

Empirical estimates of Chinook salmon egg-to-fry survival in the upper Yakima Basin

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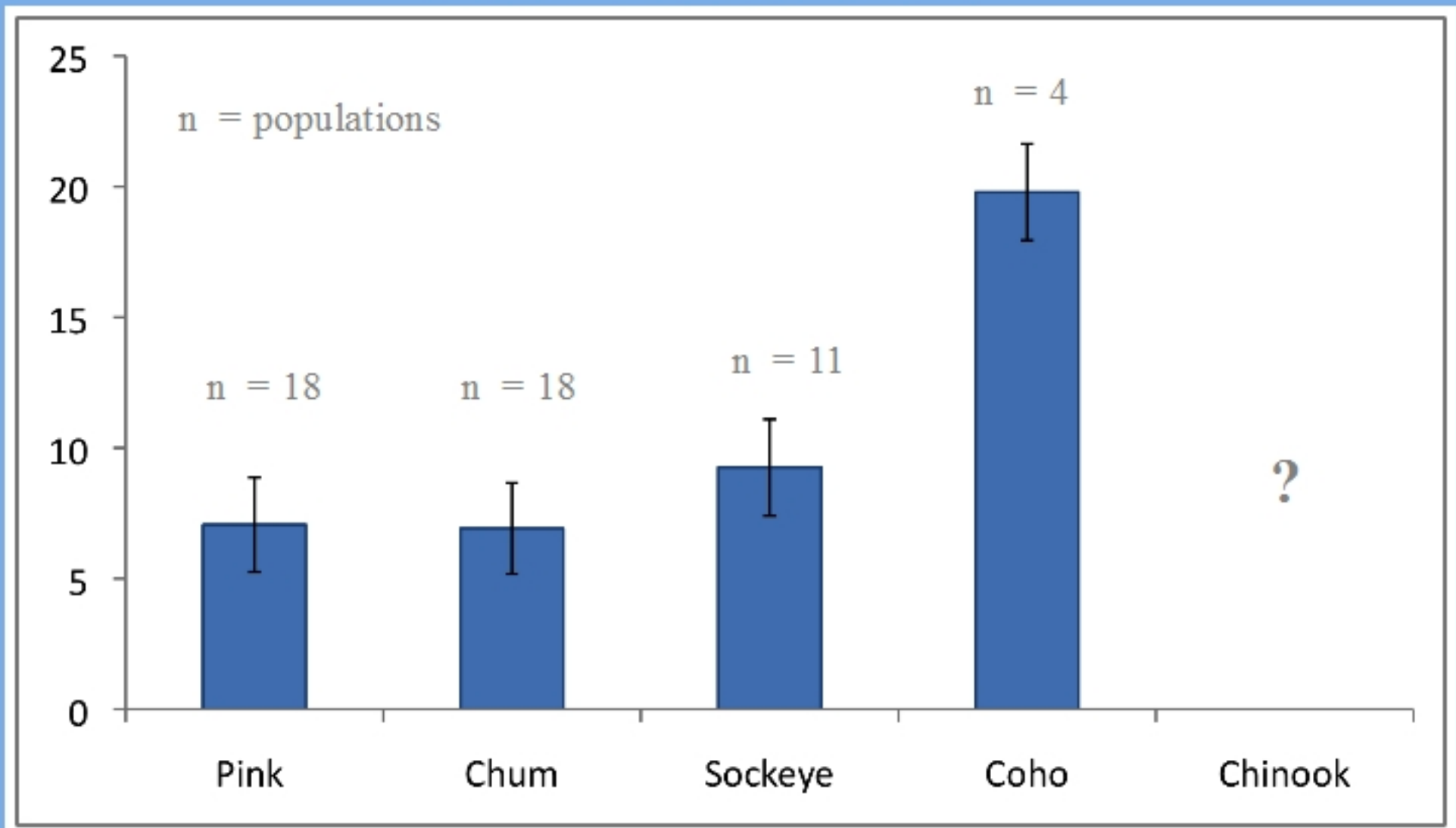


Background

- Many life cycle models
- Point to early life history
- Recovery plans
- Restoration efforts



Estimates of Salmonid Egg-to-Fry Bradford 1995



Chinook Egg-to-Fry Estimates?

