Upper Yakima River Spring Chinook Competition and Capacity 2012

Presented by
Christopher Johnson -WDFW

Photo: goodfoodworld.com

Spring Chinook Competition and Capacity History/Project goals

-Monitor for density dependant constraints to the population following supplementation.

-Identify factors which are potentially limiting to the population

---

Proposed "crowding" indices of system capacity:

- Growth: (Length, weight, and condition factor
- Food competition: (indices of fullness, intra and inter-specific competition)
- Space competition: (altered patterns of microhabitat utilization, intra and inter-specific competition)
- Expanded rearing distribution

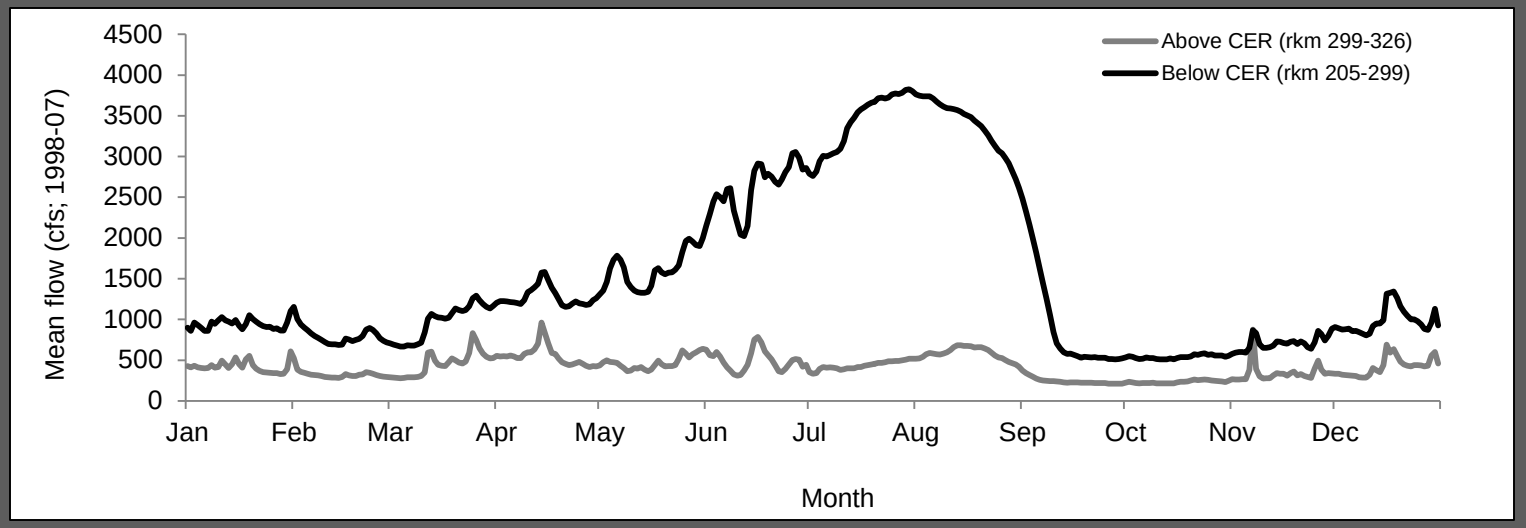
-Yakima Fisheries Project Spring Chinook Supplementation Monitoring Plan (Busack et al. 1997)

Challenges:

Spatial and temporal environmental differences

Easton

Thorp



Challenges:

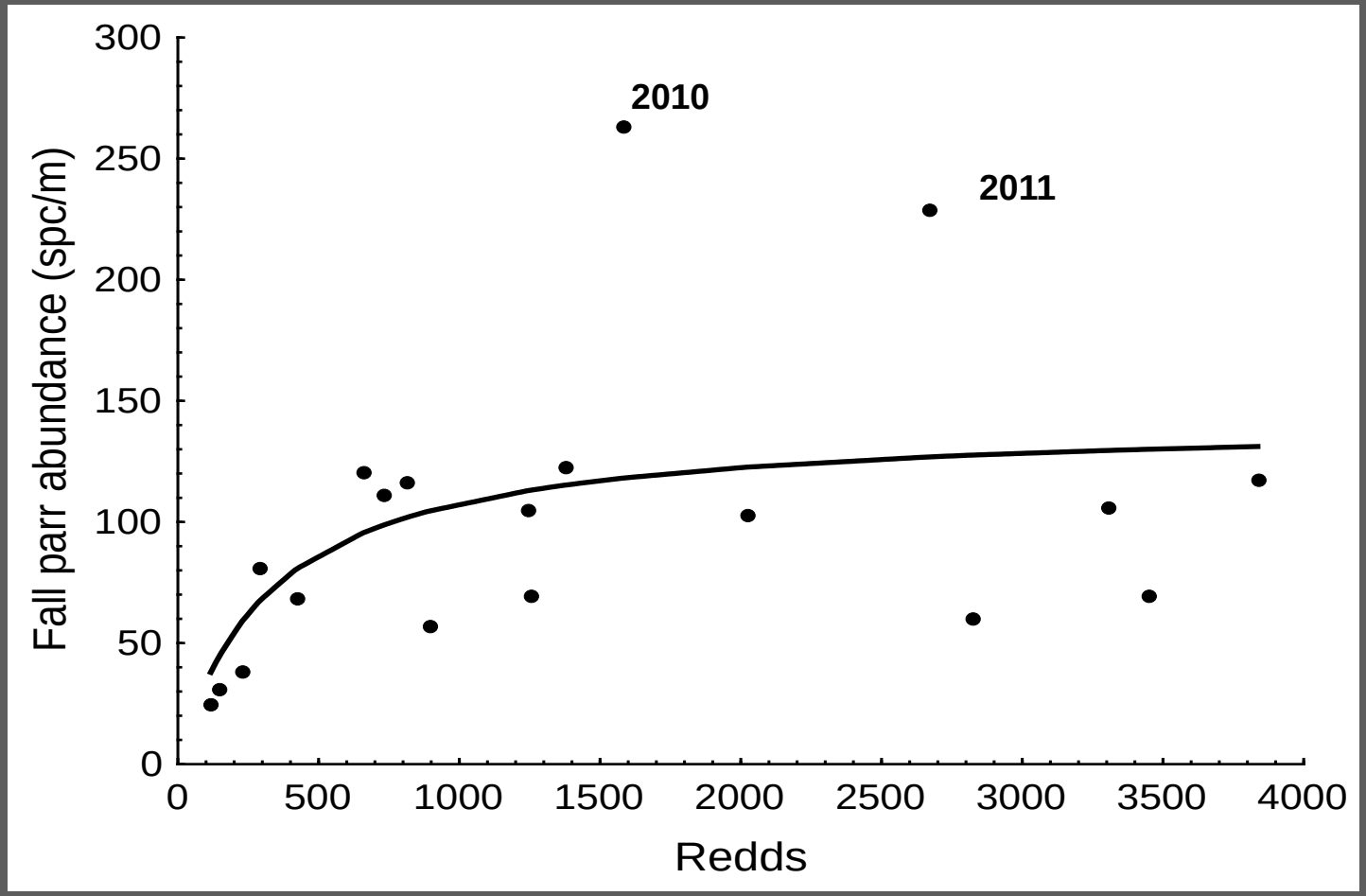
- Temporal (life-stage specific) habitat requirements
- Detectable density response among survivors

