Reconstructing a century of predator trophic position in WA with archival harbor seal bone

Salish Sea Ecosystem Conference

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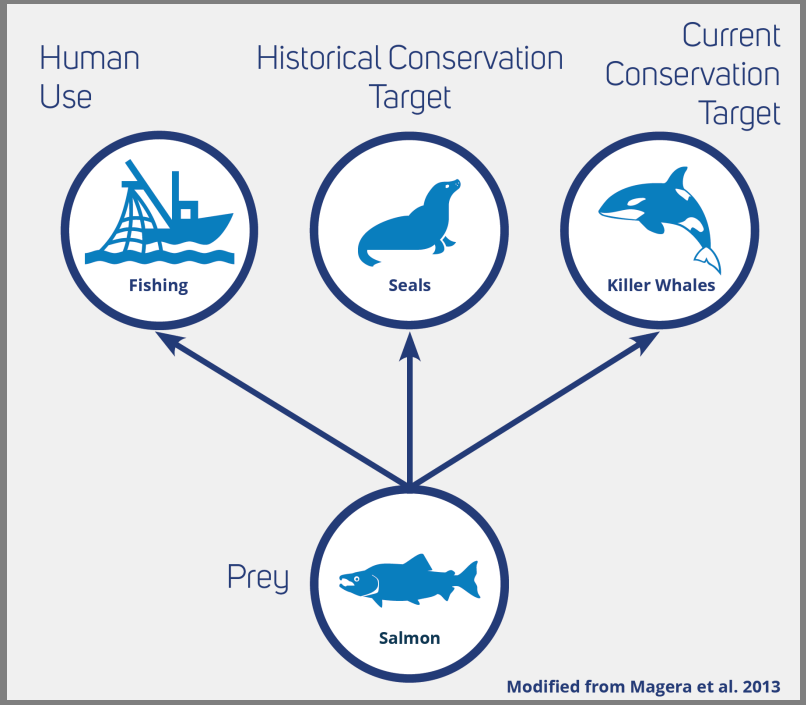
Competing Interests in the Salish Sea

1. Recovering predator populations that increase competition with humans for the same resource

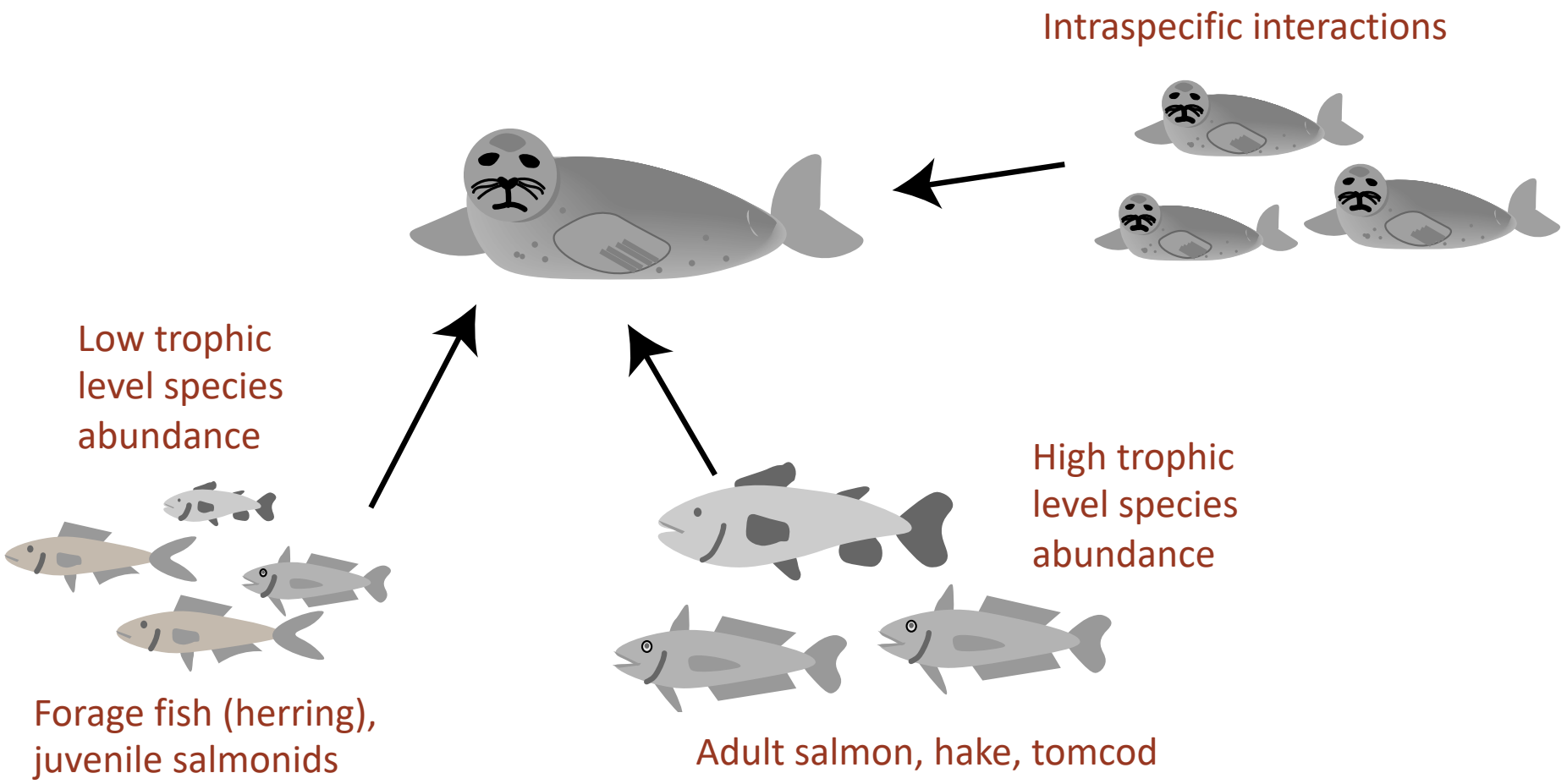
2. New tradeoffs that emerge when protected predators consume protected prey, and

