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

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2011 TDG below Bonneville Dam

Total Dissolved Gas (%)

CCIW (SYSTDG)

WRNO Site
What effect on smolts?

![Diagram showing Total Dissolved Gas (%)](image)
What effect on smolts?

Total Dissolved Gas (%)

Low Gas

High Gas

Effect?

April 1
April 23
April 24
May 3
May 5
May 19
May 22
May 23
May 27
May 28
June 15

WRNO Site

CCIW (SYSTDG)
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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<tbody>
<tr>
<td></td>
<td>High Gas (&gt;120%)</td>
<td>Low Gas (≤120%)</td>
<td>Effect Size</td>
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<tr>
<td>Bonneville</td>
<td>River</td>
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<td>Releases</td>
<td>Plume</td>
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<tr>
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<td>River</td>
<td>0.93 (.01)</td>
<td>-0.06 (.01)</td>
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<td>Plume</td>
<td>0.74 (.05)</td>
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<tr>
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<td>River</td>
<td>0.96 (.01)</td>
<td>0.01 (.02)</td>
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<td></td>
<td>Plume</td>
<td>0.66 (.20)</td>
<td>-0.18 (.24)</td>
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</tbody>
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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?