Composition of woody plant communities drives macrofungal community composition in three climatic regions

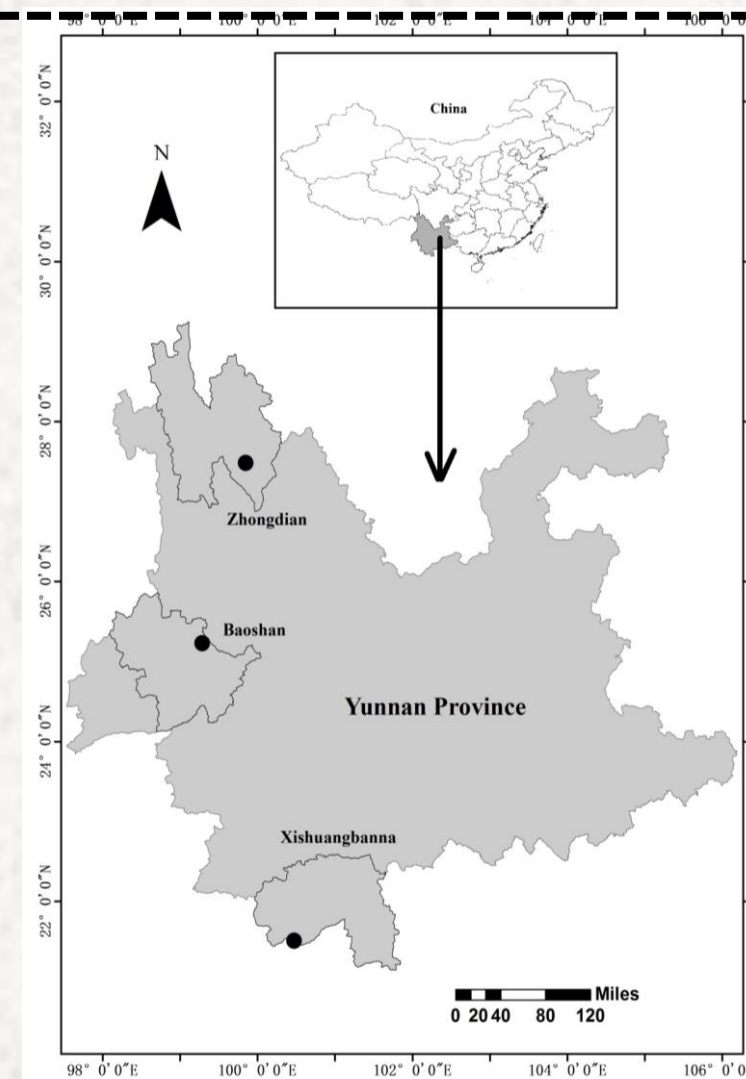*Huili Li[1,2], Jiayu Guo[1], Lei Ye[1,2], Heng Gui[1,2], Kevin D. Hyde[1,3], Jianchu Xu[1,2,4], Peter E Mortimer[1,2]*

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❶ Introduction

Macrofungi supply important ecosystem functions and economic value. Explicating the distributive patterns and diversity of macrofungal communities could provide valuable evidence for understanding their nutrient cycles and ecological service functions. Understanding which factors drive the distribution patterns of macrofungal communities is a key objective in studying the ecological processes behind macrofungal community formation. Although site-specific studies have reported on the relationship between plant and macrofungal diversity, comprehensive evidence on the relationship between macrofungal and plant community compositions on a regional scale remains scarce. Our study was designed to assess the distributive patterns and driving factors of macrofungal communities in temperate, subtropical and tropical regions. The studied regions are characterized by a decreasing elevation gradient from north to south, covering three distinct climatic zones. We hypothesize that (1) woody plant species richness and community composition are positively related to macrofungal diversity and community composition; (2) besides plant effects, abiotic factors (geography and climate) explain a considerable proportion of the variability found in macrofungal communities.

❷ Materials and methods

- Our study was carried out in northwest (Zhongdian County), west (Baoshan City) and southwest (Xishuangbanna Autonomous Prefecture) Yunnan Province;
- Thirty 100 m² plots (10 m × 10 m) were randomly selected in each of the five forest types;
- Macrofungal sampling was conducted weekly during the rainy season (June-September) in 2013 and 2014, and plant surveys were carried out in 2014;
- The taxonomic classification of macrofungal species and the nomenclature followed the rules of Index Fungorum;
- Macrofungi were divided into three functional groups: all macrofungi (ALF), ectomycorrhizal fungi (EMF) and non-ectomycorrhizal fungi (NMF);
- Woody plants were divided into three groups based on their trophic relationship with macrofungi: all plants (ALP), ectomycorrhizal plants (EMP) and non-ectomycorrhizal plants (NMP).

| Study site	Zhongdian	Baoshan	Xishuangbanna
Number of study plots	9	9	12
Longitude	99°51'19" E	99°17'25" E	100°28'45" E
Latitude	27°29'10" N	25°14'01" N	21°30'50" N
Mean elevation	3275 m	2423 m	1669 m
MAT	12.8℃	20.2℃	23.9℃
MAP	82.4 mm	127.3 mm	164.4 mm
Mean relative humidity	70.3%	72.3%	74.5%
Climate type	subalpine temperate climate	subtropical montane climate	tropical monsoon climate
Forest type	Subalpine conifer forest (SCF)	Pine forests (PF)；Evergreen broa dleaf forest (EBF)	Montane rain forest (MRF); Tea plantation (TP)
Dominant tree species	SCF: *Lyonia ovalifol ia* var. *hebecarpa* (Franchet ex Forbes & Hemsley) Chun, *Picea likiangensis* (Franchet) E. Pritz el, *Pinus de nsata* Masters and *Rhododendron racemosum* Franchet	PF: *Pinus armandii* Franchet; EB F: *Quercus rehderiana* Handel-Mazzetti, *Castanopsis orthacantha* Franchet, *Lyonia ovalifolia* Var. *elliptica* (Siebold & Zuccarini) Handel-Mazzetti	MRF: *Dendrocalamus membranaceus* Munro, *Lithocarpus truncatus* (King ex J. D. Hooker) Rehder & E. H. Wilson, *Machilus rufipes* H. W. Li; T P: *Camellia sinensis* var. *assamica* (J. W. Masters) Kitamura

❸ Results

### 3.1 Macrofungal and woody plant diversity
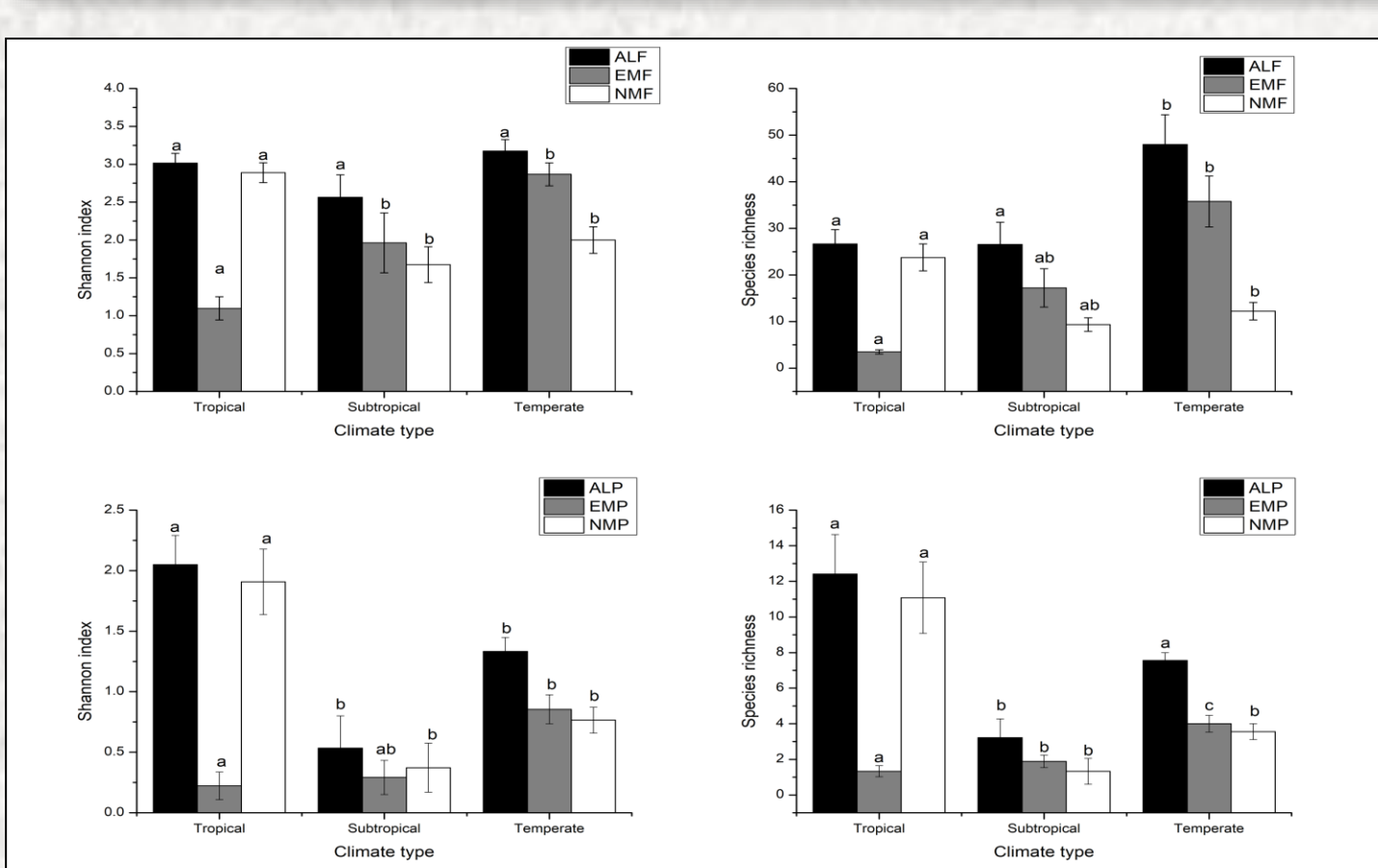
- Total macrofungal species richness and diversity were significantly greater in temperate forests compared to tropical and subtropical forests;
- The tropical forests were home to a significantly greater diversity and richness of NMF than the temperate and subtropical forests of Yunnan Province.

3.2 Correlations between plant and abiotic factors on macrofungi
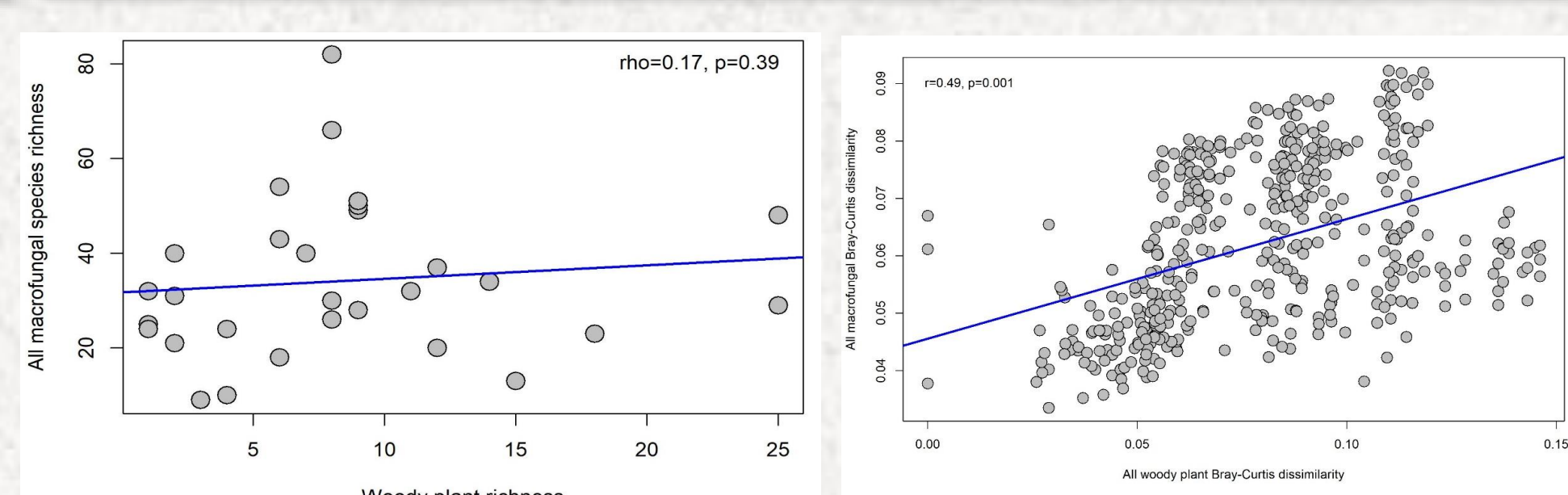
- Macrofungal species richness did not significantly increase alongside woody plant species richness, while dissimilarities in macrofungal community compositions across the three climatic regions were significantly correlated with woody plant community compositions.
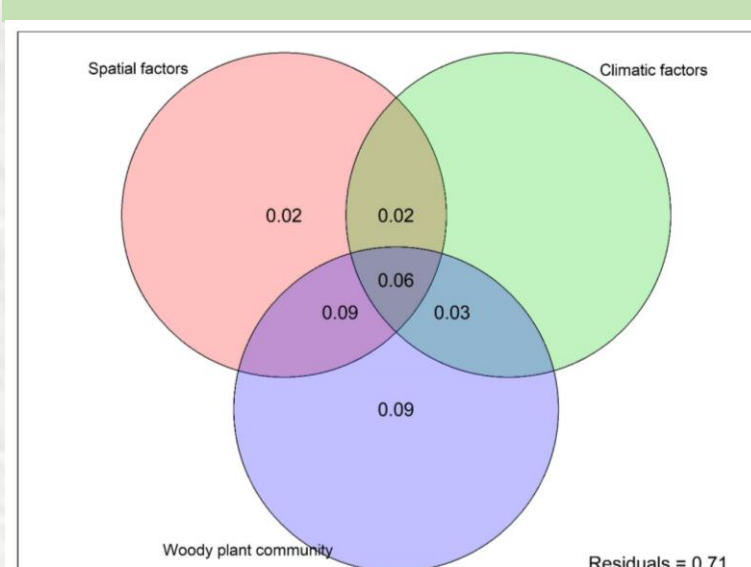
- Variation partitioning analysis indicated that variations in macrofungal community compositions were explicable by woody plant community composition, followed by spatial and climatic factors.

3.3 Correlations between the functional community compositions of woody plants and macrofungi

Dataset	BS_ALP	BS_EMP	BS_NMP
BS_ALF	0.3656/0.078	0.3735/0.05*	0.6981/0.167
BS_EMF	0.4179/0.046*	0.4283/0.023*	-0.4893/0.5
BS_NMF	0.09514/0.667	-0.3095/0.667	0.2989/0.667

Dataset	BN_ALP	BN_EMP	BN_NMP
BN_ALF	0.2597/0.013*	0.1635/0.116	0.2023/0.046*
BN_EMF	0.06073/0.305	0.1443/0.152	0.02254/0.385
BN_NMF	0.2697/0.018*	0.1223/0.178	0.218/0.036*

Dataset	ZD_ALP	ZD_EMP	ZD_NMP
ZD_ALF	0.4405/0.01**	0.4294/0.009**	0.3079/0.098
ZD_EMF	0.3984/0.024*	0.4366/0.008**	0.2401/0.156
ZD_NMF	0.3363/0.044*	0.1421/0.217	0.3625/0.056

- Twelve out of 27 combinations were significantly correlated of which ALF and EMF in Baoshan and Zhongdian were both significantly correlated with ALP and EMP;
- The Mantel test revealed that woody plant functional groups shaped macrofungal functional groups.

❹ Conclusions

- The conservation of woody plants occupies a crucial node in macrofungal conservation efforts;
- This research furthers our knowledge of macrofungal community composition across three climatic regions, and improves our understanding of macrofungal biogeography;
- Focusing on woody plant community composition as well as geographical and climatic factors is insufficient to explain the totality of responses in macrofungal diversity, but the concordance between macrofungal and woody plant communities does highlight our ability to better predict the makeup of macrofungal communities.

❺ References

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❻ Acknowledgements

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