Proposal to the Appalachian Landscape Conservation Cooperative

Project Title: A Web-Based Tool for Riparian Restoration Prioritization to Promote Climate Change Resilience (RPCCR) in Eastern US Streams

Project Description: Provision of shade via riparian restoration is a well-established management adaptation strategy to mitigate temperature increases in streams. Effective use of this strategy is contingent upon accurately identifying vulnerable, unforested riparian areas in priority coldwater stream habitats. The RPCCR is a web-based tool currently under development which is designed to allow managers to rapidly identify these high-priority riparian restoration targets. The objective of this project is to complete development of the RPCCR, link it with the Appalachian LCC website, and integrate it with ongoing stream temperature monitoring and modeling efforts within the NE Climate Science Center (NECSC) and participating Landscape Conservation Cooperatives.

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Duration of Project: December 2012 – July 2013.

Project Background: Increased stream temperature as a result of climate change (IPCC 2007) is a major concern for conservation and natural resource management in the eastern US. Temperature exerts a primary constraint on species distribution and abundance in headwater streams, and is particularly important as many species have already experienced decreases in range and occurrence associated with anthropogenic stressors (Hudy et al. 2008). At the same time, the temperature regimes of headwater streams have a significant influence downstream, and may play a key role in maintaining ecological integrity throughout the river network.

Regional climate change predictions indicate a magnitude of stream temperature increase that is likely to threaten the persistence of coldwater dependent species such as the Eastern Brook Trout (*Salvelinus fontinalis*) over much of its native range. For example, models based on simple relationships between increases in air and stream temperatures predict extirpation of eastern Brook trout in the southern Appalachian region (Flebbe et al. 2006). However, streams vary considerably in their sensitivity to increases in air temperature (Trumbo et al. 2010), and resilient streams are likely to provide refugia for coldwater fish in the context of regional climate change, allowing populations to persist A major determinant of among-stream variation in both current and predicted future temperature regimes is direct exposure to sunlight (solar gain), which is codetermined by geography (aspect, elevation, topography, and latitude) and the extent to which streams are shaded by riparian vegetation (Fu and Rich 1999). While managers cannot change geography, they can directly influence solar gain to streams by restoring riparian shade through restoration of riparian forests (Moore et al. 2005). Areas with high potential solar gain inputs (due to geographic setting) and a low percentage of canopy cover would be high priority areas for tree plantings to reduce stream temperatures. As an example of the efficacy of these actions, in one of our controlled experiments, artificial shading of only 800 m of stream reduced the summer stream temperatures by 2 C for over a mile downstream (Fink 2006). This shading effect is predicted to mitigate against the equivalent of up to a 4 C increase in air temperatures.

Nationwide, it is estimated that > 1 billion dollars has been spent on stream restoration activities in recent years (Bernhardt and Palmer 2006), with a substantial percentage of these projects involving riparian conservation and/or restoration. Projects targeting restoration of riparian areas are a priority of many federal and state agencies in addition to many Non-Governmental Organizations (NGO's) such as Chesapeake Bay Foundation, Trout Unlimited and the National Fish and Wildlife Foundation. These agencies and organizations focus on re-establishing forested riparian buffers because of the many potential benefits of an intact forested riparian corridor (Lowrance 1998) including but not limited to reduced stream temperatures. Restoration groups need to select projects that are strategic at various scales. Selecting and prioritizing riparian restoration projects that maximize limited restoration dollars have been a challenge because of the lack of prioritization tools at the appropriate scale. Further, restoration efforts that contribute to climate change resilience will be increasingly important, as demands are made on agencies to demonstrate the extent to which their activities foster adaptation to a changing regional climate.

Project Approach and Methodology: We propose to develop and implement a user-friendly web-based tool to identify priority areas for riparian restoration in the context of predicted climate change at the appropriate scale needed by practitioners. The Riparian Prioritization for Climate Change Resilience (RPCCR) tool, through static maps and a GIS server based system, will prioritize all riparian corridors (defined as within 100 meters of the NHD+ stream layer) within the target area. RPCCR builds off of our proof of concept tool used in Virginia to identify habitat patches of brook trout that are vulnerable to climate change (Figure 1). RPCCR will focus on three metrics; solar gain, percent canopy cover and elevation; metrics that directly relate to managers whose restoration activities focus on tree planting in riparian corridors (Fu and Rich 1999; PRISIM 2007; USGS 2008; USGS 2009). The elevation metric would further refine priority areas as the longitudinal distributions of many aquatic species (e.g. brook trout) are constrained by elevation (EBTJV 2006; Flebbe et al. 2006; Hudy et al. 2008).

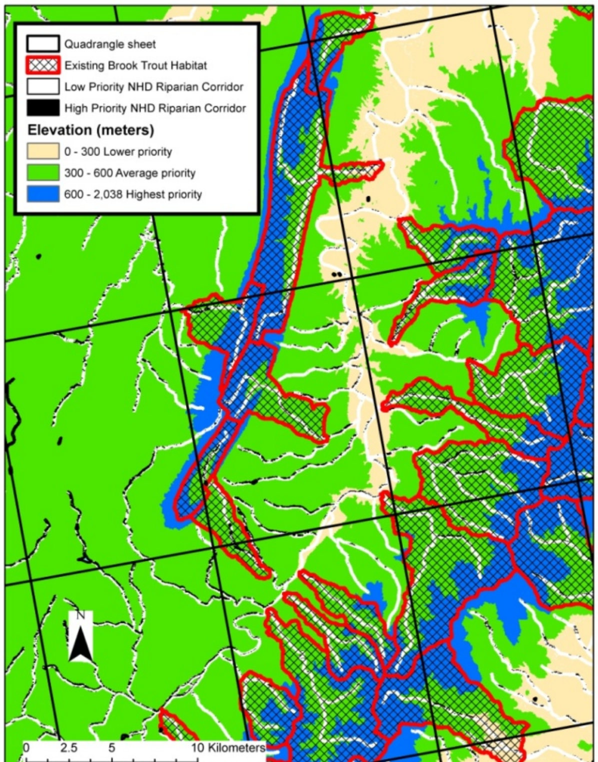

Figure 1. Riparian corridor areas in Virginia that are high priority (black = upper quartile of solar gain and less than 70% canopy cover) for riparian restoration to mitigate water temperature increases. Brook trout priority areas are defined by elevation gradients (0-300 m low priority; 300 – 600m average priority; > 600m high priority). Cross hatched polygons represent existing brook trout habitats. Blue and green elevation gradients represent potential cold water brook trout habitat.

Project Scope and Expected Products: The initial geographic scope of the project will cover the low-order streams of the North Atlantic and Appalachian LCCs. Our ultimate goal is to extend the application to the entire region served by the NECSC. We will co-host RPCCR as an open-access tool on the Appalachian LCC website, with links to the NALCC and other sites of management agencies and conservation organizations. Our objectives are two-fold. First, we will provide a ‘shovel ready’ prioritization tool for managers facing immediate on-the-ground decisions. Second we will link directly to ongoing and future stream flow, temperature, and biological response modeling projects and decision support tools. These include the integrated flow modeling and population response study currently funded by the North Atlantic LCC (Letcher, USGS-CAFRC – P.I.) and the integrated flow and temperature modeling project currently funded by the NECSC (Polebitski, UMASS – P.I.).

Timeline: We anticipate a beta version of the RPCCR by the end of March 2013 and a final version by the end of July 2013. In addition, we anticipate publishing a short article in a peer-reviewed journal detailing our project.

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