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Reintroduced beavers rapidly influence sediment storage and biogeochemistry in headwater streams of the Methow River, WA

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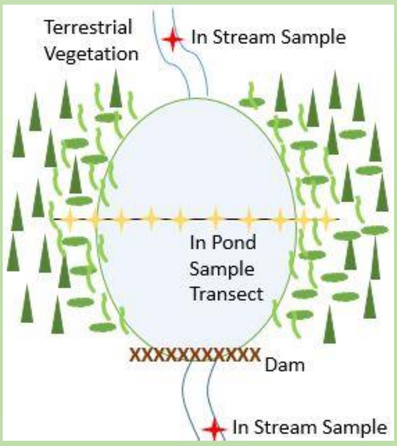
Abstract

To understand how rapidly beaver bioengineering impacts sediment organic material accumulation, we characterized the short-term, temporal dynamics of how reintroduced beavers have influenced sediment and organic material accumulation on 1st and 2nd order streams over the past decade. Sources of beaver related organics include coarse woody debris, fecal matter, and allochthonous material. We measured sediment physical properties, and analyzed samples for weight percent carbon and nitrogen. Our temporally constrained results provide insight into the rapidity at which beavers can influence biogeochemical systems in headwater streams.

Image 1. (above left) Cattle Guard beaver pond site.
Image 2. (above right) 10 cm core, pond sample at Ramsey Creek.

Field Approaches

- We selected 4 pond sites with beavers reintroduced over the past 5 years by The Methow Beaver Project and one non-beaver pond of similar size
- 10 cm sediment cores were taken along transects across the width of each pond, and in directly upstream and downstream reaches of each creek
- Wet weights of samples and basic water chemistry properties (pH, temperature, conductivity, dissolved O_2,) were taken in the field



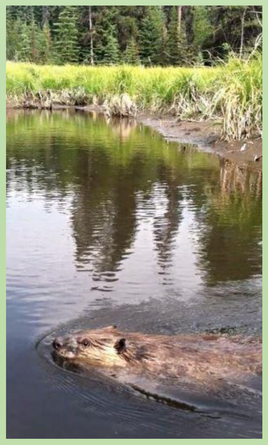


Image 3. (left) Beaver bioengineer at Upper Cub Creek. (Photo courtesy The Methow Beaver Project)

Figure 1. (above left) Beaver pond sampling site schematic. In-Pond transect and In-Stream sampling locations.

Lab Approaches

- Sediment samples were freeze dried, and then homogenized in a ball mill
- 15 mg samples of sediment were analyzed for weight percent carbon (%C) and nitrogen (%N) in an Elemental Analyzer

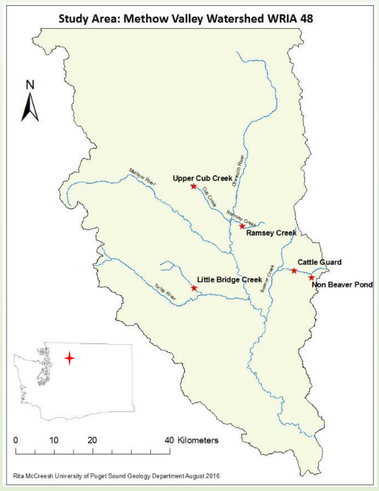


Figure 2. Study area and sites.

Image 4. (left) Water and sediment field analysis at Non Beaver Pond (photo Mairan Smith).

Key Question 1. How spatially variable is the organic content of shallow sediments within beaver pond complexes?

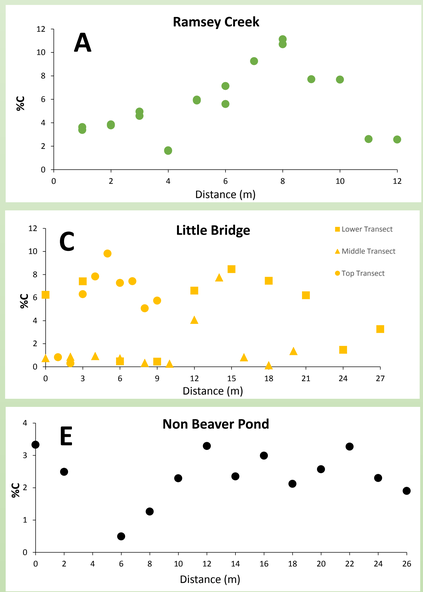


Figure 3. (A-E) Plot of %C versus distance along in-pond sample transects at sampling sites. Organic content is both laterally variable within each site, and variable among sites. These biogeochemical data compliment sedimentological and hydrological observations that suggest high heterogeneity within each site.

