APPENDIX G1-PacMARS Data Table

This document provides an annotated list of data sets considered and consulted during the PacMARS project, a listing of government organizations funding scientific collections, and a list of data archives. Our goal was to develop a comprehensive list of studies, datasets and key multidisciplinary projects in the Chukchi and Beaufort Sea region. We include expanded descriptions of data sets, links to corresponding websites, databases and points of contact. We have also included annotations on the perceived value of the accessible data to the PacMARS project. These judgments are made solely regarding the suitability of the datasets considered for the specific goals and objectives of PacMARS, and do not constitute an opinion in any other context. This document is based upon a table referred to as "Appendix A" that was included in progress reports submitted to the North Pacific Research Board and available on the PacMARS website (http://pacmars.cbl.umces.edu/). Projects/datasets are listed in alphabetical order according to acronym or long title within separate sections associated with specific themes listed below. Note that we also describe how data products are being simultaneously used during the parallel Synthesis of Arctic Research (SOAR) project within the Upper Trophics section.

Sections:

G1.1 Physical Oceanography, Chemistry and Contaminants

G1.2 Lower Trophic Levels: Plankton and Benthos

G1.3 Upper Trophic Levels: marine mammals, seabirds, and fish

G1.4 Biodiversity Programs

G1.5 Human and Social Sciences

G1.6 Multidisciplinary Programs

G1.7 Federal and State Science Programs

G1.8 Data Portals

G1.1 Physical Oceanography, Chemistry and Contaminants

G1.1 a. Physical oceanography

Beaufort Gyre Exploration Project
This Woods Hole Oceanographic Institution project is a component of the Arctic Observing Network and is described with its international partners under JWACS, the Joint Western Arctic Climate System project.

EDMIZ - Emerging Dynamics of the Marginal Ice Zone
http://www.onr.navy.mil/Science-Technology/Departments/Code-32/All-Programs/Atmosphere-Research-322/Arctic-Global-Prediction/Marginal-Ice-Zone-DRI.aspx
This is a new physical and acoustically oriented arctic research program including a sea ice emphasis that will use autonomous sampling systems. The program started in fiscal year 2012, and will work in the Beaufort Sea. Martin Jeffries at the Office of Naval Research is the key contact and a project webpage documents funded investigators and science plans at
http://www.apl.washington.edu/project/project.php?id=miz

GINA - Geographic Information Network of Alaska
http://www.gina.alaska.edu/

The Geographic Information Network of Alaska (GINA) is a University of Alaska based resource, which includes mapping tools and links to data sources. Several marine oriented projects are highlighted, including the Alaska Shorezone Mapping Project (described above under ALCC) and Seasonal Ice Zone Observing Network (SIZONET; described above under ELOKA). The GINA site primarily points to other archives of data, including the one used by the North Slope Science Initiative (NSSI), see especially the North Slope Science Catalog, http://catalog.northslope.org/, which includes a comprehensive search engine for North Slope data that has been identified by the NSSI.

IMS – Institute of Marine Science (University of Alaska Fairbanks)
http://www.sfos.uaf.edu/dm/ims-data-archive/DataBase
Key contact: Steve Okkonen, okkonen@alaska.net

The Institute of Marine Science, University of Alaska Fairbanks (UAF), is the lead oceanographic research institute for this US arctic-based university. Multi-disciplinary data are available from RV Alpha Helix cruises, some Russian, Japanese and NOAA vessel cruises (presumably with UAF researchers aboard). Some data is as early as from the 1960s. Physical oceanographic data from this resource was directly used in the PacMARS synthesis efforts.

NASA PODAAC – National Space and Aeronautics Administration (NASA) Physical Oceanography, Distributed Archive Center (PODAAC)
http://podaac.jpl.nasa.gov/

NASA's Physical Oceanography Distributed Archive Center (PODAAC) is NASA's satellite oceanographic data center. Among the products available include QuikSCAT arctic sea ice imagery and animations that show the decline of multiyear ice, as well as oceanographic data, but few data products are available at this time for the PacMARS study area.

Polar Science Center/University of Washington (PSC/UW)
http://psc.apl.washington.edu/
POC: Rebecca Woodgate <woodgate@apl.washington.edu>
The Polar Science Center includes investigators at the University of Washington conducting interdisciplinary research on the oceanography, climatology, meteorology, biology and ecology of the ice-covered regions on Earth and elsewhere in the solar system. Specifically, data from the long term Bering Strait moorings and North Pole Environmental Observatory are housed there, as well as at EOL.

SCICEX - Submarine Arctic Science Program
http://nsidc.org/scicex/data_inventory.html/

The Submarine Arctic Science Program (SCICEX) facilitated the participation of civilian scientists on research cruises about US Navy submarines during the 1990s. More recently, reductions in size of the US submarine fleet and changes in operations have reduced the capability to host civilian scientists, and all sampling efforts since 1998 have used US Navy personnel. Available data can be downloaded at the referenced webpage and additional information on the history and background on the program, as well as the advisory committee members who currently advise on sampling requests are available at http://nsidc.org/scicex/history.html and http://nsidc.org/scicex/sac.html. PacMARS PI Okkonen participated in the onboard sampling program. The results of the SCICEX program are important to understanding Arctic oceanography; for example the Study of Arctic Change (SEARCH) framework that includes the Arctic Observing Network can be traced to observations of shifts in the Pacific influenced front in the central Arctic Ocean during the 1993 USS Pargo SCICEX cruise. There are some connections with the PacMARS study area, such as the observations of high organic carbon fluxes originating from the Chukchi shelf (Guay et al. 1999; Geophys. Res. Lett., 26, 1007-1010), but sampling during SCICEX was limited to areas outside the 200-mile Exclusive Economic Zone (EEZ) of any other country, so no sampling was permitted during transits within any EEZ. As a result, we think the available data has relatively low utility for the research questions and synthesis required for PacMARS.
NRC – National Research Council http://www.nap.edu/catalog.php?record_id=13132

G1.1b. Chemistry and Contaminants

ANWAP – Arctic Nuclear Waste Assessment Program

The Arctic Nuclear Waste Assessment Program arose out of concerns in the 1990's that radioactive disposal practices in the former Soviet Union had contributed to contamination of the Arctic Ocean and its ecosystem. The program was funded through the Office of Naval Research, but unfortunately it seems to have pre-dated the systematic archiving of research data and there is no central archive. Some date are available in National Snow and Ice Data Center (http://www.nsidc.org/), particularly those collected during the 1994 Transarctic cruise of the USCGC Polar Sea and the Canadian Coast Guard Service Louis S. Laurent, which was supported in part by ANWAP funding. In other cases, the data sets are relatively small in size and were directly presented in peer-reviewed publications. Insights about sea ice transport of contaminants and sedimentation patters have relevance to PacMARS objectives, as do inventories of radionuclides in marine mammals harvested as food by Alaska Natives. Other significant findings of the program related to riverine contributions to the Arctic Ocean, sedimentation in the deep Arctic Ocean, the export of sea ice borne contaminants in the Transpolar Drift, and Arctic Ocean circulation inferred from tracer distributions from both Russian and western European sources. This program was loosely coordinated with other international efforts on the same topic led by other countries concerned about radionuclide contamination, including programs with participation of scientists from Korea, Norway, Japan, Russia, and the International Atomic Energy Agency. Two documents, available as .pdf files,

provide general information about ANWAP, including the names of principal investigators, and references to publications from the project: http://www.tos.org/oceanography/archive/10-1_edson.pdf http://ota.fas.org/reports/9504.pdf

Habitat Assessment and Marine Chemistry
http://www.afsc.noaa.gov/ABL/Habitat/ablhab_default.php
Data sets = http://www.afsc.noaa.gov/ABL/Habitat/ablhab_datasets.htm
POC: Ed Farley Ed.Farley@noaa.gov

The Habitat Assessment and Marine Chemistry Program conducts research on chemical and ecological processes that occur in marine, tidal, and watershed habitats ranging from the Arctic to the Gulf of Alaska. This program attempts to assess bioenergetics in various species and life stages, assess the impact of development and contaminants on these species and their habitats, and map and evaluate their habitat quality. Of particular note for PacMARS is the beach seining project near Barrow, Alaska, formerly led by Scott Johnson (retired) and John Thedinga (retired); Mandy Lindeberg is the current lead for that project, the data from which will be included in the SOAR project (Appendix G3).

G1.2 Lower Trophics: Zooplankton and Benthos

(NOTE: many disciplinary data sets available within the results listed in the multidisciplinary program section of Appendix G1.6)

G1.2a. Plankton

COPEPOD – The Global Plankton Data Base
http://www.st.nmfs.noaa.gov/copepod/
"The *Coastal & Oceanic Plankton Ecology, Production & Observation Database* (COPEPOD) is an online database of plankton abundance, biomass, and composition data compiled from a global assortment of cruises, projects, and institutional holdings. COPEPOD's online zooplankton and phytoplankton data content ranges from long term ecosystem monitoring surveys to detailed process studies, each accessible via a variety of search options, and each detailed via standard visual and text-based content summaries."

NOGAP - Northern Oil and Gas Action Program
http://www.arcodiv.org/Database/Plankton_datasets.html
Zooplankton and Benthos Canadian Beaufort Sea shelf
In this program in 1986, zooplankton were collected from the Canadian Beaufort Sea shelf in May, (with ice cover), and July to September (open water). The object of the study was to assess species composition, abundance, distribution and biomass of zooplankton across the Canadian Beaufort Sea. These data are among the data sets digitized during ArcOD (see ArcOD entry above). The data archive and metadata for this project, as well as a number of other zooplankton data sets are available on the ArcOD zooplankton website (http://www.arcodiv.org/Database/Plankton_datasets.html), benthos is available at www.iobis.org (data provider ArcOD)

G1.2b. Benthos

Chirikov Basin Macrobenthos
Web address: http://www.nodc.noaa.gov/cgi-bin/OAS/prd/accession/details/8900116, http://www.arcodiv.org/Database/Benthos_datasets.html
POC: Kenneth Coyle, University of Alaska Fairbanks, (907) 474-7705
This data set includes data documenting Ampeliscid amphipod abundances in the gray whale feeding areas of the northern Bering Sea, including biomass and abundance. For select cruises, abundance and biomass for the entire infaunal community is available (ArcOD link). These are data sourced from two National Science Foundation projects funded to the University of Alaska Fairbanks in the 1980s and 2000s; a fraction of the data is being archived on the EOL website as part of PacMARS efforts. Some of these data will be used in the SOAR benthic-focused project (SOAR, Appendix G3).

NPRB #604 Norton Sound benthic fauna
http://doc.nprb.org/web/06_prjs/604_Final%20report.pdf

This study used 1976-2006 bottom-trawl surveys to examine changes in distribution and biomass of dominant benthic epifauna and demersal fishes in Norton Sound. The project determined that species composition did not change over time. However, trawl catch grew significantly, driven by an increase in biomass of primarily one sea star species. The variability in biomass for each species sampled was compared to environmental parameters and indices. Several significant correlations were identified for variables in Norton Sound (east-west wind component, incident solar radiation, and the annual duration of

ice-free waters), as well as one large-scale climate index (the Pacific-North American Index). Despite this, it is clear that over this time period, biological response to climate was complex and there is no simple predictive model for both water column fish and epibenthos.

G1.3 Upper Trophics: Marine Mammals, Seabirds, and Fish

G1.3a. Marine Mammals

ASAMM - Aerial Surveys of Arctic Marine Mammals, funded by NOAA and BOEM
http://www.afsc.noaa.gov/NMML/cetacean/bwasp/index.php
POC: Megan Ferguson, megan.ferguson@noaa.gov

The Aerial Surveys of Arctic Marine Mammals (ASSAM) project is a continuation of the Bowhead Whale Aerial Survey Project (**BWASP**) and Chukchi Offshore Monitoring in Drilling Area (**COMIDA**) marine mammal aerial survey projects. Inter-agency agreements have been established for support of this activity between the Bureau of Ocean Energy Management (BOEM), Department of Interior and the National Marine Mammal Laboratory (NMML), Alaska Fisheries Science Center, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Department of Commerce. The goal of these studies is to document the distribution and relative abundance of bowhead, gray, right, and fin whales, belugas, and other marine mammals in areas of potential oil and natural gas exploration, development, and production activities in the Alaskan Beaufort and northeastern Chukchi Seas. There are links to information on aerial surveys of marine mammals at this site over a 30+ year period. Megan Ferguson is the NMML contact who can advise on crediting requirements and comment on technical use of the data. The data set itself is in Microsoft Access format. Information from these aerial surveys is being widely incorporated into various SOAR analyses and papers (Appendix G3), as well as the PacMARS data synthesis understanding of marine mammals distributions relative to other ecosystem variables and forcing functions. Data are available here:
http://www.afsc.noaa.gov/NMML/software/bwasp-comida.php

BWASP - Bowhead Whale Aerial Survey Project
http://www.afsc.noaa.gov/NMML/cetacean/bwasp/flights_BWASP.php)
This aerial survey project is now part of the ASSAM program, outlined above.

NMML - National Marine Mammal Laboratory
http://www.afsc.noaa.gov/nmml/; see also Angliss NSSI FY13 update ppt presentation
POC(s): John Bengtson, Director <john.bengtson@noaa.gov>; Robyn Angliss, Deputy Director
robyn.angliss@noaa.gov

The National Marine Mammal Laboratory (NMML) conducts research on marine mammals important to the mission of the National Marine Fisheries Service (NMFS) and the National Oceanic & Atmospheric Administration (NOAA), with particular attention to issues related to marine mammals off the coasts of Alaska, Washington, Oregon, and California. Research conducted by NMML relies on a variety of methods and tools. Determination of status and trends of marine mammal populations requires information on abundance, stock structure, mortality and net productivity. To obtain these data, censuses are carried out from ships, aircraft and on land. Radio and satellite-linked telemetry is used to determine movements and migrations, critical feeding areas and depths, and other behavioral data. Statistical analyses and modeling are carried out to investigate specific population parameters. Research programs are carried out cooperatively with many other federal, state and private sector collaborators.
Additional details of survey protocol are provided in Clarke et al. (2013) and survey data are available from the National Marine Mammal Laboratory, National Marine Fisheries Service (http://www.afsc.noaa.gov/nmml/software/bwasp-comida.php).

