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Canada's Arctic Marine Science Policy

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1. Introduction

The marine environment in the Canadian Arctic changes dramatically from the east to the west, where the vast archipelagic area is to be found (the Canadian Arctic Archipelago, equivalent to one-sixth[1] of the total area of the Arctic Ocean and surrounding seas). For example, seawater from the Pacific Ocean flows into the Beaufort Sea and moves clockwise along with the Beaufort Gyre. Some of the Arctic Ocean's surface water flows westward past the Arctic Archipelago, mixing with freshwater originally from glaciers and rivers on land. This water eventually reaches Baffin Bay, where it joins the cold Greenland Current and flows southward into the Atlantic Ocean. In the Canadian Arctic Ocean, the ecosystem shows variations in the different regions (Figure 1). Therefore, Canada's marine environmental management policy includes many bottom-up initiatives focusing on local areas.

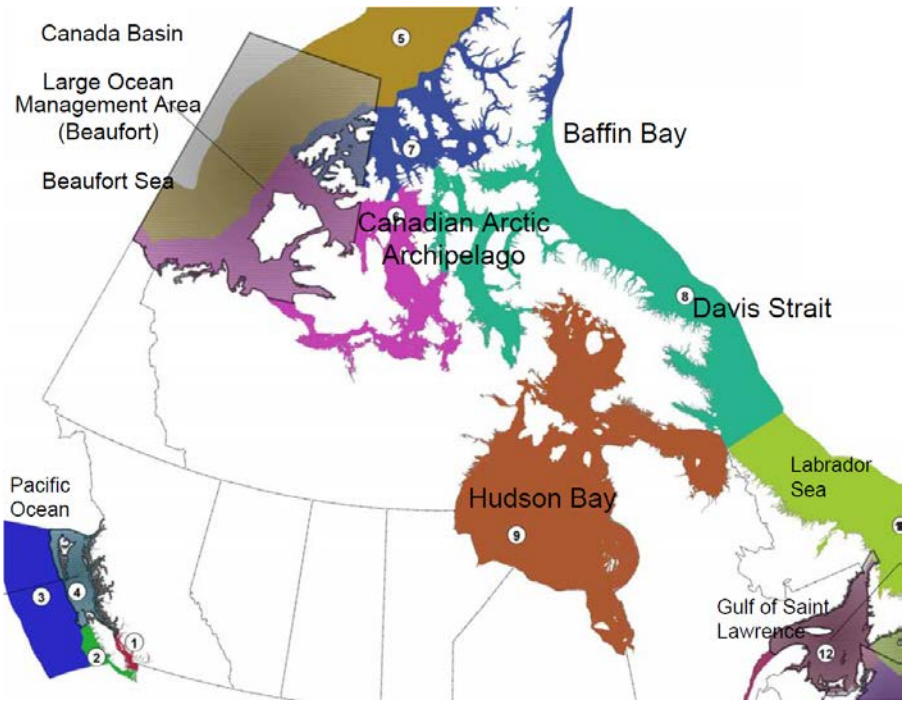

Figure 1: Marine ecological zones of Canada[2] (differentiated by color)

[1] Only the ocean part of the Archipelago. Melling, H. (2002) Sea ice of the northern Canadian Arctic Archipelago. J. Geophys. Res., 107, 3181.

[2] Modification to Government of Canada (2011) National Framework for Canada's Network of Marine Protected Areas.

The effects of climate change in Canada are extremely large within its Arctic region. For example, some parts of Hudson Bay have lost more than 90% of their sea ice in the past 30 years. [3] Consequently, the Northwest Passage, [4] which historically was covered with thick multi-year ice and difficult to pass, has become more navigable, and this has raised issues of security[5] and international environmental regulations. [6] It is not only sea ice that has diminished significantly in recent years, but also glaciers, ice caps, and the freeze-up of rivers, lakes, and marshes. [7] Since about 70% of Canada's coastline is located within the Arctic Circle, [8] there are many settlements of Inuit and other indigenous communities in the coastal area. The habitable areas are undergoing severe deterioration as a result of permafrost thawing and coastal erosion[9] (Figure 2), and the government is exploring adaptive measures that include infrastructure development. [10] Given these circumstances, Arctic marine research is particularly important for Canada. Therefore, Canada has implemented a variety of initiatives in this area that include operating a Canadian Coast Guard icebreaker specializing in scientific research. This paper will summarize Canada's policies and initiatives with respect to Arctic marine science and environmental management.

