

Evaluation of Methods to Reduce Straying Rates of Barged Juvenile Steelhead



December 5, 2013

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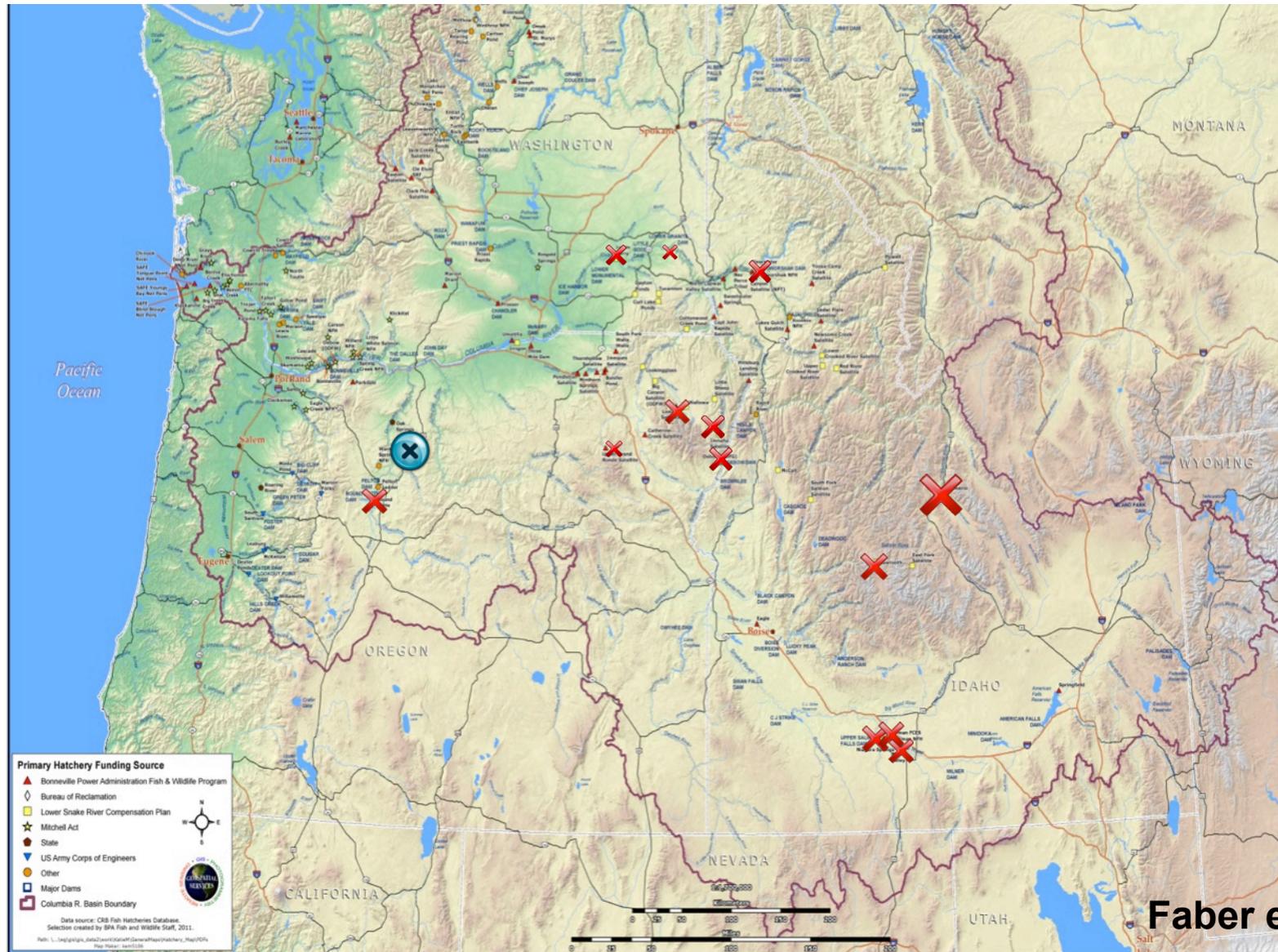


Goals

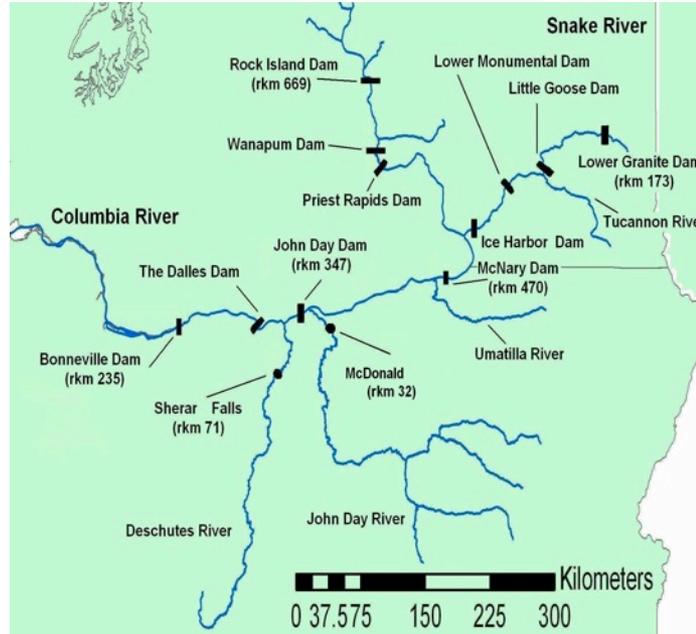
Identify and evaluate methods to reduce migration delay, wandering, and stray rates of transported steelhead



Origin of Hatchery Steelhead Strays Spawning in East Side Deschutes R. Tributaries

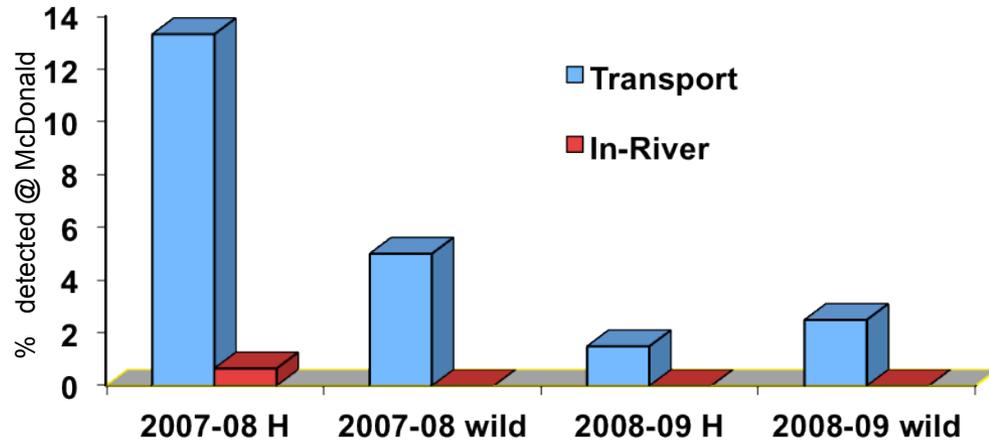
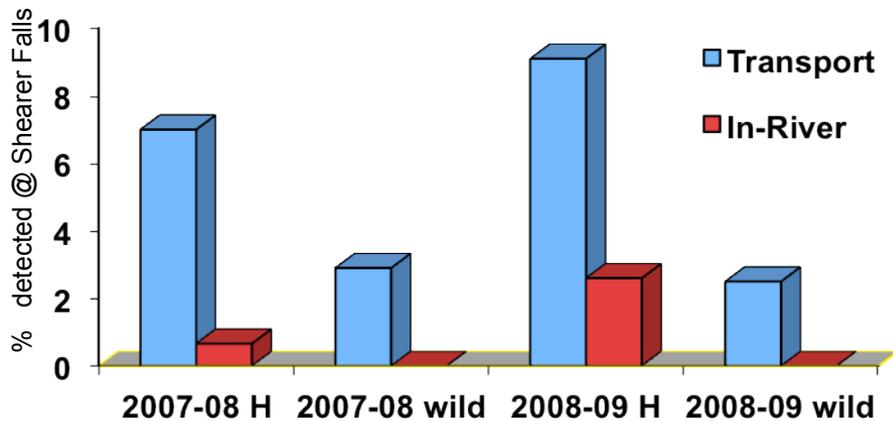


Transport increases temporary and permanent straying into Mid-C Steelhead populations



Stray Rates into Deschutes R.

Stray Rates into John Day R.



Rich Carmichael ODFW

How does barging compromise homing fidelity?

Hypothesis: Collecting and barging steelhead rapidly downstream disrupts sequential imprinting leading to increased straying



Steelhead outmigration/ sequential imprinting

In-river

- Volitional movement between water sources
- Slower outmigration
- ”Pausing” at tributaries
- Rheotactic cues



Barged

- Navigation channel
- Fast “outmigration”
- No tributary sampling
- No rheotactic cues
- Stress



Hypotheses

- Lack of novel tributary waters
- Insufficient exposure period for successful memory formation
- Insufficient current/rheotactic information
- Stress-induced impacts on thyroid activity



Objectives

Objective 1. Assess imprinting success by monitoring imprinting-associated changes in physiological function in barged vs. in-river migrants.

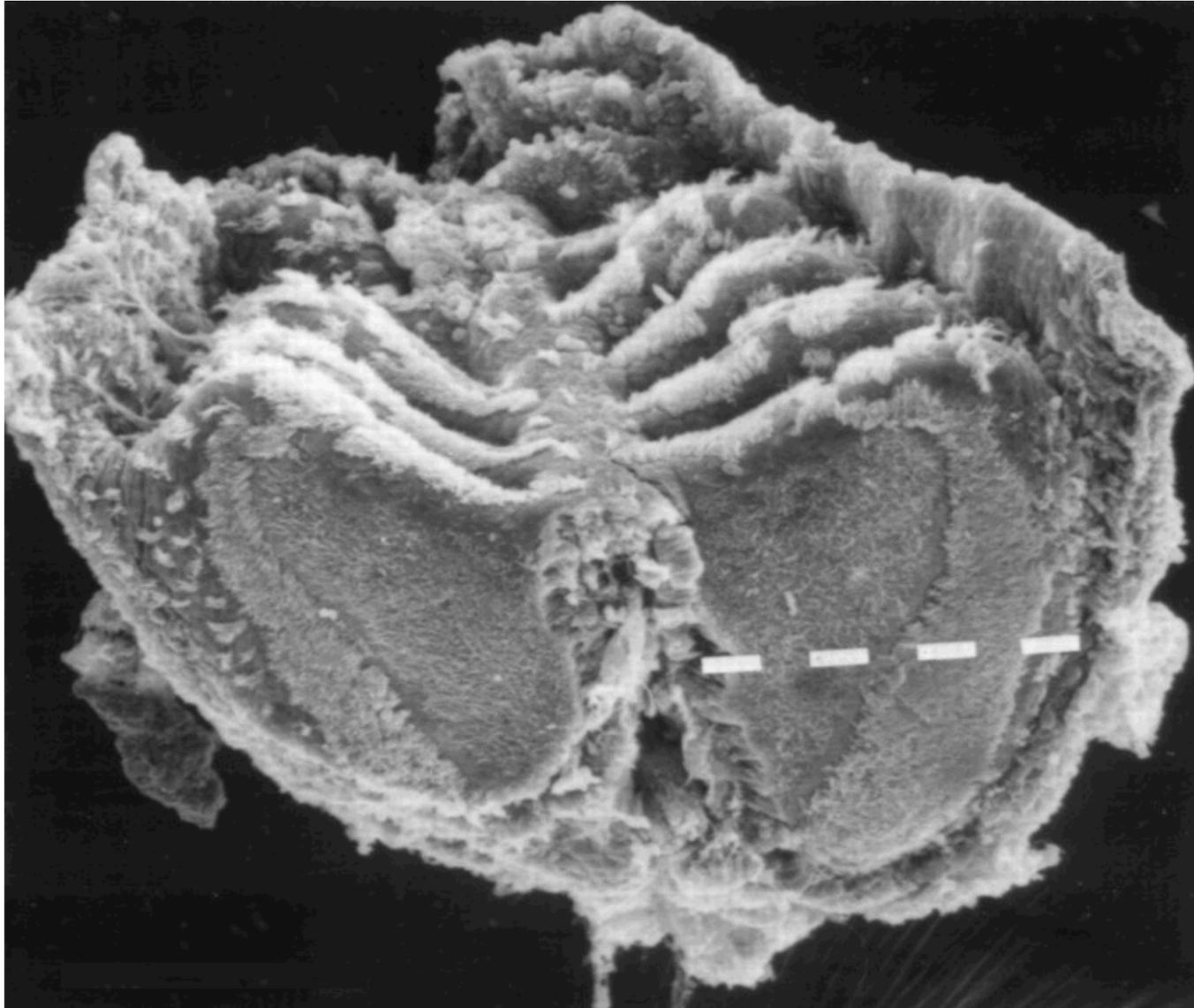
Objective 2. Identify key environmental parameters (e.g. novel tributary water) that are important for imprinting barged fish and develop barging protocols to optimize imprinting success and thereby minimize straying.

Objective 3. Initiate tests of a modified barge protocol designed to maintain survival benefits while reducing wandering, delay, and straying behavior of returning adults.

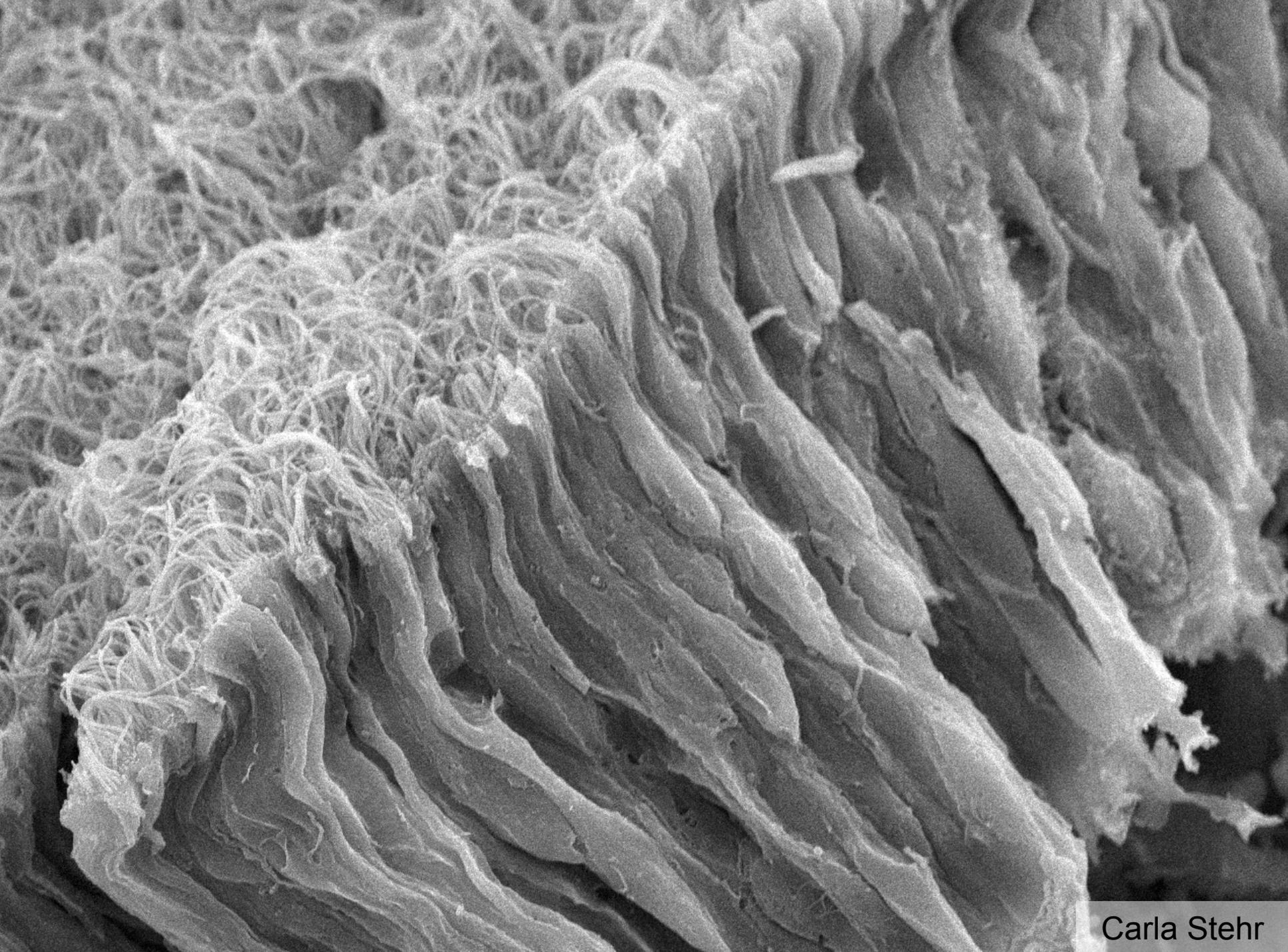
Objective 1. Assess imprinting success by monitoring imprinting-associated changes in physiological function

- **Standard barge vs. In-River migrants**
- **Assess smolting/imprinting metrics including plasma hormone levels, gill ATPase activity, expression of olfactory receptor genes in olfactory rosettes.**
- **Collect 20 hatchery and 20 wild Snake River steelhead at each sampling location/date.**
- **Assess imprinting metrics for early (Apr 30-May 10) and late (May 22-June 8) migrants/riders.**

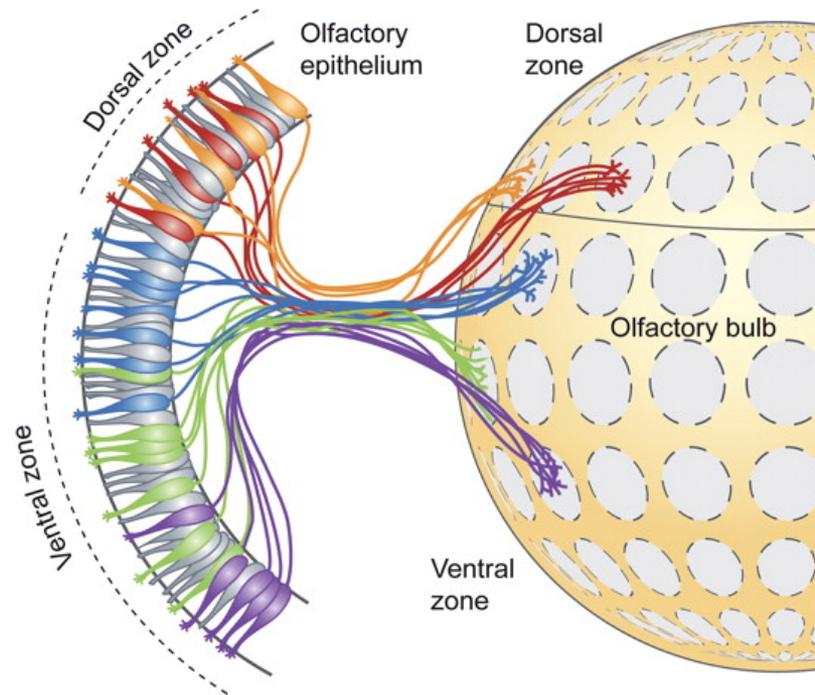
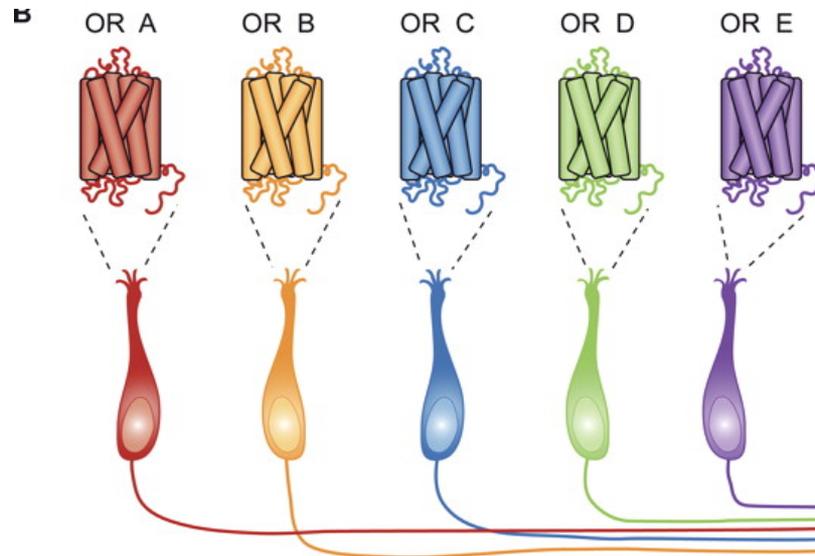
Olfactory Rosette



