Effects of supportive breeding on loci underlying fitness traits in Chinook salmon

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ORIGINAL ARTICLE

Effectiveness of managed gene flow in reducing genetic divergence associated with captive breeding

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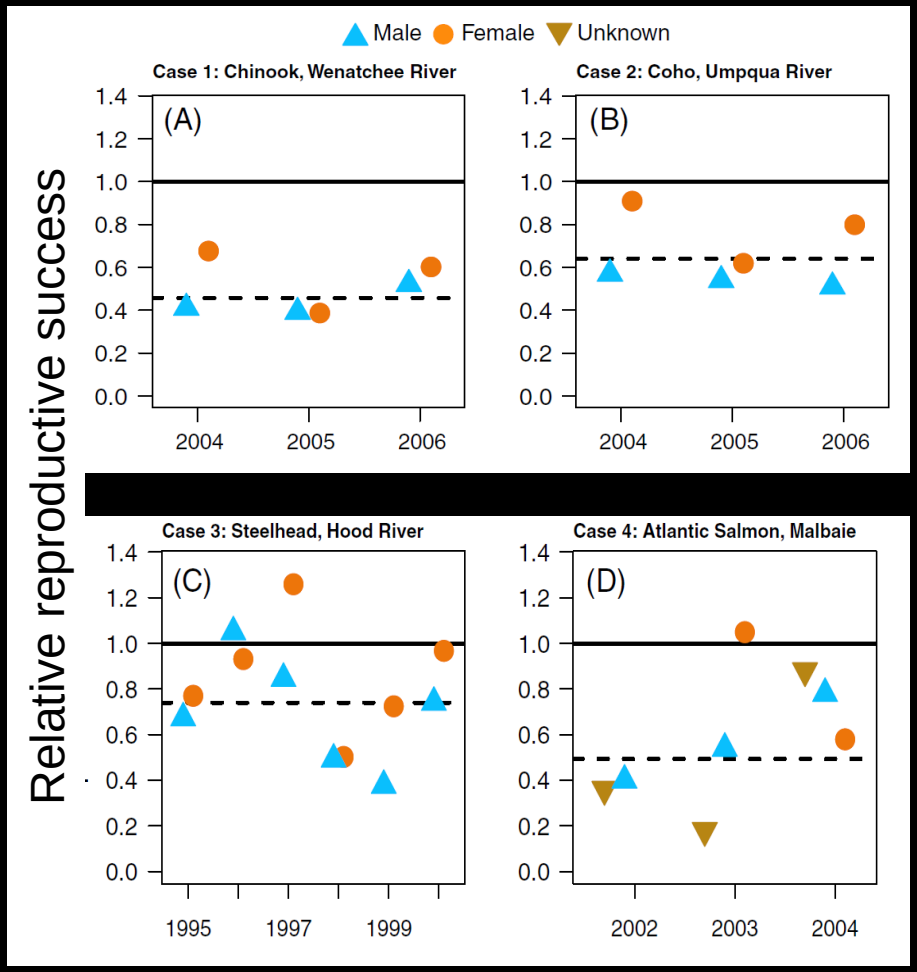
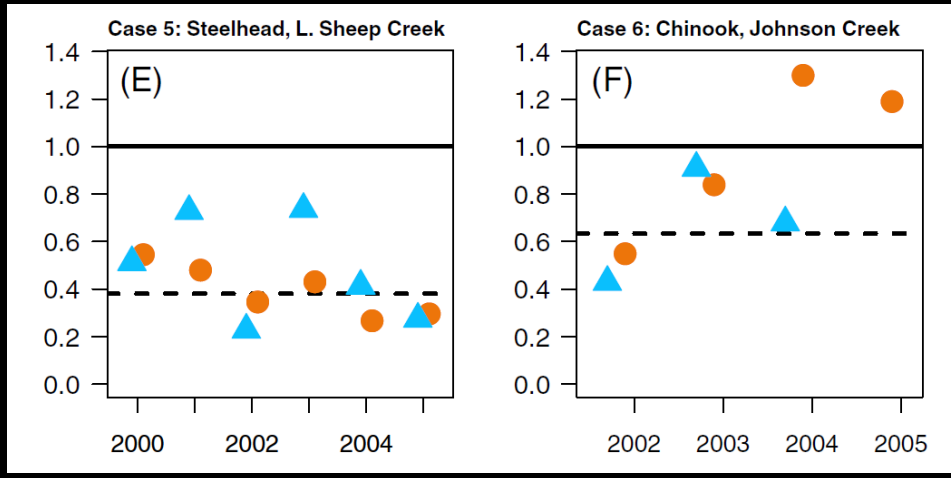
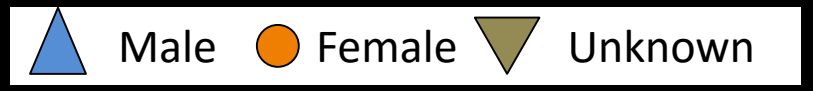
Patterns: Fitness Studies







