Annual Report for Period: 10/2007 - 09/2008
Submitted on: 09/16/2008
Principal Investigator: Ducklow, Hugh W.
Award ID: 0217282
Organization: William & Mary Marine Inst
Submitted By:
Ducklow, Hugh - Principal Investigator
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:

Name: Dolbaum, Helen
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Wilkinson, Whitney
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: Erdmann, 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:

Name: Randolph, Aaron
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Cotton, Charles
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Metheny, Nicholas
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Baker, Scott
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Fink, Douglas
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Franklin, Mike
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Kao, Albert
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Dallin, Natasha
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

Name: Morgan, Erin
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: 2008
REU Funding: REU supplement

Name: Pistone, Kristina
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: Scripps Institution of Oceanography
Home Institution Highest Degree Granted(in fields supported by NSF): Doctoral Degree
Fiscal year(s) REU Participant supported: 2008
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 Grzymski 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

National Science Teachers Association

International Polar Books Club

http://www.grida.no/polarbooks/about.aspx

Moonlight Publishing

University of Michigan

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
Kirsten Carlson, children's book illustrator and designer
Kristen McCurry, children's book editor
William Decker, University of California San Diego licensing dept.
Diane McKnight, University of Colorado
Amy Rhinehart, Moonlight Publishing
Monica Elsner, Central Arizona LTER
Rhian Salmon, Education Coordinator, International Polar Year
Lauren Haney, polar books project coordinator
Melissa Pirkin, Point Reyes Bird Observatory National Wildlife Refuge
NOAA National Marine Fisheries/Southwest Fisheries Science Center
Hubbard Brook LTER (Children's Book Fund)
Erin Oleson, Scripps Institution of Oceanography
Donna Fraser, Polar Ocean Research Group
Moira Decima, graduate student, CCE LTER

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:

Educational Research Findings

The increased influence of the whole language approach to learning and the added emphasis for educators to infuse ocean literacy principles into educational products affected the majority of Palmer's K û 12 educational and outreach efforts this year. Palmer engaged in writing its first children's science trade book, called Sea Secrets: Tiny Clues to a Big Mystery due out in the Fall, 2008. It is a collaborative project integrating the research behind two LTER sites. It focuses on three ocean mini-mysteries involving a bird, a whale and a penguin taking the reader on a journey through the Pacific Ocean from the California Current down to the polar waters west of the Antarctic peninsula. Combining science

exploration, field-work and ocean discovery, it engages the reader in long term observations about the Pacific ocean and how three of these ocean animals might possibly be connected. Understanding the ocean is integral to understanding the planet on which we live and we feel the book helps to visualize that connection. Our children's book was designed with the intention of helping students see what's happening around the world and how it's all connected. Because incorporating trade books into classrooms is occurring around the world (Madrazo G. 1997), Sea Secrets is a means to translate some of those connections.

To assist readers in understanding the complex topics in the book we are involved in the ongoing development of an activity guide that will compliment the book and showcase a collection of activities, experiments, case studies and fact sheets for elementary through high school level children. These additional resources provide educators, students and general users the opportunity to engage in the science on another level and elaborate on a few of the connections that naturally exist between science and other subjects like language arts, art and mathematics. Our intention in developing an activity guide is to provide readers opportunities to investigate science in more personally meaningful ways and encourage them to go out and explore their ocean environment (Frederick, 2003).

Project Development and Education and Outreach Activities (2008)

The essence of our education and outreach program this year centered around connecting with people including scientists, informal and formal organizations, graduate students, artists, writers, editors and other educational coordinators. These interactions not only developed the books concept but also assured us the science was accurate, integrated and international. Securing the endorsement of the International Polar Book Club broadened our outreach efforts beyond the states and allowed us to share our science stories and their connections on a global scale. This fortified Palmer's education and outreach involvement in the International Polar Year for 2008 and creates potential partnerships over the next several years. Sea Secrets contributed to the initial launch of the polar book clubs website http://www.grida.no/polarbooks/
and will continue to collaborate with the clubs participants.

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 Nitrosospira-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,

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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 xontributes to the disciplines of physical, biological and chemical oceanography, Antarctic and climate science.

