Quantifying competition between two demersal fish species

Swedish Oikos 2023, Gothenburg

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https://maxlindmark.github.io/

Lunneryd et al., Aqua reports 2022:5; Wikimedia commons

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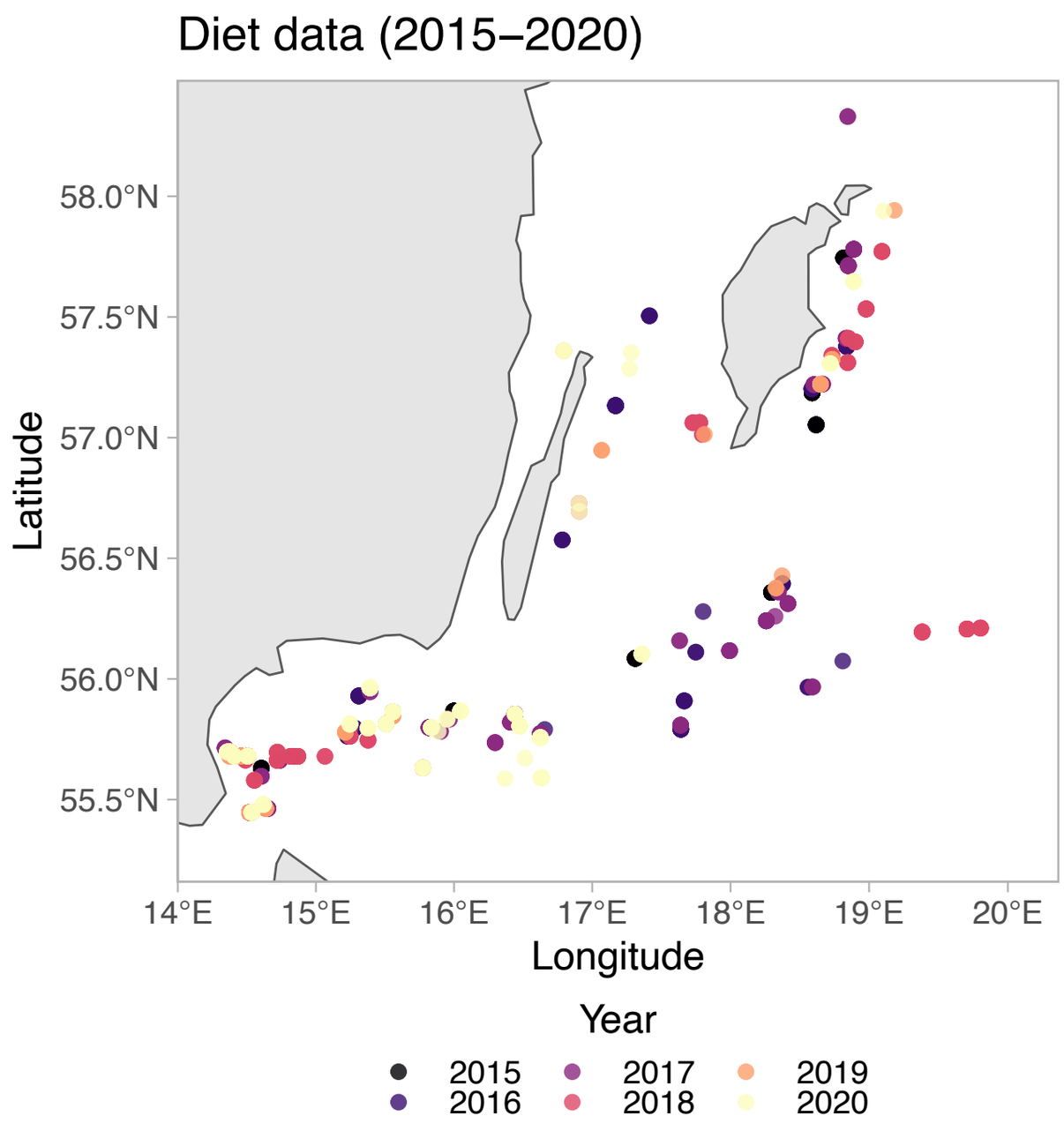
Part I: potential competition

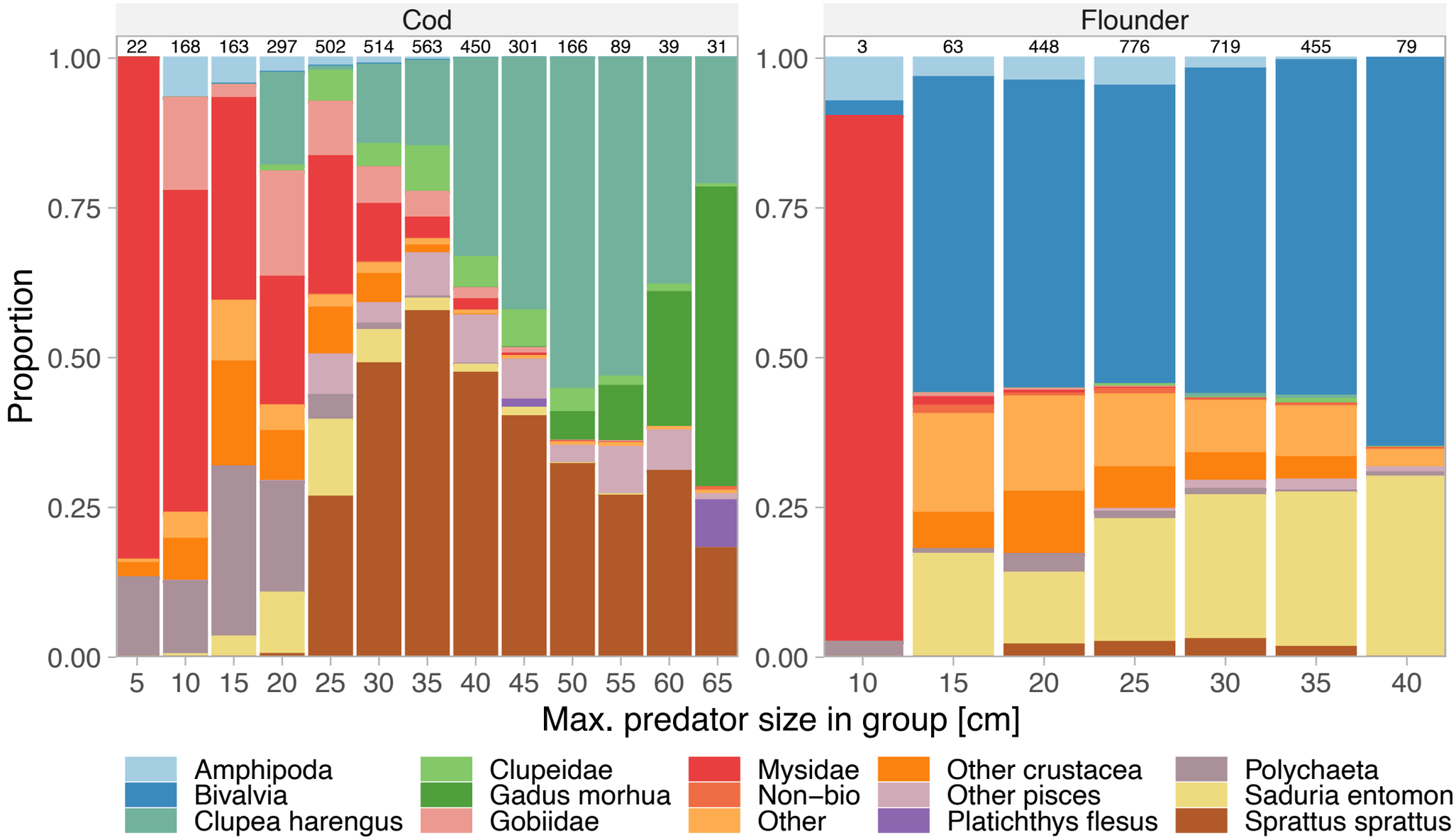
- Dietary overlap
- Spatial overlap
- Opposite population trajectories

Link & Auster (2013) Bulletin of Marine Science

Dietary overlap

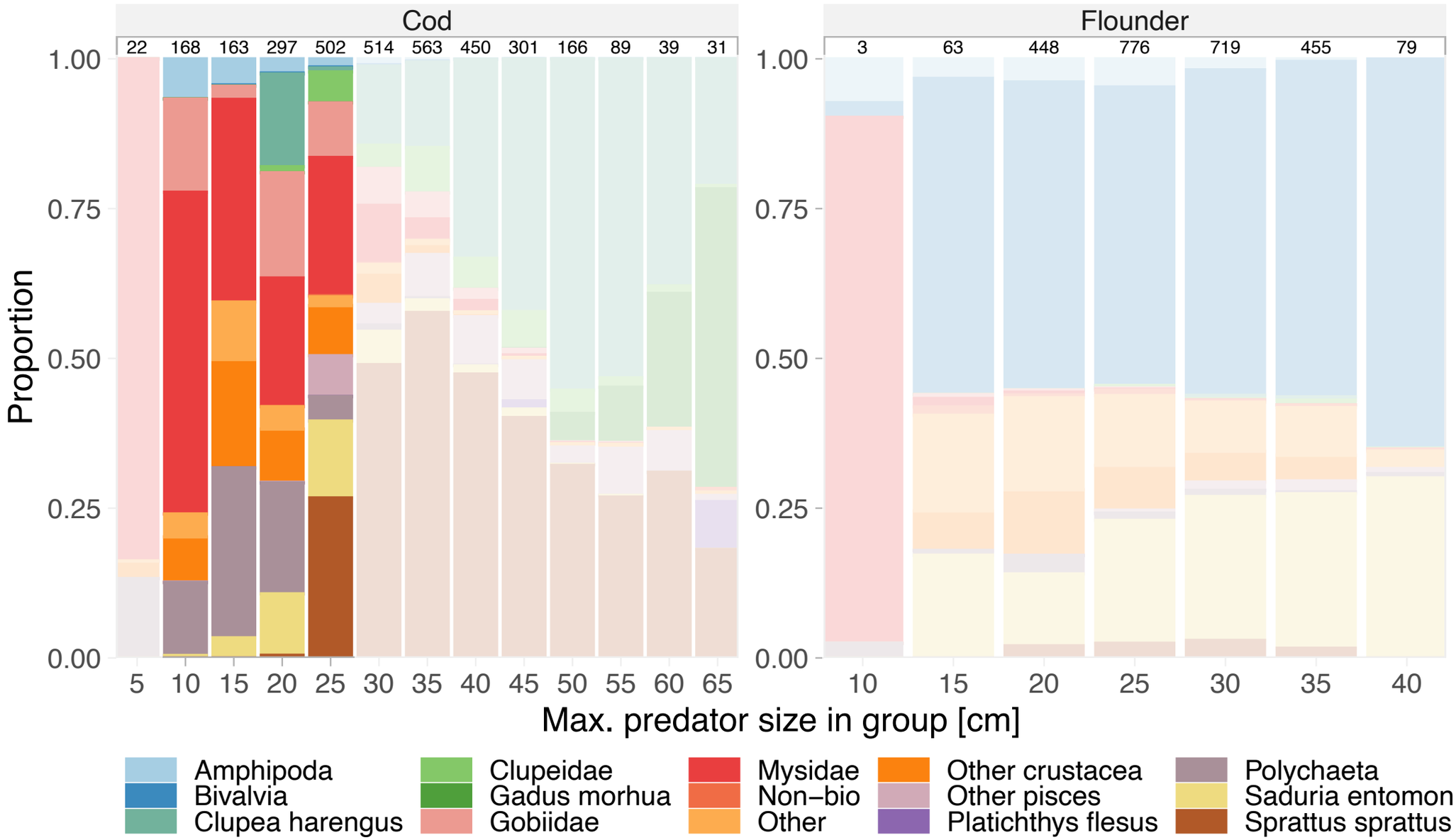


Diet overlap



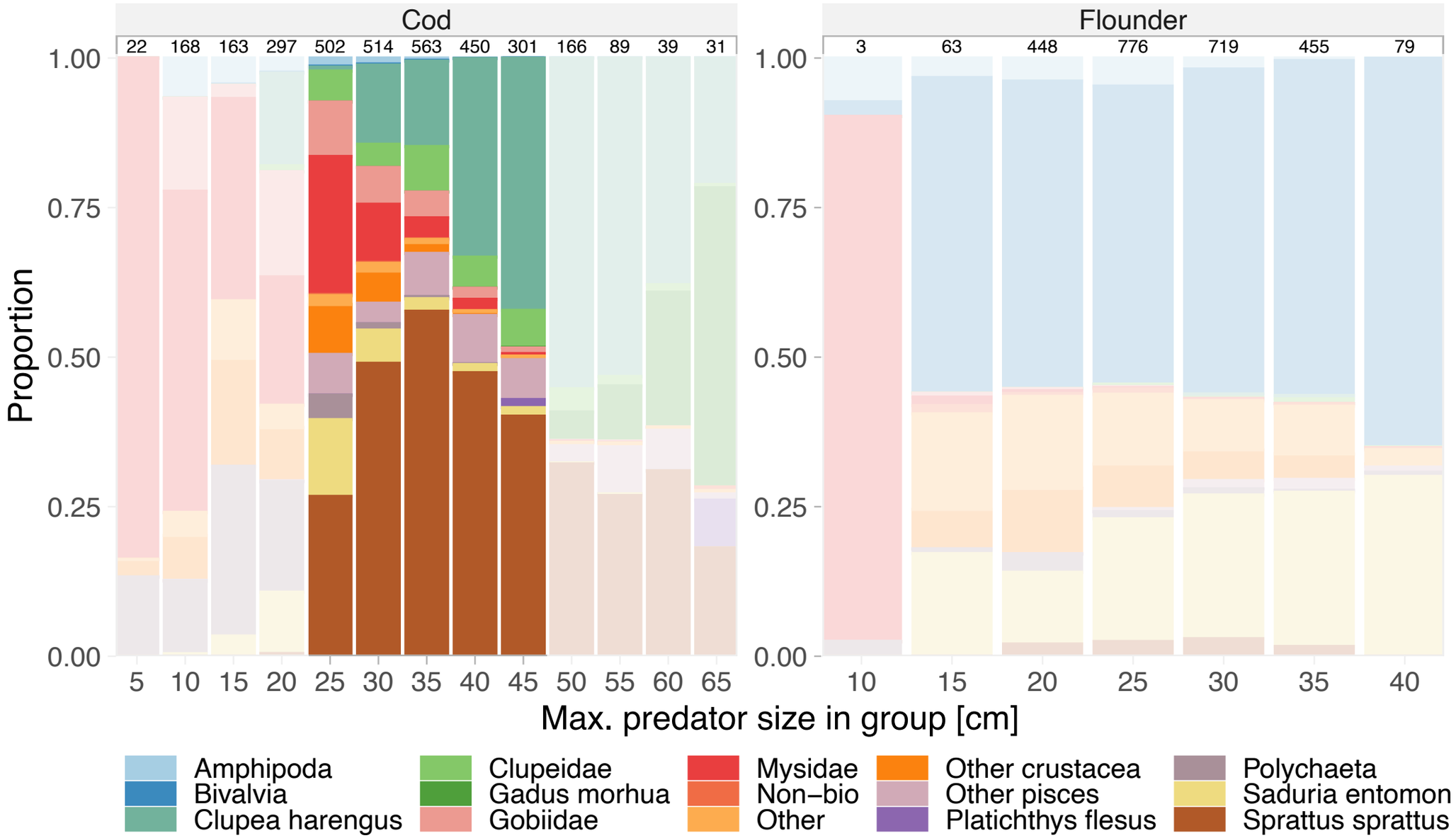
Diet overlap

Group 1: Small cod (mainly benthic)



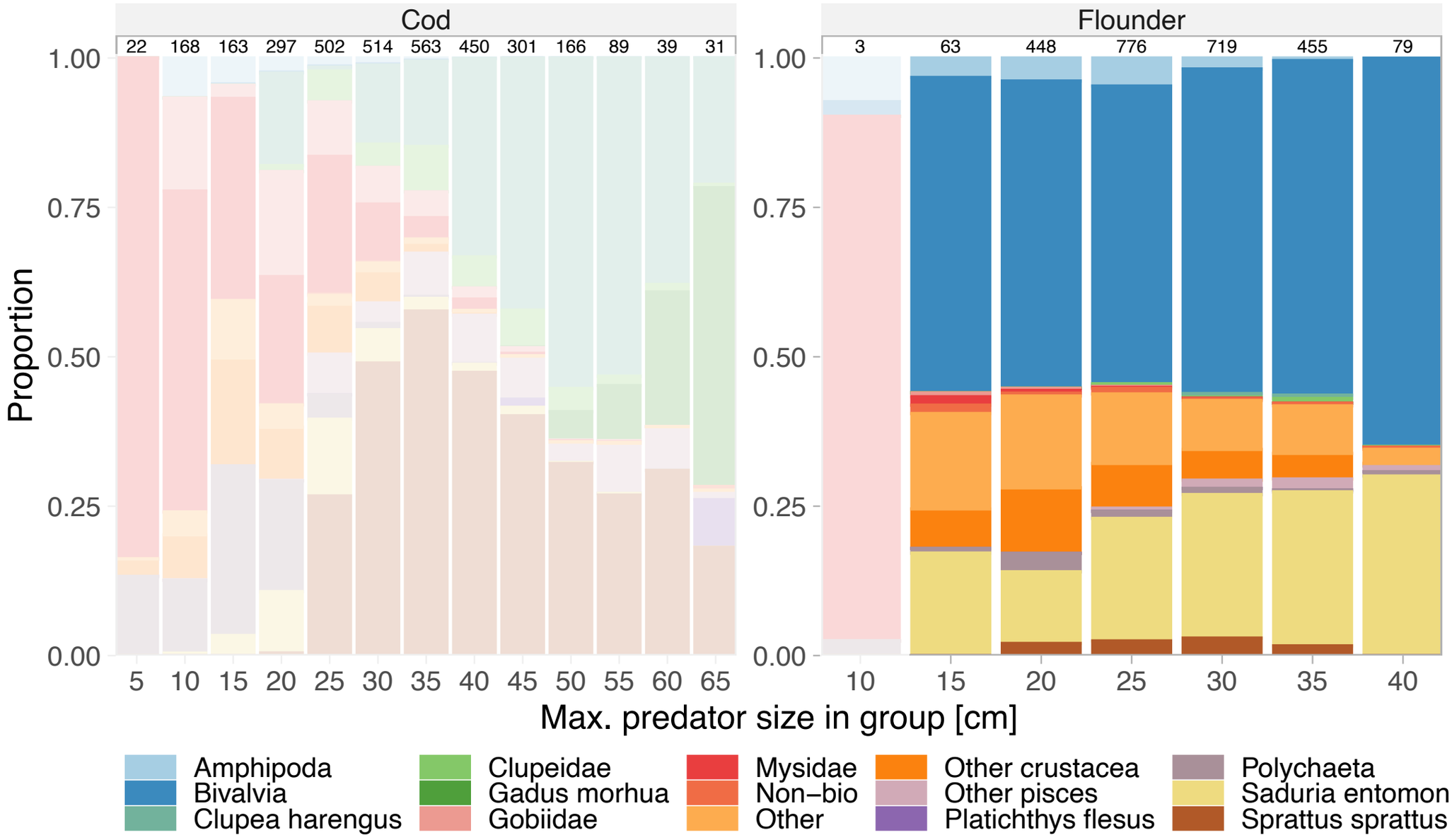
Diet overlap

Group 2: Medium cod (potentially benthic)

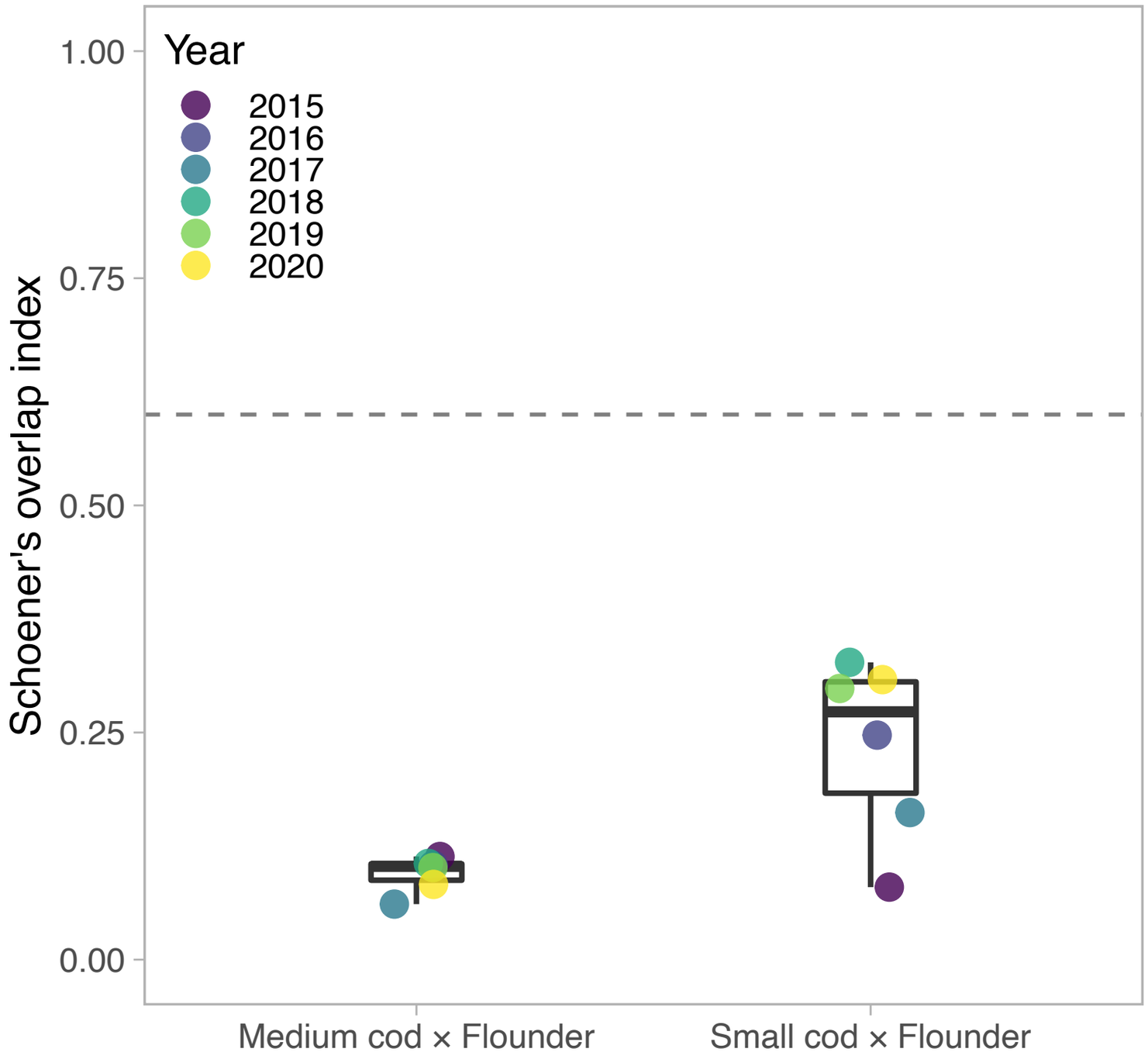


Diet overlap

Group 3: Flounder (mainly benthic)



Diet overlap?



