Gas Supersaturation May Reduce the Survival of Yearling Chinook Salmon in the Lower Columbia River and Ocean Plume

Ian Brosnan, NASA Ames Research Center
David Welch, Kintama Research Services
Melinda Jacobs Scott, formerly Kintama Research Services

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2011 TDG below Bonneville Dam

Total Dissolved Gas (%)

CCIW (SYSTDG)

WRNO Site

April 1
April 23
April 24
May 3
May 5
May 19
May 22
May 23
May 27
May 28
June 15
What effect on smolts?
What effect on smolts?
Gas Bubble Trauma (GBT)

130 % TDG: GBT, LT_{20} at 3-6hrs, predation

120 % TDG: GBT, LT_{20} at 40-120 hrs

110 % TDG: GBT, No mortality at 22 d

Repeated exposure increases susceptibility
Tagged smolts screened for scale loss, external marks, lesions, etc.
Bonneville Release Site
- 580 tagged smolts
- Held in flow-through tanks
- 20 GBT mortalities

Warrendale Release Site
- 200 tagged smolts
- Transported by barge in gas-stripped tanks
Estimating Effect Sizes

• Model survival for each group in each migratory segment, with a common detection parameter at each subarray
• Calculate daily survival as $S^{1/T}$
• Bootstrap resampling for estimating standard errors
• Subtract low exposure survival from high for effect size
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<th>Survival Rate (per day)</th>
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<td></td>
<td>High Gas (&gt;120%)</td>
<td>Low Gas (≤120%)</td>
<td>Effect Size</td>
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<td>Bonneville Releases</td>
<td>River</td>
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<td>Low Gas (≤120%)</td>
<td>Size</td>
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<tr>
<td><strong>Bonneville</strong></td>
<td>River</td>
<td>0.93 (.01)</td>
<td>0.99 (0.0)</td>
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<td></td>
<td>Plume</td>
<td>0.74 (.05)</td>
<td>0.89 (.02)</td>
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<tr>
<td><strong>Warrendale</strong></td>
<td>River</td>
<td>0.96 (.01)</td>
<td>0.95 (.01)</td>
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<tr>
<td></td>
<td>Plume</td>
<td>0.66 (.20)</td>
<td>0.84 (.12)</td>
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• Repeat exposure, flow through tank
• ~132% TDG, mortality w/ in hours

• Gas stripped barge
• ~125% TDG, Mortality in days
• Plume in 3 days

• Chronic effects expressed during habitat transition?
• Low survival relative to river
• Likely not the saltwater transition
But wait, there’s more...

- **Temperature?** 8-13 C
- **Turbidity?** *Increases with TDG*
- **Disease?** *No significant change*
Acknowledgements

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Questions?