Testing the match-mismatch hypothesis across terrestrial trophic interactions.

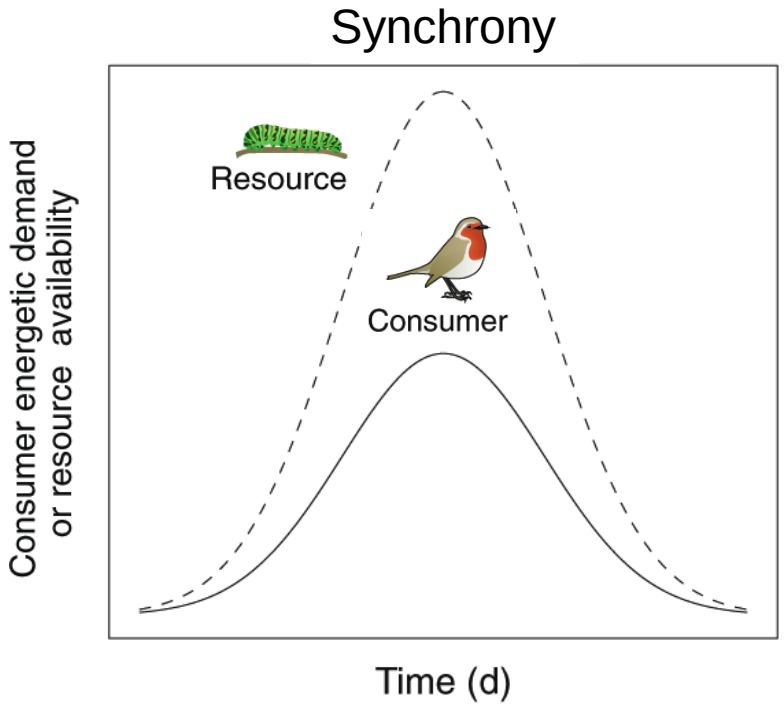
Heather Kharouba[1]
&
Elizabeth Wolkovich[2]

Kharouba Lab
Global Change Ecology

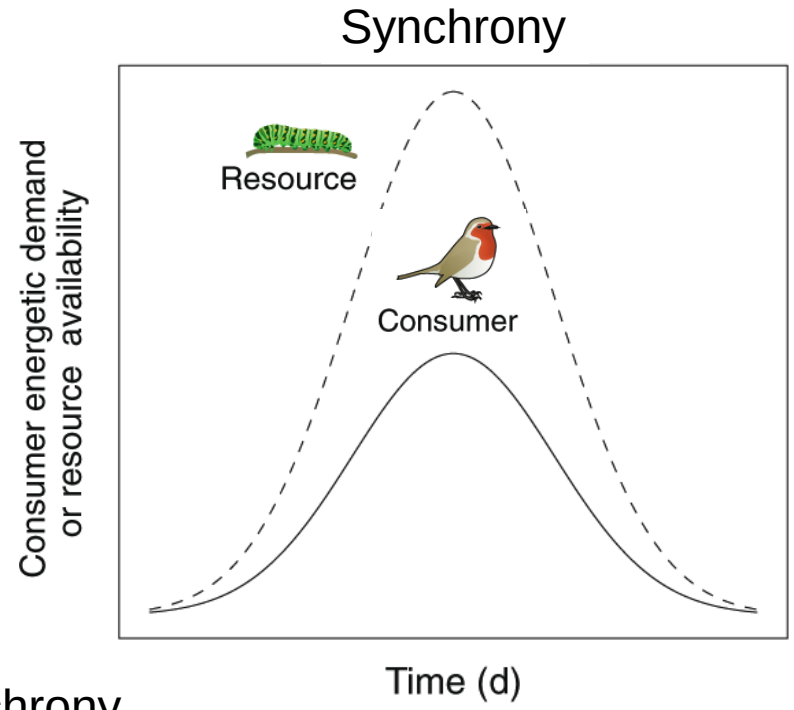
[1]University of Ottawa [2]University of British Columbia

The timing of species interactions are shifting with climate change.