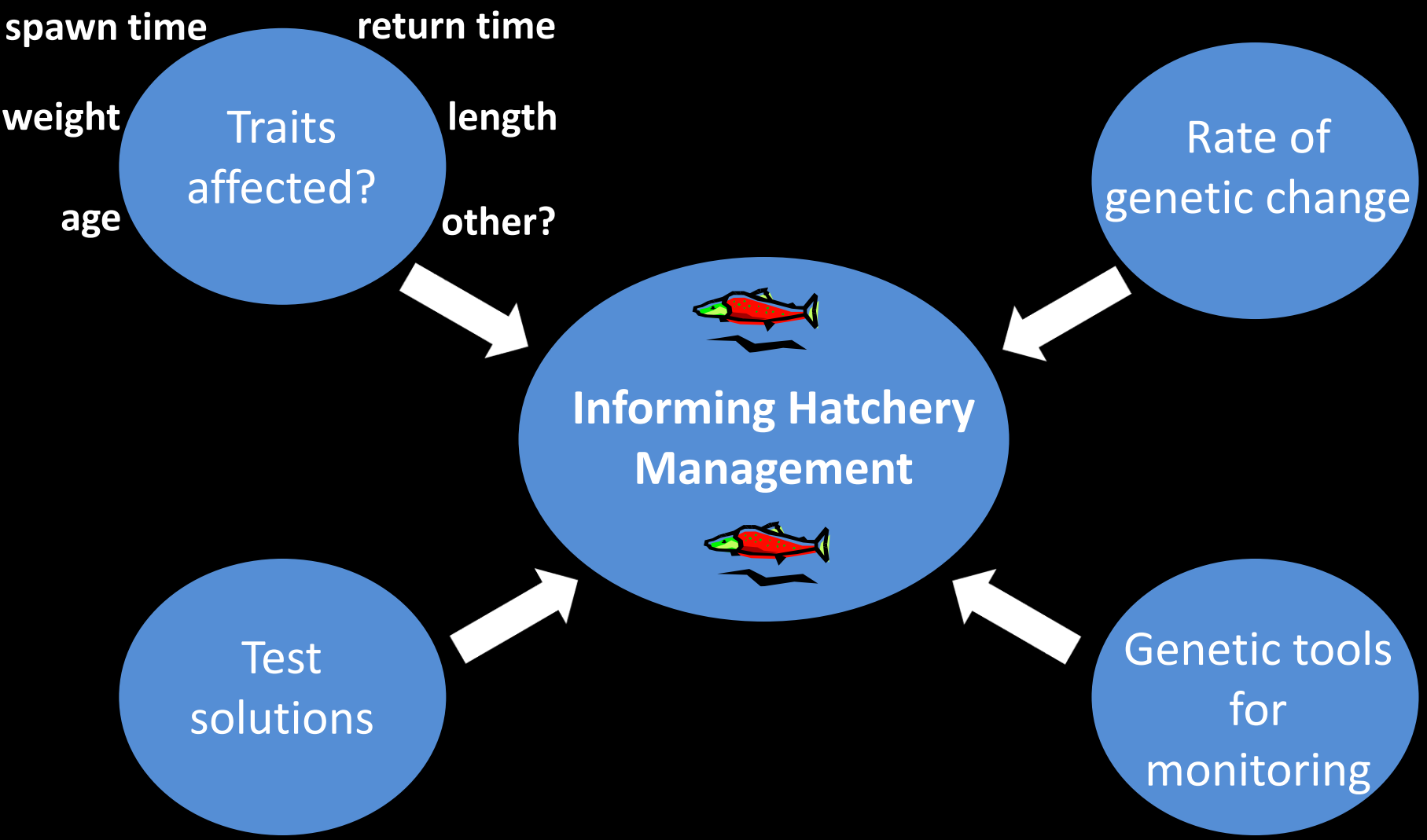
Christie et al. 2014

Fish born in hatcheries do not produce as many offspring in the wild as wild-born fish

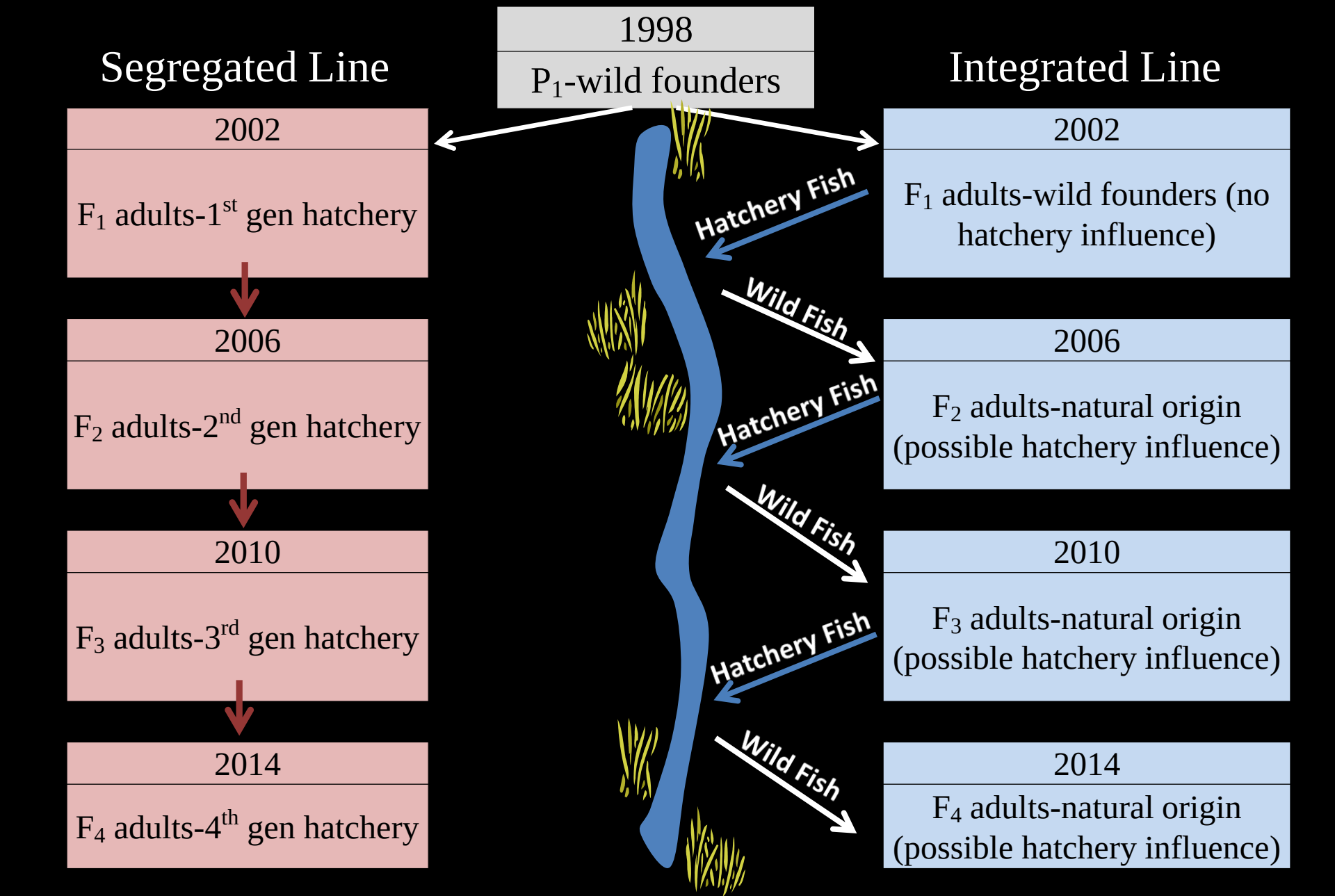
Unresolved Questions

- **Mechanisms underlying reduced fitness? Which fitness traits are most affected by the hatchery?**
- **Relative importance of domestication vs. genetic drift and inbreeding?**
- **Effects on genetic variation?**
- **Long-term impacts of hatchery fish on wild populations?**
- **Effectiveness of possible solutions?**

