

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

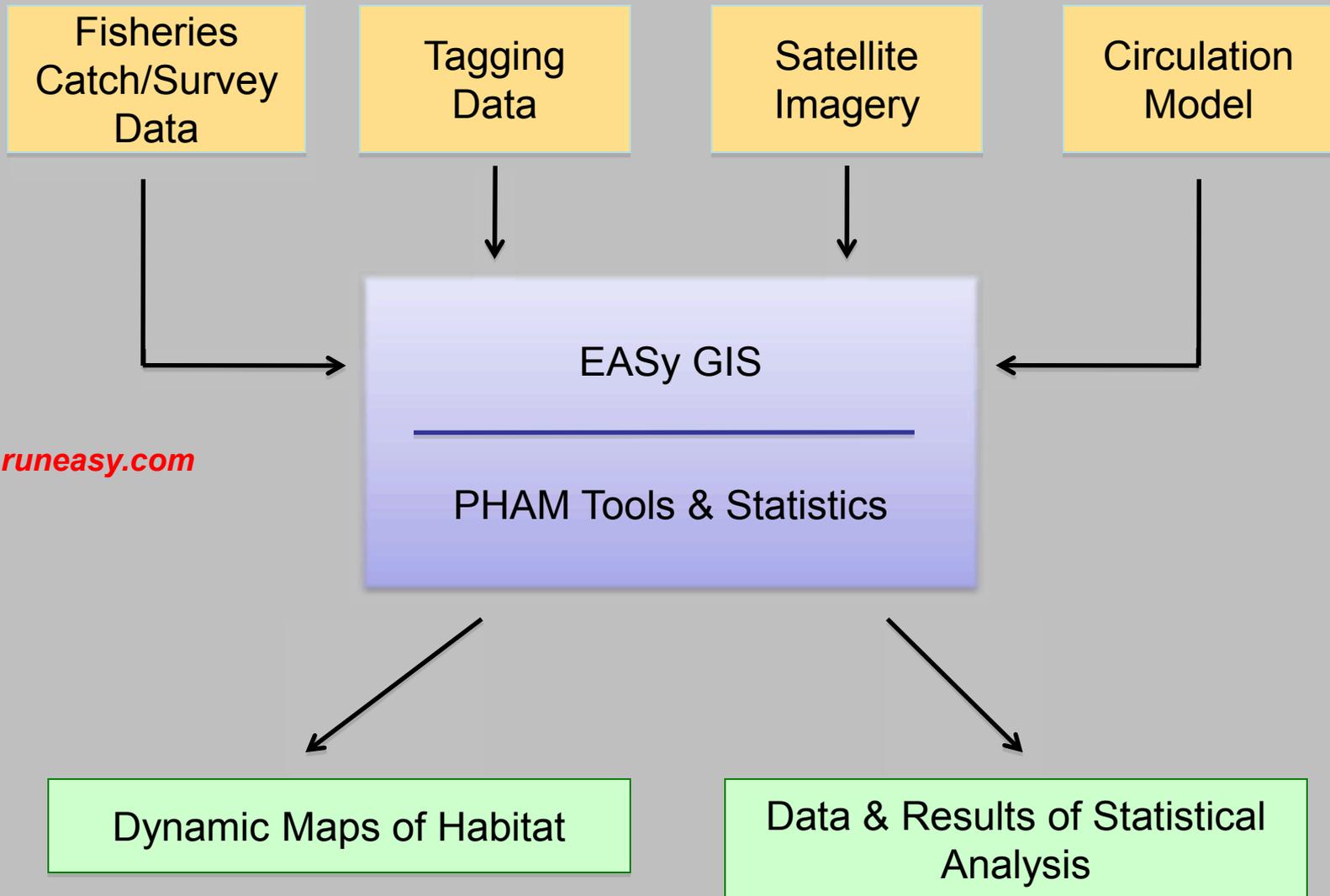


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# Pelagic Habitat Analysis Module (PHAM)



# Improving Fisheries Management

## Stock Assessment / By-catch

### **Tuna of the EPO**

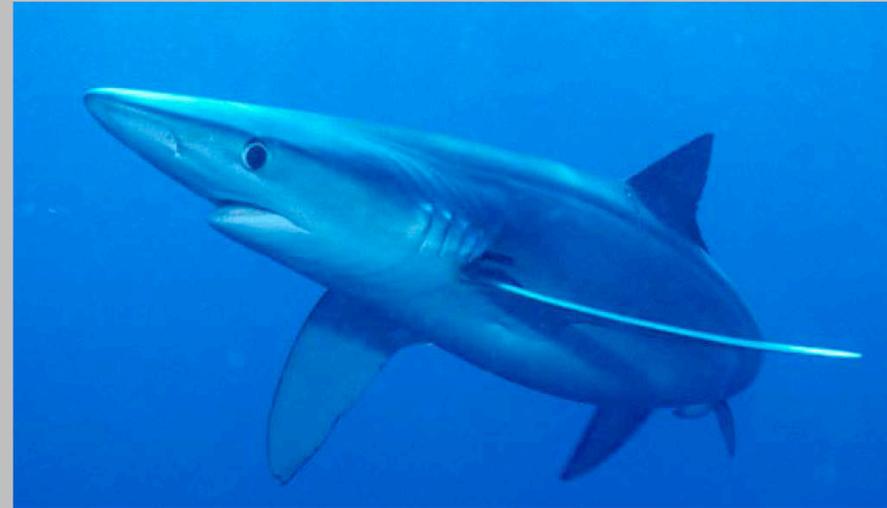
- Important Commercial Species (\$2-3 B annual revenues Eastern Pacific)
- Stock assessment models only provide a reliable estimate of recruitment several years after the fact
- Very little (if any) environmental data used in stock assessment models

### **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



Mako Shark (*Isurus oxyrinchus*)



Blue Shark (*Prionace glauca*),



Common Thresher Shark (*Alopias vulpinus*)

## 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
- GHRSSST
- AVHRR SST
- AVISO SSH
- Quikscatt Winds
- NOAA Coastwatch Frontal Probability
- NSA JPL Frontal Probability
- EPTO Bathymetry

