1. PROJECT INFORMATION

NPRB Project Number:	818
Title:	Walrus Distributional and Foraging Response to Changing Ice and Benthic Conditions in the Chukchi Sea
Subaward period	June 1, 2008 to May 30, 2010
Amount of funding	$ 176,349
Report period	January 1 to June 30, 2009
Report submission date	July 15, 2009
Lead Author of Report*	Dr. Chadwick Jay

**Although there may be only one lead author of the report, all PIs and co-PIs of the project, as identified in the approved statement of work and listed below, are responsible for the content of the Semiannual Progress report in terms of completeness and accuracy.*

Principal Investigator(s), Co-Principal Investigators and Recipient Organization(s):

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2. PROJECT OVERVIEW

a. Briefly (4-5 sentences) describe both the research purpose and the underlying need for this research.

Walruses make foraging trips from sea ice and land to feed on benthic organisms. During ice-free conditions in the Chukchi Sea, their access to offshore foraging areas is reduced and they become more dependent on nearshore resources. We propose to compare the foraging range and effort of walruses using land haul-outs as a consequence of shelf-free ice conditions to walruses using ice haul-outs in the Chukchi Sea. The foraging costs due to increased travel time to food patches from land may be significantly higher than the costs from sea ice haul-outs and result in reduced energy stores before wintering in the Bering Sea. We will also compare nearshore to offshore infaunal and epifaunal walrus prey communities and changes in these communities that may have occurred from retrospective analysis of archived benthic data. This project will provide insights into environmental mechanisms responsible for changing distributions and foraging behaviors in walruses from climate change that can ultimately impact benthic communities and walrus vital rates.

b. State your hypothesis(es).

We predict that foraging effort will be greater, and foraging range will be less, when walruses use land haul-outs than when they are able to use ice haul-outs. We predict that changing ice conditions over the past decade has resulted in a redistribution of productive areas and community structure. In addition, we

predict that the community structure of prey that is accessible to walruses from land haul-outs will be different than that in offshore areas where they can be accessed by walruses using sea ice haul-outs.

c. List the objective(s) of the research project, exactly as described in your approved Statement of Work.

1. Radio-tag walruses in summer from a ship in May/June and from small boats off Barrow June/July with support from other funding sources.
2. Radio-tag walruses that come to shore during minimum ice extent in fall with radio tags purchased in part from NPRB funding this proposal.
3. Compare location and behavioral data between walruses using ice-based haulouts with those from walruses using land-based haulouts.
4. Compile infaunal benthic data into a GIS database; epifaunal data are more qualitative
5. Analyze the spatial distribution of infaunal assemblages relative to environmental correlates and time periods.
6. Compare walrus foraging characteristics and locations between land-based and ice-based walruses and their relation to the distribution of infaunal benthic prey.

d. Provide a table showing the timeline and milestones for the entire project.

Timeline and Milestones
Project Duration: 2 years, June 1, 2008 – May 31, 2010

2008	**Completion Date**	**Outcome**
Order radio-tags	June	
Deploy radio-tags on walruses	September	Provide near real-time tracking data to public via USGS website after deployments
Compile walrus tracking and behavior data and pertinent benthic data into GIS database	December	
Complete summer Chukchi Sea field sampling-opportunistic (July); also support through other funding	July	Chukchi samples in process of sorting as well in line-up for sorting
Collecting data files for retrospective benthic analysis	December	
2009		
Graphically summarize walrus benthic faunal data; Presentation at annual NPRB symposium	January	Progress report to NPRB
Draft analysis of walrus and benthic data	June	
Past Chukchi Sea benthic data set being entered into GIS and PRIMER databases; processing new samples collected in summer 2008	ongoing	
Provide new benthic data for GIS entry to Chad Jay	Jan-ongoing	Prepare poster for NPRB Alaska Symposium
Final analysis	December	Present results to Eskimo Walrus Commission, FWS, and MMS

2010		
Presentation at annual NPRB symposium and/or AGU/ASLO Oceans meeting	Jan or Feb	
Draft report	February	
Presentation at the Oceans meeting in Portland, Oregon		
Final report	May	
Prepare manuscripts for journal submissions		

3. PROGRESS SUMMARY

a. Describe report period progress.