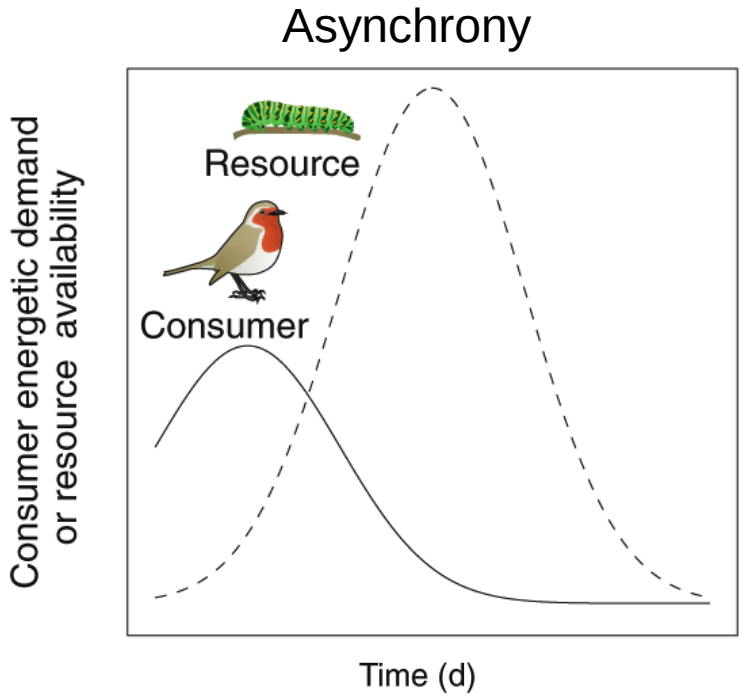
Pre-climate change



Pre-climate change

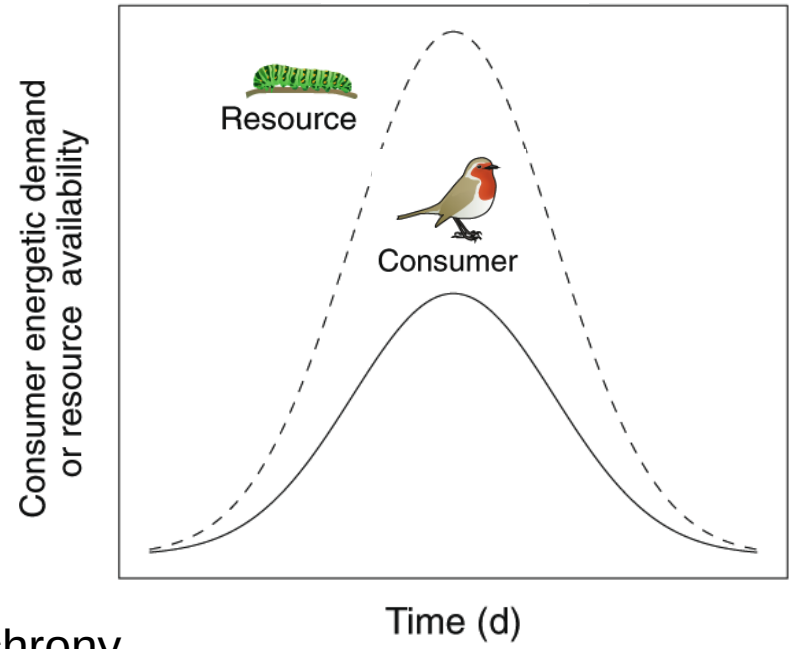


With climate change



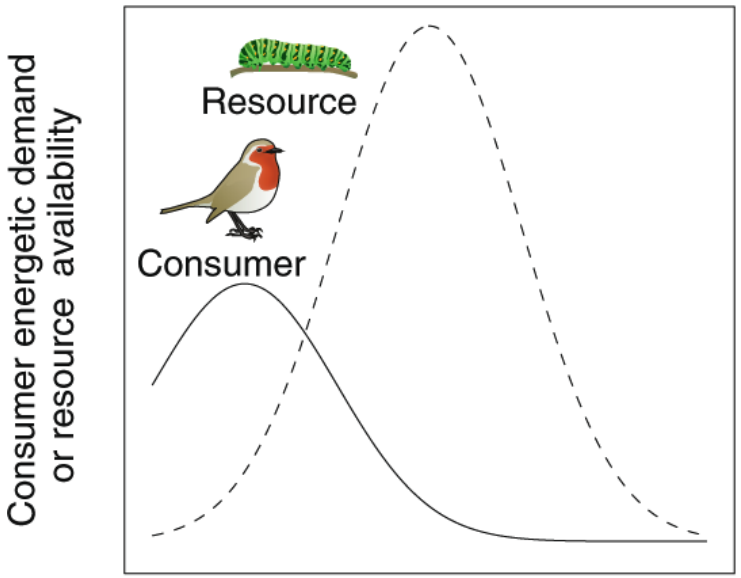
Pre-climate change

Synchrony

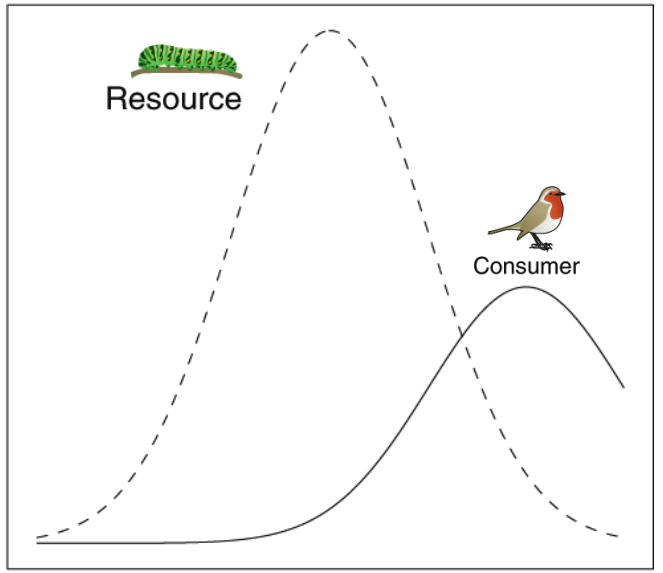


With climate change

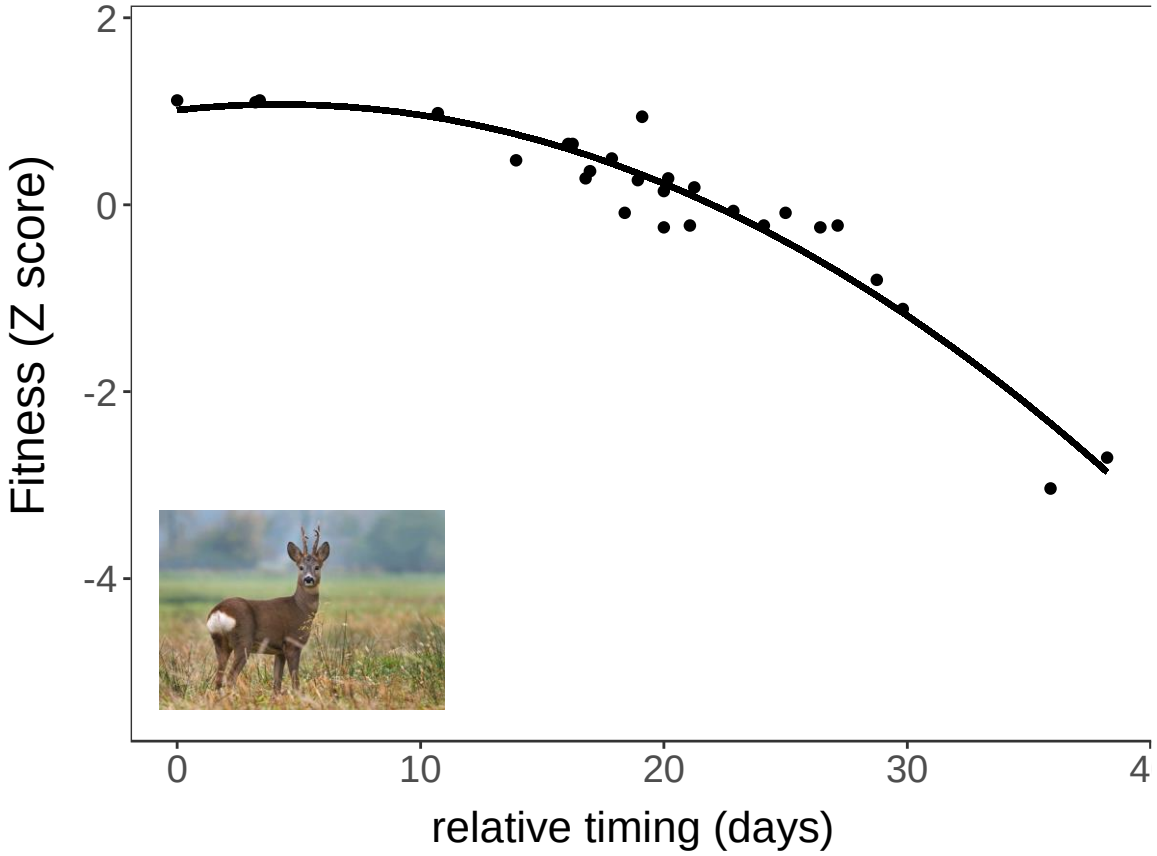
Asynchrony



Asynchrony



These shifts can have negative fitness consequences but hard to predict



Plard et al. 2014. PloS Biology 12:e1001828;

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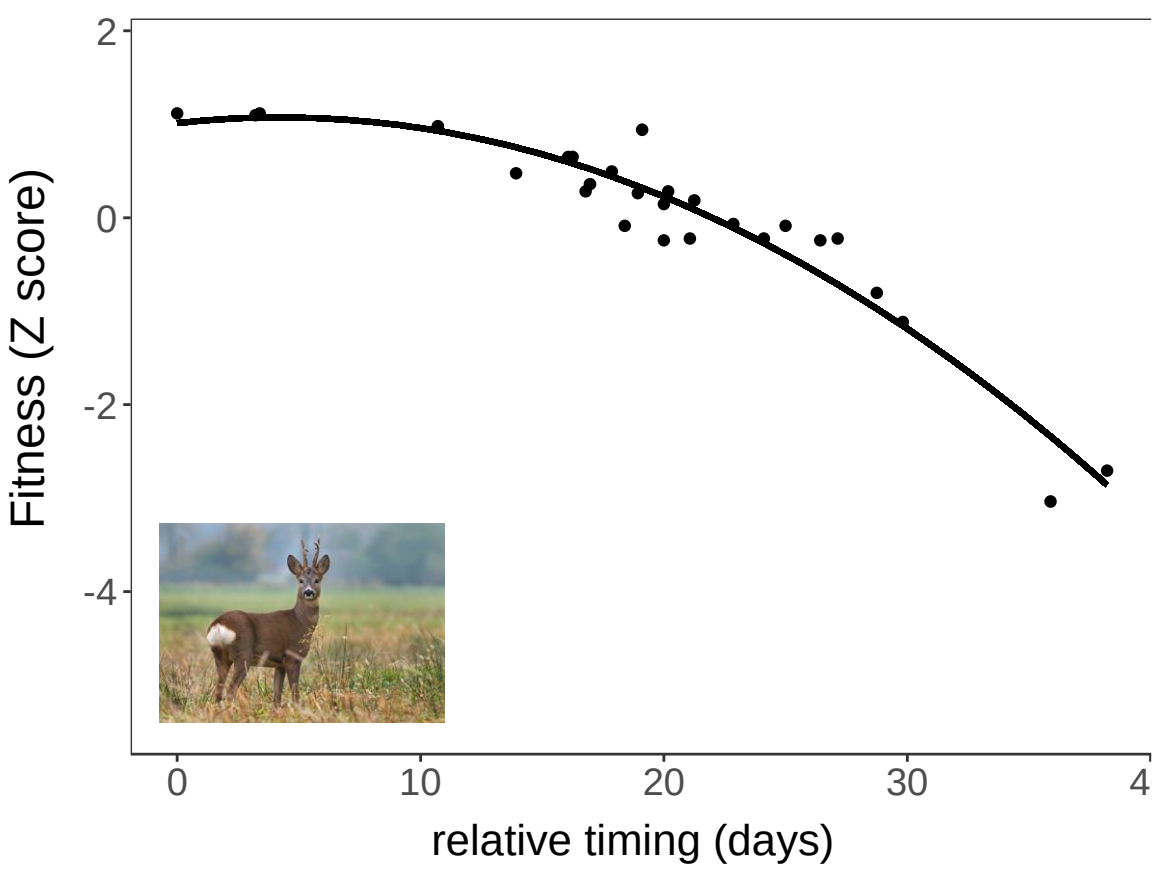
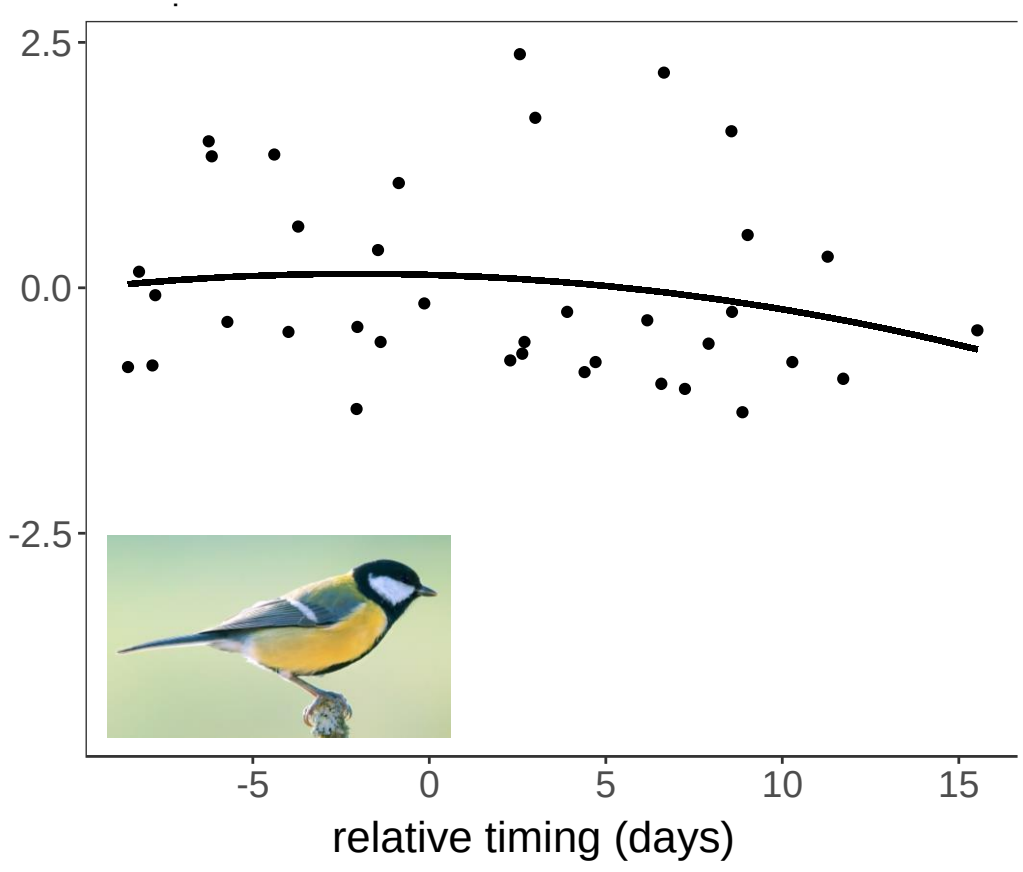


