Richness asymmetry with past **forest loss and gain** in pollen data

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Outstanding Student & PhD candidate Presentation contest

1. Introduction

- Forests have global importance due to significant carbon storage and biodiversity.
- Climate change is impact biome ranges and carbon pools are shifting spatially.
- How will these shifts impact biodiversity?
- And what does the relationship of carbon storage and forest biodiversity look like in the Northern Hemisphere?
- Modern observational data tends to cover short time scales with little climatic change so we turn to paleoecological data to investigate past biodiversity dynamics (Fig 1)

What did the relationships of forest cover, forest cover trends, and pollen richness look like in the past 10,000 years?

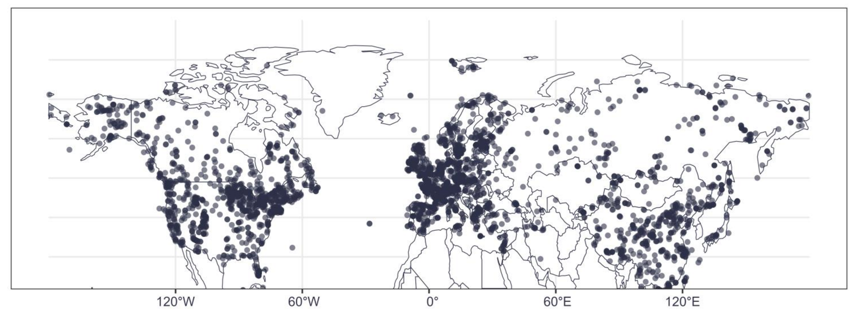


Fig 1: Paleo pollen record locations in Europe, North America, and Asia (n = 3089)

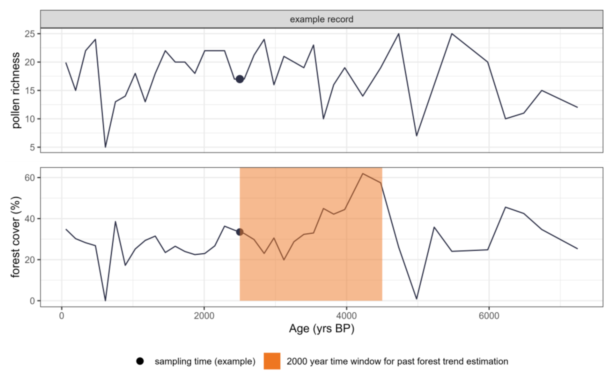


Fig 2: Example time series of pollen-based forest cover and richness and the window for past trend estimation.

2. Data and Methods

- Northern Hemisphere pollen records for the past 10,000 years
- landscape signal in the data due to large source areas for pollen in lake sediments
- irregular timeseries for each record
- taxonomic compositions from corrected pollen counts
- pollen-based reconstructed forest cover
- corrected richness by accounting for different total pollen counts
- past forest cover trends in dynamic 2000-year windows with linear models (Fig 2)

3. Carbon storage-richness trade-off

- Step-wise richness change and forest cover change have an overall negative relationship. (Fig 3)
- Looking at change within the time series ensures that differences in regional species pools do not influence the analysis.
- Landscapes therefore tend to lose richness when gaining forest cover
- This negative relationship seems to be dominant in the entire Northern Hemisphere indicating that denser forests, with more carbon storage, tend to be less diverse.