NSB/DWM - North Slope Borough/Department of Wildlife Management

http://www.north-slope.org/departments/wildlife/

The North Slope Borough Department of Wildlife Management (NSB/DWM) is an important player in community-invested research on the North Slope, particularly studies relating to marine mammals and waterfowl. There are several categories of research accomplished through North Slope Borough funding. For wildlife studies, refer to:http://www.north-slope.org/departments/wildlife/studiesNresearch.php; For subsistence co-management activities that are coordinated with federal and state agencies, refer to: http://www.north-slope.org/departments/wildlife/co-management.php; POC(s): Senior Scientists: Craig George craig.george@north-slope.org, Robert Suydam robert.suydam@north-slope.org

The NSB/DWM facilitates sustainable harvests and monitors populations of fish and wildlife species through research, leadership, and advocacy from local to international levels. The Department diversifies funding opportunities through the submission of grant proposals focusing on subsistence species and issues of the highest interest to North Slope residents. The DWM is responsible for helping to assure participation by Borough residents in the management of wildlife resources, by keeping these resources at healthy population levels, and to assure that residents can continue their subsistence harvest of wildlife resources. Thirty-year partnerships with state and federal agencies (see subsistence co-management activities) include studies focused on bowhead whales, belugas, ices seals, seabirds, sea ducks and nearshore marine fishes, among other. The 1978-2011 bowhead abundance data can be requested via a "data availability agreement" or through a formal request. The 'final' population estimates are all published in the peer-reviewed literature. There are other datasets on harvest numbers of bowheads that are available through the DWM or Alaska Eskimo Whaling Commission (AEWC). Data from ongoing studies on beluga whales and nearshore fisheries are also available upon request. Note that data from several of these studies, including contaminants, are being used in SOAR analyses and papers (Appendix G3). Information on a diverse array of research projects are available under the 'Studies and Research Projects' web link on the DWM website.

PWID - Pacific Walrus International Database
http://alaska.usgs.gov/science/biology/walrus/pwid/index.html

The Pacific Walrus International Database includes legacy and current data on Pacific walruses, including land and at sea ice haulout counts, harvest data from Russian sources, sex/age composition, reproduction, mortality, harvest statistics, and morphometry. and at-sea observation data. This is a controlled access database, but metadata describing the available data are readily available at the referenced website. Chad Jay, a walrus specialist from the US Geological Survey served as a PacMARS collaborator and assisted with the contributions of current satellite telemetry data for walrus distributions, as well as helping to integrate the insights available from this database into the overall understanding of walrus biology within the PacMARS study area. A SOAR benthic paper (Grebmeier et al.) will utilize walrus data in a synthesis mode.

SOAR - Synthesis of Arctic Research
http://www.arctic.noaa.gov/soar/
POC(s): Sue Moore <Sue.Moore@noaa.gov>, Phyllis Stabeno Phyllis.stabeno@noaa.gov

The SOAR program aims to create a platform for collaboration among scientists and Alaska Arctic residents. The SOAR has the overarching goal of using available data, analytical and modeling approaches to identify and test hypotheses that cross scientific disciplines. The geographic area is the Pacific Arctic sector, including the northern Bering, Chukchi and Beaufort seas, with time frames extending from days to decades. The aim is to develop peer-reviewed scientific papers to support understanding of relationships among oceanographic conditions, benthic organisms, lower trophic (forage

fish and zooplankton) and upper trophic (seabirds, and marine mammal) species distribution and behavior in the Pacific Arctic. The SOAR project is supported by the Bureau of Ocean Energy Management (BOEM), and will assist in their evaluation of oil and gas development in the Arctic. The first phase of SOAR (2011-2014) is focused on development of 16 peer-reviewed papers for publication as a Special Issue of *Progress in Oceanography* (Table X).

G1.3b. Seabirds

LGL – LGL Limited (Environmental Research Associates) Studies
http://lgl.com/

LGL has carried out a wide variety of studies on marine and aquatic resources, many of which are related to oil and gas exploration and production along the coastal Beaufort Sea. Their studies include the following: (1) extensive ecological research on *Arctic* Cod (*Boreogadus saida*) and other fish, (2) investigation of the effects of seismic activities on whales and (3) surveys of terrestrial and marine birds.

NPPSD - North Pacific Pelagic Seabird Database
http://alaska.usgs.gov/science/biology/nppsd/index.php
POC: Gary Drew (gdrew@usgs.gov) and John Piatt (jpiatt@usgs.gov)

The NPPSD now contains more than 325,000 samples dating back to the 1970's OCSEAP surveys, detailing the distribution of marine birds at sea in the North Pacific, including data from the PacMARS area. The database now includes a large number of transects in the northern Bering and Chukchi/Beaufort seas collected largely by the FWS (K. Kuletz) as part of NPRB and BOEM funded cruises (2006-2012) and industry programs such as CSESP (Chukchi Sea Environmental Studies Program; www.fairweatherscience.com) . Many of the research publications resulting from the database are available in electronic versions. USGS has ended the current round of data assimilation (through 2012), and are working on finalizing Version 2.1 of the database, expected to be released by end of 2013. Some bird distribution maps are readily available at the referenced webpage, while the overall Microsoft Access database that is available now is distributed via a CD (Drew, G.S., and J.F. Piatt. 2012. North Pacific Pelagic Seabird Database v2.0.. Research publications resulting from the database are documented, and many of these publications are available in electronic versions. Public availability of data from this public website is limited, but data collected as part of NPRB and BOEM–funded projects are available separately via Kathy Kuletz (USFWS), a PacMARS collaborator. Currently, oceanographic context or appropriate links for the bird observations is not provided, but USGS is building a database that links bird ecology (body size, diets, energy consumption) to seabird densities at sea so we can examine spatial patterns in biodiversity, energy flow, fish consumption , etc., and relate these to biogeographic features such as bathymetry, primary production, and sea surface temperature, etc. This work will be made available to PICES and NOAA/NMFS for integrated fisheries management by January, 2014. USGS continues to receive additional sample records that will be archived until the next revision of the database. [Marine Ecology Project, contacts J. Piatt, G. Drew].

Seabirds.net
http://seabirds.net/seabirdinfonetwork.html
POC: Robert Kaler (Robert_kaler@fws.gov)

Seabirds.net is a portal for accessing global seabird databases, including the North Pacific Seabird Data Portal (NPSDP; http://axiom.seabirds.net/maps/north-pacific-seabirds) and the Circumpolar Seabird Data Portal (http://axiom.seabirds.net/circumpolar_portal.php) that are both hosted by Axiom Consulting &

Design in Anchorage. The NPSDP includes interactive maps of seabird colony, population, and diet records and are potentially key resources for understanding seabird distributions. The website notes that the mapped distribution data are preliminary and subject to correction. Other website links from seabirds.net include the Global Seabird Colony Register and ebird.org, which is a crowd-sourced, on-line checklist program that includes arrival and departure dates for specific species, and abundance information. The colony location data has been used during the SOAR marine bird and mammal hotspot analysis to control for colony-effect on seabird distributions at sea. The diet information, while still a work in progress, has potential to help link seabirds with their prey throughout the region and over time.

STAMP - Seabird Tissue Archival Monitoring Program
http://www.nist.gov/mml/csd/seabirdeggs.cfm

This archival program is tracking geographic and temporal trends in contaminants in seabird eggs, including persistent bioaccumulating contaminants (e.g., chlorinated pesticides, polychlorinated biphenyls (PCBs), brominated flame retardants [polybrominated diphenyl ethers—PBDEs], butyltin compounds, and mercury). The work involves cooperation with personnel from the U.S. Fish and Wildlife Service Alaska Maritime National Wildlife Refuge and the U.S. Geological Survey Biological Resources Division, implemented by the National Institute for Science and Technology (NIST), which is storing seabird eggs from major seabird colonies such as at Cape Lisburne using standardized protocols, under conditions that ensure chemical stability during long-term (decadal) storage, and analyzing subsamples of the stored material to determine baseline levels of contaminants of interest. The seabird egg collection is maintained in NIST's Marine Environmental Specimen Bank at the Hollings Marine Laboratory in Charleston, South Carolina. This program is a contribution to the international CAFF monitoring effort.

G1.3c. Fish

ACES-Arctic Coastal Ecosystem Study
Web address: None yet
POC: Kevin Boswell, (kmboswel@fiu.edu), 305-919-4009, Johanna Vollenweider, (Johanna.Vollenweider@noaa.gov)

Funded by BOEM, this coastal study will revisit sites in the nearshore Chukchi and Beaufort Sea sampled earlier by Johnson and Thedinga (see below). Fishes will be surveyed in 2013 and 2014 including net and acoustic surveys

BASIS - Bering-Aleutian Salmon International Survey
http://www.npafc.org/new/science_basis.html;
http://www.afsc.noaa.gov/ABL/MESA/archives/mesa_occ_basis.htm

The Bering-Aleutian Salmon International Survey-II (BASIS-II) is the North Pacific Anadramous Fish Commission (NPAFC) coordinated program of cooperative research on Pacific salmon in the Bering Sea designed to clarify the mechanisms of biological response by salmon to the conditions caused by climate changes. Recent fluctuations in the abundance, survival, and growth of salmon in the Bering Sea have occurred coincidently with fluctuations in the physical and biological oceanographic conditions. The BASIS survey of the Bering Sea epipelagic ecosystem was designed to improve our understanding of salmon ecology in the Bering Sea and to clarify mechanisms linking recent changes in ocean conditions with salmon resources in the Bering Sea.

The Bering-Aleutian Salmon International Survey Phase I site is now archived and replaced by NOAA's Ecosystem Monitoring and Assessment Program (EMA, described below). The data collections reported on the archived site include that collected during epipelagic fish surveys extending into the northern Bering Sea through 2006. Other data potentially available include physical oceanography, surface nets and zooplankton, although many of the data sets are not directly available for downloading and are reported to be in progress.

Beaufort Sea Marine Fish Monitoring http://www.afsc.noaa.gov/REFM/stocks/fit/Beaufort.php
POC: Libby Logerwell, libby.logerwell@noaa.gov

This study was undertaken in 2008 and documents fish populations in the offshore Beaufort Sea. Data collected tends to confirm expectations of low fish biomass relative to epibenthic invertebrates. Several peer-reviewed publications resulted from the study and links to those papers and the cruise report are available on the referenced website, as are NOAA personnel knowledgeable about the project. Data from this project are archived in the AFSC RACE data base and with BOEM, the funding agency. Data on epifaunal invertebrates are included in the PacMARS synthesis and fish data will be incorporated in the SOAR project describing fish of the Beaufort and Chukchi seas (G3).

Beaufort Sea Marine Fish Surveys
POC: Brenda Norcross, bnorcross@alaska.edu

These surveys include: 2008 survey see project directly above (Logerwell);
2010 WWW1004, 2011 BeauFish, 2012-2014 US Transboundary (partnering with Canadian BREA, see above).

These ongoing studies focus on fish surveys of the US Beaufort Sea, but also include surveys of epibenthic fauna, zooplankton and, for some cruises, macrobenthos. The BeauFish 2011 survey covered much of the US shelf from ~20-220 m depth. The final report is in progress. The 2012-2014 Transboundary surveys focus on the Eastern Beaufort Sea and the shelf break down to 1000 m. Because these studies are very recent, they will not be fully synthesized in the PacMARS work. A presentation is available at http://seagrant.uaf.edu/conferences/2013/wakefield-arctic-ecosystems/presentations/norcross-transboundary.pdf

EMA - Ecosystem Monitoring and Assessment NOAA Marine Fishes and Oceanography
http://www.afsc.noaa.gov/ABL/EMA/EMA_Datasets.htm

The Alaska Fisheries Science Center conducts research on fish habitat and stock assessments, as well as collecting data that includes nutrients, phytoplankton, zooplankton, temperature, and conductivity (salinity) measurements. In the PacMARS study area, on-going projects include work in the Chukchi and northeast Bering Sea. Some data are available, particularly under the BASIS project, described separately above, and these data are more extensive in the Bering Sea.

The Northeastern Bering Sea EMA program http://www.afsc.noaa.gov/ABL/EMA/EMA_NEBS.php). Pelagic trawl (surface trawl and mid water acoustics) and oceanographic data collected during the Northern Bering Sea survey are used to improve understanding of the pelagic ecosystem and assist efforts aimed at reducing uncertainty in harvest management of fishery resources important to Alaskan commercial and subsistence fisheries. The survey addresses how species distribution and marine food webs are altered by climate and seasonal loss of Arctic sea ice in the Bering Sea.

The Arctic/Chukchi Sea Ecosystem Assessment EMA program in the Chukchi Sea and Arctic http://www.afsc.noaa.gov/ABL/EMA/EMA_Chukchi.php is investigating ecosystem status and trends with the continued loss of sea ice and study its effect on the distribution, migration, energetics, and survival of commercially important fish species in the Bering Sea/Chukchi Sea. Scientists within the EMA Program partnered with the University of Alaska Fairbanks, School of Fisheries and Ocean Sciences to provide a comprehensive assessment of the northeastern Bering Sea and Chukchi Sea (NEBS/CS) ecosystems including the physical environment, the primary and secondary producers that support Arctic marine food webs, and the numerous fish species utilizing the area beginning in 2012.

Recent publications from the EMA office of NOAA Marine Fishes and Oceanography are available at: http://www.afsc.noaa.gov/ABL/EMA/EMA_Publications.php and include papers relevant to the PacMARS study areas.