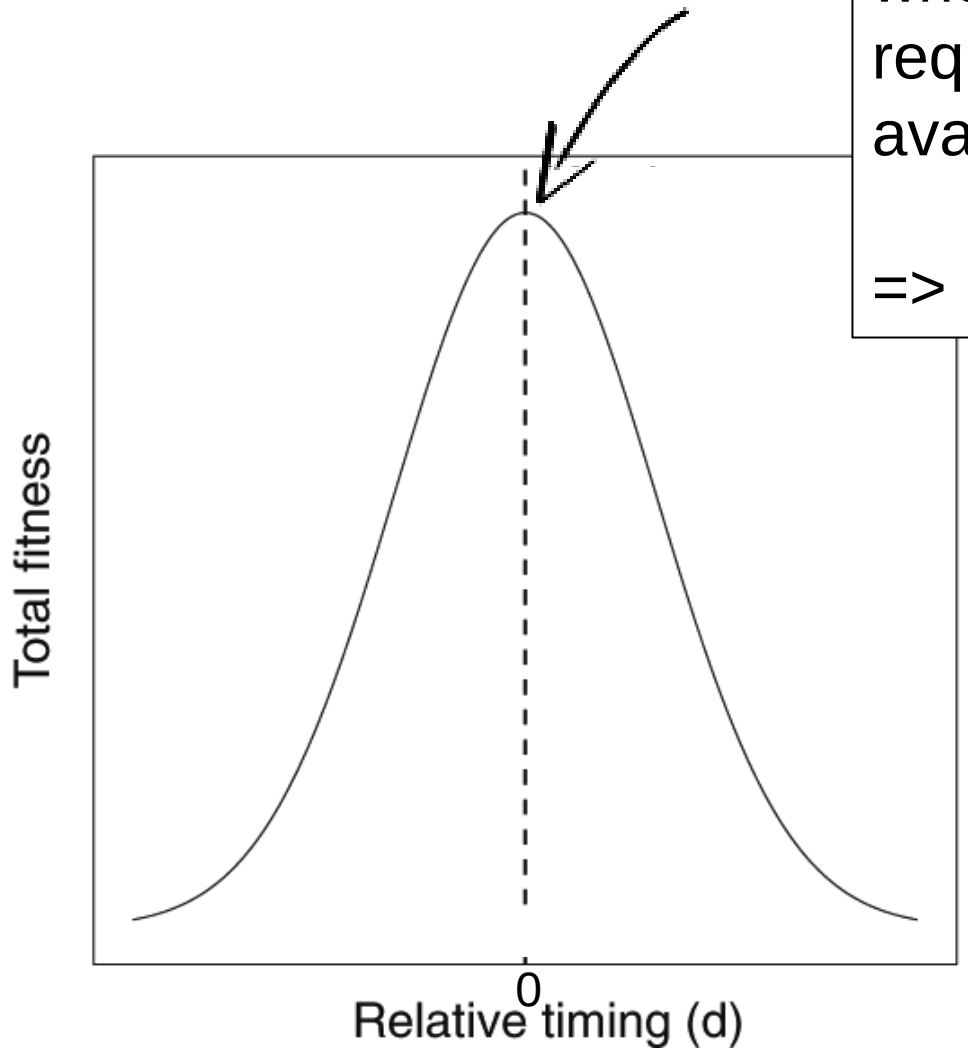


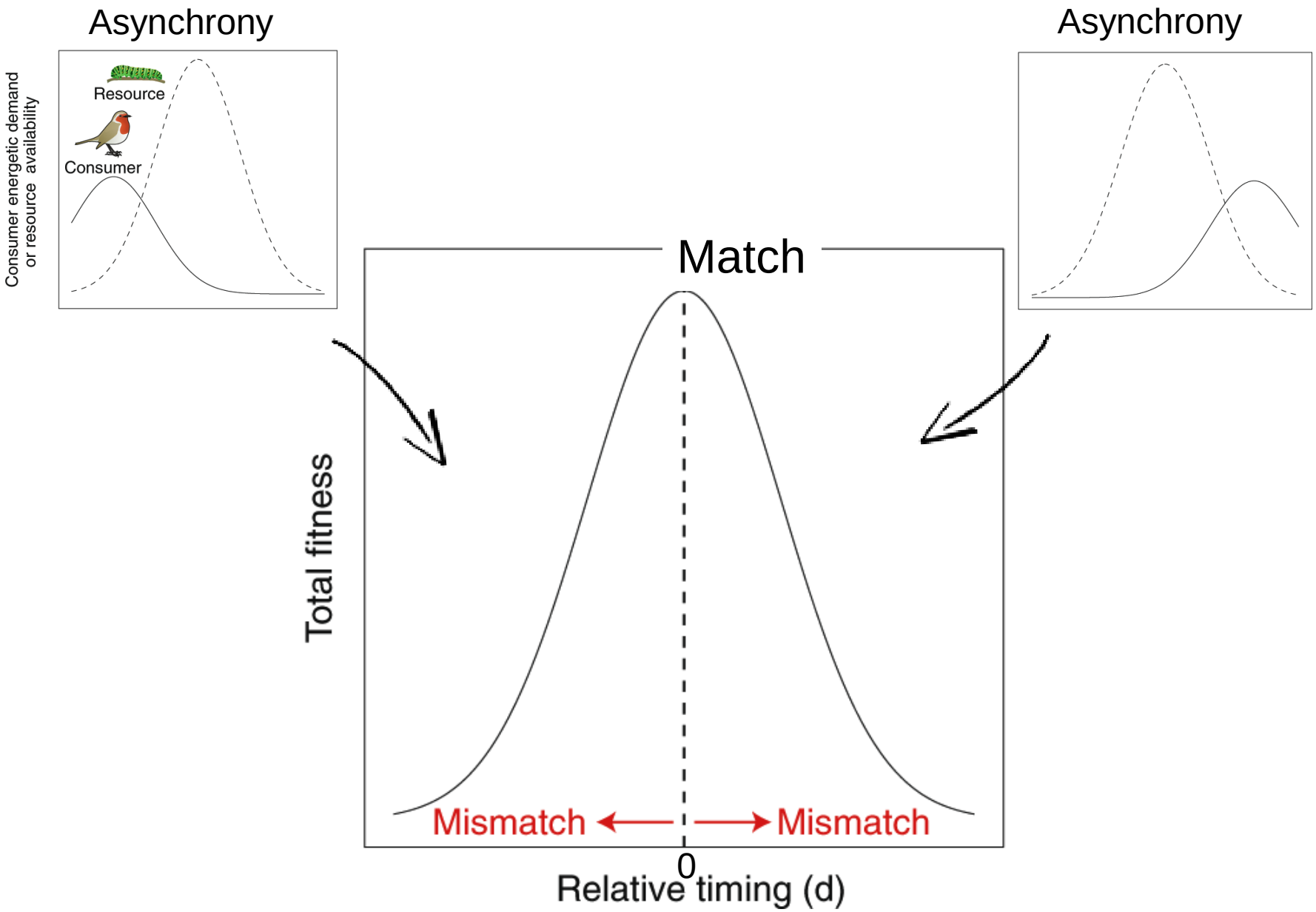
Plard et al. 2014. PloS Biology 12:e1001828; Reed et al. 2013 J Animal Ecology

The Cushing match-mismatch hypothesis

Match:
when peak food requirement = peak food availability

=> Relative timing = 0



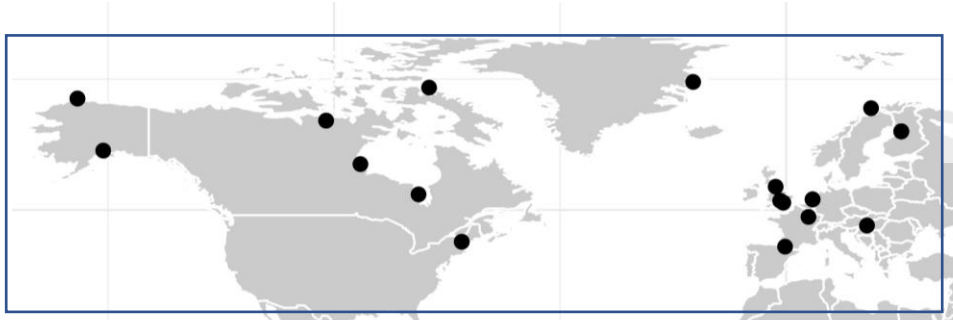

Asynchrony
Asynchrony
Consumer energetic demand or resource availability
Resource
Consumer
Match
Total fitness
Mismatch
Mismatch
0
Relative timing (d)

Testing the match-mismatch hypothesis

1. What is the prevalence of negative fitness impacts of asynchrony (i.e. mismatch) across terrestrial systems?

2. Do studies that meet the assumptions of the hypothesis more likely to find a mismatch?

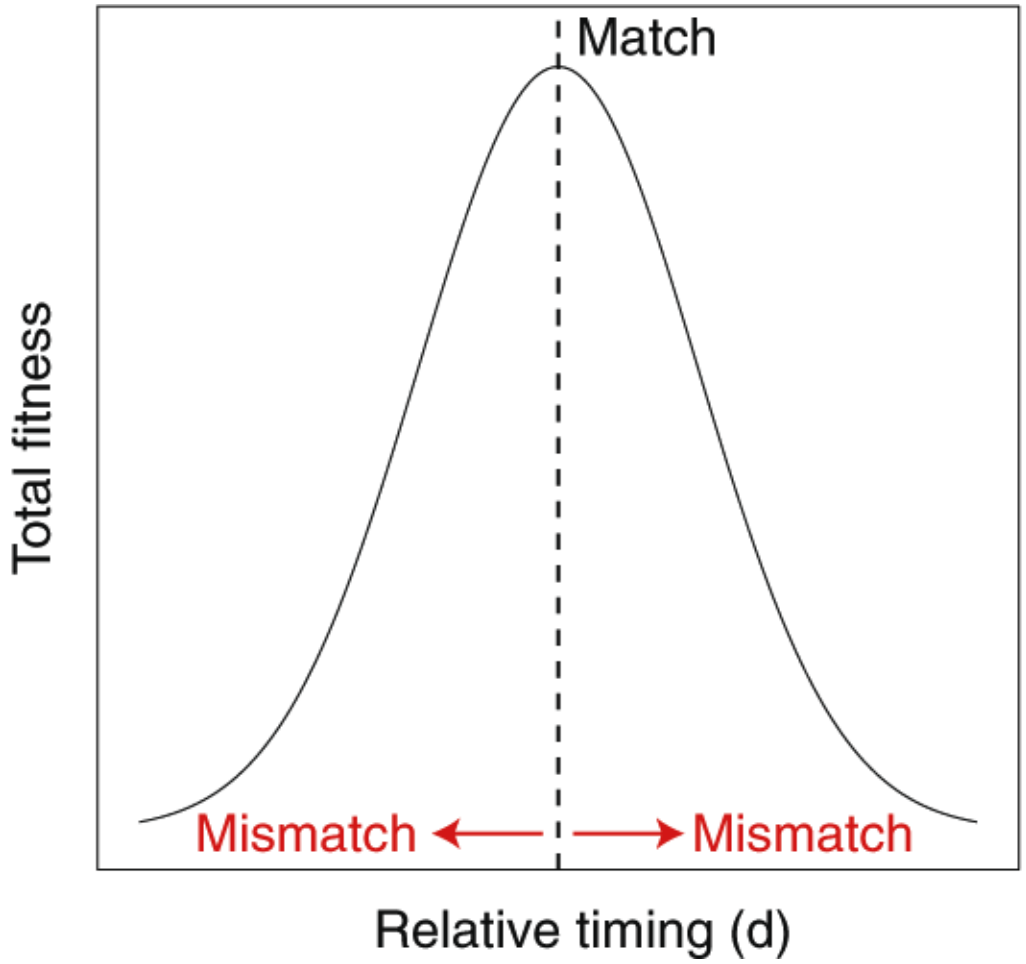
Testing the match-mismatch hypothesis



20 studies with 26 pair-wise species interactions:

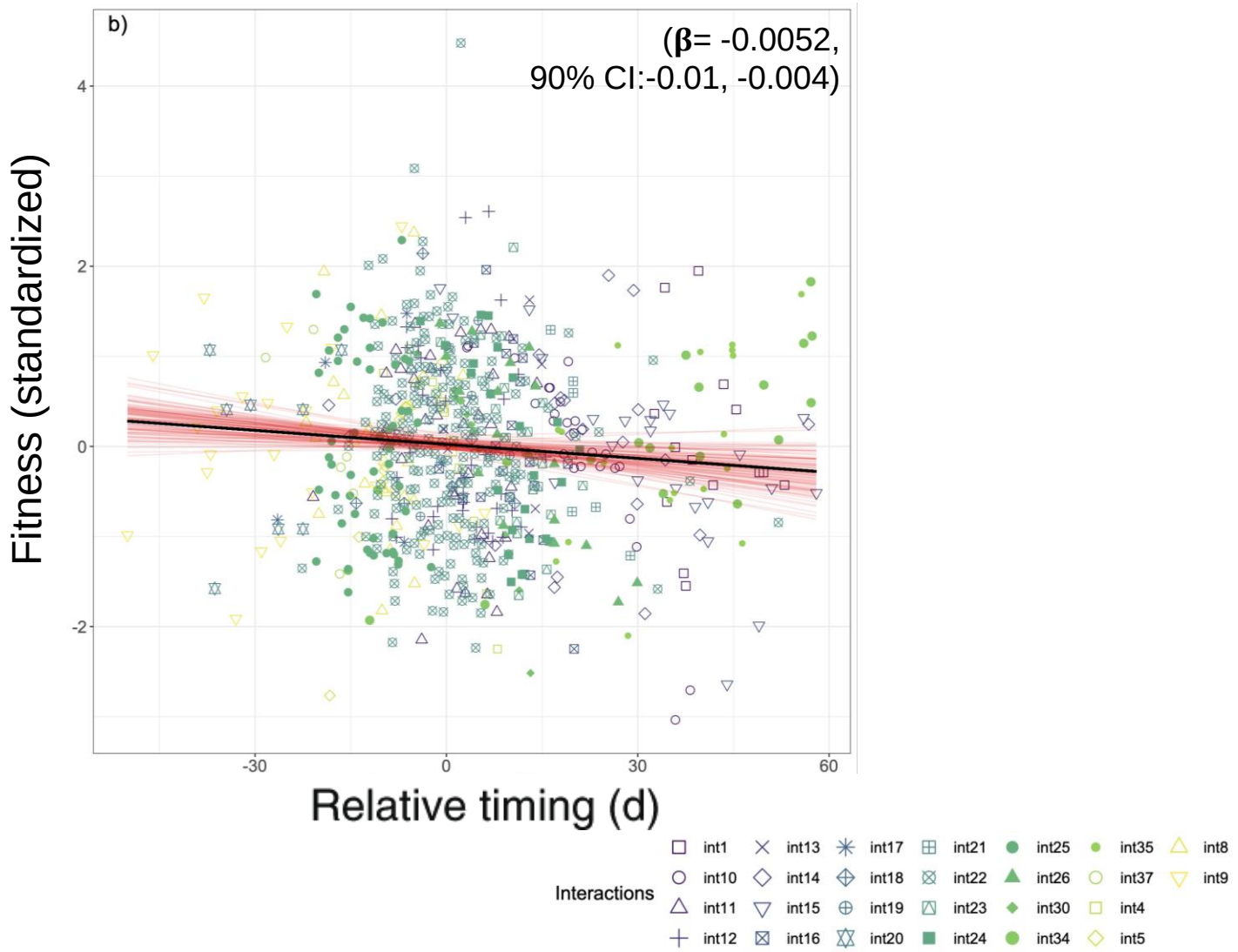
42% Passeriformes (songbirds)
15% Charadriiformes (shorebirds)
15% Anseriformes (waterfowl)
15% Insects (Hemiptera, Lepidoptera)
12% Artiodactyla (ungulates)

Kharouba and Wolkovich, *In prep*.



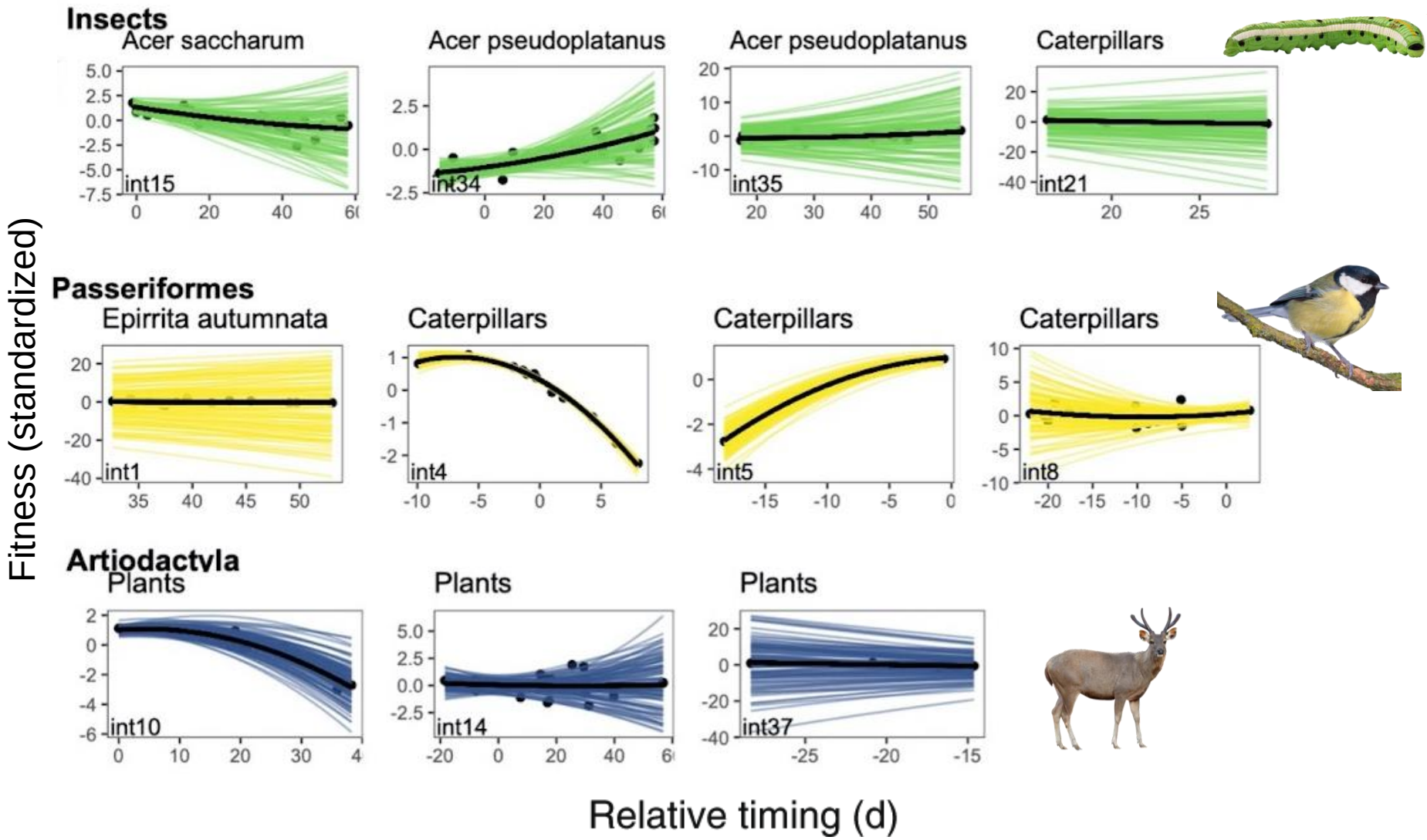
Kharouba and Wolkovich, *In prep*.

No support for the hypothesis



Kharouba and Wolkovich, *In prep*.

Both synchrony and asynchrony were prevalent across interactions



Kharouba and Wolkovich, *In prep*.

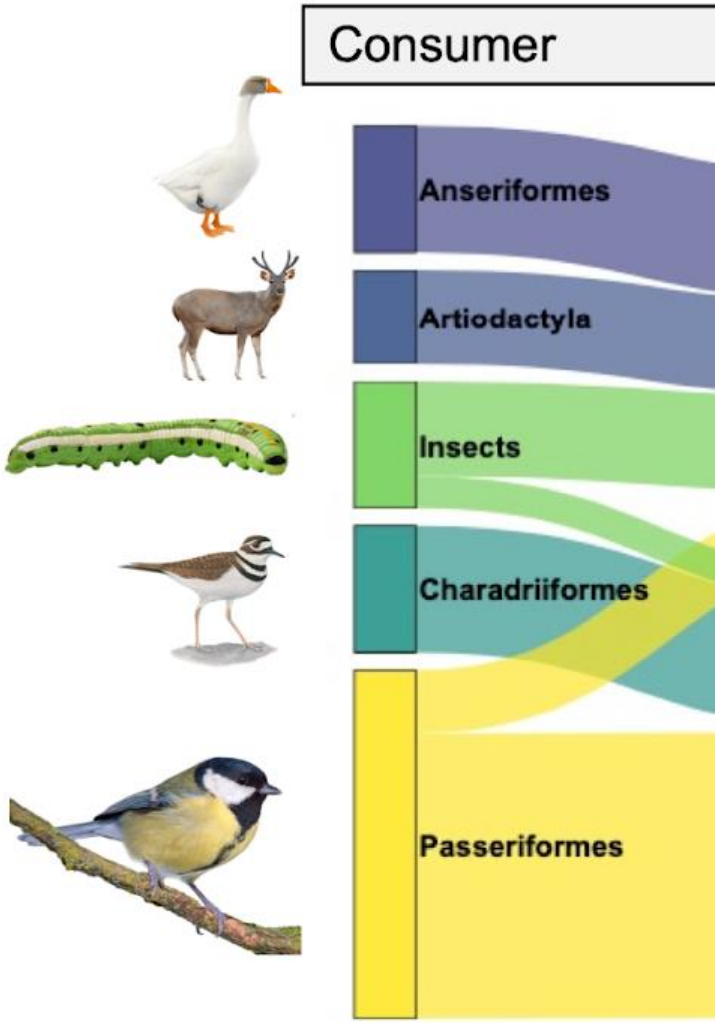
Assumptions of the hypothesis

Consumer and resource show seasonality.

Consumer is specialized on the resource.

Consumer fitness is most determined by resource.

How well do studies address assumption of seasonality?



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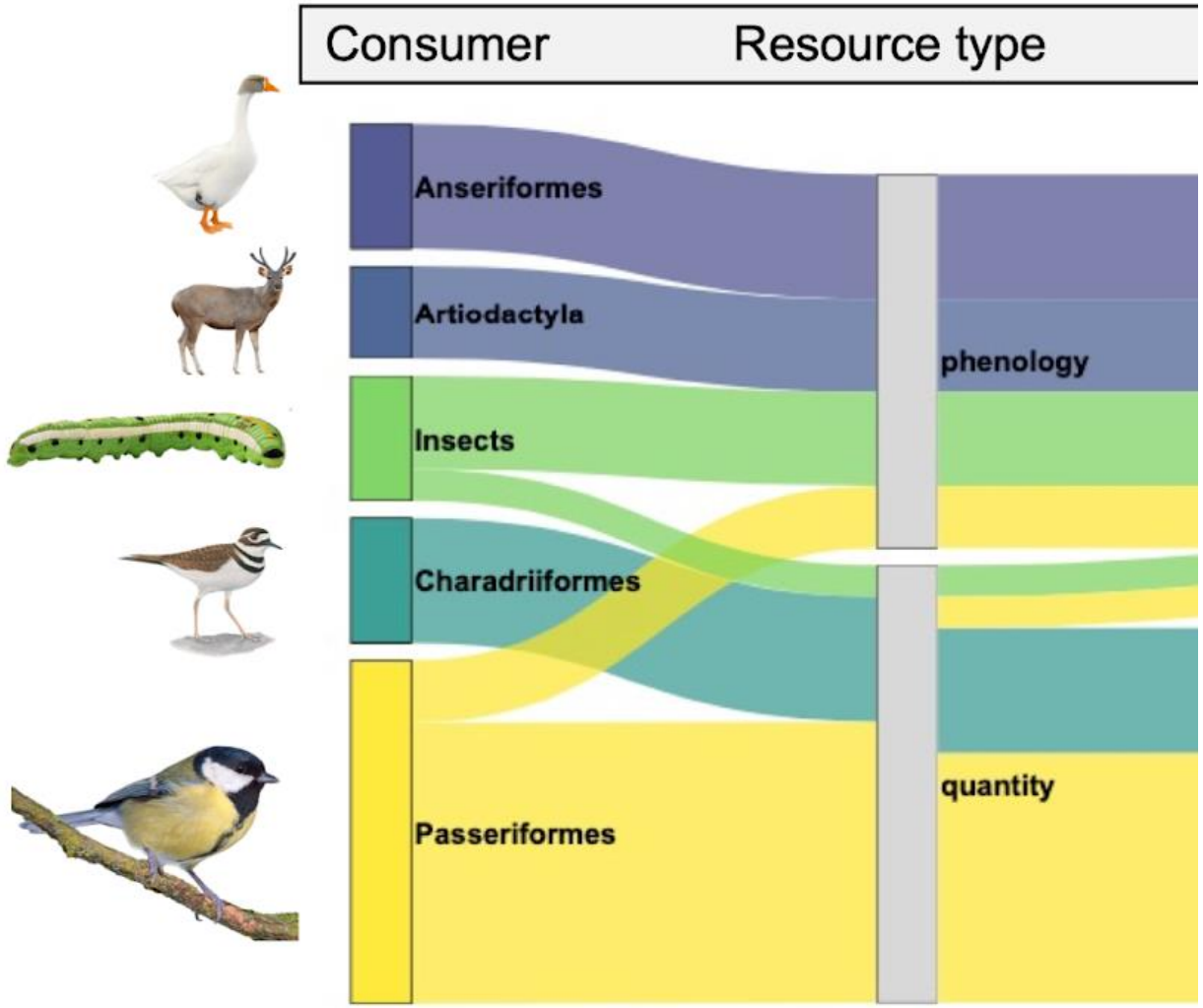
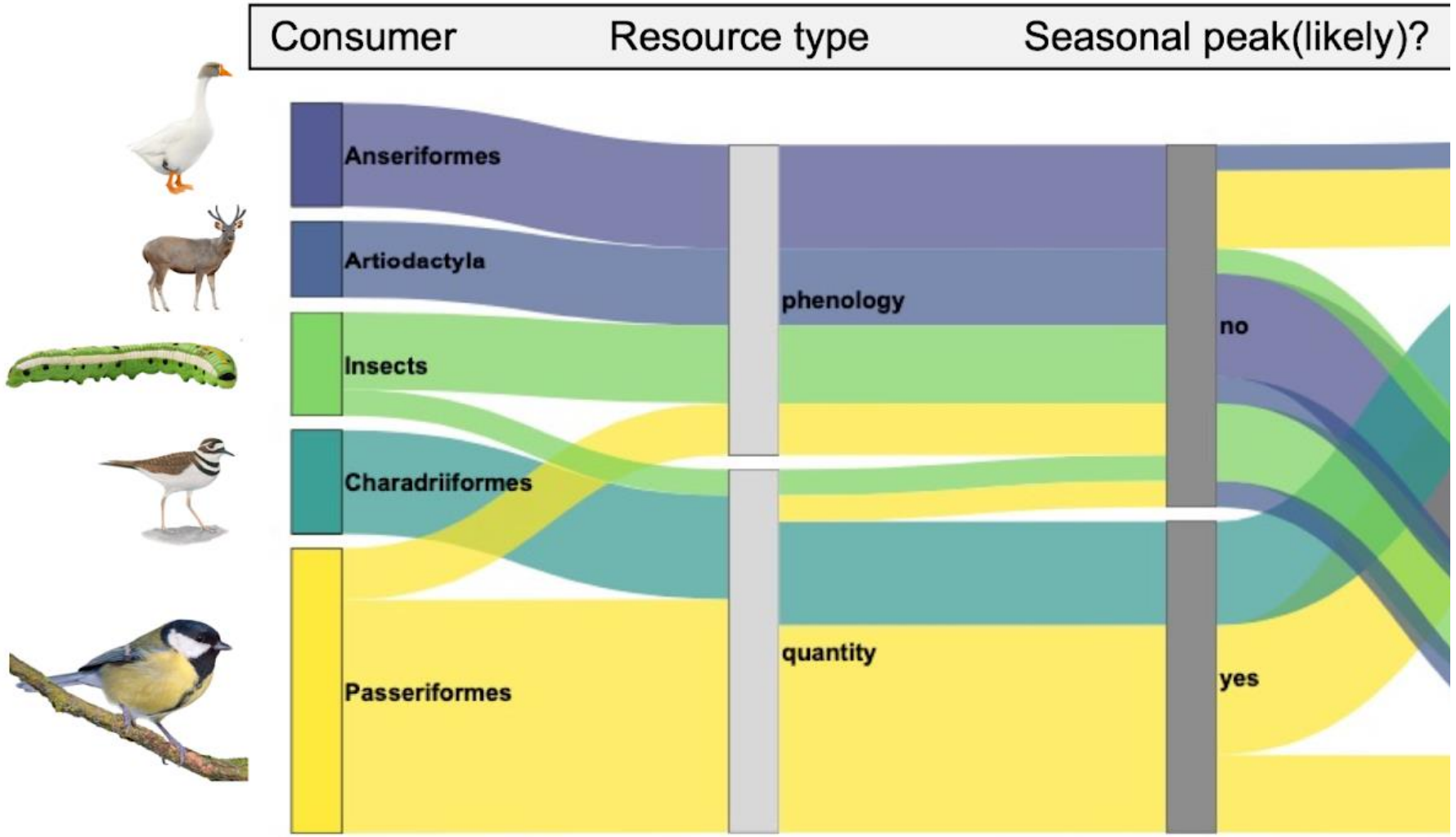


1. What type of metric do authors use to measure the resource?

Kharouba and Wolkovich, *In prep*.

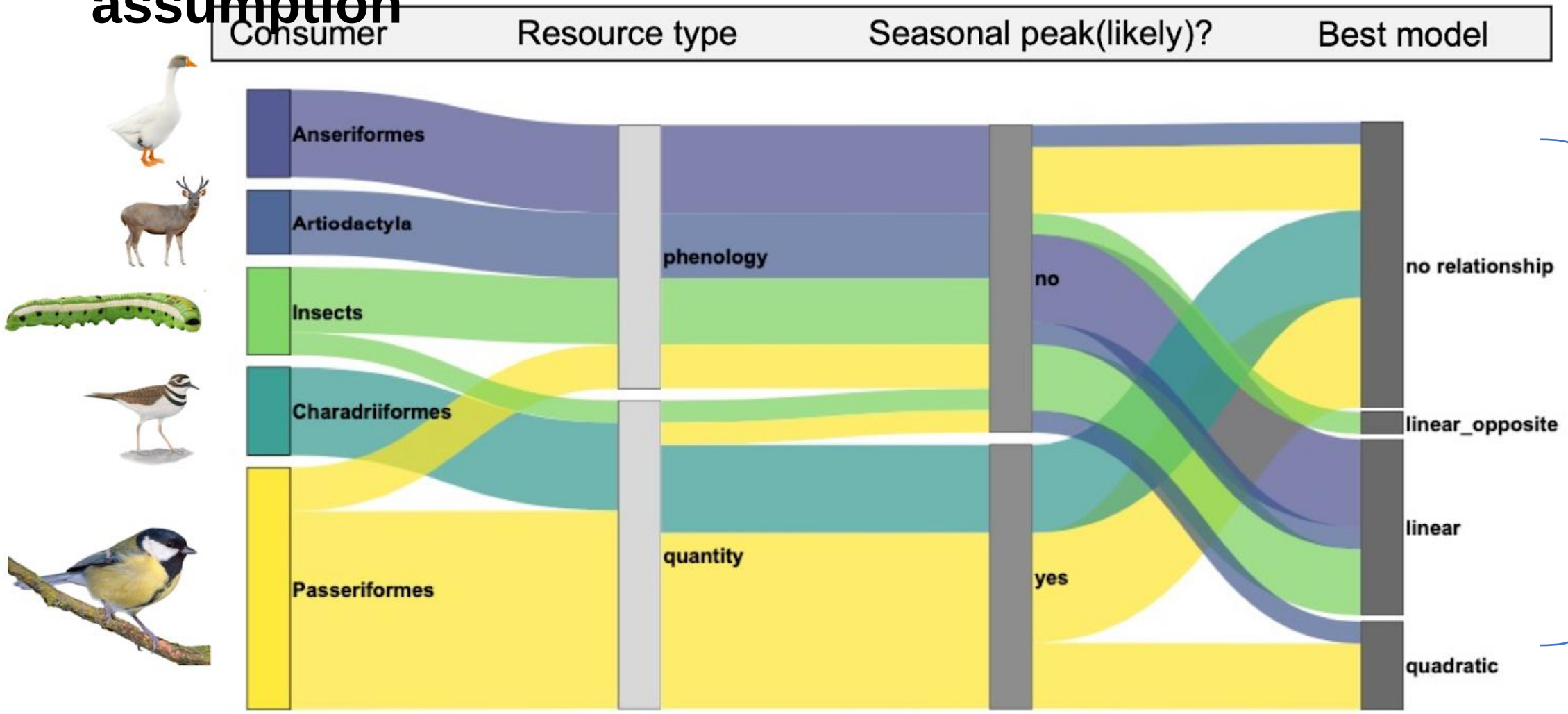
How well do studies address assumption of seasonality?



2. Is there likely to be a seasonal peak in resource?

Kharouba and Wolkovich, *In prep*.

Resource seasonality may be an important assumption



Kharouba and Wolkovich, *In prep*.

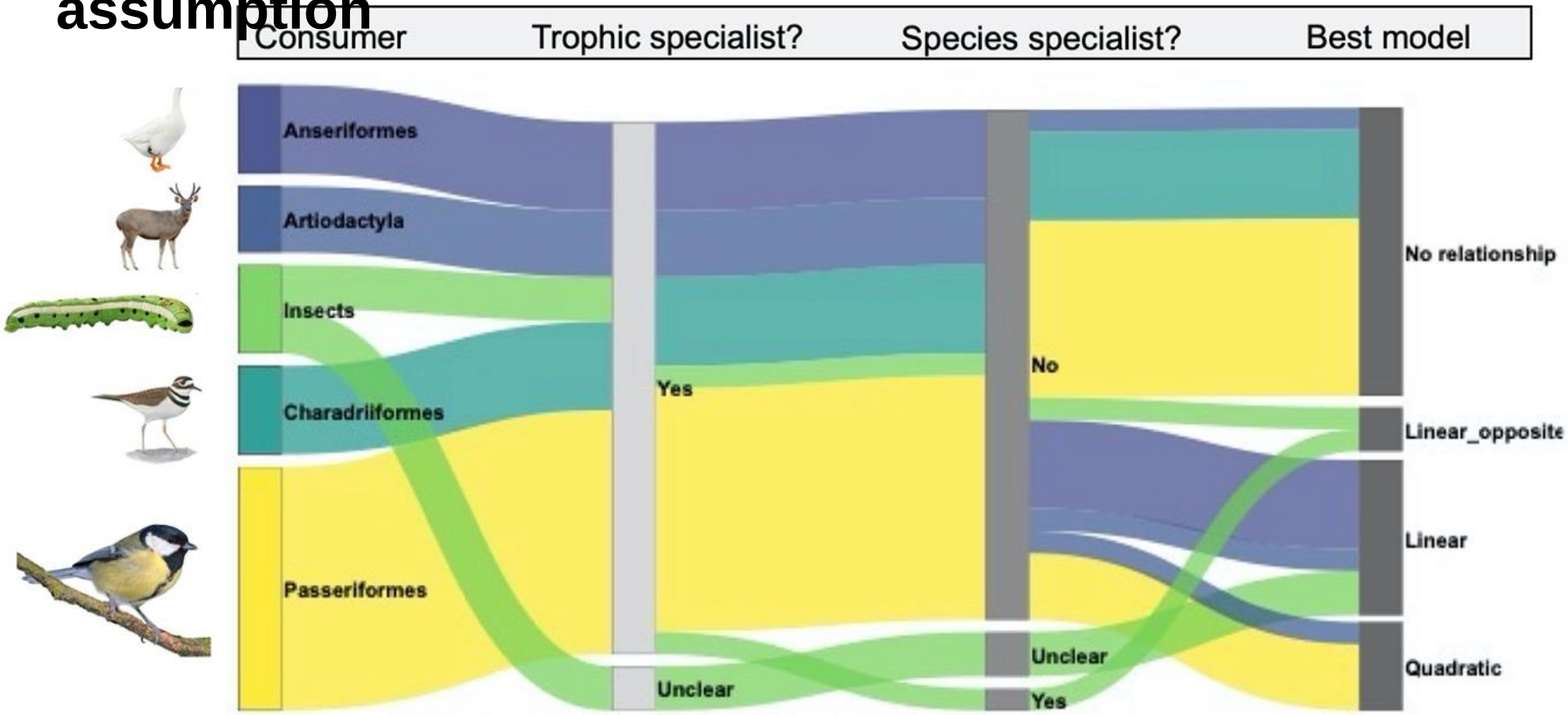
Assumptions of the hypothesis

Consumer and resource show seasonality.

Consumer is specialized on the resource.

Consumer fitness is most determined by resource.

Specialization does not seem to be an important assumption



Conclusions

Weak support for the match-mismatch hypothesis.

Better tests of the hypothesis are needed in the context of climate change.

Multiple factors- testing assumptions, data quality.

