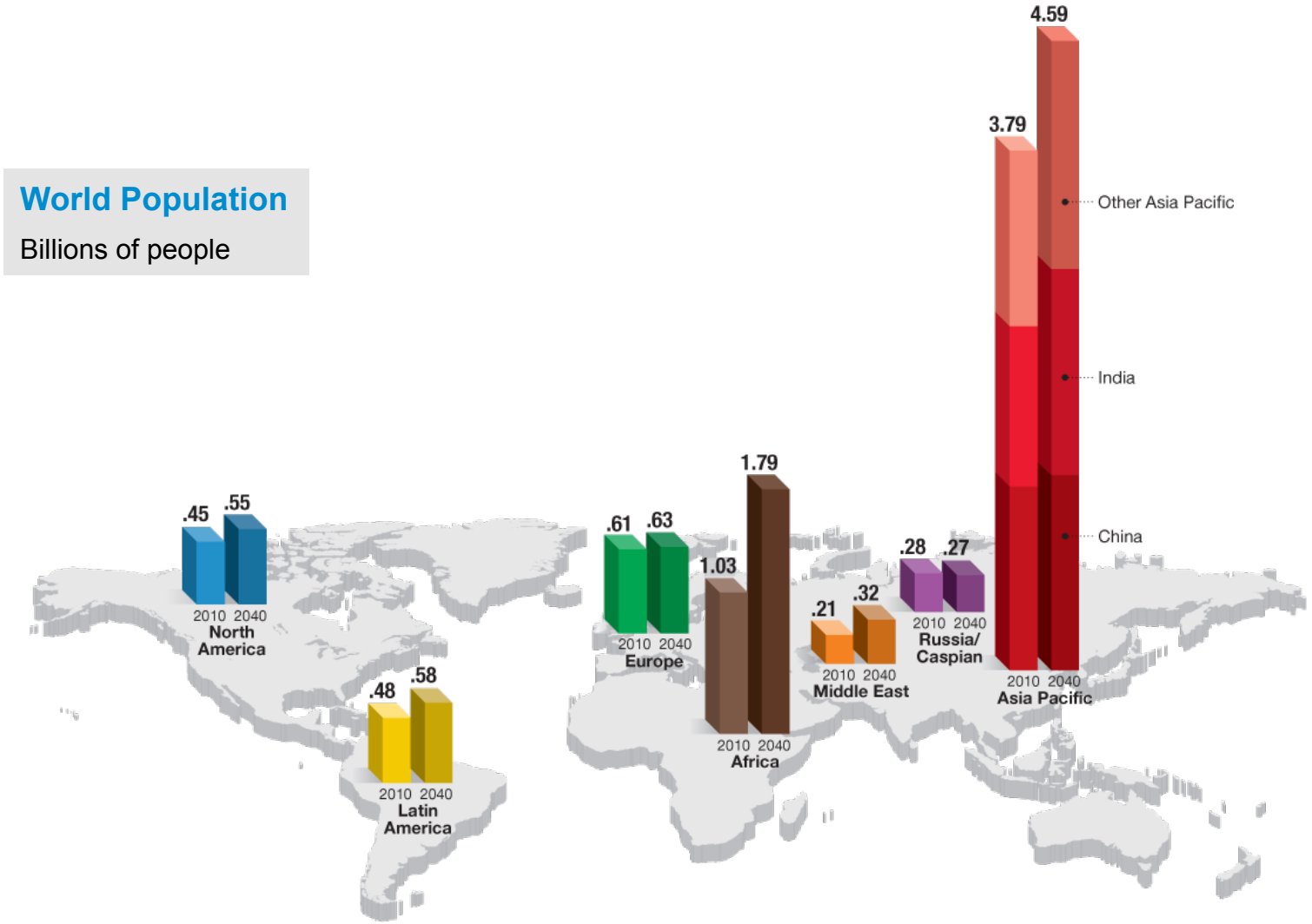
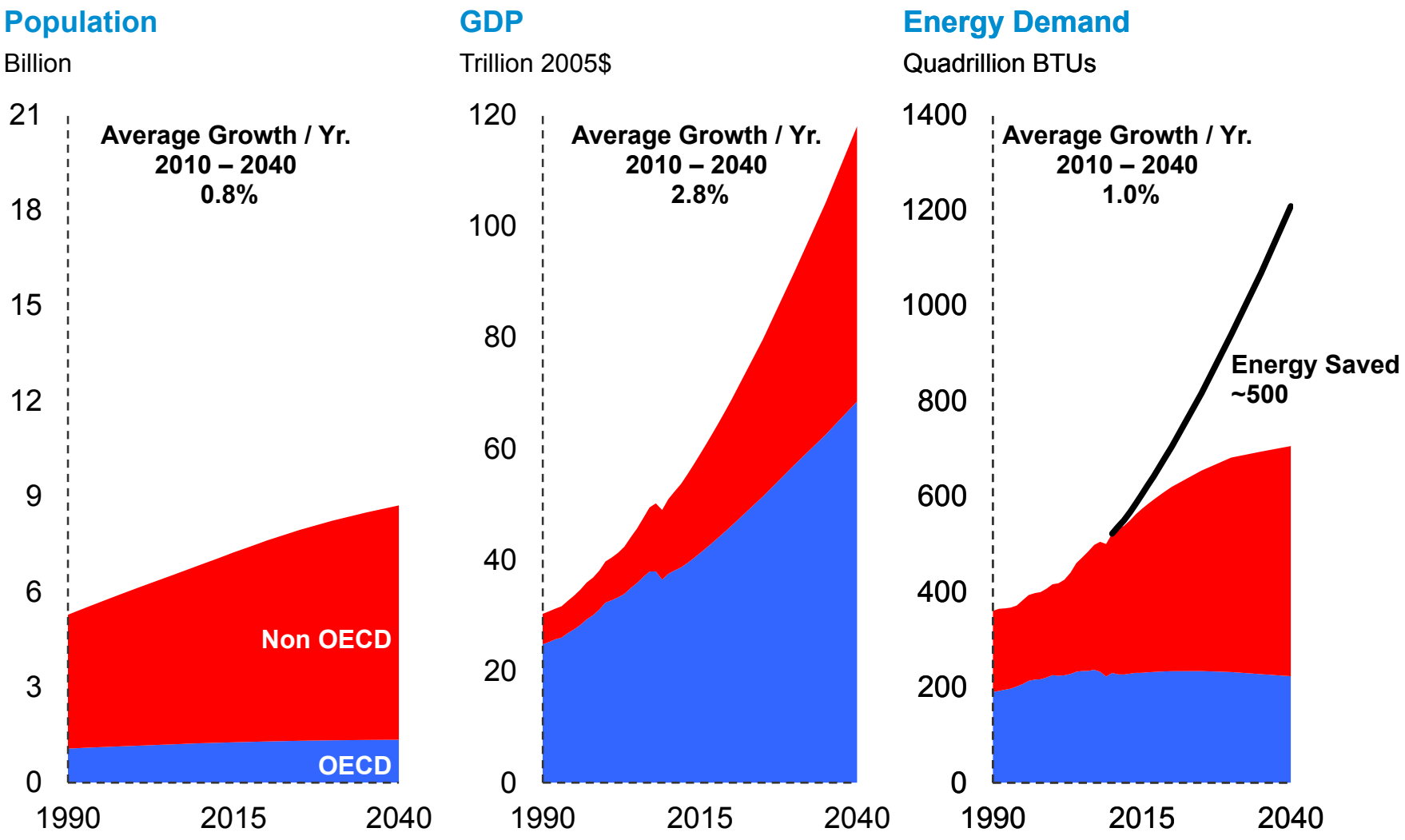
Dr. Gary H. Isaksen
Global Ocean Science & Policy

ExxonMobil

Population Trends Impact Energy Use



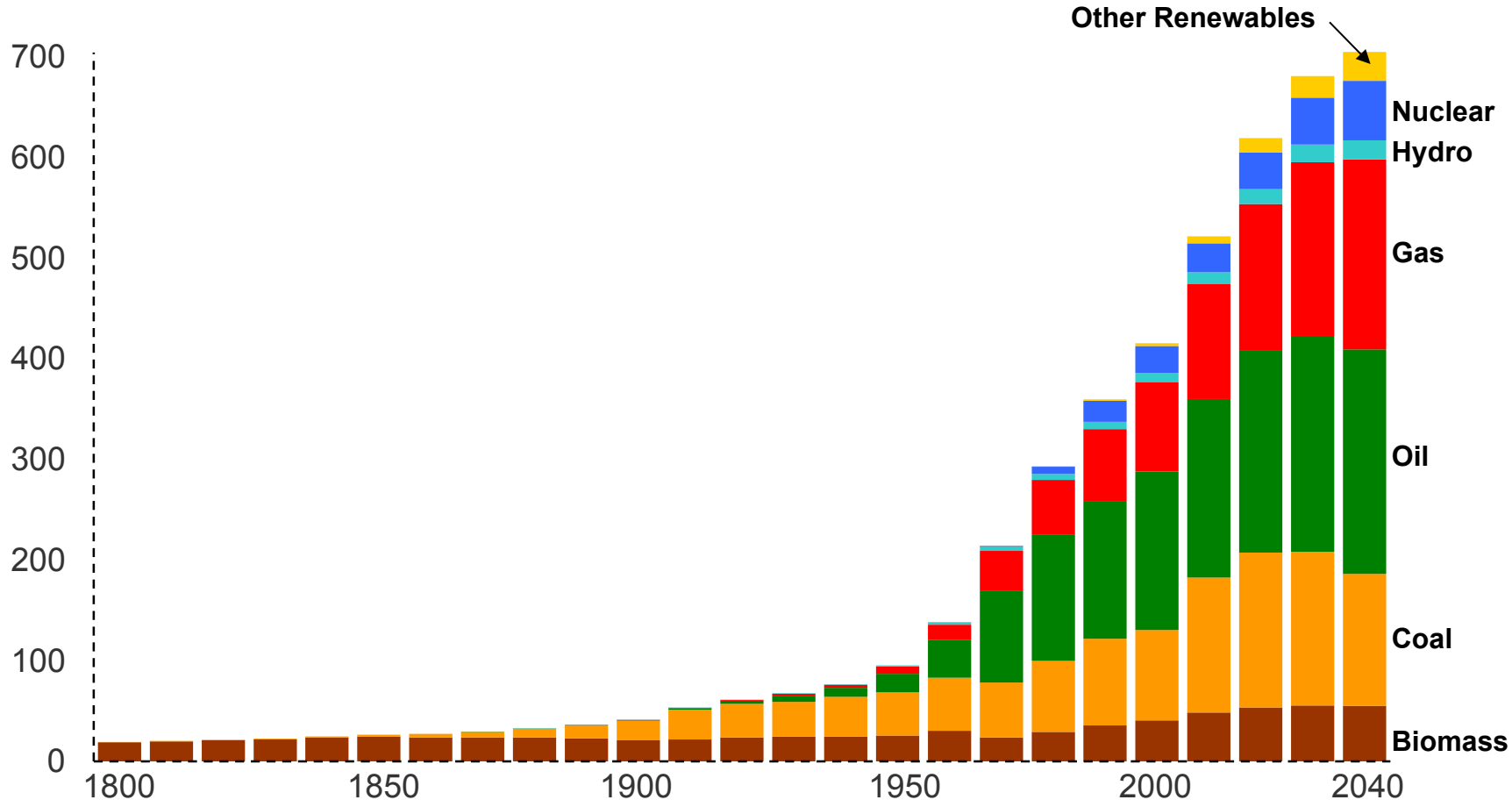
Global Progress Drives Demand



Energy Use Evolves Over Time

Global Percent Mix of Fuels

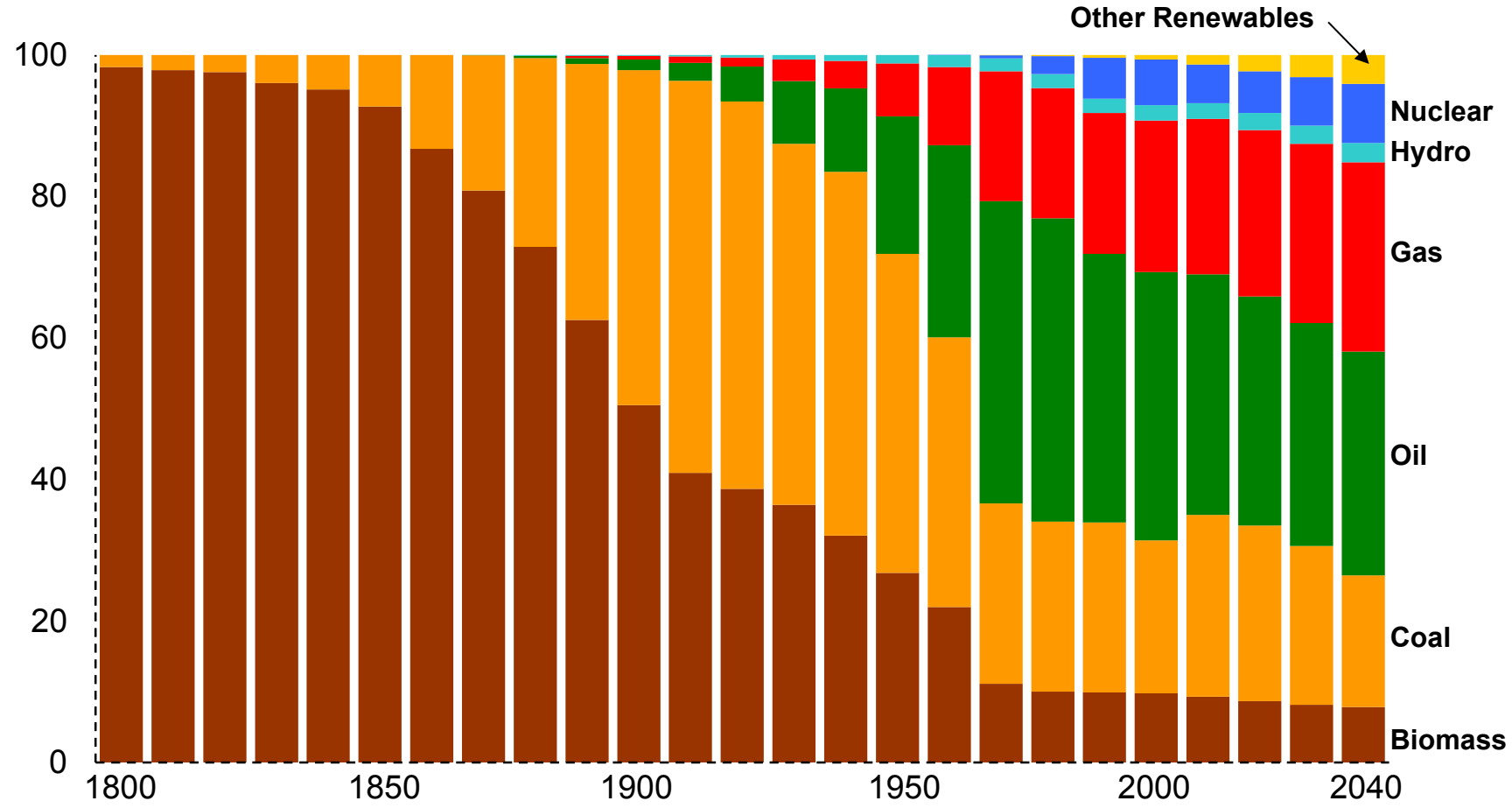
Quadrillion BTUs



Source: Smil, Energy Transitions (1800-1960)

Energy Use Evolves Over Time

Global Percent Mix of Fuels



Source: Smil, Energy Transitions (1800-1960)

The Outlook for Energy: A View to 2040

ExxonMobil 2013 Outlook for Energy *www.exxonmobil.com*

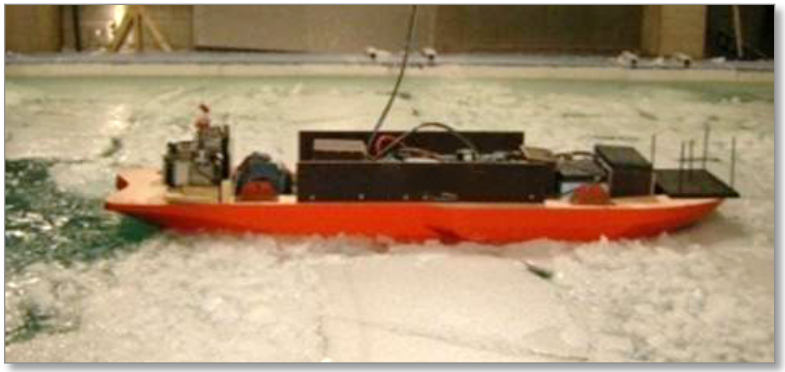
High Cost of-Supply for Arctic Hydrocarbons

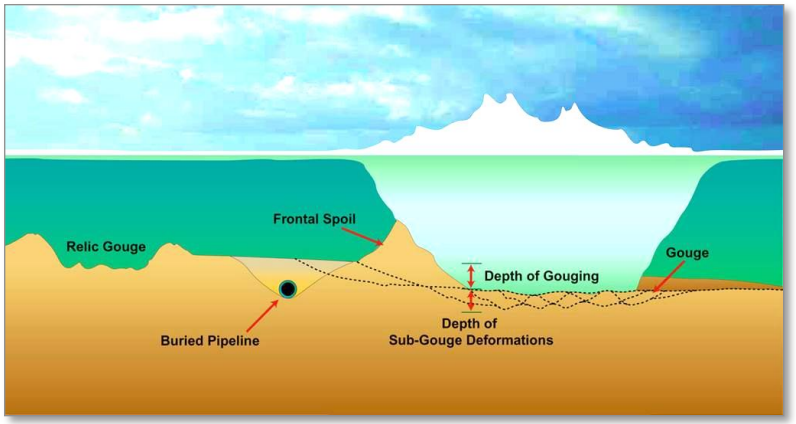
- Lack of infrastructure
- Long distance from fabrication yards
- Supply chain complexity
- Short summer installation windows
- Inhospitable to labor force
- Need for specialized vessels
- Protection of structures and wells from ice

Photos: ExxonMobil

Arctic Technology Development

- Extended season drilling capability
- Specialized well control and oil spill response capabilities
- Subsea facilities to minimize surface-piercing structures
- Deep trenching capabilities to protect export pipelines from ice
- Large icebreaking tankers and loading terminals in ice
- Arctic Research Center with Rosneft





Art & Photos: ExxonMobil

New Arctic Research Center

Rosneft - ExxonMobil

Focus:
- **Personnel Safety**
- **Environmental Protection**
- **Engaging Indigenous People**
- **Sea Ice Management**
- **Ice, Metocean and Geotechnical Surveys**
- **Development of Design Criteria**
- **Evaluation and Design of Development Concepts**

"The Arctic Research Center will be the platform for development of the most up-to-date and efficient technologies aimed at project implementation in complex and challenging climate and technology conditions. Environmental safety is our priority, and we believe the technologies developed in the ARC will enable us to implement our joint projects in the most efficient way to the benefit of all participants of Arctic exploration" **Igor Sechin, Rosneft President**

Initial Funding: ExxonMobil $450M; Rosneft $200M
Startup: June 11, 2013
Location: Moscow

Protecting the Environment

Operations & Sound

Shipping

Seismic

Construction

Drilling

Operations: Risk Management, Planning, Operations Practices

SOUND

Intensity (decibel)

Pitch / Frequency (Hertz)

Duration (Continuous v. Impulsive)

Propagation

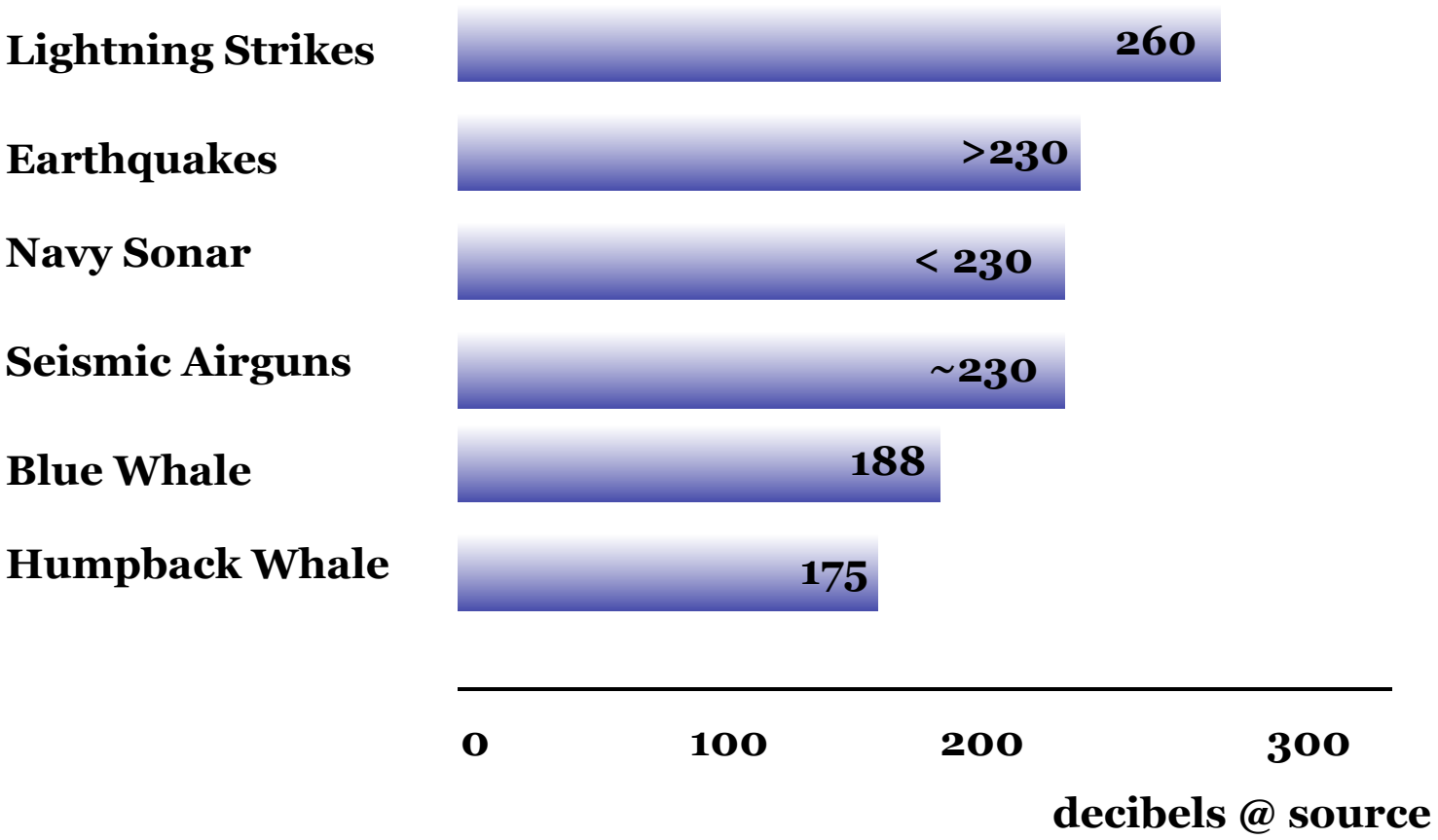
- **Divergence**
- **Attenuation**
- **Seafloor Interactions**

Marine Mammals & Fish
Use of Sound

Feeding
Breeding
Orientation
Communication

Photograph courtesy Dr. Louis M. Herman/NOAA

Sounds in the Ocean

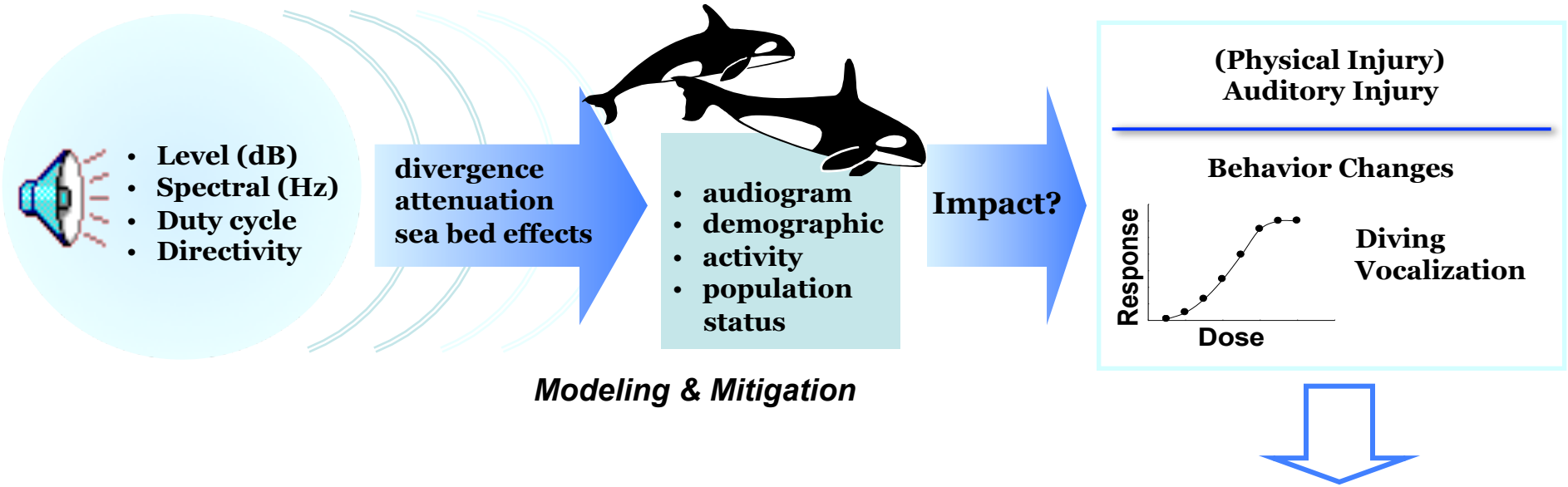


Sound source characterization and propagation

- GoM 2007
  - Industry seismic source array output in 3 dimensions up to 25kHz
  - Improves array's acoustic output modeling, risk and impact assessments
- Norway 2008-2011 *(Hjørundfjord; Møre og Romsdal)*
  - Calibrated range enables high fidelity, spectral measurements up to 50kHz
  - Data used to update standard modeling codes to higher frequencies

Marine Sound

Source .....Propagation.....Receiver.....Biological Significance



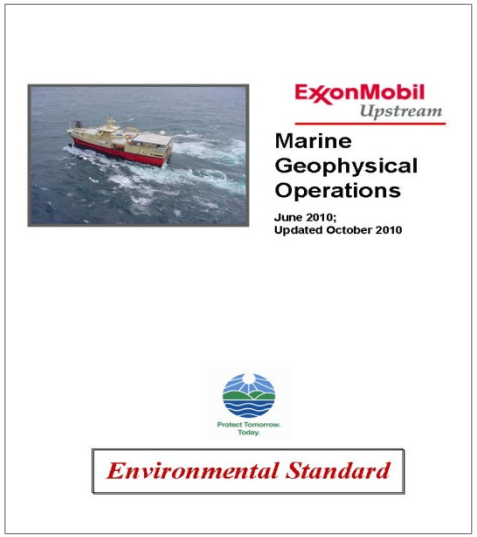
Modeling & Mitigation

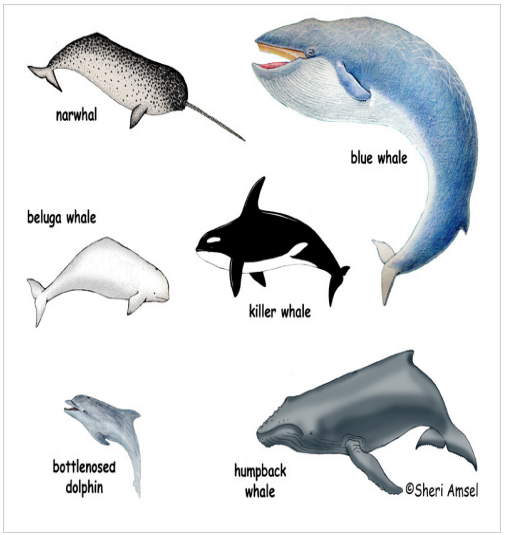
Is there a Biological Significance?

Courtesy Prof. Dan Costa, University of California at Santa Cruz

Science-Based Risk Assesments

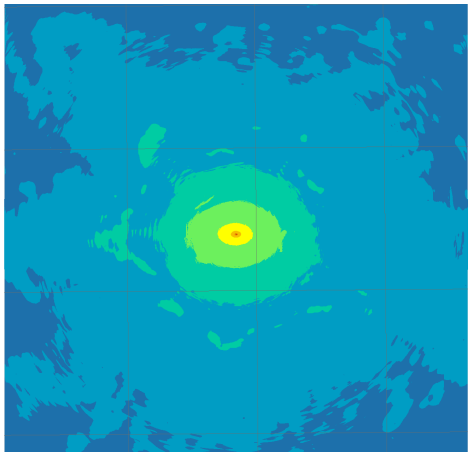
STANDARDS

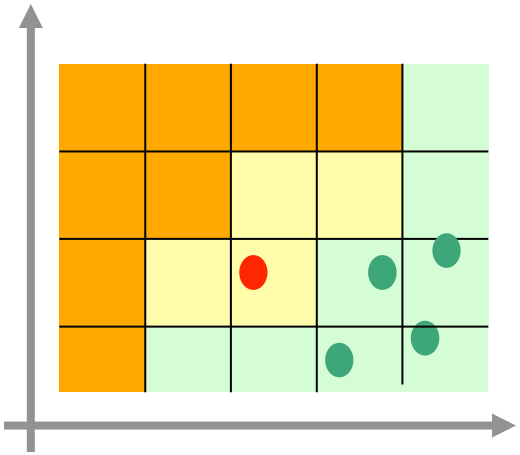




ENVIRONMENT
STUDY

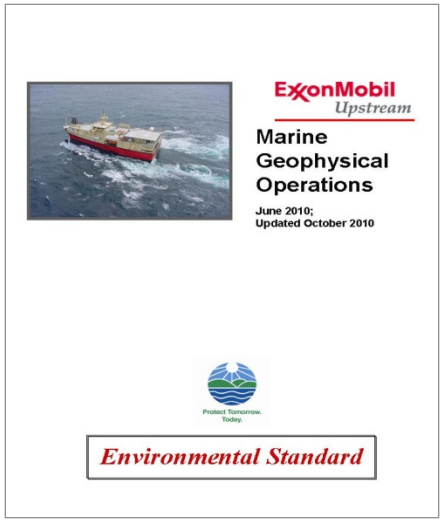
MODELING





RISK

Mitigation

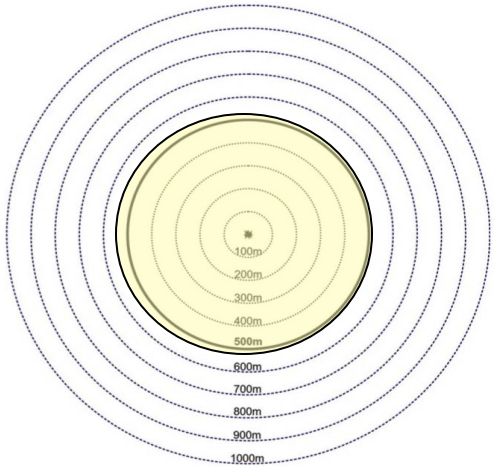


Pre-Survey Planning

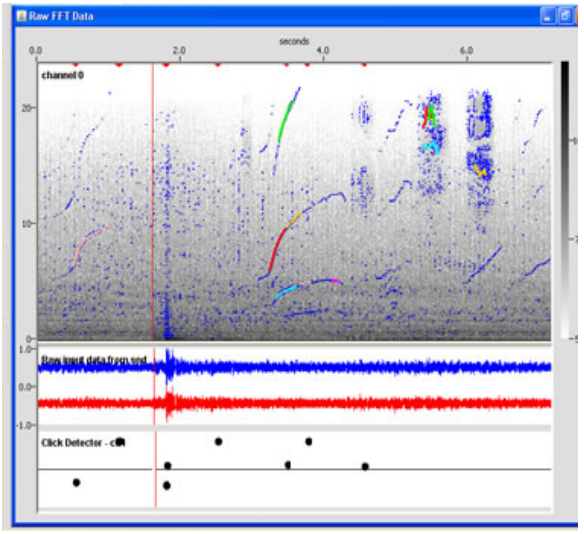
Restrictions: Time & Space

Soft-Start

Marine Fauna Observers



Exclusion Zones



PAMGUARD

Sound & Marine Life Joint Industry Program

Overview

- Research studies since 2006
- Funding: ~$6M / year
- Guidance from regulators and academic researchers
- Significant scientific progress
- Broad respect

Objectives

- Understand & define the environmental risks
- Decrease regulatory uncertainty
- Develop cost effective, credible mitigation measures
- Improve planning for offshore project development

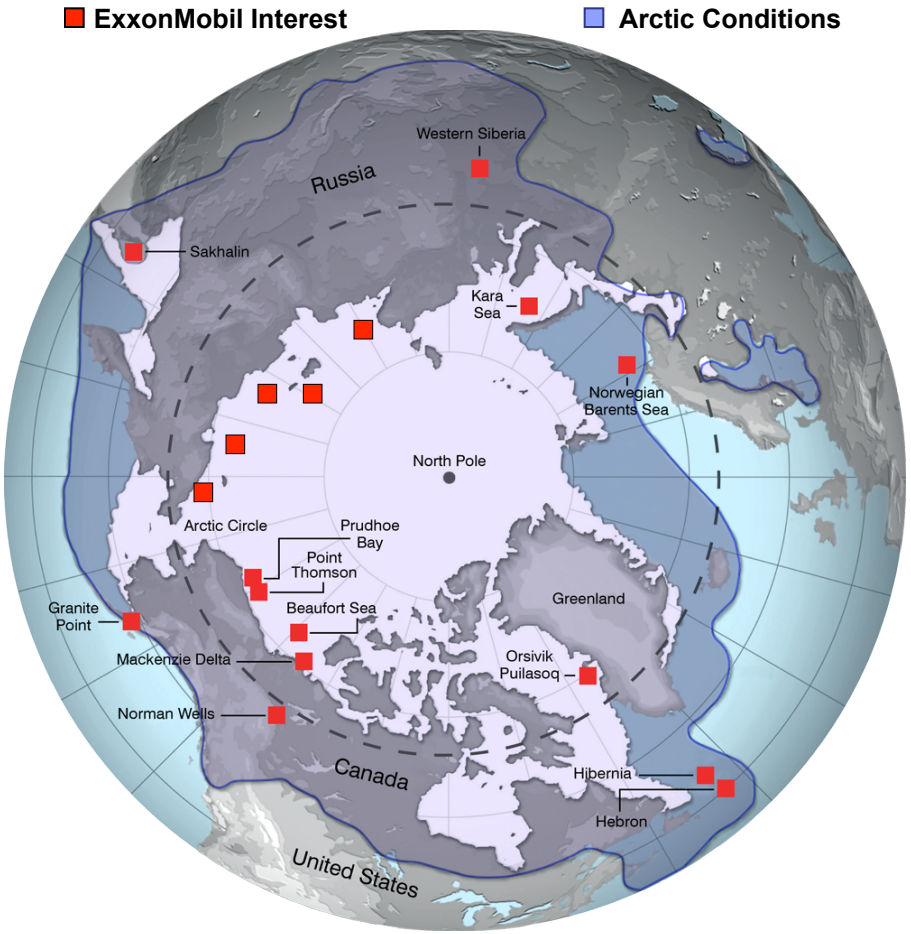
Joint Industry Program

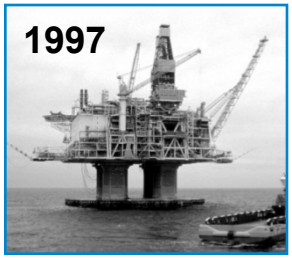
Research Focus Areas

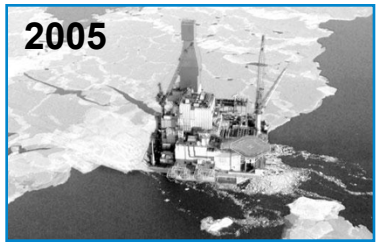
I. Sound source characterization and propagation
II. Physical and physiological effects
III. Behavioral effects and their biological significance
IV. Mitigation and monitoring technologies
V. Research tools and methods

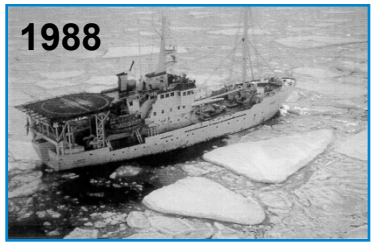
www.soundandmarinelife.org

~90 Years of Arctic Experience

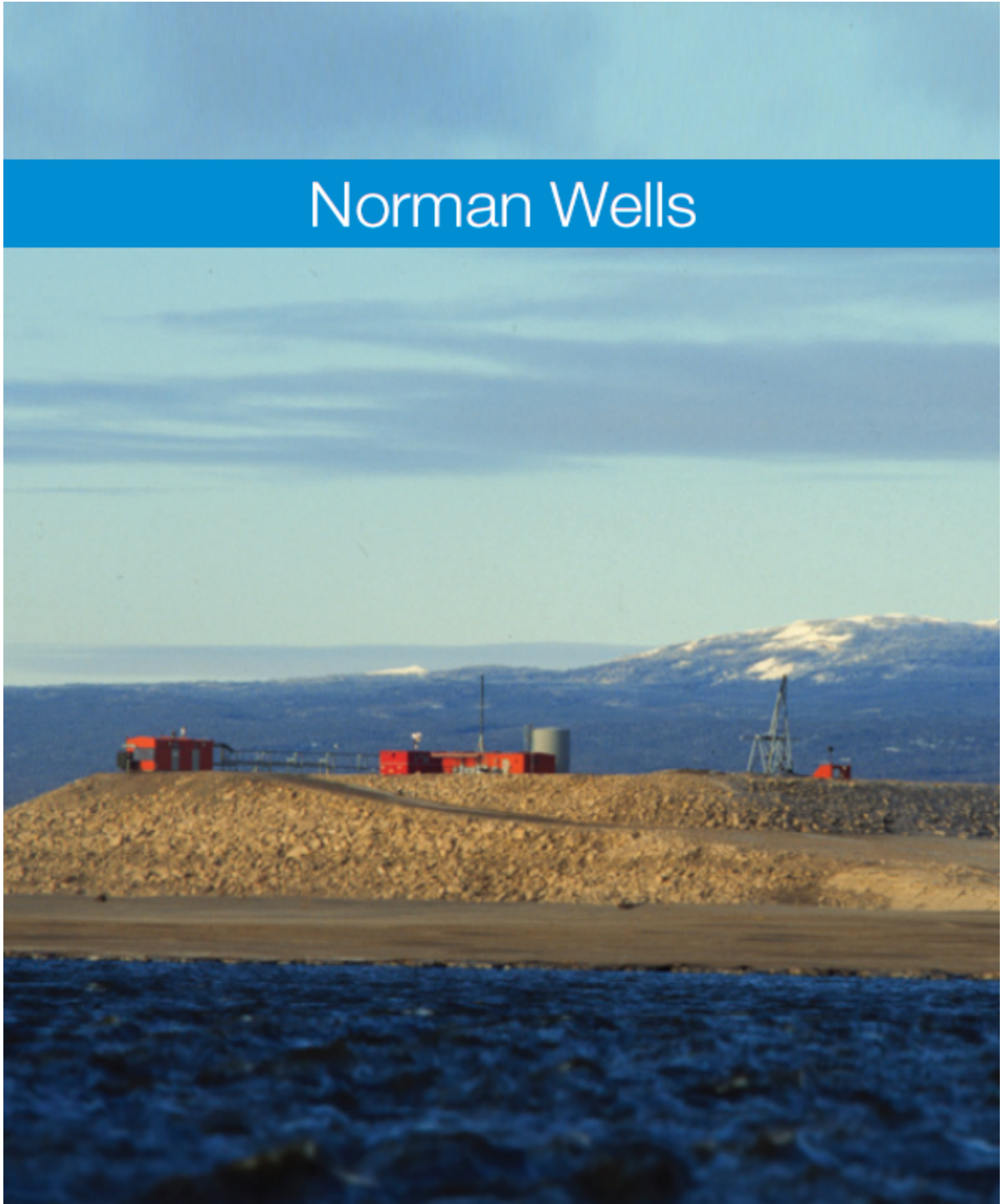








Norman Wells



1920
Discovery

1932
1st Commercial Oil Field and Refinery in Arctic Conditions

1985
1st Gravel Production Island

Alaska

1989
The Exxon Valdez supertanker ran aground in Prince William Sound. It was a tragic and deeply regrettable accident. In the aftermath EM refocused its commitment to safeguarding the environment, its employees and operating communities worldwide. We developed an even more rigorous management system and built it into the culture of our company. Today, the implementation of OIMS enables us to effectively manage the risks associated with our operations.

1965
Granite Point
Field Discovery

1966
1st EM Ice-Resistant
Platform (Granite Pt)

1968
Prudoe Bay field
Discovery

1969
1st Oil Tanker transit
through NW Passage

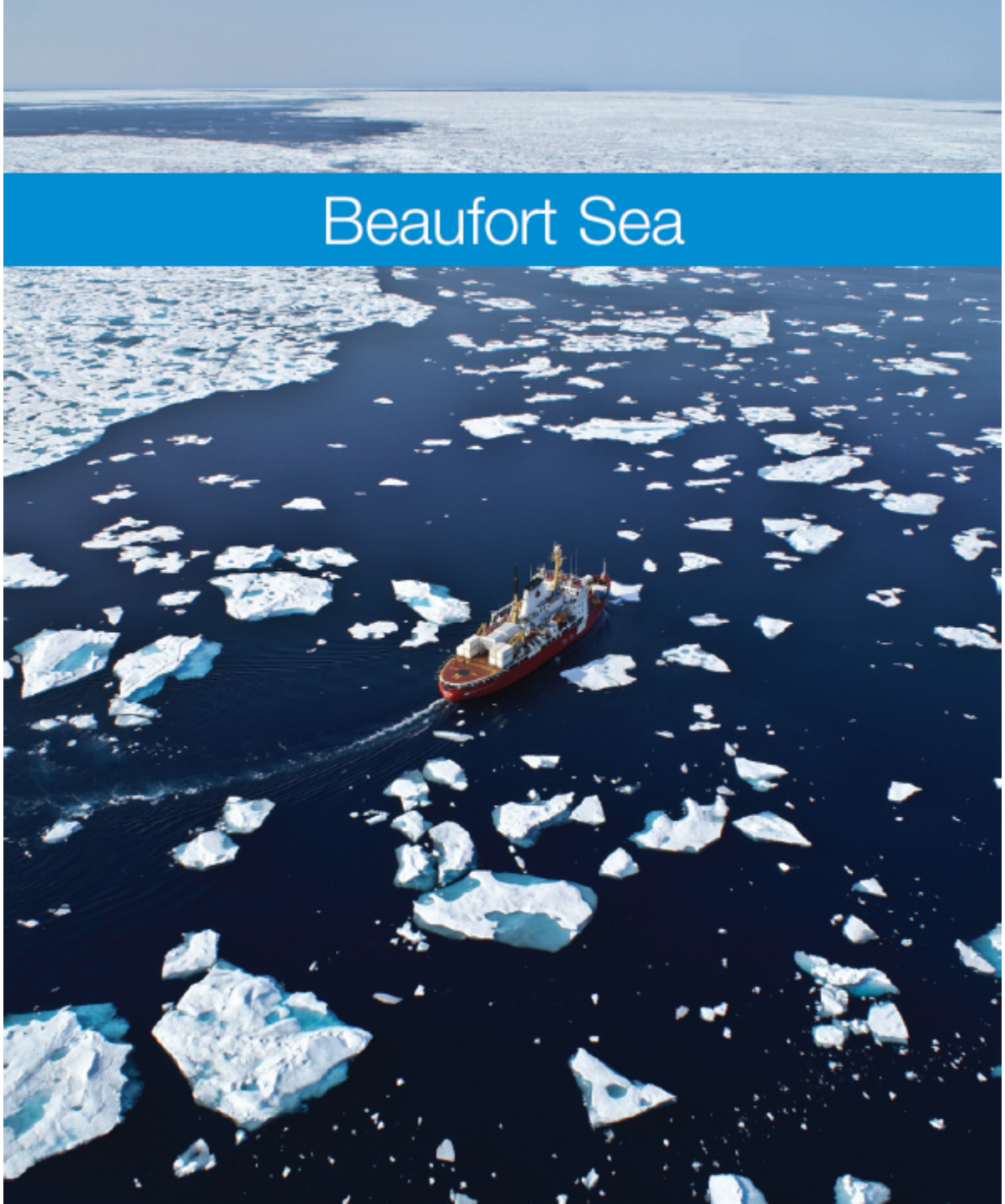
1972
OTC Award for EM part
In SS Manhattan Voyage

1975
Construction of the
Trans-Alaska Pipeline
System started

1977
Prudhoe Bay Production
Startup

1990
Outstanding Achievement
Award for application of
NASA technology for heat
Pipeline development

Beaufort Sea



Indigenous People Engagement:
From 2008 to 2011, Inuvialuit community members participated in our marine mammal observation program in the Beaufort Sea.

Inuvialuit companies were awarded a contract for the 3D geophysical seismic acquisition program in 2008 and Inuvialuit businesses were hired to help design the field data collection program in 2009.

1973
1st Artificial Exploration Island

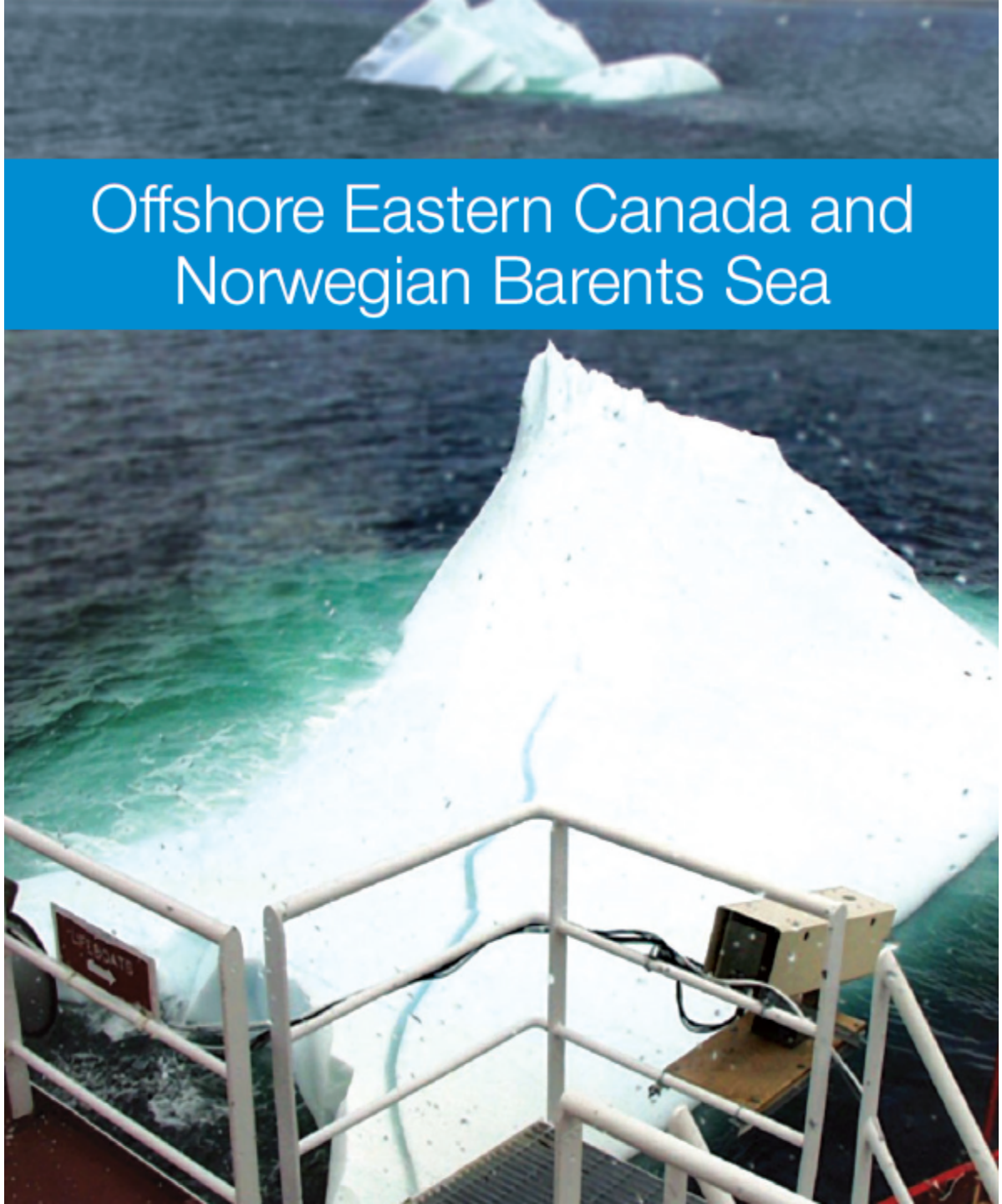
1973
World's largest outdoor Ice-test basin

1985-1986
Breakthroughs in ice-load designs for steel structures

1987
Start-up of first offshore Beaufort Sea production system

1989
World's largest Ice-spray exploration Island (Nipterk P-32)

Offshore Eastern Canada and Norwegian Barents Sea



1981-1985
ExxonMobil studied more than 700 icebergs in the Grand Banks, located offshore Newfoundland and Labrador, using both aerial photography and underwater profiling to determine iceberg drift velocity, size and mass distributions. These data formed the core of an iceberg database developed by Canadian scientists from the Memorial University of Newfoundland, the Canadian Hydraulics Center and the Centre for Cold Ocean Resources Engineering in the late 1990's.

1984-1985
Svalbard and Bear Island study data donated to Bergen University and Norsk Polar Institutt

1981-1985
Pioneering Iceberg hazard Research: 700+ Icebergs studied off Newfoundland and Labrador

1984
EM-led Pond Inlet JIP (Baffin Island) iceberg strength test program

1988
Northernmost offshore well with mobile drilling unit (Barents Sea)

1988
Established the Ice Data Acquisition Program (IDAP) w/ The Norwegian Polar Institute and The Russian Arctic and Antarctic Research Institute

1988-1994
Ice-data Acquisition Program in Barents Sea

1995
Grappling Island iceberg Impact tests

2001
Iceberg impact field program

Grand Banks

Hibernia, the first and only iceberg-resistant gravity-based structure in the world. Installed in 1997, it stands 224 meters tall and is designed to withstand the impact of a one million ton iceberg – equivalent to the weight of approximately three Empire State Buildings – with no significant damage. It is also designed to withstand contact with a six million ton iceberg, without harm to workers, the environment or operations.

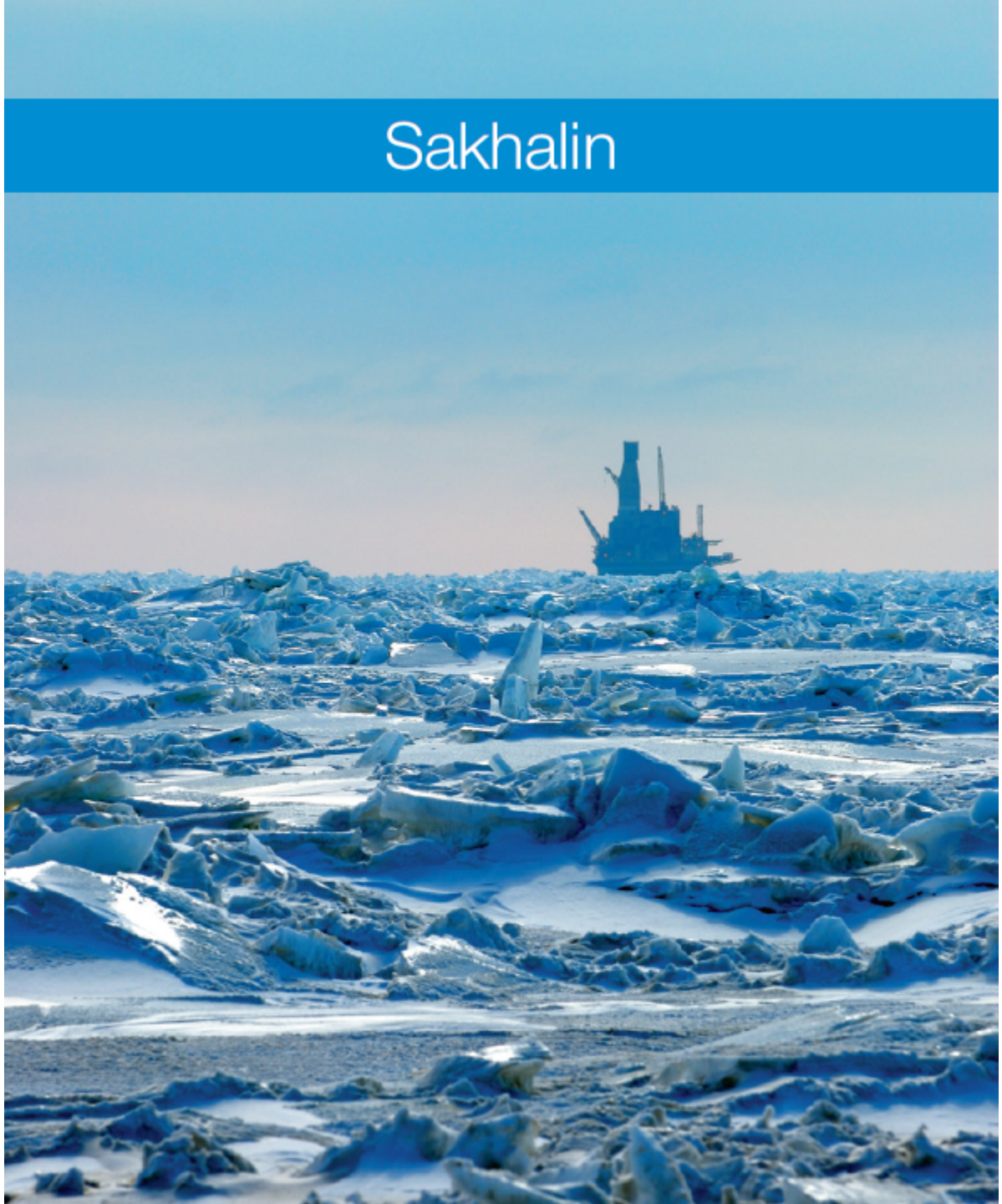
1997
Hibernia start-up: 1st Iceberg resistant Gravity Based Structure (GBS)

2002
Terra Nova Production Start-up; Installation of Disconnectable FPSO

2010
Hibernia OPA2 drill well: Canada's longest extended Reach Well at 6.3 miles

2011
Hibernia Southern Extension 1st Oil: First subsea tie-back Project to a GBS

Sakhalin



Indigenous People Engagement:
Sakhalin-1: > 13,000 jobs created. Russian nationals comprise 90% of Exxon Neftegas Limited workforce. As of 2012, two out of three dollars invested in the project have been spent doing business with Russian companies or joint ventures with Russian participation, and our operations have had a significantly positive lasting effect on the local economy.

1997
Ice-Data Collection shared with Russian Universities and the Russian Arctic and Antarctic Research Institute

1997
Unique sea ice data collection off Sakhalin

1997-Present
Research and mitigation Protection of the Western Grey Whales and their Habitat. Population increasing at 4% per year

2002
World's largest land-based Drilling Rig installed

2002
Primorye tanker Ice trials

2005
Sakhalin-1 production start; Orlan offshore platform installed

2010
Odoptu field production Start

2012
World's longest ERD well Z-44 completed (7.6 miles)

HAVFORSKNINGSINSTITUTTET
INSTITUTE OF MARINE RESEARCH

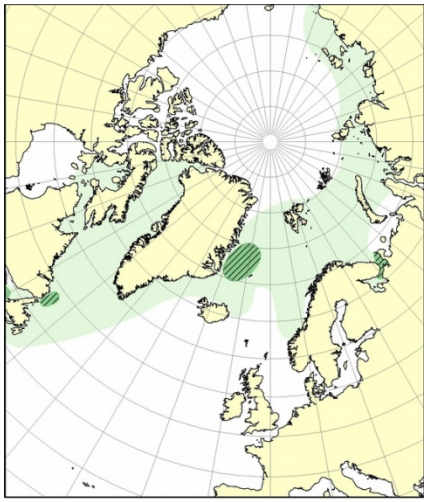
The Joint Venture Project on Seal Distribution and Migration Patterns in the Greater Barents Sea Area

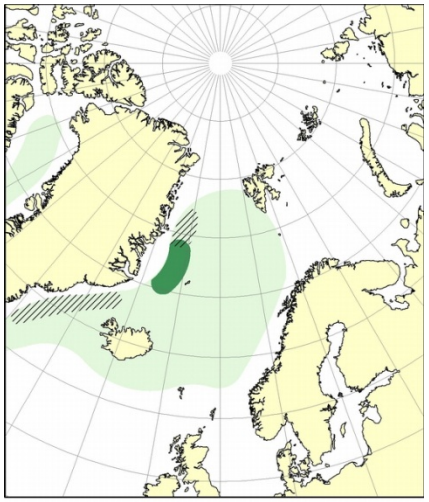

Harp Seal

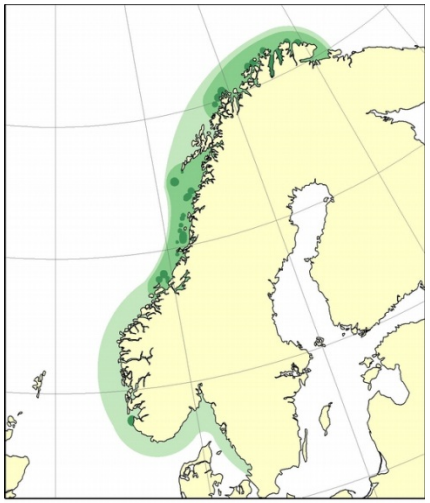

Hooded Seal

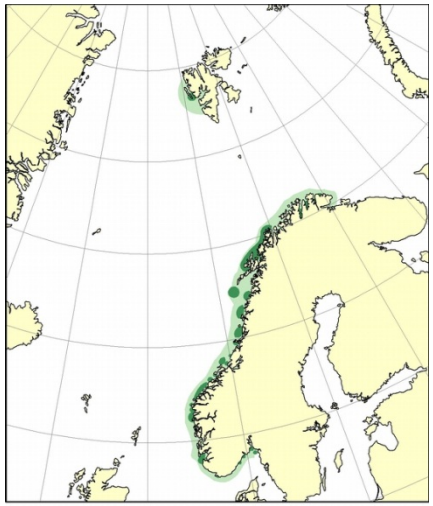

Grey Seal


Harbor Seal


Grønlandssel
Hårfellingsområde
Kasteområde
Utbredelsesområde


Klappmyss
Kasteområde
Hårfellingsområde
Utbredelse


Havert
Høy konsentrasjon
Omr. med mye vandring
Utbredelsesområde

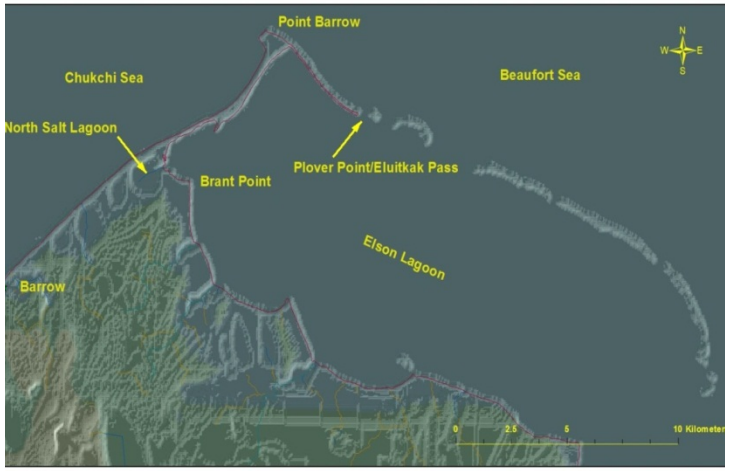

Steinkobbe
Høye konsentrasjoner
Utbredelsesområde (innefor 12NM)

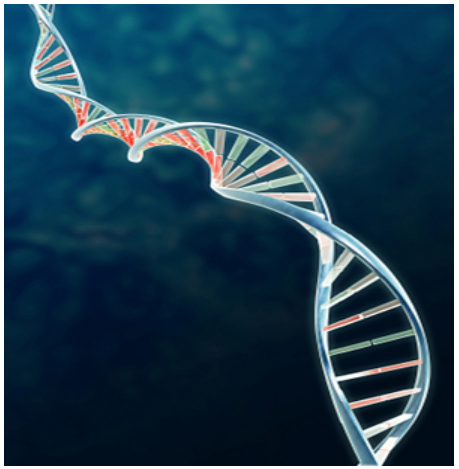
Fisheries and Oceans Canada

ExxonMobil

Elson Lagoon: Fish e-DNA Study

ExxonMobil, Battelle and the North Slope Borough





- Proof of Concept: Qualitative Species Assessment from e-DNA
- eDNA extracts from water samples analyzed using DNA sequencing
- Targeting fish DNA
- Results compared with catch data from subsistence fishermen gillnet records.
- Next: Marine Mammals

The Russian Arctic

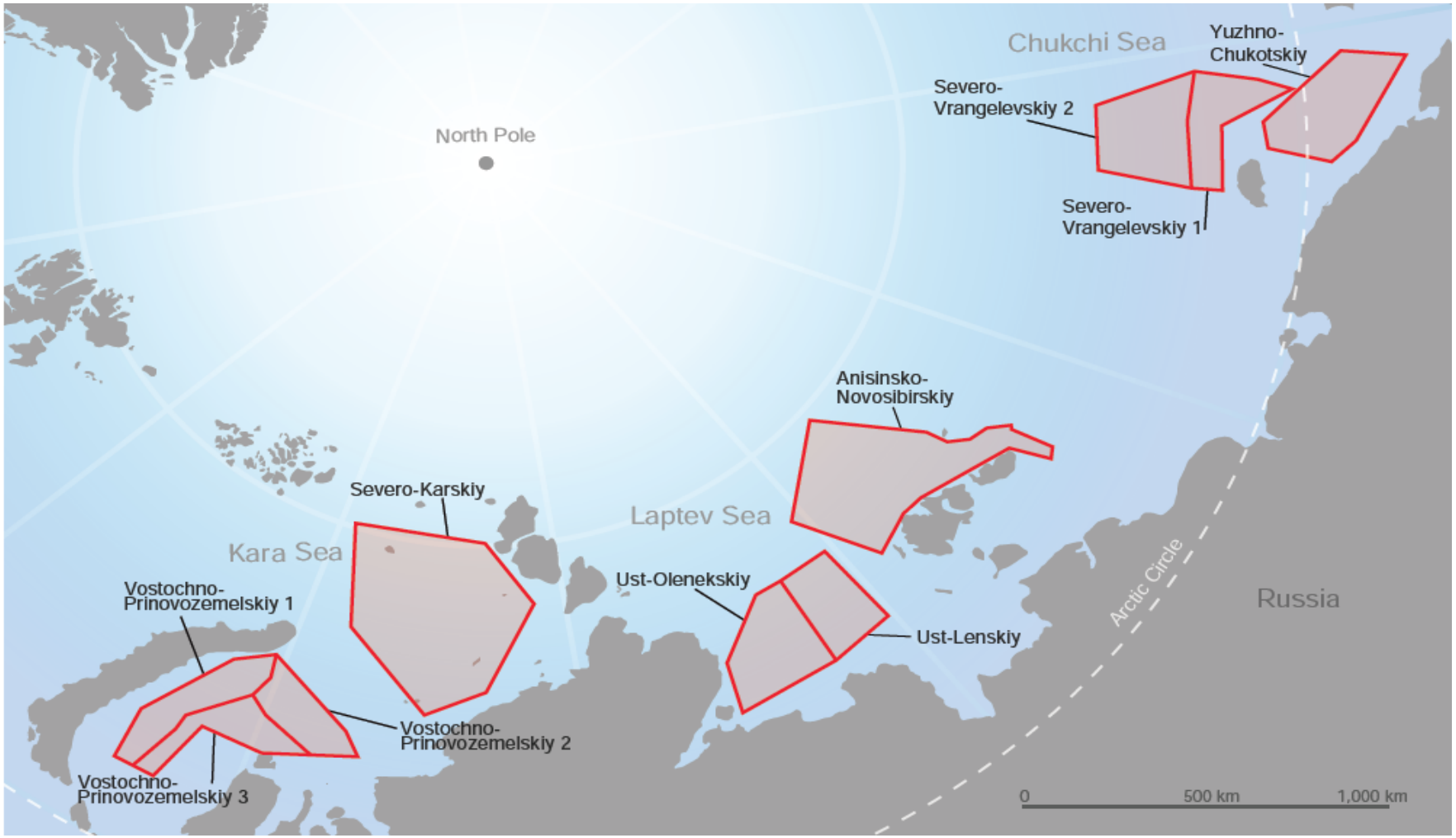
- Western Gray Whales monitoring since 1997.
- Aimed at safeguarding and collecting data on the population's current condition, biology and habitat.
- Field work components:
  - Acoustic calibration and real time acoustic monitoring
  - Photo Identification
  - Ship and land based WGW distribution surveys
  - Land based behavioral observations
  - Benthic observations; Food resources surveys

Marine Biology Institute (Vladivostok);
Pacific Oceanological Institute (Vladivostok);
All-Russian Fisheries and Oceanography Research Institute (Moscow);
Sakhalin State University (Yuzhno-Sakhalinsk)
Oregon State University (Tagging)
Texas Tech University (Biopsy analyses)

Tracks and information on the tagged whales can be found at: http://mmi.oregonstate.edu/Sakhalin2010 and http://mmi.oregonstate.edu/Sakhalin2011

Photos Courtesy Prof Bruce Mate, Oregon State University

The Russian Arctic



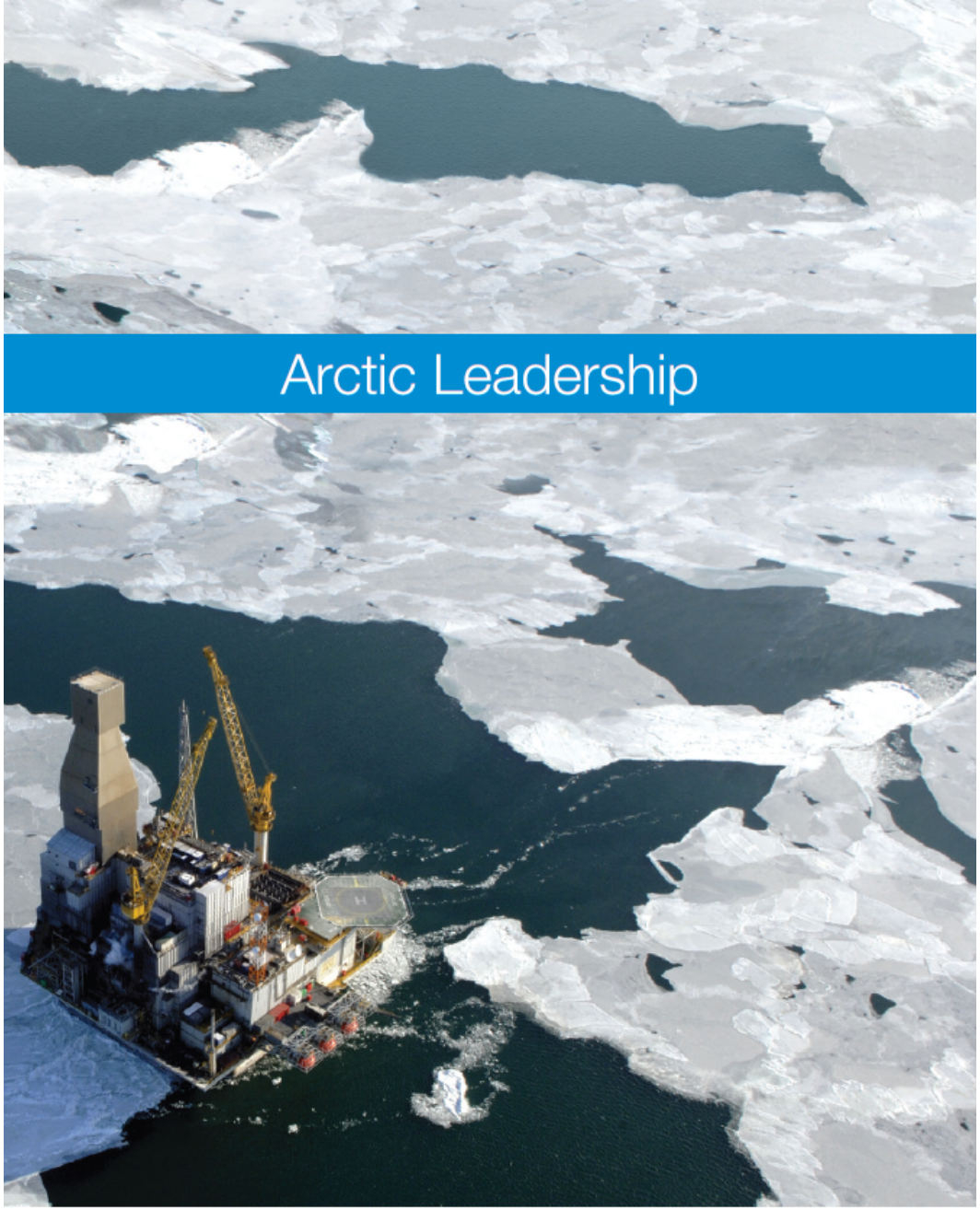
- Exploration acreage: 726,000 square kilometers (280,000 square miles)
- ExxonMobil to invest $3.2 billion in opening oil and gas production in the Kara Sea
- Rosneft has calculated reserves in the Kara Sea's East-Prinovozemelsky field at 35.8 billion barrels of oil and 10.3 trillion cubic meters of natural gas.


spitsbergen-svalbard.com


Source: Wikimedia commons


photo taken by Ansgar Walk, Wikimedia Commons


Photo By Paul W.J. de Groot at nl.wikipedia



www.exxonmobil.com

ExxonMobil
Taking on the world's toughest energy challenges.™

International, Cross-Sector Business Leadership Alliance

Cross sector voice for ocean industries (e.g. shipping, oil/gas, fisheries, aquaculture, tourism, offshore renewables)

Forum for leadership and collaboration

Risk reduction, Mitigation

<u>Goals:</u> A healthy and productive global ocean and its responsible use

<u>Members:</u>
Direct Ocean Users

Ocean User Support Industries
(e.g. shipbuilders)
Essential Ocean Use "Infrastructure"
(e.g. Insurance, Finance, Legal)

<u>Arctic</u>
Dialog with Arctic Council Sustainable Development Working Group (SDWG) to tackle priority Arctic issues that can benefit from private sector collaboration and engagement

WORLD OCEAN COUNCIL

The International Business Alliance for Corporate Ocean Responsibility

www.oceancouncil.org

Dr. Gary H. Isaksen
Global Ocean Science & Policy

ExxonMobil