3. Multiple predator populations that compete for the same limited prey.

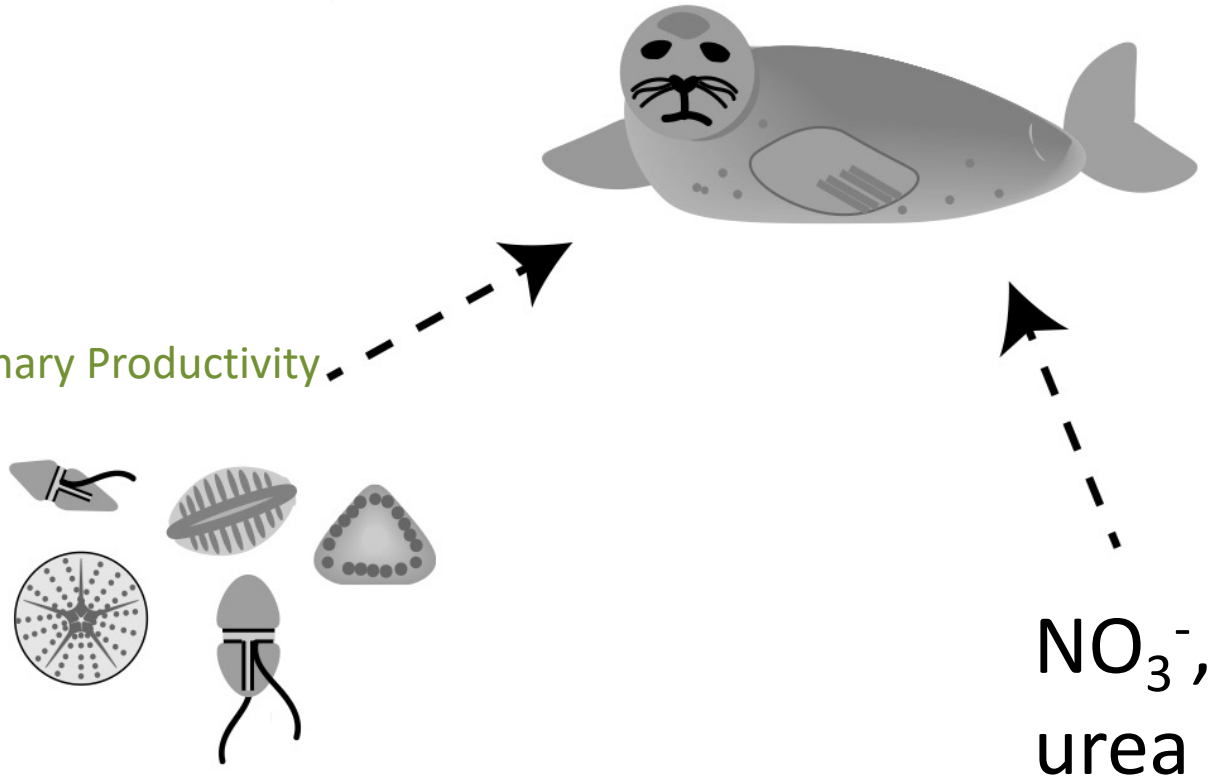


How are harbor seals interacting with the food web?

