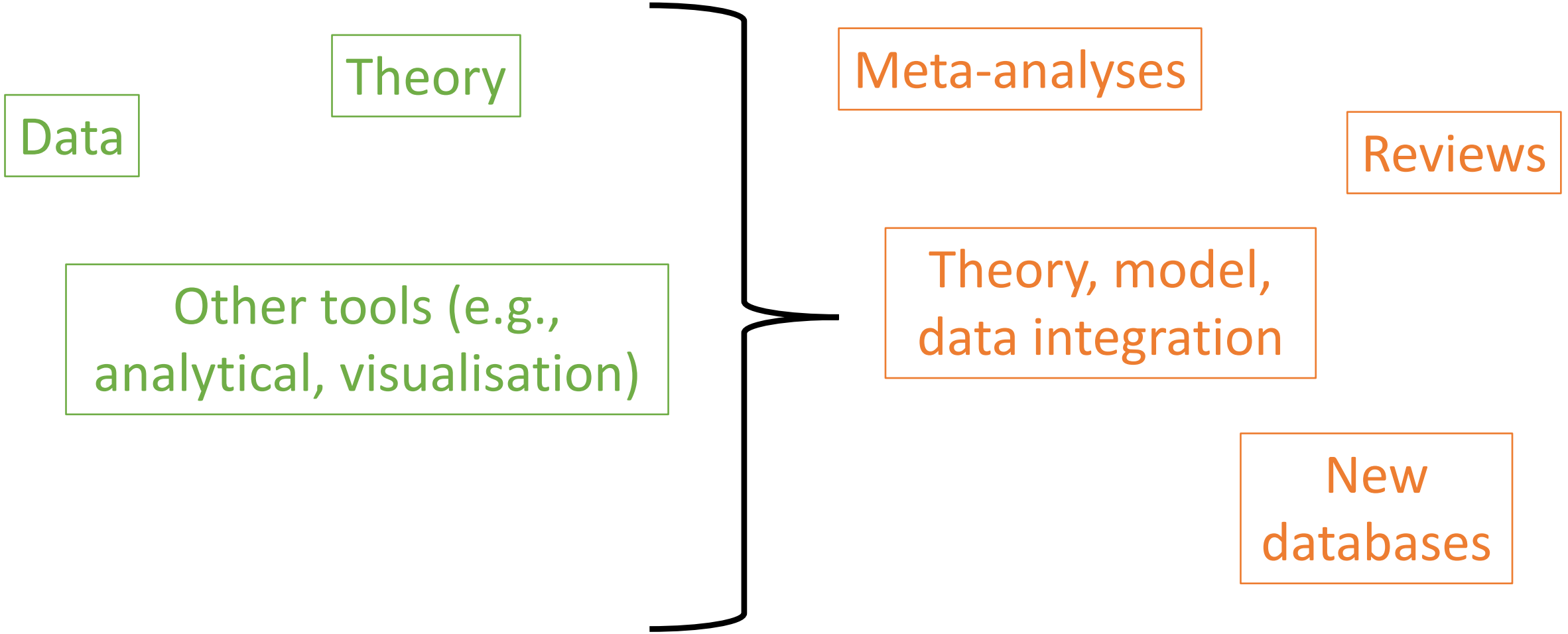
Evidence synthesis in ecology

Modelling species distribution and biodiversity patterns

MLU 2021

Synthesis in ecology and environmental science



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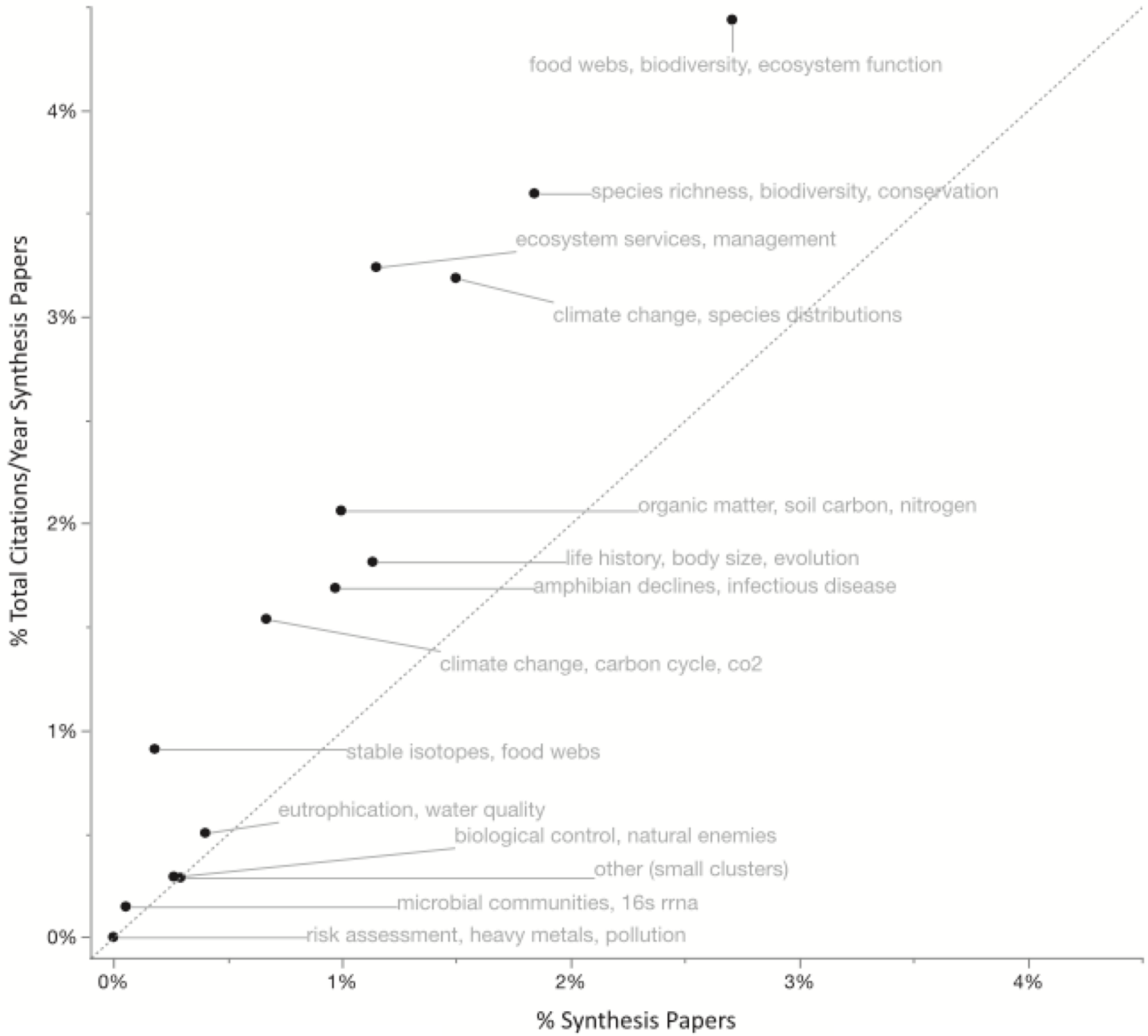
Carpenter et al. 2009 *BioScience*

Why synthesis?

