

Effects of Defaunation on Tropical Forest Ecosystem Services

Objectives

1. Quantify differences in forest structure between intact and defaunated forest in Ivindo National Park, Gabon.
2. Calculate forest stand aboveground biomass (AGB) and genus richness along a defaunation gradient.
3. Examine the provisioning services of tree species used by local communities near the park.

Background

- Defaunation – decline in animal populations due to overhunting – has decreased large mammal abundances by ~40% in tropical forests^{1,2}.
- Altered animal communities change plant-animal interactions: e.g., large-seeded tree species that rely on animals for dispersal have experienced 70-95% decrease in reproduction^{3,4,5}.
- Declines in animal populations have cascading effects on forest structure, plant richness and composition, and diversity, which may affect ecosystem services such as carbon storage and provisioning services for local communities^{2,5,6,7,8,9,10}.
- Tropical forests store 25% of the world’s carbon—changes to this biome may release stored C back to the atmosphere, with severe consequences for global climate change^{7,11}.

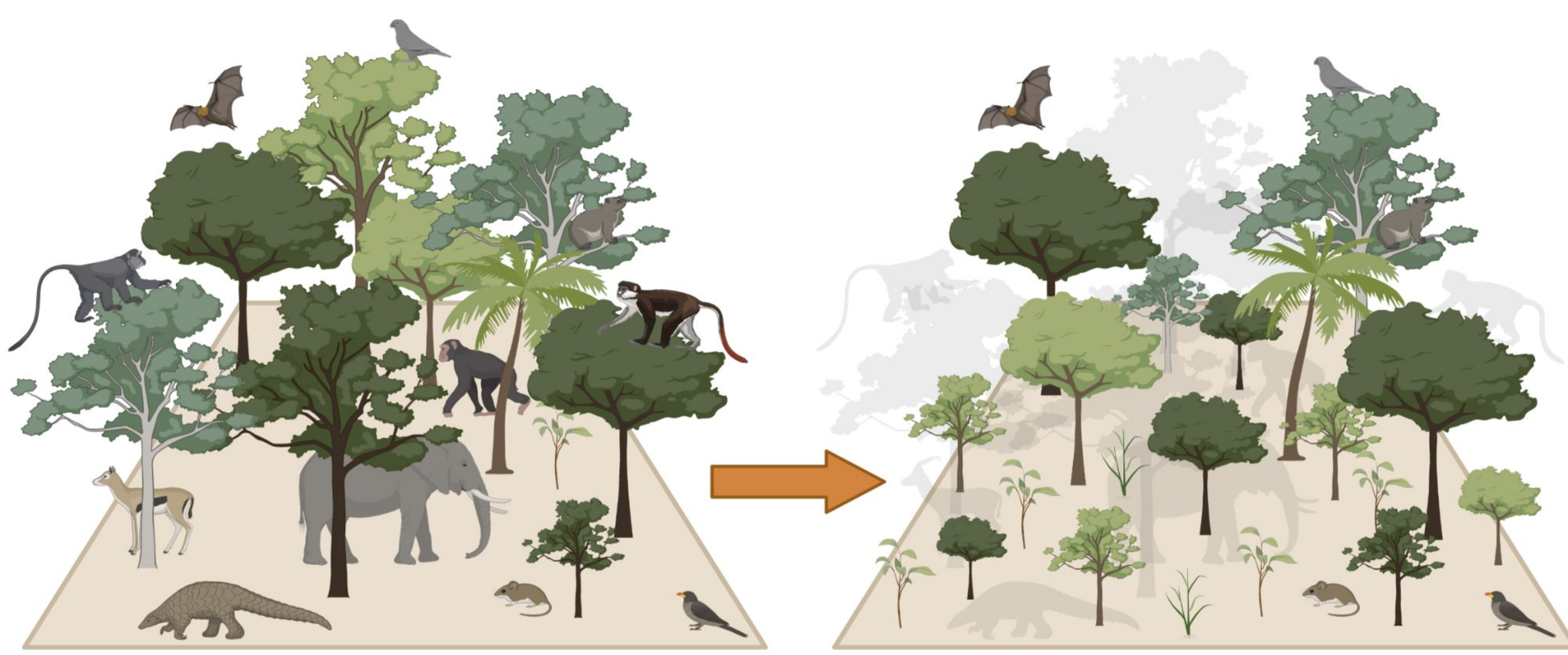


Figure 1. Hypotheses of changes in aboveground biomass (AGB), plant richness, and long-term diversity shifting from intact forest to defaunated forest (created in biorender.com).