from Weth et al. 1996

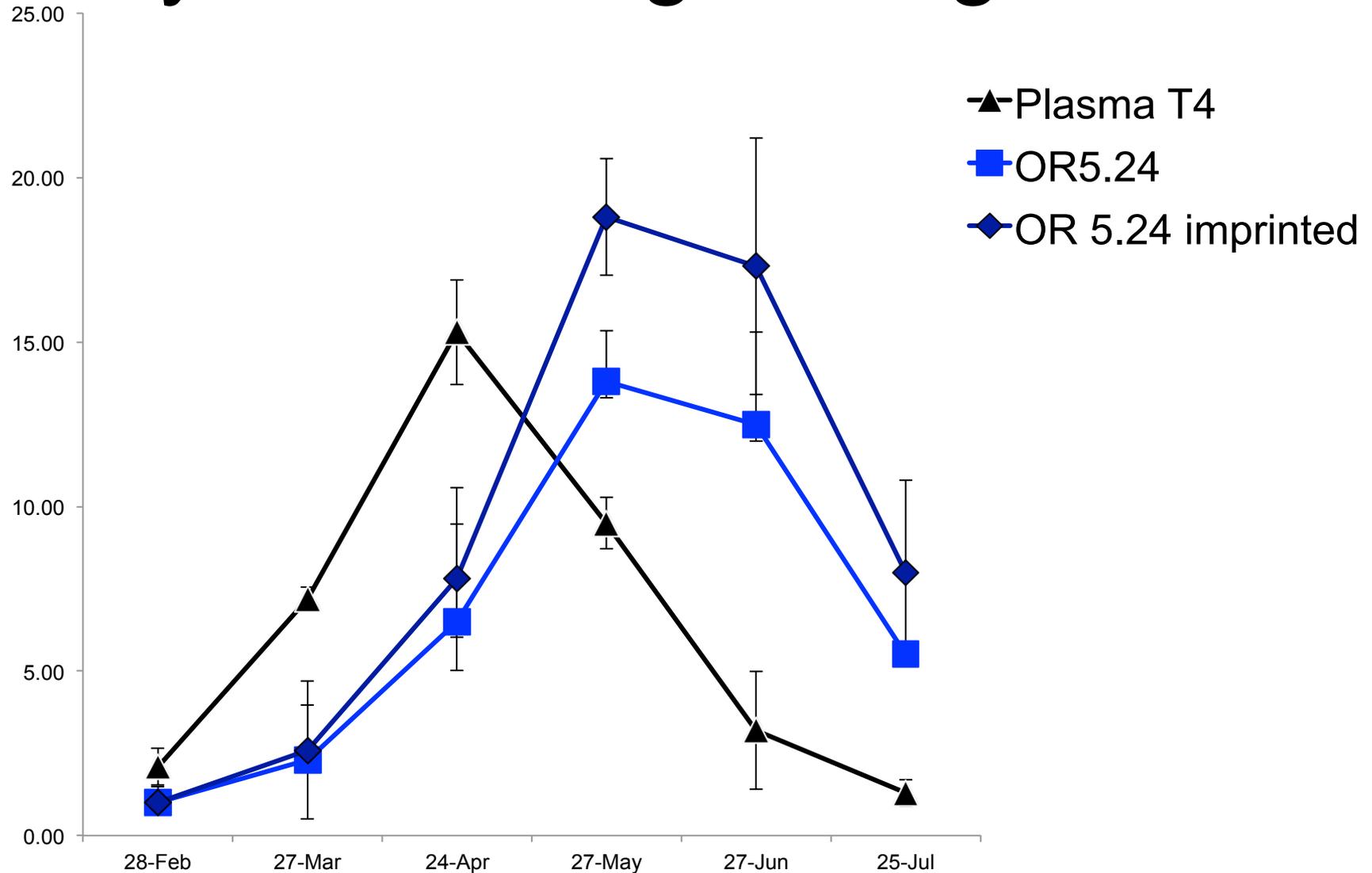


Spatial Map of Olfactory Neurons



From DeMaria and Ngai 2010

Changes in endocrine/olfactory system during outmigration



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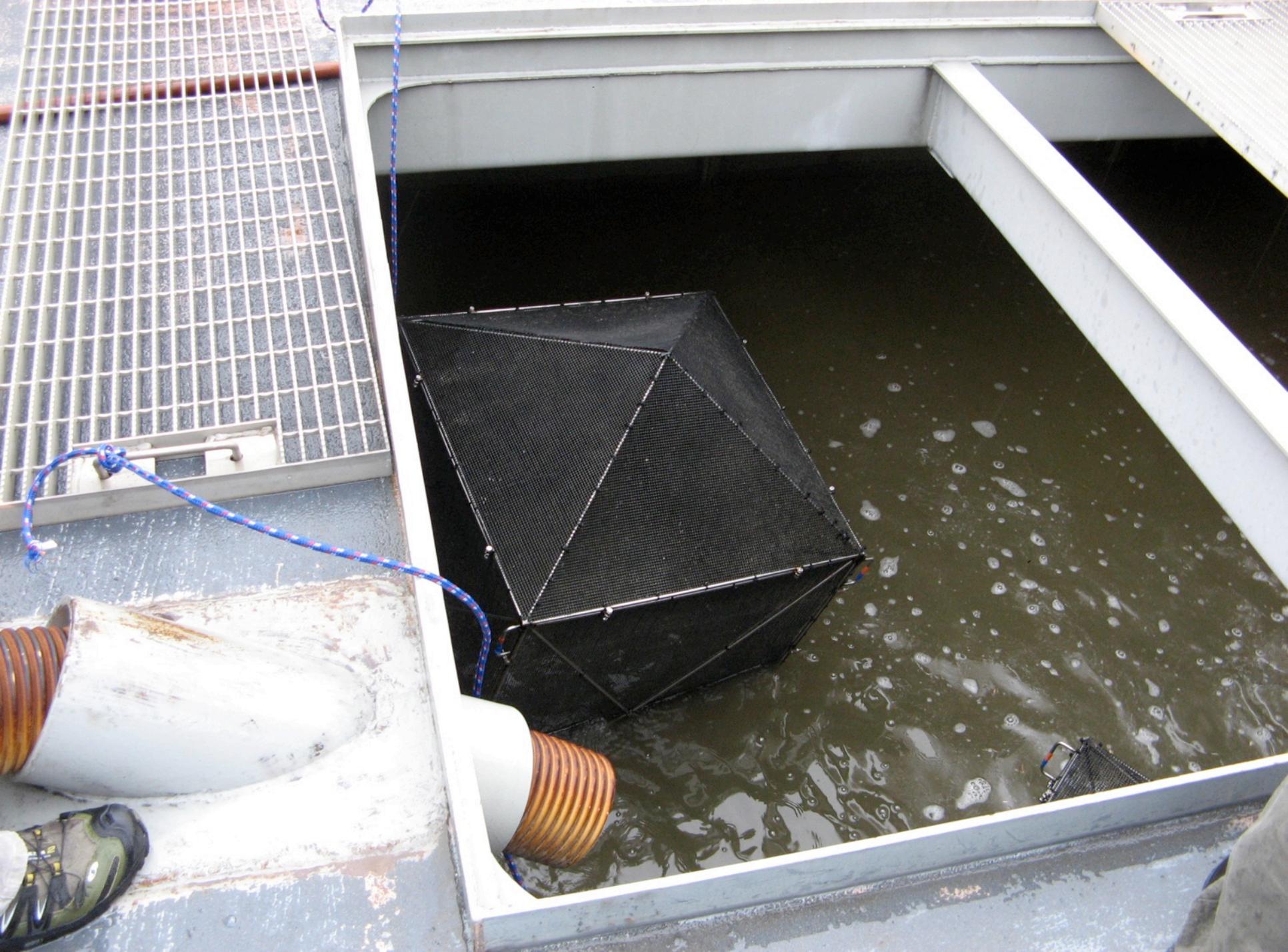
Objective 1. Barged fish

- Collect Steelhead smolts at Lower Granite Dam on Snake River
- Load steelhead smolts into net pens within barge holds and sample (20H/20W) fish at:
 - Lower Granite (Day 1, ~10 AM)
 - McNary (Day 1, ~Midnight)
 - Bonneville (Day 2, ~6 PM)
- Conducted 2x:
 - early (May 1-4)
 - late (May 22-25)