[3] September's ratio. Vincent, W. F. (2020) Arctic Climate Change: Local Impacts, Global Consequences, and Policy Implications. The Palgrave Handbook of Arctic Policy and Politics, 507–526.

[4] A passage through the Canadian Arctic Archipelago from the Beaufort Sea to the Baffin Bay. In 1906, the Norwegian explorer Amundsen became the first to successfully go through the entire passage.

[5] Canada claims jurisdiction of the passages in the Arctic Archipelago and has opposed the arguments of the United States and others who consider them to be international straits. Ikejima (2013), *Hokkyoku no gabanansu: Takoku-kan seido no genjo to kadai. Hokkyoku no gabanansu to Nihon no gaiko senryaku* (Arctic governance: current circumstances and issues of multilateral systems. Arctic governance and Japan's diplomatic strategy) The Japan Institute of International Affairs, 63-78.

[6] Canada played a leading role in the formulation of the "International Code for Ships Operating in Polar Waters (Polar Code)," which entered into force by the International Maritime Organization in 2017. However, because it prioritized an agreement among all countries to issue the convention, it did not reach an agreement to set stricter environmental regulations prescribed by coastal states for ships to pass the waters (based on Article 234 of the UN Convention on the Law of the Sea).Bartenstein, K. (2019) Between the Polar Code and Article 234: The Balance in Canada's Arctic Shipping Safety and Pollution Prevention Regulations. Ocean Development & International Law 50, 335–362.

[7] Vincent, op.cit.

[8] Environment and Climate Change Canada (2016) Pan-Canadian Framework on Clean Growth and Climate Change.

[9] Fritz et al. (2017) Collapsing Arctic Coastlines. Nature Climate Change 7, 6–7.

[10] Environment and Climate Change Canada, op.cit.

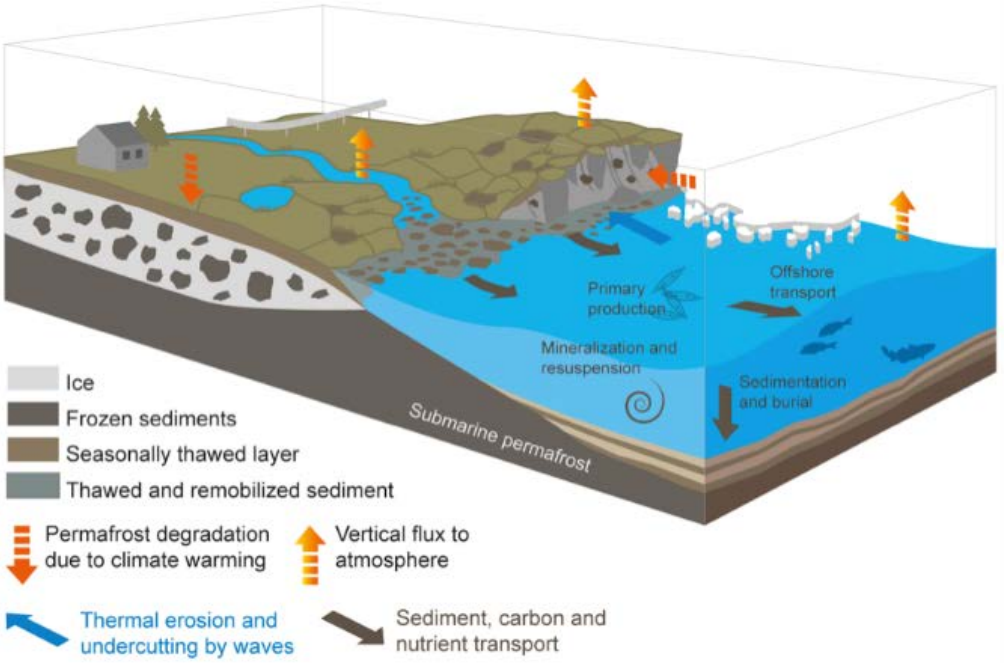

Figure 2: A representative example of Arctic coastal erosion caused by permafrost degradation [11]

