Reviewing wildlife biodiversity research from African rangelands

Devan Allen McGranahan [1]   Kevin P. Kirkman [2]

[1]School for Natural Resource Sciences—Range Science Program, North Dakota State University, Fargo, North Dakota USA

[2]Grassland Sciences Department, University of KwaZulu-Natal, Scottsville, South Africa

Overview

- African rangelands are diverse. Understanding responses of biodiversity to disturbance is critical to conservation management. **As ecological theory & research analytical methods have developed worldwide, has African biodiversity science kept up?**
- We systematically reviewed primary literature on bird, small mammal, herptofauna, and invertebrate responses to disturbance in African rangelands, **principally fire and grazing**.
- Overall, solid understanding of biodiversity response is limited geographically, & within taxa limited by insufficient replication, lack of experimentation, & weak community analysis.
- **Spatial & temporal heterogeneity are overlooked** and should be combined with multivariate analysis of long-term datasets to relate management and disturbance interactions to community assembly and succession.

Review methods

- Web of Science search with disturbance-related wildcard terms graz* OR herbivor*; fire OR burn*; AND africa*
- Inclusion criteria: Original data on faunal response to treatment/management from rangeland ecosystem
- Each paper searched backwards/forwards: Bibliographies + "cited by" in Google Scholar (same inclusion criteria)

Table 1:We ranked the analyses we encountered by strength, based on their (1) sensitivity to individual species identity and (2) ability to test dissimilarity among groups or along gradients:

Category	Explanation/description
None	univariate responses (ANOVA, t-test) are species-specific
Very weak	MANOVA, richness, & diversity indices (Shannon, Simpson, etc) lack information on species identity
Weak	Dissimilarity indices, classification, indicator species
Moderate	Ordination without testing group dissimilarity
Strong	Ordination & clustering that tests dissimilarity
Very strong	Ordination that tests dissimiliarity among groups or along environmental gradient

The diversity of biodiversity research in sub-Saharan Africa

Rangeland biomes of Africa

Tropical & Subtropical Grassland, Savanna, Shrubland
Temperate Grassland, Savanna, Shrubland
Flooded Grassland, Savanna
Montane Grassland, Savanna
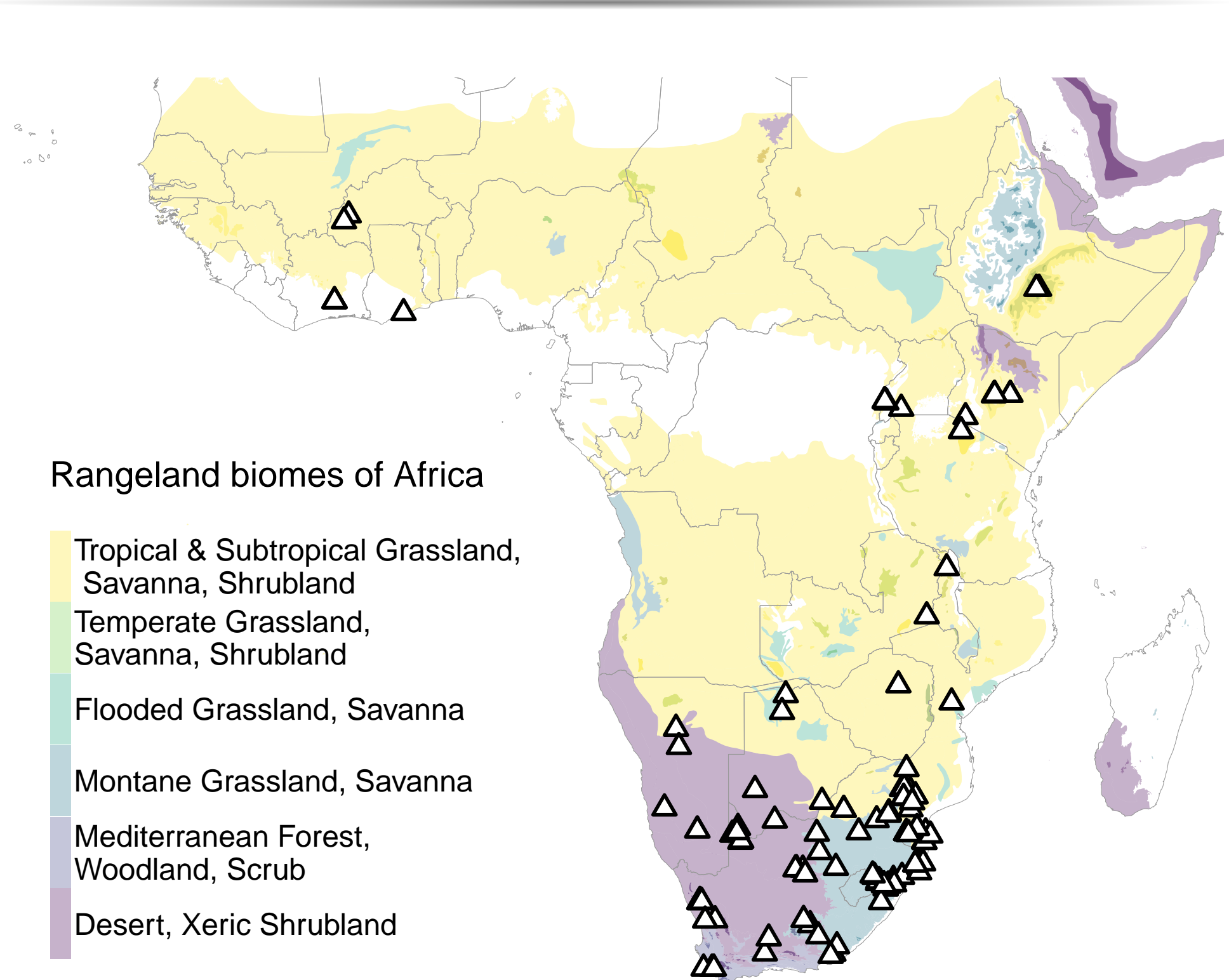Mediterranean Forest, Woodland, Scrub
Desert, Xeric Shrubland