Methods

- Tagged and measured every plant (height > 1.5m) to calculate forest structure
- Identified tree genera in 6 sub-plots to calculate aboveground biomass (AGB), and genus richness
- Interviewed 66 adults in 9 villages about the tree species and tree parts they used



Figure 2. (left) Master’s student, Laura Toledo, interviewing community members; Figure 3. (right) PhD students, Halina Malinowski (lower) and Camille DeSisto (upper), and research assistant Jean Paul Mengourakwe (right) measuring tree DBH.

Study Site

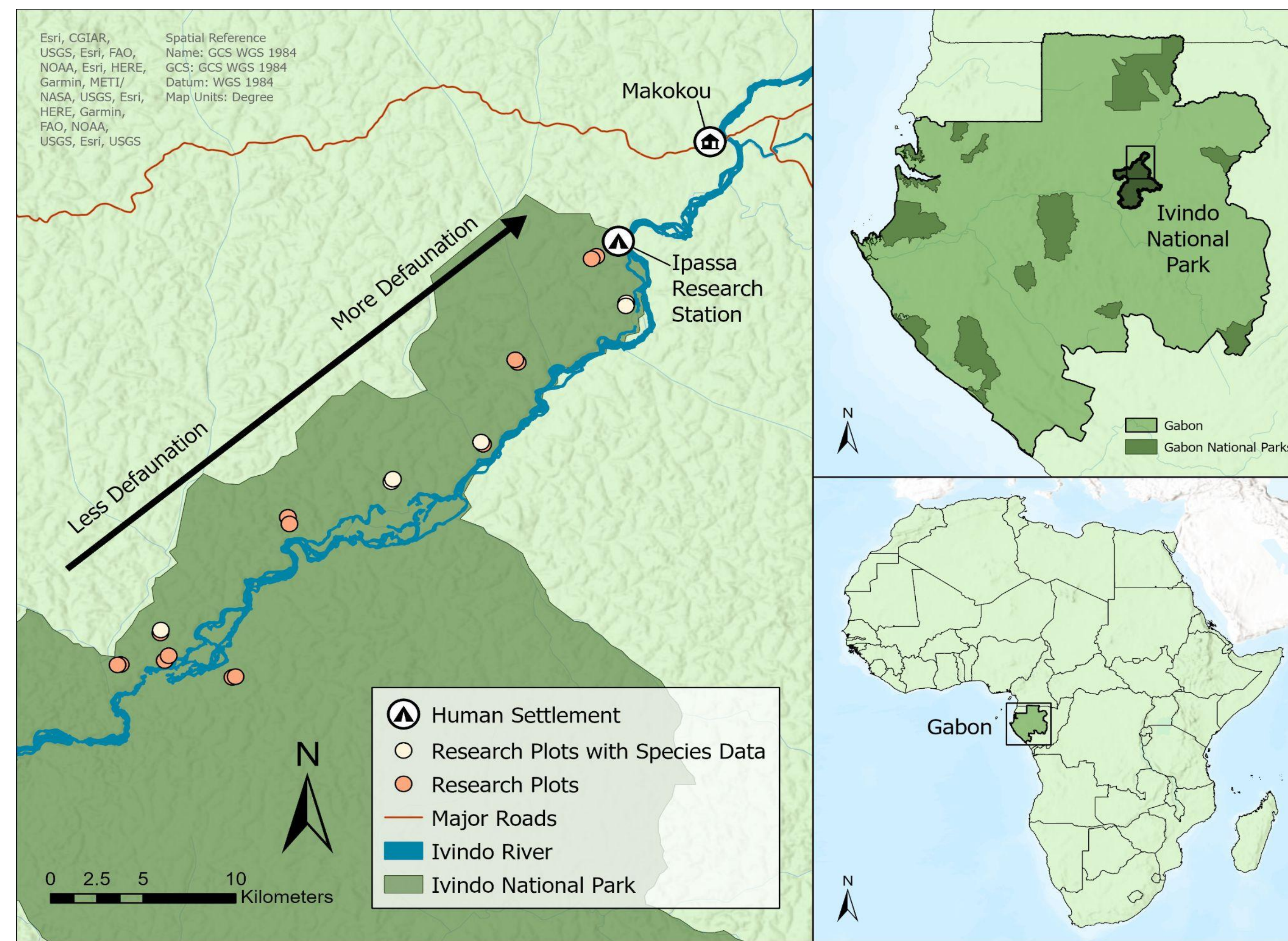


Figure 4. Map of forest plots along the defaunation gradient in Ivindo National Park, Gabon.

Results

- Intact forests have lower tree abundances and average DBH than defaunated forests (contrary to expectations; may be explained by remaining large trees and introduced understory trees) (Figure 5.)
- AGB may increase with higher levels of defaunation, but genus diversity is not related to the defaunation gradient (Figure 6.)
- All participants used tree species for provisioning services
- Food was the most commonly mentioned provisioning service, and fruit was the most commonly mentioned tree part (Figure 7.)