2. Canada's ocean policy

Canada enacted its Oceans Act in 1997. The Oceans Act established the national maritime jurisdictions and presented three basic principles of management strategy: sustainable development, integrated management, and precautionary approaches. [12] Canada formulated its Oceans Action Plan in 2005 and is promoting integrated ocean management under the Department of Fisheries and Oceans Canada (DFO Canada). Five Large Ocean Management Areas were established based on these policies. In the management area of the Beaufort Sea, for example, the Regional Coordination Committee, comprised of the federal and local governments, and the Beaufort Sea Partnership, comprised of local stakeholders, jointly formulated an integrated management plan and selected ecologically and biologically significant areas. [13]

Canada set a goal to establish Marine Protected Areas (MPAs)[14] from 10% of its coastal and ocean areas by 2020, in line with the Convention on Biological Diversity and the United Nations Sustainable Development Goals (SDGs). By 2019, it had successfully designated

[11] Fritz et al. (2017) Collapsing Arctic coastlines. Nature Climate Change, 7, 6-7. Nunataryuk Project, https://nunataryuk.org
[12] The Ocean Policy Research Institute, The Sasakawa Peace Foundation (2018) *Sogo-teki Kaiyo Seisaku no Sakutei to Suishin ni kan-suru Chosa Kenkyu—Kakkoku oyobi Kokusai Shakai no Kaiyo Seisaku no Doko* (investigative research on the formulation and promotion of comprehensive ocean policy: ocean policy trends of individual nations and international society)
[13] http://www.beaufortseapartnership.ca/
[14] Fisheries and Oceans Canada. Canada's MPA Strategy (2005); Government of Canada (2011) National Framework for Canada's Network of Marine Protected Areas

approximately 14%. In the Arctic Circle, it established the Tarium Niryutait MPA, the first in the Arctic, as well as the Tuvaijuittuq MPA, which is equivalent to 5.5% of all MPAs and is located on the north side of the Arctic Archipelago. For the selection, an executive committee comprised of DFO Canada and local governments and stakeholders narrowed down the targeted areas for each marine ecological zone. However, some have raised issues regarding the integrated ocean management process – specifically, concerning mutual distrust among stakeholders and a lack of leadership. [15] Thus, this effort should not end with the establishment of zoning, but is expected to foster partnerships that can continuously implement effective protection and management for the ecosystems[16].

3. The Canadian government's Arctic and northern policy

In September of 2019, the federal government announced the Arctic and Northern Policy Framework[17] led by the Department of Crown-Indigenous Relations and Northern Affairs Canada (CIRNA Canada). It replaced Canada's Northern Strategy (2009) and the Statement on Canada's Arctic Foreign Policy (2010). The Framework is innovative because it was jointly formulated based on discussions held for approximately two years with stakeholders from three northern provinces, three territories, and indigenous groups. Emphasizing "reconciliation" [18] and "partnerships" with indigenous peoples, it presents eight main goals that include polar region infrastructure, economic strengthening, and security. Context for the Framework includes the threat of warming in Canada's Arctic region, which has progressed at a rate roughly three times faster than the global average [19], and the need for government to respond to changes such as the new industries that have arisen in now accessible Arctic Ocean areas, as well as inhabitant safety.

Regarding science and environmental management, Goal 5, "Canadian Arctic and northern ecosystems are healthy and resilient," in particular states that Canada will make an international contribution toward reducing greenhouse gases, understands changes in marine climates from environmental monitoring and research, and ascertains the fragility of ecosystems. And Goal 4, "Knowledge and understanding guides decision-making," states that Canada will consider the traditional knowledge of indigenous peoples on equal terms with scientific knowledge and, in conjunction with its possessors, will utilize it in academic

[15] Sneddon (2018) Barriers to Implementing a Bottom-Up Management Approach to Coastal MPAs: a Canadian Case Study, Dalhousie University.

[16] Payton (2020) Marine Protected Areas: May or May Not Include Actual Protection, Hakai Magazine.

[17] Canada's Arctic and Northern Policy Framework (2019). https://www.canada.ca/en/crown-indigenous-relations-northern-affairs/news/2019/09/the-government-of-canada-launches-co-developed-arctic-and-northern-policy-framework.html

[18] Ibid. Annex. The Framework made "Reconciliation" and "partnership" as principles, taking account the nation's history of inhibiting indigenous peoples' rights through policies such as cultural assimilation.

[19] Ibid.

studies. They have already applied such traditional knowledge in the activities of ArcticNet, [20] a Canadian consortium that promotes Arctic research, as well as in public health and other fields.

However, some have pointed out that the Framework lacks numerical targets and concrete measures[21]. For example, Environment and Climate Change Canada announced in 2016 a numerical target of a 30% reduction in greenhouse gases compared to the 2005 level by 2030. [22] However, the Framework does not mention this target. The key will be whether the federal government can develop an action plan that includes a budget with other departments as well as CIRNA Canada.

4. Moratorium on offshore drilling

While the Arctic and Northern Policy Framework aims to bolster the economy, the Trudeau administration has been implementing an environment-friendly moratorium policy since December 2016 that semi-permanently ceases to issue new oil and natural gas drilling leases in the Arctic ocean[23]. Moreover, they have prohibited exploratory drilling under existing leases since July 2019[24]. This moratorium policy is to be reviewed and evaluated every five years based on scientific data with stakeholders, including drilling companies. CIRNA Canada, the department in charge of the evaluation and review, has been implementing research programs to analyze and predict ocean conditions and weather in the Arctic coastal areas so as to obtain scientific data that will provide a basis for the evaluation (an example is the Beaufort Regional Strategic Environmental Assessment program[25]). With some provincial governments demanding local economic development under the Framework and calling for resumption of drilling[26], the evaluation in 2021 is expected to be closely watched.

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[20] ArcticNet. http://www.arcticnet.ulaval.ca. Funding is provided by the Networks of Centres of Excellence of Canada, a federal government program to promote interdisciplinary academic studies.

[21] CBC (2019) Ottawa's new Arctic policy has lofty goals, but few details on how to reach them, critics say, https://www.cbc.ca/news/canada/north/arctic-policy-framework-short-on-details-1.5278433/. Policy Opinions (2019) Laudable goals for the North have been identified, but what is missing is a budget and a timeline for action, https://policyoptions.irpp.org/magazines/september-2019/a-better-road-map-needed-for-arctic-and-northern-policy-framework

[22] ECCC (2016). Pan-Canadian Framework on Clean Growth and Climate Change.

[23] US-Canada Joint Arctic Leaders' Statement (2016). https://pm.gc.ca/en/news/statements/2016/12/20/united-states-canada-joint-arctic-leaders-statement

[24] Orders In Council (2019). https://orders-in-council.canada.ca/attachment.php?attach=38451&lang=en

[25] BRSEA (2019). https://rsea.inuvialuit.com/

[26] Cabin Radio (2018) Canada sets out path to Arctic oil and gas co-management, https://cabinradio.ca/9992/news/economy/canada-sets-out-path-to-arctic-oil-and-gas-co-management. Radio Canada International (2018) Ottawa signals it's open to talks on offshore Arctic oil and gas development, https://www.rcinet.ca/en/2018/10/05/ottawa-signals-its-open-to-talks-on-offshore-arctic-oil-and-gas-development

5. Scientific research trends

■ Organizations leading domestic and international science projects

ArcticNet is a consortium promoting Arctic research that originates in Canada. It was established in 2003 at the request of researchers. ArcticNet has assisted and promoted research and created a network for the purposes of exploring with stakeholders how anthropogenic factors affect ecosystems and human society and building a knowledge base for national strategies. Above all, it has achieved great success by establishing a system that permitted general scientists to use the Canadian Coast Guard icebreaker *Amundsen* (Figure 3) for research. [27] The system led to great strides by subsequent research in the Canadian Arctic Ocean, and particularly the Beaufort Sea and Arctic Archipelago. Taking a researcher-led bottom-up approach, ArcticNet has published policy suggestion reports to advise the federal government and indigenous peoples concerning environmental impacts. [28] In 2020 they will strengthen research that contributes to the "blue economy."[29] The federal government also sees the blue economy as a priority issue in line with the SDGs, [30] and thus the needs of both sides are mutually met. It should be noted in light of the icebreaker *Amundsen*'s age (a total of 40 years in service) that many people are requesting a new icebreaker. In 2019, the government announced its intention to build six new icebreakers at shipyards in Quebec beginning in 2027, from which a replacement for the *Amundsen* is expected.[31]

