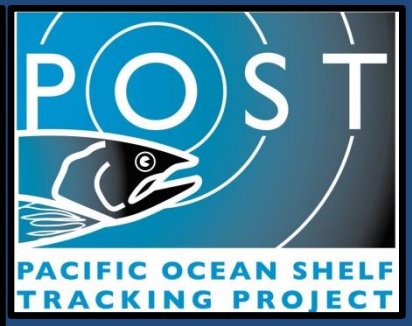
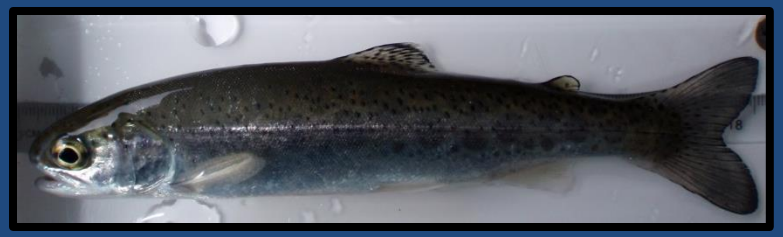
Sex biased survival and differences in migration of wild steelhead (*Oncorhynchus mykiss*) smolts from two coastal Oregon Rivers

Neil Thompson, Camille Leblanc, Jeremy Romer, Carl Schreck, Michael Blouin and David Noakes



A smolt is a smolt is a smolt……right?



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Study Objectives

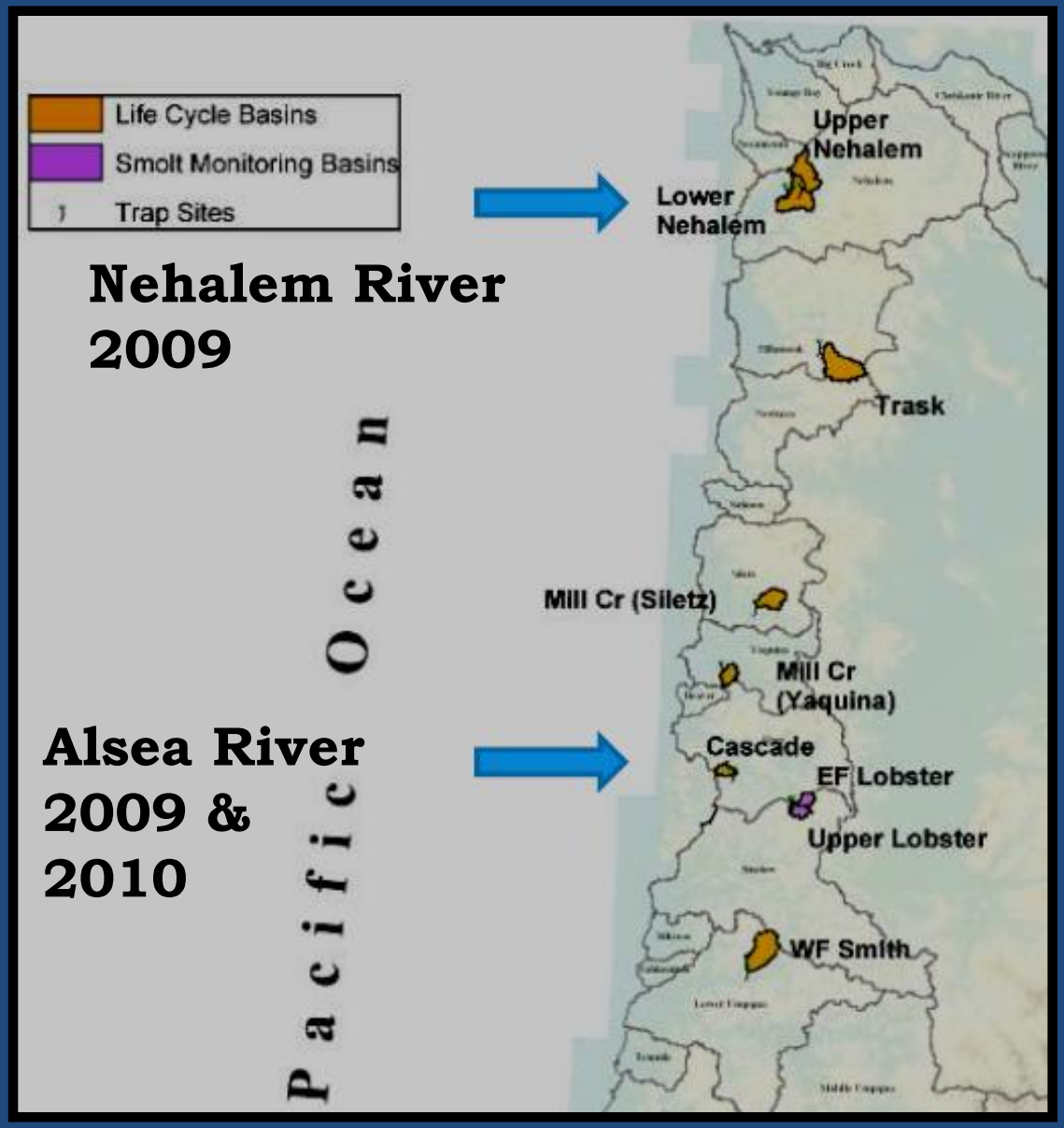
- Sex biased survival during migration?
- If so, what mechanisms may be causing the difference?

Hypotheses

1. No difference in survival
   - Based on little phenotypic differentiation

2. Females have higher survival
   - Alternative developmental paths/thresholds for anadromy

Rivers studied



Methods

- Screw trap
- V7 acoustic tags
- Tissue, length, weight
- Date

Methods

- Receiver arrays

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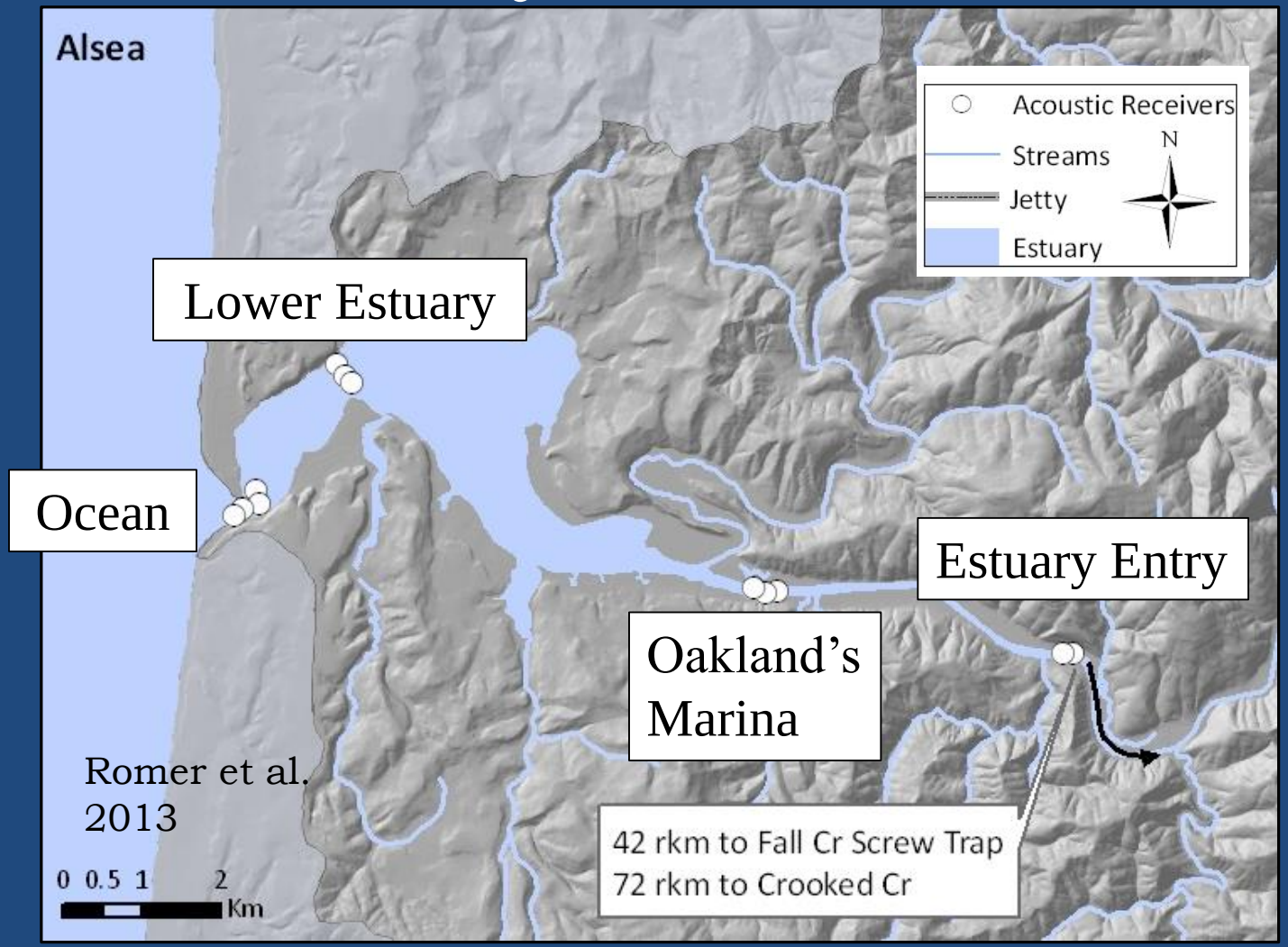
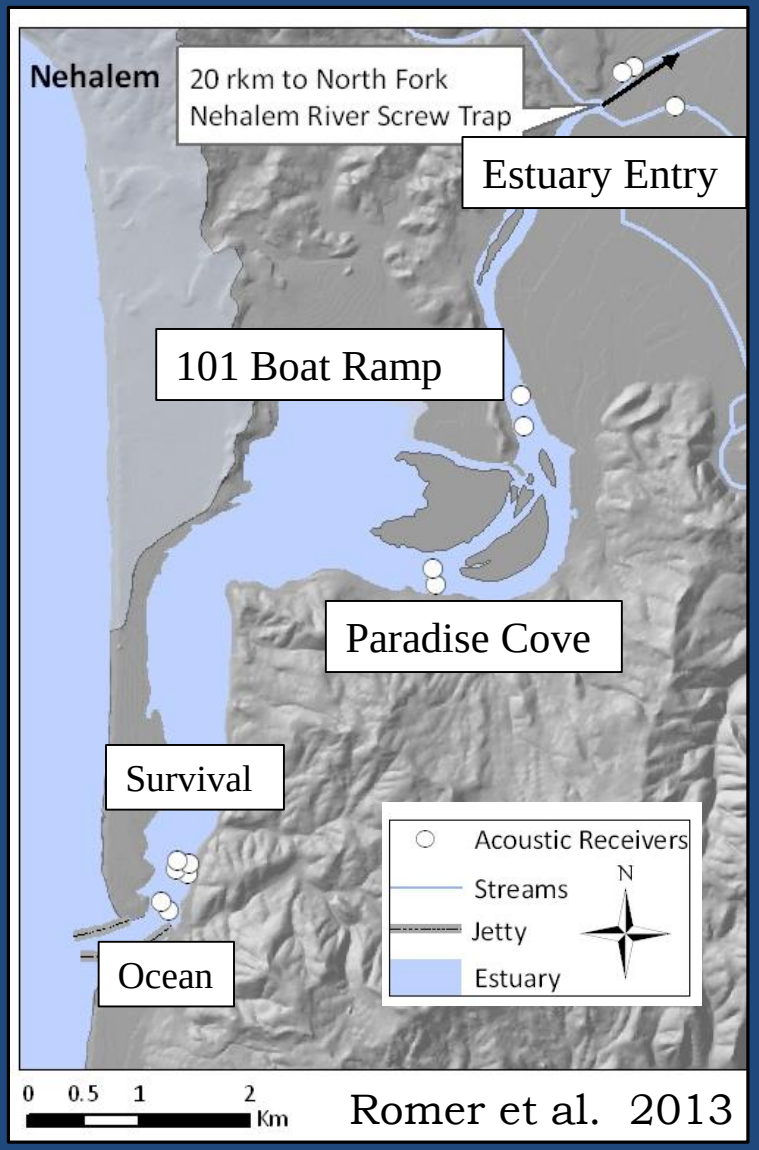


