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**ON  
DEFENDING U.S. ECONOMIC INTERESTS IN THE CHANGING ARCTIC:  
IS THERE A STRATEGY?**

**BEFORE THE  
COMMITTEE ON COMMERCE, SCIENCE AND TRANSPORTATION  
SUBCOMMITTEE ON OCEANS, ATMOSPHERE, FISHERIES, AND COAST GUARD  
UNITED STATES SENATE**

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Chairman Begich, Ranking Member Snowe, and distinguished members of the Subcommittee, thank you for the opportunity to submit testimony on U.S. strategies to address the changing Arctic and to highlight some of the actions NOAA is taking to address Arctic issues. My name is Jane Lubchenco, Under Secretary of Commerce for Oceans and Atmosphere and the Administrator of the National Oceanic and Atmospheric Administration (NOAA). On behalf of NOAA, I would like to thank the committee for its continued attention to the issues associated with a changing Arctic and the myriad impacts to its people and the ecosystems on which they depend. I would also like to recognize Chairman Begich and the other Members of this committee for their leadership and support on Arctic issues, including the Arctic-related legislation that you are working to advance in this Congress.

I will now describe some of the actions NOAA is taking to address Arctic issues. This hearing puts a well-deserved spotlight on emerging Arctic opportunities and challenges, and the Federal Government's role in helping the United States to take advantage of those opportunities. The Administration is currently working to implement the January 2009 Directive (*National Security Presidential Directive 66/Homeland Security Presidential Directive 25*) on Arctic Policy, the July 2010 Presidential Memorandum on arctic research policy, which reinvigorates interagency research coordination in the Arctic, and the July 2010 National Ocean Policy's recognition of the Arctic as an area of special emphasis. Adopted by the President via Executive Order 13547 on July 19, 2010, the National Ocean Policy calls for "better ways to conserve, protect, and sustainably manage Arctic coastal and ocean resources... new collaborations and partnerships to better monitor and assess environmental conditions... [and] improvement of the scientific understanding of the Arctic system and how it is changing in response to climate-induced and other changes." On July 12, 2011, the President issued Executive Order 13580 to establish an Interagency Working Group on Coordination of Domestic Energy Development and Permitting in Alaska. The purpose of this working group is to coordinate the efforts of Federal agencies responsible for overseeing the safe and responsible development of onshore and offshore energy

resources and associated infrastructure in Alaska and the U.S. Arctic Outer Continental Shelf (OCS).

As you know, there is now widespread evidence of climate change in the Arctic region, most dramatically observed in loss of sea ice. In four of the last five years, we have witnessed the lowest sea ice extents on record, as well as a 35 percent decrease in thicker multi-year sea ice. Shifts are evident in ocean ecosystems from the Aleutian Islands to Barrow, and across the Arctic Ocean, due to a combination of Arctic warming, natural variability, and sensitivity to changing sea ice conditions.

As sea ice retreats and the Arctic becomes more accessible, cascading needs for information, readiness, response, and assistance are created. NOAA is receiving increasing requests for timely weather forecasts and disaster warnings, improved seasonal and long-range forecasts of sea ice and other conditions, more comprehensive and current navigation charts, tide tables, and elevation data, improved oceanographic information, and more baseline data on protected species and ecosystems. The maritime community is anticipating a future open Arctic trade route and is concerned about accurate navigation charts, weather and disaster forecasts and emergency response capacity. The fossil fuel industry is seeking permitting approvals for oil and gas exploration in the Chukchi and Beaufort Seas for 2012, with increasing information needs concerning potential impacts, behavior of oil in frigid waters, and appropriate response capacity.

Economic drivers can also threaten marine and coastal ecosystems as well as Arctic inhabitants already affected by the rapidly changing climate. Native coastal communities are requesting assistance in relocating entire villages or burial grounds, information about likely changes in whales, seals and fish, and more accurate weather and oceanographic conditions. They are faced with changing precipitation patterns, later freezing and earlier thawing of snow and ice, damaging storm surge with loss of the sea ice barrier protecting homes and businesses on the coast, and changing sea level. Furthermore, changes in the Arctic may affect climate and the functioning of ecosystems around the globe, so changes in the region affect us all. Climate changes already apparent in the Arctic may portend future changes in global climatic conditions.

