

Glomsrød, Solveig (Ed.); Duhaime, Gérard (Ed.); Aslaksen, Iulie (Ed.)

Book

The economy of the North 2015

Provided in Cooperation with:

Statistics Norway, Oslo

Reference: (2017). The economy of the North 2015. Oslo-Kongsvinger : Statistisk sentralbyrå.

This Version is available at:

<http://hdl.handle.net/11159/2919>

Kontakt/Contact

ZBW – Leibniz-Informationszentrum Wirtschaft/Leibniz Information Centre for Economics
Düsternbrooker Weg 120
24105 Kiel (Germany)
E-Mail: [rights\[at\]zbw.eu](mailto:rights[at]zbw.eu)
<https://www.zbw.eu/>

Standard-Nutzungsbedingungen:

Dieses Dokument darf zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden. Sie dürfen dieses Dokument nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, aufführen, vertreiben oder anderweitig nutzen. Sofern für das Dokument eine Open-Content-Lizenz verwendet wurde, so gelten abweichend von diesen Nutzungsbedingungen die in der Lizenz gewährten Nutzungsrechte. Alle auf diesem Vorblatt angegebenen Informationen einschließlich der Rechteinformationen (z.B. Nennung einer Creative Commons Lizenz) wurden automatisch generiert und müssen durch Nutzer:innen vor einer Nachnutzung sorgfältig überprüft werden. Die Lizenzangaben stammen aus Publikationsmetadaten und können Fehler oder Ungenauigkeiten enthalten.

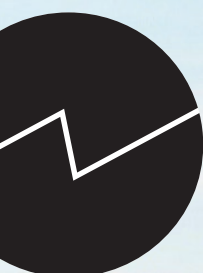
<https://savearchive.zbw.eu/termsfuse>

Terms of use:

This document may be saved and copied for your personal and scholarly purposes. You are not to copy it for public or commercial purposes, to exhibit the document in public, to perform, distribute or otherwise use the document in public. If the document is made available under a Creative Commons Licence you may exercise further usage rights as specified in the licence. All information provided on this publication cover sheet, including copyright details (e.g. indication of a Creative Commons license), was automatically generated and must be carefully reviewed by users prior to reuse. The license information is derived from publication metadata and may contain errors or inaccuracies.

Solveig Glomsrød, Gérard Duhaime and Iulie Aslaksen (eds.)

The Economy of the North 2015



Sustainable Development
Working Group



ARCTIC COUNCIL



Statistisk sentralbyrå
Statistics Norway

°CICERO



Nordic
Co-operation

*Solveig Glomsrød, Gérard Duhaime and
Julie Aslaksen (eds.)*

The Economy of the North 2015

Statistiske analyser

I denne serien publiseres analyser av statistikk om sosiale, demografiske og økonomiske forhold til en bredere leserkrets. Fremstillingsformen er slik at publikasjonene kan leses også av personer uten spesialkunnskaper om statistikk eller bearbeidingsmetoder.

Statistical Analyses

In this series, Statistics Norway publishes analyses of social, demographic and economic statistics, aimed at a wider circle of readers. These publications can be read without any special knowledge of statistics and statistical methods.

© Statistics Norway

When using material from this publication,
please give Statistics Norway as your source.

Published 21 March 2017

ISBN 978-82-537-9508-9 (print)

ISBN 978-82-537-9509-6 (electronic)

ISSN 0804-3221

Design/cover: Siri E. Boquist

Cover photo: Davin Holen

Print: Statistics Norway

Standard symbols in the tables**Symbol**

Category not applicable	.
Data not available	..
Data not yet available	...
Not for publication	:
Nil	-
Less than 0.5 of the unit employed	0
Less than 0.05 of the unit employed	0.0
Provisional or preliminary figure	*
Break in the homogeneity of a vertical series	—
Break in the homogeneity of a horizontal series	
Revised since the previous issue	r

Preface

The objective of *The Economy of the North 2015* is to present a comprehensive overview of the economy of the circumpolar Arctic, including the traditional production activities of the indigenous peoples. The report has been produced as part of the ECONOR III project, carried out under the Sustainable Development Working Group (SDWG) in the Arctic Council. The ECONOR III project was carried out with Norway as lead country, Canada and the United States as co-leads, and the Saami council as co-lead among the Permanent Participants of indigenous organizations.

The ECONOR III project is mainly funded the Norwegian Ministry of Foreign Affairs and the Nordic Council of Ministers. Additional financial support is provided by institutions participating in the ECONOR network of statistical bureaus and academics, the Arctic Monitoring and Assessment Program (AMAP), and the Research Council of Norway (NFR). The work is supported by cooperation with the projects GLOBIO and Nature Index and Nomadic Herders Sápmi funded by the Norwegian Ministry of Climate and the Environment (KLD). The Arctic Council working group Conservation of Arctic Flora and Fauna (CAFF) has provided data and scientific advice.

The *Economy of the North 2015* is the result of contributions from the ECONOR network of experts and researchers from national statistical offices and academic institutions located across the Arctic nations, and data have been compiled from many sources. Without the expertise and contributions from the ECONOR network, and their access to data sources, this report could not have been produced. While the report is the result of contributions from the entire ECONOR network, the individual chapters bear the names of the authors. Statistics Norway has hosted the editorial group that compiled and edited the contributions from the project network.

Several sections in Statistics Norway have contributed to the ECONOR III report with data for Norway and statistical advice. The National accounts section has provided data, including data from satellite account for tourism. The Manufacturing and R&D statistics section has compiled the presentation of Svalbard statistics. The Population statistics section has contributed the presentation of Sámi statistics. The Natural resources and environmental statistics section has provided land use data. The International secretariat has provided support and cooperation with the Barents secretariat.

The present report is a pioneering work in the sense that the path outlined in the first two ECONOR reports *The Economy of the North* and *The Economy of the North 2008* is still new and relatively unexplored, with various challenges of statistical and conceptual nature. *The Economy of the North 2015* updates the time series of the previous ECONOR reports.

The *Economy of the North 2015* was edited by Solveig Glomsrød (chief editor) of CICERO, Gérard Duhaime (co-editor) of Université Laval, Quebec, and Iulie Aslaksen (co-editor and project leader) of the Research Department of Statistics Norway. Lars Lindholt of the Research Department of Statistics Norway also participated in the editorial group. Marit Vågdal did the technical editing, and Siri Boquist was the photo editor. The *Economy of the North 2015* and the previous ECONOR reports are available at www.ssb.no.

Statistics Norway thanks all the individuals, institutions and organizations having provided support, funding, data, analysis, texts, illustrations, and scientific and statistical advice for *The Economy of the North 2015*. Since data are compiled from different sources in several countries, Statistics Norway has not followed standard quality assurance, and a disclaimer applies, where it is emphasized that data and interpretations are the responsibility of the respective authors and not of Statistics Norway or the cooperating institutions or the funding agencies.

The *Economy of the North 2015* is submitted to the Arctic Council in order to become deliverable to the 2017 Ministerial Meeting of the Arctic Council.

Statistics Norway, 3 February 2017

Kjetil Telle

Contents

Preface	3
1. The Economy of the North 2015: An introduction	7
<i>Solveig Glomsrød, Gérard Duhaime and Iulie Aslaksen</i>	
2. Social and economic inequalities in the circumpolar Arctic.....	11
<i>Gérard Duhaime, Andrée Caron, Sébastien Lévesque, André Lemelin, Ilmo Mäenpää, Olga Nigai and Véronique Robichaud</i>	
Box I. The use of Purchasing Power Parities in this report.....	24
<i>Bjart Holtsmark and Taoyuan Wei</i>	
3. Comparative analysis of Arctic economies at macro level.....	27
<i>Ilmo Mäenpää, Solveig Glomsrød and Taoyuan Wei</i>	
Box II. Notes on Gross Domestic Product and Value Added Comparisons Across Arctic Regions	34
<i>Scott Goldsmith</i>	
4. Arctic economies within the Arctic nations.....	37
<i>Solveig Glomsrød, Ilmo Mäenpää, Lars Lindholt, Helen Mc Donald, Taoyuan Wei and Scott Goldsmith</i>	
Box III. The value of having the exclusive right to exploit a natural resource	69
<i>Mads Greaker and Lars Lindholt</i>	
Box IV: Svalbard – coal, tourism and research.....	70
<i>Jan Henrik Wang and Jan Erik Kristiansen</i>	
Box V: Arctic's Emerging 'Other' Economies: Technology, Knowledge and Culture in the New Arctic Economy	74
<i>Andrey N. Petrov</i>	
5. Arctic petroleum extraction under climate policies.....	79
<i>Lars Lindholt and Solveig Glomsrød</i>	
Box VI: Mineral extraction in the Arctic	86
<i>Lars Lindholt</i>	
6. Interdependency of subsistence and market economies in the Arctic	89
<i>Davin Holen, Drew Gerkey, Even Høydahl, David Natcher, Martin Reinhardt Nielsen, Birger Poppel, Paul Inge Severeide, Hunter T. Snyder, Mary Stapleton, Ellen Inga Turi and Iulie Aslaksen</i>	
Box VII. Social responsibility in the Barents region nickel mining industry	127
<i>Adrian Braun</i>	
7. The Arctic as a "hotspot" for natural resource extraction and global warming	129
<i>Birger Poppel, Mads Fægteborg, Mia Olsen Siegstad and Hunter T. Snyder</i>	
8. Tourism in the Arctic: economic impacts	137
<i>Kristine Grimsrud</i>	
9. Ecological change in Arctic regions – a GLOBIO3 pilot study of impacts on biodiversity	149
<i>Wilbert van Rooij, Iulie Aslaksen, Philip Burgess, Per Arild Garnåsjordet and Svein D. Mathiesen</i>	
10. Concluding remarks.....	163
<i>Solveig Glomsrød, Gérard Duhaime and Iulie Aslaksen</i>	
List of authors and other contributors	164
List of figures	165
List of tables.....	168

1. The Economy of the North 2015: An introduction

Solveig Glomsrød, Gérard Duhaime and Iulie Aslaksen

The Arctic regions belong to different national regimes, and information on social and economic issues has been dispersed and not been easily available at the circumpolar level. A central task of the ECONOR III project has been to contribute to filling this gap by presenting a comprehensive overview of the scale and structure of the circumpolar Arctic economy. Among several good reasons for compiling an overview of the circumpolar Arctic economy is a need for an information platform from where to assess the sustainability of the Arctic communities in terms of natural wealth management and vulnerability towards climate change and global policies and trends.

The Economy of the North 2015 report finalizes the ECONOR III project which has been headed by Statistics Norway, Center for International Climate and Environmental Research – Oslo (CICERO) and Université Laval, Quebec, Canada, in cooperation with a circumpolar network of statisticians and academics. The purpose of this third report has been to update the economic statistics of the previous versions, The Economy of the North, published in 2006, and The Economy of the North 2008, and to include a wider set of socioeconomic variables to more clearly depict the livelihood of Arctic people¹. Other objectives have been to shed light on the value of natural resources in the Arctic and to bring forward knowledge about how indigenous peoples manoeuvre between subsistence activities and the market economy.

The Arctic Region as referred to in this report is depicted in the map in Figure 3.1. It covers Northern Russia with the Republics of Karelia and Komi, the Murmansk and Arkhangelsk Oblasts, the Yamal-Nenets and Khanty-Mansii Autonomous Okrugs, the Taimyr and Evenk former Autonomous Okrugs, the Republic of Sakha, the Magadan Oblast, and the Chukotka and Koryak Autonomous Okrugs. The American Arctic includes Alaska and the Northern territories of Canada (Northwest Territories, Yukon, Nunavut). The European Arctic consists of Greenland, Faroe Islands, Iceland and Arctic

Norway (including the Svalbard Archipelago and Jan Mayen), Arctic Sweden and Arctic Finland.

Following changes in the Russian Federation legislation, the statistical definitions of Arctic Russia have been changed. In The Economy of the North 2015 we present data for the regions previously defined as Arctic Russia, in order to retain time series and achieve statistical comparability. In the new definition, Karelia, Khanty-Mansii and Magadan do not belong to the Arctic Zone, while several regions of Krasnoyarskiy Krai and entire Nenets Autonomous okrug do. Previously included regions – Evenk autonomous okrug and Taimyr autonomous okrug – have become parts of Krasnoyarskiy Krai and Nenets autonomous okrug.

Since the publication of The Economy of the North 2008, the backdrop of this statistical work has shifted considerably. A global financial and economic crisis in 2008 rearranged the framework for economic activity, above all for resource based industries, dominating most Arctic economies. It takes time before regional statistics is updated. The previous report brought new evidence of how the shifting of gear in the global economy affected the Arctic economies and living conditions of the population, by capturing the development in a period where prices on petroleum and



Settlement, Greenland. Photo: Crestock

minerals embarked upon steeply rising curves. This updated report reflects a period with resource prices going all time high in 2008, then falling dramatically before peaking again and returning to pre-crisis levels in 2012, which is the most recent year we capture.

The financial crisis had deep impacts globally, but left particularly marked footprints in the less diversified Arctic economies. Although resource income in several



Highway running through Alaska wilderness/Crestock

regions are transferred to owners outside the Arctic regions, and declines in income thus primarily will be felt outside the Arctic, the regional and local tax revenues, royalties and wage income also suffer.

Chapter 2 presents in telling figures how this situation affects core elements in human welfare in Arctic regions. The composition of the population, the life expectancy and rate of infant mortality are all observations that convey crucial information on livelihood and living conditions, which gross regional product (GRP) for Arctic regions cannot convey: A quick glance at GRP would not bring us close to the reality concerning the basis for livelihood, because a substantial share of GRP is from petroleum and mining activities largely owned and taxed from outside the region itself.

Chapter 3 looks at the Arctic with a bird's eye perspective and presents macro level data of land area, population, GRP per capita and disposable income of households per capita by region. Regional data are depicted in relation to the non-Arctic regions of the corresponding Arctic states, and to the circumpolar level.

It is important to have in mind that the data in this report on revenues in resource extraction of production include the wealth component of natural resources. In resource rich communities like the Arctic regions the sustainability of wealth management is particularly important. Resources that have been extracted from the ground represent a loss in wealth that conceptually should not be counted as income. However, by national account conventions they are still included in income. Because the natural wealth is not explicitly accounted for, resource revenues can easily be consumed contrary to principles of long-term sustainability. To avoid myopic behaviour, revenues from petroleum production have

in some cases partly been invested in financial funds. An alternative or supplement could be more investment in human capital. As the Arctic economies generate a substantial share of their income from resource extraction, it would have been useful to have data for genuine income generation in addition to the value of straight-forward resource depletion. The Arctic region has higher extraction costs than in other regions and consequently the wealth loss component of reported income tends to be lower. As the report illustrates, however, the shares in GRP of extractive industries in the Arctic regions are high and it therefore remains a relevant question for the Arctic regions if wealth management is sustainable from their perspective.

On the other hand, the scarcity of pristine nature implies that the wealth component of nature is increasing. The nature value of Arctic wilderness, northern lights, rich biological resources, and traditional living, shows up indirectly in income data for tourism and harvesting of renewable resources. The increased demand for other nature values has sharpened conflicts over land use between mineral industries and the renewable nature based industries, not the least for traditional living, with hunting, fishing and herding by indigenous peoples. In some regions these conflicts have reached the political arena at Arctic state level, in particular with respect to petroleum and mineral extraction. These aspects are to some extent captured in Chapter 4, looking more closely into the regional economic activities.

Chapter 4 on The Arctic Economy within the Arctic Nations leaves the circumpolar perspective and looks closer at the role of each regional economy in the national context. The core tables in this chapter are compiled to present a consistent set of data by region, when possible at the same level of detail by industry

in order to show economic structure in comparable categories.

Petroleum in the Arctic is the topic of chapter 5. Natural resource wealth is not really a fixed fortune – in real economic terms natural wealth of a certain resource will increase or decline along with our preferences and needs – including what will be perceived as a cost of future greenhouse gas emissions.

One of the large uncertainties confronting the investors in the Arctic is the future price of petroleum, as well as the uncertainty about impacts of future climate policies. The New Policies Scenario of IEA expects the price of crude oil (in 2015 USD) to be USD 79 in 2020, rising to USD 124 by 2040². However, if climate policy efforts manage to prevent global warming beyond 2 °C as agreed upon in Paris, the corresponding oil prices will have to be USD 73 and USD 78, still above the level of USD 60-70, which the oil industry holds as sufficient for making substantial resources in the Arctic attractive from a commercial point of view. For natural gas, policies for a 2 °C scenario will reduce gas prices in the US, EU China and Japan by 12- 22 per cent in 2040. In climate policies the need for alternatives to coal is urgent. Natural gas, with lower emissions per energy unit, is seen by many as part of the solution. Chapter 5 presents a model based analysis of the impact of climate policy on the prospects for gas and oil exploration in Arctic regions towards 2050.

This report has a strong focus on the commercial activity in the Arctic. For several of the Arctic regions, employment and revenues from petroleum and mineral extraction or commercial fisheries are the pillar of the economy. However, the Arctic has a rich wildlife that provides substantial nutritional and cultural values to the Arctic communities. Fishing and hunting for own consumption and sharing is a major source of subsistence livelihood for many people³. This source of income and consumption may at first glance seem to be decoupled from the shifting performance of the global economy – but even this local and mostly unregistered production feels the change, because availability of cash income from wage income and sales is important for being able to purchase equipment and means of transportation for hunting, fishing and herding. In Alaska, dividends from the Alaska Permanent Fund are an important source of funding for the subsistence activities. Hence, subsistence activities and the cash economy are mutually dependent on each other for providing consumption possibilities in the Arctic today, and are at the same time part of a lifestyle that represents continuity, sharing and connection to nature.

Chapter 6 on the interdependency of subsistence and market economies in the Arctic gives a brief overview of the importance of subsistence activities in different Arctic regions. With some notable exceptions, as in Alaska, subsistence activities are mostly invisible in official statistics. Chapter 6 provides information

on subsistence activities in Alaska, Northern Canada, Northern Russia and Greenland, and on the economy of Sámi reindeer husbandry in Norway. Some results from the SLiCA- Survey of Living Conditions in the Arctic – project are reported⁴.

The Arctic as a hot spot is highlighted in case studies of environmental and social challenges from mining projects. Chapter 7 conveys results from surveys among local people near a rare earth minerals/uranium mining project, on their access to information, income opportunities and concerns about potential pollution and damage to agriculture and tourism. A circumpolar study of the economic importance of tourism is presented in Chapter 8.

Land use conflicts arise between the global demand for energy and resources and the traditional management of land and renewable resources by indigenous peoples and other local people. Impacts of land use change and climate change are illustrated by pilot studies with the GLOBIO model in Chapter 9.

Climate change impacts on the economies of the Arctic regions, which at the time of the first ECONOR project were in their initial phase, are now happening at a large scale. What was previously projected to take place in the distant future is now occurring. The sea ice is at its lowest level. Coastal areas erode, the process of thawing permafrost is running and wildlife is disturbed. These effects are already affecting the Arctic economies, however, in a macro level overview like ECONOR climate effects are still over-shadowed by other changes and turbulence in resources rich and small economies. However, a notable case is that from 2011 the temperature sensitive mackerel came north to Greenland in sufficient number to contribute markedly to income from fisheries and export.

Presenting an economic overview of the Arctic regions in comparable terms offers some particular challenges that go beyond the question of quality and coverage. To add up or compare income accounted for in different countries it is necessary to transform the numbers to a common currency. The US dollar is frequently used for this purpose, and most people have an understanding of how much a dollar can buy in the world market. However, a translation of income based on a straightforward use of market exchange rates will normally lose some of the information about the true capacity to consume in the domestic market of a specific region. To adjust for price differences in domestic markets purchasing power parity (PPP) indicators have been established as an attempt to harmonize income measures across regions. However, the PPP transformation may sometimes lead to biased assessment of income from the production activities in different regions. This problem is further discussed in Box I.

Some Arctic regions are regions within states, and it is a general phenomenon that regional economic statistics



has been less developed and is less complete than the one at the national level. It may also occur that regional data are unavailable at detailed level due to confidentiality reasons as the number of enterprises involved is too low. Further, some Arctic regions are nations or autonomous regions with small populations and limited capacity for economic statistics and national accounts.

The major challenges associated with production of regional statistics are outlined in Box II. Due to the diversity in the statistical material, the data and interpretations in this report should be read with care.

The data have been given a common format facilitating comparison of income, production and economic structures among the individual Arctic regions. This represents a major improvement on earlier available material and may work as building block in a further process towards a harmonized database on arctic economic issues. The path outlined in the ECONOR reports is still new and relatively unexplored. For example, the definitions of household equivalent income for studies of inequality may be different in different Arctic regions.

It is our hope that the present overview of the Arctic economy will inspire work to further strengthen the information basis from where to assess the sustainability of the Arctic communities in terms of natural wealth management and environmental challenges.

Notes

¹ Glomsrød, S. and I. Aslaksen (2006): The Economy of the North. Statistics Norway, SA 84. Glomsrød, S. and I. Aslaksen (2009): The Economy of the North 2008. Statistics Norway, SA 112.

² IEA (2016): World Energy Outlook 2016 OECD/IEA, Paris.

³ AHDR (Arctic Human Development Report) I and II.

⁴ SLiCA- Survey of Living Conditions in the Arctic.

The circumpolar ECONOR network consisted of the following persons and institutions:

Alexander Goncharov, Federal State Statistical Service, Russia

Gérard Duhaime, Université Laval, Canada (Co-editor)

Andrée Caron, Université Laval, Canada

Helen McDonald, Statistics Canada

Ilmo Mäenpää, University of Oulu, Finland

Birger Poppel, Ilisimatusarfik, University of Greenland

Marianne Eriksson, Statistics Sweden¹

Scott Goldsmith, University of Alaska at Anchorage, USA

Davin Holen, University of Alaska at Fairbanks, USA

Andrey Petrov, University of Northern Iowa, USA

Edita Zahirovic, Statistics Norway

Lars Lindholt, Statistics Norway

Solveig Glomsrød, CICERO Center for International Climate and Environmental Research (Chief editor)

Iulie Aslaksen, Statistics Norway (Co-editor)

¹ Statistics Sweden has not been actively involved in the ECONOR III project, however, for future ECONOR projects we aim to achieve more active cooperation with Statistics Sweden along with all national statistical offices of the Arctic states.

The editorial group at Statistics Norway and CICERO has consisted of:

Solveig Glomsrød, CICERO (Chief editor)

Iulie Aslaksen, Statistics Norway (Co-editor)

Lars Lindholt, Statistics Norway

The editorial group at Université Laval, Quebec, Canada has consisted of:

Gérard Duhaime, Université Laval (Co-editor)

2. Social and economic inequalities in the circumpolar Arctic

Gérard Duhaime, Andrée Caron, Sébastien Lévesque, André Lemelin,
Ilmo Mäenpää, Olga Nigai and Véronique Robichaud

Translated from French (Canada) by Elliott Macklovitch

I remember the bright silks and sparkling faces I had seen that day, in gala trim, swanlike sailing down the Mississippi of Broadway; and I contrasted them with the pallid copyist, and thought to myself, Ah, happiness courts the light, so we deem the world is gay, but misery hides aloof, so we deem that misery there is none.

Herman Melville, *Bartleby the Scrivener*, 1853

Introduction

Although social and economic inequalities appear in social science studies of the Arctic, they are rarely the focus of systematic attention at the level of the entire circumpolar region. Recent large-scale international research programs provide numerous indications of the presence of such inequalities. In the update of the Arctic Human Development Report (AHDR), dimensions like demography, health, education and the economy are examined in an effort to identify the principal trends that have marked the last decade. The report highlights significant disparities between rich and poor regions, or between regions with high or low levels of education¹. In the wake of the AHDR, the Arctic Social Indicators (ASI) program proposes a human development monitoring system with a series of indicators that characterize the situation in each region. The ASI program's latest publication offers regional case studies with rich data sets, and reveals several types of inequalities, such as in urban or rural areas or in the indigenous or total population². Finally, the Megatrends program, run by the Nordic Council of Ministers, identifies numerous contrasts between Arctic regions, as regards, for example, the level of economic development or industrial structure³.

Several studies agree that growth in inequalities and their increasing complexity are central characteristics of globalization⁴. Since 1980, on a world-wide level, the following appears to be dominant trends in these inequalities: they have declined between nations, but have increased within nations, especially within rich nations⁵. The reasons for the relative increase in inequalities within rich countries (partial deindustrialization, job insecurity, rise in poverty) are different from those in poor countries (export-driven development). Moreover, in most countries, the gap between the richest and poorest segments of society has widened under the influence of similar forces.

Many recent studies suggest that the circumpolar Arctic is involved in the process of globalization, with considerable impact on economic structure, socio-economic conditions and social inequalities. Some support this assumption with a few relevant indicators; others illustrate the basic mechanisms with empirical arguments that are more or less detailed, borrowed mainly from international law, geopolitics or economics⁶.

In our previous comparative study for 2006, in *The Economy of the North 2008*, we showed that there are important differences in social and economic conditions across the circumpolar Arctic⁷. We collected widely used indicators of demography, health, education and economic situation. The results suggested the existence of distinct patterns that characterized the socio-economic differences between the main geopolitical groups of Arctic regions, in North America, the Nordic countries, and the Russian Federation. In North America, the indicators generally showed the most favourable economic and social conditions for human development; in Arctic Russia, they generally showed less favourable economic and social conditions, while the Arctic regions of the Nordic countries were somewhere in the middle. In short, the indicators pointed to social situations that were quite specific, corresponding to different political and economic systems of the Arctic regions. However, none of these general patterns reflected the situation in all sub-regions. The situation in the most prosperous sub-regions - Alaska, Troms



Greenland/Colorbox

Table 2.1. **Selected social and economic indicators¹ and composite index². Arctic regions. 2012³**

Regions	Population	Population growth 2000-2012	Female rate	Youth rate	Demographic dependency	Life expectancy	Infant mortality	Tertiary education	Economic dependency	Disposable income ⁴	GDP	Composite index
	N	Per cent			Ratio	Years	Per 1000 live births	Per cent	Ratio	USD-PPP per cap		n
Alaska	731 449	1.3	47.9	14.5	0.43	78.0	5.2	36.2	0.6	43 394	78 515	7.13
Northwest Territories	41 460	0.7	49.2	21.7	0.38	78.1	7.2	20.1	0.6	30 993	88 936	6.00
Nunavut	31 905	2.1	48.6	32.7	0.56	73.8	26.3	10.5	2.1	24 735	52 742	3.97
Yukon	33 900	1.5	49.7	17.3	0.36	77.4	0.0	25.4	0.7	33 219	59 823	6.13
Faroe Islands	48 211	0.4	48.1	21.5	0.58	82.0	6.3	41.5	0.7	16 713	35 056	5.37
Lapland	182 844	-0.5	49.8	20.5	0.56	80.0	..	23.7	1.4	17 430	33 269	3.98
Oulu	400 670	0.8	49.6	20.5	0.57	80.8	..	27.1	1.4	16 756	32 760	4.60
Kainuu	80 685	-1.0	49.9	14.6	0.59	79.0	.	22.0	1.3	17 090	28 282	3.57
Greenland	56 749	0.0	47.1	22.0	0.41	70.9	8.9	16.0	1.2	12 258	30 085	3.72
Iceland	319 575	1.1	49.8	18.4	0.50	82.3	1.1	27.3	0.9	17 152	39 866	5.36
Finnmark	73 787	0.1	48.7	17.7	0.50	78.9	2.3	23.3	0.9	22 062	41 479	4.75
Nordland	238 320	0.1	49.7	18.1	0.55	80.5	1.6	22.3	1.0	21 560	40 493	4.62
Troms	158 650	0.5	49.5	14.8	0.51	80.3	6.0	26.6	0.9	22 265	42 403	5.09
Norrbotten	248 591	-0.3	49.2	15.7	0.59	80.8	..	15.9	1.1	18 832	47 336	3.91
Vasterbotten	259 942	0.2	49.7	17.1	0.55	81.2	..	20.7	1.1	17 615	34 992	4.22
Arkhangelsk	1 213 533	-1.2	53.3	17.1	0.66	70.1	7.1	17.5	1.0	14 689	22 985	3.41
Chukchi	50 988	-1.3	49.3	22.2	0.49	60.7	21.2	21.2	0.5	27 212	53 396	4.04
Karelia	639 681	-1.2	54.4	16.3	0.66	68.6	7.6	19.1	1.1	12 545	14 291	3.46
Khanty-Mansii	1 561 238	0.7	51.1	20.9	0.47	71.9	4.5	24.0	0.7	22 774	91 425	5.47
Komi	889 837	-1.5	52.8	18.1	0.57	68.7	5.9	17.8	0.9	16 404	31 292	3.65
Magadan	154 485	-2.2	51.5	17.1	0.53	66.5	8.4	23.7	0.7	22 544	29 940	3.59
Murmansk	787 948	-1.5	52.2	16.6	0.55	69.9	6.6	21.0	0.9	17 449	21 730	3.91
Sakha	955 859	0.0	51.4	23.5	0.58	68.3	9.6	21.6	1.0	17 630	32 710	4.14
Yamal-Nenets	536 558	1.2	49.7	21.8	0.43	70.7	10.5	26.6	0.4	31 511	111 899	7.25

¹ Population growth: average annual per cent; female rate: per cent women in total population (relative to global average at 49.59 in 2012, from World Bank); youth rate: per cent of 0-14 years in the total population; demographic dependency: (0-14) + (65 +) / (15-64); infant mortality: per 1000 live births; tertiary education: per cent of tertiary level graduates in total population; economic dependency: (non-employed/employed person in total population); disposable income: personal disposable income in 2010 USD-PPP; GDP: gross domestic product in 2010 USD-PPP.

² The composite index calculation does not take into account total population and infant mortality.

³ Alaska: life expectancy 2010; Canada: 2011, except economic data 2012; Norway: life expectancy 2010, infant mortality 2011; Russia: educational attainment 2010. For infant mortality data were not available by the time of collecting data. For Candada the 2011 census data were used. Regarding the Yukon infant mortality rate, it was 0.0 for 2011, but for 2012 it was 2.2.

⁴ The discrepancy between the household disposable income data presented in this chapter and Chapter 3 can be explained by the different conversion procedures used: in this chapter, the household disposable income has been converted in PPP to ensure comparability across the regions, and based on constant 2010 prices to ensure comparability between 2006 and 2012. In Chapter 3, the household disposable income was not compared across time and was based on constant 2010 USD-PPP.

and Yamal-Nenets – was very different from that of the poorest sub-regions – Nunavik, Greenland and Arkhangelsk. We found that the key to a proper explanation lay both in the local characteristics and in the structure of society, such as population size, proportion of indigenous peoples, industrial structure, infrastructure development, natural resources extraction regimes, political conditions, as well as globalization as a factor that generates social inequalities.

The study reported in this chapter updates and extends the comparative study and explores some aspects of inequality in economic and social conditions across the circumpolar Arctic. We extended the methodology we developed for *The Economy of the North* 2008, in order to compare the situations in 2012 and 2006. Comparing the indicators allowed us to verify whether the models we previously identified for 2006 are still relevant in 2012. The results also allowed us to see if the relative ranking of regions and sub-regions is still valid.

Methodology

Our study focuses on demography, health and education, and the economic situation. We gathered additional indicators and revised and harmonized the set of indicators for 2006 and 2012, the most recent year for which data were available. We collected data for 2006 and 2012 on the following ten indicators: (1) proportion of women in the total population, (2) life expectancy at birth, (3) infant mortality rate, (4) graduation rate at the tertiary education level, (5) disposable income per capita, (6) economic dependency ratio (proportion of non-employed persons to employed persons in total population), (7) population growth, (8) demographic replacement rate (proportion of women in reproductive age to children from 0 to 14 years), (9) demographic dependency ratio (proportion of children and elders to adults), and (10) gross regional product (GRP) per capita. GRP is gross domestic product (GDP) at regional level (Table 2.1). The indicators were transformed to a common format, presented as an index on a scale from 1 to 10, where 1



Arctic Canada, Igloodik. Photos: Mary Stapleton

represents the least favourable condition, and 10 the most favourable condition for human development⁸ (see Box 2.1). The results were displayed in nine-point radar-shaped diagrams (Figures 2.1 to 2.8), and the more of the total area that is covered, the more favourable are the indicators in terms of human development. A composite index for each region was calculated as average of the scaled indicators (Table 2.1, last column). The composite index and the radar-shaped diagrams do not include infant mortality. Data on infant mortality are no longer recorded for the Arctic regions in Finland and Sweden. Available data on infant mortality are given in Table 2.1 and Annex 2.1. In the previous study for 2006, the proportion of indigenous peoples in the total population was recorded, but in the present study

we did not not retain this indicator, as a lack of systematic data on indigenous peoples prevails, and the efforts required to overcome this obstacle were beyond the reach of this study.

Our study covers the following regions of the circumpolar Arctic: Alaska (USA); Yukon, the Northwest Territories and Nunavut (Canada); Greenland and the Faroe Islands (Denmark); Iceland; Finnmark, Troms and Nordland (Norway); Norrbotten and Vasterbotten (Sweden); Lapland, Kainuu and Oulu (Finland); and Arkhangelsk, Chukotka, Karelia, Khanty-Mansii, Komi, Magadan, Murmansk, Sakha, Yamal-Nenets (Russian Federation). We were not able to include the regions of Nunatsiavut (or Inuit Labrador) and Nunavik covered in the previous study (see Box 2.2) because of changes to practices at Statistics Canada. The Norwegian island of Svalbard is also excluded, as in the previous study. Following changes in the Russian Federation's constitutional law, Rosstat adjusted its statistical coverage, as described in the Chapter 1, in particular the regions of Evenk and Taimyr (Dolgan-Nenets) are now included in the territory of Krasnoyarsk. Apart from the economic data, most of the other data were taken from the socioeconomic database ArcticStat, www.ArcticStat.org, (Annex 2.2) based on data from the national statistical agencies of the Arctic countries. The economic data are the same as those in Chapter 3 of this report. Where data were not available, data from the most recent available year were used.

Box 2.1. Converting social and economic indicators to a common scale

Since the indicators are of different units, they have been converted into indices on a scale of 1 to 10. For each indicator, the lowest observation was subtracted from the set of regional observations. The differences were expressed as shares of the gap between the highest and lowest observation. The resulting ratios were multiplied by 10, to obtain indices expressed on a scale from 1 to 10. For the following indicators, the first step was calculated differently, to express that low values are beneficial: for infant mortality, economic dependency and demographic dependency, the observation for each region was subtracted from the highest observation. In the case of the female proportion, the observation for each region was subtracted from the global average (and converted to an absolute value by adding 10).

The share of women in the population and the youth rate are presented differently in the radar diagrams and the bar diagrams (Figures 2.11 to 2.18). The bar diagrams depict the actual share of women in the population and the actual proportion of children aged under 15 years. In the radar diagrams, the youth rate is replaced by a demographic replacement rate based on the ratio between children (aged 15 years and younger) and women (aged 15-54 years) as a proxy measure for the total fertility rate (which is not available for all Arctic regions), and we calculated the distance of this fertility rate proxy to the minimal replacement rate used in developed countries (defined as 2.1 children per woman). We then calculated the distance between the fertility rate proxy and the replacement rate of 2.1.

The composite index was calculated as the average of these indices (except infant mortality), allowing us to produce a comparative ranking of the regions.



