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Revealing **dynamic macroecological patterns** to understand biodiversity shifts in the Anthropocene

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Biodiversity crisis: the need to elucidate the underlying causes

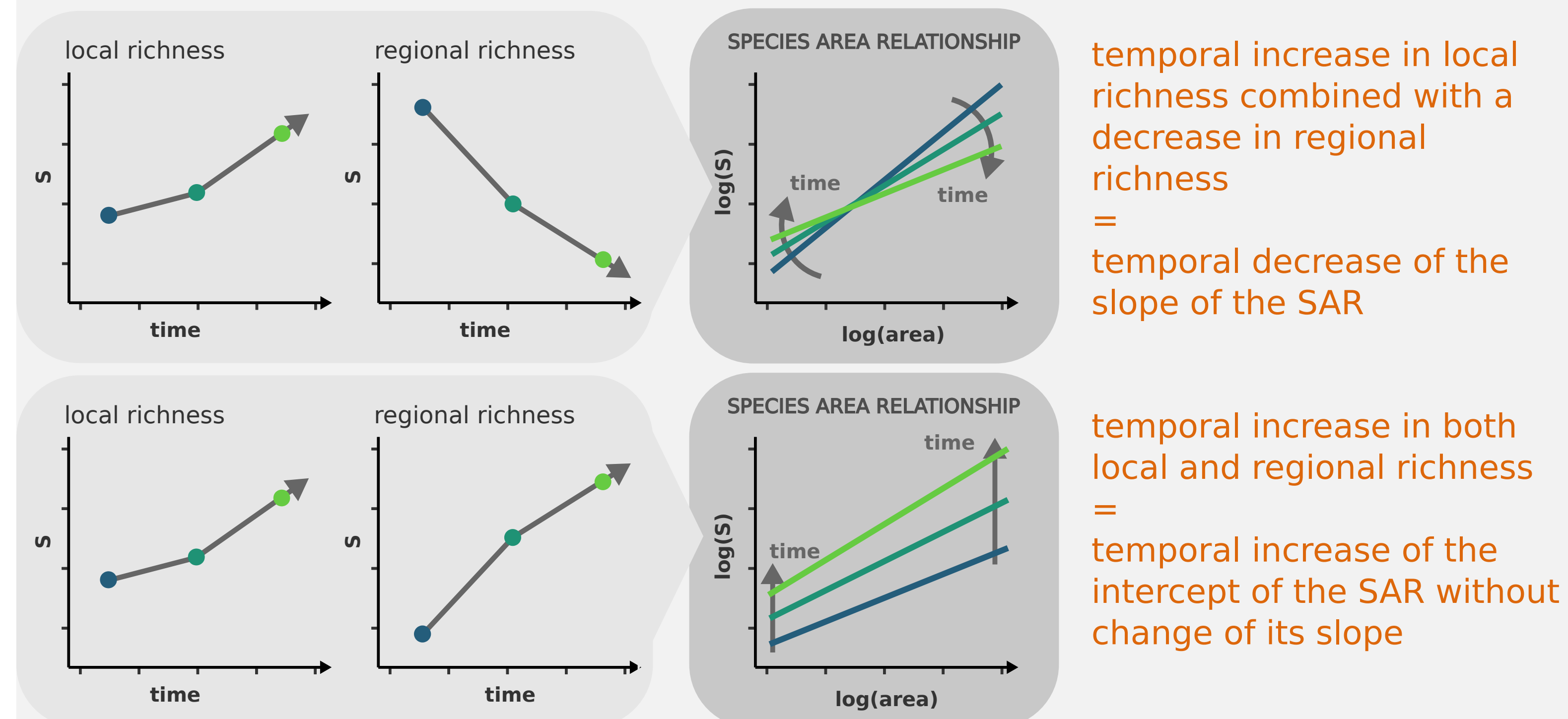
Observational studies documenting **shifts in the diversity of life present complex scenarios** incorporating seemingly conflicting outcomes¹:

