FRAMEWORK AND TOOLS FOR DEVELOPING A LOW-IMPACT SHIPPING CORRIDOR IN THE ARCTIC OCEAN

September 7, 2018

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INTRODUCTION

This paper is meant to inform the World Wildlife Fund's (WWF) Low-Impact Shipping Corridor Project, which aims to develop a new framework for protecting the wildlife, ecosystems, and subsistence resources in the Arctic Ocean. The focus of this discussion will be on shipping activities in U.S. and Canadian waters within the Chukchi and Beaufort seas, but the principles and tools described here could be applied elsewhere in the Arctic as well.

The purpose of this memorandum is three-fold. Part I provides an overview of the legal framework and tools that could be used to establish low-impact shipping corridors in the Arctic Ocean. Part II discusses some of the laws governing marine pollution and how they may be relevant for low-impact shipping corridors. Part III presents several examples of existing vessel routing schemes and management measures that show what is already being done to protect the marine environment and illustrate what further steps could be taken in the Arctic.

The good news is that there are ample legal authorities and mechanisms in place to facilitate the development of low-impact shipping corridors in the Arctic Ocean, including directional routing, designated areas, operation and oversight systems, and no-discharge zones. Moreover, there have been substantial efforts in recent years to actually utilize these authorities and mechanisms for marine protection. The main challenges going forward will be in gathering sufficient data and mobilizing enough political will to establish and expand such protections in the Arctic Ocean.

BACKGROUND

The Arctic Ocean is a critically important ecosystem, which supports some of the most unique wildlife in the world, and this in turn has supported a subsistence culture for more than a thousand years.[1] The Arctic region serves as a breeding, feeding, and/or migratory habitat for many birds, fish, and marine mammals, including a number of endangered species.[2]

As climate change progresses, Arctic seas have become increasingly ice-free in late summer and early fall.[3] This has made Arctic shipping far more feasible than it has ever been before, as shown in Figure 1.[4] Indeed, the overall number of commercial vessels traversing the Arctic has increased significantly in recent years, and the upward trend is projected to continue as melting ice makes the Arctic more accessible.[5] Even travel through the most formidable and impassable areas of the Arctic has already begun. From 2001 to 2016, more than 100 vessels passed through the Northwest Passage, with the first large passenger cruise ship traversing it in 2016.[6] During the same time period, 200 large vessels traveled the Northern Sea Route near the coast of Russia.[7] In 2017, the first commercial ship traveled the Northern Sea Route unescorted by an icebreaker.[8] And in 2018, the first bulk fuel delivery was made to the North Slope of Alaska by a barge carrying 2 million gallons of diesel fuel.[9]

As vessel traffic increases, there is greater potential for ships to collide with each other; run aground on land or rocks; spill oil and hazardous substances; injure or kill marine mammals; disrupt feeding, migration, and reproductive behaviors; and otherwise harm the marine environment.[10]

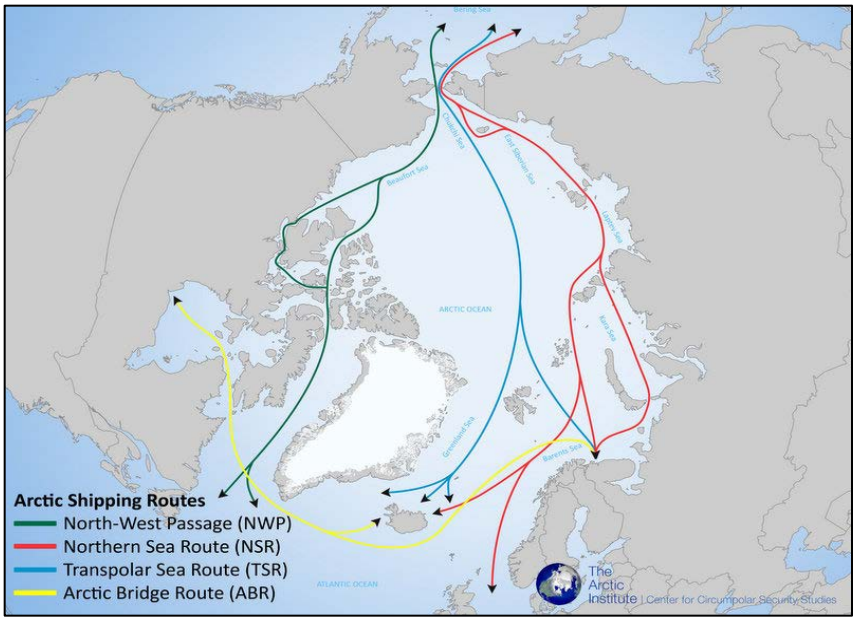

Figure 1 - Routes opening up to shipping as warming temperatures reduce Arctic sea ice. (Source: The Arctic Institute)

The International Maritime Organization (IMO) is a specialized agency of the United Nations responsible for the safety and security of shipping and the prevention of ship pollution.[11] The IMO facilitates the development of international maritime conventions and establishes international rules and standards governing vessel traffic.[12] The IMO is considered the principal international authority concerning shipping.[13]

The Arctic Council, established through the Ottawa Declaration of 1996,[14] is an intergovernmental forum composed of the eight Arctic nations—Canada, Denmark (for Greenland), Finland, Iceland, Norway, Russia, Sweden, and the United States.[15] In addition to these member states, indigenous peoples' organizations, such as the Inuit Circumpolar Council, serve as permanent participants.[16] The Arctic Council has issued numerous guidelines and reports, such as the Arctic Environmental Protection Strategy,[17] the Arctic Climate Impact Assessment,[18] the Arctic Council Offshore Oil and Gas Guidelines,[19] and the Arctic Marine Strategic Plan.[20] One of the most relevant here is the Arctic Marine Shipping Assessment (AMSA) published by the Arctic Council in 2009.[21] The AMSA Report provided recommendations concerning safety, marine infrastructure, and environmental and subsistence protection, and it encouraged member states to work with the IMO to harmonize and update standards for vessels operating in the Arctic.[22] In particular, the AMSA calls for engagement with Arctic communities and environmental protection, including the designation of environmentally sensitive areas.[23]

The Arctic Council has taken steps to establish governance regimes as well. Through the Ilulissat Declaration in 2008, five of the eight Arctic states (those with coastline on the Arctic Ocean) declared that the "law of the sea" is an "extensive international legal framework" and that they "therefore see no need to develop a new comprehensive international legal regime to govern the Arctic Ocean."[24] At the same time, however, the

coastal states expressed a willingness to cooperate in the areas of environmental protection, navigation safety, and scientific research, and to form bilateral and multilateral arrangements between relevant states.[25] In 2011, the Arctic Council issued its first legally binding instrument concerning Arctic search and rescue.[26] Since then, the Arctic Council has successfully facilitated the negotiation of two other legally binding agreements as well, one pertaining to oil pollution preparedness and response[27] and the other relating to scientific cooperation.[28]

Maritime infrastructure in the Arctic Ocean region remains limited, however. There are no IMO-approved vessel routing measures in the region.[29] Moreover, on the U.S. side, there is no permanent Coast Guard presence, and the closest U.S. Coast Guard facilities are hundreds of miles away in Dutch Harbor and Kodiak, Alaska.[30] The Canadian Coast Guard has a stronger presence in the Arctic, as discussed in Parts I(C) and III(C)(2) below. There are still no deepwater ports in either the U.S. or Canadian regions of the Arctic at present, but Canada is in the process of developing a deepwater port at Iqaluit.[31] The United States has considered developing a deepwater port in Nome, Port Clarence, Cape Darby, or Barrow, Alaska.[32] The U.S. Army Corps of Engineers (Corps) began a feasibility study in 2011, and it identified expansion of the existing port in Nome as the most feasible site for "initial Arctic port investment," but the study process was suspended in 2015.[33] A provision of the 2016 Water Infrastructure Improvements for the Nation Act directed the Corps "to determine if there would be national security benefits associated with building an Arctic deep-draft port."[34] Not much has happened since then, but the Corps has recently started pulling together a study team and held planning meetings in Nome in late April 2018.[35] Just prior to the meetings, the Alaska Legislature adopted a resolution acknowledging that "the retreat of Arctic sea ice is increasing the seasonal navigability of the Arctic Ocean, which has resulted in an influx of traffic and activity in the circumpolar Arctic," and lamenting that, while the "other seven Arctic nations have been very proactive in addressing the changing situation in the Arctic and have begun to assert their interests in the region," the U.S. has lagged far behind.[36] The resolution identified an urgent need to develop key infrastructure and defense capabilities in the Arctic, and it urged Alaska's congressional delegation to pursue the establishment of a U.S. Coast Guard port and improve emergency response capabilities in the region.[37] The Nome City Council voted in support of the resolution a few days later.[38] In August 2018, leaders of the U.S. Coast Guard, U.S. Navy, and U.S. Senator Dan Sullivan visited Nome as part of an effort to move the project forward.[39]

LEGAL FRAMEWORK

The United Nations Convention on the Law of the Sea (UNCLOS) sets forth a comprehensive legal framework governing the use of the world's oceans.[40] UNCLOS entered into force in 1994, and it has been ratified or acceded to by 168 parties, including Canada and all of the other Arctic nations, except the United States.[41] Although the United States has not yet ratified UNCLOS, it generally abides by it and recognizes its baseline provisions as

customary international law.[42] UNCLOS defines various zones, summarized in Figure 2, and it establishes key principles relevant to shipping, including the following:

- Establishes coastal states' "**territorial seas**" (0 to 12 nautical miles from coastline) and defines their rights and responsibilities within these zones;[43]
- Guarantees foreign ships the right of "**innocent passage**" (traveling through in good faith without calling at any port) through territorial seas;[44]
- Allows coastal states to impose controls on shipping within their "**contiguous zones**" (12 to 24 nautical miles from coastline) to prevent and punish "infringement of its customs, fiscal, immigration or sanitary laws and regulations within its territory or territorial sea;"[45]
- Establishes coastal states' "**exclusive economic zones**" (EEZ, 12 to 200 nautical miles from coastline) and defines their rights and responsibilities within these zones;[46]
- Allows coastal states bordering "**international straits**" (narrow waterways between one part of the high seas or EEZ and another) to impose some controls on shipping;[47]
- Guarantees all ships the right of "**transit passage**" (freedom of navigation for the purpose of continuous and expeditious transit) through international straits;[48] and
- Guarantees freedom of navigation on the "**high seas**" (beyond coastal state jurisdiction) and defines ship rights and responsibilities there.[49]

UNCLOS also includes extensive provisions relating to the protection and preservation of the marine environment.[50]

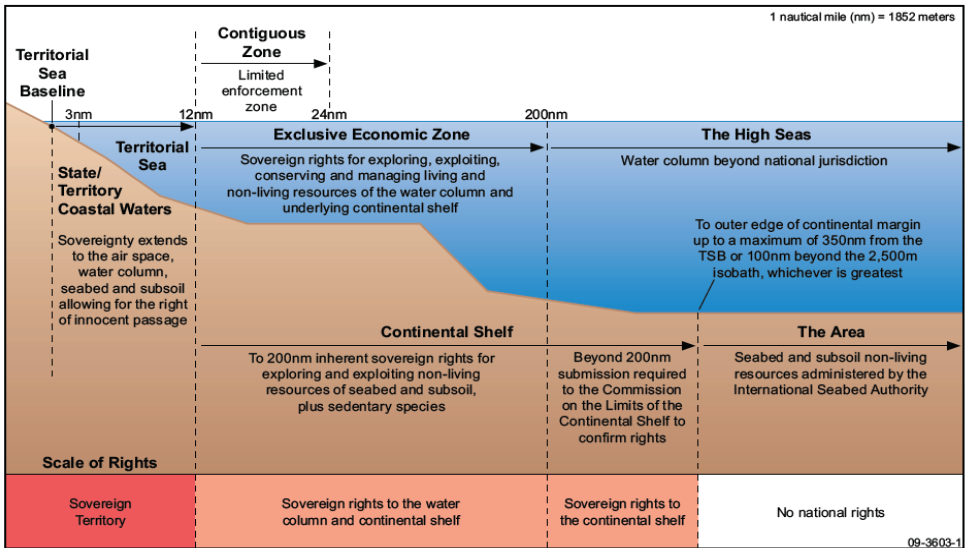

Figure 2 – Maritime Zones Recognized Under International Law (Source: NOAA)

UNCLOS divides responsibility for navigation safety, environmental protection, and other matters between coastal states (those bordering the waters where a vessel passes), the port state (the vessel's destination), and the flag state (the state with which the vessel is registered). A coastal state can exercise full

sovereignty over ships in its internal waters and set conditions for entry into ports in these waters,[51] and it must publicize any known navigational dangers within its territorial sea.[52] The flag state has primary responsibility for controlling ship navigation.[53] All states have some responsibility for controlling pollution and protecting the marine environment.[54]

Article 22 allows a coastal state to unilaterally establish sea lanes and traffic separation schemes within its territorial sea and require ships to follow these lanes or schemes, so long as the coastal state takes into account (a) any relevant IMO recommendations;[55] (b) any channels customarily used for international navigation; (c) the special characteristics of particular ships and channels; and (d) the density of traffic.[56] A coastal state may also unilaterally prescribe standards regarding navigation, pollution control, and other matters for its territorial sea, but these standards generally cannot apply to the "design, construction, manning or equipment of foreign ships unless they are giving effect to generally accepted international rules or standards."[57]

Article 211 requires states to establish both international standards and domestic regulations regarding marine pollution.[58] States, acting together through the IMO, are directed to "promote the adoption ... of routeing systems designed to minimize the threat of accidents which might cause pollution of the marine environment, including the coastline, and pollution damage to the related interests of coastal States."[59] A coastal state's marine pollution laws apply to foreign vessels in its territorial seas, as long as the laws do not impede innocent passage,[60] and to foreign vessels in its EEZ, as long as the laws conform to and give effect to "generally accepted international rules and standards" established through the IMO.[61] Additionally, where international rules and standards are "inadequate to meet special circumstances," a coastal state can seek IMO approval for "special mandatory measures for the prevention of pollution from vessels" within a "clearly defined area" of the EEZ.[62] After the defined area is established, the coastal state can unilaterally adopt additional laws and regulations relating to discharges and navigational practices, but these additional laws "shall not require foreign vessels to observe design, construction, manning or equipment standards other than generally accepted international rules and standards."[63]

Of particular relevance for the Arctic, Article 234 gives each coastal state the right to unilaterally adopt and enforce laws for the "prevention, reduction and control of marine pollution from vessels in ice-covered areas" in its EEZ where "particularly severe climatic conditions and the presence of ice covering such areas for most of the year create obstructions or exceptional hazards to navigation, and pollution of the marine environment could cause major harm to or irreversible disturbance of the ecological balance."[64] Such laws must be "non-discriminatory" and have "due regard to navigation and the protection and preservation of the marine environment based on the best available scientific evidence."[65]

Coastal state control is more limited in international straits. The right of "transit passage" is defined as the exercise of the "freedom of navigation and overflight solely for the purpose of continuous and expeditious transit of the strait."[66] Coastal states bordering an international strait may unilaterally adopt and enforce laws relating to navigation safety, vessel traffic, pollution control, fishing, customs, fiscal, immigration, and sanitary issues,[67] as long as these laws and regulations do not "discriminate in form or in fact among foreign ships" or have the "practical effect of denying, hampering or impairing the right of transit passage."[68] With IMO approval and consent of the other bordering states, a coastal state can also "designate sea lanes and prescribe traffic separation schemes" within an international strait "where necessary to promote the safe passage of ships."[69]

PART I
VESSEL TRAFFIC MANAGEMENT

Conceptually, a low-impact shipping corridor may be seen as consisting of three components. Much like a highway on land, the shipping corridor would consist of: (1) the route and its map, (2) the rules that travelers must abide by, and (3) the authorities that enforce those rules. While safety is a fundamental concern, environmental protection can also play an important role both in the design of the route and in the behavior expected of its users. The vessel traffic management provisions discussed in this part encompass all three components, along with overarching safety and environmental protection objectives.

A key international agreement governing shipping is the International Convention for the Safety of Life at Sea of 1974 (SOLAS), which entered into force in 1980.[70] It has been ratified or acceded to by 164 parties, including the U.S., Canada, and all other Arctic countries, representing over 99% of global shipping tonnage.[71] SOLAS and its associated codes set international safety standards for the construction, equipment, and operation of merchant ships.[72] The implementation of SOLAS is overseen by the IMO, and SOLAS recognizes the IMO as the sole international body responsible for establishing vessel traffic routing schemes and areas to be avoided.[73] Flag states are responsible for ensuring the compliance of their ships with SOLAS requirements.[74] The main substantive chapters of SOLAS govern ship construction and fire safety (Chapter II), life-saving equipment and arrangements (Chapter III), radiocommunications (Chapter IV), navigational safety (Chapter V), stowage of cargo (Chapter VI), dangerous goods (Chapter VII), nuclear ships (Chapter VIII), safety management (Chapter IX), safety measures for high-speed craft (Chapter X), inspections, surveys, and other safety measures (Chapter XI), bulk carriers (XII), compliance verification (Chapter XIII), and polar safety (Chapter XIV).[75]

Chapter V of SOLAS recognizes that ship routing, ship reporting, and vessel traffic systems "contribute to safety of life at sea, safety and efficiency of navigation and/or protection of the marine environment,"[76] and it encourages their establishment in accordance with IMO guidelines.[77] SOLAS also requires most large ships engaged in international voyages to be equipped with Automatic Identification Systems (AIS) and Long-Range Identification and

Tracking (LRIT) Systems that can automatically transmit information about the ship to other ships and to coastal authorities.[78] Additionally, much like UNCLOS, SOLAS imposes a duty on states to provide navigational warnings.[79]

Another important international agreement governing shipping is the International Regulations for Preventing Collisions at Sea (COLREGs), a convention of the IMO.[80] The COLREGs entered into force in 1977 and have since been ratified or acceded to by 159 nations—including the United States, Canada, and all other Arctic nations—representing more than 99% of global shipping tonnage.[81] The COLREGs aim to avoid collisions and ensure navigation safety.[82] They include provisions relating to maintaining a proper look-out (Rule 5), safe vessel speed (Rule 6), determination of collision risks (Rule 7), actions to avoid collision (Rule 8), transit through narrow channels (Rule 9) and, of particular relevance here, adherence to traffic separation schemes (Rule 10).[83] Under Rule 10, fishing vessels "shall not impede the passage of any vessel following a traffic lane" but are allowed to engage in fishing in the lanes.[84]

The IMO recently achieved another major milestone by overseeing the adoption of the International Code for Ships Operating in Polar Waters (Polar Code), which entered into force in 2017.[85] The Polar Code includes both safety provisions, made mandatory through amendments to SOLAS, and environmental provisions, made mandatory through amendments to MARPOL, as discussed in Part II below.[86]

International agreements governing vessel traffic—including SOLAS, the COLREGs, and the Polar Code—are implemented largely through domestic laws and regulations. Shipping governance statutes in the U.S. and Canada identify protection of the marine environment as a fundamental policy objective, along with protection of human safety and property. In the Ports and Waterways Safety Act (PWSA), for instance, the U.S. Congress made the following findings and declarations:

> (a) that navigation and vessel safety, protection of the marine environment, and safety and security of United States ports and waterways are matters of major national importance; (b) that increased vessel traffic in the Nation's ports and waterways creates substantial hazard to life, property, and the marine environment; (c) that increased supervision of vessel and port operations is necessary in order to — (1) reduce the possibility of vessel or cargo loss, or damage to life, property, or the marine environment; … and (d) that advance planning is critical in determining proper and adequate protective measures for the Nation's ports and waterways and the marine environment … .[87]

The PWSA broadly defines the "marine environment" to include the navigable waters of the United States and the land and resources within and under those waters, including the seabed and subsoil of the Outer Continental Shelf, fishery resources, "and the recreational, economic, and scenic values of such waters and resources."[88]

Canada has established similar policy goals. A key objective of the Canada Shipping Act (CSA), for instance, is to "protect the marine environment from damage due to navigation and shipping activities."[89] Additionally, Canada's Arctic Waters Pollution Prevention Act of 1970 (AWPPA) is intended to ensure that "arctic waters adjacent to the mainland and islands of the Canadian arctic are navigated only in a manner that takes cognizance of Canada's responsibility for the welfare of the Inuit and other inhabitants of the Canadian arctic and the preservation of the peculiar ecological balance that now exists in the water, ice and land areas of the Canadian arctic."[90]

The U.S. Coast Guard is the main agency responsible for implementing the PWSA and other maritime laws in the United States, and it has the authority to implement vessel reporting, routing, and management measures in both internal and offshore waters.[91] The Coast Guard can also construct, operate, maintain, improve, or expand vessel traffic services in any port or place within the United States' jurisdiction or covered by an international agreement.[92]

More generally, the PWSA grants the Coast Guard broad authority to "control vessel traffic in areas subject to the jurisdiction of the United States" that it has determined to be "hazardous, or under conditions of reduced visibility, adverse weather, vessel congestion, or other hazardous circumstances."[93] To address such hazards, the Coast guard may specify "times of entry, movement, or departure," establish "vessel traffic routing schemes," establish "vessel size, speed, draft limitations and vessel operating conditions," and restrict operation to "vessels which have particular operating characteristics or capabilities."[94] Congress's statement of policy, quoted above, makes clear that the hazards encompassed within the Coast Guard's mandate include hazards to the marine environment.