Leftovers, Nuvahut/Photo: Mary Stapleton

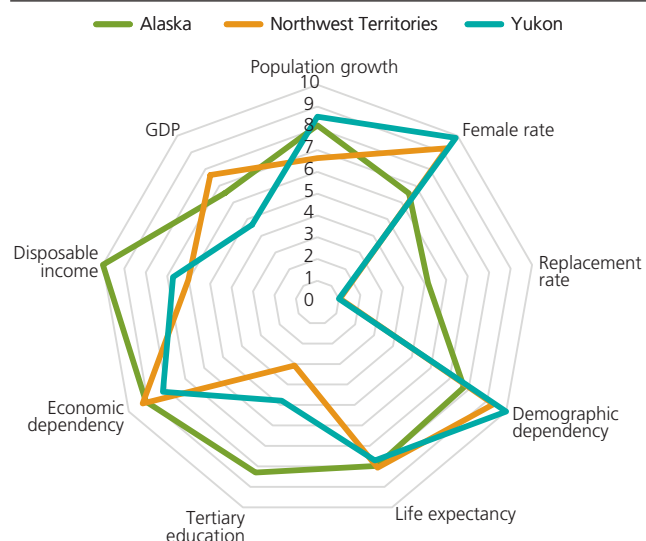
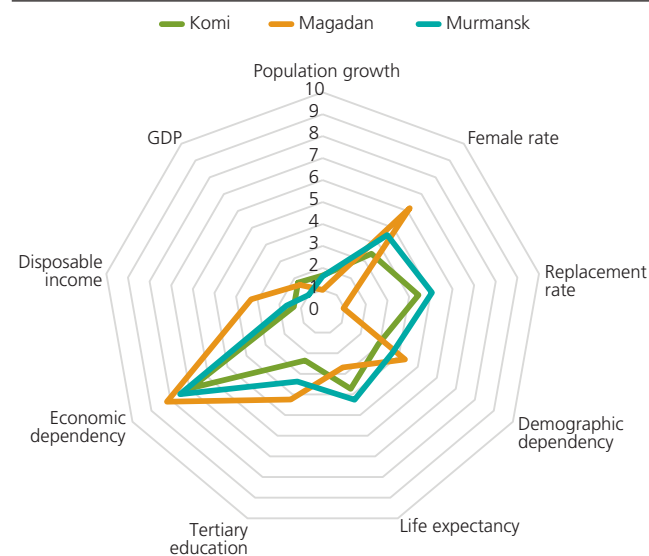
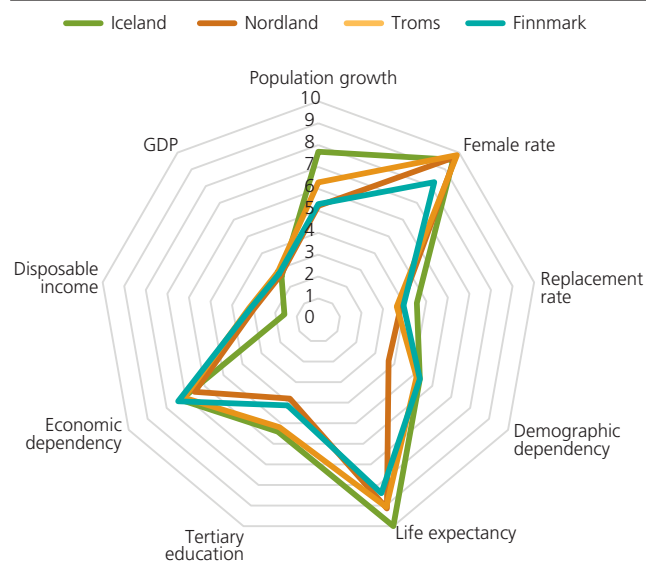
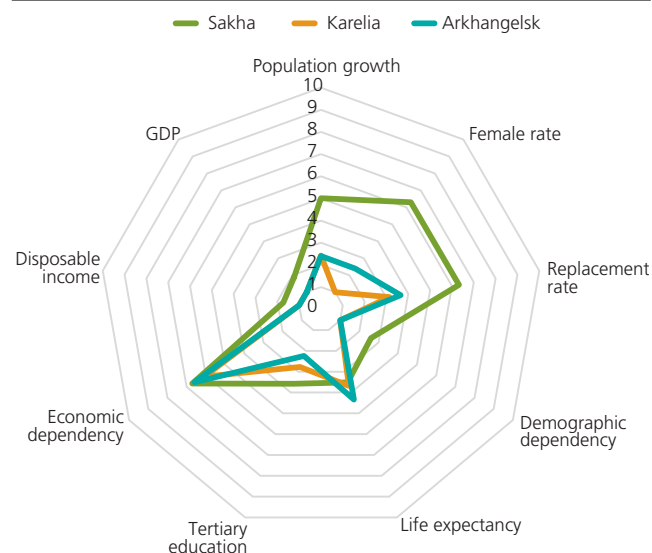
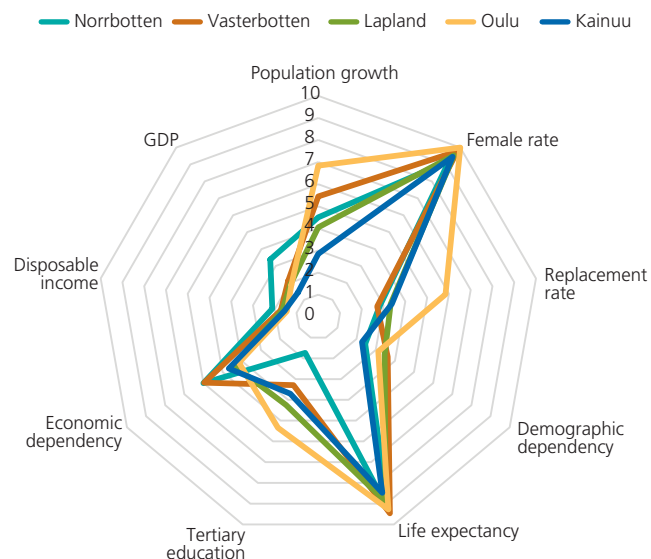
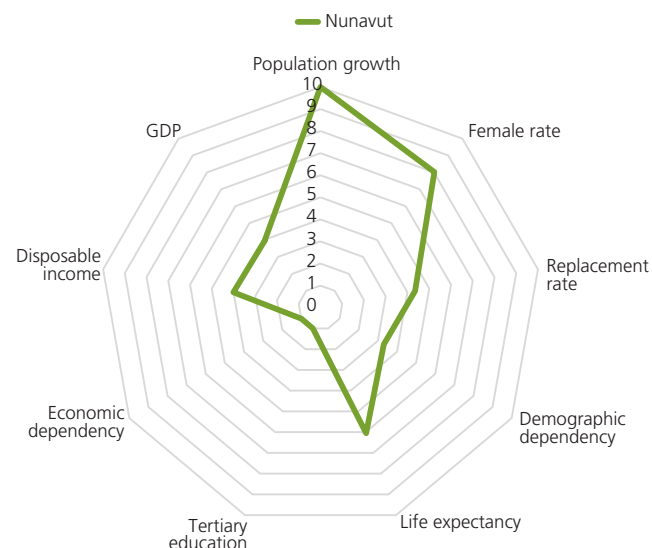
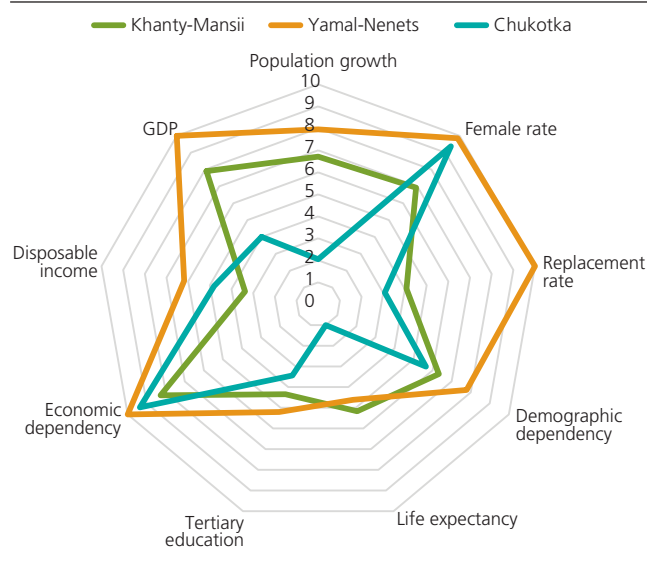
Figure 2.1. **North America model, main pattern, 2012**Figure 2.4. **Russian Federation model, main pattern, 2012**Figure 2.2. **Nordic Countries model, main pattern, 2012**Figure 2.5. **Russian Federation model, main pattern, 2012 (cont.)**Figure 2.3. **Nordic Countries model, main pattern, 2012 (cont.)**Figure 2.6. **North America model, variation, 2012**

Figure 2.7. **Nordic Countries model, variation, 2012**Figure 2.8. **Russian Federation model, variation, 2012**Table 2.2. **Arctic regions distribution by socio-economic model, 2012**

Model	Main pattern	Variation
North America Model Figure 2.1 and 2.6	Alaska Northwest Territories Yukon	Nunavut
Nordic Countries Model Figure 2.2, 2.3 and 2.7	Iceland Nordland Troms Finnmark Norrbotten Vasterbotten Lapland Oulu Kainuu	Faroe Islands Greenland
Russian Federation Model Figure 2.4, 2.5 and 2.8	Arkhangelsk Karelia Komi Magadan Murmansk Sakha	Chukotka Khanty-Mansii Yamal-Nenets

The Three Worlds

The results confirm structural differences in inequalities between the Arctic regions of North America, the Nordic countries and the Russian Federation, (Figures 2.1 to 2.8). The pattern is similar to what was observed in the study for 2006 as reported in *The Economy of the North 2008*. The results also confirm that, beyond certain similarities between the regions within a given model, there also exist variations within the typical pattern (Table 2.2).

The majority of Arctic regions in North America appear to be rather favourable to human development, with the highest disposable income per capita, longest life expectancy, and lower rates of demographic and economic dependencies, together with a rather high population growth rate and female rate. The indicators GRP per capita and education display average values, whereas the replacement rate is below average (Figure 2.1).

Throughout the Nordic Arctic regions, life expectancy is the highest in the most egalitarian regions (Figure 2.9). The situation in the Arctic regions of the Nordic countries shows a different pattern. First of all, most Nordic Arctic regions enjoy the longest life expectancy and has female rate close to the global average. The other indicators are all at average or below. Both gross regional product (GRP) per capita and disposable income per capita are relatively low compared to the North American regions (Figures 2.2 and 2.3).

Most of the Arctic regions in the Russian Federation show a very different situation. The female rate (share of women in the population) is far from the global average, and the rates of economic dependency are low. All the other indicators are generally below average (Figures 2.4 and 2.5). Table 2.1 illustrates the considerable differences in population size within the Arctic regions. The Russian Federation represents about 70 per cent of the entire population of the circumpolar Arctic, with the largest populations found within Khanty-Mansii and Arkhangelsk.

Despite significant Russian progress achieved in 2012 compared to 2006, life expectancy and education were still at lower levels in the Arctic Russian regions compared to the Nordic regions. The Arctic Russian regions Khanty-Mansii, Yamal-Nenets and Chukotka diverge in several ways from the main pattern of the Russian model. These resource-rich regions have the highest GRP per capita of the Arctic Russian regions (Figure 2.8), due to the exploitation of natural resources.

There are notable variations from the three typical patterns (Table 2.2). In North American Arctic and the Nordic Arctic regions, the variations are found in isolated regions with small populations. In Nunavut, the picture is practically the opposite of the typical North American model. The population has an average life expectancy, but a significant proportion of depen-

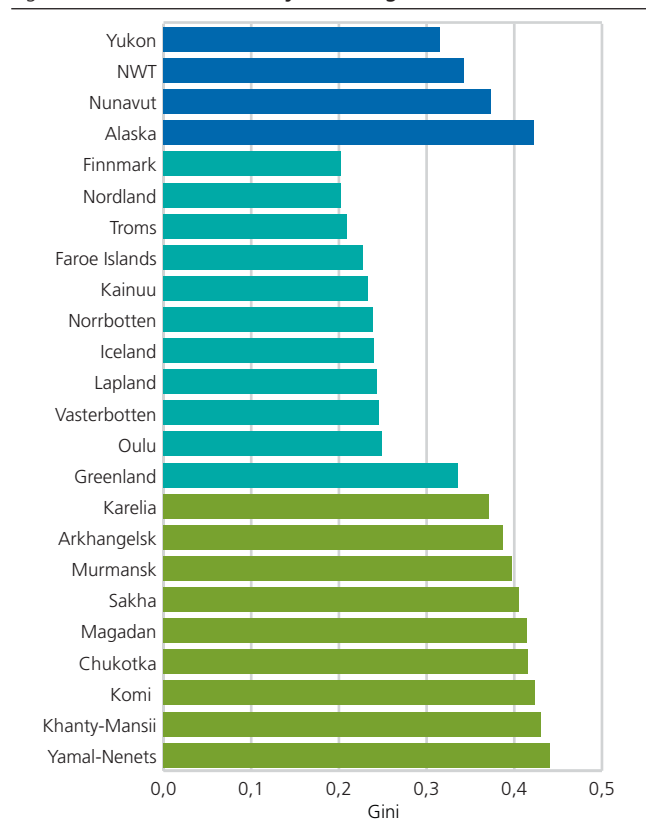


Longyearbyen, Svalbard, the world's northernmost city. Photo: Crestock

dents, and the level of education is among the lowest in the entire circumpolar region (Figure 2.6). The situation of Greenland and the Faroe Islands is generally similar to the main Nordic model. However, Greenland and the Faroe Islands clearly differ from the other regions, and in particular life expectancy, education and economic dependency ratio are more favourable in the Faroe Islands than in Greenland (Figure 2.7).

In Arctic Russia, the sub-regions that differ from the general model, are Yamal-Nenets, Khanty-Mansii and Chukotka (Figure 2.8). The GDP per capita in Yamal-Nenets is the highest within the circumpolar Arctic and several indicators are also very favourable in the other two regions. Altogether they show variations that recall the main pattern of the North American model (Figure 2.1).

Figure 2.9. **Gini coefficient by Arctic regions 2012**

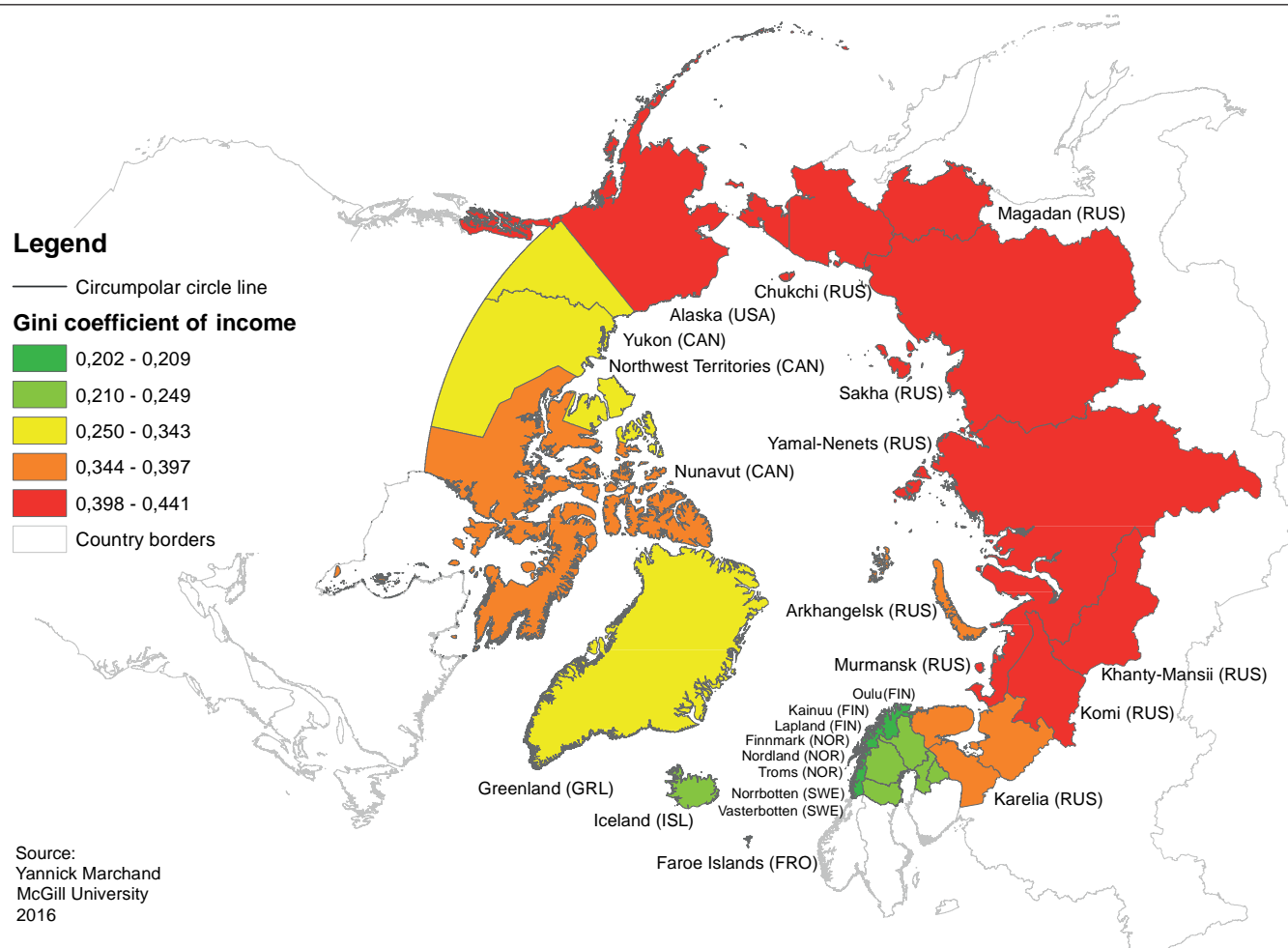


In summary, this circumpolar comparative analysis for 2012 shows that the socio-economic indicators for the Arctic regions reproduce the models that were initially identified in 2006, with regard to the three main models for the Arctic regions in North America, Nordic countries and Russian Federation, and the variations that occur within those models.

Income distribution and inequalities

The Gini coefficient is a measure of income inequality within a given population. The coefficient varies between 0 and 1, where 0 signifies perfect equality, and 1 corresponds to complete inequality, i.e. where a single person has the entire income of the economy.

Gini coefficients by Arctic sub-regions are displayed in Figure 2.9. The Gini coefficients range between 0.2 and 0.43. The lowest inequality is found in Finnmark, followed by the other Nordic regions of the Arctic. In the Nordic regions the level of disposable income per capita is low, but supplemented by comprehensive public services as a consequence of redistribution of tax revenue, in accordance with national social policies. The more egalitarian distribution of income reflects that these sparsely populated regions belong to the Nordic countries. Supported by a diversified economy that contributes to their funding, these policy orientations do bear fruit in terms of improved welfare⁹.

Figure 2.10. Map of circumpolar Arctic income inequality measured by the Gini coefficient. 2012¹

¹ When available, the Gini coefficients for disposable income of households were selected, however, for some regions the Gini coefficients are based on different income concepts, income equivalence scales or statistical units.

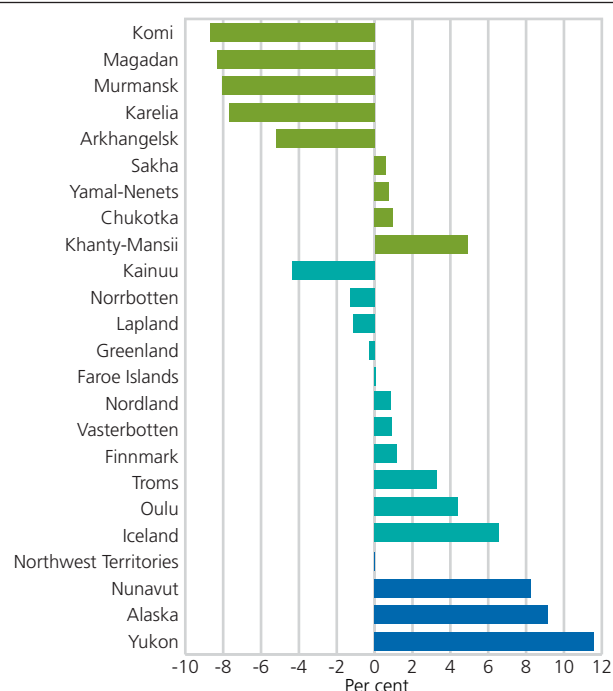
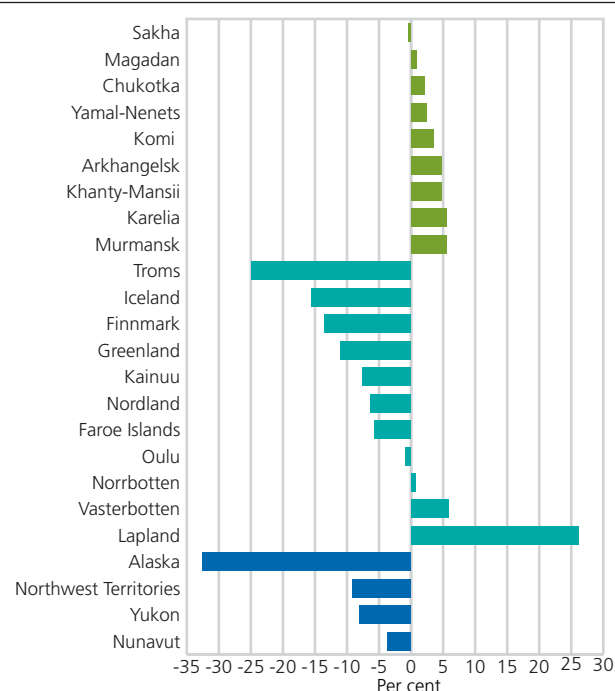
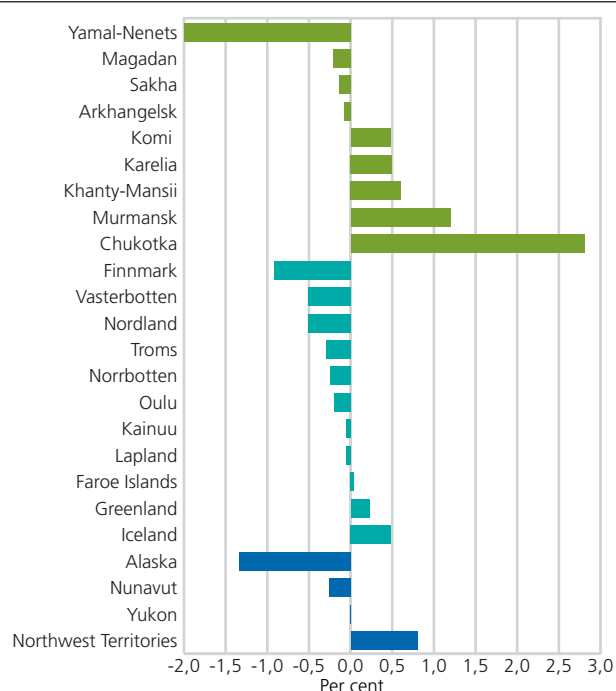
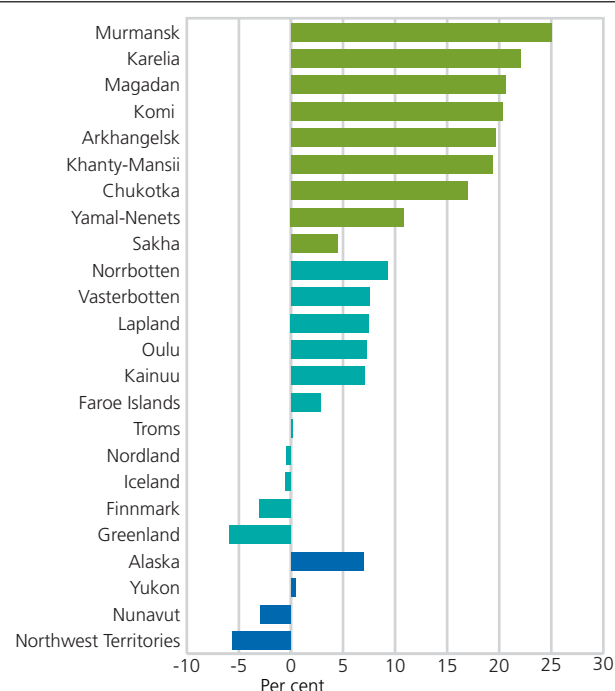
The American and Russian regions of the Arctic have Gini coefficients above the median with Yamal-Nenets on top. The resource-rich regions of Khanty-Mansii, Yamal-Nenets and Chukotka, with the highest level of disposable income per capita and GRP per capita, also have the highest inequality measured by the Gini coefficient. Within the regions inequalities can be observed as a result of e.g. highly paid employees in the mining sector¹⁰ and other activities related to extractive industries.

The economic inequalities may be exacerbated by inequalities in access to other social resources, e.g. health services and housing¹¹. The dismantling of the USSR and the deep crisis that marked the ensuing decade and the following years, led to economic liberalization and the erosion of the social safety net¹². For example, in-kind benefits such as free housing, which previously were the norm, were replaced by cash payments. This “monetization of assistance” contributed to an increase in inequalities, since the amounts granted did not take into account the high cost of living in the North¹³.

Alaska is the North American region where the income inequalities are the highest, with a Gini coefficient of about 0.42. The Gini coefficients for the Canadian

Arctic regions are situated in the middle, between high inequality in Alaska and resource-rich Arctic Russian regions, and low inequality in the Nordic regions. A study of inequality in the region inhabited by Canada’s Inuit (which covers part of the Northwest territories, Nunavut, Nunavik in Quebec and Nunatsiavut in Labrador) for 2010 showed that inequalities in this region remained very strong, and indigenous people were five times more prevalent in the lowest two deciles of the income distribution, and four times less numerous in the upper two deciles¹⁴. In 2006, the indigenous poverty rate was 44 per cent, more than three times the Canadian rate¹⁵. While these studies certainly suggest major inequality gaps, it is essential to achieve better statistical coverage, both geographic and temporal, before we can reach firm conclusions consistent with the approach and methodology adopted here.

Figure 2.10 displays the Gini coefficients on a map where green color indicates low inequality and red indicates high inequality. The Gini coefficients were calculated by the national statistical agencies in the Arctic countries¹⁶. When available, the Gini coefficients for household disposable income were selected. The Gini coefficients for some regions were calculated with different income concepts, with income

Figure 2.11. **Population by Arctic regions, changes between 2006-2012**Figure 2.13. **Youth rate by Arctic regions, changes between 2006-2012**Figure 2.12. **Female rate by Arctic regions, changes between 2006-2012**Figure 2.14. **Demographic dependency ratio by Arctic regions, changes between 2006-2012**

equivalence scales or different statistical units. Moreover, the lack of underlying data on source of income and its distribution across regions and social groups limits the depth at which we can understand the distribution of income.

For some regions the Gini coefficients were not available for the appropriate geographical level; in these cases, an estimate was calculated based on Gini coefficients of each sub-regions, from which the average value was calculated.

Circumpolar changes

Figures 2.11 to 2.18 give a circumpolar overview of the direction and magnitude of the percentage change from 2006 to 2012 in the indicators. Note that the share of women in the population as presented in Figures 2.11 to 2.18 is the actual proportion of women in the regions, not the difference between the regional share of women and the global rate.

In the North American Arctic the population has increased whereas the demographic dependency ratio

Figure 2.15. Life expectancy by Arctic regions, changes between 2006-2012

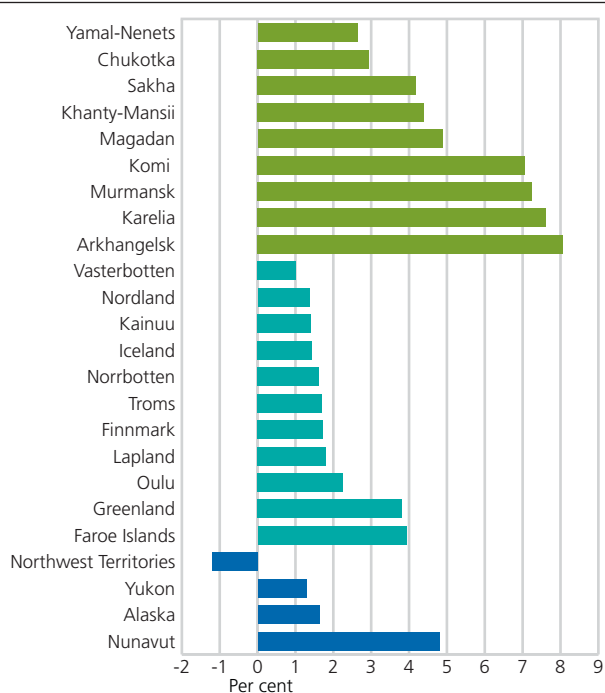
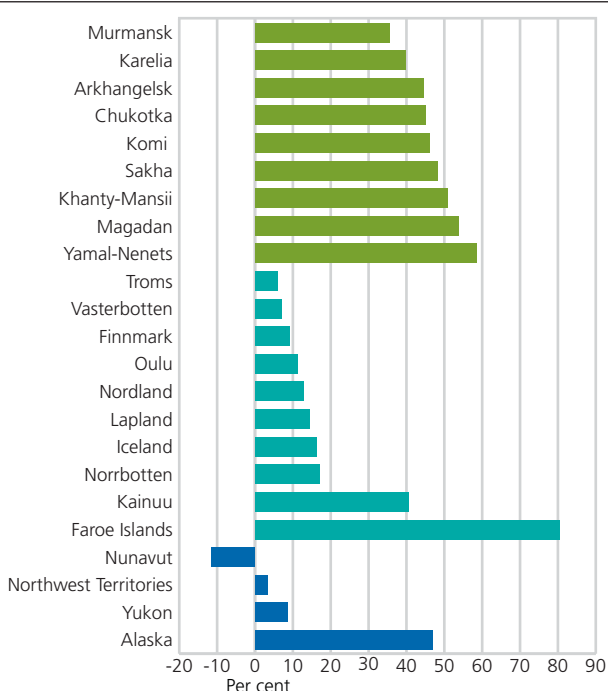


Figure 2.16. Tertiary education by Arctic regions, changes between 2006-2012



has declined, except in Alaska. The youth rate has declined. The proportion of women has declined, except in the Northwest Territories. Social and health indicators show a relative improvement, with an increase in life expectancy, except in Northwest Territories. The largest increase in life expectancy was found in Nunavut. There has been an increase in education except in Nunavut. The value of economic indicators also increased, in terms of disposable income per capita and in terms of gross regional product (GRP) per capita, although not in the Northwest Territories.

Figure 2.17. Disposable income per capita by Arctic regions, changes between 2006-2012

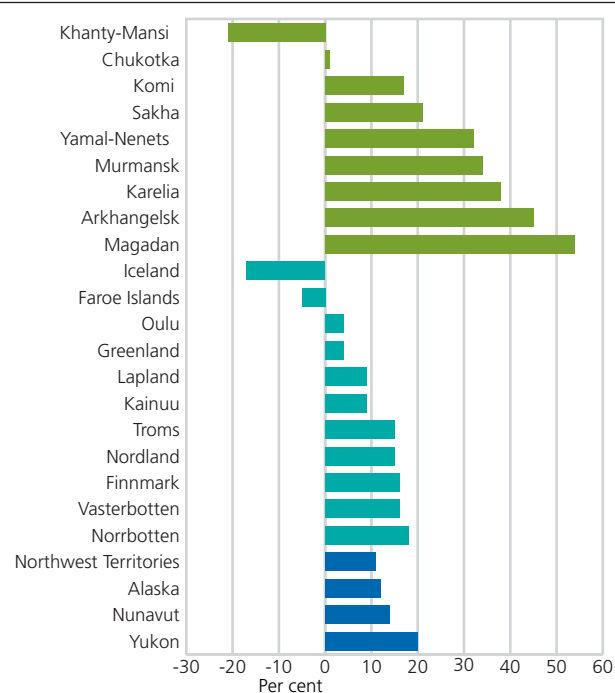
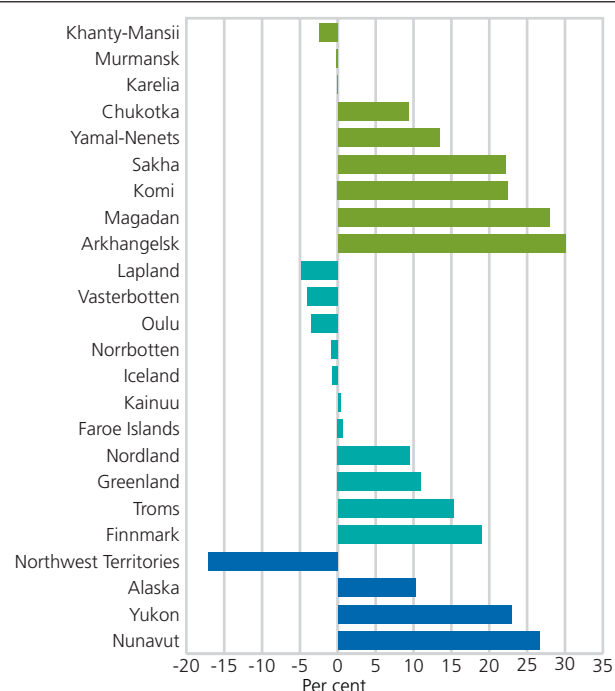


Figure 2.18. Gross domestic product per capita by Arctic regions, changes between 2006-2012



Except for the changes in the proportion of women and replacement rate, the changes observed might suggest that the North American Arctic regions, which already displayed a favourable situation in 2006, have further improved their situation in 2012. However, we also observe that regions belonging to the other two main models to a large extent have caught up with the North American levels.

Arctic Russia had the highest GRP per capita in 2012, and the GRP per capita of both Yamal-Nenets and



Tyonek Fish Camp – A fish camp in Tyonek on the shore of West Cook Inlet, Southcentral Alaska in June 2004. Photo: Davin Holen

Khanty-Mansii were higher in 2012 than those of Alaska and the Northwest Territories. The economic indicators do indeed show significant improvements: disposable income per capita has increased everywhere, except in Khanty-Mansii, and the same is true for the GRP per capita, except in Khanty-Mansii, whereas in Murmansk and Karelia there was no change. Advances are seen in the demographic and social spheres, although with two opposing trends.

On the one hand, the population of Arctic Russia has decreased by about 3 per cent. This decrease is unevenly distributed, as most sub-regions experienced a significant decline in their population, in line with the Russian model, whereas some sub-regions had a relatively modest population growth. The proportion of women in the population also underwent changes, and overall it increased slightly. The replacement rate increased everywhere, contributing to an increase in the demographic dependency ratio. The indicators show significant improvements in life expectancy and educational levels, as well as a decline in infant mortality.

In several of the Arctic Russian regions the depopulation that began during the economic crisis on the 1990s is still continuing. Factors suggested to explain these changes include rising mortality rate among adult males and a higher out-migration of men than women, with the latter remaining “locked in poverty traps”. These factors, and even more the high mineral prices, contribute to increasing inequality.

Between 2006 and 2012 many indicators showed significant differences between the two types of

regions, the main model and the variations. These differences appear in the size and direction of the observed changes, where the resource-rich regions have positive population growth, smaller increase in demographic dependency (Figure 2.14), and lower increase in life expectancy. The female proportion of population had its largest increase in Chukotka and declined in Yamal-Nenets (Figure 2.12). For the economic indicators, Khanty-Mansii is the only region to have decline in disposable income per capita. Considerable differences continue to exist in the demographic structure of these regions relative to the main model.

The situation of the Nordic Arctic regions lies somewhere between that of North America and Russia, and is more nuanced. The demographic indicators of the Nordic Arctic regions show both increase and decline. Overall, the population increased slightly, while the proportion of women in the total population decreased slightly. The replacement rate also declined, and the demographic dependency ratio increased. However, these changes were generally quite moderate, as for other indicators. Overall, the economic indicators show a slight increase. While almost all the social and health indicators show improvements, here too the changes are moderate.

The infant mortality rate has decreased in four of the six Nordic regions for which we have data, and is still among the lowest in the circumpolar Arctic.

There are a few exceptions to the Nordic model, above all in the Faroe Islands and in Greenland. The increase in life expectancy is stronger in these two regions. The situation in Greenland tends to be closer to other

Box 2.2. Nunavik

Nunavik, the northernmost region of Quebec (Canada), is inhabited by some 12,000 people, over 90 per cent of whom are Inuit (Table 1). Social conditions more closely resemble those of the adjoining territory of Nunavut than they do those of the main pattern of the North American model, as represented by Alaska. When the data from 2011 are compared to those of 2001 (Figure 1), certain indicators suggest that the gap is narrowing ever so slightly between the two models, e.g. life expectancy or the replacement rate. But overall, the differences remain considerable, and several have actually increased, such as the level of education.

The central industry for Nunavik residents is public administration. Public spending accounts for 30 per cent of the region's economic activity, and it has doubled in ten years. This is about 4 times higher, per capita, than it is in Quebec as a whole. Yet this public spending amounts to only a fraction of the profits that are derived from the exploitation of the region's resources. Large scale resources extraction, mainly mining, now represents over 40 per cent of the territory's entire economic activity. Between 2003 and 2012, this industry has seen its value increase eight-fold. However, its impact on residents' income is curtailed by the organization of these operations. As opposed to public administration, which is closely linked with the daily life of the residents, mining operation is largely disconnected from the region itself¹.

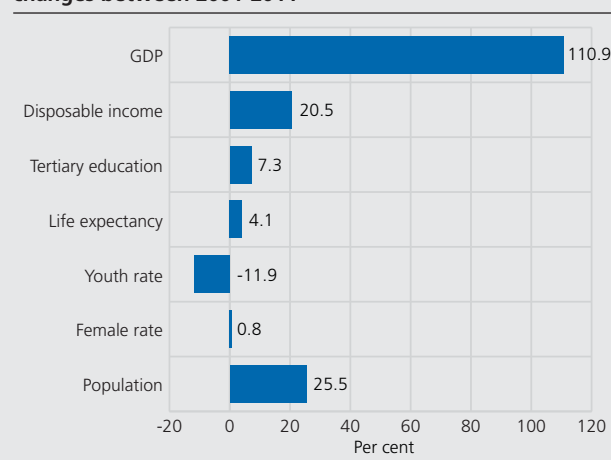
Economic inequalities remain significant. In 2012, GRP per capita was 111 per cent higher than in 2003, but the disposable income per capita increased by only 21 per cent. More than 60 per cent of all personal income generated by economic activity within the region was directly transferred outside of Nunavik, having been paid to transient workers in resource extraction and the construction industries. Among indigenous peoples, disposable income stood at about 13 656 USD PPP per capita (2010), while that of non-native residents was three times higher, at 46 393 USD PPP per capita (2010). And despite their lower incomes, the Nunavimut are confronted with much higher consumer prices than people in southern Quebec on the order of 60 to 80 per cent higher, just for food². Nunavik is not connected by road to the south, and shipping is practicable only for a short navigation season³.

¹ Duhaime, G., N. Bernard, and A. Caron, Mining on Aboriginal Land. Hidden in Plain Sight, V. II. Contributions of Aboriginal Peoples to Canadian Identity and Culture, ed. C. Voyageur, D.R. Newhouse, and D. Beavon. 2011, Toronto: University of Toronto Press. Robichaud, V. and G. Duhaime, Nunavik Eco-

Table 1. **Selected social and economic indicators. Nunavik, changes between 2001-2011**

Indicators	2001	2011	Variation (n)
Population (N)	9 632	12 090	2 458
Female rate (%)	48.9	49.3	0.4
Youth rate (%)	38.9	34.3	-4.6
Life expectancy (years)	63.3	65.9	2.6
Tertiary education (%)	9.6	10.3	0.7
Infant mortality (/000)	21.3	19.4	-1.9
Disposable income per capita (USD-PPP 2010)	13 954	16 821	2 867
GDP per capita (USD-PPP 2010)	27 171	57 299	30 128

Figure 1. **Selected social and economic indicators, Nunavik, changes between 2001-2011**



conomic Portrait 2012. Final Report on the Construction of a Social Accounting Matrix for Nunavik. Research Report, 2015. p. 1-18 <http://www.nunivaat.org/documents/Publication/Rapport-final-MCS2012-v3-eng.pdf>.