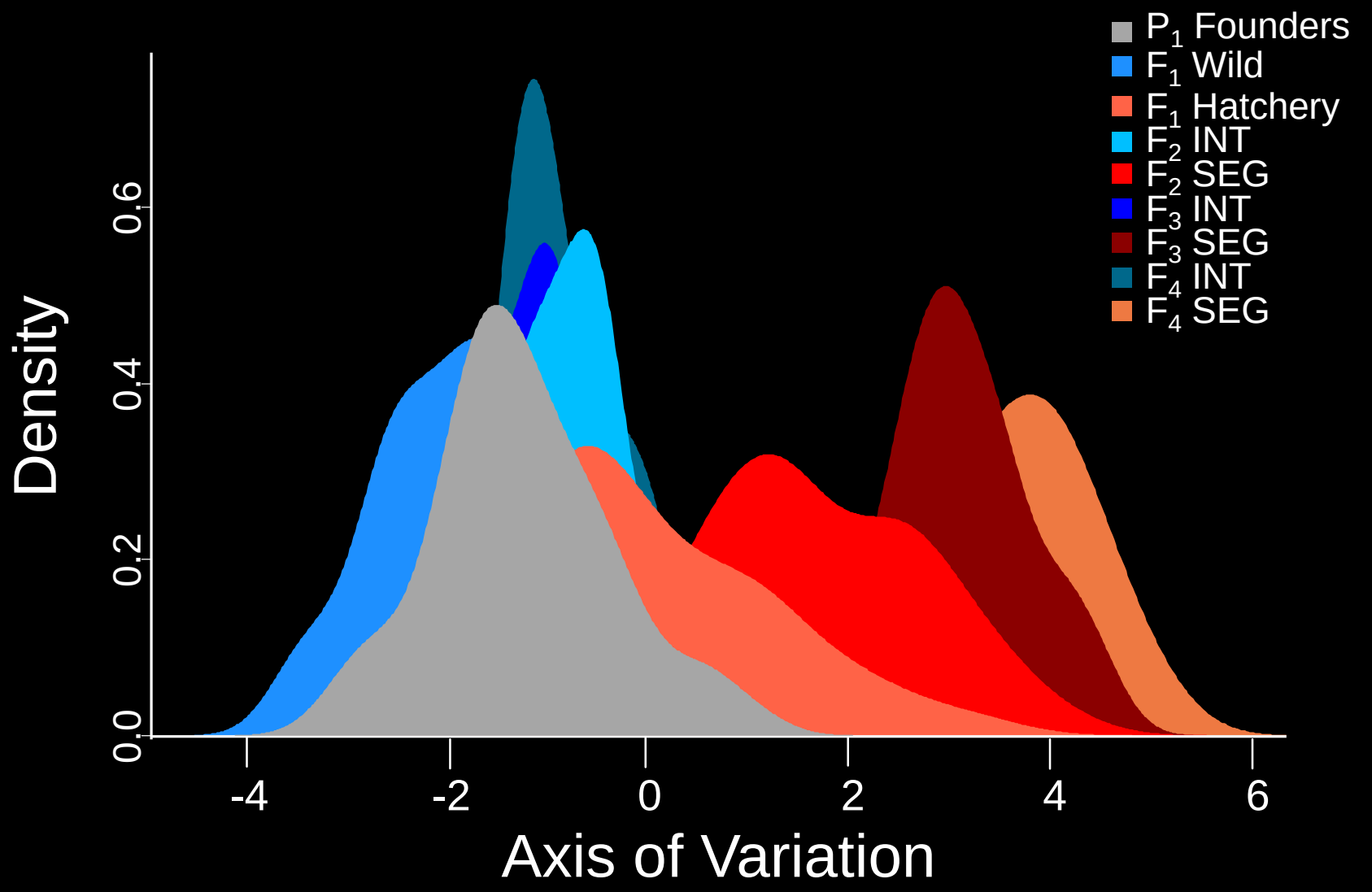
Applications of Genomics



Cle Elum Supplementation and Research Facility Spring Chinook salmon



Temporal Change in Genetic Variation



Waters et al. 2015

Aim: Determine traits that may reduce the fitness of captive-born individuals in the wild

Objectives:

1. Link key fitness traits to loci using two methods.
2. Compare trait-linked loci to regions of divergence to determine which traits respond to genetic adaptation to captivity.

Products:

1. Genetic tools for monitoring populations
2. Adjusted hatchery management practices(?)
3. Information for risk assessment

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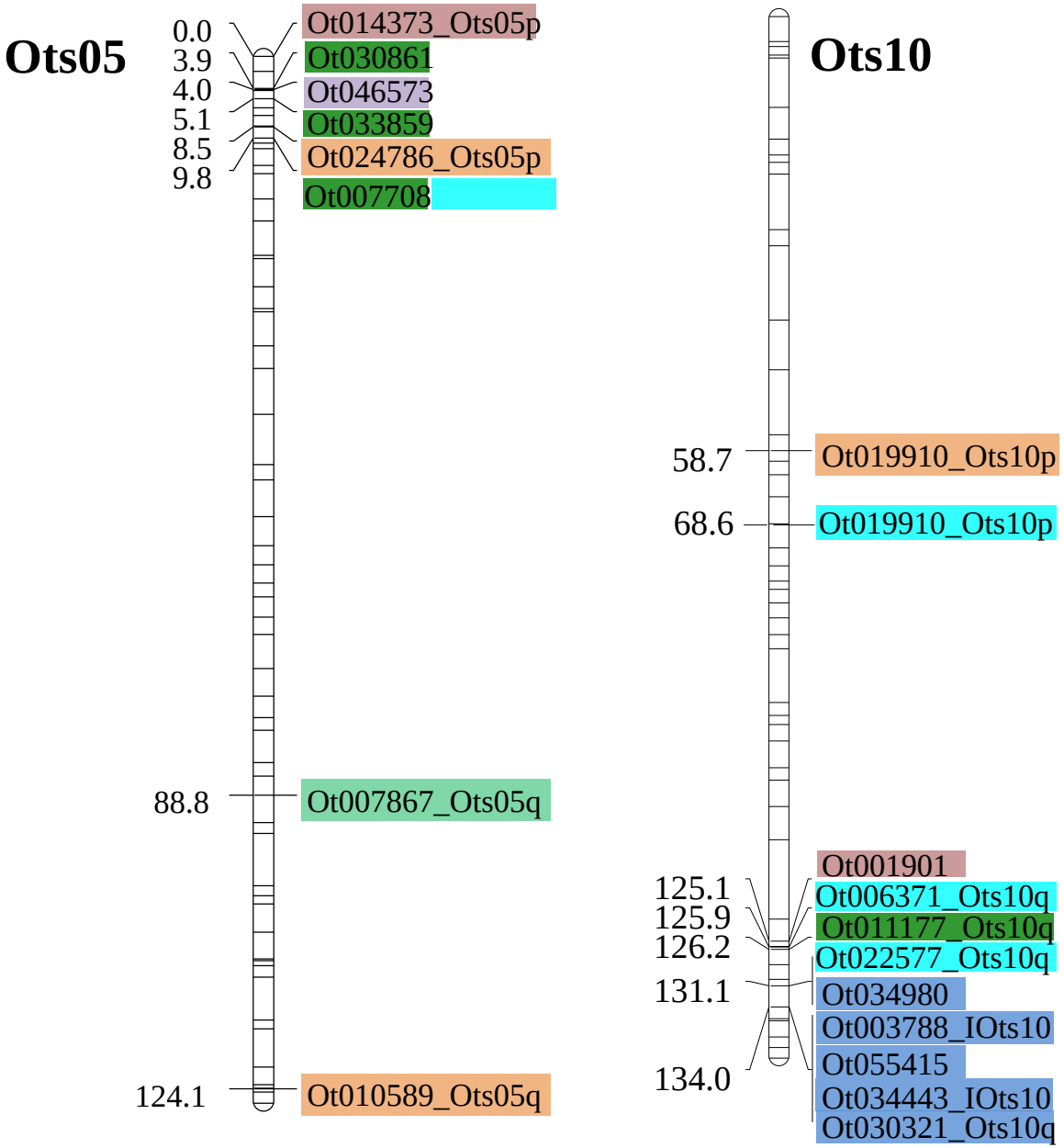
Multi-Trait Mapping Reveals Candidate Regions



