

# Juvenile steelhead evaluations in the Imnaha River basin

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# Project Goals

- Understand and compare the abundance and performance of hatchery and natural-origin steelhead emigrating from the Imnaha River.



# Relationship with Projects

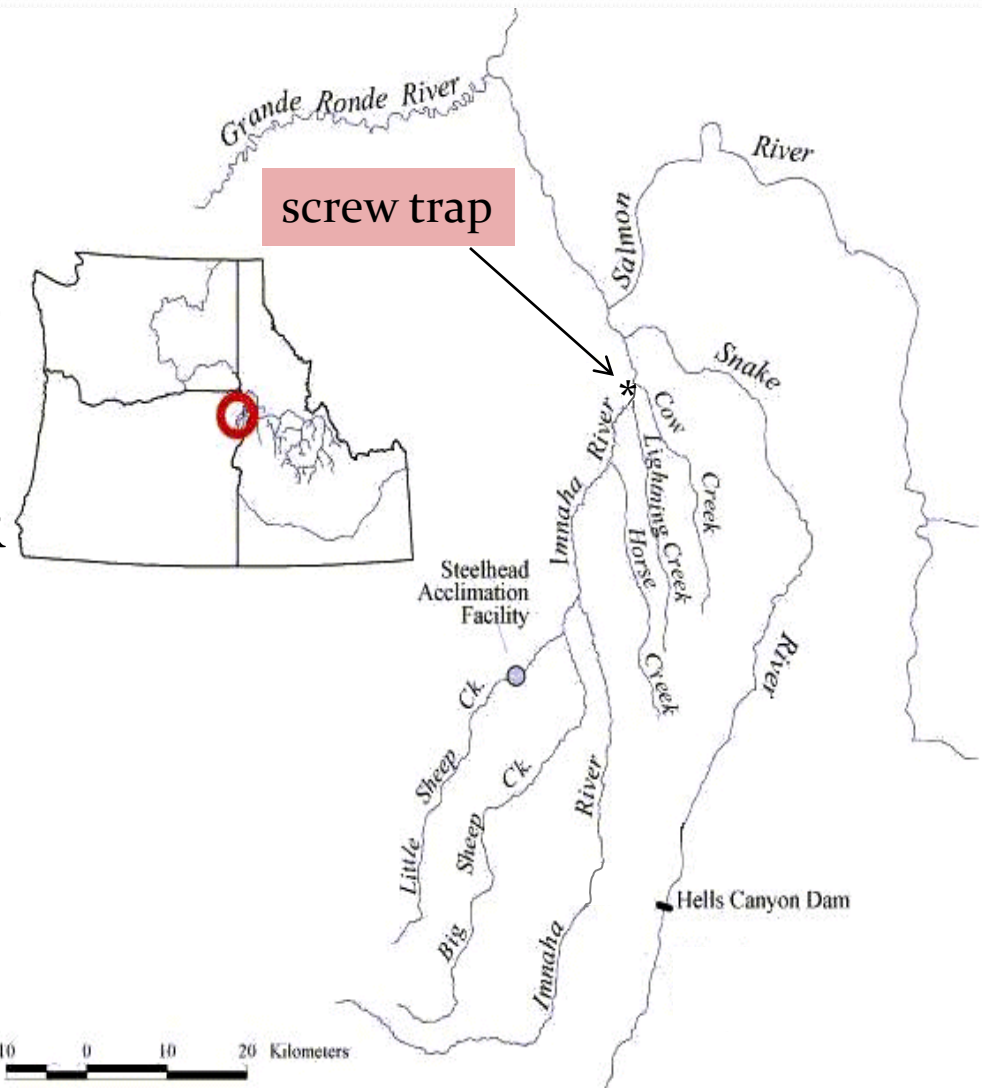
- Cost-share with the Innaha River Smolt Monitoring Project
  - Funded by LSRCP and Bonneville Power Administration
- Fish Passage Center
  - Weekly data for real-time evaluations of juvenile performance





# Methods: trap operations

- Trap site at river kilometer 7
  - below >95% of the steelhead spawning/rearing habitat
- 1994 – 2010 operations
  - March 1 – June 15; October 1 – ice up
- 2010 – present
  - Year round trapping
- Remote site – 2 hours to Joseph, OR
- Near “real-time data”



# Juvenile Steelhead Objectives

Evaluate and compare hatchery- and natural-origin steelhead performance by quantifying the following juvenile steelhead performance measures

1. Emigrant abundance
2. Emigration timing (arrival timing at the trap)
3. Size/condition factor at emigration
4. Juvenile arrival timing to LGR
5. Juvenile survival

# Objective 1: Juvenile hatchery/natural comparisons

## • **Methods**

- Screw trapping 24 hr/day, March 1 – June 15
- PIT tag NOR, recapture HOR juvenile steelhead
- Trap efficiency estimation
  - Release 50 fish/day upstream and use mark/recapture analysis
- Survival to screw trap and through the hydrosystem
  - Cormack/Jolly-Seber (CJS) estimators at trap and LGR and MCN

# Adult Steelhead Objectives

Evaluate and compare hatchery- and natural-origin steelhead by estimating the following adult steelhead life history attributes

- Adult arrival timing to BON and LGR
- Adult conversion rate to LGR
- Smolt to adult return (SAR)
  - LGR to LGR

