Overview of fisheries habitat prediction using the Pelagic Habitat Analysis Module (PHAM)

D A Kiefer, E M Armstrong, D P Harrison, M G Hinton, S Kohin, S Snyder, F J O'Brien

© 2011 California Institute of Technology.
Government sponsorship acknowledged
Pelagic Habitat Analysis Module (PHAM)

- Fisheries Catch/Survey Data
- Tagging Data
- Satellite Imagery
- Circulation Model

EASy GIS

PHAM Tools & Statistics

Dynamic Maps of Habitat

Data & Results of Statistical Analysis

visit runeasy.com
Improving Fisheries Management

Stock Assessment / By-catch

Tuna of the EPO
- Important Commercial Species ($2-3 B annual revenues Eastern Pacific)
- Stock assessment models only provide a reliable estimate of recruitment several years after the fact
- Very little (if any) environmental data used in stock assessment models

Sharks of the California Current
- Stock assessment model for Thresher Sharks – Input from PHAM GAM
- By-catch Management – Where does habitat overlap commercial fishing?
- Distribution of pregnant females
Blue Shark (*Prionace glauca*),

Mako Shark (*Isurus oxyrhynchus*),

Common Thresher Shark (*Alopias vulpinus*),

Blue Shark (*Prionace glauca*),
Fisheries Data

- Survey Data
- Commercial Catch Data
- Vessel Logbook Data
- Recreational Fishing Data
- Tagging data (not yet)

Environmental Characteristics

Satellite Imagery

- Seawifs Chl
- Modis Chl
- Modis SST
- GHRsst
- AVHRR SST
- AVISO SSH
- Quickscatt Winds
- NOAA Coastwatch Frontal Probability
- NSA JPL Frontal Probability
- EPTO Bathymetry

NASA ECCO 2 Model

- Mixed Layer Depth
- SST
- Temperature at Depth
- SSH
- Sea Surface Salinity
- Currents

EASy Built In

- Earth Magnetic Field
- Longitude
- Latitude
- Month
PHAM screen of habitat analysis interface, map of calculated spawning sites, and graphical results of analysis.
Common Thresher & Mako Shark Analysis

- **Sea Surface Temperature**
- **Chlorophyll**
- **Bathymetry**
- **Sea Surface Height**

Graphs showing data analysis for Common Thresher and Mako Shark.
PHAM Common Thresher Shark Habitat Prediction for 2000 based on chlorophyll and SST
Warm Years: 1998-2009

The habitat scale is derived from a non-linear and multidimensional combination of concurrent sea-surface temperature, chlorophyll concentration and the gradient derived from sea-surface height images.

The pattern described by the seasonal movement of the habitat explains the fisheries patterns of US and Canada and the migrations routes suggested in the 1940's.

*Unpublished results kindly provided by Juan P. Zwolinski, Robert L. Emmett, and David A. Demer of the Southwest Fisheries Science Center.*
Conclusions

- We have assembled a system that integrates satellite and model output with fisheries data.

- We have developed tools that allow analysis of the interaction between species and key environmental variables.

- Demonstrated the capacity to accurately map habitat of Thresher Sharks *Alopias vulpinus* & *pelagicus*. Their seasonal migration along the California Current is at least partly driven by the seasonal migration of sardine, key prey of the sharks.

- *If you are interested in using PHAM software (free) please contact kiefer@usc.edu.*

Initial Tasks for this Year

- Incorporate electronic tag tracks for Bigeye and Yellowfin tuna of the Eastern Pacific in order to define the 3 dimension of their habitat.

- Apply PHAM tools to building a stock assessment model for Thresher sharks.

- Build interface between our EASy geographical Information System and R statistics program.