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The Trajectory of the USGS Changing Arctic Ecosystems Initiative

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USGS Alaska Science Center

U.S. Department of the Interior
U.S. Geological Survey

Talk Outline

- The role and trajectory of USGS science in the Arctic
- What is the USGS Changing Arctic Ecosystem (CAE) initiative?
- Current and future plans for work in the Arctic

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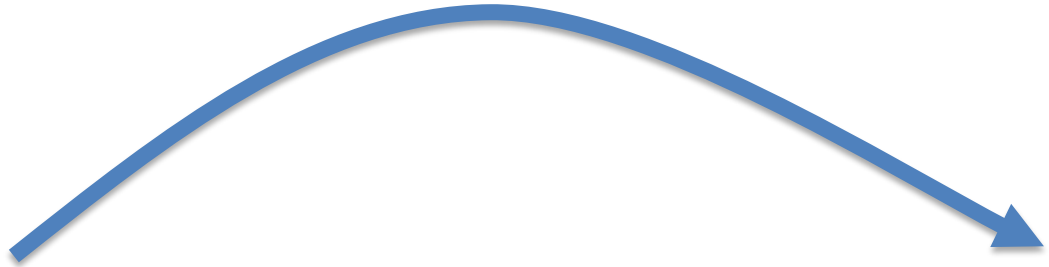
USGS science trajectory

Mission of USGS is to provide science information:

- Natural hazards
- Water
- Energy & Minerals
- Climate & Land Use
- Core Science Systems
- Environmental Health
- Ecosystems (Wildlife)



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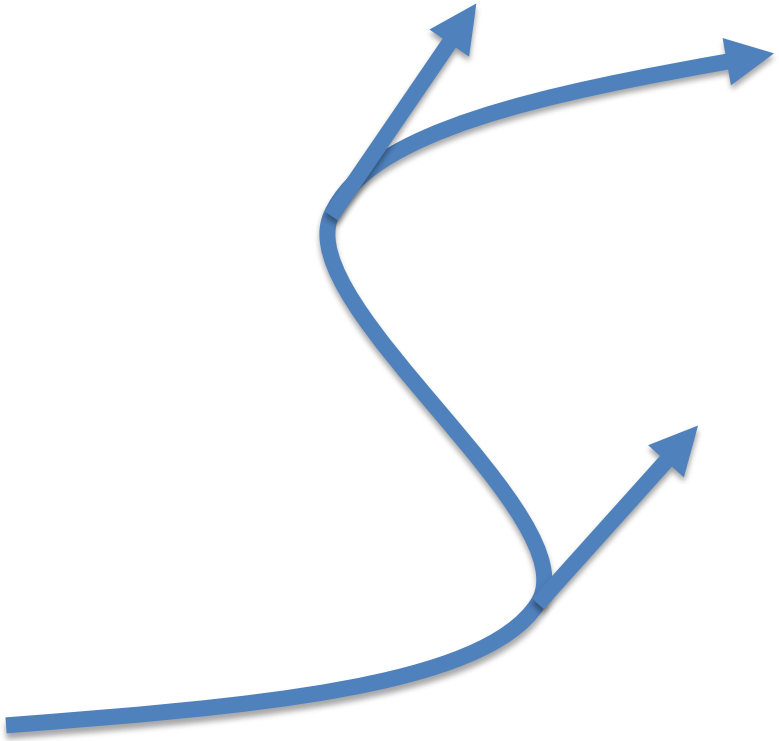
USGS science

But, not on autopilot:

- **Responsive –** to new issues and new information needs
- **Innovative –** seek new tools to supply timely, relevant, and useful information about the Earth and its processes
- **Integrated –** and more than one initiative



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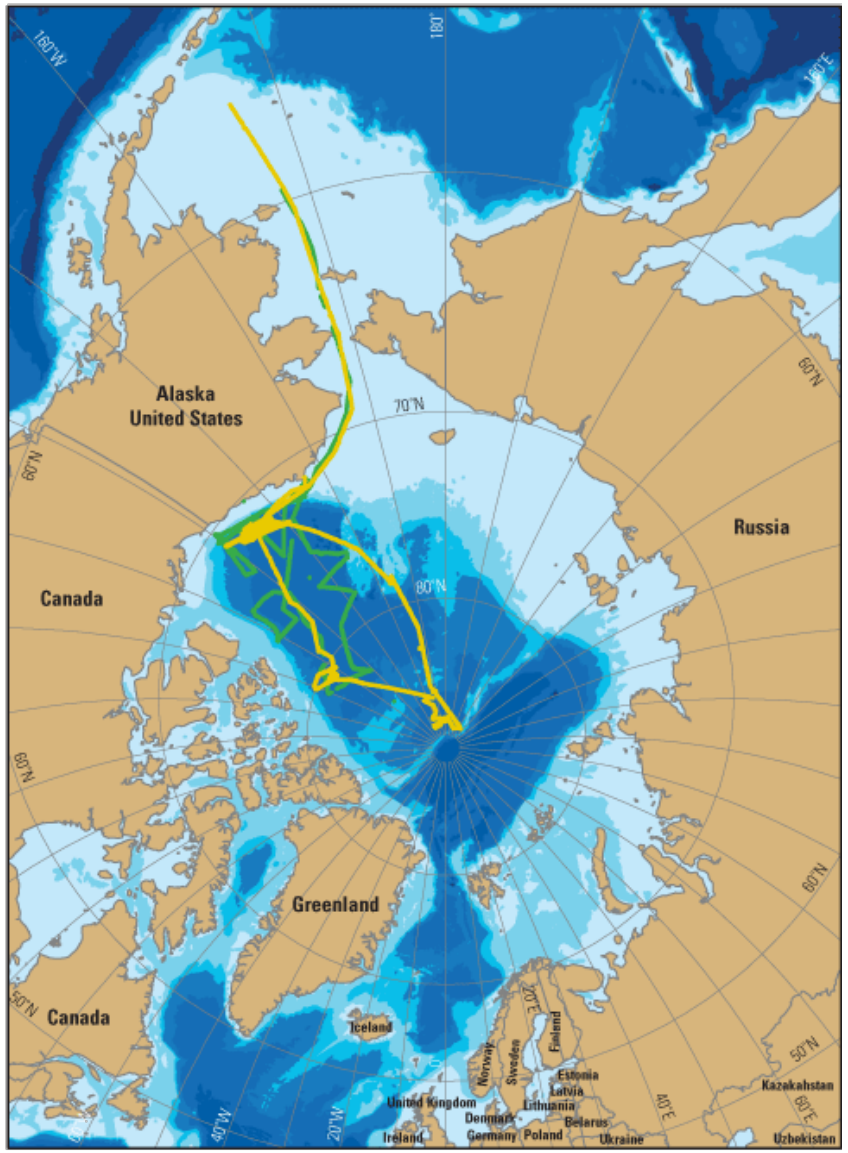
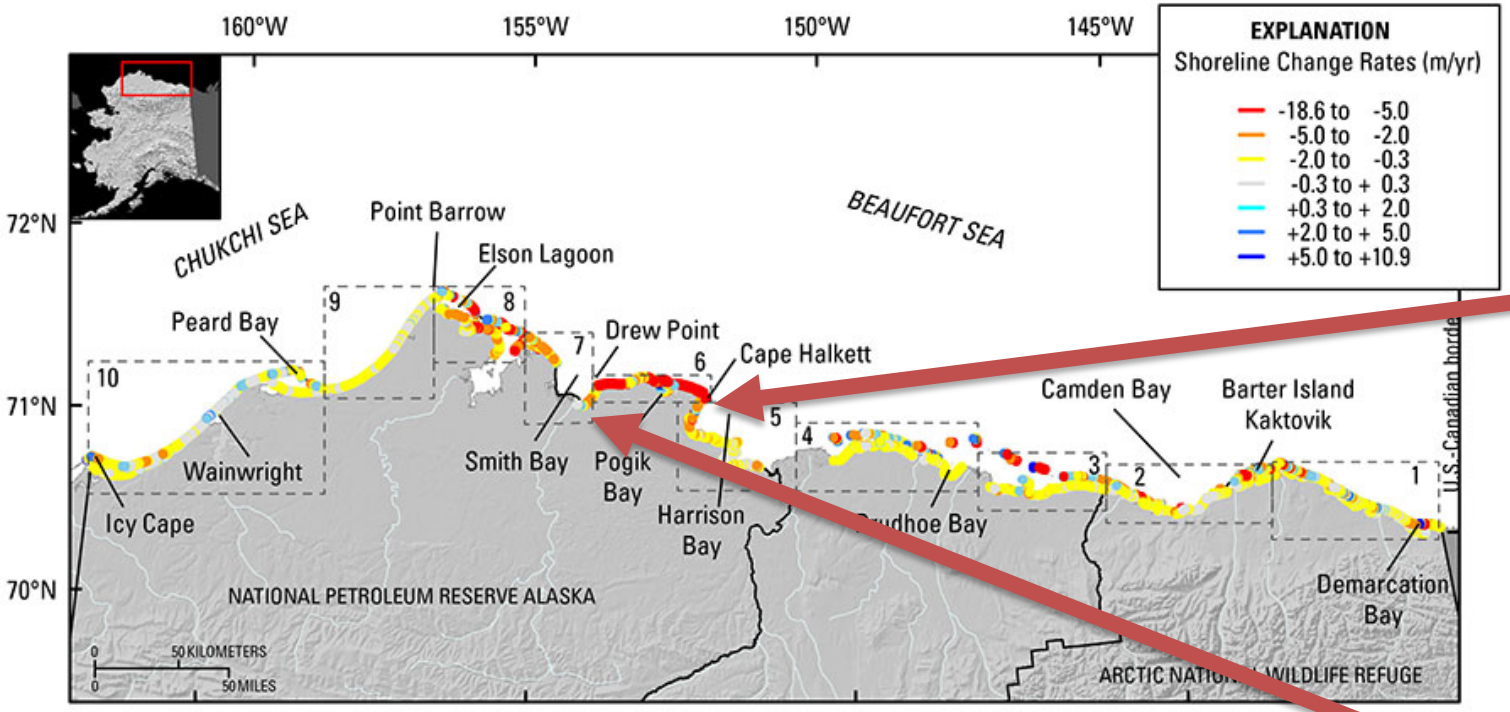
CAE is not all that USGS does in the Arctic



Ocean acidification

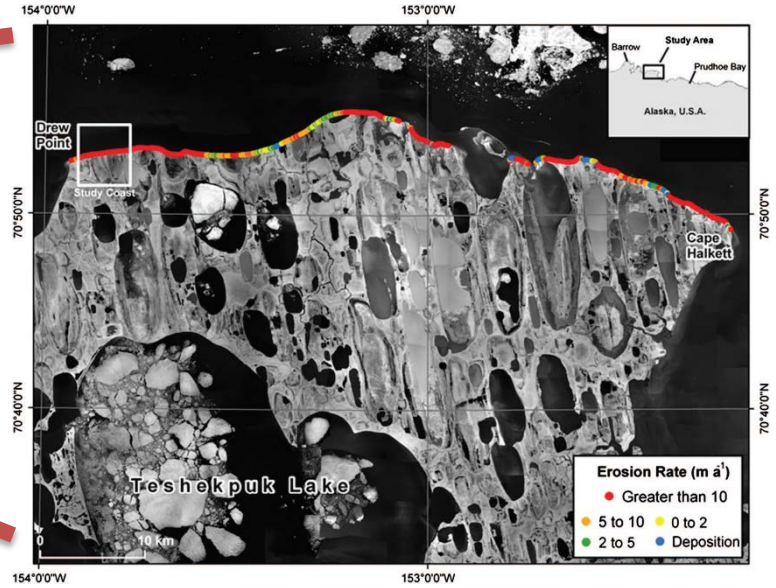
Robbins (2012) USGS Fact Sheet

CAE is not all that USGS does in the Arctic



Gibbs and Richmond (2015) USGS Open File Report

Coastal erosion



Ravens et al. (2012)

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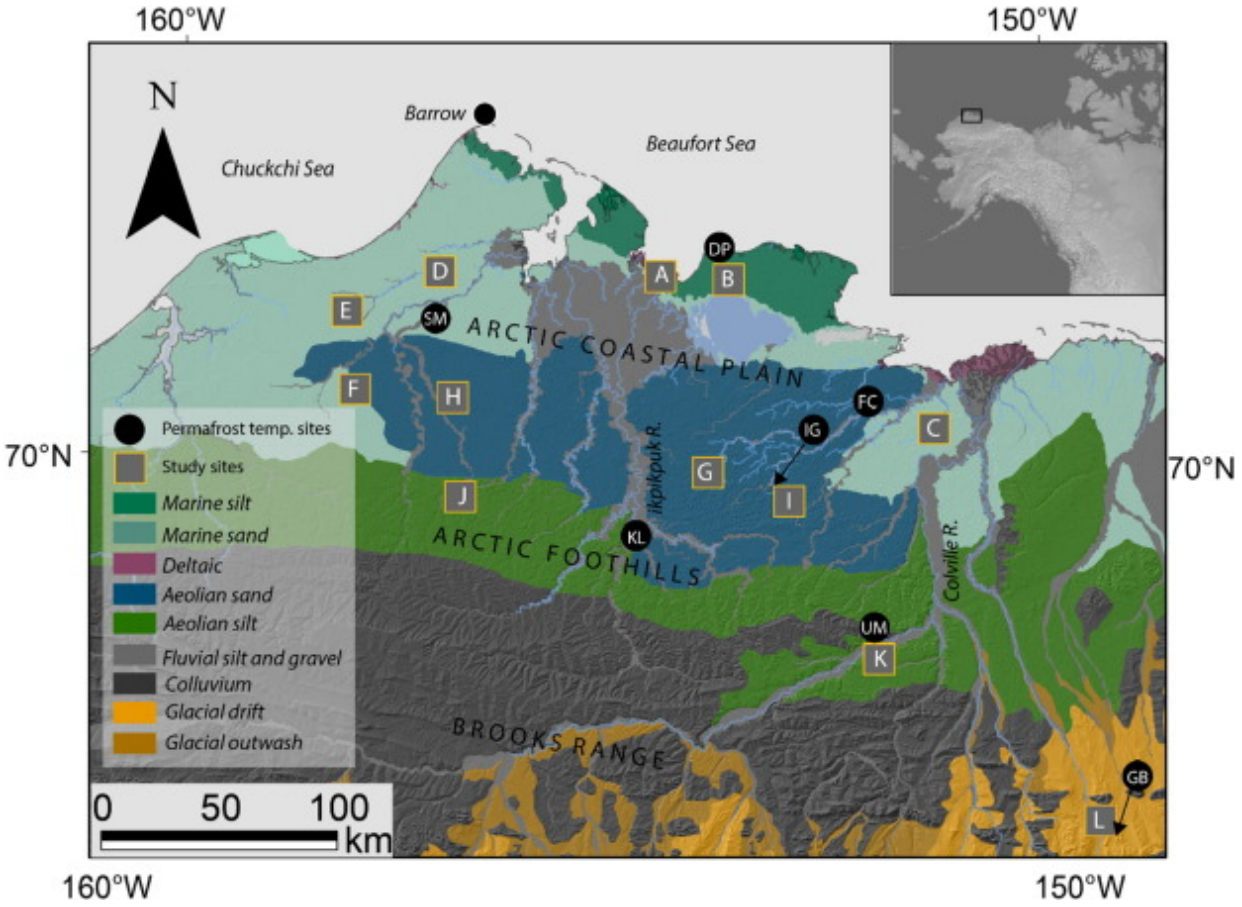
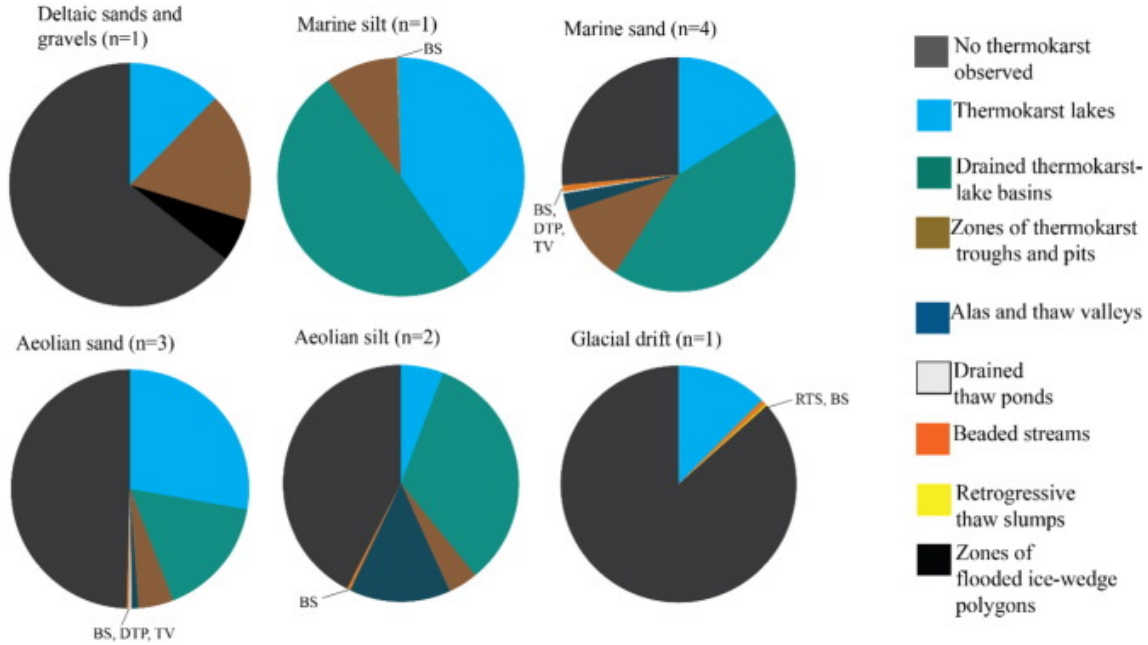


Farquharson et al. (2016) Geomorphology

Thermokarst



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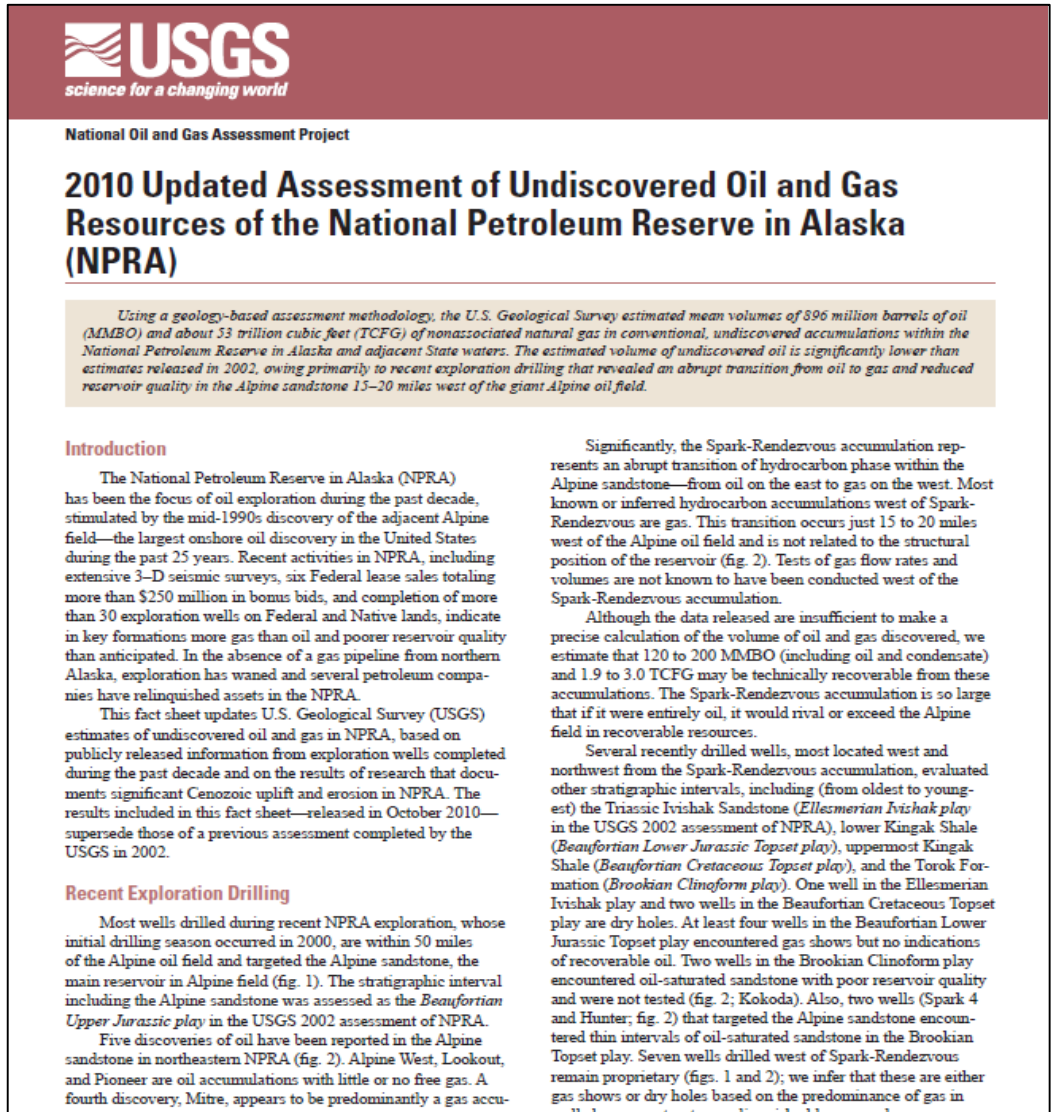

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National Oil and Gas Assessment Project

2010 Updated Assessment of Undiscovered Oil and Gas Resources of the National Petroleum Reserve in Alaska (NPRA)

Using a geology-based assessment methodology, the U.S. Geological Survey estimated mean volumes of 896 million barrels of oil (MMBO) and about 53 trillion cubic feet (TCFG) of nonassociated natural gas in conventional, undiscovered accumulations within the National Petroleum Reserve in Alaska and adjacent State waters. The estimated volume of undiscovered oil is significantly lower than estimates released in 2002, owing primarily to recent exploration drilling that revealed an abrupt transition from oil to gas and reduced reservoir quality in the Alpine sandstone 15–20 miles west of the giant Alpine oil field.

Introduction

The National Petroleum Reserve in Alaska (NPRA) has been the focus of oil exploration during the past decade, stimulated by the mid-1990s discovery of the adjacent Alpine field—the largest onshore oil discovery in the United States during the past 25 years. Recent activities in NPRA, including extensive 3–D seismic surveys, six Federal lease sales totaling more than $250 million in bonus bids, and completion of more than 30 exploration wells on Federal and Native lands, indicate in key formations more gas than oil and poorer reservoir quality than anticipated. In the absence of a gas pipeline from northern Alaska, exploration has waned and several petroleum companies have relinquished assets in the NPRA.

This fact sheet updates U.S. Geological Survey (USGS) estimates of undiscovered oil and gas in NPRA, based on publicly released information from exploration wells completed during the past decade and on the results of research that documents significant Cenozoic uplift and erosion in NPRA. The results included in this fact sheet—released in October 2010—supersede those of a previous assessment completed by the USGS in 2002.

Recent Exploration Drilling

Most wells drilled during recent NPRA exploration, whose initial drilling season occurred in 2000, are within 50 miles of the Alpine oil field and targeted the Alpine sandstone, the main reservoir in Alpine field (fig. 1). The stratigraphic interval including the Alpine sandstone was assessed as the *Beaufortian Upper Jurassic play* in the USGS 2002 assessment of NPRA.

Five discoveries of oil have been reported in the Alpine sandstone in northeastern NPRA (fig. 2). Alpine West, Lookout, and Pioneer are oil accumulations with little or no free gas. A fourth discovery, Mitre, appears to be predominantly a gas accu-

Significantly, the Spark-Rendezvous accumulation represents an abrupt transition of hydrocarbon phase within the Alpine sandstone—from oil on the east to gas on the west. Most known or inferred hydrocarbon accumulations west of Spark-Rendezvous are gas. This transition occurs just 15 to 20 miles west of the Alpine oil field and is not related to the structural position of the reservoir (fig. 2). Tests of gas flow rates and volumes are not known to have been conducted west of the Spark-Rendezvous accumulation.

Although the data released are insufficient to make a precise calculation of the volume of oil and gas discovered, we estimate that 120 to 200 MMBO (including oil and condensate) and 1.9 to 3.0 TCFG may be technically recoverable from these accumulations. The Spark-Rendezvous accumulation is so large that if it were entirely oil, it would rival or exceed the Alpine field in recoverable resources.

Several recently drilled wells, most located west and northwest from the Spark-Rendezvous accumulation, evaluated other stratigraphic intervals, including (from oldest to youngest) the Triassic Ivishak Sandstone (*Ellesmerian Ivishak play* in the USGS 2002 assessment of NPRA), lower Kingak Shale (*Beaufortian Lower Jurassic Topset play*), uppermost Kingak Shale (*Beaufortian Cretaceous Topset play*), and the Torok Formation (*Brookian Clinoform play*). One well in the Ellesmerian Ivishak play and two wells in the Beaufortian Cretaceous Topset play are dry holes. At least four wells in the Beaufortian Lower Jurassic Topset play encountered gas shows but no indications of recoverable oil. Two wells in the Brookian Clinoform play encountered oil-saturated sandstone with poor reservoir quality and were not tested (fig. 2; Kokoda). Also, two wells (Spark 4 and Hunter; fig. 2) that targeted the Alpine sandstone encountered thin intervals of oil-saturated sandstone in the Brookian Topset play. Seven wells drilled west of Spark-Rendezvous remain proprietary (figs. 1 and 2); we infer that these are either gas shows or dry holes based on the predominance of gas in

Energy assessments

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Houseknecht et al. (2010) USGS Fact Sheet

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History of the CAE Initiative

2007 – Secretary of the Interior asked USGS to conduct analyses to reduce uncertainty around the future status of polar bears for the USFWS listing decision

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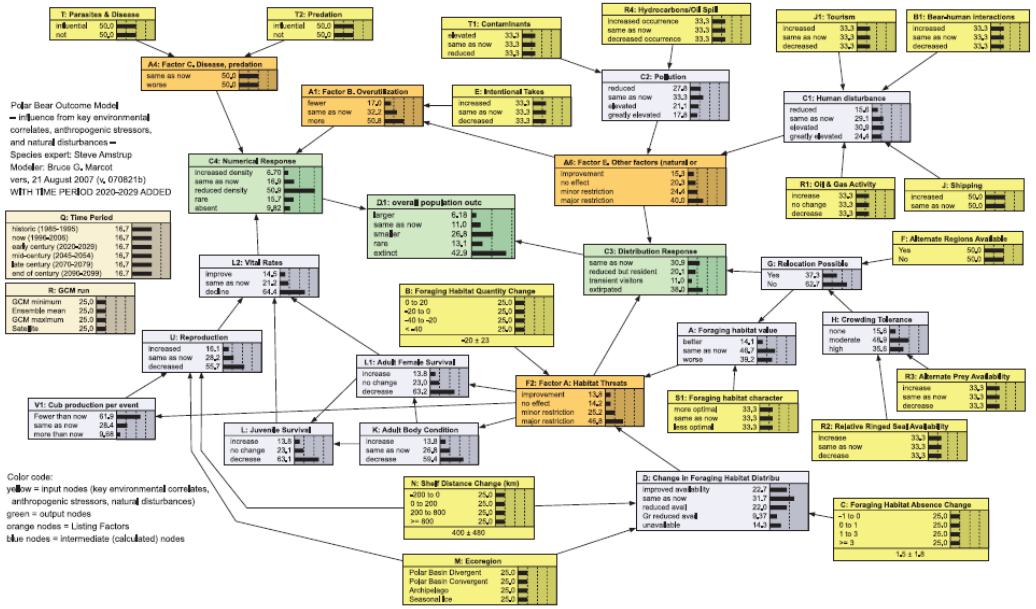

Amstrup et al. (2008)

- Decline in sea ice drives model
- Large decline of bears in some areas by 2075-2095

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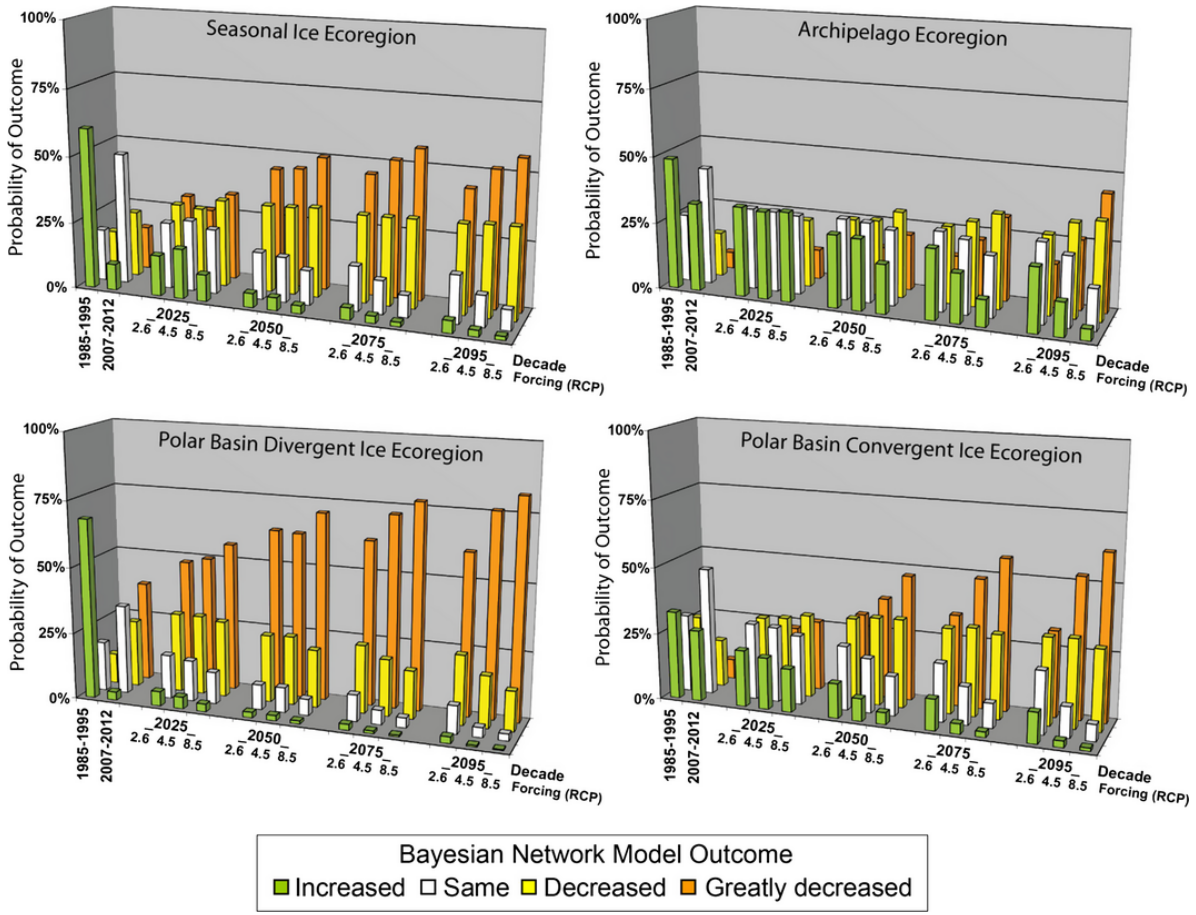
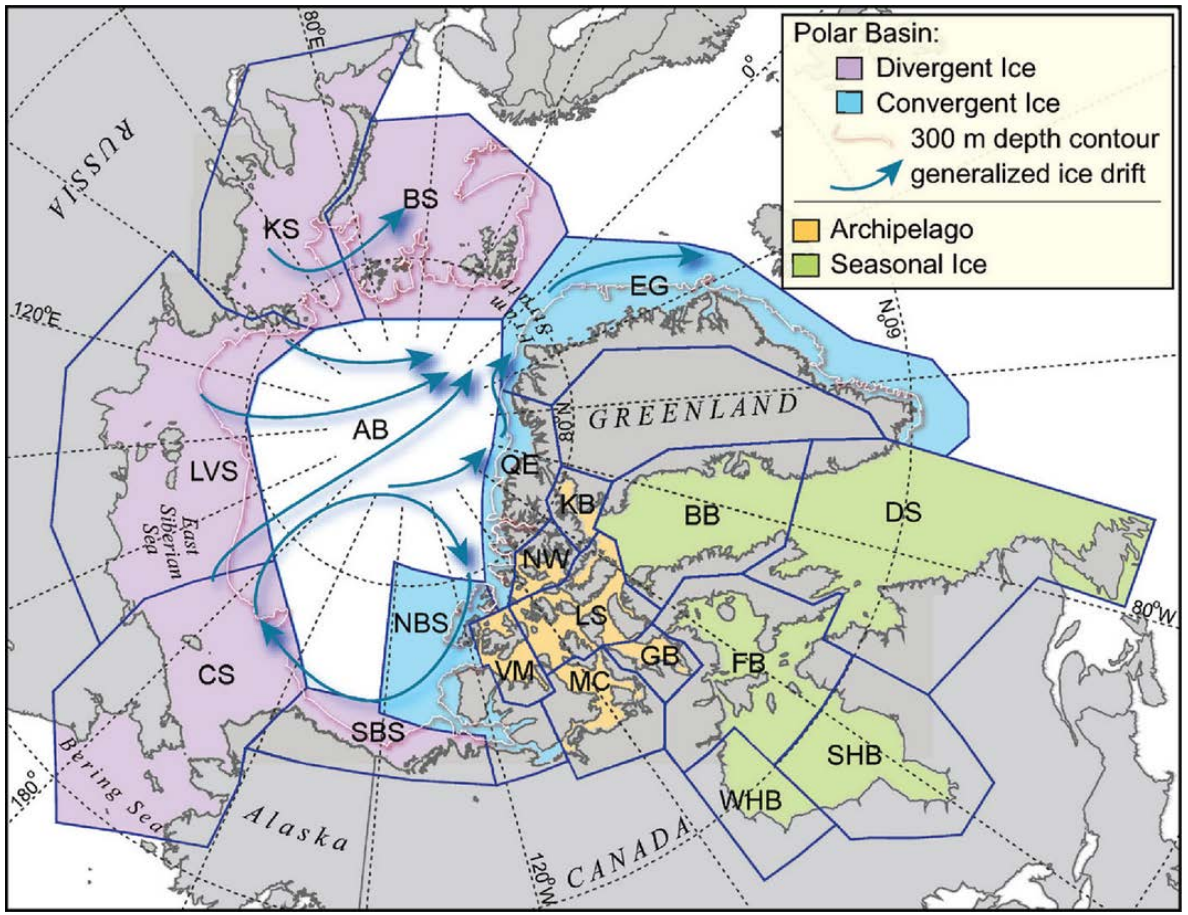
Forecasting the relative influence of environmental and anthropogenic stressors on polar bears





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Atwood et al. (2016)

Ecosphere

Volume 7, Issue 6, 29 JUN 2016 DOI: 10.1002/ecs2.1370

http://onlinelibrary.wiley.com/doi/10.1002/ecs2.1370/full#ecs21370-fig-0004

History of the CAE Initiative

2010 – Directive from the Department of Interior to use similar approaches for other high priority species and their habitats in terrestrial and marine ecosystems of the Arctic

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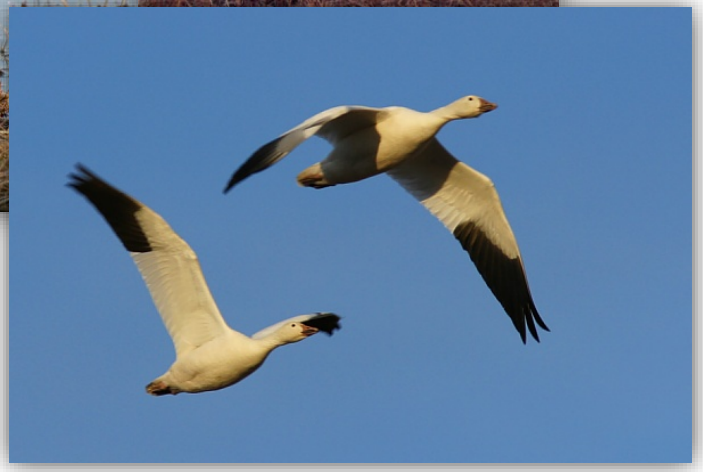
A similar modeling approach?



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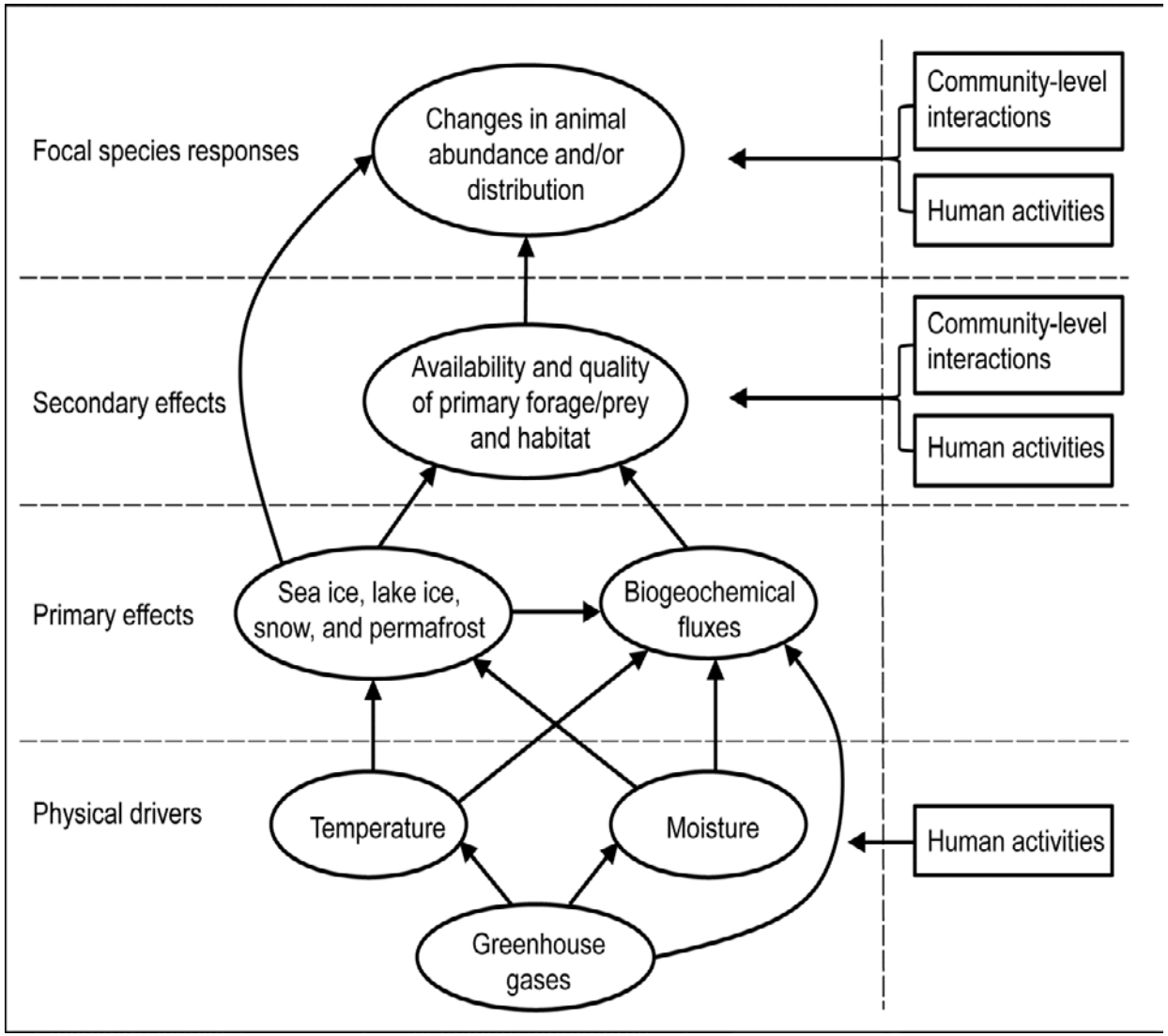
A model for wildlife response



Van Hemert et al. (2015) BioScience

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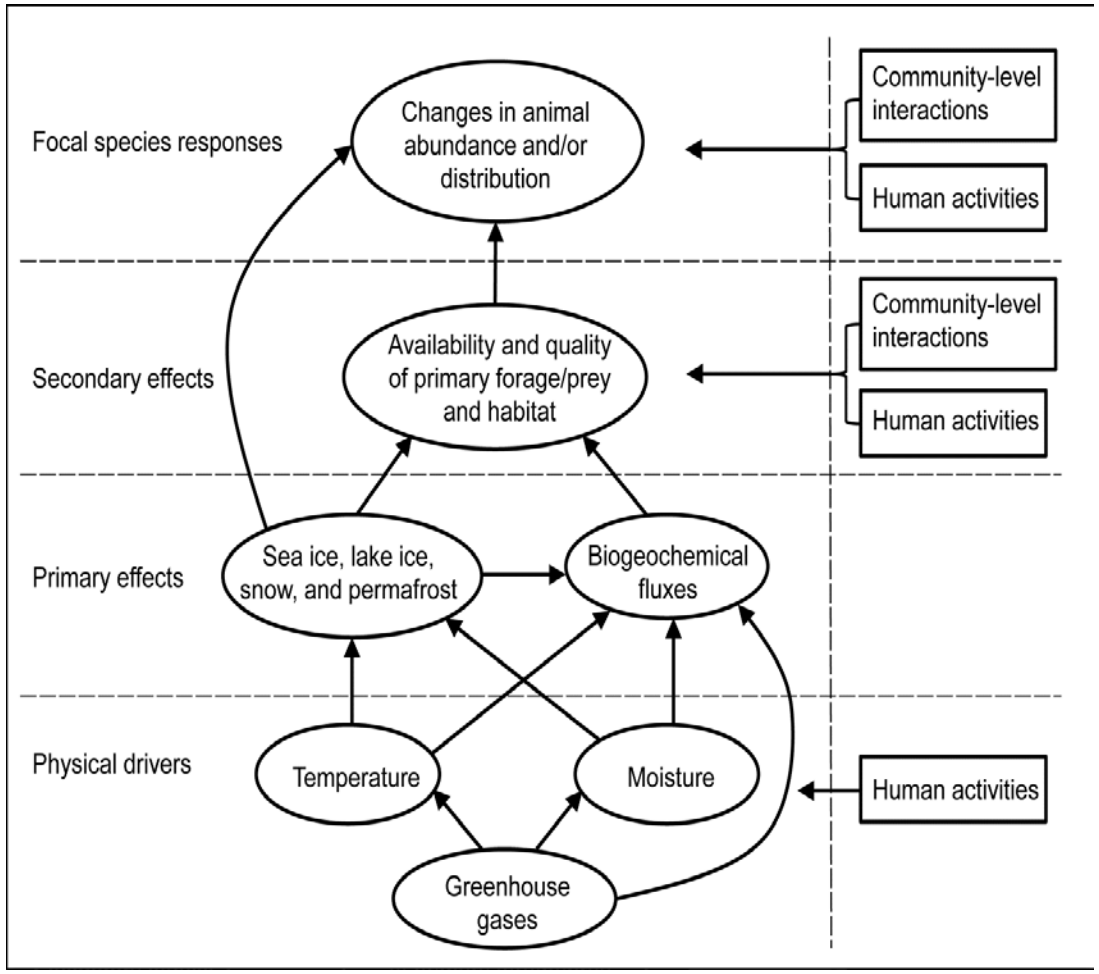
Goals of CAE (since 2010)

- Quantify wildlife and habitat response to arctic changes
- Determine how and why of these responses
- Forecast future responses to inform to inform decision making



Van Hemert et al. (2015) BioScience

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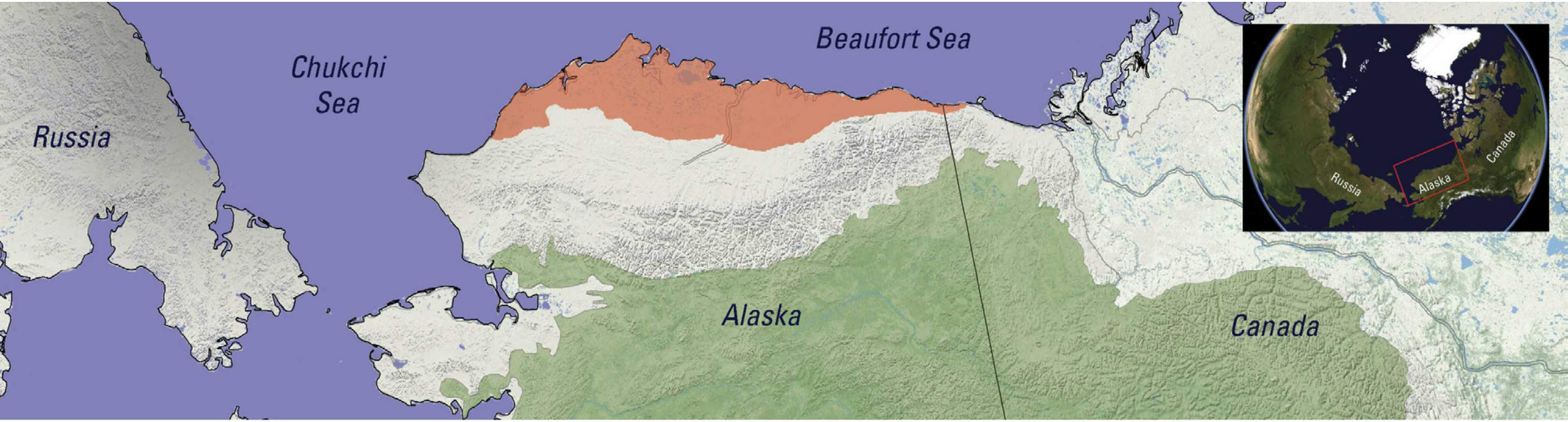
Where we are working



Marine Ecosystem of the Chukchi and Beaufort Seas

Continuous Permafrost Ecosystem

Discontinuous Permafrost-Boreal Forest Ecosystem

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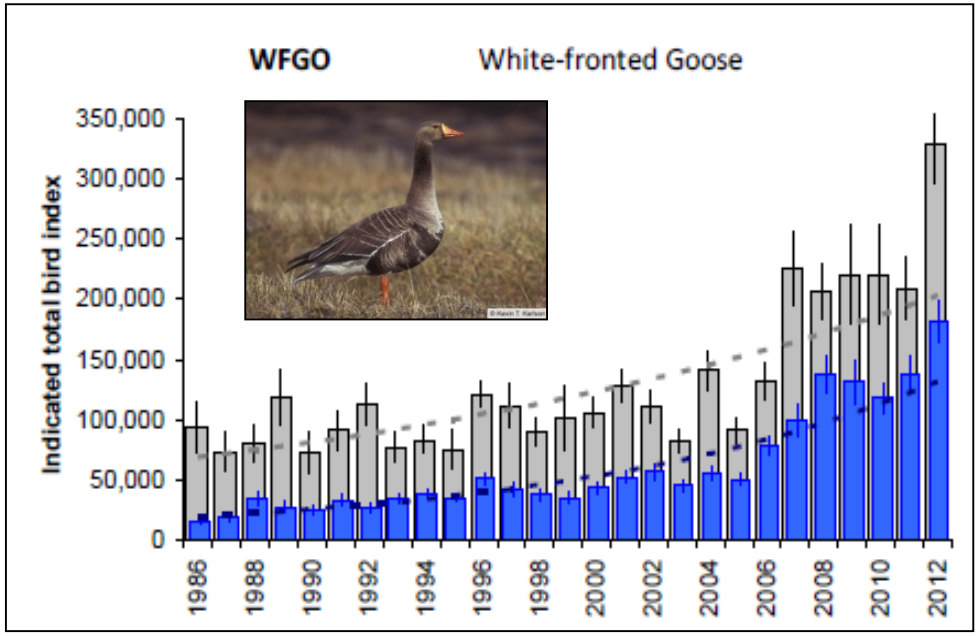
Wildlife response and research directions:



- 2007 onshore haul out
- Forage and energetics?

- Increase in goose populations
- What are the mechanisms?

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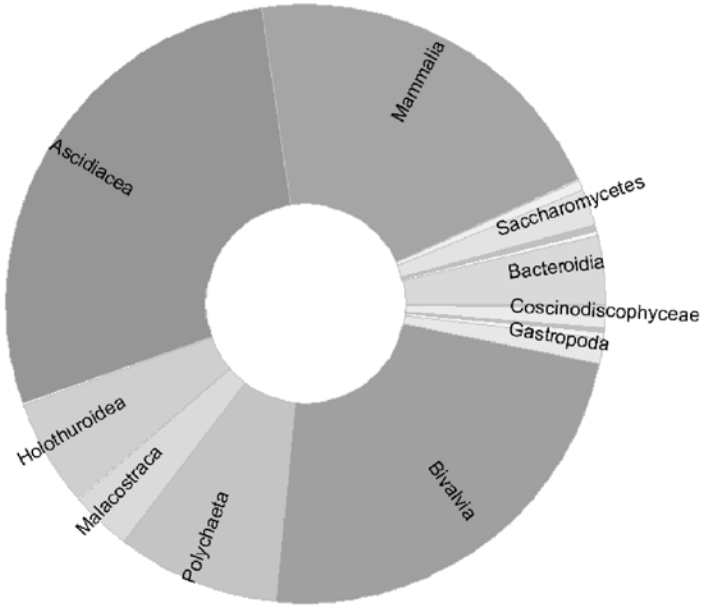
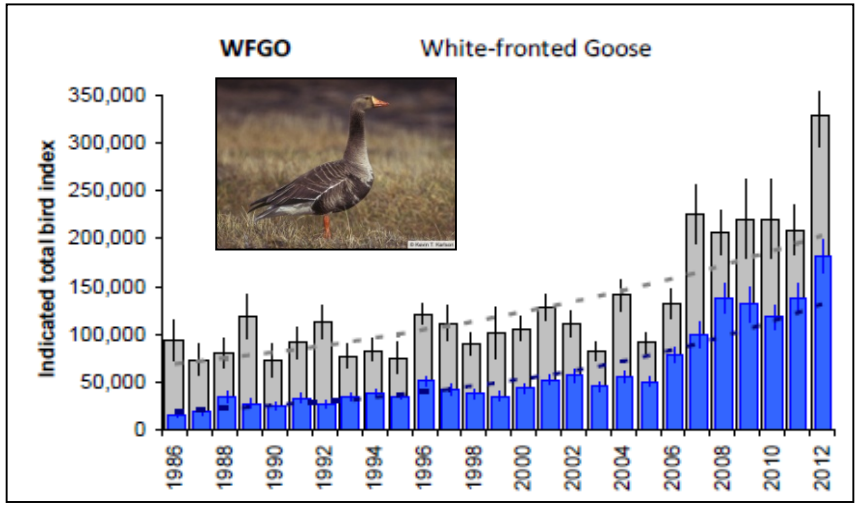
Stehn et al. (2013)
USFWS Alaska

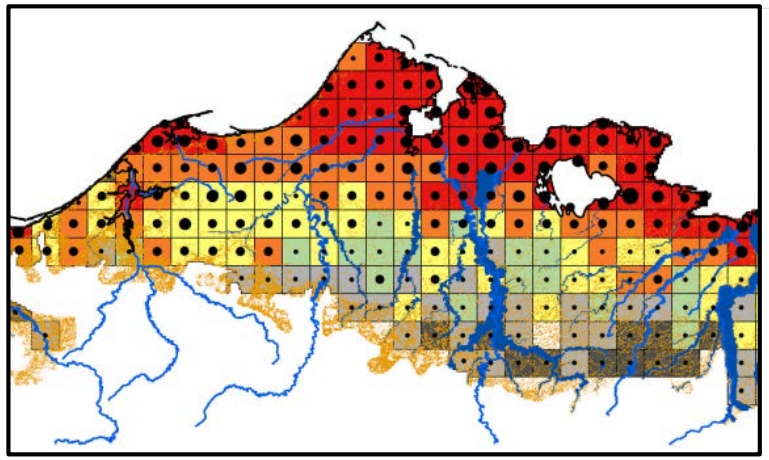
Wildlife response and research directions :

Forage and energetics

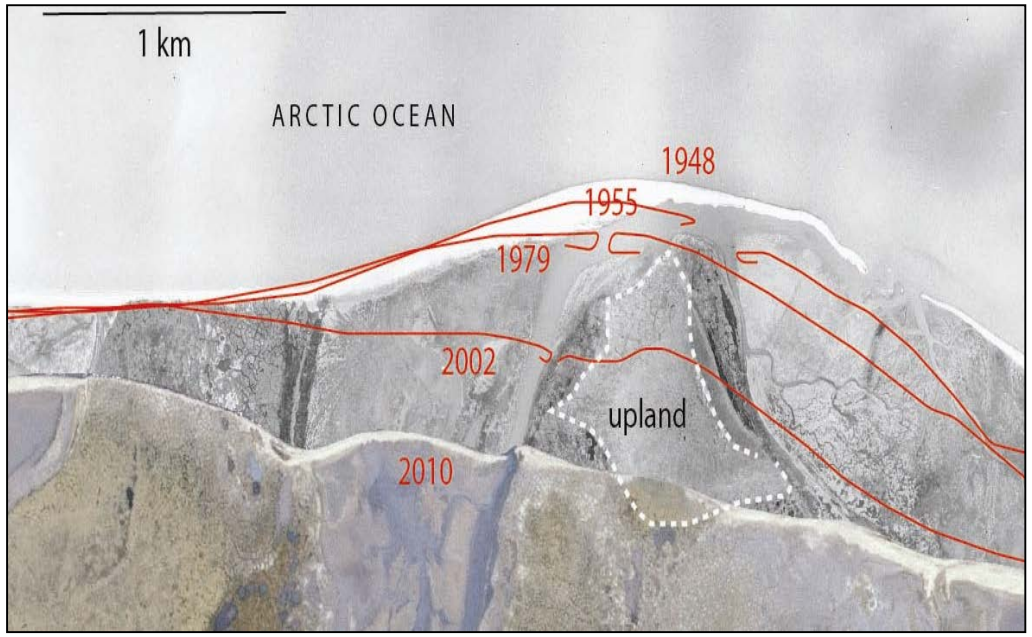




What are the mechanisms?



Wildlife response and research directions :



- Coastal erosion and changes in hydrology, habitats
  - Implications?

- Earlier arrival and more time onshore
- Forage and health?

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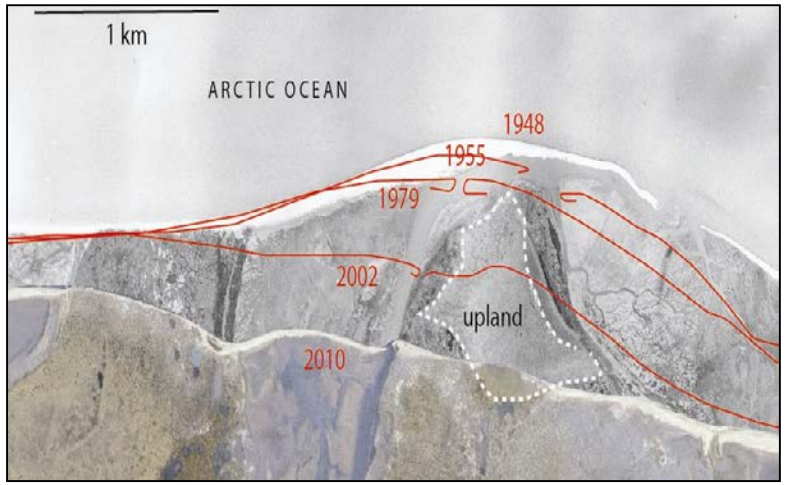
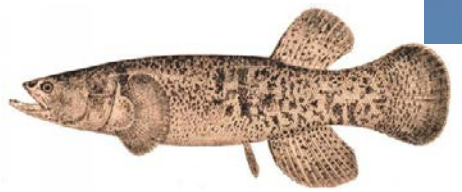
Wildlife response and research directions :



Haynes et al. (2015)

Coastal changes

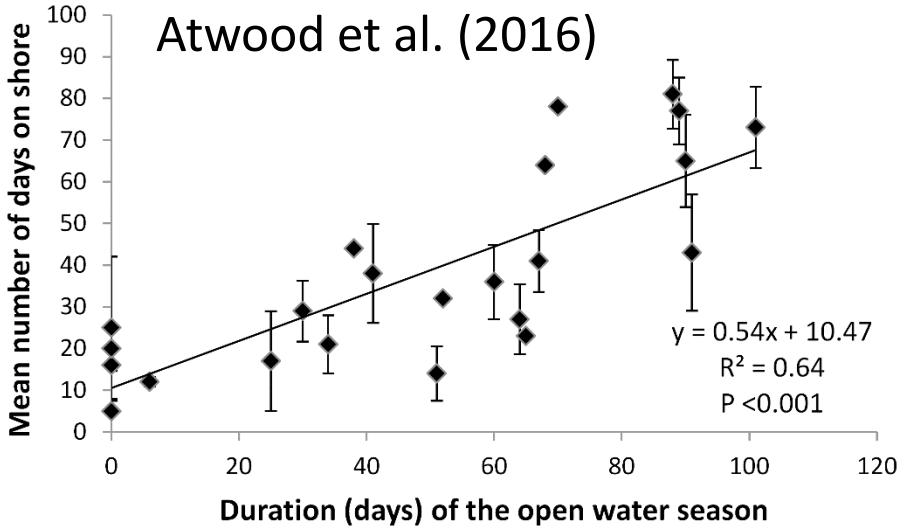
Hupp et al. (2015)



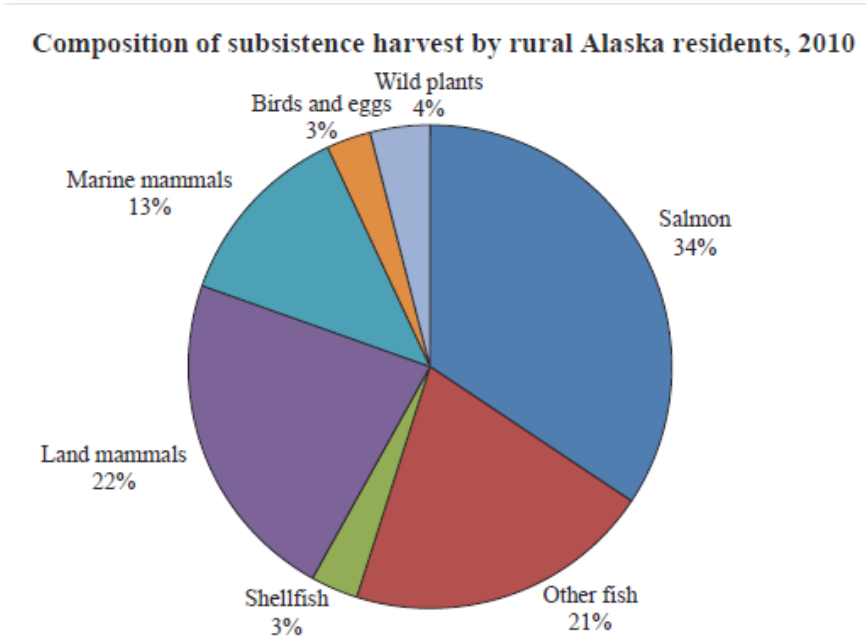
Laske et al. (2016)

On shore bears

Atwood et al. (2016)



Wildlife response and research directions :



- New species communities
- Wildlife disease transfer?

- Disease prevalence
- Health of subsistence resources

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*Alaska Department of Fish and Game

Why is this important?

- Work focused on Department of Interior ‘trust species’
- Natural resource changes and decisions are often many years in the making:
  - Offshore and onshore development
  - Wildlife management plans
  - Different patterns across a variable environment

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Hasn’t this been done before?

- Molting Black Brant in and around Teshekpuk Lake

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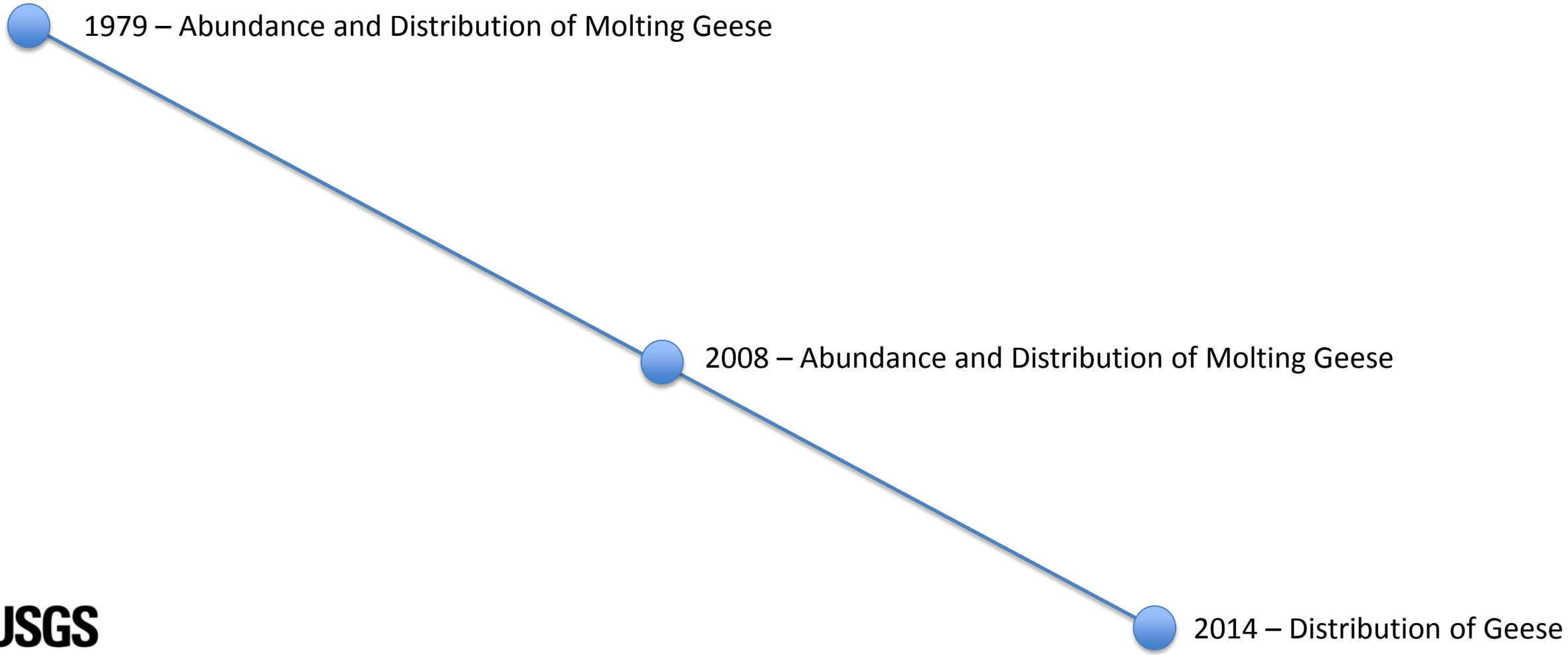
Research timeline in the NPR-A



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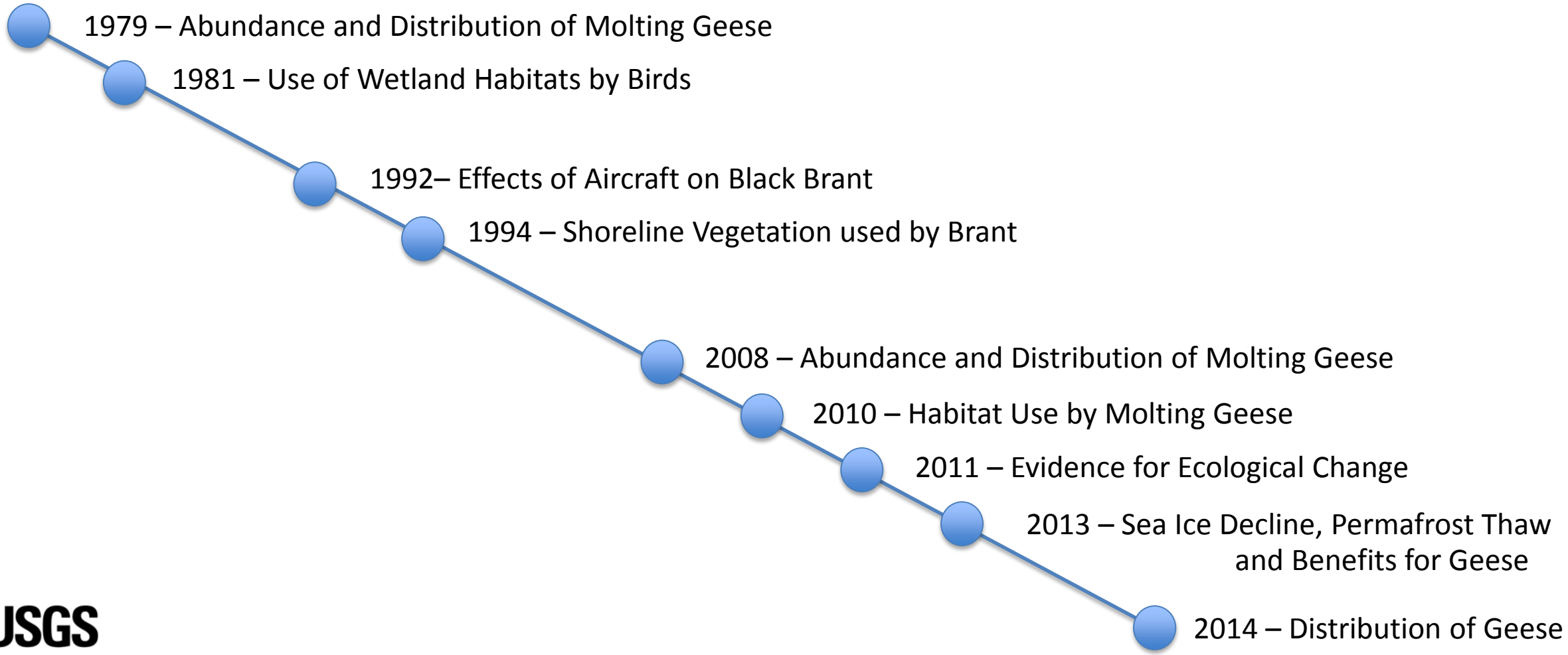
Research timeline in the NPR-A



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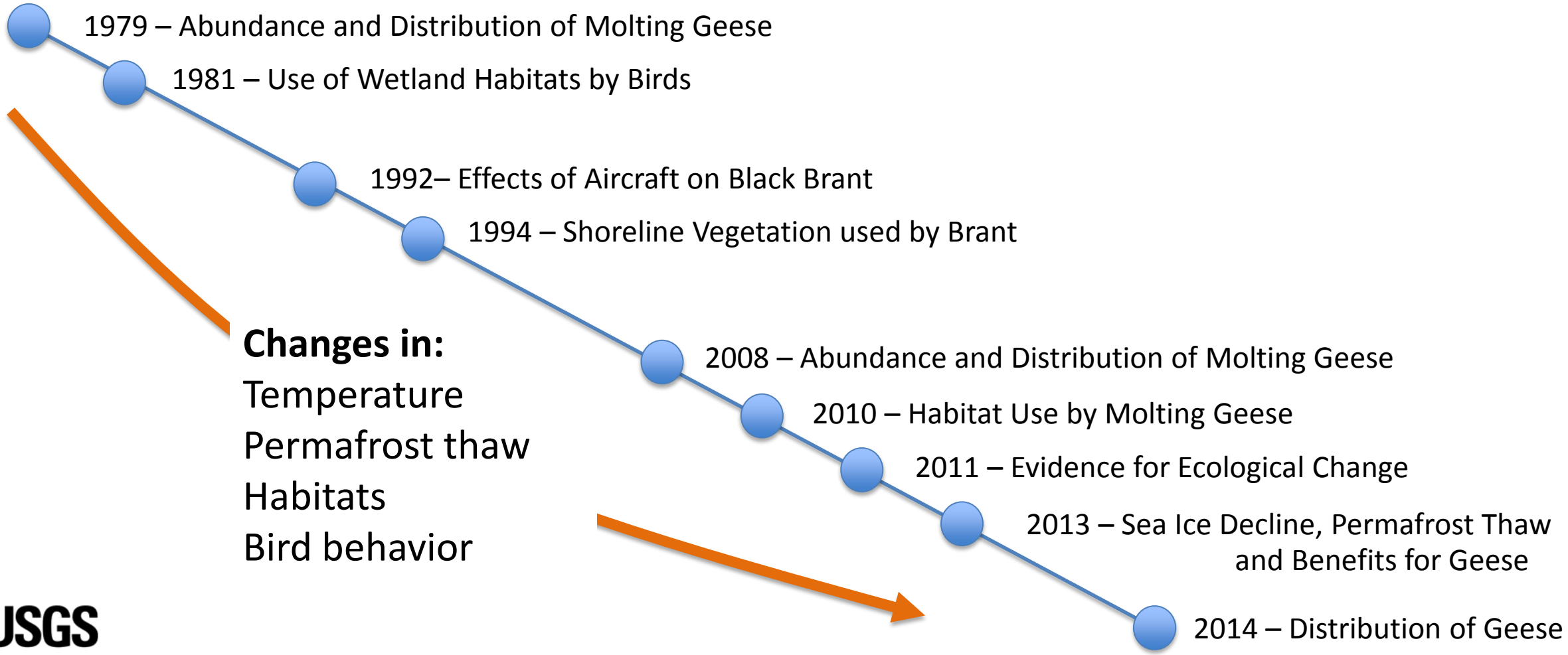
Research timeline in the NPR-A



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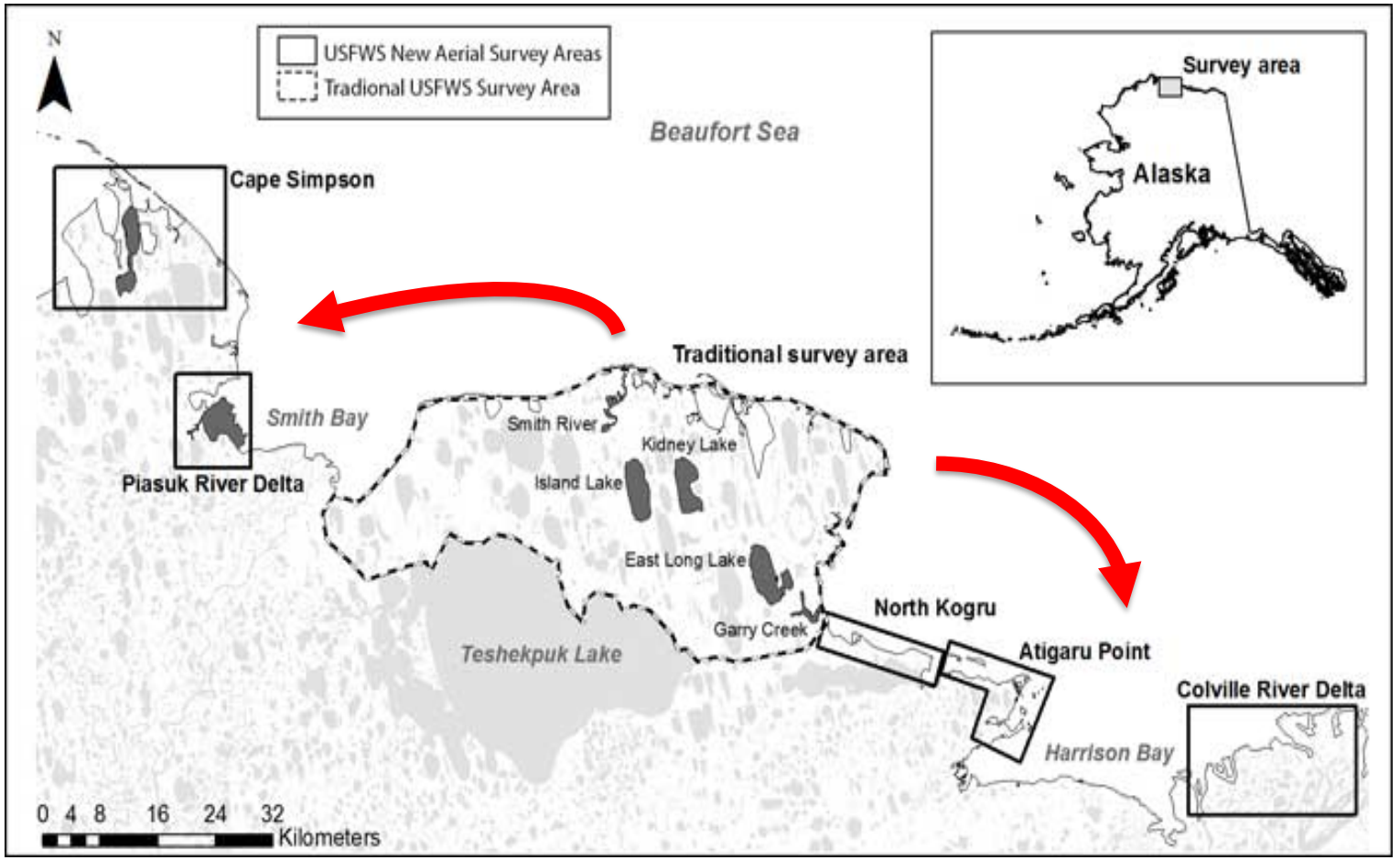
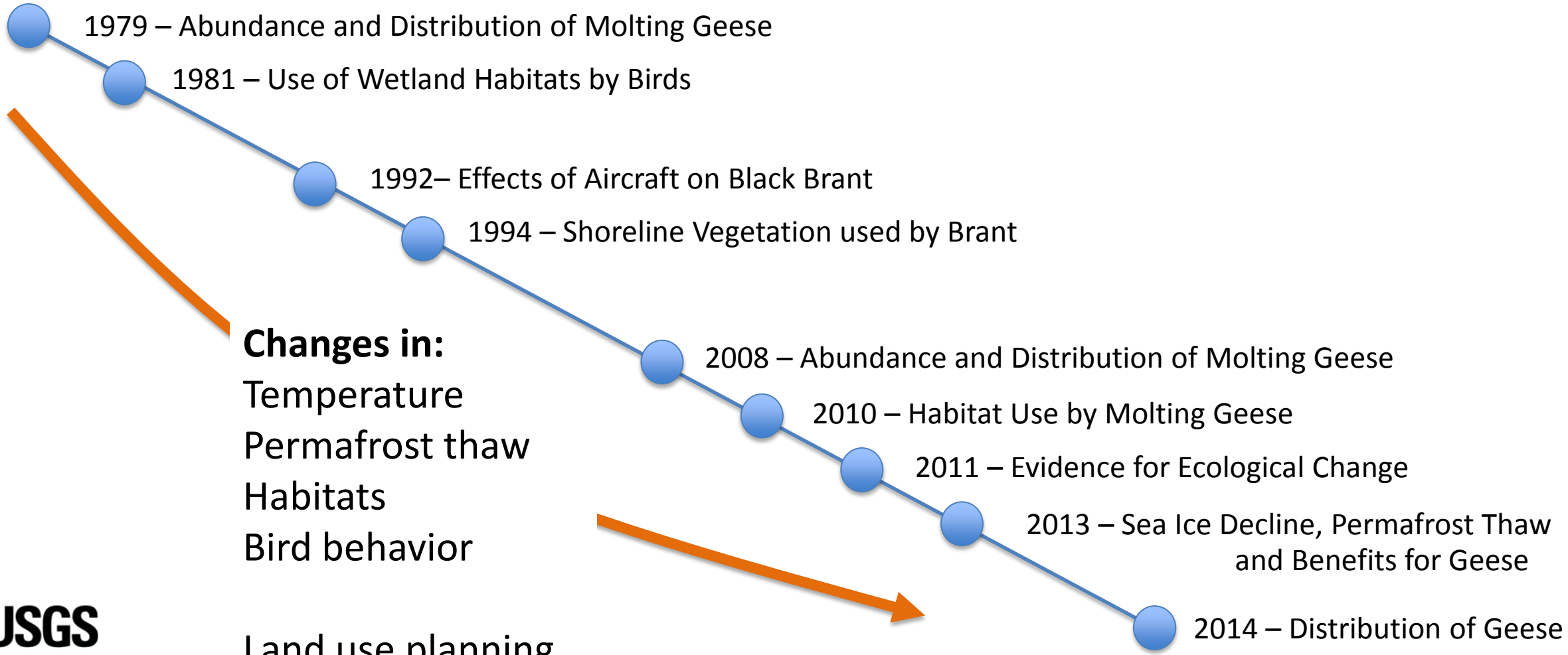
Shifts in Black Brant distribution

- In 2008 study, five new molting areas identified
- In 2011-2013, USFWS added these areas to annual survey
- Counted an additional 7,000 – 15,000 molting birds



Lewis et al. (2009, 2011), Flint et al. (2014a, 2014b)

Research timeline in the NPR-A



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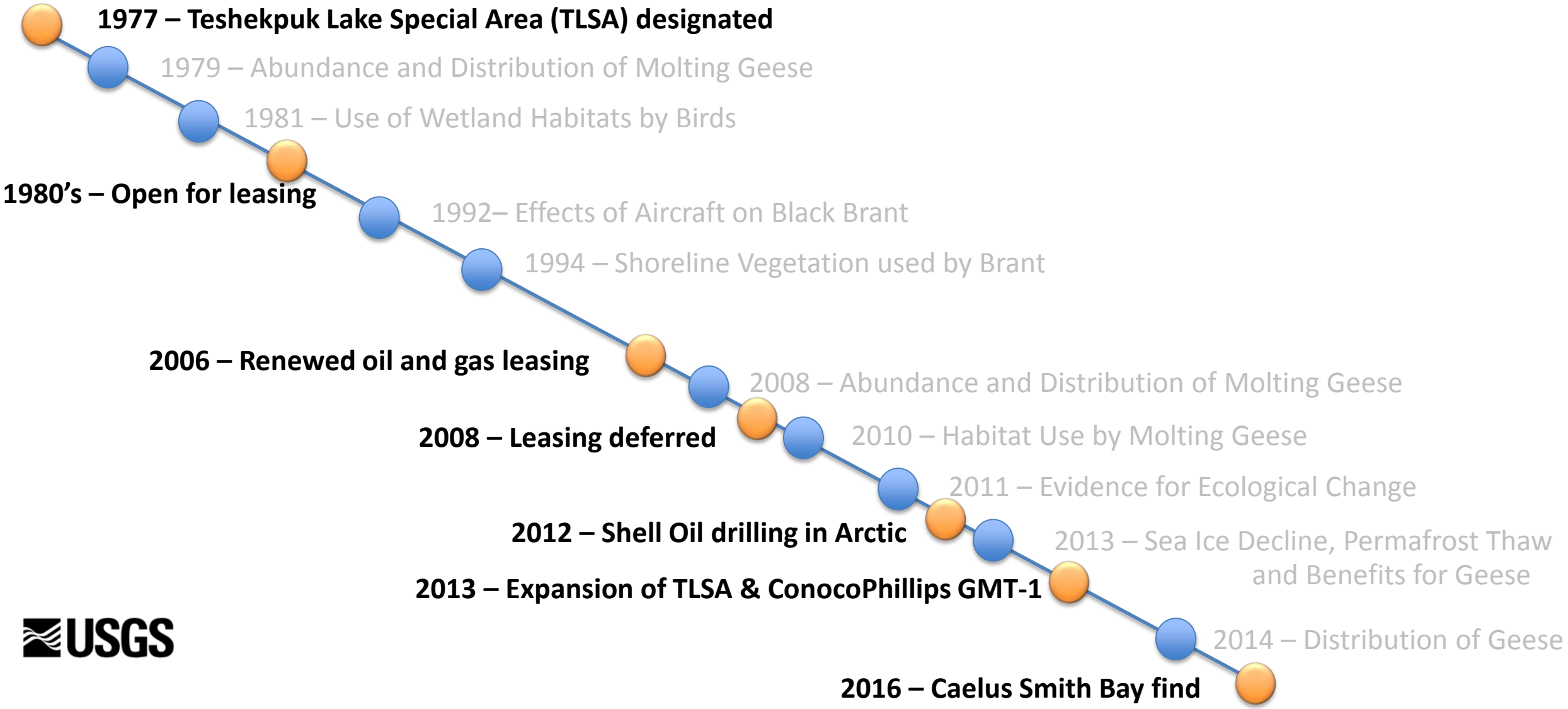
Development timeline in the NPR-A



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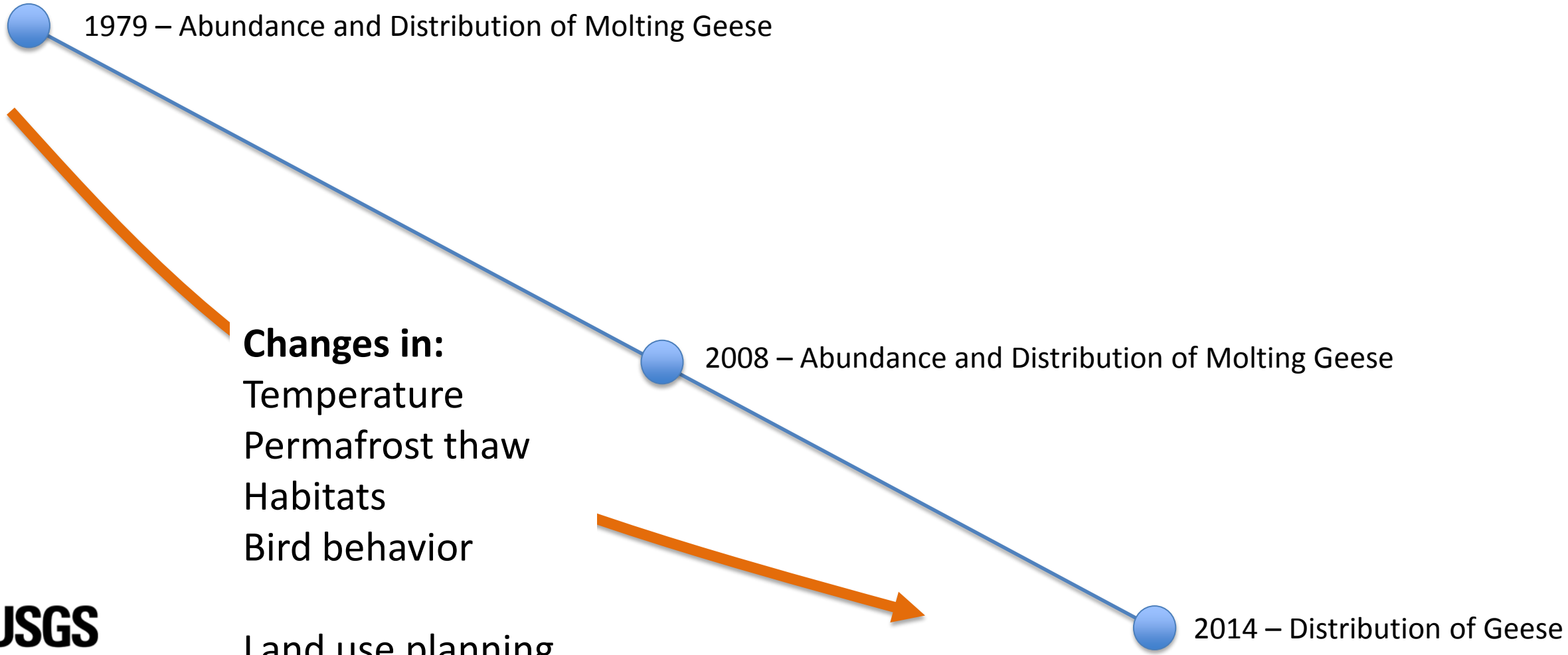
Hasn’t this been done before?



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- The role and trajectory of USGS science in the Arctic
- What is the CAE initiative?
- Current and future plans for work in the Arctic
  - Observational science
  - Hypothesis-driven science
  - New directions based on public feedback
  - New directions based emerging issues

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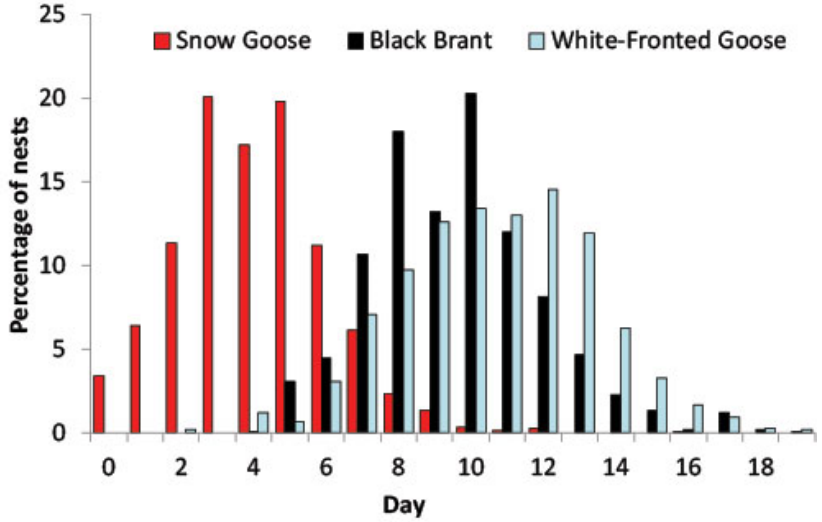
Observational science



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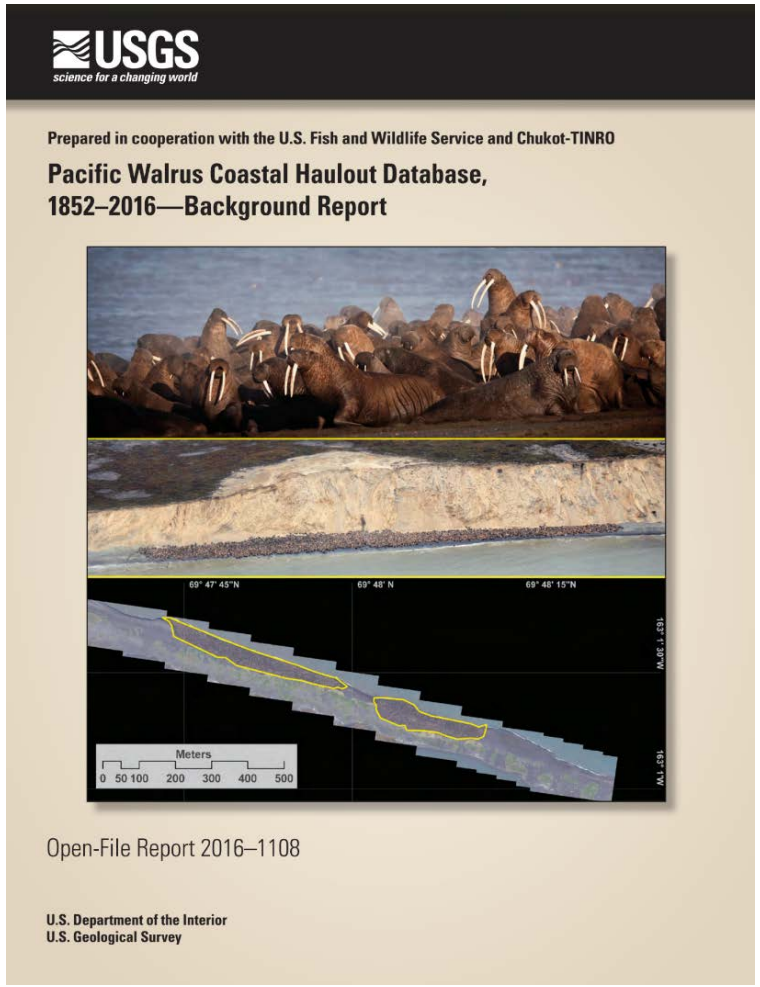
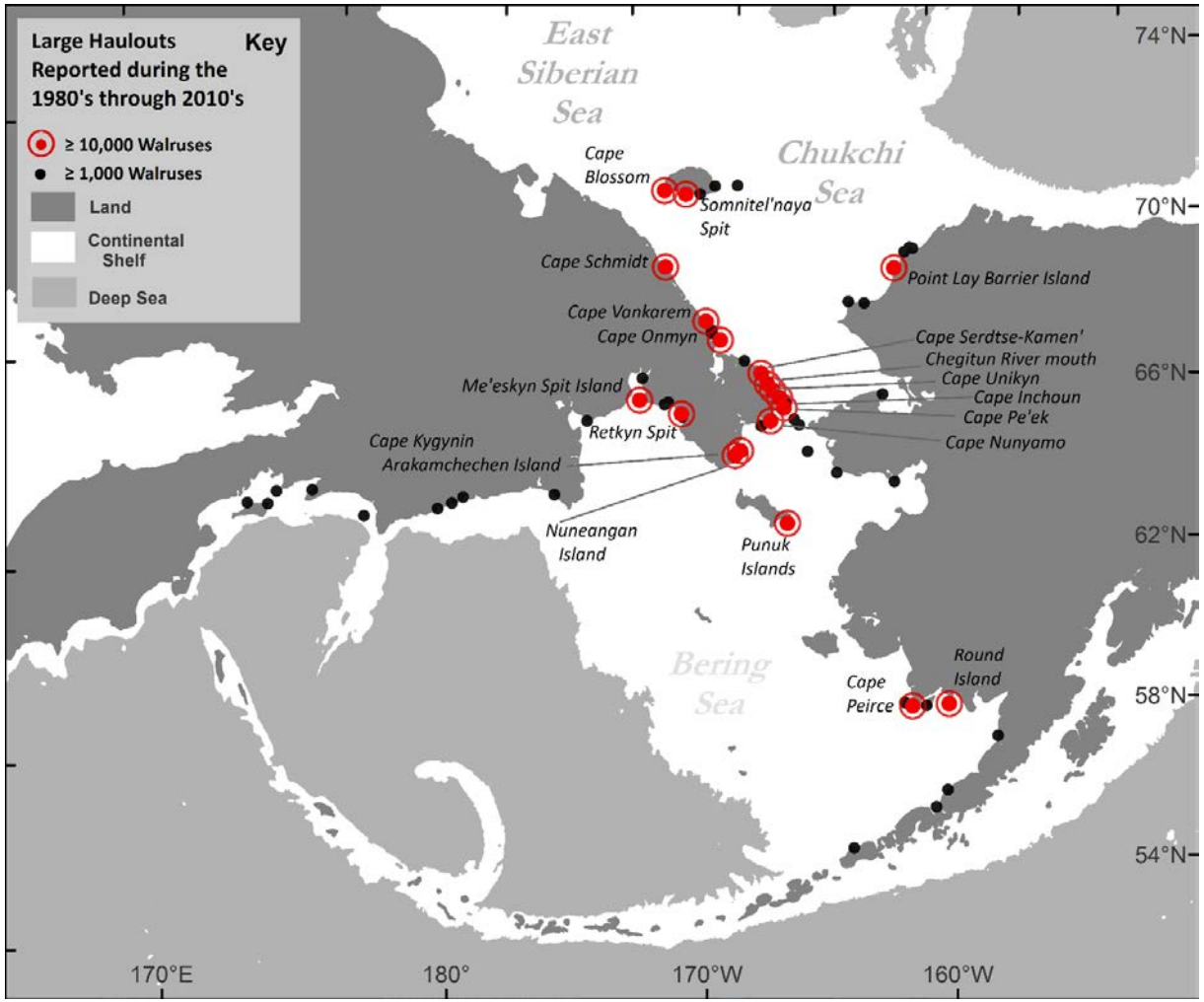
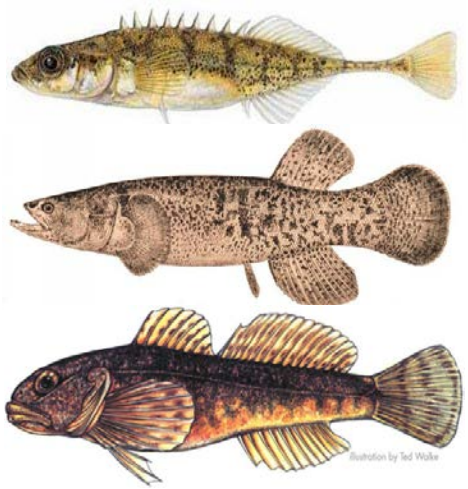
Observational science

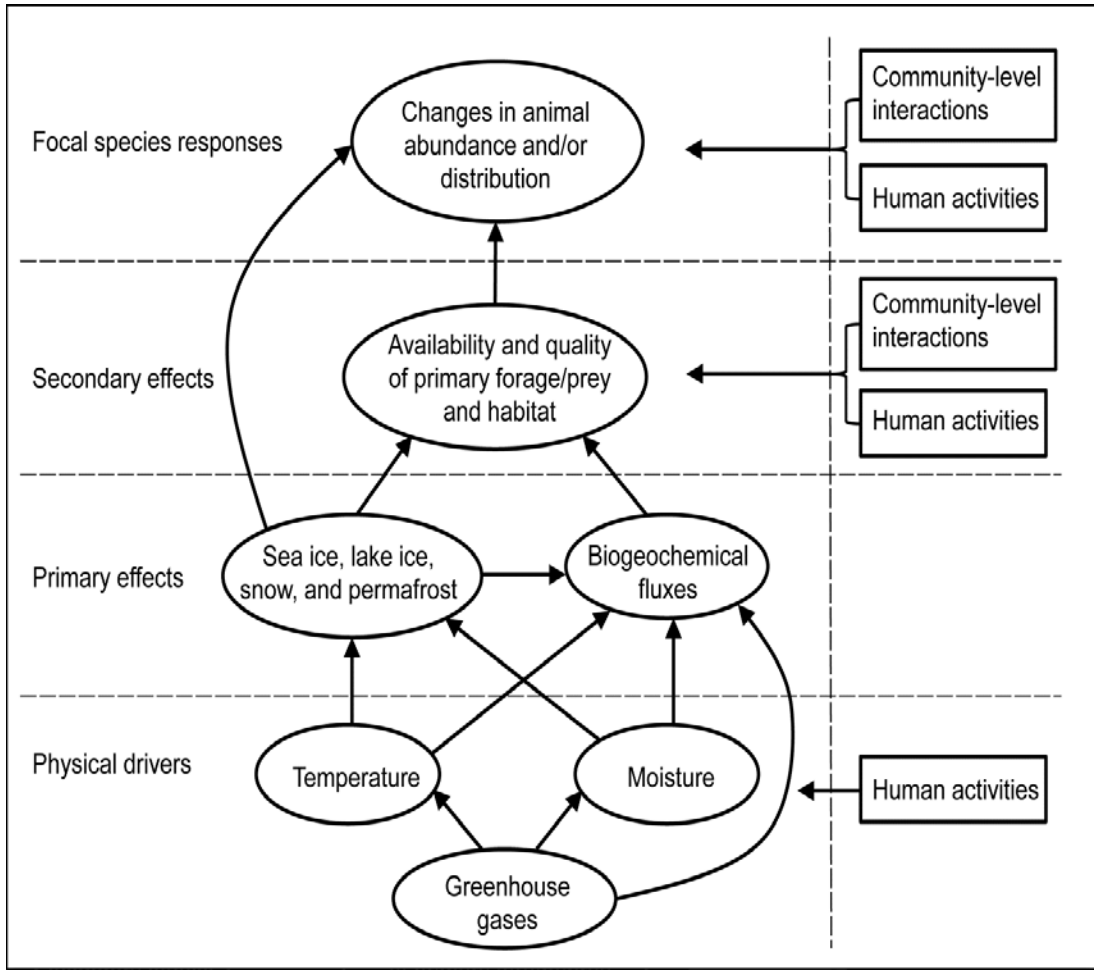




Fischbach et al. (2016)

Hypothesis-driven science: Why?

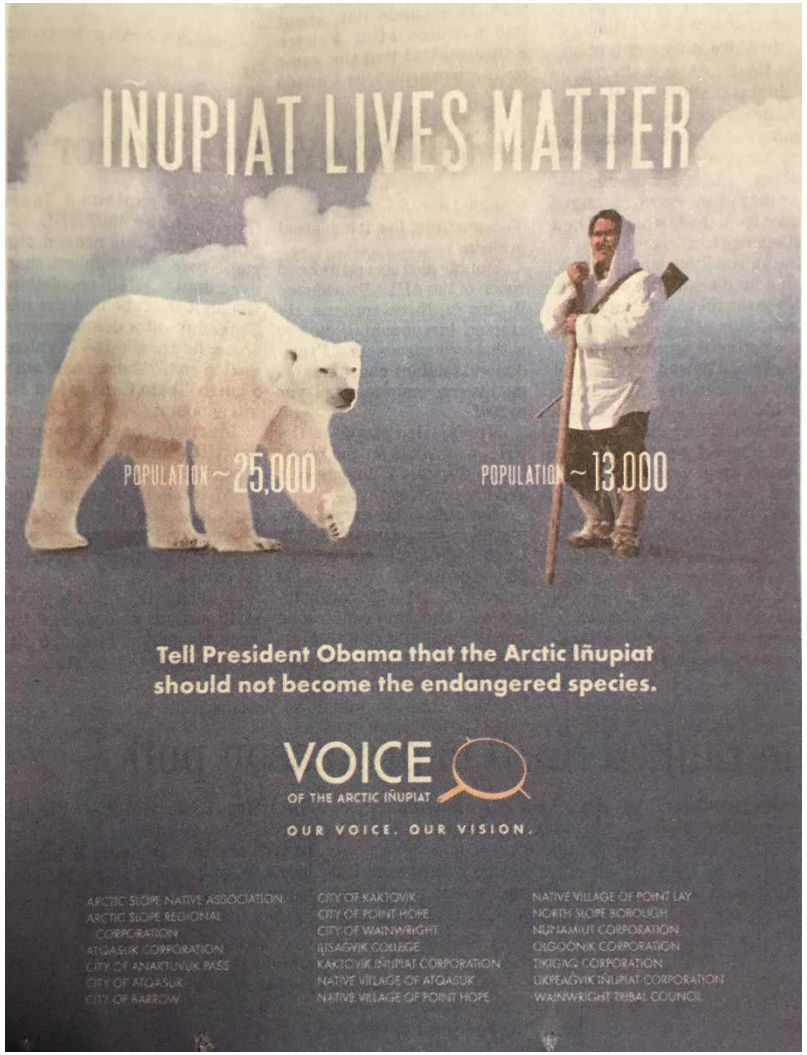




Van Hemert et al. (2015)

Current and future plans: communication

- Active communication with the public about our work
- Involvement and dialogue with people in communities where work takes place
- Communities in the Arctic are also responding to climate change



ADN, September 2016

Recommendations from NPR-A subsistence panel

- Studies on the North Slope should be delayed for two years to reduce aircraft traffic
- Conduct an inventory of water quality
- Conduct caribou surveys annually in light of declining herds
- Provide information on diseases and parasites in subsistence species

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Current and future plans: Emerging issues

- Coastal erosion and Alaska village infrastructure
- Equip communities with monitoring tools to establish long-term baselines
- Provide information on diseases and parasites in subsistence species
- Arctic science as STEM educational platform

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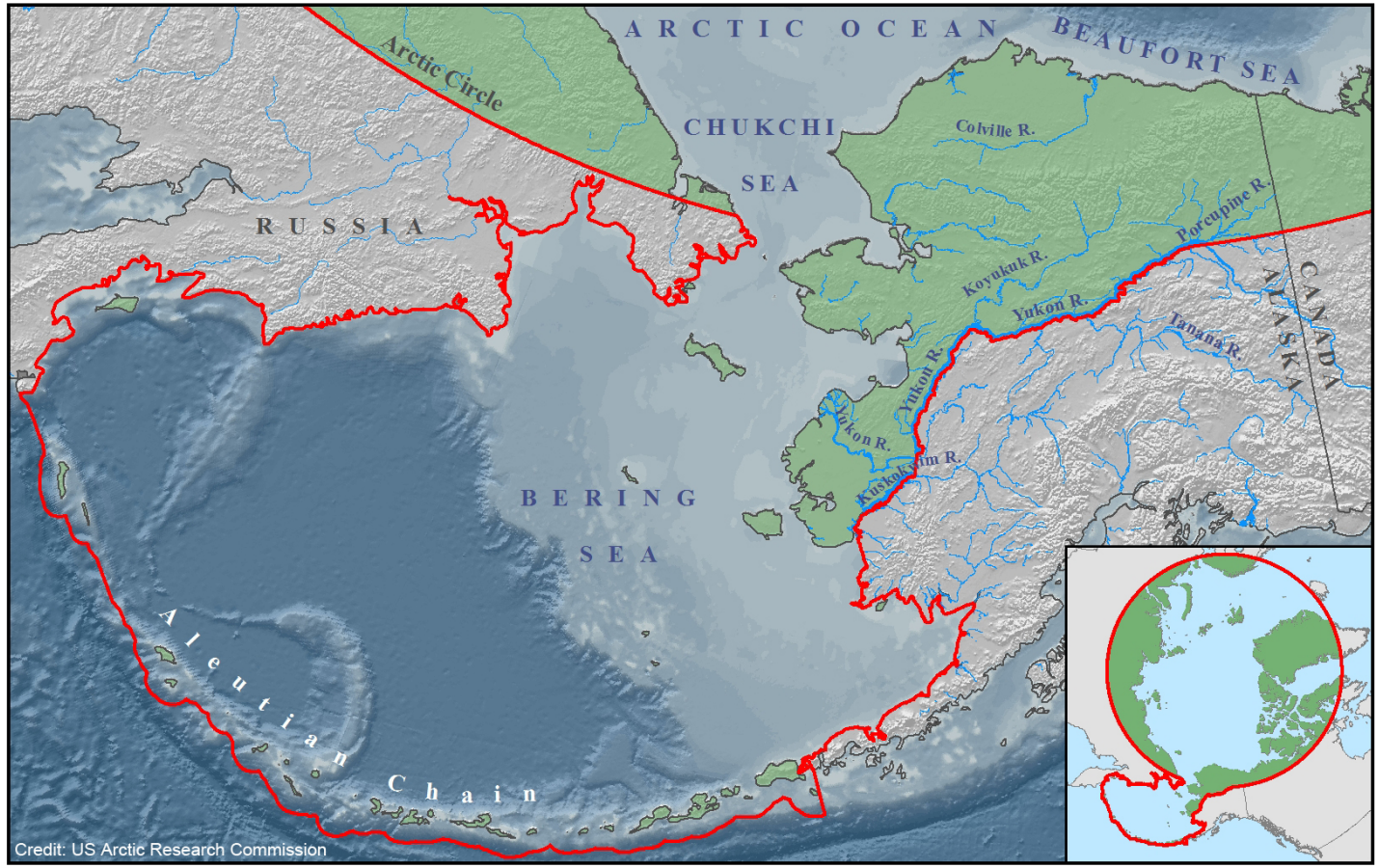
Future research areas

Arctic Boundary as defined by the Arctic Research and Policy Act (ARPA)

All United States and foreign territory north of the Arctic Circle and all United States territory north and west of the boundary formed by the Porcupine, Yukon, and Kuskokwim Rivers; all contiguous seas, including the Arctic Ocean and the Beaufort, Bering and Chukchi Seas; and the Aleutian chain.[1]



Acknowledgement: Funding for this map was provided by the National Science Foundation through the Arctic Research Mapping Application (armap.org) and Contract #0520837 to CH2M HILL for the Interagency Arctic Research Policy Committee (IARPC).

Map author: Allison Gaylord, Nuna Technologies. May 27, 2009.

1. The Aleutian chain boundary is demarcated by the 'Contiguous zone' limit of 24-nautical miles.

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Closing thoughts

- CAE and other USGS science will remain flexible and responsive to agency and public needs to inform decisions
- Producing quality science across a changing landscape of temperature and land use takes time
- Communication and soliciting feedback remains a priority

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Upcoming seminars in this series

November 10th, 2016 – Karyn Rode
The role of polar bear behavior in defining resiliency and limitations to sea ice loss

January 26th, 2017 – Steve Matsuoka & Sarah Thompson
Avian adaptations to climate change in the boreal forest – Arctic transition zone

February 16th, 2017 – Iris Cato & Paul Flint
Differences between arctic and sub-arctic grazing systems for geese

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Upcoming seminars in this series

March 9th, 2016 – Rachael Loehman
Climate impacts to plant, animal, and human communities on the Yukon-Kuskokwim Delta

April 6th, 2017 – Molly McDermott
Diet of migratory songbirds across a range of changing habitats in western Alaska

May 11th, 2017 – Vanessa Von Biela
Bivalve growth in response to changing sea ice conditions in the Chukchi Sea

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The Trajectory of the USGS Changing Arctic Ecosystems Initiative

Questions?

U.S. Department of the Interior
U.S. Geological Survey