## Objective 2: Adult hatchery/natural comparisons

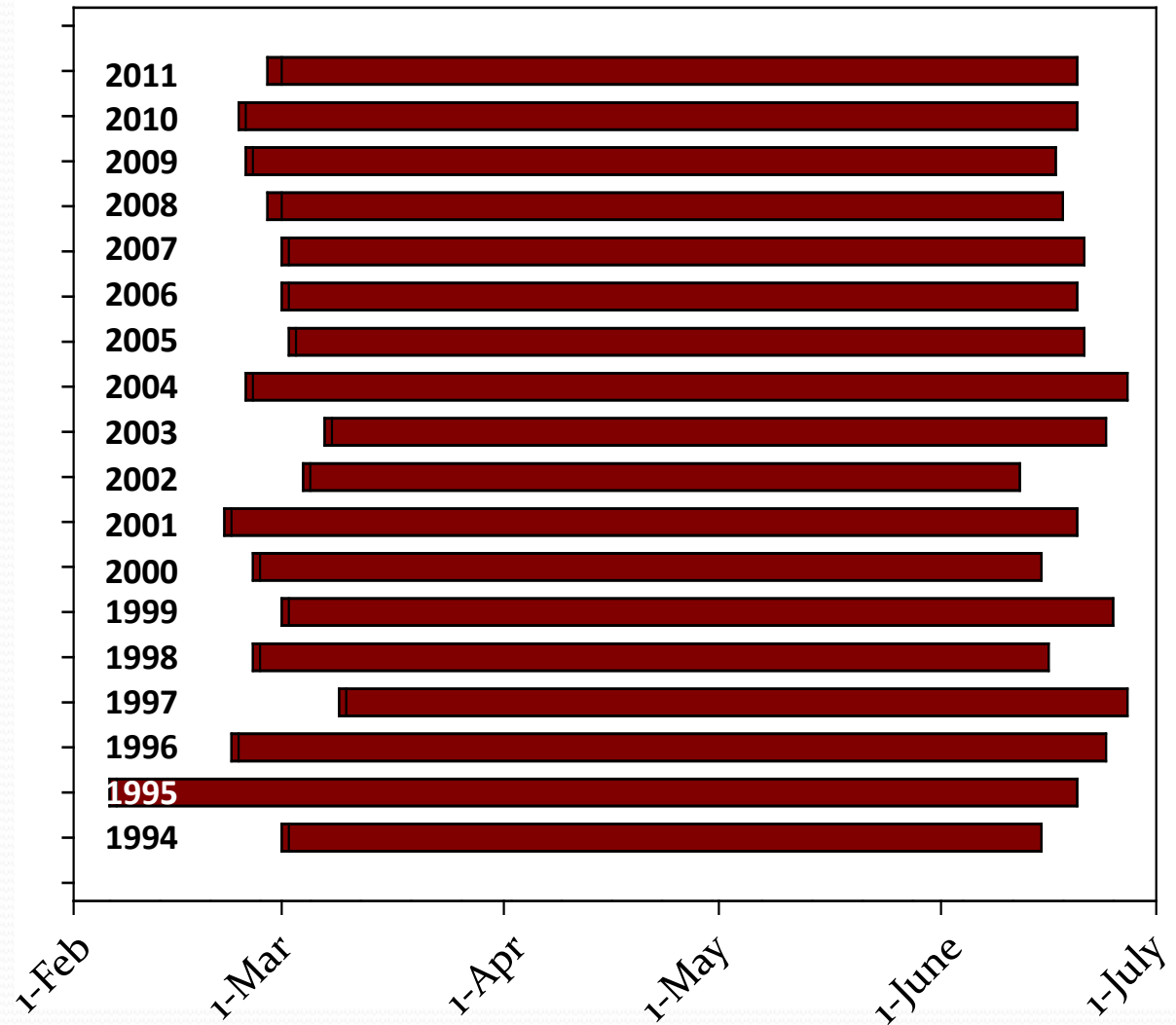
- **Methods**

- PIT tag analysis from release at the trap through returns to LGR



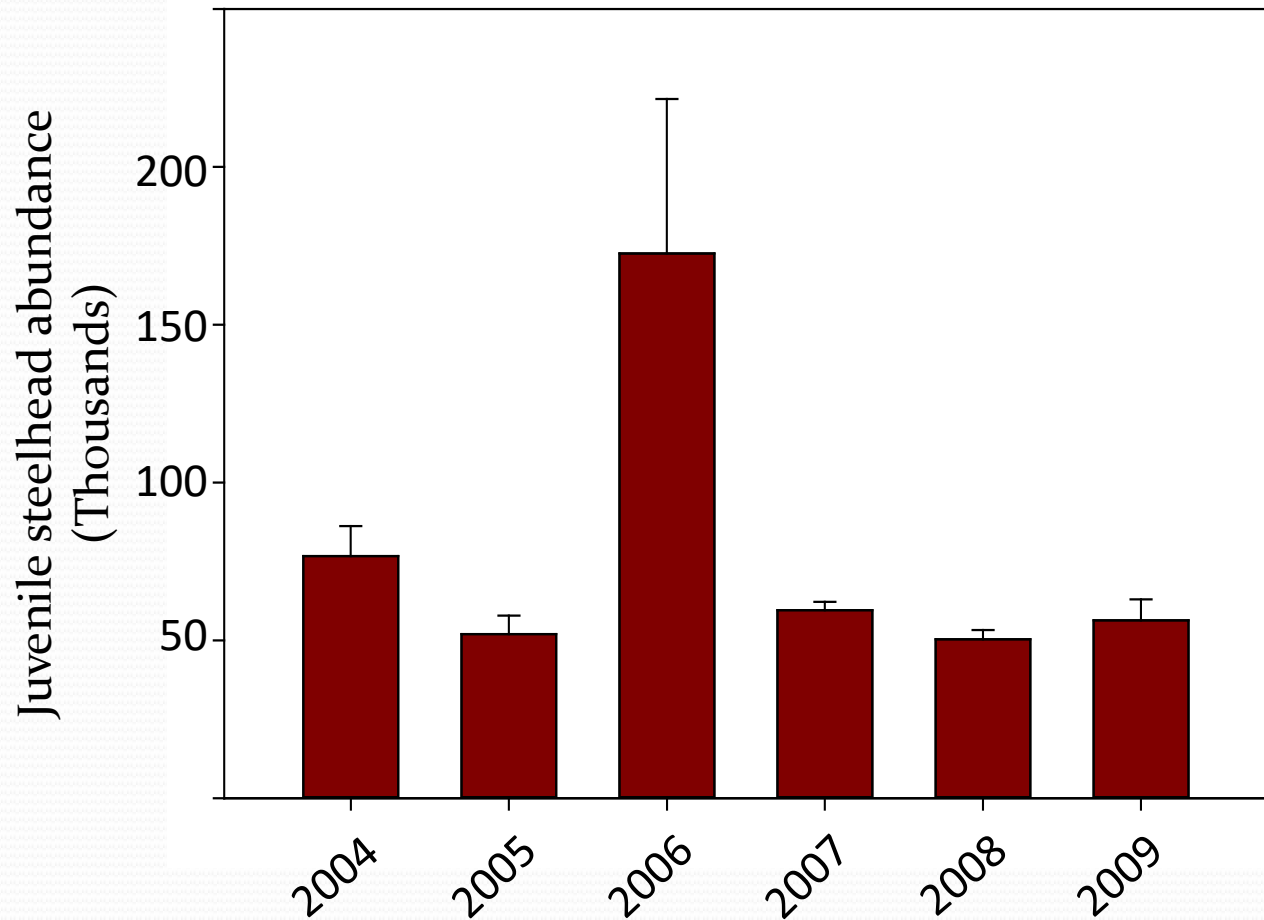
# Screw Trap operation dates

- Trap generally operated from March 1 – June 20
- High water reduced operations from 0 – 22 days per year
- 2010 – 2011 year round trapping revealed 5% of juvenile steelhead were captured outside the trapping period (March 1 – June 20)



# Results: Juvenile emigrant abundance

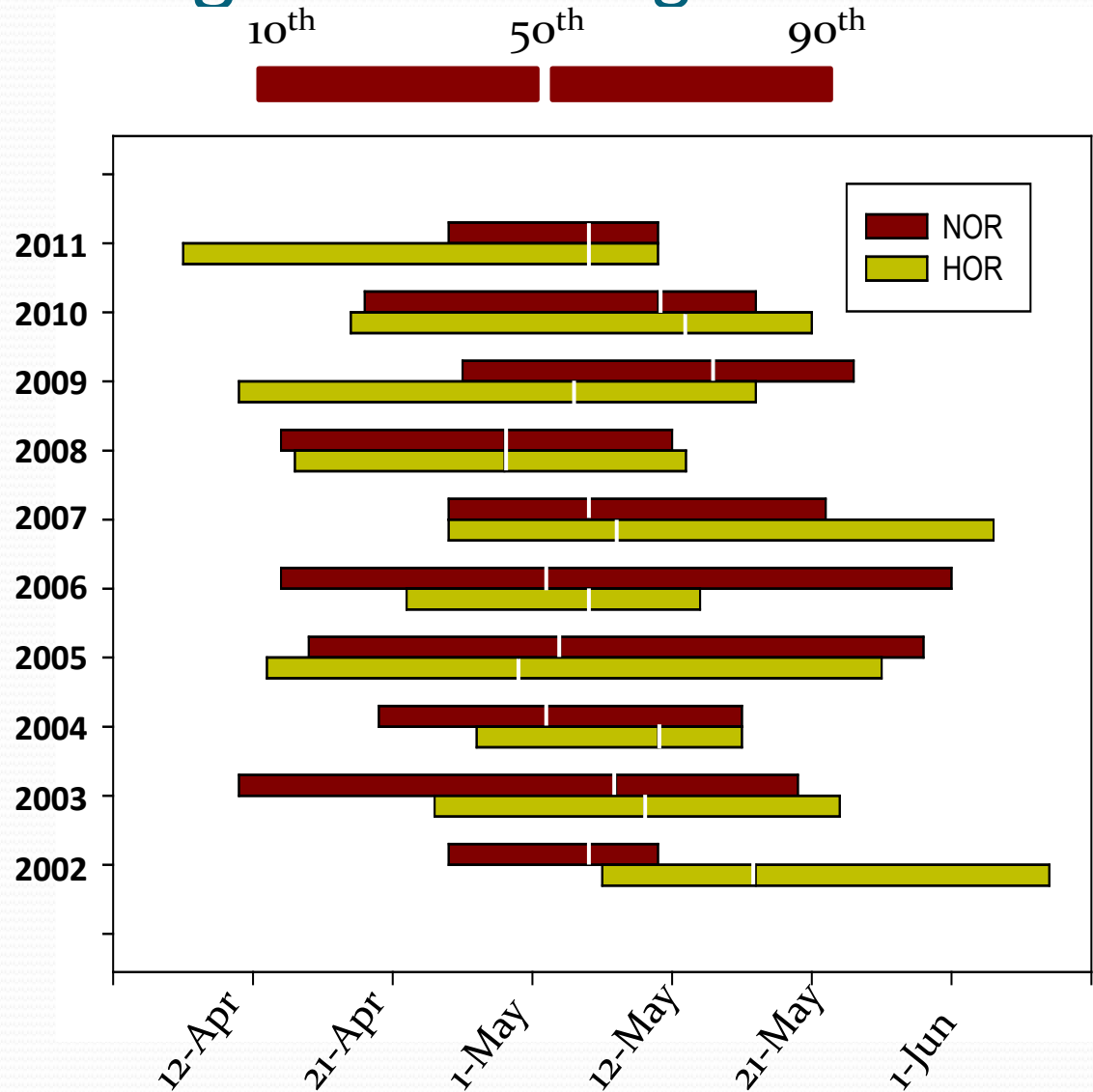
- Estimates of juvenile emigrant abundance based on trap efficiency trials



