

Examining Different Approaches to Managing Arctic Shipping in Canada through a Corridors Approach: Global Case Studies



Photo Credit: Dr. Luke Copland

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2019

ESPG 
Environment, Society
and Policy Group

Recommended Citation

Reid, M. B., and Dawson, J. (2019). Examining different approaches to managing shipping through a corridors approach: global case studies. Ottawa: University of Ottawa.

Acknowledgements

This report is a product of a larger study titled: ‘Developing Co-Management and Decision-Making Processes for Arctic Shipping Risks in Nunavut’. The research project was funded by Nunavut Research Institute (Nunavut Arctic College) and Irving Shipbuilding. Other organizations that provided support for the proposal include MEOPAR, Department of Fisheries and Oceans, Canadian Coast Guard, Oceans North, and the Mattimatalik Hunters and Trappers Organization. Support for this research from these organizations is gratefully acknowledged. Thank you to Alison Cook for the digital cartography created for use throughout this report.

Data Management

Metadata for the larger study has been permanently housed in the Polar Data Catalogue and can be found here: <https://www.polardata.ca/> Polar Data Catalogue is a database of metadata and data that describes, indexes, and provides access to diverse data sets generated by Arctic and Antarctic researchers. The metadata records follow ISO 19115 and Federal Geographic Data Committee (FGDC) standard formats to facilitate exchange with other data centres.



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Executive Summary

Case studies of different approaches to managing shipping reviewed in this report include, [1](#)) the Beaufort Sea Large Ocean Management Area (LOMA), [2](#)) the Bering Strait Two-Way Shipping Routes, [3](#)) the Imappivut Marine Management Plan, [4](#)) the Indigenous Community Boat Volunteer Pilot Program (ICBVPP), [5](#)) the Pacific North Coast Integrated Management Area (PNCIMA), [6](#)) the Great Lakes - St. Lawrence Seaway System, [7](#)) the Newfoundland and Labrador (NFL) Port Readiness Program, [8](#)) the Panama Canal, [9](#)) the Torres Strait & Great Barrier Reef (GBR) Region, and [10](#)) the Malacca & Singapore Straits. “Key findings and strengths” as well as “Areas for improvement” for each approach are described using themes that emerged during the literature and information review process, and included: *Shipping operations, Marine Safety, Training, Economic opportunities, Marine environment protection, and Technology and information.*

Some *key findings and strengths* that emerged most prominently throughout the analysis of multiple case studies were related to; traffic lanes, voluntary routing measures and shipping corridors; use of aids to navigation; emergency, operational and/or environmental response training; subsistence activities that support local economies; protected and/or significant areas and resources; and use of AIS, GPS, GIS and/or VTS to improve navigational safety and/or support research. Some *Areas for improvement* that emerged among the examples were related to; outdated infrastructure, and lack of research and Indigenous community involvement; lack of aids to navigation and inadequate boundaries for SAR; outdated response training; poor marketing scheme; and insufficient oil spill response.

Introduction

Over a 26-year period, marine traffic through the Canadian Arctic has increased substantially in Inuit Nunangat (Dawson et al. 2018). From 1990-2015, the total distance of vessels travelling through Nunavut waters had more than doubled (Dawson et al., 2017). Currently, there is no formal institutional arrangement for marine governance and decision-making to help manage this increase (Wang, 2017), but there are a mix of players, including various federal departments, Inuit government agencies, regional Inuit organizations, institutions of public governance, and industry. There are also several initiatives being implemented to help manage this increase by supporting the establishment of a system of low-impact shipping corridors, including; the Northern Marine Transportation Corridors (NMTC) (Chénier et al., 2017); the Integrated Arctic Corridors Framework (Pew Charitable Trusts, 2016); the Arctic Corridors and Northern Voices project (ACNV) (Carter et al., 2017a, b, 2018a, b, c, d, e, f, g, h and Greydanus et al., 2018), and multiple initiatives being planned within the Oceans Protection Plan (Government of Canada, 2019). Low-impact shipping corridors have been defined as maritime areas that contain marine transportation information and services in support of economic development, community re-supply, safety, and environmental protection (Leyzack, Chénier, & Hinds, 2014) and, which are designed to have as little impact on the environment as possible (Chénier et al., 2017).

The objective of this report was to conduct a review of global case studies to identify key areas of strength as well as areas identified for improvement based on existing marine shipping management approaches that seem relevant to a 'low impact corridors' framework. The results from this study offer a basic understanding of how marine shipping management is conducted in existing Canadian and international cases, which can ultimately serve as a guide for partners and decision-makers in the Canadian Arctic in the establishment of an appropriate management approach for marine shipping through Arctic waters.

The report includes ten case studies that include examples of marine shipping management plans, established shipping areas, shipping through key straits, the use of key routes, and management programs. Each case is consistently described under the subtitles; *key findings and strengths*, and *Areas for improvement* that emerged in various themes throughout the literature review process. Introductory information to each case is provided in a *Context of shipping management approach* section. This is followed by the *themes related to the case*, and a *Partners decision-makers* sections that includes an inventory of relevant parties involved in the management approach named in the literature used to conduct the review.

At the end of the report is a summary table (See Table 1) of the *Key findings and strengths* and *Areas for improvement* for each marine shipping management approach listed by case. The following guide lists and cross-references the themes, *Key findings and strengths*, *Areas for improvement* and sub-categories related to the themes throughout the report. Number references correspond to the case studies analyzed.

Shipping operations

Key findings and strengths

- Right of navigation¹ and resource extraction³;
- Traffic lanes^{2, 8, 10}, (voluntary) routing measures^{2, 5, 10}, and shipping corridors^{1, 2};
- Port systems and services^{5, 6, 7, 9, 10};
- Resource provision/resupply^{1, 2, 4};
- Vessel types^{2, 5, 9} and speed limits⁶.

Areas for improvement

- Outdated infrastructure^{6, 7};
- Governance issues^{6, 10};
- Lack of research regarding consequences of shipping and mechanisms to deal with them with Indigenous community engagement⁹;

Marine Safety

Key findings and strengths

- National defense and public safety operations^{1, 5, 6};
- Recommendations for safer navigation²;
- Aids to navigation^{9, 10};
- Search and rescue operations^{3, 4};
- Safety system suited to local needs^{3, 4};
- Vessel design^{5, 6} and ship inspections^{6, 9};
- Responses to marine threats (i.e. piracy)¹⁰.

Areas for improvement

- No existing aids to navigation²;
- Inadequate boundaries for effective SAR⁵;
- Inadequate services and infrastructure for safe navigation⁸;
- Uncharted hazards⁹;
- Insufficient awareness to threats¹⁰.

Training

Key findings and strengths

- Emergency and/or environmental response training^{4, 5, 9};
- Operational training^{4, 6, 8};
- Programs to increase Indigenous participation in the marine sector^{4, 9};
- Training program to combat maritime threats¹⁰;
- Cruise tourism management training⁷.

Areas for improvement

- Insufficient/outdated oil spill^{1, 9} and pollution response training¹⁰.

Economic opportunities

Key findings and strengths

- Careers in the marine sector^{4, 6, 8, 9};
- Subsistence activities^{2, 5, 9, 10};
- Resource industries (i.e. oil operations and fisheries)^{1, 5, 2, 9};
- Marine tourism^{1, 3, 7};
- Tolls⁸ and fines^{6, 8};
- Government funding^{4, 8, 9};
- Revenue from local shipping operations¹⁰.

Areas for improvement

- Poor marketing scheme^{6, 7}; and
- Lack of guaranteed local economic benefits⁷.

Marine environmental protection

Key findings and strengths

- Protected and/or significant areas and resources (i.e. MPAs, EBSAs...)^{1, 2, 3, 5, 6, 8, 9};
- Oil spill^{8, 10} and pollution response systems^{6, 8, 10};
- International conservation targets³;
- Regulations on ballast water discharge^{6, 9};
- Invasive species prevention and mitigation⁹.

