# JIMAR ANNUAL REPORT FOR FY 2011

**P.I. NAME**: Kelvin Richards (UH), Claire Paris (UMiami)

**NOAA OFFICE** *(Of the primary technical contact)*: PIFSC

**NOAA SPONSOR NAME**: Sam Pooley

**PROJECT PROPOSAL TITLE**: Early Life Stage Dispersal of Yellowfin Tuna (*Thunnus albacares*) in the Central North Pacific

**FUNDING AGENCY**: NOAA

**NOAA GOAL** *(Check those that apply)*:

x To protect, restore, and manage the use of coastal and ocean resources through ecosystem-based 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.

Mission Support

**PURPOSE OF THE PROJECT** *(One paragraph)*:

The purpose of this project is to understand larval dispersal patterns of yellowfin tuna (*Thunnus albacares*) in the Hawaiian Region. We are investigating the early life stage movement of yellowfin tuna, quantifying the degree of larval self-retention in the Hawaiian region and export to or from other tropical regions of the Pacific, thus providing supplemental information on the origin of yellowfin tuna available to Hawaii fisheries that is vital for local-scale management. We are accomplishing this by incorporating the output from a three-dimensional model that simulates ocean circulation (HYCOM) into a biological model (BOLTS) that depicts adult spawning strategies, larval development, behavior, and dispersal (Paris et al. 2007). This allows the characterization of larval dispersal pathways in the Hawaiian archipelago and we are investigating how these patterns vary across years and over ecological time scales relevant to the management of pelagic resources. In summary, this project fills a gap in the understanding of marine population dynamics in the study area, while having the potential to improve stock assessment and fisheries management.

**PROGRESS DURING FY 2011** *(One-two paragraphs)*:

*Include a comparison of the actual accomplishments to the objectives established for the period, along with reasons for the slippage if established objectives were not met*

During the fiscal year 2011 we set up, ran and performed analysis of sensitivity with BOLTS, using both velocities from the global and regional implementations of HYCOM. The following parameters were tested: a) number of released larvae, b) interval of release, c) mortality, d) diffusion coefficient, e) pelagic larval duration, f) time of release, g) depth of spawning (considering 2D displacement). Such tests were fundamental to verify if the model reached stability and is capturing the scales of flow variability. We linked hydrodynamic outputs from the regional and global HYCOM to observations. We investigated how changes to the physical environment can affect larval dispersal and connectivity patterns around the Hawaiian Islands. This was done by comparing the connectivity patterns for the Main Hawaiian Islands given by the global HYCOM and the regional HYCOM forced with local winds, for the period from May/2009 to December/2010. The differences indicated the importance of the local wind forcing in producing variable flow conditions that affect the dispersion properties of larvae.

We also characterized the Lagrangian Coherent Structures in the flow for May/2009 to March/2010. The location of the unstable and stable manifolds were estimated by computing the Finite Size Lyapunov Exponents (FSLE). This was done to understand the underlying mechanisms that provide pathways as well as barriers to the transport of larvae. The results of those experiments resulted in two symposium presentations and we are finalizing a manuscript for publication with our major findings. This analysis allowed us to address the following outcomes: 1) Using the regional HYCOM we determined the non-persistence of transport barriers, and their seasonal variability (Hypothesis H1) 2) The comparison of connectivity matrices and larval dispersal pathways with the location of LCSs verified that barriers can influence the larval transport between spawning and retention sites of yellowfin (Hypothesis H2).

**PLANS FOR THE NEXT FISCAL YEAR** *(One paragraph)*:

A new and improved version of the BOLTS model called Connectivity Modeling System (CMS) will be implemented for yellowfin tuna by August/2011. Specific modules of the model will be modified and/or developed to address particular characteristics of the yellowfin tuna larvae. Biological traits will be considered in the model and their effect on connectivity will be tested. We expect to receive contributions from the IATTC Early Life History Research Group to define key experiments to be conducted.

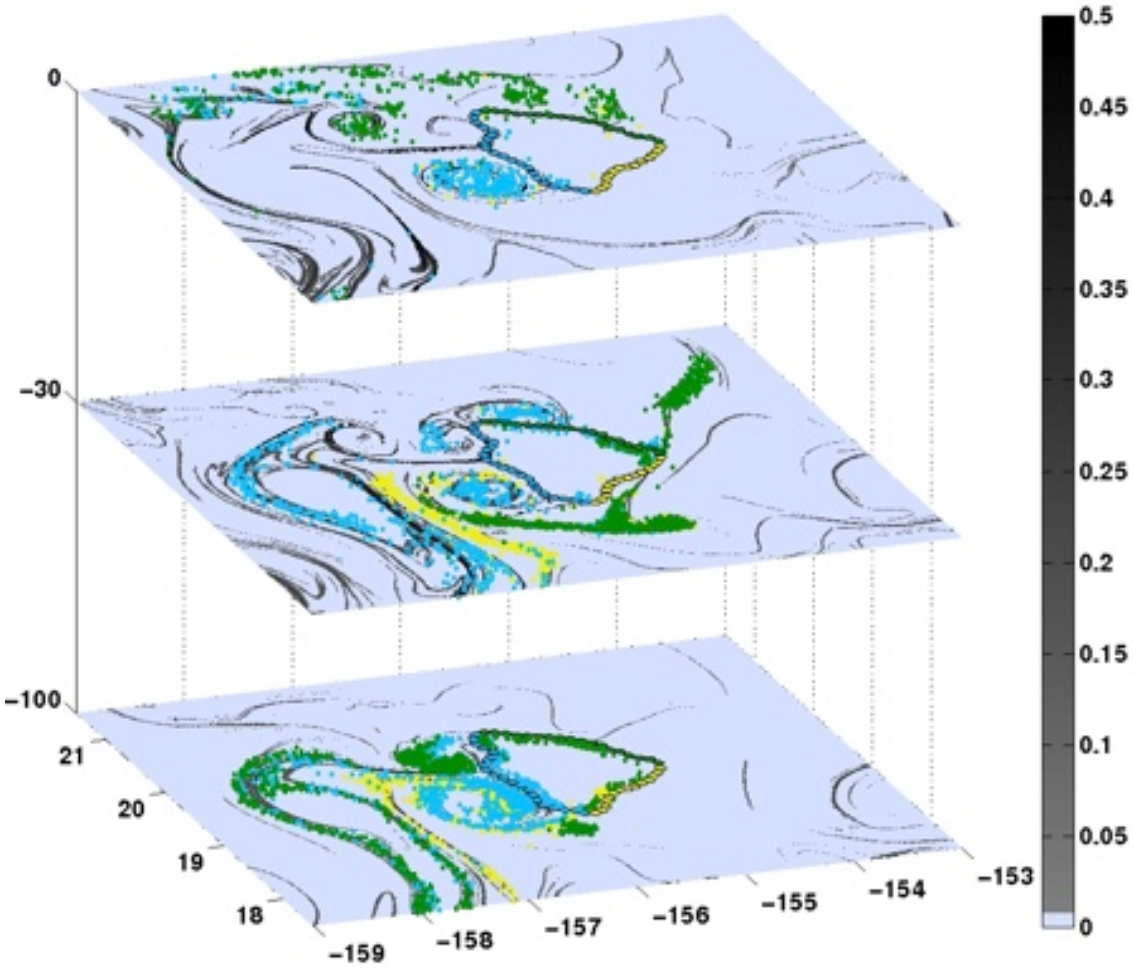
**LIST OF PAPERS PUBLISHED IN REFERRED JOURNALS DURING FY 2011**
**OTHER PAPERS, TECHNICAL REPORTS, ETC.**
**PUBLICATION COUNT**
*complete excel attachment (*JIMAR publications request*)

**GRADUATES**:
*Names of students graduating with MS or PhD degrees during FY 2011; Titles of their Thesis or Dissertation*
None

**AWARDS:**
*Name of JIMAR employees or project receiving award during the period, and Name of award.*
None

**PERSONNEL** *(on Subcontracts)*:
*For projects that awarded subcontracts in the fiscal year, please provide the number of supported postdocs and students from each subgrantee.*

**IMAGES AND CAPTIONS**:
*We will also be including images for the annual report. Please send two of your best high-resolution, color images (photo, graphic, schematic) as a* ***JPEG or TIFF (300 dpi)*** *with a caption for each image. If you do not have an electronic version of the image, a hardcopy version may be dropped off at the JIMAR office located in the Marine Sciences Building, Room 312*




Caption 1: Finite Size Lyapunov Exponents (days-1) and larvae positions for surface, 30 and 100 meters, from the regional HYCOM for 9 of August. FSLEs were calculated backwards for 30 days. Larvae were released on 18 of July and advected for 23 days.

Caption 2: Connectivity for the Big Island from June 2009 to May 2010, showing the major flows observed for each region for the global (faded color) and regional (stronger color) HYCOM at surface.

**ACRONYMS**:
*Please provide the complete descriptions for any acronyms used in any areas of the report. For example: UH (University of Hawaii)*
UH: University of Hawaii
UMiami: University of Miami
BOLTS: Biophysical Offline Larval tracking System
HYCOM: Hybrid Coordinate Ocean Model