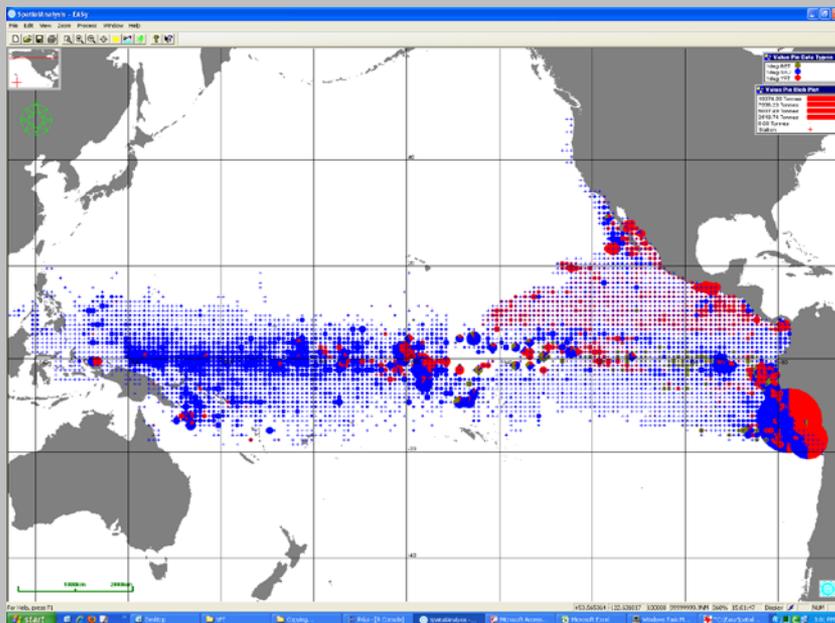


### NASA ECCO 2 Model

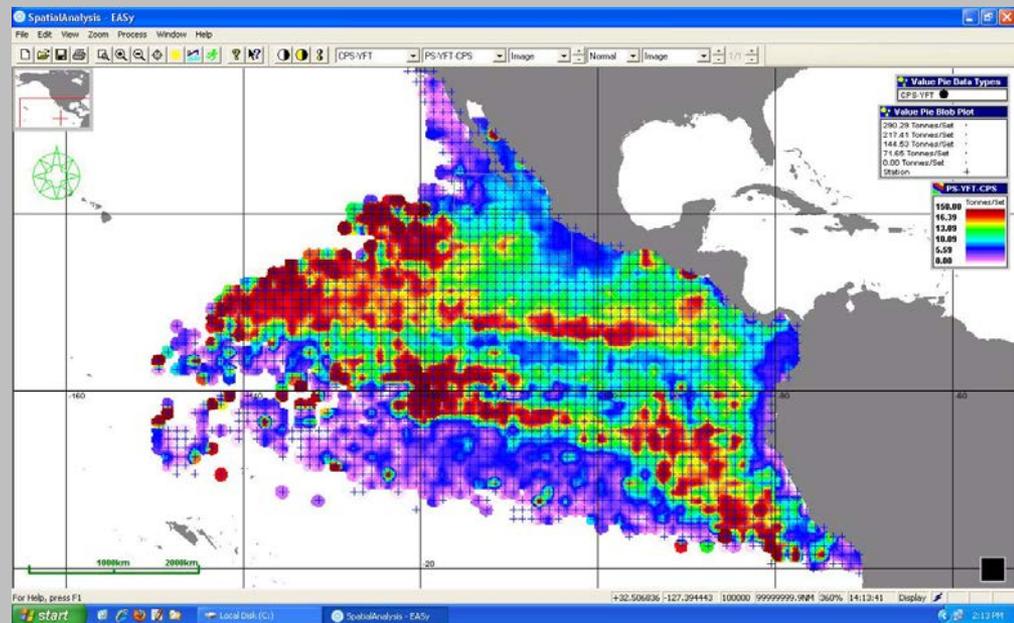
- Mixed Layer Depth
- SST
- Temperature at Depth
- SSH
- Sea Surface Salinity
- Currents

### EASy Built In

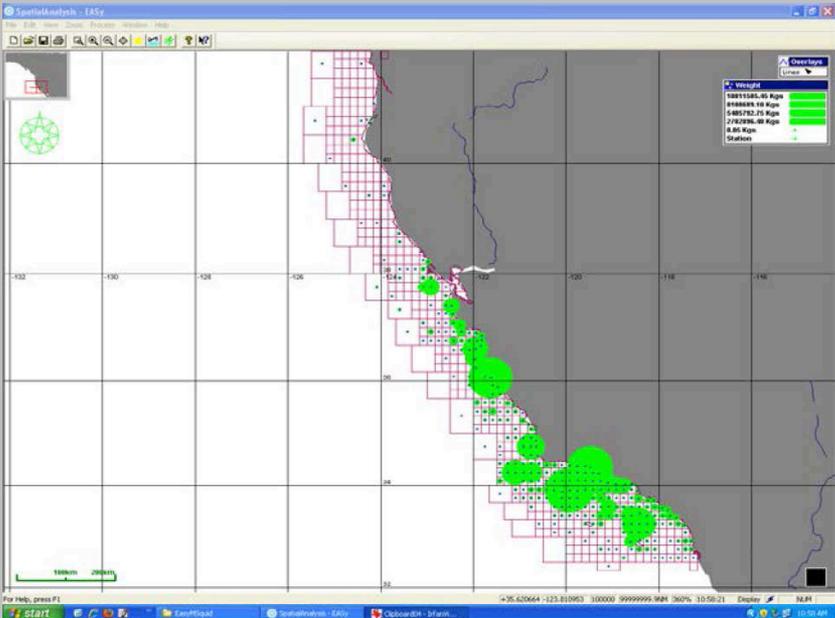
- Earth Magnetic Field
- Longitude
- Latitude
- Month



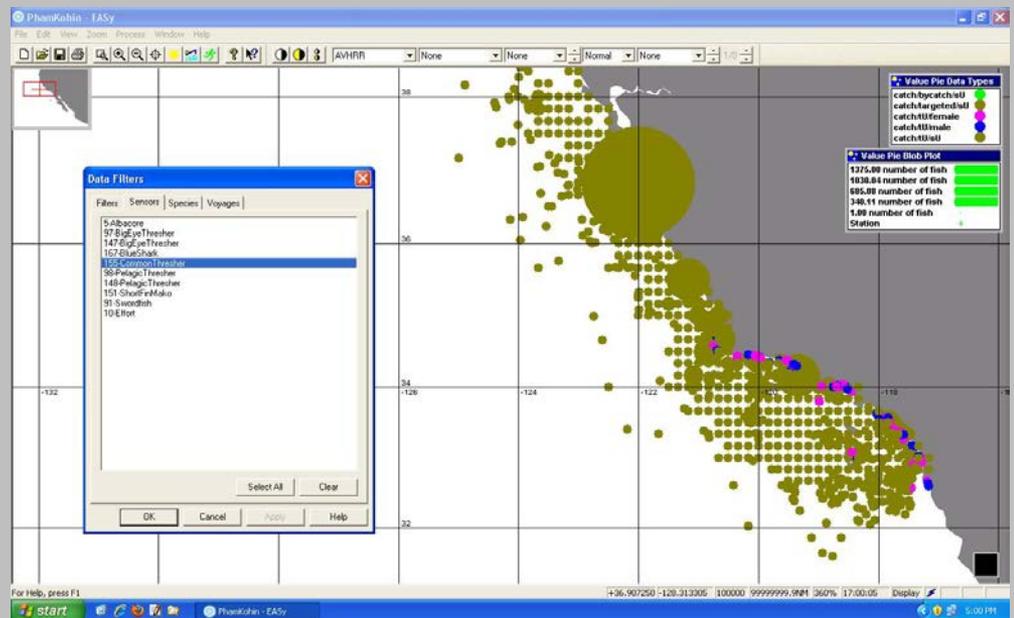
**Average catch per set (Purse Seine) Tuna, IATTC 35yrs**



