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A Changing Climate

A shifting Arctic strategy

Members of the Coast Guard Cutter *Polar Star*'s deck department work in below freezing temperatures to remove ice from the ship's deck and deck equipment while underway in the Chukchi Sea, in December 2020. While Arctic winters are still harsh, regional waters are progressively more open in the summer months, raising concerns about safety and security as vessel traffic increases and other countries make moves to claim natural resources. Coast Guard Photo by Petty Officer 1st Class Cynthia Oldham

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On the Cover: Scientists from Oregon State University and the Virginia Institute of Marine Science spotted this walrus in the Chukchi Sea from the R/V Sikuliaq during September 2016 National Science Foundation-funded Arctic research cruise. Researchers are continuing to study how a changing climate may be affecting wildlife, and the entire way of life, in the Arctic.

National Science Foundation photo
by Kim Kenny

Corrections to the Winter 2020 issue

In the article *Teamwork and Determination: Mitigating the threat of pollution from the historic wreck of the Coimbra*, the CGC *Westwind* was named at the top of the second column on page 101. The CGC *Sweetgum*, is the cutter from which the wrecks were assessed.

On page 128 of Winter 2020, the answer to the first Nautical Deck Queries question was not complete, and therefore incorrect. Please find the question and the complete, correct answer on page 119 of this edition.

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Assistant Commandant's Perspective

by Rear Admiral Richard V. Timme
Assistant Commandant for Prevention Policy
U.S. Coast Guard

The Coast Guard has operated in the Arctic Ocean for more than 150 years. Since that time, the Arctic operational, physical, economic, and geopolitical environments have significantly evolved. Moreover, climate change is now driving simultaneous paradigm shifts in regional security, safety, and stewardship, the impacts of which are rapidly converging on the Coast Guard's statutory missions.

Sea ice is receding. Storms are

Champion's Point of View

by Mr. Shannon R. Jenkins
Senior Arctic Policy Advisor
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As a maritime nation, the United States derives a significant portion of our economic power from the flow of national and international maritime commerce. The maritime transportation system (MTS) is what enables its uninterrupted flow, accounting for $5.4 trillion dollars of annual economic activity and the employment of more than 30.8 million Americans. The ease of moving cargo and people within and beyond our coasts fuels this nation's competitive economic advantage, advances trade, generates capital, and drives the domestic economy forward. This, in turn, protects power abroad and helps safeguard our national interests.

The Coast Guard bolsters the U.S. economic power derived from maritime commerce through the management and advancement of the MTS, which is the lifeblood of the global economy. As a military maritime force

increasing in frequency and magnitude. The coast is eroding; and permafrost is thawing. Alaskan Natives are struggling to sustain their culture and way of life while both Arctic residents and non-residents are pursuing emerging opportunities. Many Arctic and non-Arctic partners and competitors are seeking to leverage the opening Arctic for economic advantage and to influence regional governance.

At the same time, the types and intensity of regional commercial maritime activity are also evolving. Oil and gas exploration have dominated the region for years. Now, due to environmental changes, the Arctic is also experiencing a surge in ecotourism and a northward-shift in both regulated and illegal, unreported, and unregulated, fisheries, which shape the food and economic security landscape across the planet. Additionally, over the past 10 years and across all industry sectors, shipping through the Bering Straits has experienced steady, but measured, growth. Projections indicate up to 370 transits by 2030, a roughly 300 percent increase from 2008. The composition of Arctic maritime commerce may yet further adapt in unexpected ways to technological advances and global market forces.

These systemic changes do more than increase the demand signal for Coast Guard services to monitor, protect, and regulate regional maritime activity. Their breadth and depth drive an unprecedented need for collaboration to meet America's needs in the modern Arctic.

While the risks to the nation and the service's mission execution from climate change in the Arctic are significant, the Coast Guard is well positioned to rise to the challenge. The articles in this issue of *Proceedings* highlight our unique and versatile blend of regulatory authority, response capabilities, and cultivation of strong national and international partnerships to promote safe, secure, and responsible maritime activity across the Arctic.

with multiple missions and unique law enforcement, intelligence, and regulatory authorities, the service leverages unique authorities, jurisdiction, and operational capabilities to safeguard the efficient and economical movement of that commerce. No other government agency has such far-reaching impact within the maritime domain.

The Arctic is rapidly becoming a more important part of the MTS discussion. Because of environmental changes occurring across the region, opening sea lanes are poised to expand destinational shipping within the Arctic and open valuable alternative trade routes between North America, Europe, and Asia. This has powerful implications for both commerce and military mobility and elevates the importance of an efficient MTS in the Arctic as a critical component of the nation's security and prosperity.

Increasing commercial shipping combined with emerging technologies and new methods for offshore natural resource exploration, production, and transportation pose challenges and risks unlike anywhere else for the service, industry, and the Arctic residents and environment. Therefore, replicating the MTS that exists in the contiguous United States is not a viable option in the region. The service must complement its existing MTS management tools with innovative strategies, policies, and technologies developed in partnership with both the public and private sectors.

To accomplish this, the Coast Guard must prepare now to have the adaptive capacity, strategic awareness, and modern systems, assets, and workforce to facilitate, safeguard, and advance commerce across ALL of America's waterways. The service's capability and capacity decisions are informed by, and derives part of that strategic awareness through, collaborations like the development of this issue of *Proceedings* and the cross-modal conversations that it hopefully engenders.

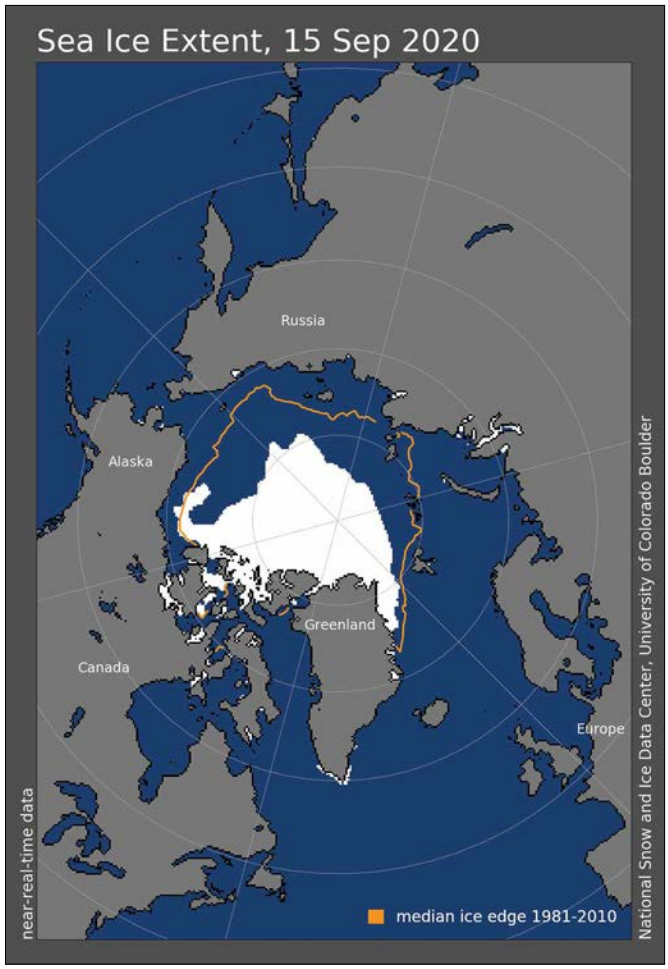
We greatly appreciate all of the august contributors for their time and energy. Most of all, we thank them for their wisdom and thank you, the reader, for your interest. We welcome the feedback and dialogue that the ideas and recommendations here will spur across the federal, commercial, academic, and public spectrums. The end goal is always to advance the safe, responsible growth in U.S. and global maritime commerce, the byproduct of which is a means to maintaining U.S. economic power and influence.

Navigating the Arctic's 7Cs

U.S. Coast Guard advancing America's interests in the Arctic

by Dr. Mike Sfraga
Director, Polar Institute
Woodrow Wilson International Center for Scholars

In the Arctic we are witnessing the opening of a new ocean and a fourth accessible, U.S. maritime border. The Arctic Ocean joins the Atlantic Ocean, Gulf of Mexico, and the Pacific Ocean as a critical, geographic component of our country's maritime ring of economic, homeland, and national security. The Coast Guard will serve an increasingly important role in protecting U.S. interests in the region, advancing commerce, ensuring national and civil security, and providing critical surface presence in a dynamically changing diplomatic and environmental landscape.



On September 15, 2020, the Arctic sea ice minimum was 1.44 million square miles, the second lowest recorded since September 2012. For comparison, the orange lines show the 1981 to 2010 average extent of Arctic ice. Graphic courtesy of the National Snow and Ice Data Center

Indeed, as the primary surface presence of the United States in the Arctic, and the first responder to any incident that falls under its 11 statutory missions, the Coast Guard must be empowered to meet the nation's needs across a broad range of geographic regions, including the Arctic. As the Coast Guard's 2019 *Arctic Strategic Outlook* states, "The Arctic maritime domain will continue to open and increased activity will create more demand for Coast Guard services. Near-term variability will result in a dynamic operating environment that exposes mariners and Arctic communities to unpredictable levels of risk."

In an effort to meet these new challenges the *Arctic Strategic Outlook* identifies three lines of effort to further the Coast Guard's goals in the region:

- enhance capability to operate effectively in a dynamic Arctic domain
- strengthen the rules-based order
- innovate and adapt to promote resilience and prosperity in the Arctic

In order for these lines of effort to be effectively transitioned to an overall strategy, with corresponding tactics and sufficient resourcing, the goals must be considered in the broader context of a new, global Arctic.

The Arctic, including Alaska, the state by which the United States is an Arctic nation, is experiencing rapidly evolving risks, threats, and opportunities. Therefore, a new framework may be helpful to re-conceptualize the evolving situation, as well as gauge the applicability of the strategic components contained within the *Arctic Strategic Outlook*. To that end, I offer a framework entitled *Navigating the Arctic's 7Cs*. The framework is composed of seven key drivers that I believe must be addressed to effectively navigate the multifaceted realities of a globalized Arctic Region.

The framework's 7Cs are:

- Climate
- Commodities
- Commerce
- Connectivity

- Communities
- Cooperation
- Competition

To effectively protect the homeland as well as enable and enhance economic opportunities, the Coast Guard should consider how each of these components is addressed and advanced within the *Arctic Strategic Outlook*. Indeed, the 7Cs are interrelated and interdependent. You cannot separate one from the other because effectively addressing the realities of the Arctic requires such an approach.

1. Climate

Global warming is real, rapid, and relentless. According to NASA, Arctic Ocean sea ice extent in September, the time of year when it reaches its minimum, has declined more than 13 percent per decade since 1979. Moreover, a series of reports and findings in the last quarter of 2020 indicate a landscape undergoing dramatic change. The National Snow and Ice Data Center (NSIDC) announced this year's September Arctic sea ice minimum was the second lowest recorded when compared to the lowest extent observed in September 2012. More disturbingly NSIDC also reports October sea ice satellite data indicated the lowest recorded sea ice coverage for the month, and significant portions of the Arctic Ocean remained ice free in the month of November. And as the year draws to a close, the National Oceanic and Atmospheric Administration (NOAA) released in December its 15th annual Arctic Report Card. NOAA's report paints a stark picture: The Arctic continues to warm, melt, thaw, green, erode, and dry at a pace far quicker than previously forecasted.

Associated sea ice decline has many implications for the United States including a more accessible Alaskan coastline; increased risk to mariners; stronger and more frequent storms; threats to coastal communities due to coastline and permafrost degradation; and shifting subsistence patterns. Global warming is the preeminent driver of change in the Arctic and requires a rapid, yet responsible, evolution of the Coast Guard's posture, strategy, and operations. It also requires the U.S. government to provide necessary resources so the Coast Guard can effectively execute its mission, and for applicable federal agencies to shoulder a share of the responsibility.

Indeed, a "whole of government" strategy and approach is required. But in order to more effectively meet their mission in the Arctic, the Coast Guard must have accurate, reliable, and sustained information about the Arctic environment in which it is to operate. This cannot be over emphasized, so to address this critical need, the *Arctic Strategic Outlook* calls for additional Arctic research and associated funding. A perfect starting place is adoption and resourcing of the United States Arctic Research Commission's *Report on the Goals and Objectives for Arctic Research 2019–2020*. Nine recommendations that enhance the nation's ability to "Observe, Understand, and Forecast Arctic Environmental Change" are identified in the document and would go far to support the Coast Guard's Arctic mission sets. Moreover, it is essential that funding be made available for the NOAA's National Weather Service and National Ocean Service to enhance the operational marine and terrestrial observation network in Alaska.

2. Commodities

The rapidly changing climate and landscape is opening resource development opportunities throughout the Arctic, including Alaska. With a coastline of nearly 34,000 miles, 2,500 of which are in the Arctic, Alaska has significant potential for economic development at the community, state, and federal levels. The subsequent 1 million square miles of the U.S. Arctic Exclusive Economic Zone (EEZ), currently extending 200 nautical miles out from the Alaskan coastline, provides a vast landscape of opportunities to satisfy global commodity markets and ensure our nation's energy security. It simultaneously presents a significant challenge to the Coast Guard's mandate to uphold American sovereignty. The Coast Guard shares responsibility for managing and regulating the nation's maritime borders and all actions within them with Customs and Border Protection, Immigrations and Customs Enforcement, and the Bureau of Safety and Environmental Enforcement. This includes those actions that promote economic prosperity and threaten U.S. sovereignty and economic independence.

With an expected increase in fisheries activities in Bering Sea, Bering Strait, and elsewhere in the Arctic, the Coast Guard will be ever-more challenged to provide support to both domestic and international interests in the region. Prior to the COVID-19 pandemic, Arctic tourism was on the rise. According to *Cruise Industry News*' 2019 Expedition Market Report, "expedition' cruising is the fastest growing market in the entire shipping industry." As noted in the *Arctic Strategic Outlook*, "as cruise ship and transpolar aviation traffic grows, so does the potential need for mass rescue operations in remote, icy waters. The current state of response capabilities makes this one of the most challenging of all possible scenarios." Proper prevention and management measures could mitigate the risk of these accidents as well as potential environmental and economic impacts.

Response capabilities regarding natural resource emergencies also must be expanded and enhanced. The Arctic is estimated to hold 13 percent of the world's undiscovered oil, 30 percent of the world's undiscovered natural gas, and 20 percent of the undiscovered natural gas liquids. The increased availability of these resources

as a result of continued and rapid Arctic Ocean sea ice decline may reenergize the global commodity market's interest in the Arctic as supply and demand, as well as political realities, ebb and flow.

Applicable and enduring federal support should be allocated to the Coast Guard's search and rescue requirements as noted in *Arctic Strategic Outlook*, with particular attention given to asset allocation along the Bering Strait and North Slope of Alaska.

Members of Coast Guard Station Juneau, Alaska, conduct a cruise ship escort of Princess Cruise Lines' *Ruby Princess* in April 2018. Arctic tourism is on the rise and as cruise ship traffic grows so does the potential for rescue operations in isolated, ice-covered waters. Coast Guard photo by Petty Officer 1st Class Jon-Paul Rios

3. Commerce

Increased access to a wide array of natural resource commodities has led directly to an increase in shipping and related activities in the Arctic, most notably in the Russian Arctic. There has been a dramatic increase in commercial activity along Russia's Northern Sea Route (NSR) since 2014, primarily driven by its regional resource extraction and subsequent transport systems to domestic and international markets. Some experts calculate as much as 20 percent of Russia's GDP is linked to the Arctic. President Vladimir Putin aims to quadruple cargo shipments along the NSR to 80 million tons per year by 2024 through enhancement and expansion of Russia's investments in Arctic infrastructure. Russia's Yamal Peninsula, an epicenter of this commerce, is now emblematic of a globally integrated Arctic, complete with foreign direct investment from China and other non-Arctic nations. This is the new Arctic; an expanding and somewhat globally integrated Arctic economic system, supported by increased infrastructure development that stands in stark contrast to the lack of activity in America's Arctic.

The United States should take note of this growing Russian Arctic infrastructure network and its ever-growing relationship with Asian markets. Renewed interest in America's Arctic as a source of energy security has spurred conversation about the need for, and feasibility of, a year-round or seasonal energy and transit complex in Alaska. Although much work would need to be done, a public-private partnership may be of interest as the U.S. looks to secure its own energy sources and take advantage of vast liquid natural gas (LNG) reserves along Alaska's coast in an effort to meet growing demand from Asian markets. Yet, for LNG development and shipping to occur in and around Alaska, it must be economically feasible, safe, reliable, regulated, and have a significant Coast Guard presence.

The United States has a well-functioning Marine Transportation System (MTS), and it is at the core of the nation's economic prosperity. The Coast Guard maintains the safety, security, and efficiency of the MTS, promulgating and enforcing regulations that enable more than $5 trillion in economic activity per year. While challenging, an extension and variation of the MTS could be established in America's Arctic. The *Arctic Strategic Outlook* describes a similar model that would require an adaptation of MTS management tools, as well as innovative policies and technologies that are Arctic-appropriate. This can only be accomplished with the support and partnership of public and private sector entities and would be a tangible, actionable step the United States can take to prepare for future opportunities.

Additionally, the *Memorandum on Ocean Mapping of the United States Exclusive Economic Zone and the Shoreline and Nearshore of Alaska*, issued on November 19, 2019, provides encouraging steps towards expediting shoreline and nearshore mapping capabilities. Funding NOAA's National Ocean Service for a 20-year program to conduct hydrography and chart the U.S. Arctic EEZ would advance this effort, key to the development of an Arctic MTS.

4. Connectivity

There are many ways to describe connectivity in an Arctic context. We tend to think of connectivity in a telecommunications context, but we should consider a

broader application of the term to include digital and physical infrastructure. We do not have a digital or infrastructure gap in America's Arctic—we have a digital and infrastructure abyss. This abyss is not just a Coast Guard issue to address, but a problem that jeopardizes our national, homeland, and economic security, and one that must be met by the collective and integrated family of federal agencies. To be clear, telecommunications and infrastructure in the Arctic requires a coordinated and leveraged approach involving governance and operational expertise from local, state, and federal entities.

Closing this abyss in the Arctic with respect to the Coast Guard will require innovative solutions that are flexible and scalable, coupled with persistent public-private investment. Joint efforts with local communities, state agencies, and other federal institutions—including scientific and research organizations—would result in more reliable and redundant communication and infrastructure solutions. As stated in the *Arctic Strategic Outlook*, these solutions should incorporate investments in, and funding for, "ice-breaking ships, such as the Polar Security Cutter, aviation assets, unmanned or autonomous systems, and trained personnel" capable of operating in the harsh, remote arctic environment. If these investments are not made, the United States will continually fall behind other Arctic and non-Arctic nations.

Moreover, the United States does not have a major deep-water port from Alaska's Dutch Harbor in the Aleutians to its shared northern boundary with Canada along the Beaufort Sea. This landscape spans the strategically important maritime boundary with Russia through the Bering Sea, Bering Strait, and Chukchi Sea. Without a viable deep-water port, or string of ports, in the American Arctic, commercial opportunities, search and rescue needs, and national security interests will not be realized. The 2020 National Defense Authorization Act once again includes language to advance one or more strategic Arctic ports. The United States must recognize and invest in the potential for dual-use facilities and capabilities in Alaska, starting with at least one multi-use port.

5. Communities

The people of Alaska, and more specifically the Indigenous peoples of Alaska, are on the vanguard of a changing, dynamic, shifting, thawing, and melting landscape. For many Alaskan communities the land is their life, their identity, their culture, and the source for most of their food. Nearly three dozen Alaskan communities have been identified by a 2009 Army Corps of Engineers report as being seriously threatened by environmental change and may need to be relocated, and this number is likely to grow. Stressed on many levels, these communities have adapted and thrived in this landscape for thousands of years, but the changes are happening too fast, too dramatically, and too unpredictably to navigate with any certainty.

Alaskan communities live at the forefront of environmental change, and face consequential risks that develop as a result of those changes. For them, an oil spill represents not just an environmental disaster but a threat to the

During Arctic Edge in February 2020, Canadian Army Master Cpl. Andrew Tyrrell, left, and Canadian Cpl. Sean Thomas troubleshoot a medium-range radar at Fort Greely, Alaska. Approximately 1,000 U.S. military personnel participated in the joint exercises. As the Arctic sees more commercial activity, the need for digital and physical infrastructure increases. Marine Corps photo by Staff Sgt. Anthony Kirby

stability of the ecosystems upon which their livelihoods, food security, and cultural identities depend. Continued engagement between the Coast Guard and Alaskan communities should be applauded and expanded through the Marine Safety Task Force initiative. In more than 100 Alaskan communities, the task force conducts safety and environmental protection missions, like surveying and checking bulk fuel storage facilities—a life-sustaining resource throughout the state's remote areas. As noted in the *Arctic Strategic Outlook*, "the Coast Guard has been part of life in many Arctic communities for over 150 years as a neighbor, law enforcer, and life saver. Alaskan Natives have been partners and teachers, and we continue to benefit from their traditional wisdom and deep understanding of the Arctic domain." Traditional knowledge will play a key role in the future viability of these communities and will be an important component of the Coast Guard's formulation of strategic, operational, and tactical decision-making.

6. Cooperation

United States' continued participation and leadership in the Arctic Council, the Arctic Economic Council, and the Arctic Coast Guard Forum is in our nation's interest. These entities shape and reinforce a rules-based governance structure for the Arctic. They help to identify and conduct research needed to understand, mitigate, and address the impacts of a warming Arctic while advancing sustainable development and stewardship. The Arctic and Antarctic regions are the only places, aside from the International Space Station, where the United States and Russia have an enduring, long-term cooperative relationship, even in times of high tension. Because the Arctic Security Forces Roundtable has been on hold since the Russian annexation of Crimea, the Arctic Coast Guard Forum plays a more important role in maintaining open lines of communication between the two countries.

Petty Officer 3rd Class Holly Hugunin, an inspector with Coast Guard Sector Anchorage, Alaska, talks with Kenny Morgan, a Morgan Fuels facility manager in Kalskag, Alaska, in May 2019, as part of Sector Anchorage's 2019 Marine Safety Task force initiative. The task force works alongside more than 100 Alaskan communities. Coast Guard photo by LCDR David Evans

It is important that on shared security concerns related to oil spill response, protecting marine living resources, shipping, and SAR, the United States continues to work collaboratively with Russia and the other Arctic nations. However, perhaps nothing highlights the potential for unforeseen conflict in the Arctic more than this summer's potentially disastrous meeting. The Russian Federation was conducting military exercises in international waters, more than 12 miles off the coast of Alaska in the Bering Sea, when it encountered domestic fishing fleets operating in the same area and within the United States' 200-mile EEZ. While details of the August 2020 incident weren't immediately made public, such an encounter will likely not be the last in a region of increased economic and geopolitical importance.

This encounter makes clear the need for open lines of communication. The Coast Guard must continue to shape and lead the efforts of the Arctic Coast Guard Forum, and play a key role in the future of the Arctic Economic Council as it encourages continued, sustained, and responsible development of the North. It must also engage, where appropriate, with the Department of State within the Arctic Council to advance United States' interests throughout the region.

7. Competition

The *Arctic Strategic Outlook* notes U.S. adversaries seek to weaken "the international order that underpins a free and open maritime domain." It also states that, "clear and universally held norms, coupled with transparency, can dissipate" the "cloud of ambiguity" under which they are operating.

When exploring the competitive dynamic in the Arctic between the United States, China, and Russia, we should consider each country's broader approach and national mindset. In the Arctic, as it does elsewhere, China plays the game "Go," characterized by a long-term, methodical strategy to exert influence and power in a calculated fashion. Meanwhile, Russia plays "Survivor," attempting to sustain an economy crippled by western sanctions, a declining population, and an overreliance on natural resource development for both domestic and international markets. Finally, the United States plays "Twister," attempting to balance its global leadership roles in the Atlantic Ocean, Pacific Ocean, Indian Ocean, South China Sea, Mediterranean Sea, Baltic Sea, and elsewhere, against the challenges presented by a new, accessible Arctic Ocean. These statements are not meant to be pejorative. Rather they are a reality of U.S. global importance and the challenges presented to the Coast Guard and Department of Defense when trying to address a new,

The heads of the eight Arctic nations' coast guards take part in the Arctic Coast Guard Forum academic roundtable at Coast Guard Base Boston in June 2016. The group signed a joint statement that established the framework for a multi-year strategic plan in the Arctic. Coast Guard photo by Petty Officer 2nd Class Patrick Kelley

competitive, and consequential region like the Arctic.

Presence, both operational and strategic, is critical to U.S. power projection in the Arctic region. The Coast Guard is the critical, visible leader in this area as it endeavors to perform its missions while countering new regional competition from both Russia and China. Yet, the Coast Guard has only one medium icebreaker, the Coast Guard Cutter *Healy*, that services the Arctic region, and one heavy icebreaker, the *Polar Star*, which is already well past its expected service life and serves our nation's interest in the Antarctic. Therefore, the *Arctic Strategic Outlook* highlights the need for six polar security cutters to more effectively carry out its array of current and future missions in both the Arctic and Antarctic regions. To be sure, the Coast Guard is but one of the nation's services that plays a key role in the new great power competition dynamic, but this role must be supported through strategic and assured funding to meet its service commitment to the nation.

In the Arctic, physical and political presence is mandatory. Presence produces influence. Presence enhances national and civil security. Presence enables and protects commerce. Commerce generates opportunities that transform "sustainable" communities into thriving communities.

The United States will not be well positioned to address the realities of a changing Arctic and shape the future of this region unless it creates a comprehensive, science-driven, fact-based, coordinated, and integrated national policy to navigate the Arctic's 7Cs. It is clear the Coast Guard's 2019 *Arctic Strategic Outlook* takes into consideration each interconnected component of the 7Cs framework and, with the support of the federal government to execute its strategy, will be in a far better position to support the nation's Arctic ambitions.

Editor's note: *This paper drew, in part, from previous Congressional testimony.*

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A New Arctic

Presenting new threats and demanding new platforms

by CAPT William Woityra
Commanding Officer
USCGC Polar Star
U.S. Coast Guard

Not long ago, the icebound waters of the Arctic were of limited interest to just about anyone outside of the Indigenous peoples living there and a small group of scientific researchers studying the region. In the past decade, however, the environmental and geopolitical conditions in the Arctic have been marked by rapid and unprecedented change. The United States, led by the Coast Guard, is acting swiftly and decisively to respond to these changing conditions and position ourselves for the new climatological and strategic realities of the region.

Since 2000, the coverage of ice in U.S. Arctic waters has diminished significantly, and these waters are increasingly ice free in the summer months.[1] Previously unreasonable, or otherwise high-risk activities, are now possible and increasingly common in the region. From a Coast Guard perspective, the responsibility of managing maritime safety, security, and stewardship in the region is made more difficult by media-fueled public misunderstanding of the risks of operating in the region. Such media accounts often fail to recognize the very real dangers of operating in high latitudes.

On June 9, 2020, the White House issued the memorandum "Safeguarding U.S. National Interests in the Arctic and Antarctic Regions."[2] The memo directs the Coast Guard to continue the acquisition of Polar Security Cutters with the intent of ensuring a persistent U.S. presence in the Arctic and Antarctic. It goes on to propose an expansion of the Coast Guard's ice operations mission[3] to include economic security. The memo defines this as "facilitation of resource exploration and exploitation and undersea cable laying and maintenance" that might be carried out by medium icebreakers augmenting the future fleet of heavy icebreakers, already designated as Polar Security Cutters (PSC).

This emphasis is an entirely consistent and well-advised response to the rapidly shifting Arctic climatological and geostrategic environment. The memo acknowledges the inadequacy and diminished operational capabilities of the Coast Guard's existing icebreaking fleet—the heavy icebreaker *Polar Star*, commissioned 1976, and the medium icebreaker *Healy*, commissioned in 1999—relative to current and emerging future mission demands. The actual fragility of the Coast Guard's icebreaking capability was revealed in August

Coast Guard Cutter *Polar Star* heaves in the ice in McMurdo Sound, Antarctica during Operation Deep Freeze 2020. Opportunities for navigation and maneuvers have developed and become more normalized allowing the Coast Guard to have better stewardship of the region. Coast Guard photo by Senior Chief Petty Officer NyxoLyno Cangemi

2020, when *Healy* suffered an electrical fire in a main motor which led to cancellation of all planned Arctic operations for the rest of the summer.[4]

"This casualty … means that the United States is limited in icebreaking capability until the *Healy* can be repaired, and it highlights the nation's critical need for Polar Security Cutters," Vice Admiral Linda Fagan, Coast Guard Pacific Area Commander, said. This incident, coupled with the presidential memorandum, certainly underscores the urgent need to recapitalize our national icebreaking fleet to address emerging threats in the Arctic and Antarctic.

The memo further demands an analysis of fleet size and composition, optimal domestic and international basing locations, and options to bridge the capability gap until the PSC fleet reaches full operational capability. These measures are an inspiring and welcome development from the White House, and have been well-received by congressional leaders and policy advisors that have persistently advocated for an enhanced U.S. presence in the Arctic.[5] A capable and reliable fleet of icebreakers is now a necessity for the United States and other Arctic nations in the dynamic geopolitical environment that is emerging from behind the retreating ice.

The demand for icebreakers and icebreaking today, as in the past, comes down to three main requirements for ships capable of breaking ice. The first requirement is couched in the strategic national imperatives of sovereign presence, sea control, and power projection. These are typically functions of the U.S. Navy, but, for icebound waters, have been ceded to the Coast Guard by an interagency memorandum of understanding since 1965. The second requirement for icebreaking is the safety, security, and stewardship of icebound waters—all responsibilities assigned to the Coast Guard in Title 14 of the U.S. Code. The third, and final, requirement for icebreaking is economic. Ships moving through icy waters need assistance transiting safely to keep the national economic engine running throughout the frozen months.

Resource exploration and development in ice covered waters also demands icebreaking. This responsibility also falls to the Coast Guard, based on President Franklin Roosevelt's December 21, 1936, Executive Order 752. While these economic functions have historically only been carried out in domestic waters, the new presidential memorandum seems to indicate that this icebreaking function will soon extend to Arctic waters.

The urgency of icebreaking platforms is based on nascent resource exploitation, increased vessel traffic, accelerating foreign government activity, and new rules and international agreements. The newly exposed Arctic resources include oil, gas, and living resources. Destinational and transit shipping traffic is increasing in the Arctic and has been matched by a marked increase in eco-tourist and major cruise expedition interest in the region. Other governments are staking claims in the Arctic and expanding their operational presence.[6] The United Nations Convention on the Law of the Sea

Coast Guard Cutter *Polar Star* navigates through pack ice in the Ross Sea, Antarctica, in 2020. Coast Guard photo by Senior Chief Petty Officer NyxoLyno Cangemi

The Coast Guard Cutter *Polar Star* ice rescue team following a training session in Antarctic waters during Operation Deep Freeze 2020. Nations around the world with Arctic real estate are training their militaries and have started or plan to start building Arctic-capable military vessels. Coast Guard photo by Senior Chief Petty Officer NyxoLyno Cangemi

(UNCLOS) allows nations to submit claims for exclusive economic rights to the resources on and below the seabed on their extended continental shelf. Russia; Canada; Norway; and Denmark, on behalf of Greenland, have already submitted hotly contested extended continental shelf claims to the United Nations Commission on the Limits of the Continental Shelf. Russia, famously, and symbolically, planted a Russian flag on the sea bed at the North Pole in August 2007.[7] The United States, having not yet ratified UNCLOS, is ineligible to submit a claim.[8]

As the physical, economic, and geopolitical environment of the Arctic evolves, every other maritime Arctic nation, including Russia, Canada, Finland, Norway, and Denmark either operates, has started construction, or plans to build armed military vessels capable of operating in Arctic waters.

Finally, the United States is subject to new agreements that govern our responsibilities in the Arctic, including the 2013 Arctic Aeronautical and Maritime Search and Rescue agreement, the 2013 Agreement on Cooperation on Marine Oil Pollution Preparedness and Response, and the International Maritime Organization's 2014 Polar Code.

In April 2019, the Joint Navy-Coast Guard Integrated Program Office awarded a contract to VT Halter Marine to build up to three new heavy icebreakers to defend U.S. interests and conduct Coast Guard missions in the Arctic and Antarctic. With Congressional funding secured, and the hard work of the Integrated Program Office, detail design of the PSC is well underway,[9] and its first scheduled operational deployment is to support Operation Deep Freeze in 2027. Its delivery is not a minute too soon, as it will eventually take the place of *Polar Star*, a ship commissioned in 1976 and designed with the latest and greatest technology the 1970s had to offer. *Polar Star* has accomplished amazing things for 40 years in the harshest, most unforgiving environment on Earth, but now is exactly the right time to invest in a fleet of icebreakers that will support national interests for the generation to come.

The PSCs will be purpose-built vessels, with military capabilities and systems, including Coast Guard damage control capabilities and survivability. They will be interoperable with the existing Coast Guard fleet and leverage the same training and qualification programs. The ships will have modern weapons systems

and a robust C4ISR suite, including multi-mode radar, to support maritime domain awareness and on-scene command and control in the Arctic, where long-range communications are difficult. They will have a flight deck and hangars capable of holding two MH-60 helicopters, as flight capabilities are crucial for search and rescue, ice reconnaissance, and over-the-horizon surveillance.

The PSC will have an 80-day endurance, especially important for operating thousands of miles away from the nearest port facility. It will be able to provide a sustained, persistent presence in the U.S. Exclusive Economic Zone, asserting U.S. sovereignty in the region and supporting Coast Guard missions.

It will also have accommodations for 180 crew and mission personnel, including aviation, dive, law enforcement, and science detachments. Since the Coast Guard provides the only icebreakers in U.S. federal service, the ship is being designed to support the widest possible array of missions for the interests of the whole of U.S. government from the outset.

Coast Guard Cutter *Polar Star* ice rescue personnel certifying the safety of sea ice before granting ice liberty. The new Polar Security Cutters will be able to continuously break ice over 6 feet (2 meters) thick, guaranteeing navigation capability through any ice-covered waters. Coast Guard photo by Senior Chief Petty Officer NyxoLyno Cangemi

The PSC will have multi-beam sonar for bathymetric analysis, and will be ready to collect environmental samples and data from the Arctic and Antarctic. By including these survey capabilities, the new icebreaker will be ready to support National Oceanic and Atmospheric, Office of Naval Research, and State Department requests to document and study the regions. As important as all of the other features, the ship will be able to continuously break ice up to 2 meters thick, guaranteeing access to any ice-covered water on Earth. Finally, this will be a new and sustainable vessel, with modern systems, and an expected service life of 30-plus years.[10]

Leading the acquisition, the PSC Integrated Program Office has been lauded for its accomplishments and success in accelerating an already tight schedule. The office's team was recognized by the Department of Homeland Security as the fiscal year 2018 Major Acquisition Program of the Year.[11] There are a lot of great icebreakers out there truly defining state of the art, especially some using Finnish technology, but none that can achieve our rigorously developed operational requirements. There is no question heavy icebreakers are expensive, in part due to the number of unique features described above, but they are an investment to safeguard our national security and the safety, security, and stewardship of American ports, waterways, and territory. This investment is long overdue, but we are quickly moving forward to correct that. We look forward to building these new platforms and deploying them to the ends of the Earth to help write the next chapter in the history of U.S. icebreaking.

About the author:

CAPT William Woityra is commanding officer of U.S. Coast Guard Cutter Polar Star. *He previously managed U.S. icebreaking policy at Coast Guard Headquarters (CG-WWM), and has completed a Fulbright Scholarship in Finland studying icebreaker design, operations, and management with the Finnish Transport Agency.*

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Complex Security Threats in a Changing Arctic

by Rebecca Pincus
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The situation in the Arctic has become volatile as physical, political, and economic changes collide. Beyond the environmental changes on the land and in the ocean, the reemergence of global power competition and the rise of new technologies are reshaping how humans interact with the region. These changes, dangerous if not understood and carefully addressed, are intensified by sharp swings in the global economy that affect demand for Arctic resources.

The United States, in conjunction with allies and partners around and beyond the Arctic, need to provide leadership and reassurance during this turbulent period.

Arctic Warming

The Arctic region is warming fast—twice as fast as the rest of the world. Permafrost, the permanently frozen ground found in the Arctic, is thawing and collapsing, endangering all kinds of infrastructure, from roads and runways to traditional ice cellars. Russia's massive Nornickel oil spill early in 2020 resulted from thawing permafrost leading to the collapse of an oil tank. Permafrost thaw also leads to coastal erosion, which is accelerated by stronger storms pounding Arctic coastlines that used to be protected by sea ice. Disappearing sea ice has its own set of consequences like making whale hunting increasingly dangerous for Indigenous communities. It also makes it harder for polar bears to hunt seals; walruses to find haul-outs to rest; and for all the other ice-reliant patterns of life that make the Arctic so unique.

The physical changes driven by Arctic warming have mixed economic impacts with some interests benefiting and others experiencing costs. Someone must pay to replace infrastructure threatened by thawing permafrost, or move villages that are eroding, or bolster search and rescue capacities. Consequently, a longer navigation season opens increased opportunities for maritime shipping and commerce, as well as lower-cost access to Arctic natural resources.

Economic Consequences

The economic changes taking place in the Arctic can be grouped into two categories:

- The increased use of the Arctic as a transit corridor as shrinking sea ice opens more space for navigation.
- The development of Arctic resources—hydrocarbons, minerals, ores, gemstones, rare earth metals, and other nonrenewable resources of the Arctic basin.

While Arctic fisheries are a potential third category, the Central Arctic Fishing Moratorium has tapped the brakes on these plans until a robust management scheme is in place.

Swings in the global economy also increase uncertainty in the Arctic. While the region contains large amounts of natural resources, many of them are distant from transportation infrastructure, and therefore require

A polar bear mom and cub cautiously navigate broken ice in October 2019. Arctic warming is causing sea ice to disappear and threatening animal life throughout the region. Photo courtesy of the Alfred Wegener Institute

significant investment to bring to market. Developing oil or gas fields or mines takes years of investment, which may be difficult to commit to during a time of global market volatility. Within a decade, global markets have been rocked, first by the 2008–2009 recession and then a global pandemic. In particular, oil prices have been on a roller-coaster ride. As the European Central Bank observed in 2012, "The recent episode of rapidly rising and falling oil prices appears to have been unprecedented in terms of both the speed and magnitude of the movements."[1] The COVID-19 pandemic again threw global markets into turbulence and it is not yet clear how resource prices will respond.

The Arctic region contains large amounts of natural resources but adequate funding and infrastructure stand in the way of transporting to the rest of the world. Market volatility over the last decade has made investing in this remote area unfeasible. pichitstocker | Adobe Stock

The Arctic Power Struggle

Increased economic activity in, around, and through the Arctic is taking place in the context of a great power struggle, which raises the stakes for all involved, especially Russia, China, and the United States, while the smaller Arctic nations are caught in the middle. While Russia has a core national interest in this unique region because of a resource extraction-based economy that will be increasingly centered on Arctic oil and gas, China's interest in the region's resources and shipping routes is not a top priority. But the Arctic is in the United States' backyard, and Alaska is of utmost importance both to the U.S. economy and homeland security.

Previously stable political and security arrangements in the region were the result of decades of careful diplomacy aimed at stabilizing the U.S.-USSR/Russia balance. It is no surprise that Arctic cooperation centers on environmental protection with one of the earliest examples being the 1973 Treaty on the Conservation of Polar Bears. Arctic cooperation was kicked into high gear by the 1991 Arctic Environmental Protection Strategy (AEPS), which grew into the Arctic Council in 1996. Environmental stewardship is a soft-politics area with high levels of shared values and low political stakes. The Nordic states played leading roles in formulating the AEPS and Arctic Council, and other multilateral forums, like the Barents-Euro Arctic Cooperation, in order to provide structure and dialogue to reduce Cold War-era tensions.

Small and medium-sized Arctic states are again emphasizing multilateral diplomacy and governance as a means of tamping down the risks of the current power competition, which is alarming the Nordic states. Generated by the Nordic states, a recent report on Nordic foreign policy called out Russia's disregard of basic human rights as well as China's departure from liberal democratic norms. But it also noted "question marks" about the future of the rules-based global order, observing that "The U.S. is more inward looking than ever since the end of World War II and is increasingly withdrawing from multilateral fora."[2] Continued U.S. engagement and leadership is important to countering this perception. This is particularly critical now because Russia will be taking the chairmanship of both the Arctic Council and the Arctic Coast Guard Forum from Iceland, the current chair, in the spring of 2021.

Technology's Influence

In some ways, the power struggle in the Arctic is playing out in terms of technology. New technologies have a variety of applications spanning civilian and commercial uses all the way to military applications. For example, 5G technology and fiber optic cables promise to close the critical communications gaps in the Arctic region, but also create intelligence vulnerabilities. Similarly, unmanned systems are proliferating in the Arctic. While unmanned aerial vehicles, unmanned underwater vehicles, and other platforms may provide important services in gathering environmental data, responding to emergency situations, and improving spill response, the technology can also be used in surveillance systems and unmanned weapons delivery systems.

China is leaping ahead in icebreakers. Having purchased its first, the *Xue Long* more than a decade ago, its second, domestically built icebreaker, *Xue Long* 2, entered service in 2019. Two more heavy icebreakers, one conventionally powered and the other nuclear powered, are under construction. Russia continues to build icebreakers to support commercial shipping along the Northern Sea Route, but has also begun to construct armed icebreakers for both the Russian Navy and Border Guard. The U.S. Coast Guard is also building icebreakers, although there is uncertainty about the final composition of the polar security cutter purchase.

Potential for Armed Conflict

Competitive dynamics are also evident in the military domain. Russia is engaged in a multiyear effort to push its defensive perimeter farther north to its Arctic coastline and islands. It is building and refurbishing military bases and airfields and installing new radar systems and area-denial weapons. Moscow is also increasing operations and exercise tempo in the Barents Sea. In response, NATO has also increased its operational tempo in the area. Additionally, the United States is also bolstering defensive capacity in Alaska, including stationing two squadrons of F-35s at Eielson Air Force Base and refurbishing the NORAD early warning system.

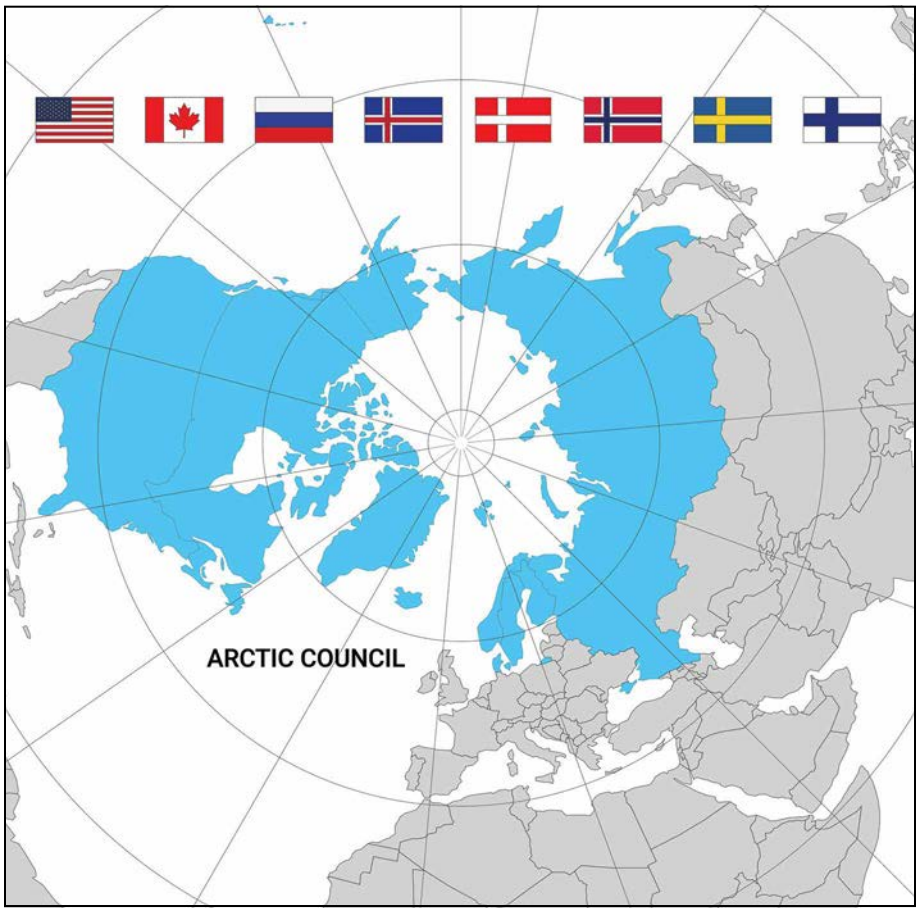
While threats in the Arctic run the gamut, the risk of outright kinetic conflict is low, though security risks remaining below the level of conflict are present and growing. However, crises could spin up into conflict, whether out of an environmental or human disaster that escalates the situation, an economic competition, or an unintended accident during the course of military exercises. The likely trajectory of unintended escalation in the Arctic puts the U.S. Navy, Coast Guard, and Air Force at the forefront. In recognition of this reality, these three services have all recently released Arctic strategies to inform and guide behavior.

U.S. Military Strategy

While the Navy, Air Force, and Coast Guard Arctic strategies largely align, the differences in how the services think about and define risk and conflict reveals their different operational and mission identities. The Navy's strategy notes that "nations have demonstrated the ability to resolve differences peacefully," in the Arctic and underscores the unlikeliness that any of the eight Arctic states would risk a large-scale conflict.[3] The Navy is facing many competing demands for presence, particularly in the Indo-Pacific region, and recognizes that high-end warfare in the Arctic is unlikely.

The Air Force's strategy describes the Arctic as "a region of strategic opportunity" and concludes that the changes occurring in the region create "potential for intensified regional competition as well as opportunities for cooperative endeavors with allies and partners."[4] The service also recognizes the growing importance of the Arctic to space and the importance of Arctic locations to detecting and responding to next-generation missile technology, including hypersonics.