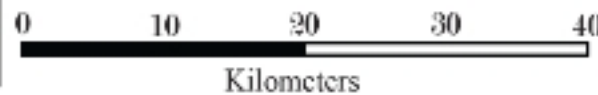
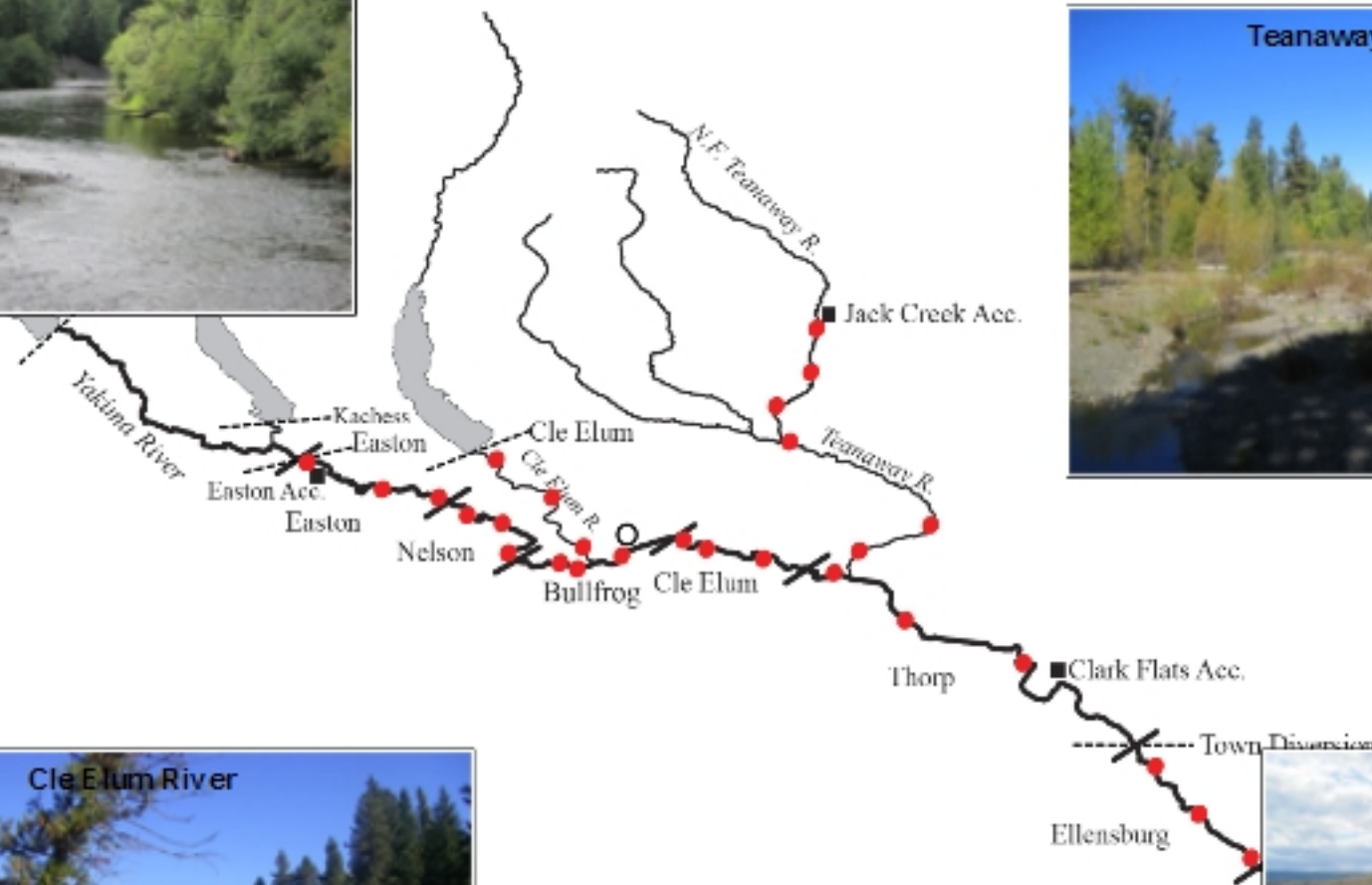
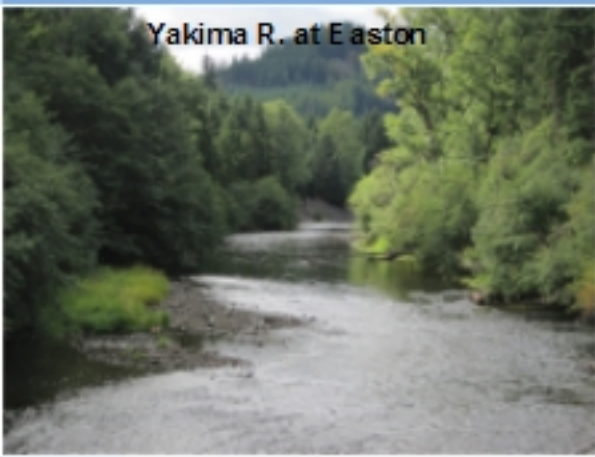
- “Published evaluations are so few and variable that it is difficult to draw firm conclusions”
 - Healey 1991
- ⑩ Jensen et al. 2009 – Meta-analysis of existing egg-to-fry studies
 - Chinook – 8 lab studies
- ⑩ Few field studies


Objectives

- Develop simple method that can be replicated across numerous sites and basins
- Estimate egg-to-fry survival over a range of habitat conditions in one or more basins
- Examine relationship between survival and key physical variables
- Provide estimates that can be used to improve life cycle models & recovery efforts

