

An Inventory of Food Web Models

Definitely Opinionated and Likely Incomplete

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A Brief, Incomplete History

- **Dynamics**

- *Few Species*
- *Top-Down/Bottom-Up*
- *Trophic Cascades*
- *Stability / Coexistence*
- *Transients*
- *Complexity - Stability*

- **Structure**

- *Complexity/Connectance/Diversity - Stability*
- *Diversity-Productivity*
- *Food Chain Length*
- *Generalism/Specialism*
- *Nestedness/Modularity*

History -> Now

- Dynamics

- *Few Species*
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- Structure

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Data

Number of Species

Traits

Foraging Biology

Allometry

Predator-Prey Mass Ratios

Temperature Scaling

Predation Risk/Behaviour

Energy Flux

**New Methods and Ideas, But
Not New Questions?**

Why Model Food Webs

- describe and explore dynamics and stability and IS
- predict dynamics and stability under natural and anthropogenic environmental variation
- describe complexity and structure ->
 - *Theory about complexity:diversity:stability*
 - *Theory about complexity:diversity:productivity*
- predict effects of climate change on food web complexity, structure, dynamics
 - *Feedbacks*

Why Model Food Webs

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- predict effects of climate change on food web complexity, structure, dynamics
 - *Feedbacks*
 - ***Multiple Stressors***
- predict complexity and structure -> origins of complexity
 - *TRAITS: Size, Foraging, Movement/Space, Costs*

A Classification

DYNAMIC

TOPOLOGICAL

A Classification

DYNAMIC

TOPOLOGICAL
(Static)

ODE
(L-V
Macarthur-
Rosenzweig)

SIZE
SPECTRA
(*PDE*)
(Blanchard /
Anderson)

SPECIES
(Cascade/
Niche;
Cohen/
Williams,
Martinez)

GROUPS
(Allesina)

