Streambank Stability and the Presence of Invasive Riparian Vegetation in the Brodhead Watershed, PA

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1. Introduction:

The Brodhead Watershed has a drainage area of 285 miles in Monroe and a small portion of Pike Counties in northeastern Pennsylvania. Many small tributaries contribute to this drainage area. The watershed includes five main streams including Brodhead Creek, Paradise Creek, McMichael Creek, Pocono Creek, and Marshall's Creek. The main stream in the watershed is Brodhead Creek. All runoff in this watershed eventually flows into Brodhead Creek, and then into the Delaware River near Delaware Water Gap, Pennsylvania.

Three 100 year floods have affected the watershed in the past three years. The water from these floods ripped through the Brodhead Watershed severely eroding the stream banks, and endangering properties and private roads. These floods may have also carried invasive vegetation to areas where no invasives were previously found. Exotic species such as Japanese knotweed and Japanese barberry began to appear in the smaller tributaries, and are now found throughout the entire watershed. These exotic, invasive plants displace indigenous species and deplete biodiversity among the native vegetation.

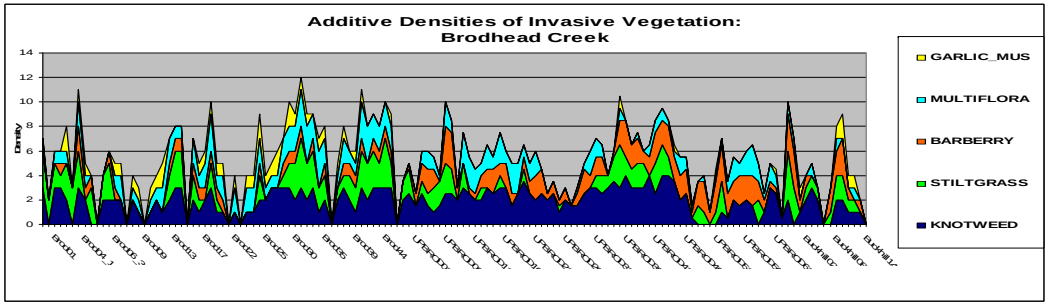

Figure 1: Additive densities of invasive vegetation from the lower reach to the upper reach of Brodhead Creek.

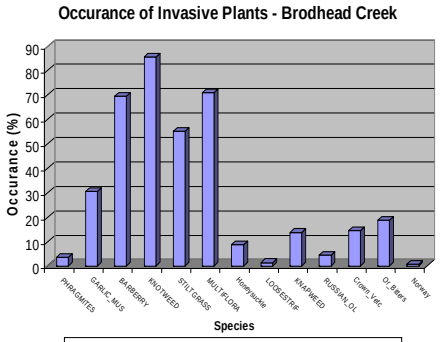

Figure 2: The number of times a specific invasive plant was observed throughout Brodhead Creek.

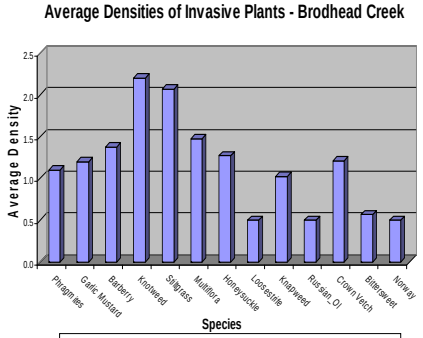

Figure 3: The average densities of invasive plants observed throughout Brodhead Creek.

2. Methodology:

Bank Stability: The stability of the stream banks was calculated using the *Pfankuch-Rosgen* Channel Stability Evaluation Method. A GPS unit was 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 was calculated as the sum of all of these factors. If a portion of a stream had a high bank stability index this means the bank is less stable, or dangerous to properties in the vicinity.

Invasive Vegetation: The presence and density of invasive flora is noted using an estimated density method (Braun-Blanquette, 1932). Both left and right banks are observed with canopy cover and soil moisture being noted.

Software: XY coordinate data is imported from the GPS unit into ArcMap software. This data is joined with DEM, bank stability, and invasive vegetation data to analyze the features of the river network and surrounding landforms.