The Canadian Coast Guard has been granted similar authorities. The agency may, for example, "regulat[e] or prohibit[] the navigation, anchoring, mooring or berthing of vessels for the purposes of promoting the safe and efficient navigation of vessels and protecting the public interest and the environment."[95]

For simplicity, the following discussion of vessel traffic routing and management measures will focus primarily on U.S. domestic laws. Canada and other countries have similar laws implementing the COLREGs and their own domestic shipping policies.

A. DIRECTIONAL ROUTING

A directional ship routing system requires vessels to use specific traffic routes. Ship routing systems can be established to improve safety, navigation, or protection of the marine environment.[96] They may be either voluntary or mandatory, and they may apply to all ships, certain categories of ships, or ships carrying certain cargos.[97] The following are some of the main types of vessel traffic routing measures in common usage:[98]

A "**traffic separation scheme**" (TSS) is a vessel routing scheme "aimed at the separation of opposing streams of traffic by appropriate means and by the establishment of traffic lanes."[99] While the original purpose of TSSs was to prevent collisions and improve the safety of international shipping,[100] they can also be used for the protection of the marine environment, such as by preventing collisions with whales and other marine mammals or reducing the risk of oil spills.

A marine "**traffic lane**" is an "area within defined limits in which one-way traffic is established."[101] A marine vessel traffic lane is similar to a highway traffic lane on land with vehicle traffic traveling in a defined lane in one direction.

A marine "**separation zone**" or "**separation line**" is a zone or line (1) separating traffic lanes in which ships are proceeding in opposite directions; (2) separating a traffic lane from the adjacent sea area; or (3) separating traffic lanes designated for particular classes of ships proceeding in the same direction.[102] In light of the three subtypes described above, a marine separation zone could be analogous to a wide strip of land separating opposing lanes of traffic along a divided highway, a wide shoulder providing a safety buffer from potential collisions with animals emerging from an adjacent forest, or buffer zones separating lanes of traffic entering a bridge or tunnel from each other. Similarly, a marine separation line could be analogous to a painted yellow line separating opposing lanes of traffic along a rural highway, a safety fence or markers preventing vehicle traffic from veering into a cliff or water body, or a painted white line between lanes on the same side of a multi-lane highway.

A marine "**two-way route**" is a route "within defined limits inside which two-way traffic is established, aimed at providing safe passage of ships through waters where navigation is difficult or dangerous."[103] A two-way route for marine vessel traffic is analogous to a wide dirt road with no lanes traversing rugged terrain. While traffic would generally travel on either side in opposing directions, a fallen tree or sinkhole might force vehicles to use the entire width in order to travel safely.

A marine "**fairway**" is a "lane or corridor in which no artificial island or fixed structure, whether temporary or permanent, will be permitted."[104] Marine fairways are much like those in golf and horse racing, where competitors are assured they will encounter no manmade hazards or obstacles.

A "**deep water route**" is a "route within defined limits which has been accurately surveyed for clearance of sea bottom and submerged articles."[105] A deep water route is "intended for use by ships that require the use of such a route because of their draft in relation to the available depth of water in the area concerned."[106] Other traffic "should, if practicable, avoid following deep water routes."[107] Deep water routes are often used to provide safe passage for oil tankers, and smaller fishing boats and pleasure craft would do well to stay out of their way.

A marine "**recommended route**" is a "route of undefined width, for the convenience of ships in transit, which is often marked by centreline buoys."[108] Just as a rancher might use a rope line to find her way home in dense fog or blizzard conditions, a recommended route indicates an unobstructed marine passageway, but it does not separate vessel traffic or establish lane boundaries. A recommended route can be dangerous at times due to the tendency of mariners to "hug the line," which increases the risk of head-on collisions.[109]

An "**inshore traffic zone**" is a "designated area between the landward boundary of a TSS and the adjacent coast."[110] While marine traffic lanes would be comparable to a highway or beltway bypassing a city, the area traversed by criss-crossing surface streets heading from the highway into the city would be analogous to an inshore traffic zone.

Proposals for ship routing systems outside states' territorial seas generally must be submitted to the IMO for approval, and states with a common interest in a particular area are encouraged to submit a joint proposal.[111] Each proposal should demonstrate the need for the particular type of system and its expected impact on navigation.[112] Proposed routes should follow existing patterns of traffic flow as closely as possible.[113] Proposals intended to protect the marine environment should explain how the system would reduce the risk of damage and describe any environmentally sensitive areas.[114]

After IMO approval, the parties to SOLAS must "do everything in their power to secure the appropriate use of ships' routeing systems adopted by the [IMO]."[115] Moreover, individual ships must "use a mandatory ships' routeing system adopted by the [IMO] as required for its category or cargo carried and in accordance with the relevant provisions in force unless there are compelling reasons not to use a particular ships' routeing system," and if so, "[a]ny such reason shall be recorded in the ships' log."[116] IMO-approved routing systems are published in the IMO publication "Ship's Routeing,"[117] and their details are announced in weekly Notices to Mariners issued by the U.S. Coast Guard,[118] Canadian Coast Guard,[119] and comparable agencies in other countries. They are also depicted in the U.S. Coast Pilot volumes,[120] included on nautical charts,[121] and disseminated in other similar ways.

In the United States, the U.S. Coast Guard has been tasked with designating "necessary fairways and traffic separation schemes" in order to "provide safe access routes for the movement of vessel traffic."[122] These designations "shall recognize, within the designated area, the paramount right of navigation over all other uses."[123] The Coast Guard is authorized, but not required, to "make the use of designated fairways and traffic separation schemes mandatory for specific types and sizes of vessels."[124]

Prior to making any such designation, the U.S. Coast Guard must "undertake a study of the potential traffic density and the need for safe access routes" and "publish notice of such undertaking in the Federal Register."[125] Additionally, in consultation with other federal agencies and affected states, the Coast Guard must "take into account all other uses of the area," including resource extraction, "the establishment or operation of marine or estuarine

sanctuaries," and "recreational or commercial fishing" activities.[126] Moreover, "to the extent practicable, the Coast Guard "shall ... reconcile the need for safe access routes with the needs of all other reasonable uses of the area."[127]

When developing vessel traffic routing schemes, the U.S. Coast Guard is required to "take into account all relevant factors concerning navigation and vessel safety, protection of the marine environment, and the safety and security of United States ports and waterways," including but not limited to:

> (1) the scope and degree of the risk or hazard involved; (2) vessel traffic characteristics and trends ... ; (3) port and waterway configurations and variations in local conditions of geography, climate, and other similar factors; ... (5) the proximity of fishing grounds, oil and gas drilling and production operations, or any other potential or actual conflicting activity; (6) environmental factors; (7) economic impact and effects; ... and (9) local practices and customs, including voluntary arrangements and agreements within the maritime community.[128]

Furthermore, in addition to its consultations with other federal agencies and states, the Coast Guard must, "at the earliest possible time, consult with and receive and consider the views of representatives of the maritime community, ports and harbor authorities or associations, environmental groups, and other parties who may be affected by the proposed actions."[129]

Finally, the U.S. Coast Guard is expected to integrate its vessel traffic routing schemes into the international maritime regime. Toward that end, the Coast Guard is directed to issue "reasonable rules and regulations governing the use of such designated areas, including the applicability of rules 9 and 10" of the COLREGS in connection with "narrow channels and traffic separation schemes, respectively, in waters where such regulations apply."[130] The Coast Guard must also notify the IMO of any designation or modification of a vessel traffic routing scheme.[131] If such a scheme is mandatory for U.S. vessels, the Coast Guard must seek cooperation from other nations in order to make the scheme mandatory for their vessels to the same extent.[132]

B. DESIGNATED AREAS

Vessel traffic can also be controlled by establishing designated areas based on safety, security, or marine environment protection concerns and requiring ships to avoid those areas or to adhere to heightened precautionary measures when traversing them. The following are a few examples of vessel traffic control through the establishment of designated areas:

A marine "**area to be avoided**" (ATBA) is an "area within defined limits in which either navigation is particularly hazardous or it is exceptionally important to avoid casualties and

which should be avoided by all ships or certain classes of ships."[133] ATBAs thus may be established for reasons of exceptional danger or especially sensitive ecological and environmental factors. For example, an ATBA could guide vessels away from a shallow, rocky shoal that presents a high risk of groundings or collisions, or it could serve to protect a marine mammal calving or nursing area in which a vessel collision or grounding would have especially severe consequences.

A "**particularly sensitive sea area**" (PSSA) is "an area that needs special protection through action by IMO because of its significance for recognized ecological, socio-economic, or scientific attributes where such attributes may be vulnerable to damage by international shipping activities."[134] "**Associated protective measures,**" such as a 'special area' designation for pollution or an ATBA routing designation, are adopted at the time a PSSA is established in order to protect the area against environmental damage from shipping.[135] To be identified as a PSSA, a proposed area must meet at least one of the ecological, socio-economic, or scientific criteria identified by the IMO.[136] Ecological criteria include factors such as the uniqueness or rarity of the area; the presence of critical habitat in the area; the degree to which the area is representative of a certain habitat type; the area's diversity and productivity; the presence of spawning or breeding grounds or migratory routes in the area; or the naturalness, integrity, or fragility of the area.[137] Social, cultural, and economic criteria include the extent to which people depend on the ecological health of the area for social or economic purposes; the extent to which the area is important for the support of traditional subsistence or food production activities; or the presence of historical or archaeological sites.[138] Scientific and educational criteria include factors such as whether an area is of particular scientific interest; whether it can provide a baseline for monitoring studies; or whether it provides an outstanding opportunity for education.[139] In addition to the above criteria, an application for designation of a PSSA must describe the area's vulnerability to damage from international shipping activities.[140] Vulnerability is based on vessel traffic characteristics, such as the type of maritime activities in the area, the types of vessels that use the area, the characteristics of the vessel traffic, and the extent to which vessels carry harmful substances.[141] Vulnerability also relates to natural characteristics, such as water conditions, weather conditions, and the presence of potential hazards like sea ice, tidal streams, or ocean currents.[142] Proposals for PSSA designation can consider additional factors, including any history of accidents or stresses from other environmental sources.[143] To establish a PSSA, a state must submit an application to the IMO proposing an area for PSSA designation and associated protective measures.[144] If multiple states have a common interest in an area, they should submit a coordinated proposal to the IMO for consideration.[145] The PSSA and protective measures should be made effective as soon as possible after the IMO approves the proposal.[146] Fifteen PSSAs have been established around the world, but there are none so far in Arctic waters.[147]

A marine "**precautionary area"** is an "area within defined limits where ships must navigate with particular caution and within which the direction of flow of traffic may be

recommended."[148] A precautionary area is much like the area at the bottom of a ski hill where signs caution skiers to slow down because multiple runs are converging with each other. A precautionary area can serve to control traffic flow around an area that may pose hazards to shipping or may complement a designated ATBA.[149]

Under U.S. law, a "**regulated navigation area**" (RNA) is a "water area within a defined boundary for which regulations for vessels navigating within the area have been established."[150] This is a general designation for any area with hazardous conditions in which the local U.S. Coast Guard District Commander has issued site-specific regulations concerning "times of vessel entry, movement, or departure," "vessel size, speed, draft limitations, and operating conditions," or other guidelines and restrictions.[151] RNAs are used for a wide variety of purposes, including maintaining order and safety at busy ports, harbors, and canals, providing extra caution near bridge construction sites, establishing winter closures due to ice, and protecting the integrity of sediment caps designed to remediate contamination at submerged Superfund sites.[152] RNAs may also be established to provide for navigation safety when conditions require higher standards of control than that provided by the Navigation Rules.[153] Such RNAs may require vessels to comply with specific criteria in order to enter the area. [154] RNAs may also be established to protect an environmentally sensitive area to limit activities such as oil transfers that would create a high risk of harm. [155] RNAs may be expansive—one includes all of the navigable waters within the First Coast Guard District (i.e., the New England states).[156]

A "**safety zone**" is a designated "water area, shore area, or water and shore area to which, for safety or environmental purposes, access is limited to authorized persons, vehicles, or vessels."[157] A safety zone "may be stationary … or it may be described as a zone around a vessel in motion."[158] The U.S. Coast Guard Captain of the Port or District Commander has broad authority to control activities and enforce restrictions within a safety zone.[159] Stationary safety zones have been established, for example, in designated areas and during specified dates and times around bridges, sunken vessels, fireworks displays, air shows, dredging operations, ports and harbors experiencing hurricane conditions, and industrial facilities during offloading activities.[160] Some examples of mobile safety zones include those surrounding aircraft carriers, parade vessels, cruise ships, dry docks undergoing relocation, swimmers in a racing event, and vessels carrying liquefied natural gas or other hazardous materials.[161]

A "**security zone**" is a designated "area of land, water, or land and water … for such time as is necessary to prevent damage or injury to any vessel or waterfront facility, to safeguard ports, harbors, territories, or waters of the United States" from "destruction, loss, or injury from sabotage or other subversive acts, accidents, or other causes of a similar nature," or to "secure the observance of the rights and obligations of the United States."[162] The U.S. Coast Guard Captain of the Port has broad authority to control activities and enforce restrictions within a security zone, including intrusive measures such as taking "possession and control of any vessel" and removing "any person, vessel, article, or thing" from the

security zone.[163] Security zones are typically established around facilities that may be targeted by terrorists or saboteurs, such as nuclear power plants, oil refineries, liquefied natural gas terminals, military facilities, and NASA space facilities.[164]

C. OPERATION & OVERSIGHT

While vessel traffic routing and designated areas are important tools to address threats to the Arctic marine environment, measures directed at vessel operation and oversight can also strengthen protection of the Arctic marine environment.

Vessels traveling in marine waters are subject to numerous international and domestic standards depending on their characteristics and cargo. This discussion will focus on measures that may be especially useful in low-impact shipping corridors. Speed limits, for instance, have been identified as important for reducing ship strikes that can injure or kill marine mammals.[165] They can be utilized in conjunction with many of the vessel routing measures described above. Speed limits may be suitable, for instance, in precautionary areas where vessel traffic congestion is expected, or in two-way routes where narrow channels increase the risk of accidents.

In the marine shipping context, enhanced operational controls and oversight are commonly implemented through the establishment of vessel traffic service (VTS) areas and authorities, which serve a function analogous to air traffic control. The concept of managing ship movements through a shore-side radar first appeared in the port of Liverpool in 1949, and VTS services evolved and spread across Europe and elsewhere to help ensure each port's commercial well-being.[166] The U.S. Coast Guard established VTSs in several busy U.S. ports during the 1970s and 1980s.

SOLAS authorizes coastal states to adopt, implement, and enforce shore-based VTS systems,[167] which can range from simple information exchange with ships to comprehensive management of vessel traffic in a particular area.[168] The IMO defines a VTS as "a service implemented by a Competent Authority, designed to improve the safety and efficiency of vessel traffic and to protect the environment."[169] A VTS "should have the capability to interact with the traffic and to respond to traffic situations developing in the VTS area."[170] SOLAS limits mandatory VTSs to the territorial seas of a coastal state,[171] and VTSs cannot alter the legal regimes governing international straits.[172] A government establishing a VTS in its territorial waters "should endeavor to follow relevant IMO guidelines" but is not required to seek IMO approval, as long as the level of traffic or risk justifies the service and the service does not impair the right to navigation in international straits.[173] A VTS is particularly appropriate where there is high traffic density; traffic carrying hazardous cargoes; difficult hydrographical, hydrological and meteorological elements; sensitive environmental receptors; or changes in the traffic pattern resulting from developments in the area.[174] As with vessel routing systems, IMO guidelines call for cooperation and agreement when two or more nations have a common interest in

establishing a VTS for a given area.[175] A VTS established by multiple countries "should have uniform procedures and operations."[176] Once a VTS is established, parties to SOLAS "shall endeavour to secure the participation in, and compliance with, the provisions of vessel traffic services by ships entitled to fly their flag."[177]

Under U.S. domestic law, the U.S. Coast Guard is authorized to designate a VTS Area in "any port or place" under U.S. jurisdiction or authorized under an international agreement.[178] The term VTS refers to a "service implemented by the United States Coast Guard designed to improve the safety and efficiency of vessel traffic and to protect the environment."[179] The VTS has the "capability to interact with marine traffic and respond to traffic situations developing in the VTS area."[180] The term "**vessel traffic service area**" (VTS Area) refers to "the geographical area encompassing a specific VTS area of service."[181] In other words, a VTS consists of the officials, methods, and rules governing a geographic zone designated as a VTS Area. These terms should not be confused with a "**vessel traffic center**" (VTC), which is the "shore-based facility that operates" the VTS for a VTS Area.[182] A VTS Area can be divided into sectors for the purpose of allocating responsibility to multiple VTCs or specifying differing operating requirements in different locations.[183]

A "**vessel movement reporting system**" (VMRS) is a "mandatory reporting system used to monitor and track vessel movements."[184] A "**vessel movement center**" (VMC) is the "shore-based facility that operates the vessel tracking system" for a VMRS Area or for a sector within such an area.[185] A VMC "does not necessarily have the capability or qualified personnel to interact with marine traffic, nor does it necessarily respond to traffic situations developing in the area," as a VTS does.[186]

Different types of vessels are subject to varying levels of requirements within a VTS Area. Small vessels (i.e., fishing vessels under 300 gross tons and recreational vessels 65 feet or less in length) are statutorily exempt from requirements to install and use specified navigation, communications, and tracking equipment within a VTS,[187] but they may be subject to other VTS requirements.[188] The next level is a "**vessel traffic service user**" (VTS User), which refers to a vessel within a VTS Area that is (1) subject to the Bridge-to-Bridge Radiotelephone Act, (2) required to participate in a VRMS (see below), or (3) required to be equipped with an Automatic Identification System (AIS).[189] The highest level of oversight is applied to a "**vessel movement reporting system user**" (VRMS User), which is a VTS User that is also required to participate in a VRMS.[190]

A VTS has several oversight and navigation assistance functions, including the following:

Advisories. To "enhance navigation and vessel safety, and to protect the marine environment," a VTS is tasked with issuing advisories and responding to vessel requests for information regarding conditions within the VTS area, including but not limited to:

- Hazardous conditions or circumstances;

- Vessel congestion;
- Traffic density;
- Environmental conditions;
- Characteristics and navigation plans of nearby vessels;
- Temporary measures in effect;
- Local conditions and activities, such as ferry routes, dredging, etc.; and
- Anchorage availability.[191]

Directions. A VTS can also "issue ... directions to enhance navigation and vessel safety and to protect the marine environment," such as controlling, supervising, or otherwise managing traffic by "specifying times of entry, movement, or departure to, from, or within a VTS area."[192] It is mandatory for VTS Users (and sometimes other vessels within a VTS Area[193]) to "maintain a listening watch" and to "comply with all ... directions issued by a VTS."[194] If a deviation is necessary due to the "exigencies of safe navigation," the vessel may deviate, but "only to the extent necessary to avoid endangering persons, property or the environment," and such deviation must be reported promptly to the VTS.[195] VTS Users also have a duty to "respond promptly when hailed and communicate in the English language."[196]

Notification. It is also obligatory for VTS Users (and sometimes other vessels within a VTS Area[197]) to promptly notify the VTS of the following circumstances:

- Marine casualties;
- Pollution incidents;
- Involvement in the ramming of fixed or floating objects;
- Defects or discrepancies in aids to navigation (e.g., nautical markers, lighthouses);
- Hazardous conditions (e.g., collision, fire, explosion, grounding, leaking, damage, injury or illness of a person aboard, personnel shortages);
- Improper operation of required vessel equipment;
- Situations involving hazardous materials; and
- Hazardous vessel operating conditions (e.g., malfunctioning equipment, impairments to navigation, impairments to maneuverability).[198]

Reporting. The following categories of vessels are also required to comply with detailed reporting requirements within a VTS Area or VRMS Area: (1) power-driven vessels 131 feet or more in length; (2) towing vessels 26 feet or more in length; and (3) vessels certificated to carry 50 or more passengers for hire.[199] The requirements for these vessels include:

- Maintaining a listening watch;

- Responding to requests for information from the VTC or VMC regarding the ship, its owner, size, type, draught, position, course, speed, last port of call, destination, pilot, route, radio, defects or limitations, personnel, passengers, cargo onboard or in tow, pollution, and lost goods, as well as weather conditions and other information;
- Submitting a detailed "**sailing plan**" to the VTC or VMC at least 15 minutes before navigating in a VTS Area;[200]
- Submitting a detailed "**position report**" to the VTC or VMC upon entering a VRMS Area, at designated reporting points, and whenever directed by the VTC or VMC (vessels equipped with functioning AIS equipment can rely on the automated system to satisfy these requirements);[201] and
- Submitting a detailed "**final report**" to the VTC or VMC upon arriving at the vessel's destination or when leaving the VTS Area.[202]

Measures. In addition to providing advisories and directions and handling notifications and reporting on an ongoing basis, a VTS may issue permanent regulatory "measures ... to enhance navigation and vessel safety and to protect the marine environment."[203] Such measures may include, but are not limited to: (1) designating temporary reporting points and procedures; (2) imposing vessel operating requirements; and (3) establishing vessel traffic routing schemes.[204] Further, "[d]uring conditions of vessel congestion, restricted visibility, adverse weather, or other hazardous circumstances," a VTS is authorized to "control, supervise, or otherwise manage traffic, by specifying times of entry, movement, or departure to, from, or within a VTS area."[205]

In addition, the U.S. Coast Guard Commandant can, by regulation, establish a "**special area**" within a VTS where vessels are subject to a set of specified operating requirements.[206] Within a special area, all VTS Users must use "as short a hawser [towing cable] as safety and good seamanship permits" when towing astern.[207] Additionally, VMRS Users must: (1) obtain "prior approval" from the VTS before entering or getting underway, (2) obtain "prior approval" from the VTS and "make safe passing arrangements" through bridge-to-bridge communications with any other vessel also subject to VMRS requirements before meeting, crossing, or overtaking such vessel, and (3) not enter the special area if a "hazardous vessel operating condition or circumstance exists."[208]

Requirements and informational resources for each VTS are compiled into a VTS User's Manual.[209] VTS Users are required to carry a copy of the Coast Guard's VTS regulations on board, and for convenience these are usually incorporated into the VTS User's Manual as well as into the U.S. Coast Pilot volume for the region.[210] Vessels that fail to comply with a VTS requirement or regulation may be denied entry into U.S. navigable waters.[211]

There presently are 12 VTS locations in the United States, shown in Figure 3, including one in Prince William Sound, Alaska, and two managed cooperatively by the U.S. and Canada (Puget Sound and St. Mary's River).[212]

Transport Canada has similar authority to designate VTS zones under the CSA,[213] and these are managed by the Canadian Coast Guard through marine communications and traffic services (MCTS) centers.[214] There are presently 12 MCTS centers in Canada, including one in the Arctic (Iqaluit, Nunavut, see Figure 4) and the two managed cooperatively with the U.S.[215]

As discussed above, Canada is in the process of developing a deepwater port at Iqaluit, which would be consistent with its status as Canada's Arctic MCTS center. Similarly, if the U.S. were to move forward with the development of a deepwater port in Nome, this could potentially be an appropriate location for a U.S. Arctic VTC if a VTS Area were established for the region.

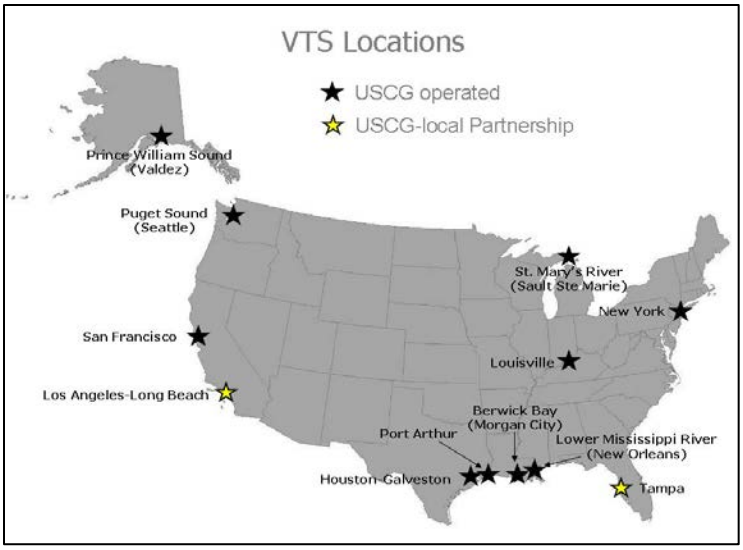

Figure 3 – VTS Locations in the United States (Source: U.S. Coast Guard)

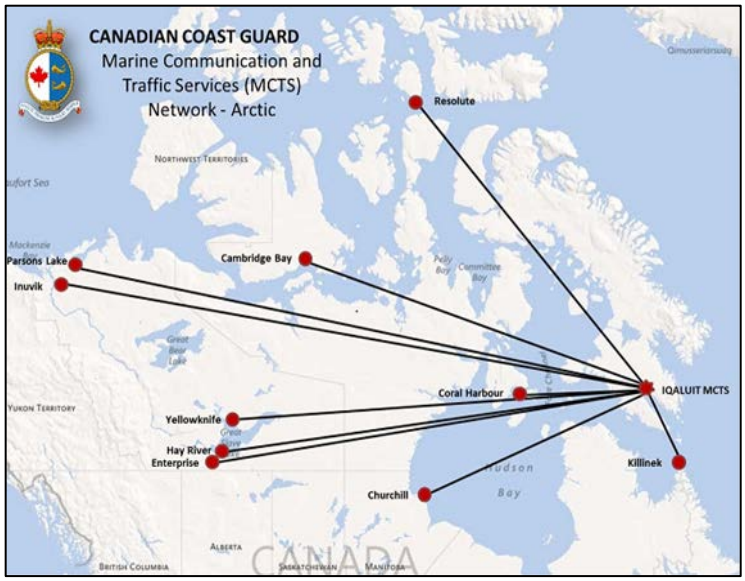

Figure 4 – Canadian Arctic MCTS Network Based in Iqaluit, Nunavut (Source: Canadian Coast Guard)

PART II
POLLUTION

The pollution-related elements of a low-impact shipping corridor could involve the same features (route, rules, and enforcers) and objectives (safety and environmental protection) described above.

The primary international agreement governing ship pollution is the International Convention for the Prevention of Pollution from Ships, known as the Marine Pollution Convention (MARPOL), which entered into force in 1983.[216] MARPOL has been ratified by 157 nations—including the United States, Canada, and all other Arctic nations—representing more than 99% of global shipping tonnage.[217] Like SOLAS and the COLREGs, MARPOL is overseen by the IMO.[218] MARPOL governs various types of marine pollution, including oil pollution (Annex I), noxious liquids (Annex II), harmful packaged materials (Annex III), sewage (Annex IV), garbage (Annex V), and air pollution (Annex VI).[219] Canada has ratified all six Annexes, while the U.S. has ratified all except Annex IV governing sewage.[220] MARPOL also allows "special areas" of the ocean to be designated for protection from various types of pollution.[221] The Polar Code sets forth numerous additional provisions governing marine pollution, as discussed in more detail below.[222]

In the United States, the Act to Prevent Pollution from Ships (APPS)[223] gives the Secretary of the department in which the U.S. Coast Guard is operating the authority to administer and enforce MARPOL, including the authority to adopt implementing regulations.[224]

In Canada, the CSA is an overarching statute governing shipping and implementing MARPOL, and Transport Canada has issued numerous regulations implementing it.[225] Additionally, since 1970, Canada has relied on the AWPPA and regulations thereunder as a means to "prevent pollution of areas of the arctic waters adjacent to the mainland and islands of the Canadian arctic."[226]

The following discussion will focus primarily on those topics with perhaps the most relevance for low-impact shipping corridors—oil and hazardous substances, underwater noise, and special areas for pollution prevention. Other types of pollution from vessels (e.g., sewage, ballast water, garbage, air emissions) are regulated extensively under international and domestic law and will be discussed briefly here, but these may be difficult to address on a corridor-specific basis given that individual states generally may not regulate the "design, construction, manning or equipment of foreign ships" beyond giving effect to generally accepted international rules or standards.[227] On the other hand, it may be possible to address these types of pollution through special area designations, as discussed below.

A. OIL & HAZARDOUS SUBSTANCES

MARPOL contains numerous provisions designed to protect against oil and hazardous substance pollution. For instance, Annex I requires double-hulled oil tankers,[228] and it prohibits the use of certain types of heavy fuel oils (HFOs) in the Antarctic region.[229] Annex II details pollution control measures for about 250 specific noxious liquid substances carried in bulk, and it prohibits the discharge of residues containing such substances within 12 miles of the nearest land.[230]

Another convention specifically dedicated to oil pollution, the International Convention on Oil Pollution Preparedness, Response and Cooperation (OPRC), entered into force in 1995.[231] The OPRC is coordinated by the IMO, and its parties include the U.S., Canada, and all other Arctic nations, among a total of 112 nations representing 76% of global shipping tonnage.[232] The OPRC requires parties to establish a national system for responding to oil pollution incidents, and it commits parties to cooperating internationally in response to pollution incidents.[233] The OPRC also requires ships to carry an oil pollution emergency plan and to report pollution incidents to coastal authorities. A protocol to the OPRC addressing hazardous substances was adopted in 2000.[234]

There are also specific international protections against oil pollution in the Arctic. As noted above, the Arctic Council has facilitated the establishment of the Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic (MOPPRA), which entered into force in 2016 and has been ratified by all eight Arctic nations.[235] MOPPRA requires parties to maintain national systems for oil spill response, conduct assessments and notify other parties of oil pollution incidents, engage in oil spill monitoring activities, cooperate and provide assistance to each other in responding to oil pollution incidents, conduct joint exercises and training, and undertake other activities.[236] Additionally, the Polar Code prohibits oil and noxious liquid discharges from vessels in Arctic waters,[237] and it contains structural requirements for new ships built in January 2017 or later.[238] Furthermore, in April 2018, the U.S. and seven other nations co-sponsored a proposal at the IMO's Marine Environment Protection Committee (MEPC) meeting for a ban on the use of heavy fuel oils (HFOs) in the Arctic, which they seek to be implemented by 2021.[239] Fourteen other nations have expressed support for the ban, and the MEPC has directed a subcommittee to develop text for a ban and conduct a study on its impact.[240]

Under domestic law in the United States, the Oil Pollution Act (OPA) and U.S. Coast Guard regulations thereunder establish a comprehensive prevention, response, and liability regime to deal with oil pollution from vessels and facilities.[241] Further, the APPS statute applies the requirements of MARPOL Annexes I (oil) and II (noxious substances) to vessels located in U.S. waters.[242] Canadian domestic laws, most notably the CSA and Marine Liability Act (MLA), establish a similarly comprehensive regime for prevention, response, and liability associated with oil spills and other types of pollution from vessels.[243] Canada

also specifically protects Arctic Waters from such pollution under the AWPPA and regulations thereunder.[244]

Despite these many international and domestic laws and regulations designed to prohibit, prevent, and impose liability for spills of oil and hazardous substances, they still occur with some regularity. The recent oil spill at the Port of Rotterdam, Netherlands, in June 2018 is a powerful reminder.[245] Given that a robust oil and hazardous substance pollution regulatory regime already exists, adding on more stringent oil pollution controls within a low-impact shipping corridor is not likely to make a great difference, even assuming such measures would be permissible under international law.[246] Instead, since such discharges generally result from accidental collisions, rather than intentional discharges, the features of low-impact shipping corridors most effective in preventing spills will likely be those drawn from the vessel traffic management framework discussed above, including ship routing, designated areas, and operation and oversight mechanisms designed to reduce the incidence of collisions and encourage avoidance of sensitive areas.

B. UNDERWATER NOISE

Underwater noise is becoming a concern for marine mammals and their habitat in the Arctic, especially as Arctic seas have become increasingly ice-free in late summer and early fall and as seasonal ship traffic from tourism and freight is projected to rise. Underwater noise is not yet regulated under international law, but its harmfulness and the need for regulation have long been recognized, and some steps have been taken toward that end.

UNCLOS defines "pollution of the marine environment" as the "introduction by man, directly or indirectly, of substances or energy into the marine environment, including estuaries, which results or is likely to result in such deleterious effects as harm to living resources and marine life, hazards to human health, hindrance to marine activities, including fishing and other legitimate uses of the sea, impairment of quality for use of sea water and reduction of amenities."[247] Since sound is a form of energy and a well-known cause of harm to marine life, it is clearly encompassed within this definition.[248] The regulation of underwater noise would thus be consistent with UNCLOS.[249] At present, however, MARPOL only regulates discharges of "oil and other harmful substances" from ships, without reference to sound or any other forms of "energy,"[250] and none of its six Annexes address underwater noise pollution.

Momentum has been growing, however, for international regulation of underwater noise. In a 2005 report to the U.N. General Assembly, for instance, then-Secretary General Kofi Annan listed underwater noise as one of five "current major threats to some populations of whales and other cetaceans" and identified noise as one of the ten "main current and foreseeable impacts on marine biodiversity" on the high seas.[251] Since 1992, the IMO-MEPC has likewise recognized the harmful effects of shipping-related ocean noise and made this a subject of its agendas and work programs.[252] The work has focused mainly on chronic,

rather than acute, sources of sound, and studied factors such as ship type, size, loading conditions, method of propulsion, speed, and bottom topography.[253]

Most significantly, in 2014, the IMO-MEPC adopted voluntary guidelines to protect marine life from the harmful impacts of underwater noise from commercial shipping (IMO Noise Guidelines).[254] The IMO Noise Guidelines explicitly state that the "international community recognizes that underwater-radiated noise from commercial ships may have both short and long-term negative consequences on marine life, especially marine mammals."[255] They are meant to apply to noise generated by commercial ships (not military ships, sonar, or seismic activities),[256] and they provide advice to ship designers, builders, and operators.[257] They identify propeller cavitation as the source of "[m]uch, if not most, of the underwater noise" from commercial ships, but acknowledge onboard machinery and operation as relevant sources as well.[258]

The IMO Noise Guidelines encourage the use of computer modeling to help identify noise sources and develop control measures,[259] as well as adherence to objective standards and specifications.[260] Recognizing that new ship design provides the greatest opportunity for noise reduction, the IMO Noise Guidelines provide specific recommendations for the design of new ships, particularly with respect to propellers, hulls, and onboard machinery.[261] The Guidelines also identify noise-reducing retrofit technologies for existing ships, as well as general operation and maintenance practices that can help minimize underwater noise and its impacts, including propeller cleaning, underwater hull surface maintenance and coatings, optimization of ship speed and propeller pitch, and routing to avoid known sensitive habitats and migratory areas.[262]

If one or more low-impact shipping corridors were developed for the Arctic, the IMO Noise Guidelines provide a useful roadmap for noise reduction. Since noise controls generally involve "design, construction, manning or equipment standards," however, the Guidelines would first have to become "generally accepted international rules or standards."[263] There are many pathways for doing so, albeit rather challenging ones, including the development of an additional Annex to MARPOL or negotiating a separate agreement under the auspices of the IMO or the Arctic Council. Thereafter, coastal states could draw from the Guidelines in establishing noise pollution controls within their territorial zones and EEZs. For instance, coastal states could predicate authorization to pass through a low-income shipping corridor on ships' installation and usage of the Guidelines' recommended retrofit technology (i.e., new state-of-the-art propellers, wake conditioning devices, and air injection to propellers) and implementation of the recommended operation and maintenance practices (i.e., propeller cleaning, underwater hull surface maintenance and coatings, optimization of ship speed and propeller pitch).

Underwater noise could also serve as a factor supporting the establishment of one or more ATBAs, PSSAs, special areas, or other designated areas in which passage is not allowed, speed restrictions are imposed, or other noise reduction measures are implemented. The

establishment of one or more VTS Areas and associated VTCs might be a suitable approach for implementing and enforcing such requirements.

C. OTHER TYPES OF POLLUTION

Ballast water, sewage, garbage, and air emissions from vessels are governed by several international agreements. As discussed above, even within their territorial seas, coastal states generally may not adopt rules governing the design, construction, manning or equipment of foreign ships unless they are giving effect to the international rules and standards adopted under these agreements.[264] Since pollution controls typically do address these considerations, any effort to impose more stringent pollution controls in a low-impact shipping corridor would likely be difficult, absent widespread consensus and entry into a new or modified international agreement. On the other hand, if all or part of a corridor has been designated as a "special area" under MARPOL, as discussed in Part II(D) below, more stringent controls would be allowed for the categories of pollution governed by MARPOL. The following is therefore just a brief overview of the international agreements governing ballast water, sewage, garbage, and air emissions from vessels.

***Ballast Water*.** Ballast water is water that has been pumped from the sea into chambers in a ship's hull and used to reduce stress on the hull, provide transverse stability, improve propulsion and maneuverability, and compensate for weight changes due to cargo loading and off-loading.[265] Ballast water can cause harm, however, due to the bacteria, microbes, invertebrates, eggs, cysts, and larvae that it contains and the resulting transfer of non-native species from one place to another.[266] A few examples of invasive aquatic species that have caused health, ecological, and economic problems around the world after being transported in ballast water include various types of cholera, water fleas, mitten and green crabs, toxic algae, round goby fish, comb jellyfish, sea stars, zebra mussels, and kelp.[267]

More than 14 years of international negotiations led to the adoption of the International Convention for the Control and Management of Ships' Ballast Water and Sediments (Ballast Water Convention) in 2004.[268] It entered into force in 2017, and to date it has been ratified or acceded to by 75 states representing 75% of global shipping tonnage, including all of the Arctic states except the United States and Iceland.[269] Under the Convention and the Guidelines adopted thereunder, vessels are required to develop and implement a ship-specific management plan, manage ballast water to a certain standard, and carry a record book and certificate.[270] Eventually, most ships will need to install on-board ballast water treatment systems.[271] The adoption of the Guidelines and certification of ballast water treatment technologies have removed the major barriers to ratification, and a number of additional countries are expected to accede to the Ballast Water Convention in the near future.[272]

***Sewage*.** The discharge of raw sewage from vessels can create or exacerbate health hazards, oxygen depletion, algae blooms, and degradation of beaches and other scenic

areas with unsightly and foul-smelling accumulations.[273] Annex IV of MARPOL regulates sewage discharges from ships that are engaged in international voyages and are either certified to carry more than 15 persons or above 400 gross tonnage in size.[274] Annex IV generally prohibits the discharge of raw sewage within 12 nautical miles of land and treated sewage within 3 nautical miles of land, and it requires ships to be equipped with an approved sewage treatment plant, comminuting and disinfecting system, or holding tank.[275] It also includes detailed regulations regarding sewage control equipment, rates of discharge, port reception facilities, and requirements for survey and certification.[276] Stricter sewage-related requirements apply in polar waters under the Polar Code and MARPOL provisions making the Polar Code mandatory.[277]

Garbage. Garbage released from ships can be deadly to marine life. The greatest danger comes from plastic, which can be mistaken by wildlife for food and can trap wildlife in ropes, nets, bags, and other items.[278] Microplastics are increasingly recognized as a serious problem as well. These small plastic particles come from abrasive skin cleansers and other hygiene products and from the breakdown of plastic bottles, plastic bags, synthetic clothing, and car tires.[279] Annex V of MARPOL and the Guidelines adopted thereunder broadly regulate all ships, and they generally prohibit the discharge of any type of garbage into the sea, except in narrowly defined circumstances.[280] They also require governments to ensure the provision of adequate reception facilities and ports and terminals, and they include provisions relating to port state inspections, placards, garbage management plans, recordkeeping, cargo residues, and shipboard incinerators.[281] More stringent garbage-related requirements apply in polar waters under the Polar Code and MARPOL provisions making the Polar Code mandatory.[282]

***Air Emissions*.** Air pollution from ships contributes to smog, particulates, acid rain, climate change, and ozone depletion. Annex VI of MARPOL limits emissions of the main precursors to such pollution—sulfur oxides (SOx), nitrous oxides (NOx), and volatile organic compounds (VOCs).[283] It also prohibits deliberate emissions of ozone-depleting substances, regulates shipboard incineration, and governs evaporative emissions of VOCs from tankers.[284]

D. SPECIAL AREAS FOR POLLUTION PREVENTION

In addition to the various types of designated areas that can be established in the vessel traffic management context, MARPOL provides for "special areas" where mandatory measures may be adopted for pollution prevention.[285] To qualify as a special area under MARPOL, the proponent must show that the basic MARPOL requirements do not provide adequate protection and that the area's oceanographic, ecological, and vessel traffic conditions justify "special mandatory methods for the prevention of sea pollution."[286] Oceanographic conditions weighing in favor of special area designation include circulation patterns, temperature, salinity stratification, low flushing rates, extreme ice state, and adverse winds that could cause harmful substances to be concentrated or retained in the

waters or sediments of the area.[287] Ecological conditions supporting special area designation include depleted, threatened or endangered marine species; areas of high natural productivity; spawning, breeding and nursery areas; areas representing migratory routes for sea-birds and marine mammals; rare or fragile ecosystems; critical habitats; and areas of critical importance for the support of large marine ecosystems.[288] With respect to vessel traffic, special area designation may be warranted where traffic levels are high enough that conformance with the usual requirements of MARPOL would be insufficient to protect the area from pollution.[289] A party to MARPOL may use other factors to support a request for special area designation as well.[290] The proponent must submit a proposal to the IMO explaining how the area fulfills the criteria for designation under the MARPOL annex applicable to the type of pollution in question.[291] If two or more states have a common interest in a particular area, they may submit a joint proposal.[292] If the IMO approves the designation, it becomes effective when adequate reception facilities exist in the area to accept the relevant type of pollutant.[293]

The Antarctic, for example, is a designated special pollution area for oil (Annex I), noxious liquid substances (Annex II), and garbage (Annex V).[294] This essentially creates a no-discharge zone for oil, noxious liquids, and mixtures containing them. Oil can only be discharged under extremely limited circumstances (e.g., maximum concentration of effluent is 15 parts per million), and vessels must have sufficient storage capacity on board to contain oily materials.[295] For noxious liquid substances, there is a complete discharge prohibition in the Antarctic Area.[296] With respect to garbage, discharges into the water are generally prohibited.[297] Only food wastes and cargo residues may be discharged, and stringent restrictions must be adhered to for such disposals.[298] Otherwise, garbage must be retained on board for later disposal ashore.