Contributions in Education and Outreach (2008)

The children's book and the activity guide summarize the majority of our outreach efforts this year and have truly demonstrated cross-site collaboration, network level participation and the integration of research and education. Our public speaking engagement (NMEA, 2008) titled Translating Science to Teach intends to communicate the interchange between research and the teaching community and demonstrates ways to transform science into exceptional learning experiences. Sea Secrets will exemplify this and help articulate our findings with other marine educators from all over the country. Our involvement here also affords us the opportunity to expose our books website http://cce.lternet.edu/outreach/seasecrets/. and demonstrate other supportive materials on our site education and outreach webpage http://pal.lternet.edu/outreach.

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.

(2008) The children's book is part of a larger effort to open communication between formal science institutions and the general public. The book is a means to contribute to the dynamic learning environment created when translating the social aspects of science, its perspectives, methods, data and knowledge. Maintaining this communication fosters a culture that supports a community of learning among site research science, the surrounding community and the broader public going beyond the discipline. (Hodson, 2003)

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
Animal, Human Subjects, Biohazards: None

Categories for which nothing is reported:

RESEARCH ACTIVITIES: Palmer LTER 2007-2008.

Note: This award is currently in a no-cost extension period following the scheduled end on Sept 30, 2008. The purpose of the extension is to facilitate transition from the existing co-PIs Vernet and Ross-Quetin to new co-PIs Schofield and Steinberg, as well as data submission by Vernet and Ross-Quetin. This annual report is abbreviated. A full narrative description will be submitted as the Final Report.

Field Season. In April, 2008 we completed the sixth and last field season of the current award 0217282, and the 17th in the Palmer LTER program that commenced in 1991-92. The annual summer cruise (LMG 08-01, L. Quetin, Chief Scientist) and summer season at Palmer Station were both successful. Field operations commenced at Palmer Station in mid-October and continued until the end of March with few 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.

We also recovered and redeployed the first physical oceanography mooring with conductivity and temperature sensors and current meters at Station 300.100. Five additional moorings were deployed for Doug Martinson's IPY SASSI project. The goal of these moorings is to detect intrusions of warm, nutrient-rich Upper Circumpolar Deep Water (UCDW). They will be recovered and turned around in January 2009.

Meetings. Our annual meeting was held at the MBL in Woods Hole, MA in August, 2007. This meeting was attended by Ducklow, Bill Fraser, Sharon Stammerjohn, Doug Martinson, Karen Baker, Beth Simmons and new PAL co-PIs Scott Doney (WHOI), Debbie Steinberg (VIMS) and Oscar Schofield (Rutgers). The main focus of the annual meeting was new scientific directions for PAL in 2008-14. Ducklow, Fraser, Martinson and Stammerjohn attended the Antarctic Integrated and Systems Science (AISS) Workshop at NSF in June, 2007. Ducklow co-organized a workshop on Antarctic Socio-Ecology with Berry Lyons (MCM). It was held in May in Baltimore in conjunction with the LTER Science Council Meeting. A separate report on this meeting was filed earlier. Several PAL co-PIs and their students, technicians attended and presented papers or posters the Ocean Sciences Meeting in Orlando, FL in February.

Publications. A package of papers focusing on longer-term analyses of PAL results was submitted to Deep-Sea Research, part II in April. The papers have been published online and will be published as a special dedicated volume later this year.

Data Management. Initial design of Datazoo, an information system that provides a single portal to multiple applications, was completed and the system launched as a production system at the end of 2007. With developers and users having full functionality assembled in one dataspace, the system was largely redesigned in 2008 in order to achieve a more robust internal architecture and a more transparent stakeholder interface. In this process a logging of user access was established. Modules including the unit dictionary, participant module, and term set lists were restructured into an API form thus providing a more serviceable and extensible infrastructure from which to grow (Conners and Kortz, 2008). A core feature of the information system is data and metadata management through web interfaces with tiered permissions that enable data providers to participate in making their data accessible. The new system is built upon

a relational database with object-oriented API layer that supports Web-based data query, integration, and exchange. Interdependent sets of dictionaries describe datasets to the column level. There are currently 39 cruise datasets (studies) in the data system together with three non-cruise long-term non-cruise datasets (weather, ice, and sedimentation). Having redesigned the display interface and having added a comprehensive management interface in the last year, we will turn in the next year to populating the database with recent as well as legacy datasets.

