

**Annual Report for Period:**10/2006 - 09/2007**Submitted on:** 07/02/2007**Principal Investigator:** Ducklow, Hugh W.**Award ID:** 0217282**Organization:** William & Mary Marine Inst**Title:**

LTER: PALMER, ANTARCTICA LTER: Climate Change, Ecosystem Migration and Teleconnections in an Ice-Dominated Environment

**Project Participants****Senior Personnel****Name:** Ducklow, Hugh**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Burreson, Eugene**Worked for more than 160 Hours:** Yes**Contribution to Project:**

participated on research cruise aboard LM GOULD

**Name:** Martin, Daniel**Worked for more than 160 Hours:** Yes**Contribution to Project:**

Mr. Martin was a Staff Research Associate and the field team leader for the secondary production component at Palmer Station in the austral spring. He was in charge of the core sampling, including diving operations, acoustic transects from the zodiac once the ice cleared, and conducting growth experiments with larval krill sampled either with divers or with a net from the zodiac. Support was provided with cost-share funds from University of California at Santa Barbara.

**Name:** Patterson, Donna**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Curchitser, Enrique**Worked for more than 160 Hours:** Yes**Contribution to Project:****Post-doc****Name:** McCallister, Shannon**Worked for more than 160 Hours:** Yes**Contribution to Project:**

participated on research cruise aboard LM GOULD

**Name:** Carrillo, Christopher**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Millerand, Florence**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Montes-Hugo, Martin**Worked for more than 160 Hours:** Yes**Contribution to Project:**

**Graduate Student****Name:** Oakes, Stephanie**Worked for more than 160 Hours:** Yes**Contribution to Project:**

Ms. Oakes conducted experiments with larval krill at Palmer Station during the austral spring of 2002 as part of her Ph. D. thesis. She also assisted with the core program of sampling for the secondary production component during the Oct-Dec time frame. During the remainder of the year she continued the analysis of samples from previous winter cruises and drafting the chapters for her thesis.

**Name:** Garibotti, Irene**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Stammerjohn, Sharon**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Daniels, Robert**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Jackson, Steve**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Waterson, Elizabeth**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** France, Kristin**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Ribes, David**Worked for more than 160 Hours:** No**Contribution to Project:****Name:** Schwager, Katherine**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Luo, Yawei**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Myers, Kristen**Worked for more than 160 Hours:** Yes**Contribution to Project:**

**Undergraduate Student****Name:** Fuller, Michelle**Worked for more than 160 Hours:** Yes**Contribution to Project:**

Ms Fuller was a senior at University of California at Santa Cruz when she was part of the research team for the secondary production component on board the LM Gould in January 2003. She was a volunteer. She participated in all aspects of the core sampling and conduction of experiments during the cruise.

**Name:** Wright, Matthew**Worked for more than 160 Hours:** Yes**Contribution to Project:**

Mr Wright was a sophomore at University of California at Santa Barbara when he was part of the research team for the secondary production component on board the LM Gould in January 2003. He was a volunteer. He participated in all aspects of the core sampling and conduction of experiments during the cruise.

**Name:** Valicenti, Lyndon**Worked for more than 160 Hours:** Yes**Contribution to Project:**

Ms Valicenti was a junior at University of California at Santa Barbara when she was part of the research team for the secondary production component on board the LM Gould in January 2003. She was a volunteer. She participated in all aspects of the core sampling and conduction of experiments during the cruise.

**Name:** Holmes, Michael**Worked for more than 160 Hours:** Yes**Contribution to Project:**

Mr. Holmes was a junior at California Polytechnical Institute in San Luis Obispo when he was a member of the secondary production research team on board the LM Gould in January 2003. He assisted in all aspects of sampling and conducting experiments during the cruise.

**Name:** Ducklow, William**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Quetin, Gregory**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Lum, Kimberly**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Powers, Meghan**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Conners, James**Worked for more than 160 Hours:** Yes**Contribution to Project:**

Web and database expertise

**Name:** Nakase, Dana**Worked for more than 160 Hours:** Yes**Contribution to Project:**

**Name:** Rich, Shannon

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

#### Technician, Programmer

**Name:** Boch, Charles

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Mr. Boch was a field assistant during both the austral spring sampling from Palmer Station and on board the LM Gould during the annual cruise. He did both SCUBA diving and zodiac sampling at Palmer Station, and supervised the midnight to noon shift on board the LM Gould. Partial support was provided with Palmer LTER funds.

**Name:** Johnson, Charleen

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

**Name:** Ireson, Kirk

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

**Name:** Kozlowski, Wendy

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

**Name:** Sines, Karie

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

**Name:** Horne, Peter

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

**Name:** Denker, Christopher

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

**Name:** Anderson, Cynthia

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

**Name:** Geisz, Heidi

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

**Name:** Jerrett, Jennifer

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

**Name:** Pickering, Brett

**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**

**Name:** Chapman, Erik

**Worked for more than 160 Hours:** No  
**Contribution to Project:**

**Name:** Iannuzzi, Richard

**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**

**Name:** Salerno, Jennifer

**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**

Worked in lab and Participated on annual research cruise.

**Name:** Mills, Brendon

**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**

**Name:** Wanetick, Jerry

**Worked for more than 160 Hours:** No  
**Contribution to Project:**

**Name:** Evans, Daniel

**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**

**Name:** Watson, Jordan

**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**

**Name:** Acheson, Leana

**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**

**Name:** Cochran, Michele

**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**

**Name:** Yarmey, Lynn

**Worked for more than 160 Hours:** No  
**Contribution to Project:**

**Name:** Kortz, Mason

**Worked for more than 160 Hours:** No  
**Contribution to Project:**

**Name:** Haber, Shaun

**Worked for more than 160 Hours:** Yes

**Contribution to Project:****Name:** Erickson, Matthew**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Blum, Jennifer**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Gorman, Kristen**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Montaigne, Fen**Worked for more than 160 Hours:** Yes**Contribution to Project:****Other Participant****Name:** Turnipseed, Mary**Worked for more than 160 Hours:** Yes**Contribution to Project:**

participated on research cruise aboard LM GOULD

**Name:** Ross, Robin**Worked for more than 160 Hours:** Yes**Contribution to Project:**

Dr. Ross was a co-PI for the secondary production component of the Palmer LTER. The general tasks include (1) planning and preparing for the field season, both at Palmer Station and for the annual cruise, (2) participation in the field season, (3) data entry and analysis, and (4) manuscript preparation and submittal. She was Chief Scientist for the January 2003 cruise aboard the LM Gould. Partial support was provided.

**Name:** Quetin, Langdon**Worked for more than 160 Hours:** Yes**Contribution to Project:**

Dr. Quetin was a co-PI for the secondary production component of the Palmer LTER. The general tasks include (1) planning and preparing for the field season, both at Palmer Station and for the annual cruise, (2) participation in the field season, (3) data entry and analysis, and (4) manuscript preparation and submittal. He conducts the dry suit training class for the divers participating in the austral spring field season for the Palmer LTER. Partial support was provided.

**Name:** Lindsey, Emily**Worked for more than 160 Hours:** Yes**Contribution to Project:**

Ms Lindsey graduated from Brown University in May 2002, and joined the secondary production research team both at Palmer Station in December and on board the LM Gould in January 2003. She participated as an assistant in all aspects of the core sampling from zodiacs and from the ship, and in conducting experiments with Antarctic krill.

**Name:** Rawls, Dawn**Worked for more than 160 Hours:** Yes**Contribution to Project:****Name:** Baker, Karen

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

**Name:** McCoy, Kim

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

**Name:** Smith, Raymond

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

**Name:** Vernet, Maria

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

**Name:** Ferrara, Michelle

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

**Name:** Tillbury, Graham

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

**Name:** Bechtel, Jefferey

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

**Name:** Bostrom, Erin

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

**Name:** Veloza, Adriana

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

**Name:** Fraser, William

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

**Name:** Martinson, Douglas

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

**Name:** Rapoport, Shana

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Participated on annual research cruise.

**Name:** White, Bryan

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Participated on annual research cruise and at Palmer Station.

**Name:** Pelletreau, Karen

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Participated on annual research cruise.

**Name:** Loomis, Eli

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Participated on annual research cruise and at Palmer Station.

**Name:** Cheng, Brian

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

**Name:** Green, Kristen

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

**Name:** Kaiser, Amy

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

**Name:** Watts, Jason

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

**Name:** Haupt, Alison

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

**Name:** Talley, Shannon

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

**Name:** Cadiz, Robin

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

**Name:** Lefens, Mark

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

**Name:** Thomas, Austen

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

**Name:** Spence, Jessica

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**



**Name:** Sprague, Josh  
**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**

**Name:** Davis, Katie  
**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**

**Name:** Holloway, Stephen  
**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**

**Name:** Chakos, Diane  
**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**

**Name:** Duplantier, Adrian  
**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**

**Name:** Lemein, Todd  
**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**

**Name:** Sabo, Kathleen  
**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**

**Name:** Huang, David  
**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**

**Name:** van Dover, Cindy  
**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**

**Name:** Eam, Boreth  
**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**

**Name:** Husby, Jenny  
**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**

**Name:** Wohlford, Tristan  
**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**

**Name:** Schram, Julie

**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**

**Name:** Hammond, Sam

**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**

**Name:** Lowe, Alex

**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**

**Name:** Burner, Ryan

**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**

**Name:** Engels, Mary Sophia

**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**

**Name:** Haman, Katherine

**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**

**Name:** Thigpen, Tyler

**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**

**Name:** Lucas, Hannas

**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**

**Name:** Erdman, Eric

**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**

**Name:** Kirchman, David

**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**

**Name:** Yochum, Noelle

**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**

#### **Research Experience for Undergraduates**

**Name:** Raulfs, Estella

**Worked for more than 160 Hours:** Yes  
**Contribution to Project:**

participated on research cruise aboard LM GOULD

**Years of schooling completed:** Freshman  
**Home Institution:** Other than Research Site  
**Home Institution if Other:** College of William and Mary  
**Home Institution Highest Degree Granted(in fields supported by NSF):** Doctoral Degree  
**Fiscal year(s) REU Participant supported:** 2003  
**REU Funding:** REU supplement

**Name:** Rogers, Lauren

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

participated in research at Palmer Station

**Years of schooling completed:** Other  
**Home Institution:** Other than Research Site  
**Home Institution if Other:** Stanford University  
**Home Institution Highest Degree Granted(in fields supported by NSF):** Doctoral Degree  
**Fiscal year(s) REU Participant supported:** 2003  
**REU Funding:** REU supplement

**Name:** Tutrow, Jonathan

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

**Years of schooling completed:** Sophomore  
**Home Institution:** Other than Research Site  
**Home Institution if Other:** Loyola Marymount University  
**Home Institution Highest Degree Granted(in fields supported by NSF):** Master's Degree  
**Fiscal year(s) REU Participant supported:** 2002  
**REU Funding:** REU supplement

**Name:** Middaugh, Nicole

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Participated on annual research cruise with LTER-REU support.

