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Perspective
EXPERT INSIGHTS ON A TIMELY POLICY ISSUE

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The U.S. Coast Guard Is Building an Icebreaker Fleet

What Comes Next? Issues and Challenges

International interest in polar regions continues to grow, bringing with it increasing concerns about competition, safety, economic opportunity, and the environment. The White House recently issued a memorandum reaffirming a call for a fleet of polar-security icebreakers to serve U.S. interests in the Arctic and Antarctic (Trump, 2020). In the Arctic, the United States is responsible for such activities as maintaining sovereignty in maritime areas under U.S. jurisdiction, managing resources (e.g., fisheries) in these waters, maintaining waterway access to icebound ports and communities, and ensuring the safety and security of vessels operating in the vicinity of ice. In the Antarctic, the United States maintains a research and diplomatic presence within the broader global community.

For several years, icebreaking has been identified among important capability gaps for U.S. polar operations.[1] Only two existing U.S. Coast Guard cutters—the *Polar Star* and the *Healy*—are capable of operating in heavy polar ice, and both have limited time left in their operational life spans.

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Continued interest in polar icebreaking presents an opportunity to enhance U.S. presence in the Arctic and Antarctic. The United States is moving forward with a plan to build three additional icebreakers and hopes to fund three more. This Perspective outlines three recommendations for doing so:

- Assess further needs for implementing additional icebreaking capacity.
- Ensure that new vessels are built with a changing, multimission operating environment in mind.
- Consider other, related capability investments as part of planning, including additional people and materiel.

In the sections that follow, we expand on each of these recommendations. We also include short scenarios to illustrate some potential roles for icebreakers.

Why Additional Polar Icebreakers Are Needed

The Coast Guard operates the U.S. government's two working icebreakers. The *Polar Star* is a heavy polar icebreaker, designed to break ice up to 21 feet thick. Commissioned in 1976, it is showing its age, despite a massive overhaul a decade ago. The Coast Guard also uses parts from its deactivated sister ship, the *Polar Sea*, to help keep it operational.[2] The *Healy* is a more modern ship, built in the late 1990s. However, it is capable of breaking up to only 8 feet of ice, making it a medium polar icebreaker rather than a heavy one. Like all polar icebreakers, both ships are built for strength: These lumbering vessels are designed to smash through ice at a few miles per hour or to use backing-and-ramming techniques for ice thicknesses approaching their maximum capabilities.[3] They are far sturdier than the icebreaking ships used in the Great Lakes or parts of the northeastern United States, the most capable of which can break only 3.5 feet of ice. These polar icebreakers' systems have been designed to survive and operate in two of the most extreme environments on the planet.

Although used primarily for scientific research and polar resupply, these polar icebreakers also help the Coast Guard fulfill its responsibilities as one of five armed forces in the United States (10 U.S.C. § 101[a][4]). U.S. law requires the Coast Guard to fulfill national defense requirements and icebreaking facilities "on, under, and over the high seas and waters subject to the jurisdiction of the United States," which include the nation's Arctic waters (14 U.S.C. § 102[4]). Also, the U.S. Department of Homeland Security has a memorandum of agreement with the U.S. Department of Defense to, "in ice-covered and ice-diminished waters . . . [provide] assured surface access" in support of Department of Defense missions (U.S. Government Accountability Office, 2016, p. 63). An icebreaker is certainly not a warship: It has minimal weapon capabilities, and, although its hull is thick, it is not designed to be resilient to attack.

A Coast Guard mission need statement dating back to 2013 calls for up to three heavy and three medium icebreakers (O'Rourke, 2020b, p. 31). The

service is already well on the way to obtaining the capability for heavy icebreakers. It initiated its acquisition program for new heavy polar-security cutters (PSCs) in 2013, and, on April 23, 2019, the Coast Guard awarded a contract to VT Halter Marine in Pascagoula, Mississippi, for the first of potentially three heavy PSCs. Construction of the first heavy PSC is scheduled to begin in 2021, with delivery planned for 2024. The contract has options for second and third heavy PSCs to be delivered in 2025 and 2026, and the Coast Guard already has most of the funding for the second heavy PSC (O'Rourke, 2020a).

The United States as an Arctic nation, and the Coast Guard as the service charged with the responsibility of physically enabling operations in icy waters, need to continue the push for more icebreakers. This includes focus on medium PSCs to diversify the portfolio away from only the costlier heavy icebreakers.[4]

Arguing that several vessels are required for the U.S. icebreaking fleet is straightforward even without considering specific mission-related demands. These vessels need to address two vast regions at opposite ends of the planet (albeit typically in alternate seasons, operating primarily during each polar region's summer). Having the capability for mutual rescue requires more than the two aging existing vessels and the two heavy PSCs that have funding marked for them. Furthermore, the older vessels must eventually be retired, and even newer ones will require both regular and unexpected maintenance. In light of this, the Coast Guard's initial proposal for three heavy and three medium icebreakers is reasonable to enable

U.S. law requires the Coast Guard to fulfill national defense requirements and icebreaking facilities "on, under, and over the high seas and waters subject to the jurisdiction of the United States," which include the nation's Arctic waters.

simultaneous operations at both poles with potential for mutual rescue,[5] even if two ships are home ported or requiring maintenance at a given time. An in-depth mission analysis—more detailed and updated from the 2013 version—would help determine the specifics of how many heavy, medium, and light polar icebreakers will be required to achieve given levels of overall capability, capacity, and risk reduction.[6] For example, tests of the new Russian icebreaker *Arktika* could not be finalized in October 2020 because the thin sea ice

proved no challenge to the vessel, further highlighting the challenges of changing conditions for icebreaker planning.

Having a fleet of around six operational polar icebreakers would place U.S. government capacity in a similar place to that of Canada, Finland, Sweden, and China. The table summarizes and the map illustrates the number of polar icebreaking vessels worldwide by country, according to 2017 Coast Guard data.[7] Russia maintains the largest icebreaking fleet by far; it also has the longest border adjacent to ice-covered waters of any country and a long history of polar exploration. Canada also has sovereignty over large swaths of ice-covered waters, both in the Arctic and within the Hudson Bay. Although Finland and Sweden currently have no land or inland waterway outlets into the Arctic Ocean, they have substantial icebreaking missions to maintain seaways at lower latitudes. Norway, in contrast, enjoys largely open waterways around its borders, but it does require some icebreaking support for operations around Svalbard, for example.

Other countries—notably, Australia, Chile, South Africa, Argentina, and the United Kingdom—maintain small icebreaking capabilities to support Antarctic-area operations. China has indicated that both poles motivate its expansion of its icebreaking capability and now builds and operates four of its own icebreakers.

Each of these countries must weigh the cost against its operational needs for vessels that ultimately conduct a very particular mission that is not universally needed. The cost of the three heavy Coast

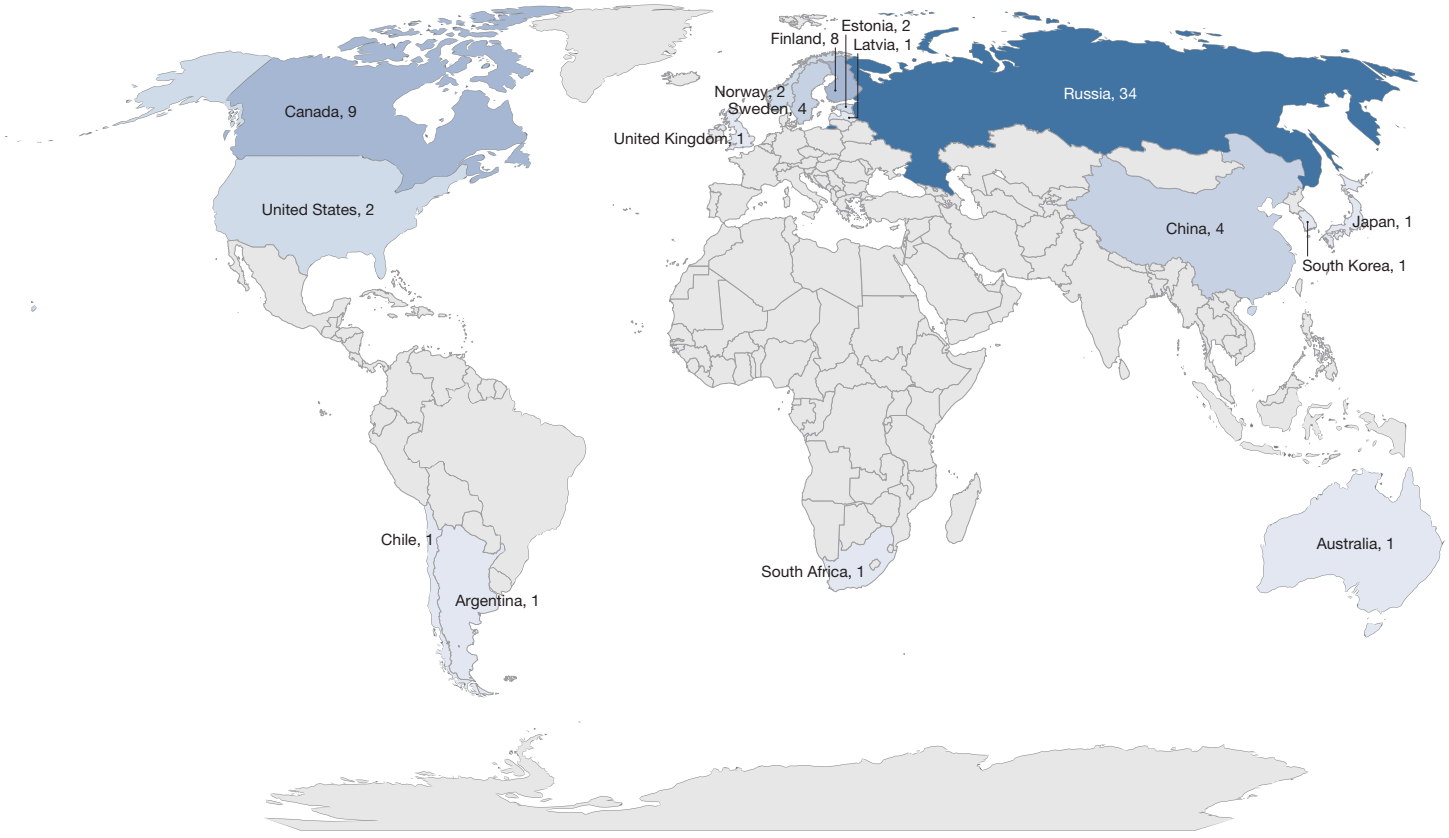
Number of Polar-Capable Icebreaking Vessels, by Country, 2017

