Chapter 1
An Introduction

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Abstract This chapter considers the current state of change within the Nordic Arctic and some of the challenges it presently confronts. It then moves on to examine the particular vision of the region that has developed within the Nordic community. It discusses some of the forces that have helped to create this Nordic vision of the Arctic and the ways in which many of these same forces continue to a fashion a distinctive Nordic attitude and approach to the area. The essay then addresses some of the leading concerns of the Nordic community regarding the future of the Arctic region. It also considers some of that community's efforts to collectively plan for the responsible development of its most northern areas. Special attention is given to the role played by the Joint Nordic Initiative on Arctic Research. It takes note of its overall guiding concerns and objectives and considers how the four Nordic Centers of Excellence in Arctic Research may help to build new pathways for scientific investigation in the region and needed policy development. The essay concludes with a brief summary of some of the research initiatives that have been part of the efforts of the Centers and which are explored in greater detail within the subsequent chapters of this volume.

Keywords Nordic region · Arctic research · NordForsk · Centers of excellence · Arctic

The past two decades have witnessed major changes within the Arctic. A variety of forces ranging from climate change to the continued exploitation of its natural resources have combined to alter the face of the region in a significant manner. Often the people who live within the contemporary circumpolar North feel at a loss as how best to respond to these altered conditions. The challenges of adaptation

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and building new resilience within their communities and environment can appear to be often daunting. The specific paths that they should follow toward a more predictable and sustainable future may not always appear that clear (Evengård et al. 2015).

This is certainly the case in the Nordic Arctic. This far northern edge of Europe provides a clear example of how northern communities have had to confront multifaceted change within their midst and to develop new strategies and approaches to deal with it. Although the region has, perhaps, received less attention than other areas of the circumpolar North, the challenges and opportunities found there are not that dissimilar from those seen in northern Alaska, Canada or Russia. What is distinctive about this particular northern community, however, is the manner in which its residents have sought to organize their thinking and actions regarding how change can be addressed and acted upon.

Central to this Nordic undertaking has been an effort to share analytical resources and apply scientific research to the challenges and opportunities arising from these changing Arctic conditions and circumstances. One of the best examples of this approach has been the establishment of a Joint Nordic Initiative on Arctic Research facilitated by NordForsk, the research arm of the Nordic Council of Ministers. Under its auspices four major Centers of Excellence have been created to examine pressing northern concerns and to facilitate policy discussions on such diverse topics as climate induced change, health security, natural resource utilization and community enhancement (NordForsk 2016).

The effort to create and implement an organized response to change in the Nordic Arctic is the focus of this volume. The work first considers a number of the more pressing needs of the region and then examines how research is being organized to respond to them. The work also examines some of the specific challenges and opportunities that arise in conducting scientific investigations across such a broad domain. It discusses the merits of utilizing both multidisciplinary teams of investigators and the application of specific research methods aimed at encouraging community engagement and benefit. Each of these undertakings represents an innovative step in Arctic research and, as such, worthy of careful analysis and consideration.

However, before moving in this direction, it might be profitable to begin this discussion by first considering the context for such efforts. This necessitates a brief view of the Nordic region, itself, and its dimensions. It also requires some consideration of the manner in which the Nordic community has traditionally viewed its own most northern lands. It is probably helpful, as well, to examine how Nordic policy toward the Arctic has been conceived and developed over time and what may appear to be the priority concerns of the region today. All of this can contribute to a better understanding of the distinctive Nordic perspectives on the Arctic that guide these current scientific research activities.

1.1 The Nordic Region

The Nordic community is composed of five countries—Denmark, Finland, Iceland, Norway and Sweden along with associated areas such as Greenland, the Faeroe Islands and Svalbard. Their total population is relatively small—some 27 million individuals who collectively represent less than 1% of the world's total. In geographic terms, the Nordic territory is somewhat larger—representing close to 3.4 million square kilometers and collectively forming the seventh largest region in the world (Fig. 1.1). As such, the Nordic area is a significant but relatively sparsely populated component of the globe (Nordic Council 2018).

It is also a region whose history and societal development are not particularly well known by those outside its borders. The Nordic region has not commanded the attention that other areas of the world have done so over the last few centuries. Nonetheless, the Nordic societies continue to play significant roles in the economic, social, political, cultural and scientific evolution of the global community. Its citizens have also assumed leading positions within a number of international organizations charged with the responsibility of promoting global peace, security and environmental protection.

As such, the Nordic region has been seen as providing an example of how "small states" or societies can exert influence far beyond their expected capacity to do so. In continually "punching above their weight" the Nordics have come to command the attention and admiration of observers from across any number of fields and endeavors (Ingebritsen 2006). The Nordic example or "model" is frequently referenced by those inside and outside of the region as a way of addressing and solving major societal needs and concerns in the contemporary era. One of its most frequently cited features is how Nordics tend to work together to address common needs and opportunities. This tradition of cooperation and the pooling of resources among neighbors can be seen across a variety of areas (Hilson 2008). The collective Nordic response to the challenges of the Arctic is but one of these and forms a connecting thematic thread within this volume and will be examined in a variety of contexts within its subsequent chapters.

1.2 The Nordics and the Arctic

The portion of each Nordic state that can be found within the Arctic varies from nation to nation. However, depending upon the definition of the Arctic utilized, fully a quarter to a third of each Nordic state's territory can be deemed to be located within this region. Most of these northern areas are sparsely settled with no more than 10% of each Nordic country's citizen's to be found there. Yet they represent a significant element of societal wealth that is rooted in the development and utilization of the natural resources found in these northern lands. Despite this fact, the North

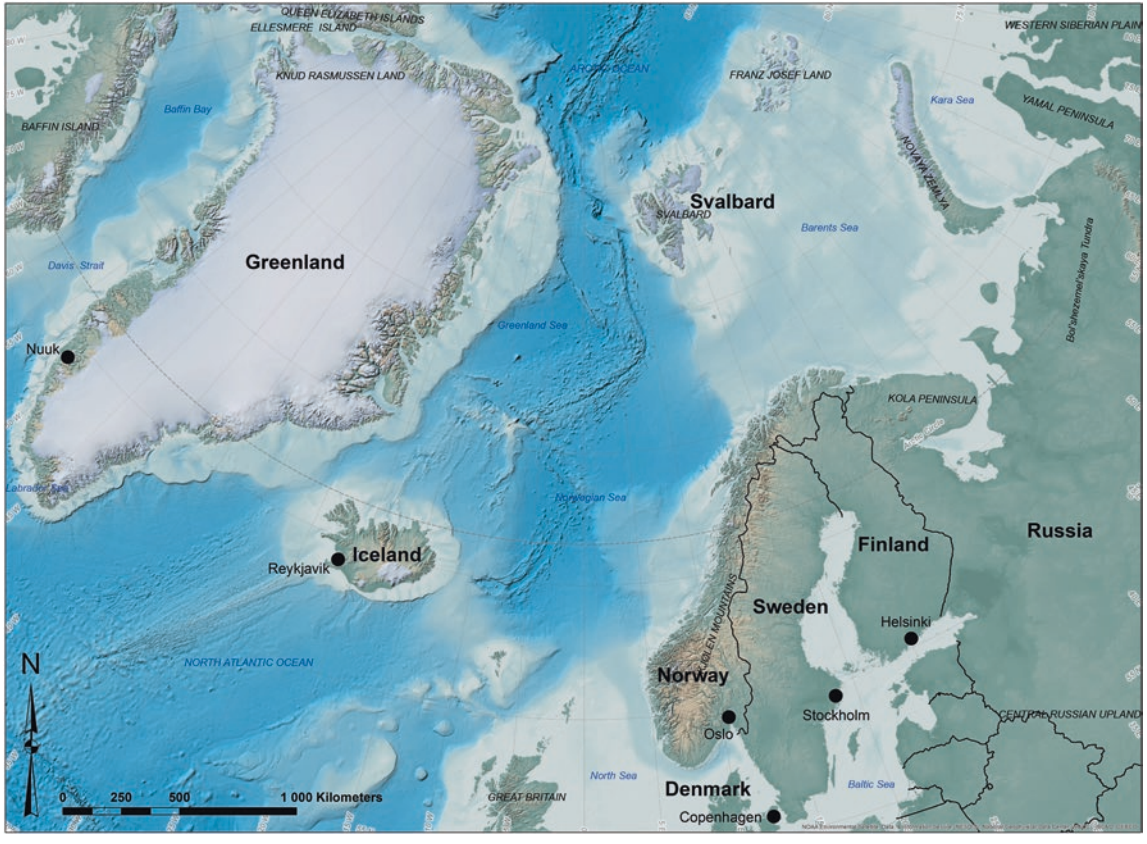

Fig. 1.1 The Nordic region

has also experienced high levels of unemployment that are reflective of the periodic declines in its natural resource-based economies. The Nordic North has also witnessed regular outmigration from its more remote areas to both urban centers within the region as well as to communities located further south. In its wake, the region has suffered a variety of societal challenges including both outmoded transportation and communication networks and the inadequate provision of health and social services when compared to southern communities.

The Nordic Arctic is not generally well-known or understood by either its own fellow citizens or external observers. The northern areas of each country do not figure prominently in either their national histories or their society's day-to-day operations. It is an area that tends to be overlooked by government and the media. The "northern dimension" of these countries is not usually promoted or popularized by them to the same extent as can be seen in other circumpolar societies such as Canada, Russia or Alaska. Tourists and recreational enthusiasts spend time in the region, but most visitors—foreign or domestic—rarely see the Nordic Arctic as a place for permanent settlement, broad-scale economic investment or cultural enhancement. These northern communities face a regular challenge in promoting themselves and receiving adequate attention and resources from power centers situated in the south. Often, they are viewed as being too remote or too small in population to figure in the overall calculus of either key private or public sector decision-makers (Eriksson 2008).

Despite this lack of a prominent Arctic profile, the Nordic states have made significant contributions over time to the development of a true circumpolar community. They have contributed some of the most noteworthy of the early explorers who sought to map its lands and chart its waters. Names like Leif Ericsson, Vitus Bering, Adolf Erik Nordenskiöld and Fridtjof Nansen occupy positions of importance in such efforts. Similarly, Nordic scientists such as Carl Linnaeus, Harald Sverdrup, Hans Ahlmann and Kristian Birkeland all played prominent roles in developing the fields of Arctic biology, meteorology, glaciology and ecology. More recent Nordic researchers have also led the way in advancing new technologies of importance to the development of the Arctic including those related to transportation, communication and scientific observation and measurement (Sörlin 2013).

Nonetheless, much of any Arctic dimension of the Nordic countries tends to derived from the profile of its indigenous populations—the Sámi in Norway, Sweden and Finland and the Inuit in Greenland. These communities have figured prominently within most Nordic visions of their Arctic lands and in the development of a growing tourism industry within the region. Along with the iconic appeal of the reindeer, polar bear and the northern lights, the traditional cultures of these northern peoples have helped to provide a distinctive image of the region for both their domestic and external audiences (Müller 2015). However, like many other indigenous communities across the globe, this popular imagery can be at variance with reality. Both the Sámi and the Greenlandic Inuit societies face a number of challenges that make the continuation of their traditional lives in the Arctic ever more problematic over the coming years. Climate change, the steady over-exploitation of natural resources within their lands and the introduction of post-modern

ways of life all pose significant problems. Likewise, the reluctance of government officials to recognize their traditional rights and the uneven treatment they have received from bureaucracies situated in the south remain a serious concern (Kuokkanen 2019).

On the whole then, the dominant Nordic view of the Arctic can be seen to be somewhat limited and uneven in character. Though significant portions of their own national territories are to be found in the region, there has been a tendency on the part of the Nordics to give only somewhat limited attention to the needs, concerns and interests of the lands and people found there. Frequently seen as a remote area "above the fold in the map" residents and policymakers from the rest of the Nordic area are only now becoming more fully aware of the challenges and opportunities that need to be addressed there.

1.3 The Nordics and Arctic Policy Development

The development of distinctive northern or Arctic policies has varied among the five Nordic countries especially in the domestic context. Some of the Nordic states like Finland and Norway have developed extensive efforts at northern regional development and promotion. Others like Sweden and Iceland have preferred to address the needs and challenges of their northern communities within the framework of overall national policies designed to encourage economic growth and the provision of necessary social services throughout their societies. Denmark's unique relationship with Greenland and the Faeroe Islands has resulted in very locally focused efforts undertaken in conjunction with the home rule administrations. As a consequence, no common "Nordic model" has emerged from such endeavors.

At an international level, however, there has been more of a shared perspective and approach to the concerns of the Arctic. As countries long-experienced in global diplomacy and international organization, the Nordics have acted largely in concert with one another in promoting a common agenda for action that includes protection of the environment, addressing climate change, encouraging sustainable development and providing adequate health, education and social services for the entire circumpolar community. They have also provided necessary leadership for the main coordinating and problem-solving bodies that have emerged within the area. The ideas behind the Rovaniemi Process and Barents Cooperation have their origins within the Nordic societies and can be seen as logical extensions of the previous efforts at cooperation and collaboration embodied by the Nordic Council (Young 1998).

Similarly, the Nordic states have played significant roles in the development and evolution of the Arctic Council. They have encouraged this key forum for Arctic enhancement to expand its efforts and increase its effectiveness (Nord 2016a). During their first terms as successive chairs of the body, Norway, Denmark and Sweden promoted a common Scandinavian agenda that sought to strike a balance between demands for environmental protection and sustainable development across the Arctic. They also worked together to bring new issues and participants to the

decision-making table. This successful model of cooperation and innovation has continued during the subsequent chairmanships of Finland and Iceland (Koivurova 2019).

The one topic that has eluded a broad Arctic consensus among the Nordic states at the international level has been with respect to the provision of "hard security". Three of the countries (Denmark, Iceland and Norway) have been long-term members of the North Atlantic Treaty Organization (NATO) and have viewed the Arctic as a component of this mutual defense arrangement. They continue to maintain strong ties with the other Arctic NATO countries, Canada and the United States. The two other Nordics, Sweden and Finland, have elected not to join NATO and have pursued more non-aligned defense policies. With such distinct differences in approach with respect to defense planning, the Nordics have chosen to focus their collective efforts on "soft security" needs of the Arctic region including environmental monitoring, species protection and the furthering of community resilience in the wake of climate change (Eklund 2019).

Each of the Nordic states has also displayed differing approaches in outlining their overall Arctic policies and priorities. Some like Norway and Finland have been quite active and engaged in articulating their national perspectives on the region including an extensive consideration of both the domestic and external dimensions of their Arctic visions. Others like Denmark, Iceland and Sweden have been more hesitant and circumspect in such undertakings. Nonetheless, they have pursued a fairly consistent set of agendas during their chairmanships of the Arctic and Barents Councils focusing on items such as the effects of climate change, the need for economic diversification and the use of green technologies (Government of Finland 2017).

A commonly shared characteristic of the Nordic states in their approach to Arctic matters at both regional and international levels has been their offering of both focused attention and necessary funding to advance agreed upon new initiatives. Whether in the context of international climate negotiations or through their specific support and funding of Arctic Council and Barents Council initiatives, the Nordics have always been seen as strong and visible advocates for action to address growing matters of Arctic concern. They have always provided both scientific expertise and sufficient resources to support such efforts. As a consequence of this tradition of commitment, the Nordics as have been viewed as potential leaders in the effort to address some of the more pressing challenges faced by the Arctic today (Nord 2019).

1.4 What Are the Current Concerns of the Nordics with Respect to the Future of the Arctic?

Over the past decade, a number of assessments have been made of what are the priority concerns of the Nordic states with regard to changes in the Arctic—both from a sector and circumpolar perspective. National studies, regional investigations

and plans for action by such bodies as the Arctic Council and Barents Councils provide good overviews of what contemporary Nordics are thinking (Government of Sweden 2018). In reviewing these documents, a consistent top-ten list of priority items tends to emerge. At the top of this list is environmental protection. From the issuance Environmental Protection Strategy in 1992 until the present day this has been the number one priority of the Nordic states with regard to the Arctic. The monitoring, defense and encouragement of healthy ecosystems within the region has been a consistent concern of the Nordic community (Keskitalo 2004).

Over the last decade this leading issue has been augmented by a second major concern—that of climate change. The Nordics have been in the forefront of nations asking for action in response growing alterations in the world's climate. They have led the way at international negotiations to impose restrictions on the production of greenhouses gases which are seen as primary contributors to climate change around the globe. They also have been at the forefront in drawing attention to the significant increases in temperature and ice-melt within the Arctic region and to the detrimental consequences that such developments have for both the immediate circumpolar community and the broader world (Hernes 2012).

A third commonly-held perspective of the Nordics with regard to the needs of the Arctic is a consequence of the two mentioned above. In highlighting the challenges and the need for action in the areas of environmental protection and climate change, the Nordics have been leaders in the promotion of such concepts as sustainability, adaptability and resilience. From the Brundtland Report in 1997 onwards, the Nordics have pioneered new thinking and approaches regarding how the modern world can respond in an effective manner to major socio-environmental challenges. They have stressed the need for humankind in its present and future evolution to live and work more in harmony with its natural setting, The Nordic countries have been in the vanguard of efforts to establish effective "green policy" practices and to share their ideas with the broader global community—including their fellow residents of the Arctic region (Government of Sweden 2017).

This concern for maintaining the environmental health of the globe has been advanced within the context of Nordic thinking with respect to the economic development of the Arctic. As noted above, the natural resources of the North have long been a central component to the economies of five Nordic states. All see their continued utilization to be important elements of their future economic growth and prosperity. The major change that has come in the last few decades, however, is the new emphasis given by the Nordics to the sustainable development and utilization of the resources of the region. This has become the fourth major focus for Nordic thinking with regard to the Arctic. Whether in the case of forestry, fishing, or energy production new focus has been placed by the Nordics on sustainability and the future development of these industries in harmony with their natural settings. Equally important, new attention has been given by the Nordics both to how threatened enterprises like reindeer herding and mining can be made more responsive to their communities and whether new economic initiatives such as tourism, recreation and those related to modern science can be developed in a sustainable manner in these areas (Sköld 2015).

A fifth focus of Nordic attention directed toward the Arctic relates to technology and research. The five Nordic countries have long been recognized as global leaders in scientific research and technological innovation. Increasingly these five countries have directed new thought to how such expertise can be applied to the challenges of living and working in their own Arctic lands. Over the last few decades, major initiatives have been undertaken by both private and governmental funders to promote investment in transportation, communication and cutting-edge scientific research within their northern communities with the goal of promoting them as new hubs of innovation. These initiatives have been augmented by other efforts to stimulate additional research and growth in more traditional technologies such as in ice breaking and snow removal, the production of specialized mining and forestry tools as well as in the creation of world-class winterized clothing and recreational equipment. The advancement of research and investment in such areas has been a priority for all of the Nordic states when they have headed such bodies as the Arctic Council and the Barents Council (Barents Regional Council 2013).

Health is a sixth significant interest of the Nordics with respect to the Arctic. Part of their concern relates their continued need to provide adequate health services within their own northern communities. This is supplemented by a real interest in the articulation of best health care practices that can be shared throughout the circumpolar world. Nordic concern in health matters in the North also includes a focus on the education and training of health care workers and the utilization of new approaches, methods and technologies there. Still another dimension of this Nordic focus on health matters in the Arctic is the community's stated desire to develop an effective response to the introduction of new pathogens into northern lands as a result of climate change (Parkinson et al. 2015). The effort to create additional monitoring and response capabilities to meet the challenges of these climate sensitive infections (CSIs) will be detailed in subsequent chapters of this book.

A similar Arctic challenge that has been identified by the Nordics relates to the offering of education and training in the region. This seventh overall area of focus arises from perceived need to provide new and enhanced educational opportunities for their citizens of the region. This comes as a response to continued higher levels of unemployment in northern areas and the need for local residents to adapt their capabilities to changing global economic conditions. Not only is there a requirement to provide new training options within established resource-based communities, but there is also a need to offer new educational programs that would allow residents to pursue careers in new high-tech and knowledge-based industries that are increasingly being introduced into the region. This requires the provision of an expanded menu of postsecondary programs into the Arctic by local colleges and universities as well as the delivery of technologically enhanced distance education programs from outside the area (Nord and Weller 2002).

Linked to this education-focused interest in the Arctic is also an increased Nordic attention to the challenges faced by young people in northern societies. The problems confronted by youth in these communities not only relate to the established issues of employment, health and education opportunities as noted above, but also can be seen to be linked to specific lifestyle concerns such as the excessive use of

alcohol and drugs along with their participation in violence and crime. Added to this growing youth agenda of concern are additional problems related to the potential outmigration of young people from the area and need to ensure that both they and their elders have adequate connectivity to the outside world. These broad socio-cultural questions have become important priorities of Nordic concern for the Arctic and form a seventh focus of discussion and activity (Larson and Petrov 2015). Their impact will be considered in some of the chapters of this volume.

A related focus of concern—that of gender—forms a distinctive eighth area of Nordic interest in the contemporary Arctic. Here is included the perceived need to offer an adequate voice and set of opportunities for both women and men of the region. The vast majority of the Nordic community believes that both men and women should have clear options to pursue their lives and careers in the Arctic. Similarly, they desire to see any existing gender disparities in employment, education, health and social services removed from the region. Most importantly, they share a commitment to having both women and men have an opportunity to help design and shape both the features and futures of their northern communities. The traditional Nordic belief in furthering both gender equality and gender perspectives can be seen to be operative in these northern lands as well as in areas to the south. Several of the research projects detailed in this volume examine its imprint within the different communities of the Nordic North.

A ninth area of Nordic interest in the Arctic stems from similar roots. Democracy and public participation in regional decision-making processes are also seen by the Nordics as essential elements for the development of the Arctic. This includes local and indigenous populations having a voice and say in matters affecting their own communities. It requires that government and private firms take the affirmative step of consulting with indigenous peoples and local residents before they begin new undertakings in the area. It also means securing the necessary approval and "buy-in" from such groups before any such initiatives are commenced. Increasing number of Nordic observers of the Arctic also maintain that the traditional knowledge (TK) and expertise from both indigenous and local peoples need to be respected and incorporated into any decision-making process (Aylott 2014). This effort at beneficial participation and inclusion is examined within a number of the research projects detailed in this book.

A tenth major concern of the Nordics with regard to the Arctic's future relates to the need for broad engagement of all circumpolar parties in its design and implementation. As long-time proponents of international cooperation and multilateralism, the Nordics have championed the development of effective governance frameworks for the region. As noted above, they have been strong advocates for the creation such bodies as the Arctic Council and the Barents Councils and sought to enhance their mandates and scope of their operation. They have also consistently sought to encourage international cooperation in research and policy development aimed at addressing broad circumpolar needs. These efforts continue as a central feature of their desire to see the Arctic region function as an area of peace and collaboration and as a means to avoid any emergence of a new Cold War that might transform it into a zone of possible conflict (Nord 2016b).

1.5 Pathways to the Future

The Nordic perspective on the Arctic also contains within itself a distinctive element of looking to the future. The five Nordic states are known internationally as societies that are progressive and forward looking. They have produced over the decades many individuals and groups who have been in the forefront of cutting-edged science, artistic design and social reform. They are interested in emerging global patterns and trends along with the forces and factors that spur their development. As such, it is not surprising that the Nordic vision of the Arctic should embody an orientation toward forecasting and prediction (Government of Sweden 2011). Both are considered as essential elements in the process of building pathways to the future in the circumpolar region.

Embodied within this endeavor is a commitment to secure adequate data and information regarding the physical, biological and social dimensions of these northern lands and their residents. Such an initiative is no small undertaking and it has occupied a substantial element of Nordic investigations of the Arctic over the past century. Yet these data gathering exercises have always been linked in the minds of most Nordic explorers, scientists and researchers with how such findings can be best put to the service in preserving and enhancing the ecosystems of the region (Sörlin 2014). With this as background, one of the central elements of the Nordic approach to building pathways to the future in the Arctic has been that of using scientific investigation to assess the prospective needs and opportunities of the region. A number of these efforts are outlined in the subsequent chapters of this volume.

Another defining characteristic of the Nordic vision of the Arctic's future is an effort to foster and strengthen regional capabilities to respond to ongoing challenges. Whether this is in regard to creating greater resiliency in the face of ongoing climate change or offering new economic and educational opportunities for Arctic residents, all such endeavors require significant attention and investments by government and the private sector in the lands and peoples of the region (Arctic Council 2013). It necessitates, as well, a new awareness and thinking regarding what may be the most necessary environmental, health, education and business investments to be made in the area. In several of the chapters which follow, these undertakings to build and enhance Arctic capabilities and response by the Nordic community and its northern residents are outlined and discussed.

Effective efforts in all of these areas also require commitment and buy-in from the residents of the region. The long-practiced Nordic traditions of democracy and participation demand that this be secured. Yet this has not always been the case. Despite the good intentions of some policy planners and bureaucracies located in the south, indigenous peoples and other northern residents have often felt excluded from the process of designing and building an adequate pathway to the future within their own lands and traditions. New initiatives to establish confidence and trust and to incorporate the views of such individuals and groups need to be undertaken if a productive and harmonious future Nordic Arctic is to be secured (Berg and Klimenko

2016). Examples of some of the innovative efforts to encourage community engagement in knowledge production and policy development are presented and discussed in a number of the chapters within this book.

Finally, still another important element of the Nordic view of the future Arctic is one that calls for regular evaluation and assessment. The Nordic community has long believed in the importance of testing and measuring the impact of major investments of time, energy and resources. Before making such major commitments, the long-established practice has been to investigate the risks and benefits of such investment and to determine, as far as possible, the likely consequences. Careful analysis ahead of funding has been the hallmark of Nordic scientific research (Gustafsson and Røgeberg 2015). Not surprisingly then, both national and pan-Nordic investment in Arctic research over recent decades has followed this pattern. In this book an effort is made to explain why the initiative to create Nordic Centers of Excellence in Arctic research was deemed necessary at this time. Additionally, discussion is provided regarding how such an undertaking can be funded and evaluated over time. The precise processes for assessment and evaluation of this major Nordic research investment in Arctic research are also detailed in this book. Likewise, towards the end of the volume a focused discussion is offered regarding how future Arctic research of this type might be best designed and assessed.

1.6 Nature of the Volume

As noted earlier, the purpose of this volume is to investigate the Nordic community's perspectives on the Arctic and its views on how responsible development As of the region can be achieved. The specific framework in which this examination takes place is the current effort by NordForsk to establish and maintain four Nordic Centers of Excellence for Arctic Research. This initiative and the specific lines of inquiry that have arisen from it provide the basis for this book's consideration of how the needs and aspirations of the contemporary Nordic Arctic are being addressed by some of its leading researchers. Within this volume, there are four important questions or thematic lenses that help to focus and link their separate reporting of their work. The first of these is: How does the research presented provide new insights and understanding of the challenges and opportunities existing in the contemporary Nordic North? The second of these questions is: In what manner does the research discussed inform the process of developing an appropriate policy response? A third shared concern is: How can the use of interdisciplinary teams and methods help to enhance such research efforts? The fourth question that connects and frames the assembled research essays is: How can community engagement and participation become more central to such research inquiries? Each of the contributing authors to this book addresses one or more of these concerns in their individual essays.

The present volume itself is divided into six parts. The first part includes this introductory essay by the editor that seeks to provide an overview of the Nordic

community, its traditional views of the Arctic, and some of the shared concerns of its citizens regarding the current needs of the region. It also touches upon some of the necessary requirements for constructing a pathway for action to meet them. This discussion is complemented by an accompanying chapter offered by Gunnel Gustafsson, the former Director of NordForsk, which looks at the circumstances that led to that body's decision to create a Joint Nordic Arctic Research Initiative. This essay also considers some of the research objectives and future policy discussions that NordForsk sought to encourage through such action. Together, the material contained in this first portion of the volume provides the context for the subsequent reporting of the specific research efforts by the four Nordic Centers of Excellence.

The second part of the book is devoted to the CLINF Center of Excellence. This multidisciplinary and multinational research effort is aimed at examining how climate change is having an impact on the health of animals and humans within a region stretching from Greenland to Siberia. The first chapter in this part is written by the co-directors of the Center, Birgitta Evengård of Umeå University and the Tomas Thierfelder of the Swedish University of Agricultural Sciences (SLU). Within their essay they provide both an overview of some of their specific research efforts and a discussion of their central goal of establishing a consortium of scientists to address the growing problem of climate sensitive infections (CSIs) in the Arctic. They also consider how the various research findings stemming from their work can be best communicated and shared with decision-makers and the public of the region.

The following chapter—also written by Professors Thierfelder and Evengård—offers a more detailed discussion of the methods utilized within the CLINF project to provide a synergetic assessment of CSIs in the Arctic. Here attention is directed toward the project's collation and dissemination of relevant data and the development of real-time surveillance programs for selected infectious diseases in the area. Consideration is also given to efforts to design CLINF as truly integrated research project with defined linkages between its several areas of concern and the sharing of information and data. It also explores some of the challenges associated with implementing an interdisciplinary science approach and creating a process of bilateral engagement with stakeholders and knowledge users at the local, national and international levels.

The third chapter in this part of the book picks up on this discussion of methods and highlights efforts by the CLINF team to advance new approaches at forecasting future aquatic and land-based environmental conditions that can lead to the development and spread of CSIs. Authored by a team of researchers led by Gia Destouni of Stockholm University and Shaun Quegan of Sheffield University, the chapter seeks to describe the available environmental models that could be utilized and the necessary data required to drive and test them. They also discuss new ways in which to quantify the uncertainty within these models so that they can be better utilized within the context of Arctic CSI prediction.

The final contribution to this part of the volume that focuses on the CLINF project is provided by a group of researchers led Grete Hovelsrud of Nord University in Norway, Camilla Risvoll from the Nordland Research Institute and Jan Åge Riseth

of the Norwegian Research Institute (NORCE). In this jointly authored essay, the investigators describe their efforts within CLINF to examine how multiple stressors—including climate change and CSIs—are creating new challenges for Sámi reindeer herders in northern Norway. In their investigation, they focus their attention on how resource development and other human activities combine with climate change to necessitate adaptation strategies by the herders. They go on to discuss the necessary requirements for some of these. They also explore how local and traditional knowledge from the region may play a significant role in helping to develop the most effective of these approaches.

The third portion of this volume is devoted to the research efforts of the ARCPATH Arctic Centre of Excellence. In begins with an overview of the main objectives of the Centre. This essay is jointly authored by the lead coordinators of the Center, Astrid Ogilvie of the Stefansson Institute in Iceland and Yongqi Gao of the Nansen Environmental and Remote Sensing Centre in Norway, along with several of their fellow key investigators. The chapter focuses on the three central goals of ARCPATH: (1) to predict regional changes in Arctic climate over the coming decades; (2) to increase understanding and reduce uncertainties with regard to how climate change interacts with various societal factors; and (3) to utilize this combined knowledge to improve regional climate predictions and assist Arctic coastal communities in their efforts at adaptation. The several different work packages of the ARCPATH project are detailed as well as the necessary coordinating efforts to advance such multidisciplinary and integrative research that is aimed at building pathways to action.

The following chapter in this part of the book is focused on ARCPATH's development and utilization of sophisticated computer-based climate models. Shuting Yang of the Danish Meteorological Institute and some of her ARCPATH colleagues explain how these climate models seek to represent the known physics of the North Atlantic climate system, which includes the atmosphere, ocean, land surface and ice of the region. They then describe how these models can be utilized for a number of purposes including studying the dynamics, interactions and feedbacks within the climate system, examining climate variability in the past and present, and in predicting the dimensions of future climate change. The authors note that ARCPATH applies regional high-resolution climate models and decadal climate predictions to provide more accurate information of climate change in the Arctic and the Nordic seas over the coming years. This is vital knowledge for efforts focused on community resilience and adaptation within northern coastal areas.

The third essay in this ARCPATH focused part of the book looks specifically at such efforts. Laura Malinauskaite and her colleagues from the University of Iceland considers the cases of Andenes in Norway, Ilulissat in Greenland, and Húsavik in Iceland with regard the changing availability of marine mammals close to these communities. She applies the concept of Ecosystem Services (ES) to consider the multiple benefits derived from the presence of such marine mammals in these northern communities and endeavors to build an enhanced model of the interconnectedness of ecological and sociological processes that result in the enhancement of human wellbeing. In the essay, Malinauskaite and her research

partners provide the reader with an expanded understanding of the underlying processes that enable Arctic coastal communities to benefit broadly from the presence of whales. They also identify key actions from each of the case studies that help to advance our awareness of the necessary requirements for sustainable management of whale resources in the Arctic.

The fourth chapter of this part of the book looks at ARCPATH's efforts to engage local northern communities in its research efforts. Catherine Chambers from the University Centre of the Westfjords and her ARCPATH research partners suggest that community engagement in the research process involves more than communication and outreach. They suggest it must also include the co-production of knowledge. Within this chapter Chambers and her colleagues sets forth what this entails. They argue that there is no single template that can be imposed from the outside in order to further such undertakings. Nonetheless, they take note some of the most effective strategies and best practices that have been advanced. They then explore their possible utilization within the Nordic North. Drawing from their experiences within the ARCPATH project, they advance the idea of a "sliding scale of community engagement" that can be utilized to conceptualize the definition of community engagement activities within in such a large research project and assist evaluators in measuring their effects.

The fourth part of this volume is rooted in the work of the ReiGN Nordic Centre of Excellence. Its first chapter is written by Øystein Holand from the Norwegian University of Life Sciences who is the lead investigator for the Center along with researchers associated with the project. Their essay discusses the major challenges faced by reindeer husbandry across the Nordic North and the need for new data and perspectives in order to create more effective management schemes. They suggest that a real opportunity for interdisciplinary and comparative research exists today within such endeavors. The researchers argue that by integrating both natural and social science perspectives, a more holistic and comprehensive vision can be achieved. They outline in this chapter some the major findings of the ReiGN Center of Excellence and suggests how they can assist in to promoting new societal responses and management methods that could help to create a more adaptive and viable reindeer husbandry in Fennoscandia.

The second chapter of this ReiGN focused part of the book considers one of the chief questions raised by the reindeer herding communities of the region. What are the factors and forces that have led to major fluctuations in reindeer populations in Fennoscandia over the last few decades? Here, Annti-Juhani Pekkainnen and Olli Tahvonen of Helsinki University and Jouko Tahvonen of the Natural Resources Institute of Finland seek to provide some answers to this important concern. They start by examining the different environmental, economic, sociological and regulatory drivers of contemporary reindeer herding. They then utilize bio-economic modeling to illustrate their individual and collective impacts. The authors proceed in their essay to illustrate how such modeling efforts can also be of great assistance in formulating responsive and effective regulatory and management schemes. The stated goal of their research effort is to provide a better understanding of how

sustainable numbers of reindeer can be achieved by utilizing the best analytical approaches, methods and tools.

The next chapter in this part of the book presents another aspect of the ReiGN research project—how social science research methods can highlight other issues of concern to the reindeer herding communities of the Nordic North. The essay considers the difficult question of reindeer herders as "rights holders" versus "stakeholders" within the region. Here Simo Sarkki and Hannu Heikkinen from Oulu University and Annette Löf from the Centre for Sámi Research at Umeå University explore the complex relationship between the two perspectives from conceptual and methodological vantage points. They suggest that the idea of a "rights holder" is a preferable frame to utilize when considering the particular case of Sámi reindeer herders in Finland, Norway and Sweden and offer their reasoning. They argue that such an approach is both more sensitive to the realities of local histories and contributes to situating discussion of rights, stakes and relations within a broader indigenous research literature focusing on decolonizing and dependency. The authors provide illustrative examples of how this alternative perspective advances our understanding of the particular needs and challenges faced by such groups.

The fourth and final chapter of this part of this book addresses the issue of how community engagement in research on reindeer herding in the Nordic North can be accomplished. The co-production of knowledge by combining local insight and experience with traditional scientific methods has been increasingly viewed as a means of both democratizing science and empowering northern communities in the management of natural resources in their areas. In their jointly authored essay, Tim Horstkotte of the Swedish University of Agricultural Sciences (SLU), Élise Lépy of Oulu University and Camilla Risvoll of the Nordland Research Institute discuss the possibility of such an approach within the context of reindeer husbandry within Fennoscandia. In particular, they focus attention on its prospects for promoting regional and cross-national dialogue between herders and scientists on the question of supplementary feeding. They discuss in their chapter how mutual learning can take place and how its insights can be best communicated among both local practitioners and broader policy and management communities. This chapter also provides an excellent example of how researchers from different NCoEs (ReiGN, REXSAC and CLINF) have combined their research interests in the co-production of knowledge to produced significant findings on a collaborative basis and across disciplinary lines.

The fifth portion of the volume is devoted to a consideration of the REXSAC Center of Excellence. Its principal organizer, Sverker Sörlin of the Royal Institute of Technology in Stockholm (KTH), offers an introductory chapter which provides an overview of this multifaceted research initiative that focuses its research efforts on resource extractive industries and their impact on communities in the Nordic Arctic. He outlines in his essay the several lines of investigation that the project embodies and examines key theories of resource extraction and their relationship to ideas of economic development and sustainability in northern settings. He also

considers some of the challenges of working with and applying such policy concepts as sustainability, assessment and "best practices" within such investigations.

The second chapter in this part of the book is written by Dag Avango from the Luleå University of Technology and Gunhild Rosqvist from Stockholm University. In their essay they describe some of the research efforts of REXSAC that examine how mining communities in the Nordic Arctic have dealt with the legacies of past mining operations and under what circumstances such legacies can ascribe new values after extraction has ended. They discuss how the REXSAC investigators have approached this research problem in an interdisciplinary manner combining methods and approaches from the humanities and social sciences in addition to those of the natural sciences. They also consider how this type of inquiry can generate new insights into three main post-extractive processes: environmental remediation, heritage making and re-economization.

The third chapter of this REXSAC-focused part of the book is co-authored by Kirsten Thisted and Frank Sejersted from the University of Copenhagen. In their essay they continue the examination of resource extraction industries in the Nordic North focusing on how emotions and affective response to such undertakings can be best considered. They note that that within the field of resource extraction there has been consensus among past researchers that emotions should be avoided in conducting their analysis. They question the utility of such an approach. The authors investigate how affect and emotion as cultural practices serve to empower discourses that connect—or disconnect—resource extraction efforts with broader undertakings such as community building and nation building. Their analysis is based on REXSAC supported studies and field work in Greenland and in the Sámi communities of northern Scandinavia.

The sixth and final part of this volume is centered on the challenges of research synthesis , evaluation and assessment. It features an initial chapter by Leslie King of Royal Roads University and Astrid Ogilvie of the Stefansson Arctic Institute that examines the need for collaborative research and the difficulties—and promise—of harvesting and integrating research findings across geographic and disciplinary divides. They discuss the challenge of such synergistic efforts within the context of the ARCPATH project. The second chapter of this final portion of the book is co-authored by Andre van Amstel of Wageningen University, Amy Lovecraft of the University of Alaska, Roberta Marinelli of Oregon State University and the editor of this volume, all of whom have served on the Scientific Advisory Board for NordForsk's Joint Nordic Arctic Research Initiative. In their essay the authors explore how assessment and evaluation have been integral components of the overall project and some of the specific steps they have pursued in performing their important role in measuring the progress and accomplishments of the NCoEs. They discuss what have been some of the collective strengths and limitations of the four projects. The authors take a brief look at how other research bodies elsewhere in the world have promoted, developed and assessed similarly large and multidisciplinary research efforts. They also consider some of the specific challenges inherent in conducting such inquiries within the Arctic today.

This theme of evaluation is further advanced in the concluding chapter of the book. Here, Douglas Nord, the editor of the volume considers the overall impact of the Joint Nordic Arctic Research Initiative. He highlights what have been some of the most significant conceptual and methodological insights and innovations that have emerged from its sponsored inquiries. He describes how the Centers of Excellence have advanced the effort of conducting important scientific research utilizing multidisciplinary teams and perspectives. The author also considers how new efforts at knowledge building in the Nordic North can facilitate the construction of participatory bridges between researchers and residents of northern communities. He also argues that the NCoEs have also played critical roles in suggesting what may be appropriate directions for future policy formulation. Most of all, he suggests that the new Centers of Excellence in Arctic Research have encouraged a close examination of some of the major concerns of the Nordic communities regarding the Arctic and equipped them with the necessary analytical tools to construct new pathways to action.

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