JIMAR ANNUAL REPORT FOR FY 2009

P.I./SPONSOR NAME: Kevin Weng, Reka Domokos, Kim Holland, and Jeffrey Polovina

NOAA OFFICE (Of the primary technical contract): PIFSC

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):

- ✠ 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

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 (NEC) 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 recruitment into 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.

PROGRESS DURING FY 2009 (One-two paragraphs, including a comparison of the actual accomplishments to the objectives established for the period, and the reasons for the slippage if established objectives were not met):

As all proposed field work for the project was completed in FY08, work during this fiscal year focused on completing all *in situ* (bioacoustics, currents, CTD casts) and satellite (sea level anomaly and sea surface color) data analyzes. Since data analyzes during FY08 revealed that micronekton biomass is higher over the plateau and flanks of the seamount than in nearby waters, and that bigeye tuna aggregate at the seamount at least partially to feed, data analyzes during FY09 focused primarily on quantitatively describing the effect of the environment on the composition and distribution of micronekton at Cross Seamount as well as at different regions within the study area. At present, a manuscript is being prepared for publication in a referred journal on the composition and distribution of micronekton and the effects of the seamount environment on micronekton.

Data analyzes during FY09 revealed that the increased micronekton biomass is likely due to the availability of increased forage that is not the result of a trophic cascade originating in higher primary production due to upwelling caused by island effects. Current data persistently shows downwelling over the summit and flanks of the seamount with magnitudes that can reach over 20 cm s^{-1}. Small doming of density contours were observed within 200 m of the plateau floor (Fig. 1, left, bottom panel), too deep to result in upwelling of nutrients into the eutrophic zone This corresponds with the apparent lack of an effect of the seamount on chloropigment concentrations (Fig. 1, left, fourth panel from top). Interactions between the abrupt topography and impinging currents and internal tides are likely trap planktonic organisms that are not able to swim against currents that can reach almost 50 cm s^{-1} magnitudes, thus providing forage for the increased micronekton biomass.

The Seamount's effects on micronekton are confined to the plateau and the immediate flanks, not extending to more than 1-2 km from the shallow, 700-1500 m flanks (Figure 2). On a 24 hrs cycle, the largest difference between micronekton biomass in the shallow scattering layer (SSL) over the plateau and away from it is between 00:00 to 18:00. After 18:00, as micronekton start migrating into the SSL, the SSL biomass increases over the flanks and surpasses that over the plateau by 20:00. Between 20:00 and 24:00, micronekton migrate over the plateau and restore the overall daytime and nighttime pattern. On larger scales, the region surrounding Cross Seamount tend to have lower biomass of all regions in the study area except for a region south of Cross seamount. As all other study regions are located to the east and north of Cross Seamount, it is likely that those regions are affected more by the eddies generated in the islands' wake than Cross Seamount that lies at the south edge of the path of these eddies. Eddies were observed to have a profound effect on micronekton biomass. During the 2008 cruise, a large cyclonic eddy occupied the region called "Control Site", located about half-way between Cross Seamount and Oahu. The signature of the eddy can be readily seen in the *in situ* temperature, salinity, dissolved oxygen, chloropigments, and density records (compare Fig. 1 middle and right panels), as well as satellite altimetry data. During the 2008 observations, micronekton biomass both in the SSL and the Deep Scattering Layer (DSL) were dramatically higher than those during the 2005 observations.

PLANS FOR THE NEXT FISCAL YEAR (One paragraph):

During FY10, I will finish preparing the manuscript on the characterization of micronekton at Cross Seamount and the effects of the seamount environment to be published in a peer-reviewed journal. I will finish the quantitative analyzes on the spatiotemporal distribution and biomass of bigeye tuna at Cross Seamount and prepare manuscript to be published in a peer-reviewed journal.

LIST OF PAPERS PUBLISHED IN REFERRED JOURNALS DURING FY 2009, in the following format: (Author or authors with last name and initials, publication year: Article title. *Journal name*, volume, page range.) For example: Charney, J.G., and A. Eliassen, 1964: On the growth of the hurricane depression. *J. Atmos. Sci.*, 21, 68-75.

none

OTHER PAPERS, TECHNICAL REPORTS, ETC.:

Domokos, R., 2009: Bigeye tuna and its forage base at Cross Seamount. Presented at the 60th International Tuna Conference, May 18-21, Lake Arrowhead, CA.

Domokos, R. 2009: The effects of the Cross Seamount environment on the distribution, movement patterns, and biomass of bigeye tuna (*Thunnus obesus*) and its forage. Annual Report to the Western and Central Pacific Fisheries Commission

Domokos, R., 2009: The effects of the Cross Seamount environment on the distribution, movement patterns, and biomass of bigeye tuna (*Thunnus obesus*) and its forage. Report to the Western Pacific Regional Fishery Management Council

Domokos, R., 2008: Bigeye tuna and its forage base at Cross Seamount. Presented at the PFRP PI workshop, Nov. 18-19, Honolulu, HI.

Domokos, R., 2008: Development of a fisheries independent method of biomass estimation of bigeye tuna (*Thunnus obesus*) at Cross Seamount, Hawaii. Annual Report to the Advanced Sampling Technology Working Group, National Marine Fisheries Service.

