A Phylogenetic Perspective on the Individual Species-Area Relationship in Temperate and Tropical Tree Community

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Introduction

- **Species coexistence**

  niche-based theory (e.g. Tilman 1982)

  neutral theory (e.g. Hubbell 2001; Chave 2004)

- **Spatial distribution**

  leave a spatial signature (Hubbell et al. 2001)

Introduction

Species-area relationships (SARs)

Introduction

How individual species structure diversity in tropical forests

Thorsten Wiegand*†, C. V. Savitri Gunatilleke‡, I. A. U. Nimal Gunatilleke‡, and Andreas Huth*

Species-area relationships (SARs)

Individual species-area relationships (ISARs)

Introduction

How individual species structure diversity in tropical forests

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Species-area relationships (SARs)

⟹ **Individual species-area relationships (ISARs)**

Role of species

- **accumulator**
- **repeller**
- **neutral species**

Wiegand et al. 2007, *PNAS*, 104 (48): 19029-19033

Introduction

Species area relationships (SARs)

Individual species area relationships (ISARs)

Introduction

Species area relationships (SARs)

Individual species area relationships (ISARs)

Individual phylogentic area relationships (IPARs)

Introduction

- **Do ISARs change predictably across latitude?**
- **Is the phylogenetic diversity in the neighborhood of species accumulators and repellers higher or lower than that expected given the observed species richness?**
- **What is the distribution of accumulator, repeller and neutral species on the phylogenetic tree?**

Methods

- **Study sites**

FDP	Country	Forest Type	Latitude	Area (ha)	Species Richness
Ailaoshan	China	Subtropical Moist Forest	24.32 N	6	76
BCI	Panama	Tropical Moist Forest	9.154 N	50	299
Edoro – 1	Congo	Tropical Rain Forest	1.437 N	10	315
Edoro – 2	Congo	Tropical Rain Forest	1.437 N	10	326
Korup	Cameroon	Tropical Rain Forest	5.074 N	50	494
Lenda – 1	Congo	Tropical Rain Forest	1.437 N	10	349
Lenda – 2	Congo	Tropical Rain Forest	1.437 N	10	300
Wabikon Lake	U.S.A.	Temperate Deciduous Forest	45.551 N	25	36
Xishuangbanan	China	Tropical Rain Forest	21.612 N	20	468

Methods

- **Study sites**
- **Species selection**

  Totally 2,728 species, 1,020,699 individuals

  - **all species**
  - **species that abundant ≥ 70 and DBH ≥ 1 cm**

Methods

- **Study sites**
- **Phylogenetic tree reconstruction**
  - **Phylomatic** (Webb and Donoghue 2005)
  - **Phylocom** (Webb et al. 2008)

Methods

- **Study sites**
- **Phylogenetic tree reconstruction**
- **Individual species-area relationships**
  - **ISAR** (Wiegand et al. 2007)
  - **heterogeneous null model**

Methods

- Study sites
- Phylogenetic tree reconstruction
- Individual species-area relationships
- Individual phylogenetic-area relationships
  - phylogenetic diversity metric
  - tip shuffle null model

Methods

- Study sites
- Phylogenetic tree reconstruction
- Individual species-area relationships
- Individual phylogenetic-area relationships
- Phylogenetic distribution of accumulator, repeller and neutral species
  - NRI & NTI

