Understanding the consequences of range expansion and increasing abundance of California sea lions in B.C. waters

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PINNIPED RESEARCH PROGRAM

Pinniped Research Program
DFO Nanaimo, BC

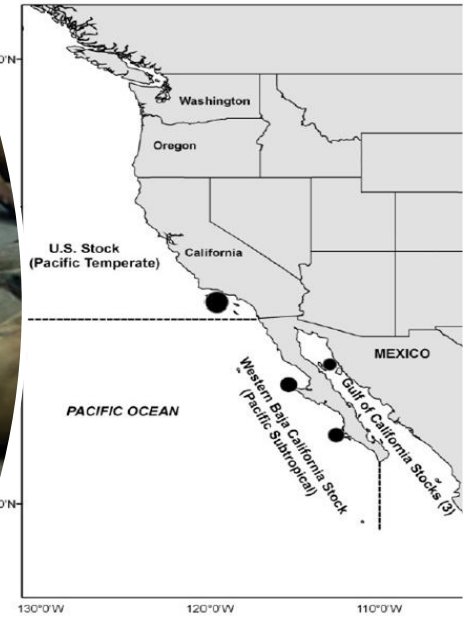
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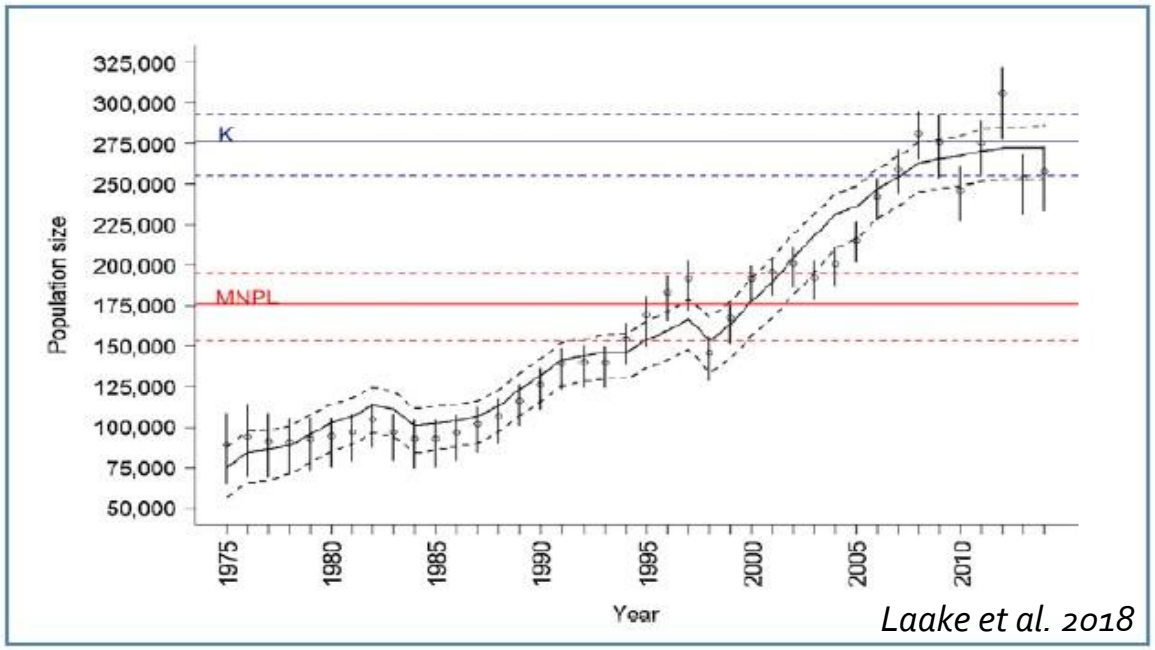


California sea lions *(Zalophus californianus)*:

- breeds in California/Mexico May-June
- The 2014 US breeding season population was estimated at 258, 000 (stabilized ~ K)
- After breeding, males migrate northwards to forage
- A proportion of the population overwinters in BC, often co-occuring with Steller sea lions at haulouts