1. Dietary overlap: ⊗ (*but some common prey*)
2. Spatial overlap?
3. Opposite population trajectories?

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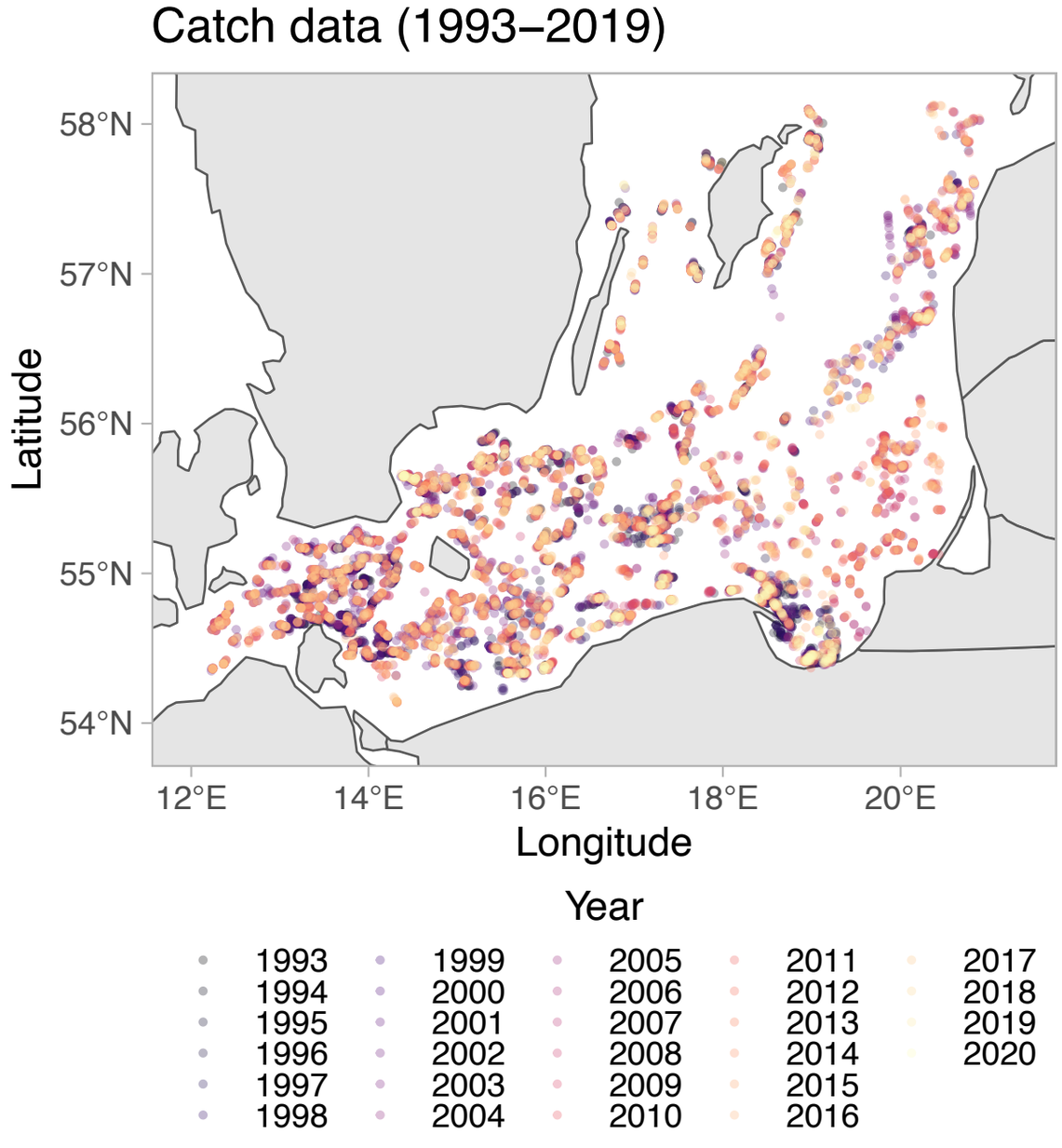
2. Spatial overlap?

3. Opposite population trajectories?

Catch data

- Biomass density at location s in time t $[kg/km^2]$
- Covariates: temperature, salinity, oxygen, depth, substrate



Biomass models

- Spatiotemporal predictive-process GLMMs using TMB and INLA
- SPDE approach to Gaussian Random Fields
- Tweedie distribution (log link)

$$\mathbb{E}[y_{s,t}] = \mu_{s,t}$$

$$\mu_{s,t} = f^{-1}(X^{main}_{s,t}\beta + \omega_s + \epsilon_{s,t})$$

Link function

Design matrix

Vector of coefficients

Spatial random effect

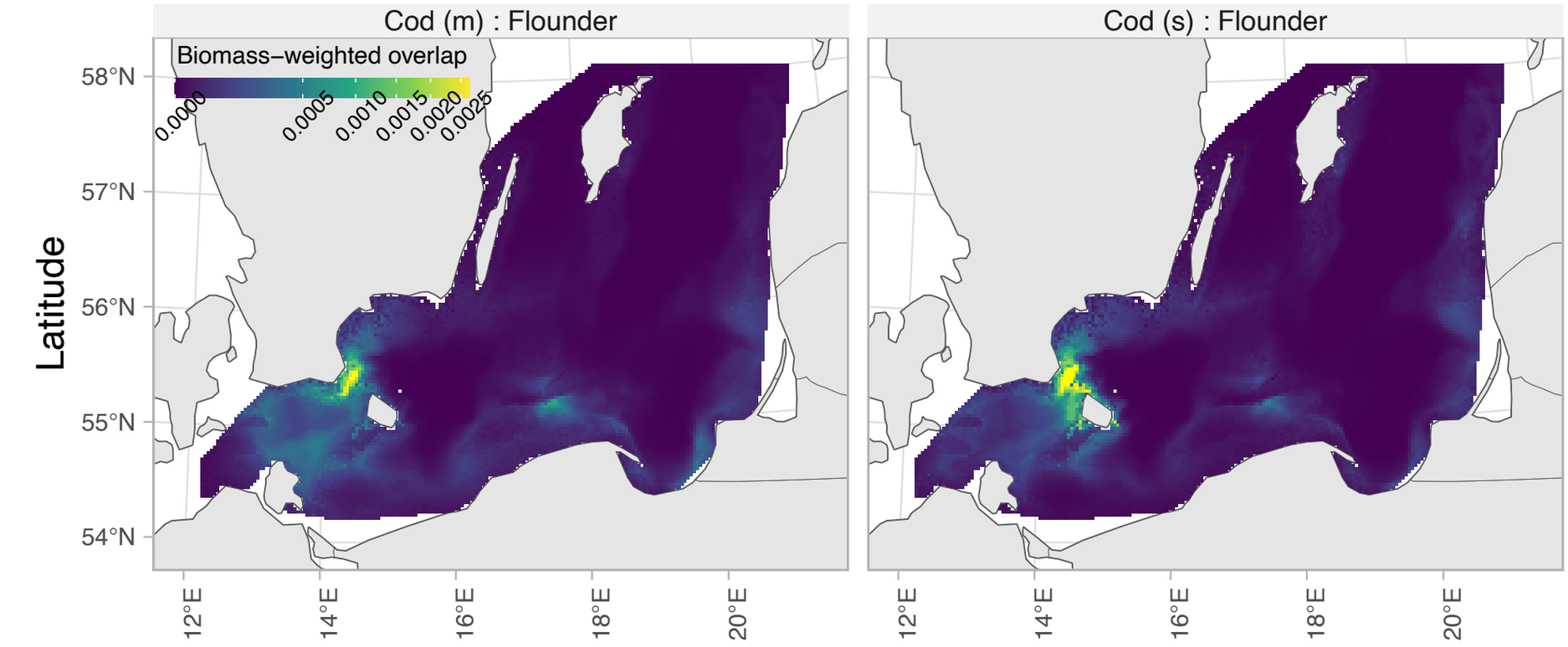
Spatiotemporal random effect

Anderson *et al.*, (2022) bioRxiv

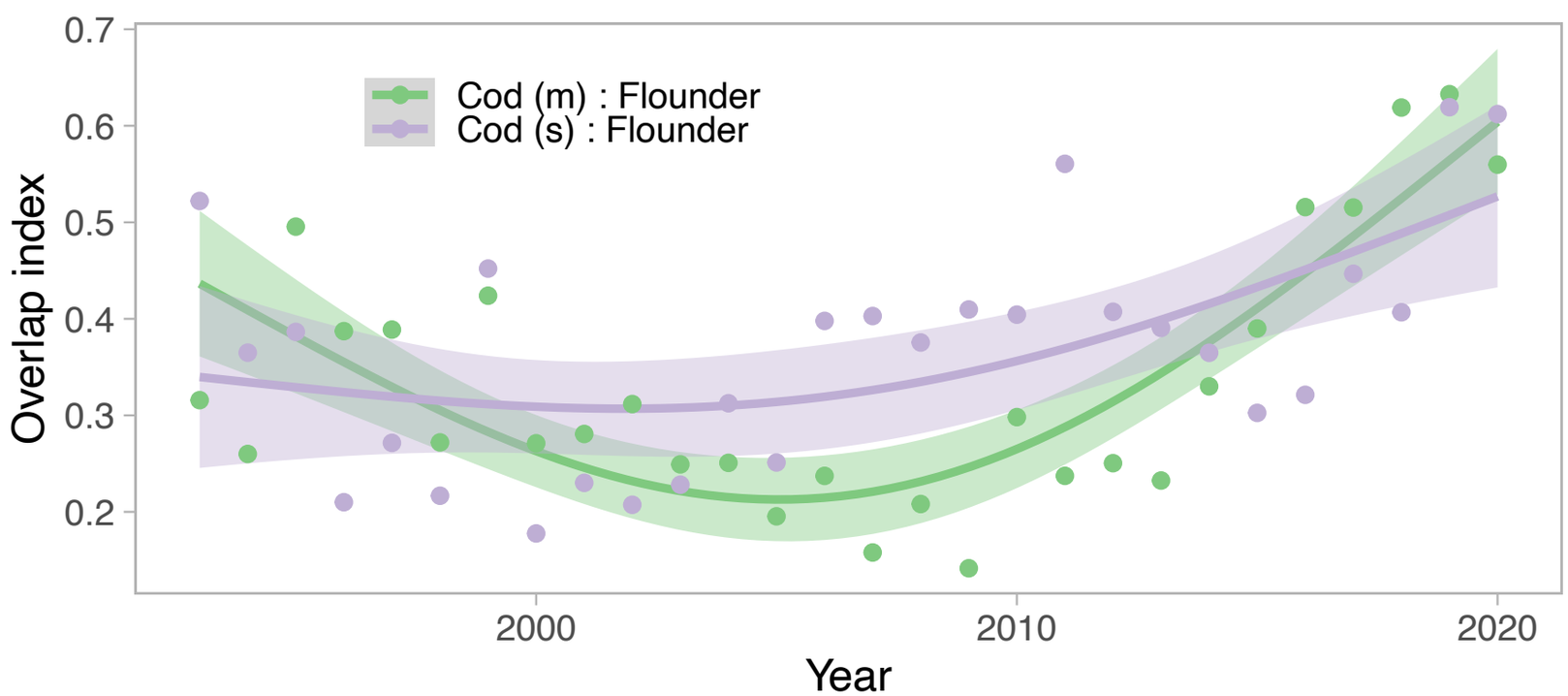
Spatial overlap?