Areas for improvement

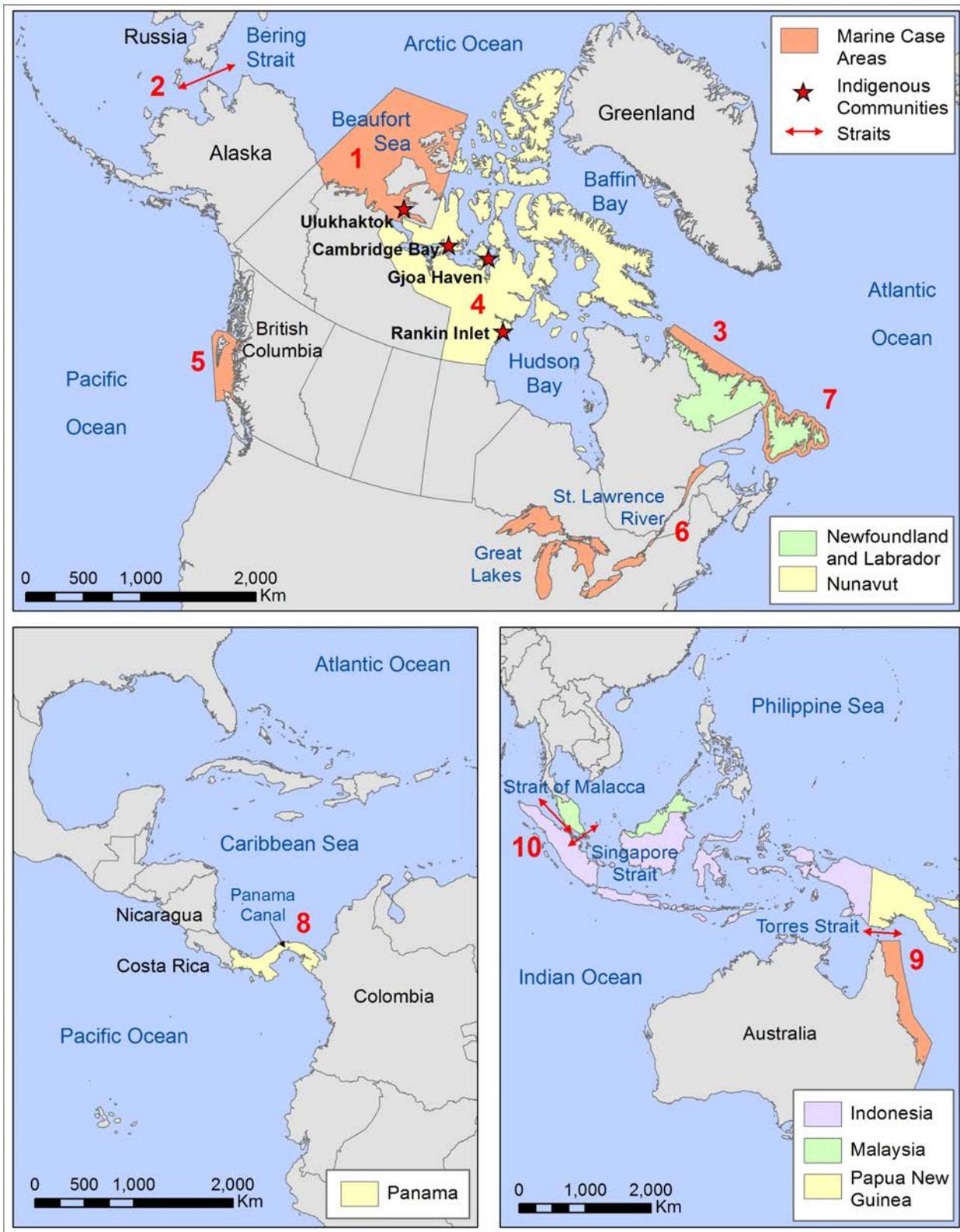
- Insufficient oil spill response systems^{1, 2, 5, 9};
- Insufficient discharge regulations²;
- Lack of strategies to protect natural/cultural resources⁷.

Technology and information

Key findings and strengths

- AIS^{2, 6, 9}; GPS²; GIS⁸; VTS^{8, 9, 10};
- Hydrographic survey data²;
- Internet communication technologies⁷;
- Meteorological ocean sensors⁹;
- SAR equipment and technology^{4, 5}.

Map 1. Different Approaches to Managing Arctic Shipping: Map of Global Case Studies



Methods

Determining which cases to include in the report and how to develop the themes involved a scoping review process, meaning there were no restrictions placed on the types of materials information was drawn from (Creative Commons Attribution 4.0, 2018). This method was deemed appropriate as there is not yet an existing body of literature that has been comprehensively reviewed on the topic of marine shipping management approaches; and the vast, complex nature of the topic was conceived to be less susceptible to a more systematic review process (Peters, Godfrey and Khalil et al., 2015). Keeping with the broad and inclusive nature of the method; criteria for deciding which cases to review was kept simple; cases could exist within Canada or be international; must include a marine shipping management regime or framework with potentially transferable attributes to the developing a management approach for shipping corridors in the Canadian Arctic. Cases with strong Indigenous community engagement, partnership and/or leadership were prioritized for review.

Establishing themes and identifying sub-categories was both an emergent and iterative process (Frels, 2016). Themes were developed as they emerged in the literature while information as being gathered, and were continuously revisited and refined throughout the entire review process. Sub-categories were established by condensing and simplifying information related to the themes. There has been some work that explores how to evaluate marine shipping management arrangements (see Wang, 2017), but the lack of an existing body of literature related to the subject combined with its complexity and multitude of players involved provided a challenge for establishing what constitutes a *Strength* versus an *Area for improvement* (see Table 1). In order to remain as objective as possible, these aspects of the cases were decided based on whether the function in question (or lack thereof) was described as a positive or negative attribute towards the management approach described within the literature.

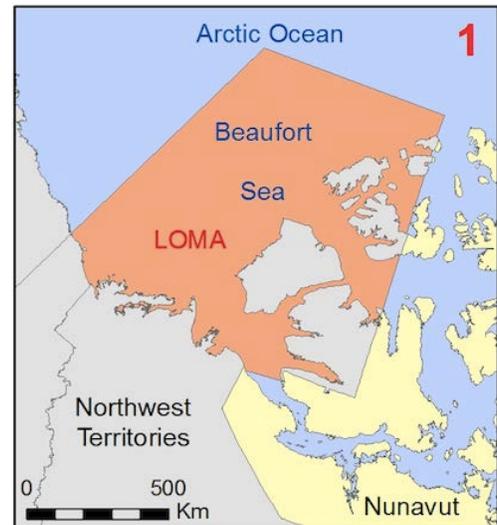
It should be noted that the objective of this paper is not to act as a cumulative account of all functions of the management approaches discussed in this report, but rather a summary of “highlights” reflected in the literature. Most of the cases are not described using every single theme; e.g. there is no information for *Training* under the St. Lawrence Seaway case. This is not meant to indicate there are no training programs or opportunities involved in the system; rather that, during the review process other themes emerged much more prevalently, and those were given priority when deciding what information to include in the report. Finally, this report is also not intended to be prescriptive and does not provide recommendations, but rather outlines relevant observations that may be used by decision makers, stakeholders, and rights holders involved in Arctic shipping governance in Canada.

