Testimony of
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Before the
House Committee on Transportation and Infrastructure
Subcommittee on Coast Guard
and
Maritime Transportation

July 16, 2008

Chairman Cummings, Ranking Member LaTourette, and distinguished members of the Committee, I am pleased to appear before the Subcommittee again to speak on behalf of the National Science Foundation. NSF is an extraordinary agency, with an equally extraordinary mission of enabling discovery, supporting education, and driving innovation – all in service to society and the nation.

INTRODUCTION

The National Science Foundation was established in 1950 to initiate and support basic scientific research and programs, to strengthen scientific research potential and science education programs at all levels in the mathematical, physical, medical, biological, social, and other sciences, and to initiate and support research fundamental to the engineering process and programs to strengthen engineering research potential and engineering education programs at all levels in the various fields of engineering (NSF Act of 1950; 42 USC 1861 *et seq*).

The Agency also chairs the Interagency Arctic Research Policy Committee (IARPC), created under federal statute to coordinate Arctic research sponsored by federal agencies, and it manages the U.S. Antarctic Program on behalf of the U.S. government as directed by Presidential Memorandum 6646 (1982).

The Arctic and Antarctic are premier natural laboratories whose extreme environments and geographically unique settings enable research on fundamental phenomena and processes not feasible elsewhere. In addition, climate changes now being observed in the earth's Polar Regions require careful study in view of their possible implications for northern residents and for those living in the mid-latitudes. Changes in Polar Regions are tightly coupled to the global earth system, with changes in one strongly impacting the other.

Polar research depends heavily on ships capable of operating in ice-covered regions, either as research platforms in the Arctic and Southern Oceans or as key components of the logistics chain supporting on-continent research in Antarctica. Many areas in the Arctic and Antarctic are only accessible by ship. As the primary U.S. supporter of fundamental research in these regions, NSF is the primary customer of polar icebreaker and ice-strengthened vessel services for scientific research purposes.

NSF responsibilities in the Arctic and in Antarctica take somewhat different forms, and with the Committee's indulgence I'll explain briefly how they differ with respect to icebreaker requirements. *But in both cases the question of how best to meet those responsibilities boils down to consideration of three factors: cost, performance, and policy.*

NSF REQUIREMENTS IN THE ARCTIC

NSF supports research on the Arctic Ocean, atmosphere, and land areas, including marine and terrestrial ecosystems and their relationships to the well-being of local populations. In addition to research in individual disciplines, support is provided for interdisciplinary approaches to understanding the Arctic region, including its role in global climate. Over the last decade, changes have been measured in the distribution of polar ice cover, in atmospheric composition, Arctic Ocean conditions, some terrestrial parameters, as well as in northern ecosystems. Residents of the North are seeing these environmental changes affect their lives. It is important to determine whether these changes correlate to a short-term shift in regional atmospheric or ocean processes or whether they are the result of longer-term global change.

In the Arctic, science on land and in coastal areas tends to be based at a few sparsely distributed, remote outposts, and in many cases access by ship is the most advantageous means, even for projects that are not inherently oceanographic. In its few years of service, the Coast Guard icebreaker *Healy* has supported research in a variety of areas including biology, sea ice, marine geology and geophysics, cartography, physical and chemical oceanography and atmospheric science.

As research has advanced and become more technologically sophisticated, NSF has increasingly relied on coordinated international multi-ship expeditions to access the Arctic region and laboratory facilities. For example, while the USCGC *Healy* does have the capability to work alone in the deep Arctic during summer, any vessel by itself is more risky, making multi-ship arrangements necessary in lieu of an icebreaker research platform with more robust capabilities. The USCG *Polar Sea* and *Polar Star* have sufficient icebreaking capability to operate in the deep Arctic, but they have limited research capabilities , by design, and have been needed in the Antarctic. International collaborations also have become necessary, as the demands for research aboard the *Healy* have intensified. Recent international partnerships with Sweden involving their icebreaker, the *Oden*; and with Germany and their icebreaker, the *Polarstern*; have been highly successful, as have collaborations by NSF, National Oceanic and Atmospheric

Administration (NOAA) and other agencies with various Canadian, Chinese, Russian and other ships.