Study Design & Site

n = 81 artificial redds/yr



Roza 

2010 Chinook Redds Locations

Map and data - Andy Dittman & Darrah May

Kachess Lake

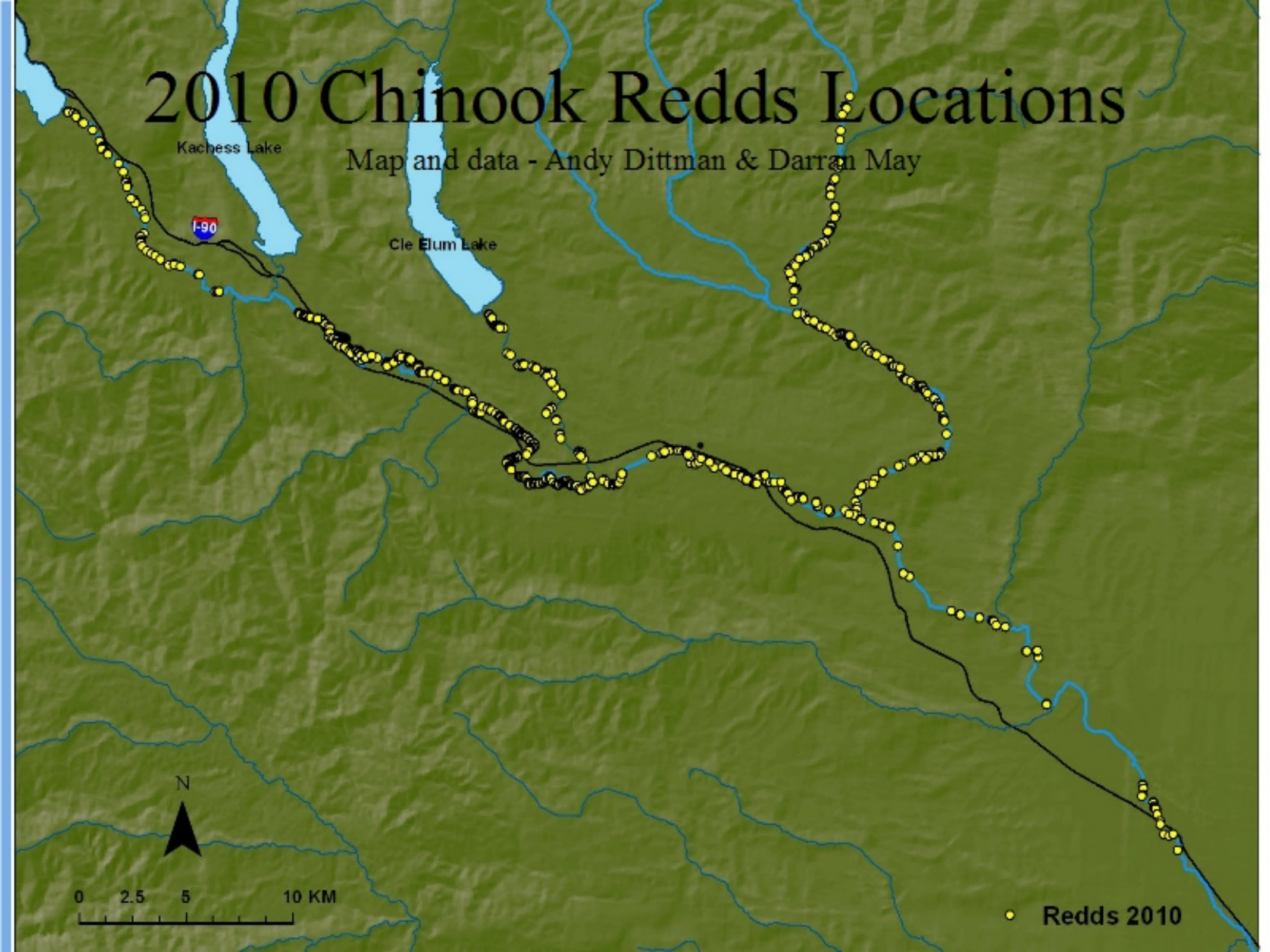
Cle Elum Lake

I-90

N

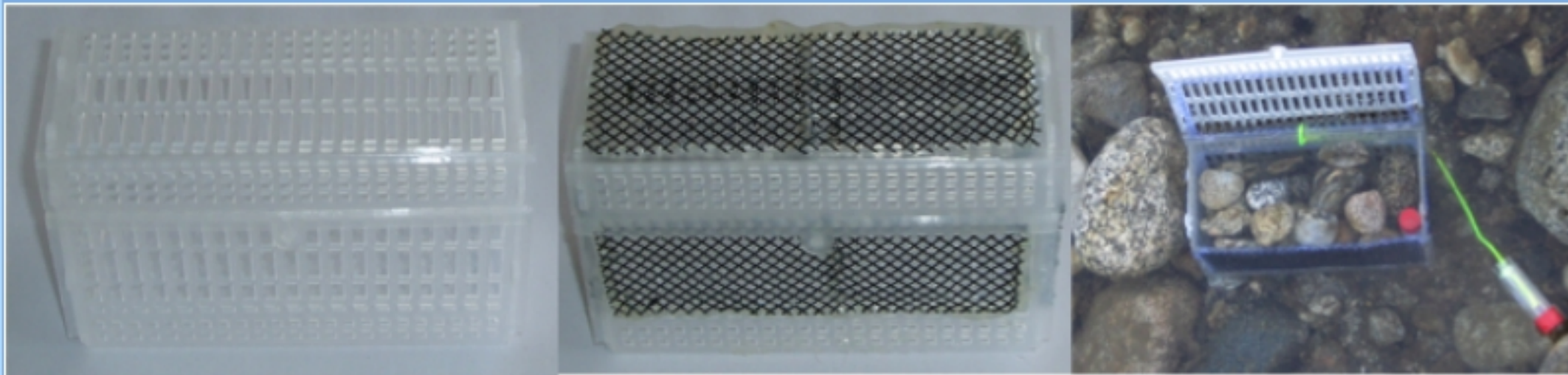
0 2.5 5 10 KM

• Redds 2010



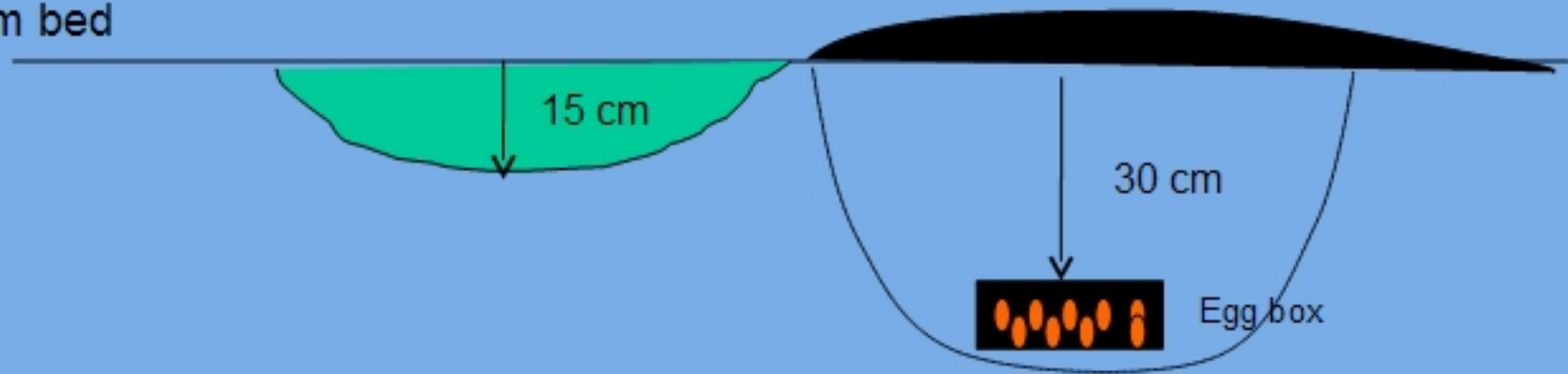
Methods – Egg Boxes

- Whitlock-Vibert Box
- Clean native gravels
- 100 eggs per box



Methods – Redd Construction

Stream bed



Habitat measures



Methods: gamete collection

- Gametes collected over a three week period in September 2009 & 2010.
- 900 eggs from each of three females each week
- 100 eggs and ~0.5 ml milt per box



Methods: egg box placement

- Box preparation
- On-site fertilization
- Previously excavated gravels strained to remove fine sediment



Egg box recovery

- Target 900 accumulated thermal units (deg. C)
- Counts of live fry, remaining eggs and any post-hatch mortalities
- Fine sediment retained (fines = $< 2\text{mm}$)



Developmental stage

$$k_D = \frac{10 \cdot \sqrt[3]{\text{Weight in mg}}}{\text{Length in mm}}$$

(Bams 1970)

