Private practices degrading public streams: history and impacts of channelization and levee construction in Big Barren Creek watershed, Mark Twain National Forest, Missouri

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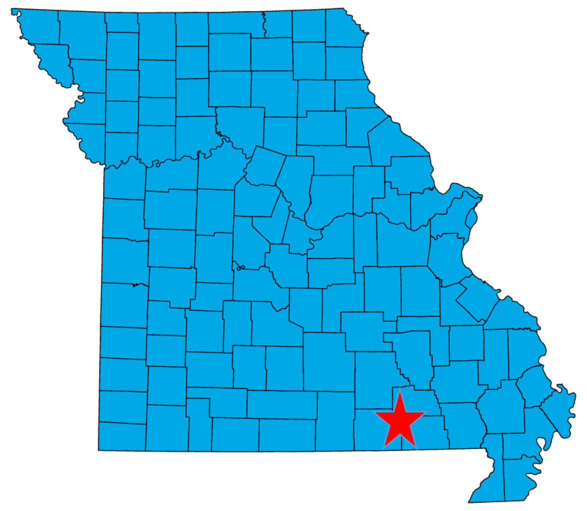
Abstract

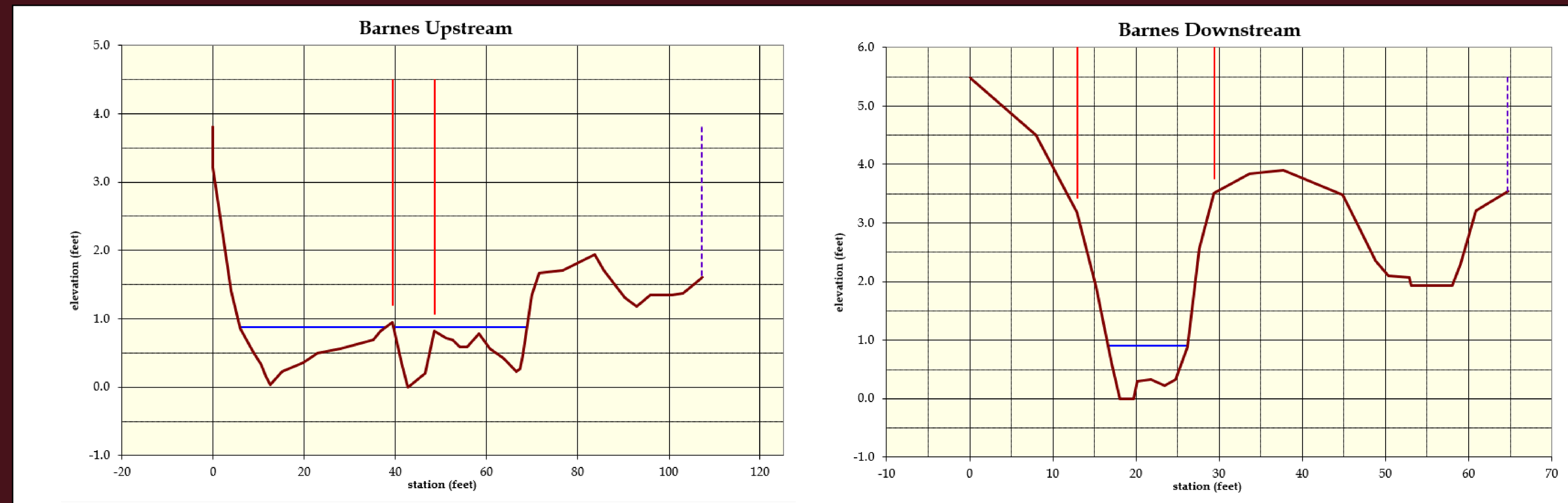
The impacts of agricultural channelization and subsequent head-cut development on the geomorphic transformation of stream channels and network patterns are poorly understood on the Ozark Highlands. In the Big Barren creek (BBC) watershed, channelization is a prevalent land use practice for flood management as well as an attempt to control erosion, improve drainage, and create a straighter channel. This human disturbance, through levee construction and gravel mining, modifies the balance of available and transported sediment causing channel instability. While channelization widens and deepens stream beds with the goal of containing flood events within the channel, it can degrade a healthy riparian vegetation zone and increase the risk of damaging floods. This study aims to assess the history of channelization, head-cut locations, and channel form changes to better understand the geomorphic processes and disturbance trajectories in BBC. A LiDAR DEM was used to map the locations and distribution of channelized and head-cut channels. Further, channel morphology and bed material surveys were performed at several head-cut sites to identify the characteristics and consequences associated with their formation and extension upstream. Channelization became a common practice beginning by the 1950s with some new projects occurring after 2000. Landowners excavate the entire channel length on private property with upstream head-cutting and downstream sediment pulses extending onto adjacent public lands. On-going maintenance efforts including ad hoc bank stabilization and gravel mining practices unintentionally reactivate channel erosion to continue the disturbance cycle. Historical channel development by human action illustrates the role of historical contingency in geomorphic evolution in BBC.

