Benthic Carbon Cycling within the RUSALCA Program

Jackie Grebmeier and Lee Cooper
Chesapeake Biological Laboratory
University of Maryland Center for Environmental Sciences
Solomons, Maryland, USA

March 11, 2012
RUSALCA PI Meeting
Miami, Florida
Warming Chukchi Sea

Shifts in (A) annual sea ice persistence and (B) chlorophyll a concentrations between 2003 and 2009. Fig. updated and modified from Grebmeier et al. 2010, courtesy of Karen Frey.
Benthic Carbon Cycling and Ecosystem Structure in the Pacific Arctic Region as part of RUSALCA

Objectives

• evaluate carbon export to benthos via sediment oxygen uptake and nutrient exchange studies (HAPS corer)
• sediment indicators (TOC, chl a, grain size)
• benthic infaunal population structure and biomass (133 cm² cores and 0.1 m² van Veen grabs)
• stable and radioisotope analyses

PIs: Jackie Grebmeier and Lee Cooper, UMCES/CBL
Sediment Community Oxygen Consumption - RUSALCA 2009

Predicted Sediment Community Oxygen Consumption (mmol O₂/m²/d):
- < 4
- 4 - 8
- 8 - 12
- 12 - 16
- 16 - 20

Map showing the distribution of predicted sediment community oxygen consumption across the region, with color gradients indicating different consumption rates.
Sediment community oxygen consumption 1984-2010

• spatial patterns indicative of the amount of carbon reaching the sediments

(updated from Grebmeier et al. 2006, unpubl. data)
High nutrient efflux from sediments in regions of high organic carbon deposition during RUSALCA 2009

- highest outflux nutrients in SE Chukchi Sea “hotspot” where highest carbon export and benthic infaunal biomass
- lowest outflux nutrients in offshore East Siberian Sea and north of Pt. Hope off Alaska
Sediment Chlorophyll a (mg/m²)-short-term indicator of carbon supply to benthos

- Depends on overlying water column production seasonally
C/N surface sediments - indicator of quality food supply
C/N versus C-13 carbon isotope relationship

\[ C/N = -14.246 - 0.968 \times \delta^{13}C_{\text{V-PDB}}; r^2 = 0.646 \]

Cooper et al. 2009, Deep-Sea Research
Comparison $\delta^{13}C$ values over time series (1993, 1995, 2004) in the Chukchi Sea

Cooper et al. 2009, Deep-Sea Research
1. Sediment community oxygen consumption (SCOC) and surface sediment chlorophyll (sed chl a) were highest under the Anadyr water in the SE Chukchi Sea and in portions of the East Siberian Sea and Long Strait, indicative of efficient carbon export to the benthos.

2. Areas of highest carbon export to the benthos (SCOC, sed chl a) coincident with highest areas of infaunal biomass (gC/m²) which are important prey to walrus gray whales, and bearded seals.

Thank you.

Acknowledgements: Many thanks to Betty Carvellas for assistance at sea as well as preparation of an outreach web journal posted at http://arctic.cbl.umces.edu. Stanislav Denisenko and Petr Strelkov (Zoological Institute, St. Petersburg, Russia) and Alexander Bosin and Alexander Kolesnik of the Pacific Oceanology Institute in Vladivostok, Russia) for assistance with deck operations on stations. Many thanks to Linton Beaven, Marisa Guarinello, Christian Johnson, Monika Kedra, Kathryn Osborne, Regan Simpson, and Lisa Wilt at CBL/UMCES for infaunal sortig and sediment analyses. GIS data interpolations and graphics were provided by Marisa Guarinello and Allyne Balard at CBL. Funding was provide by the Arctic Program (Climate Dynamics Office) of the US National Oceanic and Atmospheric Administration.