As the United States begins to confront these Arctic challenges, it is evident that understanding and effectively managing the changing ecosystems, expectations, and opportunities in the Arctic requires a solid foundation of ecological and socioeconomic information. Yet despite the wealth of traditional ecological knowledge, exploration, and research to date, even the most basic data are lacking. Interagency and stakeholder dialogues, such as the ongoing interactions in conjunction with developing the National Ocean Policy's Arctic Strategic Action Plan, continually underscore this point: Federal agencies need accurate information about human and environmental conditions in the region in order to comprehensively manage the various U.S. Arctic interests and support effective stewardship and investment decisions.

NOAA recognizes that a strategic approach leveraging our strengths and those of our sister agencies with Arctic-relevant missions is essential if the United States is to take advantage of emerging economic opportunities there without causing irreparable harm to this fragile region. As the uses of the Arctic environment evolve, NOAA believes it is important that decisions and actions related to conservation, management, and use are based on sound science and support

healthy, productive, and resilient communities and ecosystems. We seek to better understand and predict changes there. We recognize that because the region has been relatively inaccessible, and without widespread need for such information, the Arctic is deficient in many of the science, service and stewardship capabilities that NOAA provides to the rest of the Nation.

To facilitate internal and external coordination on Arctic requirements, NOAA has developed a comprehensive Arctic strategy that integrates and aligns our numerous and diverse capabilities within the broader context of our Nation's Arctic policies and research goals, and supports the efforts of our international, Federal, state and local partners and stakeholders. NOAA's Arctic Vision and Strategy (available at [http://www.arctic.noaa.gov/docs/arctic\\_strat\\_2010.pdf](http://www.arctic.noaa.gov/docs/arctic_strat_2010.pdf)) has six priority goals, derived directly from stakeholder requirements:

- 1) Forecast Changes in Sea Ice
- 2) Strengthen Foundational Science to Understand and Detect Arctic Climate and Ecosystem Changes
- 3) Improve Weather and Water Forecasts and Warnings
- 4) Enhance International and National Partnerships
- 5) Improve Stewardship and Management of Arctic Ocean and Coastal Resources
- 6) Advance Resilient and Healthy Arctic Communities and Economies

These goals were selected because they represent areas where NOAA has the expertise to address emergent Arctic issues that meet two key criteria: providing the information, knowledge, and policies to meet NOAA mandates and stewardship responsibilities; and providing the information, knowledge, and services to enable others to live and operate safely in the Arctic. We also believe that these are the highest priority areas where NOAA can have an impact on environmental and economic sustainability in the Arctic.

Within NOAA's existing capacity for Arctic action, we have had some modest successes in implementing our strategic goals. On sea ice, for example, NOAA and its partners, including the U.S. Army Corps of Engineers Cold Regions Research and Engineering Laboratory, issued the 2010 and 2011 Arctic Report Cards, showing summer sea ice extent well below 1990s levels with sea ice thinning, older sea ice disappearing, and ocean temperatures warming. The loss of sea ice affects marine access, regional weather, ecosystem changes, and coastal communities. As ice cover diminishes, marine food webs are expected to dramatically shift from seafloor-dominant systems that favor species such as crabs to water column-dominant systems that favor commercial fish species such as pollock. The understanding of ice as a habitat also has implications for oil spill response and damage assessment. As the Arctic Ocean becomes seasonally passable and tourism, oil and gas exploration, and shipping increase, floating sea ice and changing marine weather will present a major threat to maritime safety and increase the potential for oil spills from vessel traffic in the region. Sea ice also has significant implications for effective oil spill response and assessment.

NOAA currently conducts operational sea ice analysis and forecasts, evaluating sea ice projections through Intergovernmental Panel on Climate Change climate models, conducting and analyzing along with NASA, satellite and airborne observations of sea ice freeboard or thickness, improving satellite image analyses, and contributing to the international Arctic buoy program.

NOAA's National Weather Service has a sea ice desk at the Anchorage Weather Forecast Office, which provides operational sea ice forecasting in Alaska. NOAA's National Environmental, Satellite, Data, and Information Service partners with the Navy and Coast Guard to maintain the National Ice Center in Suitland, Maryland, which provides operational analyses and forecasts of sea ice conditions and hazards in the Arctic and collaborates with the National Weather Service sea ice desk to provide Alaska products five days a week. NOAA also supports the National Snow and Ice Data Center, along with NASA and NSF, within the Cooperative Institute for Research in Environmental Sciences at the University of Colorado, where a vast array of Arctic data are stewarded and made available to both academic and public users.

