ASSESSING LANDSCAPE CAPACITY TO REGULATE FLOODS IN SELECTED WATERSHEDS ACROSS NORTH CAROLINA AND VIRGINIA

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Scientific knowledge about ecosystem services (ES) – the benefits people derive from nature – is increasingly being used to inform how we manage land and water. A globally important ES, especially in the context of rapid urban development, is the ability of landscapes to regulate floods. Most flood control programs focus on the infrastructure built to reduce flood damage. However, the value of natural ecosystem components, such as forests and wetlands, in slowing run-off and enhancing infiltration to groundwater, thereby reducing floods, is starting to be recognized. Better tools are needed to quantify and map the capacity of landscapes, including natural and built components, to regulate floods.

To assess flood regulation capacity, we examined how spatial and temporal patterns of flood regime (measured as the number, magnitude, and duration of floods) vary with landscape structure across and within small, gauged watersheds in non-tidal North Carolina (NC) and Virginia (VA). We analyzed 23 years (1991 to 2013) of instantaneous discharge data (~15 minute interval) for each of the 31 watersheds. We tabulated the number of floods as well as their magnitude and duration above the gauge-specific discharge with 80% of a one-year return interval. We used a low threshold to define a flood because large precipitation events are uncommon and largely unmanageable, instead small and intermediate floods seem to be events where management can curtail flood damage. Our objectives were to test the effect of landscape structure on the three flood regime metrics by assessing anthropogenic, natural and anthropogenic + natural models.

Our study indicates that most of the variance of the magnitude of floods can be explained with the natural + anthropogenic model, while flood duration and frequency are better explained by natural models. We found a decrease in magnitude and number of floods but an increase in flood duration as forest cover increases. Opposite trends occur as urban cover increases: increasing magnitude and number of floods, but decreasing duration. During the 23 year time period, precipitation shows a declining trend. We found no effect between the number, magnitude and duration of floods and precipitation. Since the 1990s, the number and spatial extent of best management practice structures (i.e. detention ponds) that influence surface hydrology has increased substantially in urban watersheds. Despite this increase, our results show that urban areas still experience short-duration, high-magnitude, frequent floods.

In contrast to other studies that track changes in flooding through time, our study uses higher resolution discharge data than what is normally used (instantaneous vs. daily discharge) to empirically test changes in flood regime across a large spatial extent and the longest temporal record available. Understanding the effects of natural and anthropogenic variables on flood regime can lead to more effective flood management. Our ES approach suggests there may be benefits to adopting a more integrative approach to flood management and river conservation.

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