Spatial overlap?

A



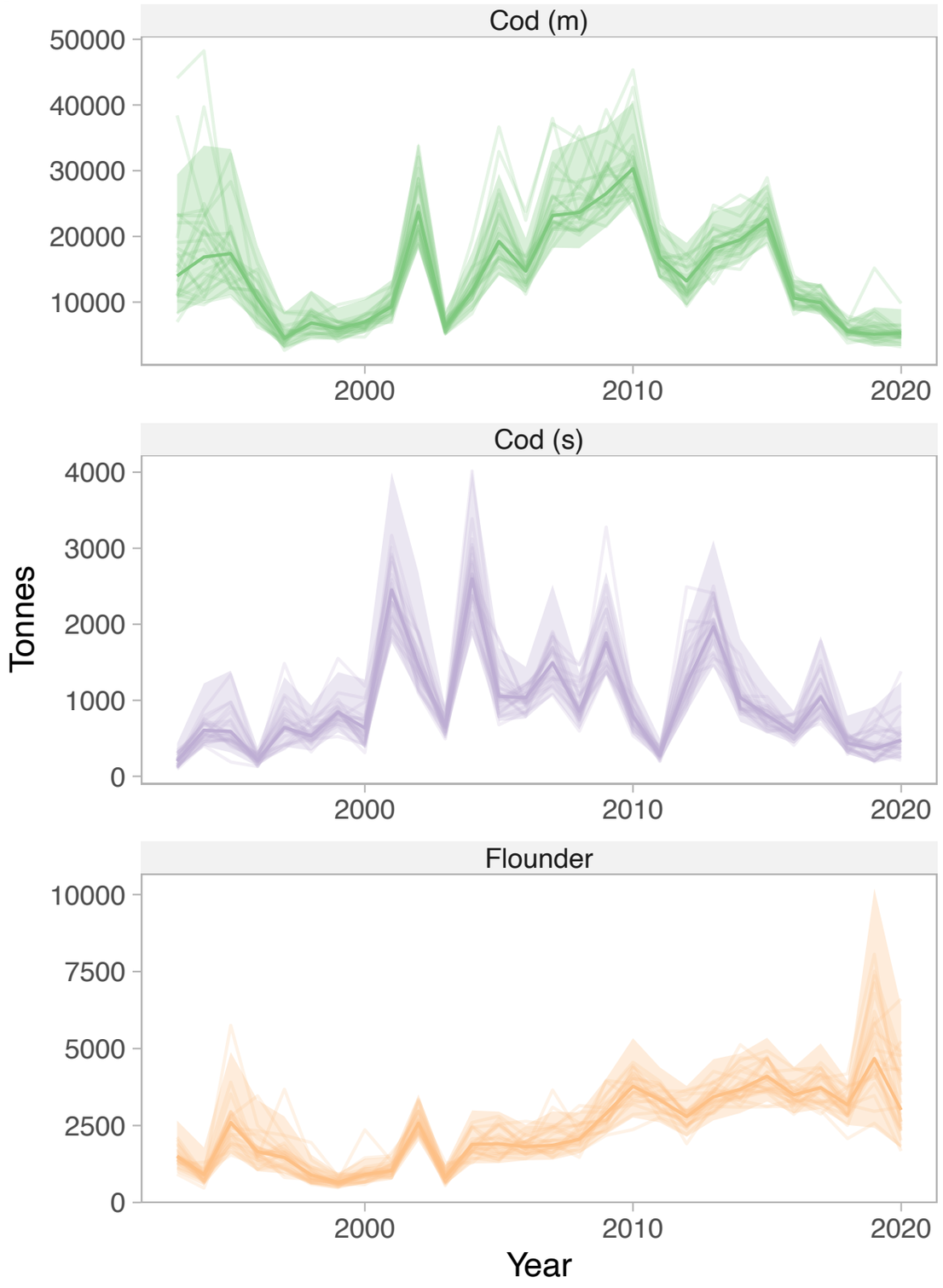
B



Opposite population trajectories?

Opposite population trajectories?

A



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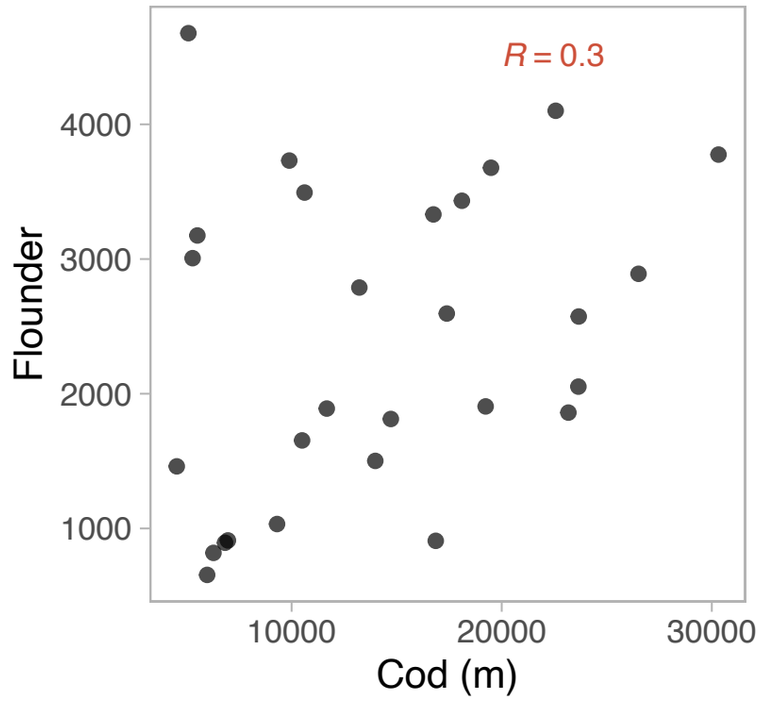
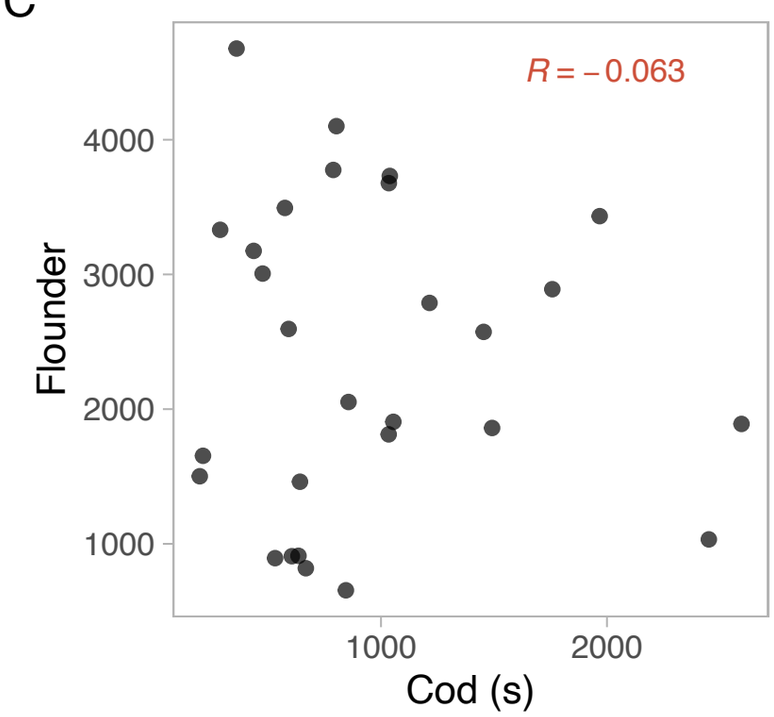


