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CRUISE REPORT[1]

VESSEL: *Oscar Elton Sette*, Cruise 06-02 (OES-38)

CRUISE PERIOD: 15 February – 02 March 2006

AREA OF OPERATION: American Samoa Exclusive Economic Zone (EEZ) (Fig. 1)

TYPE OF OPERATION: Oceanographic survey equipment testing was carried out approximately 15-18 nmi south of the Island of Tutuila. Oceanographic survey operations were conducted at a tuna tagging site in the northwest corner of American Samoa EEZ, at two eddy sites in the northern part of the EEZ and to the east of Tutuila, and at a control site to the southeast of Tutuila. All survey operations consisted of 1000-m conductivity-temperature-depth (CTD) casts along acoustic Doppler current profiler (ADCP) and EK60 transect lines, spaced at 15 nmi from each other. Survey operations at the tuna tagging site included daytime and nighttime deep (~500 m) and nighttime shallow (~120 m) Cobb trawls in addition to the CTD casts and ADCP and EK60 transects.

ITINERARY:

15 February — Start of cruise. On board Réka Domokos, Lisa De Forest, Eva Landren, Lucas Moxey, and Victoria S. Okimura. Departed Pago Pago Harbor, American Samoa, at 1000; proceeded to the south of Tutuila and commenced testing oceanographic survey equipment.

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15-16 February	Continued survey equipment testing then proceeded to Pago Pago Harbor.
17 February	Left Pago Pago Harbor at 0900 and headed northeast toward the last known position of *Adelita* (~ lat. 13ºS, long. 170ºW), a commercial longline fishing vessel from which tuna tagging operations were conducted. After establishing contact with Donald Hawn on board the *Adelita* and obtaining the vessel's current position, proceeded to the tuna tagging site at ~ lat. 11ºS, long. 173ºW.
18 February	Arrived at the tuna tagging site and commenced survey operations at 0800.
19-21 February	Continued survey operations at the tuna tagging site. Survey operations were interrupted by a rendezvous with the *Adelita* at 1200 on 19 February. Embarked Donald Hawn.
21 February	Transited to first eddy (Eddy #1) transect at ~ lat. 11º48'S, long. 171º03'W – lat. 10º04'S, long. 169º13'W and commenced oceanographic survey operations.
22-23 February	Continued survey operations along the Eddy #1 transect line.
24 February	Completed survey operations at Eddy #1 and transited to the second eddy (Eddy #2) transect, at ~ lat. 14º30'S, long. 169º30'W – lat. 13º59'S, long. 165º56'W.
25 February	Commenced oceanographic survey operations at Eddy #2.
26-27 February	Continued survey operations along the Eddy #2 transect line.
28 February	Upon completing survey operations at Eddy #2, commenced survey operations at the control site ~ lat. 14º30'S, long. 169º30'W – lat. 15º40'S, long. 169º59'W.
01 March	Completed survey operations along the control transect line and commenced transiting to Pago Pago Harbor, Tutuila.
02 March	Arrived at Pago Pago Harbor at 0800 and disembarked Réka Domokos, Lisa De Forest, Donald R. Hawn, Eva Landren, Lucas Moxey, and Victoria S. Okimura. End of cruise.

MISSIONS AND RESULTS:

A. Conduct CTD casts and continuous ADCP and Thermosalinograph (TSG) measurements to characterize the physical environment at the high shear regions of eddies and meanders between the westward flowing South Equatorial Current (SEC) and eastward flowing South Equatorial Counter Current (SECC).

A total of 39 CTD casts and 53 ADCP transects were conducted along transect lines at the 4 sites chosen for the observations: the tuna tagging site, 2 eddy sites, and a control site (Table 1). Of the 39 total, 6 CTD casts at 3 locations and 20 ADCP transects were conducted at the tuna tagging site, an ~50 nmi x 50 nmi area. This site was chosen to obtain information on the environment in the region where seven mature albacore and two mature bigeye were successfully tagged during the first days of the cruise (14-19 February). From maps of AVISO seasurface height and estimated geostrophic currents, as well as from the ADCP data, the tuna tagging site was identified as a relatively high shear region near the northern edge of an anticyclonic eddy.

The two eddy transect lines were selected by examining the most recent (10 days old) AVISO seasurface height and geostrophic current data that were used to identify high shear regions at the boundaries of eddies within the EEZ. At both eddy sites, the transects were run twice: first from west to east with CTD casts spaced at every 15 nmi, then from east to west as one continuous run.

The transect line at Eddy #1 was located to traverse the boundary region between an anticyclonic and cyclonic eddy, starting and ending at the approximate eddy centers. A total of 12 ADCP transects and 11 CTD casts were conducted along the 150-nmi long line. Unprocessed ADCP data from this transect indicate the presence of the expected strong shear region between the two eddies, and preliminary CTD salinity records suggest that the water at the anticyclonic and cyclonic eddies had signatures consistent with that of the SECC and SEC, respectively. On the other hand, expected changes in mixed-layer depths associated with the eddies are not evident from the CTD records. Towards the end of Eddy #1 operations, the most recent AVISO data downloaded (new AVISO data is available twice a week) showed the passing of the anticyclonic eddy to the south and the disintegration of the cyclonic eddy in the east.