The Coast Guard is a key actor in preparing for many types of Arctic security threats and in shaping the international environment to prevent escalation of risk. Its *Arctic Strategic Outlook* describes the region as "a strategically competitive space" and focuses on the importance



Evolving from the Arctic Environmental Protection Strategy in 1996, the Arctic Council addresses issues faced by Arctic governments and Indigenous people. As the region becomes more open and a power struggle brews over territory and resources, the Council will continue to have an important role. George_Skr | Shutterstock.com

Coast Guard Research and Development Center (RDC) personnel test an unmanned maritime system from the Coast Guard Cutter *Healy* in the Arctic in July 2017. The RDC tested this and other unmanned systems that have the potential to be force multipliers for the Coast Guard, supplementing forces and providing increased maritime domain awareness in the region. Coast Guard photo by Petty Officer 2nd Class Meredith Manning

of preventing conflict while pursuing U.S. objectives.

"As the only U.S. Service that combines both military and civil authorities, the Coast Guard is uniquely suited to address the interjurisdictional challenges of today's strategic environment by modeling acceptable behavior, building regional capacity, and strengthening organizations that foster transparency and good governance across the Arctic."[5] From a mission perspective, the Coast Guard is an organization aimed at defending national interests at and, mostly below, the level of war. In this role it is crucial in the Arctic because there, the United States seeks to manage growing risks and prevent disagreements from rising to the level of conflict to maintain healthy, rules-based competition.

Conclusion

In the Arctic, the intersection of physical, political, and economic change, as well as many new actors, creates turbulence and uncertainty. U.S. participation in multilateral governance organizations is important and leadership, through the Coast Guard and others, like NOAA, NSF, and other science agencies, will be a key ingredient to provide consistency, reassurance, and clarity.

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Dr. Rebecca Pincus is an assistant professor in the Center for Naval Warfare Studies' Strategic and Operational Research Department at the U.S. Naval War College. Her areas of research lie at the nexus of national security and the natural environment, and her current research interests center on the strategic implications of an opening Arctic, including for the North Atlantic/GIUK region and the Russian Arctic. Dr. Pincus previously served as primary investigator at the U.S. Coast Guard's Center for Arctic Study and Policy. She was a Fulbright Fellow in Iceland in 2015 with the Icelandic Ministry of Foreign Affairs, also working closely with the Icelandic Coast Guard and teaching at the University of Iceland.

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The "Cold" War

International and domestic ramifications if America stakes a claim to the extended continental shelf

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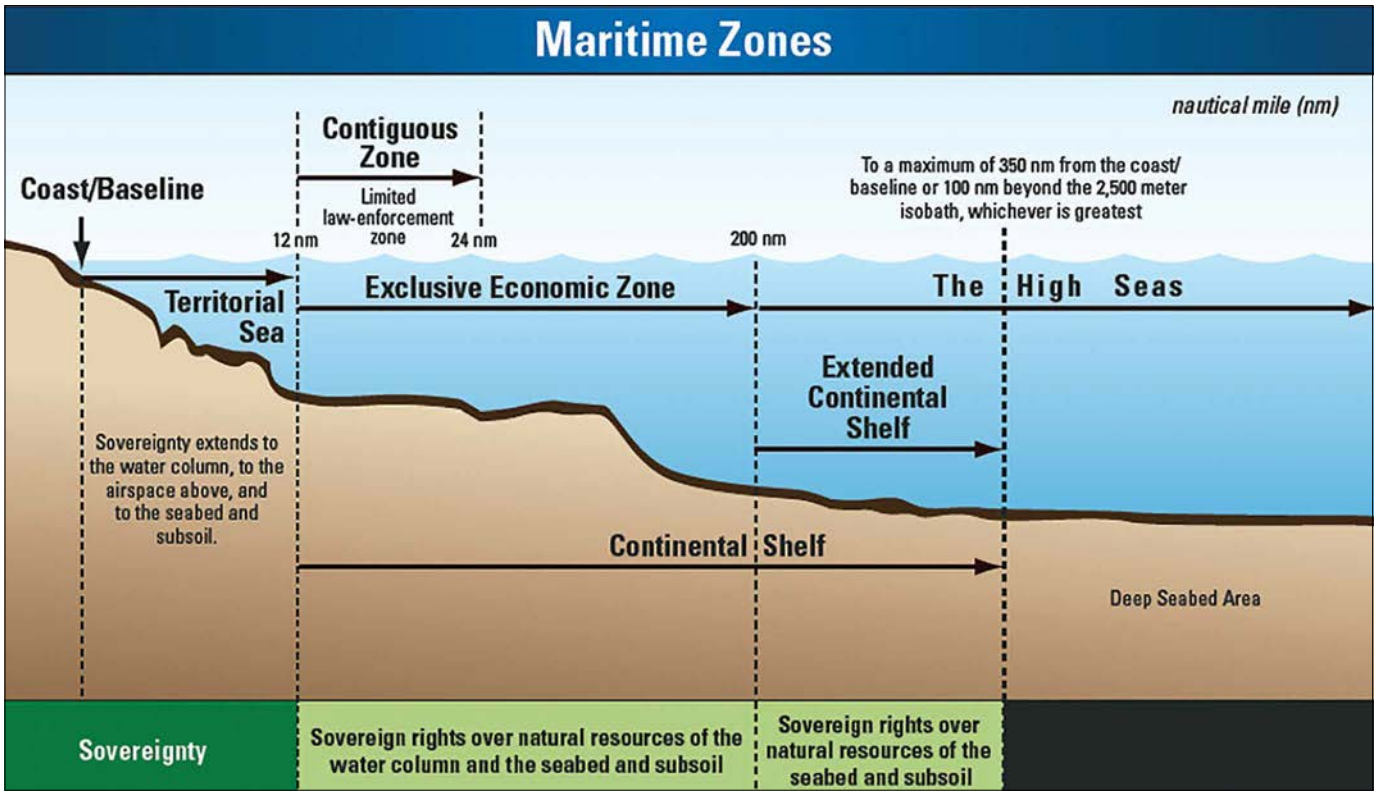
The United States has a vested interest in making claims to maritime boundaries in the complex Arctic region. However, as other countries, all signatories of the United Nations Convention on the Law of the Sea (UNCLOS), seek to establish a footprint in the region, the uncertainty surrounding U.S. policy could result in various outcomes. This article analyzes these outcomes based on the ratification of UNCLOS, using precedent to project the impact of a potential U.S. claim to the extended continental shelf (ECS).

Like the Cold War of the 20th century, every policy decision, or non-decision, made by the United States will have cascading domestic and international implications. Referring to the Soviet Union, President Ronald Reagan said, "Only as partners can we hope to achieve the goal of a peaceful community of nations."[1] In that same 1982 speech he questioned the path forward asking, "How should we deal with the Soviet Union in the years ahead? What framework should guide our conduct and our policies toward it?"

American leadership previously emphasized cooperation with Russia and the other Arctic nations. Like



Under the United Nations Convention on the Law of the Sea, the continental shelf is that part of the seabed over which a coastal state exercises sovereign rights with regard to the exploration and exploitation of natural resources. These resources can include oil and gas deposits, as well as other minerals and biological resources of the seabed. The legal continental shelf extends out to a distance of 200 nautical miles from its coast, or further if the shelf naturally extends beyond that limit. Courtesy of the NOAA Office of Ocean Exploration and Research

the physical geography of the Arctic, the rhetoric has changed. Referencing the importance and the accomplishments of the Arctic Council in 2019, former Secretary of State Mike Pompeo said, "We face a new era of challenge in the region. Now is the time for increased vigilance and increased partnership and even more courage."[2]

Notably, Secretary Pompeo went on to challenge both Russia and China on their increasing dominance in the region. President Reagan's unanswered question resonates today. What framework should guide U.S. conduct in the Arctic? More specifically, does the United States benefit by ratifying UNCLOS, or does it continue to operate purely under customary international law?

In a world of modern technology, detailed satellite images, and a globalized economy, the Arctic region remains uncharted in many respects, including geographically, economically, and legally. The earth's changing climate has created a maritime landscape that fluctuates from year to year. By virtue of being on the top of a round ellipsoid, the Arctic is surrounded by eight unique nations, each pursuing its own agenda. Because this region is unique and the geography previously inaccessible, there are competing desires to fill the power vacuum in this "last frontier." Eight nations, as well as several concerned parties, are jockeying for legal position to ensure their individual and collective goals are met. These constant changes mean the United States is at a crossroads for asserting its territorial claim.

The United States' maritime claim to the Arctic regions exists as an extension of the state of Alaska, which boasts an exclusive economic zone (EEZ) larger than the rest of the United States' EEZ territory combined. Beyond the EEZ, which extends 200 nautical miles (nm) from the baseline, Article 76 of UNCLOS permits a state to claim an extended continental shelf up to 350 nm if there is a "natural prolongation of the land territory." This extended continental shelf claim exerts a sovereign right to explore and exploit the natural resources of the continental shelf including oil, gas, and minerals, found in the soil and subsoil. These claims matter because, per a 2008 study by the U.S. Geological Survey, there is an estimated 90 billion barrels of undiscovered conventional oil resources north of the Arctic Circle, as well as 30 percent of the world's undiscovered conventional natural gas reserve.[3] Based on the figures above, the U.S. would claim not only a spot along a viable shipping route, but have energy resources beyond those of the Gulf of Mexico. Considering the Arctic is bursting with economic potential, and is also the most direct route between several of the world's most powerful nations, the United States has a vested interest in planting its proverbial flag. To do so, however, there must be formal ratification of the legal framework in place, or the nation may face the ramifications of operating outside of it.

A Historical Perspective from the United Nations (U.N.) notes that, until 1958, maritime international law on the open ocean was historically recognized through customary international law. That year, the international community held the first of three major conferences to develop UNCLOS as we know it today. The third conference convened in 1973 and concluded nine years later with the Convention on the Law of the Sea approved and open for signature shortly thereafter.[4] UNCLOS' stated purpose is to establish a "legal order for the seas and oceans which will facilitate international communication, and will promote the peaceful uses of the seas and oceans, the equitable and efficient utilization of their resources, the conservation of their living resources, and the study, protection, and preservation of the marine environment …"[5]

There are currently 168 parties to the Convention, though the United States is not one of them. However, in 1945, President Harry S Truman unilaterally established that the United States exercised sovereign rights over the

In late 2017, the Bureau of Safety and Environmental Enforcement approved ENI U.S. Operating Company Inc.'s request to conduct oil drilling operations on the Outer Continental Shelf. The exploratory well was drilled from a man-made artificial island in the Beaufort Sea off the northern coast of Alaska. Courtesy of Bureau of Safety and Environmental Enforcement

continental shelf, stating the nation "regards the natural resources of the subsoil and sea bed of the continental shelf beneath the high seas but contiguous to the coasts of the United States, subject to jurisdiction and control."[6] He also noted that in "cases where the continental shelf extends to the shores of another state, or is shared with an adjacent state, the boundary shall be determined by the United States and the state concerned, in accordance with equitable principles."[7]

UNCLOS, Article 76, Definition of the Continental Shelf, Section 1, states:

> *"… as the seabed and subsoil of the ocean "that extend beyond its territorial sea throughout the natural prolongation of its land territory to the outer edge of the continental margin," or "200 nautical miles from the baselines from which the breadth of the territorial sea is measured where the outer edge of the continental margin does not extend up to that distance."*

Former U.S. Secretary of State Michael R. Pompeo, front row, fourth from the left, participates in the Arctic Council Minister Meeting in Rovaniemi, Finland, in May 2019. Arctic nations as a whole face some uncertainty as political and natural circumstances evolve around managing the Arctic region. Department of State photo by Ron Przysucha

However, the idea of an extended continental shelf existed well before the formation of UNCLOS or the subsequent Commission on the Limits of the Continental Shelf (CLCS), established as a body within the U.N. Its purpose is to "facilitate the implementation of the United Nations Convention on the Law of the Sea (the Convention) in respect to the establishment of the outer limits of the continental shelf beyond 200 nautical miles (M) from the baselines from which the breadth of the territorial sea is measured."[8]

Set forth in Article 3 of Annex II, the functions of the commission are to consider submissions by coastal states concerning the limits of the continental shelf in areas where those limits extend beyond 200 nautical miles. Additionally, by providing recommendations, as well as technical and scientific advice, it assists coastal states in the preparation of ECS submissions. For a state to claim ECS, it must either establish the boundary based upon distance from its baseline, or upon the slope of the continental shelf as a prolongation of its territory.

The distance claim is relatively straightforward. A state simply proves the area claimed lies within 200 nautical miles from its baseline. The claim based upon the slope of the continental shelf is more difficult to prove because it requires scientific data, geomorphology, seismic imaging of the seafloor, and external acceptance. Therefore, it is more susceptible to challenges from the international community.

Arctic nations, and others with interest in the region, have also used international agreements inside and outside of the UNCLOS to dictate sovereignty. For those who have ratified UNCLOS, the CLCS can make "recommendations to coastal states" which, if accepted, then become binding. Note, however, that the CLCS is a commission made up of scientific and technical experts, and does not have judicial powers. Recommendations only become "final and binding" for a state who is both a party to UNCLOS and who bases its claim to the limits on the continental shelf on the commission's recommendations.[9]

Precedent from previous CLCS decisions, as well as those of the International Court of Justice (ICJ), the principal judicial body of the U.N., indicate some possible outcomes if the United States submits a claim under UNCLOS. In 1969, the ICJ adjudicated two cases involving the Federal Republic of Germany versus the Netherlands and the Federal Republic of Germany versus Denmark.[10] The cases centered around disputes involving the delimitation of areas of the continental shelf in the North Sea for access to natural resources, including oil. The court identified that the equidistance principle in the first UNCLOS agreement had not met the requirements to be considered customary international law. They acknowledged some instances where states not party to the UNCLOS treaty used equidistance, but said this may not be sufficient alone. The ICJ held that, despite equidistance being a previously stated determinative factor, per the UNCLOS definition at the time, the countries must do what is generally fair. Equitable principles derive from sovereign equality because it requires

both states to consent to the result. States must negotiate amongst themselves to determine what is fair.[11]

So, consider *Nicaragua v. Colombia*, decided by the ICJ in 2012, to determine how ECS claims are evaluated in accordance with UNCLOS. Nicaragua filed a territorial maritime dispute against Colombia concerning a series of legal claims, including one for delimitation of a continental shelf extending beyond 200 nautical miles.[12] On page 666 of that decision, the court held that, despite Colombia not being a party to UNCLOS, Nicaragua had not established that it had a continental margin that went far enough as to encroach on Colombia's 200 nautical mile EEZ. Because Colombia was not a state party to UNCLOS, customary international law applied. Separately, however, they acknowledged, "Article 76, Paragraph 1 of UNCLOS forms part of customary international law."

Also consider the dispute between Bangladesh and Myanmar concerning the delimitation of their maritime boundary, the International Tribunal on Law for the Law of the Sea (ITLOS) extended the rationale of the ICJ in the North Sea cases, under the framework applied in the South American dispute. There, ITLOS considered that UNCLOS parameters "embodie[d] the concept of a single continental shelf" without any distinction acknowledging that the shelf had a limit of 200 nautical miles.[13] Regarding their jurisdiction to determine a boundary, ITLOS held that a state's entitlement to the ECS exists "by the sole fact that the basis of entitlement, namely sovereignty over the land territory, is present. It does not require the establishments of outer limits." Extrapolating the state's inherent right to the ECS, irrespective of the default 200 nautical mile limit, this judgement implies that a state holds that right, separate from such a determination by a judicial body or commission, such as the CLCS. The CLCS only exists as a way to strengthen the ECS claim against other states.[14]

The steadily changing Arctic environment and the region's untapped natural resources have created the potential for a power struggle among the Arctic States over extended continental shelf claims. olinchuk | Adobe Stock

In the Arctic, Russia provides an initial example of an ECS claim and submission to the CLCS. In 2001, Russia submitted claims to the continental shelf in the Barents Sea, encroaching on a potential claim from Norway; and the Bering Sea, encroaching on a potential claim from the United States. Russia also claimed the Lomonosov Ridge as an extension of the Russian ECS. The CLCS neither accepted nor denied the request, recommending instead that Russia resubmit the request with more robust scientific data. In 2007, Russia resubmitted their ECS claim with additional scientific data on the Siberian continental plate. Denmark and Canada have also submitted ECS claims, each claiming the Lomonosov Ridge is an extension of their own territorial jurisdiction.[15] Russia submitted a revised claim in 2015, but the CLCS has not made a recommendation on the Lomonosov Ridge. All of these complicated claims and conflicts exist separate and apart from any potential ECS claims made by the United States, but may play a role in the future of Arctic geopolitics.

With CLCS and ICJ precedent, in

context with the current geopolitics of the region, a U.S. claim may cause unintended ripple effects to domestic policy and international partnerships. However, if the United States ratified UNCLOS, it could file a "legitimate" claim, meaning the claim would be strengthened as it pertains to any potential conflicts with other Arctic nations. Ratifying UNCLOS would also provide a venue to properly refute potential overreach claims from other nations, like Russia's claim to the Lomonosov Ridge, for example. Beyond the surety of the system to support an ECS claim, ratifying UNCLOS would validate maritime enforcement. It would also provide assurances to international maritime partners that the United States is operating on the same playing field—an important sentiment to promote peaceful cooperation in the Arctic region.

However, should the United States not ratify UNCLOS, an ECS claim may still be respected in accordance with customary international law. Domestically, U.S. maritime law already functions in accordance with UNCLOS, and thus the Coast Guard, as the nation's maritime law enforcement branch, would have the authority and jurisdiction to continue to assert sovereignty in this region. Regardless of the political justifications for not ratifying UNCLOS, were the United States to make an ECS claim, based on the geomorphology and geography of the Arctic region, many of the limits would not border the international seabed area, but rather existing states like Russia or Canada.[16] The United States has effectively functioned outside the signature-based confines of UNCLOS since its inception, and could continue to do so via bilateral or multilateral agreements. The precedent from ITLOS suggests states have an inherent right to their ECS and, so long as they have the valid data to establish such a claim, can do so without CLCS validation.

Were the United States to make an ECS claim without becoming a party to UNCLOS, it can point to customary international law for validation. While not signatory, the United States recognizes UNCLOS as customary international law.[17,18] Emphasizing the ICJ's rationale in North Sea cases, the United States can rely on customary international law and the precedent of equitable solutions to outweigh specific verbiage in the UNCLOS treaty. If the United States does make a claim, there is the risk of challenges from neighboring countries, of negative precedent from the ICJ, and the threat of throwing existing agreements into legal limbo. The sovereignty of the United States' ECS might be challenged as have the actions in the South China Sea. A domestic response to maintain domain awareness would require additional maritime assets in a region still marked by inhospitable conditions. This could lead to an escalation in tensions and further destabilize the region.

The fluid geography and the potentially lucrative economic benefits of the Arctic create a need for measured and equitable responses for all parties involved. As members of the Arctic Council collaborate and other nations, like China, attempt to make room at the table, the region is fast approaching a procedural "diplomatic gridlock."[19] This is where policy decisions, and even non-decisions, will become a part of history that shapes the Arctic.

Editor's Note: *This article was submitted to the faculty of the Marshall-Wythe School of Law at the College of William & Mary in partial satisfaction of the requirements for the Doctor of Jurisprudence degree. The views expressed herein are solely those of the author and do not reflect the official positions of the Department of Homeland Security or the U.S. Coast Guard.*

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Stepping Stones to a Secure Arctic

Strategic importance of arctic island chains grows in lockstep with rise in polar temperatures, state rivalry

by Barry Scott Zellen, Ph.D.
Class of 1965 Arctic Scholar
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The maritime security and geopolitics of islands, island chains, and archipelagos—and the distinct political geography they categorize—undergirds and reinforces much strategic thinking with regard to emerging zones of maritime and naval competition around the world. In our era of polar thaw, this is especially true in the Arctic where a wide range of systemic changes have transformed the region, fostering its reconnection to the world ocean.[1]

Island Chains and International Security

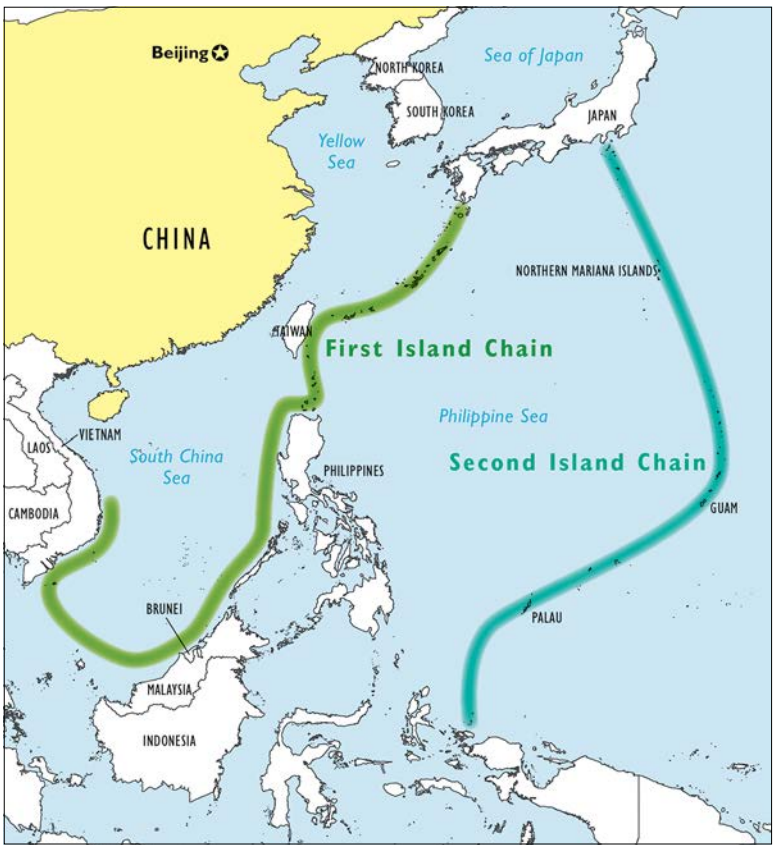
By understanding the geopolitical significance of these marine structures, and their enduring importance to a stable world order, we can better contextualize the emerging strategic importance of Alaska and adjacent areas across the Arctic region. This understanding also applies to other remote regions in the world where the security and alliance integration of isolated islands, island chains, and archipelagos bears a striking similarity to the security challenges facing the circumpolar north.[2]

Much attention has been paid to island chains in discussions of Chinese naval strategy in recent years, as the People's Liberation Army Navy continues its evolution from regional brown water fleet to blue water naval power.[3] This has been galvanized by Beijing's ongoing fleet modernization and naval expansion from its proximate first island chain[4] out to the more distant, mid-Pacific third island chain.

Unsinkable Aircraft Carriers and Contested Regions

Punctuating the world ocean much the way frontier forts punctuated the American West, Taiwan is more than a network of "unsinkable aircraft carriers,"[5] as famously described by General Douglas MacArthur during the early Cold War. The term has been applied to a diverse constellation of strategic islands including Britain, Malta, Iceland, the Aleutians, Japan, and Singapore. It was applied to myriad South Pacific island and atolls during World War II and the Cold War, and to the many islets of the South China Sea fortified by Beijing in recent years.

These unsinkable aircraft carriers provide essential



China's military strategists are increasingly including two island chains in their maritime perimeter. The first includes Borneo, Taiwan, Okinawa, and Kyushu, while the second extends from Eastern Indonesia to Japan's main island of Honshu via Palau, Guam, the Northern Marianas, and Iwo Jima. Department of Defense map

forward offshore supply depots; safe harbors for repairs, recovery, and maintenance; and air strips for power projection and over-the-horizon air defense. These define a strategically advantageous zone for persistent presence, force resilience, and effective control of surrounding air and sea space as central to recent Expeditionary Advanced Base Operations strategies as they were to our island-hopping efforts in World War II.[6]

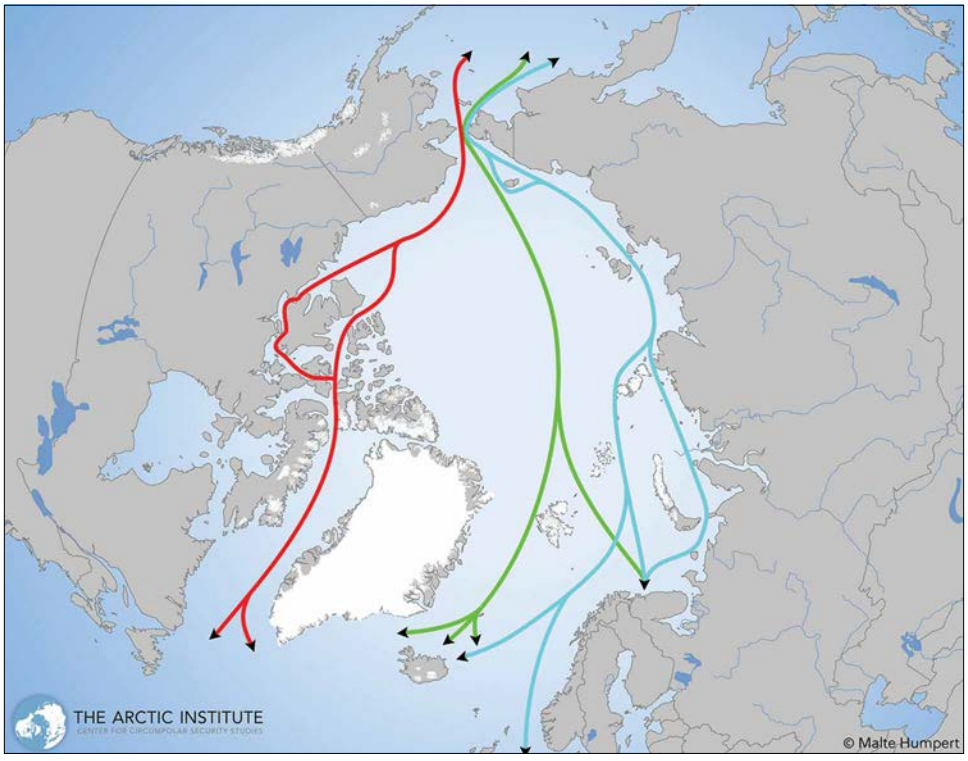
A modernized version of the offshore coaling stations central to Mahanian naval strategy, well-defended islands and archipelagos can be costly to neutralize during war. In times of peace, they become *de facto* zones of unrivalled economic, diplomatic, and political influence, and stepping stones toward further strategic expansion. This importance of island and archipelagic control to larger states' abilities to project military power, defend trade routes, assert diplomatic influence, and contain regional rivals explains why Beijing has fortified so many islands and archipelagic clusters. This is evident from its "Great Wall of Sand"[7] in the South China Sea to its "String of Pearls" arcing across the Indian Ocean. Indeed, Moscow has done much the same to its own chain of Arctic islands immediately north of Russia's mainland.[8]

That both major powers, and leading rivals to western influence, sense this same vulnerability and opportunity suggests Beijing and Moscow share a view of geopolitical theory and its intersection with naval strategy. As cognizant of this geopolitical view now as it was during the Cold War, the West is moving to counterbalance. This also explains why the White House, amidst its many pressing challenges, has mustered the renewed energy, foresight, and policy attention to reassert and clarify its polar interests, as expressed in its June 9, 2020, memo on Arctic security.[9] The re-opening of an American consulate in Nuuk, Greenland, for the first time since 1953 preceded this memo by just one day. Only a year before, the White House briefly floated an unsolicited bid for sovereign acquisition of Greenland from Denmark, which Denmark quickly rejected.[10] Around same time, it committed over a billion dollars in funding for its long-anticipated icebreaker modernization program. Appropriate to the increasingly contested Arctic region, it's known as the Polar Security Program—providing a robust, mobile platform for sovereign assertion from Alaska to the North Pole.[11]

Irregular Strategic Polygons and Invisible Fault Lines

There has been much recent discussion of a triangular strategic competition[12] in the Arctic between the United States on the one hand, and Russia and China on the other. The latter pair of rivals are widely perceived to have the advantage of momentum, while the States' plays catch-up. In her seminal Spring 2020 *Strategic Studies Quarterly* article, National War College professor Rebecca Pincus explains that the "Arctic is an important locus for great power competition and triangular balancing between the US, China, and Russia. It is what political science professor Rob Huebert has dubbed the 'New Arctic Strategic Triangle Environment.'"[13]

Huebert's "New Arctic Strategic Triangle Environment" is an elegant concept, rooted in a tripolar diplomatic dialectic predating President Nixon's historic 1972 overture to Mao's China, realigning American and Chinese strategic interests after an earlier Sino-Soviet alignment. The reality of Arctic geopolitical competition is much more multiangular, multilevel, and asymmetrical. It is more accurately visualized as an irregular strategic polygon with a dynamic mix of largely stable bilateral



As the Arctic continues its historic thaw, proposed shipping routes will start to call into question national sovereignty for Arctic states. Graphic courtesy of The Arctic Institute

and multilateral interstate relations. To this is added the complexity of an overlapping, but largely invisible to outsiders, set of internal and transnational fault lines of conflict, yielding a diverse but largely collaborative group of predominant stakeholders. This includes Arctic and non-Arctic states, inclusive of their national, regional, and local governments and major economic actors; Indigenous peoples' organizations, some holding regional and local governing powers; and numerous issue-specific NGOs. The end results are dynamically shifting alignments of interests and a complex patchwork of governing systems with extreme variance and volatility over time, yielding a complexity that eludes easy explanation or simple strategic statement.[14]

While triangularity may elegantly describe one of the many salient levels of analysis in Arctic geopolitics, this trinity of states comprised by the United States, China, and Russia is anything but equal when it comes to relative power and influence in the Arctic. Without Arctic territory of its own or a seat at the Arctic Council's table as an observer state, China is, in the most important ways, not even a significant player. This stands in marked contrast to Russia, whose Arctic territories are the world's largest, or the United States, which with its Arctic NATO partners Canada, Denmark/Greenland, Iceland, and Norway, presents a formidable and united bloc. It is along these sovereign shores that all proposed marine shipping routes in a warming Arctic will pass. Indeed, as the Arctic continues its historic thaw, its archipelagic nature becomes increasingly apparent.

Colonial States and Sovereignty by Proxy

A triangular strategic rivalry pitting Washington's interests against the alignment of those of Moscow and Beijing presumes an inherently Westphalian nature of the Arctic states. But this is far from the case in much of the Arctic, where most of the states are not unitary nation-states, but instead independent, one-time colonial states. These were cobbled together in earlier centuries by unitary states of the Westphalian core that expanded across the seas, leaving Indigenous peoples and their local governing structures largely intact and enabling colonial rule via local proxies. This, in turn, preserved the prior power relationships of the precolonial world, whether sultanates, caliphates and emirates of Eurasia's rim, or the tribal polities of the Americas, that would be successfully leveraged in the interest of ascendant colonial powers. Because of this defining feature of Arctic states, a lingering fault line is the internal divide between center and periphery, with settler elites in command of the state apparatus to the south, and Indigenous communities in the remote hinterland. The latter have been gradually regaining self-governing powers, with the exception of Iceland, which was settled prior to the arrival of the eastward migrating Inuit, leaving this one Arctic state a truly unitary Westphalian polity.

The Arctic without ice, though unlikely to be experienced before mid-century and then only temporarily, reveals a maritime domain defined by islands, archipelagos and increasingly strategic island chains comparable to the Pacific and Atlantic. Pyty | Shutterstock.com

Understanding this internal dynamic, and achieving a stable balance of interests through inclusive and respectful policies of native inclusion, enrichment, and, empowerment may be of momentous consequence in the event of external agitation by a non-Arctic state. This historic struggle for the human terrain of the Arctic is thus of great importance to the future stability of the region. It requires forward thinking investment, respectful relationship-building and sustainment, and a continuous process of confidence-building measures to ensure that the legitimacy of the rule of the sovereign states of the Arctic remains intact and uncontested. Otherwise, a foreign interloper such as China could destabilize the status quo. Because many socioeconomic challenges face northern villages across the Arctic, this is a potential vulnerability that an external power could seek to exploit—and, some argue, has already become a target for exploitation by Beijing. These Indigenous homelands have been imperfectly integrated with the political economies of the Arctic states, despite much progress and effort in recent years, and "Fourth World" challenges persist, eclipsing those of the Third World. This remains a near universal fault line across the Arctic that challenges the seven Arctic states that have Indigenous populations engaged in ongoing processes of cultural renewal, economic development, and the restoration of land rights.

Progress on this front has varied greatly by region

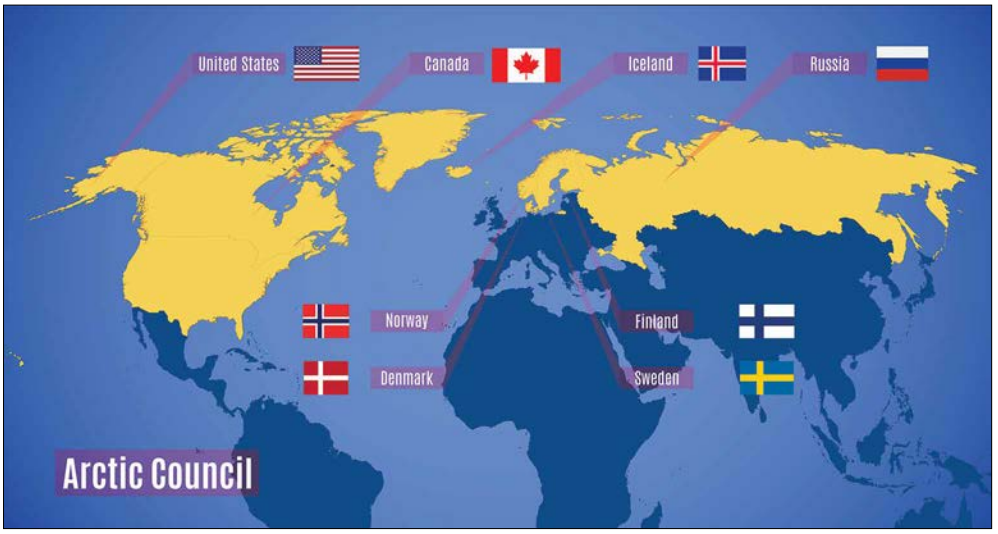
and by state, offering an opportunity, albeit an uneven one, that differs greatly across the Arctic, for external exploitation. Russia has, in recent years, mastered the art of hybrid warfare, as demonstrated in its persistent but low-level interventions along the arc of what it once referred to as its "near abroad,"[15] with particularly effective results in Crimea. And Beijing has similarly deployed "checkbook diplomacy"[16] to co-opt elites along the global network envisioned by its Belt and Road Initiative (BRI), including its northern component, the Polar Silk Road. But China has faced strong blowback against what the United States has successfully reframed as "debt-trap diplomacy."[17] And Russia's aggressiveness has generated a near-universal distrust, particularly by border states fearing they could become the next Crimea. Tactical blunders by both Moscow and Beijing, through clumsy and overconfident efforts to coerce smaller polities and peoples, have blunted their capacity to project power into the Arctic. One exception, of course, is Moscow's own Arctic territories and waters where its sovereignty remains uncontested, but where it remains behind its democratic Arctic counterparts on reconciling state and tribal interests.

Universalizing Indigenous Empowerment

Intriguingly, the strengthening alignment of interests between Indigenous peoples and their sovereigns across the non-Russian Arctic from Alaska to Finland can provide the democratic Arctic with an advantage over Russia. Indeed, Moscow's own native peoples remain marginalized; with many Indigenous leaders in exile, their lands and resources remain encroached upon or expropriated, and their homelands threatened by outside interests.[18] One can even imagine the democratic Arctic states mastering the art of hybrid warfare, just as many, by necessity, re-mastered the art of counterinsurgency warfare during the long Global War on Terror.[19]

By turning the tables on Moscow, the democratic Arctic can win the battle for the hearts and minds of Russia's own oppressed native peoples. To some degree, this is already underway with the warm diplomatic reception enjoyed by Russian Indigenous leaders in Arctic institutions like the Arctic Council, where Indigenous organizations enjoy a distinct membership status as Permanent Participants (PPs). PPs are second only to the founding member states—the Arctic 8—and are superior in power to the many observer organizations and states, among which China is included. Russia may already be realizing its security can be strengthened by achieving parity with its democratic counterparts on the Arctic Council in the area of native rights and empowerment. This is reflected in its latest Arctic strategy extending through 2035, which devotes significant and unprecedented attention to Indigenous issues. If Moscow continues in this direction, Arctic collaboration can be strengthened, further eroding the saliency of the strategic triangularity described above, and restoring the condition known as Arctic exceptionalism.

With its deep pockets, China may take the opportunity to retool its approach, shifting away from the naked power grab of debt-trap diplomacy and foster a more mutually beneficial model of Arctic economic development. This could reposition Beijing to more adeptly exploit any failures by the Arctic states to sufficiently support and re-empower their own Indigenous peoples, who are intimately aware of any unevenness in Arctic social, cultural, and economic development. A triumph by the democratic Arctic states is by no means guaranteed in the battle for Indigenous hearts and minds, but we still have many advantages over Russia and China. These could make it impossible for either rival to meaningfully undermine western influence in the region or to dilute the sovereignty we have over their respective Arctic territories. Thus, if there is indeed a new Cold War in the Arctic region, the home front in each of the Arctic states, where continued gains in native development are crucial, will be an important theater of engagement. But it is one where the United States and its allies have many opportunities and advantages to consolidate victory.



As the Arctic region opens up to more vessel and exploration traffic, Arctic states will be best served by joining together in regional policy decisions. WindVector | Shutterstock.com

Since the 17th century, the National Guard has provided first-line national defense, and the Scout Battalions of the 297th Infantry, Alaska Army National Guard, composed mostly of Inuits, continue this historic mission today across the vast Arctic tundra. Mort Kunstler depicts this in, "Guardians of the North." National Guard image

And to strengthen our Arctic sovereignty through more inclusive and effective governance, in partnership with the Indigenous peoples of the Arctic, as we achieved in the past with the Alaska Eskimo Scouts during World War II.

Of equal importance to securing the home front in any looming Arctic Cold War is maintaining control over the many islands, island chains, and archipelagos of the Arctic and adjacent gateway regions. These are of increasing importance to not only the security of the Arctic region, but to global stability and world order itself. It is true that much of the insular and archipelagic Arctic north of Canada's mainland is either lightly settled or unsettled. Where settled, the region remains haunted by complex histories of resettlement whose pain lingers generations later. This could provide a weakness for potential exploitation by China of otherwise recognized claims of Arctic sovereignty, much the way it exploited other such sovereign weaknesses in the South China Sea. In the latter, China fortified unoccupied islands adjacent to much weaker states that lacked effective means of asserting sovereignty against the rival claim. While in the former, the islands of Canada's High Arctic, like those off Russia's mainland or the sovereign and semi-sovereign island polities of the High North Atlantic, are internationally recognized. And Canada's Arctic neighbors recognize its claims just as Canada reciprocally recognizes the claims of its Arctic neighbors, with few, and largely insignificant, exceptions. It would thus be immeasurably harder for China to replicate its tactics as developed in the South China Sea. Indeed, doing so would almost certainly generate a universal rebuke from the entire membership of the Arctic Council, state and Indigenous alike, and lead to China's isolation—from not only the democratic Arctic states, but its partner-of-the-moment Russia. This is a consequence Beijing would find humiliating, and which would show the fragility of Beijing's current entente with Moscow.

And while China may seek to influence the loyalties of Indigenous communities across the Arctic through its

checkbook, such efforts will likely catalyze a renewed effort by the democratic Arctic sovereigns to invest in the development of their northern frontier communities. We saw this recently after China sought to assert itself in Greenland,[20] which ironically precipitated not only the 2019 White House overture to "buy" Greenland from Denmark, but a longer-term and more mutual diplomatic re-engagement between the United States and Greenland. This includes the June 10, 2020, re-opening of the U.S. consulate in Nuuk, an offer of direct U.S. aid to help Greenland battle the COVID-19 pandemic, and the resolution of a lingering base maintenance contract dispute at Thule. This suggests Beijing will ultimately have to accept its place in the Arctic order as an outsider, an Arctic Council observer state with maritime and commercial interests, but limited strategic, military, or diplomatic space for expansion.

A more concerted effort by the democratic Arctic states to court Moscow through existing international institutions like the Arctic Council and the Arctic Coast Guard Forum can greatly help toward this end. By strengthening ties within the Arctic states to their Indigenous communities, and their relationship with fellow Arctic sovereign, Russia, the members of the Arctic Council can greatly reduce the likelihood of experiencing a new polar Cold War. With long traditions of Indigenous engagement to build upon and a solid foundation for enduring intra-Arctic collaboration, active participants in the Arctic Council and Arctic Coast Guard Forum are well positioned to take the lead on these initiatives. While the Cold War divided not only the Arctic but much of the planet into competing military-diplomatic-economic blocs, today's world is much more integrated and thus much less likely to bifurcate again. The added unity fostered by the long, continuing processes of Arctic globalization and economic integration will ultimately trump whatever regional advantages China may seek. As much as Beijing may persist in its pursuit of such advantage, with continued unity among the Arctic states China will, in the end, emerge both humbled and disappointed by the results of its efforts.

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No Longer Protected by Our Isolation

by Julie Kitka
President
Alaska Federation of Natives

As president of the Alaska Federation of Natives (AFN), I have worked with a remarkable group of Native leaders, state and federal officials, and those in the private sector for many years to improve opportunities and resolve challenges faced by Alaska Native people in our homeland.

Representing more than half of the federally recognized tribes in the United States, regional tribal consortiums, and Native village and regional corporations, AFN has changed over the years. Once a loose federation of Alaska Natives leaders, it has evolved into a highly organized network of Native leadership and institutions governed by a 37-member board of directors representing all areas of the state along regional and village lines, as well as along Native institutional lines. Each October, AFN's three-day convention is attended by nearly 5,000 Native leaders who renew friendships and address current issues. To include others not able to attend the convention in person, the event is covered live via statewide gavel-to-gavel television, radio, and live-web-streaming for viewership internationally.

Our Vision

Alaska Natives have an important role in our country's national security. As the largest landowners in the state, representing nearly 20 percent of the population, we are a strong Indigenous community with growing capacity and capabilities. Prior to World War II, we were the majority population in Alaska. Today, we have networks and institutional capacities, having created and run many complex institutions including Native housing authorities, health corporations, tribal consortiums, and corporations. In many ways, we stand in the place of the federal government in areas which have little presence. We have strong and diverse traditional cultures that help our people adapt to rapid change and provide for the next generation. We have goals and aspirations for ourselves; the agency to act independently and in partnership with others; and value working with honorable people of good character.

When we envision military engagement in Alaska, it is with the goal of ensuring the we are not invisible to them, nor that we are seen see as dots on a map. Second, we want a respectful, trusting relationship. We want to align our strengths and capabilities with the military mission in Alaska because we recognize the military build-up here is occurring for a reason. The threats to our country are real and very complex. We understand that climate change, increasingly ice-free open waters and transportation routes, changing technology and communications, competition for trillions of dollars-worth of natural resources—including fish—and the national interests and aspirations of countries like Russia and China can lead to conflicts. The world has gotten smaller, and we are no longer protected by our isolation.

Background

Representing more than 170,000 Alaska Natives, AFN is the largest statewide Native organization. Organized in 1966, it brought the Native leadership together to secure a fair settlement of our aboriginal land claim rights. Land claims settlement legislation was moving through the Congress, driven in part by the discovery of the United States' largest oil field in Prudhoe Bay. To develop the bay, the government and interested companies needed clear title to the land, which was hindered by unresolved

Organized in 1966, the Alaska Federation of Natives brought Native leadership together to secure a fair settlement of aboriginal land claim rights. Graphic courtesy of Alaska Federation of Natives

Native land claims. On December 18, 1971, Congress enacted the Alaska Native Claims Settlement Act of 1971.

With this background, let me address three main themes:

1. The historic land claims settlement between the government and Alaska Natives occurred in 1971. It has been amended to address the real social and economic needs of Alaska Natives by each Congress since. It is called a "living law" and is the equivalent of a statutory treaty.
2. Among the government's tools are two effective models—compacting and contracting—to engage Alaska Natives in the larger economy or to access and provide essential government services. These models have done more to build capacity within Native corporations and tribal consortiums, under a shorter timeline, than any other approach. Implementation of our historic land settlement and massive investments of federal and state resources over several decades have changed the face of Alaska.
3. The rapid change taking place in the Arctic includes the environment, transportation, technology, economics, and people-to-people engagement.

Alaska Native Claims Settlement Act

It is critical to the understanding of these issues to understand what Congress and the president intended when they enacted the 1971 Alaska Native Claims Settlement Act (ANSCA). The act is the foundation of much of Alaska Natives' economic and legal relationship with the federal government, but it is much more than that. It also embodies most of our economic and relational agreements with the government, agreements for which our people relinquished valid legal claims to lands and resources in Alaska, our homeland. The land claims settlement freed Alaska to receive its lands and the federal government to manage them.

The people of the United States and the federal government got a bargain. The Trans-Alaska oil pipeline, which delivers 1.8 million barrels of oil a day to domestic consumers, was built. The fields of Prudhoe Bay alone have delivered several hundreds of billions of dollars in goods, services, and taxes to the federal government. ANCSA made all of this possible by addressing the status and valid land claims of Alaska Natives.

The world-class discovery of 25 billion barrels of oil in Prudhoe Bay, together with the need for clear title to build a pipeline across Alaska to transport the oil, created a sense of urgency and an historic opportunity for the land claims settlement. In December 1971, after years of effort by members of Congress, Alaska Native leadership, and others, President Richard Nixon signed ANCSA into law.

