WORK PLAN

For Analytical Support of an Integrated Ecosystem Assessment of the California Current Large Marine Ecosystem FY11 - FY13

NOAA/NCCOS is conducting the following work for the NOAA California Current Integrated Ecosystem Assessment, in support of the NOAA/NMFS Northwest Fisheries Science Center.

Background

NOAA is working on an Integrated Ecosystem Assessment (IEA) of the California Current Large Marine Ecosystem (CCLME) on the U.S. West Coast (Brand *et al*. 2007; Horne *et al*. 2010; Levin and Schwing 2011). The ultimate aim of the California Current IEA is to improve what is known about the web of interactions that links drivers (e.g. coastal development, seafood demand, commerce) and pressures (e.g., fishing, habitat loss, pollution)to ecosystem-based management, and to forecast how changing environmental conditions and management actions affect the status of the ecosystem.

Groundfishes are identified as an important IEA component because they constitute a large proportion of biomass in the CCLME and are critical to the economic engines of coastal communities in Washington, Oregon, and California. The IEA uses population size and population condition as groundfish indicators to assess risks and management objectives. NMFS has examined how these indicators have changed in the past and is using a spatially explicit, coupled biological-oceanographic simulation model, known as the California Current Atlantis Model (CCAM), to investigate changes under different management scenarios (Levin and Schwing 2011). The model integrates physical, chemical, ecological, and anthropogenic processes in a three-dimensional, spatially explicit domain and allows exploration of potential effects of natural and human-induced perturbations over a range of spatial and temporal scales.

A critical step of the IEA process is selection, monitoring and analysis of ecosystem indicators. For groundfishes Levin and Schwing (2011) used groundfish abundance, age structure and spatial structure to assess change. They also identified several improvements for future work. The proposed work here draws from suggestions by Levin and Schwing (2011) as well as conversations with Levin, The Nature Conservancy (TNC), Environmental Defense Fund (EDF) and state coastal managers to predict estimates of groundfish abundance and distribution at fine spatial scales that can be used for new, improved indicators.

We plan to compile observations in the NWFSC's West Coast Groundfish Survey from 1998-2010. These observations will be used to predict species-specific abundance for size classes of fishes above and below the best available estimate of the average median size at reproductive maturity reported in the literature.

NCCOS is currently developing spatially-explicit groundfish distribution models on the West Coast to evaluate bycatch avoidance strategies and evaluate conservation areas for EDF and TNC. These models, scheduled to be completed in summer of 2013, will provide relative abundance information for 15 species of groundfish along the entire West Coast, some of which represent functional groups in the California Current IEA and can easily be integrated into CCAM. We propose to develop distribution models for the following 21 species, which are not part of existing NCCOS efforts:

Arrowtooth flounder	*Atheresthes stomias*
Jack mackerel	*Trachurus symmetricus*
Lampfish	*Myctophidae*
Longnose skate	*Raja rhina*
Pacific grenadier	*Coryphaenoides acrolepis*
Pacific sanddab	*Citharichthys sordidus*
Redstripe rockfish	*Sebastes proriger*
Rex sole	*Glyptocephalus zachirus*

Shortbelly rockfish	*Sebastes jordani*
Spiny dogfish	*Squalus acanthias*
Aurora rockfish	*Sebastes aurora*
English sole	*Parophrys vetulus*
Flathead sole	*Hippoglossoides elassodon*
Greenspotted rockfish	*Sebastes chlorostictus*
Greenstriped rockfish	*Sebastes elongatus*
Pacific hake	*Merluccius productus*
Splitnose rockfish	*Sebastes diploproa*
Spotted ratfish	*Hydrolagus colliei*
Stripetail rockfish	*Sebastes saxicola*
Yellowtail rockfish	*Sebastes flavidus*
White croaker	*Genyonemus lineatus*

Tasks

1. Obtain NMFS trawl data.
    a. NWFSC annual slope and shelf trawl survey data (i.e. FRAM data) (1998 – present)
2. Obtain basic spatial environmental and oceanographic predictors. Examples are:
    a. Depth
    b. Benthic Habitat
    c. Sea surface and/or bottom temperature climatologies
    d. Distance to shelf edge and shore
3. Process, format, conduct quality control and quality assurance checks, and prepare trawl and environmental data for spatial analyses.
4. Parameterize binomial (presence/absence) and trans-Gaussian (abundance) geostatistical models for species of interest (see list above).
5. Employ a generalized linear modeling (GLM) approach to link environmental predictors to each species' long-term mean pattern of abundance and probability of occurrence.
6. Perform geostatistical interpolation (indicator and ordinary kriging) on residuals left over after fitting GLM
7. Sum geostatistical and GLM models to obtain final predictive models.
8. Combine interpolations across species and map combined predictions and associated degree of certainty
9. Assess accuracy of predictions with independent cross-validation
10. Identify suitable mapping extents based on distribution of data and conversations with NMFS and other relevant parties, and use these to map local hotspots/coldspots.
11. Model temporal trends and develop maps showing areas of increasing and decreasing abundance for each species of interest.
12. Perform cross-validation, Monte Carlo simulation, and other model assessment and validation exercises to characterize the uncertainty in predictions.
13. Work with NMFS staff throughout the project to identify spatial predictors, evaluate model performance and prepare outputs useful to CCAM.

Deliverables

- Predictive maps of long-term average pattern of abundance for each species, time period, size class of interest
- Maps showing level of uncertainty in predictions at each location
- Report describing methods and results
- List and discussion of potential groundfish population size and condition indicators
- Formats: Digital data (ArcGIS) and PDF

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