Arctic Requirements: Ship Cost and Reliability

According to information provided by the Coast Guard, over the past decade NSF has typically used approximately 90 percent of the 185-200 days current USCG deployment standards allow *Healy* to spend at sea. Science programs are limited by the ship time available on the USCGC *Healy* and also by the number of berths available for science. *Healy* can accommodate up to 50 scientific personnel in addition to its operational Coast Guard crew of about 80. Other nations' research icebreakers with comparable icebreaking capability typically operate with crews half the size of Healy's, with comparably greater numbers of scientist berths.

The *Healy* also faces limitations in its icebreaking capacity, especially during the spring when the ice coverage north of Alaska has been thick enough in some years (2004, 2005) to beset the ship for several days.

Under the current arrangement, NSF is responsible for funding *Healy* operations and maintenance while the Coast Guard is responsible for operating the ship and carrying out its maintenance program. Coordination between the two agencies is arranged under an MOA in which NSF provides the Coast Guard with a set of operational requirements annually based on an interagency call for icebreaker needs and the Coast Guard responds with an operational plan and cost estimate based on those requirements. Total *Healy* costs are approximately $24 million annually, or about $130,000 per day at sea in 2007.

I will return to the issues of cost, availability and policy shortly.

Plans have been underway for several years to construct a new ice-strengthened ship that could support scientific studies in the waters around Alaska. NSF has assigned high priority to building this ship, the Alaska Region Research Vessel (ARRV), and construction funds were included in the President's FY08 budget request for acquisition planning. It is estimated that it will take 2.5 years to construct and deploy the ship once a shipyard contract has been issued. The ship will be operated by the University-National Oceanographic Laboratory System (UNOLS) which operates a number of research vessels. The ARRV, which will replace the *Alpha Helix*, will be designed to work in up to 3 feet of ice. The ARRV will thus be able to conduct research cruises year round in the Gulf of Alaska and the southern Bering Sea; and in the summer, as far north as the Chukchi and Beaufort Seas during minimum ice cover. During heavy ice periods in the Bering Sea, the ARRV would probably need the assistance of the *Healy*. Estimated operating costs are about $20K – $30K/day. Arctic sea ice has diminished significantly since the ARRV design was established and thus ARRV's reach now extends farther into the Arctic Ocean than had been anticipated, making the ship even more valuable to the research community.

Finally, we need better access to the deep ocean in the Arctic. Options for supporting research in the deep Arctic should be integral to any study of future icebreaker needs.

In conclusion, the *Healy* is a capable and relatively new ship that can be the mainstay of U.S. Arctic Ocean research for years to come. However, under the current operational model the operating costs are significantly higher than non-military research icebreakers and its capability as an all-seasons deep arctic research platform is also limited.

NSF REQUIREMENTS IN ANTARCTICA

NSF provides approximately 85 percent of the U.S. funding for fundamental research in the Antarctic and the southern ocean. This research addresses a wide array of topics across many disciplines. For instance, researchers are studying topics as wide-ranging as the evolution of the ozone hole; the impact of extreme environments on gene expression; the effects of ultraviolet radiation on living organisms; the relationship between changes in the ice sheet and global sea level; global weather, climate, and ocean circulation; the role of Antarctica in global tectonics and the evolution of life through geologic time; and the early evolution of our universe, as well as its current composition.

This research requires access to ships serving *two quite different functions:* multi-purpose icebreakers that can operate in the Southern Ocean as research platforms that also resupply our coastal Palmer Station on the Antarctic Peninsula; and heavy-duty icebreakers that can open a resupply channel through fast ice to McMurdo Station. From McMurdo, supplies are transferred to the U.S. research station at the South Pole and to temporary remote field stations at various points on the continent. These two requirements are met in quite different ways.

Antarctic Ship-Based Research Platforms: Ship Cost, Availability and Policy

U.S. Antarctic Program ship-based research and Palmer Station resupply depend primarily on two privately-owned vessels, the *Laurence M. Gould* (LMG) and the *Nathaniel B. Palmer* (NBP).

The NBP is leased by NSF’s prime contractor, currently Raytheon Polar Services Company (RPSC), from the Louisiana-based shipping company, Edison Chouest Offshore (ECO). The vessel was built to specifications developed on the basis of input from the science community. The ship is an ABS A2 icebreaker capable of breaking 3 feet of level ice continuously at 3 knots, with 13,000 shaft horsepower and a displacement of 6,800 long tons. It is outfitted with all of the winches and A-frames necessary for deploying and retrieving oceanographic instrumentation. The vessel is fully outfitted with on-board oceanographic instrumentation and a networked computer suite, including multi-beam sonar, and has 5,900 ft^2 of lab space and 4,076 ft^2 of open deck space for oceanographic work and staging and a helicopter pad and hanger.

The NBP averages 300 days a year underway in support of science.

As is the case for the NBP, the *Laurence M. Gould* is leased by Raytheon from Edison Chouest Offshore (ECO). Also like the NBP, the vessel was designed and built on the basis of input from the science community. The ship is smaller than the NBP and has less ice breaking capability, as it was designed to operate in the more benign ice regions surrounding the Antarctic

Peninsula. The ship is an ABS A1 ice-strengthened vessel with 4,600 shaft horsepower and a displacement of 3,400 long tons and can break one foot of level ice at a continuous 3 knots. It is fully instrumented with on-board oceanographic instruments and a networked computer suite. The LMG has the dual purpose of supporting oceanographic science and providing re-supply to Palmer Station, located on the Antarctic Peninsula. It should be noted, however, that the LMG will soon be at the end of its service contract. NSF recently issued a request for proposals to procure a replacement for the LMG.

The LMG averages 320 days a year underway in support of scientific research and associated logistics.

Annual costs for the NPB and LMG in 2007 were $16.3M and $7.5M, respectively, resulting in respective day costs of $54.3K and $23.4K for these ships.

Antarctic Station Resupply: Ship Cost, Reliability and Policy

As noted above, the resupply of the McMurdo and South Pole Stations, as well as of temporary remote field stations in Antarctica, depends on gaining access to the McMurdo pier through the ice in McMurdo Sound. Since 1988 the channel was opened by one U.S. Coast Guard Polar Class vessel (either the *Polar Star* or the *Polar Sea*), but more recently two icebreaking vessels have been needed due to extreme ice conditions and concerns about the reliability of the aging Polar Class vessels.

After opening the channel, the icebreaker escorts two resupply vessels, a government-owned tanker and a chartered freighter, to and from the ice pier at McMurdo. These resupply vessels are ice-strengthened vessels under the operational control of U.S. Transportation Command's (USTRANSCOM) Component Command, Military Sealift Command. (Military Sealift Command utilizes commercial contracts for construction, maintenance and staffing of vessels. As a result, MSC operates a fleet of cargo ships and tankers that are contractor-owned and operated or government-owned and contractor-operated.)

In FY05, acting on advice from the Coast Guard that a second icebreaker should be brought in to assist the *Polar Star* due to extreme ice conditions in McMurdo sound, NSF chartered the Russian icebreaker *Krasin* for the purpose. The Coast Guard's *Polar Sea* was undergoing repairs and no other U.S. icebreakers were available, as the *Healy* was needed in the Arctic to support research. Italso lacks both the maneuverability and performance for the McMurdo break in. In FY06 the *Polar Sea* was undergoing extensive repair. NSF again chartered the Russian icebreaker *Krasin* and held *Polar Star* in reserve (and eventually brought it in to assist in the final stages of the break-in). The situation was similar in FY07. *Polar Sea* was ready for duty but the Coast Guard recommended that a backup vessel again be employed due to continuing extreme ice conditions. NSF therefore arranged to use a Swedish research icebreaker (the *Oden)* under the auspices of the U.S. - Sweden S&T Agreement, both to open the channel to McMurdo Station and to host a joint U.S. - Swedish research expedition aboard the ship in the Southern Ocean. Polar Sea assisted with the final stages of the McMurdo break in. Based on the excellent performance of *Oden* in FY07 and the success of the joint research program, NSF elected to use the *Oden* again in FY08, this time as the primary icebreaker, holding the *Polar Sea* in reserve where it could also respond to any needs for its services in the Arctic. The *Polar Sea* deployed to the Arctic in FY08 in order to maintain crew proficiency.

The USCG has performed its icebreaking mission in Antarctica with distinction for many decades, but with increasing difficulty in recent years. Its two Polar Class icebreakers are nearing the end of their estimated service lives and are becoming increasingly difficult and costly to keep in service. According to the USCG, there are several years of service life in the *Polar Sea*, but the *Polar Star* has now been placed in caretaker status per agreement with USCG in view of the decreasing need for her services and the high cost of putting her back into service. The need to rely, first on the *Krasin* and then on the *Oden* has already been mentioned as has the need to keep the *Polar Sea* available to meet the needs in the Arctic and perhaps as occasional backup for the annual McMurdo Station break-in. Given this state of affairs, NSF has given careful consideration to how best to meet the needs of the scientific community over the long-term.

Under the current arrangement between NSF and the Coast Guard, NSF provides all the funding for USCG icebreaker operations and maintenance in support of scientific research, and the Coast Guard carries out those duties. NSF provided just under $54M for operation of the USCG polar class icebreakers in 2007. In addition, NSF provided approximately $7.5 million out of its base budget for fuel and charter of *Oden*. When chartering commercial vessels such as the *Krasin* and the *Oden*, NSF pays only for the time that the ships are under charter.

USE OF COMMERCIAL SHIPS AND MODELS/MODES OF OPERATION

As noted above, NSF has met the research community’s need for research platforms in the Southern Ocean through long-term contracts with private firms for ice-strengthened ships and icebreakers and through partnerships that provide access to other country’s research vessels. For resupply of McMurdo and South Pole Stations, NSF has depended until recently entirely on U.S. Coast Guard icebreakers secured through reimbursement arrangements, and on chartered Military Sealift Command capabilities. More recently, NSF has had to arrange for chartered vessels to complement USCG capabilities. In the Arctic, NSF has relied on the Coast Guard’s *Healy* and on partnerships with other countries. Once constructed and commissioned, the Arctic Regional Research Vessel (ARRV) will significantly increase the capacity for ship-based research in the coastal Arctic regions and where ice cover is relatively thin.

A variety of models have been and are being used by the U.S and other countries for meeting polar icebreaker needs. The U.S. Coast Guard and the Chilean and Argentinean Navies operate their icebreakers using military personnel. Some countries build their ships to meet military specifications and others do not. The German research icebreaker, the *Polarstern*, is owned by the government but operated by a private contractor. The Swedish government’s operational arrangements for the *Oden* are similar to the German model. Both the *Oden* and the *Polarstern* are able to operate more than 300 days annually as a consequence of ship design and mode of operation. The Arctic Regional Research Vessel (ARRV) will be operated by civilian crews under contract to the University-National Oceanographic Laboratory Systems (UNOLS).

As noted above, NSF employs a contractor to operate and maintain the privately-owned *Laurence M. Gould* and *Nathanial B. Palmer*. The ships were built under a long-term lease agreement between the ship-owners and the Federal government, such that the construction costs are partially amortized over the duration of the lease (with the ship reverting to the owner at the government's option at the end of the lease). These ships also operate more than 300 days annually.

Finally, and as noted previously, the Military Sealift Command meets its needs (and those of NSF's for transport to McMurdo Station) either through commercial charters for ships and crews, or through government-owned, contractor-operated arrangements.

MEETING FUTURE NEEDS

International cooperation to provide icebreaker research platforms is expected to increase, both in arranging multi-ship expeditions and in sharing platforms. Certainly as Germany and the European community move forward in constructing the planned *Aurora Borealis*, NSF will work to establish mutually beneficial partnerships.

NSF's commitment to polar research and its responsibility for management of the U.S. Antarctic Program remains constant and therefore perpetuates the need for an icebreaker to open the shipping channel through the Ross Sea to enable resupply of the McMurdo and South Pole stations. Because opening the channel to McMurdo requires only a fraction of the time a modern icebreaker can operate annually, there may be interest among shipbuilders in providing icebreaker services to NSF under a contract in which the builder can lease the ship to others (other countries or private firms) during the remainder of the year.

An interagency working group co-led by the Department of State and the National Security Council is currently reviewing U.S. Arctic policy, and icebreaking needs will likely figure into the new policy. Clearly, the economics and efficiencies of the various acquisition and operating models merit further study and will depend on the suite of validated requirements put forth in the policy review. For research in the Arctic, the *Healy* should be a mainstay for many years to come, though its utility is restricted by its 200-day operational limitation. The *Healy's* inability to access the deep Arctic during periods of heavy ice cover is another limitation. These limitations, combined with a military deployment mode, make the *Healy* as currently operated, a very expensive way to meet the needs of the research community.

And as noted above, once in service the *ARRV* will be a valuable additional resource for Arctic research.

For Antarctic research the issues are different. The two existing Coast Guard Polar Class ships are at or close to the end of their service life. The Polar Star is in caretaker status, and the Polar Sea is expensive to maintain relative to the costs for the use of foreign, non-military ice breakers over the past several years such as the Russian Krasin and Swedish Oden. The overriding question is how to open the channel through the ice to McMurdo Station so that year-round operation of the nation's McMurdo and South Pole stations can continue. This year-round occupation is central to demonstrating the "active and influential presence" which is the cornerstone of U.S. policy in Antarctica as articulated in Presidential Memorandum No. 6646 on U.S. Antarctic Policy and Programs (February 5, 1982). Other factors contributing to this presence are the 600 days annually that NSF's research vessels, the *LM Gould* and the *NB Palmer*, operate in Antarctic waters; the approximately twenty C-17 Air Force flights annually that fly passengers and cargo between New Zealand and McMurdo; and the more than 400 Air National Guard LC-130 flights annually that provide transportation for people and equipment throughout the continent. Furthermore, NOAA charters the Russian *R/V Yuzhmorgeologiya* approximately 100 sea days per year in support of its Antarctic program. This program focuses on living marine resources at the Antarctic Peninsula in support of U.S. interests at the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) to which the United States is signatory.

In considering how best to insure the continued annual resupply of McMurdo Station and to meet our responsibility for the entire U.S. Antarctic Program, NSF operates in accordance with U.S. Policy and the instructions contained in Presidential Memorandum No. 6646, that "Every effort shall be made to manage the program in a manner that maximizes cost effectiveness and return on investment."

The Arctic policy review will certainly help inform future icebreaker discussions, but even if a decision were made today to build or refurbish an icebreaker, it would be years before the ship got underway. Accordingly, to meet its ongoing requirements in a cost-effective means, NSF has made arrangements to lease an icebreaker from Sweden (NSF signed a 5-year agreement with Sweden for a joint research program in the Southern Ocean with Sweden additionally providing break in services for the USAP.). NSF sees a need to keep the USCGC Polar Sea available to meet needs in the Arctic and perhaps as occasional backup for the break-in to McMurdo Sound. This, however, is clearly only a short-term solution. With an eye looking to the long-term, and after consultations with officials in OSTP and OMB, I wrote on May 31, 2006, to the chair of the NAS/NRC icebreaker study, Dr. Anita Jones, as follows: "Given the rapidly escalating costs of government providers for icebreaking services and the uncertain availability of USCG icebreakers beyond the next two years, it is NSF's intention to … [seek] competitive bids for icebreaking services that support the broad goals of the USAP. This competition will be open to commercial, government, and international service providers." The request for proposals will not be for ships but rather for services and we would expect the service providers to use their ships for other purposes when not in service to meet NSF needs. Thus the cost to the Foundation could be substantially reduced.

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