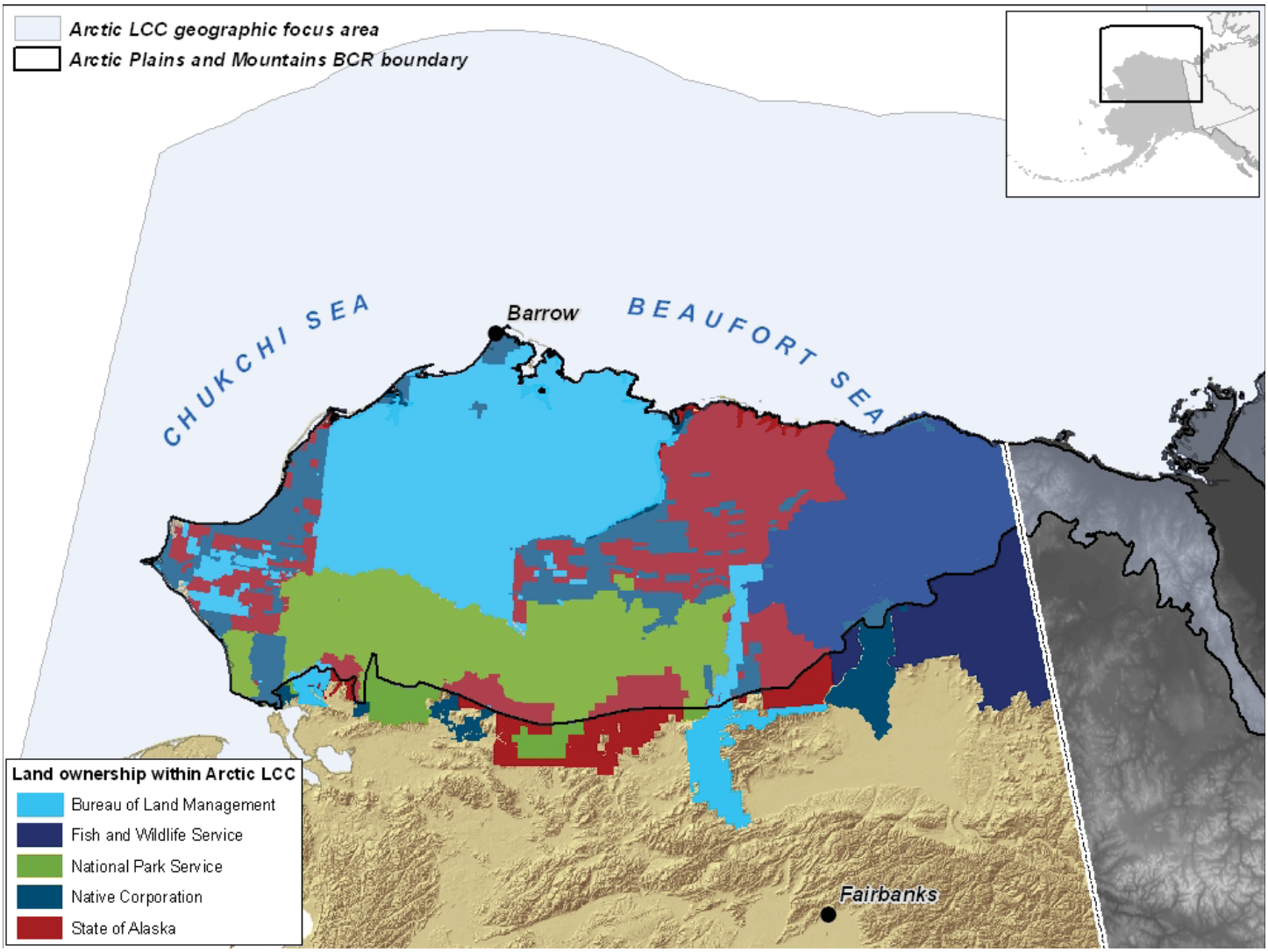
U.S. Fish & Wildlife Service

Arctic Landscape Conservation Cooperative

Development and Operations Plan

1. Geographic Scope and Importance of the Arctic Landscape Conservation Cooperative (LCC)

The Arctic LCC encompasses the Arctic Plains and Mountains Bird Conservation Region, covering the North Slope of Alaska and extending into Canada and adjacent marine areas of the Beaufort and Chukchi seas.



The area is comprised of three ecoregions: the rugged slopes and valleys of the Brooks Mountain Range, the rolling hills and plateaus of the Arctic Foothills, and the broad Arctic Coastal Plain, with its vast wetlands and abundant lakes.

The Arctic is managed by several state and federal agencies with various missions and trust responsibilities. The US Fish and Wildlife Service (USFWS) manages the 18-million-acre Arctic National Wildlife Refuge (Arctic NWR). The Bureau of Land Management (BLM) manages resource development in the National Petroleum Reserve – Alaska (NPR-A), a landscape of over 23 million acres, covering the entire western portion of arctic Alaska. The National Park Service (NPS) manages over 15.5 million acres across four parks (Gates of the Arctic, Noatak, Cape Krusenstern and Kobuk Valley). The State of Alaska manages over 18.5 million acres for resource development, subsistence, and wildlife.

The Arctic has been selected for special emphasis in FY 2010 because:

1. It is the region projected to experience the most pronounced warming on the North American continent, and climate effects on wildlife have already been documented.

2. Important fish and wildlife resources include Endangered Species Act (ESA) listed threatened and candidate species, migratory birds, marine mammals, and the Arctic National Wildlife Refuge (Arctic NWR). Additionally, Alaska Natives in the Arctic depend on the harvest of fish and wildlife species such as caribou to meet their subsistence needs; these harvested species are also management priorities for the State and all Federal agencies under ANILCA.
3. The Arctic is an area of great importance for oil and gas development and the Bureau of Land Management, Minerals Management Service, and the State have extensive responsibilities to reconcile fish, wildlife, and habitat protection with oil and gas development. Climate change is already affecting the conduct of mineral exploration activities, and is expected to have major impacts on infrastructure planning and engineering.

Development of the Arctic LCC

The Arctic LCC will build from a solid foundation of coordination among the various agencies and engage new partners. The Alaska Climate Change Executive Roundtable (ACCER) was established jointly by the USFWS and the U.S. Geological Survey (USGS) in 2007, and has grown to include over twenty State, Federal, University, and NGO senior executives. The ACCER provides a forum in which these organizations share strategies and challenges and work toward improved coordination and collaborative action. Topical workgroups have been formed to develop recommendations for addressing shared, statewide science needs for down-scaled climate data and models, wildlife and habitat change models, sea level rise assessments and improved data integration and collaboration.

