Predator-prey size relationships of small pelagic fishes

Wesley Greentree, Alex Schmill, Eneko Bachiller, Richard Brodeur, Elizabeth Daly, Joshua Egan, Todd Miller, Justin Suca, Francis Juanes

Small Pelagic Fish Symposium
7 May 2026

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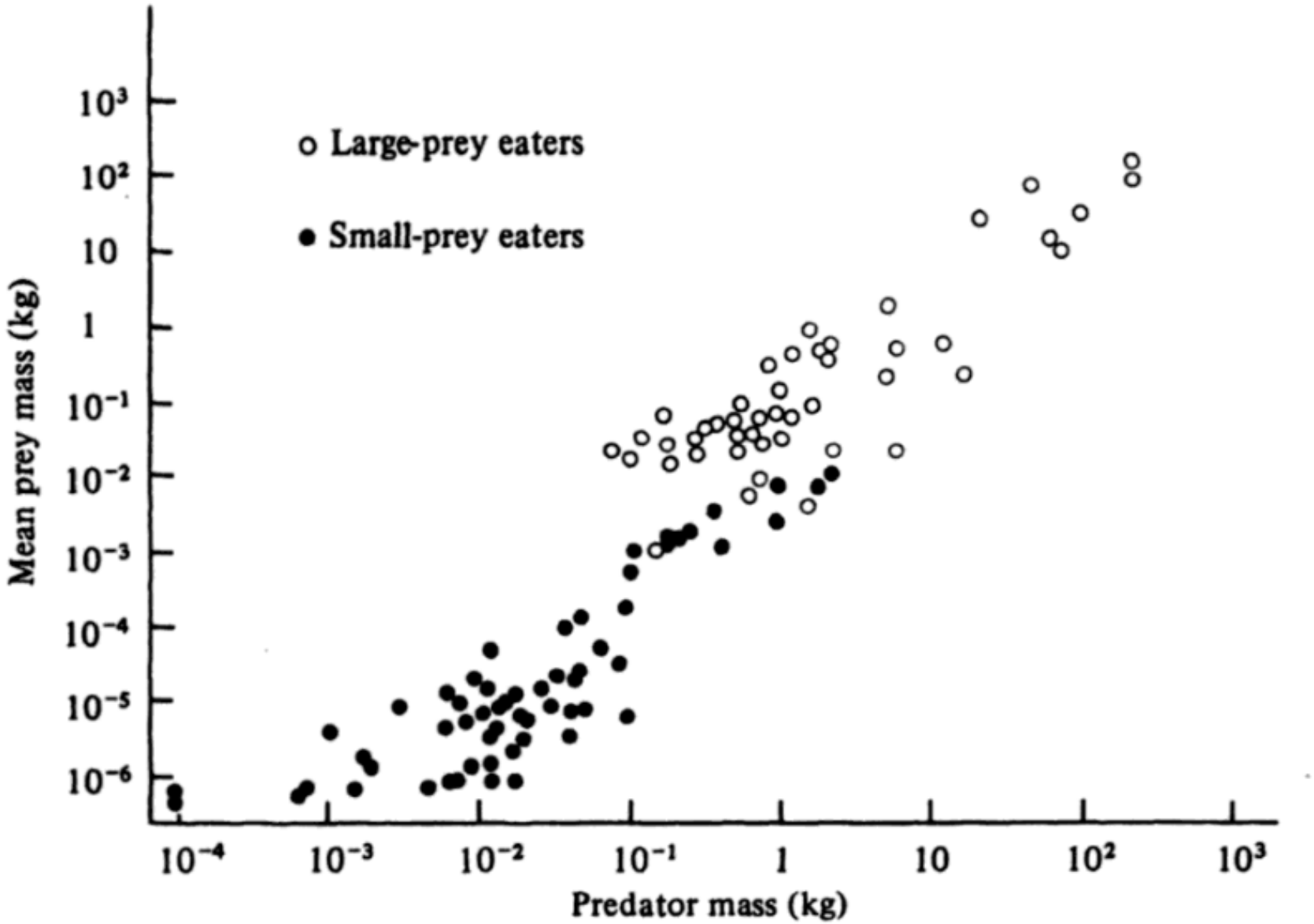
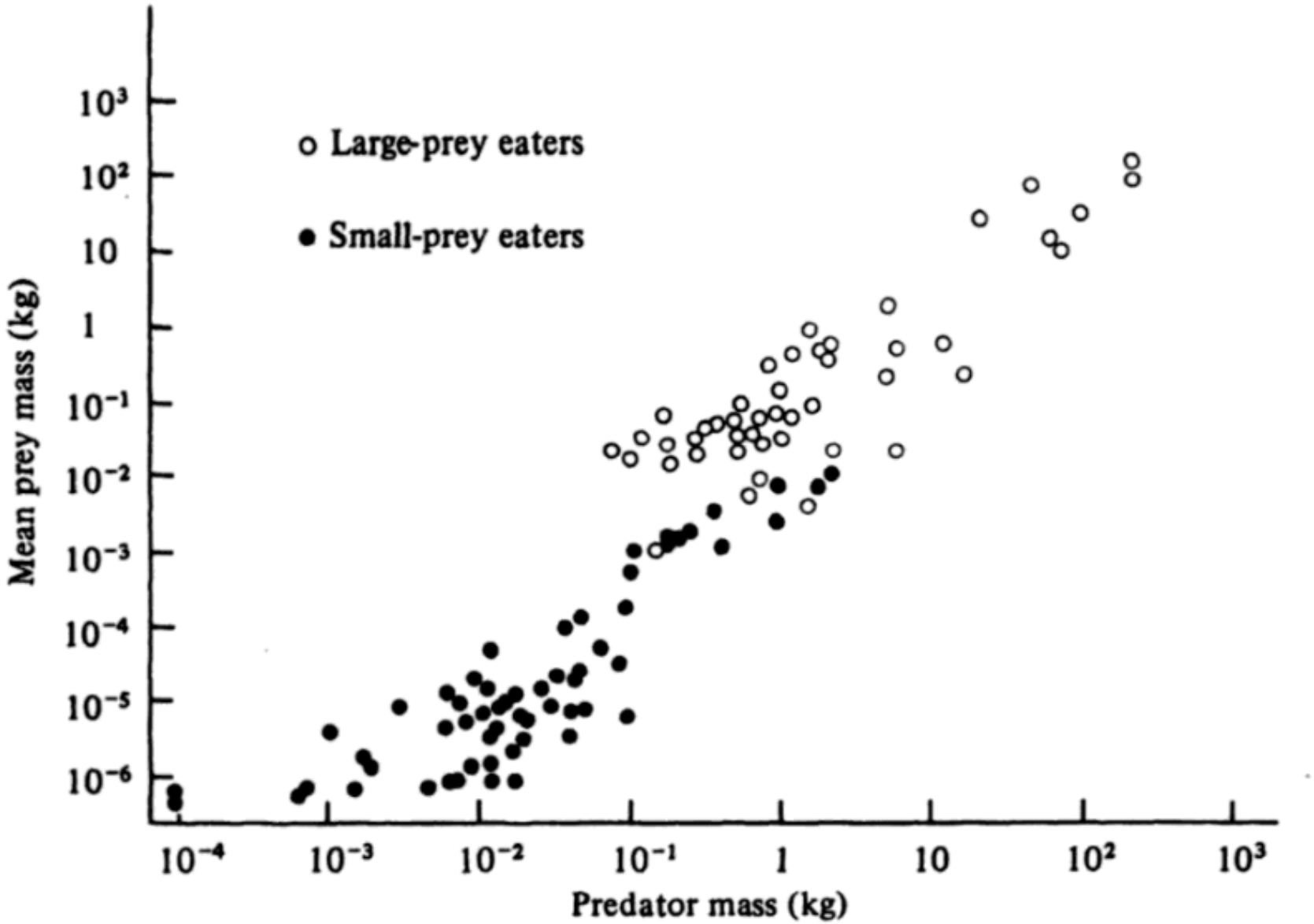
Larger organisms tend to eat larger prey



Peters 1986


Yi Liu

Larger organisms tend to eat larger prey



Peters 1986

Predator-prey size relationships

Some predators can eat prey that are similar size or larger

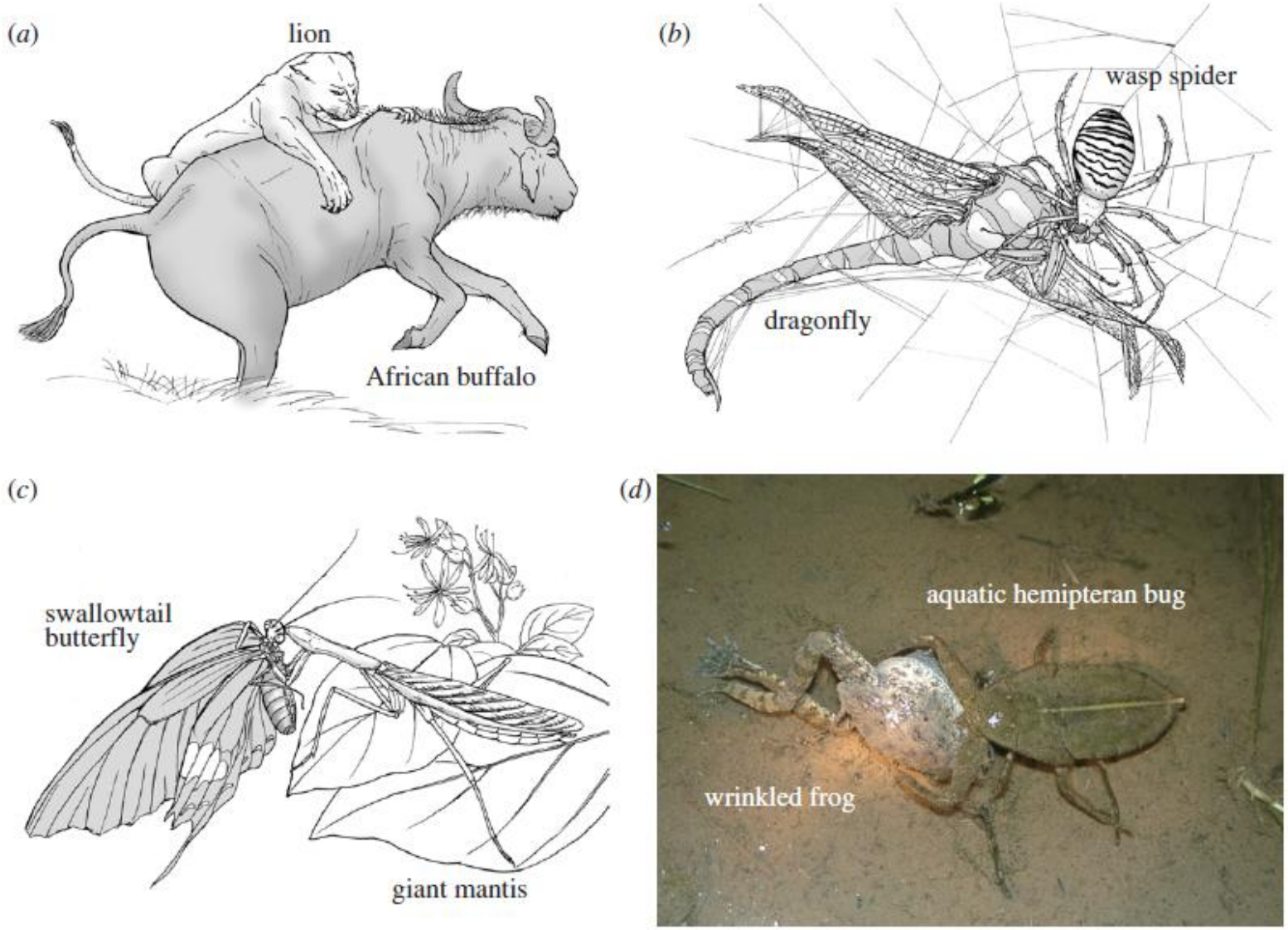
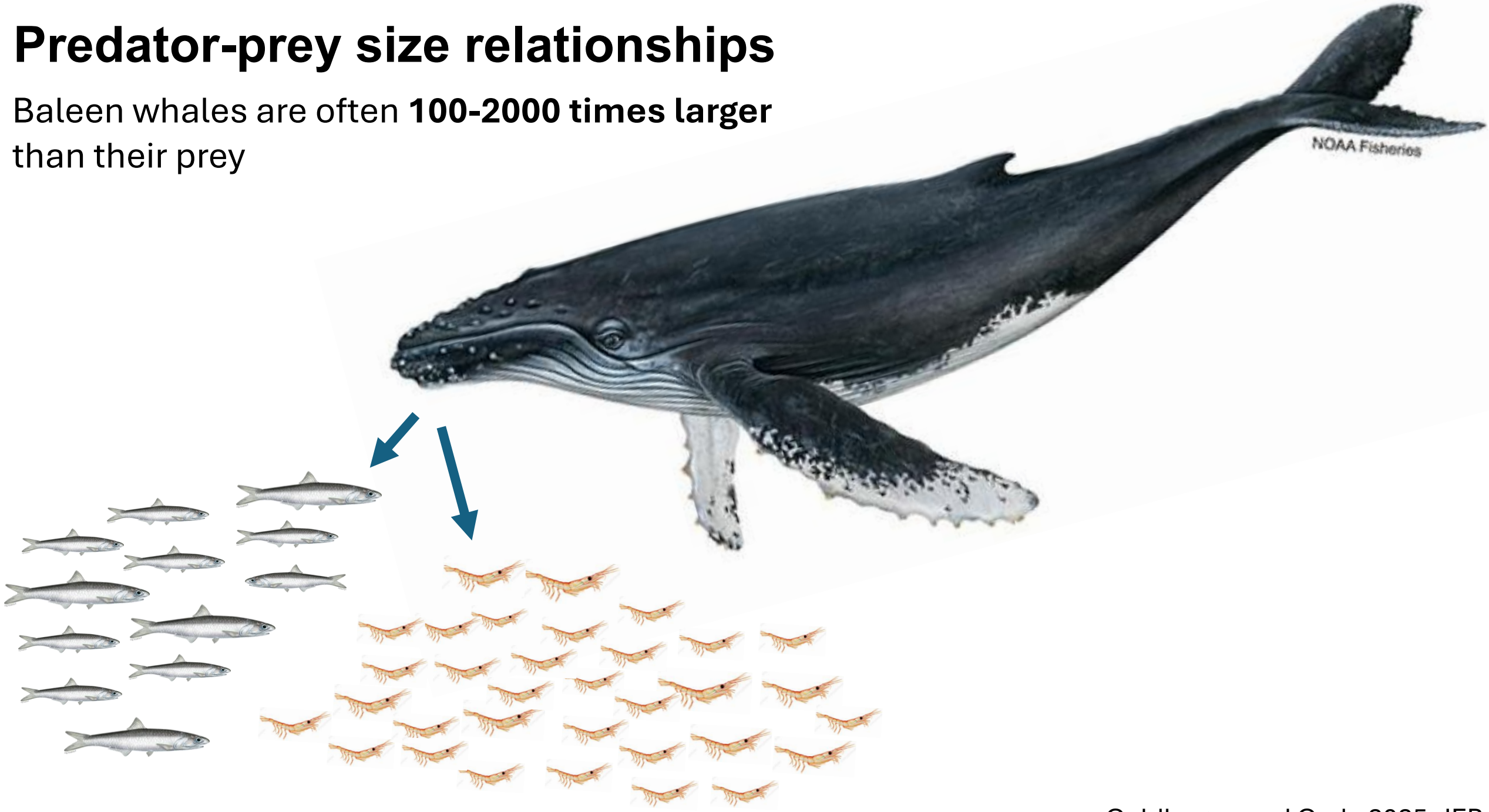


Figure 1. Examples of interactions in which predators attack relatively large prey. (Online version in colour.)