**Years of schooling completed:** Junior  
**Home Institution:** Same as Research Site  
**Home Institution if Other:**  
**Home Institution Highest Degree Granted(in fields supported by NSF):** Doctoral Degree  
**Fiscal year(s) REU Participant supported:** 2004  
**REU Funding:** REU supplement

**Name:** Mills, Anne

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Participated on annual research cruise with LTER-REU support.

**Years of schooling completed:** Junior  
**Home Institution:** Same as Research Site  
**Home Institution if Other:**  
**Home Institution Highest Degree Granted(in fields supported by NSF):** Doctoral Degree  
**Fiscal year(s) REU Participant supported:** 2004  
**REU Funding:** REU supplement

**Name:** Tsui, Tracee

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Analyzed data and developed outreach website.

**Years of schooling completed:** Junior

**Home Institution:** Same as Research Site

**Home Institution if Other:**

**Home Institution Highest Degree Granted(in fields supported by NSF):** Doctoral Degree

**Fiscal year(s) REU Participant supported:** 2004

**REU Funding:** REU supplement

**Name:** Haber, Shaun

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

**Years of schooling completed:** Freshman

**Home Institution:** Same as Research Site

**Home Institution if Other:**

**Home Institution Highest Degree Granted(in fields supported by NSF):** Associate's Degree

**Fiscal year(s) REU Participant supported:**

**REU Funding:** REU supplement

**Name:** Kelly, Joann

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

Joann worked in Ducklow's lab at VIMS, processing and analyzing sediment trap samples, and helping out with other routine lab duties.

**Years of schooling completed:** Freshman

**Home Institution:** Same as Research Site

**Home Institution if Other:**

**Home Institution Highest Degree Granted(in fields supported by NSF):** Doctoral Degree

**Fiscal year(s) REU Participant supported:** 2004

**REU Funding:** REU supplement

**Name:** Moore, Kelly

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

**Years of schooling completed:** Sophomore

**Home Institution:** Same as Research Site

**Home Institution if Other:**

**Home Institution Highest Degree Granted(in fields supported by NSF):** Doctoral Degree

**Fiscal year(s) REU Participant supported:** 2005

**REU Funding:** REU supplement

**Name:** Hoffman, Cliff

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

**Years of schooling completed:** Sophomore

**Home Institution:** Same as Research Site

**Home Institution if Other:**

**Home Institution Highest Degree Granted(in fields supported by NSF):** Doctoral Degree

**Fiscal year(s) REU Participant supported:** 2005

**REU Funding:** REU supplement

**Name:** Ma, Julian

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

**Years of schooling completed:** Junior

**Home Institution:** Other than Research Site

**Home Institution if Other:** College of William and Mary

**Home Institution Highest Degree Granted(in fields supported by NSF):** Doctoral Degree

**Fiscal year(s) REU Participant supported:** 2007

**REU Funding:** REU supplement

**Organizational Partners**

**Digital Library for Env and Sci Edu**

**NSF Artists and Writers Program**

**California Center for Ocean Sci Edu**

**Scripps Committee for Outreach Programs**

**San Diego Supercomputer Center**

**University of Wisconsin, Madison**

**Old Dominion University**

**University of La Plata**

**University of Nevada Desert Research Institute**

DRI Post-doc Joseph Grzymiski participated on our annual cruise

**Instituto Argentino de Nivologia**

Dr. Irene Garibotti from the Instituto Argentino de Nivologia, Glaciologia y Ciencias Ambientales; Mendoza, Argentina collaborated with coPI Maria Vernet on several manuscripts reporting on LTER findings.

**UCSD Teacher Education Program**

**Teacher's Experiencing Antarctica**

**LTER Network Office**

**UCSD Preuss Middle/High School**

**Rawls Byrd Elementary School**

**University of Florida**

Dr. T K Frazer of University of Florida: worked at Juan Carlos I base (Spanish) on Livingston Island; with a group transported by the Spanish Navy visited Palmer Station and received live krill and phytoplankton cultures. Members of the visiting party consulted with various people on station to learn about different ways to conduct science at stations in the Antarctic.

### **Spanish Antarctic Program, Juan Carlos B**

Dr. T K Frazer of University of Florida: worked at Juan Carlos I base (Spanish) on Livingston Island; with a group transported by the Spanish Navy visited Palmer Station and received live krill and phytoplankton cultures. Members of the visiting party consulted with various people on station to learn about different ways to conduct science at stations in the Antarctic.

### **UCSD Science Studies Program**

### **UCSD Laboratory for Comparative Human Co**

### **Satellite Educational Resources Consortium**

### **TenXSys**

Boise, ID

### **Aquarium of the Pacific, Long Beach C**

### **Ocean Literacy Network**

### **Santa Clara University**

### **University of Quebec**

### **Rutgers University**

### **Webb Research Corporation**

### **California State University-Fullerton**

### **Other Collaborators or Contacts**

Helena Karasti, Oulu University, Finland  
 Geoffrey Bowker, UCSD Communication Department  
 Cheryl Peach, UCSD Birch Aquarium  
 Lucy Bledsoe, NSF Artists and Writers Program  
 Cindy Baker, College of William and Mary Public Relations  
 Pete Barnes, K12 teacher  
 Lara Kessler, K12 schools  
 Daniel Grossman, NSF Media Program  
 Martha Ferrario, University of La Plata  
 Rebecca Dickhut, VIMS  
 Elizabeth Canuel, VIMS  
 Michael Bender, Princeton  
 Matthew Reuer, Princeton  
 David Kirchman, U Delaware  
 Craig Carlson, UCSB  
 Mary Cerrullo, Children's book writer  
 Cyndy Chandler, Data Manager of the JGOFS Data Office, WHOI

Paula Levin, Graduate Coordinator Teacher Education Program  
 Indalecio Manzano, Science Chair UCSD Preuss Elementary/Middle School  
 Thomas K Frazer, University of Florida  
 Christine Ribic, Univ of Wisconsin  
 William Walker, M.S., Collaborator, NMFS., Seattle, WA.  
 Eileen Hofmann, Ph.D., Collaborator, Old Dominion U., Norfolk, VA.  
 UCSD SIO California Current Ecosystem LTER  
 UCSB Santa Barbara Coastal LTER  
 UCSD SIO/CalCOFI Program  
 Alison Murray, Desert Research Institute  
 Chris Fritsen, Desert Research Institute  
 William Large, NCAR  
 Erik Chapman, Old Dominion Univ  
 Steve Emslie, U. of North Carolina, Wilmington  
 Jose Torres, U. of South Florida  
 Dan Lubin, SCRIPPS  
 Alec Barron The Preuss School  
 Susan Musante TIEE  
 Tamara Ledley DLESE/SERC/NSDL  
 Daniel Edelson/David Smith Northwestern University  
 Jay Hendricks (high school teacher) Rancho Bernardo High School  
 Harry Helling/Rick Baker Ocean Institute, Dana Point  
 Renne Carleton San Diego State University (second year student)  
 Debi Kilb SIO Visualization Center Director/Scientist  
 Naomi Oreskes, Department of History, UCSD  
 David Ribes, Information School, University of Michigan  
 Geoffrey Bowker, Santa Clara University  
 Oscar Schofield, Rutgers Coastal Ocean Observation Lab  
 Clayton Jones, Webb Research Corporation  
 Bill Curtsinger, underwater photographer  
 Christy Millsap, Rancho Bernardo High School  
 Mary Miller, Live@the Exploratorium  
 Oona Doherty, Teton County Library, Jackson, WY  
 Season Mussey, middle school teacher, UCSD Preuss School  
 Eugene Domack, Hamilton College  
 Amy Leventer, Colgate College  
 Mike Polito, University of North Carolina, Wilmington  
 Steve Emslie, University of North Carolina, Wilmington  
 David Amblas, Universidad de Barcelona, Spain  
 David Ainley, H.T. Harvey & Associates, San Jose, CA  
 Christine Ribic, University of Wisconsin, Madison  
 Erik Chapman, Old Dominion University  
 Eileen Hofmann, Old Dominion University  
 Dan Costa, University of California, Santa Cruz  
 Jose Torres, University of South Florida

### Activities and Findings

**Research and Education Activities: (See PDF version submitted by PI at the end of the report)**

Please see attached PDF file.

**Findings: (See PDF version submitted by PI at the end of the report)**

Please see attached PDF file.

**Training and Development:**

We provide a rich experience in field research -- both at Palmer Station and aboard LM GOULD for numerous undergrad and graduate students listed in our participants section.

**Outreach Activities:**

The Palmer LTER partnered with Scripps Committee for Outreach Programs in Education (SCOPE) taking science into the classroom through the efforts of SIO graduate student participants. PAL LTER partners with other San Diego based programs such as Partnerships Involving the Scientific Community in Elementary Schools (PISCES) as well as with the Birch Aquarium's efforts with the California Center for Ocean Science Education Excellence (COSEE) support and purchase of toolkit materials.

Twelve volunteers were taken into the field as part of the Palmer LTER field program for the 2002-2003 season. In addition, a Research Experience for Undergraduates student participated in the January cruise. NSF Artist and Writer participant Dan Grossman was hosted by Palmer LTER participants while in the field at Palmer Stations. Contributions to his online website for both teacher guides and for photo galleries. An Antarctic Storytelling Workshop in conjunction with NSF Writer and Artists Program participant Lucy Bledsoe took place in San Diego in March 2003 in coordination with the Palmer LTER Information Management component.