**Average catch per set (Purse Seine) for Yellowfin Tuna, IATTC 35 Yr Timeseries**

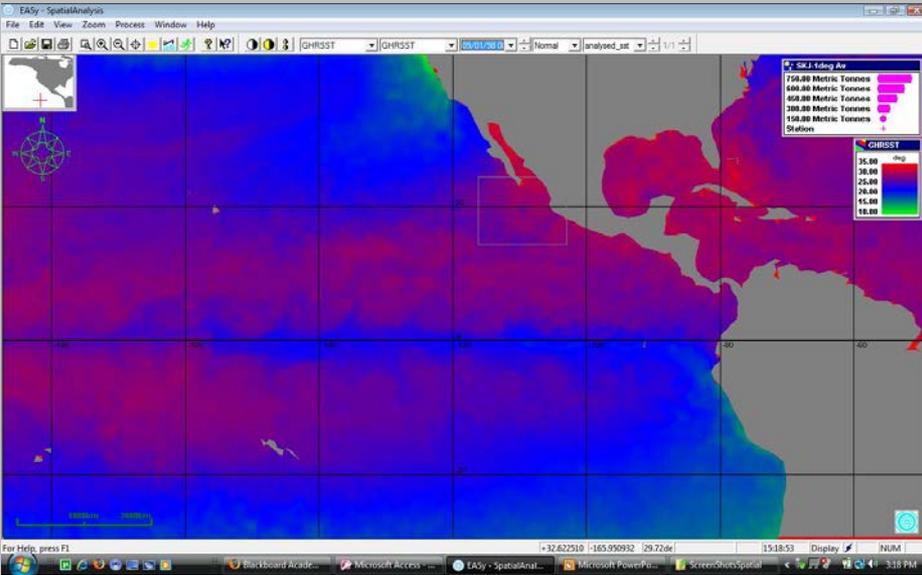


**Average Catch Market Squid**

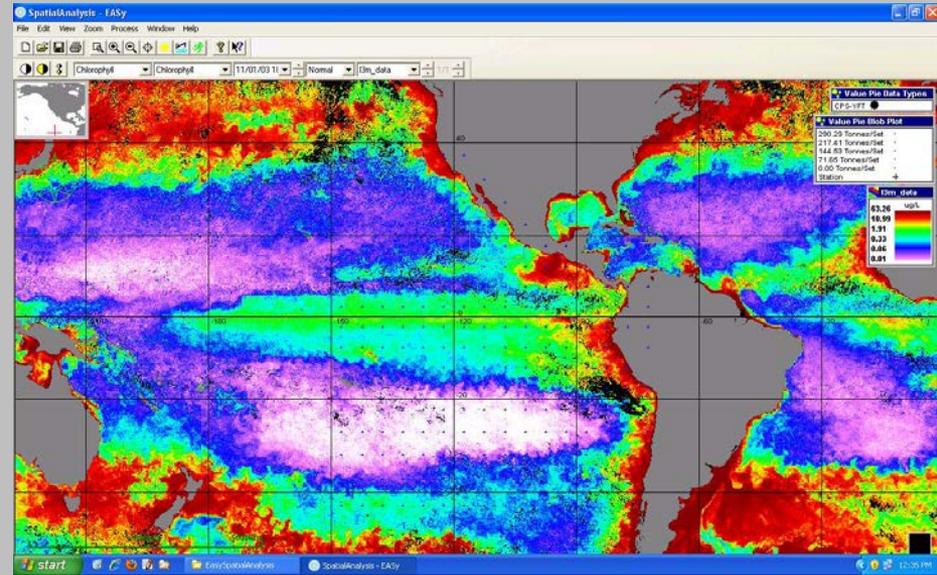


**Average Catch Number by Sex – Common Thresher Shark, SWFSC**

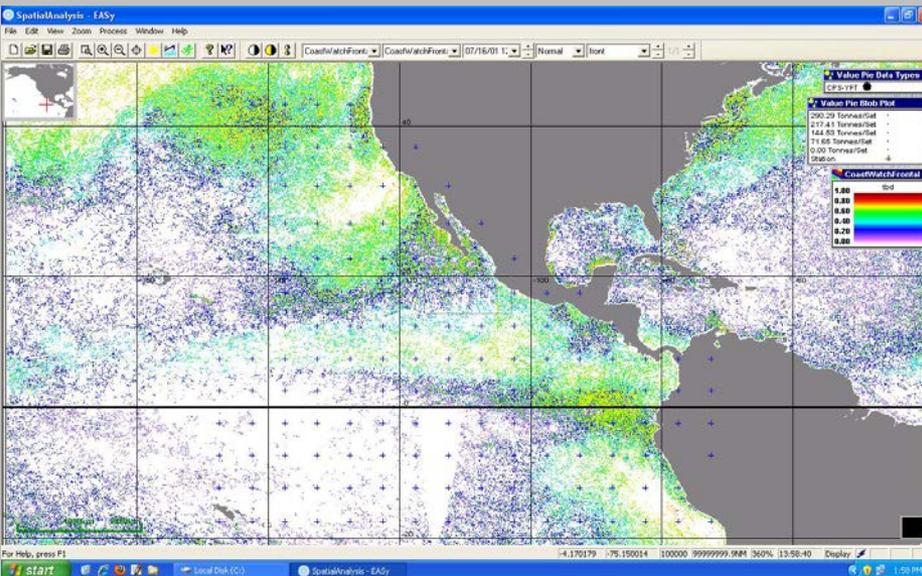
# Environmental Characteristics



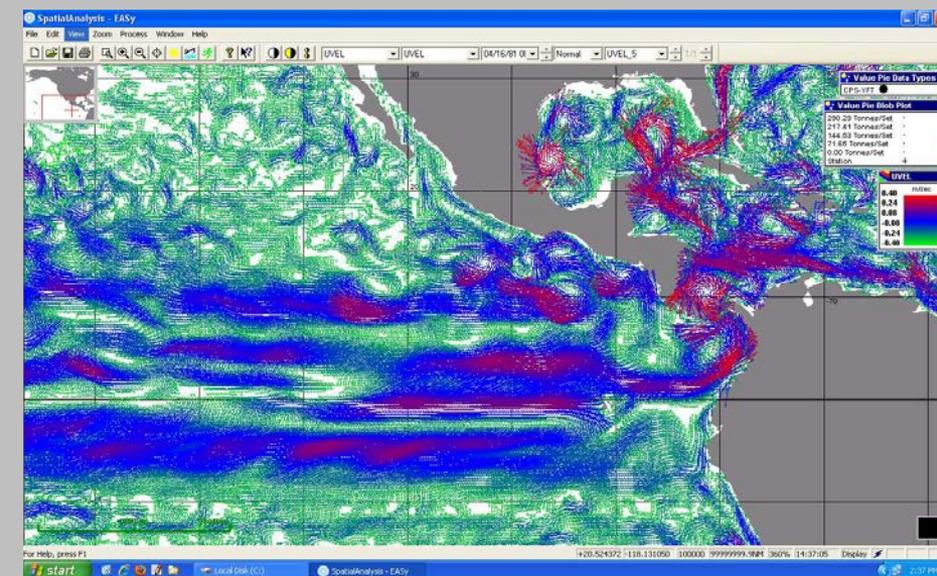
**GHRSSST Sea Surface Temperature**



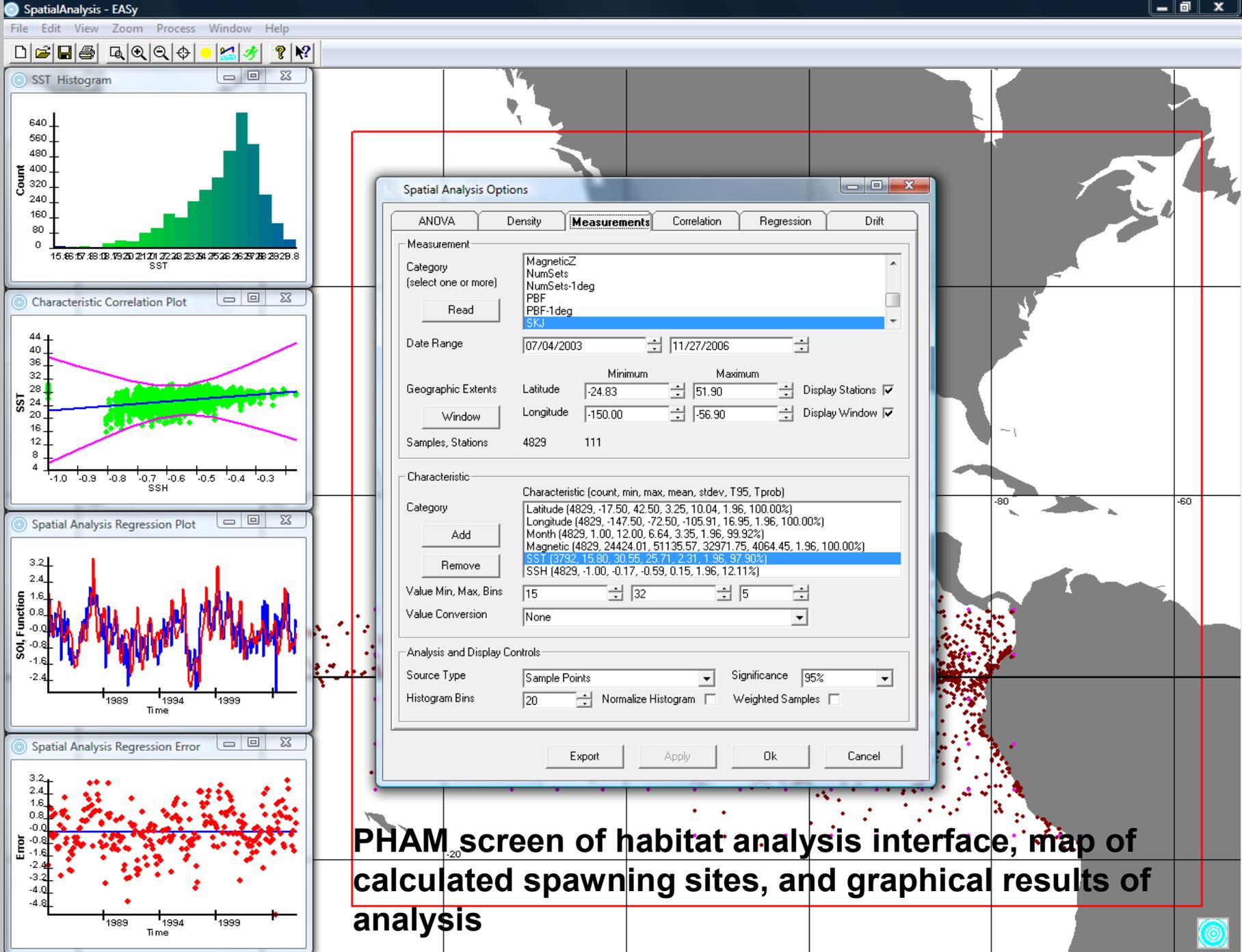