- Generality and interdisciplinarity

✓ High relative impact
✓ Bridge disciplines



Halpern et al. 2020 *BioScience*

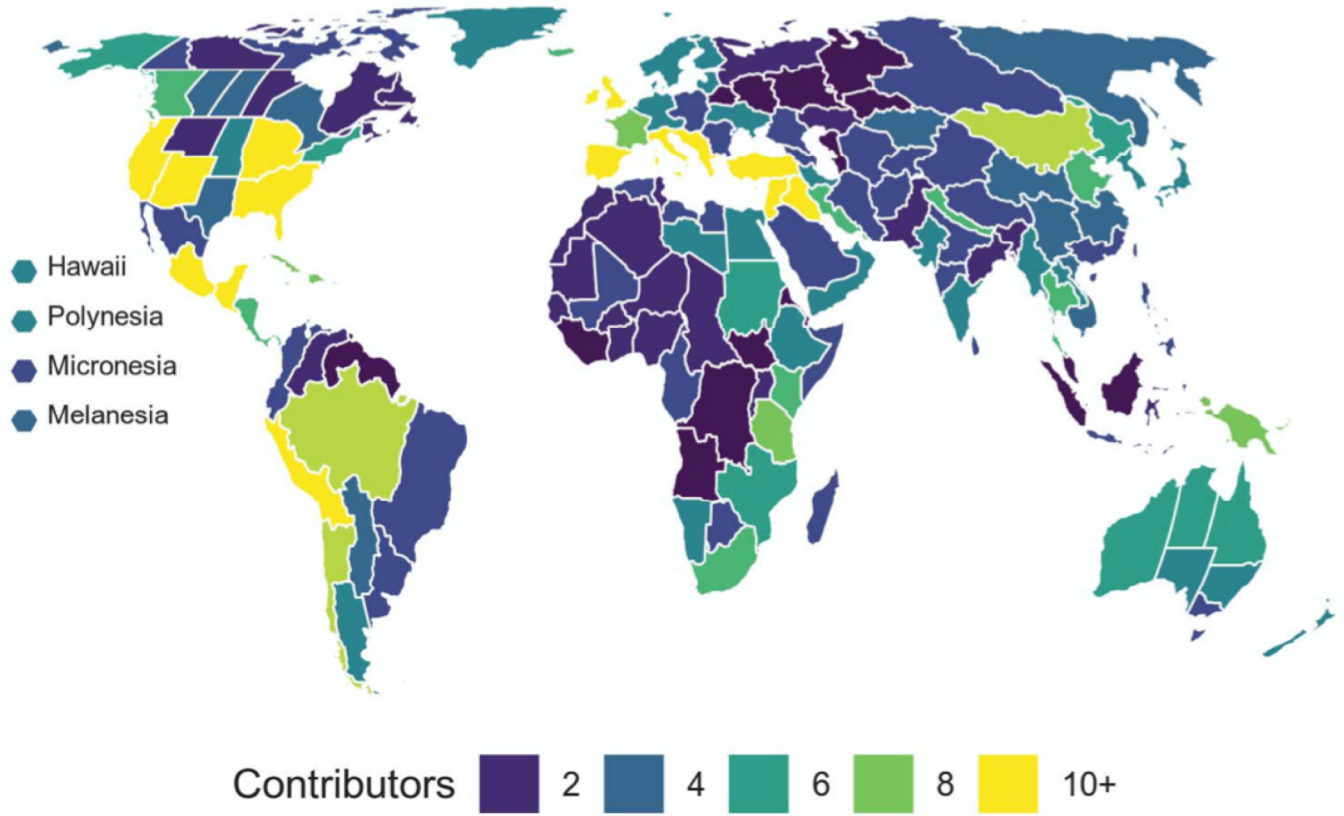
Why synthesis?

- Generality and interdisciplinarity
- ‘Burden of knowledge’

(Jones 2009 Rev Econ Stud)