- > global and regional decreases in species richness (gamma diversity) appear to contradict local observations of "no net loss" or local increases in species numbers (alpha diversity)^{2,3,4}
- > reduction of species differentiation between sites (biotic homogenization) appear as a pervasive feature of the biodiversity crisis⁵, but is more and more challenged by empirical evidence and scaling inconsistencies^{6,7}
- > the average decline in population abundance appears as a critical aspect of biodiversity loss⁸, although it is still subject to scrutiny⁹

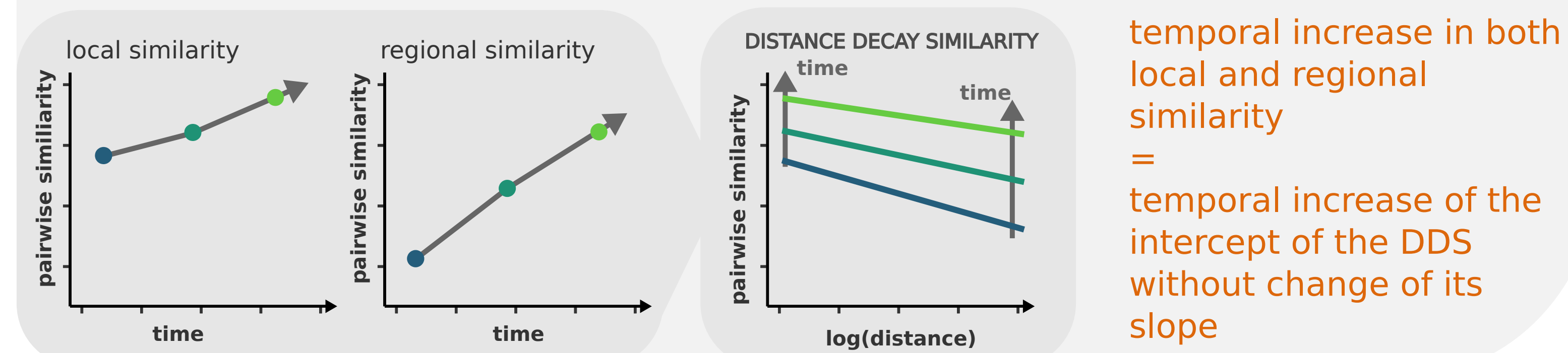
This lack of coherence and underconsideration of underlying processes impedes any unambiguous and general elucidation of the human drivers of biodiversity dynamics
Considering dynamic macroecological patterns synthesize and reconcile different diversity trends and can help to understand their underlying processes

Integrate diversity changes across space and time

> **the Species-Area Relationship SAR** is the positive relationship between the number of sampled species and the increasing area sampled¹⁰



