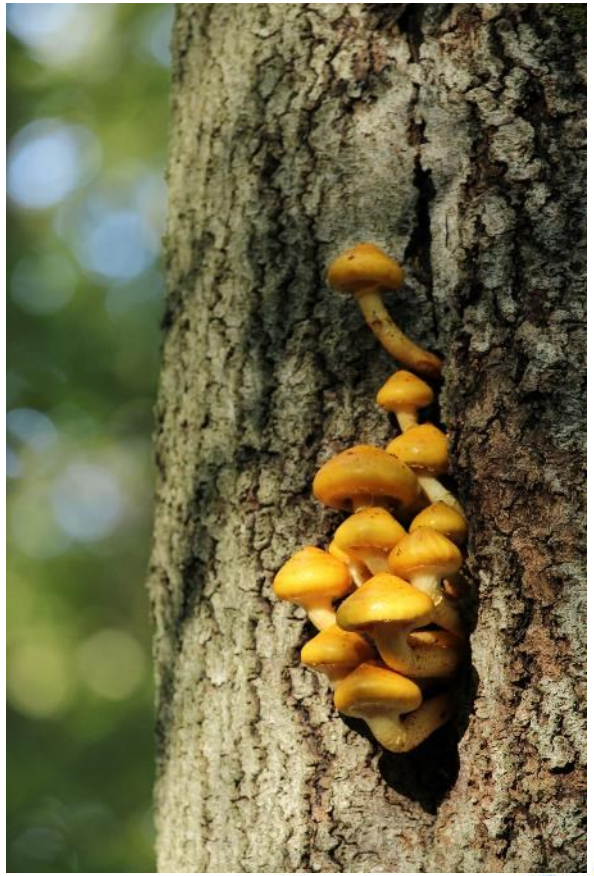


Tree-related microhabitats in European old-growth forests: a proxy for biodiversity?

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Overview

- Forest structural indicators and biodiversity
- Study regions
- Results
- Index of biodiversity potential
- Conclusion
- Future task



Forest management and biodiversity

Structure	Old-growth	Selective harvest	Shelterwood	Biodiversity
Several canopy layers	++	++	–	+
High variation of tree sizes	++	++	–	+
High spatial heterogeneity	++	++	–	+
Presence of advanced regeneration	++	++	–	0
Wide decay class distribution of CWD	++	++	–	++
Large number of big trees	++	+	+	+
High stand volume	++	+	+	0
Large number of trees older than 150 yr	++	+	–	++
Large number of snags (high stumps)	++	–	–	++
Large amount of fallen CWD	++	–	–	++
Diverse stem, branch and crown structures in living trees	++	–	–	++