Country	Vessels
Russia	34
Canada	9
Finland	8
Sweden	4
China	4
United States	2
Norway	2
Estonia	2
Australia	1
Chile	1
Japan	1
South Korea	1
South Africa	1
Latvia	1
Argentina	1
United Kingdom	1

SOURCE: Office of Waterways and Ocean Policy, 2017.

NOTE: This table includes only government-owned and -operated vessels capable of operating independently in the Arctic that were working or under construction in 2017. This does not include light icebreaking vessels, such as those employed to break lake ice. It also does not include planned investments (not yet being built), nonoperational vessels (e.g., *Polar Sea*), or vessels independently owned or operated by nongovernment entities. We selected these criteria to most accurately contextualize planned U.S. government icebreakers.

Number of Government-Owned or -Operated Polar-Capable Icebreaking Vessels, in Existence or Under Construction in 2017



Guard PSCs is a large part of the overall Coast Guard budget at $2.6 billion, equivalent to more than one-fifth of the Coast Guard's annual budget of $12.3 billion (Office of Waterways and Ocean Policy, 2017; Headquarters, 2020).[8] Although these expenditures are distributed over multiple years, they remain large relative to the Coast Guard's budget for any given year. For example, in fiscal year 2021, the $555 million to be spent on acquiring PSCs constitutes 47 percent of the Coast Guard's total budget for vessel acquisition (Headquarters, 2020).

Acquisition also takes time: The previously cited presidential memorandum calls for a fully deployable fleet of icebreakers by 2029 (Trump, 2020). To meet

this goal, the Coast Guard should also explore the benefits and limits of increasing ice strengthening in versions of large cutters that are already operational or in production (the national security cutter) and cutters that are currently in the design phase, such as the offshore patrol cutter. The presidential memorandum also calls for examining leasing options, and this endeavor is something that has been examined in the past alongside expanding partnerships with some of the countries listed in the table.[9] For example, the *Aiviq* is an operational commercial ice-reinforced vessel that theoretically could help keep waterways open in some areas of Coast Guard operation. However, Coast Guard leadership has pushed back on proposals to lease this nonmilitary vessel because of the modifications[10] that would be needed to execute the service's broader responsibilities (Gould, 2016).

Still, these other options should receive more scrutiny. A dual approach of acquiring a healthy fleet while pursuing leasing, partnering, or retrofitting in the interim could be valuable to consider. This option also offers an opportunity for short-term expansion of the fleet, as needed, in the future.

U.S. polar icebreakers aid in scientific research, resupply research stations and remote communities, and provide presence and readiness for such contingencies as search and rescue.

U.S. Icebreakers Need to Be Ready for a Diverse, Changing Operating Environment

Increased Demand for Icebreakers

The diversity of potential situations in which icebreakers might be employed must also continue to be considered in acquisition planning. As of 2020, the United States' polar icebreakers conduct primarily two missions. The first is scientific research, performed together with the National Science Foundation and other partners: Understanding polar environments is important in characterizing global weather and oceanographic patterns, as well as how these are changing over time. The second mission is resupply, primarily for research stations in Antarctica but also for remote Alaskan communities. For example, during the winter of 2011–2012, the medium icebreaker *Healy* enabled a tanker to deliver critical fuel supplies to the city of Nome, Alaska. In addition, these cutters have enabled presence and readiness for possible polar contingencies, such as search-and-rescue events; the *Healy* was

present for parts of the *Crystal Serenity*'s historic transit of a large cruise ship from Seward, Alaska, to New York through the Northwest Passage with 1,700 passengers and crew members aboard (Rosen, 2016).