Objective #1.
As in summer of 2008, in June 2009, we again radio-tagged walruses in the southern portion of the Chukchi Sea. Thirty-four adult females were tagged and are being tracked as the majority of them move into the northern portion of the Chukchi Sea and a fewer number of them move into waters off the northern coast of Chukotka. Another set of radio-tags will be deployed off Barrow in July.

Objectives #2 and 3.
As described in the last progress report, radio-tags were purchased for deployment on walruses that come to shore during ice minimum conditions in fall 2008. Although the main pack ice retreated far to the north of the Chukchi continental shelf and over the deep Arctic basin as predicted, sparse remnant sea ice remained over parts of the shelf and persisted over the shelf long enough to provide walruses with sufficient haul-out platforms to remain offshore they did not come to shore (as they did during ice minimum conditions in 2007). As a result, we were unable to meet our objective of radio-tagging walruses on shore in September 2008. We will make another attempt to radio-tag walruses on shore in September, 2009. This effectively delays our fall collection tracking data from shore-based walruses by one year. As a result, we anticipate that we will request an extension on the project's final reporting deadline.

Objective #4 and 5.
We are accumulating and inputting all available infaunal and epifaunal abundance and biomass data from the Chukchi Sea, including faunal composition, into a GIS database. Although we have cruises overlapping the 2006-2008 time period, we also have nearly 25 cruises for inclusion in the retrospective analysis for the Chukchi Sea from 1970-2008 that we are including in our analyses.

b. Describe preliminary results.

We are compiling radio-tracking data from walruses radio-tagged in the southern portion of the Chukchi Sea in summers of 2008 and 2009 from other funding sources, and will begin analysis of these data in fall 2009. The first period of data collection from shore-based walruses was not completed as noted above and therefore data analysis of radio-tagged walruses from this part of the project has not yet begun.

For the benthic studies, Figure 1 presents some of the benthic infaunal diversity (left panel) and biomass (right panel) results for our retrospective study. From these retrospective analyses, the dominant fauna in the region of walrus feeding are bivalves, sipunculids and polychaetes (Fig. 1, left panel) and there are "hotspot" benthic biomass sites in the SE Chukchi Sea and to the NE near upper Barrow Canyon.