The icebreaker *Amundsen* is based at the Coast Guard base in Quebec City at the Saint Lawrence Riverside. The research projects are managed by ArcticNet's sister organization, Amundsen Science. These ArcticNet organizations are also based at Laval University in the Francophone area of Canada, which has led to active research exchanges with France and EU countries in particular. The exchanges have sought joint research and joint facility use through such undertakings as Takuvik, a French-Canadian organization that supports Arctic research, and Horizon 2020, [32] a major scientific research program of the EU. In 2018, the Arctic Research Icebreaker Consortium, an international project, was launched for the joint use of research vessels capable of observing ice-covered areas, with four EU countries as well as the United States and Canada participating. [33] The consortium will facilitate further

[27] Normally sails in summer for scientific purposes, e.g., she sailed for 102 days in 2019 summer.
[28] Integrated Regional Impact Studies. http://www.arcticnet.ulaval.ca/iris-report
[29] From an interview with a representative of a concerned organization (mentioned later) conducted by the author.
[30] Prime Minister of Canada (2018) Statement by the Prime Minister on the Sustainable Blue Economy Conference, https://pm.gc.ca/en/news/statements/2018/11/28/statement-prime-minister-sustainable-blue-economy-conference
[31] Naval News (2019) and other sources. https://www.navalnews.com/naval-news/2019/08/six-new-icebreakers-to-be-built-for-canadian-coast-guard/
[32] Takavik is a research partnership program between Laval University of Canada and the National Center for Scientific Research of France. It supports research on themes concerning anthropogenic impacts on Arctic ecosystems, http://www.takuvik.ulaval.ca/. Horizon2020, https://ec.europa.eu/programmes/horizon2020/en
[33] ARICE, https://arice.eu/

international cooperation in Arctic Ocean observation.

Figure 3: The Canadian Coast Guard's academic research icebreaker *Amundsen*
(Copyright @ Doug Barber, ArcticNet)

Sentinel North, a Canadian interdisciplinary program, has been established within Laval University. [34] It promotes technologies applicable to the Arctic, including not only ocean-related technologies but also laser optics, neural networks, and biotechnology. Also, the Center for Northern Studies, [35] established by a partnership of universities, manages nine land-based observation stations: most of them are located in areas of indigenous communities. The stations are for surveys and monitoring of polar soil, vegetation, and lakes and marshes. As for government-led initiatives, the Canadian High Arctic Research Station (CHARS) operated by Polar Knowledge Canada, [36] which was established by CIRNA Canada in 2015, conducts research with an emphasis on renewable energy and the effects on infrastructure that are caused by the change in sea ice and permafrost, which should be useful for communities in the polar region.

■ Highlights of icebreaker research

The icebreaker *Amundsen* conducted the first over-winter cruise in the Beaufort Sea

[34] Sentinel North. Funding is provided by an large-scale research grant scheme of the federal government, the Canada First Research Excellence Fund, https://sentinellenord.ulaval.ca/

[35] The Centre d'études nordiques, http://www.cen.ulaval.ca/

[36] The Canadian High Arctic Research Station (CHARS), https://www.canada.ca/en/polar-knowledge/CHARScampus.html

during the overarching project Canadian Arctic Shelf Exchange Study (CASES)[37] in 2003-2004, where it contributed to biogeochemical carbon flux research from the delta of the Mackenzie River to the Canada Basin. For the international Circumpolar Flaw Lead (CFL)[38] project during the International Polar Year 2007-2008,[39] researchers from 27 nations gathered aboard the *Amundsen* to clarify the formation process of ice flaw leads in the Amundsen Gulf. Since 2016, ship-time requests for the private sector's environmental studies in the Beaufort Sea have declined as a result of the moratorium policy on offshore drilling, while more observations have been conducted in Baffin Bay and other areas on the Atlantic side. In the summer of 2020, the *Amundsen* will finally return to the Beaufort Sea for an international project[40] to study the effects of thawed permafrost on ecosystems in the shoaling delta areas, where past data is extremely scarce, taking advantage of its maneuverability. (Note:This plan was postponed to 2021 due to COVID-19 closures.)

