Investigating the Influence of Changing Winter Climate Patterns on Bedload Transport: Sheepscot River, Maine, USA

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Rivers in Maine are experiencing significant geomorphic and ecosystem changes as winters become warmer and shorter. Climate change has caused snowfall and river ice cover to decrease and seasonal melting patterns to become irregular. Therefore, a greater frequency of moderate to high magnitude flood events are occurring, driving habitat degradation across many river ecosystems. Atlantic Salmon populations are particularly endangered. Maine's coastal rivers serve as the last remaining habitat for the natural spawning of Atlantic Salmon in the United States. Salmon are dependent on riverbed gravel to build their nests and therefore changes to bedload transport are detrimental to their survival. Determining the specific climate induced variables driving increased bedload transport and subsequent habitat degradation within Maine rivers is essential to directing future restoration efforts. The relationship between bedload transport and the decline in river ice coverage during the winter is not well understood.

Our study seeks to build on the work done by Snyder et al. (2008) which investigated changes in bedload transport in relation to intensive land use and the construction of dams on the Sheepscot River and Narraguagus River. We selected one of the river sections studied by Snyder et al, located on the main stem of the Sheepscot River just downstream of the Sheepscot Pond and Palermo State Fish Rearing Station. We chose two river sites within the Palermo Preserve: upstream and downstream of a previous dam site and two log jams. The sites were easily accessible while also providing variation in slope, bedrock exposure, and volumetric flow rate. Additionally, because these sites were previously studied by Snyder et al, we will be able to compare future results to evaluate the changes in bedload transport that have occurred after nearly two decades.

In the field, we used a gravelometer to measure the sizes of 200 rocks at each site, randomly sampling the riverbed at 10 points along 20 cross-sections of the river in order to gauge the sediment size distribution. We then removed 100 rock samples representative of the riverbed size at each location. In the Roux Center lab, we used a rock saw, adhesive sealant, and white spray paint to place radiofrequency identification (RFID) tags in each rock and ensure that the rocks would be retrievable visually. After logging the RFID tag numbers, we placed the rocks back in the Sheepscot at their respective upstream and downstream sites. A GPS tripod and survey autolevel were used to measure and record the precise location of each rock placement. As the study continues, the tagged rocks will be located repeatedly using an RFID reader and their precise position within the river will be recorded again. Transport measurements taken after high magnitude flood events and during the winter are of the greatest interest to our study.

In the lab, I used QGIS software to analyze the existing geomorphology of the Sheepscot River Watershed. I obtained raster and vector datasets from the Maine Department of Agriculture, Conservation, and Forestry and the USGS. After creating a "mask layer" outlining the area of the Sheepscot River Watershed, I clipped the raster datasets to create maps of the watershed's bedrock geology and elevation/slope. I then created a vector layer for the Sheepscot River contour using the Google Satellite Hybrid feature, which I overlaid on each map. I inserted vector data points to visualize dam locations within the watershed. Being able to visualize these variables together allows for further watershed analysis through the River Styles Framework, a step procedure for interpreting the characteristics of a river to allow restoration potential to be better understood. As the study continues over the following years, closer analysis of river reaches will further improve understanding of the Sheepscot River behavior.

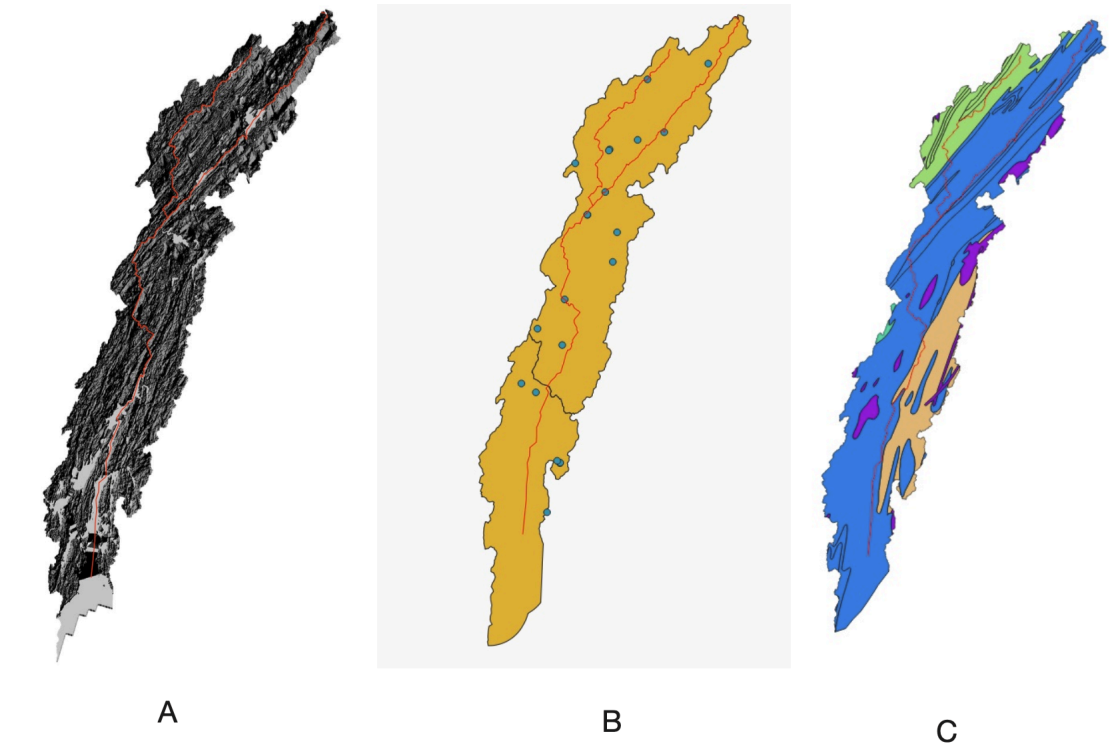

Figure 1. Sheepscot River Watershed QGIS products A) Digital elevation model with river contour B) Watershed mask layer with dam locations and river contour C) Bedrock geology with river contour

Figure 2. Retrieving rock samples from the Palermo Preserve sites in July.

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