kD =
1.9861



kD =
1.9817



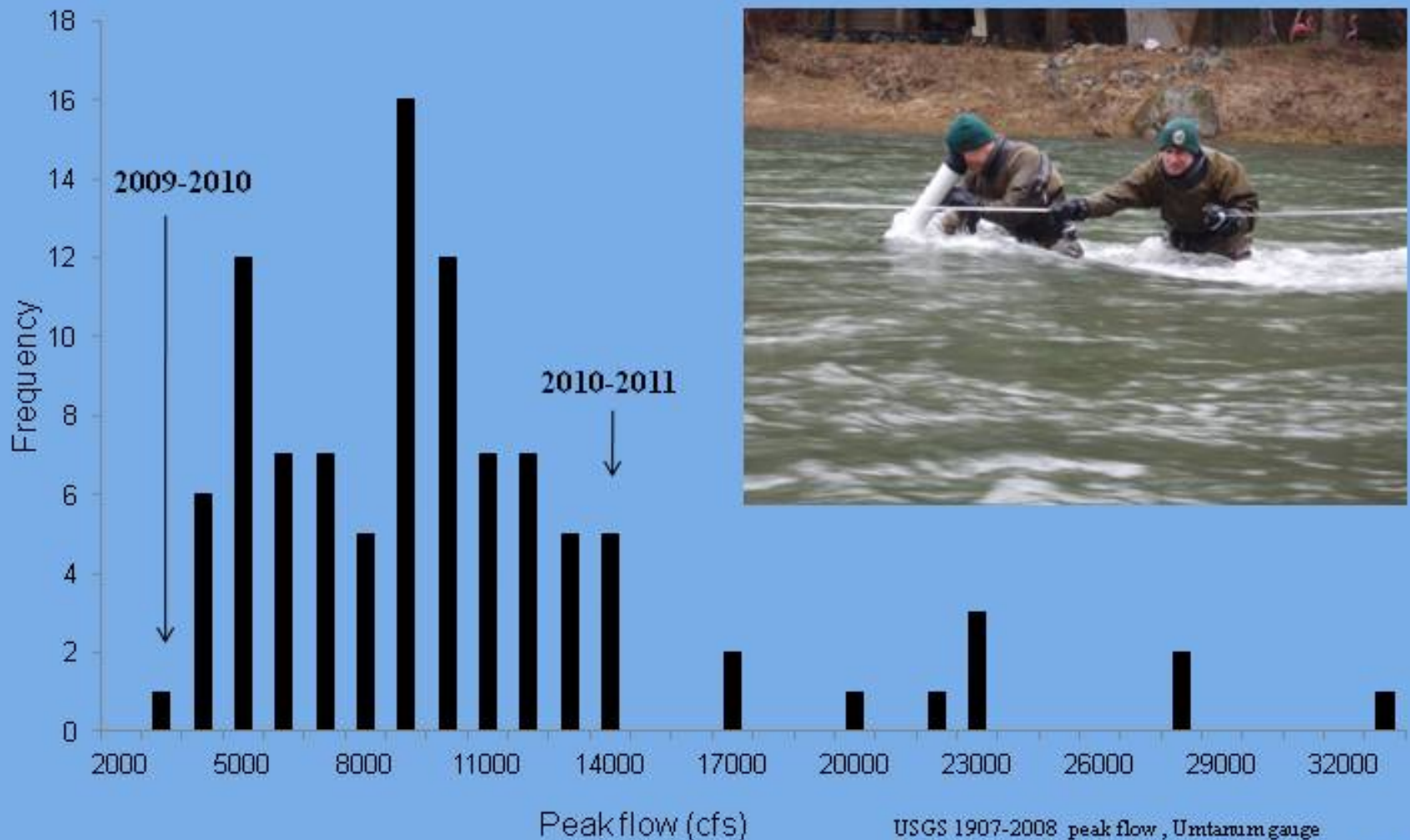
kD =
1.9744



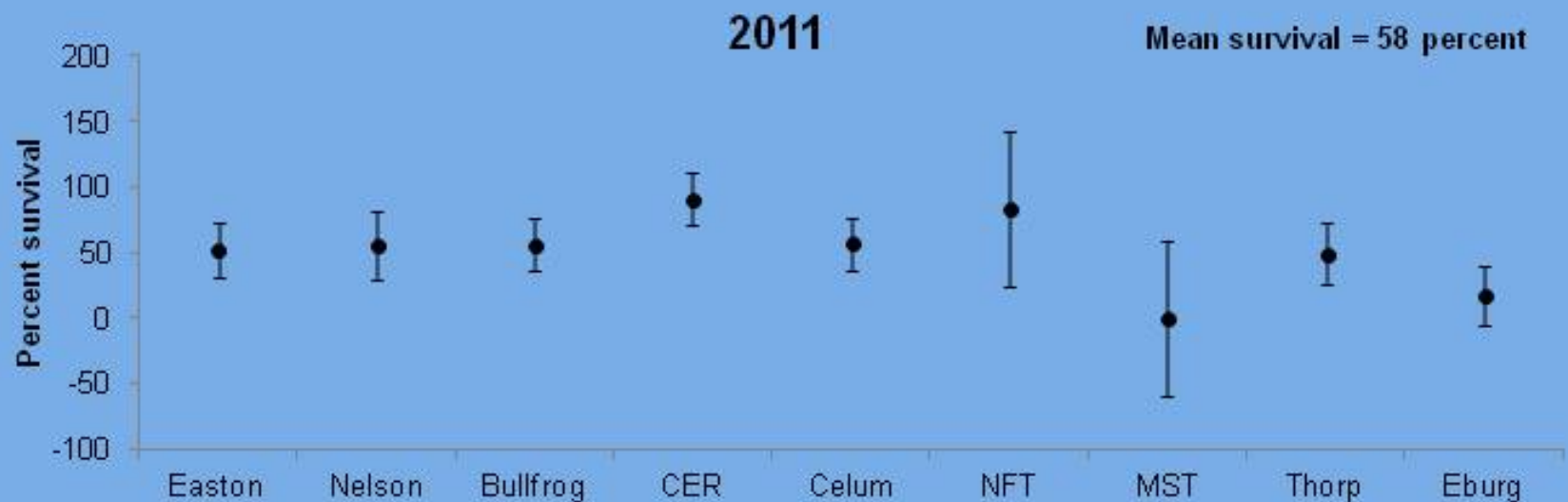
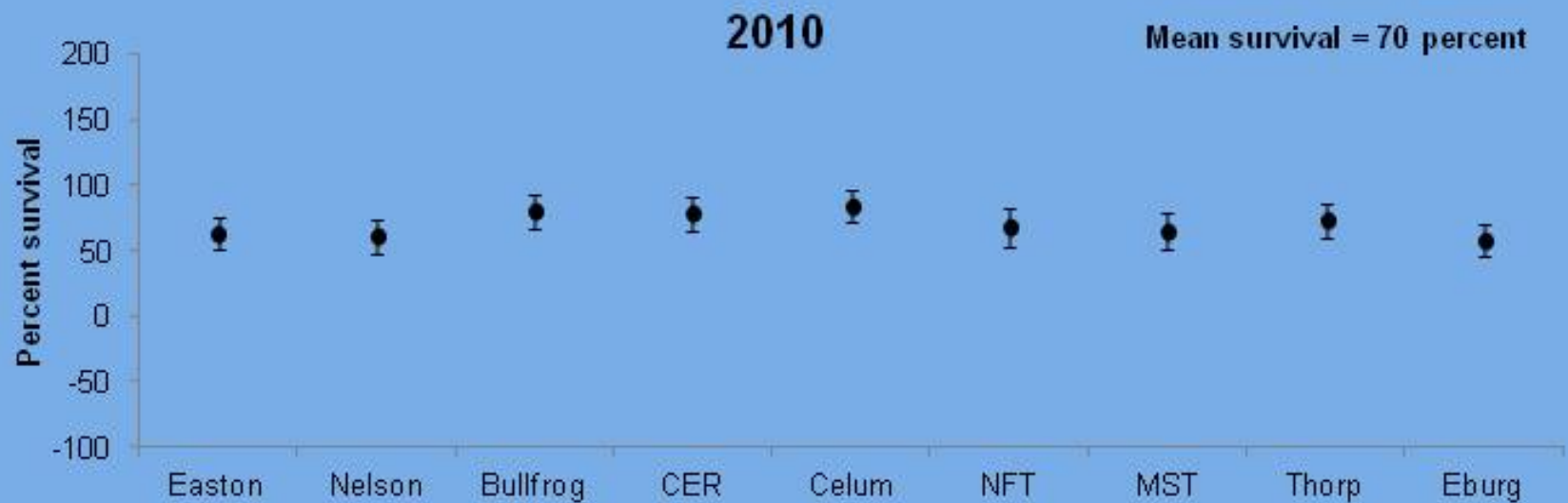
kD = 1.8779