Figure 1:Location of studies included in review

Response variables & statistics

- Most studies collected data on species abundance (Below)
- Many also used these data for community analysis (Right)
- Richness & diversity indices are common, but they ignore species identity & fail to detect different assemblages
- Multivariate stats allow testing groups & gradients, but most ordinations simply plotted groups differently.

Figure 3:Relative frequency of response variables reported at least twice
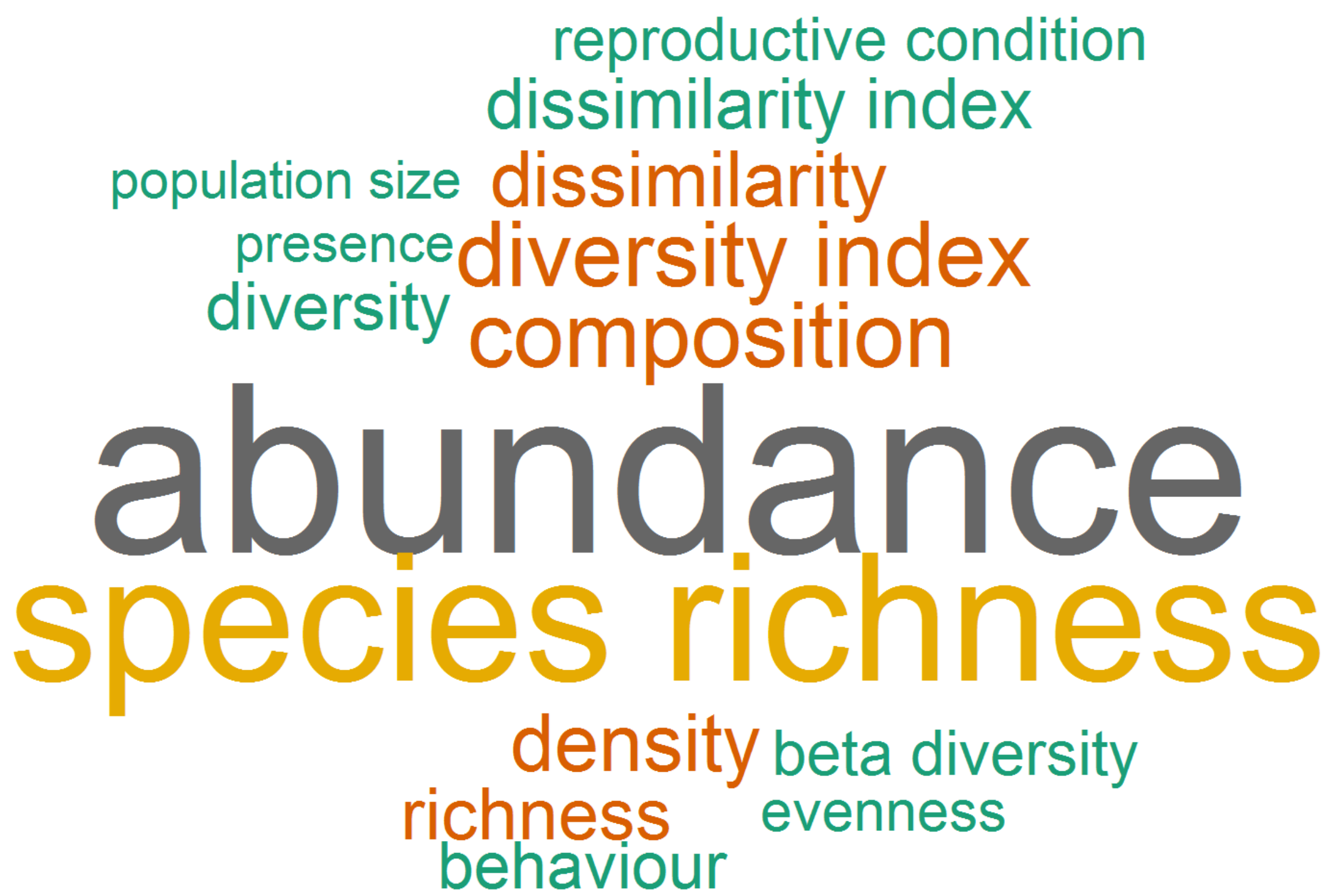
- Most research comes from South Africa