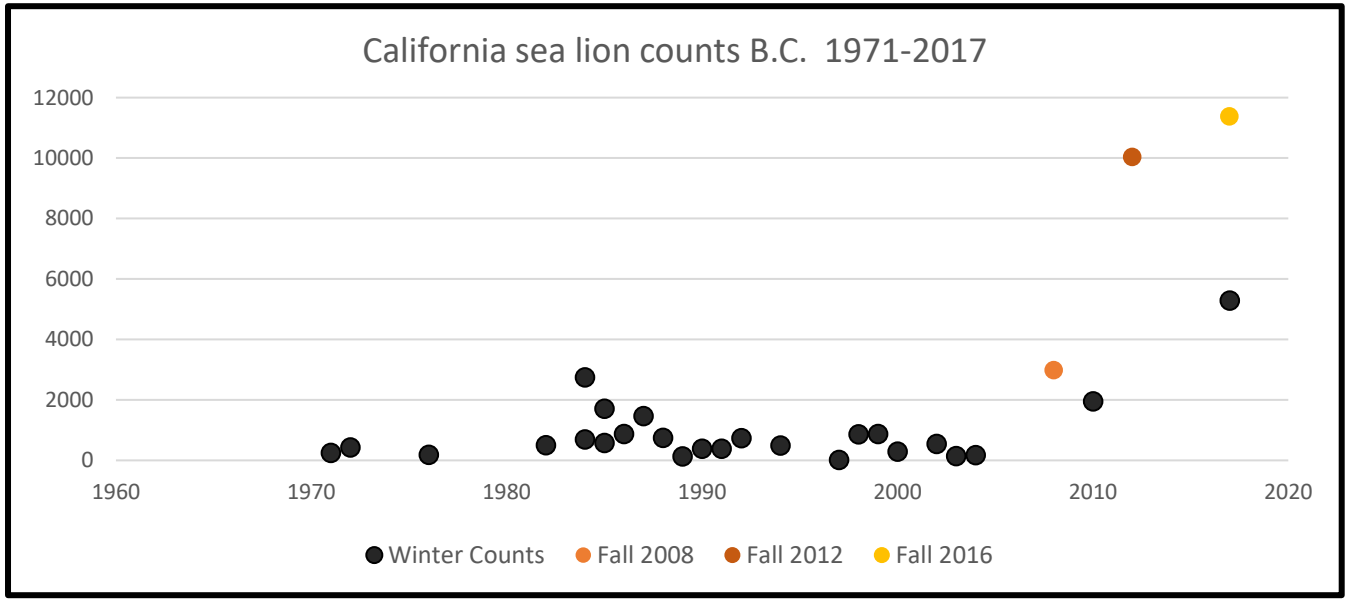


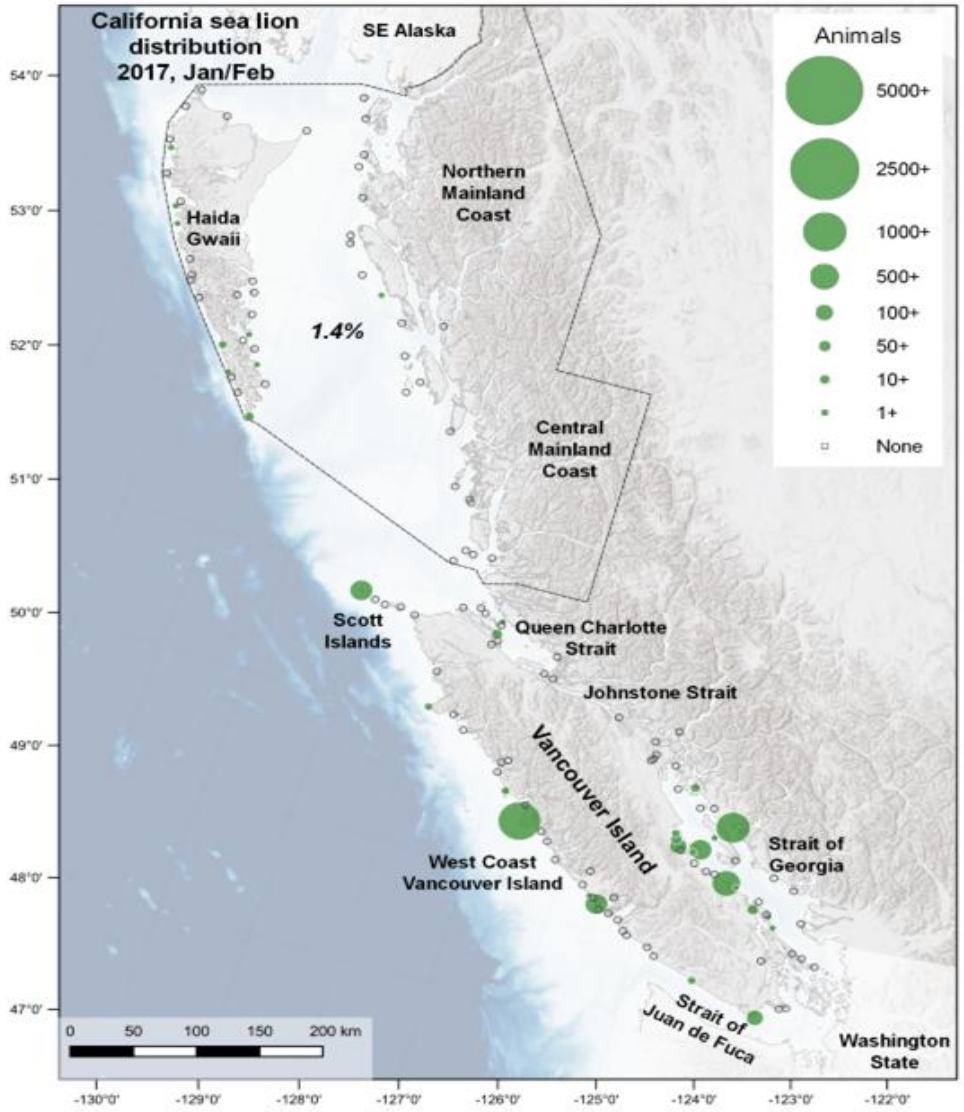


Laake et al. 2018

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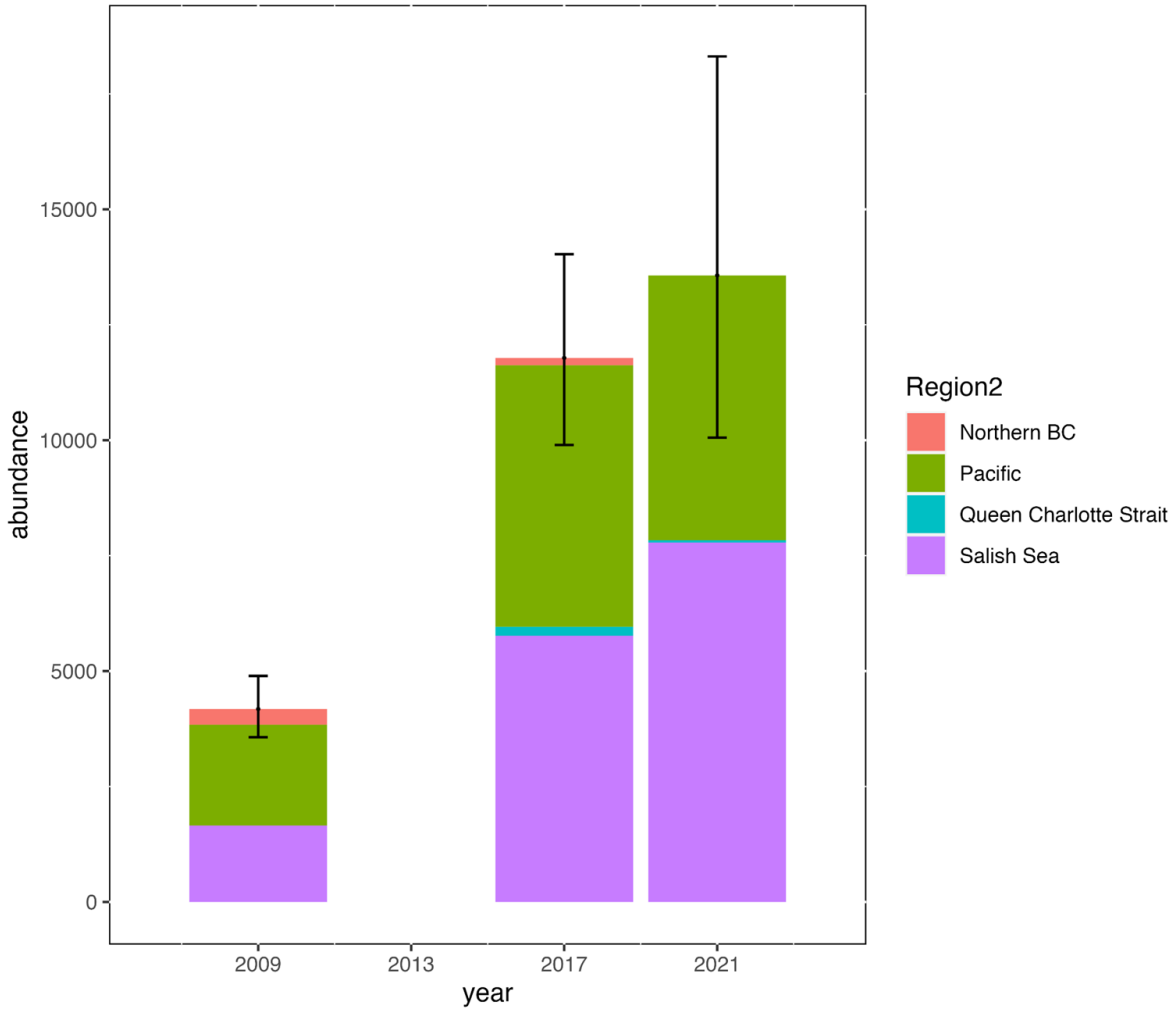
- Few CSL were observed in BC before the 1960s
- 1971-2008 less than 2000 animals
- Large aggregations (and increased counts) were observed during fall and winter Steller sea lion surveys between 2008-2017
- start arriving in BC waters in August and leave by May