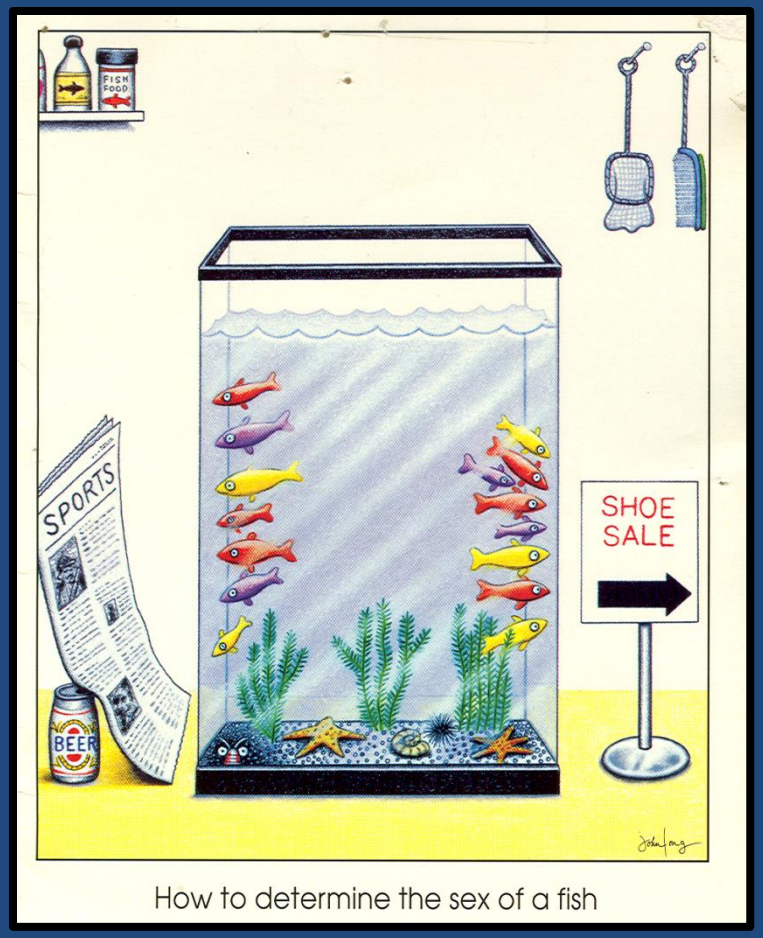
Methods

- Receiver arrays



Methods

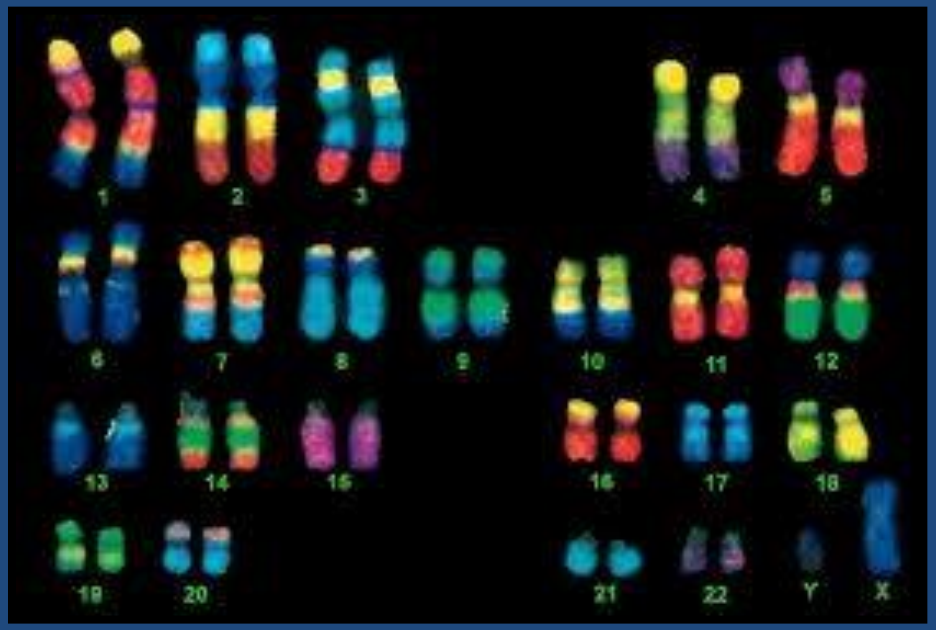
- Sex determination

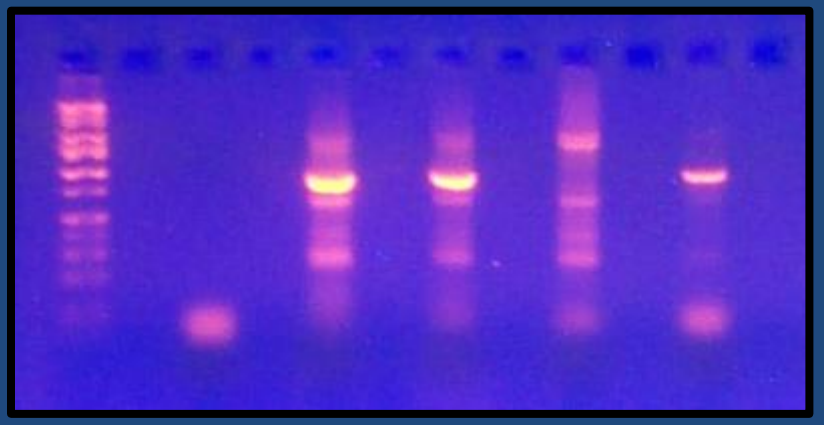


How to determine the sex of a fish

Methods

- Sex determination
  - *OmyY1* marker (Brunelli et al. 2008)