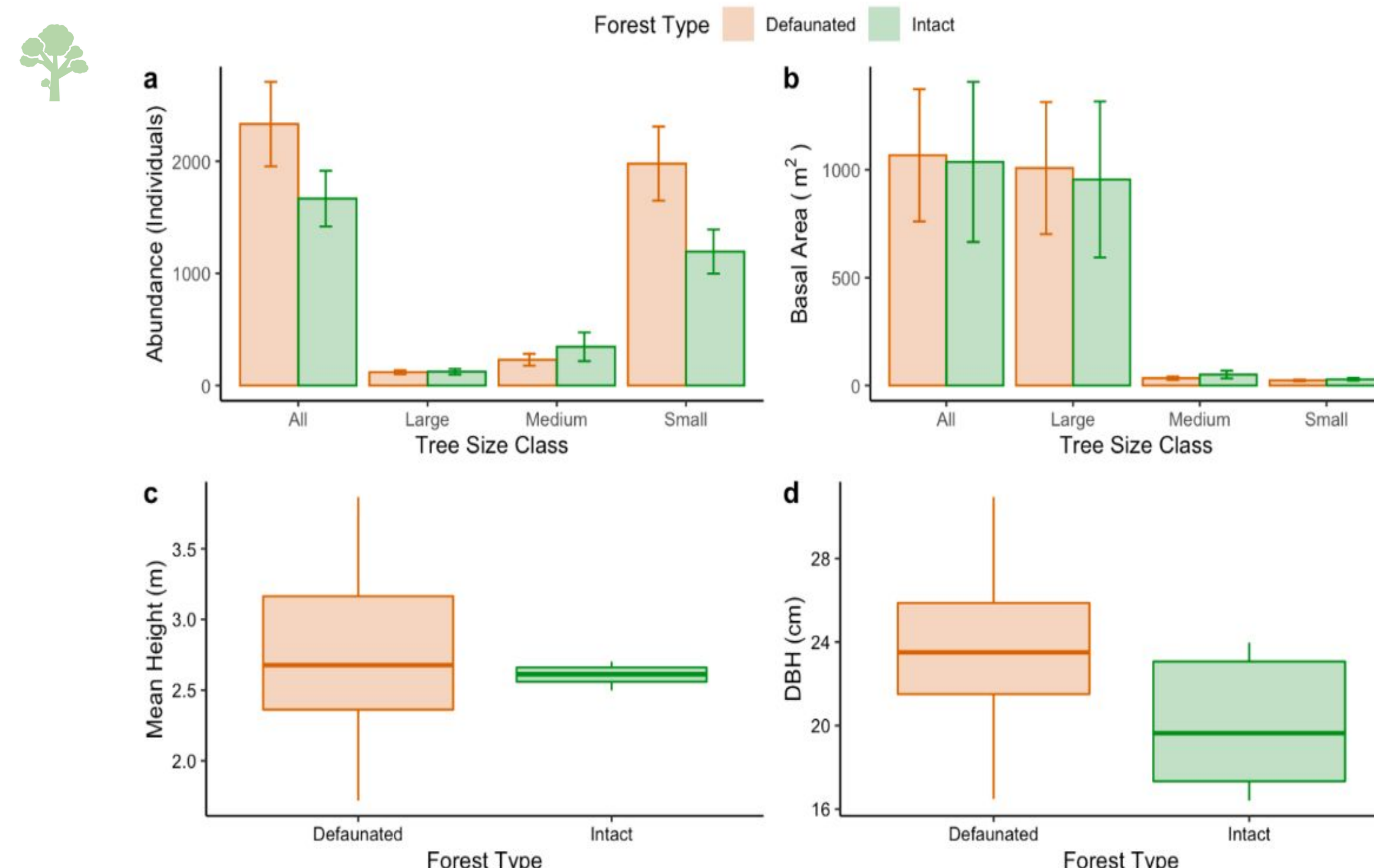


Figure 5. Differences in forest structure (a: abundance, b: basal area, c: height, d: DBH) between defaunated and intact forest stands. Error bars in (a) and (b) represent 95% confidence intervals.