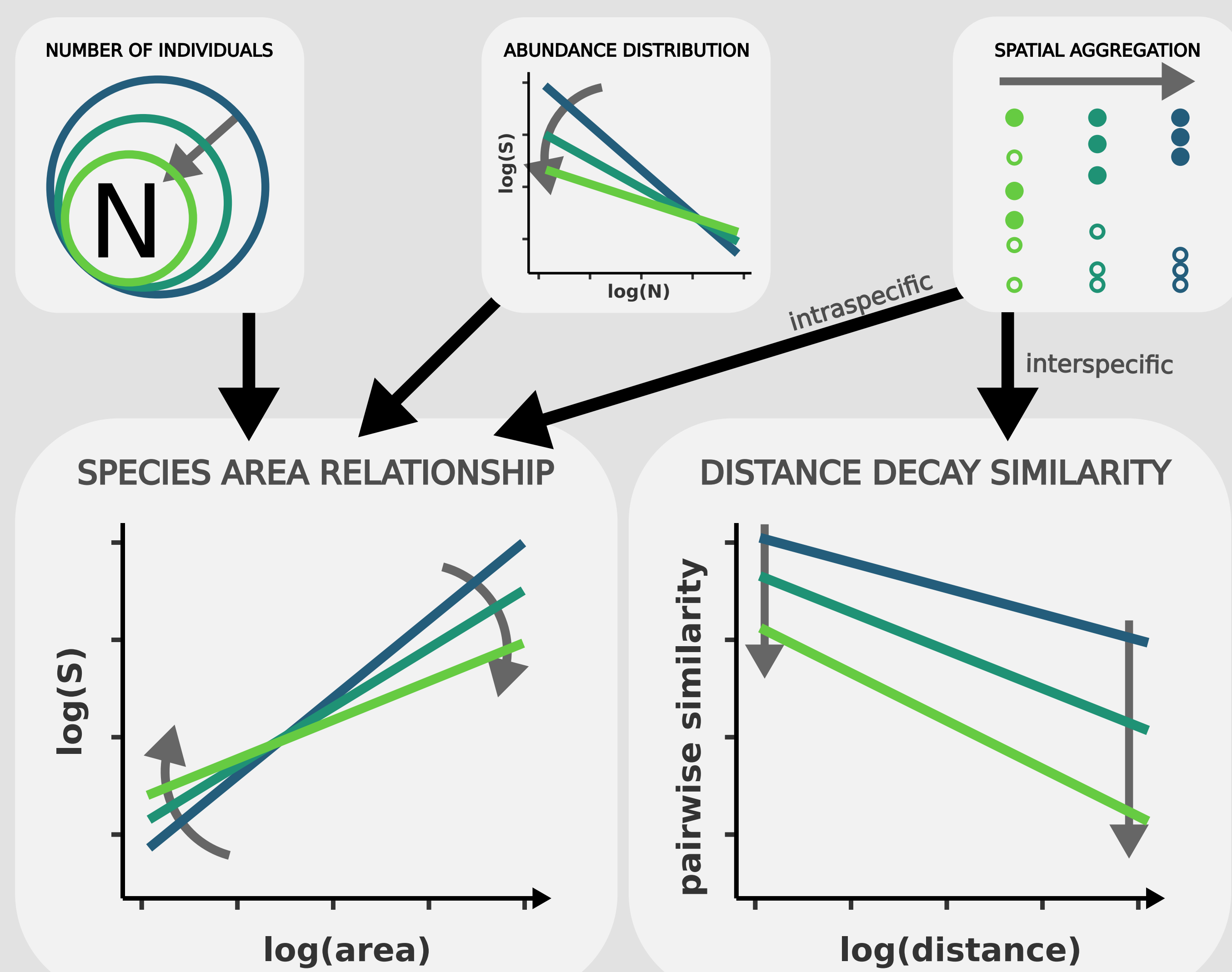
> **the Distance Decay of Similarity DDS** is the negative relationship expected between the compositional similarity of pairs of sites and the distances between these sites¹¹



Reveal mechanistic links between macroecological patterns

SAR and DDS are interlinked and governed by three proximate components acting as levers driving the dynamics of macroecological patterns^{15,16}

- > **the total numbers of individuals** in communities
- > **the distribution of abundance** among species
- > **the spatial aggregation** of species and individuals



Recast dynamic macroecological patterns with traits

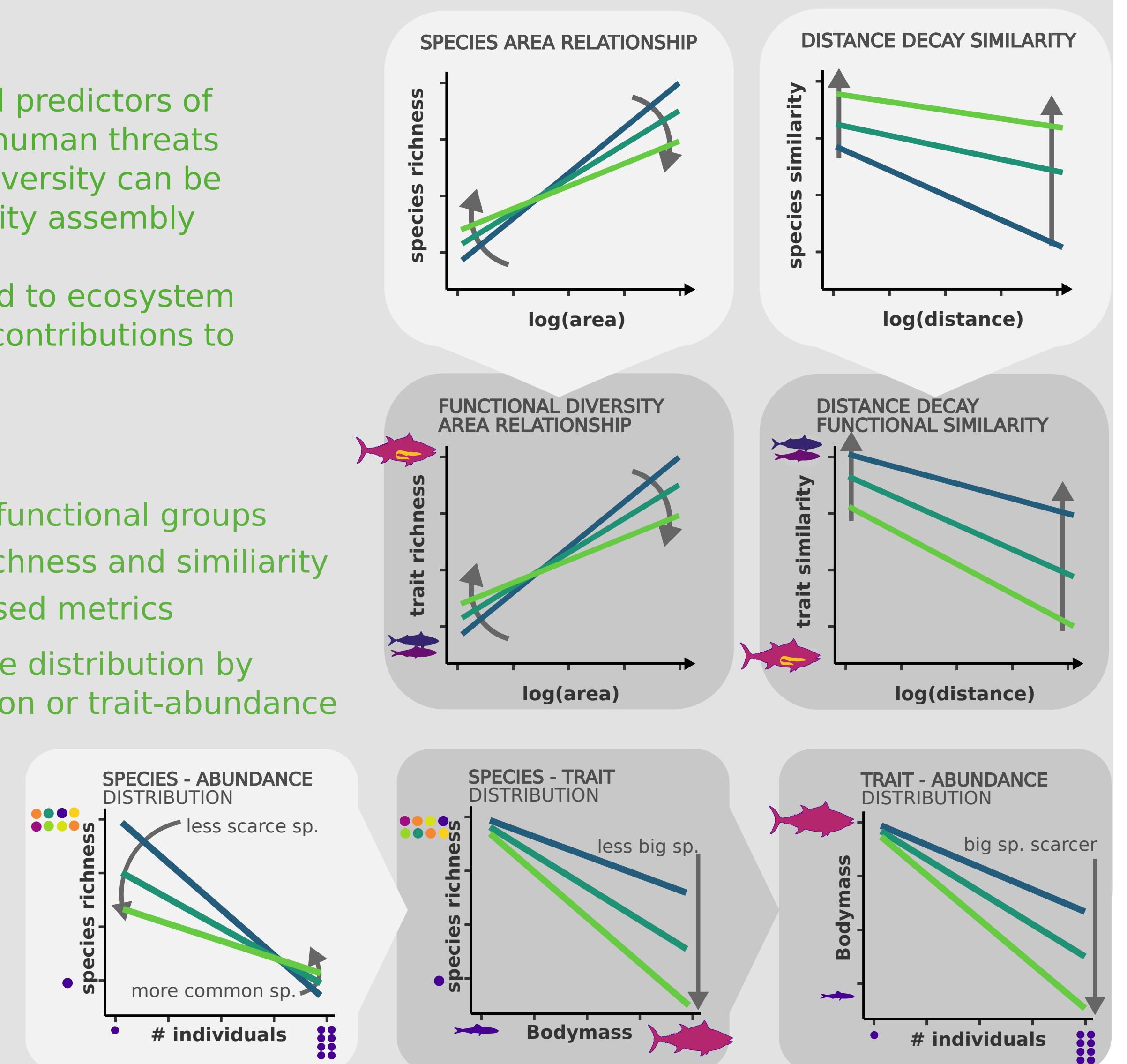
> **incorporating functional traits into dynamic macroecological patterns** offers promising means to better identify the influence of global change drivers on biodiversity dynamics^{12, 13}

> **why ?**

- traits can be good predictors of species responses to human threats
- patterns of trait diversity can be used to infer community assembly processes
- traits can be linked to ecosystem functions and nature contributions to people

> **how ?**

- separate species functional groups
- replace species richness and similarity by equivalent trait-based metrics
- replace abundance distribution by species-trait distribution or trait-abundance distribution¹⁴