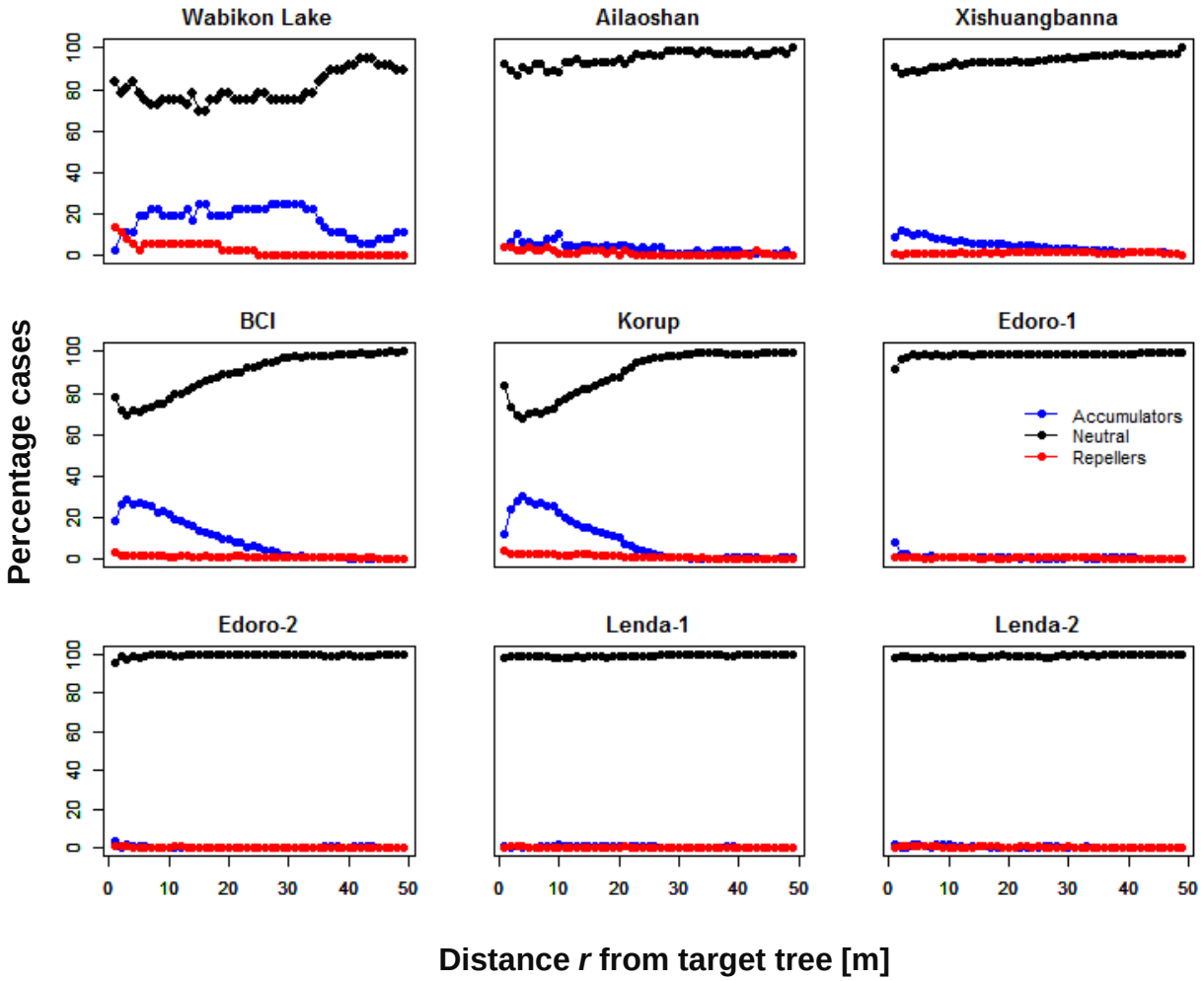
Results and Discussion

- Individual species-area relationships
- Individual phylogenetic-area relationships
- Phylogenetic distribution of accumulator, repeller and neutral species