Egg-to-fry

Fry-to-parr

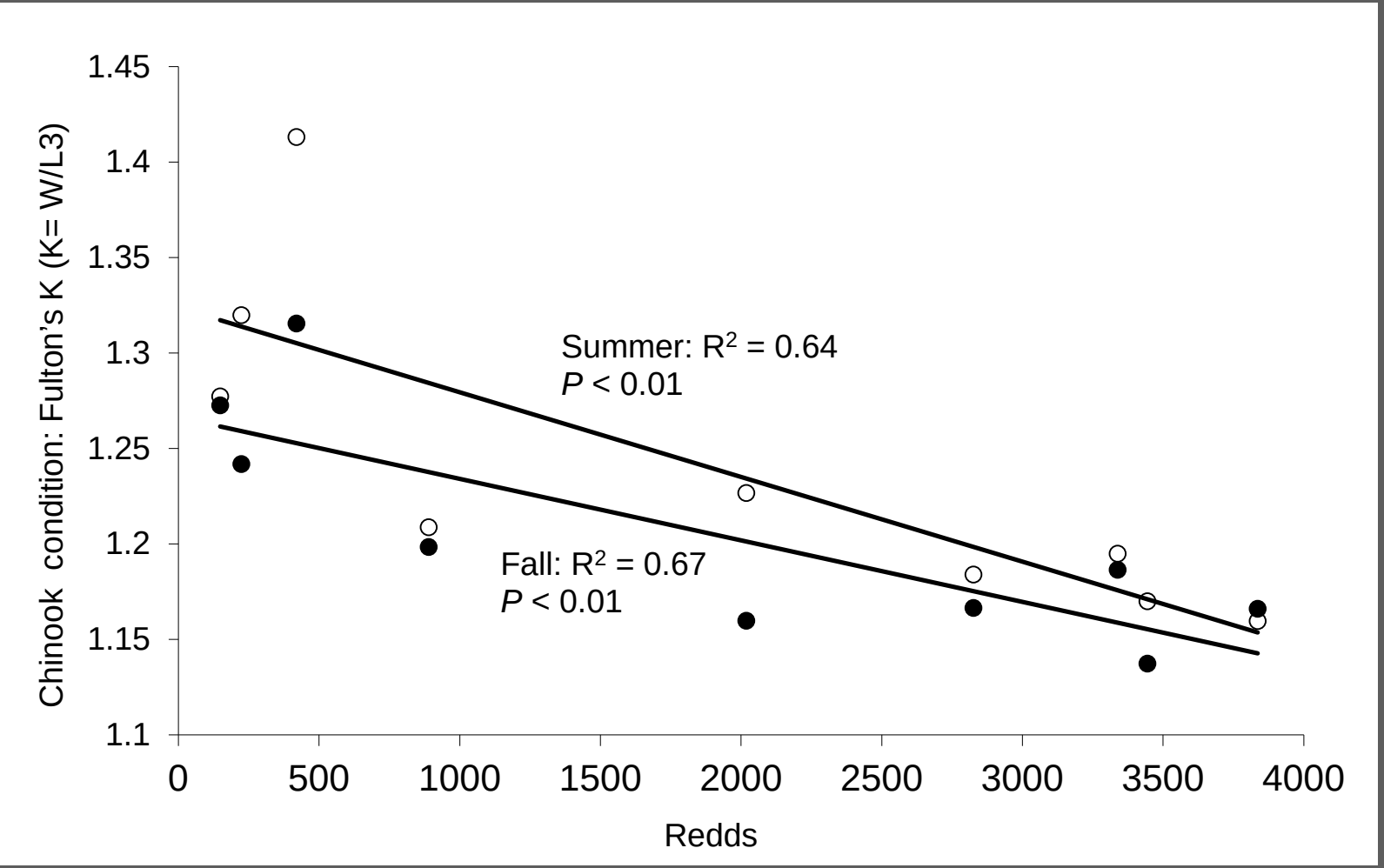
Parr-to-smolt

Upper Yakima River Spring Chinook Beverton-Holt Recruitment Curve 1994-2011



Redds: YKFP redd surveys
Spring Chinook visual abundance estimates: Gabriel Temple, WDFW
Fall parr vs. Chandler smolt estimates 1994-2010: $R^2 = 0.69$, $P < 0.01$

Spring Chinook Condition 1998-2006



Johnson et al. (2009)

Allometric growth (Sample date vs. K) $R^2 < 0.02$

Spring Chinook competition indices 1998-2005

Rank	Species	Per Capita Food	Space competition
1	**SPC**	**70.7**	**2.9**
2	RBT	61.7	3.70E-02
3	MWF	50.6	1.60E-02
4	RSS	47.5	5.40E-04
5	HSPC	42.1	4.80E-04
6	EBT	40.5	7.70E-05
7	SUK	32.4	3.30E-05
8	COHO	31.2	0
9	CUT	28	0