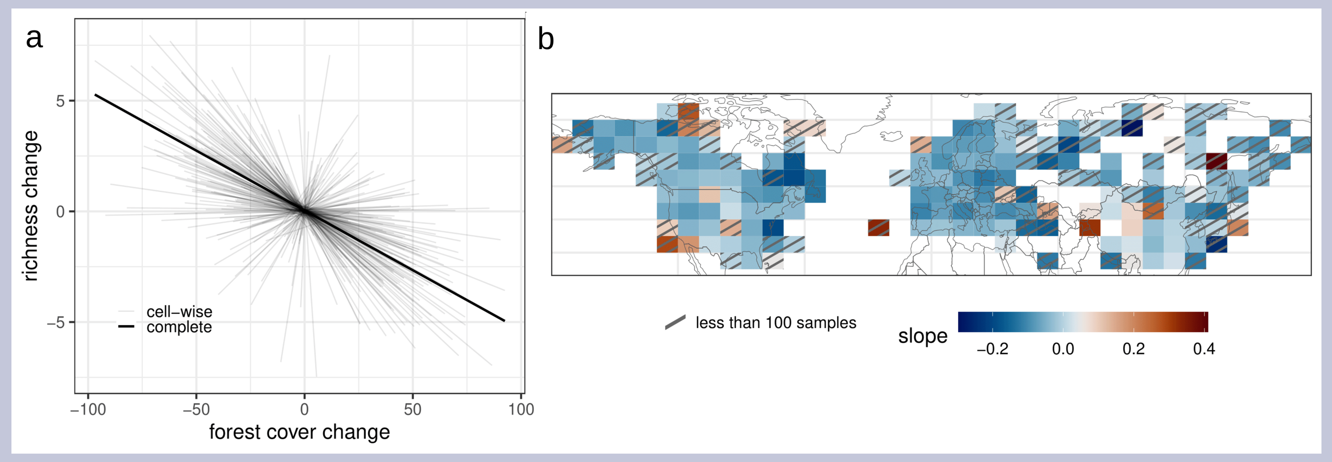
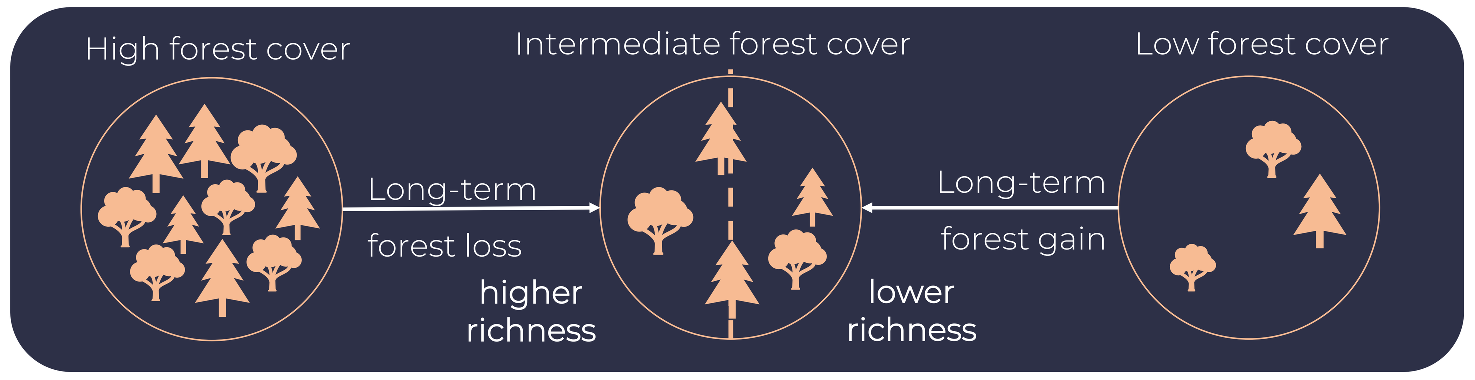


Fig 3: a) Linear models of stepwise richness change as a function of stepwise forest cover change for all samples and spatially gridded samples. b) Slopes of the linear models in Northern Hemisphere gridcells.