Results

- **Individual species-area relationships**

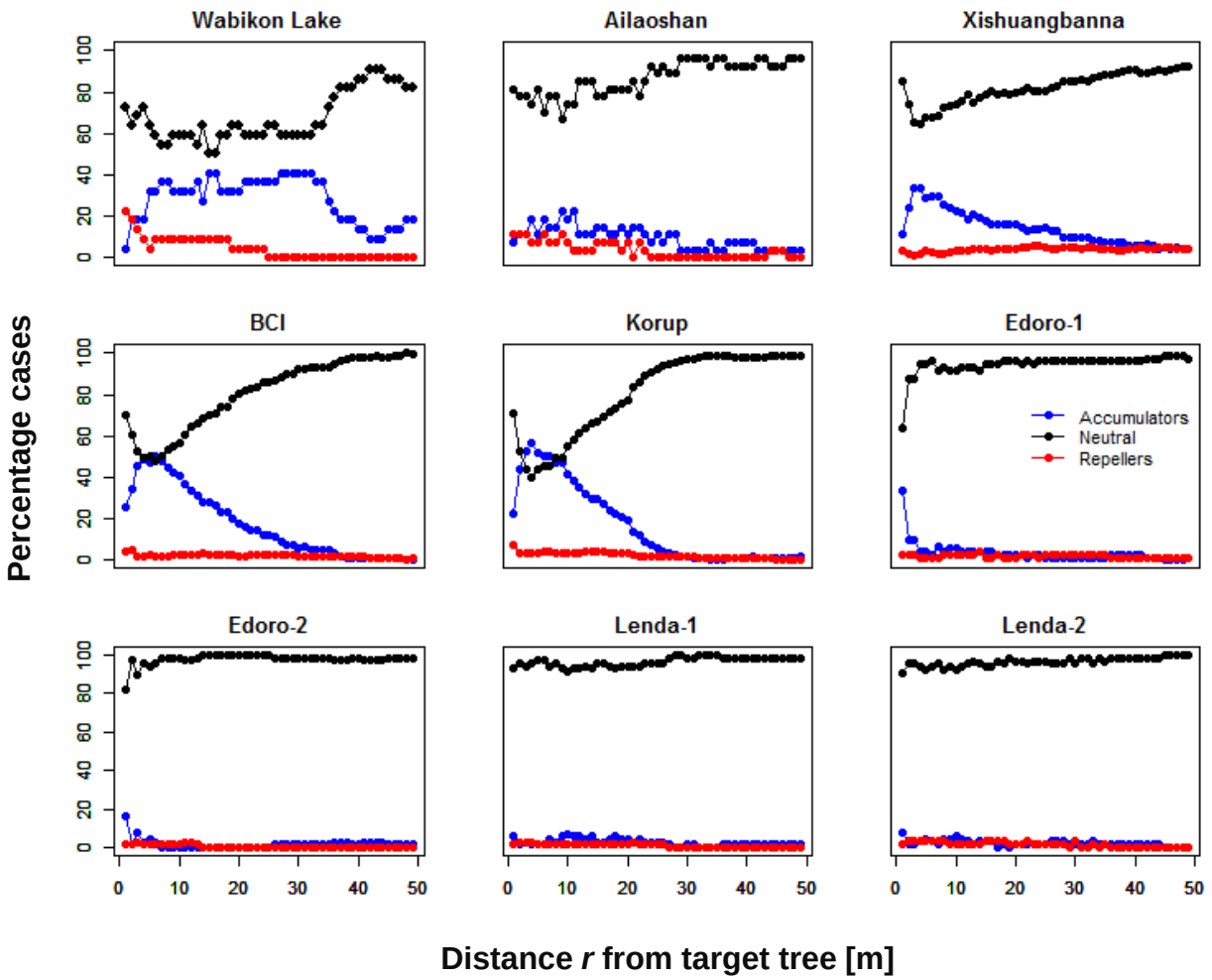
all species



Results

