ANNUAL REPORT FY11
Habitat Assessment Funded Research
Progress Report

Project Title: Relating Population Abundance of Groundfish Species to Habitats using Predictive Models and Broad-scale Seafloor Maps

Principal Investigator(s):
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Goals:

The overarching goals and objectives of the project are to develop statistical models that predict densities of demersal fish species and assemblages and to couple these models with the broad-scale seafloor habitat maps in a geographical-information-systems (GIS) environment to spatially predict fish densities on a regional basis.

Approach:

The year-1 objective is to develop statistical models that predict densities of individual demersal fish species and multi-species fish assemblages over broad spatial scales. We will base these models on a number of associated habitat variables (e.g., depth, substratum type, patch size and configuration) and the densities of co-occurring fish species, using a sub-set of our database from central California. A variety of models will be considered, such as generalized linear (GLMs) and additive models (GAMs). Model predictions will be validated using sets of data that were not used in the original modeling efforts. We also could consider a temporal component to the models to evaluate variability in species-habitat relationships in relation to changes in fish densities over time (currently our database spans 1992-2008). Issues related to spatial scale also will be explored.

The year-2 objective is to couple these models with the broad-scale seafloor habitat maps in a GIS environment to forecast fish densities on a regional basis. Such efforts have been limited in deep water systems because of the lack of detailed habitat maps from which broad-scale fish densities can be derived. The recent availability of habitat maps from the multibeam-acoustic surveys of the seafloor within California's territorial waters makes this proposed effort possible.

Work Completed:

A post-doctoral scholar (Lisa Wedding) was hired on a 2-year appointment through University of California Santa Cruz, and began working on this project September 2011. We have made great progress in just a few months. A database has been compiled to support the year-1 objective of developing statistical models that predict densities of individual demersal fish species and multi-species fish assemblages. Several metrics have been derived from in-situ data to support the predictive modeling (Table 1). For instance, a measure of habitat heterogeneity was calculated based on the number of different habitat patches encountered within the sample transects. Fish density and biomass for rockfish assemblages and species have been calculated

using this database. The fish species and assemblage data are currently being combined with in-situ predictive metrics to support modeling efforts. A manuscript is being drafted as this work progresses.

Table 1. Metrics compiled for predictive models of demersal fish species and assemblages. In-situ metrics are currently being integrated into a database and compiled by sample transect to inform modeling of rockfish density and biomass. Remotely sensed metrics (e.g., slope, habitat richness, etc.) are being derived from multibeam sonar data in a Geographic Information System (GIS) to support spatially predictive mapping efforts.

Predictive Modeling Metrics *(in-situ)*	**Predictive Modeling Metrics *(remotely sensed)***
Depth	Depth
Temperature	Habitat richness
Habitat heterogeneity	Slope
Habitat type	Slope of slope
	Rugosity
	Fractal dimension
	Aspect

Spatial data sets are being compiled to support the year-2 objective to couple these models with the broad-scale seafloor habitat maps in a GIS environment and to forecast fish densities on a regional basis (Figure 1). The most up-to-date multibeam sonar data sets are being synthesized to provide a bathymetric base layer to support the spatially predictive models. Further, the bathymetry rasters will be used to derive a suite of metrics that characterize the seafloor complexity and configuration (Table 1). A bathymetric synthesis will be completed by December 2011 and the derived metrics will be processed at that time. A marine GIS user group meeting is being organized for January 2012 to support the acquisition of all relevant marine spatial data sets to support our predictive mapping efforts. There are no problems or unexpected results to date.

Applications:

From these predictive models and maps of density for various demersal species, population size (total abundance and biomass, when coupled with size composition) can be estimated in the study area. We are coordinating our research with several stock assessment scientists at SWFSC Fisheries Ecology Division to focus our predictive mapping effort on several key species of interest (e.g., cowcod, boccacio, etc.). These results should have direct application to improve stock assessments for these species and to identify those areas important to the restoration or rebuilding of depleted stocks. There will be additional applications to coastal and marine spatial management, especially on local and regional scales, in addressing such needs as the identification of essential fish habitats and the design and monitoring of marine protected areas.