² Duhaime, G. and A. Caron, Consumer prices Monitoring in Nunavik 2011-2013, 2013, Canada Research Chair on Comparative Aboriginal Condition: Québec. p. 1-88 <http://www.nunivaat.org/documents/Publication/Suivi-des-prix-2011-2013-eng.pdf>.

³ Rodon, T., F. Lévesque, and J. Blais, De Rankin Inlet à Raglan, le développement minier et les communautés inuit. Études/Inuit/Studies, 2013. 37(2): p. 103-122. Duhaime, G., A. Caron, and S. Lévesque, Nunavik in Figures 2015, Full Version, 2015, Canada Research Chair on Comparative Aboriginal Condition: Québec. p. 1-133 <http://www.nunivaat.org/documents/Publication/Suivi-des-prix-2011-2013-eng.pdf>

regional models than the Nordic, e.g. with regard to the increase in the proportion of women in the population.

Thus far, our comparative analysis has shown that the three main models, along with their respective variations, remain relevant. The changes within each model differ both in direction and in magnitude. The greatest improvements have taken place in Arctic Russia, mainly in the economic, social and health spheres. But beyond the general models, there are many variables that differ between the regions. This is the case of the female proportion, for example, which increases in roughly half of the regions, but decreases in the other half.

Our approach has several limitations. We compared two years, 2006 and 2012, rather than analysing the time series, which could have indicated trends. However, our selected indicators are rarely available in complete and consistent time series, making the goal of systematically monitoring trends over time illusory.

Summary

The recent changes reveal a phenomenon that is visible in the indicators for 2012 and the change over the period from 2006 to 2012: The different models appear to be converging. The most striking evidence of this is the rise in the economic indicators in the regions that make up the Russian Arctic model, which now attain

levels comparable to those in the Nordic Arctic regions. Additional evidence comes from the improvements in the indicators that relate to living conditions: the greatest improvements were in Arctic Russia, whereas the more modest improvements in the Nordic countries are attributable to the fact that these regions already had high living conditions.

However, while the levels of disposable income per capita and GRP per capita are becoming similar in resource-rich Russian Arctic regions and the Nordic Arctic regions, the socio-economic situation still cannot be considered equivalent. Indeed, given the same income, the Scandinavians' standard of living is higher, since it is supported by generous social benefits.

In the North American Arctic, the results for change between 2006 and 2012 show characteristic differences between the main model and Nunavut: Life expectancy in Nunavut has increased more, education level has declined in Nunavut and increased in the other regions, GRP per capita has increased more and youth rate declined less than in the other regions. The Russian model displays high inequality, reflecting the investment boom in the petroleum and mining sectors attracting workers with high qualifications and high wages¹⁷.

Major internal inequalities also exist in the area of health. The situation is particularly unfavourable in the Arctic regions of the Russian Far East¹⁸. The model of



the Nordic countries show a more nuanced situation. The Arctic regions that conform to the main Nordic model have undergone modest improvements or declines; but differences are diminishing between those regions and those that show variations, i.e., Greenland and the Faroe Islands, particularly to the advantage of the Faroe Islands.

In summary, the dominant features of the socioeconomic portrait of the circumpolar Arctic are the following: a major gap that continues to exist between the three large geopolitical groups; a modest convergence in some aspects; and inequalities that are highest in Russia, high in America, and lower in the Nordic countries¹⁹.

Notes

- ¹ Larsen, J.N. and G. Fondahl, Arctic human development report II. Regional processes and global linkages, 2014, Nordic Council of Ministers: Copenhagen. p. 500.
- ² Larsen, J.N., P. Schweitzer, and A. Petrov, Arctic Social Indicators. ASI II: Implementation, 2014, Nordic Council of Ministers: Copenhagen. p. 328.
- ³ Rasmussen, R.O. e.a., Megatrends, 2011, Nordic Council of Ministers: Copenhagen. p. 205.
- ⁴ Walby, S., Globalization and Inequalities. Complexity and Contested Modernities. 2009, Thousand Oaks: Sage. 508. Dufy, C. and F. Weber, L'ethnographie économique. Repères, ed. P. Combemale. 2007, Paris: La Découverte. 122. Edelman, M. and A. Haugerud, eds. The anthropology of development and globalization: from classical political economy to contemporary neoliberalism. 2005, Wiley-Blackwell: Malden. 416.
- ⁵ Manzagol, C., La mondialisation. Données, mécanismes et enjeux. Campus. 2011, Paris: Armand Colin. Cohen, D., Richesse du monde, pauvreté des nations. Essais. 1997, Paris: Flammarion.
- ⁶ Foucher, M.d., L'Arctique. La nouvelle frontière. 2014, Paris: CNRS Éditions. Lasserre and Frédéric, eds. Passages et mers arctiques. Géopolitique d'une région en mutation. 2010, Presses de l'Université du Québec: Québec. 516
- ⁷ Duhaime, G. and A. Caron, Economic and Social Conditions of Arctic Regions, in The Economy of the North 2008, S. Glomsrod and I. Aslaksen, Editors. 2009, Statistics Norway: Oslo. p. 11-23.
- ⁸ Sen and A. K., Development as Freedom. 1999, Oxford: Oxford University Press. United Nations Development Programme, Human development report. , 1990. p. 189. Wilkinson, R. and K. Pickett, L'égalité c'est mieux. Pourquoi les écarts de richesses ruinent nos sociétés. 2013, Montréal: Écosociété. 379.
- ⁹ Huskey, L., I. Maenpaa, and A. Pelyasov, Economic systems, in Arctic human development report II. Regional processes and global linkages, J.N. Larsen and G. Fondahl, Editors. 2014, Nordic Council of Ministers: Copenhagen. p. 151-182.
- ¹⁰ Fondahl, G., S. Crate, and V.V. Filippova, Sakha Republic (Yakutia), Russian Federation, in Arctic Social Indicators. ASI II: Implementation, J.N. Larsen, P. Schweitzer, and A. Petrov, Editors. 2014, Nordic Council of Ministers: Copenhagen. p. 55-92. Rasell, M., Neoliberalism in the North: the transformation of social policy in Russia's northern periphery. Polar Geography, 2009. 32(3): p. 91-109.
- ¹¹ Walby, S., Globalization and Inequalities. Complexity and Contested Modernities. 2009, Thousand Oaks: Sage. 508.
- ¹² Åslund, A., How capitalism was built: the transformation of Central and Eastern Europe, Russia, the Caucasus and Central Asia. 2nd ed ed. 2013, Cambridge: Cambridge University Press. xv, 423 p.
- ¹³ Rasell, M., Neoliberalism in the North: the transformation of social policy in Russia's northern periphery. Polar Geography, 2009. 32(3): p. 91-109.
- ¹⁴ Lévesque, S. and G. Duhaime, Inequality and Social Processes in Inuit Nunangat. The Polar Journal, In print.
- ¹⁵ Duhaime, G. and R. Édouard, Monetary Poverty in Inuit Nunangat. Arctic, 2015. 68(2): p. 223-232.
- ¹⁶ Due to methodological differences, there are some limits to the comparison of the Gini coefficients. Canada is the only country where the statistical agency does not calculate Gini coefficients for its northern territories. The only available income dispersion measures for Northwest Territories, Nunavut, and Yukon can be found in Marchand, Y. (2016). Analyse spatiale de l'inégalité des revenus: perspectives de la ruralité canadienne (Mémoire de maîtrise). Université McGill. We get access to these results before their publication, and the authorization to use them here, thanks to the exceptional collaboration of Yannick Marchand and Sébastien Breau.
- ¹⁷ Rasell, M., Neoliberalism in the North: the transformation of social policy in Russia's northern periphery. Polar Geography, 2009. 32(3): p. 91-109.
- ¹⁸ Rautio, A., B. Poppel, and K. Young, Human health and well-being, in Arctic human development report II. Regional processes and global linkages, J.N. Larsen and G. Fondahl, Editors. 2014, Nordic Council of Ministers: Copenhagen. p. 297346.
- ¹⁹ Raviot, J.R. Comprendre le nouveau régime russe. Strates, 2006 Gaddy, C.G. and G.W. Ickes, Prosperity in Depth: Russia Caught in the Bear Trap. 2013, London: The Legatum Institute. Benedictow, A., D. Fjaertoft, and O. Lofsnaes, Oil dependency of the Russian economy: an econometric analysis, 2010, Statistics Norway: Oslo.

Annex 2.1. Changes in selected social and economic indicators¹ and composite index². Arctic regions, changes between 2006 and 2012³

Regions	Population	Female rate	Youth rate	Demographic dependency	Life expectancy	Infant mortality	Tertiary education	Economic dependency	Disposable income	GDP	Composite index
	n	Per cent		Ratio	Years	Per 1000 live births	Per cent	Ratio	USD-PPP per cap		n
Alaska	61 396	-0.65	-7.00	0.03	1.26	-1.52	11.55	-0.01	4 667	7 292	-0.13
Northwest Territories	-5	0.39	-2.18	-0.02	-0.96	3.00	0.66	-0.14	3 193	-18 367	-0.96
Nunavut	2 430	-0.12	-1.26	-0.02	3.38	16.30	-1.36	0.48	3 042	11 097	0.11
Yukon	3 525	0.00	-1.51	0.00	0.99	-11.00	1.99	-0.26	5 496	11 148	-0.01
Faroe Islands	28	0.02	-1.31	0.02	3.10	1.91	18.51	0.03	-950	233	0.20
Lapland	-2 091	-0.03	4.25	0.04	1.42	..	3.01	-0.14	1 404	-1 708	0.10
Oulu	16 962	-0.10	-0.17	0.04	1.78	..	2.75	0.00	693	-1 167	-0.26
Kainuu	-3 665	-0.03	-1.20	0.04	1.10	..	6.36	-0.19	1 419	108	0.51
Greenland	-152	0.11	-2.74	-0.03	2.60	-6.50	n.a.	0.32	525	2 976	-0.73
Iceland	19 684	0.24	-3.39	0.00	1.16	-0.30	3.80	0.09	-3 529	-265	-0.44
Finnmark	850	-0.45	-2.75	-0.02	1.33	-2.00	1.93	-0.23	2 967	6 608	0.16
Nordland	2 063	-0.26	-1.22	0.00	1.09	-1.70	2.53	-0.19	2 890	3 532	0.21
Troms	5 065	-0.15	-4.91	0.00	1.35	2.30	1.52	-0.08	2 970	5 615	-0.21
Norrbotten	-3 295	-0.12	0.11	0.05	1.29	..	2.31	-0.21	2 854	-420	0.36
Vasterbotten	2 361	-0.26	0.95	0.04	0.82	..	1.34	-0.10	2 405	-1 470	-0.12
Arkhangelsk	-66 667	-0.04	0.77	0.11	5.23	-3.10	5.39	-0.10	4 572	5 312	1.05
Chukchi	488	1.35	0.46	0.07	1.74	-2.00	6.59	0.25	193	4 564	0.32
Karelia	-53 419	0.27	0.85	0.12	4.86	0.00	5.43	0.08	3 470	-14	0.81
Khanty-Mansii	72 938	0.31	0.96	0.08	3.03	-3.00	8.10	0.02	-5 984	-2 278	-0.57
Komi	-84 763	0.25	0.62	0.10	4.53	-1.10	5.63	-0.16	2 421	5 743	0.79
Magadan	-14 015	-0.11	0.13	0.09	3.10	-5.80	8.28	-0.06	7 882	6 537	0.61
Murmansk	-69 052	0.62	0.86	0.11	4.72	-3.70	5.49	-0.05	4 439	-29	0.72
Sakha	5 859	-0.07	-0.11	0.02	2.74	-1.00	7.03	-0.02	3 026	5 922	0.89
Yamal-Ne nets	3 958	-1.01	0.51	0.04	1.82	-2.50	9.85	-0.06	7 573	13 269	1.01

¹ Population growth: average annual per cent; female rate: per cent women in total population (relative to global average at 49.59 in 2012, from World Bank); youth rate: per cent of 0-14 years in the total population; demographic dependency: (0-14) + (65 and +) / (15-64); infant mortality: per 1000 live births; tertiary education: per cent of tertiary level graduates in total population; economic dependency: (non-employed/employed person in total population); disposable income: personal disposable income in 2010 USD-PPP; GDP: gross domestic product in 2010 USD-PPP.

² The composite index calculation does not take into account total population and infant mortality.

³ Alaska: life expectancy 2010; Canada: 2011, except economic data 2012; Norway: life expectancy 2010, infant mortality 2011; Russia: educational attainment 2010.

Annex 2.2: ArcticStat**Circumpolar Database**

As a result of multiple sources, finding the relevant socio-economic data for the Arctic regions has long been a highly time-consuming procedure.

ArcticStat was created in order to overcome this difficulty and to increase the research capacity by taking advantage of already existing data. This unique databank aims to facilitate research by importing, stocking and organizing in a friendly-user way socioeconomic data covering 30 Arctic regions belonging to 8 countries: Alaska, Northern Canada, Greenland and Faroe Islands, Iceland, Northern Norway, Northern Sweden, Northern Finland and the Northern Russian Federation.

The data that can be found in ArcticStat cover dwellings, population, language, health, education, migration, economy, employment and other social issues. It is a free-access web-based databank which links users directly with the relevant tables on web sites where they originate and, in case of such procedure is not possible, offers a PDF and an EXCEL copy of these tables.

ArcticStat was launched on October 1st 2007. It gives access to more than 10 200 tables through 8 indicators and some 75 sub-indicators. ArcticStat was created by the Canada Research Chair on Comparative Aboriginal Condition of Université Laval, Canada, as a major Canadian contribution to the International Polar Year. It can be found at www.arcticstat.org

Box I. The use of Purchasing Power Parities in this report



Street business – Siberian women trying to supplement the household budget through street selling. Photo by Gérard Duhaime

The main purpose of this report is to provide an overview over economic activity in the Arctic regions. A major challenge has therefore been to add up and compare production data for different regions in different countries. There are some particular challenges associated with such comparisons. A translation of production data based on a straightforward use of market exchange rates (MER) will normally not reflect the true production volumes of the different regions. To adjust for price differences in domestic markets Purchasing Power Parity (PPP) indicators have been applied. However, also PPP conversion may sometimes lead to a biased assessment of production and income levels.

Chapter 3 provides an overview of the economic activity in the circumpolar region. Based on PPP-conversions it is estimated that gross product of the Arctic in 2012 accounted for 0.5 percent of the world economy, or 466 billion USD-PPP, of which the Arctic regions of Russia accounted for 323 USD-PPP, or 70 percent. PPP-converted gross products (value added) might be considered as proxies for income. In that respect income levels in the Arctic vary from a low of 31 400 USD-PPP/capita in Greenland to a high of 81 700 USD-PPP/capita in Alaska, cf. Figure 3.10. It is interesting to note the differences between national and regional income within the

different nations bordering the Arctic. For example, per capita income of Russia is around 22 000 USD-PPP at the national level while it is almost 57 000 USD-PPP in the Russian Arctic regions. In Norway the pattern is reversed: While per capita income at the national level is 69 000 USD-PPP, the income level of the Norwegian Arctic regions is 44 000 USD-PPP. Hence, while Norway has a considerably higher national PPP-corrected income level compared to Russia, the income level of Arctic Russia is higher than in Arctic Norway.

As noted the data for the different countries have originally been reported in national currencies, but have in this report been converted into a common currency using purchasing power parities. Alternatively the national currency data could have been converted into a common currency by use of the market exchange rates. The Russian share of the Arctic gross product would, for example, then have been estimated to 50 per cent, instead of 69 per cent, cf. also Figure 2.

In most studies comparing different countries PPP-conversion is preferred to market exchange rates. We have followed this tradition and have applied PPP-converters developed by the International Comparison Program and the OECD-Eurostat PPP-program.

The advantage of PPP-conversion is that it takes into account that price levels vary considerably between countries. A frequently applied illustration of the variation in price levels is the price of a Big Mac in different countries. Using market exchange rates the average price of a Big Mac in Stockholm was 4.53 USD in April 2006, where as the price in Moscow at the same time was 1.77 USD. This illustrates that almost identical products are priced quite differently even in the Arctic countries if we use market exchange rates as the basis for price comparisons. Consequently MER-conversion of production levels might give seriously misleading numbers as far as production and consumption levels are concerned.

When practicing PPP-conversion we would have preferred to use PPP-factors specific for the Arctic regions in each country, but Arctic-regional PPP-factors have not been developed. Instead we have applied PPP-factors for the national economies.

It is difficult to judge to what extent the use of national PPP-measures is misleading. If the economies of the Arctic regions simply were downscaled versions of the economies of the respective nations and products were priced uniformly across regions, the national PPP-converters would not have been a source of error. However, the Arctic regions are quite different from their respective national economies, as discussed in chapter 4. Moreover, the general price levels are different between different regions within the individual countries. A Big Mac is, for instance, more expensive in Anchorage than in New York. Hence, just as the use of MER-based numbers would represent a source of error, using national PPP-based numbers is also a source of error.

The Russian Arctic region is more dominated by oil and gas production than the rest of the Russian economy. Oil and gas are internationally tradable goods and the relatively high average income level of the Russian Arctic is largely due to the oil and gas industry. The dominance of the petroleum industry in the Russian Arctic indicates that the use of a PPP-converter calculated for the whole Russian economy will probably represent an over-correction when it is applied to the Russian Arctic regions.

Figure 1 illustrates how sensitive the estimates of regional GDP per capita are to the choice between PPP and MER. When PPP-factors are applied, regional GDP per capita in Russian Arctic is higher than in the Arctic regions of the Scandinavian countries. However, as MER-factors are applied, the income levels in Arctic Russia appear to be much lower.

It should be noted that we have reported data on regional GDP, not gross regional incomes, which have not been available for all Arctic regions. Because regional GDP, contrary to gross regional income, does not include transfers between regions, regional GDP per capita does not constitute a precise representation of income levels in the different regions.

Figure 1. GDP per capita by Arctic Region 2012.
1 000 USD at 2010 prices

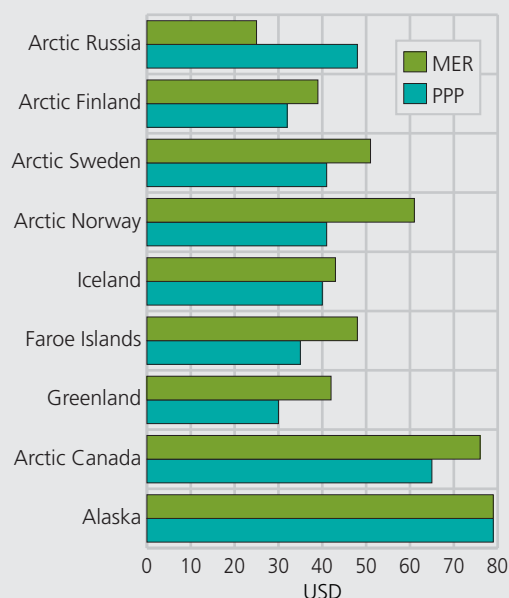
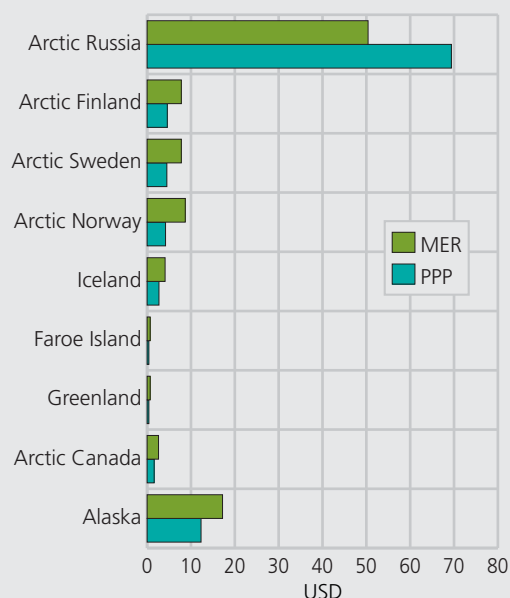


Figure 2. Arctic Region share of total circumpolar GDP.
2012. Per cent





Nuuk, Greenland. Photo: Tom Nicolaysen

3. Comparative analysis of Arctic economies at macro level

Ilmo Mäenpää, Solveig Glomsrød and Taoyuan Wei

In a global perspective the Arctic is at the same time huge and tiny. Almost 10 million people live on 8 per cent of the global land area – vast land areas of wilderness, hiding valuable resources, surrounded by a living ocean between surface sea routes and seabed minerals.

The resources of the Arctic have been subject to increased attention over the last decades due to high economic growth in emerging economies and associated growth in demand for minerals. While the attraction to resources has dominated the attention for a long time, the focus has increasingly turned to climate change, which runs twice as fast in the Arctic as globally.

Rapidly shrinking sea-ice challenges wildlife and traditional hunting and erodes coastal shorelines. The thawing of the tundra already damages ice roads, buildings and other infrastructure. It seems the Arctic is bit for bit broken in pieces by global warming, driven by the worldwide consumption of mineral resources, which the Arctic exports in large scale.

Variations in the regional endowments of natural resources lead to considerable variation in regional gross domestic product across the Arctic. However, transfers within Arctic states tend to modify the gaps in disposable income per capita between Arctic regions and their non-Arctic counterparts. This chapter takes a broader look at the Arctic economies from a macro level perspective, taking a circumpolar outlook as well as comparing the Arctic regions with their non-Arctic counterparts within the Arctic states.

The Arctic economies are generally confined to regions that are encompassed or traversed by the Arctic Circle. In many contexts, however, regions in Europe that are situated somewhat to the south of the Arctic Circle, but participate in the cooperation of the Barents Euro-Arctic Council¹ are included among the Arctic economies. The Arctic regions of the ECONOR project largely comply with this definition, however the Canadian region of Nunavik is left out because Nunavik is part of Quebec and lacks official regional accounts² (Figure 3.1).

Eight countries have regions belonging to the Arctic economies: United States, Canada, Denmark, Iceland, Norway, Sweden, Finland and Russia. The Arctic regions Greenland and Faroe Islands are represented as sovereign countries corresponding to their extensive Self-Governance Rule within the realm of Denmark.

The overview presented below illustrates regional indicators on land, population and economic activity in terms of Gross Regional Product (GRP). Further, Disposable income of households (DIH) is included to indicate economic welfare of the populations living in the regions. The data used in this analysis are based mainly on the regional accounts of the statistical offices of the Arctic countries to provide a meaningful comparison of private access to goods and services. However note that the provision of public services differ among the Arctic regions.

The regional data are converted from local currencies to USD in purchasing power parities (PPP). Box 3.1 explains the reason for using PPP rather than market

Box 3.1. The harmonisation of economic values across regions

United States, Canada and Sweden provide gross regional product (GRP) at market prices (including the product taxes minus subsidies) whereas other countries present GRP at basic prices (at factor cost or as gross value added). From detailed regional accounts of United States, Canada and Sweden the share of product taxes less subsidies were available, however, and all the GRP figures could be converted into basic prices.

In the national statistics the figures of GRP and disposable income of household (DIH) are expressed in national currencies. They are converted to unified purchasing power parity (PPP) values and expressed in USD 2010. The PPP conversion factors have been taken from OECD Statistics. The role of the PPP conversion factors is to adjust for differ-

ences in regional purchasing power, thus providing a better indicator of the capacity to consume based on regional price levels while at the same time achieving a unified valuation. However, national PPP conversion factors reflecting national price levels have been used, causing some bias in the GRP and DIH values, because the price levels in Arctic regions may differ from the country average price levels.

Regional accounts for Norway, Sweden, Russia, Greenland and Faroe Islands are available only at current prices. To get the volume growth of the regional economy the GRP of the years 2000-2012 are converted into USD 2010 prices by using the implicit price index of the national GDP series from OECD statistics.

Figure 3.1. The circumpolar Arctic



Source: www.arcticstat.org

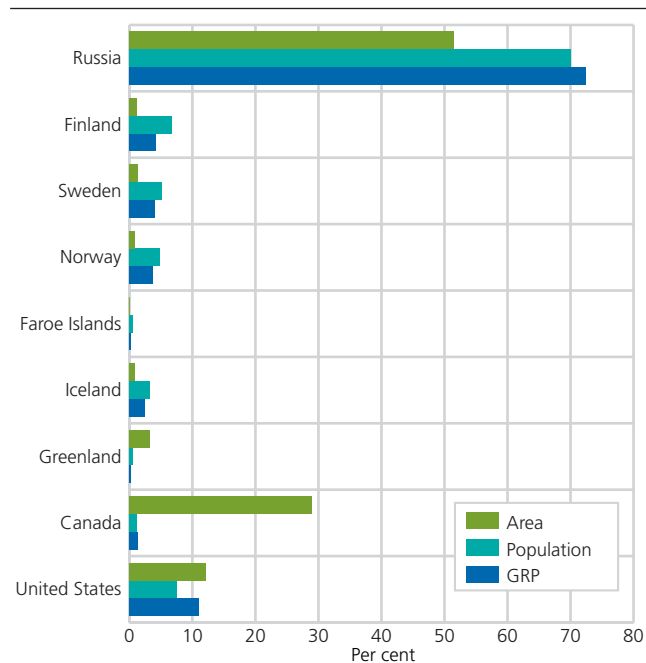
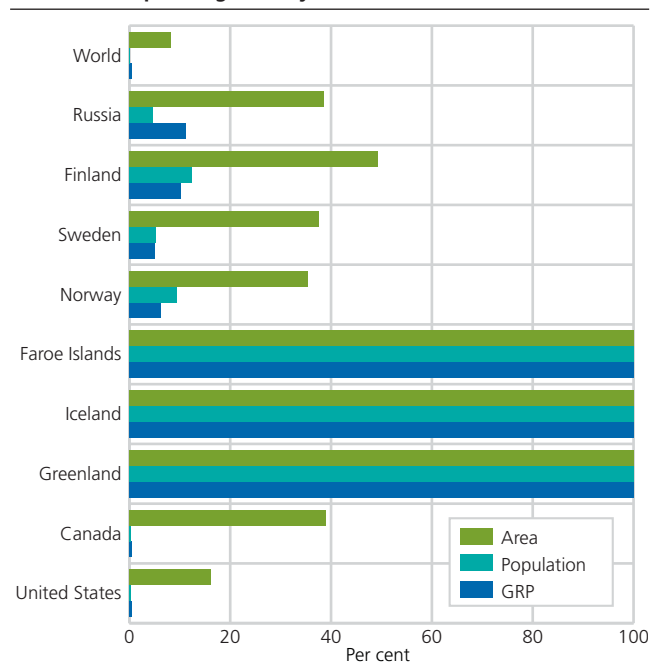
exchange rates when comparing across regions and countries and illustrates some of the steps that have to be taken when harmonizing the valuation of economic data across regions.

An overview of Arctic economies

At circumpolar level the Arctic regions with 0.1 percent of the world population generated 0.5 percent of global gross domestic product (GDP) in 2012. The Arctic covers as much as 8 percent of the global surface area, however, Arctic states hold different shares of the Arctic in terms of land area, population and GDP.

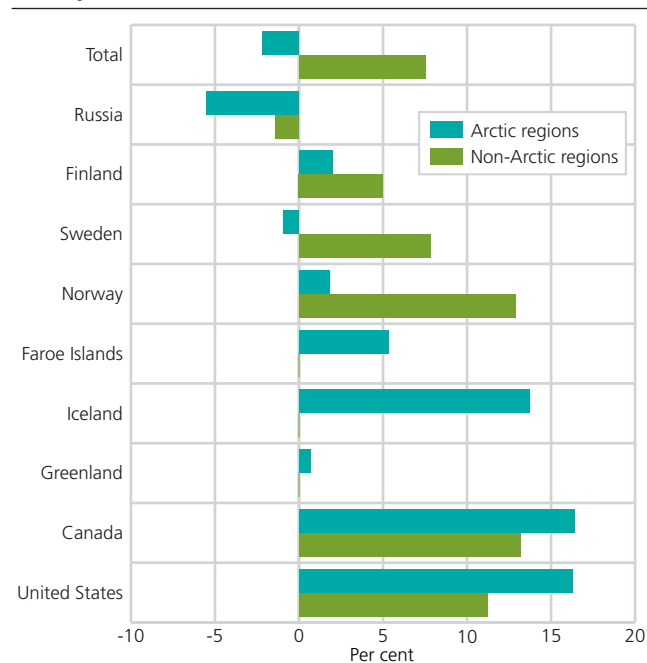
Figure 3.2 illustrates the role of the Arctic states within the entire Arctic region. Russia's Arctic area covers slightly more than half of the total Arctic land area. The Russian gross regional product (GRP) amounts to 70 percent of the total Arctic economy and the population share of the Arctic is similarly high. Canada has the second largest share (29 per cent) of the Arctic surface area, but has disproportionately low population density and economic activity level.

Then follows USA at 12 per cent of the Arctic land area. Only small shares are left for the other regions covering

Figure 3.2. **Arctic surface area, population and GRP of Arctic states as share of the Arctic total. 2012. Per cent**Figure 3.3. **Arctic region share of surface area, population and GRP of corresponding country. 2012. Per cent**

1 to 3 per cent with Greenland as the largest, covering 3 per cent, with its ice-free area. The Arctic regions of Norway, Sweden, Finland and Iceland all have small shares of the territory (1 per cent) but their population densities and economic activity levels are relatively higher.

Russia, Fennoscandinavia and Iceland have higher shares of Arctic population than land area. Russia has a slightly higher share of Arctic GRP than of population, whereas Arctic regions of Fennoscandinavia and Iceland all have lower shares of Arctic GRP than of popu-

Figure 3.4. **Population growth. Arctic and non-Arctic regions by country. 2000-2012. Per cent**

lation. Arctic Canada is so sparsely populated that its shares in population and Arctic GDP are dwarfed when compared with the share of Arctic Canada's territory.

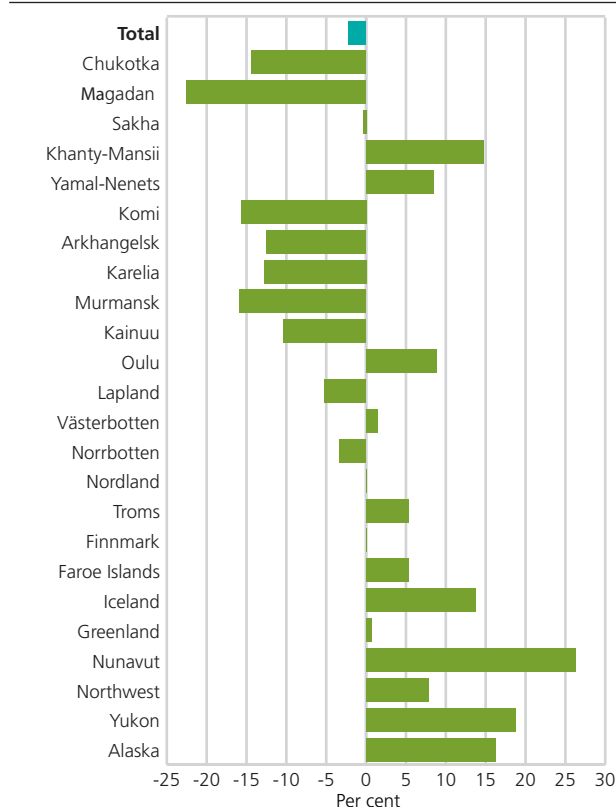
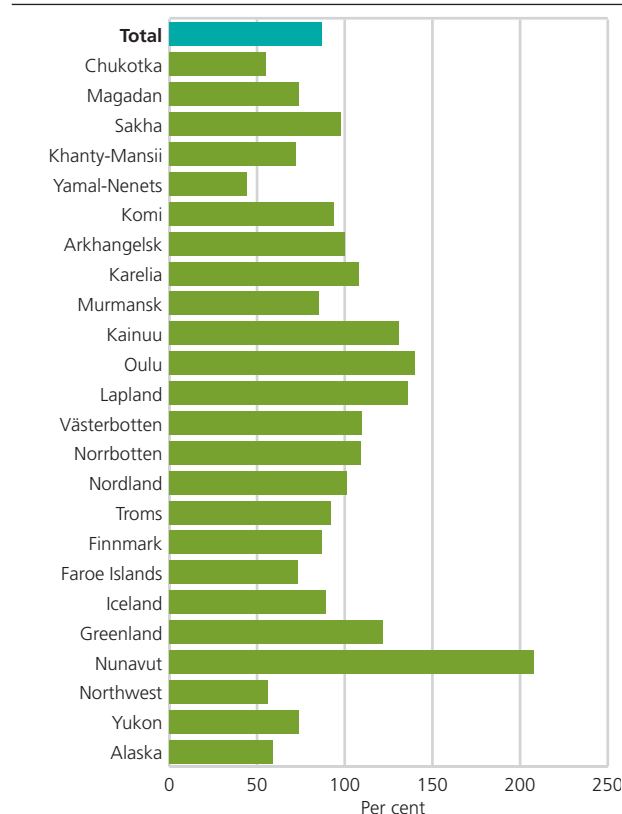
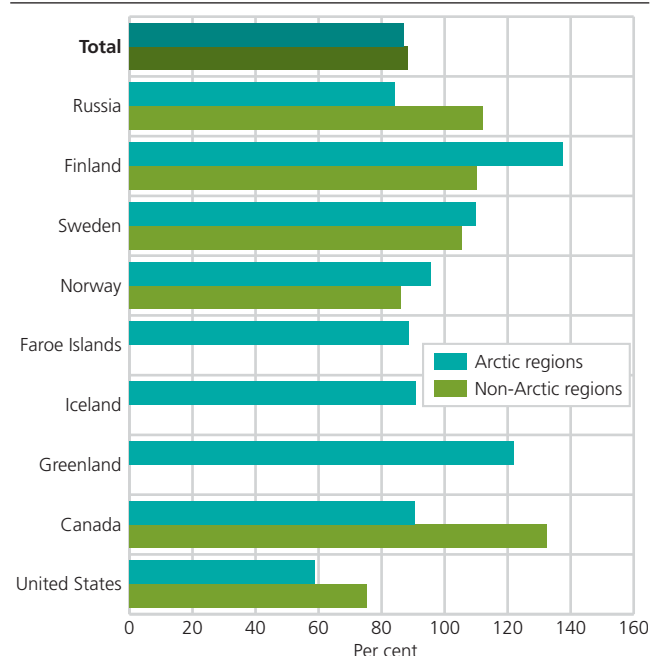
Figure 3.3 illustrates the Arctic shares of area, population and GDP of each Arctic state. Faroe Islands and Greenland are considered Arctic states in this context, as different from previous ECONOR reports, where they were represented as separate Arctic regions of Denmark. Greenland and Faroe Islands have Self-Governance in most policy areas, including management of natural resources. However, foreign policy and security issues of national concern remain under Denmark.

The Russian Arctic has a higher share of Russia's GDP than of population, whereas Northern Finland and Norway generate smaller shares of national GDP than their shares in populations. In Sweden the Arctic shares of national population and GDP are fairly equal. For Canada and the United States the non-Arctic economies and populations are totally dominating.

Population

During 2000-2012 there has been a 2 per cent decline for the Arctic population as a whole (Figure 3.4). The Russian Arctic has by far the largest population among the Arctic regions and a strong decline of 5 per cent in that region is only partly balanced by the increase in population in most other Arctic regions. There has been relatively strong population growth in both Northern Canada and Alaska of around 17 per cent over the period.

Iceland had a somewhat lower population growth of 13 per cent, still a marked growth when considering

Figure 3.5. **Population growth by Arctic sub-region. 2000-2012.**
Per centFigure 3.7. **Dependency ratio, by Arctic sub-region. 2012.**
Per centFigure 3.6. **Dependency ratio in Arctic and non-Arctic regions, by country. 2012. Per cent**

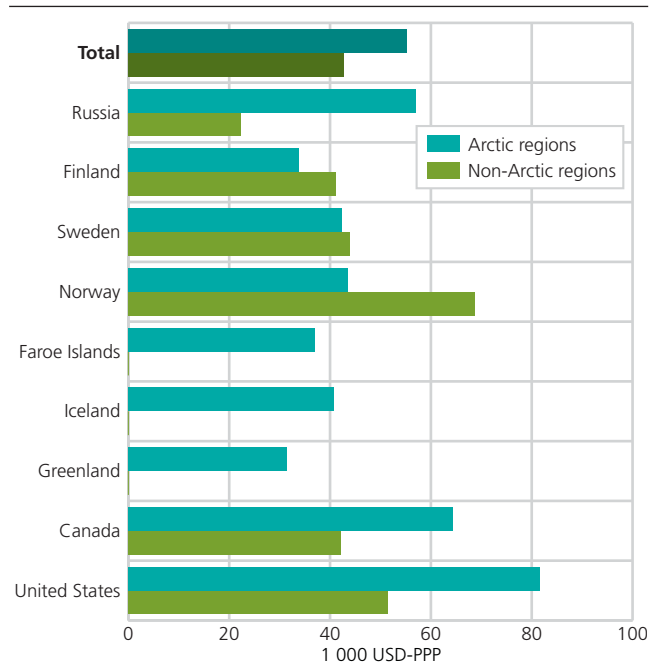
that the financial crisis increased emigration. Still, the population stayed constant during 2008-2011, in the wake of the financial crisis. As a result of generous policy towards families with children Iceland has had relatively high birth rate in European context, generating a population with a large share of the population below 35 years. The share of woman employed is 78 per cent, highest in the world, and almost all children are in day-care (90 per cent).

Arctic Norway, supposed to have similar day-care and employment conditions for women, has only a marginal population growth compared with Iceland. This indicates that there is still lack of opportunities for jobs and day-care as the population is spread along the coast, imposing high cost in extending the services, whereas in Iceland the majority of the population lives in the capital of Reykjavik and thus can benefit from the centralized services. The population decline in Arctic Sweden was 1 per cent, being the only northern regions with negative population growth besides the Russian Arctic. However, Russia also had negative population growth outside the Arctic areas.