Education and Outreach. Palmer engaged in writing its first children's science trade book, called *Sea Secrets: Tiny Clues to a Big Mystery* due out in the Fall, 2008. It is a collaborative project integrating the research behind two LTER sites. It focuses on three ocean mini-mysteries involving a bird, a whale and a penguin taking the reader on a journey through the Pacific Ocean from the California Current down to the polar waters west of the Antarctic peninsula. Combining science exploration, field-work and ocean discovery, it engages the reader in long term observations about the Pacific ocean and how three of these ocean animals might possibly be connected.

The essence of our education and outreach program this year centered around connecting with people including scientists, informal and formal organizations, graduate students, artists, writers, editors and other educational coordinators. These interactions not only developed the books concept but also assured us the science was accurate, integrated and international. Securing the endorsement of the International Polar Book Club broadened our outreach efforts beyond the states and allowed us to share our science stories and their connections on a global scale. This fortified Palmer's education and outreach involvement in the International Polar Year for 2008 and creates potential partnerships over the next several years. *Sea Secrets* contributed to the initial launch of the polar book clubs website **http://www.grida.no/polarbooks/** and will continue to collaborate with the clubs participants. Currently we are negotiating to have Sec Secrets on sale at the store at Palmer Station.

RESEARCH FINDINGS: Palmer LTER 2007-2008.

Note: This award is currently in a no-cost extension period following the scheduled end on Sept 30, 2008. The purpose of the extension is to facilitate transition from the existing co-PIs Vernet and Ross-Quetin to new co-PIs Schofield and Steinberg, as well as data submission by Vernet and Ross-Quetin. This section is adapted from the recent proposal. A full narrative description will be submitted as the Final Report.

Overall. Our recent results emphasize detailed analyses of long-term spatial and temporal patterns, and understanding the variability and trends about those patterns. We have developed long-term climatologies (average spatial distributions) of properties and have begun to determine the relationships among their space and time variations using empirical orthogonal function (EOF) analysis. A group of papers describing this work is now published online in Deep Sea Research Part II (Ducklow 2008).

The life histories of most polar marine species have evolved to be phenologically synchronized with the seasonal cycle of sea ice. We have identified seasonal patterns of sea ice variability and climate co-variability to assess how the seasonal cycle is changing in the west Antarctic Peninsula (WAP) region (Stammerjohn *et al.*, 2008a). Four new metrics of seasonal sea ice variability relevant for understanding ice-climate and ice-ecosystem co-variability were extracted from spatial maps of satellite derived daily sea ice concentration: (a) day of advance, (b) day of retreat, (c) the total number of sea ice days (between day of advance and retreat), and (d) the percent time sea ice was present (or sea ice persistence). The spatio-temporal variability describes distinct on-to-offshore and alongshore differences in ice-ocean marine habitats, characterized overall by a longer sea ice season in coastal regions (6.8 to 7.9 months) versus a shorter sea ice season over the shelf (4.1 to 5.3 months), with on-to-offshore differences increasing south-to-north. These sea ice changes impact *seasonal* ice-ecosystem interactions, are contributing to climate migration along the WAP, and are profoundly changing the WAP marine ecosystem.

Our CTD dataset offers the most long-lived, consistent gridded observations of Antarctic waters (Martinson *et al.*, 2008). The physical characteristics, water column structure and spatio-temporal modes of variability are related to clearly defined variations in plankton distributions and processes. The water masses in the study region are well separated according to classic T-S defined water mass characteristics and bathymetrically controlled features, dividing the sample domain into three sub-regions: slope, shelf and coastal waters Consistent with isolated observations reported previously, the ACC is always present along the shelf-break where the Upper Circumpolar Deep Water (UCDW) marks its farthest southern extent in the WAP. Flooding of UCDW onto the continental shelf provides the heat responsible for providing ~28 Wm^{-2} on annual average to the WAP, which is presently undergoing the most rapid recent regional winter warming on Earth. The spatio-temporal variability of the delivery and distribution of ocean heat is consistent with changes in the state of ENSO and in the strength of the SAM.