1. Beaufort Sea Large Ocean Management Area (LOMA)

Beaufort Sea; Mackenzie Delta; Yukon North Slope; Arctic Islands, Canada. Status: Existing

Context of shipping management approach

Large Ocean Management Areas (LOMA's) initiated by DFO aim to implement the Integrated Management (IM) pillar of the Oceans Act as a collaborative planning process. The Beaufort Sea LOMA includes the marine portion of the Inuvialuit Settlement Region (ISR) (DFO, 2017a). The Beaufort Sea Partnership (BSP) uses the Oceans Action Plan and Inuvialuit Final Agreement (IFA) as a framework for collaboration within a regional governance partnership that employs traditional and scientific knowledge-based planning, adaptive management, and ecosystem-based planning for all marine activities (BSP, 2018).



Shipping operations

- Public right of navigation for shipping through the Beaufort Sea LOMA during the ice-free season (Cobb et al., 2008).
- Shipping through Mackenzie Delta/along Arctic coasts provide community resupply, hydrocarbon activity support and transport (ibid).
- Seafloor bathymetry in shallow water dictates location of the corridors, and shipping routes/dates are guided by ice regimes (ibid).

Marine safety

- Shipping through Mackenzie Delta/along Arctic coasts provides safety/military functions (ibid).

Training

- Local communities in need of updated incident response plans and capabilities (Thomson, 2018).

Economic opportunities

- Many locals work as tour operators, guide fishing/hunting trips as marine tourism increases with less ice cover (Cobb et al., 2008).
- Communities rely on marine shipping/sea lift operations for resource industries; oil/gas exploration and gravel/sand extraction (SCEWG, 2009).

Marine environment protection

- **Marine Protected Areas** - Tarium Niryutait, Anguniaqvia niqiqyum (DFO, 2017a).
- **EBSA's** – ten EBSA's identified by scientists and community members (Cobb et al., 2008).
- Canadian Beaufort Sea Fisheries Management Plan (BSFMP) protects 800,000+ km² of the LOMA from large-scale commercial fisheries (Pew Charitable Trusts, 2014).
- Community re-supply ships can carry up to 18,000 tons of fuel oil, Mary River Mine tankers carry up to 4,500 tons, but the largest response equipment only recovers 1000 tons (Mirbach, 2017).

Partners and decision makers

- Beaufort Sea Regional Coordinating Committee (RCC) – Inuvialuit Regional Corporation (IRC); Inuvialuit Game Council (IGC); Fisheries Joint Management Committee (FJMC); Yukon Government; Government of the Northwest Territories; DFO; Natural Resources Canada; TC; Environment Canada; PC; Indian and Northern Affairs Canada (Cobb et al., 2008).
- BSP – advises RCC: Federal/territorial agencies, OAP Signatories, municipalities, Inuvialuit Councils, land claims Councils/Committees (BSP, 2018).
- BSFMP - DFO, FJMC, IRC, IGC, board of federal/Inuvialuit reps, (Cobb et al., 2008)
- Communities - Paulatuk, Tuktoyaktuk, Sachs Harbour, Aklavik, Inuvik, Ulukhaktok (ibid).

2. The Bering Strait U.S. and Russian Two-Way Shipping Routes

Chukotskiy Peninsula, Russia and Alaska, U.S. Status: Existing

Context of shipping management approach

The 6 two-way shipping routes and 6 precautionary areas are the first internationally recognized routing measures approved by the IMO for polar waters, proposed by the U.S. and Russian Federation in response to increased traffic through the Bering Strait (Midgett, 2018). The U.S. coordinated the proposal with Federal State, appropriate foreign State agencies and federally recognized Tribes and Tribal organizations (NCSR, 2017), such as Kawerak Inc., representing 20 Alaskan Native Villages in the region (Joling, 2018).



Shipping operations

- Measures are meant to be voluntarily applied to ships of 400+ gross tonnage, domestic and international (NCSR, 2017) to ensure no obstructions (Joling, 2018).
- The eastern Bering Sea along Alaska's coast is shallow (average depths from 6-75m), so the lanes ensure depths of at least 18.3m (ibid).
- Routes/precautionary areas allow for bi-directional traffic, suitable for ships of all types/sizes, afford more navigational space than a traffic separation scheme for ships that need to avoid ice but remain within a properly surveyed navigation corridor (NCSR, 2018).
- Traffic includes oil operations; resupply of diesel/commodities to Alaskan villages; transporting ore from Arctic mines to North American/Asian markets (USGC, 2013).

Marine safety

- Recommendations help ships avoid shoals, reefs and islands (Ham, 2018), improve monitoring and allow more time for intervention if a ship breaks down (NCSR, 2018).
- No existing aids to navigation associated with the routing measures (ibid).

Training

- Adoption of Polar Code standards for training ships operating in harsher waters (Medearis, 2018).

Economic opportunities

- Routes will not limit access to areas for commercial fishing or subsistence activities (NCSR, 2018)

Marine environment protection

- IMO declared areas to be avoided (ATBA) around the Nunivak, Saint Lawrence and King Islands (Kawerak Inc., 2018).
- Themes from workshops by Kawerak's Marine Program: no discharge in ancestral waters; concern for impacts of a spill; shipping does not impact marine wildlife. IMO did not address discharge or oil spill preparedness but routing measures and ATBA's should mitigate impacts to wildlife (ibid).
- Concerns over lack of resources prepared to respond to an oil spill (Joling, 2018).

Technology and information

- Routing measures are within GPS (NAVSTAR and GLONASS) and AIS coverage (NCSR, 2017).
- Boundaries and traffic patterns are based on hydrographic survey and AIS data (NCSR, 2018).

Partners and decision makers

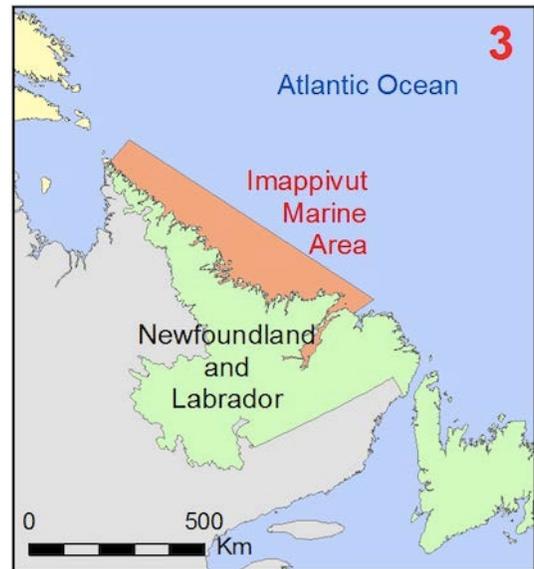
- United States, Russian Federation, other user State agencies, community residents of coastal Alaska, Kawerak Inc.

3. Imappivut Marine Management Plan

Labrador Sea and Nunatsiavut waters, Canada. Status: Existing

Context of shipping management approach

Led by the Nunatsiavut Government in partnership with the Government of Canada, the Imappivut project is an integrated marine plan for the waters covered by the Labrador Inuit Land Claims Agreement. It will focus on gathering knowledge to identify areas, uses and activities of ecological, social, cultural and economic importance to Labrador Inuit (Imappivut, 2018). Stakeholders “have signed a Statement of Intent that would see the governments working together cooperatively towards an integrated vision for the marine waters of northern Labrador... that will recognize and respect Labrador Inuit rights and interests”. The Statement ensures the marine zone under the Labrador Inuit Land Claims Agreement is protected and developed sustainably (PC, 2017).



Shipping operations

- Under the Agreement, right to develop/extract resources are within federal jurisdiction; however, the Canadian Gov't must consult the Nunatsiavut Gov't before development of minerals in the marine zone, including any marine transportation (Barker, 2018).
- The plan should act as a means for Labrador Inuit to engage in management of the region as potential for oil and gas exploration in the Arctic incites an increase in shipping through the marine zone (Bisset, 2018) and address community concerns (Sevunts, 2017).