Nakazawa et al. 2013, Biol. Lett.

Predator-prey size relationships

Baleen whales are often **100-2000 times larger** than their prey



Goldbogen and Cade 2025, JEB


Jared Towers

What determines predator-prey size relationships?

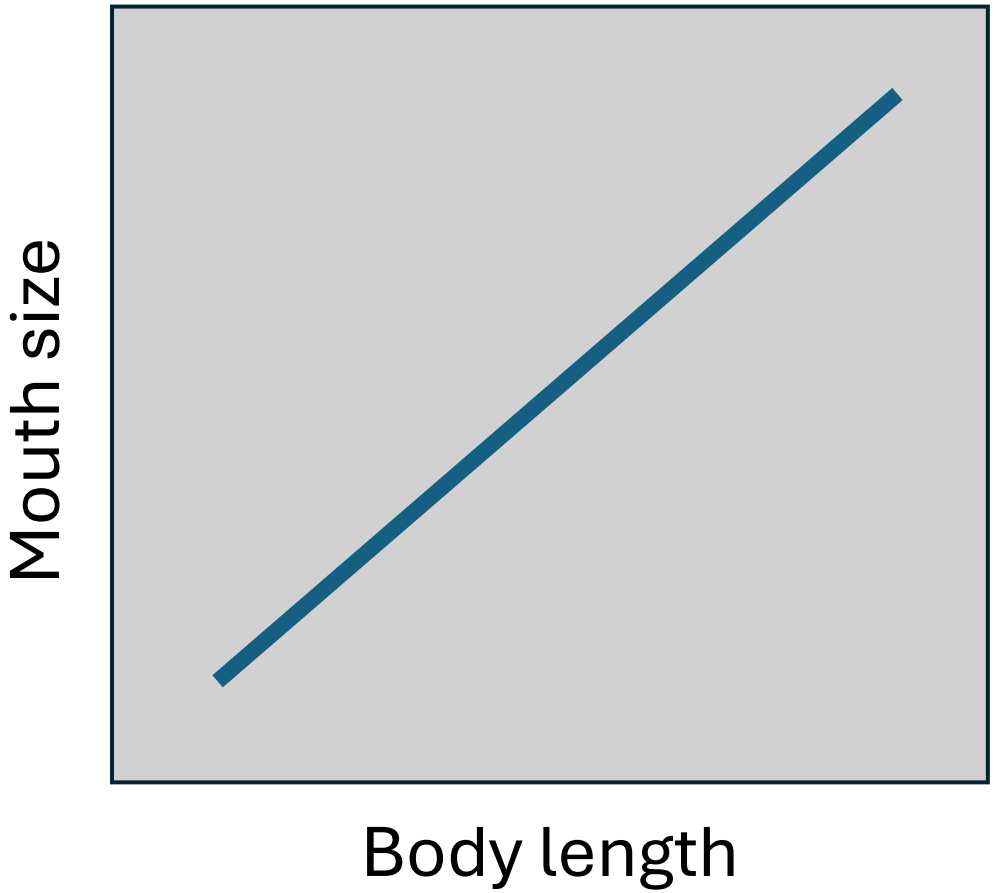
What determines predator-prey size relationships?

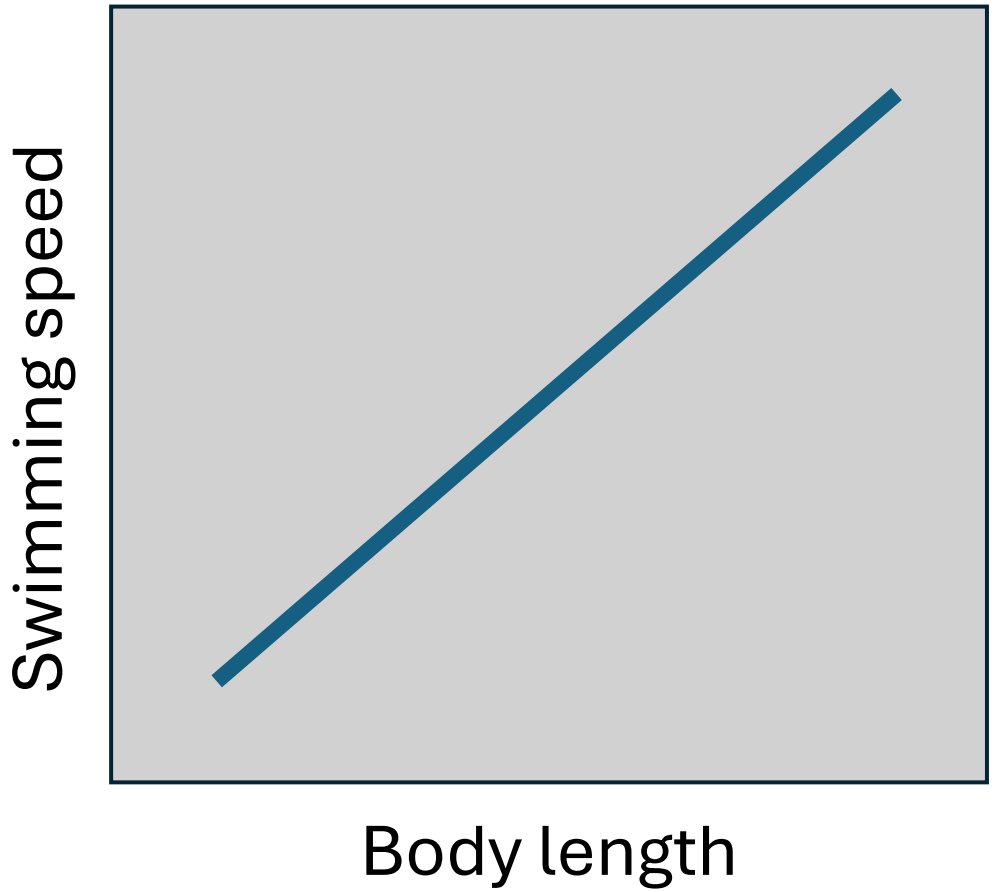
Mouth size
(most fish don’t chew their food)

What determines predator-prey size relationships?

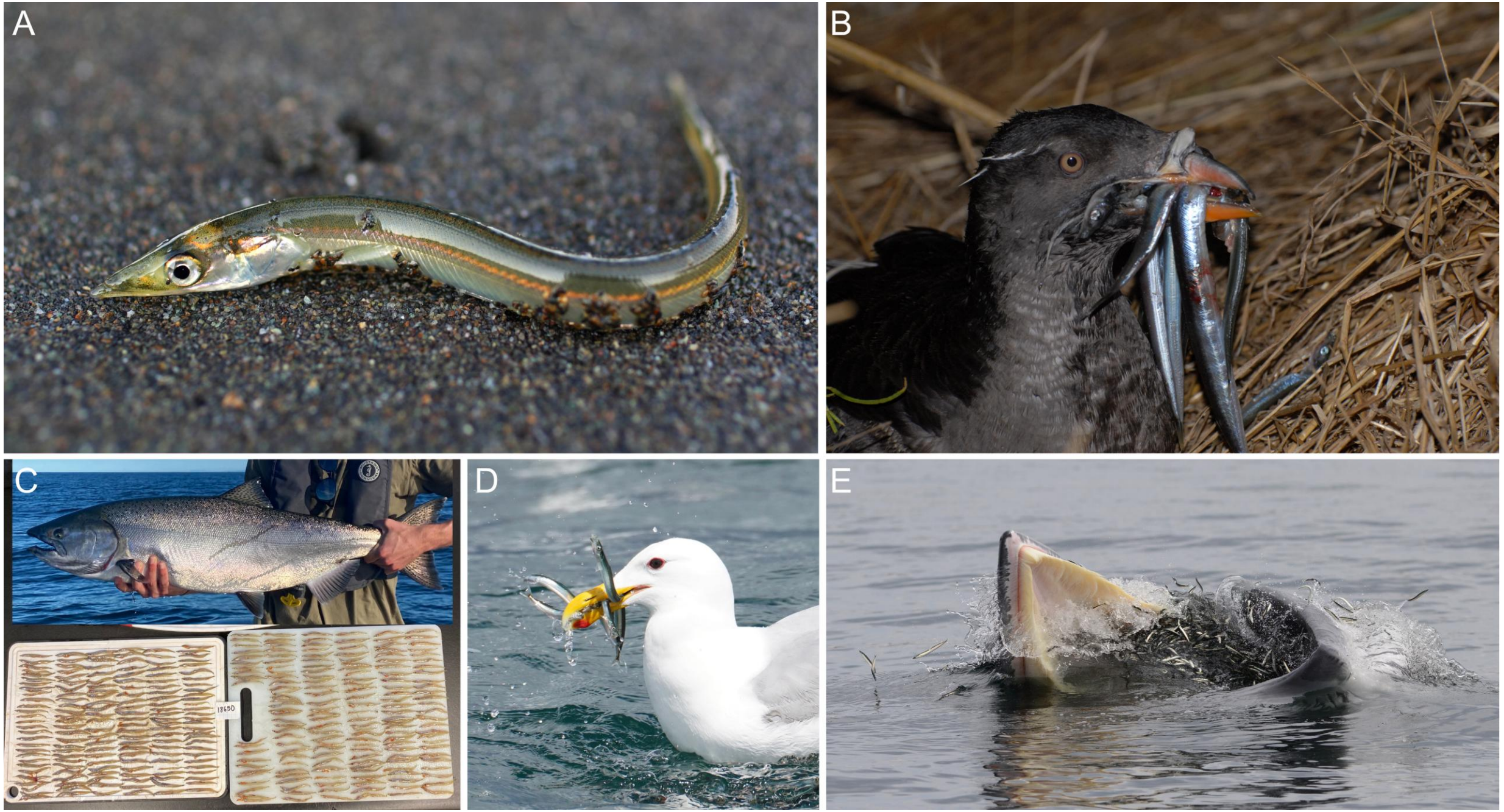
Swimming speed

What mediates predator-prey size relationships?



