

Habitat-based Predictive Models and Maps of Rockfish Abundance off California

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Concept

A number of management actions have been taken to support the rebuilding of overfished rockfish stocks on the west coast, including time and area closures, fishing gear modifications, minimum stock size thresholds, and catch and size limits. Understanding the association between habitat and rockfish distribution and abundance is integral to meaningful stock and habitat assessments in support of these management actions.

The SWFSC Habitat Ecology Team has been developing predictive models and regional maps of the abundance of various species of Pacific rockfishes based on visual survey observations of fish numbers, sizes, and associated habitat variables (depth; substrate types; indices of seafloor complexity; predicted bottom temperature; indices of productivity).

Diverse habitats and fishes

Study Setting and Surveys

Complexity in both oceanographic and topographic aspects of habitat promotes highly diverse assemblages of demersal fishes, including 50+ species of both healthy and overfished rockfish stocks off central and southern California.

Our survey efforts and models are focused on data-poor and overfished species that occur primarily in untrawlable habitats at 35-400 m water depth.

We collect fishery-independent data on fish counts and sizes, area surveyed, depth, seafloor substratum types using non-extractive visual methods and human-occupied submersibles.

Advanced tools to survey demersal communities

Example 1: Predicting Rosy Rockfish Abundance off Central California

(From: Wedding and Yoklavich In Review)

Point observations of density and biomass from visual surveys

Generalized Additive Models

Response curves based on habitat co-variables for GAM-predicted density (left) and biomass (right) of Rosy Rockfish

Maps of density and biomass predicted from environmental covariates

Gridded seafloor habitat data derived from 5-meter resolution bathymetry within State waters

From these models and maps we can:

- Estimate total biomass in study area
- Quantify habitat capacity
- Prioritize habitats for conservation
- Evaluate potential risk to rockfish stocks

Example 2: Estimating Unfished Potential of Cowcod Abundance off Central and Southern California

(D. Huff and M. Yoklavich In Progress)

Cowcod rockfish are designated as overfished, and consequently occupancy in their rocky habitat is very low.

We are developing GAMs to estimate 'unfished potential abundance' using Cowcod size and density from visual surveys and environmental variables (bottom temperature and current velocity, primary productivity) output from coupled ecosystem-oceanographic models.

Example response curves based on habitat co-variables for GAM-predicted density

We are identifying a *reference condition* to calibrate our statistical model using data from sites with the greatest number of 'fishable' sized rockfishes of any species.

With this approach we want to avoid the pitfall of developing a model in which the number of individuals observed may not represent all suitable habitat because of the depleted condition of the stock.

Alternative hypotheses are assessed using an information theory/model selection approach.

Model performance is assessed using out-of-sample prediction accuracy.

We will estimate unfished potential abundance within cowcod depths and bottom types.

Potential cowcod abundance can be compared between Southern California Bight and the Central Coast.

Comparisons can be made with more traditional assessments that are based on fishery data.

Our results can help in understanding affects of climate change on fish distributions.