Size Spectra

A Classification

DYNAMIC

TOPOLOGICAL

ODE

ODE +
Allometry +
Temperature

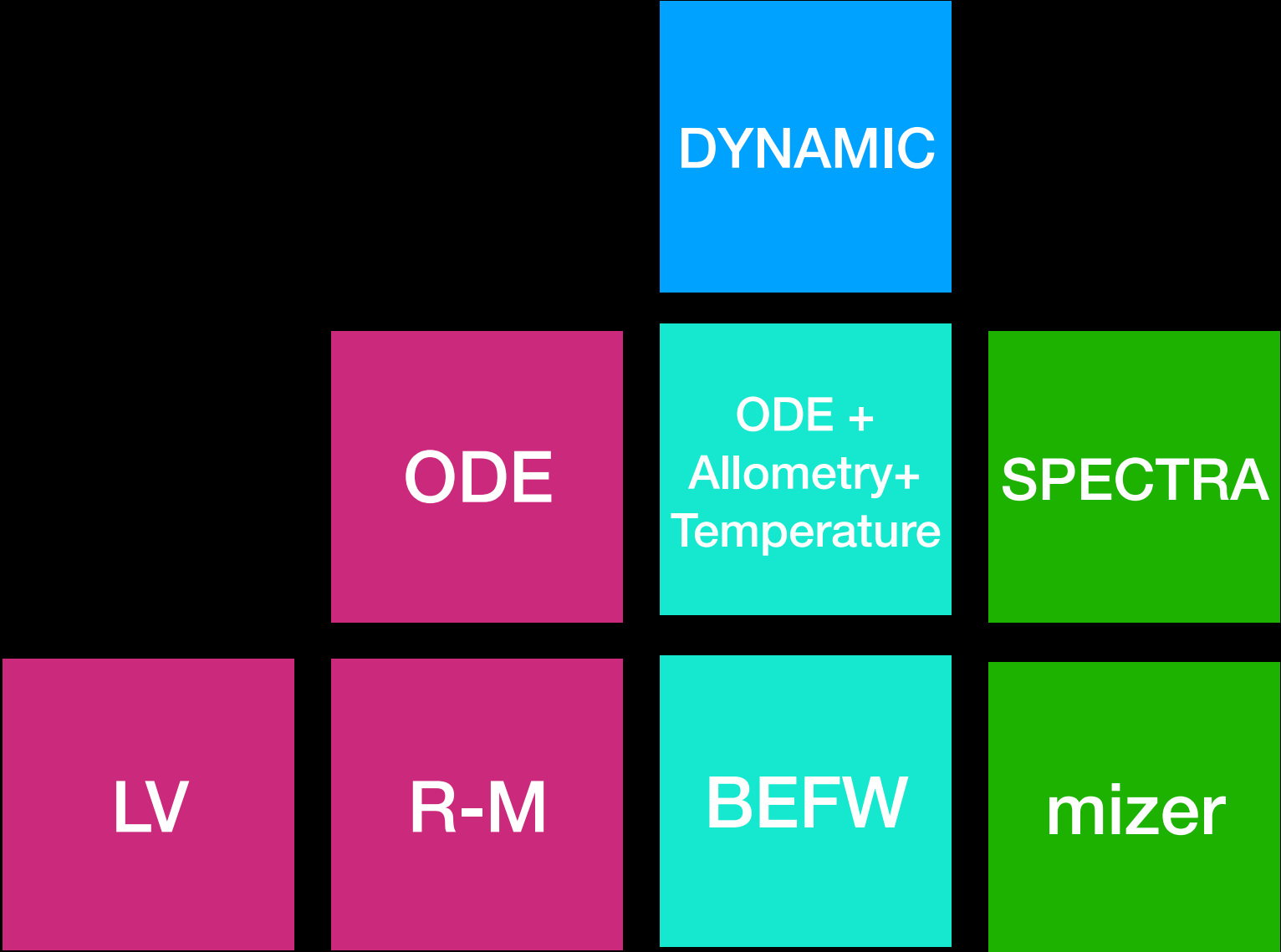
SPECTRA
PDE

SPECIES
(Cascade/
Niche/ADBM/
Portalier)

GROUPS

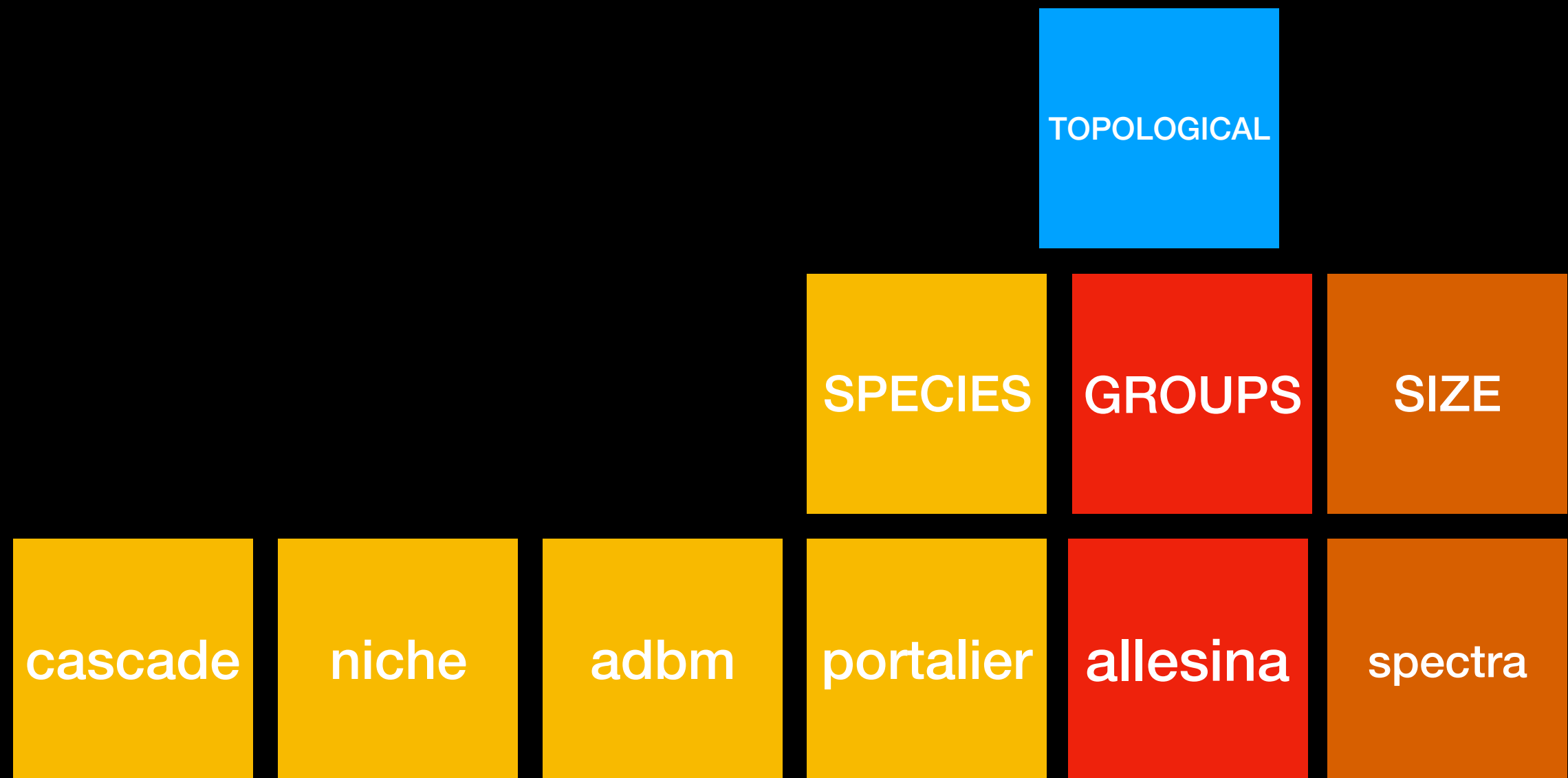
SIZE

A Classification



Metric				
Pop Dynamics	X	X	X	X
Community Structure (Body Size Ratios, TIB etc)			X	X
biodiversity	X	X	X	X
2° Extinction	X		X	X
harvesting	X	X		X
productivity	X	X	X	X
stability	X	X	X	

