The influence of salinity on leaf-litter breakdown rates in tidal streams

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Background

- Tidal streams connected to estuaries can sequester carbon ten times as quickly as forest (NOAA 2019; Krauss et al. 2018).
- However, aquatic microbial decomposers emit carbon into the atmosphere by breaking down dead, riparian leaves (Djukic et al. 2018).
- Our study quantifies the rate of litter breakdown by microbes in tidally influenced stream water.

Methods

- We dried and weighed cottonwood leaves before and after the one month stream placement to measure the change in mass.
- Data loggers at each of three sites recorded electrical conductivity (EC) and stream temperature every fifteen minutes (Figure 1).

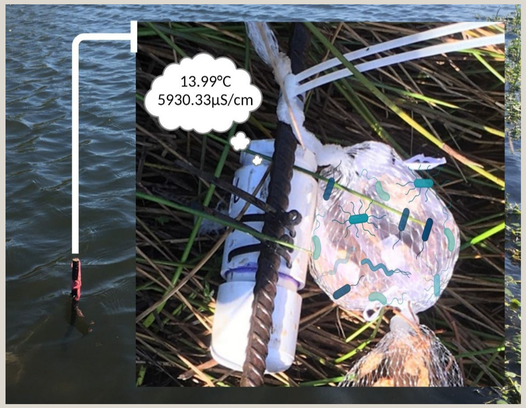

Figure 1. Only microbes can pass through the fine mesh bag to decompose the leaf-litter.

Results

- Increasing salinity was associated with increasing breakdown rates, explaining 24% of the variation after accounting for the effects of temperature (Figure 3).
- The coefficient of determination for litter breakdown rates vs stream water temperature is $r^2 = 0.56$.
- The average mass of leaf litter decomposed in the fine mesh bag is 0.063 g.
- Unexplained variation can be attributed to environmental factors such as light, pollutants, and substrate type.

Figure 2. To provide perspective to Figure 3, we measured stream water across a range of salinities from 5,000 to 20,000 µS/cm which is considered estuarine water by some sources.

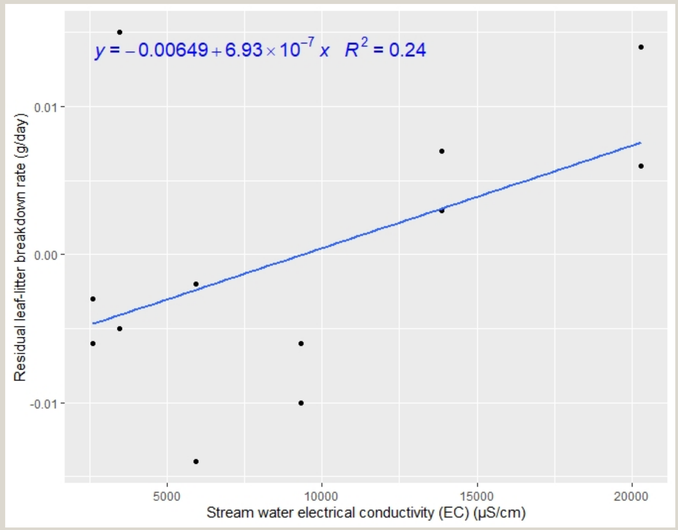

Figure 3. The scatter plot has a root mean square error of 0.008 g/day.

Conclusions

- Although we did not investigate microbial species richness or abundance, it is likely the fine mesh leaf packs allowed microbes to decompose litter and prevented aquatic invertebrates from decomposing litter.
- This relationship may be the result of increasing abundance and/or efficiency of microbes in higher EC water. There may also be a shift in microbial communities as salinities increase.
- Coastal freshwater streams will likely experience salinity intrusion from climate-driven sea-level rise and storm surges. We conjecture that increasing salinity in estuaries may lead to greater carbon cycling by microbial communities in coastal streams.

Future work in progress

- Litter breakdown rates are calculated by dividing the change in litter mass by 30 days deployed in the stream. Yet, we do not know if an even rate of breakdown occurs every day over the 30 day period.
- How does the rate of leaf-litter decomposition in coastal streams vary each week over a one month period?
- We hypothesize that litter breakdown rates will peak after the first two weeks.
- We are planning to deploy four leaf packs in each stream channel and retrieve one leaf pack per week for each of the four sites.

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- Figure 1 and 2 were created with BioRender.com.

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