C



1. Dietary overlap: ⊗ (*but some common prey*)
2. Spatial overlap? ✓
3. Opposite population trajectories? ⊗

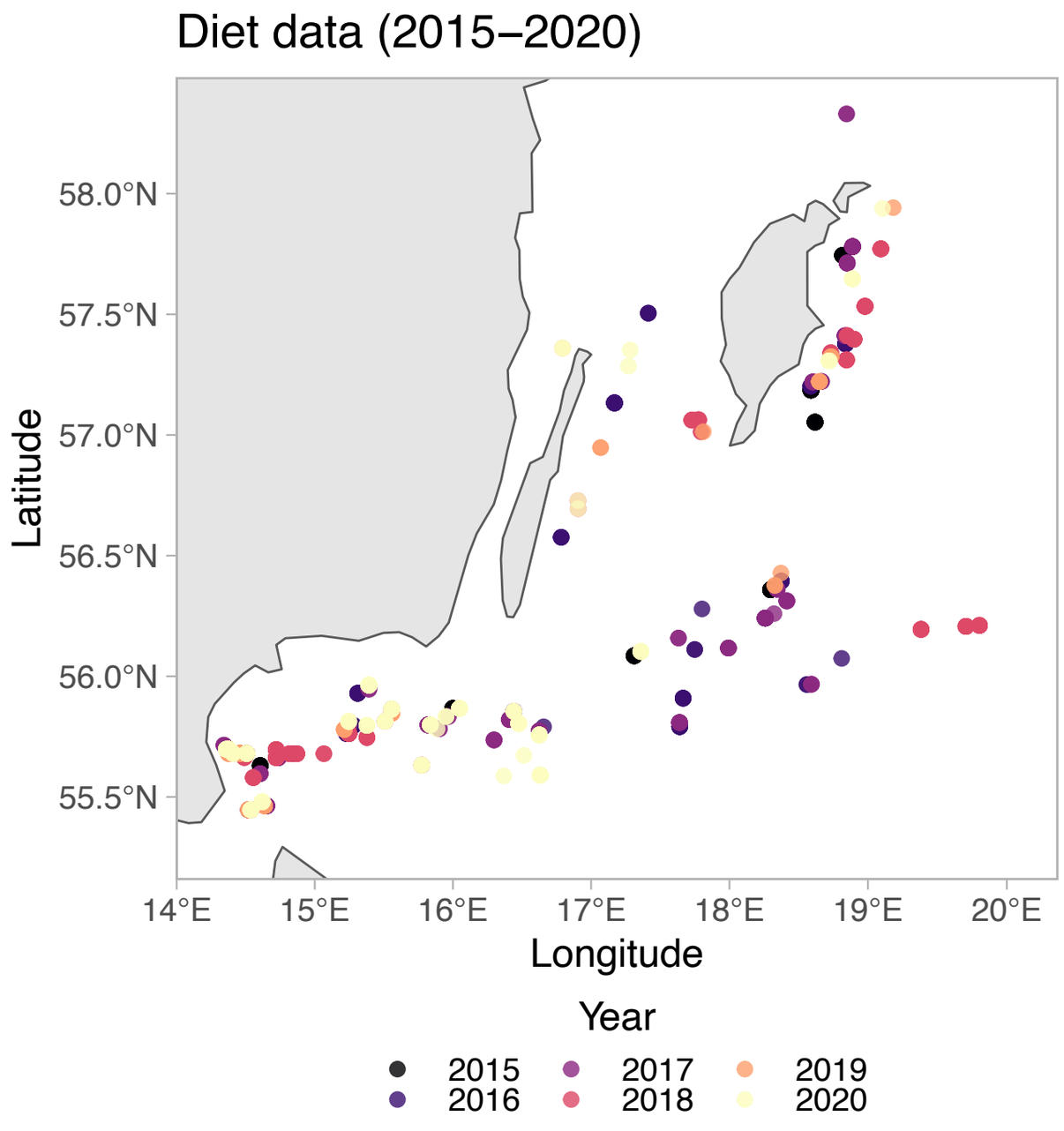
Part II: potential competition

- Are they competing for a *limiting* resource?

Diet data

- Feeding ratio of Benthos and *S. entomon* $[w_{prey}/w_{pred}]$ for individual at location s in time t