Acknowledgements

Vicki Senior
Anna Tucker
Andy Gougherty
Simon Leather
Deirdre Loughnan

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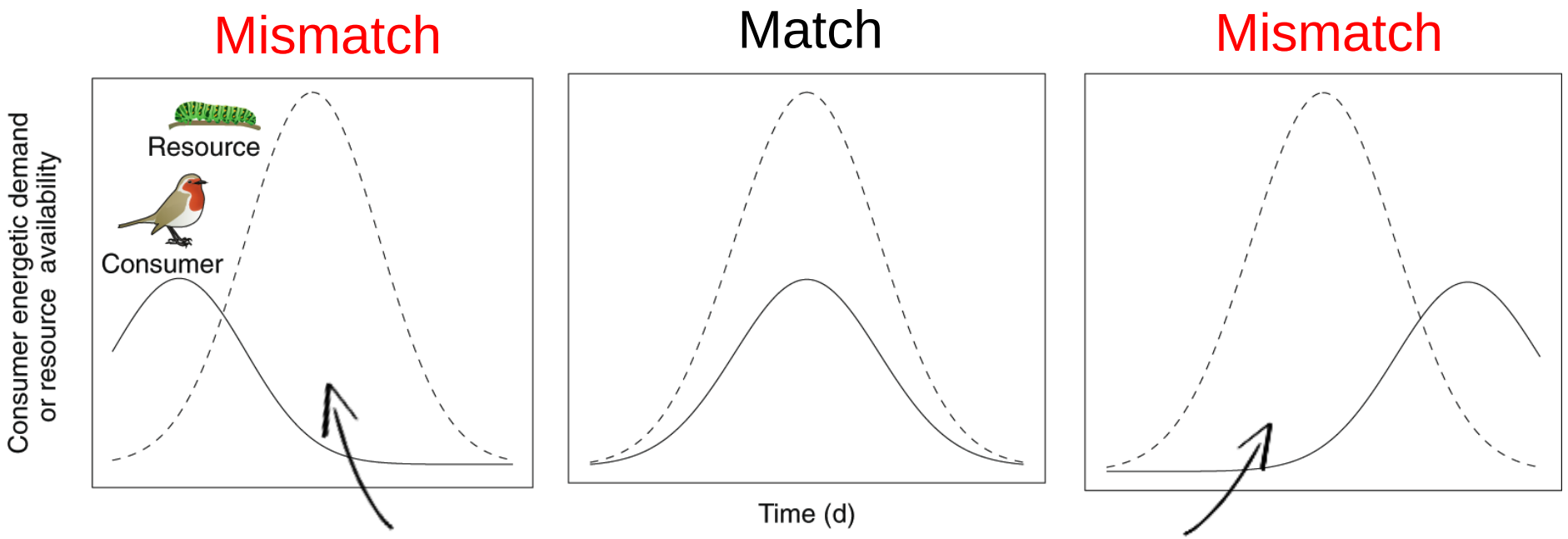
The Cushing match-mismatch hypothesis