Communication with the public occurred through Antarctic Sun article ([http://pal.lternet.edu/lter/biblio/2002/mccoy\\_apv\\_pg6\\_ant\\_sun2002\\_29dec.pdf](http://pal.lternet.edu/lter/biblio/2002/mccoy_apv_pg6_ant_sun2002_29dec.pdf)) as well as an LTER Network News article on outreach with schools ([http://pal.lternet.edu/lter/biblio/2003/LTER\\_newsletters/Spring2003/pg05\\_spring03\\_vol16no1.pdf](http://pal.lternet.edu/lter/biblio/2003/LTER_newsletters/Spring2003/pg05_spring03_vol16no1.pdf)). In addition, William and Mary initiated a new website 'William and Mary in Antarctica' (<http://www.wm.edu/Antarctica/index.php>) and held a variety of outreach activities in collaboration with teachers who participated in a variety of ways with the field experience. In addition, a Picture-of-the-Day ship activity resulted in public outreach for the Palmer LTER January 2003 cruise. It was followed up by coordination of the photos into the Palmer LTER online photo gallery.

Discussions with the LTER Schoolyard cross-site efforts developed over plans for an All Scientists Meeting Workshop to be held jointly by the Information Managers and the LTER Education Representatives. Discussions with the Digital Library activities continued with participation at the Joint Conference for Digital Libraries in May 2003. A mini workshop was held with previous TEA participant Besse Dawson as well as with the NSDL group Science Education Resource Education (SERC) led by director Cathy Manduca.

Beth Simmons, a high school oceanography teacher with training in curriculum development, initiated design of a Palmer LTER framework for case-based module development. Training through the 'Understanding by Design' program continued with a PALTER prototype module 'Penguin Bones' used as a presentation module.

Please see attached Activities file for more information on Outreach Activities.

**Journal Publications**

Hollibaugh, J. T., N. Bano and H. W. Ducklow., "Widespread Distribution in Polar Oceans of a 16S rRNA Gene Sequence with Affinity to Nitrospira-like Ammonia- Oxidizing Bacteria.", *Applied and Environmental Microbiology*, p. 1478, vol. 68, (2002). Published,

Garibotti, I. A., M. Vernet, M. E. Ferrario, R. C. Smith, R. M. Ross and L. B. Quetin, "Phytoplankton spatial distribution in the Western Antarctic Peninsula (Southern Ocean)", *Marine Ecology Progress Series*, p. 21, vol. 261, (2003). Published,

Garibotti, I. A., M. Vernet, W. A. Kozlowski and M. E. Ferrario., "Composition and biomass of phytoplankton assemblages in coastal Antarctic waters: a comparison of chemotaxonomic and microscopic analyses", *Marine Ecology Progress Series*, p. 27, vol. 247, (2003). Published,

Thomas K. Frazer, Langdon B. Quetin, Robin M. Ross, "Abundance, sizes and developmental stages of larval krill, *Euphausia superba*, during winter in ice-covered seas west of the Antarctic Peninsula", *J. Plankton Res*, p. 1067, vol. 24, (2002). Published,

Karen L. Haberman, Robin M. Ross, Langdon B. Quetin, Maria Vernet, Gabriella A. Nevitt, Wendy Kozlowski, "Grazing by Antarctic krill *Euphausia superba* on *Phaeocystis antarctica*: an immunochemical approach", *Mar. Ecol. Prog. Ser.*, p. 139, vol. 241, (2002). Published,



- Karen L. Haberman, L. B. Quetin and R. M. Ross, "Diet of the Antarctic krill (*Euphausia superba* Dana) I. Comparisons of grazing on *Phaeocystis antarctica* (Karsten) and *Thalassiosira antarctica* (Comber).", *J. Expt. Mar. Biol. Ecol.*, p. 79, vol. 283, (2003). Published,
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### Web/Internet Site

**URL(s):**

<http://pal.lternet.edu>

**Description:**

Palmer LTER Home Page

### Other Specific Products

**Product Type:****Teaching aids****Product Description:**

Palmer LTER Education Outreach Trunks

**Sharing Information:**

Collection of books, videos, maps, posters, manuscripts and artifacts relevant to polar research. Shared with formal and informal educators and researchers in our laboratory, during workshops or classroom visits.

**Product Type:****Physical collection (samples, etc.)****Product Description:**

Palmer LTER Photo Gallery

**Sharing Information:**

Collections of photos of Antarctic field work or environment shared via web.

**Product Type:****Physical collection (samples, etc.)****Product Description:**

Continue archive of preserved samples of zooplankton (in formalin) and fish larvae (in ethanol) from every station occupied during the annual summer cruise.

Continue collection of frozen samples of young Antarctic krill in the spring for condition factor analysis, and of frozen samples of all sizes of Antarctic krill for wet weight analysis.

**Sharing Information:**

After the planned analysis of the preserved samples is completed, all samples are shipped to the Smithsonian Institution for long-term archival, and are available to any researcher making the request.

**Product Type:****Audio or video products****Product Description:**

A video of Antarctic krill under the ice has been edited from underwater footage taken by SCUBA divers.

**Sharing Information:**

The video clip can be viewed through the Palmer LTER web site.

### Contributions

**Contributions within Discipline:**

Palmer LTER has maintained a regional-scale time series of key ecological and biogeochemical properties and processes over the past 13 years in one of the most remote and hostile regions on the planet. In doing so, we have also maintained a creative and vital program and made important fundamental observations on the response of the Antarctic marine ecosystem to climate change. We thus demonstrate how a long-term approach to science transcends monitoring and contributes to the disciplines of physical, biological and chemical oceanography, Antarctic and climate science.

**Contributions to Other Disciplines:**

We contribute uniquely to the work of long-term environmental science by continuing development of the Ocean Informatics conceptual framework for information management and informatics work enmeshed with an ongoing project science team. Participatory Design is an approach that in partnership with Science & Technology Studies participants is jointly explored as a working field method. This partnership allows us to consider 'how we do our science' while we are doing our science in order to address the changing expectations with respect to community science today. This interdisciplinary effort aims to create mechanisms addressing informatics literacy, information system sustainability, data interoperability, and cross-project collaboration. Some cross-project informatics topics include dictionaries and metadata templates developed by working closely with co located programs: the LTER California Coastal Ecosystem (LTER CCE), the California Cooperative Ocean Fisheries Investigations (CalCOFI), and the Southern California Ocean Observing System (SCOOS).

Ongoing collaborative efforts (Baker/Bowker/Karasti) of PAL LTER serve as a unique bridge for information science, digital library science, and organizational informatics, taking into account sociotechnical issues while remaining grounded within a practicing environmental field research project. The NSF/CISE/BDEI grant 'Designing an Infrastructure for Heterogeneity of Ecosystem Data, Collaborators and Organizations' continues to investigate a conceptual framework sensitive to infrastructure development, as explored in the fields of CSCW, social informatics and scientific collaboratory assessment. A particular focus on collections of documents contributes to ongoing digital library work on federated repositories and information flow.

We are contributing to the disciplines of social science and information science. The Ocean Informatics environment augments and creates alternatives to traditional computer science, information system, and technology approaches to data and information management. Further, the synergistic Comparative Interoperability Study (NSF/HSD) co led by Bowker and Baker represents an interdisciplinary effort linking environmental science, information management, and social science (science and technology studies) and continues to work closely with LTER in its second of three years. This project involves joint research on interrelated organizational, social and technical aspects of information, technology, and science collaboration providing social scientists unique access for innovative fieldwork on the topic of how science is done. Goals in this work include developing the notion of bidirectional communication and opening up discursive practices and perspectives highlighting design and articulation as important elements for ongoing environmental research programs.

#### **Contributions to Human Resource Development:**

Palmer LTER continues to train graduate students in oceanography and climate science and affords them valuable experiences for fieldwork in the Antarctic. Through our ongoing REU program, we also take undergraduate volunteers on our annual cruise and we have hosted teachers at Palmer Station. Finally through our Outreach Programs we expose K-12 students to Antarctic Science and demonstrate the attractions and rewards of careers in science. Finally, there is an ongoing mentoring of environmental scientists with respect to information management which is an integral part of the LTER vision, contributing to the development of data sharing and archival practices.

Our field program has traditionally attracted both graduate and undergraduate students interested in gaining more experience in a variety of areas, including project planning and logistics, implementing and developing field methods and data management and analysis. Most of these students remain with our program for 2-3 years, and eventually seek positions with state and federal governments, or pursue other degrees.

(B-013): In 2006-07, two new technicians, Hannah Lucas and Eric Erdman, were incorporated into our program's training and development. Both these individual are contemplating advanced degrees.

#### **Contributions to Resources for Research and Education:**

(please see also human resources)

A major strength of our outreach focus is the coordinated activity that creates a bidirectional flow of information between between field science, information management, education, and informal outreach through synergistic site education activities such as coordination of the Palmer LTER education workshops, participation in the LTER Network Education Committee and interaction with other LTER site schoolyard programs.

The roles of education/outreach coordinator and information manager in being developed synergistically within the PAL LTER environment contribute to development of a shared conceptual framework of information flow and information exchange. In addition, through enactment of an 'ocean informatics environment', a contemporary approach to training with a focus on 'science-in-making' is being explored through engagement in design activities.

The role of education/outreach coordinator was led by the PAL local information manager for a number of years while developing partnerships that informed the LTER PAL team about education and outreach opportunities and configurations. The last two years, a transitional phase has



transpired. The role of education/outreach coordinator was defined to fit within local community and organizational configurations; the role was enacted as a liaison position, effectively creating a new type of interface between local formal and informal organizations and an ongoing research program (Baker and Simmons, submitted). A general education framework with inquiry-based and local signature elements was developed together with an inquiry-based Instruction Module as a deployment mechanism. Through our education-informatics components partnership joint focus on information and learning, a framework and instruction module were prototyped. This work creates an approach to addressing information science literacy through traditional education venues.

Participation in a graduate online ecology course at University of California, Fullerton regarding the 'Ecological Response of Antarctic Krill to Environmental Variability: Can We Predict the Future' proved a valuable experience in understanding krill in the WAP region. The collaboration and online interaction with local education coordinators not only broadened our outreach collaborations but enriched the context for which to develop instructional materials, in particular for the children's book. The interaction with the scientists was invaluable. Participation in NSTA Web Seminars, 'The Impact of Polar climate change on living systems' is another professional development experience where Beth Simmons used online learning technologies to interact with nationally acclaimed experts, NSTA Press authors, and scientists, engineers, and education specialists from NSTA partners such as NASA, NOAA, FDA, and the NSDL. This experience was also used to connect with local experts and research additional resources for Palmer education and outreach. Finally, our coordination with CCE LTER provides an important foundation for joint projects and proposals over the long term. (ie. Carbon Flux proposal, San Francisco's Exploratorium project, Pier Project, Larsen B project)

### **Contributions Beyond Science and Engineering:**

The Palmer LTER outreach and education, as coordinated by our information manager, is integral to our science program and provides an important contribution to the flow of information to the public in general and to the community over time. An increased understanding of ecosystem response to disturbance on decadal scales (ie, climate change; see Synthesis volume discussed elsewhere) is an important issue for both public education and for national policy.