- **Individual species-area relationships**

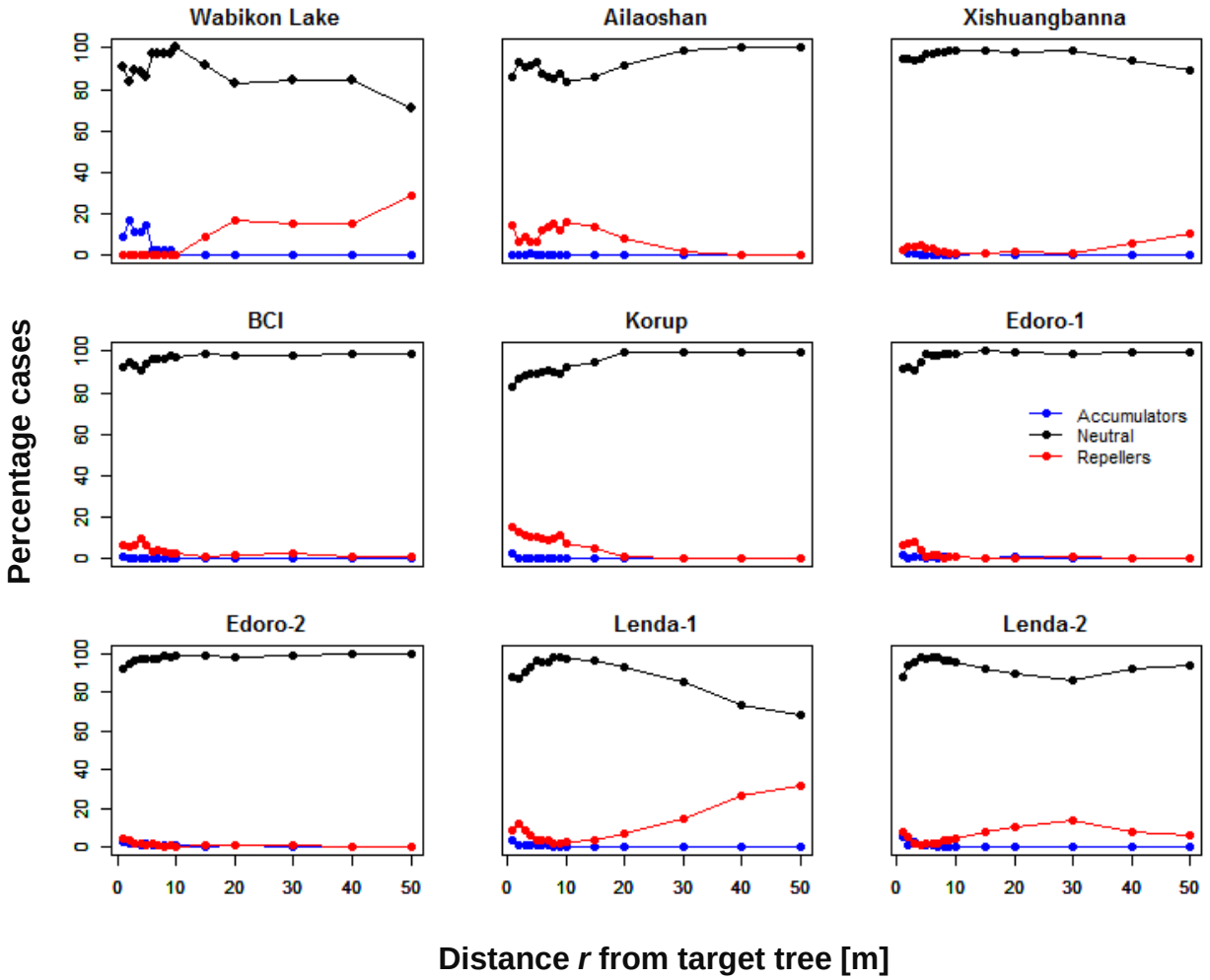
species that abundant ≥ 70 and DBH ≥ 1 cm



