The Value of Simple Mechanistic Models

and

How to Use their Squishy Data

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Three Major Factors Control Recruitment and Natural Mortality

- Predation

- Food availability

- Temperature
  - Can in part be offset by food availability

Predation

- May be hard to model
- Need to know:
  - Biomass of predators
  - Consumption rates of predators
  - Availability of alternative prey
  - Spatial overlap

Food Availability

- May also be hard to model
- Need to know:
  - Biomass of species of interest
  - Consumption rates of species
  - Consumption rates of competitors and their biomass
  - Availability of alternative prey
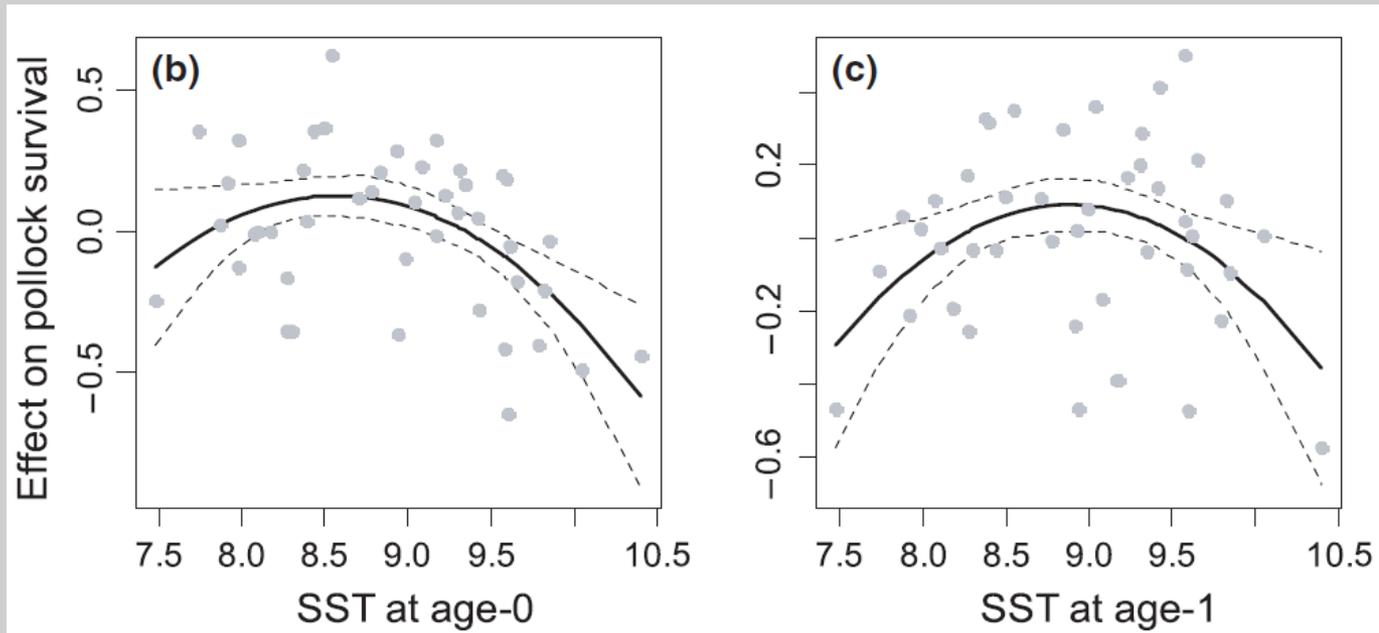 - Spatial overlap of consumer and prey

Food Availability II

- Eisner and Yasumiichi 2017:

Age-3=1485+37(LZoop), R^2 =0.66, p-value=0.002
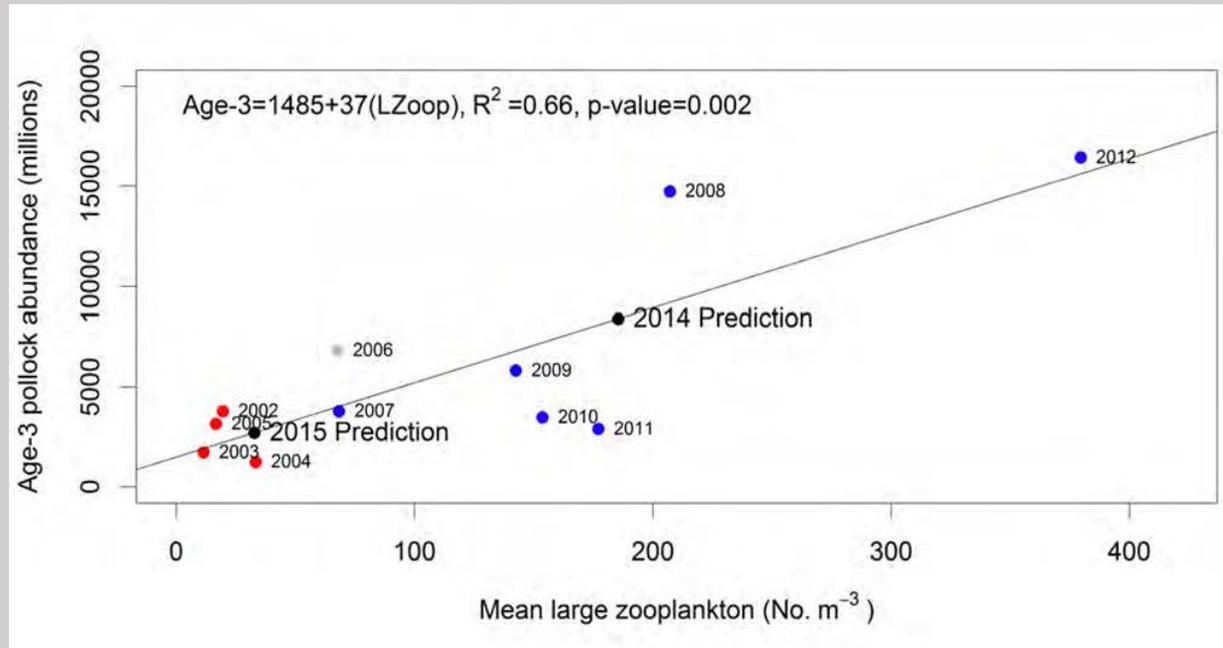
- Simple model, considerable explanatory and predictive value

- Possible to add effect of bottom temperature (Coyle & Gibson, 2017), spawner biomass
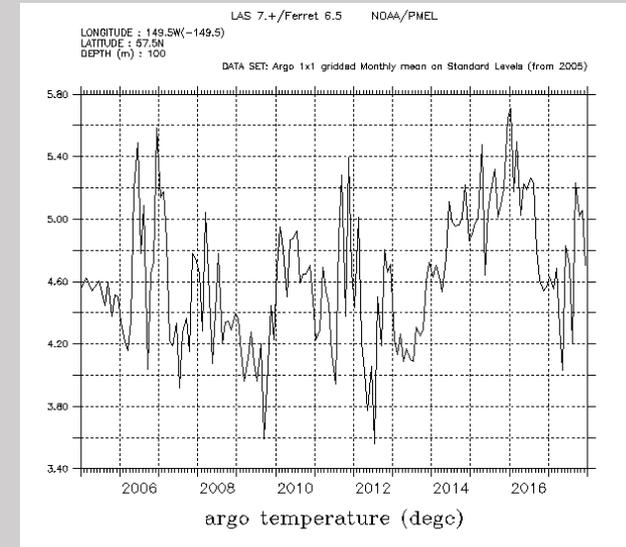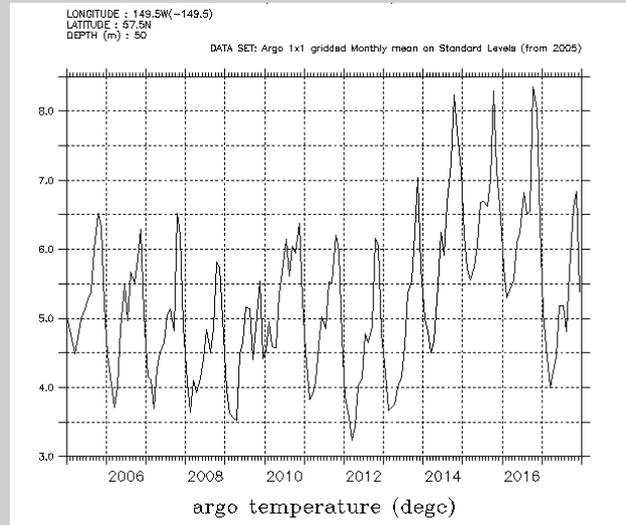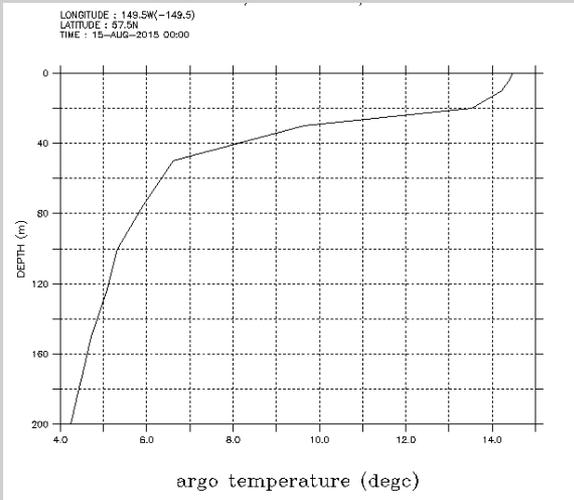
Temperature

- Dome-shaped impact on pollock survival (Coyle et al. 2011):

- Very warm and very cold temperatures bad
  - Cold hits eggs and larvae, freezing of adults(?)
  - Warm speeds metabolism; depletes lipids

Temperature in a Context

- Gulf of Alaska Blob in 2015-2017 Courtesy Nick Bond)

- Temperature responses of Pacific cod
  - Chung, Kim & Kang (2013): most cod caught 0°C - 8°C; top temp.12.8°C
  - Hanna et al. (2008): 4 -11°C; metabolic rate 28% higher at 11°C

- Ecosystem Context
  - Prey status important

How to Incorporate Information in Assessment and TAC setting Processes

- Unconventional data
    - Seabird diets and reproductive success
    - Zooplankton abundance

- Sometimes hard to quantify
    - What is abundance or availability of forage fish?

- Insufficient history to assess reliability
    - How many years are enough?