The Seabird component (B-013) is collaborating with TenXsys, Inc., Boise, Idaho, in the development of an artificial AdÚlie penguin egg to remotely monitor certain physiological parameters such as heart rate and body temperature. If successful, this effort will result in the production of inexpensive instruments to measure a variety of environmental stressors, including human impacts, on this and other species of birds.

### **Special Requirements**

**Special reporting requirements:** None

**Change in Objectives or Scope:** None

**Unobligated funds:** less than 20 percent of current funds

**Animal, Human Subjects, Biohazards:** None

### **Categories for which nothing is reported:**

**RESEARCH FINDINGS: Palmer LTER 2006-2007****Overall:**

We said this last year, but now we really, truly are about to submit a comprehensive set of manuscripts for publication in a dedicated volume of *Deep-Sea Research II* (H Ducklow, Guest Editor). These mss will document, describe and analyze the results of the first decade of observations on the LTER sampling grid. This collection of papers represents a detailed and comprehensive analysis of regional-scale variability in physical oceanography, sea ice, climate, ecological and biogeochemical properties in the PAL LTER study region. We believe it serves as a model for analysis of oceanographic data well beyond the PAL and pan-Antarctic realm. Some of the specific findings from these analyses are outlined below.

Following the LTER All-Scientists Meeting, PAL and MCM investigators met in a one-day workshop at Colorado State, hosted by Diana Wall. During the scientific presentations and subsequent discussions, we realized that we had observed similar responses to a common climate event in our two, very different study sites. The Southern Annular Mode (SAM) had been locked in a positive state for a decade, causing (or enhancing) a cooling trend at MCM and a warming trend near Palmer. In 2001, the SAM switched to a negative state, causing warming, increased glacier runoff, soil flooding and rising lake levels at MCM. The same switch led to unusual meteorological conditions in the Palmer region, especially late, heavy springtime snowfalls. At MCM there were species-specific changes (both increases and decreases) in the keystone predator nematodes. At Palmer, the apex predator Adélie penguin experienced near-total breeding failures. Thus a climate teleconnection caused similar responses in two distinct Antarctic ecosystems across the continent from each other. It wasn't until we were able to meet as a whole group that we made this connection. The experience, as well as the recognition of these parallels between our two sites, points up the need for continental-scale, integrated systems-level investigations of Antarctic systems, and the support and mechanisms to do it. We presented these findings at the recent AISS meeting at NSF. We have high hopes for establishing a solid, correctly focused AISS program.

**Specific findings:****Seabirds (Fraser B-013).**

The removal of snow fences from experimental Adélie penguin colonies following two years of snow deposition manipulation experiments resulted in Adélie penguin chick weights that were not significantly different from those in control colonies without snow fences. This provided conclusive experimental evidence that snow-landscape interactions act independently of marine influences in determining chick weights, thus demonstrating a previously unrecognized mechanism that controls chick survival and demography in this species. Although these dynamics were previously suspected, experimental confirmation has far-reaching implications to a broad suite of ecological issues, including the effects of landscape geomorphology on biological populations, the

mechanics of source-sink population dynamics, and, now, the possibility of establishing basic conceptual and empirical links between marine and terrestrial ecology.

### **Phytoplankton and optics (Vernet B-016 and Vernet/Smith B-032).**

#### *Vernet/Montes-Hugo Findings:*

We explored the potential relationships between particle beam attenuation ( $c_p$ ), chlorophyll a concentration (chl), heterotrophic bacteria abundance (BA) and bacterial carbon production (BCP) in marine waters. Organic detritus and phytoplankton excretion provide substrate for heterotrophic bacteria and are expected to contribute significantly to  $c_p$  ( $\lambda = 660$  nm). Thus, it is hypothesized that  $c_p$  is positively related to BA and BCP if the dominant optically active component (detritus or phytoplankton) covary with heterotrophic bacteria. To test this scenario, chl, BA, BCP, and  $c_p$  from surface samples (0-20 m) were analyzed in a variety of localities representing different latitudes, trophic structure, and upwelling conditions. In general,  $c_p$  values had a significant positive relationship with BCP (64.7% of datasets analyzed) and the empirical models of  $c_p$ -BCP were not always linear. Preliminary observations suggest a greater importance of the role of detritus in low/mid latitude waters compared to polar waters. Based on partial correlation coefficients (multiple regression), BA had only a significant contribution to  $c_p$  variability (~20%) on mid/low latitudes whilst chl accounted for significant fraction of  $c_p$  variability in polar (>90%) and non-polar (~80%) waters. In summary, we propose two types of bio-optical systems to explain the observed dependency between  $c_p$  and BCP: 1) waters where phytoplankton and bacteria covary, and 2) waters where detritus and bacteria covary.

In shelf waters of the western Antarctic Peninsula, with abundant macro- and micronutrients, water column stability has been suggested as the main factor controlling primary production. Freshwater input from sea ice melting is recognized as the principal factor in stabilizing the upper water column by forming a shallow summer mixed layer. Retreating sea ice in the spring and summer define thus the area of influence, the sea ice zone (SIZ) and the marginal ice zone (MIZ). A 12-year time series (1995-2006) was analyzed to address two main questions: (1) what are the spatial and temporal patterns in primary production; and (2) to what extent and in what ways is primary production related to sea ice dynamics. Data were collected on cruises performed during January of each year, within the region bounded by 64°S and 64°W to the north and 68°S and 66°W to the south. Average primary production rates vary by an order of magnitude, from ~250 to ~1200 mg C m<sup>-2</sup> d<sup>-1</sup>. A strong onshore-offshore gradient is evident along the Peninsula with higher production observed in inshore waters. Regional production varied by a factor of 7. Maximum rates were measured in 2006 and minimum in 1999, 1788 to 248 mg C m<sup>-2</sup> d<sup>-1</sup>, respectively. Principal Component Analysis showed that high primary production in January is associated with enhanced shelf production towards to south, explaining 58% of the variability in space and time. Positive primary production anomalies are related to positive anomalies in the timing of sea retreat in the spring and summer (i.e. late retreat) supporting the hypothesis that production in the wAP shelf is related to sea ice dynamics. Timing of sea ice advance in the fall and persistence of ice in the winter season are also related to summer production, but to a lesser extent. To first

order, shallower summer mixed layer depths in the shelf correlate with late sea retreat, in support of the hypothesis that water column stability promotes higher primary production. No regional trend in primary production was detected within the 12-year series, in contrast with reported decline in Antarctic krill, *Euphausia superba*. We conclude that more than half of the primary production on the WAP shelf is associated with shallow summer mixed layers in conjunction with spring and summer sea ice retreat.

*Smith findings:*

- (1) The dominant spatial patterns and seasonal variability of pigment biomass over an extended grid west of the Antarctic Peninsula have been identified. Seasonal climatologies (September through April) and their respective anomalies have been computed. Observed patterns show that the earliest spring blooms (Oct/Nov) begin offshore in the Southern Antarctic Circumpolar Current Front (SACCF) zone and then are followed by blooms within the marginal ice zone and over the shelf as the season progresses.
- (2) Our satellite-based observations provide additional evidence of the influence of the high latitude atmosphere-ice response to ENSO and SAM variability on pigment biomass variability. Mechanisms involve an atmosphere-ice response that contributes either to an early spring sea ice retreat and high biomass offshore (e.g., in response to La Nina and/or positive SAM events) or a late spring sea ice retreat and low biomass offshore (e.g., in response to El Nino and/or negative SAM events).
- (3) These satellite observations are consistent with several hypotheses related to the growth and decay of phytoplankton blooms within these Antarctic
- (4) The SACCF is a previously unquantified source of primary productivity seaward of the WAP shelf break. Our observations suggest that the SACCF may have a more profound influence on the western Antarctic Peninsula ecosystem than previously thought. We find relatively high pigment biomass in the SACCF zone during every spring (Oct/Nov). The role of this phytoplankton biomass within the WAP ecosystem has yet to be fully elucidated.

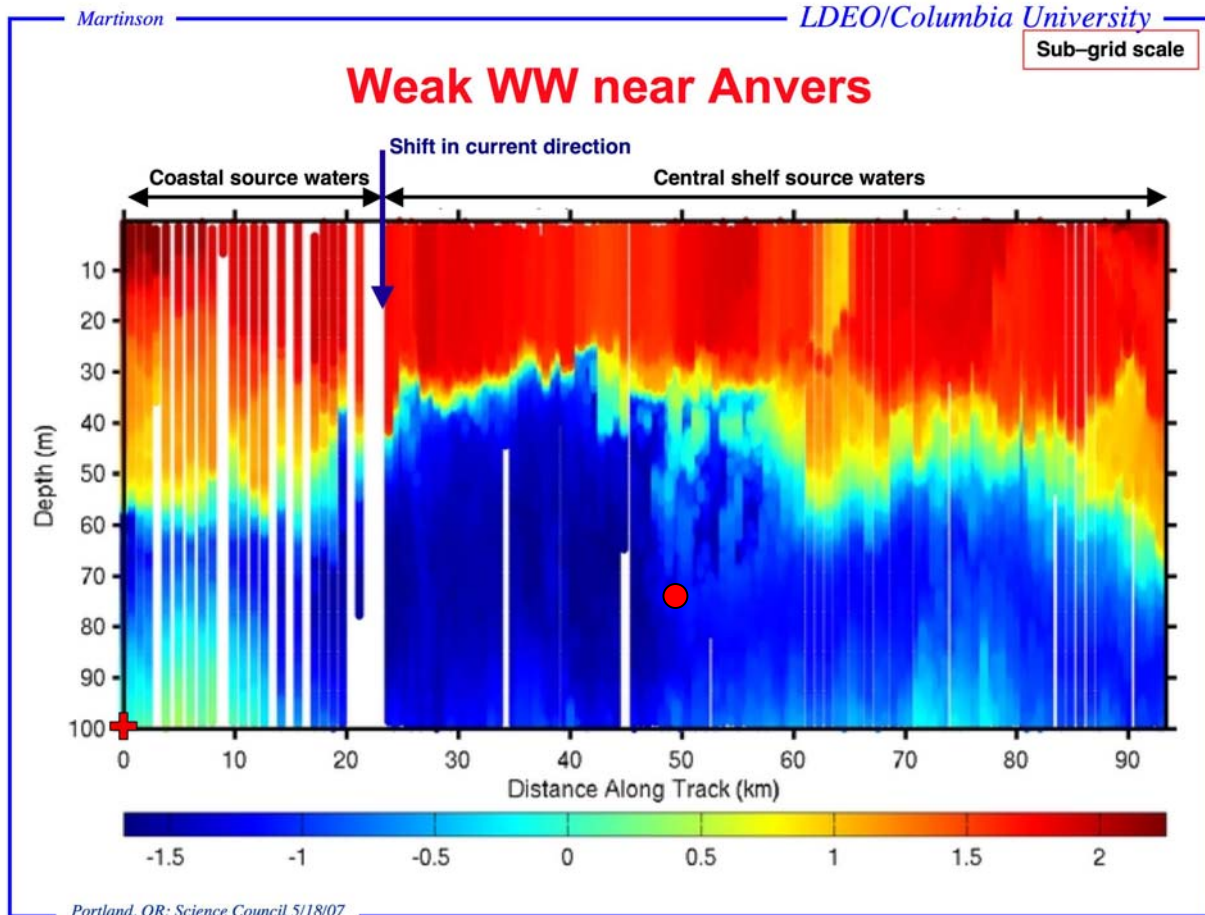
**Physical Oceanography (Martinson B-021)**

Major new findings come from our 2007 Slocum glider deployment. This glider sampled the entire length of the grid and, while only a feasibility study, it immediately yielded important scientific information: (1) the water near Anvers Island, with anomalously weak Winter Water (WW), is coming from a different source location (the coast) than waters elsewhere in the grid; (2) the upper 100 m thick slab of surface water, the entire length of the grid is moving offshore (providing a direct answer to the circumstantial evidence showing an upwelling environment over the entire grid). These results, and their implications to the ecosystem are presently being prepared into a paper. Also, our recent first 12 year analysis (accepted for publication in DSR-2), we have done additional examination of historical water profile data in the broader region to gain better understanding of the change in heat content of the UCDW delivered to the LTER grid since the middle of the 1900s. Initial results suggest that in our immediate area the heat content has increased substantially, but over a broader upstream range of stations, the

scatter is substantial suggesting that the different filaments of the ACC may be showing different histories, and/or the historical data (particularly the XBT data) may require further qa/qc, something we are now investigating.

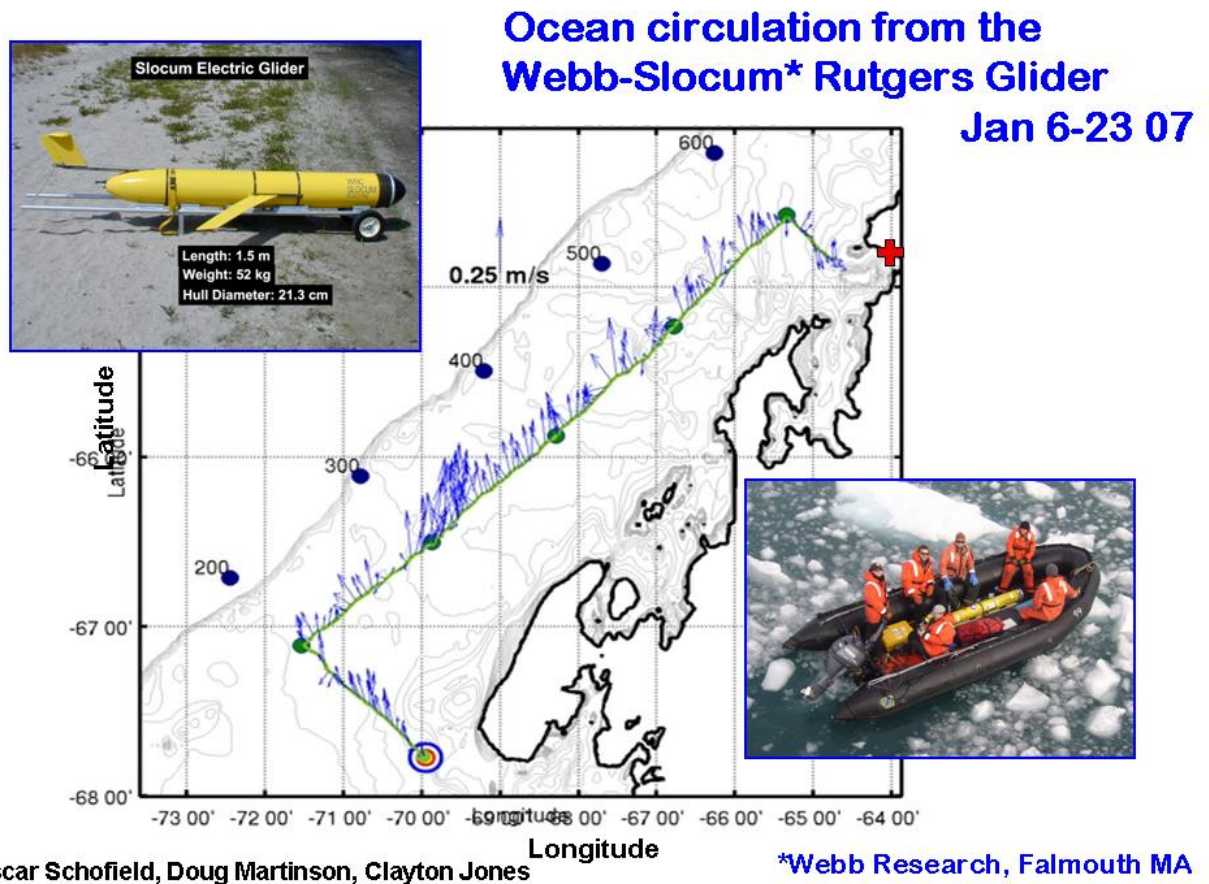
**Major Findings Summarized:**

The mooring deployed in the center of our grid, designed to document the frequency of UCDW flooding events into the gird, and their ability to spread beyond the canyon through which they enter, will not be recovered until 2008, and thus are not available at this time. However, the SLOCUM glider, deployed from Palmer Station, which sailed the entire length of the grid down the 100 stations, provided excellent data, and are currently being analyzed (with new figures and a paper soon to follow), answered several perplexing issues that have been plaguing us. (1) We have long wondered why the ocean waters in the vicinity of Palmer Station shows little to no Winter Water (the thick near-freezing remnant winter mixed layer water). This water appears to play an important role in the ecosystem, most notably limiting the presence of lanternfish, which are abundant in the low WW areas. While not providing a complete answer, an immediate answer to this question became apparent within the first 24 hours of the flight, as seen in Figure 1, the glider sampled weak WW regions from Palmer station, and then, approximately 20-25 km from Palmer, the glider crossed a front, and immediately began sampling the more typical mid shelf waters with a well developed WW layer. The current directs provided by the glider show that the weak WW waters are supplied from the east of Anvers Island, likely the coastal waters that also show weak WW. At the front, the currents began sweeping in from the central portion of the grid, bringing in the more typical water profiles. We are now planning process studies to determine why the coastal waters may not form much WW, but initial investigations suggest that the long sea ice covered season in the coastal regions with little ice divergence may strongly buffer the water column from ice formation, limiting the WW.



**Figure 1:** Indication of dramatic climate change over the Antarctic peninsula. Mooring location shown by red dot (in heart of PAL–LTER sampling grid); red cross is location of Palmer Station where glider was launched.

Another immediate finding solved the question of upwelled UCDW onto the continental shelf, a problem heretofore hampered by the lack of a reliable forcing data set allowing us to predict the response of the Ekman layer. We have considerable circumstantial evidence suggesting that the southern portion of our grid is a consistent upwelling environment (e.g., dynamic topography climatology showing a cyclonic circulation cell). The northern half of the grid shows ocean characteristics and ecology consistent with upwelling, but the dynamic topography is more equivocal. However, the glider, sampling the upper 100 m of the water column (effectively the Ekman layer) showed this Ekman layer is moving offshore over the entire length of the grid (figure 2) — solid evidence (better than that possible from forcing data) that the grid, during our occupation of it, was upwelling the entire length!



**Figure 2:** Upper 100 m surface current vectors for entire glider path. As clearly seen, over entire length of grid, the 100 m slab of water is moving offshore, forcing upwelling of deeper offshore water onto the shelf to conserve mass (flight took several weeks, so high frequency variations are clearly not impacting this finding).

#### **Zooplankton and micronekton (Ross/Quetin B-028).**

No new findings to report.

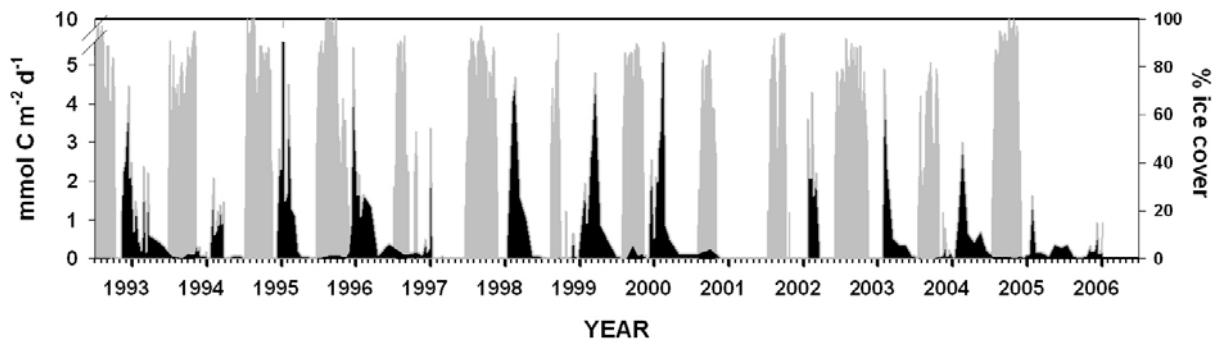
#### **Microbes and Biogeochemistry (Ducklow B-045).**

We pursued serious data analysis in 3 areas: 1) completing a manuscript on the 1993-2006 sediment trap results; 2) starting to look more closely at underway  $p\text{CO}_2$  data collected with Colm Sweeney's system aboard the LM GOULD during our cruises in January 2003-06 ( $n=33,000$ ) and 3) working with Martin Montes on relationships among phytoplankton, bacteria and optical properties (described in the 016 section above).

*Sediment trap results:* Carbon flux varies by almost 4 orders of magnitude within years and the annual flux varies by a factor of ten between years. The export flux in this region, as in other Antarctic coastal and

**Figure 1.** Carbon flux (black) at 150 meters depth observed by the PAL Sediment Trap mooring, 1993-2006. Sea ice % cover at the trap site is indicated in gray shading.

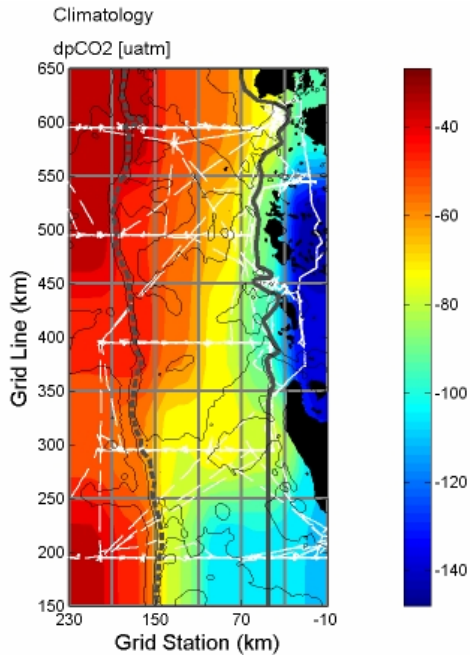
seasonal sea ice zones, is highly periodic. In the WAP, the peak flux occurs following ice retreat and very low fluxes are associated with the wintertime, ice covered period. The date of the peak export is now happening about 40 days later in the season than it did in the earlier years of the trap deployment. Peak fluxes ranged from 1-10  $\text{mmol C m}^{-2} \text{d}^{-1}$  while the winter values were  $<0.001 \text{mmol C m}^{-2} \text{d}^{-1}$ . The mean annual flux is 0.2  $\text{Mol C}$



$\text{m}^{-2}$  indicating an export ratio of about 1% of the annual primary production. The low e-ratio is consistent with recent models of community structure for this region, suggesting a strongly regenerative plankton system. This is a surprising result. Nitrogen metabolism studies and traditional concepts of Antarctic foodwebs favor a higher export ratio. Elemental composition of the exported material captured in the sediment trap averaged C:N:P of 225:28:1, also indicating efficient regeneration of N and P (particularly P) from the falling particles. Very high C:P ratios (400-600) accompanied and strongly corresponded with the time of the peak flux, suggesting intensive P regeneration in the Austral summer. C:N:P in winter was closer to the Redfield values.

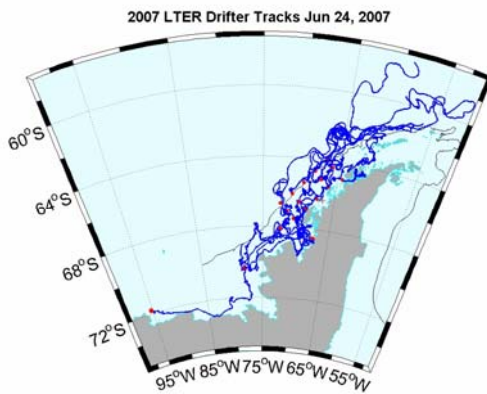
*Underway  $\Delta p\text{CO}_2$  data* are collected on all LMG cruises (sea ice permitting). The data obtained during the LTER January cruises provide a valuable regional-scale record of the metabolic state of the shelf habitat during the Austral summer. The climatological (mean areal) distribution of  $\Delta p\text{CO}_2$  shows the ocean surface is negative (i.e., permitting air to sea  $\text{CO}_2$  flux) throughout the PAL study region (Figure X). However there is considerable interannual and within-year, within-grid variability, with some years showing positive  $\Delta p\text{CO}_2$  (outwelling) offshore.





**Figure X.** Climatological distribution of air-sea  $\Delta p\text{CO}_2$  (ppm) for January-February 2003-2006.

**Circulation and Current Drifters:** In January 2005 we initiated Lagrangian studies of the currents in the LTER region, in collaboration with Bob Beardsley and Dick Limeburner at WHOI. About 15 surface drifters were released throughout the grid in each of the past 3 seasons and tracked by satellite. The drifter tracks show a range of behaviors at several space and time scales. Over the period of LTER cruise operations (ca 7 Jan – 5 Feb), drifters and water parcels remain in the same location, suggesting the temporal and spatial coherence of our ship-based samples (i.e., quasi-synoptic sampling of LTER Grid over  $\sim 4$  weeks). Over longer periods, drifters move well north and south of the study area and become entrained in sea ice. There are drifters in both the Drake passage and Bellingshausen Sea ([http://www.whoi.edu/science/PO/LTER\\_Drifter/](http://www.whoi.edu/science/PO/LTER_Drifter/)).



**Figure 3.** Drifter tracks for January to June 2007.

**Information Management (Baker)**

We are finding the focus of a local, long-term informatics environment benefits from articulation work (Baker and Millerand, 2007 HICSS), enactment mechanisms (Miller and Bowker, in press), and recognition of design strategies for differing knowledge provinces (Baker and Miller and, 2007, ASIST). Further, acting upon an understanding of information infrastructure as an intertwined set of social, technical and organizational arrangements is critical to providing new ways to support contemporary mandates for work with scientific data (Miller and Baker, accepted; Baker and Bowker, 2007; Karasti et al, 2006)

**Education and Outreach (Baker/Simmons)**

We enabled and contributed to collaboration among students, educators and scientists to enhance our existing, vibrant learning environment. In doing so, we continue to incorporate inquiry learning, literacy and current pedagogical teachings. Our framework and instructional learning model are refined and will be published on the Palmer Education Web page to reflect this research and provide coherent guidance for future interchange over the long-term.

*Project Training and Development*

We have laid the groundwork for publishing the children's book. Understanding local university royalty rights, establishing scientific context for the children's book and aligning the author's intent with a supplemental guide have required frequent coordination among author, illustrator and photographer and outreach coordinator. Palmer Education and Outreach program has also dedicated considerable effort to broaden the context for Palmer's outreach efforts over the long term. The redesign and development of the Education and Outreach web page is currently under construction in order to more effectively reach and attract a wider audience. This long-term vision has involved engagement additional help in curriculum writing, teacher feedback, web programming and involvement with local student volunteers.

**RESEARCH ACTIVITIES: Palmer LTER 2006-2007.****Overview**

In April, 2007 we completed the fifth field season of the current award, and the 16th in the Palmer LTER program that commenced in 1991-92. The annual summer cruise (LMG 07-01) and summer season at Palmer Station were both successful. Field operations commenced at Palmer Station on 17 October (a month earlier than the past 2 years) and continued until the end of March with only a few, minor interruptions. The summer LMG cruise was successful with no missed stations. During the cruise we visited Rothera Station to carry out joint scientific operations and visit with our BAS colleagues. There were three significant additions to this year's cruise. In collaboration with Oscar Schofield (Rutgers Univ) we deployed the Rutgers-Webb-Slocum glider, equipped with temperature, salinity, light and fluorescence sensors. The glider flew from Station E at Palmer Station, to Station 600.100, thence south along the xxx.100 grid line and finally on the 200 line into Marguerite Bay where it was recovered successfully. The glider provided us with a high-resolution look at circulation, temperature and phytoplankton structure. A manuscript is in preparation for Science.

We also deployed a physical oceanography mooring with conductivity and temperature sensors and current meters at Station 300.100. The goal of this mooring is to detect intrusions of warm, nutrient-rich Upper Circumpolar Deep Water (UCDW). It will be in place until next January and samples every 20 minutes. The mooring was designed and built by Doug Martinson and Rich Iannuzzi (Lamont-Doherty) and it was deployed by our RPSC support group (Andy Nunn, Greg Buikema, Meghan King, Kevin Pedigo and Fred Stuart; see B-028 report below). Finally, we were able to sail further south and occupy stations along the 100 line in south Marguerite Bay. The goal of this activity is to attempt to observe physical and biological properties nearer to the polar baseline condition that existed in the immediate Anvers Island region prior to regional warming, providing a basis for comparison with the current conditions to the north, already impacted by warming.

We didn't hold a separate annual meeting in 2006, due to the late occurrence of the midterm Site Review in May. However all but one of the coinvestigators plus postdoc Martin Montes-Hugo, graduate students Erik Chapman (ODU), Heidi Geisz (VIMS), Wendy Kozlowski (SDSU), Kristen Myers (VIMS) and Stephanie Oakes (UCSB) as well as Information Manager Shaun Haber attended the LTER All-Scientists Meeting in September. Following the ASM we had a highly successful one-day workshop with MCM-LTER to review each program's research and educational efforts and explore opportunities for cross-site cooperation (see Research Findings). Hugh Ducklow and Berry Lyons (MCM) visited colleagues at the French Polar Institute in Brest in March 2006 to discuss possible collaboration and personnel exchanges. Ducklow, Bill Fraser, Sharon Stammerjohn and Doug Martinson attended the Antarctic Integrated and Systems Science (AISS) Workshop at NSF in June, 2007.

We are currently finalizing a special, guest-edited volume of Deep-Sea Research, part II, focusing on longer-term analyses of PAL results. It will be submitted later this year and published in 2008. A list of manuscripts is appended.

Specific project activities are presented below.