Through it common oversight role, the ACCER will ensure close coordination between the Arctic LCC and the USGS Alaska Climate Change Response Center (Figure 2). The ACCER Landscape Conservation Cooperative Oversight Committee, comprised of executives from Cooperative member agencies, will serve as the oversight group for the Arctic LCC, while the ACCER Hub Steering Committee will provide the initial governing partnership for the proposed USGS Alaska Climate Change Response Center. Priority science needs and management questions will be developed jointly by the Oversight Committee and the LCC technical staff.

The Arctic LCC will capitalize on the momentum generated by the 2009 Wildlife Response to Environmental Arctic Change (WildREACH) workshop, which was attended by over 100 physical scientists, biologists, managers from state and federal agencies, non-governmental organizations, and academic institutions. The workshop focused on identifying priority multi-disciplinary science needs for predicting effects of climate change on arctic species and their habitats in terrestrial and freshwater systems. The workshop also served as a springboard for developing and expanding partnerships, and culminated in a comprehensive report. As we continue to build the Arctic LCC, we will rely on collaborative forums to design and deliver conservation that addresses the common concerns of multiple partners.

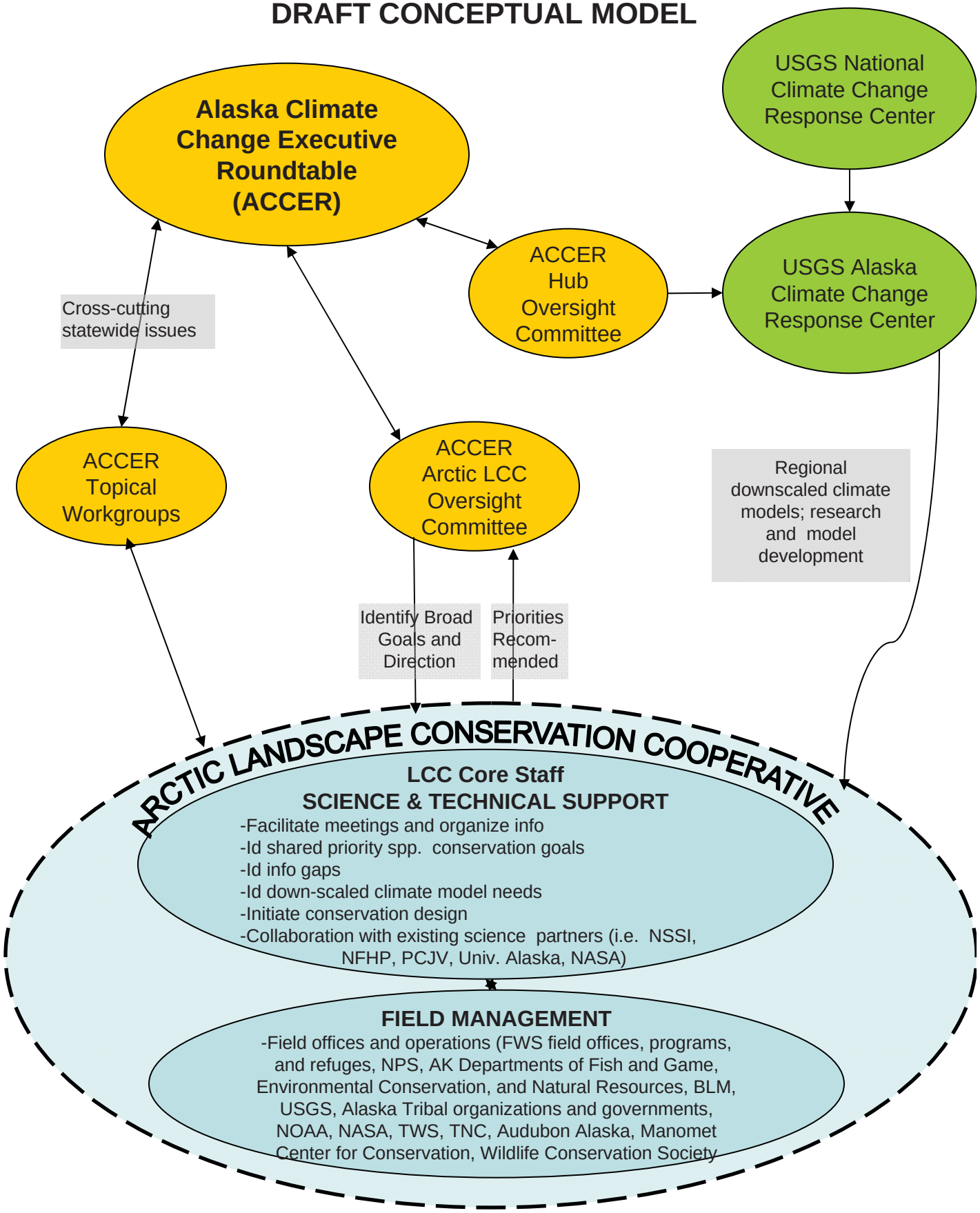
The Arctic LCC has many challenges ahead, despite the advantage of an engaged group of cooperators and a strong start in identifying science capacity needs. Potential partners, particularly Tribal and Native organizations, will need to be more fully integrated into discussions of priorities. Furthermore, we are in the early stages of identifying focal species, habitats, and conservation objectives around which we will develop coordinated conservation planning and design to guide conservation delivery. The Arctic LCC will be key to convening and facilitating the planning, design and delivery processes and to fulfilling priority science needs.

2. Key Partners

Cooperators to date include a wide array of State and Federal agencies and NGOs; we have engaged the State and DOI agencies more extensively than others. Many were also extensively involved in 2009 pilot efforts that produced the WildREACH

1. Martin, Philip D., Jennifer L. Jenkins, F. Jeffrey Adams, M. Torre Jorgenson, Angela C. Matz, David C. Payer, Patricia E. Reynolds, Amy C. Tidwell, and James R. Zelenak. 2009. Wildlife Response to Environmental Arctic Change: Predicting Future Habitats of Arctic Alaska. Report of the Wildlife Response to Environmental Arctic Change (WildREACH): Predicting Future Habitats of Arctic Alaska Workshop, 17-18 November 2008. Fairbanks, Alaska: U.S. Fish and Wildlife Service. 138 pages. http://alaska.fws.gov/wildreach.htm

ARCTIC LANDSCAPE CONSERVATION COOPERATIVE: DRAFT CONCEPTUAL MODEL



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foundation.