**SeaWiFS Chlorophyll**



**NOAA Coastwatch Frontal Probability**

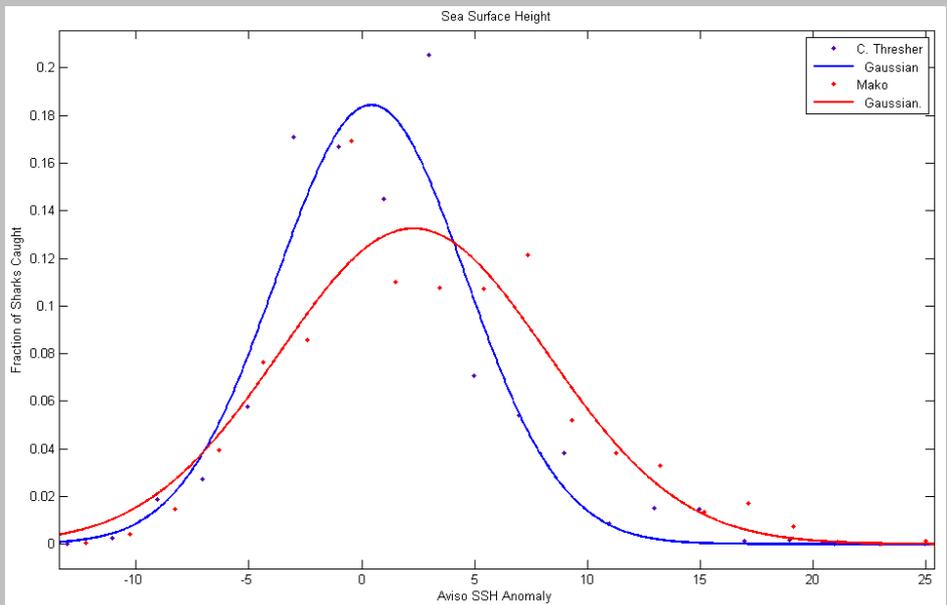
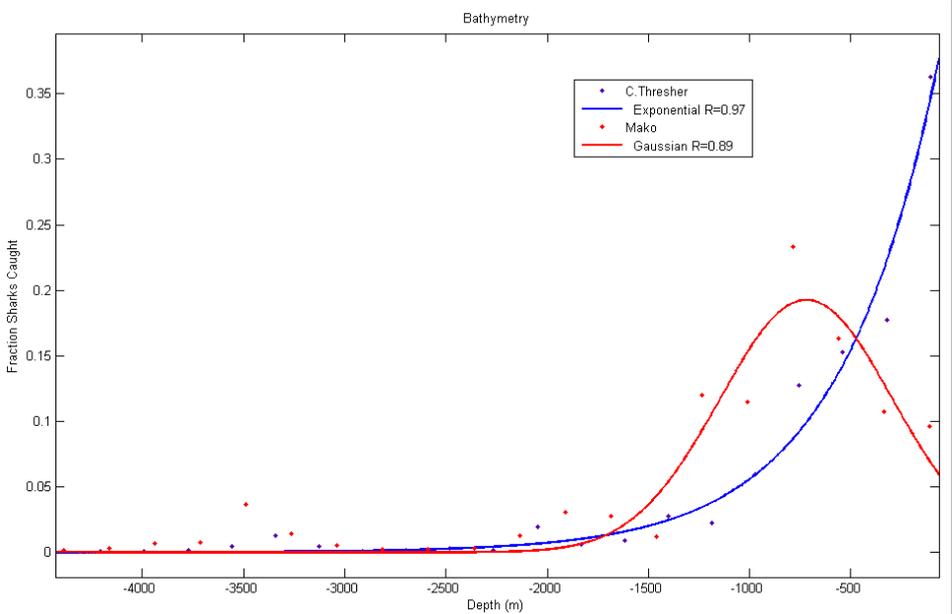
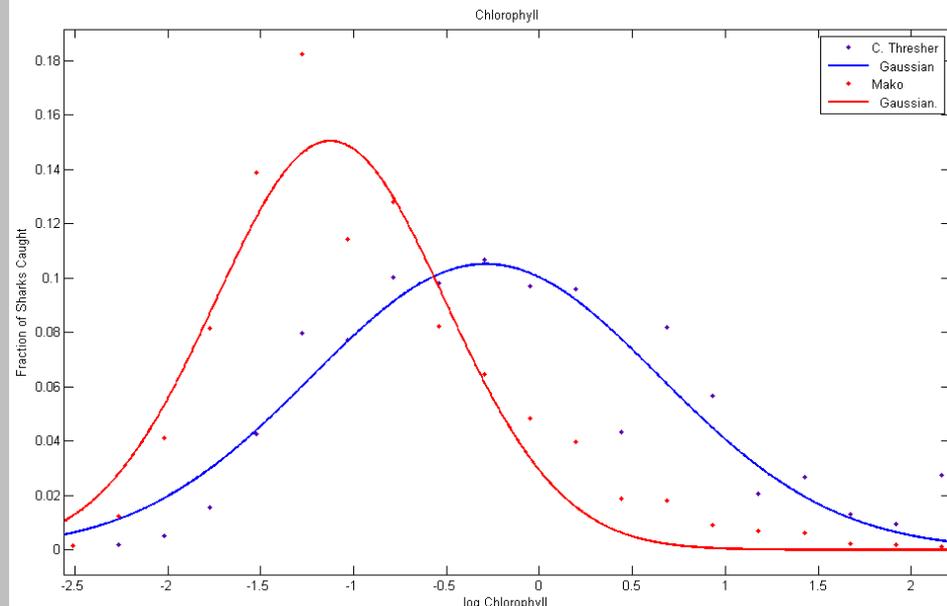
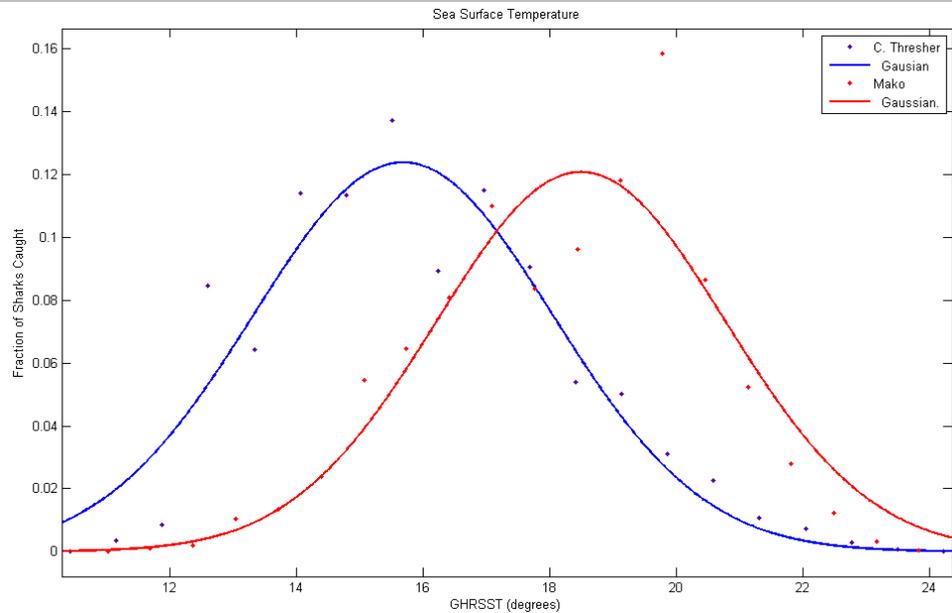