Peak flow conditions Yakima 1907-2011

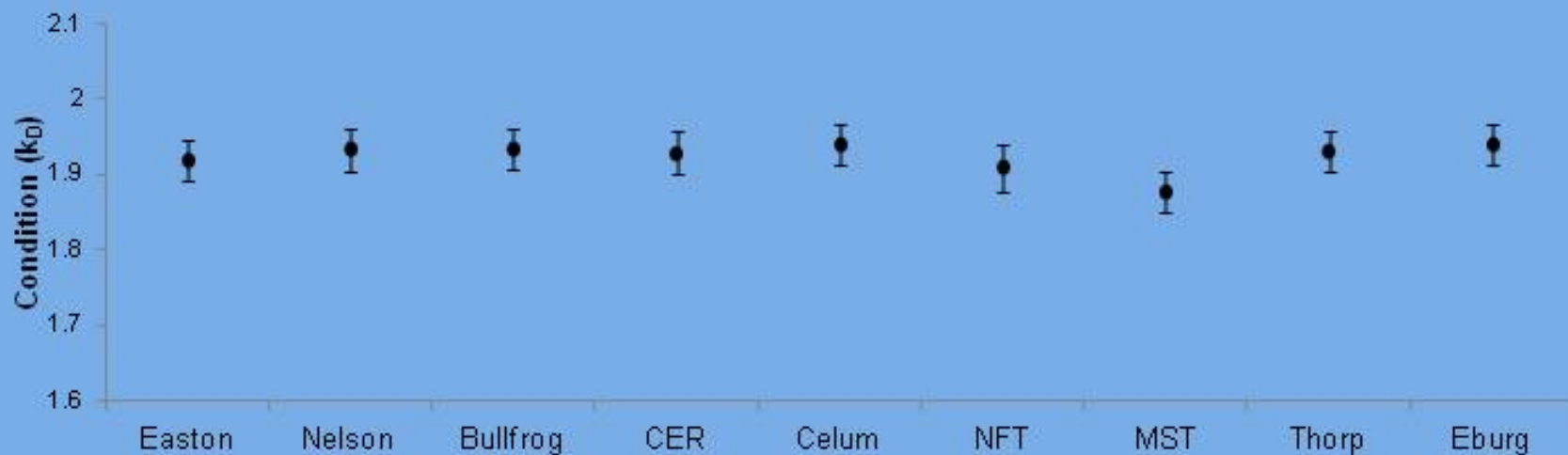


Survival by reach

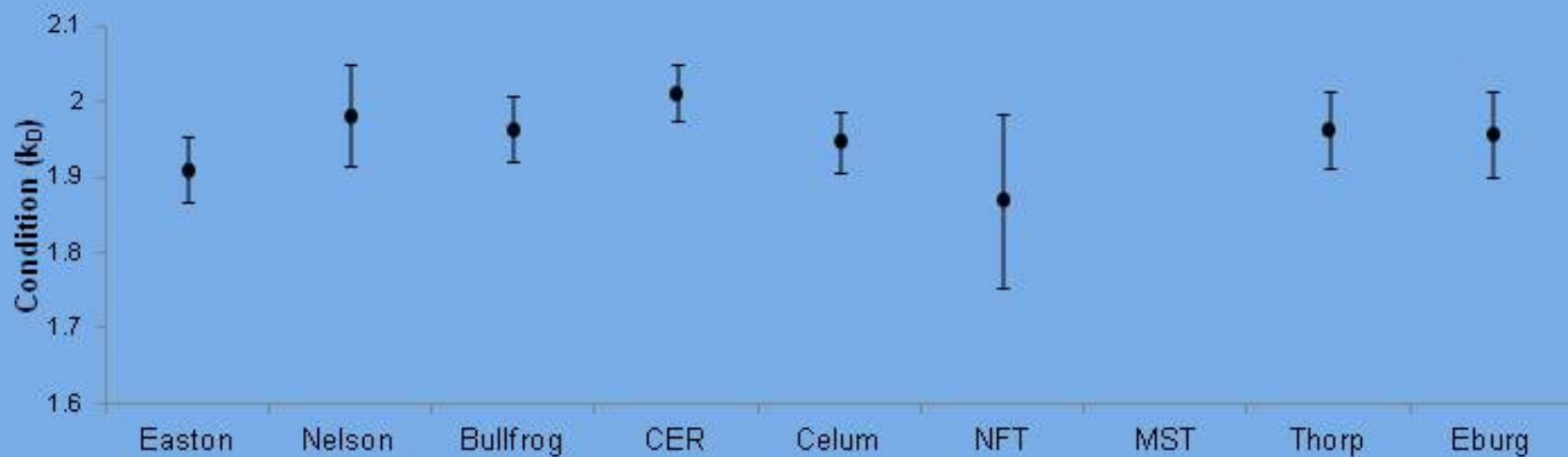


k_D by reach

2010

