Does invertebrate drift vary spatially within a stream and affect food availability for salmonid fishes?

COLLEGE OF NATURAL RESOURCES, UNIVERSITY OF IDAHO

Callie Story, Christopher Caudill

Abstract

Invertebrate drift is the downstream transport of invertebrates within flowing freshwater systems like streams and rivers, which is a significant contributor to food availability for salmonid fishes. Streams also transport detritus which is important in nutrient and carbon flux in water systems. Despite there being a significant interest in drift effects on broader food web implications, there is much of the process that is not well understood. In a lotic freshwater system, there is drift driven by the hydraulics of the water (passive drift) and drift driven by intentional movements (active drift). Based on this idea of differing drift forces the two main objectives of this study are: 1) Does the concentration of macroinvertebrate BMI or detritus vary spatially within a stream due to local variation in velocity and turbulence (stream hydraulics)? 2) Can detritus weight (CPOM) be an indicator of active versus passive drift for aquatic invertebrates?

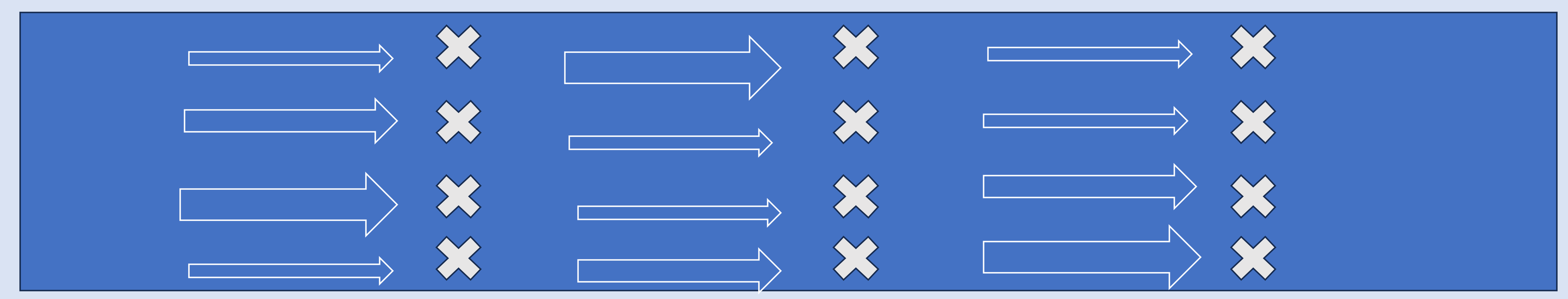
Background

- Invertebrate drift: the downstream transport of invertebrates, is a significant contributor to the health and abundance of drift-feeding fish, especially salmonids, in freshwater lotic systems (Naman et al. 2016)
- Detritus (organic matter) also drifts downstream which is known to be important for nutrient and carbon flux within streams (Cross et al. 2007)
- There are two types of drift:
  - Active: intentional migration of invertebrates
  - Passive: movement due to stream velocity and turbulence
- Emerging stream restoration methods for salmonids assume consistent drift concentrations within a stream (Humpries and Ruxton 2001), but this assumption has not been widely tested.

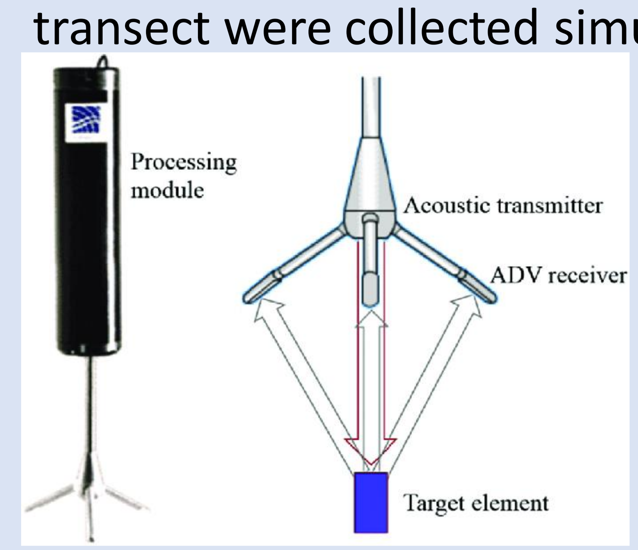
Objectives

1) Does the concentration of macroinvertebrate BMI or detritus vary spatially within a stream due to local variation in velocity and turbulence (stream hydraulics)?
2) Can detritus weight (CPOM) be an indicator of active versus passive drift for aquatic invertebrates?