- Return time
- Fork length
- Weight
- Age at maturity
- Run time, Brieuc *et al.* 2015
- Single test, outlier locus
- Multi-test, outlier locus

Chinook salmon

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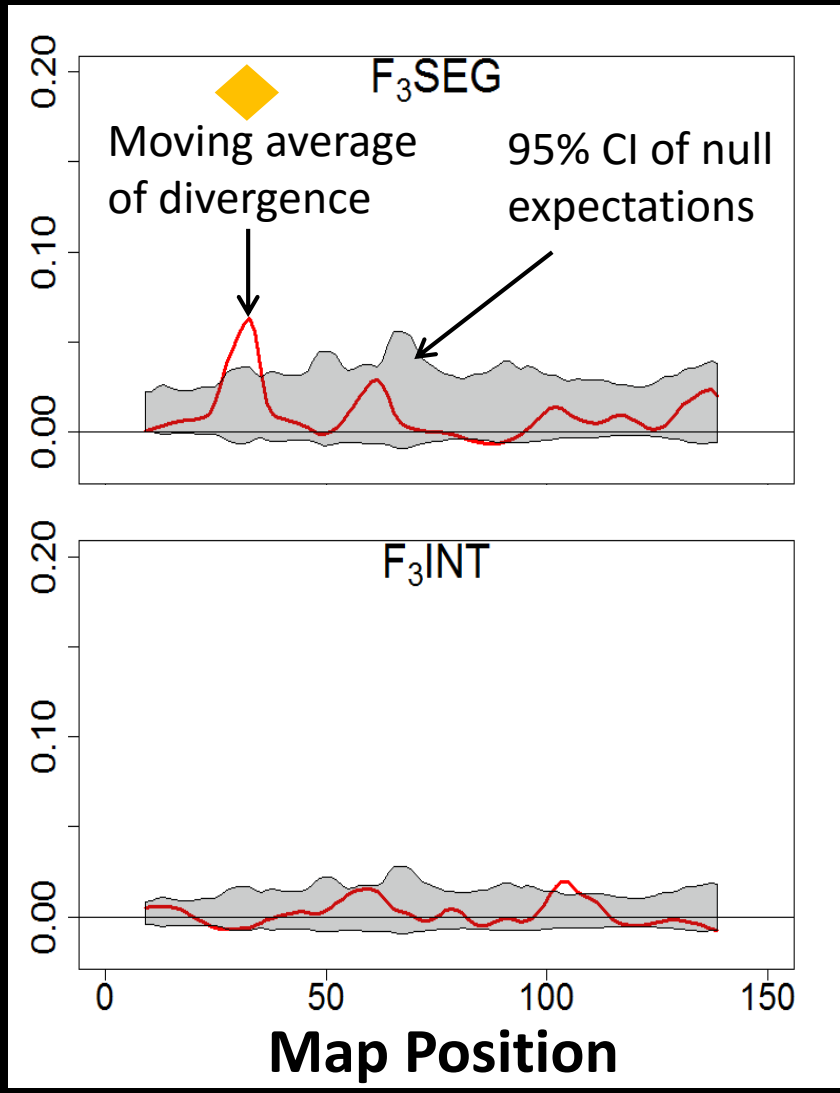
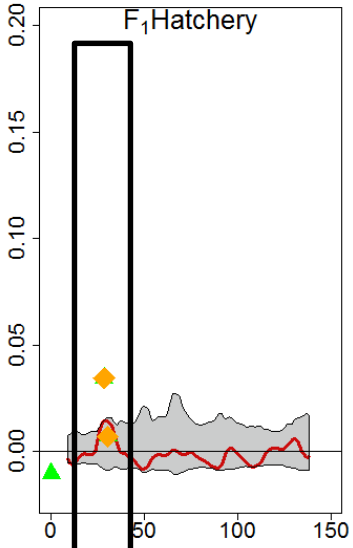
Possible Signs of Domestication

Loci and regions of the genome consistently divergent in the SEG line when compared to the P_1 founders



Temporal changes in “outlier” loci

F_{ST}



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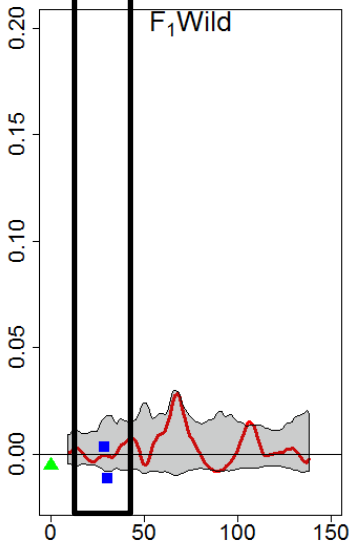
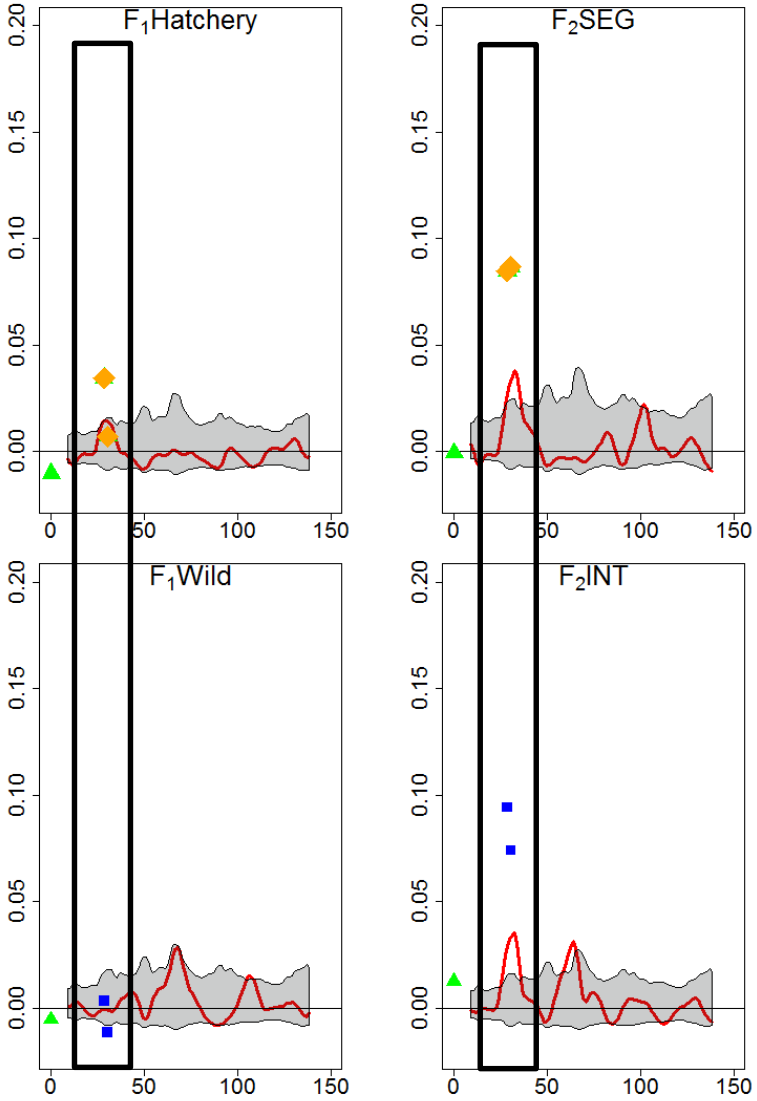