Figure 3.5 shows population growth during 2000-2012 by Arctic sub-region. In Arctic Russia the only sub-regions with population growth were the petroleum regions of Khanty-Mansii and Yama-Nenets. Arctic regions in Western Europe generally have had minor changes in population size. In Finland there was population growth in Oulu, in contrast to declines in Kainuu and Lapland. The American Arctic sub-regions have all had population growth in the range of 5 to 25 per cent, with Nunavut and Yukon at the top, followed by Alaska.

Dependency ratio

A useful socio-economic indicator is the economic dependency ratio, which is the number of persons unemployed or outside the labour force per employed person. The persons outside the labour force include children, elderly, disabled, students, unemployed, and,

Figure 3.8. **Gross regional product (GRP) per capita, by Arctic region. 2012. 1 000 USD-PPP**

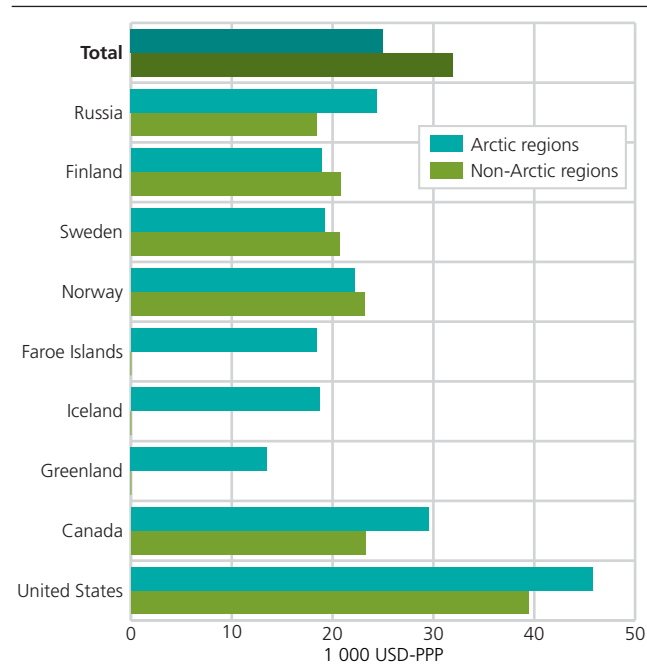
especially relevant in the Arctic, people involved in the informal subsistence economy.

Factors that increase the dependence ratio can be high population growth, with many children to support, or low population growth with an ageing population. Unemployment also increases the dependency ratio. A large migrant workforce, for instance temporarily or seasonally employed in resource extraction (mining and petroleum) leaving their families behind outside the region, will also reduce the dependency ratio.

Figure 3.6 shows that in USA, Canada and Russia the Arctic regions have lower dependency ratios than the non-Arctic regions. The use of seasonal and migrant labour in petroleum and mining industries may explain the low dependency ratios of the United States (Alaska) and Arctic Russia. Arctic regions of Finland, Sweden and Norway all have higher dependency ratios in Arctic regions than in non-Arctic parts of the countries. However, the differences for Norway and Sweden are less pronounced than for Finland.

The dependency ratios of Arctic sub-regions are presented in Figure 3.7. For understanding the factors behind the differences of dependency ratios, more detailed statistics on the population age structure etc. would be needed. The main petroleum producing regions Alaska, Khanty-Mansi and Yamal-Nenets, have fairly low dependency ratios, indicating use of seasonal/temporary labour. So is the case with the Northwest Territories of Canada with diamond production.

The highest dependency ratio is in Nunavut, with two additional persons to support for every employed person. Then follows Northern Finland, with high dependency ratio in all three sub-regions, however,

Figure 3.9. **Disposable income of households per capita, by Arctic region. 2012. 1 000 USD-PPP**

these ratios have declined somewhat since 2005. Greenland has a slightly lower dependency ratio than the sub-regions of Northern Finland, all well above the average for the Arctic.

The economies of the Arctic

Figure 3.8 shows GRP per capita of Arctic regions and non-Arctic counterparts in 2012. In most Arctic regions GRP per capita is higher than in corresponding non-Arctic areas, except in Norway, Sweden and Finland. A high share of mineral extraction with high returns in the economies outside Arctic Fennoscandinavia contributes to this, however, the more densely populated areas also have more diverse and viable economies. Norway has a substantial petroleum production, although mainly in non-Arctic regions. This extraction takes place off-shore and the income is by statistical convention assigned to a virtual "region" representing the off-shore petroleum areas. However, in national accounting a small part of the value added from petroleum extraction is assigned to the county where the income is generated. In Northern Russia with its huge petroleum and other mineral production the GRP per capita is more than double the non-Arctic level. Northern Russia, Alaska and Northern Canada have the highest GRP per capita among the Arctic regions.

Figure 3.9 shifts the focus from GRP or value generation at regional level to the actual income of people living in the Arctic. In Russia, Canada and USA the disposable income of households per capita is higher in Arctic regions than in non-Arctic. In Finland, Sweden and Norway the Arctic regions are slightly behind the rest of the corresponding countries. Alaska, Northern Canada and Arctic Russia have the highest disposable income of households per capita, whereas Greenland has the lowest disposable income level.

Figure 3.10. **Gross regional product (GRP) per capita and disposable income of households (DIH) per capita, by Arctic sub-regions. 2012. 1 000 USD-PPP**

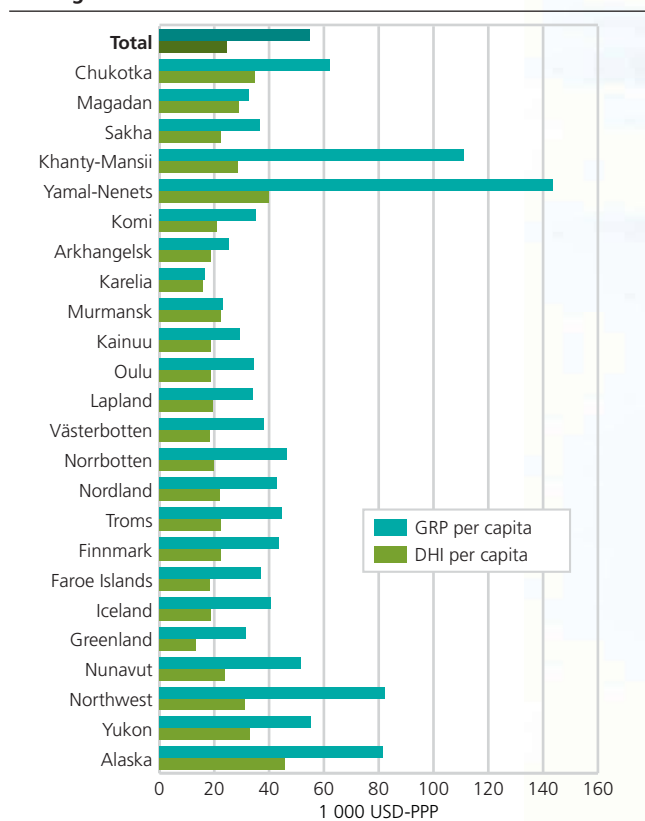
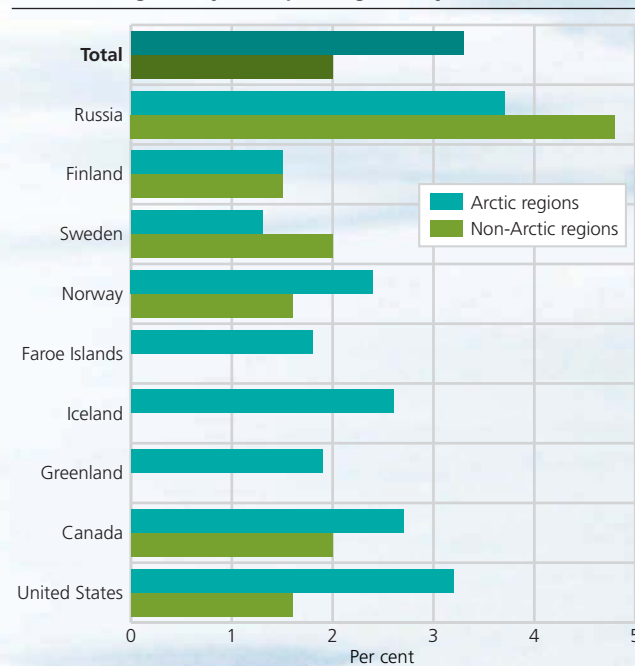


Figure 3.10 compares GRP per capita and disposable income of households per capita (DIH/capita) at a more detailed regional level. Alaska has the highest DIH per capita followed by Yamal-Nenets, Chukotka, Yukon and the Northwest Territories. Arctic Finland, Sweden and Norway all have about similar levels of DIH per capita.

Figure 3.11 gives an overview of economic growth rates by Arctic and Non-Arctic regions, in terms of average yearly percentage growth in GRP measured in purchasing power parities (GRP-PPP). At circumpolar level the growth rate of Arctic regions (3.2 per cent) has been markedly higher than in the non-Arctic regions of the Arctic states (2.0 per cent). The highest growth occurred in Arctic Russia (3.6 per cent). However, Russia outside the Arctic had an even higher average annual growth rate of 4.7 per cent.

Alaska and Northern Canada came out as the second and third fastest growing regions with 3.2 per cent and 2.7 per cent respectively. In contrast to the Russian Arctic, Alaska and Northern Canada achieved higher growth rates than their non-Arctic counterparts, for Alaska about twice as high. Characteristically, Arctic Russia, Alaska and Northern Canada had the highest growth rates, reflecting that they loom large in mineral and petroleum extraction, with high world market prices during most of the period, although interrupted by declines during the financial crisis.

Figure 3.11. **Average annual economic growth of Arctic and non-Arctic regions, by corresponding country. 2000-2012. Per cent**



Interestingly, Iceland had a higher growth rate (2.6 per cent) on average than Northern regions of Finland, Sweden and Norway and the Faroe Islands, considering the deep economic crisis Iceland experienced in 2008.

When looking at a lower regional level the variation is substantial (Figure 3.12). Chukotka and Arkhangelsk in Russia have by far had the highest growth at 6.5 and 6.1 per cent respectively. In Chukotka a large development program with investments in mining, infrastructure and social services has been supported by the multimillionaire Roman Abramovitsj. Khanti-Mantii and Yamal-Nenets achieved 4.0 per cent on average with Sakha and Komi slightly behind (3.6 per cent and 3.0 per cent). Magadan, which had negative growth on average during the first five years came out with 1.4 per cent for the whole period, Karelia had a similar modest growth rate (1.5 per cent) whereas the Murmansk region almost stagnated (0.1 per cent).

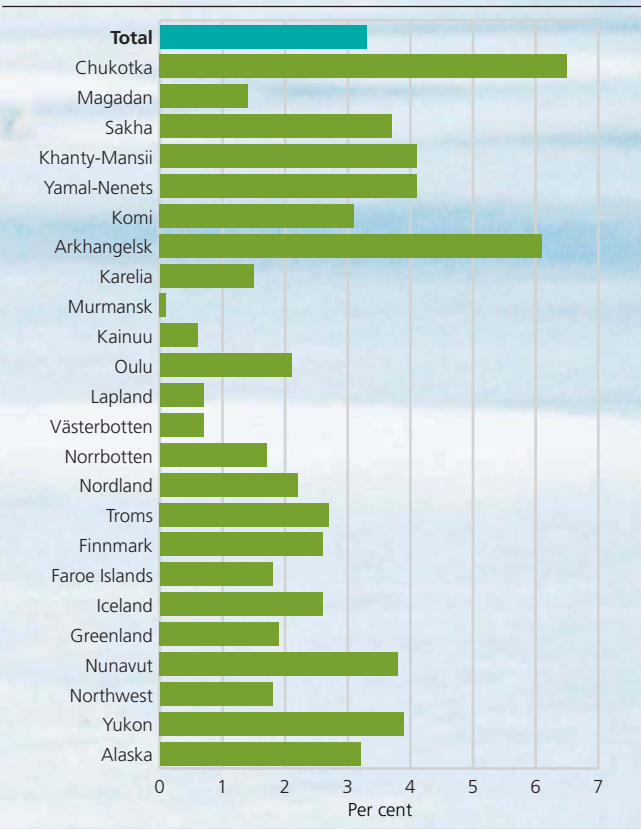
The growth in Northern Canada was uneven among sub-regions, with high growth in Yukon and Nunavut (3.9 per cent and 3.7 per cent) but somewhat below 2 per cent in the Northwest Territories. In Arctic Finland the region of Oulu kept an annual growth of 2 per cent, and with minor growth rates in Lapland and Kainuu.

Notes

¹ <https://www.veac.st>

² Regional accounts for Nunavut have, however been compiled for 1938, 1991, 1998 and 2003, and are available at [Nunivaat.org](http://www.nunivaat.org) or <http://www.nunivaat.org/TableViewer.aspx?U=http://www.chaireconditionautochtone.fss.ulaval.ca/extranet/doc/152.pdf>. See also Duhaime, G, and V. Robichaud, 2007. Economic Portrait of Nunavut 2004. Québec, Canada Research Chair on Comparative Aboriginal Condition, 66p.

Figure 3.12. Average annual economic growth, by Arctic sub-region. 2000-2012. Per cent



Box II. Notes on Gross Domestic Product and Value Added Comparisons Across Arctic Regions

Gross Domestic Product (GDP) is the total value of final goods and services¹ produced within a territory in a specified time period. It is one of the important measures of the level of economic activity in a region, along with employment and personal income.

GDP is a measure of how much output a region can produce as well as how much income it can generate from that production. In this regard GDP is equivalent to Value Added (VA), defined as the economic contribution to goods and services production at each step in the production process by the factors of production—mostly labor and capital. Since the sum of value added equals both the value of output and the income to factors of production, total income equals total output.

The international standard for measuring GDP is established in the System of National Accounts (SNA93) prepared by representatives of the International Monetary Fund, European Union, Organization for Economic Cooperation and Development, United Nations, and World Bank. The rules and measures for the measurement of national accounts are designed to be flexible, to allow for differences in local statistical needs and conditions.² GDP statistics are available for most countries and are commonly used to track and compare economic performance.

GDP is generally measured in the local currency, and so to compare the economic activity or performance between different countries requires that they be converted to a common base, typically using either the currency exchange rate or the purchasing power parity exchange rate. The choice depends on the objective of the comparison. The former compares the international purchasing power of different economies. The latter is a better measure of the domestic purchasing power of the average producer or consumer within the countries. Some implications of this choice with relevance for The Economy of the North are illustrated in Box I.

Analysts using GDP as a measure of economic performance for a country need to keep in mind that it has a number of well-known shortcomings including:

1. Non-market transactions (child rearing, homemaker production, etc.) are generally excluded.
2. Economic «bads» are included. More production simply means a higher GDP, regardless of what is produced.
3. The value of leisure and other aspects of the quality of life are excluded.
4. The distribution of income across the population is not measured.
5. The sustainability of production is ignored.

In many countries GDP is also calculated at a regional level, allowing comparisons between regions within a country as well as between regions in different countries. These comparisons need to recognize certain features of regional GDP calculations, particularly when the regions are small and remote.

1. Residency—GDP is a measure of the value of production within a region, regardless of the residence of the labor used in production or the ownership of the capital. A companion measure at the national level, Gross National Product (GNP), measures the value of production by the residence of the owners of the labour and capital used in production, wherever that production takes place, but there is no comparable figure at the regional level, at least in the United States.

This can be a problem when using GDP as a measure of the income of a small and remote regional economy. A significant share of the work force could consist of commuters or seasonal workers who live outside the region. A large share of the capital could be owned by non-residents and the profits from production could leave the region. If these conditions are true then the income accruing to the residents of the regional economy will be less than the value of production.

It is also possible that the opposite would be the case. The state of Alaska controls a large investment fund, the Alaska Permanent Fund, with a portfolio of investments that is entirely outside the state. Each year the Fund generates several billion dollars of income that is not included in Alaska GDP because the production associated with those investments occurs outside the state.

2. Federal Assistance—A remote rural region of a national economy may be dependent upon assistance from the central government to pay for and provide public services, over and above the level that taxes from the region to the central government can provide. In such a case the GDP, which generally includes all public sector spending in the region, will be an overestimate of the productive capacity of the region itself by the amount of the «subsidy». For example, an increase in the subsidy will increase GDP, even though it does not represent a strengthening of the regional economy.

3. Location of Production—When production involves inputs located in different regions it can be difficult to allocate the share of value added attributable to each region. For example oil production on Alaska's North Slope depends on the inputs physically located in Alaska, but also on capital and labor inputs located in the headquarters offices of the oil companies outside the state. Allocating economic rents (the value of output in excess of that required to compensate capital and labor) between regions in this case is arbitrary.

Production may occur in one region and be reported in another. A share of the seafood harvested in the ocean adjacent to Alaska is done by boats headquartered outside the state. The value of their harvest is reported as occurring in other locations rather than in Alaska.

4. Valuing Subsistence Activities—A share of the population in many remote rural regional economies engages in productive activities outside normal economic markets, such as the subsistence activities of indigenous people. The valuation of these subsistence activities can be handled in several different ways in the GDP accounts. They may be excluded altogether as is the case in the United States. If they are included, there may be differences in the types of activities included. For those included activities valuation may be done by comparison of the outputs to similar outputs that have market prices (replacement value), by valuing the outputs at the cost of the inputs, or by some other method of imputing a value to the activity.

5. Price Variation—Small remote regional economies may be dominated by a limited number of primary commodity producing industries. The value added in the production of those commodities can be quite volatile from year to year because of volatility in their market prices. The Alaska GDP is heavily influenced by the importance of oil production, and much of the change in GDP from year to year is a result of the change in the price of oil rather than any change in the physical output of the economy.

This volatility means that comparisons with other regions are sensitive to the year in which the comparison is made. A comparison when the price of oil is high will indicate a larger Alaska economy relative to other locations than would be the case of a comparison when the price of oil is low.

6. Data Collection Difficulties—The small size of regional economies results in less precision in estimates of GDP based on sampling (due to sampling error). Remoteness can also contribute to imprecision due to the challenges of data collection associated with travel, weather, and other variables.

¹ Including exports.

² Countries may differ in the types of non-market activities they chose to include in GDP. They also may differ in which prices they use to present output figures. Among the alternatives are market prices (including any sales, property, and excise taxes) or factor costs (market prices net of taxes which are not a return to a factor of production).



Iceberg, Icefjord north of Nuuk, Greenland. Photo: Tom Nicolaysen

4. Arctic economies within the Arctic nations¹

*Solveig Glomsrød, Ilmo Mäenpää, Lars Lindholt, Helen Mc Donald,
Taoyuan Wei and Scott Goldsmith*

The Arctic economies are small with limited diversification and thus vulnerable to any abrupt changes in demand for their export. This chapter has a focus on the economic structures and growth of Arctic regions. Most of the economies of the Arctic regions are based on raw material export. When looking at the price indices of fish, minerals and energy in Figures 4.1 and 4.2 there is reason to reflect on how these world market conditions have affected the arctic regions during the last years and after the financial crisis.

The ECONOR projects have followed the economy from 2002 to 2012, capturing peaks and turbulence in world raw material prices. The previous version of this report – The Economy of the North 2008 – covered the development from 2002-2005, capturing a doubling of the raw material prices but just missing the coming steep rise and peak in 2008 before the financial crisis sent prices back to 2005 level. The current report compares the situation of 2008 with 2012-levels before the prices in particular for energy levelled off, still at a relatively high level before falling abruptly from 2014.

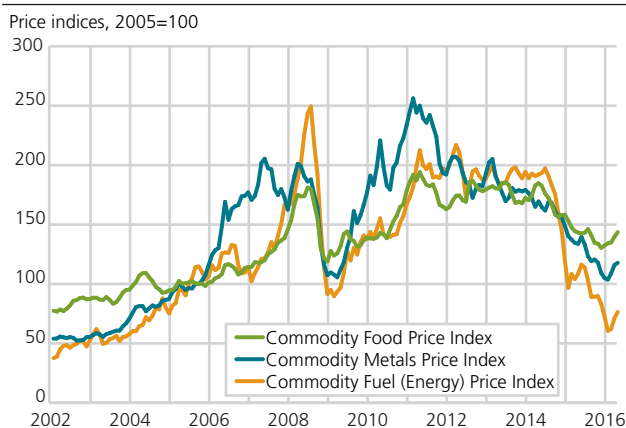
Fish prices (Figure 4.2) have shown some similarities with the development of mineral prices, but enjoyed a more sustainable increase, in particular for farmed fish which is getting increasingly more important for Arctic regions.

In the following presentation of National Account data and other statistics on economic development in the Arctic regions, it is useful to keep in mind the recent raw material price development when interpreting the results. The main bulk of economic data in this chapter goes up to 2012.

For the most part, the information in this chapter is viewed from an intra-national rather than a comparative international perspective, although some comparisons among the regions are made in the concluding remarks to this chapter.

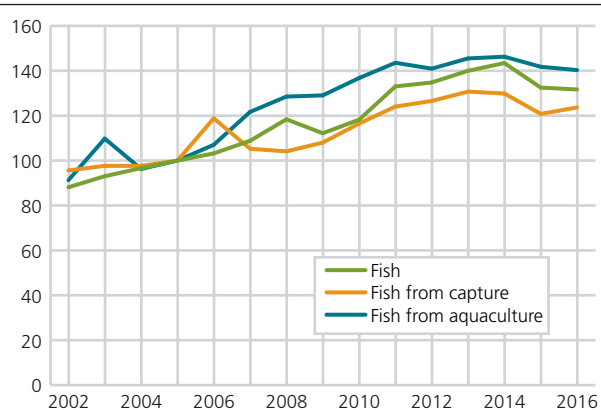
For each of the Arctic regions this chapter contains a core table showing gross regional product (GRP or GDP for nations) in current prices and the contribution to GRP by industry at a disaggregated level. At our level of detail we hope to make the main activities of the individual Arctic region visible. In addition, standardized figures present contribution to GRP by main industry category in the regional economy. These core tables and figures generally refer to the years 2008 and 2012. The tables present value added or contribution to GRP in local currency in order to focus on the Arctic element of their respective national or federal economies. Further, a set of figures show GRP volume index and growth rate during 2000-2012. The data for the Arctic regions are based on national statistics. Data sources by region are listed in Box 4.4.

Figure 4.1. Price indices of food, metals and energy. 2002-2016



Source: IMF (2016): Primary commodity prices <http://www.imf.org>

Figure 4.2. Price indices for fish. 2002-2016



Source: OECD-FAO
<http://stats.oecd.org/viewhtml.aspx?QueryId=71240&vh=0000&vf=0&il=&lang=en#>

¹ The authors thank Anton Orlov, CICERO, for compiling figures and tables, and Cara Williams, Statistics Canada, for statistical advice and data for Canada.



Alaska

Alaska has 735 000 inhabitants and about half the population lives within the Anchorage region. During the period 2000 to 2012 Alaska had the second highest population growth among the arctic regions, only marginally lower than the population growth in Northern Canada. Alaska also had the highest disposable income per capita among arctic regions in 2012, markedly higher than the average for non-arctic states of the USA.

The backbone of the economy is the petroleum industry. However, the giant oil field of Prudhoe Bay on the North Slope is in the decline phase and uncertainty around future oil prices and international climate policies questions the sustainability of the petroleum income level.

As shown in Table 4.1 income from Oil and gas extraction declined in nominal terms from 2008 to 2012, reducing the share in the regional GRP from 23 per cent in 2008 to 19.3 per cent in 2012. However, an increase in Other mining partly compensated for the petroleum income reduction. Petroleum and Other mining contributed 24.3 per cent to GRP in 2012, against 26.6 per cent in 2008. Most of the petroleum is transported by pipeline to the port of Valdez for further sea transport. Transportation by pipeline is the third largest industry with a share in total value added at 6.3 per cent in 2012, up from 5.7 per cent in 2008. Hence, the mineral business is making up 30 per cent of total income in direct terms. With turbulent mineral prices and increasing seriousness in climate and environmental policy, Alaska is among the arctic regions that are most exposed to the green transition.

The Alaska seafood industry consists of the harvesting and processing of numerous species of seafood found in the waters within and surrounding the state. In 2012 the gross product from this activity was about USD 750 million based on a wholesale value of about USD 3 billion. The industry employs about 20 thousand on an annual basis although much of the activity is seasonal.

Table 4.1. Value added¹ by industry. Alaska. 2008 and 2012

	2008		2012	
	Mill. USD	Per cent	Mill. USD	Per cent
Agriculture, forestry and fishing	178	0.4	225	0.4
Mining and quarrying	11 906	26.6	12 203	24.3
Oil and gas extraction	10 287	23.0	9 668	19.3
Other mining and quarrying	1 619	3.6	2 535	5.0
Manufacturing	1 482	3.3	996	2.0
Fish processing	574	1.3	521	1.0
Processing of wood and paper	23	0.1	10	0.0
Coal and oil manufacturing, chemicals	664	1.5	240	0.5
Other manufacturing	221	0.5	225	0.4
Utilities	662	1.5	847	1.7
Construction	2 043	4.6	2 208	4.4
Wholesale and retail trade	2 416	5.4	2 648	5.3
Transportation and storage	4 386	9.8	5 286	10.5
Transportation by pipeline	2 546	5.7	3 184	6.3
Other transportation and storage	1 840	4.1	2 102	4.2
Accommodation and food services	1 085	2.4	1 194	2.4
Financial and insurance services	1 031	2.3	954	1.9
Real estate activities	3 422	7.6	4 365	8.7
Public administration and defence	8 824	19.7	10 573	21.1
Education	119	0.3	129	0.3
Health care and social work	2 331	5.2	3 102	6.2
Other service activities	4 858	10.9	5 486	10.9
Total	44 743	100.0	50 216	100.0

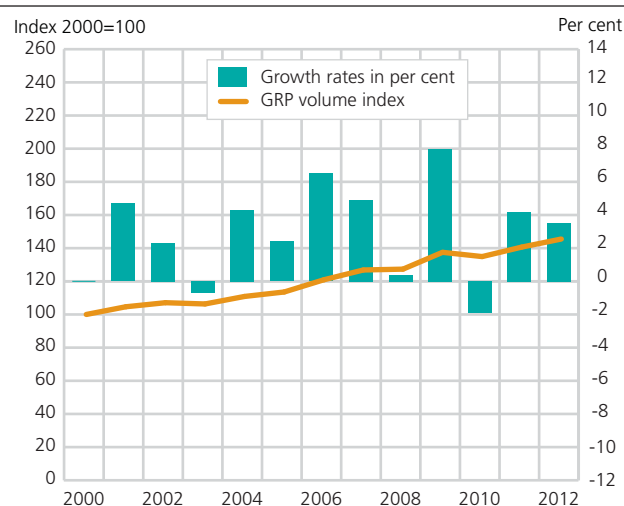
¹ At basic prices.

Manufacturing industries slightly diminished their share in the Alaskan economy. The drop in value added in Manufacturing between 2008 and 2012 was mainly a result of several refinery closures in 2010 and 2012.

Public administration and defence was markedly higher in 2012 than in 2008, increasing its contribution to GRP from 19.7 per cent to 21.1 per cent in 2012. Besides Public administration and defence, Health care and Real estate services increased their activities.

Tourism in terms of Accommodation and food services plays an important role in the economy with about 2.4

Figure 4.3. GRP volume index and growth rate. Alaska. 2000-2012



Box 4.1. The Alaska Native Regional Corporations

Twelve Alaska Native Regional Corporations were established in 1971 with the passage of the Alaska Native Claims Settlement Act (ANCSA) which extinguished aboriginal land claims in the state. The act conveyed 44 million acres (about 10 percent of the land within the state) along with USD 962.5 million to about 80 thousand Alaska Natives (at least one fourth Native ancestry). The act did not eliminate the federal responsibility for the social and health needs of Alaska Natives.

The land and cash were distributed to 12 regional corporations (and about 200 village corporations). Eligible Natives were enrolled and given shares in a village corporation and one of 12 regional corporations.

Since their inception these for-profit corporations have worked to develop their land holdings and invest their capital both within Alaska and outside the state. Benefits to shareholders include employment opportunities, dividend payments, scholarships, cultural preservation, land management, economic development, and advocacy for Alaska Native peoples.

The corporations operate in most industries within the state including petroleum, mining, seafood, tourism, construction, finance, engineering, transportation, and government contracting. Many also have significant business outside Alaska in government contracting.

Total revenue of the regional corporations in 2015 was USD 8.7 billion and net income was USD 241 million. Total dividends to shareholders was USD 167 million and donations to Native non-profits totaled USD 16 million. Each ANCSA Regional corporation has non-profit counterparts that channel the delivery of federal health, housing, and social services programs to the Native community within its jurisdiction.

http://ancsaregional.com/wp-content/uploads/2013/12/2016-ANCSA_Economic-Report.pdf

per cent of GRP in 2012, having kept pace with the economy at large during 2008-2012. The activity fell somewhat in the wake of the financial crisis, before rising again from 2009.

Finance and insurance activities was 8 per cent higher in 2012 than in 2008 whereas Real estate activities increased by 28 per cent. Growth in Construction in this period was 8 per cent in nominal terms. The population growth is likely to have contributed to the growth in the Real estate sector.

Royalties and taxes from petroleum industry have over the years generated large revenues for the State of Alaska, largely financing the public sector and investments in infrastructure. In addition, revenues have been set aside in the Alaska Permanent Fund.

With Prudhoe Bay in decline and lower oil prices the petroleum income falls short of covering the state expenditures to the same extent. Foreseeing a situation with less petroleum income, the government

Figure 4.4. Value added by main industry. Alaska. Per cent of GRP. 2008 and 2012

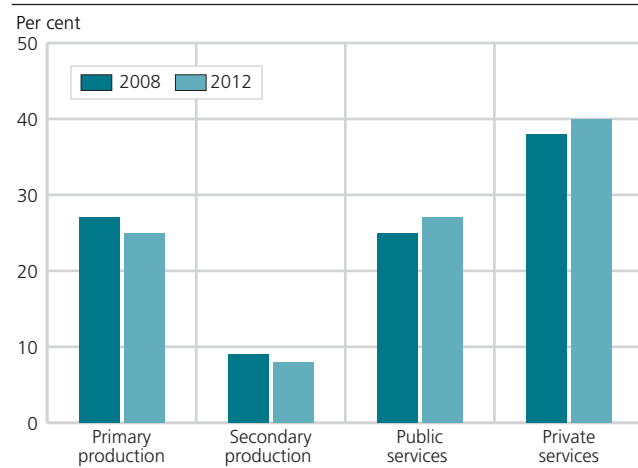


Figure 4.5. Gross regional product (GRP) per capita and Disposable Income for Households (DIH) per capita. United States. 2012. 1 000 USD-PPP

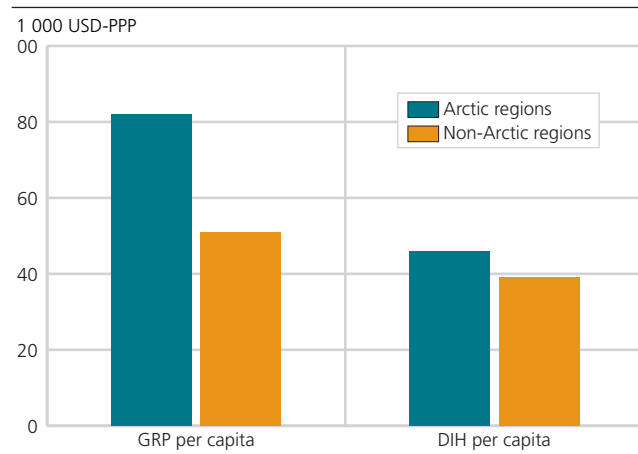
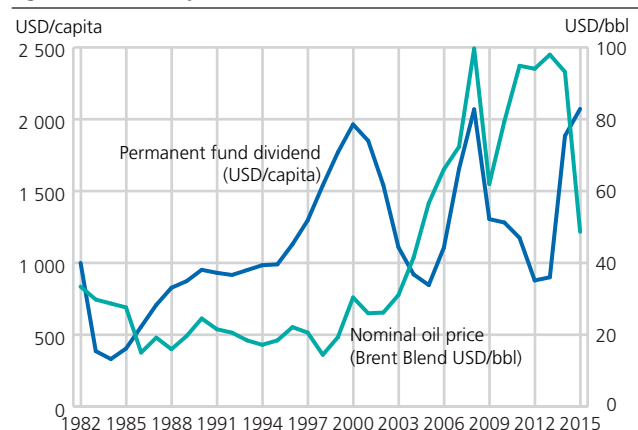


Figure 4.6. Alaska permanent fund dividend



Source: Alaska permanent Fund Division, <http://www.apfc.org/home/Content/dividend/dividendamounts.cfm>

established the Alaska Permanent Fund in 1976 to turn petroleum income into a sustained source of income. The fund has received 25 per cent of royalties on petroleum production and ended the fiscal year 2016 with a balance of USD 52.8 billion, unchanged from a year earlier. Net investment income (USD 400 million) and new deposits from royalties (USD 300 million) on petroleum production were just offset by the annual

draw to pay the Permanent Fund dividend (USD 700 million). The special dividend program allocates a share of annual fund revenues to each inhabitant of Alaska following a scheme that smooths the return over the last 5 years, amounting to USD 2072 per person in 2015 (Figure 4.6).

Still, the deposit to the fund in the fiscal year 2016 only corresponded to a saving of about 10 per cent of the state government's income from petroleum, which also includes taxes on production, property and income in addition to the royalties i.e. tax on petroleum value at well-head.

When the large oil incomes started to flow in Alaska in the late 1970s, the dividend scheme worked as a strong incentive for the population to support the establishment of the fund. The fall in oil prices in 2015 together with smaller oil volumes accelerates the income loss

and requires additional income sources to balance the budget. Opening up for using a sustainable return on the Alaska Permanent Fund financial investments might cover expenditures without reducing the value of the Fund and without ending the Permanent Fund's dividend program.

Federal government has been another source of income through direct expenditure and transfers to the state government. Direct expenditures to federal activity relates to management of public lands, services to Alaska natives and military activities.

The growth rate of the senior (aged 65+) population in Alaska has been the highest in the nation for many years. Retiree expenditures as well as publicly funded health care spending on their behalf has become a significant source of economic diversification. The cash flow into the state from this spending is difficult to estimate but is similar in magnitude to the cash flow from tourist visitors to the state.

A large share of the air cargo traffic between the Far East and the US mainland stops in Anchorage to refuel, change crews, and perform routine maintenance. There is no public data on the value of services provided in Alaska by the international air cargo carriers, but Anchorage International Airport annually ranks as one of the largest in the world in terms of total cargo handled¹.

As Alaska is relying on the mineral extraction for most of its income, the state is sensitive to shifts in global demand and business cycles in general. As shown in Figure 4.3 the economy has been in steady growth towards 2012. Alaska avoided the recession in 2008 experienced by most Arctic regions and even had substantial growth of 8 per cent in 2009 before the economy contracted by 2 per cent in 2010.

GRP per capita is considerably higher in Alaska than in non-arctic states of the USA (Figure 4.5). Disposable income of households (DIH) per capita is also somewhat higher in Alaska. This partly reflects the higher wage levels in petroleum and other mining industries, however, the Permanent Fund Dividend program provides annual cash transfers to each citizen, thus contributing to disposable income and reducing income differences, as every person including children



receives the same amount. Compared with other states in the USA, Alaska is among those with smallest income differences.

Petroleum

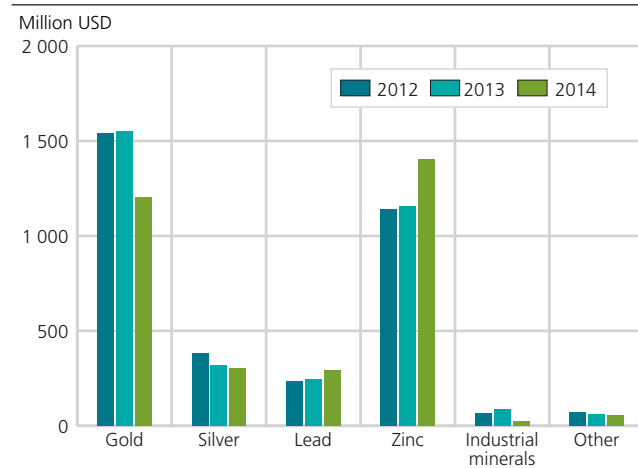
When including shale oil and shale gas Alaska's share of proven US oil and gas reserves is around 7 and 2 per cent, respectively². However, Alaska has huge amounts of undiscovered petroleum resources amounting to 5188 Mtoe³ oil and 5261 Mtoe gas (USGS 2008), corresponding to somewhat over 30 percent of US undiscovered resources.

Explorations at Prudhoe Bay, the largest oil field in the USA started in the 1960s and oil came on stream in 1977 when the Alaska pipeline was opened. Prudhoe Bay peaked in 1988 and the decline of this giant field has not been compensated by supply from other fields, reducing the taxes and royalties to the state and federal governments. The pressure for opening up new reserves is increasing although low petroleum prices more recently have modified this. However, the federal government considers the vulnerability of the pristine nature and the conservation of wilderness. The Alaska National Wildlife Refuge is a potential oil-rich coastal plain to the east of Prudhoe Bay. Federal land covers about 2/3 of the state of Alaska and environmental regulations might constrain future off-shore extraction further. Petroleum investments have long lead time, and in addition to acceptable prices, predictable policies are important for project development.

Exploration drilling offshore in the Chukchi Sea northwest of Alaska has been carried out by Royal Dutch Shell. The drilling met resistance from environmental organizations due to the risk of environmental hazards in vulnerable areas, with limited capacity to deal with pollution, for instance oil spills under the ice. However, in 2015 after months with low oil prices Shell decided to close the well and drop plans for further drilling outside the coast of Alaska, referring to limited discoveries and high costs. Later that year both Shell and Statoil withdrew from their offshore drilling leases in the Chukchi and Beaufort Seas as requests for retaining leases after their expiry in Beaufort (2017) and Chukchi (2020) were declined. US Department of the Interior subsequently cancelled upcoming lease sales as planned for in the offshore leasing program 2012-2017, considering the low oil price and reduced investment activity.

In 2016 the White House set new safety rules for offshore drilling in the Chukchi and Beaufort Seas, specifically focusing exploratory drilling from floating vessels, after experiencing Shell's drilling rig running on ground in 2012. The regulations of petroleum and other mineral extraction are clearly subject to federal and state level political leadership. However, a growing request to conserve nature and climate might influence the future prospects of petroleum extraction (see Chapter 5).

Figure 4.7. **Mineral production of Alaska. 2005-2007**



Other minerals

The value added in Other mining than petroleum increased markedly from 2008 to 2012 and as seen in figure 4.7 the dominant mineral in terms of production value are zinc and gold. The production value of zinc also increased markedly from 2012 to 2014, whereas the value of gold declined as the price of gold declined after peaking around the financial crisis. Production of lead increased somewhat in 2014, whereas the production value of silver declined.

Fisheries

The harvest, primarily of salmon, halibut, shellfish, and groundfish, is taken partially by Alaska residents but also by boats based in other ports along the west coast of the US. Processing of the harvest occurs both on shore in Alaska and elsewhere and on large processing vessels.

The fisheries are managed to sustain their yield over time, primarily by limiting the number of harvesters and their catch. The salmon and shellfish harvests are managed by the state while the halibut and groundfish fisheries are managed by the federal government.

Tourism

As seen from Table 4.1, petroleum, other mining and public services dominate the economy. Other industries play minor roles, however, in this picture it is easy to forget the role of tourism, which is generating income in many industries like transportation, hotels and restaurants etc. Tourism is not an industry in national account context, but satellite accounts have been developed (see Chapter 8). For Alaska a satellite account was developed for 2004. A recent update for 2013 indicates that tourism in Alaska contributed 6.9 per cent to GRP.

Notes

¹ <http://www.aci.aero/News/Releases/Most-Recent/2016/04/04/ACI-releases-preliminary-world-airport-traffic-rankings>

² BP (2016).

³ Million tons of oil equivalents.

Box 4.2. The Alaska Permanent Fund and the Permanent Fund dividend

The Alaska Permanent Fund is a sovereign wealth fund of the state of Alaska established in 1976 by a vote of the people to preserve the wealth from petroleum production for future generations. Since its inception about 18 percent of petroleum revenues have been deposited into the fund either as constitutionally required contributions or special legislative appropriations of windfalls. The legislature also annually adds an amount to the principal to offset the effects of inflation on its value. Today the fund has a balance of USD 52 billion, about USD 75 thousand per capita.

The fund portfolio is invested in a broad range of non-Alaskan income producing assets ranging from bonds to real estate. It generates annual income after inflation today averaging about USD 2.5 billion. These earnings can be spent at the discretion of the legislature, but spending of the principal is prohibited by the constitution.

Since 1982 about half the fund earnings have been used to pay an annual dividend, the Alaska Permanent Fund dividend, to every Alaska resident. In this way all residents have been able to share directly in the petroleum wealth. The dividend has grown over time with the fund, reaching USD 2 072 in 2015. The total amount distributed as dividends each year represents a significant share of household income for many Alaskans. Since its inception the cumulative Permanent Fund dividends have been USD 55 thousand (2015 USD) per person.

Fund income not appropriated to the dividend (or inflation proofing) has been reinvested.

The Permanent Fund has successfully transformed a portion of state non-sustainable petroleum revenues into a sustainable financial asset that can produce an annual flow of income for future generations of Alaskans. In doing so it has also helped to constrain the growth of public spending and moderated the economic cycles generated by price sensitive fluctuating oil revenues. The current success of the fund can be attributed to a number of factors.

First, management of the fund is largely independent of the other branches of government and it has a clearly defined and narrow purpose which is to manage its portfolio to generate income for the state. It has no role in two challenging political questions—how much revenue to extract from the production of petroleum, and how to spend the earnings it produces.

Second, the fund is not a development bank. Alaska has collected more oil revenues than originally anticipated and has taken advantage of the occasions when revenues were high to create programs that have deflected pressure on the fund to take on the role of fostering economic development through capital investments in the state. These programs have included a number of agencies—including the Alaska Renewable Resources Corporation, Alaska Industrial Development and Export Authority (AIDEA), the Alaska Housing Finance Corporation (AHFC), the Alaska Science

and Technology Foundation, the Alaska Energy Authority, and the Alaska Aerospace Development Corporation—designed to promote economic development in the state. Consequently, there has been limited pressure to “put the fund to work” building the Alaska economy.

Third, only about 10 percent of the petroleum revenue stream has been constitutionally dedicated to the fund. This has left 90 percent for the legislature and governor to spend on expanded government programs and reduced taxes for businesses and households.

Fourth, there is a continuing perception that the state wasted its original bonanza—a USD 900 million bonus payment collected from producers in 1968 at a time when the state budget was only USD 150 million. Consequently, there is pressure to deposit any new windfalls into the Permanent Fund, where they will be safe from wasteful spending.

Fifth, the fund has a policy of not investing in Alaska. It looks worldwide to build a portfolio to maximize long term return on investment adjusted for risk. In this way it avoids any political pressure to funnel money into particular investments favored by powerful individuals or groups or to invest in local projects that produce a non-monetary benefit rather than a financial return.

Sixth, the Permanent Fund corporation is probably the most highly respected institution in the state. This partly stems from the fact that many of Alaska’s most respected leaders, such as former Governor Jay Hammond, helped guide the formation of the fund and have been continuing advocates. In addition, the fund has been fortunate to have on the board many members perceived to be visionary and responsible custodians, such as banker Elmer Rasmuson, the first board chairman. The board has also been able to attract high quality staff, both from within and outside the state, beginning with the first executive director, Dave Rose.

Operational transparency adds to confidence in the corporation. Board meetings are open to the public and held in communities throughout the state. The corporation publishes a clearly written annual report, produces educational materials for Alaskans, and maintains a speaker’s bureau. One can access a current list of portfolio holdings on a daily basis, the value of the fund, and detailed minutes of past board meetings from the corporation web site. It reports annually to the legislature. Finally, because Alaska is a small state, the board members are widely known in their communities.

Second guessing the investment decisions of the corporation is not a popular pastime even in times of down markets. The attention of the public is concentrated on the issue of how to collect the fair share of petroleum wealth from the companies producing oil in the state. Once the wealth has been converted to financial assets the public feels confident that these assets will be professionally managed for their benefit.

Scott Goldsmith,
University of Alaska at Anchorage

And finally, the Permanent Fund dividend has created a constituency protecting the fund. (This constituency is a proxy for future Alaskans whose voices cannot be heard today.) Alaskans have come to expect the annual dividend and react very poorly to any suggestions for changing the way the Permanent Fund is managed. Most Alaskans feel that individuals can benefit more from deciding themselves how to spend at least a portion of the public wealth rather than allowing the government to decide on their behalf. And many feel that since the oil production is on land owned by the state, they have a right, as individuals, to an annual dividend payment.

Although the Permanent Fund has accumulated an impressive balance over its 40-year life, looking ahead it faces its biggest challenges as Alaska transitions away from a petroleum based economy.

Alaska has relied almost entirely on petroleum revenues to fund government (about 90 percent) for 40 years. But now oil production is only 25 percent of its 1989 peak level, and although rising oil prices offset declining production for many years, oil revenues alone can no longer fund public needs. And since the state economy has not been able to develop an alternative tax base to replace petroleum, funding for government will need to rely on Permanent Fund earnings in the future.

Ironically, it is the vehicle for success in growing the Permanent Fund that is the greatest impediment in the transition to accessing the earnings to help pay the costs of government. A large share of dividend recipients feel that the sole purpose of the Permanent Fund is to pay the dividend. For them the fund is not a saving account but rather an income distribution fund. In fact, many Alaskans now incorrectly refer to the fund as the Alaska Dividend Fund.

Opposition to the use of the earnings of the fund for anything other than payment of the dividend was clearly demonstrated when 83 percent of the electorate voted in 1999 in opposition to an advisory vote to use the portion of fund earnings not dedicated to the dividend to help fund government.

Not everyone thinks the dividend is a problem. In particular, former governor Jay Hammond, the father of the dividend, argued that the best way to ensure balance between private and public consumption was to distribute all the earnings of the fund as a dividend and require the government to "claw back" through taxation what was needed for public spending.

Beyond the issue of how fund earnings are allocated in a post petroleum economy, is the question of the appropriate amount of earnings that can be spent in any year that will balance the needs of the current and future generations. A simple spending rule would impose some discipline against the tendency to overspend in the present.

Such a rule could be based on a percentage of fund value or it could be a specific amount that adjusted over time based on inflation, population, and other variables. But the rule should recognize that as long as the state is collecting current petroleum revenues it should continue to save a share as it has in the past. So in a transition until there is no petroleum left to produce, saving should continue in the same fashion as the last 40 years.

The ultimate purpose of the Alaska Permanent Fund is to help to sustain the economy after the non-sustainable petroleum resource has depleted. Finding the right answers to two questions—how much to draw from current earnings and what to spend it on—will be critical in determining whether the fund achieves its ultimate purpose.



Photo: Colorbox



The Canadian North

The Canadian North is defined as the three Northern Territories, namely, Northwest Territories, Yukon Territory and Nunavut. The population of Arctic Canada as of July 1, 2014 was 117 053 and was fairly evenly distributed among the three territories. The Canadian North is sparsely populated, and the Northern Territories combined accounted for only 0.3 per cent of total Canadian population and 0.5 per cent of Canadian GDP in 2014.

Mining continues to be a dominating industry in the Canadian North accounting for 17 per cent of Arctic Canada's GRP in 2012. However, its contribution to the territorial economy was markedly lower in 2012 than in 2008. Public administration and defence contributed 19 per cent to GRP, followed by Real estate activities which accounted for 11 per cent of Arctic Canada's GRP. Petroleum declined from 7.5 per cent in 2008 to 3.9 per cent in 2012.

The dominance of the government in the territorial economy was less pronounced in 2008 than in 2012 as the mining and petroleum industries lost some steam in the wake of the financial crisis. Health care and social work markedly increased its share of the economy.

Figure 4.8 shows real growth of the territorial economy, i.e. growth in income adjusted for inflation. The territories are small economies influenced by high variability in mineral extraction, which is reflected in the economic growth rates, with a market recession in 2008-2009.

The structural changes were substantial from 2008 to 2012 (Figure 4.9). Value added in primary industries which are mainly Petroleum and Other mineral extraction was reduced. Secondary industries with Manufacturing, Utilities and Construction kept a constant share whereas Public and Private services both increased in relative terms.

Arctic Canada's disposable household income per capita was 30 per cent higher than the level in non-arctic Canada in 2012 (Figure 4.10). The high income in Arctic Canada's mineral and energy industries, and their relatively high wage level, combined with the small population, may contribute to the higher disposable income per capita. The relatively high federal transfers to the Northern Territories may also be a factor. Disposable income per capita of Yukon and North West Territories were markedly above the average for non-arctic Canada, whereas Nunavut was just marginally higher.

Table 4.2. Value added¹ by industry. Arctic Canada. 2008 and 2012

	2008		2012	
	Mill. CAD	Per cent	Mill. CAD	Per cent
Agriculture, forestry	0.7	0.0	5.5	0.1
Fishing	2.7	0.0	5.9	0.1
Oil and gas extraction	682.2	7.5	358.3	3.9
Other mining and quarrying	1742.5	19.1	1585.0	17.2
Manufacturing	30.1	0.4	48.0	0.5
Utilities	162.5	1.9	191.8	2.2
Construction	764.0	9.1	749.0	8.4
Wholesale and retail trade	573.4	6.8	573.0	6.5
Transportation by pipeline	49.3	0.6	60.3	0.7
Other transportation and storage	312.7	3.7	323.8	3.6
Accommodation and food services	164.4	2.0	186.0	2.1
Financial and insurance services	204.1	2.4	227.0	2.6
Real estate activities	780.7	9.3	956.0	10.8
Public administration and defence	1376.5	16.3	1692.0	19.1
Education	443.4	5.3	529.0	6.0
Health care and social work	479.1	5.7	603.0	6.8
Other service activities	639.2	7.6	766.0	8.6
Total	8425.4	100.0	8878.0	100.0

¹ At basic prices.

Petroleum and mining

Despite fluctuations in output and prices in recent years, diamonds continue to make a major contribution to the economy of the Northern Territories. As much as 80 per cent of diamond production and 95 per cent of the values of diamonds currently mined in Canada are produced in the Northwest Territories, the only territory mining diamonds in 2014. Diamonds mined in the Northern Territories in 2014 made Canada the world's third largest producer in value terms and fifth largest producer in volume. The diamond mines currently in production in the Northwest Territories are characterized by high grade deposits which increase their economic viability.

Only a few companies are processing diamonds in Northwest Territories and most of the diamonds from the Northwest Territories are exported outside Canada as rough or un-worked diamonds. In 2014, the value of diamond production in the Northwest Territories was CAD 1.80 billion down from the peak value of CAD 2.1 billion in 2004.

The diamond industry has had a positive impact on other sectors in the economy of Arctic Canada, including exploration, which has been carried out to some extent in Nunavut as well as in Northwest Territories. In 2014, diamonds accounted for 71 per cent of total exploration and deposit appraisal expenditures in the Northwest Territories. Foreign investors generally consider Canada, including the Northwest Territories, more attractive from both a geopolitical and investment risk perspective than many other diamond producing countries. However, it is expensive to construct and maintain a diamond mine in the Northwest Territories as a number of factors contribute to high construc-

Table 4.3. **Basic indicators. Arctic Canada. 2014**

	Northwest Territories	Yukon	Nunavut
Population	43 980	36 990	36 083
Share of GRP in all three Northern Territories (per cent)	48.2	26.5	25.3
Transfers ¹ as share of public revenues (2014-2015)	68.0	74.0	85.0

¹ From the federal government.

tion and maintenance costs including a harsh climate, transportation on ice roads, and environmental commitments.

From 2008 to 2014, the gold production in Canada's north rose from 2 370 kilograms to 17 015 kilograms. In dollar value, the gold production rose from CAD 71 million in 2008 to CAD 770 million. While all three of Canada's northern territories are gold producers, Nunavut is the largest gold producer among the three Northern Territories.

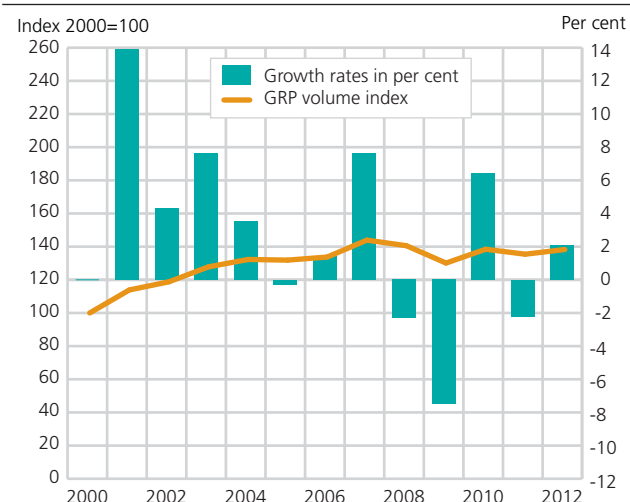
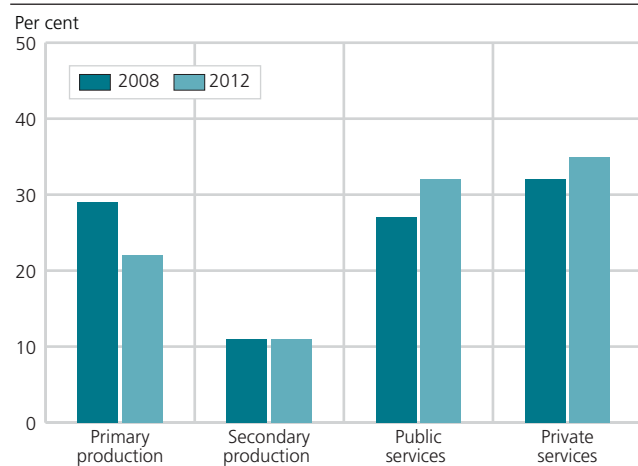
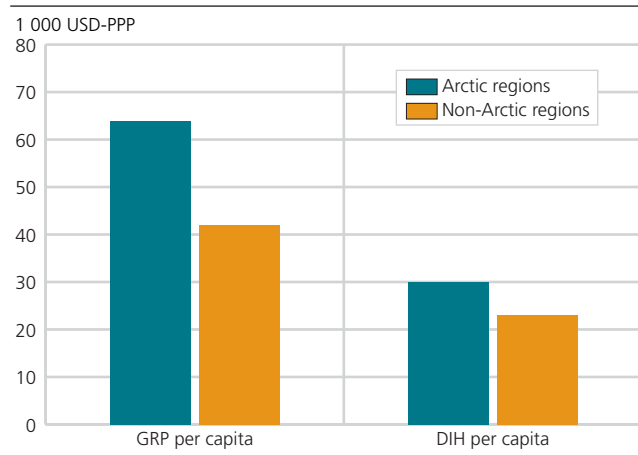
Oil and gas extraction from conventional sources has continued to decline as producing wells and fields are coming to the end of their lifespan. Between 2008 and 2014, the value of oil and gas extraction in the Northern Territories declined from CAD 682 million to CAD 419 million.

Most of the crude oil produced in the Territories is shipped to Ontario while most of the natural gas is shipped to British Columbia. Gas production in Northern Canada is connected to the North American gas market, where the price is currently determined in response to supply and demand.

The volume of crude oil extracted in Arctic Canada fell from 941 thousand cubic metres in 2008 to 642 thousand cubic metres in 2014 (Figure 4.12). The value of oil production has varied around the same level in nominal terms, interrupted by a peak at CAD 622 million in 2008 prior to the financial crisis, then settling around CAD 399 million in 2014. The volume of gas extraction in Arctic Canada fell from 240 million cubic metres in 2008 to 120 million cubic metres in 2014 (Figure 4.13). Natural gas prices also declined during this period, with the result that the value of gas production fell even more rapidly from CAD 64 million in 2008 to only CAD 12 million in 2014.

The Territories

In 2012, public administration was the largest sector in the economy of the Northern Territories. In all three Territories, the territorial government is larger than both the federal government sector and the municipal and aboriginal government sector. Transfers from the Canadian federal government are a substantial source of funding for the territorial governments. In 2014–2015, transfers from the federal government accounted for 76 per cent of total public revenues in the three Territories, compared with 21 per cent for all provinces

Figure 4.8. **GRP volume index and growth rate. Arctic Canada. 2000-2012**Figure 4.9 **Value added by main industry. Arctic Canada. Per cent of GRP. 2008 and 2012**Figure 4.10. **Gross regional product (GRP) per capita and Disposable Income for Households (DIH) per capita. Arctic Canada. 2012. 1 000 USD-PPP**

and territories in Canada. For the individual Territorial governments, the share of revenues accounted for by federal government transfers ranged from 68 per cent in Northwest Territories, to 74 per cent in Yukon and to a high of 85 per cent in Nunavut.

Figure 4.11. **Diamond production. Arctic Canada. 2002-2014**

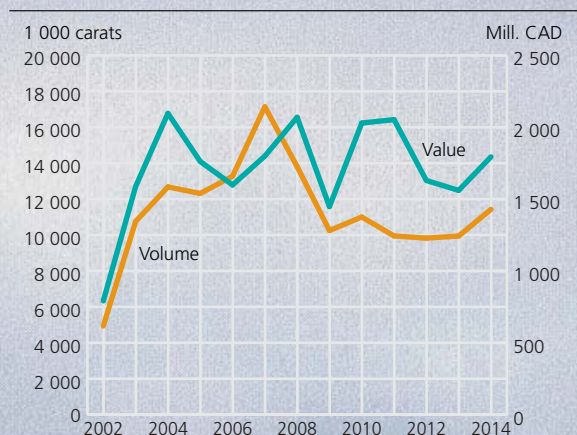


Figure 4.12. **Oil production. Arctic Canada. 2002-2014**

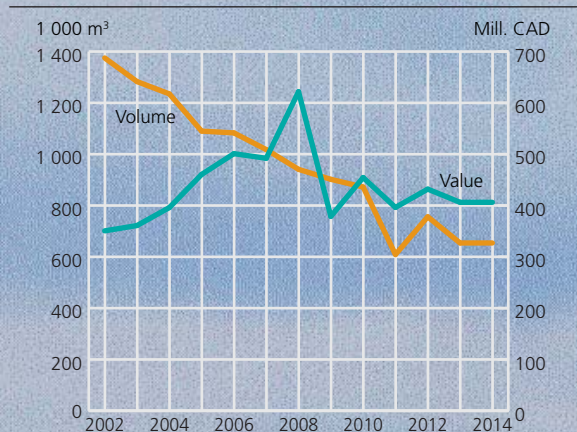
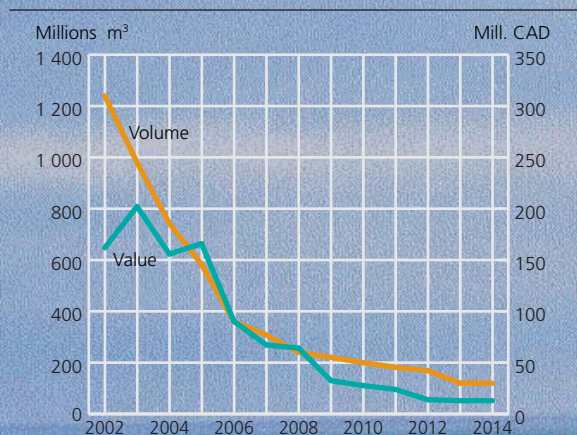
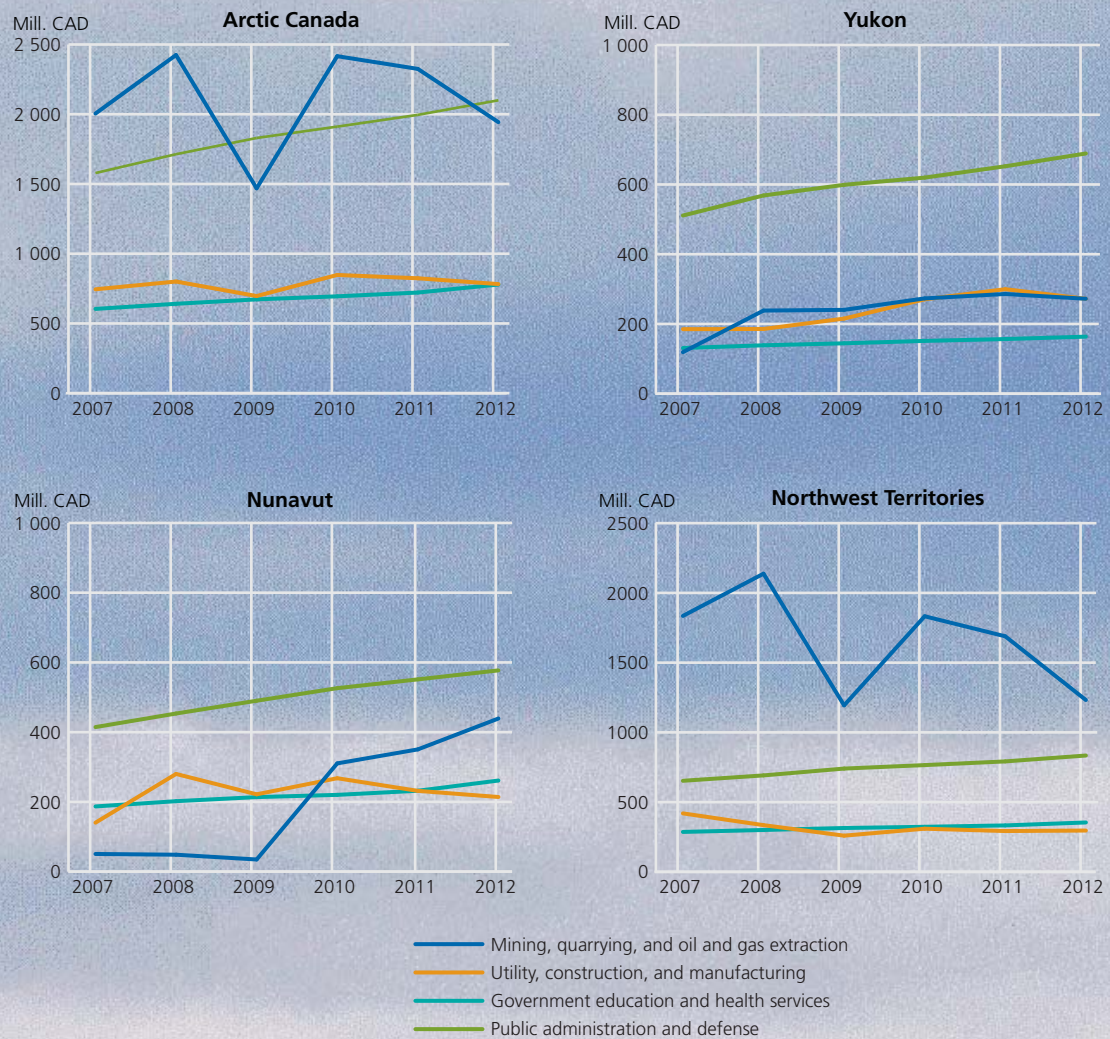


Figure 4.13. **Natural gas production. Arctic Canada. 2002-2014**



While the Territorial governments are largely funded by federal government transfers, it should be noted that the federal government is benefiting from the economic activity related to diamonds through royalties and increased business and personal income taxes generated by the sector. For Arctic Canada as a whole and particularly the North West Territories the mining industry is the backbone of commercial activity. Public administration and defence has increased in all territories, in particular in Nunavut. Government education and health has increased slightly for Northern Canada at large, although not in proportion to Public administration. In Nunavut the mining industry income shifted to a higher level in 2010, at the time when the Meadowbank gold mine started extraction.

Figure 4.14. Value added in selected industries. Arctic Canada. 2007-2015. Mill. CAD



Source: Statistics Canada Table 381-0030 - Provincial gross domestic product (GDP) at basic prices, by sector and industry, annual (dollars)



Faroe Islands

The Faroe Islands are a self-governing part of the Danish Realm. The judicial system, defence, national security, and foreign affairs are the main areas still under Danish jurisdiction. Faroe Islands had 49 000 inhabitants by 1 January 2015 of which 20 000 live in the capital of Torshavn. The livelihood has throughout history been based on the ocean and the marine resources. It still is, and Faroe Islands has built up business and expertise within fisheries, aquaculture and marine engineering.

The financial crisis also affected Faroe Islands and unemployment increased from 1.5 per cent in 2007 to 7.4 per cent in 2010, declining somewhat to 5.1 per cent in 2012. The trend of population growth was broken by a marked rise in emigration mainly by young people.

Table 4.4 shows GDP or value added by industry in 2008 and 2012. Fisheries increased its share in the

Table 4.4. Value added¹ by industry. Faroe Islands. 2008 and 2012

	2008		2012	
	Mill. DKK	Per cent	Mill. DKK	Per cent
Agriculture and forestry	24	0.2	16	0.1
Fishing	976	9.3	1 366	11.4
Aquaculture	255	2.4	369	3.1
Mining and quarrying	23	0.2	26	0.2
Fish processing	656	6.2	825	6.9
Other manufacturing	462	4.4	498	4.2
Utilities	90	0.9	160	1.3
Construction	898	8.5	605	5.1
Wholesale and retail trade	981	9.3	988	8.3
Transportation and storage	757	7.2	990	8.3
Accommodation and food services	182	1.7	221	1.9
Financial and insurance services	395	3.8	439	3.7
Real estate activities	1 171	11.1	1 417	11.9
Public administration and defence	647	6.2	756	6.3
Education	660	6.3	764	6.4
Health care and social work	1 292	12.3	1 381	11.6
Other service activities	1 051	10.0	1 222	10.2
Total	10 520	100.0	11 943	100.0

¹ At basic prices.

national economy from 9.3 to 11.4 per cent whereas aquaculture expanded from 2.4 to 3.1 per cent of GDP.

These industries are the basis for fish processing, the dominant activity within Manufacturing. All together, the seafood industries generated 21 per cent of total value added in 2012. The marine economy also draws upon other manufacturing industries supplying fisheries as well as offshore petroleum exploration.

The largest single industry in terms of generated value added is the Real estate sector with 11.9 per cent of GDP in 2012.

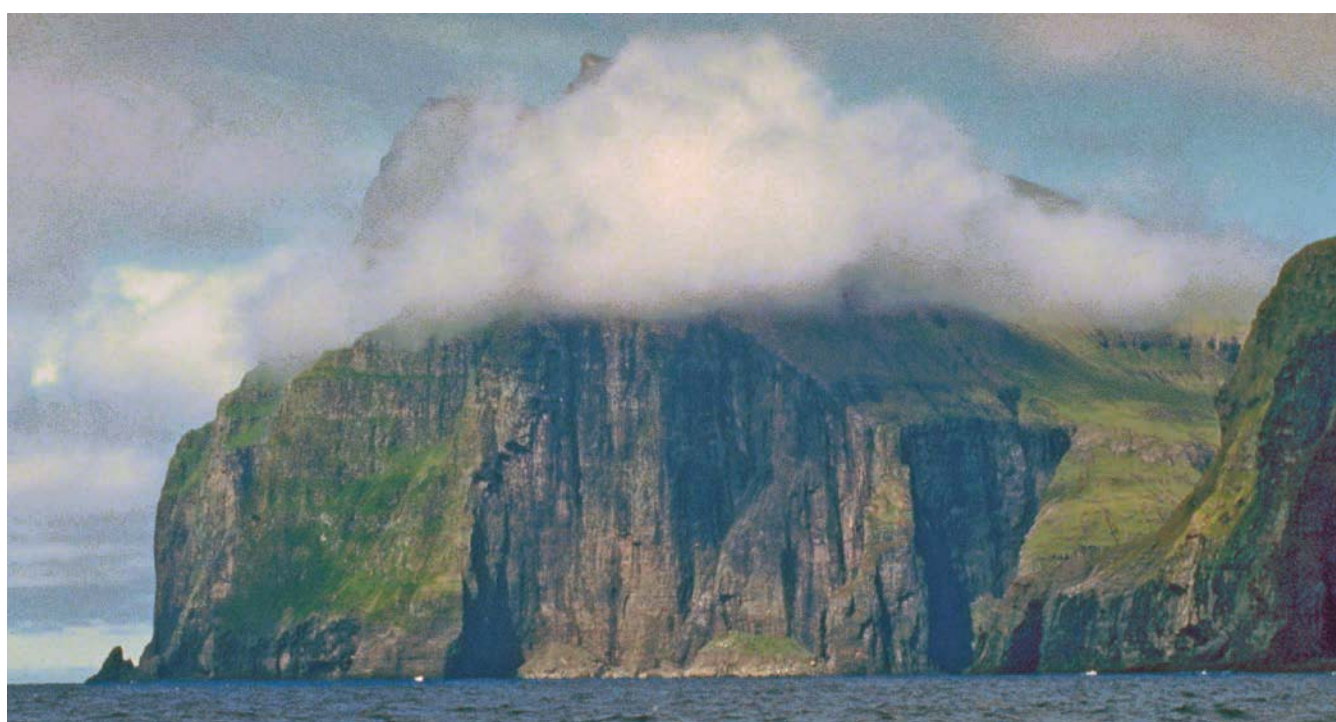
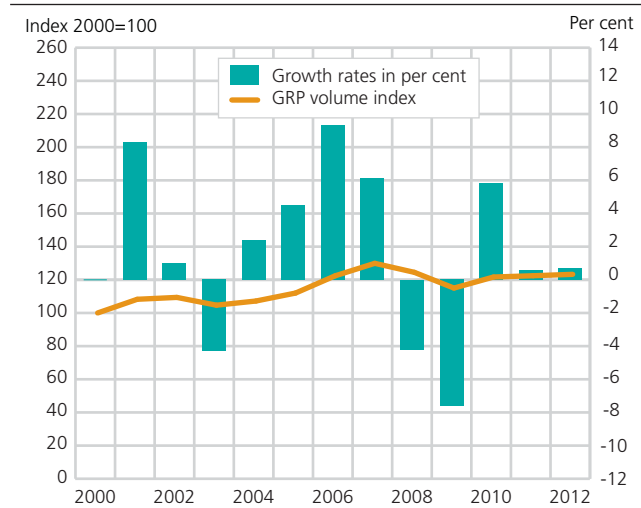


Figure 4.15. GRP volume index and growth rate. Faroe Islands. 2000-2012



The highest growth rate is seen in Utilities (electricity, gas and water supply) mainly driven by electricity production which increased by as much as 78 per cent during the period. Transportation increased its share markedly from 7.2 to 8.3 per cent.

Construction contracted substantially as a result of a strict financial regime in the wake of the financial crisis. Public administration and Education sustained their shares of the gross product, however, Health care and social work fell somewhat behind compared with the economy at large.

Faroe Islands is a small economy highly dependent on the seafood industry. The period around the financial crisis was also turbulent for the country. The income in fisheries declined 32 per cent from 2008 to 2009 and a further 13 per cent in 2009.

Value added in fish processing was relatively unaffected during the first years of the crisis, before increasing again during 2009-2012. The number of employees in fish processing kept up during 2008-2010 but declined by as much as 20 per cent in 2011.

Lower income in fisheries reduced demand from shipyards and mechanical industries. The number of employed person fell 4 per cent in 2008 and a further 16 per cent in 2009, and was still 14 per cent below 2007 level in 2012.

During these years there were positive underlying trends, first of all in salmon farming, reaching an export value of 1.8 billion DKK in 2012, more than double the level in 2008. In pelagic fisheries the catch and export value of mackerel rose markedly from 2009 - 2010.

Figure 4.15 shows the highly variable growth of the economy in real terms, not only during the financial crisis, but more like a fact of life in a small and diversified economy. However, the years of the financial

Figure 4.16. Value added by main industry. Faroe Islands. Per cent of GRP. 2008 and 2012

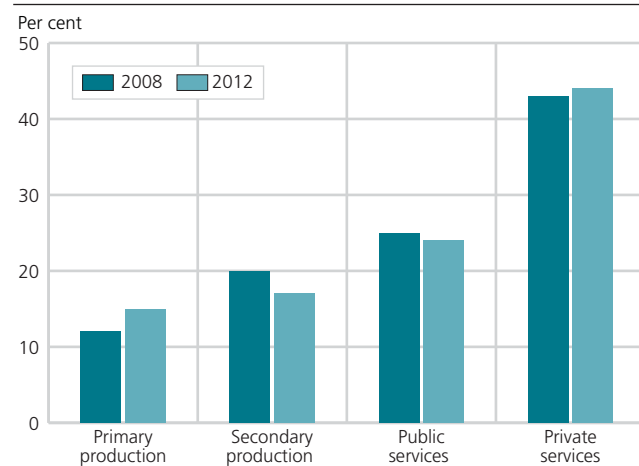
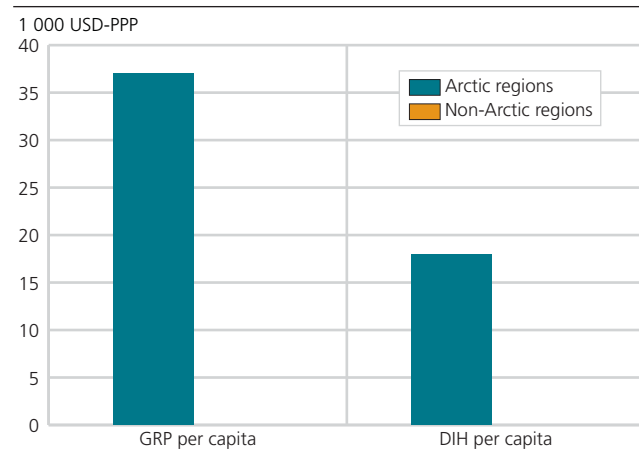


Figure 4.17. Gross regional product (GRP) per capita and Disposable Income for Households (DIH) per capita. Faroe Islands. 2012. 1 000 USD-PPP



crisis brought set-backs in 2008 and even more in 2009 before growth returned in 2010. The financial crisis imposed a decline in real GDP of 4 per cent in 2008 and further close to 8 per cent in 2009. A growth rate of 6 per cent in 2010 repaired some of the damage, followed, however, by two years of marginal growth well below 1 per cent.

Figure 4.16 shows that primary industries mainly based on fish resources increased their share in the total economy, particularly supported by the substantial growth within aquaculture. Mining and quarrying kept constant and at a marginal level. The decline in secondary industries is the result of a marked fall in Construction, which growth in Fish processing and Utilities could not compensate for.

The share of disposable income per capita in GDP per capita is 49 per cent (Figure 4.17).

Natural resources

Fisheries are the backbone of the economy, as much as 80 per cent of the export value is from fish products. Figure 4.18 shows development in catches by main species during 2008-2015. Blue Whiting was the dominating catch in 2008 in terms of volume, but fell drastically and only started to regain its position by 2012, reaching its former catch level towards 2015. The decline in 2008 followed an agreement between the coastal states of EU, Norway, Iceland and Faroe Islands on a long term plan to increase the recruitment and re-establish a sustainable stock. The catch of mackerel was negligible until 2010 when it increased to nearly 100 000 tons per year, a level more than sustained towards 2015. This opportunity might reflect that mackerel tended to migrate further into northern waters due to a substantial rise in the sea temperature.

Figure 4.19 shows the value of fish export by main species during 2008-2015. Blue Whiting is mainly used for fish meal and hence contributes relatively modest to the value of fish export. The export value of farmed salmon more than doubled during 2008-2012, before increasing even more steeply towards 2014.

Faroe Islands generates more than 50 per cent of its electricity from renewable sources, but fossil fuels are still important for heating and transportation, including for the large fishing fleet. Hydropower is the dominating source, and the potential for further renewable capacity growth is large, both for wind and tidal power.

