JIMAR ANNUAL REPORT FOR FY 2012

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

NOAA SPONSOR (NOAA TECHNICAL LEAD) NAME :

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

FUNDING AGENCY:

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)*: *Include at least one objective.*

The purpose of this project is to understand larval dispersal patterns of yellowfin tuna (*Thunnus albacares*) in the Hawaiian Region. We investigated the early life stage movement of yellowfin tuna, quantifying the degree of larval self-retention in the Hawaiian region, thus providing supplemental information on the origin of yellowfin tuna available to Hawaii fisheries that is vital for local-scale management. We accomplished this by incorporating the output from a three-dimensional model that simulates ocean circulation (HYCOM) into an Individual-based model (CMS) 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 2012 *(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 2012 we set up and run the Individual-based model CMS using velocities from a regional implementation of HYCOM to generate larval distributions of yellowfin tuna around the Main Hawaiian Islands and Cross Seamount. This methodology revealed potential characteristics of yellowfin tuna larval dispersal pathways in the Hawaiian archipelago. Specifically, we evaluated if larvae spawned around the MHI and Cross Seamount were locally retained, and if biological traits affect yellowfin tuna larvae retention and seasonal variability. Finally, estimates of inshore-offshore larval distribution patterns, and its implications for larval survival, were explored.

The proportion of larval retention from different mortality schemes (absence of mortality, constant mortality, and spatially-temporally varying mortality) were not significantly different. In the same way, using different ontogenic vertical migration (OVM schemes did not substantially affect the proportion of retained larvae. Further, different mortality or migration schemes did not significantly affect inshore-offshore larval distributions. All results were tested with a t-test, at 95%. Considering these results, no mortality coefficient was applied to the larvae. Their behavior was parameterized by the first OVM scheme, with larvae concentrated between 10 to 20 meters depth. The number of eggs released per spawning site was based on Itano (2000). A minimum of 40 eggs (per release site) were released in November, while a maximum of 800 eggs were spawned in July.

According to the results, the physical environment during yellowfin tuna spawning season was favorable for larval retention. Simulations results showed that after 20 days of dispersal, the number of retained larvae was nearly constant, at both inshore (less than 37 km from the islands) and offshore (less than 92 km) regions around the MHI and Cross Seamount. This was a strong indication that yellowfin tuna larvae released in Hawai‘i were locally retained. Despite the high amount of larval retention (40%), no persistent pathways or concentration zones were present for the period of simulation. Indeed, larvae dispersed by the averaged flow field showed even larger retention values (Figure 1), implying that the time evolving eddying flow contributed to disperse larvae at the spatio-temporal scales considered in this study. Although the physical environment was conducive to larval retention, no seasonal cycle was apparent in the retention patterns, indicating that other factors are optimizing the spawning cycle observed for yellowfin tuna in the Hawaiian Islands. The inshore-offshore dispersal probabilities obtained with the model showed that the proportion of larvae retained nearshore (less than 10 km from the coast) increased with time and independently of the release location (Figure 2).

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

LIST OF PAPERS PUBLISHED IN REFERRED JOURNALS DURING FY 2012
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 2012; Titles of their Thesis or Dissertation
Ana Carolina Vaz, PhD degree in Oceanography. Dissertation title: "Flow variability. Larval dispersal and fisheries management in Hawai'i".

AWARDS:
Name of JIMAR employees or project receiving award during the period, and Name of award

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*

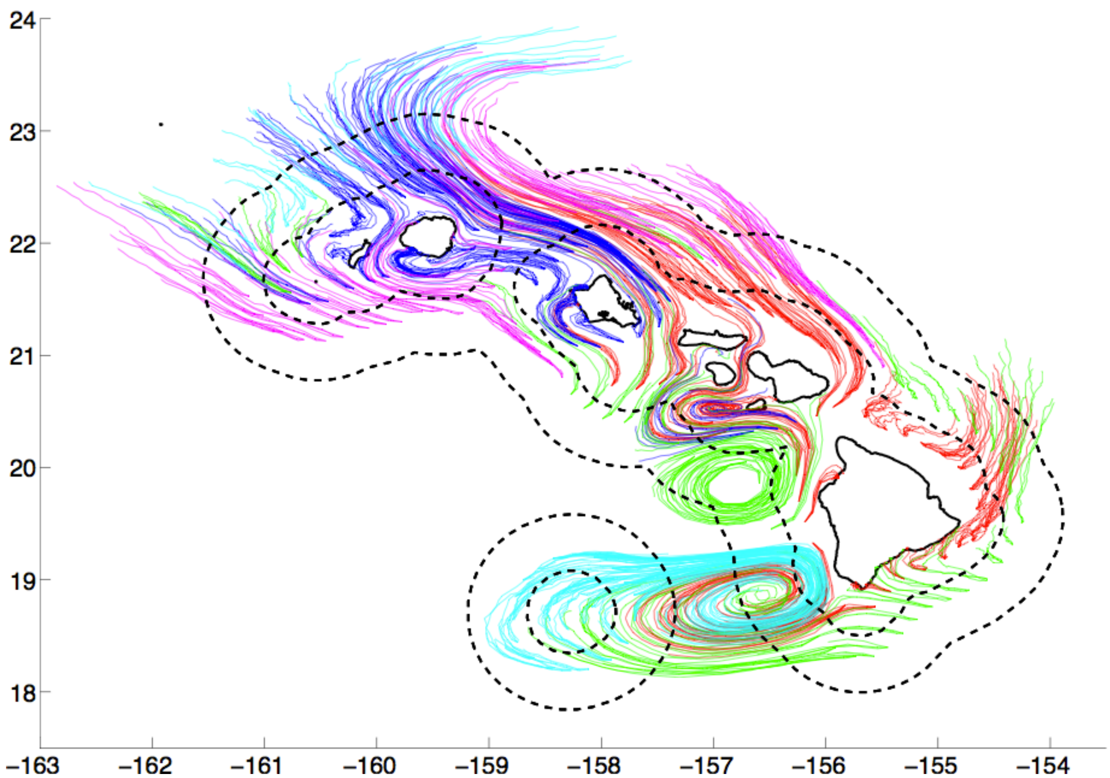

Figure 1: Trajectories of larvae dispersed for 30 days by the regional HYCOM flow fields averaged from 2009 to 2011. Colors are used to highlight dispersal from different areas.

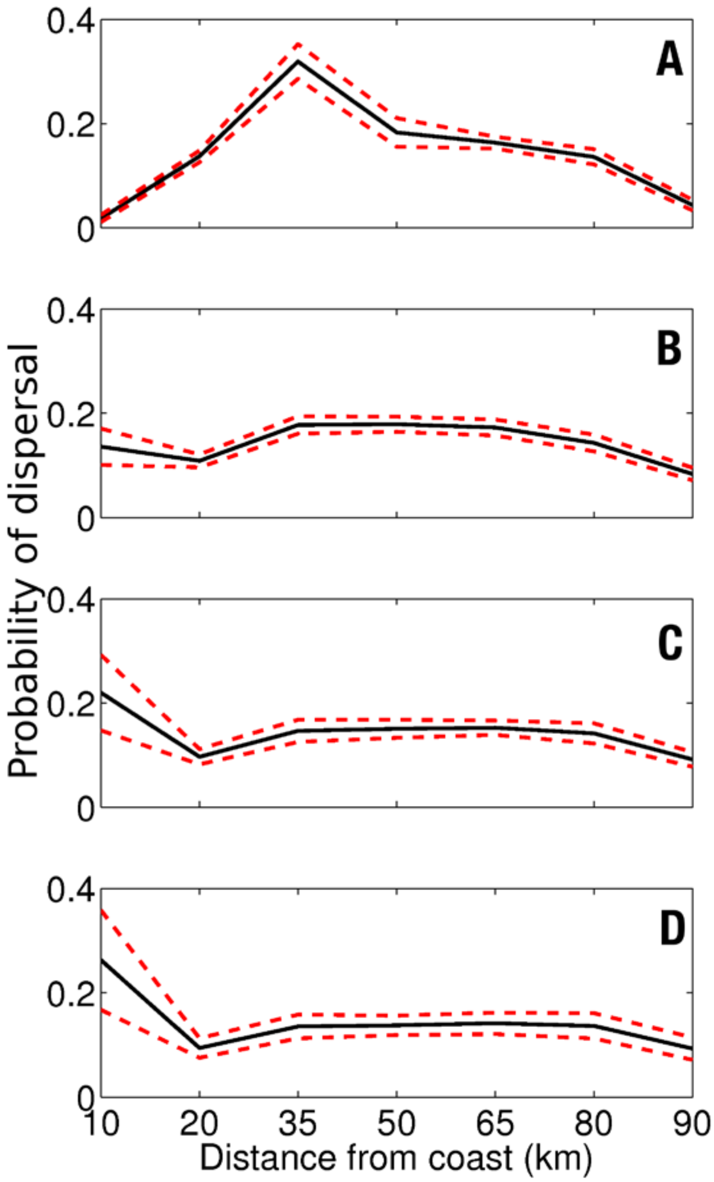

Figure 2: Mean (black) and standard deviations (red) of the monthly onshore-offshore dispersal probabilities of (a) hatching eggs (1 day of dispersal), (b) feeding larvae (6 days of dispersal), (c) post-flexion larvae transitioning to piscivory (16 days of dispersal), (d) transitional juvenile (26 days of dispersal). Mean and standard deviations are based on 100 simulations, during the spawning season of yellowfin tuna from 2009 to 2011. The dispersal kernels are based on the number of larvae within 90 km of the Hawaiian Islands, not considered dispersion to the open ocean. Larval stages were based on Margulies *et al.* (2007), Wexler *et al.* (2011) and Jeanne Wexler (*personal communication*).

ACRONYMS:
Please provide the complete descriptions for any acronyms used in any areas of the report. For example: UH (University of Hawaii)
CMS: Connectivity Modelling System
HYCOM: Hybrid Coordinate Ocean Model
MHI: Main Hawaiian Islands
OVM: Ontogenic vertical migration
UH: University of Hawai‘i
UMiami: University of Miami