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US AMLR Vessel Survey (*R/V Yuzhmorgeologiya*)
South Shetlands, Antarctica

We completed the second leg of the 2008 AMLR survey on March 7th, and closed both the Cape Shirreff and Copacabana field camps. The Elephant Island and South Areas (Bransfield Strait) were also completed and zooplankton, acoustically inferred biomass, phytoplankton and nutrients as well as bird and marine mammal observations were made. We are now in transit to Punta Arenas and are scheduled to arrive at 1500 Saturday 15 March.

Acoustics

Acoustically derived biomass for both the Elephant Island and South Areas was determined. In general, biomass of krill in both areas was about half that determined on the first Leg. The biomass in Elephant Island was estimated at 850 000 tons, and exhibited at very high CV (>50%). In the South Area, the biomass was estimated at 380 000 tons, and also exhibited a rather high CV of 49%. Mean density of krill in each area was 19 and 15 g m².

Krill and Zooplankton: South Shetland Island Region

A total of 65 stations were sampled in the South Shetland Island region during leg 2, 44 of which were in the Elephant Island Area and 21 in the South Area. Krill were more frequent in Elephant Island samples (91%) vs. those in the South (86%). Largest catches in the Elephant Island Area (1000-3200 individuals) were located over outer shelves northeast and west of the island while those in the South Area (2000-19000) were in southern Bransfield Strait. Index of dispersion values (5200 vs. 564) reflect the high degree of patchiness in the South compared to Elephant Island Area.

Krill lengths ranged between 19-57 mm and the overall length-frequency distribution was strongly dominated by modes representing one- and two-year-old krill from the 2005/06 and 2006/07 year classes (28 mm and 44 mm, respectively). This is generally similar to the length-frequency characteristics observed in the South Shetland Island region during January Survey A. However, the greater representation of larger and older krill, particularly in the Elephant Island Area where individuals >45 mm constituted 36% of the catch, likely resulted from their seasonal onshore movement from oceanic waters. Such individuals were rare during Survey A, suggesting an unusually strong northward seasonal displacement this year.

Bimodal length distributions characterized both areas, but the primary mode in the Elephant Island Area was 45 mm while that in the South Area was 28 mm. Accordingly, mature individuals comprised 68% vs. 29% of catches in the respective areas. Juveniles made up 14% of individuals in the Elephant Island Area compared to 33% in the South. Greater proportions of

advanced female maturity stages (e.g., developing ovaries, gravid and spent) were represented in the Elephant Island Area (56% vs. 24%), possibly reflecting a final spawning bout by the larger animals.

Larval krill were present in 64% and 86% of samples in the Elephant and South Areas, with greatest concentrations (1500-13000 individuals) located over the deep basin in eastern Bransfield Strait. Moderately large catches (e.g., 200-1000 individuals) were more evenly distributed over the western Bransfield Strait basin than the east. Early calyptopis (stage 1) comprised 97% of the larvae. Overall larval krill concentrations and development observed here during Survey D were similar to those last month, suggesting advective transport out of the sampled area, perhaps with concentration and retention in frontal regions such as those sampled in the Joinville Island Area during Survey A and to the east during the transit from the South Orkneys Area.

Copepods, notably *Metridia gerlachei*, *Calanoides acutus* and "unidentified others", were the numerically dominant zooplankton taxa in both the Elephant Island and South Areas. Post-larval *Thysanoessa macrura*, post-larval and larval krill and chaetognaths followed these in abundance, with modest differences in relative abundance rankings between the two areas. Overall zooplankton composition and abundance in these two areas were fairly similar to those observed here last month.

Krill were equally abundant in the South Shetland and South Orkney Island regions during Survey D. While they shared length distributions dominated by one- and two-year-old krill, the proportions of small krill (80% <36 mm) and juvenile stages (66%) in the South Orkneys region differed greatly from the more multigenerational size/age/maturity composition represented in the South Shetland Island region (70% >35 mm, 52% mature, 47% of mature females in advanced stages). Additionally, larval krill were virtually absent from the South Orkney Island region but were among the numerically dominant taxa in the South Shetland Island region, constituting 4% of total mean zooplankton abundance.