These results will provide managers, policy makers, and the public with information that can be used in the conservation and management of sustainable marine resources (both the fisheries and associated habitats). Development of models of co-occurring species and associated habitats will have application to ecosystem-based management, providing information needed to manage a more complete demersal fish community. By including measures of spatial variability, this work will advance our understanding of the ecological processes that influence demersal fish distribution and abundance.

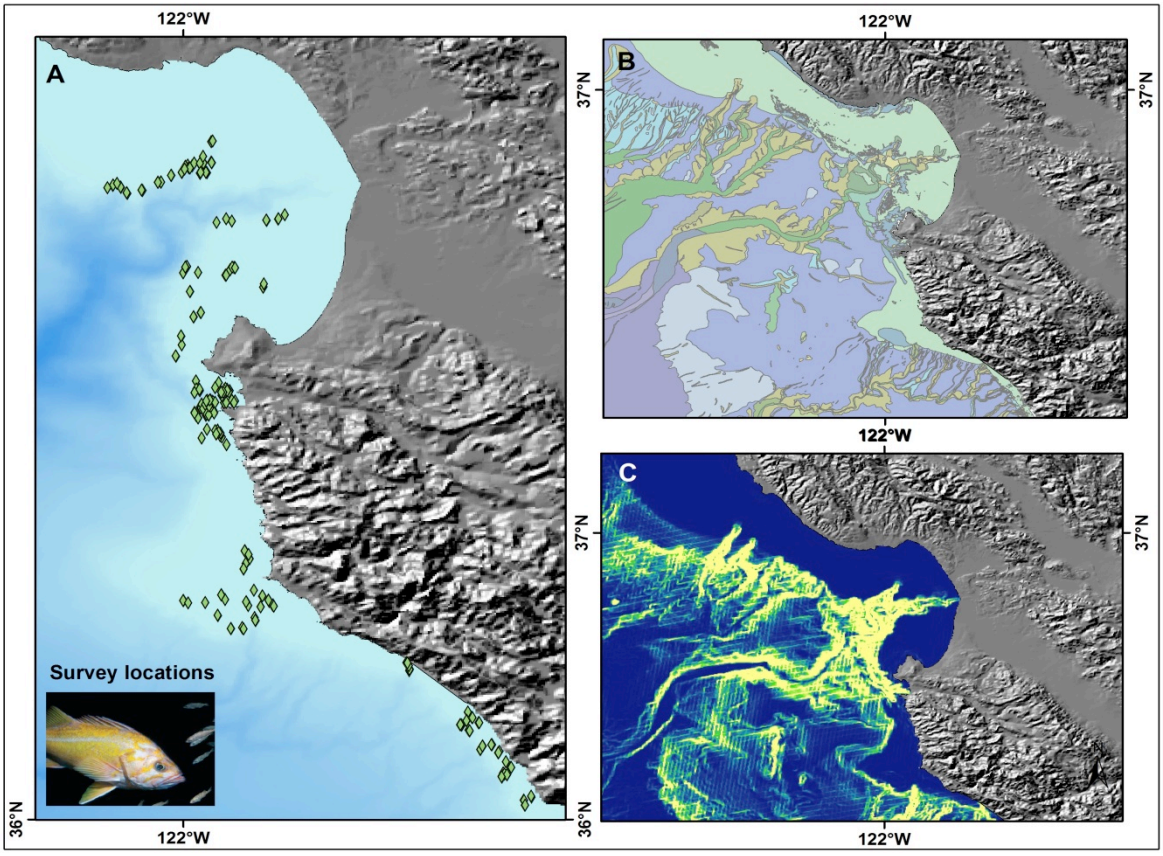

Figure 1. Spatial data sets compiled to support predictive modeling, including (A) multibeam data and map of submersible survey locations, (B) benthic habitat map, and (C) multibeam-derived product (e.g., habitat complexity, or rugosity).

Publications/Presentations/Webpages:

- Invited presentations
    - Marine GIS User group meeting - January, 27, 2012 (L. Wedding)
    - UC Santa Barbara Marine Science winter seminar series - March 6, 2012 (L. Wedding)
- Publications
    - Multivariate predictive modeling of demersal fish density and biomass using submersible survey data. (in prep) *Marine Ecology Progress Series.*
- Webpages
    - http://swfsc.noaa.gov/HabitatEcology/