- 78% of studies were observational
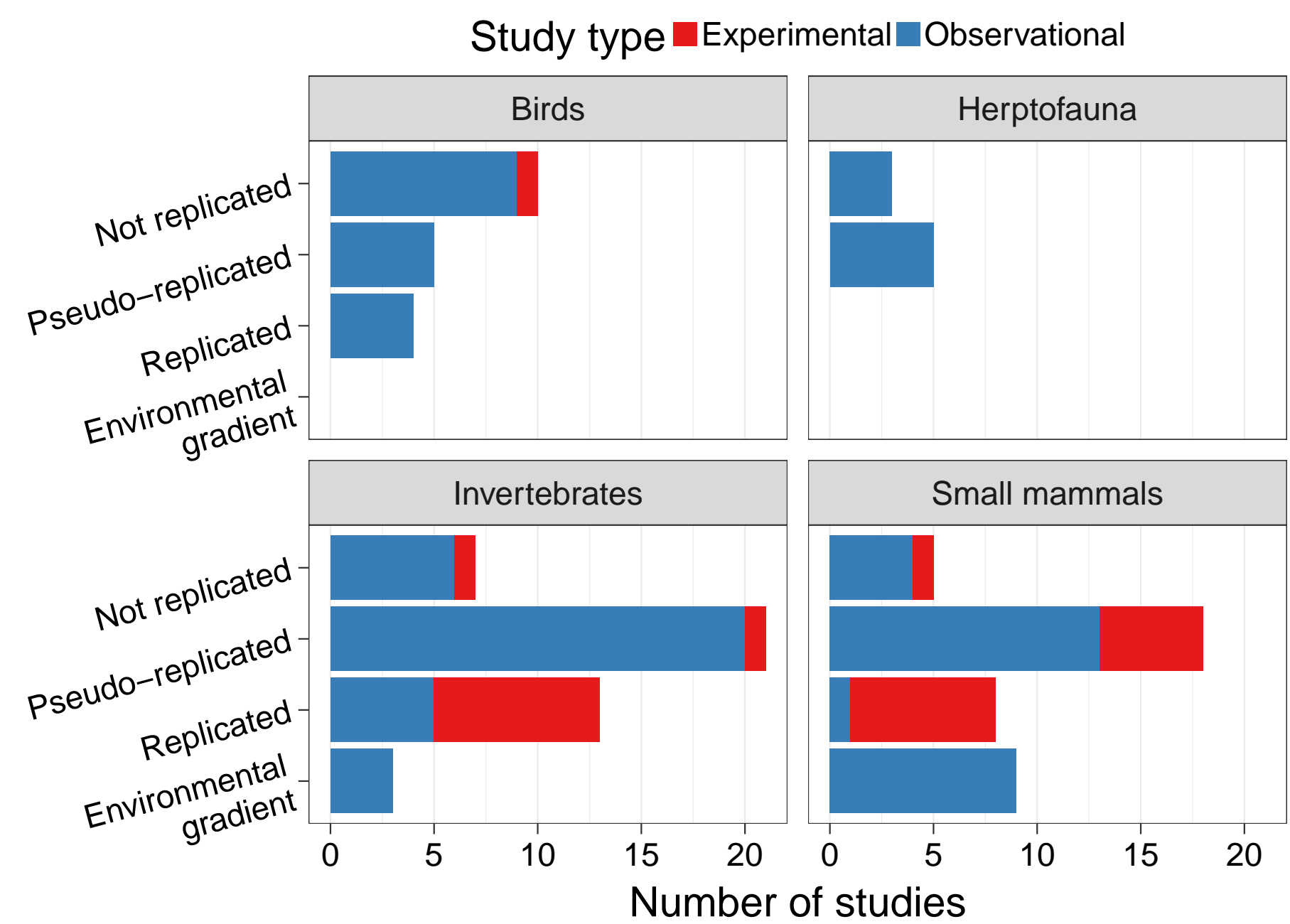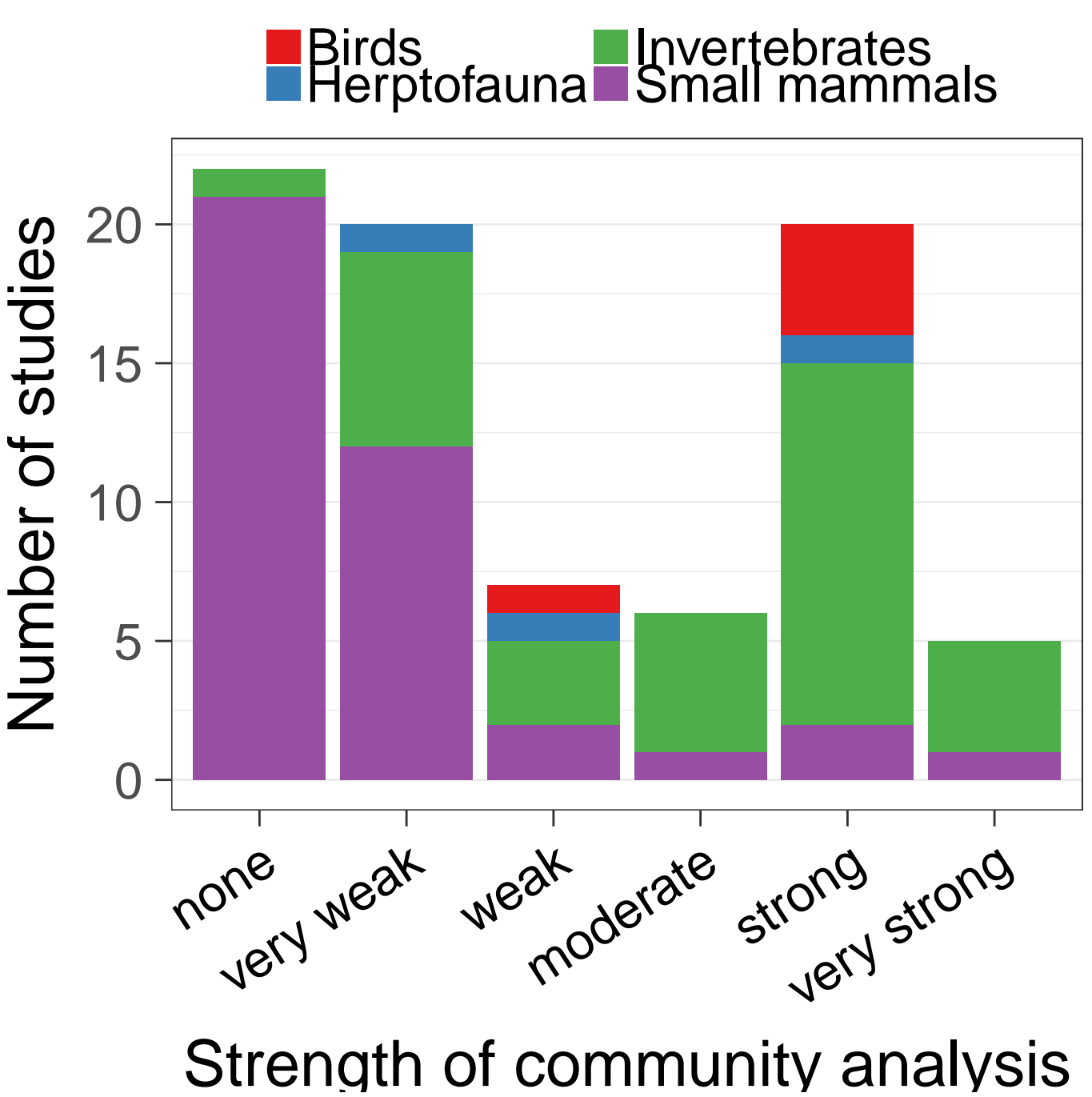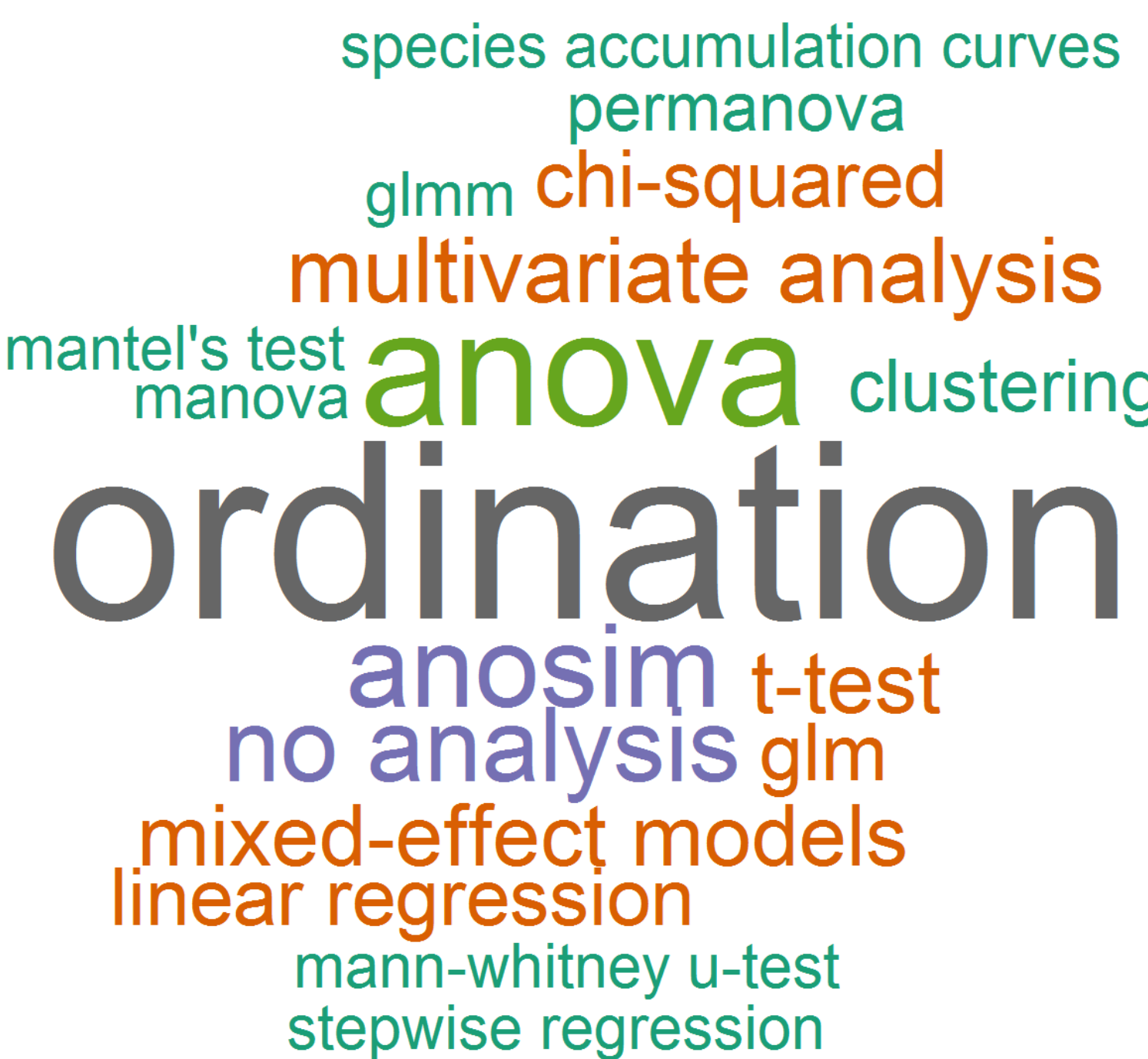- 64% were pseudo-replicated or not replicated

