Holding up the bank! An investigation of factors that affect streambank erosion

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ES-245: Hydrology and Limnology

Introduction:

Flowing water is vital for transportation of clean water, delivery of nutrients, and recharge in groundwater aquifers. Nonetheless, flowing water can lead to erosion of streambanks if the force of the moving water exceeds the resisting forces of the bank material. Though this is often a natural process, the intensification of this process in response to human activity can have detrimental effects to the environment. High rates of streambank erosion have been linked to increased turbidity, suspension of sediments, increased nutrient inputs, further loss of vegetation, and degradation of macroinvertebrate and fish habitats. Hydraulic and gravitational forces and streambank characteristics are known to impact soil erosion rates. The streambank characteristics examined in this project were vegetation cover and bank soil type. Vegetation is needed to reduce bank degradation because the roots are high in tensile strength, meaning root-permeated soil can withstand high load or stress. To add to that, soil type may have an impact on erosion rates, since differing soil types have differing suction forces. It was hypothesized that streams with low abundance of vegetation and low proportions of clay in the streambank soil would have high rates of erosion.

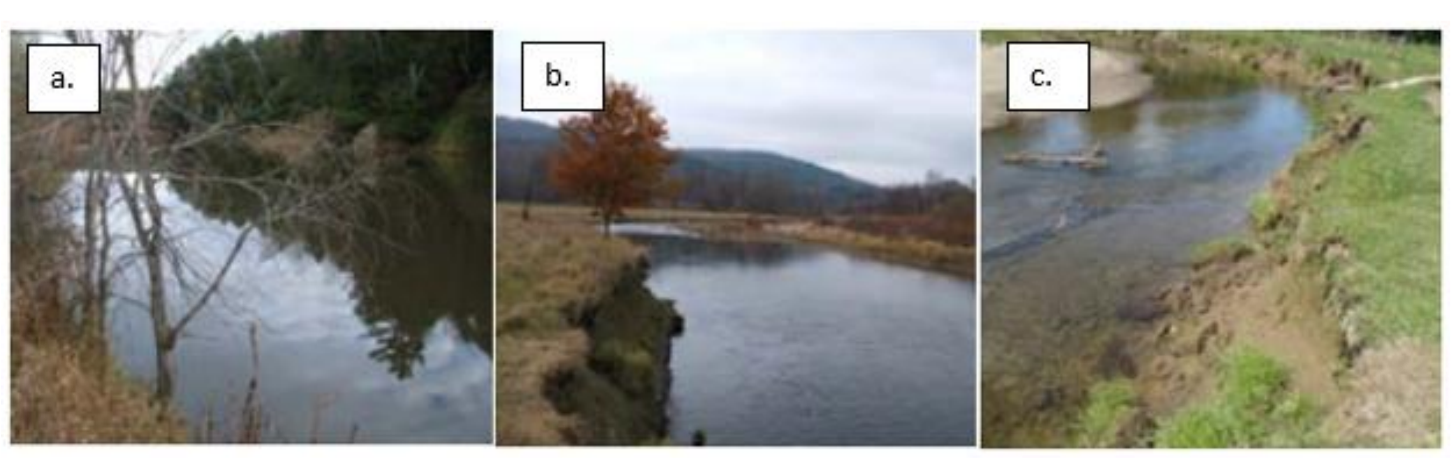


Figure 1: These images were taken by Simon et al. (2012) along the Missisquoi River. A streambank with minimal erosion impact is pictured in Image (a), a bank with intermediate erosion impact is shown in Image (b), and a bank severely impacted by erosion is shown in Image (c).

Methods:

Research by Simon et al. (2012) showed measurements for erosion rates, designation of channel stability indices, and quantification of streambank factors for 27 different sites along the Missisquoi River in Vermont and the select tributaries (Black Creek, Hungerford Brook, Jay Branch, Mud Creek, Trout River, and Tyler Branch). Specific streambank characteristics were plotted against the erosion rate measurements or the channel stability index values. Correlation tests were run on the plots that showed a strong trend.