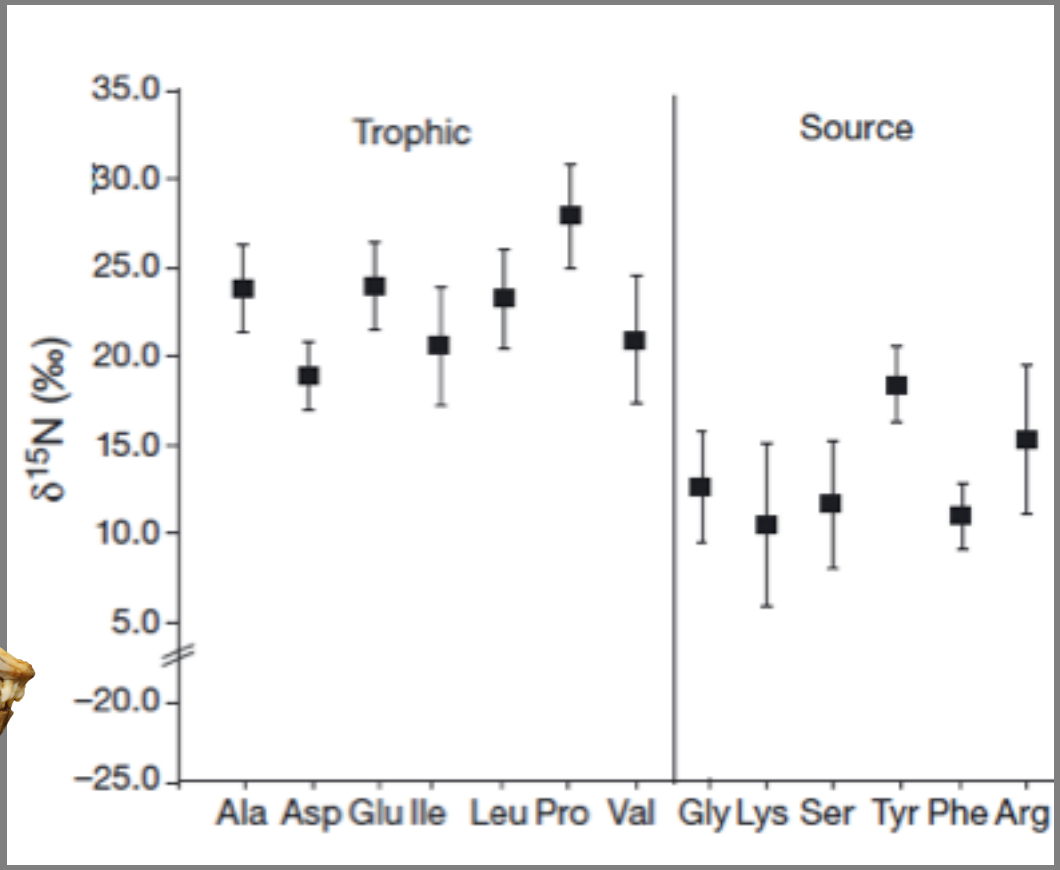
How do *food web* conditions impact harbor seal trophic position?



How does coastal *productivity* (indirectly) impact harbor seal trophic position?



