



Report on the Arctic Capabilities of the U.S. Armed Forces

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About This Report

The Homeland Security Operational Analysis Center (HSOAC), a U.S. Department of Homeland Security (DHS) federally funded research and development center (FFRDC) operated by the RAND Corporation, was commissioned to generate a report on the Arctic capabilities of the U.S. armed forces, as directed in Section 8424 of the National Defense Authorization Act (NDAA) for Fiscal Year 2021. This report documents the U.S. armed forces' current and planned Arctic capabilities, as well as other nations'—allies', other partners', and potential rivals'—operating capabilities in the Arctic. We evaluated limitations to U.S. access and presence, including issues related to domain awareness and communications. We also considered how cooperation with federal, international, and commercial entities affects the ability to execute national security missions and priorities where access and presence are a means for doing so.

The research was conducted using a mixed-method approach that relied on interviews, capability documentation, computer simulation and data analysis, logic modeling, and a tabletop exercise. The scope was broad in terms of mission and domain, although, in accordance with the fiscal year 2021 NDAA and research sponsor interests, some aspects of this report emphasize the surface maritime domain and U.S. Coast Guard (USCG) statutory missions, including defense readiness; ice operations; ports, waterways, and coastal security; search and rescue; law enforcement; and marine environmental protection response activities. The report's expansion beyond the scope requirements of the original NDAA is based on the need to analyze additional areas to address those that were explicitly stated in the NDAA.

This research is intended to inform the U.S. Congress and support continued Arctic planning and investments by the USCG and other U.S. armed forces. Information found in this report was current as of May 2022. We acknowledge that the ongoing war in Ukraine at the time of this writing could influence Arctic issues.

This research was sponsored by the USCG Office of Requirements and Analysis (CG-771) and conducted in the Infrastructure, Immigration, and Security Operations Program of the RAND Homeland Security Research Division, which operates HSOAC.

About the Homeland Security Operational Analysis Center

The Homeland Security Act of 2002 (Public Law 107-296, Section 305, as codified at U.S. Code, Title 6, Section 185) authorizes the Secretary of Homeland Security, acting through the Under Secretary for Science and Technology, to establish one or more FFRDCs to provide independent analysis of homeland security issues. The RAND Corporation operates HSOAC as an FFRDC for DHS under contract HSHQDC-16-D-00007.

The HSOAC FFRDC provides the government with independent and objective analyses and advice in core areas important to the department in support of policy development, decisionmaking, alternative approaches, and new ideas on issues of significance. The HSOAC FFRDC also works with and supports other federal, state, local, tribal, and public- and private-sector organizations that make up the homeland security enterprise. The HSOAC FFRDC's research is undertaken by mutual consent with DHS and is organized as a set of discrete tasks. This report presents the results of research and analysis conducted under task order 70Z02321FMDW01300, Report on Arctic Capabilities of the Armed Forces.

The results presented in this report do not necessarily reflect official DHS opinion or policy.

For more information on the RAND Homeland Security Research Division, see www.rand.org/hsrd. For more information on this publication, see www.rand.org/t/RRA1638-1.

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Summary

The United States has considerable interests in the Arctic and is one of just eight countries with territory in the region. It also has a responsibility to prepare and protect its armed forces that could be called on to secure its Arctic interests and protect its sovereignty as the region becomes an increasingly active security environment. In this report, we employ an inclusive definition of *security*, one that includes national and homeland defense, homeland security, and stewardship and safety. Russia continues to maintain and upgrade large-scale, credible Arctic military capabilities. Moreover, China's growing economic and scientific aspirations in the region could enable it to expand its influence and capabilities there. Beyond strategic competition and growing concerns about tensions between Russia and the North Atlantic Treaty Organization (NATO) (which could yet increase since the 2022 intensification of the war in Ukraine), the armed forces of the United States—particularly the U.S. Coast Guard (USCG)—contend with safety, law enforcement, legal, other homeland and national security, and environmental issues in the region.

The U.S. Congress has passed legislation reflecting its concerns about the ability of U.S. armed forces to operate freely in the Arctic and to protect themselves in the region, as well as the capabilities of the U.S. armed forces relative to those of other (especially potential rival) nations. Specifically, the National Defense Authorization Act (NDAA) for Fiscal Year 2021 identified the need for a report on the Arctic capabilities of the armed forces. Overall, the report elements requested in the NDAA raise two research questions:

- How do the U.S. armed forces' capabilities differ from those of other countries operating in the Arctic, including Russia, China, and various U.S. allies and like-minded partners?
- To what extent are foreign military and commercial entities operating in parts of the Arctic inaccessible to U.S. armed forces, particularly in the surface maritime domain, and what potential risks might these activities and any differences in regional access pose to USCG forces and to U.S. national interests?

To meet the needs identified in this legislation, the USCG Office of Requirements and Analysis (CG-771) commissioned a study by the Homeland Security Operational Analysis Center, a federally funded research and development (R&D) center operated by the RAND Corporation for the U.S. Department of Homeland Security (DHS). The study was conducted using a mixed-method approach that relied on different qualitative and quantitative data sources. The research team conducted interviews with more than 20 USCG and U.S. Navy maritime planners and operators with experience and jurisdiction in the Arctic. The research team also had access to other U.S. government decisionmakers and Arctic scholars through engagements at events and conferences through such institutions as the Atlantic Council, the Arctic Frontiers Conference, the Canadian Global Affairs Institute, and U.S. Northern Command. Capabilities were documented using publicly available information about capability inventories, Arctic operations, and relevant exercises and supplemented with interviews and expert engagements. Furthermore, the team examined Russia's and China's plans and possible intentions for the Arctic, given the emphasis on these two countries in the fiscal year 2021 NDAA. Gridded monthly mean sea ice–concentration and thickness projections were employed to develop assumptions for how Arctic surface maritime access might evolve in the future from a physical science perspective. In addition, we adapted an existing geographic information system–based model to operationalize the implications of projected sea ice–decline patterns by simulating (1) access differentials between vessels of differing icebreaking capabilities and (2) travel time comparisons between various port facilities. The interviews, capability documentation, threat analysis, future sea ice projections, and geographic information system modeling all fed scenarios and assumptions that were used for a tabletop exercise (TTX) that examined U.S. Arctic access and associated challenges under various circumstances. The TTX was conducted with

more than 70 participants, including representation from the U.S. Air Force, U.S. Army, the USCG, the U.S. Navy, U.S. Space Force, U.S. European Command, the North American Aerospace Defense Command, U.S. Northern Command, the U.S. National Guard, U.S.-based military research centers and laboratories, and academia. Finally, the team employed a logic model to synthesize results from the interviews, threat analysis, modeling, and TTX that pertained to USCG needs for operating in the Arctic.

This report summarizes the findings of this research and is intended to, at a minimum, address the congressional request; it could also contribute related, independent findings about broad U.S. Arctic needs and issues. In the rest of this summary, we describe our main findings and recommendations.

The United States Has Important Arctic Capacity and Capability Shortfalls

Analysis conducted over the course of this project suggests that **a primary limitation for the United States is capacity, rather than capability, to operate in the Arctic.** (*Capability* refers to what can be accomplished, while *capacity* refers to the volume, frequency, or amount that can be done.) In other words, there is no evidence of other Arctic actors being able to access parts of the Arctic that the United States fundamentally cannot, based on the inventory of U.S. capabilities that are either currently available or planned for the near term. However, the team found that Russia (in both government and commercial interests) has the capacity to sustain a strong day-to-day presence in the maritime Arctic in a way that the United States does not. Furthermore, Russian knowledge of operating in varying sea ice conditions is considerable, although safely navigating the maritime Arctic appears to be a challenge for all actors. China's capacity is also growing, while the capacity of several U.S. allies and like-minded partners is also growing or steady, with few exceptions. Other Arctic countries also have a strong capability to operate across the Arctic land, coastal, and air environments.

The U.S. armed forces' most-urgent needs for Arctic access and presence fall into the following categories:

- assets with proximity to support response
- multidomain awareness and communications
- infrastructure for response and logistics
- sufficient cadres of personnel who are trained, current, and proficient with the skills to operate in this harsh environment
- tactics and equipment for low-probability, high-impact incidents
- the ability to scale presence.

In comparing U.S. Arctic capabilities with those of other Arctic states, the research team observed that each of four attributes—capacity, priority, capability, and interoperability—limits U.S. access to and presence in the Arctic. These attributes are defined in Figure S.1.

Most important is that the U.S. armed forces face a lack of capacity in the region to meet strategic security interests in ways articulated by national, departmental, and service-specific Arctic strategies. There are simply not enough polar-capable assets and trained personnel to ensure enduring presence across the region at scale. Also notable is that other Arctic actors' regional capabilities are generally scaled to their geographies, needs, and interests. In contrast, despite its polar interests, the United States faces substantial capacity shortfalls in many areas. For example, as of this writing, the USCG had two operational polar icebreakers: the half-century-old heavy icebreaker USCG Cutter (USCGC) *Polar Star* and the medium icebreaker USCGC *Healy*. Historically, aside from the period when the USCGC *Polar Star* was temporarily out of service pending a major refit from 2006 through 2012, the current fleet is the smallest it has been in the past 60 years, as

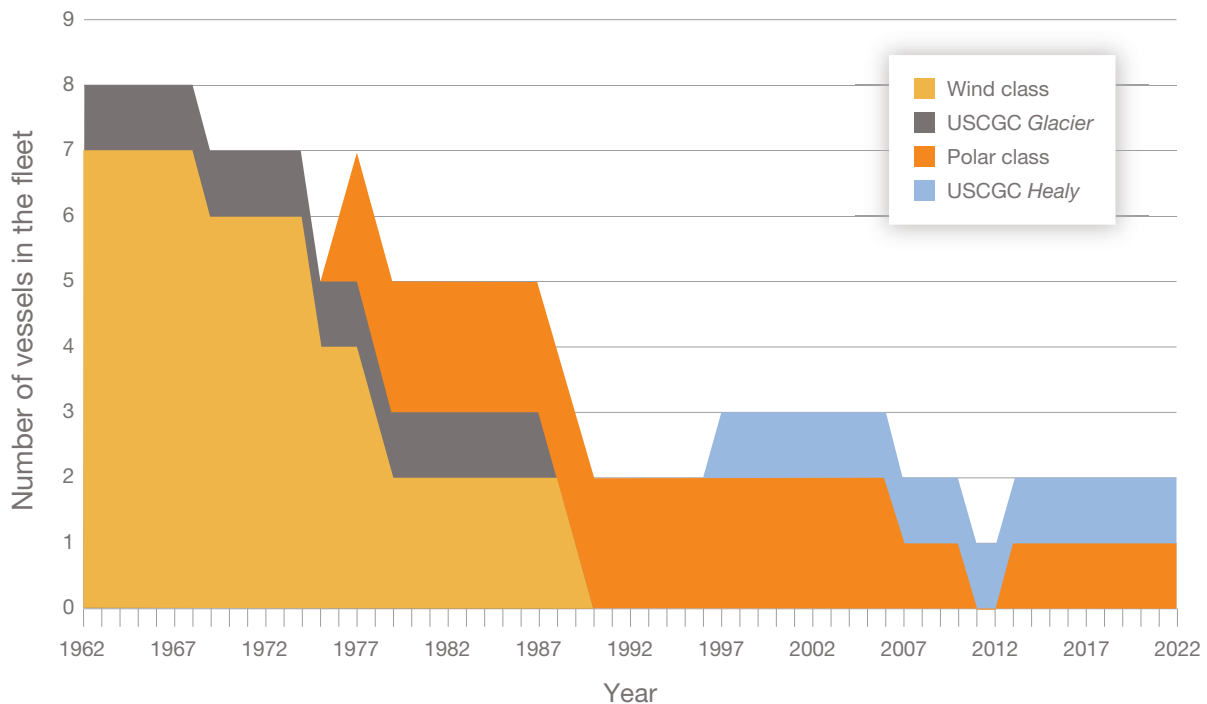
FIGURE S.1
Four Attributes Illustrated in the Comparative Capability Analysis



shown in Figure S.2. In the early 1960s, the USCG had eight icebreakers capable of operating in the Arctic or Antarctic; as of this writing, it had two active icebreakers capable of operating in the polar regions.

The capacity attribute is exacerbated by priority at the national level for the Arctic, which drives decisions about global force management and capability allocation and apportionment. The USCG would benefit from operating in the Arctic with additional joint resources for domain awareness, communications, and

FIGURE S.2
The U.S. Coast Guard Polar Icebreaking Fleet, 1962–2022



SOURCES: Features information from USCG, “US Coast Guard Cutter Fact Sheets (Alphabetical),” webpage, undated-b; and USCG, *The Cutters, Boats, and Aircraft of the U.S. Coast Guard*, June 14, 2018.

NOTE: This chart includes only ice-capable icebreakers, not the less capable icebreakers designed for the Great Lakes and northeastern United States. The Polar class of vessels, such as the USCGC *Polar Star*, is a specific class of icebreaker within this category of ice-capable icebreakers.

defensive capabilities. Achieving this end could be hindered at least in part by the priority attribute, although we acknowledge that undertaking a decision at the national level to prioritize more resources for the Arctic would necessarily reduce resources for other important missions. This report does not offer any recommendations as to whether the Arctic should be prioritized, just that more assets might be available for the region if it were afforded even higher priority.

Capability issues also exist, most prominently for domain awareness, communications, logistics, and USCG defensive measures. However, these are, in part, similar challenges for all Arctic actors. The main difference is that some other actors have prioritized their existing capabilities for Arctic operations to a greater extent than the United States has, and they have invested in capacity (i.e., having more instances of those capabilities). Finally, even where allies and partners have capabilities that can mitigate U.S. military shortfalls in the Arctic, being able to rely on those capabilities requires a high degree of interoperability.

Leaving these issues without resolution could lead to several types of risk to U.S. regional interests, including the following:

- potential inability to fulfill responsibilities (e.g., for search and rescue and oil spill response) when called on
- loss of life, property, economic potential, and environmental integrity
- limitations in being able to operate with and rely on partners
- growth in Russian control and potential for aggression in concert with a loss of possible opportunities to engage in positive diplomacy
- expansion of China's regional influence
- accidental escalation of NATO–Russia tensions
- global perception of U.S. absence and a security void, which would exacerbate some of the other risks
- lack of control over Arctic narratives.

Recommendations

We developed a series of recommendations based on the research findings to further bolster the USCG's ability to work with fellow armed forces to secure U.S. regional interests, domestic and international, which we present in this section.

Bolster Momentum in Implementing the Arctic Strategies of the U.S. Department of Homeland Security, the U.S. Coast Guard, the U.S. Department of Defense, and the Military Services

Funding and the need to attend to other priorities can make it challenging to bridge the gap between strategy and action. Regularly updating strategy documents, formalizing actions and collaborations through implementation plans, advocating for stronger emphasis on the Arctic in national-level strategies and plans as appropriate, and continuing to place liaisons in other U.S. government and foreign-partner offices would help enable momentum and continuity of effort.

Continue Efforts to Expand Funding for Priority U.S. Coast Guard and U.S. Department of Homeland Security Needs

No single investment will resolve all the challenges identified in this and other reports (i.e., there is no silver bullet). However, this research further establishes the basis for certain needs that the USCG and DHS have

already identified. Given the USCG's leading role and responsibilities in much of the Arctic, these needs should be addressed to improve collective U.S. capabilities in the Arctic, including those that involve other services.

First, fund additional icebreaking vessels to mitigate some surface maritime presence shortfalls, enabling the USCG to be simultaneously present in both the western and eastern parts of the North American Arctic and in the various approaches to these areas, in addition to fulfilling Arctic responsibilities. Adding ice-breaking vessels would also increase the likelihood that an icebreaker would be close enough to any event in the Arctic to effectively address it in a timely manner. However, planning for future icebreaking capabilities must consider that most of the regional activity will occur in the increasingly protracted warmer months, so other vessels with the appropriate strengthening or hardening could also be used to meet some capacity shortfalls.

Second, complete the deepwater port at Nome, Alaska. This will emplace a more capable key maritime logistics node in the U.S. Arctic,¹ more than 700 miles north of the one at Dutch Harbor in southern Alaska. The vast distances in the Arctic make it difficult to respond within a few days in many locations without port infrastructure to host ships and support operations. Equitable engagement on local cultural and environmental issues is key to the success of this future infrastructure.

Third, consider making more use of naval facilities along the New England coast to support operations on the other side of the North American Arctic. An Atlantic base is particularly important for increasing responsiveness and on-station time in the vicinity of Canada and Greenland and in the European Arctic. Partnering with Canada could also be useful in this respect as it completes refurbishment of its Nanisivik Naval Facility in Nunavut, in northeastern Canada, which could also help support U.S. Arctic operations in eastern North America and Europe.

Fourth, identify low-hanging fruit for domain-awareness and communication investments. This could involve carefully reviewing the design of new cutters and considering what missions these might conduct that could require specialized capabilities, such as undersea monitoring equipment, to support the defense readiness mission. This could also involve working with joint partners to determine whether the USCG and other DHS components, as needed, can take advantage of existing U.S. Department of Defense contracts or plans to buy equipment and services that could help limit the cost for DHS.

Seek Opportunities to Benefit from Commercial Investments

Commercial enterprises are working on solutions for domain awareness, communications, and logistics in the region knowing that potential consumers include not only other businesses but also local communities, the military, and other government agencies. This presents an opportunity for USCG and perhaps broader DHS R&D and acquisition to take advantage of commercial innovation and form early partnerships to ensure that designs meet their specific needs and to gain access to capabilities (e.g., bandwidth, novel concepts for mobile infrastructure) in the early stages of deployment, when demand might exceed supply.

Strengthen Research Partnerships

Several U.S. entities—such as the University of Alaska, the USCG R&D Center, and the U.S. Navy's Office of Naval Research—have strong Arctic technology research programs. DHS-wide and USCG leveraging of these institutions for Arctic expertise should continue. DHS and the USCG should also continue coordinat-

¹ Naturally, some important local community and environmental factors must be considered.

ing with Department of Defense partners, including the recently inaugurated Ted Stevens Center for Arctic Security Studies.

Funding projects is one way to strengthen research relationships, of course, but there are also other options to consider. For example, DHS and the USCG might explore supporting additional fellowship programs, hosting conferences, and inviting the research community to increase participation in exercises and experiments when appropriate. It might also be beneficial to conduct additional outreach to the National Science Foundation, the National Aeronautics and Space Administration, and the National Oceanic and Atmospheric Administration to find opportunities to shape research proposal calls or synchronize matching research funding. The USCG is also partnering with the Navy on different research partnerships, some of which include federally funded R&D centers.

Additional above-the-line funding might be needed and should be considered for prioritization to enable resolving the issues noted in this report. Without prioritizing R&D funding, addressing this recommendation will be difficult.

Strengthen International Partnerships

The USCG and DHS have recognized the importance of international partnerships in Arctic strategy documents and, in some instances, have developed deeper ties with foreign partners for Arctic presence, training, exercises, and gaming. Similarly, U.S. military services have worked closely with their international counterparts to improve their collective capabilities in the Arctic, with all involved countries benefiting from the reciprocal exchange of knowledge about capabilities, capacity, geography, and experiences. We recommend that the USCG, DHS, and—as appropriate—military services continue taking part in and expanding partnerships when possible. These include tactical engagements, such as the international shiprider program, as well as research. Efforts can include finding ways to share intelligence and other information more widely and sooner. Investments can also make better use of partnerships—by, for example, increasing interoperability to enable greater shared use of Arctic-savvy personnel and improving overall capacity.

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Introduction

The United States has a variety of military, economic, environmental, scientific, political, and other interests in the Arctic. The region is essential for safeguarding the northern flanks of both North America and Europe. Thousands of people live in the Alaskan Arctic, a region of rich resources and a fragile environment. As one of just eight Arctic nations, the United States, alongside its allies and partners, has interests in and responsibilities for securing the region. All six of the U.S. military services—the U.S. Air Force (USAF), the U.S. Army, the U.S. Coast Guard (USCG), U.S. Marine Corps, U.S. Navy (USN), and the U.S. Space Force (USSF)—play roles in contributing to Arctic security.¹ Most of these services have published formal Arctic strategy documents.

The Arctic is a challenging region in which to operate. Its physical remoteness and its vastness create a dual challenge exacerbated by sparse infrastructure. The Arctic's extreme and variable climate is harder on personnel than more-temperate environments are. It also damages equipment and prevents some systems from being used there at all. Communications and situational awareness capabilities are also attenuated by limited numbers of assets and unique polar electromagnetic effects.

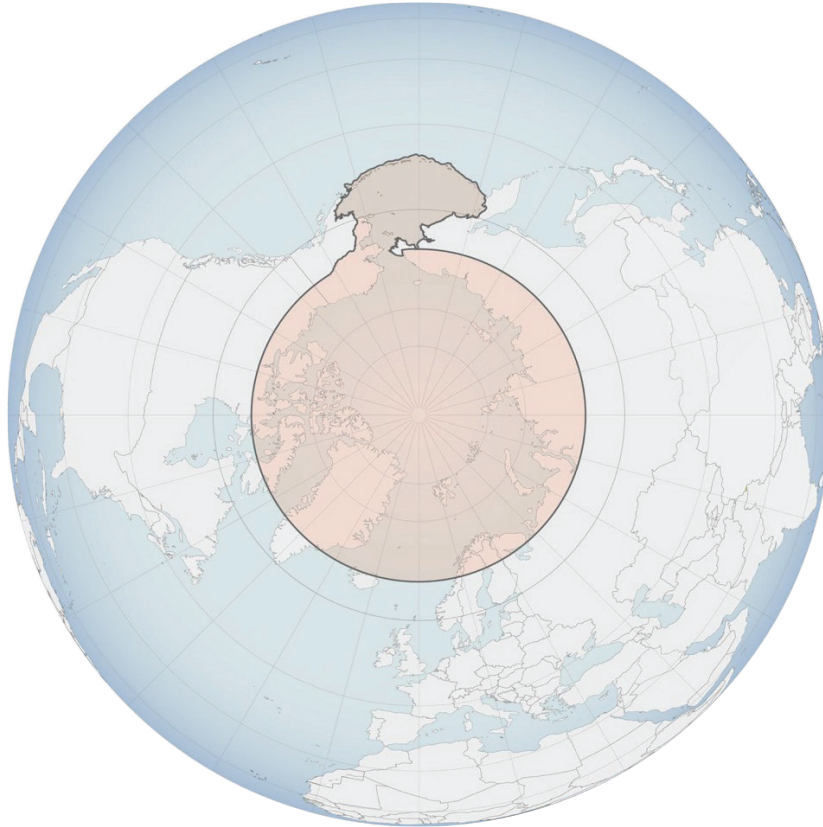
Moreover, the U.S. military has invested relatively little in Arctic capabilities for the size of its Arctic area of responsibility, compared with the investments made by some other countries. As we discuss later in this report, Russia and China have focused on expanding their Arctic capabilities in recent years (as have some U.S. allies and partners). The U.S. Congress indicated concern about these issues in Section 8424 of the National Defense Authorization Act (NDAA) for Fiscal Year (FY) 2021. The NDAA specified the need for a report on the Arctic capabilities of the armed forces that would compare the Arctic military capabilities of the United States, Russia, China, and other nations.² The specified report would encompass issues involving all of the military services, although some of the NDAA language focused on maritime access and especially on risks associated with USCG forces operating in the region with or without support from other services—in particular, the USN. The USCG Office of Requirements and Analysis (CG-771) commissioned the Homeland Security Operational Analysis Center (HSOAC), a federally funded research and development center operated by the RAND Corporation for DHS, to do this research and publish the current report in fulfillment of the NDAA's mandate. At times, the need for supporting information to analyze items mentioned in the NDAA led to additional research that had not been explicitly mandated in it.

The U.S. government formally defines the Arctic region as encompassing the area within the Arctic Circle, as well as the entire Bering Sea and those portions of Alaska to the northwest of the Porcupine, Yukon, and Kuskokwim Rivers. This region is shown in Figure 1.1, and its definition was enshrined into law in the Arctic Research and Policy Act of 1984. Around 40 percent of it is land (approximately 11,618,330 km²), most

¹ Five of these services are part of the U.S. Department of Defense (DoD), while the USCG is a military service with missions for DoD and for the U.S. Department of Homeland Security (DHS).

² It is also excerpted in this report as Appendix A, available online.

FIGURE 1.1
The U.S. Congress’s Definition of the Arctic



SOURCE: Features information from Public Law 98-373, an act to provide for a comprehensive national policy dealing with national research needs and objectives in the Arctic, for a National Critical Materials Council, for development of a continuing and comprehensive national material policy, for programs necessary to carry out that policy, including federal programs of advanced material research and technology, and for innovation in basic material industries, and for other purposes, July 31, 1984, Title I, Arctic Research and Policy Act of 1984.

of which rings the Arctic Ocean.³ Although various scientists and organizations have proposed and used other definitions for the Arctic, in this report, we use the official U.S. government definition. Naturally, the boundaries of the Arctic are porous, with actions outside the region affecting those within it and vice versa, so we periodically touch on issues outside the region.

Overall, the report elements requested in the NDAA raise two research questions:

- How do the U.S. armed forces’ capabilities differ from those of other countries operating in the Arctic, including Russia, China, and various U.S. allies and like-minded partners?
- To what extent are foreign military and commercial entities operating in parts of the Arctic that are inaccessible to U.S. armed forces, particularly in the surface maritime domain, and what potential risks

³ Arctic Centre, University of Lapland, “Multi-Coloured Arctic,” webpage, undated. The area estimate is calculated based on the data provided by the Center for Circumpolar Security Studies at the Arctic Institute. It includes all of Iceland plus Lapland in Finland and presumes that one-fifth of Russia is inside the Arctic Circle. See Center for Circumpolar Security Studies, Arctic Institute, “Country Backgrounders,” webpage, undated.

might these activities and any differences in regional access pose to USCG forces and to national interests?

Research Objectives, Tasks, and Methods

This report employs a definition of *security* that includes national and homeland defense, homeland security, and stewardship and safety. This research meets four objectives, which collectively oriented the scope of work such that it would, at a minimum, address the five elements required in the NDAA and could contribute related, independent findings about needs and issues through a USCG lens (given that the USCG was the research sponsor):

- Document U.S. armed forces' current and planned Arctic capabilities, with emphasis on defense readiness, ice operations, port and waterway security, search and rescue (SAR), law enforcement, and marine environmental response (MER) from a USCG perspective.
- Document other nations'—including allies', partners', and competitors'—operational capabilities (including domain-awareness capabilities) in the Arctic.
- Identify U.S. armed forces' capability needs based on the difference between the aims articulated in strategies and current and near-term capabilities.
- Identify how the United States can enhance mission effectiveness in the Arctic through USCG and DoD partnerships with other Arctic nations.

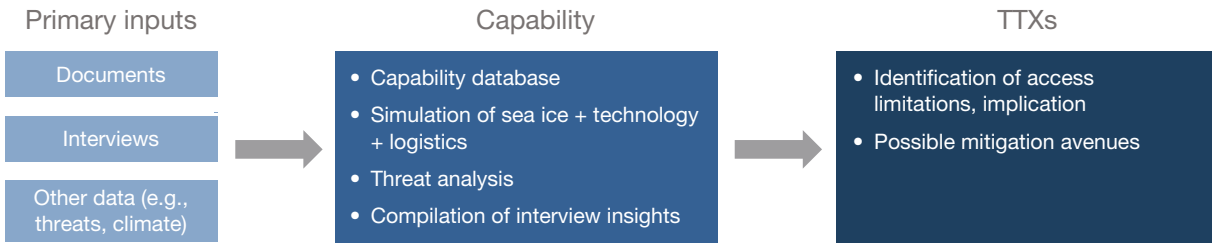
In turn, we employed a mixed-method approach to execute six research tasks to meet these objectives:

1. Compare the Arctic capabilities of the United States, Russia, China, and other countries.
2. Describe commercial and foreign military surface maritime forces currently operating in conditions that are inaccessible to U.S. surface maritime forces.
3. Assess potential security risks that military forces of other countries operating in the Arctic pose to USCG forces.
4. Identify potential security risks that foreign military forces operating in Arctic pose to U.S. interests.
5. Compare the Arctic domain-awareness capabilities of the USCG operating alone with capabilities possible in the context of joint operations (i.e., with other services) or coalition operations (i.e., with other services, allies, and partners).
6. Compare the defensive capabilities of the USCG operating alone with capabilities possible when operating jointly with other services or in a coalition with international partners.

Primary activities used to execute these research tasks included review of published strategies and research documents for key themes, subject-matter expert (SME) interviews with members of the USCG and USN (given the focus on surface maritime operations), capability documentation, threat analysis, geographic information system (GIS)-based computer simulation, a series of tabletop exercises (TTXs) that included participation from across the U.S. armed forces and other U.S.-based experts, and a logic model for USCG Arctic needs. Figure 1.2 illustrates in simplified form the research process used.

We interviewed more than 20 USCG and USN maritime planners and operators with experience and jurisdiction in the Arctic. We also had access to other U.S. government decisionmakers and Arctic scholars through engagements at events and conferences through such institutions as the Atlantic Council, the Arctic Frontiers Conference, the Canadian Global Affairs Institute, and U.S. Northern Command (USNORTHCOM). Capabilities were documented using publicly available information about capability inventories, Arctic oper-

FIGURE 1.2
Summary of Research Flow



ations, and relevant exercises and supplemented with the interviews and expert engagements. Furthermore, given the emphasis on Russia and China in the FY 2021 NDAA, we examined those two countries' plans and possible intentions for the Arctic and, subsequently, the potential Arctic-relevant implications of the 2022 intensification of the war in Ukraine and deepening of ties between Russia and China. We reviewed the various U.S. Arctic strategy documents in addition to those documents used to distill information about capabilities and those employed to synthesize publicly available knowledge about Russia's and China's Arctic activities and intentions. We also employed available gridded monthly mean sea ice–concentration and thickness projections to develop assumptions for how Arctic surface maritime access might evolve in the future from a physical science perspective. In addition, we adapted an existing GIS-based model to operationalize the implications of projected sea ice–decline patterns by simulating (1) access differentials between vessels of differing icebreaking capability and (2) travel time comparisons between various port facilities.⁴

The interviews, capability documentation, threat analysis, future sea ice projections, and GIS modeling all fed scenarios and assumptions that were used for a TTX that examined U.S. Arctic access and associated challenges under various circumstances. The TTX was conducted with more than 70 participants and included representation from the USAF, the U.S. Army, the USCG, the USN, USSF, U.S. European Command (USEUCOM), the North American Aerospace Defense Command (NORAD), USNORTHCOM, the U.S. National Guard, U.S.-based military research centers and laboratories, and academia. Finally, we employed a logic model to synthesize results from the interviews, threat analysis, modeling, and TTXs that pertained to USCG needs for operating in the Arctic. Additional information on these methodological approaches can be found in the chapters that follow and the appendixes available online. The documents examined are referenced throughout the report.

The FY 2021 NDAA specifies a focus on areas inaccessible to USN surface maritime forces. However, it does not indicate a particular time frame; we ultimately focused on the present (2022) and the future date of 2035. We selected 2035 to enable planned and funded capabilities to be incorporated into the analysis while limiting the degree of uncertainty about the physical, geopolitical, and operational environments. The NDAA also does not suggest a set of missions or activities to be conducted in the Arctic that should be considered in this report. Nor was there a U.S. armed forces' Arctic mission set as of the writing of this report, although we acknowledge that the Arctic strategy documents referred to earlier in this chapter contain specified strategic aims and missions that are not explicitly coordinated between these documents. That said, cooperation with allies and like-minded partners and concern about potential adversarial activities are somewhat common themes across these documents. We also note that one of NORAD's missions, to conduct "aerospace warning, aerospace control and maritime warning in the defense of North America," covers areas of the U.S. and

⁴ Scott R. Stephenson and Laurence C. Smith, "Influence of Climate Model Variability on Projected Arctic Shipping Futures," *Earth's Future*, Vol. 3, No. 11, November 2015.

Canadian Arctic in its regions.⁵ Furthermore, USNORTHCOM “plans, organizes and executes homeland defense and civil support missions” and geographically splits combatant command responsibility for the Arctic with USEUCOM, although U.S. Indo-Pacific Command also has jurisdiction in the north Pacific approaches to the Arctic.⁶

Thus, our assumption about Arctic missions focused the research on a combination of homeland defense, cooperation with allies and like-minded partners, strategic competition, and a subset of USCG statutory missions.⁷ In coordination with the research sponsor, we identified a subset of USCG missions considered in the research that included defense readiness, ice operations, port and waterway security, SAR, law enforcement, and MER. Defense readiness included consideration of both gray zone-type threats and preparation for military operations and escalation management in different parts of the Arctic. Although we recognized the potential for other missions and other types of threats or operations (e.g., nuclear deterrence or power projection to support other global operations), we explicitly declined to focus on these in order that we could better consider issues more specific to the Arctic region.⁸

Limitations

This research had numerous limitations. First, because of limitations on both time and access, we could not interview all the experts who could have provided valuable input to the research. Second, additional participants in the TTXs would have been useful. Although several important organizations were represented, we could not, for example, equally balance the number of participants from each branch of the military. We would also have liked to have participation from the Joint Staff and U.S. Indo-Pacific Command, among other key stakeholders. We also limited our interviews and TTXs to U.S. participants, to focus on U.S. interests, capabilities, capacities, and needs. We attempted to partially rectify limitations in our expert elicitation by engaging experts familiar with broad aspects of the Arctic (e.g., from academia), by participating in external Arctic meetings and conferences that included non-U.S. participants, and by drawing on our prior Arctic work.⁹

Another limitation was our access to detailed information on U.S. and other nations’ Arctic capabilities. The primary reason for this is that these data are typically not neatly compiled, even if they are accessible, so we had to draw from numerous sources and, in some cases, make inferences (e.g., based on participation in an exercise). Despite our having gathered considerable detail on Russia’s and China’s Arctic activities and intentions, potential sensitivities could limit our ability to cover all key issues in this report. Finally, we did

⁵ NORAD, “North American Aerospace Defense Command,” webpage, undated.

⁶ Timothy Hale, “COCOM World Map,” image, U.S. Army Reserve photo gallery, undated; USNORTHCOM, “Our Story,” webpage, undated.

⁷ That is, those missions pertaining to maritime (surface and subsurface) and air threats.

⁸ In other words, we focused on issues about Arctic operations rather than utilizing the Arctic as a strategic location to enable operations elsewhere.

⁹ This work includes Stephanie Pezard, Abbie Tingstad, Kristin Van Abel, and Scott R. Stephenson, *Maintaining Arctic Cooperation with Russia: Planning for Regional Change in the Far North*, RAND Corporation, RR-1731-RC, 2017; Benjamin J. Sacks, Scott R. Stephenson, Stephanie Pezard, Abbie Tingstad, and Camilla T. N. Sørensen, *Exploring Gaps in Arctic Governance: Identifying Potential Sources of Conflict and Mitigating Measures*, RAND Corporation, RR-A1007-1, 2021; Abbie Tingstad, *Climate Change and U.S. Security in the Arctic*, RAND Corporation, CT-517, 2019; Abbie Tingstad, 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*, HSOAC operated by the RAND Corporation, RR-2310-DHS, 2018; and Abbie Tingstad, Scott Savitz, Dulani Woods, and Jeffrey A. Drezner, *The U.S. Coast Guard Is Building an Icebreaker Fleet: What Comes Next? Issues and Challenges*, RAND Corporation, PE-A702-1, 2020.

not use alternative climate projections and models to model future sea ice patterns. However, prior research has demonstrated that the patterns represented in our work are fairly consistent regardless of which projections and models are used.¹⁰

Report Outline

The remainder of this report focuses on key topics identified in the FY 2021 NDAA for this work to address. Chapter 2 identifies current U.S. Arctic interests through a review of its key strategy documents, including those of DoD and DHS. Chapter 3 reviews current and planned U.S. armed forces' Arctic capabilities in the context of selected other countries' assets and commercially available capabilities. Chapter 4 distills research results on U.S. Arctic shortfalls, risks, and needs. Chapter 5 summarizes our findings, and Chapter 6 provides a conclusion and specific recommendations to the USCG and DHS, some of which could also have relevance to the other armed forces and DoD.

Finally, we have provided (separately online) eight appendixes that provide detailed documentation of specific research methodologies and other topics that were essential for generating the observations and findings discussed in the main body of the report, as well as more details that might be of interest to specific subsets of readers. Appendix A reproduces Section 8424 of the FY 2021 NDAA requiring a "report on the Arctic capabilities of the Armed Forces." Appendix B provides a more in-depth examination of Russia's and China's Arctic interests and investments. Appendix C provides the results of the TTX series and interviews, which were particularly salient in informing the findings, conclusions, and recommendations in this report. Appendix D details icebreaking capabilities and illustrates some possible implications of any additional capacity in this area. Appendix E outlines the logic model that was used to synthesize results from our research activities that informed our conclusions about capability needs and capacity issues. Appendix F provides additional technical details about our use of a computer simulation of Arctic surface maritime access. Appendix G describes the TTX and the scenarios used. It includes details on the scenarios, theoretical state of the world, and shocks to the international order. For additional context on strategic issues in the region, Appendix H summarizes outstanding issues for Arctic cooperation and disputes.

¹⁰ See, for example, Pezard et al., 2017, and Stephenson and Smith, 2015.

U.S. Arctic Interests

In this chapter, we discuss why it is imperative that the United States and its armed forces have a presence in the Arctic, as well as how access issues can limit this presence. As noted in Chapter 1, the United States has numerous, diverse interests in the Arctic region. We begin with a more detailed review of these through the lenses of different U.S. national and service-specific strategy documents. Understanding U.S. interests provides important context for why regional presence and, hence, access are needed. The rich variety of interests we describe here imply, in some cases, competing values or, at the very least, competition for priority. For example, encouraging economic development can, in some circumstances, invite further marginalization of Indigenous communities and harm to the natural environment. Different interests can lead to different needs for presence and access, so we explored diverse sources to capture a holistic view.

We also discuss how factors of change could evolve the United States' Arctic interests. Regional interests do not exist in a vacuum; rather, they are subject to several important forces—climatic, geopolitical, economic, and social—that are charting the future of this northernmost region of the world. These changing factors also influence the safety of the armed forces protecting national interests, whether because of evolving environmental hazards, new law-enforcement demands, or an aggressive competitor operating in the region.

Interests Articulated in Arctic Strategy Documents

The 2010 National Security Strategy was historic in its attention to the Arctic. Although more-recent documents have superseded it, we note it here because it succinctly articulates the United States' Arctic interests since the onset of the 21st century:

The United States is an Arctic Nation with broad and fundamental interests in the Arctic region, where we seek to meet our national security needs, protect the environment, responsibly manage resources, account for indigenous communities, support scientific research, and strengthen international cooperation on a wide range of issues.¹

In 2022, the United States released a new national Arctic strategy; prior to this, the most recent national strategy had been released in 2013, which was subsequently accompanied by a 2014 implementation plan and a 2016 implementation framework. The 2013 strategy identified lines of effort related to security and stewardship interests, in addition to encouraging international cooperation. The 2022 document also organizes security first, acknowledges the importance of Indigenous presence and history in the region, and notes diverse regional challenges related to safety and stewardship. This most recent strategy continues to emphasize the importance of dialogue and—as feasible—cooperation.

¹ Executive Office of the President, *National Security Strategy*, White House, May 2010, p. 50.

DoD, DHS, and most of the armed services have also produced their own Arctic strategy documents in which they have articulated their respective roles in managing and protecting U.S. interests and their regional objectives and missions. These strategies stress several common themes, including the advancement of U.S. security interests, the enhancement of Arctic capabilities and operations, the pursuit of responsible stewardship, and the strengthening of international cooperation with allies and partners, especially other Arctic states. The 2019 DoD Arctic strategy outlines three goals: Enhance Arctic operations, build Arctic awareness, and advance Arctic governance.² It also stresses the need to strengthen the rule-based order in the Arctic.³

DoD's high-level objectives correspond closely with those in the 2021 DHS Strategic Approach for Arctic Homeland Security. This strategy articulates the need to secure the homeland through persistent presence and all-domain awareness; strengthen access, response, and resilience in the Arctic; and advance Arctic governance and a rule-based order through targeted national and international engagement and cooperation.⁴

Furthermore, the April 2019 USCG Arctic Strategic Outlook presents several points of relevance to the Arctic region. It notes Russia's coercion of other states and attempts to expand its sphere of influence in other parts of the world, which it might seek to replicate in the Arctic environment. The authors also commented that competitors had found ways to use established international frameworks to their advantage, when possible, but also to defy those frameworks when convenient. They cited China's attempts to counter freedom of navigation and its impingement on other countries' territories in the South China Sea as potentially foreshadowing future efforts elsewhere, including the Arctic.

How the Changing Physical, Geopolitical, Economic, and Social Environments Affect Interests and Security

The United States has had sovereign rights and responsibilities in the Arctic since it acquired Alaska from the Russian Empire in 1867. Although U.S. public interest in the region has periodically waxed and waned and changed in character over the decades since then, the concept of having formal responsibilities in the region—and the role the armed forces play in executing these—has not. However, changes in the physical, operational, geopolitical, economic, and social environments in the most-recent few decades have foreshadowed and, in some cases, realized changes in emphasis and in urgency related to U.S. national interests in the Arctic region. For example, the possibility of a navigable waterway across the North Pole and the need to engage and leverage Indigenous knowledge have spotlighted these types of issues to the U.S. public. This has, in turn, begun to shift demand in some cases for armed forces' access to and presence in the Arctic to maintain security of U.S. national interests. In this section, we describe in some detail what has been shifting in the Arctic, then discuss why these shifts affect demand for armed forces' presence in and access to the Arctic.

Climate Change Impacts

In the past several years, the Arctic has been gaining global attention because it is considered a canary in a coal mine for global climate change. This region is experiencing more-rapid climate warming than much of

² Office of the Under Secretary of Defense for Policy, DoD, *Report to Congress: Department of Defense Arctic Strategy*, June 2019, p. 1.

³ Office of the Under Secretary of Defense for Policy, 2019, p. 1.

⁴ Office of Strategy, Policy, and Plans, DHS, *Strategic Approach for Arctic Homeland Security*, February 17, 2021, p. 15.

the rest of the planet for multiple reasons, including the fact that losing snow and ice accelerates warming because these materials are more reflective of sunlight than the bodies of water into which they melt are.

Many of the ongoing, resulting effects are quite negative for Arctic communities, wildlife, and environment. Rising sea levels, coastal erosion, and melting permafrost are removing and destabilizing the ground beneath settlements and communities. Melting sea ice alters marine ecosystems. The loss of land-based ice raises sea levels and has major landscape and ecosystem effects. Iconic species, such as polar bears, are losing their habitat and ability to sustain themselves.

Other Arctic climate change impacts have received more debate over the relative problems and potential opportunities they drive. One of the best publicized of these is the anticipation of an opening of parts of the Arctic Ocean that had previously been less accessible because of thick year-round ice cover. This trend is oversimplified, for several reasons:

- First, Indigenous populations and others have long lived and operated in various portions of the Arctic, including its waters.
- Second, surface maritime access is increasing, but mainly during the warmer months of the year, while thawing permafrost on land is actually making access more difficult in some locations.
- Third, even with reduced seasonal ice cover in many places, the Arctic Ocean is still a vast, difficult-to-navigate area with numerous other environmental impediments, such as little or no daylight in winter, electromagnetic interference due to polar ionospheric effects, moving ice, and shallow, relatively uncharted waters along much of the Northwest Passage (NWP).

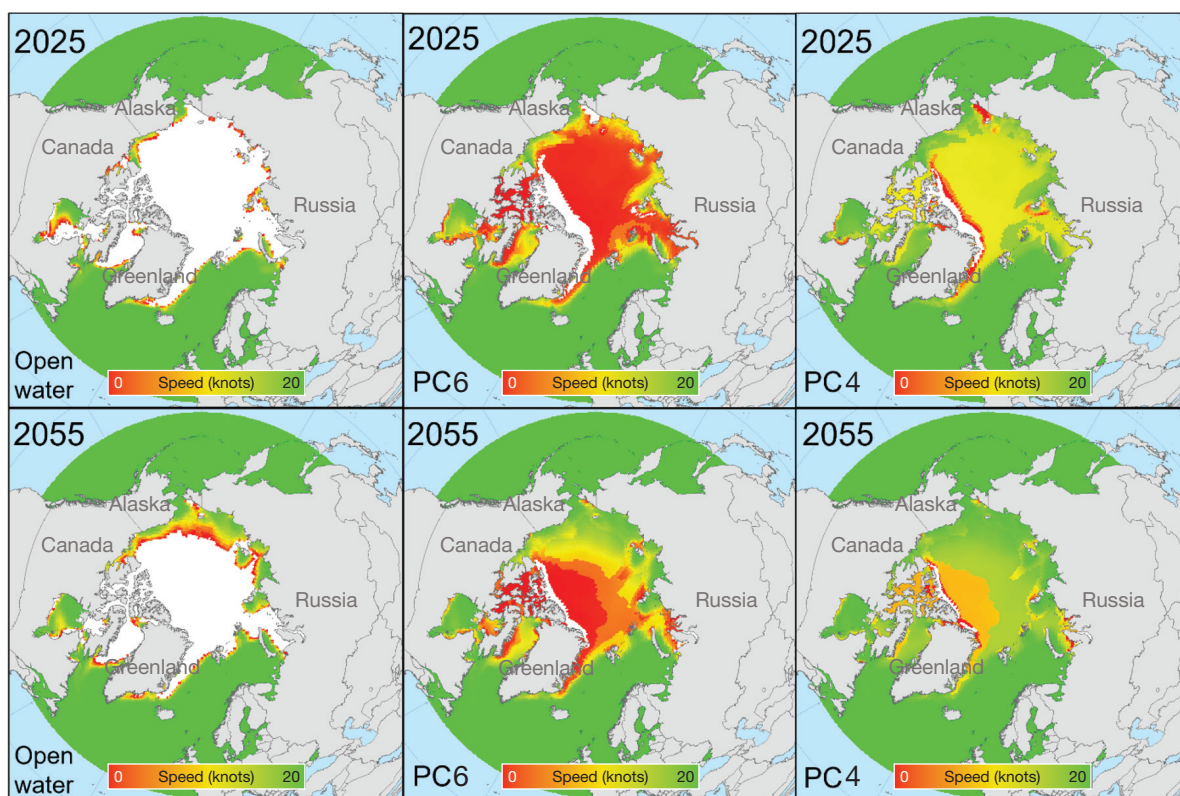
Maritime Routes and Accessibility

The potential to open maritime routes through the Arctic for economic and strategic purposes is very important to the future of the region and for connecting it to global locations, markets, and perhaps even conflicts. Figure 2.1 illustrates what some models suggest Arctic maritime surface accessibility might look like in the future for two polar-class (PC) vessels and an open-water (non-ice-strengthened) vessel in June 2025 and 2055.⁵ Accessibility for an open-water vessel is in the leftmost column, followed by accessibility for the two categories of polar icebreakers; the top row is for June 2025, while the bottom one is for June 2055. Note the patterns of varying maritime access related to physical sea ice and technological icebreaking capability. The seasonal diminution of sea ice is not uniform across the region, with greater impediments to movement in the North American Arctic than in the Asian or European portions. The heft of icebreaking capability (hull strengthening and engine characteristics) particularly matters when traversing through areas of the North American Arctic, which is projected to retain harder ice that has continually remained frozen for multiple years and whose ice cover is expected to be less predictable, especially during seasonal transitions.

These maritime accessibility changes are opening the possibility of strategically and economically viable trans-Arctic routes. Figure 2.2 illustrates the three major maritime routes through the Arctic Ocean.

⁵ *Polar capable* in this context refers to a vessel's operating capabilities in ice conditions, where the highest rating (1) indicates "year-round operation in all Polar waters"; ratings are from 1 to 7. The International Maritime Organization (IMO) and International Association of Classification Societies (IACS) established PC ratings to harmonize ice navigation requirements across numerous national classification systems. See, e.g., Andrew Kendrick, *Integration of Polar Classes and Arctic Ice Regime Shipping System*, National Research Council Canada, March 2005.

FIGURE 2.1
Maps of Potential Arctic Surface Maritime Access in June for Three Vessel Categories in 2025 and 2055



SOURCE: Features data from Community Earth System Model 2 (CESM2) sea ice projections (see Appendix F, available online).

NOTE: White = inaccessible. PC4 = "Year-round operation in thick first-year ice which may include old ice inclusions"; PC6 = "Summer/autumn operation in medium first-year ice which may include old ice inclusions" (GlobalSecurity.org, "World Wide Icebreaker Classes," webpage, undated).

Economic Potential and Natural Resources

From an economic perspective, climate change and the increasing global focus on the Arctic could result in growth from, in, and through the Arctic region. As we have mentioned, the Arctic holds considerable resources that could be marketable to global markets, such as oil, natural gas, and coal; fish and other proteins; minerals, including rare earth elements; and timber and other natural resources. Furthermore, several Arctic locations have—or are developing—tourism opportunities, expanding industrial areas, and promoting lifestyles through sustainable cities. Finally, the Arctic could become more central to global logistics. Currently, much shipping in the Arctic is to and from different points within the region, or from the region to bring goods (especially energy) to markets. In the future, shipping through the Arctic from and to non-Arctic points could become more viable. Other transportation infrastructure has already proven advantageous; for example, some airlines are taking advantage of northern airports to fly shorter distances between Asian countries and North America.

The Arctic's wealth of natural resources has raised the specter of resource wars. However, there are reasons actual conflict over extractable resources is likely to be limited, at least in the next few decades. Although the Arctic has a handful of sovereignty disputes, as discussed in Appendix H (available online) and shown in Figure 2.3, most of the Arctic's mineral resources that are likely to be commercially recoverable through the

FIGURE 2.2
Map of Arctic Maritime Routes

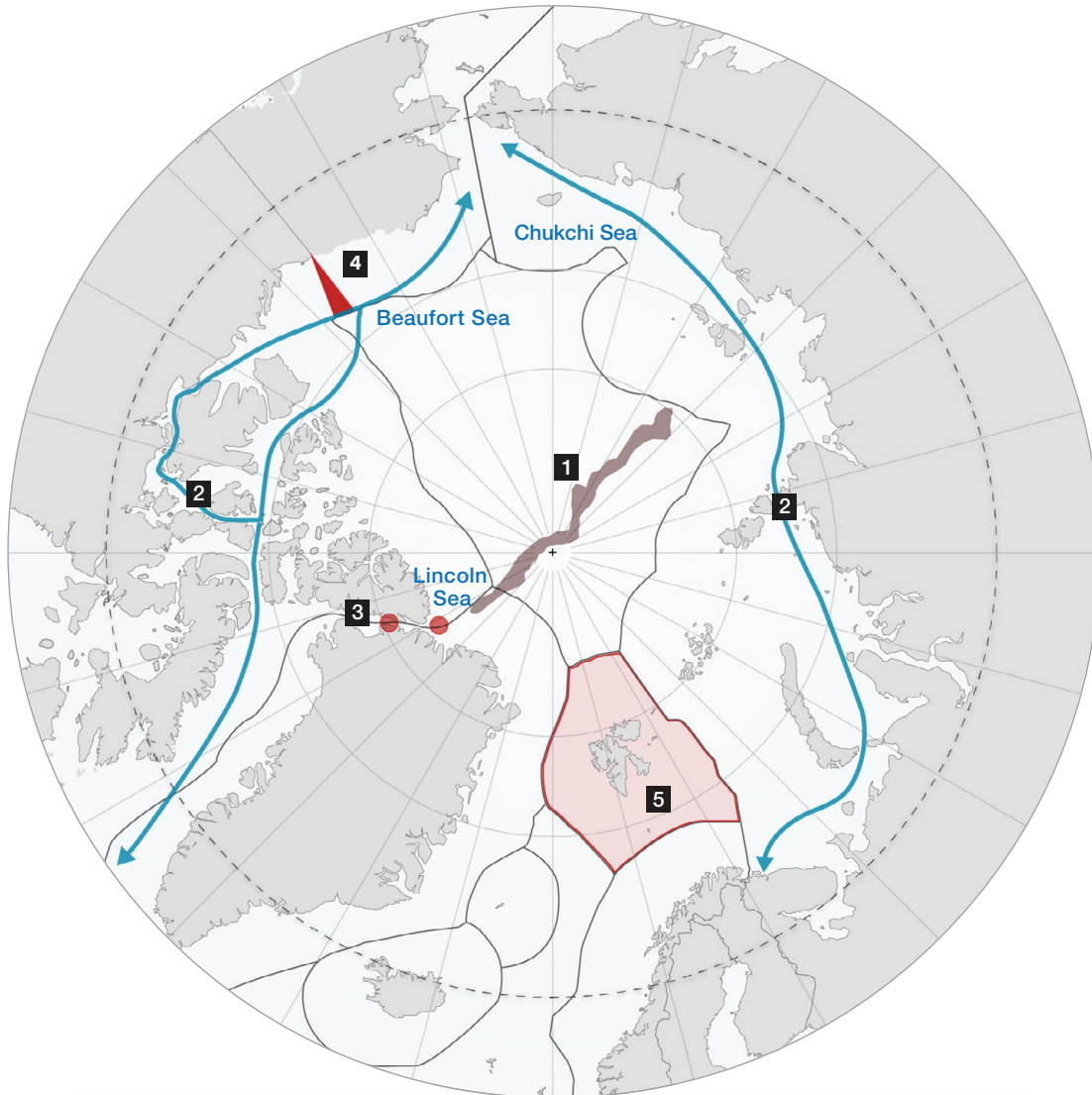


SOURCE: Features data from CESM2 sea ice projections in a general circulation model (see Appendix F, available online).

NOTE: NSR = Northern Sea Route. TSR = Transpolar Sea Route.

middle of the 21st century clearly lie within the undisputed jurisdiction of one of the eight Arctic countries. As Appendix H describes, disagreements between Russia, Canada, and Denmark over extended continental shelf claims (Figure 2.4) involve assertions of exclusive rights to mine the seabed more than 200 nautical miles from land in the northernmost reaches of the Arctic, areas that are not likely to be commercially

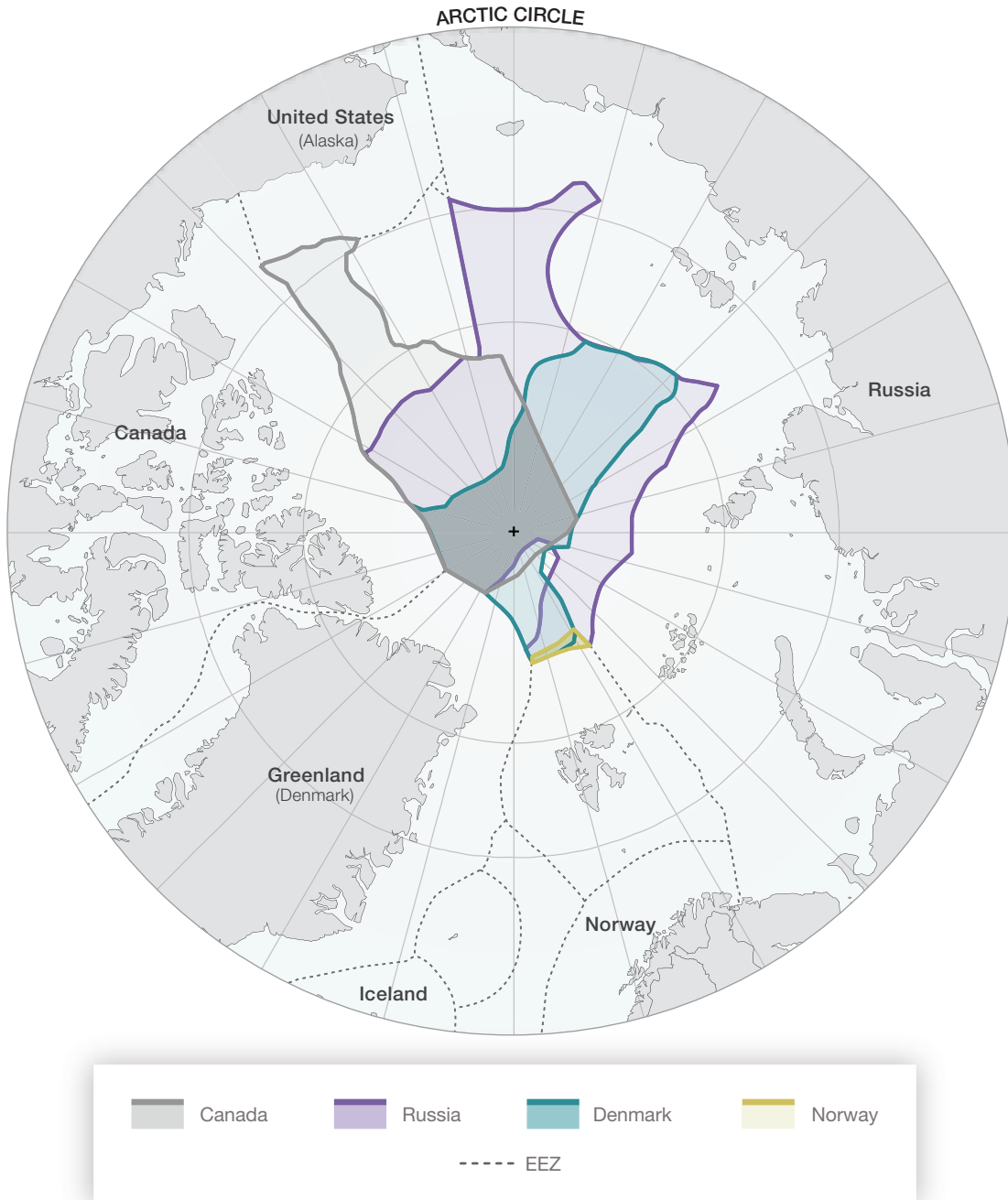
FIGURE 2.3
Map of the Arctic, Highlighting Disputed Areas



- 1** Disagreements over seabed rights under the Lomonosov Ridge
- 2** Disagreement over rights of innocent passage in waters within Canadian and Russian Arctic archipelagos (the NWP and NSR)
- 3** Denmark–Canada disputes over Hans Island and portions of the Lincoln Sea (resolved in 2022)
- 4** United States–Canada dispute over part of the Beaufort Sea
- 5** Norway–Russia disputes over the waters surrounding the Svalbard archipelago

NOTE: Black lines signify exclusive economic zone (EEZ) boundaries.

FIGURE 2.4
Map of Submissions for Extending the Arctic Continental Shelf Extension



NOTE: The United States has not yet submitted a claim for an extended continental shelf.

viable for mining for many decades.⁶ Commercial fishing is already prohibited in these areas by a 2018 treaty, agreed to by all of the Arctic states, as well as China, Japan, South Korea, and the European Union (EU).⁷ Only one dispute has real economic relevance: Russia and Norway also disagree over whether Norway has a 200-nautical mile EEZ around the Svalbard archipelago (an area similar in size to Montana), which could have economic relevance in terms of both fisheries and mining.

Most of the remaining territorial disputes in the Arctic are, and have been, among staunch allies. For example, Canada and Denmark previously disagreed over ownership of a barren, uninhabited rock less than half the size of New York City's Central Park, despite already having demarcated their maritime boundaries in the waters around it. They also disagreed over which country had exclusive economic rights in a maritime area slightly larger than Washington, D.C., just beyond the northernmost land in the world. These disputes are now resolved, as discussed in Appendix H, available online. Similarly, the United States and Canada disagree over exclusive economic rights in a triangular maritime area the size of New Jersey, north of the Alaska–Yukon border.

What is disputed from an economic and, increasingly, security perspective is access to sea lanes proximal to Arctic Ocean coastlines, introduced earlier in Figure 2.2. Russia and Canada claim control over the NSR (also known as the Northeast Passage) and the NWP, respectively. In response, the United States and other countries have asserted a right of innocent passage, or the right to innocently traverse passages they identify as international straits. Both Russia and Canada have sought to leverage legal arguments based on the United Nations Convention on the Law of the Sea (UNCLOS) to make their cases. Because of the historically extreme ice cover, both Russia and Canada have maintained *de facto* control over these waterways, although, as we have noted, the United States and others have taken limited actions to dispute or contest this situation.

In recent years, however, the prospect of modest easing of warm-season accessibility to parts of the Arctic Ocean has brought the potential for economic and strategic waterways, and added activity (e.g., resource extraction, tourism), seemingly much closer. In some cases, this potential is being realized. For example, the Yamal liquefied natural gas (LNG) project in north-central Siberia has brought additional activity to the region, including more tanker traffic transporting LNG to Asian (especially Chinese) markets. What was once firmly theoretical is now becoming less abstract, and with that have come questions about governance and security in the region.

The United States and Security Concerns About Russia and China

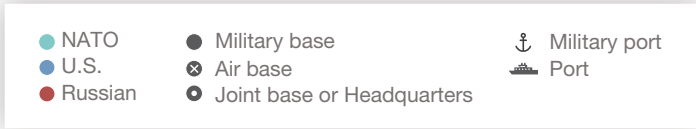
Although security concerns in the Arctic—which is strategic because of the short distance between the United States and Russia there—abated after the Cold War, the region has gained renewed relevance for U.S. national security in the past couple of decades. This stems partly from the overall resurgence of Russia's military capabilities and partly from Russia's expansion of both military and civilian activity in the region. Now, since the 2022 intensification of the war in Ukraine, regional geopolitics and security might be even more relevant.

Figure 2.5 illustrates two views of security posture in the Arctic. Although it has sometimes been demonstrative about its aspirations to dominate the Arctic (e.g., by insisting that it has full sovereignty over the NSR along its northern fringes), Russia's greater challenge to U.S. interests stem from its increasing investments in dual-use military infrastructure, ice-capable assets, and military exercises in the region. Notable Russian Arctic infrastructure investments include ports, air bases, and nuclear power plants and investments to improve capabilities in domain awareness, SAR, and numerous exercises.

⁶ A nautical mile is equivalent to 1.15 statute miles or 1.85 km.

⁷ U.S. Department of State, "The Agreement to Prevent Unregulated High Seas Fisheries in the Central Arctic Ocean Enters into Force," media note, June 25, 2021.

FIGURE 2.5
Russia's and the North Atlantic Treaty Organization's Postures in the Arctic



NOTE: AFB = Air Force base, AS = air station, JBER = Joint Base Elmendorf–Richardson, NATO = North Atlantic Treaty Organization, SFS = Space Force station. Finland joined NATO in 2023, and Sweden had submitted its NATO letter of application as of 2022.

Most recently, Russia's attack on Ukraine has renewed concerns of the possibility of conflict in the Arctic,⁸ long thought to be a relatively safe zone thanks to Russia's economic interest in keeping the region stable. Finland's land border with Russia is almost 1,300 km long. Norway also shares a land border with Russia, and the United States—by virtue of Alaska—shares with Russia both a lengthy maritime border and management of the Bering Strait, a key Arctic maritime choke point. In the Bering Strait, United States-owned Little Diomed Island and Russia-owned Big Diomed Island are just 3.8 km apart, and it is possible to walk across the ice from one to the other.

Another security issue for the United States and some other countries in the region is the growing role of China. Although China does not adjoin the Arctic, it has sought to present itself as a “near-Arctic state”⁹ that will play an influential role in the region's future, with its Polar Silk Road integrated into its Belt and Road Initiative (BRI; formerly known as One Belt One Road) construct for infrastructure development and a dominant role for China in global transportation networks. Its investments in polar icebreakers and Arctic science, as well as its attempts (with some success, particularly in Russia) to secure commercial involvement in many Arctic countries, could enable it to shape the Arctic security environment in ways that disadvantage the United States.¹⁰ China's vision of the Arctic as a global common could incentivize it to seek a greater role in regional governance, beyond its current Arctic Council observer status. Furthermore, China's attempts at growing economic and scientific ties with various Arctic countries could increase its political influence in the region, as well as its ability to operate militarily in the Arctic in the future, should it choose to develop the assets to do so.

Regional Communities

Emerging and continuing economic possibilities through resource extraction, shipping and tourism, preferences for sustainable lifestyles and Arctic landscapes, and potential for renewable energy and other transformations have important implications for the roughly 4 million residents above the Arctic Circle, many of whom are Indigenous. Arctic residents' demographics, cultures, and languages, and social issues that Arctic residents face, vary widely across the region. Although many communities might welcome some types of economic growth, they also have many valid concerns, including environmental destruction, loss of access to traditional lands and livelihoods, and the cultural and economic effects of an influx of temporary workers. Some recent Arctic development has bypassed local communities and Indigenous populations altogether; they have not reaped many of the benefits of education, income growth, introduction of technology, enhanced medical care, or infrastructure investment. There are, however, also many examples of local communities partnering with national governments and external investors to scale up fishing and other economic activities that are already part of local culture and history.

People in the Arctic are at the forefront of regional security. In such remote places as there are in this region, people there observe firsthand the issues that arise and are often first responders when needed. From a broader security angle, local communities can play a strong role in supporting or opposing economic and infrastructure development and choices about foreign activities, including investments.

⁸ Abbie Tingstad, Stephanie Pezard, Benjamin Sacks, and Scott Stephenson, “Putin's Actions in Ukraine Are Spilling North,” *The Hill*, March 29, 2022.

⁹ State Council of the People's Republic of China, “Full Text: China's Arctic Policy,” January 26, 2018.

¹⁰ David Auerswald, “China's Multifaceted Arctic Strategy,” *War on the Rocks*, May 24, 2019.

Why Access and Presence Are Needed to Secure Interests

The concepts of access and presence are irrevocably intertwined, so we use the terms interchangeably throughout this report. We define *access* as the ability to reach or transit through spatial objectives without hindrance.¹¹ *Presence*, in turn, can be defined as several related things, including the fact of being in a particular place, making a strong impression, and being sent to deal with a particular situation (especially in reference to a group).¹²

From these definitions, it is clear that access is required for presence and vice versa. The United States cannot expect to have personnel, ships, submarines, aircraft, vehicles, installations, and other fixed and mobile infrastructure in the Arctic (presence) without the capabilities to enter and move through the region (access). Similarly, having fixed and mobile infrastructure and trained personnel present in the region certainly facilitates being able to better access it—it is always easier to move unimpeded if the capabilities required to do so are already in place. In this way, access and presence build on each other.

For decades, militaries have maintained presence in the Arctic region, even if, at times, covertly and hence not in the public eye. During the Cold War, for example, both the Arctic undersea and air domains were what we might today term *competitive* or *contested environments* and were part of the overarching deterrence strategies of the Soviet Union and the United States. After a period of post-Cold War quiescence, in which armed forces' presence in the Arctic could generally be characterized by limited deterrence, early warning, safety, and law enforcement with limited means, Arctic stakeholders are rethinking what military roles, presence, and access should look like given the changing landscape of the region.

In this research, we focused on several benefits to U.S. national interests and the safety of those securing these from enhanced ability to get there and stay there. In the most basic sense, presence and access ensure the ability to respond in a timely and effective manner to a variety of events that happen or could happen in the Arctic. The United States has signed two important international agreements that guarantee each Arctic nation's commitment to SAR and marine oil pollution.¹³ These agreements lock in the expectation that the United States will be prepared, willing, and able to respond to these incidents within its jurisdiction. Access is important for several reasons:

- **U.S. response requirements extend beyond these agreements.** For example, the USCG's 11 statutory missions include different types of law enforcement, support to navigation, and readiness to assist with defense-related operations. There is no exception for the Arctic in these; the USCG must be prepared to conduct its missions anywhere the service must operate. Similarly, the Arctic is a key region for homeland defense and homeland security. Fixed and mobile presence and access are required to facilitate this objective.
- **Presence and access also help ensure resilience, or the ability to recover from adverse events, conditions, or trends.** Initially responding to an event is one thing. Being able to sustain access and presence to follow through on extended response (e.g., to an oil spill) and recovery is another. This means that having a handful of capabilities that can spend a few days in a couple of locations is not enough. Long-term operations require the presence of strong logistics and sustainment.

¹¹ Adapted from “access, n. (II)(3)(a),” *Oxford English Dictionary*, Oxford University Press, 2021.

¹² Adapted from “presence, n. (1)(a),” *Oxford English Dictionary*, Oxford University Press, 2021.

¹³ Agreement on Cooperation on Aeronautical and Maritime Search and Rescue in the Arctic, Can.–Den.–Fin.–Ice.–Nor.–Russ.–Swed.–U.S., May 12, 2011; Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic, Can.–Den.–Fin.–Ice.–Nor.–Russ.–Swed.–U.S., May 15, 2013.

- **Presence and access promote strategic partnerships.** Consider, for example, the necessity of being able to participate in exercises and operations with partners. Regular engagement enabled through access and presence is needed to ensure interoperability and to leverage partners in a region where capabilities and infrastructure are generally sparse.
- **Presence and access are required for competition and deterrence, when necessary.** Both Russia and China have Arctic interests. Their respective geographies, histories, and interests are very different. For many years, it might have seemed absurd to consider Russia and China in the same sentence concerning the Arctic. Now, as Russia's war on Ukraine is ongoing at the time of this writing, all signs point to a strengthening of the Sino-Russian relationship, including with respect to Arctic collaboration. The Arctic is the only region in which the United States faces presence and collaboration of its two primary competitors, along its Alaskan maritime border. Whereas the United States is often seen as playing the away game, the Arctic—regardless of specific location—should very much be considered a home game. In this report, we consider several constraints on access and presence, including the following:
 - limited or no capability: cannot do something
 - limited or no capacity: do not have enough of something
 - low priority for the Arctic: not allocated for northern operations
 - lack of interoperability with partners: unable to effectively team with partners
 - challenges from potential adversaries: antiaccess activities.

We discuss these in considerable detail in later chapters and the online appendixes, beginning with a survey of what capabilities the United States has and how these compare with those of selected other Arctic actors.

U.S. Armed Forces' Arctic Capabilities and Capacities Compared with Those of Other Countries

An examination of Arctic capabilities across the United States, its allies and like-minded partners, and potential adversaries is a key component of the information requested by Congress in the FY 2021 NDAA. Operations in the Arctic are challenging for military forces because of the region's remote location and extreme conditions. All eight Arctic countries, along with several other states, maintain some level of Arctic-relevant capabilities. Figure 3.1 lists the countries for which we examined capabilities.

No asset type is used exclusively in the Arctic. For example, icebreakers are required in both polar regions; aircraft on skis can be used wherever there are large, frozen bodies of water; all-terrain vehicles are often needed for mobility in austere areas; and people trained in survival and expeditionary tactics can face logistics-poor environments around the globe.¹ Furthermore, some Arctic countries stage strategic capabilities in the Arctic for the purposes of broader defense, deterrence, or global power projection. For example, the Arctic is the shortest route between Russia and North America, and this has made the region a focal point for possible missile and air attack since the dawn of the Cold War. Finally, some commercially held assets can be and are used in the Arctic for economic purposes and sometimes in service of state objectives. Our compilation of Arctic capabilities includes all assets and capabilities about which the project team had access to information that bear relevance to operating in the Arctic region.

In the rest of this chapter, we explore each country's capabilities and capacities based on the information available to the project team. The focus is on aircraft, ships, and other vehicles rather than infrastructure. Although building and maintaining Arctic infrastructure are critical, as has been discussed in other HSOAC publications, infrastructure is inherently immobile and therefore relevant in only a specific portion of the Arctic. Vehicles, on the other hand, are more geographically versatile.²

Where data were available, commercial icebreakers are included but distinguished from government-owned icebreakers. Later in the chapter, we also summarize some similarities and differences between countries in 2022 and as projected in 2035, a year we chose because current plans project additional changes in capabilities by then and because the Arctic's physical environment will also likely be different.

Capabilities

The United States

The U.S. Arctic is important for the country's broader strategic advantages. Alaska is near many of the Arctic Circle aviation paths that connect North America to Asia and Europe—the shortest flight routes between North America and parts of Asia and Europe that are of strategic interest to the United States. GEN Billy

¹ Indeed, the harsh Arctic environment can—and often does—drive human and machine performance requirements.

² Tingstad, Savitz, Van Abel, et al., 2018.

FIGURE 3.1
Entities Included in the Analysis and a Subset of Relevant Organizational Ties

	Arctic Council	Arctic Council Observer	NATO and FVEY	NATO	ACGF	IMO	Partnership for Peace	Commercial
United States	■		■		■	■		
Canada	■		■		■	■		
Norway	■			■	■	■		
Denmark (includes Greenland)	■			■	■	■		
Iceland	■			■	■	■		
Sweden ^a	■				■	■	■	
Finland ^a	■				■	■	■	
United Kingdom		■	■			■		
Australia			■			■		
New Zealand			■			■		
France		■		■		■		
Germany		■		■				
Russia	■				■	■		
China		■				■		
Commercial ^b								■

NOTE: ACGF = Arctic Coast Guard Forum. FVEY = Five Eyes, an alliance of Australia, Canada, the United Kingdom (UK), and the United States.

^a Sweden and Finland applied to join NATO in 2022. Finland joined NATO in 2023. Sweden had not yet formally become a member at the time of this writing.

^b Might sometimes participate in coordination activities with governments through, for example, professional organizations and conferences.

Mitchell, one of the founders of the USAF, described Alaska as “the most strategic place on earth.”³ All U.S. services have Arctic capabilities, which we summarize in this section.

The USCG possesses three polar icebreakers: the USCG Cutter (USCGC) *Polar Star*, the USCGC *Polar Sea*, and the USCGC *Healy*. As of 2022, only the USCGC *Polar Star* and the USCGC *Healy* were capable of deploying. The USCG placed the USCGC *Polar Sea* in an in-commission special status in 2010 without the ability to deploy. The USCGC *Polar Sea* provides spare parts for the USCGC *Polar Star*. The United States also has commercial icebreakers, which we did not include in this analysis.⁴

The USCG plans to construct polar security cutters (PSCs), also known as the *Polar Sentinel* class, which would augment and eventually replace *Polar Star*. The USCG also proposes to construct Arctic security cut-

³ Michael J. Forsyth, “Why Alaska and the Arctic Are Critical to the National Security of the United States,” *Military Review*, January–February 2018, p. 114.

⁴ The National Science Foundation (NSF) additionally operates Research Vessel *Nathaniel B. Palmer*. The United States also possesses one commercial icebreaker. Finally, the University of Alaska Fairbanks operates the *Sikuliaq* research icebreaker.

ters (ASCs) that would augment the PSCs' capabilities. The current program includes three PSCs, but there could also be a need for medium icebreakers. Although PSCs' anticipated roles are evolving, they might have an increased role in national defense, living marine resource enforcement, SAR, and, although it is not a statutory function, interaction with Alaskan communities. Science operations are not an organic function, but the PSCs will have the space, weight, and power to conduct them. The PSC concept is shown in Figure 3.2.

The PSCs will host a mission system based on the USN's Aegis Combat System, providing the PSCs with improved domain-awareness capabilities. The PSCs are intended to meet USCG mission requirements, which include the following:

maintain defense readiness in the Arctic and Antarctic regions; enforce treaties and other laws needed to safeguard both industry and the environment; provide ports, waterways and coastal security; and provide logistical support—including vessel escort—to facilitate the movement of goods and personnel necessary to support scientific research, commerce, national security activities and maritime safety.⁵

Potential ASCs would likely be similar to Arctic offshore patrol vessels (OPVs) in terms of icebreaking capability. With their shallow draft, ASCs would be able to operate in shallow waters near Alaska's coast and the North American east Arctic, currently inaccessible to existing icebreakers and the planned capabilities of the PSCs.

Aside from their icebreaking vessels, the USCG and the USN operate a fleet of surface and subsurface vessels that contribute to the Arctic capabilities of the United States. But the USCG's Legend-class national

FIGURE 3.2
The U.S. Coast Guard Cutter *Polar Sentinel* as an Example of the Polar Security Cutter Concept



SOURCE: Acquisition Directorate, USCG, "Polar Security Cutter," fact sheet, March 2021.

security cutters (NSCs) are not designed to operate in or near ice-laden waters. Smaller USCG cutters will

⁵ Acquisition Directorate, 2021.

also occasionally deploy to the lower Arctic during the ice-free season. Joint Rescue Coordination Center Juneau is one of the SAR bases of operation in the U.S. Arctic region.⁶

USN cruisers and destroyers can operate near the Arctic as well, and USN nuclear submarines routinely operate under the ice in the Arctic. All U.S. submarines are nuclear powered and able to operate under the Arctic ice. Many can operate *through* the ice, as shown in Figure 3.3. The USN operates nearly 70 submarines.

The United States could build a military facility at Ramsund Naval Base in Norway, as was discussed in a 2022 Congressional Research Service report.⁷ If such a facility is completed, the USN could more readily undertake regular Arctic surface operations in ice-free areas.⁸

The U.S. Marine Corps is also active in the Arctic, most notably through its rotating presence in Norway, where it conducts exercises and collaborates with Norwegian, UK, Dutch, and other ground forces. The Marine Corps also operates aboard USN ships in the region.

The USCG, USN, and USAF all contribute to Arctic air capabilities. The USCG operates multiple aircraft in the Arctic, notably including the HC-130J for patrol and surveillance and the MH-60T and MH-65C/D for recovery and rotary-wing operations.⁹ In Alaska, the USAF operates JBER and Eielson AFB with 54 fifth-generation F-22 Raptor fighters, as well as mobility, logistics, and refueling aircraft. The U.S. Arctic region's Alaska Rescue Coordination Center also operates out of Elmendorf.¹⁰

FIGURE 3.3

USS *Connecticut*, Nuclear-Powered General-Purpose Attack Submarine Ship 22, in the Arctic



SOURCE: Reproduces a photograph by USN/MCS 1st Class Michael B. Zingaro.

⁶ Ronald O'Rourke, Laura B. Comay, John Frittelli, Caitlin Keating-Bitonti, Jane A. Leggett, Jonathan L. Ramseur, Pervaze A. Sheikh, and Brandon S. Tracy, *Changes in the Arctic: Background and Issues for Congress*, Congressional Research Service, R41153, version 189, March 24, 2022, p. 54.

⁷ O'Rourke et al., 2022, p. 43.

⁸ Astri Edvardsen, "Norway Explores Cooperation with the US and UK on Maritime Surveillance in the High North," *High North News*, February 10, 2023.

⁹ USCG, *The Cutters, Boats, and Aircraft of the U.S. Coast Guard*, June 14, 2018..

¹⁰ O'Rourke et al., 2022, p. 54.

The New York Air National Guard's 109th Airlift Wing operates ten LC-130s that are equipped with skis and can hence land on ice. At JBER, the Alaska National Guard provides SAR capabilities with H-60s that are inflight refuellable from USAF C-130 tankers assigned to the same squadron. The 673rd Air Base Wing at JBER also supports U.S. Army Alaska.¹¹ The USAF also operates six F-35 Lightning II fighters from Eielson AFB. The USAF plans to increase its Alaskan capabilities in the next decade with 48 F-35As at Eielson AFB and eight C-130Js for the Air National Guard and Reserve.

Although many capabilities in the joint force, such as those discussed above, are equipped with defensive capabilities to counter military threats, this is not necessarily true for USCG assets because of the USCG's focus on homeland security missions. An organic or self-contained defensive capability would include the necessary equipment to execute, as necessary, a kill chain (find, fix, track, target, engage, and assess) against at least some types of military threats.

The United States could consider building facilities at three Norwegian airfields: Rygge, Sola, and Evenes.¹² The USAF is upgrading the airfield infrastructure at Naval Air Station (NAS) Keflavik, Iceland, including KC-135 refueling tankers.¹³ The USN, in addition to having the ability to deploy aircraft carrier strike groups near the Arctic, currently operates P-8 Poseidon aircraft from Keflavik and is exploring opportunities to operate P-8s in Alaska. USCGCs routinely deploy to the Arctic with an aviation detachment. Recently, they have included both rotary-wing aircraft (H-60s and H-65s) and a ship uncrewed aircraft system (UAS).

NORAD and USNORTHCOM also play roles in the Arctic. NORAD's mission includes "aerospace warning, aerospace control and maritime warning for North America."¹⁴ These missions include the detection, validation, and warning of an attack against North America, as well as of attacks by aircraft, missiles, or space vehicles. NORAD works with other commands, such as USNORTHCOM, to accomplish these missions. In the Arctic, NORAD also performs exercises, such as 2022's Operation Noble Defender, which included aircraft and personnel from the United States and Canada.¹⁵

The USSF acquires, operates, and sustains the Global Positioning System (GPS), providing 24/7 global coverage and highly accurate position, velocity, and timing data to widely deployed GPS user equipment. Although GPS service is not optimized for the poles, access to GPS signals enhances real-time battlespace awareness for command and control (C2), synchronizes communications, and enables all forms of precision operations, such as target location, weapon delivery, SAR, and logistical support to U.S. and allied users. Additionally, GPS satellites host U.S. Nuclear Detonation Detection System capabilities. The U.S. Army Alaska Arctic Support Command provides logistics via Installation Management Command—Pacific.¹⁶ The Army also provides medical evacuation support from UH-60 aircraft.¹⁷

The U.S. Army has ground forces who are trained to operate in the Arctic. The Army has "approximately 11,600 Soldiers serv[ing] in Alaska at Fort Wainwright and Joint Base Elmendorf–Richardson under the command of U.S. Army Alaska. Major active-duty Army units include two brigade combat teams, a combat sustainment support battalion, and two aviation battalions."¹⁸ In 2022, the Army announced that it had

¹¹ JBER, homepage, undated.

¹² Edvardsen, 2023; O'Rourke et al., 2022, p. 43.

¹³ Paul McLeary, "US Expands Icelandic Airfield for Tankers, Big Cargo Lift," *Breaking Defense*, July 18, 2019.

¹⁴ NORAD, undated.

¹⁵ NORAD, "NORAD to Conduct Arctic Air Defence Operation," press release, February 15, 2022.

¹⁶ Installation Management Command—Pacific, U.S. Army, homepage, undated

¹⁷ Dayton Will, "Alaska Army Guard Aviators Support Operation Arctic Care; Get Critical Training," National Guard, April 19, 2017.

¹⁸ Deputy Chief of Staff for Operations, Headquarters, U.S. Army, "The Army Arctic Strategy," *Stand-To!* April 2, 2021.

selected BAE Systems' Beowulf vehicle for its Cold Weather All-Terrain Vehicle. The Army National Guard and Army Reserves also provide support throughout the region.

Domain awareness in the Arctic comes primarily from three sources: USCG icebreakers, other surface assets, and aircraft and satellites. This last set includes USAF and USN aircraft, DoD reconnaissance satellites operated by the USSF and other services, and sensing and analytic capabilities housed across the armed services and in other government organizations, including the U.S. National Ice Center and the National Aeronautics and Space Administration (NASA). Arctic domain awareness is key to understanding the operational environment. The USCG is the primary eyes and ears of the U.S. regular cutter patrols and provide some of the best domain-awareness information. The USCG additionally relies on the aircraft in its inventory and on other services for satellites. Furthermore, the National Ice Center provides important analytic products to help guide navigation decisions (e.g., daily ice concentration, projected sea ice motion in future days), as well as planning (e.g., anticipated Arctic Ocean-wide accessibility for different icebreakers).

Weather units in other military services also compile and maintain data critical to domain awareness. Within the USAF, such functions fall under the responsibility of the 557th Weather Wing. Within this unit, the 14th Weather Squadron collects, protects, and exploits climate data to optimize military and intelligence operations and planning, while the 16th Weather Squadron develops and operates applications to generate environmental intelligence.¹⁹

The P-8s in Alaska would offer increased domain awareness. The USN is funding the development of uncrewed undersea vehicles and buoys for scientific monitoring in the Arctic.²⁰ At Keflavik, the USN has renovated hangars to accommodate P-8s on a rotational basis.²¹

The USAF and USSF operate early-warning systems throughout the Arctic. Clear SFS provides ballistic-missile early warning and space domain awareness. At Utqiagvik in North Slope, the Alaska Radar System includes 15 radars, three of which are part of the North Warning System. At Eareckson AS, there is a missile defense radar. Finally, Thule Air Base in northwest Greenland has a ballistic-missile early-warning and space domain-awareness system.²²

The Missile Defense Agency has plans with Lockheed Martin to finalize development of and transfer to the USAF a Long Range Discrimination Radar, which is "an S-band radar for the Ground-based Midcourse Defense anti-ballistic missile system," at Clear SFS by 2023 because the USAF desires joint all-domain C2 in the Arctic.²³

The U.S. military performs exercises in the Arctic to train personnel in the Arctic environment and test procedures. Exercise Arctic Eagle-Patriot 2022, for example, involved hundreds of active-duty, National Guard, civilian first responder, and foreign military participants.²⁴ The United States also participates in NATO exercises in the Arctic, such as Exercise Cold Response 2022, which included 30,000 military personnel from 27 countries.²⁵

¹⁹ 557th Weather Wing, USAF, "14th Weather Squadron," webpage, undated; 557th Weather Wing, USAF, "16th Weather Squadron," fact sheet, current as of May 2021.

²⁰ Joseph Trevithick, "The Navy Now Has a Submarine Aggressor Unit," *RealClear Defense*, August 15, 2020.

²¹ McLeary, 2019.

²² Theresa Hitchens, "New Air Force Arctic Strategy May Update Planes for Polar Ops," *Breaking Defense*, July 21, 2020.

²³ Jen Judson, "Alaska-Based Long-Range Ballistic Missile Defense Radar Fielding Delayed by a Year," *Defense News*, August 7, 2020; Frank Wolfe, "Air Force Envisions Improved Communications and Sensor Capabilities for Arctic," *Defense Daily*, October 5, 2020.

²⁴ Joseph Vonnida, "National Guard Troops from 15 States Join Arctic Exercise," U.S. Army, March 1, 2022.

²⁵ NATO, "Exercise Cold Response 2022: NATO and Partner Forces Face the Freeze in Norway," press release, March 7, 2022, updated March 25, 2022..

In the Antarctic, the Joint Task Force Support Forces Antarctica (Operation Deep Freeze) provides logistics and support for the U.S. Antarctic Program (USAP). The USAP oversees the activities of USAF, Air National Guard, Air Force Reserve Command, USN, and USCG personnel who participate.²⁶ The breakout of the USAP's McMurdo Station for replenishment is an annual requirement for the USCG's icebreaking capabilities.

Despite the size of the U.S. Arctic, civilian infrastructure and centers remain limited. There are no deep-water ports in the northern U.S. Arctic. Small turboprop aircraft (e.g., Cessna Caravan) are used to connect communities because most villages are not connected by either road or rail. Kotzebue, Nome, and Utqiagvik have runways capable of handling larger jet aircraft. Few ships traverse the Bering Strait, let alone go north of the Bering Strait in the Arctic Ocean. Many communities need to have food, medical, and other critical supplies flown in at considerable expense; some are able to leverage tug and barge traffic through shallow ports and seasonally available ice roads and snow machine (snowmobile) access, among other modes. Several local nonprofit organizations, including Marine Exchange of Alaska, seek to promote shipping in Alaska's harsh environment.

Russia

Russia has 24,140 km of Arctic coastline, most of the Arctic's population, and vast Arctic resources that fuel the entire Russian economy. Not surprisingly, it has large military capabilities in the Arctic, including the largest fleet of ice-capable icebreaking and ice-capable ships of all the Arctic states, many of which are nuclear-powered, as well as ice-capable nuclear-powered submarines.²⁷ Russia operates the Global Navigation Satellite System (GLONASS), a counterpart to GPS. Russia's system has a similar number of satellites to what GPS has (31 or 32), but its satellites' orbits are more highly inclined from the equator, thereby offering better coverage of the polar regions. In addition, Russia's Arctic forces include multirole tactical combat aircraft; maritime patrol; intelligence, surveillance, and reconnaissance (ISR); SAR fixed- and rotary-wing aircraft; ice-capable ground forces equipped with ballistic- and cruise-missile systems; space assets with Arctic access; air- and ground-based antisatellite capabilities; and a growing logistics infrastructure. Furthermore, Russia's upgrade and expansion plans affect capabilities in the sea, air, land, and space domains and include continuing environmental cleanup and infrastructure buildup efforts across the Arctic Zone of the Russian Federation (AZRF). In this section, we present only a summary of Russia's military capabilities in the Arctic. For more information on Russia's military disposition and activities, see Appendix B, available online. We also note that Russia's military and commercial Arctic assets could be affected in various ways depending on the intensity and duration of the war in Ukraine that was underway at the time of this writing.

We consulted several publicly available sources to perform rigorous analysis of Russia's icebreaking fleet. Our main source of this information became the USCG's "Major Icebreakers of the World 2020" publication.²⁸ We conducted further research across publicly available sources to look for changes in Russia's fleet of active PC icebreakers in the two years previous to this writing. We also used additional sources to identify which icebreakers were managed by Russia's military, other government agencies, and commercial entities. Our research uncovered some variability in reporting on the precise number of Russia's icebreakers among

²⁶ USAP, "About USAP Participants," webpage, undated-a.

²⁷ Coastline information comes from Center for Circumpolar Security Studies, Arctic Institute, "Russia," webpage, June 19, 2020a. The data we found in publicly available sources represent estimated total inventory and do not account for the operational status of individual assets.

²⁸ Office of Waterways and Ocean Policy, USCG, DHS, "Major Icebreakers of the World," infographic, updated 2020. Note that there is an updated version from 2022 (Office of Waterways and Ocean Policy, USCG, DHS, "Homeports of Major Polar Icebreakers," updated April 5, 2022) that does not significantly alter the analyses presented here.

publicly available sources. We attributed some of this variability to (1) the types of sources of information on which some of the reporting relied, particularly on the information coming from the Ministry of Defence of the Russian Federation and Russia's state-owned news agency, Telegraph Agency of the Soviet Union (Telegrafnoye agentstvo Sovetskogo Soyuza, or TASS); (2) the types of icebreakers these reports included in their counts; and (3) the reports' focus on the general size of Russia's icebreaking fleet compared with that of other countries, as opposed to the detailed icebreaker order of battle.

To strengthen our analysis of Russia's icebreaking fleet, we researched several public sources from academic and nonprofit organizations, news agencies, and military and defense databases that focus on Arctic research.²⁹

As of this writing, Russia maintains a sizable, albeit aging, icebreaking fleet of 55 heavy, medium, and light military, civilian, and commercial icebreakers.³⁰ Of these, 18 are military icebreakers: three heavy nuclear-powered icebreakers, 11 medium diesel-powered icebreakers, and four light diesel-powered icebreakers.³¹ In addition, Russia's military has 28 smaller diesel-powered icebreakers with displacement between 2,100 and 2,900 tons.³² One heavy nuclear-powered icebreaker is currently under construction for Russia's military, as are two medium diesel-powered icebreakers that will be armed with cruise missiles and one light diesel-powered icebreaker.³³ Furthermore, Russia's maritime border guard (counterpart to the USCG and falls under Russia's Federal Security Service [Federal'naya sluzhba bezopasnosti, or FSB]) has 11 diesel-powered icebreaking patrol ships with displacement between 2,785 and 3,525 tons and one medium diesel-powered icebreaker currently under construction.³⁴

The remainder (37) of Russia's heavy, medium, and light icebreakers come under civilian management (government and commercial) and are used predominantly for commercial purposes.³⁵ These include civilian nuclear-powered and research icebreakers that can support shipping operations and respond to emergency situations and ice-reinforced vessels to transport cargo along the NSR.³⁶ Several more commercial ice-

²⁹ Some of these sources were *The Barents Observer*; the Bellona Foundation; the George C. Marshall European Center for Security Studies; Janes military equipment and defense news publications; *The Maritime Executive*; the Polar Connection; Reuters; Russian trade literature, such as *Sudostroenie* (Shipbuilding) *Info*; RussianShips.info; the USCG; *The Washington Times*; the *World Maritime University Journal of Maritime Affairs*; and public announcements from the websites of commercial companies, such as Nornickel.

³⁰ In this discussion, we are including military, civilian, and commercial Russian icebreakers to add context to the total number of Russian icebreakers that frequently appears in various literature sources (Janes, "Icebreakers: Russian Federation," website, updated March 15, 2022a; Office of Waterways and Ocean Policy, 2020).

³¹ Mike Glenn, "U.S. Icebreaker Gap with Russia a Growing Concern as Arctic 'Cold War' Heats Up," *Washington Times*, September 23, 2021; Janes, 2022a; Office of Waterways and Ocean Policy, 2020; Gabrielle Tétrault-Farber, "Russia Says the World's Largest and Most Powerful Icebreaker Just Joined Its Fleet," *Insider*, September 22, 2020; Christopher Woody, "As US Tries to Close 'Icebreaker Gap' with Russia, Its Only Working Icebreaker Is Making a Rare Trip North," *Insider*, November 9, 2020.

³² Janes, 2022a.

³³ Thomas Nilsen, "Construction Starts for FSB's Large Icebreaking Patrol Vessel," *Barents Observer*, August 1, 2020; Atle Staalesen, "Russian Navy Builds More Icebreakers," *Barents Observer*, January 7, 2022.

³⁴ Nilsen, 2020; RussianShips, project 97 webpage, undated.

³⁵ Janes, 2022a.

³⁶ Pavel K. Baev, "Chapter 4: Russia and the Arctic: High Ambitions, Modernized Capabilities, and Risky Setbacks," in Graeme P. Herd, ed., *Russia's Global Reach: A Security and Statecraft Assessment*, George C. Marshall European Center for Security Studies, 2021; Dimitrios Dalaklis, Megan L. Drewniak, and Jens-Uwe Schröder-Hinrichs, "Shipping Operations Support in the 'High North': Examining Availability of Icebreakers Along the Northern Sea Route," *World Maritime University Journal of Maritime Affairs*, Vol. 17, June 2018; Robert Hammitt, "Icebreakers: An Overview," *Polar Connection*, January 24,

breaking assets are in the works, as are cargo ships with their own icebreaking capability, as a sign of future Arctic shipping.³⁷ Russia is planning to build more icebreakers in the next several years.³⁸

Russia's submarine strength has decreased significantly (77 percent) since the end of the Cold War.³⁹ The current submarine inventory of Russia's Northern Fleet is somewhere between 26 and 41 and includes nuclear-powered ballistic-missile and guided-missile firing and attack submarines, conventionally powered submarines, and minisubs.⁴⁰ Additionally, Russia is expected to have approximately ten additional nuclear-powered ballistic-missile submarines by 2024, which would provide additional continuous-at-sea patrols.⁴¹ Only 20 percent of Russia's submarines are mission ready at any given time, which is considerably lower than the U.S. average.⁴²

Russia's Arctic air assets are also numerous, but aging, and are intended to perform a mix of offensive and defensive missions. These assets include more than 80 fourth-generation multirole tactical combat aircraft, more than 50 maritime ISR and antisubmarine warfare fixed- and rotary-wing aircraft, and counterspace systems and antisatellite weapons.⁴³ Upgrades in the Arctic fleet include new fourth-generation fighter jets and amphibious aircraft for SAR operations.⁴⁴ Russia has also built and modernized 19 airfields with runways able to handle all types of aircraft, including nuclear-capable strategic bombers, facilities for support personnel, oil storage, hangars, and construction facilities.⁴⁵

Russia's numerous ground forces are perhaps the most vulnerable of all forces in the region to the harsh Arctic conditions and are equipped with offensive and defensive weapons and military equipment. Russia's Arctic ground forces' military capabilities include tanks, coastal defense systems, anti-aircraft artillery, air defense systems, C2 and early-warning assets, electronic warfare assets, and medical, logistics, and engineer units for combat support.⁴⁶ Russia has made efforts to upgrade its existing equipment for Arctic conditions, as well as provide new equipment that is survivable in the Arctic, such as ambulances with transport tractor bases, snow- and swamp-adapted vehicles, Arctic logistics facilities, military snow vehicles, and life support.⁴⁷

Russia's space assets can also support the country's military activities in the Arctic. Russia has fielded several space capabilities with Arctic access, which include communications; early warning; positioning,

2017; Nornickel, "Nornickel Assists in a Rescue Operation in the Eastern Part of the Northern Sea Route," press release, December 1, 2021.

³⁷ Hammitt, 2017; Office of Waterways and Ocean Policy, 2020.

³⁸ Baev, 2021; Glenn, 2021; Janes, "Russian Federation: Navy," webpage, last updated June 25, 2021d; Maritime Executive, "Russian Shipyard Launches Missile-Carrying Icebreaker," October 28, 2019; Ministry of Defence of the Russian Federation, "Osnasheniie Voienno-Morskogo Flota Rossii Korabliami Ledovogo Classa Budet Prodoszheno [Equipping Russian Navy with Ice-Class Ships Will Continue]," January 3, 2021a; Office of Waterways and Ocean Policy, 2020.

³⁹ Janes, "The Submarines of Russia's Northern Fleet," *Intelligence Briefings*, February 14, 2019.

⁴⁰ International Institute for Strategic Studies, "Chapter Five: Russia and Eurasia," *Military Balance*, Vol. 121, No. 1, February 24, 2021b; Janes, 2019.

⁴¹ Janes, 2019.

⁴² Janes, 2019.

⁴³ International Institute for Strategic Studies, 2021b.

⁴⁴ Alexander Bratersky, "Russia's Arctic Activity to Increase with Fresh Strategy and More Capability Tests," *Defense News*, April 11, 2021.

⁴⁵ Kostya Manenkov and Vladimir Isachenkov, "Russia's Northernmost Base Project Its Power Across Arctic," *Associated Press News*, May 18, 2021.

⁴⁶ Janes, 2021d.

⁴⁷ Ministry of Defence of the Russian Federation, 2021a.

navigation, and timing; and ISR.⁴⁸ In addition, Russia has Sopka-2 radar systems that provide domain awareness in the Arctic.⁴⁹ Overall, Russia's military capabilities achieve several tasks to underscore the country's presence and defend its territories in the Arctic:

- Russia's icebreaking fleet provides power projection and combat-generation capabilities, in addition to supporting emergency response and commercial shipping operations through its Arctic waters.
- Russia's aerospace forces also generate combat capabilities and conduct SAR operations. Additionally, they contribute to Russia's domain awareness through maritime and air patrol and ISR operations.
- Russia's space assets further contribute to the country's domain awareness in the region and support the combat, rescue, and transit operations in the Arctic.
- Finally, Russia's ground forces, in addition to generating ground combat power, defend Russia's Arctic, support rescue operations, and maintain Russia's military infrastructure across its Arctic bases.

For logistics and basing, 19 airfields have been built or modernized.⁵⁰ For example, Nagurskoye Air Base in Alexandra Land has an extended runway to handle all types of aircraft, including nuclear-capable strategic bombers, and it hosts the Arctic Clover (also known as the Arctic Trefoil or Northern Clover) facility for personnel, oil storage, hangars, and construction facilities.⁵¹

Russia also has ambulances with transport tractor bases, Trekol Vega snow- and swamp-adapted vehicles with ultralow-pressure tires, Arctic logistics facilities, A1 and TTM-1901-40 military snow vehicles with heated cabins and life support systems suited for polar regions.⁵²

Russia's civilian centers and infrastructure are complex and geographically oriented. Infrastructure is relatively advanced in the Barents region, including the Kola Peninsula, Murmansk, and Arkhangelsk. Indeed, Murmansk is the largest city in the Arctic Circle. Much of this region's development derives from its military importance to Russia, as well as Murmansk's status as a deepwater port. Communities are well connected by air and road. In addition, Russia has built increasingly extensive civilian infrastructure in and around Sabetta, the home of the Yamal LNG project. It is now a scheduled destination for several Russian airlines. The situation is different east of the Yamal Peninsula and Norilsk. As in much of the U.S. and Canadian Arctic, the Siberian Arctic is sparsely populated, except for a few urban centers, such as Yakutsk and Anadyr in the Russian Far East. Medicine, some food, materials, and people have to be flown in, often to primitive airstrips. This is beginning to change as Russia becomes increasingly aware of SAR and security needs in its Far East, especially if it desires increased NSR traffic. Recently, Russia has established or rehabilitated a series of SAR stations along its Arctic coast, ostensibly to support commercial use of the NSR. However, some have argued that such stations could serve a dual-use purpose, supporting military as well as civilian operations.

The Arctic and Antarctic Research Institute, a state scientific and sea ice information organization to support domain awareness and safe navigation along the NSR, including climate and sea ice monitoring and prediction. The institute regularly produces ice maps of the Arctic Ocean, Eurasian Arctic (Barents Sea), and Southern (Antarctic) Ocean and maintains several scientific observatories, including one on Svalbard.

We discuss Russian Arctic interests, activities, and infrastructure in detail in Appendix B, available online.

⁴⁸ International Institute for Strategic Studies, 2021b.

⁴⁹ Sergey Sukhankin, "Completing the Arctic Shield: Russian Activities on Wrangel Island," *Eurasia Daily Monitor*, Vol. 17, No. 48, April 9, 2020.

⁵⁰ Bratersky, 2021.

⁵¹ Manenkov and Isachenkov, 2021.

⁵² Ministry of Defence of the Russian Federation, "New Snowmobiles Have Arrived in the Arctic Brigade of the Northern Fleet," January 8, 2021b.

Canada

Canada possesses a large portion of the Arctic, both on land and sea. The Canadian Armed Forces have robust Arctic capabilities to help the country deal with Arctic commerce and defense and enhance its sovereignty in the region.

The Royal Canadian Navy (RCN) and Canadian Coast Guard (CCG) operate in the Arctic. The CCG has a fleet of icebreakers and ice-capable ships. As of March 2022, the CCG had two heavy, five medium, and eight light icebreakers in the fleet.⁵³ Additionally, the service wants to build and convert additional icebreakers. The CCG is considering two heavy conversions, one medium conversion, and six new icebreakers to be built. Descriptions of icebreaker classes follow later.

The RCN is currently building a fleet of ice-capable vessels designed to break 1 m of one-year-old ice. The *Harry DeWolf*-class Arctic OPV is an active program, with a fleet of six vessels planned by the mid-2020s.

Additionally, the CCG is exploring acquiring one or two additional vessels in the class.⁵⁴ The other primary class in the RCN, the *Halifax*-class frigate, is mainly an open-ocean class of ships based in Vancouver, British Columbia, and Halifax, Nova Scotia. This class is not ice capable.

Under the surface, the RCN operates a fleet of four *Victoria*-class fast-attack submarines. The submarines are planned for replacement in the next decade.⁵⁵ They are not capable of staying under Arctic ice, however,⁵⁶ and therefore do not represent added capability for the RCN in the Arctic. Their eventual replacement will need to account for Canada's significant Arctic territory.

Canada possesses significant air capabilities in and near the Arctic in support of national sovereignty and NORAD. The Royal Canadian Air Force has four squadrons of CF-18 Hornets available for defense, two squadrons of CP-140 Aurora ISR aircraft, and two squadrons of CH-148 Cyclone ISR aircraft.⁵⁷

A crucial aspect of ensuring the effectiveness of these capabilities is continually exercising them. Canada's armed forces conduct a large-scale annual Arctic exercise called Operation NANOOK, which includes diverse partners from across the Canadian government and internationally. Its maritime component entails deploying, training, conducting incident management and SAR, and maintaining presence; it focuses on eastern Canada, adjacent to Greenland. Recent iterations of Operation NANOOK have included substantial participation by the USCG and USN, as well as by Danish, French, and other forces. Operation NANOOK takes place each late summer and early fall and typically includes three phases—Tatigiit (incident management), Nunakput, and Tuugaalik (maritime security and defense)—with each phase addressing different mission goals. USCG Atlantic Area (LANTAREA) typically supports the Tuugaalik and Tatigiit phases. Nunakput is primarily an internal phase for Canadian forces and agencies.

The Canadian Arctic, much like its neighboring U.S. counterpart, is sparsely populated and poorly maintained outside Nunavut's capital, Iqaluit. Villages depend on airplanes and ships to deliver much-needed supplies, such as medicine. Several companies, including Buffalo Airways, Canadian North, and Air Inuit, have become prosperous thanks to their ability to connect Arctic communities that otherwise could likely not exist. Southern Canada is linked by rail to its maritime Arctic via the Port of Churchill on the Hudson Bay, which is capable of handling Panamax-size vessels at four deepwater berths. However, economic concerns have limited use of the port in recent years.

⁵³ CCG, "Icebreaking Fleet of the Canadian Coast Guard," webpage, modified December 5, 2021.

⁵⁴ Edward Lundquist, "Canadian Patrol Ship Circumnavigates North America on First Voyage," *Seapower*, December 17, 2021.

⁵⁵ Blair Shaw, "Canada's Next Generation Submarine," Navy General Board, July 19, 2021.

⁵⁶ Joe Varner, "Canada's Arctic Problem," Modern War Institute at West Point, August 2, 2021.

⁵⁷ International Institute for Strategic Studies, *Military Balance 2022*, London, 2022a, p. 46.

Canada possesses numerous climate and ice monitoring and prediction capabilities. The Canadian Ice Service publishes weekly maps of ice predictions four months in advance, as well as season-long summaries. Environment Canada also compiles and publishes daily weather reports based on local forecasts and radar and satellite data.

The Kingdom of Denmark (Including Greenland)

The Kingdom of Denmark is a NATO country whose Arctic role stems from its sovereignty over Greenland; it is a permanent member of the Arctic Council. Denmark currently possesses four icebreaking tugboats. The 6,000-ton vessels have ice capabilities. On the surface, the Royal Danish Navy operates four OPV frigates, which have ice-reinforced hulls and icebreaking capabilities, and three *Knud Rasmussen*-class OPVs with ice-reinforced icebreaking capacity. The Royal Danish Navy also has one OPV frigate under development. The Danish Arctic Response Force has one ranger company, one Navy Special Forces group, and one Sirius Dog Sled Patrol.

Among Nordic countries, Denmark has some of the most-robust domain awareness in the Arctic.⁵⁸ The Joint Arctic Command (JACO) is a Danish defense command with the primary mission of conducting Arctic patrols in and within the vicinity of Greenland and monitoring surrounding areas, such as the Faroe Islands. The command also handles other missions and tasks, such as SAR, patient transport, and fishery inspections. JACO also handles military tasks, duties related to the Danish Navy, and disaster response. Furthermore, on February 11, 2021, the Danish government passed a bill to further increase domain awareness, earmarking almost 1.5 billion Danish kroner on air surveillance radar on the Faroe Islands, including the following:

- long-endurance surveillance drones
- space-based surveillance
- ground station
- satellite communication (SATCOM)
- coastal radars
- ship-based tactical UASs.

Exercise Argus is an annual JACO-led exercise held in western Greenland each summer. The exercise first took place in 2018 with participants from Denmark, Greenland, and France. Exercise Argus focuses primarily on SAR and MER but includes other incident management exercise series as well.

Denmark's weather and ice monitoring and prediction capabilities include coverage of Greenland and its maritime areas. The Danish Meteorological Institute publishes weather data from the European Centre for Medium-Range Weather Forecasts, which runs global weather models. The institute also regularly publishes maps and satellite images of Greenland's ice sheets and sea ice cover.

Greenland's capital, Nuuk, is the country's seat of government and offers many services. However, its airport at Kangerlussuaq, often used by international polar scientists to access the Greenland ice sheet, is deteriorating, requiring the construction of a new international airport within the next few years. As in Alaska and much of Arctic Canada, civilian infrastructure and centers are sparse and not well connected to each other except by air and sea. Tusass A/S (formerly TELE Greenland A/S) is working to enhance internet services throughout the region. Poverty remains a real concern; as of 2018, an estimated 16 percent of Greenland's

⁵⁸ We use *Nordic nations*, a term that encompasses Iceland, Norway, Denmark, Sweden, and Finland. Although *Scandinavia* is more commonly used, technically, that term refers only to Norway, Sweden, and Denmark.

population lived below the poverty line.⁵⁹ Greenland's economy remains heavily dependent on fishing and tourism; it survives, in part, on an annual Danish block grant to ensure that the government can continue functioning and provide basic services to the territory's estimated 60,000 people.

Norway

Norway's military capabilities in the Arctic encompass tactical combat aircraft, maritime-patrol aircraft, icebreaking and other surface ships, ground forces, and submarines. The country's plans include upgrading its fleet of combat tactical and support aircraft, its ice-capable surface ships, and its ground and submarine forces. Additionally, Norway has been repositioning its ice-capable forces farther north and expanding its logistical infrastructure to accommodate prolonged surface and subsurface operations in Arctic waters.

Norway has been maintaining some offensive capability for its Arctic mission, primarily through its air and ground forces. It has a dedicated fleet of multirole tactical combat and support aircraft for Arctic operations and plans to replace most of its older F-16AM/BM combat aircraft with fifth-generation F-35A fighters.⁶⁰ The new aircraft will be stationed in the north and center of the country, providing an improved quick-reaction capability.

Norway's ground forces also include ice-capable units with offensive characteristics. These include two rifle companies and one ranger company, with primary equipment that includes tanks, infantry combat vehicles, armored personnel carriers, and improved self-propelled Howitzer guns.⁶¹ Norway also plans to procure a new tank and long-range precision weapons, in addition to acquiring more cold-weather, all-terrain vehicles capable of operating in the Arctic.⁶²

Although Norway maintains Arctic surface and subsurface warfare capabilities, most of its surface warships do not have icebreaking capability. The country currently maintains one Arctic icebreaker and several frigates, corvettes, coast guard patrol vessels, minehunters, minesweepers, and autonomous underwater vehicles with mine-countermeasure capabilities.⁶³ Norway's plans to enhance its surface fleet for Arctic operations are to acquire new coast guard patrol vessels with ice-strengthened hulls and larger vessels for additional mine countermeasures.⁶⁴

In addition to upgrading its offshore patrol capability—which would improve its domain awareness—Norway is upgrading its SAR, ISR, and special mission capabilities at its northern bases. The Royal Norwegian Navy operates a large surveillance ship and ISR submarines.⁶⁵ The Royal Norwegian Air Force operates multirole maritime ISR and patrol aircraft, SAR, and special mission aircraft that the country also planned to replace with upgrades starting in 2022.⁶⁶

Finally, understanding the vastness of the Arctic region and the limitations of the combat ranges of its Arctic assets, Norway has built up its logistics infrastructure. It has repositioned a floating quay from a decommissioned Arctic naval base to the maintenance Ramsund base to enable its Arctic submarines to

⁵⁹ Joe McCarthy, "The Crazy Reason Greenland Is Rooting for Climate Change," *Global Citizen*, May 4, 2018.

⁶⁰ Janes, "Norway: Air Force," webpage, updated April 14, 2021a.

⁶¹ Janes, "Norway: Army," webpage, updated April 14, 2021b.

⁶² Janes, 2021b; Jen Judson, "US Army Embarks on Competitive Prototyping Journey for Arctic Vehicle," *Defense News*, April 5, 2021.

⁶³ Janes, "Norway: Navy," webpage, updated April 14, 2021c.

⁶⁴ Janes, 2021c.

⁶⁵ Janes, 2021c.

⁶⁶ Janes, 2021a; Gerard O'Dwyer, "Norway Sets Timeline to Deploy Sub-Hunting Aircraft in the Arctic," *Defense News*, August 27, 2021.

recharge their batteries and operate in the Arctic for months if needed.⁶⁷ More importantly, the Ramsund naval facilities would also serve as a regular resupply base for U.S. naval submarines and ships along Norway's North Atlantic coast.⁶⁸ Norway also expanded its Tromsø naval facility farther north, which could help U.S. submarines resupply.

To provide domain awareness, Norway has the *Marjata IV* surveillance ship.⁶⁹ It also has multirole maritime and combat aircraft, which perform domain-awareness tasks. As of this writing, Norway has four P-3C Orion aircraft.⁷⁰ Norway operates the Svalbard Satellite Station near Longyearbyen. The government is also developing two Arctic satellites that will be controlled by a ground station based in Tromsø.⁷¹ The country is cooperating with the United States to develop two high-frequency (HF) military SATCOM satellites.⁷² Domain awareness is further supported by ice charts produced weekly by the Norwegian Meteorological Institute Ice Service. This service also publishes weather forecasts and satellite images of ice-covered areas.

Norway's logistics and basing are provided by the floating quay at Ramsund base and the new logistics and support vessel His/Her Norwegian Majesty's Ship (HNoMS) *Maud*, delivered in mid-2021.⁷³ Norway has also recently welcomed an ice-class research vessel (RV), the RV *Kronprins Haakon*.⁷⁴ For air logistics and resupply, Norway has four C-130J aircraft.⁷⁵

Norway enjoys advanced civilian centers and infrastructure north of the Arctic Circle. It is home to the Arctic Circle's second-largest city, Tromsø, which is also a deepwater port. Another port also exists at Bodø. Roads (especially E6) connect Norwegian Arctic communities along its northern boundary to Kirkenes, near the Russian border. Widerøe provides comprehensive air-link services connecting Arctic Norway with the rest of the country and even beyond via connections at Oslo and Helsinki. Scandinavian Airlines System (SAS) provides service to Longyearbyen, Svalbard. These communities are also connected with high-speed internet, even as far as remote Svalbard.⁷⁶

Sweden

Sweden is an Arctic state and a founding permanent voting member of the Arctic Council. It is also a member of the Barents Euro-Arctic Council. It therefore possesses significant vested interests in maintaining Arctic governance mechanisms, peace, and security. As of this writing, it possesses four Arctic icebreakers.⁷⁷ Specifically, they are four medium icebreakers, the *Oden*, the *Ymer*, the *Frej*, and the *Atle*, intended to break up ice in the northern portion of the Gulf of Bothnia between Sweden and Finland. All four icebreakers are operated by the Swedish Maritime Administration and are unarmed. In 2020, Sweden and Finland announced that they would jointly design a new icebreaker class. The contract was awarded to Aker Arctic Technology.⁷⁸

⁶⁷ Janes, 2021c.

⁶⁸ O'Rourke et al., 2022, p. 43.

⁶⁹ Janes, 2021c.

⁷⁰ Janes, 2021a.

⁷¹ Arctic Infrastructure Inventory, Polar Institute, Wilson Center, "Space Norway Satellites," webpage, undated.

⁷² USSF, "USSF's EPS-R Program on Schedule for Historic Polar Mission," December 8, 2021.

⁷³ Janes, 2021c.

⁷⁴ Norsk Polarinstitutt, "FF Kronprins Haakon: Norway's Ice-Class Research Vessel," webpage, undated.

⁷⁵ Janes, 2021a.

⁷⁶ Kevin McGwin, "On Norway's Internet Frontier, the Future Is Here—Again," *ArcticToday*, November 8, 2019.

⁷⁷ Center for Circumpolar Security Studies, Arctic Institute, "Sweden," webpage, June 19, 2020b.

⁷⁸ Maritime Executive, "Finland and Sweden Collaborate to Design Next Icebreaker," November 2, 2020.

Sweden does not operate any ice-hardened warships. The Swedish Navy operates three *Gotland*-class diesel-electric submarines and one *Södermanland*-class diesel-electric submarine.⁷⁹ Both classes are likely designed for Gulf of Bothnia and Baltic Sea operations, not Arctic conditions. Like their Nordic neighbors, Swedish ground forces routinely train in the Arctic to maintain specialized ice capabilities.⁸⁰ Alongside JAS 39 Gripen fighter jets, Sweden possesses Saab 340 command, control, communications, computers, ISR (C4ISR) aircraft capable of monitoring the Gulf of Bothnia, Arctic Sweden, and, if needed, Arctic Norway and Finland.

Sweden possesses highly developed Arctic civilian centers and infrastructure. Roads connect Arctic Swedish communities. Kiruna is the largest city in Arctic Sweden. It maintains an airport capable of handling larger jets and road and rail links with the rest of the country and possesses a city center, hospital, markets, and other amenities not found in much of the U.S. or Canadian Arctic. In recent years, Kiruna has become a space research center. Luleå University of Technology maintains its Department of Computer Science, Electrical and Space Engineering near the city. The European Space Agency also maintains several satellite tracking stations in the area. Tourism and mining dominate its economy. Mining operations and other factors have necessitated a major move of the city two miles east.⁸¹ The Swedish Meteorological and Hydrological Institute provides regular weather forecasts and weather-related satellite imagery. The Swedish Ice Service also publishes ice charts during winter, which include information on ice drift.

Finland

Finland is an Arctic state and a founding permanent voting member of the Arctic Council. It is also a member of the Barents Euro-Arctic Council. Like its neighbors, it possesses significant vested interests in maintaining Arctic governance mechanisms, peace, and security. As of this writing, it possesses three polar icebreakers: the *Polaris*, the *Nordica*, and the *Fennica*.⁸² In addition, it possesses four smaller icebreakers of the joint Swedish–Finnish *Atle* class: the *Kontio*, the *Otso*, the *Sisu*, and the *Urho*.⁸³ These icebreakers are designed for ice-clearing activities in the Gulf of Bothnia in the Baltic Sea, not the High Arctic.⁸⁴ Finland also operates three small icebreakers—the *Hermes*, the *Thetis*, and the *Voima*—to help clear ice in the Gulf of Bothnia.

In 2020, Sweden and Finland announced that they would jointly design a new icebreaker class. The contract was awarded to Aker Arctic Technology.⁸⁵ The Finnish Navy is planning on acquiring four *Pohjanmaa*-class corvettes by 2028. This class will be capable of navigating some ice and shallow waters with an ice-strengthened hull.⁸⁶ Like their Nordic neighbors, Finnish ground forces routinely train in the Arctic to maintain specialized ice capabilities.⁸⁷ Alongside its fighter capabilities, the Finnish Air Force also possesses

⁷⁹ Janes, “Gotland (A 19 Class [SSK]),” *Fighting Ships*, December 1, 2021e; Janes, “Södermanland (A 17) Class (SSK),” *Fighting Ships*, webpage, March 23, 2022b.

⁸⁰ WION News, “Swedish Troops Train for Arctic Warfare Amid Tensions in Strategic High North,” undated.

⁸¹ David Nickel, “Kiruna: A Mining Town on the Move in Northern Sweden,” *Forbes*, March 23, 2021.

⁸² Center for Circumpolar Security Studies, Arctic Institute, “Finland,” webpage, updated August 1, 2022a; USCG, “USCGC Polar Star (WAGB 10),” webpage, undated-a.

⁸³ USCG, undated-a. Some experts might consider *Urho* and *Sisu* to be in a separate class.

⁸⁴ *Far North* is another term for *Arctic*. *High Arctic* refers to areas above 75 or 80°N, though this is not set in stone. The terms are somewhat colloquial.

⁸⁵ Maritime Executive, 2020.

⁸⁶ Gerard O’Dwyer, “Finland to Bolster Navy’s Surface Fleet with New Ships, More Missiles,” *Defense News*, webpage, January 13, 2020.

⁸⁷ “Arctic Finland to See Biggest Military Exercise of the Year,” Radio Canada International, May 19, 2021; Finnish Army, Finnish Defence Forces, “Finland to Participate in Cold Response 2022 in Northern Norway,” press release, March 4, 2022.

Construcciones Aeronáuticas Sociedad Anónima (CASA) C-295 C4ISR aircraft capable of patrolling the Gulf of Bothnia, Arctic Finland, and, if needed, Arctic Norway. For logistics and surveillance, Finland maintains a fleet of C-160R Transall aircraft, Beech 350ER King Air, and one squadron of E-3F Sentry aircraft.⁸⁸

Like those of other Nordic countries, Finland's civilian centers and infrastructure are well established and connected with other parts of the country. Rovaniemi, capital of Lapland, possesses both a major airport and rail facilities linking it with the rest of Finland. U.S. officials have proposed construction an under-sea telecommunication cable from Japan to Finland to Canada to improve secure communications.⁸⁹ Arctic roads lead to ports at Kemi and Oulu. The Finnish Meteorological Institute publishes ice charts twice weekly during autumn and daily as ice conditions worsen in winter. The institute also publishes local weather information as interactive charts and models.

Iceland

Although Iceland is an Arctic state, its ice capabilities are rather limited, and it does not have any government-owned or commercial icebreakers or ice-capable vessels. The Icelandic Coast Guard has four vessels: the *Thor*, the *Týr*, the *Ægir*, and the *Baldur*. The first three of these are cold weather-capable surface patrol vessels, while the fourth, the *Baldur*, is an auxiliary research and surveillance ship used for hydrographic surveying in the summer.⁹⁰

Iceland does not have an air force similar to the USAF; the Iceland Air Defence System resides under the Icelandic Coast Guard. Iceland's air capabilities consist of one fixed-wing Bombardier DHC-8-Q314 used for SAR, maritime and ice patrol, and ambulatory services, and rotary-wing assets, including one Aerospatiale Super Puma AS332L1 and two Airbus Super Puma H225s, with each helicopter able to hold up to 18 passengers.⁹¹ In addition, Iceland has uncrewed aerial vehicles, such as Hermes 900 remotely piloted aircraft systems that were tested to patrol its EEZ.⁹²

Iceland has no standing armed forces but has a 250-person coast guard. The Icelandic Coast Guard is considered a paramilitary force.⁹³ The Iceland Air Defence System is part of the Icelandic Coast Guard and provides domain awareness. It relies on four radar stations, each of which has a surveillance radar:⁹⁴

- H1 at Miðnesheiði
- H2 on Mount Gunnolfsvík
- H3 at Stokksnes
- H4 on Mount Bolafjalli.

At Keflavik, the USN has renovated hangars to accommodate USN P-8 surveillance planes on a rotational basis.⁹⁵

⁸⁸ International Institute for Strategic Studies, *Military Balance 2021*, London, 2021a, p. 104.

⁸⁹ Clothilde Goujard, "Finnish-US Internet Cable Planned to Bolster Europe's Digital Trade with Asia," *Politico*, December 22, 2021.

⁹⁰ Icelandic Coast Guard, "Search and Rescue," webpage, undated-b; International Institute for Strategic Studies, 2021c.

⁹¹ Icelandic Coast Guard, undated-b; International Institute for Strategic Studies, 2021c.

⁹² Hafstað, Vala, "Icelandic Waters Watched by Drone," *Iceland Monitor*, May 2, 2019.

⁹³ Icelandic Coast Guard, "Security and Defence," webpage, undated-c; International Institute for Strategic Studies, 2021c.

⁹⁴ Icelandic Coast Guard, "Íslenska loftvarnakerfið [The Icelandic Defense System]," webpage, undated-a.

⁹⁵ McLeary, 2019.

Icelandic civilian centers and infrastructure are considerably advanced, with the qualification that nearly all of Iceland, except Grimsey Island, falls *outside* the Arctic Circle. Major urban centers, such as Reykjavik and Akureyri, enjoy international air access and high tourism rates. The Icelandic Coast Guard protects Iceland's sizable fishing fleet. The Icelandic Meteorological Office provides daily weather forecasts and regularly publishes satellite maps of sea ice cover in winter.

United Kingdom

The UK is the closest non-Arctic state in Europe to the Arctic Circle and was tied with China as the first country to define itself as a “near-Arctic state.”⁹⁶ The UK published Arctic policy papers in 2013, 2018, and 2022.⁹⁷ The British Antarctic Survey maintains its permanent UK Arctic Research Station at Ny-Ålesund, Svalbard, Norway.⁹⁸ Historically, however, its interests have focused more on the South Atlantic and the Antarctic.

The UK currently possesses two icebreakers of various sizes: the Royal Research Ship *Sir David Attenborough* (PC4), operated by the UK's Natural Environment Research Council and British Antarctic Survey, and HMS *Protector* (PC unknown), operated by the Royal Navy. Both vessels are normally positioned in the South Atlantic and the Antarctic but ostensibly could be repositioned in the Arctic or High Arctic if required. Only HMS *Protector* is armed. As of this writing, the UK has no plans to build additional icebreakers. In its most recent Arctic strategy, “The UK's Defence Contribution in the High North,” the UK's Ministry of Defence announced that it would prioritize the use of P-8 Poseidon C4ISR aircraft to patrol the High North and the Arctic, as well as enhance cooperation with allied and partnered Arctic states.⁹⁹ Apart from HMS *Protector*, the Royal Navy does not have any ice-hardened vessels currently capable of sailing in Arctic icebound waters.

This is not to say that UK vessels are not involved in Arctic affairs. The Royal Navy is often involved in High North multinational naval exercises. Most recently (March 2022), the Royal Navy's HMS *Queen Elizabeth* aircraft carrier was the lead ship in NATO's Cold Response exercise that crossed the Arctic Circle.¹⁰⁰ The Royal Navy also deploys *Astute*- and *Vanguard*-class nuclear-powered general-purpose attack submarine ship (SSNs) and ballistic-missile SSNs (SSBNs), respectively, to the Arctic and the North Pole, although details on those activities are unknown. UK ground forces, notably the Royal Marines, routinely train with their Norwegian counterparts in the Norwegian Arctic.¹⁰¹

The UK has domain-awareness capabilities that benefit the Arctic. Remote Radar Head Saxa Vord in the Shetland Islands was closed in 2006 but reopened in 2018 to provide situational awareness and, in particular, early warning of Russian military activity. It was reopened as an uncrewed facility that could be monitored

⁹⁶ Select Committee on the Arctic, United Kingdom Parliament, “Chapter 6: The UK and the Arctic,” *Responding to a Changing Arctic: Report of Session 2014–15*, 2015.

⁹⁷ Ministry of Defence (UK), “The UK's Defence Contribution in the High North,” March 29, 2022; Polar Regions Department, Foreign and Commonwealth Office (UK), *Adapting to Change: UK Policy Towards the Arctic*, October 17, 2013; Polar Regions Department, Foreign and Commonwealth Office (UK), *Beyond the Ice: UK Policy Towards the Arctic*, April 4, 2018.

⁹⁸ British Antarctic Survey, Natural Environment Research Council, UK Research and Innovation, “UK Arctic Research Station,” webpage, undated.

⁹⁹ Ministry of Defence (UK), 2022, pp. 2, 8.

¹⁰⁰ Hilde-Gunn Bye, “Cold Response 22: UK's Largest Warship to Lead NATO's Maritime Task Force in the Arctic,” *High North News*, March 9, 2022.

¹⁰¹ Royal Navy (UK), “Cold Weather Training,” webpage, undated.

remotely.¹⁰² The UK also has aircraft that provide domain awareness. These include one squadron of RC-135W Rivet Joint aircraft, one squadron of Sentinel R1s, and one squadron of Shadow R1s. The P-8 Poseidon MRA1 is replacing the Nimrod MRA2, retired several years ago, for C4ISR duties. Finally, by sea, the type 45 destroyers possess domain-awareness capabilities.¹⁰³

UK logistics in the Arctic are provided by a mix of assets. The Royal Navy operates three Bay-class dock landing ships, four Tide-class auxiliary fast combat support ships with a hangar, two Wave-class oil replenishment tankers, one Fort-class auxiliary oil replenisher with hangar (AORH), and one *Argus*-class casualty treatment vessel.¹⁰⁴ On the ground, the UK has an engineering regiment. Airlift support for both poles is provided by the Royal Air Force.

The UK does not possess any permanent civilian centers or infrastructure in the Arctic. It does, however, maintain a scientific presence at Ny-Ålesund, Svalbard, Norway. The UK is active in scientific research in the Arctic and disseminates Arctic weather and sea ice information through the UK Meteorological Office.

Australia

Although Australia is obviously not an Arctic state, it maintains polar icebreaking and other ice capabilities for missions to Antarctica, some of which could be repurposed for the Arctic when needed. We included consideration of Australia in this analysis despite lack of formal equities or activities in the region because it is an important U.S. ally whose Antarctic capabilities could contribute to Arctic contingencies, given enough time to transport assets there. As of 2022, the Australian government operated one icebreaker, the research and supply vessel (RSV) *Nuyina*. The RSV *Nuyina* entered service in 2016 and is capable of operating for 90 days per deployment. It carries cargo and personnel to and from Antarctic and sub-Antarctic locations. The ship's capacity includes the ability to carry 96 cargo containers, 1,200 tons of cargo, 1.9 million liters of fuel (including 500,000 L of aviation fuel for the embarked helicopter), and nearly 120 expeditionary crew; it has more than 5,000 m³ of cargo space.¹⁰⁵

The Royal Australian Navy (RAN) currently operates eight *Anzac*-class frigates and is building nine *Hunter*-class frigates. These ships give the RAN domain-awareness and combat capabilities, although they were not designed for polar use. The RAN also operates six *Collins*-class submarines and has plans to build a nuclear-powered replacement that would make Australian submarines better able to operate in polar regions under the ice. Australia possesses no civilian centers or infrastructure in the Arctic.

New Zealand

Like Australia, New Zealand is obviously not an Arctic state, but some of its maritime and air capabilities can support operations in polar regions. We included consideration of New Zealand in this report despite lack of formal equities or activities in the region because—like Australia—it is an important U.S. ally whose Antarctic capabilities could also be used in the Arctic, given sufficient time to deploy them there. At the time of this writing, New Zealand does not have any government-owned or commercial icebreakers but has

¹⁰² Defence Committee, UK House of Commons, *On Thin Ice: UK Defence in the Arctic*, 12th report of Session 2017–19, HC 388, July 19, 2018; Royal Air Force (UK), “RAF Typhoon Overflew Newly Installed Air Defence Radar at Saxa Vord,” May 29, 2018.

¹⁰³ Andrew Chuter, “British Warship to Get a Boost in Firepower with New Missile,” *Defense News*, July 7, 2021; International Institute for Strategic Studies, 2021a, pp. 157–159.

¹⁰⁴ International Institute for Strategic Studies, 2021a, pp. 157–159.

¹⁰⁵ Australian Antarctic Program; Australian Antarctic Division; Department of Climate Change, Energy, the Environment and Water; Australian Government, “RSV *Nuyina*: Australia’s Antarctic Icebreaker,” webpage, undated.

two ice-capable Protector-class OPVs: Her Majesty's New Zealand Ship (HMNZS) *Wellington* and HMNZS *Otago*. The two OPVs have strengthened hulls that enable them to navigate in Antarctic waters where they could encounter ice. The OPVs carry out a variety of missions around the coast of New Zealand and in the surrounding ocean areas.¹⁰⁶

In addition to the two ice-capable OPVs, New Zealand has two aging *Anzac*-class frigates, HMNZS *Te Mana* and HMNZS *Te Kaha*, and one AORH, HMNZS *Aotearoa*. The two frigates are being upgraded to extend their life spans into the 2030s, by which point new frigates could replace them.¹⁰⁷ The HMNZS *Aotearoa* resupplied McMurdo Station and Scott Base in Antarctica in 2022.¹⁰⁸ Regarding future capabilities, in the context of the Southern Ocean Patrol Vessel project, New Zealand is exploring options to develop a vessel that could operate in the Antarctic, such as an ice-strengthened southern OPV that can navigate between New Zealand and Antarctica.¹⁰⁹

In terms of air capabilities, New Zealand has five upgraded C-130H Hercules aircraft, and it is procuring five new C-130J-30 Hercules aircraft, with the first due to be delivered in 2024 and the full fleet expected to become operational by 2025.¹¹⁰ Currently, Royal New Zealand Air Force C-130s provide medical evacuation services from the USAP's McMurdo Station in Antarctica, and the new C-130s will be intended to carry out operations in New Zealand, the South Pacific, and Antarctica.¹¹¹ Future air procurements also include four P-8 Poseidon maritime-patrol aircraft and a sealift vessel. The latter is planned to be acquired in the late 2020s.¹¹²

To maintain domain awareness in the Antarctic, New Zealand relies on a wide variety of assets, including uncrewed aerial vehicles, such as the Polar Fox—which is extremely robust and reliable for harsh weather of Antarctica—and civilian sail drone uncrewed surface vehicles.¹¹³ For maintaining maritime domain awareness, New Zealand also relies on the Maritime Anomaly Indication and Alerting tool, which “can tell when a vessel in New Zealand waters is behaving out of character,” with the resulting data contributing to maritime surveillance and SAR efforts.¹¹⁴

New Zealand's space awareness capabilities were enhanced in 2015, when it developed an experimental ground satellite station on the Whangaparaoa Peninsula. In addition to the ground station, New Zealand also maintains space awareness through “a small optical observatory to accurately track and measure position and brightness of satellites as they pass over New Zealand.”¹¹⁵ In addition to New Zealand's space awareness capabilities, in Antarctica, the United States has the Defense Satellite Communications System (DSCS)-3

¹⁰⁶ New Zealand Ministry of Defence, “Southern Ocean Patrol Vessel,” webpage, last updated May 2021.

¹⁰⁷ Thomas Manch, “Why Doesn't New Zealand Have Submarines? AUKUS Highlights Pressing Military Question for Government,” *Stuff*, September 18, 2021; Ships Hub, “Replenishment Oiler HMNZS Aotearoa (A11),” webpage, undated.

¹⁰⁸ “New Zealand Send Auxiliary Ship HMNZS Aotearoa to Antarctica,” *Navy Recognition*, February 4, 2022.

¹⁰⁹ New Zealand Ministry of Defence, 2021.

¹¹⁰ Nick Perry, “New Zealand Military Buys 5 Lockheed Hercules Planes for \$1 Billion,” *Defense News*, June 5, 2020.

¹¹¹ New Zealand Defence Force, “RNZAF Carries Out Medevac from Antarctica,” news story, July 12, 2021; Perry, 2020.

¹¹² International Institute for Strategic Studies, “Military Balance Plus: New Zealand Country Profile,” last updated January 13, 2022b; Manch, 2021.

¹¹³ Defence Technology Agency, New Zealand Defence Force, “Unmanned Aircraft Flight in Antarctica,” webpage, undated-c; Saildrone, “Saildrone Fleet Launches in New Zealand on Epic Journey,” press release, January 21, 2019.

¹¹⁴ Defence Technology Agency, New Zealand Defence Force, “Maritime Domain Awareness,” webpage, undated-b.

¹¹⁵ Defence Technology Agency, New Zealand Defence Force, “DTA Looking into Space,” case study, undated-a.

B7 satellite, which provides “limited daily coverage between South Pole Station and an NSF gateway teleport implemented at the International Antarctic Center in Christchurch, New Zealand.”¹¹⁶

New Zealand has one Antarctic research station at Scott Base.¹¹⁷ Royal New Zealand Air Force C-130 Hercules and Boeing 757 flights provide support and transport light engineering teams and support personnel to the base, including plant operators, cargo handlers, communication, and administration staff.¹¹⁸ New Zealand does not possess any civilian centers or infrastructure in the Arctic, but some of its ice-capable equipment and personnel could be redeployed there in a contingency.

France

France is not an Arctic country but, like several of its European allies and partners, maintains vested interests in the region. It became an observer state of the Arctic Council in 2000 and maintains one heavy icebreaker, *l’Astrolabe* (PC5/6). A private firm, Ponant, also operates an ice-capable cruise ship, *Le Commandant Charcot*,¹¹⁹ which is hybrid powered by LNG and electric generators.¹²⁰ France has used *l’Astrolabe* to primarily support its Dumont d’Urville Antarctic research station, but the icebreaker can be used in Arctic if required. France’s naval vessels, notably its *Mistral*-class helicopter carriers, have participated in High North and Arctic NATO exercises. The frigate *Bretagne* has also participated in at least one Arctic NATO exercise.¹²¹ France possesses Dassault Atlantique 2 ISR aircraft with deicing capabilities, although it is unknown whether they have been used in the High North.¹²² French ground forces actively participate in NATO training exercises in the Arctic.¹²³ France possesses four *Le Triomphant* SSBNs and four *Rubis* SSNs that can operate in the Arctic. Details of their Arctic operations are unknown. Logistics and supplies for France are provided via airlift support provided by France’s Air and Space Force. France does not possess any permanent Arctic civilian centers or infrastructure. It does, however, maintain a scientific presence at Ny-Ålesund, Svalbard, Norway.

Germany

Germany became an observer state of the Arctic Council in 1998 and published its Arctic strategy, highlighting scientific research and environmental protection, in 2013.¹²⁴ Its Alfred-Wegener-Institut operates one scientific icebreaker, the *Polarstern* (PC5/6), to conduct Arctic and Antarctic research.¹²⁵ Germany’s Federal Waterways and Shipping Administration additionally operates four light icebreakers to ensure ice-free shipping access to the German coast and rivers during the winter. These include the *Neuwerk*, the *Arkona*,

¹¹⁶USAP, “Defense Satellite Communications System (DSCS),” webpage, undated-b.

¹¹⁷Antarctica New Zealand, “Scott Base,” webpage, undated.

¹¹⁸New Zealand Ministry of Defence, “Antarctica,” webpage, undated.

¹¹⁹Malte Humpert, “Research Vessel Kronprins Haakon and Cruise Ship Le Commandant Charcot Team Up at North Pole,” *High North News*, August 1, 2022, updated January 2, 2023.

¹²⁰Ponant, “Beyond Exploration: Aboard Le Commandant Charcot,” webpage, undated.

¹²¹Ministry of the Armed Forces (France), *France and the New Strategic Challenges in the Arctic*, Paris, 2019.

¹²²Janes, “Dassault Atlantique 2,” *All the World’s Aircraft*, September 8, 2020.

¹²³“Sweden’s Snowy Forests Provide Setting for Arctic Warfare Training,” France24, May 20, 2021.

¹²⁴Center for Circumpolar Security Studies, Arctic Institute, “Germany,” webpage, updated August 1, 2022b.

¹²⁵Alfred-Wegener-Institut, “Research Ice Breaker Polarstern,” webpage, undated.

the *Mellum*, and the *Scharhörn*.¹²⁶ German ground forces participate in such Arctic exercises as Trident Juncture.¹²⁷

German logistics in the Arctic via sea are supported by four auxiliary general ships (*Schwedeneck* and *Stollergrund* classes), three auxiliary general intelligence ships (*Oste* class), six replenishment oilers (*Elbe* class), and three AORHs (*Berlin* class). Airlift logistics support is provided by the German Air Force.

Germany does not possess any permanent Arctic civilian centers or infrastructure. It does, however, maintain a scientific presence at Ny-Ålesund, Svalbard, Norway. Germany also participated in the Multidisciplinary Drifting Observatory for the Study of Arctic Climate, with the RV *Polarstern* sailing into the Arctic Ocean.¹²⁸

China

China is a relative newcomer to the Arctic, although it has participated in Arctic science and other activities for several decades. Although it is not an Arctic nation itself, China has recently begun planning policy for the Arctic. In 2012, it declared itself to be a “near-Arctic state.”¹²⁹ In January 2018, China’s State Council Information Office released a white paper on the country’s new Arctic policy. The paper, “China’s Arctic Policy,” details how the country would engage in the Arctic.¹³⁰ The paper gives a partial account of China’s Arctic strategy, highlighting scientific and economic interests in the region while eliding China’s military and strategic interests. China’s polar analysts divide China’s Arctic interests into three core priorities:

- **security** (安全, anquan): The Arctic is crucial for China’s nuclear deterrence.
- **resources** (资源, ziyuan): China wants access to Arctic minerals and hydrocarbons, fishing, tourism, and transport routes.
- **strategic science and technology** (科技, keji): Access to the Arctic is essential for the rollout of the Beidou global navigational system, China’s counterpart to GPS. Beidou is crucial for China’s cyberwarfare capabilities and C4ISR.¹³¹

China currently operates two heavy icebreakers—the *Xue Long 1* (21,000 tons) and *Xue Long 2* (14,000 tons)—and two medium icebreakers.¹³² One or two additional icebreakers are planned to be added to the fleet in the mid-2020s, one of which will be nuclear powered;¹³³ one or both would be larger than the previous vessels at 26,000 tons.¹³⁴

In September 2019, China launched its first polar observation satellite, the BNU-1, to monitor sea ice drift and ice shelf collapse. The BNU-1 will greatly improve China’s remote sensing capability and help expand

¹²⁶ MarineTraffic, “Arkona,” webpage, undated-a; MarineTraffic, “Mellum,” webpage, undated-b; MarineTraffic, “Neuwerk,” webpage, undated-c; MarineTraffic, “Scharhörn,” webpage, undated-d.

¹²⁷ “NATO Confirms German Troops to Spearhead ‘Trident Juncture’ Exercises,” *Deutsche Welle*, August 17, 2018.

¹²⁸ Alfred Wegener Institute, “German Ship Completes Historic Arctic Expedition,” webpage, undated.

¹²⁹ Mia M. Bennett, “How China Sees the Arctic: Reading Between Extraregional and Intraregional Narratives,” *Geopolitics*, Vol. 20, No. 3, April 2015, p. 654.

¹³⁰ State Council of the People’s Republic of China, 2018.

¹³¹ Anne-Marie Brady, “Facing Up to China’s Military Interests in the Arctic,” *China Brief*, Vol. 19, No. 21, December 10, 2019.

¹³² Malte Humpert, “China Reveals Details of Newly Designed Heavy Icebreaker,” *High North News*, December 16, 2019; Office of Waterways and Ocean Policy, 2020. *Xue Long* means “snow dragon.”

¹³³ Office of Waterways and Ocean Policy, 2020.

¹³⁴ Humpert, 2019.

Arctic shipping.¹³⁵ On orbit, China has 132 satellites: nine for communications, 45 for navigation, 29 for ISR, eight for meteorology and oceanography, and 41 electronic intelligence and signal intelligence (SIGINT) satellites. Most of these 132 satellites do not appear designed for Arctic-specific purposes, although efforts might be underway to monitor Arctic shipping routes from space.¹³⁶

As of this writing, China does not possess any other dedicated Arctic military assets or permanent Arctic civilian centers or infrastructure. It does, however, maintain a scientific presence at Ny-Ålesund, Svalbard, Norway, and the China Iceland Arctic Research Laboratory near Kárholl, Iceland. The China Meteorological Administration publishes daily weather reports and radar and satellite images of the Arctic region.

We summarize China's broader military capabilities here as well, noting again that these are not intended or designed for use in the region. Under the surface, China has a submarine fleet that consists of six Jin-class (type 094) SSBNs, six type 093 SSNs, four type 093-A SSNs, and 46 nonnuclear hunter-killer antisubmarine warfare submarines. Like the USN's submarines, the People's Liberation Army (PLA) Navy (PLAN) submarines could operate below and through the ice. Although they are large and powerful, the PLAN, PLA Air Force, and China Coast Guard do not have any Arctic- or Antarctic-specific capabilities. China has no Arctic-specific brigades. However, potential brigades for Arctic utility include 15 special operations brigades, including the Snow Leopard Commando Unit, that have approximately 400 troops. China's aircraft capabilities are not Arctic specific. For ISR, they include one regiment with a JZ-8F Finback and one brigade with a JZ-8F Finback. Chinese airborne early-warning and control aircraft include one regiment with KJ-500 and one regiment with a KJ-200 Moth, KJ-2000, and Y-8T. SAR aircraft include four brigades that can have a Y-5, an Mi-171E, and a Z-8, as well as one regiment with a Y-5, an Mi-171E, and a Z-8.¹³⁷ In Appendix B (available online), we discuss additional information on China's Arctic ambitions and activities.

Commercial

We have already referred to some commercial capabilities in this report, especially with respect to icebreaking. There are too many entities to describe each individually. Instead, we supplement the country-by-country discussion above by noting some types of commercial capabilities that are also present in the Arctic. Some aspects of this discussion could also include not-for-profit organizations, but the majority of focus is on commercial ones. Many times, a commercial organization can be more agile in its activities than a government organization and access funds that a government entity cannot, which is why some of the most-important innovation in ice capabilities is in the hands of commercial organizations. Depending on what partnerships have been forged, some countries might benefit more than others from these commercial capabilities. Here, we focus on three primary areas that are particularly challenging in the Arctic:

- domain awareness and communications
- fixed shoreside infrastructure
- mobile platforms.

U.S. firm Edison Chouest Offshore, for instance, operates the *Aiviq* as a charter icebreaker for Shell and other contractors.¹³⁸ The U.S. government has considered purchasing or leasing the *Aiviq* because of

¹³⁵ Heiner Kubny, "Chinese Microsatellite Monitors Polar Regions," *Polar Journal*, July 25, 2020.

¹³⁶ Malte Humpert, "China to Launch Satellite to Monitor Arctic Shipping Routes," *High North News*, December 8, 2020.

¹³⁷ International Institute for Strategic Studies, 2021a.

¹³⁸ Professional Mariner, "Aiviq: Pride of Shell's Alaskan Drilling Fleet," October 16, 2012.

its proven strength in the Arctic.¹³⁹ Norway similarly has three commercial icebreakers—the *Viking II*, the *Vidar Viking*, and the *Balder Viking*—available for charter use.¹⁴⁰ Commercial shipping more generally has enhanced mobile platform capabilities and domain awareness, especially through the NSR.

Russia, the United States, and Canada have all developed offshore petroleum platforms that operate in the Arctic. These, too, provide valuable fixed presence and an additional layer of domain awareness.

Domain Awareness and Communications

The principal capability to highlight here comes from work in commercial space, which supports both domain awareness and communications.

Terrestrial communications are often difficult in the Arctic, given limited communication infrastructure that is perennially damaged by the harsh physical environment. Satellite coverage is generally limited by the fact that few satellites have orbits that are highly inclined with respect to the equator, and long-distance HF communications suffer from interfering ionospheric activity. Three commercial companies—Iridium, Immarsat, and Starlink—are currently investigating the possibility of constructing purpose-built Arctic low earth-orbit (LEO) constellation satellites. Creating LEOs specifically designed for the Arctic has the potential to greatly enhance polar communication reliability and bandwidth. Space will continue to become more important for effective Arctic (and Antarctic) communications.

Nongovernment (including some not-for-profit) organizations also support data processing, analysis, and visualization that are relevant to the Arctic. These data can greatly aid in enhancing situational awareness, SAR, and resource knowledge.

These commercial enterprises include Global Fishing Watch, the Alaska Ocean Observing System, and Marine Exchange of Alaska. The Alaska Ocean Observing System has developed more than 2,700 geospatial “biological, chemical and physical” data sets specifically designed to aid Alaskan fishers, tourist vessels, and other shipping.¹⁴¹ Some of the data are available in real time.¹⁴² Marine Exchange of Alaska provides mariners with more than 60 weather stations and 150 automatic identification system (AIS) receivers to enhance local and statewide situational awareness, especially in adverse weather conditions.¹⁴³ Marine Exchange of Alaska communicates information it collects, including distress information, with the USCG.¹⁴⁴

Fixed Shoreside Infrastructure

Commercial enterprises conducting resource-extraction and shipping activities have built facilities and transportation infrastructure to enable their activities.

Commercial enterprises also conduct resource-extraction and shipping activities involving the construction of facilities and transportation infrastructure to enable their activities. In the U.S. Arctic, there are presently no deepwater ports north of the Arctic Circle. Significant mining occurs at such mines as the Red Dog Mine, Fort Knox Mine, Pogo Gold Mine, and Usibelli Coal Mine.¹⁴⁵

¹³⁹ Liz Ruskin, “Sullivan Still Seeking a ‘Bridge’ Ship to Fill the Icebreaker Gap,” KTOO, December 23, 2021.

¹⁴⁰ Pierre Leblanc, “An Out-of-the-Blue Icebreaker Opportunity,” *Maritime Executive*, January 2, 2018.

¹⁴¹ Alaska Ocean Observing System, “Ocean Data Explorer,” webpage, undated.

¹⁴² Alaska Ocean Observing System, undated.

¹⁴³ Marine Exchange of Alaska, homepage, undated.

¹⁴⁴ Marine Exchange of Alaska, undated.

¹⁴⁵ Center for Mine Training, University of Alaska Southeast, “Alaska Mines,” webpage, undated.

Similarly, few airports are capable of accommodating aircraft larger than the Cessna Caravan and other small commuter turboprop aircraft. Above the Arctic Circle, only Kotzebue and Utqiagvik possess airfields big enough to handle larger aircraft, which they can do only in relatively clear weather conditions.

The situation is slightly more positive in the North American eastern Arctic, where Indigenous groups operate a system of airfields plied by Air Inuit in a variety of aircraft. Iqaluit, the capital of Nunavut, has a relatively new airport and is capable of handling large jet aircraft. Greenland possesses two airports capable of handling large aircraft: Kangerlussuaq and Thule Air Base.

The European Arctic is more developed than its North American counterparts. Major airports exist in multiple Arctic communities (e.g., Tromsø, Murmansk), served by such airlines as Widerøe and UTair. Tromsø also possesses a deepwater port.¹⁴⁶

Mobile Platforms

Commercial enterprises have found opportunities to both transport natural resources out of the Arctic and facilitate the movement of people and goods to and from the region. The capabilities discussed in this section include those for surface maritime, air, and ground domains.

Commercial ice capabilities extend beyond icebreaking ships. A remarkable number of commercial aircraft ply the Arctic, transporting passengers and goods. Indeed, aircraft constitute a crucial lifeline for many Arctic communities. These include the Ravn Alaska and Alaska Airways based in the United States; Buffalo Airways, Canadian North, and Air Inuit based in Canada; Widerøe in Norway, and UTair and Nordavia in Russia. These airlines, among others, provide commercial situational awareness and other links both between Arctic communities and between those communities and the rest of the world. Because of relatively small population in the American west Arctic, airline development there is less mature than in the European Arctic. Interestingly, as noted earlier, in the American east Arctic, Air Inuit has built a successful enterprise plying an extensive network of routes connecting diminutive Indigenous communities in Arctic Québec with Montréal.¹⁴⁷

Road and rail infrastructure is relatively well developed in the European Arctic; roadways extend to Murmansk, the Kola Peninsula, and Arkhangelsk. Road and infrastructure are more primitive outside of urban centers in the Siberian Arctic. It remains primitive in the American west Arctic as well; most villages rely on aircraft to travel between communities because they usually are not linked by road or rail.

Arctic and sub-Arctic waters hold important fish stocks; in the future, Arctic states might need to take greater action to protect these stocks against long-distance fishing fleets from other countries. They also need to monitor the growing volume of Arctic shipping—both through the Arctic and to and from Arctic ports—and ensure that adequate infrastructure exists to support it.

In the future, uncrewed vehicles could play a bigger role in contributing to Arctic mobility. For example, General Dynamics is investigating the use of its remotely piloted aircraft for Arctic operations. Challenges include having the required communications and energy, appropriate takeoff and landing areas, ability to persist through adverse weather conditions, electronics that are hardened against frost, and deicing capabilities as needed.

¹⁴⁶ Ajay Menon, “12 Major Ports of Norway,” *Marine Insight*, October 8, 2021.

¹⁴⁷ Air Inuit, “Destinations,” webpage, undated.

Selected Similarities and Differences

We considered present (2022) capacity, as well as existing plans for capacity changes by 2035.¹⁴⁸ Table 3.1 summarizes similarities and differences in 2022 capabilities and capacities, as well as any major changes anticipated by 2035 that were called out in this chapter.

¹⁴⁸ This included at least partially funded investments, announced divestments, and cases in which there was no planned follow-on capability.

TABLE 3.1
Summary of Capabilities, Including Major Anticipated Changes by 2035, for Several Arctic Actors

Actor	Maritime	Air	Space	Ground	Logistics
United States	<ul style="list-style-type: none"> Icebreakers (2), submarines (~70) 2 or more icebreakers, maintaining surface combatant and increasing submarine fleets (general) 	<ul style="list-style-type: none"> 4th-generation aircraft (>50), 5th-generation aircraft (~6); seasonal USCG fixed and rotary wing; Alaska and N.Y. National Guard assets > F-35 presence, P-8 presence in Iceland 	<ul style="list-style-type: none"> USSF and civilian agency assets; large fraction of space-based capabilities for domain awareness, communications, and navigation not uniquely oriented to regional challenges Extremely HF communications (with Norway) 	<ul style="list-style-type: none"> NORAD-NORTHCOM domain awareness capabilities, activation of Army's 11th Airborne Division, Army and Marine Corps troops and exercises Beowulf Arctic vehicle, investments in basic survival, domain awareness (e.g., for missile defense) upgrades 	<ul style="list-style-type: none"> Installations in Alaska and Greenland, capabilities from the Army and other services Plans for Nome, Alaska, deepwater draft port, expanding operations from Iceland and Norway
Russia	<ul style="list-style-type: none"> Icebreakers (>50), submarines (20–40), surface combatants (fraction of fleet) 3 or more icebreakers, including 1 that is armed, nuclear-powered submarines (general), increasing surface combatant fleet (general) 	<ul style="list-style-type: none"> Large fraction of >80 4th-generation aircraft and >50 other aircraft capable of operating in region 4th-generation fighter and SAR aircraft upgrades 	<ul style="list-style-type: none"> Capabilities for domain awareness, communications, and navigation oriented toward regional challenges 	<ul style="list-style-type: none"> Domain awareness, missile defense, electronic warfare, ground troops equipped for survival, mobility in all-weather situations Ongoing upgrades to existing equipment for Arctic conditions: new medical, logistics, combat, life support vehicles 	<ul style="list-style-type: none"> Installations throughout Arctic territory, several dual-use and modernizing, most accessible via 2 or more transit mechanisms Continued ecological cleanup, construction of facilities to house personnel and families, additional equipment
China	<ul style="list-style-type: none"> Icebreakers (2), RVs 1–2 icebreakers 	<ul style="list-style-type: none"> Not applicable 	<ul style="list-style-type: none"> Scientific cooperation on space with Nordic countries Ongoing to improve comms for GPS satellite throughout NSR 	<ul style="list-style-type: none"> Limited forces prepared for cold-weather operations (not focused on Arctic) 	<ul style="list-style-type: none"> Not applicable
U.S. allies	<ul style="list-style-type: none"> Icebreakers (~30), OPVs (Denmark), aircraft carrier (UK), submarines > icebreakers (Finland, Sweden), > OPVs (Canada, Denmark), > submarines (Canada), ice-strengthened vessels (Norway) 	<ul style="list-style-type: none"> Large fraction of 4th-generation and ISR aircraft capable of operating in the region, F-35 (Norway) F-35 purchase by Canada and Finland 	<ul style="list-style-type: none"> Capabilities for domain awareness, communications, and navigation oriented toward regional challenges (especially Canada, Norway) Extremely HF communications (Norway) 	<ul style="list-style-type: none"> Domain awareness, missile defense, ground troops equipped for survival, mobility in all-weather situations 	<ul style="list-style-type: none"> Installations in respective territories, with variable connectivity Reopening and upgrade of Nanisivik Naval Facility

Table 3.1—Continued

Actor	Maritime	Air	Space	Ground	Logistics
Commercial	<ul style="list-style-type: none"> Icebreakers (~40% of those operating in the region) and ice-strengthened vessels Expected increase in capacity and capability to operate in ice-covered waters 	<ul style="list-style-type: none"> Several small regional airlines, some of which partner with global airline services 	<ul style="list-style-type: none"> Communications by Inmarsat, Iridium, and Starlink 	<ul style="list-style-type: none"> Science, oil and gas, mining, fishery, forestry, and other industry locations; airports, roads, rail, maritime ports Growing availability of space capabilities 	

Arctic Shortfalls, Risks, and Needs

In this chapter, we consider the U.S. armed forces' potential shortfalls, risks, and needs for access to and presence in the Arctic. We defined *shortfall* as the difference between stated or inferred U.S. goals or interests in the Arctic, as articulated in national, DoD, and service component Arctic strategies, and the armed forces' estimated ability to gain the appropriate access and presence to support them. We identified shortfalls by compiling findings from the capability survey (Chapter 3 and Appendix D), the TTX and interviews (Appendix C), and GIS-based modeling (Appendix F) and considered them in the context of U.S. Arctic interests as described in U.S. strategy documents (Chapter 2), Russia's and China's regional interests (Appendix B), and the limited ongoing Arctic-focused disputes (Appendix H).¹

We described risk qualitatively because of the broad scope of this research effort; applying quantitative approaches to risk analysis would have proven prohibitive for reasons of both cost and time. We relied primarily on the TTX (Appendixes C and G) and examination of Russia's and China's regional interests (Appendix B) to assert what consequences to U.S. interests would likely arise under plausible adverse regional scenarios.

We identified needs broadly through the capability comparison and qualitative trend projections (Chapter 3 and Appendix D), the TTX and interviews (Appendix C), a logic model (Appendix E), and the GIS-based modeling (Appendix F). We did not prescribe precisely how these needs should be met, but we do mention specific capabilities that emerged as logically relevant throughout our analyses. We also did not endeavor to speculate on how the United States should prioritize the Arctic relative to its other interests globally. We simply note that national, DoD, and service components have published Arctic strategies prioritizing the Arctic as a U.S. area of responsibility (AOR). Like shortfalls, needs were articulated on the basis of protecting a stated or inferred U.S. regional interest rather than through a broader global lens.

Shortfalls

Contrary to the potential implication in the FY 2021 NDAA that there could be “commercial and foreign military surface forces currently operating in the Arctic in conditions inaccessible to Navy surface forces,”² we found that a primary limitation for the United States is capacity, rather than capability. In other words, we did not find evidence of other Arctic actors being able to access parts of the Arctic that the United States cannot. However, we did find that Russia's capacity (both government and commercial interests) in particular to sustain day-to-day presence in the maritime Arctic is very high. Furthermore, Russian experience operating in varying sea ice conditions is also considerable, although safely navigating the maritime Arctic appears to be a challenge for all actors. China's capacity and that of several U.S. allies and like-minded part-

¹ All the appendixes mentioned are available online.

² Section 8424(b)(2).

ners are also growing or steady. Other Arctic countries also have a strong ability to operate across the Arctic land, coastal, and air environments.

Recent progress on the PSC program and development of a deepwater port at Nome, Alaska, are improvements for the U.S. Arctic. They are not, however, silver bullets for Arctic access and presence problems. Although additional icebreaking capability and an upgraded port are necessary steps forward, they are not sufficient to meet all of the U.S. armed forces’ future needs. Four attributes (shown in Figure 4.1) constrain the U.S. armed forces’ access to and presence in the Arctic in ways that differ from those of other countries in some respects and thus represent shortfalls.

Capacity is an attribute of numbers—are there sufficient assets and associated personnel, logistics, and other supporting equipment to ensure Arctic access in order to maintain presence as needed? **Priority** considers whether capabilities—in whatever amounts they exist—are or can be made available for Arctic operations. **Capability** can be constrained or lacking when available assets and people cannot operate in the Arctic because they require additional equipment, modifications, or training to succeed in their missions. Finally, **interoperability**, subject both to capacity and capability effects, can present barriers to leveraging available capacity when there are technological, training, tactical, or ideological differences.

Capacity

We reviewed U.S. capacity in comparison with that of several other countries and commercial entities using a broad understanding of access, which included air, cyberspace, the electromagnetic spectrum, ground, space, subsurface maritime, and surface maritime (including coastal access). We also considered communications and domain awareness, which cut across all of these.

Capacity Versus Capability

The NDAA’s language describes access limitations in terms of capabilities, asking about where U.S. forces were unable to operate but rival nations could. The expert-elicitation process during the TTX, corroborated by the study team’s other analyses, revealed that many U.S. limitations with respect to Arctic access and presence are primarily *capacity*-driven, not *capability*-driven. In other words, much of what might be needed for effective future Arctic operations is already largely within existing U.S. inventories or funded plans or available through friendly partners and allies. Where there are capability issues, accompanying capacity problems greatly exacerbate the mismatch between emerging regional needs articulated in various Arctic strategies and existing equipment, architectures, training, and policy. In this section, we describe some of the capacity

FIGURE 4.1
Four Attributes Illustrated in the Comparative Capability Analysis



problems in more detail. We do not, however, speculate on precisely what the appropriate force mix or size should be for the Arctic, which would require a formal force structure analysis.

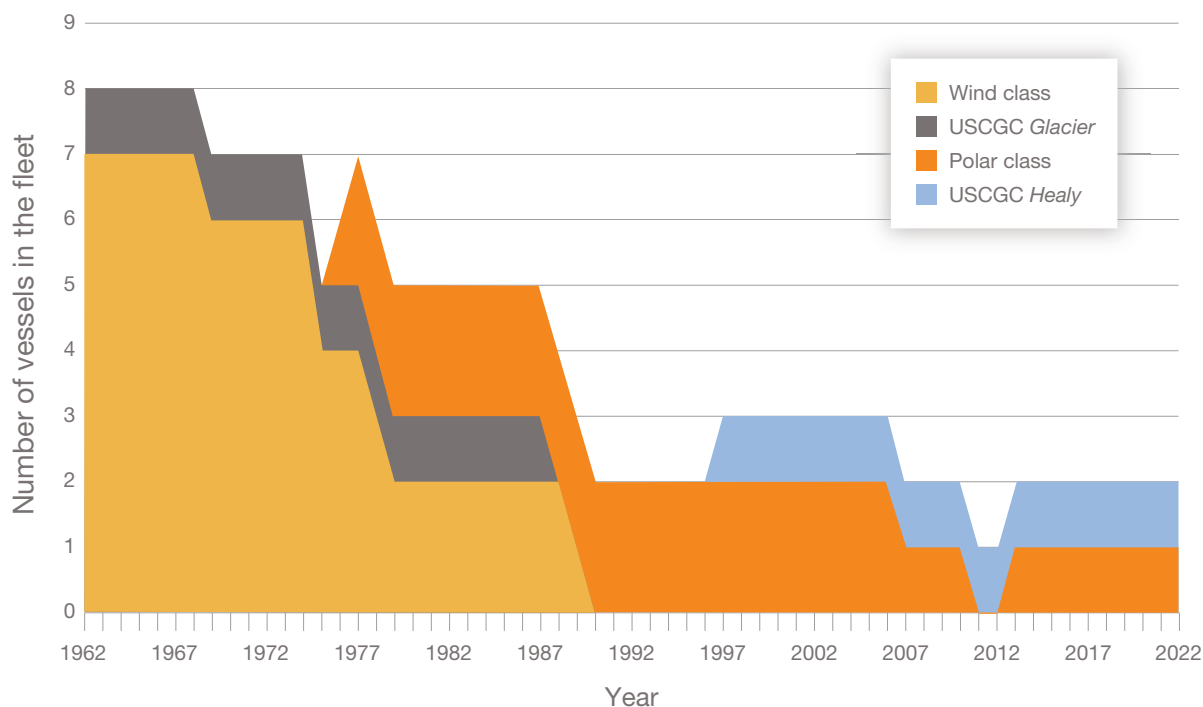
As of this writing in 2022, the USCG had two operational polar icebreakers, the heavy icebreaker USCGC *Polar Star* and the medium icebreaker USCGC *Healy*. The *Polar Star* will be 60 years old by 2035, so it might no longer be in service, although the *Healy* would be in only its mid-30s. The current USCG fleet is the smallest it has been in the past 60 years, aside from the period when the *Polar Star* was temporarily out of service for a major refit from 2006 through 2012 (see Figure 4.2). At its peak, the USCG had eight icebreakers capable of operating in the Arctic or Antarctic. The FY 2021 NDAA has appropriated two PSCs for the USCG and authorized it for up to six. Most or all of these would presumably be in service by 2013. (The USCG's program of record is for three PSCs.)

As discussed already, the problem for the United States regarding heavy icebreakers is not capability but capacity: There are not enough of them to establish consistent presence across the Arctic, particularly given that they also conduct Antarctic operations. As also noted earlier, there are few polar-orbit satellites or air assets that can operate in the region.

Infrastructure Density

As discussed at length in Appendix C, available online, the North American Arctic has sparse infrastructure in every domain, while the European Arctic is better served in this regard but still has a lower infrastructure density than Europe has in lower-latitude environments.

FIGURE 4.2
The U.S. Coast Guard Icebreaking Fleet, 1962–2022



SOURCES: Features data from USCG, undated-b, and USCG, 2018.

Geographic Distances

The capacity attribute is severely exacerbated by the “tyranny of distance” in the Arctic, reflecting vast distances within the region, as well as between the region and the rest of the world. Figure 4.3 illustrates this problem. The top map shows the parts of the U.S. Central Command AOR where U.S. forces have been operating extensively in recent decades, superimposed on the Arctic, while the bottom map superimposes the contiguous United States on the Arctic, all using the same scales. Distances can be immense even just within Alaska, especially when going by sea, let alone within different subregions of the Arctic, such as its North American and European portions. This is especially important given that USCG SAR responsibilities extend to the North Pole.

Priority

Several TTX participants and interviewees stressed that, even if the U.S. military has substantial capacity in certain assets, this fact often does not translate to using these assets to shore up capacity for Arctic access and presence. Issues getting priority for the Arctic are particularly acute for some “high-demand, low-density” capabilities, such as capabilities designed or modified for cold-environment operations, very specialized reconnaissance assets, uniquely trained crews or ground units, and prepositioned emergency response kits.

The reasons behind limited prioritization of assets for the Arctic are varied, depending on circumstances. In many cases, an asset has limited utility in the Arctic region. There are two likely causes for this: Either the asset is not hardened or has not been otherwise adapted for the environment or there is potentially less payoff in using the asset in the Arctic than in another region in which the United States has interests. For example, this happens in the case of some reconnaissance assets. Given that there is less overall activity in the Arctic than some other regions, the payoff from using an asset in the Arctic might not be perceived as being as high as using it elsewhere. Moreover, some sensors do not work well in the Arctic environment: For example, electro-optical/infrared sensors cannot image through the cloud cover that typically blankets much of the Arctic.

Another reason for limited resources being available for the Arctic is simply that other regions and missions are sometimes deemed to be higher priorities in many cases, despite the fact that DoD, DHS, and the service components have published Arctic strategies stressing the need to increase resources in the Arctic region. For example, the USCG’s NSCs provide some of the service’s most advanced capabilities. Although these are not ice strengthened, some of our interviews suggest that they could nonetheless provide helpful sensing, law-enforcement, and other capabilities south of the ice edge during the warmest months in the Arctic. However, the USCG does not recommend routinely employing non-icebreaking assets in support of polar operations.

Many USN, Marine Corps, USAF, and Army capabilities face a similar situation. Surface ships, vehicles, aircraft, and domain awareness and communication bandwidth, among others, could be devoted to shoring up NATO’s eastern flank, deterring aggression in the Pacific, or attending to needs in the Middle East. Even capabilities present in Alaska or at Thule Air Base in Greenland are serving a primarily strategic purpose, leveraging locations in the Arctic for achieving broader homeland defense, deterrence, and global power projection objectives.

One recent exception to this pattern has been the rotational deployment of U.S. Marine Corps personnel and capabilities for presence, exercises, and training in Norway.³ The United States has also sent other

³ Marine Corps Forces Europe, “U.S. Marines Complete Norway Deployment for Arctic Warfare Training,” *Marines*, December 4, 2020; Jasmine Scott, “U.S. Forces Prepare to Join Norway’s Biennial Exercise Cold Response 22,” U.S. Navy, press release, March 11, 2022.

FIGURE 4.3
A Scale Comparison of Core Areas of the U.S. Central Command Area of Responsibility and the Contiguous United States with the Arctic Circle



capabilities to participate in NATO exercises in the north, including Cold Response and Trident Juncture. This has undoubtedly helped U.S. forces prepare and has demonstrated NATO solidarity. It has also evidently piqued Russia, whose Northern Fleet is headquartered at Severomorsk, not far from its border with Norway. Both NATO military and commercial systems have experienced interference with communications and navigation in the vicinity of northern Norway and Finland during some of NATO's activities in the region.⁴

Finally, some assets, such as icebreakers, could be prioritized for polar use, but there is such high demand that many potential needs cannot be met. A good example is U.S. investment in and support for polar science. Although this might seem academic in application initially, science is crucial for meeting both strategic objectives and operational or tactical ones. Science provides a way to establish strategic presence and collaborate with partners. It also supplies crucial information every day (in some cases, every hour or minute) to support safety and early warning of threats and hazards. Yet with only two operational polar icebreakers as of 2022, the USCG must devote one (*Polar Star*) entirely to Antarctic missions and the other (*Healy*) to the Arctic. The powerful *Healy* can cover only so much water and ice; when supporting a mission off the coast of Nome, Alaska, it cannot quickly pivot to responding to a safety incident somewhere else within the U.S. AOR, such as the North American east Arctic. Indeed, such a voyage through the NWP, when the route is even passable, takes a handful of weeks, assuming that everything is ready to go and the right personnel are aboard.

In principle, capabilities currently not prioritized for Arctic activities could be made available in the future if an urgent need for access and presence is required (e.g., SAR incident, oil spill, adversarial activity). That said, there are no guarantees that (1) assets will be proximal enough to the Arctic to have a positive impact on the situation, (2) there will be sufficient maintenance and logistics to support them, (3) personnel will have the right training to operate in the Arctic, and (4) the required modifications or equipment additions have been made or could be made in a timely way. Thus, priority represents its own problem because “we’ll send it if we need it” is not a realistic option.

Interoperability

It is worth keeping in mind that, for capability (as well as, to a large extent, capacity and interoperability), cooperating with U.S. allies and partners can help alleviate some gaps and act as a force multiplier. Security cooperation activities have provided important benefits to the United States in the Arctic. For instance, multinational exercises, such as Trident Juncture and Cold Response, regularly contribute to building interoperability between the United States and its partners.⁵ The U.S. presence in Thule Air Base in Greenland is made possible by a defense agreement with Denmark.⁶ The U.S. Marine Corps has gained cold-weather warfare skills from the Norwegian military.⁷ Allies and partners provide the United States with capabilities, access, and knowledge that augment the U.S. ability to operate in the Arctic. At a strategic and operational level, military-to-military discussions between the Arctic countries' security forces take place within the Arctic Security Forces Roundtable (to which Russia has not been invited since its 2014 illegal annexation of

⁴ Nerijus Adomaitis, “Norway Says It Proved Russian GPS Interference During NATO Exercises,” Reuters, March 18, 2019; Gerard O’Dwyer, “Norway Accuses Russia of Jamming Its Military Systems,” *Defense News*, March 8, 2019.

⁵ See, for instance, Jim Garamone, “U.S., NATO Assess Lessons of Trident Juncture Exercise,” U.S. Department of Defense, January 17, 2019.

⁶ Agreement Between the United States of America and Denmark Amending and Supplementing the Agreement of April 27, 1951, U.S.–Den., August 6, 2004, 04 T.I.A.S. 0806.

⁷ See, for instance, III Marine Expeditionary Force, “1,000 US Marines Arrive in Norway for Cold-Weather Training,” *Stars and Stripes*, January 11, 2021.

Crimea).⁸ Most security cooperation activities, however, take place bilaterally or between groups of countries that do not necessarily include all Arctic countries—NATO being one example. Seven of the eight Arctic states will be NATO members, with Russia conspicuously outside the alliance.

However, there are limits to how much of a force multiplier security cooperation can be. We considered interoperability broadly in our analysis as including more-conventional interpretations—related to technical problems or differences in tactics—but also ideological differences that prevent partnering or access even where technically and procedurally possible.

Security cooperation activities present challenges at times, even with highly capable allies and partners, such as those found in the Arctic region. Constraints on using security cooperation might include “misaligned priorities and self-interest, the capacity of third party countries to absorb U.S. or allied assistance, different standard operating procedures, and even competition for military sales among allies.”⁹ Other constraints include national caveats that can limit the types of operations in which allies and partners will agree to participate, the need to take into account the fact that allies and partners might have vastly different levels of capabilities in certain domains (even within the “highly capable allies and partners” category), and the “perennial challenge” of information-sharing with allies and partners. Although the United States has close relationships with the Nordic countries (Denmark, Iceland, Finland, Norway, and Sweden), they are not members of FVEY (United States, Canada, Britain, Australia, and New Zealand).¹⁰ Only Canada is also both an Arctic country and a member of FVEY. At the strategic level, understanding and considering the political imperatives under which U.S. allies and partners operate is crucial to understanding their regional priorities, what they are willing to share and spend resources on, and what U.S. expectations should be of how its allies and partners can help it address its own capability gaps.¹¹

Capability

As we described earlier, limitations on the capability attribute for access are generally less problematic for the United States than capacity limitations are, not least because all Arctic actors face these capability problems with access, presence, mobility, and logistics in the Arctic. Although it can be argued that countries that, like Russia and Norway, have prioritized Arctic capability investments have an advantage over the United States in overcoming regional access problems, it must also be borne in mind that with more capability and presence also come more sustainment and operational needs. For example, Russia’s vast northern infrastructure is crumbling and falling to the ground because of permafrost fluctuations. Infrastructure aids presence, but maintaining that infrastructure is difficult and resource-intensive.¹²

Limited All-Domain Awareness

As mentioned in Appendix C, available online, limited domain awareness—knowing who is doing what in the Arctic—was repeatedly cited as a key U.S. shortfall. All-domain awareness constraints are often also

⁸ Jacob Gronholt-Pedersen, “Russia Calls for Military Meetings Between Arctic States as Tensions Rise,” Reuters, May 20, 2021; USEUCOM, “Military Leaders Discuss Arctic Security, Cooperation in Annual Forum,” press release, November 10, 2021.

⁹ Angela O’Mahony, David E. Thaler, Beth Grill, Jennifer D. P. Moroney, Jason H. Campbell, Rachel Tecott, and Mary Kate Adgie, *Prioritizing Security Cooperation with Highly Capable U.S. Allies*, RAND Corporation, RR-A641-1, 2022, p. 8.

¹⁰ O’Mahony et al., 2022, pp. 7, 56.

¹¹ O’Mahony et al., 2022, pp. 67–72.

¹² Maxim Shemetov, “Russia’s Remote Permafrost Thaws, Threatening Homes and Infrastructure,” Reuters, October 18, 2021; Atle Staalesen, “The Looming Arctic Collapse: More Than 40% of North Russian Buildings Are Starting to Crumble,” *Barents Observer*, June 28, 2021.

related to limitations in communications in the Arctic, which we discuss next. As previously noted, this report examines all-domain awareness at greater length in an appendix that is not available to the public.

Constrained or Inconsistent Communications

The Arctic's extreme environment hinders communication through damage to various nodes and by interrupting various links, as discussed at length in Appendix C, available online.

Challenges to Autonomous System Use

A problem that came to light primarily through interviews and literature review is the relative lack of research and development (R&D) on autonomous and semiautonomous systems that can effectively operate in the Arctic via air, over land, or on or under the ocean surface. Although autonomy would generally provide an excellent solution to the Arctic tyranny of distance, among other problems, the environment presents difficult challenges for robotics, such as navigation, communications, energy supply, and wire insulation. Although no country is immune to these, the United States—with the exception of research undertaken by certain institutions, such as the University of Alaska and the Cold Regions Research and Engineering Laboratory—has only a limited history of experimenting with autonomous devices to overcome distance and presence issues. Some countries, such as Russia and Norway, have more experience and, in some cases, are more regularly using such capabilities as airborne drones to help with northern surveillance.¹³ For the United States, this appears to be a question of capability development—“we don't know what we don't know”—combined, perhaps, with perceptions of relative geographic priorities, given that U.S. drone systems have been, until recently, in high demand in other parts of the world, such as the Middle East.

Service-Specific Challenges

Capability gaps in the areas of domain awareness, communications, and autonomy are experienced across U.S. armed forces operating in the Arctic and were thus consensus topics discussed at length during the TTX events, which featured mixed groups from across the services. Some of our interviews revealed other capability shortfalls more specific to certain services, although we did not endeavor to thoroughly define or address any service-specific gaps.

Deepwater Port Infrastructure

Building a deepwater Arctic port in Alaska has been the subject of discussion for many years. Now, the U.S. Congress has authorized a deepwater port in Nome that, pending continued support and funding, would alleviate this major maritime logistics issue for the North American Arctic.¹⁴ Dutch Harbor in Unalaska is an existing deepwater port in the U.S. Arctic; however, it is substantially south of the Arctic Circle.

Ground Mobility

Another example is the considerable challenge for the U.S. Army in ground-based mobility in the Arctic; this can be problematic all year round but for different reasons in different seasons. Movement across snow and ice requires specialized tires or other traction, fuel mixes, means of keeping engines warm, and insulation of wires, tubes, and water. In contrast, movement across muddy, seasonally unfrozen ground and loss of access to ice roads in warmer weather presents a different set of problems. Finding vehicles and associated mainte-

¹³ Thomas Nilsen, “Norway Deploys Radiation Drones Along Its Coast Amidst Nuclear Emergency Concerns,” *Barents Observer*, December 3, 2021; Oriana Pawlyk, “Norway Worries Melting Arctic Ice Will Incite Drone Ops and Conflict,” *Military.com*, May 22, 2019.

¹⁴ Catherine Rubano, “Congress Authorizes Deepwater Port in Nome,” Alaska Public Media, January 14, 2021.

nance, logistics, and sustainment suitable not only for extreme physical environments but also for changing conditions throughout the year is an important capability challenge for ground forces.

Aviation Infrastructure

Many areas of the North American Arctic lack airstrips and airfields, hangars, maintenance facilities, and fuel logistics. This is particularly relevant for tactical and transport aircraft that could support missions in the Arctic rather than just flying from the region or through the region to other destinations. For example, there are excellent civilian and military aviation logistics in both Anchorage and Fairbanks, Alaska, but these are both south of the Arctic Circle. Some northern Alaskan communities—notably, Utqiagvik—do have small airports, but their capacity is small, and distances, whether by air, sea, or land, are vast throughout the state and the Arctic more generally.

Risks

Now we turn to some of the primary risks of concern should shortfalls persist. Note that we loosely use the definition of *risk* as likelihood multiplied by consequence. All of the concerns described in this section are at least plausible, if not quite likely, to occur without future action on the part of the United States. Each describes a unique consequence. We recognize that decisionmakers, such as combatant commanders, have their own risk assessments. The risk articulations here are not intended to conflict with existing articulations of risk but rather to reflect the outcome of our research process.

Lack of Readiness: Not Being Able to Fulfill Mission Responsibilities

The capacity issues we have discussed and lack of priority for access to existing capabilities (e.g., law-enforcement vessels, intelligence) are very likely to lead to an inability to fulfill mission responsibilities should needs increase or otherwise change in the Arctic (for example, with increasing scientific research, tourism, or economic activity that expands populations).

One area of particular concern for the USCG and U.S. government is SAR. The United States has signed a multilateral agreement with the other Arctic countries delineating SAR responsibilities across the region (Figure 4.4). However, the United States' ability to execute to fulfill this commitment if and when there is a need is in question given the lack of assets available to access the region (especially in the highest latitudes) and the lack of logistics to support SAR. Interoperability also remains a critical issue; despite multilateral exercises involving Arctic states, true SAR interoperability remains an unfulfilled goal.

The United States is also a signatory of the Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic (signed in 2013), which is also a legally binding agreement among the eight Arctic states. In the U.S. Arctic, the USCG is challenged in fulfilling the responsibilities associated with its marine environmental protection statutory mission for similar reasons as those for SAR.

Note that needs for both SAR and environmental response, among other types of missions the USCG conducts with its partners, will also increase if and as the United States increases the presence of its armed forces in the region. The safety and environmental impacts of increasing presence will need to be further explored to facilitate planning.

We can also imagine a defense-related situation in which a bad actor attempts to deny access to and through the Arctic region. In this case, the United States would have few tactical assets and trained personnel who could attempt to address or navigate around the situation, and it would need to commit strategic air, naval, and potentially ground or other power to resolve the situation, potentially then escalating into a full conflict.

FIGURE 4.4
Search-and-Rescue Responsibilities Outlined in the Agreement Brokered Through the Arctic Council in 2011



SOURCE: Features information from Office of Ocean and Polar Affairs, U.S. Department of State, "Arctic Region," webpage, undated.

NOTE: Each country's SAR responsibilities extend to the North Pole.

Vulnerability to Attack: Loss of Life and Property

Lives, property, and economic and environmental integrity are at stake in the Arctic every day. Particularly acute examples include SAR and armed forces challenged by an antiaccess situation. Furthermore, units operating in the Arctic that are unaccustomed to doing so or unaccustomed to military threats could easily put themselves in additional danger merely through lack of preparedness for risks posed by factors other than combat. Also, as mentioned in Appendix C, available online, Arctic operations are vulnerable to diverse types of attack, in part because of a lack of assets and infrastructure: There is little resilience in the face of adversary action or extreme circumstances. Both the USCG and DoD are responsible for environmental protection as well, especially for spill response. This is a critical issue for the Arctic because of the tyranny of distance, infrastructure challenges, and extreme environmental conditions.

Limited Ability to Operate with and Rely on Partners

Relying on allies and partners might seem to be a simple and inexpensive option for mitigating gaps. The Arctic region's expansive area, challenging conditions, and operational distances provide opportunities and challenges to partnering. In the Arctic, countries partner for a variety of reasons, including research, operations, and defense. Defense cooperation between the United States and other countries is guided by DoD. We discuss this issue in some detail here because cooperation and partnering stated in various U.S. Arctic strategies are so important. The Defense Security Cooperation Agency defines *security cooperation* as consisting of

all activities undertaken by the Department of Defense (DoD) to encourage and enable international partners to work with the United States to achieve strategic objectives. It includes all DoD interactions with foreign defense and security establishments, including all DoD-administered Security Assistance (SA) programs, that build defense and security relationships; promote specific U.S. security interests, including all international armaments cooperation activities and SA activities; develop allied and friendly military capabilities for self-defense and multinational operations; and provide U.S. forces with peacetime and contingency access to host nations.¹⁵

Security cooperation is further described as “an important tool of national security and foreign policy and . . . an integral element of the DoD mission.”¹⁶ The term covers a wide variety of activities, which a 2022 RAND report broke down into 11 categories:

- **military aid**, which includes funding through foreign military financing, excess defense articles, and other grants and loans
- **arms sales and transfers**, such as U.S. arms sales through foreign military sales and direct commercial sales
- **military capacity-building**, such as U.S. activities under Section 1206 of each NDAA and Section 333 of U.S. Code Title 10 (the train-and-equip authority)
- **education and training**, including international military education and training, professional military education, and regional centers
- **personnel exchanges**, such as U.S. activities under the Military Personnel Exchange Program and the State Partnership Program
- **military exercises**, both bilateral and multilateral and those that involve foreign partners

¹⁵ Defense Security Cooperation Agency, “Security Cooperation Overview and Relationships,” *Security Assistance Management Manual*, April 30, 2012.

¹⁶ Defense Security Cooperation Agency, 2012.

- **access-related agreements**, such as status-of-forces agreements and agreements related to base access and information-sharing
- **armament-related agreements**, such as those for codevelopment of systems and for research, development, test, and evaluation activities
- **sustainment of donor-nation equipment** by the donor, the partner, or third parties
- **institutional capacity-building** to strengthen the partner institutions that support security services
- **humanitarian assistance/disaster relief (HA/DR)**, which supports efforts to relieve suffering.¹⁷

However, working with partners requires investment—in training and exercises, as well as in equipment to ensure interoperability. It also requires bringing capabilities to ensure value as a partner. Partnerships work both ways. Although the USCG is working to achieve seamless interoperability with Arctic allies and partners, it has yet to achieve this goal, exposing limitations in relying on allies and partners over enhancing national capacity.

The USCG also uses cooperation as a tool to influence Russia’s activities and behavior. For example, the USCG has spill-response joint contingency plans with both Russia and Canada, both of which were recently updated (Russia’s prior to its invasion of Ukraine). The USCG conducts TTXs with both countries around these joint contingency plans—although these are currently on hold with Russia.

Loss of Opportunities to Engage and Counter Russia

Limitations on U.S. Arctic access means that there are fewer opportunities to engage and counter Russia when needed. There is value to this in the spirit of engagement and keeping lines of communication open with a neighboring country, Russia’s present attack on Ukraine and the subsequent pause of Arctic Council meetings notwithstanding.¹⁸ The two countries must comanage activities in the Bering Strait region and, in theory, could back up each other’s SAR and other nonmilitary mission needs because of their geographic proximity. Despite the ongoing war in Ukraine, the United States and Russia are maintaining a low level of cooperation for dealing with emergencies in the Bering Strait area.¹⁹

More access would also shore up the United States’ ability to convincingly counter any aggression from Russia, including antiaccess campaigns in the Arctic. Our summary of Russia’s Arctic ambitions and activities (Appendix B, available online) suggests that one of the greatest concerns for the United States in this regard would arise from Russia’s attempts to control traffic in the NSR, with which the United States disagrees but has limited capacity to challenge in a way that does not result in vertical and horizontal escalation. The other major sore spot for Russia in the Arctic is the posturing of NATO forces close to its military stronghold in and around the Kola Peninsula, near Russia’s border with Norway.

Overall, the United States has robust strategic assets and strategic-deterrence capabilities. However, an increased number of operational and tactical assets in Alaska (and potentially also closer to eastern North America) would give the United States possibly less escalatory but still effective options.

¹⁷ Michael J. Mazarr, Nathan Beauchamp-Mustafaga, Jonah Blank, Samuel Charap, Michael S. Chase, Beth Grill, Derek Grossman, Dara Massicot, Jennifer D. P. Moroney, Lyle J. Morris, Alexander Noyes, Stephanie Pezard, Ashley L. Rhoades, Alice Shih, Mark Stalczyński, Melissa Shostak, David E. Thaler, and Dori Walker, *Security Cooperation in a Strategic Competition*, RAND Corporation, RR-A650-1, 2022, p. 3.

¹⁸ U.S. Department of State, “Joint Statement on Arctic Council Cooperation Following Russia’s Invasion of Ukraine,” media note, March 3, 2022.

¹⁹ Yereth Rosen, “Despite Ukraine War, US and Russia Continue Emergency Cooperation in the Bering Strait,” *Arctic Today*, April 11, 2022.

Tacit Acceptance of China's Influence

If China's Arctic presence grows and transforms, the United States risks appearing to have all bark and no bite in the region without more day-to-day presence. China could fill this gap. As in the case of Russia, tactical- and operational-level assets would be more valuable for this—to prevent escalation and to address the problems likeliest to be associated with China, such as illegal, unreported, and unregulated (IUU) fishing²⁰ and covert intelligence operations. China declared itself as a “near-Arctic state” as early as 2012.²¹ It has also argued that the Arctic region constituted a global commons that should be shared by all states, not simply the eight that adjoin it. There are concerns that China might use its long-distance fishing fleet—the world's largest—to fish in the central Arctic following the expiration of the Central Arctic Ocean Fisheries Agreement (CAOFA) in 2034. These fishing vessels could be dual-use civilian–military assets to monitor U.S., allied, and partners' military activities.

China is demonstrating its seriousness in Arctic operations in the construction of a third icebreaker, the *Xue Long 3*; efforts to construct scientific and ground satellite stations in some Arctic states; significant economic and infrastructure investments in Iceland and Scandinavia; and the *Xue Long 1's* and *Xue Long 2's* repeated passages through Canada's NWP to “fly the flag” and demonstrate China's ice capabilities.²²

However, China is very unlikely to challenge the United States militarily in the Arctic. Rather, China is seeking to gain influence through economic means and by participating in rulemaking. Although its influence in the Arctic Council is constrained by its observer status, IMO and other international bodies to which China is party help create rules that apply to the Arctic. Gaining additional experience operating in the Arctic could indirectly help the U.S. armed forces inform (as appropriate) U.S. government decisions about what rules are needed or not and help regulate China's activity in U.S.-administered parts of the Arctic when the U.S. armed forces are in law-enforcement roles or supporting civilian missions.

Accidental Escalation of Tensions

We have already referred to accidental tension escalation in relation to Russia and China. Better domain awareness and communications are particularly important for this issue. Crucially, sending more strategic assets to the Arctic could work at odds with goals of reducing tensions. Thus, capabilities aimed at gaining knowledge and communicating and maintaining a presence in support of safety, security, and stewardship within the Arctic as opposed to global power projection assets in service of other security needs would be best to avoid capacity growth becoming an escalation problem unto itself. Normalizing U.S. federal-level presence, activities, and exercises in the Arctic region in the service of regional security would also be preferable for alleviating any risks of accidental escalation rather than periodic or inconsistent forays into the Far North, which could cause undue speculation of the causes or reasons behind it.

Further complicated by the effects of climate change is that the Arctic is increasingly an environment in which weather conditions can rapidly change. The United States needs to be prepared with sufficient capabilities and domain awareness to mitigate the impact of these adverse weather conditions and reduce the risk of an accident with a Russian or Chinese asset, thereby accidentally escalating tensions.²³

²⁰ Committee on IUU Fishing and Seafood Fraud, National Ocean Council, National Oceanic and Atmospheric Administration (NOAA), “Department of Defense,” webpage, undated.

²¹ Sacks et al., 2021, p. 2.

²² Auerswald, 2019a; Atle Staalesen, “China's New Icebreaker Completes First Arctic Expedition,” *Barents Observer*, September 29, 2020.

²³ Sacks et al., 2021, pp. 8–9.

Maintaining a persistent presence in support of safety, security, and stewardship rather than global power projection assets is achievable. It includes the construction of PSCs and ASCs that can interdict IUU fishing and illegal smuggling, perform SAR, and conduct vessel safety and security checks. Under Title 10, USCG vessels can also engage other military assets. It often does so in cooperative ways, such as through exercises under the ACGF, Exercise Argus, and Operation NANOOK. It also includes upgrading existing airfields not only for military traffic but for civilian traffic, bolstering links between isolated Arctic communities. It involves collaboration with other members of the Arctic Council, including Russia, to continue to integrate regional SAR capabilities to help mitigate the chance of accidental escalation. In sum, it involves normalizing U.S. presence, activities, and exercises in the Arctic region as a means of deescalating tensions associated with that presence.

Perception of U.S. Absence and a Security Void

Lack of U.S. day-to-day presence could lead to broader perceptions of an absentee owner and lead to a security void, inviting more illicit activity and presence of other countries seeking influence close to U.S. territory. Again, the primary issue is capacity, not capability. The United States can and does demonstrate its presence in the Arctic, whether through patrols by the USCGC *Healy* or the positioning of F-22 Raptor fighter jets to JBER. In 2018, the USS *Harry S. Truman* carrier strike group deployed to the Arctic Circle—and again recently during Exercise Cold Response in 2022. U.S. Submarine Force continues to routinely conduct operations in the Arctic region. Other naval exercises or training include Exercise Ragnar Viking, Exercise Dynamic Mongoose, Ice Exercise, Exercise Cold Response 2022, and continued training events between the U.S. Marine Corps and Norway’s forces.

Rather, it is an issue of capacity. It needs to demonstrate a persistent, strong, resilient presence in the pan-Arctic now and especially into the future as diminishing sea ice promotes maritime accessibility to deter potentially adversaries from upsetting Arctic peace, cooperation, and stability, the recent events in Ukraine notwithstanding. The appropriation and approval of three new PSCs, with the possibility of additional PSCs and ASCs, would go some way to maintaining a constant presence in the U.S. Arctic and enhance domain awareness, reducing both the risk of an adversarial antiaccess operation and the perception of a U.S. absence and security void in the Arctic. Training more contiguous United States–based forces in operating in the severe Arctic climate would also demonstrate the United States’ seriousness in protecting its Arctic interests.

Other, potentially less expensive but no less important ways exist for the United States to demonstrate a persistent and responsible security presence in the Arctic. The construction of a deepwater port at Nome; the upgrading of Alaskan communities’ airstrips into airfields capable of accepting larger aircraft and thereby increasing connectivity between isolated, largely Indigenous communities; investment in medical capabilities in these isolated communities; and upgrading aging early-warning system units all demonstrate persistent, year-round presence that is generally nonescalatory in nature.

Lack of Control over Arctic Narratives

Having regular access to domain-awareness, communications, and response capabilities sets the stage for controlling the narrative as situations arise in the Arctic. DoD, DHS, service component, and other U.S. Arctic strategies have noted this issue. This is particularly important as information warfare gains in dominance and disinformation campaigns are tools regularly used by U.S. rivals.

For example, if the United States’ sole Arctic-assigned icebreaker, the USCGC *Healy*, breaks down because of operational or mechanical issues, it might have to wait days or weeks for an allied or partner icebreaker to rescue it. Russia could turn a rescue of the *Healy* by one of its own 40-plus icebreakers into an information

competition win that could be embarrassing for the United States and its interests. China rescuing the *Healy* with *Xue Long 1* or *Xue Long 2* would be even more embarrassing.

The United States has the means to counter adversarial disinformation campaigns in the U.S. Arctic but needs to employ them. On the civilian side, this means providing local communities with resilient internet access and frequency modulation (FM) stations, similar to the national Arctic network employed by Canada.

The United States must possess control over its Arctic narrative. As DoD, DHS, service component, and other U.S. Arctic strategies indicate, the United States is an Arctic country. All too often, the American public forgets that the United States is an Arctic country with statutory and tactical responsibilities to Americans who reside in the region, as well as significant strategic interests, such as ISR operations, NORAD, and supporting Indigenous peoples' ways of life, both at the local level and through such international organizations as the Arctic Council. The United States can maintain control over its Arctic narrative through the construction of PSCs and ASCs, enhancing existing Arctic infrastructure, finding new ways to deepen collaboration with Indigenous communities, hosting more visits from U.S. naval vessels, and an active public affairs campaign that highlights U.S. accomplishments and the importance of continued multilateral cooperation in the Arctic.

Conclusions on Risks

We found that, contrary to the expectations implied in the FY 2021 NDAA, potential risks relate to the United States' ability to sustain regular operations to meet emerging needs much more than to less ability to access the Arctic than other countries (especially Russia and China) have. In other words, whereas the United States can demonstrate presence in the Arctic, it practices presence in only a narrow array of missions in which there is historical precedent (e.g., strategic deterrence, science, fishery management in the Bering Sea). The capabilities, practices, architectures, and training honed for this limited number of missions in past decades are not necessarily well aligned to emerging or future needs and cannot easily be scaled up to meet the full variety of credible future Arctic demands. This creates risk to national interests and to the safety of the armed forces charged with protecting those national interests.

Needs

Finally, we articulate in a general sense what the U.S. armed forces need in order to limit risks associated with ongoing shortfalls. Note that these are similar to those identified in past strategies, assessments, and other documents published by the White House, DoD, DHS, and the service components. In this sense, the new needs are still the old ones. Nonetheless, there have been ongoing developments, and our research provides an opportunity to update the list of needs, which we categorize into six types, based on the urgency articulated to us by SMEs:

- assets with proximity to support response
- awareness and communications
- infrastructure for response and logistics
- a sufficient cadre of trained, current, and proficient people to operate in the Arctic
- tactics and equipment for low-probability, high-impact incidents
- the ability to scale presence.

Assets with Proximity to Support Response

Together with improvements in logistics is having the assets with the right capabilities to execute national security missions. Specifically, these assets need to be capable of responding to a variety of threats and hazards within a relevant travel distance from where such incidents might occur. The United States does have valuable strategic assets, such as fighter aircraft, regularly present in Alaska, well within a reasonable range to support some types of military operations in the Arctic and to deploy and project power to other regions as needed.

What the United States lacks are capabilities dedicated to the Arctic rather than strategically located there. For example, more capacity is needed in tactical rotary- and fixed-wing aircraft, all-season ground vehicles, cold weather-capable vessels more agile than icebreakers, and persistent surveillance across a wider area. Prioritizing strategic capabilities and those that can be deployed and used elsewhere is important, not least in cost savings. A lack of dedicated Arctic response assets can ultimately prevent the United States from conducting both routine and emergency response to threats and hazards in the Arctic, which can ultimately lead to bigger security issues, including loss of life and property, strategic surprise, and growing presence of competitors seeking to “fill the (security) void.”

Awareness and Communications

We cannot overemphasize the importance of domain awareness and communication as a need for Arctic access and presence. This crucial issue was brought up in each of the dozens of interviews we conducted and throughout the nine breakout groups in the TTX. These linked needs are by far the most consistently articulated across all U.S. armed forces. As a result, if one need had to be prioritized for next steps, it would be this one. As previously mentioned, all-domain awareness is more deeply examined an appendix to this report that is not available to the public.

Priorities for communications are straightforward, and their solutions exist, even if they might be expensive: more voice (first priority) and data above 70°N. For domain awareness, a few areas are both important and either lacking or at least inconsistent across U.S. armed forces: awareness of potentially adversarial foreign military and illicit commercial activity in the maritime and information domains:

- **maritime:** The Arctic is an ocean surrounded by land, and capabilities and capacity to capture easily consumed intelligence (e.g., pictures that can be shared with the media as needed) are limited.
- **information domain:** The United States has difficulty knowing whence cyber, electronic, informational, and other effects are emanating.

Infrastructure for Response and Logistics

Infrastructure—from ports and airfields to roads and broadband communications to hospitals and schools—is often cited as a key problem in the Arctic. Parts of the Arctic, especially in northern Europe, are well outfitted in terms of many types of infrastructure. However, this is not the norm across the region writ large. This is a key reason national governments and commercial entities have limited presence in the Arctic and local communities can be self-reliant and practice resilience.

From the perspective of the U.S. armed forces, much infrastructure is needed, but most crucial are four specific types that consistently limit U.S. reach and persistence in the Arctic:

- First, **capturing or transporting, storing, and distributing energy** is essential for any operation, especially when there are typically long distances involved and a vital need for heat and breaking ice. Fuel and energy infrastructure can be very spartan even where it exists in the Far North. The armed forces

are constrained in where they can go and how long getting to those destinations will take without robust energy logistics, which include the need for specialized fuels, batteries, and other types of energy and storage that can withstand very low temperatures and a dynamic environment.

- Second, there is little **infrastructure to support maintenance**, which includes prepositioned structures, personnel, parts, and other equipment to conduct maintenance, as well as an ability to move equipment and tools into proximity as needed. This means that, if an asset is damaged, parts unexpectedly break down, or an asset needs routine maintenance, it must be transported to lower latitudes or an agreement with a partner country must be negotiated if there is even an ability to conduct maintenance in a partner's facility.
- Third, the United States does not have a **robust ability to support temporary infrastructure** through a lily-pad model (e.g., building some basic infrastructure, such as pads with power and water hookups ready to go in multiple locations rather than permanent locations that are difficult to build and maintain and might not be best positioned for future utilization).
- Finally, many parts of the Arctic have **very limited medical facilities**, and facilities that do exist are rarely large and able to support mass casualties or specialized procedures. This means that any personnel with physical or mental health issues generally need to be transported to lower latitudes for care. Even emergency medical supplies that could be provisioned might not be viable under Arctic conditions. For example, frozen blood is not terribly useful for emergency transfusions.

People

Experts echoed earlier strategies and research throughout the course of this project concerning the need to build more cadres of personnel trained for the Arctic environment. These personnel must be prepared to contend with and overcome the physical, mental, and emotional realities of operating in the region. They will be physically challenged by biting temperatures in the winter and incessant insects in the summer, as well as rough terrain and seas all year. Extreme shifts in the amount of daylight can affect mental health and windows available for conducting different kinds of operations. The same limitations that inhibit personnel's ability to call their headquarters also affect their connectivity home, an essential element of emotional well-being.

Personnel need to be trained and equipped to deal with numerous Arctic hazards as indicated above and might also require better defensive capabilities in some cases. Defense also necessitates an ability to know when they might be targeted and decide on appropriate countermeasures to employ. Training for the Arctic goes beyond surviving in cold weather, although that is no doubt a vital element.

Autonomy will undoubtedly continue to be a key enabler for Arctic presence and access, as we discuss in other sections. Yet there will be no replacement for humans in any future scenario that would look familiar to those alive today, especially in a region where, like the Arctic, safety and security have historically been forged through the cooperative work of humans, even if machines aid in mission execution.

Having humans who are unprepared for physical, mental, and emotional challenges of the Arctic has a direct implication for the United States' ability to create and maintain presence in the region. Humans cannot survive in this region without proper training, experience, and equipment. The United States has demonstrated a commendable increase in commitment to participating in Arctic training and exercises in recent years. Although it has been generally successful, instances of needing to delay completion of training or not being able to complete aspects of exercises warn of the challenges that could arise with a larger deployment of unprepared personnel to the Arctic region. Additionally, the looming large expansion of USCG icebreakers will require a commensurate increase in the number of crew members trained and proficient for unique extreme-latitude operations. Finally, surging numbers of personnel and volumes of materiel is extremely difficult in the Arctic's austere environment and location.

Tactics and Equipment for Low-Probability, High-Impact Events

At times, responding to threats and hazards requires specialized equipment, such as newer surface-to-air missile systems, oil spill kits, and specialized blood logistics. The armed forces' capabilities to deal with these are typically positioned at lower latitudes. As the Arctic sees more activities of different types, making more of this available in the north will likely become necessary. Otherwise, response risks being much too slow to avoid costly effects that might have been reduced had response been faster.

Alongside equipment, tactics are necessary for dealing with rare events with high impact. Once again, the standard playbook will likely not be sufficient because of unique challenges in the Arctic, including limited daylight during much of the year, snow whiteouts, severe storms, poor capability to predict fast-changing environments, and cold temperatures. Thus, tactics must be tested, improved, and codified with an Arctic environment in mind.

Ability to Scale Presence

Finally, there is a difference between demonstrating presence and practicing it. The former is about proving a concept; the latter shows regular capability and competence. Having a credible ability to scale up presence that is balanced across strategic, tactical, and operational capabilities is needed for the U.S. armed forces to respond to the full spectrum of threats and hazards that might be present in or come through the Arctic. It will be necessary for limiting the presence and influence of adversaries that will test U.S. intent and capability and for remaining a credible partner to allies and other like-minded countries. It will also be needed to provide needed support that the state of Alaska and Indigenous and other resilient local communities should expect from the federal government as they navigate the problems and opportunities associated with the many changes underway in the Arctic.

In addition to fulfilling the needs for infrastructure, people, and assets described above, there are initiatives that can be set in motion to better enable an ability to scale presence. Continuing the recent trend of more-frequent exercises with allies, such as Canada and Norway, would render interoperability more routine between the two countries.

Shortening the timeline to get science and technology agreements in place, especially between the United States and Canada, would also be very valuable. Codeveloping capabilities builds in interoperability and resilience.

Overcoming information-sharing problems—specifically, to share more ahead of a crisis declaration—is also imperative. Information-sharing among NATO allies is not entirely seamless; efforts to share information with other partners are even further from seamless. Committing to sharing information crucial to the peace and stability of the Arctic region could be furthered through enhanced partnering²⁴ to support shared commercial observing and sensing systems and by expanding information-sharing policies (much as NATO did for operations in Afghanistan that included non-NATO partners—acknowledging that this was a conventional war) and updating systems for information-sharing beyond the existing NATO Battlefield Information Collection and Exploitation System (BICES).

²⁴ C. Porcile, “Communication Information,” North Atlantic Treaty Organization, c. 2003.

Summary of Findings

As an Arctic country, the United States must rely on its armed forces as part of a broader partnership across federal, state, local, tribal, international, and commercial entities to secure interests in the region. These interests include supporting the Americans who live there, producing energy and food, securing strategic waterways and other locations, leveraging scientific and traditional knowledge, and protecting unique environments and cultures. Securing interests necessitates presence, which, in turn, requires access. In the previous chapters and in the online appendixes, we highlight that, although the U.S. armed forces can and do operate in the Arctic, those available in 2022 for this purpose are not sufficient for securing U.S. interests and ensuring the safety of the armed forces into the future. Here, we summarize our research findings on issues and limitations related to the U.S. armed forces' capabilities and capacity to maintain Arctic access for the purposes of achieving presence to secure these interests. These findings are synthesized from all of our research summarized in the preceding chapters and in the online appendixes. We organize our findings based on the information requested in the FY 2021 NDAA Section 8424, the original text for which can be found in Appendix A (available online) of this report.

The U.S. Coast Guard, Even with Joint Partners, Lacks the Capacity to Meet Arctic Strategy Aims

Although the United States has substantial strategic capabilities for operating from or through the Arctic, its capacity and capability for conducting operations to secure its Arctic interests are more limited than those of other Arctic countries. This is even more of an issue for instances of the USCG operating alone in the region, rather than with joint and interagency partners. Per the FY 2021 NDAA request, we have noted in this report why the USCG operating alone is not advantageous from the perspectives of domain awareness and self-defense or protection from threats. Our findings suggest that the benefits of operating jointly and with like-minded partners in the Arctic are not specific to these two areas.

In general, other Arctic countries have scaled their capabilities and capacity to their respective Arctic needs, considering natural hazards, military threats, and the sizes of their populations and economies. Even Russia's investments, including its now famously large number of icebreakers and well-publicized efforts to refurbish Cold War-era infrastructure, are at least roughly aligned with its massive Arctic territory, including just over 50 percent of the circumpolar coastline, and its equally sizable economic ambitions for the region. White House, DoD, DHS, and service component Arctic strategies have sought to rectify this gap, but sufficient resources have not yet been allocated.

Similarly, China's polar investments mirror its scientific and economic ambitions. It is not alone among countries without polar territory in owning icebreakers. The fact that China has multiple ice-capable vessels and is planning for more does not directly threaten the United States. Still, we assessed that those concerns about China utilizing Arctic activities for opportunistic dual-purpose activities and for strategic messaging are potentially valid.

Yet domain awareness and communications are admittedly difficult for everyone operating in the region. However, other regional stakeholders' focus on the Arctic does give them some advantages. In some cases, geography is also advantageous. For example, the Nordic countries are small, and even their non-Arctic portions are nonetheless very close and quite similar climatically to the Arctic, so many of their capabilities are suitable for the region. One other exception would be some aspects of Russia's military buildup in the Arctic, a limited number of which could be interpreted as posturing aggressively, not purely defensively.

The issue that the United States faces has been most visible with respect to icebreaking; like others, we have noted the severe capacity problem arising from the United States maintaining only two operational polar icebreakers. Continuing to sustain funding for the PSC program and potentially obtaining funding for an ASC program will be essential for right-sizing the icebreaking fleet relative to needs, which exist at both poles and are likely to continue increasing in the future Arctic as science missions continue and demand increases for participation in exercises, SAR, and law enforcement.

The United States will need more than these icebreakers and strategically focused assets, such as submarines, fighter aircraft, and bomber aircraft, to maintain a credible Arctic presence across its sizable Arctic territory. The existing inventory is necessary for demonstrating presence, but it is not sufficient for practicing ongoing presence and readiness for a wide array of plausible contingencies in the Far North and asserting strategic influence. Principal among the capabilities that should not be lost in the discussion of icebreakers are domain awareness, communications, and logistics for sustainment.

We have highlighted three types of domain-awareness challenges the United States will face if increasing its Arctic presence:

- First, the existing system in place for strategic warning and response has not yet been fully evaluated and adapted for threats designed to elude legacy sensing architectures or target modernized critical infrastructure.
- Second, this existing system was not designed with law enforcement and other Arctic regional needs in mind.
- Third, the emergence of the region as one of strategic competition could leave the USCG and other tactical regional operators with limited means of identifying potential threats to their platforms.

As noted elsewhere, in the appendix that is not available to the public, we examine all-domain awareness, as well as other capabilities and various threats, in greater depth.

Similarly, much of the Arctic communication available to the United States was not designed for sustained presence and mobility in the context of operations in (rather than from or through) the Arctic. The limitations we have described come in different varieties. These include physical limitations on extending communications available farther south to work in the Arctic; competition among armed forces for access to strategic communications; limited depth in the sequence of primary, alternative, contingency, and emergency communications; few tangible options for supporting higher-bandwidth applications; and dilemmas with respect to policy about communicating among partners (both between U.S. internal organizations and with external countries).

Another common theme from our TTXs and interviews that we have emphasized is the issue of sustaining presence once initiated. The only U.S. Arctic presence sustained year-round is at Thule Air Base in northwestern Greenland. Creating and sustaining more presence in and around far northern Alaska and maintaining a capability to deploy a sustained presence elsewhere (e.g., to the Greenland-Iceland-United Kingdom [GIUK] gap between the European Arctic and North Atlantic) will require substantial investment in infrastructure, inventories, personnel, and plans. This would include better leveraging the Army's ground presence in Alaska, planning between the USCG and the USN for maritime infrastructure and capabilities, coordinating between the USCG and the USAF to enable more-regular tactical air presence, planning for

prepositioned stock and south-to-north movement of supplies (including determining routes), and collaborating with Alaska state, Indigenous, commercial, and other partners.

It is also true that other Arctic countries do not have the global reach and responsibilities the United States does. The Arctic, as a historically peaceful and difficult-to-access region, has typically not been a high priority for U.S. armed forces, homeland security, SAR, environmental response, and law-enforcement investments, except during the height of the Cold War, when the region played a key strategic role in the overarching U.S. deterrence and homeland defense strategies. However, this is already beginning to change: As White House, DoD, DHS, and service component Arctic strategies have noted, the Arctic is again becoming a zone of major power competition.

The U.S. Armed Services Will Be Challenged by Foreign Military and Commercial Activities

The Arctic has, at times, been somewhat isolated from geopolitical tensions rising farther south. Despite its strategic importance during the Cold War, this region did see some unique cooperation between the United States and Russia on issues specific to the Far North, such as the conservation of polar bears. More-recent observations suggest that climate change and expectations of regional economic potential have established conditions for the Arctic to become more vulnerable to spillover of tensions or even conflict. For example, the Arctic was not spared in the fallout from Russia's illegal annexation of Crimea in 2014. Both Russia and NATO allies have since increased military exercises in the Arctic region and have limited security cooperation in the Far North. Other forms of Arctic governance—such as the Arctic Council, which explicitly excludes military matters from its charter—have not been affected by Russia's February 2022 invasion of Ukraine that resulted in a pause in all collaborative Arctic activities with Russia and other Arctic states.

As a result, our compiled analysis of military threats in the Arctic suggests that the U.S. armed forces will increasingly contend with strategic competition in this region, like in other parts of the globe where the United States has a military presence, to promote national interests and support allies and partners. This conclusion is similar to those identified in key national Arctic strategy documents. As competition intensifies, the Arctic will become ever more vulnerable to spillover from conflicts arising elsewhere. Unlike the other armed forces, the USCG has historically been viewed by strategic competitors differently—more diplomatic and less menacing. This has enabled the USCG to conduct safety, national security, and stewardship missions in the Arctic and elsewhere even when conditions are tense with strategic competitors. However, this also means that the USCG might not be trained and equipped to recognize and deal with certain tactical threats that historically would have not been levied on the USCG because of the service's unique role.

We did not assess that the Arctic would see an independent conflict caused by tensions arising over regional economic or other issues. For example, despite years of publicity, resources in the Arctic are generally well delineated by who owns them. Where they are not, systems are in place to negotiate disputes, and, to this point, these have been seen as legitimate by all parties involved.

In addition to contending with rivals in the Arctic, the U.S. armed forces—especially the USCG, because of its particular statutory missions that include law-enforcement roles—will need to monitor growth in commercial activities, both licit and illicit. The most pressing area will be in continuing to manage fisheries, especially anticipated growth in IUU fishing as global demand for protein increases, fisheries respond to a warming climate, and Indigenous groups in some areas gain more political and economic autonomy. Growth in tourism, especially ecotourism, will increase demand for SAR and environmental response, as well as for customs and border protection. Remote northern communities in North America have historically not had the infrastructure in place to accommodate regular border crossings of people and goods that is seen in the

European Arctic. At some point in the future, there could also be a need to respond to drug- and human-trafficking incidents. Although these are not of immediate concern in the North American Arctic (at least not at any scale), it is plausible that such illicit activities will be drawn north with additional economic development and transport to and from the region, which might be drawn into the Arctic under more-amenable physical conditions thanks to the general lack of infrastructure for detection and law enforcement.

Finally, in some ways, the U.S. armed forces can also be challenged by allied or otherwise-friendly foreign militaries. Our examination of capabilities, access, and interviews reflect a theme that the United States is less prepared than would-be Arctic partners to operate in the region. This hinders the United States' ability to glean the most benefit from training and exercises. Starting under some circumstances at a disadvantage means that the U.S. armed forces must use these opportunities to catch up rather than pursuing more-advanced concepts. It is also conceivable that the United States would miss the opportunity to participate in some types of events, or at least participate to a more significant level, if allies and friendly partners were to perceive a lack of capability or capacity. Depending on the circumstances, this issue could extend to self-defense or the ability to enable self-rescue or support other allies and friendly partners.

Potential Security Risks to U.S. Coast Guard Forces Are Driven Largely by U.S. Capacity and Capability Issues

In the NDAA, Congress explicitly asks about potential risks to USCG forces in the region and areas that might be inaccessible to surface maritime forces. Our analysis suggests that, despite growing competition in the Arctic, some of the fundamental security risk to USCG forces might not be direct threats from Russia, China, illicit tradespeople, or other aggressive actors. Rather, the limitations on U.S. capacity and capability to scale up for enduring regional presence contribute to three types of issues:

- First, there are scenarios in which the USCG more generally would find it difficult to perform self-protection and self-rescue irrespective of the reason (e.g., military threat, law-enforcement problem, natural hazard) for the need.
- Second, these limitations set the conditions for developing a security void in parts of the North American Arctic. Limited domain awareness, ability to quickly communicate relevant information, and presence to proactively manage problems place USCG forces at a starting disadvantage before a bad actor ever makes a move.
- Third, these same challenges affect the ability of the USCG and other U.S. armed forces to respond to emerging situations (including NATO defense) elsewhere in the Far North.

Furthermore, we did not encounter any regions of the Arctic in our TTX and complementary modeling and simulation analysis that would be fundamentally inaccessible to U.S. surface maritime forces given the appropriate pooling of resources at scale across the joint force and U.S. interagency.

The United States has been fortunate that the overall security risks in the Arctic region itself have historically been limited. In the future, these risks are likely to remain less severe than those in other parts of the United States and the world in which the USCG and other armed forces operate. In other words, the so-called pacing threat in the Arctic is not an external set of bad actors like it is elsewhere. **The United States itself is placing the USCG and armed forces in a difficult position in the Arctic by necessitating presence through overarching strategies and plans without providing the appropriate capabilities in sufficient capacities to perform these missions to the same level of success as they would be if performed elsewhere in the United States and in the world.**

Presence Cannot Be Scaled Up Without Trained Personnel, Domain Awareness, Communications, and Logistics

For many, the concept of armed forces' presence denotes physical and technological capabilities: ships, submarines, aircraft, ground vehicles, and similar platforms. There is no doubt that investment in such platforms would greatly promote U.S. Arctic access and presence. Yet the project TTX, interviews, and computer modeling emphasized four other types of essential capabilities without which next-generation or recapitalized platforms would not be effective or even operational: trained personnel, domain awareness, communications, and logistics. Personnel need to be acclimated to operating in the extreme Arctic environment, where even basic operational tasks can be difficult. Domain awareness remains limited owing to the use of a single Arctic-dedicated icebreaker (USCGC *Healy*), few overflights, and relatively few early-warning stations. Polar ionospheric conditions and poor infrastructure hamper communication, while logistics suffer from few roads and viable airstrips.

The Arctic Physical Environment Will Continue to Be a Formidable Adversary

Protecting the armed forces during their missions to secure the United States' interests in the Arctic region is of utmost importance. Although there are various military threats, such as antiship and anti-aircraft missiles, our research suggests that the likeliest and most-consequential threats will come from the Arctic's physical environment and the present lack of capability, capacity, and preparedness for dealing with these challenges. The dangers of navigating through vast, poorly charted areas with extreme weather conditions, operating in a data vacuum with limited communications, and lacking personnel trained and ready to persist in a harsh, logistics-poor environment are—and will continue to be—formidable.

Conclusions and Recommendations

Failing to address the operational needs of the armed forces in the Arctic can lead to multiple types of risks. These include the international perception of a security void and tacit tolerance of nefarious Russian and Chinese activities, loss of life, damage to national security, diminished economic potential, environmental degradation, and loss of resilience among resident communities.

Several of the experts elicited in interviews and the TTX emphasized the problem of priority given to the Arctic relative to other acquisition, logistics, personnel, training, and decisions that facilitate operations in other parts of the United States and the world. Historically, the United States has invested federal funds in the Arctic for strategic military or economic reasons or in support of other national-level goals. Much less priority and attention have been placed on fulfilling potential needs to enable security, safety, and stewardship in U.S.-administered areas of the region and on the United States' ability to support regional allies and partners as needed. This applies to specialized infrastructure, equipment, and training needed to operate in the region, as well as to availability of more-generalized capabilities for Arctic operations, because these are often deemed needed elsewhere.

We did not formally assess needs in the Arctic relative to other demands on the U.S. armed forces. The strategic benchmark for our analyses was in the summary of interests and goals (Chapter 2), examination of Russia's and China's ambitions and activities in the region (Appendix B, available online), and a look at ongoing regional disputes (Appendix H, available online). Policymakers will need to consider what other global or domestic aims will need to give to enable more focus on the Arctic.

In the remainder of this chapter, we offer seven broadly formulated recommendations that describe some pathways through which the United States can begin or continue taking steps to address the central issues of capacity, priority, interoperability, and capability (Appendix C, available online).

Recommendation 1: Bolster Momentum in Implementing U.S. Department of Homeland Security, U.S. Coast Guard, U.S. Department of Defense, and Military Service Arctic Strategies

Funding and the need to attend to other priorities can make it challenging to bridge the gap between Arctic strategies and action. Despite acknowledging the importance of the Arctic, many general (non-Arctic) U.S. strategy documents that strongly determine or influence priority-setting at every level of government place the bulk of their emphasis on other regions. For example, the 2022 National Defense Strategy recognizes China as the pacing threat for the United States, although it also acknowledges the continued presence of Russia as an important problem set.¹ Naturally, the United States must make choices in what to prioritize, and we do not debate these. It is merely a point of fact that, **if the Arctic is not clearly prioritized in priority-**

¹ DoD, "About," webpage, undated.

setting national strategies, investing in the capabilities, people, partnerships, and training and exercises that Arctic strategies suggest are needed for securing national interests in the region will continue to be difficult.

Regularly updating strategy documents, formalizing actions and collaborations through implementation plans, advocating for stronger emphasis on the Arctic in national-level strategies and plans as appropriate, and continuing to place liaisons in other U.S. government and foreign-partner offices will help to enable momentum and continuity of effort. Another aspect for which the USCG and DHS could consider additional advocacy would be for the White House to release a new U.S. national-level Arctic strategy. At the time of this writing, nearly ten years and three administrations had passed since a national Arctic strategy was released. In contrast, both Russia and China have produced much more-recent Arctic strategy documents. Timely national strategy documents not only demonstrate and communicate interests in the region but also provide key guidance to coordinate efforts at securing interests in dynamically changing security and physical environments.

Recommendation 2: Continue Efforts to Expand Funding for Priority U.S. Coast Guard and U.S. Department of Homeland Security Needs

This report and others have articulated numerous needs for improving Arctic access and presence. We must emphasize that there are no silver bullets—no single investment will resolve the multitude of problems. However, we also recognize that not every good investment can be made, and there are some important first steps that can be taken.

Thus, we recommend that **funding continue for the new icebreakers (precise numbers and fleet mix to be determined) and an additional Alaska deepwater port**, based on our interviews, TTX, and modeling. This recommendation follows from the well-documented disparity in icebreaking capacity between the United States and many other nations, Arctic and otherwise, that have some icebreaking capabilities, despite the vast size of the U.S. Arctic maritime area (not all requiring icebreaker support to access) and having national responsibilities at both poles. This recommendation also draws on the GIS-based analysis of transit times through the Arctic between port locations. Fully funding additional icebreakers (PSCs and ASCs) could mitigate presence shortfalls and increase the likelihood that an icebreaker would be close enough to any event in the Arctic to effectively address it in time.

Icebreaking vessels are valuable for Arctic surface maritime access, but we also caution against inflating the need for icebreaking vessels, considering that the preponderance of Arctic activity (especially by those arriving in the region from lower latitudes for economic, military, or other purposes) will continue to be in the expanding warm season. It might be quite feasible to support many Arctic needs using ice-hardened or ice-strengthened vessels; more analysis is needed to determine when these types of assets will be an appropriate option.

Icebreaking vessels are also slow, are needed to support missions at both poles, and require especially rigorous maintenance. Thus, when icebreaking vessels are needed to meet the challenging conditions of the maritime Arctic, multiple vessels homeported on different coasts will be needed to increase responsiveness: Attempting to support every subregion of the Arctic from a home port on one coast would result in long delays. These vessels come with a need for specialized personnel, maintenance, and logistics. Furthermore, because the Arctic operating environment is changing, icebreakers might need to carry out and support such functions as self-defense and law enforcement, which must be considered in their design.

For example, as noted above, Congress appropriated PSCs for the USCG in the FY 2021 NDAA and authorized up to six; the USCG's program of record is for three PSCs. A heavy icebreaker can access almost any

location within the Arctic under most conditions. The problem is that these assets need to operate across two vast areas at opposite poles of the planet, and each will be operationally available for only part of the year because of maintenance and training requirements. Even if they are homeported in distributed locations, icebreakers' presence is inherently limited by their small numbers, their slow speeds when breaking ice, and the Arctic's vast scale. In the TTX, we assumed that additional icebreakers that had been conceived of but not formally proposed or funded were not available in 2035, to help us determine whether the funded icebreakers alone were sufficient; they were not. Fully funding additional icebreakers (PSCs and ASCs) could mitigate presence shortfalls and increase the likelihood that an icebreaker would be close enough to any event in the Arctic to effectively address it in a timely manner.

Completing the deepwater port at Nome, Alaska, with partners from across the U.S. government could also prove to be a game changer. This will emplace a more capable key maritime logistics node in the U.S. Arctic. With Washington and Maine being the northernmost states on either coast within the contiguous United States, a deepwater port in northern Alaska would be a substantial improvement in the timeliness of access to the Bering, Chukchi, and Beaufort Sea areas of the Arctic. This being noted, there are important local community and environmental considerations related to port expansion. The high volume of silt from the Snake River means that deepwater-draft vessel access to the port will need to be monitored and managed on a regular basis, perhaps via periodic dredging.

The deepwater port at Nome would also positively affect logistics but is only one piece. Numerous experts articulated concerns about fuel, maintenance, and medical logistics in particular. Given the vastness of distance and general lack of infrastructure in the Arctic, operators are always concerned about when and how to refuel, especially if the scale of operations might expand.

Lack of infrastructure and vast distances also affect maintenance and medical logistics. At present, the armed forces must return to lower latitudes in the event of anything beyond very minor maintenance or medical issues (or, in the case of the latter, potentially facilitate transport for the affected people). Once again, this is not an adequate solution if scaling up presence is the aim.

In addition to new capabilities at Nome, the United States can consider the possibility of making more use of naval facilities along the New England coast. This is also a case in which partnering can be useful, such as when Canada completes refurbishing the Nanisivik Naval Facility in Nunavut. Additional work on mobile technical capabilities and tactics should also be investigated. Logistics on the Atlantic side of continental North America are particularly important for increasing responsiveness and on-station time in the European Arctic.

Finally, there could be opportunities for making investments in "low-hanging fruit" for domain awareness and communications. This could involve carefully reviewing the design of new cutters and considering what missions these might conduct that might require specialized equipment, such as undersea monitoring equipment to support the defense readiness mission. This could also involve working with joint partners to determine whether the USCG and other DHS components, as needed, can take advantage of existing contracts or plans to buy equipment and services that could help limit the cost for DHS.

Recommendation 3: Seek Opportunities to Benefit from Commercial Investments

Throughout this report, we have referred to several limitations related to operating in the Arctic that are entirely or mostly unique to this region's geography and environment. Although they are daunting, this means that everyone seeking to operate in the region faces the same issues and, to some extent, has use for similar solutions. The silver lining is that commercial enterprises are working on solutions for domain aware-

ness, communications, and logistics in the region knowing that there could be users not only in business but also in local communities, the armed forces, and other government users. As discussed in interviews and the TTX (Appendix C, available online), this presents an opportunity for USCG and perhaps broader DHS R&D to take advantage of commercial innovation and ideally partner in the very early stages to ensure that designs meet their specific needs and to gain access to capabilities (e.g., bandwidth, novel concepts for mobile infrastructure) in the early stages of deployment, when demand might exceed supply.

One example area in which the U.S. armed forces are already taking this type of approach is in leveraging commercial space. Efforts to **engage in R&D with commercial partners must continue**, and we recommend considering **expanding support for selected fiber communications, maritime and aviation logistics (including for mobile infrastructure), and autonomous-vehicle projects** if viable and useful.

Recommendation 4: Strengthen Research Partnerships

Even as the U.S. armed forces seek to expand some investments in existing commercial projects, there are also opportunities to further pursue basic research on the leading edge of capability development and for mitigating the environmental, safety, and other impacts of potentially increasing the footprint of the armed forces in the Arctic. For example, several institutions in the United States, such as the University of Alaska, the USCG R&D Center, and the USN's Office of Naval Research, have strong Arctic technology research programs. We suggest that these **partnerships continue and expand in increasingly diverse ways**. In addition to funding research itself, the armed forces can explore the possibility of more fellowship programs, hosting conferences, and inviting the research community to increase participation in exercises and experiments when appropriate. This recommendation is based on information derived from the TTX and in interviews (Appendix C, available online).

It might also be beneficial to conduct additional outreach to NSF, NASA, and the National Oceanic and Atmospheric Administration (NOAA). One specific collaboration example that is ongoing is the Naval Sea Systems Command Arctic Integrated Project Team that interfaces with science and technology organizations of the USCG, NOAA, and several federally funded R&D centers. DHS and the USCG should also continue coordinating with DoD partners, including with the Ted Stevens Center for Arctic Security Studies.

Recommendation 5: Strengthen International Partnerships

The U.S. armed forces already recognize the importance of international partnerships in their Arctic strategy documents. In recent years, actions have also supported these valuable words by developing deeper ties with foreign partners for Arctic presence, training, exercises, and gaming. For example, the U.S. armed forces—the Marine Corps in particular—have developed deeper ties with Norway for Arctic training and exercises. The United States also hosts other countries in Arctic exercises. The USCG is very active in the ACGF. The USN and the USCG are engaging with NATO's Science and Technology Organization. The International Cooperative Engagement Program for Polar Research is yet another example of an Arctic-based international partnership, which facilitates discussions and information exchanges. There are numerous other examples of ways in which international partnerships are being forged in the Arctic area.

We recommend that the USCG, with its joint partners, continue on this path and **expand partnerships when possible**. This includes finding ways to share intelligence and other information more widely and sooner. The United States should also consider how to best invest to make better use of partnerships—for example, for interoperability as an avenue to meeting expanding requirements for Arctic-savvy crews (e.g., possibly through foreign shiprider and other programs) or to enable new and different exercises to occur (e.g.,

in different terrain). This recommendation is based on the examination of U.S. strategy documents (Chapter 2), the capability survey (Chapter 3 and Appendix D [available online]), the TTX and interviews (Appendix C, available online), and summary of key issues that include consideration of partnerships and security cooperation (Chapter 4).

In the past several decades, the climatic and geostrategic landscape of the Arctic has been changing. The United States is an Arctic country and can no longer rely on a low baseline of human activity in the region to continue into the future; nor can it focus on strategic competition solely at lower latitudes. The United States' armed forces are the most capable in the world but are largely not optimized for operating at high northern latitudes. For many years, it has not been clear that they would have to. Now, with Arctic access and presence increasingly important for domestic and international interests and for the safety and security of the armed services themselves as they operate in the region, it has become imperative to do more.

Change cannot come about all at once. This report articulates some priorities based on multiple types of analysis and elicitation of information from members of the armed forces themselves. Now, it is up to leaders in the U.S. government to decide how and when to invest and act on prioritizing the Arctic in the interest of the United States and its people, especially those living or serving in the high northern latitudes.

Abbreviations

ACGF	Arctic Coast Guard Forum
AFB	Air Force base
AIS	automatic identification system
AOR	area of responsibility
AORH	auxiliary oil replenisher with hangar
AS	air station
ASC	Arctic security cutter
AUV	autonomous underwater vehicle
AZRF	Arctic Zone of the Russian Federation
BICES	Battlefield Information Collection and Exploitation System
BRI	Belt and Road Initiative
C2	command and control
CAOFA	Central Arctic Ocean Fisheries Agreement
CCG	Canadian Coast Guard
CESM2	Community Earth System Model 2
CIAO	China Iceland Arctic Research Observatory
C4ISR	command, control, communications, computers, intelligence, surveillance, and reconnaissance
CLCS	Commission on the Limits of the Continental Shelf
DHS	U.S. Department of Homeland Security
DoD	U.S. Department of Defense
EEZ	exclusive economic zone
EU	European Union
FFRDC	federally funded research and development center
FSB	Federal'naiia sluzhba bezopasnosti, or Federal Security Service
FVEY	Five Eyes
FY	fiscal year
GIS	geographic information system
GIUK	Greenland-Iceland-United Kingdom
GPS	Global Positioning System
HA/DR	humanitarian assistance/disaster relief
HF	high frequency
HMNZS	Her Majesty's New Zealand Ship
HSOAC	Homeland Security Operational Analysis Center
IACS	International Association of Classification Societies
IMO	International Maritime Organization
ISR	intelligence, surveillance, and reconnaissance

IUU	illegal, unreported, and unregulated
JACO	Joint Arctic Command
JBER	Joint Base Elmendorf–Richardson
LEO	low earth orbit
LNG	liquefied natural gas
MER	marine environmental response
NAS	naval air station
NASA	National Aeronautics and Space Administration
NATO	North Atlantic Treaty Organization
NDAA	National Defense Authorization Act
NOAA	National Oceanic and Atmospheric Administration
NORAD	North American Aerospace Defense Command
NSC	national security cutter
NSF	National Science Foundation
NSR	Northern Sea Route
NSRA	Northern Sea Route Administration
NWP	Northwest Passage
OPV	offshore patrol vessel
PC	polar class
PLA	People’s Liberation Army
PLAN	People’s Liberation Army Navy
PSC	polar security cutter
RCN	Royal Canadian Navy
R&D	research and development
RV	research vessel
SAR	search and rescue
SATCOM	satellite communication
SFS	Space Force station
SIGINT	signal intelligence
SME	subject-matter expert
SSBN	ballistic-missile nuclear-powered general-purpose attack submarine ship
SSN	nuclear-powered general-purpose attack submarine ship
TTP	tactics, techniques, and procedures
TTX	tabletop exercise
UAS	uncrewed aircraft system
UK	United Kingdom
UNCLOS	United Nations Convention on the Law of the Sea
USAF	U.S. Air Force
USAP	U.S. Antarctic Program

USCG	U.S. Coast Guard
USCGC	U.S. Coast Guard cutter
USEUCOM	U.S. European Command
USN	U.S. Navy
USNORTHCOM	U.S. Northern Command
USSF	U.S. Space Force
VHF	very high frequency

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The United States has considerable interests in the Arctic and is one of just eight countries with territory in the region. It also has a responsibility to prepare and protect its armed forces that could be called upon to secure its Arctic interests as the region becomes an increasingly active security environment. Russia continues to maintain and upgrade large-scale, credible Arctic military capabilities. Moreover, China's growing economic and scientific activities in the region could enable it to expand its influence and capabilities there.

Beyond strategic competition and growing concerns over the possibility of a North Atlantic Treaty Organization (NATO)–Russia clash, the armed forces of the United States—particularly the U.S. Coast Guard (USCG)—continually contend with safety, law enforcement, legal, other national security, and environmental issues in the region. The National Defense Authorization Act for Fiscal Year 2021 requires a report on the Arctic capabilities of the armed forces. This report summarizes the findings of this research and is intended to, at a minimum, address the congressional request and could also contribute related, independent findings about needs and issues.

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