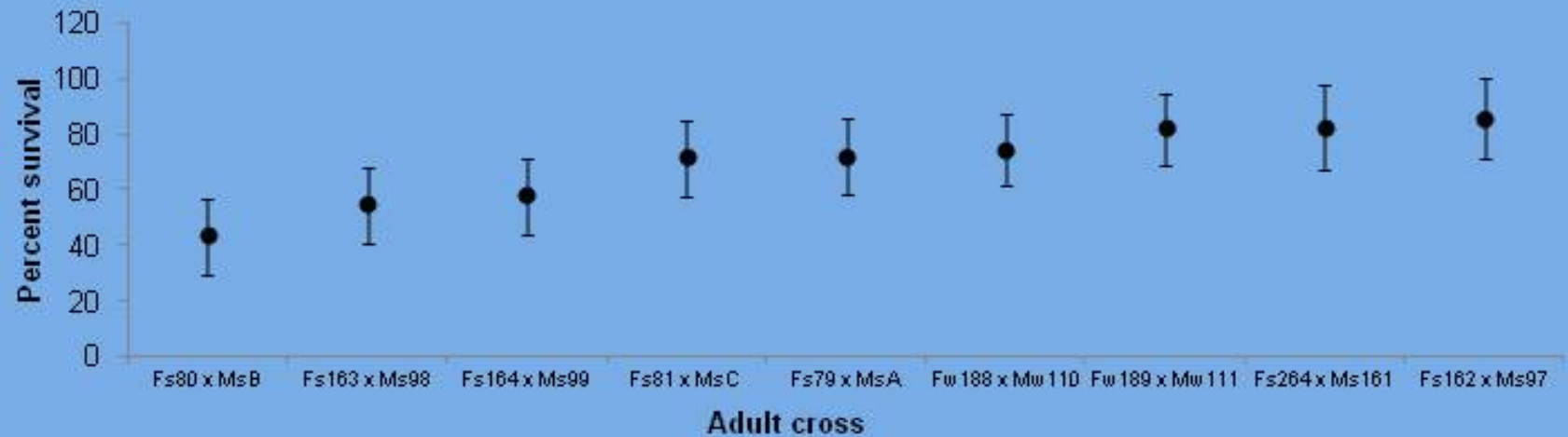


2011

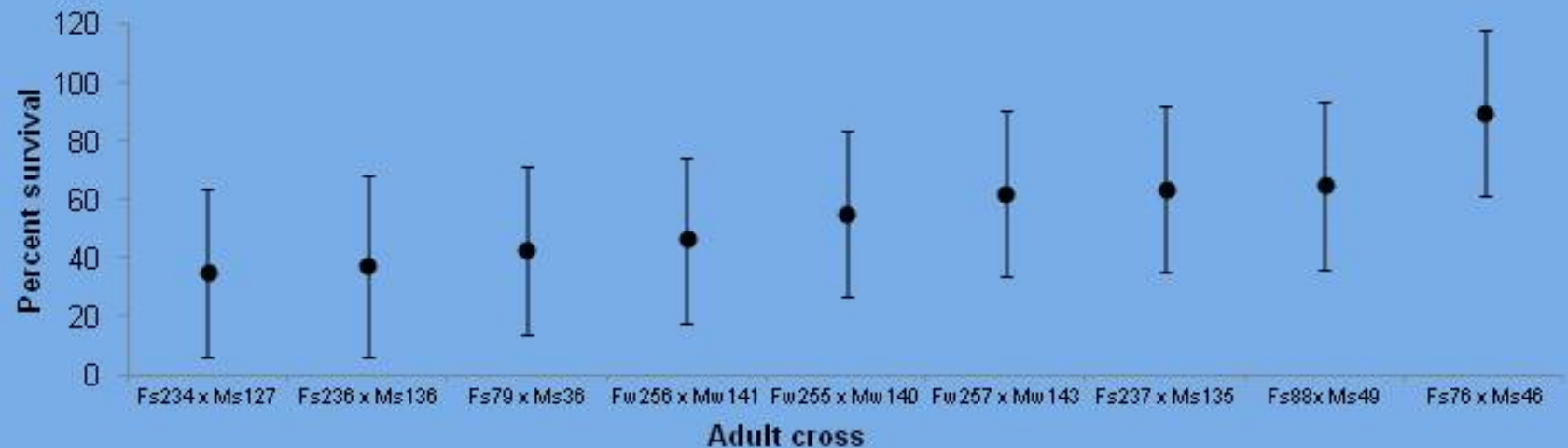


Survival by adult cross

2010

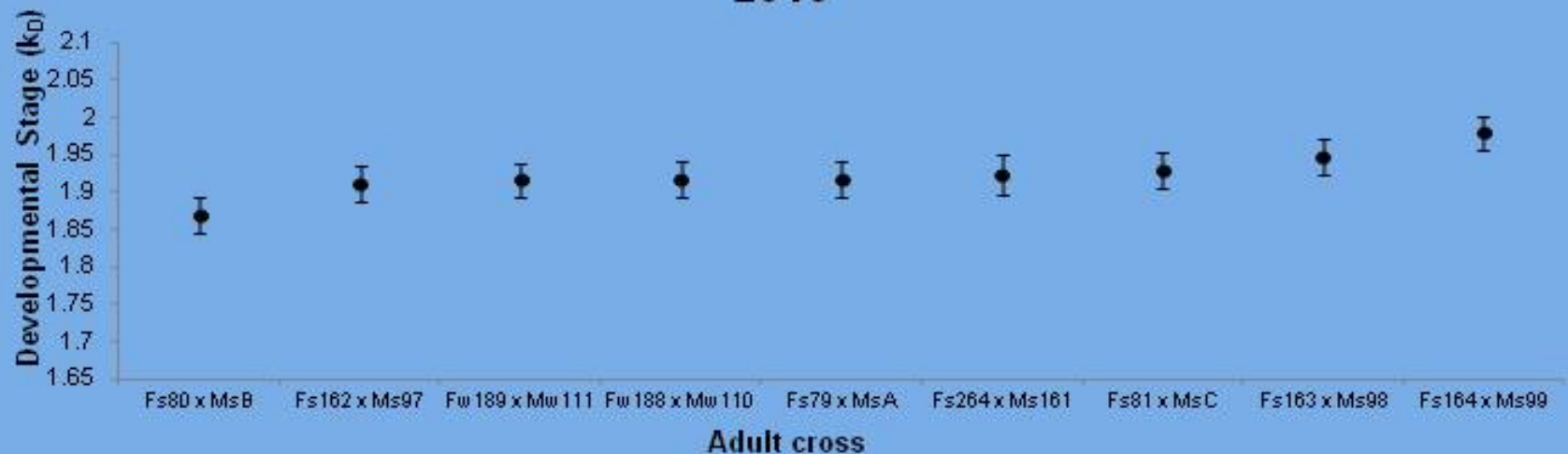


