Reducing Recruitment Uncertainty in Alaskan Sablefish Stock Assessment

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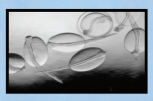
Introduction and Background

Sablefish (*Anoplopoma fimbria*) are a fast-growing, highly valuable commercial groundfish species in the North Pacific. Adults occur in depths >200 m along the continental slope, shelf gullies, and deep fjords. Little is known about their early life history. Spawning and egg incubation take place at depth (~500 m) in early spring. Larvae swim to the surface, collecting at the shelf break. Juveniles overwinter nearshore and begin to move offshore, reaching adult habitat four to five years later.

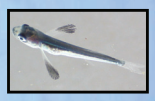
The stock is assessed with an age-structured model, and information to estimate recent recruitment is sparse and highly variable. Additionally, recruitment appears to be more related to the environment than spawning biomass. The purpose of this project is to evaluate the various sources of early life history data and explore integration of several environmental time series within the sablefish stock assessment model to reduce the uncertainty of recent recruitment estimates.

Methods



Early Life History Data:

- Collect NOAA Fisheries Survey Data
  - Pelagic: Young of the Year (YOY)
    - BASIS-GLOBEC, FOCI, ABL Gillnet
  - Benthic: Juveniles
    - NMFS Bottom Trawl
- Qualitative comparison with recruitment
  - Sampling discontinuous and not directed



Cross-Shelf Transport Model:

- Ocean Surface CURrent Simulator
  - Daily surface currents, retrospective
  - Start: high spawning, critical area
- Onshore/Offshore Index
  - Define time period for model
  - Use 1000m depth line as barrier
  - Positive offshore, negative onshore

Sablefish Model Indices:

- Identify mechanisms and select indices
  - Large scale (Aleutian Low)
  - Cross-Shelf Transport (OSCURS)
  - Vertical Stability and Mixing (freshwater)
- Run model with environmental index
- Model Comparisons
  - 1000 random simulations versus index

Preliminary Results

Early Life History Comparison (Fig. 1):

- High autocorrelation in low recruitment
  - No large year classes since 1970s
- Critical pathways during high recruitment
  - Unimak Pass, Shelf gullies (white circles)

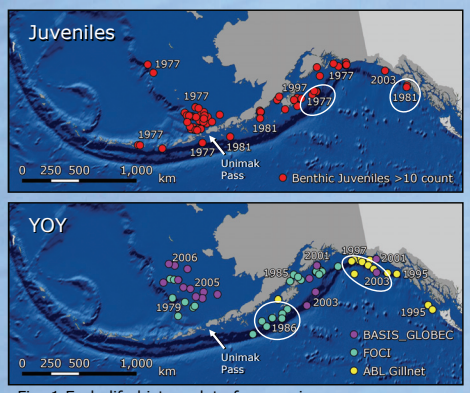


Fig. 1 Early life history data from various sources

Cross-Shelf Transport Model (Fig. 2):

- Female Population and critical areas
  - Southeast Alaska and Kodiak
- Transport defines two mechanisms
  - Conditions for YOY and returning juveniles

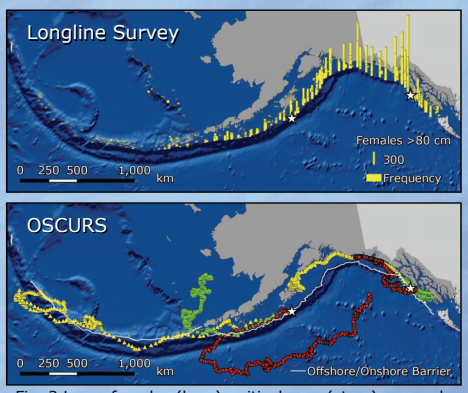


Fig. 2 Large females (bars), critical area (stars), example transport pathways (dot, triangle, square)

High Resolution – *In Progress* (Fig. 3):

- Bottom Trawl Temperatures (below)
- Satellite-derived Time Series
  - Pathfinder V5, Multi-mission altimetry,
  - SeaWiFS Primary Productivity

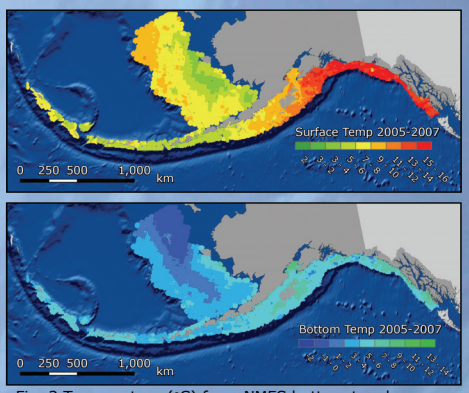


Fig. 3 Temperature (°C) from NMFS bottom trawl survey

Sablefish Model Comparisons:

- Three indices better than 90% of random
  - East Pacific Index in spring/summer
  - Spring freshwater discharge for YOY
  - Fall Kodiak transport for returning juveniles
- Improvement in recruitment uncertainty

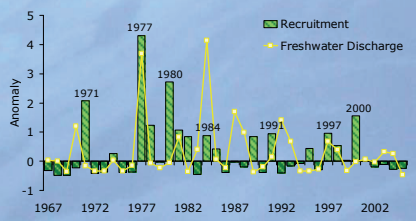


Fig. 4 Recruitment anomalies from model with index

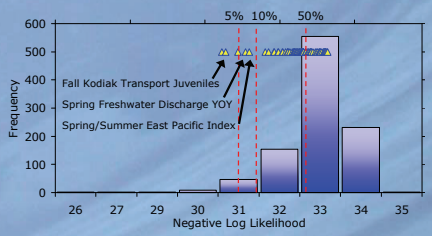


Fig. 5 Recruitment likelihood for indices (△) & 1000 random

Discussion

Early life history data provides evidence for potential critical pathways during years of high recruitment, and model comparisons suggest large scale changes in climate, freshwater, and transport explain some of the recruitment variability of sablefish. Relationships may be more indirect, where the index is indicative of food availability for YOY or juveniles. The 2009 Center of Independent Experts review of the sablefish assessment suggested exploring spatially explicit modeling. The next step will be to analyze high resolution data at spatial scales related to sablefish life history and fisheries management. Incorporating environmental data in the stock assessment may allow for early detection of recruitment trends and increase efficiency in harvest decisions.