Maximizing ISR Effectiveness in the High North

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ABSTRACT

An Arctic State since the days of Imperial Russia, the Russian Federation recently embarked upon a systematic re-establishment of Arctic presence designed to ensure that Russian economic, defense and geopolitical interests are secured through an uncertain future of intense environmental change. Many of these interests run counter to the vision of the United States and our North Atlantic Treaty Organization (NATO) partners of a free and open Arctic. Safeguarding this vision depends on American and NATO ability to execute Dynamic Force Employment (DFE) in the 'High North'[1]. Use of such a flexible strategy, in turn, underscores the importance of maintaining situational awareness over the region through the use of Intelligence, Surveillance and Reconnaissance (ISR) capabilities.[2] To improve ISR capability at providing effective and actionable Arctic battlespace awareness and threat warning, this paper will examine the traditional pillars of ISR sensor evaluation (Access-Fidelity-Accuracy-Timeliness, AFAT) and apply them in a broader, operational context to breakdown methods by which ISR can be optimized to support Arctic operations.[3] This mixing of tactical doctrine with strategic planning demonstrates how the US and NATO may effectively posture, procure and process ISR forces and information to support a free and open Arctic.

Steadily increasing average Arctic temperatures due to the effects of climate change are rapidly altering the physical environment in the High North. The retreat of Arctic Sea ice, currently estimated at a rate of 12.85% per decade, unlocks maritime terrain previously inaccessible to human exploitation.[4] This terrain above approximately 66 degrees North Latitude, commonly termed the 'High North' and shown in Figure 1, has significant economic and political implications, yet lacks firm precedent by which countries may lay claim to the recently unlocked resources the region has to offer. The most common basis used for Arctic claims is the United Nations Convention on the Law of the Sea (UNCLOS) which provides a nation with territorial waters 12 nautical miles from their shore and exclusive economic rights out to 200 NM from the same location, with additional extensions to claim limits provided for proven extensions of a nation's continental shelf.[5]

Based upon the CLOS, there are eight countries that lay claim to some portion of the Arctic: Five of the nations are NATO members – the United States, Canada, Norway, Denmark and Iceland; two are NATO partners – Finland and Sweden; while the final nation is the competitor – Russia.[6] Of these eight nations, five are members of the North Atlantic Treaty Organization (NATO), two are NATO partner nations and only Russia is viewed as a strategic competitor.[7] Russia demonstrated a desire to exploit the Arctic at the expense of the other Arctic nations, substantially investing in forces and infrastructure in the region that run contradict the vision of the Arctic as an open, cooperative space.[8] Russia's actions led the other Arctic nations, in particular the United States and its NATO allies, to prioritize the development of improved Intelligence, Surveillance and Reconnaissance (ISR) capabilities in order to maintain situational awareness of Russian activities in the Arctic.[9]