2011

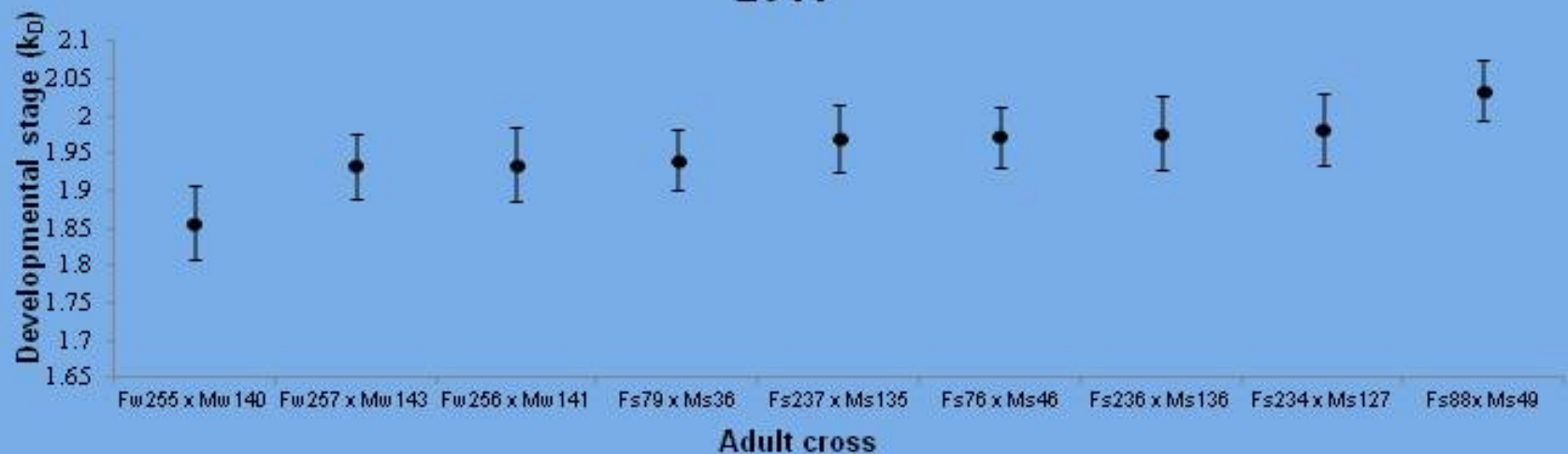


k_D by adult cross

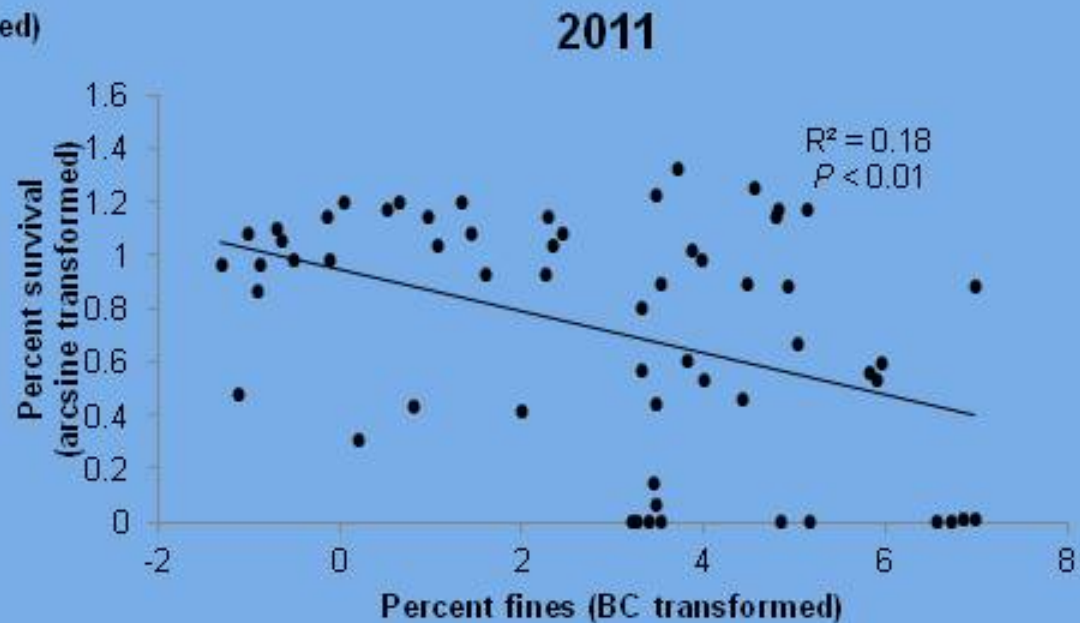
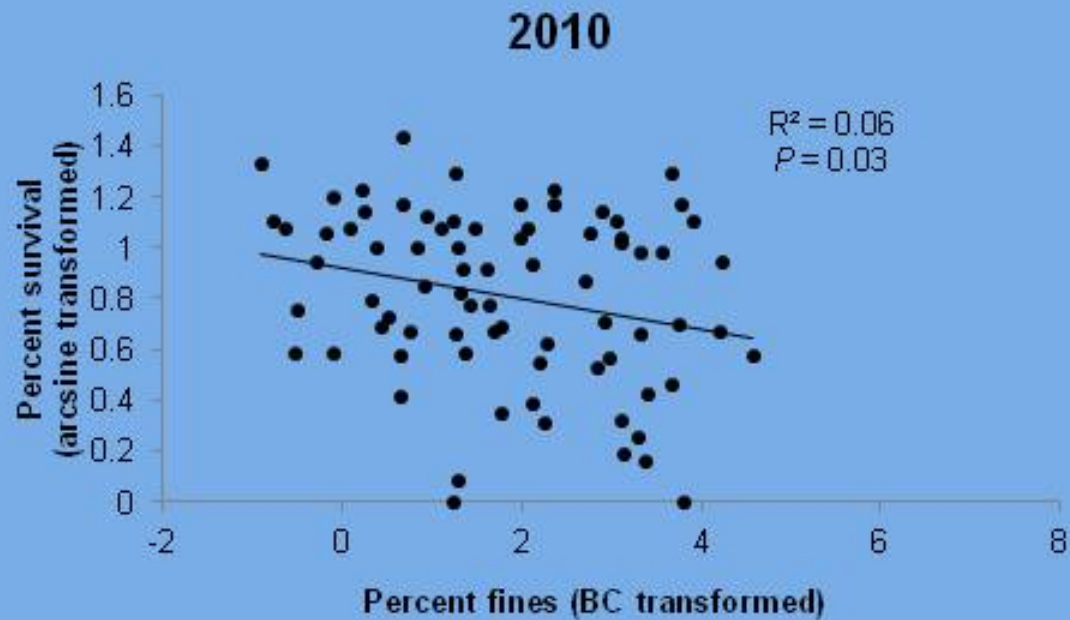
2010