For extinguishing aboriginal claims across the state of Alaska, Alaska Natives were allowed to retain fee simple title to 44 million acres of land and received $962.5 million for lands transferred to state, federal, and private interests. As part of a large Congressional experiment, ANSCA rejected a reservation and tribal model of land settlements and authorized Alaska Natives to create regional and village for-profit corporations. Under ANCSA, the corporations were authorized to select and receive conveyance of the land entitlement and monetary payments from the state and federal governments as the act required. Alaska Natives became shareholders in these corporations, electing Native boards of directors and getting acquainted with the corporate structure. Our Native corporations own and manage Native lands and assets. For the most part, they are not in tribal ownership. It took years and, in some cases, decades to get ANCSA's promises implemented. It is critically important to understand ANCSA was a land settlement, not a settlement of all claims. Native people were concerned with not only the land, but their culture

In 1968, 25 billion barrels of oil were discovered in Prudhoe Bay, Alaska, bringing about the need for the Trans-Alaska Pipeline. Before that could be built, however, the government needed clear title to the land it would cross, leading President Richard M. Nixon to sign the Alaska Claims Settlement Act in December 1971. Alberto Loyo | Shutterstock.com

The Alaska Federation of Natives has spent decades protecting the hunting and fishing way of life for the Alaskan people. As industries and special interests look to develop the land, the Federation works to reduce or eliminate environmental destruction. Photo courtesy of the Alaska Federation of Natives

and the ability to survive by hunting and fishing. The cry of "Take our Land, Take Our Life" accurately reflects the Native people's level of concern

The public policy decision to put the land and resources in Native corporations versus tribes, and a more tribal structure, was a shift from traditional settlements with Native Americans. For many years now, we have continued to have discussions on the roles of federally recognized tribes and of Native corporations. AFN supports both types of institutions, and works to strengthen them. Many Native leaders have spent their whole working lives trying to make the corporate structure work for our people while maintaining Native values and aspirations. This structure has been an amazingly flexible tool, opening new types of opportunities, and Native people have adapted to it.

AFN has continued its support of Alaska Native self-determination by continuing support for Native corporations and their growth in capability, as well as by continuing support for Alaska's federally recognized tribes and tribal consortiums. The federation has spent decades protecting our hunting and fishing cultures through law and regulations, and has worked with the tribes to maintain and increase funding for tribal programs like health care, housing, social service programs, tribal courts, and tribal rights in general.

An Effective Model

Compacting and contracting are two effective tools that allow Alaska Natives to build capacity and competence and meet the Department of Defense's mission.

Why discuss Native compacting and contracting with the federal government? Both are tools that the Department of Homeland Security, the Coast Guard, and the Department of Defense can use to accomplish their goals, whether individually, or in combination with other federal departments for a whole-of-government approach.

Compacts

Self-governance compacts are authorized by the 1975 Indian Self-Determination and Education Assistance Act, Public Law 93- 638, as amended. They are primarily used for tribes to assume operation of the Indian Health

Service and Bureau of Indian Affairs (BIA) programs. However, the statute also authorizes tribal compacting of programs from other bureaus of the Department of the Interior, which publishes an annual list of all non-BIA programs, services, functions, and activities that are eligible for inclusion in self-governance agreements. There are required programmatic targets. Currently, nearly the entire Indian Health Service and BIA is compacted with Alaska Native tribes, consortiums, or statewide compacts running the state hospitals, regional hospitals, and subregional and village health clinics, for example.

Alaska Natives seek to put aside dependency and show initiative and leadership in our relationship with the federal government by supporting innovation and new arrangements which can provide for the needs of Alaska Native people, and supporting U.S. interests like national security. We actively study different arrangements the government has with others and seek to adapt where appropriate. Alaska is also held up as a model in a number of areas for other U.S. interests abroad. Alaska Natives have been involved in leadership exchanges and discussions for years with Indigenous leaders from various nations including Canada, Greenland, and Russia.

Living on land scattered across the state, as Alaska Native people shape our future, we seek greater opportunity to make decisions affecting the federal land, which surrounds our communities. This includes decisions on the management of fish and game, land use, and water rights. Currently, AFN and the tribes are seeking to expand shared decision making using cooperative agreements and expanding responsibilities in existing co-management bodies. The co-management arrangements vary by which federal law applies, the species, range—including international waters—and the desire of the local people.

Contracting

The Alaska Native corporations have broader responsibilities than many other typical American corporations because of ANCSA. They were not started as ordinary corporations, nor were they intended to function as such. In more than 200 separate laws, Congress tasked Alaska Native corporations with different roles and responsibilities and opened up various opportunities. In fact, a small number of these corporations participate in full and open competition in the federal contracting marketplace because of their capabilities and experience.

For years the Small Business Association (SBA) ignored Native corporations, partly due to the remoteness of Alaska, the unusual nature of Native corporations, and the light staffing presence of the agency in Alaska. But the association's 8(a) Business Development program, the federal government's primary means of developing small businesses owned by socially and economically disadvantaged individuals, changed that. Through this program, Alaska tribes and Native corporations have the opportunity to provide cost-effective, quality services to the government.

Across the Arctic, Indigenous peoples still hold to traditional ways of living by preserving and working the natural land. However, some Indigenous peoples are inclined towards a newer and more modern lifestyle. Either way, the Alaska Federation of Natives represents and stands with all Indigenous people across the state. Photo courtesy of the Alaska Federation of Natives

In the 1990s, Section 8(a) of the SBA program was modified to provide special consideration for Native corporations and American Indian Tribes. The purpose was to encourage business development in some of the most socially disadvantaged communities while providing strong incentives for federal agencies to contract with Native owned businesses. Native corporations and Tribes became eligible to negotiate federal contracts through direct award, compete for contracts reserved for 8(a) eligible bidders, and own more than one 8(a) company.

Participation in the 8(a) program facilitates economic development and growth in Native and Tribal communities. This growth benefits Native corporations' shareholders and tribal memberships through sustainable and predictable dividends, elder benefits, scholarships, burial assistance, educational training, internships, and contributions to Native and non-Native nonprofit corporations, and advocacy efforts on behalf of the region or tribe.

Today, many Native corporations and Tribes have demonstrated a record of maturing from emerging small 8(a) businesses to successful, competitive small business, strengthening their institutional structures and gaining the experience necessary to compete for both competitive and sole-source awards. Through the 8(a) program, regional and village corporations compete in markets nationwide, and provide services to the federal government in diverse business lines. Native corporations further promote and encourage the use of other small business contractors, often teaming or joint venturing with local service-disabled veteran-owned small businesses, women-owned small businesses, and other minority businesses, thus stimulating local jobs.

SBA 8(a) contracting has created the benefits intended and our corporations have built up a capacity that did not exist before. Methodically, efficiently, and responsibly, these corporations have built the capacity to provide employment for Native shareholders, training to young people, and scholarship opportunities. As intended, they have developed managerial and business expertise, and have helped create an economic stability where none existed before. Our people take pride in this work, and these efforts help young people see what it takes to succeed in modern America. Their leadership, capacity, and institutions mean they are well positioned to be strategic partners, and as this leadership continues to develop, capacity will grow.

Rapid Change in the Arctic

Not all Indigenous peoples have the same interests. Some want to preserve traditional ways of life, while others want greater participation in dominant state structures. However diverse, Indigenous peoples share the struggle for self-determination and a history of injustice from conquest and colonization. As a result, they have faced centuries of discrimination in terms of basic rights to their ancestral property, language, cultures, governance, and basic services, including education, health, nutrition, water, sanitation and housing. Across the Arctic, Indigenous peoples share ties to their homelands, their traditional ways and cultures, and desires to improve the lives of their families and communities. Though their national governmental structures and opportunities may vary, in many ways Indigenous peoples across the Arctic are the same, and there is a high level of formal and informal engagement among them.

Conclusion

Alaska Natives provide a distinctive and remarkable case study in the way Native communities can interact with federal and state governments and participate in economic and social development, while preserving traditional ways of life. Understanding Alaska Natives, and other Indigenous peoples in the Arctic, is critical to a mission of success in the region.

Our connection to the land and our subsistence hunting and fishing cultures remain strong, transcending boundaries across the North. Land connects people to one another and is the foundation for mutual interdependence and co-existence. Our identity, a sense of belonging, inclusion, and human dignity is fundamentally linked to the ownership of our land, the settlement of our land rights, and the recognition of our property rights. ANSCA gave us a foothold to participate in the modern economy while protecting our cultures and homeland.

A truly original act, ANSCA requires Alaska Natives to engage in the corporate, market economy, and has transformed the state. The success of this model in Alaska affects all Indigenous people in the Arctic, but it falls to Alaska Natives to implement this complex land settlement using the tools of a corporate structure. We accomplish this by meaningfully engaging in our economic life and making the difficult choices we made every day over the last 40-plus years.

Alaska Natives are also extremely organized and open to engagement and collaboration with the U.S. military. We come to the table with the tools of Native corporations and tribal consortiums, and have built tremendous contracting and compacting capabilities over the last four decades.

About the author:

Julie Kitka serves as the president of the Alaska Federation of Natives. A Chugach Eskimo living in Anchorage, Alaska, she has an honorary doctorate in humane letters from the University of Alaska, Anchorage, and an honorary doctorate in law from the University of Alaska, Fairbanks. She recently received a Commander's Public Service Award from the Department of the Air Force, and a Director's Award from the Department of Justice, FBI.

The *Arctic Marine Shipping Assessment* and Its Lasting Importance

A commentary

by Lawson W. Brigham, Ph.D.
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U.S. Coast Guard Academy

Conducted from 2004 to 2009, the Arctic Council's *Arctic Marine Shipping Assessment* (AMSA) *2009 Report* is a historic Arctic assessment and policy document of significant and lasting relevance to the Coast Guard. The most important outcomes of AMSA, and those most relevant to the Coast Guard, are the 17 recommendations approved at the April 2009 Arctic Council Ministerial Meeting in Tromsø, Norway.

Notably, Coast Guard senior civilian managers and officers were key contributors to the effort. As members of the Council's Working Group on Protection of the Arctic Marine Environment (PAME), many in the Coast Guard have worked more than a decade implementing AMSA's recommendations.

The AMSA assessment, conducted under PAME and led by the United States, Canada, and Finland, encompasses the work of more than 200 marine experts including: the Arctic states; the Permanent Participants; global maritime and non-governmental organizations; and shipping companies. These experts held 13 major workshops on scenarios of future Arctic navigation; Arctic indigenous marine use; environmental impacts; marine infrastructure needs; marine insurance; Arctic marine incidents and response; maritime industry perspectives; and AMSA integration to support the research. Additionally, 14 town hall meetings were held in Arctic coastal communities so local, Indigenous citizens could share concerns and perspectives on increasing marine traffic and the potential impacts on their way of life.

AMSA was a broad, complex assessment of Arctic marine activity, including Indigenous marine use, addressing an array of safety and environmental protection challenges, as well as the definition of Arctic shipping. The assessment was conducted consistent with the Arctic Council's 1996 charter that mandates a focus on environmental protection and sustainable development. The AMSA team took a holistic approach to Arctic shipping and included all vessels of 100 tons or more that could discharge effluents into Arctic marine waters and release emissions into the lower atmosphere. The snapshot of AMSA baseline data for 2004 to 2005 included all vessels operating in the Arctic and noted the types of vessels, activities they were undertaking, and cargo they might be carrying. In all, the *AMSA 2009 Report* contains 96 findings, all relevant to the Coast Guard and its approach to Arctic operations and regulatory responsibilities. Select key findings include:

- The United Nations Convention on the Law of the Sea (UNCLOS) is the legal framework for the Arctic Ocean and for regulation of shipping according to maritime zones of jurisdiction. UNCLOS Article 234 provides coastal states with the right to adopt and enforce non-discriminatory laws and regulations for the prevention, reduction, and control of marine pollution in ice-covered waters.
- Arctic sea ice will likely continue to retreat through the 21st century, however, Arctic sea ice cover will remain in late autumn, winter, and early spring.
- The International Maritime Organization (IMO) is the appropriate body for the Arctic states to turn to regarding all Arctic-related marine safety, security, and environmental protection issues.

For more information

View the *Arctic Marine Shipping Assessment 2009 Report* at www.pame.is/images/03_Projects/AMSA/AMSA_2009_report/AMSA_2009_Report_2nd_print.pdf

The eight Arctic states are active, influential IMO members.

- One key driver of increased Arctic commercial shipping is natural resource development; the dominant shipping mode is destinational, versus trans-Arctic, today and in the future where resources are moved out of the Arctic by ship to global markets.
- The most significant environmental threat from Arctic marine operations is the release of oil either accidentally or by illegal discharge.
- The impacts of increased Arctic marine activity on Arctic communities can be direct or indirect; given the variety of marine activities and shipping, and the range of social, cultural, and economic conditions in Arctic communities, impacts may be positive or negative.
- There is a critical marine infrastructure deficit in the Arctic Ocean. Among what is lacking are ports; hydrography and charting; communications; meteorological and oceanographic data; aids to navigation; and response capacity. The only regions with adequate marine infrastructure are the coasts of Iceland, northern Norway and northwest Russia.
- There are critical areas of the Arctic marine environment that are of heightened ecological and cultural significance, many of which will be at higher risk from current and future Arctic marine operations.
- There are many uncertainties in the future of Arctic marine navigation influenced by a host of key factors including governance; degree of Arctic state cooperation; climate change speed and variability; oil prices and other commodities pricing; new resource discoveries; an Arctic maritime disaster; radical changes in global trade; marine insurance industry roles; multiple use conflicts; and, more.
- Increased marine traffic in the Central Arctic Ocean is a reality during summer (from the AMSA database of 2004 to 2005) with the presence of polar research ships on expeditions and Russian nuclear icebreakers carrying tourists to the North Pole.
- As of April 2009, there were no mandatory IMO rules and regulations for ships operating in Arctic waters. Safe navigation in ice-covered waters

Coast Guardsmen navigate through a narrow channel prior to examining navigational markers in Kobuk Lake southeast of Kotzebue, Alaska. The crew was deployed in support of Operation Arctic Crossroads 2010 and examined the area to gather GPS coordinates for a potentially new aids to navigation structure. Coast Guard photo by Petty Officer 3rd Class Walter Shinn

depends on the experience, knowledge, and skill of the ice navigator; in 2009 there were no uniform international standards.

The AMSA effort can be viewed from three related perspectives. The first is as a baseline assessment of Arctic marine activity and a historic snapshot of Arctic marine use early in the 21st century. The second is as a strategic guide for a host of states and their maritime agencies, Arctic residents, marine operators, stakeholders and actors, such as non-governmental organizations, involved in current and future marine operations and shipping. The last is as a policy framework document focused on protecting Arctic people and the environment.

As a strategic and policy statement, AMSA expressed to the world the Arctic states' shared commitment to protecting Arctic people and the environment in an era of increasing use of the Arctic Ocean. But it is the third perspective that is the most influential, and its lasting importance should not be underestimated. The AMSA recommendations were negotiated to a consensus by the Arctic states so the Arctic Ministers could approve them at the April 2009 Arctic Council Ministerial Meeting.

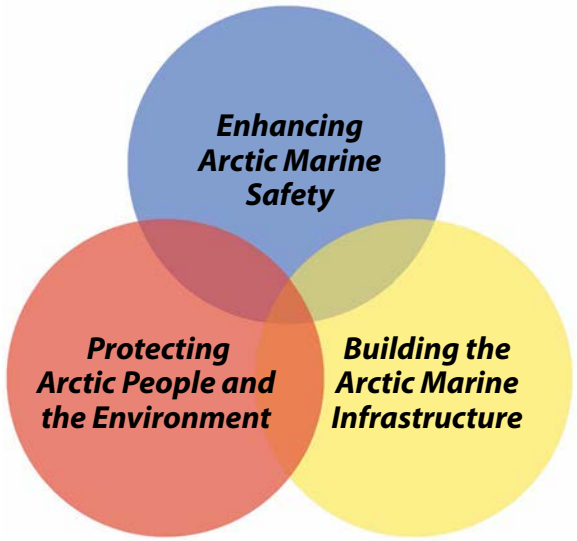
One of the major tasks of the AMSA team was to better understand the many uncertainties that might influence the future of Arctic marine operations and shipping. To game these out, a scenario planning process—creating scenarios or plausible futures—was employed. The process is much like one of the tools used in the Coast Guard's earlier strategic planning efforts, and today's Evergreen process which underpins organizational strategic thinking and planning. The scenarios workshops identified more than 120 major factors and uncertainties that could shape the future of the Arctic Ocean including legal and governance regimes; climate change; new resource discoveries; world trade patterns; new Arctic maritime state users like China, Japan, and Korea; marine use conflicts; and maritime disasters.

The AMSA effort identified as three primary drivers or uncertainties the demand for Arctic natural resources and resulting trade and governance. The scenarios framework, or axis of uncertainty, was bounded by these primary factors, and the roles of climate change and continued Arctic sea ice retreat were fully considered in the scenarios.

Arctic sea ice retreat was assumed to provide for greater marine access and potentially longer seasons of navigation. However, in AMSA, and within the plausible scenario narratives, globalization of the Arctic and development of Arctic natural resources were considered the primary drivers of increased commercial marine use, especially by large ships, in the region. The AMSA scenarios work was a success in that it facilitated new and unconstrained thinking, and clearly illustrated the complexity of future use of the maritime Arctic to the Arctic Council community. The process also highlighted the key uncertainties, major risks, and connections of the Arctic to the global economy. Notably, today most of the large commercial ship traffic in the Arctic Ocean is related to the carriage of natural resources out of the Arctic to global markets, and the resupply of ports and communities throughout the region. The report listed these in three, inter-related themes enhancing marine safety, protecting Arctic people and the environment, and building the Arctic marine infrastructure. These themes are fundamental to understanding the challenges in responding to increased Arctic marine use and the future investments required to achieve enhanced marine safety and environmental protection throughout the Arctic Ocean. The Arctic Council understood that the AMSA recommendations would require increased international cooperation among the Arctic states, IMO and other international organizations, and in the emergence

Coast Guard Seaman Alex Cason tends to an unmanned underwater vehicle aboard Coast Guard Cutter *Healy*. The vehicle, operated by the Woods Hole Oceanographic Institute, was used in a joint simulated oil spill recovery exercise designed to survey beneath the ice during a September 2013 Arctic exercise. Coast Guard photo by Petty Officer 3rd Class Grant DeVuyst

AMSA Themes



Enhancing Arctic Marine Safety	Greater Arctic state influence in international organizations; mandatory IMO measures for Arctic ships; the uniformity of Arctic shipping governance; strengthening passenger ship safety in Arctic waters; and, the need for an Arctic SAR agreement
Protecting Arctic People and the Environment	Arctic indigenous marine use survey; engagement with Arctic communities; areas of heightened ecological and cultural significance, and special marine areas; and measures addressing invasive species, oil spill prevention, impacts on marine mammals, and air emissions
Building the Arctic Marine Infrastructure	Addressing the infrastructure deficit; need for Arctic marine traffic systems and environmental response capacities; and, investing in hydrographic, meteorological, and oceanographic data

of new public-private partnerships.

In the years since the release of the 2009 report, the Arctic states and international maritime community have made significant progress in advancing issues raised in AMSA. Foremost is the historic and mandatory *International Code for Ships Operating in Polar Waters*, or the Polar Code, which came fully into force in July 2018. The Coast Guard was a key player in the Polar Code's development at IMO, representing the interests of the United States as an Arctic state and as a globally connected maritime nation.

Since AMSA, the Arctic states signed two major, binding agreements, the 2011 *Agreement on Cooperation on Aeronautical and Maritime Search and Rescue in the Arctic*, and the 2013 *Agreement on Cooperation on Marine Oil Preparedness and Response in the Arctic*. Other accomplishments related to the AMSA recommendations include identifying Arctic areas of heightened ecological and cultural significance; greater emphasis on Arctic issues by the Arctic states at international organizations; increased hydrography and charting efforts by the Arctic states; development of World Meteorological Organization METAREAs for the Arctic Ocean; and establishing the International Hydrographic Organization's Arctic Regional Hydrographic Commission.

The AMSA recommendations continue to provide a solid framework for the Arctic states and their maritime agencies to focus on this new era of extraordinary change in the Arctic. For the Coast Guard, AMSA remains a strategic guide and foundational document for its involvement in the Arctic Ocean's future.

All parties involved can be proud of their work in developing AMSA, including the Arctic Council for initiating the assessment and gaining approval of its recommendations, and the United States for its key leadership from State Department, NOAA, Department of the Interior, and Coast Guard experts. The Coast Guard can also be confident knowing it helped create a seminal document that provides a lasting policy framework for the Arctic states and enhances Arctic marine safety and environmental protection for the 21st century and beyond.

METAREAs, geographical sea regions used to coordinate transmission of meteorological information to mariners on international voyages through international and territorial waters, are part of the Global Maritime Distress Safety System. The regions are identical to NAVAREAs which are used to coordinate the transmission of navigational hazards.

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Dr. Lawson W. Brigham is a Resident Fellow at the Woodrow Wilson International Center for Scholars in Washington, D.C., and a research professor at the University of Alaska Fairbanks. He is a retried Coast Guard captain who served as commanding officer of U.S. Coast Guard Cutter Polar Sea *(WABG 11), and served as chair of the Arctic Marine Shipping Assessment.*

Shipping Through an Arctic Council Lens

The protection of the Arctic Marine Environment Working Group

by Peter H. Oppenheimer
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Over the last few decades, diminishing Arctic sea ice has coincided with a modest but notable increase in the region's marine activity. Between 2013 and 2019, the number of ships entering the Arctic—as defined by the International Maritime Organization's International Code for Ships Operating in Polar Waters, or the Polar Code—increased by 25 percent, from 1,298 ships to 1,628 ships. The total distance sailed by ships in the Arctic during this period increased by 75 percent, from 6.5 million nautical miles to 10.7 million nautical miles.[1] Even with this increase, Arctic ship traffic is comparatively lower than other regions of the world—at least for now. Most Arctic ship traffic is also seasonal, taking place during summer months when the sea ice retreats. During winter months, when much of the Arctic Ocean ices over, Arctic ship traffic dwindles. However, as global populations, national economies, and maritime trade grow, and as the annual average extent of Arctic sea ice trends lower, regional ship traffic will undoubtedly increase in the coming years.

Most Arctic ship traffic is destinational, conducted for resupplying communities, supporting marine tourism, and moving natural resources out of the Arctic. A much smaller but slowly growing volume of shipping is trans-Arctic, undertaken primarily to move goods between Europe and Asia more quickly and at a lower cost than alternate routes. There is also intra-Arctic shipping, involving transport within the region among Arctic States, as well as trade and transport between ports of a single Arctic State. These nuances are often lost in media articles that exaggerate projected trans-Arctic shipping.

The prospect of increasing Arctic shipping of all kinds has drawn the attention of governments, industry, and academics as well as local communities and Indigenous peoples of the Arctic. One focal point of this attention is the Arctic Council. Established in 1996 by the eight Arctic States, the Arctic Council is the preeminent intergovernmental forum promoting consensus-based cooperation and coordination among the Arctic States, Arctic Indigenous communities, and other Arctic inhabitants on common Arctic issues, particularly environmental protection and sustainable development.[2] It pursues these twin goals with the assistance of 38 accredited observers, 13 of which are non-Arctic States.[3]

> The Arctic States comprise Canada, Finland, Iceland, the Kingdom of Denmark, Norway, the Russian Federation, Sweden, and the United States.

Within the Arctic Council, six working groups carry out the research, monitoring, assessments, and studies that constitute the bulk of the Council's science and policy activities. Of these six working groups, the Protection of the Arctic Marine Environment Working Group (PAME) is the hub of Arctic Council activities related to the protection and sustainable use of the Arctic marine environment. PAME's mandate includes the development of measures, policy recommendations, and guidelines to help address environmental change resulting from sea-based activities, including shipping. Since the Arctic Council's inception, PAME has conducted groundbreaking work related to Arctic shipping, with the 2009 *Arctic Marine Shipping Assessment (AMSA) Report* representing its most well-known achievement.[4]

This article explains PAME's role with respect to Arctic shipping, describes the working group's relationship to the International Maritime Organization (IMO),

provides an overview of its major shipping-related accomplishments, and summarizes its ongoing efforts to contribute to safe and environmentally sustainable Arctic shipping.

PAME's Role in Arctic Shipping

PAME's origin may be traced to the Arctic States' adoption of the *Arctic Environmental Protection Strategy* in 1991.[5] The 1996 Ottawa Declaration firmly established PAME, and subsequent Arctic Council Ministerial Declarations elaborated PAME's role and tasked it with a broad array of responsibilities that include shipping-related matters.

In response to a ministerial mandate, PAME developed the 2009 *AMSA Report*, which included 17 policy recommendations that have since defined the parameters of PAME's Arctic shipping work. These recommendations are divided into three themes:

- enhancing Arctic marine safety
- protecting Arctic people and the environment
- building Arctic marine infrastructure

PAME has pursued many projects under these themes, all with the overarching goal of advancing navigational safety, promoting environmentally sound marine operations, and protecting Arctic ocean and coastal areas.

PAME's Relationship to the International Maritime Organization

In pursuing this overarching goal, PAME is mindful of its role, especially in relation to IMO. IMO is the global standard-setting body for the safety, security, and environmental performance of international shipping, while PAME is a non-regulatory regional body with a mandate focused on environmental protection and sustainable development. In working to advance the *AMSA Report*'s recommendations and subsequent ministerial direction, PAME has carved out a role focused on:

- collecting, synthesizing, and analyzing reliable information
- producing high-quality reports and assessments
- making sound policy recommendations

In doing so, PAME has informed and influenced decision making by Arctic States and the IMO. It also has helped Arctic States better coordinate their national efforts to support safe and environmentally sustainable Arctic shipping, including at the IMO. The current IMO-PAME relationship attests to PAME's ability to "stay in its lane" while generating reliable and authoritative input that informs and shapes IMO actions. In no small part due to PAME's shipping-related work, IMO became an accredited Arctic Council observer[6] in 2019 and formalized its participation in PAME's Shipping Expert Group.

PAME's Major Shipping-Related Accomplishments

Arctic Regional Arrangement for Port Waste Reception Facilities

To assist Arctic States in providing adequate facilities for the reception of ship-generated wastes, an obligation under the International Convention for the Prevention of Pollution from Ships (MARPOL), PAME studied the feasibility of developing a regional arrangement for port waste reception facilities. Under such an arrangement, Arctic States would meet the waste reception needs of ships calling at ports within the Arctic without each port offering reception facilities. Instead, within a Regional Reception Facility Plan, Arctic States would designate certain ports as Regional Ships Waste Reception Centers (RSWRCs) where adequate facilities are available to receive all types of ship-generated wastes. The RSWRCs would be located conveniently to prevailing regional shipping patterns to avoid forcing ships to deviate from their voyage solely to dispose of ship-generated wastes ashore.

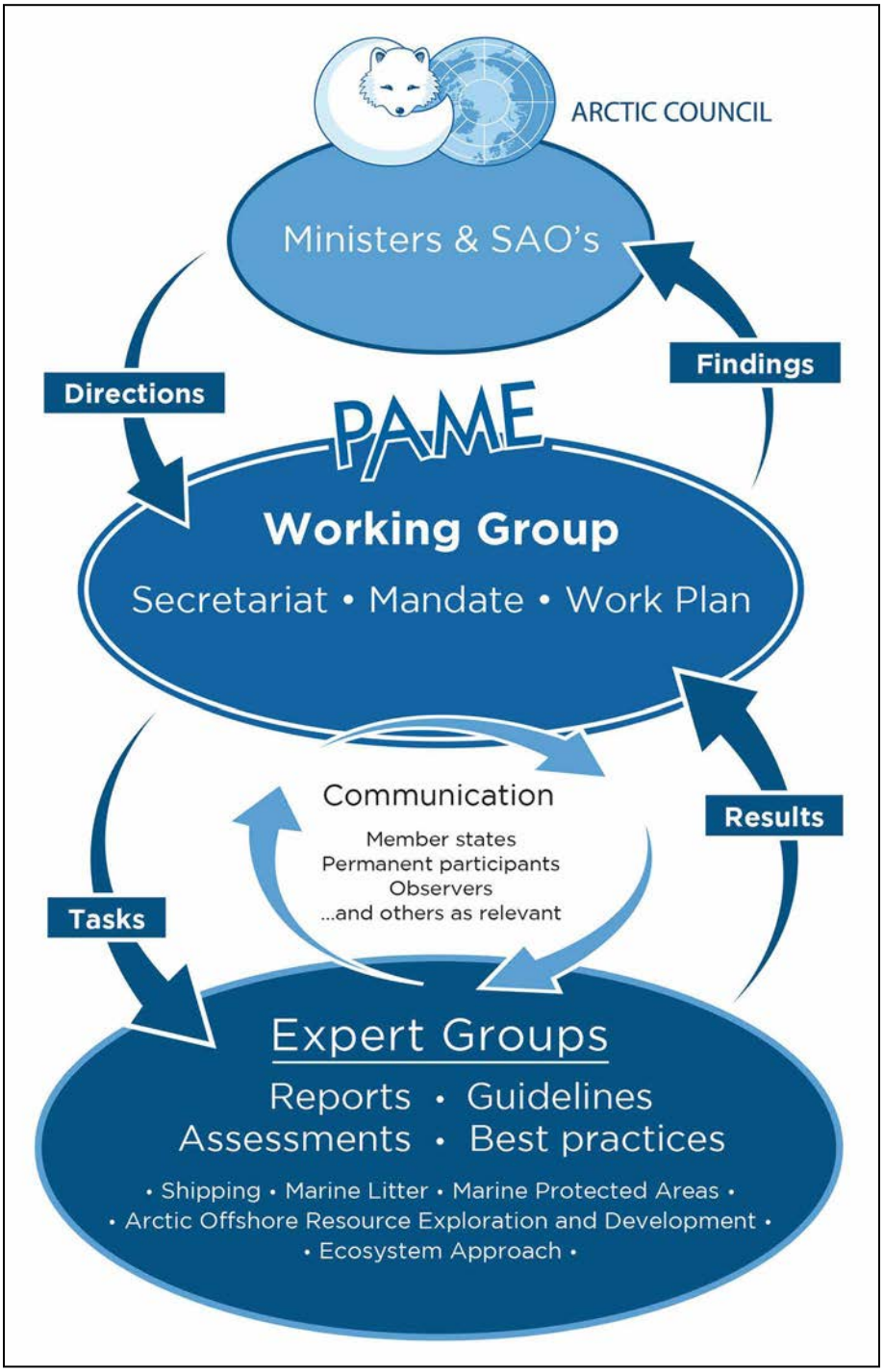
Based on its study, PAME determined that developing a regional arrangement was feasible and developed an outline, guide, and plan to do so. In May 2018, the Arctic States jointly submitted this information in a paper to IMO's Marine Environment Protection Committee. The committee subsequently adopted a new work output authorizing the submission of proposed MARPOL amendments that would allow the creation of the desired Arctic regional arrangement for port waste reception facilities. PAME has begun preparing the proposed amendments and anticipates that Arctic States will submit them to IMO in 2022.

Arctic Marine Tourism Best Practice Guidelines

In 2015, Arctic ministers approved the *Arctic Marine Tourism Project Best Practice Guidelines*, a set of

The Protection of the Arctic Marine Environment is a working group of the Arctic Council and the hub of protection and sustainment activity for the Arctic marine environment. Graphic courtesy of the Protection of the Arctic Marine Environment

recommendations devised by PAME to supplement and strengthen existing mandatory requirements and voluntary policies in place to support sustainable and responsible Arctic marine tourism.[7] Their focus is on raising awareness of, and thereby minimizing, the adverse impacts marine-based tourism may have on wildlife and Indigenous peoples, promoting ecologically and culturally sensitive behavior by tourists when ashore, and fostering science-based collaboration between vessels engaged in tourism and research communities. Only three of the 13 recommendations made in the guidelines expressly pertain to shipping. One encourages the carriage of automatic identification system technology on all vessels engaged in marine tourism activities that are not already required to do so. The second urges Arctic States to ratify the IMO's Ballast Water Management Convention.[8] The third endorses improved communications and regular engagement between vessel operators and the local coastal communities they visit or pass by.



Graphic courtesy of the Protection of the Arctic Marine Environment

Arctic Shipping Best Practice Information Forum

PAME established the Arctic Shipping Best Practice Information Forum in 2017 to support the effective and timely implementation of IMO's Polar Code. The Forum facilitates the exchange of information and best practices among its participants related to the Polar Code and associated Arctic shipping issues, including:

- hydrography
- navigation
- search and rescue
- cold weather impacts
- training
- ship equipment, systems, and structure

The Forum is open to all Arctic Council members and accredited observers, as well as widely recognized professional organizations dedicated to improving safe and environmentally sound marine operations in the Arctic, as demonstrated by expertise and experience in Arctic shipping.

The Forum hosts an annual two-day meeting in London and its principal product is a publicly-accessible web portal with links to hundreds of authoritative and reliable information sources indispensable to effective implementation of the Polar Code. The portal contains information specific to each Polar Code chapter and

relevant to all those involved in safe and environmentally sound Arctic shipping, including vessel owners/operators, regulators, classification societies, marine insurers, and Indigenous and local communities.

For more information

To access the Arctic Shipping Best Practice Information Forum's web portal, go to https://www.pame.is/projects/arctic-marine-shipping/the-arctic-shipping-best-practices-information-forum

To date, the Forum has held four annual meetings, with attendance growing from 35 to 140 participants representing nearly 80 different entities. Due to the COVID-19 pandemic, the fourth annual meeting took place virtually November 24 and 25, 2020.

Arctic Ship Traffic Data System

In response to a growing need to collect and distribute accurate, reliable, and up-to-date information on shipping activities in the Arctic, PAME launched the Arctic Ship Traffic Data (ASTD) System in 2019.[9] The ASTD System contains a wide range of ship traffic information—currently from 2013 to the present—including the number of ships operating in the Arctic, their type, flag, tracks, and distance sailed. It also notes activity in specific areas like the Polar Code Area, Arctic State exclusive economic zones, the Central Arctic Ocean, measurements of ship air emissions, and types and amounts of fuel consumed. Access to the ASTD System is restricted to eligible users, and the extent of access varies with the status of the eligible user. With the exception of the Russian Federation, all Arctic States and their governmental instrumentalities have unfettered, no-cost access to ASTD System data. Access for other eligible users is tiered, and generally involves a modest fee.

Since launching the ASTD System, PAME has granted access to more than 35 applicants, ranging from other Arctic Council working groups to government agencies and academic institutions. National Geographic's use of ASTD System data in its September 2019 magazine issue on the Arctic[10] highlighted the value of the system and presages its many benefits such as increased awareness and better understanding of Arctic ship traffic patterns. With changes in Arctic sea ice extent and projected growth in Arctic shipping, the ASTD System will allow the Arctic Council to be at the forefront of monitoring trends and assessing any changes for use in its studies, assessments, analyses, and development of recommendations that enhance Arctic marine safety and support protection of Arctic peoples and the environment.

Heavy Fuel Oil Use and Impacts

The *AMSA Report* found that a release of oil into the Arctic marine environment, either through accidental release or illegal discharge, is the most significant threat to the Arctic marine environment. It recommended that the prevention of oil spills be the highest priority for environmental protection. Ever since, PAME has pursued initiatives to identify and address the risks associated with the use and carriage of heavy fuel oil (HFO) by ships in the Arctic. As a result of these initiatives, PAME has issued several important reports:

- **HFO in the Arctic Report**—Phase I identified the risks associated with the use and carriage of HFO by ships in the Arctic; considered potential mitigation strategies, examined reliance on HFO in the Arctic; and forecast HFO use and carriage trends.
- **HFO in the Arctic Report**—Phase II(a) provided a comprehensive picture of maritime traffic in the Arctic for a one-year period; modeled fuel consumption and air emissions; contained a high-level risk analysis of frequencies of incidents leading to HFO spills; included a qualitative review of expected traffic development, and concluded with a gap analysis of the regulatory regime for both the use and carriage of HFO in the Arctic.
- **HFO in the Arctic Report**—Phase II(b) evaluated HFO use and carriage by vessels operating in areas of the Bering Sea outside the definition of the Arctic as defined by the Polar Code.
- **HFO in the Arctic Report**—Phase III(a) examined shipping incidents between 1970 and 2014 involving releases of HFO and other fuel in waters of the Arctic and near-Arctic, as well as the effect of HFO releases on the marine environment.
- **HFO in the Arctic Report**—Phase III(b) investigated the possible hazards to engines and fuel systems using HFO in cold climates compared to those that use other fuel types in similar conditions.[11]

In addition, PAME partnered with the Arctic Council's Sustainable Development Working Group to prepare a report summarizing information about on shore use of HFO by Arctic Indigenous peoples, as well as the extent to which they rely on ships that burn HFO to transport goods and supplies. The report found almost no on-shore HFO use by these communities, but limited reliance on ships burning HFO to provide supplies and to export minerals from local mines, which provide them with some economic benefits.

Noticing a correlation between slowly melting sea ice and an uptick in Arctic vessel traffic, several groups, including residents and Indigenous people, are working together to minimize environmental impact. ondrejprosicky | Adobe Stock

Compendium of Arctic Ship Accidents

The *AMSA Report* contains summary information on marine incidents and accidents in the Arctic for 1995–2005, a substantial initial achievement. With growth in the volume and diversification of economic activity, including shipping, in the Arctic region, PAME realized there was a need for comprehensive and accurate Arctic marine accident information for more recent years. The group therefore embarked on an effort in partnership with the Arctic Council's Emergency Pollution and Prevention Response (EPPR) Working Group to collect and compile it, inaugurating the Compendium of Arctic Ship Accidents (CASA) project.

A major impetus for the CASA project was the recognition that spill mitigation, prevention, and response in the Arctic presents significant operational challenges due to the distances involved, limited infrastructure, and the inherent difficulties in recovering oil from ice-covered waters. PAME and EPPR foresaw the Compendium as an aid to the analysis of incident locations and incident concentrations, the identification of possible causes and impacts, and the design of potential risk mitigation options and strategies.

After three years of work collecting, compiling, and verifying ship accident data submitted by the Arctic States, PAME completed the Compendium in 2020. It covers 2005-2018, and its geographic scope aligns with the Arctic as defined in the *AMSA Report*. Incident-specific information, including date and location, is captured, as is ship type, the nature of the accident, and the consequences of the incident where that information is available. Work is underway to incorporate the CASA project data into the ASTD System.

Underwater Noise in the Arctic

Though comparatively lower than noise levels in non-polar regions, noise levels in the Arctic are forecast to rise in the coming decades. In absolute terms, the Arctic is likely to remain quieter than many other regions where human activity is particularly intense, but the relative change in the Arctic may be dramatic.

To contribute to work on anthropogenic underwater noise in other forums—such as IMO and the International Whaling Commission—and to better understand and inform efforts to mitigate the impacts of underwater noise in the Arctic, PAME completed the *Underwater Noise in the Arctic: A State of Knowledge Report* in 2019.[12] The report provides a baseline understanding

of underwater noise in the Arctic region, including ambient sound levels, underwater noise created by anthropogenic activities, and the impacts of underwater noise on marine life. Among the report's key findings are that vessel activity has been increasing throughout the region and may lead to a louder Arctic. Preparation of the report disclosed many gaps in knowledge that PAME hopes to help address in future work.

Noise levels in the Arctic are predicted to rise in the future as activity increases. In comparison, the region will stay quieter than more developed areas of the world, but the slightest noise level increase will be a surprise to marine life. Juliya Shangarey | Shutterstock.com

PAME's Ongoing Shipping-Related Work

PAME's docket of shipping-related projects is lengthy, but among the most important of these is one to revisit the *AMSA Report*'s 17 recommendations, which are more than 10 years old. For example, recommendations that have come to fruition—the Arctic Search and Rescue Agreement—would be removed while others would be reconfigured to account for ministerial guidance such as the Arctic Marine Strategic Plan (2015–2025). Proposed updates to the AMSA will be finalized and made public after approval by Arctic ministers in May 2021.

Other pending PAME projects address the interpretation and practical application of the Polar Code by Arctic States and accredited observer states, black carbon emissions from shipping activity in the Arctic, and the environmental toxicity and fate of light and intermediate fuel when spilled in cold waters. PAME is also building on previous projects to analyze current trends in Arctic marine tourism using the ASTD System and to develop acoustic intensity maps for shipping in the Arctic. This latter project is particularly ambitious, as it aims to obtain a better understanding of underwater noise emissions, or 'noiseprint,' from shipping in the Arctic, identify areas where underwater noise from shipping and areas of heightened ecological significance overlap and pose risks, and investigate possible mitigation strategy options to reduce the impact of underwater noise incidentally generated by shipping in the Arctic.

Conclusion

PAME has made substantial contributions to safe and environmentally sustainable shipping in the Arctic and is committed to its work in this area. Those interested can monitor PAME's work at www.pame.is.

* The views expressed in this article are the author's alone and do not necessarily represent those of NOAA or the U.S. Department of Commerce.

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The Right of Transit Passage through the Arctic Straits

by John T. Oliver, B.A., LL.M., S.J.
Former Senior Ocean Policy and Programs Advisor
Office of Emerging Policy
U.S. Coast Guard, retired

> *"Freedom of the seas is a top national priority. The Northwest Passage is a strait used for international navigation, and the Northern Sea Route includes straits used for international navigation; the regime of transit passage applies to passage through those straits."*
>
> — White House, National Security Presidential Directive 66
> Homeland Security Presidential Directive 25, "Arctic Region Policy," January 9, 2009

Perhaps the most important of the "crown jewels" the international maritime community achieved in negotiating the 1982 United Nations' Convention on the Law of the Sea[1] (UNCLOS) was the inclusive, globally assured right of transit passage through, over, and under international straits. As provided in Part III of UNCLOS, transit passage "applies in straits which are used for international navigation between one part of the high seas [or exclusive economic zone (EEZ)] and another part of the high seas [or EEZ]." It contains two criteria: geographic, meaning the strait must connect two bodies of international water and airspace; and functional, meaning the strait must be used for international navigation.

Moreover, the right includes all vessels and aircraft, including military craft and submarines, so long as they are operating in their "normal modes" (Article 39.1(c)). Although all vessels and aircraft must proceed through or over the strait in "continuous and expeditious transit," "without delay," and consistent with the U.N. Charter and UNCLOS (Articles 38, 39), the strait state(s) may not "hamper" vessels or aircraft in transit. Additionally, they must advise of any dangers to navigation and may not suspend passage during peacetime (Article 44).

International Shipping Routes in the Arctic Region

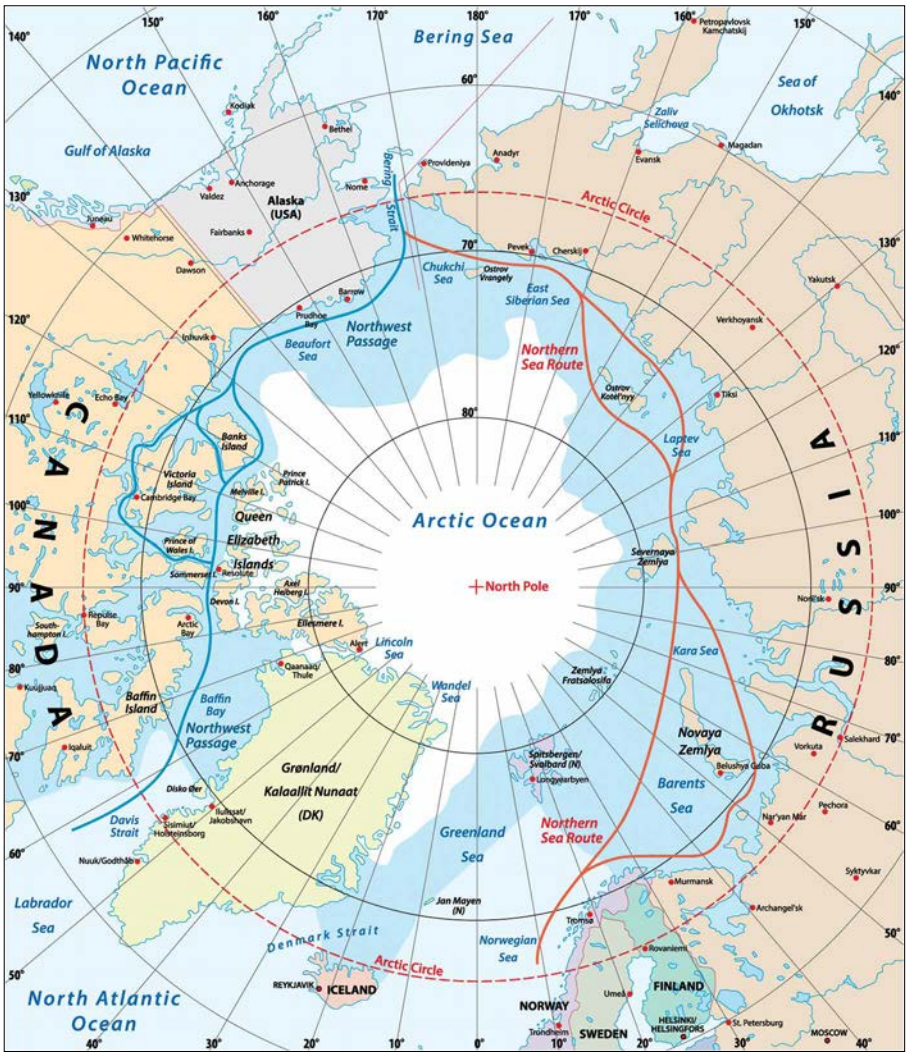
The Arctic Ocean contains several international straits that meet these two criteria. At 44 nautical miles (nm) wide, the Bering Strait obviously meets the two tests, separating Alaska and Siberia while connecting the North Pacific Ocean with the Arctic Ocean. However, in contrast to other vitally important international waterways, such as the Strait of Hormuz, Bab el Mandeb, and the straits of Malacca and Singapore, each of which is used by many thousands of vessels each year, only a few hundred vessels ply the Bering Strait annually. Indeed, the Bering Strait sees far less traffic in an entire year than the Dover Strait and many others accommodate in a 24-hour period. The few vessels using the Bering Strait are mostly tugboats towing barges to supply towns and industrial sites in the Arctic region, indigenous whaling and fishing craft, research and adventure tourist vessels, and tankers and bulk ore carriers transporting raw materials to outside markets. Moreover, most of these vessels use the Bering Strait during the summer and early fall months when that waterway is completely free of ice.

In recent years, global warming has caused the continued retreat of permanent sea-ice cover in the Arctic Ocean, a phenomenon occurring in the Arctic region at twice the pace of the rest of the world.[2] This has caused a boom of economic activity in parts of the region. This potential seasonal absence of ice in the central Arctic Ocean raises the intriguing possibility of a direct, less politically fraught, deep-water, trans-Arctic route directly between the North Atlantic and North Pacific. However, the most likely navigational routes in the near term are through the waters of northern Russia via the Northern Sea Route or Canada via the Northwest Passage.[3] A number of large vessels transporting oil, natural gas, and ore transit the Northern Sea Route every year, usually accompanied by Russian icebreakers. Likewise, a few research vessels and adventure cruise ships transit the Northwest Passage each summer.[4] Most of these voyages take place with the express permission of the Russian or Canadian governments. While the number of such transits has been very limited in the past, diminishing sea ice and growing economic prospects in the region portend significant increases in regional shipping activity over

the next few decades.