Methods – Logistic Regression

- Alsea model

Survival = fork length +
date of tagging +
sex +
fork length^2 +
(fork length*sex) +
(date of tagging*sex)

Methods – Logistic Regression

- Alsea model

- Nehalem model

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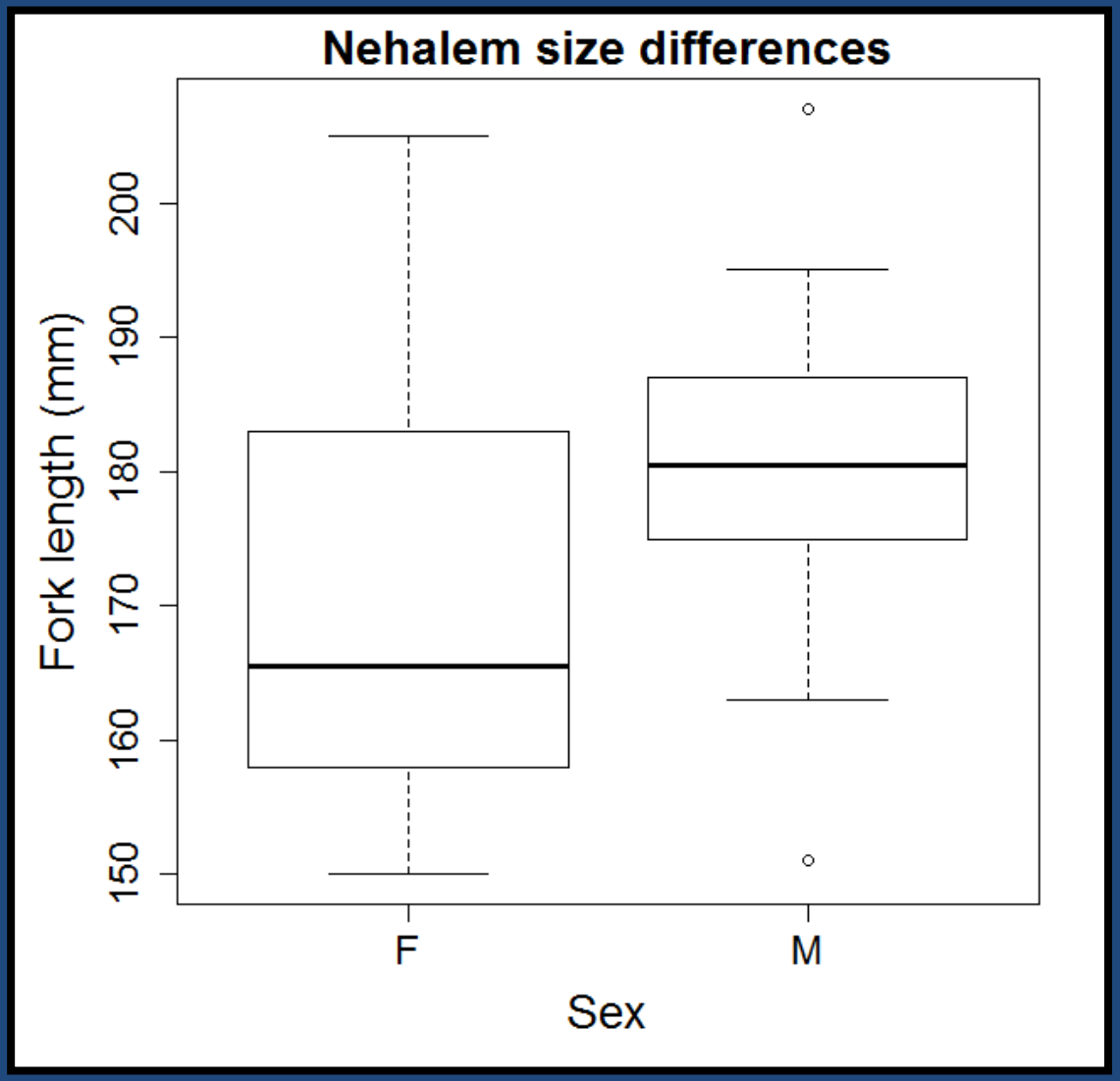
Methods – Logistic Regression

- Alsea model
- Nehalem model
- Drop in deviance F-test

Sexes different sizes



Nehalem model (males and females separated)

Survival = fork length + fork length^2

Results – Alsea River 2009

- Survival : Females 40%, Males 18%
  - Males 0.329 odds of survival

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- Sex [$Pr(x^2_1 > 3.865) = 0.049$]
- (fork length*sex) [$Pr(x^2_1 > 5.206) = 0.022$]