Canopy Layering

Very Large Trees

Deadwood

Tree microhabitats

Brunet et al. 2010

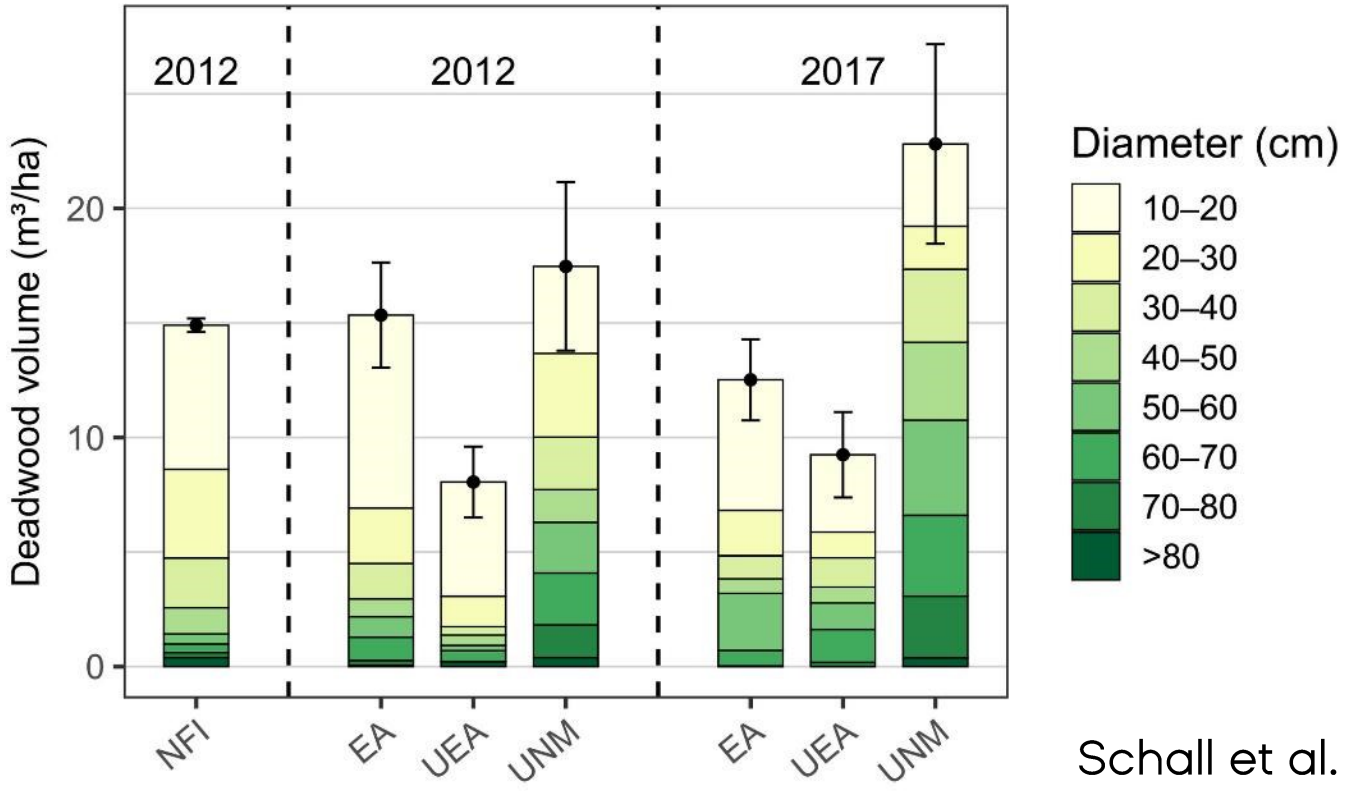
Forest management and biodiversity

Table 3. Habitat value of different management systems for species groups in European beech forests, based on the studies reviewed. ++: high, +: moderate, –: low.

Species group	Shelterwood	Shelterwood with tree retention	Selective harvest	Selective harvest with tree retention
Herbaceous plants	++	++	++	++
Ground arthropods	+	++	+	++
Land snails	–	+	+	++
Saproxylic fungi	–	+	+	++
Saproxylic beetles	–	++	+	++
Hole nesting birds	–	+	+	++
Saproxylic flies	–	+	+	++
Epiphytic bryophytes	–	–	+	++
Epiphytic lichens	–	–	+	++
