

Brodhead Watershed Association

Invasives Species Management Plan – Phase I

Department of Conservation and Natural Resources

Grant – BRC-RC1-11-5

Final Report

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Project Activities:***From the Project Scope of Work:***

Summary: *The Project will take place in three phases: 1) data collection, field inventorying and community education; 2) mapping, analysis and prioritization; and 3) development of a management plan. During the three years duration of the present contract, work in the first two phases will be accomplished for priority areas of the watershed.*

- 1) *Data collection / field inventory / education*** - *volunteers will be trained in invasive species identification, inventory and mapping protocols, and in the use of a GPS unit and will walk streams, trails and publicly owned lands to map locations of invasive species. Inventory and mapping protocols developed by The Nature Conservancy and the Delaware River Invasive Plant Partnership will be utilized. Educational information specific to the watershed will be developed and provided to landowners and, as requested, Master Gardeners will walk private lands with landowners to identify location of invasive species and to provide landowners with information on invasive species identification and control.*

Training:

Seven training workshops were held and 55 volunteers (including Master Gardeners) trained:

Train the Trainers- 1/25/06 – Monroe Co. Conservation District – 9 volunteers

Cherry Valley – 4/7/06 – Nancy Veety home – 14 volunteers

Buck Hill – 4/13/06 – Buck Hill Golf Club – 18 volunteers

Lower Brodhead – 4/28/06 – Dansbury Park - 7 interns

Lower Brodhead – 5/6/06 – Glen Park, Stroudsburg – 9 volunteers

Upper Brodhead – 5/8/07 – Evergreen School – 5 volunteers

Lower Brodhead – 5/07 – Glen Park - 7 Interns

The training included both volunteers and student interns. We found that, although volunteers were interested in learning about identifying invasive species, and control methods, interns are much more reliable at doing the actual field work and data gathering. In fact, in Cherry Valley, one volunteer did most of the field work in the Cherry Creek riparian corridor, with the assistance of paid interns. A similar situation occurred on the Buck Hill Creek. Other trained volunteers could not make the time to do the field work.

Data Collection/Field inventory:

Two Garmin handheld GPS units (Map 60 CS) and an Olympus Stylus 600 camera were purchased. A data entry form, Riparian Invasive Plant Survey Manual and flip-charts of invasive plants' pictures and descriptions were developed. (*see Appendix A*)

During the summer of 2006, East Stroudsburg University student interns, Jake Brunkard, Victoria Schaller and Nicole Taibi, their professors, Dr. Jerilyn Jewett-Smith and Dr. Shixiong Hu, and volunteers walked the stream corridors of the Lower and Upper Brodhead including Buck Hill Creek and Leavitt Branch in the headwaters, Cherry Creek, and all the streams of the Paradise watershed.

During the summer of 2007, interns Jennifer Reader, Christian Lichty and Molly Brunkard walked the Pocono Creek and McMichael Creek.

712 data points were generated, 250 meters apart, along each stream corridor. Distribution and abundance of riparian invasive plants were investigated. The following six invasives were found to be dominant: Japanese barberry, Japanese stiltgrass, Japanese knotweed, garlic mustard, multiflora rose, bush honeysuckles. Other invasives identified are purple loosestrife, tree of heaven, autumn and Russian Olive and phragmites; these were not common throughout the watershed. Each observation section was scored for the cover class (abundance) of the six dominant invasive species using a modified Braun-Blanquette value. Values ranged from 0 to 4. A section in which the invasive plant was rare scored 1, scattered scored 2, common-scattered patches scored 3 and dense or continuous scored 4. Latitude and longitude of each data point were recorded by GPS units. Photos were taken at most data points, with an emphasis on zones where riparian invasives or erosional features were prominent.

This Project had the benefit of additional intern time through a project managed by Dr. Shixiong Hu, a Study of Major Flood Impacts on Bank Erosion in the Paradise Creek Watershed, funded by an East Stroudsburg University Faculty Development and Research (FDR) grant. Dr. Hu, his son John Hu and ESU interns Shane Law, Michal Niemoczynski, Mark Edwards and Steven Hall worked on the bank stability assessment and also collected invasive plant data for this project. Before going into the field, the interns were trained in invasive plant identification and the field work protocols we are using. Dr Hu's project, and interns, covered the main stem and all tributaries in the Paradise watershed in 2006 and 2007.

Students, volunteers and professors walked a total of 130-150 miles of stream corridor in the course of the first two years of the project.

