Totally RAD Impassable Barriers: How Geologic Features Separate Summer and Winter-run Steelhead in the Eel River and Beyond

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Summer-run have experienced a more precipitous decline
Barriers in the Eel River are known as “roughs”
A number of questions existed regarding present and historical distribution of summer steelhead in the Eel

• Do summer and winter-run fish spawn and rear in different locations in the Eel?
• Are summer-run alleles present above Scott Dam?
• Are summer-run alleles being maintained as standing variation in the South Fork Eel River?
• Additional questions not covered in this talk
River backpacking (minking) combined with night sampling is the most efficient method for obtaining samples.

- Spatial Distribution
- Young of the year sampling
- Lab work and analysis
A number of questions existed regarding present and historical distribution of summer steelhead in the Eel

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We observe distinct spatial segregation around the major Lost Duzen and Middle Fork Eel barriers at the GREB1L region.
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- Do summer and winter-run fish spawn and rear in different locations in the Eel?
- Are summer-run alleles present above Scott Dam?
- Are summer-run alleles being maintained as standing variation in the South Fork Eel River?
The summer-run allele is present in the resident trout population above Scott Dam
A number of questions existed regarding present and historical distribution of summer steelhead in the Eel

- Do summer and winter-run fish spawn and rear in different locations in the Eel?
- Are summer-run alleles present above Scott Dam?
- Are summer-run alleles being maintained as standing variation in the South Fork Eel River?
We do not detect the presence of summer-run alleles in nearly 1600 individuals sampled.

<table>
<thead>
<tr>
<th>Year</th>
<th>Homozygous winter</th>
<th>Heterozygous</th>
<th>Homozygous summer</th>
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<tr>
<td>2017</td>
<td>422</td>
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<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>1593</td>
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Summer-run alleles are not being maintained as standing variation in the South Fork Eel winter-run population

“Thus, the premature migration (summer-run) allele does not appear to be masked in the heterozygous state and cannot be expected to be maintained as standing variation in populations that lack the premature migration phenotype”
-Prince et al., 2017

“As in the Hood River samples, heterozygotes in the BONAFF dataset exhibited Bonneville passage days that were often intermediate to either homozygote.”
-Willis et al., 2020
Conclusions from the Eel

• Summer and winter-run steelhead are reproductively isolated by distinct geographic barriers
• Summer-run steelhead inhabited the Upper Eel above Scott Dam prior to dam construction
• Loss of summer-run genotype = loss of summer-run phenotype
• Summer-run listed as Endangered under CESA
Additional questions about summer-run steelhead in the Eel River and beyond

• Is there genetic evidence of summer-run steelhead in the North Fork Eel and Mattole Rivers?

• What is the distribution of summer and winter-run alleles around barriers in Redwood Creek, the Mad, Smith, Trinity, Klamath and Rogue Rivers?

• Fall-run steelhead in the Eel, Klamath and Rogue Rivers.
Minking crosses state lines

- River backpacking and nighttime dip netting are effective outside of the Eel
- Barriers come in many forms
Summer-run steelhead inhabit river systems with cooler upper reaches and seasonal barriers.
Fall-run questions

• Refinement of the markers that explain run-timing in steelhead.
• Is the half-pounder life-history in the Eel, Klamath and Rogue associated with the fall-run marker?
• What is the distribution of fall and summer-run fish in the Klamath and Rogue?
• Are all the summer-run fish in the Rogue genetically fall-run?
Conclusions from beyond the Eel

- Roughs are not the only geologic features separating winter and summer-run and minking is still great
- Look for more results from our extensive sampling in the next year
Suggestions to consider to improve heart, home and the world

• To heal our rivers, we must heal ourselves
• Treat your smartphone like a landline
• Find comfort in inconvenience
• Use muscle-energy
• Reconsider purchases and investments
• Cultivate mystery
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