- Covariates: temperature, salinity, oxygen, depth, flounder, cod, *S. entomon*



Diet data

- Delta-Beta distribution (logit links)
- Priors: $\beta \sim N(0,1)$

$$\mathbb{E}[y_{s,t}] = \mu_{s,t}$$

$$\mu_{s,t} = f^{-1}(X^{main}_{s,t}\beta + \omega_s)$$

Link function

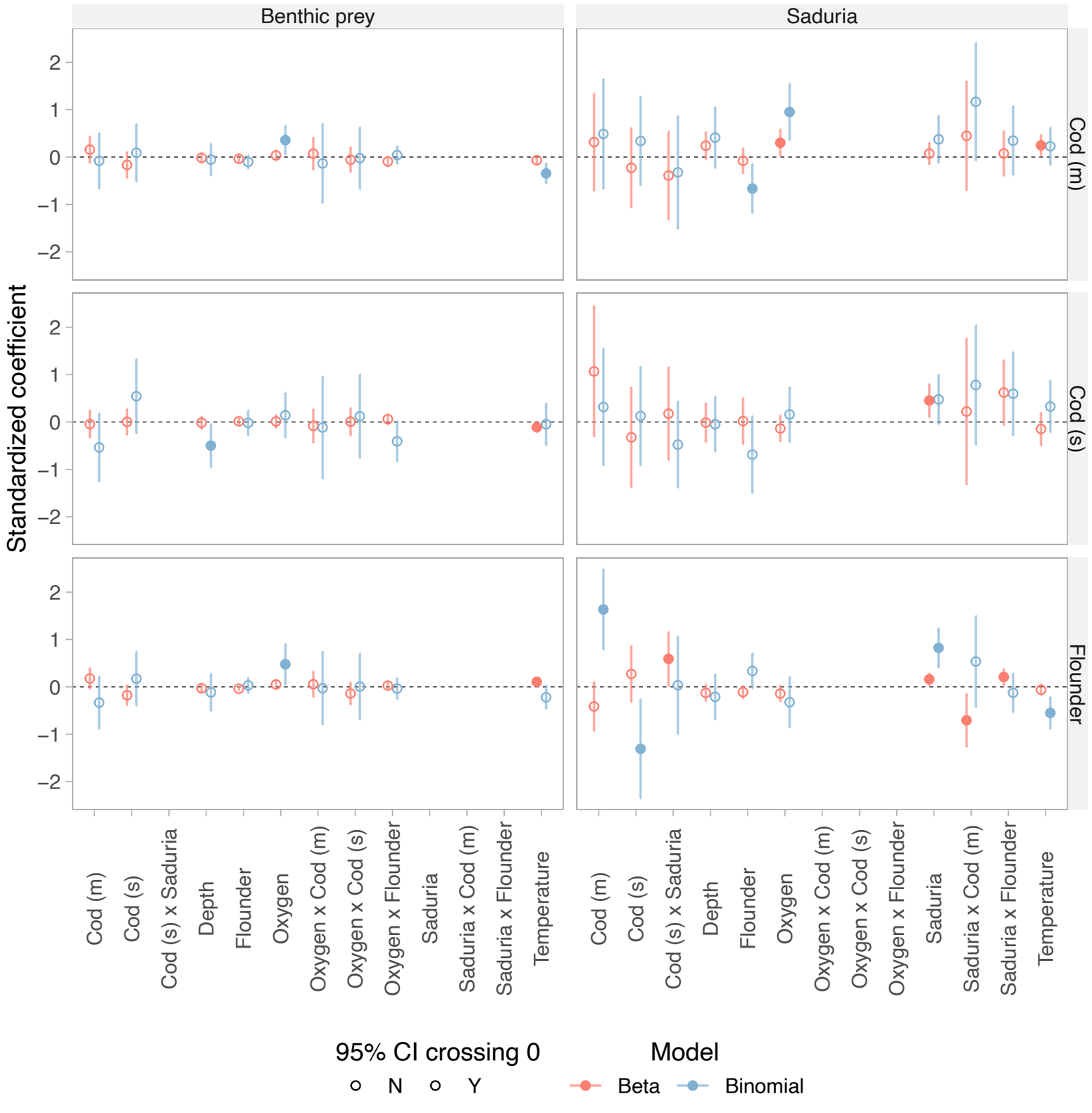
Design matrix

Vector of coefficients

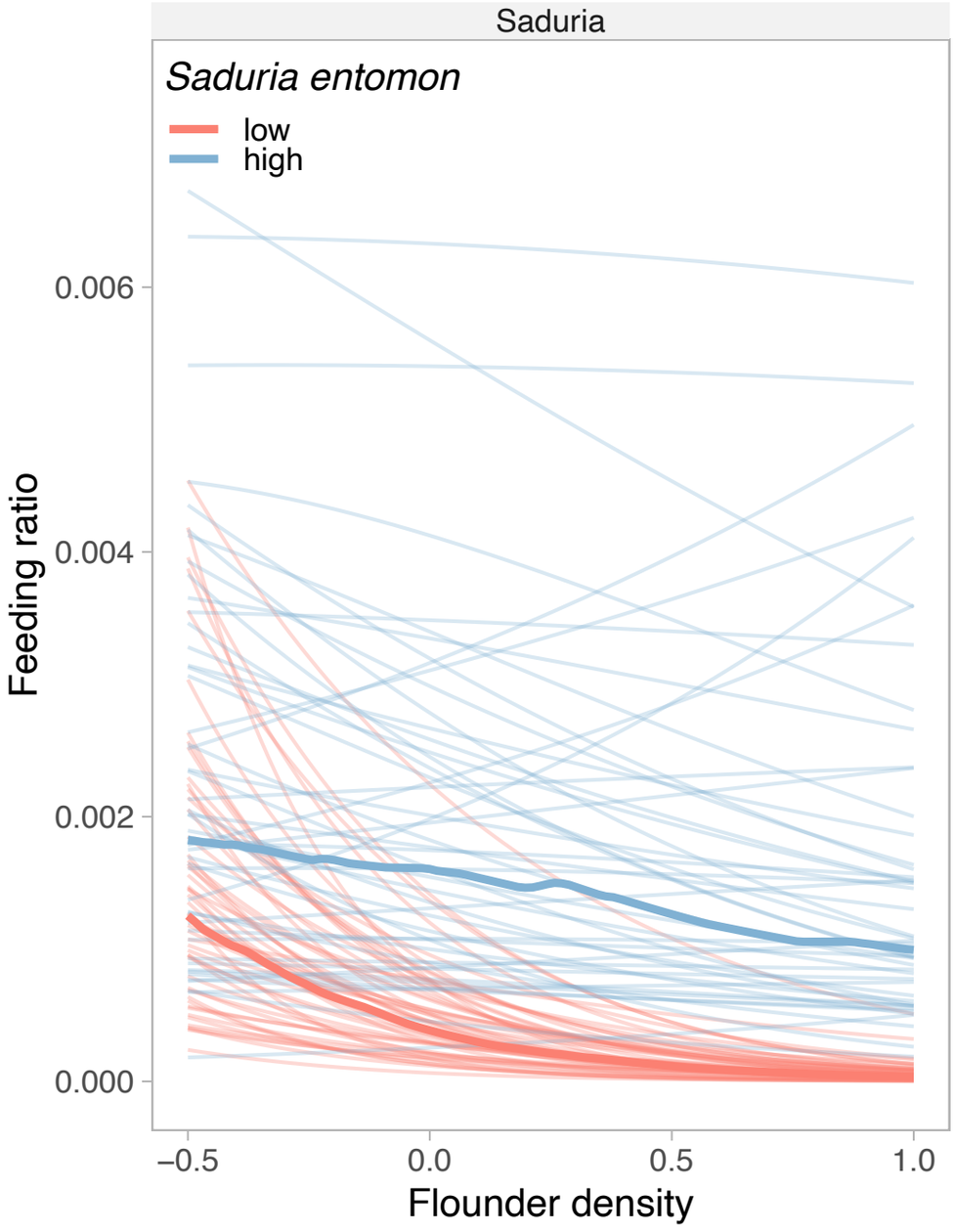
Spatial random effect

Anderson *et al.*, (2022) bioRxiv

Diet model coefficients



Interspecific competition (for *S. entomon*)



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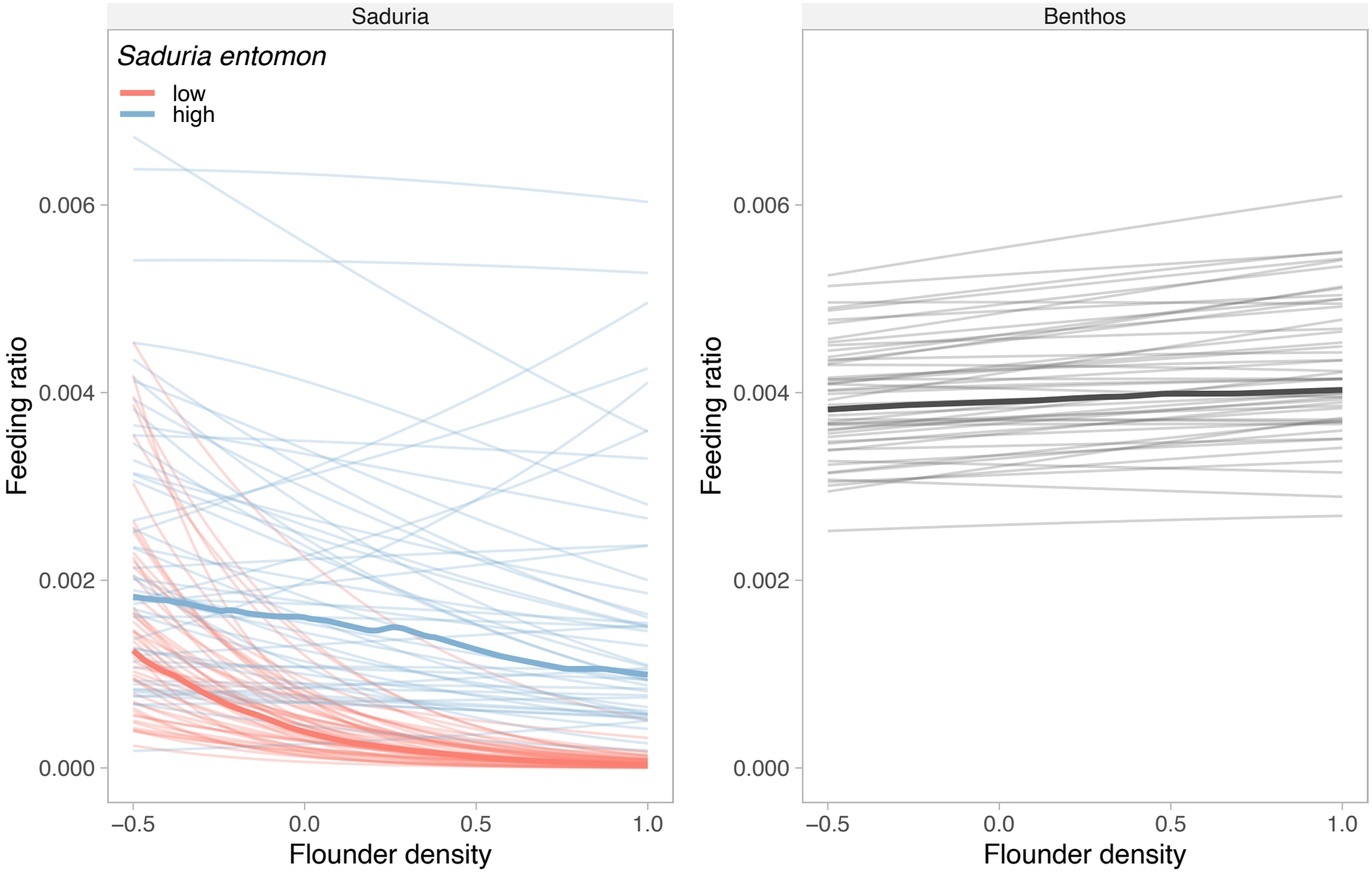