Compound Specific Stable Isotope Analysis of Amino Acids: Primer

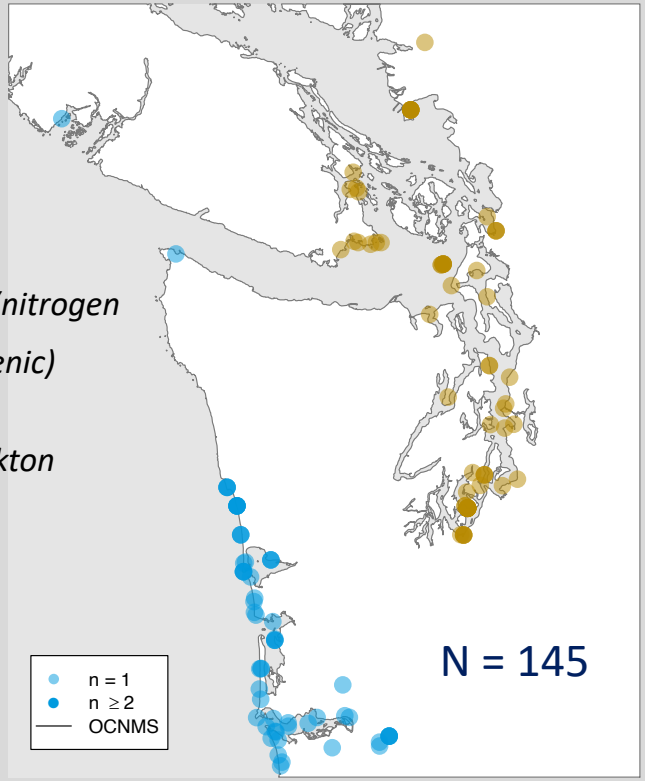


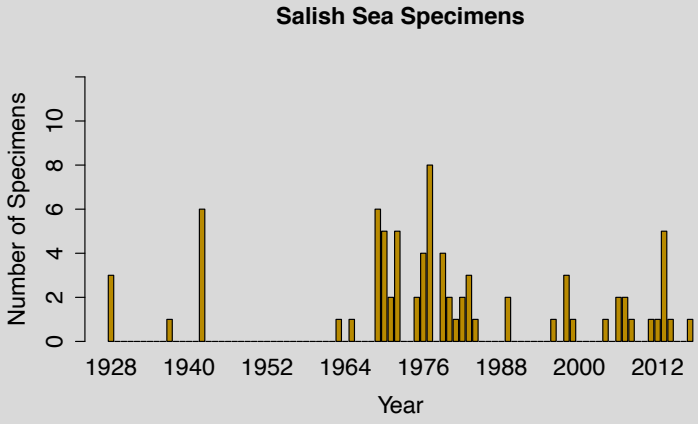
Germain et al. 2013

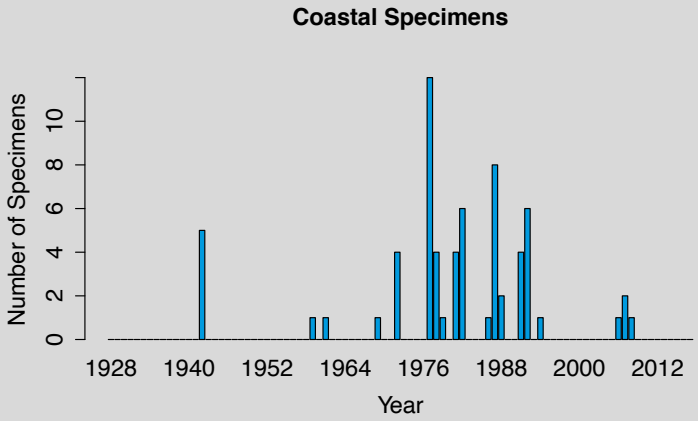
$$TP = [(\delta^{15}N_{Tr\text{-}Sr,\ seal} - TEF_{Tr\text{-}Sr,seal} + 3.4) / TEF_{Tr\text{-}Sr,plankton}] + 1$$

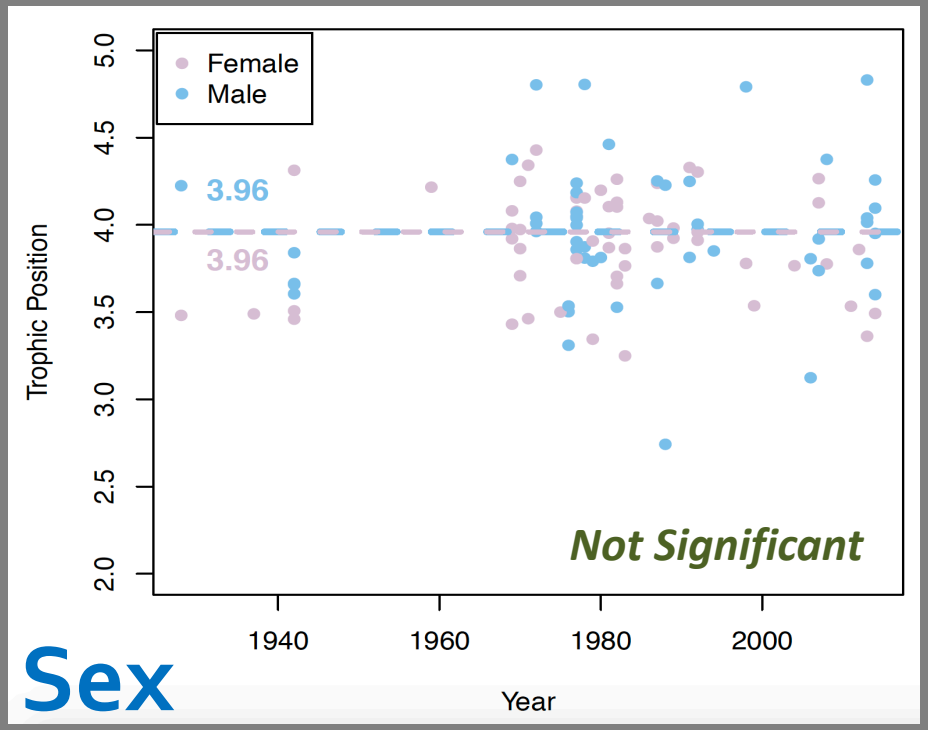
Analysis of museum specimens for retrospective trophic position and coastal productivity time series

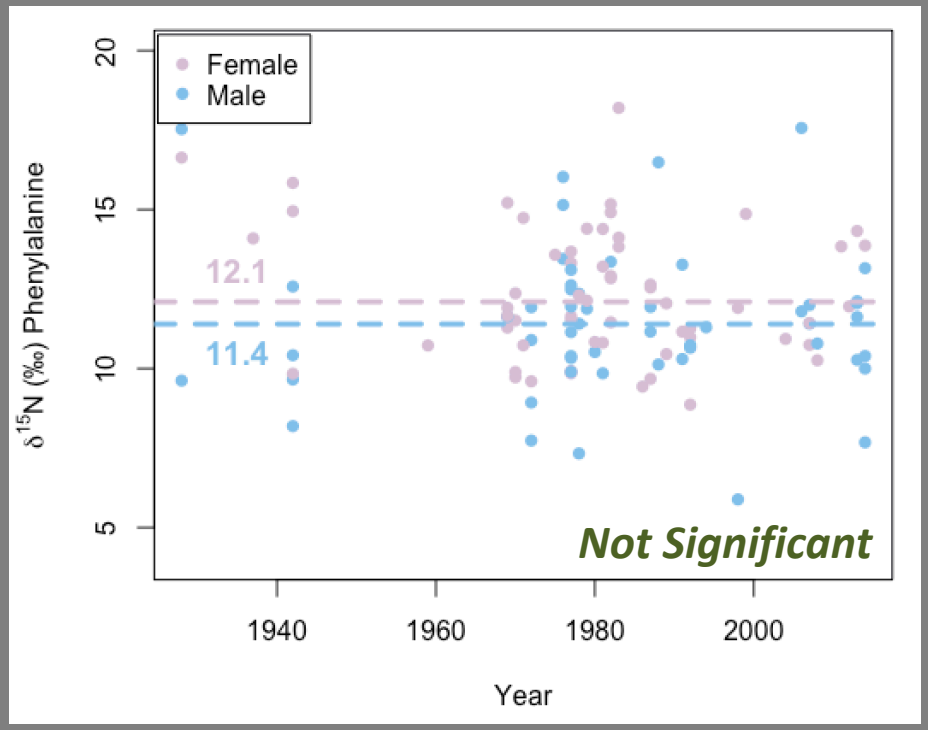
- Trophic position
- $\delta^{15}N_{Phe}$ *(nitrogen sources ie. anthropogenic)*
- $\delta^{13}C$ *(phytoplankton growth)*

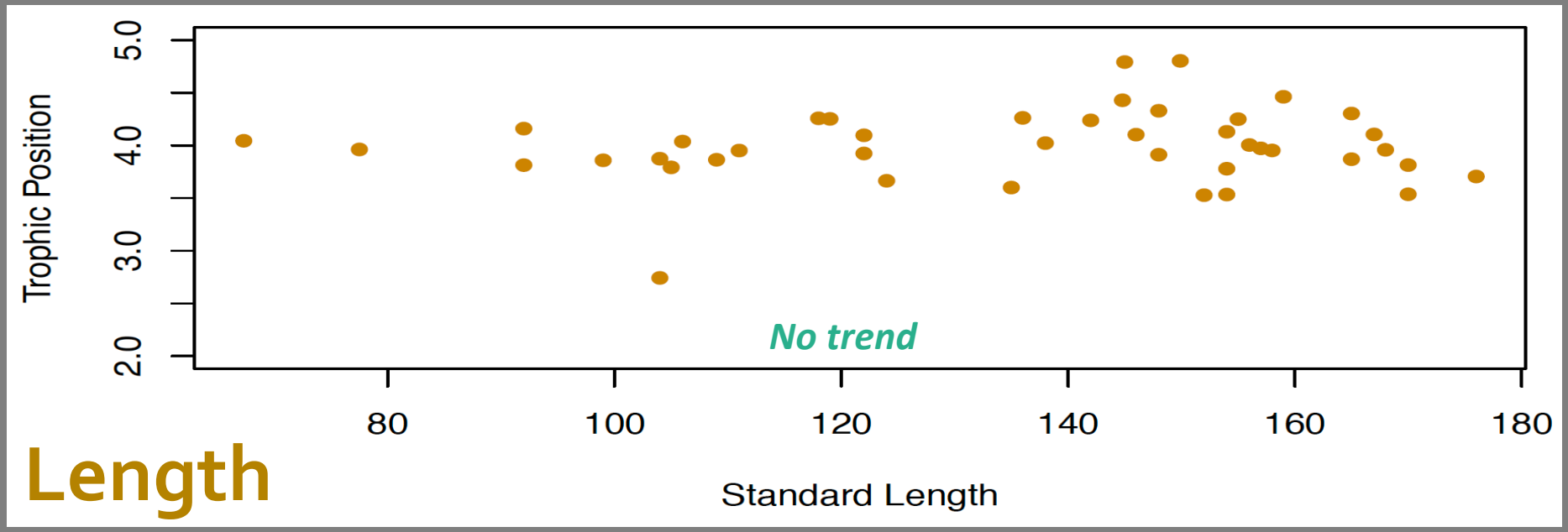







Female
Male
3.96
3.96
Not Significant
Trophic Position
Year
Sex


Female
Male
12.1
11.4
Not Significant
δ15N (‰) Phenylalanine
Year


No trend