**NASA ECCO2 Ocean Currents**

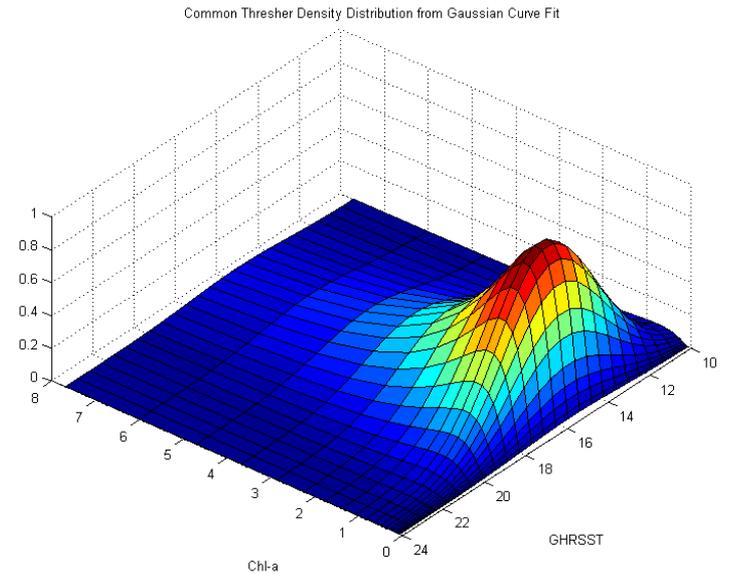
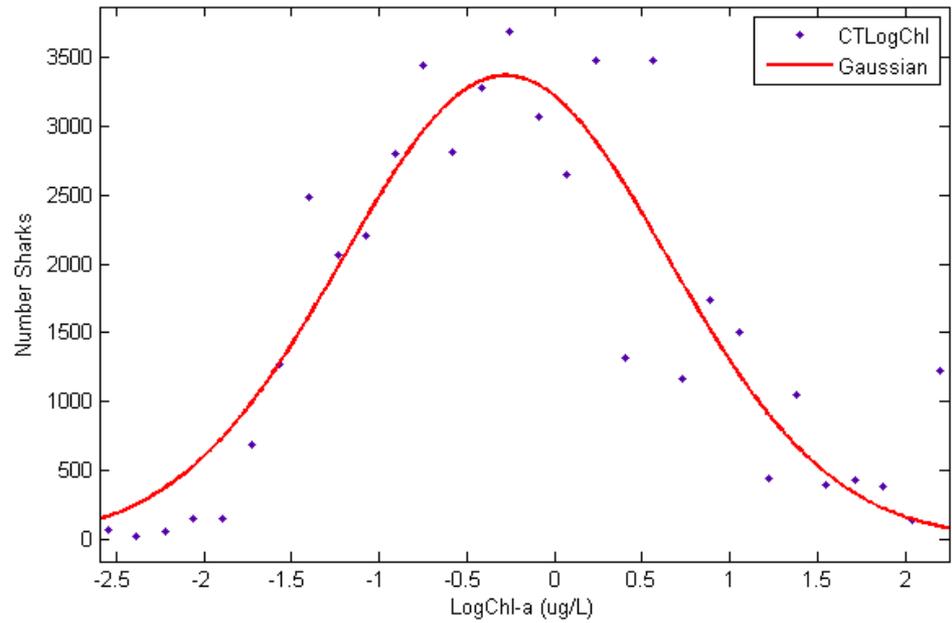
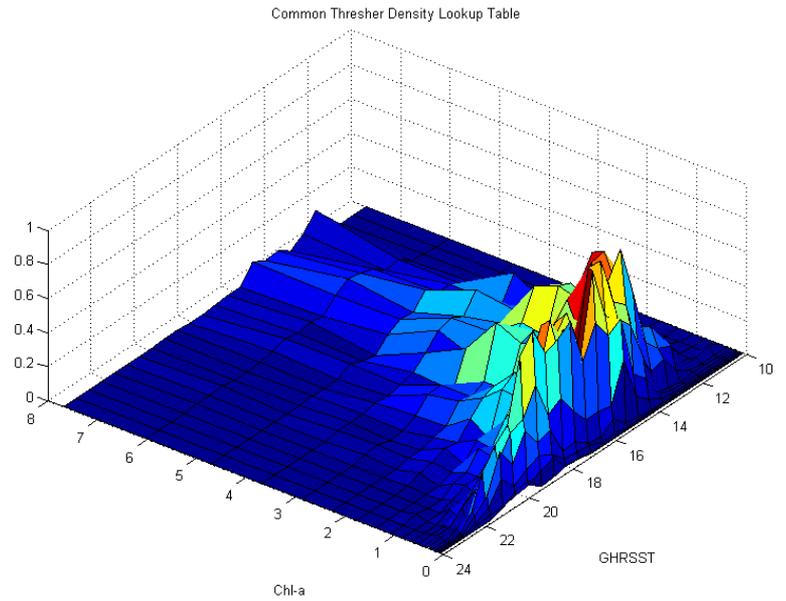
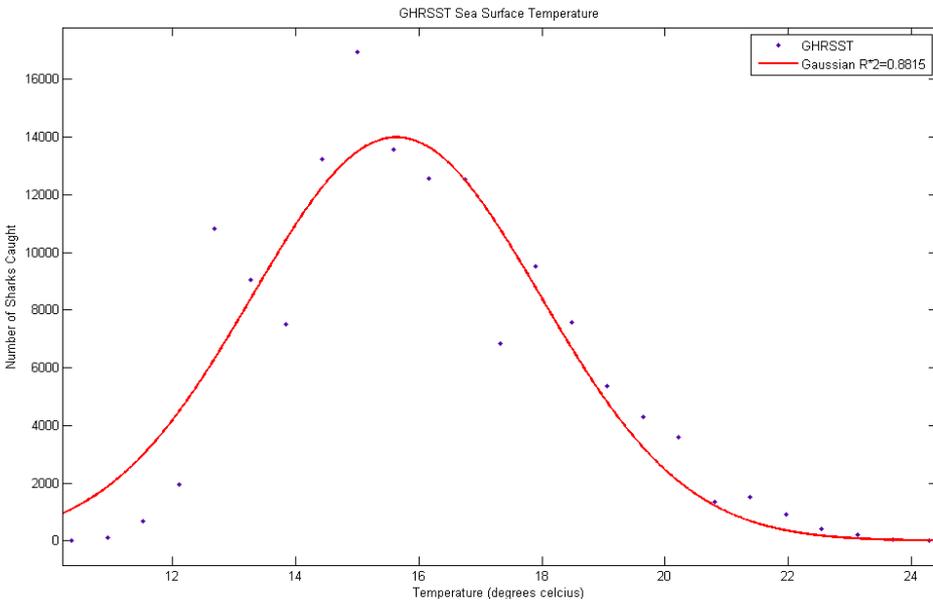


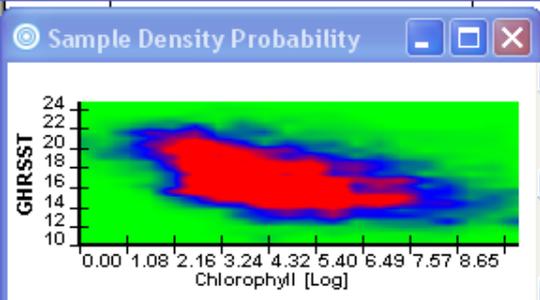
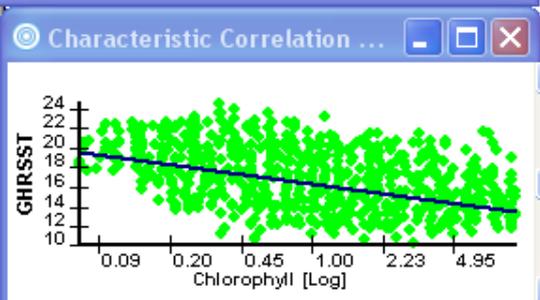
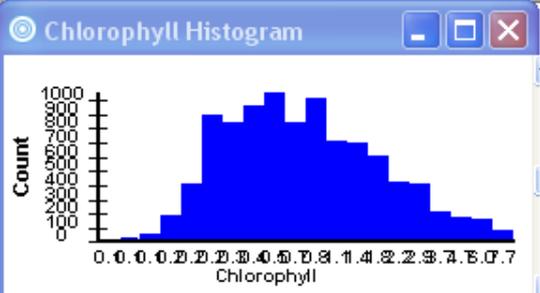
**PHAM screen of habitat analysis interface, map of calculated spawning sites, and graphical results of analysis**

