

# THE GLOBAL ARCTIC: THE SUSTAINABILITY OF COMMUNITIES IN THE CONTEXT OF CHANGING OCEAN SYSTEMS

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## Executive Summary

The Arctic is being profoundly transformed by climate change. This has implications on terrestrial and marine ecosystems, affecting those who live on and from them. It is time to develop a shared scientific vision to protect these vital ecosystems as best we can, produce science for evidence-based decision-making and enhance collaborative scientific investigations of these issues. The G7 Academies propose the following:

- Research cooperation relying on augmented interdisciplinary research supported by large scale international science initiatives in combination with cooperative decision-making among Arctic nations;
- Training individuals from a diversity of fields and backgrounds, including those residing in the Arctic, to ensure the necessary scientific capacity to address global and local issues;
- Accessible, usable and timely science databases that can be shared among all stakeholders and decision makers;
- Programs on remote sensing linked with in-situ monitoring activities integrating sustained high-inclination satellite missions, new technologies for underwater measurements and regionally-integrated in-situ monitoring that incorporates local knowledge.

## THE GLOBAL ARCTIC: THE SUSTAINABILITY OF COMMUNITIES IN THE CONTEXT OF CHANGING OCEAN SYSTEMS

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### A Changing Arctic Ocean and Ecosystems

Arctic air temperature is increasing at twice the rate of the global average, equating to an approximate 2°C increase over the course of the 20<sup>th</sup> century. Since satellite measurements began in 1979, Arctic sea ice extent has declined in all months of the year and at an astonishing rate of 13.2% per decade for the month of September (or 86,100 square kilometers per year). These changes have global consequences for ocean temperatures, salinity, water circulation and acidification. Particularly significant is the Greenland ice sheet, which has been losing about 270 billion tons of ice every year since the early 2000s, and as a result now contributes to around 25% of global mean sea level rise. Fresh water increases in the Arctic due to sea ice melting, Greenland ice mass loss, and Siberian river runoff alter Arctic ocean circulation patterns, and impact air-sea interactions and related chemical exchange processes that can have consequences on a global scale.

Changes to the Arctic climate system have resulted in less predictable weather patterns; sea ice formation occurring later, earlier sea ice break-up; melting of glaciers; thawing permafrost, with the potential increase of methane release; increased coastal and soil erosion. Most researchers expect that, due to climate change, the Arctic will become largely free of sea ice (i.e. less than 1 million km<sup>2</sup> in extent) during the summer months sometime between 2030 and 2070, profoundly transforming regional and global environmental processes. All of these factors will

result in profound changes to important feedback loops such as when sea ice, which reflects light, turns to open water that absorbs heat – meaning that climate change will continue in the region and at an accelerated rate. Furthermore, there will be a significant shift in the abundance of species, their seasonal occurrence and geographic distribution, thereby affecting Arctic food webs and local food security.

### Healthy Oceans, Healthy Communities, and Healthy Peoples

The Arctic is being significantly impacted by climate change. Biophysical impacts related to changing temperature, precipitation, extreme weather events, sea ice, and permafrost will have implications for terrestrial and marine ecosystems, which in turn have consequences for the health and well-being of the numerous coastal communities in the region. All communities in the Arctic will be affected as they rely on the services of healthy ecosystems for hunting, fishing, local economic enterprises, as well as for physical and mental health. The seaways enable bulk maritime re-supply with essential north/south and international economic connections that are fundamental to domestic and international trade. There is also a strong and vibrant Indigenous presence in many communities across the Arctic where cultural networks transcend national borders, where travel over water and importantly over sea ice has occurred for thousands of years, and where connections to a healthy ocean are entwined in the cultural fabric and well-being of local society.

## THE GLOBAL ARCTIC: THE SUSTAINABILITY OF COMMUNITIES IN THE CONTEXT OF CHANGING OCEAN SYSTEMS

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### **Sovereignty, Security and Sustainability**

The changing Arctic Ocean also has major implications for global security, national sovereignty, and international trade related to: increased access to new global marine trade and transportation routes; lengthened ice-free shipping seasons; and increased opportunities and pressures related to Arctic tourism, Arctic fisheries and natural resource development. It is predicted that climate-related changes to the Arctic regions could stimulate investments ranging from US\$ 85-265bn over the next decade, offering the potential for significant and long-term sustainability opportunities for communities and governments in the region. However, with these largely climate change-induced socio-economic changes come increased potential risks such as: oil spills, shipping disasters and environmental contamination with subsequent public health risks, as well as the potential for the introduction of invasive species. There are also ramifications for search and rescue operations, human safety, mortality, and morbidity, together with impacts to infrastructure and livelihoods in the North. There are also risks related to local capacity, whereby larger global forces may overwhelm and impede locally led initiatives.

While the Arctic marine environment sustains unique and globally important ecosystems, it remains among the least-understood basins and bodies of water in the world. This lack of scientific understanding is concerning, as changes to the Arctic Ocean have complex and wide-reaching biophysical implications for local and global environmental processes. They also have significant repercussions for the health and well-being of local communities, and they could influence the future of global maritime trade, and with it, the potential for altered global power relations.

### **Sharing a Scientific Vision for Peoples and Marine Environments**

The G7 Academies stress the critical need to support and enhance basic Arctic research endeavours and cooperation that promote healthy and thriving coastal communities in the context of changing ocean systems. To address this need, the G7 Academies propose a vision of broad international collaboration that includes natural, social, and health sciences, engineering, humanities, and Indigenous knowledge in order to:

- Understand how climate change and human activities impact vital Arctic ecosystems;
- Develop innovative and interdisciplinary approaches and technologies to address these challenges;
- Use this knowledge to enable rich and robust evidence-based decision-making to inform decisions and manage and minimize environmental and sociological impacts.

### **The G7 Academies recommend:**

#### **1. Research Cooperation**

- Funding considerably more international and interdisciplinary research, including Indigenous knowledge, in both natural and social sciences to ensure that sound scientific, environmental and societal decisions are made for future development and the well-being of all;
- Developing innovative conservation and governance approaches to support the health and well-being of Arctic ecosystems.

#### **2. Building Science Capacity**

- Training individuals from a diversity of fields and

## THE GLOBAL ARCTIC: THE SUSTAINABILITY OF COMMUNITIES IN THE CONTEXT OF CHANGING OCEAN SYSTEMS

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backgrounds that will ensure the necessary expertise is available internationally;

- Training those residing in the Arctic is essential: this will incorporate locally-driven science questions and foster development of circumpolar research infrastructure.

### 3. Accessibility of Information

- Develop interoperable and open data-sharing platforms and sample-archiving systems;
- Provide appropriate communication infrastructure that enables information sharing in a timely manner and is usable by diverse communities.

### 4. Enhanced and Linked Remote Sensing and in-situ Monitoring Programs

- Continue high-inclination satellite missions dedicated to monitoring long term changes in terrestrial ecosystems, as well as in ice and ocean conditions; this would also ensure safe and optimal navigation across the Arctic;
- Extend the development of research vessels, and autonomous vehicles, platforms, cabled observatories and sensors that operate in open water, under the sea ice and on the ocean floor;
- Integrate these broader scale systems with regionally-integrated in-situ monitoring programs that incorporate local knowledge.



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