UMATILLA

UMATILLA

Juvenile Fish
Transportation









ARGONAUTS

HIGH FIVE
Latex Exam Gloves
Powder-free
Low Lactose Content

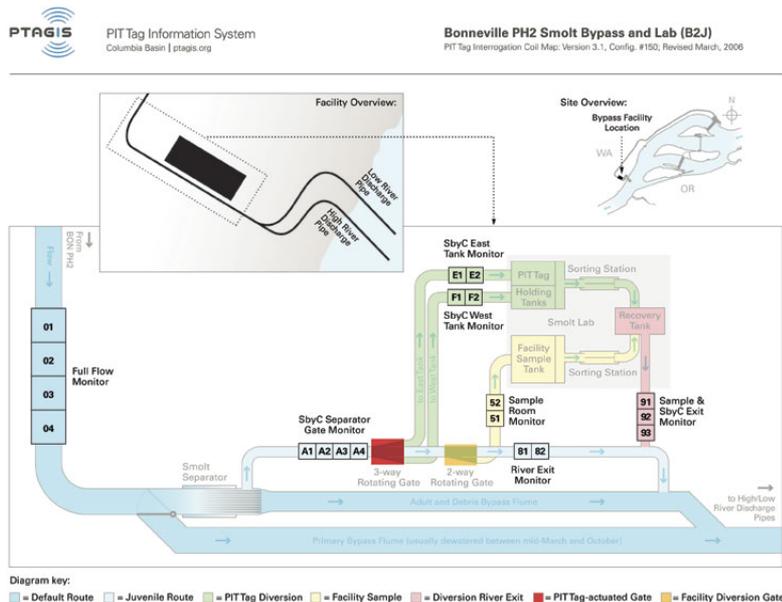
DARRAN

DARRAN



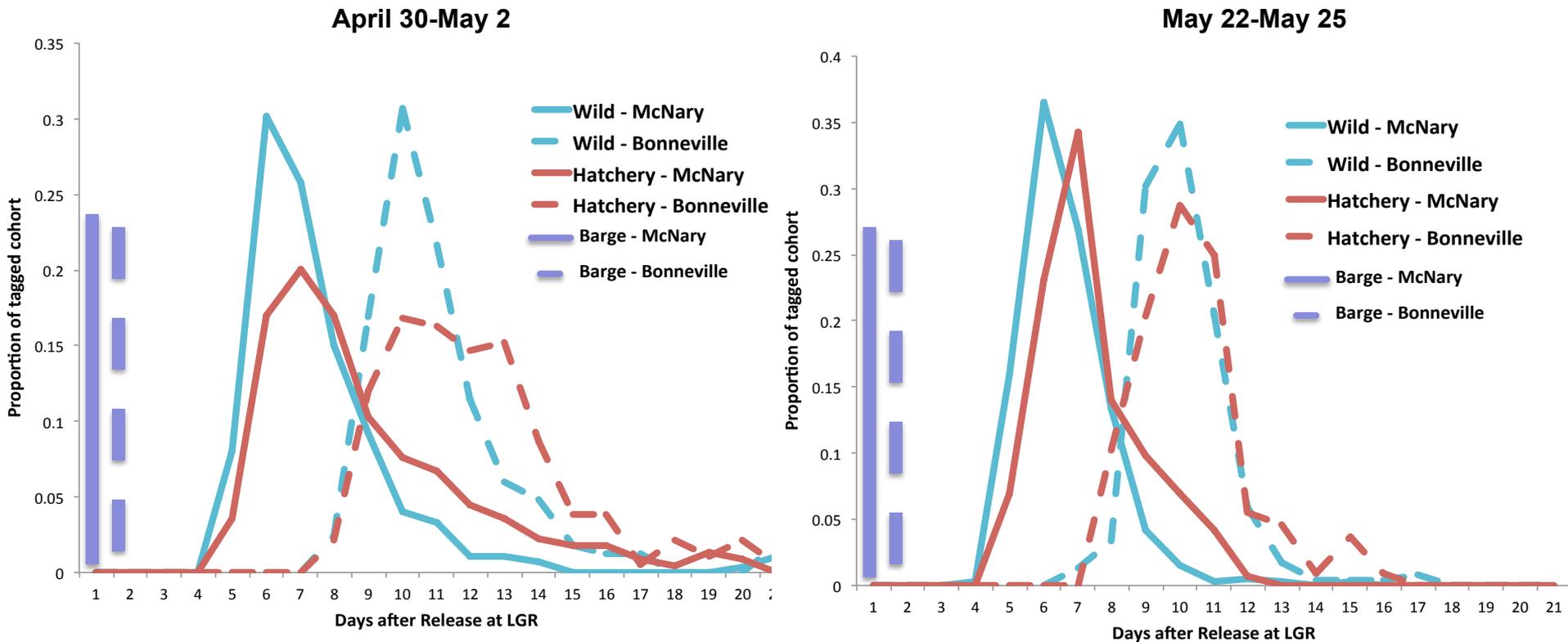
Objective 1. In-river migrants

- Pit tag Steelhead smolts at Lower Granite Dam on Snake River
 - Early: May 1-4 (Hatchery 2931; Wild 2865)
 - Late: May 22-25 (Hatchery 1945; Wild 3923)
- Using Sort by Code system, sample (20H/20W) from this cohort of fish at:
 - McNary (Day 6-7)
 - Bonneville (Day 10-15)



