



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

## Appendixes

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## About These Appendixes

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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. Our main 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. These appendixes support that report.

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 our 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 our 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. These appendixes and the report they support present the results of research and analysis conducted under task order 70Z02321FMDW01300, Report on Arctic Capabilities of the Armed Forces.

The results presented in these appendixes do not necessarily reflect official DHS opinion or policy.

For more information on the RAND Homeland Security Research Division, see [www.rand.org/hsrd](http://www.rand.org/hsrd). For more information on the main report and web-only appendixes, see [www.rand.org/t/RRA1638-1](http://www.rand.org/t/RRA1638-1).



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# Appendix A. Fiscal Year 2021 National Defense Authorization Act Report Request

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This appendix reproduces verbatim Section 8424 of the FY 2021 NDAA, in which Congress requested this report.

## REPORT ON THE ARCTIC CAPABILITIES OF THE ARMED FORCES.

(a) REPORT REQUIRED.—Not later than 180 days after the date of the enactment of this Act, the Secretary of the department in which the Coast Guard is operating shall submit to the appropriate committees of Congress a report setting forth the results of a study on the Arctic capabilities of the Armed Forces. The Secretary shall enter into a contract with an appropriate federally funded research and development center for the conduct of the study.

(b) ELEMENTS.—The report required by subsection (a) shall include the following:

(1) A comparison of the capabilities of the United States, the Russian Federation, the People’s Republic of China, and other countries operating in the Arctic, including an assessment of the ability of the navy of each such country to operate in varying sea-ice conditions.

(2) A description of commercial and foreign military surface forces currently operating in the Arctic in conditions inaccessible to Navy surface forces.

(3) An assessment of the potential security risk posed to Coast Guard forces by military forces of other countries operating in the Arctic in conditions inaccessible to Navy surface or aviation forces in the manner such forces currently operate.

(4) A comparison of the domain awareness capabilities of—

(A) Coast Guard forces operating alone; and

(B) Coast Guard forces operating in tandem with Navy surface and aviation forces and the surface and aviation forces of other allies.

(5) A comparison of the defensive capabilities of—

(A) Coast Guard forces operating alone; and

(B) Coast Guard forces operating in mutual defense with Navy forces, other Armed Forces, and the military forces of allies.

(c) FORM.—The report required under subsection (a) shall be submitted in unclassified form, but may contain a classified annex.

(d) APPROPRIATE COMMITTEES OF CONGRESS DEFINED.—In this section, the term “appropriate committees of Congress” means—

(1) the Committee on Armed Services, the Committee on Commerce, Science, and Transportation, and the Committee on Appropriations of the Senate; and

(2) the Committee on Armed Services, the Committee on Transportation and Infrastructure, and the Committee on Appropriations of the House of Representatives.

## Appendix B. Competition in the Arctic: Russia and China

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Russia and China are the primary competitors in the Arctic that could challenge, and have challenged, activities of the United States and its allies and partners in the Arctic. This appendix describes how Russia and China have challenged these activities thus far and what future challenges the United States could face in this region. Our discussions focus on strategic objectives of Russia and China in the Arctic; the geopolitical, domestic, economic, and military activities that support these objectives; and conclusions about what these activities could mean for the United States in the Arctic.

At the outset of this discussion, the authors acknowledge the changes the intensification of the war in Ukraine have brought to Arctic cooperation. Since 2022, Russia has increased its focus on engagement with China, and Finland and Sweden have submitted applications to join the NATO alliance, with the former joining the alliance in 2023. The Arctic Council has paused meetings and other activities in response to Russia's war against Ukraine.

### Russia's Strategic Objectives in the Arctic

Russia is an internationally recognized Arctic state and a founding member of the Arctic Council; it also possesses the largest Arctic coastline, Arctic EEZ, and Arctic population of any Arctic state.<sup>1</sup> The AZRF officially consists of "Murmansk region, Nenets, Yamal-Nenets, and Chukotka Autonomous Okrugs, Komi Republic, and northern municipalities of Arkhangelsk region, Krasnoyarsk Krai, Republic of Sakha (Yakutia) and the Republic of Karelia."<sup>2</sup>

Several national strategic policies underpin Russia's activities in the Arctic. Most recently, Putin issued Executive Order 164, "Fundamentals of State Policy of the Russian Federation in the Arctic Until 2035" (i.e., Russia's Arctic policy framework), in March 2020 and the associated Executive Order 645, "Strategy for Developing the Russian Arctic Zone and Ensuring National Security Through 2035" in October 2020.<sup>3</sup> In July 2022, Putin also approved a newly updated naval doctrine that prioritizes defending the Arctic theater of operations and harnessing

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<sup>1</sup> Center for Circumpolar Security Studies, Arctic Institute, "Russia," webpage, June 19, 2020a.

<sup>2</sup> Arctic Council, "The Russian Federation," webpage, undated-b.

<sup>3</sup> Vladimir Putin, "Ob Osnovah Gosudarstvennoi Politiki v Rossiiskoi Federatsii v Arktike na Period do 2035 Goda [Fundamentals of State Policy of the Russian Federation in the Arctic Until 2035]," Kremlin, Executive Order 164, March 5, 2020a; Vladimir Putin, "O Strategii Razvitiia Arkticheskoi Zony Rossiiskoi Federatsii i Obespecheniia Natsional'noi Bezopasnosti na Period do 2035 Goda [Strategy for Developing the Russian Arctic Zone and Ensuring National Security Through 2035]," Kremlin, Executive Order 645, October 26, 2020b.

its resources.<sup>4</sup> According to existing analysis of both documents, Russia's Arctic strategy articulates three objectives:

- Maintain mutually beneficial bilateral and multilateral agreements with the sub-Arctic states.
- Develop the resource base and increase the economic growth of the AZ [AZRF] and its share of Russia's total GDP [gross domestic product].
- Protect Russia's borders and interests in the spheres of security and economy.<sup>5</sup>

Furthermore, the Arctic policy framework outlines Russia's national security concerns as follows:

1. Attempts by foreign governments to reconsider the basic international treaties that regulate business and other activities in the circumpolar North.
2. Incompleteness of international legal delimitations of the seas in the Arctic.
3. Debarment by foreign governments or international associations of the Russia's creation of legal business or other activities in the Arctic.
4. Foreign military forces in the Arctic.<sup>6</sup>

Consequently, Russia's activities in the Arctic focus on reaching Russia's main strategic objectives within established international laws while questioning everyone else's efforts to do the same, to justify expanding Russia's military presence and intensifying economic and military activities in the region. Russia actively seeks to maintain the existing set of Arctic governance mechanisms, including such international institutions and mechanisms as UNCLOS and the Commission on the Limits of the Continental Shelf (CLCS), independent regional bodies as the Arctic Council, and so-called track II means of informal diplomacy, because they work in Russia's favor.<sup>7</sup> These mechanisms are also part of Russia's strategy to maintain domain awareness in the Arctic, which we discuss in subsequent sections.

Russia also seeks to develop the AZRF's considerable natural resources and socioeconomic well-being, protect its environment, ensure its "peace and stability," and maintain the NSR "as a

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<sup>4</sup> Kremlin, "Russian Federation Naval Doctrine Approved," press release, July 31, 2022; Vladimir Putin, "Morskoiia Doctrina Rossiiskoi Federatsii [Naval Doctrine of the Russian Federation]," Kremlin, Executive Order 512, July 31, 2022; Prokhor Tebin, "The New Naval Doctrine of Russia," Valdai Discussion Club, August 4, 2022.

<sup>5</sup> Pär Gustafsson, "Russia's Ambitions in the Arctic Towards 2035," Swedish Defence Research Agency, Memo 7624, October 2021, p. 4.

<sup>6</sup> Gustafsson, 2021, p. 5; Putin, 2020a.

<sup>7</sup> 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, pp. 1–2. Track II diplomacy is also known as *back-channel diplomacy*, in which unofficial representatives of both sides come together with the support of their governments. See, for example, Jennifer Staats, Johnny Walsh, and Rosarie Tucci, "A Primer on Multi-Track Diplomacy: How Does It Work?" commentary, U.S. Institute of Peace, July 31, 2019.



national transportation lane.”<sup>8</sup> Russia’s vast petroleum and natural gas deposits in its Arctic EEZ amount to more than half of *all* Arctic petroleum and natural gas deposits and make up two-thirds of Russia’s total petroleum and natural gas deposits.<sup>9</sup> Russia plans to invest \$85 billion in the AZRF’s development through 2025.<sup>10</sup>

Third, Russia is deeply concerned with the security of the AZRF and the NSR, the latter of which it views as its territorial waters that other nations’ ships can transit only with its permission. As sea ice continues to decline, Russian officials are concerned that the country’s northern border could become more susceptible to Western naval forces’ transit, requiring ever-greater investment in military and dual-use assets. Russia’s Arctic policy framework explicitly calls out what the Russian government believes to be foreign states’ efforts to undermine international laws and “create systems of national laws and regulations that ignore existing agreements and regional cooperation frameworks.”<sup>11</sup>

However, given all of Russia’s concerns in the Arctic, Russia’s Arctic strategy is primarily defensive in nature and designed to enhance its northern border and the AZRF’s productivity, as well as improve Arctic living conditions and maintain its ecology. It emphasizes that the AZRF requires unique approaches to pursuing socioeconomic development and ensuring national security in the Arctic and incorporates the following efforts across varying policy areas to achieve these goals:

- social development of the AZRF
- economic development of the AZRF
- infrastructure development of the AZRF
- science and technology development for Arctic exploration
- environmental protection and ecological security
- international cooperation development
- defending citizens in AZRF territories from natural and human-caused disasters
- public safety in the AZRF
- military security—defending and protecting Russia’s national borders in the AZRF.<sup>12</sup>

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<sup>8</sup> Gustafsson, 2021, p. 4.

<sup>9</sup> See, for instance, James Black, Stephen J. Flanagan, Gene Germanovich, Ruth Harris, David A. Ochmanek, Marina Favaro, Katerina Galai, and Emily Ryen Gloinson, *Enhancing Deterrence and Defence on NATO’s Northern Flank: Allied Perspectives on Strategic Options for Norway*, RAND Corporation, RR-4381-NMOD, 2020, p. 8; Pavel Devyatkin, “Russia’s Arctic Strategy: Energy Extraction (Part III),” Center for Circumpolar Security Studies, Arctic Institute, February 20, 2018a; Atle Staalesen, “In Push for Global Lead in LNG, Moscow Takes Aim on Arctic Tundra,” *Barents Observer*, March 25, 2021a; and Pat Davis Szymczak, “Russian LNG Aims High, Leveraging Big Reserves and Logistical Advantages,” *Journal of Petroleum Technology*, September 1, 2021.

<sup>10</sup> “Investments in Russian Economy in Arctic to Exceed \$86 Bln Until 2025,” Telegraph Agency of the Soviet Union, March 29, 2019.

<sup>11</sup> Nazrin Mehdiyeva, “Strategy of Development of the Arctic Zone of the Russian Federation and the Provision of National Security for the Period to 2035,” North Atlantic Treaty Organization Defense College, Russian Studies Series 1/21, last updated June 25, 2019.

<sup>12</sup> Putin, 2020b.

Thus, Russia's civilian and military systems, infrastructure, and goals are indelibly intertwined in the Arctic.

## Achieving Domain Awareness Through International Frameworks

Russia maintains a deep awareness of Arctic geopolitical activities through its active participation in several Arctic-relevant institutions and mechanisms. Since 2021, Russia has held the rotating chair of the Arctic Council—the most important Arctic governance mechanism.<sup>13</sup> It maintains a hotline communication system with Norway to prevent potential misunderstandings or missteps in the Arctic and remains an active participant in the Barents Euro-Arctic Council with the EU and Nordic nations. Russia's invasion of Ukraine in February 2022, however, resulted in the seven other Arctic Council members suspending their participation in this body. Although the Arctic Chiefs of Defence meetings were suspended following Russia's illegal annexation of Crimea in 2014, Russia continued to participate in the ACGF until its invasion of Ukraine in 2022, cooperating with Arctic coast guards to maximize collective maritime domain awareness in the Arctic region. Russia closely monitors UNCLOS-related activities, especially because it has an extended Arctic continental shelf claim currently under review by the CLCS.

## Russia's Territorial Claims

In line with Russia's efforts to defend its Arctic territories is its use of established international legal frameworks to lay claim to some disputed territories. Following the successful resolution in 2010 of its decades-long dispute with Norway on the delimitation of their respective EEZs in the Barents Sea, Russia has three ongoing (albeit low-level) disputes related to territories in the Arctic:

- One pertains to a stretch of seabed that extends more than 463,000 square miles in the central Arctic Ocean, Barents Sea, Bering Sea, and Sea of Okhotsk and that Russia seeks to have recognized as an extension of its continental shelf.<sup>14</sup> This claim partly overlaps with similar ones from Denmark (for seabed extending from Greenland's continental shelf) and from Canada.
- The second issue relates to the status of the NSR, which Russia describes as its internal waters, whereas the United States and other countries see it instead as part of the high seas.
- The third ongoing issue relates to Russia's disagreement with Norway's establishment of a fishery protection zone around the Svalbard archipelago.

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<sup>13</sup> Arctic Council, "The Russian Chairmanship of the Arctic Council Begins Under the Theme 'Responsible Governance for a Sustainable Arctic,'" webpage, June 28, 2021.

<sup>14</sup> Klaus Dodds, "Flag Planting and Finger Pointing: The Law of the Sea, the Arctic and the Political Geographies of the Outer Continental Shelf," *Political Geography*, Vol. 29, No. 2, February 2010, p. 70; Marlène Laruelle, *Russia's Arctic Strategies and the Future of the Far North*, M. E. Sharpe, 2014, p. 99.

None of these disagreements, however, has so far led to serious tensions between Russia and other countries involved, and any risk of escalation has been successfully managed.

Coastal states are authorized under Article 76 of UNCLOS to exploit the underground resources of their seabeds within a limit of up to 200 nautical miles off their shores. However, if they can successfully demonstrate that part of the seabed beyond that limit is geologically similar to the seabed below that limit—constituting, in effect, a physical extension of their continental shelves—they can then obtain the right to exploit its resources. These rights do not extend to the column of water above the seabed, meaning that they do not create fishing rights or privileged access for navigation. Before issuing its recommendations, the CLCS decides whether a country's claim is backed by convincing scientific evidence. In the case of overlapping claims, any set of recommendations from the CLCS would be followed by bilateral or multilateral negotiations between the states involved to settle on a final delimitation of their respective continental shelf extensions.<sup>15</sup>

Russia was the first Arctic state to submit such a claim in 2001. The CLCS found insufficient scientific evidence to back it, leading Russia to resubmit in 2015. Russia subsequently filed extensions in 2021, enlarging its claims.<sup>16</sup> Meanwhile, Denmark submitted a series of claims between 2009 and 2014 that partly overlapped with the Russian one, as did Canada in 2019, shortly before reaching the ten-year limit within which states could make such claims.<sup>17</sup> Considering the backlog of claims submitted to the CLCS (a fairly small UN body), it will take several years before Russia's, Denmark's, and Canada's respective claims all receive recommendations, at which point all three states can begin negotiations. It could thus be decades before the sovereign areas of the disputed continental shelf in the Arctic receive their final delimitations, particularly in light of the fact that it took more than 40 years for Russia and Norway to come to an agreement on the delimitations of their respective EEZs in the Barents Sea.<sup>18</sup>

Although there are undoubtedly large amounts of resources, including oil and gas, in the disputed continental shelf, it is important to note that the exploitation of these underground resources would raise significant technological challenges because of the depth at which they are

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<sup>15</sup> Cornell Overfield, "An Off-the-Shelf Guide to Extended Continental Shelves and the Arctic," *Lawfare*, April 21, 2021; 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, p. 41.

<sup>16</sup> Martin Breum, "Russia Extends Its Claim to the Arctic Ocean Seabed," *ArcticToday*, April 4, 2021.

<sup>17</sup> Division for Ocean Affairs and the Law of the Sea, United Nations, "Submissions, Through the Secretary-General of the United Nations, to the Commission on the Limits of the Continental Shelf, Pursuant to Article 76, Paragraph 8, of the United Nations Convention on the Law of the Sea of 10 December 1982," webpage, last updated August 11, 2022. Each state has ten years after the date it ratified UNCLOS to submit continental shelf extension claims.

<sup>18</sup> Arild Moe, Daniel Fjærtøft, and Indra Øverland, "Space and Timing: Why Was the Barents Sea Delimitation Dispute Resolved in 2010?" *Polar Geography*, Vol. 34, No. 3, 2011, p. 145.

located and the meteorological and physical conditions under which exploration and extraction would have to occur.<sup>19</sup> Meanwhile, much more-accessible resources are available to Russia, Canada, and Greenland closer to their shores.<sup>20</sup> It is also worth noting that, so far, Russia has followed the process laid out by UNCLOS to advance its claim—it was actually the very first state to make use of this process and refer a claim to the CLCS.<sup>21</sup> Additionally, Russia’s continental shelf claim in the Sea of Okhotsk, which it submitted in 2013, received recommendations just a year later that attributed to Russia all of the seabed it had claimed.<sup>22</sup> This successful precedent for Russia suggests that Russia has a vested interest in continuing to respect this process for its broader Arctic claim—if only to not undermine the authority of the past decision made in regard to the Sea of Okhotsk.

A second ongoing dispute involving Russia in the Arctic relates to the NSR, which follows Russia’s northern shore from the Barents Sea to the Bering Sea and was officially opened to non-Russian ships in 1991.<sup>23</sup> The NSR is of great strategic importance to Russia. It is resource rich and is, as scholar Arild Moe described it, “The only way to access many areas along the northern coast; further it offers the shortest way between Russia’s east and west.”<sup>24</sup> In a 2012 Russian federal law pertaining to the NSR, Russia described it as an aggregation of Russia’s EEZ, territorial sea, and internal waters.<sup>25</sup> Russia requires ships transiting through the NSR to request permission to do so ahead of time, through the NSR Administration (NSRA). NSRA may also mandate that ships use (for a fee) icebreaker services and ice reconnaissance services.<sup>26</sup> To justify that it requires permission to transit over its EEZ—which should, under UNCLOS, allow innocent passage and transit passage, neither of which requires the permission of the coastal state—Russia invokes UNCLOS Article 234, which gives each coastal state exceptional rights to

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<sup>19</sup> For an estimate of undiscovered oil and gas in the Arctic, see Kenneth J. Bird, Ronald R. Charpentier, Donald L. Gautier, David W. Houseknecht, Timothy R. Klett, Janet K. Pitman, Thomas E. Moore, Christopher J. Schenk, Marilyn E. Tennyson, and Craig J. Wandrey, “Circum-Arctic Resource Appraisal: Estimates of Undiscovered Oil and Gas North of the Arctic Circle,” U.S. Geological Survey, Fact Sheet 2008-3049, version 1.0, July 23, 2008.

<sup>20</sup> Pezard, Tingstad, et al., 2017, p. 43.

<sup>21</sup> Laruelle, 2014, p. 98.

<sup>22</sup> CLCS, Division for Ocean Affairs and the Law of the Sea, United Nations, “Recommendations Prepared by the Subcommission Established for the Consideration of the Submission Made by the Russian Federation,” Annex V of “Summary of Recommendations of the Commission on the Limits of the Continental Shelf in Regard to the Partial Revised Submission Made by the Russian Federation in Respect of the Sea of Okhotsk on 28 February 2013,” February 4, 2014.

<sup>23</sup> Daria Gritsenko and Tuomas Kiiski, “A Review of Russian Ice-Breaking Tariff Policy on the Northern Sea Route 1991–2014,” *Polar Record*, Vol. 52, No. 263, March 2016, p. 145.

<sup>24</sup> Arild Moe, “A New Russian Policy for the Northern Sea Route? State Interests, Key Stakeholders and Economic Opportunities in Changing Times,” *Polar Journal*, Vol. 10, No. 2, 2020, p. 209.

<sup>25</sup> Viatcheslav V. Gavrilov, “Legal Status of the Northern Sea Route and Legislation of the Russian Federation: A Note,” *Ocean Development and International Law*, Vol. 46, No. 3, 2015, p. 257.

<sup>26</sup> Sean Fahey, “Access Control: Freedom of the Seas in the Arctic and the Russian Northern Sea Route Regime,” *Harvard National Security Journal*, Vol. 9, No. 2, 2018, p. 175.

regulate “ice-covered areas” within its EEZ in order to prevent accidents and the environmental damage that this could cause to coastal communities, and argues that it applies to the NSR.<sup>27</sup> Because the United States has not ratified UNCLOS, it is unable to involve itself in the legal aspect of this dispute.

The United States disagrees with Russia’s position and sees it as an infringement on the freedom-of-navigation principle.<sup>28</sup> In December 2018, then–Secretary of the Navy Richard Spencer expressed U.S. intentions to conduct freedom-of-navigation operations through the NSR, although the United States has so far not carried out this intention. The United States has also conducted, with its allies, two naval exercises in 2020 in the Barents Sea, in Russia’s vicinity.<sup>29</sup> Meanwhile, an additional strain on Russia’s position is the diminution of ice over the NSR due to climate change, which will make Russia’s justification for extended control over the route under Article 234 less and less tenable in the future and potentially open the route to stronger international contestation.<sup>30</sup>

Finally, the Svalbard archipelago has been the subject of long-time tensions between Russia and Norway. The Soviet Union signed the Treaty Concerning the Archipelago of Spitsbergen (also known as the Svalbard Treaty) in 1935, recognizing Norway’s sovereignty over the archipelago. However, there have been recurrent (albeit low-level) tensions regarding the rules applying to Svalbard; Russia—as well as several other countries, including the UK—claim that Norway’s establishment in 1977 of a fishery protection zone extending 200 nautical miles off the coast of Svalbard should have been made with the consent of the other signatories to the Svalbard Treaty.<sup>31</sup> This disagreement has led to several incidents between Russian fishing vessels and the Norwegian Coast Guard—the most serious taking place in 2005, when a Russian trawler under arrest took off for Russian waters with two Norwegian inspectors still on board—but has never seriously escalated, and both states appear to manage the situation through continued dialogue.<sup>32</sup>

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<sup>27</sup> Fahey, 2018, p. 176.

<sup>28</sup> See, for instance, Michael R. Pompeo, Secretary of State, “Looking North: Sharpening America’s Arctic Focus,” remarks, Rovaniemi, Finland, May 6, 2019, and Nikolaj Skydsgaard and Humeysa Pamuk, “Blinken Says Russia Has Advanced Unlawful Maritime Claims in the Arctic,” Reuters, May 18, 2021.

<sup>29</sup> Center for Strategic and International Studies, “Maritime Security Dialogue: A Conversation with Hon. Richard V. Spencer, Secretary of the Navy,” transcript, December 6, 2018; Skydsgaard and Pamuk, 2021.

<sup>30</sup> Sacks et al., 2021, pp. 7–8.

<sup>31</sup> Laruelle, 2014, pp. 106–107.

<sup>32</sup> Andreas Østhagen, Anne-Kristin Jørgensen, and Arild Moe, “The Svalbard Fisheries Protection Zone: How Russia and Norway Manage an Arctic Dispute,” *Arctic and North*, Vol. 40, 2020, pp. 156, 159–167.

## Drivers Behind Russia's Activities in the Arctic

As discussed in the previous section, on Russia's strategic objectives in the Arctic, Moscow has attempted over the years to balance the expansion of its military presence in the Arctic with regional cooperation efforts as a way to reaffirm its standing as a great power both domestically and internationally but also to maximize the economic benefits it could extract from the Arctic region.<sup>33</sup> In addition, Russia's security services have exploited the geopolitical and economic dynamics at play in the Arctic to draw the Kremlin's attention and expand their budgets.<sup>34</sup>

In this light, the main drivers behind Russia's interest and activities in the Arctic can be grouped into three categories: (1) geopolitical factors, such as Russia's opposition to the activities of Western or NATO countries in the Arctic, and Moscow's perceived need to counterbalance U.S. presence in the region; (2) Russia's domestic political dynamics and other internal considerations; and (3) economic factors, which include the country's economic dependence on revenues from exploitation of oil and natural gas in the Arctic region, as well as maritime transit fees. In the rest of this section, each of these categories is presented in more detail. These geopolitical, domestic, and economic factors motivate Russia to show off its military capabilities and safeguard its sovereignty over its EEZ and continental shelf in the Arctic.<sup>35</sup>

### *Geopolitical Climate*

The Arctic is a region where, on the one hand, Russia acknowledges the presence of areas of mutually beneficial cooperation with Western countries, including the United States, which it advances in such regional fora as the Arctic Council. On the other hand, Russia perceives the Arctic to be another region where it needs to compete with the United States and other Western countries for resources and geopolitical influence.<sup>36</sup> Geopolitical competition and Russia's concerns have only increased in recent years in the context of evolving climate conditions. In the past, the extremely cold climate of the region preserved the so-called eternal ice, which, for Russia, represented a natural barrier protecting the country's very long Arctic coast from the presence of external rivals. With the increase in temperatures across the globe in recent years, the Arctic's eternal ice not only began to melt but also no longer freezes in winter to the extent that it used to,<sup>37</sup> opening up the area to potential naval threats from Russia's rivals, which could make inroads through the Bering Strait or from military bases in Greenland and Norway. From the

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<sup>33</sup> Stacy R. Closson, "Russian Foreign Policy in the Arctic: Balancing Cooperation and Competition," Wilson Center, Kennan Cable 24, June 2017, p. 2; Marlène Laruelle, "Russia's Arctic Policy: A Power Strategy and Its Limits," *Russie.Nei.Visions*, No. 117, March 2, 2020, p. 5.

<sup>34</sup> Arctic SMEs, interview with the authors, October 15, 2021.

<sup>35</sup> Closson, 2017, p. 4.

<sup>36</sup> Closson, 2017, p. 2.

<sup>37</sup> Satria Akbar Sigit, "Some Arctic Ground Lost Its Eternal Ice. Is It That Bad?" *Earthbuddies*, February 6, 2019.

Kremlin's perspective, these new Russian vulnerabilities justify Russia's expanded military presence in the region<sup>38</sup> and increase Russia's determination to oppose Western and NATO countries and counterbalance U.S. presence in the Arctic region.

#### Opposition to North Atlantic Treaty Organization Countries in the Arctic

More broadly, Russia is concerned with NATO's activities in the Arctic. Six of the eight Arctic states are NATO members, and NATO's engagement with the region has a long history dating back to the Cold War. If Sweden joins NATO, then seven of eight Arctic countries will be NATO members. The Arctic represents the alliance's northern flank, and, from a military standpoint, it plays several key roles, including that of a direct sea line of communication and vital supply route in wartime. In recent years, NATO carried out military exercises, such as Exercise Trident Juncture 2018, which constituted the largest exercises in the Arctic since the 1980s and which accentuated Russia's concerns about NATO presence and activities in the Arctic. In the context of renewed tensions in the relationship between Washington and Moscow, in general, and increased competition in the Arctic among great powers and regional players, specifically, Russian concerns related to NATO countries bordering the Arctic have been rising.<sup>39</sup>

In addition, Russia's own actions in the Arctic in the past two decades have contributed to the increase in tensions with NATO countries. During a 2007 scientific expedition, personnel on a Russian submarine planted a flag on the seabed at the North Pole. Russia has also carried out repeated violations of Norwegian air space and agreed-upon maritime boundaries around the disputed Svalbard archipelago. In 2013, Russia had declared NATO to represent the primary national security threat in the Arctic, and the Kremlin made countering the NATO threat in the Arctic a top priority for the region.<sup>40</sup>

However, despite Moscow's anti-NATO rhetoric and unilateral actions or claims, Russia has also attempted to engage in cooperative behavior with NATO countries in the Arctic. For instance, in 2010, Moscow signed a bilateral agreement with Oslo regarding the demarcation of maritime boundaries. On the economic front, Moscow has also engaged in cooperation with Norway and neighboring countries in the Barents Sea, from which it needed financial and technological assistance to develop the Arctic region. These countries also represent markets for Russia's Arctic region exports. However, in the aftermath of the Ukraine crisis in 2014, the presence of international sanctions against Russia ended many of the projects and developments that Russia had started in partnership with its European neighbors in the Barents Sea. Despite Russia's aggressive behavior against Western countries and NATO in other regions, such as the

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<sup>38</sup> Janis Kluge and Michael Paul, "Russia's Arctic Strategy Through 2035," Stiftung Wissenschaft und Politik, November 26, 2020.

<sup>39</sup> Elizabeth Buchanan, "The Overhaul of Russian Strategic Planning for the Arctic Zone to 2035," North Atlantic Treaty Organization, document review, Russian Studies Series 3/20, last updated May 19, 2020.

<sup>40</sup> Closson, 2017, pp. 1, 2, 6.

Baltics, Syria, and Ukraine, the Kremlin continued to pursue cooperative behavior with NATO countries in the Arctic.<sup>41</sup>

To conclude, in general, Moscow seems to be inclined to compete for status in the Arctic with the NATO countries, including the United States, while being open to cooperation with them within the confines of the Arctic Council and regionally with the neighboring countries in the Barents Sea.<sup>42</sup> Russia's 2022 invasion of Ukraine, however, resulted in the United States and the other six Arctic Council states suspending meetings until further notice, hindering the ability of the United States and its Arctic allies and partners to engage with Russia on Arctic issues and vice versa.

### Counterbalancing U.S. Presence and Influence in the Arctic

In addition to more broadly opposing NATO countries in the Arctic, Russia is concerned more specifically with counterbalancing U.S. presence and influence in the Arctic. Russia has the longest Arctic coastline, a larger Arctic population, and more Arctic economic activity than any other country. In addition, Russia has traditionally had a strong maritime presence in the Arctic and, in the vicinity of its borders, has de facto controlled the maritime transit routes through the region.<sup>43</sup> These factors, together with the longstanding United States–Russia rivalry, make Russia inclined to be more sensitive to U.S. presence and influence in the Arctic.

As part of Russia's efforts to counterbalance U.S. presence and influence in the region and to project the image of a global power on the same footing with the United States, Russia has built and maintained a strong military and economic presence in the Arctic. Russia's power projection efforts in the Arctic are exacerbated by the Kremlin's concerns that the United States considers Russia to be a declining power that can no longer pose a serious threat to the United States, despite the fact that recent U.S. security and defense strategies identify Russia together with China as great-power competitors.<sup>44</sup>

Next to such big-picture strategic considerations are operational-level concerns related to the disagreement between Russia and the United States over the status of the NSR, where the United States claims the right of free navigation in opposition to Russia's claim that the route traverses its own internal waters. Russia expects that all ships that use the NSR will ask permission for passage and pay transit fees for using the services of icebreakers and pilots that accompany vessels through the NSR.<sup>45</sup>

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<sup>41</sup> Closson, 2017, pp. 1, 2, 6.

<sup>42</sup> Closson, 2017, p. 2.

<sup>43</sup> Jonathan Jordan, "Russia's Coercive Diplomacy in the Arctic," Center for Circumpolar Security Studies, Arctic Institute, July 6, 2021.

<sup>44</sup> Jordan, 2021.

<sup>45</sup> Dmitry Gorenburg, "Russian Interests and Policies in the Arctic," *War on the Rocks*, August 7, 2014.



## *Domestic Politics*

In addition to geopolitical factors, domestic politics and concerns drive Russia's interest and activities in the Arctic. For instance, the October 2020 "Strategy for Developing the Russian Arctic Zone and Ensuring National Security Through 2035" mentions both socioeconomic development and national security goals for the Arctic region.<sup>46</sup> These goals are closely interconnected with one another, as we demonstrate in the next section, on Russia's economic interests in the Arctic. This latest strategy document on the Arctic mentions the importance of developing seaport infrastructure and shipping routes through the NSR and the Barents, White, and Pechora Seas. Furthermore, it identifies climate change, decreasing birth rates (or low population density), reduced migration to the region, poor access to public services, poor transport infrastructure, and higher risk of diseases as some of the major challenges and threats with negative effects on the development of the AZRF.<sup>47</sup> Among these, declining population, low levels of geological resource exploration, and the development for social, transport, and communication networks represent the top three areas of concern for Moscow. Moscow has identified, among the top threats to national security in the Arctic, its inadequate response to environmental issues and the slow and poor state of technical development for the region, including delays related to the development of the NSR and in the manufacturing of equipment suited to operate in Arctic conditions.<sup>48</sup> In this context, Moscow aims to stop the population outflow from the Arctic that has been consistently occurring since the dissolution of the Soviet Union; the outflow stems from both the region's extreme climate and the fact that the cost of living there is higher than in other parts of Russia. Moreover, the thawing of the permafrost has a negative effect on the region's infrastructure, which is already barely developed or in bad condition because of inadequate funding.<sup>49</sup>

The lack of alignment between the priorities of Russia's federal government and those of regional governments in the Arctic, as well as across government agencies, has affected the region's governance and how policies are implemented, leaving unclear what is ultimately Russia's role in the Arctic.<sup>50</sup> Although, on the one hand, Moscow has identified the Arctic as a region of geostrategic importance, on the other hand, it views the region as "just one of many problematic and structurally weak regions across the Federation," deserving some \$200 million in development funds for the 2021–2023 period, as opposed to \$3.4 billion destined for Crimea.<sup>51</sup>

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<sup>46</sup> Putin, 2020b, p. 2.

<sup>47</sup> Troy Bouffard and P. Whitney Lackenbauer, "The Development of the Russian Arctic Council Chairmanship: A Strategic Plan of Preparation and Pursuit," North American and Arctic Defense and Security Network, strategic perspective, March 30, 2021, pp. 3–4.

<sup>48</sup> Buchanan, 2020.

<sup>49</sup> Kluge and Paul, 2020; Stolyarov, 2020.

<sup>50</sup> Closson, 2017, p. 7.

<sup>51</sup> Kluge and Paul, 2020, p. 2.

Domestically, Russian leaders see the exploitation of natural resources in the Arctic and the opening of the NSR as an opportunity to enhance Russia's power, especially from an economic standpoint, in ways that can be exploited for domestic political gain. Russia's claim that Arctic natural resources are to be found in territory that Russia controls is aimed to play well with domestic audiences.<sup>52</sup> Most of Russia's bellicose rhetoric associated with the country's sovereignty claims in the Arctic and the military buildup in the region are directed mostly at rallying domestic audiences around the flag.<sup>53</sup> For instance, from 2015 to 2017, Moscow spent some 75 percent of its military infrastructure budget to expand its presence in the Arctic region. This military expansion was followed by announcements of economic expansion of the region amounting to some \$2.8 billion between 2017 and 2025.<sup>54</sup> All of these investments and announcements are aimed mainly at domestic audiences within Russia and are often surrounded or framed within a very nationalistic perspective.

The link between Russian nationalism and the Arctic has been formed from the very top of Russia's leadership. In the past, Russia's president, Vladimir Putin, drew parallels between Russia's national identity and Russia's Arctic ambitions, presenting the Arctic as one of the pillars in Russia's quest to return to great-power status.<sup>55</sup> Nationalism has also been a driving force behind the protectionist policies Moscow put in place to regulate traffic through the NSR. Policies designed in recent years have placed tariffs on vessels that pass through the NSR while also requiring proof of liability insurance. Additional protectionist policies that Russia has put in place require that foreign vessels use Russian icebreaker services and pilots together with weather and ice reports to navigate through the NSR, all of which are available for a fee. In 2015, Moscow also considered legislation that would have restricted the export of Russian Arctic oil and gas resources along the NSR to only Russian ships, prohibiting foreign vessels from this activity. The legislation was adopted in 2017 and began to be implemented in 2018.<sup>56</sup> Also, in 2017, Russia's government put the State Atomic Energy Corporation Rosatom in charge of the NSR through the NSRA and limited the traffic of foreign ships, which now require transit permission from Russia's government and need to submit a 45-day notification.<sup>57</sup> Such legislative measures not only play well in terms of Russian nationalism but are also meant to

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<sup>52</sup> Closson, 2017, pp. 2, 4.

<sup>53</sup> Gorenburg, 2014.

<sup>54</sup> John D. Watson, "Russia's Recent Conquests and Long-Term Strategy in the Arctic," *Wild Blue Yonder*, July 2, 2021.

<sup>55</sup> Matthew Melino and Heather A. Conley, "The Ice Curtain: Russia's Arctic Military Presence," Center for Strategic and International Studies, undated.

<sup>56</sup> Pavel Devyatkin, "Russia's Arctic Strategy: Maritime Shipping (Part IV)," Center for Circumpolar Security Studies, Arctic Institute, February 27, 2018b.

<sup>57</sup> Malte Humpert, "Russia to Reorganize Northern Sea Route Competencies," *High North News*, November 10, 2017; Melino and Conley, undated.

develop living and economic conditions in the Arctic region, which represent a top priority of the latest Arctic strategy.<sup>58</sup>

### *Economic Activities*

Moscow's attempts to consolidate power in the Arctic region have a twofold economic aim: (1) to bring in foreign investment and (2) to use the revenues or financial resources of domestic oil and gas companies toward regional development and counterbalance the effect of sanctions and the lack of appropriate resources in the federal budget destined for the Arctic.<sup>59</sup>

Russia is economically dependent on the Arctic region for revenues from oil, natural gas, and vessel transit fees. In terms of natural resources, Russia's Arctic region is estimated to have some "13 percent of the world's oil, 30 percent of the world's natural gas, and rare earth minerals" deposits.<sup>60</sup> A 2008 U.S. Geological Survey team assessed that Russian offshore oil reserves likely stood at some 30 billion barrels, natural gas reserves at some 34 trillion cubic meters, and liquid natural gas at some 27 billion barrels, lending some credibility to Moscow's statement that the areas of the Arctic to which Russia has claims might "hold more petroleum deposits than those currently held by Saudi Arabia."<sup>61</sup>

Next to the resource abundance of the Arctic region, the economic exploitation of the NSR contributes to Russia's interest in the Arctic. The NSR links European and Asian markets and represents a source of income for the approximately 2 million Russians who populate Russia's Arctic territories.<sup>62</sup> Overall, the NSR is considered to represent "the most viable route through Arctic waters," and it is likely to become even more accessible as a result of climate change and in the context of port improvements and the increased presence of ice cutters. The NSR has the potential to become one of the three largest energy corridors in the world by connecting Russia's energy-rich Arctic zone to the Atlantic and Pacific.<sup>63</sup> Putin stated that, in 2020, some 33 million tons of cargo crossed through the NSR and set the unrealistic expectation that the volume of cargo transiting this route would amount to some 80 million tons by 2024.<sup>64</sup> However, despite the fact that the NSR cuts down the transit time by at least two weeks compared with the traditional route that connects Asia and Europe through the Suez Canal, the current transit tonnage makes up a tiny percentage of the 1 billion tons of cargo that annually transit through the

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<sup>58</sup> Kluge and Paul, 2020.

<sup>59</sup> Closson, 2017, p. 7.

<sup>60</sup> Closson, 2017, p. 2.

<sup>61</sup> Gorenburg, 2014.

<sup>62</sup> Closson, 2017, p. 2; Melino and Conley, undated.

<sup>63</sup> Closson, 2017, p. 4.

<sup>64</sup> Buchanan, 2020.

Suez Canal.<sup>65</sup> This lag is likely to persist in the near future given that Egypt expanded the Suez Canal, which is now open to transit for more ships and for larger-tonnage vessels than previously.<sup>66</sup> Even in light of the March 2021 incident when the *Ever Given* container ship became stuck for a week in the Suez Canal and Russia attempted to capitalize on the incident to promote the NSR as an alternative waterway, several factors detract from the NSR's viability in the short and medium terms: the higher cost of transportation, environmental risks, and the limited number of navigation permits that Russia issues.<sup>67</sup> The current situation in Ukraine and Russia's unpredictable and destructive behavior in the international system also increase the risk to ships that transit through Russian waters and close to Russia's border, lowering the attractiveness of the NSR as an alternative to the Suez Canal.

So far, the development of the NSR has been stalled as a result of extreme weather patterns and other international developments, such as dips in global oil demand and the implementation of sanctions after the 2014 invasion of Crimea, which affected investments in the energy sector and the sharing of technologies with Russia.<sup>68</sup> The transit viability of the NSR is also affected by the administrative obstacles, high transit fees, and protectionist measures Moscow put in place on use of the NSR for the transport of Russian natural resources extracted in the Arctic region, which favors Russian companies, as discussed in the previous section, on domestic drivers.<sup>69</sup> These measures and the fact that the NSR remains covered by ice for the majority of the year, despite some ice melting in recent years resulting from climate change, have led some analysts to assess that the NSR is likely to become economically viable only at some point after 2035.<sup>70</sup>

## Russia's Military Activities in the Arctic

As a result of Russia's geopolitical goals and economic activities in the Arctic and in line with Russia's strategic concerns about the growing conflict potential in the region, Russia's military activities in the Arctic have expanded in the past decade.<sup>71</sup> Russia has (1) intensified its ecological cleanup and infrastructure buildup efforts across its Arctic territories to achieve military security and maintain domain awareness, (2) conducted more military training and exercises in the Arctic, (3) conducted more trips to the Arctic for scientific exploration, and

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<sup>65</sup> Fred Weir, "Russia Breaks the (Polar) Ice on Its Northeast Passage Aspirations," *Christian Science Monitor*, October 13, 2021.

<sup>66</sup> Devyatkin, 2018b.

<sup>67</sup> Polina Leganger Bronder, "Russia's Northern Sea Route Push Is Met with Scepticism," *Barents Observer*, April 5, 2021; Christopher Woody, "Ever Given Is No Longer Blocking the Suez Canal, but Russia Sees a Long-Term Benefit from It Being Stuck," *Insider*, March 30, 2021b.

<sup>68</sup> Closson, 2017, pp. 4–5.

<sup>69</sup> Devyatkin, 2018b.

<sup>70</sup> Devyatkin, 2018b.

<sup>71</sup> Putin, 2020b, p. 2.

(4) increased its routine air and sea patrols to improve domain awareness in the region. Staying true to the nature of its Arctic strategy, Russia has characterized most, if not all, of this activity as defensive and necessary to deter the United States' and NATO's perceived increasingly aggressive military activities in regions close to Russia's national borders.<sup>72</sup>

### *Ecological Cleanup*

Since approximately 2012, Russia's armed forces have been working to make the Arctic more habitable and hospitable to prolonged military presence and sustained military operations. For example, in the summer of 2013, Russia sent ten combat ships on a 2,000-mile expedition to deliver equipment; large-scale, life-sustaining facilities; materiel resources; property; and fuel to the Novosibirsk islands.<sup>73</sup> Additionally, to stop the population outflow and improve the region's degraded infrastructure (noted under "Domestic Politics" above), Russia has intensified its efforts to remove remaining Soviet-era debris from its Arctic territories to make these locations more habitable and accessible for Russia's military operations. Russia needed to clear hundreds of thousands of square kilometers of territory, remove tens of thousands of tons of metal and send it back to Russia for further processing, demolish unusable structures, and recultivate the earth across its Arctic territories. Thus, in 2015, Russia's minister of defense, Sergei Shoigu, reported that the ministry had begun to take specific measures to clear more than 65,000 tons of metal that had accumulated in the Arctic.<sup>74</sup> Between 2015 and 2020, the ministry cleared territory in several Arctic regions and developed housing for service members.<sup>75</sup> During this time, the Ministry of Defence also formed temporary units (consisting of 186 personnel) for ecological cleanup in the Arctic.<sup>76</sup>

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<sup>72</sup> Ministry of Defence of the Russian Federation, "Russian Defense Minister General of the Army Sergei Shoigu During a Trip to the Northern Fleet Held a Working Meeting in Severomorsk," April 13, 2021d; V. Semiriaga, "Ugrozi I Vizovi Rossii v Arktike [Threats and Challenges to Russia in the Arctic]," *Armeiskii Sbornik [Army Digest]*, No. 10, 2021.

<sup>73</sup> Y. Krinitskii, P. Borisenko, and I. Kovalev, "Bor'ba za Arktiku—Problema Sovremennosti [Battle for the Arctic Is a Modern Problem]," *Armeiskii Sbornik [Army Digest]*, No. 2, February 2016.

<sup>74</sup> Ministry of Defence of the Russian Federation, "Tezisy Doklada Ministra Oborony Rossiiskoi Federatsii na Rasshirennom Zasedanii Kollegii Minogorony Rossii [Executive Summary by the Minister of Defense of the Russian Federation at the Russian Defense Ministry Board Session]," December 11, 2015.

<sup>75</sup> Ministry of Defence of the Russian Federation, "Vystupleniie Ministra Oborony Rossiiskoi Federatsii Generala Armii Sergeia Shoigu na Rasshirennom Zasedanii Kollegii Minoborony Rossii [Testimony of the Minister of Defense of the Russian Federation General of the Army Sergei Shoigu at the Russian Defense Ministry Board Session]," December 22, 2016; Ministry of Defence of the Russian Federation, "Tezisy Doklada Ministra Oborony Rossiiskoi Federatsii Generala Armii S. K. Shoigu na Rasshirennom Zasedanii Kollegii Minogorony Rossii [Executive Summary by the Minister of Defense of the Russian Federation General of the Army S. K. Shoigu at the Russian Defense Ministry Board Session]," 2018a; Ministry of Defence of the Russian Federation, "Doklad Ministra Oborony Rossiiskoi Federatsii na Rasshirennom Zasedanii Kollegii Minoborony Rossii [Executive Summary by the Minister of Defense of the Russian Federation at the Russian Defense Ministry Board Session]," 2020.

<sup>76</sup> Ministry of Defence of the Russian Federation, "V Voiskah Zavershen Otbor Lichnogo Sostava dlia Formirovaniia Vzvodov Ekologicheskoi Ochistki v Arktike [The Military Has Completed the Selection of Personnel to Form Platoons for Ecological Cleanup in the Arctic]," April 18, 2017b.

## *Russia's Domain-Awareness Infrastructure*

Russia's most recent Arctic strategy critiques the slowness of the Russian government's ability to fulfill promises made in its 2008 Arctic policy framework, especially in the development sector. These criticisms surround the AZRF's declining population, "underdeveloped" infrastructure, "inefficient geological prospecting," slower-than-expected construction of new icebreakers, SAR facilities, and transportation infrastructure, and lack of appropriate instrumentation to "[monitor] the environment."<sup>77</sup>

In response to this criticism and in line with the current Arctic policy framework and on the heels of the progress made with its ecological cleanup efforts, Russia has been expanding its infrastructure projects and developing a sophisticated network of dual-use and military assets to provide it with a relatively high degree of domain awareness in the Arctic. It is refurbishing Soviet-era assets and constructing new facilities, including SAR stations, airfields, customs stations, military bases, long-range patrols, and electromagnetic intelligence-monitoring stations. Alongside air patrols and a 50-strong icebreaker fleet,<sup>78</sup> Russia maintains a greater degree of persistent Arctic domain awareness than most Arctic states.

Throughout the AZRF, Russia has reopened, "refurbished," or expanded 13 airfields, ten radar stations, 20 border stations, and ten SAR stations.<sup>79</sup> The volume of modern communication equipment for armed forces suitable for operation under Arctic conditions grew by 20 percent between 2012 and 2017. In 2016, the Ministry of Defence erected equipment for radar units and aviation guidance centers on Wrangel Island, as well as Alexandra Land and Cape Schmidt.<sup>80</sup> Since then, the ministry has also built and reconstituted military airfields in Franz Josef Land archipelago, Novosibirsk islands, Anadyr, and the Kotelny and Srednii islands.<sup>81</sup> To illustrate the scope of Russia's efforts to improve Arctic military infrastructure, Table B.1 lists some of the primary air bases in Russia's Arctic region and summarizes the current state of development for notable facilities and weapon systems.

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<sup>77</sup> Gustafsson, 2021, p. 5.

<sup>78</sup> Center for Circumpolar Security Studies, 2020a.

<sup>79</sup> Melino and Conley, undated.

<sup>80</sup> Ministry of Defence of the Russian Federation, 2016.

<sup>81</sup> Ministry of Defence of the Russian Federation, "Ministerstvo Oborony Rossiiskoi Federatsii: Podrobnnee [Ministry of Defense of the Russian Federation: In Detail]," November 7, 2017c; Vladimir Suhoruchenko, "Obespechit' Bezopasnost' Rossii v Arktike [Ensuring Russia's Security in the Arctic]," *Zashchita i Bezopasnost' [Defense and Security]*, No. 4, December 31, 2019.

**Table B.1. Selected Infrastructure in the Arctic**

Base	Location	Facility	Weapon System	Primary Use of Base
Wrangel Island	Novosibirsk islands	<ul style="list-style-type: none"> <li>Trefoil military compound<sup>a</sup></li> </ul>	<ul style="list-style-type: none"> <li>Sopka-2 radar</li> </ul>	<ul style="list-style-type: none"> <li>It is part of the “protective dome” network of state-of-the-art radars covering Russia’s northern coastline.</li> <li>Sopka-2 radar also controls civilian air traffic and provides meteorological data for mariners traversing the NSR.</li> </ul>
Temp	Kotelny Island, Novosibirsk islands	<ul style="list-style-type: none"> <li>Trefoil military compound</li> <li>Airfield</li> </ul>	<ul style="list-style-type: none"> <li>Sopka-2 radar</li> <li>Bastion-P transporter erector launcher coastal defense</li> <li>Pantsir-S1 coastal defense</li> <li>Other: communications, radar C2, subsurface vessels, antiair and antiship capabilities</li> </ul>	<ul style="list-style-type: none"> <li>It serves as an early-warning radar station for air surveillance.</li> <li>It serves as territorial defense—denies aerial, maritime, or land access to NATO and U.S. forces.</li> <li>It is part of an antiaccess and area-denial bubble in the Russian Arctic.</li> </ul>
Nagurskoye <sup>b</sup>	Alexandra Land, Franz Josef Land	<ul style="list-style-type: none"> <li>Trefoil military compound</li> <li>2 airfields (one will be capable of supporting year-round flights)</li> <li>334 facilities</li> <li>59 buildings and facilities for personnel of radar unit and aviation guidance center</li> </ul>	<ul style="list-style-type: none"> <li>Bastion-P</li> </ul>	<ul style="list-style-type: none"> <li>It provides territorial defense and power projection with SAR capabilities.</li> <li>It can function for 18 months with 150 people.</li> <li>It reinforces Russia’s multilayered maritime- and air-denial power with air–sea–land capabilities.</li> <li>Its proximity to Greenland, Iceland, Norway, and the GIUK gaps could disrupt NATO’s vital sea lines of communication between North America and Europe, hindering U.S. military reinforcement to Europe.</li> </ul>
Rogachevo	Novaya Zemlya		<ul style="list-style-type: none"> <li>S-400 system</li> <li>Other: radar, electronic warfare, SIGINT forces and equipment</li> </ul>	<ul style="list-style-type: none"> <li>It secures northwest Arctic territory.</li> <li>It protects the most-vital military assets on the Kola Peninsula and fills potential gaps in radar coverage.</li> </ul>

Base	Location	Facility	Weapon System	Primary Use of Base
Belush'ia Guba	Novaya Zemlya	<ul style="list-style-type: none"> <li>• New kindergarten</li> <li>• 3 residential buildings</li> <li>• Medical facility</li> <li>• Recreation facility</li> <li>• Preschool and primary school</li> </ul>		<ul style="list-style-type: none"> <li>• It is intended to accommodate 360 children.</li> <li>• It has capacity for 168 apartments.</li> </ul>
Gadzhiyevo	Kola Peninsula		<ul style="list-style-type: none"> <li>• High concentration of defensive and offensive assets</li> </ul>	<ul style="list-style-type: none"> <li>• It expands and adds depth to Russia's defense of its most strategic Arctic territory (ensures the survivability of second-strike nuclear assets).</li> <li>• It secures Russia's freedom of movement in the maritime and air domains.</li> </ul>
Severomorsk-1	Kola Peninsula	<ul style="list-style-type: none"> <li>• 20 facilities to support minimum aircraft launch requirements</li> <li>• Modern radio and lighting equipment</li> </ul>	<ul style="list-style-type: none"> <li>• Large weapon bunkers</li> </ul>	<ul style="list-style-type: none"> <li>• It is the site of large-scale military exercises practicing bastion defense and intercontinental ballistic missile testing.</li> </ul>
Plesetsk Cosmodrome	Kola Peninsula			<ul style="list-style-type: none"> <li>• It conducts RS-24 Yars intercontinental ballistic missile testing.</li> </ul>
Tiksi <sup>c</sup>	Tiksi	<ul style="list-style-type: none"> <li>• Modular town with dormitories</li> <li>• Administration buildings</li> <li>• Diesel-run power station</li> <li>• Water and fuel reservoirs</li> </ul>	<ul style="list-style-type: none"> <li>• 3rd Air Defense Division (300 personnel)</li> <li>• S-400 surface-to-air missile</li> <li>• Radio technical regiments</li> <li>• MiG-31 deployments</li> </ul>	<ul style="list-style-type: none"> <li>• It fuses Russia's military needs and ambitious economic plans.</li> <li>• It provides SAR facilities.</li> </ul>



Base	Location	Facility	Weapon System	Primary Use of Base
Cape Schmidt	Chukotka	<ul style="list-style-type: none"> <li>• Equipment for radar units</li> <li>• Aviation guidance centers</li> <li>• Meteorological center</li> <li>• Dormitories</li> </ul>	<ul style="list-style-type: none"> <li>• Units of Arctic air defenses</li> </ul>	<ul style="list-style-type: none"> <li>• It provides permanent positions for conducting combat air patrols.</li> </ul>

SOURCE: Features data from “Boevoye dezhurstvo po ohrane Arkticheskikh shirot [Combat Patrols to Defend Arctic Territories],” *Boevaia vakhta* [Combat Watch], No. 2, January 24, 2015; Mathieu Boulègue, *Russia’s Military Posture in the Arctic: Managing Hard Power in a “Low Tension” Environment*, Chatham House, Royal Institute of International Affairs, research paper, June 28, 2019; Melino and Conley, undated; Ministry of Defence of the Russian Federation, “Tezisy Doklada Ministra Oborony Rossiiskoi Federatsii Generala Armii S. K. Shoigu na Rasshirennom Zasedanii Kollegii Minogorony Rossii [Executive Summary by the Minister of Defense of the Russian Federation General of the Army S. K. Shoigu at the Russian Defense Ministry Board Session],” 2017a; Ministry of Defence of the Russian Federation, 2018a; Ministry of Defence of the Russian Federation, “Tezisy Vystupleniia Ministra Oborony Rossiiskoi Federatsii Generala Armii S. K. Shoigu na Rasshirennom Zasedanii Kollegii Minogorony Rossii [Executive Summary by the Minister of Defense of the Russian Federation General of the Army S. K. Shoigu at the Russian Defense Ministry Board Session],” December 24, 2019b; Ministry of Defence of the Russian Federation, 2020; Ministry of Defence of the Russian Federation, “Minoborony Rossii Postroit v Arktike Trei Zhilykh Doma dlia Voennosluzhashchikh i Detskii Sad [Russia’s Defense Ministry Will Build Three Residential Buildings for Service Members and a Kindergarten],” March 29, 2021c; and Sergei Nikanorov, “Armiia Rossii—Kak Arkticheskaia Tsvilizatsiia [Russian Military as an Arctic Civilization],” *Nezavisimaia Gazeta* [Independent Newspaper], March 17, 2020.

<sup>a</sup> Also known as Arctic Clover facilities because of their shape resembling the three-leafed clover.

<sup>b</sup> The northernmost military base in the world.

<sup>c</sup> Center for Strategic and International Studies imagery does not show evidence of S-400 systems or the considerable expansion.

In the western Russian Arctic, these domain-awareness assets constitute an important part of Russia’s Bastion defense zone in and around the Kola Peninsula and the Barents Sea. The Bastion defense zone is intended to protect the bulk of Russia’s sea-based nuclear forces based in and around Severomorsk.<sup>82</sup> Russia’s Bastion domain-awareness capabilities might extend as far southeast as the GIUK gap.<sup>83</sup> Russia augments radar capabilities in the Kola Peninsula with long-range bomber, ISR, and patrol aircraft sorties within its Bastion zone. The reconnaissance flights also monitor ice coverage to support safe navigation for civilian ships along the NSR. Russia has established customs and border protection assets throughout the NSR to ensure the country’s oversight of vessels seeking passage through it.<sup>84</sup> Five choke points spread throughout the NSR also ensure Russia’s control and maximize its domain awareness in the surrounding region: the Kara Strait; Kotelný Island and the Lyakhovsky Islands; Wrangel Island; Novaya Zemlya; and between Novaya Zemlya and Franz Josef Land.<sup>85</sup>

<sup>82</sup> Boulègue, 2019, pp. 6–7. Also see Matthew Melino, Heather A. Conley, and Joseph S. Bermudez Jr., “The Ice Curtain: Bringing Transparency to the Arctic: Modernization on the Kola Peninsula,” Center for Strategic and International Studies, brief, March 2020.

<sup>83</sup> Black et al., 2020, p. 9.

<sup>84</sup> Mark Adomanis, “Russia Plans Massive Arctic Expansion,” *USNI News*, August 9, 2012, updated May 29, 2013.

<sup>85</sup> David Auerswald, “Now Is Not the Time for a FONOP in the Arctic,” *War on the Rocks*, October 11, 2019b.

In the eastern Arctic, Russia's domain-awareness activities involve primarily the use and construction of dual-use assets to protect and support activities through the NSR.<sup>86</sup> These dual-use assets, although designed primarily for nonmilitary activities, also provide enhanced situational awareness that could prove useful in a conflict situation.<sup>87</sup> Russia has completed or is constructing SAR centers at Naryan-Mar, Dudinka, Arkhangelsk, Murmansk (Arkhangelsk and Murmansk being within the Bastion zone), Vorkuta, Tiksi, Anadyr, Pevek, and Sabetta.<sup>88</sup> In the central Arctic, Russia has installed Bastion-P and Pantsir-S1 air defense systems on Kotelny Island and Novaya Zemlya.<sup>89</sup>

This buildup is also supporting the growing Russian military personnel presence across the Arctic. As Table B.1 illustrates, the Ministry of Defence is building up some of Russia's Arctic bases to support short-term equipment and personnel deployments (up to one year) and permanent basing and plans to provide most of the comforts of other permanent bases across Russia. Some locations either already include or have plans to build kindergarten, preschool, and primary school facilities; residential buildings and recreational facilities for service members and their families; and modern medical facilities.<sup>90</sup> To demonstrate the gravity of these plans and continuous progress in these areas, in 2017, the Ministry of Defence reported that service members in the Arctic received more than 100 urgent and planned telemedicine consultations.<sup>91</sup> The ministry has also been working with Gazprom Neft and Rosneft oil and gas companies to build refueling stations at military air bases and with natural gas producer PAO NOVATEK to convert boilers to use LNG to help cut expenses for boiler fuel consumption by 2025.<sup>92</sup>

Russia has renovated Soviet-era facilities and will continue to construct new military and dual-use assets in the AZRF.<sup>93</sup> The Ministry of Defence has built hundreds of facilities across hundreds of square kilometers at new and existing installations to improve education, health care, and living conditions for personnel and their families in a harsh environment. These installations also serve Russia's military objectives to provide bastion defense and secure Russia's freedom of movement in the Arctic, as well as support SAR operations, border enforcement, and overall domain awareness.

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<sup>86</sup> Jim Townsend and Andrea Kendall-Taylor, *Partners, Competitor, or a Little of Both? Russia and China in the Arctic*, Center for a New American Security, March 30, 2021, p. 8.

<sup>87</sup> Eugene Rumer, Richard Sokolsky, and Paul Stronski, *Russia in the Arctic—A Critical Examination*, Carnegie Endowment for International Peace, March 29, 2021, pp. 9–10.

<sup>88</sup> Hege Eilertsen, "Four New SAR Centers in the Russian Arctic," trans. Elisabeth Bergquist, *High North News*, February 2, 2018.

<sup>89</sup> Townsend and Kendall-Taylor, 2021, p. 8.

<sup>90</sup> Ministry of Defence of the Russian Federation, 2021c.

<sup>91</sup> Ministry of Defence of the Russian Federation, 2017a.

<sup>92</sup> Ministry of Defence of the Russian Federation, 2020.

<sup>93</sup> Jyri Lavikainen, "Strengthening Russia's Nuclear Forces in the Arctic: The Case of the Kinzhal Missile," Center for Strategic and International Studies, September 14, 2021, p. 1. Also see generally Boulègue, 2019.

### *The Northern Fleet—Russia’s Arctic Defenders*

In 2014, Russia’s Ministry of Defence created the Northern Fleet Joint Strategic Command to defend Russia’s national interests in the Arctic.<sup>94</sup> The basic structure of the Northern Fleet includes the 80th Separate Motorized Rifle Brigade specifically designed to operate in the Arctic environment. The brigade’s equipment includes special armored vehicles with wide tracks and self-propelled howitzers, antiaircraft artillery systems, snowmobiles, Arctic kitchens, bakeries, water supply tanks, and mobile radio communication systems—all capable of operating in the Arctic’s low temperatures and over its harsh terrain.<sup>95</sup> As of February 28, 2020, the Northern Fleet also included a new air defense division formed specifically for the Arctic.

Russia views its airborne capability in the Arctic as a unique advantage of the Northern Fleet. Housed within the Kola Flotilla, Russian Airborne Forces conducted their first mass tactical airborne operation in 2014, dropping forces and military equipment in the Arctic.

More recently, during a workshop in Severomorsk in April 2021, minister of defence General Shoigu remarked that the Northern Fleet was capable of countering existing threats to Russia in the Arctic.<sup>96</sup> Shoigu further noted that the Ministry of Defence “is systematically working to increase the combat capabilities of the Northern Fleet.”<sup>97</sup> Since its creation, the Northern Fleet has gained 23 ships and vessels, including the strategic missile submarine *Yuri Dolgorukiy* and multipurpose nuclear submarine *Severodvinsk*. The missile destroyer *Marshal Ustinov* has been modernized, and efforts are ongoing to modernize the heavy nuclear missile destroyer *Admiral Nakhimov*. Coastal forces also received three divisions of coastal missile defense systems Bal and Bastion. Building the necessary infrastructure for the Arctic Group has been one of the development priorities for Russia’s armed forces, as has ensuring that all Northern Fleet ships and the newly formed Arctic Brigade receive the required combat training to maintain the fleet’s combat readiness in the Arctic’s severe climate conditions.<sup>98</sup>

### *Russia’s Military Activities in the Arctic: Responding to the North Atlantic Treaty Organization Threat*

As noted earlier (in “Opposition to North Atlantic Treaty Organization Countries in the Arctic” earlier in this appendix), Russia views NATO as the primary national security threat in the Arctic, a perception that could intensify given Finnish and Swedish efforts to join the alliance. As a result, much of Russia’s military activity in the Arctic has been in response to this

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<sup>94</sup> Ministry of Defence of the Russian Federation, “Severnii Flot [Northern Fleet],” webpage, undated.

<sup>95</sup> Ministry of Defence of the Russian Federation, “New Snowmobiles Have Arrived in the Arctic Brigade of the Northern Fleet,” January 8, 2021b; Nikanorov, 2020.

<sup>96</sup> Ministry of Defence of the Russian Federation, 2021d.

<sup>97</sup> Ministry of Defence of the Russian Federation, 2021d.

<sup>98</sup> Ministry of Defence of the Russian Federation, undated; Ministry of Defence of the Russian Federation, 2017c; Nikanorov, 2020.

perceived threat. Countering NATO's reconnaissance activities has been one priority for Russia. In 2016, Russia's General Shoigu reported that the Ministry of Defence had observed an increase in reconnaissance activities between 2006 and 2016 from NATO along Russia's perimeter.<sup>99</sup> Specifically, during this time frame, the number of NATO reconnaissance flights along Russia's borders increased by almost three times and by almost eight times along Russia's southwest border, according to the ministry. By comparison, the number of such flights in the 1990s amounted to 107; in the 2000s, it grew to 298; and, in 2016, it grew to 852. In response, the ministry increased its fighter aircraft patrol flights by 61 percent to secure Russia's airspace in the Baltics, the Black Sea, and the Arctic. During 2018, Tupolev Tu-142 and Ilyushin Il-38 antisubmarine aircraft, as well as Sukhoi Su-24MR reconnaissance aircraft, conducted more than 100 patrols in various regions over the Arctic Ocean.<sup>100</sup> In 2019, the ministry announced that the Northern Fleet's naval aviation assets would continue to patrol the Arctic on a regular basis from all-weather airfields in the Arctic islands and Russia's mainland. However, the number of sorties of Russia's patrol aircraft remains well below those recorded during the Cold War.<sup>101</sup> As articulated in our report, a discussion of all-domain awareness, other capabilities, and various threats can be found in the appendix that is not available to the public.

Aside from patrolling the skies to defend Russia's airspace above the Arctic, Russia has engaged in more-active interference in NATO's activities in the region. During NATO's Exercise Trident Juncture 2018, Russian units jammed GPS signals in northern Finland and northern Norway and announced that it would carry out missile tests in the Norwegian Sea during Trident Juncture.<sup>102</sup> GPS jamming is of particular concern to NATO because it also threatens the safe operation of civilian entities. NATO spokesperson Oana Lungescu noted that cyberattacks and electronic warfare have also become more frequent and severe.<sup>103</sup>

### *Russia's Combat Training in the Arctic*

The Northern Fleet has steadily increased the scale and intensity of combat training in the Arctic for its submarines, maritime surface combatants, ground (including marine forces), and air assets and personnel.<sup>104</sup> Russian nuclear submarines first conducted under-ice training in the

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<sup>99</sup> Ministry of Defence of the Russian Federation, 2016.

<sup>100</sup> Ministry of Defence of the Russian Federation, "In 2019, Pilots of the Northern Fleet Will Continue Flights in the Arctic on a Regular Basis," January 1, 2019a.

<sup>101</sup> Boulègue, 2019, pp. 8–9.

<sup>102</sup> 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; Brooks Tigner, "Electronic Jamming Between Russia and NATO Is Par for the Course in the Future, but It Has Its Risky Limits," Atlantic Council, November 15, 2018.

<sup>103</sup> Tigner, 2018.

<sup>104</sup> Baev, 2021.

Arctic in 1960.<sup>105</sup> In 2021, Russia's nuclear submarines attracted worldwide attention again when three simultaneously emerged from under the ice for the first time in the history of both Russian and Soviet fleets.<sup>106</sup>

The last decade of the 20th century and the first decade of the 21st century included Russian bilateral and multilateral exercises with the United States, Japan, Canada, and Norway. These exercises focused on improving coordination and communication among the participants in SAR operations (e.g., disaster evacuation) and other issues in the Far North, such as using another country's equipment with minimal instruction, responding to an incident based on minimal available information, and working with another country without translators.<sup>107</sup> SAR operations continue to play a vital role in Russia's combat training in the Arctic and remain one of the few areas of cooperation between Russia and the United States and Norway. Russia's airborne units in particular, along with Belarus' and Tajikistan's deployment forces, have landed on a piece of drifting ice and set up a base camp complete with sustainable life support during a humanitarian SAR exercise. Figures B.1 through B.3 show the main trends observed in Russia's combat training in the Arctic since 2012.

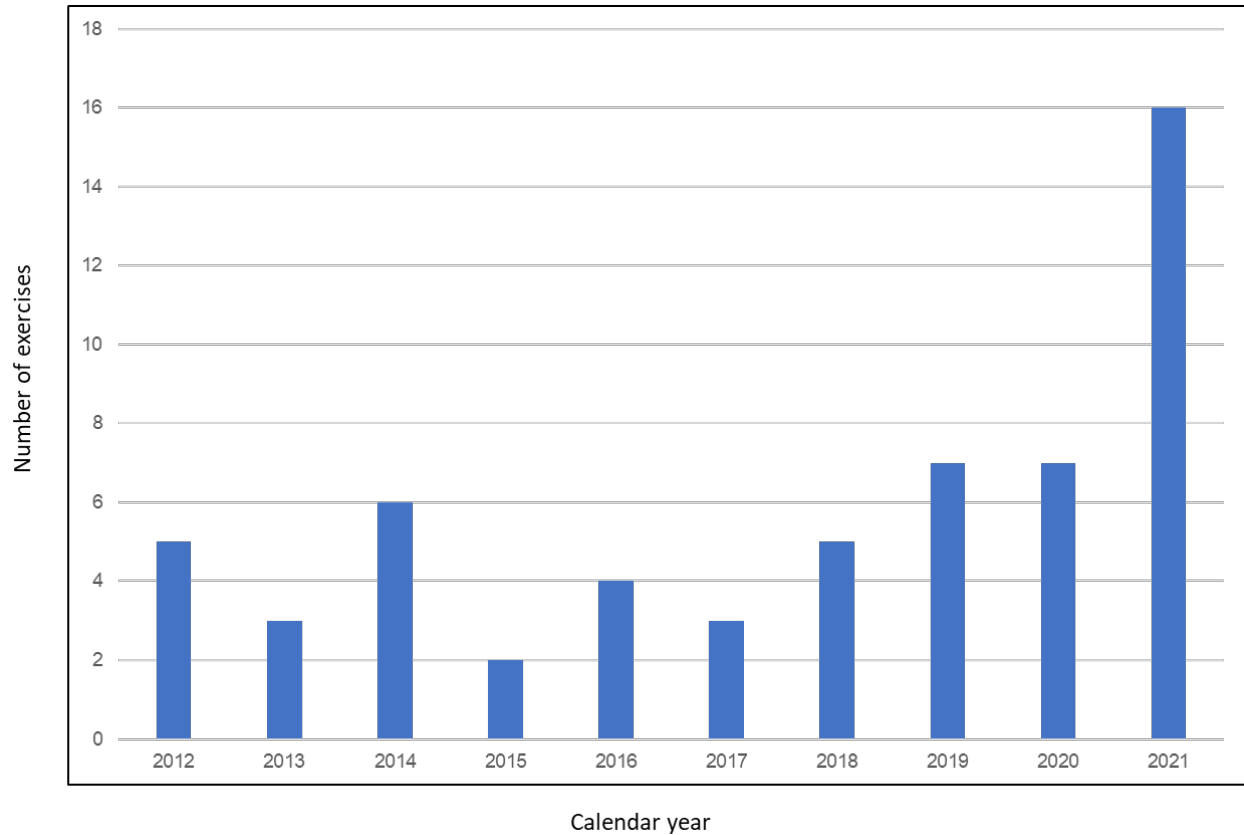
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<sup>105</sup> G. Ryzhonok, "Flotovodets: V Okeanskom Plavanii [Naval Commander: On Ocean Navigation]," *Flag Rodiny* [*Flag of the Motherland*], No. 32, 2000.

<sup>106</sup> Dmitrii Liah, "'Umka' Probivaet Led ['Umka' Breaks the Ice]," *Oborona Rossii* [*Defense of Russia*], No. 4–5, 2021, pp. 44–47.

<sup>107</sup> For example, A. A. Iefremkov, "O Mezhdunarodnom Sotrudnichestve Poiskovo-Spasatel'nyh Sluzhb [About the International Cooperation of Search and Rescue Services]," *Voennaia Mysl'* [*Military Thought*], No. 11, 2003, and "Sovmestnyie Ucheniia v Arktike [Combined Exercises in the Arctic]," *Na Strazhe Zapoliar'ia* [*Guarding the Arctic*], No. 6, 2011.

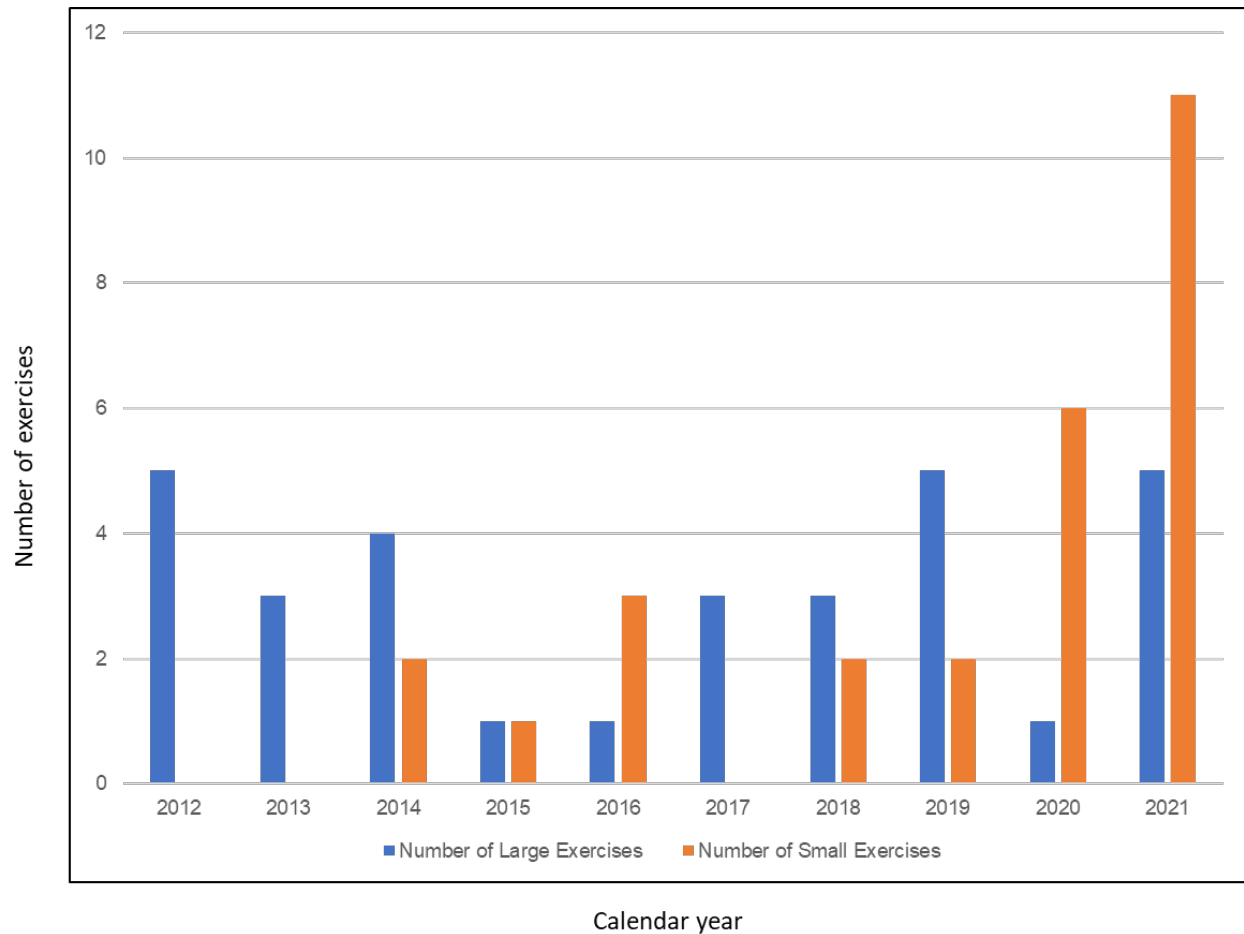
**Figure B.1. Russia's Military Exercises in the Arctic, 2012–2021**



SOURCE: Features data from press releases from the Ministry of Defence of the Russian Federation. We used the ministry's website and an East View Information Services database to identify articles on Russia's combat training and exercises in the Arctic. We included such sources as press releases (e.g., Ministry of Defence of the Russian Federation, "Sily Poiskovo-Spasatel'nogo Obespecheniia Severnogo Flota Vishli v Barentsevo More dlia Uchastiia v Mezhdunarodnom Ucheniia 'Barents-2021' [Search-and-Rescue Forces of the Northern Fleet Went to the Barents Sea to Participate in the International Exercise 'Barents-2021']," June 2, 2021f) and evaluations and assessments of past exercises (V. Vasilenko and S. Subbotin, "Osobyie Zadachi dlia Arkticheskoi Zony [Unique Issues in the Arctic Zone]," *Armeiskii Sbornik [Military Digest]*, No. 5, 2020).

NOTE: We chose the date range 2012 to 2021 because it provided better data fidelity available from public sources. In addition, 2012 was the year the Ministry of Defence drafted the action plan to reform many aspects of Russia's armed forces and has been providing more information about the progress of reform activities since 2012. Finally, more reporting exists for more-recent activity, perhaps because of higher interest and more emphasis on reporting recently for this type of activity.

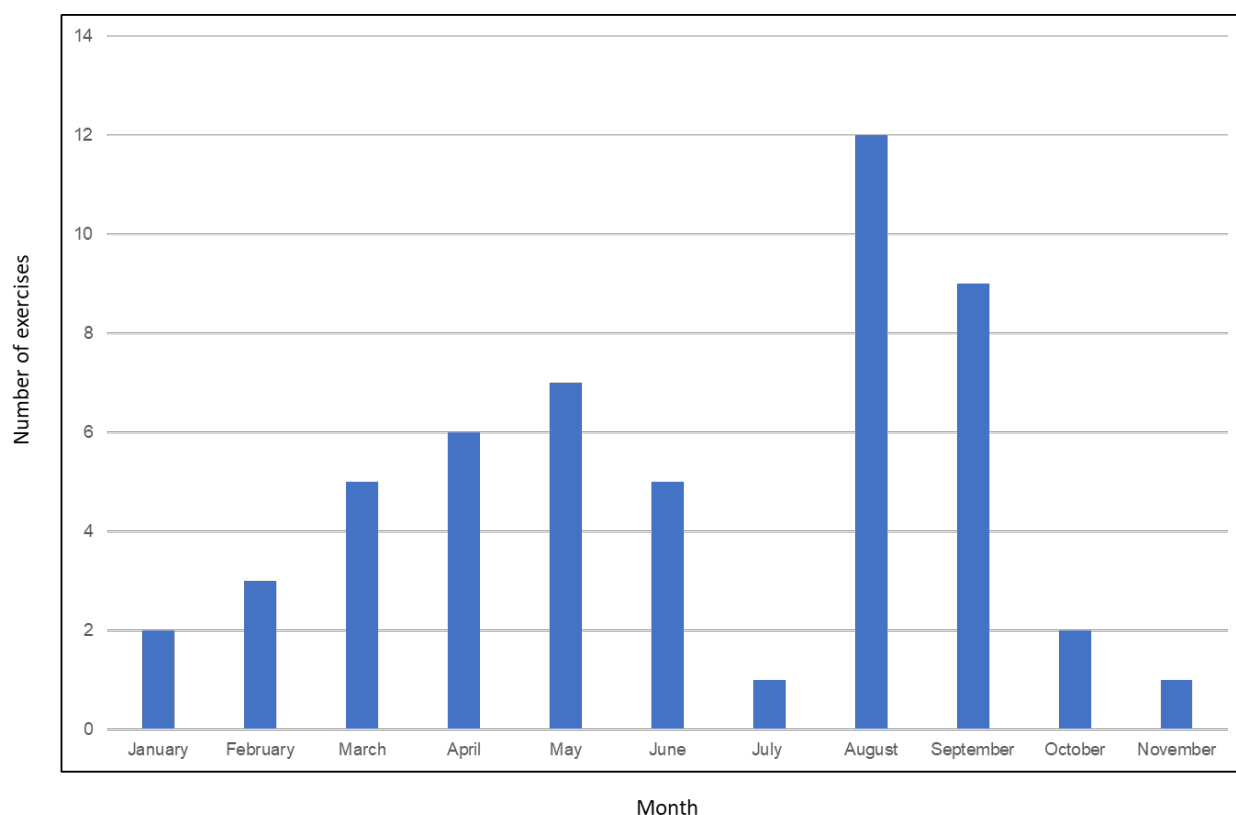
**Figure B.2. Trends in Large and Small Russian Exercises in the Arctic, 2012–2021**



SOURCE: Features data from press releases from the Ministry of Defence of the Russian Federation. We used the ministry's website and an East View Information Services database to identify articles on Russia's combat training and exercises in the Arctic. We included such sources as press releases (e.g., Ministry of Defence of the Russian Federation, 2021f) and evaluations and assessments of past exercises (Vasilenko and Subbotin, 2020).

NOTE: We categorized an exercise as large if it was of strategic nature (e.g., Zapad 2017 or annual Arctic strategic exercise of the Northern Fleet) or was identified as "large-scale" or "strategic" in the press release. We categorized an exercise as small if it was tactical in nature (e.g., live-fire missile training exercises).

**Figure B.3. Monthly Russian Exercise Activity in the Arctic, 2012–2021**



SOURCE: Features data from press releases from the Ministry of Defence of the Russian Federation. We used the ministry’s website and an East View Information Services database to identify articles on Russia’s combat training and exercises in the Arctic. We included such sources as press releases (e.g., Ministry of Defence of the Russian Federation, 2021f) and evaluations and assessments of past exercises (Vasilenko and Subbotin, 2020).

NOTE: Most large exercises, such as the Northern Fleet’s annual trips to the Arctic that lasted two to three months, included multiple exercises conducted by Northern Fleet units on land and at sea. We counted these instances together as one major exercise.

### Combat Training Trend 1: Russia’s Fluctuating Relationship with Norway

Russia experiences an oscillating relationship with Norway. Russia and Norway have been conducting bilateral and multilateral training exercises since 1995 (e.g., Barents, Pomor, Northern Eagle, Arctic). This relationship paused between 2014 and 2017, following Russia’s annexation of Crimea, and resumed with Exercise Barents 2017, a SAR exercise. Since 2017, Russia has been routinely simulating air-wing attacks on Norwegian military assets, primarily against the coastal radar installations in Vardø, which are funded by the United States. According to Russian Foreign Ministry spokesperson Maria Zakharova, the information the radar obtains “is beamed to the U.S.”—specifically, the missile defense system.<sup>108</sup> Most recently, Russia

<sup>108</sup> Ministry of Foreign Affairs of the Russian Federation, “Briefing by Foreign Ministry Spokesperson Maria Zakharova, Moscow,” May 23, 2019; Tom O’Connor, “Russia Will ‘Take Measures’ Against U.S. Radar Near Its Border, Thought to Be Part of Missile Defense,” *Newsweek*, May 23, 2019.



participated in Exercise Barents 2021 with Norway's joint rescue coordination center, air patrol, and airspace C2 forces. The exercise focused on coordinating activities to search for and rescue those in distress at sea, as well as preventing oil pollution of the sea during intensive industrial development of the Arctic.<sup>109</sup> Russia and Norway had planned to hold the exercise again in 2022.<sup>110</sup> It is unclear how this relationship will move forward, given Russia's actions in Ukraine since 2022.

### Combat Training Trend 2: Expanding to Large-Scale Exercises and Out-of-Port Trips

Since about 2012, Russia's combat training in the Arctic has increasingly involved large-scale exercises and routine trips to the Arctic territories conducted by the Northern Fleet. Russia conducted its first large-scale amphibious assault landing on the unequipped coast of the Kotelny Island.<sup>111</sup> A year later, the Northern Fleet embarked on its first trip to the Arctic to exercise defending Russia's territories from terrorist threats and human-caused disasters.<sup>112</sup>

The Northern Fleet has undertaken such trips every year since 2013 and increased the scope of the exercises during these trips. An exercise in 2015 involved 1,000 personnel, 14 aircraft, and 34 pieces of special and military equipment; an exercise in 2021 involved 8,000 personnel and 800 pieces of equipment.<sup>113</sup>

### Combat Training Trend 3: Emphasizing Joint, Realistic Training

Furthermore, the Northern Fleet has notably emphasized joint training with units from other military districts and commands and realistic training with modern weapons and equipment suitable for the Arctic environment. In 2015, the Northern Fleet's Russian Airborne Forces and Arctic Brigade units conducted amphibious landing, raids, and reconnaissance in "unknown territory" in the Arctic based on realistic training scenarios.<sup>114</sup> The Kola Flotilla has conducted a first-of-its-kind joint command staff exercise to respond to crisis situations in the Arctic.<sup>115</sup> Other joint exercises included units from the western and central military districts and the Russian Geographical Society.<sup>116</sup>

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<sup>109</sup> Ministry of Defence of the Russian Federation, 2021f.

<sup>110</sup> Ministry of Defence of the Russian Federation, "Severnii Flot Prodolzhit Vzaimodeistviie s Norvegiei v Oblasti Spaseniia na More [Northern Fleet will Continue to Cooperate with Norway in the Area of Rescue at Sea]," December 29, 2021h.

<sup>111</sup> Nikanorov, 2020.

<sup>112</sup> "Ofitsial'nyi Otdel [Official Department]," *Morskoi Sbornik [Naval Bulletin]*, No. 10, October 31, 2015.

<sup>113</sup> "Ofitsial'nyi Otdel," 2015; "Sluzhba Informatsii [Press Service]," *Na Strazhe Zapoliar'ia [Guarding the Arctic]*, No. 31, August 13, 2021.

<sup>114</sup> "Ofitsial'nyi Otdel," 2015.

<sup>115</sup> Ministry of Defence of the Russian Federation, 2021c.

<sup>116</sup> For example, Vladimir Mukhin, "The Northern Fleet Prepares for Defense of Taimyr Peninsula," *Nezavisimaya Gazeta [Defense and Security]*, No. 167, August 7, 2020.

The Northern Fleet has also conducted groundbreaking training with new specialty equipment and weapon systems in harsh climate conditions. During Exercise Barents 2017, the fleet's SAR forces exercised cleaning up an accidental oil spill for the first time using a new autonomous high-capacity drainage system.<sup>117</sup> A year later, during the same exercise (Exercise Barents 2018), the Bastion coastal defense system participated in an Arctic exercise for the first time.<sup>118</sup> Exercise Barents 2018 was also the first time the multipurpose icebreaker *Ilya Muromets* took part in a SAR activity in the Barents Sea.<sup>119</sup>

#### Combat Training Trend 4: Ensuring Security Along the Northern Sea Route

Since about 2018, combat training in the Arctic has also focused on ensuring secure passage through the NSR. Northern Fleet ships have coordinated with the Coast Guard of the Border Service of the FSB during several exercises, with the objective of ensuring security along the NSR.<sup>120</sup> More recently, the border directorate for Russia's western Arctic region also participated in the Northern Fleet's strategic exercise to defend traffic along the NSR.<sup>121</sup> Exercise scenarios involved apprehending vessels violating shipping regulations in the NSR, defending ships from terrorist attacks as they transited the NSR, and practicing freedom of navigation through the NSR.

### China's Arctic Policy

Although China has no territory or any territorial claims in the Arctic, it became an Arctic Council observer state in 2013, and its "rise as a polar power has been dramatic and rapid."<sup>122</sup> China first described itself as a "near-Arctic state" in 2012.<sup>123</sup> In 2018, China published its first-ever Arctic policy, known also as China's Arctic white paper.<sup>124</sup> The United States later

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<sup>117</sup> Aleksandr Paniushkin, "Terpiashchiie Bedstviie Spaseniy [The Disaster-Stricken Have Been Rescued]," *Na strazhe Zapoliar'ia* [Guarding the Arctic], No. 21, June 9, 2017.

<sup>118</sup> "Uspeshnyi Debiut [Successful Start]," *Strazh Baltiki* [Guarding the Baltics], No. 37, September 28, 2018.

<sup>119</sup> Ministry of Defence of the Russian Federation, "Sily Poiskovo-Spasatel'nogo Obespecheniia Severnogo Flota Primut Uchastiie v Sovmestnom Rossiisko-Norvezhskom Uchenii 'Barents-2018' [Search-and-Rescue Forces of the Northern Fleet Will Participate in a Joint Russian-Norwegian Exercise 'Barents-2018']," May 16, 2018b.

<sup>120</sup> Alexandr Iakovlev, "Iz Arktiki s Liubov'iu [From the Arctic with Love]," *Na Strazhe Zapoliar'ia* [Guarding the Arctic], No. 38, October 4, 2019.

<sup>121</sup> Ministry of Defence of the Russian Federation, "BPK 'Severomorsk' i PSK 'Poliarnaia Zvezda' Proveli v Arktike Sovmestnoie Uchastiie [Long-Distance Carrier 'Severomorsk' and Border Patrol Ship 'Poliarnaia Zvezda' Conducted a Joint Exercise in the Arctic]," August 16, 2021g.

<sup>122</sup> Mia M. Bennett, "North by Northeast: Toward an Asia-Arctic Region," *Eurasian Geography and Economics*, Vol. 55, No. 1, 2014, p. 77; Anne-Marie Brady, *China as a Polar Great Power*, Woodrow Wilson Center Press with Cambridge University Press, 2017, p. 3; State Council of the People's Republic of China, "Full Text: China's Arctic Policy," January 26, 2018.

<sup>123</sup> Sacks et al., 2021, p. 2.

<sup>124</sup> State Council of the People's Republic of China, 2018.

criticized China's self-description as a near-Arctic state when then-Secretary of State Mike Pompeo stated before the Arctic Council ministerial in May 2019, "There are only Arctic States and Non-Arctic States. No third category exists and claiming otherwise entitles China to exactly nothing."<sup>125</sup> China, however, sees that the polar regions will have "significant influence over the ecology, marine biology, economics and trade" in China's future and views the Arctic as a global, not a regional, issue.<sup>126</sup>

China's Arctic policy rests on five objectives:

1. Deepening the exploration and understanding of the Arctic
2. Protecting the eco-environment of the Arctic and addressing climate change
3. Utilizing Arctic Resources in a Lawful and Rational Manner
4. Participating Actively in Arctic governance and international cooperation
5. Promoting peace and stability in the Arctic Conclusion.<sup>127</sup>

China's Arctic strategy explicitly recognizes the Arctic states and their maritime territorial zones, contiguous zones, and EEZs in the Arctic. As an observer in the Arctic Council, China recognizes the applicability of UNCLOS in the Arctic.<sup>128</sup> China also ratified the 1920 Svalbard Treaty in 1925.<sup>129</sup> As a member of IMO, China participated in the development of the Polar Code, although its involvement was limited.<sup>130</sup> Finally, it was one of nine countries (plus the EU) that signed CAOFA, which placed a moratorium on such fishing until 2037.<sup>131</sup>

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<sup>125</sup> Pompeo, 2019. Using a term it might have borrowed from the UK, China uses *near-Arctic state* to refer to a state close to the Arctic Circle. See Rush Doshi, Alexis Dale-Huang, and Gaoqi Zhang, *Northern Expedition: China's Arctic Activities and Ambitions*, Brookings Institution, April 2021, pp. 2, 15; Sacks et al., 2021, p. 2; and Select Committee on the Arctic, UK Parliament, "Chapter 6: The UK and the Arctic," *Responding to a Changing Arctic: Report of Session 2014–15*, 2015. Also see Pompeo, 2019, and State Council of the People's Republic of China, 2018.

<sup>126</sup> "极地未来对中国影响重大 – 专访中国海洋大学极地问题专家郭培清 [The Future of the Polar Regions Will Have a Significant Impact on China: Interview with Guo Peiqing, an Expert on Polar Issues at Ocean University of China]," 上海市科学技术协会 [Shanghai Association for Science and Technology], July 10, 2008; State Council of the People's Republic of China, 2018.

<sup>127</sup> State Council of the People's Republic of China, 2018.

<sup>128</sup> This is listed as one of the criteria for admitting observers issued by the Arctic Council. See Arctic Council, "Arctic Council Observers," webpage, undated-a.

<sup>129</sup> Nengye Liu, "China and One Hundred Years of the Svalbard Treaty: Past, Present and Future," *Marine Policy*, Vol. 124, February 2021.

<sup>130</sup> Trym Aleksander Eiterjord, "Arctic Technopolitics and China's Reception of the Polar Code," Arctic Council, May 26, 2020b.

<sup>131</sup> Directorate-General for Maritime Affairs and Fisheries, European Commission, "Arctic: Agreement to Prevent Unregulated Fishing Enters into Force," news announcement, June 25, 2021.

Furthermore, climate change—notably, its impact on commercial shipping and its prospect through the Arctic due to melting sea ice—has spurred China’s ambitions in this region.<sup>132</sup> China’s Arctic policy begins by describing the changes that “global warming” (climate change) has caused in the Arctic region and explains that melting sea ice could offer “opportunities for the commercial use of sea routes and development of resources in the region.” It underscores the fact that commercialization of the Arctic could have economic, social, and environmental implications for all international actors and calls for “rational use of the region” and “international cooperation” in the “exploration for and utilization of Arctic resources by making the best use of [countries’] advantages in capital, technology, and domestic market[s].”<sup>133</sup>

China is especially interested in the development of and international cooperation across Arctic shipping routes. Free and unfettered access to the region is critical to China’s ambitions that picture the Arctic as part of a Polar Silk Road—under the umbrella of China’s BRI. China’s Arctic policy paints the BRI as an “important cooperation initiative” for Chinese industries to emulate in the Arctic by developing Arctic infrastructure that would help develop the Polar Silk Road.<sup>134</sup>

Furthermore, China has deep interests in developing and accessing Arctic resources. Its Arctic policy acknowledges the “sovereign rights of Arctic states over oil, gas and mineral resources in the areas subject to their jurisdiction” and invites Chinese companies to “participate in the exploitation of oil, gas and mineral resources in the Arctic, through cooperation and on the condition of protecting the eco-environment of the Arctic.”<sup>135</sup>

China’s interests in Arctic resources further encompass the region’s fisheries. China actively participated in the negotiation of CAOFA, and its Arctic policy is careful to underscore balancing “enjoying [China’s] lawful right to conduct fisheries research and development in the high seas” with conservation and responsible use of Arctic fisheries.<sup>136</sup> Additionally, China has highlighted that maintaining this balance is an international responsibility and calls for a “legally binding international agreement on the management of fisheries,” including the “establishment of an Arctic fisheries management organization.”<sup>137</sup> This thinking is in line with CAOFA

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<sup>132</sup> Stephanie Pezard, Stephen J. Flanagan, Scott W. Harold, Irina A. Chindea, Benjamin J. Sacks, Abbie Tingstad, Tristan Finazzo, and Soo Kim, *China’s Strategy and Activities in the Arctic: Implications for North American and Transatlantic Security*, RAND Corporation, RR-A1282-1, 2022.

<sup>133</sup> State Council of the People’s Republic of China, 2018.

<sup>134</sup> State Council of the People’s Republic of China, 2018.

<sup>135</sup> State Council of the People’s Republic of China, 2018.

<sup>136</sup> State Council of the People’s Republic of China, 2018.

<sup>137</sup> State Council of the People’s Republic of China, 2018.

Article 13(3), which includes the possibility of establishing such an organization after the treaty's expiration in 2034.<sup>138</sup>

Climate change similarly drives China's interest in developing the Arctic's tourism industry. The melting of ice and snow in the region have given rise to Arctic tourism because accessing the area is easier and demand for so-called last-chance or extinction tourism has increased.<sup>139</sup> China's Arctic policy recognizes that China is an important provider of Arctic tourists and "encourages its enterprises to cooperate with Arctic States in developing tourism in the region,"<sup>140</sup> which can also advance Chinese economic interests.

Overall, China's policy goals in the Arctic promote active participation in the region's international governing activities and free and equal access to its resources, shipping routes, and scientific research and economic development opportunities. Because China is not a voting member of the Arctic Council (it is, along with several other countries, an observer state) but understands the council's geopolitical and economic importance, China remains sensitive to the fact that the governance of Arctic affairs has been "dominated by certain Western powers and Russia."<sup>141</sup> As a result, China's policy also hints at strategies to increase Chinese participation in Arctic governance.<sup>142</sup> As with the Polar Silk Road initiative, the policy further calls for collaboration in Arctic development matters across sectors, especially in transportation, infrastructure, and resource development, and stresses that such collaboration will lead to a "win-win result" in which Arctic "benefits are shared by Arctic and non-Arctic states as well as by nonstate entities, and should accommodate the interests of local residents including the indigenous peoples."<sup>143</sup>

### *Increasing Access to the Arctic Through International Partnerships*

As a non-Arctic state, China's air, maritime, and subsurface domain awareness in the region is limited. As a result, China is actively working to develop and mature its regional presence through several avenues: scientific research, construction of ground stations that support satellite monitoring, and economic investments in various projects. These means are also part of China's

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<sup>138</sup> Agreement to Prevent Unregulated High Seas Fisheries in the Central Arctic Ocean, Can.–Ice.–Den.–Nor.–U.S.–Russ.–China–Japan–S. Kor.–European Union, October 3, 2018, p. 11. Also see Nong Hong, *China's Role in the Arctic: Observing and Being Observed*, Routledge, 2020, pp. 22–24.

<sup>139</sup> See, for example, Aurora D'Aprile, "Arctic Tourism: How the Great North Is Becoming the New Exotic," *Foresight*, August 21, 2018.

<sup>140</sup> State Council of the People's Republic of China, 2018.

<sup>141</sup> 孙凯 [Sun Kai] and 武珺欢 [Wu Junhuan], "北极治理新态势与中国的 深度参与战略 [The New Situation of Arctic Governance and China's Deep Participation Strategy]," 国际展望 [Global Review], No. 6, 2015.

<sup>142</sup> 程保志 [Cheng Baozhi], "试析北极理事会的功能转型与中国的应对策略 [On the Functional Transformation of the Arctic Council and China's Countermeasures]," 国际论坛 [International Forum], Vol. 15, No. 3, 2013; Sun Kai and Wu, 2015.

<sup>143</sup> State Council of the People's Republic of China, 2018.

strategy to increase domain awareness in the Arctic. Through these means, China is aiming to develop into an “Arctic Great Power.”<sup>144</sup> In the rest of this section, we present China’s cooperation with Arctic states other than Russia and the United States to introduce the broader discussions that will follow on China’s geopolitical and economic ambitions and to complement the analysis of China’s dynamics with the United States and Russia. We also note that China’s engagement with Arctic states has changed since the 2022 intensification of the war in Ukraine. Generally speaking, ties with Russia are growing stronger, and some types of engagement with other Arctic states have decreased (in some cases, they had done so even prior to 2022).

#### China's Cooperation with Canada: Scientific Research, Energy Investments, and Infrastructure Development

China participates in several nonmilitary Arctic activities that have garnered attention owing to their relative size and scale. China possesses two *Xue Long*-class icebreakers (the *Xue Long* and the *Xue Long 2*), which it uses for scientific research.<sup>145</sup> The *Xue Long* has undertaken several Arctic expeditions that have tested the NSR’s potential as a trading route.<sup>146</sup> In 2017, the *Xue Long* traversed the NWP with Chinese and Canadian scientists onboard, prompting concerns by some Arctic experts that China had obtained important intelligence about the NWP’s geography and navigation.<sup>147</sup> Although Canadian officials insisted that the transit was purely for scientific research, Chinese officials announced that it marked the opening of a new trade route and part of China’s Polar Silk Road program.<sup>148</sup> China plans to construct at least one new heavy icebreaker and potentially a nuclear icebreaker in the next decade.<sup>149</sup> Furthermore, China maintains two permanent scientific research stations in the Arctic: the Yellow River station and the China Iceland Arctic Research Observatory (CIAO).<sup>150</sup> As a signatory of the 1920 Svalbard (Spitzbergen) Treaty, in 2004, China exercised its privilege to establish the Yellow River research station at Ny-Ålesund, Svalbard,<sup>151</sup> and, in 2012, it “negotiated with Iceland to set up a

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<sup>144</sup> 赵洋 [Zhao Yang], “身份叙事与中国参与北极事务身份建构 [Identity Narrative and the Construction of China’s Identity in Arctic Affairs],” 东北亚论坛 [Northeast Asia Forum], Vol. 1, 2022.

<sup>145</sup> Yun Sun, “Defining the Chinese Threat in the Arctic,” Center for Circumpolar Security Studies, Arctic Institute, April 7, 2020.

<sup>146</sup> Heljar Havnes and Johan Martin Seland, “The Increasing Security Focus in China’s Arctic Policy,” Center for Circumpolar Security Studies, Arctic Institute, webpage, July 16, 2019.

<sup>147</sup> Adam Taylor, “China Sent a Ship to the Arctic for Science. Then State Media Announced a New Trade Route,” *Washington Post*, September 13, 2017.

<sup>148</sup> Taylor, 2017.

<sup>149</sup> Malte Humpert, “China Looking to Expand Satellite Coverage in Arctic, Experts Warn of Military Purpose,” *High North News*, September 4, 2019.

<sup>150</sup> Brady, 2017, pp. 149–150.

