Exploring predators as samplers
How can we use diet data to quantify prey distribution and density?

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Background

Prey availability is an important factor influencing habitat quality for predator species. Distributions of groundfish predators are also known to respond to localized prey abundances. Currently, standardized surveys in the Gulf of Alaska (GOA) do not adequately sample prey species (e.g., euphausiids, forage fishes, benthic invertebrates) and the capacity to expand survey scope is limited. Predator diet data has been used to quantify spatial and temporal trends of prey in other systems [1-4]. This project aims to utilize readily available diet data from the National Oceanic and Atmospheric Administration (NOAA), Alaska Fisheries Science Center's (AFSC) bottom trawl survey to assess prey distribution and density in the GOA.

Research Objectives

- Use diet data from groundfish predators to quantify spatiotemporal variation in prey densities throughout the GOA.
- Utilize a multivariate statistical framework – joint species distribution models (JSDMs) – to model prey taxa. JSDMs provide a multivariate context to quantify species correlations and improve model performance for more rare taxa.
- Create prey informed species distribution models (SDMs) for commercially important groundfish in the GOA.
- Quantify differences between prey informed and non-prey informed predator groundfish SDMs.

References

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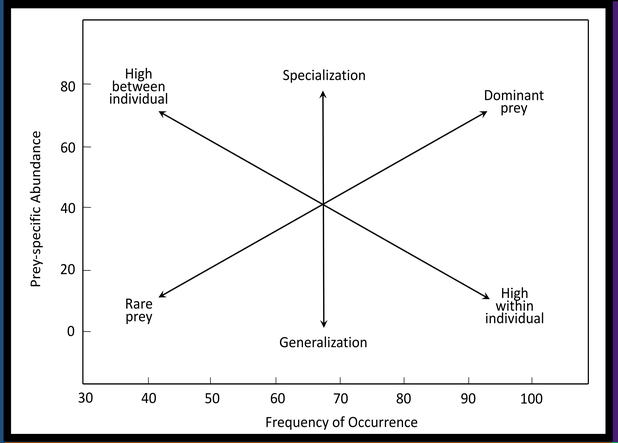
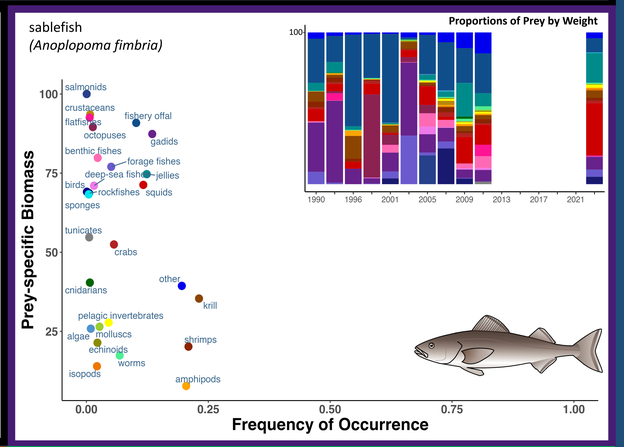
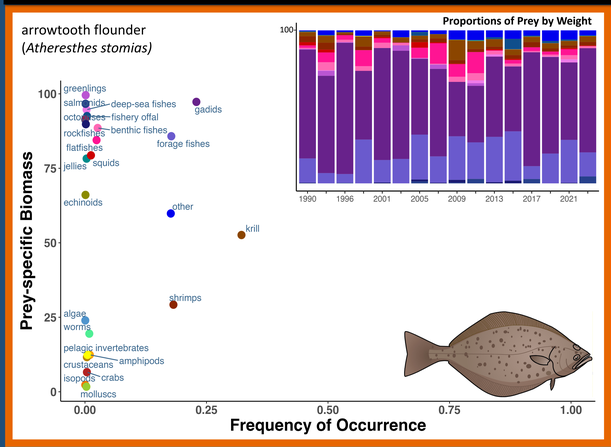
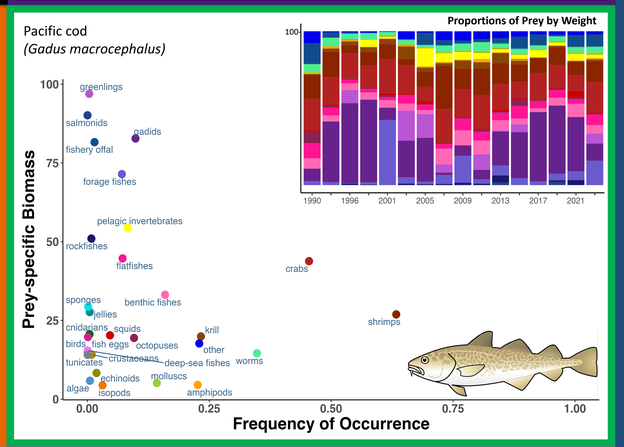
NOAA FISHERIES

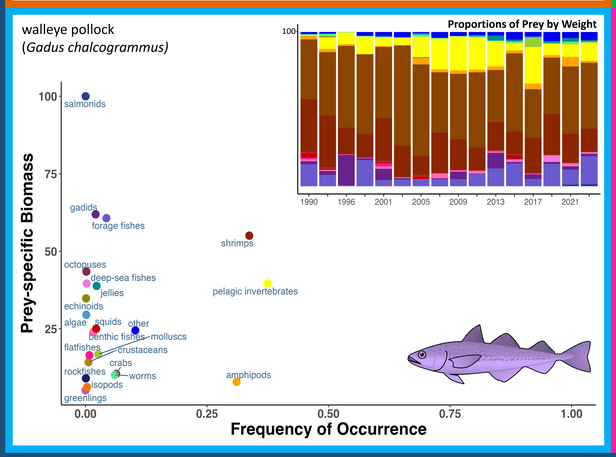
Predator Diet Composition

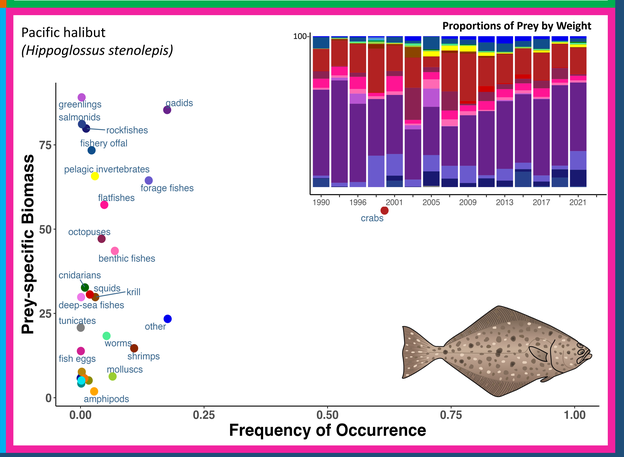












Predator feeding strategy diagram [5]

Diet data subset to 50% length at maturity for Pacific cod, pollock, and arrowtooth flounder. All samples retained for sablefish and Pacific halibut.

Frequency of Occurrence = $O_i = \frac{J_i}{P}$

J_i = number of fish containing prey i

P = number of fish with food in their stomachs

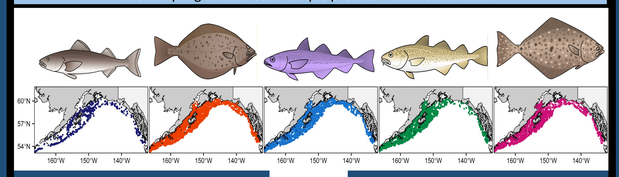
Prey-specific Abundance = $P_i = (\frac{S_i}{S_{t\,i}})100$

S_i = grams of prey i in stomachs

$S_{t\,i}$ = total grams of prey in predators that contain prey i

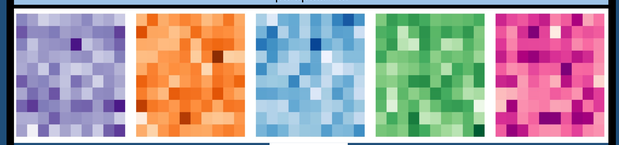
Workflow Diagram

Grams of prey per grams of predator, weighted for predator size representation, will be used as the sampling unit for each unique predator-haul combination.



Joint species distribution models (JSDMs) will be used to model prey densities as a function of predator species and size, along with a suite of environmental covariates (e.g., depth, occurrence of structure-forming invertebrates). Model development will be done using *tinyVAST* [6].

Prey distributions and densities will be predicted for the GOA from each predator's sampling perspective.



Predator-specific prey predictions will be combined in a composite index to provide interspecies corroborations of prey distribution and density.