Marine safety

- In support of the Plan, CCG is leading risk-based analysis of maritime search and rescue delivery (RAMSARD) to understand maritime risks and SAR capacity of the Labrador coast (DFO, 2018).
- CCG will be acquisitioned 4 SAR lifeboats to further enhance capabilities (DFO and CCG, 2017).

Economic opportunities

- Imappivut considers which areas are best suited for tourism to promote economic growth based on input from Elders and other regular users (Lesperance, 2017).

Marine environment protection

- The project ensures Inuit interests are at the forefront of decision-making while contributing to achieving Canada's international marine conservation targets (Imappivut, 2018).
- To maintain healthy oceans coastal communities, the Governments intend to explore new solutions such as the Indigenous Protected Areas initiative (PC, 2017).
- Imappivut may also initiate work on potential national marine conservation area of Torngat Mountains National Park (ibid).
- Government and community collaboration to protect portion of the coastline and MPA's (ibid).

Technology and information

- Internet and social media used to update partners and provide forums for input (Barker, 2018).

Partners and decision makers

- Governments of Canada and Nunatsiavut, Dep't of Environment and Climate Change, Parks Canada, DFO, and the CCG (PC, 2017). Oceans North has supported research and local engagement (Sevunts, 2017).

4. Indigenous Community Boat Volunteer Pilot Program (ICBVPP)

Gjoa Haven; Cambridge Bay; Rankin Inlet; Nunavut; Ulukhaktok, Canada. Status: In progress

Context of shipping management approach

The Indigenous Community Boat Volunteer Program (ICBVPP) is a platform for partnership between the Government of Canada and Indigenous communities. The Government is working to improve marine safety and responsible shipping by providing \$1 million in funds to four Arctic communities to buy search and rescue boats. The ICBVPP is a four-year program, after which the Coast Guard will identify with communities which are interested in participating in the future (DFO, CAR, 2018).

Shipping operations

- The program aims to ensure that communities who possess knowledge of local waters and are historically first responders to marine incidents have the tools required to respond to emergencies and be recognized with a formal role in the marine SAR system (ibid).

Marine safety

- Aims to establish a world-leading marine safety system suited to needs of locals (ibid).
- Canadian Coast Guard Auxiliary (CCGA) SAR operations will be improved through development of an Arctic in-shore rescue boat station (Minister of Fisheries, Oceans and CCG, 2017).

Training

- Program aims increase Indigenous participation in the marine sector through completion of Indigenous Community Response training and expansion of CCGA membership in the Arctic (ibid).
- The CCG College will continue to implement training initiatives to improve efficiency, safety and ability of crew members to respond to emergencies (ibid).
- To meet new Polar Code Training Requirements, the College will test a new Ice Management Simulator, as well as train new Officers, personnel and other partners in ice operations (ibid).
- Individuals training to work at a rescue boat station learn how to coordinate with the joint rescue center, aircrafts and other ships (CBC, 2017), as well as safe boat handling, marine first aid, radio communications, search patterns and CCG operations (CBC, 2018).

Economic opportunities

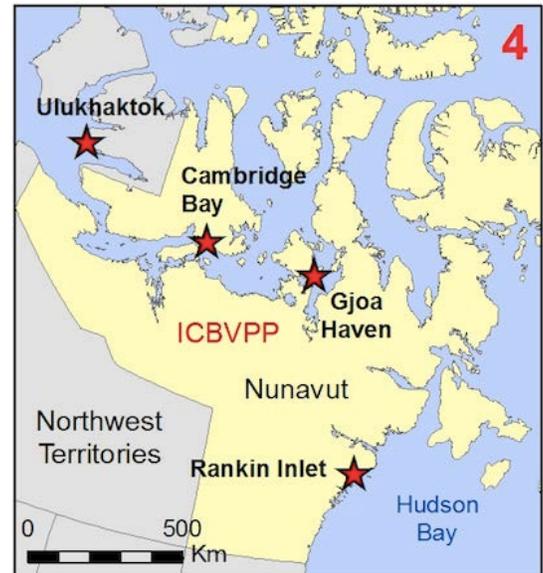
- Indigenous Community Boat Pilot Program allows communities to apply for funding for SAR equipment. To apply, communities must be part of a CCGA unit or in the process of becoming one (Cyprien, 2018).
- In 2017, the CCG held an information session at the High Arctic Research Station in Nunavut to recruit 8 Inuit or Inuvialuit students (6 crew members and 2 back-ups) to work at the first rescue boat station. Candidates had to be enrolled in a post-secondary institution, and would work in two-week rotations (CBC, 2017).

Technology and information

- SAR boats, equipment and technology meet the Canadian Coast Guard Auxiliary and Transport Canada standards (Fisheries and Oceans Central and Arctic Region, 2018).

Partners and decision makers

- Government of Canada, DFO, GGC, communities: Gjoa Haven, Cambridge Bay, Rankin Inlet, Nunavut and Ulukhaktok (Fisheries and DFOceans Central & Arctic Region, 2018).

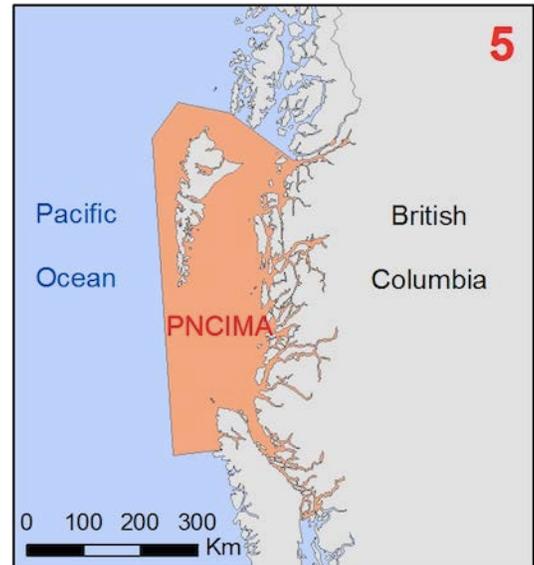


5. Pacific North Coast Integrated Management Area (PNCIMA)

BC Coast, Canada. Status: Existing

Context of shipping management approach

The PNCIMA is one of five LOMA's in Canada's Oceans Action Plan, 2005 (PNCIMA, 2017) directed by First Nations leaders and federal/provincial staff through the Collaborative Governance MOU and PNCIMA Steering. It contains the Gwaii Haanas Islands in Haida managed cooperatively by the Government of Canada and Council of the Haida Nation through the Archipelago Management Board (AMB, 2010b). PNCIMA is a joint federal-provincial-First Nation planning framework for conservation and management of human activities (DFO, 2017b).



Shipping operations

- Four deep-sea ports in BC handle large portion of western provinces' marine exports (LOS, 2011).
- Constant vessel traffic through Inside Passage Route (cruise ships, tankers, tugs, barges, fishing).
- Great Circle Route passes near the Gwaii Haanas, but is the shortest distance between Asian Pacific Rim ports and the west coast of North America (ibid), for which there is a Voluntary Tanker Exclusion Zone (TEZ) (OSTF, 2002).

Marine safety

- Trans-Alaska Pipeline System (TAPS) tankers are built with two systems (two engines, screws, rudders) to reduce risk of both systems disabling (Reid, 2008).
- TEZ considers risk of disabled tankers grounding; fishing boat/tanker collisions; industry's interest to keep boundary near shore; position tankers are predicted to ground before a tug arrives. Parts of the boundary fall short of distance required for a tug to arrive in severe weather (OSTF, 2002).
- Research, monitoring, enforcement, national defense, public safety activities (PNCIMA, 2017).

Economic opportunities

- Subsistence activities; commercial fisheries; cruise ship tourism; marine mining (ibid).

Training

- Starting in BC, Indigenous Community Response Teams will be trained with CCG to support SAR missions, environmental response, and incident management (TC, 2016).

Marine environment protection

- **Marine Protected Areas** - Endeavor, SGaan Kinghlas-Bowie Seamount, Hecate Strait/Charlotte Sound Glass Sponge Reefs (DFO, 2017b). Disturbance is prohibited unless approved by the Minister; must align with the *Shipping Act, '01*; no anchoring in protected zone (Oceans Act, 2017).
- Contains the Gwaii Haanas Marine Area, Gwaii Haanas National Marine Conservation Area Reserve, Haida Heritage Site and two PC Natural Marine Regions (AMB, 2010b).
- No dedicated rescue tug (OSTF, 2002); Response Organizations (RO) collect fees from Responsible Parties to clean up to 1K tons of oil. Ship owners do not have to hire RO's (Reid, 2008), and there can be delays between dispatch and cleanup (LOS, 2011).

Partners and decision makers

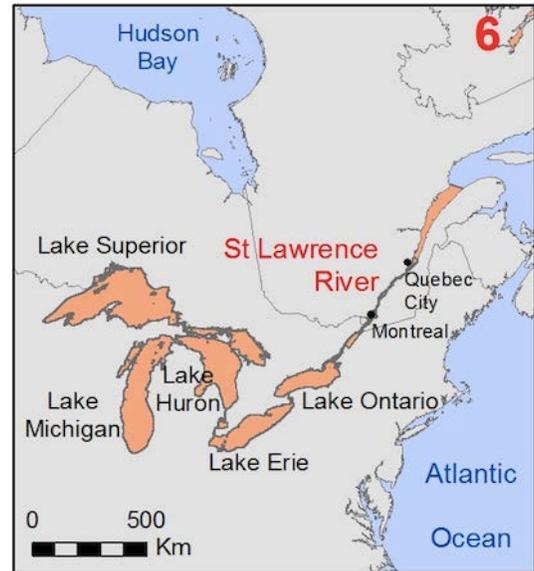
- DFO, CCG, Legislative Assembly for West Vancouver Sea-to-Sky, BC's Minister of Forests, Lands and Natural Resource Operations, Gitxaala Nation Fisheries, North Coast Skeena First Nations Stewardship Society, Haida Gwaii, North Coast and Central Coast First Nations, members of PNCIMA Collaborative Governance MOU, PC (PNCIMA, 2017), Council of the Haida Nation.

6. The Great Lakes - St. Lawrence Seaway System

Montreal, Canada to Lake Erie and New York State, U.S. Status: Existing

Context of shipping management approach

The St. Lawrence Seaway is bi-nationally co-managed by the St. Lawrence Seaway Mgmt Corp. (SLSMC), that is responsible for Canadian facilities; and the Saint Lawrence Seaway Dvlp't Corp. (SLSDC), agency of the U.S. Dep't of Transportation, who coordinate management of regulations, traffic and operational activities (Seaway Corps., 2018). The Mohawk Council of Akwesasne approved a \$45M settlement for damages caused by the Seaway, and reclaimed ownership of expropriated lands (Hale, 2018). The St. Lawrence River Area of Concern (AOC) is divided by the international border, and reaches the Saint Regis Mohawk Tribe (U. S.), and the Mohawk Council of Akwesasne (Canada) (Saint Regis Mohawk Tribe, n. a.).



Shipping operations

- In 2017, the gov't ordered a 10-knot speed limit to protect right whales (National Post, 2017).
- Challenges of disjointed governance; lack of regulatory/operational harmonization (MTSS, 2016).
- Physical features of the seaway limit vessel size, combined with outdated infrastructure (ibid).

Marine safety

- Matters of law enforcement or national security are decided by the RCMP or Dep't of National Defense (English et al., 2014).
- TC and the US Coast Guard (USCG) monitor and enforce IMO standards of vessel design and operations. Ships are subject to inspections and certification oversight (ibid).

Training

- Mariners must receive specialized training and licensing by government authorities (ibid).
- Training, support initiatives and orientation programs offered to new graduates, as well as ongoing professional development opportunities (St. Lawrence Mgmt. Corp., n.a.).

Economic opportunities

- Careers: mariners, lock operators, longshoremen, vessel agents, freight forwarders, ship handlers, shipyard workers, stevedores, terminal operators, Coast Guard personnel... (Seaway Corps., 2018)
- Non-compliant ships of the speed limit (above) were subject to a \$25K fine (National Post, 2017).
- Costs and inefficiencies result in decreased competitiveness, and lack of mechanism to take advantage of private capital (U.S.) (MTSS, 2016).

Marine environment protection

- AOC was declared "environmentally degraded" by 14 Beneficial Use Impairments (Saint Regis Mohawk Tribe, n. a.).
- Ships from Atlantic to Canadian ports (vice-versa) must exchange ballast 320km from shore in seas 200m deep. Ships without ballast must flush their tanks with saltwater (Seaway Corps., 2018)
- The Canada-US Joint Marine Pollution Contingency Plan includes preparedness, response and local level planning (English et al., 2014).

Technology and information

- Required integrated AIS system (ibid).

Partners and decision makers

- SLSDC, SLSMC, Saint Regis Mohawk Tribe, Mohawk Council of Akwesasne, TC, CCG, USCG.

7. Newfoundland and Labrador Port Readiness Program

Coast of Newfoundland and Labrador, Canada. Status: Existing

Context of shipping management approach

The Port Readiness Program (PRP) is a provincial initiative with ties in Europe and New Zealand (Intervale, 2005), managed by the Cruise Association of Newfoundland and Labrador (CANAL), org. of cruise industry development (Hull and Losekoot, 2012), with administrative assistance from Intervale Associates (Intervale, 2005). The PRP provides ports with needs assessments, a training manual, workshops and a marketing program to strengthen transatlantic links (Intervale, 2016), and encourages ports to have cruise committees to work alongside CANAL/cruise lines (Hull and Losekoot, 2012)

Shipping operations

- PRP supports provincial ports in managing increasing numbers of passengers; improve service to cruise lines; increase cruise ship calls to ports (Hull et al., 2005).
- Good service provisions, easy access to ports (Hull and Losekoot, 2012).
- Outdated docking facilities (limited size/capacity), and lack of port services (ibid).

Training

- 300+ partners in 18 workshops underwent training on the organization of cruise tourism; success factors; and a checklist for hosting cruise ships (ibid).
- Workshops aim to improve excursions, services, infrastructure, and transport (Hull et al., 2005)
- The Port Readiness Manual provides information related to cruise industry development and a guide on hosting cruise ships designed for cruise committees, municipal governments, port authorities, tour operators, retail operators and tourism operators (Intervale, 2005).

Economic opportunities

- PRP aims to inform local communities of revenue opportunities (Hull et al., 2005).
- Small coastal communities outside St. John's are popular with (and benefit from) adventure expedition cruises (Newfoundland and Labrador Heritage, 2011).
- Local attractions (natural, cultural and recreational) are well-developed, but how local economic benefits can be assured is still a question (Hull and Losekoot, 2012).
- Lack of marketing support (ibid).

Marine environment protection

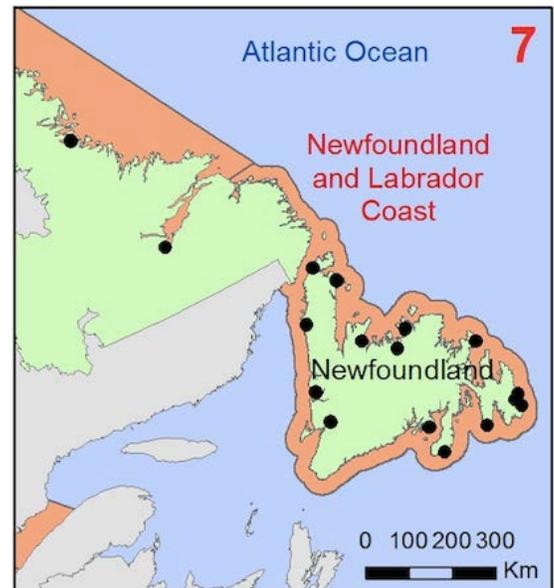
- Need for integrated coastal management strategies that promote collaborative decision-making, development and protection of areas/resources in ports of call (Stewart and Draper, 2006).
- How natural/cultural resources will be protected remains a question (Hull and Losekoot, 2012)

Technology and information

- Intervale and the New Zealand Tourism Research Institute (NZTRI) worked to facilitate internet communication technologies for sustainable tourism practices (web audit of the Atlantic Outdoor Adventure Partnership (AOAP); online Needs Assessment for CANAL) (Intervale, 2016).