<sup>151</sup> Trym Aleksander Eiterjord, “The Geopolitics of Chinese Arctic Research,” Max Planck Institute for the History of Science, Lise Meitner Research Group: China in the Global System of Science, c. 2020a.

second Arctic research station, on 158 hectares of farmland not far from the northern Icelandic port town of Akureyri.”<sup>152</sup>

China has also made some economic inroads into the Canadian Arctic. It owns the Nunavik Nickel mine and is invested in the proposed Lac Otelnuk mine and Izok Corridor Project’s zinc and copper mine.<sup>153</sup> The Izok project requires the development of Grays Bay Road and Port Project. Nunavut Tunngavik and Canada’s National Trade Corridors Fund had committed a total of CAD 28.75 billion (USD 21.0 billion) by August 2019.<sup>154</sup>

Chinese telecommunication equipment company Huawei also works with the Canadian Arctic’s telecommunication networks.<sup>155</sup> Canada has become considerably warier of Chinese investments since 2018, when it detained Huawei chief financial officer Meng Wanzhou for three years at the request of U.S. authorities seeking her extradition on charges of bank fraud and violation of U.S. sanctions on Iran.<sup>156</sup> China responded by detaining two Canadian nationals, Michael Spavor and ex-Canadian diplomat Michael Kovrig.<sup>157</sup> They were released soon after Canada released Meng in 2021. Citing national security concerns, Canada blocked Chinese investment in a gold mine located approximately 100 km from a NORAD early-warning station in Cambridge Bay, Nunavut.<sup>158</sup> Note that, since the intensification of the war in Ukraine in 2022 and other global events, ties between Canada and China have cooled somewhat.

#### China’s Cooperation with Iceland: Energy Investments, Scientific Exploration, and Shipping Routes

Iceland and China have been cooperating on geothermal energy projects, polar science and education, and infrastructure and port construction for more than 40 years.<sup>159</sup> Since about 2011, Chinese and Icelandic companies have been developing joint geothermal projects to build “low-carbon” cities in China using Icelandic terrestrial-heat technology.<sup>160</sup> In 2012, China signed a

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<sup>152</sup> Brady, 2017, p. 150.

<sup>153</sup> Michael Byers and Emma Lodge, “China and the Canadian Arctic,” in John Higginbotham and Jennifer Spence, eds., *Canada’s Arctic Agenda: Into the Vortex*, Centre for International Governance Innovation, September 26, 2019, p. 104.

<sup>154</sup> MMG, “Izok Corridor,” webpage, undated.

<sup>155</sup> Huawei Technologies, “Connecting Canada’s North,” webpage, undated; Jeremy Luedi, “Northern Canada Could Be Left Out in the Cold If Ottawa Passes Huawei 5G Ban,” CBC News, March 2, 2020.

<sup>156</sup> James Durso, “Canada: Won’t Get Fooled Again?” *The Hill*, October 4, 2021.

<sup>157</sup> Cameron Jenkins, “Canadian Businessman Sentenced to 11 Years in Chinese Prison,” *The Hill*, August 11, 2021.

<sup>158</sup> Robert Fife and Steven Chase, “Top Defence Official Says China Is a Threat to Canadian Arctic,” *Globe and Mail*, March 10, 2021, updated March 11, 2021; Steven Frank, Kait Bolongaro, and Stephen Wicary, “Trudeau Shuts Out China Again by Rejecting Arctic Gold Deal,” Bloomberg, December 22, 2020; Alexandra Stevenson, “Canada Blocks Chinese Takeover on Security Concerns,” *New York Times*, May 23, 2018.

<sup>159</sup> Ragnar Baldursson, “Iceland Targets China’s Geothermal Energy Market,” *China Daily*, updated March 7, 2011; Yang Jian, “China’s Economic Initiatives in the Arctic,” *Global Asia*, Vol. 15, No. 4, December 2020.

<sup>160</sup> Baldursson, 2011; Jian, 2020.

framework agreement with Iceland to support greater cooperation in this field, as well as in marine and polar science.<sup>161</sup> In 2018, China opened CIAO near Karholl, Iceland, reflecting warming Sino–Icelandic ties at that time.<sup>162</sup> Finally, Iceland too sees the benefits of emerging shipping routes in the Arctic that would shorten the distance between China and U.S. and European economies and turn Iceland into a potential North American east Arctic shipping hub, especially for traffic through the central Arctic route that China has been eyeing.<sup>163</sup> As such, Iceland remains open to future cooperation with both China and the United States as important global economies,<sup>164</sup> although the impact of the intensification of the Ukraine war in 2022 remains to be seen.

#### China's Cooperation with Sweden: Satellite Monitoring

Since 2017, China has operated a satellite monitoring station at Kiruna, Sweden. This station was ostensibly designed to support China's Gaofen remote sensing system.<sup>165</sup> In 2019, however, the Swedish Defence Research Agency articulated its concern that "the ostensibly civilian cooperation with China could, in fact, be controlled by the PLA and used to supplement military surveillance of the Arctic region with implications for Sweden's national security."<sup>166</sup>

#### China's Cooperation with Greenland: Satellite Monitoring, Airport Access, and Mineral Mining

Observers of China's activities in Europe have also noted that China "discreetly" tried to establish a similar satellite monitoring ground station in collaboration with the Greenland Institute of Natural Resources in 2017.<sup>167</sup> Relatively little is known about these efforts. However, China's attempt to establish such a facility underscores the country's ambitions in the region.

In 2019, China conducted its third field test exploring how to improve terrestrial and satellite communications for its Beidou (Big Dipper) GPS throughout the NSR. Officially, China has stated that this study was intended to determine communication quality for Chinese commercial

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<sup>161</sup> Jian, 2020.

<sup>162</sup> International Network for Terrestrial Research and Monitoring in the Arctic, "China Iceland Arctic Research Observatory," webpage, undated. On warming China–Iceland relations, see David Auerswald, "China's Multifaceted Arctic Strategy," *War on the Rocks*, May 24, 2019a.

<sup>163</sup> Baldursson, 2011; Jian, 2020.

<sup>164</sup> Jian, 2020.

<sup>165</sup> Space Science Data Coordinated Archive, National Aeronautics and Space Administration, "Gaofen 5," webpage, version 5.1.12, October 28, 2021.

<sup>166</sup> Jana Robinson, "Arctic Space Challenge for NATO: Emerging from China's Economic and Financial Assertiveness," *Journal of the Joint Air Power Competence Centre*, Vol. 30, Spring–Summer 2020, p. 37.

<sup>167</sup> Jichang Lulu, "Greenland: China Discreetly Launches Satellite Ground Station Project," blog post, December 14, 2017.



vessels transiting the NSR, although some commentators pointed that improved communications could also have military applications.<sup>168</sup>

Greenland has so far successfully avoided China's efforts to establish a large presence in the country. In 2019, Greenland rejected China's two-year effort to fund the development of three Greenlandic airports, including a new international airport, following sustained engagement with the United States and Denmark.<sup>169</sup> Greenland's government was reluctant to fund the airports, and its prime minister flew to Beijing in 2017 to ask Chinese state-run banks to finance the project. During the next two years, Greenland's government would collapse and the United States would enlist the help of Danish officials to turn the tide of this effort. As a result, the Danish government provided loans for two of Greenland's airports, and Greenland financed the third.<sup>170</sup>

The April 2021 election of a Greenlandic government that supported "environmentally responsible mining" might have further complicated China's plans for expanded activities in Greenland.<sup>171</sup> Prime minister Múte B. Egede's administration has paused development of the Kuannersuit (also known as Kvanefjeld) mine, banned uranium mining, and withdrawn the license of General Nice Development, a Chinese state-owned enterprise, to mine the Isua iron ore field near Greenland's capital, Nuuk.<sup>172</sup> At the same time, the two parties in the governing coalition—Inuit Ataqatigiit and Simuit—are both dedicated to independence for Greenland from Denmark, and this could be beneficial for Beijing in that Copenhagen has stymied some of China's past ambitions to develop influence in Greenland.<sup>173</sup>

#### China's Cooperation with Finland: Air Transportation Routes, Satellite Monitoring, and Shipping Technology

Finland has served as an air hub between the Nordic nations and East Asia for many years. Its Helsinki-Vantaa Airport currently serves six destinations in greater China with direct scheduled flights, more than any other Nordic airport.<sup>174</sup> With this foundation, China wanted to buy an airport in Finland to establish a joint "Research Center for Arctic Space Observations and

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<sup>168</sup> "FOI Warns of Swedish Space Cooperation with China," Sveriges Television News, January 13, 2019; Humpert, 2019.

<sup>169</sup> Drew Hinshaw and Jeremy Page, "How the Pentagon Countered China's Designs on Greenland," *Wall Street Journal*, February 10, 2019; Michael Paul, "Greenland's Project Independence," *Stiftung Wissenschaft und Politik*, No. 10, January 28, 2021, p. 2.

<sup>170</sup> Hinshaw and Page, 2019.

<sup>171</sup> Jacob Gronholt-Pedersen, "Greenland Strips Chinese Mining Firm of Licence to Iron Ore Deposit," Reuters, November 22, 2021b.

<sup>172</sup> Gronholt-Pedersen, 2021b.

<sup>173</sup> Jacob Gronholt-Pedersen, "Greenland's New Coalition Partner Won't Seek Changes to Uranium Ban," Reuters, April 4, 2022.

<sup>174</sup> Jian, 2020.

Data Sharing” in Sodankylä, Finland, to conduct climate research flights to collect data on Arctic conditions.<sup>175</sup> However, this pursuit halted in March 2021, when Finland’s military blocked China’s bid.<sup>176</sup>

China is one of the main markets for the export of Finnish Arctic shipping technology.<sup>177</sup> In 2012, the Finnish shipbuilder Aker Arctic provided the concept and basic design for the *Xue Long 2* and called the ship “the world’s most advanced polar research vessel.”<sup>178</sup> This PC3 icebreaker entered service in 2019.<sup>179</sup>

#### China’s Cooperation with Norway: Environmental Protection, Fisheries, Oil and Gas Exploitation, and Shipping Routes

Norway is an important economic and maritime power in the Arctic and has engaged with China on several efforts. Chinese equipment manufacturing companies have helped Norwegian oil companies build large offshore oil drilling platforms.<sup>180</sup> Applying the same engineering principle, one of China’s major state-owned shipbuilders (China Shipbuilding Industry Corporation) helped Norway build an offshore aquaculture farm.<sup>181</sup> This facility can also serve as a gateway into the European market for Chinese manufacturers as part of the BRI.<sup>182</sup> Finally, Norway hosts the closest western port to Asia accessible through the NSR. Political representatives of Kirkenes, Norway, visited China in 2018 to discuss the future demand of China’s shipping industry for Arctic ports and to assure China that Norway continued to support opening the NSR to Chinese shipping companies.<sup>183</sup>

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<sup>175</sup> Thomas Nilsen, “Finland’s Military Blocked a Chinese Bid to Buy an Arctic Airport for Climate Research Flights,” *Arctic Today*, March 5, 2021a; Robinson, 2020, p. 38.

<sup>176</sup> Nilsen, 2021a.

<sup>177</sup> Jian, 2020.

<sup>178</sup> Malte Humpert, “China Launches Domestically-Built ‘Xue Long 2’ Icebreaker,” *High North News*, September 11, 2018.

<sup>179</sup> Jian, 2020.

<sup>180</sup> China International Marine Containers, “Offshore,” webpage, undated; Jian, 2020.

<sup>181</sup> Jian, 2020; Zhong Nan and Liu Kun, “Norway’s Fish Industry Gets Chinese Boost,” *China Daily*, updated June 5, 2017; Brian Wang, “First Ocean Fish Farm Raising 1.5 Million Salmon Three Miles Off Norway,” *Next Big Future*, August 7, 2018.

<sup>182</sup> Nan and Kun, 2017.

<sup>183</sup> Jian, 2020; Atle Staalesen, “Kirkenes Port Developers Put Their Faith in the Chinese,” *Barents Observer*, June 7, 2019.

### *Drivers of China's Interest and Activities in the Arctic*

In the past decade and a half, China has consistently worked to gain a foothold in Arctic affairs.<sup>184</sup> Because China possesses no sovereign territory and the corresponding sovereign rights to fish and extract resources in the Arctic, this claim was frowned on by most of the countries in the region, which, by virtue of their geography, population, politics, and culture, have a direct and longstanding connection to the Arctic.<sup>185</sup> China based its claim to be a near-Arctic state on being a signatory party to the 1920 Svalbard Treaty, which gives all signatories equal rights to trade on the islands, and on its history of presence and involvement in conducting scientific research in the Arctic region.<sup>186</sup> As a result of lacking sovereign territory in the Arctic region, China has been working harder to manage growing Arctic interests within existing legal and policy frameworks.<sup>187</sup>

As we introduced earlier, China indicated in its 2018 Arctic policy that its interests in the region extend beyond scientific research and include economic aspects, such as the building of a Polar Silk Road that would link China to Europe through the Arctic.<sup>188</sup> The use of the Arctic as an alternative to the Strait of Malacca represents a potentially attractive alternative shipping route for China, given the shorter transit times and lower piracy-related risks.

Some have estimated that China took approximately a decade to become an actor with stakes in the region, mainly as a result of its economic activities and involvement in climate- and environment-related governance issues.<sup>189</sup> In general, in recent years, China has tried to become involved in a wide variety of governance issues in the Arctic as a way to gain a foot in the door, build its legitimacy as a stakeholder, and gain influence, with geopolitics also playing a role in China's presence and activities in the region.<sup>190</sup> Overall, China's interest and activities in the Arctic, including its claim as a near-Arctic state, are driven mainly by geopolitical and economic considerations, with domestic politics playing a more indirect role than in Russia's case. Although domestic considerations (i.e., the need to feed its large population and use the narrative of China's global expansion to maintain domestic control) are not to be neglected, they feed directly into the geopolitical and economic factors driving China's interest and activities in the

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<sup>184</sup> Gisela Grieger, "China's Arctic Policy: How China Aligns Rights and Interests," European Parliamentary Research Service, briefing, PE 620.321, May 2018, p. 1; Nancy Teeple, "Great Power Competition in the Arctic," Network for Strategic Analysis, policy report, April 13, 2021.

<sup>185</sup> Grieger, 2018; Teeple, 2021.

<sup>186</sup> Emil Avdaliani, "China Seeks to Boost Its Role in the Arctic," China Observers in Central and Eastern Europe, May 24, 2021.

<sup>187</sup> Grieger, 2018.

<sup>188</sup> Grieger, 2018.

<sup>189</sup> Jian, 2020.

<sup>190</sup> U.S. government Arctic experts, interview with the authors, November 15, 2021; Teeple, 2021.

Arctic, which are discussed in the rest of this section, and influence Beijing's expansion of its soft and hard power, scientific research, investments in fossil fuel and mineral extraction.<sup>191</sup>

However, China's presence in the region raises a series of concerns at the geopolitical level and related to economic coercion and environmental protection, with some analysts considering China to be a wild card that could threaten existing regional cooperation among Arctic states and spread dual-use Arctic capabilities that result in security threats.<sup>192</sup> Furthermore, in light of China's behavior in the South China Sea vis-à-vis the Philippines and the treatment of ethnic minorities in China, some of the positions that the country advanced in the 2018 Arctic white paper on its commitment to the existing legal framework and UNCLOS and to respecting the special status of Indigenous people in the region are questionable.<sup>193</sup> The rest of this section presents the geopolitical and economic factors that motivate China's presence and activities in the Arctic.

### Geopolitical Factors

The main geopolitical factors that drive China's interest and activities in the Arctic are Beijing's desire for prestige, its great-power ambitions, and its rivalry with the United States, with the Arctic being one of the regions of the world that is becoming a locus of strategic competition. In this vein, some West-based analysts argue that the Arctic is emerging as a locus for strategic rivalry.<sup>194</sup> Naval exercises and Russian government officials' statements draw the attention of the Arctic states to the unfolding of strategic competition dynamics in the region, most of which are the result of recent developments in the international arena rather than a consequence of dynamics specifically pertaining to the Arctic.<sup>195</sup> In this section, we unpack these geopolitical factors (e.g., China's desire for prestige, its great-power ambitions, and rivalry with the United States), which are closely interconnected and reinforce one another, and the geopolitical implications of economic investments and scientific research presence in the region.

#### *Desire for Prestige, Great-Power Ambitions, and Rivalry with the United States in the Arctic*

When assessing China's presence in the region and claims to be a near-Arctic state, Beijing's quest for worldwide prestige and great-power status are key factors to consider. China's ambitions to expand its influence beyond East Asia are revealed by the investments undertaken globally under the BRI and, in the Arctic, in the context of infrastructure investments in the Russian and, to a much lesser extent, Icelandic Arctic that aim to provide Beijing with a foothold

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<sup>191</sup> Andreas Raspotnik and Andreas Østhagen, "A Global Arctic Order Under Threat? An Agenda for American Leadership in the North," *Polar Points*, March 10, 2021.

<sup>192</sup> Jian, 2020; Teeple, 2021.

<sup>193</sup> Grieger, 2018.

<sup>194</sup> Raspotnik and Østhagen, 2021.

<sup>195</sup> Raspotnik and Østhagen, 2021.

in the region.<sup>196</sup> In addition, the misperception that some Chinese analysts harbor of the Arctic as terra nullius (as discussed in the previous section) likely influenced Beijing's actions attempting to fill the power vacuum that it erroneously assumed existed in the region.

China's search for prestige, worldwide power projection, and hegemonic ambitions have two key manifestations in the Arctic: (1) through investments and economic initiatives and (2) through the conduct of polar scientific research. In the "Economic Factors" section that follows this one, we discuss the economic factors behind China's presence and interest in the Arctic; in this geopolitical section, we present the geopolitical implications of Chinese investments in the Arctic, followed by a discussion of the geopolitical implications of China's scientific research presence in the region, all of which are interrelated.

#### *Geopolitical Implications of Chinese Investments and Economic Initiatives in the Arctic*

Investments and economic initiatives in the Arctic not only advance China's economic interests in the region (see next section) but also have geopolitical implications and advance China's great-power ambitions, desire for prestige, and Beijing's stance in the strategic competition with the United States.

For example, China's interests in infrastructure projects in Russia and Iceland and in Greenlandic rare earth minerals signal China's search for economic opportunities and for presence in the region. They also aim to shape the respective countries' orientation toward China. In Greenland's case, the financial benefits associated with China's investments could provide this region of Denmark with leverage toward achieving its desired goal of independence. As of 2022, several Chinese Arctic investments outside of Russia have been paused or halted.<sup>197</sup> China also uses Anchorage airport cargo capabilities to facilitate global logistics, for example.<sup>198</sup>

Critics of CIAO have also expressed concern about China's intelligence-collection activities in the region.<sup>199</sup> China's intelligence-collection activities—and the ability of Chinese nuclear submarines to use deepwater ports in the region—could provide Beijing with a competitive edge over Washington and have direct implications for strategic competition.

#### *Geopolitical Implications of China's Scientific Research Presence in the Arctic*

Next to more-recent developments, such as the presence of China's investments and economic initiatives in the Arctic, China has several decades of experience of conducting scientific research in the region. For China, the country's ability to carry out polar research while being a nonpolar power is viewed as a matter of national pride and is aimed to build international

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<sup>196</sup> Y. Sun, 2020.

<sup>197</sup> Sou-Jie van Brunnersum, "China Failed Its Arctic Ambitions in Greenland," Politico, October 22, 2022.

<sup>198</sup> Alex DeMarban, "Anchorage Airport Among Nation's Busiest as Pandemic Boosts Cargo Activity," *Transport Topics*, November 3, 2020.

<sup>199</sup> Auerswald, 2019a; Melody Schreiber, "A New China-Iceland Arctic Science Observatory Is Already Expanding Its Focus," *ArcticToday*, October 31, 2018.

prestige while allowing Beijing to reap some real benefits associated with gaining an improved understanding of how changes in climate and weather patterns could have an impact on China.<sup>200</sup>

Next to scientific benefits, the scientific information that China gains in the context of its presence in the Arctic furthers Beijing's geostrategic and economic ambitions, including those related to alternative shipping routes, fishing, and resource extraction, as discussed in the "Economic Factors" section that follows this one.<sup>201</sup> Furthermore, Beijing has also declared that its "activities, assets and other interests in the polar regions [are] intrinsic to China's national security," exacerbating the existing concerns among the Arctic states related to the potential dual use of China's investments and scientific research stations in the region.<sup>202</sup> For instance, China's control over critical infrastructure—which China seems interested in acquiring and which can host China's vessels along Arctic routes—could contribute to China improving the security of its vessels that traverse the region.<sup>203</sup>

In addition to prestige and projecting a worldwide image as a great power that can be an active player in faraway regions, such as the Arctic, China's scientific research presence through the two *Xue Long* icebreakers, its scientific presence in Svalbard and Iceland, and Huawei's contract to handle telecommunications for Svalbard can also lend itself to dual-use applications, including intelligence-collection purposes, and to advancing Beijing's military ambitions.<sup>204</sup> In terms of intelligence collection, China could use its scientific research presence to learn about the polar environment, observe the signal traffic of other countries, gain insights on good places for submarines to hide (in this way, strengthening China's sea-based nuclear deterrence), and collect communications and SIGINT.<sup>205</sup>

Alongside the dual purposes for intelligence collection, icebreakers and stations have potential military applications that include expansion of coverage for the BeiDou Navigation Satellite System, which is a dual-purpose civilian–military technology.<sup>206</sup> Furthermore, the scientific expeditions in which China's two *Xue Long* icebreakers engage translate into operational experience that China's crews gain in terms of navigating in the harsh Arctic climate. Moreover, the *Xue Long 2* can carry out such expeditions independently of Russia's icebreakers, reinforcing China's stance as an independent Arctic player.<sup>207</sup>

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<sup>200</sup> Jian, 2020.

<sup>201</sup> Grieger, 2018.

<sup>202</sup> Y. Sun, 2020.

<sup>203</sup> Auerswald, 2019a.

<sup>204</sup> By 2018, the *Xue Long* had conducted eight scientific expeditions in the Arctic (Huawei Technologies, "Telenor Chooses Huawei for Arctic Circle LTE Build," *Light Reading*, June 27, 2011; Ingrid Lundestad and Øystein Tunsjø, "The United States and China in the Arctic," *Polar Record*, Vol. 51, No. 4, July 2015; World Economic Forum, "China Aims to Play a Major Role in Arctic Affairs. Here Are Its 5 Key Policy Goals," July 27, 2018).

<sup>205</sup> Grieger, 2018.

<sup>206</sup> Grieger, 2018; Teeple, 2021.

<sup>207</sup> Avdaliani, 2021.

## Economic Factors

Economic factors also play a role in China's presence and interest in the Arctic region, and they are closely related to China's geopolitical ambitions and search for international prestige, as discussed in the previous section. However, some observers of China's investments in infrastructure in the Arctic (including in LNG and port developments) have accused China of practicing "predatory economics" to create economic dependence in economically vulnerable entities, such as Greenland and Iceland, facilitating China's desire to gain a foothold in the Arctic.<sup>208</sup>

The main economic factors can be grouped into four main categories:

- advancing the Polar Silk Road (which represents the Arctic dimension of China's BRI)
- developing alternative sea shipping routes, such as the NSR, that allow China to shorten transport time and cut shipping costs while avoiding piracy encounters on traditional maritime choke points, such as the Strait of Malacca, the Gulf of Aden, and the Horn of Africa
- exploiting natural resources, such as hydrocarbons, rare earth minerals, and Arctic fish
- opening up the Arctic for Chinese tourism.

We briefly present each of these factors in the rest of this section.

### *The Polar Silk Road*

The Polar Silk Road represents the Arctic dimension of China's BRI. China unveiled the concept of the Polar Silk Road in 2018, which includes both economic and navigation and access objectives, most of which focus on Russia and northern Europe. In the context of the Polar Silk Road, Beijing advanced various infrastructure investments, such as developing ports along the NSR, an LNG project in the Yamal Peninsula, and port facilities and bases in Iceland and Greenland.<sup>209</sup>

From an economic standpoint, cooperation in the Arctic between Russia and China became closer after the West imposed sanctions on Russia after its 2014 illegal annexation of Crimea and support of separatists in Ukraine's Donetsk and Luhansk regions. Although Western companies had been Russia's preferred partners to develop infrastructure along the NSR, China became Russia's go-to partner after 2014 for developing infrastructure and ports in the Russian Arctic, despite the Chinese companies' lack of experience with projects in the Arctic climate. In the same context, Russia and China partnered to develop the Yamal Peninsula LNG project. China's participation in the LNG project reduces its reliance on coal and oil and facilitates the country's transition to the use of cleaner energy (see details in the next subsection).<sup>210</sup> Chinese companies have also announced their intent to invest in a new railway project and a deepwater port that will

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<sup>208</sup> Teeple, 2021.

<sup>209</sup> Jian, 2020; Teeple, 2021.

<sup>210</sup> Jian, 2020.

be built close to existing port facilities for larger vessels.<sup>211</sup> Russia and China have also agreed on jointly constructing the Power of Siberia gas pipeline to connect the Kovyktinskoye and Chayandinskoye fields with China.<sup>212</sup>

However, Sino–Russian Arctic cooperation may have its limits. For example, Russia’s reliance on extractive technology from the West and its concerns about China’s rise are two obstacles that hinder cooperation, though sanctions and the Ukraine war might be shifting its position.<sup>213</sup> Russia was also initially resistant to China’s application for Arctic Council observer status.<sup>214</sup> In 2015, Russian foreign minister Sergey Lavrov noted in a speech at a youth forum in Russia that China is a key Arctic partner.<sup>215</sup>

Other infrastructure investments under the Polar Silk Road include China Telecom partnering with Finnish companies to lay submarine fiber-optic telecommunication cables above the Arctic Circle.<sup>216</sup> China’s interest in undersea telecommunication cable projects across the world has increased in recent years, with the Arctic Ocean bed being one of several areas of opportunity China has identified and sought to exploit. China’s involvement in the development of undersea telecommunication cables around the world has raised concerns about their potential dual use, how they can enable China’s intelligence-collection activities and potentially disrupt internet traffic in situations in which China finds disruptions opportune.<sup>217</sup>

#### *Developing Alternative Sea Shipping Routes*

China is highly dependent on the ocean economy for food and energy.<sup>218</sup> After facing for several decades the so-called “Malacca dilemma,” the challenges and vulnerabilities associated with navigating through the Strait of Malacca that provides China with the shortest route between East Asia and the Middle East, China has explored, in recent years, the idea of using as an alternative the Arctic shipping routes: the NSR, the NWP, and the Transpolar Sea Route.<sup>219</sup> Chinese observers of the Arctic have noted that waterways that will open up because of melting ice and could alter global maritime transportation patterns—including for China’s commercial

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<sup>211</sup> Jian, 2020.

<sup>212</sup> Francesco Sassi, “What the ‘Power of Siberia’ Tells Us About China–Russia Relations,” *The Diplomat*, December 7, 2019.

<sup>213</sup> Devyatkin, 2018a.

<sup>214</sup> Elizabeth Wishnick, “Will Russia Put China’s Arctic Ambitions on Ice?” *The Diplomat*, June 5, 2021.

<sup>215</sup> “China Is Russia’s Priority Partner in Arctic Cooperation—Lavrov,” Telegraph Agency of the Soviet Union, August 24, 2015; Wishnick, 2021.

<sup>216</sup> Jian, 2020.

<sup>217</sup> Jeremy Page, Kate O’Keeffe, and Rob Taylor, “America’s Undersea Battle with China for Control of the Global Internet Grid,” *Wall Street Journal*, March 12, 2019; Justin Sherman, “The US–China Battle over the Internet Goes Under the Sea,” *Wired*, June 24, 2020.

<sup>218</sup> Luke Coffey, “China’s Increasing Role in the Arctic,” Heritage Foundation, February 11, 2020.

<sup>219</sup> Paweł Paszak, “China and the ‘Malacca Dilemma,’” Warsaw Institute, February 28, 2021.



shipping industry and military—encouraging China to continue to pursue development of such waterways to benefit China’s economic interests.<sup>220</sup> Beijing hopes that, by using Arctic maritime routes as an alternative to the shipping lanes that traverse the Strait of Malacca, this would free China from the island chains that bind it and would decrease the vulnerability to a potential naval blockade by the USN that can control and secure sea lines of communication between the coast of Africa and East Asia.<sup>221</sup>

Furthermore, the Arctic shipping lanes provide a shorter alternative to China’s “Maritime Silk Road,” the shipping lanes connecting China and Europe. Some estimated that the NSR would cut the duration of the voyage between Europe and Asia by 35 percent from the traditional shipping route through the Suez Canal, reducing fuel costs and carbon dioxide emissions.<sup>222</sup>

In this vein, in 2013, the first Chinese commercial shipping vessel conducted a trial trip to the Arctic Ocean to test the viability of such an alternative shipping route.<sup>223</sup> In addition to attempting to mitigate the risks associated with piracy in the Strait of Malacca and the Gulf of Aden and circumventing a potential U.S. naval blockade, the use of alternative shipping routes through the Arctic would also facilitate China’s access to Russia’s energy resources, improving China’s energy security.<sup>224</sup>

However, the use of alternative shipping routes through the Arctic region will present several challenges, including the seasonal, high-risk nature of navigating the Arctic; extreme weather conditions; presence of ice floes; costs with Russia’s icebreaker escorts; high insurance premiums; tonnage restrictions; and the fact that the USN can interdict traffic in the Bering Strait just as easily as in the Strait of Malacca. Other challenges associated with traversing the Arctic include inadequate satellite coverage, shoreside infrastructure, and SAR capabilities. All these factors make Arctic shipping routes more suitable for destination shipping (or getting specific merchandise from one location to another) than for “on-time” shipping, in which commercial vessels are expected to deliver merchandise at a specified time.

Moreover, China and Russia differ in their interpretations of UNCLOS Article 234 as it pertains to the NSR. Although China identifies the NSR as key to its economic ambitions in the Arctic, Russia believes that Article 234 provides legal authority for it to declare the NSR as internal waters subject to its customs, patrols, and restrictions. Even if China cannot shift

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<sup>220</sup> 余春 [Chun Yu], “北极航道 改变世界的未来 [Arctic Waterways Changing the Future of the World],” 广东造船 [Guangdong Shipbuilding], Vol. 1, 2022; 钱凌煜 [Qian Lingyu], “北极航线经营现状及发展建议 [Operational Status and Development Suggestions of Arctic Routes],” 中国远洋海运 [Maritime China], Vol. 1, 2022.

<sup>221</sup> Paszak, 2021.

<sup>222</sup> Grieger, 2018; Mary Kay Magistad, “China’s Arctic Ambitions Have Revived US Interest in the Region,” *The World*, October 12, 2020.

<sup>223</sup> Jian, 2020.

<sup>224</sup> Grieger, 2018.

Russia's stance on Article 234, it might become increasingly uncomfortable with Russia's authority over China's vessels transiting the NSR.<sup>225</sup>

Despite these realities, China Ocean Shipping Company (COSCO)—a leading Chinese commercial shipping company—consistently engages in commercial traffic through the NSR as a way to regularize operations through the region and to supplement its use of traditional shipping routes.<sup>226</sup>

#### *Exploitation of Natural Resources, Including Arctic Fish*

China's interest in exploiting natural resources, such as minerals, oil, natural gas, and fish, represents a key factor driving Beijing's activity in the Arctic. Beijing's quest to access raw materials in the Arctic—which, according to a 2008 U.S. Geological Survey report, is estimated to harbor some 13 percent of the world's undiscovered reserves of oil and some 30 percent of its undiscovered natural gas—created some fears in Moscow that it was being perceived not as an equal but only as a lower-level partner meant to satisfy China's growing energy needs.<sup>227</sup> Because many of the energy resources are located either in sovereign territory or in EEZs, China has to engage directly in bilateral agreements with such countries as Russia to gain access to their respective resources.<sup>228</sup>

As mentioned earlier, owing to Western sanctions against Russia, NOVATEK, one of the largest independent natural gas producers in Russia, signed agreements with the China National Petroleum Corporation and the China Development Bank to fund the Yamal LNG project, as well as with the China National Offshore Oil Corporation.<sup>229</sup> To date, China has provided roughly 30 percent, or \$13 billion, of the funding for the NOVATEK Yamal LNG project, and, under these agreements, Chinese companies will also acquire a 20-percent share in NOVATEK's Yamal LNG 2 project (recently renamed Arctic LNG 2).<sup>230</sup> These projects also help satisfy China's own petroleum interests in the Arctic and will continue to provide investment opportunities for Chinese shipping companies, including ship leasing, logistic infrastructure, and shipbuilding.<sup>231</sup>

Despite the fact that China already controls the vast majority of the world's rare earth mineral production, it has shown an interest in mining Greenland's ample rare earth resources, which would solidify its near-monopoly on these key industrial materials.

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<sup>225</sup> Nengye Liu, "China–Russia Trouble on the Arctic Silk Road?" *The Diplomat*, July 21, 2017.

<sup>226</sup> Grieger, 2018; Jian, 2020.

<sup>227</sup> Avdaliani, 2021; Grieger, 2018.

<sup>228</sup> Grieger, 2018.

<sup>229</sup> Closson, 2017, p. 7; Devyatkin, 2018a; Jian, 2020.

<sup>230</sup> Jian, 2020; Townsend and Kendall-Taylor, 2021, p. 9.

<sup>231</sup> Jian, 2020; 王林 [Lin Wang], "北极油气开采潮再起 [The Tide of Oil and Gas Exploration in the Arctic Is Rising Again]," 中国石油和化工产业观察 [*China Petrochemical Industry Observer*], Vol. 12, 2021.

Moreover, as global warming advances and fish stocks migrate north as a result, there might be increasing fishing opportunities in non-EEZ waters in the Arctic. China possesses the world's largest long-distance fishing fleet and is especially interested in the potential for central Arctic fishing.<sup>232</sup> Given China's need to feed its large population, it is likely that access to Arctic fish resources will play an increasing role in the future, alongside access to other resources, such as minerals and natural gas. For the short term, in 2017, China agreed to preserve the existing fish stock in the Arctic and signed a moratorium (CAOFA) on commercial fishing in the central Arctic Ocean that is legally binding for Beijing.<sup>233</sup> CAOFA will expire in 2034.

Finally, China's scientific research expeditions could also have economic implications (besides the geopolitical ones discussed in the previous section), allowing Beijing to map the seabed and identify the resource-rich areas that it could exploit in the future.<sup>234</sup>

#### *Opening Up the Arctic for Tourism*

One last aspect that makes the Arctic of interest is opening the region to Chinese tourists and developing tourism in the region. Observers of China's Arctic ambitions and activities have argued that China views Arctic tourist destinations as strategic territories and, as a result, "seeks to commodify them by identifying, developing and exploiting their resources in ways that transcend territory."<sup>235</sup> Tourism, then, is not simply a means to entertain visitors but to develop China's "enterprises, tourism agencies and their regulators, along with infrastructure to facilitate the movement of tourists and ensure their safety" in destination regions.<sup>236</sup> Chinese tourism operators put pressure on Beijing to lift restrictions on them, setting up independent tourist ventures in polar regions. The Chinese government sensed the presence of an opportunity to project influence and enhance presence in both the Arctic and the Antarctic by allowing tourism operators to set up ventures in the two polar regions and transform them into a market for Chinese tourists.<sup>237</sup> Thus, without claiming territorial sovereignty in the Arctic, China is seeking to "territorialize" the Arctic through tourism and its potentially sizable footprint.<sup>238</sup> It is expected that, in the coming years, the number of Chinese tourists in the Arctic will increase.<sup>239</sup> An increase in the presence of tourists in the Arctic would also translate to increased requirements

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<sup>232</sup> Chuin-Wei Yap, "China's Fishing Fleet, the World's Largest, Drives Beijing's Global Ambitions," *Wall Street Journal*, April 21, 2021.

<sup>233</sup> Grieger, 2018.

<sup>234</sup> Avdalani, 2021.

<sup>235</sup> Mia M. Bennett and Benjamin Lucca Iaquinto, "The Geopolitics of China's Arctic Tourism Resources," *Territory, Politics, Governance*, 2021, p. 3.

<sup>236</sup> Bennett and Iaquinto, 2021, p. 3.

<sup>237</sup> Brady, 2017, pp. 101–102.

<sup>238</sup> Bennett and Iaquinto, 2021, p. 3.

<sup>239</sup> Grieger, 2018.

for rescue capabilities and other structures in place designed to provide safety for Chinese tourists traveling to the region.<sup>240</sup>

### *China's Military Activities in the Arctic*

China does not currently possess any permanent military assets in the Arctic. The PLAN conducted notable, yet rare, expeditions to the Arctic in 2015 and 2021. In 2015, the task force came within 12 nautical miles (the edge of U.S. territorial waters) off the Aleutian Islands. Despite these activities, operations remain a challenge for the PLAN for reasons that include C2; difficulties in at-sea replenishment, logistics, and sustainment; a lack of overseas basing; and insufficient fleet air defenses once outside the coverage provided by China's surface-to-air and land-based air assets. Additionally, although no PLAN submarine activity in the Arctic has been publicly revealed to date, the United States views this issue as a potential emerging threat to U.S. operations in the Arctic.<sup>241</sup> And although some observers of China's Arctic activities have expressed concern that China could deploy its growing ballistic submarine fleet to the Arctic, both for domain-awareness and deterrence purposes, others believe that this development is unlikely to happen anytime soon.<sup>242</sup> Finally, the USCG did observe Russian and Chinese warships operating together in the Bering Sea in September 2022.<sup>243</sup>

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<sup>240</sup> Grieger, 2018.

<sup>241</sup> Phil Steward and Idrees Ali, "Pentagon Warns on Risk of Chinese Submarines in Arctic," Reuters, May 2, 2019.

<sup>242</sup> Anne-Marie Brady, "Facing Up to China's Military Interests in the Arctic," *China Brief*, Vol. 19, No. 21, December 10, 2019; Robert Farley, "Would China Send Nuclear Ballistic Missile Submarines to the Arctic?" *1945*, January 3, 2022; Adam Lajeunesse and Timothy Choi, "Here There Be Dragons? Chinese Submarine Options in the Arctic," *Journal of Strategic Studies*, 2021.

<sup>243</sup> Melody Schreiber, "A U.S. Coast Guard Ship Unexpectedly Encountered Chinese and Russian Warships Off Alaska," *ArcticToday*, September 26, 2022.

## Appendix C. Insights from the Tabletop Exercise and Interviews

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We conducted a TTX over the course of three separate sessions in February 2022 that included 77 SMEs from the military, academia, and elsewhere in government. We also conducted more than 20 interviews with military, academic, and government SMEs to examine the current state of U.S. operations in the Arctic, what capability and capacity gaps existed and the risks they posed, and what future capabilities might be required to ensure that the U.S. military and DHS can conduct their statutorily authorized missions in the U.S. Arctic. Together, these two data sources informed a large part of our work. We discuss them in this appendix because the themes in our findings and recommendations are driven by the narratives we collected during the course of these activities. Although our expert-elicitation instruments were shaped based on the FY 2021 NDAA language, we did not constrain our data collection of expert feedback to only what was contained in the legislation.<sup>244</sup>

### The Arctic Tabletop Exercise

#### *Purpose*

We recognized that, in addition to reviewing documentation, garnering subject-matter expertise directly was crucial to understanding the nature and implications of U.S. access limitations in the Arctic. One useful tool for eliciting such expertise is a TTX in which participants are asked to immerse themselves in one or more scenarios that stress existing or projected future capabilities. This appendix summarizes the purpose, key assumptions, and overarching findings from the TTX. For further information on the TTX's conduct and structure, see Appendix G.

The primary goals for the TTX were to elicit participants' expert insights on two key matters: (1) potential U.S. Arctic access problems and (2) the risks these might pose to U.S. national interest and the safety of the armed forces. We elicited these insights by having participants evaluate potential capability and capacity shortfalls in six possible scenarios, all of which nominally took place in June 2035.<sup>245</sup>

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<sup>244</sup> As part of our research process, to maintain impartiality and authenticity of the work, we did not selectively eliminate observations and findings.

<sup>245</sup> We chose June because it strikes a good balance between having more traffic and activity than winter months (based on historical activity) but also enough ice cover that our scenarios would include differences in accessibility for different actors. We selected 2035 because it was far enough into the future that it was reasonable to assume that things would be different from how they are today but not so far into the future that we would be unable to make reasonable assumptions about operating capabilities and capacities.

We defined *access* as the ability to reach or transit through spatial objectives without hindrance.<sup>246</sup> Access vis-à-vis maritime (surface or subsurface), air, space, ground, cyberspace, and the electromagnetic spectrum was the primary focus, but participants were encouraged to offer insights in other domains they believed to be relevant to the scope of the project. In the rest of this appendix, we briefly discuss the participants, structure, flow, and key assumptions of the TTX.

The nearly 80 experts who participated came from all of the U.S. armed forces—the U.S. Army, the USAF, the USN, the Marine Corps, the USSF, and the USCG—as well as academic, government, and other professional backgrounds. Every participant had planning, operational, or security-related research experience with or in the Arctic. We also had participants from the armed forces with experience developing strategy, operational plans, and requirements for U.S. military Arctic mission sets, including joint or combatant command mission sets, as well as participants with deep technical knowledge of existing and planned capabilities. From academia and other research organizations, participants were experts in Arctic security cooperation and defense strategy, polar geopolitics, marine transportation, Arctic climate change, and Arctic capability needs and technology development.

### *Key Assumptions*

To ensure a common operating picture for discussions, we had to make several key assumptions about U.S. Arctic interests and priorities; the state of sea ice concentration and other environmental factors; future capabilities of the United States, U.S. allies and partners, Russia, and China; the nature of cooperation and activities in the Arctic; and the geopolitical environment. We describe these key assumptions in this section.

#### Key Assumption 1: U.S. Arctic Interests and Priorities Are Reflected in Strategy Documents

Determining whether access limitations are a problem for the United States requires a common understanding of U.S. objectives and priorities in the Arctic. We asked participants to assume that these were reflected in strategy documents, including the following:

- 2013 National Strategy for the Arctic Region
- 2014 Implementation Plan for the National Strategy for the Arctic Region
- 2019 DoD Arctic Strategy
- 2019 USN Strategic Outlook for the Arctic
- 2019 USCG Arctic Strategic Outlook
- 2020 Department of the Air Force Arctic Strategy
- 2021 USN strategic blueprint
- 2021 Army Arctic strategy
- 2021 DHS Strategic Approach for Arctic Homeland Security.

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<sup>246</sup> Definition adapted from “access, n. (II)(3)(a),” *Oxford English Dictionary*, Oxford University Press, 2021.

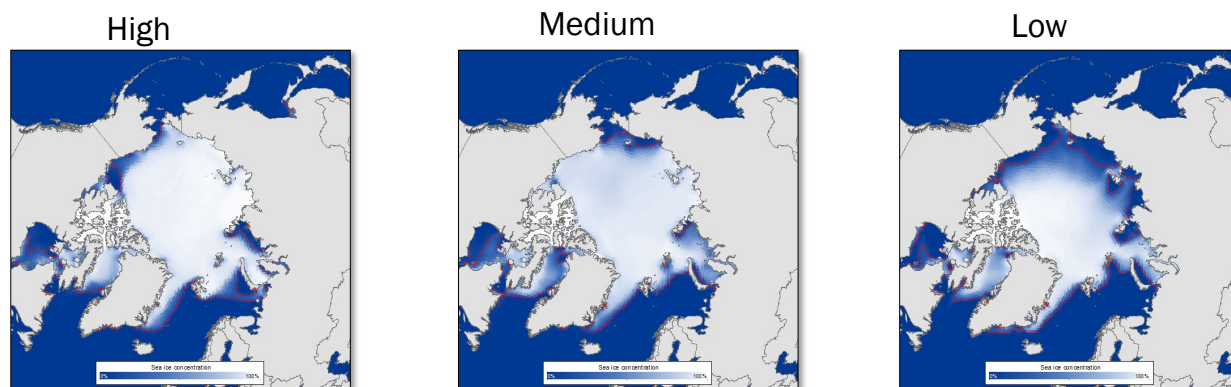
These documents emphasize several interrelated goals that can be grouped as follows:

- securing U.S. territory and security interests
- strengthening international cooperation and an open, rule-based order in the region
- enhancing all-domain awareness (discussed in greater depth in the appendix that is not available to the public)
- enhancing access, response, and resilience.

#### Key Assumption 2: Sea Ice Concentration and Extent Diminish in Accord with Global Climate Models

We gave the participants sea ice maps (see Figure C.1) that illustrate the projected average future ice concentration (percentage coverage) and extent (the area with 15 percent or more ice concentration) in June 2035. These maps represent qualitative differences in overall ice extent for high-, medium-, and low-sea ice scenarios and are illustrations of plausible climate futures rather than authoritative predictions.

**Figure C.1. Projected Average Future Sea Ice Concentration and Extent in June for High-, Medium-, and Low-Sea Ice Scenarios**



NOTE: Projected sea ice concentration is based on a CESM2 general circulation model. Astute readers might note that the medium ice-concentration scenario indicates some ice in areas that are relatively ice free in the high ice-concentration scenario. Although the high ice-concentration scenario obviously entails more ice overall, its distribution is different, reflecting complex climatic phenomena.

#### Key Assumption 3: Current Arctic Military Installations Continue to Exist

Current Arctic military installations are shown in Figure C.2.

**Figure C.2. Map of Selected Arctic Installations**





**Key Assumption 4: The United States, U.S. Allies and Partners, China, and Russia Maintain and Expand Current Capabilities as Planned**

Chapter 3 provided a high-level overview of the assumed Arctic capabilities in 2035 for the United States, its allies and partners, Russia, and China organized into nine bins:

- icebreaking and ice-capable ships
- surface maritime assets
- subsurface maritime assets
- air
- space
- ground
- cyberspace
- logistics
- commercial capabilities.

Our assumptions were informed by this research on current and planned capabilities as discussed in Chapter 3.

**Key Assumption 5: Russia and China Continue to Cooperate in the Arctic but Maintain Differences in the Degree and Nature of Arctic Activities**

Table C.1 summarizes assumed Arctic activities for Russia and China for purposes of the TTX. These assumptions were based on the research the project team conducted as part of the analysis of U.S. interests discussed in Chapter 2 and the threat characterization in Appendix B.

**Table C.1. Assumed Arctic Activities for Russia and China in 2035**

Area of Interest	Russia	China
Strategic	Russia's Arctic strategy is mainly defensive, but its military activities and capabilities increasingly offer the potential for aggression.	China incorporates the Arctic into the BRI and promotes the Arctic as a "global commons" and a larger role of non-Arctic nations in Arctic governance.
Economic	Russia is economically dependent on the Arctic region for revenues from oil, natural gas, and vessel transit fees, meaning that the country has a vested interest in stability but must also protect its economic resources.	Natural-resource extraction, shipping, fishing, and tourism are likely to grow, potentially creating tensions with other Arctic stakeholders.
Military	Russia has highly capable assets, including situational awareness in and around the Kola Peninsula and Barents Sea regions to protect its nuclear deterrent. It might be more sensitive to U.S. presence in the western Russian Arctic (i.e., near NATO countries) than in the eastern Russian Arctic (i.e., near Alaska). Also, it is building up its eastern regions with infrastructures intended to support civilian and military purposes.	China does not have an overt military presence in the Arctic, but there is the possibility of the dual use of its scientific research stations on the ground that could be used to map the Arctic seabed and for reconnaissance and intelligence collection.

### Key Assumption 6: Geopolitically, in 2035, the World Looks Similar to How It Looks in 2022 but with More Tensions Between the United States and Its Allies on the One Hand and Russia and China on the Other

In 2035, the Arctic is less tense than other parts of the globe, but Russia and China still present challenges in that region. The Arctic Council still exists and functions as it did prior to the invasion of Ukraine. The United States and China have the world's largest economies, as measured by gross domestic product. The United States is continuing to struggle with internal partisanship, contributing to difficulty in shaping widely supported and enduring policies. China is led by a Xi Jinping–like leader with singular authority and strong control. China seeks to play a dominant role in influencing the nations of South, Southeast, and East Asia, with the United States opposing its attempts to do so. Russia is led by a Vladimir Putin–like leader, also with singular authority and strong control. Russia seeks to dominate its near abroad (or the space of the former Union of Soviet Socialist Republics) and beyond, with the United States opposing it. NATO and other U.S. alliances have held together; the Baltic states are independent and part of NATO. Borders look roughly like they do in 2022, Ukraine is independent but not part of NATO, a frozen conflict simmers in eastern Ukraine, and hostility to Russia remains as high as it was during the 2022 war.

### *Overarching Themes*

TTX participants identified several essential areas requiring focus to achieve objectives in the scenarios they were given (and ultimately the goals reflected in U.S. strategy documents summarized in Chapter 2), as well as shortfalls that imperil the ability of U.S. armed forces to do so. We have grouped these TTX themes as follows:

- capacity limitations
- sparse facilities and transportation infrastructure
- limited all-domain awareness
- constrained communications
- vulnerability to attack via electronic, cyber, information, and physical means
- the need for effective cooperation across services, departments, and governments
- barriers to interoperability with allies and partners
- limited personnel and equipment readiness for Arctic operations.

The remainder of this section describes each of these themes in turn. In some cases, we highlight only access problems that were raised; in others, we also include some examples of mitigation options that were discussed at some length during the TTX.

### *Capacity Limitations*

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 partners and allies. Where there are capability issues, accompanying capacity problems greatly exacerbate the mismatch between emerging regional needs and existing equipment, architectures, training, and policy.

For example, as later described in Appendix D, Congress has funded construction of three heavy icebreakers that will be operational by 2035, when our scenarios take place. (The current heavy icebreaker USCGC *Polar Star* will be 60 years old by then, so it could be out of service, although the current medium icebreaker USCGC *Healy* would be in only its mid-30s.) 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. The USCGC *Polar Star* operates primarily in the Antarctic, while the USCGC *Healy* operates primarily in the Arctic. 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 the three PSCs funded and in the current program of record were operational but that the additional PSC and ASCs were not.<sup>247</sup> These assumptions helped us determine whether the funded icebreakers alone were sufficient; they were not. Funding these additional icebreakers 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.