The production of wind power increased from 4.2 per cent of total electricity production in 2005 to 17.7 per cent in 2015, whereas thermal based electricity declined from 55.4 per cent to 39.9 per cent in the same period.¹

The first licensing round for petroleum exploration in the Faroe Islands was held in 2000. However, so far commercially viable discoveries have not been made. The Norwegian petroleum company Statoil has been one of the most active oil companies operating in Faroese waters². The Faroese government has announced a new exploration round in 2017³. The Faroese economy has, however, benefited from the demand for supply services from mechanical industries and transportation during exploration activity.

Notes

¹Faroe Islands in figures 2016.

²The official site of the Faroe Islands (2016): Oil Exploration and Off-shore, <http://www.faroeislands.fo/economy-industry/oil-offshore/>

³The Faroese Ministry of Trade and Industry (2015): The Faroese announce the 4th Exploration Round to be held in 2017, Press release 7th May.

Figure 4.18. Fish harvest by main species. 2008-2015

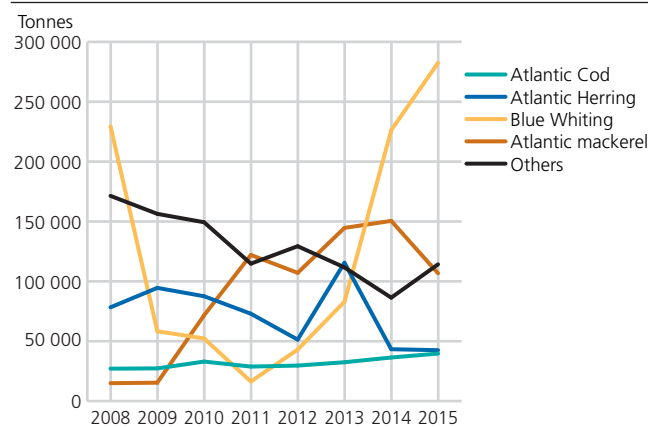
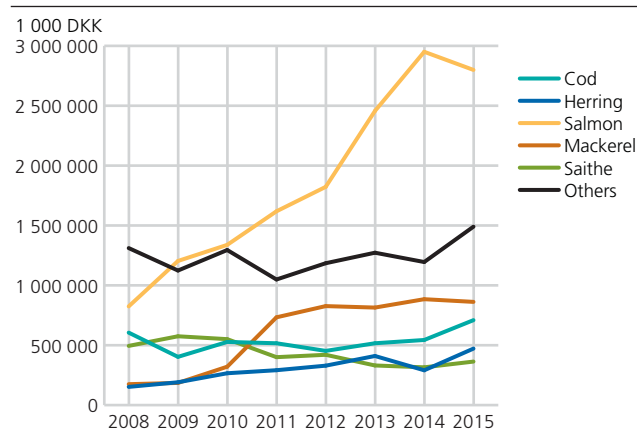


Figure 4.19. Export of fish products by species. 1 000 DKK





Arctic Finland

Northern Finland consists of the sub-regions Lapland, Kainuu and Oulu with a total population of 454 000 in 2016. The region differs from most other Arctic regions in that the manufacturing industry is highly developed and integrated in the global economy. A particular characteristic of the manufacturing industry of Arctic Finland is the large presence of electronic industry and other high-tech activities with the city of Oulu as one of the main centres.

The success of the electronics industry in the Oulu region is based on the cooperation between the industry, the University of Oulu and the city in providing industrial infrastructure. The core activity in the electronics industry has been the mobile phone technology. During 2000 to 2005 there was a structural change moving assembly work to China, leaving highly productive technological tasks in Oulu. As a result, there was a rapid growth in value added of the Electronic industry in Northern Finland at 15 per cent per year, whereas employment declined by 4 per cent per year¹. The period 2008 to 2012 has been one of decline starting with the financial crisis and accelerated by international competition. Nokia, the motor of this industry in Finland and a world leading producer of mobile phones in 2011 surrendered to competitors, leading to the sell-off of Nokia's Device and services unit to Microsoft in 2014. However, in early 2017 a new mobile phone from a Finnish company is out on the market.

The decline reduced the contribution of the electronic industry from 11.3 per cent of GRP in 2008 to 6.3 per cent in 2012, being a major factor behind a slightly lower GRP in 2012 than in 2008 in Northern Finland (Table 4.5).

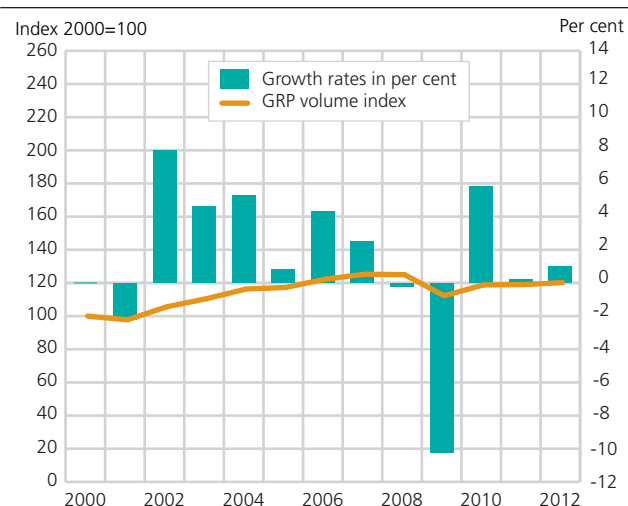
The Manufacturing industry as a whole lost 40 per cent of its value added in nominal terms from 2008 to 2012, down from 26.6 per cent of the regional economy to 16.6 per cent. The reduction was 46 per cent in Electronics industry and even larger in production of Basic metals and metal products (54 per cent), falling from 6.7 per cent to 3.2 per cent of GRP. The loss in manufacturing due to the coincidence of an industry failure

Table 4.5. Value added¹ by industry. Arctic Finland. 2008 and 2012

	2008		2012	
	Mill. euro	Per cent	Mill. euro	Per cent
Agriculture,	144	0.8	210	1.2
Forestry and Fisheries	562	3.1	557	3.1
Mining and quarrying	208	1.2	450	2.5
Manufacturing	4 793	26.6	2 940	16.6
Paper and printing industry	422	2.3	255	1.4
Manufacture of basic metals and fabricated metal products	1 221	6.7	566	3.2
Electrical and electronics industry	2 040	11.3	1 113	6.3
Other Manufacturing	1 110	6.2	1 006	5.7
Utilities	603	3.4	515	2.9
Construction	1 428	7.9	1 280	7.2
Wholesale and retail trade	1 137	6.3	1 191	6.7
Transportation and storage	738	4.1	826	4.7
Accommodation and food services	329	1.8	346	1.9
Information and communication	465	2.6	438	2.5
Financial and insurance services	253	2.6	247	2.5
Real estate activities	1 844	10.2	2 124	12.0
Professional, scientific and technical and administrative services	1 074	6.0	1 264	7.1
Public administration and defence	1 041	5.8	1 265	7.1
Education	1 150	6.4	1 340	7.5
Health care and social work	1 754	9.7	2 218	12.5
Other service activities	482	2.7	543	3.1
Total	18 005	100.0	17 754	100.0

¹ At basic prices.

Figure 4.20. GRP volume index and growth rate. Arctic Finland. 2000-2012



and the global economic downturn was large enough to leave a footprint on most of the economic activity in the region.

There was declining income in Utilities, Construction and Financial services. The public sector, however, partly compensated the decline with a marked growth in nominal terms in the range of 4 to 6 per cent per year on average, and increased their share in the economy from 21.9 to 27.1 per cent. Both Public administration and Education increased markedly. However, Health

care and social work increased the most, reflecting the economic and social challenges associated with loss of income and increasing unemployment. Although small in 2008 the value added of the Mining industry more than doubled during the period, benefitting from the high mineral prices (Figure 4.1). Transportation services also increased, and Real estate services even more. The knowledge based sector of Professional, scientific and technical services increased its share from 6 to 7 per cent of GRP.

In real terms economic growth has been substantial but uneven during the first years of this millennium (Figure 4.20). However, in 2008 the economy lost steam and 2009 saw a decline of 10 per cent in income generation after the financial crisis. This fall was only partly compensated by 6 per cent growth in 2010 followed by a modest growth towards 2012.

It is frequently said about mineral rich Arctic regions that they are dependent on their resources. However, the development in Northern Finland during this



Figure 4.21. Value added by main industry. Arctic Finland. Per cent of GRP. 2008 and 2012

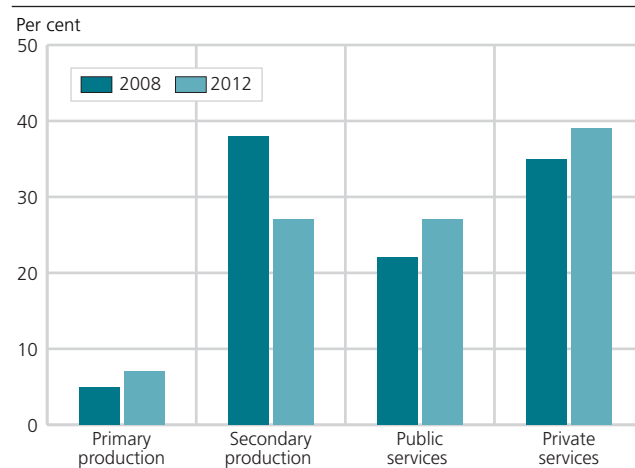
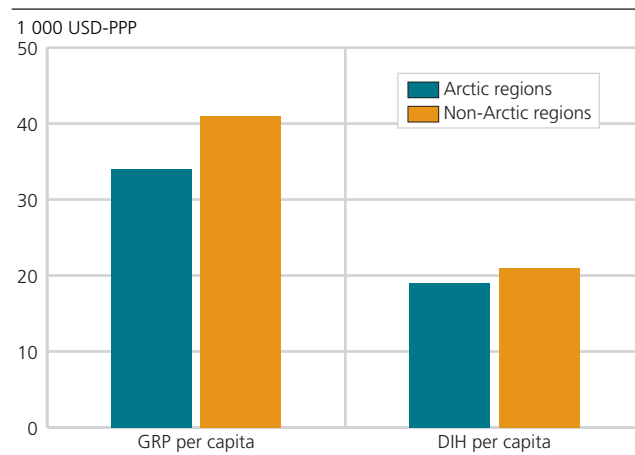


Figure 4.22. Gross regional product (GRP) per capita and Disposable Income of Households (DIH) per capita. Arctic Finland. 2012. 1 000 USD-PPP



period illustrates that having a large manufacturing industry can be as vulnerable to market forces as the petroleum based regions. The lack of diversity is the challenge for small communities.

Figure 4.21 illustrates the unusually abrupt changes in the balance between main industries from 2008 to 2012. Primary industries are modest, at 5 per cent of GRP in 2008 but increased to 7 per cent due to growth in Agriculture and in particular in Mining. The strong decline in secondary industries from 38 per cent to 27 per cent of GRP was mainly balanced by the increase in Public services and also by Private services as well as Primary Production.

Both GRP per capita and disposable income of households per capita are somewhat lower in the arctic region than in the non-arctic region. Disposable income per capita in 2012 was 19 000 USD-PPP, corresponding to 56 per cent of GRP per capita generated in Northern Finland. In 2005 this share was as high as 64 per cent².

Notes

¹ Glomsrød, S. and I. Aslaksen (2009): The Economy of the North 2008. Statistics Norway, SA 112.

² Glomsrød, S. and I. Aslaksen (2009): The Economy of the North 2008. Statistics Norway, SA 112.



Nuuk, Greenland. Photo: Tom Nicolaysen

Greenland

Greenland is a self-governing part of the Danish Realm. The judicial system, defence, national security and foreign affairs are the main areas still under Danish jurisdiction. The population counts 56 000 people and population growth has been low or negative after 2000 with falling birth rates and variable, but net emigration. The labour force is declining and people tend to move from towns and settlements where employment opportunities are few to places with employment and education opportunities. It represents a demographic challenge that future investment projects and work opportunities are far from current living areas.

Greenland is more than ice. The ice-free area is about the size of Sweden. Climate change is twice as rapid in the Arctic than in the rest of the world and contributes to extended growth season and enhanced agriculture. Seafood and in particular cold water shrimps and Greenland halibut are the main export products. Greenland is not member of EU, but has a special agreement with EU on fisheries. Tourism is important, with more foreign visitors per year than inhabitants, however, the number of visitors declined somewhat during the years after the financial crisis (see Chapter 8).

Greenland depends on an annual block grant from Denmark, and transfers to cover the activities still under Danish jurisdiction. In 2015 the block grant and transfers amounted to DKK 4.2 billion.

Table 4.6 shows value added by industry in 2008 and 2012. Income in Fisheries increased substantially, primarily in offshore fisheries. Table 4.7 shows the income generated by the different activities within the fishing industry. Fisheries generated 7 per cent of GRP in 2012, up from 5.3 per cent in 2008. Being the main source of export products, the fisheries have an important role in the economy. Among industries targeting domestic purposes, Construction, Trade and Transportation are dominating, each accounting for about 10 per cent of

Table 4.6. Value added¹ by industry. Greenland. 2008 and 2012

	2008		2012	
	Mill. DKK	Per cent	Mill. DKK	Per cent
Agriculture and forestry	312	2.8	366	2.8
Fishing	593	5.3	973	7.1
Petroleum and other mining	78	0.7	13	0.1
Manufacturing	544	4.8	400	3.0
Utilities	279	2.5	432	3.3
Construction	1 150	10.2	1 358	10.3
Wholesale and retail trade	1 011	9.0	1 374	10.5
Transportation and storage	1 173	10.4	1 243	9.5
Accommodation and food services	256	2.3	278	2.1
Financial and insurance services	168	1.5	208	1.6
Real estate activities	986	8.7	1 110	8.5
Public administration and defence	1 292	11.4	1 355	10.3
Education	879	7.8	984	7.5
Health care and social work	564	5.0	683	5.2
Other service activities	2 005	17.8	2 351	17.9
Total	11 290	100.0	13 128	100.0

¹ At basic prices.

Table 4.7. Fisheries in Greenland. Value added¹ 2008 and 2012. Mill DKK

	2008	2012
Inshore fishing	334	445,7
Offshore fisheries	245,4	503
Other Fishing	13,6	24,3
Total	593.0	973.0

¹ At basic prices.

gross regional product (GRP). The share of Public administration in GRP was 10.3 per cent in 2012, slightly lower than in 2008, whereas Education and Health sectors roughly sustained their shares. There was a marked increase in Utilities, largely a result of the start-up of a new hydropower plant at Sisimiut in 2010. Petroleum and mining was reduced to only 0.1 per cent of GRP in 2012, down from an already low level in 2008, reflecting that exploration activity is put on hold. Agriculture and hunting increased in line with GRP.

Figure 4.23. GRP volume index and growth rate. Greenland. 2000-2012

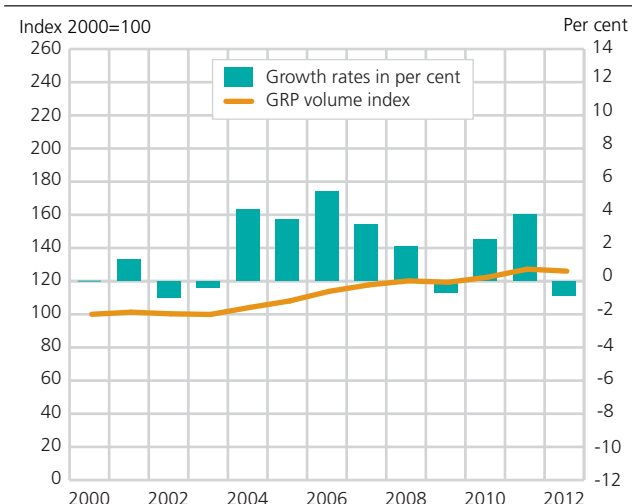


Figure 4.24. Value added by main industry. Greenland. Per cent of GRP. 2008 and 2012

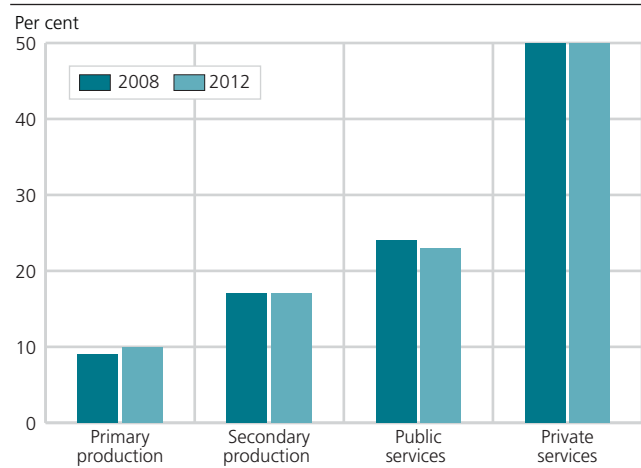
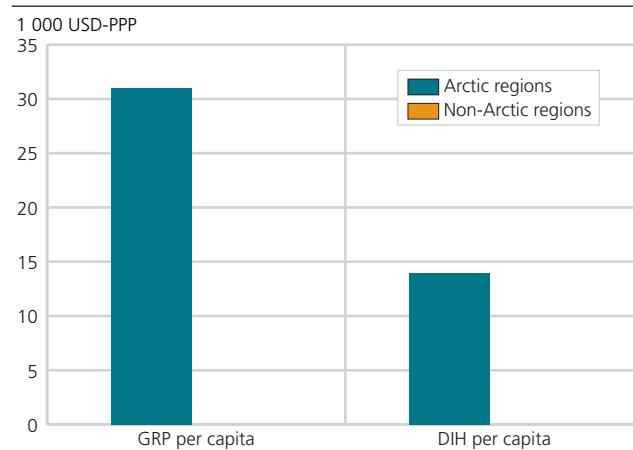


Figure 4.23 shows real GDP growth during 2000-2012. After several years with growth in real GRP the financial crisis in 2008 led to negative growth in 2009, followed by 2 years with marked economic growth before the growth rate turned negative again in 2012. The GDP decline in 2009 was less than one per cent, and marginal compared with the set-backs in most other arctic regions. The period afterwards has seen negative economic growth.

From 2008 to 2012 there has been a small increase in Primary production, not because of growth in petroleum and mining, which actually declined, but from an

Figure 4.25. Gross regional product (GRP) per capita and Disposable Income for Households (DIH) per capita. Greenland. 2012. 1 000 USD-PPP



enhanced bio-economy i.e. the fisheries (Figure 4.24). Secondary production declined somewhat as growth in Utilities and Construction did not compensate for the reduction of income in Manufacturing. There were practically no changes for private services. Among public services only Health care and social services increased in relative terms.

Disposable income of households per capita is 45 per cent of GRP per capita (Figure 4.25). The transfers from Denmark represent about a third of the total and is allocated to government activities and expenditures, showing up as generated income in various public and



private industries. Greenland aspires to move towards economic independence and see their rich metal and energy resources as options to approach this target.

Petroleum

So far there is no petroleum production in Greenland, but according to US Geological Surveys 2008, Greenland has considerable undiscovered resources of 47 billion barrels of oil equivalents (bboe), of which oil is around 25 bboe and gas 22 bboe. However, the location of these resources provides challenges in terms of ice and storms, and the neighbourhood of a pristine natural environment. Greenland is not expected to be developed in the very near future because the time lag between discoveries and production tend to be considerable in the Arctic.

Natural gas has been detected by seismic surveys, but no findings have proven viable so far. Several petroleum companies have stopped their exploration activities the last couple of years. Currently, oil and gas companies hold 15 licenses to explore in Greenland. While none of them is actively drilling at the moment, the license holders are actively analyzing seismic data in preparation for future drilling. If petroleum companies start to expect higher future prices, Greenland's oil and gas activity could recover again¹.

Minerals

The Greenland Self-Government Authority has primary sovereignty over mineral resources. However, half of potential mineral revenues above DKK 75 million will be subtracted from the Danish block grant.

In 2012 there was negligible mining production in Greenland. Because of low world market prices the olivine mine near Maniitsoq was closed in 2010. The Nalunaq gold mine near Nanortalik in South Greenland was opened in 2004 as the first mine in 30 years and producing until the end of 2008. However, it was reopened in 2009 due to rising gold prices during the financial crisis, only to close down in 2013 when the prices came down. Substantial reserves of rare earth minerals are found in Kvanefjell. However, the rare earth minerals are mixed with uranium, making extraction an issue of foreign policy and security, areas outside the Greenland Self-Government Rule. Two years ago, Greenland's parliament, Inatsisartut, abolished its zero-tolerance policy for uranium mining. An agreement between Greenland and Denmark recognizes Denmark as the authority on nuclear safeguard, physical protection and exports, whereas Greenland retains the control of the mining. The environmental assessment has not been concluded yet and no permissions have so far been granted. Environmental groups criticize the planned disposal of waste in the Taseq Lake.

A case study of the uranium project in Chapter 7 documents the public discourse on the political and environmental issues.

Figure 4.26. Catch of fish and shellfish. Ton

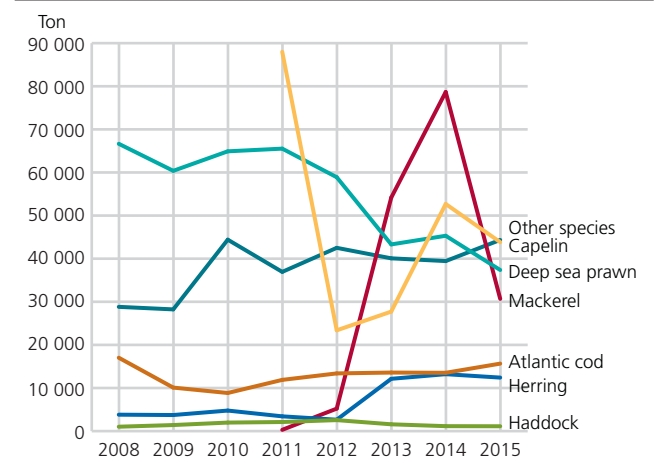
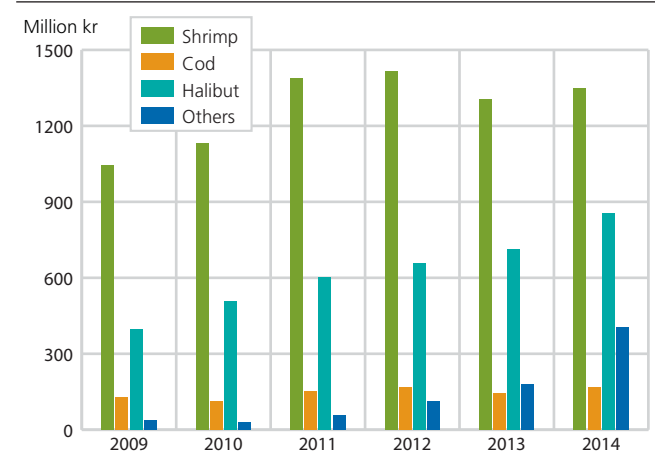


Figure 4.27. Export of fish and shellfish. Greenland



Fisheries

After 2011 the catch of deep sea prawns has declined. However, climate change with increasing sea temperature has introduced the mackerel as a new resource in Greenland waters. In 2011 the mackerel was seen for the first time in Greenland waters and in 2014 mackerel made up 23 per cent of total Greenland fish export value, an example of how global warming can substantially affect the economy of a country (Figure 4.27), in this case to its benefit.

Notes

¹ The Arctic Journal (2017): Oil firms in Greenland: "we're still here", 30. January, <http://arcticjournal.com/oil-minerals/1607/oil-firms-greenland-were-still-here>



Arctic catfish sold at local marketplace, Nuuk, Greenland. Photo: Tom Nicolaysen



Iceland

Iceland had a population of 332 000 people with the majority living in or around the capital Reykjavik. Tradition and language are well taken care of, and the country is well known for their historic sagas from the Viking era. More recently Iceland has played a role in the 2008 financial and economic crisis that deserves a saga of its own. Since 2008 Iceland has been through a serious economic collapse but emerged as a recovery success story already at a turning point by mid-2011, in contrast to the persistent crisis in some EU countries in Southern Europe. The population of Iceland was stable during 2008-2011, before increasing somewhat towards 2016. The number of newborn went markedly up during 2008-2010, returning closer to pre-crisis level in 2011, when the arrows started to turn upwards again for the economy. Usually, economic hardship leads to reductions in births, however, Iceland has a welfare system providing parents with a 6 months paid leave to care for newborn. To the economy it was convenient with a baby-boom when the opportunity cost of having children was lower than in a growth economy with low unemployment.

A brief overview of the driving forces behind the financial bubble and crash is found in our previous report *The Economy of the North 2008*. The main policy measures leading Iceland back on track are summarized in Box 4.3.

As shown in Table 4.8, Fisheries is the pillar of the economy. Together with the Fish processing industry the harvesting of fish resources contributed 9.2 per cent to GRP in 2012, up from 6 per cent in 2008. Agricultural production is small, but increased markedly during the period 2008 to 2012. Mining remains marginal and Manufacturing other than Fish processing lost position from 8.5 per cent of GRP in 2008 to 7.8 per cent in 2012, still high in an Arctic context. A main component in manufacturing is production of aluminium, an electricity intensive product for export, and an outlet for the huge hydropower resources of Iceland, which are still unconnected to other countries. The production by the new aluminium smelter in Reydarfjörður

Table 4.8. Value added¹ by industry. Iceland. 2008 and 2012

	2008		2012	
	Mill. ISK	Per cent	Mill. ISK	Per cent
Agriculture and forestry	9 310	0.6	17 734	1.0
Fishing and aquaculture	61 221	4.0	102 121	5.8
Mining and quarrying	1 691	0.1	1 037	0.1
Fish processing	38 235	2.5	60 734	3.4
Other manufacturing	130 875	8.5	137 957	7.8
Utilities	65 489	4.3	95 862	5.4
Construction	117 325	7.6	72 013	4.1
Wholesale and retail trade	116 982	7.6	148 518	8.4
Transportation and storage	64 815	4.2	83 055	4.7
Accommodation and food services	23 647	1.5	35 526	2.0
Financial and insurance services	131 642	8.6	135 483	7.7
Real estate activities	139 319	9.1	152 867	8.6
Public administration and defence	260 185	16.9	296 038	16.7
Education	83 233	5.4	95 082	5.4
Health care and social work	104 942	6.8	111 211	6.3
Other service activities	186 419	12.1	223 032	12.6
Total	1 535 326	100.0	1 768 270	100.0

¹ At basic prices.

fjörður started in 2008 and increased output further in 2010. Thus the export of aluminium started just when the financial and economic crisis set in, modifying the effects upon the economy.

Utilities including electricity and heat supply is increasingly important with 5.4 per cent of GRP in 2012 versus 4.3 per cent in 2008, with power to the aluminium smelter in Reydarfjörður as an important driver. Construction on the other hand dropped from 7.6 per cent in 2008 to only 4.1 per cent in 2012, partly a consequence of completing the aluminium smelter in Reydarfjörður. Among the service industries, Wholesale and retail trade increases its share and so did Transportation. Accommodation and food services increased markedly as a consequence of the devaluation of the Icelandic krona, increasing the number of tourists visiting Iceland.

Figure 4.28. GRP volume index and growth rate. Iceland. 2000-2012

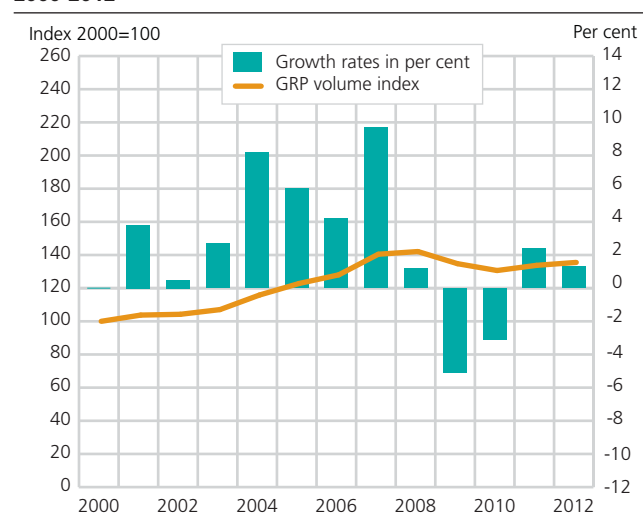


Figure 4.29. Value added by main industry. Iceland. Per cent of GRP. 2008 and 2012

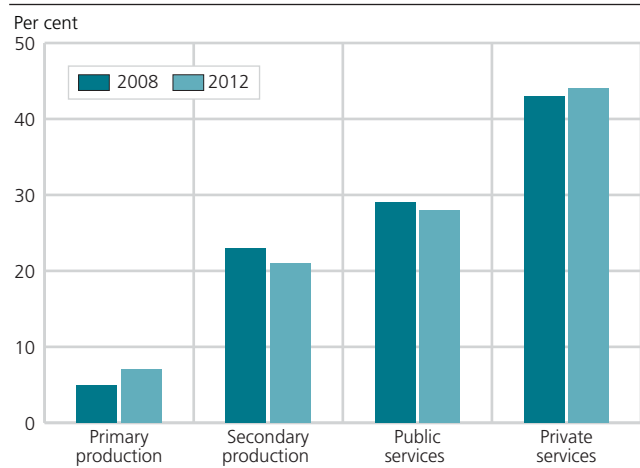


Figure 4.30. Gross regional product (GRP) per capita and Disposable Income for Households (DIH) per capita. Iceland. 2012. 1 000 USD-PPP

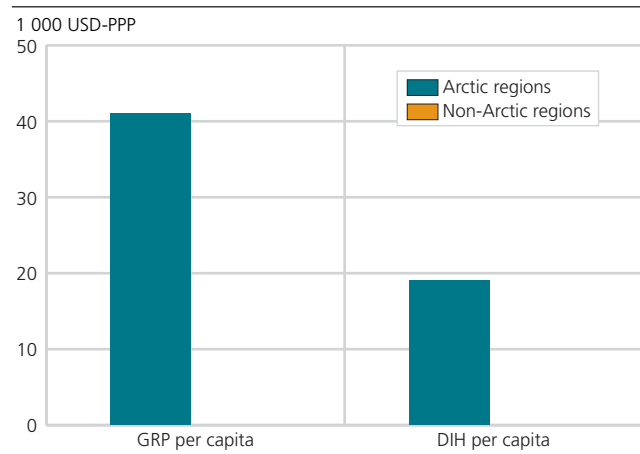


Figure 4.28 summarizes the tough years of crisis before signs of recovery in 2011 and 2012.

Figure 4.29 illustrates the change in the role of main industries in Iceland. In 2008 the share of private services was 43 per cent, roughly stable since 2002, but interrupted by a record high 50 per cent share in 2005 due to the bubble in the financial sector¹. In 2012 the share of private services was down to 44 per cent of the economy. Public services in terms of Administration and Education almost sustained their shares, however, Health care and social work was relatively larger in 2008 than in 2012, a reflection of the needs being lower as growth took off. The diminishing share of Secondary industries is mainly caused by the decline in Construction after the financial crisis, which the substantial growth in utilities and fish processing could not compensate for. The increase in primary production is due to fisheries and farming, whereas mining has declined.

In 2012, the disposable income of households per capita was 46 per cent of GRP per capita (Figure 4.30).

Box 4.3. Pots, pans and the recovery of Iceland's economy from the financial crisis *Solveig Glomsrød*

Iceland went into a deep financial and economic crisis in 2008 when the three biggest banks in Iceland collapsed in the wake of the Lehman Brothers bankruptcy in the USA. The collapse of the Icelandic bank sector was the largest financial crisis experienced by a single country. The total balance sheets of the three banks was 8-10 times the national GDP.

The pots and pans demonstrations sent a clear message about the responsibility of the crisis and forced the government to resign due to a serious lack of control and regulation of the bank sector. Bankers responsible for the collapse were arrested and prosecuted.

Freedom of capital movement was suspended in agreement with the IMF to prevent foreigners from selling assets in Icelandic krona and to stop krona owned by foreigners to flow into Iceland. An IMF support programme for Iceland was implemented, including a loan of USD 2.1 billion to stabilize the exchange rate and strengthen public finances. The government and IMF agreed upon a very gradual consolidation of public finance, accepting a budget deficit of up to 10 per cent of GDP. The approach of the IMF and the government was Keynesian and not one of austerity, as has been the case in Greece, Spain, Ireland and Italy.

Thanks to having their own currency, Iceland was able to devalue the krona and restructure the economy via the exchange rate rather than through a lower wage level. A devaluation increased the revenues of the export industries like aluminium production and fisheries, and encouraged visiting tourists, who flew in with foreign currency.

Iceland was never in the position to bail out the banks and the only feasible path was to write-down the claims of creditors and depositors. In June 2015, the government lifted the control on capital flows imposed in 2008. However, foreign depositors to the failed banks would have to accept a write-down of their assets to end the asset freeze.

The fact that Iceland had low sovereign debt before the crisis provided the country with the opportunity to mitigate the impact of the crisis by taking up new loans.

In 2011, Iceland resumed economic growth, however, unemployment was still high and hardship of the people substantial, in spite of measures to relieve the impact of the crisis on the situation of the households. The Icelanders way out of the crisis is widely recognized for the fast recovery of their economy.

Tourism

The attraction of glaciers, fjords, hot springs and mid-night sun has fueled the tourism in Iceland, together with the Game of Thrones shooting fields. The tourist boom started with the devaluation of the Icelandic Krone in 2008 and has continued to grow. An informal supply through Airbnb increased rapidly, just when the economy was down and many households needed more income. The tourist boom has, however, led to



Nesjavellir geothermal power plant in Iceland. Photo: Crestock

a substantial increase in housing prices in Reykjavik and regulations are recently being implemented. The income has become so important to the economy that questions arise what consequences a major turn of the tourist flow might have, for instance following a setback like the 2010 eruption of Eyjafjallajökull. Currently the export value of tourism counts about a third of total exports. This illustrates that the boom and bust challenge easily occurs in the small arctic countries and regions. When a success activity emerges, it might occur in the service industries as well as in extractive industries like petroleum and mining.

Energy

Iceland is richly endowed with geothermal energy and Hydropower, covering more than 60 per cent of primary energy consumption. Currently Iceland has 5 major geothermal power plants producing 26.2 per cent of the nation's electricity. In addition, there is geothermal heat delivered to 87 per cent of all buildings. As much as 74 per cent of total electricity production is from hydro power. A negligible 0.1 per cent of (stationary) energy consumption is based on fossil fuels. Per capita Iceland is the world's largest producer of electricity. There has been large investments and growth in power intensive manufacturing for export, i.e. the Alcoa smelter in Reydarfjörður. The smelter was operational in 2008 and the hydro power plant to power it was completed in 2009.

Fisheries

Figure 4.31 shows the catch of main species. As in Faroe Islands and Greenland the catch of mackerel increased in 2011 when the stock was more accessible due to a warmer ocean. Capelin is dominating in terms of tons landed, but is mainly used for fish meal and of lower commercial value. As seen from Figure 4.32 cod is the most important in terms of export value.

Figure 4.31. Catch by species. Tonnes

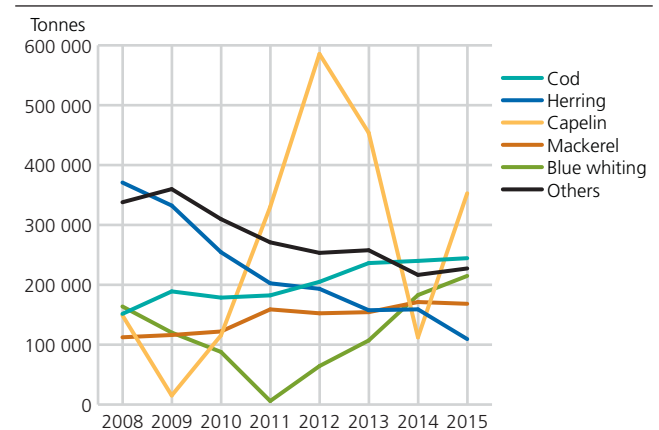
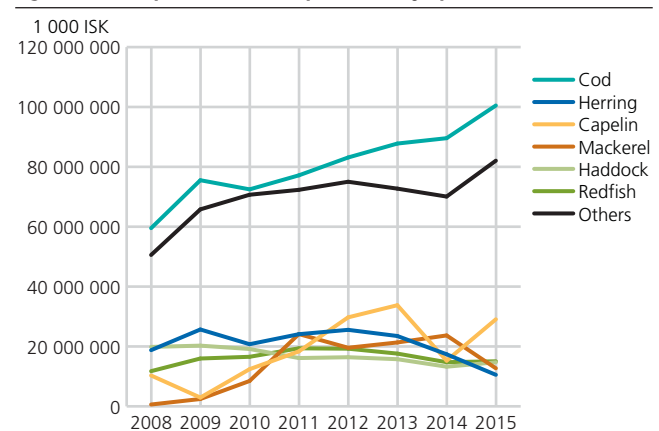


Figure 4.32. Export of marine products by species. 1 000 ISK



Notes

¹ Glomsrød, S. and I. Aslaksen (2009): The Economy of the North 2008. Statistics Norway, SA 112.



Arctic Norway

Arctic Norway consists of the counties Nordland, Troms, Finnmark and the Svalbard Archipelago, with a total population of 482 000. The population has increased by 2 per cent over the period 2008 to 2012 (Figure 3.4).

Fisheries have been a major source of living during history and now also strengthened by aquaculture. The seafood industry including fisheries, aquaculture and fish processing represents a strong sector in Northern Norway. Besides rich fish resources the surrounding oceans have petroleum resources which are promising, whereas fields in the North Sea, where most of Norwegian petroleum production has taken place, are in decline.

