2006 Annual Report

Barrow Environmental Observatory

Prepared by
BEO Subcommittee
Barrow Arctic Science Consortium
Barrow, Alaska
www.arcticscience .org

March 2007

Front Cover: Looking north to BEO along Elson Lagoon; *photograph provided by Michael Kanevskiy*.
Inset: Participants in the "Mexico Alaska scientific/cultural student interchange - A pilot project"; *photograph provided by Leslie Pierce.*

In August 2006, BASC hosted a pilot international student exchange which contributed to and benefited from the interdisciplinary and inter-institutional networks that underpin the BASC organization. A dozen students from three indigenous communities (Barrow, Alaska; Ixtlan de Juarez, Oaxaca; and San Juan Nuevo, Michoacan) were incorporated into on-going scientific research teams: bio-complexity (SDSU and UTEP), archaeology, and whale biology (North Slope Borough Department of Wildlife Management) for three days a week during the month. Their hands-on involvement included lectures offered by the scientists themselves (Steve Hastings, Glenn Sheehan, Anne Jensen, Craig George, Robert Suydam, and Dan Enders, among others). They had the opportunity to talk with Inupiaq elders about their environmental knowledge and were introduced to ways in which environmental knowledge is contained within the Inupiaq language by Jana Hacharak (NSB High School) and Fannie Akpik (Ilisagvik College). Their arctic experience was then enhanced by an additional month's work in the biologically diverse communities of Ixtlan de Juarez and San Juan Nuevo Parangaricutiro. The students were required to produce daily reports of their research experiences. They undertook weekly research challenges based on the varied sources of information they were exposed to; they generated public presentations around focused questions at the end of each stay: and were required to generate written reports. Ilisagvik College recognized the successfully completed program as worthy of three credits in two introductory college courses: the Nature of Science and Man, and Society and Culture.

Barrow participants were: Timothy Barr, Megan Edwardson, Krista Frantz, Selma Khan, M J Roseberry,

Ixtlan de Juarez participants were: Atzin Balderas, Rodolfo Garcia Juarez, Monsterrat Gorgonio, Fabiola Miguel Cisneros, Jorge Rojas Perez (a member of the communal authorities), Yanet Marin Castillejos (science teacher).

San Juan Nuevo Parangaricutiro participants were: Citlali Anducho Campoverde, Edgar Espinoza Rochin, Anibal Martinez Zintzun, Rafael Chavez (science teacher)

The program was coordinated by Dr. Barbara Bodenhorn, Department of Anthropology, Cambridge University, and grew out of a larger, three-year project in the two Mexican communities entitled "The Roots of Success" coordinated by Drs. Laura Barraza (UNAM, Morelia Campus) and Barbara Bodenhorn. The program had multiple sponsors including NSF, local Barrow sponsors (Rotary Club, Mayor's Office, ECHO, BEUCI, Ilisagvik College); Mexican sponsors – SEMARNAT and CONAFOR (both arms of the Mexican National government), State of MIchoacan; the National University of Mexico, a Mexico City chapter of Rotary as well as COBACH and CECYTE (preparatory schools Oaxaca and Michoacan), the Comisariado de los Bienes Comunales, Ixtlan de Juarez, Oaxaca, and the Municipality of San Juan Nuevo Parangaricutiro; and, from England, support included a Gibbs Travelling Fellowship, Newnham Colleges as well as additional support from Pembroke College, Cambridge University.

Contents

Acknowledgements: Starting in Spring 2006, Lewis Brower, BASC Station Manager, provided local supervision and oversight of operational and regulatory activities on the BEO. Alice Brower provided permit and user-day information. Chico Perales, VECO Polar Resources (VPR) provided statistics on the 2006 installations. Charlie Sassara coordinated UICC activities. Glenn Sheehan provided information on permitting and assisting in editing the report. Jerry Brown, Chair, BEO Subcommittee, prepared the report.

Introduction

Summary

This is the Third Annual BEO Report and it follows the general format of previous reports (see BASC website). The major infrastrucuture activity this year focused on the next phase of development for the NSF-funded project Biocomplexity Project. Several projects continued under the NSF Study of the Northern Alaska Coastal System (SNACS) program and the U.S. Fish and Wildlife Service. Several projects continued long-term monitoring activities (erosion, permafrost temperatures, air-ground temperature and active layer, ITEX, and bird surveys). Thus the BEO continues to fulfill its role to observe long-term changes and trends in the physical and biological environments. In all, 22 individual projects and subprojects were active on the BEO this year involving approximately 140 individual researcher and non-BASC support personnel. Planning for the International Polar Year (2007-2009) continued with Barrow observational activities were identified as part of approved projects for the (permafrost observatory (TSP), active layer (CALM), coastal dynamics (ACD), tundra experiment (ITEX) and carbon in permafrost (CAPP). Other sites at Barrow will be part of additional IPY projects (such as the Tundra Biome "Back to the Future" and the Ray-Murdoch Expedition; see www.ipy.org). In recognition of Barrow's past and current contributions to science, the Alaska State Legislature recognized Barrow as Alaska's Arctic Science City and as Alaska's focal site for the 125th Anniversary the first International Polar Year (see back cover).

Background

The Barrow Environmental Observatory (BEO), 7,466 acres of arctic tundra near Barrow, Alaska, was permanently set aside for research in 1992 by the Ukpeagvik Iñupiat Corporation (UIC-the Barrow Village Corporation). The Barrow Arctic Science Consortium (BASC), a not-for-profit organization dedicated to scientist/community collaboration, was asked by NSF to manage the BEO for science, and was designated as manager by the landowner, UIC. In January 1998 the BASC Board of Directors established the BEO Management Committee (BEO MC) to develop and manage the reserve. Through a series of Cooperative Agreements with BASC, the National Science Foundation's (NSF) Office of Polar Programs has supported planning and management of the BEO (current agreement OPP 0447422).

On July 1, 2003 the NSB Assembly adopted NSB Ordinance Serial No. 75-6-40 that designates the BEO as the first zoned Scientific Research District. Under provisions of the SRD ordinance, the Master Plan serves as the vehicle for a single, multiyear land-use permit. This simplifies the land-use permitting process, as individual projects normally will not be required to obtain NSB permits for research on the BEO. Equally important is the fact that the Master Plan provides for the strategic and planned growth of services in and around the BEO.

Three major types of research utilize the BEO Scientific Research District:

* Process and Experimentation
* Population Biology and Biodiversity
* Environmental Monitoring

A BEO Working Group was formally organized in 2004 and was subsequently renamed BEO Subcommittee. The BASC Board meeting agreed that an annual report would be prepared and be provided to UIC and the Borough as part of the BASC responsibility to manage the BEO as the Scientific Research District. Central to this report are summaries of projects that are active on the BEO, and other related activities including infrastructure development and data and information.

The BEO SC met formally at Barrow on April 24, 2006 (summary in appendix). Members of the BEO SC are:

Jerry Brown, Chair
Bart Ahsogeak, UIC
Tom Albert, retired, NSB DWM

Allison Graves Gaylord, Nuna Tech
Robert Suydam, NSB DWM; Brian Person (DWM alternate)
Nora Rojek, Fish and Wildlife Service, Fairbanks; Rick Lanctot, FWS Anchorage (alternate)
Audrey Taylor, UAF (Graduate Student)
Craig Tweedie, University of Texas at El Paso
Ex Officio Members:
SMAC, Bernie Zak, Chair and representatives of the DWG and SAG
BASC, Glenn Sheehan, Executive Director

2006 Infrastructure Development and Planning

UIC Permits: Each non-resident user of the BEO is required to apply for and receive a UIC land-use permit before beginning work on the BEO. Of the total 266 UIC Land Use permits issued by BASC in 2006, approximately140 were for non-resident users of the BEO. A total of approximately 195individuals used the BEO in 2006 (see Appendix for list of participants by project and activity.) A number of groups and individuals visited the BEO and the Biocomplexity site during the year including the Arctic Research Commission, the World Presidents Organization, Alaska Conservation Foundation**,** and NSF representatives.

Starting in 2006 each person who received a permit for use of the BEO received an informational package that included a copy of the 2005 BEO report, guidelines for the use of the BEO and an agreement form on conditions for access to the BEO (Appendix). The process was greatly enhanced this year by the hire of Lewis Brower, BASC Station Manager, who also assumed responsibility for disseminating the BEO information package as part of the UIC permitting process.

Government Permitting: Both the development of the Cake Eater Road access node to the BEO and the major landscape manipulations proposed in the project "Biocomplexity Associated with the Response of Tundra Carbon Balance to Warming and Drying Across Multiple Spatial and Temporal Scales" (BE project) were included in the BEO Master Plan at the time of NSB redistricting to create the Scientific Research District. The map shows the locations of the 2005 and 2006 installations and infrastructure components based on the DGPS provided under the BAID project (Figure1).

The permitting process for the Tundra Manipulation project was described in the 2005 report. Land owners and permitting agencies were kept informed of activities including the replacement of the matted trail with elevated broadwalks. BASC is responsible for annual surveys of potential eider duck nesting areas. Data from the surveys allow, if needed, the temporary modification of on-the-ground activity near specific nest locations during the nesting season. Surveys in both 2005 and 2006 were conducted by local students.

Elevated Boardwalk: An elevated boardwalk was required to facilitate foot traffic to and along the experimental sites and was designed by VECO Polar Resources (VPR). In 2005 the "Tommy Docks" (boardwalks) were installed in three partial transects on the drained lake adjacent along the Tramline that is designed to carry instruments for the experimental observations. While the docks performed their intended purpose they proved to require regular adjustments to accommodate differential settling. The major 2006 infrastructure activity was the extension of the boardwalk systems along the tramlines and replacement of the harden trail with the elevated broadwalk system, primarily in very wet sections. In spring 2006 UICC installed a total of 5688 linear feet of boardwalk. Chico Perales (VPR) provided quality control during and following installation and reported the following statistics:

- Control shed to Eddy Tower: 4,200 lineal feet (36 inch wide)
- Outer Tram Extensions: 1044 lineal feet (24 inch wide)
- Special Extension (middle tram): 192 lineal feet (24 inch wide)
- Oberbauer spurs: 204 lineal feet (24 inch wide)
- Gamon Boardwalk Ends: 48 lineal feet (24 inch wide)
- Boardwalk between the Control Shed and Cake Eater Rd.: 150 linear feet
- Geoblock matted trail removed: 4500 linear feet

- Geoblock matted trail installed: 200 linear feet (to pond site southeast of Control Shed
- Gamon tram track extensions – 982 linear feet
- Installation and testing of a monopole special support system was undertaken in 2006. Sections of the Geoblock matted trail were removed and stockpiled.

Other Installations: Generator power was supplied to the eddy tower north of the generator and west of the manipulation area. UICC drilled three 20-foot boreholes in spring 2006; one each in the flooded, drying and control sections. Craig Tweedie instrumented the holes with temperature data loggers. UICC provide generator power was provided to the outer eddy tower located north of the generator module.

During spring 2006 a small building was installed at the BEO Cake Eater Road entrance to provide on-sight workspace, shelter and storage. A 24-foot long platform was installed on the west side of Cake Eater Lake to provide access for sampling and instrumentation. The platform was built in the Barrow High School students under the supervision of shop teacher Paul Johnson.

Operations and Maintenance: BASC contracted with UICC to provide routine generator maintenance and refueling service for the BE project. Other contracted tasks include periodic adjustment of boardwalk and snow removal. Additional issues are addressed on a case-by-case basis, with BASC determining who should perform the specific task. Lewis Brower designated snow mobile trails for Fall 2006 access to the Biocomplexity sites.

IT Developments: As reported in 2006, BASC completed a 100Mbps radio connection between the main BASC facility and the Control Shed. At the Control Shed, four directional antennas provide 802.11b/g coverage spanning nearly a mile in all directions. NSF directed BASC to submit a proposal (pending) that includes establishing wireless connectivity throughout much of the BEO.

Planning for 2007: Detailed VPR planning for the flooding and drying manipulation commenced in 2006. Golder Associates, Inc. was hired by VPR to design the experiment. Following an October pumping test by BASC, a site visit and several teleconferences a meeting was held in San Francisco in December during the Annual Meeting of the American Geophysical to discuss final design and an installation. The design calls for a spring 2007 installation of about 2000 feet of a rigid vinyl barrier in a narrow trench across the treatments areas. A pumping system would be installed to maintain water levels. A weir would be placed at the southern drainage point to gauge runoff.

The 6,700-foot power line is scheduled for installation in Spring 2007. It will terminate near the current location of the Communications Shed. BEO wireless conductivity is planned in conjunction with the operation of the Barrow Global Climate Change Research Facility. A webcam will be installed in the vicinity of the Cake Eater Road access and Schoolyard projects.

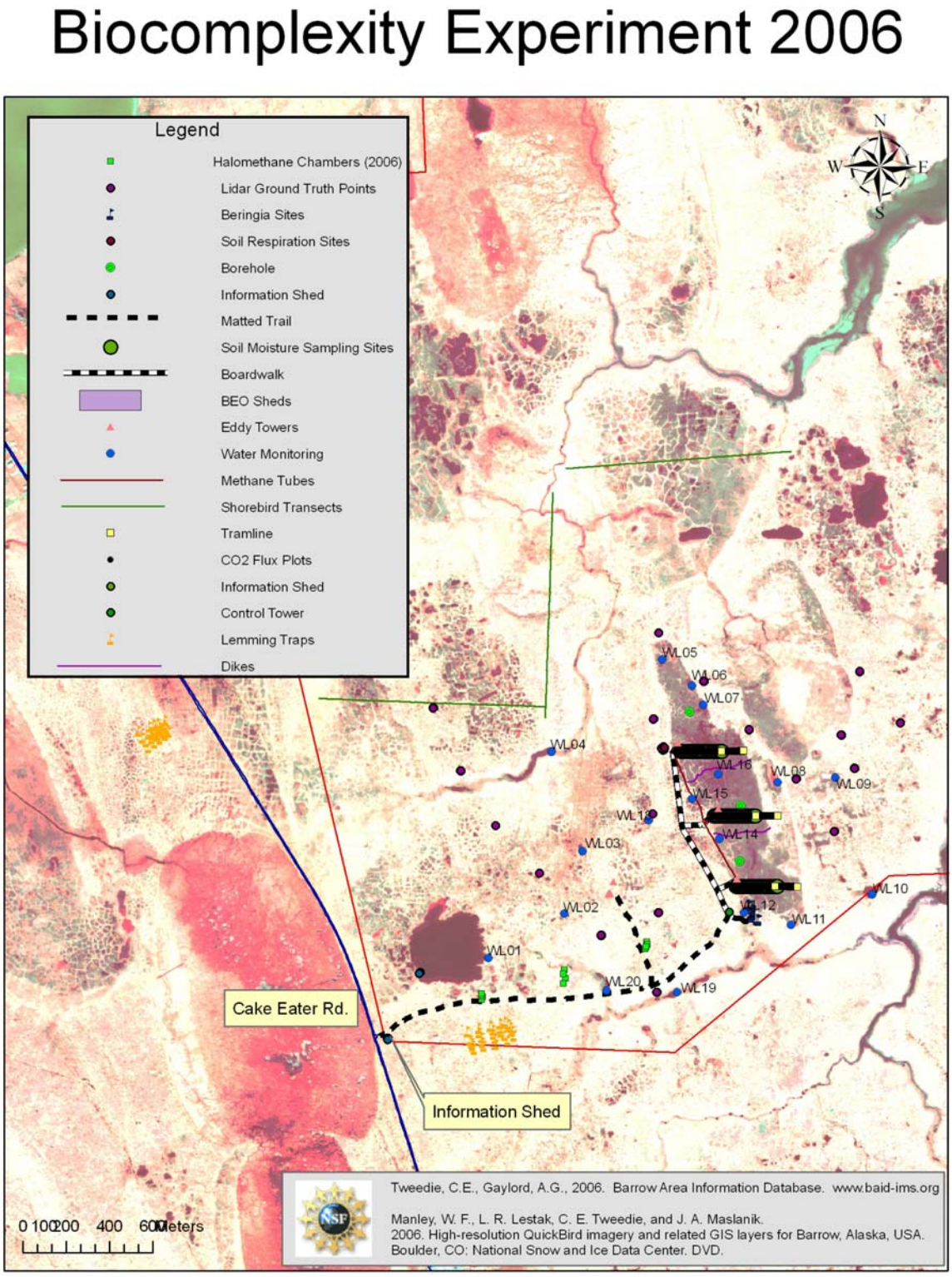

Figure 1. Map of Biocomplexity project research design and infrastructure development (Map prepared by Allison Graves Gaylord and Adrian Aguirre)

Figure 2. Aerial oblique photograph of the Biocomplexity site looking north. Boardwalks, trams, towers and instrument sheds were installed primarily in spring 2005 and 2006. In the foreground the south tram line closely parallels the boardwalk. A spur branches off and terminates at the southern most eddy tower. From the south tower (foreground), sampling tubes run north to the methane sampling shed (center), and the beginning of the north tram line. The boardwalk running west of the methane shed connects with the main boardwalk and runs north to south with access to all three trams and towers (left side). See Figure 1 for overall design.