Bayes Temporal Bayes and temporal Sliding window

Temporal changes in “outlier” loci



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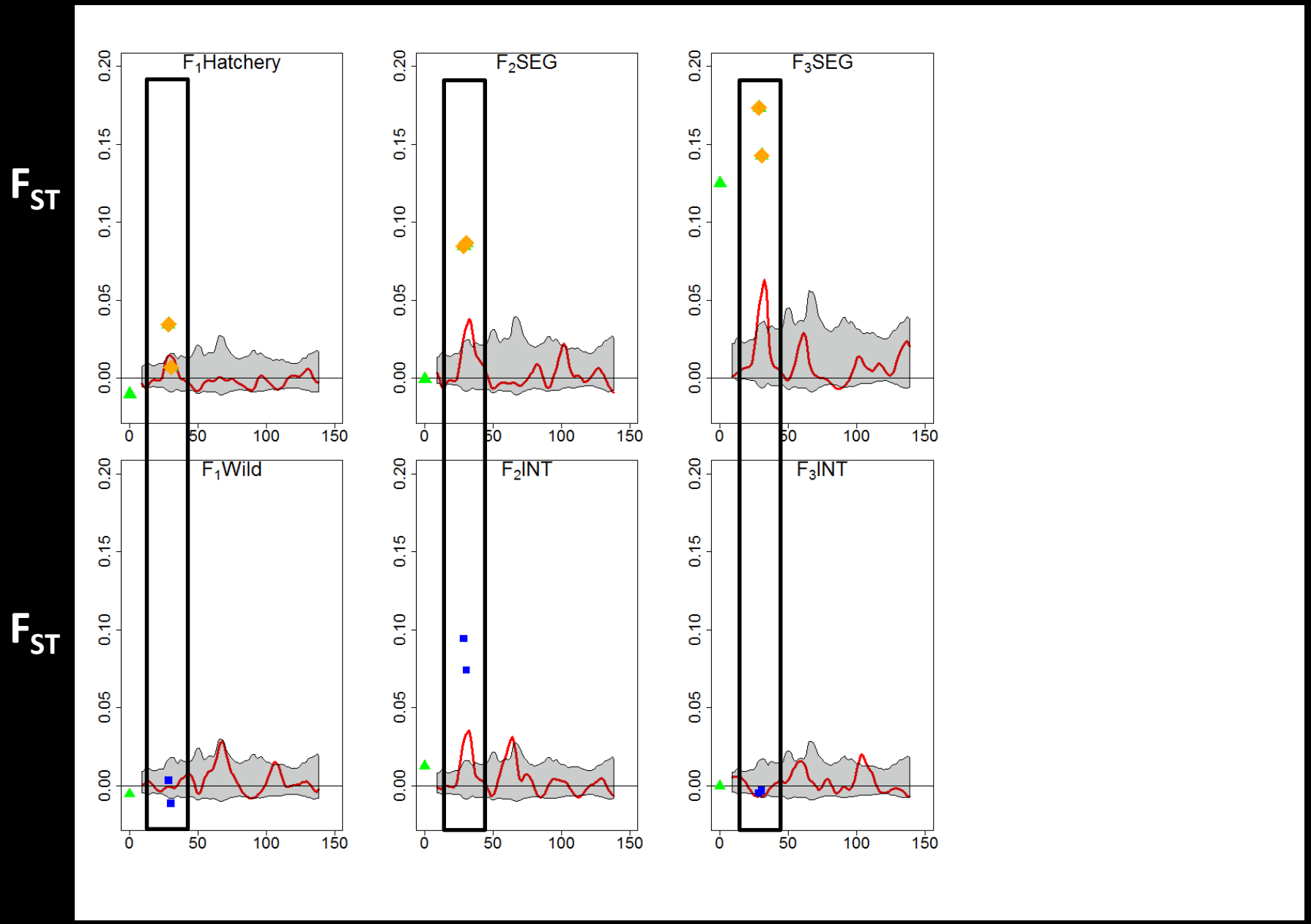

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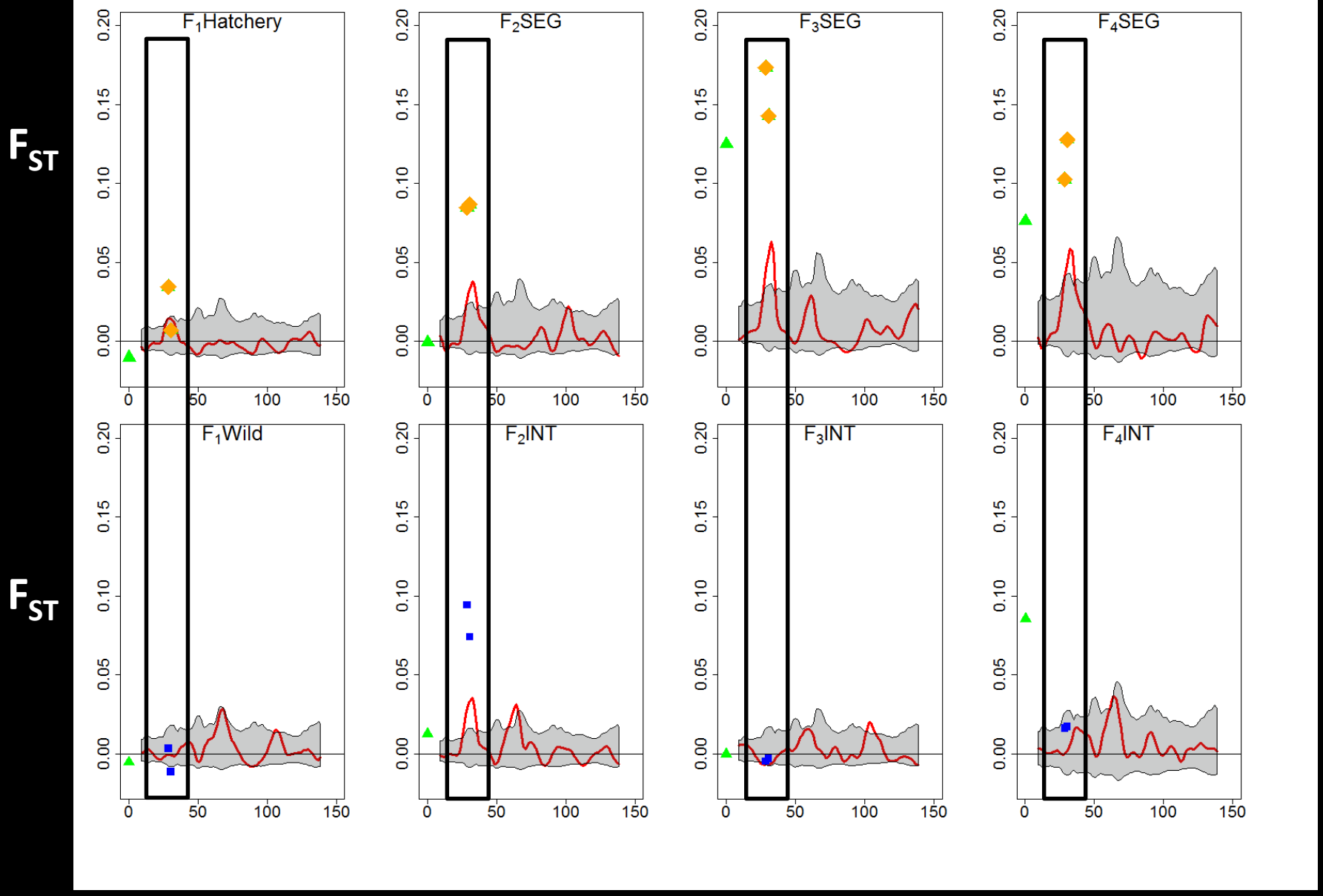
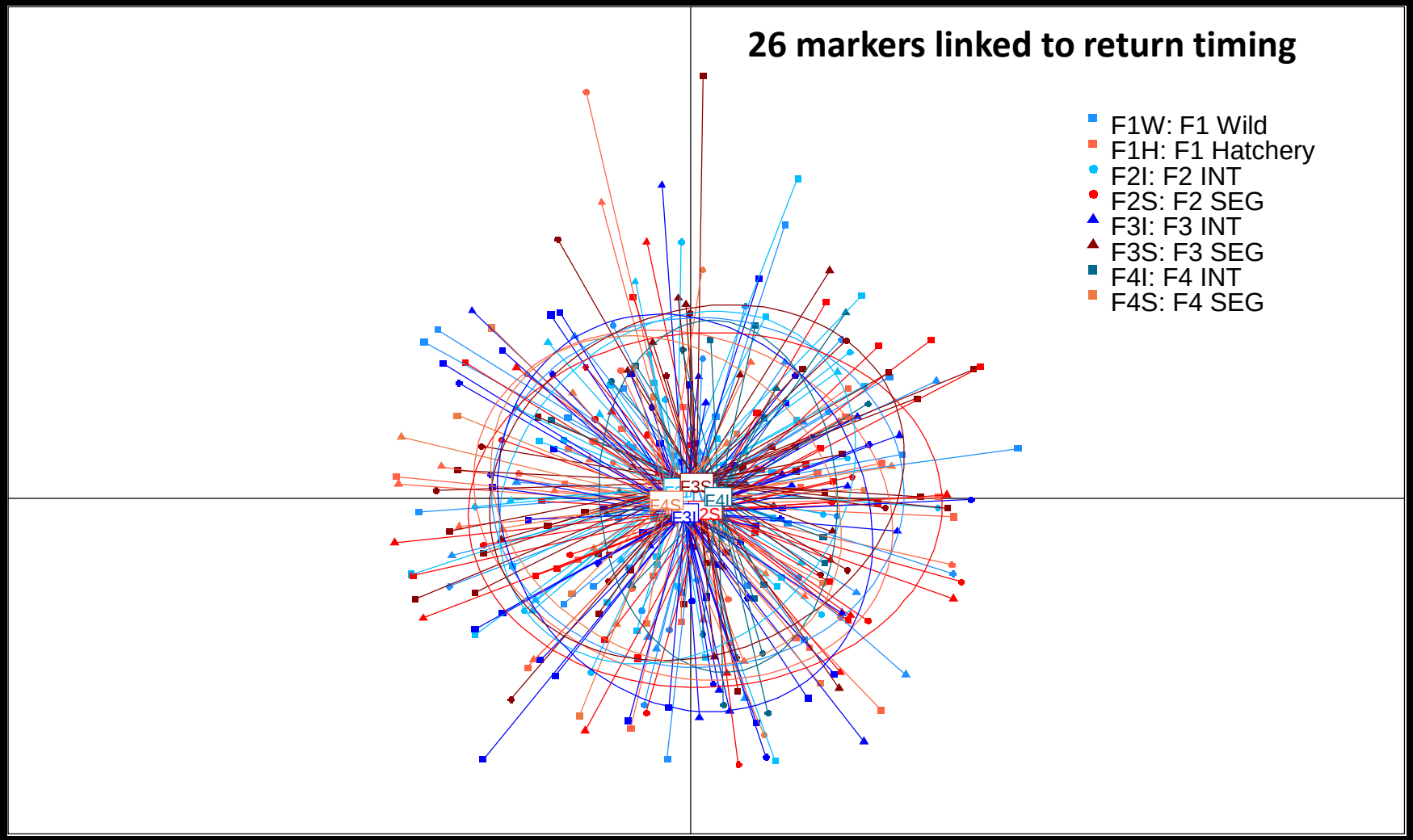


Linking Traits and Selection

- Do trait-linked loci separate INT and SEG lines?
- Look for overlap between loci associated with traits and outlier loci
- Null results ≠ no domestication

Has Domestication Selection Affected Return Time?



