Streambank Stability and the Presence of Invasive Riparian Vegetation in Paradise Creek, PA

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1. Introduction:

The Paradise Watershed is a small sub-watershed located within Monroe County in northeastern Pennsylvania (Fig. 1). The main stream of the watershed is the Paradise Creek, a body of water representing the characteristic step-pool, riffle-pool stream landform. The creek originates from the confluence of two smaller tributaries. These tributaries, Yankee Run and Tank Creek, carry runoff drained from the Pocono Plateau in the far west of the watershed and dump their contents into the headwaters of the Paradise Creek (Fig. 2). After winding through the forested hills and valleys for close to ten miles, the creek spills into the larger Brodhead Creek.

Three 100-year floods have affected the watershed in the past two years. The first occurred after five to six inches of rain fell from the remnants of hurricane Ivan in September 2004. The second flooding event transpired in April of 2005 from a combination of snowmelt and excessive precipitation. The last and most recent 100-year flood happened over the period of a week during late June 2006 in which a low pressure air mass stalled over the northeast delivering large amounts of rain to the entire region. The water from these floods ripped through the Paradise Creek severely eroding the stream banks and endangering properties and public roads.

In recent years the appearance of invasive vegetation has been noted in the Paradise Watershed. Exotic species such as Japanese knotweed and Japanese barberry have started to appear in the smaller tributaries. These plants displace indigenous species and deplete biodiversity among the native vegetation.

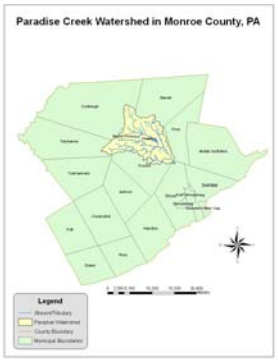

Fig. 1 Location of the watershed

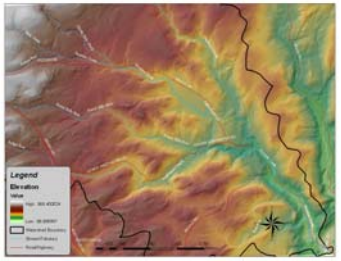

Fig. 2 Elevation: the watershed boundary is delineated in bold black

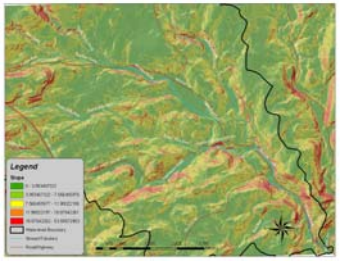

Fig. 3 Slope: steeper slopes are shown in orange and red

2. Methodology:

Bank Stability: The stability of the stream banks is calculated using the *Pfankuch-Rosgen* Channel Stability Evaluation Method. A GPS is utilized to record waypoints every 250 meters. At each of these points, the upper banks, lower banks, and stream bed are assessed based on factors such as mass wasting, upper and lower bank cutting, bottom size distribution, and deposition. Total channel stability is calculated as the sum of all of the factors, with a higher stability index meaning the banks are predisposed to future erosion.

Invasive Vegetation Presence: The presence and density of invasive flora is noted using an estimated density method. Both left and right banks are observed with canopy cover and soil moisture being noted. Software: XY coordinate data is imported from the GPS into ArcMap. This data is joined with DEM, bank stability, and invasive vegetation data to analyze the features of the river network and surrounding landforms.

3. Data Analysis:

Bank Stability: Preliminary analyses of the bank stability suggests that bank erosion is present in moderate to severe amounts throughout the entirety of the Paradise Creek (Fig. 4). Sharp bends and meanders in the stream bed show excessive cutting. Comparing steep bank slope (Fig. 3) to bank instability shows there is correlation between the two. Downstream, the streambed broadens and can accommodate more peak flow thus explaining more modest erosion. Figure 5 shows a stream front property that is endangered by unstable banks.

Fig. 4 Bank Stability: a higher index indicates a more unstable bank

Fig. 5 A property along the creek where the foundation has partially collapsed

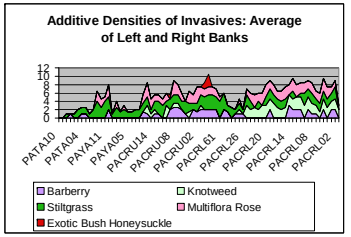

Fig. 6 Chart showing additive invasive densities from upstream to downstream

Invasive Vegetation Presence: The five prevailing invasive species found in the creek are show with maps generated using ArcMap (Fig. 7-11). Japanese stilt grass showed a fairly constant and widespread distribution throughout the creek. Japanese knotweed was absent in the upper reaches and headwaters of the creek, but started to be present in great abundance in the areas downstream. A variety of invasive honeysuckle species, namely Morrow's honeysuckle, Japanese honeysuckle, and Amur honeysuckle, recorded all together as "exotic bush honeysuckle" comprised a very spotty distribution. One hotspot is visible in the upper reaches of the creek. Japanese barberry and Multi-flora rose showed similar density and distribution patterns. A large bulk of the plants were present in the upstream regions followed by a drop in numbers. Further downstream the numbers increased again. As shown in Figure 6, upstream Paradise creek has a limited number of invasive plant species. However, as the stream moves further down into the watershed, more exotics begin to appear, at times having all five species present.

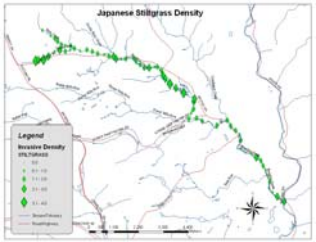

Fig. 7

Fig. 8

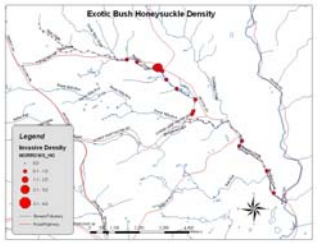

Fig. 9

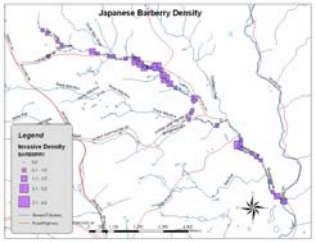

Fig. 10

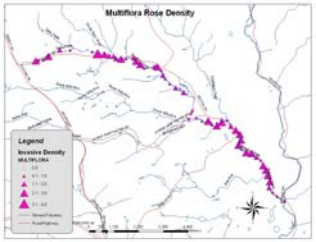

Fig. 11

Figures 7-11 illustrate the four following levels of plant density:

1= Rare, single plants

2= Small patches, easily counted

3= Large patches

4= Dense, continuous stretches

4. Conclusion:

Bank stability: Results indicate that 1) the banks along the Paradise Creek have been subjected to great erosion due to the flooding events 2) this erosion has created instability in stream banks that endangers private property as well as municipal and state roads 3) future floods will cause extensive damage if no measures are taken to stabilize these banks

Invasive Vegetation Presence: Results indicate that 1) exotic plants are replacing native species the riparian areas along the Paradise Creek 2) densities of this vegetation will continue to rise as it continues to spread throughout the watershed

References: