Chapter 27
Arctic Science in the Common Interest

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Abstract The international polar research community has just finished celebrating the 125th anniversary of the first International Polar Year (IPY) 1882–1883. Although the full impact and benefits of IPY 2007–2008 will not be felt for some years – many of its research projects and activities are still underway – attention has now shifted to the legacy aspects of IPY. Over the course of IPY 2007–2008, Arctic nations offered non-Arctic nations unprecedented access to Arctic research infrastructure (e.g. research stations, observation and monitoring networks). Despite the growing body of knowledge, we do not completely understand the potential environmental and social consequences of rapid climate change in the Arctic. The region is attracting international interest for its resource potential, possible new shipping routes as a result of decreasing ice cover, and international boundary and sovereign rights issues that have not yet been settled. Along with climate change, Arctic residents will have to overcome many other challenges such as large-scale economic development, and accelerating health and social issues in communities. Sound knowledge-based strategies are needed to help address the cumulative effects of climate change while taking into account multi-jurisdictional regulations and interests, and environmental impacts. These must involve responsible economic development, sustainable communities, and the use of local expertise in northern communities. This paper examines the need for a sound understanding of the processes at work in the Arctic, a solid bridge that links science and policy, and the importance of long-term sustainable scientific collaboration to improving governance and avoiding conflict in Arctic regions.

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P.A. Berkman and A.N. Vylegzhanin (eds.), *Environmental Security in the Arctic Ocean*,
NATO Science for Peace and Security Series C: Environmental Security,
DOI 10.1007/978-94-007-4713-5_27,

27.1 Introduction

The international polar research community has just finished celebrating the 125th anniversary of the first International Polar Year (IPY) 1882–1883 and the 50th anniversary of the first International Geophysical Year (IGY) 1957–1958. Like its predecessors, the fourth IPY 2007–2008 is expected to constitute a major landmark for international polar science.

Over the last 24 months the world's polar research community came together in a flurry of coordinated scientific activity at both ends of the globe. Hundreds of research and outreach projects undertaken by thousands of scientists from over 60 countries are giving us better understanding of the physical, chemical and biological processes near the poles and bringing new insights into the circumstances – past, present and future – of those who live in the circumpolar world.

Although the full impact and benefits of IPY will not be felt for some years – many of its research projects, data management initiatives, and outreach and training activities are still underway – attention has shifted to the legacy aspects of IPY, and the question of how to maintain large-scale multinational interdisciplinary research programs.

Over the course of IPY 2007–2008, cooperation and collaboration formed the cornerstone of the IPY research projects and resulted in unprecedented access to Arctic research infrastructure (e.g. research stations, observation and monitoring networks). Many nations expanded their national Arctic research programs, and made substantial investments to support their scientists. A number of extensive multidisciplinary networks were established. An extraordinary amount of information from this international effort has been collected and is still being analyzed.

IPY 2007–2008 has already left a large legacy footprint. It has demonstrated the advantage of working together through bilateral and multilateral agreements, and it has inspired a new generation of polar scientists to keep pooling their resources, form solid partnerships, share information, and ultimately generate a greater understanding and appreciation for the Arctic. This is very timely, given the decreasing ice cover and increased accessibility to the Arctic Ocean basin, and the drive for resource exploration and development.

The Arctic Ocean basin is a complex and diverse environment shared by five Arctic states: Russia, Canada, USA, Finland and Denmark/Greenland Cooperation among them is often difficult, as each has its own political and social agenda. The five nations, however, share interests such as trade and transportation, environmental protection and security, natural resource development, the role of indigenous peoples, oceans management, climate change adaptation, and scientific cooperation.

Today more than ever there is a need for scientific and research collaboration and cooperation in these shared areas of interest. The interest in and drive for economic development and resource exploration and extraction by Arctic as well as non-Arctic nations in the Arctic Ocean is escalating. This underscores the need for informed and responsible decision making to ensure the safety and security of people living

and working in Arctic communities and to maintain the integrity of the northern environment for current and future users.

This paper discusses the need for sustainable international research programs, the importance of long-term scientific collaboration in Arctic regions, and the value of involving Arctic residents in the decision-making processes.

27.2 Climate Change: The Game Changer

Research results have already shown that climate change has destabilized Arctic ecosystems including sea ice, the Greenland ice sheet, mountain glaciers, permafrost, and vegetation. The impact of these changes on the physical and biological systems, as well as on people, is large and projected to grow.

As a result of the decreasing ice cover – in particular multi-year ice – the Arctic is becoming more accessible. Arctic regions are fast becoming new frontiers for economic development opportunities including resource exploitation, and political disputes, and as a result are receiving an unprecedented amount of international attention. We need to ensure that there is a solid understanding of the environmental processes at work in the Arctic and that there is a strong link connecting science and policy. The knowledge and information gained over the next few years must form the bases for the decisions and actions that governments will take to mitigate or adapt to change in the Arctic.

The research has demonstrated the direct links between the Arctic regions and the rest of the planet. We now know that these regions are feeling the effects of global climate change more intensely than anywhere else on Earth. Despite the growing body of research we do not yet completely understand the potential consequences of climate change in the Arctic.

The effective application of accumulated knowledge requires the development of sound comprehensive strategies that can help address the cumulative effects of climate change and take into account various stakeholders, multi-jurisdictional regulations and interests, environmental impacts and other concerns specific to the Arctic. Fundamental to such a course of action are responsible economic development, sustainable communities, the commitment to achieving consensus between parties, and the use of traditional knowledge.

Along with climate change, Arctic residents will have many other challenges to overcome and difficult questions to resolve: potential geopolitical disputes, an increase in commercial shipping, economic development including large scale industry, security concerns, emerging health and social issues in northern communities, and how to work with non-Arctic nations to accommodate their interests in economic development and governance of the Arctic.

The following sections provide an overview of some of the more pressing impacts of climate change and provide a context for the role international scientific collaboration and cooperation can play in addressing them. By no means should it be considered a comprehensive review of climate change impacts.

27.3 The Environment

There is tremendous diversity in the environment and ecosystems of the north. Many Northerners depend on the environment for their subsistence and cultural needs; and many other Canadians benefit from visiting and enjoying the vast wilderness areas across the north, which also brings tourism employment to communities. Recent years have seen increased development across the north.

Imbalance of species distribution, impact of invasive species, changes of migration patterns, productivity changes and a longer growing seasons have all been raised as long-term impacts of climate change, as have the effects of permafrost change the integrity of ecosystems, landforms, and infrastructure. Long-term data will be required to distinguish long-term permanent change from short-term variability.

Of particular concern to the people in the north is the long-term impact on country foods. In 25 years' time the critical questions will be the availability and sustainability of seal, whale, caribou, waterfowl, and fish for communities in their current locations. The regimes of rivers and lakes are already changing and affecting physical conditions, ecology, and the economy. There is concern about changes in the quantity and timing of the freshwater input to the Arctic Ocean, the effects on atmosphere–ocean interactions, and changes near the shore. Permafrost and glacier melt will increase the sediment load of rivers, stressing the ecology of the rivers and near-shore zones at the mouths of rivers. These environments are critical to country food species such as beluga and fish.

Baseline environmental data is being collected and environmental assessment techniques for northern ecosystems are being formulated to ensure timely and accurate assessment of future developments, and their effective management and impacts.

Environmental change is occurring at an unprecedented rate, highlighting the need for monitoring to help provide the information required for informed decisions. To this end, efforts are underway to better coordinate monitoring sites around the circumpolar north. Connecting terrestrial and ocean observatories sites is critical for coverage across the Arctic Basin to provide a complete picture of climate change and its effects. This is being undertaken by the Sustaining Arctic Observation Networks project.

27.4 Social Transformation

Weather patterns and ice conditions are becoming less predictable, which is a concern to local hunters. In order for northern communities to take advantage of economic development opportunities, higher levels of school completion and training will be needed. Assessment of the potential impact of developments on communities must also be conducted to ensure that they benefit, rather than harm, the social, health, and general well-being of Canada's northern citizens.

Communities across the north share many challenges. While some in larger centres enjoy living standards similar to the south, small communities face isolation, high costs of living, and extreme social and health problems. Many northern residents

rely on the land to provide their food, but the availability and safety of country foods can be compromised by external factors such as climate change and airborne pollutants. Large-scale developments such as pipelines, mines, and oil and gas present additional challenges to the social structure of northern communities. Large influxes of people and money, while providing northerners with opportunities, can seriously impact communities where people generally wish to participate in the wage economy without compromising their ability to hunt, trap and fish.

Health issues often reflect changes in cultural, social, and environmental conditions. In the North, changes in these factors have placed enormous stress on populations. The current focus on nutrition, social and mental health issues will continue in the short and medium terms but change will bring new stressors in the medium to long term. Vulnerability to new diseases among northern people differs from the national population and may be related to genetic as well as behavioral and environmental factors. As a result of climate and other forms of change, new diseases may become more common (e,g., diabetes).

27.5 Economic Prospects

The Arctic is no longer seen as a harsh inaccessible region, but rather one with considerable economic and investment potential. By all accounts it is about to become a very busy place.

The Arctic holds the promise of substantial resources, including large oil and gas deposits, minerals, and fish. Polar transportation routes are also being considered by Russia, Europe and China and may result in increased commercial traffic in the Arctic Ocean. More attention will have to be paid to regulation and enforcement in Arctic waters. Search and Rescue (S&R) capabilities will also have to be coordinated and the responsibility and cost for providing S&R will have to be shared.

It is necessary to understand the importance of infrastructure in the Arctic, and this is especially so for the oil and gas industry. Different requirements for safety and security for people living and working in the Arctic will be necessary. Specialized northern knowledge and technology are required to provide tools for northern development, environmental protection, and improved living conditions for northern residents.

Development activities such as construction, power generation and distribution, and transportation have to deal with some unique conditions in the north. Extreme cold, permafrost, low daylight hours in winter and limited transportation infrastructure are some examples. In many cases, specialized technologies are needed to address these challenges because those developed in more southern latitudes cannot do the job.

Ice hazards to shipping in the Arctic Ocean basin will remain high for the foreseeable future with risks to safety and the potential for environmental disasters. Transport of people and goods – particularly illegal transport – through Arctic waters may pose a security risk.

Given the increased commercial shipping and tourist traffic it is likely that international consortiums will be formed to develop large-scale infrastructure that will be used by transport companies from many countries. This type of construction should be planned so as to bring benefit to northern communities, and indigenous organisations and northerners need a role in the decision-making process. This is particularly relevant when looking at the implementation of guidelines, and the development of best practices and negotiating policy instruments. Guidelines for shipping and transportation that will protect Arctic environment and people need to be developed in cooperation with non-arctic nations as well. This type of cooperation can also be very helpful in advancing international cooperation where S&R operations are concerned.

As activity increases, the need for cold weather technologies, winter and all-season roads, access to electricity, and construction in and outside existing communities will also increase. Large-scale projects like pipelines, hydroelectric projects, railways, and mines will all depend on state-of-the-art northern technology in order to avoid malfunctions and to minimize negative impacts on the environment. There is interest in decreasing the north's reliance on diesel-generated electricity and this will require specialized technology for alternative power sources such as micro hydro or wind generation that can operate under northern conditions.

It cannot be stressed enough that arctic residents must be involved in decision-making on resource development and safety and security. Development of hydrocarbon resources, transportation routes, or tourism must be undertaken in a reasonable and responsible manner using advanced technology and best practices and procedures.

27.6 Geopolitics

Arctic coastal states encircling the Arctic Ocean are also looking to enlarge their Exclusive Economic Zones, the areas over which they can exercise jurisdiction– including the resources under the sea bed. Fortunately most of the Arctic coastal states are undertaking this expansion in an orderly manner as outlined in the guidelines set out under *United Nations Convention on the Law of the Sea* [4] – Article 76.

Moreover, all five Arctic coastal states have a common commitment to orderly settlement of any possible overlapping claims as outlined in the *Ilulissat Declaration* [1] and have agreed to work together towards the responsible management of the unique Arctic ecosystem.

However, disputes related to natural resources may arise. International companies may seek to work outside national borders and at the international level through such fora as the World Transportation Organization or the International Seabed Authorities Commission to gain access to resources. These possibilities serve to highlight the importance of existing international mechanisms and agreements for cooperation and settlement of disputes. Bilateral relations with our neighbors in the Arctic through regional mechanisms like the Arctic Council and other multilateral institutions are seen as part of the solution to such situations.

27.7 Science and Technology: Cooperation and Collaboration

It has never been more important for the polar research community to ensure that we continue developing international collaborative research opportunities for citizens, scientists, politicians and policy-makers to work together, to build on the achievements of IPY, and to develop a strategy for future economic development and environmental protection. Clear communication with politicians and policy-makers is challenging but essential, despite the lingering uncertainties in climate-change science. Public awareness helps considerably in getting messages to politicians, and it is therefore important that scientists and researchers share their results not only with colleagues but also with the general public.

International cooperation and Pan-Arctic collaboration have been focusing on capacity development and knowledge generation, but today include developing regulatory and enforcement capabilities. The Arctic states must be able to respond to the increase in international activity that a more accessible Arctic will bring.

Through international cooperation and collaboration programs like IPY 2007–2008 our understanding of the impacts of climate change and the opportunities that come with globalization increase. By working collaboratively, science and technology development will play a critical role in the sustainability and protection of the Arctic.

At first glance present day Arctic research programs seem very fragmented and diverse. The arctic research community includes many players, from regional to international, working to improve our understanding of the environmental, economic and social processes taking place there. There are, however, also international organizations working on pan-Arctic cooperation and collaboration in research: the International Arctic Science Committee; the International Arctic Social Sciences Association; the Northern Forum; the Barents Euro-Arctic Region; Arctic Council; the Indigenous Peoples Secretariat; the University of the Arctic; and the Northern Research Forum to name but a few.

All this activity brings hope for better communications, and more rapid confirmation of scientific data and dissemination of results. We know that policy needs to be based on reliable information; it should also be timely, account for a broad range of perspectives, and be applicable over the long term. Despite the many efforts being made however, there is still a disconnect between what scientists recommend and what policy makers implement.

Can scientific cooperation and collaboration help eliminate this disconnect? We need to keep in mind that the science/policy interface should not be overly complicated. Clear objectives are required, and it is far better to connect policy-makers and scientists early on in a process than in the later stages in order to produce beneficial outcomes.

International collaboration at the scientific level would seem a viable and practical way to enable all interested parties to become more involved in Arctic matters. In order for this approach to succeed, interested nations must show a commitment to substantial research activity in the Arctic, be prepared to share research information, have an active exchange of scientists, and be prepared to support multinational research programs.

An example of such an endeavour is the ocean-bed mapping project under UNCLOS. Here several nations are working together to collect bathymetric readings on the extent of their respective continental shelves. Joint collaborations of this nature offer affordable, reliable data that can be shared and provides decision-makers the most up-to-date, reliable information.

Another concept that has been put forward by Russia and has been gaining increased acceptance among the scientific community is the idea of an International Polar Decade [2] as a legacy aspect of the IPY 2007–2008. The idea is to capitalize on the international collaborative momentum created by IPY 2007–2008 at a time when polar research is central to our understanding of global physical processes and climate change, but is also increasingly threatened by external pressures for economic and resource development.

