Prediction of Suitable Rockfish Habitat

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Yelloweye rockfish, *Sebastes ruberrimus*, the target species for the demersal shelf rockfish (DSR) longline fishery in Southeast Alaska, is long-lived (O'Connell and Funk 1987), late maturing (O'Connell and Fujioka 1991), and highly residential (O'Connell 1991). These life history characteristics result in a species that is extremely vulnerable to over harvest. The Alaska Department of Fish and Game (ADF&G) sets the total allowable catch for yelloweye to no greater than 2% of the exploitable biomass; biomass is estimated from density, average weight, and habitat area (Brylinsky et al. 2007). The estimated area of rockfish habitat is the factor of interest for this study. Rockfish habitat is delineated by a combination of multi-year DSR fishery logbook data and acoustic (multibeam and/or sidescan sonar) survey data. We consider acoustic survey data a better predictor of rockfish habitat than logbook fishery data, so in areas where acoustic survey data is available, we use it instead of fishery data. However, in some locations only high resolution bathymetry in the presence or absence of fishery data is available. The purpose of this project is to determine if we can improve our estimate of available rockfish habitat by using bathymetry to predict locations where yelloweye rockfish occur. A model to predict yelloweye abundance was produced using generalized linear models with catch per unit effort (CPUE) data from the directed commercial fishery, depth and other characteristics derived from bathymetry, such as slope, rugosity and bathymetric position index. In the future we will test the predictive ability of the model, as well as compare the prediction of yelloweye abundance to habitat type in locations where backscatter has been interpreted. In addition, we will explore models that incorporate yelloweye presence/absence data derived from submersible surveys as the dependent variable.

Introduction

- Yelloweye rockfish is a highly valued species yielding an average price per pound of $1.70 from the 2008 directed fishery for demersal shelf rockfishes (DSR).
- Yelloweye rockfish composed 96% of the species assemblage of demersal shelf rockfishes in all commercial fisheries since 2001 (Brylinsky et al. 2007).
- The full potential of the DSR fishery has not been realized in recent years due to area (2003–2005) and complete closures (2006 and 2007).
- The DSR fishery of the Southeast Outside Subdistrict is managed jointly by NMFS and ADF&G with a habitat based stock assessment.
- Habitat is delineated by a combination of multi-year DSR fishery logbook data and acoustic (multibeam and/or sidescan sonar) survey data interpreted into bottom type.
- We consider acoustic data a better proxy of suitable yelloweye habitat, as a consequence in locations where both data types are available we use solely acoustic data to delineate habitat.
- We hope to improve our estimation of suitable yelloweye rockfish habitat in locations where opportunistic bathymetry data is available in the absence of acoustic data.

References

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Objectives

1. Predict yelloweye rockfish abundance using bathymetric data.
2. Delineate suitable rockfish habitat from yelloweye abundance prediction for incorporation into the stock assessment.

Methods

Dependent variables

Yelloweye abundance data was compiled from two different sources:

1. Catch per unit effort (CPUE) data- the number of yelloweye rockfish caught per hook was determined from fishermen's logbooks.
2. Presence/Absence data- yelloweye rockfish observations from submersible surveys were used to designate presence of yelloweye rockfish.

Independent variables

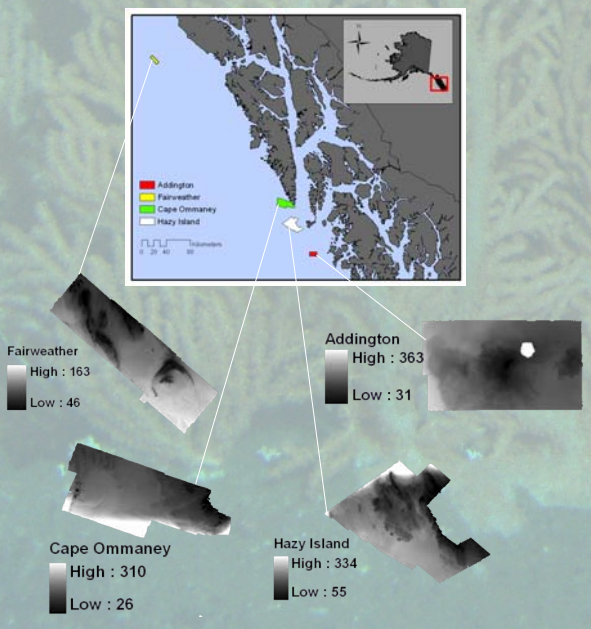
- Habitat characterization was performed from location and depth (x,y,z) data to produce the following independent variables: 1) depth, 2) slope, 3) rugosity, 4) bathymetric position index (BPI) broad, and 5) BPI fine

Rugosity = a measure of terrain complexity, surface area to planar area, or "bumpiness".

BPI = a measure of where a designated location is relative to surrounding locations. The broad (small) scale BPI uses a larger analysis neighborhood compared to fine (large) scale BPI.

- Four areas of high-resolution (5x5m cells) bathymetric data were used for habitat characterization.

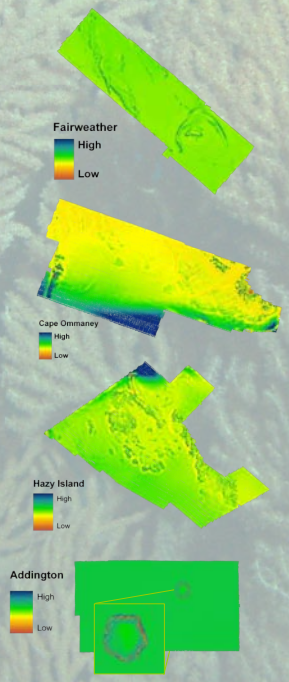
High-resolution bathymetric datasets



Fitting the model

- Independent variables were sampled at the locations of CPUE data.
- The Marine Geospatial Ecology Tools (Roberts et al. 2007) were used to fit variables with a generalized linear model.
- A stepwise regression was used to select model terms.

Progress so far…Yelloweye Rockfish Abundance Prediction



CPUE based prediction model

Linear terms: $-\beta_0 + \beta_1 D - \beta_2 S + \beta_3 R - \beta_4 Br + \beta_5 Bf$

Quadratic terms: $\beta_6 D^2 - \beta_7 R^2 - \beta_8 Br^2 + \beta_9 Bf^2$

Interaction terms: $\beta_{10} DS - \beta_{11} DR - \beta_{12} DBr + \beta_{13} SR \beta_{14} SBf + \beta_{15} RBr$

Variables: Depth (D), Slope (S), Rugosity (R), BPI Broad (Br), BPI fine (Bf)

- High resolution bathymetry and derived characteristics are useful in prediction of trends in abundance of yelloweye rockfish.

Future Work

- Test the ability of the model to predict yelloweye abundance by randomly selecting 10% of the data to "hold out", refit the model, and test the prediction in the "hold out" area. Perform repetitively.
- Compare predicted yelloweye abundance with interpretation of habitat as hard, mixed, and soft from acoustic data.
- Delineate suitable rockfish habitat from yelloweye abundance prediction for incorporation into the stock assessment.
- Produce a yelloweye prediction model with submersible survey data for comparison.
- Apply the model to "new" bathymetric datasets.