The various islands defining these passageways are separated from one another, and from the Russian and Canadian mainland, by a series of often narrow, relatively shallow, waterways. The Northern Sea Route extends more than 3,000 nm from the Barents Sea in the west to the Bering Strait in the east, passing through several straits formed by offshore Russian islands over the course of the route. The Northwest Passage consists of several routes extending some 2,000 nm through the Canadian Arctic island archipelago from Baffin Bay, west of Greenland, to the Beaufort Sea, eventually linking the north Atlantic and Pacific Oceans.

Beginning in the summer of 2007, both the Northwest Passage and Northern Sea Route opened to shipping without icebreaker assistance, making it possible for most oceangoing vessels to circumnavigate the North Pole for the first time in human history. One Northern Sea Route study projects "remarkable shifts in trade flows between Asia and Europe, heavy shipping traffic within the Arctic, and a substantial drop in Suez traffic. Projected shifts in trade also imply substantial pressure on an already threatened Arctic ecosystem."[5] The Northern Sea Route shaves roughly 3,000 miles and 11 days off travel between Europe and Asia, a significant gain over the normal route using the Suez Canal and Strait of Malacca. Although it will take longer in coming, the Northwest Passage promises similar commercial advantages. A 2016 Copenhagen Business School report predicted large-scale trans-Arctic shipping will become economically viable by 2040.[6]



Economic activity in part of the Arctic region has been increasing due to sea ice permanently melting away. lesniewski | Adobe Stock

Of course, these Artic sea routes will remain operationally challenging. Large, drifting chunks of ice, especially during the spring breakup, can severely damage the hull, propeller, or rudder of an unprotected vessel. Lack of modern charts and infrastructure to respond to a maritime disaster also mean greater uncertainty, risk, and insurance costs. Russia is spending billions to enhance its Arctic capabilities, but Canada is lagging.[7] Bad weather, particularly severe marine storms and fog, further complicates safe navigation and operations. Because containerized traffic operates in a just-in-time mode that does not tolerate delays, and the isolation of these passages that prevents shipping companies from arranging multiple profitable port visits on the same voyage, the transportation industry does not yet view Arctic routes as promising.

U.S. Transits of the Arctic Straits

Although the number of U.S.-sponsored transits have been few and far between, a number of American vessels transited through these international straits between the 1940s and 1960s. U.S. merchant vessels, reflagged as Soviet vessels and manned by Russian crews, used portions of the Northeast Passage, or the "Pacific Route," during World War II to carry Lend-Lease war materials from cities on the West Coast to ports in Siberia.[8] In 1957, the Coast Guard cutters *Storis* (WAG 38), *Spar* (WAGL 403), and *Bramble* (WAGL 392), accompanied by a Canadian ice breaker, HMCS *Labrador*, became the first U.S. vessels to transit and chart portions of the

Northwest Passage.[9] The next year the U.S. nuclear-powered submarine, USS *Nautilus* (SSN 571), made the first of many submerged transits of the strait.[10] In July 1965, the U.S. Coast Guard icebreaker *Northwind* (WAGB 282) conducted oceanographic survey operations and became the first western government vessel to operate in the Kara Sea.[11] However, the icebreaker's real, but at the time classified, mission was to exercise the inclusive right to transit the Northeast Passage without obtaining permission from the Russian government. However, that aspect of the mission was unsuccessful, and the voyage caused predictable diplomatic friction with the Soviet government.[12]

In August and September 1969, a Humble Oil-chartered oil tanker, SS *Manhattan*, carrying only one symbolic barrel of oil, traversed the Northwest Passage in both directions.[13] The voyage tested the feasibility of large-scale tanker shipments from the North Slope of Alaska to market before the ultimate decision to build the Trans-Alaska Pipeline.[14] Even though the mission planners had coordinated with Canadian authorities, and both U.S. and Canadian icebreakers provided escort services for part of the voyage, this trip generated an angry outcry from Canadian politicians, press, and public.[15] Partially in response to this controversial voyage, the Canadian Parliament enacted the 1970 Arctic Waters Pollution Prevention Act, which asserted Canadian jurisdiction, for environmental protection purposes, over all ships approaching within 100 nm of Canada's Arctic coast.[16] In 1985, another law extended that distance to 200 nm.

That same year, the Coast Guard's heavy icebreaker *Polar Sea* (WAGB 11) transited the Northwest Passage on a voyage from Greenland to Alaska. Although the cutter coordinated its voyage with the Canadian Coast Guard, the event infuriated most Canadians. In response to a Canadian reporter's question about why the United States had not asked for permission, an American spokesman said there was no legal requirement to do so, causing further diplomatic and political tensions. The Canadian government issued a declaration in 1986 reaffirming Canadian exclusive rights to its Arctic waters, a claim the United States refused to recognize. Under pressure from Prime Minister Brian Mulroney and President Ronald Reagan to reach a compromise, the two governments negotiated a bilateral agreement on "Arctic Cooperation" in 1988.[17] Under the agreement, vessels engaged in transit passage or passing through a foreign state's EEZ are not permitted to engage in research activities without the prior permission of the coastal state. That 1988 agreement notes that all U.S. Coast Guard icebreakers engage in scientific research, that they would always request permission from Canada before passing through its Arctic waters, and Canada would cooperate in approving such requests.[18] At the same time, the agreement explicitly reserves the legal positions of both parties.[19] The Canadian government has repeatedly expressed its commitment to expanding its ability to detect and respond to violations of its maritime sovereignty in the region. On the other hand, the United States has consistently expressed its view that these are international straits, open to all for continuous and expeditious transit and overflight.

Russian and Canadian Efforts to Protect the Environmentally Fragile Arctic Region

The Arctic waters and land are environmentally fragile. During the nine years of negotiations leading to UNCLOS, both Canada and the Soviet Union lobbied for the adoption of special provisions to protect their ice-covered waters. As a result, Article 234 permits coastal states with at least some waters covered by ice for most of the year to adopt and enforce laws and regulations within its EEZ to prevent vessel-source pollution. To balance this broad grant of exclusive maritime jurisdiction, Article 234 requires that such laws and regulations

Canadian Coast Guard Ship *Louis S. St-Laurent* approaches Coast Guard Cutter *Healy* in the Arctic Ocean in September 2009. The two vessels took part in a multi-year, multi-agency survey that helped define the Arctic continental shelf. Coast Guard photo by Petty Officer Patrick Kelley

Any vessel operating without an icebreaker escort through the Arctic still needs to be reinforced and ice capable. Arctic sea routes are not free of risk and drifting chunks of ice can significantly damage a ship. Arctic sea mapping and response resources are currently lacking, thus putting vessels at great risk when navigating the region. a_medvedkov | Adobe Stock

not discriminate in form or fact among users, give due regard to freedom of navigation, and take into account the best scientific information available. In addition to drawing straight baselines around their offshore Arctic islands to claim them as internal waters, both Canada and Russia have passed stringent laws and enacted regulations to protect the fragile Arctic environment off their coasts. Any long-term plan to promote increased shipping through the Arctic region to support robust economic development must protect the fragile marine and terrestrial environments.

Economic and Military Activity in the Arctic

Economic and military activity in northern Siberia has always been far more advanced than any other Arctic nation. In recent years the Russian Federation, despite its economic and budgetary challenges, has expended vast resources to open the Northern Sea Route to domestic and international maritime traffic. In addition to building a fleet of icebreakers far larger and more advanced than any other country,[20] Russia has greatly expanded its Arctic port facilities. This is in addition to deploying military and emergency response equipment and personnel and making Artic economic development a cornerstone of its long-term national policy goals.[21]

Ice-strengthened tankers, paying stiff fees and accompanied by Russian icebreakers, have carried oil and natural gas from Siberia to the energy-hungry economies of east Asia. During the summer and early fall months when there is no ice complicating passage, these straits enable vessels of all kinds to reduce mileage and travel time between Europe and Asia, as compared to the normal routes. Similarly, in 2016, a Chinese company expressed a desire to make regular voyages of cargo ships to the eastern United States and Europe using the Northwest Passage. Fully loaded, the vessels in question were simply too large and their draft too great to use even the expanded and enhanced Panama Canal.

Excessive Maritime Claims and Navigational Challenges

Although both Canada and Russia are parties to UNCLOS, the regulatory schemes they have imposed on vessel traffic passing through their waters are inconsistent with UNCLOS' navigational provisions. Relying on controversial straight baseline claims, both countries maintain that these straits constitute internal waters over which they enjoy complete control. These exclusive sovereignty claims will complicate the future of commercial shipping activity through the Arctic region. However, the United States and other major maritime states, including the European states, Japan, and China, reject most of these claims.

Most maritime nations view them as international straits through which all states enjoy the inclusive right of unimpeded transit passage. As recently as June

2019, the Department of State reiterated that the United States would "view Canada's claim that the waters of the Northwest Passage are internal waters of Canada as inconsistent with international law."[22] However, even if all ships had a legal right to free and unencumbered passage, other navigational challenges currently limit the usefulness of both the Northwest Passage and the Northern Sea Route.

Challenges to Arctic Navigation

- Ice
- Relatively shallow water—15 meters in places
- Lack of modern charts and aids to navigation
- Insufficient infrastructure and resources to respond to a maritime disaster

International Cooperation to Ensure Safe Navigation and Environmental Security

All of these diplomatic, environmental, and operational challenges cry out for a comprehensive international solution. Fortunately, UNCLOS provides guidance as to how this might best be accomplished. Article 41 provides: "States bordering international straits may designate sea lanes and prescribe traffic separation schemes for navigation in straits where necessary to promote the safe passage of ships." Before doing so, however, they must cooperate in formulating proposals, which they must then refer to the International Maritime Organization (IMO) as the "competent international organization with a view to their adoption." (Article 41.4.)

Once the IMO has carefully reviewed and approved any such proposal, the strait states must publish the scheme on applicable charts and in sailing directions, which ships in transit must respect. When navigational hazards require trained pilots with local knowledge to transit the coastal waters safely, the applicable regulations may require ships of a certain tonnage or carrying dangerous cargoes to employ a pilot to use the strait. This collaborative process has been followed for most all key international straits in the world, including Gibraltar, Dover, Hormuz, and Malacca.

Over the past decade, the Coast Guard conducted the *Bering Strait Port Access Route Study* to determine how best to deal with the competing navigational, environmental, and political challenges in the Bering Strait and its approaches. These included avoiding collisions and groundings, preventing marine pollution, protecting marine mammals, fish, and sea birds, and promoting the equities of the indigenous peoples who have long lived in the Arctic region. This process culminated in negotiations with the Coast Guard's Russian Federation counterparts, which led to the joint submission to the IMO for rules governing the Bering Strait and its approaches. After careful review, these voluntary regulations governing maritime traffic in the strait entered into effect in January 2019.

In the opinion of many, the time has come for the Canadian and the Russian Federation governments to develop similar proposals to ensure safe and environmentally prudent navigation in and around the Northwest Passage and Northern Sea Route.[23] However, given that these are international straits, these can no longer consist of unilateral acts by these nations. Instead, taking into account the inclusive rights to freedom of navigation and based on the best scientific evidence available, these two governments should develop proposals for their neighbors and the IMO to evaluate, discuss, fine-tune, and approve.

Appropriate proposals might well include traffic lanes, seasonal restrictions, speed limits, areas to be avoided, and even requirements to use pilots and icebreaker or tug escorts for tankers and other large vessels, when conditions make such precautions prudent. In proposing such rules for IMO review and approval, all concerned must ensure that any proposals conform to international standards and expectations, including freedom of navigation. By following the terms of UNCLOS and appropriately engaging the international maritime community, a comprehensive solution would protect the equities of both the coastal and user states.

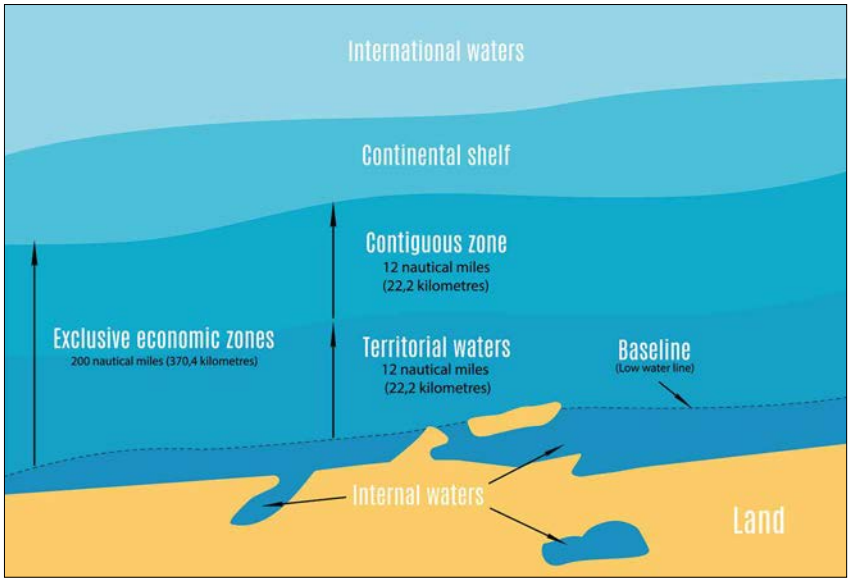
The United States Should Join UNCLOS

In the meantime, and as soon as possible, the United States should take the necessary steps to join UNCLOS. Accession to UNCLOS would protect U.S. rights, freedoms, and uses of the sea and airspace throughout the Arctic region and the rest of the world. It would also strengthen our arguments for freedom of navigation and overflight through the Arctic straits, South China Sea, Strait of Hormuz, and other critical navigational highways.

Only by joining UNCLOS can the United States maximize legal certainty and best secure international recognition of our sovereign rights with respect to the U.S. extended continental shelf in the Arctic, with its vast natural resources, and elsewhere. Moreover, joining would protect U.S. businesses involved in laying and maintaining critically important submarine cables which carry trillions of dollars of financial and other business-related data every day. It would also guarantee the United States its critical seat at the table to directly engage in applying and advancing the law of the sea for itself and its allies.

The Way Forward

As part of a negotiated regime to ensure navigational safety and environmental protection, the Canadian and Russian governments would promote safe shipping in the region by conceding that the Northwest Passage and the Northern Sea Route constitute international navigation routes. Such a concession would also encourage prudent economic development, protect the environment, and promote the equities of the indigenous peoples living in the region. Canada and Russia have the most to gain should these international waterways maximize their potential as increasingly viable shipping routes, and the broader world community would benefit by taking advantage of the shorter routes. Moreover, a recognition of transit passage rights by these two maritime powers would promote freedom of navigation of international waterways throughout the world.



Graphic illustration of claims to coastal waters. chocolatefather | Adobe Stock

By finally taking the steps necessary to join UNCLOS, the United States will regain its leading role as a critically important player in promoting the rule of law governing the world's ocean spaces. These steps would constitute win-win advances for the entire international community.

About the author:

John T. Oliver recently retired as the Senior Ocean Policy and Programs Advisor in the Office of Emerging Policy at Coast Guard Headquarters, after more than 14 years. He previously served as a surface warfare officer and judge advocate in the U.S. Navy, retiring in 2003 as a captain after 30 years of active duty. He is a graduate of Stanford University (B.A., 1973); the University of Washington School of Law (J.D., 1980); and the University of Virginia School of Law (LL.M. 1987; S.J.D. 1993). His post-graduate legal education focused on ocean law and policy. He continues to teach a graduate-level seminar, "National Security and the Law of the Sea," at the Georgetown Law Center.

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Preparing for an Expanded U.S. Arctic Marine Transportation System

Vessel activity in the region expected to grow

by Geoffrey Dipre, Ph.D.
Policy Advisor to the Executive Director,
U.S. Committee on the Marine Transportation System

In 2019, 307 vessels were reported in the area of the Arctic for which Coast Guard's District 17 is responsible. While this set a record for the largest number of unique vessels operating in the U.S. Arctic in a single year, maritime traffic in the region has been increasing for more than a decade. This increased traffic has the potential to impact the missions of several U.S. departments and agencies, therefore it is necessary to assess our current capabilities to support this growth and bring about a safe, secure, and successful Arctic marine transportation system.

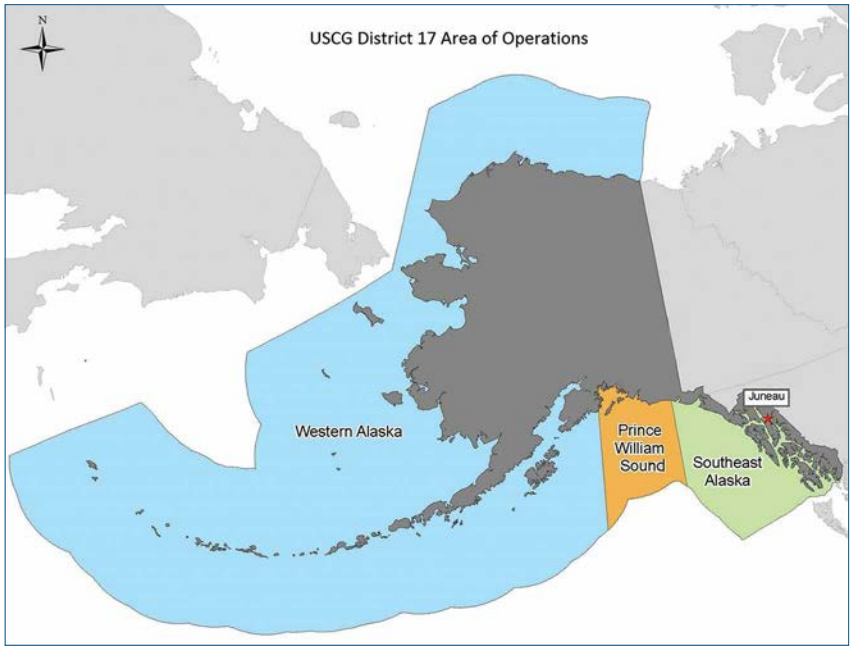
Understanding the Shift

To better understand the changes in maritime traffic, the U.S. Committee on the Marine Transportation System (CMTS) published the report, *A Ten-Year Projection of Maritime Activity in the U.S. Arctic Region, 2020–2030*, hereafter referred to as the vessel projection report.[1] Focusing on the northern U.S. Arctic, including portions of the Chukchi and Beaufort Seas, and the waters surrounding the Bering Strait, the report examines past and present vessel activity patterns and presents four vessel projection scenarios out to the year 2030. Based on conservative assumptions, the most plausible scenario estimates that the number of vessels operating in the U.S. Arctic by 2030 will be more than triple the 120 unique vessels present in 2008.

When planning for this future growth, it is imperative to understand the various risks and uncertainties inherent to operating in the Arctic. Between the extreme and fragile physical environment, the high cost of mobilization, and the considerations of indigenous communities, the Arctic is a uniquely challenging region. This is especially true for infrastructure, where there is an overall lack of existing infrastructure able to support vessel operations. Only by addressing these areas and mitigating the region's risks, can the expected growth in vessel activity be safely ushered in and the U.S. Arctic sustain a robust marine transportation system.

Vessel Activity From 2008 to 2018

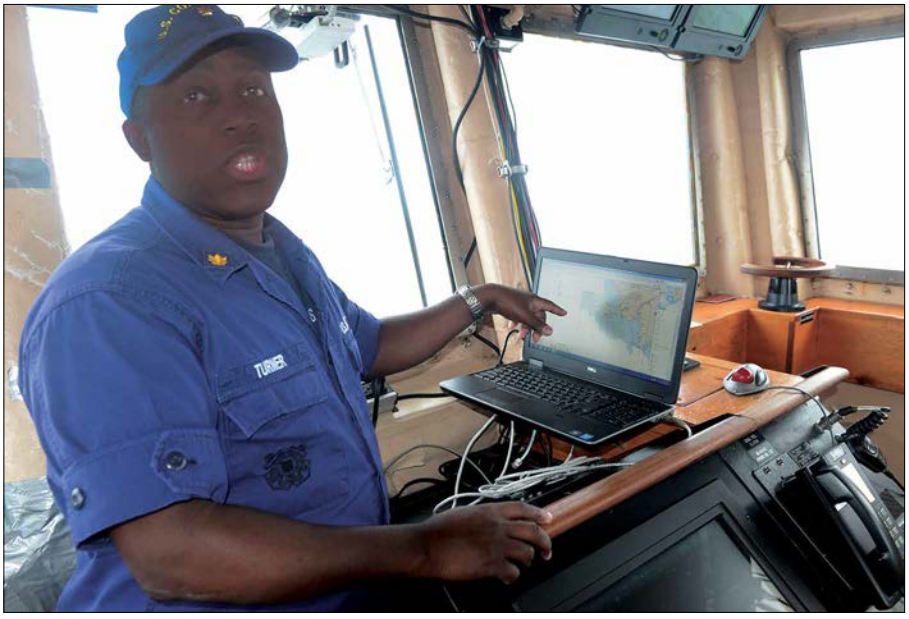
In 2008, District 17 began compiling data on the number of unique vessels operating in the area extending from the Bering Strait north to the North Pole, east to Banks



The Coast Guard's District 17 area of operation encompasses more than 3,853,500 square miles and more than 47,300 miles of shoreline throughout Alaska and the Arctic. It is slightly different than District 17's area of interest, which extends from the Bering Strait, north to the North Pole, east to Banks Island and west to New Siberian Islands. Coast Guard graphic

Island, and west to the New Siberian Islands. All unique vessel data throughout this article is based on this data, which shows that between 2008 and 2015, there was a steady increase in the number of vessels in this area, with activity peaking in 2015 with 300 vessels reported. This peak coincided with Royal Dutch Shell PLC's (Shell) exploratory drilling efforts at the Burger Prospect in the Chukchi Sea. Shell ceased its efforts in 2016, and vessel activity slowed but did not stall, falling to an average of 279 unique vessels per year between 2016 and 2018.

Natural resource exploration and exploitation represents just one of the many drivers that influences vessel activity in the Arctic. Between 2015 and 2017, more than 50 percent of the vessels operating in the region were tug, towing, and cargo vessels, 11 percent were fishing vessels, and 9 percent were related to tourism. Additionally, 7 percent were tankers, 6 percent were used for government activities like search and rescue and law enforcement, while 5 percent were scientific research vessels.[2] This distribution is evidence that growth will most likely occur in a number of different industries which may be due, in part, to the region's increasing accessibility.



Coast Guard LCDR Mike Turner explains the Automated Identification System (AIS) while underway aboard the Coast Guard Cutter *Healy* in August 2014. The Marine Exchange of Alaska, which owns and operates the terrestrial AIS stations throughout Alaska, has been monitoring the length of the navigation season, as represented by the presence of commercial vessels, in the Bering Strait region since 2010. From 2010 to 2018, the navigation season increased by an average of seven days per year. Coast Guard photo by Petty Officer 1st Class Shawn Eggert

The expanded navigation season has been a notable change in the U.S. Arctic over the last decade. The Marine Exchange of Alaska (MXAK), which owns and operates the terrestrial automatic identification system (AIS) stations throughout Alaska, has been monitoring the length of the navigation season in the Bering Strait region as represented by the presence of commercial vessels since 2010. From 2010 to 2018, the navigation season increased by an average of seven days per year.[3] Based on the MXAK data, the beginning of the season has occurred as early as mid-May with the end of the season extending as late as December.

Between 2015 and 2017, U.S. and Russian ships accounted for 40 percent and 24 percent, respectively, of the vessels operating in the CMTS study's area of interest, but the total number of flag states reported grew from 25 in 2015 to 32 in 2017.[4] Additionally, pan-Arctic sea routes—the Northern Sea Route and the Northwest Passage—have become more active. Prior to 2008, the number of unique vessels completing a full transit of the Northwest Passage rarely exceeded five in any given year, but between 2008 and 2019, an average of 17 vessels completed the transit each year.[5] While the majority of these vessels were personal adventure watercraft, the Northern Sea Route transits have mostly been cargo and tanker traffic. Both routes have potentially major implications for international trade and shipping, and overall operations in the Arctic have started to expand from primarily regional shipping to more international shipping.

When looking back at the past decade of vessel activity patterns, it is important to note that these data points most likely underestimate the overall volume of maritime traffic. They are reliant on ships broadcasting AIS data, which many small craft are not required to do. As a result, some activities are not represented in the data, the most notable of which is subsistence hunting. Subsistence hunting—fishing activities and the harvesting of marine mammals—is the longest ongoing type of vessel activity in the Arctic. While there is little information available regarding the number of vessels used in this practice, the vessel projection report estimated the AIS-based data may underrepresent total small vessel traffic by as much as 40 percent due to the exclusion of subsistence-hunting craft.[6] Additionally, focusing on the number of unique vessels operating in the region does not present the whole story. The logistical challenges of the Arctic, namely the presence of sea ice, inherently limits the number vessels able to navigate the environment. Therefore, other criteria, like the number of transits made each season, may be more relevant when planning for future growth.

Planning for Future Vessel Activity

The growth in vessel activity over the last decade shows no signs of slowing down. Between the changes in the physical environment making the Arctic more accessible, interest from an increasingly diverse set of stakeholders, and new opportunities related to natural resources and shipping, there are a variety of factors that seem likely to sustain this growth moving forward.

As previously noted, the conservative estimate indicates a tripling of the number of vessels by 2030, as compared to 2008 numbers. The vessel projection report's scenarios were developed by reviewing potential drivers that could lead to an expansion or decline in vessel activity. In 2018, the CMTS and the U.S. Arctic Research Commission held a technical workshop on Arctic vessel activity that brought together more than 40 subject matter experts. Focusing primarily on commercial activities, the participants identified more than 70 drivers that influence vessel operations, 36 of which were quantifiable. These drivers were categorized into four major sources of growth and were used to calculate the projection. The CMTS study assumed each source was fully independent from one another. The four primary sources of growth include natural resource activities, infrastructure development, expansion of the Arctic fleet, and seasonally rerouted shipping through the Arctic.

Reviewing the drivers of vessel activity also requires an understanding of current and future infrastructure needs. In 2016, the CMTS published the report, *A Ten-Year Prioritization of Infrastructure Needs in the U.S. Arctic,* to assess maritime infrastructure in the region and issue recommendations to ensure a safe and secure Arctic marine transportation system.[7] A follow-up report, *Revisiting Near-Term Recommendations to Prioritize Infrastructure Needs in the U.S. Arctic* (2018), provides updates on the near-term recommendations and includes the latest version of the "Current Status of MTS Infrastructure in the Arctic" table.[8] These reports help highlight existing infrastructure that will support each source of vessel activity growth, as well as identify the gaps that still need to be addressed.

In the northern U.S. Arctic, there is an overall lack of existing infrastructure. This can range from physical infrastructure, like roads and highways, to communication infrastructure including telephone or cable lines. Developing this infrastructure has the potential to play a major role in vessel traffic growth, as sealift will most likely be used to provide supplies and shipments to support construction efforts. Similarly, existing MTS-related infrastructure would benefit from expansion to support increased domestic and international maritime activity, as there are current limitations related to ports, nautical charts, aids to navigation, communications, emergency response, and rescue capabilities. For example, growing vessel activity will require adequate port reception facilities to receive and dispose of ship-generated wastes in accordance with the International Convention for the Prevention of Pollution from Ships.[9] There are currently 10 ports south of the Bering Strait and one port north of it, and these ports will need to ensure their facilities can support increased vessel activity and waste management.[10]

One recent advancement has been the Port of Nome Modification Feasibility Study. The U.S. Army Corps of Engineers approved this proposed expansion project for the port in May 2020.[11] If authorized, the port would deepen the existing outer basin to 28 feet and create a new deep-water basin with a depth of 40 feet. A deep water port could enhance the economy of the region and facilitate the expected increase in maritime operations.

Nearly half of the quantifiable growth drivers were related to natural resource exploration and development, including things like offshore geological and geophysical research, oil and gas activities, liquefied natural gas (LNG) production, mining, and offshore wind development. In particular, LNG shipments from Russia and mining operations in Alaska and western Canada are expected to contribute a large portion of the projected vessel growth. Alaska also contains extensive LNG resources, but it is unlikely that LNG export operations from Alaska's North Slope will be established by 2030.

The primary risk related to natural resource activities is the possibility of oil spills, which could be especially devastating in the fragile Arctic environment. There is some infrastructure in place to mitigate this risk, but it is limited in the northern U.S. Arctic. For example, oil spill removal organizations are present on the North Slope, but some of these organizations have little to no open-ocean capability, limited wildlife response equipment, and little experience dealing with Arctic spills.[12] There are also ongoing efforts to enhance oil spill readiness and response capabilities, and products like the *Alaska Incident Management System Guide for Oil and Hazardous Substance Response*, provide guidelines to responders in Alaska.[13] These efforts will undoubtedly need to be expanded as vessel traffic and operations related to natural resource development increase over the next decade.

Another factor that will likely increase vessel traffic in Arctic waters is the expansion of polar-capable vessels. Many nations have plans to expand their fleet of vessels able to navigate the challenging environment. These include the Coast Guard's new Polar Security Cutters, icebreaking research vessels, and Polar Class cruise and adventure ships. As the Arctic has become a globally strategic region, this expansion is not only limited to Arctic nations. For example, China added a second icebreaking research vessel in 2018, and plans to add 21 icebreaking LNG-tankers by 2030.[14,15]

A robust national icebreaker fleet can maintain defense readiness in the U.S. Arctic, enhance operational safety, and support development. However, the U.S. icebreaker fleet currently consists of only two vessels, Coast Guard Cutters *Polar Star* and *Healy*. There are plans to expand, as the Coast Guard requested six new polar icebreakers as part of its Polar Security Cutter program. Construction on the first ship is slated to begin in 2021, with an estimated 2024 delivery.[16] Additionally, a presidential memorandum was issued in June 2020 to build a fleet of polar security icebreakers that will be deployable by 2029.[17]

Finally, an often-discussed result of the changing Arctic environment is the opening of new shipping lanes that can significantly reduce transit times in comparison to established transoceanic routes. For example, carriers shipping between northern Europe and the Far East that use the Northern Sea Route can cut travel distances by 35–60 percent, as compared to traditional routes like the Suez Canal. Theoretically, this can lead to sizable savings in operational costs. However, the unique demands of navigating polar waters have not diminished, and several factors can influence the number of vessels able to traverse these routes in any given year. Predictable limitations, including international regulations like the IMO Polar Code and the shallow nature of these routes—the Northwest Passage has a controlling draft of only 33 feet—can be planned for, but unpredictable environmental conditions cannot. For example, in 2018 extensive icing limited the total number of transits across the Northwest Passage to three. Additionally, search and rescue and emergency response services may be particularly important if environmental conditions shift significantly while vessels are at sea.

Adequate information infrastructure, ranging from hydrographic surveys and shoreline mapping, to communication capabilities and marine weather and sea-ice forecasts, can help support vessel growth in this category. Along the U.S. portion of these shipping routes, there are efforts underway to enhance information infrastructure through means such as mapping the shoreline and nearshore of Alaska, as directed per a presidential memorandum.[18]

Conclusion

Marine transportation in the Arctic is expanding as the region becomes more accessible. By looking at past vessel activity patterns, and considering the myriad drivers that influence vessel operations, it is clear that increasing activity will continue over the next decade. Growth will primarily be due to natural resource activities, infrastructure development, an expanding global icebreaker fleet, and potentially profitable new shipping routes. Additional factors, such as developing international interests, the unpredictable and challenging physical environment, and cultural considerations for indigenous communities will play an important, but less quantifiable, role.

About the author:

Geoffrey Dipre is the current Sea Grant Knauss Fellow with the U.S. Committee on the Marine Transportation System (CMTS) and the staff lead for the CMTS's Arctic Marine Transportation Integrated Action Team. He earned his Bachelor of Science from the University of Miami in Florida, and his Ph.D. from the Byrd Polar and Climate Research Center at The Ohio State University.

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Increasing Maritime Commerce in the Arctic

Blue economy as a catalyst for improving Arctic security

by Elizabeth "Ellee" Matthews
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Traditionally, Arctic security is referenced in terms of geopolitics, international relations, and military strategies.[1] However, a growing body of research urges recognition of a more holistic perspective, in which the interacting dimensions of the Arctic's "soft security" characteristics, such as economic, food, health, and environmental security, are used to assess the region's overall resilience.[2,3] One goal in the Coast Guard's *Arctic Strategic Outlook*, "Innovating and Adapting to Promote Resilience and Prosperity," is of significant strategic importance to all Arctic stakeholders, and effectively accomplished through a multifaceted effort that strengthens local supply chains, economies, and infrastructure.[4]

Effective economic development is key to building regional capacity, increasing collaboration and coordination with stakeholders, and promoting safe and sustainable Arctic communities.[5] Robust and diversified maritime commerce will increase the Coast Guard's opportunities to collaborate and innovate with stakeholders and foster "cooperative federalism." The Coast Guard can most effectively serve Arctic citizens, protect the environment, safely advance waterways management, and mitigate risk through partnerships with communities that are seeking a greater role in maritime governance by developing new technology, procedures, and infrastructure.

The outlook highlights the current and anticipated strategic and operational environment of the Arctic region, and outlines a number of challenges, opportunities, risks, tasks, and priorities aligned to the Coast Guard's statutory missions. Considering the outlook in the context of the U.S. National Security Strategy, perhaps the nation's greatest point of interest in the Arctic is to advance measures that further the economic security of America's citizens in the region. In many ways advancing measures that incentivize economic security, while remaining mindful that such measures should align with environmental goals, can advance U.S. national interests in the Arctic region in a way that is affordable and ultimately sustainable.

As the United States' entrance to the Arctic domain, Alaska's mainland alone boasts approximately 6,640 miles of coastline. That's more than the coastlines of the other 49 states combined.[6] As a result, securing the state's vast, remote coastline requires careful planning and coordination of limited resources. Moreover, dynamic, and powerful environmental changes continue to invoke increasingly complex security challenges. For instance, warming trends are producing significant consequences in both marine and terrestrial environments in the form of sea-level rise, thawing permafrost, coastal erosion, and declining seasonal sea ice extent and thickness, to name a few.[7] Such changes further bring unprecedented challenges to those living in the region as variations in marine mammal migrations and declining sea ice threaten food security, while thawing permafrost and increased coastal erosion threaten vital infrastructure and, in some cases, entire communities.

Today's U.S. Arctic region remains economically challenged. While oil subsidies from the greater Prudhoe Bay area support Alaska's North Slope Borough, and a zinc mine provides subsidies to Alaska's Northwest Arctic Borough, these industries have not created any associated manufacturing anywhere in Alaska. Accordingly, economic conditions for citizens across the U.S. Arctic remain challenging, and are characterized by high unemployment. There are few employment opportunities other than local governance, scattered small businesses, and service sector jobs for many towns and villages across this principally rural region. While subsistence-based lifestyles are chosen by many as a way to

maintain cultural heritage and Indigenous traditions, in many rural locations it also is an economic necessity to provide food that would otherwise simply be too expensive for too many.

If generations of Alaska's "Arctic Sentinels" who have occupied the state's coastlines villages and towns for generations are unable to provide for themselves and their families, they will be compelled to leave this region for places like Fairbanks and Anchorage. This has been the case for many of these residents' relatives over the past decades. In many ways, a depopulated American Arctic poses a considerable security threat to national interests. If the United States is unable to secure its Arctic frontiers, they become vulnerable to foreign investors who may seize such an opening. Such a remark is not meant to raise an alarm that Alaska is currently at risk for invasion, but to shine a light on a potential outcome of migration from the region caused by a chronically depressed economy. Both of these issues may result in increased willingness to allow foreign investments, which may advance economic development measures that run counter to American security interests. Conversely, a preventive approach, aligned with U.S. interests, that advances both Arctic economic and environmental security by creating industry, employment, and a sustainable future to advance a strengthened U.S. Arctic is a worthy goal.

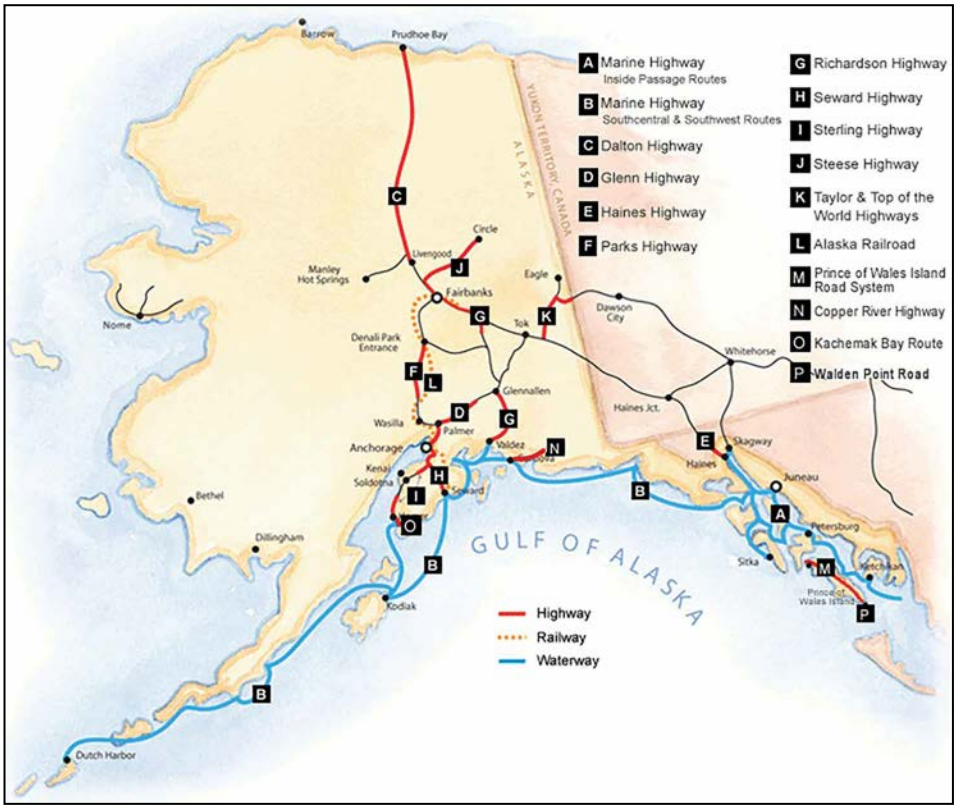
As the Arctic is a complex, multidimensional, and rapidly changing region, it is important to assess the ways in which maritime commerce may impact this complex security landscape. To set the stage, the following section will first discuss the current characteristics of Alaska's security environment, with a focus on the region's interconnected economic, food, health, and environmental components. Following this section, will be a discussion on "blue economy," a particularly innovative approach that addresses the intertwined nature of Alaska's soft security characteristics. In particular, blue economy as a combined measure of "economic and environmental security" recognizes the need to protect Alaska's vast, vital ocean space, while capitalizing on its resources for the benefit of human, animal, and environmental well-being. In other words, in an Alaskan and U.S. Arctic context, blue economy represents an approach that leverages the region's maritime resources as a foundation for building strength and resilience.

Defining "Rural Alaska and the U.S. Arctic region"

Before discussing the interrelated security characteristics of Alaska, it is first important to explain what this article means when discussing "remote rural Alaska." Generally, this is defined as the portions of the state not accessible via road, rail, or marine highway systems in Northern and Western Alaska.[8,9] Figure 1 illustrates this territory.

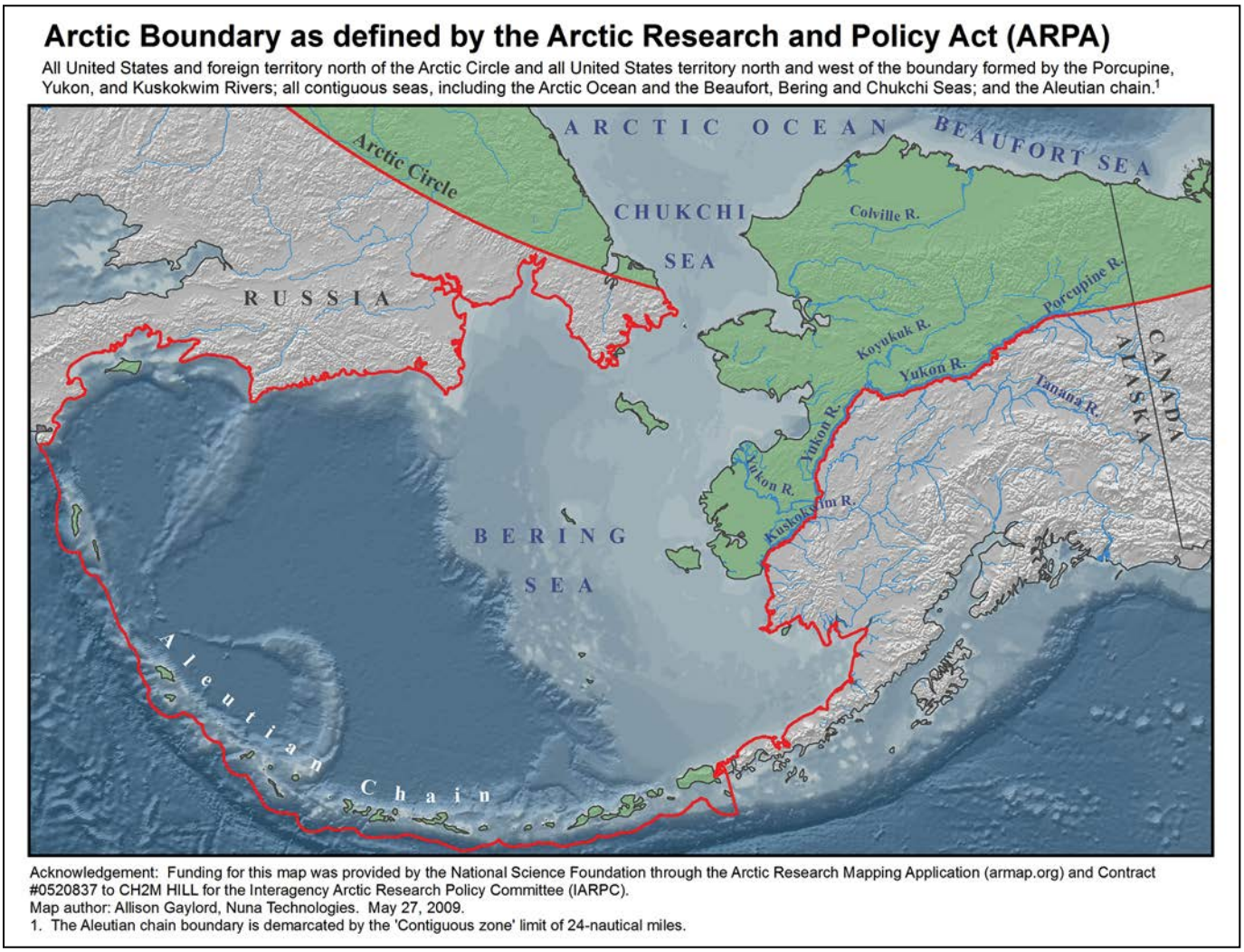
The federal government's definition of the Arctic was established by Congress through the Arctic Research and Policy Act of 1984.[10] Importantly, the Act expanded the United States' formal definition of the Arctic beyond the traditional latitudinal borders of the Arctic Circle to include the entirety of the Bering Sea and much of Western Alaskan. Section 112 of the Act defines the term Arctic as "all United States and foreign territory north of the Arctic Circle and all United States territory north and west of the boundary formed by the Porcupine, Yukon, and Kuskokwim Rivers; all contiguous seas, including the Arctic Ocean and the Beaufort, Bering, and Chukchi Seas; and the Aleutian chain."[11] Figure 2 illustrates this definition.

Figure 1: Alaska's marine, road, and railway highways



Graphic courtesy of the Alaska Department of Transportation and Public Facilities

Figure 2: The U.S. federal definition of the "Arctic Boundary"



Graphic courtesy of the U.S. Arctic Research Commission

An Interconnected Perspective on Unpacking Arctic Security in Alaska

According to the National Oceanic and Atmospheric Administration's 2019 Arctic Report Card, the average annual land surface temperature north of 60 degrees north latitude for the time frame of October 2018 through August 2019 was the second warmest since 1900.[12] In the marine environment, the mean sea surface temperatures in 2019 for the Beaufort and Chukchi Seas were 1 degree Fahrenheit to 7 degrees Fahrenheit warmer than the 1982–2010 August mean.[13] In terms of security, such rapid environmental changes induce a cascade of impacts on the residents of the region, particularly those that depend on the earth's resources for their physical, economic, and cultural survival.

For instance, the Arctic's rapidly changing environment causes a wide variety of interconnected challenges when it comes to the food web.[14] Alaska is unique in that harvesting wild food, primarily subsistence fishing, hunting, and gathering, plays a pivotal role in the state's overall level of food security. A 2018 report by the United States Department of Agriculture reported that subsistence food accounts for approximately 50 percent of Alaska residents' energy intake.[15] Subsistence food is even more important for Alaska's rural residents, who acquire approximately 25 percent of caloric requirements from wild food. Residents within the U.S. Arctic region are more reliant on subsistence food sources than residents in other Alaskan regions.[16]

However, U.S. Arctic residents report that rapid environmental changes have reduced subsistence population species, introduced invasive species and infectious diseases, as well as altered migration patterns.[17] Furthermore, food safety is increasingly threatened as warming temperatures inhibit the traditional use of permafrost cellars to preserve food harvests throughout the year.[18]

Compounding matters are the soaring prices of

Permafrost is permanently frozen ground. Some Arctic residents use a "permafrost cellar," hallowed out space in the permafrost used as a natural "freezer," to preserve food.

store-bought food as an alternative to subsistence harvesting. For instance, a 2019 report by the Alaska Department of Labor and Statistics reported that at $396, the average cost for a week of groceries in rural Alaska is more than double the national average. The U.S. average is $149 a week, based on a family of four with two children.[19]

Food insecurity is defined as the disruption of food intake or eating patterns because of lack of money and other resources.[20] Unpredictable subsistence food sources, vulnerable supply chains, and high store-bought food prices all contribute to an overall food insecurity rate of 13.9 percent in Alaska. That is comparatively higher than the United States' overall food insecurity rate of 12.5 percent.[21] When focusing on Alaska's most food-insecure regions, the highest rates are located in the western and interior regions, with rates ranging from 21.3 percent to 26.7 percent food insecurity. These threats are compounded by sparse population densities and vast geographic distances that prohibit regional subsistence food distribution, and a critically limited supply chain infrastructure that contributes to high food costs and limited availability.