Partners and decision makers

- CANAL, Atlantic Canada Opportunities Agency, Human Resources and Skills Development Canada, Northern Coastal Experience, NZTRI, Destination St. John's, Parks Canada, Hospitality Newfoundland and Labrador, Intervale Associates Inc. (Intervale, 2005).



8. The Panama Canal

Bay of Panama to Limón Bay, Panama. Status: Existing

Context of shipping management approach

The Panama Canal and Panama Canal Watershed (PCW) are managed by the Panama Canal Authority (ACP) (Llácer, 2005); an autonomous agency of the Panamanian Government (Canal de Panamá, 2018). The ACP has exclusive charge of operation, administration, maintenance and modernization of the Canal that is legally and financially autonomous with its own patrimony and right to administer it (National Assembly, 1997).

Shipping operations

- The Neopanamax Locks expansion is 70ft wider and 18ft deeper; it added a third lane which doubled cargo capacity; increased slot capacity and the maximum allowed ship beam and draft (Canal de Panamá, 2018).

Marine safety

- Safety concerns related to new locks eliminating electronic locomotives tethered to ships to help tug boats guide them through the Canal (Buschschluter, 2015). In 2018, tug captains refused to guide ships due to the reduced number of crew members on tug boats they believed endangered the safety of crews and the Canal (World Maritime News, 2018).

Training

- The PCC developed training and education programs in maritime specialties (MIPPE, 1990).
- Around \$10 million/yr is spent on training programs for operation of the Canal (ACP, 2017).

Economic opportunities

- Toll system meets IMO guidelines and allows ACP to control toll policies despite possible changes to the International Convention on Tonnage Measurement of Ships (Llácer, 2005)
- The toll considers total ship volume and whether the ship is laden or in ballast (ACP, 2015).
- National Panamanians now comprise over 95% of the Canal's workforce (ACP, 2017).
- Vessels who do not submit a Panama Canal Shipboard Oil Pollution Emergency Plan (PCSOPEP) within 96 hours of arrival must pay minimum \$2,500 to transit (Adimar Shipping, 2018).

Marine environment protection

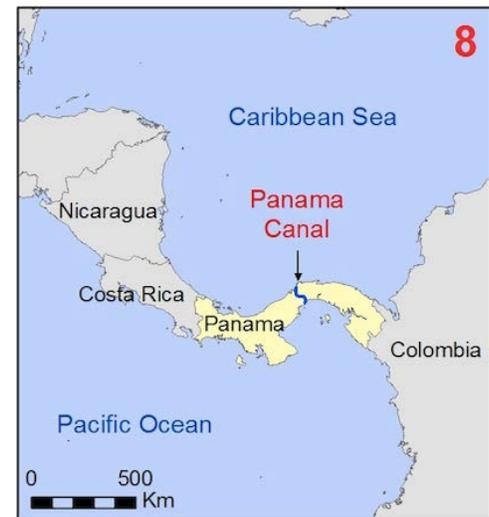
- Since 2016, the Canal has recycled 60% of water used per transit; aims to reduce 160M tons of CO₂ emissions in the next decade (Canal de Panamá, 2018)
- Local communities' subsistence methods pressure the PCW' natural resources, so the ACP and National Environment Authority (ANAM) set up an Inter-Institutional Canal Watershed Commission (CICH) for locals to participate in decisions concerning the PCW. 3 sub-watersheds have been chosen for projects proposed by local residents (WBCSD, 2005).
- The PCSOPEP implements emergency provisions for vessels of 400MT carrying capacity. If an oil spill occurs, vessels activate their response plan and notify the ACP (Adimar Shipping, 2018).

Technology and information

- GIS system monitors land use changes; a methodological report computes carbon sequestration; a system of indicators measures progress (Tetra Tech, 2018).
- Enhanced VTS for live view of the Canal integrates vessel tracking with maritime operations database information (ACP, 2017).

Partners and decision makers

- Gov't of Panama, ACP, ANAM, PCW Conservation Restoration Fund, local PCW communities, Tetra Tech, US Gov't, US Agency for Int'l Development.



9. Torres Strait and the Great Barrier Reef Region

Coastal Queensland, AU and Papua New Guinea. Status: Existing

Context of shipping management approach

The bilateral Torres Strait Treaty, 1985 that covers the Australia-Papua New Guinea (PNG) border and the Torres Strait Protected Zone, recognizes local traditional ways of life, protects flora/fauna, and allows for traditional visitation between Torres Strait and PNG inhabitants. As the Strait is an international shipping route, in recognition of environmental risks, it is classified as a Particularly Sensitive Sea Area (PSSA) by the IMO. Most of the sea/seabed is under the Torres Strait Regional Sea Claim and 20+ Registered Native Title Bodies Corporate (NESMG, 2014).

Shipping operations

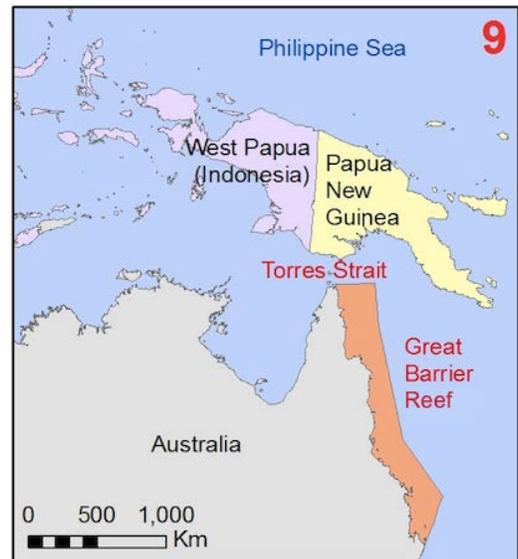
- Department of Agriculture and Water Resources regulates movement of all vessels from the Torres Strait under the *Biosecurity Act 2015* (Commonwealth of Australia, 2018).
- Operating a vessel over 7m long in the Torres Strait protected zone or Torres Strait permanent biosecurity zone must be reported to the Dep't of Agriculture and Water Resources (ibid).
- Queensland Regional Harbour Masters (RHM) manage movement of ships within pilotage areas through five Port VTS centers. Ships cannot move within the pilotage areas without communicating with the VTS center (NESMG, 2014).
- Port pilotage is regulated by Maritime Safety Queensland (MSQ), and coastal pilotage in the GBR has been compulsory since 1991 (ibid).
- Due to PSSA status, shipping is managed under internationally agreed upon measures (pilotage and ship reporting requirements, routing measures, Vessel Traffic Services) (ibid).
- Research is needed on consequences of shipping operations in the region, and mechanisms for managing them must be improved with more engagement from Indigenous communities (ibid).

Marine safety

- Australian Maritime Safety Authority (AMSA) provides aids to navigation (fixed, floating, visual, electronic) and a coastal Vessel Traffic Service (VTS) (ibid).
- The Strait is generally shallow and contains numerous uncharted hazardous shoals (ibid).
- Australian Transport Safety Bureau (ATSB) undertakes “no blame” safety investigations to establish causes of accidents (ibid).