A special area established under MARPOL based on pollution concerns could serve as a design feature of a low-impact shipping corridor. As long as there is sufficient data to support the designation, a special pollution area and associated discharge restrictions for oil, noxious liquids, harmful packaged materials, sewage, garbage, air pollution, and perhaps eventually underwater noise could help protect sensitive regions of the Arctic from pollution-related impacts.

PART III
EXAMPLES OF SHIPPING REGIMES

The development and implementation of one or more shipping corridors for the Arctic Ocean will need to be based on the vessel traffic management and pollution control frameworks described above. It will be helpful to understand how these frameworks and the tools they offer have already been used to protect the marine environment and to draw lessons from these experiences to inform future efforts. The following discussion describes the main features of several existing schemes designed to protect whales from ship strikes, preserve subsistence resources and activities, prevent oil spills and other catastrophic

events, and encourage international cooperation toward these ends. It also includes some thoughts on the dynamic components of such schemes, which allow for both temporal and geographic flexibility to ensure the effectiveness of the programs as environmental conditions change and to avoid unnecessary over-regulation.

A. Protecting Whales from Ship Strikes: Atlantic and California Coasts

A key concern for the establishment of a low-impact shipping corridor in the Arctic Ocean is the protection of whales and other marine mammals from ship strikes and other disturbances. A scientific study released in July 2018 is the first to consider potential shipping impacts on marine mammals in the Arctic.[299] The researchers looked at the impacts of shipping on seven Arctic marine mammal species. The most vulnerable were found to be narwhals (tusked whales) in large part because they spend the summer concentrated in specific locations right in the middle of existing shipping routes, rely on sound, and are notoriously sensitive to disturbance. Beluga whales, bowhead whales, and walruses were also found to be particularly vulnerable. A low-impact shipping corridor could help protect whales and other marine mammals in the Arctic Ocean, and there is substantial precedent for regulatory measures that could be incorporated into such a corridor. Over the past twenty years, collaborative efforts to gather whale sighting and vessel traffic data and translate these into specific vessel reporting, routing, and operation schemes have reduced the incidence of whale collisions in coastal waters offshore of New England, Florida, and California.

1. Atlantic Coast

North Atlantic right whales are baleen whales that feed on krill and small fish. By the end of the 19th century, commercial whalers had hunted them to the brink of extinction. Today, they are one of the world's most endangered large whale species, with only an estimated 450 individuals remaining.[300] The whales' two main critical habitat areas are their foraging grounds off the coast of New England and their calving areas along the southern U.S. coast from North Carolina to Florida.[301] Since these areas, as well as the migration routes between them, overlap with major shipping lanes, vessel strikes are one of the leading causes of right whale mortality, along with entanglement in fishing nets.[302]

To protect right whales from ship strikes, marine areas near Massachusetts and Florida are governed by a mandatory ship reporting system under SOLAS.[303] In support of its proposal to the IMO in 1998 for the creation of such a system, the U.S. detailed the collision risks faced by the whales and the steps that it had taken under domestic law (i.e., the Endangered Species Act and Marine Mammal Protection Act) to protect the species.[304] The U.S. also contended that a species-specific reporting system was warranted because (1) the North Atlantic right whale was immediately endangered with extinction; (2) major international shipping lanes passed through areas of critical habitat for the whale; and (3) ship strikes posed the greatest threat to the whale's survival and recovery.[305] The IMO

ultimately agreed with these justifications, and the mandatory ship reporting system went into effect in 1999.[306]

The New England reporting area (known as WHALESNORTH) spans the approaches to Cape Cod Bay, Massachusetts Bay, and the Great South Channel and aims to protect right whale feeding grounds.[307] The Florida reporting area (known as WHALESSOUTH) protects right whale calving grounds along a 90 nautical-mile stretch of coastal waters.[308] When entering the system, ships of 300 tons or more are required to provide the ship name, call sign or IMO identification number, position, course, speed, route, and destination.[309] The U.S. Coast Guard informs ships about right whales, their vulnerability to ship strikes, precautionary measures they can take, and locations of recent whale sightings.[310] The portion of the reporting area off the Massachusetts coast is effective year-round, while the portion covering the whales' calving grounds off of the eastern Florida coast is seasonal, operating from November 15 through April 16 each year.[311]

The North Atlantic right whale mandatory ship reporting system was groundbreaking because it was the first designed primarily to protect a single species of wildlife, rather than to increase vessel safety. The reporting system alone, however, was not very effective in protecting whales. In 2004, the National Marine Fisheries Service (NMFS) acknowledged that, despite the mandatory ship reporting system and other efforts, North Atlantic right whales were still being killed as a result of vessel collisions and that supplemental measures may be needed to protect them.[312] At the urging of environmental groups through a petition and litigation, NMFS eventually adopted a rule in 2008 limiting the speed of vessels over 65 feet in length to 10 knots in areas and at times of year when North Atlantic right whales are expected to be present.[313]

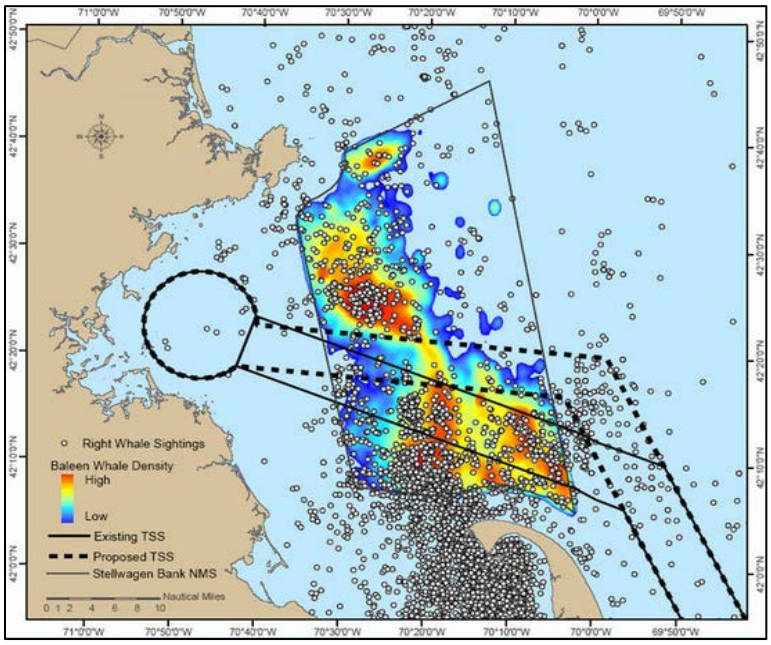

Figure 5 – North Atlantic Right Whale Sightings and Vessel Traffic Lane Shift (Source: Stellwagen Bank NMS)

Other steps have been taken to protect North Atlantic right whales as well. In 2006, the IMO approved a lane shift modification to an existing TSS traversing the Stellwagen Bank National Marine Sanctuary (NMS) near Boston in order to move large ships away from waters with high concentrations of whales, as shown in Figure 5.[314]

Additionally, in 2009, the U.S. Coast Guard adopted, and the IMO later approved, a voluntary seasonal ATBA under SOLAS corresponding with the whales' feeding area in the Great South Channel near Boston for ships weighing 300 gross tons or more, as shown in Figure 6.[315] The ATBA restriction goes into effect each year between April 1 and July 31, when the whales face the highest risk of ship strikes in this area.[316]

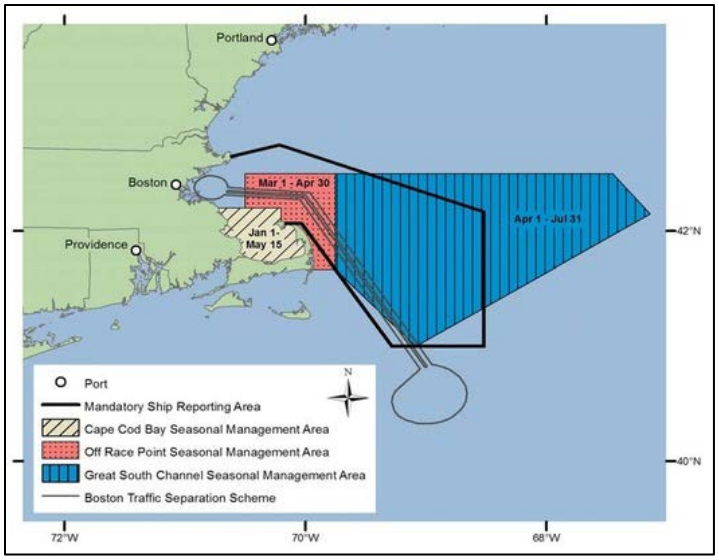

Figure 6 – Great South Channel ATBA (Source: NOAA)

Furthermore, in 2012, NOAA developed an iPad and iPhone application that warns mariners when they enter areas of high risk of collision with North Atlantic right whales.[317] The free application also provides information about whale management measures, including speed limits, ATBAs, and the latest data about right whale detections, all overlaid on NOAA digital charts.[318] The application uses near real-time acoustic buoys that allow the locations of whale calls to be shown on a screen.[319]

Scientists estimate that these efforts, particularly the speed limits, have reduced the ship strike mortality risk for North Atlantic right whales by approximately 80-90 percent.[320] Despite these reductions, some ship strikes still occur, and with a declining population, every death matters.[321] Unfortunately, 2017 was a particularly bad year, with 17 right whale mortalities.[322] Most of these occurred in the Gulf of St. Lawrence, which is under the jurisdiction of Canada and has no ship strike or bycatch reduction measures in place.[323] The adoption of speed limits and other vessel management measures in Canadian waters thus has the potential to reduce right whale mortality due to ship strikes even further.

2. California Coast

Along the California coast, the Santa Barbara Channel and San Francisco Bay are heavily transited by large commercial vessels approaching and departing the ports of Los Angeles, Long Beach, and San Francisco, with thousands of cargo ships passing through each year.[324] Since the areas also contain seasonal feeding grounds and aggregation hotspots for endangered blue, humpback, and fin whales, ship strikes are a significant challenge.[325] For example, between 1988 and 2012, there were 100 documented large whale ship strikes along the Southern California coast,[326] including 5 blue whales struck and killed by commercial vessels in the fall of 2007 alone near the Channel Islands NMS.[327] Growing concern for the whales, along with the success of North Atlantic right whale protection efforts along the Atlantic coast, helped spur efforts to protect blue whales, humpback whales, and other whale species along the California coast from shipping-related impacts.

With the goal of reducing the co-occurrence of ships and whales, coalitions of government agencies, research institutes, and non-governmental organizations worked with the U.S. Coast Guard to develop modifications to the shipping lanes in the IMO-approved TSSs governing the approaches to the ports of Los Angeles, Long Beach, and San Francisco, and the revised schemes went into effect in June 2013.[328] The modifications to the Southern California TSS shifted the inbound lane shoreward and away from known whale concentrations and reduced the width of the separation zone between the lanes from 2 to 1 nautical miles.[329] Figure 7 shows the blue whale sighting data and the proposed lane changes that were ultimately adopted into the TSS.

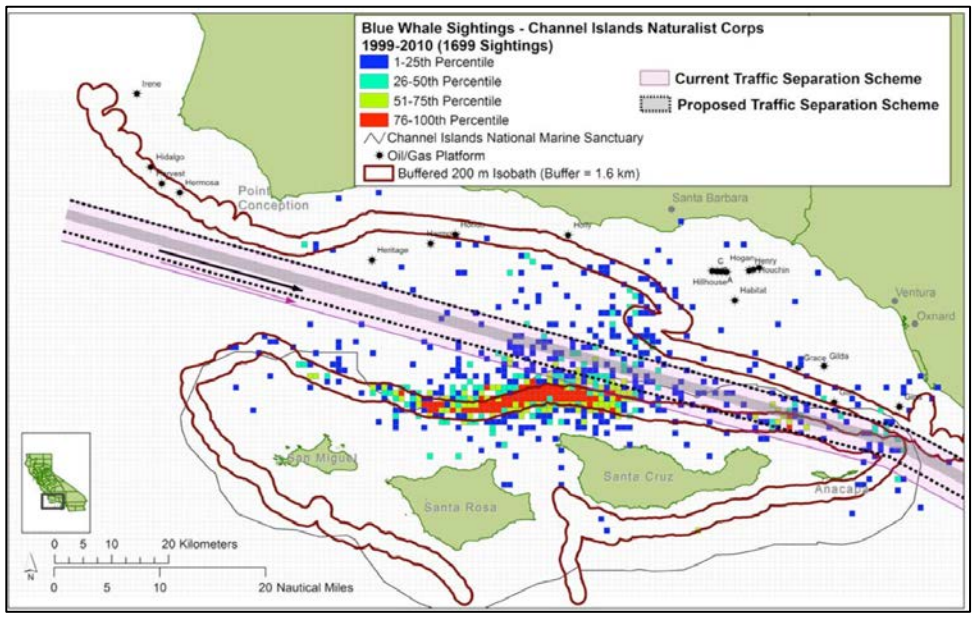

Figure 7 – Blue Whale Sightings and TSS Off Southern California Coast (Source: NOAA)

In the San Francisco Bay area off the northern California coast, the Coast Guard operates a VTC, and the IMO-approved TSS for the area is located entirely within the associated VTS Area.[330] The modifications to the San Francisco Bay TSS lengthened the approach lanes, added separation zones between inbound and outbound vessel traffic, and endeavored to avoid areas used by humpback whales and other whales to the

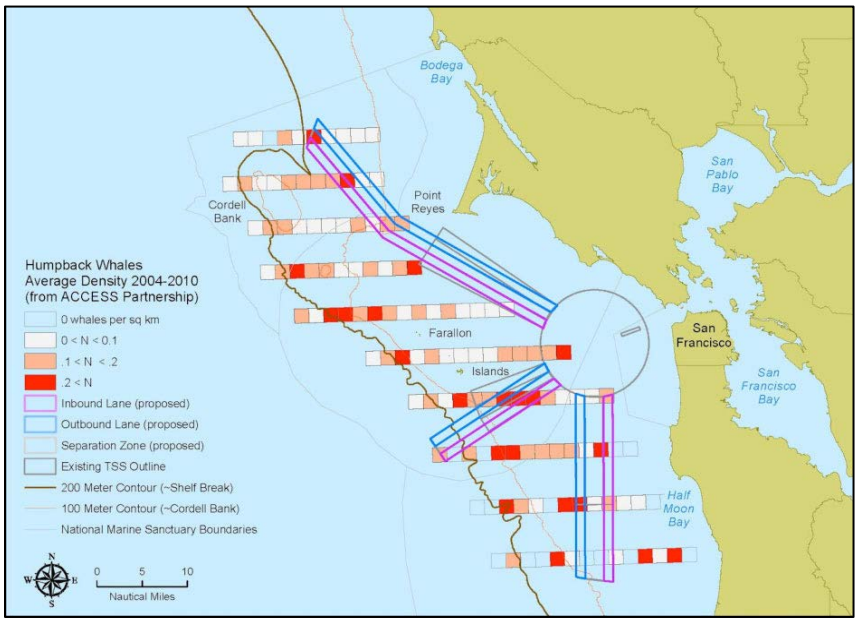

Figure 8 – Humpback Whale Sightings and TSS Off Northern California Coast (Source: Applied California Current Ecosystem Studies)

extent feasible.[331] Figure 8 shows humpback whale sighting data and lane changes adopted into the San Francisco Bay TSS.

In the absence of speed limits, however, the success of the California vessel management efforts in protecting whales has been limited. As such, in 2011, a group of conservation organizations petitioned NOAA to establish a 10-knot speed limit for vessels longer than 65 feet traveling within four National Marine Sanctuaries off the California coast.[332] NOAA declined to adopt mandatory speed restrictions, citing its other ongoing efforts to reduce ship strikes and the need for further study and collaboration with the shipping industry.[333] In declining the petition, however, NOAA acknowledged that speed limits, such as those in effect off the Atlantic coast, are a "legitimate management tool" for reducing ship strikes.[334]

Since then, the conservation groups and federal, state, and local government partners have developed and implemented a voluntary speed reduction (VSR) program for vessels transiting California coastal waters. Since vessel speed reductions help minimize air pollution,[335] as well as ship strikes, the voluntary speed reductions are incentivized using funding from California's cap-and-trade auction proceeds.[336] In 2014, seven global shipping companies participated in a trial program modeled after successful pollution-reduction measures at the ports of Los Angeles and Long Beach.[337] They were paid $2,500 for each trip completed at 12 knots or slower through a 130-mile stretch of the Santa Barbara Channel during summer and fall, the peak season for blue whale feeding and smog pollution in the area.[338] In addition, the VSR program sponsors collaborated with the shipping companies in a positive public relations campaign.[339] By 2017, the VSR program had expanded from 27 to 143 ship transits and from 7 to 11 global shipping companies, and speed reduction zones were added off the northern California coast.[340] Of the vessel transits in 2017, 66% slowed to less than 10 knots—a greater speed reduction than the 12 knots expected—and 75% of those traveling between northern and southern VSR regions either slowed down or did not speed up to make up time in between the regions.[341] The program has continued through the summer-fall 2018 season, and a fleet-based approach will be added in 2019.[342] Federal legislation introduced in the fall of 2017 seeks to expand the voluntary program to encompass all shipping channels along the U.S. Pacific coast from Canada to Mexico.[343]

3. Lessons Learned

The re-routing of shipping traffic to avoid whales off the Atlantic and California coasts of the U.S. should serve as a useful precedent when arguing for similar routing measures as part of a low-impact shipping corridor in the Arctic Ocean. It is now well-established that, as long as there is sufficient data to demonstrate where the species in question spends its time and its vulnerability to ship strikes, it is entirely appropriate and consistent with IMO rules to design shipping routes in a manner that will avoid collisions with endangered or threatened species of whales or other marine mammals.