# Common Thresher & Mako Shark Analysis



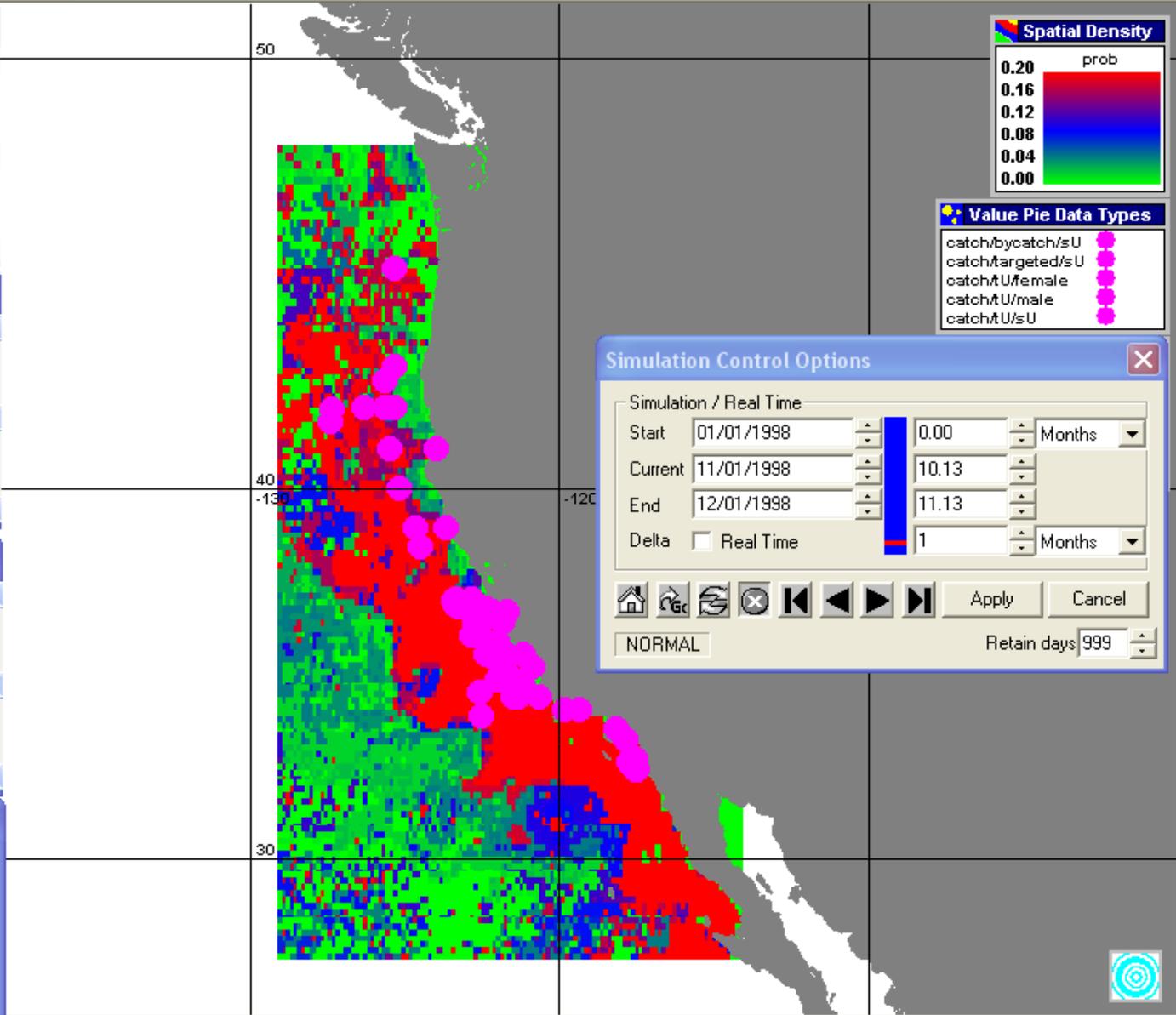
# Common Thresher Shark Habitat Mapping





### Status Window

**11/01/1998**  
Date



### Simulation Control Options

Simulation / Real Time

Start: 01/01/1998, 0.00 Months

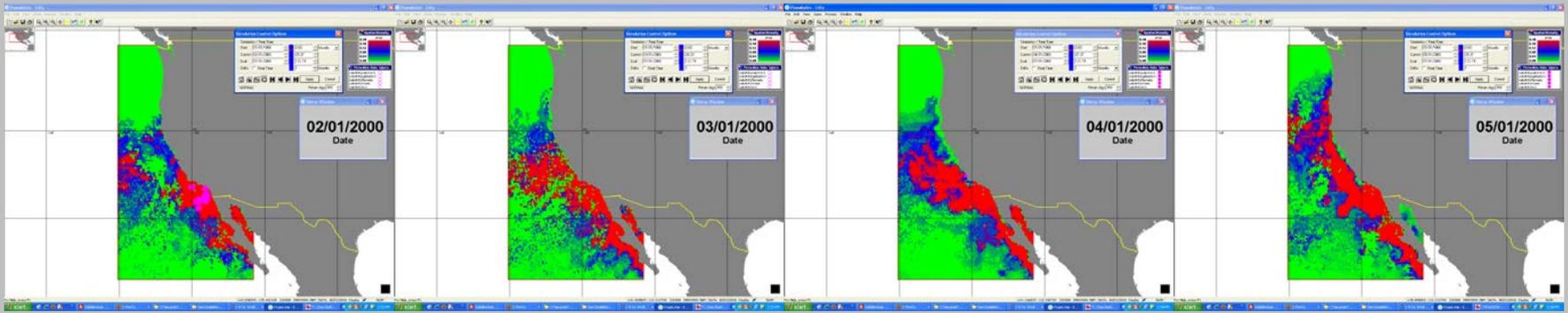
Current: 11/01/1998, 10.13

End: 12/01/1998, 11.13

Delta:  Real Time, 1 Months