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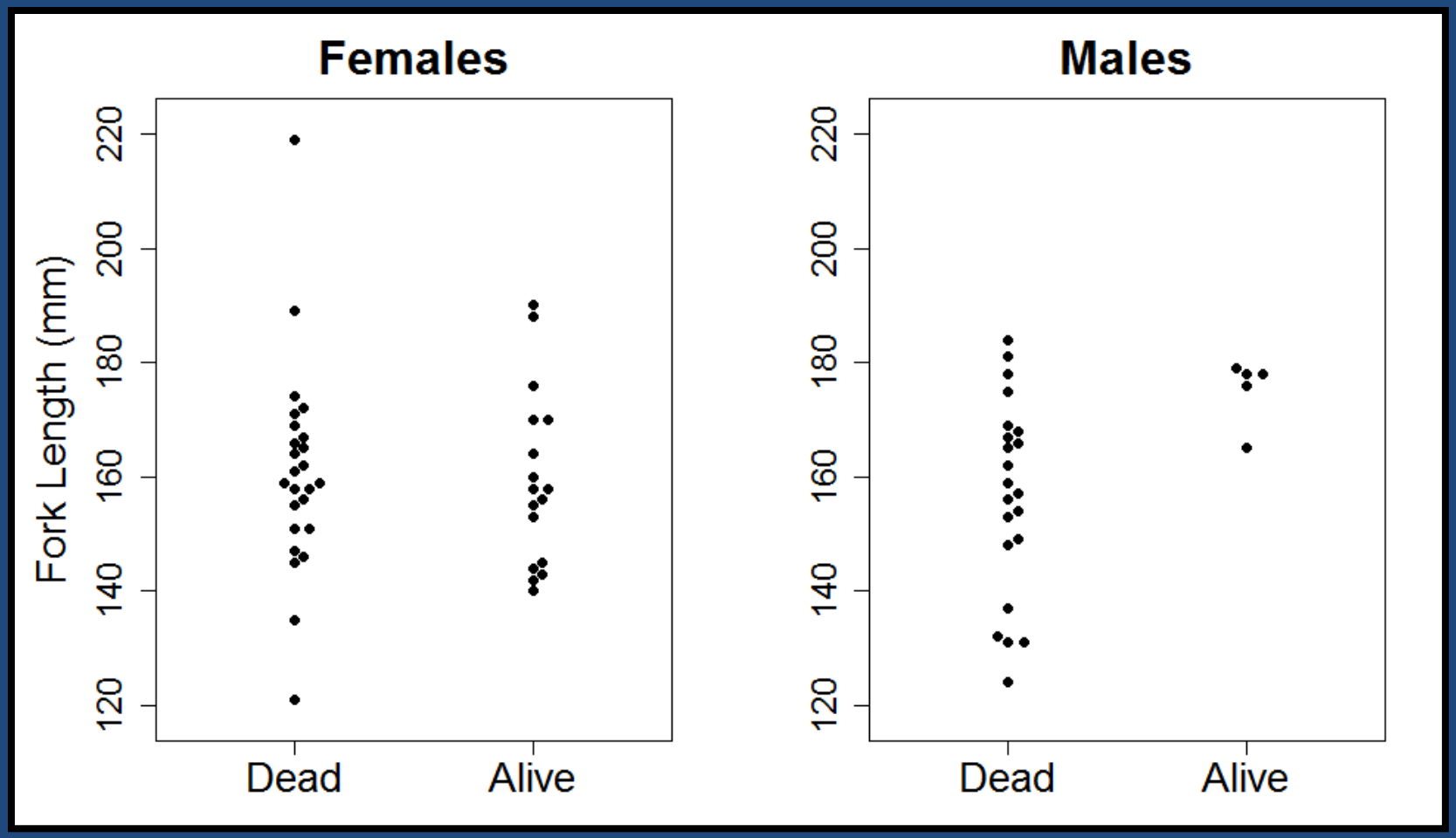

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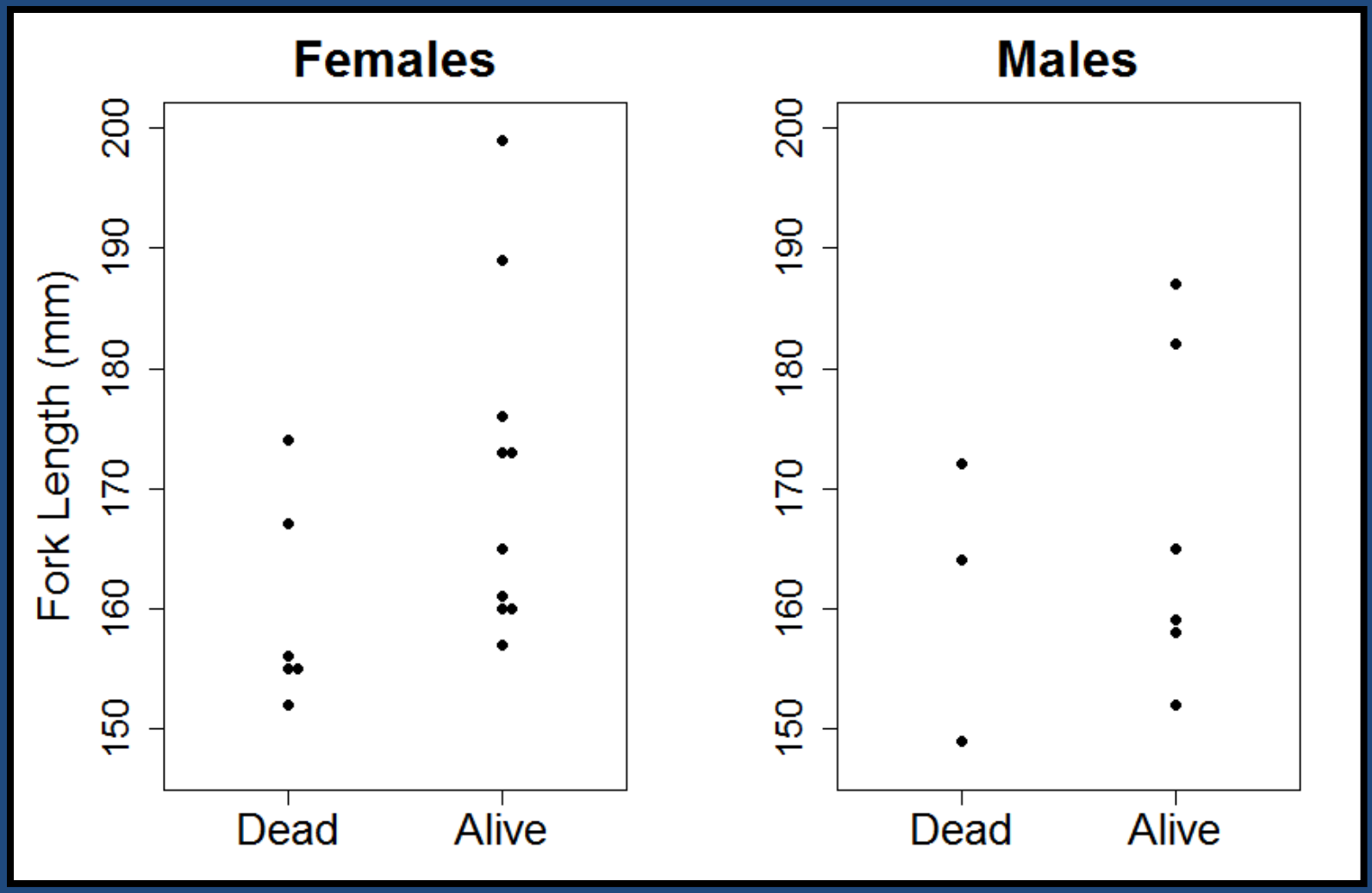