# Results: Emigrant migration timing

- median arrival timing at the screw trap

- NOR steelhead
- HOR - Little Sheep Creek acclimated

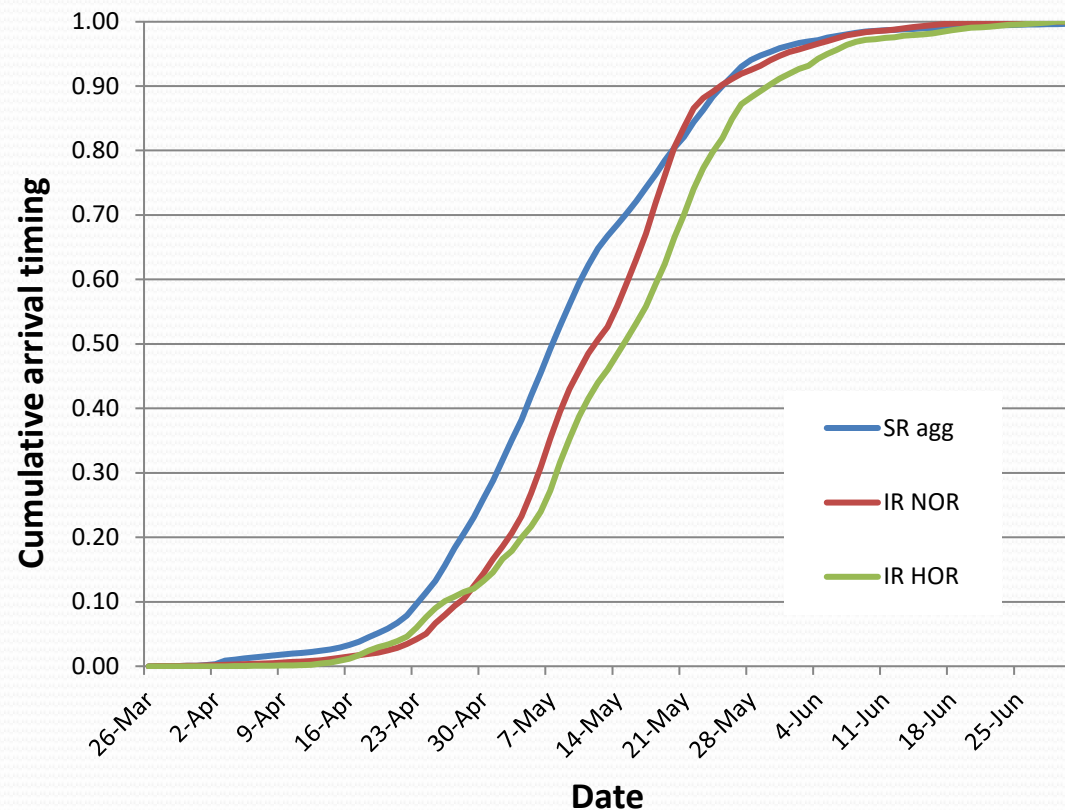


# Results: Emigrant arrival timing, LGR

- Combined data, 1998 – 2011
- \*Significant difference in arrival timing at LGR for Imnaha River NOR, Imnaha River HOR and Snake River aggregate

	max D	date
SR agg vs HOR	0.222	7-May
SR agg vs NOR	0.152	5-May
IR NOR vs HOR	0.140	20-May

	Date		
	10th %	median	90th %
IR NOR	24-Apr	12-May	25-May
IR HOR	26-Apr	15-May	31-May
SR agg	23-Apr	8-May	25-May



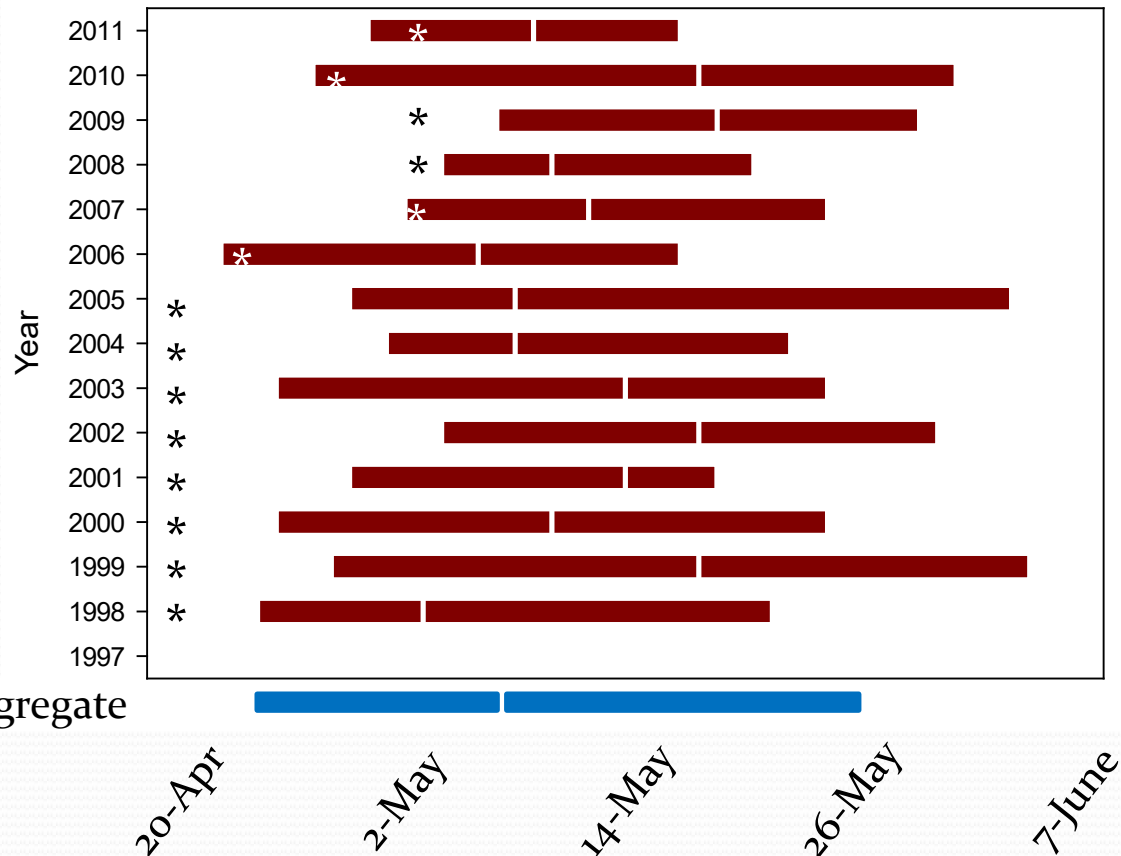
\*( $P < 0.001$ ; Kolmogorov-Smirnov two sample test)