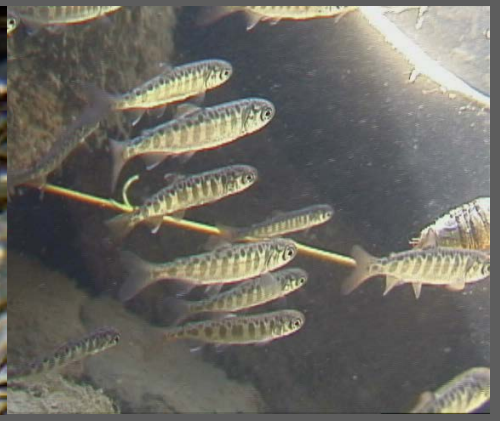
Pearsons et al. (2007)

Current investigations

- Life-stage and reach-scale specific investigations
- Development and/or refinement of methods

Egg-to-fry

Fry-to-parr

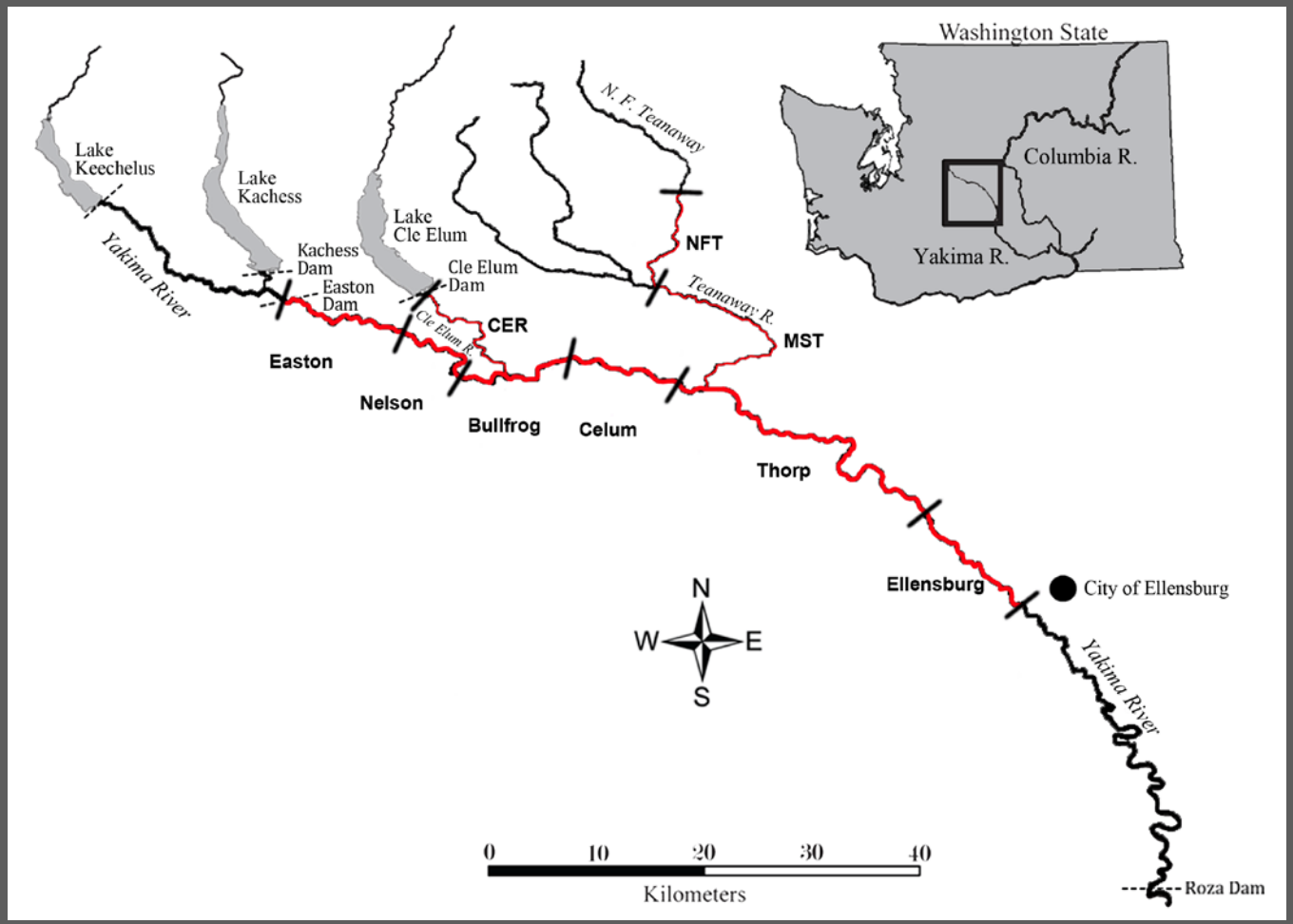


Parr-to-smolt

Egg-to-fry

C. Johnson[1], P. Roni[2],T. De Boer[1] & G. Pess[2]

Whitlock-Vibert egg box



[1]WDFW
Ecological Interactions Team
Ellensburg, Washington

[2]Watershed Program
Fisheries Ecology Division
Northwest Fisheries Science Center
Seattle, Washington

