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Pinniped Research Program
DFO Nanaimo, BC

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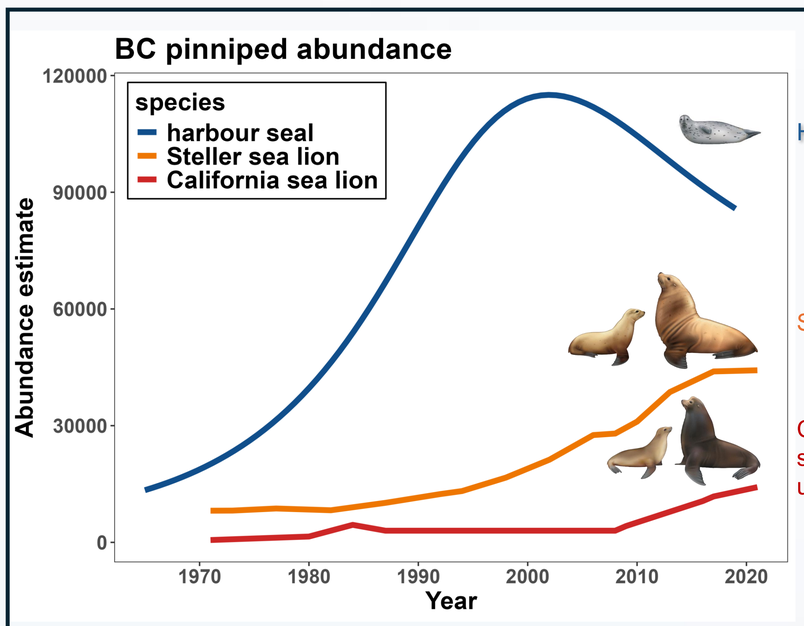
The role of recovering coastal pinnipeds on the productivity and dynamics of forage communities in British Columbia food webs



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INTRODUCTION

Ecosystem Shift: Broad ecosystem changes are occurring in British Columbia (BC) coastal waters, marked by large increases in several marine mammal populations since protections were established in the 1970s.



Target species

Harbour Seals: Year-round; breed in BC.

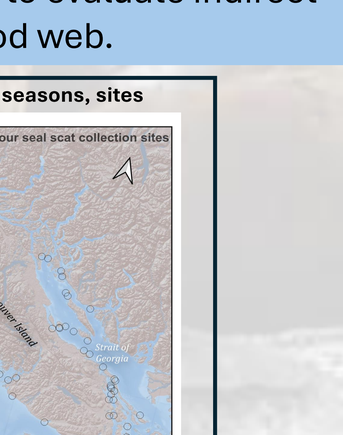
Steller Sea Lions: Year-round; breed in BC.

California Sea Lions: Seasonal; males arrive late summer from southern breeding grounds & remain until spring.

DFO. 2025. Steller Sea Lion (*Eumetopias jubatus*) Abundance in Canadian Pacific Waters in 2021. DFO Can. Sci. Advis. Sec. Sci. Resp. 2025/033; DFO. 2023. California Sea Lion Abundance Estimation in Canada, 2020–21. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2023/016.; DFO. 2022. Stock Assessment of Pacific Harbour Seals (*Phoca vitulina richardii*) in Canada in 2019. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2022/034.

Dual Roles: Increased pinniped populations exert both top-down and bottom-up effects on ocean biomass and production. They act as major consumers of fish and invertebrates, while serving as primary prey for transient killer whales.

The Paradox: Despite rising predation pressure, for example, the spawning stock Biomass of Pacific herring— a key diet component, primary forage fish, & vital commercial species— has steadily increased.



From: Pacific Herring Spawn Index Data
https://open.canada.ca/data/en/dataset/d892511c-d851-4f85-a0ec-708bc05d2810

OBJECTIVES AND METHODS

Quantify Diet: Determine the diet of three sympatric pinniped species across broad spatial and temporal scales in BC.

