

# Survival and Migration behavior of hatchery winter steelhead reared at three different densities

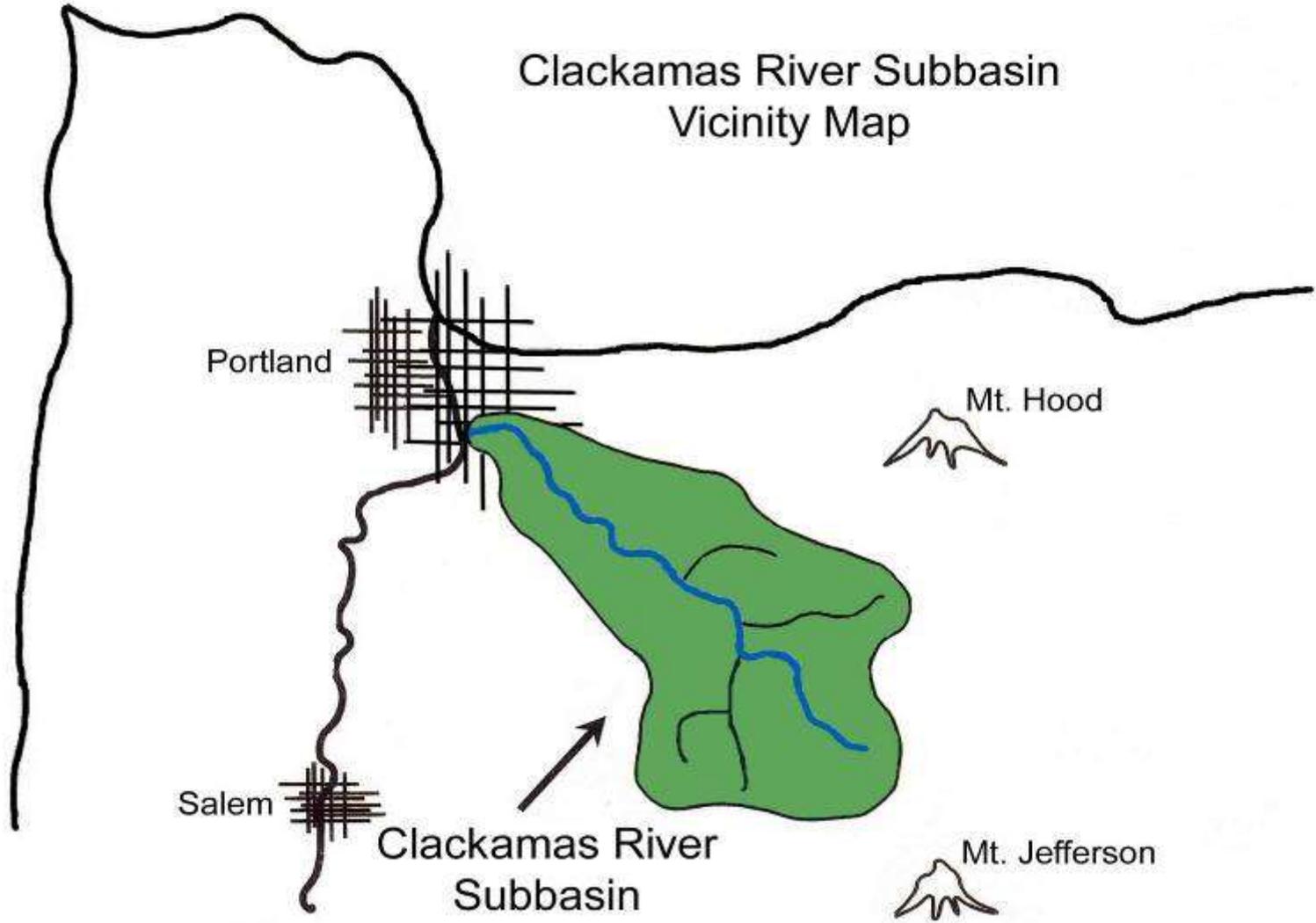


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# What we (think we) know

- Optimum emigration occurs when hatchery smolts released at lengths 190-199mm (*Fessler & Wagner (1969); Folmer & Dickoff (1981); Tipping (1997)*)
- Fish < 190mm at release had lower migration rates (*Folmer & Dickoff (1981)*)
- Between 19.8% and 65.5% of hatchery steelhead are nonmigrants (*Tipping et al.1995; Tipping and Byrne 1996*)
- Increased mortality and **residualization** can occur if fish do not migrate during release year (*Tipping et al 1995*)



