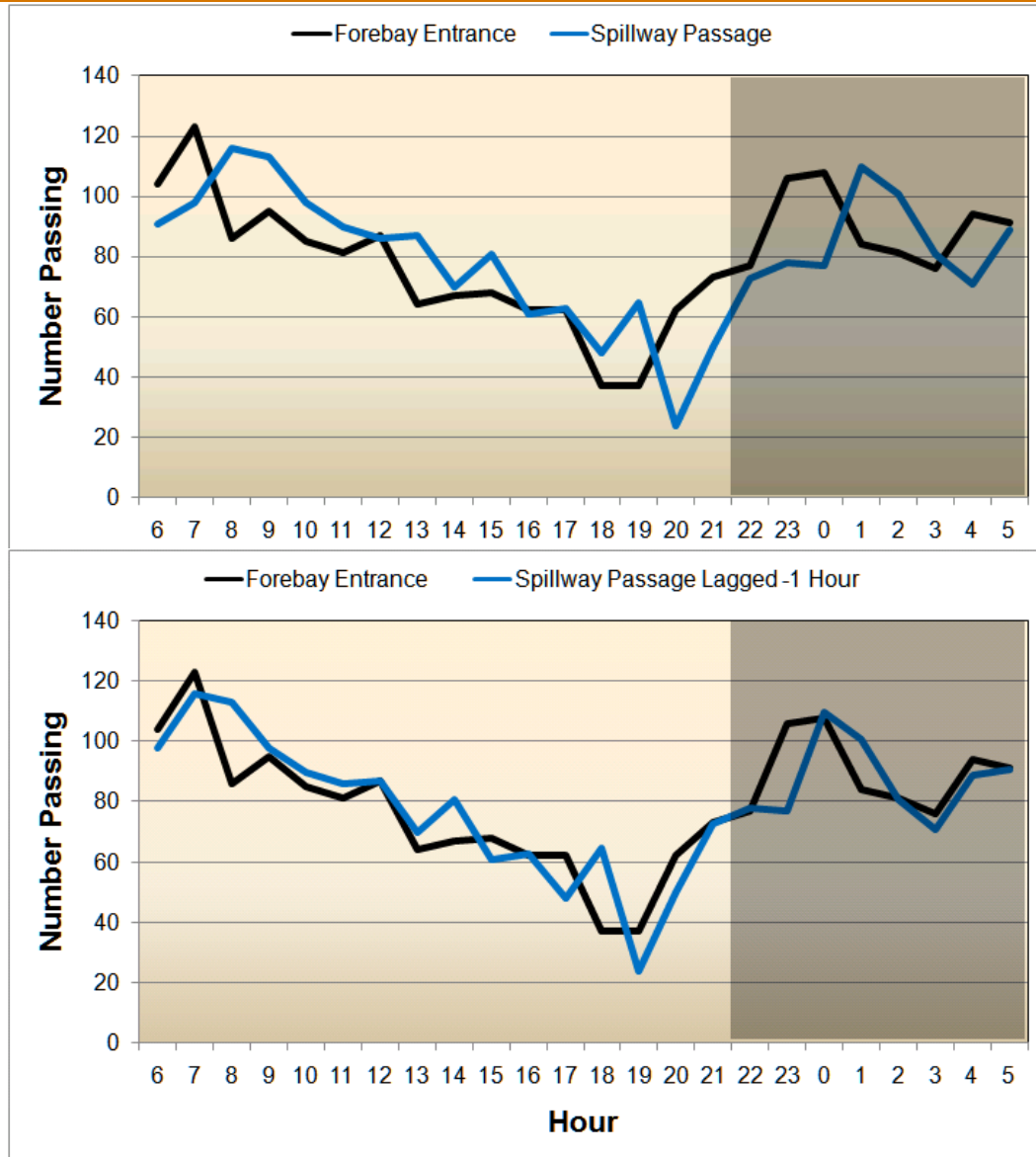
Diel Arrival of Fall Chinook at BON Forebay by Release Location



Bonneville Dam Survival for Fall Chinook (Virtual Releases at the Forebay Entrance)