# Results: Emigrant arrival timing, LGR

- Annual NOR juvenile arrival timing at LGR
- Later arriving juvenile HOR steelhead were transported at a higher proportion



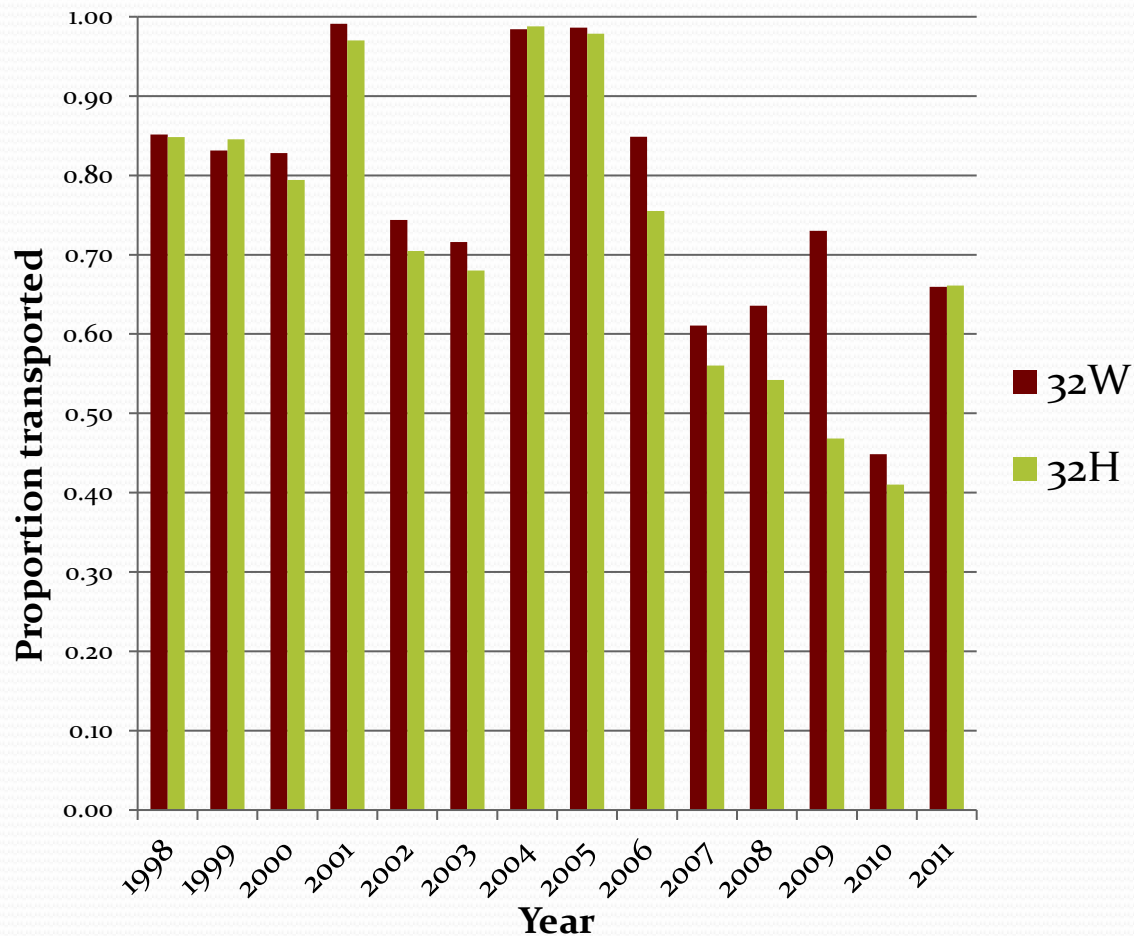
\*Initiation of transportation at LGR





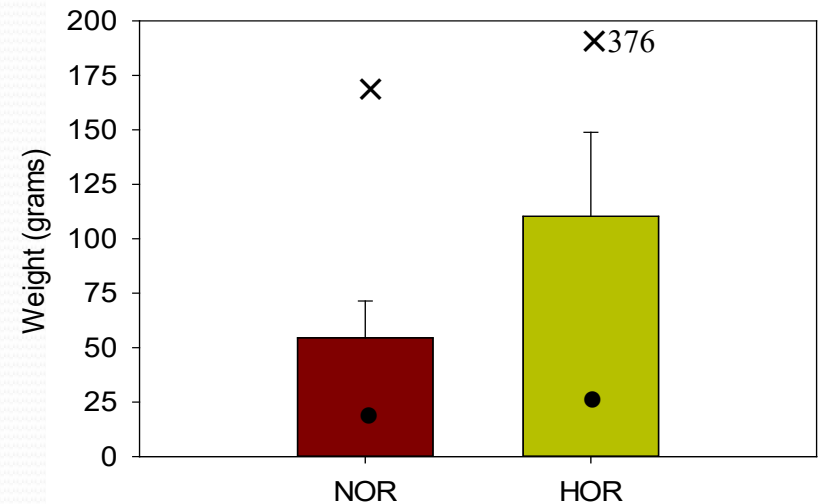
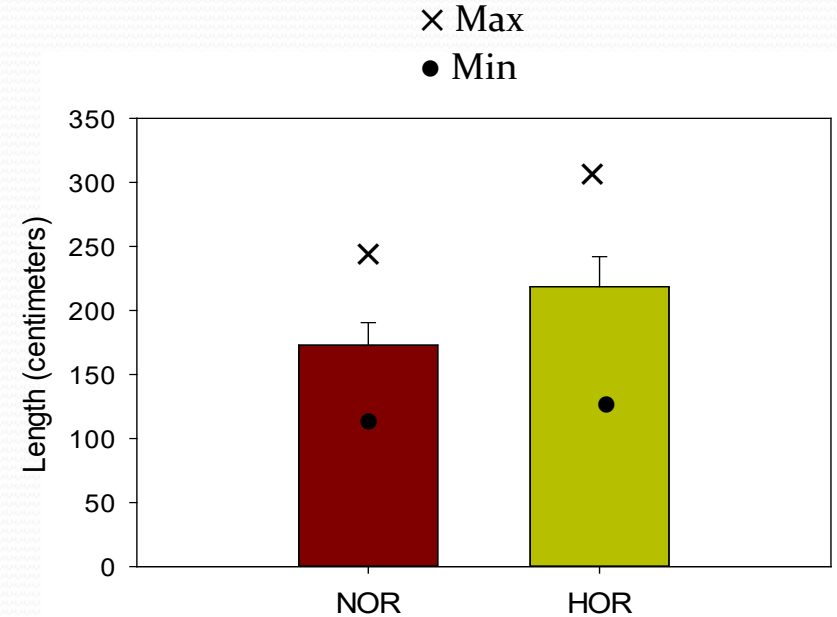
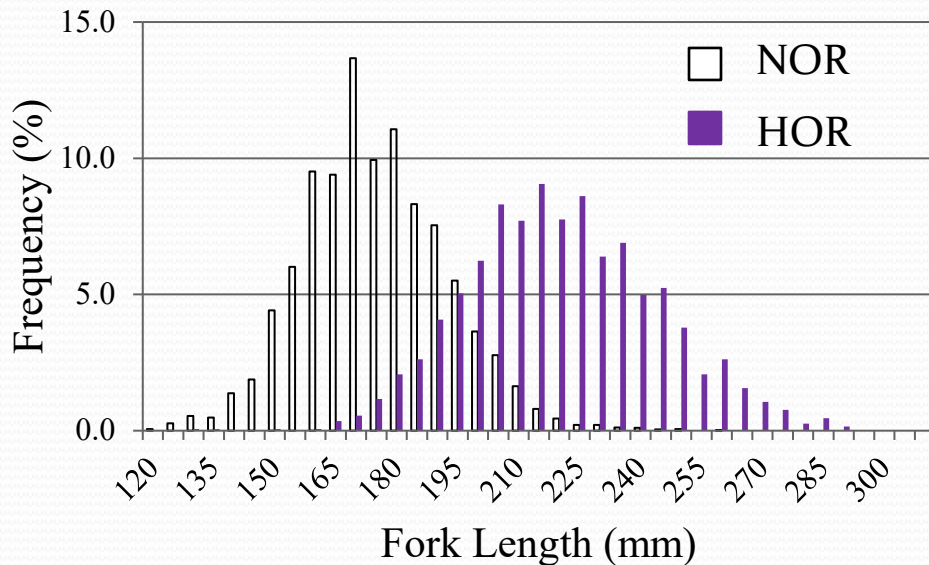
# Proportion transported