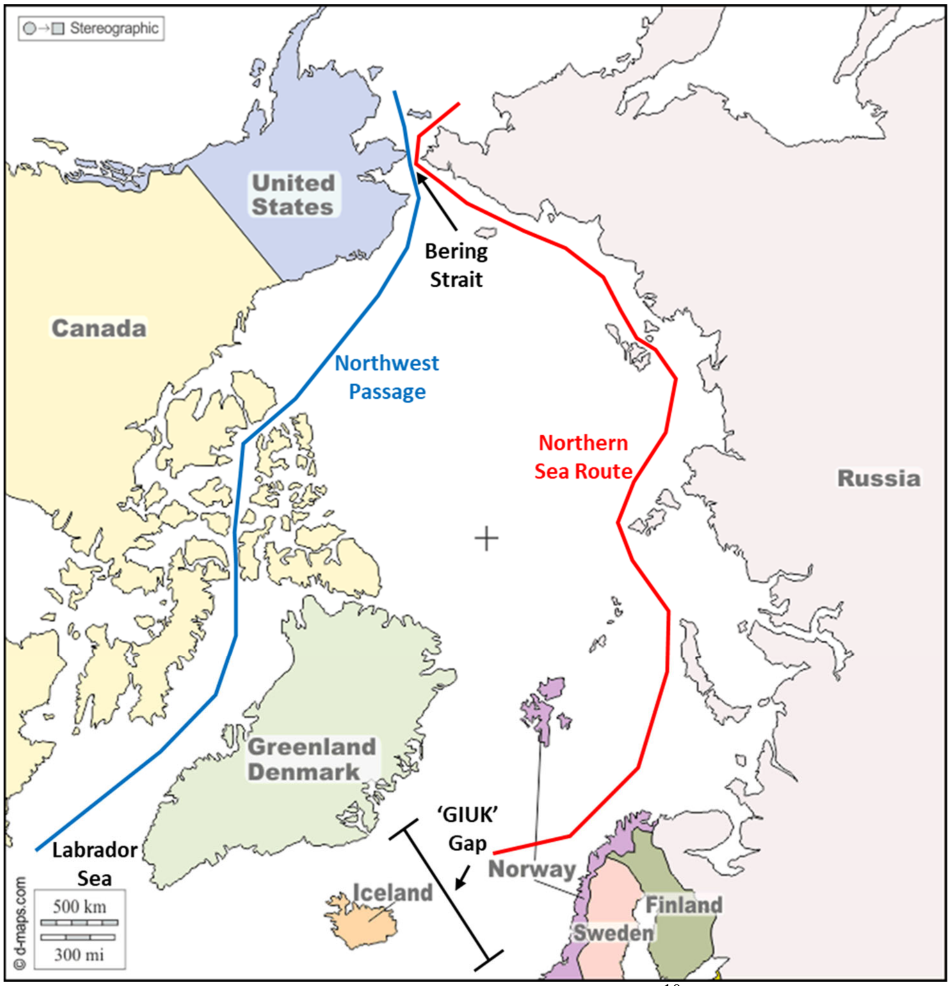

Figure 1. View of the High North[10]

Russian interests in the region can be broadly placed into three primary categories: economic, defense and diplomacy. First and foremost of these is economics. The most current estimates suggest that up to 13% of the world's undiscovered oil and 30% of natural gas reserves are located in the High North.[11] [12] For an economy that relies heavily on the export of mineral commodities, 64% of GDP in 2020, the potential discovery of resources estimated to double Russia's known oil and gas reserves represents a significant economic boost.[13]

In addition to the mineral wealth held by the Arctic, the economic potential of a controlling stake in what is known as the 'Northern Sea Route' (NSR) between the Atlantic and Pacific Oceans could provide Russia a steady stream of revenues from transit and pilot vessel or icebreaker support fees.[14] The NSR, previously icebound and inaccessible without time-consuming and expensive icebreaker support, shortens the transit between Europe and Asia by 40%, bypassing many of the world's primary maritime chokepoints along the way, including the Suez Canal, Straits of Malacca and Panama Canal.[15]

National defense is another consideration at the forefront of Russian strategic decision-making. Historically a land-power, Russia struggled with the constraining limits imposed by geography on its naval power since the time of Peter the Great.[16] Despite Russian lease agreements on the port of Sevastopol, prior to the annexation of Crimea, Russia lacked a secure, year-round, ice-free deep-water port resulting in it being at best a part-time naval power and reliant on other domains to ensure its defense.[17] The receding Arctic sea ice unlocks the prospect of year-round surface vessel access to Russian ports on the Kola Peninsula. This reduced sea ice also affords the Russian Navy freedom of maneuver in the Arctic, providing strategic depth and increasing force survivability should it become necessary.[18]

An ice free Arctic has even more profound implications when viewed in the context of strategic nuclear deterrence. Russia's ballistic missile submarine fleet, based on the Kola Peninsula and itself unconstrained by sea ice thanks to the benefits of sub-surface travel, is nonetheless afforded increased lethality and survivability by the receding ice. The reasons for this are twofold: less launch-constraining sea ice in the Arctic Ocean means larger operating areas for submarine-launched ballistic missile (SLBM) operations and the umbrella of Russian surface and land-based defensive systems positioned in Russian Arctic complicate an adversary's ability to hunt these strategic assets.[19]

Finally, the diplomatic implications of Russian control over the Arctic cannot be understated. Returning to the NSR, Russian control of an alternative sea lane that is not dependent on passage through traditional chokepoints and its corresponding vulnerability to U.S. and Allied naval action provides strategic options for nations that may have divergent interests from the United States.[20] The NSR also grants Russia greater economic leverage on worldwide trade, introducing the prospect of Russian threats to limit movement through the NSR as geopolitical leverage on the world stage, much in the same way Iran uses its proximity on the Straits of Hormuz to influence global affairs. Separately, Russian control of an increased share of the world's oil and gas wealth improves their influence over global oil supplies and supports continued European dependency on Russian natural gas, providing an offset to Western initiatives to reduce Europe's dependence on Russian energy sources.

For the United States and its Allies, many interests mirror those of the Russians, particularly where natural mineral commodities are involved, yet these commodities are not nearly as critical to the European and American democracies due to their well-developed, diverse economies.[21] Instead, European and American interests are primarily based upon the maintenance of the Arctic as a shared space for international navigation and commerce.[22] The United States and NATO view Russian attempts to control access to the Northern Sea Route as an inherent risk to the rules-based global order and contradictory towards current attitudes to other worldwide sea lanes.[23] Smaller Arctic nations, such as Iceland and Greenland, are also aware of the geopolitical importance of their locations and the influence it affords them in the pursuit of their own security and geopolitical interests on the world stage.[24]

Arctic states therefore invest significant effort into the formulation of strategies that will enable them to advance their interests in the region, often tying these strategies to those of other Arctic states to create a collective hedge against a regional balance of power that strongly favors Russia.[25] For the United States, operations in the Arctic are but one of many theaters in which forces must be prepared for employment. The United States therefore requires effective use of Dynamic Force Employment (DFE) strategies to create and maintain a credible, yet flexible, deterrent to hostile acts in the Arctic.[26] To utilize this deterrent effectively, the US understands that Arctic awareness in necessary to recognize and respond to Russian attempts to permanently alter the Arctic status quo in their favor. The United States is also not alone in this assessment as both NATO and Norway also recognize the need to "enhance situation awareness across the High North" in order to safeguard their interests.[27] [28]

Despite the emphasis placed upon ISR in the Arctic regions, limitations to effectively employ ISR still exist. When evaluating ISR capabilities, a framework known as 'Access-Fidelity-Accuracy-Timeliness (AFAT)' is often used to examines the four main categories of ISR sensor effectiveness.[29] Access doctrinally evaluates a sensor's ability to 'see' a target, either physically or electronically.[30] Fidelity evaluates a sensor's ability to properly identify or characterize a target.[31] Accuracy characterizes a sensor's ability to correctly geo-locate a target.[32] Finally, timeliness evaluates the ability of a sensor to convey its collected information and for that information to be processed, analyzed and disseminated.[33] On a strategic-level, these four pillars of sensor effectiveness can be summarized as 'posture, procure and process'.

When examining access on this scale, the term 'posture' effectively summarizes the strategic need to have assets in-place to conduct ISR operations, primarily divided into the two sub-considerations of ISR basing and remote sensing availability.[34] From a basing perspective, the availability of regional basing options and the infrastructure to support those bases must be established at locations where they will be utilized to the greatest possible effect. To arrive at a useful recommendation, it's important to understand which locations are most likely to be critical to advancing national interests in the Arctic. Despite the retreat of the Arctic sea ice, there still exist only three primary entry points into the Arctic Ocean: 1) the Bering Strait off the coast of Alaska, 2) the Greenland-Iceland-UK (GIUK) Gap and 3) the Northwest Passage through the Labrador Sea in Canada's Far North. Each of these chokepoints rest adjacent to NATO territory and provide convenient locations from which to base ISR assets. Due to this, land-based ISR should be prioritized within range of these chokepoints to maximize awareness of passing maritime traffic and provided advance warning of possible hostile acts control or disruption. In addition to these key chokepoints, persistent awareness of higher latitudes must to be established through investment in remote sensing systems tailored to observation in the High North.[35] These systems should include a mix of multi-domain assets to include air-, sea-, land- and space-based observation systems, as well as manned and unmanned assets with complementary capabilities. [36]

Both fidelity and accuracy can be strategically applied during the 'procurement' of ISR sensors with complementary air and space capabilities that are specifically tailored to the operational environment and missions of the High North. [37] First among these uniquely Arctic capabilities is the ability to perform real-time tracking of sea ice formations in the Arctic Ocean. Unlike most theaters, where the physical environment is static, the Arctic will present a dynamic physical environment of sea ice that will cause routine changes to operating areas and areas of interest.[38] Two examples, encompassing both active and passive sensing capabilities, include synthetic aperture radar (SAR) imaging and passive microwave sensing in use by civil and scientific authorities to track Arctic sea ice limits, movements and compositions.[39] [40] Training on how to best exploit this environmental information to form an accurate and comprehensive picture of the operating environment also needs to be taught to Arctic intelligence personnel, an effort already being explored by the US Army.[41] The starting point for this is rooted in firm emphasis on Joint Intelligence Preparation of the Operational Environment (JIPOE) methodologies for young intelligence analysts. Even with this firm baseline, however, it will be important to train personnel on the technical operating limitations of both friendly and adversary equipment to appropriately apply these principles.

Future Arctic ISR sensors must also be optimized for operations in the extreme environmental conditions present in the Arctic. The main two environmental considerations that must be accounted for are extreme cold-weather sensing operations and electromagnetic interference caused by solar interference in the northern latitudes.[42] [43] Quantum illumination, just one developmental technology worthy of exploring for use in Arctic, could mitigate the effects of electromagnetic noise in the remote sensing environment often found in Earth's northern latitudes.[44] In addition to achieving actionable fidelity, sensors must be able to accurately geo-locate their targets despite the effects solar interference often poses to Positioning, Navigation and Timing (PNT) technologies.[45] Besides the 'brute-force' method of increasing signal-noise ratios of PNT transmitters, other possible mitigation measures to ensure accurate positional fixes by ISR assets include the development and fielding of advanced inertial and celestial navigation systems, the use of terrestrial PNT transmitters positioned in areas of interest and the relay of positional information gathered by external sensors, such as ground-based radar, back to ISR platforms by way of data links.

The final pillar of sensor evaluation is timeliness, best examined in the strategic context as the 'processing' of ISR information to ensure its usefulness. From the standpoint of information processing, communication infrastructure and command and control (C2) integration are the primary focus areas for developing a credible ISR capability. Emphasis should first be placed on developing effective and redundant communication links and nodes to support an expanded Arctic footprint. Over-air communication links in the High North suffer from much of the same electromagnetic spectral interference that plagues remote sensing operations. [46] Satellite communication capabilities in the Arctic also suffered from the equatorial, geostationary orbits of legacy communication relays, resulting in unreliable satellite connections above 65 degrees north.[47] Responding to these concerns, the US began a program of investment improving the state of satellite communications architecture in the Arctic. The United States Navy and Coast Guard implemented the Mobile User Objective System (MUOS), providing proven and effective satellite communications coverage up to 89.5° north. Meanwhile the United States Air Force contracted with Northrop for the development of the Enhanced Polar System - Recapitalization (EPS-R) program with the goal of assuring persistent satellite communications in the Arctic.[48] [49]

Despite the investment in satellite communication technologies, development on improving alternative, non-space based, communication methods should continue in parallel to ensure overall infrastructure redundancy and survivability. [50] Examples of areas for continued investment include the construction of more high frequency (HF) radio networks, researching improvements to communications signal processing to improve reliability in Arctic electromagnetic interference, utilizing land-, sea-, and air-based communications relays to reduce the distances signals must travel, and the expansion of terrestrial fiber-optic cable networks to the far northern expanses of Arctic territories to tie back into a nation's primary C2 architecture.[51] This last part is especially important given the need for a reliable mechanism incorporating collected sensor data into national processing, exploitation and dissemination architectures. Due to the emphasis placed upon international partnerships to ensure a free and peaceful Arctic, procurement and training must also be conducted with an assumption that multi-national coalitions will be jointly collecting and exploiting collected information. Information data architectures, therefore, must be standardized between nations and incorporated into a common intelligence picture capable of being displayed, modified and passed into the C2 networks of both the United States and its Arctic partner nations, a project currently in development by Boeing through its Integrated Remote Sensing for the Arctic (IRSA) development group.[52] Such C2 networks may also integrate disparate and geographically separated sensors with machine learning and artificial intelligence (AI) initiatives, such as the United States' Project Maven.[53] Utilizing machine learning and AI algorithms should ease the burden on intelligence personnel to interpret the vast amount of data flowing from sensors postured in the High North, both speeding the dissemination of actionable intelligence and reducing the overall training burden inherent to preparing for operations in a new and relatively unknown theater.

By examining Russian and allied interests in the High North, it is possible to assess Russian intent in the region and examine that intent against US and NATO goals of an open and free Arctic. With that understanding, and by making use of the Access-Fidelity-Accuracy-Timeliness framework for evaluating ISR capabilities, prioritized objectives may be determined which further the development of an effective ISR infrastructure for the High North in terms of posture, procurement and processing. In the interest of deterring Russian actions to control or deny international use of Arctic waters, this breakdown informs future development of ISR capabilities tailored to the unique Arctic environment, supporting improved overall execution of strategic DFE in the High North.

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