2006 Project List and Reports

Abiotic and Chemistry

Observatory Projects

Barrow Permafrost Observatory - Vladimir E. Romanovsky and Kenji Yoshikawa

The Circumpolar Active Layer Monitoring Network-CALM II (2004-2008): Long-Term Observations on the Climate-Active-Layer-Permafrost System - Fredrick E. Nelson and Nikolay I. Shiklomanov

Arctic Coastal Dynamics (ACD) Observatory: Elson Lagoon Key Site, Jerry Brown

Process Projects

Spatial and Temporal Variability of Ground Temperature and Thaw Northern Alaska - Kenneth M. Hinkel

Collaborative Research on Flux and Transformation of Organic Carbon Across the Eroding Coastline of Northern Alaska - Torre Jorgenson and Chien Lu Ping

Community-based Coastal Monitoring Subproject: Community-based Observations – Torre Jorgenson

Collaborative Research on Snow and Ice Processes in the Deposition and Fate of Mercury in the Arctic - Matthew Sturm, Joel Blum and Bill Simpson

Ecosystem Interactions

Collaborative Research on Biocomplexity Associated with the Response of Tundra Carbon Balance to Warming and Drying Across Multiple Spatial and Temporal Scales - Walter C. Oechel, John Kimball, and Craig Tweedie

Biocomplexity Subproject: Eddy Covariance Carbon Flux - Walter Oechel

Biocomplexity Subproject: Infrastructure Development and Experimental Design - Craig Tweedie

Biocomplexity Subproject: Methane Fluxes - Yoshinobu Harazono

Biocomplexity Subproject: Plot Level CO_2 Fluxes – Steve Oberbauer

Biocomplexity Subproject: Tramline and Instrumentation Development – John Gamon

Biocomplexity Subproject: Remote Sensing and Hydroecological Process Models - John Kimball

Developing an Understanding and Predictive Capability of the Interconnections Among Arctic Terrestrial, Atmospheric, and Marine Systems – Walter Oechel

International Tundra Experiment – Patrick Webber and Robert Hollister

Rapid Assessment of recent changes in land cover and carbon balance in Beringia – Craig Tweedie

Halomethane gas exchange in northern Alaskan coastal ecosystems – Robert Rhew

Faunal Populations

Physiology of Winter-Breeding Microtine Rodents in the High Arctic – Ian Gerard van Tets

Breeding and Post-Breeding Shorebird Studies at Barrow Alaska – Richard Lanctot and Bart Kempenaers

Steller's Eider Breeding Biology Studies at Barrow Alaska – Nora Rojek

Breeding Ecology of Snowy Owls – Denver W. Holt

Database Support

Barrow Area Information Database and Internet Map Server (BAID-IMS) - Craig Tweedie and Allison Graves Gaylord

Outreach

Arctic LTER Project: Schoolyard- John Hobbie, Glenn Sheehan

Saturday Seminars – Jill Exe

Tundra Warming Project - Leslie Pierce

Winter lake Project - Tim Buckley

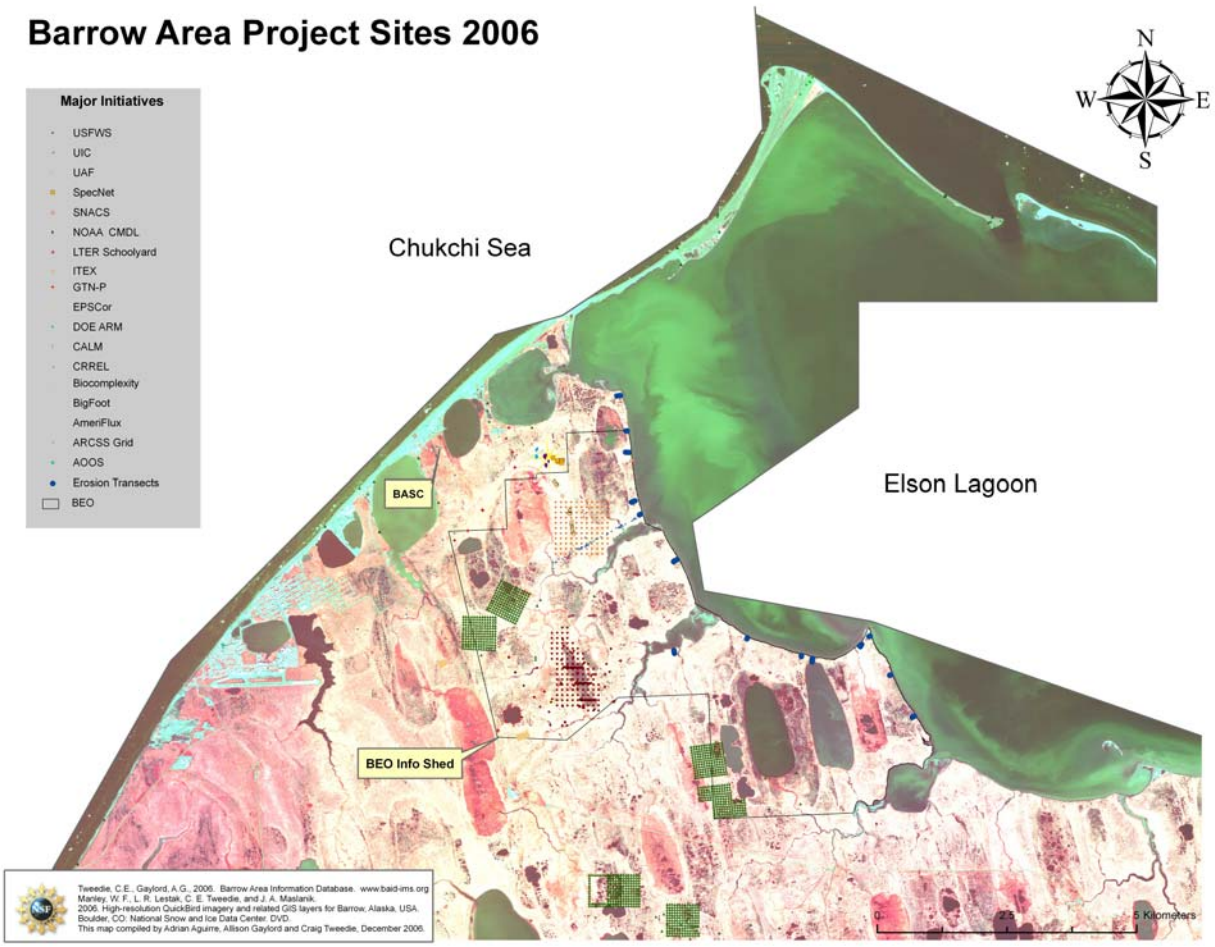

Figure 3. The map showing the location of current research sites (as of August 2006). Additional sites and metadata are available on the Barrow Area Information Database – Internet Map Server (BAID-IMS) or on-line < http://baidims.org>. *(Map prepared by Allison Graves Gaylord and Adrian Aguirre).*

ABIOTIC AND CHEMISTRY

Project Title: Barrow Permafrost Observatory

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Hanno Myers and Lutz Schirrmeister, Alfred Wegener Institute, Potsdam
Jerry Brown, International Permafrost Association

Brief Activity Report

The Barrow observatory sites are part of the Global Terrestrial Network for Permafrost (GTN-P) consisting of stations located throughout both hemispheres and is a program coordinated by the International Permafrost Association (IPA). During 2005 the Joint Committee for the International Polar Year (IPY JC) approved the Permafrost Observatory Project (Project 50) lead by Jerry Brown on behalf of the International Permafrost Association. The BEO and adjacent sites with its permafrost temperature measurements dating back to the late 1940s are major contributors to the IPY network.

Dataloggers for the deep boreholes, soil temperature and automatic climates stations continue to operate. The 2005 data was downloaded in spring 2006 by Yoshikawa and Saito. Unfortunately, the BEO sites had been vandalized and the batteries stolen apparently in Fall 2005. Fortunately data from boreholes closer to CMDL were not vandalized and comparison of continuous recordings in 2005-2006 with Brewer's 1950s data is possible. Permafrost temperatures are about 1^0C warmer now compared to the 1950s.

The BEO holes were revisited in the Fall and it was noted that the solar panels had been damaged. These above-ground station provides near-surface climate and snow depth data. If vandalism continues to be a problem we may move part of the station to the more secure part of the BEO adjacent to CMDL, and maintain the below ground instrumentation in buried container.

As part of the UAF EPSCoR program Yoshikawa and Saito drilled and instrumented a 6-meter deep hole behind the Barrow High School. Tim Buckley and students will use this site for classroom projects and compare data with the BEO sites. Doug Goering, UAF EPSCoR project leader, visited the school in September and gave a series of presentations and demonstrations. A second borehole was drill in close proximity to Brower's Café where the 1888—1889 Ray Expedition measured permafrost temperatures, Data loggers have been installed in six meat cellars in Browerville and Barrow and personnel from the CALM project periodically download and process the data. Brown installed a logger in a 15-foot deep borehole on the wet tundra adjacent to the Barrow Global Climate Change Research Facility. Data from it, the three 20 foot Biocomplexity boreholes, the BEO and adjacent boreholes will be organized into a common database.

Hanno Myers and Lutz Schirrmeister, AWI, collected additional samples from the buried ice wedge investigated in Spring 2004. This site, although not on the BEO, is providing important historical data of the Barrow region over the last 20, 000 years. A draft manuscript has been prepared and a paper will be submitted in 2007.

Recent Publications and Presentations

Brown, J., and V. E. Romanovsky, 2006. Status report on the International Permafrost Association's contribution to the International Polar Year. In Proceedings, Earth Cryosphere Assessment: Theory. applications and prognosis of alterations. Tyumen, 29-31 May 2006 Vol.1, pp. 13- 18.

Brown, J. 2006. Permafrost and the International Polar Year. Proceedings of the 13th International Conference: Cold Regions Engineering 2006, Current Practices in Cold Regions Engineering. July 23-26, 2006, Orono, Maine, 9 pp.

Meyer, H., L. Schirrmeister, A. A.Andreev, D. Wagner, H.-W. Hubberten, K. Yoshikawa and J. Brown 2005. A buried ice-wedge system as archive for the late Quaternary environmental history near Barrow, Alaska. 2nd European Conference on Permafrost, June 12-16, 2005, Potsdam, Germany, p.16 (abstract).

Meyer, H., L. Schirrmeister, A. Andreev, D. Wagner, H.-W. Hubberten, K. Yoshikawa and J. Brown 2005. Multi-proxy approach to a buried ice-wedge system, Barrow, Alaska, CliC 2005: 1st CliC International Science Conference, April 11-15, 2005, Beijing, p.187 (abstract).

Meyer, H., L. Schirrmeister, A. Andreev, D. Wagner, A. Bobrov, H-W. Hubberten, K. Yoshikawa and J. Brown (In prep). Late Quaternary environmental and genetic history of a buried ice-wedge system near Barrow, Alaska.

Project Title: The Circumpolar Active Layer Monitoring Network-CALM II (2004-2008): Long-Term Observations on the Climate-Active-Layer-Permafrost System

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Kenneth M. Hinkel, University of Cincinnati
Jeff Munroe, Middlebury College
Yuri Shur, and Mikhail Kanevskiy, University of Alaska-Fairbanks
Melanie Schimek (graduate student)
Christopher Karmosky (graduate student)
Dmitri Streletskiy (graduate student)
Alexey Shiklomanov (high school student)

Brief Activity Report

The Barrow CALM sites are part of an international network of approximately 125 stations located throughout both hemispheres. It is part of the GTN-P and IPY Project 50. The Barrow active-layer observatory consists of the CRREL plots (established in 1962) and the NSF ARCSS/CALM grid (established in 1992). The CRREL site consists of 20, 10x10 m plots randomly distributed along a 2.1 km transect. The ARCSS/CALM site is a 1000x1000 m grid with grid nodes located at 100 m intervals (121 sample points). The ARCSS/CALM grid overlaps several of the CRREL plots. Both are probed mechanically to determine the average near-maximum thaw during the last half of August. A continuous series of annual maximum active layer measurements exist, starting in 1992 for both sites. Summer 2006 was relatively cool at Barrow, producing a mean thaw depth of only 32.4 cm on the ARCSS/CALM grid. This value is slightly below the mean value for the past ten years of measurement. Thaw depth on the CRREL plots averaged 33.7 cm in 2006. When compared to the cool summers of the 1960s the 2006 depth of thaw was substantially less than the 43 cm measured in 1968. The April project, using ground-penetrating radar. produced a series of three-dimensional maps of the active layer and upper permafrost, The maps include the underlying ice-wedge networks.

Recent Publications, Presentations and Dissertations

Masters theses

Little, Jon (2006). *Frost Heave and Thaw Settlement in Tundra Environments: Applications of Differential Global Positioning System Technology.* M.S. thesis, Department of Geography, University of Delaware, 160 pp.

Streletskiy D.A. 2005. *Spatial and Temporal Regularities of Permafrost Active Layer Formation on the North Slope of Alaska*. M.S. Thesis, Moscow State University, Moscow, Russia, 46 pp. (in Russian)

Refereed Journal Articles

Hollister, R.D., Webber, P.J., Nelson, F.E., and Tweedie, C. E. (2006). Soil thaw and temperature response to air warming varies by plant community: Results from an open-top chamber experiments in northern Alaska. *Arctic, Antarctic, and Alpine Research* 38(2): 206-215.

Shiklomanov, N.I., Anisimov, O.A., Zhang, T., Marchenko, S.S., Nelson, F.E., and Olke, C., (2006). Comparison of model-produced permafrost active layer fields: results for Northern Alaska. *Journal of Geophysical Research-Earth Surface* (in review)

Shiklomanov, N.I., Streletskiy, D.A., Nelson, F.E., and Klene K.E. (in preparation). Long-term monitoring of air and ground surface temperature on the North Slope of Alaska.

Munroe, J., Doolittle, J., Hinkel, K., Nelson, F., Kanevskiy, M., and Kimble, J. (in preparation). Three-dimensional representation of permafrost features using ground-penetrating radar.

Presentations

Streletskyi, D.A., Shiklomanov, N.I., and Klene, K.E., (2006) Effects of tundra vegetation on the ground thermal regime. *Annual Meeting of the Association of American Geographers, Chicago, IL*, March 2006.

Shiklomanov, N.I., Anisimov, O.A., Zhang, and Nelson F.E., (2006) Validation of spatial permafrost models using a multiscale, hierarchical approach: Results for North-Central Alaska. *Annual Meeting of the Association of American Geographers, Chicago, IL*, March 2006.

Nelson, F.E. and Shiklomanov, N.I. (2006) The Circumpolar Active Layer Monitoring (CALM) program: long-term observations on the climate-active layer-permafrost system. Presented at research synthesis workshop "*Vulnerability of Carbon in Permafrost: Pool Size and Potential Effects on the Climate System*," National Center for Ecological Analyses and Synthesis, Santa Barbara, CA, March 2006.

Nelson, F.E., Shiklomanov, N.I., Hinkel, K.M., Brown, J. and Mazhitova, G. (2006). CALM II: The Circumpolar Active Layer Monitoring Network. Presented at the 18th Annual ARCUS Meeting and Arctic Forum.

Schimek, M.A., Streletskiy, D.A., Shiklomanov, N.I., Nelson, F.E., and Klene, A.E. (2006). Active-Layer Thickness and Ground Surface Temperature in North-Central Alaska: Results from CALM's First Decade. Presented at the 63rd Eastern Snow Conference, Newark, DE, June 2006.

Nelson, F.E., Shiklomanov, N.I., Hinkel, K.M., Brown, J. and Mazhitova, G. (2006).The Circumpolar Active Layer Monitoring (CALM) Network. Presented at the 18th World Congress of Soil Science, Philadelphia, July 2006.

Shiklomanov N.I., Nelson, F.E., Streletskiy, D.A., Klene, A.E., Schimek, M.A., and Little, J. (2006) Long-term active layer and ground surface temperature trends: results of 12 years of observations at Alaskan CALM sites. Fall Meeting American Geophysical Union, San Francisco, CA, December 2006.

Project Title: Arctic Coastal Dynamics (ACD) Observatory: Elson Lagoon Key Site

Project Leader:
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Funding Source: 2006 BASC Cooperative Agreement (NSF OPP-0447422?)

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Ben Sawyer, BASC

Brief Activity Report

The 11-km Elson Lagoon section is one of 24 key sites identified under the circumarctic Arctic Coastal Dynamics (ACD) program that is coordinated by the International Permafrost Association (IPA). During 2005 the Joint Committee for the International Polar Year (IPY JC) approved the new project Arctic Circum-Polar Coastal Observatory-Networks (ACCO-Net; Project 90). The Elson Lagoon key site with its shoreline erosion measurements dating back to the late 1940s is a major contributing site to ACCO-Net and includes a community-based outreach program under the SNACS organic carbon transformation project.

The annual measurements of coastal erosion between Brant Point and Mayoeak Creek were conducted in early to mid August 2006, using the VPR provided helicopter. All 14 permanent transects were visited. Distances were taped between the closest permanent benchmark and the edge of the bluff. Section D between Tekegarkrok Point and Mayoeak Creek continues to show the maximum rates of erosion with huge losses between 15 and 17m. The area around Brant Point encounter an average of 10 m of erosion in the past year. The entire 11-km long edge of the BEO Elson Lagoon coastline was walked in 2006 by Adrian Aguirre using the DGPS. Results were compared with the same survey conducted in 2003 by Serbin. A total of 82,607 m^2 or 20.4 acres of BEO land has been lost in the three-year period. The average rate of erosion for this period was 2.69 m/yr.

Recent Publications and Presentations

Aguirre, A, A. Graves, J. Brown, and C. Tweedie, 2005. High Precision Monitoring of Coastal Erosion in the Inupiat Eskimo Village of Barrow Alaska. Poster presentation. Society for Advancement of Chicanos and Native Americans in Science (SACNAS) annual conference, Denver Colorado, September 29-October 2.

Aguirre, A., C.E. Tweedie, J. Brown, A. Graves, 2006. Continuous monitoring of coastal erosion in the Inupiat village of Barrow, Alaska using high precision differential global positioning system (DGPS). Eos Trans, AGU 87(52), Fall Meeting Suppl., Abstract

Brown. J. 2006, The IPA contribution to the International Polar Year and the Arctic Coastal Dynamics. 6th ACD Workshop, 22-26 October 2006, University of Gronigren, Netherlands, pp. 16-17.

Francis-Chythlook, O, and J. Brown, 2005. Additional Erosion Observations for the Elson Lagoon Key Site, Barrow, Alaska, ACD-Arctic Coastal Dynamics, 5th International Workshop, October 13-16, 2004, McGill University, Montreal, Canada, Reports on Polar and Marine Research 506, pp. 38-41.

Jorgenson, M. T., J. Brown, T. Buckley, S. Fredrickson, H. Brower, D. Payer, and J. Woods, 2006. Village-based monitoring and remote sensing of coastal dynamics along the Alaskan Beaufort coast, 6th ACD Workshop, 22-26 October 2006, University of Groningren, Netherlands p. 25.

Jorgenson, M. T, and J Brown, 2005. Classification of the Alaskan Beaufort Sea Coast and Estimation of Sediment and Carbon Inputs from Coastal Erosion. Geo-Marine Letters 25:69-80.

Project Title: Collaborative Research Spatial and Temporal Variability of Ground Temperature and Thaw, Northern Alaska

Project Leaders:
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Funding Source:
K. M. Hinkel (NSF OPP-0094769)
F. E. Nelson (NSF OPP-00995088)

Personnel in addition to Project Leaders

These projects were not officially active although collaboration in the field continued with CALM and lake basin personnel.

Brief Activity Report

Since 2001, a 150 km^2 area in and around Barrow has been monitored using ~70 data loggers recording air temperature at hourly intervals to assess the occurrence of an Urban Heat island (UHI). The UHI magnitude (MUHI) is calculated as the difference in the mean daily temperature of the urban and rural area. The MUHI is most pronounced in winter months (December-March), with temperatures in the urban area averaging 2ºC warmer than in the surrounding tundra and occasionally exceeding 6ºC. The MUHI is maximized under cold and calm conditions, and is strongly and directly correlated to natural gas utilization on a monthly basis. Integrated over the home heating season, there is an 8% reduction in freezing degree days in the village. However, it is unlikely that anthropogenic heat contributes to the forward shift in the snow meltout date that has been observed near Barrow over the past 60 years. With coauthor Fritz Nelson, the results are forthcoming in JGR-Atmospheres.

The second project was initiated in autumn 1997, on an existing 2.2 km-long, 4.0 m-high snow fence located on the east side of the Cake Eater Road, adjacent to the BEO A large drift develops each winter on the downwind side of the fence, and a smaller drift forms upwind. To monitor the thermal impact on ice-rich permafrost, nine soil temperature measuring sites were installed near the fence; an additional three sites were located in the undisturbed tundra as a control. The results of the six-year study indicates that soil temperatures beneath the drift are 2-14°C warmer than the control in winter due to the insulting effects of the snow. Since the drift persists 4-8 weeks after snow has disappeared from the undisturbed tundra, soil thaw is delayed and soil temperatures in summer are 2-3°C cooler than the control. The mean

soil temperature over the period of record has warmed 2-5°C, and the upper permafrost has thawed. The ground surface has experienced 10-20 cm of thaw subsidence in many places, and widespread thermokarst is apparent where snow meltwater ponds. Both direct soil warming and the indirect effects of ponding contribute to permafrost destabilization. Graduate student John Hurd participated in this project.

Others Barrow-based project activities include research on thaw lakes and drained thaw lake basins and soil carbon in collaboration with Wendy Eisner, Jim Bockheim and the CALM project (see Nelson report).

Recent Publications and Presentations

Bockheim, and J.G., Hinkel (2005) Characteristic and significance of the transition zone in drained thaw-lake basins of the Arctic Coastal Plain. Arctic 58: 406-417.

Hinkel, K.M. and Nelson, F.E. (2005). Spatial and Temporal Patterns of the Urban Heat Island at Barrow, Alaska, presented at the annual meeting of the Association of American Geographers, Denver.

Hurd, J., Hinkel, K.M., Eisner, W.R., Jones, B.J. and Beck, R.A. (2005). Monitoring Ground Subsidence in Continuous Permafrost Using Differential Global Positioning System, presented at the annual meeting of the Association of American Geographers, Denver.

Hinkel, K.M. and Nelson, F.E. (in press). Anthropogenic heat island at Barrow, Alaska during winter: 2001-2005. Journal of Geophysical Research-Atmospheres.

Hinkel, K.M., Jones, B.M., Eisner, W.R., Cuomo, C.J., Beck, R.A. and Frohn, R. (in press).

Methods to assess natural and anthropogenic thaw lake drainage on the western Arctic Coastal Plain of northern Alaska, Journal of Geophysical Research-Earth Surface.

Hinkel, K.M. (in press). The urban heat island of Cincinnati, Ohio, Geography Research Forum.

Hinkel, K.M. and Hurd, J.K., Jr. (2006). Permafrost destabilization and thermokarst following snow fence installation, Barrow, Alaska, U.S.A., Arctic, Antarctic and Alpine Research, 38(4), 530-539.

Hinkel, K.M. (2006). Comment on "Formation of oriented thaw lakes by thaw slumping" by Jon D. Pelletier, Journal of Geophysical Research-Earth Surface, 111, F01021, doi:10.1029/2005JF000377.

Hinkel, K.M., Frohn, R.C., Nelson, F.E., Eisner, W.R. and Beck, R.A. (2005). Morphometric and spatial analysis of thaw lakes and drained thaw lake basins in the western Arctic Coastal Plain, Alaska, Permafrost and Periglacial Processes, 16(4), 327-341.

Frohn, R.C., Hinkel, K.M. and Eisner, W.R. (2005). Satellite remote sensing classification of thaw lakes and drained thaw lake basins on the North Slope of Alaska, Remote Sensing of the Environment, 97, 116-126.

Project Title: Collaborative Research on Flux and Transformation of Organic Carbon Across the Eroding Coastline of Northern Alaska

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Funding Source: (SNACS: Study of Northern Arctic Coastal Systems)
M. T. Jorgenson (NSF OPP-0436165)
C. L. Ping (NSF OPP – 0436179)

Personnel in addition to Project Leaders
Fugen Duo, Daniel Fortier, Lorene Lynn (University of Alaska, Fairbanks and Palmer)

Brief Activity Report

The team returned to the Alaskan Beaufort Coast during late July and early August 2006 to complete their sampling of soil and permafrost characteristics at 50 sites along the coast. The data from these sites will be used in their study of the flux and transformation of carbon along the eroding coastline to calculate carbon stocks, erosion rates, and fluxes of carbon into the nearshore environment. The helicopter-supported sampling was done out of Prudhoe Bay and Kaktovik. Ping, Lynn, Duo, and Fortier did more intensive sampling at Barrow in mid-August. In September, Jorgenson visited the village-based monitoring sites at Barrow, Colville Delta, and Kaktovik to download his time-lapse cameras, water-level recorders, and soil temperature recorders and to resurvey the coastal erosion transects.

Recent Publications and Presentations

Dou, F., Guo, L., Ping, C., Jorgenson, T., 2006. Distribution and characterization of soil organic carbon along the coastline of Northern Alaska. Fall Meeting American Geophysical Union, San Francisco, CA, December 2006.

Jorgenson, M.T. and Brown, J. 2005. Classification of the Alaskan Beaufort Sea Coast and estimation of carbon and sediment inputs from coastal erosion. *Geo-marine Letters* 25:69-80.

Jorgenson, T., Ping, C.L., Guo, L., Shur, Y., Brown J. 2005. A multi-scale approach to assessing the flux and transformation of organic carbon across the eroding coastline of Northern Alaska. in Arctic Coastal Dynamics: Report of the 5th International Workshop. McGill University, 13-16 October, 2004, *Reports on Polar and Marine Research 506,* pp. 65-68.

Jorgenson, T., Ping, C.L., Guo, L., Shur, Y., Michaelson, G.J., Dou, F., Tumskoy, V., Kanevsky, M. and Brown, J. 2005. Flux and transformation of soil organic carbon across the eroding coastline of Northern Alaska, Preliminary Results. Fall MeetingAGU , December 5-9, 2005 (Eos Trans. AGU, 86(52), Fall Meet. Suppl., Abstract OS43B-03).

Lynn, L. A., Ping, C., Jorgenson, T., Dou, F., 2006. Changes in Soils and Permafrost as a Function of Distance to the Beaufort Sea Coast, Alaska. Fall Meeting American Geophysical Union, San Francisco, CA, December 2006.

Ping, C., Dou, F.,Fortier, D., Jorgenson, T., Kanevskiy, M., Lynn, L. A., Michaelson, G. J., Shur, Y. L., 2006. Pedological Properties of the Eroding Coastline along the Beaufort Sea, Alaska. Fall Meeting American Geophysical Union, San Francisco, CA, December 2006.

Community-based Coastal Monitoring Subproject (SNACS)

Project Leader: Mark T. Jorgenson, ABR, Inc.
Funding Source: M.T. Jorgenson (NSF OPP-0436165)
Personnel in addition to Project Leaders:
Tim Buckley, Science Teacher NSB School District, and high school students
Harry Brower, Jr., North Slope Department of Wildlife Management
Joeb Woods, Jr., Local Coordinator, Nuiqsut
Susan Fredrickson, Teacher, NSB School District

Brief Activity Report

Community-based observational programs have been developed for Barrow, Nuiqsut and Katovik erosion sites. Students and teachers participate in classroom and field trips to learn surveying and monitoring techniques. These sites and observational programs are part of the IPY Arctic Circum-Polar Community Observation-Network (ACCO-Net) and its outreach activities. In 2006, data was retreived from water level recorders, time-lapse cameras, and temperature dataloggers. Surface elevations and thaw depths were resurveyed at all sites.

Recent Publications and Presentations

Jorgenson, M. T., J. Brown, T. Buckley, S. Fredrickson, H. Brower, D. Payer, and J. Woods, 2006. Village-based monitoring and remote sensing of coastal dynamics along the Alaskan Beaufort coast, 6th ACD Workshop, 22-26 October 2006, University of Groningren, Netherlands p. 25.

Jorgenson, T., J. Brown and T. Buckley. 2005. Village-based network for coastal monitoring. Alaska. International Conference on Arctic Planning II, Copenhagen, Denmark. Poster Abstract, Theme 3, pp. 13-14.

Jorgenson, M.T. and Brown, J. 2005. Development of a Village-Based Coastal Monitoring Network along the Beaufort Sea Coast: A Project for the Study of Northern Alaska Coastal Systems. Presentation at the Inupiat Heritage Center, Barrow, March 22, 2005.

Project Title: Collaborative Research on Snow and Ice Processes in the Deposition and Fate of Mercury in the Arctic

Project Leaders:
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Personnel in addition to Project Leaders
Don Perovich and Tom Douglas, Stephanie Saari, CRREL
Joel Blum and Jerry Keeler, University of Michigan
Bill Simpson,UAF; Gerd Hoenninger (UAF and University of Heidelberg, Germany)
Laura Aviles-Alvarez, student (UAF); Wiley Bogren and Chris Poleshenski, students (Dartmouth College)

Brief Activity Report

In 2006, we continued to sample in the BEO on an intermittent fashion, using other trips to Barrow as opportunities for sampling. The sampling targeted specifically those areas where work from 2005 indicated uncertainty. In particularly we sampled actively across the snow melt period in the BEO (on land) and off-shore on the sea ice of Chukchi Sea. Samples in the BEO were collected at the Myoeak River site and just south of the ARM site in the Central Marsh. Sampling typically consisted of core samples through the entire snow pack, and surface samples. Samples were taken for both mercury and ions. Experiments on the re-emission of mercury from the snow pack were conducted adjacent to the BEO. These consisted of monitoring the mercury concentration within and above the snow pack while exposing the snow to light in the solar spectrum. These experiments were quite successful and results are now being analyzed. We cored through the ice on several lakes in the BEO to obtain lacustrine sediments for the analysis of mercury. We also unsuccessfully tried to core the sediments in Elson Lagoon (unfrozen

wet sediments would not stay in the core tubes). Several papers are in preparation or in review. Our work will be featured in a special SNACS session at the AGU Fall Annual Meeting in San Francisco.
A new project will allow us to continue our measurement on snow sublimation in the BEO.

Recent Publications and Presentations

Alvarez-Aviles, L., W.R. Simpson, T.A. Douglas, M. Sturm, and D.K. Perovich (2006) Observations of Chemical Composition in Frost Flower Growth Process and Their Implication in Aerosol Production and Bromine Activation Chemistry. Eos, Transactions of the Fall American Geophysical Union Meeting.

Domine, F., A. S. Taillandier, W. R. Simpson, and K. Severin (2005) Specific surface area, density and microstructure of frost flowers, *Geophys. Res. Lett.,* 32, L13502.

Douglas, T. A., M. Sturm, W. R. Simpson, S. Brooks, S. Lindberg, and D. Perovich (2005) Elevated mercury measured in snow and frost flowers near Arctic sea ice leads, *Geophys. Res. Lett.,* 32, L04502.

Douglas, T.A., M. Sturm, C.J. Ashjian, T. Jorgensen, W.C. Oechel, C. Ping, R.C. Rhew, and M. Stieglitz (2006) Studies of the Northern Alaskan Coastal System: Ongoing project work and synthesis activities. Eos, Transactions of the Fall American Geophysical Union Meeting.

Douglas, T A, Sturm, M Simpson, W R,Alvarez-Aviles, L, Blum, J D, Perovich, D K, Keeler, G J, Lammers, A, Biswas, A: Mercury deposition to snow and ice provides a link between the lower atmosphere and the cryosphere in northern Alaska, American Geophysical Union Fall Meeting, San Francisco, California, 2005.

Hoenninger, G , Staebler, R , Morin, S , Netcheva, S , Simpson, W , Savarino, J, Bottenheim, J: *Out On The Ice*, American Geophysical Union Fall Meeting, San Francisco, California, 2005.

Simpson, W R, Hoenninger, G S , Platt, U: Spatial Gradients in Halogen Oxides Across the North Slope of Alaska Indicate That Halogen Activated Airmasses are Spatially Large, American Geophysical Union Fall Meeting, San Francisco, California, 2005.

Simpson, W. R., L. Alvarez-Aviles, T. A. Douglas, M. Sturm, and F. Domine (2005) Halogens in the coastal snow pack near Barrow, Alaska: Evidence for active bromine air-snow chemistry during springtime, *Geophys. Res. Lett.,* 32, L04811.

Sturm, M., J.D. Blum, T.A. Douglas, W. Simpson, D.K. Perovich, and G. Keeler (2006) Mercury deposition in the snow pack of the arctic Alaskan coastal system. Eos, Transactions of the Fall American Geophysical Union Meeting

Sturm, M, Shepson, P B , Bottenheim, J W , Pinto, J , Blum, J , Simpson, W R , Perovich, D K , Douglas, T, Brooks, S , Rhew, R , Keeler, G: *LEADX-2005:* A system study of near-surface winter tropospheric processes near Barrow, Alaska, American Geophysical Union Fall Meeting, San Francisco, California, 2005.

ECOSYSTEM INTERACTIONS

Project Title: BE/CBC Biocomplexity Associated with the Response of Tundra Carbon Balance to Warming and Drying Across Multiple Spatial and Temporal Scales

Project Leaders:
Walt Oechel, San Diego State University
John S. Kimball, University of Montana
Craig E. Tweedie, The University of Texas at El Paso

This project is a multi-investigator effort that is examining how biological and physical processes interact to control carbon uptake, storage and release in Arctic tundra ecosystems and how the self-organizing nature of these interactions varies across multiple spatial and temporal scales. A unique, large scale flooding and draining experiment forms a significant component of this project. The various sub-projects address methane flux, plant species interactions, fine scale remote sensing, fine scale chamber fluxes, large scale ecosystem fluxes and modeling.

Biocomplexity Subproject: Eddy Covariance Carbon Flux

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Personnel in addition to Project Leaders
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David Lipson and Yoshi Harazono, CPI
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Masahito Ueyama, Donatella Zona, Hiroki Ikawa (doctoral candidates)
Nana Nashida (masters student)
Irene Kopetz, Cove Sturtevant (post graduate)
Joe Verfaillie (technician)

Brief Activity Report

A major goal of the eddy covariance carbon flux measurements in this project is to quantify ecosystem level changes in carbon flux as a result of drying and flooding. Past results indicated that the Arctic tundra had changed from a sink to a source for carbon, in part attributed to long term drying and warming. However, subsequent to these observations the system returned to a sink during the growing season (remaining a source on an annual basis when late fall, winter and early spring is considered).

Efforts in 2006 were focused on the continuation of measurements on the drained lake within the BEO that will be the site of a large-scale manipulation experiment in 2007. The drained lake will be divided into three sections along the longitudinal axis with one area serving as a control, another area where the water table will be lowered and another area where it will be raised. At the large scale, major changes in methane and CO_2 flux are anticipated to take place as a function of changes in soil moisture. Seasonal CO_2 flux were measured in 2005 and 2006 in each of the three treatment areas using both the

eddy covariance and the gradient method to establish a baseline that incorporates inter and intra seasonal variation. In 2005, methane was not measured while in 2006 we used a Horiba closed path methane analyzer and compared these measurements with those from a prototype methane analyzer (both an open and closed path versions). Good agreement was found between both of the analyzers as well as between the techniques of measurement (gradient vs. eddy).

While measurement and detection of carbon flux changes at the large scale is important, mechanistic understanding can best be achieved at finer scales. Within the drained lake there are microscale differences in elevation that result in complex moisture, vegetation, nutrient and redox potential differences. To address these differences, soil respiration was measured in a number of micro-sites within both dry and wet areas, as well as moss photosynthesis, redox potentials, and microbial biomass. Moss photosynthesis was inhibited by high light intensities that tended to be exacerbated by drier conditions. Soil respiration rates were higher under relatively moist soil conditions compared to drier soils. Experimentally lowering the water table of soil microcosms greatly stimulated respiration, indicating a strong O_2 limitation and the potential for large pulses of CO_2 loss during drainage of the ecosystem. At the microscale, methane flux tended to be directly related to soil moisture (more release to the atmosphere under wetter conditions) while CO_2 flux was inversely related (more release to the atmosphere under drier conditions).

Recent Publications and Presentations

Harazono Y, Mano M, Miyata A, Yoshimoto M, Zulueta RC, Vourlitis GL, Kwon H, Oechel W (2006) Temporal and spatial differences of methane flux at arctic tundra in Alaska. Mem. Natl Inst. Polar Res., Spec. Issue, 59:79-95.

Hastings, S.J., Oechel, W.C., Kinoshita, G.Y., and Zulueta, R.C. (2006). The effects of elevated soil temperature and altered water table on ecosystem carbon flux of an Arctic coastal tundra ecosystem near Barrow, Alaska. Eos Trans. AGU, 87(52), Fall Meet. Suppl., Abstract C43A-06

Nakamoto, K, W.C. Oechel, and D. Lipson (2006) Continuous Measurement of CO_2 concentration in Arctic Soil by Small Open-path Type CO_2 Sensors. Eos Trans. AGU, 87(52), Fall Meet. Suppl., Abstract C51A-0380.

Zona D., Oechel W., Hastings S., Oberbauer S., Kopeta I. (2006). The contribution of mosses to the complex pattern of diurnal and seasonal metabolism the wet coastal tundra ecosystems near Barrow, Alaska. Eos Trans. AGU, 87(52), Fall Meet. Suppl., Abstract B51A-0298.

Biocomplexity Subproject: Infrastructure Development and Experimental Design

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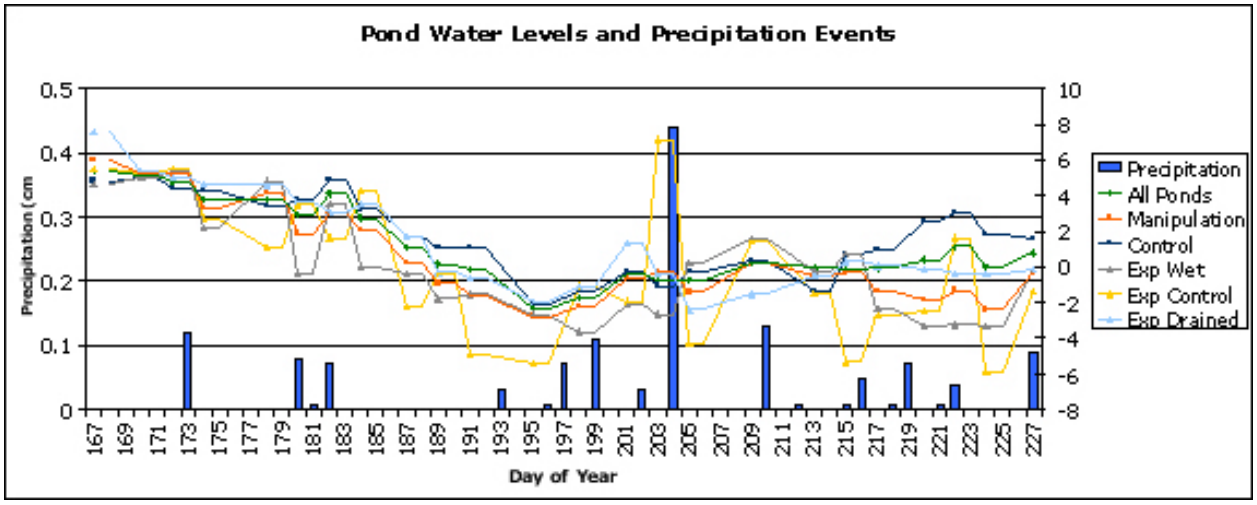
Adrian Aguirre, Karla Martinez (undergraduate students)

Brief Activity Report

This project is a multi-investigator effort that is examining how biological and physical processes interact to control carbon uptake, storage and release in Arctic tundra ecosystems and how the self-organizing nature of these interactions varies across multiple spatial and temporal scales. A large scale flooding and draining experiment forms a significant component of this project. UTEP's SEL involvement in this project focuses on understanding landscape level change and plant species interactions and performance. Much of the field effort in 2006 was devoted to the establishment of the infrastructure for the large scale flooding and draining experiment and collecting baseline data for implementing the flooding and draining manipulation. For the latter, water level was recorded every couple of days for 20 ponds in the manipulation area. Ponds were located both outside and within the experimental area, including each of the three treatments (flooded, control and drained). Pond height generally decreased from breakup until mid July and then increased slightly by the end of the summer as shown below.



During 2006, a vegetation map was developed for the flooding and draining area by performing a supervised classification of 2002 Quickbird satellite imagery as shown on the map below. A formal accuracy assessment of this map is currently underway but suggests that for the classes of vegetation reported, the map is more than 80% accurate. From airborne LIDAR flown in September 2005, a high resolution Digital Elevation Model was produced and the drainage/stream and catchment network for the experimental area was modeled. From breakup to the third week in August, stream flow and water was collected at the outlet stream from the experimental basin. Analysis of particulate and dissolved organic carbon from these samples is currently being analyzed.

Recent Publications and Presentations:

Edith Jaurrieta, Emerald Laija, Craig Tweedie. 2005. Large-scale experimental flooding and draining of arctic tundra to better understand the impact of soil moisture on ecosystem carbon balance – hydrological baselines for the manipulation. Society for Advancement of Chicanos and Native Americans in Science (SACNAS) annual conference, Denver Colorado, September 29 – October 2. poster.

Americans in Science (SACNAS) annual conference, Denver Colorado, September 29 – October 2.

Emerald Laija and Craig Tweedie. 2005. Distribution of *Arctagrostis fulva* in relation to the hydrology of ponds in the Barrow area. Poster presentation. Society for Advancement of Chicanos and Native Americans in Science (SACNAS) annual conference, Denver Colorado, September 29 – October 2.

Edith Jaurrieta, Emerald Laija, Craig Tweedie. 2005. Large-scale experimental flooding and draining of arctic tundra to better understand the impact of soil moisture on ecosystem carbon balance –

hydrological baselines for the manipulation. Poster presentation. Second International Conference on Arctic Research Planning (ICARP II). Copenhagen, Denmark, November 9-12.

Edith Jaurrieta, Emerald Laija, Craig Tweedie, 2005. Spatial and temporal fluctuations in water levels of tundra ponds: baseline studies associated with a large-scale flooding and draining experiment in northern Alaska. Fall Meeting, American Geophysical, San Francisco, California, poster.

Biocomplexity Subproject: Methane Fluxes

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Project Participants other than Project Leader
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Hiroki Ikawa (Graduate student, SDSU)
George Burba (LiCor), Tyler Anderson (LiCor, technician)

Brief Activity Report

Atmospheric methane (CH_4) concentration is about 0.5 % of CO_2 so finding a sensor to use in the field and that can measure the flux of methane can be challenging. We applied the gradient method at the Biocomplexity field site in 2005 measuring CO_2 flux with good performance. The sampling tubes were extended from the methane measurement shed to the south, central and north towers.

In 2006, we utilized a newly developed closed path CH_4 sensor to detect CH_4 concentration profiles of each towers from mid June till the end of October. These data were compared with another, new open path methane sensor using the eddy covariance technique and in general, we found good agreement with respect to both flux and concentrations. In addition, we compared methane data concentrations collected at the Biocomplexity site with measurements at the NOAA site 3 km away and found good agreement. Modifications of the analyzer will continue through the fall, winter and spring allowing us to continue measurements of flux in 2007.

Recent Publications and Presentations

Engstrom, R., A. Hope, H. Kwon, Y. Harazono, M. Mano, and W. C. Oechel, 2006: Modeling evapotranspiration in Arctic coastal plain ecosystems using a modified BIOME-BGC model. J. of Geophysc. Res., 111, G02021, doi:10.1029/2005JG000102, 2006.

Harazono, Y., M. Mano, M. Ueyama, A. Miyata, and W. C. Oechel, 2006: Temporal and spatial differences of methane emission and uptake at Arctic and sub-arctic tundra in Alaska. Mem. Natl Inst. Polar Res., Spec. Issue, 59, 79-95, 2006.

Harazono, Y., N. Nishida, M. Ueyama, M. Mano, A. Miyata, W. C. Oechel, 2005, Controlling factors on greenhouse gas exchange at arctic wet tundra in Barrow, Alaska, Proceedings of the 6th International Workshop on Global Change Connection to the Arctic (GCCA6), Tokyo, Japan, Dec 12-13, 2005, 178-181, 2005.

Nishida, N., Y. Harazono, M. Ueyama, and Y. Kitaya, 2006, Relationship between Vegetation Indexes and Measured CO2 Flux over a Wet Sedge Tundra and the Remote-sensing Application. Presentation at the 2006 Annual Meeting of Agricultural Meteorology Society, Japan,

Biocomplexity Subproject: Plot Level CO_2 Fluxes

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Funding Source San Diego State University FIU project ID 202601539

Project Participants in addition to Project Leader
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Andrea Kuchy, techniican

Brief Activity Report

1) Establish two additional sample sites along the Biocomplexity project boardwalk 100 m extensions and install boardwalk spurs at each location (2 x 3 boardwalks = 6 additional sites). Sites were chosen using a stratified random design.
2) Upgrade the mini-meteorological station we keep at the central boardwalk location to include additional soil temperature measurements in treatment plots. This weather station is used to collect high frequency (1 minute) data during the flux measurements (see below).
3) Measure daily courses of chamber-level net ecosystem CO_2 exchange and ecosystem dark respiration of the three Biocomplexity treatments areas at weekly intervals. Each site was sampled every 4 hours in a 24-hour period. Because of the distance between the treatment areas, only half of the six sample sites are measured in a 24-hour period. We measured the new sample sites (Item 1) at the noon measurement period only. Two sample daily courses were conducted per week, weather, equipment, and bears permitting. Measurements were taken from snowmelt until the third week in August. Along with these measurements, the mini-weather station recorded light level, air temperatures, relative humidity, and soil temperatures at 1-minute intervals during the 24-hour sample periods. Water level in the chamber bases and thaw depth at each sample site was measured after each 24-hour sampling. An NDVI camera or PP systems UNI-SPEC was used each week to determine the NDVI of the vegetation in the sample plots measured for chamber-level CO_2 exchange.
4) Measure peak season chamber level CO_2 fluxes on the ITEX sites at Barrow and Atqasuk. Sites were sampled for one set of 24-hour measurements taken every 4 hours. Atqasuk was to be measured in the last week in July and Barrow the first week in August. Equipment problems prevented completion of the Atqasuk measurements.
5) Collect leaf tissue of the dominant species and soil nutrient solutions at approximately 3-week intervals for leaf nutrient analysis along the three Biocomplexity areas.
6) Coordinate a peak season biomass sampling with other members of the Biocomplexity team. 7) Establish temperature measurement transects across the tram boardwalks (see Issues below). We established three transects of 8 thermochron dataloggers each perpendicular to the tram boardwalks to measure soil temperatures over the winter at various distances away from the boardwalks to test for effects of snow accumulation along the boardwalks on soil temperature.

We continued to see substantial variation in CO_2 exchange across the Biocomplexity research area in the absence of the flooding/draining treatment. Fluxes measured in 2006 were fairly different from those in 2005, when we had much drier and sunnier conditions.

The tram boardwalks were effective snow fences over the winter and the areas adjacent to the boardwalks, including our flux chamber sites and the tram remote sensing corridor, did not melt out until 1-2 weeks after the centers of the treatment areas. This phenological delay is a potential large concern as the tram robot spectrometer measurements and to some extent the chamber-based flux measurements may not reflect the flux tower measurements. However, the new boardwalk extensions did not have the snow accumulation, having been installed after most of the snow drift, and are a potential test of this issue. Our flux measurements suggest that the first 200 m of the boardwalks (snow accumulation) had lower gross primary production than the new 100-meter extensions that did not accumulate snow. However, we only sampled two sites on each of those extensions, so the difference is probably not significant, but is suggestive. We had considerable difficulties with gas exchange equipment with two different failures of LI-6200 gas analysis systems. BASC was very helpful in expediting repair of one of the machines. SDSU and UTEP were also very helpful in supplementing our personnel during the flux measurements.

Trips to the site: Two diurnals per week were made with an average of four trips per day. On non diurnal sample days, approximately two trips to the site were taken per day. We estimate our group made approximately 180 trips along the matted trail to the Biocomplexity site and back, many by bicycle.

Recent Publications and Presentations

Olivas, P. and S. F. Oberbauer. Water and temperature effects on the carbon balance in wet tundra: a new ITEX warming experiment at Barrow Alaska. Presentation at the 13th International Tundra Experiment Workshop, Coral Gables, FL.

Biocomplexity Subproject: Tramline and Instrumentation Development

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Personnel in addition to Project Leader
Santonu Goswami, David Lin, Karla Martinez, Amit Raysoni, Yenlai Chee (UTEP)

Brief Activity Report

During the late spring, the 200m tram lines crossing the Biocomplexity experimental manipulation on the BEO were extended to 300m. Each tram line now spans the entire lake basin that will be manipulated from 2007. Gamon trained the UTEP students in June and students, lead by Santonu Goswami measured reflectance along each tramline every few days from just prior to breakup until late August. Reflectance is measured every meter along each tramline using a UNISPEC dual channel spectrometer and a semi-automatic robotic cart. Soil moisture was sampled manually each time reflectance was measured and data are currently undergoing correction following calibration of the soil moisture probe to the soils of the Biocomplexity sampling area.

Data are processed to track the Normalized Difference Vegetation Index (NDVI), a measure of vegetation 'greenness', the Photochemical Reflectance Index (PRI), a measure of carotenoid pigment levels, and the Water Band Index (WBI), a measure of surface moisture. Summary data are given for each

index below for each tramline in the Biocomplexity experimental area. Sampling will continue during the summer 2007 snow free period, when the experimental manipulation is planned to be initiated.

Recent Publications and Presentation

Goswami et al. Measuring Ground Reflectance in Barrow, Alaska, Summer 2006, Presented at the Working Group meeting of Spectral Network, NCEAS, Santa Barbara, California, (2006 September).

Biocomplexity Subproject: Remote Sensing and Hydroecological Process Models

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Field Personnel
None at Barrow

Brief Activity Report

The research team has developed a carbon model that uses MODIS and AMSR-E remote sensing inputs to estimate daily heterotrophic respiration, and net ecosystem CO_2 exchange from local landscape to pan-Arctic basin spatial domains. Activities have included developing input algorithms and preparation for validation at eddy-flux tower sites spanning the range of Arctic landcover and biome types. The tundra tower sites located on the North Slope of Alaska are Barrow (2 sites; Harazono and Oechel), U-Pad, Atqasuk, Ivotuk, and Happy Valley.

Long-term meteorological data have been developed for each site for process modeling and sensor validation. These data span the years 1979 to 2004. Regression relationships between daily National Climatic Data Center (NCDC) records and each flux tower site were used for estimating daily maximum and minimum temperatures. The micro-meteorological model MT-CLIM was used to estimate the daily average temperature, precipitation, vapor pressure deficit, solar radiation, and day length at each site. The BIOME-BGC model was parameterized and run at each site over the period 1979-2004 for describing ecosystem processes. Spatially explicit BIOME-BGC runs were also conducted for the pan-Arctic basin spatial domain using corrected ERA-40 and NCEP/NCAR daily reanalysis meteorological records from 1958 to 2002 and 2005, respectively. The model runs are being used for scaling up tower measurements for validating remotely sensed inputs and the results of the carbon model.

Other activities have focused on soil temperature and soil moisture retrieval algorithm development and refinement from AMSR-E, a passive microwave sensor on the NASA Aqua satellite. These inputs drive the heterotrophic respiration component of the carbon model for estimating soil and litter respiration. We combine these results with MODIS GPP and LAI information to compute net CO_2 exchange (NEE) at daily and annual time steps. We also analyzed other satellite remote sensing time series data to assess recent trends and climate sensitivity of terrestrial carbon uptake and storage processes for the region. We applied the MOD17 production efficiency model using satellite AVHRR and MODIS sensor integrated time series data records to assess annual variability and long-term (1982-2005) trends in NPP and the effects of recent warming and drying on vegetation productivity. We also utilized satellite microwave remote sensing time series from the Special Sensor Microwave Imager (SSM/I) to quantify

seasonal thaw trends and applied these results with satellite based LAI and NPP records and gridded ecosystem process model simulations to assess the ecological impacts of earlier and longer growing seasons for vegetation productivity and soil carbon storage.

Recent Publications and Presentations

Jones, L., J. Kimball, K. McDonald, E. Njoku, and W. Oechel, 2006. MODIS and AMSR-E synergistic modeling of Arctic and boreal terrestrial carbon dynamics. NASA Global Vegetation Workshop 2006: Long-term global monitoring of vegetation variables using moderate resolution satellites. August 8-10, 2006, Missoula MT (http://www.ntsg.umt.edu/VEGMTG/posters/posters.html).

Jones, L.A., J.S. Kimball, K.C. McDonald, E. Njoku, and W.C. Oechel, 2006. Satellite remote sensing of daily surface soil temperature and moisture in boreal and Arctic biomes using the AMSR-E microwave radiometer. Eos Trans. AGU, 87(52), Fall Meet. Suppl., Abstract B43A-0249.

Jones, L.A., J.S. Kimball, K.C. McDonald, S.K. Chan, E.G. Njoku, and W.C. Oechel, 2006. Satellite microwave remote sensing of boreal and Arctic soil temperatures from AMSR-E. IEEE Transactions in Geoscience and Remote Sensing (In review).

Kimball, J.S., L.A. Jones, K.C. McDonald, E. Njoku, and W.C. Oechel, 2006. A satellite remote sensing approach for mapping soil respiration and terrestrial carbon exchange for boreal and Arctic biomes using MODIS and AMSR-E. Eos Trans. AGU, 87(52), Fall Meet. Suppl., Abstract B43A-0242.

Kimball, J.S., K.C. McDonald, and M. Zhao, 2006. Spring thaw and its effect on terrestrial vegetation productivity in the western Arctic observed from satellite microwave and optical remote sensing. Earth Interactions 10(21), 1-22.

Kimball, J.S., M. Zhao, A.D. McGuire, F.A. Heinsch, J. Clein, M. Calef, W.M. Jolly, S. Kang, S.E. Euskirchen, K.C. McDonald, and S.W. Running, 2006. Recent climate driven increases in vegetation productivity for the Western Arctic: Evidence of an acceleration of the northern terrestrial carbon cycle. Earth Interactions (In press).

McDonald, K.C., and J.S. Kimball, 2006. Variability in frozen and thawed seasons in the terrestrial high latitudes and relationships with land-atmosphere CO_2 exchange: Characterization with spaceborne microwave remote sensing. Eos Trans. AGU, 87(52), Fall Meet. Suppl., Abstract B21A-1012.

Zhang, K., J.S. Kimball, M. Zhao, W.C. Oechel, J. Cassano, and S.W. Running, 2006. Sensitivity of pan-Arctic terrestrial net primary productivity simulations to daily surface meteorology from NCEP/NCAR and ERA-40 Reanalyses. J. Geophys. Res. - Biogeosciences (In press).

Zhang, K., J.S. Kimball, M. Zhao, W.C. Oechel, and S.W. Running, 2006. Analysis of pan-Arctic terrestrial primary productivity from 1982-2005 by combining AVHRR and MODIS products. NASA Global Vegetation Workshop 2006: Long-term global monitoring of vegetation variables using moderate resolution satellites. August 8-10, 2006, Missoula MT (http://www.ntsg.umt.edu/VEGMTG/posters/posters.html).

Zhang, K., J.S. Kimball, E.H. Hogg, M. Zhao, W.C. Oechel, J. Cassano, and S.W. Running, 2006. Satellite remote sensing detection of a recent decline in northern high latitude terrestrial vegetation productivity with regional warming and drying. Global Change Biology (In-review).

Project Title: Developing an Understanding and Predictive Capability of the Interconnections Among Arctic Terrestrial, Atmospheric, and Marine Systems

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Matt Higgins, Cheryl Laskowski, Rommel Zulueta (doctoral candidates)
Hank Loescher (collaborator)
Rena Bryan and Wanona Squirrel (post baccalaureate)
Aline Jaimes (post masters)
Natalio Panzarini (undergraduate)

Brief Activity Report

The thaw lake cycle is the dominant landscape process on the arctic coastal plain of Alaska. It is estimated that 50-75% of the area is covered in lakes or drained thaw lake basins. The age or successional state within this cycle can have a significant impact on the regional carbon exchange. The spatial variability of these drained lake basins may contribute significantly to the regional flux, and assessing these patterns across the coastal plain would address the need for spatial flux estimates across the region. This project combines both field and modeling activities to help in understanding the potential changes that the Arctic may experience. The field measurements include land, atmospheric and oceanic measurements with data used by atmospheric, oceanic, hydrological and ecosystem models

During the summer of 2006, aircraft- and tower- based eddy covariance instruments were deployed to measure the spatial and landscape variability of CO_2 fluxes in the vicinity of Barrow, Alaska. Tower sites were established at two drained lake basins of different ages, and an area that does not appear to have been affected by the thaw lake cycle. The aircraft was flown repeatedly along a flight path that encompassed the three measurement sites, which represents the major landscape features of the area. The spatial patterns in the aircraft fluxes along the flightline showed good correlation to the tower based measurements and the Normalized Difference Vegetation Index (NDVI) data acquired using the aircraft. The drained lake basins were young in age (50-200 years) and showed peak CO_2 uptake rates of 7-8 umole CO_2 m^{-2} sec^{-1} compared with 1-2 umole CO_2 m^{-2} sec^{-1} at a non-drained lake basin site and our permanent towers sites located on the BEO in polygonized tundra and our wet sedge site located at the NOAA facilities adjacent to the BEO.

We continued to measure carbon, water and energy flux at our permanent towers located at NOAA, the BEO, Atqasuk, and Ivotuk which form a latitudinal transect from the coast to the foothills of the Brooks range. Both of the coastal sites (NOAA & BEO) indicated annual sink strength of 40-60 gC $m^{-2}yr^{-1}$. The two tussock tundra sites farther south (Atqasuk and Ivotuk), unlike in previous years, were in balance with respect to carbon flux as apposed to being sources to the atmosphere, possibly due to milder summer temperatures. At the NOAA, Atqasuk and Ivotuk permanent sites, diurnal chamber measurements were made throughout the summer in order to quantify the seasonal pattern of net ecosystem flux, ecosystem respiration and gross primary productivity to better understand the controls on carbon flux and for modeling purposes.

In the fall of 2006 a 10-meter eddy covariance tower was set up at Point Barrow to measure the carbon and energy flux from the ocean and ice. The ocean modeling component of this research shows significant amount of heat entering the Arctic Ocean by way of the Bering Straits and along the Barrow Coastline. The energy flux data collected will be used in validating the ocean model. Data collected to data shows significant day to day variability as predicted by the model with peak values of sensible heat reaching 60 to 80 watts m^{-2} when there are areas of open water and air temperatures reach -5 to 0 deg C, then returning to 5-10 watts m^{-2} as air temperatures drop and ice forms a more continuous coverage.

Linking the continuous tower-based flux measurements to the spatial flux patterns and remotely sensed vegetation indices, we have a basis for scaling to the region while including the spatial variability of the drained thaw lake basins, wet sedge and tussock tundra. The scaling efforts are a combined effort of ocean, climate, hydrological and ecosystem modeling that are a part of this project.

Recent Publications and Presentations

Kwon, H. J., W. C. Oechel, *R. C. Zulueta, and S. J. Hastings (2006), Effects of climate variability on carbon sequestration among adjacent wet sedge tundra and moist tussock tundra ecosystems, J. Geophys. Res., G03014, doi:10.1029/2005JG00036.

Heinsch, F. A., M. Zhao, S. W. Running, J. S. Kimball, R. R. Nemani, K. J. Davis, P. V. Bolstad, B. D. Cook, A. R. Desai, D. M. Ricciuto, B. E. Law, W. C. Oechel, H. J. Kwon, H. Luo, S. C. Wofsy, A. L. Dunn, J. W. Munger, D. D. Baldocchi, L. Xu, D. Y. Hollinger, A. D. Richardson, P. C. Stoy, M. B. S. Siqueira, R. K. Monson, S. P. Burns and L. B. Flanagan (2006) Evaluation of remote sensing based terrestrial productivity from MODIS using regional tower eddy flux network observations. IEEE Transactions on Geoscience and Remote Sensing, Vol. 44 (7) pp. 1908-1925 (doi: 10.1109/TGRS.2005.85396).

Laskowski, C., Zulueta, R.C., and Oechel, W.C. (2006) Importance of drained thaw-lake basins for regional carbon estimates. Eos Trans. AGU, 87(52), Fall Meet. Suppl., Abstract GC51A-0455.

Project Title: International Tundra Experiment (ITEX-Barrow and Atqasuk)

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Personnel in addition to Project Leader
Field support was generously provided by the Tweedie and Oberbauer field crews.

Brief Activity Report

The ITEX sites at Barrow and Atqasuk where maintained over the summer of 2006. The project is currently in collaboration with the project: Biocomplexity Associated with the Response of Tundra Carbon Balance to Warming and Drying Across Multiple Spatial and Temporal Scales. Minimal data collection was collected by the Tweedie and Oberbauer field crews to maintain the abiotic data sets (active layer depth and temperature profiles). In addition, Phil Robertson (MSU) took preliminary samples of N_2O on the warmed and control plots as a potential first step toward a future sampling program.

The NSF ITEX-IPY project: Collaborative Research: Study of arctic ecosystem changes in the IPY using the International Tundra Experiment proposal was favorably reviewed and recommended for funding, It is a 3 year proposal with 2 field seasons. If funded an extensive biotic sampling will be performed on the plots over the next two field seasons (summer 2007-2008) in conjunction with the IPY.

Recent Publications and Presentations

Oberbauer, S.F., C.E. Tweedie, J.M. Welker, J.T. Fahnestock, G.H.R. Henry, P.J. Webber, R.D. Hollister, M.D. Walker, A. Kuchy, and G. Starr. (*in press*) Carbon dioxide exchange responses of arctic tundra ecosystems to experimental warming along moisture and latitudinal gradients. Ecological Monographs.

Hollister, R.D., P.J. Webber, F.E. Nelson, and C.E. Tweedie. (2006) Soil thaw and temperature response to air warming varies by plant community: Results from an open-top chamber experiment in northern Alaska. Arctic Antarctic and Alpine Research 38(2):206-215.

Walker, M.D., C.H. Wahren, R.D. Hollister, G.H.R. Henry, L.E. Ahlquist, J.M. Alatalo, M.S. Bret-Harte, M.P. Calef, T.V. Callaghan, A.B. Carroll, H.E. Epstein, I.S. Jónsdóttir, J.A. Klein, B. Magnússon, U. Molau, S.F. Oberbauer, S.P. Rewa, C.H. Robinson, G.R. Shaver, K.N. Suding, C.C. Thompson, A. Tolvanen, Ø. Totland, P.L. Turner, C.E. Tweedie, P.J. Webber, and P.A. Wookey. (2006) Plant Community Responses to Experimental Warming Across the Tundra Biome. Proceedings of the National Academy of Science of the United States of America (PNAS) 103(5): 1342-1346

Project Title: Rapid Assessment of Recent Changes in Land Cover and Carbon Balance in Beringia

Project Leader(s)
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Funding Source: NSF - OPP0454997

Personnel in addition to Project Leader
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Brief Activity Report

This project is assessing decadal time scale changes in ecosystem structure and function throughout the Beringia region. Measurements of plot level carbon dioxide (under varying light levels) and methane flux, hyperspectral reflectance, soil moisture, species composition, canopy structure, soil moisture and plant biomass and various site descriptive indices and micrometeorological measurements are made in the field. Using light use efficiency models derived from plot levels studies, landscape scale carbon flux is predicted for high spatial resolution satellite imagery. These are then overlain on extant high spatial resolution vegetation maps and a carbon flux signature for each vegetation type is calculated. A land cover change study is then completed by quantifying the change in land cover from multi-temporal remote sensing and the carbon flux signature derived for extant vegetation types is allocated for time series land cover distributions. The change in the carbon fixing potential of the landscape is calculated over time.

During 2006, sites were sampled on the BEO near the southern end of the Biocomplexity site, a remote site southeast of Cake Eater Road, near the ITEX site in Atqasuk, and in close proximity to the runway at Ivotuk. These sites match those sampled in Chukotka during the Swedish Beringia 2005 expedition. During 2007, several more sites will be sampled between Ivotuk and Barrow and also on the Seward Peninsula.

Recent Publications and Presentations

Lin et al. (2006) The relationship between land cover, CO2 flux, CH4 flux, Hyperspectral Reflectance and plant biomass in Arctic Tundra: initial findings from the Swedish Beringia 2005 expedition, Eos Trans. AGU, 86(52), Fall Meet. Suppl., Abstract C21C-1130.

Tweedie et al. (2006). Recent changes in land cover and carbon balance in Beringia. Cruise Report, Swedish Polar Research Secretariat.

Project Title: Halomethane Gas Exchange in Northern Alaskan Coastal Ecosystems

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Personnel in addition to Project Leaders

Yit Arn Teh and Olivier Mazeas (post docs), Triffid Abel (graduate student), Alyssa Atwood (undergraduate), University of California-Berkeley
Joseph von Fischer, Assistant Professor, Colorado State University

Brief Activity Report

Fluxes of methyl halides (CH_3Br, CH_3Cl, and CH_3I), chloroform ($CHCl_3$) and methane (CH_4) were measured within the Barrow Environmental Observatory (71ºN, 157 ºW). Twenty flux chamber (0.27 m^2) sites were chosen to cover the range of microtopographic features that characterize the wet-moist coastal sedge tundra. These 20 sites (5 transects of 4 sites each) included 8 sites next to the boardwalks of the Biocomplexity site. Air samples were collected and analyzed at UC Berkeley by gas chromatography-mass spectrometry.

Flux measurements were previously conducted in June and August, 2005, during the beginning and towards the end of the growing season, respectively. These results are currently in press at Journal of Geophysical Research- Biogeosciences. As a follow-up to the 2005 outing, we conducted flux chamber measurements on the BEO in July 2006. For this outing, we employed a new method to measure fluxes using stable isotope tracers of CH_3Br, CH_3Cl and CH_4. This method entails slightly enhancing the headspace of the chamber with ^{13}C labeled compounds, which can be tracked separately from the ^{12}C labeled compounds, thereby allowing for the simultaneous monitoring of the gross uptake and production rates of the compounds. We also monitored depth to water table and permafrost as a means of quantifying the degree of soil saturation to compare with the gas fluxes.

The general results over the last 2 years show that although production of methyl halides was observed at some sites, the majority of sites consumed CH_3Br and CH_3Cl, with much higher uptake rates at the drier sites and small emissions at the wetter site. CH_4 fluxes were also related to hydrological conditions, with higher emissions observed for the wetter sites. All sites emitted $CHCl_3$, with average emission rates that suggest that the tundra may be an important source of this compound to the atmosphere. The tundra was a minor source of CH_3I to the atmosphere.

In addition, our group conducted measurements of methane ebullition and diffusion emitted from Cake Eater Lake. In this pilot project, an east-west transect was taken across Cake Eater lake, starting from the newly installed dock. Methane bubble traps were installed at equal intervals along the transect, with separate water sampling near shore. Air samples were brought back to UC Berkeley for analysis by

gas chromatography. Water samples were brought to the BASC laboratories, and air samples were extracted following equilibration with nitrogen gas headspace. These were also then brought back to UC Berkeley for analyses by gas chromatography. Ebullition samples were also measured for ^{13}C isotope fractions at Colorado State University. Preliminary results indicate minor rates of methane ebullition from Cake Eater Lake.

Recent Publications and Presentations

Abel, T., R.C. Rhew, Y.A. Teh, A. Atwood, and O. Mazéas. (2006), Chloroform Emissions from the Arctic Tundra, *EOS Trans. AGU, 87* (52), Fall Meet. Suppl., Abstract C51A-0401.

Atwood, A., J. von Fischer, Y.A. Teh, T. Abel, and R. Rhew. (2006), Methane ebullition and diffusion from two Alaskan lakes and several small ponds, Berkeley Atmospheric Sciences Center symposium, Berkeley, CA.

Atwood, A., J. von Fischer, Y.A. Teh, T. Abel, and R. Rhew. (2006), Methane ebullition and diffusion from two Alaskan lakes and several small ponds, *EOS Trans. AGU, 87* (52), Fall Meet. Suppl., Abstract C51A-0389.

Mazéas, O., Y.A. Teh, T. Abel and R. Rhew. (2006), Arctic Tundra Fluxes of Methyl Halides. *EOS Trans. AGU, 87* (52), Fall Meet. Suppl., Abstract C51A-0401.

Rhew, R.C., Y.A. Teh, and T.A. Abel. (2005), Halomethane gas exchange in the northern Alaska coastal tundra, Berkeley Atmospheric Sciences Center symposium, Berkeley, CA.

Rhew, R.C., Y.A. Teh, and T.A. Abel. (2005), Halomethane Fluxes in the Northern Alaskan Coastal Tundra, *EOS Trans. AGU, 86* (52), Fall Meet. Suppl., Abstract A11C-06.

Rhew, R.C., Y.A. Teh, and T.A. Abel. (2006), Methane and halomethane fluxes in the northern Alaskan coastal tundra: influence of microtopography, soil redox conditions and temperature. iLEAPS (Integrated Land Ecosystem-Atmospheric Processes Study) Science Conference abstract, Boulder CO.

Rhew, R.C., Y.A. Teh, and T.A. Abel. (2007), Halomethane and methane fluxes in the northern Alaskan coastal tundra, Journal of Geophysical Research – Biogeosciences (in press).

Teh, Y.A., R.C. Rhew, and T. Abel. (2005), Methane and carbon dioxide emissions from northern coastal Arctic ecosystems, Berkeley Atmospheric Sciences Center symposium, Berkeley, CA.

FAUNAL POPULATIONS

Project Title: Physiology of Non-hibernating Rodents

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UUA-based personnel: Kalb Stevenson and April Brennan (graduate students);Willow Malick, Tammy Choromanksi, Anastazya Lencz, Caitlin Granier (undergraduates)

Brief Activity Report

The PI and field assistant (Patricia Johnston) visited Barrow briefly in August. We stayed for three days trapping lemmings under the boardwalks on the Biocomplexity site. The lemmings were tranpsorted back to Anchorage so that we can compare their reproductive and body conditions to those of voles from the same period. These results will be used as part of our NSF-funded study on winter physiology of non-hibernating rodents and will also be used as preliminary data for an NSF application to fund research specifically on lemmings in Barrow. The students associated with the project worked on the analysis of samples taken in previous seasons. These results were integrated into the publications list below.

While in Barrow, Dr. van Tets, as program director of premedical summer programs for high school students at UAA, gave a Saturday schoolyard presentation on the opportunities available to Barrow high school students, especially Alaskan native students.

The project is part f the NSF's functional and regulatory systems cluster award to UAA ($300,000 for three years) for research on winter energetics and reproduction in small non-hibernating high latitude mammals. This research is focused on the northern red-backed vole (a common species in Anchorage and Fairbanks), but preliminary data from Barrow was used in the grant application.

Recent Publications and Prosentations

Brennan, A. and van Tets I.G. (in prep.) Seasonal changes in the diet of non-hibernating, high-latitude rodents.

Stevenson, K. and van Tets I.G. (in prep.) Dual-Energy X-Ray Absorptiometry (DXA) can accurately and non-destructively measure the body condition of small, free-living rodents.

Project Title: Breeding and Post-Breeding Shorebird Studies at Barrow, Alaska, 2006

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Funding: U.S. Fish and Wildlife Service, Max Planck Society, Coastal Marine Institute (UAF), and Mineral Management Service

Project Participants other than Project Leaders
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Dr. Falk Huettmann, Institute of Arctic Biology (UAF)
Deb Nigro, Bureau of Land Management (BLM)
Audrey Taylor and Nathan Coutsoubos, doctoral candidate (UAF)
Sonja Gaessler, Max Planck Institute for Ornithology, masters candidate
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Volunteers: Josh Boadway, Kelly Boadway, Dan Fontaine, Fabrice LeBouard

Task: Reproductive Ecology of Shorebirds: Studies at Barrow, Alaska, in 2006

We conducted the fourth year of a long-term shorebird study at Barrow, Alaska (71.29°N, 156.64°W). The objectives of this study are to (1) collect baseline data on arrival date, nest initiation and effort, clutch and egg size, and hatching success of arctic-breeding shorebirds, (2) to establish a marked population of as many shorebird species as possible that would allow us to estimate adult survival, mate and site fidelity, and natal philopatry, and (3) to relate weather, predator and prey abundances to shorebird productivity. Data on demographic parameters are vitally needed to understand why many shorebirds are declining.

We located and monitored nests in six 36-ha plots. All six plots are the same as those sampled in 2005. We used the same search intensity and methodology as in 2004 and 2005. The breeding density of all shorebird species on our study area was 52.1 nests/km^2 in 2003, 66.6 in 2004, 63.0 in 2005, and 150.5 in 2006 (overall average density across years was 83.0). The exceptionally high density of nests in 2006 far surpassed previous years. As in 2005, our ability to find nests was probably enhanced by a fox removal program that allowed many nests to survive through to hatching (see below), giving us more time to find the nests. While this may partially explain the high nest densities, it seems likely that the high shorebird numbers are somehow related to the extremely high lemming, Snowy Owl and jaeger numbers. Indeed, lemmings numbers were the highest documented since the early 1990s when Denver Holt and his crew began systematically trapping them on an annual basis.

We recorded the highest breeding density of the four most abundant shorebird species in the four years of our study. These included Red Phalarope (50.5 nests/km^2), Pectoral Sandpiper (48.2), Dunlin (17.6), and Semipalmated Sandpiper (8.3). We also had record densities of Long-billed Dowitchers (11.1), Buff-breasted Sandpipers (8.3), American Golden-plovers (2.8), and Red-necked Phalarope (3.2). A total of 325 nests were located on our plots and another 92 nests were found outside the plot boundaries. Nests on plots included 104 Pectoral Sandpiper, 109 Red Phalarope, 38 Dunlin, 18 Semipalmated Sandpiper, 24 Long-billed Dowitcher, 7 Red-necked Phalarope, 6 American Golden-plover, and 1 Baird's Sandpiper. For the first time since the beginning of this study, we located Buff-

breasted Sandpiper nests on the tundra plots (n=18). Western Sandpiper and White-rumped Sandpipers were not observed on our plots in 2006, and have only been documented nesting in 2004.

The first shorebird clutch was initiated on 3 June and the last on the 3 July (on or within 1 day for both dates in prior years). Peak initiation date was the 12 June and median initiation date was the 15 June; this is within 1-2 days of median dates in earlier years. Median nest initiation dates for the more abundant species were the 11 June for Dunlin, 12 June for Semipalmated Sandpipers, 15 June for Red Phalarope, and 16 June for Pectoral Sandpipers. This pattern is similar to prior years. Predators destroyed only 8.3% of the nests in 2006 compared to 11.2% in 2005, 67.9% in 2004, and 42.6% in 2003. Across the more abundant species, hatching success (# hatching at least one young/total number of nests) was highest in Pectoral Sandpipers (90.4%, N = 94), followed by Red Phalarope (86.6%, N = 103), Semipalmated Sandpipers (93.6%, N = 29), and Dunlin (85.7%, N = 42). These numbers are even higher than in 2005 when predator removal appeared to substantially increase nest success. Alternative food sources in the form of high lemming abundance may have further enhanced shorebird hatching success, although other factors may be involved. A comparison across study plots indicated that hatching success was greater than 90% in plots 2 and 3, greater than 80% in plots 5 and 6, and equaled 72.7% in plot 8.

We captured and color-marked 342 adults and 707 young. These numbers are about two times higher than 2005 captures and three times higher than 2003-2004 captures. Thirty adults (mostly Dunlin and Semipalmated Sandpipers) captured in 2006 had been banded in a prior year. Adults captured included 91 Dunlin, 72 Pectoral Sandpipers, 61 Semipalmated Sandpipers, 60 Red Phalarope, 29 Long-billed Dowitchers, 13 American Golden-plovers, 13 Buff-breasted Sandpipers, and one each of Baird's Sandpiper, Red-necked Phalarope and Western Sandpiper. We are confident that we could have captured more birds had we had additional personnel.

We continue to conduct ancillary studies as time allows at Barrow. Avian influenza studies were a prominent feature of our work in 2006 – all captured birds were swabbed to test for the highly pathogenic H5N1 avian influenza virus. Nathan Coutsoubos (UAF) completed the second year of his PhD studies investigating how the construction of a landfill and the experimental flooding/draining of a wetland influence shorebirds (see his report). We also placed radio transmitters on 18 individuals to help Audrey Taylor (PhD, UAF) document movements to postbreeding sites (see her report). Finally, we collected eggs from Dunlin and Red Phalaropes for the second year in a row as part of a collaborative project with Sarah Jamieson (PhD, Simon Fraser University) to investigate whether shorebirds use endogenous or exogenous resources to produce eggs.

Task: Behavioral Ecology of Pectoral Sandpipers

We continued our field study on the pectoral sandpipers in the same area as in 2005 (71.32 N, 156.66 W), but enlarged by 0.6 km^2 to a total surface of 2.6 km^2. We captured (using mistnets or nest-traps) 298 adult individuals (176 males and 119 females). Five males and one female were recaptures from 2005. Besides the standard morphometric measures, we also measured the thickness of the male throat sack using a modified skinfold calliper. All individuals were blood sampled and marked with a unique combination of colour bands. The colour bands allowed us to re-sight each individual present on the study area on a daily basis. For each re-sighting, the individual's GPS position and a few standardised behavioural measures were recorded. We found a total of 87 nests, most of them in the early incubation stage. Based on our previous successful experience, we collected all eggs and artificially incubated them. The overall hatching success (at least one hatched young per nest) was 85%, which is only 5 % lower than the natural hatching rate of this species recorded on an adjacent plot. However, our method reduced predation of clutches to zero, so that overall more offspring were born in the study area. Within a few hours after hatching each chick was measured and weighed and a small blood sample was collected. All hatched chicks were brought back to the incubating female and in all cases they were accepted immediately.