Abundance estimates

2009-2021



Recent, anecdotal observations:

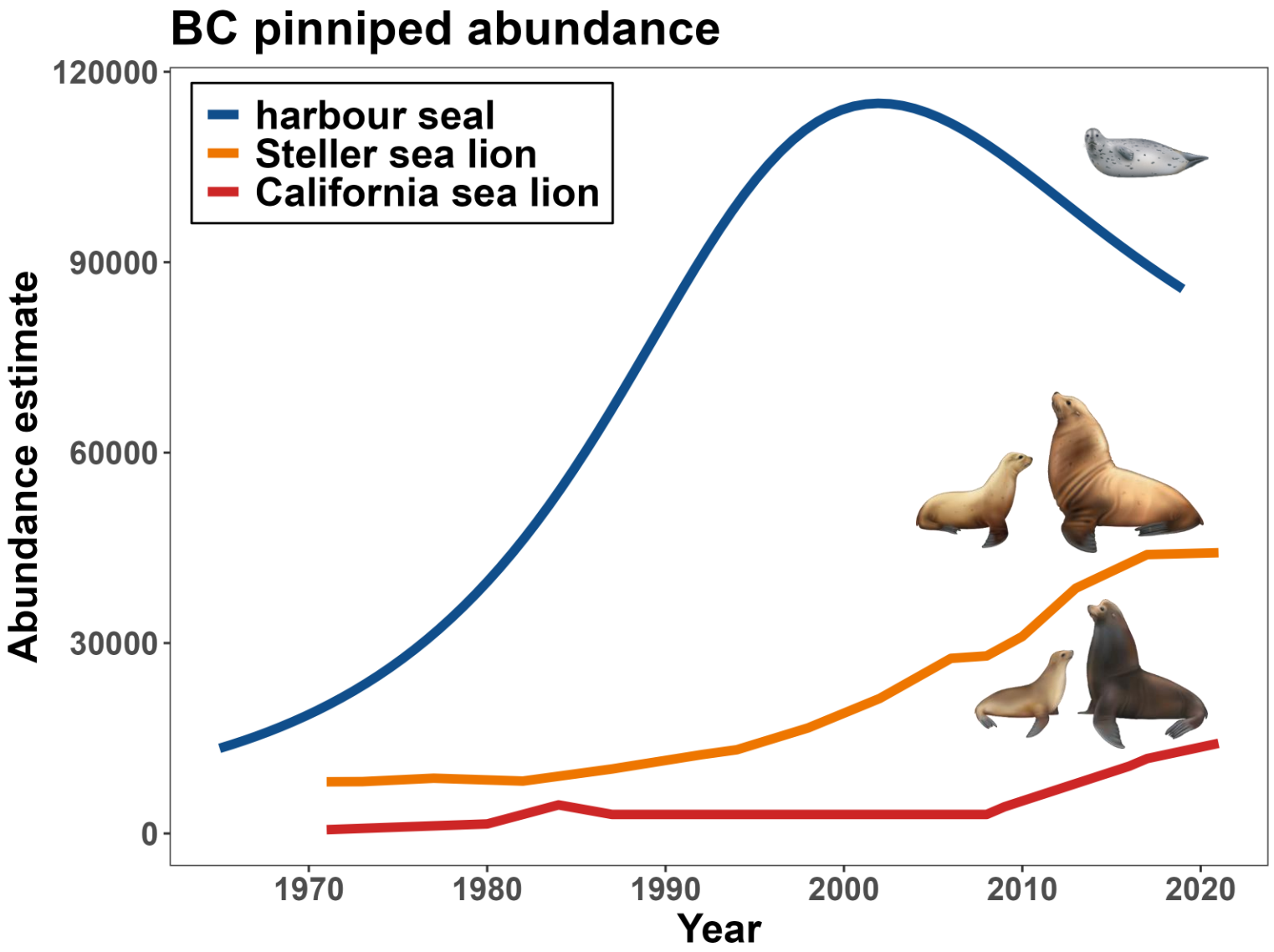
DFO

- Earlier arrival and later departure
- Winter 2026 sea lion survey: animals north of Vancouver Island
- Fall 2026: number of juvenile animals observed

US

- Small number of observations of pupping Oregon/Washington

Sympatric coastal pinnipeds in BC



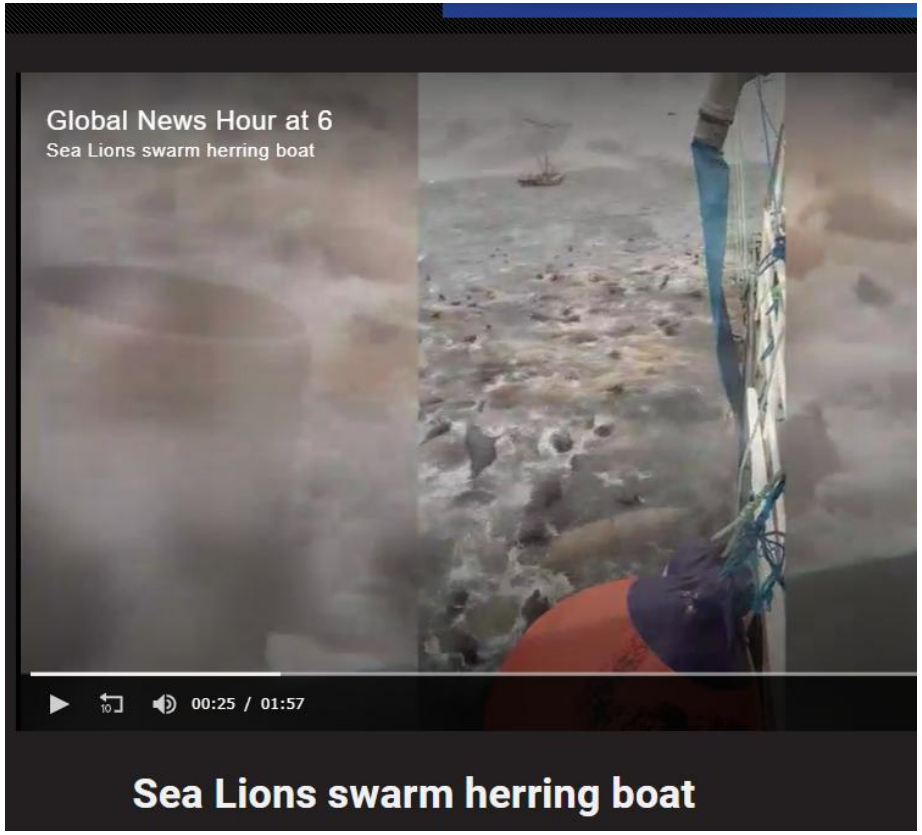
Increases in locally breeding species + transient/ seasonally migrant species (range expansion??)

Emerging drivers of human–wildlife conflict

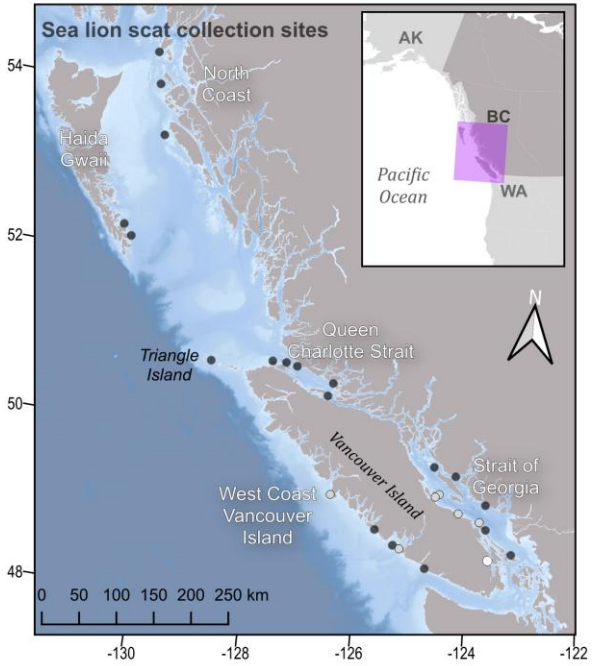
Interactions with fisheries involve both operational (direct) and biological/ecological (indirect) conflicts that impact ecosystems, local economies, and fishing fleets.

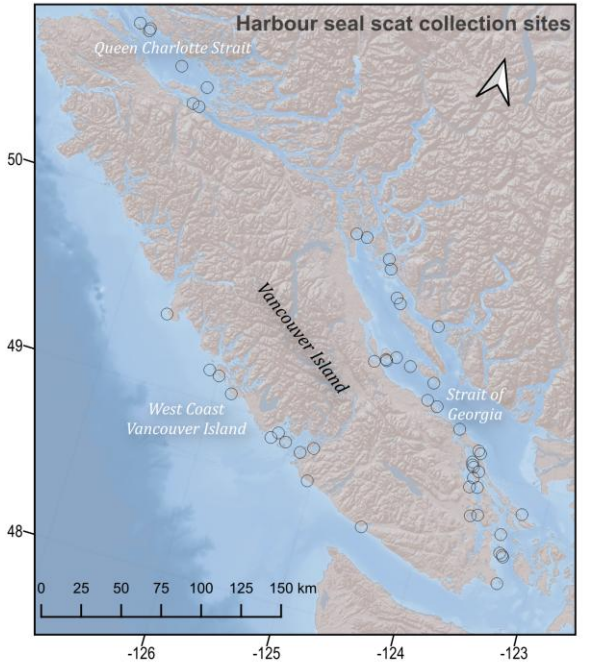
Types of Interactions

- Depredation
- Gear Damage
- Bycatch and Entanglement
- Habituation and Aggression
- Competition for Resources



Focus on ecological interactions within pinniped community – starting point is diet overlap and niche



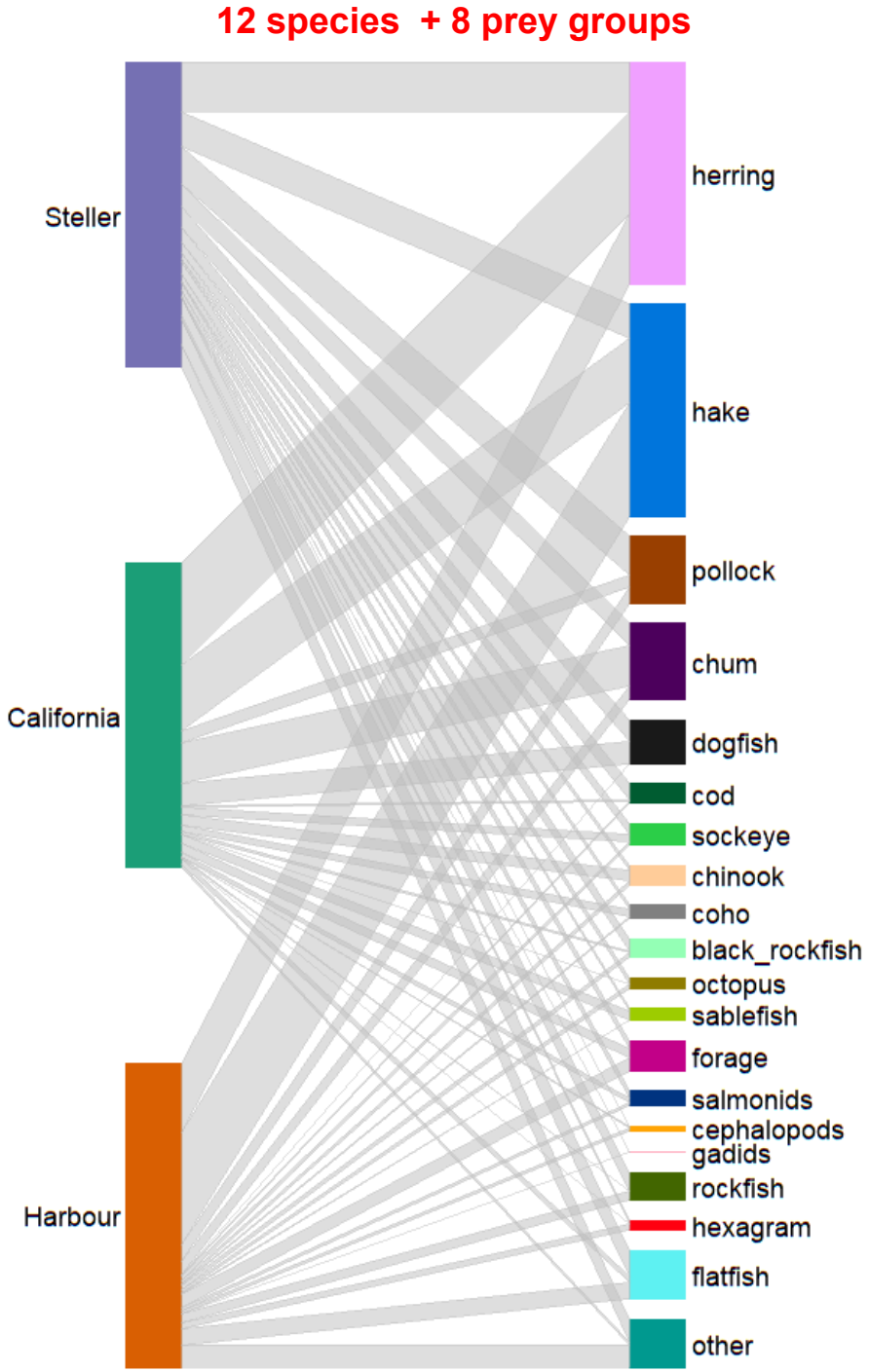


Trophic Interactions: diet estimation

2013-2019 Scat collections: hard part & DNA analysis

- Key haul out sites
- seasonal
- Multi-species as available (harbour seal, Steller and California sea lion)
- Total collections ~ 6,500

2020-2025 Scat + biopsy (Fatty Acid + Stable Isotope analysis; ~300) collections - **sea lions**



Summary: DNA metabarcoding results

- A total of 78 primary prey species were identified in pinniped scats:
- Simpsons Diversity highest for Stellers; similar in California and Harbour seals

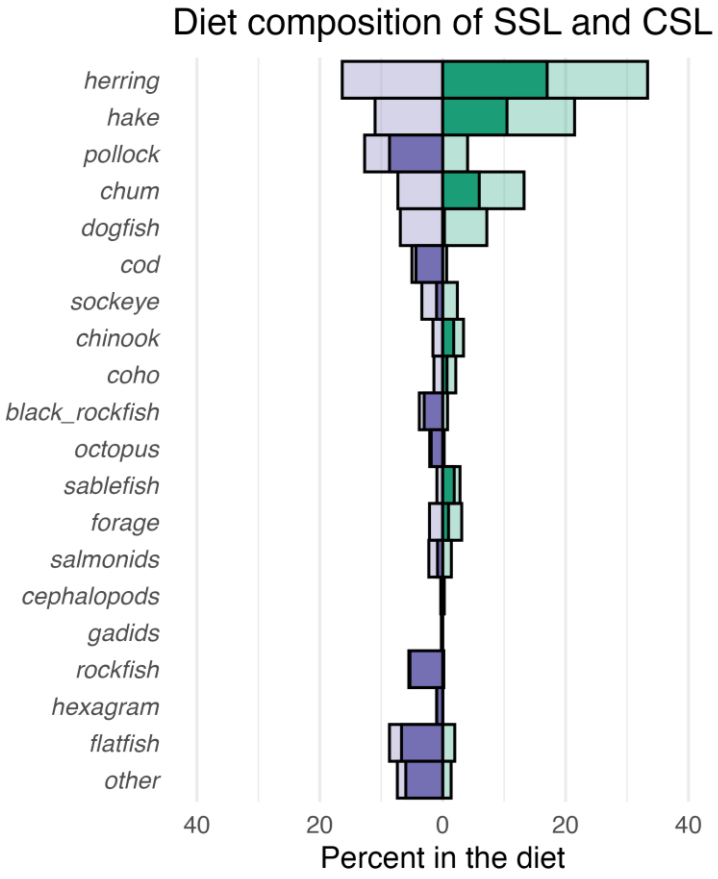
- **significant overlap**:

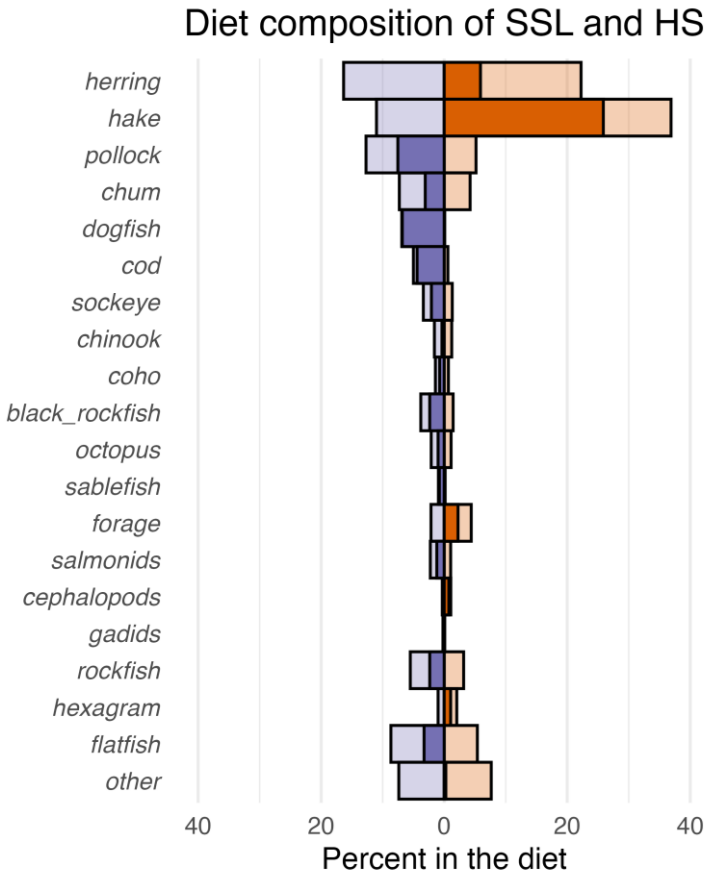
➢ 12 species account for:

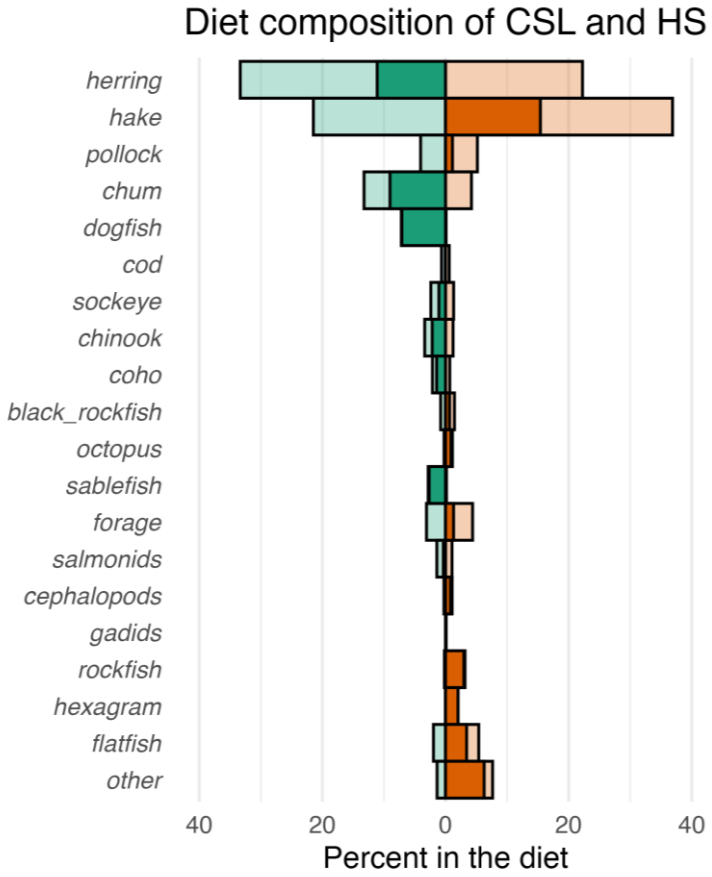
78.5% Steller diet
95% California diet
82.5% Harbour seal diet

➢ high proportions of **herring, hake, pollock, and chum salmon – all commercially exploited**

Pairwise contrasts



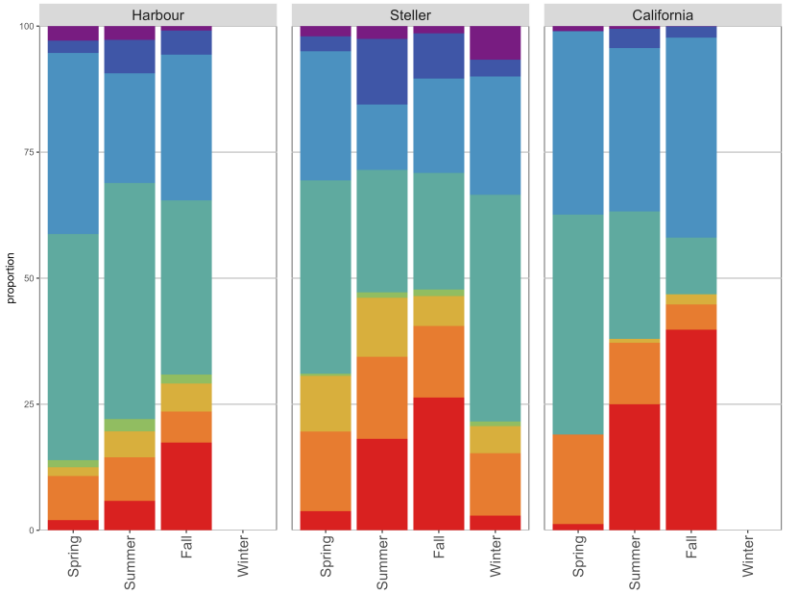




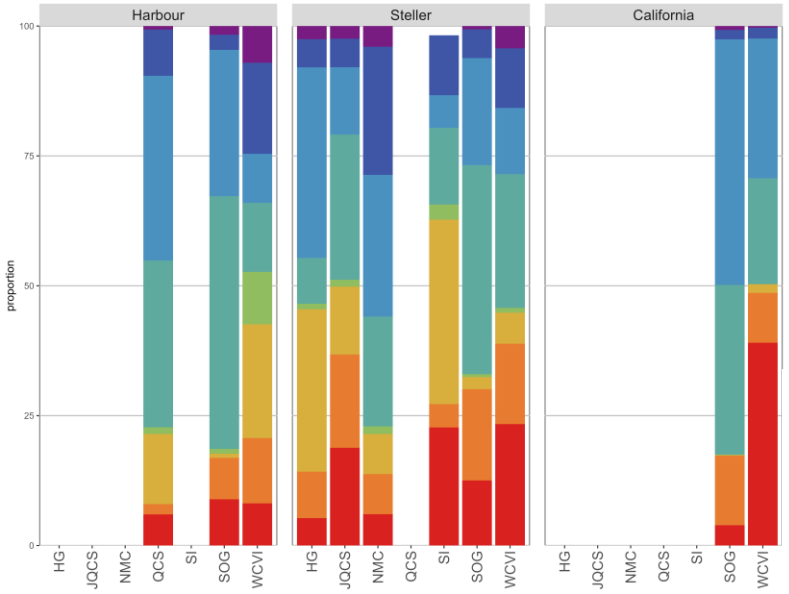
Mean diet (light shading) and relative difference (dark shading) between pinnipeds for 12 species and 8 prey groups (exclusive of species identifications) and a catch-all “other” prey category.

Variation in mean diet by…

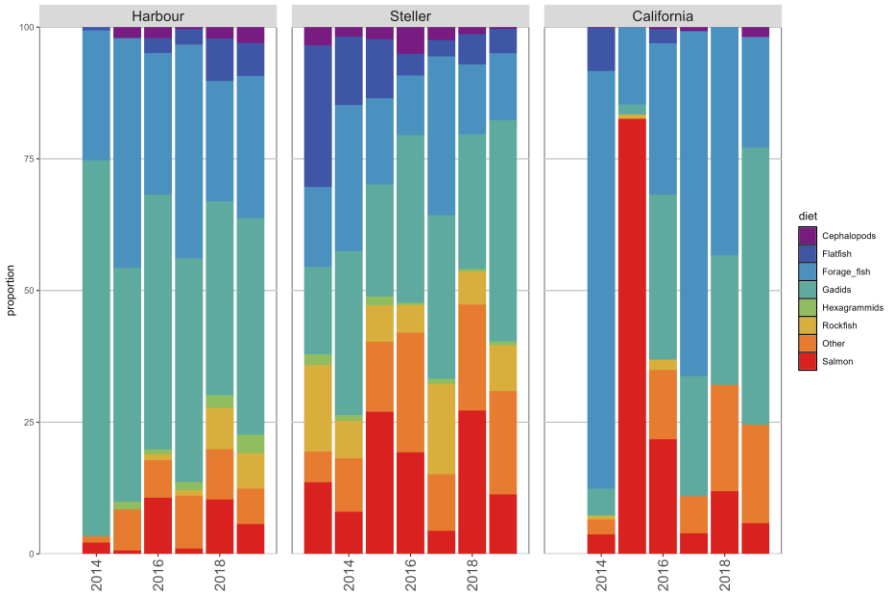
Season



Region



Year



Further variation with sex (and likely age class)

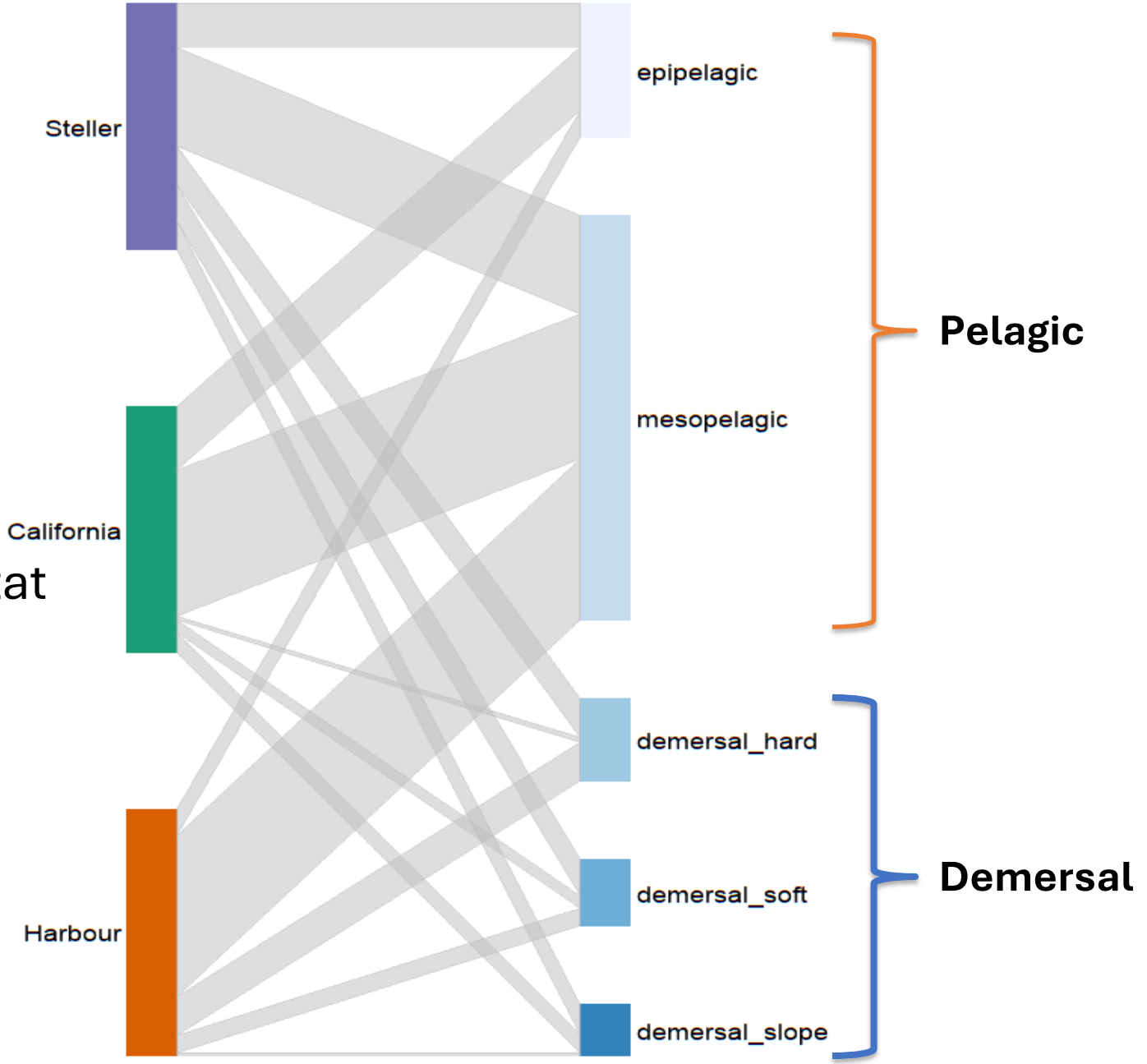
Pelagic prey:

California > Harbour > Steller
(85%) (78%) (60%)

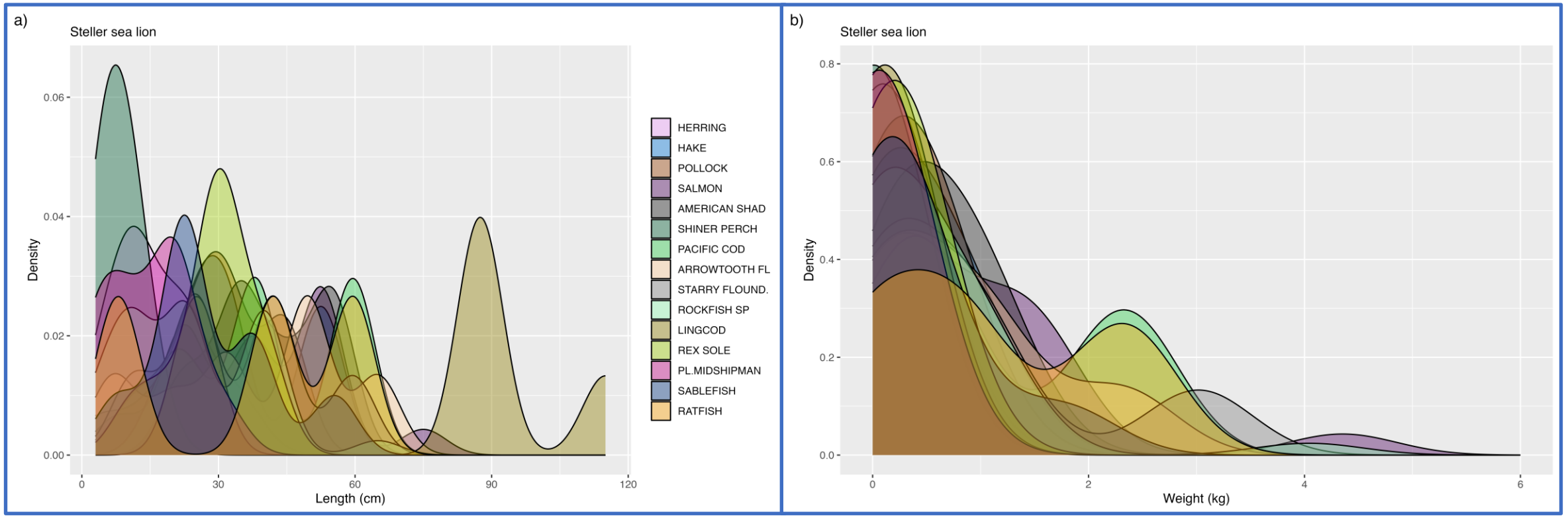
Further differentiated by finer prey habitat classifications

ex. mesopelagic prey:

Harbour > California > Steller



Prey size



Example: Probability density functions of prey size in diet of Steller sea by a) length, and b) weight.

- All three pinnipeds consume large prey of 100cm or greater, however, the majority (>60%) of fish consumed were less than 45 cm and 0.5 kg
- the mean size of prey increased with predator body size (harbor seal < sea lions)

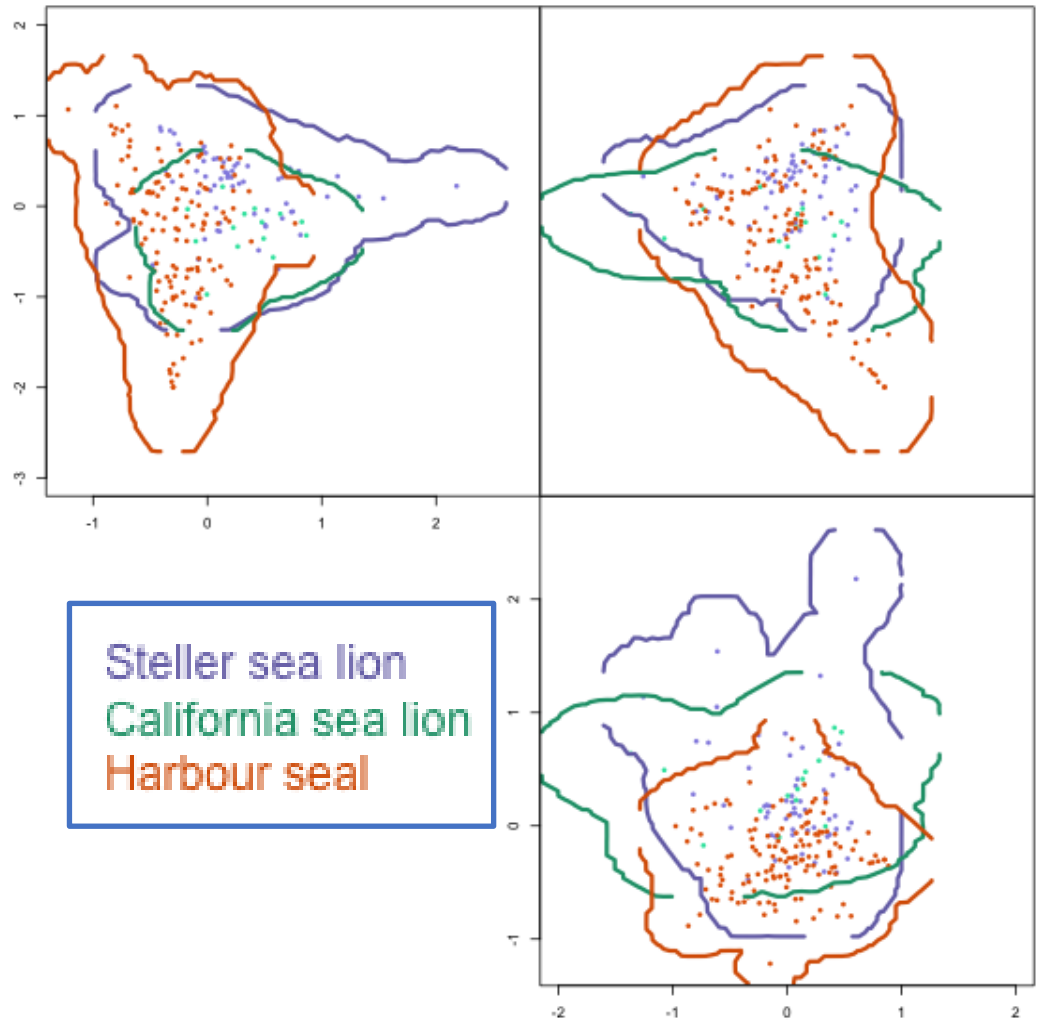
Dietary niche overlap

niche breadth (hypervolume of first three CA axes) :

Harbour > Steller > California
(7.3) (6.9) (5)

distance between hypervolume centroids (diet similarity) :

- closest for Steller and California diets (0.42)
- largest for Steller sea lion and harbour seal diets (0.74)
- intermediate for California and harbour seal diets (0.64)

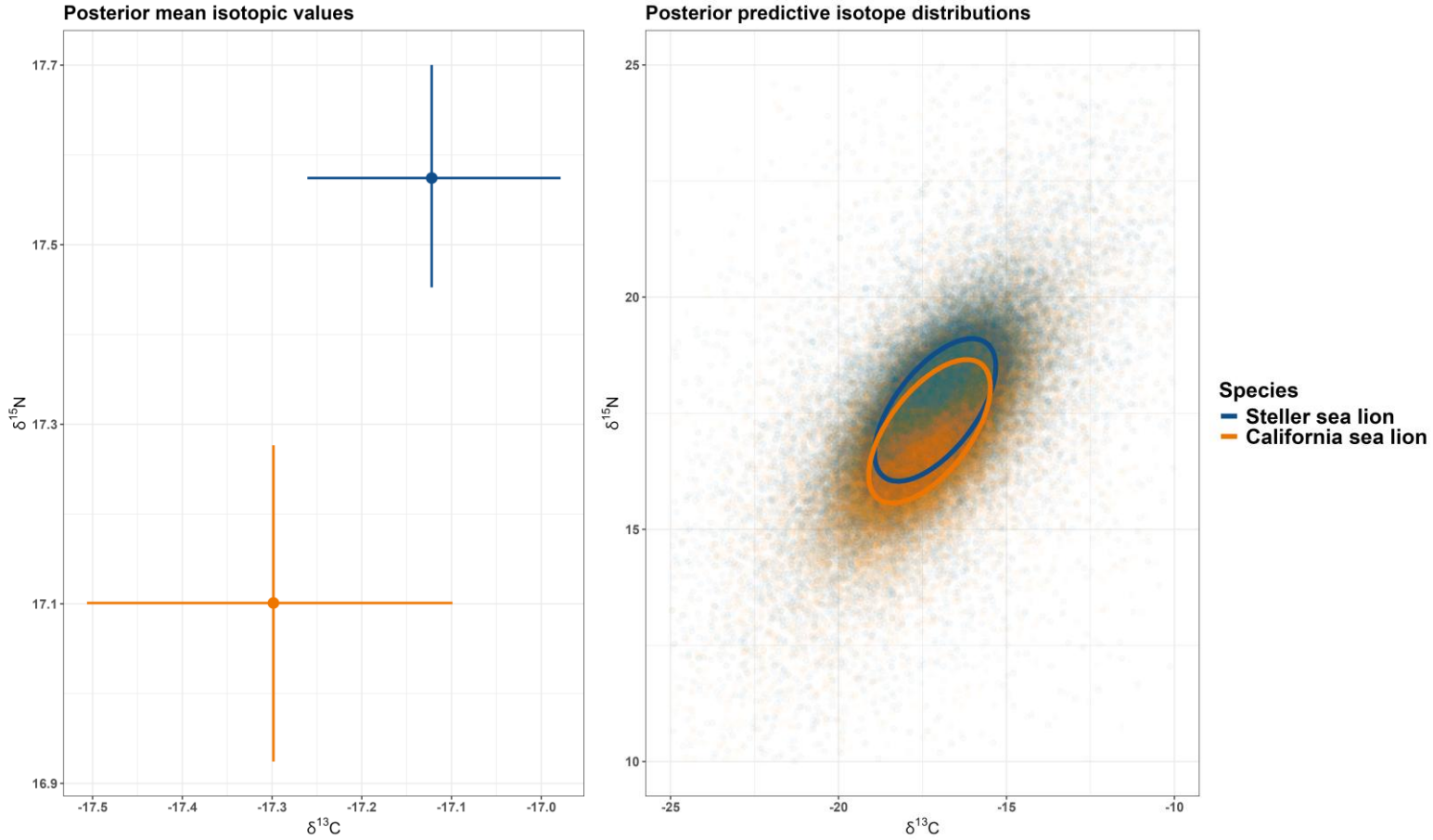


Ecological niches (95% hypervolume niche space). Correspondence axes 1 through 3 and the function hypervolume_gaussian in the R package **hypervolume** were used to quantify 95% hypervolume niche space, and the function *hypervolume_overlap_test* was used to test for significant differences in niche space.

Stable Isotopes

Mean isotope values differ: California have lower estimated mean $\delta^{15}N$, while evidence for a difference in mean $\delta^{13}C$ is less conclusive.

Individual isotope distributions overlap: median coefficient is 0.71: two species' predicted isotope-space distributions share considerable probability mass.



Overlap in isotopic space: female and younger age class of Steller sea lions

Conclusions

- somewhat novel and shifting assemblage of pinnipeds which appear to be coexisting
- shifts will likely have cascading effects with emerging points of fisheries conflict

Compounding questions…

- many fish and marine invertebrate species are expected to shift northward due to climate change, potentially creating mixed, novel communities
- California sea lions-adaptable predators but seem intimately linked to California Current System: is their recovery sustainable? Will they represent a further community strain or increased resilience??

Dynamic niche-based framework for assessing fisheries conflicts

QUESTIONS?