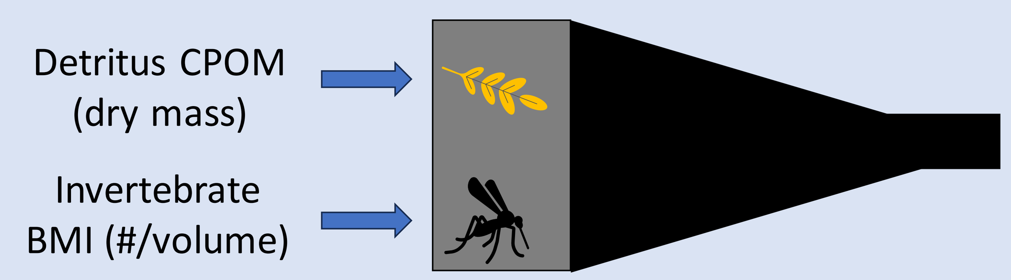
Approach



Stream sampling layout: 3 transects with 4 net sites (x) at each transect. Each transect had various flow velocities (arrows) and samples on each transect were collected simultaneously.



Nortek 64 Hz acoustic doppler velocimetry (ADV) probe to measure 3D velocity.

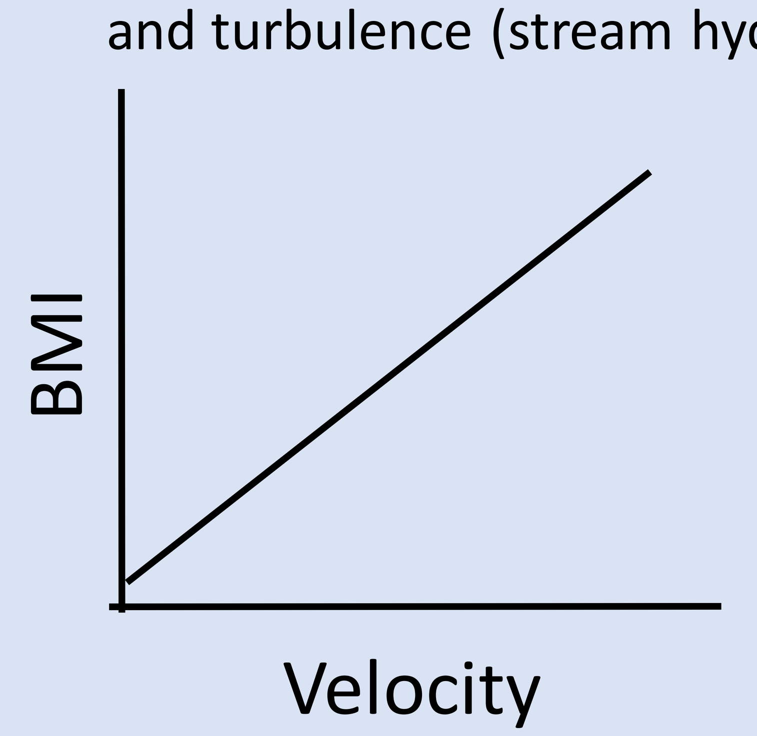


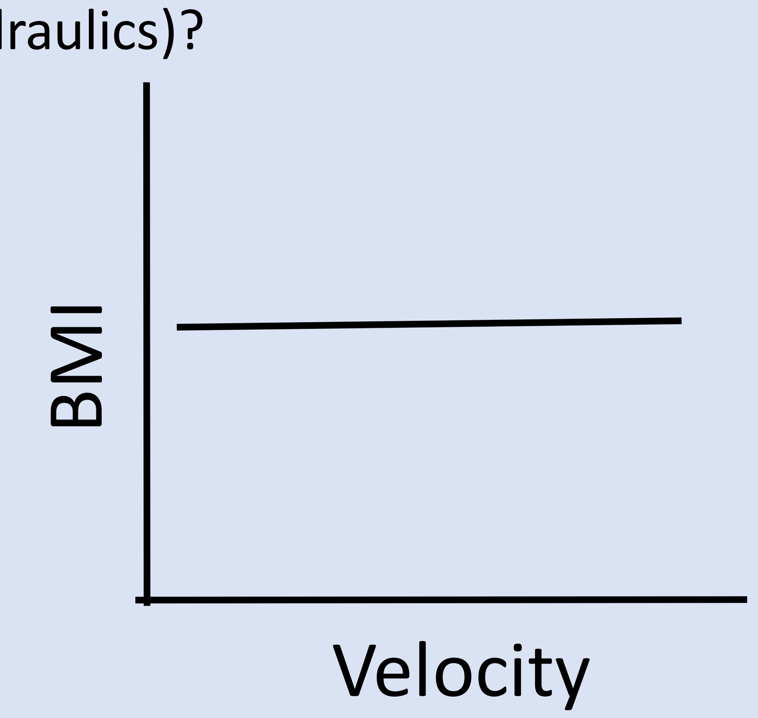
The collection net was set up in the water with an inch outside of the water to collect terrestrial invertebrates as well as aquatic invertebrates.

