Is overabundant macrophyte growth responsible for low dissolved oxygen in the lower Yakima River?

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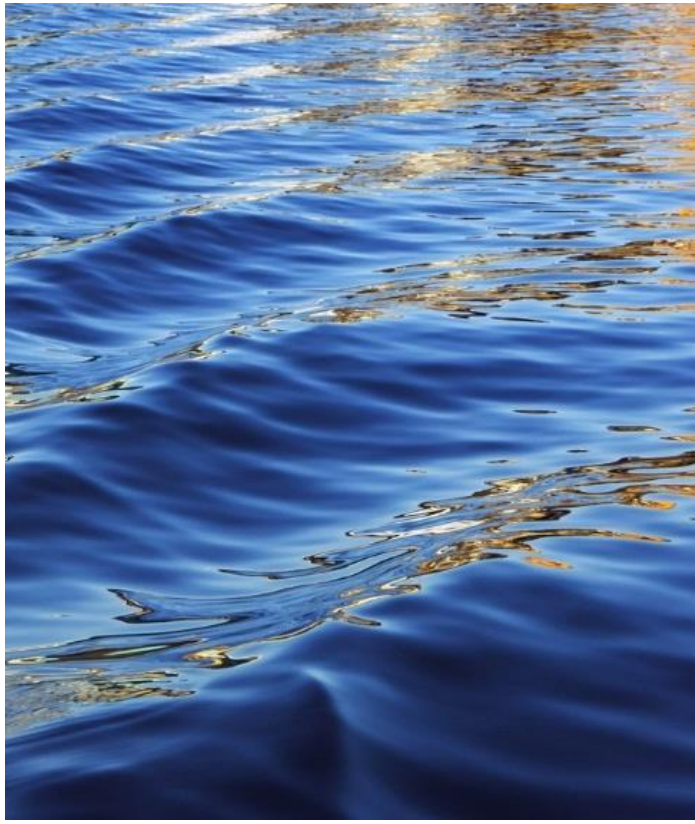
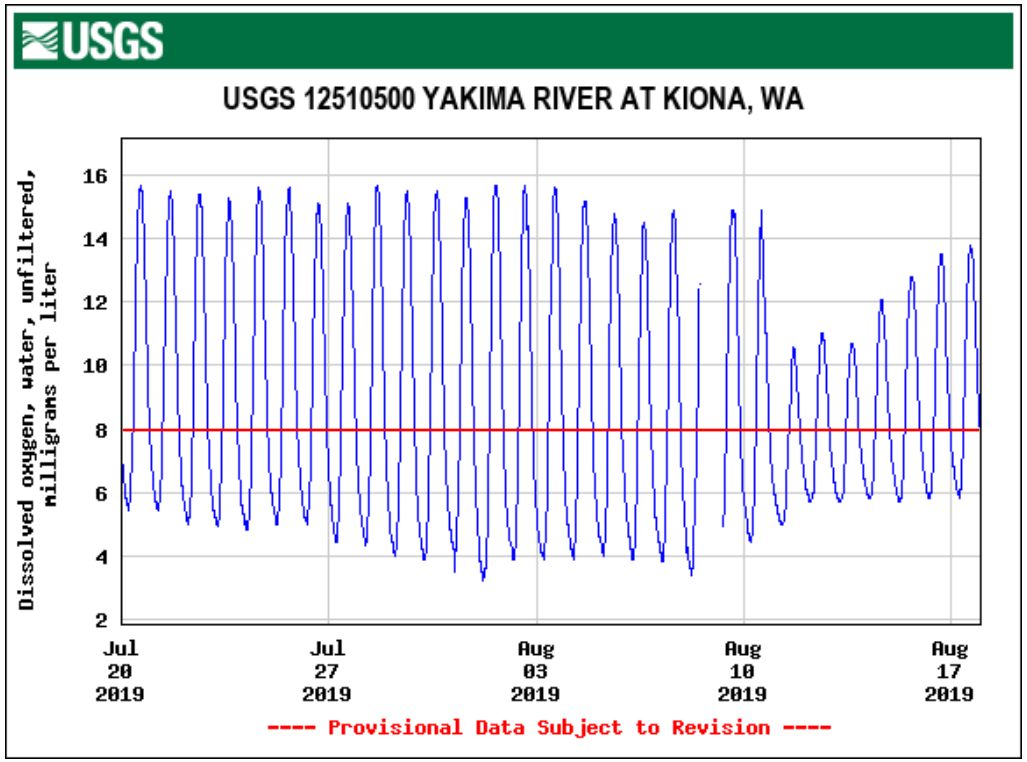