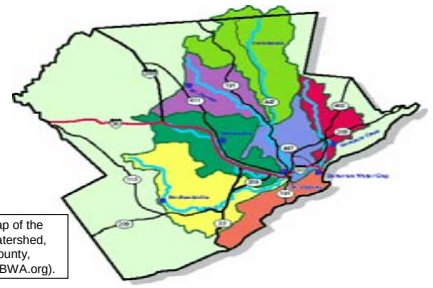

Figure 4: Map of the Brodhead Watershed, Monroe County, Pennsylvania (BWA.org).

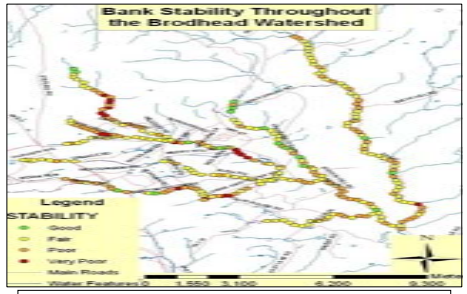

Figure 5: Brodhead Watershed bank stability map; each color indicates a specific stability level from good (green) to very poor (red)

3. Data Analysis:

Bank Stability: Preliminary analyses of the bank stability suggests that bank erosion is present in moderate to severe amounts throughout the entire Brodhead Watershed (Fig. 5). In most areas, sharp bends and meanders in the stream bed show excessive cutting. The lower portion of the watershed has yet to be assessed for bank stability. In this non-surveyed area the streambed broadens and can accommodate more peak flow.

Invasive Vegetation Presence: The five prevailing invasive species found in the watershed are shown with maps generated using ArcMap (Fig. 6-10). Japanese barberry was found throughout the watershed with patches observed in almost every stream, and hot spots observed in a few areas in the upper watershed. Japanese knotweed occurred most often and was the most dense of the invasive species, although, the southwestern portion of the watershed had few specimens of knotweed. Multiflora rose was found throughout the watershed in abundant numbers, but few very dense areas were observed. Japanese stiltgrass was scattered with some patches in the northern areas of the watershed. Stiltgrass was found to be more dense in the southern areas of the watershed, and hotspots were more common. Garlic mustard was observed scattered throughout the southern areas of the watershed. In the northern reaches, garlic mustard was rare with scattered plants growing in the northern most areas.

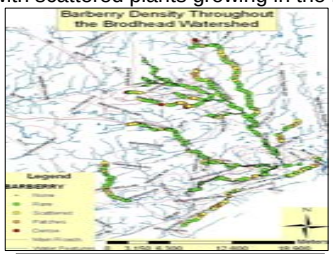

Figure 6: Brodhead Watershed barberry densities

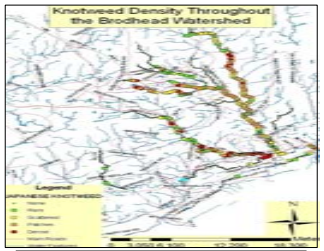

Figure 7: Brodhead Watershed knotweed densities

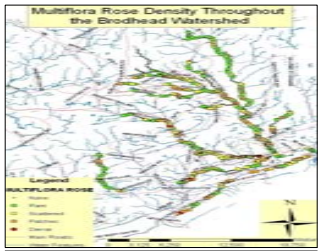

Figure 8: Brodhead Waterhsed Multiflora rose densities

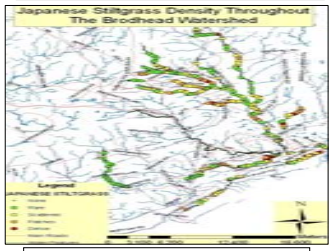

Figure 9: Brodhead Watershed stiltgrass densities

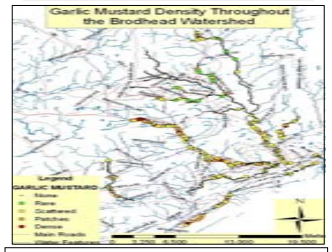

Figure 10: Brodhead Watershed garlic mustard densities

Figures 6-10 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 Brodhead Watershed have been subjected to significant 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 throughout the Brodhead Watershed 2) densities of this vegetation will continue to rise as it continues to spread throughout other areas of the watershed

References: BWA, http:/www.brodheadwatershed.org/ (access on 09/13/2007)