Training

- The Torres Strait Land and Sea Ranger Project has 13 Ranger groups (TSRA, 2016b), trained with other community response personnel under the Queensland Coastal Contingency Action Plan (QCCAP) in oil spill response (this training needs updating) (NESGM, 2014).
- The North-East Shipping Mgmt. Group (NESMG) trains Indigenous communities in SAR, maritime safety and pollution response through the GBR Marine Park Authority-led Indigenous Response Partnership and Indigenous Reef Advisory Committees (IRAC) (ibid).
- Torres Strait Maritime Pathways Project (TSMPP) enhances skills of Islander and Aboriginal people to operate commercial vessels and create maritime career pathways by completing Shipboard Safety Skill Set training, and Certificate II in Maritime Operations (TSRA, 2016a).



Economic opportunities

- The Torres Strait Land and Sea Ranger Project has provided 45 positions in 14 communities funded by the Working on Country element of the Australian Gov'ts Caring for our Country Program by the Torres Strait Regional Authority (TSRA) (TSRA, 2016b).
- Commonwealth Scientific and Industrial Research Organization (CSIRO) work with PNG community members, and the PNG and Australian Fisheries Authorities to support the local fisheries they depend on for sustenance and income (CSIRO, 2018).
- Torres Strait Islanders inhabit the 17 islands and rely on local marine resources, island gardens and trade with PNG villages (TSRA, 2016b).

Marine environment protection

- Under MARPOL it is prohibited to discharge more than 12 nautical miles from “nearest land” (seaward of the outer reef), but no controls on greywater discharges (NESGM, 2014).
- Dep't of Agriculture administers the Quarantine Act, 1908, and monitors, assesses and manages quarantine risk of vessels, crew, pests, and ballast water for all international vessels (ibid).
- 3 Indigenous Protected Areas in the region, managed/monitored by local Rangers (TSRA, 2014).
- Capacity to respond to a large oil spill is limited, coupled with regions remoteness, complex currents and reef systems (Waterhouse et al., 2013).
- National System for Prevention and Management of Marine Pest Incursions prevents arrival of pests, guide responses, and minimize impacts (NESGM, 2014).
- The Environment Protection (Sea Dumping) Act, 1981 regulates loading and dumping of waste at sea to protect Australia's coastlines. The GBRMPA can issue Sea Dumping permissions (ibid).
- The GBR is declared a PSSA by the IMO (ibid).

Technology and information

- 4 coastal monitoring stations with radar, CCTV and AIS. AMSA and MSQ installed AIS stations in the GRB, Torres Strait and locations of high risk and volume, as well as the GBR and Torres Strait Vessel Traffic Service (REEFVTS) that provides information such as reports on position, identity and intentions of other traffic, weather and hazards to ships to assist their on-board decision-making process through a traffic image of vessels transiting the area (ibid).
- Meteorological-ocean sensors measure tidal and wave heights and tide streams, Supporting tools: under-keel clearance management (UKCM) system (ibid).

Partners and decision makers

- Gov't of Australia, PNG, Torres Strait Islanders, NMSA, Torres Strait Land and Sea Rangers, TSRA, IRAC, CSIRO, Marine Pest Sectoral Committee, NESMG (AMSA, GBRMPA, MSQ, Dep'ts of Infrastructure, Environment, Industry, and Agriculture).

10. The Malacca and Singapore Straits

Indonesia, Malaysia, Singapore. Status: Existing

Context of shipping management approach

The Malacca and Singapore Straits are collaboratively managed by Indonesia, Malaysia, and Singapore (littoral states) through the Cooperative Mechanism (CM), developed with the IMO to work with user states (IRGC, 2011). CM is composed of the Cooperative Forum (for dialogue between littoral/user states); Project Coordination Committee (implements programs) and Aids to Navigation Fund (Ho, 2009).

Shipping operations

- Traffic Separation Scheme divides west and eastbound traffic lanes (IRGC, 2011)
- 5 major international ports, smaller ports and ferry terminals (Gerke and Evers, 2016).
- Governance issues related to unequal responsibility sharing among littoral/user states and partners (IRGC, 2015).

Marine safety

- Insufficient awareness to new threats and inadequacy of early warning systems. CM addressed some of these issues (piracy, oil spills) but must be strengthened (IRGC, 2015).
- Through the Malacca Strait Council, Japan has been installing navigation beacons (Ho, 2009).

Training

- New training is needed to deal with risks involved with increased amount of hazardous materials being transported through the Straits (The Nippon Foundation, 2014).
- Maritime and Port Authority of Singapore; Japanese Ministry of Foreign Affairs and ReCAAP training program for maritime officers to combat piracy and armed robbery (Abdullah, 2017).

Economic opportunities

- Local shipping has increased as ferries transit between Malaysia and Indonesia with local goods in a network of formal/informal relations (Gerke and Evers, 2016).
- Singapore enjoys greater economic benefits of the Straits than Malaysia and Indonesia who feel the expense and burden more (The Nippon Foundation, 2014).

Marine environment protection

- Maritime and Port Authority (MPA) oil spill contingency plan is ready for emergencies in Singapore (IRGC, 2015). The East Asia Response Private Limited (EARL) handles major spills (Pyburn, 2010).
- National Oil Spill Contingency Plan (NOSCP) is integrated with the Oil Spill Contingency Plan for the South China Sea (SCSCP). Petroleum Industry of Malaysia Mutual Aid Group (PIMMAG) enables the oil industry to provide support (Rahmat & Yusof, 1999).

Technology and information

- Mandatory ship reporting system STRAITREP, Marine Electronic Highway and VTS (monitor ship movements and communication between ports and ships) developed by TTEG (IRGC, 2011).

Partners and decision makers

- Gov'ts of Indonesia, Malaysia and Singapore, Indigenous communities, TTEG, committees implementing CM, Malacca Strait Council, IMO, Int'l Chamber of Shipping, Int'l Chamber of Commerce, Int'l Maritime Bureau, Int'l Association of Independent Tanker Owners (INTERTANKO), Int'l Tanker Owners Pollution Federation, AsiaPacific Economic Cooperation, Association of Southeast Asian Nations (ASEAN), the Federation of ASEAN Ship-Owners Associations, Information Sharing Centre of ReCAAP (IRGC, 2015).

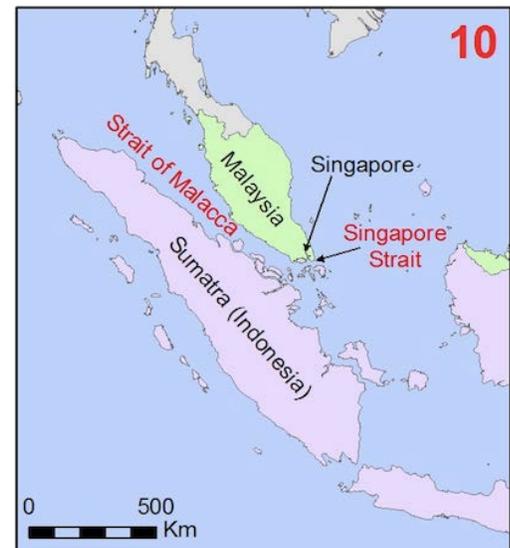


Table 1. Summary of Key Findings and Strengths and Areas for Improvement

Existing Systems	Key Findings Strengths	Areas for Improvement
Beaufort Sea Large Ocean Management Area	<ul style="list-style-type: none"> • Public right of navigation during ice-free season • Resource provision/resupply, hydrocarbon support, transport • Seafloor bathymetry dictates location of corridors • National defense and public safety operations conducted along the Mackenzie Delta and Arctic Coasts • Resource industries including oil/gas exploration, gravel/sand extraction • Locals work as tour operators and guides • Protected and/or significant areas and resources include 2 MPA's, 3 EBSA's, and protection against large-scale fishing industries 	<ul style="list-style-type: none"> • Insufficient/outdated oil spill and incident response planning and training • Insufficient oil spill response systems considering quantities of oil tankers transport through the Strait
Bering Strait U.S. and Russian Two-Way Shipping Routes	<ul style="list-style-type: none"> • Traffic lanes, voluntary routing measures and corridors ensure no obstructions and allow for bi-directional traffic • Resource provision/resupply to Alaskan villages • Recommendations for safer navigation, improved monitoring, and more time for intervention in the event a vessel breaks down • Subsistence activity areas will not be limited by shipping routes • Resource industries (ie. commercial fisheries) will also not be limited by routes • Protected and/or significant areas and resources include precautionary areas and ATBA's • Routing measures exist within AIS and GPS coverage • Hydrographic survey data dictates boundaries and traffic patterns 	<ul style="list-style-type: none"> • No existing aids to navigation associated with routes • Oil spill response and discharge regulation concerns were not addressed
Imappivut Marine Management Plan	<ul style="list-style-type: none"> • Right to resource extraction exists under federal jurisdiction, with permission from Nunatsiavut Gov't and engagement with Labrador Inuit • Search and rescue operations (RAMSARD) and equipment from CCG • Safety system suited to local needs, understand risks and SAR capacity of Labrador coast • Marine tourism areas based on input from Elders • Protected and/or significant areas and resources include potential marine conservation area(s) and development of MPA's • Contribute to International conservation targets while prioritizing Inuit interests 	

<p><u>Indigenous Community Boat Volunteer Pilot Program</u></p>	<ul style="list-style-type: none"> • Resource provision/resupply of SAR equipment to ensure communities can respond to emergencies and hold a formal role in SAR system • Search and rescue operations including rescue boat station • Safety system suited to local needs of communities • Emergency and/or environmental response training provided • Operational training with joint rescue center, aircraft and CCG operations • Programs to increase Indigenous participation in the marine sector through training and CCGA Arctic membership • Government funding via applying for SAR equipment • Careers in the marine sector for Indigenous students 	
<p><u>Pacific North Coast Integrated Management Area</u></p>	<ul style="list-style-type: none"> • Voluntary routing measures for tankers transiting near the Gwaii Haanas • Port systems and services handle large portion of marine exports from western provinces • Vessel types that pass through IPR and GCR Routes • Vessel design involves two systems to reduce likelihood of breakdowns • National defense and public safety operations are conducted along the coast • Area supports subsistence activities and harvesting of marine resources • Resource industries such as commercial fishing marine mining contribute to economic development • Marine tourism, specifically cruise ship tourism contributes to economic development • Emergency and/or environmental response training with CCG to support SAR missions is offered • Protected and/or significant areas and resources include 3 MPA's, Gwaii Haanas Islands • SAR equipment and technology meet CCGA and TC standards 	<ul style="list-style-type: none"> • Inadequate boundaries for effective SAR in severe weather conditions • Insufficient oil spill response systems due to lack of dedicated tug barge in BC
<p><u>The Great Lakes - St. Lawrence Seaway System</u></p>	<ul style="list-style-type: none"> • Port systems and services are bi-nationally co-managed (U.S. and Canada) • Speed limits have been set in order to protect right whales • Vessel design mandated by IMO standards and enforced by TC and USCG • Standards require regular ship inspections and certification oversight • National defense, public safety operations and law enforcement are conducted by RCMP or DND • Operational training; specialized training for mariners, as well as many programs available to graduate students • Offer vast numbers of careers in the marine sector 	<ul style="list-style-type: none"> • Governance issues related to harmonizing regulatory and operational functions • Outdated infrastructure and various physical features limit vessel size • Poor marketing scheme results lack of competitiveness

	<ul style="list-style-type: none"> • Ships are subject to fines who do not obey speed limits • Protected and/or significant areas and resources include the AOC • Pollution response systems include local level planning • Regulations on ballast water discharge for vessels traveling from Atlantic to Canadian ports (and vice-versa) • Use of AIS to improve navigation 	
<u>Newfoundland and Labrador Port Readiness Program</u>	<ul style="list-style-type: none"> • Port systems and services support in management cruise industry development • Cruise tourism management training, workshops, and an information manual provided to parts of call • Marine tourism with respect to informing locals of revenue opportunities, adventure cruises, local attractions contributes to economic development • Use of Internet communication technologies for sustainable tourism practices 	<ul style="list-style-type: none"> • Outdated infrastructure, limited size/capacity of docking facilities • Poor marketing scheme • Lack of guaranteed local economic benefits • Lack of strategies to protect natural/cultural resources in ports of call
<u>The Panama Canal</u>	<ul style="list-style-type: none"> • Traffic lanes locks expansion doubled cargo capacity, slot capacity, and increased maximum beam and draft of ships allowed • Operational training programs in maritime specialties are offered • Toll system meets IMO guidelines and still allows ACP to control policies • Vessels are subject to fines who do not submit a compliant PCSOPEP • Many careers in the marine sector available to national Panamanians • Government funding provided for training programs • Protected and/or significant areas and resources programs in collaboration with local communities on projects to protect the Panama Canal Watershed • Oil spill and pollution response systems are implemented by the PCSOPEP • Use of GIS and VTS to monitor land-use changes and maritime operations 	<ul style="list-style-type: none"> • Inadequate services and infrastructure for safe navigation due to too much responsibility placed on tug boat captains to guide ships through the Canal
<u>Torres Strait and the Great Barrier Reef Region</u>	<ul style="list-style-type: none"> • Routing measures imposed by PSSA status related to pilotage • Regulations on various vessel types transiting protected or biosecurity zones • Port systems and services, pilotage areas and requirements • Aids to navigation provided by AMSA • Ship inspections/investigations aimed at establishing causes of accidents • Emergency and/or environmental response training related to SAR and pollution response • Programs to increase Indigenous participation in the marine sector involve enhancing skills of Islander and Aboriginal people to operate commercial vessels • Subsistence activities such as local fisheries and trade are supported and contribute to economic development • Resource industries (i.e. oil operations and fisheries) 	<ul style="list-style-type: none"> • Lack of research regarding consequences of shipping and mechanisms to deal with them with more Indigenous community engagement needed • There are uncharted hazards such as shoals in shallow waters • Outdated oil spill response training • Insufficient oil spill response systems

	<ul style="list-style-type: none"> • Government funding provides careers in the marine sector through the Torres Strait Land and Sea Ranger Project • Protected and/or significant areas and resources include 3 IPA's, and the GBR (declared a PSSA by the IMO) • Regulations on ballast water discharge and dumping of waste at sea • Invasive species prevention and mitigation; prevents arrival, guides responses, minimizes impacts of invasive species • Use of AIS and VTS to assist on-board decision-making • Meteorological ocean sensors measure tidal wave heights and tide streams 	
<p><u>The Malacca and Singapore Straits</u></p>	<ul style="list-style-type: none"> • Traffic lanes segregate west and eastbound traffic • Port systems, services and smaller ferry terminals support international and local transport • Aids to navigation installed by Japan • Responses to marine threats (piracy, oil spills) addressed by CM • Offers training program to combat maritime threats for maritime enforcement officers • Subsistence activities such as harvesting local goods to trade with PNG villages supports economic development • Revenue from local shipping operations; network of formal/informal trade relations supports local economy • Oil spill and pollution response systems are established in Malaysia, Singapore and the South China sea • Use of VTS to monitor ship movements and enhance communication; as well as the mandatory reporting system STRAITREP 	<ul style="list-style-type: none"> • Governance issues related to unequal responsibility sharing and distribution of economic benefits • Insufficient awareness to threats and inadequacy of early warning signs; CM needs strengthening • Insufficient pollution response training to deal with increasing amounts of hazardous materials being transported through the Straits

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