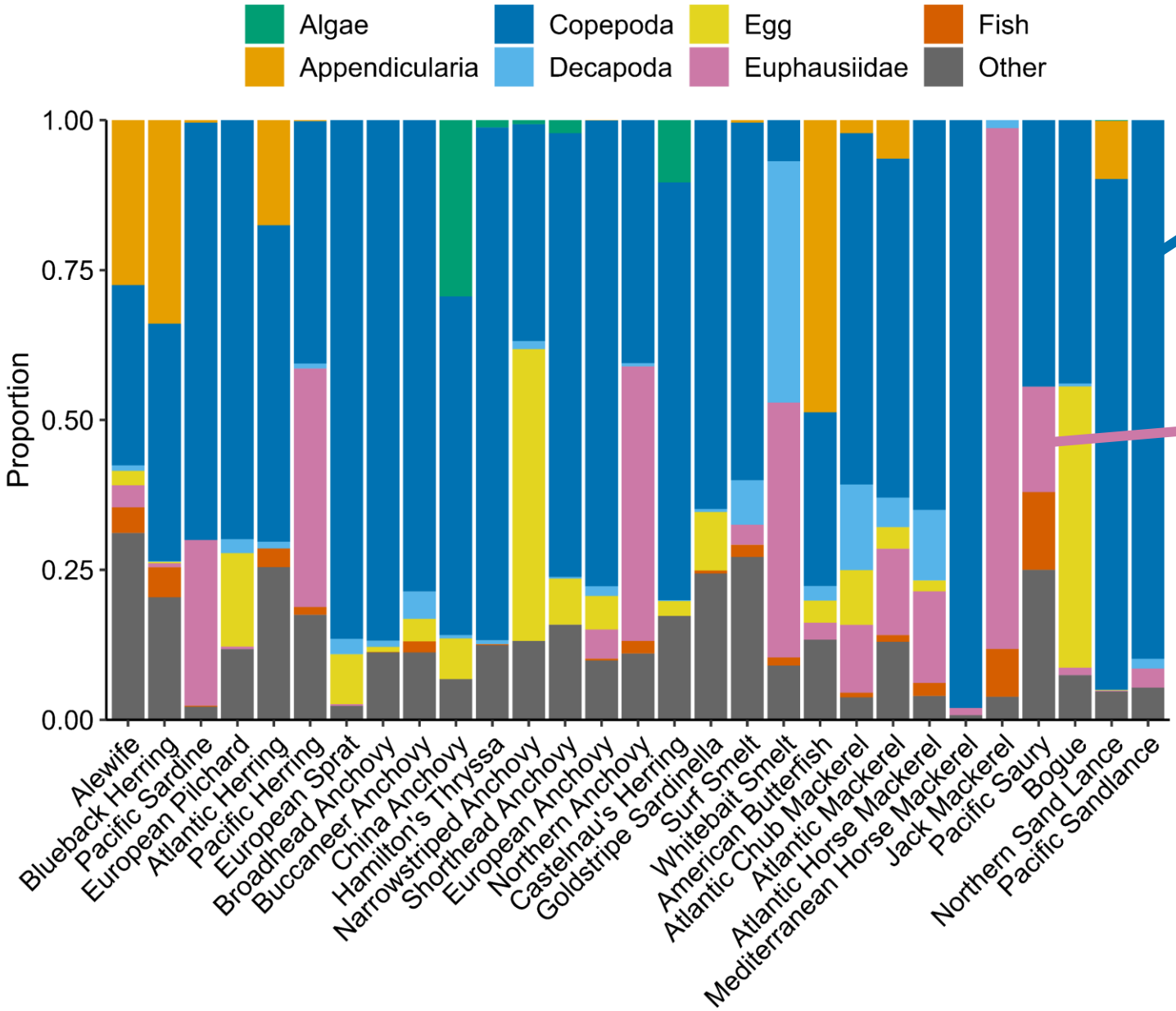


Pacific herring
Clupea pallasii

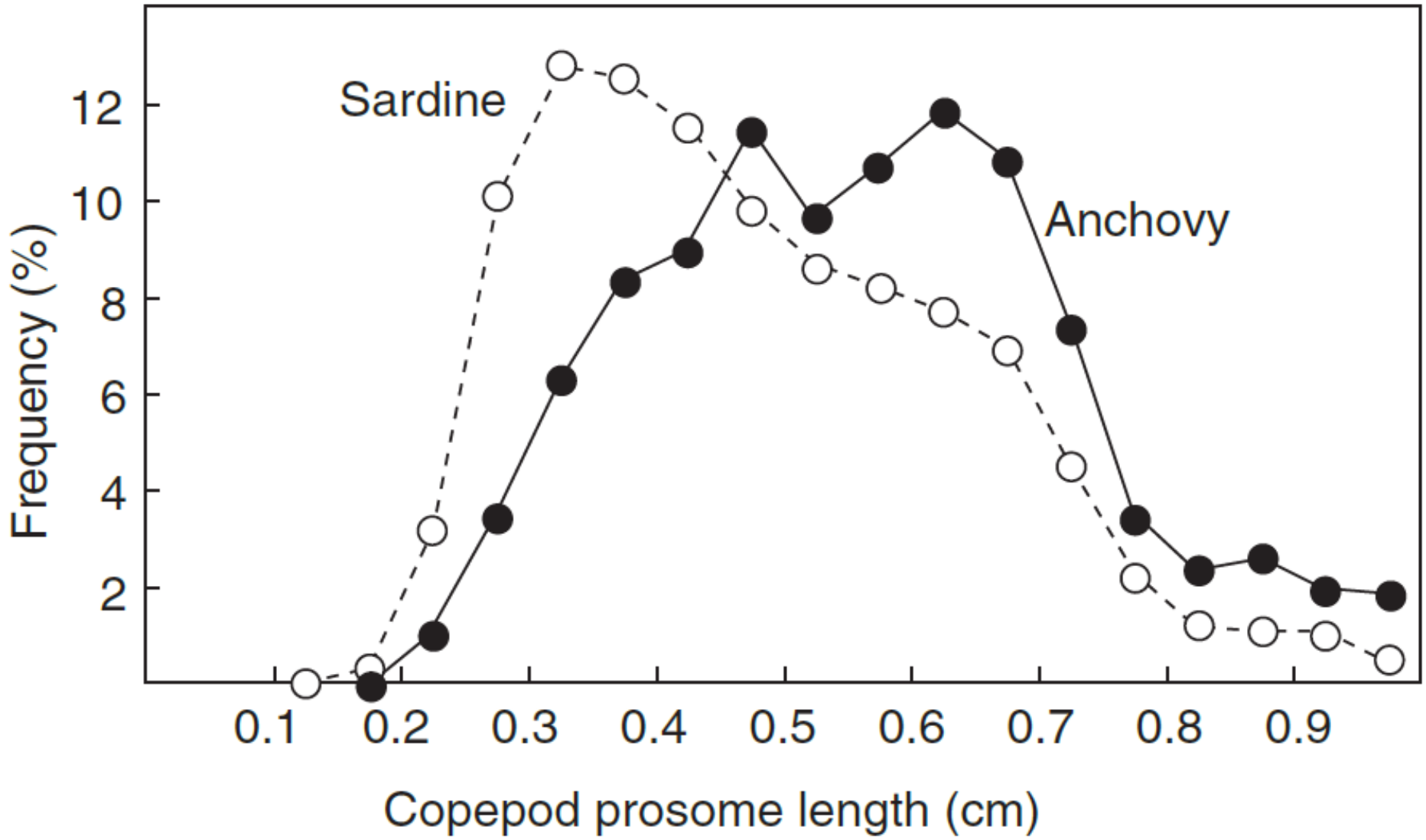


Carlson et al. in revision

Small pelagic fish eat zooplankton

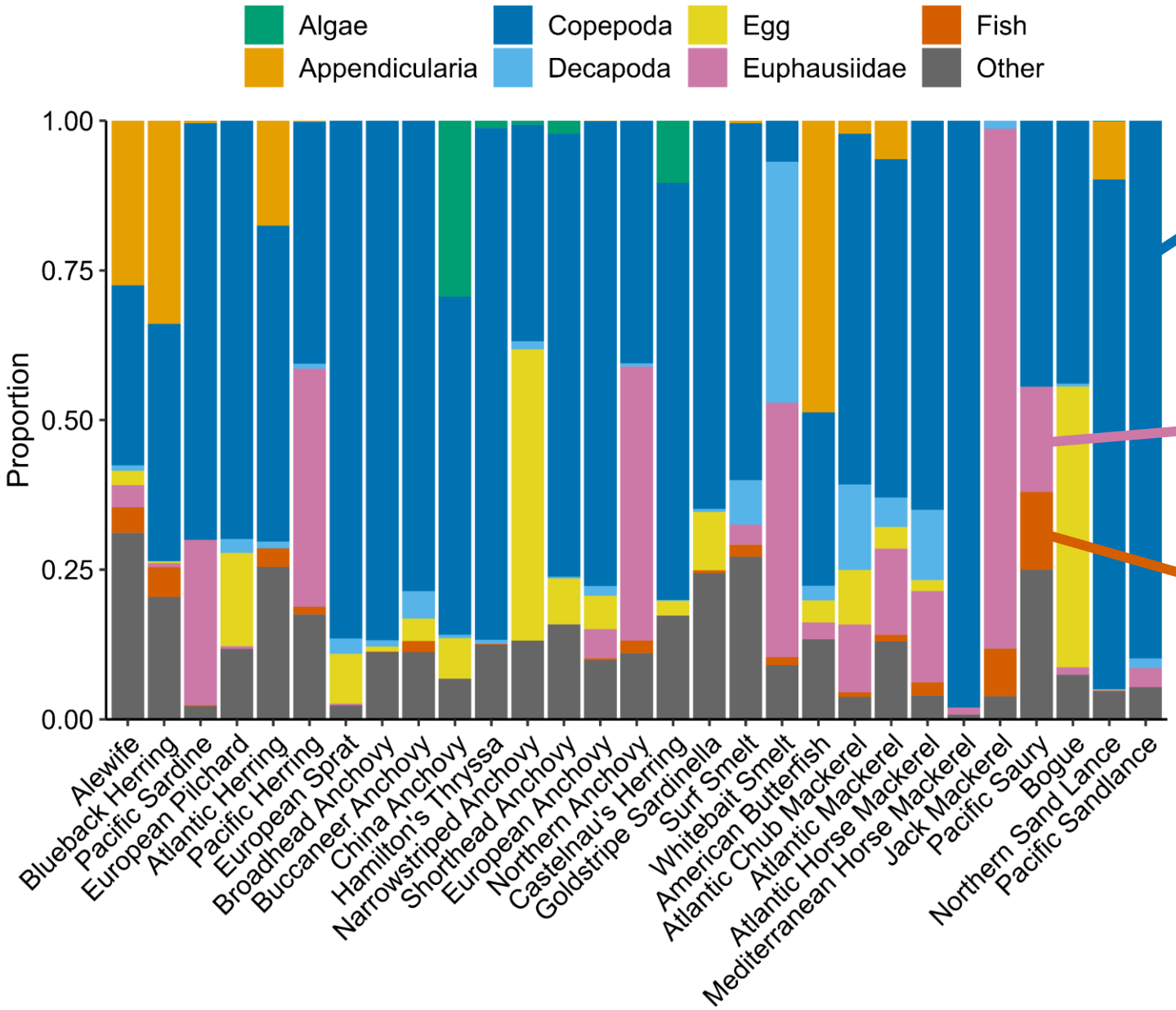


Trophic dissimilarity hypothesis



Reviewed in van der Lingen et al. 2009

Small pelagic fish eat zooplankton (mostly)

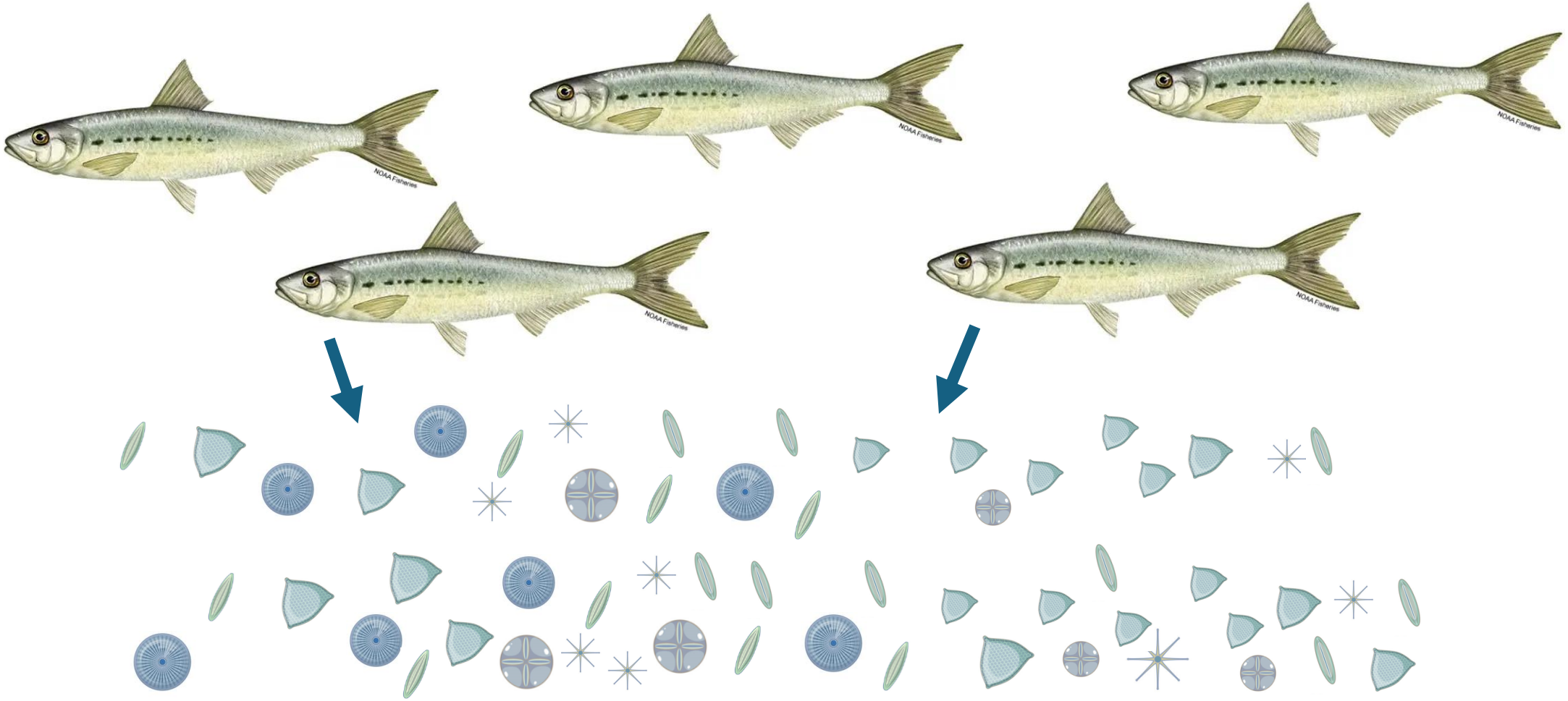


Ecology Letters, (2004) **7**: 1015–1023 doi: 10.1111/j.1461-0248.2004.00665.x

IDEAS AND PERSPECTIVES

Greenhouse gas buildup, sardines, submarine eruptions and the possibility of abrupt degradation of intense marine upwelling ecosystems

Andrew Bakun[1]* and Scarla J. Weeks[2]

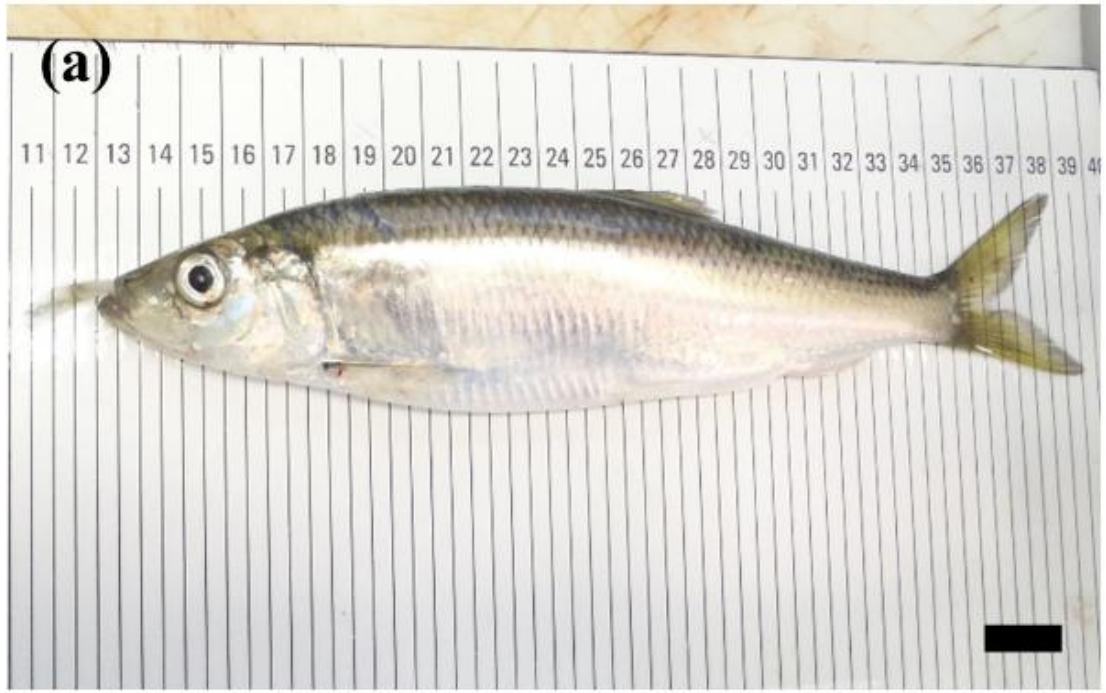


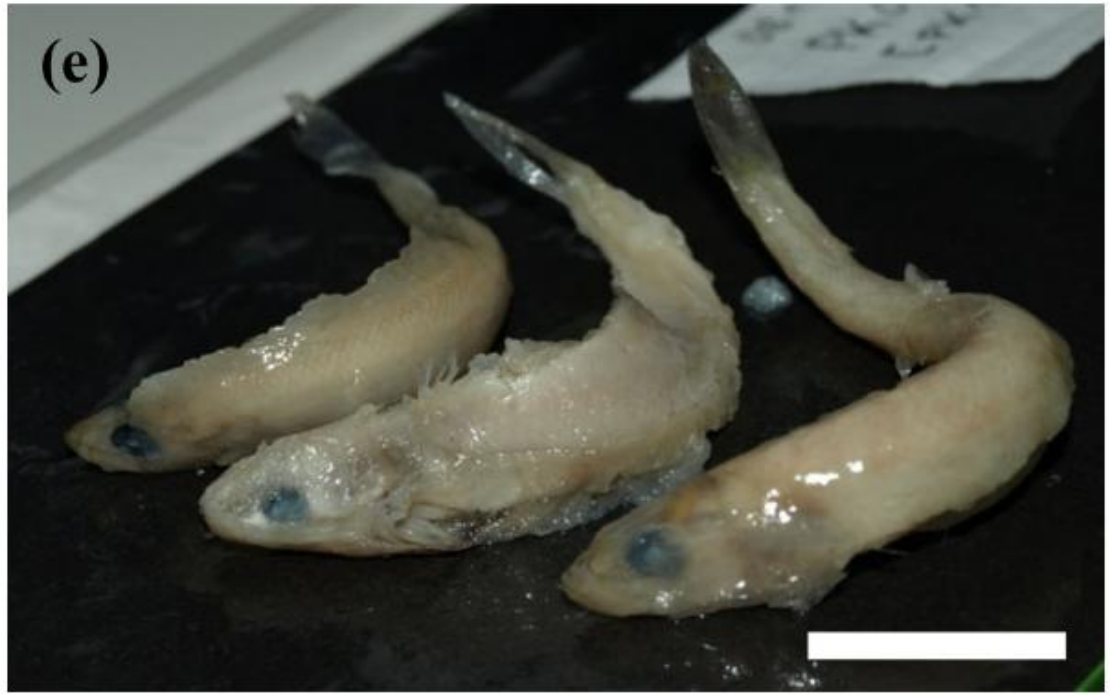
THE SCIENTIFIC NATURALIST

ECOLOGY
ECOLOGICAL SOCIETY OF AMERICA

A wolf in sheep's clothing: Planktivorous Atlantic herring preys on demersal fishes in coastal waters

