Ecohydrological Investigations of Minnesota River Sandbar Vegetation

Rachel Rausch, Christian Lenhart, and Laura Triplett
Department of Bioproducts and Biosystems Engineering,
University of Minnesota, St. Paul, MN

Project Background and Purpose

Over the past thirty years, a variety of causes ranging from agricultural practices to climate change have altered the hydrology of the Minnesota River watershed (Lenhart et al. 2011a). Increased stream flow in this watershed has been manifested in the form of increased flow volume and in increased duration of higher flow periods. Medium-high flows tend to endure until later in the summer, resulting in longer periods of sandbar inundation (Lenhart et al. 2011b).This increased period of inundation has affected the colonization of riparian vegetation on sandbars. The implications of these changes are manifested in a decreased amount of sediment deposition and retention, as vegetation increases the cohesive strength of bank materials and slows the velocity of water. This decreased velocity allows for the deposition of smaller suspended sediments onto sandbar features of a river. The Minnesota River carries the largest load of sediment of any river in the state to the Mississippi River. This study examined how increased streamflow has impacted the species distribution and amount of successful vegetation colonization as well as the soil particle size distributions of sandbars, both of which are factors that affect channel widening along the Minnesota River.

Materials & Methods

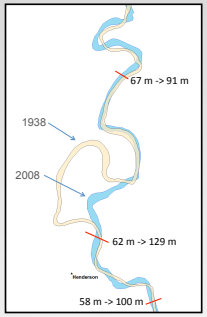


Figure 1. Channel widening has occurred on many MN River Basin streams. The MN River widened by 50-100% since 1938.

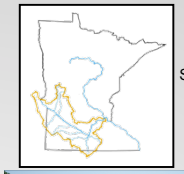


Figure 2. Map of Study Area

Figure 3. The MN River carries the largest load of sediment and nutrients in Minnesota.

Procedure

Five sandbar sites were selected along the Minnesota River. From each site a soil auger was used to collect soil samples at the depths of 1”-10” and 10”-20”. The soil samples as well as vegetation surveys were taken on a transect from the water line to the mature tree line. Vegetation surveys were completed using a .5m^2, square quadrats. The percent vegetative cover and the species found at each sampling point were recorded. Elementary bank elevation surveys were taken at each site using a leveling rod.

Sample Analysis

Each soil sample was characterized into particle size classes by mass percentage using a wet sieving technique and USDA standard soil sieves. The soil particle size data were compared to the vegetation data to ascertain whether transportable-sized sediment was being deposited in the zones of dense vegetation.

Results

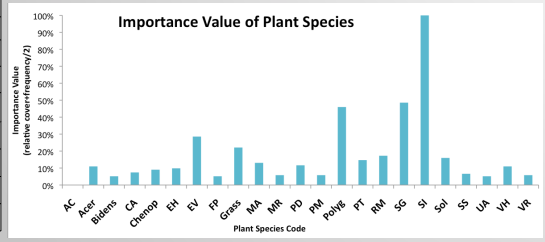
Vegetation Data

Common Name	Species Name	Code
American Elm	*Ulmus americana*	UA
ash, green	*Fraxinus pennsylvanica*	FP
Bidens	*Bidens species*	Bidens
Blue vervain	*Verbena hastata*	VH
Canada thistle	*Cirsium arvense*	CA
Common plantain	*Plantago major*	PM
cottonwood	*Populus deltoides*	PD
creeping love grass	*Eragrostis hypnoides*	EH
giant goldenrod	*Solidago gigantea*	SG
Golden dock	*Rumex maritimus*	RM
goldenrod, unid	*Solidago sp.*	Sol
Goosefoot	*Chenopodium*	Chenop
Maple- unidentified	*Acer species*	Acer
grass	unidentified species	Grass
Trembling Aspen	*Populus tremuloides*	PT
Virginia wild rye	*Elymus virginicus*	EV
Water parsnip	*Sium suave*	SS
Wild mint	*Mentha arvensis*	MA

Common Name	Species Name	Code
Monkey flower	*Mimulus ringens*	MR
River bank grape	*Vitis riparia*	VR
Sandbar Willow	*Salix interior*	SI
Silver Maple	*Acer saccharinum*	AC
Smartweed	*Polygonum sp.*	Polyg

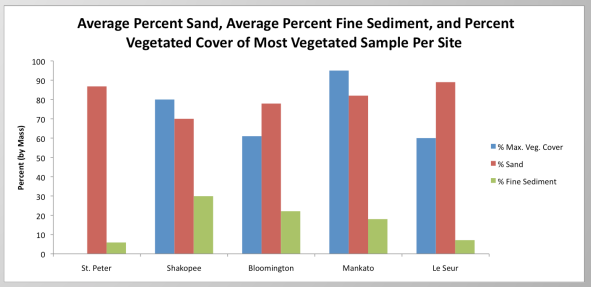
Figure 6. Plant species found at study sites

Figure 4 (above)**.** Image of Sandbar Willow (*Salix Interior*)
Figure 5 (below)**.** The plant species found through vegetation surveys are ranked to demonstrate which occurred the most frequently



Summary of Findings

- Vegetation transect data showed that new woody vegetation growth was confined to narrow belts high above the stream due to longer and more frequent periods of sandbar inundation.
- Sandbar willow was most abundant with 100% relative frequency. Cottonwood had a 20% relative frequency. The disparity in abundance may be explained by their different reproductive methods, willow by vegetative reproduction (sprouting) and cottonwood by seed.
- Sites with low bank elevation gradients from the water line to tree line were found to have particle size profiles consisting of 56% coarse and medium sand and exhibited little or no riparian vegetation colonization.
- Steeper banks had soils composed of 75% fine-very fine sand and had more percent vegetated coverage. This is due to the fact that these banks were more elevated above the water line which allowed adequate time, when soil is not inundated, for the recruitment of vegetation.
- Vegetation on these steeper slopes was found to be mostly herbaceous species, with woody species contained to the relatively flat area above the initial steep incline of the bank.



Conclusions

This study determined that there is a lack of successful vegetation colonization on flat sandbar areas. Vegetation is thought to induce sediment deposition and point-bar growth, however without vegetation this will not occur. Most of the woody vegetation colonization occurs in the early summer months, very little of which was observed due to many high flow events in the river relatively late in the season, primarily at the end of May through July. Reduced woody plant colonization reduces point-bar growth, contributing to channel widening and increased amounts of turbidity in the lower Minnesota River. Woody plants provide long-term benefits and are more frequent sandbar stabilizers than herbaceous species. Future research has been planned that will examine these relationships in greater detail.

References

Lenhart, C. ,Petersen, H. and Nieber, J. 2011a. Watershed response to climate change in the upper Midwest: The importance of low and mean flow increases for agricultural watershed management. *Watershed Science Bulletin*, Spring 2011: 25-31.

Lenhart, C.F., Titov, M, Ulrich, J.A., Nieber, J.L., and Suppes, B. “Hydrologic, Geomorphic, and Ecological Drivers of Channel Change in the Lower Minnesota River.” ASABE Publications-Draft, Transactions of the ASABE

Dixon, Mark D. "Effects of flow pattern on riparian seedling recruitment on sandbars in the Wisconsin River, Wisconsin, USA." *Wetlands* 23.1 (2003): 125-139