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Mangrove tree growth, diversity, and distribution in tropical coastline ecosystems

Sabrina Dookie, Sirpaul Jaikishun, Abdullah Adil Ansari
Department of Biology, Faculty of Natural Sciences, University of Guyana, SA.

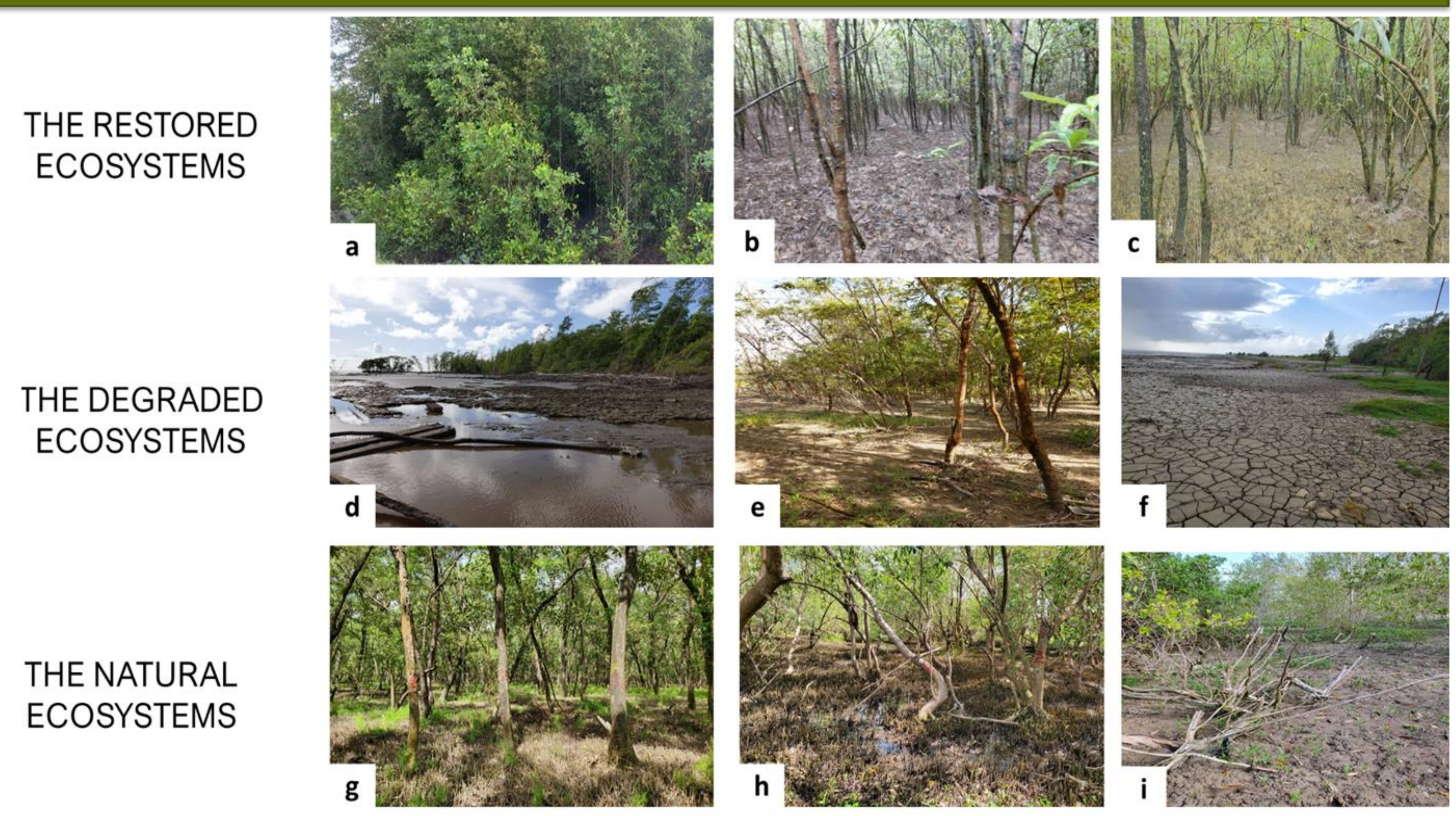
INTRODUCTION & AIM

Mangrove forests are found along the boundary between land and sea, resulting in their presence in terrestrial as well as aquatic settings. The expansion of coastal populations and the rise in sea levels are exerting pressure on mangrove forests, leading to their reduction in size and extent. The pressures encompass the combined effects of seawall building, aquaculture practices, excessive fishing, rising sea levels, extreme weather conditions, ecological invasion, and pollution (Wang *et al.,* 2020).