The experiences of both Atlantic and California whale protection efforts also point to vessel speed reduction as an important element if the suite of measures is to achieve meaningful results. Scientists have demonstrated that speed reduction leads to substantially lower whale mortality risk, and the fact that recent whale mortality has been far more common in Canadian waters lacking protective measures than in Atlantic waters where they were in effect reinforces these findings. Additionally, the successful voluntary speed reduction measures off the California coast show that financial incentives and positive publicity can help change shipping industry behavior and reduce the risk of ship strikes even when mandatory measures may be seen as infeasible or over-reaching.

Finally, both the Atlantic and California efforts illustrate the importance of collaborative efforts between government agencies, scientists, universities, non-governmental organizations, shipping industry members, and others with relevant expertise in assembling the data needed to support whale protection measures and in developing enough consensus to ensure the effective implementation of such measures.

B. Protecting Subsistence Resources and Activities: Bering Strait

Another important consideration for a low-impact shipping corridor in the Arctic is the protection of the subsistence resources and activities on which local indigenous communities depend. The IMO's recent approval of ship routing measures and ATBAs in the Bering Strait region is a helpful precedent because the development of these measures was strongly influenced by subsistence-related considerations.

The Bering Strait is a narrow international waterway between Alaska and Russia that connects the Bering Sea and North Pacific to the Arctic Ocean. It serves as a major corridor for marine mammals and seabirds migrating to and from the Arctic each year. Indigenous communities rely on the abundant waters to sustain their traditional subsistence way of life.[344]

The Bering Strait has seen an increase in shipping traffic as the polar sea ice disappears.[345] In response, the U.S. and Russia jointly sought IMO approval for a new ship routing system consisting of six two-way routes and six precautionary areas to help vessels avoid shoals, reefs, and islands and to reduce the potential for collisions and environmental harm.[346] In addition, the U.S. submitted a concurrent proposal for the establishment of three environmentally sensitive ATBAs near King Island, St. Lawrence Island, and Nunivak Island.[347] Both proposals were approved by the IMO in May 2018.[348] These are the first IMO-approved ship routing measures for polar waters, and they reflect the safety and environmental provisions of the Polar Code adopted in January 2017.[349] The routes are voluntary. They do not limit commercial fishing or subsistence activities, and their usage is recommended for ships with a gross tonnage of 400 or more.[350] Despite their voluntary nature, IMO-approved shipping routes and ATBAs generally enjoy widespread adherence due to their safety benefits.[351]

In addition to navigation, safety, collision avoidance, and environmental protection considerations, preservation of subsistence resources and activities was a driving force behind the development of the Bering Strait ship routing system. The proposals were based in large part on a Port Access Route Study (PARS) prepared by the U.S. Coast Guard after almost a decade of investigation, consultation, and coordination among international bodies, government agencies, industry stakeholders, and coastal residents.[352] The Coast Guard "reach[ed] out in person to tribes, individual coastal communities, and native umbrella organizations to discuss the PARS study, solicit input, obtain local traditional knowledge about what is actually happening in the study area, and identify areas of particular concern."[353] It also considered extensive oral and written comments about the importance of subsistence resources and activities,[354] and the final PARS included a "Subsistence and Cultural Significance" assessment as an appendix.[355]

Based on these various sources of information, the U.S. Coast Guard ultimately acknowledged that "[i]ndigenous peoples have lived along the western coastline of Alaska since time immemorial;" that their "modern day descend[a]nts remain heavily committed to subsistence hunting and gathering;" and that "subsistence hunting and gathering extends far beyond the physical need for food" and represents cultural identity and heritage, as well as a means of developing self-worth and bonding experiences where one generation teaches the next.[356] The Coast Guard further recognized that the majority of Western Alaska residents are "Alaska Natives who rely on the sea as a food source and cultural identifier," and it took this "strong reliance on the sea into consideration throughout the Bering Strait PARS."[357] Given the "connection between Alaska Natives and the sea," the Coast Guard emphasized that "a large-scale shipping accident in this region would be particularly damaging because it would not only damage the environment and marine life but also deprive Alaskan Natives of a critical food source and disrupt the local communities' cultural wellness," both for "coastal villages" and "villages far away from the sea that rely on species of anadromous fish and migrating waterfowl as food sources."[358]

The ultimate recommendations in the PARS reflected this heightened recognition of the importance of subsistence resources and activities in the region. For instance, the conclusion that a two-way route would be preferable to a TSS was based in part on the fact that the former would not impede subsistence and commercial fishing activities, while the latter would require "vessels engaged in fishing or subsistence activities ... to keep clear of other larger vessels" following the TSS.[359] Subsistence was an even more central factor in the designation of the three ATBAs. The King Island, St. Lawrence Island, and Nunivak Island areas were each specifically "intended to prevent disruption of subsistence activities," as well as to protect endangered species, minimize pollution risk, and improve navigation safety.[360]

Alaska Native Tribal leaders and entities—including the Bering Sea Elders Group and Kawerak, Inc., a regional consortium representing the twenty federally-recognized Alaska Native Tribes of the Bering Strait region—have expressed general support for the IMO

decision.[361] They see it as a first step, however, and would like to see additional measures to strengthen oil spill preparedness and pollution prevention in the region.[362]

The successful establishment of IMO-approved shipping routes and ATBAs in the Bering Strait, based to a considerable degree on the need for protection of subsistence resources and activities, will make it easier to ensure similar considerations are taken seriously when establishing routing measures for an Arctic low-impact shipping corridor. Here again, it will be important for coastal communities, Tribes, government agencies, scientists, universities, non-governmental organizations, industry members, and others with relevant expertise to work together in pulling together the data and local knowledge needed to develop and implement subsistence-related routing measures.

C. Promoting Safety and Preventing Oil Spills: Prince William Sound and Canadian Arctic

The VTS schemes in Prince William Sound and the Canadian Arctic play an important role in preventing oil spills and thus may be instructive for the development of a low-impact shipping corridor in one or more regions of the Arctic Ocean as well.

1. Prince William Sound

Prince William Sound, Alaska is an abundant ecosystem with stunning natural beauty covering about 2,500 square nautical miles.[363] It contains 150 glaciers (including 17 tidewater glaciers), and it is home to 220 species of birds (including bald eagles, marbled murrelets, black-legged kittiwakes, and glaucous-winged gulls) and at least a dozen marine mammals (including humpback, sei, fin, and minke whales, orcas, Steller sea lions, harbor seals, and sea otters).[364] At the same time, however, the Valdez Marine Terminal at the southern end of the Trans-Alaska Pipeline is situated on the shore of Prince William Sound. The Sound thus serves as a major hub for the oil and gas industry and is frequently transited by large oil tankers. Each year, about 7.7 billion gallons of North Slope crude oil are transported through 75 miles of Prince William Sound waters.[365]

The establishment and expansion of VTS operations in the U.S. have been linked to oil spills. After an oil tanker collision under the Golden Gate Bridge in 1971, Congress enacted the PWSA the next year.[366] Then, in 1973, Congress enacted the Trans-Alaska Pipeline Authorization Act, which amended the PWSA and specifically required the U.S. Coast Guard to establish and operate a VTS in Prince William Sound.[367] The PWSA was strengthened in 1978 by the Port and Tanker Safety Act based on Congress's finding that "increased supervision of vessel and port operations" was necessary to "reduce the possibility of vessel or cargo loss, or damage to life, property or the marine environment" and "insure that the handling of dangerous articles and substances ... is conducted in accordance with established standards and requirements."[368]

Then, in 1989, the supertanker Exxon Valdez ran aground on Bligh Reef, spilling 11 million gallons of oil into the pristine waters of Prince William Sound.[369] VTS operations had been scaled back due to budgetary constraints, and this played a significant role in the tragedy. A detailed assessment of the Exxon Valdez oil spill prepared by the University of Michigan concluded that VTS budget cuts had led to losses of personnel, excessive workload for remaining personnel, deterioration of the radar system to the point that it was no longer reliable, supervisors with little or no watch-standing experience, poor communication, inadequate knowledge of the whereabouts of vessels, and inadequate monitoring and reporting of ice conditions, all of which contributed to a lack of situational awareness and vigilance that set the stage for the Exxon Valdez running aground.[370] Shortly after the Exxon Valdez disaster, Congress enacted the OPA, which reiterated the requirement for the Coast Guard to operate a mandatory VTS in Prince William Sound and required it to make vessel participation mandatory at other existing and future VTSs.[371]

Figure 9 – Cleanup of Oil-Soaked Beach at Eleanor Island, Alaska April 16, 1989 (Source: McClatchy Newspapers)

Today, the VTS Area in Prince William Sound is bounded along its southern side by a line between Cape Hinchinbrook and Schooner Rock and then proceeds northward in a roughly rectangular shape that encompasses Valdez Arm, Valdez Narrows, and Port Valdez at the northern end, as shown in Figure 10.[372] The boundaries of the VTS Area are coextensive with those of an RNA designation.[373] The centerpiece of the Prince William Sound VTS is an IMO-approved TSS consisting of inbound and outbound vessel traffic lanes with a separation zone between them.[374] Vessels transiting through these traffic lanes are subject to the requirements of the COLREGs.[375] The scheme was initially approved by the IMO in 1992, and then in 2002, it was modified to establish two precautionary areas, one at Cape Hinchinbrook and the other at Bligh Reef, as well as to straighten the route, eliminate a course change, enlarge the Valdez Narrows Special Area, and create a separate Valdez Arm Special Area.[376]

In both special areas, a VTS User must meet certain safety and permitting requirements associated with towing astern.[377] A VRMS User is prohibited from entering either of the two special areas if a "hazardous vessel operating condition" exists,[378] which is defined to mean "any condition related to a vessel's ability to safety navigate and maneuver," such as missing or malfunctioning operating equipment, navigation impairments, and maneuverability impediments.[379] A VRMS User must also obtain prior approval from the

VTS before entering or getting underway in either special area, and it must obtain prior approval and make safe passing arrangements before meeting, crossing, or overtaking any other VRMS User within such an area.[380] In the Valdez Narrows Special Area, further approvals and authorizations are required, and certain vessels are subject to 6- or 12-knot speed restrictions depending on their location and cargo.[381]

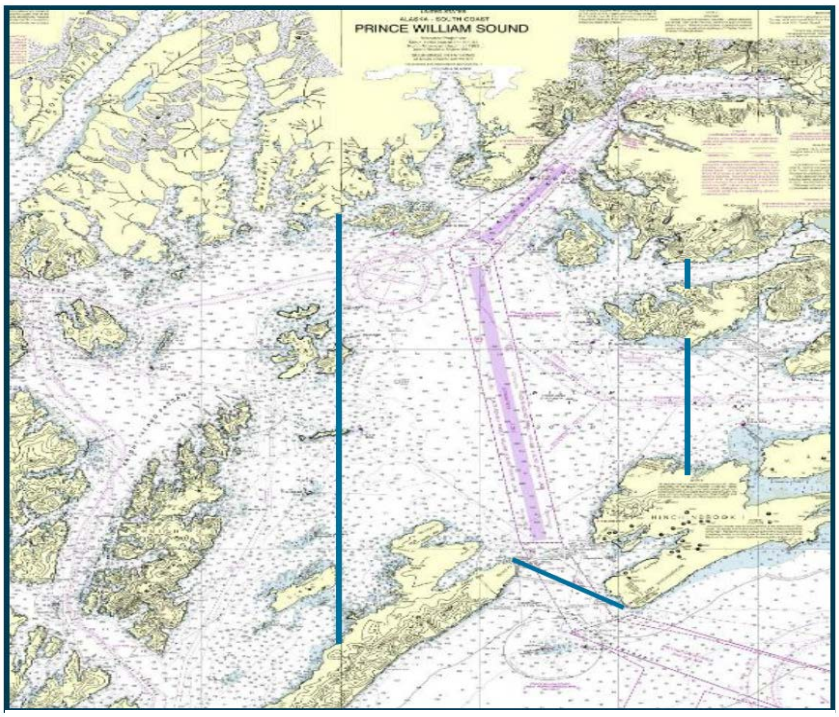

Figure 10 – Prince William Sound VTS Area and TSS (Source: U.S. Coast Guard)

Additionally, the VTS Area includes a total of five mobile and stationary "safety zones" and four mobile and stationary "security zones" near waterfront facilities, tank vessels, vessels carrying ammunition, and the areas surrounding Ammunition Island, the Port Valdez Ferry Terminal, the Valdez Marine Terminal, and the Valdez Narrows Tanker Optimum Track line.[382] Vessels traveling through or anchoring in these areas are subject to especially stringent restrictions and pre-authorization requirements.[383]

Another interesting feature of the Prince William Sound VTS is the Knowles Head Anchorage, which provides a temporary anchorage site for vessels during adverse weather or tidal conditions, vessel equipment failure, or port delays.[384]

Along with the vessel traffic routes and designated areas, the Prince William Sound VTS includes a robust array of oversight mechanisms. Vessel traffic is overseen and managed at a VTC located in Valdez about 26 miles northeast of Bligh Reef.[385] The VTC is staffed 24 hours a day, 7 days a week by Coast Guard active duty and civilian personnel.[386] The VTS's main functions include tracking and monitoring vessel traffic, keeping vessel operators and navigators informed about current weather, tidal, and ice conditions, and recommending or directing a specific course action when necessary to avoid a collision, protect property or the environment, or ensure regulatory compliance.[387] According to VTS Director Lt. J.G. Carlos Quintero, "[w]e are focused on active traffic management to prevent accidents, loss of life and damage to the environment."[388]

These VTS functions are carried out at three levels of service depending on the size and other characteristics of a particular vessel. At the first level, "information service," the VTS provides vessels with information regarding "the position, intentions, and destinations" of other vessels operating nearby, as well as information concerning "meteorological and hydrological conditions, status of aids to navigation, traffic congestion, and waterway restrictions."[389] At the second level, "navigation assistance service," the VTS "assist[s] a vessel's bridge team in the navigation decision making process," either upon request or when deemed necessary by the VTS.[390] At the third level, "traffic organization service," the VTS engages in "advance planning of vessel movements" as well as "[m]onitoring traffic and ensuring adherence to rules and regulations."[391] Traffic organization service can include "prioritization of movements, allocation of space, mandatory position reporting, established routes, speed limits, ice routing measures, weather closures, and other measures that may be considered necessary and appropriate by the VTS."[392]

The ice routing measures are noteworthy as well. When ice conditions are hazardous, the VTS has authority to convert the two-lane TSS route into a one-way zone, allow transits of the route only in daylight, or even close the entire route to vessel traffic.[393]

The operation of the VTS in Prince William Sound has been largely successful. Despite the large volume of oil tankers passing through, over the past 29 years, there have been no major oil spills in the Sound, although some smaller pollution incidents have occurred.[394] The "economic impact of keeping these vessels safe is estimated by how much the Exxon Valdez incident cost, and that was $3.8 billion," says Quintero.[395] This suggests the U.S. investment in operating the VTS in Prince William Sound has been well worth it.

2. Canadian Arctic

The Arctic Ocean offshore of the United States is bounded by a relatively linear shoreline, stretching west-to-east along the Alaska coast from the Bering Strait to the border with Canada. In contrast, the Arctic Ocean on the Canadian side of the border is interspersed with the enormous and complex Canadian Arctic Archipelago, which covers a total area of about 550,000 square miles and includes more than 36,500 islands, peninsulas, and other land masses.[396] The Arctic region encompasses more than 40% of Canada's land mass, is home to more than 100,000 people, and serves as a core component of Canadian identity.[397] It has been occupied by the Inuit and their predecessors for the past 4,000 years, and the majority of Canadian Inuit population continues to live in coastal settlements scattered throughout the islands, along with many non-indigenous people.[398] The landscape includes rugged mountains, steep fjords, and broad plains rich in mineral resources, and the waters are fairly shallow (ranging from less than 100 to 600 meters) with strong tidal currents in the narrower passages.[399] Much of the region is covered with sea ice averaging 1.5 to 2 meters thick, but the ice cover has thinned in recent years, with ice-free channels becoming larger and lasting longer.[400] The waters of the Canadian Arctic are

home to polar bears, walrus, and various species of seals and whales, including the narwhal and the beluga whale.[401]

Canada has recognized the value of investing in a VTS system for northern waters, and its VTS (or MCTS) for the Northern Canada Zone (known as NORDREG) encompasses a vast region of the Arctic Ocean.[402] The objectives of NORDREG are the enhancement of safety and movement of traffic, the strengthening of Canadian sovereignty, and the prevention of pollution of Arctic waters.[403] The foundation for NORDREG was established in 1970, with Canada's enactment of the AWPPA shortly after a U.S. ice-breaking oil tanker crossed through the Northwest Passage without seeking Canada's permission.[404] The AWPPA created a 100-nautical mile shipping safety control zone and established anti-pollution and marine safety standards within that zone.[405] In 1977, Canada adopted NORDREG regulations to manage vessel traffic within the zone out of an MCTS center operated by the Canadian Coast Guard in Iqaluit, Nunavut.[406] Initially, NORDREG operated on a voluntary basis, but the vast majority of vessels voluntarily complied because doing so gave them access to a number of beneficial services, including ice information, routing service, ice-breaker assistance, and search and rescue response.[407] Nevertheless, out of a concern for the harm that could by caused by even a few noncompliant vessels, in 2001, the CSA authorized the Canadian Coast Guard to require vessel reporting and clearance on a mandatory basis, while continuing to provide the services listed above.[408] Regulatory amendments implemented under this statutory authority made compliance with the NORDREG VTS system mandatory for certain categories of large vessels operating in the zone after July 1, 2010.[409] Moreover, in 2009, Canada extended the VTS zone out to 200 nautical miles, the outer limit of its EEZ.[410] So, today, the mandatory NORDREG VTS regime is applicable throughout the entirety of Canada's EEZ in the Arctic, as shown in Figure 11.

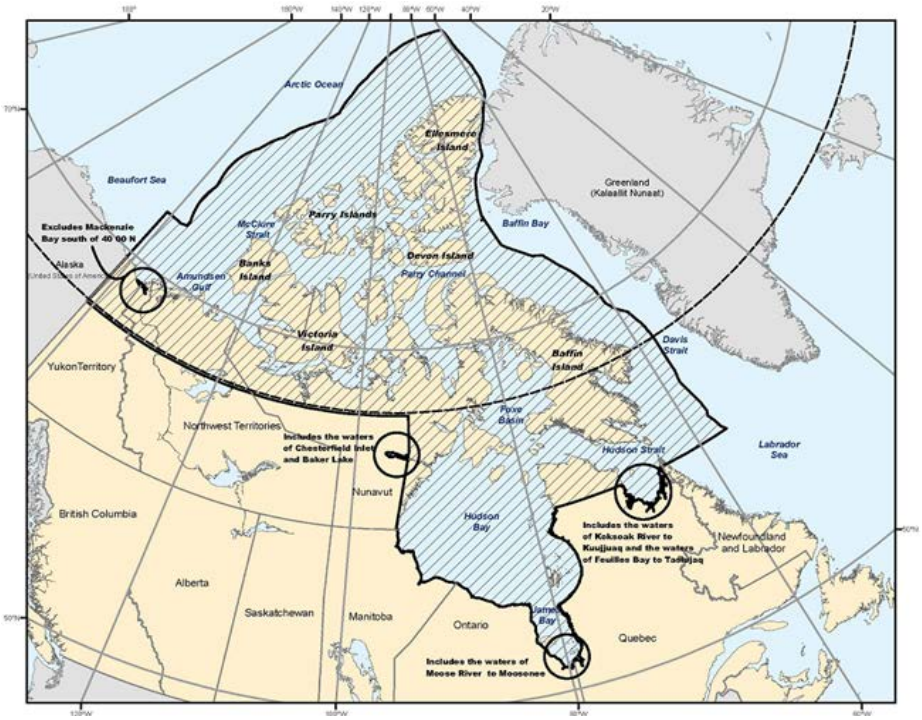

Figure 11 – Northern Canada (NORDREG) VTS Zone (Source: Transport Canada)

The NORDREG VTS represents a key component of Canada's broader "Northern Strategy," which focuses on "strengthening Canada's Arctic sovereignty, protecting the fragile northern environment, and promoting economic and social development while giving northerners more control over their economic and political destiny."[411] The Canadian government has explained that, "[w]ith mandatory reporting, the Canadian Coast Guard will be able to promote the safe navigation of vessels, keep watch on vessels carrying pollutants, fuel oil and dangerous goods, and respond quickly in the event of an accident."[412]

Despite these well-intentioned objectives, Canada's sweeping assertion of sovereignty over the Arctic and its unilateral imposition of a mandatory VTS regime throughout its EEZ have been somewhat controversial. Ordinarily, under UNCLOS, a coastal state may only impose such requirements within its internal waters and 12-mile territorial sea.[413] Moreover, if some or all of the waters within a coastal state's 12-mile zone are considered an international strait, a coastal state's ability to act unilaterally is limited by the right of transit passage and the duty of non-discrimination.[414] On the other hand, Article 234 of UNCLOS allows coastal states to unilaterally adopt and enforce laws to prevent and control marine pollution from vessels in "ice-covered areas."[415] This is one of main legal bases Canada is relying on for its broad VTS regime in the Arctic.[416] The United States has expressed disagreement with Canada's approach on various grounds, but the debate appears to have quieted down in recent years, and the two countries have been engaged in a variety of cooperative efforts pertaining to the Arctic.[417]

Under Canadian law, Canadian Coast Guard MCTS officers have been granted broad authority to require reporting and manage vessel traffic within a VTS Zone, including the NORDREG VTS Zone, for the "purpose of promoting safe and efficient navigation or environmental protection."[418] Their authority extends to all vessels within a "prescribed class,"[419] which have been defined by regulation to include all vessels with a gross tonnage of 300 or more, vessels engaged in towing or pushing another vessel where the combined gross tonnage is 500 or more, and vessels of any size carrying, towing, or pushing cargos of pollutants or dangerous goods.[420] When a vessel in one of these classes is "about to enter" or is already "within a VTS Zone," an MCTS officer has the authority to grant a "clearance" allowing the vessel to enter, leave, or proceed within the VTS Zone, and to "direct" the vessel to "provide ... any pertinent information," "use any radio frequencies in communications with coast stations or any other vessel," and to "leave the VTS Zone ... leave or refrain from entering any area within the VTS Zone ... or ... proceed to or remain at any location within the VTS Zone that may be specified."[421] Conversely, a vessel in a prescribed class shall not "enter, leave or proceed within a VTS Zone without having previously obtained a clearance" from an MCTS officer nor "proceed within a VTS Zone unless able to maintain direct communication" with an MCTS officer.[422]

The NORDREG VTS utilizes a comprehensive reporting system to carry out its oversight and traffic management functions, as well as its navigation assistance and emergency response

services. The NORDREG reporting scheme requires four types of reports: a "sailing plan," which must be submitted by a vessel prior to entering the zone; "position reports," which are required upon entry and then daily thereafter; a "final report," which is required upon berthing or departure; and "deviation reports," which are required whenever a vessel deviates from its sailing plan.[423] Additionally, vessels must report any discovery of another vessel in difficulty, an obstruction to navigation, a malfunctioning aid to navigation, hazardous ice or weather conditions, or a pollutant in the water.[424] Failure to comply with these reporting requirements, other applicable regulatory requirements, or the direction of an MCTS officer could subject the violator to fines and/or imprisonment.[425]

Unlike Prince William Sound, where the scaling back of the VTS system played a role in the *Exxon Valdez* oil spill, the NORDREG VTS has operated consistently since its establishment in the late 1970s, and it has only been strengthened and expanded since then. The fact that there has never been a major environmental incident resulting from shipping in the Canadian Arctic strongly suggests the VTS is functioning effectively.

3. Lessons Learned

Prince William Sound and the Canadian Arctic share many similar characteristics and concerns. Both regions are especially difficult for ships to navigate without assistance due to their challenging geography, weather, and ice conditions. Moreover, the wildlife, ecosystems, and indigenous communities in both places are highly sensitive to the harmful impacts of oil spills and other shipping-related disturbances. Despite the large volume of oil tanker traffic in Prince William Sound and the growth of shipping activities in the increasingly ice-free routes and passages of the Canadian Arctic, the VTS systems in both places have been effective in preventing collisions, oil spills, and other environmental harm over the past several decades.

The Chukchi Sea and Beaufort Sea regions of the American Arctic, as well as areas offshore of other Arctic nations, also share these traits but are not currently protected by any VTS system. Arctic coastal states would certainly have the legal authority to establish such a system within their 12-mile territorial seas, and they could potentially rely on Article 234 of UNCLOS, as Canada has done, to support the expansion of VTS oversight further out into their EEZs. Or, they could pursue a more consensus-oriented approach through the IMO. The establishment and implementation of such a system would require a significant investment of resources, but staffing, facilities, and operational levels could be scaled up or down depending on local needs. The investment may be worth considering as a means to ensure that the expansion of shipping activities in the Arctic proceeds in an orderly fashion and avoids serious harm to coastal communities and environmental receptors.

D. International Cooperation: Puget Sound and Strait of Juan de Fuca

The Arctic Ocean is bordered by five coastal states, and much of the recent increase in shipping traffic involves large vessels traveling through the Arctic on their way to other

destinations. As such, a low-impact shipping corridor in the Arctic will likely require the participation of two or more states in order to maximize its effectiveness. The successful long-term cooperative regime involving the U.S. and Canada in the Pacific Northwest could serve as a model for such efforts.

The Strait of Juan de Fuca is long, narrow body of water between the State of Washington on the U.S. side and Vancouver Island on the Canadian side, and it comprises part of the complex coastal waterway system of the Salish Sea. The Strait of Juan de Fuca serves as the primary connection between Puget Sound and the Pacific Ocean.[426] Puget Sound, a bay with numerous channels and branches, extends approximately 70 nautical miles from the eastern end of the Strait of Juan de Fuca to the city of Olympia, Washington.[427] While navigation is relatively simple in good weather, the area has rugged steep cliff shorelines, powerful tidal currents, strong winds and storms in the winter, and heavy fog from July to October.[428]

The Salish Sea is a flourishing ecosystem that supports commercial fisheries and traditional tribal fishing grounds, as well as eco-tourism focused on whale watching.[429] It is also home to an economically important port infrastructure utilized by many different vessel types, including large commercial and industrial vessels, fishing vessels, and one of the world's largest per capita recreational boating communities.[430] The larger ships include crude oil tankers, fast container ships, wheeled cargo ships, bulk freighters, cruise ships, and naval vessels.[431] Many of these ships carry hazardous cargo, including millions of barrels of petroleum products moving through the region annually.[432] Oceanographers estimate that a major oil spill in this region could blanket the entire area within two 24-hour tidal cycles.[433]

Vessel traffic in the Strait of Juan de Fuca and its approaches (Puget Sound, the San Juan Island Archipelago, Haro Strait, Boundary Pass, and the Strait of Georgia) is managed jointly by the Canadian and U.S. Coast Guards through a Cooperative VTS and TSS.[434] In 1979, the governments of Canada and the United States entered into a formal agreement to establish the Cooperative VTS for the region to provide for the safe and efficient movement of vessel traffic while minimizing the risk of pollution by preventing collisions and groundings.[435] The agreement has led to "excellent cooperation and joint management," and it has become a "model for the world and an ultimate example of international teamwork."[436]

A notable feature of the Cooperative VTS system is that the allocation of responsibility is based, not on international boundaries, but rather on geography and waterways, in order to provide the safest and most seamless service for mariners.[437] Vessel traffic is managed by the U.S. and Canadian Coast Guards at three traffic centers, shown in Figure 12. The Puget Sound VTC in Seattle, Washington, operated by the U.S. Coast Guard, manages vessel traffic in both the Canadian and U.S. waters of the Strait of Juan de Fuca and traffic headed to U.S. ports.[438] The Prince Rupert MCTS Centre, operated by the Canadian Coast Guard, is located on Vancouver Island and manages vessels entering the Strait of Juan de Fuca from

about 40 miles offshore.[439] The Victoria MCTS Centre, operated by the Canadian Coast Guard, manages vessels in both the Canadian and U.S. waters of the Haro Strait, Boundary Passage, and the lower Georgia Straits bound for Canadian ports as they proceed north toward Vancouver.[440] The two Coast Guards strive to make the transitions between their traffic centers smooth and transparent, and their common operational procedures and harmonized regulations help promote a spirit of cooperation and oneness of purpose.[441]

The IMO approved the original TSS associated with the VTS in 1981, and the routes have been modified several times since then to improve navigation.[442] The TSS provides for approaches, vessel traffic lanes, and a precautionary area.[443] Additionally, a special area has been designated in the eastern San Juan Island Archipelago to protect its ecological and historic attributes and associated tourism activities.[444] Within the special area, additional restrictions apply to ensure that larger and smaller vessels do not meet or overtake each other, cross or operate near each other, or otherwise impede each other's passage.[445]

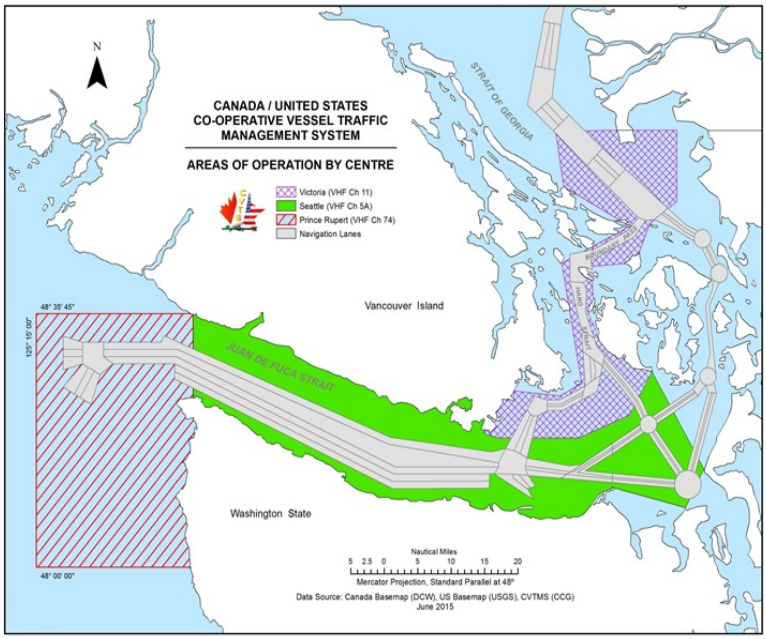

Figure 12 – Cooperative VTS Area in Puget Sound/Juan de Fuca (Sources: U.S. Coast Guard, Canadian Coast Guard)

The three VTCs communicate electronically and via telephone to advise each other of vessels passing between their respective zones.[446] Certain vessels are required to monitor the VTC radio frequencies, and larger vessels are required to make voice reports to appropriate VTC.[447] Vessels change their radio frequency as they move through the region to communicate with the appropriate VTC.[448] Vessels subject to the reporting requirements must provide an initial report, a position report at certain points in the system, and a final report.[449] Vessels must also report any deviations from the original schedule and any accidents or dangerous situations, including pollution incidents and adverse weather conditions.[450] All vessels within the TSS must comply with the COLGREGs as well as any directive issued by a VTC.[451]

The Cooperative VTS has evolved since its establishment in 1979. The two Coast Guards meet biannually as well as in periodic operational meetings, and they are constantly responding to changes in administrative and operational requirements, as well as the dynamics of the shipping industry, the environment, and public concerns.[452] In a typical year, the Cooperative VTS monitors more than 220,000 vessel transits, and it assists in 150

search-and-rescue cases, 200 law enforcement cases, and 30 pollution cases.[453] Its efforts avert 155 marine accidents annually, including many involving commercial tankers or freighters that could have devastating effects on the local environment.[454] Despite the complexity of the geography, challenging marine environment, and jointly operated VTS system, the Puget Sound/Juan de Fuca region has not had a major oil spill or other environmental disaster during the 40 years that the Cooperative VTS has been in operation. In light of the large volume of vessel traffic and petroleum products transiting through the region, this is a remarkable accomplishment and a testament to the two countries' strong working relationship.

Figure 13 – Crude Oil Tanker 'Overseas Jademar,' Detained by U.S. Coast Guard in Puget Sound for Safety Violations, 2015 (Source: Marinetraffic.com)

E. Dynamic Ocean Management

Many of the shipping regimes highlighted above include dynamic components, such as seasonal restrictions on shipping to reduce whale strikes and mobile safety and security areas surrounding critical waterfront, military, and oil industry vessels and facilities. During the lead-up to the IMO's adoption of ship routing measures and ATBAs in the Bering Strait region, a group of academic researchers at Stanford University delved into the idea of dynamic mechanisms more deeply. They conducted a rigorous analysis of the concept of "dynamic ocean management" and identified the key benefits and challenges associated with the implementation of this approach.[455] Although the ultimate IMO decision for the Bering Strait generally reflected traditional management approaches, the dynamic ocean management concept could be useful for the future development of low-impact shipping corridors in the Arctic Ocean. The following is a brief summary of the Stanford researchers' analysis and conclusions.

Global climate change is causing rapid change in the Arctic, including rising air and water temperatures and disappearing sea ice, and these changes are driving a host of environmental, social, and economic changes. For instance, many marine species are migrating northward and shifting their foraging grounds and residence times to the Arctic. Sometimes this places competitive stress on endemic species that cannot relocate elsewhere. At the same time, the warming Arctic is opening up both local and trans-Arctic transportation routes and making oil, gas, minerals, and other natural resources more accessible. The anticipated expansion of industrial and transportation activities will increase the risks of harm to marine life and intensify the stresses on wildlife, ecosystems, and coastal communities.

Traditional regulation, especially at the international scale, tends to be developed through long, slow bureaucratic processes and generate fixed requirements. This can leave a gap between the regulations on paper and the changing conditions on the ground, especially in an environment that is experiencing rapid change, such as the Arctic. A dynamic approach has the potential to avoid both the over- and under-regulation that can result from such a gap. Dynamic management often relies on traditional regulatory tools, but the parameters of these tools are adjusted on an ongoing basis. For a geographic or spatial parameter, such as the boundaries of a marine protected area, a dynamic approach would routinely adjust the boundaries on an annual, seasonal, or even weekly basis to reflect current data, such as the location of protected species or the projected extent of sea ice. One example is the eastern Australia long-line fishery. By adjusting the boundaries bi-weekly to minimize bluefin tuna bycatch, managers were able to minimize bycatch and simultaneously reduce the number of areas where fishing was prohibited. Dynamic systems like this have been able to achieve ecological outcomes equal to or better than static systems, while regulating up to 80% less geographic area.

Traditional mechanisms can be adjusted on an ongoing basis with respect to temporal or seasonal parameters as well. Seasonal restrictions on shipping to protect whales, for instance, could provide for the dates to be adjusted annually or more frequently based on recent whale activity data, or based on proxy data taking advantage of the whales' known preferences, such as water temperature, desire to be near the edge of sea ice, and other factors. Tailoring seasonal restrictions in a dynamic fashion would likely be more effective in protecting whales and less restrictive on shipping traffic than fixed dates that can only be adjusted through a full-scale amendment to an international agreement or regulation.

A third approach is known as incident-based regulation. For example, after a certain number of whale strikes in a given season, speed limits would come into effect for the remainder of the season. Fishery managers routinely use this type of approach when they open fisheries after a certain level of escapement has been reached, or close fisheries after a certain level of catch or bycatch has been reached. In keeping with a dynamic approach, the thresholds or levels that trigger the management decisions must be updated routinely based on the most current information available.

Some of the main challenges for a dynamic management approach include a greater need for data to inform ongoing decision-making and a need for extensive stakeholder engagement to facilitate ongoing consensus-building and compliance. The absence of robust data and the cost of obtaining it should not preclude the creation of a dynamic system, however. Research has shown that the establishment of dynamic management mechanisms can incentivize the development of such data by industry as a means to reduce their regulatory burdens, while ensuring that precautionary measures are in place during the interim. Moreover, even incomplete data, if current, may be beneficial where it provides an alternative to static decisions based on grossly outdated and inaccurate information. Similarly, while stakeholder engagement can be slow and cumbersome, there

are ways to structure it to generate timely and well-balanced decision-making. For example, a committee or other body can be established with voting rights distributed on an equitable basis to representatives of core stakeholder groups. Others outside the core groups could still play a valuable role through comments, data submissions, and assistance with distribution of information.

In short, dynamic ocean management shows great promise for effectively protecting the marine environment in a rapidly changing Arctic, while at the same time minimizing burdens on the shipping industry. The challenges associated with data collection and stakeholder engagement can be addressed through careful structuring of the institutions and incentives at the heart of the system.

CONCLUSION
LESSSONS FOR A LOW-IMPACT SHIPPING CORRIDOR IN THE ARCTIC OCEAN

The backbone of a low-impact shipping corridor in the Arctic Ocean would consist of some combination of the vessel routing measures discussed in Part I. A TSS, two-way route, or other directional routing measure should be developed with as much supporting data as possible to minimize the risk of collisions and groundings, as well as to avoid areas where wildlife congregate and subsistence harvesting occurs. Traffic lanes with a wide separation zone between them may be preferable in areas where space is plentiful, as these afford the most predictability for navigators and the greatest reduction of potential for collisions. In contrast, a two-way route appears preferable in narrow transit areas where ice is present as it gives navigators maximum flexibility for avoidance of ice and other hazards. A two-way route is also less likely than a TSS to impede subsistence activities, as shown in the Bering Strait example.

Linear routes could be supplemented with PSSAs, ATBAs, special areas, or other types of area designations to reinforce the routing of ships away from sensitive wildlife and their habitats, and away from subsistence resources and activities. Where shipping traffic cannot be eliminated entirely, area designations can still be helpful where they provide for speed limits, prohibit discharges of certain pollutants, or impose other operational restrictions as a means to minimize the potential harm associated with shipping traffic within a designated area.

Furthermore, it has long been recognized, at both the international and domestic levels, that written agreements and laws provide a good foundation for addressing a problem, but that real progress is generally made when standing bodies with clear authority and adequate funding and personnel are established to implement and oversee them. The success of the VTS regimes in preventing collisions, groundings, and oil spills in Prince William Sound (when fully funded after 1989), Canadian Arctic, and Puget Sound/Juan de

Fuca over a period of several decades provides substantial empirical support for this principle. Any routing measure adopted or operational restriction imposed will be far more effective where there are Coast Guard officials on-hand and in close communication with vessel operators to help them achieve and maintain compliance, and to intervene when necessary to enforce the rules and prevent close-calls from becoming devastating tragedies. All three of the VTS regimes described in this paper are now viewed as essential to ensuring safe navigation and preventing environmental harm in locales with challenging geography, weather, ice, and vessel traffic conditions. The lack of a VTS regime for the American Arctic stands out as a significant gap in the system, especially as the ice recedes and shipping traffic increases each year.

With the impressive track record of cooperation between the U.S. and Canadian Coast Guards in the Puget Sound/Juan de Fuca region, and the recent success of the joint U.S.-Russia effort to establish vessel traffic routing measures in the Bering Strait region, it should be feasible to bring the Arctic coastal states together to establish and implement a low-impact shipping corridor for the Arctic. The participants should take into account the rapid pace of environmental change in the region and consider incorporating dynamic ocean management principles into their low-impact shipping corridor regime.

NOTES

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[1] *See* Arctic Council, *Arctic Marine Shipping Assessment 2009 Report*, at 106 (April 2009) [hereafter "AMSA Report"], https://oaarchive.arctic-council.org/handle/11374/54.

[2] *See* AMSA Report, at 143, 145, 147, 176, 181; 50 C.F.R. § 17.11 (listing species designated as threatened or endangered under the U.S. Endangered Species Act, including bowhead whales, polar bears, Steller sea lions, and numerous Arctic bird species).

[3] *See* H. Hoag, Arctic Today, *The Arctic Ocean's ice-free season could extend into fall* (June 29, 2018), https://www.arctictoday.com/arctic-oceans-ice-free-season-extend-fall/?wallit_nosession=1 (discussing studies presented at the Polar 2018 Open Science Conference in Davos, Switzerland).