National Marine Fisheries Service/National Marine Mammal Lab, NOAA
http://www.afsc.noaa.gov/nmml/software/bwasp-comida.php

Fisheries survey data are available from the National Marine Mammal Laboratory, National Marine Fisheries Service

SHELFZ- Shelf Habitat and Ecology of Fish and Zooplankton
Web address: none yet
POC: Leandra deSousa, Leandra.Sousa@north-slope.org 907-852-0350

This ongoing study will collect baseline data on the habitat, abundance, distribution and species composition of zooplankton and fishes. It will identify similarities and differences between the very nearshore and offshore areas in fish and zooplankton communities. Surveys of fishes and zooplankton will be conducted from the beach to ~55 miles offshore between Barrow and Wainright in the summer of 2013 using various pelagic and demersal nets and acoustic tools with funding from the Coastal Impact Assistance Program; http://wsfrprograms.fws.gov/Subpages/GrantPrograms/CIAP/CIAP.htm

WBSFS - Western Beaufort Sea Fisheries Study
http://www.alaska.boemre.gov/reports/2010rpts/2010_048.pdf (Contact Brenda Norcross at bnorcross@alaska.edu for access password)

G1.4 Biodiversity Programs

ArcOD – Arctic Ocean Diversity

Web address: http://www.arcdiv.org/
http://dw.sfos.uaf.edu/arcod/ and www.iobis.org
POC (general): ArcOD@sfos.uaf.edu, Russ Hopcroft rrhopcroft@alaska.edu and Cheryl Clark cclarkehopcroft@alaska.edu for data issues
POC (PacMARS): Bodil Bluhm (babluhm@alaska.edu), Carin Ashjian (cashjian@whoi.edu), Kenneth Dunton (ken.dunton@mail.utexas.edu)

Arctic Ocean Biodiversity was a component of the Census of Marine Life program, and aimed to document the diversity in sea ice, the water column and sea floor, including fish, mammals & birds. This program was greatly successful in consolidating what is known and filling remaining knowledge gaps. Much of this work was accomplished during the International Polar Year although the effort extended over a decade with support from the Sloan Foundation. PacMARS investigators were directly involved in ArcOD and knowledge and experience from this project are directly reflected in the PacMARS effort. Data are accessible at www.iobis.org (chose 'search data', 'datasets', sort by provider name, and >60 data sets will show under 'ArcOD/AOOS') and www.arcodiv.org in Darwin Core format, the standard for biodiversity data. Several historic data sets were rescued and made available electronically, for example extensive zooplankton data from the Canadian Beaufort Sea collected in the 1980s (see NOGAP further down). Other examples include zooplankton collections from the US Fish and Wildlife Service vessel Tiglax, which are documented at http://www.arcodiv.org/Database/Plankton_datasets.html and benthic data from Russian collections at http://www.arcodiv.org/Database/Benthos_datasets.html. of the data compiled and more than available online was synthesized in a special issue in Marine Biodiversity 41(1) in 2011.

Arctic Biodiversity Assessment
http://www.caff.is/aba

The Arctic Biodiversity Assessment was released at the May 2013 Arctic Council meeting in Kiruna, Sweden and it provides information on status and trends in arctic biodiversity. A PacMARS investigator, Bodil Bluhm, was involved in writing two chapters in this high-level report, so information on expansion of species distributions in the Pacific Arctic, the influence of climate change, and the loss of sympagic fauna as seasonal sea ice declines are all topics that are incorporated into the PacMARS evaluation of research topics of importance in the Pacific-influenced Arctic. Other information resources in the report

CAFF – Conservation of Arctic Flora and Fauna
Web address: http://www.caff.is/
POC (general): CAFF Secretariat, caff@caff.is, +354-462-3350
POC (PacMARS): Bodil Bluhm (babluhm@alaska.edu)

The Conservation of Arctic Flora and Fauna secretariat is the biodiversity working group of the Arctic Council. Representatives of the working group are appointed by member states of the Arctic Council, and observer countries, organizations, and indigenous people organization. The secretariat supports a range of strategies that provide scientific and conservation recommendations for protecting diversity and directly conserving individual species. These strategies form a framework to ensure more effective management responses. These strategies are developed via international cooperation among countries and scientists across the Arctic. Specific CAFF programs that may be of importance to the PacMARS effort include:

(i) ABA- Arctic Biodiversity Assessment
Web address: http://www.caff.is/aba

The Arctic Biodiversity Assessment (ABA) is a major circumpolar effort to provide a description of the current state of Arctic biodiversity and it includes a full scientific assessment, released in May 2013. It is also accompanied by a suite of policy recommendations for consideration by the Arctic Council. Three versions of the report can be downloaded (recommendations for policy makers, a synthesis, and the full science report): http://www.arcticbiodiversity.is./index.php/the-report/. The full scientific assessment is a go-to, more than 500 page source for some of the best current information on the status of key ecosystem organisms, including marine mammals and migratory birds, as well as biological hotspots, human languages, and myriad other biodiversity topics. While the approach is exhaustively pan-arctic, much valuable information on the integration of the PacMARS study area within the larger Arctic is possible because of this analysis.

(ii) Circumpolar Biodiversity Monitoring Project (CBMP)

http://www.caff.is/index.php?option=com_content&view=article&id=387&Itemid=1187
http://www.caff.is/index.php?option=com_content&view=article&id=499&Itemid=1014
(marine ecosystem monitoring)
http://www.caff.is/images/marine_plan_Lowres_final.pdf
POC (general): Mark Marissink (Mark.Marissink@naturvardsverket.se)
POC (PacMARS): Bodil Bluhm (babluhm@alaska.edu)

The Circumpolar Biodiversity Monitoring Program (CBMP) is an international network of scientists, governments, indigenous organizations and non-governmental groups working to effectively monitor the Arctic's living resources. The CBMP organizes its efforts around the major ecosystems of the Arctic, coordinating marine, freshwater, terrestrial and coastal monitoring activities while establishing international linkages to global biodiversity initiatives. The CBMP emphasizes data management, capacity building, reporting, coordination and integration of Arctic monitoring, and communications, education and outreach. The marine ecosystem monitoring component is most relevant to PacMARS; the referenced marine ecosystem monitoring website includes science planning and general assessment documents, workshop and meeting reports. Information derived from CBMP has been primarily used in the PacMARS effort as background information for the biologically-oriented portions of our effort, particularly biodiversity.

(iii) CAFF/Arctic Council as part of the Circumpolar Seabird Expert Group
http://www.caff.is/expert-group-documents/view_category/16-circumpolar-seabird-expert-group-cbird

The Seabird Expert Group provides reports on selected seabird indicator species (Arcitc Biodiversity Series, 2010), monitoring needs (Petersen et al. 2008), seabird harvest (Merkel and Barry 2008), and meeting summaries.

G1.5 Human and Social Sciences

AEWC – Alaska Eskimo Whaling Commission
Web address: http://www.bluediamondwebs.biz/Alaska-aewc-com/default2.asp
POC (general): Alaska Eskimo Whaling Commission, P.O. Box 570, Barrow, Alaska 99723, 907-852-2392

The Alaska Eskimo Whaling Commission (AEWC) is a co-management entity that serves the interests of bowhead whalers in ten villages extending from Saint Lawrence Island to Kaktovik. The major objectives are to safeguard the bowhead whale and its habitat and to support the whaling activities and culture of its member communities. The AEWC plays an important role in influencing research priorities for bowhead whales and related ecosystem questions, and the individual village commissioners who serve hold significant reserves of traditional ecological knowledge. Nevertheless the organization does not directly collect or distribute research data; also see NSB/DWM.

Alaska Community Action on Toxins
http://www.akaction.org/Tackling_Toxics/Food/Traditional_Foods.html

This organization advocates for Alaska Native concerns connected with contaminants and safety of the locally harvested food**.**

Alaska Native Knowledge Network
http://ankn.uaf.edu/index.html

The Alaska Native Knowledge Network provides resources for teachers, advises on the ethics of conducting research in local communities, and provides summaries of workshops and conferences relevant for Alaska Native Studies.

Alaska Native Tribal Health Consortium Local Environmental Observer Network
http://www.anthc.org/chs/ces/climate/leo/

This Local Environmental Observer program archives community-based observations of the new species or new environmental behavior; it includes observations from communities in the PacMARS region.

AHDR – Arctic Human Development Report
Web address: http://www.svs.is/AHDR/

The Arctic Human Development Report was a high-level social science assessment of the welfare of human communities in the Arctic that was sponsored by the Arctic Council while Iceland served as a chair of the organization in 2002-2004. Electronic copies of the report are available at the referenced website, and the report was published through the Stefansson Arctic Institute, Borgir, Nordurslod, IS-600 Akureyri, Iceland. The overall report is clearly important, but is directed at summarizing knowledge and facilitating comparisons on a circumpolar basis, rather than serving as an original source of data. References in each chapter provide original data, so the report also serves identifies important bibliographical resources.

AHHI – Arctic Human Health Initiative
Web address: http://arctichealth.nlm.nih.gov/

The Arctic Human Health website is a US government data portal that provides search functions for original research publications that relate in some way or another to human health at high latitudes. The criteria are quite broad so thar many references are to papers that are not specifically health related. Bibliographical information on more than 100,000 publications, both peer-reviewed and gray literature are included. Other features of the website are links to other web portals and websites that provide information on a wide variety of arctic topics, some quite distant from human health, so this quite a good resource to keep in mind, but finding unique data or information that is unavailable elsewhere is relatively hard to find, but it does include references to out of print publications and information from special collections held in the Alaska Medical Library at the University of Alaska Anchorage.

ALCC - Arctic Landscape Conservation Cooperative
Web address: http://arcticlcc.org/
POC (general): Greg Balogh (Greg_balogh@fws.gov)

Landscape Conservation Cooperatives are an initiative led by the US Department of the Interior, which has responsibilities for national park, and wildlife refuge management, as well as other federally owned lands and resources. The mission statement of the Arctic Landscape Conservation Cooperative (ALCC) includes goals of identifying and providing information needed to conserve natural and cultural resources in the face of landscape scale stressors, particularly climate change. It is fundamentally a multidisciplinary program, supported by a steering committee and directed by a science plan (http://arcticlcc.org/about/scienceplan/), which supports coordinated actions among management agencies, conservation organizations, communities, and other stakeholders. Not all of the projects supported by the ALCC are relevant to PacMARS since the landscape protection components are often located in watersheds and on land, but we consider the ShoreZone mapping program and the Threatened Eider Database (http://arcticlcc.org/products/spatial-data/show/threatened-eider-geodatabase-for-northern-alaska-2012-edition to be two of several significant contributions of the ALCC that are relevant to the scope of the PacMARS effort. Another component of the program is the BIOMAP Alaska project, which is using local residents of Barrow, Kotzebue and Kaktovik to collect data on local observations, and upload that information via the web. Overall, ALCC is a program that is developing so not all information is readily available, such as the identity of investigators of individual ALCC projects.

ASI - Arctic Social Indicator Project
http://www.svs.is/ASI/ASI.htm

The Arctic Social Indicator project is a follow-up to the Arctic Human Development Project (AHDP), described above. The 160-page report was published in 2010 and can be freely downloaded as a .pdf file. It is a high-level synthetic summary that provides an up-to-date summary of social indicators on a pan-Arctic basis. References to original literature are included.

BIOMap Alaska
http://arcticlcc.org/projects/human-system/biomap/

This is a web-based citizen-science project to locally collect observations in Kotzebue, Barrow and Kaktovik. It is also described above under the description for the Alaska Landscape Conservation Cooperative.

BLM - Bureau of Land Management NPR-A Subsistence Advisory Panel Documents
http://www.blm.gov/ak/st/en/res/npra_sap/npra_sap_docs.html

During our PacMARS social science analysis, the transcripts from the meetings of the Subsistence Advisory Panel for the National Petroleum Reserve of Alaska, organized by BLM, were reviewed.

Although the focus is primarily on the land-based resources, a thorough review helped us identify some concerns related to the marine environment.

BREA – Beaufort Regional Environmental Assessment
Web address: http://www.beaufortrea.ca/
POC for Fisheries portion: Jim Reist

The ongoing Beaufort Regional Environmental Assessment (BREA) is a multi-stakeholder initiative to sponsor regional environmental and socio-economic research that will make historical information available and gather new information vital to the future management of oil and gas in the Beaufort Sea. Research components cover biology including lower trophic levels to mammals and birds, sea ice, meteorology, and more, see http://www.beaufortrea.ca/research/. Field campaigns for biological surveys include the summers of 2012 and 2013. Data are not yet publicly available, but presentations on first results are available from a February 2013 workshop at http://www.beaufortrea.ca/results-forum-2012-2013/.

BSSN - Bering Sea Sub Network
http://www.bssn.net/

The Bering Sea Sub Network is a current National Science Foundation project that is involving a number of local residents of Bering Sea communities in providing community-based observations, particularly through surveys. A report documenting local knowledge survey results and other data is available at the BSSN website. This project is positioned to communicate concerns from Russian villages that are participating in the project. St. Lawrence Island and the Gulf of Anadyr is as far north as the project coverage currently extends, so some lessons learned from the southern Bering Sea may not be immediately transferable to the PacMARS study area.

Bureau of Land Management Arctic Field Office National Petroleum Reserve Subsistence Studies Database
Yamin-Pasternak is actively engaged in this effort.

CAVIAR - CAVIAR Community Adaptation and Vulnerability in Arctic Regions
http://www.cicero.uio.no/projects/detail.aspx?id=30170&lang=EN
This was an International Polar Year project that examined community vulnerabilities on a pan-Arctic basis. Two communities in the PacMARS study area, Kaktovik and Wainwright, were included in the initial planning for the project.

CHONe – Canadian Healthy Oceans Network
Web address: http://chone.marinebiodiversity.ca/
POC: Paul Snelgrove, CHONe Network Director, psnelgro@mun.ca, 709-864-3270

The Canadian Healthy Oceans Network is a National Science and Engineering Research Council of Canada strategic network focused on biodiversity science for the sustainability of Canada's three oceans including the Arctic. The network includes ~ 150 researchers from 14 universities across Canada, the federal Department of Fisheries and Oceans, and seven other government laboratories, to carry out thirty-five collaborative research projects in three interconnected themes.