Epixylic bryophytes	–	–	–	++

Brunet et al. 2010

Deadwood

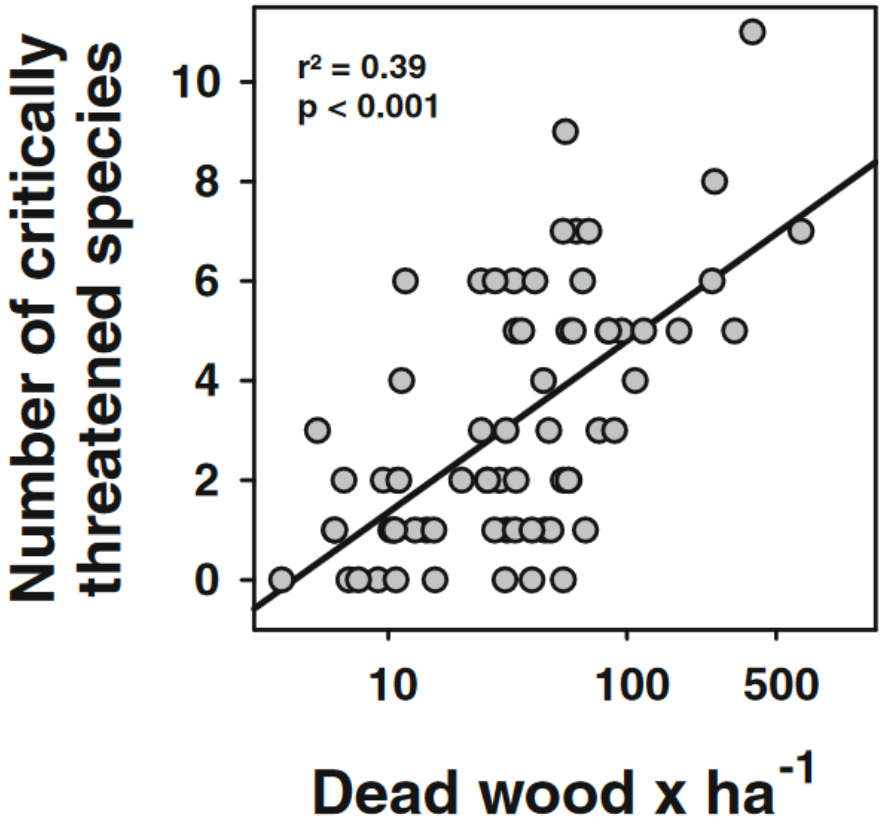


NFI ... National Forest Inventory
EA ... Even Aged
UEA ... Uneven Aged
UNM ... Unmanaged

Schall et al. 2021

Deadwood and biodiversity

- Increased Resource Availability and Surface Area (Bässler et al. 2010)
- More Habitat Diversity (Boecklen 1986)
- Correlation Between Dead Wood and Endangered Species (Müller & Bütler 2010)



Müller & Bütler 2010

Very large trees

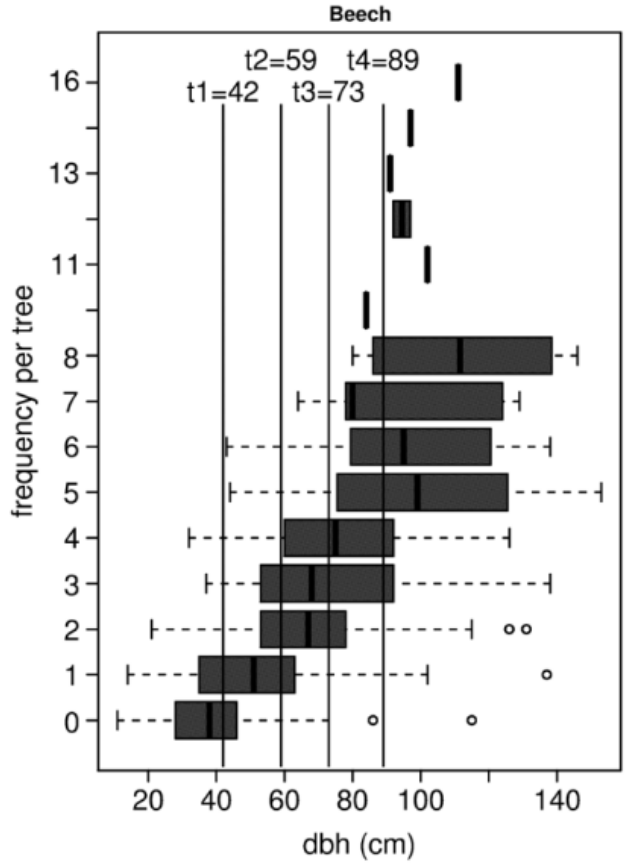


Table 5. Proportion of microhabitat-bearing trees (European beech (*Fagus sylvatica*) and silver fir (*Abies alba*)) per management diameter category.