Other limitations are also important. Air assets that can operate in the region are scarce, as are personnel with Arctic training and experience across the services. In the space domain, the fact that there are so few polar-orbit satellites hinders the ability to observe the region and facilitate communications within it. This is due to limited investments in deploying satellite constellations in the Arctic. One TTX participant mentioned that such launches are rare; in general, launching satellites into polar orbits is more difficult than doing so in other orbits. Moreover, satellites in polar orbits have a greater collision risk than most satellites, a risk that will likely be exacerbated as commercial constellations become far more numerous.

Finally, some Arctic capacity issues are due to high demand in other theaters. This point was raised with respect to diverse assets, such as intelligence-collection capabilities, non-ice-strengthened ships, and helicopters. National, DoD, and service components have published Arctic strategies identifying the Arctic as an important AOR in need of resources, but, in practice, the resources the region receives do not always reflect its stated priority.

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<sup>247</sup> 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.

### Sparse Facilities and Transportation Infrastructure

Lack of infrastructure creates a variety of issues in the Alaskan portion of the Arctic. As participants observed, although the armed forces have multiple bases in central and southern Alaska, there is not a single substantial port beyond Dutch Harbor in the eastern Aleutians, more than 800 miles south of the Bering Strait and more than 1,300 miles by sea from Utqiagvik (Point Barrow, in north-central Alaska). Nome, near the Arctic Circle, and Utqiagvik have minimal port facilities. There are also several NORAD installations. The relative locations of Dutch Harbor, Nome, Utqiagvik, and U.S. military bases in Alaska are shown in Figure C.3.

**Figure C.3. Bases and Other Locations in Alaska**



Airstrips are scarce and often spartan. Sparse roads and railways are often unconnected with one another, let alone with the wider North American network, and intermodal infrastructure is rare. Many Alaskan communities are not connected by road. Ground forces encounter difficulties related to deploying bridging capabilities in the region because of mechanical breakdowns in cold weather (i.e., floating bridges will freeze and be crushed if left in water). This paucity of infrastructure hinders movement and maneuvering capability, protracting response timelines. It

also constrains logistical, maintenance, medical, and many other types of support for assets in the region, limiting their capabilities and resilience. The lack of redundancy also limits systemic operational resilience because diminished capacity at any hub or transportation link can constrain operations. This is particularly problematic in a region where harsh environmental conditions continually batter systems and people, even in the absence of actions by opposing forces. This last problem is exacerbated by climate change, which erodes coastlines, thaws permafrost, and contributes to severer storms; hardening existing infrastructure against climate change or replacing it is necessary to maintain even the limited transportation networks that exist.

Participants pointed out that the European Arctic has a higher infrastructure density than the North American Arctic has, as well as a less severe climate at any given latitude; it is also closer to large population centers. However, its transportation network is still sparse enough that the severing of one or two links could greatly impede operations, as could the loss of key support facilities.

Numerous people in different groups cited the “tyranny of distance,” reflecting vast distances within the region, as well as between the region and the outside world.

Another consideration is the use of fixed infrastructure versus expeditionary or mobile infrastructure. This issue was not emphasized in the TTX or interviews, but we note it here for completeness because there are some advantages to expeditionary or mobile infrastructure. These include flexibility of movement to where they are most needed and less or no susceptibility to slow-moving hazards, such as permafrost melt and sea-level rise.

#### Limited All-Domain Awareness

TTX participants across numerous breakout sessions identified limited all-domain awareness or the need to know who is doing what in the Arctic as one of the key access limitations that the United States faces in the region. The USCG operating alone has substantially fewer means of sensing, processing, analyzing, and communicating domain awareness than when a joint construct was considered in response to the various scenarios considered. The USCGC *Healy* is limited in its ability to develop and sustain domain awareness over the U.S. Arctic. This is not surprising considering the capacity limitations already noted as an overarching factor and the fact that the USCG is so much smaller than the other services.<sup>248</sup> This is also why the USCG already regularly seeks (when feasible) to coordinate with other services and the broader U.S. government. Indeed, TTX participants highlighted the benefits of adding USN domain-awareness capabilities to those of the USCG, which was also echoed in the interviews we conducted. Furthermore, other joint capabilities and those of such organizations as NOAA for sea ice monitoring and modeling were highlighted as beneficial.

Some of the main aspects of all-domain awareness mentioned were maritime domain awareness (including in the subsurface and of illicit activities in various domains), air

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<sup>248</sup> The USCG’s budget is consistently an order of magnitude smaller than those of the USAF, Army, and USN.

surveillance, ocean floor mapping for accurate up-to-date maritime charts, satellite coverage, and communication coverage, with all-domain awareness being identified as critical to creating understanding and enabling decisionmaking. As previously discussed, all-domain awareness, as well as other capabilities and various threats, are examined in greater depth in the appendix that is not available to the public.

Limited all-domain awareness was often mentioned in relation to limitations in communications (see the next section) and in U.S. persistent presence in the Arctic. Next to the previously cited need for the United States to see what is occurring in the Arctic, the TTX participants brought up the importance of sharing information when working with allies and partners to increase all-domain awareness. However, restricted permissions to share and limited availability of or access to technologies and architectures enabling information-sharing hinder interoperability with U.S. allies and partners that would contribute to U.S. all-domain awareness. Participants identified reliable and resilient communications, methodical positioning of technology, and increasing intelligence support as ways to achieve all-domain awareness in the region.

### Constrained Communications

Constrained or inconsistent communications in the Arctic represent another major theme that TTX participants across several breakout groups identified. Because of extreme weather, ionospheric effects that interfere with electromagnetic transmissions near the poles, limited satellite coverage, and limited ways of passing data, communications in the Arctic are more difficult than they are elsewhere. As the latitude increases, the ability to communicate seamlessly and reliably decreases, and major gaps in very HF (VHF) coverage occur. As was mentioned earlier, most VHF radios cover only local Alaskan communities. SATCOM, including commercial communication, is available in the region, but the limited number of satellites available translates into limits on the availability of communications. In addition, SATCOM is limited largely to voice communications, and the commercial satellites are less reliable from a security perspective, with the USCG having no access to secure communications in some situations or at some points in time. Also, not all U.S. ships—including some that operate in Arctic waters—are currently equipped with Link 16, which has two main implications. On the one hand, there are communication nonconformities; on the other hand, there is a limited ability to use tactical-level data to link with DoD stakeholders.

To underscore the challenges associated with communications in the region, one of the participants who was based in the Arctic described difficulty accessing the TTX. As was noted previously, access to a secure network, such as the Secure Internet Protocol Router Network (SIPRNet), was mentioned as occupying all available bandwidth on communication devices. Regular communication outages at Thule Air Base were brought up by participants familiar with the situation (and were actually experienced by TTX participants at that location during the TTX itself). Such outages, although usually minor in nature, have pushed those who work on base to

keep handwritten records to avoid the pitfalls of relying on regularly unstable electronic communications.

Communication constraints were also mentioned as affecting information exchanges and interoperability among U.S. armed forces but also with U.S. allies and partners. TTX participants mentioned that information technology issues limited the USCG's ability to communicate securely and consistently in real time with the other U.S. armed forces. TTX participants identified the need for the United States to develop interoperability with other Arctic countries: They pointed to shortfalls in communications and the complications and vulnerabilities associated with the physical infrastructure on which such communications rely (e.g., undersea cables for internet connectivity) as considerations affecting interoperability with allies and partners. One TTX participant mentioned that joint secure communications in the region are extremely limited, perhaps almost impossible. This point was reinforced by other participants, who reiterated the challenges associated with finding a good way to share operational information with allies and partners, especially when communications are degraded. A participant aptly summarized the situation: "It is hard to be interoperable when communications are down."

Some potential solutions to the communication issue that TTX participants suggested involved having the commercial sector fill in the gap in government communications and partnering with Canada. However, both alternatives leave room for vulnerabilities in the security of such communications.

#### Vulnerability to Attack via Physical, Electronic, Cyber, and Information Means

TTX participants noted the degree to which Arctic operations are vulnerable to a variety of types of attack, including growing military threats and possible future law-enforcement challenges (fishery enforcement but perhaps also smuggling in the future). Partly, this reflects previously cited shortfalls in assets and infrastructure across multiple domains: When there are few nodes and links within a network, attenuation of any one of them can result in systemic capability reductions, which makes targeting them that much more attractive. Limitations on domain awareness exacerbate an intended target's inability to preempt an attack or respond effectively.

The USCG does have some self-protection capabilities on certain platforms, especially if we include those that provide warning so that an appropriate tactic can be employed. That said, USCG capabilities are not typically designed to counter potential military-style threats, although these could become a greater issue in the Arctic as more militaries build greater presence in the region. There were no disagreements between TTX participants (and interviewees) that the USCG operating alone would be substantially more vulnerable to various military-type threats or other violent attacks (kinetic and nonkinetic) than if the USCG were operating in a joint environment.

The difficulty of repairing damage to cyberinfrastructure enhances such infrastructure's vulnerability as a target. Repairing a severed undersea cable in the Arctic or damage from a physical accident instigated by a cyberattack could require longer timelines and more resources than doing so in densely trafficked, temperate environments. The fact that numbers of resources and personnel at Arctic installations are so limited makes the systems that depend on them relatively fragile, while the relatively small numbers of vessels, aircraft, ground vehicles, and satellites operating in the region have a constrained ability to help or protect one another. Environmental extremes can also reduce both the ability to withstand attacks and even the ability to attribute them: For example, electronic jamming could have a synergistic effect with natural ionospheric effects that degrade communications and could go undetected if system failures are attributed solely to the physical environment. Moreover, the Arctic's harsh environment shapes design choices in ways that can create vulnerabilities to attacks, such as those yielding a ship designed to break through thick polar ice that is inherently slow and has a limited capacity for armament.

Finally, some breakout groups discussed the importance of strategic narratives and the potential impacts of disinformation campaigns. For example, one group suggested that, by virtue of having better physical access to much of the Arctic, Russia might also be best poised to control the overarching narrative of unfolding events being, as it was, the first responder in the particular scenario the group was examining.

### The Need for Effective Cooperation Across Services, Departments, and Governments

Participants repeatedly noted the importance of collaboration across services, departments, and governments. Some stated that they had not previously been fully aware of the capabilities of other services and that the TTX benefited them for that reason. In an environment in which all actors struggle with scarcity and extremes, relying on others' capabilities and capacities is essential. Surviving and operating in the Arctic requires a whole-of-military, whole-of-government, and whole-of-community (local, tribal, state, federal, and fellow Arctic nations) approach. Significant coordination and planning will be needed with local governments because their utilities and infrastructure are most likely not suitable for a large USCG or other armed forces presence without substantial investment into the local government's municipality.

All-domain awareness requires the integration of information from multiple services and countries, using such assets as submarines and satellites. Particularly outside Alaska, other countries can play key roles in providing logistics, maintenance support, and communications. The United States can also learn tactics, techniques, and procedures (TTP) from countries that specialize in Arctic operations. Because U.S. forces cannot be present everywhere at once, building and strengthening bilateral and multilateral relationships with other Arctic countries is important to achieve security in the region. At the same time, the relationship needs to be reciprocal, and the United States needs to provide something of value in exchange to U.S. allies and partners. Ideally, U.S. services would be able to achieve interoperability with one another



and with their counterparts in allies and partners. However, participants identified several barriers to effective interoperability, as described in the next section.

### Barriers to Interoperability with Allies and Partners

TTX participants mentioned several barriers to effective cooperation and interoperability with U.S. allies and partners in the Arctic. Secure joint communications occur rarely, and their absence often impedes real-time information-sharing, especially at tactical and operational levels, which U.S. allies and partners would need in order to make decisions in real time. Such coordinated decisions would allow all parties to present a united front, integrate messaging, and leverage capabilities through combined instead of individual actions in the Arctic.

Security restrictions on the U.S. side and existing policies limiting the kinds of information that can be shared with foreign countries represent additional barriers to interoperability and to effective cooperation with allies and partners. Most of the mechanisms to communicate and work with U.S. allies and partners in a restricted-information environment are still being developed. When sharing of restricted information with foreign nationals is permitted, the mechanisms to do so require time to execute and can delay decisionmaking processes, translating into risk to mission and to forces in some situations.

Another barrier to interoperability and cooperation with allies and partners discussed in the context of the TTX was technology (as was mentioned briefly above), with few communication systems able to exchange unclassified and classified data across countries. For some countries, the difference in voltage of electric outlets was cited as an impediment to effective cooperation. That there are so few BICES machines and that people who need to receive a specific information might be located several hours away from the closest BICES delay communications among U.S. allies and partners, with interoperability for the USCG being mentioned to be exponentially harder than for DoD (which was already difficult to achieve).

Long times to plan and delays in the execution of missions with U.S. allies and partners that result from constrained communications and incompatible technical specifications become problematic when the United States and its allies need to tackle dynamic targets. The longer it takes for the United States and its allies and partners to provide a unified response to a situation or crisis in the Arctic, the less likely it is that they will gain or maintain control of the situation.

The fact that budgetary cycles vary across U.S. allies and partners also creates barriers to effective interoperability related to the timeline for procurement and funding of assets that would contribute to increasing such interoperability. Continuing resolutions and budgetary deadlock also create problems for future planning.

Some proposed solutions that TTX participants mentioned concerned more-frequent exercises in the Arctic between Canada and the United States to render interoperability more routine between the two countries and shortening the timeline to get science and technology agreements in place. ACGF exercises also provide opportunities to address some interoperability

issues, such as in the context of oil spill response. It remains to be seen at the time of this writing whether and how activities can resume in this context with all eight Arctic states.

### Limited Personnel and Equipment Resources for Arctic Operations

In conducting operations in the Arctic, readiness of personnel and equipment are also issues. Personnel deploying from non-Arctic areas to the Arctic inevitably take some time to acclimate psychologically and physiologically; units face a learning curve as they adjust to operating in this unique region. These polar-specific issues should be studied in greater depth. TTX participants also mentioned that most military personnel also lack training in the Arctic environment, especially joint interoperable training, and have limited Arctic knowledge and expertise. The need for a cadre of Arctic-trained and -savvy USCG and other services' members, across all ranks and specialties, will grow severer because the polar fleet will expand in the near future with three PSCs being added. In addition to the need to train and maintain an ice-capable force, the reduced readiness of equipment and personnel limits movement and maneuver and poses risks to human life for operations in the Arctic.

### Interviews with Experts

The RAND team conducted more than 20 interviews with officials representing an array of USN and USCG commands. We focused primarily on interviewing people from these two services, in contrast to the inclusion of people from all six services and elsewhere in the TTX, because the legislation mandating this study emphasized maritime access, and particularly the USCG. It was important to understand maritime issues in greater depth. All interviews were conducted on a nonattributorial basis to foster candid responses. This section explores key themes mentioned by experts during our interviews but does not directly quote or cite anyone or any office. There is considerable overlap with the "overarching themes" discussed during the TTX and described above; the two methods complement one another by confirming priority issues and rounding out specifics, even at the expense of some reiteration.

### *Important but Limited U.S. Capacity*

The USCG currently operates two icebreakers: the medium icebreaker (but larger vessel by tonnage) USCGC *Healy* (commissioned in 1999, delivered in 2000) and the heavy icebreaker USCGC *Polar Star* (commissioned in 1976). The USCGC *Healy* is based in Seattle, Washington, and normally patrols the U.S. Arctic during the summer months before undergoing heavy maintenance. The USCGC *Polar Star* is also based in Seattle and normally operates in the Antarctic to lead Operation Deep Freeze for part of the year to resupply McMurdo Station before returning to Seattle to undergo heavy maintenance.<sup>249</sup> The USCGC *Polar Star* also occasionally

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<sup>249</sup> USCG, "USCGC Polar Star (WAGB 10)," webpage, undated-a.

operates in the Arctic. Seattle has the requisite facilities to undertake the significant maintenance each ship annually requires.

The USCGC *Polar Star* is 45 years old. It is maintained with parts from an inoperable ship from the same class, the USCGC *Polar Sea*.<sup>250</sup> The USCGC *Healy*, too, has suffered problems in recent years, including issues with logistics and supply chains. Furthermore, the USCGC *Healy* is limited in its ability to develop and sustain domain awareness in the Arctic, although it remains an important scientific and domain-awareness capability despite the challenges of persistent presence in the extreme Arctic environment.

Both active vessels possess deep drafts; this means that they normally cannot traverse or dock alongside the Arctic Alaskan coast, although they have occasionally anchored off Nome and once off Utqiagvik. New vessels will need to have a shallower draft if they are to operate closer to or dock at coastal Arctic Alaskan communities. The USCGC *Healy* and the USCGC *Polar Star* can operate only their small craft during the summer months; during the end of the summer season and winter season, their equipment, such as their radar systems, can freeze.

The USCGC *Healy* can deploy two HH-65 Dolphin helicopters, but the icebreakers often do not sail with helicopters. The HH-65's use is also limited by the Arctic's extreme climate causing problems with icing.

Non-ice-hardened ships typically do not operate anywhere near the vicinity of Arctic ice for safety reasons. Ice-hardened vessels, which have strengthened hulls and additional engine power (although they are not classified as icebreakers), incur significantly higher capital and fuel costs than non-ice-hardened vessels do and yet are designed for operating in only partially ice-covered waters.<sup>251</sup>

The USCG is currently working to augment and ultimately replace its existing fleet with the PSC program. Currently, the USCG cannot cover all of the U.S. Arctic with just one or even two icebreakers, because of the vastness of the area and the relative slowness of these large ships. For example, the ability to effectively respond to maritime SAR incidents in a timely way is dependent on the proximity of the vessel and the availability of other nearby response mechanisms; a vessel being close and those other mechanisms being available at the same time is a historically unlikely set of circumstances given the vastness of the U.S. Arctic and general lack of within-region capability.

Apart from expanding its icebreaker fleet, the USCG could investigate the use of other capabilities to supported sustained regional presence, such as autonomous underwater vehicles (AUVs). AUVs can help monitor different aspects of the environment, including sea ice, and can be deployed from other vessels, such as icebreakers. The USCG's Research, Development, Test

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<sup>250</sup> Christopher Woody, "The Heavy-Duty Ship the US Needs to Protect Its Thawing Border with Russia 'Is Just Falling Apart,' Captain Says," *Insider*, March 10, 2021a.

<sup>251</sup> See Tomi Solakivi, Tuomas Kiiski, and Lauri Ojala, "On the Cost of Ice: Estimating the Premium of Ice Class Container Vessels," *Maritime Economics and Logistics*, Vol. 21, June 1, 2019.

and Evaluation and Innovation program has already accomplished research projects on UASs in the Arctic, including a joint exercise with ConocoPhillips and on the USCGC *Healy*.

### *Russian Capacity and Capability*

There was general consensus among the experts we interviewed that Russia needs more icebreakers than the United States does to fulfill its national objectives. Russia possesses vastly more Arctic territory than the United States does; has an economy that is heavily dependent on Arctic oil, gas, and minerals; and has about 200 times more people living north of the Arctic Circle than the United States does.<sup>252</sup> The Arctic constitutes its entire northern border, and the NSR is an important means of moving goods throughout much of its territory.

Historically, the USCG has enjoyed a relatively positive working relationship with the Coast Guard of the Border Service of the FSB, as demonstrated, for instance, through the ACGF. However, cooperation in this forum was affected at the time of this writing by the ongoing war in Ukraine. The USCG also has historical experience engaging with Russia's coast guard on tactical matters, including communication (e.g., of patrol intentions) to lessen the opportunity for misunderstanding.

### *Limited Communications*

Interviewees generally expressed agreement that having persistent and reliable communications remained an important issue that needed to be resolved. For example, the USCGC *Healy*'s 2021 traverse of the NWP was hampered by communication issues.<sup>253</sup>

VHF-based FM and AIS signals and ultra-HF transmissions can travel only as far as the radio horizon, which is just beyond the line of sight. HF signals can travel much farther but are subject to often-severe polar ionospheric interference, significantly degrading transmission quality. Ultralow-frequency transmissions can also travel far but suffer from limited bandwidth.

Most geosynchronous and orbiting satellites are situated far from the Arctic Circle, making satellite reception difficult, which affects communication as well as navigation. Geosynchronous satellites are particularly useful for communications because they always remain over the same location on earth. Geostationary satellites that are positioned over the equator appear to be in the same position relative to the satellite transceiver, thus negating the need for a tracking station. The satellite's signal fades, however, as the distance between the satellite transceiver and the geosynchronous satellite increases, with noticeable degradation in the distant polar regions. The Mobile User Objective System, used by DoD, is in geosynchronous orbit but is usable in the lower Arctic latitudes. However, it is not consistently available to the USCG.

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<sup>252</sup> Center for Circumpolar Security Studies, 2020a.

<sup>253</sup> Michael Fabey, "US Coast Guard Icebreaker Healy Returns to Homeport Following Northwest Passage Transit and Circumnavigation of North America," Janes Defense, November 22, 2021.

An option for tactical communication is NATO Link 16 secure communication equipment. Link 16 is a digital “anti-jam, secure, data and voice system.”<sup>254</sup> It is “supported by the Joint Tactical Information Distribution System (JTIDS) and Multifunctional Information Distribution [System] (MIDS) terminals.”<sup>255</sup> Link 16 is interoperable between air, sea, and surface units across many U.S. and NATO assets. The new PSCs are expected to have a complete Link 16 suite. The USCG is exploring collaborating with private firms to develop LEO satellite constellations over the Arctic.<sup>256</sup>

### *Limited Domain Awareness*

This topic is closely interwoven with both USCG icebreakers and Arctic communications. DoD defines *maritime domain awareness* as “the effective understanding of anything associated with the maritime domain that could impact the security, safety, economy, or environment of a nation.”<sup>257</sup> The United States currently possesses limited domain awareness in its Arctic for a variety of reasons. There are few communities, and infrastructure is poor. The USCG has only two icebreakers, only one of which is usually active in the U.S. Arctic each year. It simply cannot cover the entire U.S. Arctic, nor can it dock except in a few places along the Alaskan coast because of shallow waters. As conventionally powered vessels, U.S. icebreakers also cannot operate for as long as their Russian nuclear counterparts.

USCG and DoD aircraft can operate surveillance or SAR missions only when the weather is favorable; ice is a persistent reason aircraft are often grounded. Communications remain difficult, too, both between USCG assets and with other DoD service components and civilians.

Russia and China might increasingly stress U.S. Arctic domain awareness.<sup>258</sup> Russia has much more-comprehensive domain awareness over its Arctic than the United States does over the U.S. Arctic by virtue of its sheer number of icebreakers, SAR stations, and military and dual-use facilities scattered across the length of the NSR, though Russia also has stretches of its Arctic with fewer domain awareness capabilities. China is not currently a threat in the Arctic, but may be trying to establish better domain awareness in the region.

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<sup>254</sup> B. E. White, “Tactical Data Links, Air Traffic Management, and Software Programmable Radios,” *Gateway to the New Millennium: 18th Digital Avionics System Conference—Proceedings*, Institute of Electrical and Electronics Engineers, 1999, p. 5.C.5-1; also discussed in an interview with USCG district 17 personnel, October 15, 2021.

<sup>255</sup> White, 1999, p. 5.C.5-1.

<sup>256</sup> Murray, Kathy, “Coast Guard Research Aimed at Improving Performance at High Altitudes,” *MyCG*, December 8, 2021; members of the USCG Marine Transportation Systems (CG-5PW) Arctic policy team, interview with the authors, October 19, 2021.

<sup>257</sup> Joint Chiefs of Staff, “Maritime Domain Awareness,” *DOD Dictionary of Military and Associated Terms*, DoD, June 2020, p. 136.

<sup>258</sup> USCG National Maritime Intelligence Center personnel, interview with the authors, November 15, 2021.

The potential for growth in illegal fishing is another reason that demand for domain awareness could grow. Furthermore, much domain awareness is needed when responding to a SAR<sup>259</sup> or oil spill incident, or assisting with HA/DR.

The USCG is working to enhance its domain awareness through both traditional and emerging technologies. As discussed previously, the USCG has funding for PSCs to augment and eventually replace the USCGC *Healy* and the USCGC *Polar Star*. These vessels are expected to greatly enhance U.S. Arctic domain awareness. The USN Office of Naval Research is developing the Arctic Mobile Observing System in cooperation with the *Healy*.<sup>260</sup> Finally, growth in AUV capability and the advent of high-altitude LEO satellite constellations could provide the USCG with enhanced domain awareness throughout the U.S. Arctic.

The USCG can interoperate with other Arctic littoral states' militaries to enhance its own domain awareness, including through training and exercises. For example, the USCG regularly conducts planned trainings with the Canadian Coast Guard. USCG Atlantic Area collaborates regularly with Canadian and Danish maritime forces in various exercises. These include the Canada-led Operation NANOOK and the Danish Joint Arctic Command-led Exercise Argus. The operational areas for these exercises are vast and have included the Labrador Sea, Davis Strait, and Baffin Bay, as well as internal waters of host countries. Closer to home, the USCG also collaborates with DoD service components in Arctic-focused exercises.

### *Physical Infrastructure Challenges*

Having adequate communications and domain awareness often relies on physical infrastructure. The U.S. Arctic, however, does not have sufficient or well-maintained physical infrastructure. There are no deepwater ports for the USCG except at Kodiak, Seward, and Dutch Harbor in Unalaska, all of which are well south of the Arctic Circle in southern Alaska. Nome has only a small dock. Seattle hosts the closest deepwater port to the U.S. Arctic with facilities for maintenance and repair that would require a drydocking capability and is hence the most proximal facility capable of maintaining and repairing the USCGC *Healy* and the USCGC *Polar Star*. Runways in the U.S. Arctic are often primitive strips subject to extreme weather. Aircraft cannot fly in Arctic ice precipitation. That extreme weather also takes a heavy toll on communication infrastructure, sensors for surface and air domain awareness, and even hangars to protect aircraft.

Buildings, vessels, and aircraft require fuel, which can be difficult to deliver because of the extreme, rapidly changing weather. Aircraft require comprehensive anti-icing systems, a feature that is not always available. Icebreaker wires and electronics can also freeze under certain conditions.

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<sup>259</sup> The USCG has SAR responsibilities up to the North Pole.

<sup>260</sup> Arctic and Global Prediction; Ocean, Atmosphere and Space Sciences; Ocean Battlespace Sensing; Office of Naval Research; USN, "Arctic Mobile Observing System (AMOS)," webpage, undated.

### *Need for Specialized Personnel*

None of these factors can be addressed without personnel ready to work in the kind of extreme operational environment that the Arctic region presents. Armed forces and other personnel can require or otherwise benefit from specialized training to operate in the Arctic, including for survival purposes. Captains and their navigators need specialized training in navigating the ice and avoiding ice ridges. Communication specialists require an understanding of a variety of options to maintain contact with command. All personnel require specialized clothing. Divers require extreme cold-weather training and equipment to check icebreaker hulls and make any repairs during journeys. Engineering personnel need to be trained to undertake repairs in the extreme cold. Overall, interviews suggest relatively low availability of different types of necessary personnel specialized for working the extreme Arctic environment.

## Appendix D. Current and Potential Future U.S. Icebreaking Capabilities

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The Arctic (and general polar) capabilities maintained by each country are all part of larger armed forces with diverse capabilities and components. Specifically for icebreaking capabilities, which are uniquely in demand in the Arctic, we can narrow our view of what each country brings to the Arctic.<sup>261</sup> Current and known planned capabilities are included in this discussion.

### Background

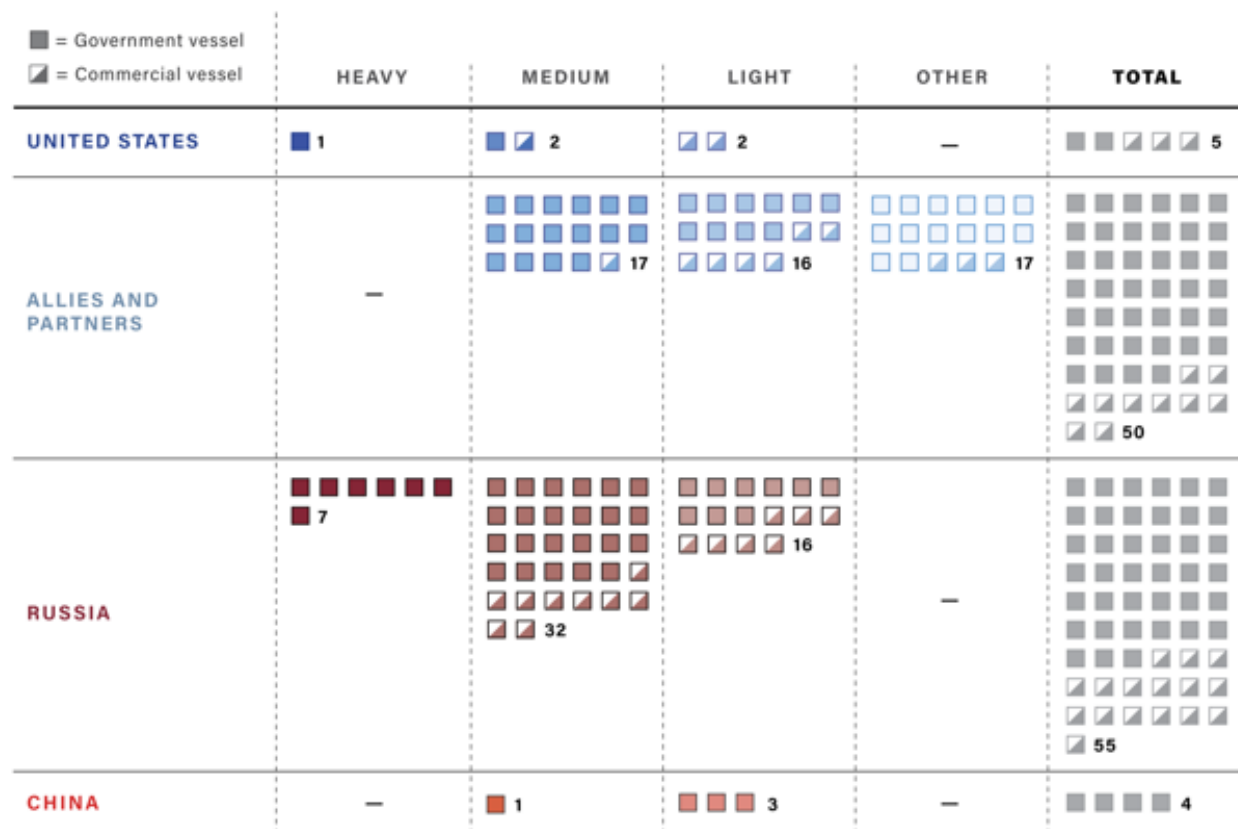
Icebreakers and other ice-capable ships often operate in isolation in the Arctic, without other types of support. They perform logistics and resupply missions, conduct scientific research and resource management, and represent a country's eyes and ears where other capabilities are limited. Traditionally, icebreakers have been categorized into three types: heavy, medium, and light. The category definitions are vague but tend to correspond to the thickness of ice and the operational capabilities of the ships. Broadly, the icebreaking capabilities of the countries analyzed, including commercial capabilities that were found, are shown in Figure D.1.

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<sup>261</sup> Australia is included in this chapter as having an Arctic capability, although its icebreaker is meant to operate in the Antarctic.



**Figure D.1. In-Service Heavy, Medium, and Light Polar Icebreakers, Both Government and Commercial**



NOTE: The “Allies and partners” row represents each of the countries described in the main report, noted in Table 3.1 in Chapter 3, as of July 2022.

In the early 2010s, IACS sought to standardize polar ratings more scientifically than the existing heavy, medium, and light ratings. The result was the development of seven PCs, shown in Table D.1. The differentiation reflects the fact that first-year ice is easiest to break, while second-year ice is harder, and multiyear ice harder still.

**Table D.1. Polar Classes**

<b>PC Ice Description (Based on World Meteorological Organization Sea Ice Nomenclature)</b>	
1	Year-round operation in all polar waters
2	Year-round operation in moderate multi-year ice conditions
3	Year-round operation in second-year ice which may include multi-year ice inclusions.
4	Year-round operation in thick first-year ice which may include older ice inclusions
5	Year-round operation in medium first-year ice which may include older ice inclusions
6	Summer/autumn operation in medium first-year ice which may include older ice inclusions
7	Summer/autumn operation in thin first-year ice which may include older ice inclusions

SOURCE: Reproduces information from IACS, *Requirements Concerning Polar Class*, revision 2, April 2016, p. 11.

The more-standard definitions permit new designs to be categorized. Icebreakers designed after 2012 all use the PC categorizations shown in Table D.1. Unlike Figure D.1, Tables D.2 to D.4 contain in-service and planned icebreakers, including identified relevant commercial capabilities.<sup>262</sup> Ships already in service are not categorized, but we used the PC descriptions to map the ice-capable ships of Australia, Canada, China, Denmark, Finland, France, Germany, Norway, Russia, Sweden, the UK, and the United States. The overall mapping of icebreakers is shown in Table D.3.

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<sup>262</sup> Current and planned capabilities shown in our report represent the data that we identified, which likely do not capture all current and planned capabilities around the world.

**Table D.2. Polar Class Ratings**

PC	Vessels	Old Categorization
1/2	25	Heavy
3/4	58	Medium
5	9	Light
5/6	40	Light
7	0	Light
Unknown	23	

SOURCES: Features data from 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; 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; Mike Glenn, "U.S. Icebreaker Gap with Russia a Growing Concern as Arctic 'Cold War' Heats Up," *Washington Times*, September 23, 2021; GlobalSecurity.org, "World Wide Icebreaker Classes," webpage, undated; Robert Hammitt, "Icebreakers: An Overview," *Polar Connection*, January 24, 2017; Janes, "Icebreakers: Russian Federation," website, updated March 15, 2022a; Maritime Executive, "Russian Shipyard Launches Missile-Carrying Icebreaker," October 28, 2019; Maritime Executive, "Finland and Sweden Collaborate to Design Next Icebreaker," November 2, 2020; Office of Waterways and Ocean Policy, USCG, "Major Icebreakers of the World," infographic, updated May 1, 2017; Office of Waterways and Ocean Policy, USCG, "Major Icebreakers of the World," infographic, updated 2020; Office of Waterways and Ocean Policy, USCG, "Homeports of Major Polar Icebreakers," updated April 5, 2022; Ronald O'Rourke, *Coast Guard Polar Security Cutter (Polar Icebreaker) Program: Background and Issues for Congress*, Congressional Research Service, RL34391, version 236, September 21, 2022; Atle Staalesen, "China's New Icebreaker Completes First Arctic Expedition," *Barents Observer*, September 29, 2020; and Atle Staalesen, "Russian Navy Builds More Icebreakers," *Barents Observer*, January 7, 2022.

**Table D.3. Polar Class Ratings, by Country, for Current and Known Planned Vessels**

Country	PC						Total
	1/2	3/4	5	5/6	7	Unknown	
United States	7	5	0	2	0	0	14
Canada	2	2	8	2	0	8	22
UK	0	0	1	0	0	1	2
France	0	0	0	1	0	1	2
Germany	0	0	0	1	0	7	8
Russia	18	38	0	17	0	0	73
Finland	0	7	0	4	0	0	11
China	2	1	0	3	0	0	6
Australia	0	1	0	0	0	0	1
Sweden	0	7	0	0	0	0	7
Denmark	0	0	0	7	0	0	7
Norway	0	1	0	1	0	6	8

SOURCES: Features data from Australian Antarctic Program, undated; Dalaklis, Drewniak, and Schröder-Hinrichs, 2018; Glenn, 2021; GlobalSecurity.org, undated; Hammitt, 2017; Janes, 2022a; Maritime Executive, 2019; Maritime Executive, 2020; Office of Waterways and Ocean Policy, 2017; Office of Waterways and Ocean Policy, 2020; Office of Waterways and Ocean Policy, 2022; O'Rourke, 2022; Staalesen, 2020; and Staalesen, 2022.

NOTE: Includes government and commercial vessels. Private-sector icebreakers are not included in these totals.

**Table D.4. Polar Class Ratings, by Country and Type, for Current and Known Planned Vessels**

<b>Class and Type</b>	<b>United States</b>	<b>Canada</b>	<b>UK</b>	<b>France</b>	<b>Germany</b>	<b>Russia</b>	<b>Finland</b>	<b>China</b>	<b>Australia</b>	<b>Sweden</b>	<b>Denmark</b>	<b>Norway</b>
<b>PC1 and PC2</b>												
In service	1	0	0	0	0	7	0	0	0	0	0	0
Future	3	2	0	0	0	11	0	2	0	0	0	0
Commercial	0	0	0	0	0	0	0	0	0	0	0	0
<b>PC3 and PC4</b>												
In service	1	2	0	0	0	23	7	1	1	4	0	0
Future	0	0	0	0	0	6	0	0	0	3	0	0
Commercial	1	0	0	0	0	9	0	0	0	0	0	1
<b>PC5</b>												
In service	0	1	1	0	0	0	0	0	0	0	0	0
Future	0	7	0	0	0	0	0	0	0	0	0	0
Commercial	0	0	0	0	0	0	0	0	0	0	0	0
<b>PC5 or PC6</b>												
In service	0	2	0	1	1	9	2	3	0	0	3	1
Future	0	0	0	0	0	1	0	0	0	0	0	0
Commercial	2	0	0	0	0	7	2	0	0	0	4	0
<b>PC7</b>												
In service	0	0	0	0	0	0	0	0	0	0	0	0
Future	0	0	0	0	0	0	0	0	0	0	0	0
Commercial	0	0	0	0	0	0	0	0	0	0	0	0
<b>Unknown</b>												
In service	0	8	1	1	4	0	0	0	0	0	0	0
Future	0	0	0	0	3	0	0	0	0	0	0	3
Commercial	0	0	0	0	0	0	0	0	0	0	0	3

<b>Class and Type</b>	<b>United States</b>	<b>Canada</b>	<b>UK</b>	<b>France</b>	<b>Germany</b>	<b>Russia</b>	<b>Finland</b>	<b>China</b>	<b>Australia</b>	<b>Sweden</b>	<b>Denmark</b>	<b>Norway</b>
Total												
In service	2	13	2	2	5	39	9	4	1	4	3	1
Future	3	9	0	0	3	18	0	2	0	3	0	3
Commercial	3	0	0	0	0	16	2	0	0	0	4	4

SOURCES: Features data from Australian Antarctic Program, undated; Dalaklis, Drewniak, and Schröder-Hinrichs, 2018; Glenn, 2021; GlobalSecurity.org, undated; Hammitt, 2017; Janes, 2022a; Maritime Executive, 2019; Maritime Executive, 2020; Office of Waterways and Ocean Policy, 2017; Office of Waterways and Ocean Policy, 2020; Office of Waterways and Ocean Policy, 2022; O'Rourke, 2022; Staalesen, 2020; and Staalesen, 2022.

For comparison, the old categorization titles are added in the “old categorization” column. The PC categorizations allow for more detail than the old categorizations. The PC ratings were created as part of this analysis and represent the best estimates we have for how in-service icebreakers would fit into the PC categorization. The majority of the icebreakers in existence today fit in the PC3/PC4 category, meaning that these ships are capable of year-round operation in second-year ice, which can include multiyear and old ice inclusions. When separated by country, we can see that the vast majority of capability is Russia’s. Table D.3 shows each country and the PC categorization of its capabilities.

Understanding which ships are currently in service and which are still planned reveals what capabilities countries have now and what they plan for the future. Table D.4 shows which capabilities are current (in service), planned, and commercial.

Table D.4 shows that the United States has one current government icebreaker that falls into the PC1/PC2 category and three that are planned for the future. The United States also has three commercial icebreakers, one PC3/PC4 and two PC5/PC6. Russia has the most icebreakers. This makes sense because Russia possesses the largest Arctic border. Canada and Finland have the most in-service NATO, allied, and partner icebreakers. The United States has two military and three commercial in service and had three additional icebreakers authorized as of July 2022. The United States is able to maintain presence in the Arctic and Antarctic for only part of the year but has the potential to increase presence in the coming years.

## Generating Presence

So far, we have discussed the size of current and planned fleets, but we have not looked more directly at the Arctic presence (practical availability for operations in the region) that is or could be generated as a result. To do so, we also needed to consider operational and maintenance cycles and the roles some vessels do and could play in Antarctica. Although the number of vessels in a country’s fleet helped us understand the total inventory, not every ship is available at any given time for operations. To better understand how fleet size translates into the underway presence the USCG can maintain, we examined the maintenance and operational cycle for each class.<sup>263</sup>

### *Operational and Maintenance Cycles*

Operations and maintenance for USCG cutters vary between ship classes. Operations and maintenance for selected current and future USCG cutters and cutter classes is shown in Figure D.2.

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<sup>263</sup> We use the term *underway presence* to denote the number of days ships are underway performing missions. The calculation of underway presence does not account for the days on station in specific mission areas.

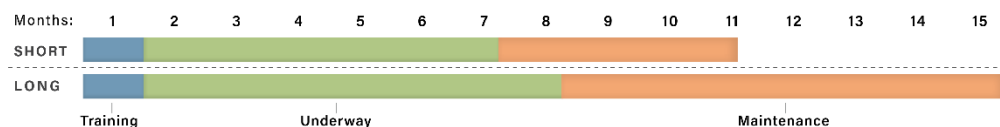
**Figure D.2. Operations and Maintenance for Selected Current and Future U.S. Coast Guard Cutters**

SHIP CLASS	Days per year		Docking periodicity
	Underway	Maintenance	
USCGC <i>Healy</i> (WAGB-20)	185 to 215	155 to 170	3 years
USCGC <i>Polar Star</i> (WAGB-10)	185 to 215	144 to 170	1 years
Legend-class Cutter (WMSL-750)	185 to 215	135 to 170	5 years
Polar Security Cutter	185 to 215	135 to 170	3 years
Arctic Security Cutter	185 to 215	135 to 170	3 years

NOTE: Legend-class cutters are also known as NSCs. PSC and ASC operations and maintenance are assumed.

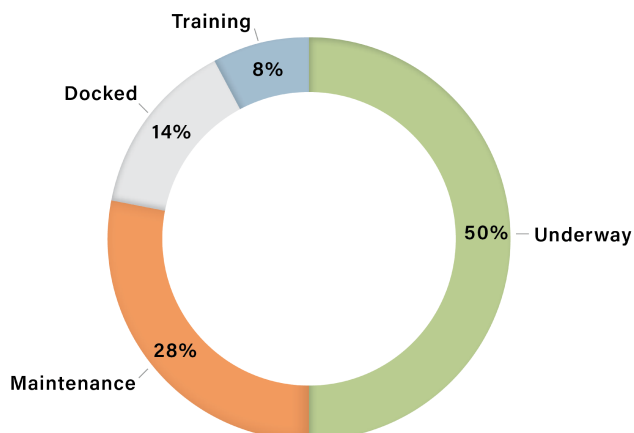
A given USCG vessel is typically underway less than half of the year and a maximum of 185 days, depending on the ship class. Training events that take place prior to getting underway are estimated to take around a month. Annual maintenance is performed at the operating station, with major docking maintenance packages at varied intervals. The dockings are assumed to typically fit within the time period the cutter would have spent at the operating station between patrols and do not affect the following underway period. In all, we get an operation and maintenance cycle that lasts between 11 and 15 months, as shown in Figure D.3.

**Figure D.3. U.S. Coast Guard Icebreaking Notional Short and Long Cycles**



As a scenario to support our calculations, we assumed that each operational and maintenance cycle lasted 12 months, which represents how the existing fleet operates. Notionally, a single PSC could provide half a year of underway presence (0.5 presence), as shown in Figure D.4.

**Figure D.4. Notional Polar Security Cutter Metrics: Three-Year Average as a Fraction of Time**



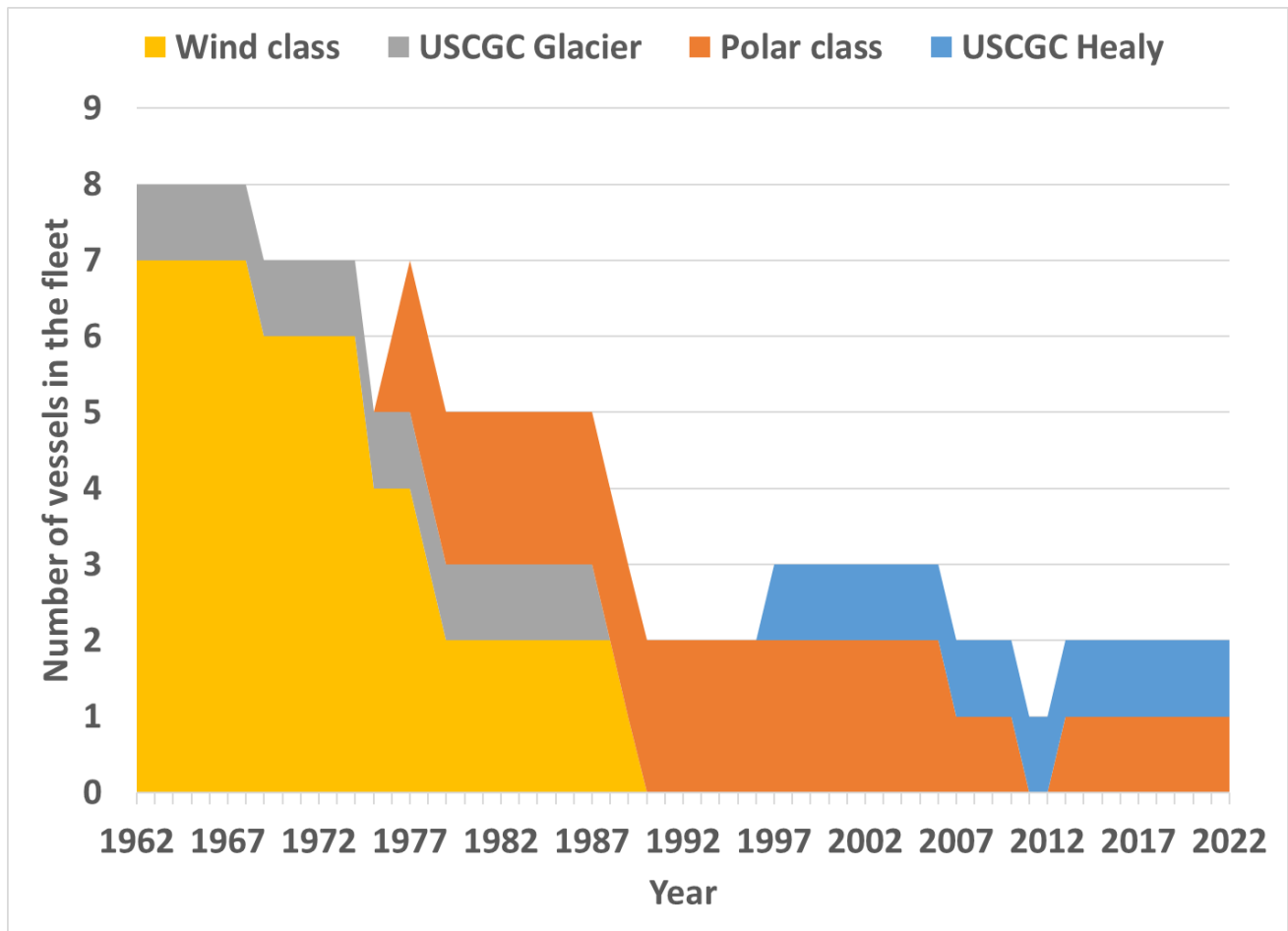
As examples, a fleet of three PSCs would provide a notional 1.5 underway presence; a fleet of six PSCs would provide a notional 3.0 underway presence; and a fleet of six PSCs and three ASCs would provide a notional 4.5 underway presence.

#### *Fleet Possibilities*

In 2022, the USCG has two operational polar icebreakers: the USCGC *Polar Star* and the USCGC *Healy*. Historically, aside from the period when the *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 seen in Figure D.5. At its peak, the USCG had eight icebreakers capable of operating in the Arctic or Antarctic. The size of the USCG icebreaker fleet declined as the Wind class and the USCGC *Glacier* aged out, which corresponded with the end of the Cold War.



Figure D.5. U.S. Coast Guard Icebreaking Fleet, 1962 Through 2022



SOURCE: 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.

As of 2022, the U.S. government had authorized three PSCs for construction. Additional PSCs and any ASCs remain conceptual. An expanding mission set, beyond the scientific missions into more security missions reminiscent of the Cold War era, would result in the need for more icebreakers, although the desired number and mix are not yet clear. The scenarios and assumptions we describe here do not represent the full fleet mix possibilities but reflect recent publicly available discussions and documents.<sup>264</sup> The two current operational icebreakers, the *Polar Star* and the *Healy*, are planned to be in service through the introduction of the PSC class. With the current service-life extension program for the *Polar Star*, we assumed that the service life would continue through the introduction of PSC 1, with a planned retirement when PSC 2 is operational.

<sup>264</sup> O'Rourke, 2022.

The USCGC *Healy* has the possibility of operating much longer with a ten-year service-life extension program that could enable operations through 2037. The scientific equipment that the *Healy* carries might not be introduced on a future PSC or ASC, although inclusion of such scientific equipment and instrumentation would be required to fully replace the *Healy*'s science mission.

We assumed that the first three PSCs would be delivered every 18 months starting with PSC 1 delivery in the third or fourth quarter of 2025. If directed by the presidential administration and authorized and funded by Congress, the USCG could authorize additional PSCs or ASCs. For the purposes of our analysis, we assumed an additional 18 months between PSC 3 and any future (currently conceptual) PSC 4 to account for long-lead materials being purchased in late 2023 or early 2024. Finally, we assumed that any (still-proposed) ASCs would come after the PSCs are built and that any future acquisition program would run four to six years, depending on the level of design.

Conceptually, if the three PSCs that are currently authorized are the only new icebreaking vessels acquired, USCG operations would not be radically different from today's. When PSC 1 is delivered in 2025 and assumed ready for its first patrol in 2027, the USCG would have three operational icebreakers for the first time since the USCGC *Polar Sea* left operational service in 2010. If the *Polar Star* retires when PSC 2 becomes operational around 2029, the USCG would continue to have three operational icebreakers until a third PSC delivers and increases the overall fleet to four (the *Healy* plus three PSCs).