Chukotka Native Marine Mammal Hunter Association
www.pacificwalrus.ru
This local Chukotka-based organization is monitoring haul-out locations of walruses in Russia with support from the Chukotka Branch of the Pacific Research Fisheries Center (ChukotTINRO). As sea ice

retreats, it has been more common for walruses to haul out on the Chukchi coast instead of resting on sea ice, and the animals are vulnerable while on shore to human disturbance. The referenced website provides information, links to literature and Russian-language reports on this shift in walrus behavior. Also posted on the website is a final report in English that summarizes traditional knowledge of walruses and hunting, based upon extensive interviews of local walrus hunters in villages of Chukotka.

COSEE – Center for Ocean Studies Education Excellence
http://www.coseealaska.net/
The Alaska Center for Ocean Studies Education Excellence is primarily an educational outreach effort, but includes useful resources for integrating Alaska Native knowledge and other topics pertinent to PacMARS.

ELOKA - Exchange for Local Observation and Knowledge of the Arctic
http://eloka-arctic.org/

The Exchange for Local Observation and Knowledge of the Arctic (ELOKA) is a project framework that was initiated during the International Polar Year. It facilitates the collection, preservation, exchange, and use of local observations and knowledge of the Arctic. ELOKA provides data management and user support through the National Snow and Ice Data Center, and it fosters collaboration between resident Arctic experts and non-resident researchers. The Bering Sea SubNetwork project, described elsewhere in this document, is one associated project. Another project under the ELOKA framework is the Seasonal Ice Zone Observing Network (http://nsidc.org/data/eloka031.html; SIZONet); see also: http://www.sizonet.org/. SIZONet is an unusual project that has a significant local community observation component that documents locally observed sea ice distributions near Wales and Barrow in the context of satellite-based data

EWC - Eskimo Walrus Commission
http://www.kawerak.org/servicedivisions/nrd/ewc/
POC: Vera Metcalf, Executive Director, VMetcalf@kawerak.org

The Eskimo Walrus Commission (EWC) co-manages subsistence walrus harvests and is primarily a stakeholder organization. Chartered in 1978 by Kawerak, Inc. of Nome, the Eskimo Walrus Commission (EWC) is the organization representing Alaska's coastal walrus hunting communities. Initially formed as a consortium of Native hunters, EWC is a recognized statewide entity working on resource co-management issues, specifically walrus, on behalf of Alaska Natives as it continues to be an essential cultural, natural, and subsistence resource to the Alaskan coastal Yupik and Inupiaq communities. A cooperative agreement between the Fish and Wildlife Service (FWS) and EWC was developed in 1997 to encourage subsistence hunters' participation in conserving and managing walrus stocks in coastal communities. In 1998, a Memorandum of Understanding among the EWC, the Alaska Department of Fish & Game, and the FWS was signed facilitating joint management of the Pacific Walrus Conservation Fund. The majority of the funds for this conservation endowment comes from the sale of raw ivory by the EWC during state conferences and events.

Extractive Industries Working Group, International Arctic Social Sciences Association (IASSA)
http://www.arcticcentre.org/InEnglish/RESEARCH/Extractive_Industries_Working_Group.iw3

This working group of the IASSA is chaired from the Arctic Centre of the University of Lapland. It aspires to be a clearing house of information on extractive industries in the Arctic, including identifying data gaps and needs. Courtney Carothers, University of Alaska Fairbanks (http://www.sfos.uaf.edu/directory/faculty/carothers/) is the key working group member who is undertaking research in the PacMARS study area. This work includes projects on: 1. Climate Change and

Subsistence Fisheries in Northwest Alaska, funded by the U.S. Fish and Wildlife Service. This study is documenting local observations of climate change relevant to subsistence fisheries in Noatak, Selawik, and Shungnak; 2. Subsistence Use and Knowledge of Beaufort Sea Salmon Populations, funded by the Bureau of Ocean Energy Management. This project is incorporating local observations from subsistence fisheries to generate better understanding about salmon use and distributions on the North Slope in response to apparent increases in salmon populations.

The First Alaskans Institute
http://www.firstalaskans.org/
Among the resources intended to help facilitate broad-range capacity building in Alaska Native communities are the links to ongoing and completed projects, some of which study indigenous perspectives on quality of life and subsistence.

Historical Subsistence Reports via UAF Rasmussen Library
Ethnographic monographs available in the UAF library.

ICC (ICC Alaska) - Inuit Circumpolar Conference
http://www.inuitcircumpolar.com/

The Inuit Circumpolar Conference (ICC) is a non-governmental stakeholder organization representing indigenous communities on a pan-Arctic basis. Part of the ICC's research program is an ongoing study of food security from the Inuit perspective and this information was used in development of the social science portion of the PacMARS synthesis. The "DRUM" newsletter, which is archived and can be accessed through a link on the ICC website, is an efficient way to stay informed on the current projects and community involvement on the regional and international levels.

IPCoMM - Indigenous People's Council for Marine Mammals
http://www.ipcommalaska.org/about.html

The Indigeonous People's Council for Marine Mammals includes as membership organizations many of the recognized co-management entities such as the Eskimo Walrus Commission that are also discussed elsewhere. Project documentation available at the referenced website includes policy documents, workshop summaries, and updates on such issues as Unusual Mortality Event and seal and walrus sickness. This resource is intended primarily to inform about the activities of the Indigenous People's Council for Marine Mammals and to assist members of indigenous communities seeking to form partnerships with government agencies and other organizations

Kawerak
http://www.kawerak.org/tribalHomePages/index.html

Kawerak, Inc. is a non-profit community development corporation based in Nome. The website referenced provides useful local information on each of the villages in the Bering Strait region. Kawerak also houses the Eskimo Walrus Commission, which is discussed in a separate entry.

Moved by the State: Perspectives on Relocation and Resettlement in the Circumpolar North
http://www.alaska.edu/move

This project was the US portion of a larger international collaboration that was conceived under BOREAS, a EUROCORES Programme of the European Science Foundation (ESF). The full ESF project is a collaboration of researchers from five countries, including the US, Canada, Russia, Greenland, and Finland. The U.S. components included five individual researchers from the University of Alaska

Fairbanks and the University of Maryland. MOVE was meant to addresses a major shortcoming in conceptualizing northern histories, presents and futures. While the phenomenon of state-induced population movements in the recent history of the circumpolar North is well known, this was the first comparative analysis of local and regional contexts and related impacts. "Moved by the state" refers to the commonality of having to cope with relocations and other population movements triggered by outside decisions. In analyzing a broad array of case studies (small and large, indigenous and non-indigenous communities, in free market and central command systems, ranging from the mid-20th to the early 21st century), the collaborative research project tested the extent of commonality. Demographic, political, social and cultural variables were used to track the similarities and differences, both among communities facing being moved now and those that have been moved in the past. Extensive fieldwork, combining participant observation, various interview and survey strategies, and the recording of oral and life histories, as well as demographic and economic data collection and analysis, are the methodological backbone of the project. The practical relevance of the project is exemplified by imminent community relocations due to direct and indirect effects of climate change. Research results, including links for downloading of two theses, and extensive background information are available on the referenced website. These research results are of value to the PacMARS study from the standpoint of identifying commonalities for community relocations that will be more likely as a result of shoreline dynamics changes and other climate-related shifts.

The Alaska Nanuuq Commission
http://thealaskananuuqcommission.org/

The Alaska Nanuuq Commission is a traditional knowledge and stakeholder organization that co-manages polar bear populations with the US Fish and Wildlife Service. The website includes links to publications exploring Native Alaskan relationships to polar bear natural history.

Native Village of Kotzebue
http://www.kotzebueira.org/

The referenced website includes a "Projects" tab that leads to the descriptions and mapping products connected with a series of seal tagging projects in Kotzebue Sound. These projects were carried out as community-agency partnerships and engaged local experts, who were able to combine subsistence opportunities with participation in the research.

Northwest Arctic Borough
http://www.nwabor.org/

The Northwest Arctic Borough is the regional government entity based in Kotzebue and extends over much of northwest Alaska. The borough website includes information on the communities in the Borough, and also informs on the Borough's Subsistence Mapping Program. A 2011 conference report that is available online at: http://www.nwabor.org/forms/SubsistenceMapConfReport.pdf summarizes the subsistence mapping project, which engages participation of subsistence experts from the NWAB communities and aims to provide cultural resources for education, as well as for planning associated with development.

RurAL CAP - Rural Alaska Community Action Program
http://www.ruralcap.com/

RurAL CAP, founded in 1965, is a private, nonprofit organization working to improve the quality of life for low-income Alaskans, specifically in rural areas. While not specifically a research organization,

knowledge from this large organization (>1000 employees in 81 Alaskan communities) was incorporated into the social science evaluation of PacMARS efforts.

SDWG - The Arctic Council Sustainable Development Working Group
http://www.sdwg.org/

The Sustainable Development Working Group (SDWG) is an entity of the Arctic Council. A number of social science and sustainable development project reports and deliverables are available on the referenced website, and some of these documents are discussed elsewhere in this document. Although a high-level, pan-Arctic entity, PacMARS used insights from working group documents as part of its analysis.

SIKU - Sea Ice Knowledge and Use
http://gcrc.carleton.ca/siku

The Sea Ice Knowledge and Use (SIKU) Project was undertaken during the International Polar Year and documented indigenous observations with a focus on sea ice and the use of ice-covered habitats. The project website that is hosted at Carleton University is a treasure of traditional ecological knowledge from Alaska and Chukotka. Other components of the project were undertaken in Greenland and Canada. Sea ice dictionaries and other traditional knowledge that was transferred were used during the PacMARS synthesis.

SIWO - Sea Ice for Walrus Outlook
http://www.arcus.org/search/siwo

The Sea Ice for Walrus Outlook (SIWO) is an activity that started in 2010, and is primarily a resource for Alaska subsistence hunters in coastal communities in the Bering Strait region. The SIWO provides weekly reports from April through June with information on sea ice conditions in the Northern Bering Sea and southern Chukchi Sea. One of the goals is to improve sea ice forecasting at smaller scales than is usually provided through the National Weather Service by incorporating knowledge and local observations from local Bering Strait residents.

SLiCA - Survey of Living Conditions in the Arctic
http://www.arcticlivingconditions.org/

The Survey of Living Conditions in the Arctic was funded in the United States by the National Science Foundation. The overall pan-Arctic project examined human living conditions of Inuit, Saami and indigenous people of Chukotka. The referenced website includes protocols protecting the raw survey data, and conditions for access, which are evaluated on a case-by-case basis. The survey results allow quantitative comparisons of the consumption of marine resources in the North Slope, Northwest Alaska, and Bering Strait region.

State of Alaska Community Database Online
http://commerce.alaska.gov/cra/DCRAExternal

This website provides a brief and basic introduction to the history, culture, and contemporary living conditions in Alaska, including the communities in the PacMARS region.

U.S. National Park Service Shared Beringia Heritage Program
http://www.nps.gov/akso/beringia/
Contact: Janis Kozlowski (National Park Service) janis_kozlowski@nps.gov

The U.S. National Park Service funds projects of scientific and community importance in the Beringia Region of western Alaska and Chukotka. The projects are typically local community-based, and relatively small in scope. A complete list of current projects is available at the program web site. The PacMARS analysis considers these projects to be important even at a small scale as they contribute to maintaining neighboring community continuity throughout the Beringia region.

G1.6 Multidisciplinary Programs

AKMAP – Alaska Monitoring and Assessment Program
Web address: http://www.dec.state.ak.us/water/wqsar/monitoring/AKMAP.htm
POC (general): Terri Lomax, dec.akmap@alaska.gov, 907-269-7635, Doug Dasher, dhdasher@alaska.edu, 907-347-7779

The Alaska Monitoring and Assessment Program (AKMAP) is a state-sponsored water survey effort that includes inland and marine waters of Alaska. It is a component of the national Environmental Protection Agency's National Aquatic Resource Surveys
http://water.epa.gov/type/watersheds/monitoring/aquaticsurvey_index.cfm/
The most relevant surveys within Alaska for PacMARS were studies in coastal waters of the Chukchi Sea in 2010-2012. These studies are considered to be still in progress, but scientists in this program have shared cruise reports and preliminary data have been presented in public meetings such as the Alaska Marine Science Symposium. Cruise reports and some of these data presentations are available at http://www.dec.state.ak.us/water/wqsar/monitoring/chukchisea.html/

We consider the data from this project to be critically important for understanding coastal processes in the Chukchi Sea that have only been poorly sampled in other research programs that have worked further offshore, such as the Bureau of Ocean Energy Management's COMIDA project. Similar research approaches were used, so the biological inventories and ecosystem data should allow for better understanding of the larger Chukchi ecosystem. Data from the AKMAP program are not readily available now, but will be included in the SOAR project focused on effects of prey dispersion, sea ice and walrus foraging in critical migration corridor for threatened eider ducks. A final report for the AKMAP the project is expected in 2014.

ANIMIDA - Arctic Nearshore Impact Monitoring in Development Area
(cANIMIDA – Continuation of Arctic Nearshore Impact Monitoring in Development Area)
Web address: http://www.duxbury.battelle.org/cANIMIDA/home/index.cfm/

The Arctic Nearshore Impact Monitoring in Development Area (ANIMIDA) was a five-year study that began in 1999, and provided baseline data and monitoring results to evaluate potential effects from site-specific production in the Beaufort Sea. The Continuation of Arctic Nearshore Impact Monitoring in Development Area (cANIMIDA) was a continuation of this effort, and included sampling from 2004 until 2007. Field efforts included sampling for turbidity, total suspended sediment, and current velocity measurements. Sediment and suspended sediment samples were analyzed for polyaromatic hydrocarbons, saturated hydrocarbons, chemical tracers, trace metals, and supporting geophysical measurements. Biota sampling included similar chemical measurements in clams, amphipods, deployed mussels, and fish. A well-organized program database that is now accessible via the referenced web site, and includes data, reports, and bibliographical information for published papers. Data and overall understanding of the Beaufort Sea that are derived from this project were important to the PacMARS.

AOS-94 Arctic Ocean Section

Some of the findings of the 1994 US-Canadian crossing of the Arctic Ocean are summarized in the book "The 1994 Arctic Ocean Section – the first major scientific crossing of the Arctic Ocean," which can be downloaded at www.crrel.usace.army.mil/library/specialreports/AOS_SR96_23.pdf. Peer-reviewed results were published in a special issue of Deep-sea Research II (1994 Arctic Ocean Section, Volume 44, Number 8, 1995), and also in a number of subsequent publications in other peer-reviewed journals, including results supported by the ANWAP program on radioactive contaminants in sea ice, water

column and sediments. Much of these data have been archived in the NSF supported ARCSS data archive that is now housed with EOL (http://www.eol.ucar.edu/projects/arcss/). The study was motivated by the need for improving "the observational base necessary for better understanding the role of the Arctic in global change". The regional coverage is on the northern end of the PacMARS focus area and contributes to understanding the changes in physics and biology at the shelf-basin transition.

ArcticNet
http://www.arcticnet.ulaval.ca/
POC (general): Louis Fortier, louis.fortier@bio.ulaval.ca, +1-418-656-5646

ArcticNet is probably the largest single current Canadian Arctic research program and is structured through Centers of Excellence that includes research on natural, human health and social sciences in partnership with Inuit organizations, northern communities, federal and provincial agencies and the private sector. Specific objectives include studying the impacts of climate change and modernization in the coastal Canadian Arctic. Of interest to the PacMARS synthesis, in particular are research cruises that have been undertaken from the CCGS Amundsen in the Canadian Beaufort Sea, including participation of international and Canadian scientists. Current Beaufort Sea projects funded through ArcticNet are described at: http://www.arcticnet.ulaval.ca/research/iris_1.php

ArcWEST - Arctic Whale Ecology Study
http://www.boem.gov/akstudies/

ArcWEST will determine relationships between dominant currents passing through the Chukchi Sea and resources delivered to the Barrow Arch area and will provide information about the dynamic nature of those relationships relative to whale distribution and habitat utilization in the eastern-Chukchi and extreme western-Beaufort seas. The objectives of the project are to assess spatial and temporal patterns of use of the Chukchi Sea by endangered bowhead, fin and humpback whales, and beluga and gray whales, to assess population structure and origin of animals, to evaluate ecological relationships for the species, including physical and biological oceanography, and to extend existing studies of bowhead whale foraging ecology into the Chukchi Sea to further understand the sources, transport and advection of krill from the Bering Strait. This study utilizes technologies including satellite tracking, passive acoustic monitoring, genetic analyses, and oceanographic and biological methodologies and technologies. Further information is available in the publication: Friday, N.A., P. J. Clapham, Berchok, C. L. Crance, A. N. Zerbini, B. K. Rone, A. S. Kennedy, P.L. Stabeno, and J.M. Napp. 2013. Arctic Whale Ecology Study (ARCWEST): Use of the Chukchi Sea by endangered baleen and other whales (Westward Extension of BOWFEST). Annual Report. Submitted to BOEM under Interagency Agreement M12PG00021. 8 pp.

BERPAC - Program for long-term ecological research of ecosystems of the Bering and Chukchi Seas and the Pacific Ocean
http://www.lib.noaa.gov (search term BERPAC)

In 1972, the United States and the Soviet Union signed an Agreement on Cooperation in the Field of Environmental Protection. The Agreement was renegotiated in 1994 with the Russian Federation as the successor signatory. Three major research cruises involving U.S. and Russian scientists were undertaken in 1976, 1984, 1988, and 1993 and work areas crossed the U.S. – Russian boundary in the Bering and Chukchi Seas. The US Fish and Wildlife Service played a key role in coordinating these multidisciplinary cruises, and proceedings from each cruise have been published in both English and Russian. An English language 292 page proceedings volume providing results from the 1993 cruise is available from at no charge Steve Kohl, FWS via email steven_kohl@fws.gov or postal mail: Office of International Affairs, Division of International Conservation, U.S. Fish and Wildlife Service, 4401 North Fairfax Drive, Room 100, Arlington, VA 22203, USA

Particularly for the later cruises in the series in 1988 and 1993, some data were incorporated into peer-reviewed papers that were published as part of the ISHTAR and related programs, and some of these data will be integrated in the SOAR benthic-focused project (Table X). Other data archiving is uneven; zooplankton data are archived at www.iobis.org under data provider ArcOD.

BEST - Bering Sea Ecosystem Study
http://bsierp.nprb.org/
http://www.eol.ucar.edu/projects/best/

Work during the Bering Sea Project, which includes both the National Science Foundation supported Bering Sea Ecosystem Study (BEST), and the North Pacific Research Board supported Bering Sea Integrated Ecosystem Research Program (BSIERP), was multidisciplinary and extended to all ecosystem parameters including biology, chemistry, and physics. The regional coverage included the Eastern Bering Sea shelf between the Aleutians and St. Lawrence Island. The study began in 2007 and is currently in its synthesis phase with several special issues published or in preparation. A number of PacMARS investigators were involved in this study, so although the area of study was for the most part to the south of the PacMARS study area, we are confident that collectively we can use knowledge being gained as research publications arise from BEST and BSIERP to advance our understanding of the PacMARS study area.

BOWFEST/SNACS
http://www.afsc.noaa.gov/NMML/cetacean/bwasp/flights_BOWFEST.php
POC(s): Julie Mocklin, <julie.mocklin@noaa.gov>, Carin Ashjian <cashjian@whoi.edu>

BOWFEST was a multiyear study started in 2007 that focused on late summer oceanography and prey densities relative to bowhead whale distribution over continental shelf waters within 100 miles north and east of Point Barrow, Alaska. BOWFEST was supported by the Bureau of Ocean Energy Management (BOEM) and other agencies, and included scientists from the National Marine Mammal Laboratory, Woods Hole Oceanographic Institute (WHOI), University of Rhode Island, the University of Alaska Fairbanks, the University of Washington, and Oregon State University, as well as local agencies and stakeholders on the Alaska North Slope. The NSF-funded Study of the Northern Alaska Coastal System (SNACS: 2005-2006) preceded BOWFEST and also focused on late summer oceanography and prey densities relative to bowhead whale distributions. Aerial surveys and acoustic monitoring were integrated with oceanographic sampling to help identify sources of zooplankton prey in conjunction with physical oceanographic processes that would make them available for whale feeding. An overall goal of the project was to understand bowhead whale behavior and distribution so that potential impacts from petroleum development activities can be minimized. Several PacMARS investigators have been involved in these studies and data from the that effort are included in their synthesis components.

BOWFEST/SNACS projects will be incorporated in several SOAR papers (Appendix G3). Because the project directly involved local stakeholders in Barrow and elsewhere on the North Slope, we consider this to be an excellent case study that improves understanding of ecosystem features through involvement of local communities. Zooplankton data from this study were incorporated into the PacMARS synthesis. See also SNACS entry and website link, annual reports are available on that website.

BSEO - Bering Strait Environmental Observatory
Web address: Discontinued

This National Science Foundation project involved fieldwork from 2000-2005 with three components: 1) shipboard sampling at key locations in the Bering Strait region in the water column and in the benthos 2)

Marine mammal tissue archiving and sampling following subsistence hunting efforts at Diomede, with distribution of tissues for scientific research and 3) pilot-scale in-situ pumping of surface seawater at Diomede to document tracer and nutrient distributions flowing through the Bering Strait in winter and summer. The shipboard sampling program has been succeeded by the Distributed Biological Observatory (described below) and shipboard data have been transferred to the EOL data archive from CCGS Sir Wilfrid Laurier cruises from 1998-2012. Tissue samples and data from the subsistence hunting program have been published in a wide variety of peer-reviewed publications and the in-situ water column data were presented in a paper published in Arctic in 2006.

C3O - Canada's Three Oceans
http://www.dfo-mpo.gc.ca/science/Publications/article/2008/17-06-2008-eng.htm

Canada's Three Oceans Project was formally initiated as a Canadian contribution to the International Polar Year, and involved an intense sampling effort in 2009 during the IPY activities using two Canadian icebreakers sailing from Victoria, B.C. (sailing north and east) and Halifax (sailing north and west). Papers resulting from this work have been submitted to a special issue of the Journal of Geophysical Research. Some work was initiated prior to IPY and has continued afterwards. In the PacMARS region, U.S., Japanese, and Canadian scientists have participated in annual cruises of the CCGS Sir Wilfrid Laurier. Benthic biology and water column sampling is now being continued as part of the Distributed Biological Observatory (described below) and data from these annual cruises starting in 1998 are being made available as a result of PacMARS efforts at the EOL data archive.

cANIMIDA - Continuation of Arctic Nearshore Impact Monitoring in Development Area (ANIMIDA); http://www.duxbury.battelle.org/cANIMIDA/home/index.cfm/

See the description of this continuation project, above, under ANIMIDA in the multidisciplinary project section of this appendix. This project is an important source of data and observations for the Beaufort Sea and several PacMARS investigators have been funded through this project.

CASES - Canadian Arctic Shelf Exchange Study
http://cases.quebec-ocean.ulaval.ca/welcome.asp

This well-documented Canadian project that accomplished work in the Beaufort Sea between 2002-2004, including an overwinter freeze-in of the CCGS Amundsen, which is of relevance to PacMARS. Much of the work has been published; a bibliography is available at http://www.aina.ucalgary.ca/scripts/minisa.dll/144/proe/proeaa/bi%2Bcases?COMMANDSEARCH, data archiving is not centralized and varies by principal investigator

CFL – Circumpolar Flaw Lead Study
http://www.ipy-api.gc.ca/pg_IPYAPI_029-eng.html,
http://umanitoba.ca/faculties/environment/departments/ceos/research/cfl.html
POC: Dave Barber, dbarber@cc.umanitoba.ca

The Circumpolar Flaw Lead project during IPY was an international framework that investigated flaw leads, including one to the west of Banks Island in the Canadian Beaufort Sea. It was the largest IPY project in Canada (in research funding) and it examined how physical changes affect biological processes within leads. The system was studied throughout its yearly cycle, to determine the effects of global warming. An overview paper on the project was published as a contribution to a special section (Atmosphere-Ocean, Volume 48, Issue 4, 2010) highlighting Canadian marine activities during the IPY. A number of other papers are now being published in a variety of peer-reviewed journals (suggested search term at http://scholar.google.com - Canadian Flaw Lead Study). For the PacMARS synthesis

effort, these recent papers have only been imperfectly incorporated into our understanding of the Beaufort Sea ecosystem in relation to work in US waters. More integrative effort to compare and contrast the systems is needed.

CHAOZ- Chukchi Acoustic, Oceanographic, and Zooplankton Study
http://www.afsc.noaa.gov/NMML/cetacean/bwasp/index.php
POC: Catherine Berchok, Catherine.Berchok@noaa.gov; Phyllis Stabeno Phyllis.Stabeno@noaa.gov

In 2010, the NOAA Alaska Fisheries Science Center (AFSC) and the Pacific Marine Environmental Laboratory (PMEL) entered into a multi-year interagency agreement with the Bureau of Ocean Energy Management, Regulation, and Enforcement (now BOEM) to document the distribution and relative abundance of bowhead, humpback, right, fin, gray, and other whales in areas of potential seismic surveying, drilling, construction, and production activities and relate changes in those variables to oceanographic conditions, indices of potential prey availability, and anthropogenic activities. CHAOZ Annual Reports are available at the website above; data from the CHAOZ project will be incorporated in several SOAR analyses, especially the Acoustic Ecology project (SOAR, Appendix G3).

CHINARE - Chinese Arctic Expeditions
http://www.chinare.gov.cn/en/

The Chinese Arctic and Antarctic Administration, through the Polar Research Institute of China and cooperating universities, has becoming increasingly active in sponsoring Arctic shipboard research using the Xuelong (Snowdragon), which was purchased from Ukraine in 1993. The Chinese government is also building a second icebreaker for use in the Arctic and Antarctic. The 2009 expedition during the International Polar Year worked in the PacMARS study area and has documented sea ice conditions, biological communities, microbiological features, geochemistry, and dissolved organic dynamics. Many of the results have been published in a special issue of Deep-sea Research (http://www.sciencedirect.com/science/journal/09670645/81/supp/C). The Chinese contributions to scientific knowledge in the PacMARS area are becoming increasingly important and fill important gaps in data and temporal coverage. In some cases, since the Chinese scientists are generally new to the area, knowledge of past work is uneven, but U.S. scientists are also unfamiliar with these new research initiatives. It is clear that successfully integrating the new knowledge and progress being made by Chinese scientists is an important near-term goal.

COMIDA CAB - Chukchi Offshore Monitoring in Drilling Area (COMIDA) Chemical and Benthos (CAB); http://comidacab.org/

PacMARS PIs at CBL, FIT, URI, UTMSI, and WHOI have been funded through this recently completed program that evaluated the overall ecosystem condition of the northeast Chukchi Sea shelf. Scientific data are archived at the National Oceanic Data Center with a redundant archive at The University of Texas at Austin; a number of manuscripts are being evaluated as contributions for a special issue of Deep-Sea Research. Goals of the project include discerning the base state of the ecosystem prior to oil and gas exploration so that future changing conditions resulting from oil and gas extraction, including biological features, contaminant distributions, and hydrographic patterns can be understood and distinguished from changes that may be due to climate change. Because of the widespread participation of PacMARS investigators in this project, we are confident that initial important findings are integrated into the current understanding of the Chukchi shelf ecosystem.

COMIDA HS - Chukchi Offshore Monitoring in Drilling Area (COMIDA) Hannah Shoal (HS) Ecosystem Study; http://comidacab.org/hannashoal/

The Hanna Shoal project is a continuation of the original COMIDA project, described immediately above that is focused on Hanna Shoal northwest of Barrow. This shallow water feature affects current flow coming from the southwest and around the north side of Hanna Shoal. It is also an area where late summer remnant sea ice is often present and used by walruses as resting platforms from which to feed. Studies currently underway are multidisciplinary and include sedimentation, contaminants, surveys of epibenthic and infaunal biological communities, foodweb structure, physical oceanography, and water column biology.

CSESP- Chukchi Sea Environmental Studies Program
http://www.chukchiscience.com/StudytheScience/tabid/215/Default.aspx;
http://www.fairweatherscience.com/reports/Reports/tabid/184/Default.aspx

The Chukchi Sea Environmental Studies Program (CSESP) is a multi-year, multi-discipline marine science research program in the northeastern Chukchi Sea funded by a consortium of oil and gas companies, specifically ConocoPhillips Company, Shell Exploration and Production Company and Statoil USA E&P Company. Since 2008, the program has collected information on physical oceanography, ocean acidification, atmospheric conditions, sediments, contaminants, benthic (epifauna and infauna), plankton ecology (zooplankton, phytoplankton, and primary production), fish, seabirds, marine mammals, and, underwater acoustics. The CSESP website provide access to science summaries, outreach product, and project presentations. Data from the 2008-2011 field seasons are available on the Alaska Ocean Observing System website (http://www.aoos.org/industry-arctic-data/) for analyses and various data sets were used in the present synthesis activity will also be available via the PacMARS data site. Data collected during this program are available for use through the Alaska Ocean Observing System (http://www.aoos.org/industry-arctic-data/). For the PacMARS study area, these data are a rich resource, although the short duration of the PacMARS synthesis project has limited the capacity to fully assimilate the contributions made by the intense scale of the sampling in areas that may be impacted by oil and gas extraction. The SOAR Acoustics Ecology project includes data from this source, in combination with recordings support by Cornell University, Scripps Institution of Oceanography, NOAA/NMML and NSF/AON. A recent volume of Continental Shelf Research, Volume 67 (2013) has multiple scientific articles covering the results from this program.

DBO - Distributed Biological Observatory
http://www.arctic.noaa.gov/dbo/

The "Distributed Biological Observatory (DBO)" is a *change detection array* observatory built along a latitudinal gradient extending from the northern Bering Sea to the Barrow Arc. DBO sampling is focused on transects centered on locations of high productivity, biodiversity and rates of biological change. The DBO sampling framework was initially tested during the successful 2010 Pilot Study, which consisted of international ship occupations of two of the DBO sites, one in the SE Chukchi Sea and one across upper Barrow Canyon. Notably, several U.S. agencies have endorsed the DBO concept in the Arctic research planning documents, including: (1) the 2010 NOAA Arctic Strategic Plan, (2) aspects in the BOEM Alaska Region planning efforts in the Chukchi Sea (COMIDA-Hanna Shoal), (3) statements in the recent USGS Science "Needs to Inform Decisions on Outer Continental Shelf Energy Development in the Chukchi and Beaufort Seas Alaska" document, and (4) interest by the Shell-ConocoPhillips-Statoil environmental program. Perhaps most importantly, the DBO is specifically included in the draft US National Ocean Policy Strategic Plan. In addition, the Marine Working Group of the International Arctic Science Committee (IASC) has endorsed the DBO and is supporting similar activities in the Atlantic sector of the Arctic. PacMARS PIs Cooper and Grebmeier are US-funded leads for project. The US Interagency Arctic Research Policy Committee (IARPC) DBO Implementation Team, comprised of a number of academic researchers and leads of US agencies (e.g. NOAA, NASA, BOEM, ONR) has a goal of full-implementation of the DBO by 2015.

ICESCAPE - Impacts of Climate change on the Eco-Systems and Chemistry
http://www.espo.nasa.gov/icescape/
Lead contact: Kevin Arrigo, arrigo@stanford.edu

ICESCAPE is an on-going NASA-funded program studying the impacts of retreating seasonal sea ice in the Chukchi Sea. A few papers have been published so far including a short article in Science documenting a productive under-ice phytoplankton bloom. Two field seasons using the USCGC Healy collected data, including studies of light penetration through ice and seawater, oceanographic features and ground truthing of satellite imagery. A deadline of September 15, 2013 has been set for submission of manuscripts for a special issue of Deep-Sea Research II that will describe results from the program. At this time, data from the project are not openly available for outside-project use, although chlorophyll data was used in the PacMARS synthesis (several PacMARS PIs are also co-investigators on ICESCAPE)

IPY - International Polar Year
http://www.icsu.org/publications/reports-and-reviews/ipy-summary

A summary, 724-page report that documents polar research activities in 2007-2008, including an executive summary, planning, research, observations, outreach and legacies is downloadable from the referenced website. This report covers activities in both the Antarctic and Arctic by numbered IPY projects that were international and circumpolar in implementation. This volume includes short, preliminary findings from a number of relevant IPY projects in the PacMARS study area, including information on the Bering Strait inflow, the Canada Three Oceans Program, RUSALCA and Bering Sea programs such as BEST. While other sources of information exist for these projects, the integration of the preliminary IPY project results from the PacMARS study area with other arctic research projects is helpful and convenient.

ISHTAR - Inner Shelf Transfer and Recycling
http://www.lib.noaa.gov/uhtbin/cgisirsi/x/x/0/5?searchdata1=ISHTAR&Submit=Find

Inner Shelf Transfer and Recycling (ISHTAR) was a National Science Foundation project with fieldwork undertaken in 1984-1988. A special issue of Continental Shelf Research (ISHTAR: Inner Shelf Transfer and Recycling in the Bering and Chukchi Seas, Volume 13, Issues 5-6, ISSN 0278-4343) includes some of the key findings of the project, although other results were published in Marine Ecology-Progress Series, Science, and other peer-reviewed outlets. The project was originally designed to be an investigation of the influence of Yukon River on the Bering Sea, with the possibility of comparing the system with the Rhine River influence on the North Sea, but the key results of the project included documenting the source and fate of high nutrient fields associated with Anadyr water flowing north from the Bering Sea into the Chukchi Sea and demonstration of the importance of the benthos to the overall ecosystem. This project also coincided with improvement in relations between the United States and the Soviet Union and ISHTAR was able to initiate some of the first comprehensive cross boundary studies in both the Bering and Chukchi Seas. Some archived data are available from the IMS archive (described above) at the University of Alaska Fairbanks and paper copies of project and cruise reports are available at NOAA libraries, e.g.
http://www.lib.noaa.gov/uhtbin/cgisirsi/x/x/0/5?searchdata1=ISHTAR&Submit=Find

JWACS-Joint Western Arctic Climate Study

The Joint Western Arctic Climate Study (JWACS) is an evolving scientific collaboration of researchers from Canada, the United States, Japan and China, working in the Canadian Basin and Beaufort Gyre, and using Canadian icebreaker assets and ice-anchored sensors. Goals have included examining the impacts of

climate variability on oceanographic processes, variation in freshwater storage in the Beaufort Gyre, as well as atmospheric science, and biological observations. The history, publications, and other information about the project are presented on the Woods Hole Oceanographic Institution's Beaufort Gyre Exploration Project (http://www.whoi.edu/page.do?pid=66296). The US participation in the project is being supported through the Arctic Observing Network, so physical and chemical sensor oceanographic data, as well as modeling results are readily available at the referenced website.

Malina Project
http://malina.obs-vlfr.fr/

The Malina Project is focused on how changes in ice cover, permafrost and UV radiation impact on biodiversity and biogeochemical fluxes in the Arctic. Much of the field work was accomplished in the Beaufort Sea in cooperation with Canadian researchers in ArcticNet, but this French based program also played a role on the NASA funded ICESCAPE program in the Chukchi Sea in 2010-2011 (see ICESCAPE entry). Presentations, documents and data on the website for the project are password protected, but many data are being published in 2012-2013 in a special issue of Biogeosciences-Discussions (http://www.biogeosciences-discuss.net/special_issue80.html), which is an interactive open access journal of the European Geosciences Union, so data results are open to all and provide new insights on how reductions in sea ice are changing mineralization rates for dissolved organic matter in the upper water column, in addition to related topics.

MIZEX West: Bering Sea Marginal Ice Zone Experiment

An early marginal ice zone investigation in February 1983, this physics study helped promote understanding of sea ice formation processes in the Bering Sea, wind forcing, the development of polynyas, and atmospheric connections. A description of the program was published in the Transactions of the American Geophysical Union, EOS (DOI: 10.1029/EO064i040p00578). The primary study area was south of the PacMARS study, but clearly the sea ice processes worked out during this study are relevant to PacMARS.

NBS SLIP - Northern Bering Sea projects (St. Lawrence Island Polynya)
http://arctic.cbl.umces.edu

These were several NSF funded research projects that PacMARS PIs Grebmeier and Cooper served on as investigators in the north Bering Sea between 1989-2008, including work with J. Lovvorn (Southern Illinois University). These data have been used in the PacMARS synthesis with other data collected during BERPAC, BEST projects. Data are archived at EOL; for links to publications, see the referenced website.

RUSALCA - Russian American Long-Term Census of the Arctic
http://www.arctic.noaa.gov/aro/russian-american/
http://rusalcaproject.com/
POC: Kathleen Crane, Kathy.Crane@noaa.gov

The Russian-American Long-Term Census of the Arctic (RUSALCA) is the largest joint U.S. – Russian program for oceanographic research and was initiated following the signing of a memorandum of agreement between NOAA and the Russian Academy of Sciences in 2003. Focused on the Beringia region at the U.S. – Russian frontier, the results of the program are very important for understanding the regional scale of the ecosystem because of the difficulties of sampling in the Russian Exclusive Economic Zone without Russian scientific and governmental partners. Data from the program, which was initiated during a 2004 joint research cruise, followed by other multidisciplinary efforts in 2009 and 2012, are now

being transferred to a data archive at the Alaska Ocean Observing System (see AOOS entry). Additional annual cruises have supplemented these multidisciplinary efforts through servicing of moorings in the Bering Strait. Several PacMARS investigators have been supported through the NOAA program, and we have incorporated data from the project into our overall synthesis.

SBI - Western Arctic Shelf-Basin Interactions
http://www.eol.ucar.edu/projects/sbi/
http://arctic.cbl.umces.edu/sbi/web-content/ (archived non-active site)

Shelf-Basin Interactions (SBI) was a scientific community designed program that developed into perhaps the largest interdisciplinary project in the PacMARS study area. It was supported by the National Science Foundation during 1999-2008. Assembled in three phases, the early retrospective and field portions were much larger in scope than a follow-on synthesis phase, so complete integration of the project results on exchange of organic materials on the outer continental shelf remains a work in progress, and peer-reviewed publications continue to be prepared, in addition to the contributions present in two special issues of Deep-sea Research. Data availabilities are generally good at EOL for this project, and several PacMARS investigators participated in the SBI project, so we think that important insights have been incorporated into our analysis. Data from SBI will be used in SOAR benthic and Barrow Canyon projects (SOAR; Appendix G3).

SHEBA - Surface Heat Budget of the Arctic
http://data.eol.ucar.edu/codiac/projs?SHEBA

The Surface Heat Budget of the Arctic (SHEBA) was an over winter freeze-in experiment in 1997-1998 using a Canadian icebreaker with US, Canadian and other international participation. During the overwinter experiment, this National Science Foundation-funded research project quantified heat transfer processes between the ocean and atmosphere. Other biological data collected during the experiment contributed to a better understanding of seasonal and annual changes in production and biological dynamics. Data from the project are available at the EOL and ArcOD archives. The project involved work well offshore (starting at a point 570 km north of Prudhoe Bay), and the core of the work involved consideration of surface albedo and heat exchange between the sea ice and atmosphere, so the data results are probably not as relevant to PacMARS as more recent multidisciplinary projects such as BEST and SBI.

SNACS - Study of the Northern Alaska Coastal System
http://www.arcus.org/arcss/snacs/
http://www.eol.ucar.edu/projects/arcss/

2005-2006
See BOWFEST; UAF, EOL, URI, UTMSI, WHOI were funded through this NSF project; data generally available; the remaining SNACS projects were primarily on land

G1.7 US Federal and State Agency Programs and International Organizations

ADF&G – Alaska Department of Fish and Game
http://www.adfg.alaska.gov//;

The Alaska Department of Fish and Game (ADFG) is an important cabinet-level Alaska state agency with responsibilities for managing fish and wildlife resources. Sustained management of fish and game within the state is mandated through the state constitution, so relative to many other state governments, this agency is disproportionally important. The agency maintains an e-library at: http://www.adfg.alaska.gov/index.cfm?adfg=library.main that serves as a repository for many documents and videos as well as bibliographical information on professional peer-reviewed papers and technical reports produced by agency employees. In particular, ADFG is a critical source of information on marine mammals in the PacMARS study area http://www.adfg.alaska.gov/index.cfm?adfg=marinemammalprogram.main, with recent professional papers covering pertinent topics such as bowhead whale migration routes and seasonal habitats http://www.adfg.alaska.gov/index.cfm?adfg=viewing.trackingmaps&map=bowhead.

The Synthesis of Arctic Research (SOAR) program anticipates two papers for the special issue of Progress in Oceanography, based in part on data from the bowhead tracking project (Appendix G3). Gray literature reports are less extensively available, and the professional paper sections are simply lists of papers in which ADFG employees were co-authors by year. Abstracts are generally unavailable and there are no tools on the website to download citations for compilation into bibliographical software libraries (e.g. .ris format files) that are common to most digital libraries. On the other hand, some portions of the website, including a searchable database of fishing and subsistence technical publications that can be downloaded as .pdf files http://www.adfg.alaska.gov/sf/publications/ provide access to information resources unavailable elsewhere. Overall, the ADFG website suffers from a mix of needs, including serving the fishing and hunting public, providing outreach to meet layperson interest in the natural history of wildlife, proving for scientific users, and other agencies, NGOs, and public stakeholder constituencies. One result is that, while the value of the resource is high, it is clearly a challenge to extract all of the pertinent information that may benefit the PacMARS effort, including gray literature reports that are not online.

