JIMAR – PFRP ANNUAL REPORT FOR FY 2007

P.I. John Sibert

Project Title: Integrative modeling in support of the Pelagic Fisheries Research Program: spatially disaggregated population dynamics models for pelagic fisheries.

Funding Agency: NOAA

NOAA Goal (Check those that apply):

- ☒ To protect, restore, and manage the use of coastal and ocean resources through ecosystem-base management
- ☒ To understand climate variability and change to enhance society's ability to plan and respond
- ☐ To serve society's needs for weather and water information
- ☐ To support the nation's commerce with information for safe, efficient, and environmentally sound transportation

1. Purpose of the Project (one paragraph)

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 2007 (One-two paragraphs, including a comparison of the actual accomplishments to the objectives established for the period, and the reasons for slippage if established objectives were not met):

Progress on goals from FY 2006:

- Analyze currently-used light-based geolocation algorithms to identify and correct the source of the autocorrelated latitude bias.

Latitude estimates computed by all manufacturers of archival tags and PSATs are biased and autocorrelated. These inaccuracies are attributable to small errors in measuring time of sunrise and sunset and are amplified by the inherent mathematical structure of the astronomical coordinate transformations that are used to compute latitude from the position of the Sun. Preliminary attempts to incorporate theoretical formulations of bias

and variance into state-space models to correct "raw" geolocation estimates are promising, but further work in required to produce a generally useful algorithm.

A new state-space model was completed to estimate the most probable track of geographic positions directly from a series of light measurements. The model estimates two geographic positions per day, without reducing the daily light data to two threshold crossing times, its covariance structure is designed to handle high correlations due to for instance local weather conditions, and it can estimate the yearly pattern in latitude precision by propagating the data uncertainties through the geolocation process. This model will find wind application among archival tag and PSAT users and is in the public domain. A paper describing this model was accepted for publication.

- Continue develop and support `kfSST` and `kftrack` software.

`kfSST` was improved by application of the "unscented Kalman filter" for greater accuracy in approximating non-linear terms and by implementation of an improved method of averaging sea surface temperatures. The unscented Kalman filter was also introduced into `kftrack` in the context of exploring the bias correction mentioned above.

- Continue development of electronic tagging data repository.

  The electronic tagging data repository is functional.

- Collaboration on the “Mixed-resolution models for investigating individual to population spatial dynamics of large pelagics” project.

This project has largely been postponed. Sporadic work has been carried out, and some important technical problems have been solved. These include how to represent the movement field in a flexible, but still tractable manner. The reason for postponing this project is that the light based geolocation model turned out to be more successful than anticipated. Work on the mixed resolution model was postponed in order to meed user demand for the new light-based model.

- Continue work on parameter optimization in SEAPODYM.

Adjoint-based methods for maximum likelihood parametric assimilation of fisheries data into SEAPODYM were succfully developed and applied to skipjack (*Katsuwonus pelamis*) and bigeye (*Thunnus obesus*) tunas in the Pacific Ocean. The estimated biological parameters are consistent with current knowledge of the physiology and behavior of these two species. A manuscript is in preparation.

3. Plans for the next fiscal year (one paragraph):

Post-doctoral researcher, Senina and Nielsen will both be leaving the PFRP in 2007. Some of current work will be not be complete before they both leave. However the remaining work is compatible with their new employment circumstances and some of the work can be completed by remotely. A new post-doctoral researcher will be recruited.

- Conclude work on the an algorithm based on the theoretical analysis of geolocation errors for application in cases where light data from tags are not available.
- Complete the initial modeling phases for combining individual and population based estimation of migration patterns.
- Begin a comparison of movement parameter estimates across species of pelagic fish derived from different tagging methods.
- Implement an optimized SEAPODYM model for yellowfin tuna (*T. albacares*) across the Pacific basin. The variable spatial resolution capabilities of SEAPODYM will be used to implement a model at 1/3 degree spatial resolution around the main Hawaiian islands for use in the Hawaii-Pacific Ocean Observing and Information System project at SOEST.

4. List of papers published in refereed journals during FY 2007.

Andersen, K. H., Nielsen, A., Thygesen, U. H., Hinrichsen, H.-H., and Neuenfeldt, S. 2007. Using the particle filter to geolocate Atlantic cod (Gadus morhua) in the Baltic Sea, with special emphasis on determining uncertainty. Can. J. Fish. Aquat. Sci. 64(4): 618-627.

Nielsen A, and Sibert, J. R. 2007. State space model for light based tracking of marine animals. Can. J. Fish. Aquat. Sci. In press.

Sibert, J. R., Lutcavage, M. E., Nielsen, A., Brill, R. W., and Wilson, S. G. 2006. Interannual variation in large-scale movement of Atlantic bluefin tuna (Thunnus thynnus) determined from pop-up satellite archival tags. Can. J. Fish. Aquat. Sci. 63(10):2154-2166.

Sibert, J., Hampton, J., Kleiber, P., and Maunder, M. 2006. Biomass, size, and trophic status of top predators in the Pacific Ocean. Science 314: 1773-76.

Maunder, M. N., Sibert, J. R. Fonteneau, A., Hampton, J., Kleiber, P., and Harley, S. J. 2006. Interpreting catch per unit effort data to assess the status of individual stocks and communities. ICES Journal of Marine Science, 63: 1373-1385.

Hampton, J., J. Sibert, P. Kleiber, M. Maunder and S. Harley 2005. Decline of Pacific tuna populations exaggerated? Nature 34:E1-E2 www.nature.com/nature

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

Senina. I., J. Sibert and P. Lehodey. 2006. Adjoint-based parameter estimation for the spatially explicit model of large pelagics (with application to skipjack tuna). Presented at PFRP Principal Investigators Workshop.

Nielsen, A. and Sibert, J. R. 2006. State space model for estimating geographic positions from light measurements. Presented at PFRP Principal Investigators Workshop.

Nielsen, A. and Sibert, J. R. 2006. From Light Measurements to Most Probable track. Presented at Wildlife Computers.

Sibert, J. and A. Nielsen. 2006. Errors in estimating latitude from light measurements. Presented at PFRP Principal Investigators Workshop.

Maunder, M.. J.Sibert, J. Hampton, and P. Kleiber. 2007. Regime shifts, stock assessment, and the management of tunas. Presented at 58th Tuna Conference.

Nielsen, A. and Sibert, J. R. 2007. A new model for light based geolocation. Presented at 58th Tuna Conference.

Sibert, J. and A. Nielsen. 2007. Systematic errors in estimating latitude for solar irradiance time series. Presented at 58th Tuna Conference.

John Sibert. 2007. Estimating geographic position from solar irradiance: errors and possible remedies. Invited seminar, Department of Environmental Biology and Fisheries Science, National Taiwan Ocean University, Keelung. April 30, 2007.

John Sibert. 2007. Getting in touch with your inner elephants: Fishery-induced changes in biomass, size structure and trophic status of top predators in the Pacific Ocean. Invited seminar, Instutute of Oceanography, National Taiwan University, Taipei. May 2, 2007.

Nielsen, A. and Sibert, J. R. 2007. Errors in light based geolocation and how to fix them. Presented at Joint Meeting of Ichthyologists and Herpetologists.

6. Graduates (Names of students graduating with MS or PhD degrees during FY 2007. Provide titles of their thesis or dissertation):

None

7. Awards (List awards given to JIMAR employees or to the project itself during the period):

None

8. Publication Count (Total count of publications for the reporting period and previous periods categorized by NOAA lead author and Institute (or subgrantee) lead author and whether it was peer-reviewed or non peer-reviewed (not including presentations):

	JL Lead Author			NOAA Lead Author			Other Lead Author		
	FY05	FY06	FY07	FY05	FY06	FY07	FY05	FY06	FY07
Peer-reviewed			2						4
Non-peer reviewed									

9. Students and Post-docs (Number of students and post-docs that were associated with NOAA funded research. Please indicate if they received any NOAA funding. For institutes that award subcontracts, please include information from your subgrantees):

Dr. Inna Senina and Dr. Anders Nielsen are employed on this project as JIMAR Visiting Scientists.

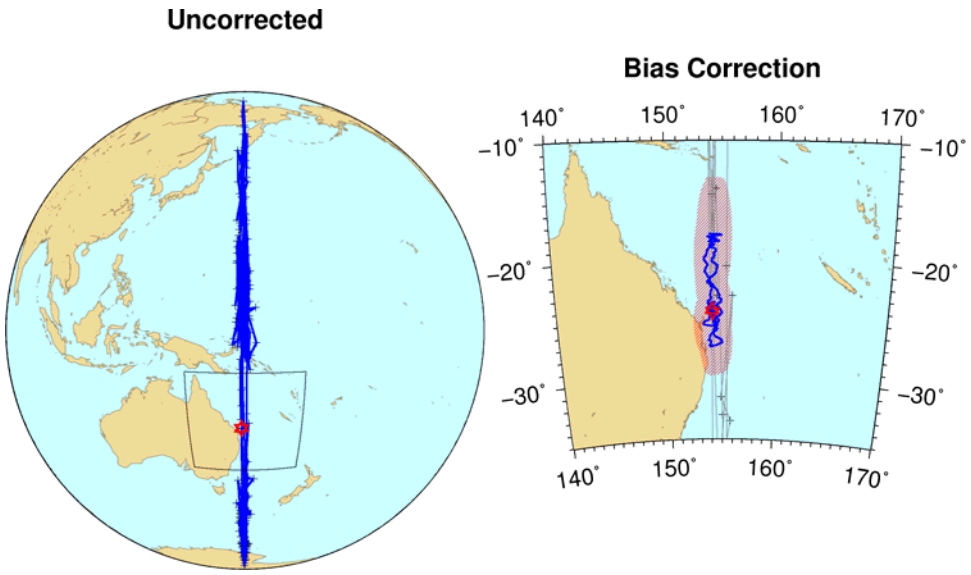
10. Personnel:

(i) Number of employees by job title and terminal degree that received more than 50% support from NOAA, including visiting scientists (this information is not required from subgrantees):

(ii) Number of employees/students that received 100% of their funding from an OAR laboratory and/or are located within that laboratory.

(iii) Number of employees/students that were hired by NOAA during the past year:

11. Images and Captions (JIMAR will be including images in the annual report. Please send two of your best high-resolution, color images (photo, graphic, schematic) as a JPEG of TIFF with a caption for each image. Hardcopies of images can be dropped off at the JIMAR office if no electronic versions are available.



Effect of systematic geolocation errors. Map on the left shows the track of a bigeye tuna tagged with an archival tag in the Coral Sea using position estimates from the tag manufacturer's geolocation algorithm. Map on the right shows the track reconstructed from the same data using a prototype bias correction algorithm. Blue line is the track. Triangles are the release and recapture position. Shaded area is the 95% confidence region around the reconstructed track.