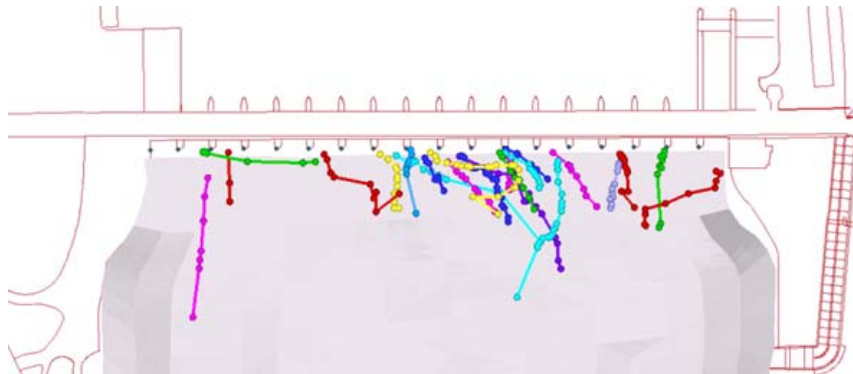
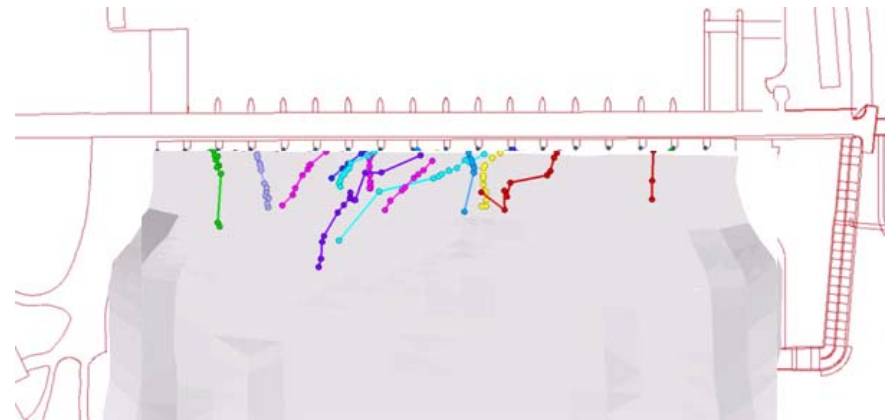
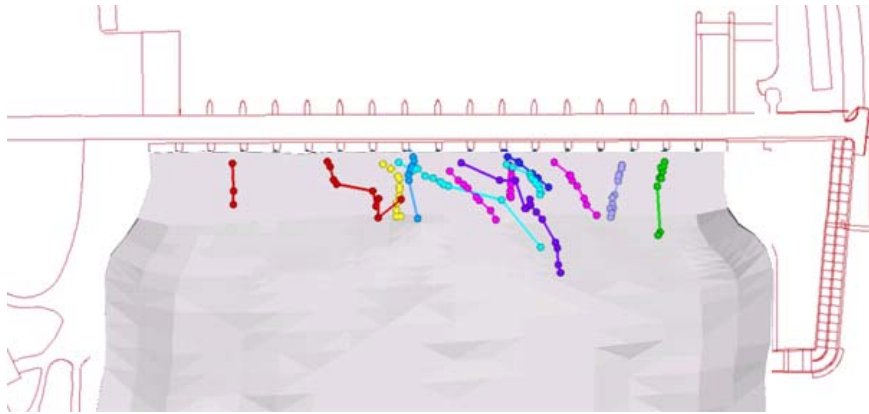