Based on the newest available AVISO map, a new location for the second transect line at Eddy #2 was selected, again to traverse a high shear region between an anticyclonic and cyclonic eddy, originating and terminating at the centers of the eddies. A total of 15 ADCP transects and 15 CTD casts were conducted along the 210-nmi long Eddy #2 transect line. Similar to the transect line at Eddy #1, unprocessed ADCP data obtained during traveling along the Eddy #2 transect show currents consistent with those of the expected high shear region, while salinity records from CTD casts are in accord with those expected of the SECC and SEC waters at the estimated centers of the anticyclonic and cyclonic eddies, respectively. Again, expected changes in mixed-layer depths associated with the eddies are not evident from the CTD records. As at the Eddy #1 site, the most recent AVISO maps obtained during the Eddy #2 operations revealed a significant change in the sea surface height patterns, although this time the shifting of eddies and meanders might have been more favorable for maintaining a relatively strong shear along the transect line.

The transect line at the control site was selected as a tangential line along the northwest boundary of the anticyclonic eddy at the origin of the Eddy #2 transect line, according to the most recent AVISO map. At 75 nmi, this transect line was relatively short because of time limitations. A total of 6 ADCP transects and 6 CTD casts (at 15-nmi distances from each other) were conducted along the control site transect. Unprocessed ADCP data fail to indicate relatively strong currents, while AVISO maps from the relevant time period, available only 10 days past the end of the cruise, indicate the almost complete dissipation of the anticyclonic eddy by this time. Based on the lack of relatively strong dynamics in this region, the data from the last transect is planned to be used as control for the data obtained at the strong shear regions during the cruise.

B. Conduct EK60 bioacoustic transects to assess the influence of the physical dynamics on the density and distribution of micronekton (and possibly nekton) in the region.

At total of 53 bioacoustic transects were conducted during the cruise: 20 at the tuna tagging xite, 12 and 15 at Eddies #1 and #2, respectively, and 6 at the control site. As a result of both the synchronization of the acoustic sounders on board the *Sette* (the RD Instruments 75 kHz ADCP sounder, the 12 kHz Simrad ES60 depth sounder, and the 38 kHz and 120 kHz Simrad EK60 bioacoustics sounders) and the installation of vent plates on the transducer pod, the noise in the bioacoustics recordings were significantly reduced in comparison to previous levels. Both the synchronization and the vent cover installation took place during the December 2005 – January 2006 inport days. Prior to survey operations, the position and proper condition of the vent plates were inspected by divers at the test site. The inspection of the vents were followed by bioacoustic transects, using various vessel speeds and headings, to test the effectiveness of the vents in increasing the signal to noise ratio of the bioacoustics recordings. From the results of these tests, as well as from the quality of the bioacoustics recordings throughout the cruise, it was determined that the installation of the plates made it possible to collect bioacoustics data at higher vessel speeds or in rougher conditions than it was previously possible. Most of the broad band, active noise prevalent during prior cruises was gone. However, active noise and bubble noise, both predominantly affecting the 38 kHz channel, were not reduced significantly. Traveling above 6 knots in conditions with winds above 15 knots resulted in making the bioacoustics recordings unusable. It seems that the reason for the 38 kHz being more affected than the 120 kHz is attributed to its front center position on the transducer pod. The elimination of this noise in the near future is essential for our ability to obtain quality bioacoustics data using the instruments on board the *Sette*.

In addition to the significant environmental noise, the close proximity of the ES60 to the EK60 transducers is the reason why the synchronization did not work optimally between these two instruments. At best, the ES60 barely sees the bottom when it is externally triggered, with its pings still showing up in the upper ~10 m of the EK60 echograms. The performance of the ES60 during synchronized operation is deemed unsafe by the ship's Commanding Officer, except while conducting operations in deep waters with well known bathymetry.

Preliminary results from the bioacoustics transects indicate that the highest sonic scattering layer is located between 500 and 900 m during the daytime, usually composed of two prominent layers at 500-650 m and 750-900 m , and in the upper 150 m during nighttimes. However, both layers persist at all times with another persistent, although thinner, layer at around 200-300 m deep. Dawn and dusk echograms display the expected vertical migratory pattern of the scattering layer with the addition that a significant portion of the organisms seem to migrate between the surface and the 750-900 m deep layer. Large aggregations of nekton were prominent throughout the days but rarely observed at nights. Almost exclusively, all nekton aggregations were found between 200 and 400 m below the surface, apparently feeding on the scattering layers at those depths.