Upper Yakima egg-to-fry survival

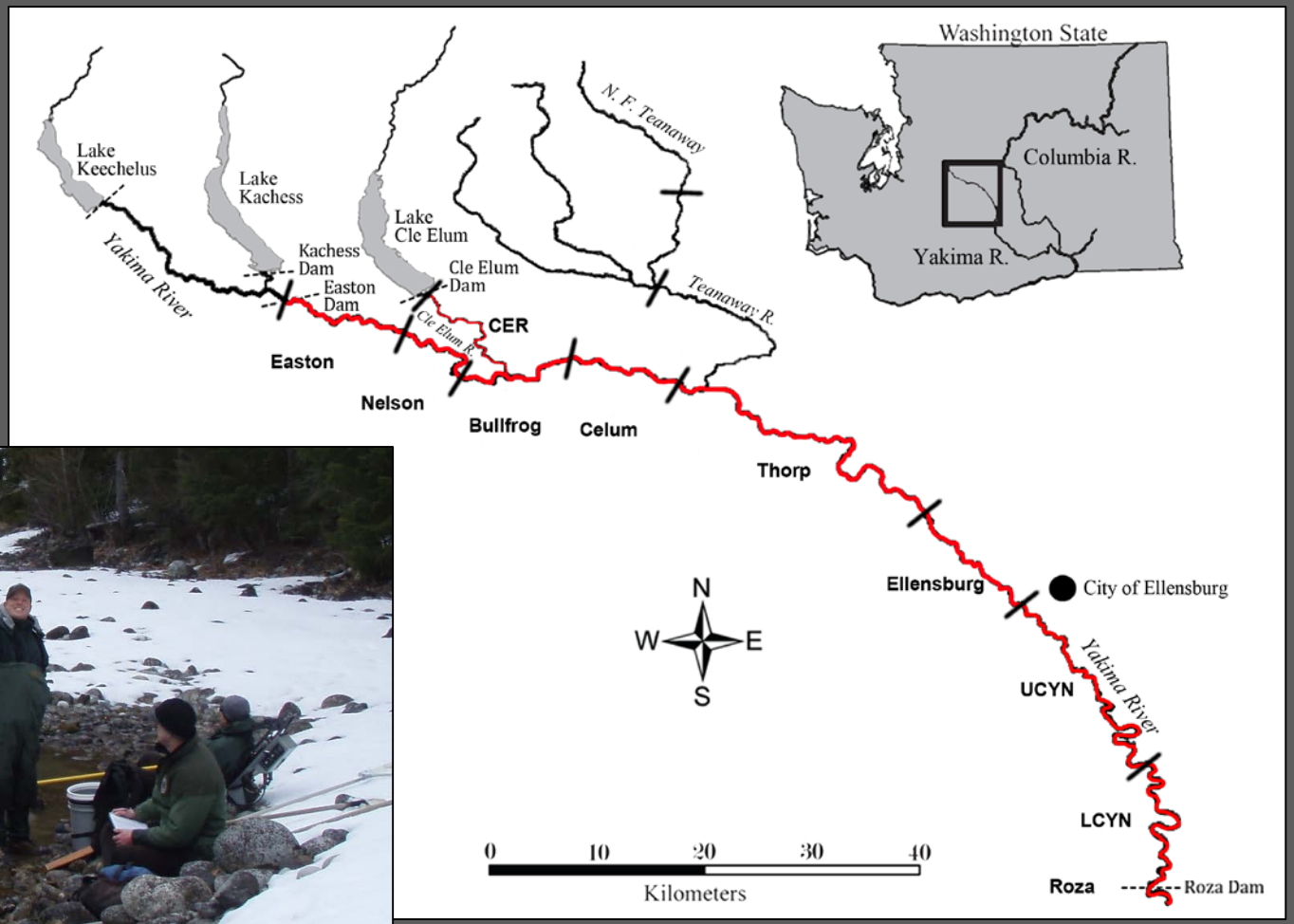
ANOVA

	Reach			Parentage		
Year	Mean	SD	*P*	Mean	SD	*P*
2009/2010	68.87	9.80	0.09	69.30	14.43	< 0.01
2010/2011	43.33	25.79	< 0.01	44.05	7.93	0.88
2011/2012*	49.14	8.73	0.32	48.37	20.81	< 0.01

*Preliminary

Fry-to-parr

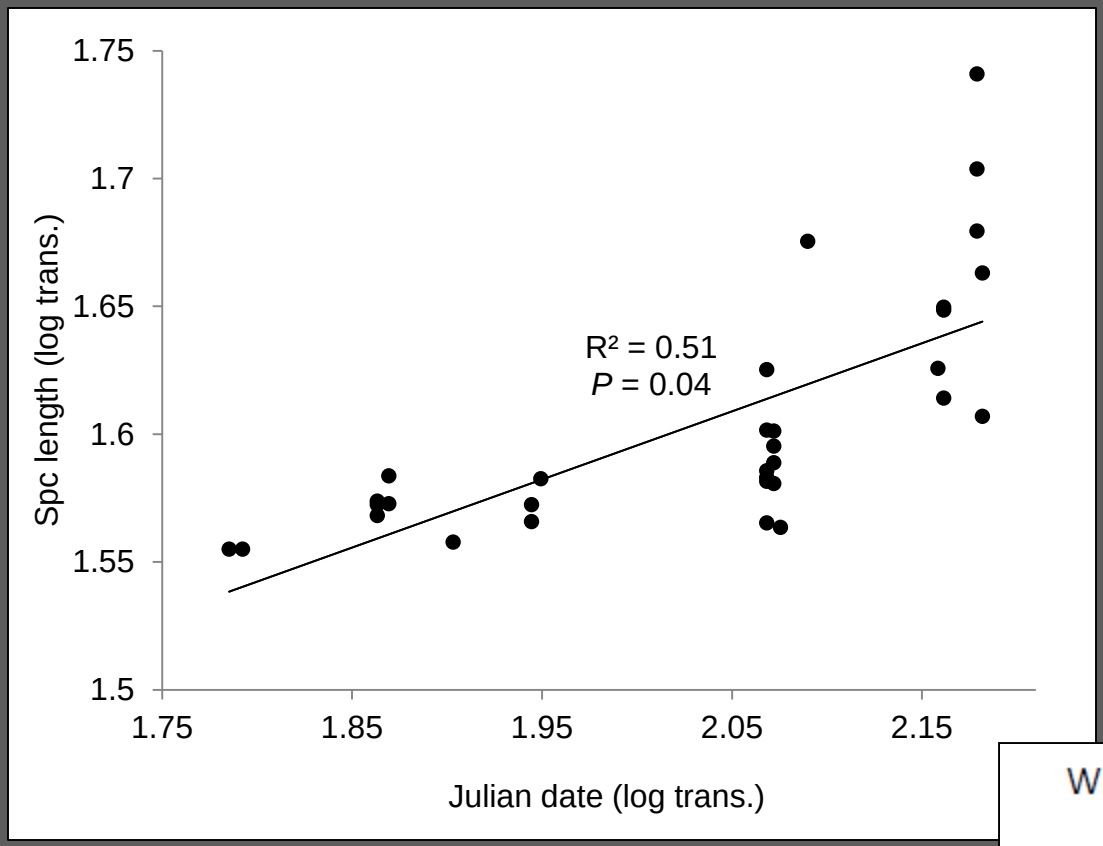
Lead technicians: Tim Webster, Trenton De Boer, and Nick Mankus -WDFW