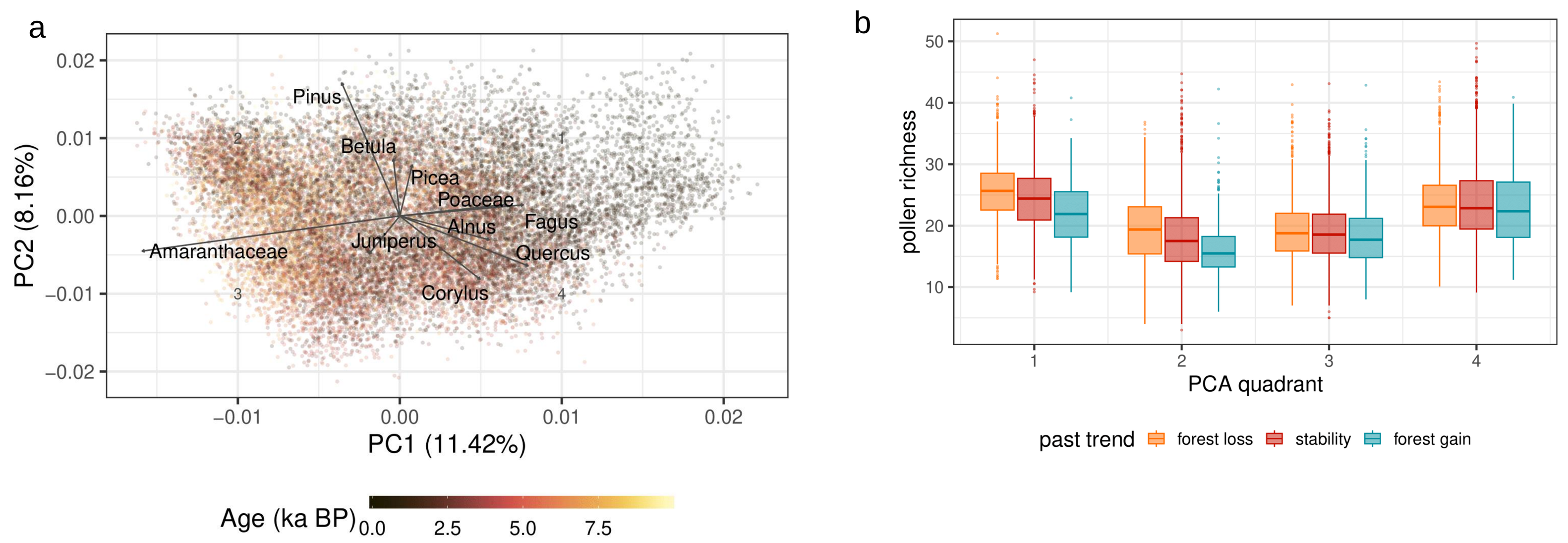


Fig 5: a) PCA of European intermediate forest cover pollen samples with sample age indicated by color. b) Boxplot of richness values separated by PCA quadrant and past forest cover trend.

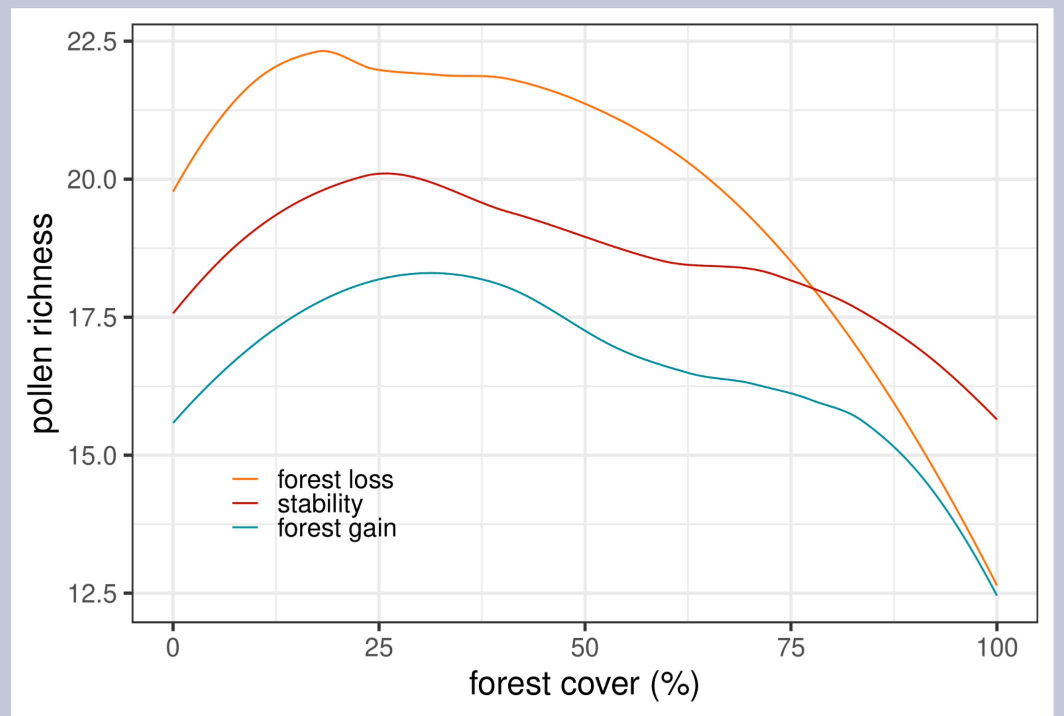


Fig 4: Loess model of pollen richness as a function of pollen-based forest cover grouped by past forest cover trends (2,000 yrs) using Northern Hemispheric pollen samples.

4. Assymetry

- Millennial forest cover trends have an impact on the landscapes richness trajectory.
- Samples with past forest loss have overall higher richness (Fig 4).
- Differences are especially high at intermediate forest cover (20-60%).
- Higher richness with past forest loss is also irrespective of overall composition as seen when comparing different trends within the quadrants of a PCA using European samples with intermediate forest cover (Fig 5).

5. Conclusions

Northern Hemispheric pollen data show:

- A **trade-off** between **carbon storage** (forest cover) and **richness** possibly due to reduced light availability and heterogeneity
- A **positive impact of past forest cover loss** on richness which could be associated with old-growth forest remnants in the landscape and increased heterogeneity.

Understanding these relationships can be useful for decision making in landscape management and predicting future change.

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