	% of microhabitat-bearing trees	
Management diameter category	Beech	Fir
Small trees (20 ≤ dbh < 25 cm)	35	6
Medium trees (25 ≤ dbh < 50 cm)	43	9
Large trees (50 ≤ dbh < 70 cm)	78	21
Very large trees		
dbh ≥ 70 cm	92	32
dbh ≥ 89 cm	99	
dbh ≥ 99 cm		70

Note: dbh, diameter at breast height.

Larrieu & Cabanettes 2012

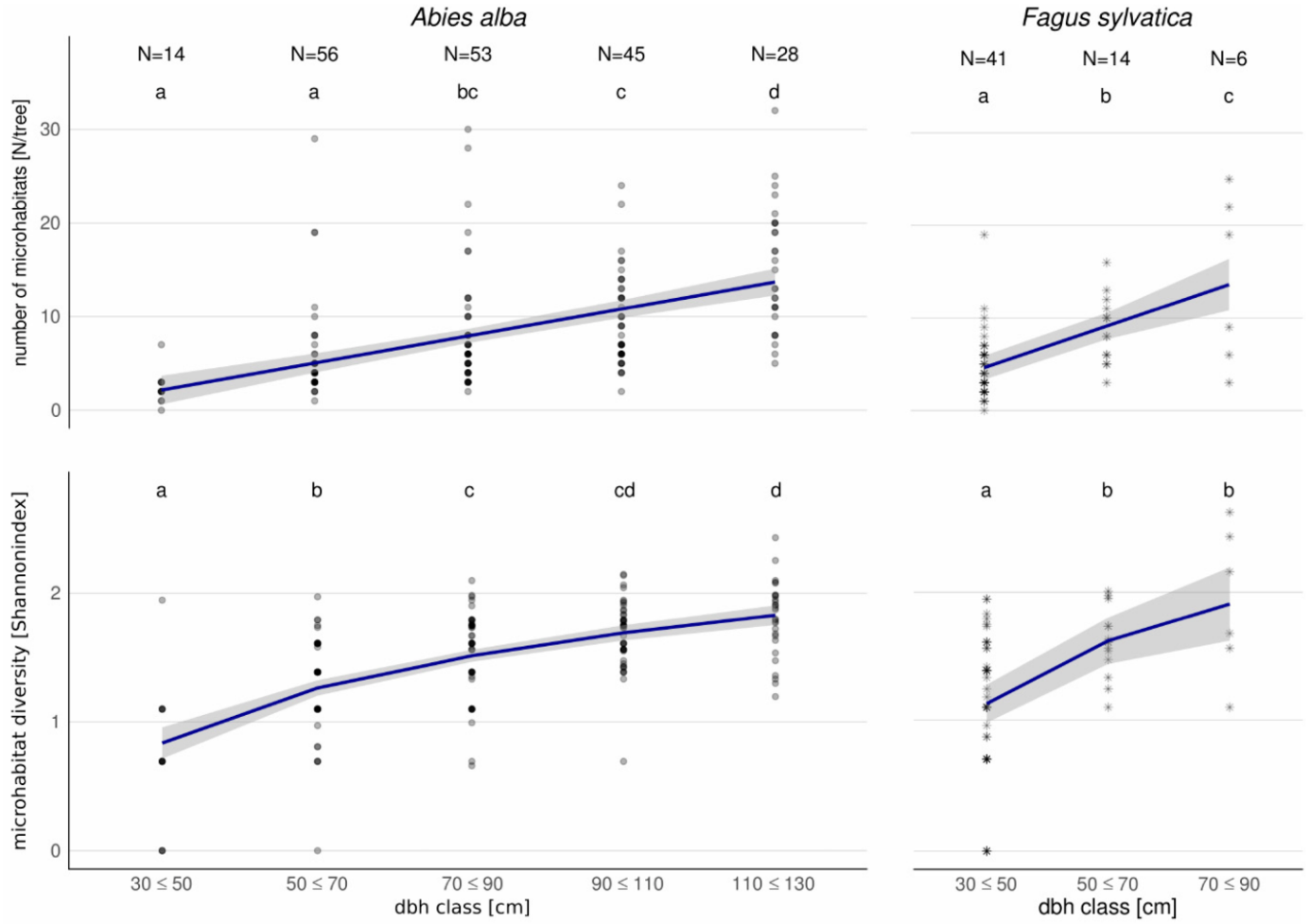
Very large trees

- Unique microhabitats (cavities, large branches, deep bark crevices)
- Support for saproxylic species (offering deadwood)
- Increased structural complexity (enhanced vertical and horizontal forest structure)

Larrieu & Cabanettes 2012



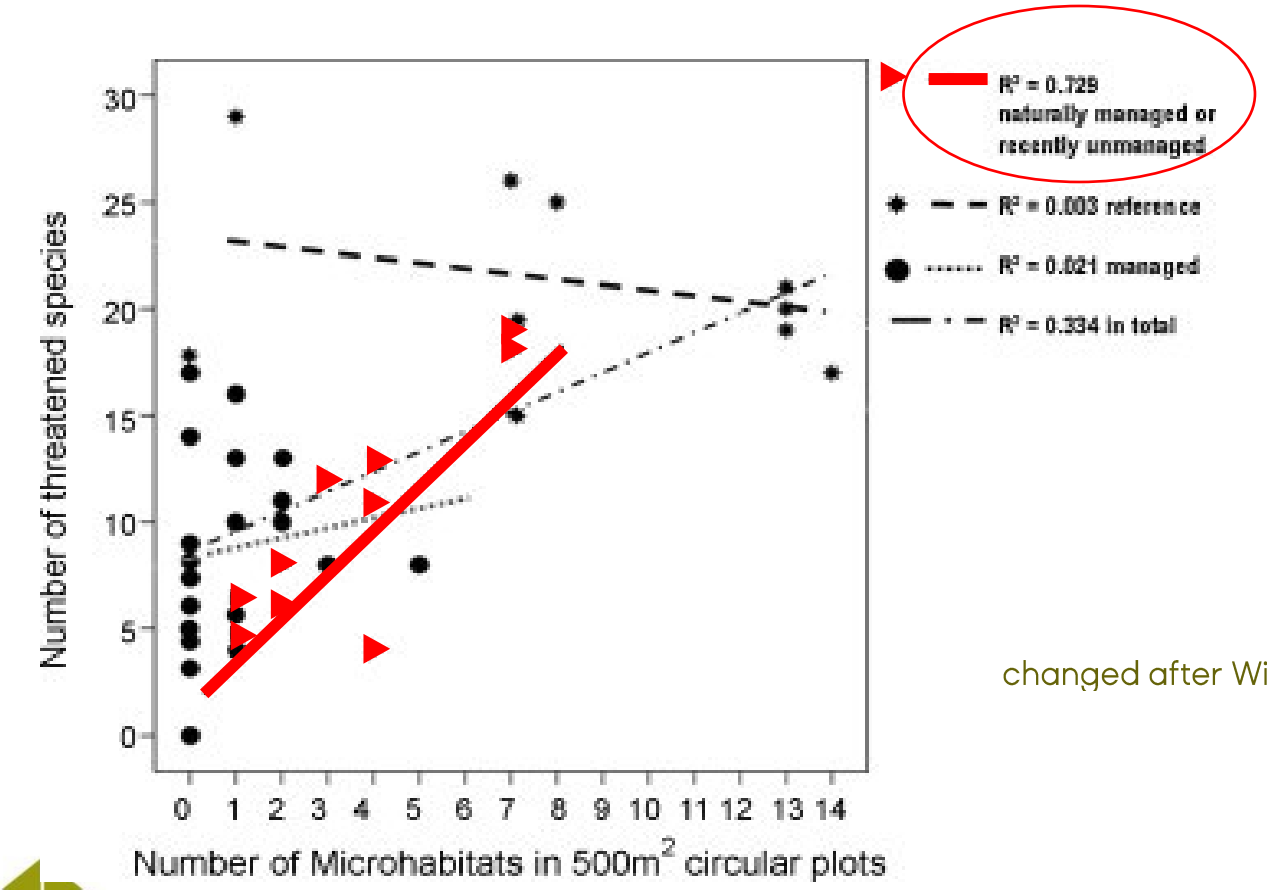
Tree-related microhabitats





Großmann et al. 2018

Tree-related microhabitats

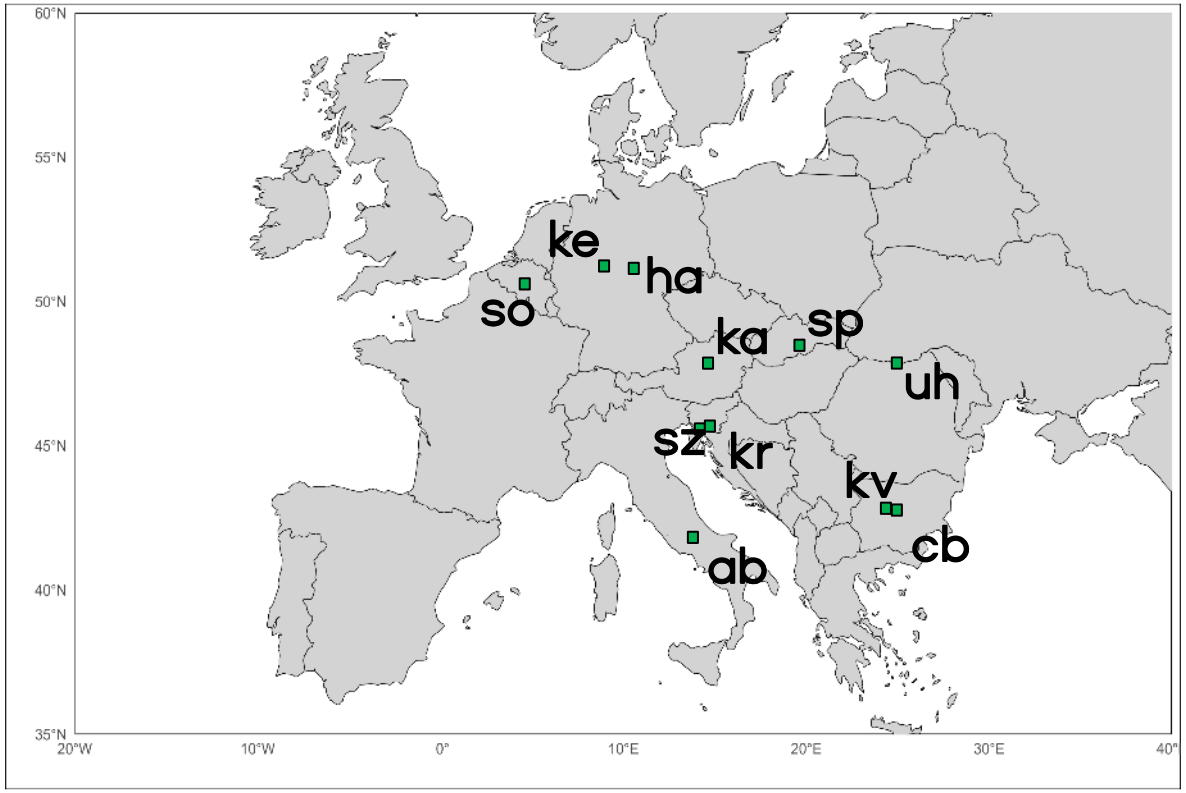


changed after Winter & Möller 2008

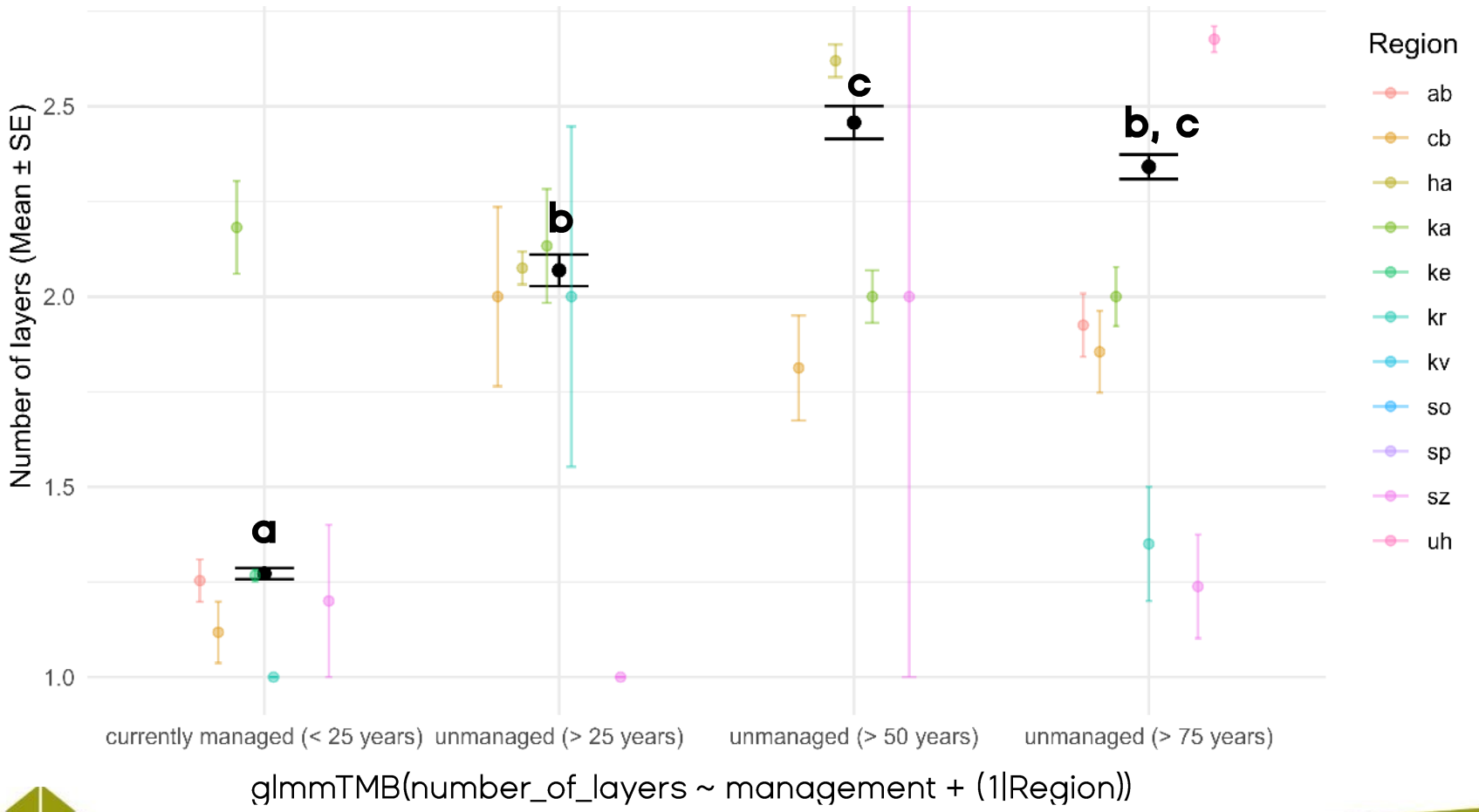
Study regions

- ab ... Abruzzen 151 Plots
- cb ... Central Balkan 120 Plots
- ha ... Hainich 393 Plots
- ka ... Kalkalpen 146 Plots
- ke ... Kellerwald 979 Plots
- kr ... Krokar 30 Plots
- kv ... Klenovsky 14 Plots
- so .. Sonian 145 Plots
- sp ... Stara planina 42 Plots
- sz ...Sneznik-Zdrocle 30 Plots
- uh ... Uholka 238 Plots

Total 2288 Plots

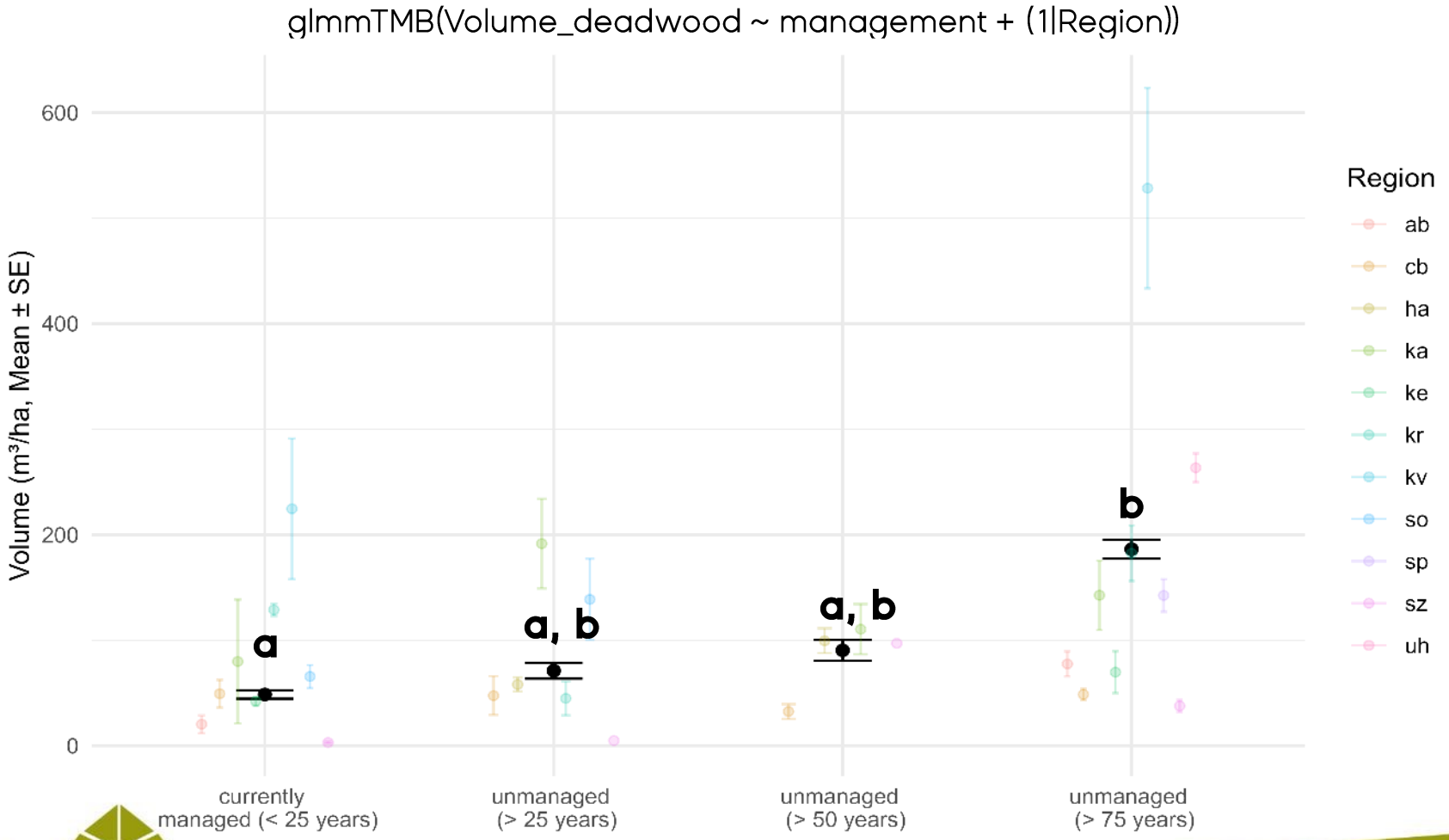


Results – Number of tree layers

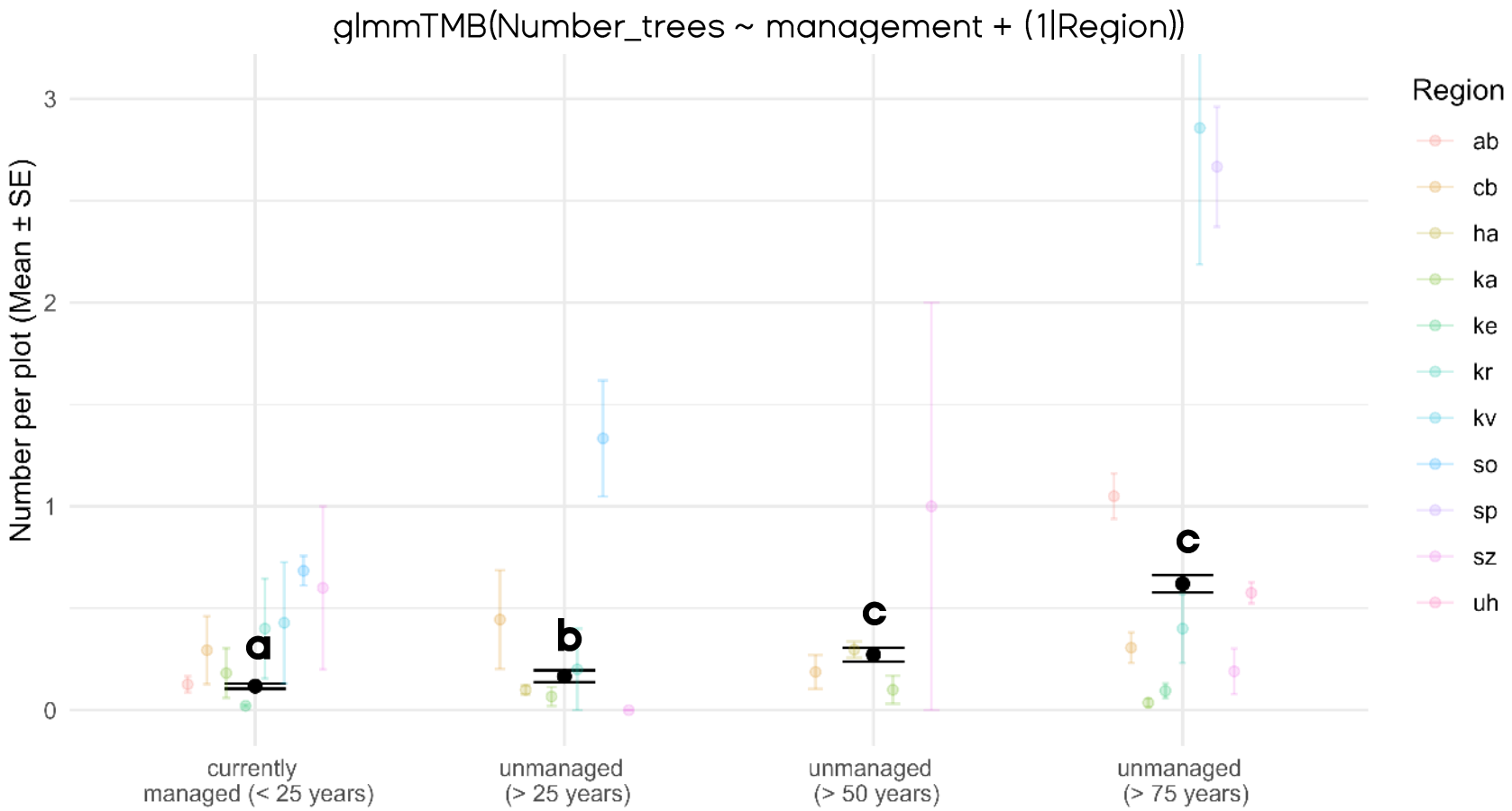


glmmTMB(number_of_layers ~ management + (1|Region))