Background



- Lower Yakima River: Kiona reach
  - Water stargrass dominates majority of reach
- USGS Yakima River eutrophication study (2004–2007)
  - Lower dissolved oxygen (DO) in Kiona than in upstream reaches
  - Below WA water quality standard for salmonids of 8.0 mg/L (red line)
  - Large diel swings: suggests metabolic effect
  - Concluded water stargrass probably largely responsible
- DO effect of water stargrass not directly measured

Macrophyte metabolism effect

- Daytime: photosynthesis dominates
  - ↑ DO
- Nightime: respiration only
  - ↓DO
- Net effect: nighttime DO deficits

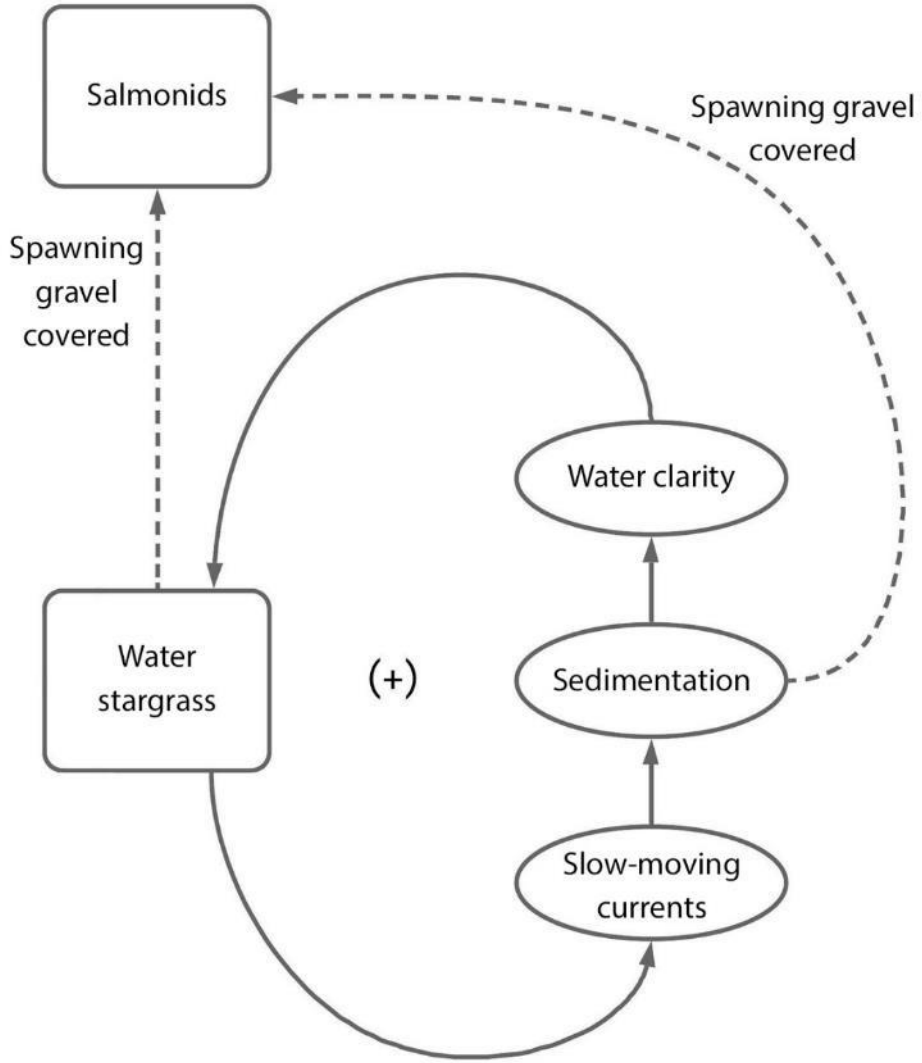
Macrophyte canopy effect

- Dense canopy alters O_2 movement
  - ↓ atmospheric diffusion
  - O_2 from floating leaves escapes to atmosphere
- Dense canopy shades lower leaves
  - ↑ daytime respiration