Task: Pre-migratory Movements and Physiology of Shorebirds Staging on Alaska's North Slope

Little information exists to quantify pre-migratory shorebird distribution across Alaska's North Slope or what factors may influence site selection, movement patterns, or residency times. This information is

critical given increased levels of human activity and development near littoral areas across the Arctic Coast. This project was initiated to gain a better understanding of the abundance, distribution, phenology, movements, and physiology of post-breeding shorebirds during the staging period, and to aid in assessing how future industrial and human activity across the North Slope may affect shorebird populations. The specific objectives for this research are (1) to assess the abundance, distribution, and species composition of shorebirds staging along North Slope coastlines prior to the fall migration, (2) to quantify phenological aspects of staging, such as timing of arrival after breeding for adult and hatch-year birds, overall and species-specific peaks in shorebird numbers, residency times at staging sites, and movement patterns of birds across the North Slope, and (3) to examine differences in measures of physiological condition (fattening rates and stress hormone concentrations) among species and sites.

We conducted four, fixed-wing aerial surveys designed to count staging shorebirds along the entire North Slope coastline from the southern end of Kasegaluk Lagoon (69.28490°N, 163.27091°W) to the eastern border of the Arctic National Wildlife Refuge (69.66046°N, 141.06690°W). Several locations that appeared to be hotspots of shorebird abundance in 2005 also hosted large numbers of staging shorebirds in 2006: Peard Bay, the southeast shoreline of Elson Lagoon, and the east side of Dease Inlet. In addition, phalaropes of both species appeared to use the barrier islands in the Beaufort Sea extensively. Semipalmated sandpipers were the most common species at all field camps again; individuals of this species also exhibited the highest fattening rates and departed from the North Slope earlier than the other species studied. Radio-equipped semipalmated sandpipers tended to move north along the Chukchi coast and east along the Beaufort coast after departing from their banding location. This is similar to the pattern observed in 2005 and leads us to believe that birds may use multiple sites along the North Slope as staging sites, or at least as temporary resting/refueling stopovers. Dunlin appeared at coastal staging areas in mid to late August, and exhibited lower rates of fat deposition and longer LOS at individual sites than other terrestrially-feeding species. We are currently investigating whether dunlin molting concurrent with pre-migratory fattening affects their rate of fat deposition, and is regulated by stress hormone (corticosterone) levels. Data entry and analysis is ongoing and is expected to comprise the majority of the upcoming year.

Task: Tundra-Nesting Shorebirds in Relation to Landscape Transformation and Climate Change

In June and July 2006, we carried out the second year of a dissertation research program on tundra-nesting shorebirds in relation to ongoing local-scale landscape transformation and climate change. Work was conducted 5-12 km south of Barrow and involved studies at a recently constructed landfill and at a water-level manipulated wetland.

The North Slope Borough began constructing a new, modern landfill during the winter of 2004/2005. Construction will be completed this winter and waste transfer will start in late 2006. This construction project provides an ideal opportunity to determine how local birds respond to a landfill prior to and during landfill use. Ten transects (8.5 km total) were established near the landfill (stratified by distance and direction). Distance sampling surveys were conducted along these transects weekly during the territory establishment, nest initiation and incubation periods of the breeding cycle, for a total of 5 surveys per transect. Individual avian detections (single or clusters) numbered 1890 from 28 species, including 1133 shorebird detections of nine species. The most common shorebirds (unadjusted counts) were Pectoral Sandpiper (n=475 detections), Red Phalarope (n=333), and Dunlin (n=160). This and similar information collected in succeeding years will allow us to assess changes in shorebird distribution and abundance as the landfill grows. We also measured parental attendance at 12 shorebird nests located in and near the landfill, using within-nest temperature probes. This information may provide mechanistic evidence of how landfill disturbance affects nesting shorebirds.

Additionally, we carried out surveys in a 60-ha wetland, whose water levels will be manipulated over the next several years, to mimic the predicted effects of global climate change on tundra hydrology (Biocomplexity Project). Surveys were conducted twice weekly on three separate 300m transects during shorebird nesting. A total of 392 avian detections were recorded belonging to 24 species, including 291 shorebird detections of 7 species. The most common shorebirds (unadjusted counts) were Red Phalarope

(n=94 detections), Pectoral Sandpiper (n=56), and Long-billed Dowitcher (n=38). Shorebird surveys will continue as the local hydrology is manipulated, providing experimental evidence of the local effects of a warming climate and altered hydrology on shorebirds.

Recent Publications and Presentations

Peer Reviewed Publications

Johnson, J., R.B. Lanctot, B. Andres, J. Bart, S. Brown, S. Kendall, and D. Payer. (in review) Distribution of shorebirds breeding on the Arctic Coastal Plain of Alaska. Arctic.

Liebezeit, J.R., P.A. Smith, R.B. Lanctot, C. Gratto-Trevor, H. Schekkerman, D. Tracy, J.A. R. Robinson, H. Meltofte, S. Kendall, R.J. Rodrigues, J.A. Morse, and B.J. McCaffery. (in press) Determining incubation stage of shorebird eggs using the flotation method: species-specific and generalized regression models. Condor.

Steiger, S.S., Goymann, W., Kempenaers, B. 2006. Plasma steroid hormones in two Arctic-breeding shorebirds: Monogamy versus polygyny. General and Comparative Endocrinology 147 (2):133-140.

Non-peer reviewed Publications

Lanctot, R.B. 2005. Connecting breeding and nonbreeding regions of Beringian Dunlin. Article in website: http://www.wetlands.org/IWC/awc/waterbirdstrategy/News.htm

Norwood, G. 2006. A "Chinese" Dunlin in Barrow! Alaska Reflections 18:7-9.

Taylor, A.R., A.N. Powell and R.B. Lanctot. (in press). Pre-migratory movements and physiology of shorebirds staging on Alaska's North Slope. OCS Study MMS 2006, Annual Report No. 11, Federal Fiscal Year 2006.

Oral Conference Presentations

Coelho Naves, L., R.B. Lanctot, A. Taylor and N. Coutsoubos. 2006. Do Arctic shorebirds lay replacement clutches? Assessment and ramification to monitoring. 12th Annual Alaska Shorebird Group Meeting, Anchorage, Alaska. 2006.

Coutsoubos, R.B., F. Huettmann, and R.B. Lanctot. 2006. Shorebirds in the urban Arctic: diversity and abundancein and around the new landfill in Barrow, Alaska. 12th Annual Alaska Shorebird Group Meeting, Anchorage, Alaska. 2006.

Johnson, J., R.B. Lanctot, B. Andres, J. Bart, SC. Brown, S. Kendall, and D. Payer. 2006. Distribution of breeding shorebirds on the Arctic Coastal Plain of Alaska. Shorebird Science in the Western Hemisphere, Boulder, Colorado.

Lanctot, R.B. 2006. Present and future shorebird research in Alaska. 10th Western Sandpiper Workshop, Vancouver, British Columbia.

Lanctot, R.B. 2006. Shorebird Research on Alaska's North Slope and the Circumpolar Arctic. 80th Annual U.S. Arctic Research Commission Meeting, Barrow, Alaska.

Lanctot, R.B. 2006. Avian influenza and other studies on the North Slope of Alaska in 2006. North Slope Borough Fish and Game Management Committee Meeting. Barrow, Alaska

Lanctot, R.B., L. Coelho Naves, A. Taylor, and N. Coutsoubos. 2006. Do Arctic shorebirds lay replacement clutches? Assessment and Ramifications. 10th Western Sandpiper Workshop, Vancouver, British Columbia. 2006.

Liebezeit, J., P. Smith, R.B. Lanctot, H. Schekkerman, I. Tulp, S. Kendall, D. Tracy, R. Rodrigues, H. Meltofte, J. Robinson, C. Gratto-Trevor, B. McCaffery, J. Morse, and S. Zack. 2006. Assessing the development of shorebird eggs using the flotation method: species-specific and generalized regression models. 11th Alaska Bird Conference, Juneau, Alaska.

Steiger, S.S., Goymann, W., Kempenaers, B. 2006. Plasma steroid hormones in two Arctic-breeding shorebirds: Monogamy versus polygyny. General and Comparative Endocrinology 147 (2):133-140.

Taylor, A.R. 2006. Staging shorebirds on Alaska's North Slope. Northern Field Office, Bureau of Land Management, Fairbanks, Alaska.

Taylor, A.R. 2006. Staging shorebirds on Alaska's North Slope. Arctic National Wildlife Refuge and Fairbanks Fish and Wildlife Office, US Fish and Wildlife Service, Fairbanks, Alaska.

Taylor, A.R., R.B. Lanctot, A.N Powell, and T.D. Williams. 2006. Should I stay or should I go now: the importance of staging sites on Alaska's North Slope. Shorebird Science in the Western Hemisphere Conference, Boulder, Colorado.
Taylor, A.R., R.B. Lanctot, A.N Powell, and T.D. Williams. 2006. Should I stay or should I go now: physiology and behavior of staging shorebirds on the North Slope. Alaska Cooperative Fish and Wildlife Research Unit Annual Cooperator's Meeting, Fairbanks, Alaska.
Taylor, A., R.B. Lanctot, and A. Powell. 2006. Staging shorebirds on Alaska's North Slope: Version 2006 Update. 12th Annual Alaska Shorebird Group Meeting, Anchorage, Alaska.
Taylor, A.R., A.N. Powell, and R.B. Lanctot. 2006. Staging shorebirds on Alaska's North Slope: results from intensive camps and an extensive survey. Coastal Marine Institute Annual Research Review, Fairbanks, Alaska.

Project Title: Steller's Eider Breeding Biology Studies at Barrow, Alaska

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Volunteers: Carlo Acuna, Rebecca DeKay, Dean Kildaw, Gerald Krausse, Kathryn Peiman, Katie Weber, Adele Young
Others: Jewel Bennett, Ted Swem, Neesha Wendling, USFWS, Fairbanks Fish and Wildlife Field Office; Sonja Jahrsdoerfer, USFWS, Alaska Regional Office, Anchorage; Heidi Cline, Tasha DiMarzio, Alaska SeaLife Center; Arnold Schouten, Dry Creek Waterfowl

Brief Activity Report

Steller's eider monitoring is conducted on the BEO, as well as on UIC land within approximately 3 km of the Barrow road system. Road surveys for Steller's eiders were conducted from 1-11 June 2006. Annual ground-based breeding pair survey for Steller's eiders, spectacled eiders, and predators was conducted from 12-21 June and nest searches for Steller's eiders were conducted from 25 June–14 July. A total of 110 Steller's eiders were counted on the survey, 18 (9 pairs) on the BEO. Sixteen nests were found; one of these on the BEO was successful. Overall nest success was 74% (highest recorded since monitoring began in 1991) and four hens were documented to fledge ducklings.

Other projects conducted this year included: digital camera monitoring of nests to identify predators and determine causes of nest failure; an artificial egg incubation project conducted jointly with the Alaska SeaLife Center (ASLC); and egg collection conducted by the ASLC to enhance the captive breeding flock at the ASLC .

Recent Publications and Presentations

Rojek, N. A. 2007. Breeding biology of Steller's eiders nesting near Barrow, Alaska, 2006. U.S. Fish and Wildlife Service, Fairbanks Fish and Wildlife Field Office, Fairbanks, Alaska. Technical Report. 53 pp.

Rojek, N. A. 2007. Update on Barrow Steller's Eider Projects. Presentation to the Steller's Eider Recovery Team, Seward, Alaska. 30 January 2007.
Rojek, N. A. 2006. Update on Barrow Steller's Eider Projects. Presentation to the Steller's Eider Recovery Team, Seward, Alaska. 10 January 2006.
Rojek, N. A. 2006. Breeding biology of Steller's eiders nesting near Barrow, Alaska, 2005. U.S. Fish and Wildlife Service, Fairbanks Fish and Wildlife Field Office, Fairbanks, Alaska. Technical Report. 53 pp.
Rojek, N. A., T. Hollmen, T. Swem, and C. L. Rossi. 2006. Conservation of the threatened Steller's eider near Barrow, Alaska: Can management actions promote recovery of this episodic breeder? Pacific Seabird Group Meeting, Girdwood, Alaska. 15 - 19 February 2006. (presentation).
Rojek, N., P. Martin, and R. Goerke. 2006. Video monitoring to determine nest fate of Steller's eiders in Northern Alaska. Final unpublished report to the Alaska SeaLife Center. 21 pp.

Project Title: Breeding Ecology of Snowy Owl

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Brief Activity Report

We completed our 15th season researching Snowy Owls and lemmings in 2006 in Barrow. The increase in Brown Lemmings during the summer and fall of 2005 resulted in the most productive year ever for Snowy Owls in Barrow, in 2006. Our research team located 37 nests of which 35 pairs produced at least one fledgling. Clutch sized ranged from 3-10 eggs, with several nests having 7, 8 and 9 egg clutches. Remarkably, one female laid nine eggs, and the pair raised nine chicks to fledging.

In the 2005 newsletter we reported on the killing of Snowy Owls at our study site in Barrow in 2003. Alaska allows the killing of Snowy Owls as a subsistence animal for any resident. At a nest in 2006 a male was shot in the back of the head and his left foot cut-off. He was found about 70 yards from the nest. Lacking male help in provisioning food, the widowed female was forced to hunt, in addition to nurturing her 6 dependent young. Although a difficult task she was able to provide enough food and protection to raise one chick, that successfully fledged. That was our only confirmed shooting incident in 2006.

Also stated in the 2005 newsletter. The United States Government Migratory Bird Treaty Act does not allow the killing of Snowy Owls. Alaska is the only place in the United Sated where Snowy Owls breed, and Barrow is the only reliable place of breeding in Alaska. Since then, efforts have been made to curtail the killings in Barrow, and combined efforts between the native Inupiat people of Barrow, the Alaska Fish and Game, Alaska's US Fish and Wildlife Service and Defenders of Wildlife from Washington, DC and Alaska, seem to be working.

Now in its 15th year, our small mammal trap index and the number of owl nests indicated that lemming populations in Barrow were probably at a peak. After low populations in the past four years, lemmings began their comeback in June of 2005 and by fall 2005, we recorded the highest numbers of lemmings

ever in our trap lines. The numbers remained high throughout the winter 2005/2006 and by spring 2006 lemmings were everywhere, resulting in a big year for lemmings and Snowy Owls.

Two species of lemmings occur in the Barrow area, the Collared Lemming and the Brown Lemming. However, it is the population fluctuations of the Brown Lemming that drive the Snowy Owl breeding ecology there. Both species of lemmings were caught in significant numbers in 2005 and 2006.

The Barrow Arctic Research Consortium deserves a special thanks for cooperation on our Snowy Owl project. The BASC logistical staff provided the means to help us access the tundra over our 100 square mile study area.

Recent Publications and Presentations

The Roost, November 2006, Volume 10, Number 1. Newsletter of the Owl Research Institute (ORI) and the Ninepipes Center for Wildlife Research& Education (NCWRE), 16.pp.

DATABASE SUPPORT

Project Title: Maintenance, Development and Innovation of the Barrow Area Information Database and Internet Map Server *(BAID-IMS ~ www.baidims.org)*

Project Leader(s):
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Brief Activity Report

BAID-IMS is a user-friendly web-based science, logistic and educational informational portal that allows users to access, view and interact with a wide range of spatial data and remotely sensed imagery focused on the Barrow area in northern most Alaska. The area of interest for BAID-IMS spans 280,000 km^2 and extends from 100km offshore and north of the city of Barrow, east to Deadhorse, west to the native village of Point Lay and south to the Brooks Range and the village of Anaktuvuk Pass. The application encompasses over 100 data layers in total and includes a range of air-borne and satellite imagery as well as thematic data. Thematic data includes USGS topographic maps, administrative boundaries, infrastructure such as roads, power lines, and native subsistence cabins, nearly 4000 active and historic research sites, vegetation, topographic and hydrographic maps, and distribution/sensitivity maps for select fauna. Users can employ standard Geographic Information System (GIS) tools to zoom, pan, measure distance, identify waypoints for uploading into Global Positioning Systems (GPS), query a range of attribute data layers and make and print their own maps. Federal Geographic Data Committee (FGDC) standard metadata has been compiled for most data layers and provides links to data centers where users can obtain copies of BAID-IMS data for more advanced analysis. A help guide is provided for all tools in the application.

During early June, UNAVCO (http://www.unavco.org/) trained Aguirre and other students of UTEP's SEL in the use of Differential Global Positioning Systems (DGPS). Real time DGPS equipment is available at BASC and is supported by UNAVCO. Working with Gaylord and Tweedie to liaise with present and past researchers, Aguirre, acquired approximately 700 DGPS locations of research sites, infrastructure and instrumentation near Barrow, Atqasuk and Ivotuk. These sites have been added to BAID-IMS. Additional map layers will be included for the 2007 field season including the Oechel et al. Biocomplexity experiment. Gaylord, through the Alaska Satellite Facility, continued to acquire near real-time images of sea ice in the Barrow area. Gaylord trained two UTEP graduate students on the methods for processing and posting these data to BAID-IMS. In addition, one of UTEP's graduate students attended a summer class on SAR Methods in Fairbanks. Image acquisitions span February to October and include over 100 images for the season. Gaylord also provided extensive training and support for

ArcGIS and the development of FGDC metadata to further the collection and processing of field data and remotely sensed imagery. The prototype server on which BAID-IMS resides at UTEP will be upgraded to high performance Dell Blade server system in 2007. BAID-IMS is now accessed through an Internet2 connection to provide maximal speed and performance. Ideas for future development are welcomed to enhance the development of this application.

Recent Publications and Presetations

See updates to www.baidims.org <http://www.baidims.org>

Aguirre, A., Gaylord, A,, Brown, J. Tweedie, C. 2006. Continuous monitoring of coastal erosion in the Inupiat Eskimo village of Barrow Alaska using high precision Differential Global Positioning System (DGPS). Poster presentation. Fall Meeting, American Geophysical Union, San Francisco.

Aguirre, A., Gaylord, A, Brown, J. Tweedie, C. 2005. High precision monitoring of coastal erosion in the Inupiat Eskimo village of Barrow, Alaska. Poster presentation. Society for Advancement of Chicanos and Native Americans in Science (SACNAS) Annual Conference, Denver Colorado, September 29 – October 2.

Tweedie, C., Gaylord, A, Zaks, D., Serbin, S., Sadak, M., Aguirre, A., (in review). The Barrow Area Information Database – Internet Map Server (BAID-IMS): A Web-based Geographic Information System for Science, Management, Education and Outreach in Northern Alaska. *Polar Record.* Cambridge University Press..

OUTREACH

Project Title: Arctic LTER Project: Schoolyard

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Personnel in addition to Project Leaders
Jill Exe (Hopson Middle School Teacher, BASC Outreach Coordinator)

Brief Activity Report

The national Schoolyard project is an outgrowth of the NSF program Long-term Ecological Research (LTER). The Barrow-based Schoolyard project is supported by the Arctic LTER based at Toolik Lake and consists of the Saturday afternoon public seminars that are held at the UIC Science Center and student conducted projects on the BEO. Jill Exe, Hopson Middle School Teacher and Glenn Sheehan (basc@arcticscience.org) and the BASC staff organize the seminars. Jill Exe is the Barrow school system coordinator. A report by Craig George and Ann Jensen was published in the jsournal Arctic that describes the on-going program: *Science Lectures in the Arctic's "Science City," Barrow, Alaska, Arctic, 2004, 57:1:110-111.*
During 2006 there were 41 Saturday afternoon presentations; see BASC web for more information on individual presentations.

