Linking Large Woody Debris Accumulation with Land Use Along a River Continuum in the Oyster River Watershed

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Introduction

Question: How is the amount of fallen wood in the Oyster river related to the land use surrounding the river, and does fallen wood in the river impact channel geomorphology?
Rational: The amount of wood in a river can impact a number of riverine processes that help regulate water quality and aquatic habitat, thus understanding the relationship between the land and the water that travels through it is very important.

- Large wood in rivers is crucial to the retention of organic material in the waterway. (Warren *et al*., 2007)
- Debris dams cause organic rich sediment to buildup, as well as increase the residence time of the water, which contributes to an increase in nutrient uptake as well as benthic storage. (Warren *et al*., 2007)

Field Methods

- Over 9 days, the 22km freshwater portion of the Oyster River was walked, from Mill Pond in Durham, up in to the headwater in Barrington.
- A GPS was used to record point locations every time there was any type of LWD in the River (470 points, 917 separate instances of LWD in the river).
- At each point the following was recorded: river width, river depth, number of separate LWD instances, type(s) and size(s) of LWD, and estimated percent flow impeded by LWD
- Additional information was recorded when appropriate, such as unique land use characteristics as well as head change associated with LWD flow obstruction.


Fallen Tree

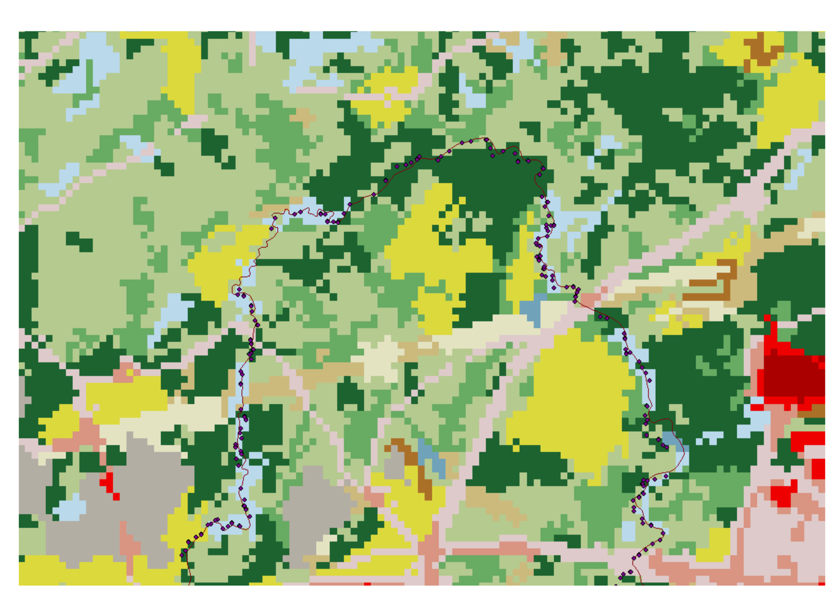

Debris Dam

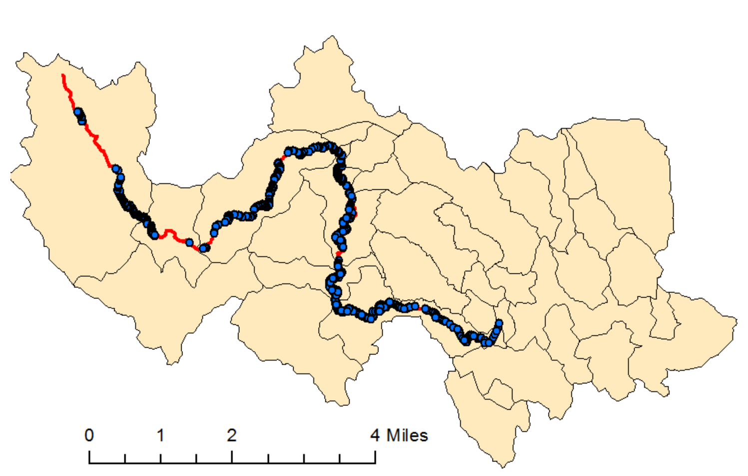

Debris Dam


Beaver Dam

Data Analysis

- GPS data was imported into ArcGIS where it could be overlaid onto other georeferenced data sets such as NLCD 2006 and local watershed shapefiles.


NLCD 2006 data was used to extract the land use type surrounding the river at each point.