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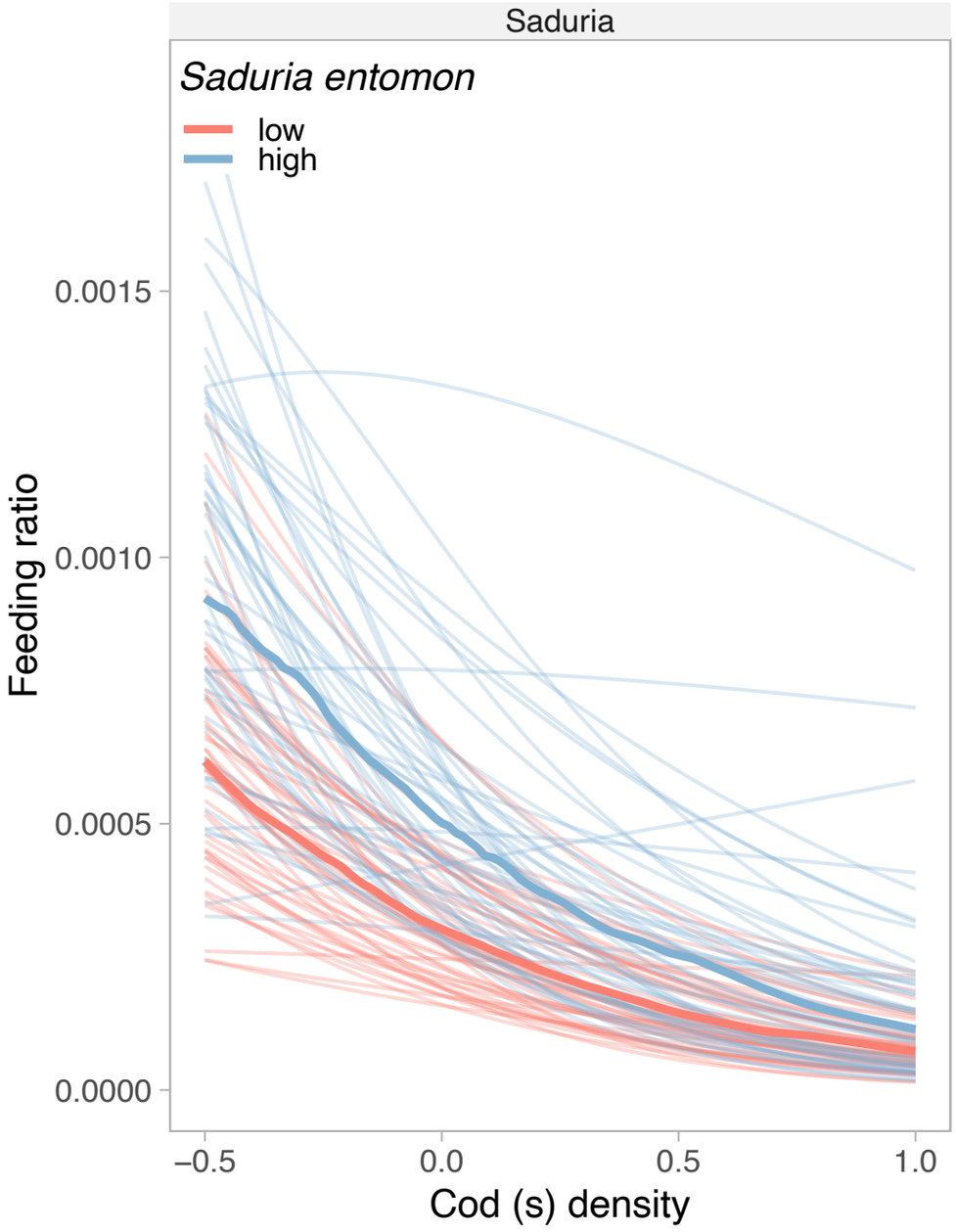

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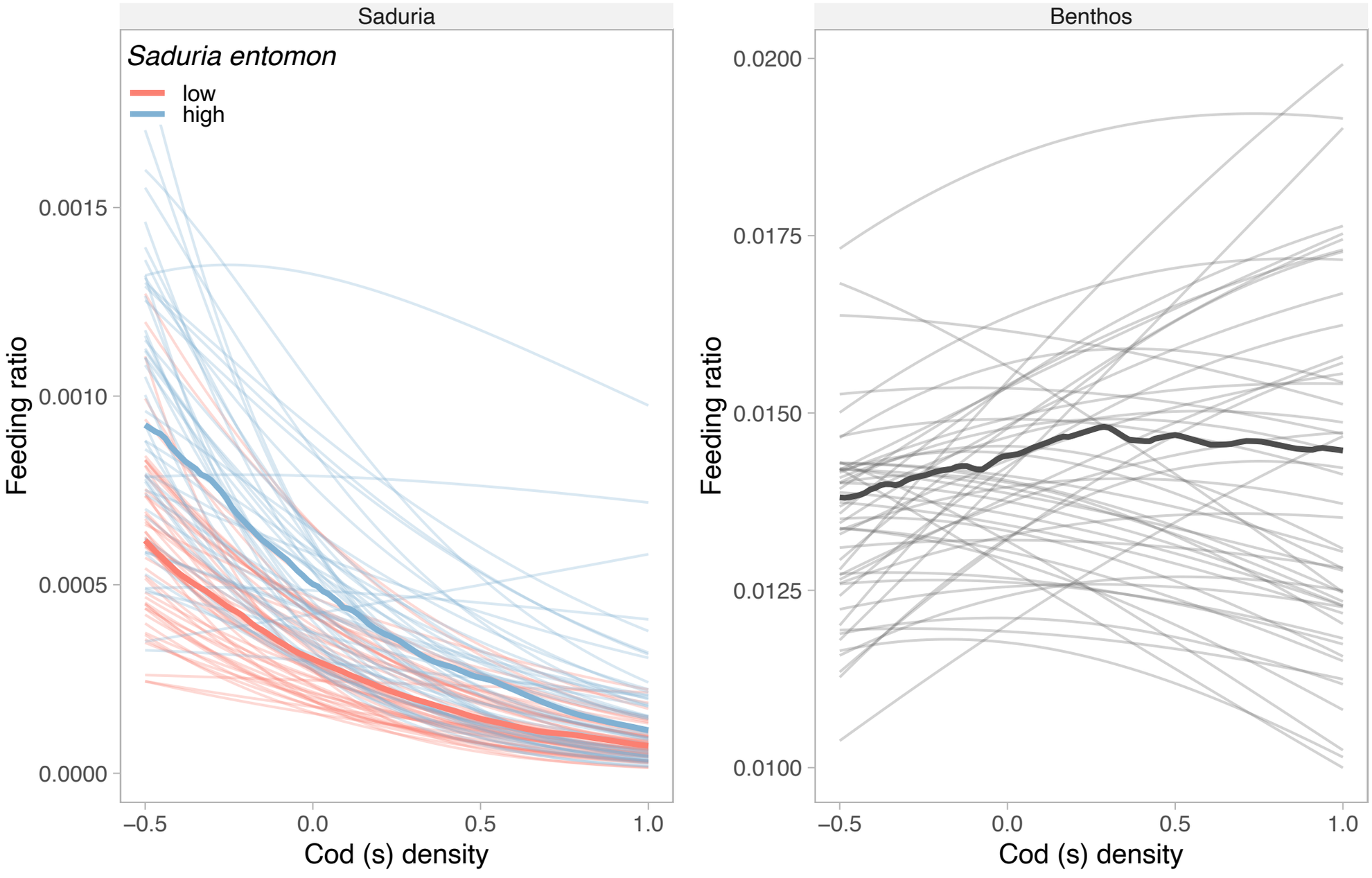

Conclusion

1. No general resource competition evident, but possibly for *Saduria entomon*

2. Low dietary overlap, high spatial overlap

Thank you for listening!

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Extra slides

Conditional effects of oxygen