It is hoped that the Polar Decade will encourage polar research nations to keep working together as they have so successfully done during the IPY 2007–2008, thus maximising efficiencies, reducing costs avoiding overlapping research, and generally providing added value and momentum through rationalization of their logistical networks and scientific resources.

The examples listed above show that there is strength in cooperation and collaboration through international research initiatives and programs. By sharing information we can help mitigate the effects of climate change and avoid unsustainable development in the Arctic.

It is clear that change is needed, both inside and outside of the Arctic, and that it will require new and innovative ideas. We may have to change the way we do research — to rethink the way science interacts with politics and society. There is a need to engage politicians at the highest level so that we may act swiftly to implement sound policies based on scientific results. It is also clear that Indigenous peoples' participation is needed at the beginning of these initiatives and research programs to ensure that policies and their implementation are not removed from the real-life situation in the Arctic.

27.8 Conclusion

The Arctic is touted as a region rich in natural resources, including hydrocarbons, minerals, flora and fauna. It is also home to thousands of people. Accountability and protection are needed to ensure the conservation and sustainability of the region for future generations.

We need to think of managing the Arctic as a process. It needs to be multidisciplinary, integrate both short and long term horizons and involve multi-stakeholder partnerships between governments, civil society, industry and academia. How we undertake the research and communicate the results to decision makers has never been more important. This information will form the bases for the decisions and actions that governments will take as we attempt to mitigate, prepare for, and deal with the effects of climate change in the Arctic.

It is crucial that the polar research community continue to develop international collaborative research opportunities for citizens, scientists, politicians, and policy-makers to work together, to build on the achievements of IPY, and to develop a strategy for future economic development and environmental protection through international cooperation. Clear communication with politicians and policy-makers is challenging but essential. Public awareness helps considerably in getting messages to politicians, and it is therefore vital that scientists and researchers share their results not only with colleagues and decision makers but also with the general public.

Measures must be instituted and research undertaken to ensure that there is a solid understanding of the processes at work in the Arctic and that a sturdy bridge links science and policy. In order to obtain a more comprehensive understanding of the processes at work and their potential impacts on people and the environment in the North and globally, the international research community will need to collaborate and cooperate – especially given the high cost and long term commitment needed to obtain all the information needed to make sound decisions. No one nation can be expected to undertake this work alone, or can afford to sustain it financially.

It was encouraging to hear Prime Minister Putin, in a speech to a September 2010 international Arctic forum hosted by the Russian Geographical Society at the University of Moscow, emphasize the fact that the Arctic's rich mineral resources can be developed cooperatively, with disputes being resolved peacefully, and with concern for the environment. His fundamental message was in the title of the international forum: *"The Arctic: Territory of Dialogue"* [3].

Increased dialogue with arctic and non-arctic nations will have to start at both at the governmental and non-governmental levels. Greater involvement of non-governmental international organizations to coordinate Arctic and Antarctic polar science will be a key component in an international effort to gain knowledge. The knowledge and information acquired must be shared in a timely manner as it will form the bases for government decisions and actions in response to changes in the Arctic. Long-term research plans need to be developed now so that we can provide policy makers and the global community with clear answers, backed up by solid scientific information, rapidly and efficiently. It is especially crucial that these steps be taken today.

Sound, comprehensive, and knowledge-based strategies are needed to help address the cumulative effects of climate change while taking into account various stakeholders, multi-jurisdictional regulations and interests, environmental impacts, and other concerns specific to the Arctic. These must involve responsible economic development, sustainable communities, a commitment to achieving consensus, and the use of local expertise in northern communities. By undertaking collaborative research at the international level and engaging indigenous people and northerners in the dialogue we have a better chance of balancing social, economic and environmental objectives while meeting national and international development objectives – without compromising the future of the Arctic.

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