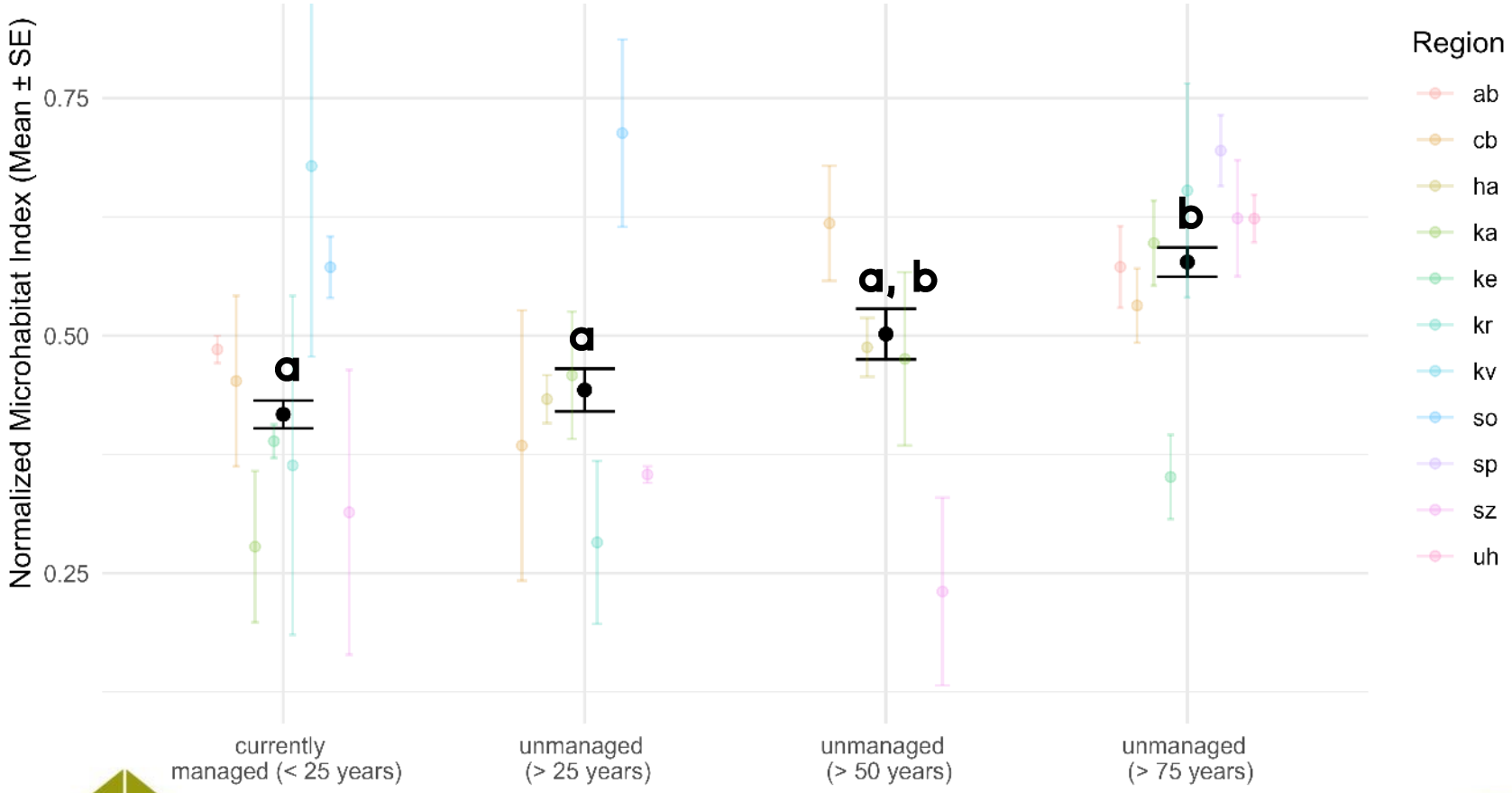
Results - Deadwood



Results - Very large trees



Results - Tree related microhabitats



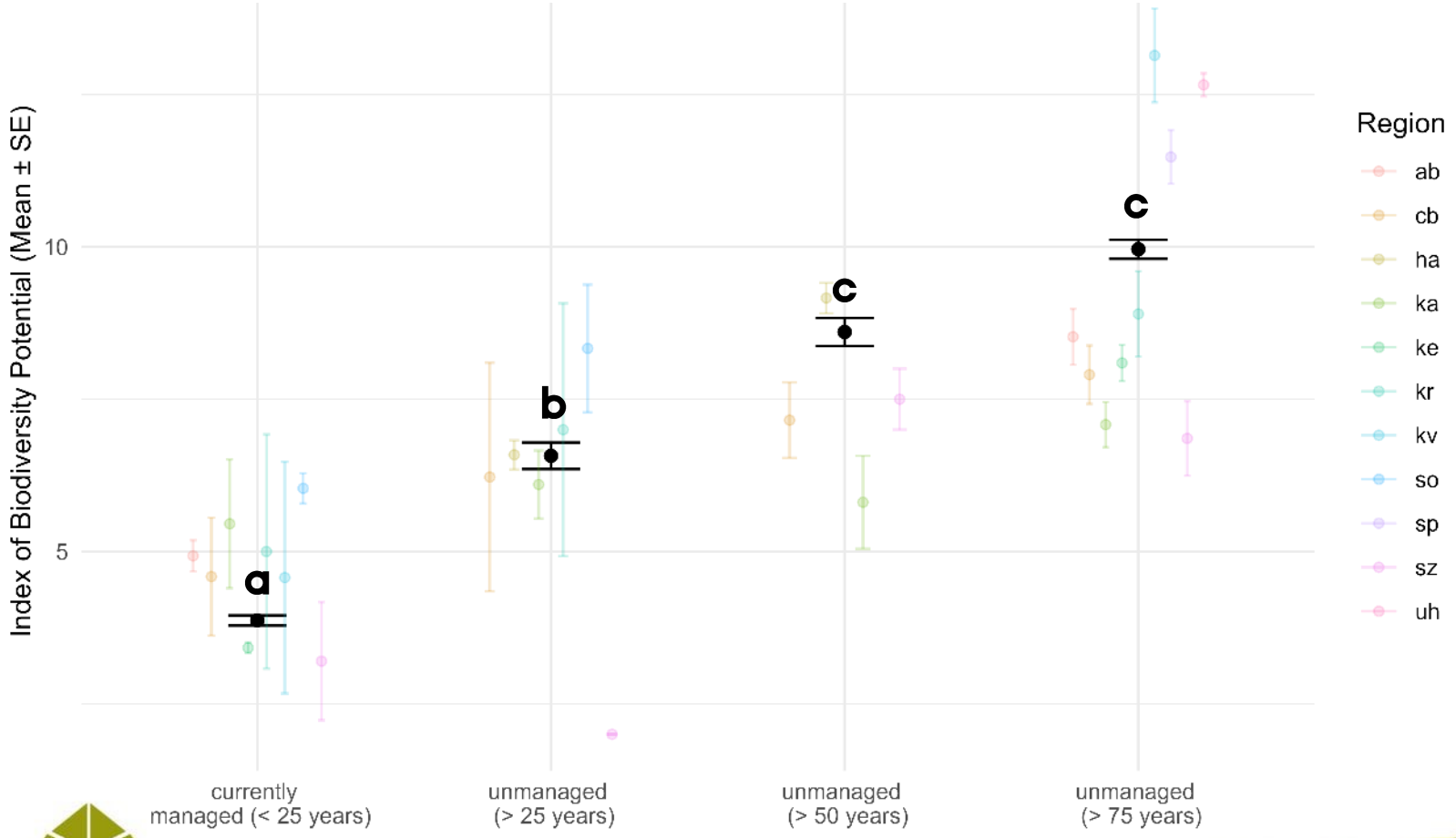
glmmTMB(NMI ~ management + (1|Region))

Index of Biodiversity Potential

- Scoring from 0 – 5 of biodiversity relevant indicators (Canopy-layer, Very large trees, Deadwood, Tree-microhabitats)
- 0 … low biodiversity potential, 5 … high biodiversity potential
- Maximum Score: 20
- Adapted after Larrieu & Gonin (using more indicators, different plot shape and size, different thresholds)

Index of Biodiversity Potential

adapted after Larrieu & Gonin, Zeller et al.



glmmTMB(IBP ~ management + (1|Region))

Conclusions

- The indicators used are closely linked to biodiversity and have shown increasing trends since the time of management abandonment.

- The scoring system for the Index of Biodiversity Potential (IBP) was adapted from Larrieu & Gonin, but may require further adjustments. For example, not all tree microhabitats are directly influenced by management practices.

- Additional site-specific characteristics, such as geomorphology and climate, could help to further refine the IBP and improve its accuracy.

Future tasks

- Dataset Imbalances and Site Variability needs to be addressed
- Accounting for Potential Natural Tree Vegetation
- Accounting for Management History
- Integration of Ecological and Historical Dimensions

Q&A

Thank you for your attention