Notionally, a larger fleet of PSCs and ASCs would provide a greater increase in USCG operations for both poles (although the focus of our report is the Arctic) and more agility in conducting rescue operations—for example, in the event that one of the icebreaking vessels were to become beset in ice. We made some additional assumptions in order to analyze what the impact of expanding the fleet beyond three PSCs might look like:

- First, on basing, we assumed that three PSCs would be stationed in Seattle, just like the *Polar Star*, the *Polar Sea* (inactive but present), and the *Healy* are now.
- Additional PSCs would be stationed at a yet-undefined base along the U.S. East Coast, in order to more efficiently respond in the eastern North American Arctic and the European Arctic.
- Notional ASCs could be stationed together for operational and maintenance economy, possibly colocated with any PSCs in Seattle or along the East Coast, or perhaps at a different location.
- Theoretically, with three PSCs, a docking maintenance provider would have one docking per year consistently. ASCs would also provide a demand for dockings. Like the PSCs would, three ASCs at one operational location would notionally need maintenance providers to perform one docking per year.

We did not attempt to identify a specific recommended mix of icebreakers and, for illustrative purposes, employed notional fleet mixes, which are not the only mixes the U.S. government might consider if a decision is made to further expand investment in icebreaking capability.

At the time of this writing, the USCGC *Healy* typically performs Arctic operations and the USCGC *Polar Star* performs Antarctic operations. Those demands do not appear to be decreasing. Therefore, for the future, we assumed that at least one PSC would perform the required yearly breakout of the USAP's McMurdo Station to allow logistics to flow in and replenish it and conduct an Antarctic patrol each year (replacing the *Polar Star*) and one would perform an Arctic patrol each year (replacing the *Healy*).

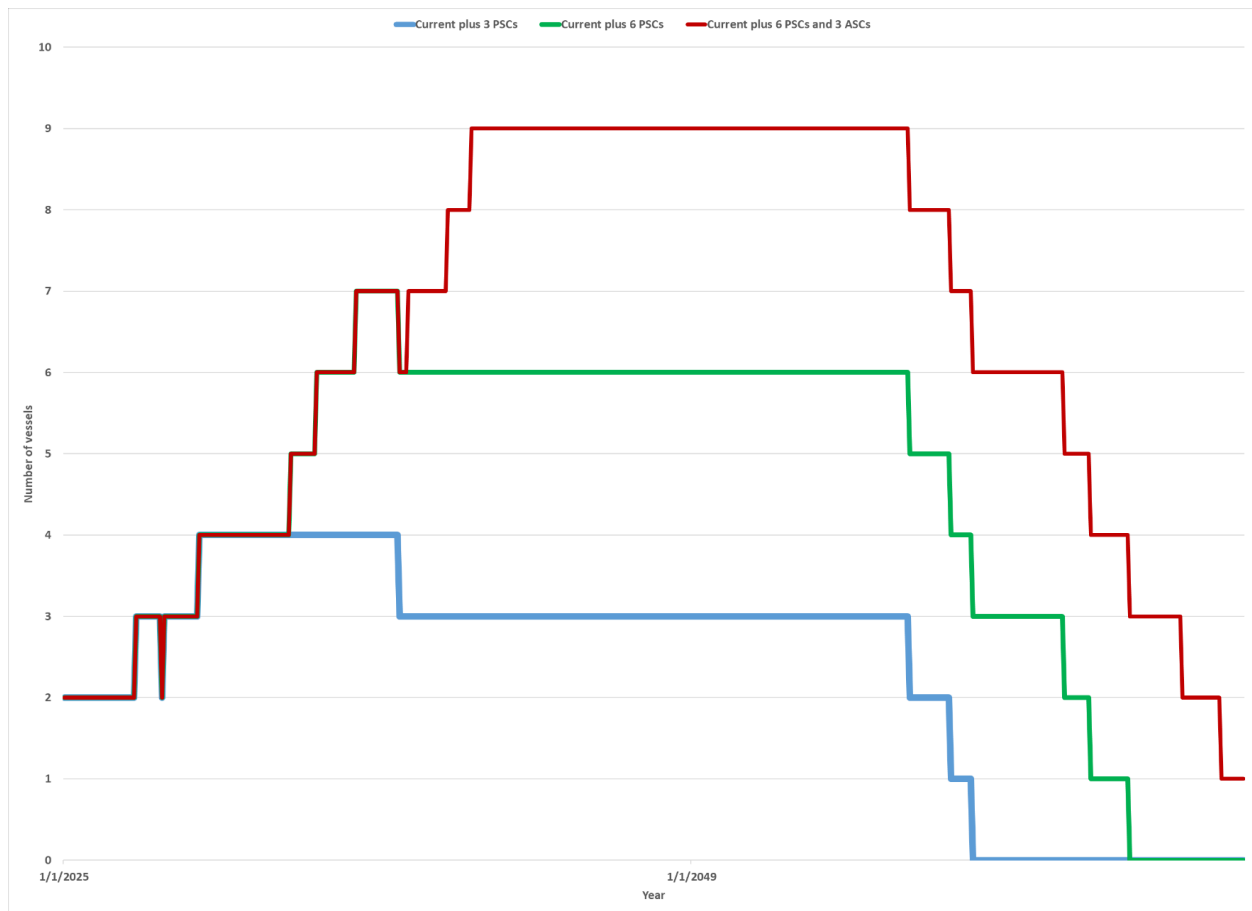
In one scenario, we assumed that one PSC would continue to perform Antarctic operations. A notional total fleet of three PSCs would then allow the other two PSCs to operate in the Arctic and provide around 1.0 underway presence in the Arctic. This would likely result in one icebreaker being on station in the Arctic at any given time throughout the year. Having three PSCs represents a 0.5 underway presence increase over the current fleet. During the two years of overlap with the USCGC *Healy*, when a third icebreaker is available, the USCG could choose to use that additional 0.5 presence in the Arctic to provide 1.5 underway presence or begin performing two-icebreaker operations again for Antarctic operations. Historically, when the long-retired Wind class has deployed two or more strong, the USCG would be able to meet other objectives, such as supply the USAP's Palmer Station in the Antarctic, underwater mapping, and other operations that a single ship cannot undertake.

In a second scenario, we assumed a fleet of six PSCs. In this case, one PSC continued to perform Antarctic operations. The increase in fleet size by three additional PSCs could allow four PSCs to operate in the Arctic and provide around 2.0 underway presence in the Arctic. This would likely result in two icebreakers being on station at different locations in the Arctic at any given time throughout the year. Six PSCs represents a 1.5 underway presence increase over the three fleet. This would mean a broader USCG Arctic presence than the current patrolling that takes place, mostly off Alaska and in the North American west Arctic. The six-PSC fleet would also permit regular two-icebreaker operations again for Antarctic operations, or more if the additional presence were applied to the Antarctic instead of the Arctic.

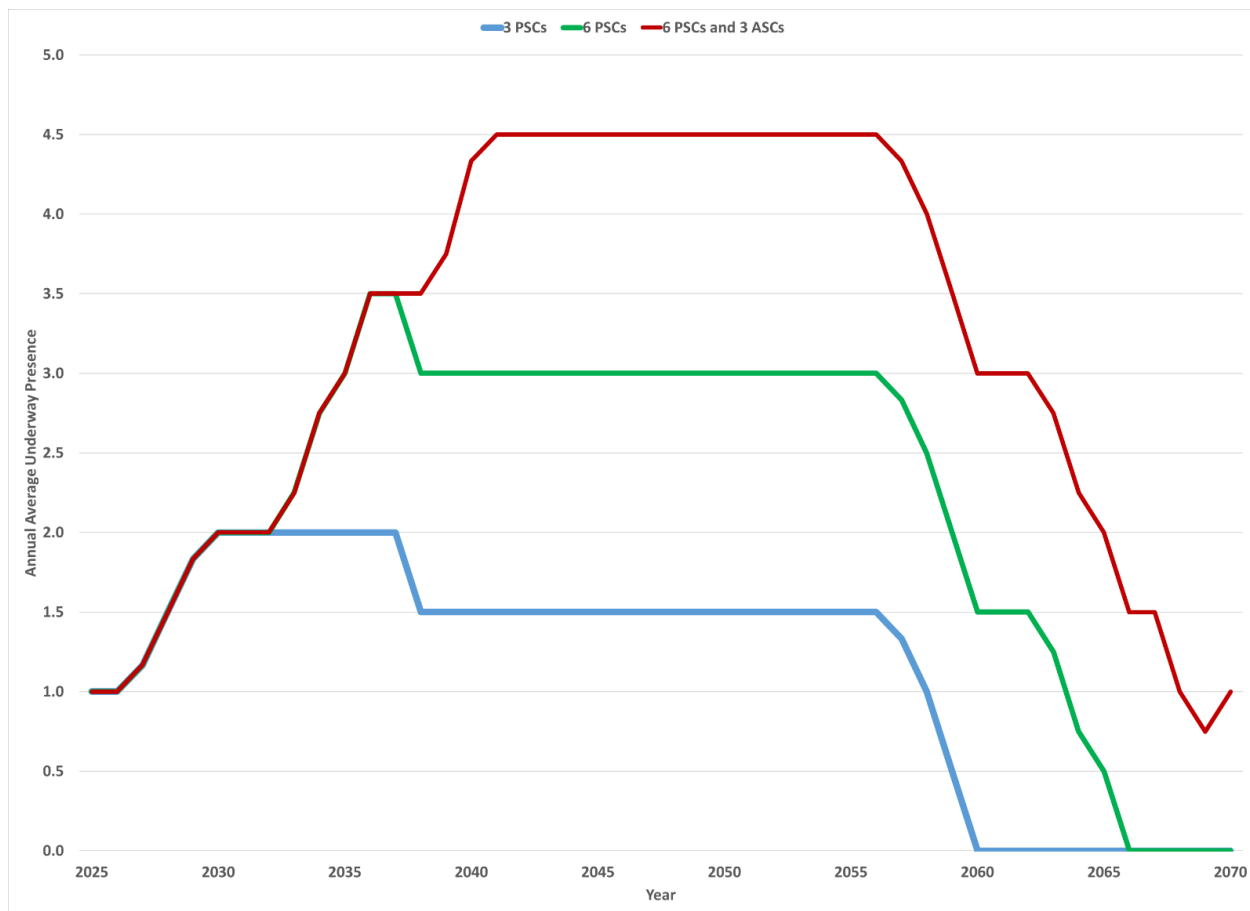
In a final scenario, we assumed six PSCs and three ASCs. Two PSCs might continue to perform Antarctic operations. The increase in fleet size by three ASCs could allow four PSCs plus three ASCs to operate in the Arctic and provide around 3.5 underway presence in the Arctic. This would likely result in three to four icebreakers being on station at different locations in the Arctic at any given time throughout the year. Three ASCs represent a 1.5 underway presence increase over the six-PSC fleet. During the eight years of overlap with the USCGC *Healy*, when a seventh icebreaker is available, the USCG could choose to use that additional 0.5 presence in the Arctic to provide 2.5 underway presence.

Figure D.6, Table D.5, and Figure D.7 illustrate some implications of the scenarios described above. These are illustrative and do not represent the variety of possible fleet mixes that might be considered.

**Figure D.6. A Notional U.S. Coast Guard Icebreaking Fleet Size over Time**



**Figure D.7. Notional Underway Presence Using Current, Planned, and Conceptual Icebreakers**



Calculating the presence that results from the different fleet sizes uses the notional information discussed earlier in this appendix. Table D.5 shows the notional underway presence generated by the different fleet-size scenarios; these are merely examples to illustrate differences and do not represent USCG-defined options.

Adding the planned (and conceptual) commissioning dates for the PSCs and any eventual ASCs, along with the plans for the USCGC *Polar Star* and the USCGC *Healy*, a realistic (though still notional) picture of fleet capacity can be seen in Figure D.7.

The insights above provide a sense of what might be achieved with additional icebreaking capacity and capability. We do not, however, speculate on precisely what the appropriate force mix or size should be for the Arctic; doing so would require a formal force structure analysis.

## Appendix E. A Logic Model Connecting Strategic Goals with Mitigation Activities and Resilient, Ice-Capable Input Options

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Organizations use logic models to understand the structure of how their day-to-day input options and activities can lead to accomplishments that support their longer-term strategic goals. A logic model can take any of several forms, the most common of which is a series of hierarchical relationships and linkages.<sup>265</sup> We designed a logic model that links the goals for the region as articulated in strategy documents to activities or actions that the USCG in particular (as the research sponsor) needs to conduct to help achieve these in a joint context. It ultimately links these activities to inputs or needs to illustrate what might be required to ultimately support the achievement of strategic aims. We used this logic modeling approach as a way of concisely summarizing some of the information discussed by TTX participants.<sup>266</sup>

The 2019 DoD Arctic Strategy states that an aim for the Arctic is “a secure and stable region where U.S. national interests are safeguarded, the U.S. homeland is defended, and nations work cooperatively to address shared challenges.”<sup>267</sup> The strategy outlines three goals: Enhance Arctic operations, build Arctic awareness, and advance Arctic governance.<sup>268</sup> These high-level objectives correspond closely with the 2021 DHS Strategic Approach for Arctic Homeland Security goals of securing the homeland through persistent presence; strengthening access, response, and resilience; and supporting a rule-based order.<sup>269</sup>

All three of these strategic goals support six broad and fundamental interests laid out in the 2010 National Security Strategy and 2013 National Strategy for the Arctic Region (and its 2014 implementation plan): Meet U.S. national security needs, strengthen international cooperation, responsibly manage resources, protect the environment, support scientific research, and consider Indigenous communities. The strategic goals singularly and in combination align with the broad and fundamental interests.

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<sup>265</sup> Scott Savitz, Miriam Matthews, and Sarah Weiland, *Assessing Impact to Inform Decisions: A Toolkit on Measures for Policymakers*, RAND Corporation, TL-263-OSD, 2017.

<sup>266</sup> Scott Savitz, Henry H. Willis, Aaron C. Davenport, Martina Melliand, William Sasser, Elizabeth Tencza, and Dulani Woods, *Enhancing U.S. Coast Guard Metrics*, RAND Corporation, RR-1173-USCG, 2015.

<sup>267</sup> Office of the Under Secretary of Defense for Policy, DoD, *Report to Congress: Department of Defense Arctic Strategy*, June 2019, p. 1.

<sup>268</sup> Office of the Under Secretary of Defense for Policy, 2019, p. 1.

<sup>269</sup> Office of Strategy, Policy, and Plans, DHS, *Strategic Approach for Arctic Homeland Security*, February 17, 2021, p. 15.

## Methodology

The logic model was built using selected inputs from a literature review of Arctic strategy documents, workshop participant elicitations, prior published RAND research, and HSOAC SME contributions:

- 2010 National Security Strategy
- 2013 National Strategy for the Arctic Region
- 2014 Implementation Plan for the National Strategy for the Arctic Region
- 2019 DoD Arctic Strategy
- 2019 USCG Arctic Strategic Outlook
- 2019 USN Strategic Outlook for the Arctic
- 2020 Department of the Air Force Arctic Strategy
- 2021 Army Arctic strategy
- 2021 DHS Strategic Approach for Arctic Homeland Security
- 2021 USN strategic blueprint
- FY 2021 NDAA
- *Exploring Gaps in Arctic Governance*<sup>270</sup>
- our 2022 Arctic workshop
- additional SME inputs.

We collected the qualitative data and categorized each datum hierarchically by whether it was an input, activity, accomplishment, or outcome. Some inputs and activities were additionally grouped because they shared strategic similarities to the policymaker (for example, communications and networked capabilities) or where there were many examples of the phenomenon (for example, mobile assets and platforms could include vessels, such as the USCG's icebreakers and cutters or various services' rotary- and fixed-wing aircraft).

Our survey of inputs and activities focused primarily on those endogenous to the armed forces and their supporting organizations, understanding that there are, of course, exogenous inputs, such as the forecast of growing vessel traffic and density in seasonally icy waters. The analytic decision had a particular impact on the goal of advancing Arctic governance. For example, a primary input excluded would be that a NATO ally might choose to strengthen its own resolve to the organization independent of U.S. policies, or a secondary input excluded might be that growing Chinese economic investment might increase uncertainty about Greenland's potential geopolitical involvement. In contrast, our analysis did include interpretations of sovereign territory from UNCLOS, freedom-of-navigation principles, EEZs, continental shelves, and airspace because, although these would likely be informed by the actions of others, the United States has chosen and could choose to act unilaterally within the rule-based order.

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<sup>270</sup> Sacks et al., 2021.

Having categorized and grouped the inputs and activities, we suggested potential linkages in how these concepts could inform accomplishments and outcomes in support of the three strategic goals. These connections are necessarily complex and interlinked, but making them typically proves a useful exercise for the policymaker to understand the nuances and dependencies within the higher-level functions.

## Narrative Description

Figure E.1 can be read in either direction because it was constructed from both the left, with inputs and activities, and right, with the strategic goals. Starting in the middle, with a question, such as “What should the armed forces accomplish in the Arctic?” the logic model provides a useful exploration into “Why?” by tracing pathways to the right and “How?” by tracking back to the left. For example, the 2019 DoD Arctic Strategy prioritized that strategic competitors’ actions should be known. Why—and for what potential outcomes? To the right, we see that this accomplishment could lead to the potential outcomes in which

- joint and allied forces can promptly respond to threats (2019 DoD Arctic Strategy)
- the United States and its partners can generate more-durable power projection (2020 Department of the Air Force Arctic Strategy, 2021 Army Arctic strategy, and 2021 USN strategic blueprint)
- a favorable regional balance of power exists to support U.S., allied, and partner interests (2019 DoD Arctic Strategy)
- competitor influence and activities are deterred or actively countered (our 2022 Arctic TTX)
- the homeland’s vulnerability to attack is decreased (2019 DoD Arctic Strategy and 2021 DHS Strategic Approach for Arctic Homeland Security).

All these outcomes fall under the three strategic goals of enhancing Arctic operations, building Arctic awareness, and advancing Arctic governance. In contrast, to the left of the accomplishment column, the decisionmaker can understand how this output is attained. First, it would rely on such activities as

- recruiting, organizing, training, and equipping personnel across all domains (2019 DoD Arctic Strategy, 2021 Army Arctic strategy, and 2021 USN strategic blueprint)
- providing integrated and continuous C4ISR systems and technology throughout the region (2010 National Security Strategy, 2013 National Strategy for the Arctic Region, 2014 Implementation Plan for the National Strategy for the Arctic Region, 2019 DoD Arctic Strategy, 2019 USCG Arctic Strategic Outlook, our 2022 Arctic TTX)
- enforcing safety and encouraging stewardship by monitoring for illegal resource-extraction activities (2019 USCG Arctic Strategic Outlook)
- participating in and leading dialogue forums by strengthening trans- and intergovernmental institutions.<sup>271</sup>

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<sup>271</sup> Sacks et al., 2021.



Second, these activities are dependent on a full range of resilient, ice-capable inputs, such as

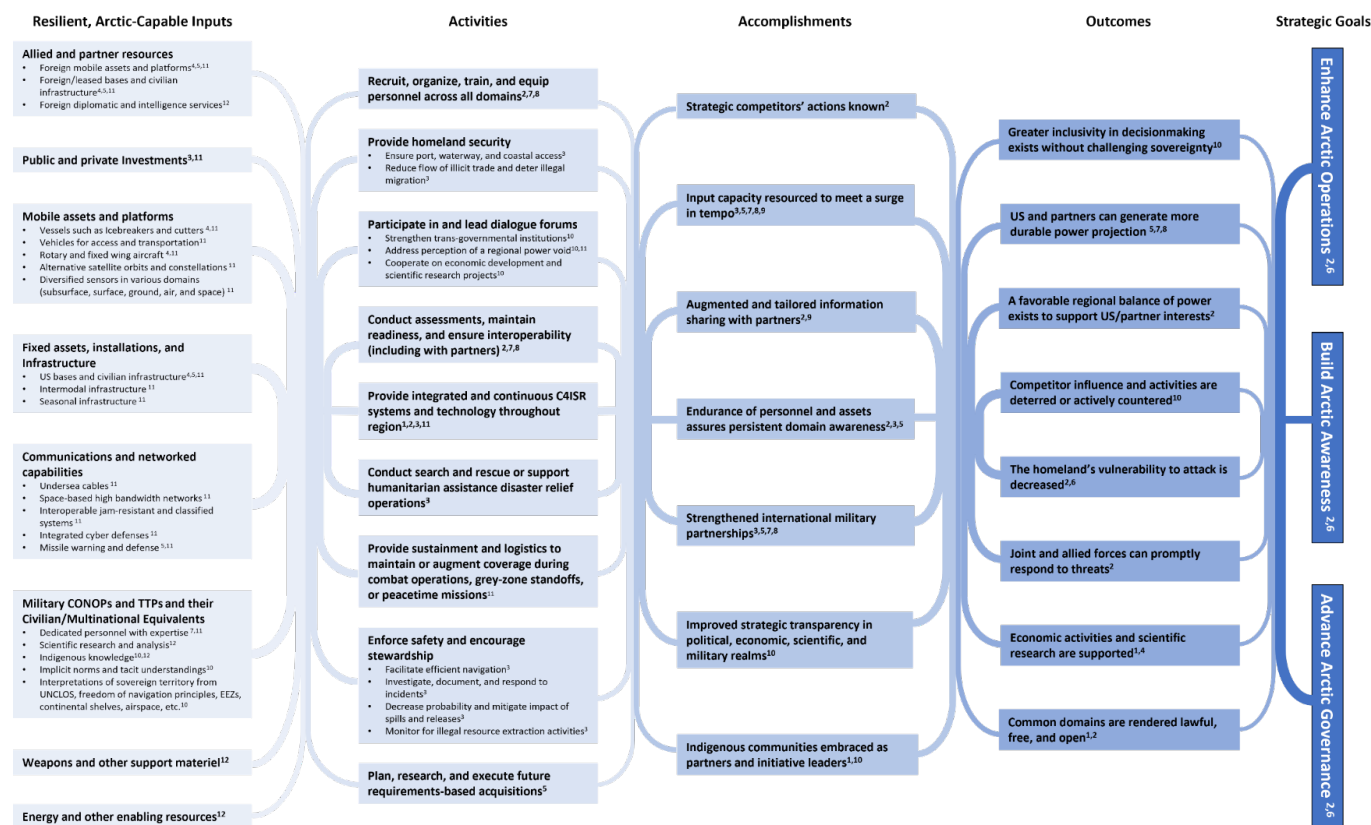
- mobile assets and platforms: for example, diversified sensors in various domains (our 2021 Arctic workshop)
- fixed assets, installations, and infrastructure: for example, U.S. bases (“Safeguarding U.S. National Interests in the Arctic and Antarctic Regions,”<sup>272</sup> 2020 Department of the Air Force Arctic Strategy, and our 2022 Arctic workshop)
- communications and networked capabilities: for example, interoperable jam-resistant and nonpublic systems (our 2022 Arctic workshop)
- military concept of operations and TTP and their civilian and multinational equivalents: for example, implicit norms and tacit understandings<sup>273</sup>
- allied and partner resources: for example, foreign diplomatic and intelligence services
- Indigenous community considerations.

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<sup>272</sup> Donald J. Trump, “Safeguarding U.S. National Interests in the Arctic and Antarctic Regions,” memorandum for the Secretary of State, the Secretary of Defense, the Secretary of Commerce, the Secretary of Energy, the Secretary of Homeland Security, the director of the Office of Management and Budget, and the assistant to the President for national security affairs, June 9, 2020.

<sup>273</sup> Sacks et al., 2021.

**Figure E.1. Logic Model of Inputs, Activities, Accomplishments, Outcomes, and Strategic Goals of the Armed Forces in the Arctic Region**



NOTE: The diagram is not meant to be mutually exclusive or comprehensively exhaustive but rather suggestive of the variety and hierarchy of strategic assumptions and participant outputs from our 2022 Arctic workshop. For example, the width of each connector, like those in a Sankey diagram, implies the number of relationships between inputs and activities, activities and accomplishments, and so forth. Additional qualitative data from surveys or interviews, for example, could be used to assess the validity and strength of the connections, as well as to understand whether and how these logic model components could be operationalized and tracked through performance metrics. The superscript numbers indicate sources that specify or support that element of the model. 1 = 2010 National Security Strategy or 2013 national strategy and 2014 implementation plan. 2 = 2019 DoD Arctic strategy. 3 = 2019 USCG Arctic Strategic Outlook. 4 = "Safeguarding U.S. National Interests in the Arctic and Antarctic Regions," 2020. 5 = 2020 Department of the Air Force Arctic Strategy. 6 = 2021 DHS Strategic Approach for Arctic Homeland Security. 7 = 2021 Army Arctic strategy. 8 = 2021 USN strategic blueprint. 9 = FY 2021 NDAA. 10 = Sacks et al., 2021. 11 = 2022 HSOAC Arctic workshop. 12 = Additional SME inputs.

## Appendix F. A Computer Simulation of Arctic Surface Maritime Access

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The methodology for projecting surface maritime accessibility in ice-covered waters utilizes the approach described by Stephenson and Smith and by Li et al. and is summarized here.<sup>274</sup>

Gridded monthly mean sea ice–concentration and –thickness projections for the area north of 45°N was obtained from one ensemble member of the CESM2 global climate system model<sup>275</sup> for the period 2022–2055, under a scenario of high greenhouse gas emissions (shared socioeconomic pathway [SSP] 5/representative concentration pathway [RCP] 8.5).<sup>276</sup> Data were

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<sup>274</sup> 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; Xueke Li, Scott R. Stephenson, Amanda H. Lynch, Michael A. Goldstein, David A. Bailey, and Siri Veland, “Arctic Shipping Guidance from the CMIP6 Ensemble on Operational and Infrastructural Timescales,” *Climatic Change*, Vol. 167, 2021.

<sup>275</sup> G. Danabasoglu, J.-F. Lamarque, J. Bacmeister, D. A. Bailey, A. K. DuVivier, J. Edwards, L. K. Emmons, J. Fasullo, R. Garcia, A. Gettelman, C. Hannay, M. M. Holland, W. G. Large, P. H. Lauritzen, D. M. Lawrence, J. T. M. Lenaerts, K. Lindsay, W. H. Lipscomb, M. J. Mills, R. Neale, K. W. Oleson, B. Otto-Bliesner, A. S. Phillips, W. Sacks, S. Tilmes, L. van Kampenhout, M. Vertenstein, A. Bertini, J. Dennis, C. Deser, C. Fischer, B. Fox-Kemper, J. E. Kay, D. Kinnison, P. J. Kushner, V. E. Larson, M. C. Long, S. Mickelson, J. K. Moore, E. Nienhouse, L. Polvani, P. J. Rasch, and W. G. Strand, “The Community Earth System Model Version 2 (CESM2),” *Journal of Advances in Modeling Earth Systems*, Vol. 12, No. 2, February 2020.

<sup>276</sup> RCPs are scenarios used for environmental modeling of radiative forcing, “a measure of the combined effect of greenhouse gases, aerosols, and other factors that can influence climate to trap additional heat” (Zeke Hausfather, “Explainer: The High-Emissions ‘RCP8.5’ Global Warming Scenario,” *Carbon Brief*, August 21, 2019). RCP8.5 is a high-emission scenario used frequently to represent what a future would look like if current practices were to continue. A complementary set of scenarios, SSPs, have been added to modelers’ toolbox in more-recent years to help model socioeconomic factors in considering effects of climate policy. SSP5 is

Fossil-fueled Development—Taking the Highway (High challenges to mitigation, low challenges to adaptation). This world places increasing faith in competitive markets, innovation and participatory societies to produce rapid technological progress and development of human capital as the path to sustainable development. Global markets are increasingly integrated. There are also strong investments in health, education, and institutions to enhance human and social capital. At the same time, the push for economic and social development is coupled with the exploitation of abundant fossil fuel resources and the adoption of resource and energy intensive lifestyles around the world. All these factors lead to rapid growth of the global economy, while global population peaks and declines in the 21st century. Local environmental problems like air pollution are successfully managed. There is faith in the ability to effectively manage social and ecological systems, including by geo-engineering if necessary. (Keywan Riahi, Detlef P. van Vuuren, Elmar Kriegler, Jae Edmonds, Brian C. O’Neill, Shinichiro Fujimori, Nico Bauer, Katherine Calvin, Rob Dellink, Oliver Fricko, Wolfgang Lutz, Alexander Popp, Jesus Crespo Cuaresma, Samir KC, Marian Leimbach, Leiwen Jiang, Tom Kram, Shilpa Rao, Johannes Emmerling, Kristie Ebi, Tomoko Hasegawa, Petr Havlik, Florian Humpenöder, Lara Aleluia Da Silva, Steve Smith, Elke Stehfest, Valentina Bosetti, Jiyong Eom, David Gernaat, Toshihiko Masui, Joeri Rogelj, Jessica Strefler, Laurent Drouet, Volker Krey, Gunnar Luderer, Mathijs Harmsen, Kiyoshi Takahashi, Lavinia Baumstark, Jonathan C. Doelman, Mikiko Kainuma, Zbigniew Klimont, Giacomo Marangoni, Hermann Lotze-Campen, Michael Obersteiner, Andrzej Tabeau, and Massimo Tavoni,

resampled to a uniform 25-km Lambert azimuthal equal-area projection using nearest-neighbor interpolation. Because of the relatively coarse resolution of CESM2 (approximately 1°) and the lack of data coverage in some straits of the Canadian Arctic Archipelago, accessibility in the NWP was assumed to be possible only in the largest marine passage (encompassing Lancaster Sound, Barrow Strait, Viscount Melville Sound, and the M’Clure Strait).

To derive estimates of recommended sailing speed in ice, the risk index outcome (RIO) was calculated based on CESM2 sea ice data.<sup>277</sup> RIO is a diagnostic metric representing the degree of risk that ice conditions pose to vessels. Accessibility is assumed to be possible where RIO is greater than 0. RIO is calculated as follows:

$$\text{RIO} = \sum_{i=1}^n C_i \text{RIV}_i,$$

where  $C_i$  is the ice concentration of ice thickness category  $I$  and  $\text{RIV}_i$  is the corresponding risk index value (RIV). RIV is a whole numeral ranging from –8 to 3 (higher values indicate lower risk), representing the combination of the vessel’s capability in ice (its PC) and the ice thickness at the location (see Table F.1). From the RIO, recommended vessel speed limits were obtained from IMO guidelines.

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“The Shared Socioeconomic Pathways and Their Energy, Land Use, and Greenhouse Gas Emissions Implications: An Overview,” *Global Environmental Change*, Vol. 42, January 2017, p. 157)

<sup>277</sup> IMO, “Guidance on Methodologies for Assessing Operational Capabilities and Limitations in Ice,” MSC.1/Circ.1519, June 6, 2016.

**Table F.1. Risk Index Values for a Variety of Vessel Classes and Ice Types**

Ice Type	Ice Thickness, in Meters	PC 1	PC 2	PC 3	PC 4	PC 5	PC 6	PC 7	Open Water
Open water	0	3	3	3	3	3	3	3	3
New ice	<0.1	3	3	3	3	3	2	2	1
Gray ice (young ice that is 10–15 cm thick)	0.1–0.15	3	3	3	3	3	2	2	0
Gray-white ice (young ice that is 15–30 cm thick)	0.15–0.3	3	3	3	3	3	2	2	–1
Thin first-year ice, 1st stage	0.3–0.5	2	2	2	2	2	2	1	–2
Thin first-year ice, 2nd stage	0.5–0.7	2	2	2	2	2	1	1	–3
Medium first-year ice less than 1 m thick	0.7–1	2	2	2	2	1	1	0	–4
Medium first-year ice	1–1.2	2	2	2	2	1	0	–1	–5
Thick first-year ice	1.2–2	2	2	2	1	0	–1	–2	–6
Second-year ice	2–2.25	2	1	1	0	–1	–2	–3	–7
Light multiyear ice less than 2.5 m thick	2.25–2.5	1	1	0	–1	–2	–3	–3	–8
Heavy multiyear ice	>2.5	1	0	–1	–2	–2	–3	–3	–8

SOURCE: Descriptions of ice types are from Antarctic Sea Ice Processes and Climate, “Glossary and Image Library,” webpage, last updated February 3, 2012.

Least-cost navigation routes were calculated using Dijkstra’s algorithm,<sup>278</sup> with travel time derived from gridded vessel speed values. Thirteen naval facilities and eight civilian ports were identified as route origin and destination points. Travel time between all origins and destinations using a heavy icebreaker (PC2) and a medium icebreaker (PC6) in June in 2025 and 2055, and travel time reductions in June from 2025 to 2055, are shown in Tables F.2 to F.20.

<sup>278</sup> Dijkstra’s algorithm is an algorithm for finding shortest paths between nodes in a network. It works by iteratively calculating the shortest path between an origin node and every other node that lies between the origin node and the destination node, stopping once the destination node has been reached.

**Table F.2. Average Percentage Travel Time Reduction from 21 Selected Ports to Each of the Other 20 Ports in June 2055 Compared with Times in 2025, for Polar Class 2 and 6 Vessels**

<b>Port</b>	<b>Location</b>	<b>PC2</b>	<b>PC6</b>
Port of Churchill	Canada	1	14
Port of Dikson	Russia	3	40
Naval Base Frederikshavn	Denmark	1	15
Port of Havøysund	Norway	3	18
Kangilínguit (Marine Station Grønnedal)	Greenland	0	15
Naval Port of Karlskrona	Sweden	1	15
NAS Keflavik	Iceland	1	16
Naval Base Kitsap	United States	1	36
Port of Kotzebue	United States	2	45
Nanisivik Naval Facility	Canada	4	31
Naval Station Newport	United States	0	13
Port of Nome	United States	2	45
Maritime Rescue Subcenter Pevek	Russia	3	47
Porkkala Naval Base	Finland	1	14
Ramsund Naval Station	Norway	2	17
Port of Raufarhofn	Iceland	1	17
Severomorsk Naval Facility	Russia	3	18
Port of Tasiilaq	Greenland	1	16
Port of Tiksi	Russia	4	47
Thule Air Base	Greenland	5	12
Port of Upernavik	Greenland	2	14

**Table F.3. Days to Travel Between Selected Ports in June 2025 Using a Polar Class 2 Vessel: North American Ports**

<b>Destination</b>	<b>Churchill</b>	<b>Kitsap</b>	<b>Kotzebue</b>	<b>Nanisivik</b>	<b>Newport</b>	<b>Nome</b>
Port of Churchill	0	12.77	8.01	4.28	5.65	8.29
Port of Dikson	8.75	9.32	4.56	5.3	9.2	4.84
Naval Base Frederikshavn	7.13	12.74	7.98	6.68	7.19	8.26
Port of Havøysund	7.14	10.82	6.06	5.18	7.29	6.34
Kangilínguit	3.1	11.13	6.36	2.64	3.58	6.65
Naval Port of Karlskrona	7.69	13.3	8.54	7.24	7.75	8.82
NAS Keflavik	4.83	11.86	7.09	4.37	4.95	7.38
Naval Base Kitsap	12.77	0	5.02	8.69	14.28	4.52
Port of Kotzebue	8.01	5.02	0	3.93	9.52	0.54
Nanisivik Naval Facility	4.28	8.69	3.93	0	5.79	4.21
Naval Station Newport	5.65	14.28	9.52	5.79	0	9.8
Port of Nome	8.29	4.52	0.54	4.21	9.8	0
Maritime Rescue Subcenter Pevek	8.52	6.15	1.55	4.44	10.03	1.67
Porkkala Naval Base	8.49	14.1	9.33	8.03	8.54	9.62
Ramsund Naval Station	6.75	11.16	6.39	5.48	6.89	6.68
Port of Raufarhofn	5.22	11.42	6.65	4.76	5.36	6.94
Severomorsk Naval Facility	7.66	10.99	6.24	5.46	7.8	6.51
Port of Tasiilaq	4.27	12.1	7.33	3.81	4.41	7.62
Thule Air Base	4.07	9.22	4.45	0.74	5.56	4.74
Port of Tiksi	9.16	7.92	3.29	5.4	10.58	3.44
Port of Upernavik	3.52	9.7	4.93	1.21	4.98	5.22

**Table F.4. Days to Travel Between Selected Ports in June 2025 Using a Polar Class 2 Vessel:  
Russian Ports**

<b>Destination</b>	<b>Dikson</b>	<b>Pevek</b>	<b>Severomorsk</b>	<b>Tiksi</b>
Port of Churchill	8.75	8.52	7.66	9.16
Port of Dikson	0	3.6	2.12	2.18
Naval Base Frederikshavn	4.7	7.28	2.95	6.48
Port of Havøysund	2.28	5.14	0.52	4.06
Kangilínguit	5.96	6.88	4.57	7.35
Karlskrona Naval Base	5.26	7.84	3.51	7.04
NAS Keflavik	4.58	6.61	3.18	5.97
Naval Base Kitsap	9.32	6.15	10.99	7.92
Port of Kotzebue	4.56	1.55	6.24	3.29
Nanisivik Naval Facility	5.3	4.44	5.46	5.4
Naval Station Newport	9.2	10.03	7.8	10.58
Port of Nome	4.84	1.67	6.51	3.44
Maritime Rescue Subcenter Pevek	3.6	0	5.28	1.84
Porkkala Naval Base	6.05	8.63	4.3	7.84
Ramsund Naval Station	2.76	5.5	1.01	4.55
Port of Raufarhofn	3.94	6.16	2.54	5.5
Severomorsk Naval Facility	2.12	5.28	0	3.96
Port of Tasiilaq	4.86	6.86	3.48	6.23
Thule Air Base	4.75	4.96	4.91	5.16
Port of Tiksi	2.18	1.84	3.96	0
Port of Upernavik	5.45	5.44	5.61	5.86



**Table F.5. Days to Travel Between Selected Ports in June 2025 Using a Polar Class 2 Vessel: European Ports**

Destination	Kangilínguit	Keflavík	Frederikshavn	Karlskrona	Porkkala	Havøysund	Raufarhofn	Tasiilaq	Ramsund	Thule	Upernavik
Port of Churchill	3.1	4.83	7.13	7.69	8.49	7.14	5.22	4.27	6.75	4.07	3.52
Port of Dikson	5.96	4.58	4.7	5.26	6.05	2.28	3.94	4.86	2.76	4.75	5.45
Naval Base Frederikshavn	4.04	2.36	0	0.57	1.36	2.43	2	3.17	1.94	6.37	5.63
Port of Havøysund	4.05	2.67	2.43	2.99	3.78	0	2.03	2.96	0.5	4.63	5.33
Kangilínguit	0	1.73	4.04	4.6	5.39	4.05	2.12	1.18	3.66	2.33	1.59
Naval Port of Karlskrona	4.6	2.92	0.57	0	0.8	2.99	2.56	3.73	2.5	6.93	6.19
NAS Keflavík	1.73	0	2.36	2.92	3.71	2.67	0.73	0.81	2.28	4.07	3.32
Naval Base Kitsap	11.13	11.86	12.74	13.3	14.1	10.82	11.42	12.1	11.16	9.22	9.7
Port of Kotzebue	6.36	7.09	7.98	8.54	9.33	6.06	6.65	7.33	6.39	4.45	4.93
Nanisivik Naval Facility	2.64	4.37	6.68	7.24	8.03	5.18	4.76	3.81	5.48	0.74	1.21
Naval Station Newport	3.58	4.95	7.19	7.75	8.54	7.29	5.36	4.41	6.89	5.56	4.98
Port of Nome	6.65	7.38	8.26	8.82	9.62	6.34	6.94	7.62	6.68	4.74	5.22
Maritime Rescue Subcenter Pevek	6.88	6.61	7.28	7.84	8.63	5.14	6.16	6.86	5.5	4.96	5.44
Porkkala Naval Base	5.39	3.71	1.36	0.8	0	3.78	3.35	4.52	3.3	7.73	6.98
Ramsund Naval Station	3.66	2.28	1.94	2.5	3.3	0.5	1.64	2.65	0	4.93	5.25
Port of Raufarhofn	2.12	0.73	2	2.56	3.35	2.03	0	1.19	1.64	4.46	3.71
Severomorsk Naval Facility	4.57	3.18	2.95	3.51	4.3	0.52	2.54	3.48	1.01	4.91	5.61
Port of Tasiilaq	1.18	0.81	3.17	3.73	4.52	2.96	1.19	0	2.65	3.51	2.77
Thule Air Base	2.33	4.07	6.37	6.93	7.73	4.63	4.46	3.51	4.93	0	0.77
Port of Tiksi	7.35	5.97	6.48	7.04	7.84	4.06	5.5	6.23	4.55	5.16	5.86
Port of Upernavik	1.59	3.32	5.63	6.19	6.98	5.33	3.71	2.77	5.25	0.77	0

**Table F.6. Days to Travel Between Selected Ports in June 2025 Using a Polar Class 6 Vessel: North American Ports**

<b>Destination</b>	<b>Nanisivik</b>	<b>Kitsap</b>	<b>Newport</b>	<b>Churchill</b>	<b>Kotzebue</b>	<b>Nome</b>
Port of Churchill	16.38	30.68	6.14	0	25.98	26.2
Port of Dikson	25.37	17.64	14.69	14.96	12.94	13.16
Naval Base Frederikshavn	17.96	25.61	7.19	7.54	20.91	21.13
Port of Havøysund	18.04	23.19	7.36	7.63	18.49	18.71
Naval Port of Karlskrona	18.52	26.17	7.75	8.1	21.47	21.69
NAS Keflavik	15.65	25.73	4.95	5.24	21.03	21.25
Kangilínguit	13.92	27.17	3.58	3.51	22.47	22.69
Naval Base Kitsap	41.09	0	30.41	30.68	5.02	4.52
Port of Kotzebue	36.39	5.02	25.71	25.98	0	0.54
Nanisivik Naval Facility	0	41.09	17.31	16.38	36.39	36.61
Naval Station Newport	17.31	30.41	0	6.14	25.71	25.93
Port of Nome	36.61	4.52	25.93	26.2	0.54	0
Maritime Rescue Subcenter Pevek	32.71	8.65	22.02	22.29	3.95	4.17
Porkkala Naval Base	19.31	26.96	8.54	8.9	22.26	22.48
Ramsund Naval Station	17.65	23.68	6.97	7.23	18.98	19.2
Port of Raufarhofn	16.06	25.08	5.37	5.64	20.38	20.6
Severomorsk Naval Facility	18.56	23.04	7.87	8.14	18.34	18.56
Port of Tasiilaq	15.14	26.32	4.46	4.73	21.62	21.84
Thule Air Base	11.18	30.2	6.42	5.48	25.5	25.72
Port of Tiksi	28.98	13.99	18.3	18.56	9.28	9.51
Port of Upernavik	12.14	29.02	5.24	4.3	24.31	24.54

**Table F.7. Days to Travel Between Selected Ports in June 2025 Using a Polar Class 6 Vessel:  
Russian Ports**

<b>Destination</b>	<b>Dikson</b>	<b>Pevek</b>	<b>Severomorsk</b>	<b>Tiksi</b>
Port of Churchill	14.96	22.29	8.14	18.56
Port of Dikson	0	9.26	7.32	5.53
Naval Base Frederikshavn	9.89	17.22	2.95	13.5
Port of Havøysund	7.47	14.81	0.52	11.08
Kangilínguit	11.46	18.79	4.64	15.06
Naval Port of Karlskrona	10.45	17.78	3.51	14.06
NAS Keflavik	10.01	17.34	3.19	13.62
Naval Base Kitsap	17.64	8.65	23.04	13.99
Port of Kotzebue	12.94	3.95	18.34	9.28
Nanisivik Naval Facility	25.37	32.71	18.56	28.98
Naval Station Newport	14.69	22.02	7.87	18.3
Port of Nome	13.16	4.17	18.56	9.51
Maritime Rescue Subcenter Pevek	9.26	0	14.65	5.6
Porkkala Naval Base	11.25	18.58	4.3	14.85
Ramsund Naval Station	7.96	15.29	1.01	11.56
Port of Raufarhofn	9.37	16.7	2.55	12.97
Severomorsk Naval Facility	7.32	14.65	0	10.93
Port of Tasiilaq	10.6	17.93	3.78	14.21
Thule Air Base	14.48	21.81	7.66	18.09
Port of Tiksi	5.53	5.6	10.93	0
Port of Upernavik	13.3	20.63	6.48	16.9

**Table F.8. Days to Travel Between Selected Ports in June 2025 Using a Polar Class 6 Vessel: European Ports**

<b>Destination</b>	<b>Havøysund</b>	<b>Kangilínguit</b>	<b>Keflavík</b>	<b>Frederikshavn</b>	<b>Karlskrona</b>	<b>Porkkala</b>	<b>Ramsund</b>	<b>Raufarhofn</b>	<b>Tasiilaq</b>	<b>Thule</b>	<b>Upernavik</b>
Port of Churchill	7.63	3.51	5.24	7.54	8.1	8.9	7.23	5.64	4.73	5.48	4.3
Port of Dikson	7.47	11.46	10.01	9.89	10.45	11.25	7.96	9.37	10.6	14.48	13.3
Naval Base Frederikshavn	2.43	4.04	2.36	0	0.57	1.36	1.94	2	3.23	7.07	5.88
Port of Havøysund	0	4.12	2.68	2.43	2.99	3.78	0.5	2.03	3.27	7.15	5.96
Kangilínguit	4.12	0	1.73	4.04	4.6	5.39	3.73	2.14	1.22	3.03	1.84
Naval Port of Karlskrona	2.99	4.6	2.92	0.57	0	0.8	2.5	2.56	3.8	7.63	6.44
NAS Keflavík	2.68	1.73	0	2.36	2.92	3.71	2.28	0.74	0.9	4.76	3.58
Naval Base Kitsap	23.19	27.17	25.73	25.61	26.17	26.96	23.68	25.08	26.32	30.2	29.02
Port of Kotzebue	18.49	22.47	21.03	20.91	21.47	22.26	18.98	20.38	21.62	25.5	24.31
Nanisivik Naval Facility	18.04	13.92	15.65	17.96	18.52	19.31	17.65	16.06	15.14	11.18	12.14
Naval Station Newport	7.36	3.58	4.95	7.19	7.75	8.54	6.97	5.37	4.46	6.42	5.24
Port of Nome	18.71	22.69	21.25	21.13	21.69	22.48	19.2	20.6	21.84	25.72	24.54
Maritime Rescue Subcenter Pevek	14.81	18.79	17.34	17.22	17.78	18.58	15.29	16.7	17.93	21.81	20.63
Porkkala Naval Base	3.78	5.39	3.71	1.36	0.8	0	3.3	3.36	4.59	8.42	7.24
Ramsund Naval Station	0.5	3.73	2.28	1.94	2.5	3.3	0	1.64	2.88	6.76	5.57
Port of Raufarhofn	2.03	2.14	0.74	2	2.56	3.36	1.64	0	1.29	5.16	3.98
Severomorsk Naval Facility	0.52	4.64	3.19	2.95	3.51	4.3	1.01	2.55	3.78	7.66	6.48
Port of Tasiilaq	3.27	1.22	0.9	3.23	3.8	4.59	2.88	1.29	0	4.25	3.06
Thule Air Base	7.15	3.03	4.76	7.07	7.63	8.42	6.76	5.16	4.25	0	1.24
Port of Tiksi	11.08	15.06	13.62	13.5	14.06	14.85	11.56	12.97	14.21	18.09	16.9
Port of Upernavik	5.96	1.84	3.58	5.88	6.44	7.24	5.57	3.98	3.06	1.24	0

**Table F.9. Days to Travel Between Selected Ports in June 2055 Using a Polar Class 2 Vessel: North American Ports**

<b>Destination</b>	<b>Churchill</b>	<b>Kitsap</b>	<b>Kotzebue</b>	<b>Nanisivik</b>	<b>Newport</b>	<b>Nome</b>
Port of Churchill	0	12.71	7.95	4.21	5.64	8.23
Port of Dikson	8.18	9.14	4.41	4.74	9.16	4.66
Naval Base Frederikshavn	7.12	12.66	7.9	6.28	7.19	8.18
Port of Havøysund	7.13	10.65	5.91	4.4	7.28	6.17
Kangilínguit	3.08	11.11	6.34	2.6	3.58	6.63
Naval Port of Karlskrona	7.68	13.22	8.46	6.85	7.75	8.74
NAS Keflavik	4.81	11.66	6.89	4.34	4.95	7.18
Naval Base Kitsap	12.71	0	5.02	8.66	14.25	4.52
Port of Kotzebue	7.95	5.02	0	3.9	9.48	0.54
Nanisivik Naval Facility	4.21	8.66	3.9	0	5.75	4.18
Naval Station Newport	5.64	14.25	9.48	5.75	0	9.77
Port of Nome	8.23	4.52	0.54	4.18	9.77	0
Maritime Rescue Subcenter Pevek	8.36	5.97	1.42	4.31	9.9	1.51
Porkkala Naval Base	8.47	14.01	9.25	7.64	8.54	9.53
Ramsund Naval Station	6.74	11.04	6.29	4.7	6.89	6.56
Port of Raufarhofn	5.2	11.27	6.5	4.73	5.36	6.79
Severomorsk Naval Facility	7.64	10.79	6.05	4.74	7.8	6.31
Port of Tasiilaq	4.26	11.82	7.06	3.78	4.41	7.34
Thule Air Base	4.06	9.19	4.42	0.74	5.57	4.71
Port of Tiksi	8.6	7.69	3.14	5.16	10.12	3.23
Port of Upernavik	3.51	9.68	4.91	1.22	4.99	5.2

**Table F.10. Days to Travel Between Selected Ports in June 2055 Using a Polar Class 2 Vessel:  
Russian Ports**

<b>Destination</b>	<b>Dikson</b>	<b>Pevek</b>	<b>Severomorsk</b>	<b>Tiksi</b>
Port of Churchill	8.18	8.36	7.64	8.6
Port of Dikson	0	3.5	2.11	2.13
Naval Base Frederikshavn	4.69	7.19	2.95	6.36
Port of Havøysund	2.27	5.02	0.52	3.95
Kangilínguit	5.92	6.76	4.56	6.91
Naval Port of Karlskrona	5.25	7.75	3.51	6.92
NAS Keflavik	4.54	6.48	3.18	5.82
Naval Base Kitsap	9.14	5.97	10.79	7.69
Port of Kotzebue	4.41	1.42	6.05	3.14
Nanisivik Naval Facility	4.74	4.31	4.74	5.16
Naval Station Newport	9.16	9.9	7.8	10.12
Port of Nome	4.66	1.51	6.31	3.23
Maritime Rescue Subcenter Pevek	3.5	0	5.15	1.78
Porkkala Naval Base	6.04	8.55	4.3	7.72
Ramsund Naval Station	2.76	5.42	1.01	4.43
Port of Raufarhofn	3.91	6.08	2.54	5.38
Severomorsk Naval Facility	2.11	5.15	0	3.8
Port of Tasiilaq	4.8	6.7	3.44	6.06
Thule Air Base	4.2	4.75	4.21	4.62
Port of Tiksi	2.13	1.78	3.8	0
Port of Upernavik	4.92	5.33	4.93	5.34

**Table F.11. Days to Travel Between Selected Ports in June 2055 Using a Polar Class 2 Vessel: European Ports**

Destination	Frederikshavn	Havøysund	Kangilínguit	Keflavík	Karlskrona	Porkkala	Ramsund	Raufarhofn	Tasiilaq	Thule	Upernavik
Port of Churchill	7.12	7.13	3.08	4.81	7.68	8.47	6.74	5.2	4.26	4.06	3.51
Port of Dikson	4.69	2.27	5.92	4.54	5.25	6.04	2.76	3.91	4.8	4.2	4.92
Naval Base Frederikshavn	0	2.43	4.04	2.36	0.57	1.36	1.94	2	3.16	5.75	5.64
Port of Havøysund	2.43	0	4.05	2.66	2.99	3.78	0.5	2.03	2.93	3.86	4.58
Kangilínguit	4.04	4.05	0	1.73	4.6	5.39	3.66	2.12	1.18	2.36	1.6
Naval Port of Karlskrona	0.57	2.99	4.6	2.92	0	0.8	2.5	2.56	3.72	6.31	6.2
NAS Keflavík	2.36	2.66	1.73	0	2.92	3.71	2.27	0.72	0.81	4.09	3.33
Naval Base Kitsap	12.66	10.65	11.11	11.66	13.22	14.01	11.04	11.27	11.82	9.19	9.68
Port of Kotzebue	7.9	5.91	6.34	6.89	8.46	9.25	6.29	6.5	7.06	4.42	4.91
Nanisivik Naval Facility	6.28	4.4	2.6	4.34	6.85	7.64	4.7	4.73	3.78	0.74	1.22
Naval Station Newport	7.19	7.28	3.58	4.95	7.75	8.54	6.89	5.36	4.41	5.57	4.99
Port of Nome	8.18	6.17	6.63	7.18	8.74	9.53	6.56	6.79	7.34	4.71	5.2
Maritime Rescue Subcenter Pevek	7.19	5.02	6.76	6.48	7.75	8.55	5.42	6.08	6.7	4.75	5.33
Porkkala Naval Base	1.36	3.78	5.39	3.71	0.8	0	3.3	3.35	4.52	7.11	6.99
Ramsund Naval Station	1.94	0.5	3.66	2.27	2.5	3.3	0	1.64	2.63	4.17	4.88
Port of Raufarhofn	2	2.03	2.12	0.72	2.56	3.35	1.64	0	1.18	4.32	3.72
Severomorsk Naval Facility	2.95	0.52	4.56	3.18	3.51	4.3	1.01	2.54	3.44	4.21	4.93
Port of Tasiilaq	3.16	2.93	1.18	0.81	3.72	4.52	2.63	1.18	0	3.54	2.77
Thule Air Base	5.75	3.86	2.36	4.09	6.31	7.11	4.17	4.32	3.54	0	0.79
Port of Tiksi	6.36	3.95	6.91	5.82	6.92	7.72	4.43	5.38	6.06	4.62	5.34
Port of Upernavik	5.64	4.58	1.6	3.33	6.2	6.99	4.88	3.72	2.77	0.79	0

**Table F.12. Days to Travel Between Selected Ports in June 2055 Using a Polar Class 6 Vessel:  
North American Ports**

<b>Destination</b>	<b>Churchill</b>	<b>Kitsap</b>	<b>Kotzebue</b>	<b>Nanisivik</b>	<b>Newport</b>	<b>Nome</b>
Port of Churchill	0	19.49	14.84	11.85	5.96	15.01
Port of Dikson	10.64	11.26	6.6	16.74	10.54	6.78
Naval Base Frederikshavn	7.39	15.01	10.36	13.49	7.19	10.53
Port of Havøysund	7.4	12.59	7.94	13.5	7.3	8.12
Kangilínguit	3.35	16.14	11.49	9.45	3.58	11.66
Naval Port of Karlskrona	7.95	15.57	10.92	14.05	7.75	11.09
NAS Keflavik	5.08	14.75	10.1	11.18	4.95	10.28
Naval Base Kitsap	19.49	0	5.02	25.59	19.38	4.52
Port of Kotzebue	14.84	5.02	0	20.94	14.73	0.55
Nanisivik Naval Facility	11.85	25.59	20.94	0	12.85	21.11
Naval Station Newport	5.96	19.38	14.73	12.85	0	14.9
Port of Nome	15.01	4.52	0.55	21.11	14.9	0
Maritime Rescue Subcenter Pevek	13.54	6.19	1.58	19.64	13.43	1.71
Porkkala Naval Base	8.74	16.37	11.71	14.84	8.54	11.89
Ramsund Naval Station	7.01	13.08	8.42	13.11	6.9	8.6
Port of Raufarhofn	5.47	14.12	9.47	11.57	5.36	9.64
Severomorsk Naval Facility	7.92	12.44	7.78	14.02	7.81	7.96
Port of Tasiilaq	4.59	15.26	10.61	10.69	4.48	10.79
Thule Air Base	5.5	19.25	14.59	6.78	6.5	14.77
Port of Tiksi	11.78	8.22	3.62	17.88	11.68	3.75
Port of Upernavik	4.23	17.98	13.32	7.79	5.23	13.5



**Table F.13. Days to Travel Between Selected Ports in June 2055 Using a Polar Class 6 Vessel:  
Russian Ports**

<b>Destination</b>	<b>Port of Dikson</b>	<b>Pevek</b>	<b>Severomorsk</b>	<b>Tiksi</b>
Port of Churchill	10.64	13.54	7.92	11.78
Port of Dikson	0	5.3	3.22	3.55
Naval Base Frederikshavn	5.8	9.06	2.95	7.3
Port of Havøysund	3.38	6.64	0.52	4.89
Kangilínguit	7.3	10.19	4.57	8.44
Naval Port of Karlskrona	6.36	9.62	3.51	7.87
NAS Keflavík	5.91	8.8	3.18	7.05
Naval Base Kitsap	11.26	6.19	12.44	8.22
Port of Kotzebue	6.6	1.58	7.78	3.62
Nanisivik Naval Facility	16.74	19.64	14.02	17.88
Naval Station Newport	10.54	13.43	7.81	11.68
Port of Nome	6.78	1.71	7.96	3.75
Maritime Rescue Subcenter Pevek	5.3	0	6.48	2.1
Porkkala Naval Base	7.15	10.41	4.3	8.66
Ramsund Naval Station	3.86	7.12	1.01	5.37
Port of Raufarhofn	5.27	8.16	2.54	6.41
Severomorsk Naval Facility	3.22	6.48	0	4.73
Port of Tasiilaq	6.42	9.31	3.7	7.56
Thule Air Base	10.4	13.29	7.67	11.54
Port of Tiksi	3.55	2.1	4.73	0
Port of Upernavik	9.13	12.02	6.4	10.27

**Table F.14. Days to Travel Between Selected Ports in June 2055 Using a Polar Class 6 Vessel: European Ports**

Destination	Karlskrona	Porkkala	Raufarhofn	Frederikshavn	Keflavik	Havøysund	Ramsund	Kangilínguit	Thule	Tasiilaq	Upernavik
Port of Churchill	7.95	8.74	5.47	7.39	5.08	7.4	7.01	3.35	5.5	4.59	4.23
Port of Dikson	6.36	7.15	5.27	5.8	5.91	3.38	3.86	7.3	10.4	6.42	9.13
Naval Base Frederikshavn	0.57	1.36	2	0	2.36	2.43	1.94	4.04	7.14	3.25	5.87
Port of Havøysund	2.99	3.78	2.03	2.43	2.67	0	0.5	4.05	7.16	3.18	5.89
Kangilínguit	4.6	5.39	2.12	4.04	1.73	4.05	3.66	0	3.1	1.24	1.83
Naval Port of Karlskrona	0	0.8	2.56	0.57	2.92	2.99	2.5	4.6	7.7	3.81	6.43
NAS Keflavik	2.92	3.71	0.72	2.36	0	2.67	2.28	1.73	4.84	0.91	3.57
Naval Base Kitsap	15.57	16.37	14.12	15.01	14.75	12.59	13.08	16.14	19.25	15.26	17.98
Port of Kotzebue	10.92	11.71	9.47	10.36	10.1	7.94	8.42	11.49	14.59	10.61	13.32
Nanisivik Naval Facility	14.05	14.84	11.57	13.49	11.18	13.5	13.11	9.45	6.78	10.69	7.79
Naval Station Newport	7.75	8.54	5.36	7.19	4.95	7.3	6.9	3.58	6.5	4.48	5.23
Port of Nome	11.09	11.89	9.64	10.53	10.28	8.12	8.6	11.66	14.77	10.79	13.5
Maritime Rescue Subcenter Pevek	9.62	10.41	8.16	9.06	8.8	6.64	7.12	10.19	13.29	9.31	12.02
Porkkala Naval Base	0.8	0	3.35	1.36	3.71	3.78	3.3	5.39	8.5	4.6	7.23
Ramsund Naval Station	2.5	3.3	1.64	1.94	2.28	0.5	0	3.66	6.77	2.79	5.5
Port of Raufarhofn	2.56	3.35	0	2	0.72	2.03	1.64	2.12	5.23	1.28	3.96
Severomorsk Naval Facility	3.51	4.3	2.54	2.95	3.18	0.52	1.01	4.57	7.67	3.7	6.4
Port of Tasiilaq	3.81	4.6	1.28	3.25	0.91	3.18	2.79	1.24	4.35	0	3.08
Thule Air Base	7.7	8.5	5.23	7.14	4.84	7.16	6.77	3.1	0	4.35	1.33
Port of Tiksi	7.87	8.66	6.41	7.3	7.05	4.89	5.37	8.44	11.54	7.56	10.27
Port of Upernavik	6.43	7.23	3.96	5.87	3.57	5.89	5.5	1.83	1.33	3.08	0

**Table F.15. Days of Travel Time Reduction Between Selected Ports in June 2055 Compared with Times in June 2025 Using a Polar Class 2 Vessel: North American Ports**

<b>Destination</b>	<b>Nome</b>	<b>Kotzebue</b>	<b>Kitsap</b>	<b>Churchill</b>	<b>Newport</b>	<b>Nanisivik</b>
Port of Churchill	-0.06	-0.06	-0.06	0	-0.01	-0.07
Port of Dikson	-0.18	-0.15	-0.18	-0.57	-0.04	-0.56
Naval Base Frederikshavn	-0.08	-0.08	-0.08	-0.01	0	-0.4
Port of Havøysund	-0.17	-0.15	-0.17	-0.01	-0.01	-0.78
Kangilínguit	-0.02	-0.02	-0.02	-0.02	0	-0.04
Naval Port of Karlskrona	-0.08	-0.08	-0.08	-0.01	0	-0.39
NAS Keflavik	-0.2	-0.2	-0.2	-0.02	0	-0.03
Naval Base Kitsap	0	0	0	-0.06	-0.03	-0.03
Port of Kotzebue	0	0	0	-0.06	-0.04	-0.03
Nanisivik Naval Facility	-0.03	-0.03	-0.03	-0.07	-0.04	0
Naval Station Newport	-0.03	-0.04	-0.03	-0.01	0	-0.04
Port of Nome	0	0	0	-0.06	-0.03	-0.03
Maritime Rescue Subcenter Pevek	-0.16	-0.13	-0.18	-0.16	-0.13	-0.13
Porkkala Naval Base	-0.09	-0.08	-0.09	-0.02	0	-0.39
Ramsund Naval Station	-0.12	-0.1	-0.12	-0.01	0	-0.78
Port of Raufarhofn	-0.15	-0.15	-0.15	-0.02	0	-0.03
Severomorsk Naval Facility	-0.2	-0.19	-0.2	-0.02	0	-0.72
Port of Tasilaq	-0.28	-0.27	-0.28	-0.01	0	-0.03
Thule Air Base	-0.03	-0.03	-0.03	-0.01	0.01	0
Port of Tiksi	-0.21	-0.15	-0.23	-0.56	-0.46	-0.24
Port of Upernavik	-0.02	-0.02	-0.02	-0.01	0.01	0.01

**Table F.16. Days of Travel Time Reduction Between Selected Ports in June 2055 Compared with Times in June 2025 Using a Polar Class 2 Vessel: Russian Ports**

<b>Destination</b>	<b>Dikson</b>	<b>Pevek</b>	<b>Severomorsk</b>	<b>Tiksi</b>
Port of Churchill	-0.57	-0.16	-0.02	-0.56
Port of Dikson	0	-0.1	-0.01	-0.05
Naval Base Frederikshavn	-0.01	-0.09	0	-0.12
Port of Havøysund	-0.01	-0.12	0	-0.11
Kangilínguit	-0.04	-0.12	-0.01	-0.44
Naval Port of Karlskrona	-0.01	-0.09	0	-0.12
NAS Keflavík	-0.04	-0.13	0	-0.15
Naval Base Kitsap	-0.18	-0.18	-0.2	-0.23
Port of Kotzebue	-0.15	-0.13	-0.19	-0.15
Nanisivik Naval Facility	-0.56	-0.13	-0.72	-0.24
Naval Station Newport	-0.04	-0.13	0	-0.46
Port of Nome	-0.18	-0.16	-0.2	-0.21
Maritime Rescue Subcenter Pevek	-0.1	0	-0.13	-0.06
Porkkala Naval Base	-0.01	-0.08	0	-0.12
Ramsund Naval Station	0	-0.08	0	-0.12
Port of Raufarhofn	-0.03	-0.08	0	-0.12
Severomorsk Naval Facility	-0.01	-0.13	0	-0.16
Port of Tasilaq	-0.06	-0.16	-0.04	-0.17
Thule Air Base	-0.55	-0.21	-0.7	-0.54
Port of Tiksi	-0.05	-0.06	-0.16	0
Port of Upernavik	-0.53	-0.11	-0.68	-0.52

**Table F.17. Days of Travel Time Reduction Between Selected Ports in June 2055 Compared with Times in June 2025 Using a Polar Class 2 Vessel: European Ports**

<b>Destination</b>	<b>Frederikshavn</b>	<b>Havøysund</b>	<b>Kangilínguit</b>	<b>Karlskrona</b>	<b>Keflavík</b>	<b>Porkkala</b>	<b>Ramsund</b>	<b>Raufarhofn</b>	<b>Tasiilaq</b>	<b>Thule</b>	<b>Upernavik</b>
Port of Churchill	-0.01	-0.01	-0.02	-0.01	-0.02	-0.02	-0.01	-0.02	-0.01	-0.01	-0.01
Port of Dikson	-0.01	-0.01	-0.04	-0.01	-0.04	-0.01	0	-0.03	-0.06	-0.55	-0.53
Naval Base Frederikshavn	0	0	0	0	0	0	0	0	-0.01	-0.62	0.01
Port of Havøysund	0	0	0	0	-0.01	0	0	0	-0.03	-0.77	-0.75
Kangilínguit	0	0	0	0	0	0	0	0	0	0.03	0.01
Naval Port of Karlskrona	0	0	0	0	0	0	0	0	-0.01	-0.62	0.01
NAS Keflavík	0	-0.01	0	0	0	0	-0.01	-0.01	0	0.02	0.01
Naval Base Kitsap	-0.08	-0.17	-0.02	-0.08	-0.2	-0.09	-0.12	-0.15	-0.28	-0.03	-0.02
Port of Kotzebue	-0.08	-0.15	-0.02	-0.08	-0.2	-0.08	-0.1	-0.15	-0.27	-0.03	-0.02
Nanisivik Naval Facility	-0.4	-0.78	-0.04	-0.39	-0.03	-0.39	-0.78	-0.03	-0.03	0	0.01
Naval Station Newport	0	-0.01	0	0	0	0	0	0	0	0.01	0.01
Port of Nome	-0.08	-0.17	-0.02	-0.08	-0.2	-0.09	-0.12	-0.15	-0.28	-0.03	-0.02
Maritime Rescue Subcenter Pevek	-0.09	-0.12	-0.12	-0.09	-0.13	-0.08	-0.08	-0.08	-0.16	-0.21	-0.11
Porkkala Naval Base	0	0	0	0	0	0	0	0	0	-0.62	0.01
Ramsund Naval Station	0	0	0	0	-0.01	0	0	0	-0.02	-0.76	-0.37
Port of Raufarhofn	0	0	0	0	-0.01	0	0	0	-0.01	-0.14	0.01
Severomorsk Naval Facility	0	0	-0.01	0	0	0	0	0	-0.04	-0.7	-0.68
Port of Tasiilaq	-0.01	-0.03	0	-0.01	0	0	-0.02	-0.01	0	0.03	0
Thule Air Base	-0.62	-0.77	0.03	-0.62	0.02	-0.62	-0.76	-0.14	0.03	0	0.02
Port of Tiksi	-0.12	-0.11	-0.44	-0.12	-0.15	-0.12	-0.12	-0.12	-0.17	-0.54	-0.52
Port of Upernavik	0.01	-0.75	0.01	0.01	0.01	0.01	-0.37	0.01	0	0.02	0

**Table F.18. Days of Travel Time Reduction Between Selected Ports in June 2055 Compared with Times in June 2025 Using a Polar Class 6 Vessel: North American Ports**

<b>Destination</b>	<b>Nome</b>	<b>Kotzebue</b>	<b>Kitsap</b>	<b>Churchill</b>	<b>Newport</b>	<b>Nanisivik</b>
Port of Churchill	-11.19	-11.14	-11.19	0	-0.18	-4.53
Port of Dikson	-6.38	-6.34	-6.38	-4.32	-4.15	-8.63
Naval Base Frederikshavn	-10.6	-10.55	-10.6	-0.15	0	-4.47
Port of Havøysund	-10.59	-10.55	-10.6	-0.23	-0.06	-4.54
Kangilínguit	-11.03	-10.98	-11.03	-0.16	0	-4.47
Naval Port of Karlskrona	-10.6	-10.55	-10.6	-0.15	0	-4.47
NAS Keflavik	-10.97	-10.93	-10.98	-0.16	0	-4.47
Naval Base Kitsap	0	0	0	-11.19	-11.03	-15.5
Port of Kotzebue	0.01	0	0	-11.14	-10.98	-15.45
Nanisivik Naval Facility	-15.5	-15.45	-15.5	-4.53	-4.46	0
Naval Station Newport	-11.03	-10.98	-11.03	-0.18	0	-4.46
Port of Nome	0	0.01	0	-11.19	-11.03	-15.5
Maritime Rescue Subcenter Pevek	-2.46	-2.37	-2.46	-8.75	-8.59	-13.07
Ramsund Naval Station	-10.6	-10.56	-10.6	-0.22	-0.07	-4.54
Porkkala Naval Base	-10.59	-10.55	-10.59	-0.16	0	-4.47
Port of Raufarhofn	-10.96	-10.91	-10.96	-0.17	-0.01	-4.49
Severomorsk Naval Facility	-10.6	-10.56	-10.6	-0.22	-0.06	-4.54
Port of Tasiilaq	-11.05	-11.01	-11.06	-0.14	0.02	-4.45
Thule Air Base	-10.95	-10.91	-10.95	0.02	0.08	-4.4
Port of Tiksi	-5.76	-5.66	-5.77	-6.78	-6.62	-11.1
Port of Upernavik	-11.04	-10.99	-11.04	-0.07	-0.01	-4.35

**Table F.19. Days of Travel Time Reduction Between Selected Ports in June 2055 Compared with Times in June 2025 Using a Polar Class 6 Vessel: Russian Ports**

<b>Destination</b>	<b>Dikson</b>	<b>Pevek</b>	<b>Severomorsk</b>	<b>Tiksi</b>
Port of Churchill	-4.32	-8.75	-0.22	-6.78
Port of Dikson	0	-3.96	-4.1	-1.98
Naval Base Frederikshavn	-4.09	-8.16	0	-6.2
Port of Havøysund	-4.09	-8.17	0	-6.19
Kangilínguit	-4.16	-8.6	-0.07	-6.62
Naval Port of Karlskrona	-4.09	-8.16	0	-6.19
NAS Keflavik	-4.1	-8.54	-0.01	-6.57
Naval Base Kitsap	-6.38	-2.46	-10.6	-5.77
Port of Kotzebue	-6.34	-2.37	-10.56	-5.66
Nanisivik Naval Facility	-8.63	-13.07	-4.54	-11.1
Naval Station Newport	-4.15	-8.59	-0.06	-6.62
Port of Nome	-6.38	-2.46	-10.6	-5.76
Maritime Rescue Subcenter Pevek	-3.96	0	-8.17	-3.5
Porkkala Naval Base	-4.1	-8.17	0	-6.19
Ramsund Naval Station	-4.1	-8.17	0	-6.19
Port of Raufarhofn	-4.1	-8.54	-0.01	-6.56
Severomorsk Naval Facility	-4.1	-8.17	0	-6.2
Port of Tasilaq	-4.18	-8.62	-0.08	-6.65
Thule Air Base	-4.08	-8.52	0.01	-6.55
Port of Tiksi	-1.98	-3.5	-6.2	0
Port of Upernavik	-4.17	-8.61	-0.08	-6.63

**Table F.20. Days of Travel Time Reduction Between Selected Ports in June 2055 Compared with Times in June 2025 Using a Polar Class 6 Vessel: European Ports**

<b>Destination</b>	<b>Frederikshavn</b>	<b>Havøysund</b>	<b>Kangilínguit</b>	<b>Karlskrona</b>	<b>Keflavík</b>	<b>Porkkala</b>	<b>Ramsund</b>	<b>Raufarhofn</b>	<b>Tasiilaq</b>	<b>Thule</b>	<b>Upernavik</b>
Port of Churchill	-0.15	-0.23	-0.16	-0.15	-0.16	-0.16	-0.22	-0.17	-0.14	0.02	-0.07
Port of Dikson	-4.09	-4.09	-4.16	-4.09	-4.1	-4.1	-4.1	-4.1	-4.18	-4.08	-4.17
Naval Base Frederikshavn	0	0	0	0	0	0	0	0	0.02	0.07	-0.01
Port of Havøysund	0	0	-0.07	0	-0.01	0	0	0	-0.09	0.01	-0.07
Kangilínguit	0	-0.07	0	0	0	0	-0.07	-0.02	0.02	0.07	-0.01
Naval Port of Karlskrona	0	0	0	0	0	0	0	0	0.01	0.07	-0.01
NAS Keflavík	0	-0.01	0	0	0	0	0	-0.02	0.01	0.08	-0.01
Naval Base Kitsap	-10.6	-10.6	-11.03	-10.6	-10.98	-10.59	-10.6	-10.96	-11.06	-10.95	-11.04
Port of Kotzebue	-10.55	-10.55	-10.98	-10.55	-10.93	-10.55	-10.56	-10.91	-11.01	-10.91	-10.99
Nanisivik Naval Facility	-4.47	-4.54	-4.47	-4.47	-4.47	-4.47	-4.54	-4.49	-4.45	-4.4	-4.35
Naval Station Newport	0	-0.06	0	0	0	0	-0.07	-0.01	0.02	0.08	-0.01
Port of Nome	-10.6	-10.59	-11.03	-10.6	-10.97	-10.59	-10.6	-10.96	-11.05	-10.95	-11.04
Maritime Rescue Subcenter Pevek	-8.16	-8.17	-8.6	-8.16	-8.54	-8.17	-8.17	-8.54	-8.62	-8.52	-8.61
Porkkala Naval Base	0	0	0	0	0	0	0	-0.01	0.01	0.08	-0.01
Ramsund Naval Station	0	0	-0.07	0	0	0	0	0	-0.09	0.01	-0.07
Port of Raufarhofn	0	0	-0.02	0	-0.02	-0.01	0	0	-0.01	0.07	-0.02
Severomorsk Naval Facility	0	0	-0.07	0	-0.01	0	0	-0.01	-0.08	0.01	-0.08
Port of Tasiilaq	0.02	-0.09	0.02	0.01	0.01	0.01	-0.09	-0.01	0	0.1	0.02
Thule Air Base	0.07	0.01	0.07	0.07	0.08	0.08	0.01	0.07	0.1	0	0.09
Port of Tiksi	-6.2	-6.19	-6.62	-6.19	-6.57	-6.19	-6.19	-6.56	-6.65	-6.55	-6.63
Port of Upernavik	-0.01	-0.07	-0.01	-0.01	-0.01	-0.01	-0.07	-0.02	0.02	0.09	0



Tables F.2 to F.20 illustrate that, although climate change is projected to increase marine access throughout the Arctic in the coming decades, the degree of increase significantly depends on the vessel's icebreaking capability. Furthermore, access to Russian ports is projected to increase to a greater degree, on average, than to non-Russian ports. Here we focus on late-spring access (June) to illustrate how access is changing outside the traditional summer navigation season. By 2055, average travel times between the selected ports are projected to reduce slightly from times in 2025 when using PC2 (heavy icebreaking) vessels. These modest reductions are due to the fact that heavy icebreakers are already capable of navigating in all but the severest ice conditions; therefore, the most-significant increases in access for these vessels would be expected in areas with high concentrations of older (i.e., multiyear), thicker ice, such as along the northern coast of Greenland and the Canadian Arctic Archipelago. In contrast, average travel times are reduced to a significantly larger degree (12 to 47 percent) when using PC6 (medium icebreaking) vessels than when using other vessels. This is due to large declines in multiyear ice and overall ice thickness. Although some ice cover is expected to remain in June by midcentury, it is projected to consist largely of ice formed during the previous winter (i.e., first-year ice), which does not typically obstruct navigation by medium icebreakers. The two ports with the largest travel time reductions are Russian (Pevek and Tiksi, 47 percent), and the two other Russian ports also experience significant reductions (Dikson, 40 percent, fifth overall; Severomorsk, 18 percent, eighth overall). These results reflect the fact that very little multiyear ice is projected to remain along the Russian coast by midcentury. See Figure F.1 for a map of selected ports.

**Figure F.1. Selected Russian and Non-Russian Ports from Which Least-Cost Routes Were Simulated Under Projected Sea Ice Conditions**



These ports were selected based on four criteria: existing port capacity and capability, at least one port per Arctic country, mix of military and civilian ports, and circumpolar coverage.

## Appendix G. Description of the Arctic Access Tabletop Exercise

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This appendix summarizes the structure, conduct, and organization of the three-session TTX we conducted to support the identification of U.S. access limitations (today and in the future).

### Overview of the Tabletop Exercise: “Identifying Limitations to U.S. Arctic Access”

The primary goals of the TTX were to elicit participants’ expert insights on two key matters: (1) potential U.S. Arctic access problems and (2) the risks these could pose to U.S. national interest and the safety of the U.S. armed forces. We elicited these insights by having participants evaluate potential capability and capacity shortfalls in six possible scenarios, all of which nominally took place in June 2035.<sup>279</sup>

We defined *access* as the ability to reach or transit through spatial objectives without hindrance.<sup>280</sup> Access vis-à-vis maritime (surface or subsurface), air, space, ground, cyberspace, and the electromagnetic spectrum was the primary focus, but participants were encouraged to offer insights in other domains they believed to be relevant to the scope of the project. In the rest of this appendix, we briefly discuss the participants, structure, flow, and key assumptions of the TTX. We also include the full set of scenarios, followed by a summary of our findings.

Participants were divided into nine breakout groups distributed across three five-hour virtual sessions or iterations of the TTX. Two TTX iterations were held on February 15 and a third on February 22. We held three iterations to accommodate participation from across U.S. time zones and in Europe. We assigned participants to breakout groups based on their backgrounds and current roles to ensure, the best we could, a representative mix from across the services and other organizations in each group.

Plenary sessions toward the beginning and end of each TTX iteration helped participants get oriented and exchange ideas, including their findings from the breakout sessions, in which they spent most of their time. Figure G.1 provides an overview of the flow of each iteration of the TTX. Breakout groups were led by a facilitator, while a cofacilitator posted on a screen the key ideas participants shared and a note-taker captured additional details of the discussion. All three

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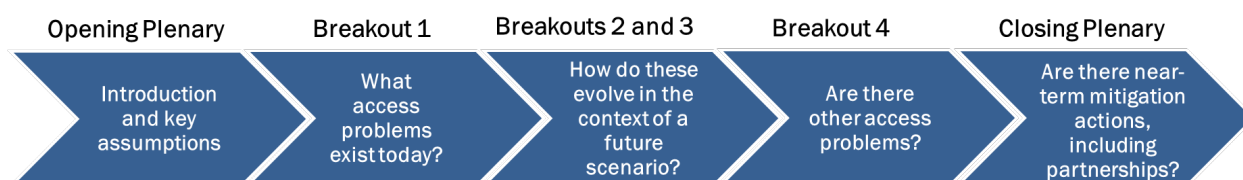
<sup>279</sup> We selected June because it strikes a good balance between having more traffic and activity than winter months (based on historical activity) but also enough ice cover that our scenarios would include differences in accessibility for different actors. We selected 2035 because it was far enough into the future that it is reasonable to assume that things will be different from today but not so far into the future that we are unable to make reasonable assumptions about operating capabilities and capacities.

<sup>280</sup> Definition adapted from “access,” 2021.

of those people (the facilitator, cofacilitator, and note-taker) were HSOAC researchers. The breakout sessions were structured to answer four research primary questions:

1. Which forms of access are most important for securing U.S. national interests (as defined in strategy documents or based on specific scenario context) in the Arctic?
2. Which forms of U.S. access are most limited?
3. How do limitations impede securing U.S. Arctic interests?
4. What near-term mitigation actions can be taken?

**Figure G.1. Overall Flow of Each Iteration of the Tabletop Exercise**



The first breakout session provided participants an opportunity to discuss present-day (including the next couple of years, up to 2025) access problems. Participants were asked what they had experienced or observed others experiencing in the Arctic with respect to U.S. access limitations. For each access problem raised, the facilitator asked why the problem was important to consider—that is, what critical mission or function could not be (consistently) performed as a result—and that access limitation’s consequences or implications for national security. This first session was important for establishing a common understanding of what *access* meant and whether or how it was limited from the U.S. perspective in the Arctic today. This set up the discussions in the rest of the exercise, which was focused on talking about how access problems might evolve in the context of a future scenario.

The second, third, and fourth breakout sessions covered one of six scenarios that was presented in three stages. First, participants were given a brief “state of the world” in 2035 (varying by scenario) and were asked to explore issues in Arctic military capabilities and capacity associated with the chronic stresses presented in the scenario (breakout session 1). Next, they were given an initial shock—a few interrelated events that required a response—and asked to describe how they would respond, constraints on their ability to respond, and how they could mitigate those constraints (breakout session 2). They were then given a second shock that posed new challenges, further stretching response capabilities and capacity, which they also addressed (breakout session 3). In the fourth and final breakout session, participants were asked to identify the top three access challenges from across the sessions and summarize their findings on a single slide, which a non-RAND participant from the breakout group shared with the other groups at the final plenary session.

## Scenarios

As discussed previously, each breakout group was assigned one of six scenarios that was presented in three stages: (1) state of the world in 2035, (2) shock 1, and (3) shock 2. The full text for each of these scenarios is contained in Tables G.2 through G.7.

**Table G.2. Scenario I: Automatic for the People**

Stage	Description
State of the world in 2035	<ul style="list-style-type: none"> <li>• Dozens of cruise ships transit through the NWP each year, increasing demand for U.S., Canadian, and Danish maritime presence in the Arctic.</li> <li>• These coast guards are unable to meet their desired levels of presence. The USCG's Arctic presence requirements have detracted from its ability to fulfill missions elsewhere.</li> <li>• Greenland's economy is being transformed by massive rare earth mining investments from China. It remains part of the Kingdom of Denmark, but its improving economic fortunes are contributing to proindependence sentiment.</li> <li>• At the same time, some parts of the Greenlandic population believe that Chinese mining companies are poisoning their environment while exploiting Greenland's resources to collect excessive profits. They also resent the presence of large numbers of Chinese mining workers.</li> <li>• In the South China Sea, China's attempts to increasingly control traffic have resulted in frequent confrontations between U.S. and Chinese ships and aircraft in the region. Fire-control radars have been turned on, and there have been numerous near-collisions in the air and sea.</li> <li>• Following most of these incidents in the South China Sea, U.S. bases in Japan experience cyberattacks.</li> </ul>
Shock 1: Guns and Radiation	<ul style="list-style-type: none"> <li>• An ice-hardened Chinese bulk cargo ship in Baffin Bay between Canada and Greenland collides with a CCG icebreaker. The CCG icebreaker, which is intact, rescues the Chinese crew. While aboard the Chinese ship, CCG personnel find a collection of automatic weapons and numerous empty gun racks. The ship ultimately sinks.</li> <li>• China demands an investigation of the incident and conducts a vigorous disinformation campaign indicating that the CCG icebreaker deliberately rammed the Chinese ship. It deploys the <i>Xue Long</i> icebreaker, which happened to be a few hundred miles away, to the area. At Canada's request, the U.S. and Danish navies and coast guards (the latter where applicable), alongside their Canadian counterparts, are sending vessels and helicopters to monitor the situation.</li> <li>• CCG personnel detect trace quantities of uranium on the clothing of the people they rescued, which suggests that the Chinese cargo vessel might have been involved in a rumored uranium-for-guns smuggling operation.</li> <li>• The Chinese government is demanding that Canada apologize for its alleged ramming attack against the cargo ship, as well as the immediate return of its crew, without any investigation of the smuggling. It claims that the uranium traces, guns, and gun racks were planted. The <i>Xue Long</i> is closely shadowing the Canadian icebreaker, which is headed toward Nanisivik Naval Facility (on Baffin Island) and has nearly collided with it twice.</li> </ul>
Shock 2: Standoff and Cyberattacks	<ul style="list-style-type: none"> <li>• An ice-hardened Chinese bulk cargo ship in Baffin Bay between Canada and Greenland collides with a CCG icebreaker. The CCG icebreaker, which is intact, rescues the Chinese crew. While aboard the Chinese ship, CCG personnel find a collection of automatic weapons and numerous empty gun racks. The ship ultimately sinks.</li> <li>• China demands an investigation of the incident and conducts a vigorous disinformation campaign indicating that the CCG icebreaker deliberately rammed the Chinese ship. It deploys the <i>Xue Long</i> icebreaker, which happened to be a few hundred miles away, to the area. At Canada's request, the U.S. and Danish navies and coast guards (the latter where applicable), alongside their Canadian counterparts, are sending vessels and helicopters to monitor the situation.</li> <li>• CCG personnel detect trace quantities of uranium on the clothing of the people they rescued, which suggests that the Chinese cargo vessel might have been involved in a rumored uranium-for-guns smuggling operation.</li> </ul>

**Table G.3. Scenario II: Storm and Stress**

Stage	Description
State of the world in 2035	<ul style="list-style-type: none"> <li>• Climate change has increased the frequency and severity of storms across much of northern and central Alaska, regardless of the season.</li> <li>• Rapidly thawing permafrost across the Arctic has caused a series of fixed-infrastructure failures and accidents, afflicting both civilian communities and military bases. Assets, such as radars, runways, ports, and roads, are often unusable for long periods.</li> <li>• Gradually declining global consumption of fossil fuels has hurt the Russian economy, and domestic satisfaction and support for leadership have declined. Russia is challenging the United States and other NATO allies and partners to distract attention from this problem.</li> <li>• Urged on by Russian media, ethnic Russian minorities in the formerly Soviet Baltic states and Ukraine conduct frequent protests against their governments while also calling for Russian intervention.</li> <li>• Despite Russia's economic challenges, it has been investing more heavily than the United States has in maintaining much of its Arctic infrastructure (both military and civilian). This reflects the Arctic's critical economic importance to Russia and the political influence of Arctic-connected people, several of whom are close to Russia's leader.</li> <li>• Intelligence indicates that Russia will launch an aggressive military exercise in the Bering Strait region at some point over the next three months.</li> </ul>
Shock 1: Storm	<ul style="list-style-type: none"> <li>• An extreme storm inflicts substantial damage across northern and central Alaska, including Fairbanks, Utqiagvik (Barrow), several villages, Fort Wainwright, Eielson AFB, Clear SFS, and Fort Greely.</li> <li>• Domain awareness, communications, and logistical capacity have all been degraded.</li> <li>• In the storm's aftermath, the Federal Emergency Management Agency, DoD, and the USCG are rushing to aid Alaskan communities and military bases, with help from Canadian responders.</li> <li>• Damage to communication and domain-awareness infrastructure leads U.S. agencies to turn to Russia for assistance. Parts of eastern Russia have also been affected by the storm, but Russia's sustained infrastructure investments have limited its impact.</li> <li>• Russia provides help with communications and domain awareness, although the United States has concerns that Russia might be collecting information on U.S. networks and creating opportunities for their future exploitation.</li> <li>• Russia's military forces also provide relief supplies, medical support, and other assistance, but some unauthorized vessels are also straying within 12 nautical miles of the U.S. coastline.</li> <li>• Russian media outlets highlight Russia's assistance, suggesting that the United States was incapable of taking care of its own people. The same message is highlighted in U.S. social media.</li> </ul>

Stage	Description
Shock 2: Sovereignty Slighted	<ul style="list-style-type: none"> <li>• A week later, Russian vessels and aircraft supporting the Alaska disaster response have concluded their mission.</li> <li>• An apartment building in Belgorod, Russia (near the Ukrainian border), experiences a massive explosion, killing hundreds, for which Russian authorities blame Ukrainian terrorists. Other sources point to faulty natural gas distribution infrastructure.</li> <li>• Russia threatens military action against Ukraine and appears to warn the United States against intervening by organizing a snap “combat readiness check” near the Alaskan maritime border.</li> <li>• There is unattributed jamming of U.S. military communications, including satellite links.</li> <li>• There are also power outages in Alaska that could be due to cyberattacks or to the cascading effects of the storm.</li> <li>• Russian fishing vessels have been increasingly observed fishing in the Alaskan EEZ, and some Russian military aircraft have made unauthorized flights over northern Alaska. U.S. authorities have responded but have occasionally been caught by surprise.</li> <li>• A Russian Army squad makes an unauthorized, unannounced 2.5-mile boat trip within the Bering Strait from Russia’s Big Diomed Island to the United States’ Little Diomed Island; personnel peacefully interact with the local community and reportedly discuss their concerns about family reunification.</li> <li>• These various sovereignty violations have been highlighted in Russian media to demonstrate Russia’s strength relative to U.S. weakness.</li> </ul>



**Table G.4. Scenario III: Things Fall Apart**

Stage	Description
State of the world in 2035	<ul style="list-style-type: none"> <li>• Heat waves and drought have curtailed global agriculture. To offset food shortages, fishing is intensifying worldwide. Increasing seasonal access to the Arctic Ocean and the northward migration of fish result in expanded fishing in Arctic and sub-Arctic waters, despite international agreements prohibiting fishing in many areas.</li> <li>• Fishing vessels from various countries often operate in other countries' EEZs. They sometimes enter the territorial seas (less than 12 nautical miles from shore) of Arctic countries.</li> <li>• Many mariners in Arctic waters are inexperienced with Arctic conditions, requiring the USCG alone to conduct multiple rescues per month.</li> <li>• Russia strengthens its partnerships with Norway regarding EEZ management and law enforcement. The United States and Canada suspect that this might be an attempt to insert a wedge between NATO allies at a time when Russia is periodically threatening both Georgia and Ukraine.</li> <li>• The United States and Canada continue to disagree over the legal status of the NWP, with Canada claiming that it is an internal waterway under complete Canadian sovereignty, while the United States claims the right of innocent passage. Canada agrees with Russia's position that Russia has sovereignty over the NSR, but other NATO members disagree.</li> </ul>
Shock 1: So Long, and Thanks for All the Fish	<ul style="list-style-type: none"> <li>• Satellite and aircraft reconnaissance reveal extensive illegal fishing by Chinese vessels within the U.S. and Canadian EEZs.</li> <li>• The United States and Canada launch an expanded law-enforcement operation accompanied by other capabilities to better secure maritime borders in the Far North and provide enhanced domain awareness. This includes intensified aerial and satellite surveillance, as well as USCG cutters, USN ships with USCG law-enforcement detachments, and CCG and RCN ships.</li> <li>• Chinese maritime militia vessels are shadowing the growing number of vessels in the region, frequently risking collisions. They occasionally aim eye-damaging lasers at U.S. and Canadian ships and aircraft, in violation of the 1995 Protocol on Blinding Laser Weapons.</li> </ul>
Shock 2: Stuck, Threatened, and Spied Upon	<ul style="list-style-type: none"> <li>• Three U.S. commercial vessels that attempt to avoid paying Russian fees by transiting north of Russia's NSR are stranded in the ice 50 miles north of Novaya Zemlya (an archipelago in the western Russian Arctic). Their communications and GPS appear to be jammed. USCG and USN vessels attempt to assist but experience jamming and detect fire-control radars being turned on. The United States turns to NATO allies for assistance and diplomatic support.</li> <li>• Russian forces appear to be conducting unannounced amphibious exercises on Wrangel Island (in Russia's northeast, near Alaska), simulating raids on and even complete seizure of Arctic islands. Some aircraft involved in these exercises veer off and approach Alaskan airspace, requiring interception.</li> <li>• Two weeks after those exercises, the Chinese icebreaker <i>Heilongjiang</i> appears off the coast of northwest Greenland, near Qaanaaq. China claims that this is related to a cultural and economic exchange, but the U.S. government suspects Chinese intelligence-gathering on activities at Thule Air Base.</li> </ul>

**Table G.5. Scenario IV: Don't Go Breaking My Ship**

Stage	Description
State of the world in 2035	<ul style="list-style-type: none"> <li>• The Russian economy is deteriorating. To mitigate this, Russia's leadership has invited even more Chinese investment in extractive industries in the Russian Arctic.</li> <li>• In return, China has received free-transit privileges on the NSR.</li> <li>• Tourism to the Arctic has expanded rapidly since the pandemic faded.</li> <li>• Numerous Chinese cruise ships sail to Alaska and across the NWP every summer, while others transit the NSR.</li> <li>• The U.S. opioid crisis remains dire, particularly within Alaskan communities, which are getting synthetic drugs (many of them Chinese-made) smuggled from Russian territory or delivered by cruise-ship crews during port visits.</li> <li>• Russia has been periodically concentrating its ground forces along its border with Norway as part of large-scale exercises, which also feature testing of electronic warfare equipment.</li> <li>• Norway has become even more supportive of marine and army forces from the United States, the UK, the Netherlands, and other NATO members to exercise along its border with Russia and to conduct rotational deployments there.</li> <li>• In the past several years, Russia has been cutting off gas supplies to Europe whenever Ukrainian representatives meet with their NATO counterparts, then resuming supplies after a few days, claiming that the disruptions were due to technical problems.</li> </ul>
Shock 1: Nations Collide	<ul style="list-style-type: none"> <li>• A U.S. fishing vessel is in distress in the Bering Strait after being struck by a Chinese cruise ship that did not follow IMO-recommended routes. Both ships experienced damage, with U.S. fatalities.</li> <li>• Beijing releases a statement claiming U.S. recklessness and suggests that Chinese cruise ships might avoid unsafe Alaskan waters unless the United States takes additional measures for safe navigation and adequate SAR.</li> <li>• This announcement creates an uproar among Alaskan communities whose economies have come to depend heavily on Chinese tourists, as well as from Alaskan politicians.</li> <li>• Russia supports China's statements that recommended routes are not mandatory and the cruise ship did not engage in any dangerous activity.</li> <li>• Both allege that the U.S. fishing vessel did not have its AIS on and suggest that it might have been involved in smuggling drugs.</li> <li>• Russia announces it will take "stronger and decisive" actions against U.S. vessels suspected of smuggling, without specifics.</li> <li>• A Border Service of the FSB vessel subsequently detains a U.S. fishing vessel in international waters for alleged smuggling.</li> <li>• Russian aircraft begin probing Alaskan airspace more frequently. U.S. intelligence observes a buildup of ground forces in northeastern Russia, and U.S. bases in Alaska experience a series of cyberattacks.</li> </ul>
Shock 2: Holding the Line	<ul style="list-style-type: none"> <li>• About one month later, U.S. Army and Marine Corps units conducting an announced exercise in northern Norway alongside their Norwegian, UK, and Dutch counterparts are finding that their communications have been jammed.</li> <li>• Multiple cyberattacks afflict both armed forces and civilian communities in northern Norway, Sweden, and Finland.</li> <li>• NATO members' air and naval bases across Europe also appear to be intermittently experiencing unexplained power outages.</li> <li>• Russian ground forces mass near the Russia–Norway border for an exercise, although it had not been previously announced.</li> <li>• Some Russian UASs from the exercise briefly intrude across the Norwegian border. One crashes in the Indigenous Sámi village of Unjárga (Nesseby).</li> <li>• A handful of Russian artillery shells from the exercise detonate within one mile of the border on the Norwegian side, although without causing damage or injuries.</li> </ul>

**Table G.6. Scenario V: The Fraying Gap**

Stage	Description
State of the world in 2035	<ul style="list-style-type: none"> <li>• Greenland, the Faroe Islands, and Scotland declared independence in the late 2020s, while they were doing well economically.</li> <li>• Their revenues from fishing, mining, oil, and tourism have recently plummeted. Iceland is in the same dire economic situation.</li> <li>• None of them has joined NATO or the EU, although NATO forces from other countries remain in their territory.</li> <li>• All of these countries have received loans, investments, and travel for high-profile people from Chinese and Russian sources.</li> <li>• Large contingents of Chinese laborers are working in these countries to build the infrastructure funded by Chinese investments.</li> <li>• Open-source satellite imagery reveals that all four countries now host Chinese and Russian antennae in supposedly commercial buildings; these could be used for signal collection or jamming.</li> <li>• These countries' traditional and social media are flooded with pro-China and pro-Russia material.</li> <li>• There are growing movements in all four countries to get NATO forces to depart. Most Icelanders want to leave NATO.</li> <li>• In the past decade, China has been demanding that Japan remove its vessels from the vicinity of the disputed Senkaku/Diaoyu Islands in the East China Sea and telling the United States to get out of East Asia.</li> <li>• Whenever there has been a close encounter between Chinese and Japanese or U.S. vessels near the Senkaku Islands, China has sent its nearest polar icebreaker close to Alaskan territorial waters.</li> </ul>
Shock 1: Maritime Menace	<ul style="list-style-type: none"> <li>• Russia and China send a massive flotilla out of Russia's Kola Peninsula. It passes between Svalbard and mainland Norway, heading toward the GIUK gap.</li> <li>• South of Svalbard, ships from the flotilla surround U.S. and Norwegian coast guard vessels, jamming their communication and navigation systems.</li> <li>• After about an hour, the Chinese and Russian ships depart.</li> <li>• Some Norwegian and U.S. personnel who were on deck at the time report intense headaches and nausea, as well as lingering concussive symptoms.</li> <li>• Russian aircraft based in the Kola Peninsula, as well as both Russian and Chinese carrier-based aircraft, repeatedly approach Norwegian and UK airspace and are intercepted by aircraft from those countries and U.S. aircraft based in Europe.</li> <li>• The Russian aircraft sometimes maneuver in ways that nearly cause midair collisions.</li> <li>• Russian and Chinese ships make port calls in the Faroe Islands, Scotland, and Iceland.</li> <li>• Other ships in the flotilla roam close to the coastlines of these countries, lingering close to NATO facilities.</li> </ul>

Stage	Description
Shock 2: Intrusions	<ul style="list-style-type: none"> <li>Over the next few weeks, ice-hardened Russian ships, as well as two Chinese icebreakers, sail around Cape Farewell at the southern tip of Greenland and make their way up Greenland's west coast, frequently stopping near small communities and having the crews visit them via small boats.</li> <li>Russian and Chinese carriers remain south of Greenland, launching aircraft that repeatedly approach eastern portions of the Canadian Arctic, requiring interception.</li> <li>The Russian and Chinese surface ships periodically cross Baffin Bay and intrude within 12 nautical miles of the Canadian coastline.</li> <li>When CCG, USCG, RCN, and USN vessels approach and demand that the Russian and Chinese ships depart, the Russian and Chinese vessels aim non-eye-safe lasers at the pilot houses, causing intense glare and lingering eye damage (violating the Protocol on Blinding Laser Weapons). Some personnel on deck experience mysterious concussive symptoms.</li> <li>There are also detections of possible unattributed submarine activity just a few miles off Canada.</li> <li>The Russian and Chinese surface ships take more than a month to make their way through Baffin Bay, then linger for a week just off the coast of Thule Air Base before completing their circumnavigation of Greenland.</li> <li>U.S. Marine Corps and Army forces on a rotational deployment in northern Norway are detecting small Russian UASs periodically crossing the border.</li> <li>The UASs appear to be conducting primarily ISR and jamming but sometimes aim small, low-power lasers at the faces of personnel.</li> <li>Russia denies these UAS intrusions and claims that any UASs that were shot down are fakes or were electronically lured into Norwegian territory.</li> </ul>

**Table G.7. Scenario VI: Three's a Crowd**

Stage	Description
State of the world in 2035	<ul style="list-style-type: none"> <li>The availability of fish in the western Pacific is rapidly declining after years of overfishing.</li> <li>Chinese fishing vessels have begun to fish in the U.S. EEZ in the Bering Sea and the Arctic Ocean on a regular basis.</li> <li>In response, the U.S. government has threatened sanctions against China.</li> <li>The number of Chinese vessels operating in the U.S. EEZ exceeds the USCG's capacity to apprehend them because of shortages of available ships and aircraft.</li> <li>Over a period of years, whenever tensions between Russia and Ukraine increase, Russian ground forces have "accidentally" had UASs and uncrewed vehicles briefly cross into Norway, the Baltic states, and Poland during exercises.</li> <li>Russian exercises in the Bering Sea and strait have gotten closer to U.S. territorial waters and have included Russian TU-95 Bear bomber flights into the U.S. air defense identification zone.</li> <li>This has prompted the United States to intercept the flights and to send assets to the region to observe the exercises.</li> <li>As China's economy has struggled, Chinese leadership is disputing territory that Russia took in the 1850s and 1860s, causing a rift between those countries.</li> </ul>

Stage	Description
Shock 1: On the Brink	<ul style="list-style-type: none"> <li>• Russia is disrupting GPS signals in the Bering Strait, affecting mariners, as well as Nome and other nearby communities.</li> <li>• A U.S. fishing boat ran aground on Big Diomed Island while transiting the Bering Strait at night during low visibility, and it is unclear what caused the grounding after the entire crew was lost.</li> <li>• A USN destroyer is closely approached by two Russian cargo ships in the Bering Sea and just manages to avoid collision with either of them.</li> <li>• The frequency of TU-95 bomber flights increases.</li> <li>• Some U.S. satellites have been permanently damaged by Russian ground-based laser attacks, which Russia denies.</li> <li>• During a Russian exercise, a large Russian UAS flies too close to the USCG's NSC <i>Stratton</i> and crashes into the flight deck of the vessel.</li> <li>• One crew member on board the <i>Stratton</i> is killed, and several are injured.</li> <li>• Russian authorities issue a statement accusing the <i>Stratton</i> of using electronic warfare against the UAS and thereby causing the incident.</li> <li>• Russian amphibious forces stage a landing exercise on Russia's Big Diomed Island, just 2.5 miles from the United States' Little Diomed Island.</li> </ul>
Shock 2: Enter the Dragon	<ul style="list-style-type: none"> <li>• During the United States–Russia confrontation, Chinese fishing vessels greatly expand the extent of their illegal fishing in both Alaska's and Russia's EEZs.</li> <li>• Cyberattacks severely degrade operations at Fort Greely and Fort Wainwright in Alaska.</li> <li>• These attacks show some indications that they might have been from China, but the attackers have apparently used some past Russian cyber tactics.</li> <li>• At the same time, military bases in Russia's far east seem to be experiencing non-U.S. cyberattacks.</li> </ul>

## Appendix H. Additional Issues in Arctic Cooperation

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There is an unhealthy preoccupation with the strategic aspects of the North; the staking of claims, the establishment of bases, the calculation of risks.—Lester Pearson, future Canadian prime minister, 1946<sup>281</sup>

In this appendix, we provide some additional background information compiled from reference documents about Arctic cooperation and disputes because these are a topic of importance for regional governance that, in turn, can affect demand for USCG and other U.S. armed forces' presence in the region. We also provide this additional background because it highlights how stable the region has been in recent decades and that the pause in formal diplomatic relations with Russia at the strategic level (e.g., Arctic Council) starting in February 2022 is quite a strong departure from the previous status quo. We start with general issues in cooperation before turning to some specific disputes of note.

### Issues in Arctic Cooperation

We take a closer look at four limitations to security cooperation that are particularly relevant in the Arctic region. We start with information-sharing and classification barriers.

#### *Classification Barriers*

As discussed in Appendix C, policies on intelligence-sharing with allies impede—or prevent altogether—the timely transmission of information.<sup>282</sup>

#### *Technology Barriers*

As also noted in Chapter 5, there is a lack of mutual compatibility among communication systems, and even electrical outlets, which hinders interoperability. There have been some recent improvements in technological compatibility. Norway, followed by Finland and Canada, have all bought or decided to purchase the F-35 as their fifth-generation fighter of choice. Furthermore, NATO combat platforms are now using the Link 16 tactical data link.<sup>283</sup>

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<sup>281</sup> Charles Emmerson, *The Future History of the Arctic*, PublicAffairs, 2010, p. 109. Originally published in L. B. Pearson, “Canada Looks ‘Down North,’” *Foreign Affairs*, Vol. 24, No. 4, July 1946.

<sup>282</sup> U.S. government participant in the TTX held February 22, 2022.

<sup>283</sup> “Northrop Goes Full-Rate Production of Link 16 Tactical Data Link for Sensor Networking on Marine Helicopters,” *Military and Aerospace Electronics*, March 25, 2022.

### *Budget Cycle Limitations*

Allies' planning and budget cycles are not aligned, as Chapter 5 indicates, making it hard to coordinate acquisitions that would contribute to interoperability.

### *Differences in Legal Interpretation*

Difference in legal interpretation can include countries disagreeing on interpretation of international law. An importance instance of this in the Arctic is seen in debates over the status of the NSR, over which Russia claims additional jurisdiction because of UNCLOS exceptions for ice-covered waters. A similar situation exists with the NWP, which Canada claims should be considered historical internal waters. In both cases, the United States and other countries (notably, China) have asserted the right of innocent passage. As noted above, although the United States abides by UNCLOS, it has not ratified that convention, and that can be interpreted as curtailing its legal and diplomatic ability to formally address this issue.

This kind of difference in legal interpretation can directly affect the ability to partner because it limits what *can* be done, even if it *could* be done. In theory, Canada could object to the United States navigating the NWP for particular purposes. For some time, Canada was also less supportive of NATO attention on the Arctic because of its sovereignty concerns: Canada preferred to limit even allies' involvement in the Canadian Arctic. This might have contributed to limited reference to the region in NATO strategic documents and the location of NATO exercises in and around Norway, which has vociferously supported NATO presence in the Arctic.<sup>284</sup> More generally, countries might grant or deny basing in or movement through their territory depending on the circumstances. The same applies to access to equipment and personnel; if a country disagrees with the purpose for or terms of use, it will limit ability to partner.

These might also include more-tactical matters, such as customary procedures or conditions under which a tactic or weapon would be used. For example, Russia is suspected of having jammed NATO (and commercial) navigation and communication capabilities during exercises. In general, NATO and the U.S. military would resort to electronic warfare under different circumstances.

This type of ideological difference could cause problems operating together under a coalition construct because decisions to act in particular ways must be made together. Importantly, this type of difference could also lead to unexpected risks for the United States, stemming from antiaccess activities of potential adversaries operating in the region. For example, some USCG platforms—notably, icebreakers—are typically devoid of much defensive equipment, and USCG personnel operating under historical assumptions would not necessarily expect to be attacked while conducting missions in the region.

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<sup>284</sup> Mackenzie Foxall, "Is the Arctic Still a Forgotten Flank? Examining NATO Engagement in the Arctic," North American and Arctic Defense and Security Network, policy primer, August 3, 2021.

## Arctic Disputes

Growing interest in the Arctic has resulted in increased exploration of sovereignty disputes within the region in the past couple of decades. Previously quiescent disagreements about ownership and authority have become more pertinent with the prospect of economic opportunities, as well as growing recognition of the Arctic's susceptibility to environmental damage. Growing disagreements between Russia and other countries have also contributed to a renewed focus on sovereignty disputes. However, other factors have also contributed to an upsurge in debate over the Arctic. Some of the impetus for the recent clamor over Arctic sovereignty has been, paradoxically, the result of an international treaty intended "to settle, in a spirit of mutual understanding and cooperation, all issues relating to the law of the sea."<sup>285</sup> UNCLOS mandated that all countries wishing to submit claims for seabed rights to extended continental shelves do so within ten years of ratification.<sup>286</sup> Four of the five nations that border the Arctic Ocean have ratified the treaty since the end of the Cold War: Norway in 2010, Russia in 2015, Denmark in 2014, and Canada in 2019. (The United States is the exception; it has signed the treaty and abides by its provisions but has not ratified it.) The four ratifying countries have a clear interest in expeditiously and effectively asserting their claims, lest they effectively relinquish them forever. China possesses no sovereign territory but bases its claim of being a near-Arctic state by virtue of being a signatory party to the 1920 Svalbard Treaty.<sup>287</sup>

In this appendix, we briefly explain sovereignty disputes in the Arctic and their implications for overall Arctic security. They are as follows:

### 1. disagreements over seabed rights under the Lomonosov Ridge

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<sup>285</sup> Preamble to UNCLOS, Afg.–Alb.–Alg.–Angl.–Ant. and Barb.–Arg.–Arm.–Austl.–Austria–Azer.–Bah.–Bahr.–Bangl.–Barb.–Belr.–Belg.–Belize–Benin–Bhutan–Bol.–Bosn. and Herz.–Bots.–Braz.–Brunei Darussalam–Bulg.–Burk. Faso–Burundi–Cambodia–Cameroon–Can.–Cape Verde–Cent. Afr. Rep.–Chad–Chile–China–Colom.–Comoros–Congo–Cook Islands–Costa Rica–Côte d'Ivoire–Croat.–Cuba–Cyprus–Czech–Dem. People's Rep. Kor.–Dem. Rep. Congo–Den.–Djib.–Dominica–Dom. Rep.–Ecuador–Egypt–El Sal.–Eq. Guinea–Est.–Eth.–European Community–Fiji–Fin.–Fr.–Gabon–Gam.–Geor.–Ger.–Ghana–Greece–Gren.–Guat.–Guinea–Guinea-Bissau–Guy.–Haiti–Hond.–Hung.–Ice.–India–Indon.–Islamic Republic of Iran–Iraq–Ir.–It.–Jam.–Japan–Jordan–Kenya–Kiribati–Kuwait–Lao People's Dem. Rep.–Lat.–Leb.–Lesotho–Liber.–Libyan Arab Jamahiriya–Liech.–Lith.–Lux.–Madag.–Malawi–Malay.–Maldives–Mali–Malta–Marsh. Is.–Mauritania–Mauritius–Mex.–Fed. States of Micr.–Mold.–Monaco–Mong.–Montenegro–Morocco–Mozam.–Myan.–U.N. Council for Namib.–Nauru–Nepal–Neth.–N.Z.–Nicar.–Niger–Nigeria–Niue–Nor.–Oman–Pak.–Palau–Pan.–Papua N.G.–Para.–Phil.–Pol.–Port.–Qatar–Rep. Korea–Rom.–Russian Federation–Rwanda–Samoa–São Tomé and Príncipe–Saudi Arabia–Sen.–Sey.–Sierra Leone–Sing.–Slovk.–Slovn.–Solom. Is.–Som.–S. Afr.–Spain–Sri Lanka–St. Kitts and Nevis–St. Lucia–St. Vincent–State of Palestine–Sudan–Surin.–Swaz.–Swed.–Switz.–Thail.–former Yugoslav Rep. Maced.–Timor-Leste–Togo–Tonga–Trin. and Tobago–Tunis.–Tuvalu–Uganda–Ukr.–U.A.E.–U.K. of Gr. Brit. and N. Ir.–United Rep. Tanzania–Uru.–Vanuatu–Viet.–Yemen Arab Republic–Federal Republic of Yugoslavia–Socialist Fed. Rep. of Yugoslavia–Zaire–Zam.–Zim., December 10, 1982, 1833 U.N.T.S. 397.

<sup>286</sup> UNCLOS, Annex II, Article 4. The phrase "extended continental shelf" is an informal way of describing the portion of the continental shelf beyond the 200-nautical mile limit. The distinction between this part of the continental shelf and that within 200 nautical miles of land is legal, not geological or bathymetric.

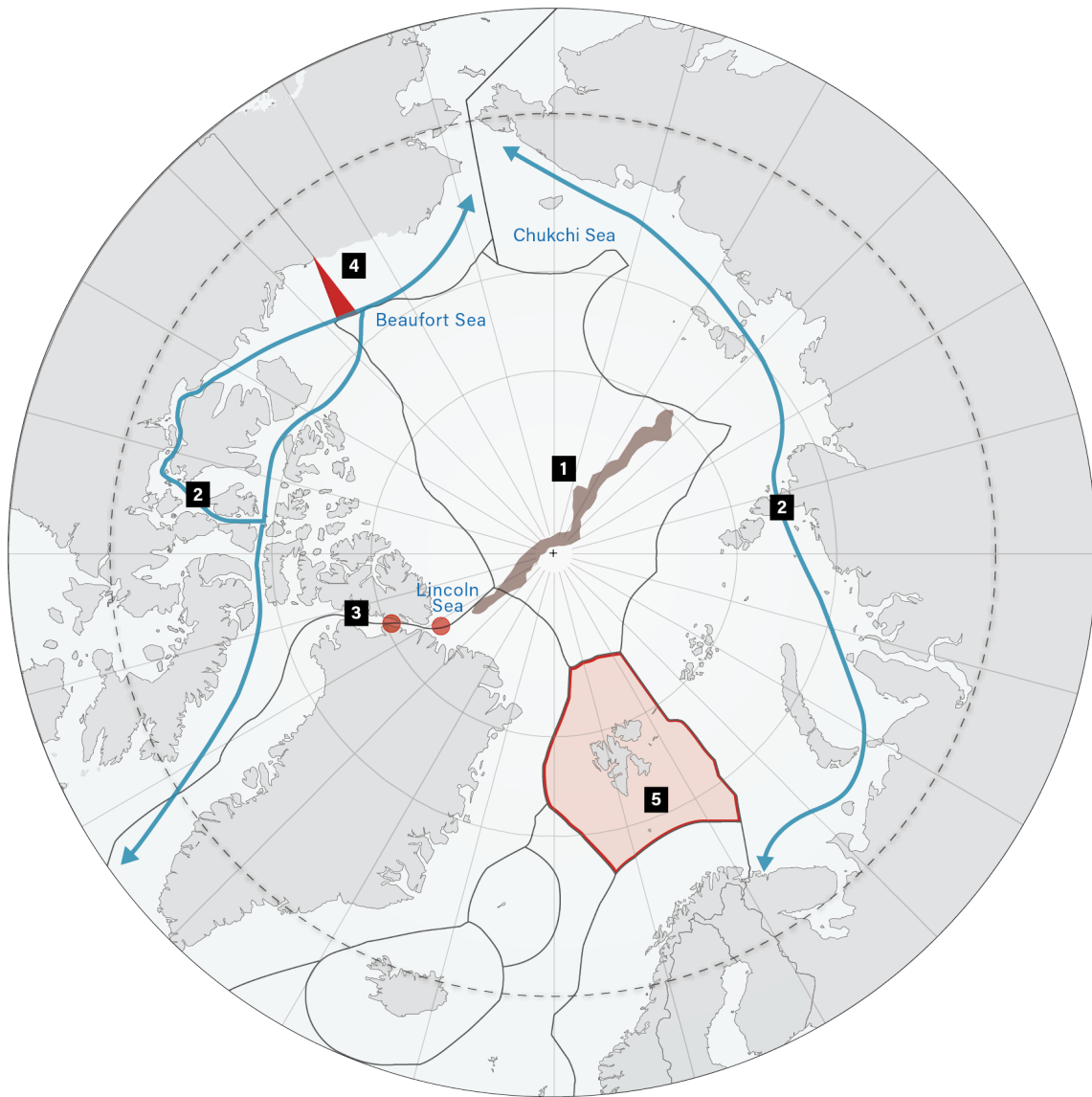
<sup>287</sup> Liu, 2021.



2. disagreement over rights of innocent passage in waters within Canadian and Russian Arctic archipelagoes (the NWP and NSR)
3. recently resolved Denmark–Canada disputes over Hans Island and portions of the Lincoln Sea
4. a United States–Canada dispute over part of the Beaufort Sea
5. Norway–Russia disputes over the waters surrounding the Svalbard archipelago.

We discuss each of these in turn in this appendix. To orient the reader, a map of the region highlighting key locations appears in Figure H.1.

**Figure H.1. Map of the Arctic, Highlighting Disputed Areas**



NOTE: Black lines signify EEZ boundaries. Arctic sovereignty disputes are numbered, as follows: (1) disagreements over seabed rights under the Lomonosov Ridge; (2) disagreement over rights of innocent passage in waters within Canadian and Russian Arctic archipelagoes (the NWP and NSR); (3) Denmark–Canada dispute over Hans Island and portions of the Lincoln Sea (resolved in 2022); (4) a United States–Canada dispute over part of the Beaufort Sea; and (5) Norway–Russia disputes over the waters surrounding the Svalbard archipelago.

### *Seabed Rights Under the Lomonosov Ridge*

The dispute involving the greatest area relates to the Lomonosov Ridge and the northernmost portions of the Arctic Ocean. To understand the nature of the dispute, it is necessary to briefly review both the geographic and legal contexts.

The Lomonosov Ridge is an elevated feature of the Arctic Ocean floor. As shown in Figure H.1, it extends across the central Arctic Ocean, spanning from near Russia to the Greenland–Canada boundary. Near its midpoint, it passes within 50 miles of the North Pole. This undersea feature matters politically because of UNCLOS provisions addressing countries’ rights to seabed resources. In general, coastal countries have the exclusive right to extract marine resources within EEZs extending 200 nautical miles from their coastlines; overlapping areas are divided along lines equidistant from both coasts.<sup>288</sup> In addition, a state with an extended continental shelf can claim the exclusive right to extract resources from the seabed (but not the water column) at a greater distance from its coastline. Specifically, a state with a protruding continental shelf has exclusive seabed rights on that shelf up to 350 nautical miles from its coastline or 100 nautical miles from a line where the depth reaches 2,500 m, whichever the state prefers (presumably the greater one). The process of staking such a claim is complex; the UN’s guide for doing so is a 530-page tome.<sup>289</sup>

In this context, the extent to which the Lomonosov Ridge can be considered an extension of any of these countries’ continental shelves affects those countries’ extraction rights.<sup>290</sup> Of the three countries, Russia was the first to submit the necessary documentation to the CLCS, in December 2001. It claimed vast areas of the Arctic Ocean, extending up to the North Pole.<sup>291</sup> In February 2002, both Canada and Denmark indicated that they required more data to be able to evaluate Russia’s claim.<sup>292</sup> The commission subsequently recommended that Russia collect more data and then resubmit its petition.

Russia’s continental shelf claims were brought to the wider world’s attention in 2007. During a Russian scientific research expedition—whose aims included better mapping of the extended continental shelf and Arctic ridges, with the potential to bolster Russia’s claims—a submersible planted Russia’s flag under the North Pole. At a subsequent press conference, the expedition’s leader proclaimed, “The Arctic is Russian.”<sup>293</sup> The United States, Canada, and other countries

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<sup>288</sup> UNCLOS, Article 76. A nautical mile is equivalent to 1.15 statute miles or 1.85 km.

<sup>289</sup> Emmerson, 2010, p. 99. The source under discussion is Division for Ocean Affairs and the Law of the Sea, United Nations, *The Law of the Sea: Training Manual for Delineation of the Outer Limits of the Continental Shelf Beyond 200 Nautical Miles and for Preparation of Submissions to the Commission on the Limits of the Continental Shelf*, 2006.

<sup>290</sup> UNCLOS Annex II, Article 4.

<sup>291</sup> CLCS, “Outer Limits of the Continental Shelf Beyond 200 Nautical Miles from the Baselines: Submissions to the Commission—Submission by the Russian Federation,” updated June 30, 2009.

<sup>292</sup> CLCS, “Canada: Notification Regarding the Submission Made by the Russian Federation to the Commission on the Limits of the Continental Shelf,” CLCS.01.2001.LOS/CAN, February 26, 2002a; CLCS, “Denmark: Notification Regarding the Submission Made by the Russian Federation to the Commission on the Limits of the Continental Shelf,” CLCS.01.2001.LOS/DNK, February 26, 2002b.

<sup>293</sup> Michael Byers, *Who Owns the Arctic? Understanding Sovereignty Disputes in the North*, Douglas and McIntyre, 2009, p. 88.

quickly stated that the action had no legal standing. However, as noted already, the extent of the shelf and Russia's rights are inextricably linked, as the foreign minister was undoubtedly aware.

In fairness, Russia's demonstrative flag-planting was not unprecedented. Robert Peary had planted a U.S. flag at the North Pole in 1909, offering to put the site at the disposal of President William Taft (who politely declined, noting that he did not know what he could do with it).<sup>294</sup> Roald Amundsen planted a Norwegian flag at the South Pole two years later. As with U.S. astronauts emplacing their country's flag on the moon, the symbol of a country's presence did not indicate a formal claim. From a legal standpoint, the expedition's mapping of the ridge is far more important than its symbolism. Notwithstanding the minister's statement, the expedition's scientific work is inextricably linked to Russia's claims, as noted above.

Canada, Denmark, and the United States have also been conducting expeditions to map the extended continental shelf in recent years; the data collected could bolster Arctic claims.<sup>295</sup>

National pride is a powerful factor at work in the debate over ownership of the Lomonosov Ridge. Successfully claiming the Lomonosov Ridge entitles the claimant to exclusive seabed rights over a large area. Although such rights do not confer full sovereignty—ships belonging to any country can freely operate and even fish in those waters without being subject to regulation by the seabed's owner—it nonetheless represents an important symbol of authority.

However, there are also potential resources at stake. An analysis by the U.S. Geological Survey indicated that considerable amounts of oil and natural gas are likely to be present in the high Arctic, including in areas subject to claims based on the extended continental shelf.<sup>296</sup> National leaders are naturally excited at the prospect of acquiring title to these additional resources based on data collection and formal applications; few expansions of national rights come at so small a price. However, even if resources are found to exist at these high latitudes, any country's ability to commercially extract them for decades or longer is extremely doubtful. They would appear to be far less enticing than the uncontested, more-proven, and substantial resources closer to countries' Arctic shorelines; according to a Danish estimate, some 95 percent of the Arctic's mineral resources are uncontested.<sup>297</sup> By definition, the areas under discussion are at least 200 nautical miles from the nearest land and therefore even farther from the nearest infrastructure. As a result, the cost of moving equipment, supplies, personnel, and resources in this area will likely be formidable. The risks to personnel would be high, and equipment would be continually degraded by the harsh polar environment. Regardless of the effects of rising temperatures, climate models agree that the high Arctic will remain ice-covered in winter and will likely contain substantial amounts of ice—whether continuous or floating—for most of the

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<sup>294</sup> Emmerson, 2010, p. 82.

<sup>295</sup> "Denmark Hopes to Claim North Pole," BBC News, October 5, 2004; Ben Leapman, "Denmark Joins Race to Claim North Pole," *The Telegraph*, August 12, 2007.

<sup>296</sup> Bird et al., 2008.

<sup>297</sup> "Too Much to Fight Over," *The Economist*, June 16, 2012, p. 10.

year in coming decades.<sup>298</sup> Any extraction activity would be buffeted by ice movements, extreme temperatures, and strong winds. The cost of extracting and moving resources from the high Arctic is likely to be great. A confluence of events in which fossil fuels from the far-offshore Arctic become cost-competitive with other types of energy is possible but, realistically, appears to be very unlikely. Conversely, because ownership of seabed rights is intended to last forever, it makes sense for Russia, Canada, and Denmark to stake broad claims to resources that could be harvested many decades or centuries in the future.

All three countries whose territory approaches the Lomonosov Ridge have continued to discuss security issues in their respective policy documents on the region. Denmark has said that its

approach to security policy in the Arctic is based on an overall goal of preventing conflicts and avoiding the militarization of the Arctic, and actively helping to preserve the Arctic as a region characterized by trust, cooperation and mutually beneficial partnerships.<sup>299</sup>

Canada's Arctic policy document also adopts a moderate tone:

The increasing accessibility of the Arctic has led to a widespread perception that the region could become a source of conflict . . . . Canada does not anticipate any military challenges in the Arctic and believes that the region is well managed through existing institutions, particularly the Arctic Council.<sup>300</sup>

Russia's policy statement on the Arctic is a little more bellicose, calling for the maintenance of required combat potential of armed forces in the region while also designating cooperation among Arctic states (including on boundary issues) as a strategic priority.<sup>301</sup>

Even allowing for a discrepancy between states' avowed peaceful intentions and their actual aims, the possibility of conflict over Arctic resources seems remote. Partly to promote mutual reassurance following the Russian flag-planting incident under the North Pole, Denmark invited the other four high Arctic states to a May 2008 meeting in Ilulissat, Greenland.<sup>302</sup> The Ilulissat Declaration adopted by all five states reiterated their commitment to "this [UNCLOS] legal framework and to the orderly settlement of any possible overlapping claims."<sup>303</sup> The declaration also mentioned the need to expand already-close cooperation among the states in such diverse areas as environmental protection, scientific research, safety of navigation, and SAR.

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<sup>298</sup> B. Ellis and L. Brigham, *Arctic Maritime Shipping Assessment 2009 Report*, Arctic Council, 2009.

<sup>299</sup> Ministry of Foreign Affairs of Denmark, *Denmark, Greenland and the Faroe Islands: Kingdom of Denmark Strategy for the Arctic 2011–2020*, August 2011, p. 10.

<sup>300</sup> Government of Canada, *Statement on Canada's Arctic Policy: Exercising Sovereignty and Promoting Canada's Northern Strategy Abroad*, 2010, p. 27.

<sup>301</sup> Dmitry Medvedev, "[Foundations of the State Policy in the Arctic Until 2020 and Beyond]," approved September 18, 2008, unofficial translation by Anatoly Karlin.

<sup>302</sup> Byers, 2009, p. 89.

<sup>303</sup> Ilulissat Declaration, Can.–Den.–Nor.–Russ.–U.S., May 28, 2008, p. 1.

## *United States–Canada Dispute over the Beaufort Sea*

The United States and Canada disagree over the maritime boundary between Alaska and Canada in the Beaufort Sea. The dispute centers on differing interpretations of the 1825 Treaty of St. Petersburg between the UK and Russia, which demarcated the northern Alaska–Canada boundary as follows: “[T]he said Meridian Line of the 141st Degree, in its prolongation as far as the Frozen Ocean, shall form the limit between the Russian and British Possessions on the Continent of America to the North West.” The disagreement centers on whether the 141°W boundary continues into the “frozen ocean” (Canada’s interpretation) or terminates at the water’s edge (the United States’ view). If the established boundary does end at the coast, then, under UNCLOS, the boundary between the two countries’ 200–nautical mile EEZ should be equidistant from each country’s nearest land masses (i.e., approximately perpendicular to the coastline).<sup>304</sup> The result is that both countries claim a wedge-shaped area of approximately 6,200 square nautical miles, almost the size of New Jersey, as part of their respective EEZs; this area is indicated in the upper left-hand corner of Figure H.1. Note that the U.S. claim is based partly on UNCLOS, which it has not ratified (although it is a signatory and abides by its provisions). Not having ratified the treaty would appear to undermine the United States’ ability to insist on applying UNCLOS in resolving the issue.

As with any boundary dispute, national pride is at stake for both sides; however, tangible resources are also believed to exist in the area under consideration. Both the U.S. Geological Survey and the Canada Energy Regulator agree that the disputed area likely contains billions of cubic meters of gas, as well as billions of barrels of oil.<sup>305</sup> The area also contains ample fish resources. Although there has been virtually no commercial harvesting of this fishery to date, a decrease in ice concentrations in this area makes such a possibility more viable. Moreover, warmer waters are beginning to contain higher concentrations of species typically seen at more-southern latitudes, such as mussels, pollack, cod, and salmon. The potential for disagreement about fishing rights was highlighted when the U.S. Department of Commerce banned commercial fishing in the Beaufort Sea in 2009, aiming to collect more data before establishing catch limits. Canada criticized the fact that U.S. regulations encompassed the disputed area.<sup>306</sup>

However, the nature of this dispute is more akin to a friendly disagreement than a basis for military conflict and does not fall within uncharted diplomatic waters. In fact, the Beaufort Sea is one of several “friendly” boundary disagreements between the United States and Canada. The two countries also dispute waters west of the Strait of Juan de Fuca (between British Columbia and Washington State), as well as near Dixon Entrance along the border between southeastern

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<sup>304</sup> 1825 Treaty of St. Petersburg, Article III; Representative for Ocean Policy Affairs, DoD, “Maritime Claims Reference Manual,” last updated February 8, 2022, pp. 654–655.

<sup>305</sup> Bird et al., 2008; Sian Griffiths, “US–Canada Arctic Border Dispute Key to Maritime Riches,” BBC News, August 2, 2010.

<sup>306</sup> Randy Boswell, “Canada Protests U.S. Arctic Fishing Ban,” CanWest News Service, September 4, 2009.

Alaska and British Columbia. In the Gulf of Maine, the two countries dispute not only water but also two tiny islands; on one of these (otherwise-uninhabited) islets, the CCG maintains a lighthouse and two personnel to operate it.<sup>307</sup> However, none of these boundary disputes is of particular importance to the United States–Canada relationship, a long-forged symbiotic system involving shared interests between countries with much in common. The two countries are democratic neighbors with tightly integrated economies and security arrangements, as well as a web of deep cultural, political, and familial ties. Like any neighbors, they have disagreements over a variety of issues, including boundary disputes that affect both their pride and their pocketbooks. However, civil disagreement about these issues represents but one aspect of the countries’ continual series of negotiations about their relationship.

Moreover, despite the Beaufort Sea dispute, the two countries have been working together on Arctic sovereignty issues. From 2008 onward, they have jointly gathered bathymetric data to help substantiate potential claims to extended continental shelf rights to the seabed.<sup>308</sup> Experts on international law and specialists on the North American Arctic region conducted a workshop in Anchorage, Alaska, in March 2010 to examine the dispute. Topics under consideration included the history of the disputed area, potential solutions to the disagreement, and the implications of the aforementioned data-collection effort. In a surprise to both sides, recently collected bathymetric data indicated that Canada could claim exclusive rights to a larger area of seabed beyond 200 nautical miles if it espoused the equidistance principle proposed by the United States, while the United States would gain a larger area if it adhered to Canada’s position regarding the 141°W meridian. Michael Byers, a Canadian legal scholar, stated, “All of a sudden, we have this almost perfect opportunity for a win-win, negotiated solution.”<sup>309</sup> Whichever country is assigned a smaller expanse within the 200–nautical mile limit will receive seabed rights to a larger area outside it, and vice versa.

The extent to which each country would gain financially from a particular approach is unknown at this time because the value of the resources within any given area is not known with any degree of precision. The costs of extraction are also difficult to estimate; presumably, these costs will be higher for far-offshore resources than for those closer to the shoreline, given increasing depths and distances from shore-based infrastructure.

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<sup>307</sup> Jennifer Loten, consul of Canada in Anchorage, “Canadian Perspectives on a Changing Arctic,” slides presented at the Arctic Policy Forum, February 2011.

<sup>308</sup> As noted previously, based on UNCLOS, such rights can extend beyond the 200–nautical mile limit. Canada must file any such claims by November 2013, ten years after it ratified UNCLOS; the United States, assuming that it ratifies the treaty, will then have ten years to file its claim.

<sup>309</sup> Griffiths, 2010; John Ibbitson, “Dispute over Hans Island Nears Resolution. Now for the Beaufort Sea,” *Globe and Mail*, January 26, 2011.

### *Denmark–Canada Dispute over Hans Island and Portions of the Lincoln Sea*

Up until 2022, both Denmark (on behalf of Greenland) and Canada laid claim to Hans Island, a small, uninhabited island in the center of the Kennedy Channel, between Canada's Ellesmere Island and the west coast of Greenland. This dispute appeared to be wholly symbolic in nature. The island, wedged between northern Greenland and Canada in Figure H.1, is a barren rock with an area of about 0.5 square miles; it has no apparent resources or other attractions. Ownership of the island does not affect sovereignty over adjacent waters because the two countries demarcated their maritime boundary in the Kennedy Channel in 1973, excluding only Hans Island itself from the agreement.<sup>310</sup> Even if major resource extraction began in the more than 100,000 square miles of water between Greenland and Canada (the Davis Strait, Baffin Bay, the Kennedy Channel, and the Lincoln Sea), it is very unlikely that such activities would be conducted on Hans Island, given its extreme northern location and correspondingly challenging environment. At 80.8°N latitude, it is more than 200 miles north of Thule Air Base. It is more than 600 miles farther north than Utqiagvik, Alaska; the two have about the same latitude differential as that between Detroit and Atlanta. Canada and Denmark finally resolved their dispute over Hans Island on June 14, 2022, dividing the island between them.<sup>311</sup>

The two countries also disputed their maritime boundary farther north, in the Lincoln Sea. The two disagreed on whether Beaumont Island, off the coast of Greenland, should be used in baseline calculations for dividing the EEZs in waters between the two countries. Beaumont Island is indisputably part of Greenland, but whether it is used as the basis for maritime claims affects ownership of an area of about 85 square miles of sea—slightly larger than Washington, D.C.<sup>312</sup> The *southernmost* part of the disputed maritime area is more than 100 miles northeast of Hans Island, at a latitude exceeding 82°N. As with Hans Island, the extreme climate in this area and its distance from land (and infrastructure) make any resource exploitation extremely unlikely for the very long term. This dispute was also resolved in 2022.

Despite close economic, political, military, and other relationships between these two NATO countries, these essentially symbolic disputes sometimes became cantankerous during the late 20th and early 21st centuries. Both countries periodically engaged in demonstrative flag-plantings on Hans Island (while also leaving behind their respective countries' alcoholic beverages, as well as heated rhetoric). In 1983, Denmark's minister for Greenland affairs visited the island, eliciting protests from Canada. Danish naval ships landed on the island in 1988, 2002, and 2003. Canada's foreign minister visited Hans Island in July 2005, prompting a negative response from Danish and Greenlandic authorities. Cooler heads prevailed by September, when a

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<sup>310</sup> Byers, 2009, p. 23.

<sup>311</sup> Ian Austen, "Canada and Denmark End Their Arctic Whisky War," *New York Times*, June 14, 2022.

<sup>312</sup> Byers, 2009, pp. 105–107.



joint statement by the two countries' foreign ministers reiterated the relatively friendly nature of the dispute.<sup>313</sup>

We have much in common, and we have worked together over many years in advancing the welfare of the Arctic region and its peoples. Through the Arctic Council and other means, we already collaborate closely on challenges facing the Arctic and the North, such as climate change, resource extraction and transport. We also expressed our satisfaction at the recent launch of our joint project to map the seabed of the Arctic Ocean. We acknowledge that we hold very different views on the question of the sovereignty of Hans Island . . . . Firmly committed as we are to the peaceful resolution of disputes, including territorial disputes, we consistently support this principle here at the United Nations, and around the world. To this end, we will continue our efforts to reach a long-term solution to the Hans Island dispute . . . . While we pursue these efforts, we have decided that, without prejudice to our respective legal claims, we will inform each other of activities related to Hans Island. Likewise, all contact by either side with Hans Island will be carried out in a low-key and restrained manner.

### *Right of Innocent Passage*

As shown in Figure H.1, the NWP and the NSR are surrounded by Canadian and Russian territories, respectively. Both of these really encompass a variety of routes, each following a different path among numerous islands or between those islands and the mainland. Both Russia and Canada insist that these Arctic maritime routes are internal waters, with ships using them subject to their full jurisdiction.

However, many other countries oppose these claims as part of a broader position. If other archipelagic states (such as Indonesia, Iran, or China) were also to declare interisland straits to be internal waters, they could restrict traffic in vital shipping lanes. The United States has been particularly vocal on the issue of freedom of navigation in the Arctic and elsewhere. It demonstratively made its case on the issue in 1985, when it sent the USCGC *Polar Sea* from Thule to Seattle via the NWP.<sup>314</sup> Prior to the voyage, U.S. authorities informed their Canadian counterparts that the trip would be “an exercise of navigational rights and freedoms not requiring prior notification,” which would appear to be an instance of one country notifying another that it was explicitly not notifying it.<sup>315</sup> Canada indicated that it approved the voyage, for which permission had not been asked, thereby restating its own position.

The United States' insistence on the issue, due to its interest in maintaining open access to shipping lanes around the world, is an issue for Canadians. According to Byers, Canada's identity is deeply interwoven with the idea of the Far North. Although only about 1 percent of

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<sup>313</sup> Government of Canada, “Canada and Denmark Issue Statement on Hans Island,” News Release 165, September 19, 2005.

<sup>314</sup> The SS *Manhattan* was accompanied by a Canadian icebreaker during its 1969 transit of the NWP, so it did not raise the same questions of sovereign authority.

<sup>315</sup> Byers, 2009, pp. 52–53.

Canadians live north of the Arctic Circle, the Arctic stirs a particular passion for Canadians, and sovereignty over it is important to them. He commented that, “For many Canadians, when the United States claims an unfettered right to use the Northwest Passage, it is like a wealthy neighbor claiming the right to tramp through our living room.”<sup>316</sup> A 2011 survey of Canadian attitudes confirms Canadians’ intense feelings about Arctic issues and strong sentiment that Canada exercises full and rightful authority over the NWP.<sup>317</sup> Canada officially designated the NWP as Canadian internal waters in 2006, demonstrating its perception and its resolve on the issue.<sup>318</sup>

Canada has offered two additional ways in which the NWP is distinct from other waterways and therefore treating them as internal waters offers no precedent for other countries to control passage in key international straits. The first is that the NWP has not been used historically as an international transit route, whereas other straits have. The second is that the ice in and around the islands has been actively occupied by Inuit Canadians and their ancestors, who have functioned atop these waters in a manner more akin to living on the land than on the sea.<sup>319</sup> Russia, not surprisingly, is also committed to its position that it has the right to control traffic moving among its islands or between its islands and its mainland territories.<sup>320</sup>

The relevant legal framework for discussing these questions is UNCLOS. Within 12 nautical miles of shore, states exert the same sovereign rights as on land, except that ships maintain the right of innocent passage through those waters. That is, they can transit through those waters so long as their movement is “continuous and expeditious,” as well as not “prejudicial to the peace, good order or security of the coastal state.”<sup>321</sup> Forbidden activities include any hostile gestures, information collection, dissemination of propaganda, interference with communications, launching submersible platforms, and unlawful pollution, fishing, or research.<sup>322</sup> From 12 to 24 nautical miles offshore, a state can prevent or punish “infringement of its customs, fiscal, immigration or sanitary laws” by ships exercising the right of innocent passage.<sup>323</sup> From 24 to 200 nautical miles offshore, UNCLOS limits coastal states to applying environmental regulations

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<sup>316</sup> Byers, 2009, pp. 19–20.

<sup>317</sup> Ekos Research Associates, *Rethinking the Top of the World: Arctic Security Public Opinion Survey*, submitted to the Walter and Duncan Gordon Foundation and the Canada Centre for Global Security Studies at the Munk School of Public Affairs, January 2011.

<sup>318</sup> “Northwest Passage Gets Political Name Change,” *Canada.com*, April 9, 2006.

<sup>319</sup> Byers, 2009, pp. 55, 119.

<sup>320</sup> Claes Lykke Ragner, *The 21st Century: Turning Point for the Northern Sea Route? Proceedings of the Northern Sea Route User Conference, Oslo, 18–20 November 1999*, Springer Science and Business Media, 2000, p. 81.

<sup>321</sup> UNCLOS, Article 19.

<sup>322</sup> UNCLOS, Article 19.

<sup>323</sup> UNCLOS, Article 33.

for foreign ships consistent with those promulgated by IMO. It does make an exception for ice-covered areas (presumably recognizing their environmental fragility), as Article 234 states:<sup>324</sup>

Coastal states have the right to adopt and enforce non-discriminatory laws and regulations for the prevention, reduction and control of marine pollution from vessels in ice-covered areas within the limits of the exclusive economic zone, where particularly severe climatic conditions and the presence of ice covering such areas for most of the year create obstructions or exceptional hazards to navigation, and pollution of the marine environment could cause major harm to or irreversible disturbance of the ecological balance. Such laws and regulations shall have due regard to navigation and the protection and preservation of the marine environment based on the best available scientific evidence.

However, the definition of *ice-covered* is ambiguous; it is unclear how much ice must be present and whether it must be year-round for an area to fall into this category. Moreover, given both seasonal variations and climate change, the boundaries of waters designated as ice-covered could shift either over the course of a single year or from one year to the next.

Given the complex geography of the Canadian and Russian archipelagoes, there are numerous narrow straits through which any vessel must pass, putting them within 24 nautical miles of a country's shoreline. As a result, a ship transiting the Arctic could avoid such a close approach only if it were willing to follow an extreme northerly route, exceeding 80°N in places as it bypassed the northernmost lands belonging to either country. A ship following such a near-polar route would encounter higher ice concentrations (and more-extreme weather generally) than ships transiting lower portions of the Arctic would. This elongated path would also be extremely distant from substantial infrastructure, including prospective support if the ship should find itself in danger. For these reasons—and insurers' cognizance of them—the overwhelming majority of commercial ships transiting the Arctic will do so by passing within 24 nautical miles of either Russia or Canada. (Noncommercial vessels, such as submarines and icebreakers, could conceivably take a near-polar route for other purposes.)

In light of this, nearly all commercial trans-Arctic vessels will be subject to some degree of regulation by Canada or Russia, per Article 33. The previously cited ambiguity about what constitutes *ice-covered* means that these countries' ability to impose non-IMO pollution rules is likewise unclear.

This issue is important to the stakeholders for two distinct, but related, reasons. One is Canada's and Russia's desire to assert sovereignty, even as others view this as a test case for freedom of the seas. Canadians and Russians view the straits surrounded by their territories as part of their patrimony, governed by their laws as much as any of their great rivers or lakes. Their declarations that these are internal waters do not appear to be sanctioned by UNCLOS but

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<sup>324</sup> UNCLOS, Article 234.

do represent strongly held beliefs and legitimate concerns.<sup>325</sup> As noted above, ships asserting a right of innocent passage through these waters are precluded from a host of activities (such as deliberate pollution or collecting information), but enforcing such rules requires that traffic be closely monitored and potentially sanctioned. The ability to charge tolls for passage would both demonstrate sovereignty and provide a potential revenue stream to help offset the high costs associated with Arctic activities.

A second consideration is the need for environmental regulation. Even an ice-diminished Arctic is a dangerous place, with low visibility, rough weather, and chunks of sea ice of varying sizes. A collision or grounding could not only endanger life and property but also potentially release substantial amounts of pollutants. The Arctic environment is easily damaged and difficult to remediate; natural remediation processes are very slow under these cold conditions. Isolated communities in the region are heavily dependent on their environment and could be adversely affected by a major pollution event.

A couple of precursor events in sub-Arctic waters underscore the hazards involved. A container of tetraethylene glycol diheptanoate en route to Korea was lost at sea in 2003, washing up a few months later on Russia's Bering Island. The island's 750 residents were wholly unprepared to respond to such an event; the container poisoned some of them (fortunately, nonfatally) while also killing birds and a seal. The next year, the Malaysian ship *Selendang Ayu* ran aground at Unalaska Island in the Aleutian chain following an engine failure. Despite heroic USCG efforts, the disaster killed six crew members while also releasing more than 300,000 gallons of heavy fuel oil and 60,000 tons of soybeans. Weather conditions impeded the remediation of both beaches and wildlife in this subsistence-hunting community surrounded by a major fishery.<sup>326</sup>

Sovereignty and environmental issues are, of course, related. However, to the degree that they can be viewed distinctly, sovereignty issues are the more intractable of the two. States can reach agreements on the types of environmental and safety controls required for a particular environment. They are less likely to be able to compromise on a fundamental set of beliefs related to whether ships have the right of innocent passage or are subject to the sovereign authority of an adjacent state. Moreover, those advocating for the right of innocent passage through Arctic archipelagoes are far more exercised about the idea in principle, for application elsewhere in the world, than they are with respect to the actual usage of such waters. They will be very reluctant to compromise on their positions, regardless of the potential benefits of reaching an agreement about the Arctic.

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<sup>325</sup> Canada calls its set "historic internal waters," emphasizing that its implicit title precedes its formal delineation of claims.

<sup>326</sup> Reid Sinclair Brewer and Nancy Deschu, eds., *The Selendang Ayu Oil Spill: Lessons Learned—Conference Proceedings, August 16–19, 2005, Unalaska, Alaska*, University of Alaska Fairbanks, Alaska Sea Grant College Program, 2006; Liesel A. Ritchie and Duane A. Gill, "The *Selendang Ayu* Shipwreck and Oil Spill: Considering Threats and Fears of a Worst-Case Scenario," *Sociological Inquiry*, Vol. 78, No. 2, May 2008.

In practical, economic terms, the dispute over the NWP is less pressing than that over the NSR. The NWP is colder, icier, rockier, narrower, less thoroughly charted, and shallower than its prospective competitor; all of these factors make commercial use of the waterway less likely. Moreover, economic use of even the NSR is likely to be limited to the shipping of bulk cargo during select months of the year. Container ships typically off-load and on-load containers at various points along their journeys, so a route that bypasses intermediate ports is less desirable than one that stops at such ports. In addition, some containerized goods are susceptible to damage at extreme temperatures. A further impediment to extensive use of this route is the difficulty of assessing insurance rates for an infrequently used passage in waters with limited charting and copious hazards; as a result, those rates will likely be higher than those for alternative routes.

Commercial ships have strong incentives to comply with the sovereignty views of the states surrounding trans-Arctic routes. Paying tolls might be repugnant as a matter of principle, but it also might enable ships to benefit from such services as escorting vessels or frequent informational updates. Lack of coordination with a neighboring state could increase timelines for SAR response (although the Agreement on Cooperation on Aeronautical and Maritime Search and Rescue in the Arctic, signed in 2011, legally obligates these states to coordinate such efforts). Noncompliance could also lead to harassment by authorities, and any of the above could raise insurance rates.

Events far from the Arctic could cause a dramatic increase in usage of either waterway, as well as a corresponding focus on Canada's and Russia's claims to sovereignty. A dramatic rise in the price of oil would make maritime shortcuts more desirable. Moreover, disruption of key waterways could make trans-Arctic shipping a viable competitor to other available commercial routes. Instability, war, or elevated levels of piracy in such places as Egypt and East Asia could dramatically curtail the use of existing routes between Europe and Asia. Faced with long diversions around Africa or via the Western Hemisphere, shippers could find a trans-Arctic route increasingly attractive. Likewise, disruption to the usage of the Panama Canal could encourage the use of trans-Arctic routes between the two oceans.

The disputes over the NWP and NSR contrast sharply with the situation in the Bering Strait, through which all trans-Arctic traffic and a great deal of destination Arctic traffic must pass. The strait is roughly bisected by Russia's Big Diomedes Island and the United States' Little Diomedes Island, which sit only a couple of miles apart. Any ship transiting to the west of these islands is passing within 12 nautical miles of Russian territory (because Big Diomedes Island is less than 24 nautical miles from the mainland), while any ship going to the east of it is passing within 12 nautical miles of U.S. territory (because Little Diomedes Island is less than 24 nautical miles from mainland Alaska). Neither state has attempted to assert that these narrow passages are internal waters, as Canada and Russia have in the NWP and the NSR. Historically, such shipping was not discussed in treaties concerning Alaska, and the right of ships to transit these waters has not been disputed. The huge environmental significance of the Bering Strait—which is a critical

path for migratory whales, fish, and other animals—and increasing usage of this maritime choke point could lead to increased interest by the coastal states in imposing environmental or other controls.

### *Disputes over Svalbard's Exclusive Economic Zone*

According to the Svalbard Treaty (the Treaty Concerning the Archipelago of Spitsbergen) of 1920, Norway has sovereignty over the Svalbard archipelago, about 400 miles north of mainland Norway. However, Norway's sovereignty is attenuated: The archipelago must remain demilitarized, and citizens of other countries that have signed the treaty have the right to live in Svalbard. Since the Soviet Union ratified the Svalbard Treaty in 1935, a few Russians and Ukrainians have moved to Svalbard, where they still make up much of the resident population. Many countries, including China and India, have set up scientific stations in Svalbard to research the Arctic environment. Norway and some of its allies assert that its sovereignty includes a 200-nautical mile EEZ around the islands, as prescribed in UNCLOS for sovereign territories. However, Russia claims that, based on the limited sovereignty prescribed by the treaty, Norway has authority only over territorial waters within 12 nautical miles of the archipelago. The result is that Russia claims that a maritime area roughly the size of Montana represents international waters in which fishing and mining can be conducted without reference to Norwegian authorities, while Norway claims that its permission is required for economic activity in this area. However, despite occasional incidents (such as when a Russian fishing vessel that Norwegian authorities were trying to detain fled, with Norwegian personnel still on board), the two countries have handled this dispute peacefully.

## Abbreviations

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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
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

## References

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- 1825 Treaty of St. Petersburg—*See* Convention Concerning the Limits of Their Respective Possessions on the Northwest Coast of America and the Navigation of the Pacific Ocean, 1825.
- 2010 National Security Strategy—*See* Executive Office of the President, 2010.
- 2013 National Strategy for the Arctic Region or 2013 national strategy—*See* Executive Office of the President, 2013.
- 2014 Implementation Plan for the National Strategy for the Arctic Region or 2014 implementation plan—*See* Executive Office of the President, 2014.
- 2019 DoD Arctic strategy—*See* Office of the Under Secretary of Defense for Policy, 2019.
- 2019 U.S. Coast Guard Arctic Strategic Outlook or 2019 USCG Arctic Strategic Outlook—*See* U.S. Coast Guard, 2019.
- 2019 USN Strategic Outlook for the Arctic—*See* Chief of Naval Operations, 2019.
- 2020 Department of the Air Force Arctic Strategy—*See* Department of the Air Force, 2020.
- 2021 Army Arctic strategy—*See* Headquarters, 2021.
- 2021 DHS Strategic Approach for Arctic Homeland Security—*See* Office of Strategy, Policy, and Plans, 2021.
- 2021 USN strategic blueprint—*See* Department of the Navy, 2021.
- “access, n. (II)(3)(a),” *Oxford English Dictionary*, Oxford University Press, 2021.
- Adomanis, Mark, “Russia Plans Massive Arctic Expansion,” *USNI News*, August 9, 2012, updated May 29, 2013.
- Agreement to Prevent Unregulated High Seas Fisheries in the Central Arctic Ocean, Can.–Ice.–Den.–Nor.–U.S.–Russ.–China–Japan–S. Kor.–European Union, October 3, 2018.
- Antarctic Sea Ice Processes and Climate, “Glossary and Image Library,” webpage, last updated February 3, 2012. As of August 22, 2022:  
<http://aspect.antarctica.gov.au/home/glossary-and-image-library.html>

- Arctic and Global Prediction; Ocean, Atmosphere and Space Sciences; Ocean Battlespace Sensing; Office of Naval Research, U.S. Navy, “Arctic Mobile Observing System (AMOS),” webpage, undated. As of March 3, 2022:  
<https://www.nre.navy.mil/organization/departments/code-32/division-322/arctic-and-global-prediction/amos-dri>
- Arctic Council, “Arctic Council Observers,” webpage, undated-a. As of April 26, 2022:  
<https://www.arctic-council.org/about/observers/>
- Arctic Council, “The Russian Federation,” webpage, undated-b. As of March 6, 2023:  
<https://arctic-council.org/about/states/russian-federation/>
- Arctic Council, “The Russian Chairmanship of the Arctic Council Begins Under the Theme ‘Responsible Governance for a Sustainable Arctic,’” webpage, June 28, 2021. As of November 10, 2021:  
<https://arctic-council.org/news/russian-chairmanship-begins-under-theme-responsible-governance-for-a-sustainable-arctic/>
- Auerswald, David, “China’s Multifaceted Arctic Strategy,” *War on the Rocks*, May 24, 2019a.
- Auerswald, David, “Now Is Not the Time for a FONOP in the Arctic,” *War on the Rocks*, October 11, 2019b.
- Austen, Ian, “Canada and Denmark End Their Arctic Whisky War,” *New York Times*, June 14, 2022.
- 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. As of April 18, 2022:  
<https://www.antarctica.gov.au/nuyina/>
- Avdaliani, Emil, “China Seeks to Boost Its Role in the Arctic,” China Observers in Central and Eastern Europe, May 24, 2021.
- Baev, Pavel K., “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.
- Baldursson, Ragnar, “Iceland Targets China’s Geothermal Energy Market,” *China Daily*, updated March 7, 2011.
- Bennett, Mia M., “North by Northeast: Toward an Asia–Arctic Region,” *Eurasian Geography and Economics*, Vol. 55, No. 1, 2014.
- Bennett, Mia M., and Benjamin Lucca Iaquinto, “The Geopolitics of China’s Arctic Tourism Resources,” *Territory, Politics, Governance*, 2021.

- Bird, Kenneth J., Ronald R. Charpentier, Donald L. Gautier, David W. Houseknecht, Timothy R. Klett, Janet K. Pitman, Thomas E. Moore, Christopher J. Schenk, Marilyn E. Tennyson, and Craig J. Wandrey, "Circum-Arctic Resource Appraisal: Estimates of Undiscovered Oil and Gas North of the Arctic Circle," U.S. Geological Survey, Fact Sheet 2008-3049, version 1.0, July 23, 2008.
- Black, James, Stephen J. Flanagan, Gene Germanovich, Ruth Harris, David A. Ochmanek, Marina Favaro, Katerina Galai, and Emily Ryen Gloinson, *Enhancing Deterrence and Defence on NATO's Northern Flank: Allied Perspectives on Strategic Options for Norway*, RAND Corporation, RR-4381-NMOD, 2020. As of August 5, 2022: [https://www.rand.org/pubs/research\\_reports/RR4381.html](https://www.rand.org/pubs/research_reports/RR4381.html)
- "Boevoe dezhurstvo po ohrane Arkticheskikh shirot [Combat Patrols to Defend Arctic Territories]," *Boevaia vakhta [Combat Watch]*, No. 2, January 24, 2015.
- Boswell, Randy, "Canada Protests U.S. Arctic Fishing Ban," CanWest News Service, September 4, 2009.
- Bouffard, Troy, and P. Whitney Lackenbauer, "The Development of the Russian Arctic Council Chairmanship: A Strategic Plan of Preparation and Pursuit," North American and Arctic Defense and Security Network, strategic perspective, March 30, 2021.
- Boulègue, Mathieu, *Russia's Military Posture in the Arctic: Managing Hard Power in a "Low Tension" Environment*, Chatham House, Royal Institute of International Affairs, research paper, June 28, 2019.
- Brady, Anne-Marie, *China as a Polar Great Power*, Woodrow Wilson Center Press with Cambridge University Press, 2017.
- Brady, Anne-Marie, "Facing Up to China's Military Interests in the Arctic," *China Brief*, Vol. 19, No. 21, December 10, 2019.
- Breum, Martin, "Russia Extends Its Claim to the Arctic Ocean Seabed," *ArcticToday*, April 4, 2021.
- Brewer, Reid Sinclair, and Nancy Deschu, eds., *The Selendang Ayu Oil Spill: Lessons Learned—Conference Proceedings, August 16–19, 2005, Unalaska, Alaska*, University of Alaska Fairbanks, Alaska Sea Grant College Program, 2006.
- Bronder, Polina Leganger, "Russia's Northern Sea Route Push Is Met with Scepticism," *Barents Observer*, April 5, 2021.
- Buchanan, Elizabeth, "The Overhaul of Russian Strategic Planning for the Arctic Zone to 2035," North Atlantic Treaty Organization, document review, Russian Studies Series 3/20, last updated May 19, 2020.

- Byers, Michael, *Who Owns the Arctic? Understanding Sovereignty Disputes in the North*, Douglas and McIntyre, 2009.
- Byers, Michael, and Emma Lodge, “China and the Canadian Arctic,” in John Higginbotham and Jennifer Spence, eds., *Canada’s Arctic Agenda: Into the Vortex*, Centre for International Governance Innovation, September 26, 2019.
- Center for Circumpolar Security Studies, Arctic Institute, “Russia,” webpage, June 19, 2020a. As of November 23, 2021:  
<https://www.thearcticinstitute.org/countries/russia/>
- Center for Strategic and International Studies, “Maritime Security Dialogue: A Conversation with Hon. Richard V. Spencer, Secretary of the Navy,” transcript, December 6, 2018.
- 程保志 [Cheng Baozhi], “试析北极理事会的功能转型与中国的应对策略 [On the Functional Transformation of the Arctic Council and China’s Countermeasures],” 国际论坛 [*International Forum*], Vol. 15, No. 3, 2013.
- Chief of Naval Operations, U.S. Navy, “Strategic Outlook for the Arctic,” January 2019.
- China International Marine Containers, “Offshore,” webpage, undated. As of April 1, 2022:  
<http://www.cimc.com/en/index.php?m=content&c=index&a=show&catid=36&id=4>
- “China Is Russia’s Priority Partner in Arctic Cooperation—Lavrov,” Telegraph Agency of the Soviet Union, August 24, 2015.
- 余春 [Chun Yu], “北极航道 改变世界的未来 [Arctic Waterways Changing the Future of the World],” 广东造船 [*Guangdong Shipbuilding*], Vol. 1, 2022.
- CLCS—See Commission on the Limits of the Continental Shelf.
- Closson, Stacy R., “Russian Foreign Policy in the Arctic: Balancing Cooperation and Competition,” Wilson Center, Kennan Cable 24, June 2017.
- Coffey, Luke, “China’s Increasing Role in the Arctic,” Heritage Foundation, February 11, 2020.
- Commission on the Limits of the Continental Shelf, Division for Ocean Affairs and the Law of the Sea, United Nations, “Canada: Notification Regarding the Submission Made by the Russian Federation to the Commission on the Limits of the Continental Shelf,” CLCS.01.2001.LOS/CAN, February 26, 2002a.
- Commission on the Limits of the Continental Shelf, Division for Ocean Affairs and the Law of the Sea, United Nations, “Denmark: Notification Regarding the Submission Made by the Russian Federation to the Commission on the Limits of the Continental Shelf,” CLCS.01.2001.LOS/DNK, February 26, 2002b.

- Commission on the Limits of the Continental Shelf, Division for Ocean Affairs and the Law of the Sea, United Nations, “Outer Limits of the Continental Shelf Beyond 200 Nautical Miles from the Baselines: Submissions to the Commission—Submission by the Russian Federation,” updated June 30, 2009.
- Commission on the Limits of the Continental Shelf, Division for Ocean Affairs and the Law of the Sea, United Nations, “Recommendations Prepared by the Subcommission Established for the Consideration of the Submission Made by the Russian Federation,” Annex V of “Summary of Recommendations of the Commission on the Limits of the Continental Shelf in Regard to the Partial Revised Submission Made by the Russian Federation in Respect of the Sea of Okhotsk on 28 February 2013,” February 4, 2014.
- Convention Concerning the Limits of Their Respective Possessions on the Northwest Coast of America and the Navigation of the Pacific Ocean, Russ.–U.K., February 28, 1825.
- Dalaklis, Dimitrios, 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.
- Danabasoglu, G., J.-F. Lamarque, J. Bacmeister, D. A. Bailey, A. K. DuVivier, J. Edwards, L. K. Emmons, J. Fasullo, R. Garcia, A. Gettelman, C. Hannay, M. M. Holland, W. G. Large, P. H. Lauritzen, D. M. Lawrence, J. T. M. Lenaerts, K. Lindsay, W. H. Lipscomb, M. J. Mills, R. Neale, K. W. Oleson, B. Otto-Bliesner, A. S. Phillips, W. Sacks, S. Tilmes, L. van Kampenhout, M. Vertenstein, A. Bertini, J. Dennis, C. Deser, C. Fischer, B. Fox-Kemper, J. E. Kay, D. Kinnison, P. J. Kushner, V. E. Larson, M. C. Long, S. Mickelson, J. K. Moore, E. Nienhouse, L. Polvani, P. J. Rasch, and W. G. Strand, “The Community Earth System Model Version 2 (CESM2),” *Journal of Advances in Modeling Earth Systems*, Vol. 12, No. 2, February 2020.
- D’Aprile, Aurora, “Arctic Tourism: How the Great North Is Becoming the New Exotic,” *Foresight*, August 21, 2018.
- DeMarban, Alex, “Anchorage Airport Among Nation’s Busiest as Pandemic Boosts Cargo Activity,” *Transport Topics*, November 3, 2020.
- “Denmark Hopes to Claim North Pole,” BBC News, October 5, 2004.
- Department of the Air Force (U.S.), *Arctic Strategy*, July 21, 2020.
- Department of the Navy (U.S.), *A Blue Arctic: A Strategic Blueprint for the Arctic*, January 5, 2021.
- Devyatkin, Pavel, “Russia’s Arctic Strategy: Energy Extraction (Part III),” Center for Circumpolar Security Studies, Arctic Institute, February 20, 2018a.

- Devyatkin, Pavel, “Russia’s Arctic Strategy: Maritime Shipping (Part IV),” Center for Circumpolar Security Studies, Arctic Institute, February 27, 2018b.
- Directorate-General for Maritime Affairs and Fisheries, European Commission, “Arctic: Agreement to Prevent Unregulated Fishing Enters into Force,” news announcement, June 25, 2021.
- Division for Ocean Affairs and the Law of the Sea, United Nations, *The Law of the Sea: Training Manual for Delineation of the Outer Limits of the Continental Shelf Beyond 200 Nautical Miles and for Preparation of Submissions to the Commission on the Limits of the Continental Shelf*, 2006.
- Division for Ocean Affairs and the Law of the Sea, United Nations, “Submissions, Through the Secretary-General of the United Nations, to the Commission on the Limits of the Continental Shelf, Pursuant to Article 76, Paragraph 8, of the United Nations Convention on the Law of the Sea of 10 December 1982,” webpage, last updated August 11, 2022. As of November 2021:  
[https://www.un.org/depts/los/clcs\\_new/commission\\_submissions.htm](https://www.un.org/depts/los/clcs_new/commission_submissions.htm)
- Dodds, Klaus, “Flag Planting and Finger Pointing: The Law of the Sea, the Arctic and the Political Geographies of the Outer Continental Shelf,” *Political Geography*, Vol. 29, No. 2, February 2010.
- Doshi, Rush, Alexis Dale-Huang, and Gaoqi Zhang, *Northern Expedition: China’s Arctic Activities and Ambitions*, Brookings Institution, April 2021.
- Durso, James, “Canada: Won’t Get Fooled Again?” *The Hill*, October 4, 2021.
- Eilertsen, Hege, “Four New SAR Centers in the Russian Arctic,” trans. Elisabeth Bergquist, *High North News*, February 2, 2018.
- Eiterjord, Trym Aleksander, “The Geopolitics of Chinese Arctic Research,” Max Planck Institute for the History of Science, Lise Meitner Research Group: China in the Global System of Science, c. 2020a.
- Eiterjord, Trym Aleksander, “Arctic Technopolitics and China’s Reception of the Polar Code,” Arctic Council, May 26, 2020b.
- Ekos Research Associates, *Rethinking the Top of the World: Arctic Security Public Opinion Survey*, submitted to the Walter and Duncan Gordon Foundation and the Canada Centre for Global Security Studies at the Munk School of Public Affairs, January 2011.
- Ellis, B., and L. Brigham, *Arctic Maritime Shipping Assessment 2009 Report*, Arctic Council, 2009.
- Emmerson, Charles, *The Future History of the Arctic*, PublicAffairs, 2010.

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

Executive Office of the President, *National Strategy for the Arctic Region*, White House, May 2013.

Executive Office of the President, *Implementation Plan for the National Strategy for the Arctic Region*, White House, January 2014.

Fabey, Michael, “US Coast Guard Icebreaker Healy Returns to Homeport Following Northwest Passage Transit and Circumnavigation of North America,” *Janes Defense*, November 22, 2021.

Fahey, Sean, “Access Control: Freedom of the Seas in the Arctic and the Russian Northern Sea Route Regime,” *Harvard National Security Journal*, Vol. 9, No. 2, 2018.

Farley, Robert, “Would China Send Nuclear Ballistic Missile Submarines to the Arctic?” *1945*, January 3, 2022.

Fife, Robert, and Steven Chase, “Top Defence Official Says China Is a Threat to Canadian Arctic,” *Globe and Mail*, March 10, 2021, updated March 11, 2021.

“FOI Warns of Swedish Space Cooperation with China,” *Sveriges Television News*, January 13, 2019.

Foxall, Mackenzie, “Is the Arctic Still a Forgotten Flank? Examining NATO Engagement in the Arctic,” *North American and Arctic Defense and Security Network*, policy primer, August 3, 2021.

Frank, Steven, Kait Bolongaro, and Stephen Wicary, “Trudeau Shuts Out China Again by Rejecting Arctic Gold Deal,” *Bloomberg*, December 22, 2020.

Gavrilov, Viatcheslav V., “Legal Status of the Northern Sea Route and Legislation of the Russian Federation: A Note,” *Ocean Development and International Law*, Vol. 46, No. 3, 2015.

Glenn, Mike, “U.S. Icebreaker Gap with Russia a Growing Concern as Arctic ‘Cold War’ Heats Up,” *Washington Times*, September 23, 2021.

GlobalSecurity.org, “World Wide Icebreaker Classes,” webpage, undated. As of February 2, 2023:  
<https://www.globalsecurity.org/military/world/icebreakers-class.htm>

Gorenburg, Dmitry, “Russian Interests and Policies in the Arctic,” *War on the Rocks*, August 7, 2014.

Government of Canada, “Canada and Denmark Issue Statement on Hans Island,” *News Release 165*, September 19, 2005.



- Government of Canada, *Statement on Canada's Arctic Policy: Exercising Sovereignty and Promoting Canada's Northern Strategy Abroad*, 2010.
- Grieger, Gisela, "China's Arctic Policy: How China Aligns Rights and Interests," European Parliamentary Research Service, briefing, PE 620.321, May 2018.
- Griffiths, Sian, "US–Canada Arctic Border Dispute Key to Maritime Riches," BBC News, August 2, 2010.
- Gritsenko, Daria, and Tuomas Kiiski, "A Review of Russian Ice-Breaking Tariff Policy on the Northern Sea Route 1991–2014," *Polar Record*, Vol. 52, No. 263, March 2016.
- Gronholt-Pedersen, Jacob, "Greenland Strips Chinese Mining Firm of Licence to Iron Ore Deposit," Reuters, November 22, 2021b.
- Gronholt-Pedersen, Jacob, "Greenland's New Coalition Partner Won't Seek Changes to Uranium Ban," Reuters, April 4, 2022.
- Gustafsson, Pär, "Russia's Ambitions in the Arctic Towards 2035," Swedish Defence Research Agency, Memo 7624, October 2021.
- Hammit, Robert, "Icebreakers: An Overview," *Polar Connection*, January 24, 2017.
- Hausfather, Zeke, "Explainer: The High-Emissions 'RCP8.5' Global Warming Scenario," *Carbon Brief*, August 21, 2019.
- Havnes, Heljar, and Johan Martin Seland, "The Increasing Security Focus in China's Arctic Policy," Center for Circumpolar Security Studies, Arctic Institute, webpage, July 16, 2019. As of December 1, 2021:  
<https://www.thearcticinstitute.org/increasing-security-focus-china-arctic-policy/>
- Headquarters, Department of the Army, *Regaining Arctic Dominance: The U.S. Army in the Arctic*, January 19, 2021.
- Hinshaw, Drew, and Jeremy Page, "How the Pentagon Countered China's Designs on Greenland," *Wall Street Journal*, February 10, 2019.
- Hong, Nong, *China's Role in the Arctic: Observing and Being Observed*, Routledge, 2020.
- Huawei Technologies, "Connecting Canada's North," webpage, undated. As of December 3, 2021:  
<https://www.huawei.com/ca/corporate-citizenship/connecting-canadas-north>
- Huawei Technologies, "Telenor Chooses Huawei for Arctic Circle LTE Build," *Light Reading*, June 27, 2011.
- Humpert, Malte, "Russia to Reorganize Northern Sea Route Competencies," *High North News*, November 10, 2017.

- Humpert, Malte, “China Launches Domestically-Built ‘Xue Long 2’ Icebreaker,” *High North News*, September 11, 2018.
- Humpert, Malte, “China Looking to Expand Satellite Coverage in Arctic, Experts Warn of Military Purpose,” *High North News*, September 4, 2019.
- IACS—See International Association of Classification Societies.
- Iakovlev, Alexandr, “Iz Arktiki s Liubov’iu [From the Arctic with Love],” *Na Strazhe Zapoliar’ia* [*Guarding the Arctic*], No. 38, October 4, 2019.
- Ibbitson, John, “Dispute over Hans Island Nears Resolution. Now for the Beaufort Sea,” *Globe and Mail*, January 26, 2011.
- Iefremenkova, A. A., “O Mezhdunarodnom Sotrudnichestve Poiskovo-Spasatel’nykh Sluzhbb [About the International Cooperation of Search and Rescue Services],” *Voennaia Mysl’* [*Military Thought*], No. 11, 2003.
- Ilulissat Declaration, Can.–Den.–Nor.–Russ.–U.S., May 28, 2008.
- IMO—See International Maritime Organization.
- International Association of Classification Societies, *Requirements Concerning Polar Class*, revision 2, April 2016.
- International Maritime Organization, “Guidance on Methodologies for Assessing Operational Capabilities and Limitations in Ice,” MSC.1/Circ.1519, June 6, 2016.
- International Network for Terrestrial Research and Monitoring in the Arctic, “China Iceland Arctic Research Observatory,” webpage, undated. As of December 1, 2021: <https://eu-interact.org/field-sites/karholl-research-station/>
- “Investments in Russian Economy in Arctic to Exceed \$86 Bln Until 2025,” Telegraph Agency of the Soviet Union, March 29, 2019.
- Janes, “Icebreakers: Russian Federation,” website, updated March 15, 2022a.
- Jenkins, Cameron, “Canadian Businessman Sentenced to 11 Years in Chinese Prison,” *The Hill*, August 11, 2021.
- Jian, Yang, “China’s Economic Initiatives in the Arctic,” *Global Asia*, Vol. 15, No. 4, December 2020.
- Joint Chiefs of Staff, “Maritime Domain Awareness,” *DOD Dictionary of Military and Associated Terms*, U.S. Department of Defense, June 2020.
- Jordan, Jonathan, “Russia’s Coercive Diplomacy in the Arctic,” Center for Circumpolar Security Studies, Arctic Institute, July 6, 2021.

- Kluge, Janis, and Michael Paul, “Russia’s Arctic Strategy Through 2035,” Stiftung Wissenschaft und Politik, November 26, 2020.
- Kremlin, “Russian Federation Naval Doctrine Approved,” press release, July 31, 2022.
- Krinitskii, Y., P. Borisenko, and I. Kovalev, “Bor’ba za Arktiku—Problema Sovremennosti [Battle for the Arctic Is a Modern Problem],” *Armeiiskii Sbornik [Army Digest]*, No. 2, February 2016.
- Lajeunesse, Adam, and Timothy Choi, “Here There Be Dragons? Chinese Submarine Options in the Arctic,” *Journal of Strategic Studies*, 2021.
- Laruelle, Marlène, *Russia’s Arctic Strategies and the Future of the Far North*, M. E. Sharpe, 2014.
- Laruelle, Marlène, “Russia’s Arctic Policy: A Power Strategy and Its Limits,” *Russie.Nei.Visions*, No. 117, March 2, 2020.
- Lavikainen, Jyri, “Strengthening Russia’s Nuclear Forces in the Arctic: The Case of the Kinzhal Missile,” Center for Strategic and International Studies, September 14, 2021.
- Leapman, Ben, “Denmark Joins Race to Claim North Pole,” *The Telegraph*, August 12, 2007.
- Li, Xueke, Scott R. Stephenson, Amanda H. Lynch, Michael A. Goldstein, David A. Bailey, and Siri Veland, “Arctic Shipping Guidance from the CMIP6 Ensemble on Operational and Infrastructural Timescales,” *Climatic Change*, Vol. 167, 2021.
- Liah, Dmitrii, “‘Umka’ Probivaet Led [‘Umka’ Breaks the Ice],” *Oborona Rossii [Defense of Russia]*, No. 4–5, 2021.
- 王林 [Lin Wang], “北极油气开采潮再起 [The Tide of Oil and Gas Exploration in the Arctic Is Rising Again],” 中国石油和化工产业观察 [*China Petrochemical Industry Observer*], Vol. 12, 2021.
- Liu, Nengye, “China–Russia Trouble on the Arctic Silk Road?” *The Diplomat*, July 21, 2017.
- Liu, Nengye, “China and One Hundred Years of the Svalbard Treaty: Past, Present and Future,” *Marine Policy*, Vol. 124, February 2021.
- Loten, Jennifer, consul of Canada in Anchorage, “Canadian Perspectives on a Changing Arctic,” slides presented at the Arctic Policy Forum, February 2011.
- Luedi, Jeremy, “Northern Canada Could Be Left Out in the Cold If Ottawa Passes Huawei 5G Ban,” CBC News, March 2, 2020.
- Lulu, Jichang, “Greenland: China Discreetly Launches Satellite Ground Station Project,” blog post, December 14, 2017.

- Lundestad, Ingrid, and Øystein Tunsjø, “The United States and China in the Arctic,” *Polar Record*, Vol. 51, No. 4, July 2015.
- Magistad, Mary Kay, “China’s Arctic Ambitions Have Revived US Interest in the Region,” *The World*, October 12, 2020.
- Maritime Executive, “Russian Shipyard Launches Missile-Carrying Icebreaker,” October 28, 2019.
- Maritime Executive, “Finland and Sweden Collaborate to Design Next Icebreaker,” November 2, 2020.
- Medvedev, Dmitry, “[Foundations of the State Policy in the Arctic Until 2020 and Beyond],” approved September 18, 2008, unofficial translation by Anatoly Karlin.
- Mehdiyeva, Nazrin, “Strategy of Development of the Arctic Zone of the Russian Federation and the Provision of National Security for the Period to 2035,” North Atlantic Treaty Organization Defense College, Russian Studies Series 1/21, last updated June 25, 2019.
- Melino, Matthew, and Heather A. Conley, “The Ice Curtain: Russia’s Arctic Military Presence,” Center for Strategic and International Studies, undated.
- Melino, Matthew, Heather A. Conley, and Joseph S. Bermudez Jr., “The Ice Curtain: Bringing Transparency to the Arctic: Modernization on the Kola Peninsula,” Center for Strategic and International Studies, brief, March 2020.
- Ministry of Defence of the Russian Federation, “Severnii Flot [Northern Fleet],” webpage, undated.
- Ministry of Defence of the Russian Federation, “Tezisy Doklada Ministra Oborony Rossiiskoi Federatsii na Rasshirennom Zasedanii Kollegii Minogorony Rossii [Executive Summary by the Minister of Defense of the Russian Federation at the Russian Defense Ministry Board Session],” December 11, 2015.
- Ministry of Defence of the Russian Federation, “Vystupleniie Ministra Oborony Rossiiskoi Federatsii Generala Armii Sergeia Shoigu na Rasshirennom Zasedanii Kollegii Minoborony Rossii [Testimony of the Minister of Defense of the Russian Federation General of the Army Sergei Shoigu at the Russian Defense Ministry Board Session],” December 22, 2016.
- Ministry of Defence of the Russian Federation, “Tezisy Doklada Ministra Oborony Rossiiskoi Federatsii Generala Armii S. K. Shoigu na Rasshirennom Zasedanii Kollegii Minogorony Rossii [Executive Summary by the Minister of Defense of the Russian Federation General of the Army S. K. Shoigu at the Russian Defense Ministry Board Session],” 2017a.

Ministry of Defence of the Russian Federation, “V Voiskah Zavershen Otbor Lichnogo Sostava dlia Formirovaniia Vzvodov Ekologicheskoi Ochistki v Arktike [The Military Has Completed the Selection of Personnel to Form Platoons for Ecological Cleanup in the Arctic],” April 18, 2017b.

Ministry of Defence of the Russian Federation, “Ministerstvo Oborony Rossiiskoi Federatsii: Podrobnnee [Ministry of Defense of the Russian Federation: In Detail],” November 7, 2017c.

Ministry of Defence of the Russian Federation, “Tezisy Doklada Ministra Oborony Rossiiskoi Federatsii Generala Armii S. K. Shoigu na Rasshirennom Zasedanii Kollegii Minogorony Rossii [Executive Summary by the Minister of Defense of the Russian Federation General of the Army S. K. Shoigu at the Russian Defense Ministry Board Session],” 2018a.

Ministry of Defence of the Russian Federation, “Sily Poiskovo-Spasatel’nogo Obespecheniia Severnogo Flota Primut Uchastiie v Sovmestnom Rossiisko-Norvezhskom Uchenii ‘Barents-2018’ [Search-and-Rescue Forces of the Northern Fleet Will Participate in a Joint Russian–Norwegian Exercise ‘Barents-2018’],” May 16, 2018b.

Ministry of Defence of the Russian Federation, “In 2019, Pilots of the Northern Fleet Will Continue Flights in the Arctic on a Regular Basis,” January 1, 2019a.

Ministry of Defence of the Russian Federation, “Tezisy Vystupleniia Ministra Oborony Rossiiskoi Federatsii Generala Armii S. K. Shoigu na Rasshirennom Zasedanii Kollegii Minogorony Rossii [Executive Summary by the Minister of Defense of the Russian Federation General of the Army S. K. Shoigu at the Russian Defense Ministry Board Session],” December 24, 2019b.

Ministry of Defence of the Russian Federation, “Doklad Ministra Oborony Rossiiskoi Federatsii na Rasshirennom Zasedanii Kollegii Minoborony Rossii [Executive Summary by the Minister of Defense of the Russian Federation at the Russian Defense Ministry Board Session],” 2020.

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

Ministry of Defence of the Russian Federation, “Minoborony Rossii Postroit v Arktike Tree Zhilyh Doma dlia Voennosluzhashchih i Detskii Sad [Russia’s Defense Ministry Will Build Three Residential Buildings for Service Members and a Kindergarten],” March 29, 2021c.

Ministry of Defence of the Russian Federation, “Russian Defense Minister General of the Army Sergei Shoigu During a Trip to the Northern Fleet Held a Working Meeting in Severomorsk,” April 13, 2021d.

- Ministry of Defence of the Russian Federation, “Sily Poiskovo-Spasatel’nogo Obespecheniia Severnogo Flota Vishli v Barentsevo More dlia Uchastiia v Mezhdunarodnom Ucheniia ‘Barents-2021’ [Search-and-Rescue Forces of the Northern Fleet Went to the Barents Sea to Participate in the International Exercise ‘Barents-2021’],” June 2, 2021f.
- Ministry of Defence of the Russian Federation, “BPK ‘Severomorsk’ i PSK ‘Poliarnaia Zvezda’ Proveli v Arktike Sovmestnoie Uchastiie [Long-Distance Carrier ‘Severomorsk’ and Border Patrol Ship ‘Poliarnaia Zvezda’ Conducted a Joint Exercise in the Arctic],” August 16, 2021g.
- Ministry of Defence of the Russian Federation, “Severnii Flot Prodolzhit Vzaimodeistviie s Norvegiei v Oblasti Spaseniia na More [Northern Fleet will Continue to Cooperate with Norway in the Area of Rescue at Sea],” December 29, 2021h.
- Ministry of Foreign Affairs of Denmark, *Denmark, Greenland and the Faroe Islands: Kingdom of Denmark Strategy for the Arctic 2011–2020*, August 2011.
- Ministry of Foreign Affairs of the Russian Federation, “Briefing by Foreign Ministry Spokesperson Maria Zakharova, Moscow,” May 23, 2019.
- MMG, “Izok Corridor,” webpage, undated. As of December 3, 2021:  
<https://www.mmg.com/our-business/development-projects/>
- Moe, Arild, “A New Russian Policy for the Northern Sea Route? State Interests, Key Stakeholders and Economic Opportunities in Changing Times,” *Polar Journal*, Vol. 10, No. 2, 2020.
- Moe, Arild, Daniel Fjærtøft, and Indra Øverland, “Space and Timing: Why Was the Barents Sea Delimitation Dispute Resolved in 2010?” *Polar Geography*, Vol. 34, No. 3, 2011.
- Mukhin, Vladimir, “The Northern Fleet Prepares for Defense of Taimyr Peninsula,” *Nezavisimaya Gazeta [Defense and Security]*, No. 167, August 7, 2020.
- Murray, Kathy, “Coast Guard Research Aimed at Improving Performance at High Altitudes,” *MyCG*, December 8, 2021.
- Nan, Zhong, and Liu Kun, “Norway’s Fish Industry Gets Chinese Boost,” *China Daily*, updated June 5, 2017.
- Nikanorov, Sergei, “Armiia Rossii—Kak Arkticheskaia Tsivilizatsiia [Russian Military as an Arctic Civilization],” *Nezavisimaia Gazeta [Independent Newspaper]*, March 17, 2020.
- Nilsen, Thomas, “Finland’s Military Blocked a Chinese Bid to Buy an Arctic Airport for Climate Research Flights,” *Arctic Today*, March 5, 2021a.
- “Northrop Goes Full-Rate Production of Link 16 Tactical Data Link for Sensor Networking on Marine Helicopters,” *Military and Aerospace Electronics*, March 25, 2022.

- “Northwest Passage Gets Political Name Change,” *Canada.com*, April 9, 2006.
- O’Connor, Tom, “Russia Will ‘Take Measures’ Against U.S. Radar Near Its Border, Thought to Be Part of Missile Defense,” *Newsweek*, May 23, 2019.
- Office of Strategy, Policy, and Plans, U.S. Department of Homeland Security, *Strategic Approach for Arctic Homeland Security*, February 17, 2021.
- Office of the Under Secretary of Defense for Policy, U.S. Department of Defense, *Report to Congress: Department of Defense Arctic Strategy*, June 2019.
- Office of Waterways and Ocean Policy, U.S. Coast Guard, U.S. Department of Homeland Security, “Major Icebreakers of the World,” infographic, updated May 1, 2017.
- Office of Waterways and Ocean Policy, U.S. Coast Guard, U.S. Department of Homeland Security, “Major Icebreakers of the World,” infographic, updated 2020.
- Office of Waterways and Ocean Policy, U.S. Coast Guard, U.S. Department of Homeland Security, “Homeports of Major Polar Icebreakers,” updated April 5, 2022.
- “Ofitsial’nyi Otdel [Official Department],” *Morskoi Sbornik [Naval Bulletin]*, No. 10, October 31, 2015.
- O’Rourke, Ronald, *Coast Guard Polar Security Cutter (Polar Icebreaker) Program: Background and Issues for Congress*, Congressional Research Service, RL34391, version 236, September 21, 2022.
- O’Rourke, Ronald, 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.
- Østhagen, Andreas, Anne-Kristin Jørgensen, and Arild Moe, “The Svalbard Fisheries Protection Zone: How Russia and Norway Manage an Arctic Dispute,” *Arctic and North*, Vol. 40, 2020.
- Overfield, Cornell, “An Off-the-Shelf Guide to Extended Continental Shelves and the Arctic,” *Lawfare*, April 21, 2021.
- Page, Jeremy, Kate O’Keeffe, and Rob Taylor, “America’s Undersea Battle with China for Control of the Global Internet Grid,” *Wall Street Journal*, March 12, 2019.
- Paniushkin, Aleksandr, “Terpiashchiie Bedstviie Spaseniy [The Disaster-Stricken Have Been Rescued],” *Na strazhe Zapoliar’ia [Guarding the Arctic]*, No. 21, June 9, 2017.
- Paszak, Paweł, “China and the ‘Malacca Dilemma,’” Warsaw Institute, February 28, 2021.
- Paul, Michael, “Greenland’s Project Independence,” *Stiftung Wissenschaft und Politik*, No. 10, January 28, 2021.

- Pearson, L. B., “Canada Looks ‘Down North,’” *Foreign Affairs*, Vol. 24, No. 4, July 1946.
- Pezard, Stephanie, Stephen J. Flanagan, Scott W. Harold, Irina A. Chindea, Benjamin J. Sacks, Abbie Tingstad, Tristan Finazzo, and Soo Kim, *China’s Strategy and Activities in the Arctic: Implications for North American and Transatlantic Security*, RAND Corporation, RR-A1282-1, 2022. As of November 29, 2022:  
[https://www.rand.org/pubs/research\\_reports/RR1282-1.html](https://www.rand.org/pubs/research_reports/RR1282-1.html)
- Pezard, Stephanie, 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. As of August 9, 2022:  
[https://www.rand.org/pubs/research\\_reports/RR1731.html](https://www.rand.org/pubs/research_reports/RR1731.html)
- Pompeo, Michael R., Secretary of State, “Looking North: Sharpening America’s Arctic Focus,” remarks, Rovaniemi, Finland, May 6, 2019.
- Public Law 116-283, William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021, January 1, 2021.
- Putin, Vladimir, “Ob Osnovah Gosudarstvennoi Politiki v Rossiiskoi Federatsii v Arktike na Period do 2035 Goda [Fundamentals of State Policy of the Russian Federation in the Arctic Until 2035],” Kremlin, Executive Order 164, March 5, 2020a.
- Putin, Vladimir, “O Strategii Razvitiia Arkticheskoi Zony Rossiiskoi Federatsii i Obespecheniia Natsional’noi Bezopasnosti na Period do 2035 Goda [Strategy for Developing the Russian Arctic Zone and Ensuring National Security Through 2035],” Kremlin, Executive Order 645, October 26, 2020b.
- Putin, Vladimir, “Morskoiia Doctrina Rossiiskoi Federatsii [Naval Doctrine of the Russian Federation],” Kremlin, Executive Order 512, July 31, 2022.
- 钱凌煜 [Qian Lingyu], “北极航线经营现状及发展建议 [Operational Status and Development Suggestions of Arctic Routes],” 中国远洋海运 [*Maritime China*], Vol. 1, 2022.
- Ragner, Claes Lykke, *The 21st Century: Turning Point for the Northern Sea Route? Proceedings of the Northern Sea Route User Conference, Oslo, 18–20 November 1999*, Springer Science and Business Media, 2000.
- Raspotnik, Andreas, and Andreas Østhagen, “A Global Arctic Order Under Threat? An Agenda for American Leadership in the North,” *Polar Points*, March 10, 2021.
- Representative for Ocean Policy Affairs, U.S. Department of Defense, “Maritime Claims Reference Manual,” last updated February 8, 2022.



- Riahi, Keywan, Detlef P. van Vuuren, Elmar Kriegler, Jae Edmonds, Brian C. O'Neill, Shinichiro Fujimori, Nico Bauer, Katherine Calvin, Rob Dellink, Oliver Fricko, Wolfgang Lutz, Alexander Popp, Jesus Crespo Cuaresma, Samir KC, Marian Leimbach, Leiwen Jiang, Tom Kram, Shilpa Rao, Johannes Emmerling, Kristie Ebi, Tomoko Hasegawa, Petr Havlik, Florian Humpenöder, Lara Aleluia Da Silva, Steve Smith, Elke Stehfest, Valentina Bosetti, Jiyong Eom, David Gernaat, Toshihiko Masui, Joeri Rogelj, Jessica Stremler, Laurent Drouet, Volker Krey, Gunnar Luderer, Mathijs Harmsen, Kiyoshi Takahashi, Lavinia Baumstark, Jonathan C. Doelman, Mikiko Kainuma, Zbigniew Klimont, Giacomo Marangoni, Hermann Lotze-Campen, Michael Obersteiner, Andrzej Tabeau, and Massimo Tavoni, "The Shared Socioeconomic Pathways and Their Energy, Land Use, and Greenhouse Gas Emissions Implications: An Overview," *Global Environmental Change*, Vol. 42, January 2017.
- Ritchie, Liesel A., and Duane A. Gill, "The *Selendang Ayu* Shipwreck and Oil Spill: Considering Threats and Fears of a Worst-Case Scenario," *Sociological Inquiry*, Vol. 78, No. 2, May 2008.
- Robinson, Jana, "Arctic Space Challenge for NATO: Emerging from China's Economic and Financial Assertiveness," *Journal of the Joint Air Power Competence Centre*, Vol. 30, Spring–Summer 2020.
- Rumer, Eugene, Richard Sokolsky, and Paul Stronski, *Russia in the Arctic—A Critical Examination*, Carnegie Endowment for International Peace, March 29, 2021.
- Ryzhonok, G., "Flotovodets: V Okeanskom Plavanii [Naval Commander: On Ocean Navigation]," *Flag Rodiny [Flag of the Motherland]*, No. 32, 2000.
- Sacks, Benjamin J., 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. As of August 10, 2022: [https://www.rand.org/pubs/research\\_reports/RR1007-1.html](https://www.rand.org/pubs/research_reports/RR1007-1.html)
- Sassi, Francesco, "What the 'Power of Siberia' Tells Us About China–Russia Relations," *The Diplomat*, December 7, 2019.
- Savitz, Scott, Miriam Matthews, and Sarah Weiland, *Assessing Impact to Inform Decisions: A Toolkit on Measures for Policymakers*, RAND Corporation, TL-263-OSD, 2017. As of August 11, 2022: <https://www.rand.org/pubs/tools/TL263.html>
- Savitz, Scott, Henry H. Willis, Aaron C. Davenport, Martina Melliand, William Sasser, Elizabeth Tencza, and Dulani Woods, *Enhancing U.S. Coast Guard Metrics*, RAND Corporation, RR-1173-USCG, 2015. As of July 12, 2022: [https://www.rand.org/pubs/research\\_reports/RR1173.html](https://www.rand.org/pubs/research_reports/RR1173.html)

- Schreiber, Melody, “A New China–Iceland Arctic Science Observatory Is Already Expanding Its Focus,” *ArcticToday*, October 31, 2018.
- Schreiber, Melody, “A U.S. Coast Guard Ship Unexpectedly Encountered Chinese and Russian Warships Off Alaska,” *ArcticToday*, September 26, 2022.
- 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.
- Semiriaga, V., “Ugrozi I Vizovi Rossii v Arktike [Threats and Challenges to Russia in the Arctic],” *Armeiskii Sbornik [Army Digest]*, No. 10, 2021.
- Sherman, Justin, “The US–China Battle over the Internet Goes Under the Sea,” *Wired*, June 24, 2020.
- Sigit, Satria Akbar, “Some Arctic Ground Lost Its Eternal Ice. Is It That Bad?” *Earthbuddies*, February 6, 2019.
- Skydsgaard, Nikolaj, and Humeyra Pamuk, “Blinken Says Russia Has Advanced Unlawful Maritime Claims in the Arctic,” *Reuters*, May 18, 2021.
- “Sluzhba Informatsii [Press Service],” *Na Strazhe Zapoliar’ia [Guarding the Arctic]*, No. 31, August 13, 2021.
- Solakivi, Tomi, Tuomas Kiiski, and Lauri Ojala, “On the Cost of Ice: Estimating the Premium of Ice Class Container Vessels,” *Maritime Economics and Logistics*, Vol. 21, June 1, 2019.
- “Sovmestnyie Ucheniia v Arktike [Combined Exercises in the Arctic],” *Na Strazhe Zapoliar’ia [Guarding the Arctic]*, No. 6, 2011.
- Space Science Data Coordinated Archive, National Aeronautics and Space Administration, “Gaofen 5,” webpage, version 5.1.12, October 28, 2021. As of December 1, 2021: <https://nssdc.gsfc.nasa.gov/nmc/spacecraft/display.action?id=2018-043A>
- Staalesen, Atle, “Kirkenes Port Developers Put Their Faith in the Chinese,” *Barents Observer*, June 7, 2019.
- Staalesen, Atle, “China’s New Icebreaker Completes First Arctic Expedition,” *Barents Observer*, September 29, 2020.
- Staalesen, Atle, “In Push for Global Lead in LNG, Moscow Takes Aim on Arctic Tundra,” *Barents Observer*, March 25, 2021a.
- Staalesen, Atle, “Russian Navy Builds More Icebreakers,” *Barents Observer*, January 7, 2022.
- Staats, Jennifer, Johnny Walsh, and Rosarie Tucci, “A Primer on Multi-Track Diplomacy: How Does It Work?” commentary, U.S. Institute of Peace, July 31, 2019.

- State Council of the People's Republic of China, "Full Text: China's Arctic Policy," January 26, 2018.
- Stephenson, Scott R., and Laurence C. Smith, "Influence of Climate Model Variability on Projected Arctic Shipping Futures," *Earth's Future*, Vol. 3, No. 11, November 2015.
- Stevenson, Alexandra, "Canada Blocks Chinese Takeover on Security Concerns," *New York Times*, May 23, 2018.
- Steward, Phil, and Idrees Ali, "Pentagon Warns on Risk of Chinese Submarines in Arctic," Reuters, May 2, 2019.
- Suhoruchenko, Vladimir, "Obespechit' Bezopasnost' Rossii v Arktike [Ensuring Russia's Security in the Arctic]," *Zashchita i Bezopasnost' [Defense and Security]*, No. 4, December 31, 2019.
- 孙凯 [Sun Kai] and 武珺欢 [Wu Junhuan], "北极治理新态势与中国的 深度参与战略 [The New Situation of Arctic Governance and China's Deep Participation Strategy]," 国际展望 [Global Review], No. 6, 2015.
- Sun, Yun, "Defining the Chinese Threat in the Arctic," Center for Circumpolar Security Studies, Arctic Institute, April 7, 2020.
- Szymczak, Pat Davis, "Russian LNG Aims High, Leveraging Big Reserves and Logistical Advantages," *Journal of Petroleum Technology*, September 1, 2021.
- Taylor, Adam, "China Sent a Ship to the Arctic for Science. Then State Media Announced a New Trade Route," *Washington Post*, September 13, 2017.
- Tebin, Prokhor, "The New Naval Doctrine of Russia," Valdai Discussion Club, August 4, 2022.
- Teeple, Nancy, "Great Power Competition in the Arctic," Network for Strategic Analysis, policy report, April 13, 2021.
- "极地未来对中国影响重大 – 专访中国海洋大学极地问题专家郭培清 [The Future of the Polar Regions Will Have a Significant Impact on China: Interview with Guo Peiqing, an Expert on Polar Issues at Ocean University of China]," 上海市科学技术协会 [Shanghai Association for Science and Technology], July 10, 2008.
- Tigner, Brooks, "Electronic Jamming Between Russia and NATO Is Par for the Course in the Future, but It Has Its Risky Limits," Atlantic Council, November 15, 2018.
- "Too Much to Fight Over," *The Economist*, June 16, 2012.
- Townsend, Jim, and Andrea Kendall-Taylor, *Partners, Competitor, or a Little of Both? Russia and China in the Arctic*, Center for a New American Security, March 30, 2021.

Trump, Donald J., “Safeguarding U.S. National Interests in the Arctic and Antarctic Regions,” memorandum for the Secretary of State, the Secretary of Defense, the Secretary of Commerce, the Secretary of Energy, the Secretary of Homeland Security, the director of the Office of Management and Budget, and the assistant to the President for national security affairs, June 9, 2020.

“Uspeshnyi Debiut [Successful Start],” *Strazh Baltiki [Guarding the Baltics]*, No. 37, September 28, 2018.

UNCLOS—See United Nations Convention on the Law of the Sea, 1982.

United Nations Convention on the Law of the Sea, Afg.—Alb.—Alg.—Angl.—Ant. and Barb.—Arg.—Arm.—Austl.—Austria—Azer.—Bah.—Bahr.—Bangl.—Barb.—Belr.—Belg.—Belize—Benin—Bhutan—Bol.—Bosn. and Herz.—Bots.—Braz.—Brunei Darussalam—Bulg.—Burk. Faso—Burundi—Cambodia—Cameroon—Can.—Cape Verde—Cent. Afr. Rep.—Chad—Chile—China—Colom.—Comoros—Congo—Cook Islands—Costa Rica—Côte d’Ivoire—Croat.—Cuba—Cyprus—Czech—Dem. People’s Rep. Kor.—Dem. Rep. Congo—Den.—Djib.—Dominica—Dom. Rep.—Ecuador—Egypt—El Sal.—Eq. Guinea—Est.—Eth.—European Community—Fiji—Fin.—Fr.—Gabon—Gam.—Geor.—Ger.—Ghana—Greece—Gren.—Guat.—Guinea—Guinea-Bissau—Guy.—Haiti—Hond.—Hung.—Ice.—India—Indon.—Islamic Republic of Iran—Iraq—Ir.—It.—Jam.—Japan—Jordan—Kenya—Kiribati—Kuwait—Lao People’s Dem. Rep.—Lat.—Leb.—Lesotho—Liber.—Libyan Arab Jamahiriya—Liech.—Lith.—Lux.—Madag.—Malawi—Malay.—Maldives—Mali—Malta—Marsh. Is.—Mauritania—Mauritius—Mex.—Fed. States of Micr.—Mold.—Monaco—Mong.—Montenegro—Morocco—Mozam.—Myan.—U.N. Council for Namib.—Nauru—Nepal—Neth.—N.Z.—Nicar.—Niger—Nigeria—Niue—Nor.—Oman—Pak.—Palau—Pan.—Papua N.G.—Para.—Phil.—Pol.—Port.—Qatar—Rep. Korea—Rom.—Russian Federation—Rwanda—Samoa—São Tomé and Príncipe—Saudi Arabia—Sen.—Sey.—Sierra Leone—Sing.—Slovk.—Slovn.—Solom. Is.—Som.—S. Afr.—Spain—Sri Lanka—St. Kitts and Nevis—St. Lucia—St. Vincent—State of Palestine—Sudan—Surin.—Swaz.—Swed.—Switz.—Thail.—former Yugoslav Rep. Maced.—Timor-Leste—Togo—Tonga—Trin. and Tobago—Tunis.—Tuvalu—Uganda—Ukr.—U.A.E.—U.K. of Gr. Brit. and N. Ir.—United Rep. Tanzania—Uru.—Vanuatu—Viet.—Yemen Arab Republic—Federal Republic of Yugoslavia—Socialist Fed. Rep. of Yugoslavia—Zaire—Zam.—Zim., December 10, 1982, 1833 U.N.T.S. 397.

U.S. Coast Guard, U.S. Department of Homeland Security, “USCGC Polar Star (WAGB 10),” webpage, undated-a. As of March 2, 2022:  
<https://www.pacificarea.uscg.mil/Our-Organization/Cutters/cgcPolarStar/>

U.S. Coast Guard, U.S. Department of Homeland Security, “US Coast Guard Cutter Fact Sheets (Alphabetical),” webpage, undated-b. As of August 11, 2022:  
<https://www.history.uscg.mil/Browse-by-Topic/Assets/Water/All/Cutters-65-ft-or-greater/>

- U.S. Coast Guard, U.S. Department of Homeland Security, *The Cutters, Boats, and Aircraft of the U.S. Coast Guard*, June 14, 2018.
- U.S. Coast Guard, U.S. Department of Homeland Security, *Arctic Strategic Outlook*, April 2019.
- van Brunnersum, Sou-Jie, “China Failed Its Arctic Ambitions in Greenland,” *Politico*, October 22, 2022.
- Vasilenko, V., and S. Subbotin, “Osobyie Zadachi dlia Arkticheskoi Zony [Unique Issues in the Arctic Zone],” *Armeiskii Sbornik [Military Digest]*, No. 5, 2020.
- Wang, Brian, “First Ocean Fish Farm Raising 1.5 Million Salmon Three Miles Off Norway,” *Next Big Future*, August 7, 2018.
- Watson, John D., “Russia’s Recent Conquests and Long-Term Strategy in the Arctic,” *Wild Blue Yonder*, July 2, 2021.
- Weir, Fred, “Russia Breaks the (Polar) Ice on Its Northeast Passage Aspirations,” *Christian Science Monitor*, October 13, 2021.
- White, B. E., “Tactical Data Links, Air Traffic Management, and Software Programmable Radios,” *Gateway to the New Millennium: 18th Digital Avionics System Conference—Proceedings*, Institute of Electrical and Electronics Engineers, 1999.
- Wishnick, Elizabeth, “Will Russia Put China’s Arctic Ambitions on Ice?” *The Diplomat*, June 5, 2021.
- Woody, Christopher, “The Heavy-Duty Ship the US Needs to Protect Its Thawing Border with Russia ‘Is Just Falling Apart,’ Captain Says,” *Insider*, March 10, 2021a.
- Woody, Christopher, “Ever Given Is No Longer Blocking the Suez Canal, but Russia Sees a Long-Term Benefit from It Being Stuck,” *Insider*, March 30, 2021b.
- World Economic Forum, “China Aims to Play a Major Role in Arctic Affairs. Here Are Its 5 Key Policy Goals,” July 27, 2018.
- Yap, Chuin-Wei, “China’s Fishing Fleet, the World’s Largest, Drives Beijing’s Global Ambitions,” *Wall Street Journal*, April 21, 2021.
- 赵洋 [Zhao Yang], “身份叙事与中国参与北极事务身份建构 [Identity Narrative and the Construction of China’s Identity in Arctic Affairs],” *东北亚论坛 [Northeast Asia Forum]*, Vol. 1, 2022.