As shown in Table 4.9 the fishing industry as a whole including harvested fish, farmed fish and fish processing contributes 5.4 per cent to GRP. The fisheries are particularly important in terms of employment in coastal communities. Petroleum extraction together with Other mining are small in comparison, although value added in these activities have more than doubled and tripled respectively from 2008 to 2012. The growth in petroleum extraction is due to a doubling in capacity in production of liquefied natural gas (LNG) at Melkøya outside Hammerfest, based on natural gas from the Snøhvit field.

Even though growth has been fast in the petroleum industry the total contribution to GRP was only 1.8 per cent in 2012. The major bulk of income in offshore petroleum is registered in an accounting county for this purpose, only a minor share is included in the regional accounts.

Dominating private industries are Real estate activities, Construction and Trade. Among public services Health care and social works is by far the largest, with 18.3 per cent of GRP, followed by Public administration (12 per cent) and Education (9 per cent). The public sectors all had higher than average growth.

Table 4.9. Value added¹ by industry. Arctic Norway. 2008 and 2012

	2008		2012	
	Mill. NOK	Per cent	Mill. NOK	Per cent
Agriculture	1 097	0.9	1 341	0.8
Forestry	93	0.1	110	0.1
Fishing	3 446	2.7	3 874	2.4
Aquaculture	1 083	0.8	2 346	1.5
Oil and gas extraction	657	0.5	1 403	0.9
Other mining and quarrying	537	0.4	1 524	1.0
Fish processing	1 234	1.0	2 407	1.5
Other food processing	661	0.5	725	0.5
Wood processing	434	0.3	441	0.3
Basic metals	2 781	2.2	1 550	1.0
Other manufacturing	6 490	5.1	5 547	3.5
Utilities	9 134	7.1	9 164	5.8
Construction	9 421	7.4	11 860	7.5
Wholesale and retail trade	10 085	7.9	11 126	7.0
Transportation and storage	5 947	4.6	8 948	5.6
Accommodation and food services	2 348	1.8	2 809	1.8
Information and communication	2 785	2.2	3 483	2.2
Financial and insurance services	4 203	3.3	5 113	3.2
Real estate activities	10 938	8.5	12 613	7.9
Professional, scientific and technical activities	3 384	2.6	3 807	2.4
Administrative and support services	2 291	1.8	2 877	1.8
Public administration and defence	13 874	10.8	18 988	12.0
Education	10 398	8.1	14 234	9.0
Health care and social work	22 147	17.3	28 982	18.3
Other service activities	2 656	2.1	3 408	2.1
Total	128 124	100.0	158 680	100.0

¹ At basic prices.

Manufacturing was lower in 2012 compared with 2008 due to reductions in Basic metal production and Other manufacturing. Fish processing almost doubled its value added. Figure 4.33 shows GRP growth rates 2000-2012 in real terms for Arctic Norway as a whole. There has been positive but variable growth in all years except in 2007, when GRP fell by 2 per cent, a timing that seems out of tune with the effect of the financial crisis, as most regions in the Arctic saw their

Figure 4.33. GRP volume index and growth rate. Arctic Norway. 2000-2012

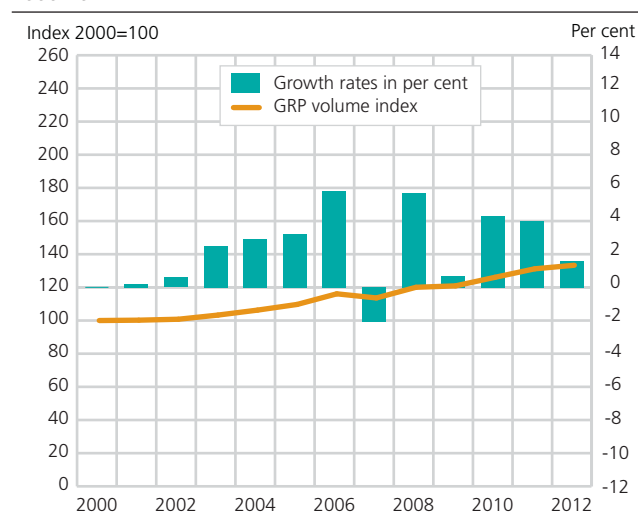
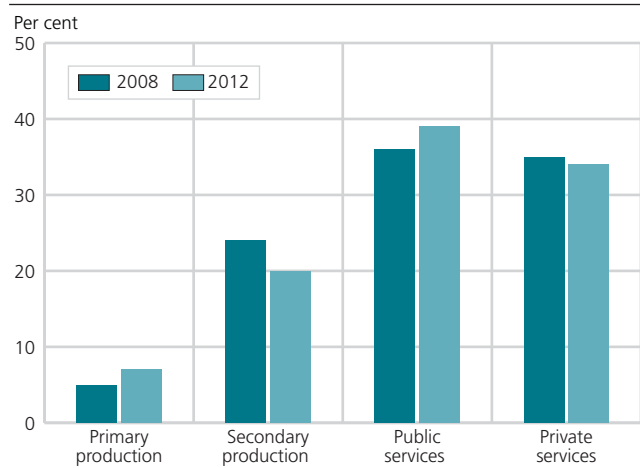


Figure 4.34. Value added by main industry. Arctic Norway. Per cent of GRP. 2008 and 2012



major declines in 2008 or 2009. Over the whole period there was 35 per cent growth, reflecting higher fish and mineral prices, but above all the increase in public services, which made up 39.3 per cent of the economy in 2012.

Figure 4.34 shows the changes in the main structure of the economy. Primary production containing the extractive industries represents only 7 per cent of GRP, untypically low in Arctic context, but higher compared with 2008. The share of primary production is low in relative terms because the public sector is so dominating. Public services have increased markedly and are clearly larger than private services, which have declined. Figure 4.35 shows that GRP per capita is considerably higher in the non-arctic regions of Norway, however, for disposable income per capita there is practically no gap.

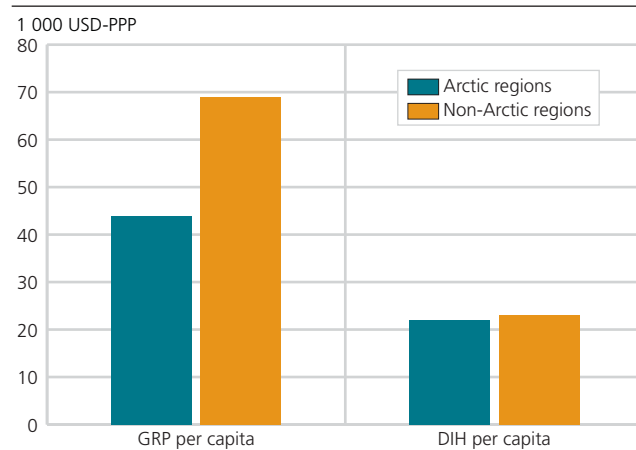
Natural resources in the economy

Today Norway is producing gas in the Norwegian Sea and the Barents Sea (Snøhvit). A new pipeline called Polarled was opened in 2016, crossing the arctic circle and transporting gas from e.g. the Aasta Hansteen field to Nyhamna/Molde on the west coast of southern Norway.

In 2016 the government opened up for new exploration licenses in the South Eastern part of the Barents Sea. With oil prices climbing towards the USD 60 per barrel oil companies tend to see profitable options for production in the arctic regions. Development of subsea technology and cost reductions increase the attraction of future offshore activity in arctic waters.

Environmental organizations oppose the decision, arguing that this activity will take Norway further away from the climate target agreed upon at the meeting of the Parties to the Kyoto protocol in Paris. The concerns are considerable about the vulnerability of the living ocean environment. The conflicting views among the public are the most apart in the case of Lofoten. Vesterålen and Senja, the spawning ground of the

Figure 4.35. Gross regional product (GRP) per capita and Disposable Income for Households (DIH) per capita. Arctic Norway. 2012. 1 000 USD-PPP



North Atlantic cod stock, the pillar of the Norwegian wild fisheries. These areas are now under renewed pressure from higher oil prices and changes in the political landscape. The rapid growth in income from the fishing industry and tourism based on renewable resources and nature are increasingly seen as threatened by petroleum activity. The arctic region of Norway has the most rapid growth in number of foreign visitors to Norway and the winter tourism is gaining popularity.

Fisheries benefit from the strong increase in demand in the world market and for the first time since 2002 the number of fishermen increased in 2016. Traditional fisheries had their third year in a row with record high results in 2016. The export of fish and fish products increased by 23 per cent to NOK 92 billion, up by NOK 17 billion from 2015.



Lofoten, Norway. Photo: Colourbox



Russian trawler in the Barents sea. © Helge Sunde / Samfoto

Arctic Russia

Arctic Russia is by far the largest among the Arctic regions both in terms of land area and population. The population is a factor 10 larger than that of the second largest region, which is Alaska. In 2013 the population counted 6.8 million, down 1.5 per cent from the level in 2008. The economy is largely based on petroleum and other mining industries, and the development during the period 2008 to 2012 strengthened the mineral basis further. Table 4.10 shows the industry structure of the economy in 2008 and 2012. Minerals saw an even higher price peak in early 2011 than petroleum did in 2008 (see Figure 4.1) and the two industries Petroleum and Other mining combined increased their contribution to GRP from 50 to 52 per cent.

The high growth industries were first of all Utilities, followed by Health care and Transportation including pipeline transportation of oil and gas. Public administration and Education also contributed slightly larger shares to GRP in 2012 than in 2008. Manufacturing lost some of its relative importance as the share in GRP fell from 5.3 to 4.0 per cent. Wholesale and retail trade and Real estate services were declining somewhat, whereas the Finance and insurance sector was small in 2008 and marginalized by 2012.

Figure 4.36 illustrates that the economic development in Arctic Russia is sensitive to the world economy and the world market for petroleum and other minerals.

During 2000-2012 Arctic Russia saw a 0.5 per cent average annual decline in population. Meanwhile there was economic growth in real terms of nearly 4 per cent per year on average. This rapid growth occurred in spite of a brief but strong recession leading to 5.5 per cent reduction in GRP in 2009 and close to zero growth in 2012. These major deviations from the trend correspond to the fall in fuel and metal prices in the world market after the financial crisis in 2008 and again, after a quick price recovery, a decline in metal prices from 2011 to 2012.

Table 4.10. Value added¹ by industry. Arctic Russia. 2008 and 2012

	2008		2012	
	Mill. Rubles	Per cent	Mill. Rubles	Per cent
Agriculture and forestry	36 346	0.9	54 076	0.9
Fishing	22 449	0.6	33 037	0.6
Petroleum and other mining	1 968 452	49.8	3 067 086	51.7
Manufacturing	208 667	5.3	235 840	4.0
Utilities	103 874	2.6	188 166	3.2
Construction	315 368	8.0	449 994	7.6
Wholesale and retail trade	287 904	7.3	407 951	6.9
Transportation and storage	273 569	6.9	431 965	7.3
Accommodation and food services	25 657	0.6	34 789	0.6
Financial and insurance services	10 715	0.3	7 884	0.1
Real estate activities	280 959	7.1	380 954	6.4
Public administration and defence	152 626	3.9	238 951	4.0
Education	81 474	2.1	128 508	2.2
Health care and social work	108 143	2.7	176 822	3.0
Other service activities	72 993	1.8	100 133	1.7
Total	3 949 197	100.0	5 936 156	100.0

¹ At basic prices.

The fuel prices and associated high income initiated an investment boom, with busy development of the huge petroleum reserves in Arctic Russia, in particular on the Yamal Peninsula. Further, a large program for investments in oil and gas extraction and transportation has been carried out in the Eastern regions of Arctic Russia to serve the increasing demand from Asian markets. The pipeline transport is planned to start after 2019¹.

Economic structure

As a consequence of high world market prices on fuels and minerals Arctic Russia became slightly more dependent on primary production, mainly of oil, gas and other minerals generating more than half of all income (Figure 4.37). Secondary industry containing Utilities, Manufacturing, and Construction declined slightly as did the share of private services in GRP. On the other hand Public services increased their share somewhat,

Figure 4.36. GRP index and growth rate. Arctic Russia. 2000-2012

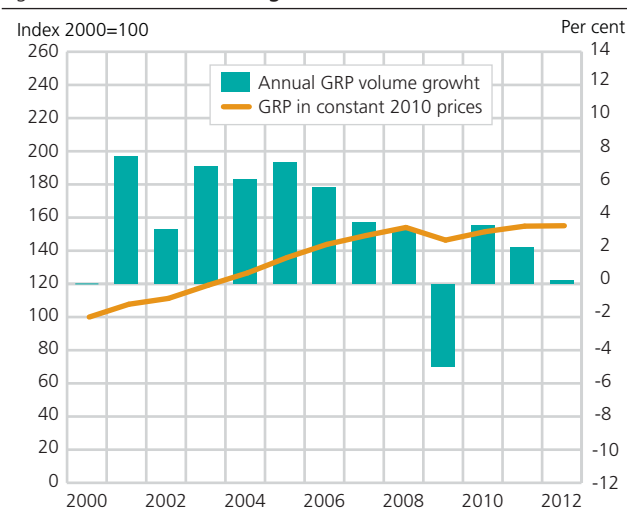
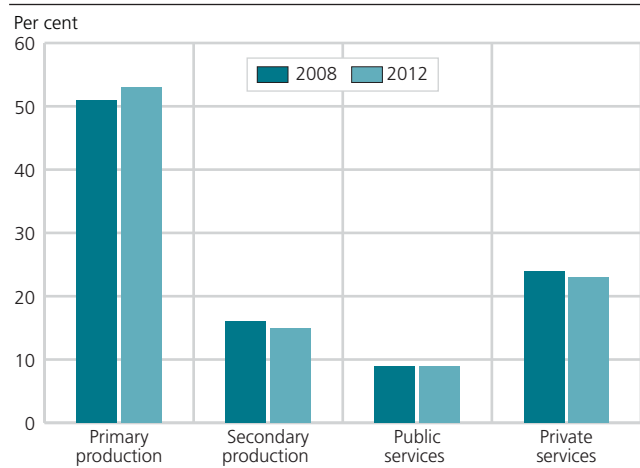


Figure 4.37. Value added by main industry. Arctic Russia. 2008 and 2012. Per cent of GDP



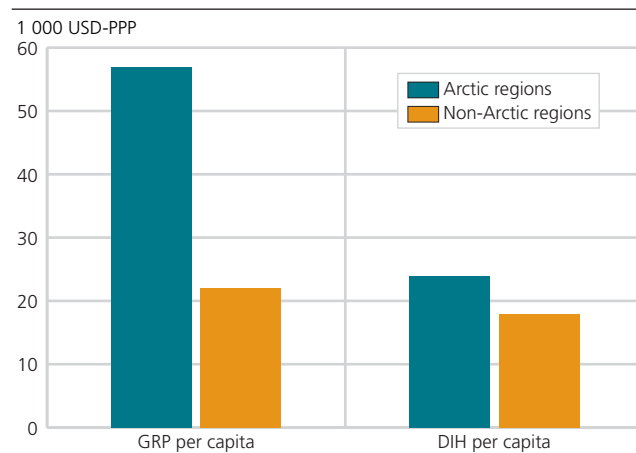
in particular driven by an increase in Health care and social work expenditures.

GRP per capita in Arctic Russia in 2012 was more than two and a half times that in non-Arctic Russia. This gap is largely a result of the petroleum industry in Arctic Russia producing 70 per cent of total Russian oil and 90 per cent of Russian natural gas (see Figures 4.39 and 4.40). Although the prices on petroleum and metals were higher in 2012 than in 2005 the GRP gap between Arctic Russia and the rest of the country was lower in 2012 than in 2005².

Petroleum

The Yamal Peninsula is a power centre of oil and gas industrial development in Arctic Russia. Rather than developing the giant deep-water Stockman gas field in the Barents Sea, petroleum investments have been directed onshore to the Yamal Peninsula. The first Russian Arctic offshore oil field, the Prirazlomnoye oil field at only 20 meters depth in the Pechora Sea, started production in 2013. In addition, the Yamal LNG plant under construction will start production in 2017 for export

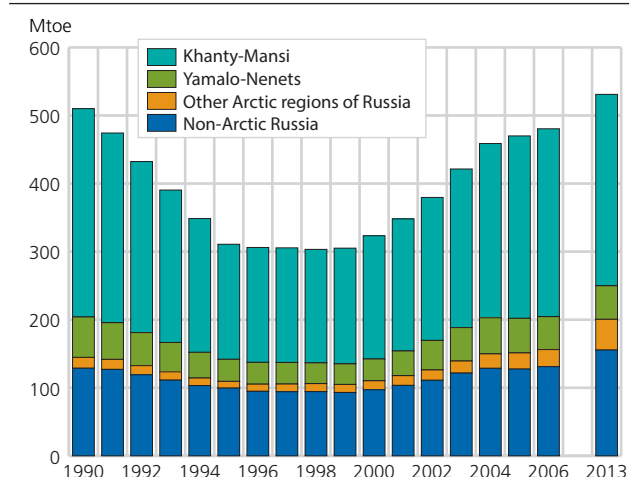
Figure 4.38. Gross regional product (GRP) per capita and Disposable Income of Households (DIH) per capita. Arctic Russia. 2012. 1 000 USD-PPP



to Asia along the Northern Sea Route and to Europe. As partner in the project China has committed to buy 3 mill. ton annually, one of the many gas supplies that might help China to switch from coal to low-carbon energy, reducing local air pollution and mitigating climate change. A new port will facilitate the expected increase in export of oil and gas as well as other minerals. New pipelines will facilitate export to Europe from the super-giant Bovanenkovo gas field, the largest in the Yamal Peninsula. The Bovanenkovo gas field started production in 2012 and is expected to contribute 20 per cent of total Russian gas production already by 2016.

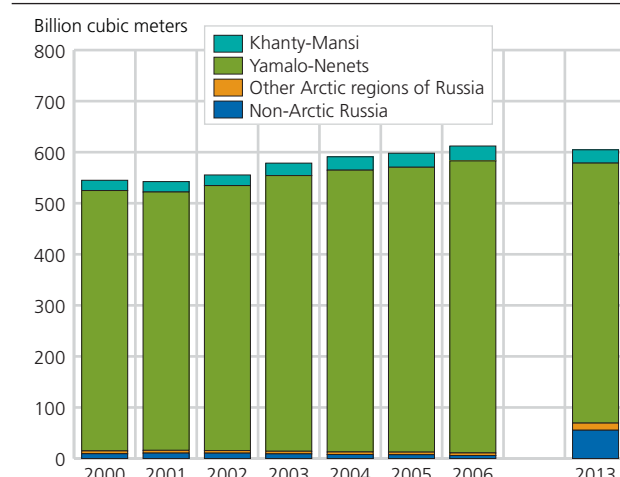
Figures 4.39 and 4.40 illustrate the position of Arctic sub-regions in oil and gas production in Russia. Russian oil production is dominated by Khanty-Mansi, with smaller shares from Yamal-Nenets and the other Arctic regions of Russia. Oil production in non-Arctic Russia holds its position fairly stable at around 30 per cent. Yamal-Nenets dominates the Russian gas industry, however, by 2013 gas production outside Arctic Russia and also in other Arctic sub-regions became increasingly important.³

Figure 4.39. Russian oil production. 1990-2013



Source: See note 3.

Figure 4.40. Russian gas production. 2000-2013



Source: See note 3.



Khanty-Mansi provides a small and fairly constant contribution to gas supply. However, the increase in Bovanenkovo gas production might re-establish the relative importance of Yamal-Nenets.

Regional development

The rich mineral resources of Arctic Russia are unevenly distributed and utilized across the 9 sub-regions. This is reflected in the different degrees of impact on regional growth around the financial crisis. Table 4.11 shows GRP by sub-region in current billion Rubles.

The oil producing Khanty-Mansi suffered a 8 per cent decline in nominal GRP from 2008 to 2009. Yamal-Nenets had a similar fall in GRP of 9 per cent.

During 2012-2014 growth was markedly lower in all sub-regions, except Yamal-Nenets, a result of large investments in petroleum and infrastructure in the region. The development of the world's largest gas field Bovanenkovo contributed to this.

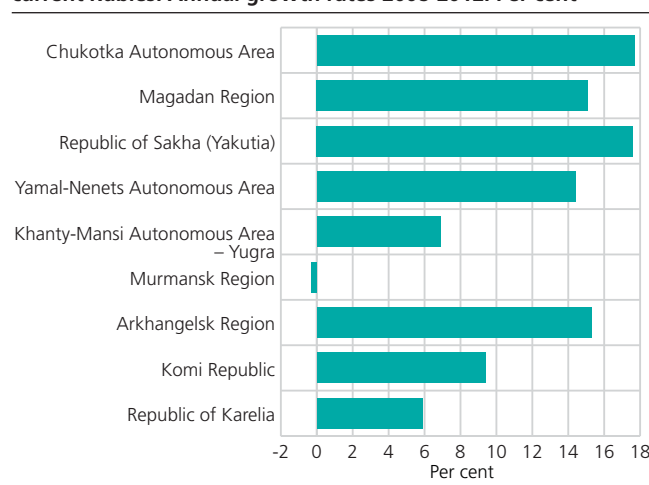
The lower economic growth in Khanty-Mansi 2012-2014 indicates limited dynamics in oil price and volumes. The oil price was still high but almost constant during these years. Yamal-Nenets had the most rapid growth during this period as a result of the heavy investment in petroleum and infrastructure. Value added of Construction within Yamal-Nenets more than doubled during these two years.

Global warming is opening up the Northern Sea Route for longer periods during the year and the possibility of reducing shipping time substantially for trade to

Table 4.11. GRP by sub-regions of Arctic Russia. 2008, 2012 and 2014

	2008		2012		2014	
	Billion Rubles	Per cent	Billion Rubles	Per cent	Billion Rubles	Per cent
Republic of Karelia	115	2.9	162	2.7	186	2.7
Komi Republic	292	7.4	481	8.1	481	7.1
Arkhangelsk Region	290	7.3	469	7.9	540	8.0
Murmansk Region	214	5.4	280	4.7	320	4.7
Khanty-Mansi	1 937	49.1	2 686	45.2	2 826	41.7
Yamal-Nenets Autonomous Area	719	18.2	1 192	20.1	1 612	23.8
Republic of Sakha (Yakutia)	310	7.8	540	9.1	660	9.7
Magadan Region	42	1.1	77	1.3	97	1.4
Chukotka Autonomous Area	31	0.8	49	0.8	57	0.8
Total	3 949	100.0	5 938	100.0	6 778	100.0

Figure 4.41. Value added in petroleum and other mining in current Rubles. Annual growth rates 2008-2012. Per cent



and from Arctic Russia is emerging. The prospects of the Northern Sea Route gives incentives for further development of harbours and other infrastructure for access to sea transport. Whereas the low bunker oil prices during the last couple of years have made the Northern Sea Route less attractive for cargo in transit, cargo to and from Arctic Russian ports along the Northern Sea route increased from 2.8 mill tons in 2013 to 4.5 mill tons in 2015, mostly as a result of increasing activity at the Yamal LNG project and upgrading of the Prirazlomnoye platform in the Petchora Sea. The future level of sea transport over Arctic Russian ports is expected to increase to 83 mill tons cargo by 2030.⁴

Notes

¹ IEA (2014): Medium-Term Gas Market report, IEA/OECD.

² Glomsrød, S. and I. Aslaksen (2009): The Economy of the North 2008. Statistics Norway, SA 112.

³ EIA (2014): Russia looks beyond West Siberia for future oil and natural gas growth, EIA/DOE, <http://www.eia.gov/todayinenergy/detail.php?id=18051>

International Business Publication (2015): Russia - Energy Policy Laws and Regulations Handbook, Volume 1, Washington, USA.

USGS (2012): Minerals Yearbook-Russia, <https://minerals.usgs.gov/minerals/pubs/country/2012/myb3-2012-rs.pdf>

USGS (2013): Minerals Yearbook-Russia, <https://minerals.usgs.gov/minerals/pubs/country/2013/myb3-2013-gg.pdf>

⁴ <http://barentsobserver.com/en/arctic/2015/10/northern-searoute-focus-domestic-projects-17-10>



Arctic Sweden

Arctic Sweden consists of the sub-regions Norrbotten and Västerbotten with a total population of 510 000 in 2013. The majority of the population lives along the coast, leaving vast areas of wilderness thinly populated and attractive for renewable energy and mining, although increasingly in interest conflict with traditional reindeer herding, hunting and tourism.

Unlike most other regions of the Arctic, Arctic Sweden has a strong manufacturing industry, second and markedly after Northern Finland in terms of share of GRP, but at the same level as Iceland. Main industries are production of basic metals and wood and paper. However, the contribution of manufacturing to the regional economy was lower in 2012 than in 2008 before the financial crisis.

Table 4.12 shows that Manufacturing generated 11.7 per cent of total value added in 2012, down from 13.0 per cent in 2008 and markedly lower than Manufacturing's share of GRP in 2005, which was 15 per cent. Wholesale and retail trade and Transportation reduced their shares in the regional economy, whereas Mining and Construction strengthened their positions. However, during 2008-2012 the most dynamic industries were Financial services, tourism in terms of Accommodation and food services and Other private services, which also includes other services to tourists than those from hotels and restaurants.

The Mining industry is of similar relative importance to the economy as Manufacturing. The Mining industry increased slightly more than the economy at large during 2008-2012 while benefiting from high metal prices during 2010-2012, increasing its share in the regional economy somewhat from 10.4 per cent in 2008 to 10.9 per cent in 2012. The Mining industry is dominated by iron ore extraction by the state owned company LKAB in the county of Norrbotten, producing 90 per cent of the iron ore within the EU. Further processing of iron ore is a major element in the Manufacturing industry.

Table 4.12. **Value added¹ by industry. Arctic Sweden. 2008 and 2012**

	2008		2012	
	Mill. SEK	Per cent	Mill. SEK	Per cent
Agriculture, forestry and fishing	5 815	3.7	5 573	3.3
Mining and quarrying	16 129	10.4	18 457	10.9
Manufacturing	20 272	13.0	19 704	11.7
Utilities	12 868	8.3	12 193	7.2
Construction	10 087	6.5	11 523	6.8
Wholesale and retail trade	10 861	7.0	11 513	6.8
Transportation and storage	11 139	7.2	11 061	6.6
Accommodation and food services	2 249	1.4	2 651	1.6
Financial and insurance services	2 413	1.6	3 100	1.8
Real estate activities	8 639	5.6	8 751	5.2
Public administration and defence	8 556	5.5	9 525	5.6
Education	10 388	6.7	11 198	6.6
Health care and social work	17 646	11.3	19 965	11.8
Other service activities	18 502	11.9	23 371	13.9
Total	155 564	100.0	168 585	100.0

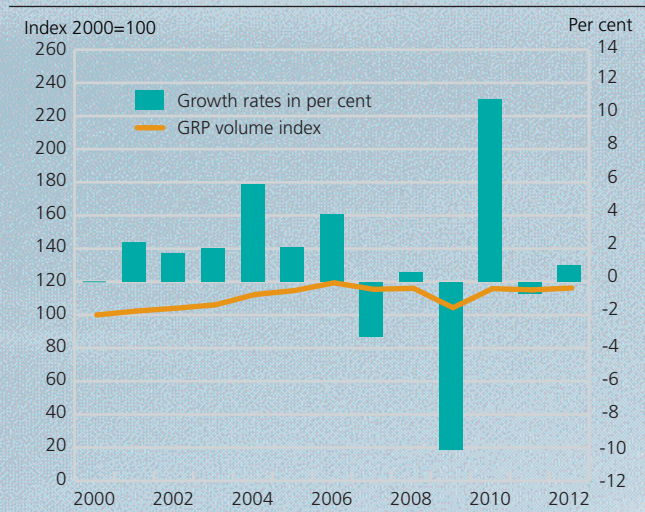
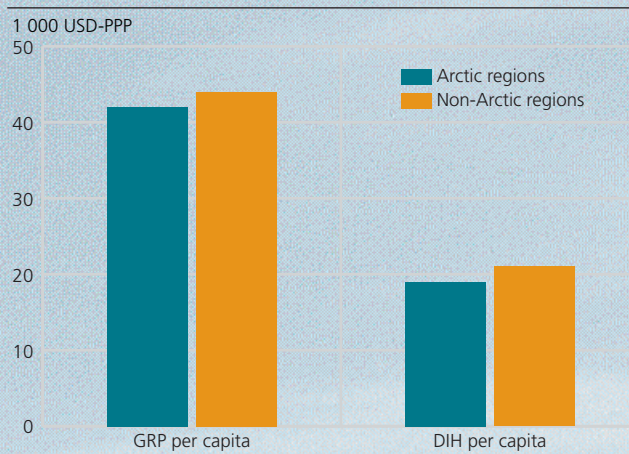
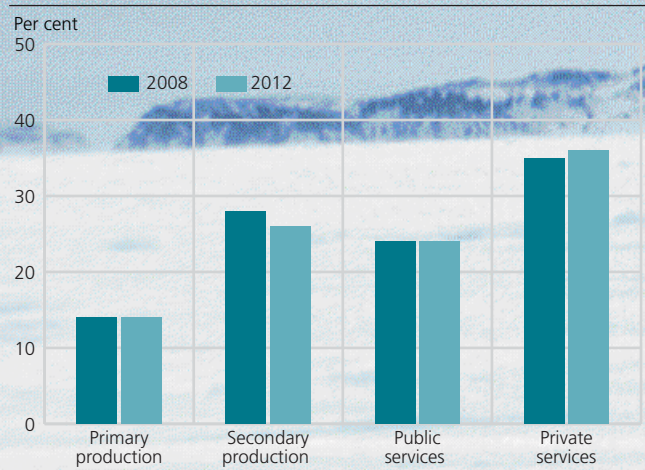
¹ At basic prices.

The value added in Utilities including electricity production, gas and water supply was slightly lower in 2012 than in 2008. Tourism in terms of Accommodation and food services increased markedly and Other private services had even stronger growth, contributing as much as 13.9 per cent to GRP in 2012. Among public services Health care and social works more than kept pace with the regional growth, increasing from 11.3 per cent to 11.8 per cent of GRP, whereas Education and Public administration roughly sustained their relative contributions.

In real terms the level of economic activity during 2010-2012 was about the same as before the financial crisis. In 2009 there was an abrupt 10 per cent fall in income, however, the 2008-level was already recaptured by 2010. There was real growth although as low as 1 per cent in 2012 (Figure 4.42).

Figure 4.43 shows the overall industrial structure of Arctic Sweden, with a substantial secondary production covering Manufacturing, Utilities and Construction at almost twice the level of primary industries. Primary industries, private and public services all compensated for the decline in secondary industries from 28 per cent to 26 per cent of GRP from 2008 to 2012.

Both GRP and disposable income per capita are lower in Arctic Sweden than in the rest of the country, a characteristic the country shares with Finland and Norway, but different from the main petroleum producers Arctic Russia, Arctic Canada and Alaska. In 2012 disposable income per capita corresponded to 46 per cent of GRP per capita. In 2005 this share was 52 per cent¹. The role of public services declined somewhat from 25.7 per cent of GRP in 2005 to 24 per cent in 2012 (Figure 4.44).

Figure 4.42. **GRP volume index and growth rate. Arctic Sweden. 2000-2012**Figure 4.44. **Gross regional product (GRP) per capita and Disposable Income for Households (DIH) per capita. Arctic Sweden. 2012. 1 000 USD-PPP**Figure 4.43. **Value added by main industry. Arctic Sweden. Per cent of GRP. 2008 and 2012**

Natural resources

Northern Sweden has no petroleum but abounds in potential for renewable energy. The hydro power potential has been crucial for developing mining and metal production and for transportation of iron ore by railway to the harbour city of Narvik in Northern Norway on the way to international markets. Vast forests provide biomass for energy purposes as well as input to wood and paper industry. Town district grids for heat based on biomass, waste and residual heat covers demand except in particularly cold periods where oil feedstock is needed. The growth in new renewable energy has been supported by national and international initiatives like electricity certificates and emissions trading. The growth in wind energy has also expanded through these measures, and the vast and thinly populated areas are seen as ideal for wind parks. Wind power generated 10 per cent of total electricity production in Sweden in 2015, and planning and projects points to Northern Sweden as a major wind energy region.

The Arctic regions contain rich mineral resources that count in global context, and are subject to extraction pressure in times with expectations of high mineral prices. Arctic Sweden is no exception and with the land covered with attractive wilderness for hunting, herding, fishing and tourism there are conflicting interests over mining activities. The mining industry in Northern Sweden is already substantial at 11.9 per cent of GRP in 2012, and other economic interests see damage to their business from new infrastructure and wounded nature. Reindeer herders object to upcoming mining projects to conserve the grazing areas and avoid contamination of groundwater and feeding grounds. There is concern among environmentalists about the pollution of land and water from leakages, for instance of heavy metals that might leak from a mine for several hundred years. Visible and other damage to the wilderness is seen as a threat to a growing tourist industry. The northern lights have become a very valuable natural resource for the arctic communities.

Circumpolar overview

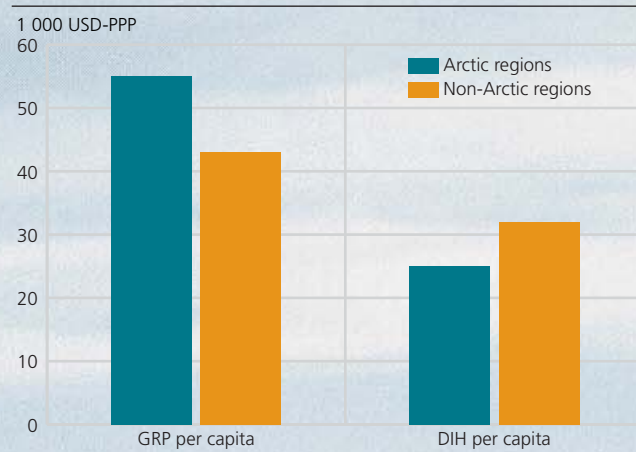
Although this chapter has mainly focused on the individual Arctic regions, the format of data allows for an overview at circumpolar level. When looking at the overall picture, the regions emerge as heterogeneous although as some, recognizable clusters. Arctic Russia, Alaska and Northern Canada are the main producers within petroleum and other mineral mining. In Arctic Russia, the primary production of mainly petroleum and minerals totally dominate the income generation, and more than 50 per cent of GRP originated in these activities in 2012 (Table 4.10). Although Arctic Russia clearly takes the lead, the three major petroleum and mineral regions have the highest shares of extractive industries in their economies. The same three regions have the lowest percentage contribution to GRP from secondary industries.

Among the other regions, Greenland and Faroe Islands are most dependent on natural resource extraction. In Arctic Sweden and in particular Arctic Finland, the secondary industries have the strongest position. Figure 4.45 shows that on average GRP per capita is higher in the Arctic region of the Arctic countries than in the southern regions, whereas disposable income of households per capita is relatively lower in the Arctic regions. However there are variations between countries.

Notes

¹ Glomsrød, S. and I. Aslaksen (2009): The Economy of the North 2008. Statistics Norway, SA 112.

Figure 4.45. **Gross regional product (GRP) per capita and Disposable Income for Households (DIH) per capita. Total. 2012. 1 000 USD-PPP**



Box 4.4. Regional accounts data sources**Alaska**

Bureau of Economic Analysis, United States, Regional data
http://www.bea.gov/iTable/index_regional.cfm

Canada

Statistics Canada, Tables by province or territory
<http://www.statcan.gc.ca/tables-tableaux/sum-som/z01/cs0003-eng.htm>

Statistics Canada, Gross domestic product, expenditure-based, provincial and territorial
<http://www5.statcan.gc.ca/cansim/a05?lang=eng&id=3840038&pattern=3840038&searchTypeByValue=1&p2=35>

Greenland

Statistics Greenland, StatBank
<http://bank.stat.gl/dialog/statfile.asp?Lang=1>

Faroe Islands

Statistics Faroe Islands, StatBank
<http://www.hagstova.fo/en/statbank>

Iceland

Statistics Iceland, National accounts and public finance
<http://www.statice.is/Statistics/National-accounts-and-public-fin>

Norway

Statistics Norway, Regional Accounts
http://www.ssb.no/english/subjects/09/01/fnr_en/

Sweden

Statistics Sweden, Regional accounts
http://www.scb.se/en/_Finding-statistics/Statistics-by-subject-area/National-Accounts/National-Accounts/Regional-Accounts/

Finland

Statistics Finland, Regional accounts (in Finnish)
<http://www.stat.fi/til/altp/index.html>

Russia

Russia in Figures http://www.gks.ru/wps/wcm/connect/rosstat_main/rosstat/ru/statistics/publications/catalog/doc_1135075100641.

Federal State Statistics Service of Russian Federation Демографический ежегодник России, 2013г. (The Demographic Yearbook of Russia) http://www.gks.ru/wps/wcm/connect/rosstat_main/rosstat/ru/statistics/publications/catalog/doc_1137674209312

Federal State Statistics Service of Russian Federation. Национальные счета России в 2006-2013гг., 2014г. [National accounts in Russia 2006-2013] http://www.gks.ru/wps/wcm/connect/rosstat_main/rosstat/ru/statistics/publications/catalog/doc_1135087050375

Federal State Statistical Service of Russian Federation. Регионы России. Социально-экономические показатели. 2002-2014 [Regions of Russia. Social and Economic Indicators. 2002-2014] http://www.gks.ru/wps/wcm/connect/rosstat_main/rosstat/ru/statistics/publications/catalog/doc_1138623506156

United Nations

United Nations, Department of Economic and Social Affairs, Population Division (2013). World Population Prospects: The 2012. Revision <http://esa.un.org/unpd/wpp/Excel-Data/population.htm>

International Monetary Fund World Economic Outlook Database, April 2015 Edition. <http://www.imf.org/external/pubs/ft/weo/2015/01/weodata/index.aspx>

OECD

Prices and Purchasing Power Parities. OECD.StatExtracts. http://stats.oecd.org/Index.aspx?datasetcode=SNA_TABLE4

The arctic regions are rich in natural resources; Alaska, Khanty-Mansi and Yamalo-Nenets have vast oil and gas deposits, Greenland, Iceland and Northern Norway enjoy access to rich fishing grounds and Canada's Northwest Territories have found large diamond deposits. Furthermore, in other regions like Northern Norway, Murmansk and Arkhangelsk, there are great hopes for discovering oil and gas in the Barents Sea.