[4] *See generally* R. Gosnell, Arctic Inst., *The Complexities of Arctic Maritime Traffic* (Jan. 30, 2018), https://www.thearcticinstitute.org/complexities-arctic-maritime-traffic/; E. Struzik, Yale Env't 360, *Full Speed Ahead: Shipping Plans Grow as Arctic Ice Fades* (Nov. 17, 2016), https://e360.yale.edu/features/cargo_shipping_in_the_arctic_declining_sea_ice; D. Dimitrios, World Maritime Univ., et al, *The Future of Arctic Shipping Business and the Positive Influence of the Polar Code*, Int'l Ass'n Maritime Economists, Annual Conference, Hamburg-Germany (Aug. 2016), https://www.researchgate.net/profile/Dalaklis_Dimitrios/publication/307570631_The_Future_of_Arctic_Shipping_Business_and_the_Positive_Influence_of_the_Polar_Code/links/580492b208ae6c2449f96a17/The-Future-of-Arctic-Shipping-Business-and-the-Positive-Influence-of-the-Polar-Code.pdf?origin=publication_detail.

[5] *See generally supra* note 4.

[6] *See* H. Hickey, Univ. Washington, UW News, *Study identifies which marine mammals are most at risk from increased Arctic ship traffic* (July 2, 2018), http://www.washington.edu/news/2018/07/02/study-identifies-which-marine-mammals-are-most-at-risk-from-increased-arctic-ship-traffic/.

[7] *See id.*

[8] *See id.*

[9] *See* M. Simton, KTVA, *2M gallons of diesel barged to North Slope for first time* (Sept. 6, 2018), http://www.ktva.com/story/39042938/2m-gallons-of-diesel-barged-to-north-slope-for-first-time.

[10] *See generally* D. Hauser, et al, PNAS, *Vulnerability of Arctic marine mammals to vessel traffic in the increasingly ice-free Northwest Passage and Northern Sea Route* (July 17, 2018), https://www.researchgate.net/profile/Donna_Hauser/publication/326139868_Vulnerability_of_Arctic_marine_mammals_to_vessel_traffic_in_the_increasingly_ice-free_Northwest_Passage_and_Northern_Sea_Route/links/5b463db10f7e9b4637cdc2cf/Vulnerability-of-Arctic-marine-mammals-to-vessel-traffic-in-the-increasingly-ice-free-Northwest-Passage-and-Northern-Sea-Route.pdf?origin=publication_detail; Ocean Conserv'y, *Navigating the North: An Assessment of the Environmental Risks of Arctic Vessel Traffic* (2017), https://oceanconservancy.org/protecting-the-arctic/take-deep-dive/navigating-the-north/; Pew Charit. Trusts, *Arctic Vessel Traffic in the Bering Strait: Key Measures for Developing Regulatory Standards* (April 2014), http://www.pewtrusts.org/-/media/legacy/oceans_north_legacy/arctic_vessel_for_print_200copiesmay20141.pdf.

[11] IMO Webpage, Introduction to IMO, www.imo.org/About/Pages/Default.aspx.

[12] *See id.*

[13] *See id.*

[14] *See* Arctic Council, *Declaration on the Establishment of the Arctic Council*, Ottawa-Canada (Sep. 19, 1996), http://www.arctic-council.org/index.php/en/about/documents/file/13-ottawa-declaration; Arctic Council, *The Arctic Council: A Backgrounder* (May 20, 2015, updated Jan. 3, 2018), https://www.arctic-council.org/index.php/en/about-us.

[15] *See* Arctic Council Webpage, Member States, https://www.arctic-council.org/index.php/en/about-us/member-states.

[16] *See* Arctic Council Webpage, Permanent Participants, https://www.arctic-council.org/index.php/en/about-us/permanent-participants.

[17] Arctic Council, *Arctic Environmental Protection Strategy*, Rovaniemi-Finland, 30 I.L.M. 1624 (June 14, 1991), http://library.arcticportal.org/1542/1/artic_environment.pdf.

[18] Arctic Council, *Impacts of a Warming Arctic: Arctic Climate Impact Assessment* (Oct. 15, 2004), http://amap.no/acia/.

[19] Arctic Council, PAME Working Group, *Arctic Offshore Oil and Gas Guidelines* (April 29, 2009), https://oaarchive.arctic-council.org/handle/11374/63.

[20] Arctic Council, *Arctic Marine Strategic Plan 2015-2025* (April 2015), https://oaarchive.arctic-council.org/handle/11374/413.

[21] *See* AMSA Report.

[22] *See id. See also* Arctic Council, *Status on Implementation of the AMSA 2009 Report Recommendations* (May 2017), https://oaarchive.arctic-council.org/handle/11374/415.

[23] *See* AMSA Report, at 6-7.

[24] *Ilulissat Declaration*, Arctic Ocean Conf., Ilulissat-Greenland (May 28, 2008), http://www.arcticgovernance.org/the-ilulissat-declaration.4872424.html. Canada, Denmark, Norway, Russia, and the United States participated in the Arctic Ocean Conference at which the Ilulissat

Declaration was developed. The Ilulissat Declaration appears to be referring to UNCLOS, but it did not directly identify this convention.

[25] *See id.*

[26] *See* Agreement on Cooperation on Aeronautical and Maritime Search and Rescue in the Arctic, Nuuk-Greenland (May 12, 2011), https://oaarchive.arctic-council.org/handle/11374/531.

[27] Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic (MOPPRA), Kiruna-Sweden (May 15, 2013), https://oaarchive.arctic-council.org/handle/11374/529.

[28] Agreement on Enhancing International Arctic Scientific Cooperation, Fairbanks-USA (May 11, 2017) https://oaarchive.arctic-council.org/handle/11374/1916.

[29] AMSA Report, at 109. The Bering Strait vessel routing measures recently approved by the IMO apply in northern waters near the Arctic Ocean. *See infra* Part III(B).

[30] *See* U.S. Coast Guard Webpage, 17th District (identifying Air Station Kodiak and Marine Safety Detachment Dutch Harbor), http://www.uscg.mil/d17/units.asp. *See also* Pew Charit. Trusts, *Oil Spill Prevention and Response in the U.S. Arctic Ocean: Unexamined Risks, Unacceptable Consequences*, at 23 (Nov. 10, 2010), http://www.pewtrusts.org/en/research-and-analysis/reports/2010/11/10/oil-spill-prevention-and-response-in-the-us-arctic-ocean-unexamined-risks-unacceptable-consequences.

[31] *See* C. Edgar, Nunatsiaq News, *Construction on Iqaluit's small-craft harbour, deep-sea port starts in July* (June 25, 2018), http://nunatsiaq.com/stories/article/65674construction_on_iqaluits_small-craft_harbour_deep-sea_port_starts_in_j/.

[32] *See* U.S. Army Corps and Alaska Dept. Transp., *Alaska Deep-Draft Arctic Port System Study*, at 35 (Mar. 2013), www.poa.usace.army.mil/Portals/34/docs/AKports/1ADDAPSReportweb.pdf; Bering Strait PARS, Comments submitted by the City of Nome, 2 (Feb. 23, 2011) ("the Port of Nome is currently reviewing design options, and seeking associated funding and support necessary to extend our facility to deeper water thereby providing the necessary Deepwater Port for the Northwest Arctic Region.").

[33] U.S. Army Corps, Press Release, *Corps, Partners temporarily suspend study for Alaska Deep-Draft Arctic Port System* (Oct. 23, 2015), http://www.poa.usace.army.mil/Portals/34/docs/civilworks/arcticdeepdraft/NewsReleaseRePauseofarcticdeepdraftportstudyOct262015.pdf.

[34] E. Brehmer, *Federal water bill requires fresh look at Arctic port for state,* Anch. Daily News (Jan. 8, 2017), https://www.adn.com/arctic/2017/01/08/federal-water-bill-requires-a-fresh-look-at-an-arctic-port-for-alaska/.

[35] *See* R. Hutchins, Journal Commerce, *Ports bill paves way for deep-water Alaska port* (Jan. 11, 2017), https://www.joc.com/regulation-policy/transportation-regulations/us-transportation-regulations/ports-bill-paves-way-deep-water-alaska-port_20170111.html.

[36] Alaska Legis., House Jt. Res. 33, *Urging the Alaska delegation in Congress to pursue the establishment of a U.S. Coast Guard port in the Arctic region; supporting the increase in defensive capabilities in the Arctic region; and encouraging the development of critical Arctic infrastructure* (April 20, 2018), http://www.akleg.gov/basis/Bill/Detail/30?Root=hjr%2033#tab1_4.

[37] *See id.*

[38] *See* City of Nome, Alaska, Res. No. R-18-04-03 (April 23, 2018), https://www.nomealaska.org/egov/apps/document/center.egov?view=detail&id=1990.

[39] *See* J. Mason, The Nome Nugget, *Senator, Top Brass Visit Port of Nome* (Aug. 17, 2018), http://www.nomenugget.com/news/senator-top-brass-visit-port-nome.

[40] *See generally* UNCLOS, 1833 U.N.T.S. 3, 21 I.L.M. 1261 (Dec. 10, 1982) [hereafter UNCLOS]; United Nations UNCLOS Webpage,

http://www.un.org/depts/los/convention_agreements/convention_overview_convention.htm; U.S. Dept. State UNCLOS Webpage, http://www.state.gov/e/oes/lawofthesea/.

[41] *See* United Nations, Chronological Lists of Ratifications of, Accessions and Successions to the Convention [UNCLOS] and the Related Agreements, http://www.un.org/depts/los/reference_files/chronological_lists_of_ratifications.htm; United Nations Treaty Series, UNCLOS, No. 31363 (1982), https://treaties.un.org/Pages/showDetails.aspx?objid=0800000280043ad5.

[42] *See, e.g., United States v. Beyle*, 782 F.3d 159 (4th Cir. 2015) ("Although the United States has not signed or ratified UNCLOS, it 'has recognized that [the treaty's] baseline provisions reflect customary international law.'") (quoting *United States v. Alaska*, 503 U.S. 569, 588 n.10 (1992)).

[43] *See* UNCLOS, Arts. 2-32.

[44] *See id.*, Arts. 17-32.

[45] *See id.,* Art. 33.

[46] *See id.,* Arts. 55-75.

[47] *See id.,* Arts. 34-45.

[48] *See id.,* Arts. 37-44.

[49] *See id*., Arts. 86-120.

[50] *See id*., Arts. 192-237 and Annex I (Highly Migratory Species).

[51] *See id.*, Arts. 2(1), 8, 25(2), and 211(3).

[52] *See id.*, Art. 24(2).

[53] *See id.*, Art. 94.

[54] *See id.*, Arts. 192-196, 207-212.

[55] UNCLOS's usage of the term "competent international organization" in the singular has been interpreted to refer exclusively to the IMO. *See* IMO Secretariat, *Implications of the United Nations Convention on the Law of the Sea for the International Maritime Organization*, LEG/MISC. 8, at 7 (Jan. 30, 2014), http://www.imo.org/en/OurWork/Legal/Documents/LEG%20MISC%208.pdf.

[56] *See id.*, Art. 22.

[57] *Id.*, Art. 21.

[58] *See id.,* Art. 211(1)-(2).

[59] *Id.*, Art. 211(1). The International Convention for the Safety of Life at Sea (SOLAS), discussed in Part I, provides more detail regarding ship routing measures.

[60] *See id.*, Art. 211(4).

[61] *Id.*, Art. 211(5). The International Convention for the Prevention of Pollution from Ships (MARPOL), discussed in Part II, provides more detail regarding pollution control.

[62] *Id*., Art. 211(6)(a)-(b). MARPOL provides more detail regarding special areas for pollution control, as discussed in Part II(C).

[63] *Id*., Art. 211(6)(c).

[64] *Id.,* Art. 234.

[65] *Id.*

[66] *Id.*, Art. 38(2).

[67] *Id.*, Art. 42(1),(4).

[68] *Id.*, Art. 42(2).

[69] *Id.*, Art. 41(1)-(4).

[70] SOLAS, 1226 U.N.T.S. 213, 32 U.S.T. 47 (Nov. 1, 1974). *See* United Nations Treaty Series, SOLAS, No. 18961 (1974), https://treaties.un.org/pages/showDetails.aspx?objid=08000002800ec37f.

[71] *See* SOLAS; IMO, *Status of Treaties* (June 8, 2018), http://www.imo.org/en/About/Conventions/StatusOfConventions/Documents/StatusOfTreaties.pdf.

[72] *See* IMO Webpage, SOLAS, http://www.imo.org/about/conventions/listofconventions/pages/international-convention-for-the-safety-of-life-at-sea-(solas),-1974.aspx.

[73] *See* SOLAS, Ch. V, Reg. 10.2. SOLAS Ch. V provisions can be viewed and navigated at http://solasv.mcga.gov.uk/.

[74] *See* IMO Webpage, SOLAS.

[75] *See generally id*.

[76] SOLAS, Ch. V, Regs. 10.1 and 11.1 (emphasis added). *Accord id.* Reg. 12.1.

[77] *See, e.g., id., Reg*. 10.1 ("Ships' routeing systems are recommended for use by, and may be made mandatory for, all ships, certain categories of ships or ships carrying certain cargoes, when adopted and implemented in accordance with the guidelines and criteria developed by the [IMO].")

[78] *See id.*, Reg. 19.

[79] *See id.*, Reg. 4.

[80] *See* COLREGs, 1050 U.N.T.S. 16; 28 U.S.T. 3459 (Oct. 20, 1972), http://www.collisionregs.com/Collregs.html (full text, as amended). *See* IMO Webpage, COLREGs, http://www.imo.org/en/About/conventions/listofconventions/pages/colreg.aspx.

[81] *See* United Nations Treaty Series, COLREGs, No. 15824 (1972), https://treaties.un.org/pages/showDetails.aspx?objid=08000002800fcf87; IMO, Status of Treaties.

[82] *See* IMO Webpage, COLREGs.

[83] *See generally* COLREGs; IMO Webpage, COLREGs.

[84] COLREGs, Rule 10(i).

[85] *See* Polar Code, http://www.imo.org/en/MediaCentre/HotTopics/polar/Documents/POLAR%20CODE%20TEXT%20AS%20ADOPTED.pdf (full text); IMO Webpage, Polar Code, http://www.imo.org/en/mediacentre/hottopics/polar/pages/default.aspx.

[86] *See* IMO Webpage, Polar Code.

[87] PWSA, 33 U.S.C. § 1221 (emphasis added), https://www.law.cornell.edu/uscode/text/33/chapter-25. *See id.* §§ 1221-1236.

[88] *Id.* § 1222(1).

[89] CSA, S.C. 2001, c. 26 § 6(c) (emphasis added), https://www.tc.gc.ca/eng/acts-regulations/acts-2001c26.htm.

[90] AWPPA, R.S.C. 1985, c. A-12, preamble (emphasis added), http://laws-lois.justice.gc.ca/eng/acts/A-12/.

[91] *See generally* 33 U.S.C. §§ 1221-1236; 33 C.F.R. Pts. 160-169; U.S. Coast Guard Webpage, Navigation Center, https://www.navcen.uscg.gov/.

[92] *See* 33 U.S.C. § 1223(a)(1).

[93] *Id.* § 1223(a)(4).

[94] *Id*.

[95] CSA, S.C. 2001, c. 26 § 136(f).

[96] *See* COLREGs, Ch. V, Reg. 10.1; IMO-Maritime Safety Committee, *Guidance Note on the Preparation of Proposals on Ships' Routeing Systems and Ship Reporting Systems*, MSC.1-Cir. 1060, § 1.2 (Jan. 6, 2003) [hereafter "SOLAS Guidelines"], https://crewtraffic.com/page/605-msc-1-circ-1060-guidance-note-on-the-preparation-of-proposals-on-ships-routeing-systems-and-ship.html.

[97] *See* SOLAS, Ch. V, Reg. 10.1; SOLAS Guidelines § 2.1.

[98] *See generally* IMO, General Provisions on Ships' Routeing, Assembly Res. A. 572(14) § 5.3 (Nov. 20, 1985) [hereafter "IMO Ships' Routeing Guidance"], http://www.imo.org/blast/blastDataHelper.asp?data_id=22369&filename=A572(14).pdf (providing guidance regarding various types of ship routing measures).

[99] 33 C.F.R. § 167.5(b). *See generally* IMO Webpage, Ships' Routeing, http://www.imo.org/ourwork/safety/navigation/pages/shipsrouteing.aspx (listing elements used in traffic routing systems). The U.S. Coast Guard administers TSSs near the cities of Portland, Maine; Boston, Massachusetts; New York, New York; San Francisco, Los Angeles, and Long Beach, California; as well as in and around the following water bodies: Narrangansett Bay, Buzzards Bay, Delaware Bay, Chesapeake Bay, Cape Fear River, Galveston Bay, Santa Barbara Channel, Strait of San Juan de Fuca, Puget Sound, Haro Strait, Boundary Pass, Strait of Georgia, Prince William Sound, and Valdez Arm. *See* 33 C.F.R. Pt. 167, Subpt. B. Similarly, Canada oversees TSSs near the cities of Halifax, Nova Scotia and Vancouver, British Columbia, as well as the following water bodies: Chedabucto Bay, Saint Lawrence River, Gulf of Saint Lawrence, St. George's Bay, and Placentia Bay. *See generally* https://en.wikipedia.org/wiki/List_of_Traffic_Separation_Schemes.

[100] *See* Oxford Reference, Overview: Traffic Separation Schemes, http://www.oxfordreference.com/view/10.1093/oi/authority.20110803105236370.

[101] 33 C.F.R. § 167.5(c). *See* IMO Webpage, Ships' Routeing (further stating that "natural obstacles, including those forming separation zones, may constitute a boundary" of a traffic lane).

[102] *See* 33 C.F.R. § 167.5(d); IMO Webpage, Ships' Routeing.

[103] 33 C.F.R. § 167.5(g).

[104] *Id*. § 166.105(a). The U.S. Coast Guard has established fairways along the coast of Alaska, the coast of California, the Atlantic coast, and in the Gulf of Mexico. *See* 33 C.F.R., Pt. 166, Subpt. B.

[105] *Id*. § 167.5(f). *See* IMO Webpage, Ships' Routeing.

[106] SOLAS, Ch. V, Annex 5 § 1.6.

[107] *Id.*

[108] IMO Webpage, Ships' Routeing.

[109] *See, e.g.,* U.S. Coast Guard, PARS, Potential Vessel Routing Measures for Reducing Vessel (Ship) Strikes of North Atlantic Right Whales, at 13, USCG-2005-20380 (Feb. 18, 2005), https://www.greateratlantic.fisheries.noaa.gov/shipstrike/doc/PARS%20report.pdf.

[110] IMO Webpage, Ships' Routeing.

[111] *See* SOLAS, Ch. V, Reg. 10.5; SOLAS Guidelines § 3.3.

[112] *See* SOLAS Guidelines § 3.1. *See generally id.* § 2.2 (referencing IMO guidance for the details of routing system proposals).

[113] *See id.* § 3.4.1.

[114] *See id.* § 3.5.2.

[115] SOLAS, Ch. V, Reg. 10.6.

[116] *Id.*, Reg. 10.7.

[117] *See, e.g.,* IMO, SHIPS' ROUTEING (2017 ed.), http://www.imo.org/en/Publications/Pages/Home.aspx.

[118] *See* U.S. Coast Guard Webpage, Navigation Center, Local Notice to Mariners, https://www.navcen.uscg.gov/?pageName=lnmMain.

[119] *See* Canadian Coast Guard Webpage, Notices to Mariners, https://www.notmar.gc.ca/index-en.php.

[120] *See* U.S. Dept. Commerce Webpage, National Oceanic Atmos. Admin. (NOAA), U.S. Coast Pilot, https://nauticalcharts.noaa.gov/publications/coast-pilot/index.html.

[121] *See, e.g.,* NOAA Webpage, Office of Coast Survey, http://www.charts.noaa.gov/InteractiveCatalog/nrnc.shtml.

[122] 33 U.S.C. § 1223(c)(1).

[123] *Id*. § 1223(c)(1).

[124] *Id*. § 1223(c)(5)(B).

[125] *Id*. § 1223(c)(3)(A).

[126] *Id*. § 1223(c)(3)(B).

[127] *Id*. § 1223(c)(3)(C).

[128] *Id*. § 1224(a) (emphasis added).

[129] *Id*. § 1224(b). *See id.* § 1221(d).

[130] *Id*. § 1223(5)(A).

[131] *Id*. § 1223(c)(5)(D)(i) (the IMO is the "cognizant international organization" referenced in the regulation).

[132] *Id*. § 1223(c)(5)(D)(ii).

[133] 33 C.F.R. § 167.5(a). *See* IMO Webpage, Ships' Routeing.