Alaska Center for Climate Assessment and Policy
http://ine.uaf.edu/accap/data_resources.html/

The website of the Alaska Center for Climate Assessment and Policy links to webinars, news stories, scenario and planning reports, policy documents, ongoing research projects and data resources held by other agencies – all intended to serve as resources for responding to Alaska's changing climate. Funded through NOAA, it is more of a clearinghouse than a source of original information not available elsewhere.

AON – Arctic Observing Network
http://www.arcus.org/search/aon
POC: Erica Key, ekey@nsf.gov

The Arctic Observing Network (AON) is the framework under which the National Science Foundation makes funding awards for projects in the Arctic that have an observational orientation. Projects include atmospheric, terrestrial and marine observations, and all funded investigators are required as a condition of funding to provide publicly accessible data to the ACADIS project, described above. The PacMARS analysis relied on several AON funded projects, which are described separately in the multidisciplinary

narrative of this appendix. Data from various AON projects will also be incorporated in Synthesis of Arctic Research (SOAR) analyses and papers (Appendix G3).

AOOS – Alaska Ocean Observing System
Web address: http://www.aoos.org/
POC (general): Molly McCammon, mccammon@aoos.org, 907-644-6703

The Alaska Ocean Observing System (AOOS) has objectives of increasing access to existing coastal and ocean data, including providing access to information and data in visually useful packages. AOOS partnered with the PacMARS project to improve access to existing data using their web-based platform. The quality and quantity of data resources available through AOOS are increasing and the flexibility and power of the web-based platform have the potential to meet the needs of many stakeholders. The orientation of the AOOS platform is perhaps more towards highlighting real-time observations, including "low-hanging fruit," such as weather data also available through the National Weather Service, but temporal aspects of data display are being enabled, as are links to data storage. Specifically, the AOOS will provide a data visualization tool to the IARPC DBO IT; see IARPC and DBO entries.

ARC – United States Arctic Research Commission
Web address: http://www.arctic.gov/
POC (general): John Farrell, Executive Director; jfarrell@arctic.gov, 703-525-0113

The United States Arctic Research Commission was established by the Arctic Research and Policy Act of 1984 (as amended, Public Law 101-609). It is a small government agency that provides recommendations and supports efforts that establish national policy, priorities, and goals for the Arctic. Other goals include promotion of Arctic research, and to communicate research and policy recommendations to both the Executive and Legislative branches of the federal government though coordinated efforts that include five-year research plans. The ARC is primarily a higher level government coordinating agency, but it does contribute unique insights through workshop reports and other activities that involve researchers, agency representatives, and other stakeholders. The Commission's Report on Goals and Objectives for Arctic Research 2011-2012 http://www.arctic.gov/publications/2011-12_usarc_goals.html is a general resource that was consulted as part of the overall PacMARS effort.

ARCSS - Arctic System Science Section (NSF)
Arctic System Science (ARCSS) are projects funded by the National Science Foundation that take a systems approach to studying the Arctic. Projects relevant to PacMARS include multi-investigator projects such as Shelf-Basin Interactions and many individual projects. Data from completed NSF ARCSS projects are archived with the Earth Observations Laboratory, which is a unit of the National Center for Atmospheric Research, which is managed by the University Corporation for Atmospheric Research. Data are now housed in an ARCSS archive at EOL http://www.eol.ucar.edu/projects/arcss/, but will be eventually merged with ACADIS (described above). In addition, ARCSS/SBI data will be used in various SOAR projects (Appendix G3).

Arctic LSS - Arctic Landscape Conservation Cooperative
Web address: http://arcticlcc.org/
POC (general): Greg Balogh (Greg_balogh@fws.gov)

Landscape Conservation Cooperatives are an initiative led by the US Department of the Interior, which has responsibilities for national park, and wildlife refuge management, as well as other federally owned lands and resources. The mission statement of the Arctic Landscape Conservation Cooperative (ALCC) includes goals of identifying and providing information needed to conserve natural and cultural resources in the face of landscape scale stressors, particularly climate change. It is fundamentally a

multidisciplinary program, supported by a steering committee and directed by a science plan (http://arcticlcc.org/about/scienceplan/), which supports coordinated actions among management agencies, conservation organizations, communities, and other stakeholders. Not all of the projects supported by the ALCC are relevant to PacMARS since the landscape protection components are often located in watersheds and on land, but we consider the ShoreZone mapping program and the Threatened Eider Database (http://arcticlcc.org/products/spatial-data/show/threatened-eider-geodatabase-for-northern-alaska-2012-edition to be two of several significant contributions of the ALCC that are relevant to the scope of the PacMARS effort. Another component of the program is the BIOMAP Alaska project, which is using local residents of Barrow, Kotzebue and Kaktovik to collect data on local observations, and upload that information via the web. Overall, ALCC is a program that is developing so not all information is readily available, such as the identity of investigators of individual ALCC projects.

BOEM - Scientific and Technical Publications
www.boem.gov/akstudies
The BOEM/MMS catalog of technical reports, charted by the year of their completion, includes a link to both natural and sociocultural studies funded by BOEM through the Alaska Environmental Studies program. Pertinent projects for this synthesis are identified throughout this data table, such as ANIMIDA, ASAMM, CHAOZ, BOWFEST, historic OCSEAP data. The sociocultural studies within the PacMARS study region cover primarily the Arctic Slope villages, offering very detailed accounts of the subsistence practices in these communities. Multidisciplinary BOEM project are found under their project acronyms throughout this data table.

Chariot – Cape Thompson Project Chariot
Web address: http://nwda.orbiscascade.org/ark:/80444/xv17795/ (link to description of paper archives of the project at the Rasmuson Library, University of Alaska Fairbanks)

The Project Chariot project was proposed as a means to construct an artificial deepwater port in northwestern Alaska by detonating nuclear explosives at Cape Thompson. The project was eventually abandoned, but not before stimulating an early campaign of ecological research to examine the potential consequences of this disruptive event. The key scientific record is the volume edited by Norman J. Wilimovsky and John N. Wolfe, The Environment of the Cape Thompson Region Alaska. U.S. Atomic Energy Commission, Government Printing Office, Washington, D.C. 1966. The book is widely available from academic libraries and can be purchased from www.amazon.com/. Much of the research that was conducted prior to the cancellation of Project Chariot project was terrestrial in origin, but some information is available in this volume on marine systems in the PacMARS study area. Given all of the marine research that has followed in subsequent decades, the description of the Chukchi Sea ecosystem in the volume seems of modest value for PacMARS objectives, although species inventories are of some value when assessing potential species range extensions over time.

Committee for the Workshop on Frontiers in Understanding Climate Change and Polar Ecosystems, Report of a Workshop, 2011

This workshop report is largely a research question resource. It considers issues on both land and sea and in the Antarctic as well as the Arctic.

IARPC - Interagency Arctic Research and Policy Committee
http://www.nsf.gov/geo/plr/arctic/iarpc/arc_res_plan_index.jsp/
POC(s): Brendan Kelly <Brendan_P_Kelly@ostp.eop.gov>; Sara Bowden, Executive Secretary, bowden@arcus.org

The Interagency Arctic Research Policy Committee (IARPC) is charged with developing five-year plans for federally sponsored research in the Arctic region. For 2013 to 2017, the IARPC, which consists of representatives from 14 Federal agencies, departments, and offices, has identified seven research areas that will inform national policy and benefit significantly from close interagency coordination; they include: (1) Sea ice and marine ecosystems; (2)Terrestrial ice and ecosystems; (3)Atmospheric studies of surface heat, energy, and mass balances; (4) Observing systems; (5) Regional climate models; (6)Adaptation tools for sustaining communities; and (7) Human health. IARPC Implementation Teams have been formed to coordinate inter-agency and academic approaches under each research area. The seven research areas do not encompass all Federal Arctic research activities that will occur over the next five years. Many important investigations outside the scope of this plan will continue to be conducted within individual agencies or through other interagency collaborations.

NOP - National Ocean Policy
http://www.whitehouse.gov/administration/eop/oceans/implementationplan/

The National Ocean Policy is a general, high-level policy document directing federal agency actions, based upon Executive Order 13547 -- Stewardship of the Ocean, Our Coasts, and the Great Lakes. The final Implementation Plan for the policy was released in April 2013 and can be downloaded at above site.

The Distributed Biological Observatory concept (described above) is specifically outlined for implementation of the National Ocean Policy: "

> **"Implement a distributed biological observatory in the Arctic to monitor changes and improve our understanding of their socioeconomic and ecosystem impacts.** The effects of Arctic changes and human activity on ecosystems and Alaskans who depend on them are poorly understood. Continued observations are needed to form a basis of understanding of the changing processes in the Arctic region. Agencies will continue to develop and deploy a distributed biological observatory, or an array of sites for consistent monitoring of biophysical responses in the Arctic marine environment, as a component of the integrated Arctic Observing Network. Regional collaboration and partnerships will increase our capacity to monitor and assess changing environmental conditions and support improved management of Arctic coastal and ocean resources. "

North Slope Science Initiative (NSSI)
http://northslope.org/
POC(s): John Payne, Executive Director, jpayne@blm.gov/; Dennis Lasseau, Deputy Director, dlassuy@blm.gov

The North Slope Science Initiative (NSSI) is an intergovernmental effort to increase collaboration at the local, state, and federal levels to address the research, inventory, and monitoring needs as they relate to development activities on the North Slope of Alaska. The NSSI has compiled a summary of long-term monitoring studies, which is supported by GINA (described above; also see http://northslope.org/monitoring/. This summary is comprehensive and not focused solely on the marine environment. Long-term monitoring is defined as multiple collections of the same variable over a period of 10 years or longer by comparable methodology on the North Slope of Alaska and in adjacent waters. Acceptable entries also include projects or initiatives that have been undertaken in the last five years that are intended to continue into the foreseeable future.

NOAA (National Oceanic and Atmospheric Administration) Arctic Theme Page
http://www.arctic.noaa.gov/

The NOAA Arctic Theme page is a general and extensive resource that provides a summary of current arctic status and includes links to the Arctic Report Card (discussed above), arctic research projects and online data supported by NOAA, and essays by researchers and local arctic residents. This is a well-developed thematic page that provides a mechanism for communicating synthetic knowledge of the Arctic in general and the PacMARS study region specifically.

NPRB – North Pacific Research Board
http://www.nprb.org/

The North Pacific Research Board is increasingly important as a facilitator of research priorities and funded science in the north Pacific, Bering Sea and north into the region considered during the PacMARS effort. While other examples are available, we cite below two projects that were specifically considered in development of our data synthesis and identification of research gaps.

NPRB #503 Arctic Ocean Synthesis 2008
http://doc.nprb.org/web/05_prjs/503_final.pdf/

The North Pacific Research Board funded a Chukchi and Beaufort Sea synthesis project in 2008 that examined existing data sets with the intent of identifying research needs in the context of climate change, and to pose questions as a basis for future science initiatives. Although similar in inspiration to PacMARS, we have had the advantage of having access to the vast array of work that unfolded during the International Polar Year and additional funding has facilitated consideration of other factors such as contaminants and other chemical indicators that were only cursorily treated in this synthesis effort. PacMARS has also been tasked with consideration of human dimensions of Arctic change; NPRB Project #503 did not solicit significant local community input. Nevertheless the effort made was valuable and given the passage of time since preparation of this report, it is timely that we consider advancing these findings that are part of a tapestry of efforts that will help direct future research efforts in the north Bering, Chukchi, and Beaufort Seas.

OCSEAP - Outer Continental Shelf Environmental Assessment Program (Bureau of Land Management-NOAA)

The Outer Continental Shelf Environmental Assessment Program (OCSEAP) was a critical legacy program during the late 1970s that potentially provides a linkage and continuity for oceanic and biological conditions dating back to that period. The data are in uneven condition, some remain as paper records, although in some cases, the data can be accessed electronically, e.g. at http://www.ngdc.noaa.gov/mgg/geology/ocseap.html/. The Arctic Project Office for OCSEAP provided scientific management and coordination in the Beaufort, Chukchi Sea, and Hope Basin oil and gas lease areas. Paper records of the project office, which operated from 1975-1982, are archived in the Alaska Polar Regions Collections and Archives of the Elmer E. Rasmuson Library at the University of Alaska Fairbanks. The Alaska Resources Library and Information Services (see ARLIS entry above) in Anchorage also maintains paper copies of OCSEAP reports and results (description at: http://www.arlis.org/resources/special-collections/ocseap-reports/. Several PacMARS investigators are familiar with OCSEAP data and worked on the project or for OCSEAP investigators as graduate students. There no doubt remain important data legacies that could still be recovered, and the PacMARS effort reflects knowledge of "low-hanging fruit."

OER - Arctic Ocean Exploration cruises (NOAA)
http://oceanexplorer.noaa.gov/explorations/explorations.html/

The Ocean Exploration Program of NOAA has sponsored work that is relevant to PacMARS efforts, particularly the 2002 cruise of Louis St. Laurent (http://oceanexplorer.noaa.gov/explorations/02arctic/) and the 2005 cruise of the USCGC Healy into the Canada Basin http://oceanexplorer.noaa.gov/explorations/05arctic/logs/summary/summary.html/. Data from this cruise was used in support of the ArcOD component of the Census of Marine Life (see ArcOD entry above), as well as other efforts. PacMARS PI Bodil Bluhm participated on this cruise and is directing the ArcOD program from the University of Alaska Fairbanks, so we are confident that important insights from this program on arctic biodiversity have been successfully incorporated into the PacMARS effort. Macrofauna, megafauna and zooplankton 2002 data are archived at www.arcodiv.org and macrofauna 2005 data are archived at EOL on the PacMARS portal.

SAON - Sustaining Arctic Observing Networks
http://www.arcticobserving.org/

Sustaining Arctic Observing Networks (SAON) was initiated by the Arctic Council, meaning it is a high-level coordination effort. SAONB supports and strengthens the development of coordinated pan-Arctic observing and data sharing systems. However, SAON itself does not undertake science planning, conduct observations, or archive data, so in our PacMARS analysis, we did not make significant use of this developing resource for arctic observations.

Scaling Studies in Arctic System Science and Policy Support: A Call-to-Research
http://www.arctic.gov/publications/arctic_scaling.html

This report is the result of an Arctic Research Commission study on appropriate scaling for arctic research programs. The report was published in 2010 and can be downloaded at the referenced website. The report covered both terrestrial and marine systems, as well as human communities, infrastructure, resource extraction, ice navigation, and commercial and subsistence harvesting of food resources. A section on oil spill preparedness is clearly relevant to PacMARS efforts. Background reading and cited references were also included in this synthetic product with an applied orientation. (see also ARC above).

TOS – The Oceanographic Society
http://www.tos.org/oceanography/archive/24-3.html/

The Changing Arctic Ocean: Special Issue on the International Polar Year (2007–2009) is a published, freely available resource that provides a synthetic summary of the state of knowledge of a number of arctic oceanographic topics.

USFWS - US Fish and Wildlife Service
http://www.fws.gov/; http://www.fws.gov/alaska/mbsp/mbm/seabirds/seabirds.htm).

The U.S. Fish and Wildlife Service (USFWS) is responsible for all migratory birds, including marine birds that move from onshore breeding colonies to pelagic waters during the non-breeding season. As part of the survey and monitoring of breeding seabirds, the Alaska Marine National Wildlife Refuge (AMNWR) conducts surveys and supports a variety of studies throughout the state; results of these efforts, including diet information, are summarized in annual 'Breeding status and population trends' reports available at: http://www.fws.gov/alaska/nwr/akmar/whatwedo/bioprojects/publications.htm. The USFWS also maintains a seabird colony database available through http://seabirds.net/seabirdinfonetwork.html. The diet information associated with the Sebirds.net site is a work in progress, but will eventually link seabirds with their prey throughout the region and over time.

Kathy Kuletz is a key contact who is assisting PacMARS investigators with use of seabird data such as the North Pacific Seabird Database and Seabird Colony Database (see Seabirds.net entry below). We are also cognizant of rich data sets that are available from cross-boundary work of the Russia and East Asia Branch of the International Affairs office of the FWS. The associated BERPAC project is described above. Finally, FWS seabird data will be used in three SOAR studies: 1) nearshore benthic prey ; 2) marine bird and mammal distribution; and 3) trophic productivity at Barrow Canyon (SOAR; Appendix G3).

USGS – United States Geological Survey
USGS report on Outer Continental Shelf (OCS) science needs: An Evaluation of the Science Needs to Inform Decisions on Outer Continental Shelf Energy Development in the Chukchi and Beaufort Seas, Alaska: http://pubs.usgs.gov/circ/1370/pdf/circ1370.pdf/

This is an important predecessor study for PacMARS; it was predicated on improving the environmental assessments undertaken prior to oil and gas leasing and criticisms that these assessments were not up-to-date. In many ways, the PacMARS effort and this report used complementary approaches, with consideration of applied and technical issues with oil extraction, and more of a focus on higher trophic level birds and marine mammals in the USGS report.

U.S. National Assessment Alaska Regions Bering Sea Impact Study (BESIS)
http://www.besis.uaf.edu/

This is a completed workshop from the 1990s. Several PIs are familiar with this project.

USN – United States Navy
http://www.navy.mil/navydata/documents/USN_artic_roadmap.pdf/

Note that “arctic” is misspelled on Navy website link to the above .pdf file.

US Navy Road Map

The US Navy Road Map is a potential resource for research questions, but the document is written for such specific issues as international security and/or at a general level so that the linkage to PacMARS goals are ambiguous.

USoDS - US State Department-Foreign Data Sets
The US State Department approves foreign vessel science requests, but there is no central repository for data that are collected by foreign vessels in the US Exclusive Economic Zone (EEZ). This is unfortunate because it limits communication of foreign vessel intentions for research in US waters near subsistence-oriented communities in Alaska.

WCCY - What is Climate Change to You?
http://2011.polarhusky.com/support/wccy/what-is-climate-change-to-you/

The PolarHusky “Go North” website is a valuable education website with resources for teachers and students.

G1.8 Arctic Data Portals and Library Resources

ACADIS - Advanced Cooperative Arctic Data and Information Service
Web address: http://www.aoncadis.org/home.htm
POC (PacMARS): James Moore (jmoore@ucar.edu)

The Advanced Cooperative Arctic Data and Information Service (ACADIS) is emerging as a key data archival service that is funded by the National Science Foundation (NSF). Investigators now funded through NSF Arctic research programs are increasingly being obligated as a condition of funding to share collected data through ACADIS. The data archive is also being used by other agencies and projects, and is directly serving PacMARS data retrieval efforts as a participating team member of the project. Strengths of the site include excellent geographical orientation displays and search tools. Some researchers remain hesitant to share data despite award conditions, so ACADIS should not be considered a completed effort that reflects all NSF-funded science in the Arctic. Data organization within the website by discipline and project also remains a work in progress.

Arctic Data portal
www.arcticdata.org

The Arctic data portal is a developing resource that serves as an archive providing access to data collected and developed through the activities of the Conservation of Arctic Flora & Fauna (CAFF) and Protection of the Arctic Marine Environment (PAME) Working Groups of the Arctic Council. High-quality maps and data displays are available for download, although the coverage is broadly pan-Arctic and some data and links, e.g. to AOOS, are available elsewhere.

Arctic EIS – Arctic Ecosystem Integrated Survey

Web address: https://web.sfos.uaf.edu/wordpress/arcticeis/
POC (general): Franz Mueter, fmueter@alaska.edu, 907-796-5448

The Arctic Ecosystem Integrated Survey (Arctic EIS) is a University of Alaska Fairbanks and Alaska Fisheries Science Center based effort that is contributing to a better understanding of the oceanography, lower trophic levels, crab, and fish communities of the northeastern Bering Sea and eastern Chukchi Sea shelf and evaluate results relative to earlier studies in the same area and relative to similar studies in adjacent regions. The work includes on-going and recent field sampling, laboratory analyses, development of geo-databases, and facilitation of data sharing and synthesis with other programs and investigators in the Chukchi Sea and adjoining ecosystems. Funding is provided by the Department of the Interior via the Fish and Wildlife Service and Bureau of Ocean Energy Management, with additional funds from NOAA, and the Alaska Department of Fish and Game. The results of this project will be of value for understanding foodweb structure and ecosystem function in the Chukchi Sea, but only limited results (e.g. copies of posters) are available at this time. Because of the contemporaneous efforts to collect data at the same time as the PacMARS synthesis, we do not expect to fully incorporate the ArcEIS results into our synthesis, but note the high potential this program should have for improving understanding of the Pacific-influenced Arctic. PacMARS PI Bluhm is a co-PI on this project.

Arctic ERMA – Arctic Environmental Response Management Application
POC (general): orr.erma@noaa.gov
Web address: http://response.restoration.noaa.gov/maps-and-spatial-data/environmental-response-management-application-erma/arctic-erma.html

https://www.erma.unh.edu/arctic/erma.html#x=-158.52172&y=69.38032&z=5&layers=12959+12913+12921+12920

The Environmental Response Management Application (ERMA) is a web-based Geographic Information System (GIS) tool funded by NOAA that is hosted at the University of New Hampshire with support from the EPA that is designed to facilitate emergency response and environmental resource managers in dealing with incidents that may adversely impact the environment. For example, currents, bathymetry, and environmental sensitivity indices are available as layers to help understand potential impacts of events such as oil spills or ship groundings. The data on the website are for the most part available from other sources, but the web-based tools the site provides are well-designed, with high functionality. We did not directly use the ERMA site in our PacMARS analysis, but recognize the value it brings to resource managers and its value for emergency response.

Arctic Report Card
Web address: http://www.arctic.noaa.gov/reportcard/
POC (general): Jana Goldman, jana.goldman@noaa.gov, 301-734-1123

The Arctic Report Card is now issued annually as a cooperative interagency effort led by NOAA. The document is peer-reviewed and edited prior to release, and summarizes current understanding of the state of the Arctic relative to historical records on a variety of topics. The Report Card is intended for a wide audience, including scientists, teachers, students, decision-makers and the general public interested in the Arctic environment and science. The Report Card is organized into five sections: Atmosphere; Sea Ice & Ocean; Marine Ecosystem; Terrestrial Ecosystem; and Terrestrial Cryosphere, and specialized topics are folded into the overall Report. Since the document is meant for widespread public use, PacMARS did not use it as a primary data source for its analysis, but several PacMARS investigators have been co-authors of the annual versions of the Arctic Report Card. We think the broad understanding of the state of the Arctic as reported in the Arctic Report Card is also reflected in the PacMARS analysis.

Arctic Science Portal
http://www.arctic.gov/portal/

The Arctic Science Portal includes links to other websites where Arctic data and general information are available, including many that are tabulated here. While it aspires to be comprehensive and cover all topics (e.g. economics, society, natural sciences), the Portal is a new resource that is still in development and must be considered a work-in-progress. It includes links to sites that are both active and inactive; explanations of organizations and acronyms are brief and in some cases not sufficient for casual users. Coverage of organizations is uneven, for example, a wide variety of web links are provided to Canadian government agencies, but only one to the each of the governments of Denmark, Iceland, Finland, Norway and Russia. Somewhat oddly, given the one link to Denmark, a separate link is also available to the government of Greenland. The data set portal links, at http://www.arctic.gov/portal/datasets.html are helpful and, with an appropriate investment, the Portal should become increasingly more valuable.

ARLIS - Alaska Resources Library and Information Services
http://www.arlis.org/

The Alaska Resources Library and Information Services (ARLIS) is a comprehensive library covering all information relating to Alaska's natural and cultural resources. A number of state and federal agencies, as well as the University of Alaska Anchorage and the Exxon Valdez Oil Spill Trustee Council are networked circulating supporters of the library's operations in Anchorage. Interlibrary loans are available to these agencies, as well as outside users, and the library can issue library cards and access upon written request, as well as through institutional affiliation. Electronic access to professional journals is available,

and there are mechanisms for requesting access to professional journals that are otherwise prohibitively expensive for casual users, but in many cases, use is restricted to access from the library itself in Anchorage. While the Library is an extremely valuable resource for users without university affiliations, as part of PacMARS, we did not make significant use of the library because many of its resources were already available through our own institutional libraries and networks.

Arctic Marine Synthesis: Atlas of the Chukchi and Beaufort Seas
http://ak.audubon.org/arctic-marine-synthesis-atlas-chukchi-and-beaufort-seas The Atlas of the Chukchi and Beaufort Seas is a cooperative project completed in 2010 between Audubon Alaska and Oceana that provided a place-based summary of a number of important ecosystem variables, as well as distribution maps for birds that are on the Audubon Alaska watch list. The format of the project includes extensive use of geographical information system tools using the best available information. References to the original data sources are provided and assessments are provided on the quality of the data that were used to prepare the mapped products.

CADIS - Cooperative Arctic Data and Information Service
http://www.aoncadis.org
The Cooperative Arctic Data and Information Service (CADIS) is the designated repository for Arctic Observing Network data and is now transitioning to a wider data depository function for additional National Science Foundation projects that involve less observational data than the Arctic Observing Network program, such as individual and multidisciplinary NSF projects. This wider project function is described under ACADIS above.

EOL - Earth Observing Laboratory
http://www.eol.ucar.edu/data; Contact: Jim Moore, jmoore@ucar.edu

The Earth Observing Laboratory is a key partner in PacMARS, providing data archiving capabilities for the project in conjunction with other funded program activities such as ACADIS, described above.

JAMSTEC Data Research System for Whole Cruise Information
http://www.godac.jamstec.go.jp/darwin/e

Data from research cruises conducted by JAMSTEC (Japanese Agency for Marine-Earth Science and Technology) in the Bering and Chukchi Seas using the R/V Mirai are archived at this web site. Data cover physical, chemical, and some biological (e.g., chlorophyll) variables. Most of the data are available. Chlorophyll and CTD data were used in the PacMARS synthesis.

NODC - National Oceanographic Data Center (NOAA)
http://www.nodc.noaa.gov/

The National Oceanographic Data Center (NODC) is the largest global source of oceanographic data and includes data from the PacMARS study area. There are some complexities to achieving successful search engine results, and in some cases the data archived and associated metadata present limitations. For example, PacMARS efforts to use OCSEAP zooplankton data were limited because life stage data were not included in the archived data. Changes in taxonomic nomenclature have also posed difficulties for long-term data sets. Particularly for older data sets such as OCSEAP, the NODC archive is invaluable and should be explored further to document changes, despite the challenges that may be posed.

NSSC - North Slope Science Catalog (see GINA entry)
http://www.north-slope.org/departments/wildlife/studiesNresearch.php

NSSI - North Slope Science Initiative – see earlier entry at GINA
http://www.northslope.org/monitoring

OBIS - Ocean Biogeographical Information System
www.iobis.org

The Ocean Biogeographical Information System is a global database for biodiversity data that can be used for evaluation of the status of knowledge on ocean biodiversity, gaps, and potential for discovery. The database system receives foundation support under the umbrella of UNESCO's Intergovernmental Oceanographic Commission and it is a legacy of the Census of Marine Life, so please also see the entry under ArcOD for information that is specific to the Arctic Census of Marine Life. There are some limitations to use of these data. For example, abundance data are lacking in most instances, so understanding processes or population dynamics is beyond the current scope of the project. ArcOD data can be downloaded from OBIS directly (http://iobis.org/mapper/, view ArcOD data provider under 'datasets' in 'search data')

Thesis and Dissertation Project Database of the University of Alaska Resilience and Adaptation Program
http://www.uaf.edu/rap/students/Alumni/

This webpage provides links to theses by early career scientists who are alumni of the University of Alaska Fairbanks Resilience and Adaptation Graduate Program; some of these theses are clearly relevant to the PacMARS study area and the intersection with local traditional knowledge in some cases.