The **State of Alaska** is a key partner, through the **Departments of Fish and Game (ADFG), Environmental Conservation (ADEC), and Natural Resources (ADNR).** As the lead fish and wildlife agency in the state, ADFG has trust responsibilities over all fish and wildlife in Alaska. ADFG has ongoing research and management programs on Alaska's North Slope. ADFG also coordinates with federal agencies and international organizations that share responsibilities for marine mammals and migratory waterfowl.

The primary focus of ADFG research and management on the North Slope are species subject to subsistence harvests (caribou, moose, bear, wolf, musk ox, walrus, seals, whales, whitefish, Dolly Varden, lake trout, and salmon) and the subsistence uses of these species. ADFG is currently working on a number of cooperative projects that relate to energy development, and these will be important to discussion of focal species:

- caribou studies (abundance, health indices, and harvest assessment) with (BLM) and the North Slope Borough (NSB);
- musk ox studies (abundance, distribution, and calving success) with USFWS;
- yellow-billed loon studies with BLM
- moose and caribou (abundance, browse, and health indices) with the NPS;
- whale studies incorporating Traditional Ecological Knowledge (TEK) with the NSB, the Alaska Eskimo Whaling Commission, several village Whaling Captain's Associations, and National Marine Fisheries Service;
- walrus studies incorporating TEK, with the USGS, NSB, and USFWS;
- polar bear (research methods) with the USGS;
- grizzly bear (movement and research methods) with BP Exploration, Inc. and ConocoPhillips Alaska, Inc;
- studies of subsistence sharing networks and use of fish, caribou, and furbearers with the NSB, BLM, NPS, and MMS.

ADFG is also pursuing a $250 K grant to improve their capacity for geospatial analysis, and to compile data layers pertaining to habitat for priority species of management interest, such as caribou and freshwater fish. ADFG is also cooperating with Arctic NWR research to explore a variety of hypotheses regarding the relative importance of changing snow conditions, parasites/disease, genetic bottleneck, and nutritional limitation on the decline of muskox.

The ADNR is the state's land management agency. ADNR has responsibility for Alaska's Coastal Management Program and oversight of Alaska's oil and gas industry. The ADEC is a lead environmental permitting agency in Alaska, with oversight responsibilities for air and water quality permits. ADEC also has lead responsibility for oil spill prevention and contingency planning and environmental health. The Commissioner of ADEC also serves as the Chair of the Governor's Climate Change Sub-cabinet.

The **US Geological Survey** is DOI's principle federal research partner in Alaska and is committed to providing support to the LCCs by Secretarial Order. USGS has been appropriated $5.0 M in FY 2010 specifically to assist the Service in building science capacity in the LCCs nationally, a portion of which will likely be directed towards the Arctic LCC. The USGS also received $15 M in appropriated FY 2010 funding to continue implementation of the National Climate Change Wildlife Science Center (NCCWSC) and to establish NCCWSC Regional Hubs responsive to the science needs of regional partners. The ACCER has endorsed the establishment of an Alaska NCCWSC Hub, which will also work interactively with Alaska LCCs. The USGS' Alaska Science Center (ASC) received a 2010 budget increase of $4.2 M devoted to the study of Changing Arctic Ecosystems and is working with the Service to identify priority projects that address management needs. Staff from the Fairbanks Fish and Wildlife Field Office (FFWFO), ASC and BLM's Arctic Field Office are continuing to coordinate on selecting priority projects which meet the needs of the LCC for monitoring and research.

The **Bureau of Land Management** manages the National Petroleum Reserve-Alaska, covering most of the western Arctic area. BLM is cooperating with multiple agencies on inventory, monitoring and trend analysis efforts. As part of BLM's Rapid Ecoregional Assessment effort in Alaska,

areas within the Arctic LCC on the North Slope will receive funding to complement a key partnership effort with FWS and ADF&G to compile geospatial data within a unified and accessible, online library. BLM also provides critical support to the North Slope Science Initiative (see below).

The **National Park Service** is a major land manager within the Brooks Range portion of the Arctic LCC, and is a leader in developing Inventory and Monitoring Program methodology. The Arctic Network conducts Inventory and Monitoring designed to track the overall condition of natural resources in parks and to provide early warning of situations that require intervention. NPS has entered into a collaborative project with USGS (WildCAST) to forecast future habitat conditions and status of key ecosystem components on National Park lands. NPS will work with the LCC to coordinate monitoring of permafrost and climate, and has offered to provide technical assistance in design of monitoring protocols and database management.

U.S. Fish and Wildlife Service has trust responsibility/management authority for listed and candidate species under the ESA (polar bears, Steller's and spectacled eiders, yellow-billed loons, Kittlitz's murrelet) that occur in the Arctic. Over $2 million has been allocated to promote coordination and development of interagency conservation for the Arctic LCC. In addition, the National Wildlife Refuge System has received $12 million (approximately $1.2 million for Alaska) to conduct inventory and monitoring (I&M) on refuges. Initially, this effort will focus on a needs assessment of baseline data and building a national database of on-Refuge inventories. The Alaska Refuge I&M will coordinate with the Arctic and subsequent LCCs to provide on-refuge data in support of conservation design and delivery.

The **Minerals Management Service** (MMS) is responsible for managing offshore mineral development in the Beaufort and Chukchi seas. MMS has an extensive studies program, and funds numerous research efforts related to physical and biological science, environmental protection, and social impacts of development.

The **North Slope Science Initiative** (NSSI) was developed as an interagency effort to facilitate the acquisition and dissemination of information needed by its members to better manage resource development (particularly oil and gas) activities on the North Slope of Alaska. NSSI recently completed a comprehensive summary of "Emerging Issues," including recommendations for priority science tasks. Current projects of interest to the LCC are the development of databases that track research and a geospatial data library. NSSI is also engaged in a landcover mapping project in association with Ducks Unlimited.