Each summer, prior to beginning the field inventory, letters were sent to property owners along the streams, informing them of the study and asking them to respond if they did not want the interns to walk the stream thru their property. About 20-30% of property owners responded positively. Most gave our team permission to access their land, some wanted to be notified of when the team would visit their property. A few property owners did not want their property walked, and did not like the approach taken in the letters. Thus, the format of the letters was changed in Phase II of the project.

Several property owners responded that they would like to know the results of the study. We have maintained a database of those owners, and will be providing them with information over the coming months.

Public Participation/Education and Outreach:

Master Gardener / private landowner outreach - Master Gardeners took part in the volunteer training workshops, and 50 riparian landowners, in the Cherry Creek and Lower Brodhead riparian corridors were contacted by letter (*see Appendix C*). However, only 2 landowners responded and requested visits by a Master Gardener. Those landowners were very interested in the information they received and seemed committed to following thru with invasive removal/native plant replacement.

Local Newspaper - We developed a monthly series for the Pocono Record of “Invasive of the Month.” A total of 13 articles were published. The invasive chosen for each monthly article was one that was at a stage in its life cycle when it was particularly obvious. In addition, several articles on the project, and its goals, were published during 2006-2007. (*see Appendices B and D*)

Workshop for Home gardeners – Dr. Jewett-Smith and interns participated in an “Open house” at a private home at which visitors could “tour” the owner’s property to see invasives and discuss removal techniques and appropriate native replacement. This day long event attracted over 50 people.

Stroud Community Day – at this public event, held in Stroud Township’s Brodhead Greenway Park in 2006, a BWA member who is also a Master Gardener tagged invasive plants in the Park and led groups of visitors on walks to discuss the invasives, removal techniques and native replacements.

Outreach to municipalities – in February of 2007 we sent a letter to all municipalities (17) in the watershed, updating them on the Project and requesting that they include in land development ordinances a list of plants (invasives) that should be avoided in developer landscape plans. We enclosed a list of invasives commonly used in landscape plans and suggested native alternatives. (*see Appendix C*)

Outreach to Brodhead Watershed Association members – regular articles were included in the BWA quarterly newsletter, updating readers on the Project and providing information on native plants. (*see Appendix D*) Drs. Hu and Jewett-Smith have worked with their students to prepare posters describing the study which we have had on display at membership meetings. (*see Appendix E*) The interns who participated have been at the meetings to explain the study, and what we have learned.

Outreach to property owners - Dawn Kendall, a volunteer who took part in the training on April 13, 2006, and later assisted interns in the mapping of the Buck Hill Creek, organized a group of about 15 volunteers to mechanically remove all the Japanese Knotweed along the Buck Hill Creek (about 200 yards). She also provided the group with information on invasives in general and Japanese Knotweed in particular. She reports a high level of interest within the Buck Hill community.

A member of the Brodhead Forest and Stream Association, a fishing club that owns 1400 acres with several miles of the Paradise and Brodhead creeks, has asked for assistance in “getting a handle on” invasives on the club’s property. Shixiong Hu has prepared maps of the Club’s property showing the location and extent of invasives in the riparian corridor. We will also provide information to the Club on removal techniques and appropriate native plant replacements. (*see Appendix F*)

As noted above, many property owners have requested information on the results of the study. We will provide them with follow-up information.

Internet outreach – At the beginning of the study, Dr Jewett-Smith developed invasive plant information and posted it on her academic webpage at East Stroudsburg University. The BWA website contains a description of the Project with a link to her page to “Learn more about invasive plants” (*see Appendix D*). We also have posted maps of the study results as they have been prepared.

Academic outreach – Dr. Jewett-Smith and Dr. Hu and their students presented papers on the Project at several state and local meetings, such as the Pennsylvania Academy of Sciences annual meetings (2006 and 2007), Association of America Geographers (AAG) annual meeting (2006), and ESU Sigma Xi Chapter annual meeting (2007). (*see Appendices E and G*) Dr. Jewett-Smith spoke at a training workshop for landscapers and pesticide applicators sponsored by Penn State Agricultural Extension.