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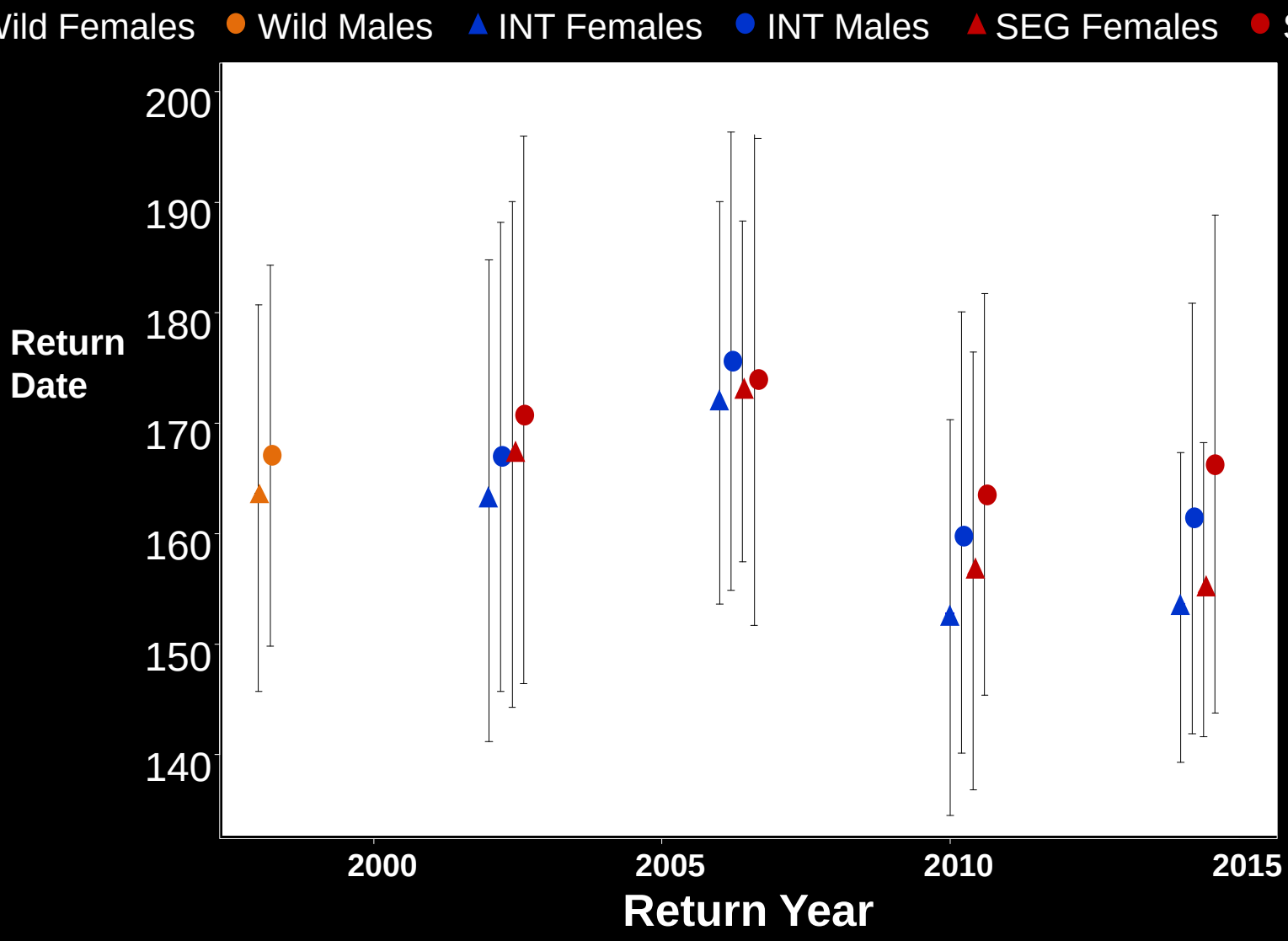
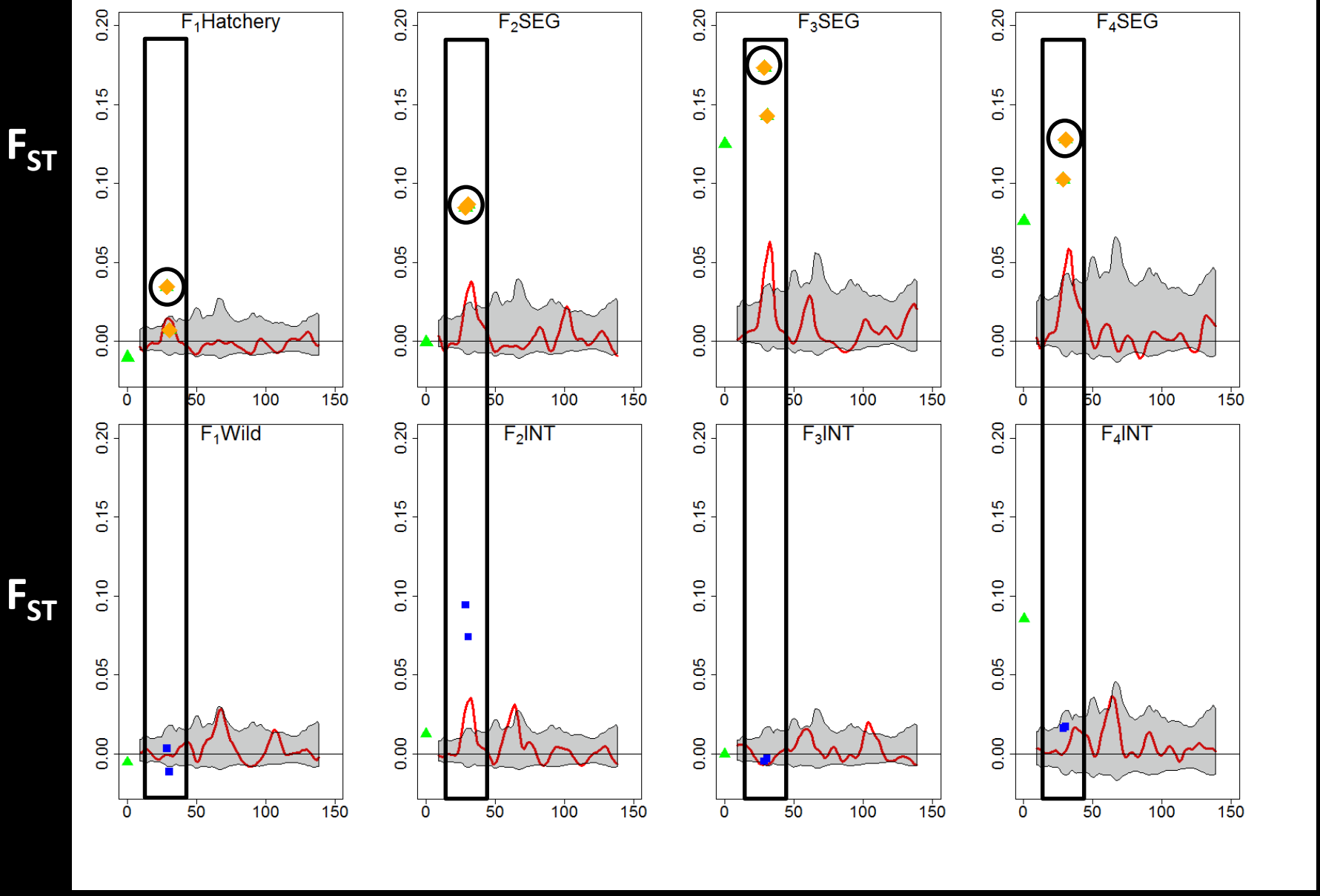


Mixed effects model: Hatchery line is not significant

Temporal changes in “outlier” loci



Moving forward: Bridging the gap between science and policy

- Share data early and often, even if components of research are not mature
- Iterative process with managers and policy makers
- Translation of science to policy assisted by solutions-driven research

Acknowledgments

Experimental lines:
Levi George, Melvin Sampson, Steve Schroder, Craig Busack, past and present members of the Independent Scientific Review Panel, and the Yakama Tribal Nation

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Questions?

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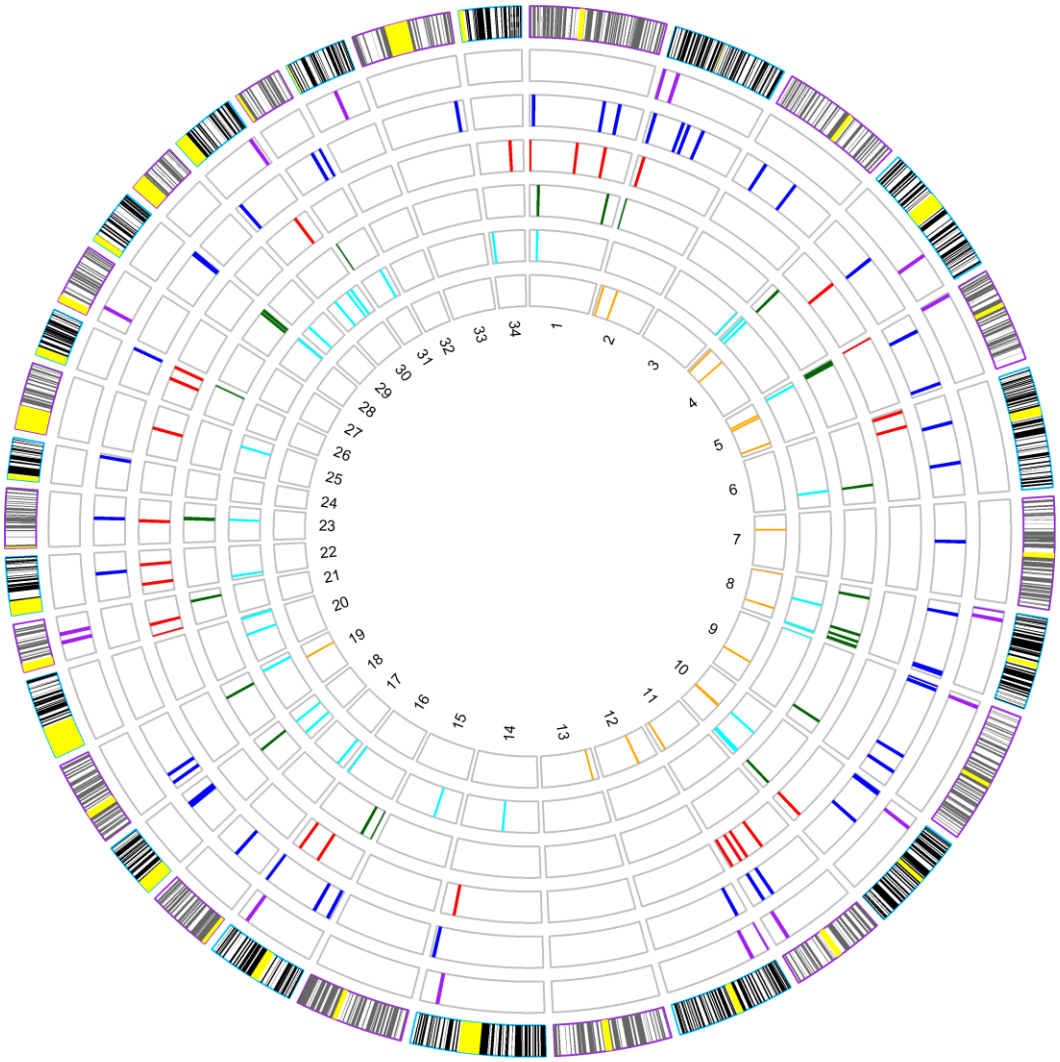
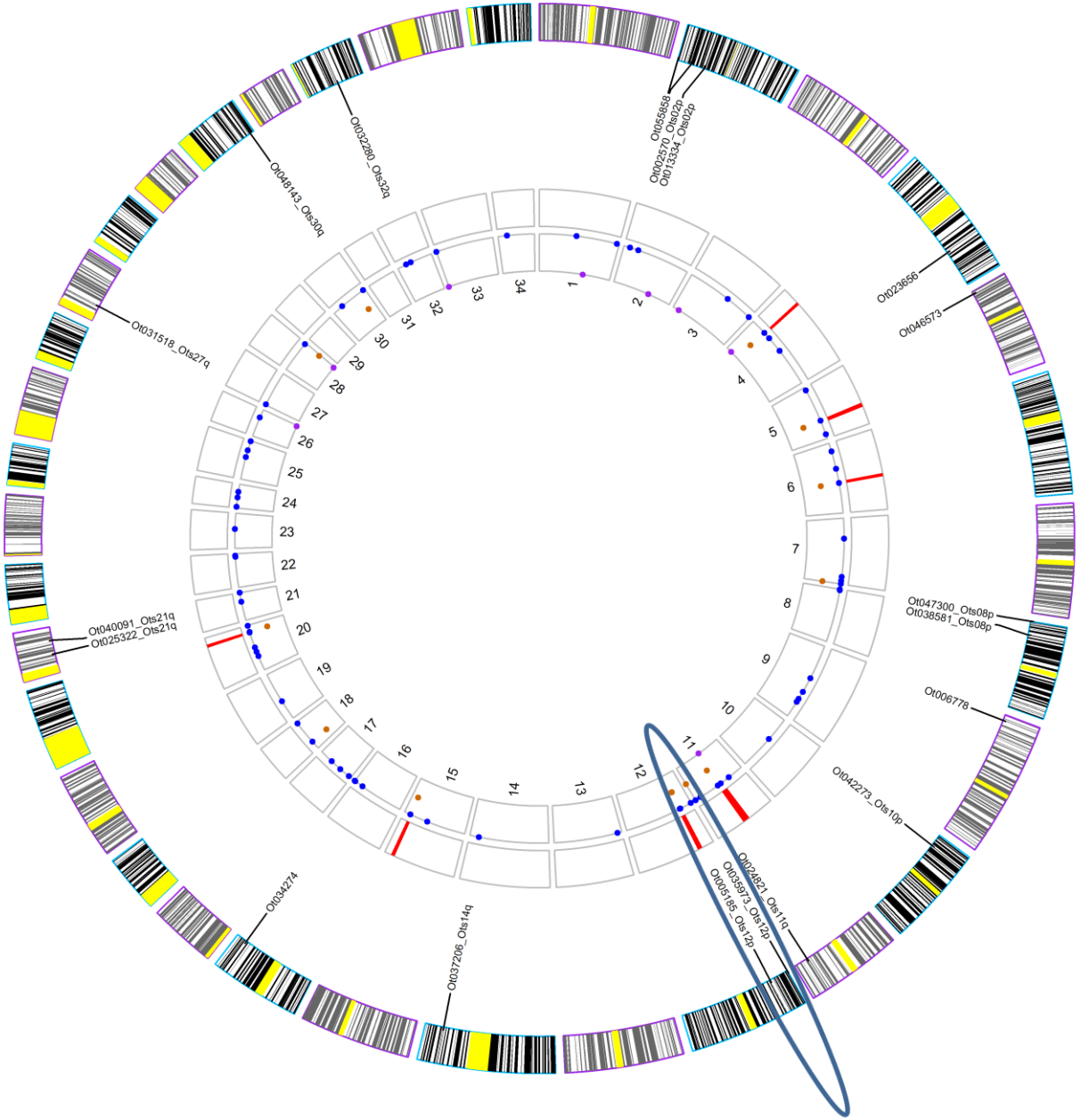
The Genetic Basis of Fitness-Related Traits in Chinook Salmon



- **Return time**
- **Maturation time**
- **Age at maturity**
- **Weight**
- **Forklength**
- **Daily growth rate**

Exploring adaptive evolution in the hatchery environment: Return time



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