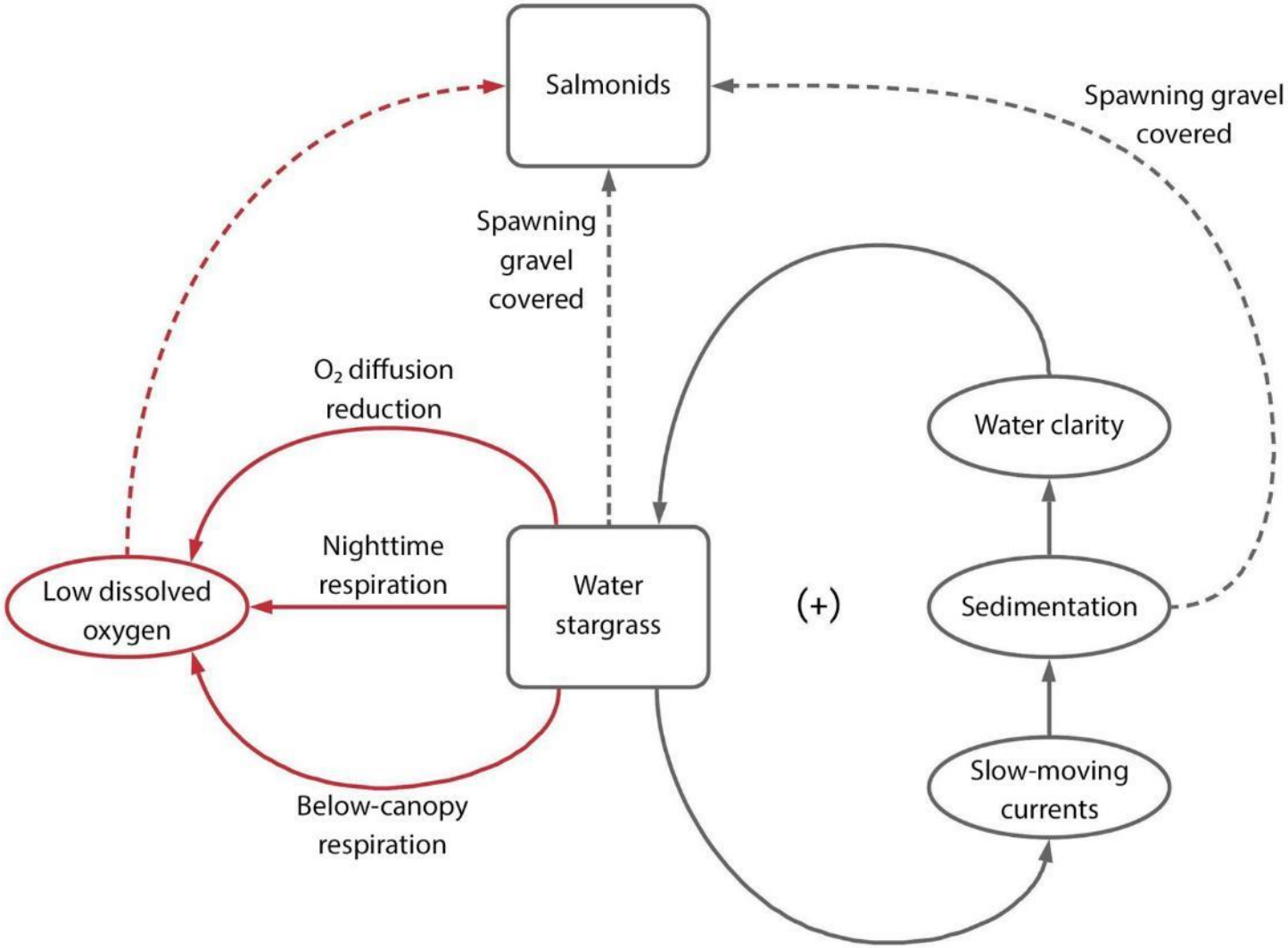
Implications:

- DO locally reduced under canopy (potentially)
- Potential DO refugia in open water

Water stargrass may degrade salmonid habitat



Water stargrass may degrade salmonid habitat



Research question and objectives

- Is water stargrass responsible for DO deficits in the Kiona reach?