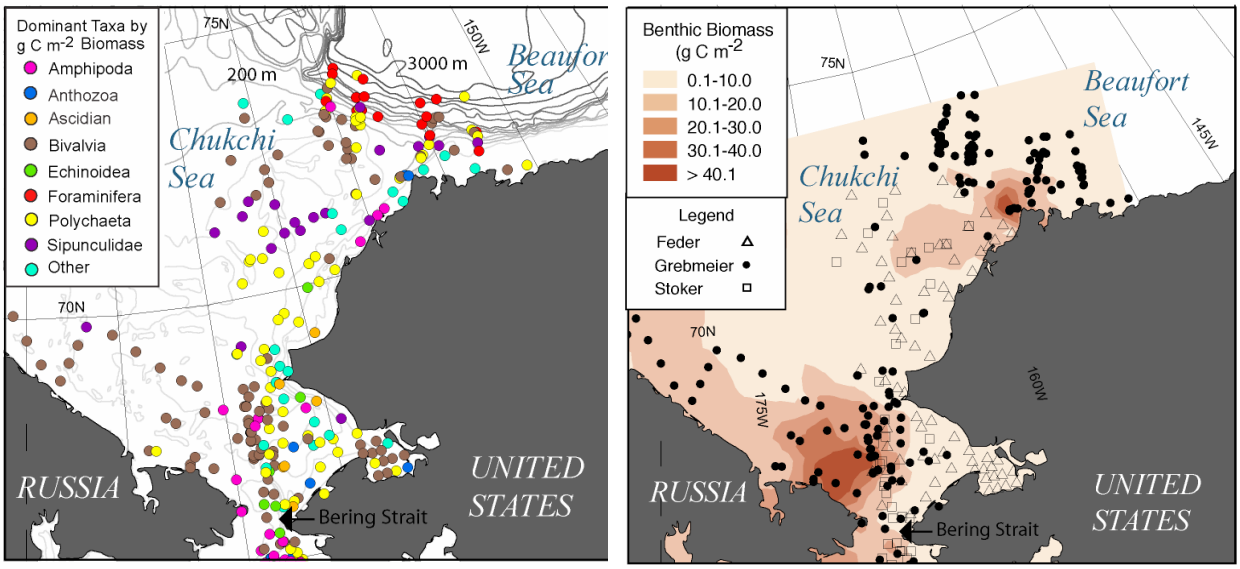

Figure 1. Distribution of dominant benthic infauna (by biomass, left panel) and associated station benthic biomass (right panel; this right panel figure is modified from Grebmeier et al. 2006) in the Chukchi Sea study area using Inverse Distance Weighting Prediction modeling (ESRI GIS software). Note that the different symbols in the benthic biomass map (right panel) are based on different data sets, with lead authors identified in Grebmeier et al. 2006 paper.

Reference. Grebmeier, J. M., L. W. Cooper, H. M. Feder, and B. I. Sirenko. 2006. Ecosystem dynamics of the Pacific-influenced Northern Bering and Chukchi Seas in the Amerasian Arctic. Progress in Oceanography 71:331-361.

c. Describe any concerns you may have about your project's progress.

The presence of remnant ice over the continental shelf in 2008 allowed walruses to remain offshore and therefore no radio-tagging was completed on shore. This project relies on obtaining information from walruses restricted to hauling on shore during ice minimum conditions in late summer-fall. We will make another tagging attempt in September 2009 and will likely request a project extension.

We will work to summarize the more spatially heterogeneous benthic data sets with the more localized tagged walrus locations, particularly when new tagging results are available.

d. Poster and oral presentations at scientific conferences or seminars

PI Jay made a visit to Savoonga on July 8-9 to participate in BSIERP's Local and Traditional Knowledge research component led by Henry Huntington. During that time, an oral presentation, which included information about this project, was given to the panel.

PI Grebmeier included some of the benthic retrospective data in a variety of oral presentations, including an invited talk at the Arctic Frontiers meeting in Tromso, Norway in January 2009, invited IPY talks in Lewis, Delaware in February 2009 and at Horn Point Laboratory/UMCES in Cambridge, MD in April 2009.

e. Education and outreach

PI Grebmeier was asked to prepare an Arctic lecture for ASLO for their web lecture series (http://www.aslo.org/lectures/), which was completed in January 2009. This lecture includes retrospective data and NPRB is acknowledged in the final slide of the presentation. Note that ASLO is obtaining a doi number so that my presentation has a copyright and I will receive publication credit for it.

4. PROGRESS STATUS

Field collection data from walruses radio-tagged on ice in the study area is going well. We are planning to collect similar data from walruses radio-tagged on the shores of Alaska, but whether walruses haul out onto shore this coming fall will be dependent on the severity of late summer/fall ice conditions. However, extreme ice minimum conditions are predicted again for this year and we will be ready to access shore-based walruses if they become available in September. This fall we will begin preliminary analyses of radio-tracking data collected in summers of 2008 and 2009.

We will continue the data entry and analyses, both GIS and PRIMER statistical studies, during summer and fall in order to produce more products for our analyses and to present for the next progress report. In addition, I plan to send my GIS technical assistant to Anchorage, AK in the fall to work with PI Chad Jay's research group to combine our benthic and walrus data sets for further GIS analyses.