Using NDVI to Investigate Evergreen Shrub Expansion along Hannah Run in Shenandoah National Park, Virginia

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INTRODUCTION

The introduction of invasive species has dramatically altered forests in the eastern United States over the last century and caused die-offs of common overstory trees, especially eastern hemlock (*Tsuga canadensis*) and American chestnut (*Castanea dentata*) (Ford et al., 2011). These die-offs have increased light incident on the forest floor and promoted the expansion of understory evergreen shrubs like rhododendron (*Rhododendron maximum*) (Cofer et al., 2018). Expansion of *R. maximum* often initiates a variety of environmental changes harmful to other species, such as dense shading that inhibits canopy tree recruitment, a reduction in soil nutrients, and changes in soil seed bank structure (Atkins et al., 2018) (Cofer et al., 2018). The goal of this research is to assess the possible expansion of evergreen shrubs along Hannah Run, Madison County, Virginia. This first order stream is on the eastern slope of the Blue Ridge Mountains and has a mean basin elevation of 715m.

METHODS

Landsat 5 TM (Thematic Mapper) imagery was collected during snow-free, leaf-off time periods to allow for maximum viewing of *R. maximum* and mountain laurel *(Kalmia latifolia),* a common co-dominant shrub. Imagery was gathered from 1985–2011 to evaluate possible expansion of these shrubs over time. Areas within 90m of Hannah Run were masked (three pixels) to study possible shrub expansion in riparian areas.

The Normalized Difference Vegetation Index (NDVI) was calculated for each pixel using Band 3 (red; 0.62–0.72 µm) and Band 4 (near-IR; 0.725–0.9 µm) to determine greenness of vegetation.

$$NDVI = \frac{Band\ 4(X_1) - Band3(X_2)}{Band\ 4(X_1) + Band3(X_2)}$$

Figure 1—Hannah Run (blue; left) in Shenandoah National Park (38.600574, -78.316456) and *R. maximum* (right).

RESULTS

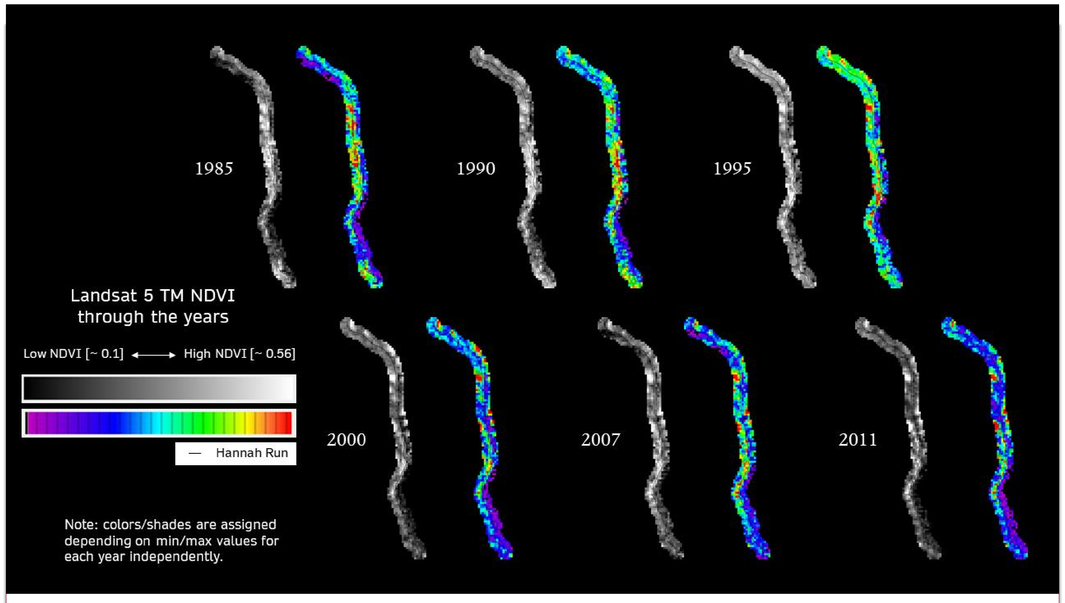

Figure 2—Final NDVI results from areas masked around Hannah Run (90m buffer).

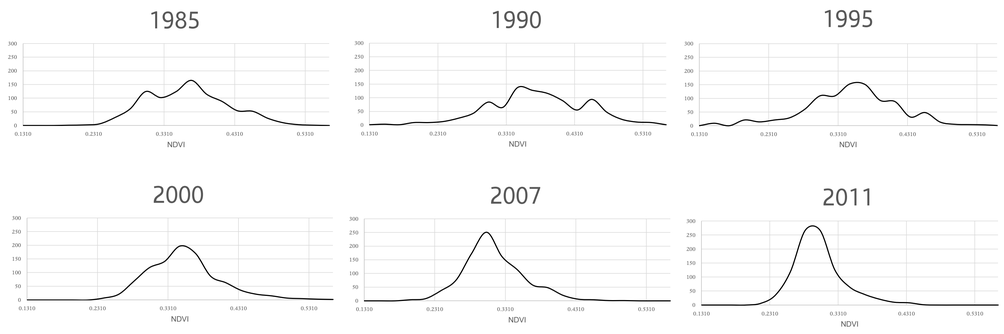

Figure 3—Frequency of NDVI in masked areas along Hannah Run for all scenes.

DISCUSSION & FUTURE RESEARCH

We expected winter NDVI to increase if evergreen shrubs have expanded along riparian areas, but our preliminary results showed an unexpected decrease in winter greenness across our time frame. This result may relate to the land use, management, or fire history at our site, or other characteristics.

Further analyses will focus on understanding possible differences in greenness between *R. maximum* and *K. latifolia* in response to different environmental and forest management processes and possibly understanding…

- The influence of aspect, elevation, and distance-to-stream on *R. maximum* and/or *K. latifolia* using pixel-wise regression.
- Determining any difference in recent evergreen shrub expansion between areas that were predominately *C. dentata* versus *T. canadensis.*
- Modeling areas where future *R. maximum* and/or *K. latifolia* expansion is likely.

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