■ Prospects for cooperation with Japan

Japan's national presence in Canada's Arctic research community is not strong. [41] Except for information exchange among individual researchers, there is little information input from Japan. More active information exchange should be facilitated through Japanese and overseas academic organizations (e.g., the Japan Consortium for Arctic Environmental Research[42]). In light of this, one idea for Japanese researchers is to submit joint project proposals with Sentinel North and other organizations that participate in student exchanges and accept researchers. The expected outcome could be not only individual career development but also a foundation for research exchange between the two nations. The 3rd Arctic Science Ministerial, scheduled for the autumn of 2020 in Tokyo, will be an excellent opportunity to make such a joint research proposal to Canada and other Arctic coastal nations. Japan, though not an Arctic coastal state, is expected to make a significant contribution to the multilateral meeting.

On another issue, Japanese researchers often have a problem obtaining budgets for the high usage costs of Canadian icebreaker cruises when applying for the cruise plan. In Canada, project participants usually include ship operating fees in their research funding; however, in Japan, academic research vessels are generally assumed to cover the cost as a joint operating expense. Therefore, most Japanese scientific research funding does not expect individual researchers to cover such overseas research cruise expenses. I suggest

[37] Canadian Arctic Shelf Exchange Study (CASES)
[38] Circumpolar Flaw Lead System Study
[39] IPY-4. International Polar Year
[40] Permafrost Carbon on the Beaufort Shelf (PECABEAU) project.
[41] Information collected by the author
[42] https://www.jcar.org/

that this Japanese research funding system be revised so as to increase opportunities for Japanese researchers to lead international oceanographic observation projects.

6. Addressing global challenges

The bottom-up approach, as emphasized in the Arctic and Northern Policy Framework, is essential for addressing environmental problems in the Canadian Arctic, where the natural environment is unique and the society diverse. On the other hand, it is necessary to further develop the conventional bottom-up scheme in order to make significant international contributions to fast shifting global challenges, [43] such as the goals of the UN Framework Convention on Climate Change for reducing greenhouse gas emissions and the integrated observation monitoring systems promoted by the Arctic Monitoring and Assessment Programme under the Arctic Council. [44] Simultaneously, the government should also implement top-down approaches that can adjust countermeasures into global standards, especially when such countermeasures are proposed from local regions and individual fields; this will help the government make interested locals and scientists aware of global issues. For instance, are there alternative industries to oil and gas drilling in the Beaufort Sea that have ceased for the sake of environmental protection? How can Canada expand international ocean monitoring networks through the activities of existing scientific consortia when it remains difficult to access Russian waters? And, should Canada propose stricter rules for the Polar Code [45] because it lacks measures for the protection of the Northwest Passage ecosystem? The federal government's skills and resources will be put to the test in determining whether success in drawing out bottom stakeholders' interest and concern for the various issues that are directly linked to these global challenges—and in sparking useful domestic discussion on them—can be achieved.

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Prof. Philippe Archambault (Science Director, ArcticNet)
Dr. Martin Fortier (Executive Director, Sentinel North)
Dr. Atsushi Matsuoka (Research Associate, Takuvik-Université Laval)

[43] Folkner et al. (2010) International Climate Policy after Copenhagen: Towards a 'Building Blocks' Approach, Global Policy, 1, 3.

[44] Arctic Monitoring & Assessment Programme, SAON, The Arctic Council (2018). The program's goal is to build an integrated Arctic observation system. In the United States, for example, the Integrated Ocean Observing System has been developed since the 1990s; however, the Canadian network's development just commenced in 2019. Ocean Networks Canada (2019) https://www.oceannetworks.ca/launch-canadian-integrated-ocean-observing-system

[45] Bartenstein, op.cit.