Results – Nehalem River

- Survival : Females 34%, Males 34%

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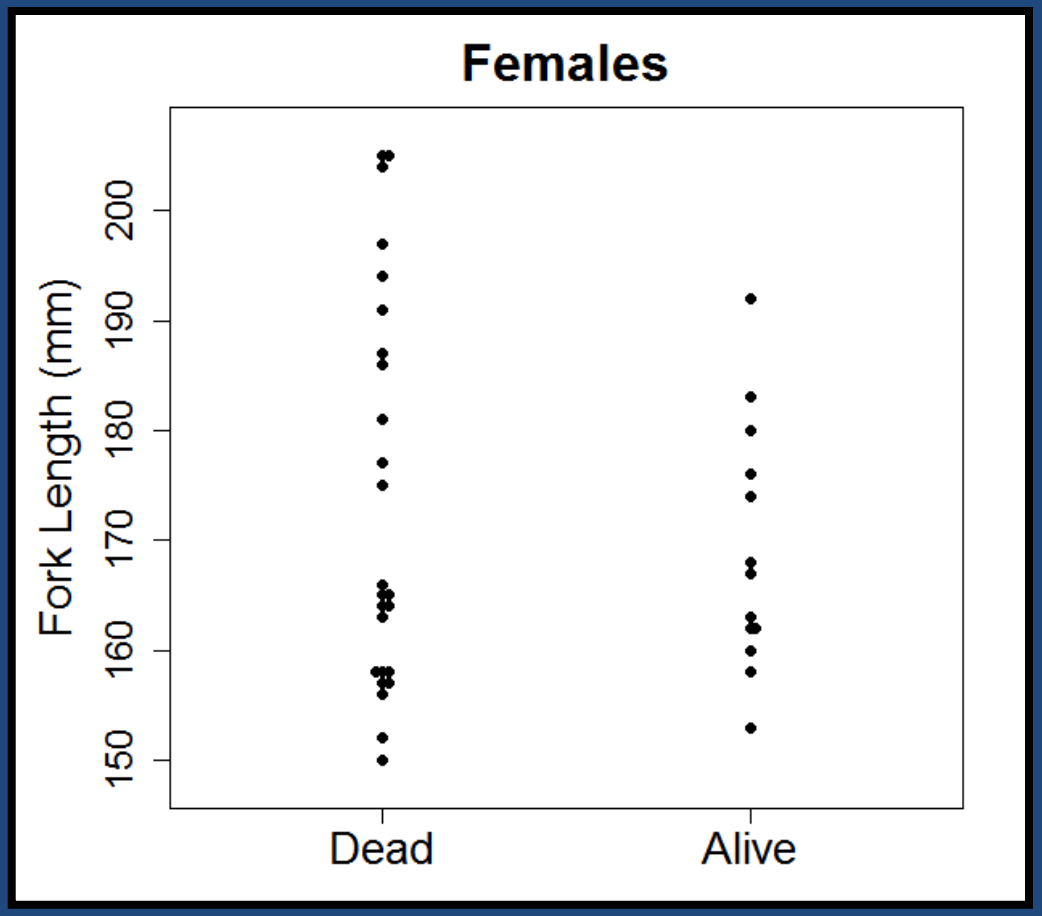
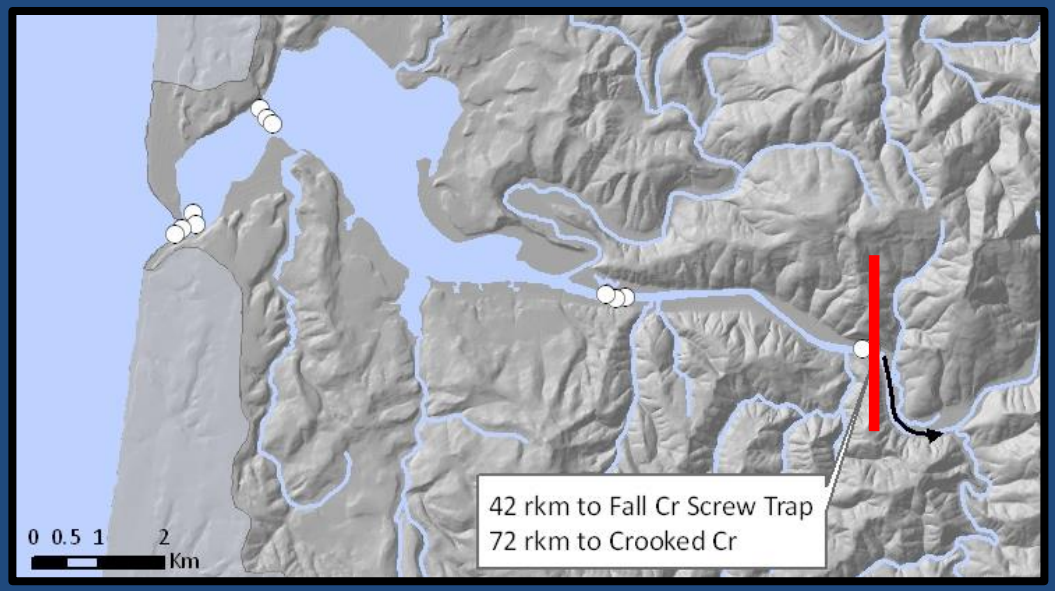
Results – Nehalem River