Despite Alaska's rank as the country's largest state by area, it maintains the fifth lowest road mileage in the nation, with approximately 82 percent of the state's communities disconnected from the road system.[22] A harsh climate, rugged terrain, expansive distances, low population density, and numerous islands, make any future road construction projects to connect Alaska's remote rural communities both difficult and extremely costly when compared to the total number of users.[23] As a result, residents of Alaska's remote rural communities rely primarily on aviation transportation to move both people and goods, which is exceedingly more expensive than land transportation.[24]

Currently, with limited port infrastructure and no icebreaker support, U.S. Arctic shipping is highly weather dependent. As a result, Arctic shipping only occurs during a short window of the summer, leaving aviation as the only year-round means of transportation to the remote U.S. Arctic. Given the reliance on aviation transportation, there is a tremendous fuel cost-savings potential of increased volume and frequency of Alaskan maritime shipping and the significant impact strategic maritime transportation system investments could have towards lowering the extraordinarily high rural Alaskan cost-of-living.

Similarly, the limited access to many of Alaska's remote rural communities translates to extremely high costs for transporting the materials, construction, and energy resources necessary for critical public health infrastructure.[25] As a result, approximately 23 percent of Alaska's 185 remote rural communities lack running water and sewer services. Instead, these communities use a combination of closed-haul water and sewer systems in which water is hauled to the home, while sewage is hauled away, as well as self-reliant systems that often include a five-gallon bucket, or pit latrines and handwashing basins.[26] Such limited sanitation infrastructure not only contributes to the existing high rates of infectious diseases in Alaska, with particularly high rates of respiratory and gastrointestinal illnesses, but a higher risk of disease transmission in general.[27,28]

Additional health security concerns in the Arctic region can be best illustrated through a One Health perspective, a Centers of Disease Control initiative that recognizes that the public health outcomes are inextricably linked to the health of animals and the surrounding environment. Threats of diseases transmittable from subsistence wildlife species are of great concern due to the prevalence of subsistence practices, and the vital importance of subsistence wildlife as a large percentage of the Arctic diet. Such threats are intensifying as rising Arctic temperatures cause a number of changes to the ecosystems of key subsistence species. In particular, warmer temperatures may allow for a larger number of infected host animals to survive winters, while also increasing their population and habitat range, resulting in increased opportunity for disease transmission to humans, with potentially devastating consequences.[29]

What is Blue Economy?

The concept can be generally understood as the use of water resources to increase socioeconomic and human well-being, while reducing environmental risks and ecological scarcities.[30] As such, the mission of a blue economy involves a two-fold approach. On one hand, blue economy initiatives recognize the necessity to protect the water resources, as the existing resources supply food and livelihoods to billions of people. On the other hand, it calls to action the need to enhance sustainable economic activity by using the "blue" resources, particularly when referencing coastal communities.[31] Beneath its broad umbrella lies the introduction of innovative market-based technologies aimed at increasing cash flow, job opportunities, food sources, local production,

economic development, and subsequently, improved overall security.[32]

Arctic Blue Economy and Maritime Commerce

Commercial marine transportation system infrastructure improvements, including increasing the capabilities, capacity, and facilities at local ports; the number and availability of response resources; and robust communications infrastructure are often effectively driven by increases in frequency and volume of shipments of goods. This means the diversification of Arctic maritime commerce through local trade and the development of an Arctic blue economy is strategically vital to increasing the resiliency of the Arctic Maritime Transportation System.

Blue Economy in Action

How does blue economy relate to Arctic security and maritime commerce? Alaska not only boasts an expansive coastline, but also contains more than 40 percent of the nation's surface water resources, with approximately 12,000 rivers and 3 million lakes greater than 5 acres.[33]

These characteristics, coupled with the security challenges described above, not only warrant action to protect the available water resources, but also further represent the need to develop a resilient and diversified economy in U.S. Arctic.

With broad applications, blue economy includes activities from the harvesting and trade of living marine resources to renewable energy. While many blue economy industries remain largely untapped, Alaska has begun to explore several innovative ways to sustainably explore the region's immense "blue" resources. For instance, in 2018, the state government published the *Alaska Mariculture Development Plan*.[34] Mariculture is the enhancement, restoration, and farming of shellfish and seaweeds.[35] The plan includes a comprehensive approach to using and expanding mariculture as a means to enhance the economic, environmental, and cultural characteristics of the U.S. Arctic's coastal communities and Alaska as a whole. In particular, mariculture provides an opportunity for economic diversification, increased domestic and international commerce, and increased access to locally harvested food.[36] In addition, shellfish elicit numerous benefits to the ocean environment through natural filtering and cleaning mechanisms that remove excess nutrients and mitigate ocean acidification, while also providing essential habitat and increased ecosystem diversity.[37] Based on these facts, mariculture presents a potential opportunity to strengthen health, economic, food, and environmental security in the U.S. Arctic region.

Alaska's mariculture development is currently primarily located in Alaska's southcentral and southeast regions, which do not exhibit seasonal shore-fast ice. In December 2019, mariculture development extended its reaches to Popof Island, a small community located on the eastern region of Alaska's Aleutian Island chain.[38] The Aleutian Islands are connected to the waters above the Arctic Circle, and shipping traffic entering or exiting the U.S. Arctic must transit near the islands. In addition, the islands are a strategic component of the North Pacific Great Circle Route, a busy shipping corridor from North America to East Asia. As such, the region boasts

Coast Guard Chief Petty Officer James Brumley prepares a site for the installation of an Aids to Navigation tower south of Point Hope, Alaska, in 2010. For a blue economy to succeed, a robust communications infrastructure, among other infrastructure improvements, is crucial. Coast Guard photo by Petty Officer 3rd Class Walter Shinn

In June 2019, the RivGen Power System was installed on the Kvichak River in Igiugig, Alaska. Developed by the Ocean Renewable Power Corporation, the turbine is engaged by the river's water current and distributes electrical power via a cable connected to the village's power grid. Photo courtesy of the Ocean Renewable Power Corporation

not only a valuable testing arena for both the biological and economic success of the Arctic mariculture industry, but also its potential viability as a component of Arctic maritime commerce.

Another industry tapping into the opportunities presented by a blue economy is renewable energy. In 2019, the small southwest Alaskan Village of Igiugig became the first U.S. tribal entity to receive a Federal Energy Regulatory Commission permit for a water-powered project not connected to a dam. Recognizing the immense power of the Kvichak River, located at the heart of the community, Igiugig used the permit to transform the river into a renewable energy source using a 35-kilowatt cross-flow river current turbine system.[39] The turbine uses the river's water current to move the device's turbines to generate electrical power that is transferred via cable to the village's microgrid.[40] The system is particularly well suited for the needs of the small Alaska community. It was built to withstand seasonal ice impacts, while preventing any damage to the river's local fish population, which serves as a major food source for Igiugig residents. Furthermore, the system greatly reduces the village's dependence on costly diesel fuel.[41]

Alaska comprises approximately 40 percent of the total river energy, 90 percent of the total tidal energy, and 60 percent of the total wave energy in the United States. This makes hydrokinetic energy, like that produced by the new system in Igiugig, exceptionally desirable for the state. However, the current exceedingly high costs of transportation in the region make it difficult to transform desires into action.[42] As maritime commerce increases in the region, it is likely that the transportation of goods and materials will increase correspondingly, thus reducing transportation costs.[43] As a result, there may be more opportunity to transport materials necessary to construct renewable energy projects in remote rural Alaska. Increasing renewable energy in rural Alaska and the U.S. Arctic could subsequently decrease dependence on extraordinarily costly diesel fuel, while minimizing environmental impacts.

The latter two examples of expanding blue economy industries provide only a glimpse into the U.S. Arctic's "blue" potential. Additional innovative ideas emerging in the state include creating technologies that use traditional knowledge to inform mariners of sea ice conditions, biopharmaceutical research using untapped organisms emerging in the Arctic ocean, bathymetry research of the Arctic seabed using underwater autonomous vehicles, online seafood community marketplaces, and Arctic tourism.[44]

Conclusion

As rural and remote communities face multiple threats to their security, and Arctic stakeholders look to promote resilience and ensure economic stability, fragile and vulnerable supply chains and transportation systems can greatly benefit from blue economy and local maritime commerce development.

When aligned with U.S. interests, a preventive approach that advances Arctic economic and environmental security and strengthens the U.S. Arctic as a whole, is a worthy endeavor. Accordingly, the Arctic marine transportation system can naturally develop in parallel with the increased shipping of locally produced goods between rural communities, and eventually export throughout greater Alaska. Economic development through blue economy can also serve as an insulator against pandemics as communities increase their capacity to conduct maritime commerce locally. As stated in the Coast Guard's *Arctic Strategic Outlook*, the service is a "culture of continuous innovation," and tomorrow's challenges cannot be met with today's paradigms.[45] With that in mind, addressing Arctic security from an innovative and holistic perspective might make way for a new and unique paradigm to address tomorrow's relationship with Arctic maritime commerce.

About the Authors:

As education and administration manager, Elizabeth "Ellee" Matthews' primarily role is to manage the Arctic Domain Awareness Center's education program which focuses on workforce development for undergraduate and graduate students seeking careers in Arctic science and technology. Born and raised in Alaska, she has focused her professional and academic career on resilience in Alaska's communities, public health challenges, human-environmental interactions, and disaster response. She received her Bachelor of Science in zoology from Colorado State University and her Master of Science in environment and development from the University of Edinburgh, Scotland.

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Small Steps in the Arctic, Giant Leaps for U.S. Arctic Policy

Three recommendations for expanding U.S. presence in the region

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"Presence = influence"[1]
—Vice Admiral Linda L. Fagan
Pacific Area Commander, U.S. Coast Guard

"Virtual presence is actual absence."[2]
—Lt. Gen. David A. Krumm, USAF,
Commander, Alaskan Command

According to the old saying, "Showing up is half the battle." The United States is failing to live by those words in the Arctic. Despite repeated affirmations over the years that it is "an Arctic Nation with broad and fundamental interests in the Arctic Region,"[3] the United States is currently unable to maintain a year-round defense presence in the region. It is thus ill-prepared for the environmental, socioeconomic, and geopolitical ramifications of a warmer and more accessible Arctic Ocean. In an era of progressive climate change, rapid technological innovation, and renewed power competition, failing to show up is a losing strategy. If the United States is committed to protecting and defending its interests in the Arctic, it needs to quickly establish a credible, year-round defense presence in the region.

To establish such a presence, the United States will need to build the infrastructure necessary to support increasing civil, defense, and private activity. That will be no easy feat. As numerous reviews have catalogued, the United States faces an infrastructure deficit across the region. This includes:

- an insufficient number of icebreakers
- the absence of any deep-water ports
- inadequate roads, airports, and other transportation assets
- fragmented water, sewer, energy, and broadband systems
- too few radars, sensors, ground stations, and satellites
- inadequate marine charting

Neither public nor private capital sources will be able to fill this huge infrastructure gap alone. With only limited commercial activity in U.S. Arctic waters, there is practically no local tax or fee revenue to support new infrastructure or a larger government presence. But without these entities, commercial operators and financial institutions deem investment in the region too risky and thus too expensive. Government agencies and private industry are each waiting on the other to act first. The result is a stalemate.

To break the stalemate, the Coast Guard—working with federal, state, and tribal partners—should take three immediate, bold steps to send a clear message to all vested parties that it intends to advance U.S. interests in the Arctic. Ultimately, these steps would put the United States back on the path to building the domain awareness, infrastructure assets, and community relationships necessary for a credible year-round presence in the region.

Recommendation No. 1: Pursue a coordinated approach to attract public and private investment in the region.

The Arctic is a sponge for capital. According to Guggenheim Partners, a global asset manager, the region will need $1 trillion in infrastructure investment over the next decade, including roads, rails, ports, clean energy facilities, and other critical infrastructure projects.[4] Of this figure, Guggenheim estimates there is $100 million in planned infrastructure investment and $25 billion in needed investment in the U.S. Arctic alone.[5,6]

When considering investment opportunities, uniformed federal agencies, particularly the National Oceanic and Atmospheric Administration, the Navy, Air Force, and Coast Guard, as well as the Army Corps of Engineers, should look at how they can leverage their own budgets. They should also leverage partnerships with other federal agencies, like the Department

of Transportation, state, local, and tribal governments, as well as the private sector. Not all projects require full funding from Congress. Instead of seeking federal appropriations for every project, agencies should identify needed projects in the region, estimate each project's total cost, and classify them according to three potential funding pathways.

The first pathway is *direct investment*. In some cases, federal appropriations will be the only way to fully fund a project. This is usually true for projects where initial costs are high, potential return on investment is low, but the project provides an essential public service. Examples abound in the Arctic, including icebreakers, major port expansion projects, and some runway upgrades. Together, federal and state funds can support other projects. In all these cases, agencies will have to go through the normal appropriations process.

The second is *cooperative investment* where parties split the cost. In some cases, multiple agencies at the federal, state, and local level could have an interest in a project, but none can afford to go it alone. In others, one agency might provide most of the project funding if another agency spends a certain amount or proportion of the overall cost, as is often the case with federal highway projects. In the Arctic, examples of critical projects that could be covered by cooperative investment include radars, buoys, sensor arrays, telecommunications, and cloud-based databases for environmental monitoring, aids to navigation, and hydrographic surveying. The state of Alaska, for example, financed the move of the Sector Anchorage office of the Coast Guard to encourage co-location at the National Guard Armory on Joint Base Elmendorf-Richardson. Alaskan taxpayers also facilitated forward basing of Coast Guard helicopters in Barrow and Nome through cooperative use of hangar space. However, all of this has happened on an ad-hoc basis, rather than through a long-term process of identifying needs, planning, and bringing investors together.

The third is *indirect investment*. In this case, a project does not need direct government financing but might benefit from securing a federal, state, local, or tribal agency as an "anchor" client or tenant. By agreeing to a contract for services, an agency—or agencies—can support private investment in projects with high up-front costs but potentially stable rates of return on investment. In the Arctic, indirect investment could be an innovative way to solve the region's networking, communication, and maintenance challenges. With the Coast Guard or other federal agencies as "anchor" tenants, the Nome and Port Clarence ports could potentially attract private capital looking for stable returns. As U.S. efforts to export liquid natural gas (LNG) directly from the North Slope progress, military and civil needs for bunker fuel, port power, and other ship services are more likely to appear, as all will seek to take advantage of locally available LNG.

As Coast Guard Admiral Linda Fagan told a Commonwealth North study group in the summer of

A Coast Guard Arctic Domain Awareness flight in May 2009 observes infrastructure above the Arctic Circle. These flights provide a better understanding of the Arctic by testing personnel and equipment capabilities, identifying challenges, surveying sea ice, and monitoring vessel traffic. Coast Guard photo by Petty Officer 3rd Class Charly Hengen

Cruise ships are among the increased vessel traffic in the Arctic as sea ice diminishes. In April 2019, Alaska Senators Lisa Murkowski and Dan Sullivan introduced the Shipping and Environmental Arctic Leadership (SEAL) Act that would facilitate investment in services to support Arctic shipping. Scott | Adobe Stock

2020, closing the infrastructure gaps in the U.S. Arctic will require a "whole of government" approach. That does not mean a new investment authority for the U.S. Arctic is necessary. But no law prevents an admiral, commander, the governor of Alaska, or any number of cabinet secretaries, or government officials from calling stakeholders together to hammer out a plan. As Frank Davidson, the late MIT professor and instigator of the Chunnel Project between England and France, used to say, "Big projects start with lunch."

Recommendation No. 2: Support the commercialization of Arctic shipping. The SEAL Act is one way to do this.

Our second recommendation proposes a coordinated public-private approach to commercializing shipping services in the Arctic. This is modeled, in part, on the congressionally chartered Comsat Corporation of the early 1960s,[7] and the Saint Lawrence Seaway cooperation arrangement.[8] The international system regulating Arctic aviation, where, since the 1950s, overflight fees, landing, and fueling fees have supported Alaska's lynchpin role in global air cargo, would also provide guidance.[9]

To attract investment to the Arctic, sources of revenue must first be identified and developed. Given the major distance savings between East Asia and Northern Europe through the Arctic, promoting Arctic shipping is an obvious place to start.

Over the past decade, the number of vessels operating in the Chukchi and Beaufort seas has increased by 128 percent. Through 2030 it could see compounded annual growth rates of 4.9 percent, according to the Committee on the Marine Transportation System (CMTS).[10] Vessel activity has also diversified. Historically, most vessels in U.S. Arctic waters were barges plying supply routes between remote coastal communities.

Today, vessels are engaged in a variety of activities, including natural resource extraction, commercial shipping, oceanographic research, and tourism.[11] The Russian Arctic has captured more than 5 percent of the world's LNG market with Arctic shipping, and plans to triple its year-round traffic through the Arctic Ocean in the next decade. Novatek's Yamal Arctic 2 project is already under construction and will more than double production from Yamal Arctic 1.[12] Along with Russia,

new LNG projects being discussed in Alaska and Canada can, if successful, bring much greater vessel tonnage and frequency to the Arctic Ocean, and will likely provide enough operating data to give confidence to other bulk cargo and container shipping.

Much of this growth has and will continue to be driven by climate change. Between 1979 and 2018, Arctic sea ice extent has decreased for all months of the year. Sea ice extent in September, when it is typically at its lowest point in the season, has declined 13 percent per decade.[13] As a result, the navigation season in U.S. Arctic waters has increased by 7–10 days each year, according to data compiled by CMTS.[14] By 2030, the navigation season in and around the Bering Strait may be 75 days longer than at present.[15]

Alaska's tallest structure in Port Clarence, Alaska, a deteriorating Long-Range Aids to Navigation tower, was brought down more than 10 years ago. Additional aids to navigation are just one component needed for the United States to successfully expand its Arctic presence. Coast Guard photo by Jim Wells

While other nations have responded to increased vessel traffic by empowering government agencies to facilitate and regulate Arctic shipping, the United States has only passed legislation envisioning a role for the itself in these newly available seaways. CMTS, the statutory interagency group overseeing the U.S. marine transportation system, has focused primarily on domestic needs, and has not prescribed steps to facilitate the opportunities this new ocean presents for American exports and service jobs. Despite the risks that vessels operating in U.S. Arctic waters face and the potential for an environmental catastrophe, the Coast Guard took decades to implement the current "Alternative Plan of Compliance" rules for oil spill prevention in the Aleutians and the Arctic. It was mandated in 1990.[16] Such rules now facilitate investment in private tugs, salvage vessels, and spill response.

Introduced by Senator Lisa Murkowski in April 2019, and cosponsored by Senator Dan Sullivan, S. 1177–Shipping and Environmental Arctic Leadership Act, or the SEAL Act, would facilitate investment in services to support Arctic shipping. If enacted, it would establish the Congressionally chartered U.S. Arctic Seaway Development Corporation. Authorized by Congress to collect revenues and issue bonds, the corporation would provide four critical services to promote safe, secure, and reliable shipping in the region.

First, it would assist with the construction of a deep-water port and facilities in the U.S. Arctic. At present, there is no deep-water port in U.S. Arctic waters. By leveraging its revenue and bonding authorities, the corporation could partner with federal, state, local, and tribal authorities to help finance port construction and expansion plans.

The Port of Nome is a prime example. In May 2019, the U.S. Army Corps of Engineers released a $611 million proposal to extend the port's causeways and deepen its basin from 22 feet to 40 feet.[17] However, as some have pointed out, the port would still not be able to accommodate larger vessels from the Coast Guard and Navy.[18] By partnering with the city of Nome, the Army Corps of Engineers, the Department of Defense, and other federal entities, the corporation could potentially provide the bridge financing required to dredge the port beyond

The Yamal Projects

Launched in 2013, Yamal LNG is a $27 billion gas project located in Sabetta on the northeast of Russia's Yamal Peninsula, along the Northern Sea Route. The project, which began gas production in 2017, is a joint venture between Novatek, Total S.A., and CNPC, the China Nation Petroleum Corporation. It has been a pioneer of year-round commercial shipping through the Arctic, and exports 16.5 MTPA of LNG, approximately 5 percent of current global demand, to Europe and Asian markets via specially constructed "double-acting" ice-breaking tankers.

A second expanded project, Yamal Arctic LNG 2, received approval on its final investment decision in September 2019. The completed project will have a total production capacity of 19.8 MTPA.

40 feet. Nome could be developed in conjunction with Port Clarence, a natural deep-water port at Cape Spencer, the old Coast Guard Long Range Navigation site. Bering Straits Native Corporation has recently acquired Port Clarence under its Alaska Native Claims Settlement Act entitlement, and Congress asked a "Port Clarence Council" to report on the opportunity.[19]

Second, the corporation would provide a coordinated approach for promoting east and west coast ports serving Arctic trade. Given increasing west-bound traffic on the Northern Sea Route, ports in Maine and other eastern U.S. states will likely see new routes and additional cargo tied to the Arctic. Eimskip, an Icelandic shipping company, has pioneered a container route between Reykjavik and Portland that has seen traffic nearly triple since its 2013 founding.[20] By including both east and west coast ports, the corporation would provide continuity for U.S. Arctic policy as it seeks to boost cooperative infrastructure investment and improve safety and reliability in both domestic and international Arctic shipping.

Third, and perhaps most importantly, the corporation would collect voluntary fees from vessels using its services in the U.S. Arctic and elsewhere. This would create a revenue stream for the corporation, enabling it to issue bonds, provide services, and invest in regional infrastructure. Additionally, it would help lessen the risk of high-cost infrastructure projects in the region and allow state, local, and tribal governments, as well as federal agencies, to be less dependent on legislative appropriations for new projects. In doing so, it would ensure that U.S. taxpayers ultimately do not subsidize efforts to improve safety, security, and reliability for foreign vessels transiting U.S. Arctic waters.

> Dutch Harbor, the closest deep draft port to U.S. Arctic waters, is more than 900 miles south of the Arctic Circle.

There are some concerns about whether the SEAL Act's fee provisions are defensible under the United Nations Convention on the Law of the Sea (UNCLOS). While charging fees for innocent passage violates both UNCLOS and the United States' long-held stance on

The Coast Guard Cutter *Healy*, the service's only operational icebreaker, leads the 370-foot Russian tanker *Renda* closer to Nome in January 2012, where the city's residents awaited the arrival of the tanker's 1.3 million gallons of petroleum products. An Army Corps of Engineers proposal would deepen the port's basin, allowing larger ships to use the port. Coast Guard photo by Petty Officer 2nd Class Charly Hengen

freedom of navigation, it is important to note that the SEAL Act empowers the corporation to collect fees *only* in circumstances where it is providing services or access to its facilities, which is consistent with customary international law and UNCLOS.

Fourth, the corporation would seek to bolster ties between U.S. Arctic residents, commercial operators, financial institutions—including the maritime insurance industry—and other Arctic states. It would establish a single agency to coordinate and/or provide infrastructure and navigation services to vessels operating in U.S. Arctic waters. This would bring together federal, state, local, and tribal authorities responsible for vessel safety, environmental protection, and infrastructure development. It would also provide a single point of contact with other nations for international coordination of shipping routes, icebreaker escorts, spill prevention and response policies, towing and salvage, and other marine services.

This last function is especially important. As sea ice melts, icebreaking and shipbuilding technologies improve, and global demand for natural resources grows, the Arctic will become increasingly more competitive than it is today. In many ways, it is already commercially more competitive than it was in 2009, before Russia's Arctic 1 LNG facility came online and traffic along the Northern Sea Route surged to historic levels.

As the eight-nation Arctic Council's *Arctic Marine Shipping Assessment* identified in 2009, the Arctic faces four distinct scenarios for future development. If regional leaders fail to articulate a stable, rules-based order, the Arctic faces either an Arctic Race, consumed by "a no-holds-barred rush for Arctic wealth and resources," or a Polar Low consigned, as the assessment's authors predicted, to a "murky and under-developed future."[21] Neither scenario should appeal to U.S. policymakers.

Through the Arctic Seaway Development Corporation, the SEAL Act would establish a basic framework to ensure that—regardless of global trade patterns or demand for natural resources—there is general agreement about impermissible activities in the region and a mechanism to resolve potential disputes. It would provide the United States with a lead entity to help the Coast Guard ensure implementation of the International Maritime Organization's Polar Code and an advocate for U.S. Arctic Policy on the international stage. It would also allow the United States to both cooperate and compete with Russia as U.S. companies seek to develop LNG export facilities on Alaska's North Slope.[22]

Ultimately, the SEAL Act must pass Congress and receive the president's signature before it becomes law. As of this writing, the bill's concept has emerged from Congress in Section 8426 of the National Defense Authorization Act of 2021, titled "Arctic Shipping Federal Advisory Committee." It establishes the Arctic Shipping Federal Advisory Committee to advise the Department of Transportation on the Arctic Marine Transportation System. CMTS, a likely interagency administrator of this approach, would have a second chance to look more closely at international markets. While the revision may delay the enactment of some of the original bill's funding authorities, there is no reason the Coast Guard or other federal agencies cannot examine existing statutes and regulations for innovative policies that ensure shipping in U.S. Arctic waters is safe, secure, and reliable.[23,24]

Recommendation No. 3: Deploy Icebreakers Sooner Rather Than Later

The most visible and immediate move the Coast Guard can make in the Arctic to fill the infrastructure and geopolitical vacuum is to rapidly advance the construction of new icebreakers. As the Trump administration's June 2020 memo, directed at the departments of Defense, State, Commerce, Homeland Security, and the Office of Management and Budget suggests, this will require a whole of government approach to enhance U.S. Arctic presence and speed the construction timeline.[25]

In Fiscal Year 2020, Congress provided $1.2 billion to construct one heavy icebreaker and secure long lead-time parts for a second under the Coast Guard's Polar Security Cutter (PSC) Program.[26] With the initial contract awarded in April 2019, the Coast Guard expects delivery of the first PSC in 2024 and the second several years later. The two vessels will replace the Coast Guard's one remaining heavy icebreaker, the 1976-built *Polar Star*, and the now-defunct 1977-built *Polar Sea*.

Unfortunately, two is too few. Given the Coast Guard's competing missions at both poles and the need for a national security presence in the Arctic, the two new ships will hardly be able to meet existing operational demands, let alone those of a more competitive Arctic future. Admittedly, the Coast Guard has recognized it will need additional surface assets. Under its PSC Program, the service plans to acquire three new heavy icebreakers over the next decade and a half, to be followed by an additional three new medium icebreakers after that. All told, it expects to spend an estimated $2.6 billion on the first three ships.[27]

While Coast Guard leadership deserves praise for moving forward with the PSC Program, the service's timeline for final vessel delivery could be much too slow. Even under best-case conditions, the present Coast Guard icebreaker fleet will not be recapitalized until 2026 at the earliest. The first new PSC will immediately replace *Polar Star*, well past its extended service life, as the service's primary workhorse in Antarctica. The second will likely serve as a backup during scheduled maintenance or emergency situations. Neither is likely to conduct year-round Arctic missions, potentially leaving

Future Development Scenarios

	Arctic Race	Polar Lows	Polar Preserve	Arctic Saga
Framing Uncertainties	▲ More Demand for Resources and Trade ◀ Less Stable Governance	▼ Less Demand for Resources and Trade ◀ Less Stable Governance	▼ Less Demand for Resources and Trade ▶ More Stable Governance	▲ More Demand for Resources and Trade ▶ More Stable Governance
High Concept	High demand and unstable governance set the stage for an economic rush for Arctic wealth and resources. This is a world in which many international players anxiously move to outwit competitors and secure tomorrow's resources today. Intense interest in Arctic natural resources.	Low demand and unstable governance bring a murky and underdeveloped future for the Arctic. This is a world in which domestic disturbances divert attention from global issues, and simmering frictions cause prolonged divisiveness. Global financial tensions are prevalent.	Low demand and stable governance slow Arctic development while introducing an extensive eco-preserve with stringent "no-shipping zones." This is a world where concern about the environment, coupled with geopolitical and economic interests elsewhere, drives a movement toward a systematic preservation of the Arctic Ocean.	High demand and stable governance lead to a healthy rate of development that includes concern for the preservation of Arctic ecosystems and cultures. This is a world largely driven by business pragmatism that balances global collaboration and compromise with successful development of the resources of the Arctic.
Primary Drivers of Change	• Global competition among many nations for future rights to resources intensified by rise of Asia; new oil and gas discoveries • Acute demand for water worldwide; continuing Middle East tensions • Climate warms faster than models predicted; tourism expands	• Global economic downturn and increasing national protectionism • Increased domestic troubles worldwide, including regional outbreaks of new-generation Avian flu • Recession of Arctic ice slower than models projected	• Arctic oil and gas reserves disappointing • Alternative energy emerges as a viable source for global growth • Public concern about climate change and conservation, especially impacts to the Arctic	• Expanded global economic prosperity • Systematic development of oil, gas, and hard mineral resources • Shared economic and political interests of the Arctic states • Climate warms as expected
Implications for Arctic Marine Navigation	• Much activity dominated by destinational traffic supporting resource development • Unilateral governance regimes lead to inconsistent infrastructure with incompatible standards • Seasonal trans-Arctic passage possible, but not economical	• Minimal Arctic marine traffic, consisting of government re-supply and research, with periodic disruptions • Market for ice-class ships cools, reducing R&D and shipbuilding • Low attention to regulations, with unenforced and mismatched standards, and no new infrastructure	• Harmonized rules for Arctic ship design and mariner training • Seasonal trans-Arctic shipping possible but proves prohibitively expensive due to environmental restrictions, frequent patrols, and aggressive enforcement • Growth of Arctic marine tourism allowed through limited number of "use permits"'	• Wide range and variety of marine activity • Navigational infrastructure and aids expanded, making marine transport safer and more efficient • Comprehensive international Arctic ship rules • New technologies make seasonal trans-Arctic shipping a possibility

Graphic courtesy of the Arctic Council

only the medium-icebreaker *Healy* to maintain a Coast Guard presence in U.S. Arctic waters until 2030.[28]

That is unacceptable. A single heavy icebreaker provides a unique platform for conducting scientific research, vessel escort, search and rescue, law enforcement, and other complex operations. In terms of power projection, it is the Arctic-equivalent of a carrier strike group. Without one regularly conducting Arctic missions, the United States will fail to meet critical national security needs in the Arctic Ocean. As a result, it would be unable to mount an effective response to a variety of low-frequency, high-impact scenarios such as a cruise ship in distress, an oil spill, or a trade blockade. With vessel traffic and marine activity increasing in the Arctic, the country cannot afford to wait another decade to establish a long-term presence in the region.

To hasten the delivery schedule, the Coast Guard should immediately seek funding to complete the first two vessels by 2024 and the third by 2025. In its FY2021 budget request, the service asks for $555 million in new funding and a $70 million rescission for the PSC Program.[29] With the first PSC already under contract, this would fully fund the second PSC. It should also seek funding for the third PSC and award contracts for the second and third at the same time, with contract incentives for building all three vessels ahead of schedule.

Furthermore, the service should ask Congress for additional funding for three medium icebreakers through the current PSC Program. While the design and scope of the three medium icebreakers is yet to be finalized, the Coast Guard should prioritize delivery of all three by 2030 at the latest. This would allow the medium icebreakers to reduce demand for heavy icebreakers sooner rather than later, allowing the service to conduct more frequent maintenance and potentially extending the service life of all six ships.

Conclusion

Finding a consensus on Arctic development will be difficult. Despite this challenge, U.S. Arctic policy must ultimately focus on establishing a robust, credible, and sustainable year-round presence in the region. The recommendations offered here are suggestions for how to get there, but they are by no means exhaustive. Given the number and scale of the challenges facing the United States in the Arctic, what is needed most are not definitive strategies but creative solutions. Cooperation and frank discussions between stakeholders will be key.

After all, showing up is only *half* the battle.

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Mead Treadwell was the 11th Lieutenant Governor of Alaska (2010–2014) and Chair of the U.S. Arctic Research Commission (2006–2010) under Presidents George W. Bush and Barack Obama. He also chairs satellite firm Iridium's Polar Advisory Board, co-chairs the Woodrow Wilson Center's Polar Initiative, chairs the Iceland-based Arctic Circle's Mission Council on Shipping and Ports, and is a member of the International Advisory Board of the UK-based Polar Research and Policy Initiative and the Arctic Today online news service.

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United States Northern Command

The Department of Defense advocate for Arctic capabilities

by CAPT Kenneth Boda
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The 2018 National Defense Strategy recognized a significant shift in the changing geopolitical landscape.

> *Eroding U.S. military advantage vis-à-vis China and Russia is undermining our ability to deter aggression and coercion in key strategic regions.*

These near-peer competitors have blatantly disregarded international norms, challenged the relatively peaceful world order, and are investing in, and exercising, military capabilities. These regimes not only threaten their regional neighbors, but have taken actions that directly threaten North America. Therefore, the National Defense Strategy concludes that the homeland is no longer a sanctuary.

This is true today, even in the Arctic where, for centuries, brutal weather and dangerous sea ice provided a fortress wall that protected the northern reaches of our continent. But the moderating climatic conditions have created new opportunities for extraction of resources and expedited shipping pathways, prompting China and Russia to invest in advancing polar capabilities. While China professes to a scientific and commercial interest in the region, Russia is conducting aviation and fleet actions in the Bering Sea and Arctic Ocean that threaten the security of our homeland. As a result of these realities, the Arctic has become a focus of geostrategic importance for the first time since the Cold War. In response, the Department of Defense issued a 2019 Arctic Strategy that establishes three objectives:

- Defend the homeland
- Compete when necessary to maintain favorable regional balances of power
- Ensure common domains remain free and open

The United States Northern Command (NORTHCOM) is the geographical combatant command responsible for conducting military operations in North America. Created following the September 11 terrorist attacks, NORTHCOM has operational control of U.S. armed forces engaged in defense support to civil authorities; hurricane response and wildland firefighting; pandemic influenza and infectious disease planning; and chemical, biological, radiological, and nuclear response. But most importantly the command, along with the collocated binational North American Aerospace Defense Command (NORAD), is responsible for homeland defense, the top priority of the National Defense Strategy. NORTHCOM and NORAD share a commander, Air Force General Glen VanHerck, and although they are two distinct commands, the synergy of the homeland defense roles each plays is enhanced by the combined staff structure in Colorado Springs, Colorado.

A North American Aerospace Defense Command F-22 fighter aircraft, left, supported by E-3 airborne warning and control system and a KC-135 refueler aircraft, intercepted two Russian Tu-95 bombers, right, escorted by two Su-35 fighter aircraft in October 2020. North American Aerospace Defense Command photo

NORTHCOM is also designated as the Defense Department's advocate for Arctic capabilities, which is particularly significant because defending the homeland necessitates operations in the high-north regions of Alaska and Canada. NORTHCOM and NORAD recognize the strategic geography of the Arctic as an avenue of approach for our peer adversaries. This knowledge requires the creation of a steady-state, purpose-built, capable homeland defense to deter aggression and protect critical infrastructure, preserve the ability to project power forward, and prevent homeland defense vulnerabilities from constraining regional and global options for our national leadership. As General VanHerck said in his July 28, 2020, testimony before the Senate Armed Services Committee, "We need persistence and domain awareness in the Arctic to ensure that we are aware and able to detect, monitor and, if needed, deter (threats)."

Petty Officer 3rd Class Jacob Holloway organizes and prepares charts on the bridge of Coast Guard Cutter *Polar Star* in December 2020. During this deployment, the 44-year-old heavy icebreaker supported national security objectives throughout Alaskan waters and into the Arctic along the Maritime Boundary Line between the United States and Russia. Coast Guard Photo by Petty Officer First Class Cynthia Oldham

NORAD, a command born at the outset of the Cold War, has long been focused on confronting adversarial threats from the Arctic. In the 1960s, NORAD compelled the United States and Canada to build the Distant Early Warning (DEW) Line of radar stations to counter the emerging threat to the homeland from Russian bombers armed with nuclear gravity bombs. Coast Guard icebreakers and airlift supported this massive operation to erect sensors that would monitor and respond to Russian military aviation threats to North America in the high north. Improvements in aviation and the advent of cruise missile technology mean that by the 1980s, Russian bombers could fly below the DEW Line radar coverage. In response, NORAD built the North Warning System, building more sensor sites and upgrading the radar used to detect Russian threats. Employing the same generation of technology as a 1980s cell phone, the North Warning System continues to monitor the airspace along our Arctic coast.

General Glen D. VanHerck, right, commander of North American Aerospace Defense Command (NORAD) and U.S. Northern Command, and Lieutenant General David A. Krumm, commander of Alaskan Command, Eleventh Air Force, and the Alaskan NORAD region, meet at Joint Base Elmendorf-Richardson, Alaska in October 2020. VanHerck was in the region to enhance partnerships, and discuss Arctic-related issues of strategic importance to NORAD and U.S. Northern Command. U.S. Air Force photo by Airman 1st Class Emily Farnsworth

Conversely, throughout the past two years, Russia has continued investing in its Arctic military infrastructure. This includes lengthening existing runways and building new ones at multiple airfields in the high north to serve as forward operating bases for modernized long-range heavy bombers armed with advanced, precision strike, air-launched cruise missiles. These aircraft can easily traverse the Arctic—the shortest avenue of approach from Russia to North America.

The cooperation between Russia and China in Arctic region economic ventures, like liquefied natural gas exports from the Russian Arctic and Beijing's "Polar Silk Road" initiative to diversify its maritime trade routes, is another concerning advance. This collaboration brings together our two most prominent adversaries in a mutually beneficial relationship that has implications for the geopolitical landscape of the Arctic region. Though the homeland is at risk, modest Arctic investments can vastly

improve our posture and deter our adversaries.

NORTHCOM and NORAD are building capability and capacity to operate in and throughout the Arctic, in all scenarios, across all domains, against any adversary. They are working with industry and the military services to find the best solutions to increase our Arctic capabilities and outpace threats and competitors. As the Defense Department's Arctic capability advocate, NORTHCOM has secured funding for Arctic surveillance and communication prototypes and increased engagements with our partners to identify gaps and collectively mitigate them. This is being done in conjunction with shaping policy to respond to the new threats posed from the Arctic. NORTHCOM's efforts in Arctic homeland defense focus on four investment pillars:

- domain awareness
- communications
- improved infrastructure
- a sustainable presence

Domain Awareness

Domain awareness is the cornerstone of information dominance, the most effective tool to fight and win the great power competition now occurring in the Arctic. NORTHCOM is pursuing sensor development and information sharing with partners and allies to understand Arctic activities in multiple domains. Investment in a modern mesh-network of sensors using current, market-available technology can protect our nation from adversarial threats. Persistent awareness across all domains—undersea surface, land, air, space, and cyberspace—is an achievable goal, and crucial to defending the homeland. With that requirement in mind, the command is working with the Pentagon to advance multi-domain surveillance capabilities for the Arctic.

NORTHCOM and NORAD have recently accomplished some important steps toward this goal, particularly investing in initiatives to monitor the Arctic airspace. For example, Thule Air Base in Greenland offers a location to forward deploy aviation forces for deterrence against our adversaries, enhancing the military's operational flexibility and situational awareness to address the changing Arctic security environment. While our close partnership with Canada is critical to continental defense, NORAD's North Warning System is essential to safeguarding our nations. Unfortunately, the systems' technology lags behind the offensive advances of our adversaries and an updated approach to domain awareness and information dominance is necessary to meet emerging threats to the homeland.

NORTHCOM and NORAD have a number of initiatives to advance Arctic domain awareness. We are advocating for sensors and data sharing with partners and allies to understand Arctic activities across multiple domains. Understanding the efficacy of public-private partnerships to speed up acquisition timelines, we are researching commercially owned and commercially operated sensing system options. Sensitive to the effects of environmental changes, we are pursuing high latitude meteorological remote sensing to support routine force deployments, combined joint exercises, and greater presence in the Arctic. Finally, we have partnered with the U.S. Navy to incorporate Arctic surface ship capability requirements into the Future Surface Combatant programs. NORTHCOM and NORAD also are investing in incremental advances in systems and initiatives with the strategic goal of achieving all-domain awareness in the Arctic.

"Future Surface Combatant" refers to a family of systems that includes a large vessel akin to a destroyer, a small vessel like the Littoral Combat Ship, a large and a medium unmanned surface vessel, along with an integrated combat system as the common thread linking all the platforms.

Communications

Military and commercial operations in the Arctic are challenged, as traditional forms of communications do not function well in that region. This issue is well documented in voice communications, but the concern today is primarily about data throughput. NORTHCOM is working with the Department of Defense (DOD) to invest globally in essential services and networks in a contested command, control, communications, and computers, or C4, environment—including the Arctic region. Information dominance hinges on effective communications and the ability to receive information from the Arctic and push it to front-line operators.

Employing legacy systems in a new way by using modern analytic methods offers some immediate improvements in Arctic communications. High frequency (HF) line-of-sight communications is one example. DOD studies in HF repeater/relay concepts are being used to develop a modern propagation model for the Arctic, improving the effects of geomagnetic interference in the Arctic. Testing indicates that HF radio waves can create reliable links that support HF voice and data communications. Another option for dependable Arctic communications is the Mobile User Objective System (MUOS), a defense satellite constellation that provides a near-term solution to improve and deliver resilient, low-bandwidth, high-latitude communications.

NORTHCOM partnered with the Coast Guard to test both HF line-of-sight and MUOS for six weeks in the summer of 2019 while aboard Coast Guard Cutter *Healy*. Using a MUOS prototype antenna and DOD software-defined radios, the icebreaker was provided with limited voice, chat, video, and data connection during the entire voyage up to 81 degrees north latitude. These successful tests offer promise for delivering reliable high-latitude communications to the joint warfighter.

Looking toward the future of persistent high-latitude communications, NORTHCOM has focused significant effort on promising ideas and technologies. For instance, we have advocated for defense agencies to explore solutions to meet communication requirements above 65 degrees north latitude. In another example of public-private partnership synergy, we are exploring multiple low-Earth orbit satellite solutions with commercial partners. These partnerships would develop user terminals and ground stations to provide high throughput data transfer capability that could supplement the North Warning System radar sites in Alaska and northern Canada, as well as low-power options for deployed units. Additionally, we have advocated support for Canada's Enhanced Satellite Communications Project—Polar, which is intended to provide guaranteed, reliable and secure access to Arctic narrow and wideband communications support to U.S., Canadian, and NATO missions. The cutting-edge technology from these initiatives has the potential to finally deliver dependable Arctic communications solutions.

Improving Infrastructure

The DOD is focused on enhancing existing Arctic facilities to support the latest weapons systems, like the F-35 Joint Strike Fighter, and train the joint warfighter to operate in the polar climate. When building Arctic infrastructure, environmental changes like coastal erosion and melting permafrost add to the complexity of withstanding harsh weather conditions. NORTHCOM and NORAD are working with allies, partners, and industry to solve complex infrastructure challenges for our bases in the Arctic.

One such important facility is the Joint Pacific Alaska Range Complex, where NORTHCOM advocated for funding to continue modernization that supports testing weapons performance in Arctic conditions. NORAD has prioritized capital construction for high north alert airbases. We also have partnered with the United States' Air Force and Army Corps of Engineers Research and Development Center and Canada's Department of National Defense to test alternative cold rapid airfield damage repair methods in the Arctic. Current methods do not work below 25 degrees Fahrenheit.

Development of a strategic arctic port that meets homeland defense requirements by providing a 40-foot, controlled depth in the harbor to accommodate destroyers and polar icebreakers is another major program that NORTHCOM is supporting. A strategic port north of Dutch Harbor, Alaska, increases Navy and Coast Guard operational reach and endurance to the Bering, Chukchi, and Beaufort Seas. NORTHCOM and NORAD secured $1.6 million dollars in funding to improve the Patriot missile site needed to protect Eielson Air Force Base in Fairbanks, Alaska, while allowing Army ground-based air defense forces and equipment to prepare for extreme cold weather conditions.

We have identified the need for advanced attack-defeat mechanisms for operations throughout the Arctic region including Arctic basing and advanced weapons and logistic support. Resilient infrastructure and

Two F-35A Lightning IIs assigned to the 356th Fighter Squadron and two F-16 Fighting Falcons assigned to the 18th Aggressor Squadron fly over Denali National Park in Alaska in May 2020. The two fighters have access to the 77,000 square mile Joint Pacific Alaska Range Complex. U.S. Air Force photo by Tech. Sgt. Jerilyn Quintanilla

logistics are required to sustain current defeat systems. Future defeat capabilities will depend on appropriate infrastructure and sustainment measures.

U.S. Navy soldiers parachute into the Arctic Circle and drop an Arctic sustainment package as part of a training exercise during Ice Exercise (ICEX) 2016. ICEX is a multi-week exercise designed to research, test, and evaluate operational capabilities in the region. ICEX allows the U.S. Navy to assess operational readiness in the Arctic, increase experience in the region, advance understanding of the Arctic environment, and develop partnerships and collaborative efforts. U.S. Navy photo by Aerographer's Mate 2nd Class Zachary Yanez

Establishing Sustainable Presence

A sustainable presence is a crucial factor in defending the homeland against aggression from the north. A persistent presence is extremely difficult to maintain in such a harsh, remote region and both commands actively promote Arctic warfighting capabilities. For instance, NORAD regularly engages with the Canadian director general for support to initiate regular collaboration in sustainable high north warfare through the Binational Logistics Coordination Cell. Additionally, NORTHCOM has championed investments to improve the military's capability and capacity to operate throughout the Arctic and we continue to deploy troops to the region and test equipment to ensure the joint force is prepared to operate in extreme cold weather conditions.