Figure 2:Number of studies per taxa, by study type

## Data analysis

Biodiversity research lacks attention to heterogeneity & variability

- Ecosystem theory and managment worldwide recognise role of spatial heterogeneity (& variability in time) in enhancing biodiversity.
- Managers can create niche diversity and increase compositional diversity with spatially-patchy disturbance, **but the heterogeneity perspective in Africa is missing**.
- Many data types familiar to researchers in Africa support heterogeneity-based analysis, but longer studies and multivariate analyses are required.

Heterogeneity is rarely a research focus:
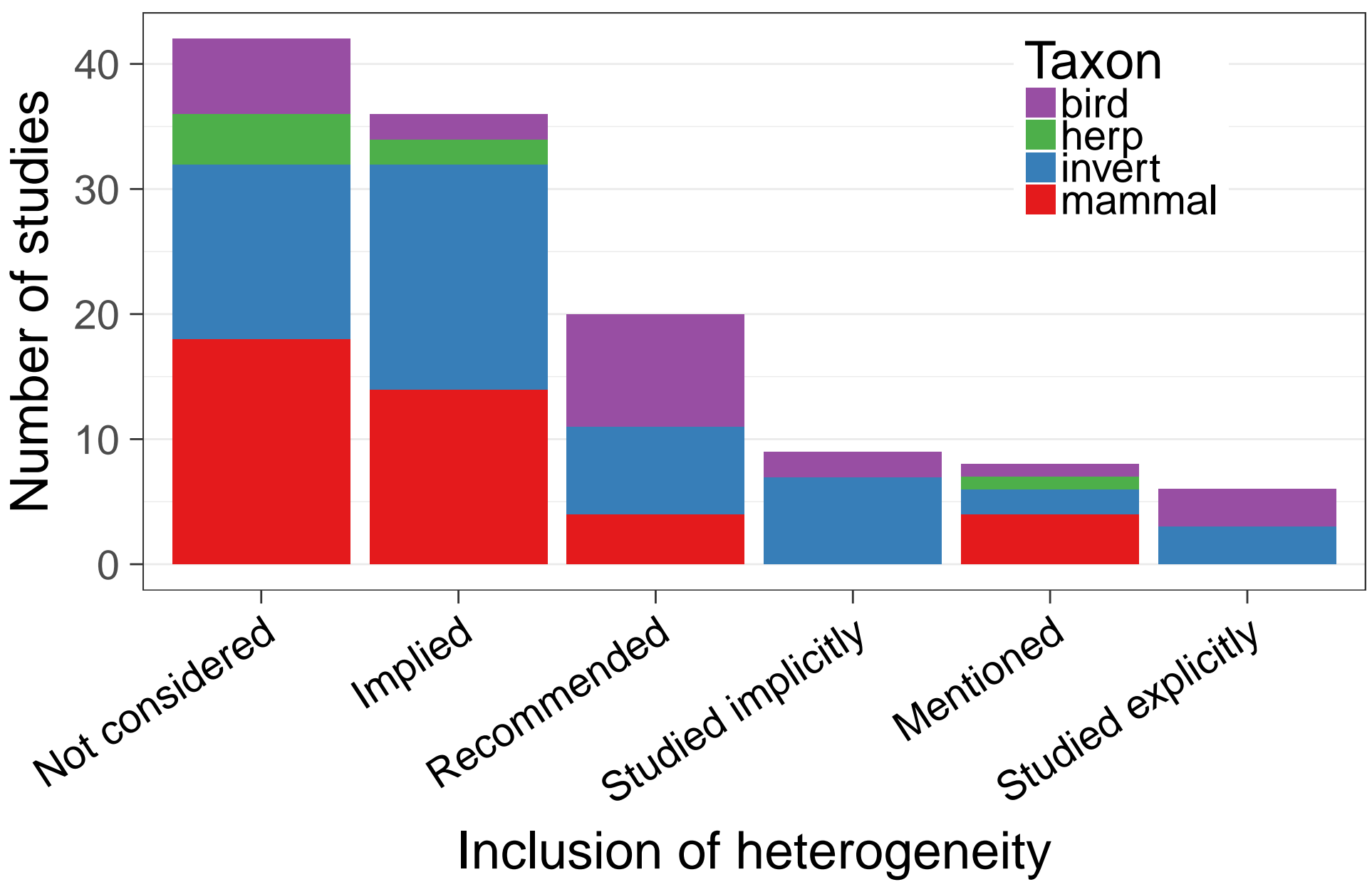
Above: We scored studies by whether they had a heterogeneity component, and if so, whether it was an explicit part of the study or could be inferred by a reader familiar with heterogeneity concepts.

Most studies are too short to show temporal patterns: