Science Sitrep # 1 - dates 16 March – 30 March inclusive - overview

The first two weeks of cruise NBP 10-02 included an exceptionally rapid transit across the Drake Passage (about 3 d) followed by a brief stop at Palmer for exchange of materiel. After logistics were handled we proceeded to the LTER sed trap site (see attached event log), deployed the traps, took pump and camera samples for 12 h and then proceeded directly to a trawling trackline about 2 h east (log). There we had several attempts at MOC-10 deployments as problems were ironed out. Two additional return visits to the vicinity of the sed trap deployment site allowed a successful recovery of the neutrally buoyant trap and the drifting trap to cap off a highly successful trap deployment sequence. In the interim we had three successful MOC 10s, a MOC 1, and a bottom tow. We caught no silverfish in the vicinity of Palmer Station.

After picking up the trap we proceeded to Charcot Island, a roughly 36 h transit. Sea ice prevented shore access for our penguin and GPS parties so we proceeded offshore to sample in the penguin foraging locations in the troughs to the south and west of the island ( see attached map). Krill were abundant, but silverfish were not present. Shore access continued to be problematic so we found a trawling trackline that would allow us to sample within the nearshore trough and still be within striking distance of the penguin colony on the island. It was in this trough that we caught large numbers of silverfish using a large (9 m2) Tucker trawl . High winds necessitated another transit offshore, where we were successful in collecting a CTD-camera pair as well as four successful MOC-10s and a MOC -1.

At present our penguin and GPS parties are ashore. The high winds experienced over the previous 24 h cleared the shore of ice, allowing access. We await news. The attached event log gives activities and positions in detail.

Science Sitrep # 2 - dates 31 March – 20 April inclusive – overview

Much has transpired since the last sitrep. Science operations at the southernmost sampling site, Charcot Island, were completed, two additional sites were occupied and a third was re-occupied. Four reports to our ongoing silverfish expedition blog sponsored by the St. Petersburg Times (<http://www.tampabay.com/specials/2010/reports/antarctic/>) were filed. Thus far, eight reports with well over a hundred photographs have been filed describing our field operations for the lay public.

**Charcot Island** We completed a respectable trawl series (11 MOC 10, 4 Tucker trawls, 2 MOC 1) at our southernmost sampling site, Charcot Island, including the capture of over 100 silverfish. The newly discovered trough adjacent to the island was characterized with respect to its water column properties and its pelagic community. Two additional troughs south of the island are used extensively by the penguin community as foraging sites and we completed a successful trawl series in each. About 100 silverfish were captured.

Four Adelie penguins were equipped with satellite tags at Charcot Island despite inclement weather and a limited number of birds present at the colony there. GPS coordinates were taken on Charcot by the Simms’ party to complete our shore ops for the Charcot Island station.

Ken Buessler’s particle flux group completed a UPC –CTD series in the troughs south of Charcot to round out our work there. Event # 76 on 31 March concluded our operations in the Charcot area.

**The transit north and Marguerite Bay**  The transit north was used to best advantage by Ken Buessler’s group by conducting a CTD-UPC series up to the Marguerite Bay sediment trap site. The first order of business once the bay was reached was to deploy Alex Simms’ field camp, which, despite some uncooperative weather, was completed on 5 April. In the days immediately following, our science schedule included a trawl series, penguin sampling, and the deployment and recovery of the sediment trap array. The Simms’ camp was taken out on 11 April after a highly successful series of collections on the raised beaches of Calmette Bay.

The time spent in Marguerite Bay included two full days of penguin diet sampling, trawling along three separate track lines (10 MOC-10’s, 1 MOC-1), a successful deployment and recovery of the sed trap array with incident sample series, and a geological field camp. It was an ambitious program for the time allotted and it went quite well. Events in Marguerite Bay concluded on 12 April with event # 132. Over 100 silverfish were captured and processed for otoliths and genetics research.

The science operations in Marguerite Bay were immediately followed by a stop at Rothera Base to pick up the refrigerated vans housing ice cores from the LARISSA program. The vans are destined for Punta Arenas where they will reside until transshipped north.

**Renaud Island** After departing Rothera the NBP attempted a passage on the inside track up Laubeuf fjord but was threatened by ice. Our inability to use the multibeam while transiting ruled out a safe passage up the fjord, forcing us to take the outside track and adding 14 hours to the transit.

The Renaud Island Adelie penguins have had a limited number of young silverfish in their diet within the last 5 years, so the Renaud Island site was critical to our assessment of silverfish on the peninsula. After two days of intensive trawling along two lines (7 MOC-10’s ; one MOC-1) known to be important penguin foraging areas, we had captured no silverfish. Further, our penguin team found no evidence of silverfish in their diet samples.

Alex Simms’ geology team was able to deploy for an additional bout of sampling on Prospect Point, vic Renaud Island. Our operations at Renaud concluded with event # 146 on 16 April.

We were pummeled by a nasty wind (60 knots) on our way to the Palmer area and our planned sed trap station stop had to be delayed as we made our way to a more sheltered area.

**Palmer re-occupation**  The shelter offered by Anvers Island and the peninsula itself allowed us to get to work in fairly short order in spite of the persistent high winds (30 knots +). We were able to finish 4 MOC-10’s in the Palmer Deep and two additional Tucker trawls in the Bismarck Strait. A recent good weather window has allowed us to deploy the sed trap array and complete a penguin diet survey on the penguins at Biscoe Point, with the added bonus of getting our geology group ashore for additional sampling. Our operations are now concluding in the Palmer area as we head offshore to recover the sediment trap today, the 20th of April. Our next science operation will be in the Croker Passage north of Brabant Island, where silverfish were found in abundance in 1983.

We have now sampled the Palmer area effectively in two widely disparate locations -occupying a total of four lines. We have found no silverfish here.

**Final Science Sitrep (# 3) - dates 21 April – 28 April inclusive – overview**

**Jose Torres, Bill Fraser, Julian Ashford, Erica Bortolotto, Gianfranco Santovito**

Science operations in the vicinity of Palmer Station were completed and two additional sites were occupied. Two additional reports to our ongoing silverfish expedition blog sponsored by the St. Petersburg Times (<http://www.tampabay.com/specials/2010/reports/antarctic/>) were filed. Thus far, ten reports with over 150 photographs have been filed describing our field operations for the lay public. The present report includes summaries from the Buessler and Simms programs in addition to summaries from Bill Fraser and Julian Ashford, both co-PI’s on B-258. Science ops for cruise NBP 10-02 are now complete and are listed in detail on the attached event log.

**Conclusion of Palmer re-occupation**

Ken Buessler’s sediment trap array was successfully recovered 21 April. CTD and camera casts were completed following the recovery and our occupation of the Palmer area concluded with beach sampling by Alex Simms’ geology group.

**Transit to Croker Passage and occupation**

The trip from Palmer Station to Croker Passage was via the Neumayer Channel followed by a transit up the Gerlache Strait. A CTD-XBT line with samples collected every 10 nautical miles up the Gerlache Strait was completed prior to occupying the deep basin within the Croker Passage.

Once on site, the trawl trackline was surveyed and four MOC-10’s, one MOC-1, and an otter trawl were completed. One silverfish was captured in total. The Croker Passage had one previous visit in 1983 in which 79 silverfish were captured with a similar trawl effort to that on NBP 10-02. It was concluded that in the intervening years the fish has become quite rare within the passage.

**Transit to Joinville Island and occupation**

Two CTD’s were completed on the transit to Joinville Island and Antarctic Sound. Once on site the sound was surveyed for penguin colonies and then, as darkness fell, the main trawl trackline was acoustically surveyed. Over the next twenty four hours three MOC-10’s were successful out of four attempts and better than 100 silverfish of all sizes were captured. A MOC-1 completed our trawl series within the Antarctic Sound. Our penguin team was weathered out in their first attempt at ops as the weather turned bad (40 knots of wind and a temperature 0f -20). They were able to deploy zodiacs and search for birds during our second day in the sound but were prevented from going to shore by wind and ice encroachment.

Science ops ended 0000 hrs on 28 April and the transit to Punta Arenas began.

**Final report – Bill Fraser – B-258**

Our fundamental objective during this cruise was to conduct a synoptic assessment of Adélie penguin foraging ecology (primarily variability in diets and foraging locations using satellite-linked tags) at 5 of the 6 recognized population centers for this species in the western Antarctic Peninsula (WAP) and northwestern Weddell Sea. Included in this effort were populations (north to south) on Joinville, Biscoe (Palmer Station), Renaud, Avian and Charcot islands, which were chosen specifically to include regions where sea ice forms annually (Joinville, Avian, Charcot) and where it does not (Biscoe, Renaud). Of interest in this regard, and indeed a primary focus of this cruise, was to confirm (by comparing diet data with net-caught samples) if the Antarctic Silverfish still occupies its historical regional range. This important food web component has an ice-dependent life history, and trends in seabird diets spanning more than 3 decades suggest that the species is now regionally extinct in sectors of the WAP where sea ice has decreased due to climate change.

With the exception of Joinville Island, where sea ice limited our movements, we obtained diet samples and deployed satellite tags at all other target population centers, thus filling the last remaining gap (i.e., the poorly sampled transition between late summer and autumn) in our knowledge of seasonal variability in the foraging ecology of Adélie penguins in the WAP. Thus, combined with the late summer 2010 efforts of the Palmer LTER, the database for this period is now informed by 32 new satellite tag deployments and 58 new diet samples. Findings thus far are preliminary, as many tags are still transmitting and the analysis of diet samples are incomplete. However, not unlike patterns observed during other seasons, the foraging locations of Adélie penguins appear to remain strongly linked to deep bathymetry near their breeding colonies. Different from other seasons, though, is that dive-depths are predominantly shallow, on average less than 20 m, whereas they tend to average in excess of 40 m at other times. A causal explanation is not yet obvious. Diets were throughout the region composed of fish and krill, again not unexpected, but it is noteworthy to point out based on fish otoliths identified onboard, that the trend in the presence of silverfish highlighted in the previous paragraph is confirmed; that is, the species is now either regionally extinct or occurs in extremely low abundances in ice free waters. Importantly, both the diet and net catch data from this cruise converge in finding that this region roughly covers an area of the shelf between Biscoe (Palmer Station) and Renaud islands.

**Final report – Julian Ashford – B-258**

In this component of the project, we aimed to address the question ‘are silverfish distributed in discrete populations along the Western Antarctic Peninsula (WAP), and between the WAP and Weddell and Ross Seas, or are these areas linked by movement?’ by testing between rival hypotheses of population segregation and connectivity using otolith chemistry. In pursuit of this, our objective for the cruise was to sample six areas along the Peninsula for silverfish and compare these for differences, both between areas and with samples from the Ross Sea taken by NIWA, and samples from the South Orkney Islands, taken on board a survey by NOAA AMLR in March 2009.

At our first sampling area off Charcot Island, we caught 108 fish all from a single length mode with a mean standard length (SL) of 16.4 (SD ± 0.9) cm. Further north in Marguerite Bay, we caught a similar sample of 120 fish with a single length mode of mean SL 15.9 (SD± 0.9) cm. This corresponded to the dominant cohort sampled during GLOBEC as 1+ yr fish in 2001 and 2+ yr fish in 2002: substituting an age of 10+ years in to the Von Bertalanffy equation given by Hubold and Tomo (1989), we estimated this cohort would now have a standard length of 16.9 cm, very similar to that found in the samples at Charcot and Marguerite Bay. By contrast, at sampling areas off Renaud Island and Anvers Island, we caught no silverfish in our trawls; and only a single silverfish of standard length 11.5 cm further north in Croker Passage. In Antarctic Sound off Joinville Island, we caught 91 fish of mean length 11.1 (SD± 1.4) cm, and 54 1+ yr fish of mean length 4.6 (SD± 0.3) cm. Moreover, whereas fish off Charcot Island and in Marguerite Bay were mature, most of the fish of 2+ yrs and older in Antarctic Sound were immature. Taking these data together, the demographic differences indicate a lack of mixing that would homogenize distributions between areas, and suggest two discrete populations at 1) the north tip of the Peninsula, and 2) the southern WAP encompassing Charcot Island and Marguerite Bay. In contrast, the distribution of total length in Antarctic Sound (without the current 1+ year class) was similar to that found in 2009 using benthic trawls off the South Orkney Islands. Mean TL for South Orkney Islands was 13.47 (SD± 3.6) cm compared to 12.84 (SD± 1.52) cm in Antarctic Sound, consistent with connectivity between the two areas.

However, population structure can be confounded with environmental effects: fish from a common source subsequently exposed to different environments can show different growth rates and mortality, and hence length distributions, whereas discrete populations exposed to the same environmental cycle can show similar dominant year classes over time. Analyses of the chemistry laid down in otoliths during early life, scheduled for our return to Old Dominion University, can be used to detect exposure to different environments during early life, and hence to test between these potential rival explanations. At the same time as the biological sampling, we undertook a series of temperature and salinity measurements through the water column using CTD, which indicated large hydrographic differences in the surface layer and at depth, where cold saline water in Antarctic Sound and Croker Passage replaced CDW off Charcot Island and in Marguerite Bay. Further contrasts are expected with Warm Deep Water on the South Orkney continental shelf, and shelf water in the Ross Sea. Based on previous studies undertaken at CQFE on related species, exposure to such large differences in hydrography generates strong contrasts in the chemistry laid down in the otoliths of Antarctic fish. In summary, as well as the successful completion of our biological sampling, the cruise has resulted in preliminary physical and biological data that indicate the otolith analyses will provide a powerful test of population structure and connectivity in silverfish around the Southern Ocean.

**Cruise report NBP10-02**

**Ken Buesseler, Andrew McDonnell, Stephanie Owens**

**Woods Hole Oceanographic Institition**

Project title: WAPflux – New Tools to Study the Fate of Phytoplankton Production in the West Antarctic Peninsula (ANT-0838866)

The broad goal of this project is to understand: **What is the fate of phytoplankton production off the west Antarctic Peninsula?** To reach that goal, we need to look at time, space and depth resolved variability in the flux and remineralization of sinking particles. We used several methods to look at particle sources, characteristics, and sinking fluxes, namely 1) neutrally buoyant sediment traps (NBSTs), 2) drifting sediment traps (including tubes for flux, polyacrylamide gels for microscopic ID and particle size spectrum and RESPIRE incubators for in situ respiration rates of sinking particles), 3) particle camera for suspended particle size spectrum, 4) large volume in situ pumps for suspended particle concentrations, and 5) thorium-234 profiles as a flux proxy.

During NBP10-02, we were successful at deploying and collecting samples with all five methods listed above. We had three main study areas where sinking particles were collected by the NBST and drifting array along with the other 3 methods. At additional sites we used only 234Th and the particle camera. In addition, along several transects we also had higher frequency surface sampling from the ships seawater line for thorium and additional particle properties and ecosystem characteristics.

In detail the main 3 sites included:

1) 130 km off Palmer Station- 2 nm from LTER sediment trap site-

Nominal start position- 64 28 S, 65 57 W; dates 3/21-3/24 2010

a. NBST (175m)

b. Drifting array- 75, 175, 275m

c. Profiles- CTD #2, 3/21; #4, 3/22; #6, 3/24 (10-15 bottle depths for 234Th and nutrients; 6 depths for HPLC pigments)

d. Particle camera- vertical profiles for suspended particle spectrum after CTD casts (n=5 total)

e. Large volume in situ pumping on 3/21 at 50, 75, 125, 175, 225 and 275m (500L, particles collected on 53 and 10 um screens)

2) Marguerite Bay-

Nominal start position- 68 11 S, 69 59W; dates 4/7-4/10 2010

a. NBST (175m)

b. Drifting array- 75, 175, 275m

c. Profiles- CTD #18, 4/7; #20, 4/9; #21, 4/10 (10-15 bottle depths for 234Th and nutrients; 6 depths for HPLC pigments)

d. Particle camera- vertical profiles for suspended particle spectrum after CTD casts (n=5 total)

e. Large volume in situ pumping on 4/7 at 50, 75, 125, 175, 225 and 275m (500L, particles collected on 53 and 10 um screens)

3) 130 km off Palmer Station- 3 nm LTER sediment trap site-

Nominal start position- 64 27 S, 65 58 W; dates 4/19-4/20 2010

a. NBST (175m)

b. Drifting array- 100, 200, 300m

c. Profiles- CTD #27, 4/19; #29a, 4/21 (10-20 bottle depths for 234Th and nutrients; 6 depths for HPLC pigments)

d. Particle camera- vertical profiles for suspended particle spectrum after CTD casts (n=2 total)

e. Large volume in situ pumping on 4/17 at 100, 200 and 300m (500L, particles collected on 53 and 10 um screens)

All equipment performed as designed and there were no losses of the NBSTs or drifting trap array which were deployed for 2-3 days autonomous from the ship. In addition to work at these 3 main sediment trap stations, we collected CTD and particle camera profiles at 10 additional sites ranging from as far south as the Charcot Island region to Bransfield straits in the north WAP area. In between profiles, underway sampling was used to look at spatial variability for 234Th, TEP (transparent exopolymers), nutrients, HPLC pigments and size fractionated chlorophyll at approx. 50 additional sites. On board analyses of 234Th on traps, 4L water samples, and pumps was conducted on approximately 350 samples during the cruise.

**Summary of Activities during the Nathaniel B. Palmer Cruise NBP10-02**

**Alexander Simms**

**Constraining the Deglaciation of the Antarctic Peninsula Using OSL Dated Beach Deposits**

**Grant Number ANT-0838781**

The main objective of our project is to use a newly developed methodology to reconstruct past sea levels along the Antarctic Peninsula over the last 10,000 years. Our new methodology uses optically stimulated luminescence (OSL) to determine the age of relict raised beaches (Simms et al., in review). The sea-level curves will be used to test glacio-isostatic model predictions for various reconstructions of the Antarctic Peninsula Ice Sheet since the Last Glacial Maximum, 20,000 years ago. Our main field locale was Calmette Bay in Marguerite Bay. In addition, we were hoping to opportunistically visit beaches in the Palmer Station and Joinville Island areas in order to broaden the geographic distribution of our data. The differences among the sea-level histories at different locations provide important constraints for determining the spatial and temporal patterns to the deglaciation of the Antarctic Peninsula.

We obtained 101 samples from five sites (Calmette Bay, Rothera Point, Litchfield Island, Biscoe Point, and Torgerson Island) throughout the Peninsula. Approximately 80 cm of snow cover prevented sampling at another site, Damoy Point near Anvers Island, and high winds and sea ice prevented us from going ashore at another site in the Antarctic Sound near Joinville Island. Of the five sites, Calmette Bay provided the best beaches with 31 raised beaches found between 0 and 41 m above modern sea level. In the five working days ashore, we were able to collect 74 samples from 22 of the beaches and conduct granulometry measurements on all of the beaches. We were also able to sample two beaches at Rothera Point in Marguerite Bay. In the Palmer Station vicinity we obtained samples from beaches at elevations of 2, 4, 7, and 17 m above present sea level. Due to weather conditions and time constraints, no samples were obtained from the Joinville Island area.