Effects of vegetation structure on nutrient outflows from a montane tropical Forest-Grassland mosaic

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Abstract

Changes in vegetation structure and composition can change soil erosion and the outflow of nutrients from an ecosystem. We investigated sediment and nutrient outflow from 11 catchments with different land covers in the montane Nilgiris, a part of the Western Ghats biodiversity hotspot, India. Preliminary analysis suggests that invasion in this landscape increases sediment and nutrient outflow. Further analysis will shed light on how invasive plant species change these outflows in this landscape.

Keywords: Invasive plants, Western Ghats, Soil erosion, Nitrate, Phosphate

1. Introduction

The *Shola*-Grassland ecosystem of the Nilgiri biodiversity hotspot, India, is a mosaic of cloud forests (called *Shola*) in valleys and sheltered folds, and open grasslands in slopes and hill tops. The grasslands are being invaded by three Nitrogen (N)-fixing woody plant species: *Acacia mearnsii* (a tree), *Cytisus scoparius* and *Ulex europaeus* (shurbs).

So, invasion is changing the structure and composition of the Nilgiri grasslands. Because invasive species can change nutrient cycling (Carpenter et al. 2011, Stewart et al. 2018), they can change nutrient outflow from the ecosystem. Since the Nilgiris are home to numerous water reservoirs, changes in nutrient outflow due to invasion can have downstream consequences on economics, human health and freshwater biodiversity.

We determined sediment and nutrient outflows from catchments with different proportions of *Sholas*, grasslands and invasives.

2. Methods

11 catchments were chosen near the Upper Bhavani dam in South-West Nilgiris (Latitude: 11°16'31"N; Longitude: 76°33'42"E) for this study. This is part of a long-term project aimed at understanding the effects of vegetation and extreme rainfall events on hydrological cycles.

From April 2014 to December 2015, in the exit points for 5 catchments, we installed modified siphon stage samplers, which collected water outflow after storm events (extreme rainfall). We measured sediment load, and concentrations of nitrates and phosphates in each collected sample.

3. Results & Discussion

In Figures (a), (b) and (c) (Invasives vs Grasslands; different vegetation structures), we see that there are more extreme outflows of all three variables from the catchment with more invasives, as compared to the catchment with low invasives. So, invasion into grasslands is increasing soil erosion and nutrient outflows.

In Figures (d), (e) and (f) (Invasives vs *Sholas*; same vegetation structure, but different composition), we see that the catchment with lowest invasion has the lowest outflows of all three variables, as compared to the catchments with more invasion. So, although both *Sholas* and invasives are woody structures, soil erosion and nutrient outflows are higher from invaded areas as compared to *Shola* patches.

4. Further analysis

We will integrate the presented data with measured water flow data from each catchment (1 minute frequency) and grab samplers (collected approximately every 2 weeks in all catchments). We will use Principal Component Analysis to determine how increasing invasion affects nutrient and sediment outflow from the Nilgiris.

5. Acknowledgements

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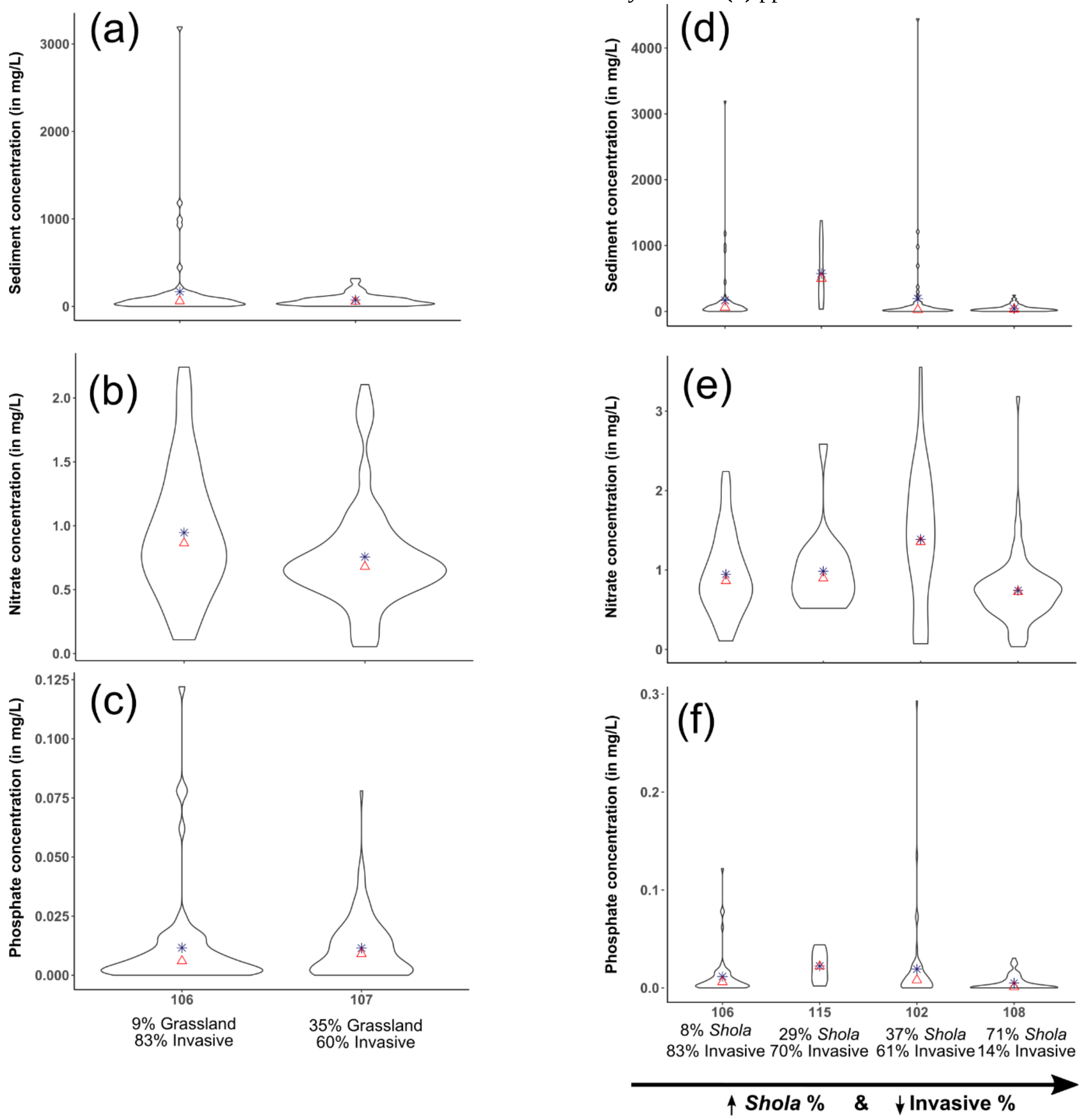

Violin plots of stage sampler data (Blue stars: Means; Red triangles: Medians). X-Axis has catchment numbers.

(a),(b),(c): Comparing sediment, nitrate and phosphate outflow between a catchment having high proportion of invasives versus a catchment having low proportion of invasives. (Both having low proportion of *Shola*)

(d),(e),(f): Comparing sediment, nitrate and phosphate outflow between catchments with increasing proportion of *Shola* and decreasing proportion of invasives. (All having low proprtion of grasslands)