We used satellite imagery to examine physical forcing and possible mechanisms influencing the distribution of phytoplankton biomass in the WAP (Smith *et al.*, 2008). SeaWiFS observations of chlorophyll-a (Chl-a) responses to the spatial and temporal variability of sea ice extent (derived from passive microwave satellite data) has provided the most complete synoptic space/time views of phytoplankton biomass within this

region to date. The 7 years of ocean color data exhibit high interannual variability, but persistent spatial patterns of phytoplankton biomass indicate important regional-scale physical controls on phytoplankton blooms. These include the position of the marginal ice zone and its impact on the mixed layer depth, the timing of spring sea ice retreat, the presence of the Southern Antarctic Circumpolar Front (SACCF, or southern edge of the Antarctic Circumpolar Current, ACC) and teleconnections with sub-polar regions (see above). The satellite observations suggest that the SACCF may be as important as sea ice retreat in facilitating spring phytoplankton blooms, depending on if and when (e.g., Nov) the frontal region is ice free.

In shelf waters of the WAP, with abundant macro- and micronutrients, water column stability is the main factor controlling primary production. Freshwater input from melting sea ice forming a shallow summer mixed layer is the principal factor in stabilizing the upper water column. Retreating sea ice in the spring and summer define the area of influence. A 12-year time series (1995-2006) confirms that the spatial and temporal patterns in primary production are related to sea ice dynamics and mixed layer depth (Vernet *et al.*, 2008). Average primary production rates vary by an order of magnitude, from <20 to >100 mmol C m^{-2} d^{-1} in midsummer (January). A strong onshore-offshore gradient is evident with higher production observed in inshore waters. High primary production in January is associated with enhanced shelf production to the south. Positive annual primary production anomalies are related to positive anomalies in the timing of sea ice retreat in the spring and summer (i.e., late retreat) supporting the hypothesis that production in the WAP shelf is related to ice-mediated ocean dynamics. To first order, shallower summer mixed layer depths on the shelf correlate with late sea retreat, in support of the hypothesis that water column stability promotes higher primary production. Mean Chl-a has increased in the south and decreased in the north since 1986.

The temporal and spatial variability of phytoplankton size structure was also investigated using the satellite record (Montes-Hugo *et al.*, 2008). Time series of an optical satellite-derived phytoplankton size structure index as well as of Chl-a, sea ice extent, temperature, salinity, nutrients, and mixed layer depth were analyzed in relation to ENSO and SAM. Temporal transitions in cell size coincided with a switch in ENSO and SAM anomalies as well as an increase in heat content of shelf waters over the WAP region. A greater frequency of southerly winds during spring and autumn (as can occur during El Nino and/or –SAM) is expected to favor the dominance of 'small' (<20 μm) phytoplankton cells in WAP waters. Conversely, the greater intensification of the Antarctic Circumpolar Current interaction with the WAP shelf-break during +SAM is expected to intensify topographically-induced upwelling and favor the dominance of 'large' (>20 μm) phytoplankton cells (mainly diatoms) that are known to flourish in upwelling systems and well-mixed waters.

Analyses of the 12-yr time-series (1993-2004) of oblique net hauls (Ross *et al.*, 2008) showed that the numerically dominant macro- and mesozooplanktonic species >2 mm included three species of euphausiids (*Euphausia superba,* Antarctic krill*; Thysanoëssa macrura*; *Euphausia crystallorophias*, ice krill), a shelled pteropod (*Limacina helicina*), and a salp (*Salpa thompsoni*). Life cycles, life spans, and habitat varied among these species. Patterns in the climatological distributions of these five species were distinct, and correlated with sea ice parameters. Common features included higher abundance in the north compared to the south, independent of the cross-shelf gradients, and cross-shelf

gradients with highs in abundance either inshore (*E. crystallorophias*) or offshore (*S. thompsoni*). Anomalies revealed cycles in the population, such as episodic recruitment in Antarctic krill. The episodic pattern in krill recruitment was two strong year classes in succession followed by three or four moderate or poor year classes. The krill recruitment index was positively correlated with the absolute value of a seasonal ENSO index, with strongest recruitment during the neutral or moderate periods of ENSO (Fraser and Hofmann, 2003; Quetin and Ross, 2003).

