JIMAR – PFRP ANNUAL REPORT FOR FY 2007

P.I./Sponsor Name: John Sibert, Réka Domokos, Kim Holland, and Jeffrey Polovina

Project Proposal Title: Synchronous assessment of bigeye tuna (*Thunnus obesus*) and micronekton biomass, distribution, and movement patterns at Cross Seamount, and the effects of the seamount environment

Funding Agency: NOAA

NOAA Goal (Check those that apply):

- X 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)

Globally, seamounts play an important role in shaping the distribution of pelagic species, such as tunas and sharks. Cross seamount in the Hawaiian archipelago --- a seamount with a 5 nmi diameter 400 m deep plateau, rising from a 5000 m seafloor and lying in the path of the North Equatorial Current and internal tides generated at the Main Hawaiian Islands chain --- is known to aggregate economically important fish such as juvenile and subadult bigeye tuna, a population which is heavily targeted by the local fishery. Reported moderate exploitation rates have recently raised concerns that the local fishery removes too many juveniles that could otherwise recruit to adult grounds and help maintain Pacific stocks. Since adult bigeye tuna are an important target species of both local and international fisheries, reducing adult populations of bigeye could have wide ranging negative effects. These concerns call for closely monitoring the biomass of bigeye tuna aggregated at Cross seamount. Since conventional fisheries dependent stock assessment methods are known to be inaccurate and biased, the current research undertakes the development of a fisheries independent method of bigeye tuna biomass estimation using active acoustics. Further, since populations of bigeye tuna depend on the biological and physical environment, the distribution, composition, and movement patterns of bigeye tuna forage, micronekton, as well as the effects of the unique environment at Cross seamount on both bigeye and micronekton, are investigated.

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):

Data for this project were collected during shipboard surveys, complimented by commercial and experimental fishing records. The *in situ* data include current magnitudes and directions from an Acoustic Doppler Current Profiler (ADCP), temperature, salinity, oxygen, and chloropigments from Conductivity-Temperature-Depth (CTD) casts, and biological backscatter at 38 and 120 kHz frequencies. Results from the acoustic backscatter are groundtruthed by fishing efforts and Cobb trawl samples for tuna and micronekton, respectively. As the first part of the two year project, an oceanographic survey of Cross seamount was conducted from April 21 through May 13, 2007, aboard the NOAA ship *Oscar Elton Sette*. Preliminary results from this survey, as well as results from a preliminary survey conducted during April, 2005, indicate that the environment at Cross seamount is highly dynamic, with currents changing on time scales as short as 30 minutes. Biomass of both micronekton and tuna at the seamount --- as well as that of other fish --- were observed to be higher than those away from it. Higher tuna biomass was evident over the shallow plateau, while higher micronekton biomass was seen both over the plateau and at the flanks. The composition of the nighttime shallow scattering layer (SSL), composed mainly of micronekton, differed over the plateau than away from it (Fig. 1), with the differences in backscattering characteristics at the two frequencies indicating relatively high biomass of fish with gas bladder, other gas bubble containing organisms, and possibly squid, at the seamount. Dense micronekton patches, at depths of approximately 700-800 m, were observed at the flanks, predominantly in the up-current directions. Dense, large aggregations (~ 3 km long, 50 m high) of bottom fish were observed directly over the plateau floor only during nighttime, predominantly over the southwestern area of the plateau. Acoustic signatures of bigeye tuna were separated from other nekton, as well as from other tuna species, using their positional, morphological and energetic acoustic descriptors, taking into account previous knowledge of the composition and depth distribution of species fished at Cross seamount. The results of fishing efforts during the surveys, although not numerous enough for statistical significance, collaborated the acoustic identification of bigeye, yellowfin, and skipjack tunas over the plateau.

Two types of acoustic objects, with characteristics consistent with those of bigeye tuna, were observed over the plateau of Cross seamount: single fish described by their Target Strength (TS) values and tuna aggregations. All tuna aggregations were observed in daytime in the central and southwestern part of the seamount plateau. These aggregations were large (111 m high, 189 m long on average), loose, and deep, with a mean depth of 200 m. The depth distribution of tuna aggregations reasonably matched those of bigeye tuna equipped with archival tags, spending a substantial amount of time at around 400 m near the depth of the seafloor. These results seem to indicate that bigeye tuna shoal during their deep excursions over the seamount plateau (Fig. 2). Generally speaking, most of the tuna targets were aggregated in daytime in the central and southwestern part of the plateau with individuals dispersing at sunset --- seemingly leaving the plateau area --- then congregating again into large aggregations at sunrise. Besides this diel cycle, daily variability in relative tuna biomass was also observed.

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

   In FY08, a second shipboard survey will be conducted during the month of April. During this cruise, emphasis will be based on survey designs optimal for biomass estimation of bigeye tuna over Cross seamount. The survey design will be based on the distribution and movement patterns of bigeye obtained from data collected during the first cruise (FY07). Data from the first cruise will be further analyzed to compare tuna and micronekton distribution and movement patterns to each other and to temperature, salinity, oxygen, chloropigments, and currents at the seamount, obtained from the CTD and ADCP records.

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

   None

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

   Domokos, R., L. De Forest, M. Doray, J. Drazen, J. Polovina (2007). Bigeye Tuna and its Forage Base at Cross Seamount. Presented at the 58th International Tuna Conference, May 21-24, 2007, Lake Arrowhead, CA.

   Doray, M., R. Domokos, J. Polovina (2007). Preliminary Results on the Spatio-Temporal Distribution of Tuna at Cross Seamount. Presented at the 58th International Tuna Conference, May 21-24, 2007, Lake Arrowhead, CA.

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):

	JI Lead Author			NOAA Lead Author			Other Lead Author		
	FY05	FY06	FY07	FY05	FY06	FY07	FY05	FY06	FY07
Peer-reviewed									
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):

1 Post-doc: Mathieu Doray

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):

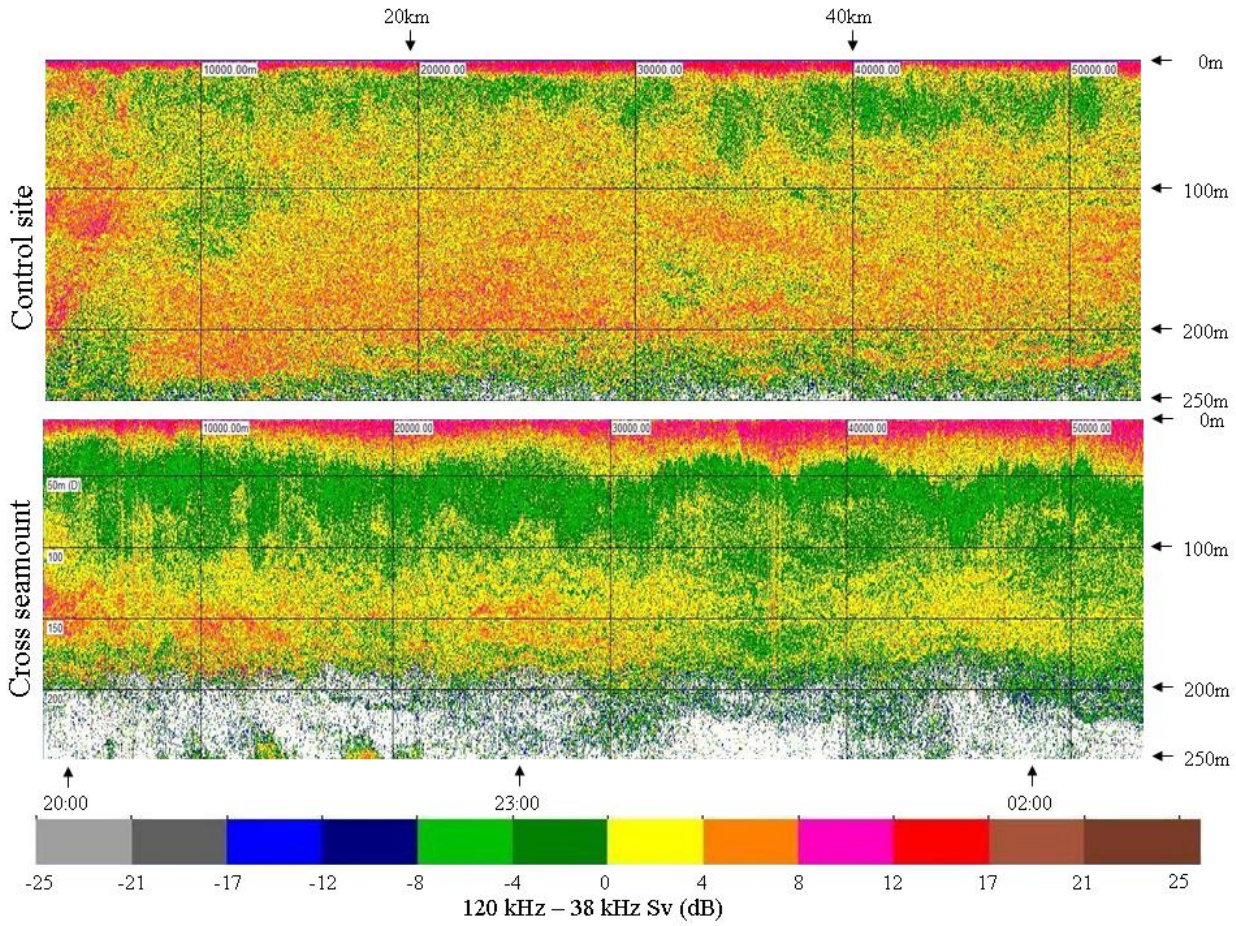
    Mathieu Doray

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

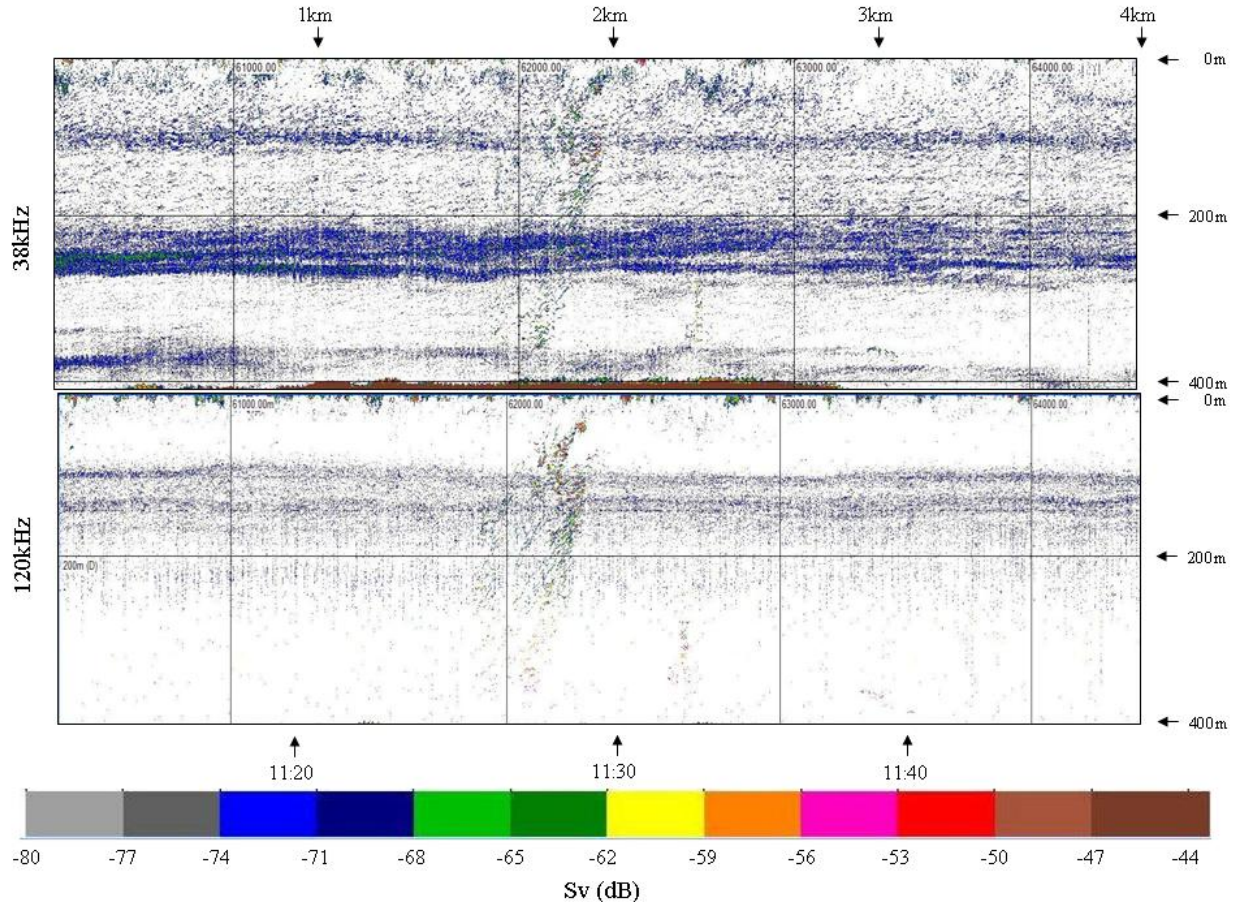
    (iii) Number of employees/students that were hired by NOAA during the past year:

    Mathieu Doray

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.



● Caption 1: Differences in the composition of the nighttime shallow scattering layer away from Cross seamount (top panel) and at Cross seamount (bottom panel), as revealed by the differences in the mean volume backscattering strengths (S_v in dB re 1 m^{-1}) at 120 and 38 kHz frequencies. x axes show distance and time, while y axes indicate depth. Note that at Cross seamount negative values dominate, indicating relatively higher abundances of fish with swim bladder, other gas bubble containing organisms, and possibly squid.



● Caption 2: Echograms showing an aggregation identified as bigeye tuna from the shape, looseness, and depth of the aggregation, as well as from the target strengths of the individuals within. x and y axes are as in Fig. 1. The upper and lower panels display the mean volume backscattering strengths (S_v in dB re 1 m^{-1}) at the 38 and 120 kHz frequencies. Note that the aggregation extends vertically from almost the surface to the 400 m deep plateau, indicating that bigeye can shoal during their deep diving behavior.

12. For multi-year projects, provide budget for the next year on a separate page.
Contact Dodie Lau to confirm whether or not your project is to receive continuation funds (e.g., year 2, year 3), and for budget preparation assistance, lau@hawaii.edu