Study Area

The three headcuts examined in this study are located in the Big Barren Creek watershed in Southeastern, Missouri just downstream of private property. The tributaries where the headcuts occur are apart of the Mark Twain National Forest.



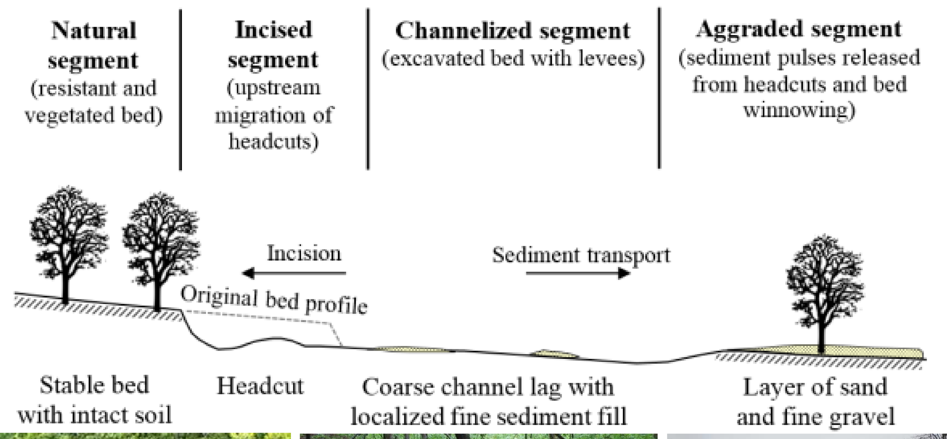
Methods

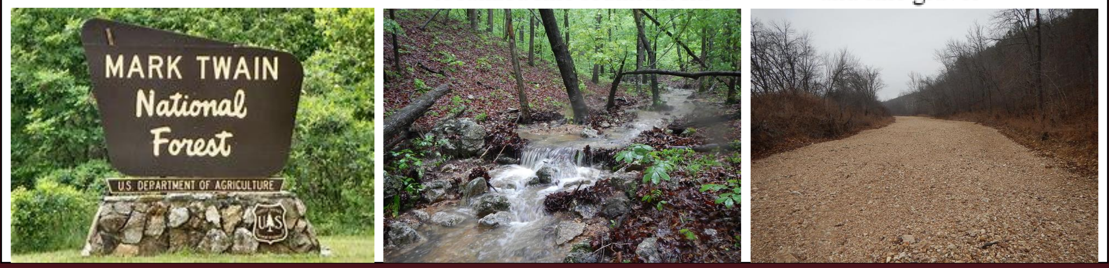


A LiDAR DEM was used to map the location of all identifiable headcut locations throughout the watershed. Site specific field data, including channel morphology and bed material size, was collected at three headcut locations. To evaluate morphological variability data was collected at two channel cross-sections sites located upstream and downstream of each headcut site. GPS points were recorded for each site and longitudinal profiles were later developed based on the site data and LiDAR elevation. The data was analyzed using cross section analyzer software to evaluate channel geomorphology and hydrology.

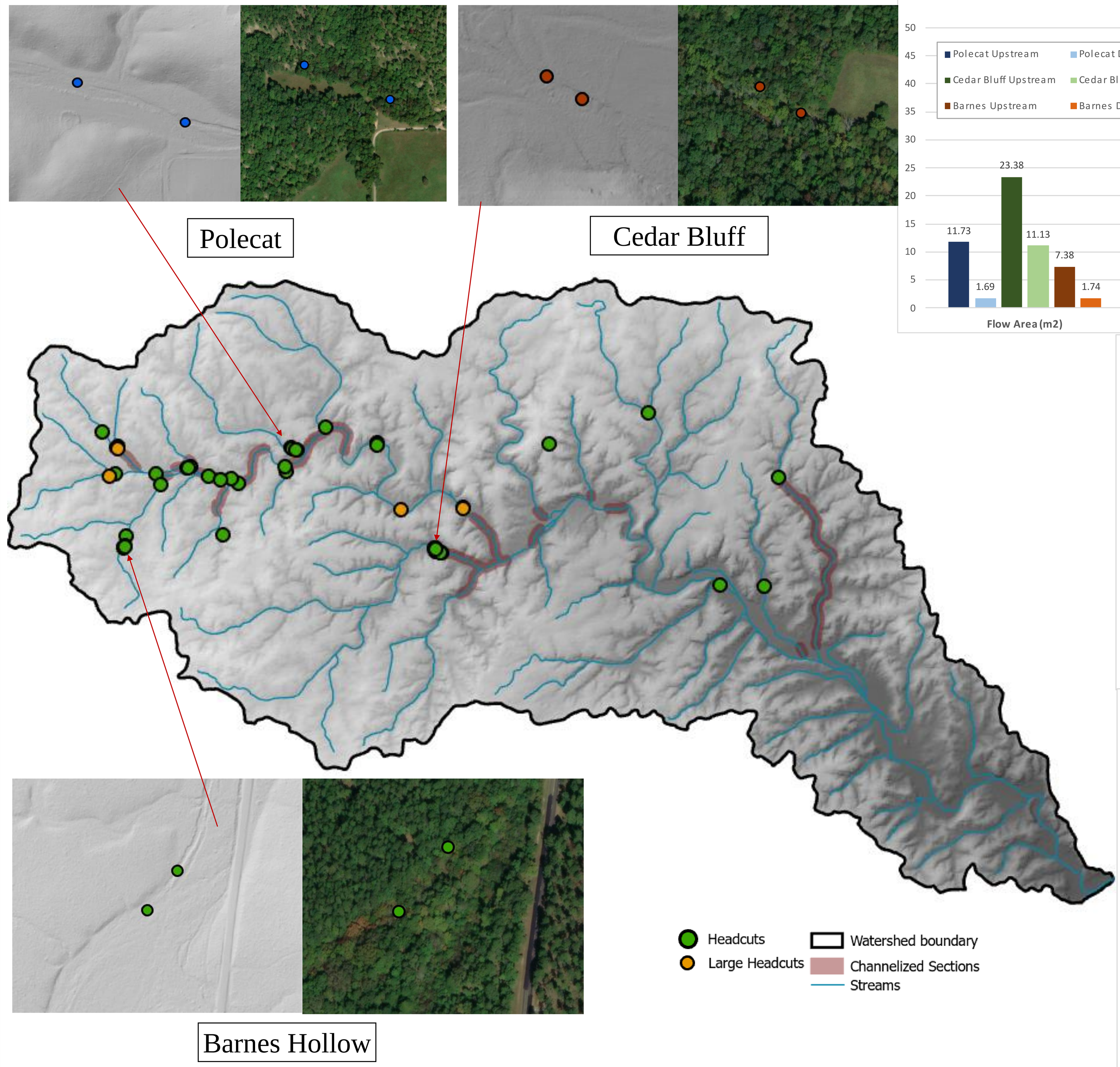
Background

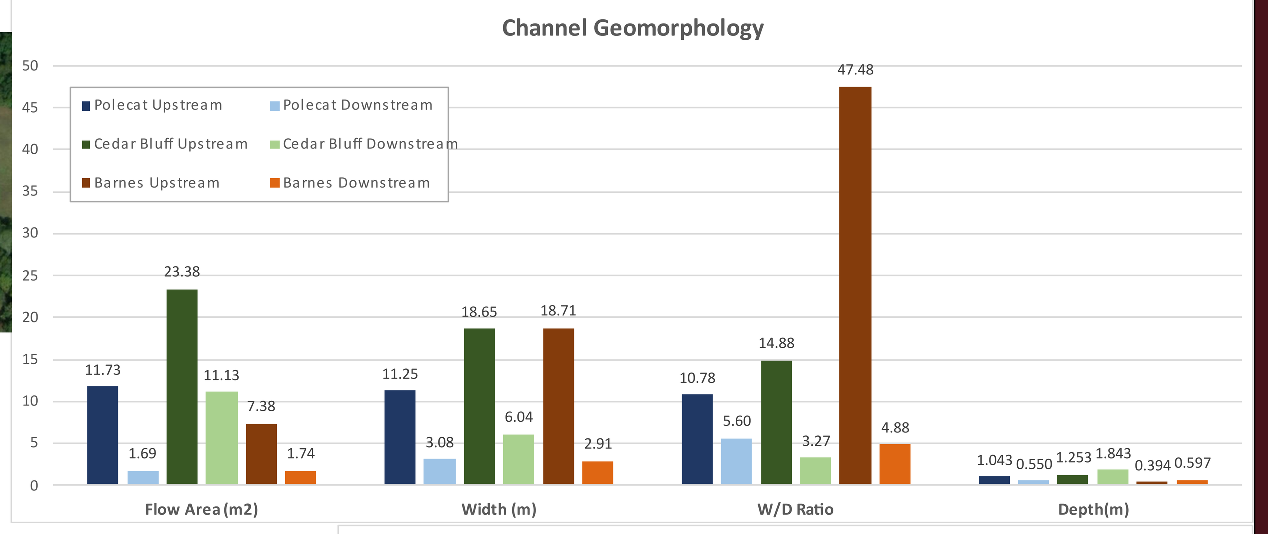
Channelization became a common practice by landowners within the Big Barren watershed starting around the 1950s with a new surge occurring after 2000. The addition of higher levees and removal of deposited gravel as an attempt to contain floodwaters to the stream contributes to the generation of sediment pulses. Subsequent upkeep of these disturbed channels unintentionally reactivates the cycle of disturbance. While agricultural channelization has, and continues to be, common practice in the Big Barren Creek watershed the impacts on the geomorphic response of stream channels is not well recorded. This study aims to expand the knowledge of the current response of three channelized Big Barren Creek tributary streams within the context of historical human disturbance across the watershed.