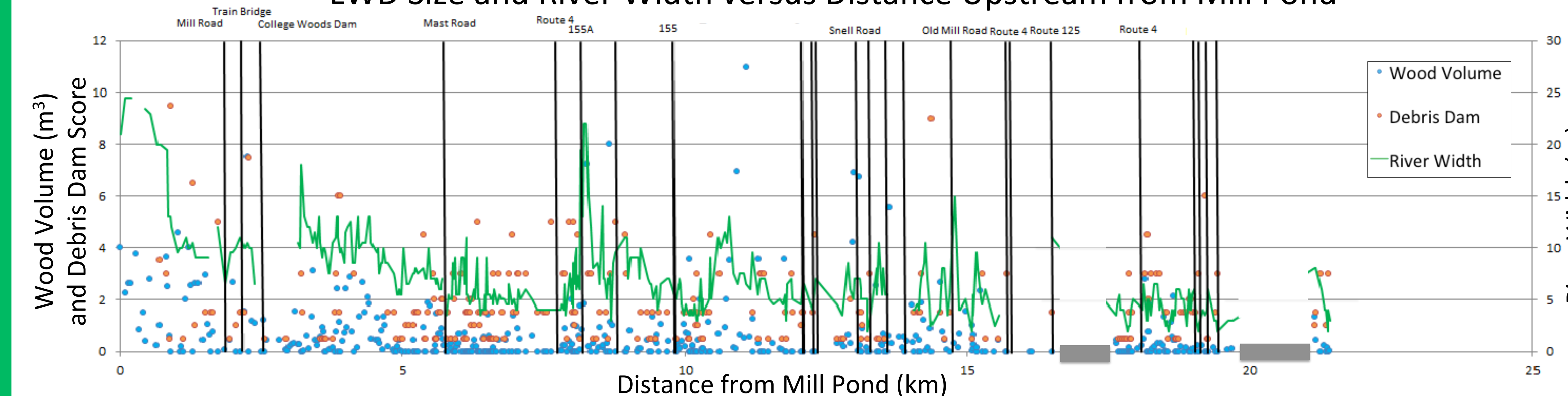


Oyster River Watershed, with the red line representing the freshwater portion of the river.

- RiverGIS was used to calculate the upstream watershed area at each point using a flow grid of Great Bay watershed given to us by the New Hampshire department of Environmental Services. Watershed areas were used to estimate the discharge at each point along the river based on mean daily runoff for the sample period.

Results

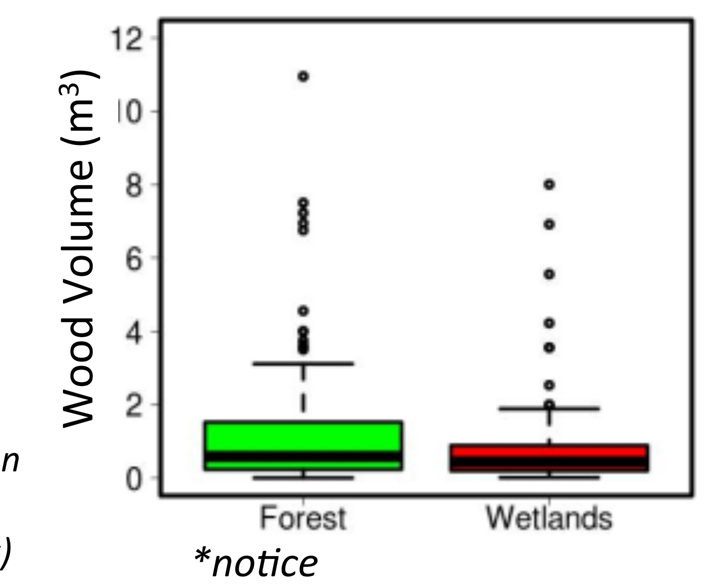
LWD Size and River Width versus Distance Upstream from Mill Pond