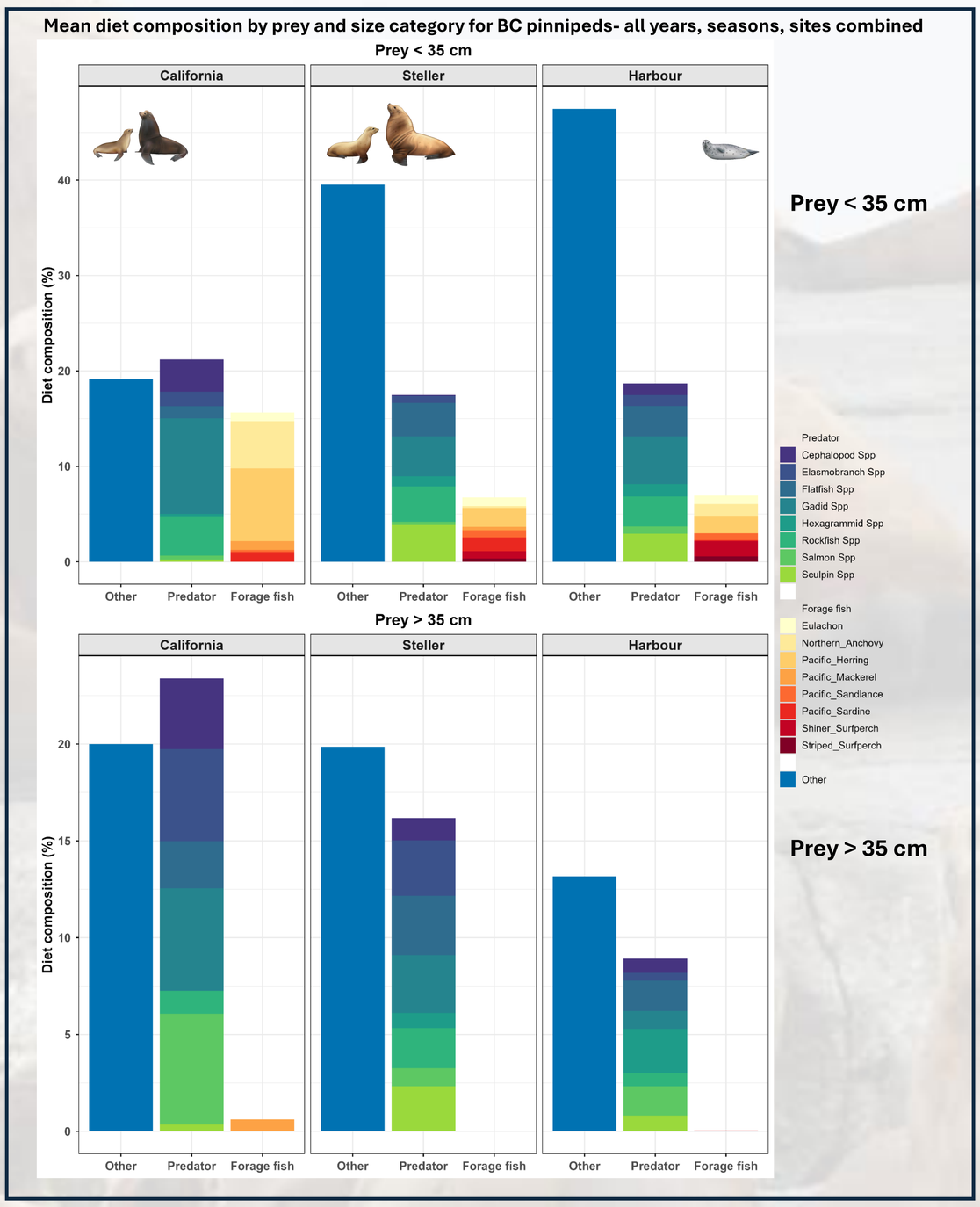
Evaluate Food Web Dynamics: Move beyond simple, tightly coupled predator-prey assumptions to evaluate indirect effects within a highly connected food web.

- **Sampling Effort:** Collected and analyzed a dataset of scat samples (n > *6,000*) 2013-2019 in 4 seasons across sites in BC
- **Diet Estimation:** Employed a dual-method approach combining DNA metabarcoding (% species contribution) and hard part analysis (size of prey) of scat.
- **Dietary Analysis:** prey categorized by size and grouped as either forage fish, predator of forage fish, or other

RESULTS

Generalist Foraging: Diet metrics confirm that all three pinniped species are generalist predators foraging within a highly complex food web.

Trophic Pathways: Pinniped consumption of *piscivorous* fish frequently exceeds their direct consumption of *forage* fish by 2.5 to 5-fold.

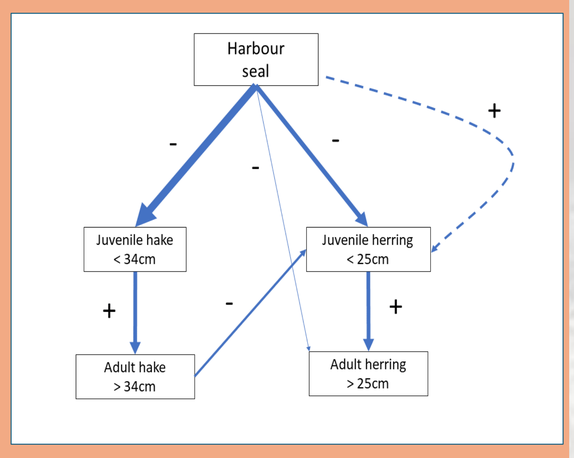


SIZE-STRUCTURED PREDATION: Example of harbour seals, hake, and herring

Indirect Positive Effects: Direct predation on a competitor/predator can yield net benefits for a prey species.

- Pinnipeds target **juvenile hake**.
- This suppresses the number of hake reaching maturity.
- Fewer adult hake results in significantly **reduced predation pressure** on juvenile herring.

Ecosystem-Wide Application: This indirect positive trophic cascade is not exclusive to herring; it likely applies to other small pelagic fish species in the region



CONCLUSIONS

Beyond Direct Predation: Evaluating marine mammal impacts purely through direct predator-prey lenses misrepresents ecosystem realities.

Management Implications: High food web connectivity means generalist predators can inadvertently buffer forage fish populations through complex, indirect pathways.