2) Mapping, analysis and prioritization – *ARCVIEW GIS maps of the Cherry Valley and the lower Brodhead watersheds showing locations of infestation will be developed. A data layer, and metadata, for each species identified will be provided. Data will be analyzed and prioritized. Mapping standards found in the California Weed Mapping Handbook, developed by the California Department of Food and Agriculture, will be used.*

Mapping and Analysis:

We purchased a Gateway Computer (Serial number 0036361654, Model 280E), an HP Deskjet Printer (Model 9800 CD) and Arcview Single Use Unkeyed License (93198) and Arview 9.1 Single Use Unkeyed Installation Package (100037) for data entry and mapping. This equipment will be used to complete Phase II of the project, and for future updating and analysis of invasive species data as we continue outreach to interested landowners and development of a management plan.

The invasive plant data were recorded in the field investigation. The presence and density of invasive flora were noted using an estimated density method. Both left and right banks were observed with canopy cover and soil moisture being noted. Initially, two sides of the creek banks were estimated separately. Later, we realized that this is meaningless due to the error of handheld GPS units. Since 2007, invasive plants in both sides of the creek were estimated together. The waypoints of the survey sites were created with handheld GPS units. The waypoints were transferred into Arc GIS software. The invasive plant data were input into a spreadsheet and joined to the attribute tables in GIS shape files. All 712 waypoints were

standardized into same format in the attribute table. The top six invasive plants, identified by statistical analysis, are: Japanese barberry, Japanese knotweed, Multiflora rose, Japanese stiltgrass, Garlic mustard and bush honeysuckles. Then, the distribution pattern of these invasive plants was mapped with Arc GIS. The hot spots were identified from these maps.

Conclusions:

Invasive riparian plants (IRPs) have been found throughout the surveyed portions of the Brodhead watershed in Monroe County, PA.

The six prevailing invasive species found in the watershed are shown with maps generated using ArcMap. (*see Appendix H*) 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. Japanese barberry was found throughout the watershed with patches observed along almost every stream, and hot spots observed in a few areas in the upper watershed. 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. The distribution of bush honeysuckles is not widespread, and probably is associated with escapes from cultivation. Results indicate that 1) exotic plants are replacing native species the riparian areas throughout the Brodhead Watershed 2) without controls, densities of this vegetation will continue to rise as it continues to spread throughout other areas of the watershed

Details --

- The IRP garlic mustard (*Alliaria petiolata*) was more common in the lower portions of the Brodhead subwatershed, throughout the Pocono, rare in the McMichael and scattered in Cherry Creek. Hot spots (areas of high density, scored at 3 or 4), were rare.
- The IRP Japanese knotweed (*Fallopia japonica*, syn. *Polygonum cuspidatum*) was most common and dense in the lower portions of Cherry and McMichael Creeks. A very dense infestation of Japanese knotweed was found at the confluence of Pocono and McMichaels Creeks, just upstream of the mouth of the McMichael into the lower Brodhead. There were also dense patches found throughout the Upper Brodhead and Pocono subwatersheds. Occasional dense patches were found in the Paradise subwatershed. Many headwaters areas were free of Japanese knotweed, including Devil's Hole, Yankee Run, the upper part of the Pocono and Cherry Creeks.
- Multiflora rose (*Rosa multiflora*) was a commonly found IRP shrub in the Brodhead Watershed, with densities of 2 – 3 (scattered or common patches) throughout. Dense (score of 4) patches occurred in the confluence regions of the Pocono and McMichael

Creeks. The pattern of infestation here did not appear to increase from headwaters to mouth as seen in J. knotweed.