Archaeological assessment reveals Earth’s early transformation through land use

ArchaeoGLOBE Project*†



Stephens et al. 2019 *Science*

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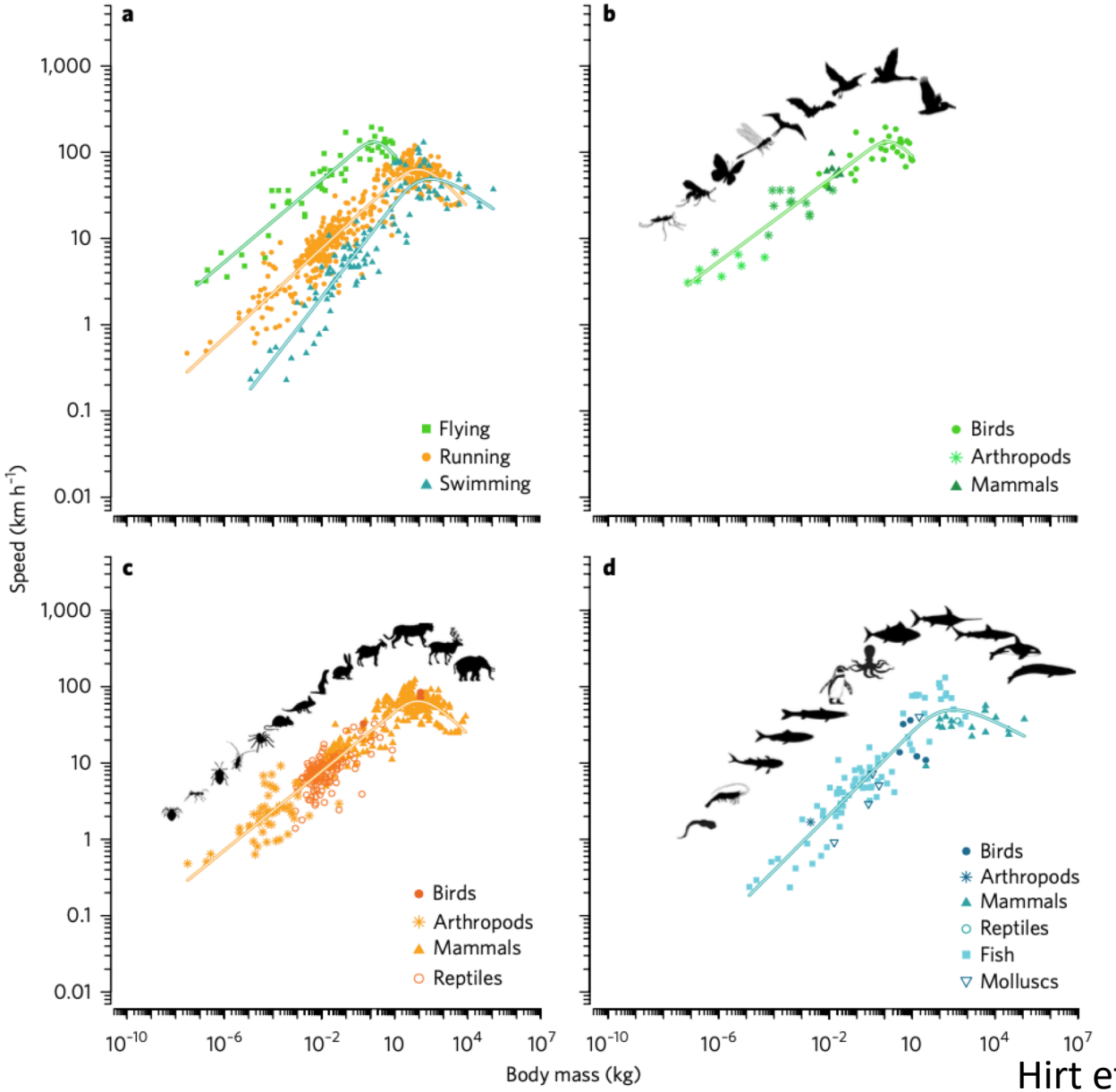
Synthesis I

Theory

Data

Other tools (e.g., analytical, visualisation)

A general scaling law reveals why the largest animals are not the fastest



Hirt et al. 2017 *NEE*

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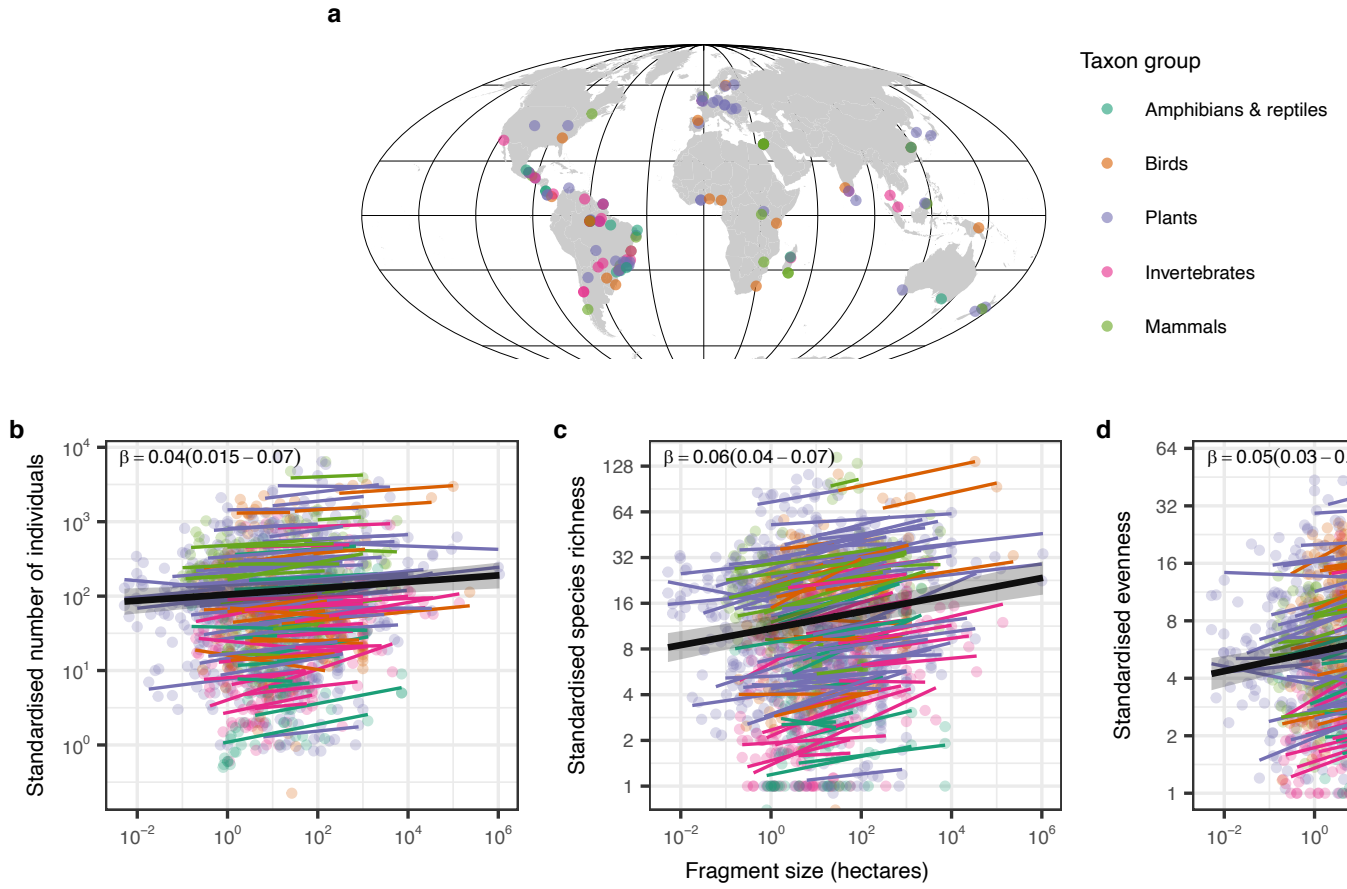
Synthesis II