Military exercises like NORTHCOM's Arctic Edge, a biennial homeland defense exercise, help make that possible. Arctic Edge 2020 linked a number of sub-exercises with participation across the joint force, including ICEX, the Navy's Ice Exercise, in March, which involved submarines and an ice camp 200 miles north of Prudhoe Bay, Alaska, and is supported by ski-equipped cargo planes. Operation Nanook is a Canadian exercise that supported Arctic Edge 2020 with CF-18 fighters and troops. Arctic Eagle is an Alaska National Guard Exercise focused on air operations, and Arctic Pegasus is a U.S. Army Alaska exercise to deploy airborne forces to protect critical infrastructure. We have increased integration and experimentation efforts during Arctic exercises to help identify rapid prototyping candidates and technology, like Project Blowfish, a non-kinetic counter-mine capability. Overall, Arctic Edge has advanced the joint force's understanding of the polar climate and improved its ability to operate in challenging conditions.

Troop acclimation to the Arctic region is important, but the proper equipment can mean the difference between warfighting success and failure. For troops deployed to the Arctic, we developed an Arctic Air Base Set Initial Capabilities to drive resourcing for testing and development of these extreme cold weather shelters. During Arctic Edge 2020, NORTHCOM partnered with the Army Natick Soldier Systems Center to test an existing hard-walled sheltering system modified for extreme cold weather field conditions. In partnership with U.S. Indo-Pacific Command, NORTHCOM sponsored an Arctic logistics summit hosted by Alaska Command at Joint Base Elmendorf-Richardson. The summit focused on identifying deficiencies in our collective ability to sustain multiple combatant command-operations in a resource-challenged joint operating area, including cold-weather sustainment, equipment, and infrastructure challenges.

NORTHCOM also has been vocally supportive of the Coast Guard and Navy Polar Security Cutter (PSC) program during Congressional and public forum opportunities. The sustainable, year-round maritime presence the PSC would provide is crucial for defending the sovereignty of the United States. A PSC is a mobile sensor to establish maritime domain awareness where needed in ice-covered waters. And the PSC's ability to escort surface combatant ships, refuel military helicopters, and relay communications to deployed forces is highly valued by the combatant command.

NORTHCOM and NORAD are singularly focused on our primary mission of defending United States and Canada. During the Cold War, the Arctic was a front line in homeland defense. With the emergence of near-peer adversaries, and their focus on the north, operations in the Arctic have become more critical than ever before.

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Autonomous Technologies

Closing resource gaps and ensuring Arctic security

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Arctic Domain Awareness Center

Operating in the Arctic is often described as operating under a "tyranny of distance." Severely limited resources, infrastructure, and environmental information combine to create a uniquely challenging operating environment filled with increased risks, unknown hazards, and limited options.

This supremely challenging environment is also home to trillions of dollars of untapped resources and some of the most productive fisheries in the United States. The ports of Dutch Harbor, Kodiak, and ports within the Aleutians landed a combined catch of 1.1 billion pounds in 2018.[1] As multiyear sea ice continues to diminish and ice-free navigation of waterways continues, more and more nations and corporations fix their gaze on Arctic exploration. As Arctic interests and operations grow, safeguarding delicate Arctic ecologies, protecting valuable natural resources, and furthering rules-based order will become more resource intensive and complex. As new and innovative technologies become operational, their strategic development, transition, and deployment can simultaneously lower risk, reduce costs, effectively protect the environment, and bolster national security.

To continue safeguarding these important resources, along with other strategic Arctic national interests, the United States must plan for a robust, year-round maritime presence commensurate with the expanding interest in the Arctic's strategic value. This includes its natural resources, and its potential as a transportation corridor between Asia, Europe, and North America. If we are not vigilant and proactive, other Arctic and non-Arctic nations will outpace us in assuring their strategic interests in the region in ways that may adversely affect the national interests of the United States.[2]

Understanding the Stakes: Examining What's at Risk

Arctic waters contain approximately 250 fish species that inhabit the region on a full-time basis. The Arctic Ocean system provides critical support for over 600 fish species.[3] Multiple marine mammals, vital to the food security and central to the culture of Indigenous people, routinely transit Arctic waters. They are highly susceptible to environmental changes like rising ocean temperatures, ingress of new and invasive species, and food chain contamination from maritime pollutants.

Fisheries

The wholesale value of Alaska seafood was $4.5 billion in 2018.[4] Bering Sea fisheries production accounts for more than half of the wild-caught fish and shellfish in

Alaskan fisheries provide the majority of wild-caught fish and shellfish in the United States. Increased vessel traffic in the Arctic will eventually start to adversely impact the hundreds of fish species in the ecosystem. reisegraf | Adobe Stock

the United States, and vital sea life for subsistence harvesting. Alaska is ranked seventh in the world in global fish exports, and its seafood industry accounts for almost $6 billion a year in total economic activity.[5]

Marine Mammal Protection

There are 12 species of marine mammals that regularly inhabit the Arctic including four species of whales, polar bear, walrus, and six species of ice-associated seals. Additional species, including killer whales (Orcas), Fin whales, Sperm whales, Blue whales, Humpback whales, and Harbor Porpoise are also found periodically, or even with some regularity, within the waters of the Arctic.[6]

Natural Resources

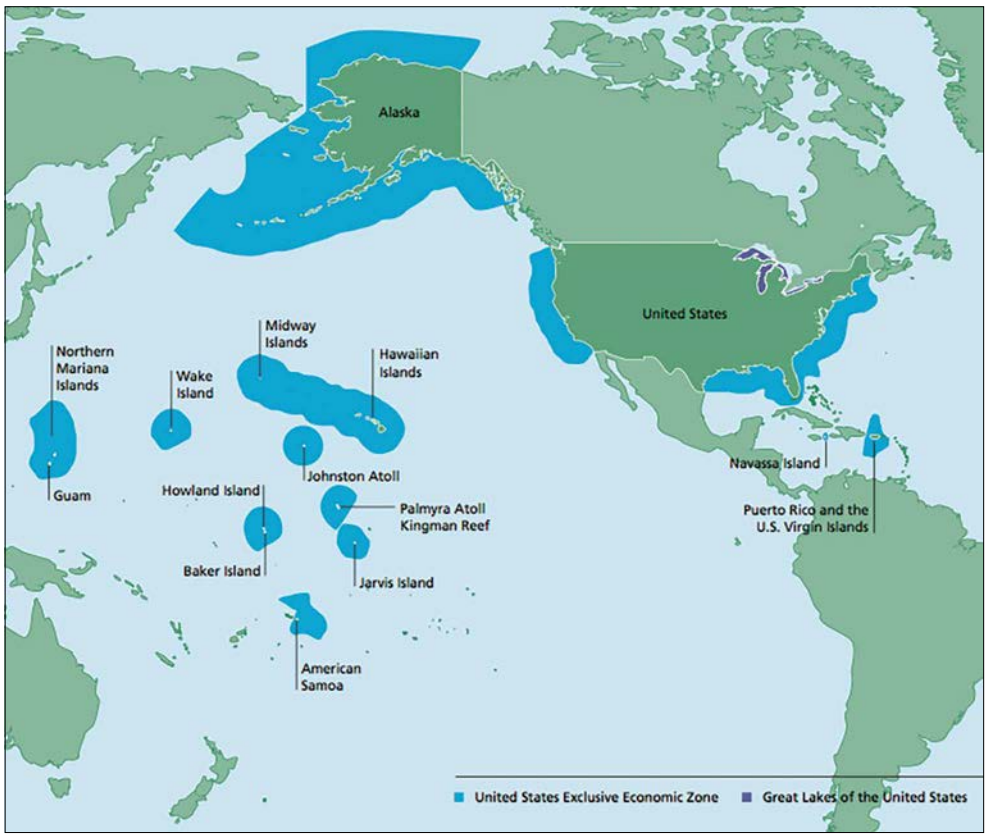
Even in this current age of uneven and uncertain global economic growth, the American Arctic presents an attractive opportunity. The region holds an estimated 13 percent of the world's undiscovered oil resources, or about 90 billion barrels, and 30 percent of the world's undiscovered gas resources, or about 1,669 trillion cubic feet of natural gas and 44 billion barrels of natural gas liquids. Of these resources, approximately 84 percent are located in offshore areas.

The Alaskan Arctic is considered to be the second most prospective Arctic province, after the West Siberian Basin, containing an estimated 29.9 billion barrels of oil, more than 221 trillion cubic feet of natural gas, and 5.9 billion barrels of natural gas liquids.[7] The value of these resources, estimated in trillions of dollars, spurs international interest and promotes interference from foreign powers.

Examining Resources and Infrastructure in Alaska and the Arctic

Depending on the territories included in the calculations, the United States exclusive economic zone (EEZ) is between 3 million and 3.5 million square nautical miles in size. The EEZ located off the Alaskan coast, much of which is in Arctic Waters, is approximately 1.4 million square nautical miles, or between 40 percent and 46 percent of the total United States' EEZ by area. Less than 10 percent of the Coast Guard's resources are stationed in this region, or at any one time patrolling off, the Alaskan coast. This illustrates that less than 10 percent of Coast Guard resources must sprint to cover 40 percent, or more, of the United States' maritime territory. Traditionally, closing this coverage gap has proved complicated and expensive. High fuel, facilities, transportation, housing, and contract labor costs in remote areas present additional obstacles and logistical complexities.

Combined with harsh operating conditions and long distances between ports and facilities, planning operations with such limited infrastructure requires additional resource and personnel movements, greatly complicating operations as the number of responders increases. Autonomous and remotely operated systems can maximize the effectiveness of available resources, reduce the number of personnel required for a mission, and independently increase domain awareness. Remotely controlled air, sea, and amphibious craft could offer some compelling options for providing persistent wide-area surveillance, especially if networked together and with sensors on other assets to help provide a common operating picture.[8]



The Exclusive Economic Zone (EEZ) off the coast of Alaska accounts for more than 40 percent of United States' maritime territory. This creates complicated, expensive challenges as less than 10 percent of Coast Guard resources are stationed in the region. Graphic courtesy of National Oceanic and Atmospheric Administration

Oil Spills of National Significance

Approximately a decade ago, the British Petroleum (BP) *Deepwater Horizon* oil drilling rig explosion and collapse in the Gulf of Mexico, renewed emphasis on Coast Guard and national incident management efforts. This is the first time a spill of national significance[9] had been declared, resulting in the need for a national structure and a national incident commander (NIC), then-ADM Thad Allen, to deconflict problem areas at all levels of government.

Oil spill planning and management dictates the need to develop and acquire spill detection and surveillance technologies to locate and map the thicker portions of the slick on the water and in the water column. While visual observations from the air are the most common means of providing spill reconnaissance, tracking and characterizing oil in the water, in any weather and 24 hours a day, is a challenge requiring remote sensing technology. These technologies have been rooted in requirements and specifications, developed, evaluated, and tested by the Coast Guard Research and Development Center, over the decades. While technologies like frequency scanning radiometers, laser fluorosensors, synthetic aperture radar, infrared sensors, and even autonomous underwater vehicles, have been developed and studied over the years, challenges posed by the Arctic cold environment remain.

Arctic Domain Awareness Center Summer internship students gather in Utqiagvik, Alaska, in June 2019. Interns are trained and prepared to be the future workforce in the Arctic. Photo courtesy of The Arctic Domain Awareness Center

Science and Technology Solutions to Cope with the Challenges

The Arctic Domain Awareness Center (ADAC) is a Center of Excellence in Maritime Research within the Department of Homeland Security's (DHS) Science and Technology Office of University Programs.

ADAC supports the Coast Guard and other DHS maritime missions in order to improve Arctic search and rescue, humanitarian assistance, disaster response, and security capabilities, including efforts to "enable the decision maker" across those mission sets. ADAC is a research network with investigation nodes across multiple universities and institutions across the United States. In addition to DHS S&T-funded research for the Coast Guard, the Center conducts education programs at the graduate and undergraduate levels as a workforce development endeavor for new applicants to the Homeland Security Enterprise.

In addition to scholarship, these student fellows participate in Center-conducted research and workshops. Each fellow participates for a minimum of two years of funded workforce development, plus two summers of internships, including ADAC's Arctic Summer Intern Project, or ASIP, which is normally conducted at the Barrow Arctic Research Center in Utqiagvik, Alaska. ASIP is a genuine Arctic research field experience that has provided students invaluable and memorable experience on the Alaskan North Slope, as well as offering insights from Alaska Native citizens and local leadership. Due to COVID-19, ASIP was a virtual event in 2020.

ADAC has become a well-known convening authority for workshops, table-top exercises, and assessments, including its Arctic-focused Incidents of National Significance workshops. These Arctic-related medium- and long-term environment events focus on longer term policy needs for Arctic operators and senior leaders, while helping develop new research through the examination of near-term challenges identified by the Coast Guard's District 17 commander. To make these large, complex workshops and symposia more successful, ADAC has jointly led workshops with responders, researchers, and Arctic residents in rural Alaska to gain detailed understandings of crisis-response shortfalls and the changing conditions of the Arctic region.

Now approaching its eighth year of investigations, ADAC has delivered important research in an array of fields including sensors, platforms, modeling, decision-support systems, and knowledge products available to the Coast Guard, other DHS Arctic operators, and for the public good. Delivered as well, are students who have now entered the Homeland Security Enterprise.

ADAC has also supported several important initiatives with the Interagency Arctic Research Policy Committee, the Office of Naval Research's International Cooperative Exchange for Polar Research and U.S. Northern Command and Alaska Command for Arctic Symposiums and Arctic Senior Leader Summits. As a mature Center of Excellence, ADAC is increasingly focused on transitioning completed research to real-world private and public sector applications. This ensures that every dollar invested in the center provides the greatest possible benefit to public good. Over the past four years, ADAC has put an average of 93 cents of every dollar invested into program research content, symposia, and student advancement.

The center has already demonstrated success in transitioning research to support the Coast Guard, the U.S. National Ice Center, National Oceanic and Atmospheric Adminitration, and the other federal and Arctic-focused maritime organizations, like the Alaska Ocean Observation System and the Alaska Marine Exchange. Outside of DHS and the Coast Guard, ADAC's key partners include the U.S. Arctic Research Commission, the Polar Institute at the Woodrow Wilson Center, and the Ukpeaġvik Iñupiat Corporation, at Utqiagvik, Alaska. ADAC retains a core "Canada-U.S." focus in advancing collaboration across a number of academic and government partners in Canada, including a key relationship with Canada's Department of National Defense, Canadian Joint Operations Command, Trent University, and National Research Council Canada.

Over the years in which ADAC has researched solutions to address shortfalls in domain awareness in the Arctic, the size and scope of the distances coupled with the paucity of telecommunications, infrastructure, and logistics is daunting and likely to persist for years to come. An enduring truth about the region is that while Arctic warming is changing the dynamics of the region quite remarkably, winters remain long and springtime is generally viewed as slow in coming. Implementing solutions to reduce risk and improve fidelity in decision-making are nearly as slow in coming as springtime in the Arctic. That said, there are reasons to believe that technology adapted and built for the Arctic may soon start advancing Arctic Domain Awareness quite substantially.

The LRAUV as a Multi-sensor Platform and Force Multiplier

ADAC's flagship research project, the propeller driven Long-Range Autonomous Underwater Vehicle system (LRAUV), will advance Arctic domain awareness and is one solution to address an oil spill in the Arctic maritime environment. The LRAUV system is designed as a helicopter-portable platform and, together with corresponding multipurpose communications, docking, and charging buoys, functions as a multi-mission capable system that can operate autonomously or be controlled remotely in excess of a month at a time with recharging. The LRAUV system project is co-led by Monterey Bay Aquarium Research Institute and Woods Hole Oceanographic Institution. The LRAUV system weighs approximately 255 pounds, is approximately 8 feet long, and can remain deployed for about 2 weeks on a single charge, and has a range in excess of 500 nautical

The Artic Domain Awareness Center's leading research project, the propeller-driven Long-Range Autonomous Underwater Vehicle system, undergoes testing in a controlled environment. The system is designed to advance domain awareness and can be one solution to address significant oil spills in Arctic waters. Photo courtesy of The Arctic Domain Awareness Center

miles. The project brings the Coast Guard a state-of-the-art capability in long-range oil-spill detection and characterization via a semiportable, easily-deployable package.

When properly equipped, LRAUV can leverage the unique long-range versatility of the open-source Tethys web-development platform for water resources to simultaneously perform a variety of missions. These missions include informing open-ocean oil-spill response operations, collecting bathymetric data, locating and characterizing oil under ice, and conducting subsurface monitoring of shipping routes and related marine mammal activity. For maritime environmental protection, the platform can readily monitor or screen for petroleum products and track their movements through the water column with an onboard SeaOWL optical oil-in-water sensor. In a large-scale pollution response effort, LRAUV can provide the critical information needed for the most effective use of limited resources. If dispersants are applied to a large-scale discharge, the LRAUV system can execute a parallel search pattern periodically collecting samples to determine the efficacy of dispersant use and inform subsequent dispersants treatments. System developers have the ability to use water gulpers with the platform to support sampling to inform treatments and LRAUV can leverage its endurance to then cover the previously defined area, adjusted for currents, multiple times. The data collected further informs the use of chemical dispersants during the incident and provides valuable data for future response best practices. If petroleum is discharged or collected under ice, LRAUV is equipped with multibeam sonar can accurately characterize it and inform response efforts. These are just a few examples of the LRAUV's potential benefits.

Conclusion

Regular and persistent Coast Guard presence and peaceful engagements support regional stability while positioning the United States as the global maritime security partner of choice.[10] Building a much-needed, increasingly vital "persistent presence" to protect marine mammals, fisheries, and natural resources from the impact of hazardous materials in a vast, remote maritime environment is undoubtedly challenging and demands the most effective and impactful deployment of limited, precious resources. Significantly greater Arctic capacity is readily attainable through new, innovative technologies that can increase the United States' Arctic presence, enhance the scope of domain awareness methods, and eliminate high-risk manned operations.

About the authors:

As an Arctic Domain Awareness Center (ADAC) senior research professional, Jason "Olaf" Roe's mission is to provide Coast Guard operator-focused coordination, guidance, and support to ADAC research, and guide project development to maximize Coast Guard operational relevance. During his 12 years of Coast Guard service in Alaska, he developed a respect and admiration for Arctic and rural Alaska, and is committed to increasing the safety and security of the Arctic region through community engagement and operationally relevant research.

As executive director of the Arctic Domain Awareness Center, retired Air Force Maj. Gen. Randy "Church" Kee, leads a distributed team of Arctic-focused science and technology, education, and student field programs, and convening activities for a wide range of Arctic stakeholders. Through his 30-year military career, General Kee led at the Squadron, Group, Wing, and Air Ops Center levels. In 2020, he was appointed by the president of the United States as a commissioner to the U.S. Arctic Research Commission.

Theophilos "Theo" Gemelas is currently a program manager overseeing three DHS centers of excellence, including the Arctic Domain Awareness, in the Department of Homeland Security's Science & Technology directorate. He previously served as an associate professor at the U.S. Naval War College, as associate director of studies at the Council on Foreign Relations, as a senior policy advisor at the Transportation Security Administration, and as a Principal Analyst at the Homeland Security Institute.

Connor Keesecker serves as the communications and research associate for the Arctic Domain Awareness Center (ADAC). In this role, he supports the development of ADAC reports and knowledge products as well as providing support for the Center's communications operations. Prior to ADAC, he worked on local community and economic development issues in Anchorage, focusing on identifying and implementing best practices in northern placemaking.

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9. A Spill of National Significance (SONS) is an oil spill that, "due to its severity, size, location, actual or potential impact on the public health and welfare or the environment, or the necessary response effort, is so complex that it requires extraordinary coordination of federal, state, local, and responsible party resources to contain and clean up the discharge." See *Spill of National Significance, Executive Reference Guide*, SONS Communications Coordination Workgroup, March 2019
10. *Changes in the Arctic: Background and Issues for Congress*, Congressional Research Service, 2020 https://fas.org/sgp/crs/misc/R41153.pdf

NOAA's Navigation Services in the Arctic

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The National Oceanic and Atmospheric Administration's (NOAA) navigation services are an important part of the U.S. Arctic marine transportation system infrastructure, enabling safety, security, and sustainability in the Arctic. Mapping Arctic waters and maintaining the foundational framework supporting this critical data set is essential to NOAA's ability to provide the services mariners, coastal communities, and other blue economy stakeholders need to operate safely in the region. The challenging Arctic environment demands unique approaches to the core NOAA mission of charting U.S. waters. NOAA's activities to overcome these challenges include:

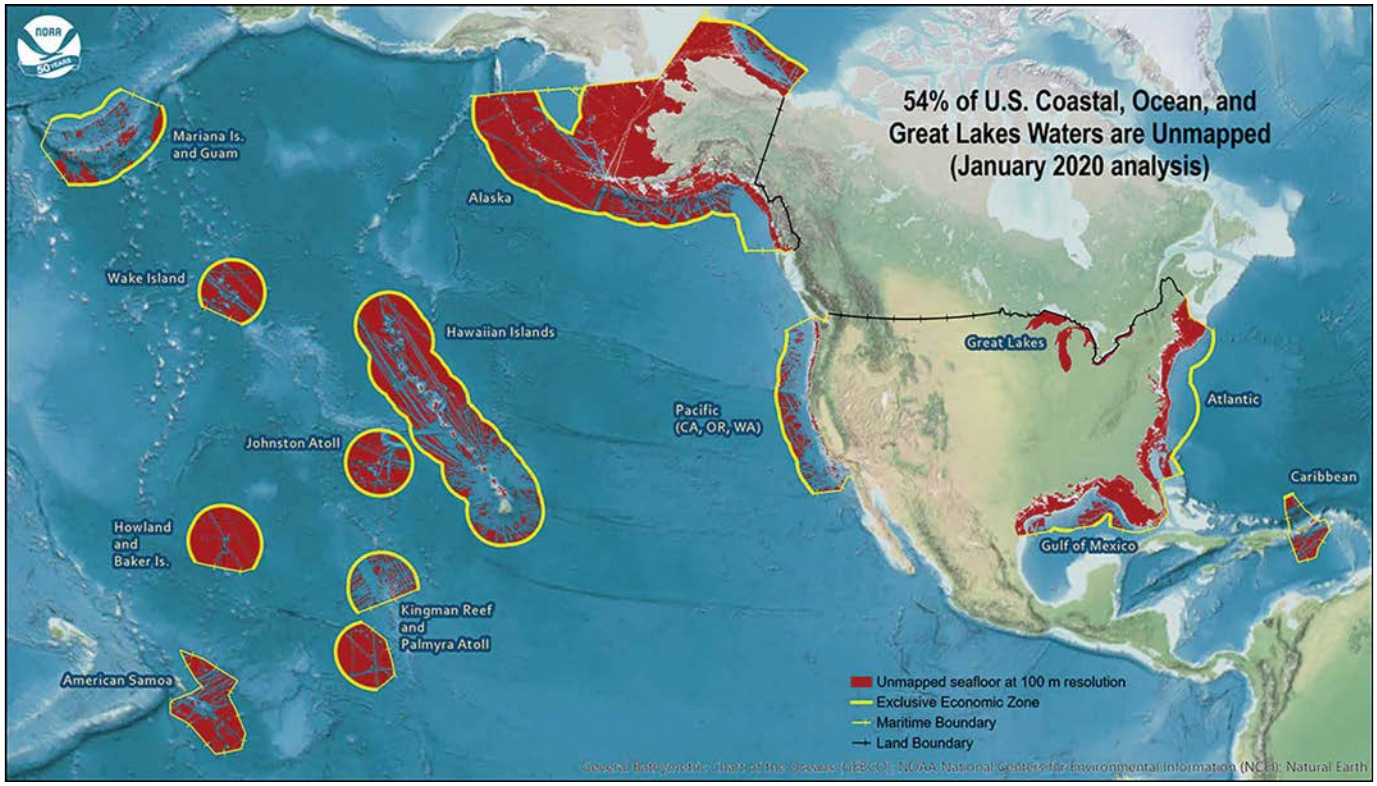
- updating plans for traditional hydrographic surveys
- sustaining adequate geodetic control and tide measurements in a harsh environment
- innovative use of uncrewed vessel technologies and other non-traditional data-gathering methods
- rescheming NOAA's nautical charts to produce a larger scale, gridded set of electronic navigational charts (ENCs) in Arctic waters

Buoyed by a growing national interest in ocean mapping, specifically in Alaska, NOAA is aggressively pursuing ways to meet the needs of the maritime community with its navigation products and services in the Arctic.

A National Focus on Mapping

NOAA's mapping objectives in the Arctic find support in the June 2020 N*ational Strategy for Mapping, Exploring, and Characterizing the United States Exclusive Economic Zone*,[1] also called the *National Ocean Mapping, Exploration, and Characterization* (NOMEC) strategy. The strategy notes

National Oceanic and Atmospheric Administration Ship *Rainier* conducts ocean surveying in Columbia Bay, Alaska. Mapping Arctic waters and maintaining foundational framework supporting this critical data is essential to the National Oceanic and Atmospheric Administration's ability to provide the services mariners, coastal communities, and other blue economy stakeholders need to operate safely in the Arctic. Photo courtesy of National Oceanic and Atmospheric Administration



Graphic courtesy of National Oceanic and Atmospheric Administration

that, "The ocean, coasts, and the Great Lakes are among the most treasured resources in the United States. They are an integral part of our national identity and our future. A comprehensive understanding of our oceans is fundamental to advancing science, building ocean-related industries, informing decisions that balance ocean use and conservation, and enhancing the nation's prosperity and security." A key goal of this interagency strategy is to map the exclusive economic zone (EEZ), which extends 200 nautical miles beyond the 12 nautical mile limit of the U.S. territorial sea. These areas comprise 3.6 million square nautical miles, nearly a third of which extends from the Alaskan shoreline into the U.S. Arctic and the Gulf of Alaska.

Essential components of the strategy include deploying new and emerging science and technology in partnership with federal and state agencies, private industry, academia, and non-governmental organizations. The initial focus is on mapping water 40 meters and deeper by 2030. This represents about 90 percent of the United States' EEZ, but only about one-third of the total level of effort. Mapping shallower waters requires a significantly higher level of effort as the swath of sonar is much smaller, but operations covering shallow water can also benefit from the use of new technology in light detection and ranging, known as lidar, and uncrewed platforms. The strategy anticipates mapping nearshore U.S. waters less than 40 meters deep by 2040.

Aligned with the NOMEC strategy, federal agencies with coastal mapping missions and requirements concurrently produced the *Alaska Coastal Mapping Strategy*.[2] Alaska's 66,000 miles of Arctic and sub-Arctic shorelines, including the state's many bays, inlets, sounds, and arms constitute a tremendous strategic, economic, and ecological resource to the nation. Accurate and contemporary mapping of Alaska's coastal and nearshore regions is critical to the informed use of these vast resources, maintaining maritime domain awareness, safeguarding the health and security of coastal communities, and strengthening the blue economy. Goals include building on existing mapping partnerships to expand data collection and deliver the priority products stakeholders need, and leveraging innovation in mapping technologies to make the job easier. Critical needs for coastal mapping data include bolstering the shipping and fishing economy through safer maritime navigation; ensuring more resilient coastal economies through flood and wave impact modeling; data-driven coastal infrastructure development; improved emergency response planning; and more effective community management plans.

Challenges of Arctic Operations

NOAA's mapping mission in the Arctic presents a number of unique challenges, the primary one being the limited operational window during summer months, which is still subject to considerable adverse weather.

This limited weather window is shared by all vessel operators, stressing the limited infrastructure in the region. These infrastructure limitations also create extended transit times to and from bases of operation which increases overhead costs considerably. An additional consideration for Arctic operations is the potential to impact Indigenous subsistence activities. Operations must be carefully communicated, planned, and monitored to mitigate adverse impacts. This challenge is only increasing as environmental shifts within the Arctic alter traditional migration patterns. NOAA continues to work with individual Indigenous communities, as well as forums like the Arctic Waterways Safety Committee, to foster open communication and collaboration regarding operational plans.

Ship and Launch Work

NOAA ships are at the end of a long logistical chain when working in the Arctic. Fuel, food, and repair facilities are limited across the Arctic, and parts and equipment must often be flown in from the continental United States. With no port facilities capable of supporting larger vessels north of the Bering Strait, many of the most critical areas of the Arctic are several days from any base of operations. With limited medical facilities aboard ships and ashore, and poor coverage for medical transport by aircraft outside of larger communities, personnel safety becomes a concern, as well.

The nature of the bathymetry found in the Arctic also presents significant challenges to NOAA's survey systems. Manned vessels with multibeam echo sounders that form the backbone of most hydrographic survey suites are operationally inefficient in the relatively shallow Bering Sea and Arctic Ocean, due to their proportional relationship between water depth and coverage. Side scan sonar, an effective tool in most shallow waters, is highly sensitive to changes in seawater chemistry. The dynamic nature of the Arctic water column then limits side scan sonar's effectiveness for near-shore data acquisition. Remote sensing alternatives such as lidar must also contend with water clarity issues caused by sediment and/or algae, and are not always practical when mapping nearshore regions.

Environmental factors must also be taken into account, as not all equipment can be safely operated in the Arctic. Small boats, called launches, are used for shallow, nearshore data acquisition, but they are difficult to deploy and recover without protected harbors of refuge. Remote sensing via lidar cannot take place on overly windy or cloudy days, a common occurrence in the region. Operational planning must develop contingencies for these conditions, as well as determine whether operations can be accomplished within the desired time frame, based on historical trends. While challenging, careful pre-mission planning can ensure the best equipment is deployed to withstand the conditions and meet mission needs.

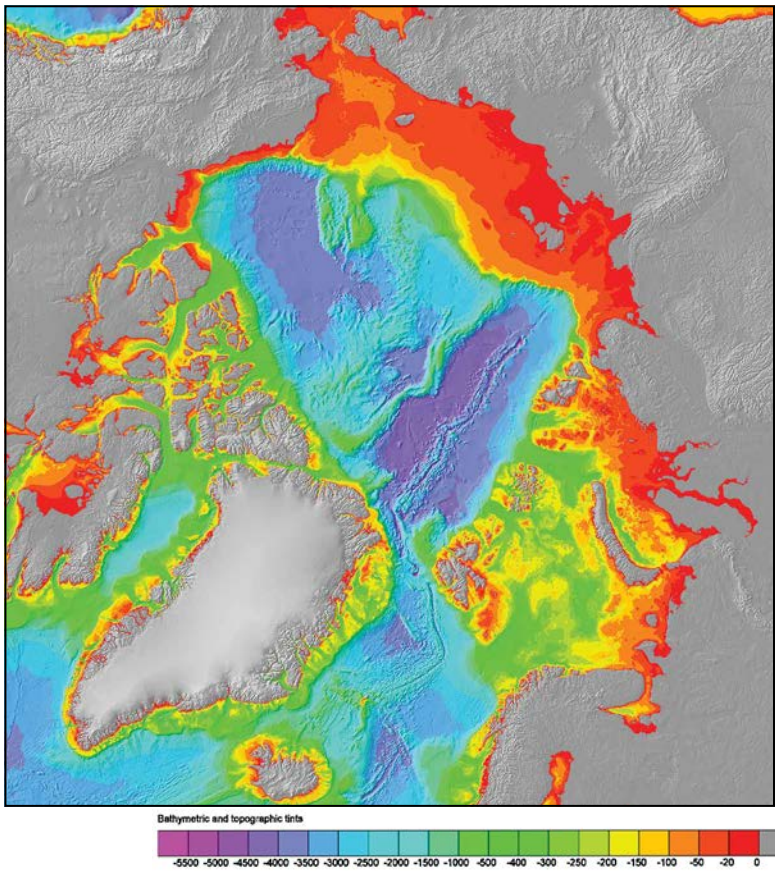
NOAA's Hydrographic Survey Plans

The logistical challenges of operating in the Arctic make meeting the national and Alaska mapping strategy goals particularly difficult. Even as sea ice retreats and opportunities increase for shipping, fishing, tourism, and other vessel traffic, the Arctic remains a demanding environment for marine transportation. There are still unpredictable ice floes, extreme weather conditions, and seasonal accessibility based on variation in ice location and subsistence hunting periods. The scale of the hydrographic survey requirement in Alaska and the Arctic is tremendous—426,000 square nautical miles, roughly twice the size of Texas—within the EEZ. Nearly half of that area is important to navigation. This vast area has had few systematic surveys, and some nautical charts still show several soundings of Russian origin taken prior to the 1867 U.S. purchase of Alaska. They still represent the best information available.

Despite the challenges, NOAA continues to focus significant survey resources on Alaska and the Arctic. Over the past three years, NOAA and its contract partners have acquired approximately 3,000 square nautical miles of hydrographic survey data in Arctic waters. For 2021, survey plans include an extensive set of project areas near Cape Newenham and the Pribilof Islands. NOAA continues to work with its partners, constituents, and other interested parties to identify future critical survey areas.

National Oceanic and Atmospheric Administration Ship *Fairweather* launches the unmanned surface vehicle BEN, or Bathymetric Explorer and Navigator, in July 2018 to collect Arctic hydrographic survey data. Vehicles like BEN help counter the logistical challenges of operating and researching in the Arctic. Photo courtesy of National Oceanic and Atmospheric Administration

The longevity of NOAA's two primary Alaska survey platforms, the 52-year-old *Rainier* and its sister ship *Fairweather*, are testaments to American shipbuilding, and are still acquiring valuable hydrographic data in Alaskan waters. Augmenting NOAA's in-house survey capacity are survey contractors, an essential component of the balanced hydrographic survey program NOAA employs in Alaska and across the nation.



As shrinking sea ice drives new vessel traffic, the National Oceanic and Atmospheric Administration is looking to partner with Arctic mariners to accomplish crowdsourced bathymetry. Graphic courtesy of National Oceanic and Atmospheric Administration

Exploring use of Novel Uncrewed Technology

NOAA has also tested uncrewed surface vessels (USV) in the Arctic for several years, working with private-sector partners and academia to develop and deploy USVs for chart-quality surveys. This year, with the COVID-19 pandemic extensively disrupting the 2020 field season for survey operations, NOAA awarded a contracted for commercially developed and maintained Saildrone USVs to be deployed in the Arctic Ocean to test their ability to acquire quality bathymetry in the U.S. Arctic while being monitored and controlled from Alameda, California. Equipped with single beam echo sounders to measure depth, the USVs zigzagged their way along the 20- and 50-meter depth contours following the North Slope from Point Hope to the Canadian border. This provided critical data that will help shape future surveying efforts. While the project is still ongoing, lessons learned in operational planning and Indigenous engagement have already provided immense value as NOAA looks forward to applying new technologies that can augment survey efforts during the short, weather-challenged Arctic season.

Crowdsourced Bathymetry

Given the paucity of bathymetry in the Arctic, all opportunities to acquire new data must be considered. As shrinking sea ice drives new vessel traffic, crowdsourced bathymetry (CSB) acquired by transiting vessels could drive two key elements to assist NOAA's surveying strategy. First, CSB can be used to evaluate the accuracy of charted soundings, highlighting both areas where new surveys are sorely needed, as well as regions which remain well-charted. Evaluating chart accuracy allows NOAA to direct surveying resources where they are needed most. Second, for areas where no data exists, CSB could be the "best available" data for charting purposes. Key to enabling this second element are low cost CSB loggers that are just entering the market. Full integration of CSB also requires the development of uncertainty models to integrate the data along with traditional sources and algorithmically determine the "best available" data to carry forward to the chart.

Considering the potential of CSB within the Arctic, NOAA wants to expand CSB contributions with mariners. With this goal in mind, NOAA and the Coast Guard have worked collaboratively for the past two years on Coast Guard Cutter *Spar* to operationalize CSB for the Coast Guard's Bechevin Bay project using positioning and sounding equipment already onboard the vessel's small boats. Although this effort was with another federal government partner, NOAA sees the greatest potential for crowdsourced bathymetry with the commercial vessels plying Arctic waters.

Geospatial Foundations for Nautical Charts

Hydrographic surveys and nautical charts rely on accurate shoreline information and a precise geodetic infrastructure with elevation, tide, and water level data. Shoreline surveys are critical to keeping nautical charts up to date. Since 2018, over 1,000 miles of updated shoreline have been compiled on NOAA nautical charts and nearly 12,000 miles have been added to NOAA's Continuously Updated Shoreline Product (CUSP). CUSP data supports various geographic information system (GIS) applications, including coastal and marine spatial

planning, tsunami and storm surge modeling, hazard delineation and mitigation, environmental studies, and occasionally assists in nautical chart updates. Shoreline data enables mariners to pinpoint their locations relative to the coast, navigate safely to and from ports, and find harbors of refuge when needed.

Several years ago, NOAA started surveying using Global Positioning System elevations instead of using traditional tide gauges to correct, or reduce, bathymetric surveys to chart datum. This new technique is called Ellipsoidally Referenced Surveys and relies on access to NOAA's vertical datum transformation tool. VDatum, as the tool is known, enables users to convert data from different horizontal and vertical datum references to a common system, making it easier to integrate diverse datasets. A robust infrastructure consisting of a network of tidal stations and Global Navigation Satellite System positioning is necessary for VDatum. While the lower 48 states are well-covered, data gaps across much of Alaska limit the VDatum capability to the southeast region of the state. This gap in coverage makes NOAA's survey work in other areas, such as the Arctic, much more challenging. NOAA is presently running an exploratory statewide datum transformation model in Alaska, although geodetic and water level observations are necessary to verify and decrease uncertainty in future model runs. Along much of the arctic coast of Alaska, it is not feasible to install permanent tide gauges, but temporary gauging data is used to refine or verify tidal datum reduction models. Any water level collected to verify the experimental models will be used to build out the VDatum model in the future. NOAA has identified 125 locations in Alaska where tidal and geodetic observations are needed to build the VDatum model.

Global nautical charting has entered exciting times as many users, national hydrographic offices, and chart-producing agencies switch their focus from paper to electronic nautical charts. Alexey Seafarer | Adobe Stock

NOAA also operates and maintains the National Water Level Observation Network (NWLON), which provides data essential for real-time navigation, surveying, and charting. These long-term observations of coastal water levels also improve understanding and predictions of coastal change, sea level change monitoring, and storm surge that are urgently needed to inform decisions by increasingly vulnerable coastal communities in the Arctic. Presently, NOAA operates 27 long-term NWLON tide stations in Alaska, 10 of which are located in the Arctic. NOAA has identified more than 30 gaps in NWLON coverage for Alaska, the majority of which are in the Arctic. The administration is working with partners like the Alaska Water Level Watch to create an implementation plan that will provide better access to water level data.

Improving Nautical Charts

Global nautical charting has entered exciting times as many users, national hydrographic offices, and chart producing agencies switch their focus from paper to ENCs. To expedite the initial creation of ENCs, they were constructed from their paper chart ancestors, retaining their various scales and irregular layouts in the new electronic format. This resulted in a product suite that was less than ideal for mariners' use in electronic systems. Often, features compiled on adjacent charts do not match seamlessly, even when they are the same scale. Commonly, the scales implemented within the six ENC usage bands are not uniform across the suite, making discontinuities even more apparent. To resolve these issues, NOAA has taken on a major rescheming effort, coupled with a plan to retire paper charts as we know them within the next five years.

In the Arctic, NOAA has already made significant improvements to ENC coverage. All of the coastal chart coverage of the North Slope down to the entrance of Kotzebue Sound has been replaced with reschemed 1:40,000 scale ENC cells. Reschemed 1:80,000 scale coverage over St. Lawrence and St. Matthew islands, Pribilof Islands, and the Etolin Strait, east of Nunivak Island has also been created. This is a considerable improvement over the 1:300,000 to 1:1.5 million scale coverage that was previously available in some of these areas.

Reschemed ENC cells will be created and released in three phases. Phase 1 includes recompiling and

Track the ongoing status of the new NOAA ENCs with the web-map at https://distribution.charts.noaa.gov/ENC/rescheme

generalizing shorelines and other features at the appropriate scale; edge matching features to ensure continuity of shoreline, depth contours, and depth areas within and across ENC cell boundaries; and releasing the ENC cells in a new, rectangular, gridded layout. Phase 2 will include updating and recompiling hydrographic contours in metric units and replacing contours previously compiled in units of whole fathoms or feet. Finally, Phase 3 will add topographic contours, road networks, addition place names, and other land features, as appropriate.

Each phase provides an incremental improvement to the product, so the public may immediately take advantage of the rescheming without waiting for the completion of all three phases.

Although substantial improvements are being made to ENC data through NOAA's rescheming effort, many users continue to prefer paper and other raster chart formats. Though NOAA is phasing out its separate, direct compilation, and maintenance of raster charts,[3] it is providing the means for users to create these charts directly from its most current ENC data. The web-based NOAA Custom Chart application enables users to define their preferred paper chart footprint, scale, and display of depth units to create a customized nautical chart. Although the chart layout is somewhat different, the portrayal of the chart data is similar to that of a traditional paper nautical chart. This application is in the prototype phase now and is expected to be fully operational by mid-2021.

NOAA Custom Chart https://devgis.charttools.noaa.gov/pod

Conclusion

The U.S. Arctic holds valuable resources and economic opportunities in the form of minerals, fishing, tourism, and a beautiful landscape. Without the road and rail network familiar to the warmer climes of the rest of the country, the coastal waters of Alaska also provide a vital supply route for many remote settlements in the state. The Arctic presents the challenges of a short operating season, severe weather, the vast expanse of the waters in the Arctic EEZ, and the logistical hurdles associated with transporting equipment, supplies, and personnel over those distances.

The need to enhance the navigation products and services available to mariners, the local community, and other stakeholders has been recognized nationally and is being acted on by NOAA in concert with other government agencies and commercial partners. This includes continuing to conduct traditional multibeam hydrographic surveys in the Arctic with NOAA and contractor ships, as well as deploying innovative technologies and techniques, such as uncrewed vessels and crowdsourced methods to collect and validate existing bathymetric data in remote areas.

NOAA continues to focus its Arctic efforts on areas that are the most significant for navigation, keeping in mind the changes in vessel traffic resulting from a diminishing seasonal ice pack, changes to animal migration patterns, and other factors. To that end, it has updated nearly 13,000 statute miles of Alaskan shoreline and acquired about 3,000 square nautical miles of hydrographic survey data in Arctic waters since 2017. This data is being used to improve electronic navigational charts and for other purposes important for understanding and sustaining the Arctic environment.

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Application of Emerging Science and Technologies to Advance NOAA Missions in the Arctic

by Rear Admiral Timothy Gallaudet
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While COVID-19 has affected every government agency, the National Oceanic and Atmospheric Administration (NOAA) has leveraged advances in science and technology (S&T) to mitigate these impacts. By focusing on six areas we are able to continue our science and stewardship missions and enable performance and efficiency improvements.

Here we describe two examples involving a fisheries survey in the Bering Sea and an ocean mapping expedition off Alaska's North Slope. These accomplishments come at a time when national-level interest in such activities has soared. The S&T focus areas we describe were promoted in the 2019 Executive Order on Maintaining American Leadership in Artificial Intelligence[1] and the fiscal year 2022 White House R&D Priorities Letter.[2] The latter specifically identifies the Arctic as an area of explicit attention. Additionally, fisheries and ocean mapping surveys were promoted in the 2020 Executive Order on Seafood Competitiveness,[3] the National Strategy to Map, Explore, and Characterize the United States Exclusive Economic Zone,[4] and the Alaska Coastal Mapping Strategy.[5]

NOAA Science and Technology Focus Areas

In 2020, NOAA finalized strategies in six emerging S&T priority areas that provide transformative advancements in the quality and timeliness of its products and services:

- artificial intelligence (AI) and machine learning (ML)
- uncrewed systems (UxS)
- 'omics and bioinformatics
- cloud computing
- big data analytics
- citizen science and crowdsourcing

These areas of focus propel NOAA's global leadership in numerical weather prediction and advancements in the American Blue Economy initiatives. Interdependencies of the six focus areas are being coordinated across the agency to promote innovation and accelerate NOAA's earth science capabilities.

Each of the six S&T focus areas supports the development of products and services that directly impact our understanding of the Arctic. AI, cloud computing, big data analytics, and UxS support the collection and distribution of data and advancements in computational capabilities. 'Omics methodologies accelerate the abilities to

What are 'Omics?

"'Omics" encompasses genomics, transcriptomics, proteomics, and metabolomics. Combined, these represent science of cell structure, function, and dynamics.

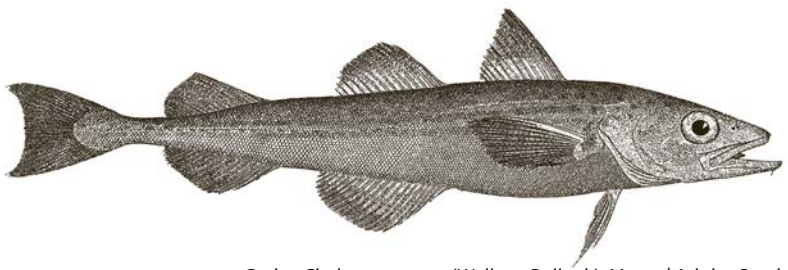
In 2020, The National Oceanic and Atmospheric Administration finalized strategies in six emerging science and technology priority areas including uncrewed systems, artificial intelligence and machine learning, `omics and bioinformatics, cloud computing, big data analytics, and citizen science, and crowdsourcing. These initiatives will help propel the Administration's global leadership in numerical weather prediction and advance the American blue economy. Kalyakan | Adobe Stock

monitor the biological communities of the oceans and the Great Lakes, providing information that is necessary for understanding life in the Arctic. By advancing the efficient collection and distribution of data required for accurate monitoring, forecasts, and guidance for decision support services, NOAA continues to stand ready to meet its scientific and technological missions and support partnerships in the face of pandemics.