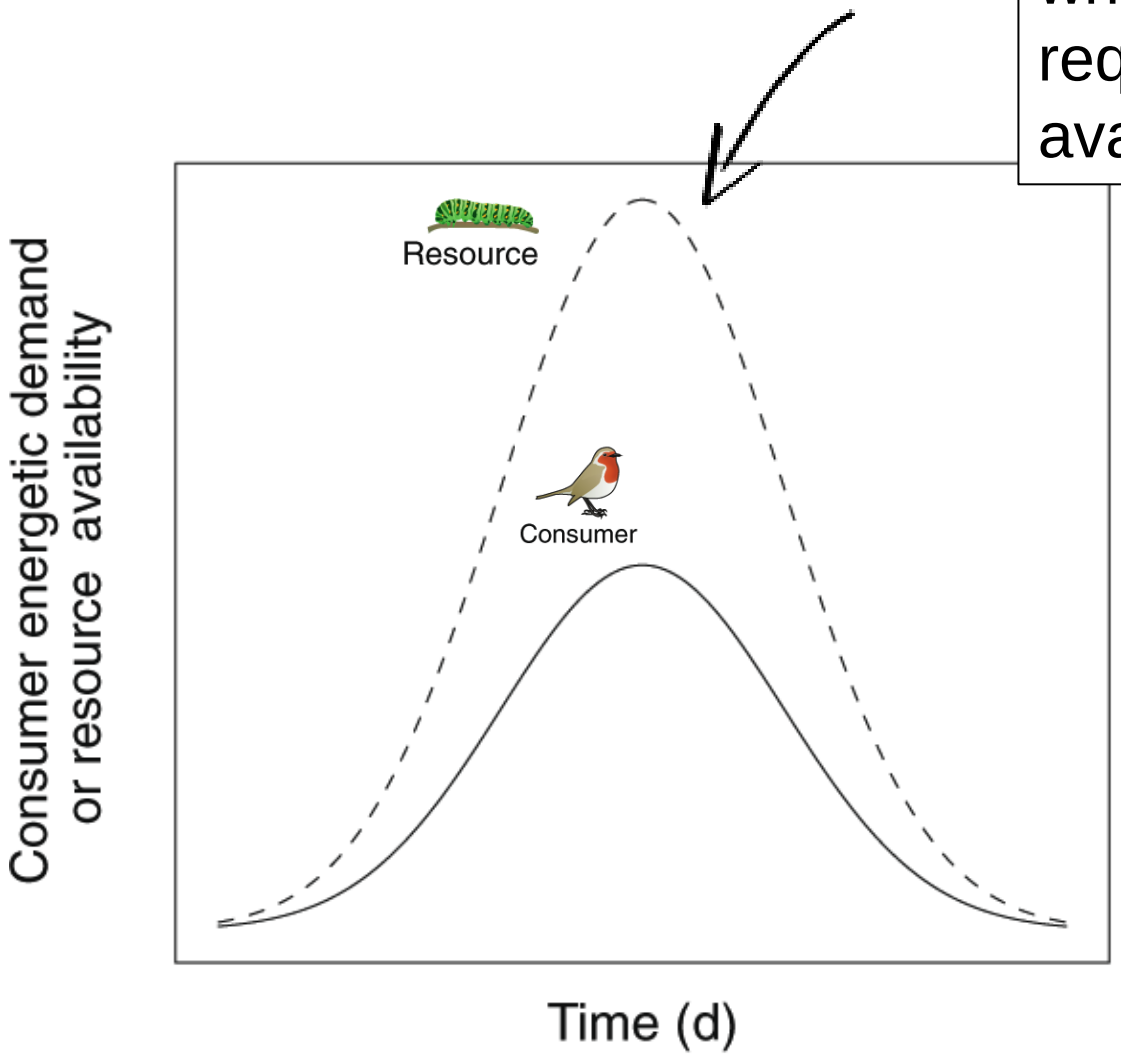


Mismatch: when gap between food requirement and food availability

Kharouba and Wolkovich, 2020. *Nature Climate Change* 10:406

The Cushing match-mismatch hypothesis

Match:
when peak food requirement = peak food availability



Kharouba and Wolkovich, 2020. *Nature Climate Change* 10:406

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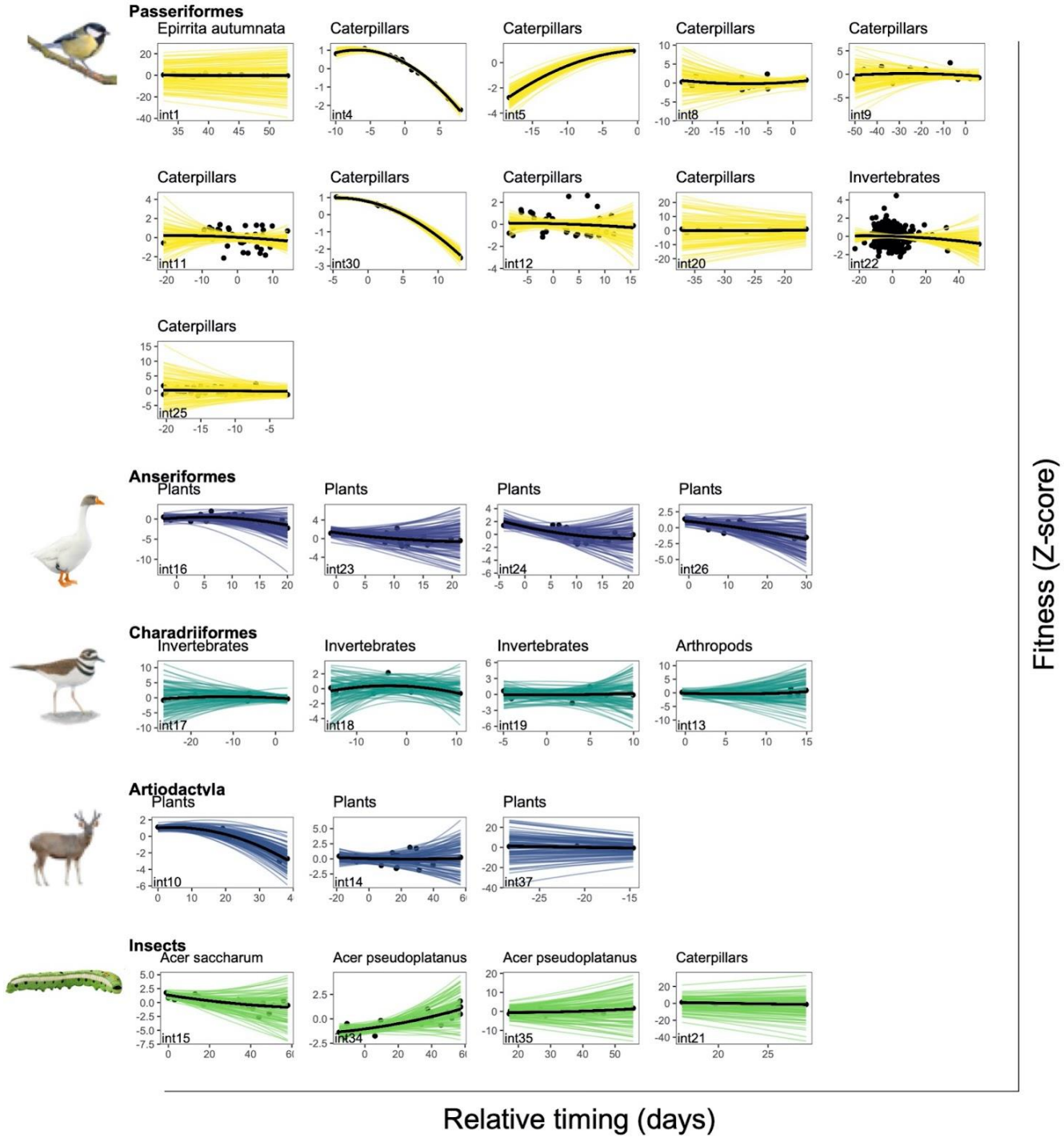
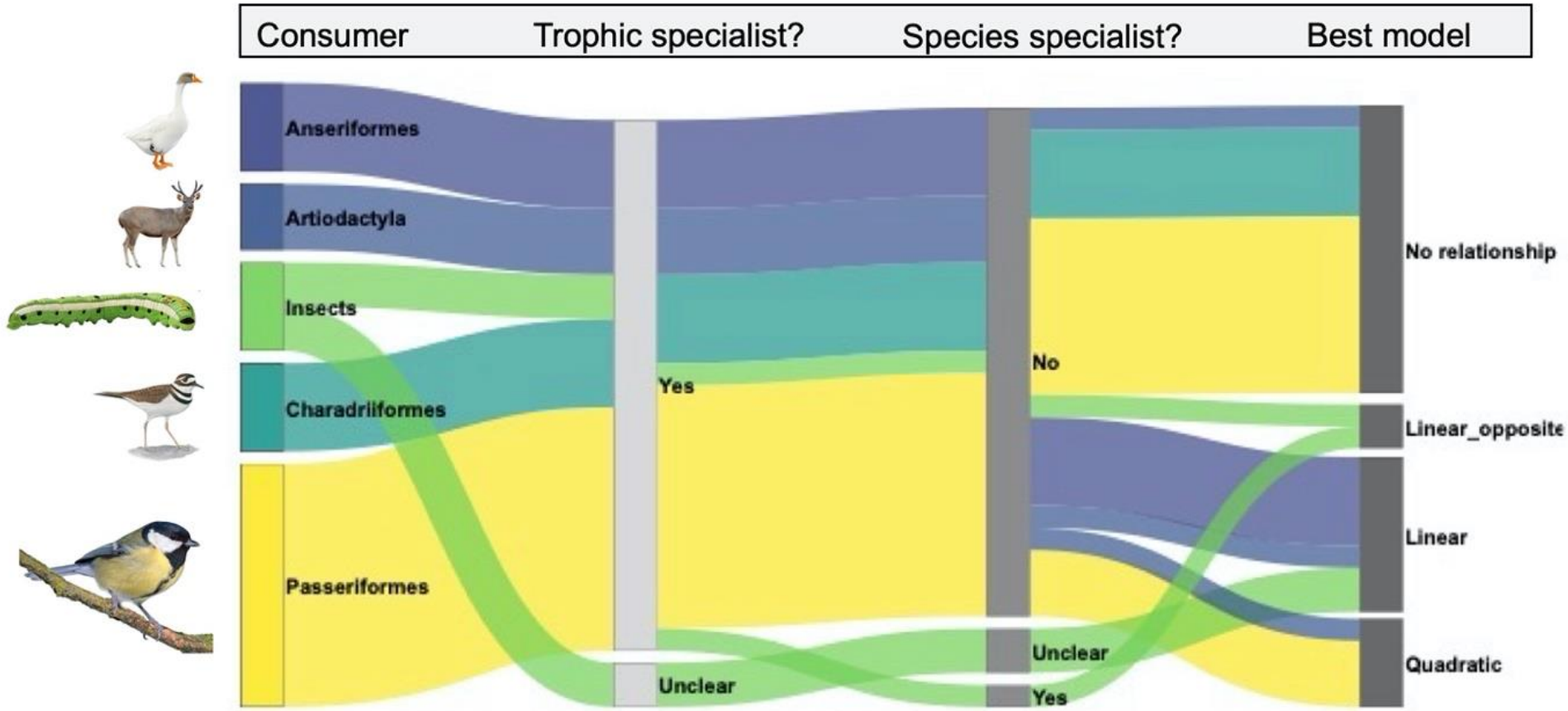
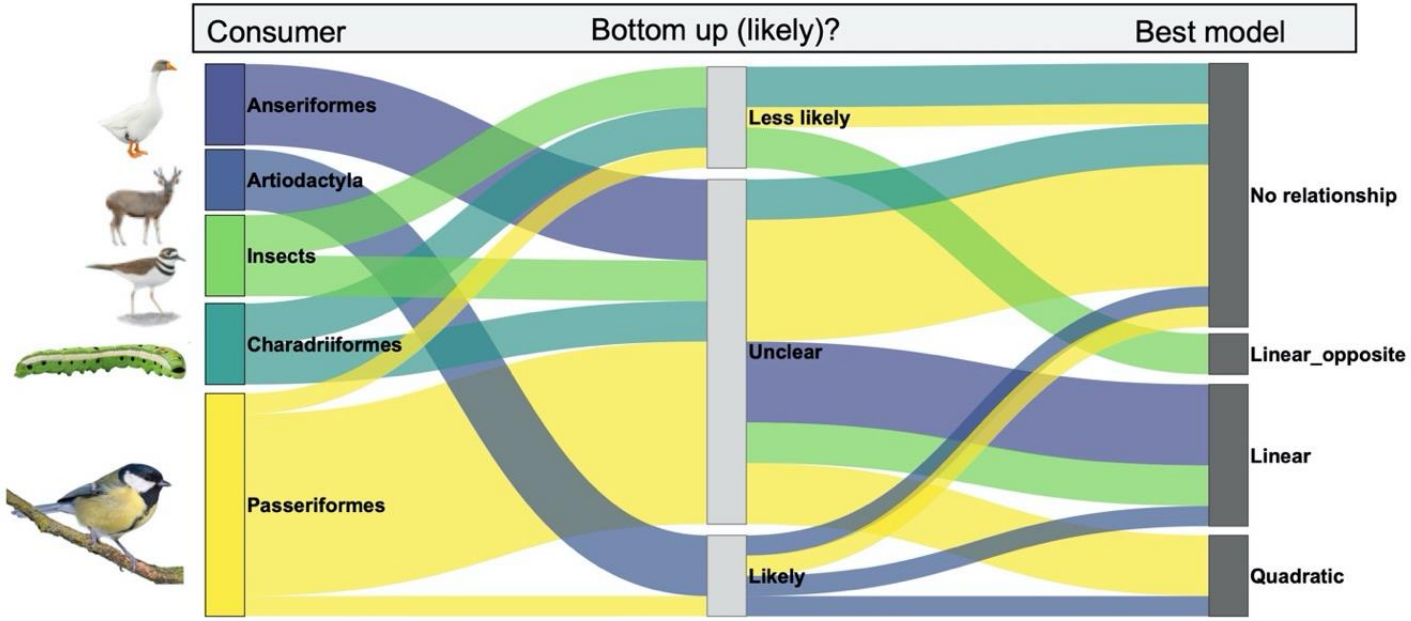
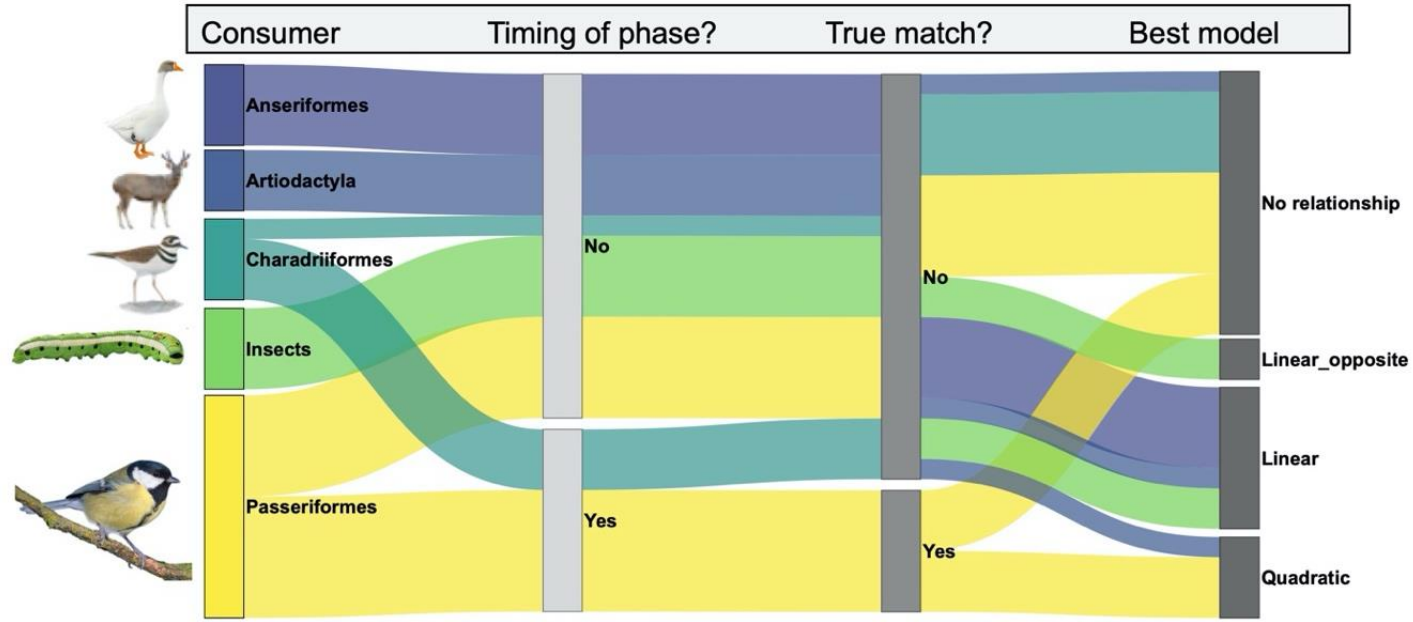



Consumer
Trophic specialist?
Species specialist?
Best model
Anseriformes
Artiodactyla
Insects
Charadriiformes
Passeriformes
Yes
Unclear
No
Unclear
Yes
No relationship
Linear_opposite
Linear
Quadratic


Consumer
Bottom up (likely)?
Best model
Anseriformes
Artiodactyla
Insects
Charadriiformes
Passeriformes
Less likely
Unclear
Likely
No relationship
Linear_opposite
Linear
Quadratic


Consumer
Timing of phase?
True match?
Best model
Anseriformes
Artiodactyla
Charadriiformes
Insects
Passeriformes
No
Yes
No
Yes
No relationship
Linear_opposite
Linear
Quadratic