Theory

Data

Other tools (e.g., analytical, visualisation)

Ecosystem decay exacerbates biodiversity loss with habitat loss



Chase et al. 2020 *Nature*

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FragSAD: A database of diversity and species abundance distributions from habitat fragments

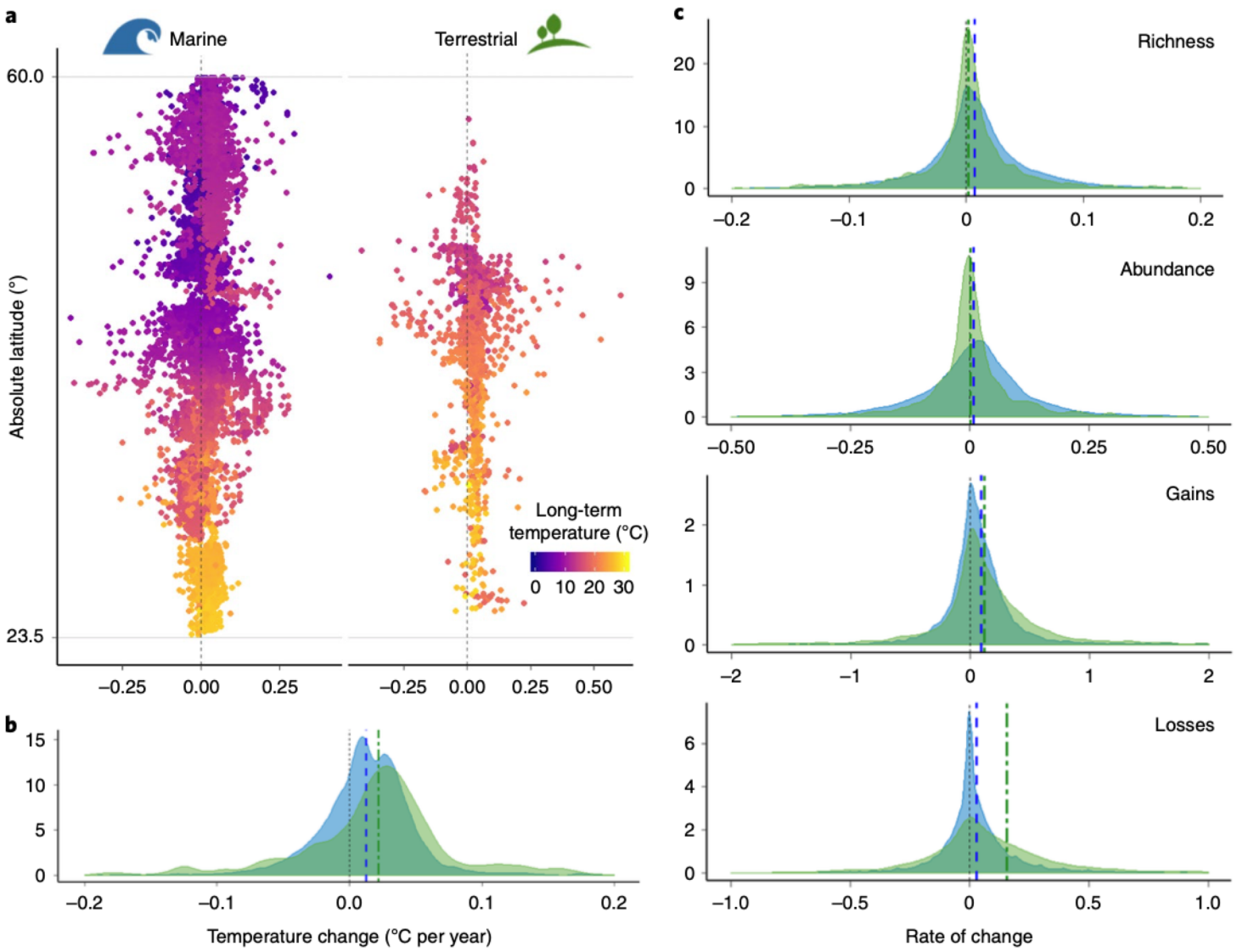
Chase et al. 2019 *Ecology*

Synthesis III

Data

Other tools (e.g., analytical, visualisation)

Temperature-related biodiversity change across temperate marine and terrestrial systems