Bering Sea Fish Abundance Survey

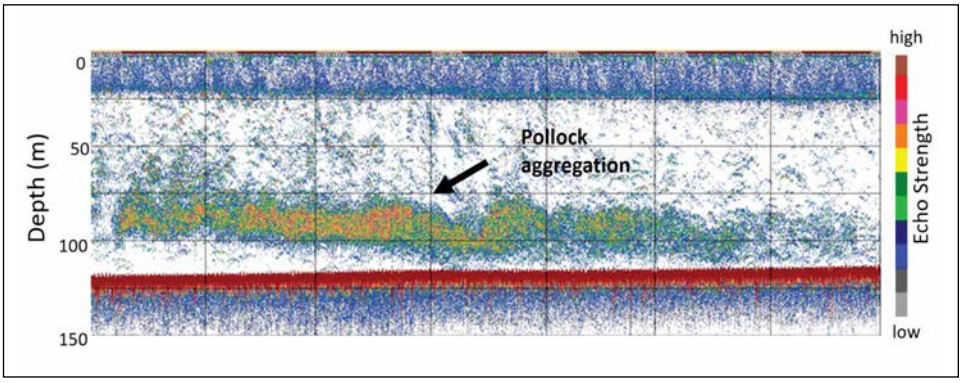
In spring 2020, the developing COVID-19 pandemic disrupted NOAA Fisheries' at-sea operations in an unprecedented fashion. The organization's planned summer fisheries surveys were delayed, and likely to be curtailed. The effects of the pandemic on the data collection capacity of the NOAA Fisheries mission in the Bering Sea provided a unique opportunity to leverage recent developments in robotic and sonar technologies and quickly execute them to reduce data loss.

Scientists at the NOAA Fisheries Alaska Fisheries Science Center (AFSC) developed a plan to collect fisheries and oceanographic data using instrumented uncrewed surface vehicles (USVs), a specific type of UxS, to mitigate the consequences of losing the full research vessel-based surveys. This was accomplished in partnership with NOAA Research's Pacific Marine Environmental Laboratory (PMEL) and supported through the NOAA Fisheries Science and Technology program. The unmanned surface vessel (USV) mission was rapidly conceptualized and implemented as the effects of the 2020 COVID-19 pandemic were emerging in late March. At-risk was the complete loss of new 2020 abundance survey data used to manage the nation's largest commercial fishery (for walleye pollock, also known as Alaska pollock). NOAA Fisheries' long-term commitment to research, development, implementation of new technologies and cultivating working relationships to both improve operating efficiencies and increase resilience was key to the rapid response and success of this work.



Gadus Chalcogrammus (Walleye Pollock). Mayer | Adobe Stock

The NOAA Fisheries mission includes managing the nation's federal fisheries based on the best available science to support healthy marine ecosystems and strong local economies. The best available data for managing pollock stocks in Alaska include time series of pollock and distribution data spanning approximately four decades. These data have been collected with ship-based acoustic-trawl and bottom-trawl surveys.



This example of a 35-minute backscatter record from the 38 kHz split-beam EK80 echosounder integrated into a saildrone shows a pollock aggregation present at 75–100 m. New technology allowed the National Ocean and Atmospheric Administration and other research partners to detect fish with low-power acoustic instruments. Graphic courtesy of the National Ocean and Atmospheric Administration

The acoustic-trawl surveys combine information from sonar measurements of sound scattering from fish and trawl catches to estimate pollock abundance. The biological data from the trawls are used to attribute sound scattering to species and size, and to estimate biological characteristics such as age, length, weight, and reproductive status. These survey data are used along with information collected during commercial fishing to estimate population size and develop management thresholds each year.

In 2018, the Alaska pollock fishery was the largest single species fishery by volume, and the sixth largest fishery by value in United States.[6] The economic impact of the 2018 pollock fisheries included 28,700 jobs and $1.5 billion in labor with 3.4 billion pounds of pollock, worth $461 million as initial value to fishers, and $1.5 billion first wholesale value, caught and processed.[7] Pollock is a key pelagic groundfish species distributed throughout marine ecosystems in Alaska with high localized densities in the Gulf of Alaska and the Bering Sea. Pollock dominate midwater fish communities in the Bering Sea, making it feasible to use USVs to conduct acoustic surveys without the biological data normally provided by net sampling. On average, pollock comprise 98 percent, with a range of 95 percent to 99 percent, of fish biomass in the trawl samples from the acoustic-trawl survey in the eastern Bering Sea. An acoustic-only estimate of abundance derived from chartered fishing vessels used in the eastern Bering Sea bottom-trawl survey makes this assumption and has been used to inform

Just west of the Golden Gate Bridge, saildrones begin their journey to the Bering Sea in May 2020. The mission was part of a 2020 partnership between the National Oceanic and Atmospheric Administration and Saildrone, Inc., to capture survey data in the Bering Sea. Saildrones are a fleet of wind and solar-powered ocean drones that monitor the state of the planet in real time, above and below the surface. Photo courtesy of Saildrone, Inc.

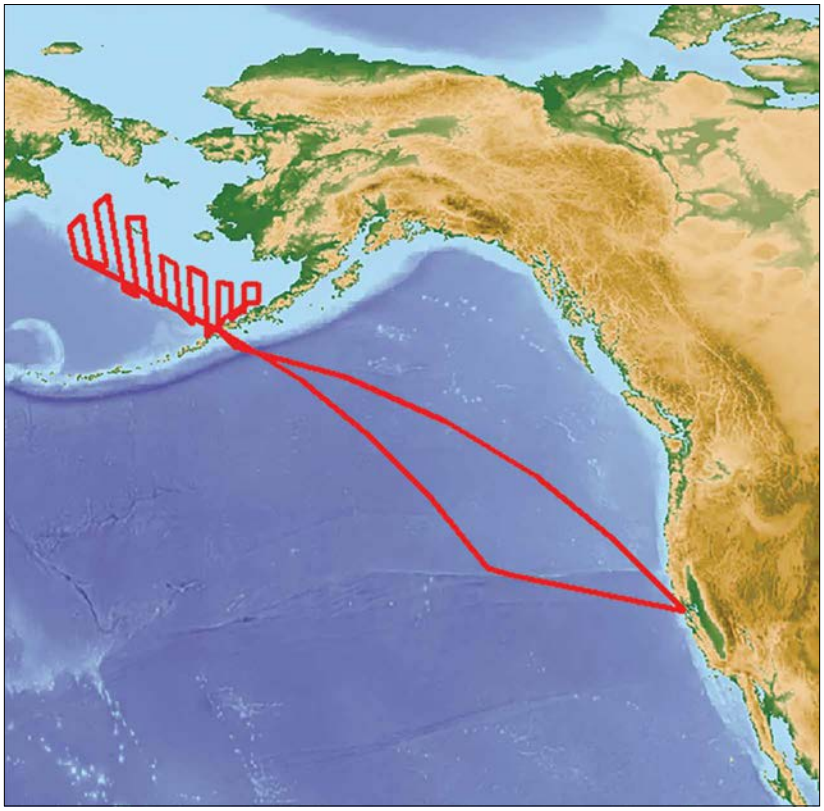
management of the pollock fishery for almost a decade.[8]

Existing technological capabilities and partnerships between AFSC, PMEL, Kongsberg, and Saildrone set the stage to rapidly implement a USV mission. For the last 5 years, this private-public partnership has developed, validated, and applied USV technology to study ecosystems in Alaska.[9,10,11] As part of this work, they instrumented the wind and solar-powered saildrones with newly designed low-power acoustic instruments to detect fish and developed the capability to collect acoustic data on long-term deployments.[12] Side-by-side comparisons of saildrones and NOAA ships were conducted to validate that they produce equivalent acoustic measurements of pollock abundance.[13] As the COVID-19 pandemic developed, it was clear that a NOAA ship-based survey to support the pollock stock assessment would likely not be possible. The previous commitments to USV research and development now provided an opportunity to collect useful data in an unprecedented situation.

For new data to be effective in the stock assessment and mitigate the potential for fish migrations in or out of the survey area, the saildrone survey timing would need to be consistent with that of the historical survey time series—June through early September. Given the time needed to prepare and deploy saildrones to cover the 100,000 square nautical miles (nmi^2) survey region on the eastern Bering Sea shelf, three USVs would be required and transect spacing would need to be 40 nmi. To assess the effect of 40 nmi transect spacing compared to the 20 nmi spacing in a typical year, archived data from the previous 14 survey years were subsampled at different sample spacing. Mean acoustic backscatter measured with 40 nmi transect spacing differed by an average of 6.4 percent with a standard deviation of 6.8 percent from that at 20 nmi spacing. Given the small loss of precision relative to the substantial reduction in survey duration and cost, the survey was conducted at 40 nmi spacing.

In mid-May 2020, three saildrones outfitted with Simrad EK80 split-beam echosounders were calibrated and launched from Saildrone's headquarters in Alameda, California. Although they are typically shipped to Alaska for deployment, travel restrictions associated with the pandemic required the saildrones transit to and from the study area from Alameda. They successfully transited the northeastern Pacific Ocean and through the 20 nmi Unimak Pass into the Bering Sea in about 45 days. Each of the saildrones started at a different point in the survey region and measured acoustic backscattering on transect lines from July 4 to August 20. Compressed summaries of the echosounder, oceanographic, and meteorological data were transmitted via satellite modem four times per hour. The summarized echosounder data were used to verify that the echosounder was operational, and informed real-time re-tasking decisions during the survey. Scientists at PMEL processed and provided the oceanographic and meteorological data in real-time to weather forecast centers worldwide via the World Meteorological Organization's Global Telecommunication System.

The saildrones completed their five-month, 5,900 nmi journey in early October, and the high-resolution acoustic data was recovered from the vehicles. Rapid analysis of the data was crucial to successfully incorporate the pollock abundance estimates into stock assessment models for management decisions by the North Pacific Fisheries Management Council in mid-November. This was facilitated by drawing on previous work developing Saildrone-specific data processing methods. For example, corrections for signal attenuation due to bubbles at elevated sea state.[14] To provide a time series of comparable data to the Saildrone-only collected data, acoustic-only abundance estimates were produced from historical



Within five months, three saildrones traveled the eastern Bering sea from Alameda, California, to collect data on pollock stocks from a 100,000 square nautical mile survey region. While not the typical collection method, the COVID-19 pandemic created the need for innovation in collecting the data. Graphic courtesy of the National Ocean and Atmospheric Administration

The National Oceanic and Atmospheric Administration (NOAA) fisheries mission manages U.S. fisheries based on the best available science to support healthy marine ecosystems and strong local economies. Due to the COVID-19 pandemic, NOAA developed a plan to collect fisheries and oceanographic data using instrumented uncrewed surface vehicles. Gorodenkoff | Adobe Stock

NOAA ship-based surveys taken between 1994 and 2019. The trends in the acoustic-only time-series track the survey biomass well, indicating that the saildrones acoustic-only measurements provided a useful measure of pollock abundance in the survey area. The 2020 acoustic observations were converted to pollock biomass units based on this relationship and incorporated into advice for fisheries management. However, it is important to recognize that without concurrent biological sampling the acoustic measurements from saildrones and other platforms cannot completely replace ship-based acoustic and trawl surveys. For example, the size and age distribution of the pollock population, which is critical for stock assessments, cannot confidently be determined without trawl samples. Thus, without concurrent biological sampling, acoustic data from saildrones or other platforms cannot completely replace ship-based acoustic and trawl surveys. However, leveraging established research partnerships and the unique capabilities of the saildrone vehicles afforded NOAA Fisheries the ability to produce useful survey information to support the management of the nation's largest fishery when traditional surveys were simply not possible.

North Slope Coastal Mapping

This May, NOAA's National Ocean Service collaborated with TerraSond and Saildrone to launch four USVs on a 3,000 nmi journey to the Arctic. The USVs departed Alameda in late May and arrived off the coast of Point Hope, Alaska, in mid-August to begin their Arctic mapping mission. Equipped with single beam echo sounders to measure depth, and a suite of oceanographic sensors, the USVs completed a zigzag pattern along the 20- and 50-meter contours following the North Slope from Point Hope to the Canadian border. On their transect back west, the saildrones further developed the 20- and 50-meter isobaths and investigated any unique depth observations from their initial transect. Upon mission completion, they will have mapped an estimated 4,000 linear nmi of Arctic waters and covered approximately 75 nmi^2 of the seafloor. The results of this contour-delineating effort will help inform a virtual lane for safe passage of commercial vessels and lead to critical chart updates along the North Slope. This public-private partnership is the first step toward resolving major gaps in Arctic nautical charts, as well as serving as an important component of the Alaska Coastal Mapping Strategy formulated under the Presidential Memorandum on Ocean Mapping.

Relevance to NOAA-Coast Guard Partnership in the 21st Century

As NOAA continues to advance the application of emerging technologies in the Arctic, we will focus them on

strengthening and expanding our collaboration with the United States Coast Guard.[15] Achieving interoperability between our UxS platforms will dramatically expand maritime domain awareness capabilities in a region where resources are limited. We will apply our NOAA AI, data, and cloud strategies to fully exploit the expanding volumes of information from these systems. Applications where such information is necessary include combined operations to detect and respond to oil spills, protect endangered species, support maritime commerce,[16] support commercial fishery safety and counter illegal, unreported, and unregulated fishing.[17] NOAA will also conduct joint research and development to achieve UxS interoperability and seamless data exchange with the Coast Guard. Going forward, we will seek to partner more closely under the framework of a memorandum of understanding (MOU) with the Department of Homeland Security's Science and Technology Directorate and the recent NOAA Uncrewed Systems MOU signed with the Scripps Institute of Oceanography. The latter is the location of USCG's Blue Tech Center of Excellence. Innovating together to advance our mission effectiveness, NOAA and the Coast Guard will make critical contributions to America's economic recovery, both within the Arctic and across the country.

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Rear Admiral Tim Gallaudet, Ph.D., U.S. Navy (ret) is the assistant secretary of Commerce for Oceans and Atmosphere and deputy administrator of the National Oceanic and Atmospheric Administration (NOAA). He served as the acting undersecretary of Commerce for Oceans and Atmosphere and NOAA administrator from 2017–2019. Before these assignments, he served 32 years in the U.S. Navy, completing his service in 2017 as the Oceanographer of the Navy. Rear Admiral Gallaudet has a bachelor's degree from the U.S. Naval Academy, and master's and doctorate degrees from Scripps Institution of Oceanography.

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Robert Foy is the science and research director at the Alaska Fisheries Science Center, NOAA Fisheries. He has a B.S. from the University of Michigan and an M.S. and Ph.D. in Oceanography from the University of Alaska. He has spent more than 25 years conducting research in the fields of marine biology, ecology, stock assessment, and fisheries management.

Dr. Jamese Sims is the NOAA senior science advisor for Artificial Intelligence where she leads coordination of artificial intelligence initiatives across the NOAA line offices and builds partnerships with the federal government, private-sector, and academia. In this role, she has also established, and leads, the NOAA Science and Technology Synergy Committee to coordinate interdependencies of the NOAA emerging science and technology focus areas including artificial intelligence, 'omics, uncrewed systems, cloud computing, data, and citizen science.

Christina Fandel is a team lead for Hydrographic Survey Division Operations in Coast Survey. Her hydrographic life spans 10 years with experience in NOAA, NGA, UNH, and the College of Charleston BEAMs program. Aside from supporting the hydrographic team, she is a fantastic baker.

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Understanding the Very Real Risks to Arctic Maritime Transportation

Four marine accident examples

by Keith Fawcett
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U.S. Coast Guard

An economical shipping route, deadly cold water, perilously shifting ice, stunning beauty, fragile ecosystem, and remoteness are all phrases that come to mind when the discussion turns to Arctic maritime transportation. As marine transportation executives and crews turn their attention to the opening sea routes and those potential opportunities, an examination of the dangers and risks to shipping is warranted.

For the purposes of this article, the Arctic will be defined as all U.S. and foreign territory north of the Arctic Circle, and all U.S. territory north and west of the boundary formed by the Porcupine, Yukon, and Kuskokwim Rivers; all contiguous seas, including the Arct and the Beaufort, Bering, and Chuk and the Aleutian chain. (15 U.S. Code

Despite the focus of this article, it must be remembered that to actually get to the defined Arctic, mariners must pass through some of the world's most challenging maritime environmental conditions. The weather conditions encountered in the North Atlantic and North Pacific can, and do, include mountainous seas, ice, and hurricane force winds, and then you steam into the Arctic domain with its own unique perils. A recent Government Accountability Office report on maritime infrastructure[1] states:

The unpredictable and harsh weather and ice conditions, combined with the vast distances and lack of maritime infrastructure, pose safety risks. For example, according to stakeholders, the "tyranny of distance" in the Arctic stretches the limited search and rescue capabilities, resulting in slow incidence response. Furthermore, a lack of a designated harbor of refuge means vessels do not have a place to moor safely in case of emergency. As a result, a representative from the International Union of Marine Insurance noted that in the Arctic even a minor incident, such as a small engine failure, can result in substantial damages and even loss of life.

Over the years there have been a number of marine accidents in the Arctic, and each one offers a cautionary

On the dive stage, Petty Officer 1st Class David Bradbury, left, and Petty Officer 2nd Class Adam Harris are lowered into the Arctic Ocean for a cold-water dive operation by crew members aboard Coast Guard Cutter *Healy* in August 2017. By conducting cold-water dives in the Arctic, the Coast Guard is building search and rescue capability. Coast Guard photo by Senior Chief Petty Officer Rachel Polish

Exploration vessel *Explorer* punctured its hull when it hit ice southeast of King George Island in Antarctica on November 22, 2007. It eventually began listing, but a rare window of calm weather allowed all 154 crew and passengers to successfully abandon ship before it sank. Photo courtesy of Michael S. Nolan

tale for the mariner and those who challenge the Arctic. An ecotourism accident that took place off the coast of Antarctica, where similar risks exists, provides one such example.

Hypothermia Danger, Large Scale Passenger Evacuation and Vessel Sinking

Of all of the examples in this article, this one might have had the most tragic outcome.

The risks and danger in the Southern Ocean and Antarctica are similar to those in the Arctic. This example from the burgeoning ecotourism industry highlights the issues with tourism, mass evacuation, and ice. Thanks to a lucky break in the normally harsh weather, there was no loss of life, though the 205-foot vessel sank in the ice field.

In November 2007, summer in the Antarctic, the exploration vessel *Explorer* was operating 25 miles southeast of King George Island in proximity to ice with 154 souls on board. The ship, operating in these remote waters and conducting these types of exploration tours for 38 years, was an ice-classed passenger vessel.[2] The tour was advertised as following in the "Spirit of Shackleton," the leader of the *Endurance* party (1914–1917) that survived their vessel being crushed by the Antarctic ice.

The *Explorer* entered the ice field on November 21, and struck ice the following day. The master thought the ice was first-year ice which is softer than "land" ice, but the hull had been pierced and was flooding with seawater. Eventually the ship began listing to starboard and the Global Maritime Distress and Safety System alarm was sent November 23 at 12:35 a.m. local time.

The master made an early decision to abandon the sinking vessel, but as it continued to list, a large piece of floating ice impacted it, blocking the launch of the open lifeboats on the port side. The crew and passengers clambered into the starboard lifeboats, as well as a number of expedition rigid hull inflatable Zodiac boats, which required a crane to launch. The engineers kept the generators running, allowing the rigid hull inflatables to launch and, as the *Explorer* slowly sank, the 154 survivors caught a break with a rare window of calm weather. Since the ship's open lifeboats' engines would not operate, the Zodiacs were required to tow the lifeboats into the open sea and gather all the vessels closer together to prepare for rescue.

Expedition ships, the *Nordnorge* and *National Geographic Endeavor* responded to the distress call, but it would be a long four hours until the ships arrived on-scene. While *Endeavor* acted as a communications relay station, the *Nordnorge* carried out the rescue operation, which was highly effective thanks, in part, to the weather remaining relatively calm. Two hours after the rescue was complete the weather deteriorated into gale force winds

and building seas. The Liberian Report of Investigation states that, if *Nordnorge*'s arrival had been delayed, there may have been fatalities from hypothermia. As it was, there was just one minor injury among those rescued.

With the rescue complete the *Explorer*, encircled with moving ice, began listing more heavily to starboard and slipped beneath the waves at 3:30 p.m. on November 23, 2007.

Dangerous Vessel Icing and Compromised Stability

While the *Explorer*'s crew and passengers escaped the extremely harsh weather of the Antarctic, the fishing vessel *Destination* wasn't so lucky. More than a decade after *Explorer*'s encounter with ice, the fishing vessel fell victim to a different effect of the Arctic's harsh weather.

The satellite distress signal from *Destination* sounded in the Coast Guard's District 17 command center, spurring the Coast Guard into action. The vessel capsized and sank, but was found near Alaska's St. George Island in the Bering Sea. Multiple Coast Guard aircraft and vessels, along with nearby fishing vessels, spent three days searching for survivors before suspending their efforts at dusk on February 14, 2017. Six crab fishermen perished in this disaster. As a result of this tragedy, the Coast Guard convened a Commandant's Marine Board of Investigation to examine the events leading to the loss of the 98.6-foot fishing vessel and provide recommendations to prevent a reoccurrence. During the course of the exhaustive investigation it would be determined that the *Destination* capsized due to loss of stability from the number, weight, and stacking of the crab pots, coupled with the accumulated ice caused by freezing water spray. Additional contributing factors were also identified. As *Destination* sailed north in the Bering Sea towards St. Paul Island, Alaska, a deadly combination of these factors, in combination with its operation, would sink the vessel.

These additional factors included a miscalculation of the crab pots' weight. Thought to weigh 700 pounds, they actually weighed 880 pounds with their associated gear, and there was additional equipment stacked on top of pots on the vessel's work deck. Icing and freezing spray had been forecasted, and ice buildup on the vessel and pots, in combination with down flooding into the No. 3 hold, would be contributing factors to the swamping and sinking. There had been vessel modifications, including

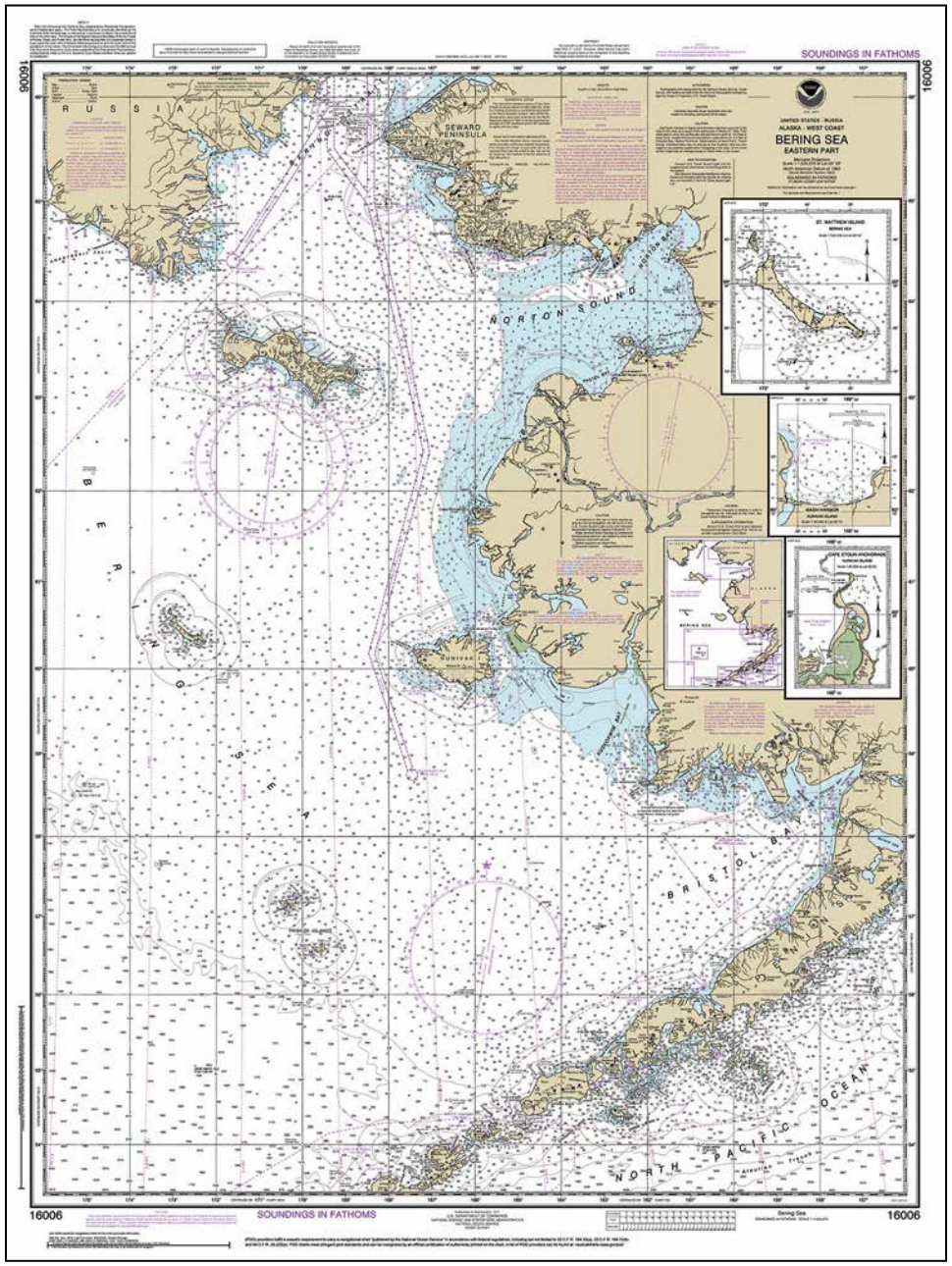
In July 2017, Coast Guard Petty Officer 2nd Class Adam Harris and Navy Petty Officer 1st Class Richard Dutton aboard the Coast Guard Cutter *Healy* conduct remote vehicle operations in search of the wreckage from fishing vessel *Destination*. The fishing vessel sank in the Bering Sea near St. George, Alaska, during extreme weather conditions five months earlier. Coast Guard photo by Petty Officer 2nd Class Meredith Manning

a bulbous bow and enclosing bow bulwarks, that were not evaluated to determine their overall effect on the *Destination*'s stability.

A little over 4 miles past St. George Island's Dainoa Point, and relative shelter, *Destination* headed into rougher, more exposed waters. At that point its automatic identification system signal was lost and the emergency position indicating radio beacon distress signal began transmitting to rescue forces. Several crabbers in the vicinity of the accident site reported significant ice accumulation during the time period of the *Destination*'s voyage, indicating they had to take measures to clear the ice from their vessel's railings, structures, and decks. The extreme cold of the water and air temperatures, and the suddenness of swamping and sinking, reduced the likelihood of survival.

Underwater Dangers and Outdated Chart Soundings

The Arctic domain of the United States is a vast, remote maritime area with some places that are seldom travelled. In terms of chart soundings, Unalaska Bay in the Aleutian Island Chain is considerably different from most of the harbors in the lower 48 states. Prior to the *Fennica*'s grounding, the last survey for nautical chart purposes was conducted in 1935.



The two-way routes shown on this chart are recommended for ships of 400 gross tonnage and upwards, however caution should be exercised as full bottom coverage surveys have not been conducted within the entire routes, so uncharted dangers may exist. NOAA chart

On July 2, 2015, a specially built Finnish ice-classed, multi-purpose vessel, *Fennica*, underway with a pilot aboard, grounded on a rock not reflected in the waterway's most current nautical chart. Post-grounding surveys of the area would identify several locations shallower than reported on National Oceanic and Atmospheric Charts 16528 and 16530. The 380-foot *Fennica* had a maximum draft of 27.6 feet.

Thankfully, the grounding led to relatively minor interior flooding of the vessel through a fracture of the hull near a ballast tank. Had the hull fracture been larger, and the *Fennica* farther from assistance, this could have been a much more significant incident. Regardless, it illustrates the concerns with chart soundings and hazard identification in the Arctic.

Though vast areas of the Arctic realm's underwater expanses are not adequately surveyed and charted to indicate the danger from rocks, seamounts, and other underwater hazards, steps have been taken to identify recommended two-way routes into the Arctic for ships. These routes, and

the areas to be avoided, provide recommended navigation areas where expanded soundings have, and will, be taken to enhance the safety of marine transportation and identify navigation dangers for shipping.

On July 2015, *Fennica*, a specially built Finnish ice-classed, multi-purpose vessel, was underway with a pilot aboard, near Unalaska Bay in the Aleutian Islands when it grounded on a rock not reflected in the waterway's most current nautical chart. Post-grounding surveys of the area would identify several locations shallower than reported on the relevant National Oceanic and Atmospheric Charts. Photo courtesy of James Dodds

Potential Remoteness of Rescue Forces and Perilous Risk for the Saviors

Careful contingency planning or adequate notice of developing emergencies allows the Coast Guard and other rescue agencies to make dramatic rescues, medevac injured crew, or deliver vital equipment. In this example, ample notice of the ongoing emergency allowed the Coast Guard to stage rescue resources near the accident scene in the remote Aleutian Island chain.

In 2004, the bulk carrier *Selendang Ayu* was steaming from Seattle, en route to her destination in China with a cargo of soybeans. A routine voyage would take the ship through Unimak Pass in the mid-Aleutian chain and then up into the Bering Sea towards the ship's destination port. The 738-foot ship was propelled by a marine direct drive diesel engine. The passage through Unimak Pass was uneventful until noon on December 6. At that point a series of events started that would ultimately lead to the crash of a Coast Guard rescue helicopter, the vessel being broken in half on the rock shoals, and loss of life.

A problem with the ship's cylinders in the massive main diesel engine resulted in a loss of propulsion north of Unalaska Island, where Dutch harbor is located. The No. 3 engine cylinder was cracked and needed repair, and it would later be determined that all but two of the ship's engine cylinders had cracked rings. The No. 6 cylinder was determined to be in the worst condition and repairs were started. While the engine crew addressed the repairs, the ship drifted in the rolling swell of rough seas. The motion of the ship made repairs difficult, as the parts being repaired were massive and unwieldy to handle even in the best of circumstances.

Each cylinder head on the Selendang Ayu was 11 feet long, 23.5 inches in diameter, and weighed 3,306 pounds.

Each cylinder head on the *Selendang Ayu* was 11 feet long, 23.5 inches in diameter, and weighed 3,306 pounds.

As the repair work was undertaken the vessel drifted toward the northern coast of rocky Unalaska Island. Dutch Harbor port authorities notified the Coast Guard at 2:45 a.m. on December 7. The Coast Guard Cutter *Alex Haley*, equipped with an HH-65 Dolphin helicopter and limited towing capacity, was nearby on fisheries patrol and diverted to the scene to render assistance if possible. Commercial tugs were dispatched and a number of Coast Guard aircraft deployed, ready to render assistance to the ship and the crew. Later in the day the Beaufort Force[3] 8 or 9 seas and wind would seriously hamper the engine repairs and affect the ship's drift towards the rocky shore.

Emergency towing operations were initiated and a commercial tug was eventually able to attach a towline to the *Selendang Ayu*, but the tug parted. Another tug attempted to assist but was thwarted by the seas and winds. Perilously close to the north coast of Unalaska Island, the *Selendang Ayu* dropped its anchor late on the morning of December 8 in an attempt to prevent grounding.

When it was determined that the anchor was not slowing the drift toward shore, and the seas and wind were too rough to tow the ship, the Coast Guard recommended helicopter evacuation of the ship's crew. Shortly before sunset the *Selendang Ayu*

After splitting in two near Unalaska Island, Alaska, in December 2004, the *Selendang Ayu*'s bow began to submerge due to weather conditions. When the vessel split, its fuel tanks leaked more than 300,000 gallons of fuel into the Arctic ocean. Coast Guard photo

grounded and the larger HH-60 Jayhawk helicopter lowered its rescue swimmer to assist the ship's crew in the final difficult hoisting evacuation. At 6:16 p.m., as the seventh crew member was being hoisted, a large ocean wave struck the bow of the ship and the spray disabled the Jayhawk's turbine engines. It fell into the tumultuous seas, overturned and sank. Quick action by the Dolphin helicopter overseeing the rescue saved the three Jayhawk crew members, as well as one person from the ship's crew, all of whom were transported to Unalaska Island for medical attention. Six members of the ship's crew perished in the crash and none of the bodies were recovered.

The *Selendang Ayu*'s master and the Coast Guard rescue swimmer, on the bow when the ship broke in half on the rocks, were rescued at 8:35 p.m., when the Dolphin helicopter returned and hoisted them to safety. Split in two, the *Selendang Ayu* began leaking fuel oil into the fragile Arctic ecosystem. Ultimately, more than 300,000 gallons of fuel oil would leak from the battered hulk.

These four marine accidents indicate the lopsided balance of risk and consequences for marine transportation in, and the approaches to, the Arctic. There are many more examples, the fishing vessels *Alaska Ranger* and *Katmai*, or the passenger ship *Prisendam*, among them. The risks to shipping in the Arctic are great, and vast distances make careful thought and meticulous planning necessary, especially when considering the need for assistance to mitigate potentially dire consequences to man and the environment. Without adequate risk mitigations, like carefully thought out voyage planning, specialized crew training, and robust vessel design, the outcome could be devastating.

About the author:

Keith Fawcett is a staff member at the U.S. Coast Guard Investigations National Center of Expertise and a licensed merchant mariner who worked in the marine industry for more than 20 years, generally in Gulf of Mexico operations. As a Coast Guard Marine Casualty Investigator, he has conducted high-profile marine casualty investigations including the investigation into the sinking of the SS El Faro, *which was lost with all hands in October 2015. He is the winner of the Coast Guard's 2015 Sener Award for excellence in marine casualty investigations.*

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2. Ice classed 1A1 Ice—A
3. Beaufort Scale wind speeds ranging from 34–54 knots, 39–62 mph

SAR in the Arctic

Rescues in the region present distinct challenges

by CAPT Clint Schlegel
Chief, Office of Search and Rescue
U.S. Coast Guard

The Arctic region poses unique operational challenges, and responding to those in distress in this part of the world is no exception. Sparse infrastructure and unpredictable, extreme weather including thick ice; icebergs; strong, shifting winds; and extremely cold temperatures are just a few trademarks of this region. Paired with historically low commercial and private maritime traffic, these challenges have not warranted high levels of internationally coordinated search and rescue (SAR). However, with the expansion of Arctic maritime and aviation routes in recent years, increased cooperation in the region to address the increasing likelihood of search and rescue operations is essential. The risk paradigm for these operations has shifted requiring a better understanding of challenges the SAR system faces in the Arctic and how the Coast Guard and the Arctic nations can cooperatively address them.

History

For centuries, saving those in peril on the high seas has been embedded in maritime culture. The obligation to save those in the Arctic, even given the extreme environment, was a strongly held duty. As an example, in 1884, the U.S. Navy's Greeley Relief Expedition, on its third attempt in three years and led by the Revenue Cutter *Bear*, finally reached the *Lady Franklin* expedition near Nunavut, Canada. Tragically, only seven of the 25 expedition crew members had survived.[1] Another heroic Arctic rescue occurred in 1897 when eight whaling ships became trapped in pack ice near Barrow, Alaska. Captain David Jarvis, commander of Revenue Cutter *Bear*, led his men on a 99-day, 1,500-mile journey over frozen terrain to reach the wrecked whalers and save them from certain death.[2] These extreme rescues were carried out in a time before standards for shipping and SAR cooperation and coordination were formalized under international law.

Ultimately driven by the tragic sinking of the *Titanic*, 13 countries signed the foundational maritime safety treaty known as the International Convention for the Safety of Life at Sea (SOLAS) in 1914. Subsequent efforts continued to update the original agreement, which now has 160 nations as signatories. In general, this treaty intended to specify construction, equipment, and operating standards to ensure the safety of vessels operating on the high seas.[3] Additional international efforts further standardized the global SAR system including the International Civil Aviation Organization's (ICAO) 1944 *Convention on International Civil Aviation* and the International Maritime Organization's (IMO) 1979 *International Convention on Maritime Search and Rescue*.

To support states in their implementation of the global SAR system, IMO and ICAO jointly published the *International Aeronautical and Maritime Search and Rescue Manual*, often referred to as the *IAMSAR Manual*, which provides guidelines for a common aviation and maritime approach to organizing and providing SAR services.[4] On a domestic level, the U.S. National SAR Supplement (NSS) to the *IAMSAR Manual* and the Coast Guard addendum to the NSS provide further details on how the Coast Guard responds to distress alerts in the maritime environment. Needless to say, there is a robust program to guide our national SAR system.

However, responding in the Arctic is a significantly greater challenge than in many other areas. Beyond the obvious environmental challenges of rescue assets operating in this area, other risks to the SAR system that could inhibit a successful rescue include unreliable distress alerting systems, availability of SAR response resources, poor communications infrastructure, and search planning. Associating these risks with the increased maritime and aviation presence in the Arctic, the eight Arctic nations signed a cooperative agreement on aeronautical and maritime SAR in 2011. This agreement recognized the additional challenges confronting Arctic SAR and committed the signatories to additional cooperation and coordination in this region.[5]

Current Challenges

Distress Alerting

To initiate a response within the global SAR system, there must be a method to signal distress and a system to receive it. In the most basic form, this includes signal mirrors, whistles, or handheld flares all of which are generally ineffective in the remote Arctic region due to limited vessels or people on shore to view or hear a distress signal. Other modern methods of distress alerting

include radio and satellite communications. Within the radio spectrum, very-high frequency (VHF) and ultra-high frequency (UHF) radio communications have limited capability for distress alerting in the Arctic due to the lack of infrastructure capable of receiving these line-of-sight radio signals. High frequency (HF) radio communications have over-the-horizon capability, but due to the unique atmospheric conditions found in the Arctic, this type of radio wave is susceptible to interference and overall reduced reliability.[6,7]

For the Arctic, the most reliable method of distress alerting is through satellite communications. However, each system operates differently and has its own inherent risks. Understanding these differences is essential to fully comprehend the risks associated with each satellite distress alerting system for those operating in the Arctic. The two commercial satellite communication providers, Iridium and Inmarsat, possess different Arctic distress alerting coverage. Iridium uses polar orbiting satellites which enable 100 percent Arctic coverage.[8] Inmarsat uses geostationary satellites centered on the equator which cause decreased signal reliability in the extreme northern latitudes. However, Inmarsat does have plans to close this Arctic coverage gap with the launch of new satellites beginning in 2022.[9]

The Arctic States

- United States
- Canada
- Finland
- Sweden
- Norway
- Iceland
- Denmark
- Russian Federation

Both commercial systems require paid subscriptions and compatible devices to access their satellite communication system and send distress alerts. Despite recent inquiries with commercial providers, it remains unclear if they will still process a distress alert if a subscription lapses, even if the laps is inadvertent due to credit card or account problems. This is certainly something no one would prefer to find out while in distress.

A non-commercial, multi-national, government sponsored satellite system, the international COSPAS-SARSAT Programme, also provides global coverage for distress alerts. This robust system receives and processes a distress alert, determines the location of the source of the alert, and transmits this information to the appropriate rescue coordination center (RCC) for further action. This service does not require a subscription, but does require ownership of a compatible distress alerting device. Although highly reliable, this system also contains risk for those operating in the Arctic.

The system is currently transitioning from low-earth orbiting search and rescue (LEOSAR) satellites to mid-earth orbiting search and rescue (MEOSAR) satellites. The LEOSAR constellation provides 100 percent Arctic coverage but the satellites range from four to 17 years past their planned service life. In addition, LEOSAR technology is dated and distress alert forwarding could take 30 minutes or more. While relying on the continued operation of LEOSAR, COSPAS-SARSAT is working to bring MEOSAR to full operating capability (FOC). MEOSAR provides 100 percent Arctic coverage without any delays in receiving alerts, however, it is still in the early operating capability (EOC) stage with several years to go until FOC is reached. This places a heavy reliance on the continued operation of the LEOSAR satellites to provide distress alerts to some COSPAS-SARSAT participants whose computer systems cannot currently

Rescue Coordination Centers

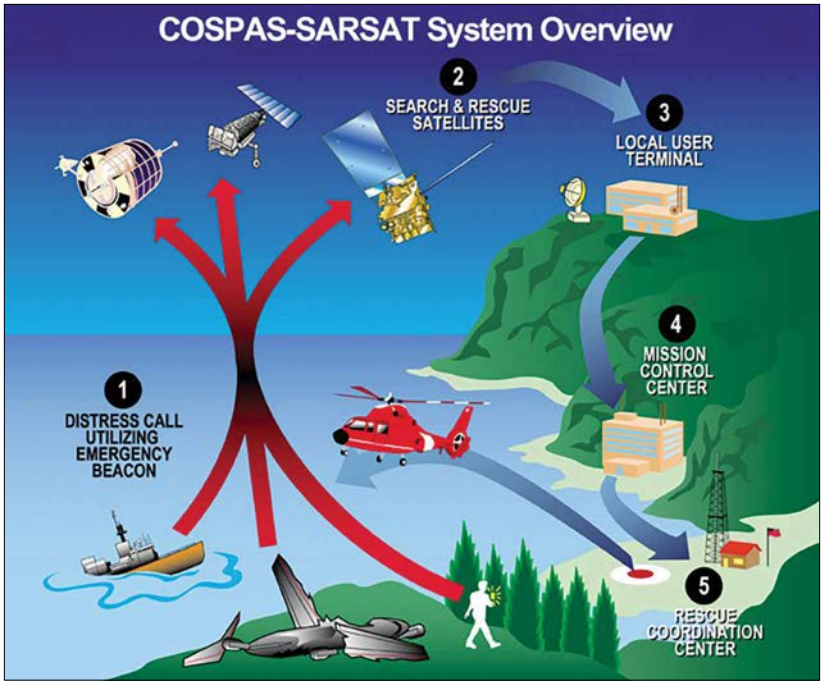
In 1944, the International Civil Aviation Organization (ICAO) met and published Annex 12 to the International Aeronautical and Maritime Search and Rescue Manual. The manual provided an international standard of what constitutes a Rescue Coordination Center (RCC). They are responsible for promoting efficient organization of search and rescue services and for coordinating the conduct of search and rescue operations within a search and rescue region (SRR). Participating countries delineate their SRRs within which they will provide search and rescue services and submit these to the International Maritime Organization (IMO) and ICAO for publishing. Each rescue region is required to have an RCC with established national procedures for development, coordination and improvement of search and rescue services for that region. Each RCC must have the ability to arrange for the receipt of distress alerts originating from within its SRR.

There are three types of defined RCCs: aeronautical, maritime, and joint. To officially be considered an RCC, the center must have 24-hour availability with SAR trained personnel who speak English. It must have associated charts which apply to their SRR, and communication capability to other RCCs and air traffic service centers to coordinate responses to distress alerts received within the respective SRR. These centers are the single point of contact within an SRR to coordinate a response to any distress alerts.

—CAPT Clint Schlegel

process MEOSAR alerts. However, as a mitigating measure, the United States has the capability to receive and process MEOSAR alerts during EOC and provide this information upon request to those RCCs who cannot yet process the alerts. With this mitigating measure, the COSPAS-SARSAT system provides highly reliable Arctic coverage of distress alerts, but until MEOSAR reaches FOC, the RCCs who cannot automatically process MEOSAR alerts may experience some delay in receiving that notification if the LEOSAR satellites cease to operate.

To summarize, while distress alerting systems have modernized and satellite systems have provided excellent Arctic coverage, the various systems still contain inherent risk, particularly for those operating in the Arctic. A prudent Arctic mariner or aviator needs to understand these risks and system limitations to make an educated decision of how or if to operate in the Arctic. Additionally, as the Arctic experiences increased commercial and private maritime and aviation traffic, the Arctic nations, and those countries with citizens who use the Arctic, must continue to invest in the distress alerting systems to ensure its reliability and functionality.



Coast Guard graphic

Rescue Resources

Once a distress alert is received, the next step is for the RCC to coordinate the response to effect a rescue, which includes identifying available SAR resources. Finding nearby rescue resources to respond to a distress alert in the Arctic is a challenge. Dutch Harbor, Alaska, is the northernmost deep-water port with adequate facilities to resupply Coast Guard ships within the United States' Arctic SAR region. It can still be a three-day transit to arrive at the northern coast of Alaska. The nearest full-time Coast Guard aviation assets are in Kodiak, 820 nautical miles south of the northern Alaska coast. Due to these limitations, the Coast Guard strategically forward deploys surface and air assets into the Arctic region during periods of increased maritime activity. This is referred to as Operation Arctic Shield. This seasonal surge also provides training and cooperative exercise opportunities to add organic rescue capacity to local and Indigenous communities. However, as the reduction in Arctic ice opens up longer periods of operability and cross-polar commercial aviation flights continue to increase year-around, other SAR resources may be required in the future. The lack of local rescue resources

A Coast Guard Response Boat-Small crew makes preparations to begin a joint rescue exercise after being deployed in the Arctic Ocean in July 2011. This two-day exercise included Air Force, Alaska Air National Guard, and North Slope, Alaska Borough personnel and offered real-time, real-world opportunities for search and rescue training and coordination in the Arctic. Coast Guard photo by Petty Officer 3rd Class Charly Hengen

is not limited to the United States, as other Arctic nations experience similar limitations.[10]

A unique avenue to fill this Arctic rescue resource gap is the Automated Mutual-assistance Vessel Rescue System (AMVER). This voluntary ship reporting system maintains a registry of more than 22,000 ships worldwide that make their vessels available to assist mariners in distress. For those operating in the Arctic, this could be a significant lifeline. The Coast Guard maintains and operates this SAR focused system, and uses AMVER's capability to develop a picture of the enrolled ships' locations in relation to a distress alert. The participating ships may then render assistance sooner than other rescue resources located in or near the Arctic region.[11] However, this system relies on effective satellite communications with AMVER vessels in order to direct them to the distress location. The Coast Guard continues to advocate for both commercial and private ocean-going vessels to enroll and participate in this voluntary program, especially those who transit the Arctic region.

Communications

Once a distress alert is received and rescue resources are dispatched, voice communications become critical in executing a rescue mission. Although radio and satellite voice communications have improved in the Arctic region over the years, they still face significant challenges. As mentioned earlier, the same challenges facing satellite distress alerts affect satellite voice communications: There are only two commercial satellite service providers, Iridium and Inmarsat.

