Nitrogen availability along an elevational transect in a tropical montane forest - Rwenzori, Uganda.

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Abstract

To better understand environmental controls on N availability in tropical montane forests, we setup an elevational transect on Mt. Rwenzori in Uganda, ranging from 1264 to 2886 m a.s.l. Analysis of total N content and $\delta^{15}N$ stable isotope composition in top 30 cm revealed a positive correlation between total N content and elevation. Total N content increased four-fold between lowland to upper montane. Whereas soil $\delta^{15}N$ decreased three-fold along the elevation transect. However, canopy N content showed negative correlation with elevation. and canopy N:P ratio revealed more N availability at the lower elevations and more P availability at higher elevations.

Keywords: Elevational transect, Nitrogen, tropical montane forest

1. Background

Tropical montane forests are important terrestrial ecosystems with high carbon storage, species endemism and biodiversity. Due to variation in climate and forest types, elevational transects in montane forests are an open-air natural laboratory for studying the influence of abiotic factors on forest composition, functionality and biogeochemical cycles. As such, through difference in climate and soil profile development, it is generally assumed that nutrient limitation shifts from P to N limitation with increasing elevation.

2. Methods

To better understand environmental controls on N availability in tropical forests, we setup an elevational transect on Mt. Rwenzori in Uganda, ranging from 1264 to 2886 m a.s.l. We collected sunlit mature canopy leaf and top soil samples (0-30cm depth). Total

N content and $\delta^{15}N$ stable isotope composition in top 30 cm was analysed using elemental analyser interfaced with an isotope mass ratio spectrometer

3. Results

We found a positive correlation between total N content and elevation. Total N content was 0.3 ± 0.1% at the lowest elevation forest (at 1264 m a.s.l.) and increased four-fold to 1.3 ± 0.1% at the upper montane forest (2886 m a.s.l.), revealing a linear increase of 0.07% per 100 m of elevation distance. Whereas soil $\delta^{15}N$ decreased three-fold along the elevation transect, declining from 8.9 ± 0.19 ‰ at lowland forest to 3 ± 0.7 ‰ at upper montane. Soil $\delta^{15}N$ trend exhibited a linear decrease of 0.39 ‰ per 100 m of elevation increase. However, canopy N content showed negative correlation with elevation with linear decrease of 0.1% per 100 m of elevation increase. Meanwhile, canopy N:P ratio revealed more N availability at the lowest elevation and more P availability at higher elevations. The results support the paradigm of shifting nutrient limitation from P to N when transiting from low land to montane forest and a conservative nutrients cycling with increasing elevation.

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