- Japanese barberry (*Berberis thunbergii*) was another common IRP woody shrub throughout the Brodhead watershed, although rarely in high density. Density patterns of 2-3 (scattered or common patches), as seen with multiflora rose were the most common. Also, as with multiflora rose, no pattern of increase in the lower parts of the watershed was seen. Scattered high density infestations in headwaters to middle reaches in parts of the Paradise were seen.
- Bush Honeysuckle - Several species of bush honeysuckles are invasive in Monroe County and within the subwatersheds of the Brodhead. As these shrubs are capable of cross breeding, and not always were with flowers or fruit during surveys, it was decided, because of the difficulty of exact species identification, to lump together the following: *Lonicera maackii* the Amur honeysuckle; *L. morrowii*, Morrow's honeysuckle; *L. tartarica* the Tartarian honeysuckle. The distribution of the honeysuckles is not widespread, and probably is associated with escapes from cultivation. The most common sites are downstream regions of the Pocono and Cherry Creek. Scattered patch size populations were seen in two sections in the middle portions of the McMichael, as well as on the Paradise, and lower and upper sections of the Brodhead subwatersheds. The scattered nature of the upstream populations means that targeted removals can, in the near future, control the spread. More effort will be needed on the McMichael, Pocono and Cherry Creek populations. This is a group of species that are valued for their deer resistance, foliage and flowers which suggests that private landowner education will play a major role in eradication and management success.
- Japanese Stiltgrass (*Microstegium vimineum*) is widely distributed in the Brodhead Watershed, except for the subwatershed of the Pocono, where it was not reported, except for a site at the confluence with McMichael Creek. As the surveys for that section of the stream were primarily conducted in the early spring 2007, prior to emergence of the annual grass, a resurvey in July 2007 was done and the species was still not found. It is likely that the species will invade, as it has been seen along roadside margins within the area. Distribution of the species along many of the tributaries of the Paradise occurred with scattered to dense patches common. Patterns within the Paradise subwatershed also pointed to the headwaters being clear of infestation and middle to lower regions hosting populations of this invasive, exotic grass. Sections of the lower Brodhead were invaded as well as a patchy distribution within the upper Brodhead. One tributary, the Leavitt Branch, had significant stiltgrass patches, ranging from scattered to dense, in the middle regions. The upper regions of the McMichael Creek showed a low incidence of stiltgrass, but densities and occurrence increased downstream to the confluence with the Pocono. Cherry Creek had scattered stiltgrass in the upper regions, which increased in the lower quarter of the watershed, with scattered to dense patches to the mouth of the stream at the Delaware River. Future statistical analyses of stream bank stability and flooding influence may help quantify the relationship between density and distribution of stiltgrass. Areas where this plant was most abundant in lower regions

of the subwatersheds coincided with a more open tree canopy and or disturbance due to urbanization.

See *Appendix H* for summary maps of these six invasives in the Brodhead watershed.

Next steps:

Using ArcGIS statistical software these patterns of distribution and abundance will be further clarified. Data will be analyzed for influences of disturbance such as stream bank stability, road and rail crossings, agricultural usage and land conversion due to development. This analysis will facilitate Phase II of this project, the development of a Management Plan for Invasive Riparian Plants.

We have received funding for, and started work on, Phase II of the Invasive Species Management Plan (DCNR grant BRC-RC1-13-3-506). During the summer of 2008, interns completed data gathering on the Marshalls Creek and continued data input. We will begin mapping and analysis in 2009 and expect to have a Management Plan completed in 2009-2010.

Explanation of GIS data CD:

1. Please copy the entire folder of BROD to C: drive in the hard disk of your computer. After copying, your data should be under C:\BROD
2. The software used to create these maps is Arc GIS 9.2. Metadata has been created based on FGDC standard. Please use Arc Catalog to view Metadata information.
3. There are five folders under C:\BROD
 - 1) Bkgd_Data: includes Brodhead Sub-watershed, Cherry Creek, Stream Network and Main Road layers
 - 2) Map_Projects: includes GIS map projects of the top six invasive plants.
 - 3) Maps_In_Photo: includes the maps of the top six invasive plants (.jpg)
 - 4) Picture_final: includes the pictures with hyperlinks to the waypoints. Some subfolders are empty due to camera failure or the surveyors' falling into creeks.
 - 5) Survey_Data: includes the data layer of all the 712 survey waypoints. The information on invasive plants can be seen in the attribute data of this layer.
4. The hyperlinks to the waypoints are based on project of "01 Barberry_Map.mxd". Click this file under C:\BROD\Map_Projects. Follow the steps as below:
 - 1) Click *View -> Data View*
 - 2) Click *View -> Toolbars -> Tools* (if *Tools* is checked, leave it there; if it is unchecked, please check it. Under most situations, it is checked by default).
 - 3) Click the lighting sign of "hyperlink" in the last one of *Tools*, then the points with hyperlinks to pictures become blue in color.
 - 4) You need the software of *Windows Picture and Fax Viewer*, in which most computers have this software with Windows platform. If your computer has more than one picture view software, it will select the default one to read the pictures with hyperlink.
 - 5) Point the mouse cursor to any points in blue, until you see a line saying "C:/Brod/Picture_final/..." (Need some patience :), then left click the mouse, you will see a new pop-up *Hyperlink* window, then, click *jump*, and you can see the pictures of the points with hyperlinks. Some waypoints have multiple pictures to show the invasive plants and landscape along the channel. You can see these multiple pictures of one waypoint by selecting the picture and click *jump*, or just using "left ->" or "right <-" arrows on your keyboard of computer.
5. All the data are compiled by Dr. Shixiong (Shawn) Hu. Please feel free to contact him by phone or email.

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