Nine years of liana removal does not alter a tropical rainforest’s fine root biomass or morphology.

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Summary

Woody vines (lianas) contribute up to 40% of the upper canopy foliage in tropical forests, and greatly inhibit trunk growth on the trees they inhabit. While weighing down branches and shading could explain this inhibition, so too could belowground competition[1,2,3]. In this context, we measured fine root biomass and morphology in the upper 10 cm of plots from which lianas had (n=8) or had not (n=8) been removed for the past nine years. We found that fine root (≤2mm) biomass, length, and mean diameter in liana removal plots did not differ from that in control plots (p≥0.2). **These data suggest that, in this tropical forest, fine root stocks and morphology are not sensitive to the removal of this functional group.**

Methods

The experiment consists of sixteen 0.64ha plots across two km^2 of forest in the Gigante Peninsula of Panamá (9.11ºN, 79.85ºW). The plots were paired based on a 2008 survey of their liana biomass and tree structure. One plot of each pair has had all lianas regularly removed by machete since March 2011. Trees have compensated for the loss of liana leaf area[4] and aboveground woody biomass[5]. Here we ask whether trees compensated for fine roots as well. We sampled in the dry season of 2020 (Jan 27-29). Nine soil samples were collected from each plot in a grid design (144 samples total). Each sample captured 63 mL of soil to a depth of 10cm. Soil was stored for ~37 weeks at 4ºC until roots (≤2mm) were isolated and washed (longer than expected due to the pandemic). We did not observe any obvious signs of root decomposition (Fig. 1a) and processing time was the same for each treatment. Root images were analyzed for diameter and length using SmartRoot plugin[6] for Fiji software[7]. Nodes were identified automatically by the software or added by hand (yellow dots in Fig. 1b) after which the software measured the diameter of the root relative to a known reference object and averaged this across the distance to the next node (green lines in Fig. 1b). These distances were also summed for total fine root length, capturing the length of curved roots through many short straight lines. Roots were then dried to constant mass at 65ºC and weighed. All samples from the same plot were averaged together to quantify plot-level fine root characteristics (n=8 each for liana removal and control).

Fig. 1 a) Plain light view of fine roots from one of our soil samples b) Roots as identified and marked for determination of length and mean diameter

Results

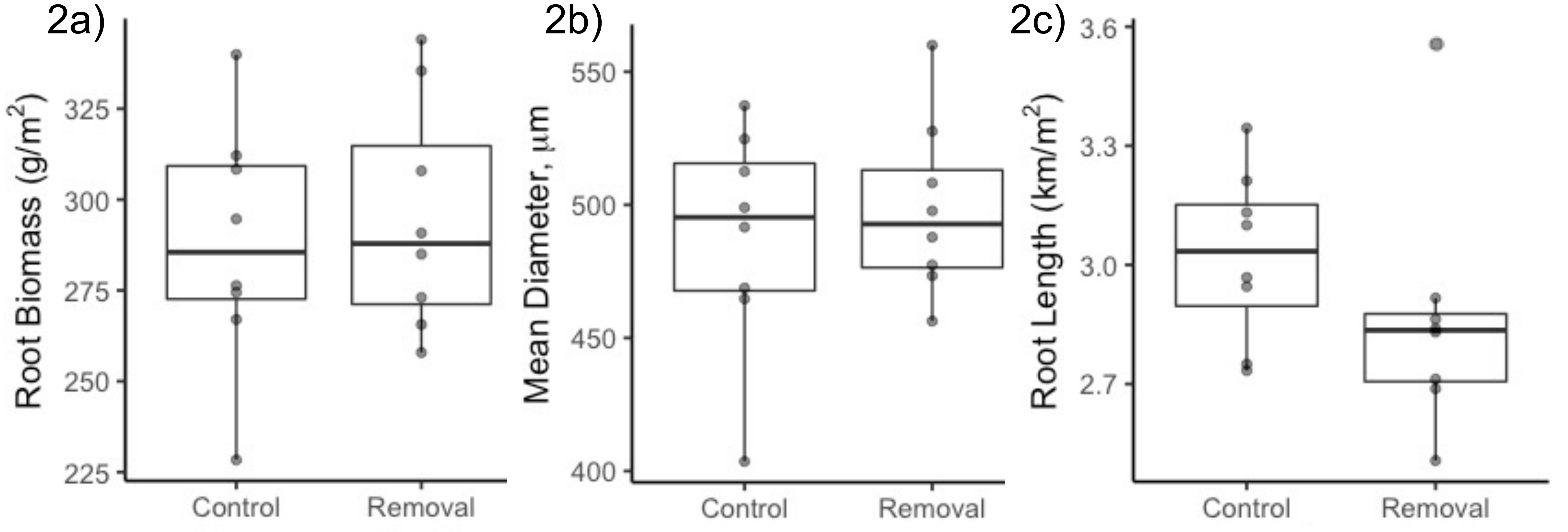

Fig. 2) There were no significant differences between the two treatments in fine root a) biomass, b) mean diameter, or c) length (paired t-test, p≥0.2). Box plots show medians, quartiles, and an outlier (≥1.5xIQR).

Discussion

Overall, **the similarity between the two treatment types suggests trees replaced liana fine roots**, similar to what they did aboveground with leaf area. **Although our sampling was spatially intensive, our conclusions are limited to the top 10cm during the dry season.** Seasonal differences are possible: litter manipulation on this peninsula found season-specific effects in the top 10cm for standing fine root length[8]. Thus, future work might find that liana removal affects fine root turnover, function, or deep stocks in this forest. In this initial study, though, there is not evidence for an irreplaceable role of liana fine roots.

References

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