DISPERSAL SOWS THE SEEDS OF RESILIENCE

Tree seed dispersal modes affect forest resilience along forest-savanna boundaries

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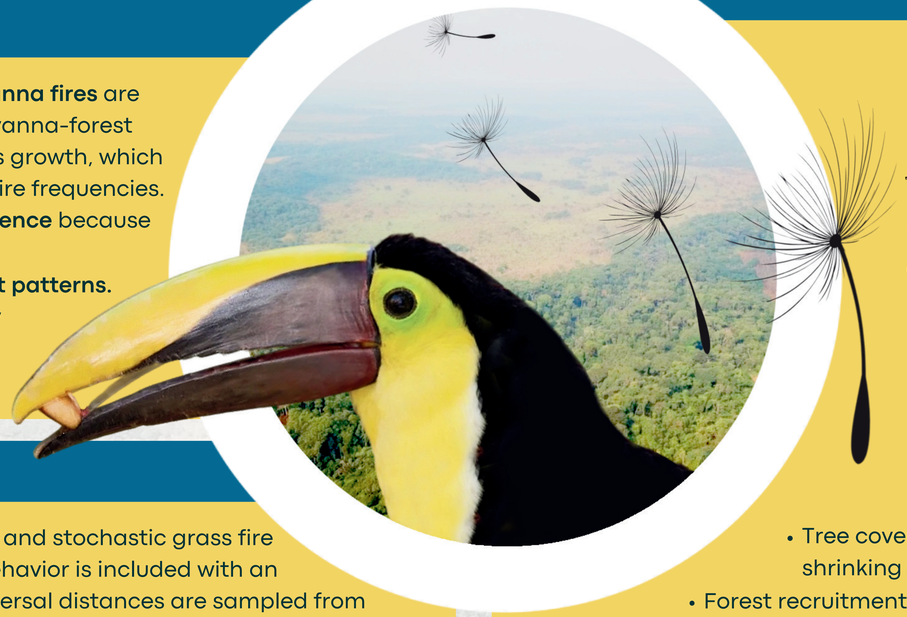
Introduction

- **Feedbacks between forest cover and savanna fires** are important drivers of forest resilience in savanna-forest ecosystems. Forest cover suppresses grass growth, which reduces fuel availability and thus curtails fire frequencies.
- **Spatial patterns of vegetation affect resilience** because they determine how easily fire can spread.
- **Different dispersal modes produce distinct patterns.**
- **Could dispersal modes affect resilience** by influencing spatial pattern formation? We investigated using our new model.



Methods

- The model simulates individual tree growth and stochastic grass fire percolation. Landscape-dependent bird behavior is included with an individual-based sub-model, and wind dispersal distances are sampled from a probability distribution. The spatial scale is 1 x 1 km at a resolution of 1 x 1 m.
- Experiments varied dispersal mode, initial tree cover, and forest spatial patterns.
- Forest recruitment rates and resilience* were measured.

*Indicator used: Minimum initial tree cover for which the system converges reliably to homogeneous forest (lower values indicate resilience to larger disturbances).

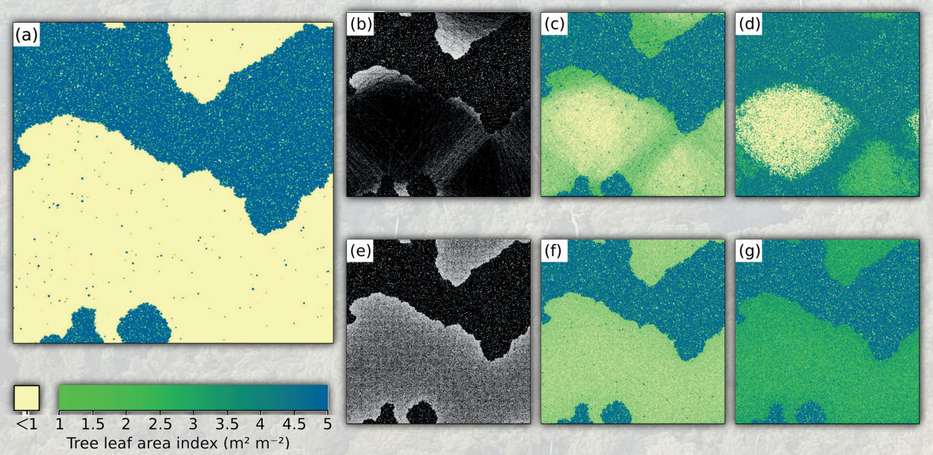


Fig. 1: Differences in spatial recruitment patterns. (a) Initial vegetation pattern. (b, e) Recruitment patterns for dispersal by birds- and wind, respectively. (c,d and f,g) Tree cover trajectories in the case of dispersal by birds and wind, respectively.

Results

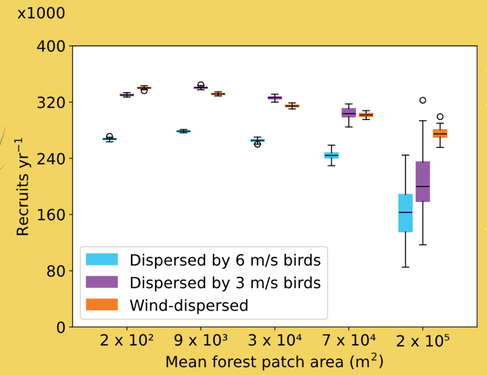


Fig. 2: Number of recruits for bird and wind dispersal and varying forest patch sizes.

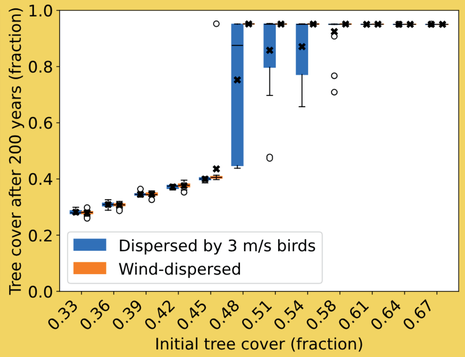


Fig. 3: Tree cover change for dispersal by birds and wind using forest patches of 2×10^5 m².

- Tree cover spatial patterns are never static; forest patches are always shrinking or expanding. **Simulation timeseries can be viewed here** ⟶
- Forest recruitment rates (Fig. 2) and rates of tree cover change (Fig. 3) are generally lower in bird-dispersed forests than in wind-dispersed forests.
- Bird behavioral parameters (e.g. flight speed) and forest spatial pattern morphology also modify recruitment rates and resilience when tree seeds are dispersed by birds.

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Discussion and future work

- Bird-dispersed forests are more sensitive to forest spatial pattern morphology because bird behavior is dependent on landscape structure - an effect that is less pronounced for wind-dispersed trees.
- Consequently, conservation efforts should consider the impact of interventions on forest spatial patterns.
- In a future study, we aim to investigate what spatial pattern features are the most important drivers of bird-dispersed recruitment rates and forest resilience.
- We also intend to include environmental heterogeneity in the model, to investigate whether this will stabilize spatial patterns and allow the model to reproduce real-world patterns.

Key takeaway

Interactions between spatial patterns of tree cover and tree dispersal modes affect tropical forest resilience.

Image credits

Bird: © elnavegante/stock.adobe.com
Savanna-forest landscape: Onishi et al. (2020). Nkala Forest: Introduction of a forest-savanna mosaic field site of wild bonobos and its future prospects. *Pan Africa News*. 27. 2-5. 10.5134/254101.
Wind-dispersed seeds: © Tester Designs/Shutterstock.com

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Abstract: