Reconstructing a century of coastal productivity and predator trophic position in the Salish Sea using archival harbor seal bone.

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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?

- **Low trophic level species abundance**
  - Forage fish (herring), juvenile salmonids

- **High trophic level species abundance**
  - Adult salmon, hake, tomcod

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

Primary Productivity

NO$_3^-$, NH$_4^+$, urea

Nitrogen availability (anthropogenic)
Compound Specific Stable Isotope Analysis of Amino Acids: Primer

\[ TP = \left( \delta^{15}N_{\text{Tr-Sr, seal}} - \text{TEF}_{\text{Tr-Sr,seal}} + 3.4 \right) / \text{TEF}_{\text{Tr-Sr,plankton}} + 1 \]
Analysis of museum specimens for retrospective trophic position and coastal productivity time series

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

$N = 145$
**Sex**

- **Trophic Position**
  - Not Significant

- **δ¹⁵N (% Phenyalanine)**
  - Not Significant

**Length**

- **Trophic Position vs. Standard Length**
  - No trend
Times series for hierarchical linear models

<table>
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<tr>
<th>Food Web (n = 52)</th>
<th>Productivity (n = 4)</th>
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<tr>
<td>Herring Biomass</td>
<td>$\delta^{15}N_{\text{Phe}}$ (nitrogen sources ie. anthropogenic)</td>
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<td>Hake Biomass</td>
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<td>Chinook Escapement</td>
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<td>Coho Escapement</td>
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<td>Harbor Seal Population</td>
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</table>
Food Web

Intraspecific competition

Salish Sea is lower (spatial variability)
Primary Productivity

Productivity impacts

Coefficient Estimate

Primary Productivity impacts

Lower in the food web with more anthropogenic N

δ¹³C
Intercept
Location
δ¹⁵N Phe

fixed
Glu
Asp
Pro
Val
Ala
Above average years = lower in food web
Harbor seal trophic ecology is linked to intraspecific competition, primary productivity, and anthropogenic nitrogen.

- Low trophic level species
- Higher trophic level species

Anthropogenic
- $\text{NO}_3^-$, $\text{NH}_4^+$, urea

*Anthropogenic*
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