Is everything a Niche model?

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Abstract: TODO

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Introduction

The Niche Model Hegemony: Establish how the Niche Model (and its topological derivatives like the Cascade model) has historically served as the "structural prior" or template for most network theory.

The Philosophy Gap: Contrast structural/topological models (which prioritise species-agnostic link distributions) with "realised/dynamic" models like ATN and ADBM (which prioritise biological mechanisms like bioenergetics and optimal foraging).

The Research Question: Do these different philosophical starting points (mechanical vs. statistical) lead to the same conclusions about community stability, or does the choice of "template" fundamentally bias our understanding of extinction dynamics?.

1 Methods

1.1 Model Selection and Implementation

Describe the seven model classes - Structural: Niche, Cascade, MaxEnt (Topological templates) vs realised/dynamic: ATN (mechanical/allometric), ADBM (energetic/optimal foraging), and Latent Trait (statistical/allometric)

Table 1: Summary of food web models used in this study. Structural models (Niche, Cascade, MaxEnt) generate network topology based on abstract or statistical rules, while realised/dynamic models (ADBM, ATN, Latent trait) incorporate species-specific traits and biological mechanisms to predict interactions. For each model, we list the main inputs and the key assumptions that govern link formation.

Model	Type	Main Inputs	Key Assumptions
Niche model (Williams & Martinez, 2000)	Structural	Species niche values	Trophic interactions structured by a 1D feeding niche; species consume all prey within a contiguous range; allows cannibalism.
Cascade model (Cohen et al., 1990)	Structural	Species rank	Consumers feed only on species with lower ranks; strictly hierarchical; no loops or omnivory.

Model	Type	Main Inputs	Key Assumptions
MaxEnt model (Banville et al., 2023)	Structural	Species richness, connectance	Links assigned to maximize entropy; captures global network properties without species-specific mechanisms.
Allometric Diet Breadth Model (ADBM) (Petchey et al., 2008)	Realised / Dynamic	Body mass, prey energy content	Consumers maximize energy intake; diet breadth determined by profitability and handling time; allometric scaling governs parameters.
Allometric Trophic Network (ATN) (Brose et al., 2006)	Realised / Dynamic	Body mass	Interactions constrained by body-mass ratios; mechanical size limits structure networks; probability of interaction follows Ricker function.
Latent trait model (Rohr et al., 2010)	Realised / Dynamic	Species traits (*e.g.,* body mass)	Interactions inferred statistically based on hidden trait correlations; can incorporate probabilistic constraints on links.

Simulation Framework: Explain how an identical species pool was used across all models to isolate the model effect from the data effect. Something about how we constrained networks and also species class assignments if and when valid in constraining the model vs needed as input for the BEFW

Dynamic Perturbation: Detail the use of a bioenergetic food web model to simulate species loss and cascading extinctions.

Metrics for Comparison: Define the macro-scale (connectance), meso-scale (motifs), and micro-scale (generality/vulnerability) properties used to evaluate structural stories. As well as some of the outputs from the dynamic models - persistence/stability

2 Results

Structural Signatures: Report how much variance is explained by the model choice.

[Figure 1 about here.]

The Niche Model Template: Identify if the structural models occupy a central 'mean space' or if the dynamic models diverge into non-overlapping regions.

Divergent Stories in Dynamics: Show how models with similar global structures (like connectance) can lead to wildly different pathways of change/collapse/straight lines.

3 Discussion

Reconstruction is Not Neutral: Discuss how models act as structural priors that condition ecological inference. Well maybe - paleo webs seems to suggest this

Template Dependence: Address the core question: Is everything a derivative of the niche model? If dynamic models show unique cascade patterns not captured by the niche model, argue that the niche template may be insufficient for dynamic questions.

Scale-Dependent Robustness: Reflect on why species-level patterns might look similar across models while the fine-grained story of dynamic change is highly model-contingent.

Implications for Theory: Suggest that researchers must align their reconstruction framework with their inferential goals rather than defaulting to a one-size-fits-all niche template.

