

**JIMAR, PFRP ANNUAL PROGRESS REPORT
FY 2003**

P.I. Name: John Sibert

Project Proposal Title: Integrative Modeling in Support of the Pelagic Fisheries Research Program: Spatially Disaggregated Population Dynamics Models for Pelagic Fisheries.

Funding Agency: NOAA

1. Purpose of the project and indicative results.

The general objective of this research is to integrate the results of different components of the Pelagic Fisheries Research Program into a consistent framework that integrates knowledge of fish movement and population dynamics, the fishing process, economics and oceanography. The primary focus is the development of spatial models of pelagic fish population dynamics that explicitly include movement, mortality, and fisheries. The work emphasizes collaboration with other PFRP projects.

2. Progress during FY 2003. Provide a thorough discussion of accomplishments and problems.

Preliminary work for the analysis of the Hawaii Tuna Tagging Project data using the advection-diffusion-reaction model (ADRM) has been completed. Fishing effort data from NMFS and HDAR sources has been assembled through 2001 and aggregated at 60 and 20 mile spatial resolution. Some delays were encountered in assembling these data.

The state space Kalman filter model was developed further and applied to a wide variety of species including marine turtles, bluefin tuna, marlins, and elephant seals. The model was extended to also be applicable tracks from animals with Argos transmitters, to estimate parameters for different segments of a track, and to estimate common suite of parameters from multiple tracks. This work was greatly assisted by Mr. Anders Nielsen, a graduate student from the Department of Mathematics and Physics at The Royal Veterinary and Agricultural University in Denmark. Mr. Nielsen created an interface to go between the Kalman filter model and the R statistical package that make the model much easier to apply. This software is available for download from the PFRP web site <http://soest.hawaii.edu/PFRP/elec.tagdata/tagdata.html>.

Work on the Kalman filter model was also assisted by a visit by Dr. Sibert to the CSIRO Division of Marine Research in Hobart, Australia sponsored by CSIRO to analyze bigeye and southern bluefin tuna tracks in the Coral Sea and Indian Ocean. In the process of analyzing the tracking data from the Coral Sea, it became clear that there are pathological autocorrelated errors in the data from some archival tags. A considerable amount of effort was invested in exploring and correcting these errors. Preliminary results indicate the bigeye behavior in the Coral Sea who the same high degree of residency as observed in Hawaii.

Dr. Shiham Adam has completed work on the neural network parameterization of the ADRM and a manuscript is in preparation.

3. Plans for the next fiscal year.

1. Complete analysis of HTTP data using the ADRM.
2. Apply the Kalman filter to tracks marine turtles to detect differences in behavior of hooked and control animals.
3. Continue examination of autocorrelated errors in the geolocation algorithms used for geolocation by light level in archival tags.
4. Complete the analysis of the CSIRO Coral Sea bigeye tracks.

One of the new projects approved from the recent PFRP RFP, “Application of a Continuous Advection-Diffusion Equation to Spatial Mixed Resolution Dynamics Population Models”, will involve a post-doctoral researcher to work in the PFRP modeling project. Dr. Adam leaves the PFRP in May 1, 2003 and a new post-doctoral researcher with expertise in numerical solution of partial differential equations will be recruited to assist with the mixed resolution model.

4. List of papers published in refereed journals during FY 2003.

Adam, M. S., J. R. Sibert, D. Itano and K. Holland, 2003. Dynamics of bigeye (*Thunnus obesus*) and yellowfin tuna (*T. albacares*) in Hawaii's pelagic fishery: analysis of tagging data with a bulk transfer model incorporating size specific attrition. *Fishery Bulletin* 101(2): 215-228.

Sibert, J. M. Musyl, R. Brill, 2003. Horizontal movements of bigeye tuna (*Thunnus obesus*) near Hawaii determined by Kalman filter analysis of archival tagging data. *Fish Oceanog* 12(3).

Sibert, J and J. Hampton, 2002. Mobility of tropical tunas and the implications for fisheries management. *Marine Policy* 27: 87–95

5. Other papers, technical reports, meeting presentations, etc.

Adam, M. S. and G. P. Kirkwood. Growth of skipjack tuna (*Katsuwonus pelamis*) in the Indian Ocean estimated using tagging data from the Maldives pole-and-line fishery. (submitted to *Fisheries Research*).

Adam, M. S and J. R. Sibert. An investigation on the use of neural networks with advection-diffusion-reaction models (ADRM) to estimate large-scale movement of skipjack tuna from tagging data. (In prep)

Adam, M. S., J. R. Sibert, D. Itano and K. Holland. Analysis of Hawaii Tuna Tagging Project data. (to appear in PFRP Newsletter, June 2003).

Adam, M.S. An integrated approach to using neural networks with advection diffusion reaction models for estimating large-scale movement patterns of tuna. Some preliminary investigations. Presentation at lunch time seminar (23 August 2002) at the Earth Systems

Science Interdisciplinary Center, University of Maryland at College Park, College Park, Maryland, USA.

Adam, M.S. Population dynamics of the bigeye tuna in Hawaii's pelagic fisheries. Presentation at the 132nd American Fishery Society Annual Meeting, Maryland, Baltimore, August 18-22, 2002.

Adam, M.S. Analysis of Hawaii Tuna Tagging Project Data. Presentation at the 15th Standing Committee on Tunas and Billfish Meeting, Honolulu, Hawaii, July 22-27, 2002.

Sibert, John. Approaches to modeling large-scale distribution and abundance of tunas: Combining information from populations and individuals. Presentation made at Census of Marine Life Workshop, "Future of Marine Animal Populations (FMAP): Data, Models and Prediction", Halifax, Canada, June 20-23, 2002.

Sibert, John. Estimating Movement Parameters From Fish Tracks. Presentation at seminar at CSIRO Division of Marine Research, Hobart, Australia, November 2002.

Sibert, John, J. Gunn, N. Clear, and J. Hampton. Fishing for artifacts: movements of bigeye tuna in the Coral Sea as determined by archival tags. Presentation at the PFRP Principal Investigators Meeting, Honolulu, Hawaii, December 4-6, 2002.

Sibert, John, J. Gunn, N. Clear, and J. Hampton. Artifact, migration and site fidelity of bigeye tuna in the Coral Sea as determined by archival tags. Presentation to be made at the 54th Annual Tuna Conference, Lake Arrowhead, California, May 13-15, 2003.

6. Names of students graduating with MS or Ph.D. degrees during FY 2003. Include title of thesis or dissertation.

None

7. For multi-year projects, provide budget for the next year on a separate page. See attached budget sheet