Titles of 2006 Saturday Schoolyard Presentations

- Commercial Fishing in Southeast Alaska
- Diabetes, What Can We Learn and Do About It?
- Growing up Then and Now: Stories from a Whaler.
- Figuring out How Dinosaurs Lived in the Arctic 70 Millions Years Ago.
- Frostbite Practical Implications
- BHS Kids Discuss Eider Journey
- Winter Movements of Arctic Fox using Satellite Telemetry
- Teachers as Learners to Benefit Students
- Invertebrate Life Cycles Associated with Arctic Sea Ice
- So You Want to be a Doctor?
- Listen to the Stories
- Bird Flu: Alaska at the Crossroads
- Friends or Family?
- Recent Developments on the Barrow Environmental Observatory
- Barrow Bird Camp 2005
- Salinity of Water: HMS Science Fair Project
- Grand Opening of the National Museum of American Indian

- The Marine Food Web and the Phenomenal Importance of Algae
- Living and Working in the Antarctic
- King Eider Research on Alaska's North Slope
- Aquatic Insects in Tundra Ponds
- Climate Change: From Barrow to Costa Rica
- National Petroleum Reserve
- Bridging the Gap and Coastal Vunerability
- Science, Luck, and Politics
- Radioactivity in the Lower Trophic Levels of the Arctic
- The Brown Lemming, A Keystone Species
- Breeding Ecology of Snowy Owls
- Health, Science, and Technology Camp
- Bioprospecting: A Strategy for Conservation and Sustainable Economic Development for the Eastern Band of Cherokee Indians
- Summer Programs in Nursing, Medicine and Medical Research at UAA
- Learning from the Past: The Archeaology of Nuvuk
- Alutiiq Masks from Kodiak
- After the Whale is Caught
- Alaska Mexico Exchange
- Polar-Palooza: A National Education & Outreach Project for International Year
- The Influence of Traditional Knowledge in Marine Mammals Management
- The Great Alaskan Gray Whale Rescue of October 1988 - Revisited
- Guiding Lights: Maori Astrology
- ICOMOS IPHC - Polar Heritage Facing Climate Change Challenges
- Sharing What We Know About Bowheads: HMS Students

Tundra Warming Project

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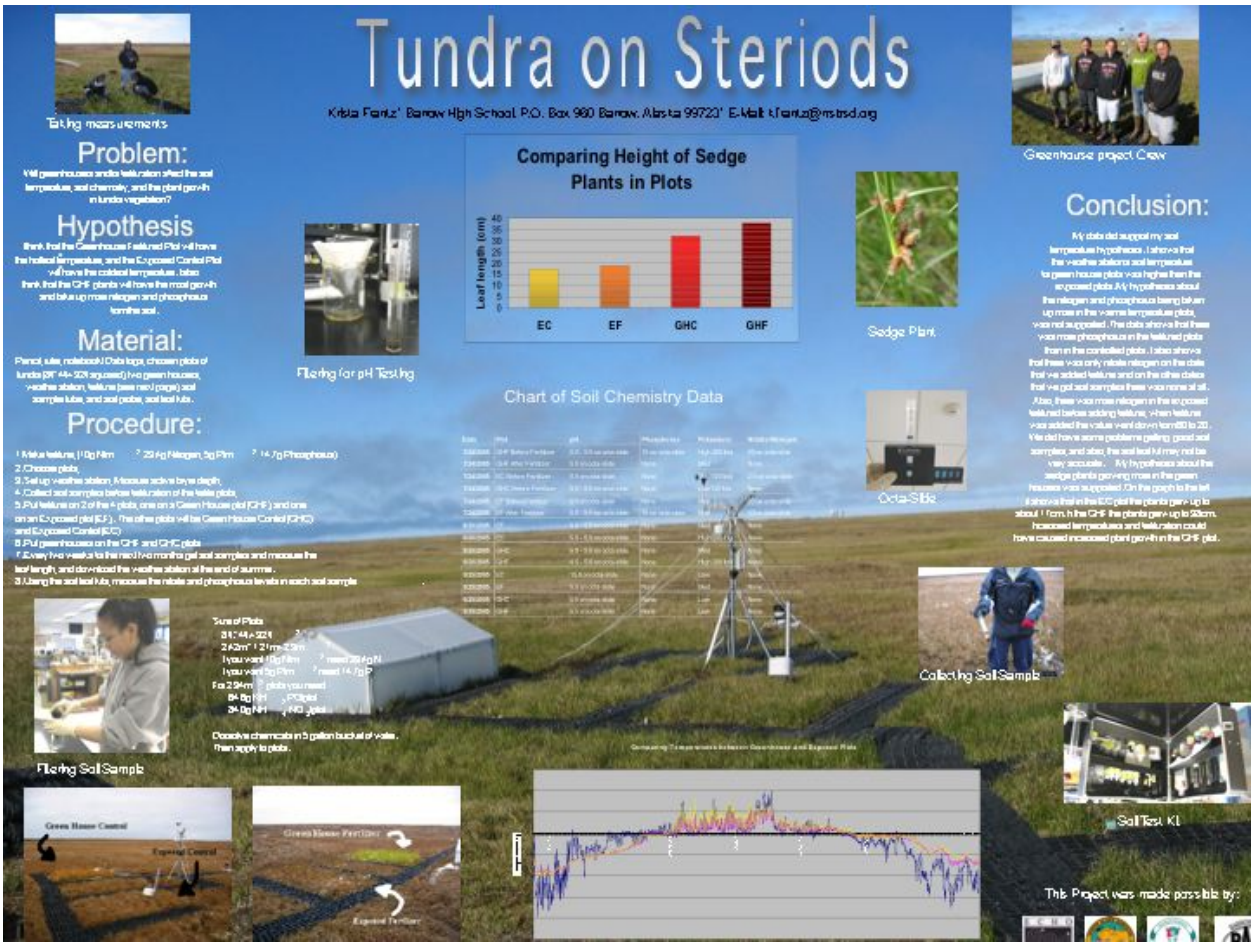
Robert Suydam (NSB-DWM), Mike Bradbury and Melinda Dorin (summer visitors), Ray and Steve Reichert (summer visitors), plus Krista Frantz, Selma Khan, Tim Barr, M J Roseberry, Megan Edwardsen (see front cover for other participants in the Mexico-Barrow project).

Brief Activity Report

For the fifth consecutive year the tundra warming-nutrient experiment was deployed by high school science students under the supervision of the science teacher, Leslie Pierce. Weather station data was collected continuously, for soil and ground air temperatures, ambient air temperature, relative humidity, wind speed, PAR light, precipitation. Data is collected on active depth layer, sedge height, and coltsfoot leaves width and length. The greenhouses were put out on the site on June 14, 2006, with the help of Robert Suydam (NSB-DWM) and Mike Bradbury and Melinda Dorin. The weather station was downloaded and new batteries installed. The site was totally clear of snow at this time. The GHF and EF plots were fertilized with the Hoagland formula on June 28, 2006, with the help of Ray and Steve

Reichert. Data collection was hampered this summer due to students being heavily involved with other projects. However, students and teachers involved in the Mexico-Barrow exchange whom are studying Global Climate Change visited the site on August 27, 2006, to learn about the project, and help collect data. Teachers and coordinators from Mexico were so impressed with the project that they are interested in setting up a similar project in their study sites in Mexico.

Krista Frantz and Julieanna Williams entered their greenhouse project, *Tundra on Steroids*, at the Barrow High School Science Fair last February. The project was based on two summers (2004 and 2005) of data collection on their part. They won an Honorable Mention for their efforts. Krista was able to continue data analysis on the project and in May bring posters to the Bishop Museum in Honolulu and the Southwest Marine Fisheries Center in San Diego (see below).



Cake Eater Lake Project

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Brief Activity Report

The Cake Eater Lake is an ideal location for Schoolyard projects. To facilitate future use of the lake, a small dock was installed on the west side of the lake with the assistance of UICC and BASC. A temperature logger was installed at the end of the dock in the upper water column and in the bottom sediments under 4 feet of water by Yoshikawa and Brown. Members of the CALM project downloaded the logger several times during the summer (Streletskiy, Shiklomanov. and Klene). Adrian Aguirre read water level several time during the summer.

A waterproof data logger was installed during the early winter in the Cake Eater Lake (CEL) bottom sediments by Tim Buckley. Unfrozen organic-rich sediments, under four feet of ice, were discovered in May 2004 by the High School science class. Based on the temperatures downloaded in early May 2006, the near-surface sediments again remained unfrozen beneath 4.5 feet of ice. To verify bottom freezing of other shallow lakes, Yoshikawa augered West Twin Lake (WTL). It had a two feet water under 5.4 feet of ice. We had assumed WTL was more shallow and froze to the bottom each year.

Rhew's University of California-Berkeley project, initiated a study in July of methane flux from the schoolyard CEL; a project that will encourage future local student involvement.

The Cake Eater Lake was designated a location for the Alaska Lake Ice and Snow Observatory Network (ALISON) http://www.gi.alaska.edu/alison/. High School students, under the direction of Tim Buckley will begin making observations on CEL in addition to those on Imikpuk Lake.

Dock on Cake Eater Lake installed in May 2006. A data logger is installed at the end of the dock in the upper water column and bottom sediments. The DGPS is seen positioned on the end of the dock *(photograph by Adrian Aguirre).*

APPENDICES

BEO Subcommittee Report: 2005 and 2006 Recommendations

April 24, 2006 Meeting

The BEO Subcommittee met at UIC-NARL on April 24, 2006. Detailed summaries of the meeting and the list of participants in the morning and afternoon sessions are available separately. The purpose of the following is to present and discuss recommendations to the BASC SMAC and Board resulting from the day-long discussions. The 2005 recommendations were reviewed and the status of each were discussed (see attachment). It is noted that the 2005 "Welcome to the BEO" handout to all BEO users was revised and that a supply of it and the 2005 Annual Report is available in the Station Manager's office and will be distributed with the UIC permit.

1. The concept of BEO "affiliates" was introduced by Tom Albert. Affiliates would comprise research areas adjacent to the BEO and include the lagoon, the Beaufort and Chukchi seas, and adjacent terrestrial sites. Although the BEO is successful and is locally known, it is not that well recognized outside Barrow. A broader approach to research potentials would be provided by the Affilates, however, in contrast to the BEO, there would be no additional protections or limitations placed on the Affiliates for use by local individuals or groups. The advantage to such an approach would be to further develop Barrow as a "Region of Scientific Interest" and thus attract more sustainable opportunities for research and the development of infrastructure, particularly in conjunction with the new research facility.

The BEO SC recommends that the concept of BEO affiliates be developed jointly with the BASC advisory groups (SAG, SMAC, DWG) and other potential users, and that a report developing a plan for the Affiliates be prepared by the end of 2006.

2. Bob Bulger briefed on the recent and planned Information Technology (IT) activities. The BEO SC was invited to provide input on the locations of the proposed towers that will be employed to provide wireless support to the Barrow region and southward. It was noted that an IT proposal to NSF is required for the planned development of these requirements, and that the BEO SC supports the need that the Digital Working Group play a role in proposal development. The timing of the move of IT from the current location to the new facility was discussed; there was agreement major changes in IT support not occur during the peak summer 2007 activities.

The BEO SC recommends that it be consulted on plans for IT developments related to and within the BEO, and that the transition to the new facility be scheduled so not to interfere with peak summer2007 research. The need for wireless communications throughout the BEO and adjacent areas remains as a high priority.

Other recommendations and concerns:

1. The BEO SC noted that the BASC Board had not met in 2006 and therefore the final list of 2005 prioritized recommendations had not been officially acted upon. The BEO SC encourages the SMAC and BASC to urge the Board to meet and consider the advisory groups recommendations.
2. The need for more information about BASC and the BEO was noted, particularly in conjunction with press activities and operational procedures. The BEO SC encourages the development of a single "Welcoming" document that can be handed out to all visitors and researchers and that is available for the opening of the new facility.
3. Planning for the International Polar

Barrow Environmental Observatory Subcommittee 2005 Meetings

The Barrow Environmental Observatory Subcommittee (BEO SC) met twice at Barrow on March 21 and August 12, 2005. Major agenda items for these meetings included:

1. Review and approval of the 2004 BEO Annual Report
2. Development of guidelines for use of the BEO
3. Permitting
4. Update of current BASC activities (including LHF)
5. Infrastructure developments on the BEO
6. Recommendations

1. At the March meeting the 45-page BEO 2004 Annual Report was reviewed and subsequently approved by the BASC Board. Copies were distributed electronically to all PIs with paper copies available at BASC for distribution to investigators and visitors and for posting on the BASC web. Most PIs were responsive to the request for input to the annual report (see template at end of report). It was decided at the August meeting that a similar request would be distributed by BASC in September and a draft compilation prepared for review and completion late in the year. Those investigators not submitting reports could be denied permits for 2006 access.

2. Draft guidelines for the use of the BEO were prepared, reviewed and distributed (see appendix). BASC Logistics was requested to provide a packet of BEO information to newly arrived researchers and to ask each to sign a form acknowledging the guidelines (form and contents of packet attached). Investigators are to be reminded not to use four-wheelers on the tundra during summer. Since the information contained in the handouts is of interest to other visitors, copies could to be made available at UIC and Borough permitting offices.

3. The process of consultation for endangered Steller's Eiders is still under review. The NSF –USFWS document CB 01-02 March 2002 is still considered draft. A plan was developed and implemented for the summer 2005 Biocomplexity surveys. Since FWS, DWM and BASC personnel are available at Barrow throughout the nesting season, it is appropriate for personnel to notify one or all of these to be contacted upon a sighting. There were two failed Eiders nests in the southern portion of the BEO in summer 2005.

4. Difficulties were encountered in use of the Logistics Help Form (LHF) and modifications will be available for Fall 2005 implementation. These changes should enable a variety of automatic reporting and tracking. Mapping capabilities have been requested.

5. Once the final Biocomplexity Projects plans were available in early 2005, BASC facilitated the submission and approval process for the Federal permits that were required. Protective trails, walkways for the tram instrumentation, generator power, and several small instrument buildings were installed on the BE drained-lake basin during the spring. This was largely a joint effort between VECO, UICC, and BASC. Since a power line was not feasible for summer 2005, a portable electric generator option was successfully developed. The BEO SC requested that non shareholders involved in construction complete LHFs and that all individuals abide by the same guidelines and procedure as researchers. A summary of BE infrastructure installation will be included in the 2005 Annual Report.

A request for a web cam at the Cake Eater Road Schoolyard projects is under consideration, as is a request by investigators to place a small building at the CE entrance for storage, shelter, emergency use and other field needs. A short, elevated walkway onto the Cake Eater Lake is needed for sampling by the Schoolyard and other projects. For 2006, a site was selected on Central Marsh Creek that would connect the BE and Central Marsh with a small footbridge (approximate 25-foot crossing).

6. The BASC Science Management Advisory Committee requested that its committees develop prioritized recommendations (see below).

7. The BEO Subcommittee was formally organized during 2004. Current members are

Jerry Brown, Chair
Bart Ahsogeak, UIC
Robert Suydam, NSB DWM; Brian Person (alternate)
Nora Rojek, Fish and Wildlife Service, Fairbanks; Rick Lanctot, FWS Anchorage (alternate)
Audrey Taylor, UAF (Graduate Student)
BASC Liaison Members
Science Management Advisory Committee, Bernie Zak, Chair
Digital Subcommittee Craig Tweedie. University of Texas at El Paso; Allison G. Gaylord (alternate)
Science Advisory Group, Craig Tweedie, Chair for balance of 2005; Bernie Coakley, starting 2006.
BASC, Glenn Sheehan, Executive Director

The BEO Subcommittee produced the first annual report (2004) of activities on the BEO (see BASC web site for a copy). The following project template is to be used for future annual reports.

BEO Subcommittee Recommendations (August 23, 2005)

High Priority

1. That BASC implement an annual project reporting procedure for users of the BEO, and prepare an annual BEO report.
2. That BASC identify a point of contact for the BEO, preferably a logistics person, and who is familiar with the Biocomplexity Project, and that the summer policy of no four-wheelers on the BEO be enforced.
3. BASC provide the Chair BEO SC with a periodic summary of Logistic Help Form (LHF) information that pertains to the BEO. A functioning LHF needs to be in place for 2006 projects including a BAID-based map for location of existing and new sites.
4. That an available wanigan-type building be installed on blocks adjacent to the Cake Eater pullout and located on BEO land for use by field personnel, winter shelter, and equipment storage.
5. That funding for infrastructure, staffing and travel for the BEO SC be discussed with the BEO SC and SMAC chairs and identified in the annual BASC budget.
6. That future teleconferencing for Biocomplexity Project operational planning by scientists and VECO include a representative from BASC, and that BASC keep BEO SC informed of related major activities.

Moderate Priority

1. That BASC install a web cam in the vicinity of the Cake Eater pullout to the BEO in support of local outreach and national and international Schoolyard activities.
2. That BASC arrange for installation of at least one footbridge across Central Marsh Slough to connect the ITEX-ARCSS area with the Cake Eater Road/BE project area (site selected in August 2005).
3. That BASC oversee the maintenance of the Cake Eater pullout including the BEO information sign and replenishing a supply of BEO brochures.
4. That BASC-BEO SC continue to update the guidelines for the use of the BEO and that BEO users agree to conform to the guidelines prior to receipt of the UIC permit. This includes submitting an annual user report.
5. That UIC Real Estate request that the NSB zoning map be updated to include the BEO Scientific Research District (SRD).

Welcome to the Barrow Environmental Observatory (BEO)

The Barrow Environmental Observatory (BEO), 7,466 acres of arctic tundra near Barrow, Alaska, was permanently set aside for research in 1992 by the Ukpeagvik Iñupiat Corporation (UIC – the Barrow Village Corporation). The Barrow Arctic Science Consortium (BASC), a nonprofit organization dedicated to scientist/community collaboration, was asked by the National Science Foundation (NSF) to manage the BEO for scientific research and the landowner UIC designated BASC to manage the BEO. Through a series of Cooperative Agreements with BASC, the NSF Office of Polar Programs has supported planning and management of the BEO.

On July 1, 2003 the North Slope Borough Assembly adopted NSB Ordinance Serial No. 75-6-40 that designates the BEO as a Scientific Research District (SRD). Under provisions of the SRD ordinance, the BEO Master Plan serves as the vehicle for a single, multiyear land-use permit. This simplifies the land-use permitting process, as individual projects normally will not be required to obtain NSB permits for research on the BEO. Equally important is the fact that the Master Plan provides for the logical and planned growth of services in and around the BEO.

Three major types of research will utilize the BEO Scientific Research District:

* Process and Experimentation
* Population Biology and Biodiversity
* Environmental Monitoring

Associated with the new procedures is the responsibility to ensure BASC compliance and to maintain related records of activities on the BEO. These records include mapping the locations of research activities. The following are activities and infrastructure developments included in the BASC BEO/SRD permitting:

- *Sampling*: soil, fauna, flora, water, sediment and shallow permafrost sampling; including placement of and removal of permanent or temporary stakes.
- *Installation of monitoring equipment*: towers for air sampling and weather observations, piles for instrumentation (cameras, video, etc.); shallow and deep boreholes for deployment of sensors; shallow burial of pipes, tubes and other instrumentation; below snow sampling devices; among others.
- *Experimental manipulations*: surface and water table modifications on plots to landscape scale; surface disturbance of vegetation and soils; construction and placement of semi-permanent objects including snow fences, chambers, enclosures, exclosures, etc.
- *Facilities*: placement of temporary buildings, shelters, foot bridges, and power lines; trenching and excavating to place equipment and related accessories including power lines with good practice and/or with zoning employed outside the BEO; development and deployment of permanent facilities; walkways and installation of wooden and artificial materials across sensitive terrain, and posting of signs and other markers.

Agreement to Accept the UIC Research Permit to Use the BEO

Pre-season Information

Name:

Project Name:

Position on project:

Institution or Organization:

Address:

Email:

Upon Arrival at BASC

Please initial the following before receiving the UIC land Use Permit

Date:

I have a copy and have or will read the BEO Guidelines for Use of the BEO: _____

I agree to submit the following information with the return of my UIC Permit (initial):

Dates on the BEO: _____

A map or DGPS locations of sites occupied: _____

Lists of samples taken with DGPS locations: _____

Instruments installed with DGPS locations: _____

Guidelines for Use of the Barrow Environmental Observatory (BEO)

The following is a list of requirements that each project and its personnel using the BEO are required to abide by:

1. An annual BASC Logistics Help Form (LHF) is required well in advance of your arrival that indicates activities that will take place on the BEO.

2. Upon arrival in Barrow each individual obtains an UIC Seasonal Land Use Permit from BASC and agrees to the following condition (3-8)s:

3. Each individual acknowledges the conditions of the Master Plan and NSB Ordinance for the Scientific Research District for samplings, installation of equipments, manipulations and placement of facilities (see Welcome to the BEO)

4. The procedures related to the protection of the endangered Steller's Eider species are understood, as are other environmental laws and regulations (see Stipulations).

5. ATVs are not used in the BEO during the snow-free period without BASC approval.

6. All investigators are expected to provide DGPS information on all sites studied. UNAVCO provides training to NSF researchers on the use of the DGPS system at BASC. In addition, at least one student assistant will be on site during the peak summer field season to assist with this requirement.

7. All investigators are to observe safety procedures related to firearms, hypothermia, and other safety issues. BASC logistics personnel are available for firearm training and other consultation. Upon observing polar bears leave the area immediately and notify BASC by cell phone or radio.

8. All personnel are expected to return their permits and unused meal tickets prior to departures. The NSF Cooperative Agreement requires a PI exit interview with the BASC Executive Director or his designee. A post-season or annual BEO activity report including recent publications is to be submitted upon request to BASC BEO SC prior to the end of the calendar year (see report template below).

ANNUAL BEO PROJECT REPORT TEMPLATE

(To be completed by PI at end of field season)

Project Title
Project Leader(s)
Institution/Agency/Organization/and Department
Address:
Telephone:
Email:
Funding Source (Grant/Contract Number):
Dates/period on BEO:
Personnel in addition to Project Leaders
Students (high school, undergraduate, graduate, post doc), technicians, others

Brief Activity Report (where, type measurements, samples taken, problems and successes)
Recent Publications and Dissertations (and Posters and Abstracts related to BEO; send reprints to BASC)

Standard Stipulations for Encounters with Eiders

Required Procedures

1. ALL members of your field party should have a copy of these guidelines and information which will allow them to identify Spectacled and Steller's Eiders.

2. Upon encountering a nesting Spectacled or Steller's Eider (first time), follow this procedure:
   - Avoid flushing the bird, if possible.
   - Obtain a GPS location, if possible, or map the nest location on a paper map or aerial photograph.
   - If you flush the female, record the number of eggs or ducklings.
   - Cover the nest with down, preferably using gloved hands or a tool.
   - Minimize time at the nest and avoid contact with eggs or ducklings.
   - Leave the area as quickly as possible, to a distance of at least 200 m.
   - If at Barrow, report your observation within 24 hours to the USFWS Endangered Species staff stationed in Barrow or contact the office in Fairbanks (phone: 907-456-0203).

3. Once discovered, minimize disturbance around an active nest, according to the following guidelines.
For brief (less than one hour) and infrequent (no more than once per day) activities:
   - Do not approach within 100 m of the nest.
   - Do not linger within 200 m of the nest.

For sustained (more than one hour) or repeated (more than once per day) activities:
   - Maintain a minimum distance of 300 m.

4. If maintaining the recommended separation distances is incompatible with your research activities, contact USFWS in Fairbanks to reinitiate consultation, as soon as possible.

5. Be alert for eider broods when in the vicinity of ponds and lakes with stands of emergent vegetation from 5 July – 25 August. Avoid approaching broods.

6. Report the encounters with Steller's or Spectacled Eider nests or broods to:

U.S. Fish and Wildlife Service
Endangered Species Division
101 12th Avenue, Rm. 110
Fairbanks, AK 99701
Phone: 907-456-0203

Recommended Procedures

If possible, revisit any known nest locations after 7 August and photograph nest contents to evaluate the likelihood that the nest hatched (or use the information provided by the U.S. Fish and Wildlife Service to evaluate that possibility).

If you have discovered a Steller's Eider nest, be alert for the presence of other nests nearby, and avoid close approach.

List and Dates of Personnel Involved in 2006 BEO Activities

(see project reports for personnel by individual project;)			
excludes BASC Logistics personnel)			
Permafrost Observatory			
Vladimir Romanovsky	Sept 22		
Kenji Yoshikawa	April 20-25		
Touro Saito	April 20-25		
Hanno Myers	April 20-25		
Lutz Schirrmeister	April 20-25		
Jerry Brown (BEO SC)	April15-24	Oct 6-7	
CALM Active Layer			
Fritz Nelson	April17-22	August 23-27	
Ken Hinkel	April 5-22	August 4-18	
Jeff Monroe	April 17-23		
Yuri Shur	April 20-23		
Mikhail Kanevskiy	April 18-28		
Cathy Seybold	April 22-28		August 23-27
James Doolittle	April 17-22		
John Kimble	April 17-22		
Kolia Shiklomanov	June 22-26		
Alexey Shiklomanov	June 22-26		
Dmitriy Streletskiy			August 23-27
Melanie Schimek	June 22-26	August 2-6	August 23-27
Christopher Karmosky		August 2-6	August 23-27
Coastal Observatory/BEO SC			
Adrian Aguirre	Aug 11-18		
Santonu Goswami	August 11-18		
Ground Temperatures (see CALM)			
Organic Carbon/Outreach			
Torre Jorgenson	April 24-28		
Chien Lu Ping		August 13-16	
Fugen Dou	April 24-28	August 13-16	
Lorene Lynn	April 24-28	August 13-16	
Mikail Kanevskiy	April 24-28		
Daniel Fortier		August 13-16	
Mercury Deposition			
Matthew Sturm	January 1-5	March 3-19	May 18-21
Stephanie Saari	January 5-6	February 2-3	April 20-21
Bill Simpson	February 12-15	March 21-23	June 6-8
Tom Douglas	March 5-22	May 24-29	
John Heinrichs	March 5-22		
Ken Tape	March 5-17		
Rick Rachow	March 12-14		

Joel Blum	March 16-22		
Britt Sorenson	March 17-April 4		
Brie Van Dam	March 17-25		
James Barres	March 17-April 1		
Jonathan Bier	March 17-April 4		
Kelsey Johnson	March 17-April 4		
Gerald Keeler	March 17-25		
Sarah Douglas	April 25-29		
Rachael Sturm	May 16-21		
Laura Aviles-Alvarez	June 11-14		
Biocomplexity- Eddy Covariance and Interconnections			
Walt Oechel	July 15- 31	Aug 15- 30	
Steve Hastings	Jun 4 – Dec 9		
Kyoko Nakamoto	Jun 3 – Sept 20		
David Lipson	July 12-18		
Joe Verfaillie	Jun 3 – Sept 20		
Donatella Zona	May 27 - Aug 31		
Irene Kopetz	June 2 - Sept 1		
Biocomplexity- Experimental Design			
Craig Tweedie	April 17-24	June 1-15	Aug 16-28
Edith Jaurrieta	April 17-24	May 29 –June 15	
David Lin	Jun 12 – Aug 18		
Amit Raysoni	May 29–Aug 19		
Adrian Aquirre	May 29–Aug 19		
Karla Martinez	May 29–Aug 19		
Yenlai Chee	May 29–Aug 19		
Biocomplexity-Methane Flux			
Yoshinobu Harazono	June 9 - June 28	Aug 29 - Sept 4	
Masahito Uneyama	August 8-16		
Hiorki Ikawa	June 9 – Aug 20	Aug 26 - Nov 2	
Nana Nishida	June 18 – Aug 6	Aug 21 – Sept 13	
Tyler Anderson	June 7- 21		
George Burba	June 7- 21		
Biocomplexity-Plot Level Fluxes			
Steve Oberbauer	June 7-19	August 14-26	
Andrea Kuchy	Jun 9 - Aug 14		
Paulo Olivas	Jun 1 - Aug 26		
Biocomplexity- Tramline Development/Reflectance			
See Experimental Design Personnel			
Santonu Goswami	June 8- 19		
Predictive Capabiity SNACS			
Walt Oechel	See Eddy		
Steve Hasting	See Eddy		
Matt Higgins			

Cheryl Laskowski	Mar 29- April 3	May 27 – Jun 3	Jun 18- Dec 9
Rommel Zulueta	Mar 29- April 3	June 11- Sept 2	
Hank Loescher			
Rena Bryan	May 31-Aug 31		
Wanona Squirrel	Jun 18- Aug 19		
Aline Jaimes	Jun 24 - Sep 30		
Natalio Panzarini	May 31-Aug 31		
ITEX (see Experimental Design and Flux projects personnel)			
Beringia Assessment (see Design project personnel)			
Halomethane Gas Exchange			
Robert Rhew	July 18-28		
Yit Arn The	July 18-28		
Triffid Abel	July 18-28		
Alyssa Atwood	July 18-28		
Olivier Mazeas	July 18-28		
Joseph von Fischer	July 18-28		
Microtine Physiology			
Ian Gerard van Tets	Sept 8-10		
Patricia Johnston	Sept 8-10		
Shorebirds			
Richard Lanctot	June 2- July 10		
Bart Kempenaers	June 7- July 8		
Falk Huettmann	June 6-10		
Audrey Taylor	July 15 –Sept 10		
Nathan Coutsoubos	June 3- July 23		
Sonja Gaessler	May 25 – July 8		
Wolfgang Forstmeier	May 25 – Jun 24		
Holger Schielzeth	June 23- July 15		
Andrea Wittenzellner	May 25 – Jul 15		
Silke Steiger	June 7- July 8		
May Yin Seet	June 7- July 8		
Mihau Valcu	May 25 – Jun 23		
Dave Krueper	June 7-July 7		
Liliana Coelho Naves	June 2 – Aug 1		
Josh and Kelly Boadway	June 5 – Sep 10		
Dan Fontaine	June 2 – July 12		
Fabrice LeBouard	June 3 – Aug 5		
Dawn Morgan	Jun 10 – Jul 15		
Blake Trask	Jun 5 – Jul 15	Sept 6-9	
Cory Gregory	Jun 6 – Jul 15	Sept 6-9	
Raimund Barth	Jun 7- Jul 23		
Deb Nigro	Jul 2-15	Aug 28-30	
Terry Kowalcyzk	Jul 12-15	Sept 6-9	
Alexis Will	Jul 12-15	Sept 6-9	

Steller's Eider			
Nora Rojek	June 1 – July 30		
Jessica Eden	June 1 – Aug 21		
Carlo Acuna	June 9 – July 15		
Rebecca DeKay	June 12 – July 15		
Dean Kildaw	July 1 – July 17		
Gerald Krausse	June 6 – July 13		
Kathryn Peiman	June 7 – July 17		
Katie Weber	June 3 – July 31		
Adele Young	June 7 – July 17		
Jewel Bennett	June 1 – June 23		
Ted Swem	June 12 – June 22		
Neesha Wendling	June 7 – June 23		
Sonja Jahrsdoerfer	June 24 – July 3		
Heidi Cline	June 29 – July 8		
Tasha DiMarzio	July 8 – July 19		
Arnold Schouten	July 11 – July 15		
Barrow High School			
Uiññiq Ahgeak	Resident		
Alice Anne Fournier	Resident		
Sean Gueco	Resident		
Siggy Patterson	Resident		
Snowy Owl			
Denver Holt	July		
Matt Seidensticker	15 June -20 Aug		
Jennifer Detienne	June 20 Aug 17		
BAID IMS			
Craig Tweedie	See Design		
Allison Gaylord	June 2-11	August 4-16.	
Adrian Aguirre	See Design		
Yenlai Chee	See Design		
Schoolyard-Saturday			
Glenn Sheehan	Resident		
Jill Exe	Resident		
Jerry Brown	October 6-7		
Schoolyard-Warming			
Leslie Pierce	August 27		
Robert Suydam	June 14, 28		
Mike Bradbury	June 14		
McLinda Dorin	June 14		
Ray, Steve Reichert	June 28		
Krista Frantz	August 27		
Selma Khan	August 27		
Tim Barr	August 27		

M.J. Roseberry	August 27		
Megan Edwardsen	August 27		
Mexican students and teachers (see cover)	August 27		
Schoolyard- Winter Lake			
Tim Buckley and students	Resident		
See CALM, Design and Permafrost personnel			
Infrastructure Development Personnel (VECO)			
Richard Perales	Mar 13-April 30	May 16- Jun 7	Jun 22 – Jul 9
Jason Neely	Mar 21-31		
Larry Levin	April 6-7		
Jay Burnside	June 25		
Mike Mckibben	June 25		
Jane Zanetell	June 29-30		
Infrastructure Development Personnel (UICC)			
Burnell, George	Aug	BRW	
Clerc, Sebastian	Apr-May	BRW	
Donovan, Michael	Apr-May, Jul	BRW	
Fischer, Charles	Mar-Apr, Jul	BRW	
Frantz, Daniel	Apr	BRW	
Gerke Jr, David	Jan-Dec	BRW	
Hopson, Clayton	Apr-Jun	BRW	
Kanayurak, Toke	Apr	BRW	
Kippi, Edward	May-Jun	BRW	
Kudralook, Herman	May	BRW	
Leavitt, Isaac	Jul, Sep-Dec	BRW	
Leavitt, Joseph	Apr	BRW	
Lindberg, William	Feb, Apr	BRW	
Napageak, Archie	May-Jun	BRW	
Overbay, Gregory	Apr, Jun-Jul	BRW	
Oyagak, Tony	Mar-Apr, Jul	BRW	
Panigeo, Vaughn	Jul	BRW	
Rexford, Bruce	May-Jun	BRW	
Rexford, Steven	Apr-Aug	BRW	
Richards, Lonny	Apr,Jul	BRW	
Stine, Abe	Jul-Nov	BRW	
Toovak, James	Apr-May	BRW	
Wilhelm, Ross	Apr	BRW	
Forbes, Brian	Jul-Dec	PM	
Sassara, Charles	Mar-Dec	PM	
Wilson, Michael	Mar-Jul	PM	
Fritzler, Timothy	Mar-Jul	Field	
Kennedy, John	Jan-Feb, April-Nov	Field	
Mackenzie, Stephen	May-Jun	Field	

Riley, Mike	August	Field	
Chris Stein (LCMF Surveyor)	August 4	Field	
Kevin Eischens (LCMF Surveyor)	August 4	Field	
(Wire-Com)			
Hamilton, Gordon	Jul-Dec		
Smith, Ken	Jul-Dec		

List of 2006 BEO Projects and Activities

THE ALASKA LEGISLATURE

*** HONORING ***

*** BARROW ***
*** 125TH ANNIVERSARY ***
*** INTERNATIONAL POLAR YEAR ***

The Twenty-fifth Alaska State Legislature is proud to recognize Barrow as Alaska's Arctic Science City and as Alaska's focal site for the 125th Anniversary of the International Polar Year, 2007 to 2009. Barrow was the site of America's First International Polar Year (IPY) in 1881-1883. The United States is now preparing to celebrate the 125th Anniversary of the first IPY and Barrow is the focal site of this occasion. The opening of the new Barrow Global Climate Change Research Facility (BGCCRF) will coincide with the celebration.

Science has been part of the community of Barrow for the past 125 years, starting in the 1880's with early international explorers hosted by Charles D. Brower. During the 1940-1980 time period, the Naval Arctic Research Laboratory (NARL), based in Barrow, established polar ice island research expeditions, conducted arctic terrestrial research, and oil and gas exploration. The research was supported by Inupiat traditional knowledge, arctic survival, and logistics expertise. Barrow has the most intensively studied and longest continuously monitored air column in the world through auspices of the National Oceanographic & Atmospheric Administration's (NOAA) Point Barrow National Weather Service, NOAA's Global Monitoring Division , the Department of Energy's Atmospheric Radiation Measurement (ARM) project, and numerous National Science Foundation projects. Additionally, research conducted by the Alaska Eskimo Whaling Commission (AEWC) has contributed enormously to the science and understanding of the bowhead whale.

Today, the Barrow Arctic Science Consortium (BASC) currently hosts over 140 active research projects. Distinguished scientists from all over the world come to Barrow to participate and contribute to a variety of research efforts. The village corporation of Barrow, the Ukpeagvik Inupiat Corporation (UIC), has set aside 7,466 acres of Native land for the continuance of long term ecological research in the area. Exciting cutting edge research on a variety of matters, including climate change, permafrost, sea ice studies, and marine and terrestrial research of all kinds is on-going at the facility.

The members of the Twenty-fifth Alaska State Legislature would like to recognize Barrow as Alaska's Arctic Science City and that Barrow is Alaska's focal site for the International Polar Year celebration, 2007-2009.

JOHN HARRIS
SPEAKER OF THE HOUSE

LYDA GREEN
PRESIDENT OF THE SENATE

Date: January 31, 2007

REGGIE JOULE
PRIME SPONSOR

Cosponsors: Representatives Harris, Chenault, Cissna, Coghill, Crawford, Dahlstrom, Doll, Doogan, Fairclough, Gara, Gardner, Gatto, Gruenberg, Guttenberg, Hawker, Holmes, Johansen, Johnson, Kawasaki, Kelly, Kerttula, LeDoux, Lynn, Meyer, Nelson, Olson, Ramras, Roses, Salmon, Seaton, Stoltze, Thomas, Wilson; Senators Olson, Green, Bunde, Cowdery, Davis, Dyson, Ellis, Elton, Hoffman, Huggins, Kookesh, McGuire, Stedman, Stevens, Therriault, Thomas, Wagoner, Wielechowski, Wilken