[134] IMO, *Revised Guidelines for the Identification and Designation of Particularly Sensitive Sea Areas*, Assembly Res. A.982(24) § 1.2 (Dec. 1, 2005) [hereafter "IMO PSSA Guidelines"], www.imo.org/blast/blastDataHelper.asp?data_id=14373&filename=982.pdf. *See* IMO Webpage, PSSA, http://www.imo.org/en/OurWork/Environment/PSSAs/Pages/Default.aspx.

[135] IMO PSSA Guidelines, §§ 1.2, 6. *See* IMO Webpage, PSSA.

[136] *See* IMO PSSA Guidelines, § 4.4.

[137] *See id.* §§ 4.4.1–4.4.11 (listing ecological criteria).

[138] *See id.* §§ 4.4.12–4.4.14 (listing social, cultural, and economic criteria).

[139] *See id.* § 4.4.15 (listing scientific and educational criteria).

[140] *See id.* § 5.1.

[141] *See id.* §§ 5.1.1—5.1.4 (listing vessel traffic characteristics).

[142] *See id.* §§ 5.1.5–5.1.7 (listing natural factors).

[143] *See id.* §§ 5.2.2, 5.2.4 (referring to other information that could be used).

[144] *See id.* §§ 3, 7. *See also id.* §§ 8 (assessment criteria).

[145] *See id.* § 3.1.

[146] *See id.* § 8.5.

[147] *See* IMO Webpage, PSSA (listing currently designated PSSAs).

[148] 33 C.F.R. § 167.5(e). *See* IMO Webpage, Ships' Routeing. http://www.imo.org/en/OurWork/Safety/Navigation/Pages/ShipsRouteing.aspx 33 C.F.R.

[149] *See* IMO Ships' Routeing Guidance § 5.3 (containing diagrams illustrating the various uses of a precautionary area designation).

[150] 33 C.F.R. § 165.10.

[151] *Id.* § 165.11. RNAs, along with safety and security zones, are established under the authority of the PWSA. *See id.* § 165.9(b). U.S. Coast Guard District Commanders and Captains of the Port have been delegated authority to establish RNAs, safety zones, and security zones. *See* 33 C.F.R. § 160.5. Permanent RNAs, safety zones, and security zones are typically designated through the federal notice-and-comment rulemaking process, but temporary designations can be made effective immediately in emergency circumstances. *See* U.S. Coast Guard, Marine Safety Manual, Vol. VI, Commandant Instruction M16000.11, Vol. VI, at 1-43 to 1-45 [hereafter "Marine Safety Manual"], https://media.defense.gov/2018/Feb/12/2001876540/-1/-1/0/CIM_16000_11.PDF.

[152] *See generally* 33 C.F.R., Pt. 165, Subpt. F.

[153] Marine Safety Manual, at 1-45.

[154] *Id.*

[155] *Id.*

[156] *See* 33 C.F.R. § 165.100.

[157] *Id*. § 165.20.

[158] *Id*.

[159] *See id*. § 165.33.

[160] *See generally id.,* Pt. 165, Subpt. F.

[161] *See generally id.*

[162] *Id*. § 165.30.

[163] *Id*. § 165.33.

[164] *See generally id.,* Pt. 165, Subpt. F.

[165] *See infra* Part III(A).

[166] See U.S. Coast Guard Webpage, Navigation Center, History of Vessel Traffic Services, https://www.navcen.uscg.gov/?pageName=vtsHistory.

[167] SOLAS, Ch. V, Reg. 12.

[168] *See* IMO Webpage, Vessel Traffic Services, www.imo.org/OurWork/Safety/Navigation/Pages/VesselTrafficServices.aspx.

[169] IMO, Guidelines for Vessel Traffic Services, Res. A.857(20), Annex 1 § 1.1 (Nov. 27, 1997) [hereafter "IMO VTS Guidelines"], http://www.maritime-vts.co.uk/A857.pdf.

[170] *Id*.

[171] *See* SOLAS, Ch. V, Reg. 12.3.

[172] *See id.*, Reg. 12.5

[173] *See id*., Regs. 12.2, 12.3, 12.5.

[174] *See* IMO VTS Guidelines, Annex 1 § 3.2.2.

[175] *Id.* § 2.2.1.

[176] *Id*.

[177] SOLAS, Ch. V, Reg. 12.4.

[178] 33 U.S.C. § 1223(a)(1).

[179] 33 C.F.R. § 161.2 (emphasis added). *See id.* § 160.5(d) (granting VTS personnel broad authority to, *inter alia*, "take other action necessary for control of the vessel and the safety of the port or of the marine environment") (emphasis added).

[180] *Id.* § 161.2.

[181] *Id.*

[182] *Id.*

[183] *Id.*

[184] *Id.* For more detailed information regarding vessel reporting and tracking systems and their role in protecting the marine environment, *see* E. Barrett Ristroph, The Wilderness Society, *Study of Ship Communications Systems and Recommendations for a Bering Sea Communications System*, Chs. 5-7 (Nov. 19, 2012).

[185] 33 C.F.R. § 161.2.

[186] *Id.*

[187] *See* 33 U.S.C. § 1223(a)(3).

[188] *See* 33 C.F.R. § 161.3.

[189] *See id.* § 161.2.

[190] *See id.*

[191] *Id.* § 161.10(a)-(k) (emphasis added).

[192] *Id.* § 161.11 (emphasis added).

[193] *See id.* § 161.3.

[194] *Id.* § 161.12(a), (c).

[195] *Id.* § 161.12(a), (b).

[196] *Id.* § 161.12(c).

[197] *See id.* § 161.3.

[198] *See id*. § 161.12(d).

[199] *See id*. § 161.16.

[200] *See id*. § 161.19.

[201] *See id*. §§ 161.20, .21.

[202] *See id*. § 161.22.

[203] *Id*. § 161.11(a) (emphasis added).

[204] *See id.*

[205] *Id*. § 161.11(b).

[206] *See generally id.*, Pt. 161; Marine Safety Manual, at 1-45 to 1-46.

[207] *Id*. § 161.13(a).

[208] *Id*. § 161.13(b).

[209] *See id*. § 161.2.

[210] *See id*. § 161.4.

[211] *See* 33 U.S.C. §§ 1228(a)(4), 1232(e); 33 C.F.R. § 160.107.

[212] *See* 33 C.F.R., Pt. 161, Subpt. C; U.S. Coast Guard Webpage, Navigation Center, VTS, https://www.navcen.uscg.gov/?pageName=vtsMain.

[213] CSA, S.C. 2001, c. 26 § 136.

[214] *See* VTS Zones Regulations, SOR/89-98, http://laws-lois.justice.gc.ca/eng/regulations/SOR-89-98/page-1.html#h-1; Canadian Coast Guard Webpage, MCTS, http://www.ccg-gcc.gc.ca/Marine-Communications/Home.

[215] *See* Canadian Coast Guard Webpage, MCTS; Fisheries and Oceans Canada, *Evaluation of the Marine Communications and Traffic Services (MCTS) Program*, Final Report (Mar. 2, 2017) (discussing consolidation of 22 centers into 12), http://www.dfo-mpo.gc.ca/ae-ve/evaluations/16-17/6B185-eng.html#ch2.2.

[216] *See* MARPOL (Nov. 2, 1973), 34 U.S.T. 3407; 1340 U.N.T.S. 184 (1973), as amended by Protocol Relating to MARPOL, 17 I.L.M. 546 (Feb. 16, 1978) [hereafter "MARPOL 1973/1978"], https://treaties.un.org/doc/Publication/UNTS/Volume%201340/volume-1340-A-22484-English.pdf (full text).

[217] *See* IMO, Status of Treaties; United Nations Treaty Series, MARPOL, No. 22484 (1978), https://treaties.un.org/pages/showDetails.aspx?objid=0800000280291139.

[218] *See* IMO Webpage, MARPOL, http://www.imo.org/en/About/Conventions/ListOfConventions/Pages/International-Convention-for-the-Prevention-of-Pollution-from-Ships-%28MARPOL%29.aspx.

[219] *See* MARPOL 1973/1978; IMO Webpage, MARPOL.

[220] *See* IMO, Status of Treaties.

[221] *See* MARPOL 1973/1978, Annexes I and II; IMO, *Guidelines for the Designation of Special Areas Under MARPOL 73/78 and Guidelines for the Identification and Designation of Particularly Sensitive Sea Areas*, Assembly Res. A.927(22) § 2.1 (Nov. 29, 2001) [hereafter "MARPOL Special Area Guidelines"], http://www.imo.org/blast/blastDataHelper.asp?data_id=10469&filename=927.pdf; IMO Webpage, Special Areas Under MARPOL, http://www.imo.org/en/OurWork/Environment/SpecialAreasUnderMARPOL/Pages/Default.aspx.

[222] *See* IMO Webpage, Polar Code.

[223] APPS, 33 U.S.C. §§ 1901-1913, https://www.law.cornell.edu/uscode/text/33/chapter-33.

[224] *See id.* § 1903.

[225] *See* Transport Canada Webpage, Marine Acts and Regulations, https://www.tc.gc.ca/eng/marinesafety/tp-tp14609-2-marine-acts-regulations-617.htm.

[226] AWPPA, R.S.C. 1985, c. A-12.

[227] *See supra* notes 57, 63, and accompanying text.

[228] IMO Webpage, Construction Requirements for Oil Tankers – Double Hulls, http://www.imo.org/en/OurWork/Environment/PollutionPrevention/OilPollution/Pages/constructionrequirements.aspx.

[229] See MARPOL, Annex I, Ch. 9, Reg. 43, http://www.imo.org/blast/blastData.asp?doc_id=13198&filename=189%2860%29.pdf; IMO Webpage, Polar Code.

[230] IMO Webpage, MARPOL.

[231] *See* OPRC, London-England, 30 I.L.M. 733 (Nov. 30, 1990), https://treaties.un.org/doc/Publication/UNTS/Volume%201891/volume-1891-I-32194-English.pdf (full text); IMO Webpage, OPRC, http://www.imo.org/en/About/Conventions/ListOfConventions/Pages/International-Convention-on-Oil-Pollution-Preparedness,-Response-and-Co-operation-(OPRC).aspx.

[232] *See* IMO, Status of Treaties.

[233] *See* IMO Webpage, OPRC.

[234] *See id*.

[235] *See* MOPPRA; Arctic Council Webpage, Agreements, https://arctic-council.org/index.php/en/our-work/agreements; Arctic Council, *Ratification completed for agreement on oil pollution preparedness and response* (June 6, 2016, updated Mar. 23, 2017), https://www.arctic-council.org/en/our-work2/8-news-and-events/401-mospa-ratification.

[236] *See generally* MOPPRA.

[237] *See* Polar Code, Part II §§ 1.1.1, 2.1.1.

[238] *Id.* § 1.2.

[239] The Maritime Executive, *IMO Moves Towards Ban on HFO in the Arctic* (April 13, 2018), https://www.maritime-executive.com/article/imo-moves-towards-ban-on-hfo-in-the-arctic#gs.8iF6lD8.

[240] *See id.*; U. Einemo, Int'l Bunker Industry Ass'n, *IMO takes first step toward Arctic HFO ban, but first needs to define 'HFO'* (April 26, 2018), http://ibia.net/imo-takes-first-step-toward-arctic-hfo-ban-but-first-needs-to-define-hfo/.

[241] 33 U.S.C. §§ 2701-2762, https://www.law.cornell.edu/uscode/text/33/chapter-40; 33 C.F.R., Part 155.

[242] 33 U.S.C. § 1902(a)(2).

[243] *See* CSA, S.C. 2001, c. 26, pts. 8, 9; MLA, S.C. 2001, c. 6, http://laws-lois.justice.gc.ca/eng/acts/M-0.7/.

[244] *See* AWPPA, R.S.C., 1985, c. A-12; Arctic Shipping Safety and Pollution Prevention Regulations, SOR/2017-286, http://laws-lois.justice.gc.ca/eng/regulations/SOR-2017-286/index.html;

[245] *See* Dutch News, *Major clean-up in Rotterdam port after 200 tonnes of heavy fuel oil are leaked* (June 25, 2018), https://www.dutchnews.nl/news/2018/06/major-clean-up-in-rotterdam-port-after-220-tonnes-of-heavy-fuel-oil-are-leaked/.

[246] *See supra* notes 57, 63, and accompanying text (explaining that coastal states generally may not impose requirements concerning the "design, construction, manning or equipment of foreign ships unless they are giving effect to generally accepted international rules or standards").

[247] UNCLOS, Art. 1(1)(4) (emphasis added).

[248] *See* J. Firestone, et al, *Response and Responsibility: Regulating Noise Pollution in the Marine Environment*, 10 J. INT'L WILDLIFE LAW POL. 109, at 124-127 (2007), https://www.tandfonline.com/doi/abs/10.1080/13880290701347408.

[249] *See id.*

[250] MARPOL, Preamble.

[251] *See* Animal Welfare Inst. Webpage, Ocean Noise, https://awionline.org/content/ocean-noise.

[252] *See id.*; IMO Webpage, Ship Noise, http://www.imo.org/en/MediaCentre/HotTopics/Pages/Noise.aspx.

[253] *See* E. Kleverlaan, IMO-MED, Presentation, *IMO and its role in protecting the marine environment in the Mediterranean Sea*, at 53 (Dec. 2016), http://www.medmpaforum.org/sites/default/files/pres.fsob3a_kleverlaan_0.pdf.

[254] IMO-MEPC, Guidelines for the Reduction of Underwater Noise from Commercial Shipping to Address Adverse Impacts on Marine Life, MEPC.1/Circ.833, Gothenburg-Sweden (July 30, 2014) [hereafter "IMO Noise Guidelines"], http://www.ascobans.org/sites/default/files/document/AC21_Inf_3.2.1_IMO_NoiseGuidelines.pdf.

[255] IMO Noise Guidelines, Annex § 1.1.

[256] *See id.* §§ 2.1-2.2.

[257] *See id.* § 3.1.

[258] *See id.* § 3.2.

[259] *See id.* §§ 5.1-5.3.

[260] *See id.* §§ 6.1-6.3.

[261] *See id.* §§ 7.1-7.3.

[262] Kleverlaan, IMO and Its Role, at 54.

[263] *See supra* notes 57, 63, and accompanying text.

[264] *Id.*, Art. 21.

[265] *See* IMO Webpage, Ballast Water Management, http://www.imo.org/en/OurWork/Environment/BallastWaterManagement/Pages/Default.aspx.

[266] *See id.*

[267] *See* IMO Webpage, Invasive Aquatic Species (IAS), http://www.imo.org/en/OurWork/Environment/BallastWaterManagement/Pages/AquaticInvasiveSpecies%28AIS%29.aspx.

[268] *See* IMO Webpage, Ballast Water Management; Ballast Water Convention, 30 I.L.M. 1455 (Feb. 13, 2004), http://library.arcticportal.org/1913/1/International%20Convention%20for%20the%20Control%20and%20Management%20of%20Ships%27%20Ballast%20Water%20and%20Sediments.pdf.

[269] *See* IMO, Status of Treaties.

[270] *See* IMO Webpage, BWM Convention and Guidelines, http://www.imo.org/en/OurWork/Environment/BallastWaterManagement/Pages/BWMConventionandGuidelines.aspx; IMO Webpage, International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM), http://www.imo.org/en/About/Conventions/ListOfConventions/Pages/International-Convention-for-the-Control-and-Management-of-Ships'-Ballast-Water-and-Sediments-(BWM).aspx.

[271] *See* IMO Webpage, International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM).

[272] *See* IMO Webpage, Ballast Water Management.

[273] *See* IMO Webpage, Prevention of Pollution by Sewage from Ships, http://www.imo.org/en/OurWork/Environment/PollutionPrevention/Sewage/Pages/Default.aspx.

[274] *See id.*

[275] *See id.*

[276] *See id.*

[277] *See* IMO, Press Briefing, *Polar Code environmental provisions adopted* (May 15, 2015), http://www.imo.org/en/MediaCentre/PressBriefings/Pages/18-Polar-Code-MEPC.aspx.

[278] *See* IMO Webpage, Prevention of Pollution by Garbage from Ships, http://www.imo.org/en/OurWork/Environment/PollutionPrevention/Garbage/Pages/Default.aspx.

[279] *See, e.g.,* Alumniportal Deutschland Webpage, *Micro particles – major threat: Microplastics in the Oceans* (July 2017), https://www.alumniportal-deutschland.org/en/global-goals/sdg-14-ocean/microplastics-oceans/#c19930.

[280] *See* IMO Webpage, Prevention of Pollution by Garbage from Ships.

[281] *See id*.

[282] *See* IMO, Press Briefing, Polar Code.

[283] *See* IMO Webpage, Prevention of Air Pollution from Ships, http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Pages/Air-Pollution.aspx.

[284] *See id.*

[285] *See supra* note 221.

[286] MARPOL, Annex I, Reg. 1(10), Annex II, Reg. 1(7); Annex V, Reg. 1(3) (each providing a similar definition of "special area"). *See* MARPOL Special Area Guidelines, Annex 1 § 2.1; IMO Webpage, Special Areas under MARPOL.

[287] *See* MARPOL Special Area Guidelines, Annex 1 § 2.4.

[288] *See id.* § 2.5.

[289] *See id.* § 2.6.

[290] *See id.* §§ 2.3, 2.8-2.10.

[291] *See id.* § 3.

[292] For instance, starting in 2009, the Contracting Parties of the Helsinki Commission (Denmark, Estonia, European Union, Finland, Germany, Latvia, Lithuania, Poland, Russia, and Sweden) jointly proposed the designation of the Baltic Sea as a special area for sewage discharges from passenger ships. The IMO approved the proposal in 2011, and the decision entered into force in 2013. *See* Helsinki Comm'n, Summary Leaflet, *Ships' Sewage in the Baltic Sea: New Special Area Regulations*, http://www.helcom.fi/action-areas/shipping/sewage-from-ships/.

[293] *See* MARPOL Special Area Guidelines, Annex 1 § 2.7.

[294] *See* IMO Webpage, Special Areas Under MARPOL.

[295] *See* MARPOL Annex I, Reg. 15; 33 C.F.R. § 151.13 (oil).

[296] *See* MARPOL, Annex II, Reg. 13; 33 C.F.R. § 151.32 (noxious liquids).

[297] *See* MARPOL, Annex V, Reg. 5(2)(a); 33 C.F.R. § 151.53 (garbage).

[298] See MARPOL, Annex V, Reg. 5(2)(b); 33 C.F.R. § 151.71.

[299] *See* Hauser, Vulnerability of Arctic Marine Mammals, *supra* note 9.

[300] NOAA Fisheries Webpage, North Atlantic Right Whale, https://www.fisheries.noaa.gov/species/north-atlantic-right-whale.

[301] *See id.*

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[303] *See* SOLAS, Annex, Ch. V, Reg. 11; 33 C.F.R, Part 169, Subpart B; U.S. Coast Guard, Mandatory Ship Reporting Ship Systems, Final Rule, 66 Fed. Reg. 58066 (Nov. 20, 2001); NOAA Fisheries Webpage, Reducing Ship Strikes to North Atlantic Right Whales, https://www.fisheries.noaa.gov/national/endangered-species-conservation/reducing-ship-strikes-north-atlantic-right-whales.

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[308] *See id.*

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[318] *See* NOAA, Press Release, New iPad, iPhone App.

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[320] *See* P.B. Conn, et al, *Vessel speed restrictions reduce risk of collision-related mortality for North Atlantic right whales*, 4 ECOSPHERE (April 3, 2013), https://doi.org/10.1890/ES13-00004.1.

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[323] *See id.*

[324] *See* Channel Islands National Marine Sanctuary (NMS) Advisory Council, Marine Shipping Working Group, Final Report, at 7 (Mar. 16, 2016) [hereafter "Channel Islands NMS Final Report"], https://nmschannelislands.blob.core.windows.net/channelislands-prod/media/archive/sac/pdfs/mswg_final_report_may2016.pdf; Gulf of the Farallones and Cordell Bank NMSs Advisory Councils, Report of Joint Working Group, at 5 (June 2012) [hereafter "Joint NMS Final Report"], https://nmscordellbank.blob.core.windows.net/cordellbank-prod/media/archive/protect/report_shipstrike_2012_jwg.pdf.

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[354] PARS, Appx. A.

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[443] *See* 33 C.F.R. §§ 167.1300-167.1332.

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