Differences between Barged and In-river Steelhead

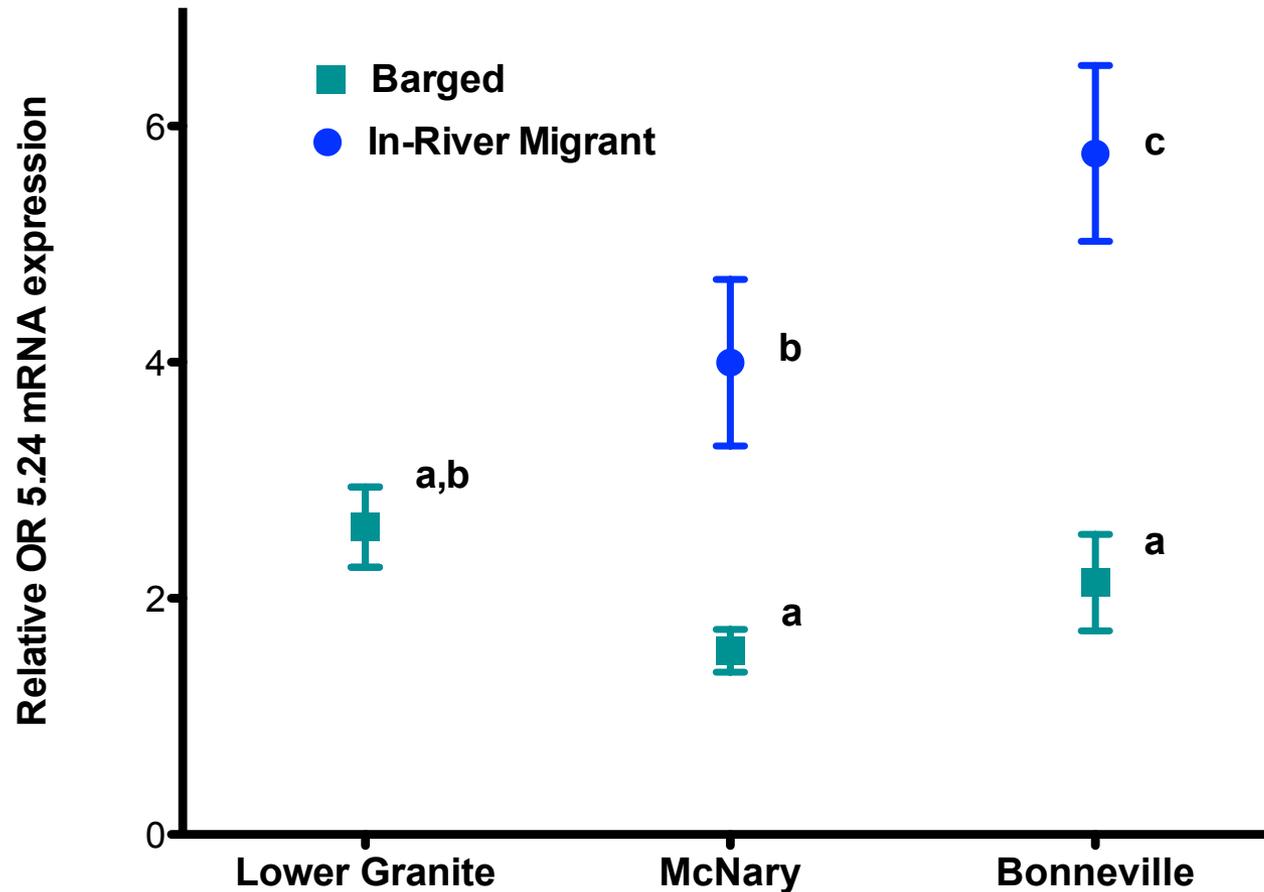
Timing



Differences between Barged and In-river Steelhead

Odorant Receptor Expression

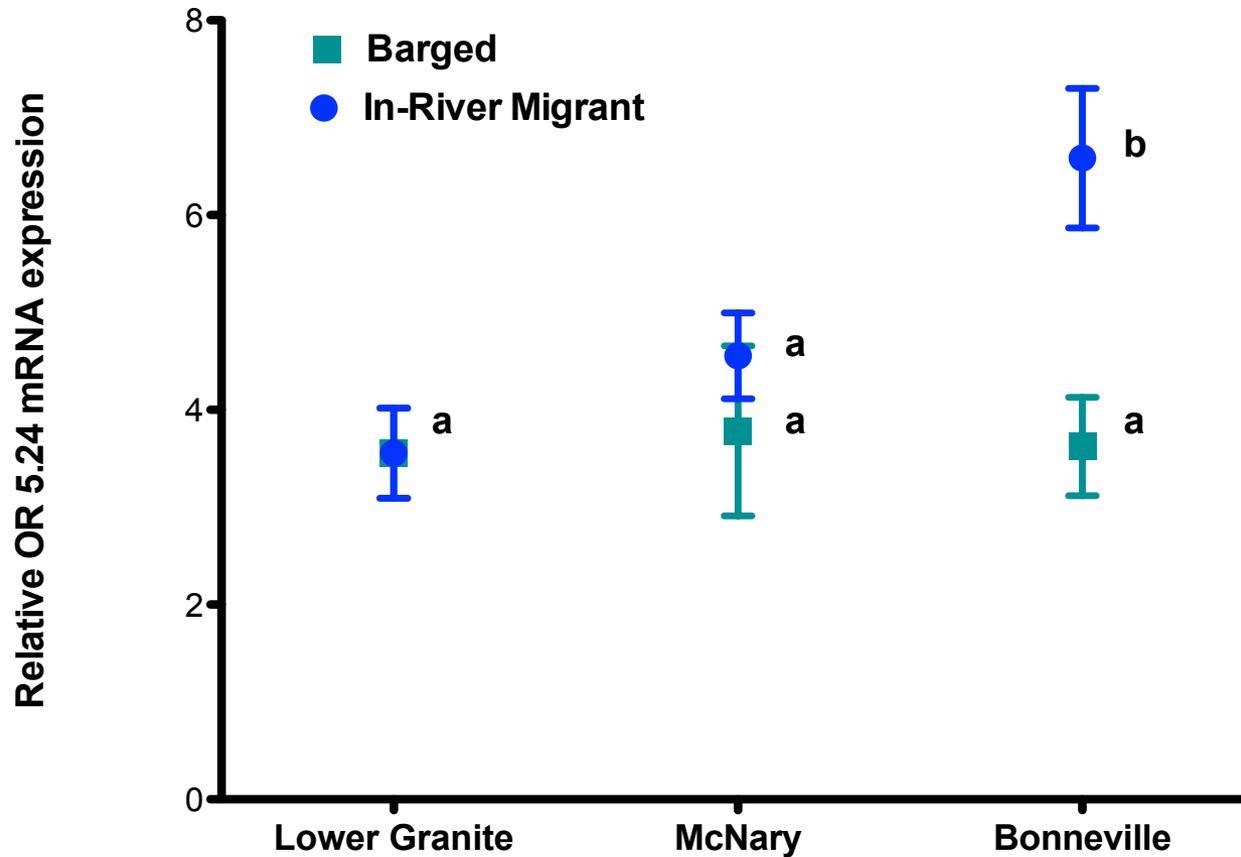
Early (May 1)



Differences between Barged and In-river Steelhead

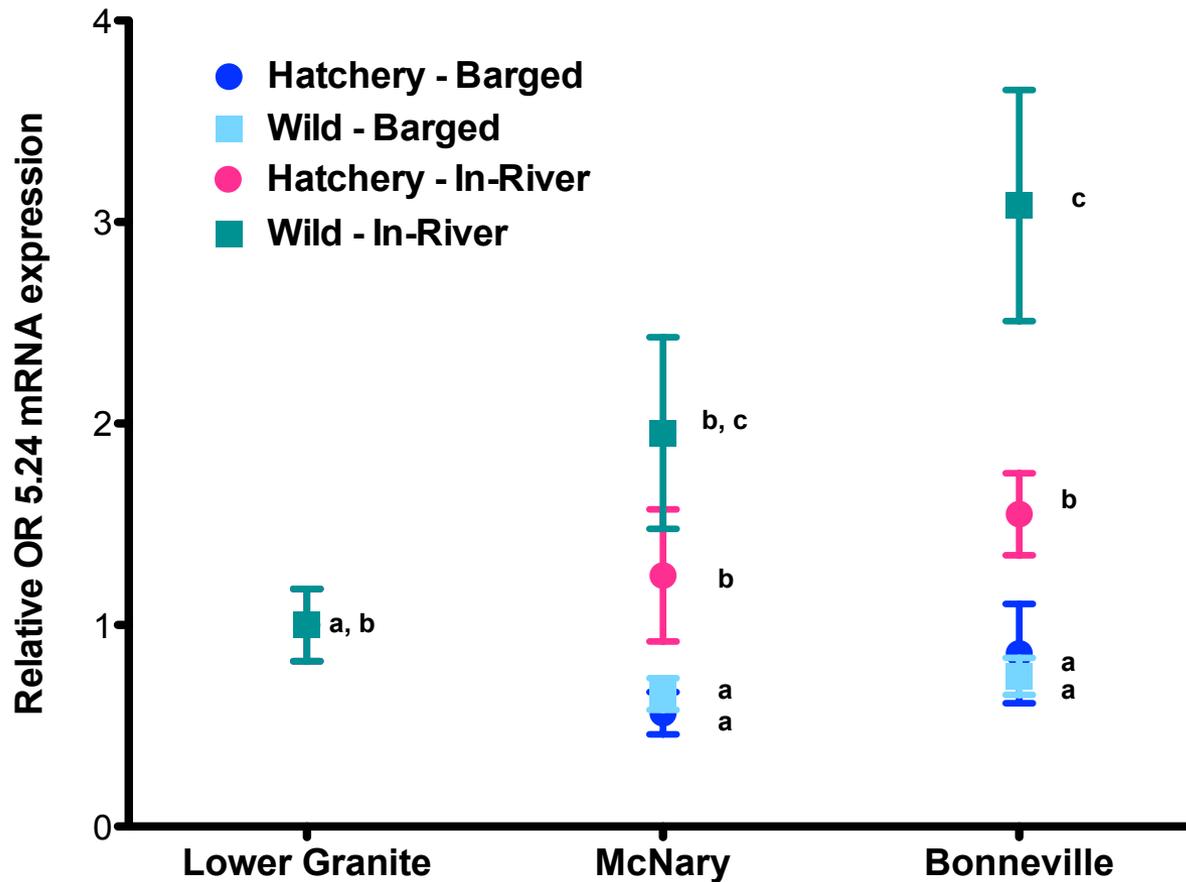
Odorant Receptor Expression

Late (May 23)



Differences between Hatchery and Wild Steelhead

Odorant Receptor Expression



Objective 2. Identify key environmental parameters that are important for successful imprinting in barged fish using a controlled laboratory study.