NOAA's National Weather Service delivers marine weather forecast services to protect life and property, enhance the economy and fulfill U.S. obligations under international treaties for the safety and security of marine transportation, energy (oil and gas) exploration, and tourism activities, and to protect northern and western Alaska coastal communities from storm surge and other inundation hazards. Major stakeholders and partners, including the U.S. Coast Guard and the State of Alaska Division of Homeland Security and Emergency Management, require more useful weather and water information for planning and decision making to protect lives, property, and manage the region's many resources. Arctic populations rely heavily on aviation and marine weather for safe transportation and access to goods and services.

The Arctic region has very little of the information infrastructure needed to provide weather forecast and warning services of a caliber comparable to mid-latitudes. A primary reason for this discrepancy is the relative coarseness of observation fields to support meteorological and oceanographic modeling and environmental observations and studies supporting weather and ice forecasts highly limited in both geographic scope and frequency. The Arctic region also presents unique numerical modeling challenges with respect to the dynamic coupled interaction of the ocean, sea ice and atmospheric processes both in near-term and long term prediction scales. For example, there is inadequate real-time meteorological data in U.S. Arctic waters to support accurate forecasting of ocean storms, which have the potential to threaten marine transportation, offshore oil and gas operations, and the Arctic coastal communities. The November 2009 failure of NASA's QuikSCAT satellite scatterometer to continue providing ocean surface wind speed and direction and sea ice thickness estimates after more than a decade of operation, the need for continued access to synthetic aperture radar (SAR) data, and the potential for a gap in satellite coverage in 2016-2017 due to the impacts of reduced funding in Fiscal Year (FY) 2011 for our next polar-orbiting satellite, the Joint Polar Satellite System (JPSS), pose challenges to Arctic weather and sea ice services capability. JPSS will contain the replacement for the NASA MODIS instrument, which is a critical tool for mapping sea ice and studying other Arctic features, currently in operation on NASA's Terra and Aqua satellites, which have already exceeded their expected lifetime.

In data-sparse areas like Alaska, polar-satellite data is critical to weather forecasting. Light aircraft aviation is a \$400 million a year industry in Alaska and since many Alaskan communities are not accessible by roads, residents often rely on aircraft as a primary mode of transportation. Furthermore, since geostationary satellite coverage is not available in large areas of the Arctic, NOAA's Search and Rescue beacon program (SARSAT) relies heavily on polar-orbiting satellites to receive signals from distressed mariners and aircraft personnel. NOAA did

not receive the full \$1.060 billion requested in the President's FY 2011 budget, which was needed to meet the planned launch date for JPSS to maintain continuity of observations. As a result, NOAA could face a data gap in the U.S. civilian polar orbit, on which both civilian and military users rely, beginning in 2016. This information is critical in real-time forecasting and warning of events such as rapid sea ice formation, river ice jams, and storms carrying hurricane force winds that are major hazards for life, property, and economic activities in the Arctic. Losing this critical piece of national infrastructure at the time when Arctic development is expected to ramp up could significantly hamper our nation's ability to protect U.S. assets in this region.

Improved sea ice and marine weather forecasting would assist the energy, maritime shipping and transportation industries, which use operational and seasonal forecasts for safety and resource exploration. Improvements in the sea ice and weather services that NOAA is currently able to provide, particularly model resolution and forecast frequency, and the integration of different types of observations (including sea ice characteristics and indigenous knowledge) into the forecasts would enhance our understanding of the Arctic environment. Accurate forecasts and models depend on the ability of NOAA and its partners to deploy a variety of sensing devices — from buoys to airborne and satellite sensors. NOAA's goal is to provide accurate, quantitative, daily-to-decadal sea ice projections to support infrastructure planning, economic development and ecosystem stewardship.

These changes in climate and sea ice are also driving changes in marine ecosystems (including species abundance and composition) in ways not yet fully understood. Biophysical and chemical changes in the ocean, combined with increasing human uses will impact the Bering, Chukchi, and Beaufort Seas. Currently, commercial harvest of groundfish, shellfish, salmon and other resources, primarily in the Bering Sea, constitute almost 50 percent of marine fish landings in the United States. Further, these same resources, plus various species of marine mammals, seabirds, and other marine life are critical to the maintenance of the subsistence lifestyle of over 40,000 indigenous people who inhabit small towns and villages on Alaska's Arctic coastline. Broad-scale biological observations are needed to understand how a changing climate and environment will impact the food web and other aspects of the ocean ecosystem, and help NOAA evaluate the impacts of man-made changes to the equation, such as permitting new drilling activity. However, NOAA's current climate modeling capacity is too gross to meet user needs for regional and local scales, and the uncertainties are large. Similarly, it is beyond the scope of existing ecosystem models to provide reliable indications of how loss of sea ice and increasing ocean temperatures will impact key species such as pollock, cod, salmon, and crab, as well as ice seal species and Arctic cetaceans (e.g., bowhead, gray, humpback, and beluga whales). NOAA has also worked closely with its international partners for decades to monitor changes in atmospheric composition, for which the changing arctic is anticipated to have significant influence in the future.

To support these foundational science needs, NOAA is striving on many fronts to improve baseline observations and understanding of Arctic climate and ecosystems in order to reduce the uncertainty in assessing and predicting impacts caused by a changing Arctic. For example, NOAA is conducting ocean acidification experiments on pollock and king crab, process studies on Steller sea lions and fur seals, and cooperative studies with Department of Interior's Bureau

of Ocean Energy Management, Regulation and Enforcement (BOEMRE) on bowhead whales. NOAA also continues monitoring of atmospheric levels at coastal Arctic observatories in partnership with other agencies and nations. All of this work is heavily dependent on in situ and remote sensing observations of the ocean and atmosphere, shipboard sampling, and long-term, community-based research on marine species. Due to the interconnected nature of Arctic ecosystems, the United States will need to continue to improve collaboration and engagement with other Arctic nations through international mechanisms, such as the Arctic Council and our bilateral relationships, to better understand, observe, research, and manage Arctic resources. This includes joint efforts such as working with Russia for elements of a distributed biological observatory. The 2011 cruise for the Russian-American Long-term Census of the Arctic (RUSALCA) to sample and deploy instruments in U.S. and Russian territorial waters has just ended. Stemming from a 2003 Memorandum of Understanding for World Ocean and Polar Regions Studies between NOAA and the Russian Academy of Sciences, this annual three-week RUSALCA cruise collects biological, geological, chemical and physical oceanographic samples to benchmark Arctic conditions and contribute to foundational Arctic science.

NOAA also provides leadership and resources to support Arctic governance and science organizations. Specifically, NOAA continues to support the Arctic Council and its working groups, which monitor and assess biodiversity, climate, and the health of humans and ecosystems, and contribute to international approaches to oil spill response, ecosystem and protected area management, as well as management of shipping. Coordination across Federal entities, such as that provided by the Interagency Arctic Research Policy Committee and the Committee on the Marine Transportation System's Arctic Integrated Action Team, are also essential to implement overarching U.S. Arctic Policy goals, particularly those identified by the U.S. Arctic Region Policy (NSPD 66/HSPD 25) and the National Ocean Policy. NOAA's partnerships with Alaska Native Organizations to co-manage marine mammals continue as important collaborations for stewardship of protected species.

In May 2011, I signed a Memorandum of Understanding between NOAA and BOEMRE to ensure effective scientific and regulatory cooperation on OCS energy exploration and development. This agreement is intended to facilitate development of baseline observations and environmental studies needed to assess Arctic drilling. Leveraging relationships such as this to build sustained observations will enable researchers to study the effects of oil and gas exploration, sea ice loss, ocean acidification, and sea surface temperature warming on Arctic ecosystems over time. This information will also inform NOAA's ecosystem stewardship, private sector economic development, and Coast Guard and Navy missions.

Currently, Alaska has limited geospatial infrastructure; sparse tide, current, and water-level prediction coverage; obsolete shoreline and hydrographic data; poor nautical charts; and inadequate oil-spill response capacity. Most Arctic waters that are charted were surveyed with obsolete technology, some dating back to the 1800s, before the region was part of the United States. Most of the shoreline along Alaska's northern and western coasts has not been mapped since 1960, if ever, and confidence in the region's nautical charts is low. NOAA's navigation services provide baseline scientific data, such as hydrography, shoreline mapping, oceanography, tides, currents, positioning and geodesy, that benefits not only navigation, but also supports more informed decisions for other economic development and resource management processes. The

establishment of an adequate geospatial infrastructure would help inform Arctic management and policy decisions that seek to balance economic development with ecosystem protection and cultural heritage. The National Ocean Policy includes an emphasis on the Arctic among its priority objectives and a Strategic Action Plan on *Changing Conditions in the Arctic*, which addresses these topics, is under development.

NOAA has made some progress in support of safe marine transportation, coastal resilience and oil spill response readiness, including finalizing an Arctic Nautical Charting Plan after consideration of stakeholder input. This plan provides a detailed scheme for additional nautical chart coverage in U.S. Arctic waters and describes the activities necessary to produce and maintain the charts for safe navigation. NOAA continues its Arctic hydrographic survey effort in FY 2011 with the Survey Vessel *Fairweather* currently up near Kotzebue, to update nautical charts for navigation and support the safe installation of an offshore lightering facility for fuel oil. Since 2007, we have acquired approximately 2100 square nautical miles of hydrographic data with modern survey methods (multibeam sonar) in the Arctic as defined by the Arctic Research and Policy Act of 1984. This includes about 726 square nautical miles for survey work done in 2009 to survey the Pribilof Canyon. The U.S. EEZ in the Arctic encompasses 568,000 square nautical miles, about a third of which is considered navigationally significant, and most of which was surveyed with obsolete technology dating back to the 1800s. Thirty eight thousand square nautical miles of navigationally significant area have been identified as highest priority for survey. Building on this need for modern survey data, NOAA worked in its role as U.S. representative to the International Hydrographic Organization to establish an Arctic Regional Hydrographic Commission with other Arctic member states in 2010 for international collaboration on hydrographic surveying, nautical charting, and other mapping activities.

In addition, NOAA is building on existing partnerships to acquire gravity data in Alaska so that by the end of FY 2012 most of the state will be covered. This project, Gravity for the Redefinition of the American Vertical Datum, will vastly improve elevation measurements by correcting meters-level positioning errors to two-centimeter accuracy, which will help coastal communities and the private sector to develop climate change adaptation strategies and make decisions on infrastructure hardening, erosion and flood controls. Based on State of Alaska Immediate Action Working Group identified priority areas, NOAA also deployed seven short term tide stations to support surveying and update tide predictions, as well as for NOAA's Vertical Datum Transformation Tool, which links bathymetry to topography to enable the development of inundation and erosion models. NOAA is now evaluating the technology and strategies needed for long-term monitoring of tides, water levels, and currents under harsh Arctic conditions. Finally, collaboration with Canada continues on joint seafloor mapping missions to help define the limits of the extended continental shelf in the Arctic per criteria set forth in Article 76 of the Law of the Sea Convention. An expedition is occurring now to map the seafloor using multibeam sonar, image the underlying sediment layers, collect dredge samples and gravity data, and conduct under-ice Autonomous Underwater Vehicle operations. The U.S. could significantly advance our economic interests in the Arctic with respect to extended continental shelf and other activities by joining the Convention.

NOAA can also support the spill response capacity of industry and Coast Guard first responders and other Arctic stakeholders, including coastal communities, Alaska Native villages, and the

State of Alaska by building the same interactive online mapping tool for the Arctic as was used during the Gulf spill response. More commonly known in the responder world as the Environmental Response Management Application, or ERMA, this powerful tool is a web-based Geographic Information System tool designed to assist both emergency responders and environmental resource managers who deal with incidents that may adversely impact the environment. The data within ERMA also assist in resource management decisions regarding hazardous waste site evaluations and restoration planning. ERMA also includes human use and human dimension data components and, for the Arctic, would include sea-ice conditions. Federal, state and tribal governments will be able to use this information and the ERMA interface not only to address oil spill planning and response, but also to assess sea-ice and shoreline erosion information. It is NOAA's hope to bring this technology online sometime next year. We also know that ERMA is only as good as the information within it, so the sharing of new datasets among agencies, the state, academia and the private sector to improve the platform is essential.

In conclusion, NOAA is striving to bring its diverse capabilities to bear on the cultural, environmental, economic, and national security issues emerging as a result of changes in the Arctic. The breadth and complexity of these impacts require a concerted, systematic and rapid effort with partners from international to local levels. NOAA's scientific capabilities are being deployed to increase understanding of climate and other key environmental trends, to predict the ecosystem response to those trends, and to offer the technical expertise needed to develop policy options and management strategies for mitigation and adaptation to the environmental challenges in the Arctic region. NOAA's service capabilities are supporting safety and security needs for fishing, marine mammal protection, marine and other modes of transportation, energy, infrastructure, and mineral exploration in the unique Arctic environment. The choices we make today will have pivotal impacts on the future state of the Arctic. There is a great deal of work to be done, and NOAA, in collaboration with our partners, is committed to strengthening Arctic science and stewardship, and providing the information, products, and services needed by our Arctic stakeholders. Key to enhancing these efforts will be the coordinated implementation of the National Ocean Policy's Arctic Strategic Action Plan.

Thank you again for the opportunity to present NOAA's role in the Arctic. We appreciate your leadership and the time and attention the Subcommittee is devoting to this important issue, and look forward to working with you in future.