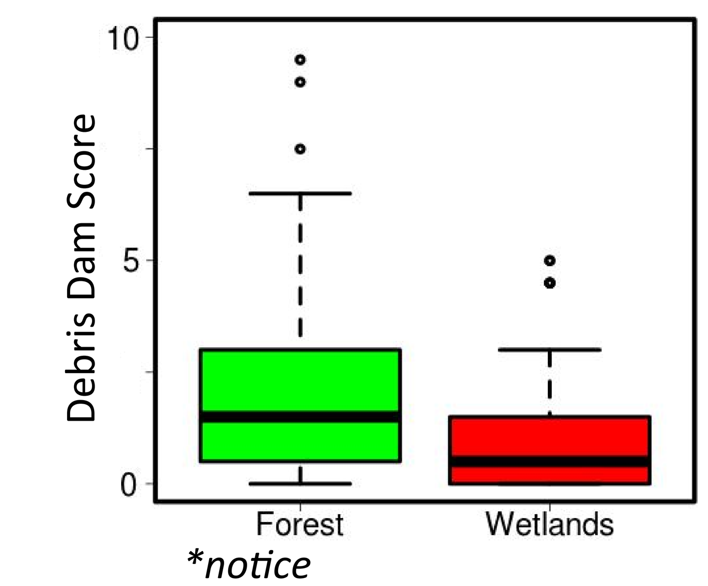


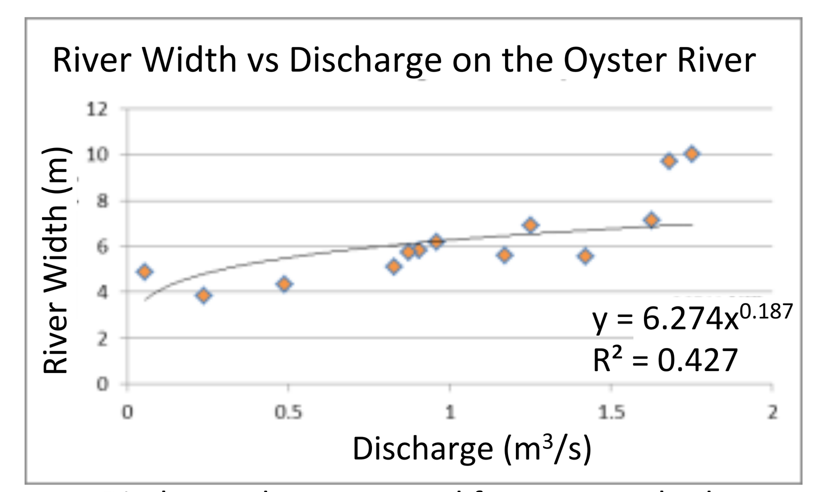
It appears that some large changes in river width occur in close proximity to road culverts. It is difficult to tell whether or not changes in river width are the result of large woody debris accumulating in the river at any given location.

	Large Wood Concentration (m^3/km)	Index of Obstruction (Debris Dam score/km)	LWD Occurrence (Instances/km)
Woody Wetlands	10.2	21.5	47.1
Forest	18.6	20.6	44.6

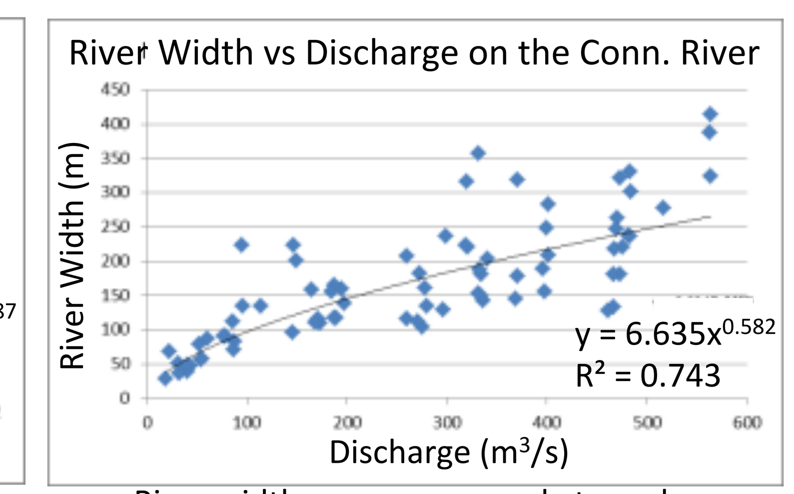
**Notice: There is a statistically significant difference between both log volume and debris dam score in forested areas versus wetland areas. (p=0.0217 and p=0.0067, respectively)*



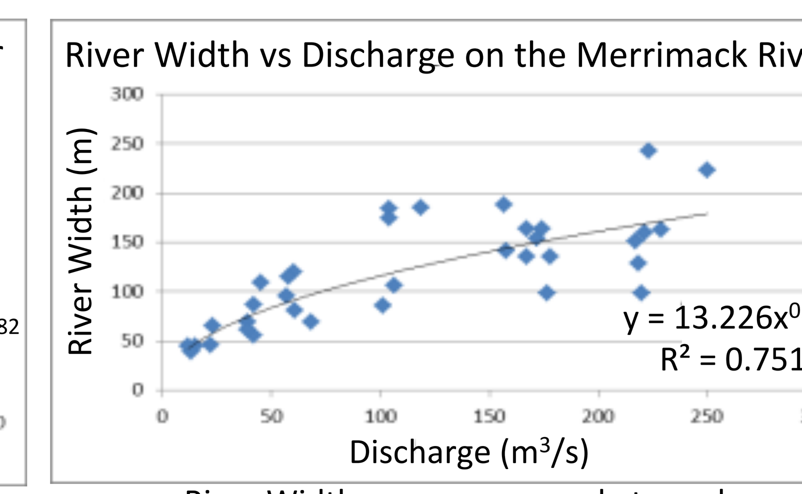




Discharge data extracted from watershed flow grid created by the NH DES



River widths were measured at regular intervals using Google Earth



River Widths were measured at regular intervals using Google Earth

Comparing the plot of river width versus discharge from the Oyster River to that of larger rivers in the region, it appears that there is a similar relationship. The equation $w=aQ^b$ relates width and discharge in a river. Because the "a" values are similar in the Oyster and Connecticut Rivers, it means that the rivers have similar widths at low discharges. This suggests that there may be similarities in channel geomorphology between the rivers, despite their tremendous size difference. Because the "a" value is much larger for the Merrimack river, widths are much larger for any given discharge.

Conclusions

Large woody debris on the Oyster River is related to land use in that areas classified as forest have larger logs as well as larger debris dams on average in comparison to areas classified as wetlands. There is also a higher concentration of large wood in forested areas. Future work may look to determine whether or not forest age is related to LWD accumulation. It is still uncertain whether or not LWD accumulation affects channel geomorphology. It appears that the channel geomorphology of the Oyster River is similar to that of the Connecticut River, although both rivers are affected by many complex factors which makes it difficult to pin point the specific impact of large woody debris accumulation on the river.

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