"These differences" [~4 mm in size at emergence] "may seem small but they are more than enough to affect the outcome of territorial disputes or predator attacks on free-swimming fry" –Quinn (2009)

Spc fry-to-parr growth

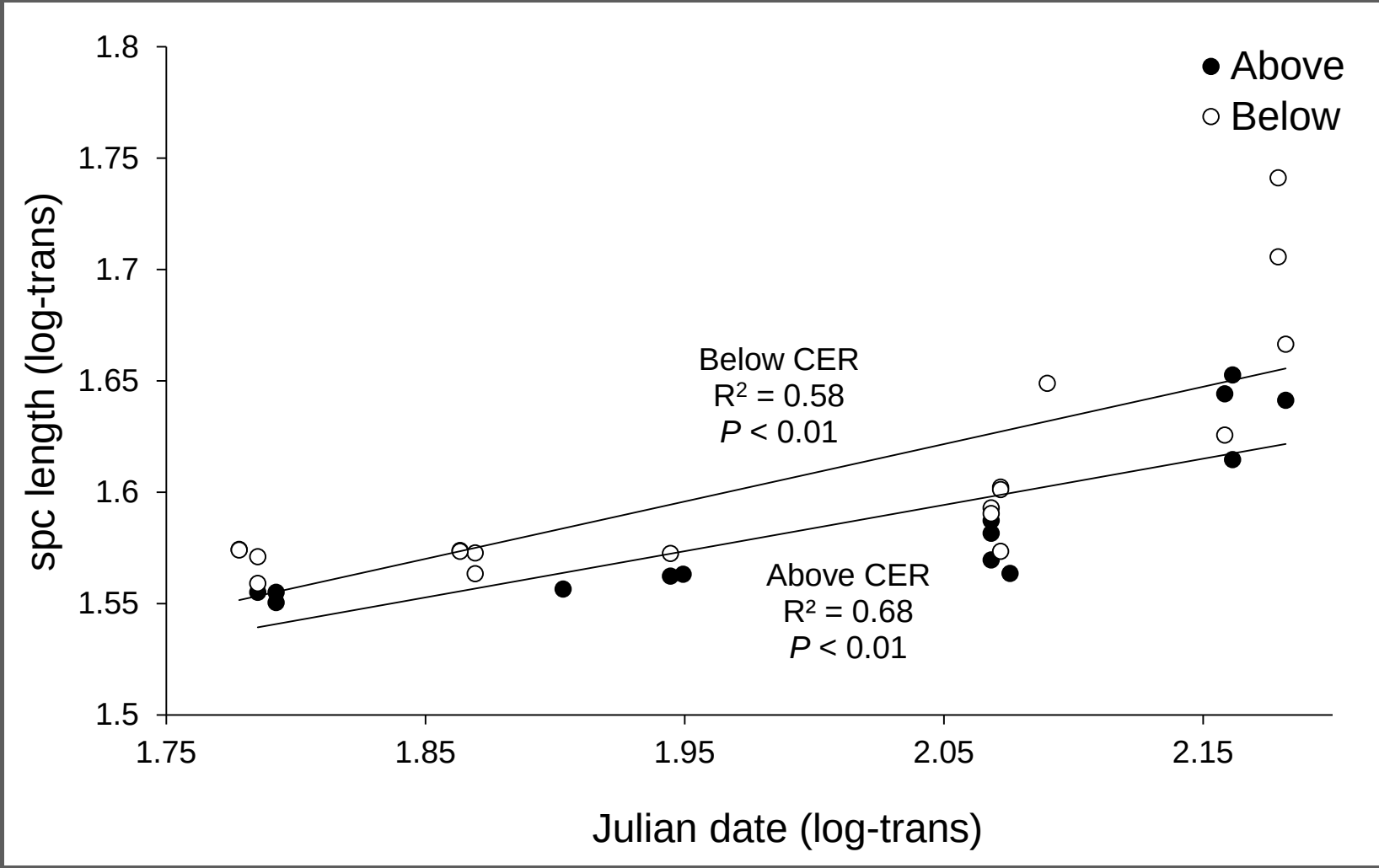
2011



Whole model: n = 28, R^2 = 0.63, $P < 0.01$

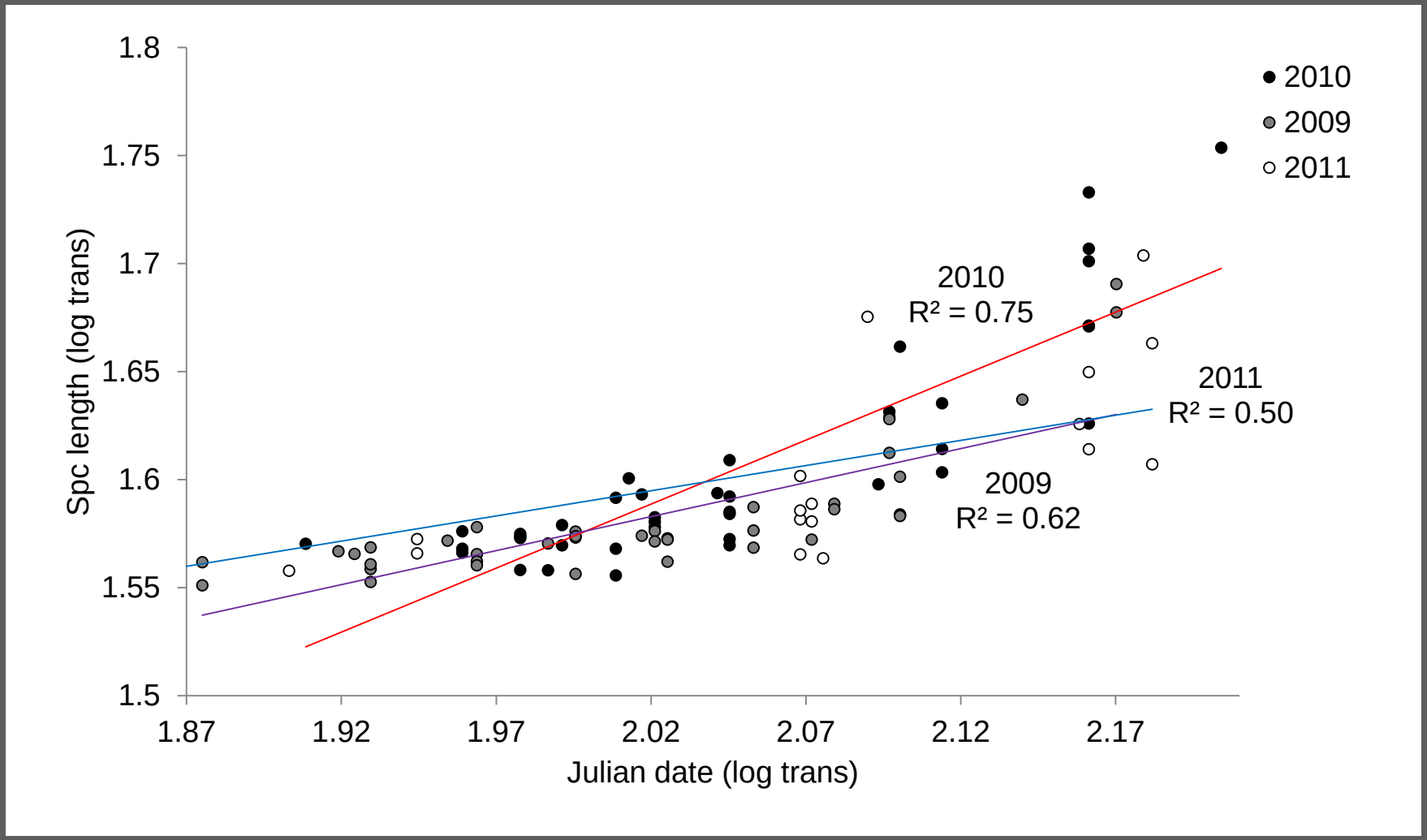
Predictor variable	Beta	Significance
Collection date	0.67	$P < 0.01$
River kilometer	-0.36	$P < 0.01$

Spc fry-to-parr growth
2011



Homogeny of slopes *P* =0.85
ANCOVA: *P* = 0.03

Spc fry-to-parr growth 2009-2011



Homogeny of slopes $P < 0.01$

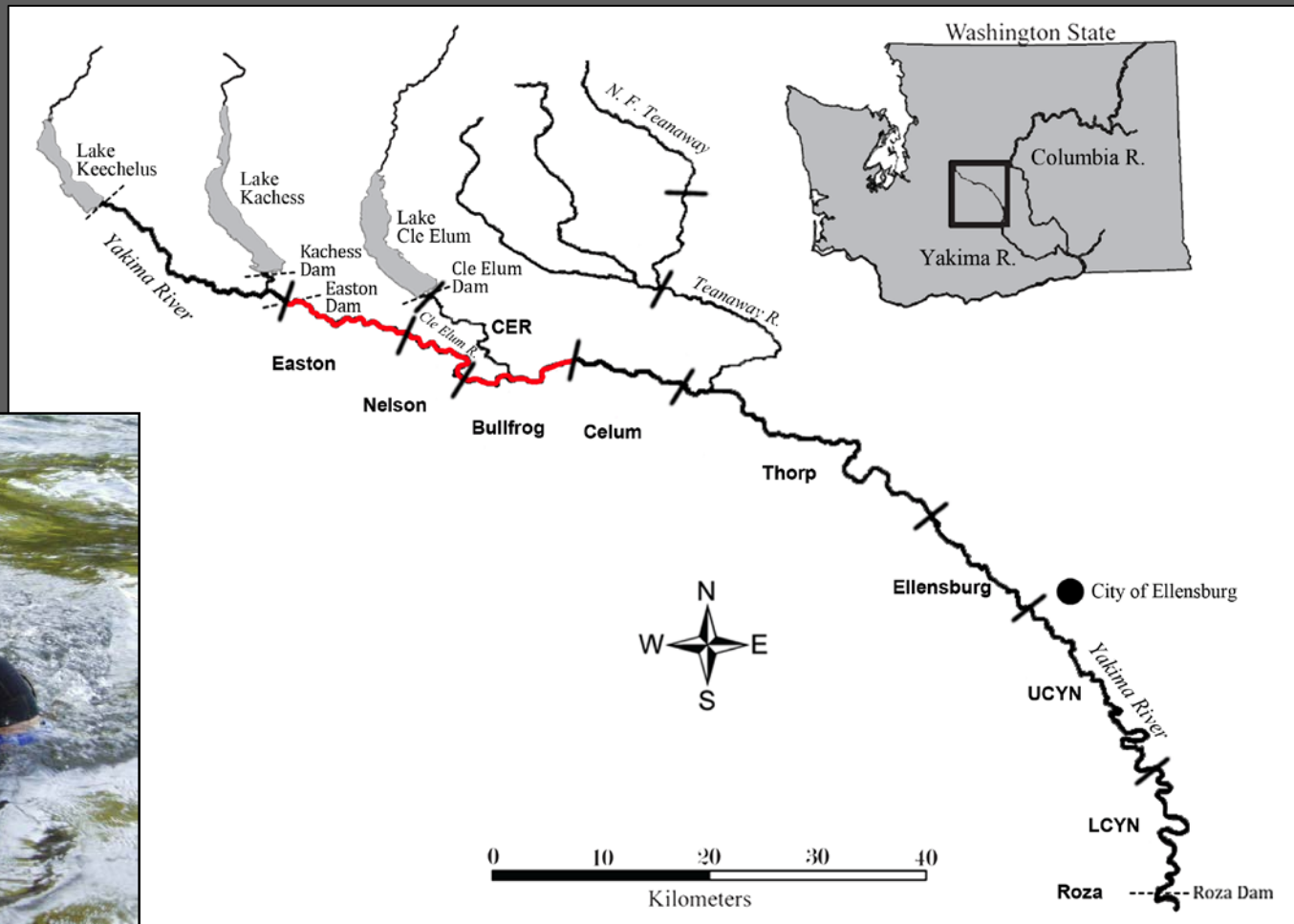
Separate slopes model: $P < 0.01$

Summer Parr

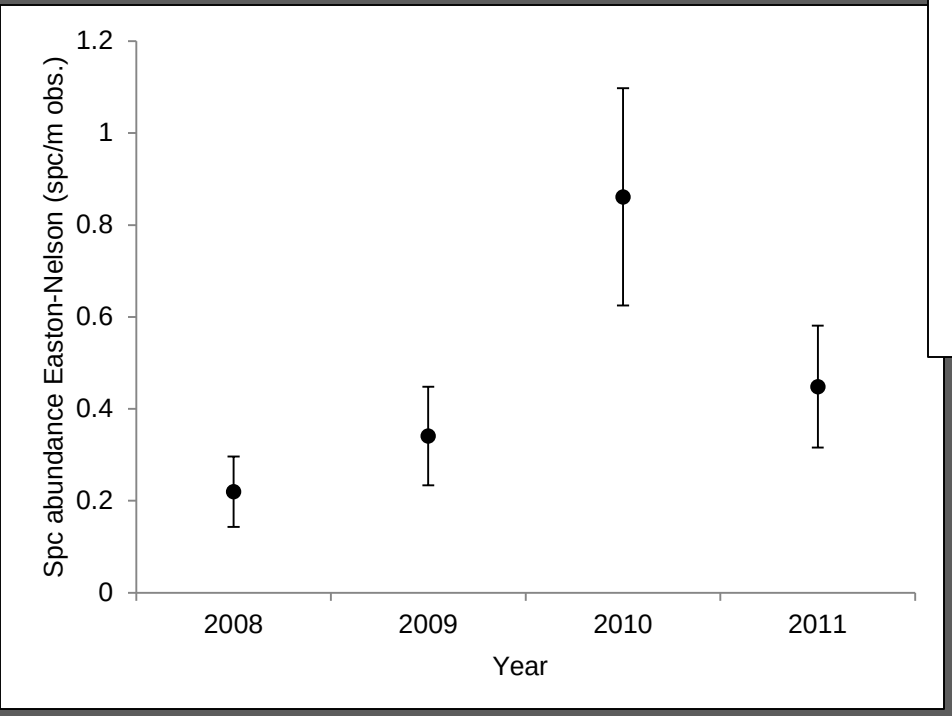
Lead technicians: Trenton De Boer, and Nick Mankus -WDFW

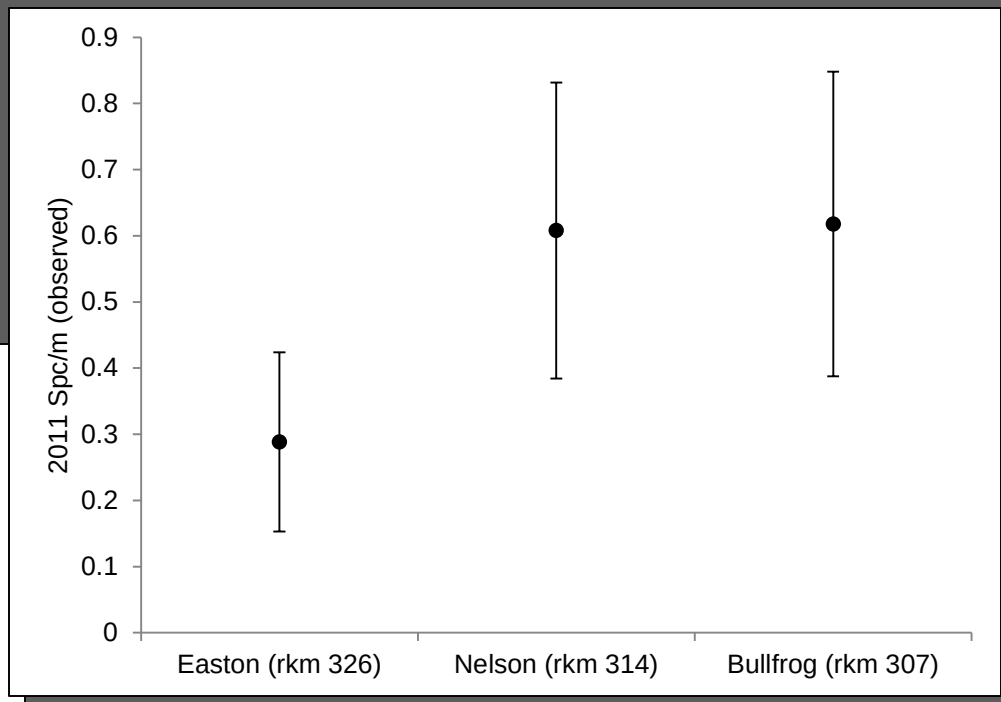
Goals:

- Relative measures of abundance among reaches
- Comparison of relative abundance among years
- Determine environmental factors critical to summer rearing Chinook in the Yakima R.