Results:

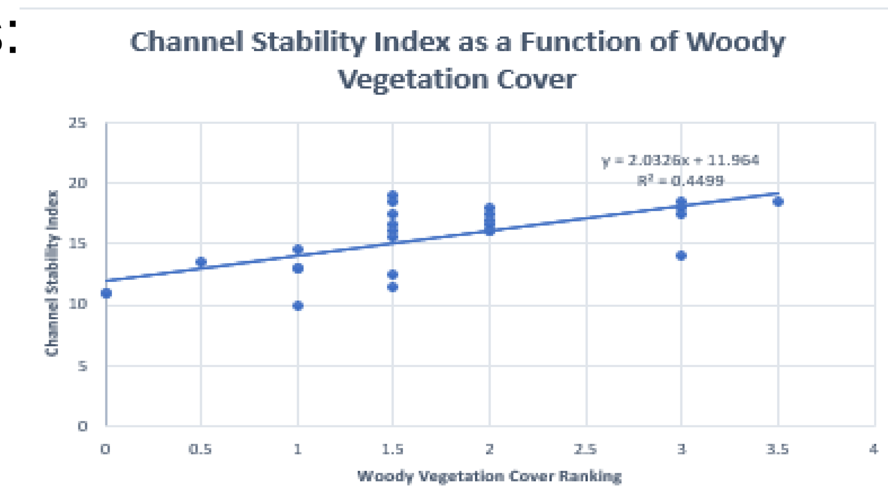


Figure 2: Simon et al (2012) used several measurements to assign CSI values to sites, which included degree of incision, degree of constriction, degree of erosion, stage of channel evolution, bank material and amount of bed/bank protection. Woody vegetation cover ranking was determined through measurements of root diameter and assessment of abundance. The higher the ranking for both parameters, the higher the impact for erosion.

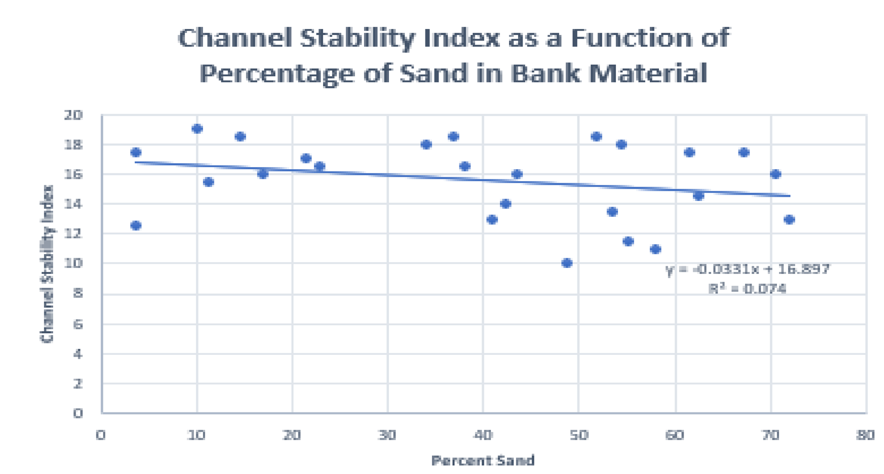


Figure 3: The CSI values are plotted against the percentage of sand in dominant bank material .

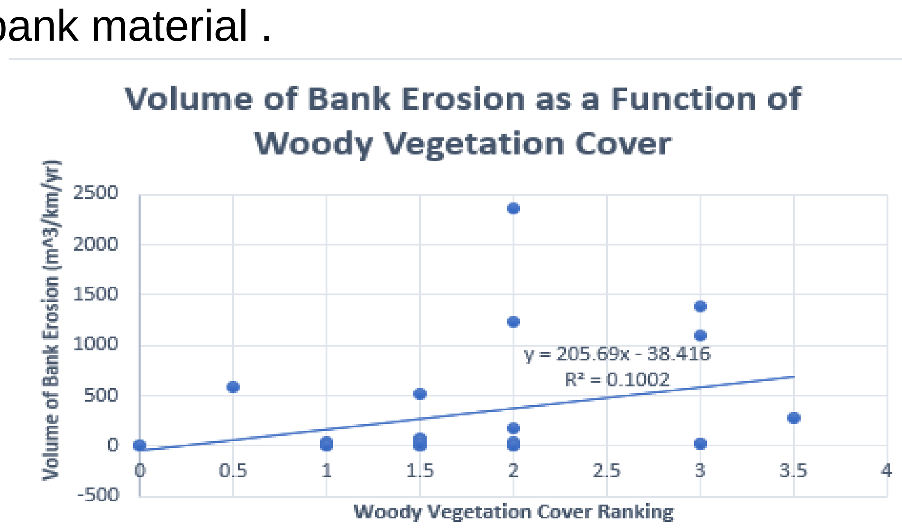


Figure 4: The volume of bank erosion measured by Simon et al. (2012) was plotted against the same vegetation cover ranking as shown in Figure 2.