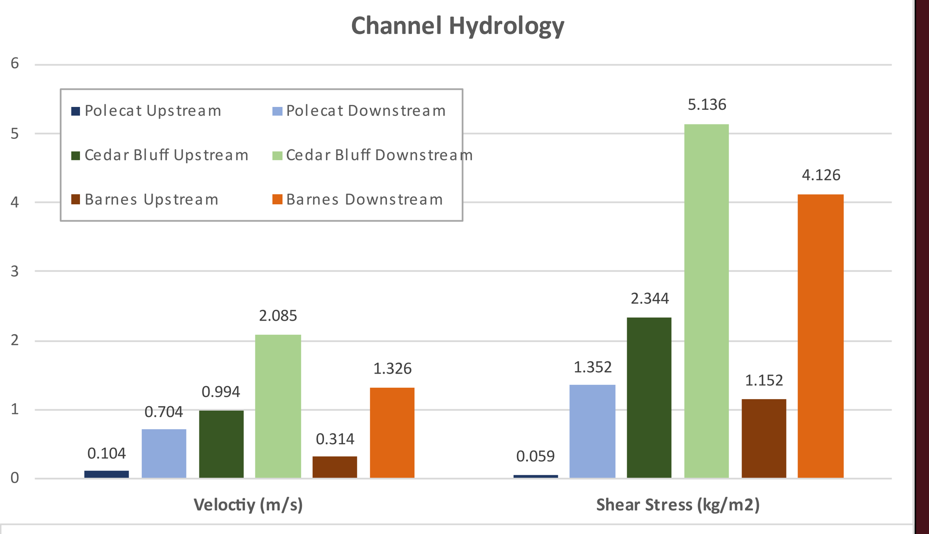


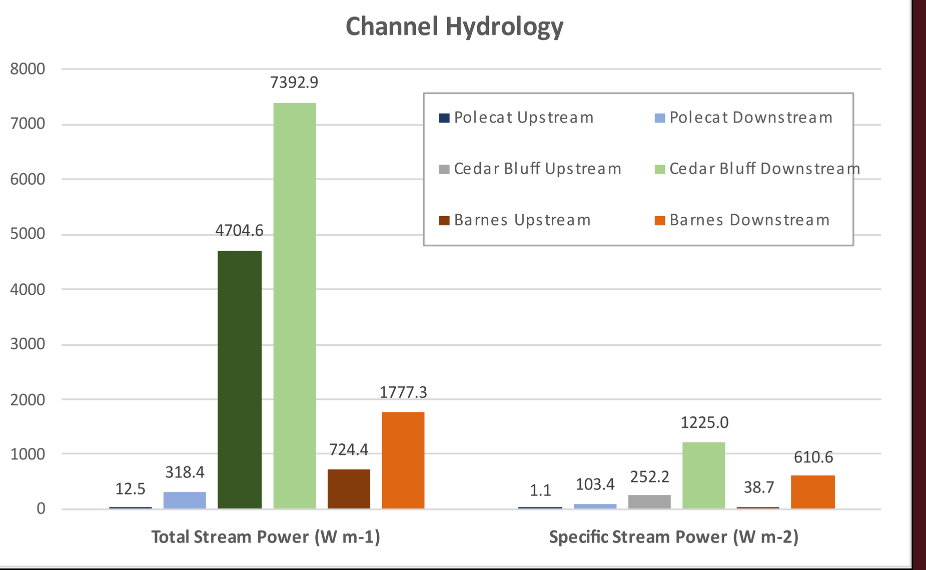


Results









Discussion and Conclusions

This study shows the effect of historic and current agricultural channelization of the tributaries in BBC:

1. Channel geomorphology: downstream of headcuts are deeper and narrower (channelized)
2. Channel hydrology: substantial increase in stream power, flow velocity and shear stress downstream of headcuts, therefore higher erosion capabilities.
3. Human disturbance is not localized, rather it is impacting the entire watershed as headcuts move up tributaries.

References

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Thies, M., 2017. Geomorphic Characteristics and Sediment Transport in Natural and Channelized Reaches of Big Barren Creek, Southeast Missouri. Missouri State University.