Apply Cancel

NORMAL Retain days 999

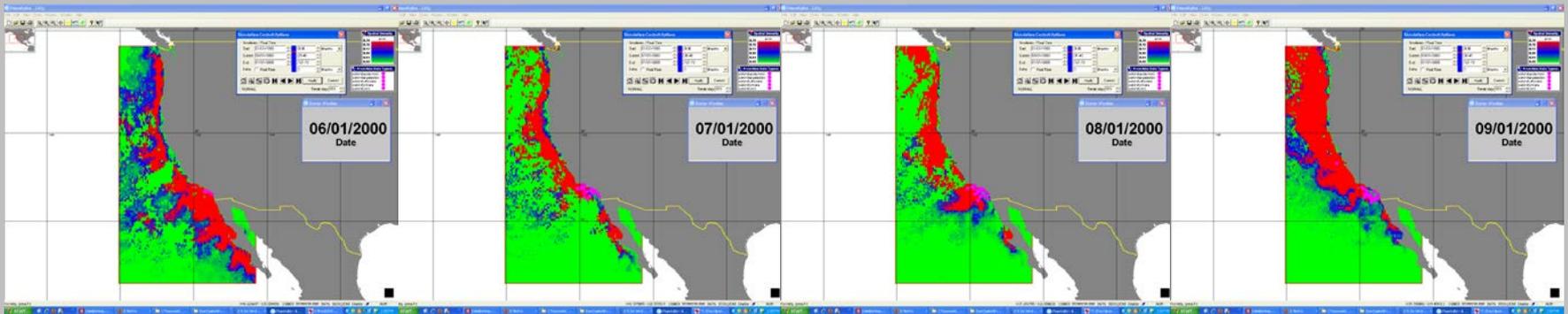


JAN

FEB

MAR

APR

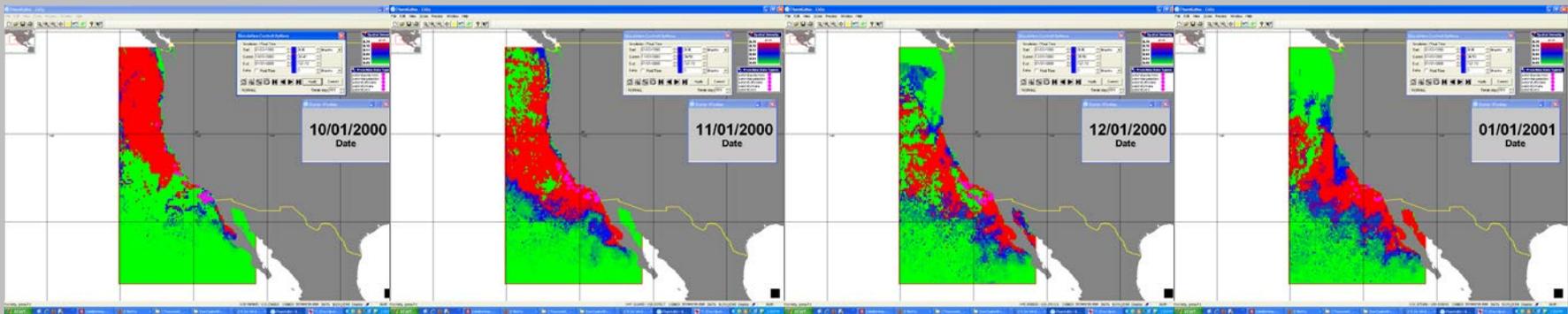


MAY

JUN

JUL

AUG



SEP

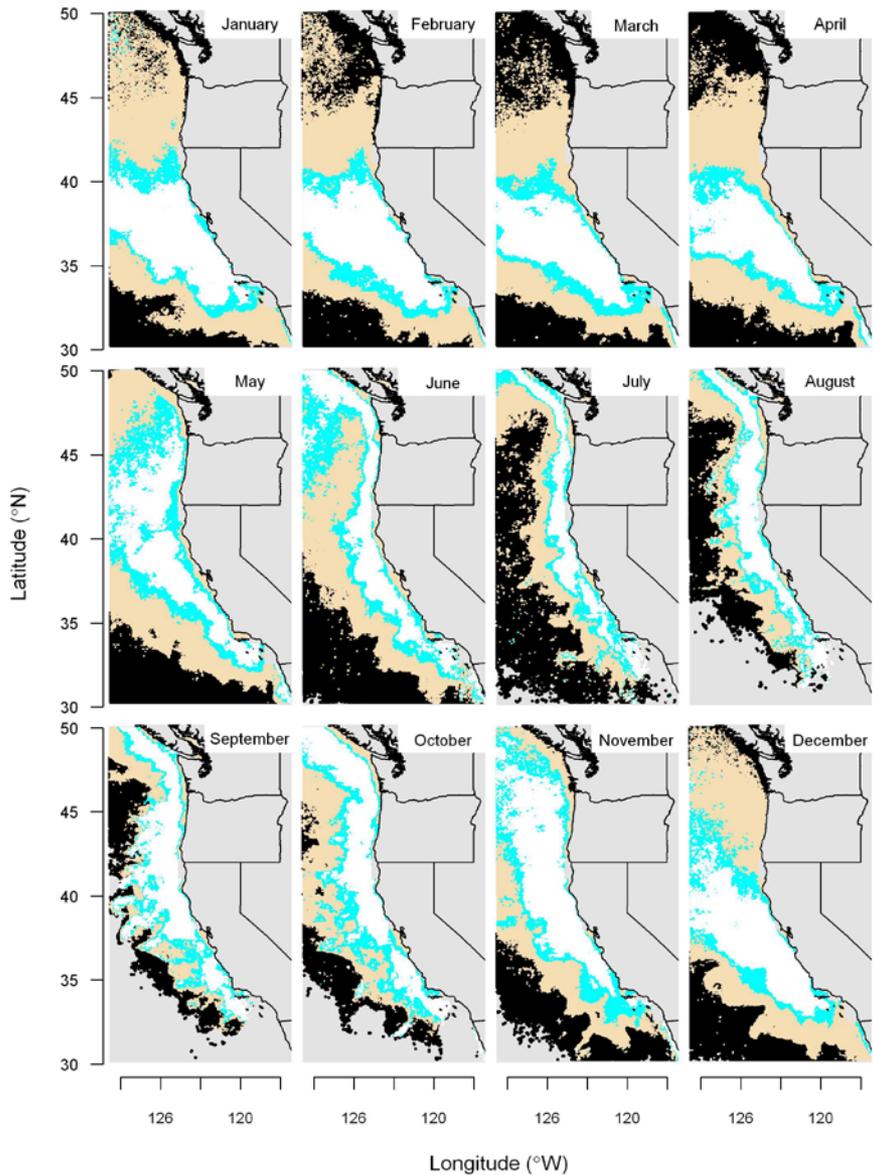
OCT

NOV

DEC

PHAM Common Thresher Shark Habitat Prediction for 2000  
based on chlorophyll and SST

-Habitat scale-



**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.