Trophic Position
Standard Length
Length

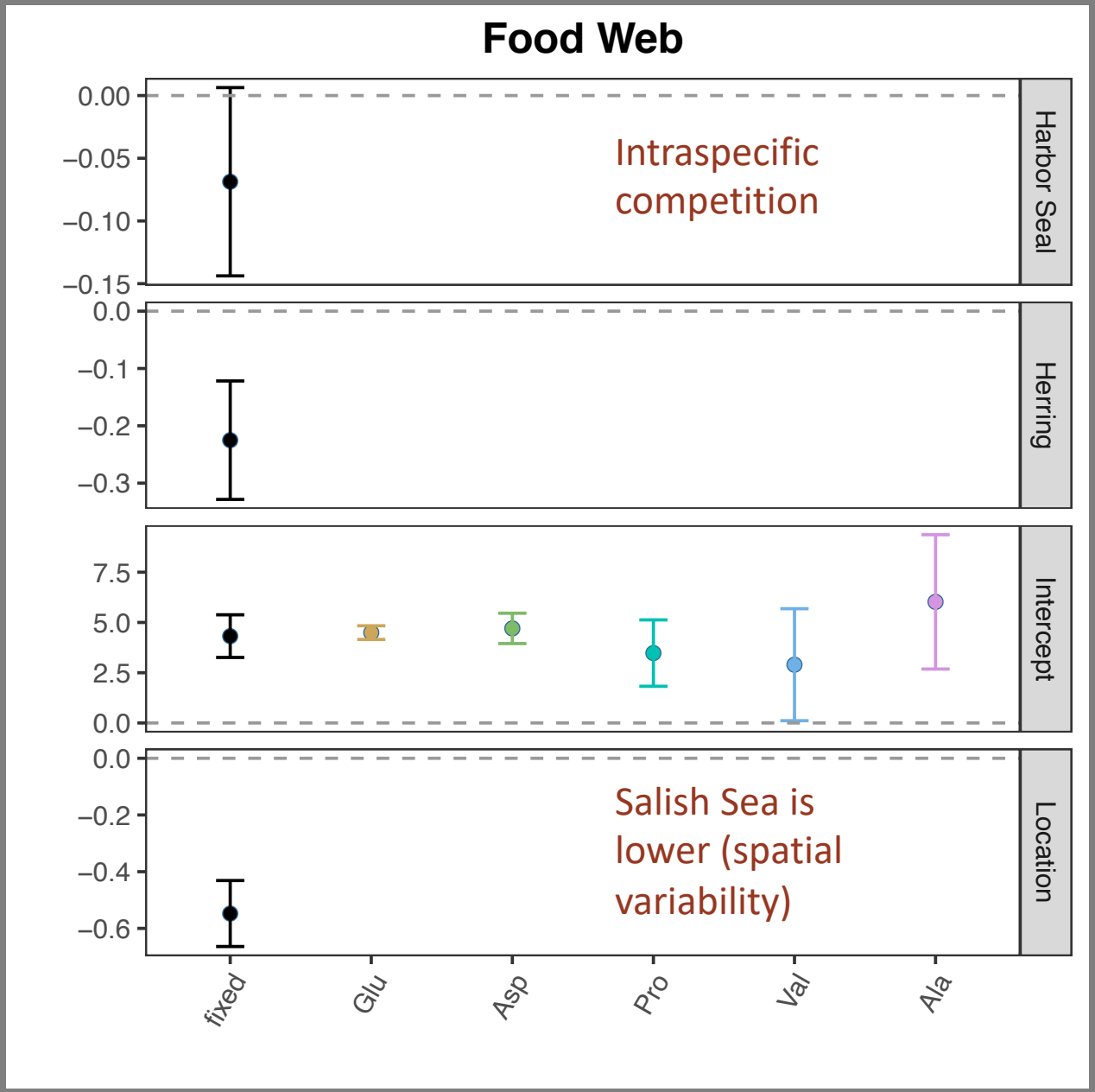
Times series for hierarchical linear models

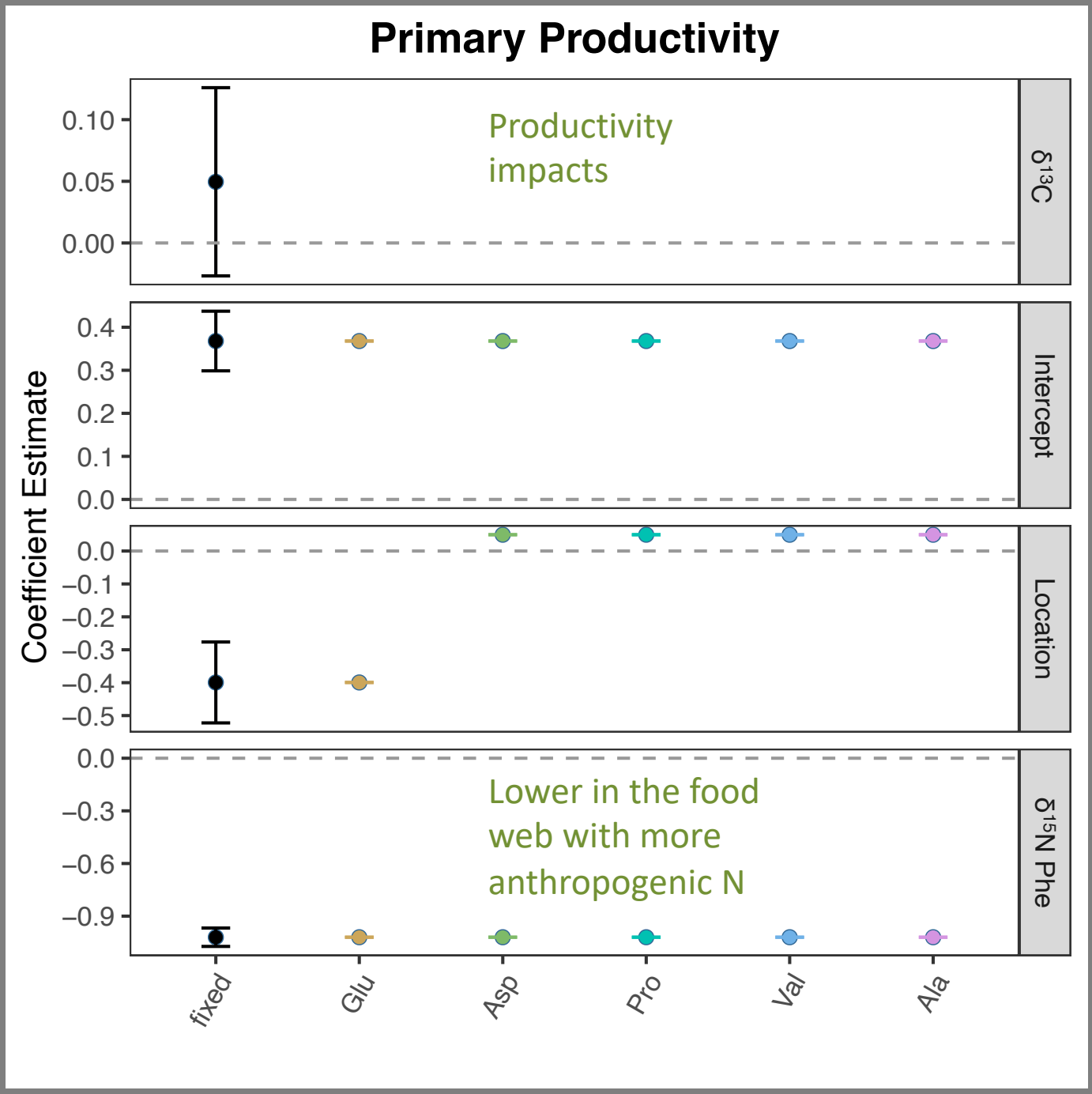
Food Web (n = 52)

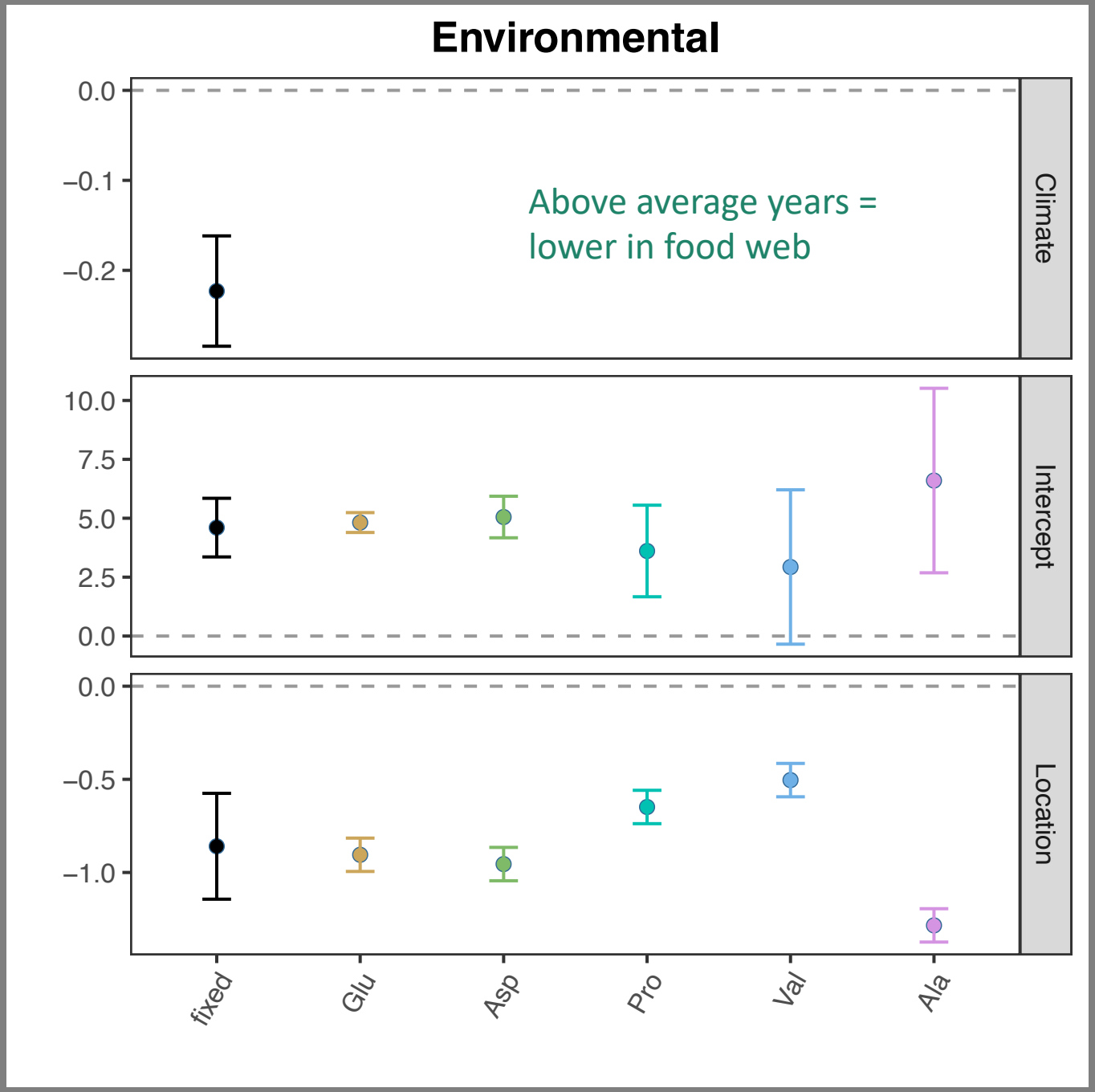
- Herring Biomass
- Hake Biomass
- Chinook Escapement
- Smolt Production (wild and hatchery)
- Chum escapement
- Coho Escapement
- Harbor Seal Population

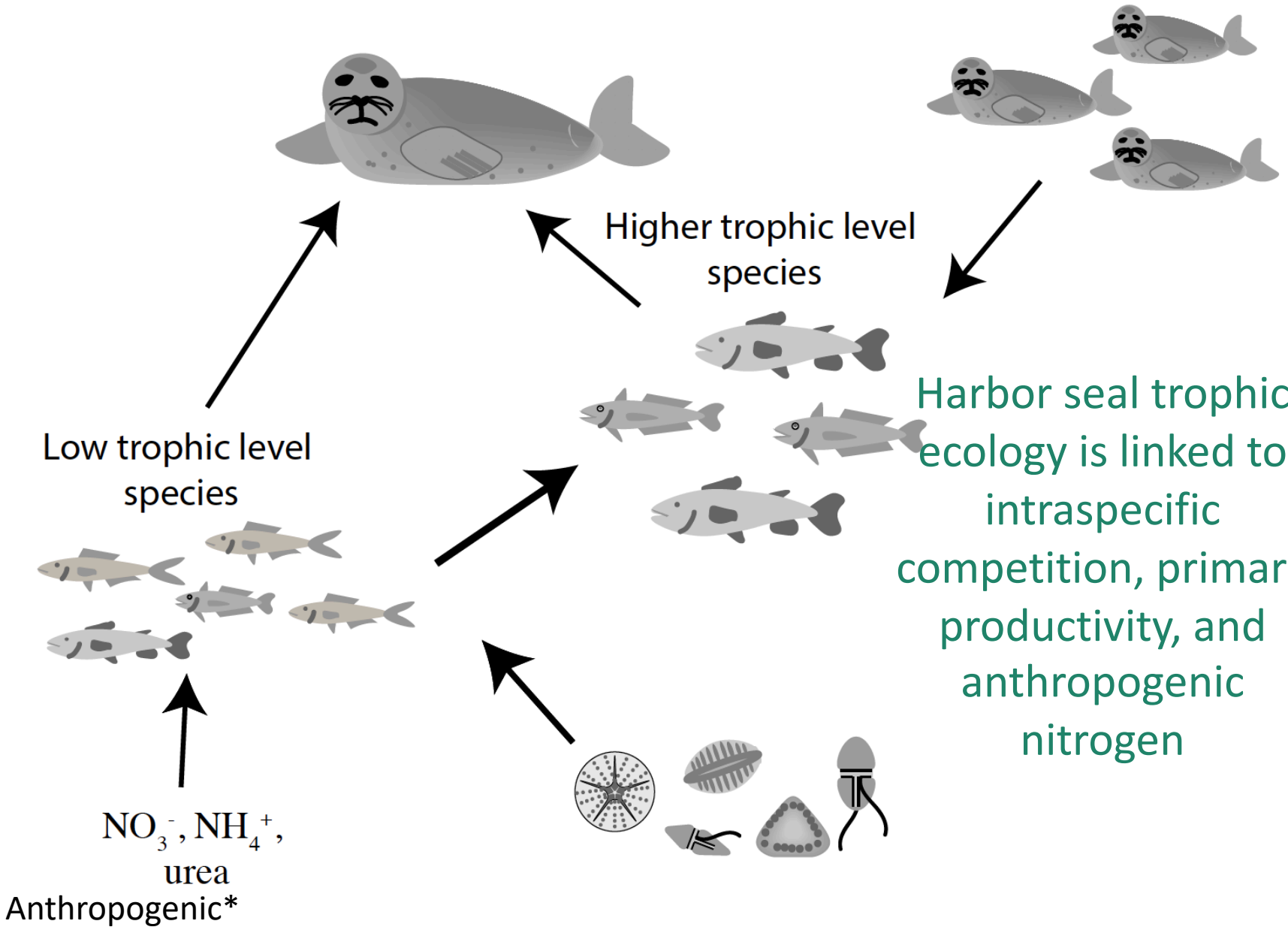
Productivity (n = 4)

- $\delta^{15}N_{Phe}$ *(nitrogen sources ie. anthropogenic)*
- $\delta^{13}C$ *(phytoplankton growth)*


Food Web
0.00
−0.05
−0.10
−0.15
Intraspecific competition
Harbor Seal
0.0
−0.1
−0.2
−0.3
Herring
7.5
5.0
2.5
0.0
Intercept
0.0
−0.2
−0.4
−0.6
Salish Sea is lower (spatial variability)
Location
fixed
Glu
Asp
Pro
Val
Ala


Primary Productivity
Coefficient Estimate
δ13C
Intercept
Location
δ15N Phe
Productivity impacts
Lower in the food web with more anthropogenic N
0.10
0.05
0.00
0.4
0.3
0.2
0.1
0.0
−0.1
−0.2
−0.3
−0.4
−0.5
−0.6
−0.9
fixed
Glu
Asp
Pro
Val
Ala


Environmental
0.0
−0.1
−0.2
Above average years =
lower in food web
Climate
10.0
7.5
5.0
2.5
0.0
Intercept
0.0
−0.5
−1.0
Location
fixed
Glu
Asp
Pro
Val
Ala



Harbor seal trophic ecology is linked to intraspecific competition, primary productivity, and anthropogenic nitrogen

How are harbor seals interacting with the food web?

- Harbor seal trophic ecology is linked to intraspecific competition, primary productivity, and anthropogenic nitrogen
- Harbor seal trophic ecology is not static, and responds to changes in the system (bottom-up forces)
- Trophic ecology is spatially variable, and predation pressure exerted on low and high trophic level species varies

Acknowledgments

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