**Seabirds (Fraser BP-013).**

The seabird research group operated in the Palmer Station region from October 2006 to April 2007, sampling daily as weather permitted, and focusing its activities on the demography, foraging ecology and breeding biology of Adélie penguins. Sampling this season was not hampered by adverse weather or ice conditions. As in past seasons, basic ecological data on other seabirds and marine mammals in the Palmer area were opportunistically obtained to ensure the continuity of species-specific databases that originated in the early 1970s. In January, two group members participated in the annual LTER cruise (LMG 07-01), continuing surveys of seabirds and marine mammals to investigate their abundance and distribution relative to annual variability in the regional oceanography. This cruise included a 5-day field camp on Avian Island, Marguerite Bay, and further exploration of the Renaud Island region, thus continuing a unique time series that compares the foraging ecology of Adélie penguins (diets and at-sea foraging locations/dive-depth profiles based on ARGOS-linked transmitters) with data from Palmer Station. Experiments to examine the effects of snow deposition on Adélie penguin demography by manipulating snow deposition patterns in breeding colonies were also concluded this season.

*Outreach activities:*

- a. A collaboration with Fen Montaigne, freelance writer, writing a book on climate change is continuing.
- b. A collaboration with Caroline Underwood, Producer, The Nature of Things, Canadian Broadcasting Corporation, Toronto, Canada, producing a documentary film on climate change is continuing.
- c. A collaboration with Meredith Hooper, U.K. freelance writer, has resulted in the recent publication of a book, *The Ferocious Summer: Palmer's Penguins and the Warming of Antarctica*. The book details the long-term history and key findings of our seabird research program.

*Publications in press*

Shearn-Bochsler, V. D., Green, E., Converse, K.A., Docherty, D.E., Thiel, T., Geisz, H.N., Fraser, W.R. and Patterson-Fraser, D.L. In Press. Avian poxvirus infection in a nestling Southern Giant Petrel (*Macronectes giganteus*) from Antarctica. Polar Biology.

Ribic, C.A., Chapman, E. Fraser, W.R., Lawson, G.L., and Wiebe, P.H. In Press. Top predators in relation to bathymetry, ice, and krill during austral winter in Marguerite Bay, Antarctica. Deep Sea Research II.

**Physical Oceanography (Martinson BP-021)**

*Major research and education activities:* No new educational activities; but deployment of a mooring and Webb Slocum glider in 2006 field season will provide unprecedented spatial/temporal coverage.

*Outreach activities:* Standard activities (LTER poster at annual Lamont Open House, and Rich Iannuzzi talking to elementary students)

*Contributions:* Numerous papers in press (in special DSR II volume), but none out at this time.

### **Phytoplankton (Vernet BP-016) and Bio-optics (Smith/Vernet BP-032)**

The phytoplankton (B-016) and bio-optics (B-032) groups carried out bi-weekly sampling via Zodiac Mark V within the 2-mile boating limit (Stations B & E) from October 2006 to the end of March 2007, and participated in the January 2007 cruise on the continental shelf. Sampling in October and November was sometimes limited by the presence of brash ice that prevented boating operations. One B-016 team member stayed on station during the month of January to maintain the seasonal B and E sampling routine. Throughout the entire field season, core variables, including daily primary production, particulate carbon and nitrogen, dissolved inorganic nutrients, and photosynthetic pigments, discrete chlorophyll and *in situ* conductivity, temperature, salinity and fluorescence measurements were taken. For the collection of in-water optical data, a Biospherical Instruments Profiling Reflectance Radiometer was deployed (PRR 880). Experiments were carried out to estimate microzooplankton grazing on phytoplankton.

Data analysis during this funding period included (1) Principal component analysis of primary production variability, sea ice dynamics and water column properties. (2) Determination of phytoplankton groups based on photosynthetic pigments using the ChemTax approach. (3) Exploratory analysis of the relationship between Antarctic phytoplankton, bacteria and optical properties in surface waters.

Post-Doctoral Researcher Martín Montes-Hugo carried out sampling at Scripps Pier to establish the fundamental relationships between phytoplankton, bacteria and detritus with biological production, respiration and optical properties. He analyzed a time series including remote sensing, phytoplankton size distribution and environmental variables applying the newly developed method of detection of cell size using MODIS images.

Wendy Kozlowski is developing a Master Thesis at San Diego State University using the existing database provided by this project (1994-2007). The questions being addressed are: How are pigments changing with regards to taxonomic composition? Are optical relationships changing in concert with taxonomic groups? Can a relationship be determined between composition and remotely sensed data? This information will be used to provide a knowledge base for future ocean color algorithms.

#### *Publications submitted and in press:*

Montes-Hugo M.A., Vernet M., Smith R., Carder K. Phytoplankton size-structure on the western shelf of the Antarctic Peninsula: A remote sensing approach. *International Journal of Remote Sensing*. In press.

Smith, R.C. and F. Remy, Ice and Climate (Chapt. 7) in "Facing Climate Change Together" by J-L. Fellous & C. Gautier, book in press.

Smith, R.C. and C.D. Mobley, Underwater Light (Chap 7), in *Photobiology*, L.O. Bjorn ed., book in press.

See also list for Deep-Sea Research II appended

#### *Presentations at scientific meetings:*

Vernet, M., K. Baker, S.B. Diaz, W. Kozlowski and K. Sines. Temporal variability in phytoplankton West of the Antarctic Peninsula. LTER All Scientist Meeting, September 2006.

Kozlowski, W.A., D. Deutschman, C. Trees and M. Vernet. Antarctic phytoplankton: composition, in-water optics and the link to remote sensing. NASA Ocean Color Remote Sensing meeting, Seattle, April 2007.

Montes-Hugo M.A., Ducklow H. and M. Vernet. Empirical relationships between particulate beam attenuation coefficient, bacteria abundance and production in oceanic waters. Presented at Earsel, Bolzano, Italy, 6-8 June 2007

### **Zooplankton and micronekton (Ross/Quetin BP-028).**

The zooplankton and micronekton (BP-028) group participated in the seasonal sampling from Palmer Station from late-October 2006 until late March 2007, and participated in the January 2007 annual cruise. Seasonal sampling included collection of Antarctic krill for 1) length and stage or mature female frequency and in situ growth rate experiments from October through December, and 2) collection of krill from schools for length frequency and pigment content from December through March, and 3) twice-weekly bioacoustic runs of two transects (B to E and F to J) within the 3.7 km boating limits of Palmer Station with a BioSonics DT-X echosounder once the waters were ice free (Dec through Mar).

On the cruise, two net tows conducted simultaneously with an acoustic transect (BioSonics DT-X echosounder) were done at each station. At each station, the catch was analyzed for zooplankton community composition, including fish larvae. If Antarctic krill or salps were in the catch, length frequency and either occurrence of mature females (krill) or phase (solitary/aggregate for salps) determinations were done on all or a subsample of the total. In situ growth and egg production experiments on Antarctic krill at selected stations allow estimations of secondary production of this dominant member of the zooplankton/micronekton community.

#### *Publications in press:*

Kawaguchi, S., L. A. Finley, S. Jarman, S. G. Candy, R. M. Ross, L. L. Quetin, V. Siegel, W. Trivelpiece, M. Naganobu, and S. Nicol. Male krill grow fast and die young. *Mar Ecol Prog Ser* 00:000-000. LTER pub #290

Quetin, L. B. and R. M. Ross. Order Euphausiacea, in "The Light and Smith Manual: The Intertidal Invertebrates of Central California and Oregon" (Fourth Edition). (J. T. Carleton, ed.)

#### *Scientific meetings attended with presentations*

Ross, R.M. and L.B. Quetin. 2006. Antarctic krill, *Euphausia superba*: Wet (and salty) foundation species? Presentation at 'Losses of foundation species and the consequences for ecosystem structure and function', workshop (Sep 23 WG Session 12) at the LTER Network All Scientists Meeting, Estes Park, September 2006. Organized by Brian Kloeppe



- Moore, K. and C. Hoffmann. 2006. A Tale of Two Fishes. Poster presented at the LTER Network All Scientists Meeting, Estes Park, September 2006. REU project. Presented by Quetin and Ross, REU mentors.
- Oakes, S.A., L.B. Quetin, R.M. Ross, J. Watson, T. Newberger, C. Boch and J. White. 2006. Do young Antarctic krill (*Euphausia superba*) feed selectively within the winter sea ice microbial community? Poster presented at the LTER Network All Scientists Meeting, Estes Park, September 2006.
- Quetin, L.B., and R.M. Ross. 2007. Life under Antarctic pack ice: a krill perspective. Presented at: Smithsonian at the Poles: Contributions to International Polar Year Science, a symposium held May 3-4, 2007, Smithsonian Institution, Washington, D. C.
- Ross, R.M., and L.B. Quetin. 2007. The Lenfest Workshop "Identifying and resolving key uncertainties in management models for krill fisheries", University Conference Center, Santa Cruz, CA 21-24 May 2007 (goal = to provide CCAMLR with independent advice on how Small-Scale Management Units (SSMUs) might be used to minimize local impacts of krill fishing on krill predators, including consideration of what science might be needed to improve their use for management purposes. Convenors will write summary report.
- Quetin, L. B., R. M. Ross and M. Vernet. Linkage Between Antarctic Krill (*Euphausia superba*) and Primary Production. 4<sup>th</sup> International Zooplankton Production Symposium, May 28 – June 1, 2007, Hiroshima, Japan. Krill workshop May 28.

#### Education activities-

Ross, R.M., and L.B. Quetin. 2007. Ecological responses of Antarctic krill to environmental variability: Can we predict the future? Presented for NSF-supported Centers for Ocean Sciences Education Excellence (COSEE) -West, Mar 21, 2007 in Santa Monica, CA. On-line viewing of video-taped lecture plus on-line question and answer session for

#### **Microbes and Biogeochemistry (Ducklow BP-045) 2004-2005.**

We changed our research emphasis at Palmer Station in 2006-07, having devoted the previous 4 seasons from 02-03 onward to documenting seasonal and interannual variability in bacterial dynamics. Now we shift toward a more experimental approach, investigating mechanisms governing the variability in community structure. This work is being done in collaboration with Dr. Alison Murray (Desert research Inst, NV) and will form the PhD thesis for Kristen Myers (Joint Brown – MBL Graduate Program). Our basic experimental design was to conduct replicated mesocosm incubations (8 x 50 liters x 10 days), following bacterial responses to various treatments (additions of potential limiting nutrients (carbon, nitrogen). Community DNA samples were collected every 3 days, then extracted, purified and analyzed in Murray's lab. Results are forthcoming. Currently we're screening genomic approaches that give the best and most cost-effective results (DGGE, TRFLP). The experiment was repeated 4 times starting Nov 3, Nov 20, Dec 18 and Jan 18, providing information on bacterial community changes in the spring-summer period. The incubations will be repeated in February-March, 2008 (summer-fall period) and (as part of our separate IPY project) in July-August, 2008. Samples were also collected for bacterial properties in the ambient water at the collection site (Palmer Station B).