Capitalizing on observations (Fraser and Hofmann, 2003; Patterson *et al.*, 2003; Fraser *et al.*, 2008), natural and planned field experiments (Massom *et al.*, 2006) and integration through modeling (Chapman *et al.*, 2008), the consequences of changes in the phenology of sea ice advance and retreat continue to emerge as key deterministic processes regulating Adélie penguin (*Pygoscelis adelaie*) population dynamics. While this observation is not new to PAL, recent results combined with model-based studies suggest that the processes in question operate over scales that are much smaller than previously thought, and affect Adélie penguin population dynamics by imposing greater or smaller energetic costs on key life history parameters. Foraging success was strongly mediated by the length of the sea ice season through its effects on krill recruitment (Fraser and Hofmann, 2003) and changes in the spatial and temporal patterns of access to these key foraging areas, especially during the critical winter period (Fraser *et al*., 2008).

Vertical export of particles from the upper 160 m into as estimated by sediment trap collections (1993 – 2007) (Ducklow *et* al., 2008) exhibited strong seasonality with high fluxes (1-10 mmol C m^{-2} d^{-1}) in November-March following ice retreat and very low fluxes (<0.001 mmol C m^{-2} d^{-1}) during the Austral winter and under sea ice cover. An average of 75% of the annual export of 196 mmol C m^{-2} occurred during the seasonal flux pulse. Over the trap record, the peak flux has shifted to occur later in the Austral summer by about 40 days since 1993. This is about the same as the increase in duration of the ice-free period in this region, believed to be a response to rapid climate warming.

Taken together all of our results of over a decade of observations and process studies (rate measurements and coordinated observations over diel to seasonal timescales) indicate several key findings: the rapid warming and loss of sea ice, dependence on sea ice variability at all trophic levels, the input of UCDW and associated heat onto the shelf, distribution patterns of biota dominated by strong gradients in the north-south (reflecting the polar-maritime climate gradient) and inshore-offshore (reflecting gradients in sea ice duration, oceanic influences and possibly glacial freshwater inputs) distribution patterns.

INFORMATION MANAGEMENT

Having established a local, long-term informatics environment supporting PAL research through articulation work (Baker and Millerand, 2007 HICSS), enactment mechanisms (Millerand and Bowker, in press), and recognition of distinct knowledge provinces (Baker and Millerand, 2007, ASIST), comparative studies were undertaken within the Ocean Informatics framework that led to articulation of a set of informatics strategies for marine science (Baker and Chandler, in press) and to definition of information infrastructure (Bowker et al, in press). We have also explored information issues associated with data curation and the digital library community (Karasti, Baker, and Schmidt, 2007; Yarmey, 2008a, 2008b) and have proposed an augmented approach to the school of Participatory Design (Karasti and Baker, in press).

Education and Outreach. The increased influence of the whole language approach to learning and the added emphasis for educators to infuse ocean literacy principles into educational products affected the majority of Palmer's K – 12 educational and outreach efforts this year. Palmer engaged in writing its first children's science trade book, called *Sea Secrets: Tiny Clues to a Big Mystery* due out in the Fall, 2008. It is a collaborative project integrating the research behind two LTER sites. It focuses on three ocean mini-mysteries involving a bird, a whale and a penguin taking the reader on a journey through the Pacific Ocean from the California Current down to the polar waters west of the Antarctic peninsula. Combining science exploration, field-work and ocean discovery, it engages the reader in long term observations about the Pacific ocean and how three of these ocean animals might possibly be connected. Understanding the ocean is integral to understanding the planet on which we live and we feel the book helps to visualize that connection. Our children's book was designed with the intention of helping students see what's happening around the world and how it's all connected. Because incorporating trade books into classrooms is occurring around the world, *Sea Secrets* is a means to translate some of those connections.

To assist readers in understanding the complex topics in the book we are involved in the ongoing development of an activity guide that will compliment the book and showcase a collection of activities, experiments, case studies and fact sheets for elementary through high school level children. These additional resources provide educators, students and general users the opportunity to engage in the science on another level and elaborate on a few of the connections that naturally exist between science and other subjects like language arts, art and mathematics. Our intention in developing an activity guide is to provide readers opportunities to investigate science in more personally meaningful ways and encourage them to go out and explore their ocean environment.