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# Study Objectives

- Evaluate **GROWTH**, **CONDITION**, and **SURVIVAL** of hatchery winter steelhead reared at different densities
- Evaluate **OUTMIGRATION BEHAVIOR** of hatchery winter steelhead reared at different densities



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# Methods

- Growth, condition, and survival evaluated for brood years 2004-2006
- Density groups, (7500, 15,000, and 22,500), replicated three times for a total of 9 raceways
- Fork length, weight, and condition factor determined at tagging and prior to release
- WST are fin clipped (adipose and right ventral) and CWT
- CWT (unique to each raceway group) used to evaluate adult survival
- Fish from each density group surgically implanted with coded radio-transmitters



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# Expected return dates of juvenile winter steelhead for brood years 2004-2006

Brood Year	Tag Date	Smolt Release	Return Year
2004	July 2004	April 2005	Jan.-March 2007 & 2008
2005	July 2005	April 2006	Jan.-March 2008 & 2009
2006	July 2006	April 2007	Jan.-March 2009 & 2010



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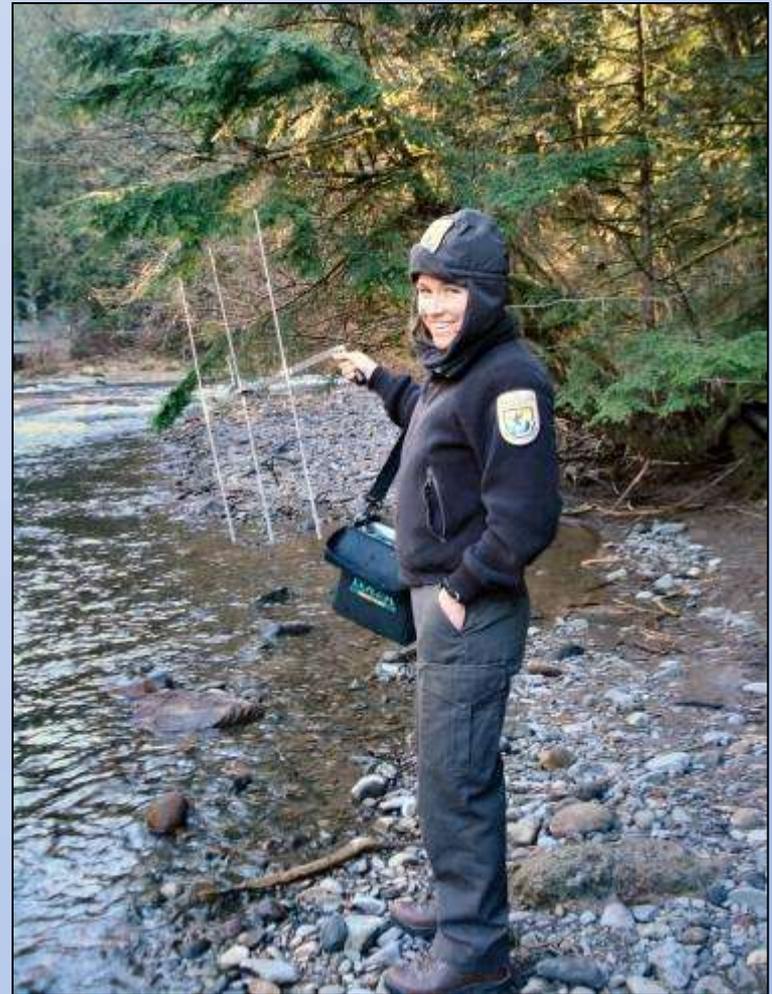
# Results

- **Density Index** ranged from

- 0.11-0.13    LOW
- 0.19-0.24    MEDIUM
- 0.28-0.37    HIGH

- **Condition Factor**

- 0.96-1.15    LOW
- 0.99-1.16    MEDIUM
- 1.00-1.22    HIGH



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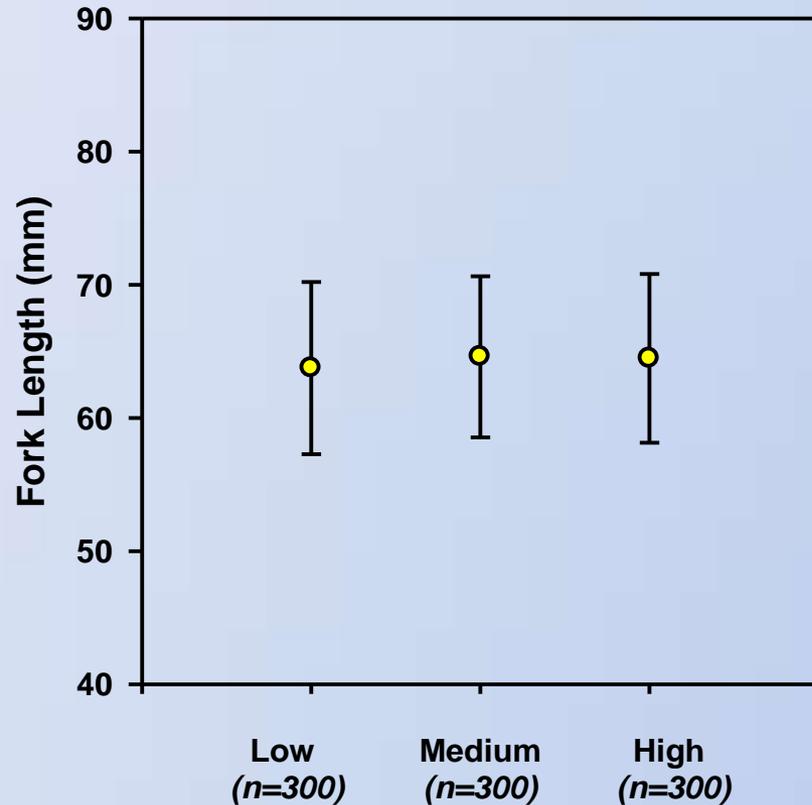
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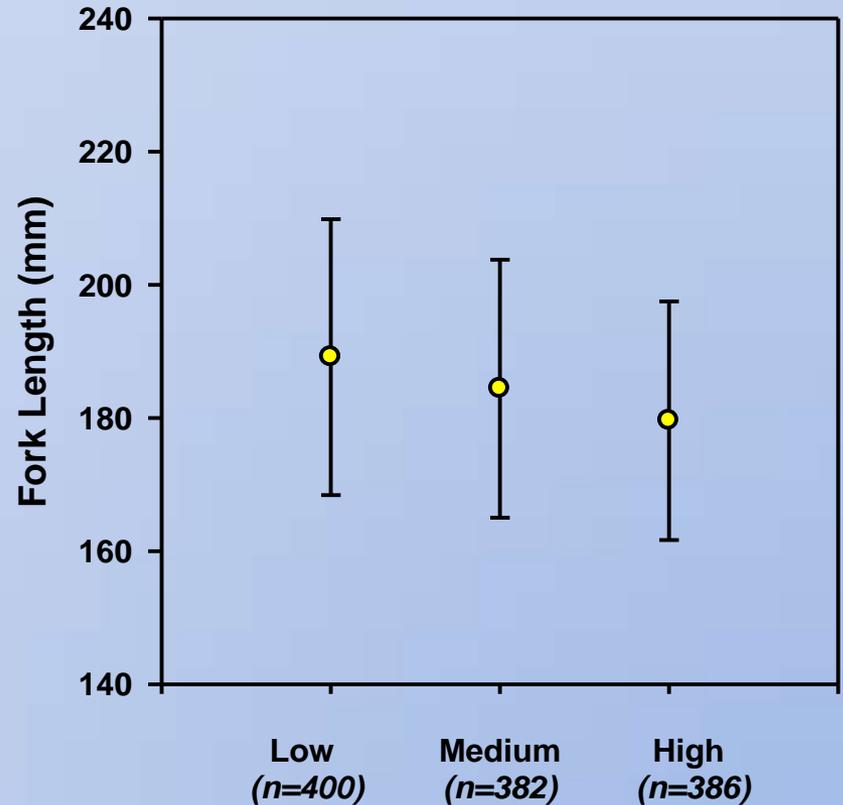