We also participated on LMG 07-01. The specific objectives of our project are to understanding the role of bacteria in the Antarctic marine foodweb and document spatial and interannual variability in selected carbon system properties (Sedimenting organic matter, DOC, DIC and Oxygen). The deep ocean sediment trap array was recovered and redeployed successfully once again. The sediment trap failed to collect material in 2001-02 but we have complete annual coverage for 12 of 13 years since the program began in late 1992 – an extraordinary record for the Antarctic. Dr. David Kirchman (Univ Delaware) participated as a guest researcher in our project, and contributed sampling for combined microautoradiography-fluorescence in situ hybridization (Micro-FISH) at selected stations within the LTER Grid. The objective is to determine what organic compounds are being utilized by specific bacterial groups.

Labwork: The progress we optimistically reported in last year's annual report for the DOC sample analyses was premature. The RPSC Shimadzu TOC-V Total Organic Carbon Analyzer was shipped to VIMS in 2006 and set up in our lab where it worked reliably. We worked down the sample backlog and returned the instrument to Palmer Station. Unfortunately it did not resume satisfactory operation after being set up at Palmer, and the remote location prevents servicing. The instrument techs try hard and are helpful but lack sufficient expertise and experience to troubleshoot and service the instrument. The long wait for replacement parts makes it impractical to depend on this instrument for our analytical needs.

Other labwork is proceeding on schedule. All core data up through March 2006 have been submitted to the PAL data archive.

#### *Publications:*

Ducklow is Guest Editor for a special volume of deep-Sea Research II, focusing on PAL-LTER results, to be published in 2008. The list of articles is appended.

Published articles are listed elsewhere in this report.

#### *Education activities:*

Julian Ma, an REU student (UVA) participated on LMG0601. A recent VIMS Master's student, Noelle Yochum participated on the cruise. Current MSc student Heidi Geisz completed her third year at the WM-SMS and is working on her thesis on pollutants in seabirds. Current Ph.D. student Kristen Myers completed her second year of classes and will again be at Palmer Station in the upcoming season. Kristen transferred to Brown-MBL when I moved to Woods Hole.

### **Information Management (Baker)**

The PAL data system, known as DataZoo, provides a single portal to multiple projects and runs in parallel with our project-specific second generation systems. Site information management activities focused this year on moving design of a third generation data system to production status. This effort is on track, as reported at our recent site review. We anticipate launch by the end of the reporting year. After launch, our focus will turn to data ingestion or migration from the second generation system. As part of the launch process, we have in place prototype deployments of both unit and attribute dictionaries, a participant and a platform dictionary as well as a refactoring of code toward more modular and object-oriented elements. Work on a local geographic dictionary has been initiated. The incorporation of data has begun with initial datasets



being the time series collections such as weather, sediments, and LTER Trends datasets. The initial datasets entail extensive engagement with users for feedback on interfaces.

A strength of the system is its introduction of web forms for data and metadata entry and modification. This represents a critical change in data handling and a new philosophy of data stewardship, moving from a pipeline model to a federated model more open to project participant interaction. The design reaches from data center to individual labs with an umbrella structure and web forms approach that prompts update of data as well as laboratory understandings of data management.

The project web was updated to include annual web page updates. There are plans for the education pages to be updated this summer. Less visible but critical is the purchase and installation of a second computational platform as part of the Ocean Informatics systems configuration. This arrangement doubles our storage capacity to the terrabyte level and permits dissociation of web services from development and user work. Security has been updated in addition to implementation of single-sign on directory services (Baker et al, 2007; Spring Databits Newsletter).

### **Outreach and Education (Baker/Simmons)**

Site information management network activities included four local information management participants attending the All Scientists Meeting and presenting four posters. As an example of our articulation efforts, eight individuals associated with Information Management contributed more than a dozen articles to Databits, the LTER Information Management Newsletter.

#### *Publications in press:*

Baker, K. S. and F. Millerand. In press. Scientific Information Infrastructure Design: Information Environments and Knowledge Provinces. Proceedings of the American Society for Information Science and Technology ASIST 2007.

Millerand, F. and Bowker, G.C. In press. Metadata Standard: Trajectories and Enactment in the Life of an Ontology. In Formalizing Practices: Reckoning with Standards, Numbers and Models in Science and Everyday Life. M. Lampland and S. L. Star (eds). Cornell University Press.

#### *Education and Outreach activities*

We have captured the essence of outreach, the concepts of ecological studies, federated network collaboration and the use of authentic inquiry science through the following specific involvements for 2007:

#### *Publications and products:*

- redesign of Education outreach web page (in progress)
- development of instructional materials to accompany children's book (in progress)

#### *Contributions, to your discipline*

- June 2006 Ocean Literacy Conference in Long Beach Aquarium

- July/August 2006 RET Work: Tale of Two Krill Curriculum writing/Children's Book Project
- Sept 19 – 22<sup>nd</sup>, 2006 Estes Park All Scientists Meeting
- October 21<sup>st</sup>, 2006 Scripps Institution of Oceanography Open House
- February 14<sup>th</sup>, 2007 PAL SLTER/Supplemental proposals due
- April 14<sup>th</sup>, 2007 Online Polar Ecology Course (Cosee West) Cal State Fullerton. ( on krill)
- May 25<sup>th</sup>, 2007 Exploratorium meeting for future collaborations for PAL Outreach
- May 29<sup>th</sup>, 2007 Teton County Library outreach shipment of materials
- June 2007 Work with local teachers on instructional materials development
- June 10<sup>th</sup>, 2007 Participation in the SIO pier walk (Bringing visiting groups out to the pier is a popular activity that is a frequent request. Many people who would like to get involved with outreach opportunities bring groups to the pier for a tour if instructional materials are available. Participation is in preparation for designing LTER materials.
- July 23<sup>rd</sup>, 2007 National Marine Educators Association (Children's Book – photographer/author meeting)
- August - Sept 2007 Development of PAL Outreach Webpage
- Work with high school student and volunteer on web page design/development
- August 20<sup>th</sup>, 2007 Palmer PI mtg. WHOI; Children's Book Working Group w/author

## **Special PAL-LTER Volume of Deep Sea Research II**

### **Manuscripts and current status (22 June 2007)**

**Final versions will be deposited in the PAL Share Drive.**

Clarke, A., Meredith, M.P., Wallace, M.I., Brandon, M.A., Thomas, D.N., 2008. Seasonal and interannual variability in temperature, chlorophyll and macronutrients in northern Marguerite Bay, Antarctica. *Deep Sea Research II* 55, 000-000. (accepted; final version in preparation)

Ducklow, H.W., Erickson, M., Kelly, J., Smith, R.C., Stammerjohn, S.E., Vernet, M., Karl, D.M., 2008. Particle export from the upper ocean over the continental shelf of the west Antarctic Peninsula: A long-term record, 1992-2006. . *Deep Sea Research II* 55, 000-000. (submitted)

Fraser, W.R., Patterson-Fraser, D.L., Ribic, C.A., Erdman, E., Chapman, E., Domack, E. and Amblas, D. Seasonal use of marine ecosystem space by foraging Adélie penguins (*Pygoscelis adeliae*) in the western Antarctic Peninsula region. *Deep Sea Research II* 55, 000-000. (In Preparation)

- Fritsen, C.H., Memmott, J., Stewart, F.J., 2008. Inter-annual sea ice dynamics and micro-algal biomass in winter pack ice of Marguerite Bay, Antarctica. *Deep Sea Research II* 55, 000-000. (accepted; final version in preparation)
- Martinson, D.G., Stammerjohn, S.E., Iannuzzi, R.A., Smith, R.C., Vernet, M., 2008. Palmer, Antarctica, Long-term Ecological Research Program First twelve years: Physical Oceanography, Spatio-Temporal Variability. *Deep Sea Research II* 55, 000-000. (accepted; final version in preparation)
- Meredith, M.P., Murphy, E.J., Hawker, E.J., King, J.C., Wallace, M.I., 2008. On the interannual variability of ocean temperatures around South Georgia, Southern Ocean: forcing by El Niño/Southern Oscillation and the Southern Annular Mode. *Deep Sea Research II* 55, 000-000. (accepted; final version received)
- Montes-Hugo, M.A., Vernet, M., Martinson, D.G., Stammerjohn, S.E., Smith, R.C., 2008. Long-term variability on phytoplankton size structure of Antarctic waters: 1997-2006 cruises, Western Shelf of Antarctic Peninsula. *Deep Sea Research II* 55, 000-000. (in review)
- Patterson-Fraser, D.L., Fraser, W.R., Stammerjohn, S.E., Ribic, C.A., Martinson, D.G. Wind effects on Southern giant petrel (*Macronectes giganteus*) breeding success and implications to demography. *Deep Sea Research II* 55, 000-000 (in preparation)
- Ross, R.M., Quetin, L.B., Martinson, D.G., Iannuzzi, R.A., Stammerjohn, S.E., Smith, R.C., 2008. Palmer LTER: Patterns of Distribution of Five Dominant Zooplankton Species in the Epipelagic Zone West of the Antarctic Peninsula, 1993 - 2004. *Deep Sea Research II* 55, 000-000. (accepted; final version in preparation)
- Smith, R.C., Martinson, D.G., Stammerjohn, S.E., Iannuzzi, R.A., Ireson, K., 2008. Bellingshausen and Western Antarctic Peninsula Region: Pigment biomass and sea ice spatial/temporal distributions and interannual variability. *Deep Sea Research II* 55, 000-000. (accepted; final version received)
- Stammerjohn, S.E., Martinson, D.G., Smith, R.C., Iannuzzi, R.A., 2008. Sea Ice in the Western Antarctic Peninsula Region: Spatio-Temporal Variability from Ecological and Climate Change Perspectives. *Deep Sea Research II* 55, 000-000. (accepted; final version in preparation)
- Vernet, M., Martinson, D.G., Iannuzzi, R.A., Stammerjohn, S.E., Kozlowski, W., Sines, K., Smith, R.C., Garibotti, I., 2008. Primary Production within the Sea Ice Zone west of the Antarctic Peninsula. *Deep Sea Research II* 55, 000-000. (reviewed and in revision)