A fundamental characteristic of an ecosystem lies in its capacity to restore itself following a disturbance. Furthermore, the primary factors contributing to the resilience of established mangrove ecosystems include sediment accretion, surface elevation increases in sedimentation and freshwater inputs, and the presence of well-maintained vegetative coverage (Duncan *et al.,* 2018). Nonetheless, mangrove ecosystems that undergo degradation may have diminished resistance and resilience as a result of alterations in landscape structure, the influence of upstream factors on sediment and the transportation of nutrients, and disturbances to the environment that impact habitat interconnectivity.

Numerous studies have been conducted on the ecological dimensions of mangrove forests. However, the precise understanding of the correlation between various ecosystem types and their influence on tree growth and development remains limited, particularly in the context of tropical coastal environments. It is well recognised that the examination of mangrove trees in many ecological contexts holds significant value in terms of forecasting the dynamics and feedback mechanisms of various nutrient cycles as well as determining their level of resistance and resilience in the face of environmental stressors. Therefore, the aim of this study is to examine the variations that exist in the distribution, density, diversity, and growth parameters of trees seen in the different mangrove ecosystem types along the Guyana coastline.

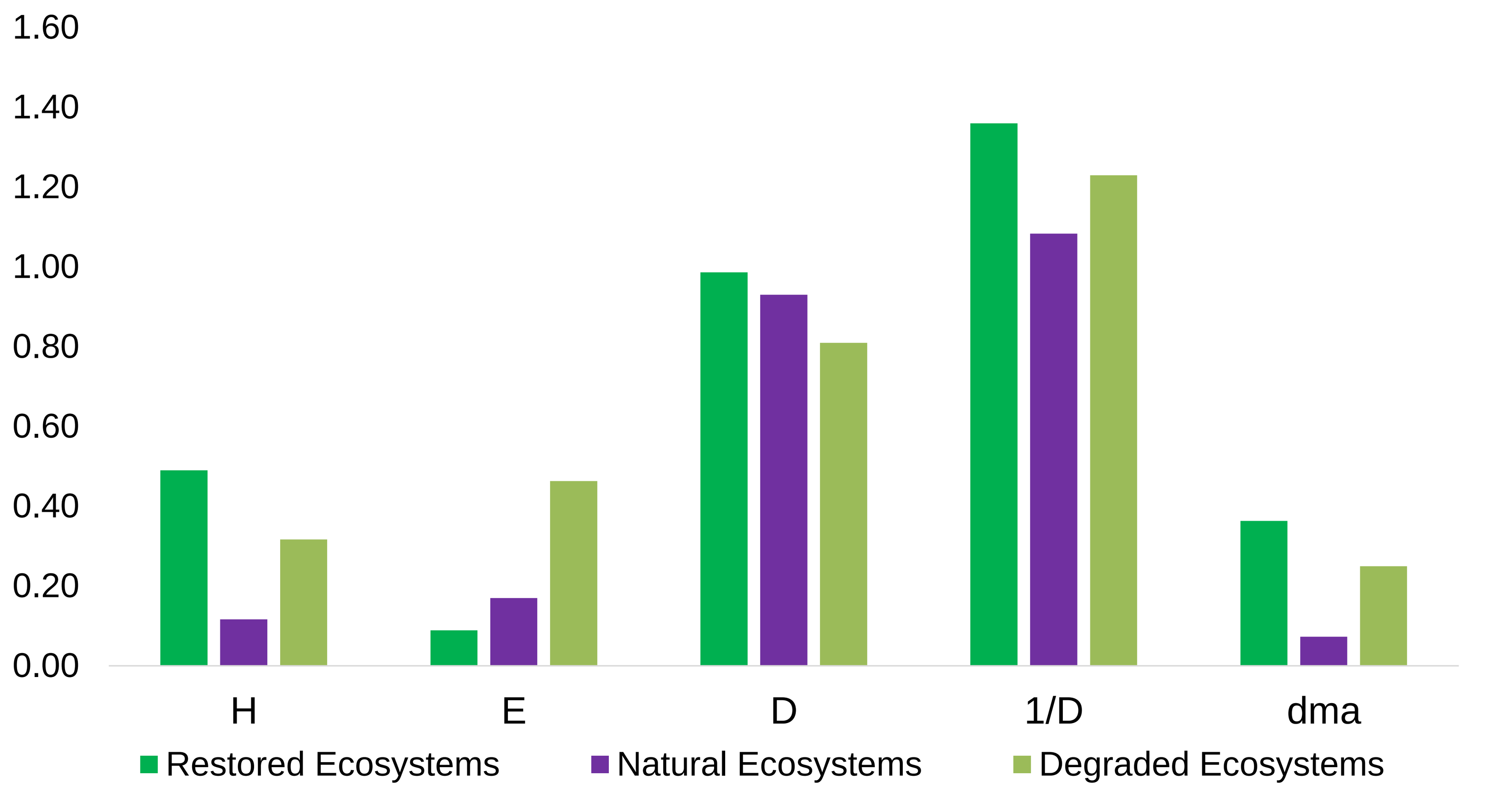
METHOD



- Nine (9) mangrove locations (**3 natural**, **3 degraded,** and **3 restored**) were chosen along the coastal region spanning from the East Coast of Demerara to East Berbice, Corentyne. The data collection process spanned twelve (12) months and was divided into four phases – two in the wet season and two in the dry season.
- Biophysical assessments were conducted on approximately 100 mangrove trees in each location using the point-centred quarter method (PCQM) (Cottam & Curtis, 1956).
- The species type (*A. germinans, L. racemosa, R. mangle*), height (HT), diameter at breast height (DBH), and basal area (BA) of each tree sample were recorded.
- The density and distribution of the trees at each site were then calculated as well as the absolute and relative frequency, species richness, and importance value.
- The species diversity, richness, and evenness were calculated using Shannon Weiner Index (H), Shannon Equitability Index (E), Simpson's Diversity Index (D), Simpson's Reciprocal Index (1/D), and Margalef richness index (dma).
- Statistical tests such as the Shapiro-Wilks test of normality, Kruskal-Wallis test, Dunn's test of multiple comparisons, Spearman rank correlation coefficients, and multiple regression analysis were utilised on the datasets after log10 transformation at a significance level of $p < 0.05$.