Assessment of alternate barging protocols using imprinting-associated changes in physiological function

- Initiated in 2011 with Wallowa hatchery steelhead**
- 2012: Assess importance of tributary sampling/period**
- 2013: Assess importance of rheotactic cues and movement**
- 2014-2015: Stress-induced impacts on memory formation**



Objective 2. Assess importance of tributary experience (novel water) and exposure period

Wallowa Hatchery steelhead



Reared to match Snake River hatchery practices (i.e. 60-100gm at release)
(establish smolt profile for physiological parameters by sampling every 3 weeks)

February-July 2012

Novel water treatments
(May 2012)

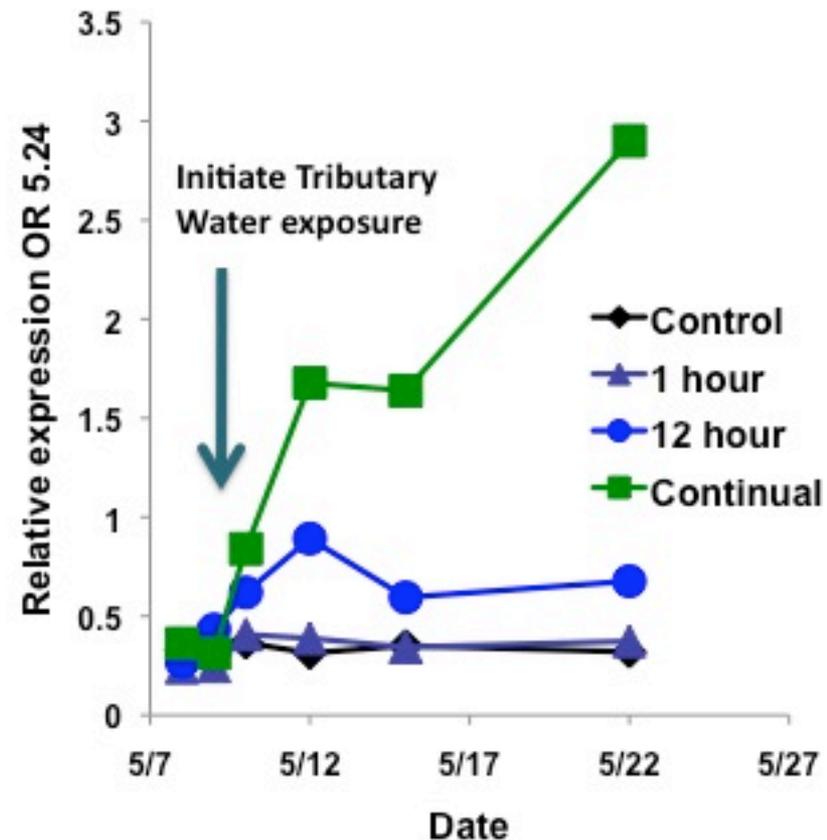
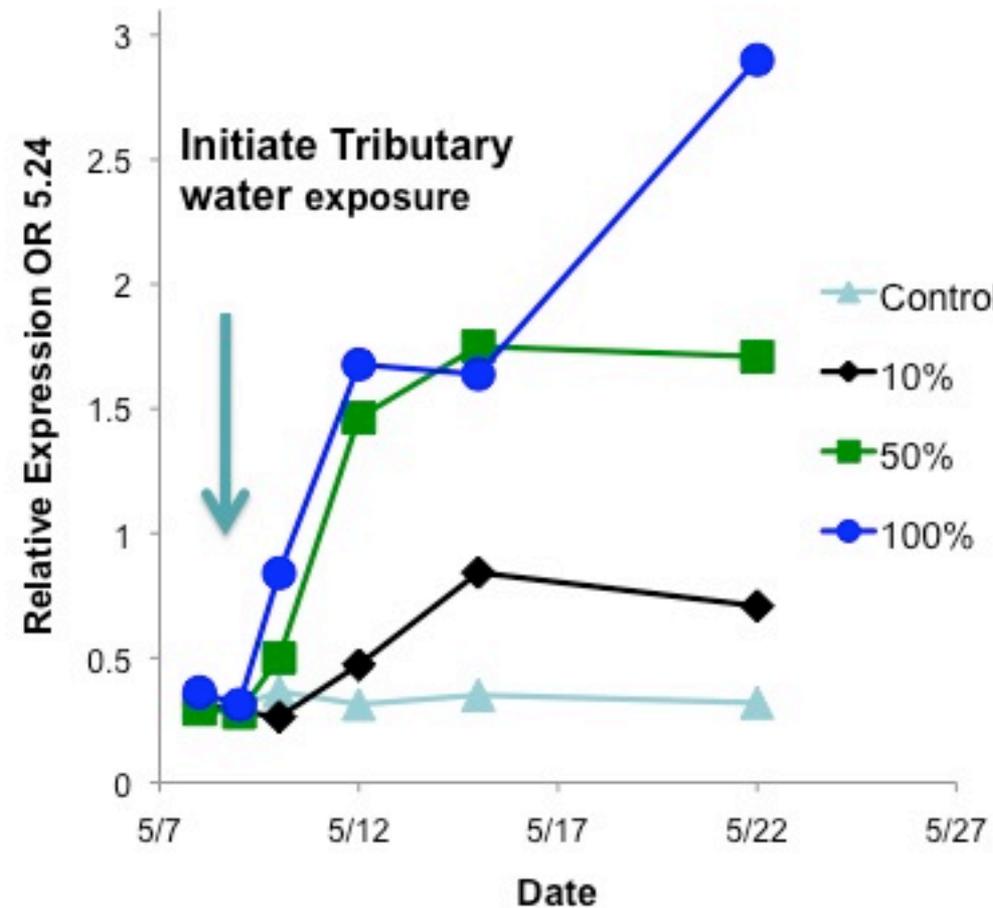
1. Control – Maintained on 100% hatchery water
2. 10% change (90% hatchery water, 10% Creek water)
3. 50% change (50% hatchery water, 50% Creek water)
4. 100% change (100% Creek water)
5. 100% change (100% Creek water); 1 hour
6. 100% change (100% Creek water), 12 hours



Sample fish at t=0,1,2, 4, 7, 14 days



Objective 2. Assess importance of tributary experience and exposure period



Conclusions

- **OR expression provides effective tool for monitoring natural imprinting-associated changes in olfactory system and should be useful for examining effects of different management strategies on imprinting**
- **Barging alters endocrine and olfactory imprinting associated physiology**
- **Hatchery and wild fish display differences in olfactory imprinting-associated physiology during outmigration**
- **Relatively short, small % change novel water exposures are sufficient for affecting changes in olfactory imprinting associated in physiology**



Future plans

- **Complete analysis of barge rheotactic cues and movement on imprinting success and management recommendations**
 - ATPase, T4 completed;
 - OR analysis/PIT tag analysis of movement by June 2014
- **Verify In-river vs. barge effects on imprinting markers**
(Additional years, Fall & Spring Chinook, Hatchery vs. Wild)
- **Analysis of barge conditions important for imprinting**
 - Effects of stress/density on imprinting
 - Importance of multiple tributaries
 - Refine exposure periods for successful imprinting



Questions?