Alaska Natives on the North Slope are deeply affected by changes in the availability of subsistence resources, and can contribute the perspective of traditional ecological knowledge to assessments of environmental change. The LCC will work with Tribal organizations, Native and Regional village corporations, rural communities, and the Bureau of Indian Affairs to ensure that Alaska Natives are full partners in conservation planning and delivery. The **North Slope Borough** (local government) staff biologists bring capacity to advise in design and implementation of conservation design and implementation of research and monitoring programs and the **Barrow Arctic Science Consortium** (a partnership of Native corporations and local government) coordinates activities of a wide variety of potential research partners.

The Scenarios Network for Alaska Planning (SNAP) of the University of Alaska Fairbanks (UAF) is a collaborative network of the university, state, federal, and local agencies, and NGOs, whose mission is to provide timely access to management-relevant scenarios of future conditions in Alaska. SNAP provides downscaled climate model output and will develop coupled models of landscape change, integrating permafrost, hydrologic, fire and vegetation models. Coupling, or integrating, these existing models will create a powerful tool to predict climate-driven habitat changes. The LCC will contract with SNAP to provide these critical data-integration functions. Once completed, the integrated model will be used to assess priority species population vulnerability and help define management actions and locations to address population shifts and threats.

The Water & Environment Research Center (WERC) of the University of Alaska Fairbanks performs basic and applied research related to water and environmental resources. The LCC will collaborate with WERC to supply a spatially-linked database of fish distribution which will be incorporated into the North Slope Decision Support System (NSDSS) for Water Resources. The NSDSS is funded by Department of Energy, at $1.3 M over 3 years.

The International Arctic Research Center (IARC) of the University of Alaska Fairbanks integrates and synthesizes research on arctic climate change and communicates the results to the global climate research community. The LCC will work closely with research faculty to develop proposals that address important data gaps relative to changes in wildlife habitat, particularly in the realms of hydrology, permafrost, and coastal process studies.

The Alaska Cooperative Fish and Wildlife Research Unit (University of Alaska Fairbanks, USGS), can conduct targeted research on species response to environmental change. Work already in progress includes a study of "Projected effects of climate-induced vegetation changes on caribou (Rangifer tarandus) energetics in northern Alaska." This work is funded by $54 K from the USGS Science Support program, $53 K from the Circumarctic Rangifer Monitoring and Assessment Network (CARMA), and $37.5 K in-kind support from others including Arctic NWR. Also underway is research that will describe the physical drivers that control timing and routes of fish migration and identify locations that may de-water and become barriers to movement. This project is funded by the FFWFO, and will be coordinated with complementary NSF-funded fish research at Toolik Lake Long-term Ecological Research Station.

International Cooperation--Beyond our geo-political borders, the Service has formed many important partnerships for the conservation of shared species and habitats through joint monitoring and scientific assessments, many of which are circumpolar in nature. One of these partnerships is the Conservation of Arctic Flora and Fauna (CAFF) Working Group of the Arctic Council, consisting of the Service and its counterparts in the other Arctic Nations (Canada, Russia, Finland, Sweden, Norway, Iceland, and Denmark/Greenland). Through this circumpolar partnership, CAFF has produced several reports including the Arctic Climate Impact Assessment. Significant current projects include the Circumpolar Biodiversity Monitoring Program (CBMP), a multi-year effort to enhance Arctic biodiversity monitoring, and the Arctic Biodiversity Assessment (ABA), which will describe the status and trends of the Arctic's ecosystems and biodiversity. Through partnering with indigenous groups, such as the Inuit Circumpolar Conference, Gwich'in Council International, Arctic Athabascan Council, and Aleut International Association, the ABA will also include an update on traditional ecological knowledge.

At a more local level, Arctic NWR staff are working with Canadian vegetation scientists and GIS specialists to produce a vegetation map for IIvvavik NP, which is contiguous with the Refuge. This work supports Parks Canada's proposal to designate the Firth River drainage, which includes areas of Arctic NWR and Ivvavik NP, as a study drainage for biotic and abiotic monitoring. specialists to produce a vegetation map for IIvvavik NP, which is contiguous with the Refuge. This work supports Parks Canada's proposal to designate the Firth River drainage, which includes areas of Arctic NWR and Ivvavik NP, as a study drainage for biotic and abiotic monitoring.

Potential partners include the National Oceanographic and Atmospheric Administration **(NOAA)** and National Aeronautic and Space Administration **(NASA)**. Both agencies are currently engaged in an effort to enhance collaboration in the arctic through the "Interagency Ocean and Coastal Interests in the Arctic" workshops. Other key participants in this effort include the US Coast Guard, MMS, National Science Foundation, and Arctic Research Commission. The Service participated in the 4 December initial coordination meeting and will continue to develop partnerships within the ocean and coastal research community.

Conservation organizations, including **The Wilderness Society (TWS), The Nature Conservancy (TNC), Audubon Alaska, Manomet Center for**

Conservation Science, and Wildlife Conservation Society, are all actively engaged in arctic climate issues. TWS, TNC, and Audubon Alaska each have a full-time GIS analyst located in Alaska. Alaska Audubon has concentrated on assembling resource data layers for the Northwest Arctic, TNC has focused on climate projections and conservation planning, and TWS has done extensive analysis of water availability, using downscaled climate models. These groups are proposing to engage in a joint project entitled "Arctic Region Conservation and Cumulative Effects Analysis," and are seeking engagement with FWS and the LCC for this effort.

The oil and gas industry conducts inventories and research related to the environmental impacts of oil and gas exploration and development. BP Exploration, Inc, maintains a long-term monitoring program of selected natural resource indicators within the Prudhoe Bay oil field. Through the regulatory process, the oil and gas industry works with agencies to identify best management practices to mitigate environmental impacts.

3. Priority Species and Habitats

Recognizing that the LCC partnership is in its initial convening stage and that the cooperative has not yet developed a consensus approach to identifying priority species and habitats, we are fortunate to have many existing collaborations on which to build. We will approach this task in an iterative manner; first by allowing each agency to identify their priorities, being careful to avoid the expectation or pattern of trying to force any one agencies' or partners' priorities on another. Using the Cooperative as a forum to learn more about the partners' priorities, we expect to find areas of mutual concern where we can leverage our research and conservation resources. Over time we expect that cooperating on identified priorities will be one of the most important accomplishments of the Cooperative.

Within the Service, the selection of priority species will be based on objective criteria that reflect ecological significance, potential for conservation success, management significance and legal mandate, and the feasibility of implementing cooperative, long-term, landscape based adaptive management. These will be evaluated jointly by all Service programs using a structured decision making process. Our key trust resources such as listed and candidate species (eiders, loons), marine mammals (polar bear, walrus), migratory birds, and the Arctic NWR already benefit from partnership efforts with entities that will be part of the Cooperative and we expect the work of the LCC will help us to better focus those collaborative efforts.

WildREACH established a list of priority species on Alaska's Arctic coast. The WildREACH priority species (Appendix1) were defined, in the context of climate change, due to their sensitivity to climate-associated habitat changes, with either positive or negative population effects. We will use this, with other information, to establish priority focal areas for the Cooperative. As the Service refines its priorities for the Arctic we will engage, through the Cooperative, with other agencies and partners to identify overlapping interests, with the goal of leveraging mutual support for proposed research, monitoring, conservation planning, design and implementation.

The WildREACH workshop was structured to identify key processes that might affect habitat availability and quality. Priority habitats (i.e., those of exceptional value to fish and wildlife and most vulnerable to projected climate-change effects), however, can be inferred, including:

- Effects of a changing hydrologic regime on **wetlands and lakes**, and the stability of flow regimes in **rivers and streams**;
- Effects of changing sea ice conditions on **coastal systems - nearshore lagoons, barrier islands, coastal wetlands, and river deltas** - which are crucial habitats for migratory birds and anadromous fish;
- Habitats of interest because of known requirements of priority species, such as **caribou calving and insect-relief habitat;** undisturbed **molting habitat** for geese in the Teshekpuk Lake region; and persistence of **deep lakes with adequate fish populations** for to support breeding yellow-billed loons.

4. Conservation Delivery Mechanisms

Resource agencies have been addressing climate change issues in the arctic for several years. Many conservation measures have been reactive as species, such as walrus, have changed established behavior patterns in response to climate-driven changes in their habitat. At the same time, researchers have been working to identify systemic changes in ecological processes and are building new models to predict how these processes may change in the future. Some models (e.g., climate-fire-vegetation) are available now while others are still in development. The Arctic LCC will provide a necessary link between research and conservation activities to help create and apply these tools so that land and resource managers can begin to make proactive decisions for conservation delivery. The products and collaborations established by the LCC will assist multiple program areas within USFWS and other agencies by providing tools to **guide monitoring, assess vulnerability, and evaluate conservation strategies.** We will pursue multiple short-term and long-term conservation delivery mechanisms, illustrated by these examples:

• ***Actions that are expected to have direct and immediate positive benefits to priority species and arctic habitats***. The Service and other management agencies, are already engaged in management that provides positive benefit to arctic wildlife and habitats.

Sea ice retreat forces walrus to haul out on land making them vulnerable to human disturbance.

For example, as walrus are increasingly found at coastal haul-outs, because of less access to receding sea ice, we are reducing juvenile mortality by using patrols to decrease human disturbance.

A hazing program protects both polar bears and people.

Polar bear mortalities for land based bears are being reduced through a similar technique and hazing. The Service has worked with the Native Village of Barrow to secure a Tribal Wildlife Grant that will fund staff to minimize human-wildlife interactions.

Section 7 consultations routinely implement conservation measures that provide positive benefits to listed species. Consultations typically prescribe protective measures such as winter-only exploration for terrestrial development, buffer zones around the activity to reduce disturbance, and deflectors on above ground power-lines to reduce bird-strikes.

Alaska is not immune to the problem of invasive species. Cooperative efforts between Service employees, partners, and volunteers on Arctic NWR have targeted detection and control of invasive plant species.

• ***Actions that strengthen the scientific basis of land management decisions***. A priority for agencies working in the Arctic is the creation and maintenance of spatial databases for species of management concern (such as threatened eiders and yellow-billed loons). These databases will improve the efficiency of consultations and minimize conflicts during planning processes for energy development. Agencies are also working with development companies to conduct infrastructure planning

that would identify key habitat (now and into the future) or habitats most vulnerable to climate change. Such planning would reduce the footprint of infrastructure on the landscape by reducing redundancy.

• ***Actions that improve our fundamental understanding of ecological changes expected under future climate conditions***. For example, we need collaborative inventory, monitoring and trend analysis to supply scientific data for habitat change models that are coupled to climate drivers. Likewise, we will take steps to promote collaborative networks to monitor geophysical and hydrologic processes, and develop ecosystem models to identify habitats at greatest risk. Building and testing these models will require a sustained multi-year effort including field studies, monitoring, and iterative model improvements based on ground-truthing and new research.

5. Building Science Capacity

Science capacity will be enhanced by hiring new employees with needed skills, and via contracts with organizations having the existing capacity to deliver products relatively quickly. These products will serve as the foundation for work in 2011 and beyond. Needed steps include:

1. Staffing: We have one fulltime position and a cross-program team which we have funded since 2008 to pilot work on the Arctic LCC. We are poised to hire additional staff, including the Science ARD, Arctic LCC coordinator, science and technology coordinator, GIS analyst, and database manager. The recruitment process will commence as soon as possible for these positions, with existing staff detailed into an LCC Initiation Team in the interim. Additionally, a needs assessment with our partners will identify additional staffing needs of mutual importance. We will also work with Refuge I&M to ensure coordination for hiring positions that will complement the LCC effort.

2. 2010 Science Needs: Identify priority projects, within the areas of emphasis identified by the ACCER, including: (1) Physical Monitoring Networks and Scaled-Down Climate Data and Models; (2) Biological Monitoring and Forecasting Wildlife and Habitat Change; (3) Coastal Resources, Sea Level Rise and Hazard Assessments; and (4) Data Integration and Collaboration. Within these broad areas, the WildREACH workshop identified critical gaps in our understanding of fundamental physical and ecological response to climate change, applicable over a wide array of species and management concerns. Addressing these gaps will be the most immediate task. Supplemental guidance on priority-setting is available through NSSI's "Emerging Issues" document. The LCC will use these and other agency material as we develop the cooperative conservation strategies.

3. 2010 "Rapid-Start" Projects: Through contracting we will implement projects and initiatives that will lay the foundation for work beyond 2010. The Arctic region is unique with regard to the high level of involvement from both public and private sector research institutions and conservation organizations. Therefore, there are numerous potential partners with the technical capability to fulfill the science information needs of the LCC. The LCC will work with these groups to identify new initiatives that support the established priorities or leverage opportunities for add-ons to existing programs that will provide an efficient mechanism for obtaining needed science in 2010.

For example, the University of Alaska SNAP program is a pivotal partner in advancing our science capacity. In partnership with climate experts at IARC, SNAP is providing access to downscaled climate models for the entire state of Alaska, at a 1-km resolution. The Arctic LCC will engage SNAP to begin development of a coupled ecosystem model that would integrate important components of several existing models on vegetation succession, disturbance regimes, hydrology, and permafrost dynamics. SNAP has existing collaborations with permafrost specialists at the UAF Geophysical Institute and WERC and IARC hydrologists. NASA is another potential partner for this

project (proposal pending).

4. Integrate LCC activities with ongoing and proposed projects that complement the priority science needs identified by the Cooperative. Many of these will involve FWS programs, including Refuges, Migratory Bird Management, the Office of Subsistence Management and the various branches with Fisheries and Ecological Service (Endangered Species, Conservation and Planning Assistance, and Assessment and Monitoring branches) as well as the other partners. Examples of potential projects include:
a) Update and expand spatial databases describing distribution and abundance of threatened spectacled and Steller's eiders, yellow-billed loons, and other migratory bird species of management concern.
b) Expand the geographic scope of an existing Arctic NWR database of fish distribution, to include the zone of oil development. These data will be integrated into a North Slope Decision Support System for Water Resources, currently under development with Department of Energy funding.
c) Work with the Migratory Bird Management program to enhance monitoring of priority species identified through cross-program consultation (see #6 below), analyze existing data to create habitat models, and integrate climate considerations into monitoring programs, such as the proposed Arctic Shorebird Demographic Network, by monitoring physical and ecological parameters that will improve our understanding of climate influences.

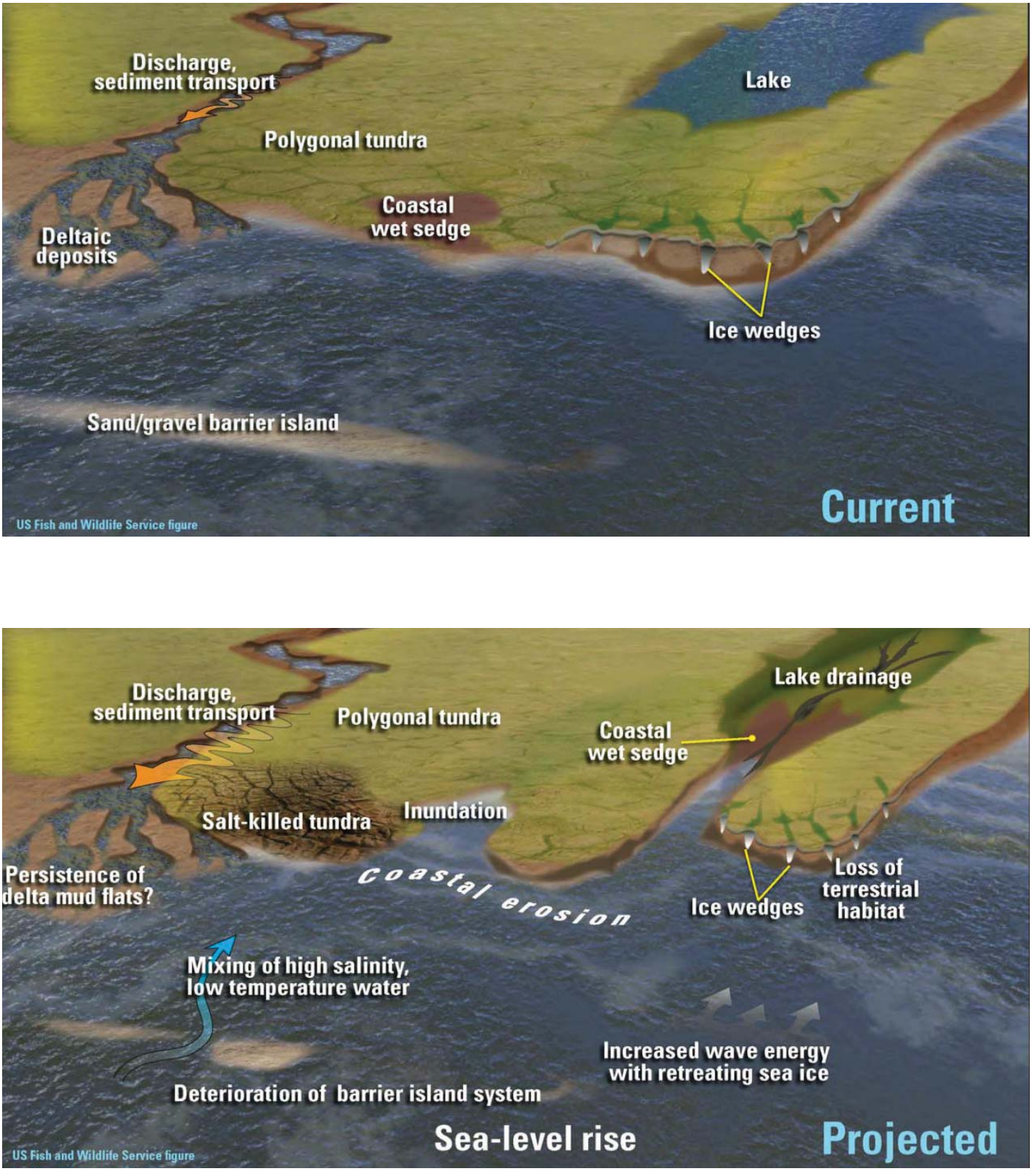
Red Phalaropes may be negatively affected by the drying of wet sedge meadows.

d) Start the next phase of the "Connecting Alaskan Landscapes" project by producing robust biome shift models and assessing alternative approaches to analysis of range-shift for a diverse set of 20 species, using existing data.
e) Continue an initiative of the Conservation and Planning Assistance branch to develop a GIS tool to analyze the environmental and economic costs and benefits of alternative configurations of energy infrastructure on the North Slope. The Nature Conservancy has funding to work with FWS on this project.
f) Monitoring changes in subsistence fish and wildlife resources and social response to those changes.
g) Continue to apply techniques of conservation genetics to document population boundaries and population-specific movement patterns for Dolly Varden and other migratory fish species to identify key habitats and predict the response of individual populations to habitat fragmentation.
5. Conduct a cross-programmatic structured decision-making (SDM) workshop to select priority species (see below) and propose biological goals. Repeat process with external partners. Building on these workshops, conduct a science needs assessment to guide project selection for 2011 and beyond.

6. Top Science Needs Exceeding Initial Allocation

Dynamical Downscaling of Climate Models

Although Alaska is fortunate to have statistically downscaled climate projections available for use in modeling exercises, these projections are limited to temperature and precipitation variables. Key improvements would vastly increase their utility in creating more powerful prediction models for the five LCCs within Alaska. Two possible approaches are: (1) targeted extensions of the statistical downscaling approach based on the superposition of GCM-derived changes onto the high-resolution PRISM climatology, and (2) dynamical downscaling using the high-resolution Weather Research and Forecasting (WRF) model over an Alaskan domain (50-75N, 130-180W) – with lateral forcing provided by the output of a global climate model,



Schematic of arctic coastline landscape, current and projected. The projected landscape illustrates elements likely to change as a result of climate warming. Figure by R. Mitchell/Inkworks for Wild-REACH from cited sources.

i.e., the ECHAM5, which has been found to outperform all other IPCC AR4 models in high latitudes. The main objective of this project would be to develop downscaled climate projections for the 5 LCCs in the Alaska region that specifically target parameters considered to be critical for developing models to forecast climate change effects on wildlife and their habitats. As a by-product, however, this project would provide a more robust understanding of the potential range of model variability and model uncertainties related to downscaling methodologies, which is a topic of critical importance to both scientists and decision-makers worldwide.

Shorebird Conservation Design
Pectoral Sandpiper on Arctic coastal plain. Photo by Ted Swem

Shorebirds are an important component of the arctic avifauna, and populations of half the regularly-occurring shorebird species in Alaska are in decline. An international Shorebird Demographics Network's (SDN) is proposed to collect demographic data crucial to the design of conservation strategies to arrest these declines. Data collected by the SDN across multiple Service regions will identify sensitive life cycle stages (breeding, migration, wintering) that may indicate when and where a species is most vulnerable. The SDN will measure demographic parameters such as adult and juvenile survival, productivity, and other variables that will feed into geo-spatial and population viability models. Additionally, site-specific habitat variables (e.g., prey and predator abundance, weather, etc) that influence demographic rates and are influenced by climate change will be measured and incorporated into the analyses. As a first step in developing the SDN, a variety of NGOs and government agencies will be enlisted to conduct intensive studies at four breeding locations in the Arctic region of Alaska; 3 additional sites have been identified in Canada but will be funded under a separate initiative. Once the framework for the SDN is established, subsequent sites would be implemented across temperate regions of North America to work on additional high priority shorebird species, as well as Alaskan species that migrate through or winter in these areas. The initial focus would be on Regions that are part of migration corridors that share shorebird species with Alaska, such as 1 and 8.

7. Expected Model Accomplishments for Arctic LCC in 2010

The Arctic LCC expects to make key contributions to conservation through the following model accomplishments in 2010. We expect 2010 to be a foundational year and to serve the Cooperators well in the short term but also into the future.

WildREACH serves as a coordinating accomplishment for the Arctic LCC. The workshop brought together over 100 scientists and managers working in the arctic. The workshop report serves as a foundation for LCC partners to refer to on the "state of the science" in the arctic. As new information becomes available, we expect the WildREACH report will be updated. Sections of the report will be updated as we refine selection of priority species and habitat and develop conservation plans.

The LCC will take a leadership role in developing authoritative geospatial data sets that describe species abundance and distribution. These data sets are needed as a prerequisite to developing reliable population-habitat models, which in turn, are a key component of biological planning and conservation design. Data sets to support such modeling efforts for the Arctic are often incomplete or in inaccessible formats. Therefore, key steps forward include 1) assembling authoritative,

spatially linked (GIS) databases that describe the distribution and abundance of priority species, and 2) making those data accessible and compatible with data layers that describe the physical and ecological parameters that describe habitat characteristics. The Arctic LCC will provide the forum for identifying priority data layers and efficient use of partner resources to complete those tasks. Several cooperators (BLM, ADFG, Alaska Audubon, Nature Conservancy) have identified this as a shared priority.

As identified by the ACCER, data integration is a top priority. The Arctic LCC will contribute to the efforts of USGS and NSSI to compile a library of mutually-compatible geospatial data sets. These objectives guide the high priority assigned to hiring a GIS specialist and database manager. In addition, the LCC will support the efforts of NSSI to compile an online catalog of research, monitoring, and resource management activities in the Arctic, as a means to facilitate collaboration and networking.

8. Unique Characteristics of the Arctic LCC

The Arctic LCC encompasses the most-rapidly warming portion of the North American continent. At current rates of warming, an entire suite of Arctic-adapted species will ultimately be displaced by the loss of suitable tundra habitats. Unlike the case for temperate species, there is no possibility of alternative habitat farther north within the borders of the US, and very little higher-latitude land-mass whatsoever, on the global scale.

The presence of continuous permafrost is unique to the Arctic, and has a profound influence on landscape response to warming. Widespread melting of frozen ground represents an ecological, as well as physical, tipping point. For instance, the Arctic is characterized by vast wetlands which support millions of migratory birds, despite the apparent paradox of annual precipitation equivalent to desert environments; these wetlands would not exist, if not for the presence of permafrost that holds water at the surface. Therefore, arctic habitats are particularly vulnerable to warming, and the processes by which habitat will be altered are distinct from those that will occur at lower latitudes. A substantial investment in arctic-specific ecosystem modeling will be required to understand and respond to these prospective changes,

To date, conservation strategies in the Arctic have focused primarily on protective measures – avoiding impacts to the most valuable habitats and addressing population declines on a case-by-case basis. Habitat restoration and active management has generally not been warranted in a region characterized by largely intact ecosystems. Climate change is a game-changer, however, and our greatest challenge is to prepare for the difficult decisions and conservation issues that will arise as the arctic landscape changes beneath our feet. We must continue to deliver conservation through the regulatory process, including protective measures that guide oil and gas development, harvest management, Section 7 consultations, and incidental take permits. While we continue to use these traditional tools, we must place now place greater emphasis on acquiring the information and understanding that will be needed to guide informed, science-based management decisions in the coming decades.

Degrading polygons, evidence of thawing permafrost, can be seen across the Arctic landscape.

People living in the Arctic have depended upon the traditional harvest of food for thousands of years. This subsistence lifestyle has not only provided the means of survival in this remote and demanding environment, but has also been the basis of a rich cultural and spiritual existence that has been

passed down through generations. The cultural identity of Alaska Natives, as well as other rural residents, living in the Arctic is closely tied to their environment. Even today, subsistence harvesting provides a large portion of the food consumed in Arctic communities since there is generally no easy access to many commercial goods and limited economic opportunities. Nowhere else in the United States is there such a heavy reliance upon wild foods as in rural Alaska. Recognizing this, the Federal Government under Title VIII of ANILCA has provided a priority for subsistence use on Federal public lands for Alaska rural residents, and Federal land management agencies in Alaska have a unique responsibility to ensure access to subsistence resources. Nevertheless, communities in the Arctic exist under social, economic, and regulatory conditions that restrict subsistence activities in comparison to historical times. Climate change tends to amplify these effects as well as to place additional burdens on subsistence lifestyles and resources.

9. Additional LCC Pilot Efforts for 2010

Although the Arctic LCC is the Alaska Region's priority for starting in fiscal year 2010, there is critical and urgent work to be done on other LCCs within the region, given the rapid change we are experiencing. In 2010, the Region will pilot efforts for a Western Alaska LCC which we expect to be fully initiated in 2011. There is ground work that needs to be accomplished so that the LCC can be fully functional early in FY11. A team of Service employees has been gathered to begin discussions with partners about the Western Alaska LCC and we hope to hire the two coordinators positions during FY10 so that key steps in identifying priority species and species assemblages can be completed early in FY11. In addition to Western Alaska, the Alaska Region has a large portion of the North Pacific LCC which will be led out of Region 1. To fully participate in the early initiation of this LCC, an additional team of Service employees has been identified to interact with Region 1 as the foundation for the North Pacific LCC is established. Service staff and partners are excited and willing to help launch these additional pilot LCCs in 2010. Many of our Service trust species cross between LCC's, particularly the Arctic and Western areas. The pilot LCCs will benefit from the work of the Arctic LCC and vice versa.

Appendix 1. Potential priority species, identified by the WildREACH workshop, based on criterion of perceived sensitivity to projected habitat change.

Species or Species Group	Parameter to Measure	Projected Change in Habitat	Positive or Negative Effect	Rationale for Response to Projected Habitat Change
Birds				
Yellow-billed loon	Distribution, fledging success	Changes in fish availability, lake drainage	+ or -	Warming lakes could increase productivity, but loss of connectivity could inhibit fish migration
Pacific loon	Fledging success	Increased productivity in warmer lakes	+	Warming could improve availability of macroinvertebrates fed to chicks; longer ice-free season allows more time to fledge
Red phalarope, pectoral sandpiper	Abundance, distribution	Drying of wet sedge meadow	-	Loss of preferred foraging habitat and/or decreased food availability
Red-necked phalarope	Abundance, distribution	Drying of wet sedge meadow, increased thermorkarst	+ or -	Loss of preferred foraging habitat in lowlands (drying of wet sedge meadow), but increased thermokarst could allow expansion into upland areas
Geese (black brant, greater white-fronted)	Gosling growth rates	Change in plant phenology	-	Growth rates are sensitive to forage quality during the fledging period
Shorebirds	Timing of arrival and nesting; chick growth and survival	Change in timing of aquatic insect life cycle stages	-	Potential trophic mismatch if timing of shorebird migration and nesting does not match temperature-regulated timing of insect abundance
Perching birds (sparrows. warblers, etc.)	Abundance, distribution	Increased shrubbiness	+	Shrub-associated species will expand their range and local abundance as shrubs increase
Common eider	Abundance, nest success	Loss of barrier islands, increased storms	-	Reduced availability of gravel islands limits nesting habitat and/or increased frequency of storm overwash increases nest loss
Long-tailed duck	Abundance and distribution during molt stage	Change in lagoon systems	-	Loss of barrier islands reduces availability of habitat for resting and disrupts trophic system of lagoons
Fish				
Arctic grayling	Growth rate, productivity, age at maturity, within-drainage distribution	Increased water temperature (associated with availability of food)	+ (until upper lethal temperature is reached)	Sensitive, ubiquitous
Broad whitefish	Growth rate, productivity, age of maturity, within-drainage distribution	Increased water temperature; loss of waterbody connectivity	-	Fish passage will depend on connectivity between lakes, small streams, and other habitats

All salmon	Regional distribution	Increased water temperature	+	Assume that expansion of range would have a positive effect
Arctic char and lake trout	Regional distribution	Changes in water quality and increasing temperatures	-	Perhaps narrow range of temperature tolerance
Aquatic insects/invertebrates	Species abundance and composition	Changes in water quality; changes in pH (resulting from acidification of terrestrial habitats)	+ or -	Rapid changes in response to environmental changes; easily sampled
Mammals				
Polar bear	Use of onshore habitats/denning	Loss of summer sea ice and principle prey	-	Shift in distribution, decline in abundance are likely to occur as sea ice disappears
Alaska marmot	Distribution, life history	Loss of alpine habitats	-	Limited distribution; little is known about this endemic species that has a limited and disjunct population
Dall's sheep	Trends in abundance, distribution	Loss of alpine habitats; more rain-on-snow events, deeper snow, warmer summers	-	Higher energetic costs, more parasites and diseases, changes in plant phenology and communities
Muskox	Trends in abundance, distribution	More rain-on-snow events, deeper snow, warmer summers, more shrubs	-	Arctic-adapted species lives in arctic Alaska year-round. Less access to winter forage, higher energetic costs, more diseases and parasites may offset positive aspects of increasing summer biomass
Caribou	Trends in abundance, distribution	More rain-on-snow events, deeper snow, warmer summers, fewer lichens, changes in plant phenology and community structure	-	Less access to winter forage, loss of lichens from increased fire or competition with other vegetation, timing of migration uncoupled from optimal foraging, more insect harassment, parasites, and diseases, and increased energetic costs may offset positive aspects of increases summer biomass
Lemmings and barren ground shrews	Distribution and relative trend	Changes in distribution and population cycles	+ or -	Arctic-adapted species likely to be affected by changes in food and shelter; important in food webs; little known about barren ground shrews (may be difficult to study)
Arctic fox	Distribution and relative trend	Changes in abundance and distribution	-	Arctic-adapted carnivore; possible competition with red foxes and disappearance of sea ice may affect distribution and abundance; important predator of birds.