A third option, the military satellite system, can provide voice communications but has been found to be unreliable in the far northern latitudes and is scheduled to be decommissioned in 2024. The replacement military system, the Mobile User Objective System (MUOS), is currently operational and provides Arctic coverage. However, integration onto Coast Guard assets is ongoing, and only organizations approved by the Department of Defense are able to access the system.[12,13]

Additionally, within the radio voice transmission spectrum, the Coast Guard's ability to receive these communications may be limited. The required land-based infrastructure to receive the line-of-site VHF and UHF radio signals is currently limited to only 20 percent of the Alaska coastline, although several Indigenous communities maintain a limited number of local receiving stations. The HF transmission spectrum offers a long-distance alternative, and its over-the-horizon frequency can typically reach distant receiving stations. However, atmospheric anomalies unique to the Arctic region can interfere with the signal causing it to be unreliable. To address these gaps during increased traffic seasons, the Coast Guard deploys a portable communication station to Utqiagivk, Alaska.[14]

Search Planning

In a distress situation, the perfect scenario is for the responding RCC to receive an exact distress location either through a satellite-based or voice distress alert. This essentially takes the "search" out of search and rescue. However, many distress alerts do not arrive with a specific distress location or enough time has passed between receiving the alert and arranging rescue assets that ocean currents and winds have relocated those in distress. In such instances, a search pattern, based on the

Establishing Communications in Utqiagivk, Alaska

Logistics for operations in the Arctic theater are complex. As a test of concept for the annual Arctic Shield exercise in 2012, the Coast Guard established a forward operating location near Utqiagivk, Alaska (previously known as Barrow). The forward operating location needed a communications platform to support the deployed assets for the exercise but faced the unique challenge of establishing a secure and reliable line of communications in the harsh, remote environment.

For long-range communications, planning officials called on Coast Guard Communications Area Master Station Pacific, located in Point Reyes, California, to provide the remote communications support.

Arriving in early July, the seven-person crew spent five days setting up a remote communication post near Barrow Point. A mere 1,250 miles from the North Pole, they had their work cut out for them. Minimal infrastructure in the region required the transfer of a transportable communications center to the area to support the needs of the seasonal operation. Through the efforts of these individuals from multiple units in a lonely tent at the northern most point of the United States, a vital link to critical resources was made available to mariners in distress. This capability was crucial in ensuring the coordination of time-sensitive responses, which is especially critical for search and rescue missions in the Arctic environment.

Reference: Coast Guard establishes presence in Barrow, by Coast Guard Petty Officer 2nd Class Grant DeVuyst (https://alaska.coastguard.dodlive.mil/2012/07/coast-guard-establishes-presence-in-barrow/)

Coast Guard Petty Officer 2nd Class Alejandro Delgado hoists Petty Officer 3rd Class John Crow during Operation Arctic Shield 2015. This exercise was part of the Coast Guard Research and Development Center's joint civil and federal search and rescue exercise near Oliktok Point, Alaska, in July 2015. Coast Guard photo by Petty Officer 2nd Class Grant DeVuyst

facts of a particular SAR case, is critical to ensure the best opportunity for locating and rescuing those in distress.

The Arctic region provides a unique challenge to the development and execution of search patterns by SAR assets on scene. Due to the curvature of the earth and the projection of this on standard navigational charts, normal navigation methods are much less effective in Arctic latitudes. Polar navigation requires the use of great circle navigation techniques. This presents a significant challenge in creating and executing search patterns in the polar region. Currently there are no solutions to the generation of highly accurate search patterns using great circle navigation techniques. Additional research and development is needed to overcome this gap and implement into the Coast Guard's SAR Optimal Planning System to ensure accurate search plans can be employed in the Arctic.[15]

The Way Forward

A key to successful Arctic SAR lies in the ability to effectively coordinate and share information among the Arctic nations. Engagement within the Arctic Council and continued adherence to the International Maritime Organization's Polar Code should continue to be leveraged to reduce risks for those operating in the Arctic region. The relatively close proximity of the Arctic nations makes cooperation and coordination efforts essential to successful SAR responses.

Distress alerting, rescue resource availability, communications, and search planning are essential elements for an effective SAR system. Continued sustainment, ongoing development and modernization of Arctic distress alerting systems will ensure RCCs are notified of a distress situation. Awareness of available rescue resources, as well as effective and reliable communications, is critical in initiating a prompt response and ensuring proper assets are sent where they are needed. Additional permanent SAR resources in the Arctic should be considered given the increasing use of its maritime transportation system.

Finally, if the distress alert does not contain a specific location, or if the distressed persons are not found at their last known position, we must have the ability to effectively generate accurate search action plans and transcribe those results into navigation methods that are effective in the Arctic region. This requires research

A Coast Guard C-130 aircrew monitors the offload of food and supplies in Kotzebue, Alaska, in July 2017. The food and supplies were delivered to the Coast Guard Cutter *Sherman* crew who was deployed in support of Operation Arctic Shield. Coast Guard photo by LT Brian Dykens

and development for more effective search planning software.

Conclusion

History has shown operating in the Arctic is hazardous and fraught with danger, and mariners and aviators have found themselves in distress and unable to survive until rescuers found them. As an organization with SAR as one of its core missions, the Coast Guard is committed to international cooperation to improve distress response in the region, especially recognizing the increase of traffic within the Arctic region. In partnership with the Arctic Council, federal, state, tribal, and local agencies, we will continue striving to improve the SAR in the Arctic region as it experiences commercial and private growth. Through the employment of new assets, technology, and partnerships, we will continue the long tradition of saving lives at sea.

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CAPT Clint Schlegel is a career aviation officer with more than 16 years flying the MH-65 Dolphin helicopter prosecuting search and rescue missions throughout the country. He has held SAR Mission Coordinator and Active Search Suspension authorities and currently serves as the office chief of the U.S. Coast Guard Search and Rescue Policy office at Coast Guard Headquarters in Washington, D.C.

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U.S. Coast Guard Polar Operations in 2035

A plausible scenario

by Dr. Lawson W. Brigham, Ph.D.
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The following is a plausible scenario of what U.S. Coast Guard polar operations could look like in 2035. It is not a prediction, but one of many possible scenarios dependent, in part, on the number of polar security cutters funded, built, and commissioned into service.

Throughout 2035, three new Polar Security Cutters (PSCs) all homeported in Seattle, have been operating effectively in polar waters. All are Polar Class 2 ships and among the most capable, non-nuclear polar icebreakers. They are:

- *Coast Guard Cutter* Storis *(WPSC 30), the newest PSC and polar icebreaker in three decades, came into service in 2025*
- *Coast Guard Cutter* Glacier *(WPSC 31), commissioned in 2029*
- *Coast Guard Cutter* Bear *(WPSC 32), commissioned in 2033, following the decommissioning of Coast Guard Cutter* Bear *(WMEC 901)*

Coast Guard Cutter Healy *(WAGB 20) continues operating in the Arctic Ocean on research missions, but is reaching the end of its 37 years of service and will be decommissioned in 2036.*

In addition to the largest icebreaking Coast Guard cutters, during 2029–2034, the service has commissioned three Polar Class 3 ships for operations around Alaska and in Greenlandic and European Arctic waters. This class is capable of operating globally, as have all polar icebreakers in the history of the service. The three ships named after the famous Wind-class polar icebreakers, are: Coast Guard Cutters Northwind *(WPSC 40) and* Southwind *(WPSC 41) homeported in Portland, Maine, and Coast Guard Cutter* Westwind *(WPSC 42) homeported in Kodiak, Alaska. Full-scale icebreaking tests for the new fleet of PSCs were conducted in the Bering Sea and the eastern Canadian Arctic.*

In 2035, the Coast Guard can look back on the nearly six decades of a complex, difficult, and ultimately successful saga to replace the polar icebreakers Polar Star *and* Polar Sea *constructed in the early 1970s. Notably, each of these PSCs exceeds the standards and requirements of the International Maritime Organization (IMO) Polar Code mandated for commercial polar ships.*

The new fleet of six, highly capable polar ships now provide the Coast Guard with a robust capacity to respond to the nation's year-round polar requirements in Alaska, the European (eastern) Arctic, and the Antarctic. In 2035, the four cutters in the Coast Guard's Pacific Area are on a rotational system where one ship must always be underway in Arctic waters, or in an operational status ready to respond to contingencies and national needs. In the Atlantic Area, two cutters, Northwind *and* Southwind *are maintaining equal operational polar readiness status. Meanwhile, the Atlantic Area is monitoring the ice navigation season on the Great Lakes and*

The Coast Guard's leadership role in providing a continued Arctic presence is essential to national security, maritime domain awareness, freedom of navigation, U.S. sovereign interests, and scientific research. Coast Guard photo by Senior Chief Petty Officer Rachel Polish

evaluating future domestic icebreaking requirements. Under the influence of continued warming in the region, beginning in 2033, the winter navigation season was only five weeks during the past two seasons.

In November 2034, Storis *deployed to the Antarctic for the annual breakout of McMurdo Sound and a lengthy oceanographic survey of the Ross Sea. The cutter returned from the Antarctic the following April and is in dry dock in its homeport of Seattle preparing for a return to the Antarctic for operations in late 2035. Following the McMurdo channel breakout in January and February 2036, operational plans call for a seven-week circumnavigation of the Antarctic continent for Antarctic Treaty inspections and an extensive coastal research program.* Storis*, and the embarked helicopter division from Coast Guard's Polar Operations Division, should be deployed for six months.* Bear *will deploy to the Antarctic in late 2036 and late 2037 to allow* Storis *a longer availability and dry docking after a decade of successful polar operations.*

In May 2035, Glacier*, the newest PSC, joined Canada's Coast Guard Ship* John G. Diefenbaker*, commissioned in 2030, for a five-month joint trans-Arctic expedition to test their combined capabilities in the Central Arctic Ocean. During late spring ice conditions, the vessels conducted oceanographic research. In late June and early July, they also conducted a joint circumnavigation of Greenland, the second in history by surface ship. Additionally, in August, both ships participated in an Arctic Coast Guard Forum-sponsored operational response exercise north of Svalbard with coast guard vessels from all eight Arctic states participating.*

Throughout the summer of 2035, Northwind *deployed to Greenland and the European Arctic from its homeport, escorting ships to the newly rebuilt Thule airbase in Greenland, and sites of the continued Distant Early Warning (DEW) rebuild in Greenland and the Canadian Arctic. Joint naval operations have been conducted with Danish and Canadian ice-capable naval ships in Greenlandic waters. Joint law enforcement operations, with embarked Danish maritime safety inspectors, also were conducted via offshore boardings to enforce the updated elements of IMO Polar Code.* Northwind *also deployed to the Norwegian Sea in September and October, joining a task force under the U.S. Navy's Second Fleet and operating near the Central Arctic Ocean with submarines and naval aircraft.* Northwind *has been operating out of Reykjavik, Iceland, and Tromsø, Norway, during its summer deployment.*

Since 2031, Westwind*, operating out of Kodiak, has deployed along the western Alaskan coast during summer and winter to provide a wide range of mission support in fisheries law enforcement, naval operations, research, hydrography, and on-scene presence during commercial offshore exploration. In February 2035, the cutter sailed to Nome, Alaska, as part of a winter scientific cruise in the northern Bering and Chukchi seas. Winter operations by polar security cutters operating out of Nome have become routine since the 2027 completion of the Nome Deepwater Port Project that allowed mooring alongside a new outer breakwater and pier. The port has proved to be an ideal location to support a persistent Coast Guard maritime presence in the U.S. Arctic.*

Several notable and highly successful polar operations have been completed since the commissioning of Storis *a decade ago. In February and March 2026,* Storis *conducted a circumnavigation of the Antarctic and, with an embarked State Department team, carried out 20 inspections of foreign stations under the rules of the Antarctic Treaty. The voyage also provided unique opportunities for surveys of penguin colonies and a seal census around the continent. From August through October 2028, a joint, Sino-U.S. Arctic Ocean Expedition was conducted using* Healy *and China's* Xue Long II*, operated by the Chinese Polar Research Institute. The intensive scientific cruise operated entirely in the Central Arctic Ocean to support the international agreement on fisheries in the region. In*

The Coast Guard needs to increase its presence in the polar regions as more waterways open up for safe passage and possible scientific exploration. A new fleet of Polar Security Cutters will significantly expand and advance the Coast Guard mission in some of the hardest to reach places in the world. Graphic courtesy of VT Halter Marine/ Designer: Technology Associates, Inc.

2029, with the arrival of the new Northwind, *the joint agreement with the Canadian Coast Guard to handle all U.S. polar operational needs in Greenland was terminated by mutual agreement.*

During summer 2030 Storis *operated with a historic naval task force sent to probe the waters of the Chukchi and Beaufort seas.* Glacier *and* Northwind*'s 2031 Antarctic deployment allowed a joint operation in McMurdo, which provided a better understanding of the Polar Class 3 cutter's capabilities as employed in treaty inspections and research around the continent.* Southwind *was a key command and control ship in summer of the same year, operating with the Second Fleet in the Norwegian Sea and conducting scientific observations along the marginal ice zone north of Svalbard.*

In the painting, "Helicopter Coming Back to Icebreaker USCGC *Glacier*," the Portland, Oregon-based Coast Guard icebreaker *Glacier* represents the Wind class icebreakers of the 1950s through the 1980s. The new Polar Security Cutters will continue, and expand upon, their predecessors' legacy. Coast Guard painting by Arden von Dewitz

All of these far-flung polar operations have been conducted during a time when the Coast Guard has been considered for transfer to a new, federal department. In addition to expanded law enforcement, icebreaking and naval operations in polar waters, the entire fleet has been involved in scientific expeditions at both ends of the world, as well as contributing to the hydrographic database around Alaska and remote polar waters. The addition of six PSCs with complementary aviation assets has transformed the Coast Guard's global operations.

Scenario Observations and Strategic Decisions

The usefulness of this scenario, or plausible future, is that it allows us to think strategically about the organizational decisions that must be made in the years to come as this new polar fleet enters into service. Scenario creation has been used in the Coast Guard's strategic planning efforts since the early 1990s, and is currently used as a component in the Coast Guard's *Evergreen* process. It has proven an effective tool for 'out of the box' thinking and engagement by senior management. This scenario's timeline out to 2035 suggests Admiral Karl L. Schultz and his *three successors* will make key strategic decisions related to the revitalization of the nation's polar icebreaker fleet.

The above scenario indicates a robust state of America's primary, federal polar fleet in 2035, the presumption being that, by 2034 the Coast Guard has been fully successful in its long quest to acquire a six-ship polar fleet. Obviously, any fewer ships—perhaps the successful acquisition of just the three Polar Class 2 ships, for example—would impact an early decision to co-locate and homeport all three ships in Seattle. In this scenario, what polar security cutter assets would be readily available to support emerging U.S. interests in Greenland and the European Arctic? Operating only out of Seattle would limit the Coast Guard's global operation.

U.S. future polar interests will plausibly be global in nature involving Alaska, the Antarctic, and the European Arctic. Long transits of PSCs from Seattle through the Panama Canal or across the Arctic Ocean to reach requirements in the Atlantic would not be operationally responsive to a broad array of national interests and users. Thus, the critical requirement for acquisition of the Polar Class 3 polar security cutters should not be underestimated. The scenario also reaffirms the global nature of Coast Guard polar operations in future decades, similar to the worldwide operation of *Glacier* (WAGB 4) and

Evergreen is the term for the process of developing and executing strategies, as well as instilling strategic intent throughout the Coast Guard.

the Wind-class icebreakers from the 1950s through the 1980s. One of the future operational challenges—even with a four-ship polar fleet in the Pacific—will be how to maintain persistent or continuous marine presence in the U.S. Arctic if this requirement emerges as a national imperative.

With this new fleet of six advanced polar ships, all with flight decks, is the implied need for a specialized aviation component, similar to the Coast Guard's past Polar Operations Division, that is integral to the multimission operation of these polar ships. Such a specialized aviation division could again be located at the Coast Guard Aviation Training Center in Mobile, Alabama. As a matter of operational doctrine, the question of whether any PSC should ever again deploy to the polar regions without an embarked aviation detachment needs to be answered.

Another critical question focuses on how autonomous vehicles might impact the requirements for helicopters. Helicopters are critical assets for polar logistics support, personnel transfers, and select mission support for law enforcement, naval operations, search and rescue, and scientific support. Leasing civilian aircraft is not a solution for the maritime law enforcement and naval requirements of future polar operations. The ability to operate with, and land a broad range of, military helicopters—foreign and domestic—remains a critical capability of the new PSCs to support joint naval operations.

Strategic placement of the PSCs and the integration of this polar fleet with Coast Guard aviation are critical decisions that likely will be made prior to the commissioning of the fleet. Other key issues and decisions revealed by the scenario include:

Polar Class 3 Ships: The central issue is what type of polar ship aligns with a broad range of U.S. national interests. Will the new PSCs be polar ships with more advanced naval capabilities? Will they handle the full range of missions? With the exception of aids to navigation, this is likely. Will the Polar Class 3 ships be capable of global ice operations and where will they normally be deployed? Designating them as something other than polar security cutters would perhaps constrain or limit their use in global operations.

Cutter Names and Homeports: The cutter names in the scenario are fictitious, but they are plausible and identifiable from Coast Guard history. The use of historic cutter names would be a conservative approach to what could be a challenging naming process. Key decisions also remain for homeporting the new fleet beyond an early plan to co-locate the three Polar Class 2 ships in Seattle. Our strategic national interests will provide a blueprint for homeporting the Polar Class 3 ships in Alaska and on the East Coast.

Importance of Scientific Capability: The new polar fleet is a unique national expeditionary asset, with each new cutter serving as a national, mobile observation platform able to operate in the most remote regions of the global ocean. Autonomous observing/sensing and hydrographic surveying are mandatory capabilities, while specific scientific and expeditionary infrastructure can plausibly be shared among the fleet. The new ships could be employed in the future to conduct classified research in the national interest. Scientific expeditions, especially joint operations with foreign polar ships, are a key component of the scenario and are highly plausible future operations.

Ship Testing in Polar Waters: Full-scale icebreaking tests will be required for each new polar security cutter. These will likely be conducted in the Bering and Chukchi seas, as well as in the Canadian Arctic. The first Polar Class 2 cutter needs to be fully tested in the channel breakout in McMurdo Sound and through sustained operations in the Antarctic. As suggested in the scenario, the first of the Polar Class 3 ships should be deployed to the Antarctic and the McMurdo icebreaking operations to evaluate and confirm the global capability of the new class.

Systems Management of the Polar Fleet: A six-ship polar fleet operating from both the Coast Guard's Atlantic and Pacific Areas will likely require a new, centralized model for scheduling and managing this global operation. New users from the Department of Defense, primarily, but not exclusively from the Navy, will require more ship time for the support of a range of classified missions and research expeditions. Other user agencies like the National Oceanic and Atmospheric Administration, U.S. Geological Survey, the Office of Naval Research, and the National Science Foundation will add to the complexity of managing the fleet's operating schedule. An increase in law enforcement operations in the U.S. maritime Arctic, and all polar waters, is plausible. The new fleet will be more highly visible and mainstream within the Coast Guard, demanding more attention from all levels of management, strategic planning, and field operations.

Manning and Training Challenges: Adding six large cutters to the Coast Guard fleet will require additional officer and enlisted personnel. Seagoing experience on polar ships will also be required for select operations and engineering crew members, and additional, advanced ice operations simulator training will be needed for the ice navigators. Future integration of the polar security cutter fleet with the domestic icebreaking fleet—buoy tender and icebreaking tug fleets—will provide a large cadre of trained, experienced personnel for polar operations.

Worldwide Logistics and Support Capacity: Future Coast Guard operations of a global fleet, including the National Security and Polar Security cutters augmented

The Canadian Coast Guard Ship *Louis S. St-Laurent* maneuvers to moor up with the U.S. Coast Guard Cutter *Healy* during a cooperative science mission to the Arctic Ocean between the nations in September 2008. New Polar Security Cutters will be fitted to conduct scientific expeditions, including potential joint missions with foreign allies. Coast Guard photo by Petty Officer 3rd Class Michael Anderson

with deployed aviation assets, will require sustained and increased funding. Future, lengthy global operations supporting national security and presence requirements will be highly plausible. Improved integration of this global fleet with Navy supply chains may be warranted. Re-engineering the Coast Guard logistical support network to support this expanded global fleet will be a complex, and likely costly, challenge.

Wildcards: In any scenario unanticipated wildcard events may shake up the narrative and plausible futures. For this scenario several wildcards that could have major impacts include:

- the continued reduction of ice on the Great Lakes and in the Arctic
- a change in the federal department to which the Coast Guard is assigned
- restrictions in the operation of open-water cutters in polar waters
- a major rebuild of the Arctic DEW Line radar sites requiring significant polar ship support for many summers
- Greenland independence requiring greater U.S. maritime presence
- unforeseen geopolitical events in the Arctic and Antarctic.

In the decades ahead, the Coast Guard's PSC fleet will be a unique national asset, supporting the United States as a leading and influential polar nation. It will enhance our global maritime law enforcement and naval capabilities, assure polar marine access for the United States—including polar research—and provide visible and effective sovereign maritime presence at both ends of the world.

About the author:

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Historical Snapshot

The NASBLA BOAT Program

A decade of safety

by Ames Holbrook
Writer, Office of Boat Forces
U.S. Coast Guard

This is the story of a revolution—one that radically changed the way the United States safeguards its people on the water. Furthermore, this really is one of those stories where two people, who happen to be experts in their field, sit down in a restaurant to solve a national security challenge bedeviling them both. These two colleagues, who will become close friends before this all plays out, decide right there to put their reputations and careers on the line for their vision.

Here's how the revolution happened.

NASBLA's instructors draw on their experience, knowledge, and skills to make the BOAT Program a success. Photo courtesy of Will Plumas

The History

From the perspective of the United States Coast Guard, 2001–2010 was eventful. In that window, America suffered the most devastating terror attack ever against our homeland, the deadliest and costliest hurricane to hit our shores in 75 years, and the largest marine oil spill in history. Through it all, the Coast Guard was hard at work on implementing a solution to the problem these events kept demonstrating was unavoidable. The Coast Guard would forever struggle to have enough boats on the water to handle grand-scale catastrophes; unless it had help. Ten years ago, that help began to manifest in the form of one of the greatest innovations in the modern history of maritime response, the National Association of State Boating Law Administrators (NASBLA) Boat Operations and Training (BOAT) Program.

In October of 2009, NASBLA held its very first BOAT course. This was the first quantifiable step toward getting more boats on the water to help handle a major event. The key here is that the additional boats on the water after that first class graduated were not Coast Guard boats. They were boats drawn from state, local, and tribal agencies, whose crews were now trained to a Coast Guard standard, from tactics to vocabulary.

On the 10th anniversary of that first NASBLA BOAT course, it is worth examining what happened then, what happened since, and where we are now.

Students and instructors share a break and provide feedback between underway exercises. Photo by Mark Farmer of Farmboy Photos

The Run-Up

Back in the heightened security environment that followed September 11, 2001, the Coast Guard concluded it would have to train local partners to assist in the task of escorting liquefied natural gas carriers into Boston Harbor. "We learned the tactics they employ [outside of the continental United States] OCONUS. We all realized that these tactics needed to be changed to those INCONUS tactics, as we were pointing M60s into the apartment building windows of East Boston," Dave Considine, then a boatswain's mate in the Coast Guard's Boston Harbor Defense Team, said. "We have been using those tactics in our Tactical Operator Course ever since."

The "ever since" began unfolding quickly, when the Coast Guard took the training from Massachusetts to New York and Maine. This got Admiral Vivien Crea's attention. Impressed with the tactical cooperation between agencies, she suggested it could be a workable program for the entire East Coast. Florida soon embraced Admiral Crea's vision, when Florida Fish and Wildlife's then-Captain Brad Williams helped create a training template that laid the groundwork for a national program of standardized training, typing, and credentialing across diverse enforcement agencies.

Early in 2002, NASBLA assembled a Council of Partners, pulling subject matter experts from every corner of the maritime law enforcement and response community. While the formation of the Council of Partners had been a reaction to the terror attacks the year before, it was Hurricane Katrina in 2005 that pressed the point. By the time Katrina's deadly floodwaters rolled back, her greatest lesson had left a lasting impression: Going forward, the Coast Guard needed state and local help with every major event, and that help would have to be trained to a common standard. Years later, the Council of Partners determined the training standard emerging on the East Coast was the solution they were looking for. In 2008, Maine Marine Patrol Major John Fetterman, Maine's boating law administrator, realized NASBLA was uniquely poised to oversee such a boat program.

In Fetterman's vision, NASBLA would help local units identify the kind of training they needed and help them find the grant money to acquire the training, allowing them to become the Coast Guard's force multipliers in disaster response. Fetterman believed NASBLA could leverage not only its history of positive partnership with the Coast Guard, but, even more importantly, its vaunted countrywide network.

While serving as NASBLA's president that same year, Fetterman met Jeff Wheeler, the deputy chief of the Coast Guard's Office of Boat Forces. During his work with the Council of Partners, Wheeler had helped set the stage for Fetterman's concept of single-standard universal training and force multiplication. The men found they shared

an identical vision for Coast Guard units training with state and local agencies from across the country and becoming a unified force. That's when the two colleagues went to dinner to solve this once and for all.

Before they left the restaurant, Wheeler and Fetterman had mapped out the way forward. Wheeler would tell his bosses that, based on the initial trials he'd seen in Florida and Maine, he was confident that NASBLA could deliver the Coast Guard's standard. Furthermore, and here was the big ask, Wheeler was going to convince the Coast Guard's admirals to gift the Coast Guard's official boat operations manual to NASBLA to build the single national standard of training.

Fetterman, now NASBLA's deputy executive director, recalls that meeting well. "NASBLA's BOAT Program would not exist had it not been for Jeff Wheeler," Fetterman said. "Jeff is the guy who put his entire reputation and career on the line by supporting my crazy idea. Jeff had the vision and confidence in his new friends, and he was as sure as I was that this was the right place, the right time, and the right partnership."

It wasn't without risk. Fetterman confesses the stakes were daunting for both of them. "We looked at each other, realizing that we had everything on the line with regards to our credibility, our reputations, and our careers. That's when Jeff looked at me and said, 'Don't muck this up!' followed by his characteristic smile and barely audible laugh. Laugh or not—I knew he meant it!"

The Tactical Operator's Course

Florida enforcement personnel participated in the NASBLA BOAT Program's first Tactical Operator's Course (TOC) in Miami, in October 2009. It was followed by a joint Coast Guard and sheriff's department course in Charleston, South Carolina, the next month.

For five mornings, students learned tactics from videos and blocks of instruction in the classroom. Afternoons were outside on the water, putting the good lessons to use in actual speed scenarios. There was a team spirit in the classes, despite the fact students often hailed from different agencies. In years ahead, federal grant money, including new boat procurement, would actually be tied to NASBLA BOAT Program certification, a national credential that would be recognized and used by the Federal Emergency Management Agency (FEMA).

The Coast Guard was so satisfied with the training, it occasionally sent its own members through the TOC. More importantly, for the first time, state and local agencies were trained and qualified in useful maritime skills and their certifications were searchable in the national database so neighboring governments and federal authorities could tap the skilled units when needed.

Those earliest classes in 2009 set the pattern. No matter who made up the class, the students studied together, eager to get on the same page. Sooner or later, they understood they would have to react to a threat from the hurricane, a chemical spill, or terrorists hell-bent

Students get underway in the afternoon to apply the morning's lessons in actual speed scenarios. Photo by Mark Farmer of Farmboy Photos

Students from multiple agencies learn the same national standard of training and build partnerships at the same time. Coast Guard photo

on blowing up the cruise ship. And they would have to work alongside other agencies using identical tactics and vocabulary to get the job done.

The Official Watersheds

On May 11, 2012, not three years after that first TOC, VADM Brian M. Salerno signed a memorandum of understanding (MOU) between the Coast Guard and NASBLA's CEO John M. Johnson. The pivotal line read:

> *The USCG hereby establishes the NASBLA Boat Operations and Training (BOAT) Program as the National Standard for the purpose of training and credentialing state, local, county and tribal maritime law enforcement officers and rescue personnel.*

In the eyes of John Fetterman, that MOU was a long-awaited validation. "No matter how good of an idea, it would have taken just one misstep for the Coast Guard and the states to turn their backs on the program," he said. "We avoided the missteps, and the MOU meant that the partnership, concept, and delivery was proven."

With that signing, VADM Salerno had officially provided every boat forces unit in the Coast Guard an invaluable resource in the form of partners they could call on for any role. This was indeed a victory, and interagency cooperation increased exponentially in the wake of the MOU. It would be five years of the Coast Guard and NASBLAs working with FEMA to develop the qualifications and resource typing for waterborne response professionals before the next breakthrough occurred.

On November 7, 2017, FEMA announced it had finalized its overhaul of the resource management component of the National Incident Management System (NIMS). As FEMA put it, typing of maritime position qualifications and resources would "greatly enhance the response to maritime incidents, and allow for Incident Commanders to more adequately request personnel and resources through the National Mutual Aid System and the Emergency Management Assistance Compact."

The upshot, between the MOU and the FEMA typing, was that the Coast Guard's original dream of force multiplication by way of activating maritime partners in other agencies was no longer a dream, but the new reality. This represented the hardening of one of the biggest maritime response assets in our nation's arsenal in measurable terms of boats and trained human capital. Fetterman looked back at those watershed events in amazement. "To this day, Jeff and I look at each other with great pride

for making the impossible happen," he said in 2019.

The Instructors

If we're going to call out the program's milestones, it's even more important that we highlight the element that has kept the BOAT Program energized every step of the way, and that is the instructors. Nearly all those with knowledge of the program cite the instructors as the key. If you hope to train capable boat professionals in the finer tactics of maritime response, you need to be an elite expert in your field. Though the instructors do possess that expertise, it is in their dedication and enthusiasm for the program that make NASBLA's instructors truly stand out.

Dave Considine, former member of the Coast Guard's Boston Harbor Defense Team in the wake of the September 11 attack, and now director of the NASBLA BOAT Program, takes particular satisfaction in his instructor corps. "The past strength and success of the BOAT Program is directly attributable to the knowledge, experience, and skills of our instructor cadre," he said.

Retired Texas Game Warden William J. "Will" Plumas's introduction to the NASBLA BOAT Program came in 2011, when he went through the TOC in Corpus Christi as a student. "I'd been working what we called border operations on the Rio Grande, and not everything we got in the course applied exactly to riverine environments, but what I learned was that doesn't matter. Good tactics are good tactics," he said.

The following year, Plumas was tapped to be an assistant instructor, and has since worked his way up to lead instructor and the program manager for NASBLA Airboat Operations. More than eight years after he was a student in a TOC class, his belief in the program hasn't waned. "We do each other a great service when we're willing to pass along our life long experiences to the new generation of maritime first responders," Plumas said.

Sergeant Keith Matthews of the San Francisco Police Department's Marine Unit is another student-turned-instructor. He said watching students' confidence and skills increase makes him as proud as hearing about the improved relations between other governmental agencies and Coast Guard operators. "[They] can then rely on each other to conduct the mission using the same tactics—that's what makes me proud and drives me forward as an instructor," he said.

"NASBLA's instructors come from diverse agencies all around the country, with broad, differing backgrounds," said TOC Instructor/Connecticut Environmental Conservation Police Captain Eric Lundin. "When we come together to teach a class, all are singly committed to that course's objectives and mission: To have the students become valuable assets in their particular maritime community."

The Program Today

In the 10 years following the first TOC, the NASBLA BOAT Program issued more than 17,000 official certifications to maritime law enforcement and first responders. To comprehend the effect those certifications have on our nation's readiness, consider that the number is double the number of boat crew personnel in the active duty Coast Guard. During the most recent program year, 2018–2019, more classes—97—were completed and more students graduated than any of the previous nine years. In the first year of the program, there were 15 instructors for a single course offering. Now there are 230 NASBLA instructors teaching four FEMA-recognized courses among more than 20 distinct NASBLA BOAT Program courses offered.

Florida Fish and Wildlife officer escorts a nuclear submarine near U.S. Naval Station Mayport. Natonal Association of State Boating Law Administrators photo

What the NASBLA BOAT Program has done for our national readiness is dramatic. Participants in the program understand they are part of a national response team, linchpins in the security, and protection of our country as a whole. And the Coast Guard has come to recognize and call on these same agencies as partners with the same interests and stakes. For the past decade, while many governmental entities have been discussing and planning, the NASBLA BOAT Program has been producing tangible real-world gains against our

nation's crisis preparedness.

Florida Fish and Wildlife personnel fire a warning shot in Jacksonville. National Association of State Boating Law Administrators photo

The Dividend: Real World Ops

Retired Major Brad Williams, Florida state law enforcement, now the National Tactical Program manager and lead instructor for the NASBLA BOAT Program has personally witnessed many of those gains. This includes the Florida Waterborne Response Teams (WRTs) who engaged in multi-year escort missions protecting nuclear submarines transiting in and out of U.S. Naval Station Mayport in Jacksonville (the original operational plan for Station Mayport ran through 2012, and the escorts continue to be scheduled case-by-case at various ports along the east coast of Florida). The frequency of the escorts had strained the limits of the local Coast Guard Station, leading the Coast Guard and the Navy to tap the Florida WRTs, credentialed graduates of the BOAT Program courses, to handle the sensitive assignment. "They ran like clockwork," said Williams, who was Florida's statewide coordinator for the missions. "And this freed up the Coast Guard to continue its important search and rescue and law enforcement duties."

As commanding officer of Coast Guard Station Castle Hill in Newport, Rhode Island, Chief Warrant Officer (Ret) Tom Guthlein also experienced the dividends of the NASBLA BOAT Program in his area of responsibility. "The fire and police side is being used to help supplement the Coast Guard's response," he said. "The Providence Strike Team requires its members to complete the Boat Operator Search and Rescue Course for two reasons. First, it makes every member interchangeable, no matter what kind of official title they have or what kind of boat they're on. Second, it means they can react right away, as soon as they arrive on the scene."

A compelling example of these principles played out on Mount Hope Bay, when a boat caught fire and four passengers wound up in the water. "Four boats responded. There was East Providence Fire on the scene, and Warwick Fire," Guthlein said. "And then there were two smaller boats, the Portsmouth Fire Department and Bristol Fire Department. One boat dealt with the fire and the other three immediately launched sector searches, and they recovered all four people."

Some of the rescuers were recent graduates of the Boat Operator Search and Rescue Course, and they credited the program's having given them the tactics they employed to rescue the survivors from the water.

The Future

When a revolution succeeds as boldly as the NASBLA BOAT Program has, looking back at its rise is instructive, but there is also value in peeking ahead. To determine where the revolution is aiming next, we turn to the two individuals John Fetterman refers to as "the trustees" of the program, Dave Considine and Brad Williams, who know better than anyone not just where the program came from, but where it is headed.

For Considine, the future starts with the instructors. "As our more seasoned instructors begin to rotate out of the program, we must have highly capable instructors ready and capable of filling that void," he said "We see a bright future in the continued expansion of maritime related courses we will be able to deliver."

Lead Instructor Brad Williams frames his own optimism about the program's future in succinct language befitting the veteran maritime responder he is. "The sea state is ever changing," he said. "It challenges us with every swell. NASBLA BOAT is uniquely capable of rising to the challenges.".

About the author:
Ames Holbrook writes for the U.S. Coast Guard's Office of Boat Forces, and is the author of multiple books, including DISCHARGE: A Veteran's Lessons on Outrunning the Pentagon, Moving Stolen Military Art, *and* Guzzling Civilian Freedom.

Chemical of the Quarter

Understanding Ethylene

by Raghunath Halder, Ph.D.
Hazardous Materials Division
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What is it?

Ethylene, also known as Ethene, is the simplest hydrocarbon compound in a series of organic compounds called alkenes, or olefins, meaning "oil-forming." It is the second most widely produced chemical in the world after sulfuric acid, and is the most widely produced organic chemical, with an annual worldwide demand of approximately 150 million metric tons in 2017.[1] One of its primary uses is in the manufacturing of polyethylene, the most common component in plastics.[2] It is also used for the manufacture of ethylene oxide, which is used for the production of ethylene glycol, and surfactants and detergents. Additionally, it is used in the production of vinyl chloride, the monomer used to manufacture polyvinyl chloride. Ethylene is also a naturally occurring plant growth chemical in trace concentrations and has effects on growth, development, and storage life of many fruits and crops.[3]

How is it produced?

It is generally produced by steam cracking a hydrocarbon feedstock that contains a high amount of light-end gases. Ethylene is separated from the resulting mixture of gases by repeated compression and distillation. The hydrocarbon feedstock most often used is natural gas that contains 2–9 percent ethane, naphtha, or shale gas, a byproduct in shale oil production. A less common method for producing ethylene is to dehydrate ethanol at 325–475 degrees Celsius using a catalyst.

Why should I care?

➤ *How is it shipped?*

At ambient conditions, ethylene is a gas with a boiling point of –103.7 degrees Celsius. Its critical temperature and critical pressure are 9.2 degrees Celsius and 734 psi, respectively. Critical temperature is the temperature at which a gas can be liquefied by applying a minimum required pressure, known as critical pressure. Given these properties, ethylene is shipped as a liquefied gas in liquid propane gas containers or in bulk shipments by vessel. Due to occurrence of cheap natural gas from shale, the United States has started exporting ethylene to foreign markets.[4]

➤ *Health and Safety Concerns*

Ethylene is not a toxic chemical, nor is it known to be carcinogenic,[5] however, it is an asphyxiant and highly flammable. It has a flashpoint of –136 degrees Celsius with a lower explosive limit of 2.75 percent and upper explosive limit of 28.6 percent by volume in air. If liquid ethylene comes in contact with the skin it can cause frostbite.

A highly flammable and reactive chemical, ethylene can react violently or explosively with some chemicals including ozone, nitrogen dioxide, nitric acid, halogens, and other oxidizing agents. Ethylene cylinders must be stored in well-ventilated areas away from any ignition sources and only non-sparking tools may be used when opening or closing these cylinders.

What is the Coast Guard doing about it?

Ethylene is transported as a liquefied gas, which is achieved by compressing ethylene to the required pressure below its critical temperature. The Coast Guard Office of Design and Engineering Standards maintains the U.S. Code of Federal Regulations Title 46, Part 154, which provides design, construction, and operational requirements for maritime vessels that transport liquefied gas. These regulations dictate that the Marine Safety Center verifies that each vessel is designed in accordance with international and domestic regulation. Furthermore, the Coast Guard Liquefied Natural Gas Carrier National Center of Expertise's dedicated team of highly experienced individuals oversee the inspector training and qualification process, and act to advocate Coast Guard regulations and policy to the industry.

About the author:

Dr. Raghunath Halder is currently working as a chemical engineer in the Hazardous Materials Division of the United States Coast Guard's Office of Design and Engineering Standards. He previously worked at Marine Corps Logistics Base Barstow in Barstow, California; Red River Army Depot in Texarkana, Texas; and Stevens Institute of Technology in Hoboken, New Jersey. He earned his bachelor's degree in chemical engineering and chemistry, and his master's and doctorate in chemical engineering. This office may be contacted at hazmatstandards@uscg.mil

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Nautical Engineering Queries

Prepared by NMC Engineering Examination Team

1. A water jacket is placed around the exhaust manifolds of propulsion diesel engines to _____.

A. Reduce heat radiation to the engine room
B. Aid in preventing turbocharger overheating
C. Condense and drain moisture from exhaust gases
D. Dampen exhaust gas pulsations in the manifold

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2. If flammable vapors have penetrated a gas-free space, which of the following actions would be the most hazardous to perform?

A. Opening switches in the space to de-energize circuits
B. Closing switches adjacent to the space to operate vent fans
C. Leaving electrical circuits energized in the space
D. Securing all power to the space from a remote location

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3. Clean, low-pressure steam drains are collected in the _____.

A. Deaerating feedwater heater
B. Contaminated drain inspection tank
C. Atmospheric drain tank
D. Main condenser hotwell

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4. When a megohmmeter is being used to test insulation resistance, current leakage along the surface of the insulation is indicated by the megohmmeter's pointer responding in a very unique way. What would be the response of the pointer?

A. Dipping toward zero then raising slowly
B. Continually rising as test voltage is applied
C. Kicking slightly down scale as voltage is applied
D. Fluctuating around a constant resistance reading

1. A. Reduce heat radiation to the engine room — **Correct answer.** "The water cooling of the exhaust manifold … prevents excessive heating of the air in the Engine room."

B. Aid in preventing turbocharger overheating — Incorrect

C. Condense and drain moisture from exhaust gases — Incorrect

D. Dampen exhaust gas pulsations in the manifold — Incorrect

Reference: Diesel Engine Operation and Maintenance, *Maleev, page 264*

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2. A. Opening switches in the space to de-energize circuits — **Correct answer.** "The chief hazard is the arcing produced when the switch is opened."

B. Closing switches adjacent to the space to operate vent fans — Incorrect

C. Leaving electrical circuits energized in the space — Incorrect

D. Securing all power to the space from a remote location — Incorrect

Reference: Marine Fire Prevention, Firefighting and Fire Safety, *MARAD, page 96*

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3. A. Deaerating feedwater heater — Incorrect

B. Contaminated drain inspection tank — Incorrect

C. Atmospheric drain tank — **Correct answer.**

D. Main condenser hotwell — Incorrect

Reference: NAVPERS 10788B, Principles of Naval Engineering, *Page 220*

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4. A. Dipping toward zero then raising slowly — Incorrect

B. Continually rising as test voltage is applied — Incorrect

C. Kicking slightly down scale as voltage is applied — **Correct answer.** "The leakage of current along the surface of dirty insulation is generally indicated by slight kicks downscale."

D. Fluctuating around a constant resistance reading — Incorrect

Reference: Operation, Testing and Preventative Maintenance of Electrical Power Apparatus, *Hubert, Page 510*

Nautical Deck Queries

Questions

Prepared by NMC Engineering Examination Team

1. **BOTH INTERNATIONAL & INLAND: You are on watch in the fog. Your vessel is proceeding at a safe speed when you hear a fog signal ahead of you. The rules require you to navigate with caution and take which action if danger of collision exists?**

   A. Slow to a minimum speed so that the vessel can be kept on course
   B. Stop your engines
   C. Slow to less than 2 knots
   D. Begin a radar plot

2. **Your vessel displaces 564 tons. The existing deck cargo has a center of gravity of 1.5 feet above the deck and weighs 41 tons. If you load of 22 tons of ground tackle with an estimated center of gravity of 2.5 feet above the deck, what is the final height of the center of gravity of the deck cargo?**

   A. 1.62 feet
   B. 1.85 feet
   C. 2.10 feet
   D. 2.46 feet

3. **When attempting to enter a compartment containing a fire, which method of applying water is best?**

   A. Solid stream directed toward the overhead
   B. High-velocity fog stream directed toward the overhead
   C. Straight stream directed into the center of the fire
   D. Sweeping the compartment with a fog stream

4. **Which is usually the most gentle way of riding out a severe storm on a larger vessel?**

   A. Head into the seas at slow speeds
   B. Rig a sea anchor
   C. Running before the seas
   D. Hove to

Corrections to the Winter 2020 issue

On page 128 of Winter 2020, the answer to the first Nautical Deck Queries question was not complete, and therefore incorrect. Please find the following question and the complete, correct answer.

BOTH INTERNATIONAL & INLAND Which equipment, to generate fog signals, is required on a vessel 20 meters in length?

A. Whistle and bell only

Correct answer. **Reference: International and Inland Rule 33(a).** *"A vessel of 12 meters or more in length shall be provided with a whistle,* ***a vessel of 20 meters or more in length shall be provided with a bell in addition to a whistle****, and a vessel of 100 meters or more in length shall, in addition be provided with a gong, the tone and sound of which cannot be confused with that of the bell. The whistle, bell and gong shall comply with the specifications in Annex III to these Rules/Regulations. The bell or gong or both may be replaced by other equipment having the same respective sound characteristics, provided that manual sounding of the prescribed signals shall always be possible."*

1. A. Slow to a minimum speed so that the vessel can be kept on course

Correct answer. "Except where it has been determined that a risk of collision does not exist, every vessel which hears, apparently forward of her beam, the fog signal of another vessel or which cannot avoid a close-quarters situation with another vessel forward of her beam, shall reduce her speed to the minimum at which she can be kept on her course. She shall, if necessary, take all her way off and, in any event, navigate with extreme caution until danger of collision is over."

B. Stop your engines — Incorrect

C. Slow to less than 2 knots — Incorrect

D. Begin a radar plot — Incorrect

Reference: Inland/International Rule 19(e)

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2. A. 1.62 feet — Incorrect

B. 1.85 feet

Correct answer. "In order to find the change in position of center of gravity, the officer must employ the Theory of Moments … each known weight, including the light ship weight, must be multiplied by the appropriate height of the weight's center of gravity(g), above the keel. Then, divide the sum of all these products (moments) by the total weights, including the weight of the light ship …" So, as per this formula, (41 tons × 1.5 feet) + (22 tons × 2.5 feet) / (41 tons + 22 tons) = 116.5 foot-tons / 63 tons.

C. 2.10 feet — Incorrect

D. 2.46 feet — Incorrect

Reference: Stability and Trim for the Ship's Officer, George, 4th Ed., *pages 50–54*

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3. A. Solid stream directed toward the overhead — Incorrect

B. High-velocity fog stream directed toward the overhead — Incorrect

C. Straight stream directed into the center of the fire — Incorrect

D. Sweeping the compartment with a fog stream

Correct answer. "To attack a substantial fire behind a closed door, the charged hose line should be positioned outside the door. Then the door should be opened only enough to insert the nozzle. Using the door to protect his body, the nozzleman should sweep a fog stream around the compartment."

Reference: Marine Fire Prevention, Firefighting and Fire Safety, *MARAD, page 208*

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4. A. Head into the seas at slow speeds — Incorrect

B. Rig a sea anchor — Incorrect

C. Running before the seas

Correct answer. "Handling Steamers in Heavy Weather: The opinion of late years is that a steamer should run slowly before a sea or lie to within the sea astern or on the quarter …"

D. Hove to — Incorrect

Reference: Knight's Modern Seamanship, Noel, 17 Ed., pages 254–255

In the News: Protecting the Force

Coast Guard Petty Officer 2nd Class Collin DeGroff, a health services technician, administers the COVID 19 vaccine to Chief Petty Officer Thomas Thelen at Coast Guard Sector Anchorage, Alaska, on January 14, 2021. The Coast Guard is working diligently to vaccinate members to combat the spread of COVID 19. Coast Guard photo by Petty Officer 2nd Class Melissa McKenzie

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Members of the Coast Guard Cutter *Polar Star*'s deck department work to clear the ship's deck of ice in December 2020. The 44-year-old heavy icebreaker is underway for a months-long Arctic deployment to protect the nation's maritime sovereignty and security throughout the region. Coast Guard Photo by Petty Officer 1st Class Cynthia Oldham