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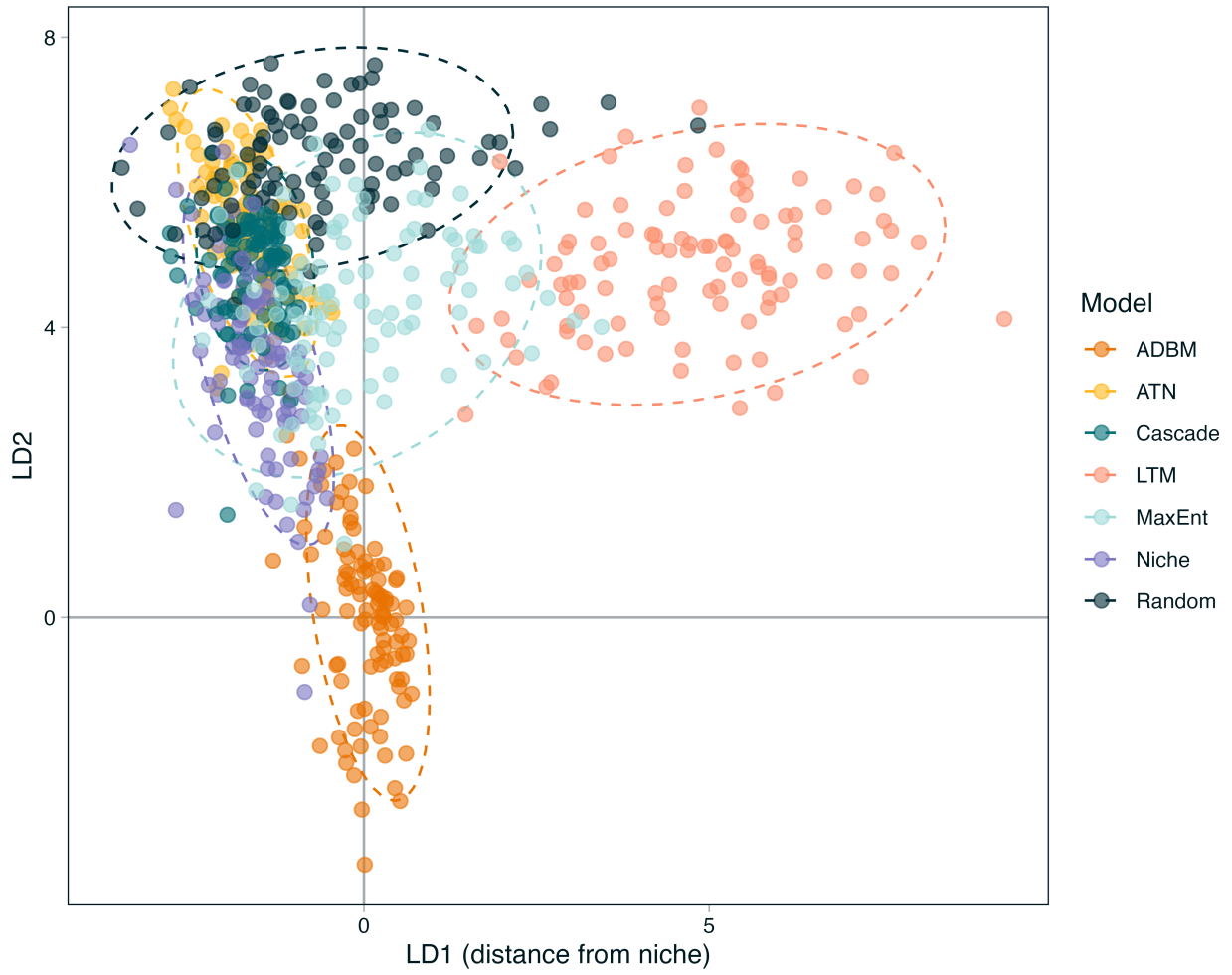

Figure 1: Linear discriminant analysis (LDA) of ecological network metrics for the seven model types. Each point represents a replicate, and ellipses indicate 95% confidence regions for each model. The second column represents the correlation of the various network metrics with the respective LDA axes.