- Length Analyses
  - Females
    - Fork length^2
    - [$Pr(x^2_1 > 4.269) = 0.03$]
  - Males
    - No effect



Migration differences - ANOVA

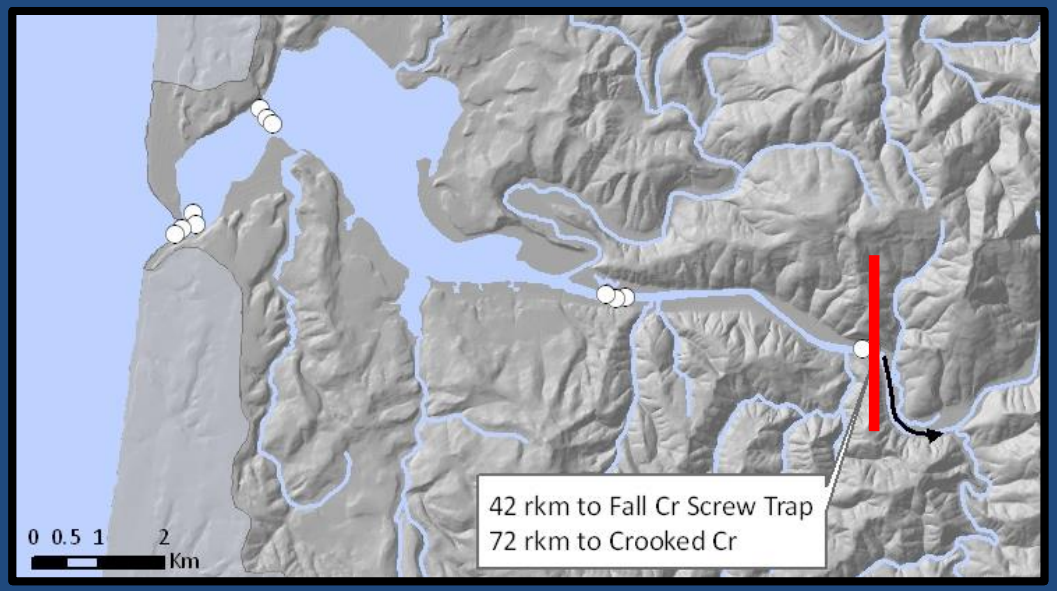
River and estuary migration



Migration differences - ANOVA

- Alsea 2009 model
  - Migration (d) = fork length + sex + (fork length*sex)
- Nehalem 2009
  - Similar to survival analysis