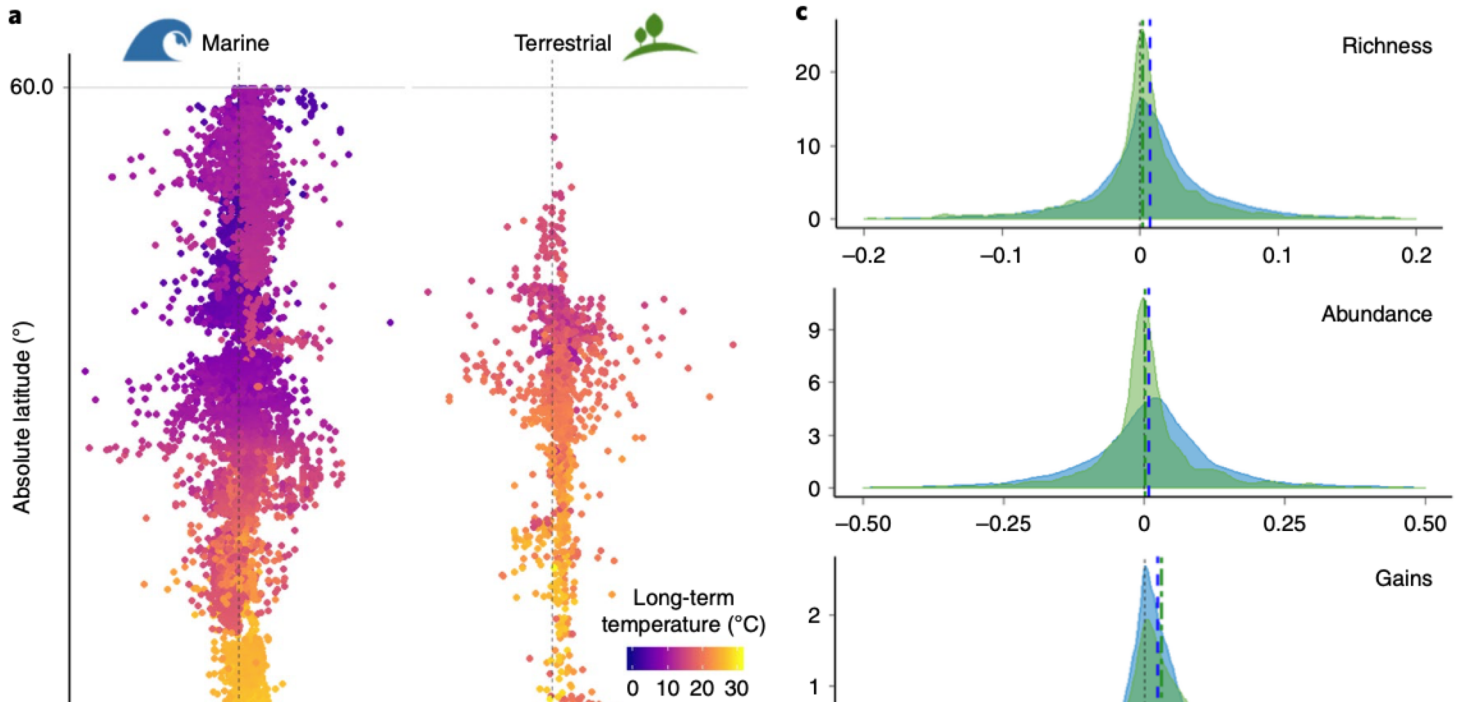
Antao et al. 2020 *NEE*

Synthesis III

Temperature-related biodiversity change across temperate marine and terrestrial systems

Data

Meta-analysis



Rate of change ~ *f*(Temperature change, Long-term temperature)

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Antao et al. 2020 *NEE*

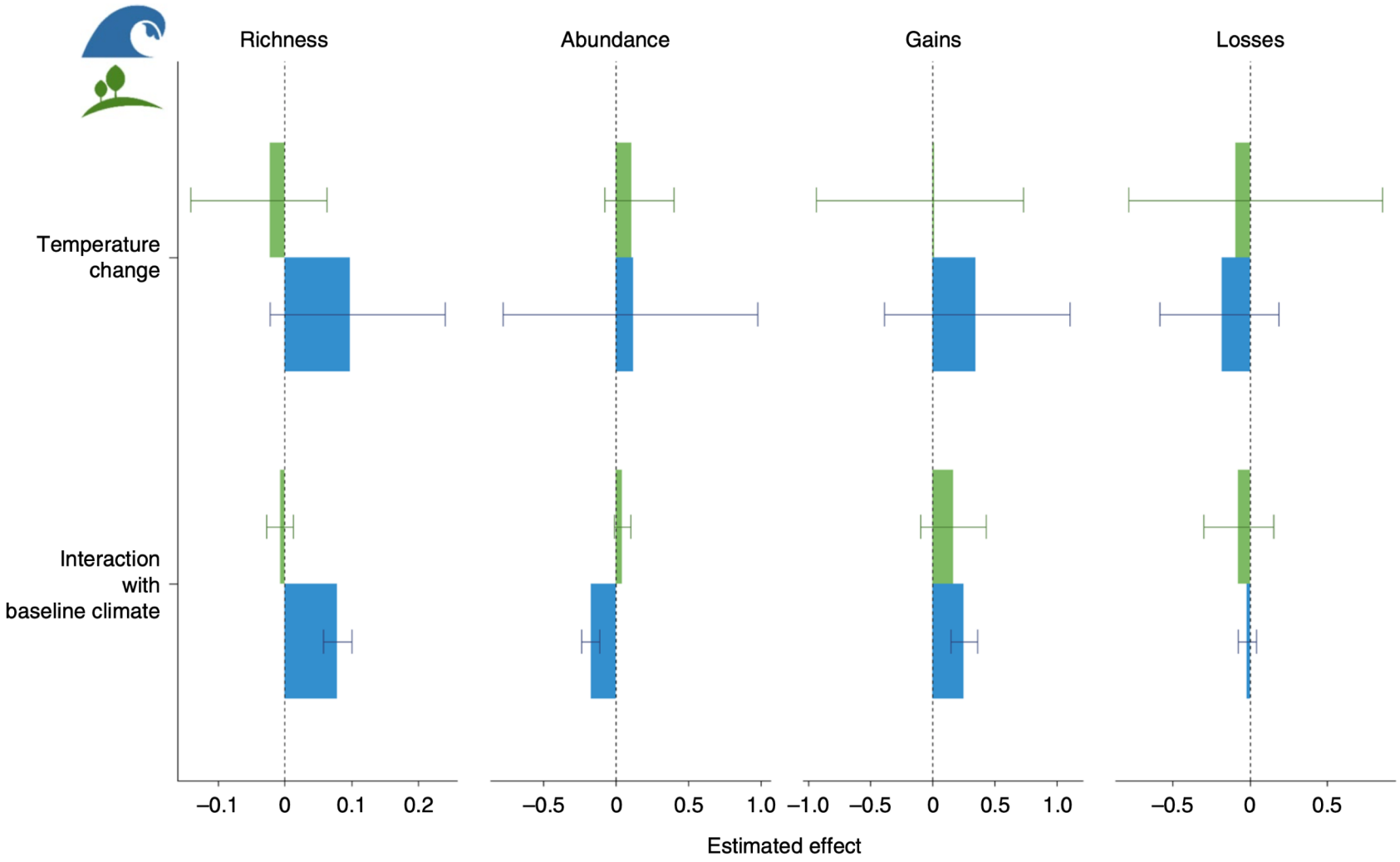
Synthesis III

Temperature-related biodiversity change across temperate marine and terrestrial systems

Data

Meta-analysis

Rate of change in:



Antao et al. 2020 *NEE*

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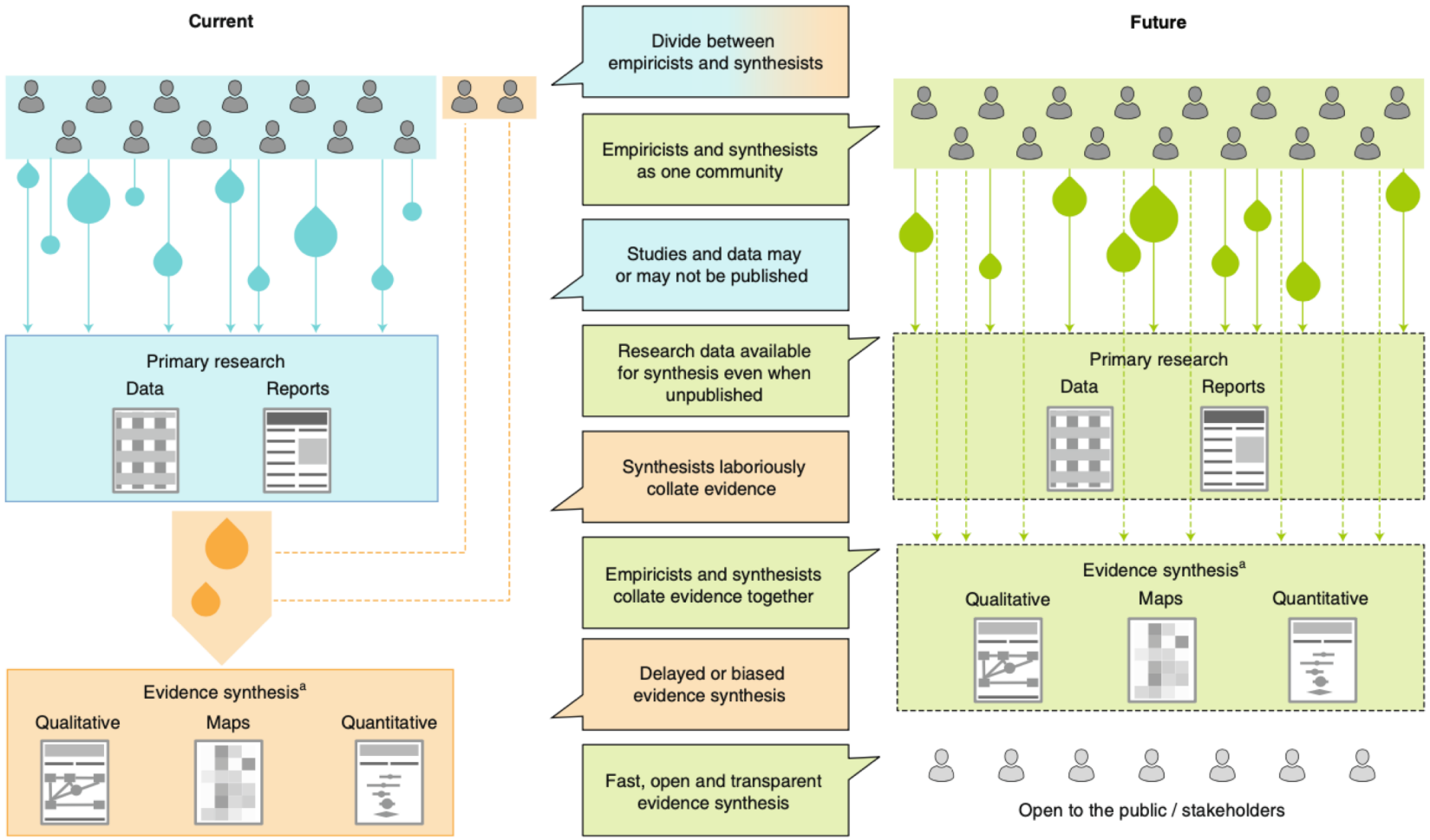
Outlook

- ‘Open synthesis community’
  (Nakagawa et al. 2020 *NEE*)



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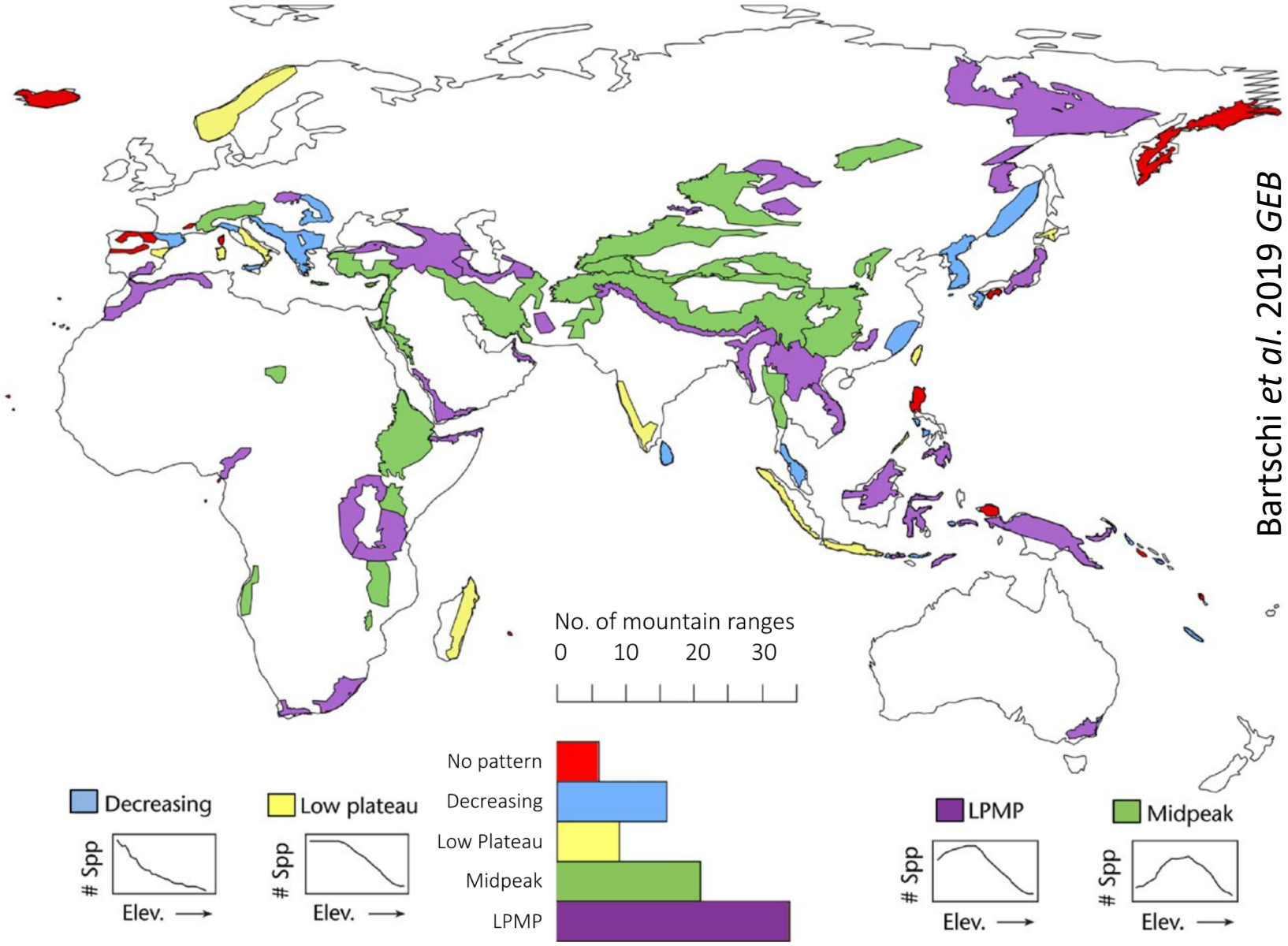
Synthesis of elevational diversity gradients