Results

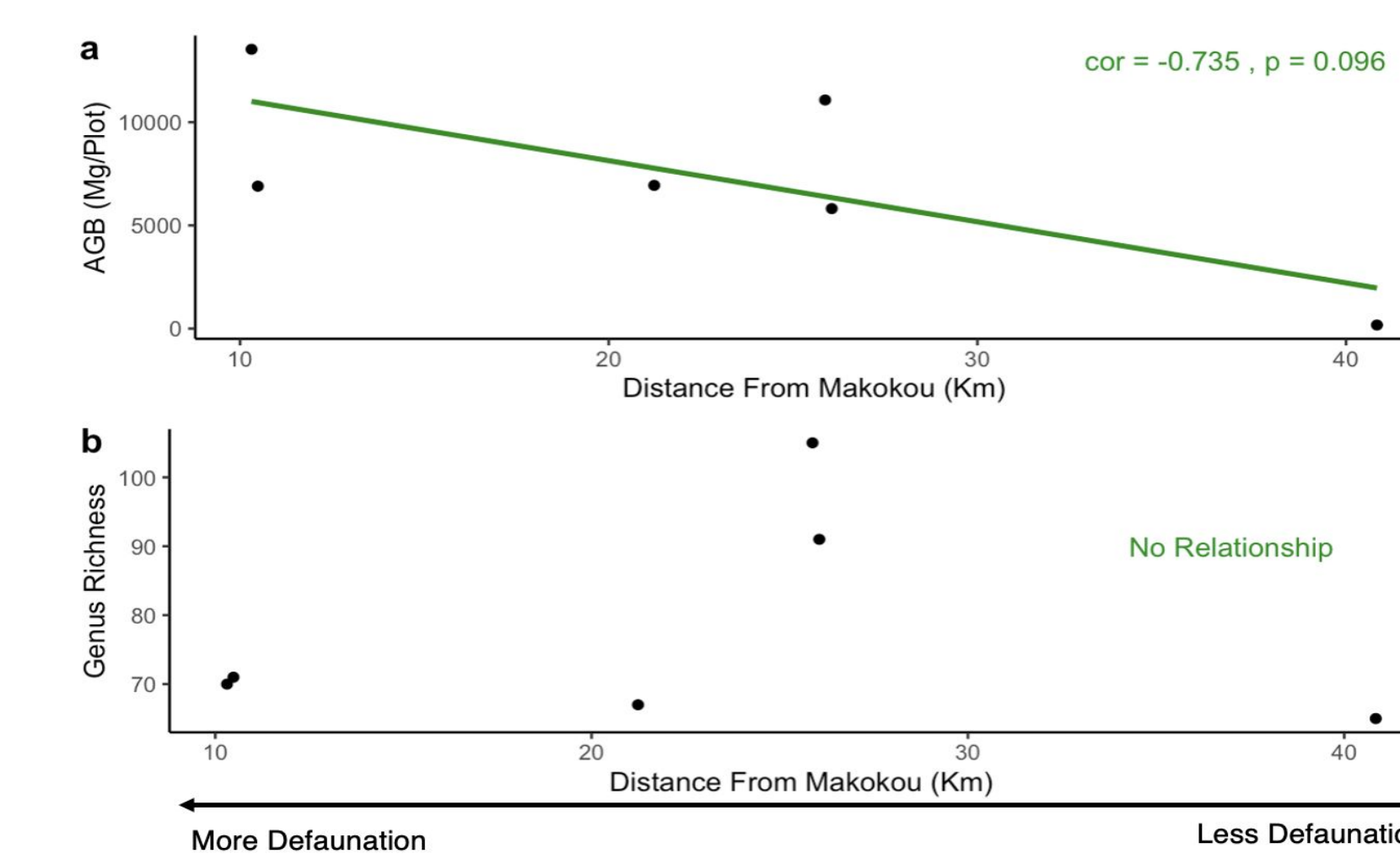


Figure 6. AGB (a) was negatively correlated with defaunation (marginally significant; $p = 0.096$), but genus richness (b) was not related to defaunation.

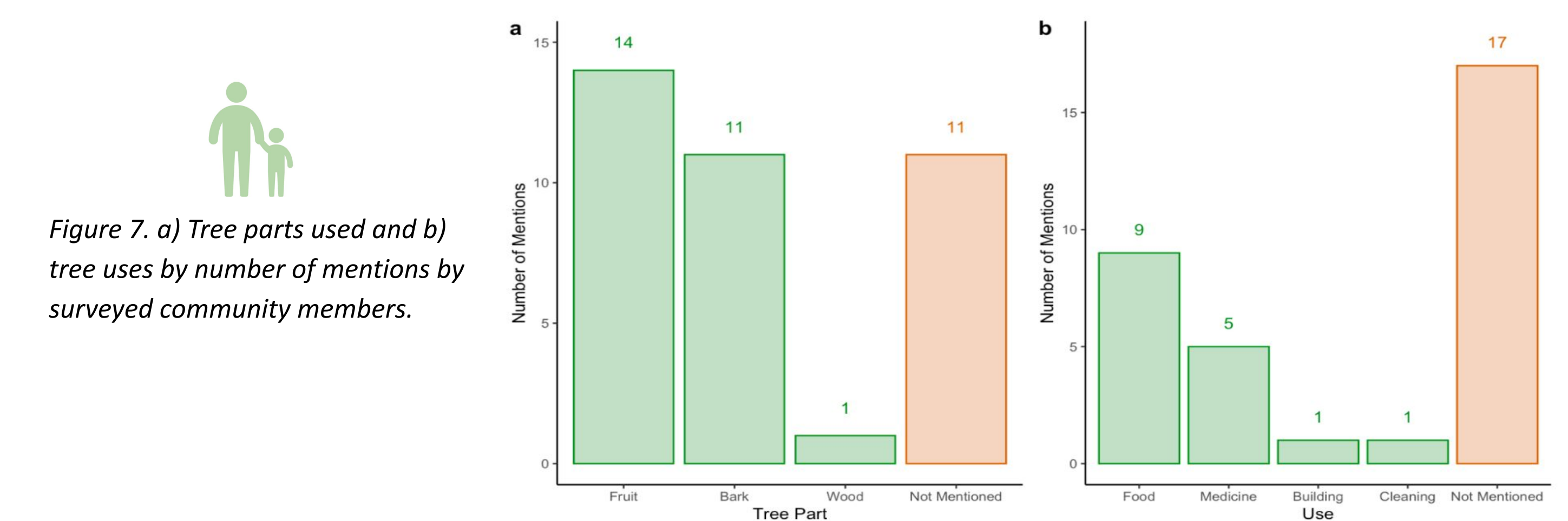


Figure 7. a) Tree parts used and b) tree uses by number of mentions by surveyed community members.

Conclusions

Through ecological and social surveys, we demonstrated several ecosystem services (carbon storage & provisioning services) provided by the tropical forest in Ivindo National Park, Gabon. Further research over a longer time scale is needed to better understand how increasing levels of defaunation may affect this vital ecosystem and its surrounding communities. Six team members will travel to Gabon this summer to collect additional data!

Next Steps

- Collect and analyze data from additional plots along the gradient
- Relate forest structure and composition to environmental variables and animal abundances
- Create an aboveground carbon map for Ivindo National Park
- Relate plant uses to social and environmental and demographic variables
- Design and implement a more rigorous surveying methodology



Figure 3. 2021 field season team

References