Paul Kotterba[1] | **Dorothee Moll**[1] | **Helmut Winkler**[2] | **Annegret Finke**[1,3] | **Patrick Polte**[1]





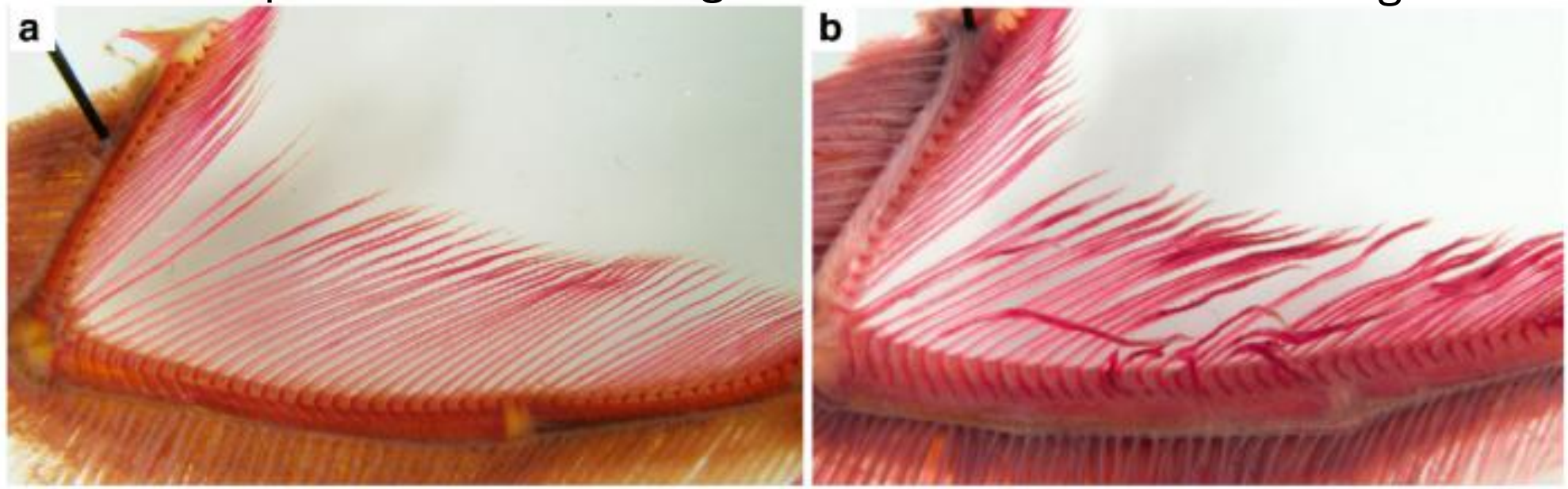
Evolution of fast-growing piscivorous herring in the young Baltic Sea

Received: 3 July 2024

Jake Goodall[1], Mats E. Pettersson[1], Ulf Bergström[2], Arianna Cocco[1],

Zooplanktivorous herring

Piscivorous herring



Goodall et al. 2024 Nat. Commun.

Mar Biol (2011) 158:1683–1690

The role of intraguild predation in the population dynamics of small pelagic fish

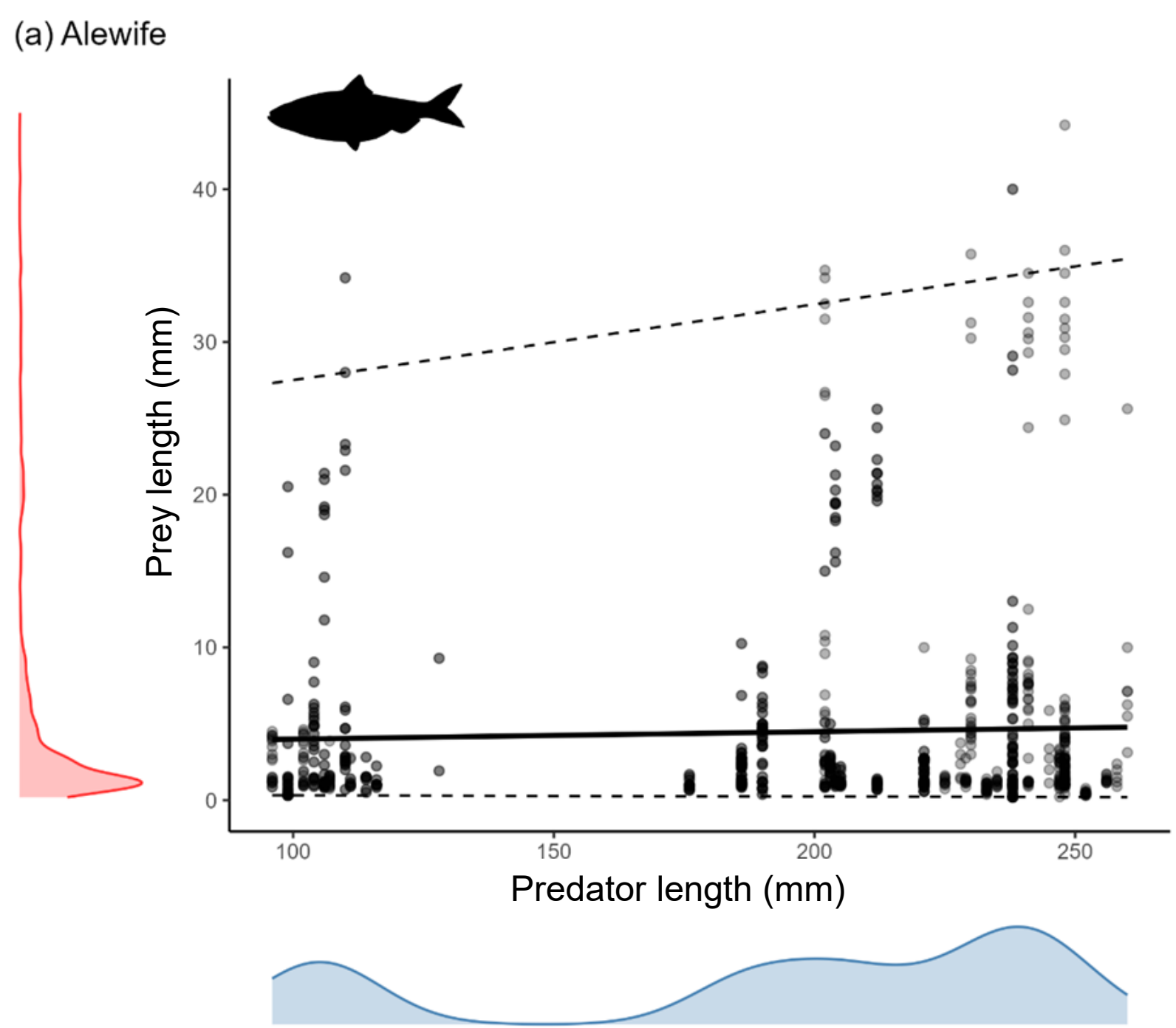
Xabier Irigoien · André de Roos

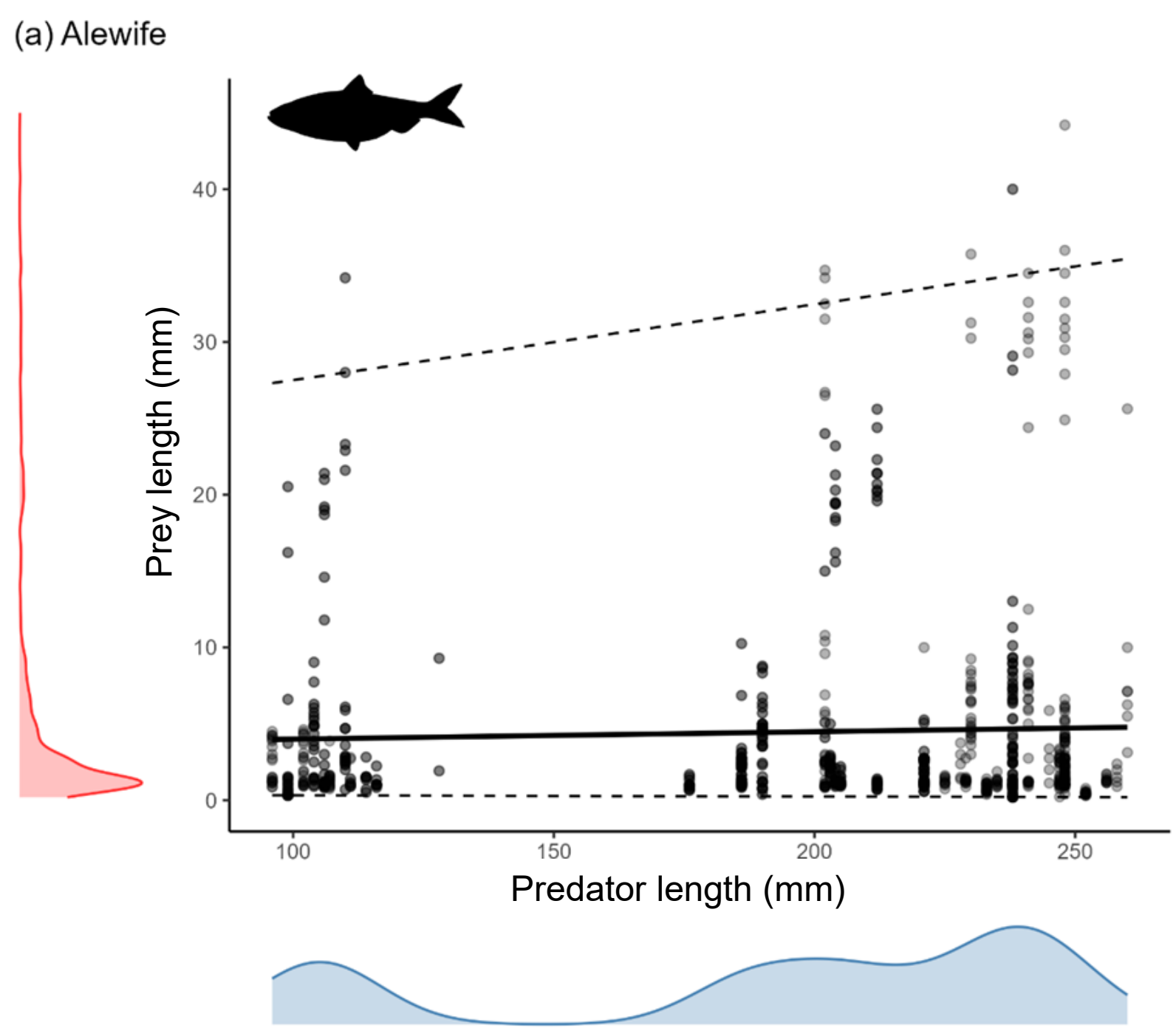
Cannibalism: small pelagic fish eating their own eggs and larvae

Intraguild predation: small pelagic fish consuming other small pelagic fish species (e.g., anchovy eating sardine eggs)

