FEAST Forage and Euphausiid Abundance in Space and Time
Assumptions, knowledge and gaps

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Background

As part of the multi-year Bering Sea Project (BEST-BSIERP), we implemented the FEAST model; the fish component of an end-to-end vertically integrated model based on dynamic prey fields, bionenergetics, and a suite of fish species . The fish module is coupled to the ROMS ocean model for the Northeast Pacific (NEP5) and a lower trophic level (NPZ) model that includes microplankton and ice bloom dynamics.

Data integration

Historical databases and retrospective data analysis were used to calibrate many of the dietary and length-weight relationships; however, the coupling with zooplankton, bioenergetics and early development required close collaboration between modelers and observational field researchers. Several participatory workshops were held in 2011-2012 to compare and contrast model outputs to results from the BSIERP field years (2007-2010).

Challenges, assumptions and gaps

- Seasonal temperatures and spatial thermal habitats were initially too warm, affecting bioenergetics as well as fish distribution. Mooring data and RACE survey bottom temperatures were used to evaluate bias and extent of cold pool and tune the model (fig 1a, b) in the Bering shelf. Data are still required to evaluate non-shelf areas.
- Age zero pollock survival to age 1 can be tuned for single years, but parametrizations are not robust to warm and cold conditions. The model nudges age one fish once at the beginning of the year . This means relative survival of age zero under different climate conditions can be evaluated but not predicted accurately. A total abundance estimate of age zeroes would inform response to climate. BASIS surveys inform distribution and relative abundance (fig 2 and 3 a,b).
- Predicted fish distribution by length (fig 4 a, b), based on distribution of predators and prey, are a core output to the model, and measured against length-specific survey trawl data.
- Sudden bouts of growth are caused by zooplankton blooms in the model. Modeled seasonal increases in energetic density correspond to observed seasonal shifts in lipid content (fig 5 a, b), but variation in timing is critical to calibration and prediction.
- Euphausiids production and predation is still controversial, with acoustic abundance estimates an order of magnitude higher that simulated values and other field measurements. Improved field estimates and related carbon budget studies are still needed as evidence in support of top-down or bottom-up controls (fig 6 a, b)

Fig.1a 2004 Bottom depth temperature , RACE/NMFS summer bottom trawl survey

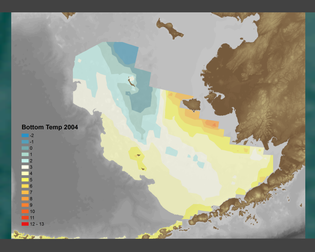


Fig.2a 2004 Pollcok age zero BASIS survey frequency of fish by haulk (left) Number of fish per unit area (right) ,data courtesy Ed Farley. AFSC Observer's database

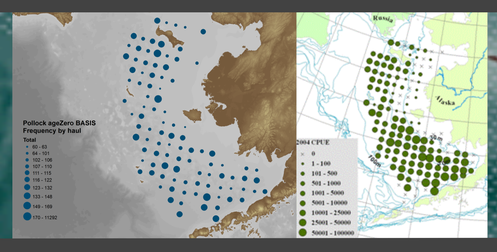


Fig.3a 2008 Pollock age zero estimete of fish/nmi from acoustic BASIS. Acoustic survey fills in 3D gaps in net BASIS survey. data Sandy Parker, UW

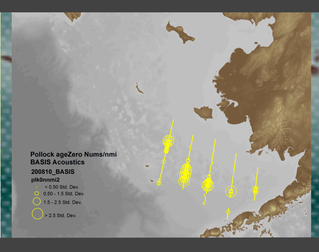


Fig.4a 2004 Pollock combined Acoustic-Bottom trawl weight CPUE data courtesy Ressler & Kotwicki

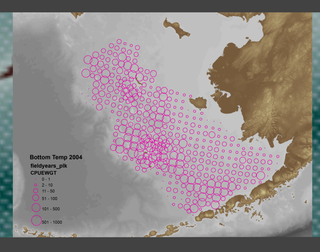


Fig.5a Seasonal Shifts in Lipid content of YOY Pollock, data Ron Heintz

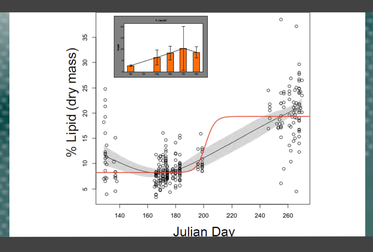
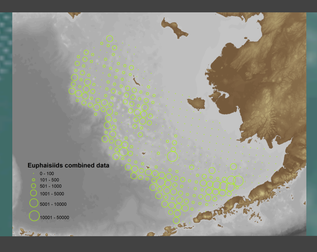


Fig.6a Euphausiids 2004 from Acoustiic Spring survey,data courtesy Patrick Ressler



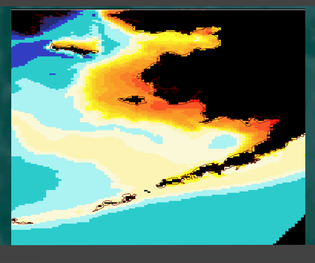


Fig.1b 2004 Summer bottom depth temperature, ROMS (oceanography module in FEAST)

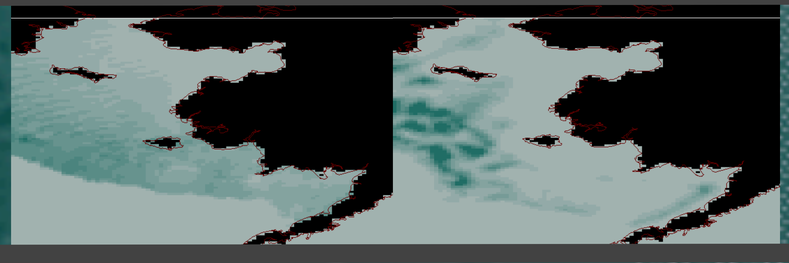


Fig.2b 2004 summer Pollock age zero number of fish as modeled by FEAST

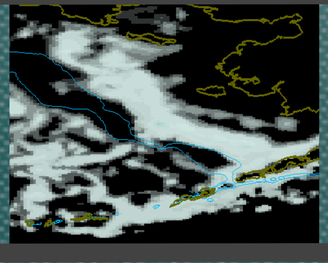


Fig. 3b 2004 Pollock age zero biomass as modeled by FEAST

Fig.4b 2004 Pollock age 1+ biomass in summer as modeled in FEAST

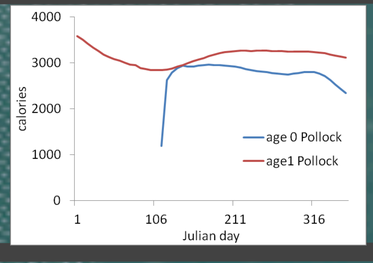


Fig5b Energy density of pollock age zero and age 1 during 2004 as modeled by FEAST. Fish were initialized Jan 1 with condition of 1 . et al. 2005)

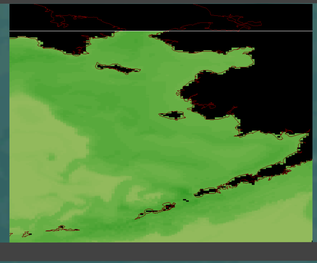


Fig.6b 2004 early June Euphausiids from NPZ module in FEAST

Acknowledgments

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