2011

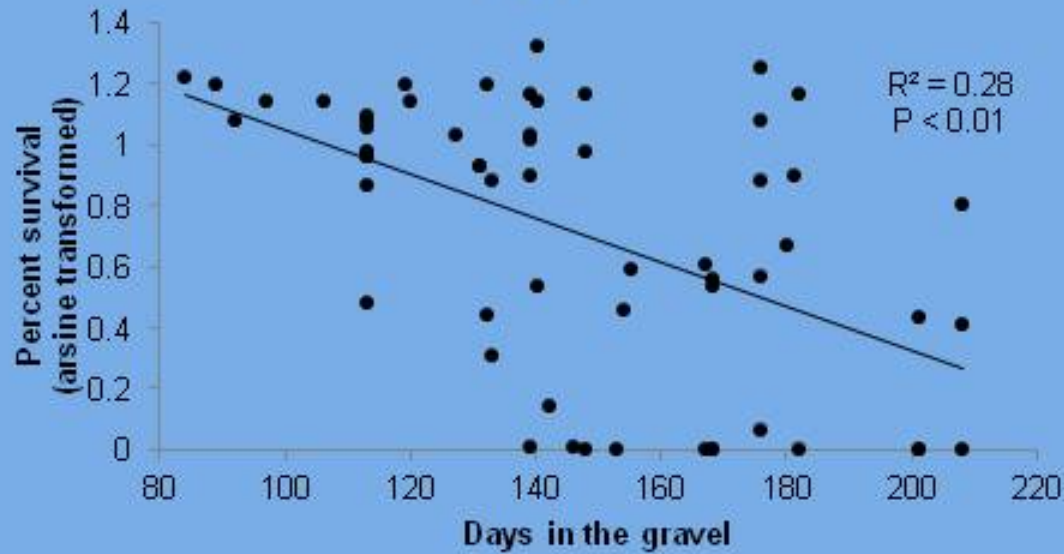


Percent fines and survival

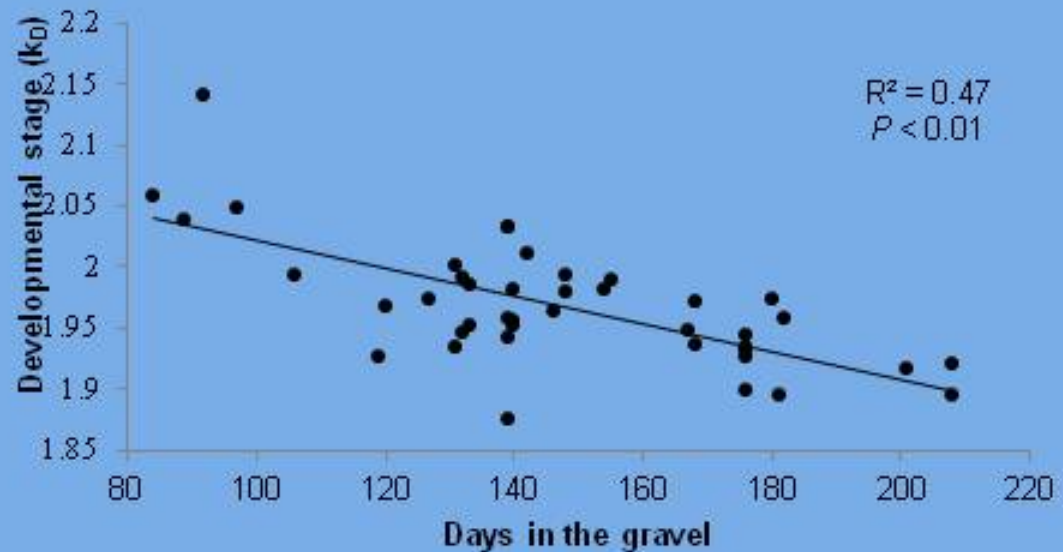


Days in the gravel

2011



2011

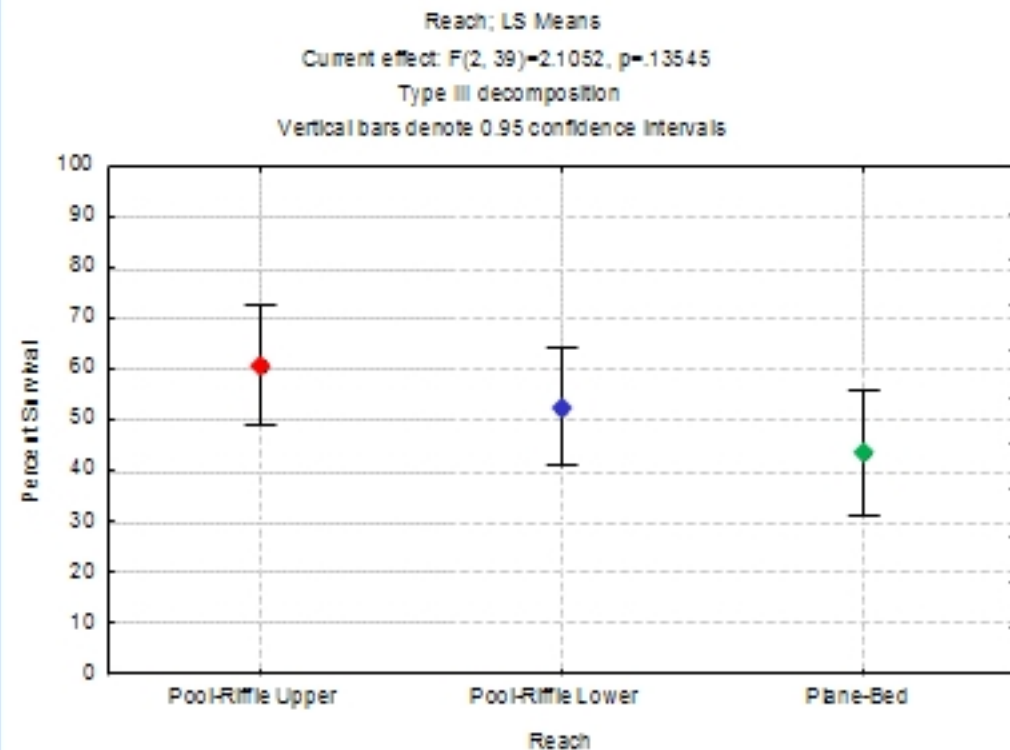


Wenatchee Basin Study

- Chiwawa River 2011
- Similar sampling design
- 18 artificial redds/reach
- 54 total



Map: Ford et al. 2010



Summary

- Habitat conditions and adult fitness appear to be primary factors affecting survival and developmental rate in the natural environment.
- Egg boxes appear to be a feasible method of estimating survival at a basin scale, and to provide comparable estimates among basins.
- Specific physical variables such as fine sediment infiltration and days of incubation may influence survival in some years.

Future Research

- Emergence timing
- Predation (e.g. invertebrates, sculpin)
- Effects of gamete holding prior to spawning
- Comparisons of survival between egg boxes and naturally constructed redds.



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