- Cumulative proportion of Imnaha River juveniles captured and transported at LGR, LGS, LMN
- Based on PIT tags



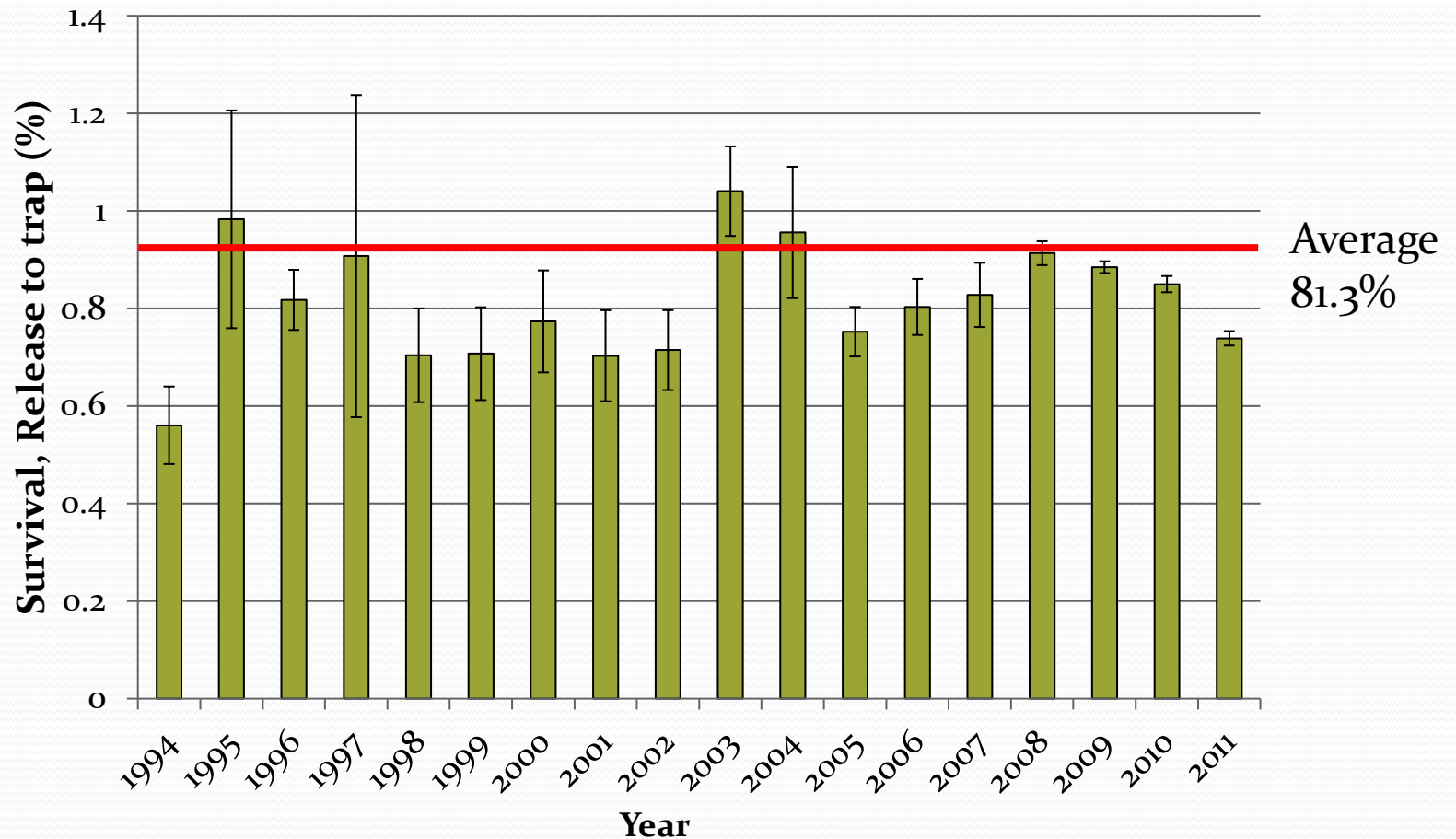
# Juvenile size comparisons

- NOR vs HOR
  - Significantly greater length and weight
  - No difference in condition factor