GRADUATES (Names of students graduating with MS or PhD degrees during FY 2009; Titles of their Thesis or Dissertation): none

AWARDS (List awards given to JIMAR employees or to the project itself during the period): none

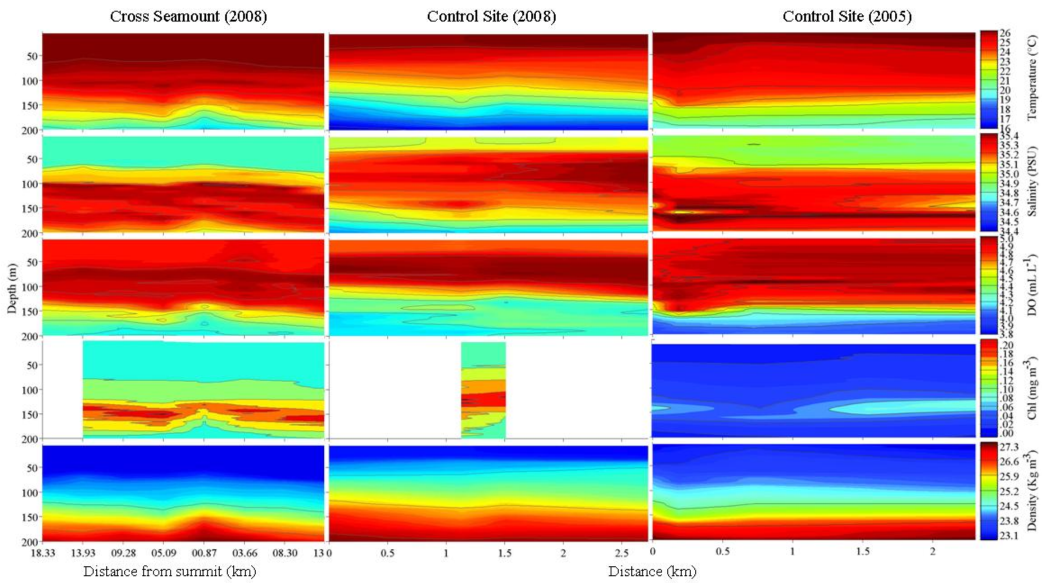
PUBLICATION COUNT (Total count of publications for the reporting period and categorized by NOAA lead author and Institute (or subgrantee) lead author and whether it was peer-reviewed or non peer-reviewed (not including presentations):

	JI Lead Author	NOAA Lead Author	Other Lead Author
Peer Reviewed			
Non-Peer Reviewed		3	

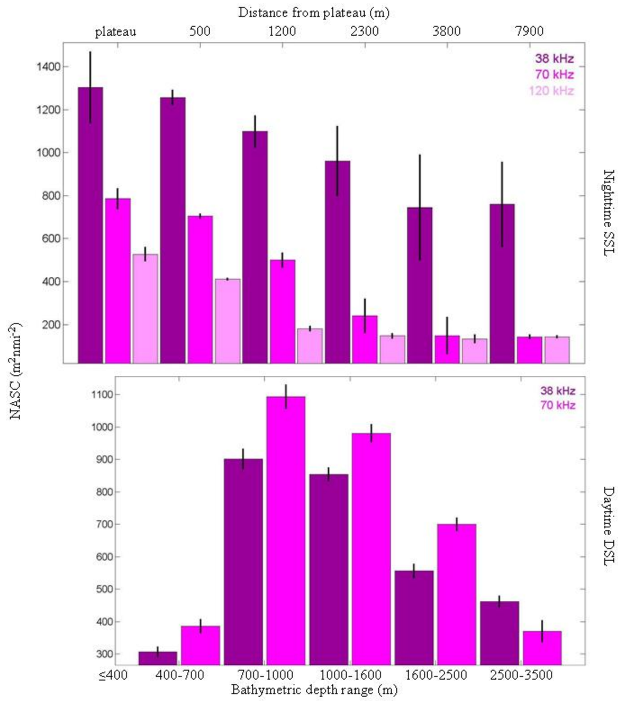
PERSONNEL:

For projects that awarded subcontracts in the fiscal year, please provide the number of supported postdocs and students from each subgrantee. None

IMAGES AND CAPTIONS (see next pages)



- Caption 1: Upper 200 m temperature, salinity, dissolved oxygen, chloropigments, and density (σ_t) at Cross Seamount in 2008 (left panel), and at the "Control Site" in 2008 (middle panel) and in 2005 (right panel), as measured by *in situ* CTD casts. During the 2008 cruise, not all casts had fluorometer on them resulting in missing values at some of the stations.



- Caption 2: Nautical Area Scattering Coefficients (NASC), a proxy for relative biomass, in the nighttime SSL (top) and in the daytime DSL (bottom), moving from the plateau (left) to deeper waters (right). NASC values are shown at 38, 70, and 120 kHz for the SSL and at 38 and 70 kHz for the DSL as the higher frequency signals attenuate before reaching the DSL. The x axis on the bottom shows the bathymetric depth ranges while the top the corresponding distance from the edge of the plateau. Note that the very low NASC in the 400-700 m range are due to most of the DSL not being present, as the depth of the DSL is typically between 500 and 900 m.