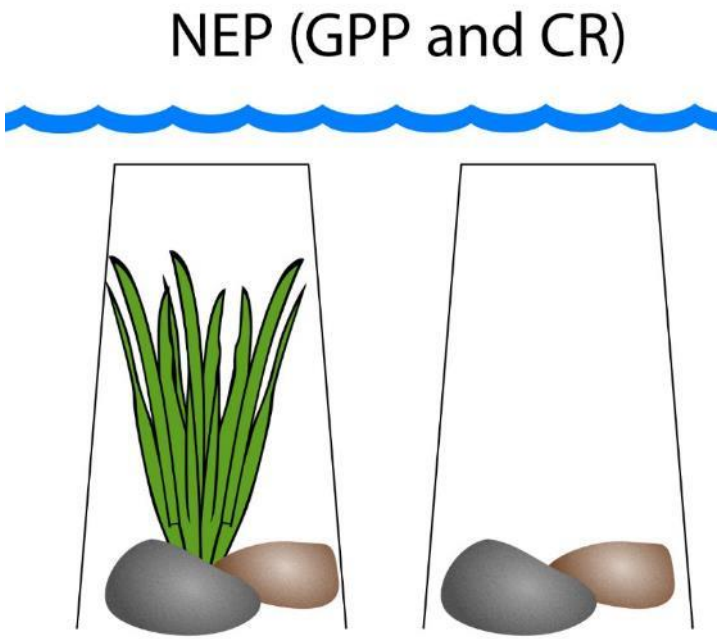
- **Objective 1:** Determine what proportion of the nighttime DO deficit is due to water stargrass respiration
- **Objective 2:** Determine if the canopy is affecting localized DO

Research locations

Site criteria

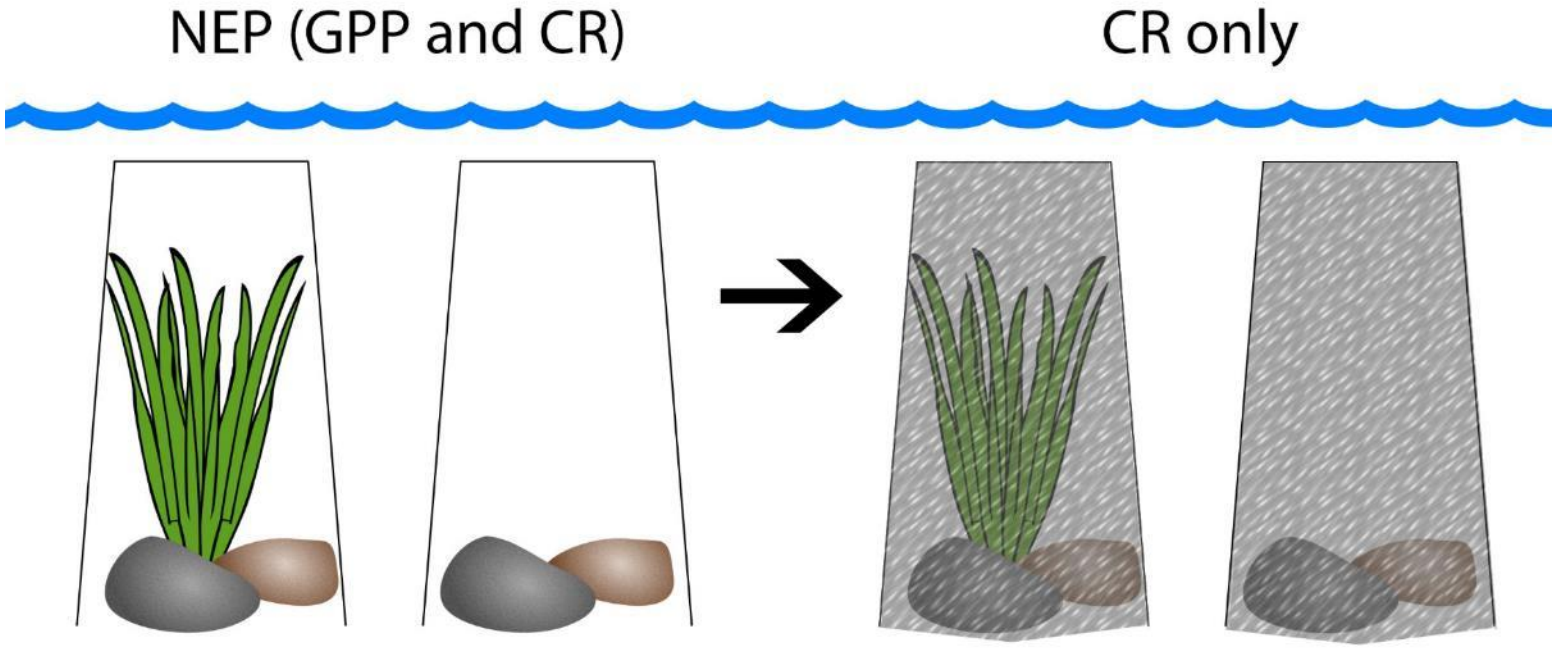
- Kiona reach
- Areas with and without WSG
- Roughly evenly spaced
- Accessible

Methods: Metabolism effect



NEP = Net ecosystem production

Methods: Metabolism effect



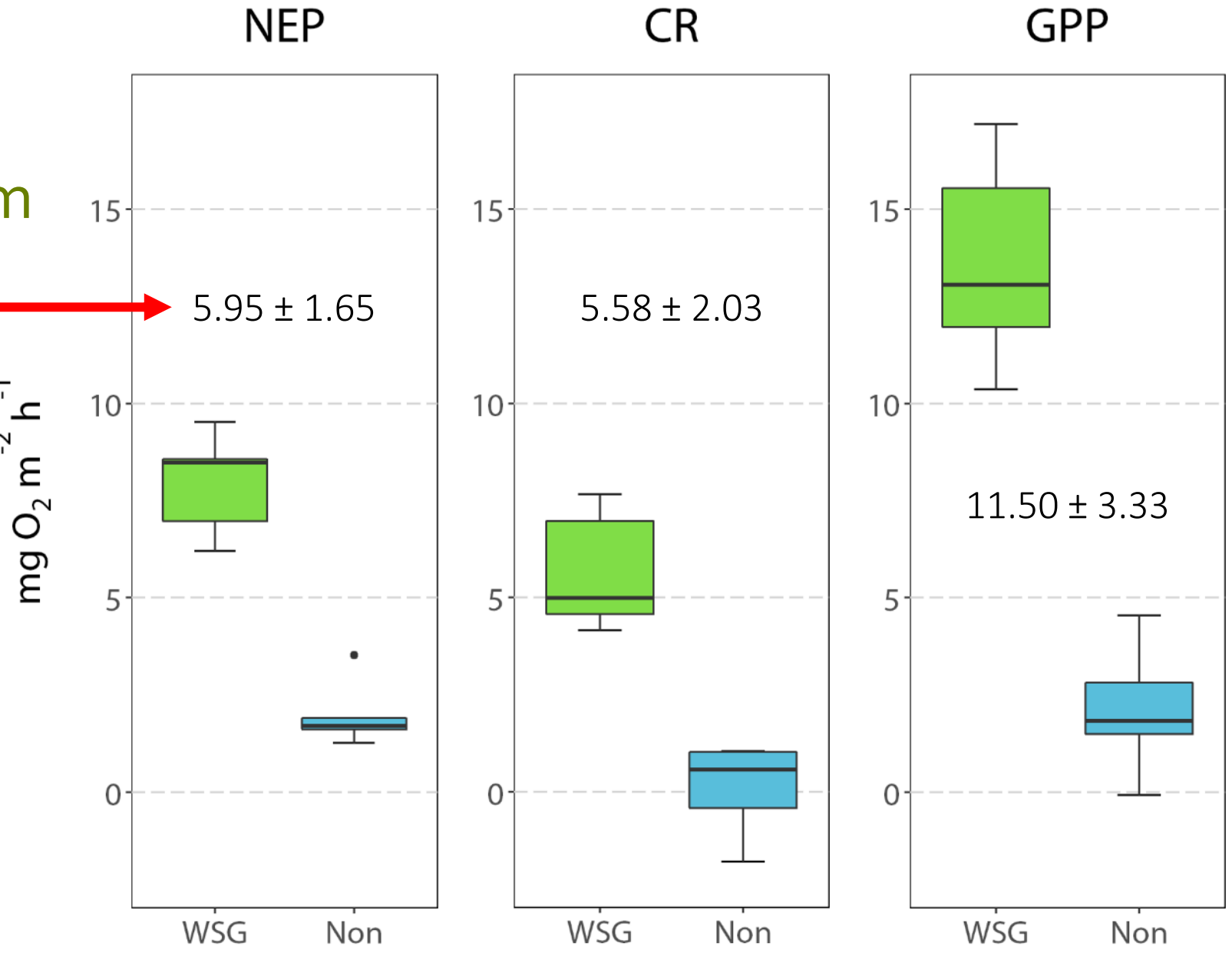
NEP = Net ecosystem production

CR = Community respiration

GPP = Gross primary production

WSG significantly increases chamber metabolism

WSG effect ± 95% CI



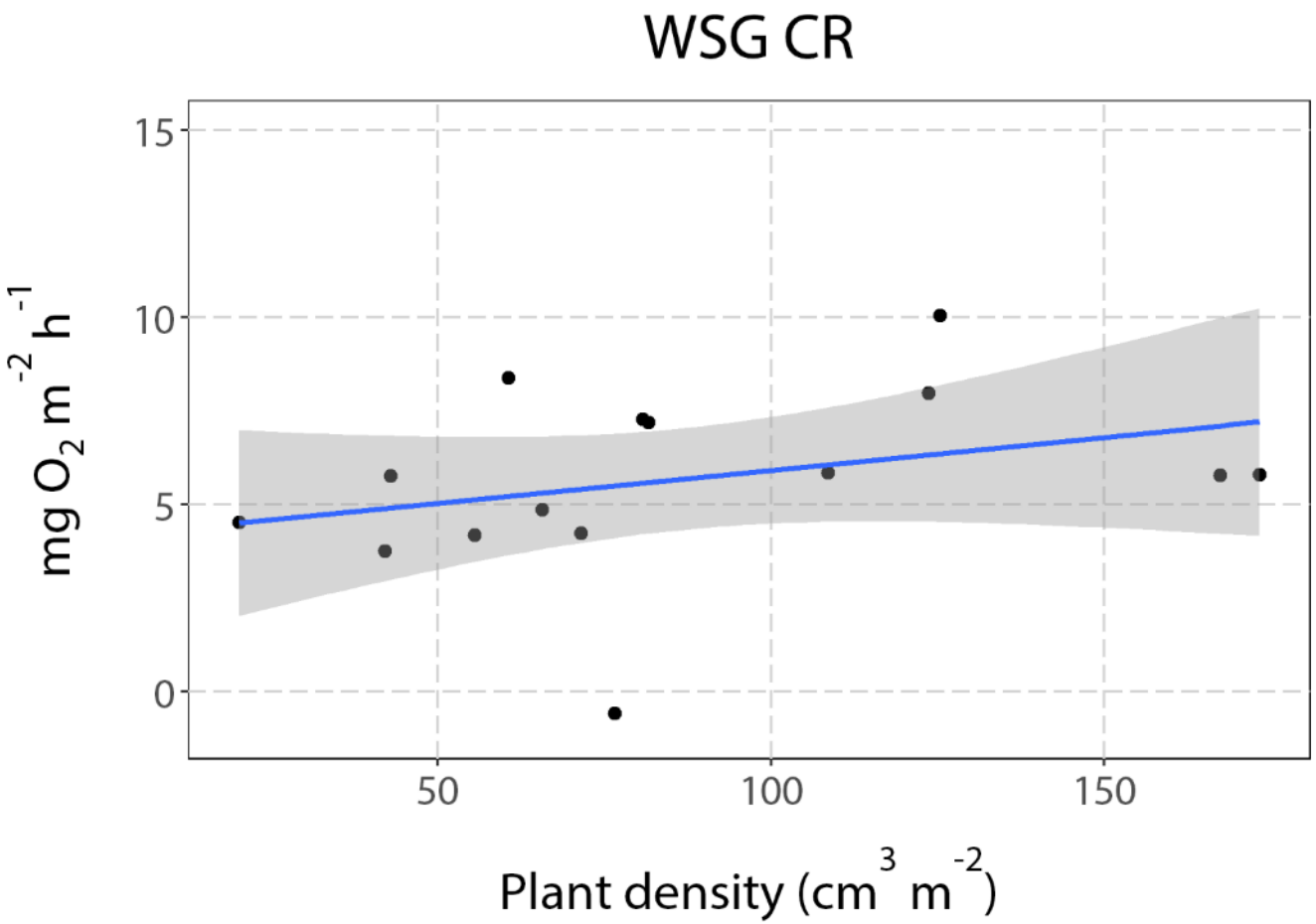
WSG effect:
Two scenarios

- If WSG covers 75% of the reach
  - Reach CR = 111.63 mg O_2 m^{-2} d^{-1}
  - WSG contribution = 91.5%

- If WSG reduced to 35%
  - Reach CR = 72.44 mg O_2 m^{-2} d^{-1}
  - WSG contribution = 65.8%

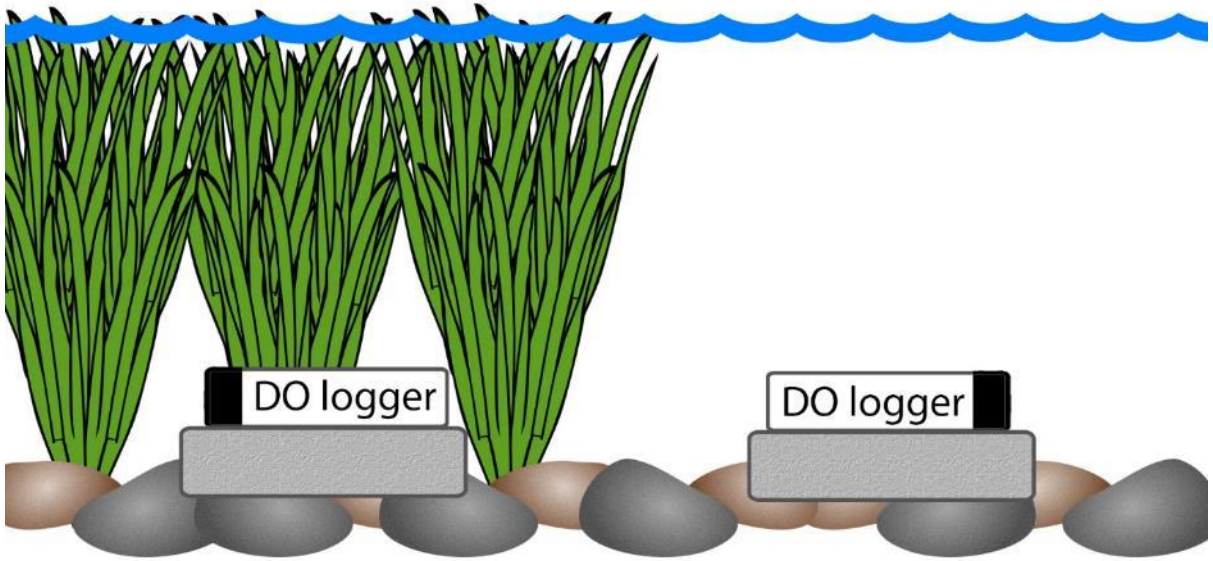
- Future: calculate effect on DO concentration using whole-stream metabolism

What controls CR?

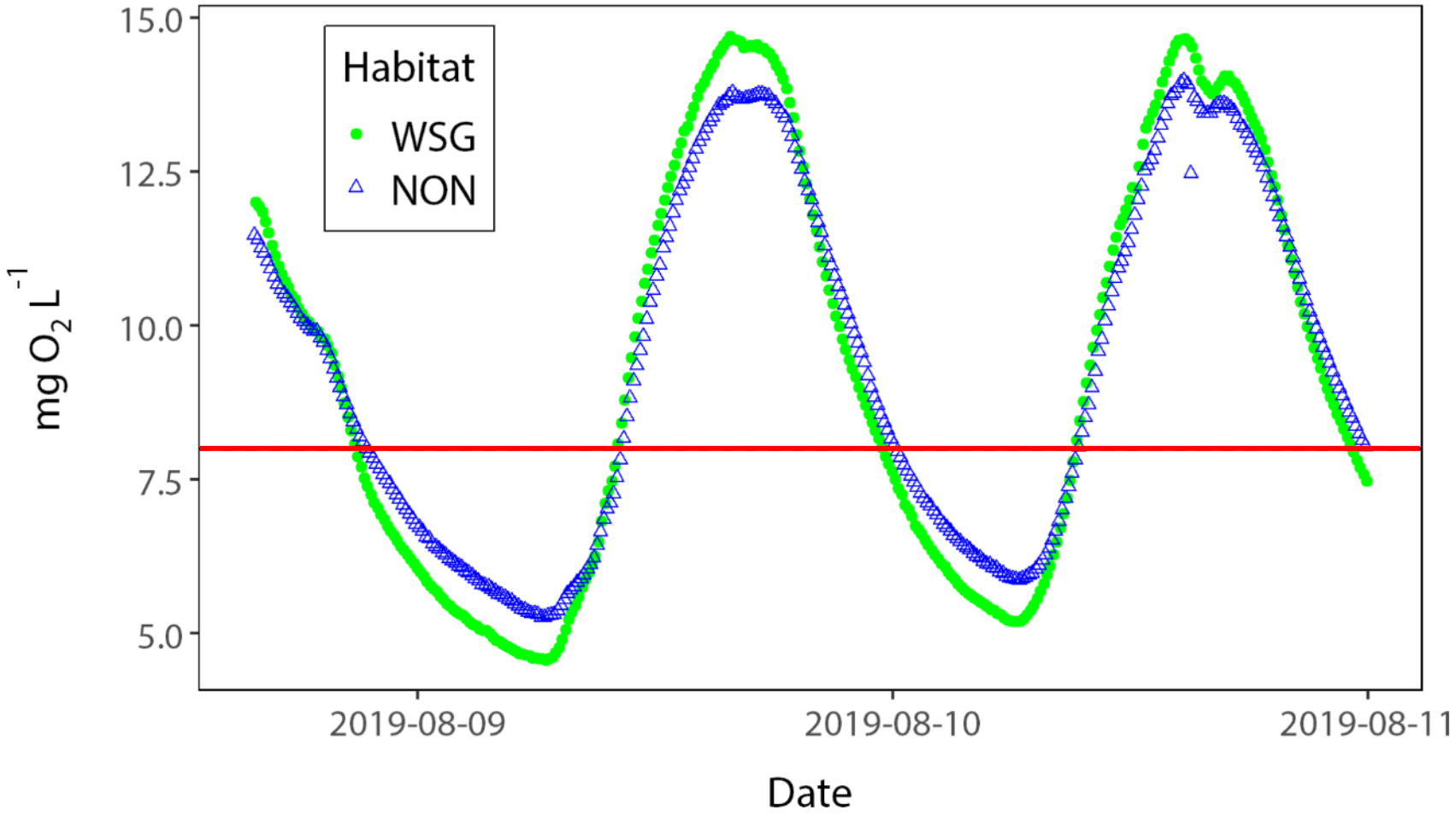


- Plant density (+ 10.2%)

Is DO beneath canopies different than in open water?



Small differences in DO between habitats



- Large diel swings
- Well below WA State water quality standard for salmonids (red line)
- Only small patches measured (≤ 23 m long)

Implications

- WSG increases CR
  - Decreases nighttime DO
- DO is the same in WSG & non-WSG
  - The river is well mixed
  - No refugia from low DO
  - Research needed: Large non-WSG patches
- If WSG abundance ≈ 75%, could account for DO deficit
- Next step: use whole-stream metabolism to estimate the reach-scale effect of reducing WSG

Appel et al. 2011

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