Diel Forebay Arrival and Spillway Passage of Fall Chinook at Bonneville Dam

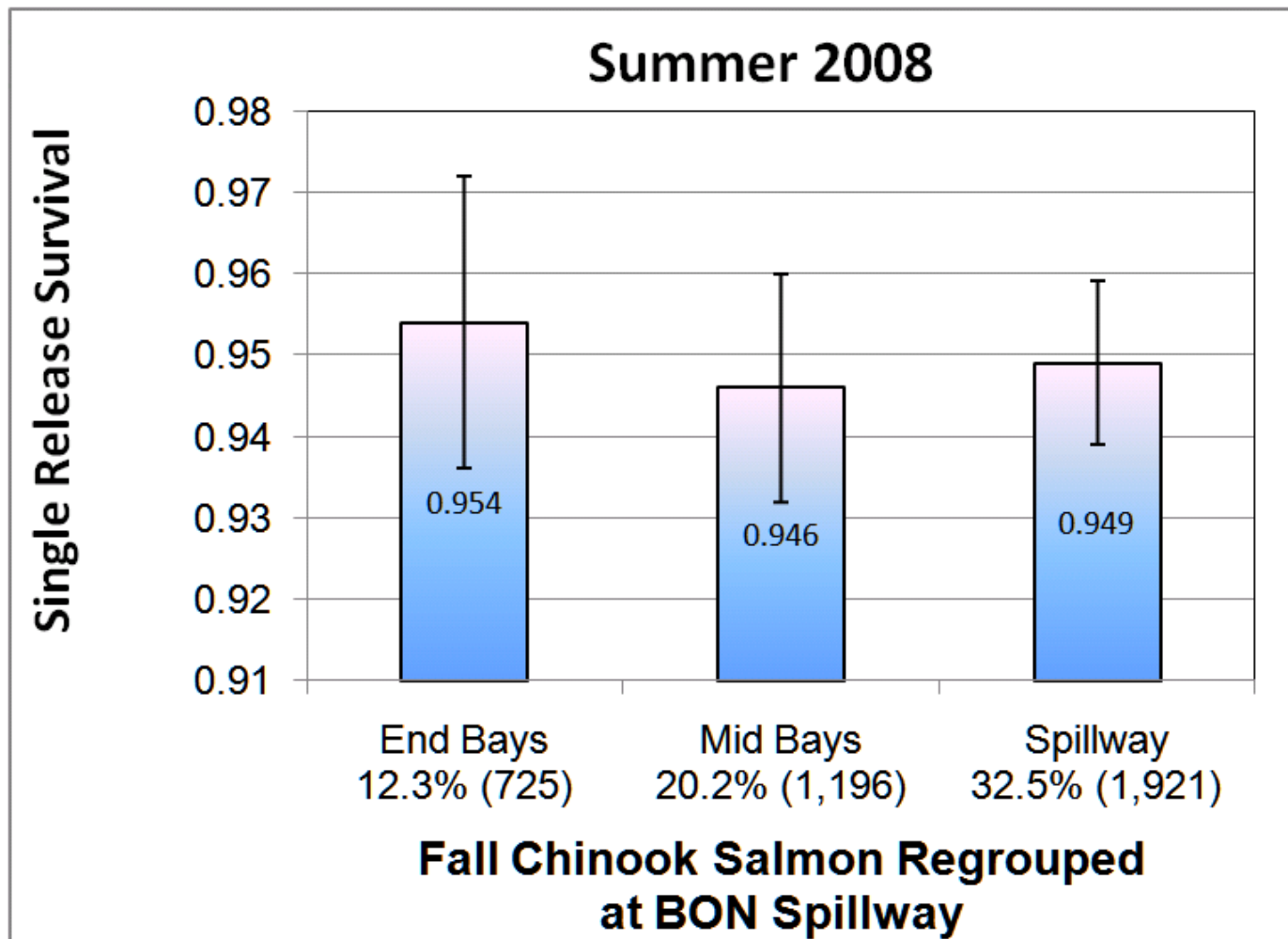


Examples of Fish Tracks

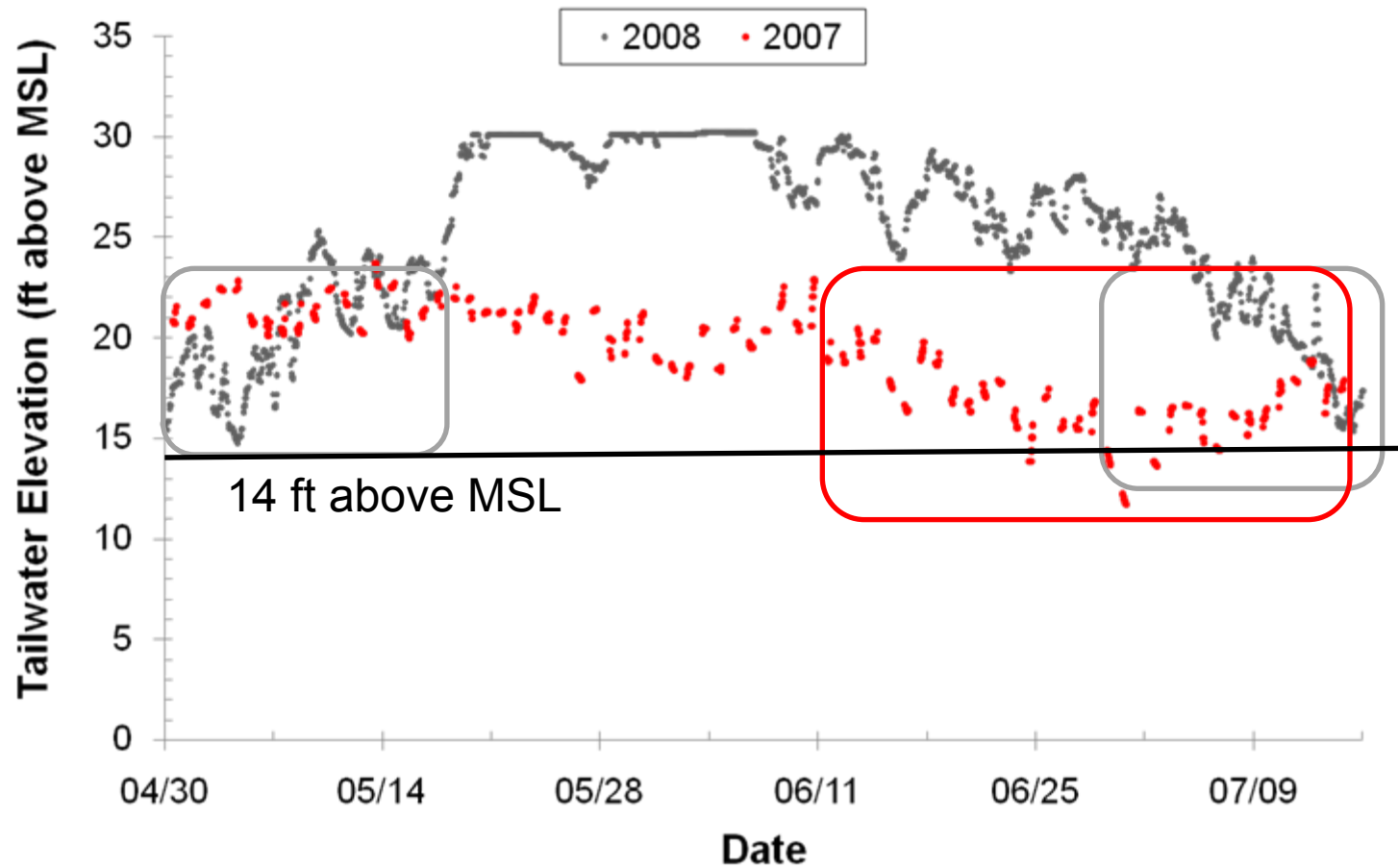
(Provided by Daniel Deng)



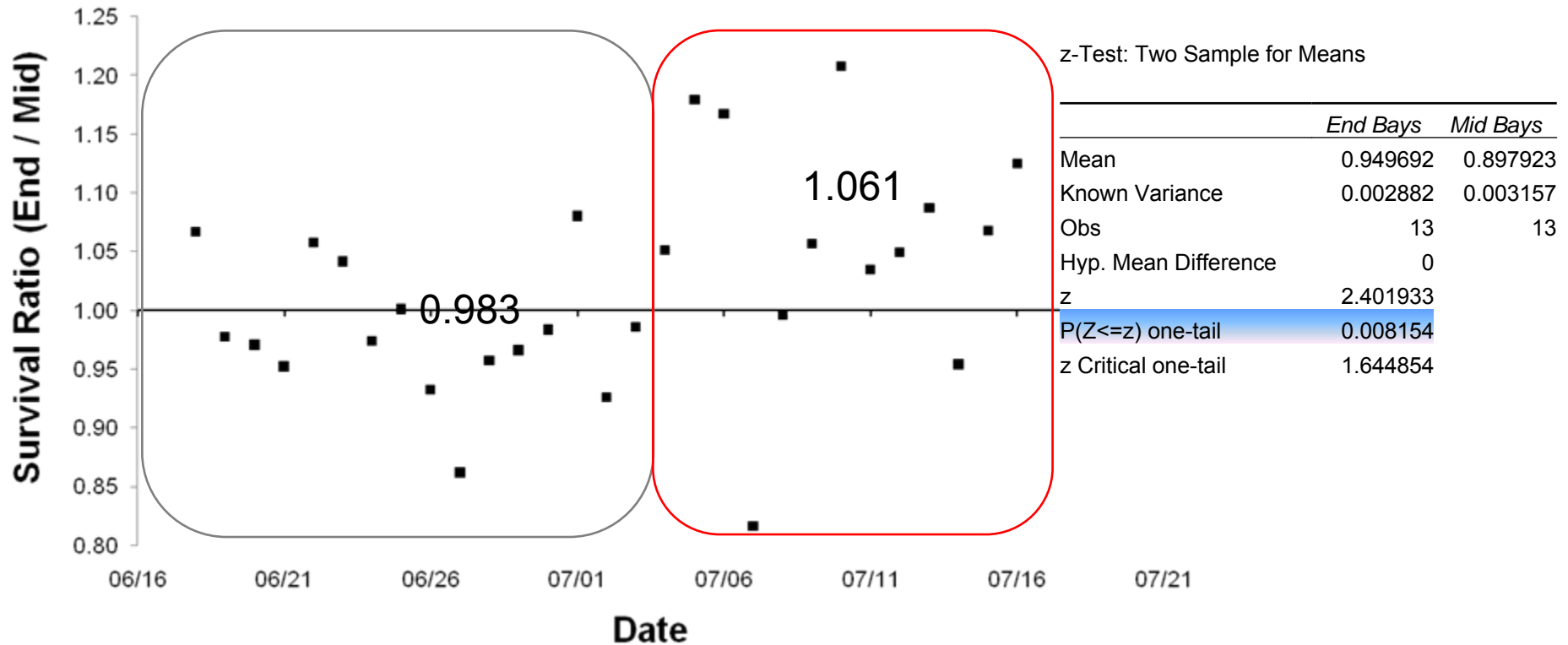
No Apparent Difference in Survival of Fall Chinook Passing End & Middle Bays in Summer



Tailwater Elevations in 2007 & 2008



Ratio of End- to Middle-Bay Survivals (Fall Chinook)



Conclusions

- ▶ Single-release dam survival estimates for BON were about 95% for each species and age group
 - Inference probably is for high-flow years only
- ▶ Paired release dam survivals were $\geq 97.8\%$ for Chinook
- ▶ Survival of fall Chinook salmon smolts passing end bays (deep flow deflectors) was $>$ survival of smolts passing middle bays (shallow flow deflectors) [95.0 vs. 89.9] after July 4 when tailwater elevations were falling
- ▶ High tailwater elevations (>25 ft above MSL) during the second half of spring and first half of summer eliminated chances of detecting differences
- ▶ Summer results were consistent with findings in summer 2007 when tailrace elevations usually were within 4 ft of shallow flow deflectors

Acknowledgements

PNNL

Jessica Carter, Kenneth Ham, Geoff McMichael, Rich Brown, Kate Deters

NOAA Fisheries

Lynn McComas, Jason Everett, Steve Brewer, Jeff Moser, and Galan Wolf

PSMFC

Supervision:

Rick Martinson

John Day Dam:

Greg Kovalchuk, Steve Goss,
Laura Daniel, Randy Wall,
John Mathieus, Kenneth Kenny

Bonneville Dam:

Dean Ballinger, Matt Meyer,
Caren Dittbrenner, Mike Jenkins, and
Linda McPhetridge

Mixing of Treatment and Reference Releases in BON Tailwater

- ▶ More treatment and reference fish reached the primary array between midnight and 0500 h than midday, afternoon, or evening each season
- ▶ Treatment and reference fish arrived during all quarters of a day