All signs point to an increased demand for the Coast Guard's missions in the coming decades and potentially expanding roles for these cutters. Scientists need to conduct research on polar climate conditions to increase their understanding of regional influence on the rest of the world. Foreign and domestic commercial interests will continue to explore the polar regions in search of shorter transit times for vessels; extraction of resources, such as minerals, oil, and fish; and tourism. Some of this monitoring can be done from the air or via satellite. For the next several decades, however, human beings will still need to actively collect and evaluate samples from the polar regions. In addition, demand for resupply and even rescue may grow as the poles become more accessible thanks to reduced summer ice cover, contributing to increased human activity in the region. As this occurs, U.S. policy requires the Coast Guard to maintain a capability to oversee national interests by executing its statutory missions.

Furthermore, U.S. interests and maritime mission demands in the Arctic and Antarctic will always differ from each other because of immutable geographic considerations: The Antarctic is a land mass surrounded by water, while the Arctic is an ocean surrounded by land, including the U.S. state of Alaska. The Arctic contains permanent populations, some of whom have lived there for millennia, as well as resource extraction that dates back decades. Although the region has some diplomatically managed maritime boundary disputes, almost all of its lands are unambiguously part of specific nations. On the other hand, the Antarctic and its surrounding oceans have no permanent inhabitants and no commercial activity except fishing and are subject to unrecognized claims by various nations. The absence of commercial activity may change because the provisions of the Antarctic Treaty that forbid resource extraction in the region (Argentina et al., 1961) are open to revision in 2048, well within the lifetime of future polar icebreakers. If extraction of oil or minerals led to disaster, U.S. icebreakers might be needed to help respond.

Shifting Missions for Icebreakers

There is substantial potential for shifts in the missions an icebreaker takes on over the course of its lifetime. In the discussion that follows, we focus on changes primarily in the Arctic due to their greater proximity in space and in time. An icebreaker that is completed in the mid-2020s, if it lasts as long as the *Polar Star*, will still be operational in the 2070s. The extent and types of human activity in the polar regions at that time may be very different from what they are now, as was explored in a 2018 Homeland Security Operational Analysis Center report that addressed potential future Coast Guard needs in the region (Tingstad et al., 2018). Although the current polar icebreakers are multimission platforms, the focus of polar icebreakers (and ice-strengthened cutters that

may contribute in the region) could expand over time to include more of the Coast Guard's diverse missions, such as environmental protection, domestic and international fishery enforcement, countering smuggling, search and rescue, and contributing to Department of Defense operations.

A harbinger of this type of shifting mission set was a massive Russian oil spill in May 2020; although the spill was on land, much of the oil poured into an adjacent river, which transported it toward the Arctic Ocean ("Putin Calls Fuel Spill Unprecedented for Russia," 2020). Responding to similar spills in the North American Arctic could require icebreaker support for protracted periods to protect the region's fragile ecosystems, on which many Alaska Native communities depend for their survival.

An example of such a scenario is explored in the previously cited Homeland Security Operational Analysis Center report (Tingstad et al., 2018, p. 56), in which an offshore rig north of Alaska catches fire and proceeds to release oil into the environment.

As economic and human activity increase in the polar regions, so will the need for search-and-rescue operations.

Responding to such a scenario would require rapid rescuing of oil workers, putting out the fire, shutting off the flow of oil, and cleaning up the oil that had already spilled. If this occurred late in the ice-reduced season, polar icebreakers or at least Coast Guard cutters capable of operating in minimal amounts of ice (ice-strengthened cutters) would be needed to address the longer-term aspects of the response. Another scenario described in that report involves an oil tanker colliding with another ship in the Bering Strait (Tingstad et al., 2018, p. 60). This might occur early or late in the ice-reduced season, so, depending on how ice conditions evolved during the response process, icebreakers or ice-strengthened cutters could be needed to rescue personnel, to attempt to prevent the ships from sinking, to curtail oil flows, and to clean up the spill.

Icebreakers or ice-strengthened cutters may also be required to ensure that domestic fishing captains comply with U.S. laws and that foreign fishing captains stay out of the United States' exclusive economic zone. The United States currently forbids commercial fishing in its Arctic waters, although the continuing northward migration of many species and overfishing elsewhere may tempt fishing vessels to try. Although most such illegal fishing would presumably be conducted during the summer months, Coast Guard icebreakers or ice-strengthened cutters would be needed to safely interdict vessels that were overconfidently operating during the early or later parts of the season: If ice conditions change rapidly, ships that can survive, operate, and rescue other vessels despite the

ice will be needed. If U.S. policy does permit commercial fishing in these waters, regulating it to limit ecological risks and hazards to mariners, the Coast Guard will still need to ensure regulatory compliance, interdict foreign fishing vessels, and conduct search and rescue. Although other vessels can perform these activities during some parts of the year, icebreakers or ice-strengthened cutters would be essential for borderline seasons and unexpected changes in ice conditions.