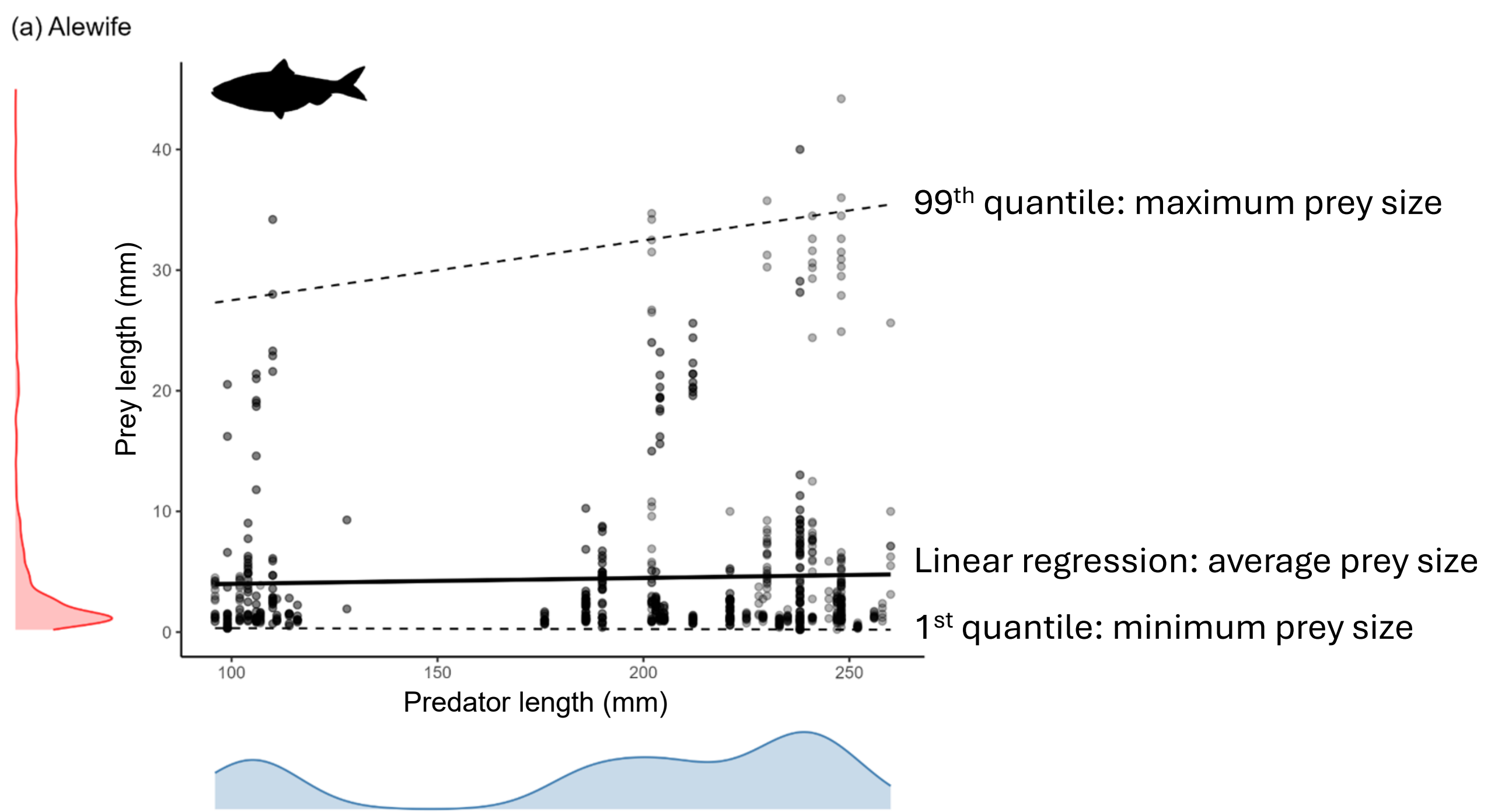
Intraguild predation hypothesized to regulate asynchronous dynamics of sardine and anchovy


Monterey Bay Aquarium


(a) Alewife
Prey length (mm)
0
10
20
30
40
100
150
200
250
Predator length (mm)



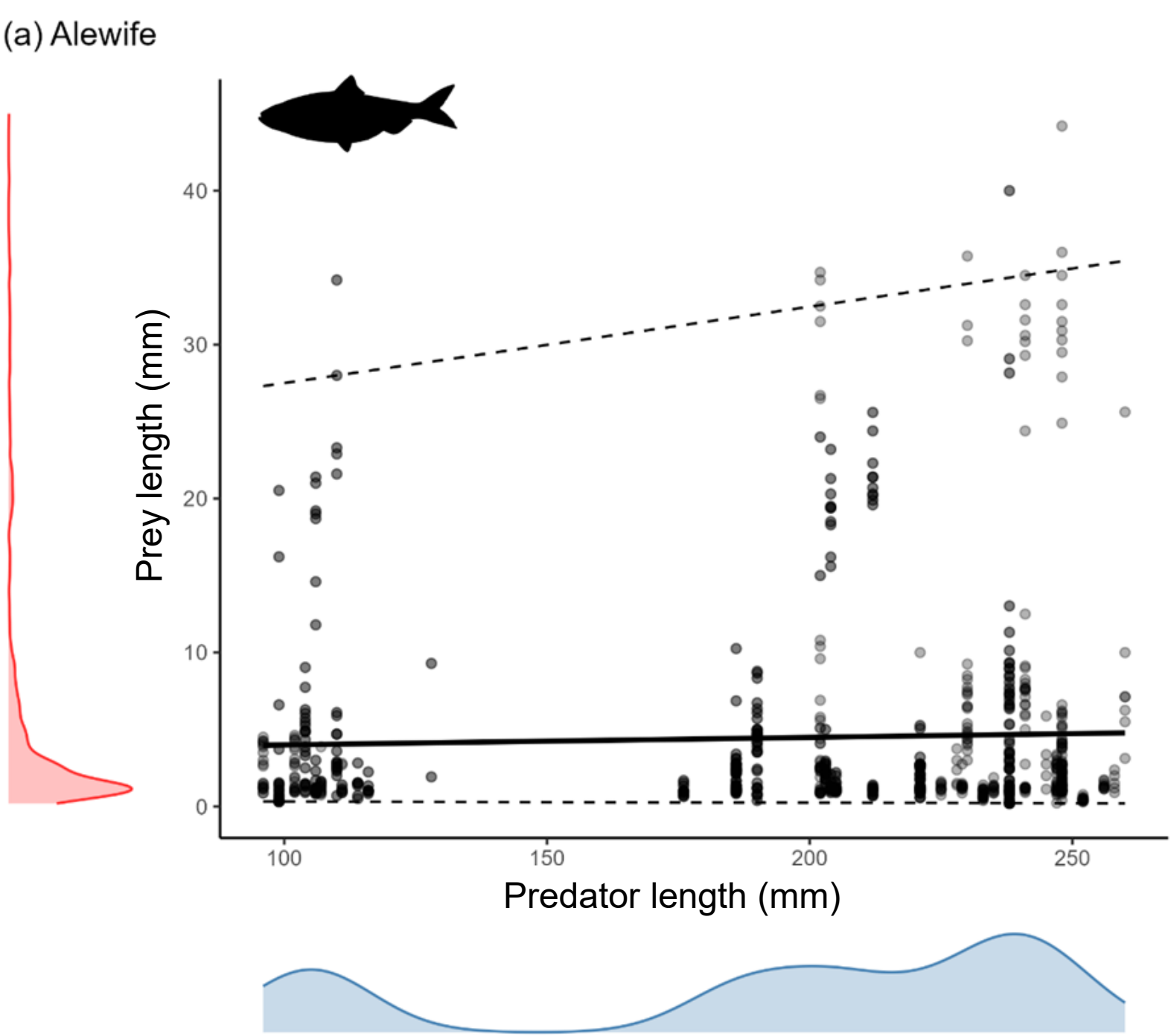
Quantile regression



99th quantile: maximum prey size

Linear regression: average prey size

1st quantile: minimum prey size



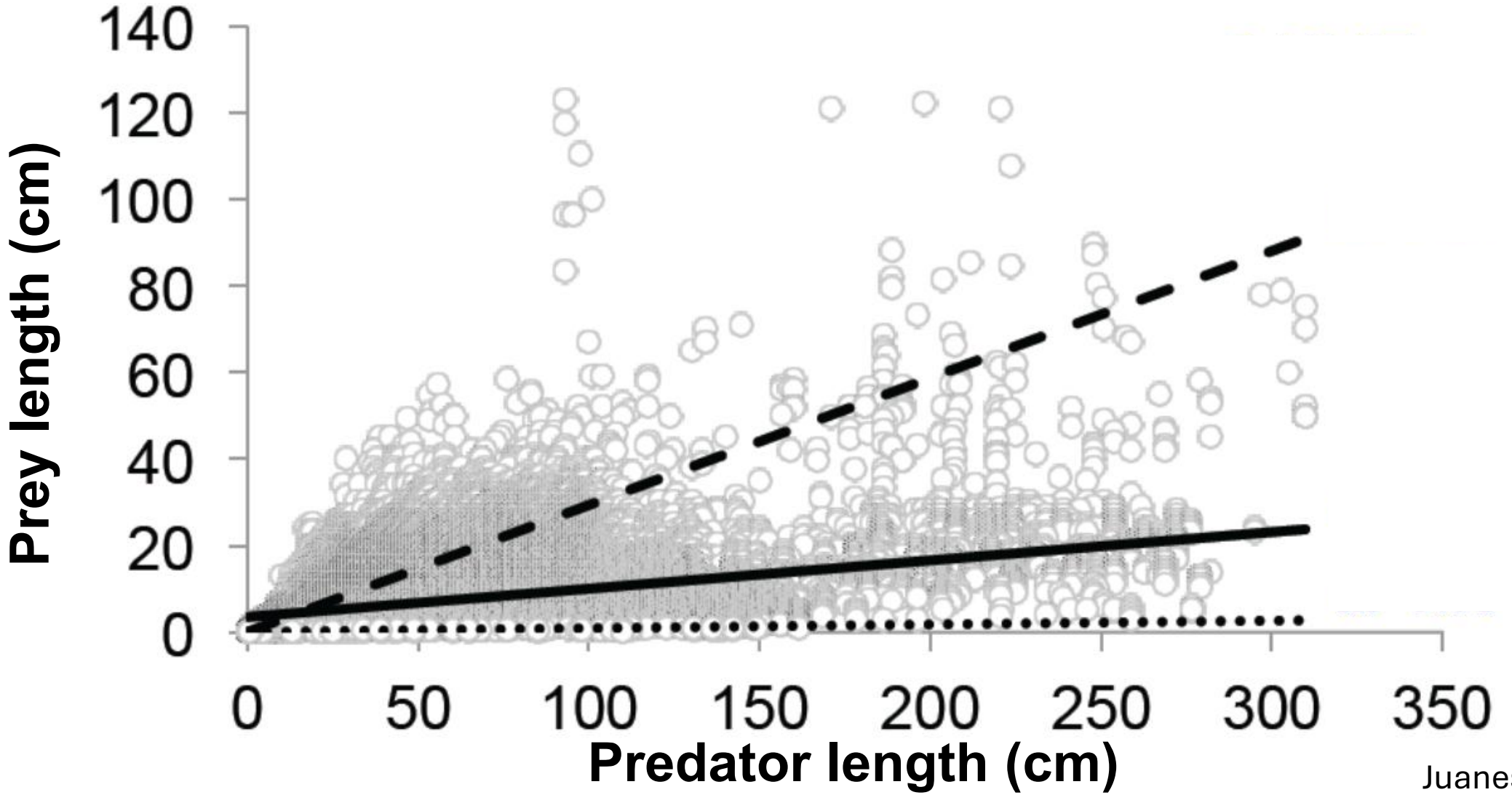
Interpretation:

Asymmetric wedge-shaped relationship

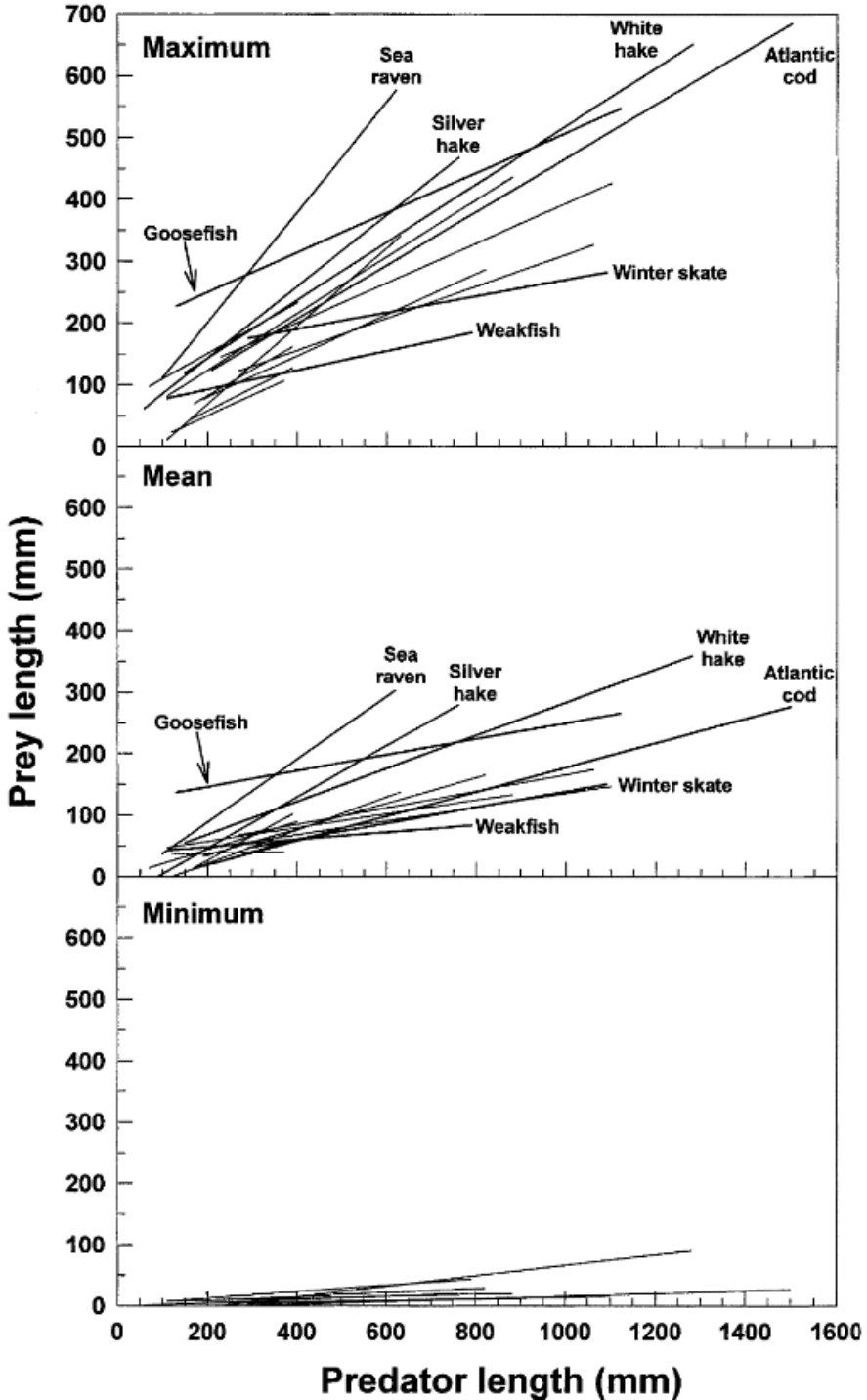
Maximum prey size increases faster

Generalized predator-prey size relationships

Predator-prey size relationship across 61 marine fish and 1 squid species



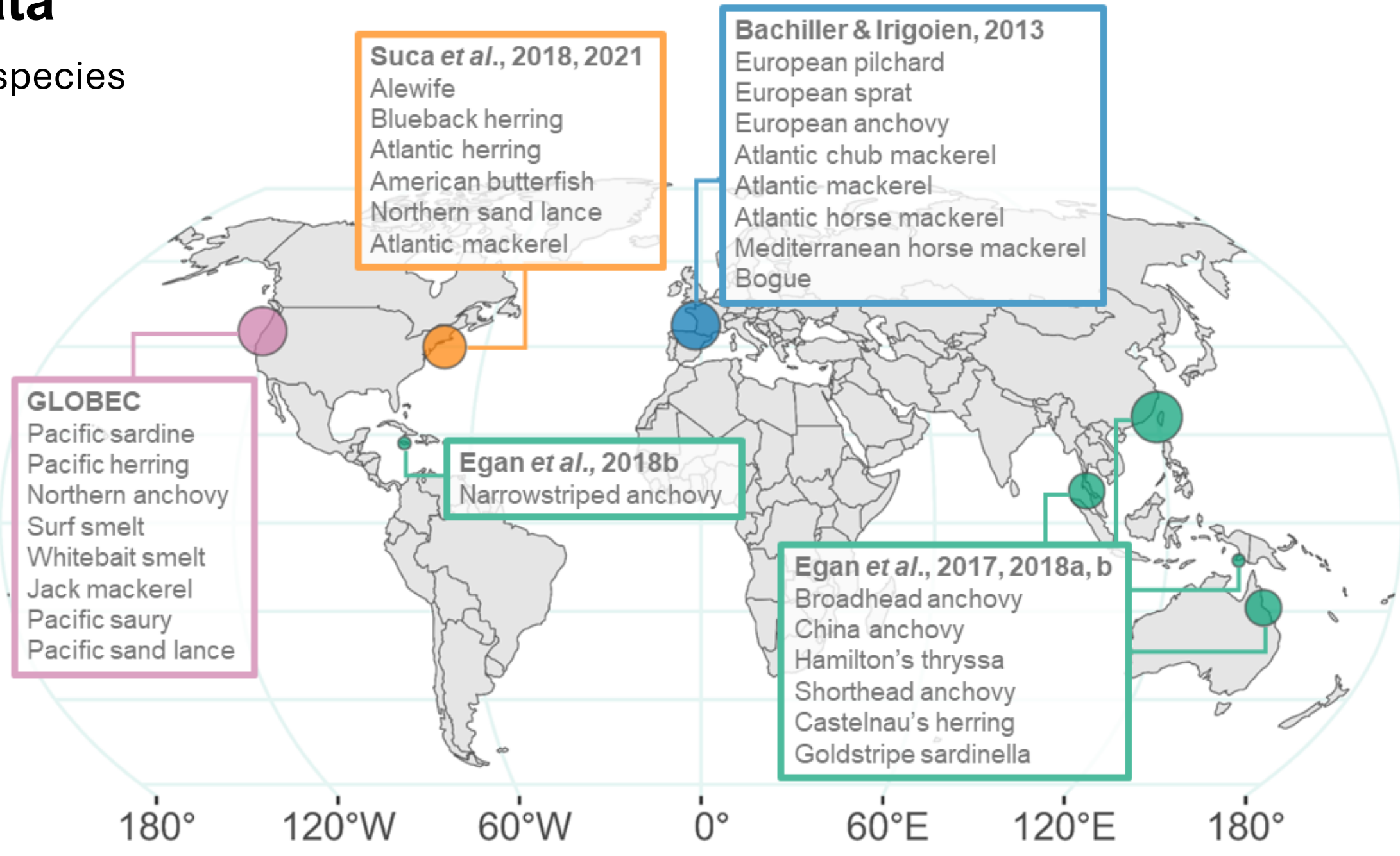
Juanes 2016, CJFAS



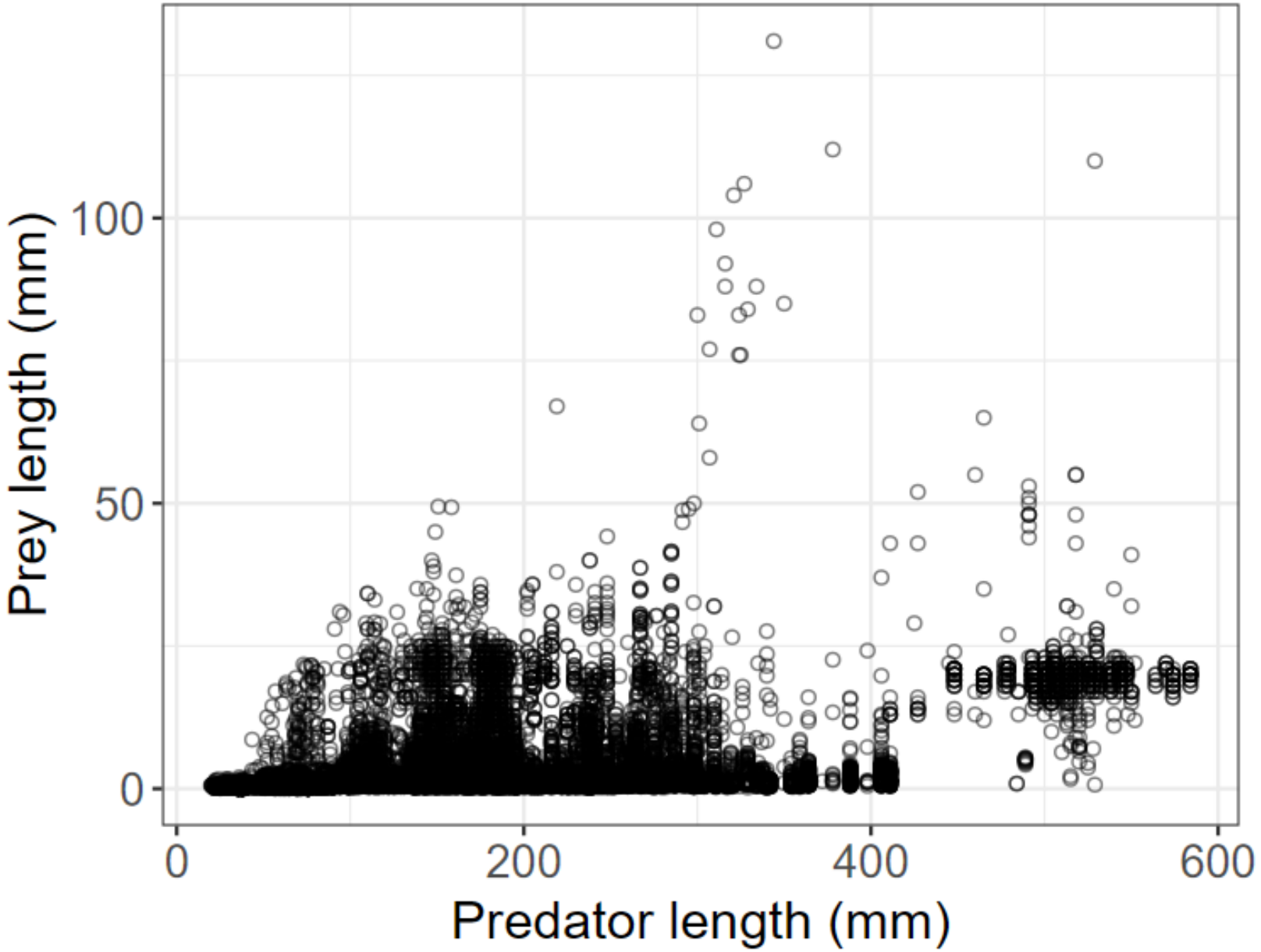
Scharf et al. 2000, MEPS

Data

29 species



Predator-prey size data

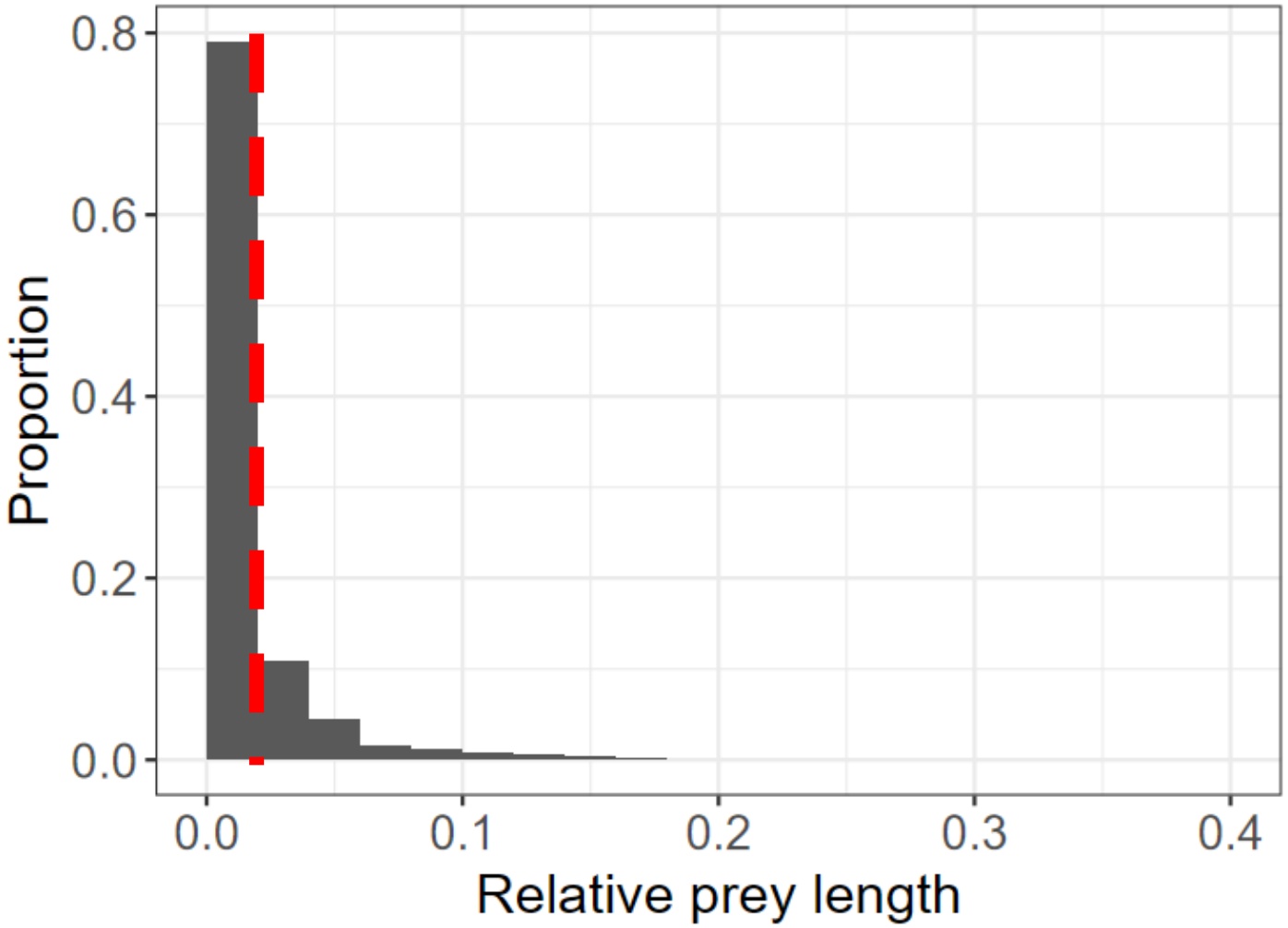


Larger prey consumed at increasing predator size

Continue to feed on very small prey

However:
Small pelagic fish eat smaller prey relative to their body than larger fish

