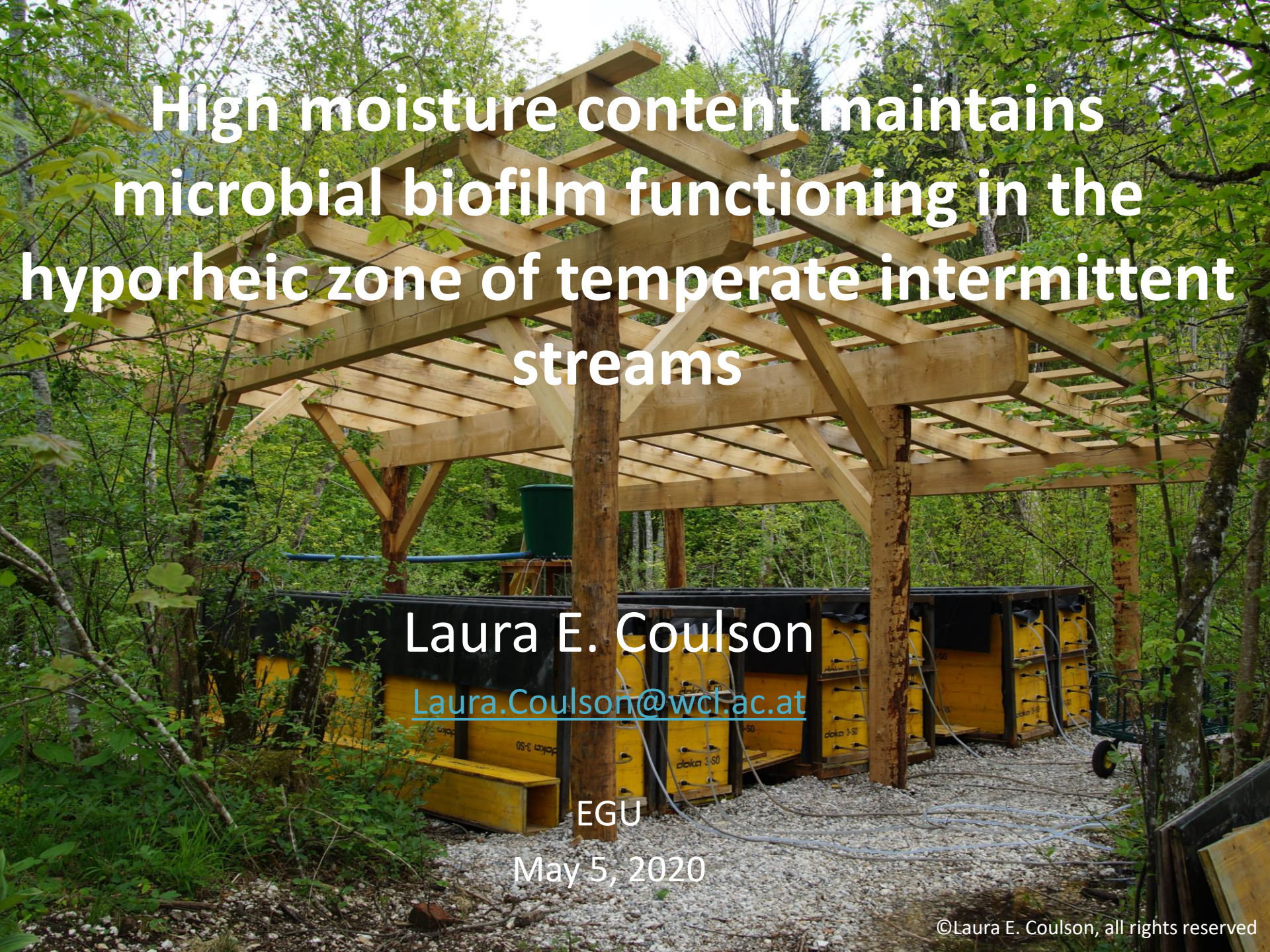
High moisture content maintains microbial biofilm functioning in the hyporheic zone of temperate intermittent streams



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Background

- Intermittent streams
  - Periodically dry
  - Increase in length and number
- Temperate streams
  - Many studies focus on Mediterranean streams
  - Different climate, different sediment
- Hyporheic zone
  - Retains moisture in dry streambed -> less impacted by drought?

Questions

1. How does intermittency affect hyporheic biofilm processes in temperate streams?
2. How does drought length impacts these processes after rewetting?

Hypotheses

1. Hyporheic biofilm processes will be sustained during short drought phases and reduced during longer drought phases
2. Longer drought phases will cause hyporheic biofilm processes to remain impacted even after rewetting, while recovery will be immediate in the flumes that experience short drought phase

Experimental Setup

The experimental setup consisted of 6 hyporheic flumes fed by water from the adjacent pristine, oligotrophic stream, the Oberer Seebach in Austria. Five of the flumes were allowed to fall dry from periods ranging from 4 to 105 days. Sediment was sampled before, during, and after drought.

Results

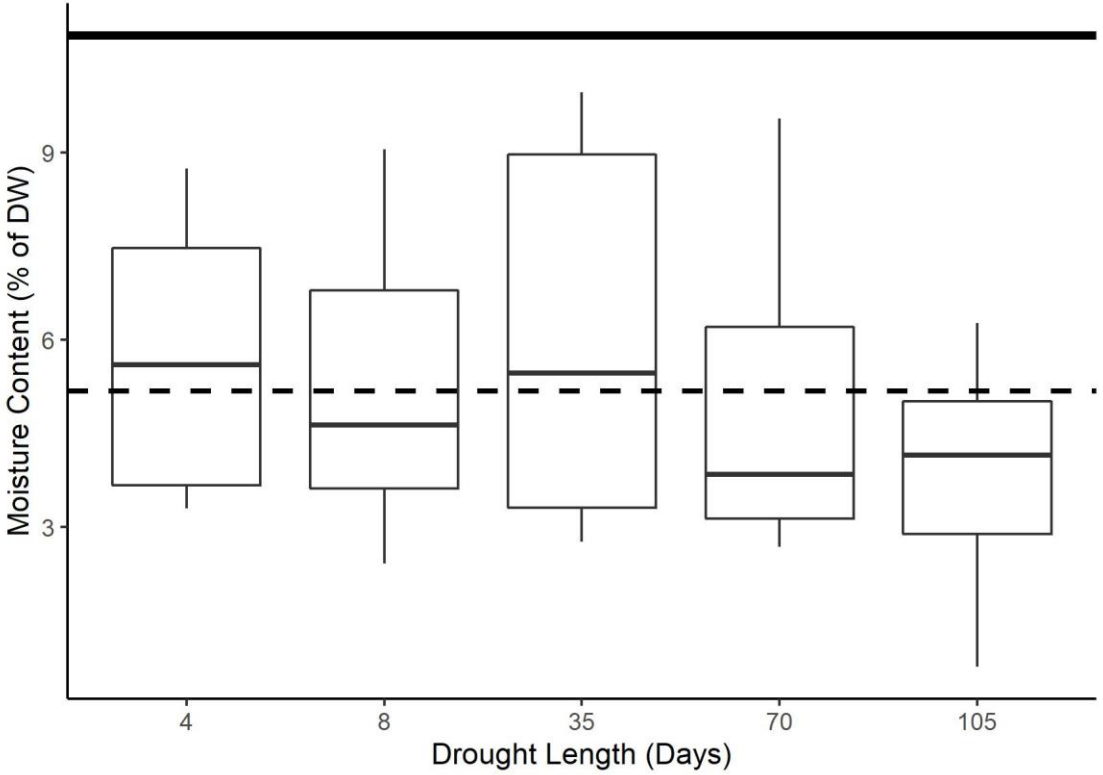

Figure: The moisture content of all drought flumes at the end of the drought phase. The solid line indicates the average moisture content during the wet phase. The dashed line indicates the average moisture content at the end of the drought period.

- Moisture content was an average of 5.17 % in all the drought flumes at the end of the drought phase.
- While, there was no significant difference in the moisture content between the flumes, the median moisture content in the longer dry flumes (70- and 105-days-dry) was lower than the mean across the flumes.

Results

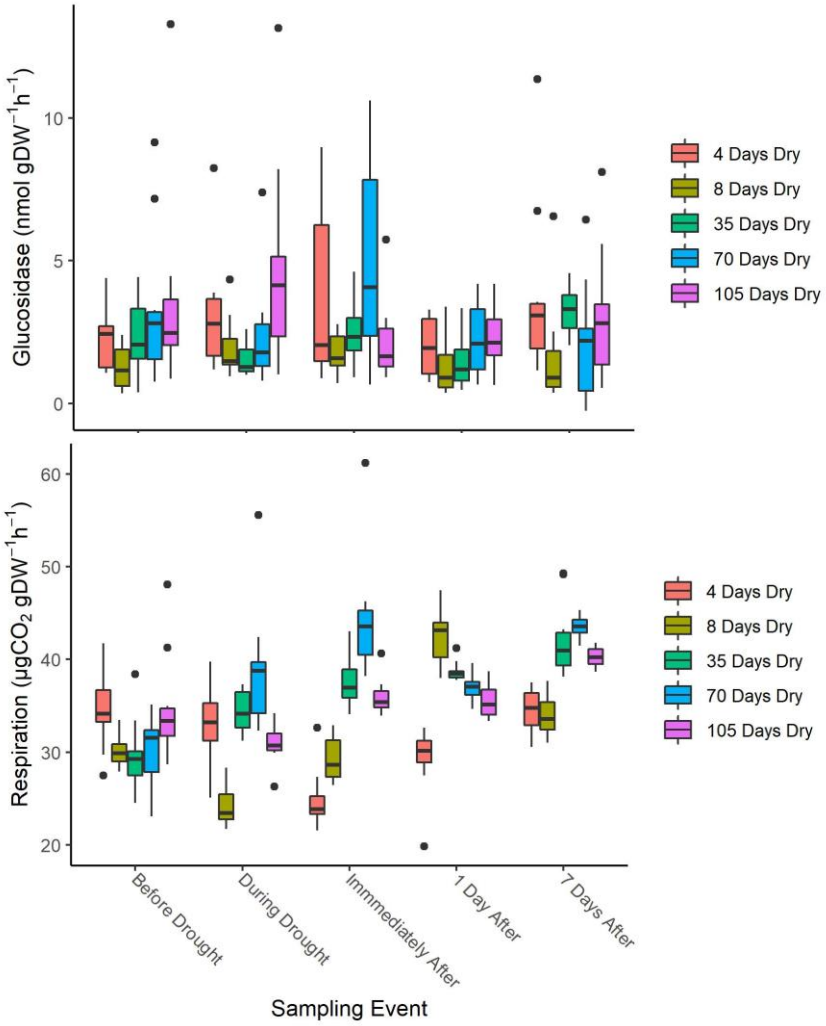

Figure: Glucosidase activity and respiration in all drought flumes across all sampling events.

- First, we evaluated if drying in general influenced the biofilm during and after the drought across all flumes comparing the mean of each drought flume across the different sampling events.
- No clear differences in biofilm processes between the drought phase and the wet phase were observed.

Results

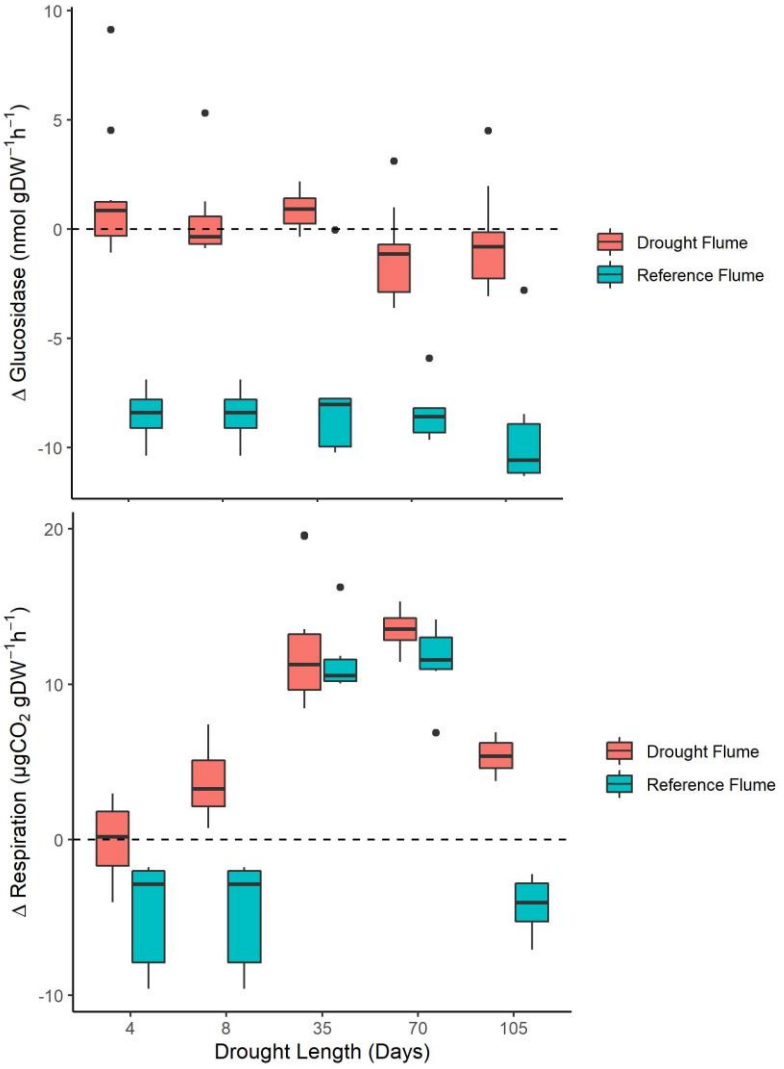

Figure: Standardized values of the drought flumes 7 days after rewetting compared to the standardized values of the reference flume.

- Secondly, we explored the effects of drought after rewetting by treating the drought flumes separately. We evaluated the post-drought status by comparing the samples from 7 days after rewetting with the reference samples during the same time period.
- No clear effect of drought length on these biofilm processes.
- However, ΔGluc differs from the change in the reference, indicating an effect of drying even 7 days after rewetting.
- The pattern for Δrespiration is similar to the pattern observed in the change in the reference flume so this can be attributed to seasonal fluctuations in respiration.

Summary

1. Moisture content in the hyporheic zone remains high enough that microbial biofilm processes can be sustained.
2. While there is an effect of drying on microbial biofilm processes even after rewetting, there is no impact of drought length.

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