- Often rely on ‘vote counting’
- E.g., Sphingid moth species richness gradients



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Synthesis of elevational diversity gradients

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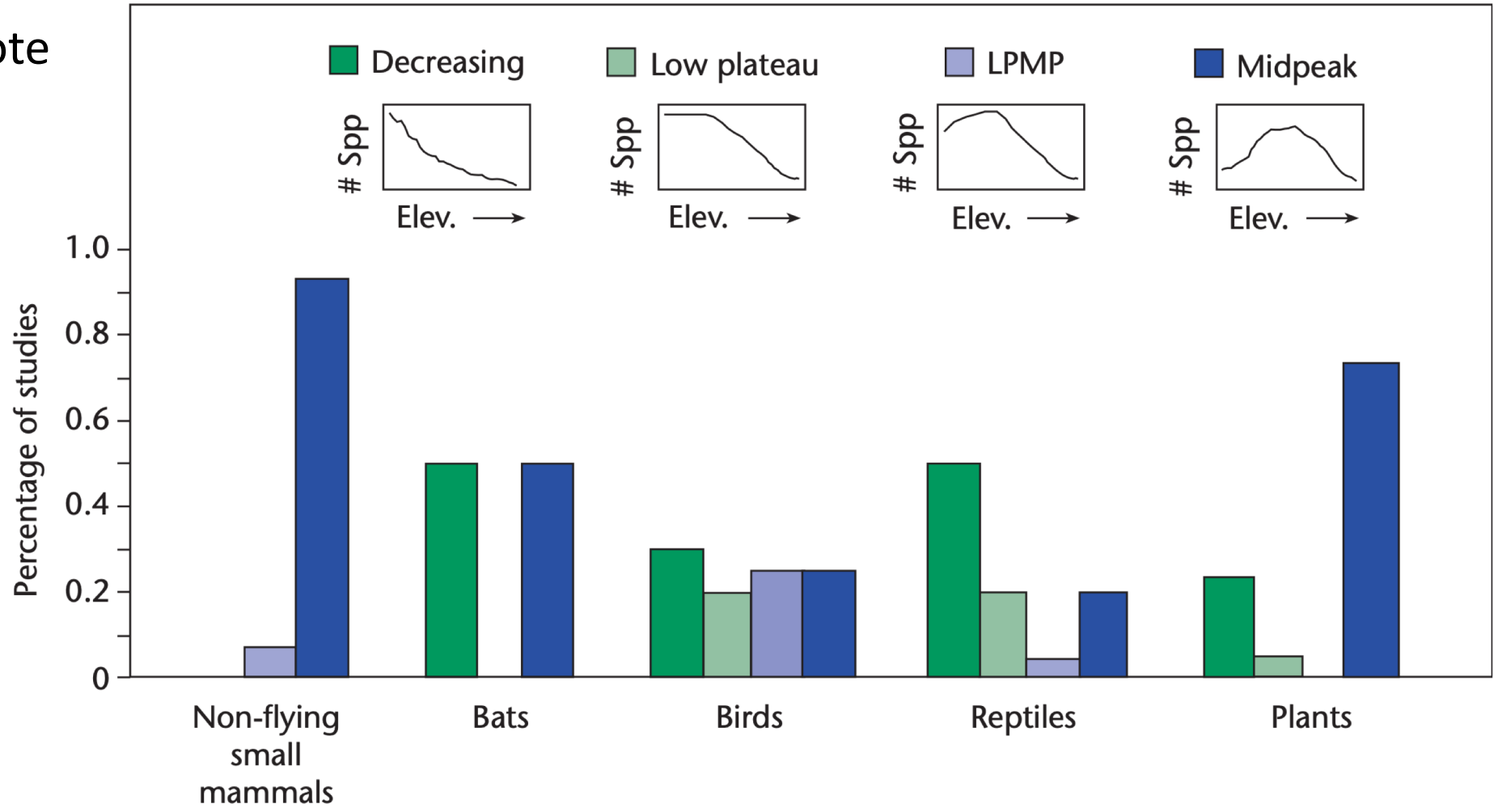

McCain & Gyrtnes 2010 eLS

Synthesis of elevational diversity gradients

- Vote counting focused on richness…do other components (N, S_{PIE}, S_n) show the same functional forms?

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Synthesis of elevational diversity gradients