The need for icebreakers to conduct search and rescue will also likely increase in line with human activity. Reduced seasonal ice cover is already increasing maritime cargo traffic in the region, as could future resource extraction, fishing, tourism, and other activities. Although cruise ships can be expected to operate in relatively safe conditions, the polar regions can sometimes appear more benign than they actually are, as was demonstrated when a cruise ship struck ice and sank off the coast of Antarctica in 2007 (Bowley and Revkin, 2007). (Fortunately, the passengers and crew were rescued by another cruise liner that happened to be nearby.) This illustrates the important point that, even if ice cover is limited, there is still the potential for accidents due to limited knowledge of ice conditions or rapid deterioration of those conditions.

As economic activity increases in the Arctic, populations in the region may also increase, potentially creating more demand for search-and-rescue capacity. An increased Coast Guard capability to provide rescue and other services to indigenous communities in the Arctic despite ice conditions would also be valuable in the event of earthquakes, extreme storms, or other disasters. Importantly, some Alaskan coastal communities currently provide their own rescue capability. They will undoubtedly remain an important partner to the Coast Guard moving forward, but the geographic scope and capacity scale of what they can provide are limited.

The focus of polar icebreakers and ice-strengthened cutters could expand to include more of the Coast Guard's diverse missions, such as environmental protection, domestic and international fishery enforcement, countering smuggling, search and rescue, and contributing to Department of Defense operations.

Preserving National Sovereignty Through Presence

Recent years have also seen increased government activity in the polar regions by Russia and, to a lesser degree, by China. Although much of this activity has not been overtly aggressive toward the United States, it does underscore the need to maintain greater presence to secure U.S. interests. In this context, the ability to achieve presence, to observe what other actors are doing, and to be able to parry possible aggression may be central parts of U.S. icebreakers' future missions.

Russia has continued to demonstrate a commitment to developing its northern regions for commercial activity, including by building extensive infrastructure and numerous icebreakers. Infrastructure recapitalization has included numerous military facilities, and Russia has asserted itself in the Arctic in the past couple of decades. For example, a Russian minisubmarine planted its nation's flag on the seafloor at the North Pole in 2007, and, under the United Nations Convention of the Law of the Sea, Russia has made expansive claims to extend its economic rights associated with the continental shelf that includes area near the North Pole. These claims overlap somewhat with those made by Denmark and Canada (Faulconbridge, 2007; Commission on the Limits of the Continental Shelf, 2015). Several Russian military aircraft have been intercepted recently off the coast of Alaska, before entering U.S. airspace (Starr and Duster, 2020).

China also envisions itself as a "great polar power," influencing both the Arctic and Antarctic, and is increasingly active in both regions. For example, China has included the Arctic within its broader Belt and Road economic initiative. The so-named Polar Silk Road would take advantage of newly seasonally open shipping lanes. China also has stakes in Arctic resources, the largest of which is the Yamal liquefied natural gas project in northern Russia ("China Unveils Vision for 'Polar Silk Road' Across Arctic," 2018).

Icebreakers Do Not Operate Alone. Other Investments Are Needed

Icebreakers are a keystone capability for having a polar presence. The Coast Guard is very aware of this importance, which is reflected in the service's plans to procure three heavy and three medium PSCs in the coming years. It will be important that these plans be supported by Congress and other policymakers. The Coast Guard will also need to periodically review and update its requirements in the Arctic to ensure that these planned investments are sufficient to meet the rapidly evolving needs in this key mission space.

It will also be important for the Coast Guard to gain support for examining the totality of Arctic capability needs from a portfolio perspective, so that the diverse missions icebreakers are intended to support are adequately resourced. Having icebreaking platforms alone is insufficient to accomplish the diverse missions that the Coast Guard could face in the coming decades; reliable communications, reconnaissance

assets, helicopters, forward staging locations, and other complementary systems will also be needed. None of the Coast Guard's missions can be executed in the Arctic with icebreakers alone. Even the ice operations mission requires use of extensive weather and ice information, communications, navigation, and heavily trained personnel, to name a few critical capabilities in addition to the cutter itself. What this means is that investments in vessels will also require an examination of every aspect needed to ensure that they can successfully play their roles in polar maritime surface missions. Furthermore, the U.S. government will need to increasingly consider what needs might exist for operating in the air, over land, and under the surface, as well as in and through outer space, cyberspace, and the electromagnetic spectrum, from a polar standpoint. Any relevance icebreakers may have for these other domains is superficially understood at best.

In addition to considering a portfolio of capabilities, expanding the size and capacity of the Coast Guard itself will be necessitated by these acquisitions (the icebreakers and their required operation and maintenance).

Expanding the number of polar icebreakers would require a corresponding increase in the resources and numbers of personnel the Coast Guard would need to operate and maintain these vessels. They will rely on more-extensive fixed and mobile infrastructure, communications, navigation, and situational awareness capabilities, which are severely lacking, especially in the northwestern Arctic. Any significant increase in icebreaking capacity and capability should be accompanied by these other important investments.

Personnel needs will also change. The Coast Guard has only about 41,000 active-duty personnel (about the same size as the New York City Police Department) and a $12.3 billion annual budget, so adding hundreds of personnel and the resources to support these ships would require a significant commitment.[11] Personnel needs would be unlikely to change substantially if only the two existing icebreakers are replaced, with little overlap between new and older vessels.

If the new PSCs are delivered in 2024, 2025, and 2026, the Coast Guard will have to add approximately 200 new seagoing positions (assuming approximately 120 crew members per PSC and recovering the positions from the decommissioning of the *Polar Sea*). This expansion represents roughly a 2-percent increase over the Coast Guard's total current number of seagoing positions. To do this successfully, the Coast Guard will have to carefully manage personnel commitments, transfers, and training to ensure that it has enough people with the specialized training and experience necessary to operate a vessel in the extreme weather conditions that the PSCs will encounter. Ensuring that there are enough trained officers and crew may require some creative approaches to qualifying crew (e.g., international exchanges, cross-training on smaller icebreakers). Commissioning new PSCs will also require that the Coast Guard augment its engineering infrastructure to support several

additional cutters that are operating far from the kinds of logistics support that all complex systems need.

Closing Remarks

Given U.S. interests in both the Arctic and the Antarctic, the United States must have the capability and capacity to operate and achieve presence in these regions to secure those interests. The investment is not an easy one to make: It adds relatively limited operating capability for the U.S. Coast Guard in comparison with its cost, given the highly specialized nature of polar operations. However, it is a very important investment to make. Although summer ice cover is declining at both poles, these regions remain subject to extreme conditions, including dynamic shifts in local ice cover, for much of the year. For many potential situations in the Arctic and Antarctic, polar icebreakers will be needed to provide the capabilities to support the increasingly diverse mission sets that are required in these regions.

There are several important planning considerations for new icebreakers, including defining future missions and determining the number that the United States should build or lease, many of which are currently being addressed by the U.S. Coast Guard through mission need statements and development of joint requirements. Overall, as the United States envisions the scale and character of its future icebreaker fleet, allowing for the possibility that the icebreakers being built may have a more diversified mission focus than current polar icebreakers is critical. Given the life spans of these assets (the *Polar Star* was built nearly 50 years ago), they are likely to be in use until the 2060s or even 2070s: The state of the Arctic, the Antarctic, and the overall globe at such distant dates remains fundamentally unknowable. Military competition, environmental protection, search and rescue, fishery enforcement, and other missions may be part of these icebreakers' repertoire, alongside traditional scientific and resupply missions.

Achieving adequate capacity in the next decade entails the acquisition of multiple icebreakers to ensure that sufficient numbers are on station at any time, including to provide for mutual rescue if needed. In addition to sustaining and expanding polar icebreaker acquisition programs for the medium and long terms, several other near-term investments should be explored as interim measures to boost capacity. These include ice-strengthening other types of cutters and leasing additional icebreaker time, as well as focusing on capabilities that do not directly relate to icebreakers, such as ensuring sufficient communications and domain awareness to support whatever operations can be conducted. Both near-term and longer-term measures, alongside the building up of complementary capabilities, such as communications and surveillance, can provide the United States with the capacity it needs to protect its interests and provide security in the remote, vast, extreme, and evolving polar environments.

Notes

[1] See, for example, Treadwell, 2009; ABS Consulting, Potomac Wave Consulting, and Systems Planning and Analysis, 2010; Laird, 2012; Arctic Domain Awareness Center, 2016; Arctic Executive Steering Committee, 2016; Independent Task Force, 2017; and Tingstad et al., 2018.

[2] Repeated massive engine failures resulted in the deactivation, despite the hull being in reasonably good condition.

[3] Backing and ramming is a technique that involves reversing and powering forward over short distances to break up very thick ice.

[4] Including building, operating, and sustaining heavy icebreakers.

[5] Medium icebreakers might be able to fulfill a large fraction of missions, but only a heavy icebreaker can handle the most-extreme environments. In addition, environmental conditions can shift during the course of a mission. Only a heavy icebreaker can rescue another heavy icebreaker under the most-adverse conditions.

[6] The Congressional Research Service reports cited earlier (O'Rourke, 2020a; O'Rourke, 2020b) contain some discussion of these issues, but a more extensive analysis involving scenarios, threats, possible future contexts, maintenance requirements, training and transit timelines, and other considerations could help specify the impact of a given size of the icebreaker fleet. The overall analysis would also contribute to dialogue about what it means that these icebreakers have multimission roles and what type of additional technological or other support they would require. It is possible that some future activities that could be supported by icebreakers might instead be conducted by other types of ice-strengthened cutters.

[7] This includes operational vessels that existed or were under construction in 2017, are technically capable of operating independently in the Arctic (regardless of whether they do in practice or not), and are owned or operated by a government entity (as opposed to a commercial vessel, which can be used for economic activities or be leased for use by others).

The most-recent data available were for 2017, and the vessels' capabilities were specified only with respect to the Arctic. However, they would presumably also be capable in the Antarctic.

[8] Some of the cost associated with these platforms reflects the need to upgrade shipbuilding equipment: Hulls of these thickness have not been built by U.S. shipyards in half a century.

[9] One concern about this approach is that assets can become unavailable if they are repurposed for other activities (e.g., resource exploration by commercial companies more timely and lucrative in their lease agreements) and might not be appropriate for executing the Coast Guard's unique blend of law enforcement and military authorities.

[10] Detailed technical specifications are not publicly available.

[11] By way of contrast, consider that the Department of the Navy has about 336,000 sailors and 186,000 marines, with a budget of $210 billion.

References

ABS Consulting, Potomac Wave Consulting, and Systems Planning and Analysis, "United States Coast Guard High Latitude Region Mission Analysis Capstone Summary," prepared for the U.S. Coast Guard, July 2010.

Argentina, Australia, Belgium, Chile, French Republic, Japan, New Zealand, Norway, Union of South Africa, Union of Soviet Socialist Republics, United Kingdom of Great Britain and Northern Ireland, and United States of America, Antarctic Treaty, 1961. As of September 30, 2020:
https://www.ats.aq/e/antarctictreaty.html

Arctic Domain Awareness Center, Center for Maritime Research, Office of University Programs, Science and Technology Directorate, U.S. Department of Homeland Security, *Rapporteur's Report: Arctic-Related Incidents of National Significance Workshop on Maritime Mass Rescue Operations*, September 6, 2016. As of September 30, 2020:
https://arcticdomainawarenesscenter.org/Arctic_IoNS

Arctic Executive Steering Committee, *Implementation Framework for the National Strategy for the Arctic Region*, Washington, D.C., March 2016. As of September 30, 2020:
https://obamawhitehouse.archives.gov/blog/2016/03/09/advancing-implementation-national-strategy-arctic-region

Bowley, Graham, and Andrew C. Revkin, "Icy Rescue as Seas Claim a Cruise Ship," *New York Times*, November 24, 2007. As of September 30, 2020:
https://www.nytimes.com/2007/11/24/world/americas/24ship.html

"China Unveils Vision for 'Polar Silk Road' Across Arctic," Reuters, January 26, 2018. As of September 30, 2020:
https://www.reuters.com/article/us-china-arctic/china-unveils-vision-for-polar-silk-road-across-arctic-idUSKBN1FF0J8

Commission on the Limits of the Continental Shelf, *Partial Revised Submission of the Russian Federation to the Commission on the Limits of the Continental Shelf in Respect of the Continental Shelf of the Russian Federation in the Arctic Ocean: Executive Summary*, 2015. As of September 30, 2020:
https://www.un.org/Depts/los/clcs_new/submissions_files/rus01_rev15/2015_08_03_Exec_Summary_English.pdf

Faulconbridge, Guy, "Russian Sub Plants Flag Under North Pole," Reuters, August 2, 2007. As of September 30, 2020:
https://www.reuters.com/article/idINIndia-28784420070802

Gould, Joe, "US Lawmaker Wants Pre-Owned Ice Ship over Coast Guard Objections," *Defense News*, September 30, 2016. As of September 30, 2020:
https://www.defensenews.com/naval/2016/09/30/us-lawmaker-wants-pre-owned-ice-ship-over-coast-guard-objections

Headquarters, U.S. Coast Guard, "U.S. Coast Guard Fact Sheet: Fiscal Year 2021 President's Budget," Washington, D.C., February 10, 2020. As of September 30, 2020:
https://www.uscg.mil/Portals/0/documents/budget/FY2021_Fact_Sheet.pdf?ver=2020-02-18-102402-127&timestamp=1582039471374

Independent Task Force, *Arctic Imperatives: Reinforcing U.S. Strategy of America's Fourth Coast*, New York: Council of Foreign Relations Press, Report 75, March 2017. As of January 10, 2018:
https://www.cfr.org/report/arctic-imperatives

Laird, Robbin, "America, Allies, and the Arctic: NORTHCOM Commander Talks Polar Strategy—Exclusive," *Breaking Defense*, December 14, 2012. As of September 30, 2020:
https://breakingdefense.com/2012/12/america-allies-and-the-arctic-northcom-commander-talks-polar-st/

Office of Waterways and Ocean Policy, U.S. Coast Guard, "Major Icebreakers of the World," updated May 1, 2017. As of September 30, 2020:
https://www.dco.uscg.mil/Portals/9/DCO%20Documents/Office%20of%20Waterways%20and%20Ocean%20Policy/20170501%20major%20icebreaker%20chart.pdf?ver=2017-06-08-091723-907

O'Rourke, Ronald, *Coast Guard Polar Security Cutter (Polar Icebreaker) Program: Background and Issues for Congress*, Washington, D.C.: Congressional Research Service, RL34391, v. 197, June 10, 2020a. As of September 30, 2020:
https://crsreports.congress.gov/product/details?prodcode=RL34391

———, *Coast Guard Polar Security Cutter (Polar Icebreaker) Program: Background and Issues for Congress*, Washington, D.C.: Congressional Research Service, RL34391, v. 199, July 29, 2020b. As of September 30, 2020:
https://crsreports.congress.gov/product/details?prodcode=RL34391

"Putin Calls Fuel Spill Unprecedented for Russia, Greenpeace Sees $1.4 Billion Damage," Reuters, June 19, 2020. As of September 30, 2020:
https://www.reuters.com/article/us-russia-pollution-damage/putin-calls-fuel-spill-unprecedented-for-russia-greenpeace-sees-14-billion-damage-idUSKBN23Q1YP

Rosen, Yereth, "The Arctic Circle May Be More Than 400 Miles North, but Seward Has Become an Arctic port," *Anchorage Daily News*, August 19, 2016. As of July 10, 2020: https://www.adn.com/arctic/2016/08/19/the-arctic-circle-may-be-more-than-400-miles-north-but-seward-has-become-an-arctic-port/

Starr, Barbara, and Chandelis Duster, "US Intercepts Russian Bombers and Fighter Jets off Coast of Alaska in International Airspace," CNN Politics, June 10, 2020. As of September 30, 2020: https://www.cnn.com/2020/06/10/politics/us-intercepts-russian-bombers-alaska/index.html

Tingstad, Abbie, Scott Savitz, Kristin Van Abel, Dulani Woods, Katherine Anania, Michelle D. Ziegler, Aaron C. Davenport, and Katherine Costello, *Identifying Potential Gaps in U.S. Coast Guard Arctic Capabilities*, Homeland Security Operational Analysis Center operated by the RAND Corporation, RR-2310-DHS, 2018. As of June 22, 2020: https://www.rand.org/pubs/research_reports/RR2310.html

Treadwell, Mead, chair, U.S. Arctic Research Commission, "U.S. Strategic Interests in the Age of an Accessible Arctic . . . What We Need to Know and Do Now," testimony for the U.S. Senate Committee on Appropriations, Subcommittee on Homeland Security, August 20, 2009. As of September 30, 2020: https://www.arctic.gov/testimony.html

Trump, Donald J., "Safeguarding U.S. National Interests in the Arctic and Antarctic Regions," memorandum for the Secretary of State, Secretary of Defense, Secretary of Commerce, Secretary of Energy, Secretary of Homeland Security, director of the Office of Management and Budget, and assistant to the President for national security affairs, Washington, D.C.: White House, June 9, 2020. As of September 30, 2020: https://www.whitehouse.gov/presidential-actions/memorandum-safeguarding-u-s-national-interests-arctic-antarctic-regions/

United Nations Convention on the Law of the Sea, December 10, 1982. As of September 30, 2020: https://www.un.org/Depts/los/convention_agreements/convention_overview_convention.htm

U.S. Code, Title 10, Armed Forces; Subtitle A, General Military Law; Part I, Organization and General Military Powers; Section 101, Definitions. As of September 30, 2020: https://uscode.house.gov/view.xhtml?req=granuleid:USC-prelim-title10-subtitleA-front&num=0&edition=prelim

———, Title 14, Coast Guard; Subtitle I, Establishment, Powers, Duties, and Administration; Chapter 1, Establishment and Duties; Section 102, Primary Duties. As of September 30, 2020: https://uscode.house.gov/view.xhtml?req=granuleid:USC-prelim-title14-section102&num=0&edition=prelim

U.S. Government Accountability Office, *Coast Guard: Arctic Strategy Is Underway, but Agency Could Better Assess How Its Actions Mitigate Known Arctic Capability Gaps*, Washington, D.C., GAO-16-453, June 15, 2016. As of September 30, 2020: https://www.gao.gov/products/GAO-16-453

About This Perspective

Icebreaking is a key enabler for maintaining polar presence amid increasing global interest in the Arctic and Antarctic. Only two operational U.S. Coast Guard cutters are capable of breaking heavy polar ice, and both have limited time left in their operational life spans. This Perspective sheds light on implementing recent plans for building additional Coast Guard icebreaking capacity. Importantly, icebreaking needs will evolve and differ between the two polar regions. More icebreaking needs to be accompanied by trained personnel and complementary capabilities, such as communications and domain awareness.

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