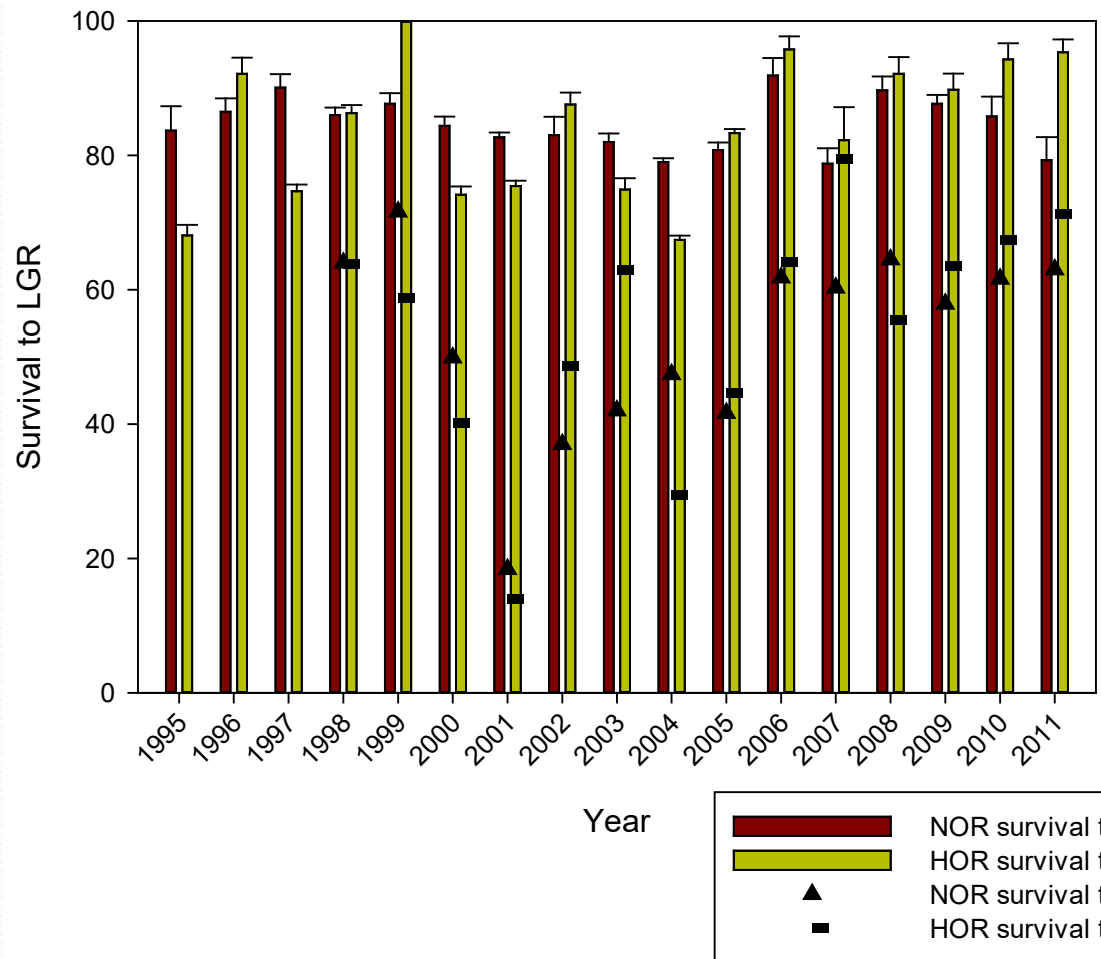
# Results: Hatchery Juvenile survival

Juvenile “survival”, release to screw trap



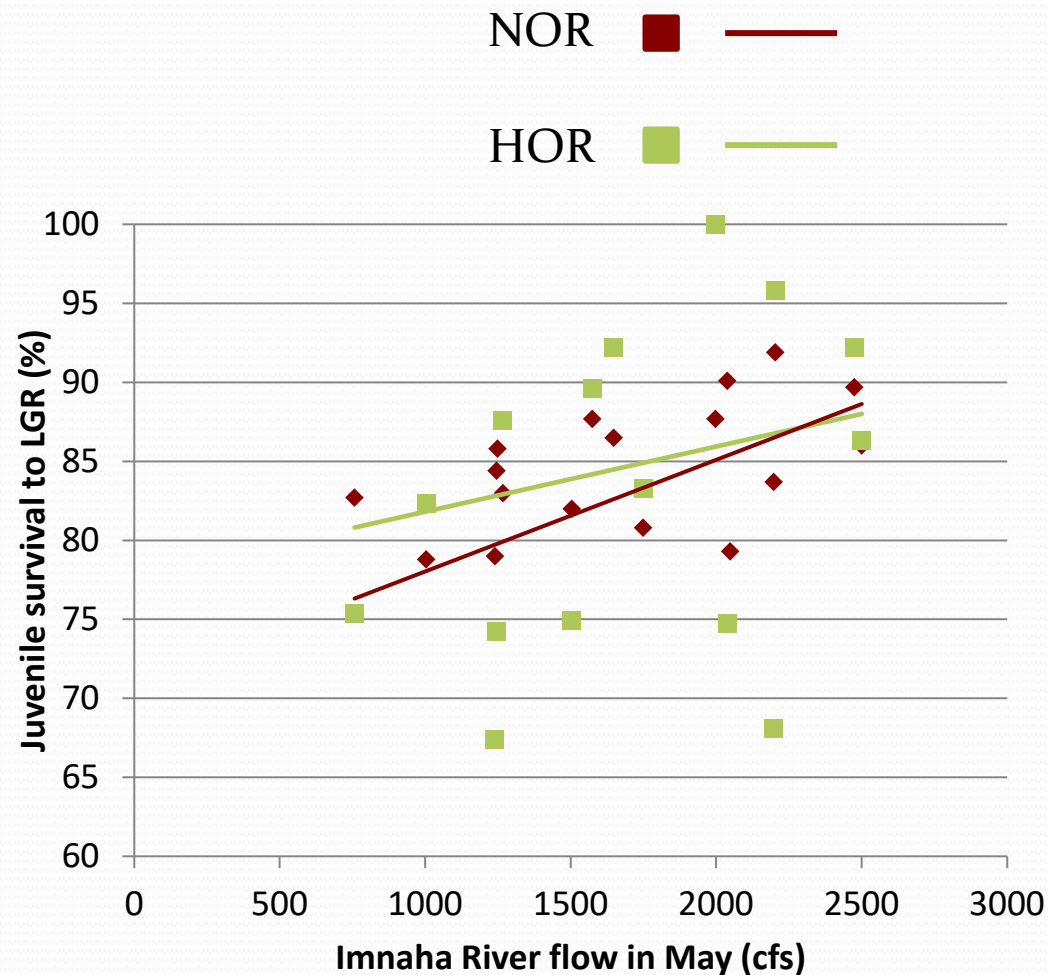
# Results: Juvenile survival, screw trap to LGR

- Relatively consistent survival to LGR
- HOR vs NOR
  - No difference in survival to LGR or MCN
- No relationship between survival to LGR and MCN



# Results: Juvenile survival and river flow

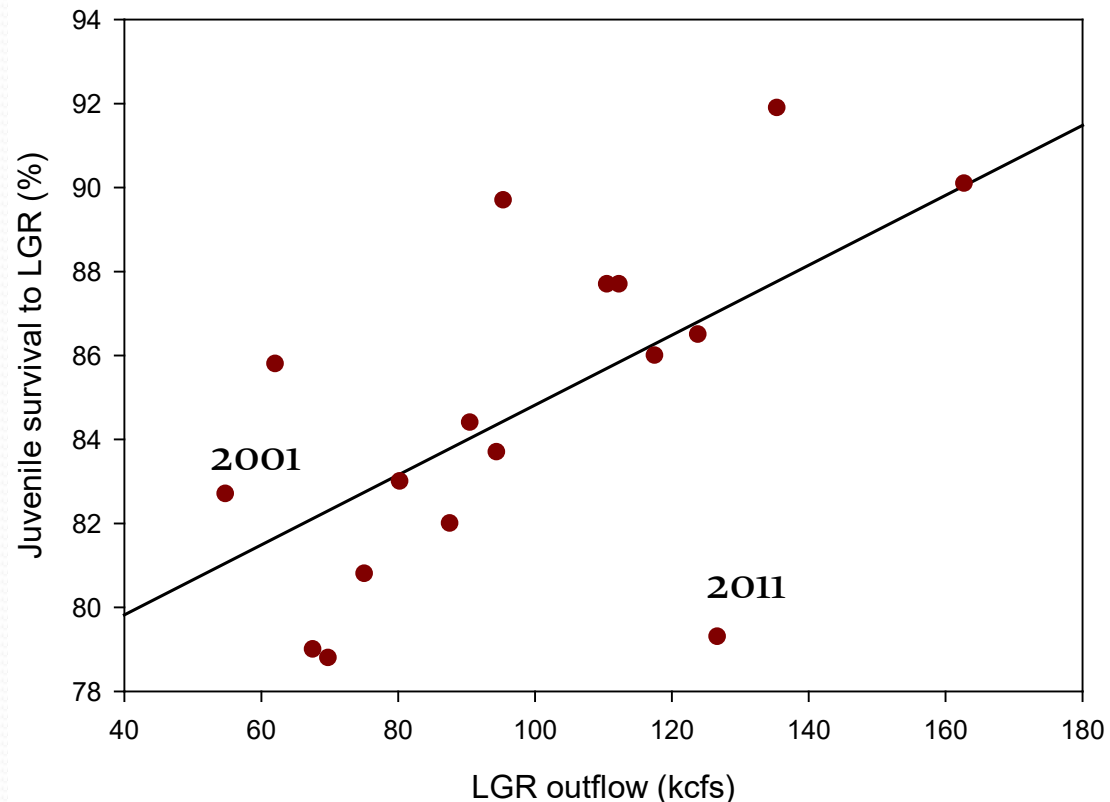
- No relationship between Imnaha River flow and Juvenile survival to LGR
- Slight positive trend
  - NOR  $r^2 = .284$
  - HOR  $r^2 = 0.139$