River and estuary migration

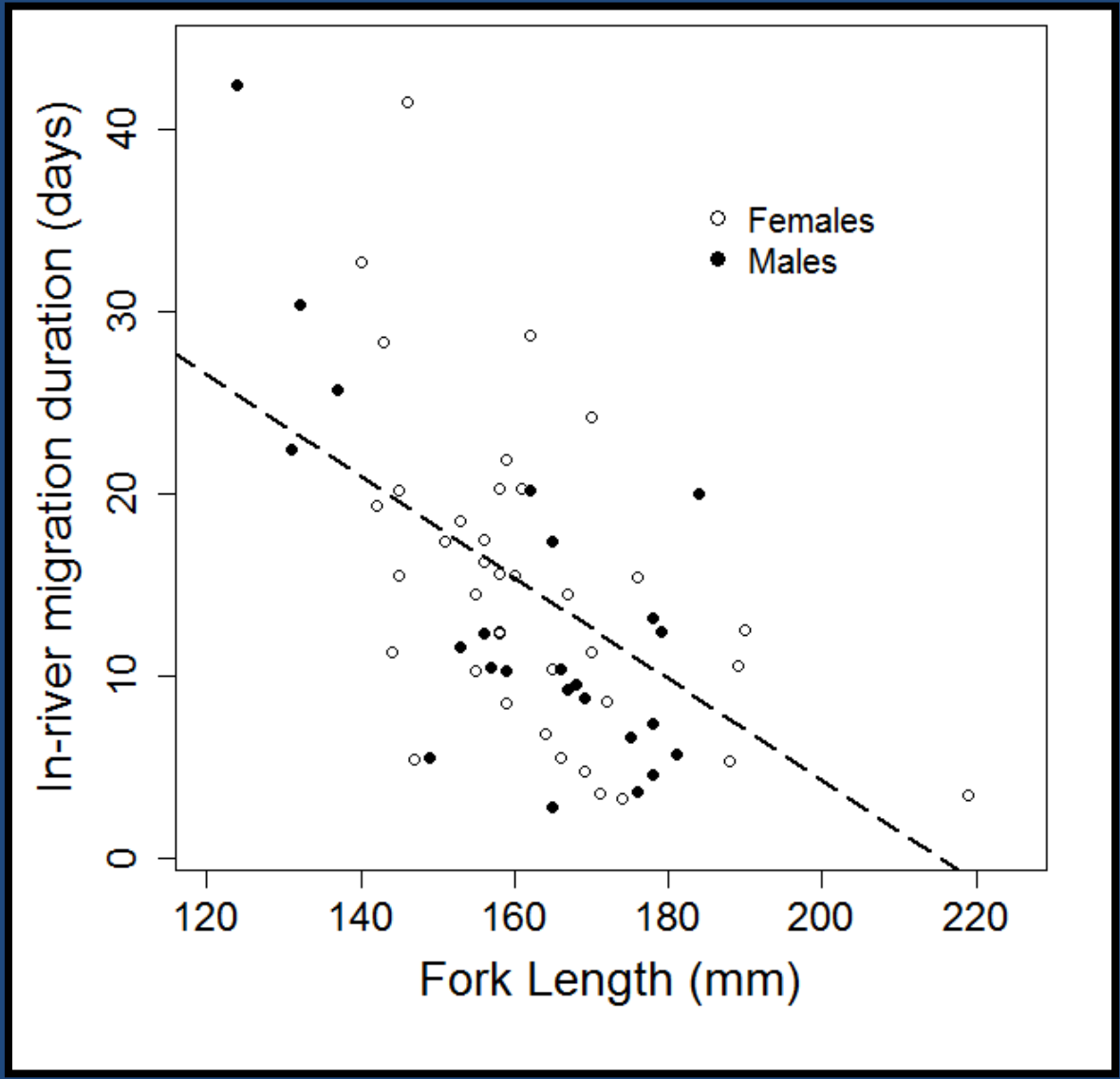


Migration Results – Alsea River Segment

- Sex ($F=0.57$, $df=1$, $p = 0.45$)
- Fork length ($F=33.9$, $df=1$, $p<0.001$)

- No effect of:
  - (fork length*sex)

Results – Alsea River 2010



Migration Results – Alsea Estuary

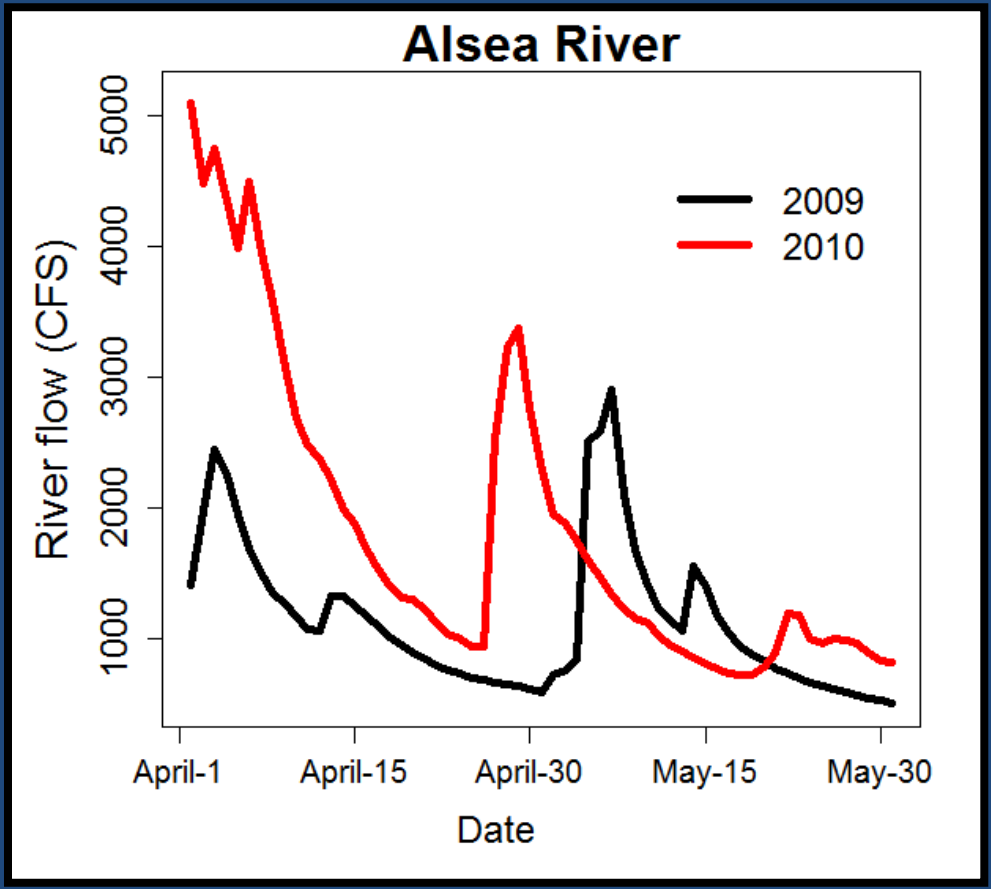
- No effect of:
  - (fork length*sex)
  - Sex
  - Fork length

Migration Results – Nehalem River and Estuary

- No effect of:
  - Sex
  - Fork length

Environmental Differences

- 2009 v. 2010
  - Major differences in flow



Mechanisms behind survival bias

- Small males did not survive (2009)
  - Not migration timing or duration
  - 2010: fish <150 mm not sampled

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  - Stress response (Overli et al. 2006)
- Behavior?
  - Anti-predator (Johnson et al. 2001)
  - Nocturnal vs. diurnal migration (Ibbotson et al. 2011)


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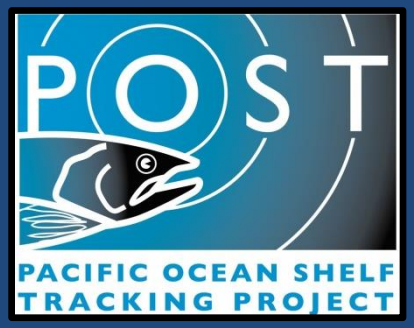
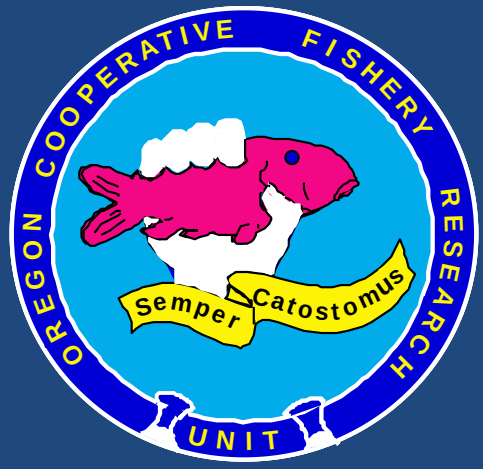
Acknowledgments





Questions?

Environmental Differences

- Alsea v. Nehalem migration distance