# Growth

BY 2004 (Tagging)

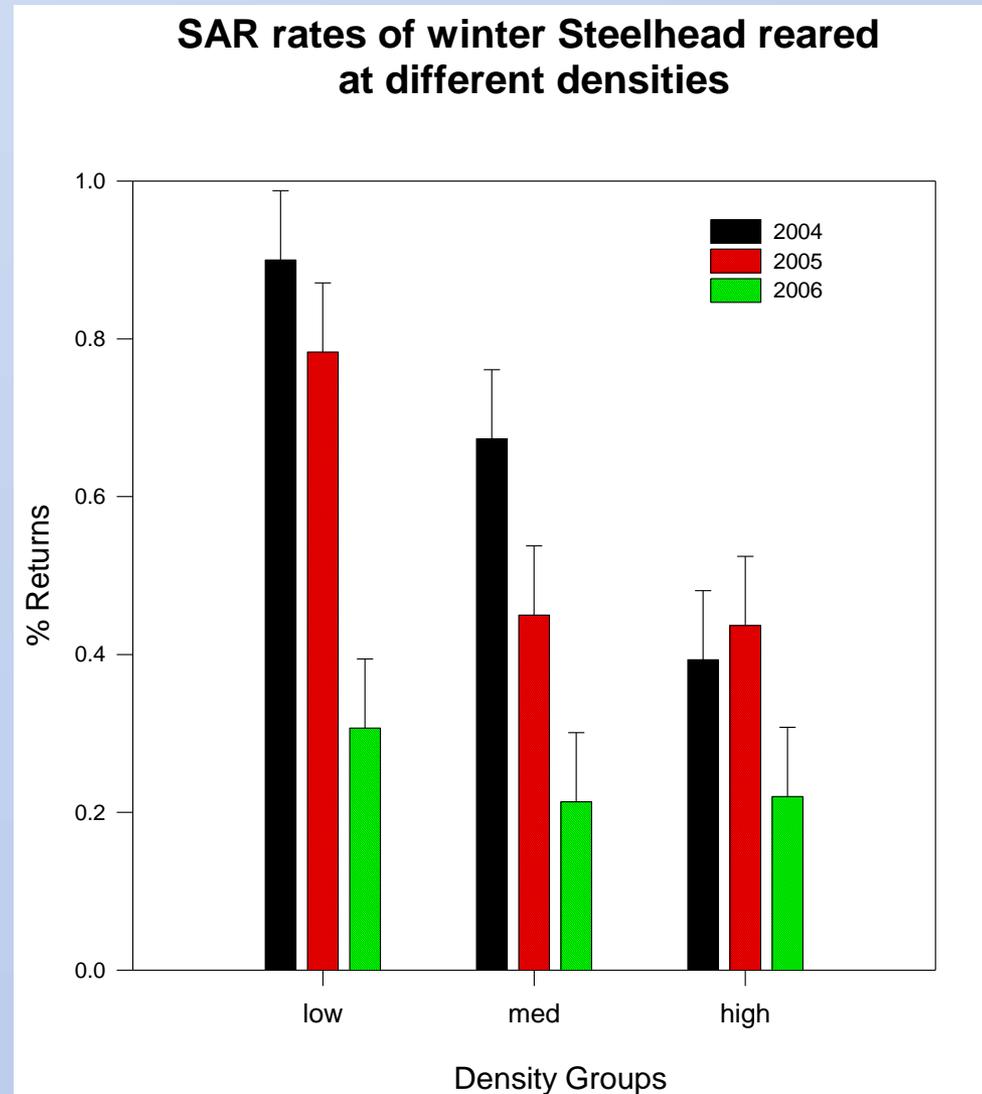


BY 2004 (Release)



