

Spatio-temporal models provide new insights on the biotic and abiotic drivers shaping Pacific Herring (*Clupea pallasii*) distribution

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INTRODUCTION

- Determining how fish respond to variation in biotic and abiotic conditions is a prerequisite to forecasting changes in productivity and spatial distribution of fish stocks.
- We investigated physical and biological drivers of spatio-temporal dynamics of Pacific Herring, a forage fish species important for commercial fisheries and First Nations in the NE Pacific.

METHODS

- Spatio-temporal vector autoregressive (VAST) models used to describe & quantify:
 - spatio-temporal fluctuations
 - abundance dynamics through time,
 - effects of abiotic and biotic factors,
 - spatio-temporal covariation with prey, predators, and competitors.
- Three fishery independent DFO surveys:
 - pelagic fish, nighttime near-surface trawl
 - multispecies, daytime bottom trawl
 - Pacific Hake, daytime acoustic.
- Zooplankton (total biomass & Herring prey)
- Environment (temperature, chl_a, salinity, oxygen, fluorescence, & transmissivity)
- Timing differed among surveys; however, expect data collected during spring and summer reflects abundance.

RESULTS

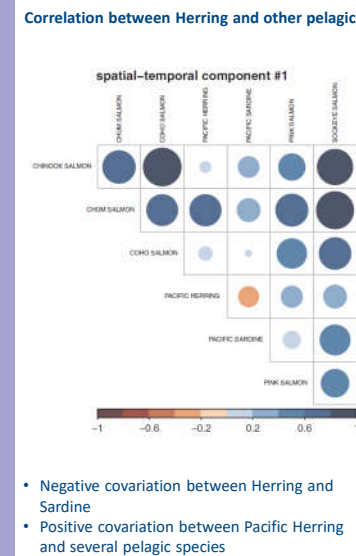
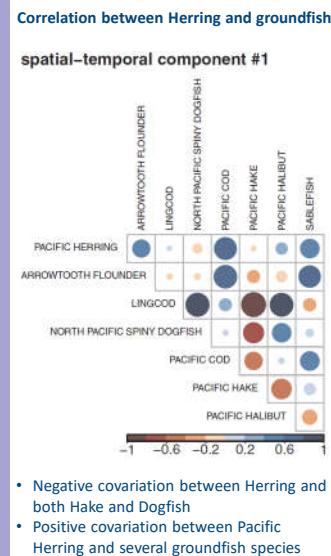
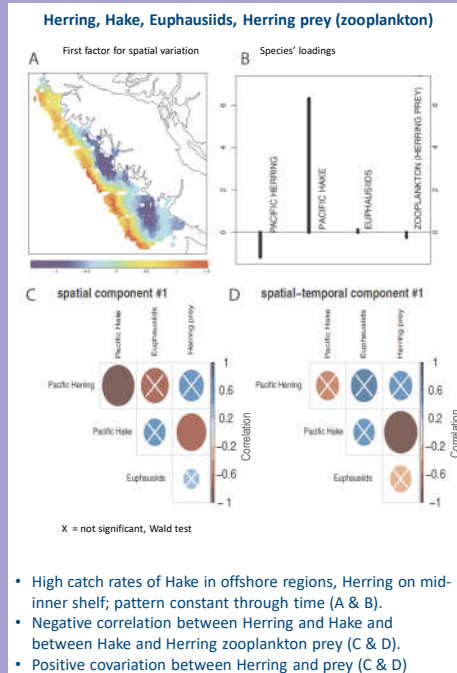
- Increased relative abundance Herring, 2006-2014
- Herring abundance quadratically correlated with May sea surface temperature
- Herring on continental shelf (<185 m)
- Euphausiids, Pacific Hake, Sablefish and Arrowtooth Flounder near shelf break (>185 m)
- Positive covariation between Herring and its zooplankton prey
- Negative covariation in spatio-temporal densities between Herring and both Hake & Sardine
- Positive covariation in spatio-temporal densities between Herring and several groundfish species (Arrowtooth Flounder, Sablefish, Halibut, Cod)

CONCLUSION

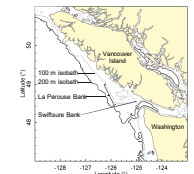
Results suggest that strongest drivers of Pacific Herring summer distribution and biomass are: i) zooplankton prey availability; ii) predator avoidance, particularly Pacific Hake; and iii) competition with sardines.

Strongest drivers of Pacific Herring summer distribution & density:

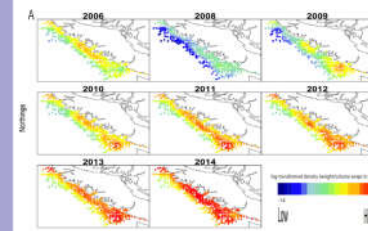
- Pacific Hake, predator
- Pacific Sardine, potential competitor
- Zooplankton prey



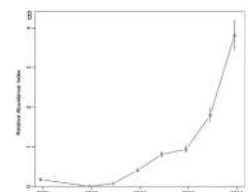
Study Area



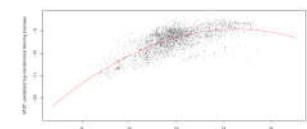
West Coast of Vancouver Island, British Columbia, Canada; a summer feeding area for multiple stocks of Pacific Herring



Herring relative abundance, 2006-2014



Herring relative abundance index, 2006-2014



log-transformed Herring biomass vs. May sea surface temperature

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