RESULTS & DISCUSSION

- The diversity indices calculated from all sites revealed that the restored ecosystems had greater species diversity, evenness, and richness followed by the degraded ecosystems, then the natural ecosystems.



- The total density (per ha) calculations reported that the restored ecosystems had greater tree densities (> 4025.58 individuals/ha) , followed by the natural ecosystems (> 1445.85 individuals/ ha), then the degraded ecosystems (< 708.65 individuals/ ha).
- Kruskal – Wallis tests reported significant differences between tree heights, DBH, and basal area with their locations (df = 8, p < 2.2e-16) throughout this study. Dunn's test revealed that the biophysical measurements of trees found in natural ecosystems significantly differed ($p < 0.05$) from the other ecosystem types.
- The Spearman rank correlation coefficients tabulated for the tree biophysical parameters [HT ~ DBH], [HT ~ BA], and [DBH ~ BA] revealed positive correlations within all nine sites and phases ($p < 0.05$, $r_s > 0.5$).
- Repeated multiple regression analyses further provided enough evidence that indicated statistically significant relationships ($p < 0.05$) between tree height, DBH, and basal area in all of their respective locations.

The observed increase in species diversity, richness, and densities in the restored ecosystems can be attributed to various factors, such as the deliberate choice of species, appropriate planting density and distance, effective replanting techniques, and proficient management methods employed during the restoration process of these forests (Xiong *et al.,* 2019). The trees in the natural ecosystems exhibited significantly greater heights, DBH, and basal areas which may be due to the age of the trees with dominating branches and stronger trunks and evidenced by an increase in stand basal area (Scales & Friess, 2019). However, the observed decrease in heights, DBH, and stand basal areas in the degraded sites might be attributed to many reasons that impose constraints on the availability of resources necessary for optimal plant growth and development such as pollution and other human induced factors.

CONCLUSION

Tree growth, density, diversity and distribution showcased variations according to ecosystem type. Significant discrepancies were observed in the diversity, density, and distribution patterns between the restored and degraded habitats. However, variations in the biophysical measurements were mostly visible in the natural and degraded ecosystems. The findings of our study provide additional evidence to support the idea that assessing the occurrence of mangrove vegetation, particularly trees, in different types of ecosystems can serve as an indicator of their ecological state as well as their ability to withstand and recover from environmental stresses.

FUTURE WORK / REFERENCES

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