# Differences?

- Significant effect of broodyear on SAR ( $p < 0.001$ ). BY 2006
- Significant effect of Density on SAR ( $p = 0.001$ ). Low density
- No interaction effect between BY and Density



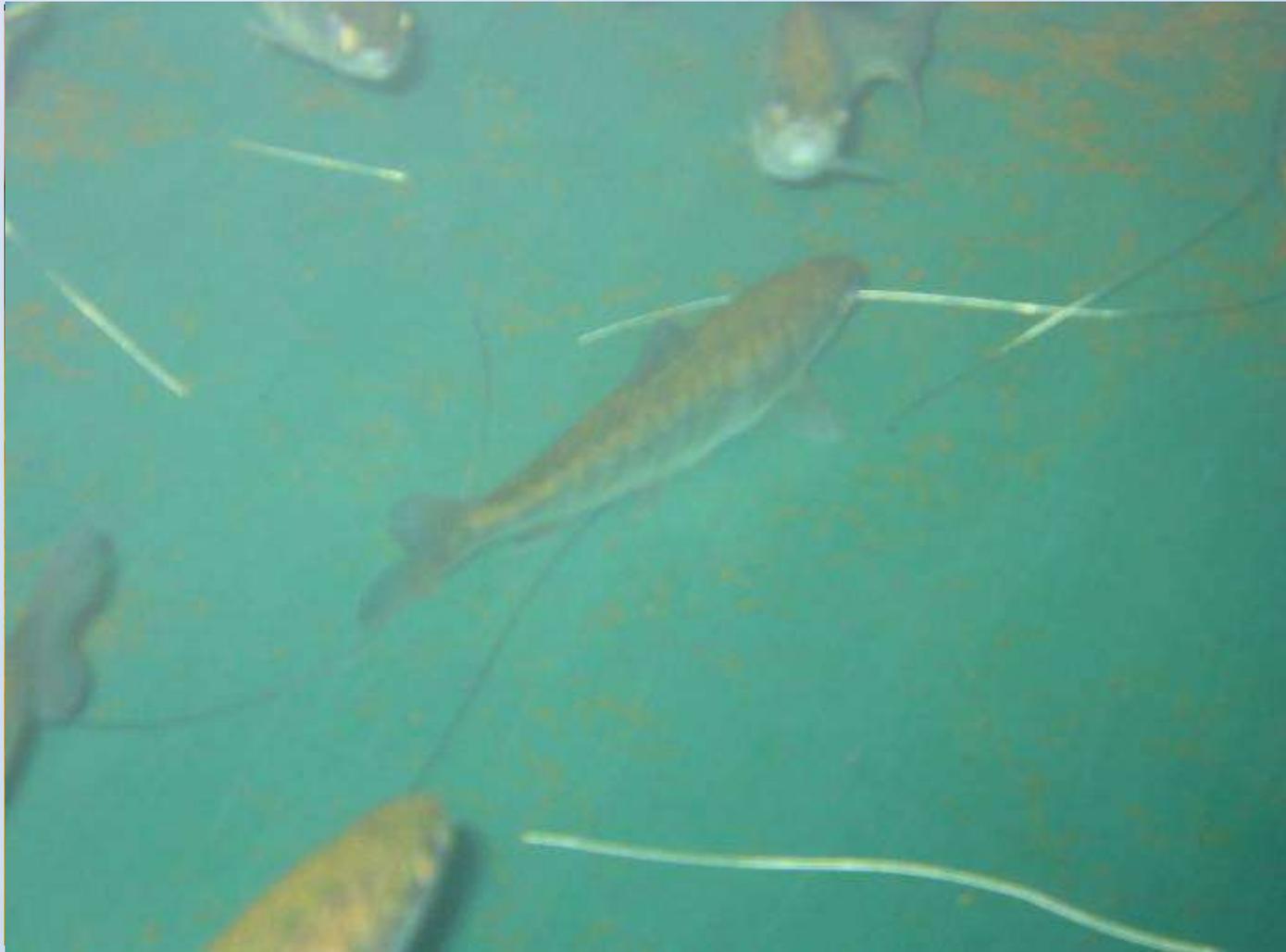
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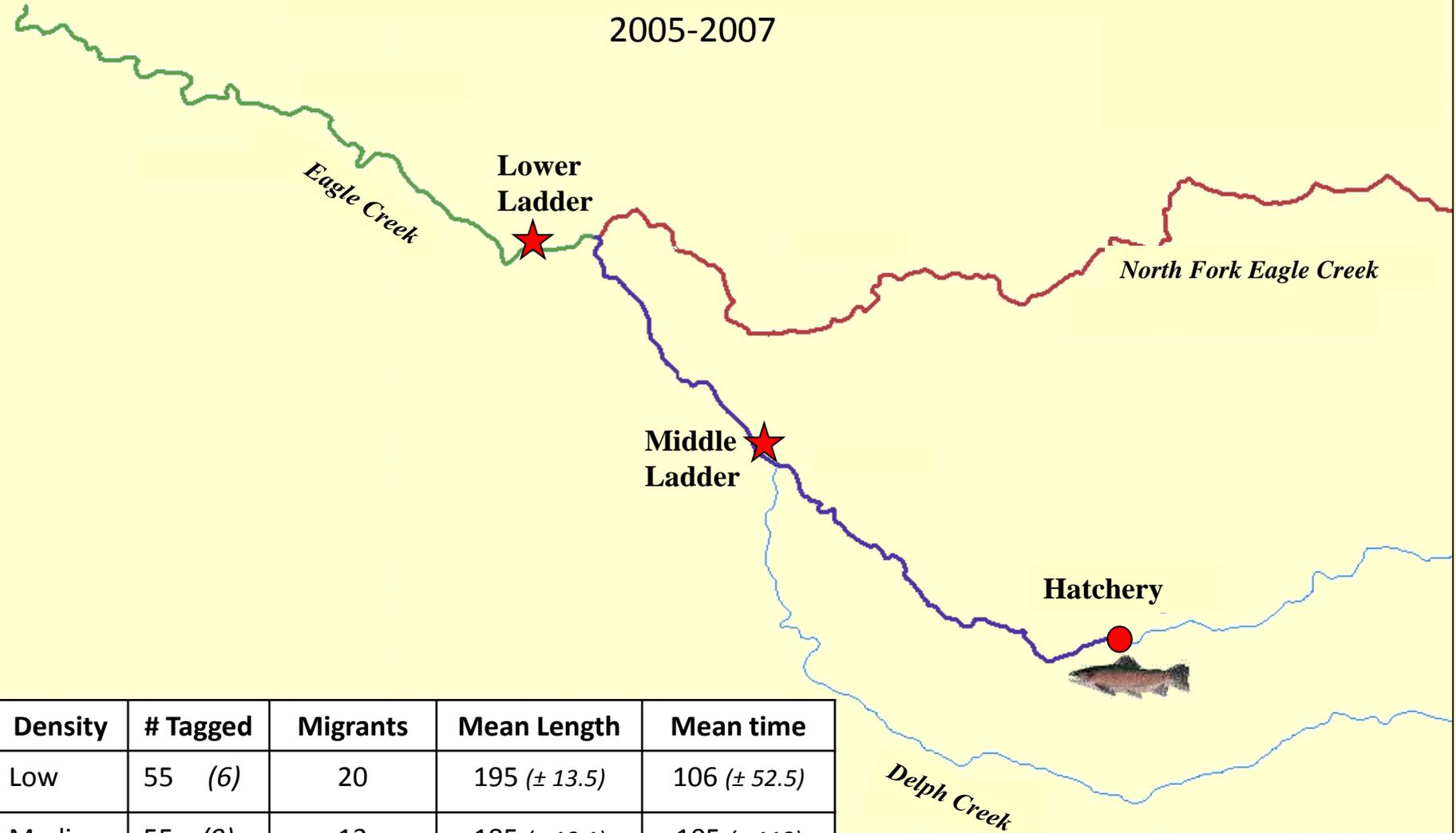
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# Migration Timing

