

North American Beaver (*Castor canadensis*) and cascading change in watersheds of the PIE LTER: A dam good research opportunity

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Research Justification

Rapid rebound of beaver (*C. canadensis*) populations has led to ongoing landscape and hydrologic change throughout watersheds of the Plum Island ecosystems (Fig. 1-2). Variations in water quality accompanying beaver influx have great potential to alter existing nutrient transport and processing capability, in turn quickly altering aquatic stream community health and composition. However, the full implication and range of aquatic ecosystem change due to beaver is largely unknown. More comprehensive study of beaver influence within the suburban PIE watersheds will therefore have immediate application for understanding aquatic ecosystem processes, closely linked ecosystem services, and the multi-use watershed management currently in place in the PIE watersheds and numerous similar regions along the eastern seaboard.



Figure 1: Time line of the construction of a beaver dam. Large impoundments can be created over relatively short time periods.

Castor canadensis...

...were absent from Massachusetts since the late 18th century when they were driven to near extinction by the fur trade.

...have increased in population dramatically since found in West Stockbridge in 1928. In 1996 a trapping referendum was passed in Massachusetts and populations have tripled since that time.

...are receiving new attention from landowners as populations alter their property.

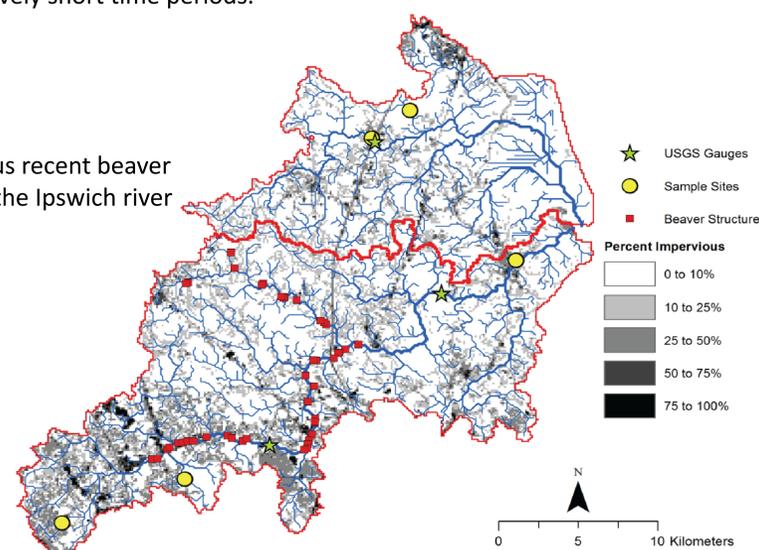
...can create dams impeding longitudinal connectivity, redistribute, add, and eliminate aquatic and terrestrial habitat over many kilometers in a single season.

...increase sediment deposition and reduce transport of nutrients through the river network.

Current & Future Research:

- **Stream Community-** Comparison of fish habitat availability and use to determine the impact of beaver dams on life history and community composition shifts.
- **In Situ Sensors-** Aquatic stoichiometric conditions surrounding and within beaver impacted stream networks on a sub hourly basis using powerful new sensors.
- **LiDAR-** Coupled with new and existing data promotes unique questions and analysis due to its high resolution, opening potential for new insight into aquatic ecologic processes (including those impacted by beaver).
- **Hotspots-** Beaver ponds effect on in-stream transport of materials.
- **Tracer additions-** Measurements of beaver impacts on residence times and storage zones, influences on metabolism, nitrogen concentrations, and nutrient cycling.
- **Regional Comparison-** New Hampshire (which still uses leg hold traps to manage beaver populations) provides an opportunity to compare watersheds with different beaver populations.
- **Hydrologic Change-** Detailed analysis and measurement of hydrologic state change across PIE watersheds including flow dynamics, storage, and network connectivity (or fragmentation).

Figure 2: Numerous recent beaver dam locations on the Ipswich river main stem.



Links to Ongoing PIE Research :

- **Fish** – Dam creation results in change to population distribution, species composition, and reproductive success. (Fig. 3, M. Mather).
- **Landscape Heterogeneity-** Flow regime, connectivity and biodiversity from headwaters to the main stem (W. Wollheim).
- **Water Chemistry-** Beaver impoundments cause changes to water chemistry including the reduction of dissolved oxygen concentrations (See Poster J. Cain).
- **Community Collaboration-** Several schools, graduate students, and post docs are working with community groups to answer questions about beaver in the PIE LTER region.

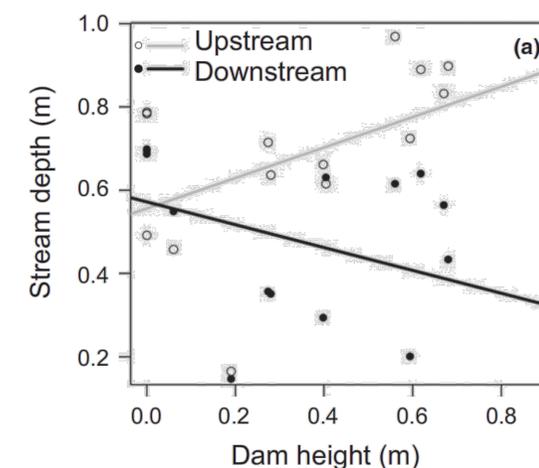


Figure 3: Stream depth (up and downstream) vs. beaver dam height. Data from various locations within the IRW (Smith and Mather 2013)

Summary:

There is urgent need to assess and understand watershed impacts caused by rapid growth of beaver populations within PIE watersheds. Failure to do so would limit ability to manage and address impacts to PIE stream community health, the human populations within the watershed, and offset resulting ecologic and anthropologic problems. Through use of newly available high resolution data and state of the art in situ measurement tools, study of beaver caused watershed change will further the knowledge of aquatic ecosystem science and guide actions to alleviate growing concern surrounding ecosystem services.