Testimony of
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Subcommittee on Coast Guard and Maritime Transportation

"Implementing U.S. Policy in the Arctic"

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Chairman Hunter, Ranking Member Garamendi and distinguished members of the Subcommittee, I am pleased to appear before the Subcommittee to speak in my capacity as the Division Director for the Division of Polar Programs. Let me first note for context that the Director of the National Science Foundation (NSF) is privileged to chair the Interagency Arctic Research Policy Committee (IARPC) under the President's National Science and Technology Council that coordinates key research activities in the Arctic. NSF is also responsible for managing the U.S. Antarctic Program on behalf of the Nation. I appreciate the opportunity to provide information on the types of vessels that NSF requires in order to most effectively meet its icebreaking needs for research in the Arctic, as well as for the research and operations of the U.S. Antarctic Program.

As NSF executes its mission to promote the progress of science, it must continuously anticipate logistical requirements that enable frontier science and engineering research. With respect to advancing the scientific frontiers to understand our planet, NSF bears a critical responsibility for providing scientists with access to the oceans that not only dominate the surface area of the earth but that are also vital to life as we know it.

Polar Marine Science Objectives

While polar oceans comprise only about ten percent of global ocean area, they exert a disproportionate influence on our climate and global carbon cycling. Thanks in part to access to an array of ice-capable assets, the U.S. research community has led discovery in polar marine science and has led the world in identifying, and understanding key issues of importance extending well beyond the poles. Globally relevant research areas for which the U.S. polar marine research community requires icebreaker support include the following:

- *Understanding the role of the polar regions in driving global climate* – The high latitude regions are the places where the deep water of the world's oceans is renewed. Year-round access to the dynamic Arctic Ocean, Southern Ocean and surrounding seas, where sea-ice, atmosphere, and ocean exchange freshwater and heat, will enable researchers to better understand the fundamental drivers of deeper water formation. Both modeling and field observations point to causal relationships between the cycling of freshwater in high latitudes, ice dynamics, and global ocean circulation patterns – all of which drive our weather patterns and condition global climate.

- *Understanding polar ice sheet contributions to the trajectory of future sea level rise* – Data that is largely satellite-based suggest that loss of ice from the polar ice sheets on land accounts for about one third of the current rate of sea level rise. That contribution is increasing and may well accelerate the rate of sea level rise in the coming decades and century. Access to dynamic areas of the Antarctic and Greenland continental ice sheet margins and grounding zones, where heat provided by the oceans is causing substantial melting, is needed to determine the nature of the processes influencing melting rates. Only with direct observations can conceptual models be developed that will allow projections of future sea level rise.

- *Paleoclimatic evolution of Antarctica and the Arctic* – The ability to acquire seafloor rock and sediment samples from high latitude areas adjacent to, and below, perennial ice provides researchers with the samples needed to better understand the paleoclimatic history of the polar regions. Polar conditions are proving to be more essential for depicting Earth's past climate state as their role in driving climate change has become better understood. Well-described configurations of global conditions at key junctures in the past are needed to test and develop better confidence in the capabilities of coupled climate models, which can then be used to improve predictions.

- *Ecosystem dynamics in a changing polar environment* – The polar oceans are displaying dramatic changes in heat, freshwater, and sea ice regimes. In the Arctic, this is evident as we have observed decreasing sea ice cover and the warming of certain seawater layers to temperatures unprecedented in 100 years of observations. In the Southern Ocean, these changes are apparent around the Antarctic Peninsula as the areal extent and seasonal duration of sea ice cover has been decreasing while the region has witnessed among the largest increases in annual average atmospheric temperatures on the planet over the past 50 years (up to 5 degrees F). In addition, warm circumpolar deep waters are making their way further up onto the narrow shelves all around the Antarctic continent. Ocean acidification and fishing pressures are also on the rise in higher latitudes. At the same time, significant changes in species compositions are being documented in both the north and south polar regions. Interdisciplinary ocean-going studies on a modern vessel are needed to achieve a process-based understanding of the effects of multiple stressors on the valuable and unique polar ecosystems. Such fundamental understanding is urgently needed to devise and inform ecosystem-based management objectives.

- *Ocean acidification and its impacts* – The need for understanding the potential adverse impacts of a slowly acidifying sea upon marine ecosystems is widely recognized and included as a priority objective in the new National Ocean Policy. In fact, acidification in polar oceans, where it is expected to occur first and foremost, appears to be ahead of model predictions. The effects of ocean acidification could significantly affect strategies for developing practices towards the sustainability of ocean resources. Basic research concerning the nature, extent, and impact of ocean acidification on polar oceanic environments in the past, present, and future is particularly urgent with the changes upon us.

Polar Marine Research Platforms

As an indication of the strong international interest in research on the polar oceans, a substantial number of countries – Australia, Canada, China, Germany, Korea, Japan, Norway, Russia, South Africa, and the United Kingdom – have, through their own research enterprises, recently constructed or are in the process of bringing into operation new ice-capable research ships. The ships range from light to heavy ice breaking capability, with several capable of both research and resupply support.

Arctic

Heightened international interest in polar regions is driven in part by changes underway in the Arctic; increased human activity in the Arctic has important implications for the environment, commerce, and security. NSF has been a strong supporter and partner in the ongoing interagency process of coordinating Arctic Region policy. For example, the National Arctic Strategy and its Implementation Plan are underpinned by enhanced scientific research efforts through IARPC. The interagency research efforts are those best advanced through interagency coordination and are aimed at helping to inform decision-makers regarding Arctic changes. The Arctic is an ocean surrounded by land, so our ability to conduct marine research is critical to understanding the Arctic system and its interaction with the global system. What follows is a summary of our current approaches to providing access to the marine science community.

NSF funded construction of an important new ship, the SIKULIAQ, [si KU lee ak], to be operated by the University of Alaska, that will begin supporting scientific research from its homeport in Seward, Alaska in early 2015. As a highly science-capable vessel, , SIKULIAQ is designed for open water and is able to operate in ice up to about three-feet-thick. It will be extremely important for studying ecosystems and ocean processes in the Gulf of Alaska and southern Bering Sea. In addition to being scientifically interesting, these waters host among the most productive fisheries in the world. In summer, the SIKULIAQ will provide access as far north as the edge of the permanent ice (nearly 80 degrees N at the minimum in September) and further into the ice when escorted by a more ice-capable ship.

Through Memoranda of Agreement with the U.S. Coast Guard (USCG), NSF has made use of USCG icebreakers to meet NSF's research needs. The 15-year-old medium-duty USCG Cutter HEALY, designed nearly 25 years ago, is a U.S.-government owned research icebreaker currently capable of operating in the Arctic during the summer. HEALY can operate continuously at 3 knots in sea ice up to 4.5 feet and up to 8 feet thick via backing-and-ramming.

Thus, the HEALY is primarily useful for summer but not winter work within the Arctic. The Arctic science community tasking for the HEALY varies from year to year depending on funded research proposals. Within the constraints of the USCG operations model, the Arctic science community has productively used approximately 90 days per year. Under current arrangements, NSF reimburses the USCG for operations costs and for the cost of fuel to transit to/from Seattle and while in the area of interest.

NSF coordinates with the USCG for scheduling, scientific technical support, and co-hosting a science community forum (the Arctic Icebreaker Coordinating Committee) regarding vessel operations. HEALY and SIKULIAQ could continue to serve as ice-capable primary research vessels for NSF and other agency supported researchers over the next two decades. While focused on scientific support, HEALY is a commissioned military vessel, capable of executing all USCG missions. As we look beyond the coming decades, we are concerned about competing demands on the USCG.

Due to the costs of positioning vessels and science demands, NSF also engages extensively with the University-National Oceanographic Laboratory System and international partners to supplement access by U.S. researchers to the Arctic and Southern Oceans. Depending upon the nature of the science program to be supported, specific arrangements range widely. NSF strives to match the most cost-effective and appropriately capable assets to meet merit-worthy science objectives. This can entail international coordination of vessels to obtain broader geographical coverage for a specific science program or more reliable access to challenging ice-covered target areas. Arrangements can be as simple as supporting U.S. investigators participating in a program organized by another nation and as complex as organizing multi-vessel charters such as a highly capable icebreaker escort of specialized science capabilities like drilling vessels. Such arrangements leverage our ability to support quality science but do not replace the need for an ice-capable primary research vessel, such as SIKULIAQ. It is the latter that ensures that U.S. scientists can drive and lead essential aspects of the polar marine research agenda.

Antarctic

In the Southern Ocean, NSF-supported researchers rely primarily on two leased vessels, the NATHANIEL B. PALMER and the LAWRENCE M. GOULD, both owned and operated by Edison Chouest Offshore under a subcontract to NSF's prime contractor for Antarctic logistics support (currently Lockheed-Martin). Both of these ships were designed and built to the specifications of the U.S. science community nearly 25 years ago. The PALMER's capability in ice is somewhat greater than that of SIKULIAQ while the GOULD is designed to operate in the more benign one-foot-thick ice regimes typical of the Antarctic Peninsula. The charter of these vessels has resulted in numerous ground-breaking discoveries that enabled U.S. world leadership in the Southern Ocean.

That said, these research ships cannot provide access on their own to some of the more scientifically important portions of the Southern Ocean, particularly those within the sea ice pack and extending up to the ice sheet edge around the perimeter of Antarctica. We were able to provide access to our research community for several years (2007-2010) through a partnership with Sweden that supported joint research expeditions aboard the Swedish icebreaker ODEN.

However, in 2011, Sweden concluded that it needed ODEN at home to support marine transportation in northern ice-covered waters. As a result, the U.S. no longer has access to that capability. One domestic alternative to ODEN would require the Coast Guard to re-deploy HEALY from current operations in the Arctic, where it is in full demand by researchers. Under its current arrangements, using HEALY in the Southern Ocean would severely impact our ability to support U.S. scientists working in the Arctic Ocean. My Coast Guard colleagues can speak better than I to the impact that deployment of HEALY to the south would have on their own Arctic missions. POLAR STAR, or its modern replacement, could conceivably perform ice escort of more science capable vessels.

Geographic Scope of Polar Marine Research

The charts below illustrate research vessel tracks supported by NSF over the last 8-10 years for Arctic and Southern Ocean research. It should be clear that multiple classes of vessel are successfully employed to meet U.S. polar marine research community needs. Going forward, we anticipate the need to utilize both primary research icebreakers and supplemental icebreaking capability for access to both north and south. We are actively engaged with the science community to define requirements and possible approaches that will keep them at the cutting edge of polar marine science as the current fleet ages. NSF expects that autonomous underwater vehicles, surface buoys, and moorings with innovative sensor systems will increasingly provide cost-effective and wide-reaching Arctic and Southern Ocean marine observations. These will not, however, remove the need for ice-capable polar vessels.

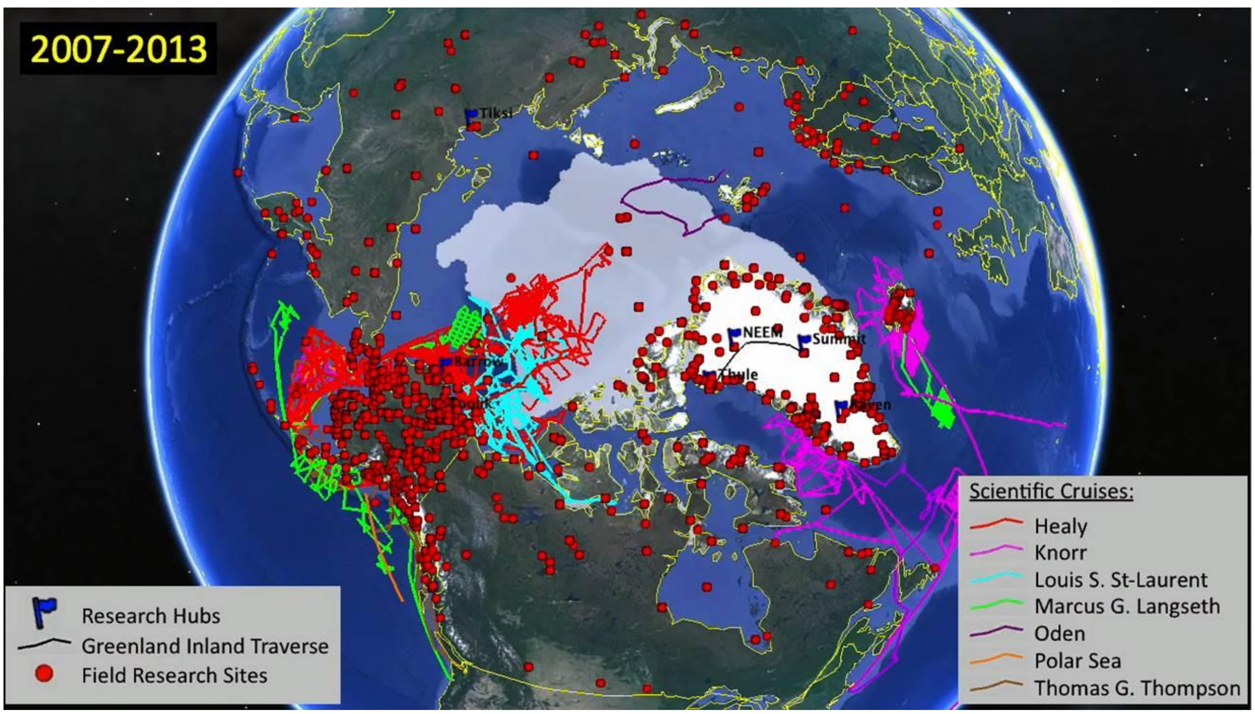

Figure 1. Research Vessel Tracks, Arctic Ocean

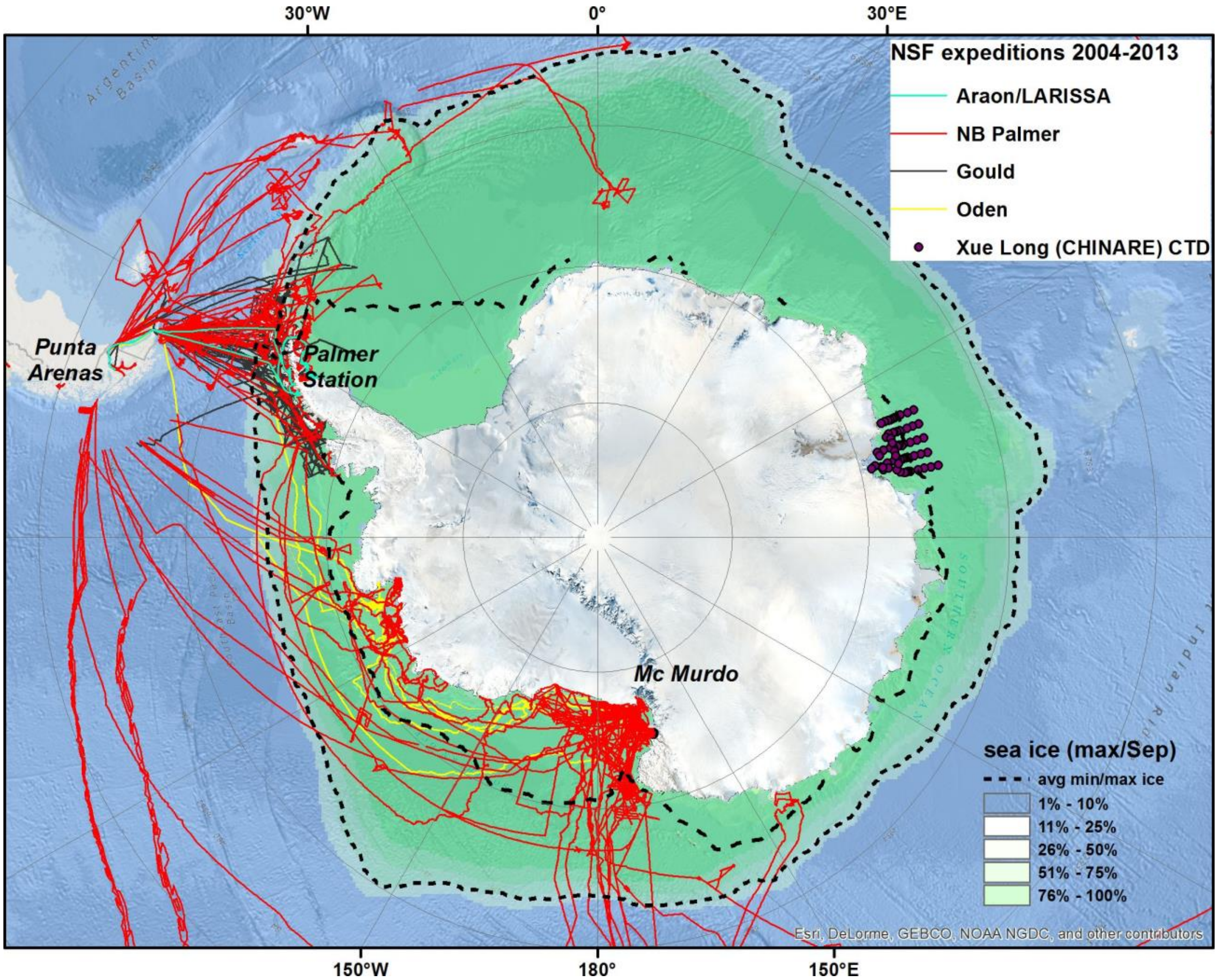

Figure 2. Research Vessel Tracks, Southern Ocean

Antarctic Operations Requirements

NSF must also rely on icebreakers for logistics in Antarctica. As articulated in Presidential Memorandum 6646 and reaffirmed in a series of Presidential Decision Directives over the years, U.S. policy calls for year-round U.S. presence at three research stations in Antarctica: McMurdo and Palmer Stations on the coast and an in-land station at the geographic South Pole. The Memorandum assigns NSF the responsibility for managing the U.S. Antarctic Program, including support for those stations. The stations support forefront research while simultaneously maintaining a presence deemed essential to U.S. geopolitical and diplomatic interests on the continent. In particular, maintaining an active and influential scientific presence in Antarctica enables the U.S. to assume a leading role in governance of the continent under the Antarctic Treaty.

For many years, the U.S. Coast Guard performed the Antarctic mission with distinction, annually opening a seasonal channel in the ice so that a tanker and cargo vessel could deliver fuel and supplies to McMurdo Station. In most years, this resupply mission requires only about four to six weeks of ice breaking services on-site each year. Without icebreaker support, both

McMurdo and South Pole stations would have to close or sharply curtail activities for lack of supplies. As the Coast Guard's heavy icebreakers – POLAR STAR and POLAR SEA – approached the end of their design lifetimes, NSF found it necessary to contract for icebreaker support from other countries, first in 2005 with Russia (KRASIN as a back up to POLAR STAR), again in 2006 (KRASIN with POLAR STAR as back up), then with Sweden (ODEN as back up to POLAR SEA in 2007 and then ODEN alone in 2008-2011, but with POLAR SEA on standby in 2008-2010), and then for two years, 2012 and 2013, by the IGNATUYK of the Russian Murmansk Shipping Company.

Last year, after a seven-year hiatus, the USCG successfully performed icebreaking services for Antarctic operations via the 38-year old refurbished POLAR STAR. Barring unforeseen circumstances, the Coast Guard anticipates it will continue to meet this mission requirement for at least the remainder of POLAR STAR's projected life of six to nine more years. We are now, however, at a critical juncture in planning how to meet this national need beyond this timeframe.

In considering how best to fulfill our responsibilities for the U.S. Antarctic Program, NSF operates in accordance with the U.S. policy and instructions contained in Presidential Memorandum 6646 that, "Every effort shall be made to manage the program in a manner that maximizes cost effectiveness and return on investment." Going forward, NSF must secure cost-effective, reliable and, ideally, long-term icebreaking services for the resupply mission that is critical for supporting the broad goals of the U.S. Antarctic Program. Ideally, such services would be supplied by a modern, highly efficient icebreaker that meets the International Maritime Organization's Polar Code. In the absence of a U.S. asset of appropriate capability, NSF would have to seek to meet its needs via the international community.

It is largely for this reason that we have actively participated in Coast Guard efforts in the last few months to define requirements and concepts of operations for a new Polar Class icebreaker. We believe that an efficient, capable, and reliable icebreaker whose design is not compromised by science requirements would best meet NSF's *icebreaking services* requirement of approximately six weeks (in January to February) per year in Antarctica and intermittent ice escort of science vessels. NSF looks forward to welcoming the SIKULIAQ into the mix of assets and continuing to benefit from the HEALY, PALMER and GOULD over the intermediate term to serve our science mission. We will continue to work with the science community and our sister agencies in planning for science-dedicated ice capable vessels as these other vessels approach their expected lifetimes over the next few decades.

We join others experienced in Arctic marine operations in warning that diminished sea ice conditions in the Arctic now and through the next several decades do not equate to diminished need for highly ice-capable assets. Our research community has provided clear evidence that storm activity is on the rise in the Arctic and movement of unconsolidated ice on heavy stormy seas can be highly dangerous. Of course, that situation pertains to all of the increasing human activity in the Arctic marine environment.

Mr. Chairman, I appreciate the opportunity to appear before the Subcommittee on these important issues on behalf of the National Science Foundation. I would be pleased to answer any questions that you may have.

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