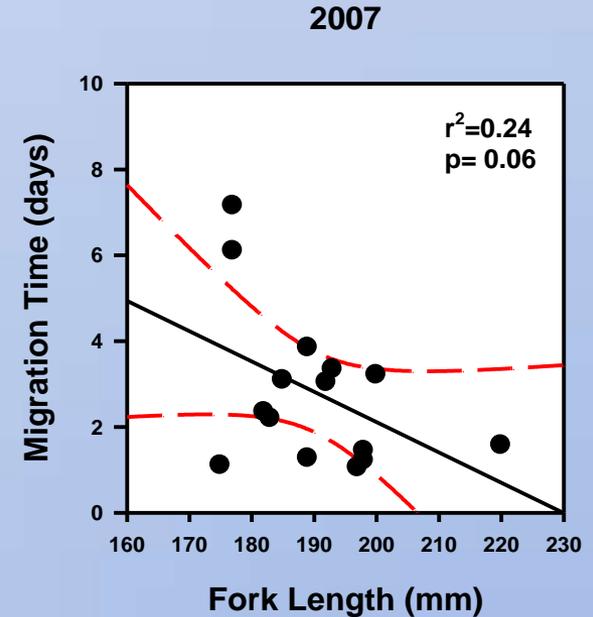
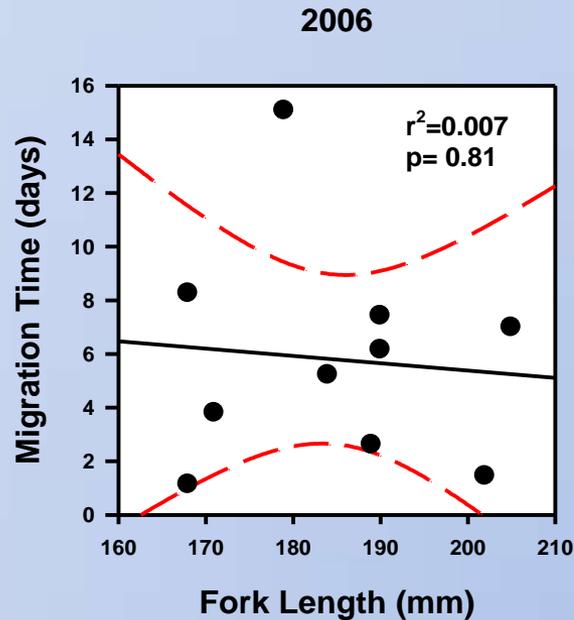
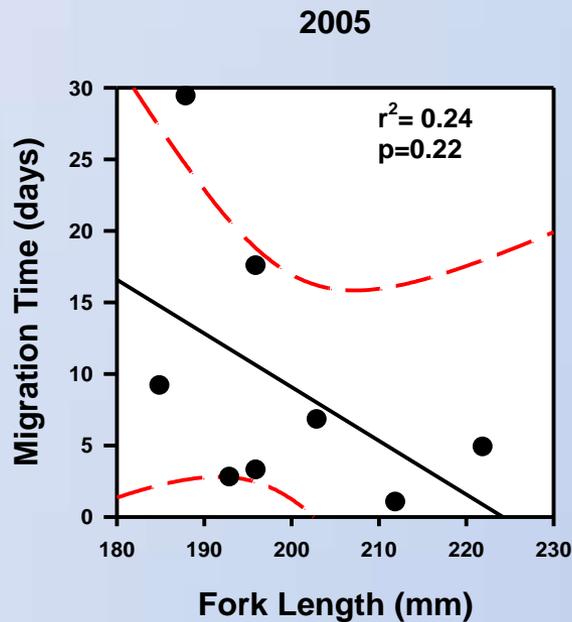
2005-2007