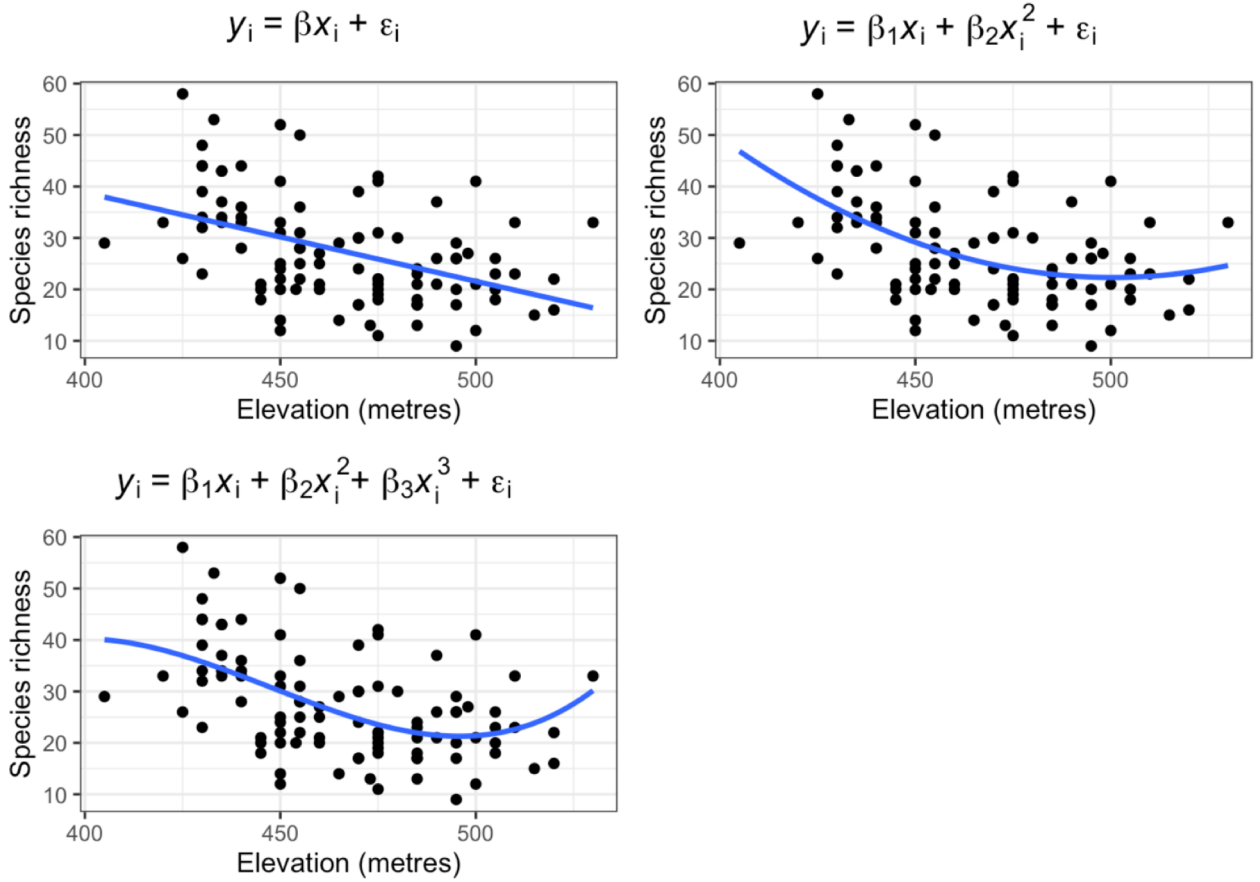
- Vote counting so far focused on richness…do other components (N, S_{PIE}, S_n) show the same functional forms?
- Can we do better than vote counting?

1. ‘Regularise’ or ‘shrink’ higher order terms.

- e.g., pull β_2 and β_3 towards zero if the data do not support their inclusion.

Some options:

- Hierarchical or multilevel models.
- Lasso (*Least Absolute Shrinkage and Selection Operator) regression?*



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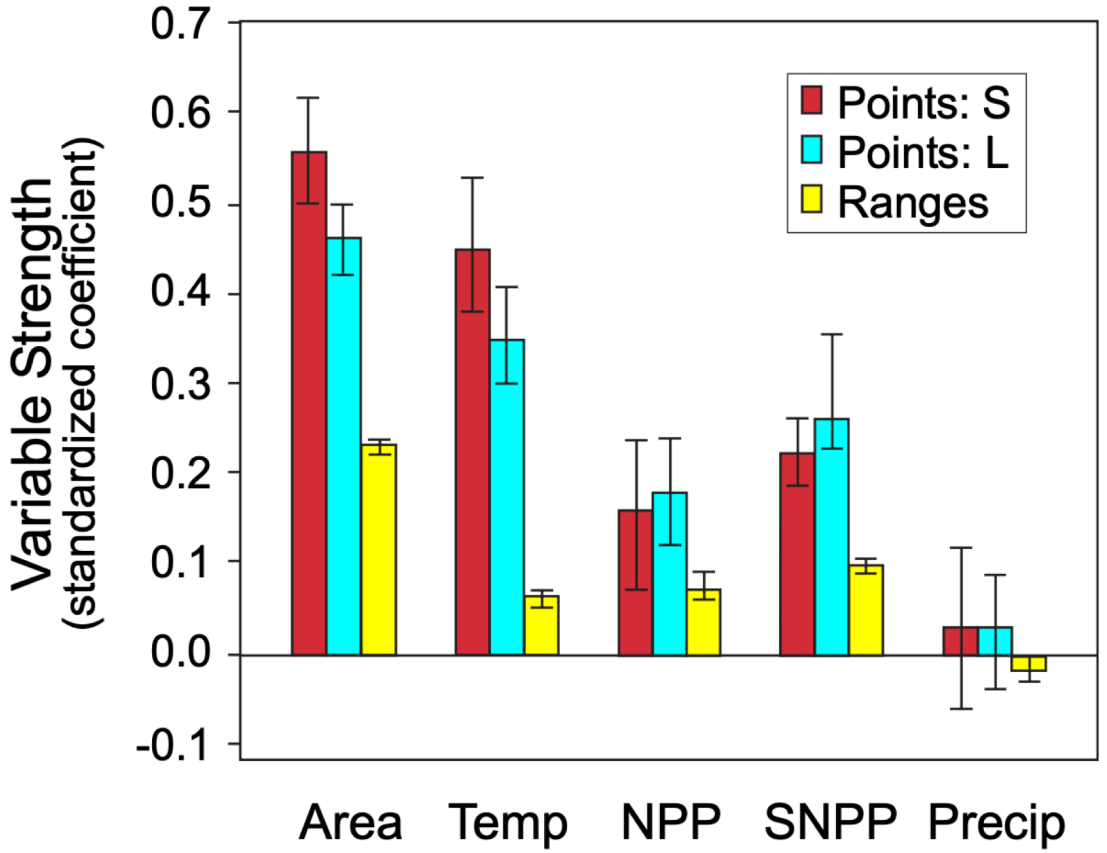
Synthesis of elevational diversity gradients

- Vote counting so far focused on richness…do other components (N, S_{PIE}, S_n) show the same functional forms?
- Can we do better than vote counting?

1. ‘Regularise’ or ‘shrink’ higher order terms.
2. Quantitative analyses of other covariates



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Bartschi *et al*. 2019 *GEB*