BMI concentration = # of invertebrates/ m^3 of water filtered

Predictions

1) Does the concentration of macroinvertebrate BMI or detritus vary spatially within a stream due to local variation in velocity and turbulence (stream hydraulics)?

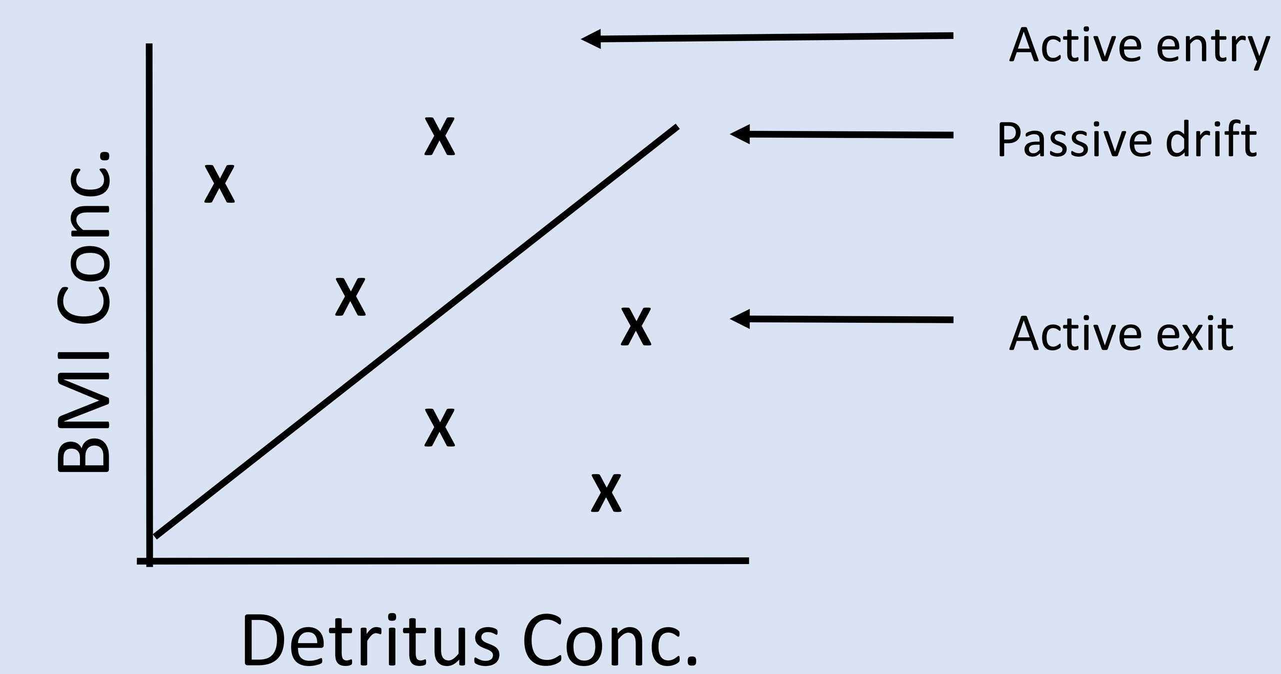




Prediction 1: # of invertebrates/m^3 of water increases in areas of a stream with higher velocity (e.g., because increased passive drift)

Prediction 2: # of invertebrates/m^3 of water would remain constant regardless of the velocity (i.e., assumption of spatially constant drift satisfied)

2) Can detritus weight (CPOM) be an indicator of active versus passive drift for aquatic invertebrates?



If detritus has a linear 1 to 1 relationship with BMI that would suggest that all invertebrates enter the water column via passive drift. Data above this line would suggest there are invertebrates actively entering and below this line suggests there are invertebrates actively exiting the water column.

Future Directions

- Continue this study to see if there are observable patterns between invertebrate concentration and velocity
- Use this data to see if current restoration methods are supported by patterns or lack of a pattern
- Once invertebrate concentration is better understood in relation to velocity, we can start looking at different variables such as species-specific patterns and effects of time of day.

References

Cross, W. F., Wallace, J. B., & Rosemond, A. D. (2007). Nutrient enrichment reduces constraints on material flows in a detritus-based food web. *Ecology*, *88*(10), 2563-2575.

Humphries, S., & Ruxton, G. D. (2001). Re-examining the drift paradox. *Trends in Ecology & Evolution*, *16*(9), 486.

Sean M. Naman, Jordan S. Rosenfeld, and John S. Richardson. 2016. Causes and consequences of invertebrate drift in running waters: from individuals to populations and trophic fluxes. *Canadian Journal of Fisheries and Aquatic Sciences*. **73**(8): 1292-1305. https://doi.org/10.1139/cjfas-2015-0363

Acknowledgements

This research is made possible by Idaho NSF-EPSCoR Program (award OIA-1757324)

Thank you to those who have assisted in past sample collection and processing: Wiley Dowler, Mia Hill, Ryan Day, Haleigh Holmgren