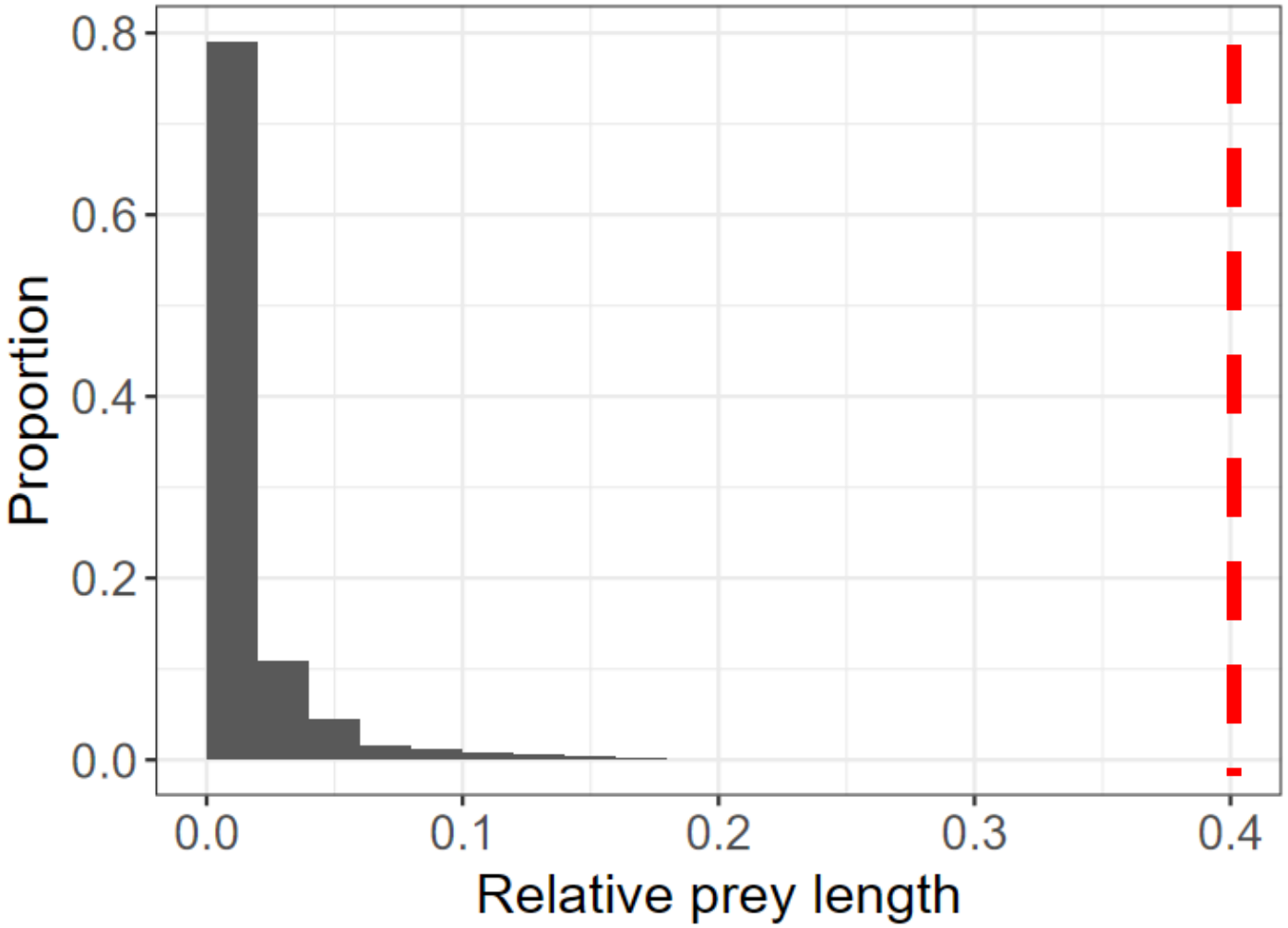
Predator-prey size data



Small pelagic fish:
79% of prey are less than 2% predator length

Maximum relative prey length: 38%

Predator-prey size data



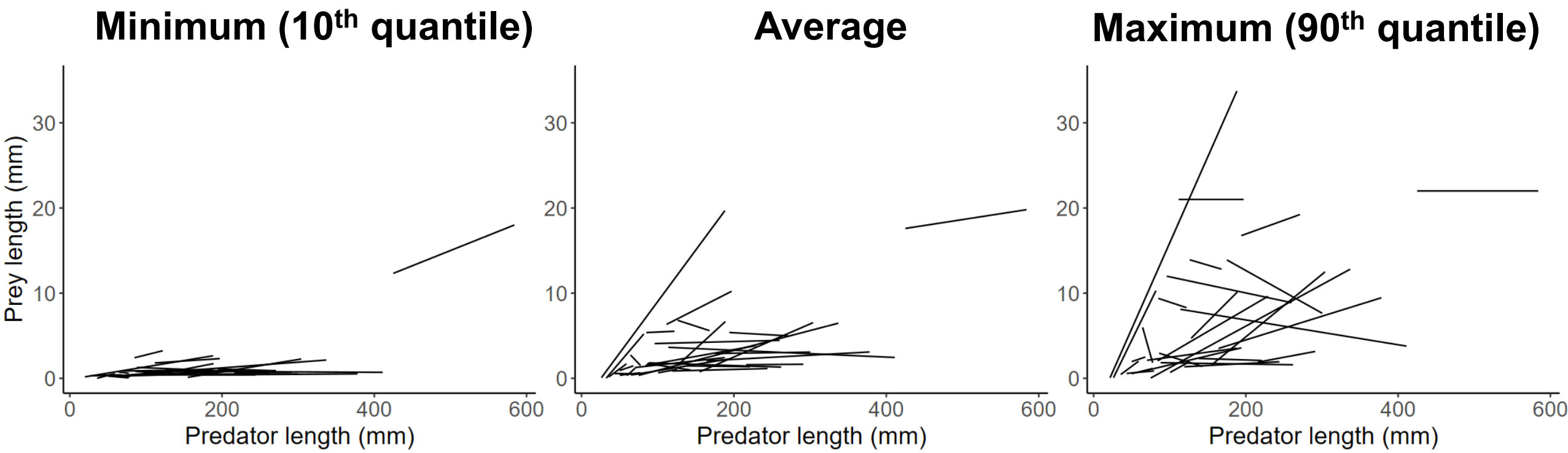
Small pelagic fish:
79% of prey are less than 2% predator length

Maximum relative prey length: 38%

Silver hake:
28% of prey are longer than 40% of predator body

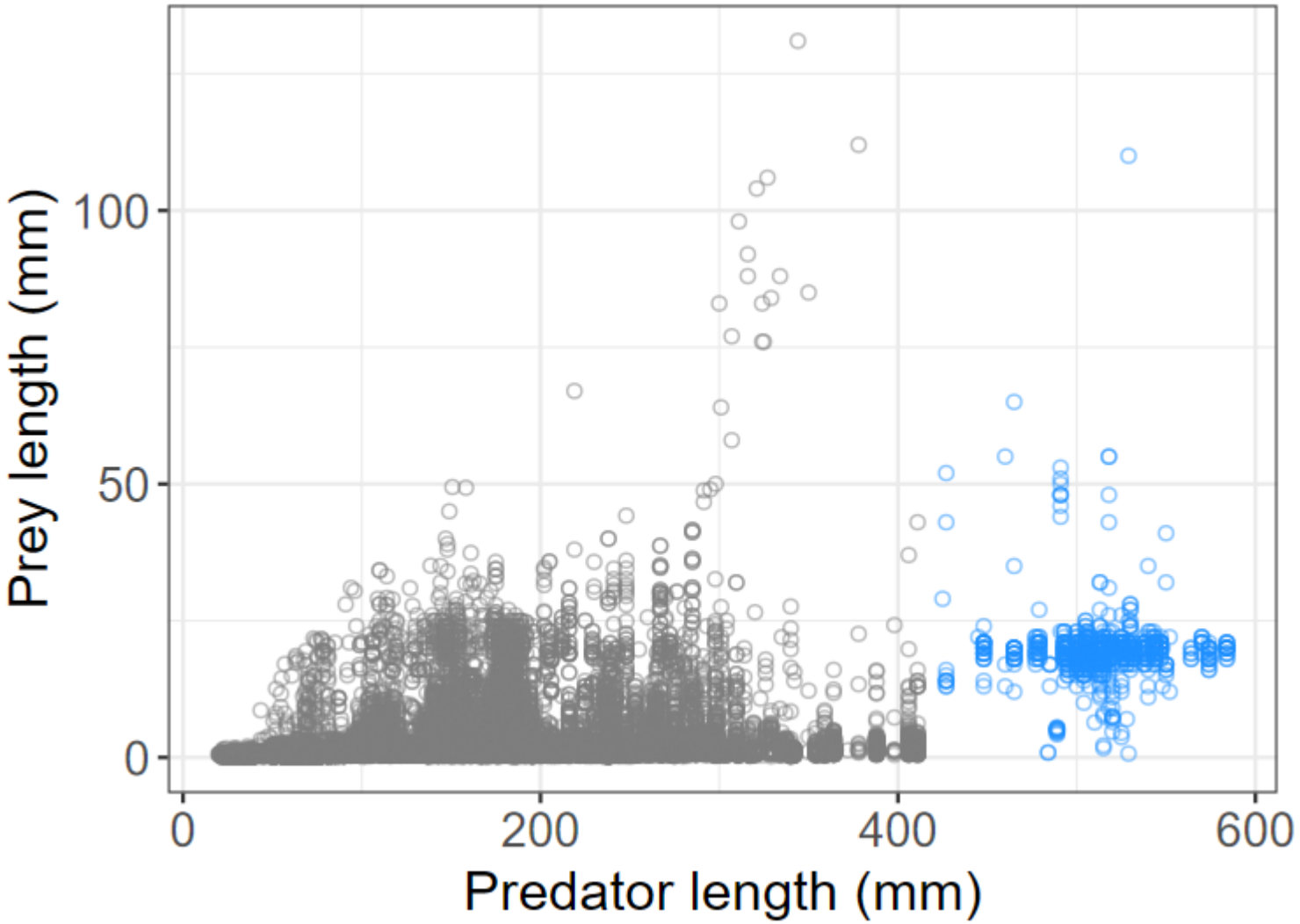
Scharf et al. 2000 MEPS

Relationships vary among SPF species



Does predator morphology drive different relationships?

Large jack mackerel remain zooplanktivorous

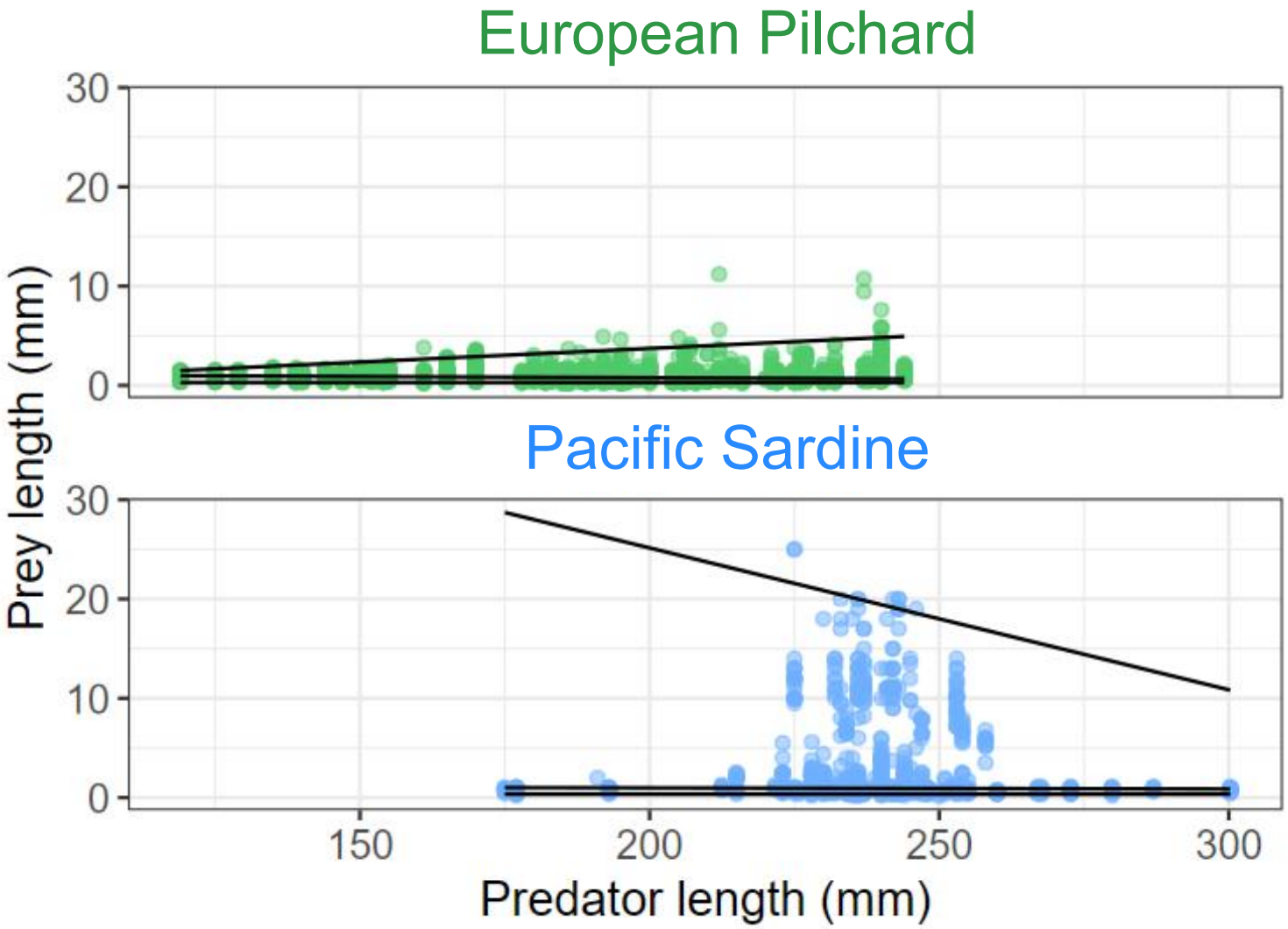


40-60 cm **jack mackerel** feed on krill, do not transition to eating fish

Morphological constraint on prey capture or ingestion?

Does predator morphology drive different relationships?

Different prey sizes of similar sardine species

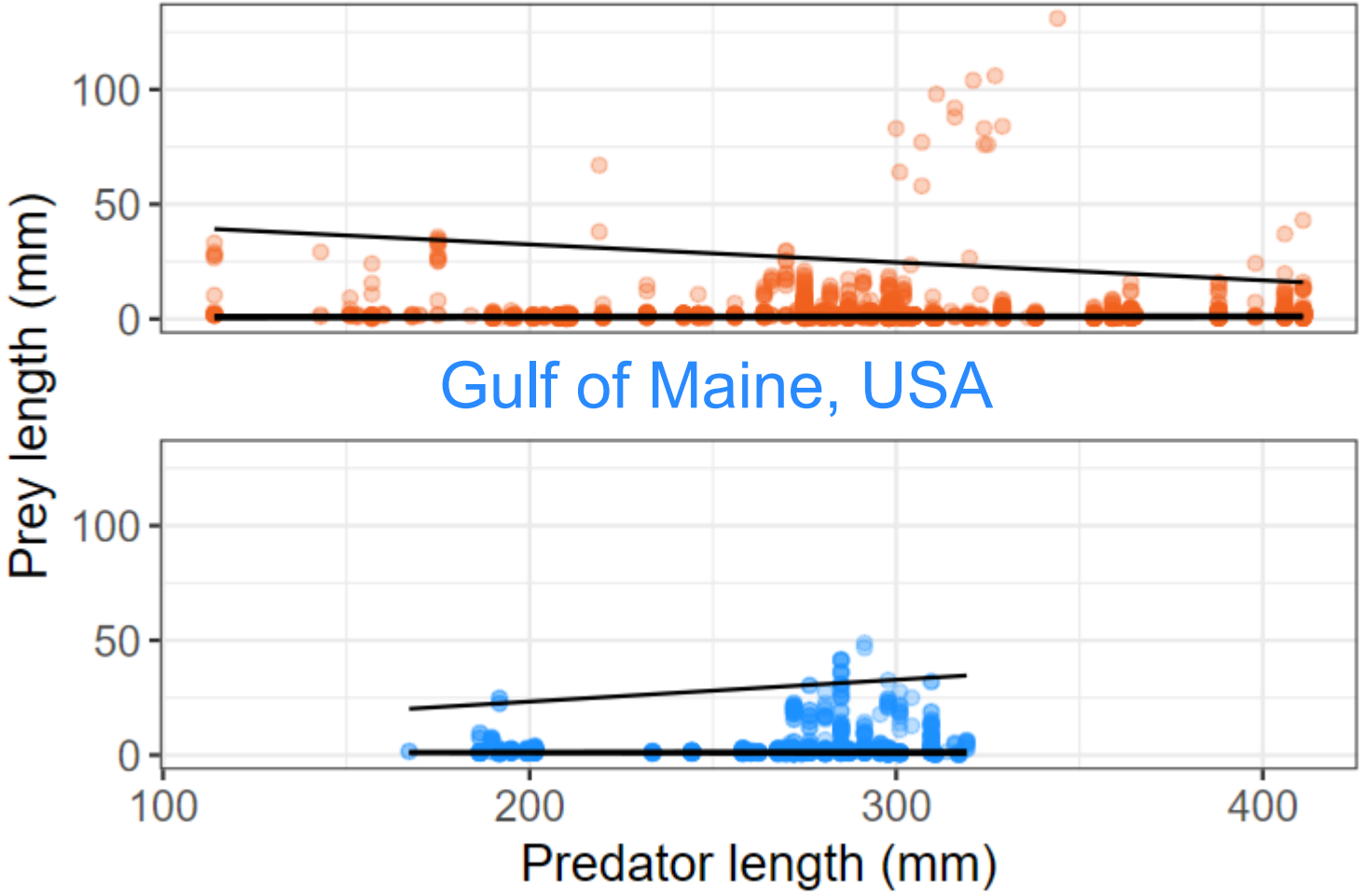


Max relative prey length: 5%

Max relative prey length: 11%

Does predator morphology drive different relationships?