Summer parr relative abundance 2008-2011





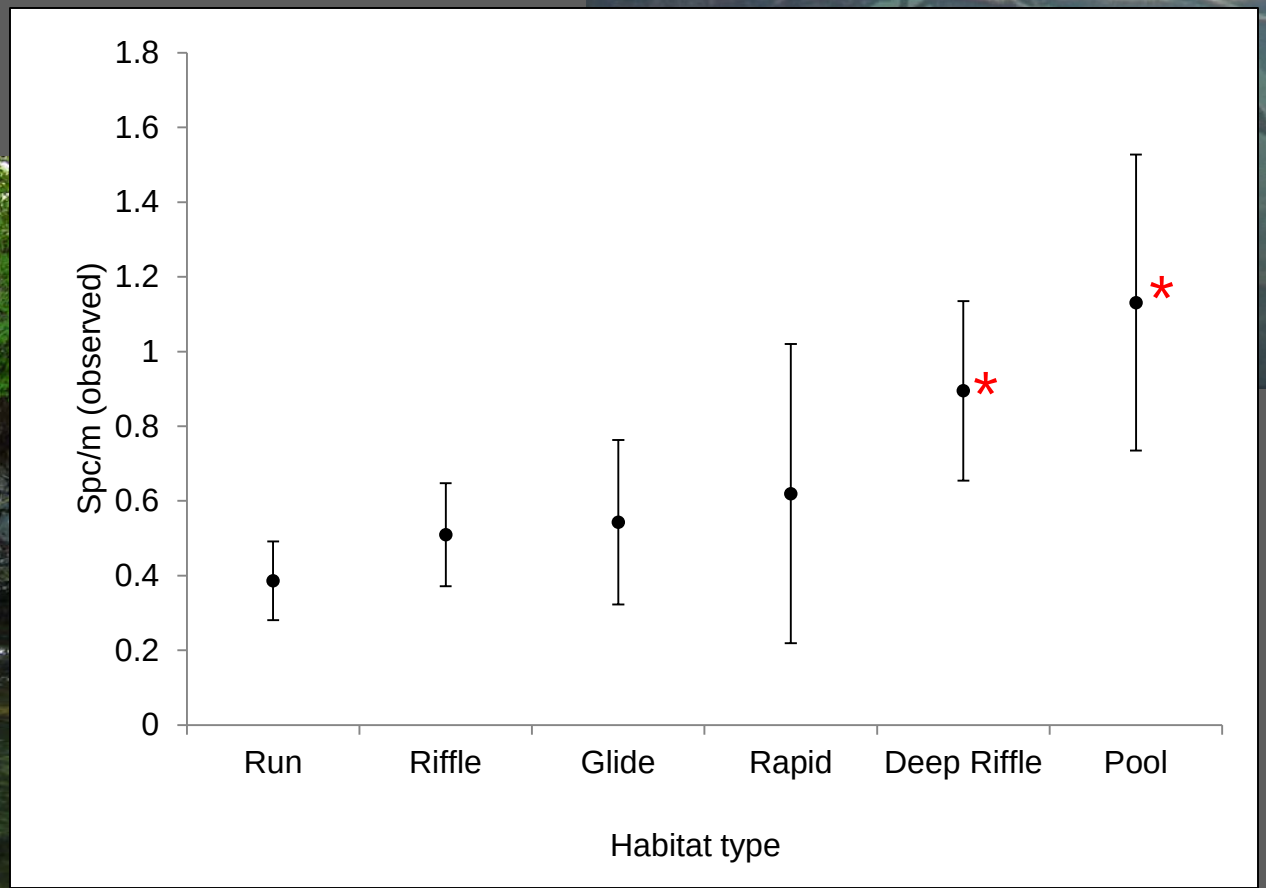
2011 ANOVA: $F_{2, 211} = 3.46$, $P = 0.03$;
min. det. Difference = 0.44 Spc/m obs

ANOVA: $F_{3, 647} = 11.54$, $P < 0.01$
Summer vs. fall abundance estimates (n = 4; $R^2 = 0.83$, $P = 0.09$)

Habitat based predictors of relative abundance 2008-2011

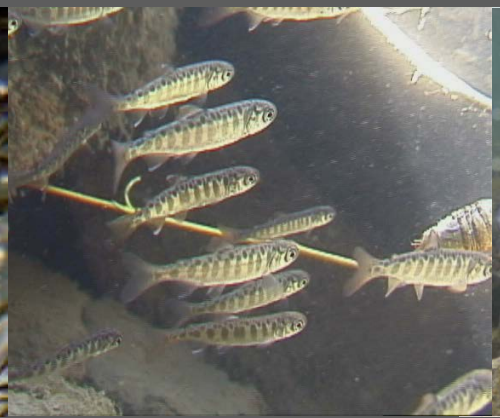
Whole model: n= 617; R^2 = 0.13, $P < 0.01$

Predictor variable	Beta	Significance
Depth	0.32	$P < 0.01$
Overhead cover	0.16	$P < 0.01$
Flow	0.07	$P = 0.08$



Summary

- Data suggest that Chinook in the upper Yakima River experience density dependant constraints in some years
- A density dependant response is evident at or prior to the summer parr life-stage.
- Life-stage specific investigations show promise in their ability to identify and isolate limiting factors




Acknowledgements

- WDFW:
  - Trenton De Boer, Nick Mankus, Tim Webster, Anthony Fritts, Gabriel Stotz, Danielle Sevold, Krystal Rodriguez, Gabriel Temple, Nicole Stokes, Molly Kelly, Zack Mays, Tanya Lamb, Steve Schroder, Chad Stockton, Cole Barret, Kyle Hatch, Bryan Bachman-Rhodes, Matt Sizer, Ben Backstrom, Mike Tonseth, Andrew Murdoch, Kevin White, Clint Deason Diana Dechand, Chad Herring.
- YKFP:
  - Charlie Strom and the CESRF Staff, Dave Fast
- BPA:
  - Patty Smith
- Oncorh Consulting:
  - Curt Knudsen
- Cascade Aquatics
  - Brenda James, Paul James, CA staff
- NOAA:
  - Andy Dittman
- UW:
  - Ryan Klett
- Grant County PUD:
  - Todd Pearsons
- Southampton Univ.
  - David Sear

Additional Information

Fry-to-parr and parr-to-smolt

Annual report to Bonneville:

Johnson, C. J., G. M. Temple. Spring Chinook salmon competition/capacity and residual/precocious male monitoring in the upper Yakima River Basin, Available: www.bpa.gov

Egg-to-fry

Johnson, C. J., P. Roni, G. R. Pess. (in press). Parental effect as a primary factor limiting egg-to-fry survival of spring Chinook salmon *Oncorhynchus tshawytscha* in the upper Yakima River basin. Transactions of the American Fisheries Society.