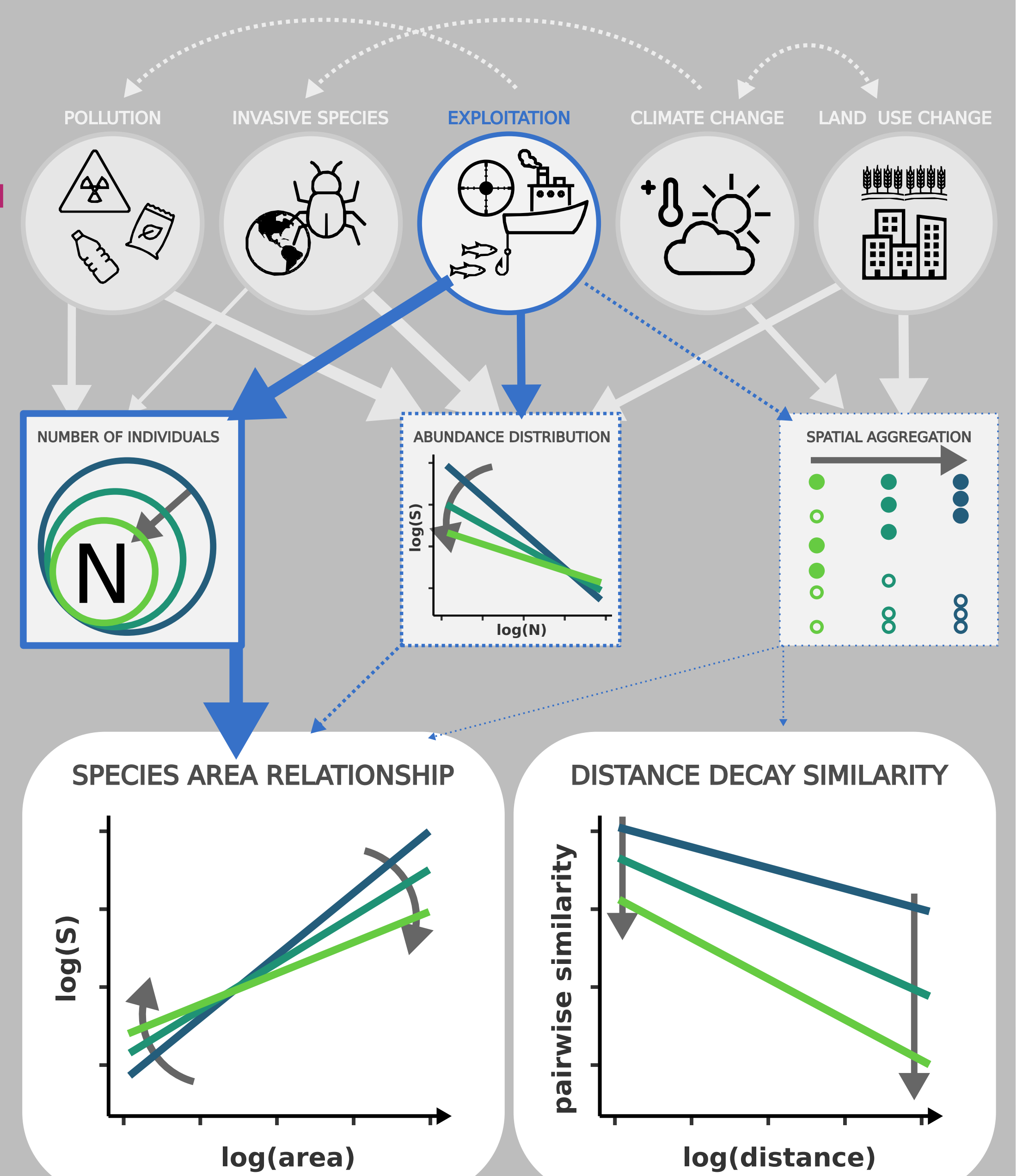
Attribute human drivers via dynamic macroecological patterns

> **human influence on diversity trends is generally assessed via process blind approaches**

> **dynamic macroecological pattern and their proximate components can be integrated into causal graph**

> **such causal pathway for biodiversity change can help understand via which proximate components human influence diversity changes, and take appropriate actions**

> **from all possible path, we here exemplify how marine intensive fisheries could affect species richness trends**



Conclusion

Dynamic macroecological patterns can reconcile discrepancy in reported diversity trends and help to better understand the drivers of biodiversity changes

References

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