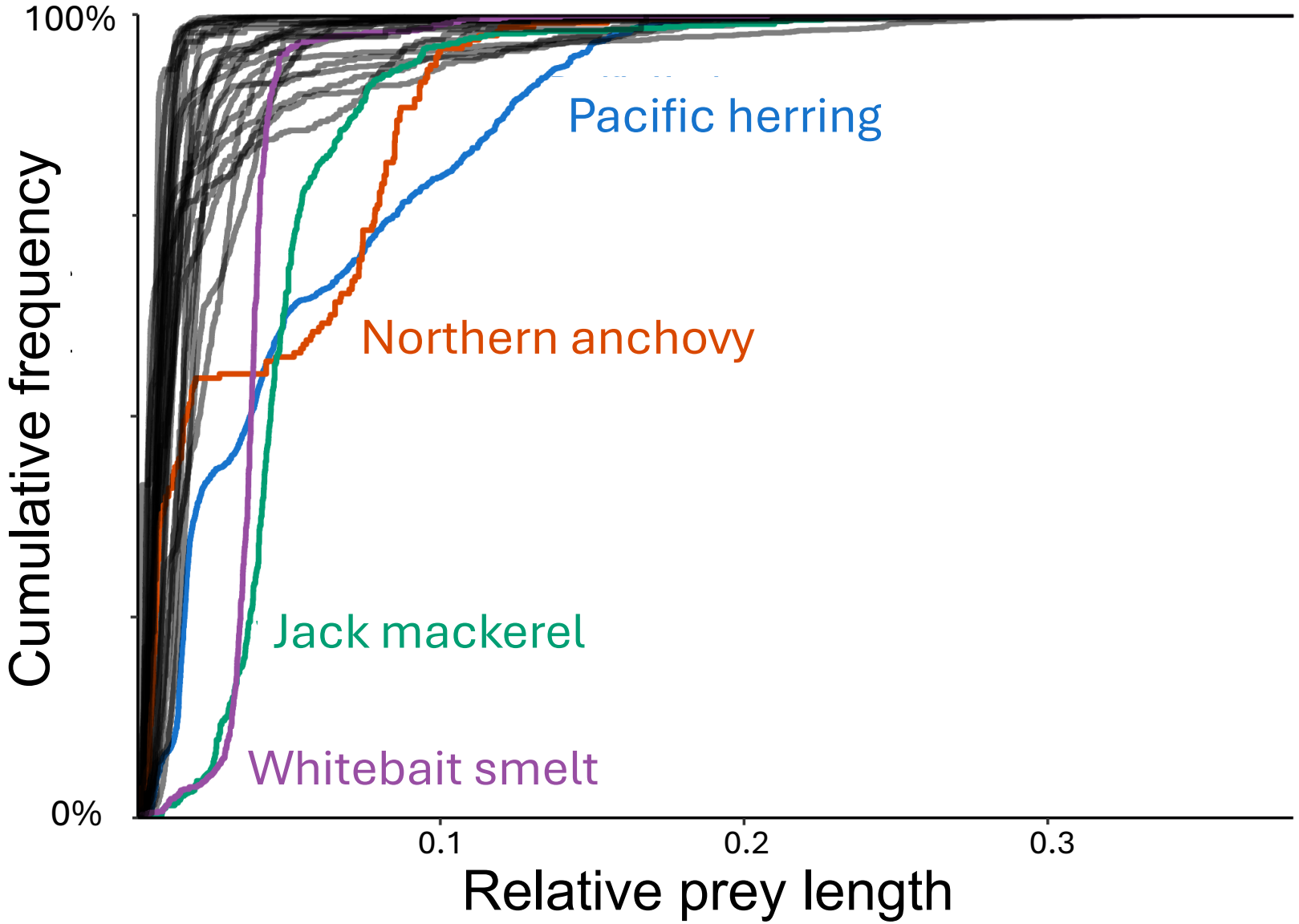
Atlantic mackerel feed on different prey sizes in different regions



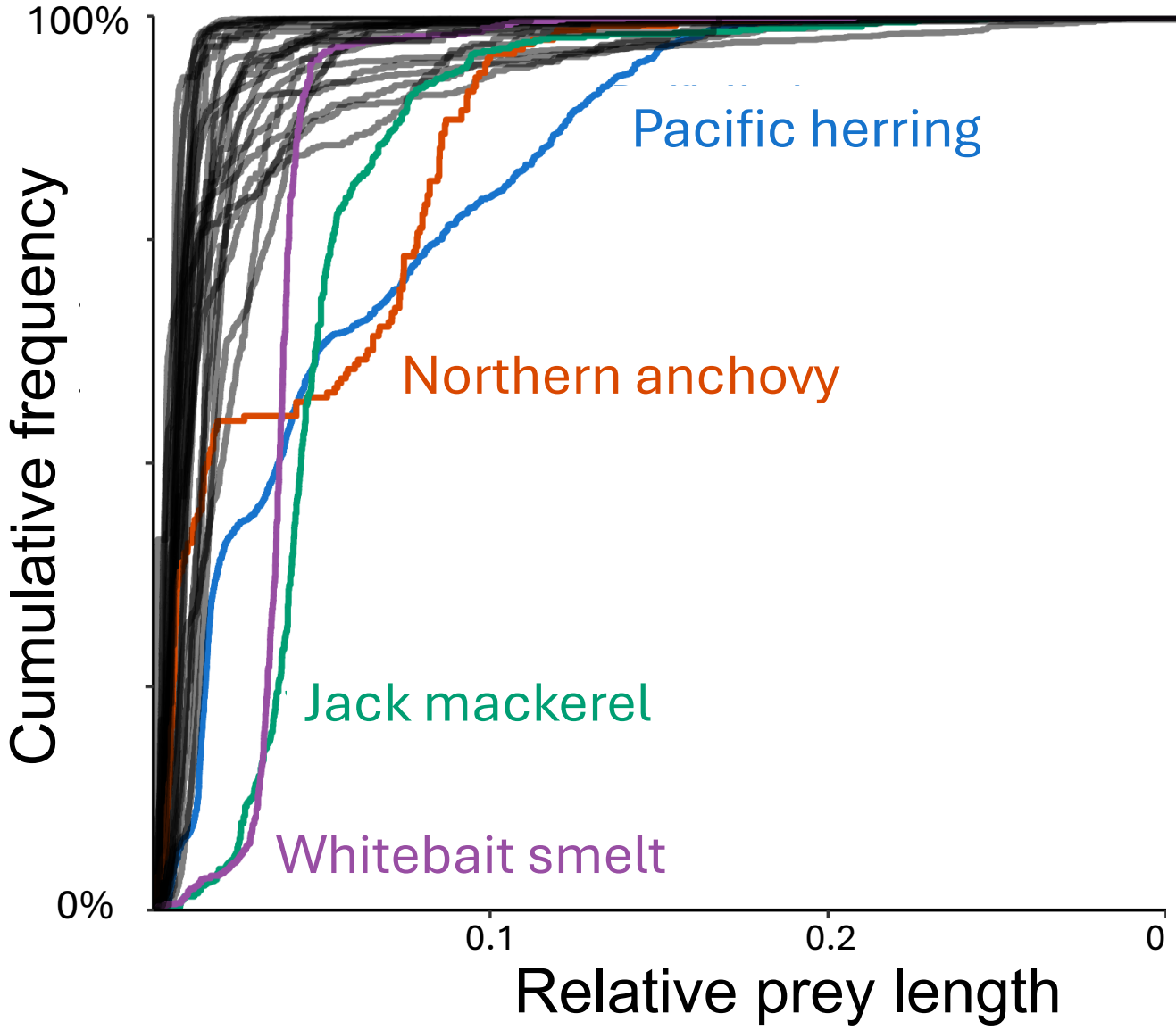
Max relative prey length: 38%

Max relative prey length: 17%

Regional prey communities may be more important than morphology



Regional prey availability may be more important than morphology

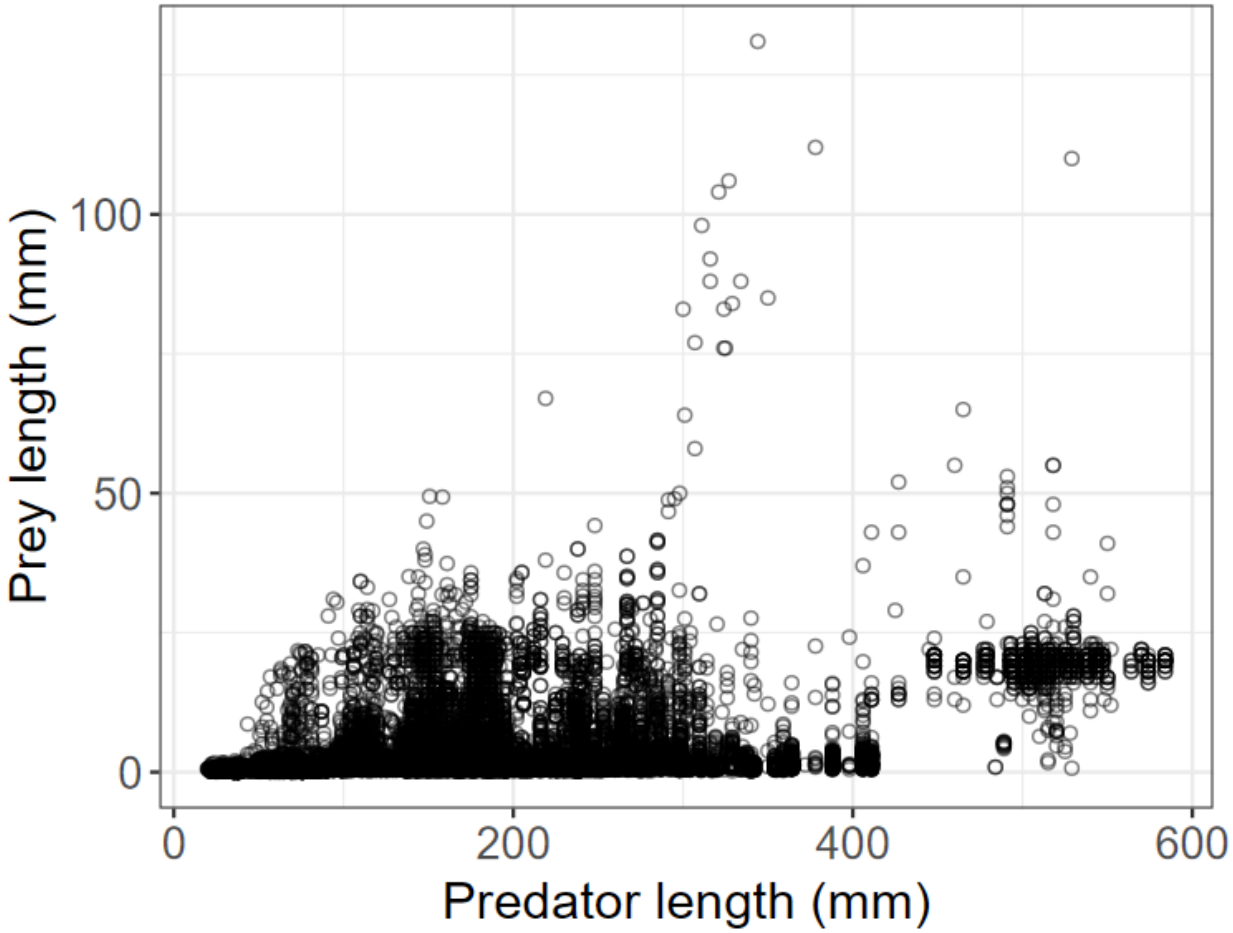


Krill are large, nutritious zooplankton that are abundant in upwelling systems

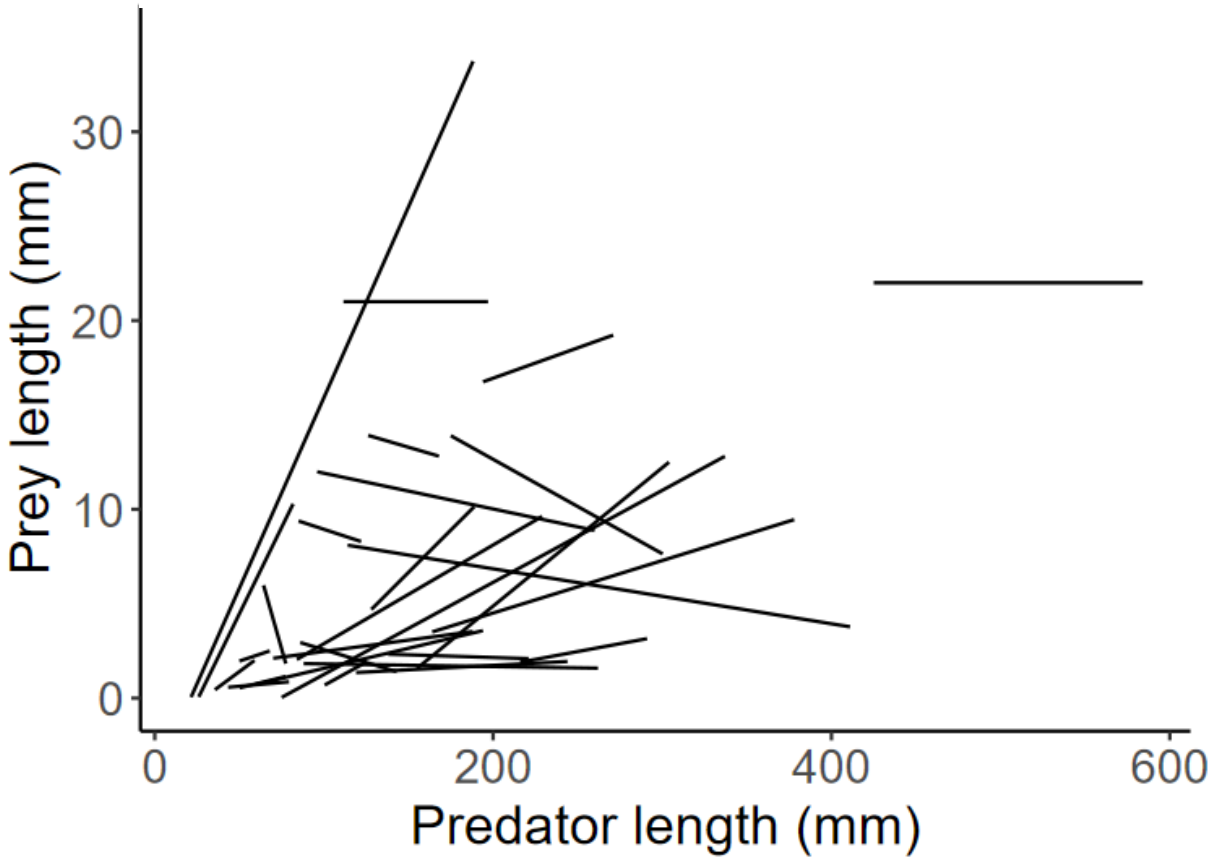
Fish sampled along west coast of USA consumed herring – translates to different predator-prey size relationships

Conclusions

- Small pelagic fish focus on small zooplankton (<2% of body length)
- Differences within and among related species suggest that extrinsic factors, not just morphology, are important



Maximum (90th quantile)



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If you have predator-prey size data, please let us know!