Image 4. (above left) Research students Rita M. and Lauren U. assist in tagging and relocating this large male beaver. May 2016, Winthrop, WA
Image 5. (above right) Beaver dam at Cattle Guard sampling site.

Key Question 2. Do beavers and their dams influence the amount and source of organic material retained in headwater stream systems?

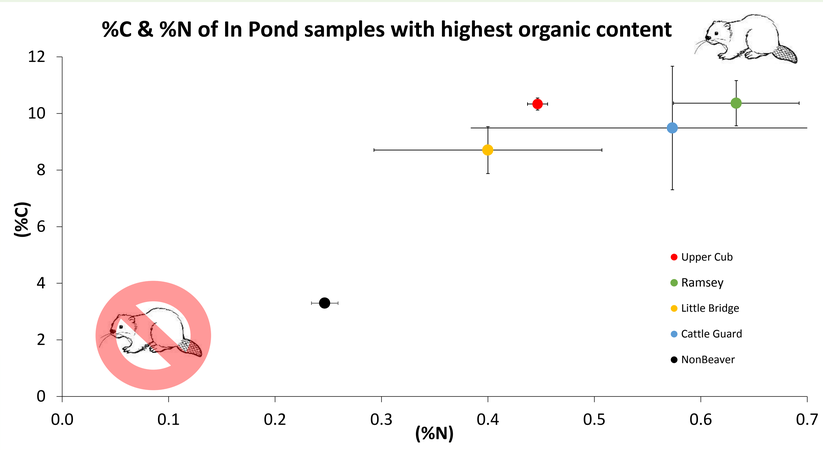


Figure 4. Plot of the average (+/- standard deviation) of the three in-pond samples with the highest %C from each site (and associated C/N ratios). The non-beaver samples are from a pond of comparable size that was not created by beaver activity. The beaver pond samples have significantly higher organic content (both %C and %N).

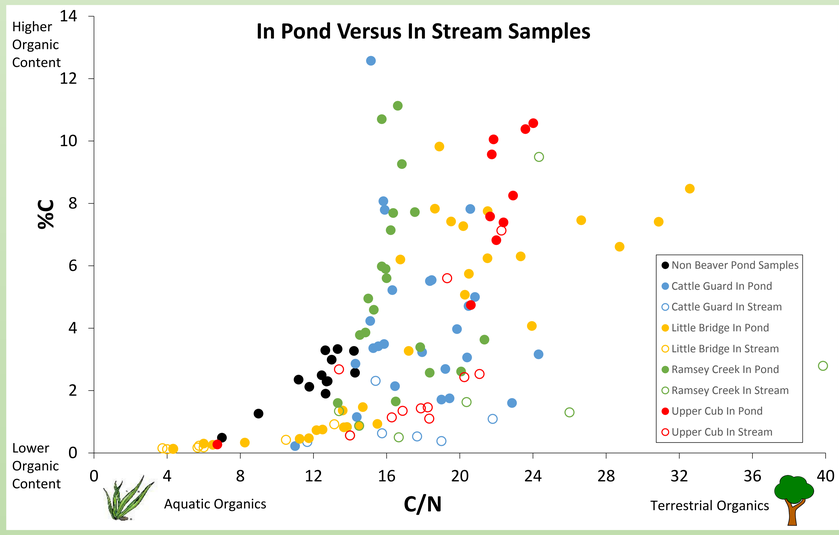


Figure 5. Plot of %C and C/N ratios for all sediment samples and sites (4 dammed creeks and 1 non-beaver pond). Within each stream there are substantial differences in %C and C/N ratios in beaver versus non-beaver samples. These results suggest that beaver ponds and wetlands store organic-rich sediments that are largely sourced from terrestrial plant biomass.

Future Research

- Isotopic analysis of vegetation and pond sediments to determine the origin of terrestrial organic material
- Analysis of sediment pit samples for bulk density and depth profiles
- GIS analysis of spatio-temporal impacts of beaver using collected GPS waypoints and Methow Beaver Project pond records

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