Mouth

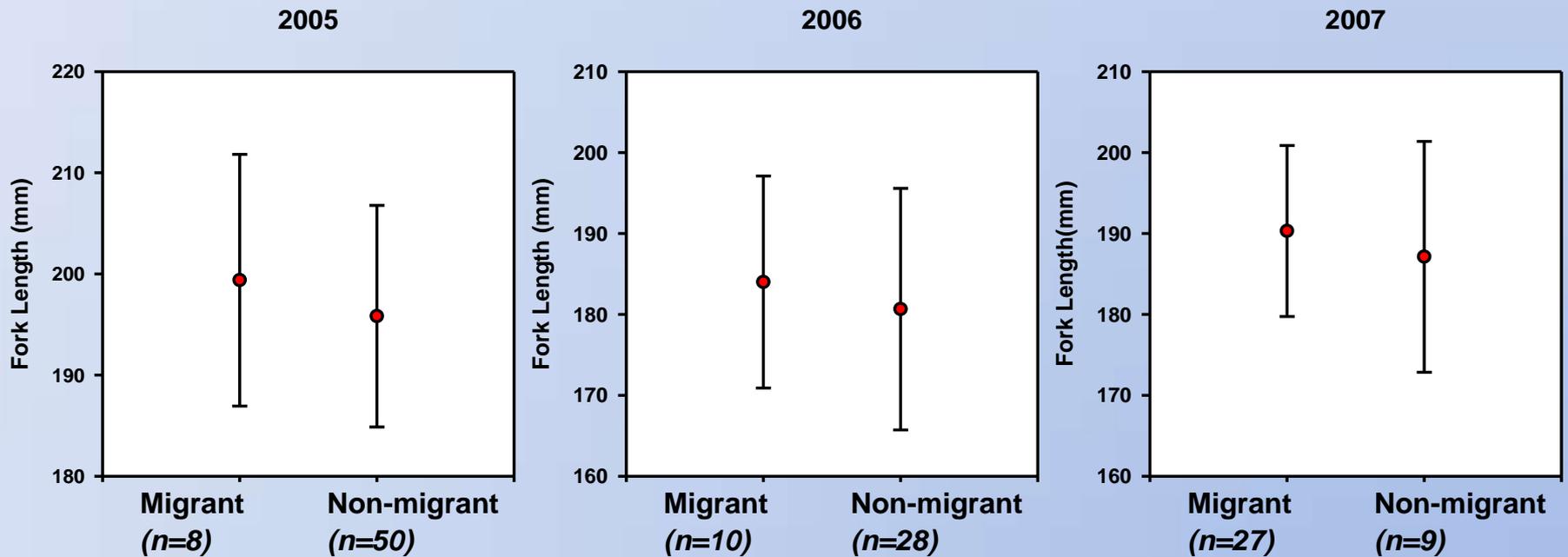


Density	# Tagged	Migrants	Mean Length	Mean time
Low	55 (6)	20	195 ( $\pm 13.5$ )	106 ( $\pm 52.5$ )
Medium	55 (9)	13	185 ( $\pm 10.1$ )	105 ( $\pm 110$ )
High	55 (5)	12	188 ( $\pm 9.7$ )	76 ( $\pm 47$ )

# Fork length and Steelhead Migration



# Mean fork length for migrant and non-migrant juvenile hatchery steelhead 2005-2007



# What it all means

- Steelhead reared at lower densities had greater survival rates (SARs)
- Residual steelhead are present in Eagle Creek
  - Migrant fish left the system quickly (3-4 days), but nonmigrants constituted 32-71% of hatchery releases
  - No correlation between fork length and migration time



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# Management Implications

- Reduce production-

  - Steelhead program 150,000 → < 100,000

- Density Indices

  - 0.18-0.20 (*around the medium density level*)

- Every facility has different needs

  - Lower densities may yield greater survival, but you may not get the #'s needed for broodstock.



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# Acknowledgments

- USFWS-Columbia River Fisheries Program
- Eagle Creek National Fish Hatchery
- Lower Columbia River Fish Health Center



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