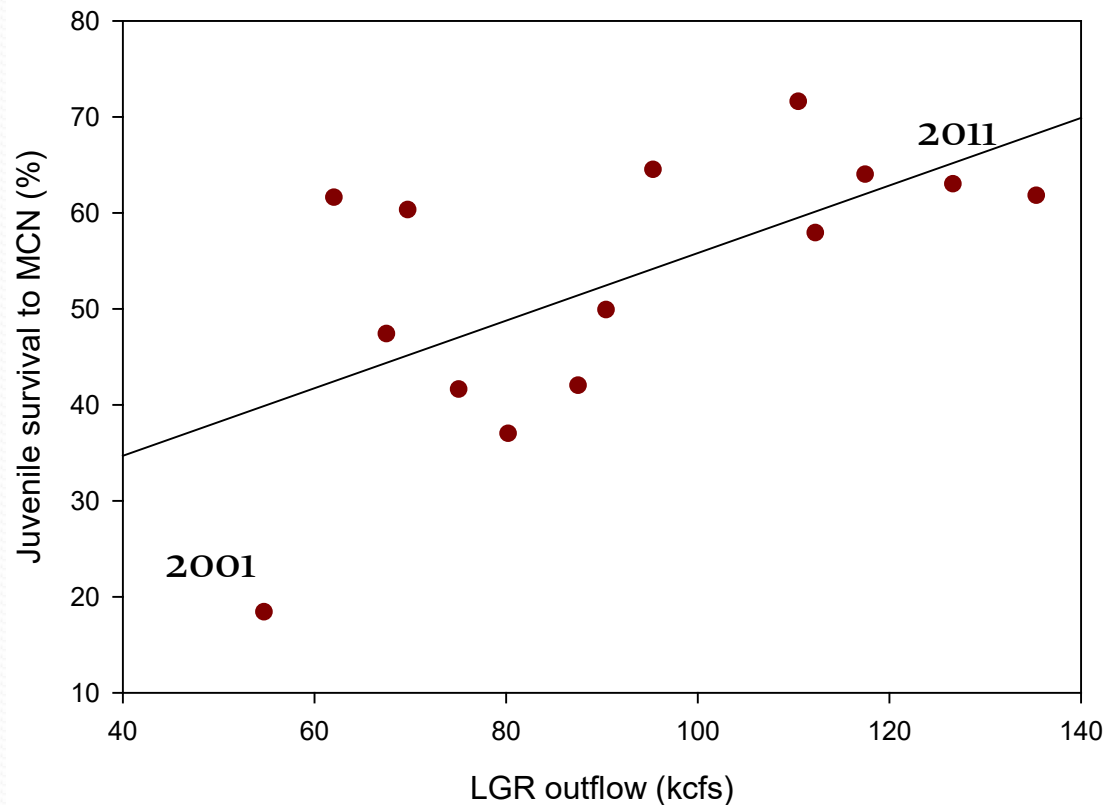
# Results: Juvenile survival and hydro conditions

- Significant positive relationship between juvenile survival to LGR
  - LGR outflow
  - spill volume
  - percent spill
- No relationship between juvenile survival and average LGR temperature



# Results: juvenile survival to MCN

- Significant positive relationship between juvenile survival to MCN
  - LGR outflow
  - spill volume
  - percent spill
- No relationship between juvenile survival and average LGR temperature



# Results: Adult arrival timing

NOR  
HOR

## • Median arrival timing

### • BON

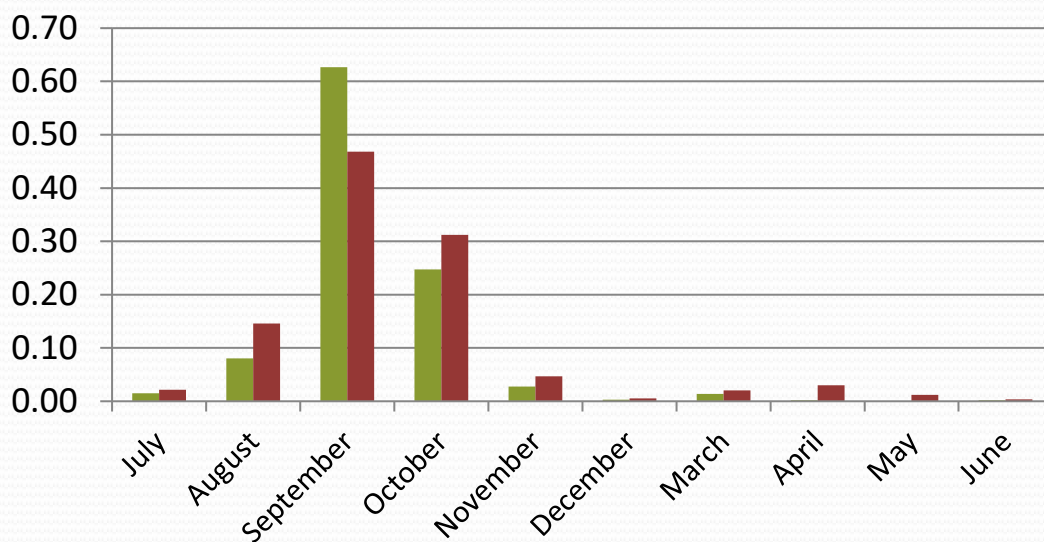
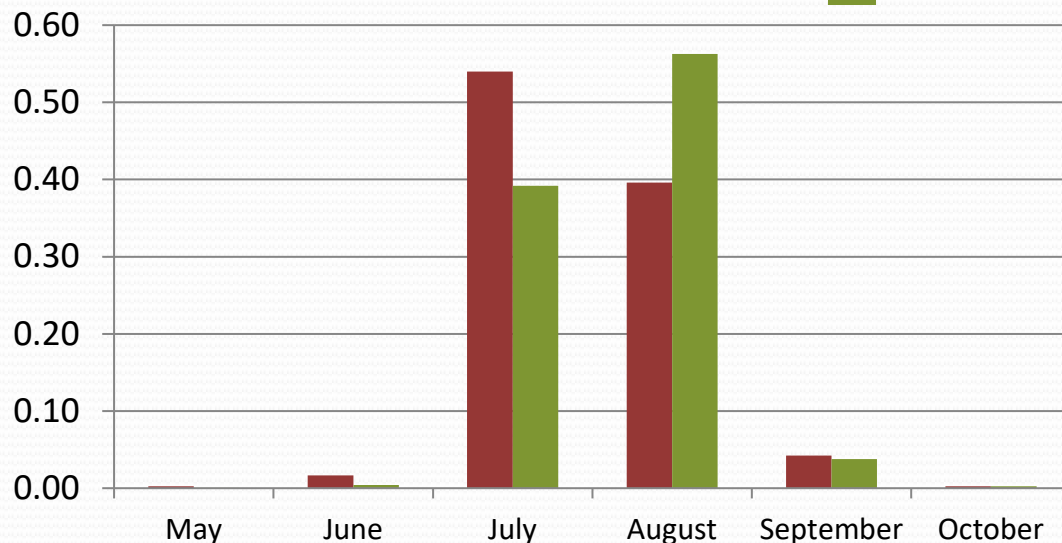
- NOR = July 31
- HOR = Aug. 8

