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Geospatial assessment of riparian zones: A case study in the Hudson River Estuary – Stockport Creek Watershed

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Abstract

Riparian restoration and protection provide key benefits in terms of both clean water and resilient communities. Unfortunately, key knowledge gaps exist in terms of understanding the current state and effectiveness of riparian corridors in New York State. The primary objective of this study was to develop a method to delineate buffer vegetation and quantify the spatiotemporal patterns of buffer vegetation variation over time. We tested our method in a sub-watershed of the Hudson River-Stockport Creek Watershed. With an overall accuracy of classifying vegetation and non-vegetation regions within aerial photos above 97%, we were able to confidently determine spatial trends in buffer vegetation for 2006 and 2015. We tested four different buffer sizes and found that there were more areas of vegetation than non-vegetation regardless of size. Hotspot analysis reveals that 15–22% of buffer areas have clusters of vegetation degradation within each year, 30–40% of buffer areas are persistently degraded across the time span studied. Ultimately, our approach can enable stakeholders, managers and community groups to not only rapidly delineate buffer vegetation from high spatial resolution aerial images, but also enable them to assess the spatiotemporal patterns of vegetation variations.

Three Summary Points of Interest

- We found decreasing trends of vegetation cover ($-1.45 - -0.07\%$, $-0.1 - -0.01\text{km}^2$) in 30–90 m buffers over time. However, the 120 m buffer showed an increasing trend (0.1% , 0.03km^2).
- Compared to riparian buffers defined from 1 m aerial imagery, results show traditional mapping products based on 30 m satellite images underestimate the proportion of buffer vegetation by 19–22% while overestimating agriculture by 10–14%, and other non-vegetation land cover by 8–9%.
- Results of cluster analysis provided further insights into spatial and temporal patterns of buffer vegetation degradation. Such information can be directly utilized to aid buffer management and restoration efforts on the ground.

Keywords: Riparian Buffer, Remote Sensing, Spatial Analysis, Spatial Autocorrelation, Land Cover, Vegetation degradation

Overview

The 2015 Hudson River Estuary Action Agenda states that riparian restoration and protection are selected actions that will provide key benefits in terms of both clean water and resilient communities for 2015–2020 (NYS DEC 2015). Unfortunately, key knowledge gaps exist in terms of understanding the current state and effectiveness of riparian corridors in New York State. Yet this is not just a regional problem; since a national panel in 2002 concluded that the United States lacked a detailed map of the location and condition of riparian ecosystems (Brinson et al. 2002), various entities have reiterated the need for a comprehensive, detailed representation of riparian zones. Many of them have also identified this as a critical data gap (Salo and Theobald 2016). Thus, to fill this gap not only supports efforts of the Hudson River Estuary Program (HREP), but also contributes to the broader national attempt in mapping riparian zones.

We conducted a pilot project mapping and assessing geospatial changes in riparian corridors within a Hudson Estuary River sub-watershed to aid riparian restoration and protection efforts by HREP, specifically the program of the Hudson Estuary Trees for Tribes (HETT). This program currently offers on-the-ground assistance to qualifying native riparian tree and shrub planting projects within targeted Hudson River watersheds. By applying our method, we generated results that provide valuable information that can help identify key riparian zones to allow targeted and effective prioritization of restoration projects, assisting in long term monitoring of riparian protection efforts, and supporting programs that aim to educate local communities about the critical roles riparian buffers play.

The attached in-depth manuscript-style report provides more information on this project and explains the background, processing flow, results, conclusions and restoration recommendations.

Policy Implications

There are currently no laws or regulations in the New York State regarding riparian buffer or zone protection. However, HETT and NYS Trees for Tribes are actively working with community groups and local governments to restore and protect riparian areas. We hope our method of delineating buffer vegetation can aid the decision and planning processes of various on-the-ground conservation efforts. The framework established by this study could also be utilized in potential riparian policy making processes for filling the information gap of buffer vegetation current states and historical trend.

Outreach Comments

We were in contact with Beth Roessler, Stream Buffer Coordinator for the Hudson River Estuary Program, periodically regarding this project. We will continue to reach out to her and share both our findings as well as the methods developed from this study. Furthermore, we will share all our findings and data from this project through a website hosted by SUNY ESF, as well as potential future presentations and publications.

Student Training

One doctoral candidate at SUNY ESF worked full time as a research project assistant for duration for this project. The training he received from this study includes enhanced understanding of: river channel boundary delineation, sampling design, supervised image classification using Google Earth Engine, and geospatial data analysis using ArcMap.

Publications/Presentations

Part of this project was presented at as a webinar named Riparian Buffer Assessment on March 19th 2018 sponsored by the New York State Geographic Information Systems Association. The remainder of this report is structured as the draft of a manuscript that will be further developed for future publication.