The lowest micronekton biomass seemed to be situated along the Eddy #2 transect line, which also appeared to exhibit the highest nekton biomass of all other regions. On the other hand, preliminary data from the test site indicated that this site had the highest micronekton biomass and also the second highest nekton densities, only to be exceeded by that at the Eddy #2 transect line. Nighttime micronekton densities seem to be comparably high at the tuna tagging and Eddy #1 sites, exceeded only by that at the test site, while daytime micronekton and nekton densities at the tuna tagging site appeared to be exceeded only by that at the test and the Eddy #2 sites, respectively. As a surprise, preliminary results imply higher micronekton and fish densities at the control site than at the tuna tagging site, although the nighttime tagging site scattering intensity seemed to be close to that at the control site. Control site nighttime micronekton densities appeared to be comparable to those at the Eddy #1 site, with higher daytime densities than at both the tuna tagging and Eddy #1 sites.

C. Conduct CTD casts to assess the influence of the physical dynamics on the biological productivity in the SECC and SEC boundary region.

Along with the temperature and salinity profiles, dissolved oxygen, photosynthetically active radiation (PAR) sensor, and fluorometer profiles were collected throughout the duration of each CTD cast. In addition, discrete 1- and 2-liter water samples were taken at 10 depths during all but one of the 39 casts throughout the cruise for extracted chlorophyll and accessory pigment determinations (Cast #33 was a 500-m deep TDR calibration only, without the collection of any water samples). In an effort to make the data comparable to the data collected from the NOAA ship *Hi'ialakai*, filters used during this cruise were changed from the "standard" 47-mm diameter filters to 25-mm diameter filters. Because of this change, duplicate samples (for both chlorophyll and accessory pigments) were obtained at three depths, chosen at the chlorophyll maxima, to make all present and future samples backward- compatible. All filtered discrete samples were wrapped in aluminum foil and stored in liquid nitrogen dewars on the vessel to be analyzed at a later date.

During Cast #04, the Seapoint fluorometer inlet fitting broke. For the rest of the cruise, the fluorometer was mounted open and unplumbed at the base of the CTD approximately at the same depth as the depth sensor. Furthermore, during Casts #12 and #13 the Biospherical Instruments PAR sensor was found to be malfunctioning, and after deeming it inoperative during Cast #14, it was removed for troubleshooting. Upon contacting the manufacturer it was determined that the sensor's amp blew and that it needed to be sent in for repair and calibration. In addition to the problems with the fluorometer and PAR sensor, a total of eight Niskin bottles failed to close after firing, so no samples could be collected at the following depths: of Cast #11, bottle #05, Cast #14, bottles #01 and #05, and Cast #17, bottles #01 and #10 (Eddy #1 Transect), and of Cast #19, bottles #01 and #05, and Cast #28, bottle #09 (Eddy #2 Transect).

D. Conduct stern trawl operations targeting the depths of the high sonic scattering layer to help in the interpretation of the bioacoustics data and to characterize the micronekton composition and density as the forage base for larger pelagic nekton.

Planned Cobb trawl operations could only be conducted at the tuna tagging site as a result of equipment failure. A total of 14 trawls were completed at the tuna tagging site, 5 during daytime and 9 during nighttime. All daytime trawls were 1 hour at depth, targeting the depth of the deep sonic scattering layer. However, because of limitations imposed by the length of the trawl winch wires, the deepest trawl depth was ~520 m, significantly curtailing our ability to sample the deep scattering layer, typically located between 500 and 900 meters. Five of the nine nighttime trawls where shallow (oblique), targeting the nighttime shallow scattering layer, typically in the upper 150 m, while four were deep (1 hour at depth), targeting the deep scattering layer. During Trawl #14 (a deep nighttime trawl), the port trawl winch came to a halt after emitting loud grinding noises. The trawl had to be aborted at ~300 m below surface and slowly pulled back up. Since the time required for the net to surface once reaching the 150 m depth was one hour (with no observable backscatter between 150 m and 300 m) the trawl was considered a shallow oblique and the samples were saved from the net. After inspecting the winch, which became completely inoperative by the end of Trawl #14, the chief engineer determined that the winch's reduction gear broke. Since there were no spare parts nor tools for the required repair, all future trawl operations had to be canceled for the duration of the cruise.

During all trawl operations, the Netmind mensuration system worked properly except for the lack of information on the vertical extent of the opening at the mouth of the net. Upon contacting the manufacturer, who informed us that the Netmind sensors operational distance is roughly 15 feet, it was determined that the footrope rides too far back behind the headrope and it is outside of the instrument's range. To obtain vertical opening information from the Netmind sensors, the Cobb net should be modified in such a way that the footrope couldn't lag behind the headrope to the present extent. Limiting the lag would reduce the distance between the headrope and the footrope to be within the operational range of the Netmind sensors.

E. Miscellaneous.

During the tuna tagging site operations (at 2100 on 20 February), the starboard engine's fan flew off its attachment point and broke into small pieces (the same engine that was repaired prior to the ship's departure from Honolulu, causing a delay and the loss of 6 seadays from the three American Samoa cruises). After the ship's crew removed the pieces and added another fan and blower, the engine remained semi-operational throughout the duration of the cruise. The maximum vessel speed was reduced to about 9 knots, causing some loss of operational time for the rest of the cruise.

SCIENTIFIC PERSONNEL:

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Attachments

Figure 1. OES 06-02 (OES-38) cruise tracks, 15 February -- 02 March, 2006.