### • Significant difference (P<0.001)

### • LGR

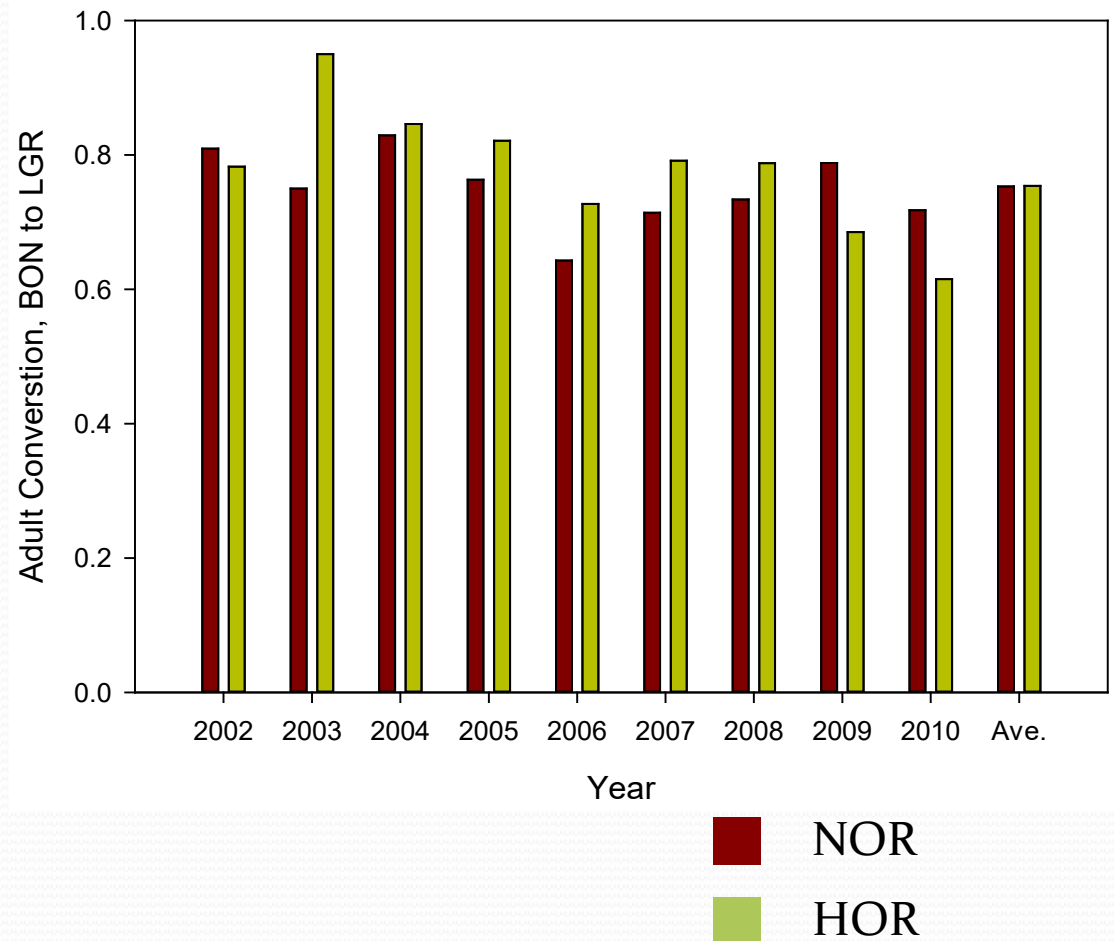
- NOR = Sept. 22
- HOR = Sept. 21

### • Significant difference (P=0.001)



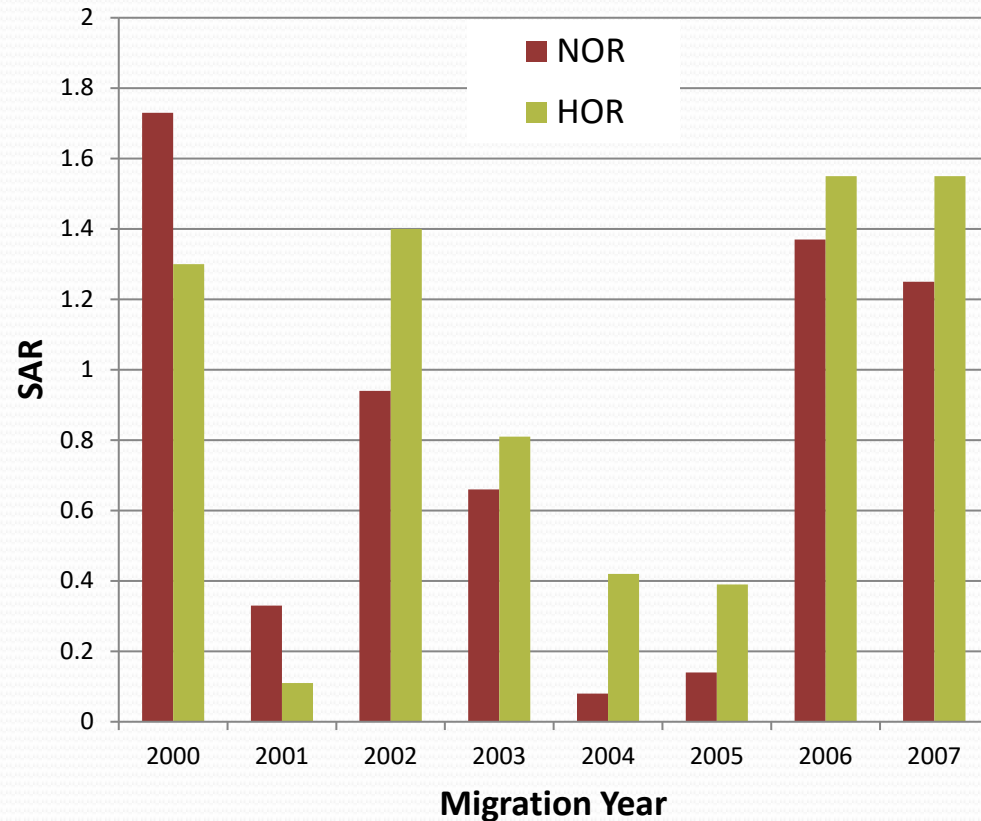
# Results: Adult conversion rates, BON to LGR

- NOR conversion
  - 0.75 (S.D. = 0.06)
- HOR conversion
  - 0.78 (S.D. = 0.10)
- No difference in conversion rate



# Results: Smolt to Adult Returns (SARs)

- NOR and HOR SARs were not significantly different ( $P = 0.33$ )
- Limitations
  - LGR to LGR
  - Survival mode, all by-passed back to the river
    - don't represent the population at large
  - Based on PIT tags
  - Not adjusted for harvest





# Juvenile Steelhead Objectives

Evaluate and compare hatchery- and natural-origin steelhead performance by quantifying the following juvenile steelhead performance measures

HOR and NOR comparisons

1. Emigrant abundance – 50k – 100k/year, NOR
2. Emigration timing – Similar, dependent on release timing
3. Size/condition factor at emigration – HOR > NOR
4. Juvenile arrival timing to LGR – NOR earlier
5. Juvenile survival - Similar, no correlation between survival to LGD and MCN

# Adult Steelhead Objectives

Evaluate and compare hatchery- and natural-origin steelhead by estimating the following adult steelhead life history attributes

- Adult arrival timing to BON and LGR – **NOR earlier to BON; HOR earlier to LGD**
- Adult conversion rate to LGR - **Similar**
- Smolt to adult return – **Similar trends, HOR > NOR**



# Recommendations

- Continue natural production monitoring
  - Use PIT tagging of juvenile steelhead in the Imnaha River to get abundance and survival estimates
- Continue evaluating hatchery juvenile steelhead performance
- Analyze the impacts of environmental variables on emigrant timing and survival
- Maintain coordination with Fish Passage Center providing real-time arrival-timing and survival information through the hydrosystem

# Acknowledgements

- Funding
  - LSRCP
  - BPA
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