Members of the Holtgrieve Ecosystem Ecology Lab, led by graduate student Megan Feddern, are trying to better understand the interactions between harbor seals, their prey and environmental changes to better inform management decisions from an ecosystem-based approach. We aim to do this by:

1. Creating a dataset of where harbor seals have been feeding in the coastal WA food web over the past 100 years from museum skull specimens.
2. Combine this dataset with other historic datasets of environmental drivers (Pacific Decadal Oscillation, El Niño Southern Oscillation, sea surface temperature) and important harbor seal prey species (herring biomass, salmon populations, Pacific Hake biomass) to identify what ecological components drive harbor seal food web position.
3. Integrate our results to develop ecological integrity indicators’ for the California Current Integrated Ecosystem Assessment (CCIEA). For this particular dataset the harbor seal food web position indicator will represent ecological interactions between harbor seals through competition, predation and environmental drivers.

USING MUSEUM SPECIMENS TO UNDERSTAND THE HARBOR SEAL’S ROLE IN THE ENVIRONMENT

RECOVERY CHALLENGES IN PUGET SOUND

Harbor seals experienced exponential growth in Puget Sound following the implementation of the Marine Mammal Protection Act (MMPA), from historic lows of approximately 2,100 in 1972 before leveling off at the current population size of 18,000 (Jeffries et al. 2003). This change in predator abundance has been correlated to declines in forage fish and salmonid survival across the WA coast, which suggests harbor seals pose a threat to the recovery of endangered and vulnerable species in the region, including Chinook salmon and southern resident killer whales (Thomas et al. 2017).

However, this change in predator abundance also coincided with a broad-scale environmental regime shift known as the Pacific Decadal Oscillation in 1977/78, a phenomenon that has also been linked to productivity of fish species in WA, including salmon.

Teasing apart these ecological drivers is challenging yet important for management of the Sound as an integrated system, so called ecosystem-based management.

WHAT DO YOU DO WHEN ONE PROTECTED SPECIES HARMS ANOTHER PROTECTED SPECIES?

Harbor seals are protected by the MMPA and believed to be a significant predator of threatened Chinook salmon and competing with endangered southern resident killer whales, while also impacting economically valuable fisheries. This poses a challenging management trade-off.

RESEARCH OBJECTIVES

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HOW DO WE DO IT?

Using a recent methodological advancement called compound specific stable isotope analysis of amino acids, we are able to measure the nitrogen isotope ratio ($^{15}$N/$^{14}$N) of eleven different amino acids preserved in bone collagen. Certain amino acids, called trophic amino acids, show an increase in $^{15}$N relative to $^{14}$N as an animal feeds higher in the food web. Other amino acids, called source amino acids, do not show this change and instead have the $^{15}$N/$^{14}$N of primary producers. By using the $^{15}$N/$^{14}$N of trophic amino acids and controlling for potential changes in distribution of $^{15}$N and $^{14}$N using source amino acids we can calculate food web position. We can decalciﬁy a small piece of bone (50 mg) to access preserved collagen and measure the $^{15}$N/$^{14}$N of the amino acids contained within that collagen and calculate the food web position of the harbor seal that collagen came from.

PROGRESS

150 museum harbor seal skull specimens from seals from 1920-2017 have been obtained and the $^{15}$N/$^{14}$N of their collagen has been measured. We now have estimates of harbor seal food web position from the Hood Canal and Puget Sound during that time period. (Figure 1)

STAY TUNED

Moving forward we will be comparing our food web position calculations to other datasets to understand the drivers of harbor seal food web positions, and how harbor seals interact with environmental drivers and prey sources. We will then work with the Northwest Fisheries Science Center to incorporate our findings into interpretable indicators for the CCIEA. We will provide an update and interpretation of our findings when we have further analyzed our data.