A Classification



Metric						
Pop Dynamics						
trophic structure	x	x	x	x	x	
food-web metrics	x	x	x			
Body size (spectra)			%	%		x
biodiversity	x	x	x	x		
2° Extinction		x	x			
stability						

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- describe complexity and structure ->
 - *Theory about complexity:diversity:stability*
 - *Theory about complexity:diversity:productivity*
- predict complexity and structure -> origins of complexity / diversity
- predict effects of climate change on food web complexity, structure, dynamics
 - *Feedbacks*
 - *Multiple Stressors*
 - *Traits*

LV :: R-M :: BEFW

**Niche, Groups,
ADBM, Portalier**

ADBM, Portalier

LV-M :: R-M :: BEFW+ADBM

2^o Extinction Dynamics

Dynamics Meets Topology

What Does Topology Offer?

Toolbox for generating variation in structure

Toolbox for generating variation in diversity

Toolbox for generating variation body size distribution

Toolbox for monitoring structure

What Does Mechanistic Topology Offer?

Toolbox for generating variation in structure

Toolbox for generating variation in diversity

Toolbox for generating variation body size distribution

Toolbox for monitoring of structure

Re-wiring RULES

2° Extinction Grid

Food Web

	Topological	Dynamic
None	Niche (Dunne et al)	
Phenomenon	Niche (Staniczenko et al)	LV Gilljam et al
Mechanism	ADBM (Thierry et al)	BEFW+ADBM Delmas et al (in prep)

Re-Wiring

Re-wiring RULES

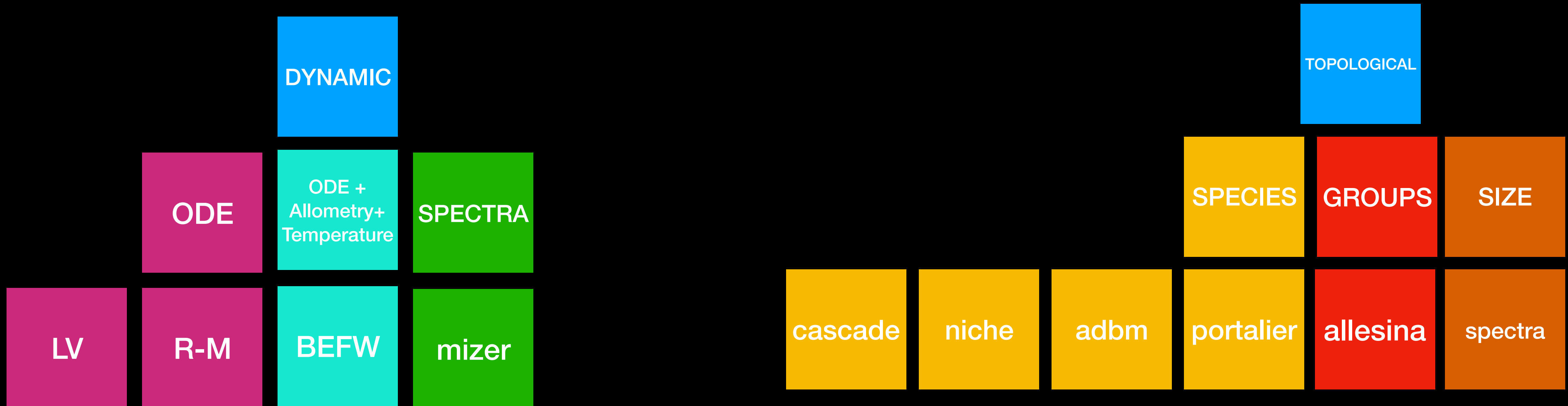
Foraging Decision

Re-wiring CRITERIA

Abundance

Energy/Metabolism

A Classification



What's missing/What's Developing

- Behavioural Ecology of Risks/
Costs
 - *Predation/mating/habitat*
 - *2-D/3-D*
- Inverse PPMR
 - *Parasites (Beckerman et al)*
 - *Herbivore-Plant Interactions*
- Multiple (>2) Stressors
 - *Specifically Spatial/Habitat Loss*
 - *Beckerman et al*
- Multiple Interaction Types
 - *Kondoh*
 - *Allesina*
- Evolution (Eco-Evo)
 - *Louille et al*
- Deeper Scales: 'Omics/Networks within
Food Web Networks

- predict the future of ecological communities, function and services under the climate crisis
- Stability at multiple scales
- Feedbacks
- Evolution