Despite a few exceptions, like larval krill, composition and abundance of the South Shetland Island zooplankton assemblage was fairly similar to that in the South Orkneys region. Copepods dominated in both regions and had similar mean and median abundance values, but proportionally were more abundant in the South Orkneys where they comprised 69% vs. 62% of the total mean. *Metridia gerlachei*, *Calanoides acutus* and "others" were the most abundant copepod taxa in both regions. Post-larval *Thysanoessa macrura* were proportionally more abundant in the South Shetland region (16% vs. 6%). Similarity between the remaining taxonomic categories is indicated by a high PSI value of 82. In addition to larval krill, regional abundance differences were apparent for *Euphausia frigida* and *Themisto gaudichaudii* (an order of magnitude more abundant in the South Shetlands Island region) and siphonophores, radiolaria and *Acanthophyra pelagica* larvae (an order of magnitude more abundant in the South Orkney Island region).

Oceanography and Meteorology

Strong South Easterly winds, peaking around 45 knots, averaging 25 knots started of the week. With a drop in pressure on Saturday (1st March) the winds veered to the North-West and

continued blowing at an average of 20 – 25knots. Towards the end of the period the pressure had stabilised and winds were averaging 15 knots from the North West. At the beginning of the week the air temperature dipped to -1°C and then increased to average 2°C for the rest of the week, with a maximum of 5°C.

The planned survey area for the second leg was completed on Friday bringing the total number of CTD casts successfully completed to 115, with a total of 16 XBT's deployed to compliment the CTD data. Salinity calibration samples from all stations were analyzed onboard, using a Guildline Portasal salinometer, and close agreement, between CTD measured salinity and the Portasal values was obtained, with an average difference of 0.0006ppt between the Salinometer and the CTD. The final CTD/Portasal correlation produced an $r^2=0.9964$ ($n= 1068$) during the cruise.

Underway comparisons of the Seabird thermosalinograph (TSG) with CTD data were undertaken during the survey. Salinity data compared with 7m CTD salinity data showed that the TSG salinity reading were on average 0.051 ppt ($n=215$) lower then the CTD, whilst the sea temperature showed the TSG to be on average 0.529°C ($n=215$) higher than the CTD 7m temperature data. This can be attributed to the heating effects of positioning the temperature sensor downstream of the seawater pump.

Phytoplankton

We completed the South Area at 21 stations where we measured chlorophyll-a, and macronutrient plus formalin preserved phytoplankton samples collected for 15 meters. Depth of the UML averaged 75 ± 65 meters, with minimum depth of 28 meters and maximum depth to shallow bottom. Chlorophyll-a concentrations averaged 0.8 ± 0.3 mg m⁻³ for the upper mixed layer, and ranged 0.3 to 1.4 mg chlorophyll-a m⁻³. Average chlorophyll-a during Leg 2 was slightly lower than found during Leg 1 that averaged 1.0 mg chlorophyll-a m⁻³ in the upper mixed layer with a maximum concentration of 2.1 mg m⁻³, and corresponded with slightly shallower upper mixed layer depth of 62 meters. High-quality in situ irradiance, chlorophyll-fluorescence, and transmissometry (blue plus red) have been obtained. No problems to report, with packing of equipment and remaining supplies currently underway. This has been a good cruise, with Chilean students working hard and successful trace-metal samples obtained.

Birds and Marine Mammal Observations

Data on the distribution, abundance and behavior of seabirds and mammals were collected during underway ship operations in the Elephant Island (EI) stratum. 33 transects were collected covering approximately 565 nautical miles of survey effort. The seabird community near EI consisted of (percentage-wise): cape petrel, southern fulmar, chinstrap penguin, Wilson's storm petrel, southern giant petrel, prions, cape petrel, Wilson's and black-bellied storm petrel, black-browed and grey-headed albatross, white-chinned petrel, soft-plumaged petrel, blue petrel and wandering albatross. In addition, three Kerguelen petrels, one South Georgian diving petrel and one white-headed petrel were observed. We encountered more feeding aggregations of seabirds near EI (primarily Cape petrel and black-browed albatross) than in the previous week's survey of

the South Orkney's. The feeding aggregations of seabirds were encountered along the boundary of Southern Antarctic Circumpolar Current.

Fin Whales were highly conspicuous in the waters near EI. We collected 97 sightings of groups for a total of 234 fin whales. Largest concentrations of whales were encountered to the northeast and southeast of EI near regions influenced by eddy systems (detected through deployment of drifter buoys). By comparison, only 34 fin whales were observed near the South Orkneys. Three humpback whales were observed in the southwest of the EI stratum. Additionally, 2 Right whales were observed near the shelf break north of EI, and one was observed near Deception Island.

Report submitted by AMLR researchers aboard the *R/V Yuzhmorgeologiya*, conducting surveys of the pelagic ecosystem in the peninsula region of the Antarctic. These reports are posted at <http://swfsc.noaa.gov/aerd-field.aspx>.