Results

- **Individual phylogentic-area relationships**

  all species



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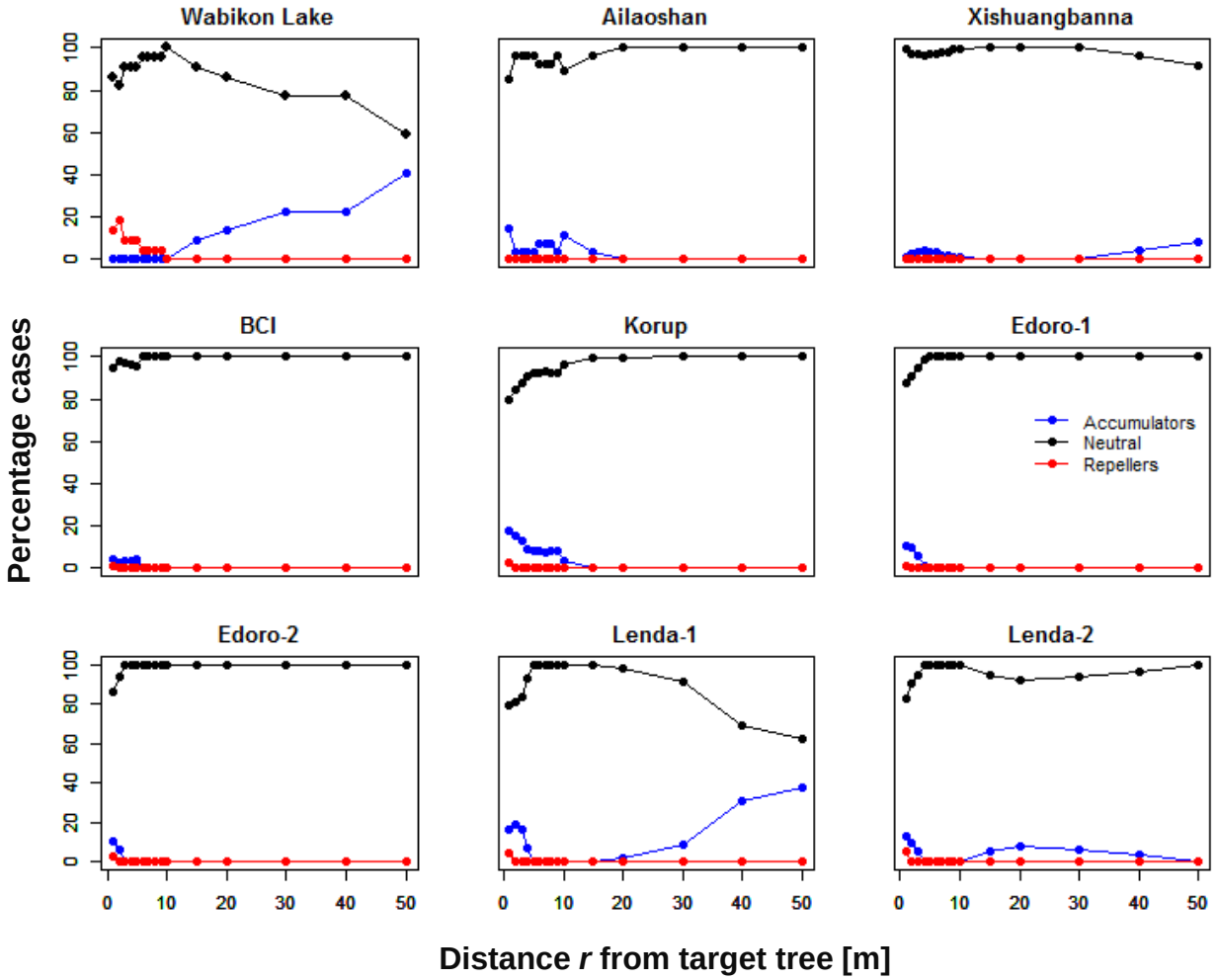

Conclusions

- **Non-neutral processes (competition and facilitation) may leave a detectable signature at small-scales spatial patterns of species diversity but result in stochastic patterns at larger-scales.**
- **Importance of past evolutionary history in dictating the ecological interactions we presently observe.**

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