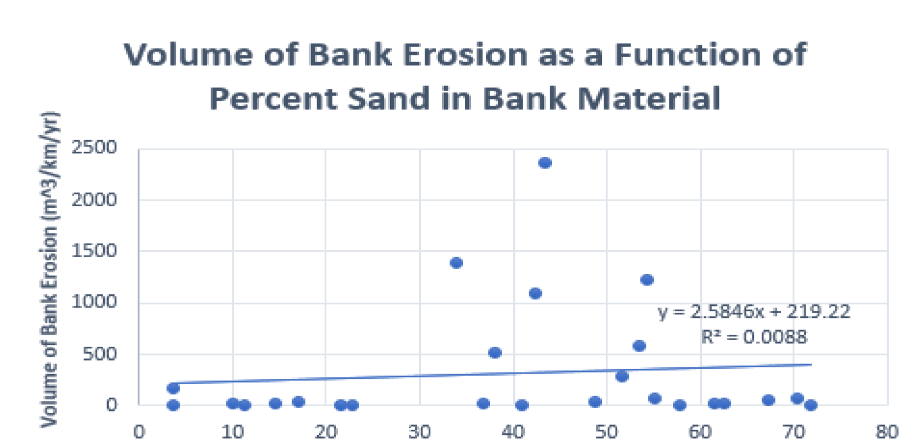
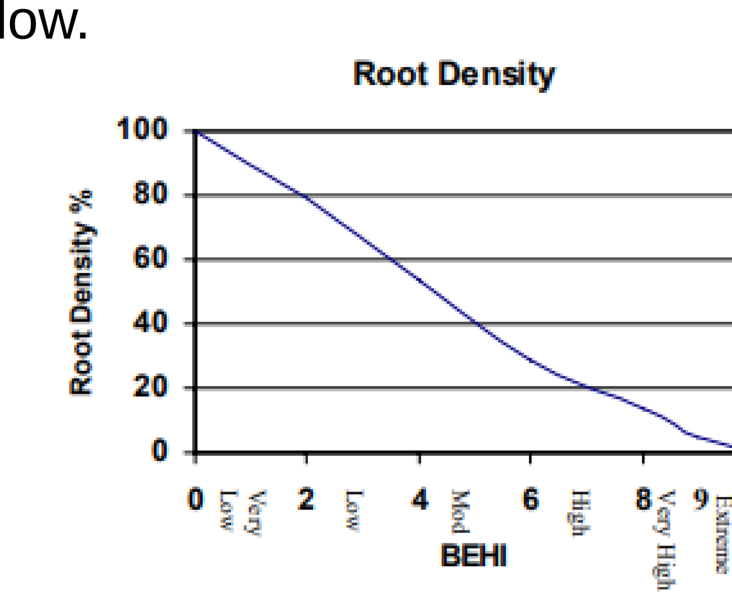


Figure 5: The volume of bank erosion measured was plotted against the same percent sand measurement as shown in Figure 3.

- When plotted against the Channel Stability Index (CSI), there was a trend with the channel factors (soil type and vegetation cover) with the CSI values. There was no trend identified for the percentage of sand plotted against the volume of bank erosion.
- There was a positive correlation between the vegetation cover and the CSI values, with a p-value of < 0.001 and correlation coefficient value of 0.6708 for the test.

Discussion/Conclusion:

These results show that the presence of woody vegetation has an impact on the stability of streambanks. Though there was a trend between the percentage of sand and channel stability index, the woody vegetation cover plotted against the stability and erosion measurements had the highest R^2 values, of 0.45 in Figure 2 and 0.10 in Figure 4. This may indicate that vegetation cover has a stronger influence on streambank erosion than soil type. However, more information needs to be found regarding the impact that soil make-up has on the stability of banks. It would be beneficial to plot the CSI values against the percentage of clay in the soil, as well. Similar research by Rosgen (2001) found that the bank erosion hazard index (BEHI) decreased with an increase in vegetation cover, with the 100% root density containing a very low to no BEHI. The plot from the research is pictured below.



Overall, the damage inflicted onto aquatic systems from the removal of riparian vegetation can be mitigated. Human activities that lead to the removal of plants along streambanks include construction of structures, logging, mining, and agricultural practices, such as poor grazing restrictions along waterways. In addition, knowing the soil type along waterways may indicate whether land could be developed in an area without immense threat of erosion, or it could signal if measures must be taken in the area to prevent mass erosion events. More studies should be conducted to better understand the many factors that influence streambank erosion and recognize which of these factors have the greatest impact.

Sources:

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Klausmeyer, Kelly J. “Streambank Erosion.” Natural Resources Conservation Service, USDA,

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