The natural resource sectors contribute by a large share to Arctic GDP. On the other hand, it does not follow that without the natural resources Arctic GDP would have been reduced by the same amount. GDP figures include the use of labour and capital to extract resources. Without the natural resources, both the labour and the capital employed could have been utilized in other sectors of the economy, and hence, they would have contributed to GDP anyhow.

In national accounting terms stocks of unexploited natural resources should be viewed as capital assets. The value of a capital asset is usually reckoned as the total discounted net income accruing from it. With respect to natural capital this is usually referred to as a stream of resource rents. The resource rents are thus the additional income a nation/region obtains from having the exclusive right to exploit a natural resource.

With point of departure in the national accounts, Eurostat (2001) and SESA-2003 defines resource rent in the following way:

Resource rent =

- i) + Basic value of output/production
- ii) - Intermediate uses
- v) - Compensation of employees
- vi) - Return to fixed capital
- vii) - Capital consumption

When calculating compensation of employees and return to fixed capital, the idea is to use wage rates and rates of return that reflect the alternative value of both the workers and the capital employed to extract the resource. For Norway the average wage rate and the average rate of return to capital for all non-natural resource based industries have been used as a measure of the alternative value¹. However, there is yet no consensus in the literature on the correct measure; for instance, The World Bank uses the average wage paid in the primary sectors as their measure for the alternative value of labour¹. Below is an example from oil and gas extraction in Norway. All figures connected to oil and gas extraction accrue to a separate «off-shore» sector in the Norwegian national accounts.

The size of the resource rents is very dependent on world market prices of oil and gas. Output price movements can explain the large increase in resource rents from the 1995-1999 period to the period 2010-2013, and the subsequent price drop explains the decline in resource rents in 2014-2015. Note also that the compensation to labour makes up a very small part of gross production, and that the compensation to capital makes up a relatively large part. To the extent that the figures from Norway are representative for the situation in the Arctic, it is of great interest from an Arctic sustainable development perspective to study further whether resource rents are reinvested in other capital assets located in the Arctic.

Not all natural resources have a positive resource rent. Studies from Norway show that even though Norway has access to rich fisheries, the resource rents are mostly negative, but on an increasing trend. These figures indicate that in organizing the fisheries, the Norwegian authorities do not only maximize the surplus from the fisheries, but also focus on other targets such as providing jobs in remote areas. However, from a resource rent perspective jobs is a cost because labour has an alternative value. As already mentioned, one may of course discuss whether the average wage rate in the non-resource sectors is the correct measure of this value.

Figure 1. Average decomposition of gross production in the Norwegian oil and gas sector. Million NOK

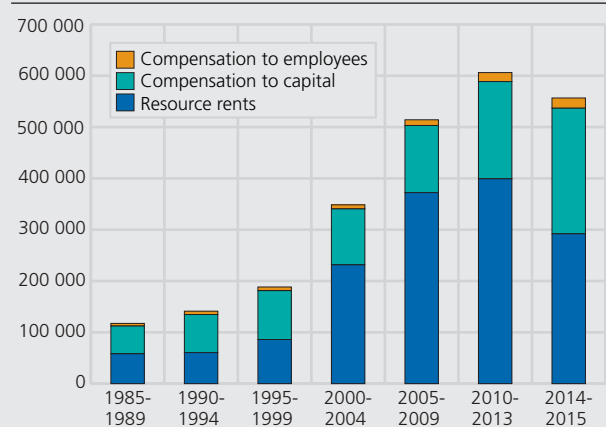
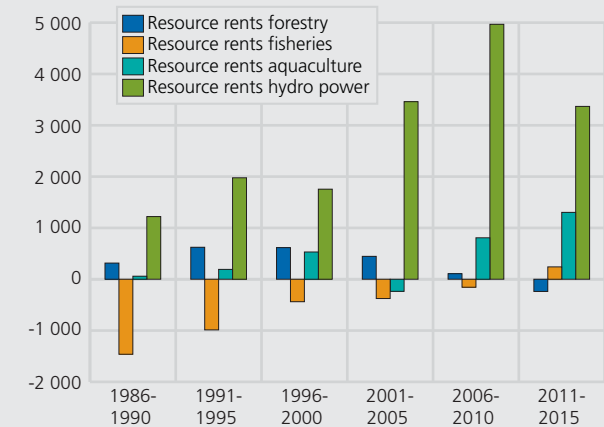


Figure 2. Five-year average resource rents from the renewable natural resources in Norway. NOK (2015-prices)/capita



¹ World Bank (1998): Estimating National Wealth: Methodology and Results, World Bank, Washington D.C.

Box IV: Svalbard – coal, tourism and research

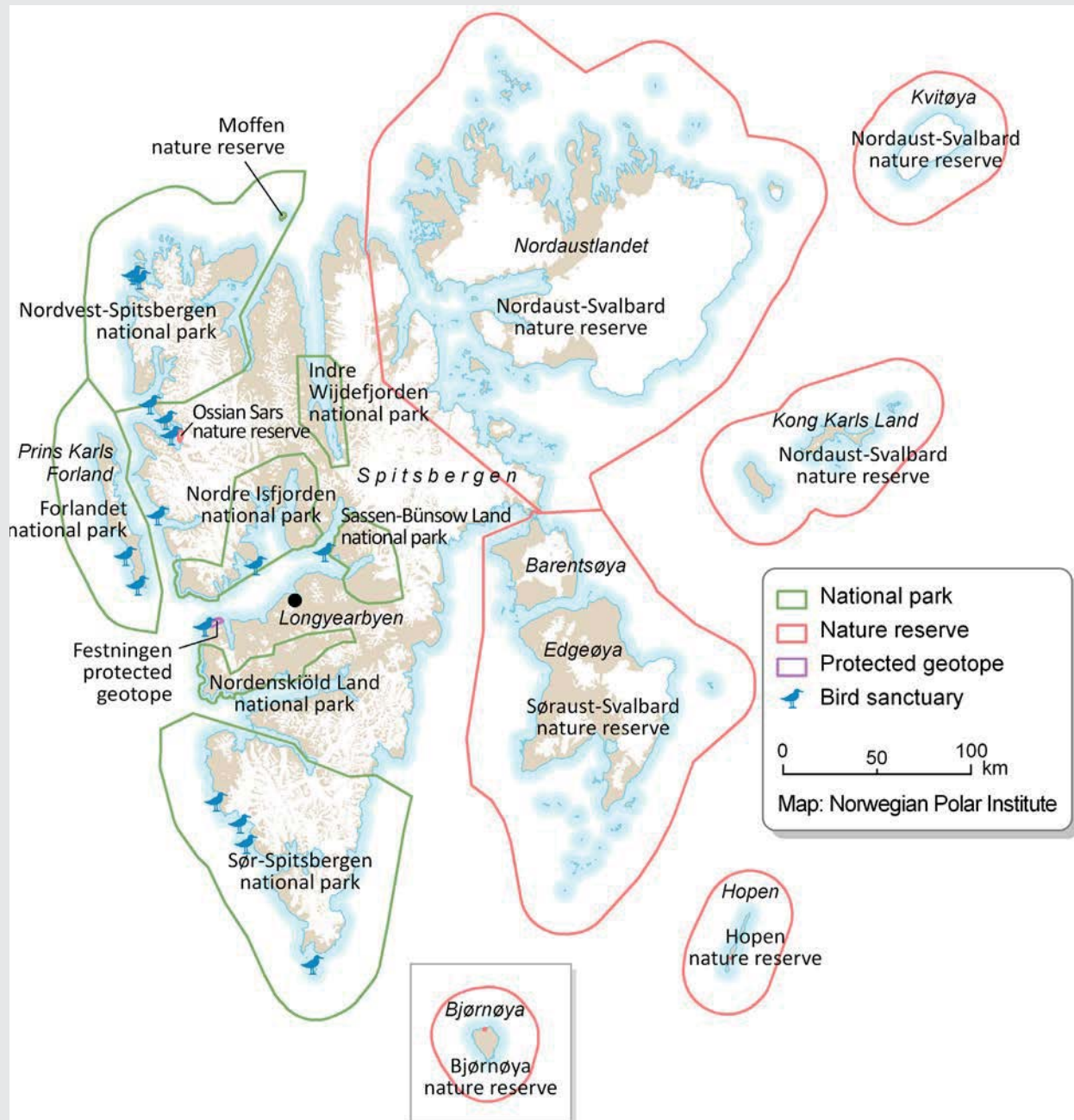
Svalbard is an archipelago¹ in the Arctic Ocean which is part of the Kingdom of Norway, but without the status of county or municipality. The area corresponds to approximately 16 per cent of the total area of land in Norway. The largest island is Spitsbergen, where all permanent settlements and human activity are located.

Longyearbyen is the Norwegian administration centre and the largest settlement on Svalbard. In the past 30 years, the town has gone from a homogenous community built up around the mining company Store Norske Spitsbergen Kulkompani, to a more diverse society. The other settlements are Barentsburg (Russian), Sveagruva, Ny-Ålesund, Hornsund and the two meteorological stations on Hopen and Bjørnøya.

Norwegian sovereignty

Svalbard was long considered a so-called terra nullius by many nations – literally a ‘no man’s land’ over which no single state held sovereignty. The Svalbard Treaty was signed in Paris on 9 February 1920 as a result of the peace conference after the First World War. The treaty provides for Norwegian sovereignty over Svalbard, while at the same time providing for certain rights for the other signatories. In 1925 the islands were officially brought under the Kingdom of Norway. Norway lays down and enforces laws and regulations on Svalbard. However the Svalbard Treaty requires Norway to grant persons and companies from the 40 signatory states equal rights to engage in hunting, fishing and certain forms of commercial activity in the archipelago and its territorial waters.

Figure 1. Svalbard. Protected areas. 2016



Protected wilderness

About 65 per cent of the land area of Svalbard is protected in one way or another in order to conserve its unique nature, landscape and cultural heritage. There are seven national parks on Svalbard, six nature reserves, 15 bird sanctuaries and one geotope (geological protection area). The national parks comprise close to 14 500 km². In addition, in excess of 20 000 km² of marine areas are included in the national parks.

The Svalbard Environmental Protection Act regulates what can and what can't be done in Svalbard's nature. It lays down important overriding principles of environmental law with regard to prudence, notification rules, the precautionary principle, total strain assessments, economic accountability for environmental damage, environment techniques and aspects of investment. The purpose of the Act is to safeguard virtually untouched area in Svalbard. Within the limits of this framework, environmentally sound settlement, research and commercial activity is provided for.

On the basis of environmental surveillance programs there are several statistics available on various formats and web portals. The motivation for all of them is to show whether the management is in compliance with the protection act and that the unique wilderness is kept unspoiled. Statistics Norway plays a central role in establishing official statistics for Svalbard and environmental statistics² is part of this.

Population of Svalbard

There are no indigenous people on Svalbard and the population consists mainly of people moving to the archipelago to work. There are about 2600 people settled on Svalbard in 2015 and the population is mainly concentrated in two settlements: Norwegians in Longyearbyen and Ukrainians and Russians in Barentsburg.

In the Norwegian settlements of Longyearbyen and Ny-Ålesund there is about 2200 residents, and the number of foreign residents are nearly 500, 23 per cent of the population. The Norwegian settlements have residents from over 40 countries. The majority of the foreigners come from Thailand, Sweden and Russia.

Few people remain on Svalbard when they get old. Compared with mainland Norway, there is a clear predominance of men in the age 25 to 59 years. Nearly 40 per cent of the population in the Norwegian settlements is in this age group. Among women there is a large proportion in the age group 25 to 44 years. The predominance of men in the population is largely due to the dominant position of coal-mining in the industrial structure.

Svalbard has been characterised as a 'churn society', and Longyearbyen has much greater turnover than a Norwegian municipality of similar size. There are a large number of both arrivals and departures: in 2014 just under 370 departures were recorded, corresponding to around 17 per cent of the population. The average length of residence in Longyearbyen is seven years – slightly longer for Norwegian residents and somewhat shorter for the foreign ones.

Figure 2. Persons in settlements on Svalbard. 1 January

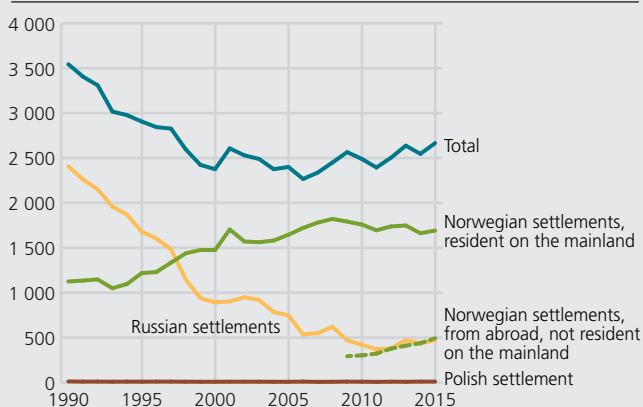
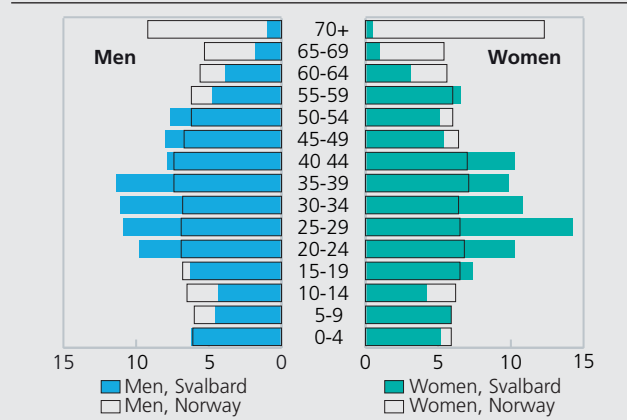


Figure 3. Age distribution in the Norwegian settlement on Svalbard and on the mainland. 1 January 2015. Per cent



The economy of Svalbard

Since the early 1900s coal mining has been the main economic activity in Svalbard. Ny-Ålesund, Longyearbyen and Barentsburg were all founded because of mining operations and extraction of coal. Ny-Ålesund is now a centre for international arctic scientific research and environmental monitoring. In Longyearbyen there is still some mining activity, but the main commercial coal production has taken place in Svea, 60 km south of Longyearbyen. The production in Svea is currently discontinued for up to three years. The Norwegian government still consider the coal production as an important industry to maintain a stable Norwegian settlement, but has also focused on tourism, research and education. The Russian settlement Barentsburg still has its foundation based on coal production, but are also engaged in research and tourism.

Statistics Norway produce annual industry statistics for Svalbard (<http://www.ssb.no/en/sts>), and figures for 2014

Box IV. Svalbard cont.

Table 1. Main economic figures for the Norwegian settlements on Svalbard in 2014 (SIC2007)

Industry	Establish-ments	FTEs	Turnover (NOK 1 000)	Public Subsidies (NOK 1 000)	Wage costs (NOK 1 000)	Invest-ments (NOK 1 000)
Svalbard total	262	1629	3 577 864	628264	1122878	836 039
B Mining and quarrying	4	351	973 732	720	333300	413 402
C+D+E Manufacturing; Electricity, gas, steam and air conditioning supply; Water supply; sewerage, waste management and remediation activities	11	39	:	:	:	:
F Construction	16	215	598 232	3 248	153 000	77 662
G Wholesale and retail trade, repair of motor vehicles and motorcycles	26	103	427 175	496	56 350	8 353
H Transportation and storage	21	98	355 026	100	99 416	58 035
I Accommodation and food service activities	16	245	300 969	42 609	101 798	85 127
J+K Information and communication. Financial and insurance activities	14	56	299 960	1 472	37 100	43 874
L Real estate activities	30	6	96 131	161	3 945	2 429
M Professional, scientific and technical activities	36	40	43 182	113 969	37 762	38 514
N Administrative and support service activities	37	96	187 642	32 763	47 752	17 244
O Public administration and defence; compulsory social security	7	72	6 428	228 206	50 908	10 756
P Education	6	163	:	:	:	:
Q Human health and social work activities	10	63	13 908	20 309	44 462	126
R Arts, entertainment and recreation	22	70	82 255	23 139	30 733	4 238
S Other service activities	7	11	7 191	4 295	5 219	210

Source: Statistics Norway

show that there was a total of 1630 FTEs (full-time equivalents) of labour performed in the Norwegian settlements, including Svea. About 20 per cent of these FTEs are directly linked to the production of coal, but when including subcontractors the number is considerable higher. The statistics also show the diversity in the industrial structure, and shed light over the economic development in tourism, education and research.

Production of coal

In 1906 the American John M. Longyear founded the Arctic Coal Company. At the same time he founded Longyearbyen in Adventdalen on the island of Spitsbergen. The American company was purchased ten years later by Store Norske

Spitsbergen Kullkompani (Store Norske). The company has since then operated in 100 years with coal production on Svalbard, and the production grew considerably when the Svea Nord mine started production in 2002. The company had about 380 persons employed in 2013, most of them in connection with the production in Svea. The Russian mine in Barentsburg has been in production since the 1930s and is operated by the company Trust Arktikugol. The company has also operated mines in other parts of Spitsbergen, but Barentsburg is the only one currently in production.

In 2014 Store Norske got considerable financial difficulties, mainly due to falling international prices on coal. Nearly a third of the employees will lose their jobs. The production in Svea is currently discontinued for up to three years. It is expected that this reduction in activity will have considerable impact on the economic situation also for other parts of the economy on Svalbard, and affecting a lot of the subcontractors.

Tourism

The Norwegian government has pursued a policy where it has been important to facilitate industries other than coal mining to ensure a robust basis for settlement in Longyearbyen in the long term. The tourism industry lives of the untouched nature and ecotourism is a niche they have wanted to develop. After the commercial focus on tourism in Longyearbyen started up in the early 1990s, this industry has exhibited strong growth. Enterprises classified as accommodation and food service activities on Svalbard had a turnover of NOK 300 million in 2014 and accounted for 245 of the 1630 FTEs performed on Svalbard. Accommodation statistics from Statistics Norway show a 46 per cent increase in the number of guest night on Svalbard from 2010 to 2014.

There are currently two commercial airlines flying from the

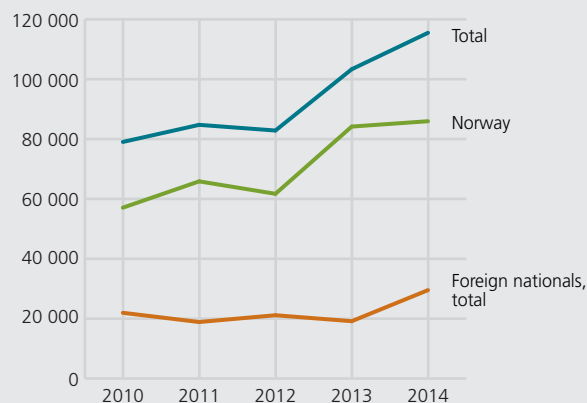
Figure 4. Shipped coal from Svalbard. Tonnes



¹ It has not been any coal shipping from Russian mines in Barentsburg in 2009 and 2010 due to fire spring 2008.

Source: Directorate of Mining with Commissioner of Mines at Svalbard, Store Norske Spitsbergen Kulkompani.

Figure 5. **Number of guest nights in accommodation establishments on Svalbard, by nationality**



Source: Statistics Norway

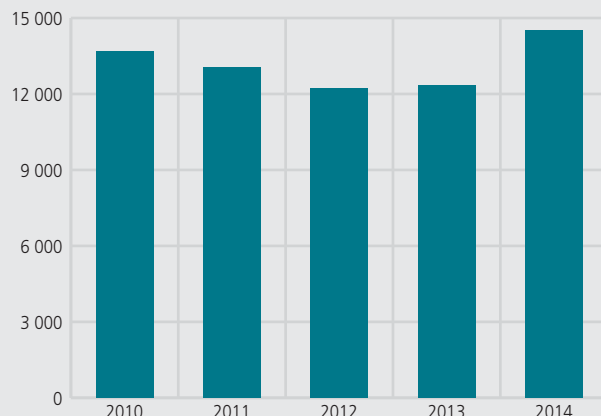
Norwegian mainland regularly. No estimates are available of how many airline passengers are tourists, but there has been a 55 per cent increase in passenger traffic from 2010 to 2014, reaching about 80 000 passenger arrivals at Svalbard airport in 2014. Tourists arriving by sea have also increased in latter years, and over 35 000 passengers arrived Svalbard by over-seas cruise liners in 2014.

Research and education

To enhance Svalbard as a platform for Arctic research the Norwegian government has since the 1990s developed significant research infrastructure in terms of research stations and laboratories, satellite download stations and observatories on Svalbard. In addition several Norwegian research vessels operate in Arctic waters. Kings-Bay AS is a state-owned company situated in Ny-Ålesund. The company activities are to provide services and promote research and scientific activities, as well as to develop Ny-Ålesund as an international Arctic scientific station. Several nations have permanent research stations located in Ny-Ålesund, such as Norway, China, Great Britain and Germany. According to statistics from Kings-Bay AS there were performed 14 500 research man-days in 2014, a growth of 17 per cent from 2013. Research man-days include field days, and support and logistics activity originating at the stations.

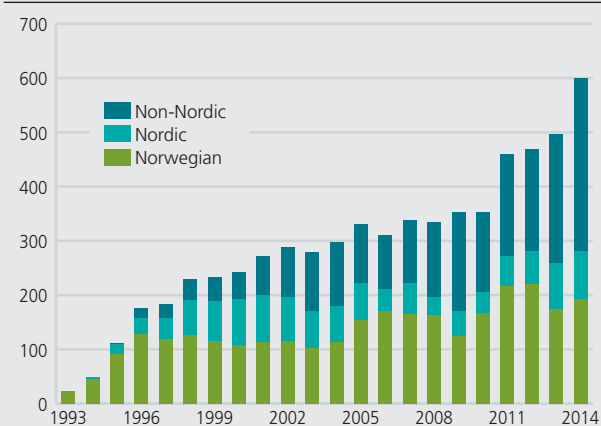
The University Centre in Svalbard (UNIS) situated in Longyearbyen was created by the four oldest Norwegian universities in 1993. The University offers various courses at the master's and doctoral levels. The courses focus on Arctic biology, Arctic geology, Arctic geophysics and Arctic technology. The number of students has increased significantly in the past years, and nearly 600 students from 44 countries were affiliated with the University Centre in 2014. This is a 20 per cent increase in students compared with 2013.

Figure 6. **Research man-days in Ny-Ålesund, including field days, support and logistics activity**



Source: Kings-Bay AS

Figure 7. **Students at the University Centre in Svalbard (UNIS)**



Source: UNIS

More statistics on Svalbard

Svalbard is a separate topic on Statistics Norway's website, under the STATISTICS' tab. Current and up-to-date statistics on and analyses of topics discussed in this article can be found there. The website also provides detailed background data on the various statistics.

¹ Svalbard is defined as a land area situated between 74 and 81 degrees north, between 10 and 35 degrees east.

² <http://www.ssb.no/en/natur-og-miljo/artikler-og-publikasjoner/environmental-impacts-and-indicators-for-the-state-of-the-nature-on-svalbard>

³ <http://www.ssb.no/en/sts>

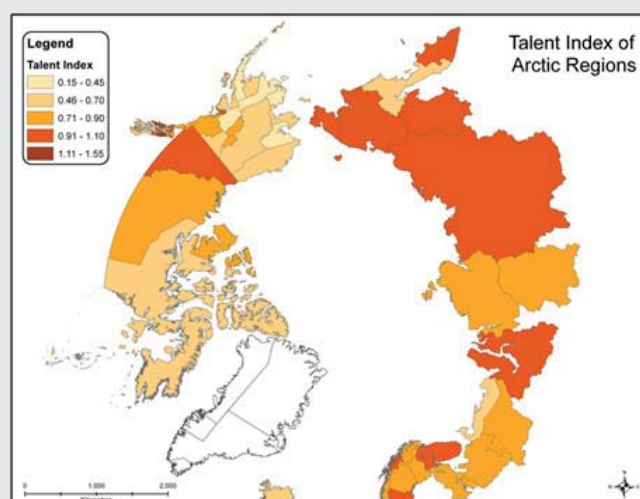
Box V: Arctic's Emerging 'Other' Economies: Technology, Knowledge and Culture in the New Arctic Economy¹

Under 'other' economies we incorporate a broad range of economic activities, which are not resource extraction (non-renewable and large scale), public sector or traditional subsistence activities, although they may be connected to these through various linkages. 'Other economies' tend to have stronger internal linkages and multipliers, generate more local development, and serve as avenues to empower local communities. At the same time, 'other economies' are not solely local², but can also be a part of international economy in the Arctic. More importantly they can serve as alternative avenues to connect Arctic's local economies with the global economic system. Examples of 'other economies' include knowledge-based industries such as professional and technical services (also providing services to the resource industries), arts and crafts, small-case custom manufacturing, food, recreation and local retail trade.

In most regions of the Arctic, excluding Russia, 'other' industries produce 30-50 per cent of GDP. The 'other' economies can be contrasted to the Arctic "pillar" sectors of natural resource extraction, public sector and traditional subsistence activities. A more detailed analysis shows that some of these industries have higher productivity and lesser volatility than the resource sector, and therefore are more compatible with the notion of sustainable economic development in Arctic regions. Based on data from ECONOR II, GDP generated by the non-pillar sectors, excluding construction, in 2005-2010 was approximately USD 120-125 billion³. When compared to the staple sector, especially mining, some of the new industries grew faster and demonstrated higher productivity⁴. The role of these industries is also enhanced by the fact that they are prevalent in Arctic urban centers, which now concentrate most of the of Arctic's population⁵. Although the volume of the 'other' economy in the Arctic is substantial, their share is smaller compared to the southern regions.

Recent studies demonstrate that despite formidable difficulties some peripheral communities are able to develop a diversified economy by engaging local human capital⁶. Investment in and development of human capital, has been identified as key element in stimulating 'other' economic activities and diversifying local economies⁷. Human capital in this context can be defined as a stock of knowledge and skills vested

Figure 1. Talent Index in Arctic regions



in the local population, while creative capital refers more specifically to the aggregate ability to generate 'meaningful new forms' (i.e. to innovate) that have economic value⁸. For peripheries to become 'hot spots' economic growth spurred by 'other' economies there has to be a connection to localized knowledge and social capital that can be formed with institution-building and formation of civic society⁹.

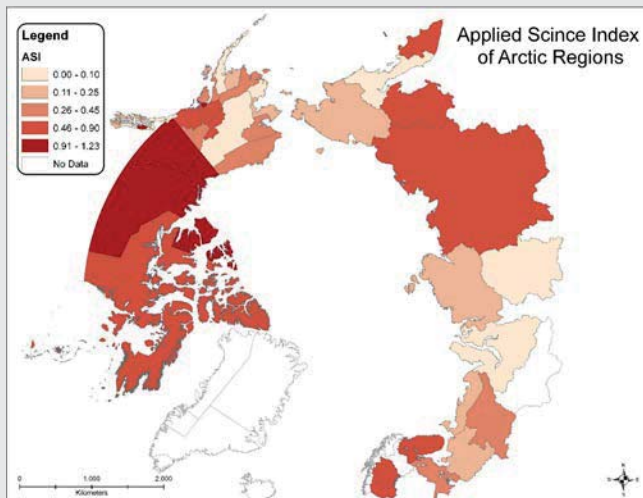
A development based on knowledge and human capital is part of a larger sustainable development strategy, especially for Arctic cities and towns¹⁰. Bringing and sustaining knowledge and human capital-intensive industries provides a new opportunity for northern urban communities to diversify their economic base, to break away from the boom-bust cycles, and reduce dependency on external economic and political actors. Recent studies demonstrated that some Arctic cities have considerable concentrations of highly educated professionals¹¹. These are mainly administrative and urban centers. Albeit only some Arctic regions could strongly capitalize on 'other economies,' it is certainly a key ingredient necessary for achieving sustainable development in northern urban communities.

Table 1. Talent Index (TI) in selected Arctic cities (Ranking)

City	Population	TI	City	Population	TI	City	Population	TI
Anadyr	10 071	1.72	Noyabrsk	89 507	1.14	Hammerfest	8 022	0.89
Nuuk ¹	15 469	1.55	Bodo	38 618	1.11	Narvik	15 175	0.88
Umeå	112 547	1.51	Luleå	73 405	1.11	Faribanks	93 779	0.87
Salekhard	32 218	1.50	Bilibino	4 449	1.09	Apatity	47 224	0.84
Novy Urengoy	82 532	1.47	Whitehorse	20 461	1.09	Monchegorsk	37 182	0.83
Nadym	34 228	1.42	Iqaluit	5 236	0.99	Olenegorsk	24 184	0.80
Yakutsk	224 083	1.39	Ukhta	97 942	0.98	Taimyr/Dudinka	24 090	0.80
Yellowknife	18 700	1.29	Harstad	19 164	0.98	Kirovsk	24 469	0.79
Juneau	30 661	1.29	Norilsk	135 666	0.96	Piteå	40 934	0.77
Reykjavik	201 585	1.28	Alta	14 815	0.96	Skellefteå	71 870	0.76
Magadan	84 575	1.27	Labytnangi	21 302	0.96	Vorkuta	68 685	0.74
Tromsø	55 014	1.25	Boden	27 554	0.96	Tura	12 234	0.69
Murmansk	240 369	1.16	Anchorage	290 588	0.95	Kandalaksha	30 334	0.67
Severomorsk	53 418	1.16	Vadso	6 125	0.92	Kiruna	23 049	0.65
			Pevek	3 660	0.91	Susuman	7 417	0.63

¹ Baseline is Greenland.

Figure 2. Applied Science Index in Arctic regions



Circumpolar scan of knowledge economy: talent and knowledge workers

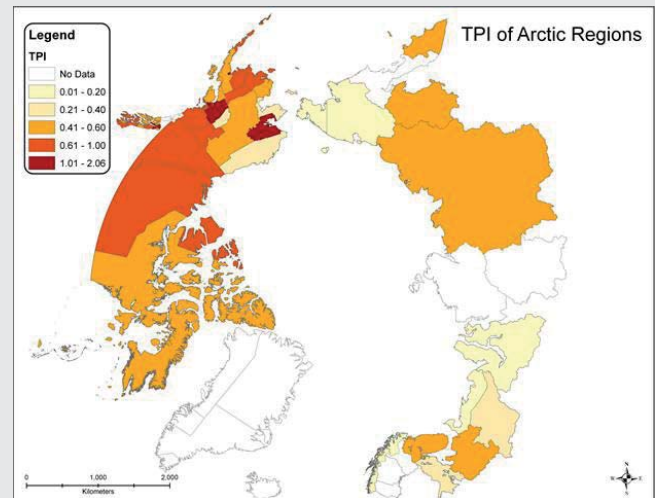
The data on knowledge economy in the Arctic is very limited, as it is not a part of the mainstream economic geographic analysis. To provide a circumpolar view of the Arctic knowledge economy one has to resort to proxies. In this study we use three main indirect measures: Talent Index (TI), Applied Scientists Index (ASI) and Tech Pole Index (TPI). The two first indices are occupation-based and defined as location quotients (LQ) of adult population with a university degree (TI) and of people in labor force with occupations in applied and natural sciences, computer science and engineering (ASI), i.e. the quotient of the region's score relative to the national level. Tech-Pole Index (TPI) is a LQ of the employment in high technology sectors (NAICS Information and Professional, Scientific and Management and Administration). The data used are from the period between 2006 and 2010. The analysis considers two scales: regions and cities. Only largest cities (population over 20 000) and regional capitals are included.

Figure 1 shows the Talent Index for the circumpolar regions. It is evident that most Arctic regions have relatively weak human capital as described by this index. However, Yukon and Murmansk, Yamal-Nenets and Eastern Siberia regions in Russia demonstrate levels of TI slightly exceeding 1.0 (i.e. greater than national level). In fact, Yamal-Nenets Okrug and Kamchatka Oblast' were ranked 9th and 10th among top Russian regions in 2002.

As seen in Table 1, Arctic cities also have varying degrees of 'talent' concentration. Some are 'talent hot spots', as regional and national capitals, including Anadyr', Salekhard, Yakutsk, Umea, Magadan, Juneau, Yellowknife, Tromso, and Reykjavik. Another large cluster of highly educated labor force is observed in Yamal-Nenets Okrug of Russia (reflecting the influx of educated labor migrants in the last decade).

TI only measures the relative level of educational attainment, but fails to consider skills obtained without formal training and the degree of actual engagement of in knowledge economy. The Applied Science Index (ASI) measures a relative concentration of labor force in applied and natural sciences, computer science and engineering (U.S. National Occupation Classification categories or their foreign equivalents), i.e. in

Figure 3. Tech Pole Index in Arctic regions



highly-skilled occupations pertaining to knowledge economy. Similar to TI, ASI is quite low in the Arctic. However, we see a number of concentrations, notably the Northwest Territories, Yukon and urban Alaska. In Yakutia and northern Scandinavia ASI is also higher than in most Arctic regions. Although not a perfect proxy of the spatial distribution of Arctic's knowledge economy, ASI indicates that people with knowledge occupations tend to locate in urban and more industrial areas. In Alaska and the Canadian North they are especially highly concentrated relative to the national level.

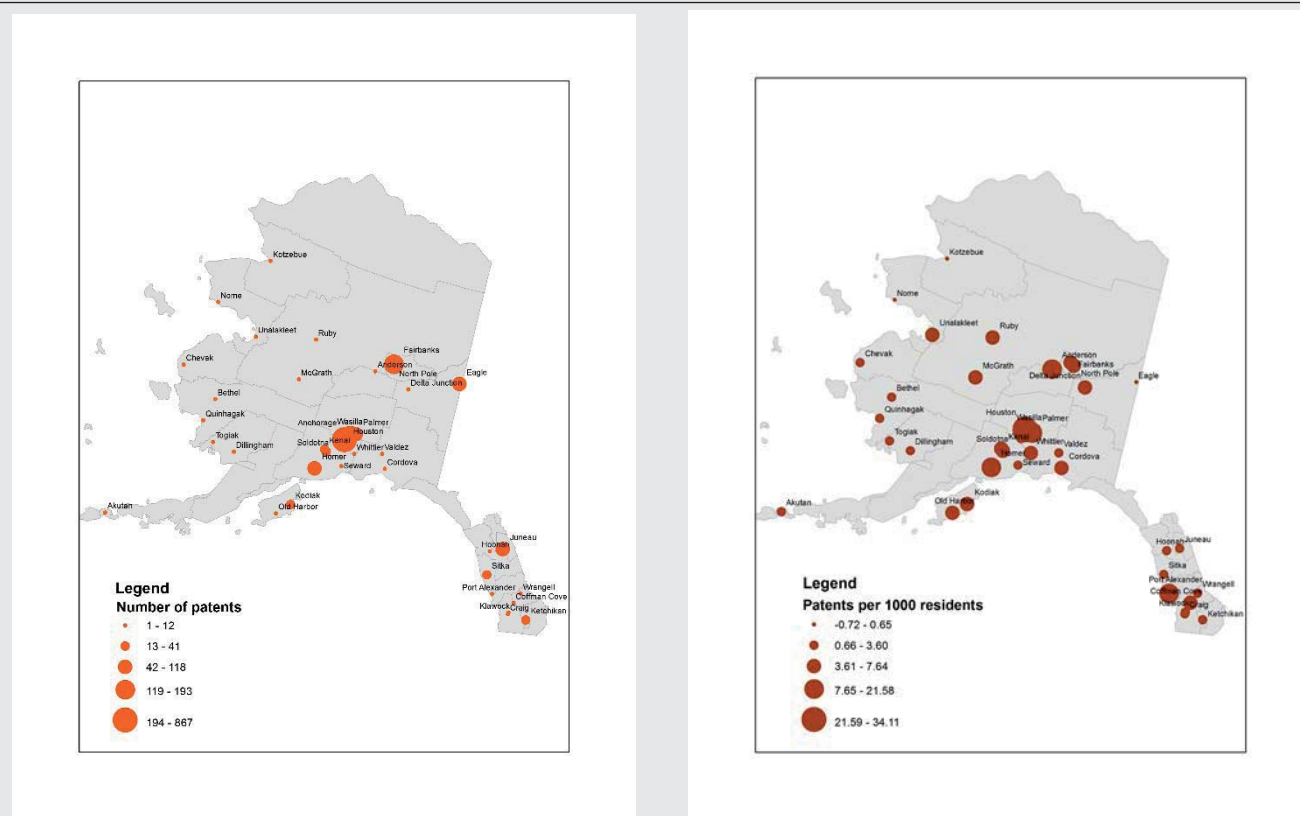
Finally, the third proxy of knowledge economy is the Tech Pole Index that looks at employment in high-tech industries¹² (Figure 3). TPI generally follows ASI and is larger in the Northwest Territories, Yukon and selected regions of Alaska. The index is much lower in northern Eurasia. Remarkably, oil and gas-rich regions of the Russian Arctic have very small volume of high-technology employment. Most engineers and technology workers (captured by TI and ASI) are employed in the extractive industry, which (in this context) is not considered high-tech.

Regional knowledge economy: the geography of patents in Alaska

Patents are routinely utilized as a proxy to characterize knowledge economy¹³. Patents are registered and recognized product or process innovations. In the United States, patents are awarded by the US Patent and Trademark Office (USPTO) based on examining inventions¹⁴. The volume of patents registered in a particular region may be considered as closely related to the size of the knowledge economy in the area.

The total number of patents granted to Alaska residents since 1976 was 1 959 (Figure 4), of which 855 were issued to inventors living in Anchorage, 191 to those in Fairbanks, and 73 in Juneau. Other top places include Wasilla (117), Homer (64), and Palmer (58). On the other hand, many communities have zero or very few patents. A large concentrations of patents in urban Alaska is not surprising. However, if normalized by population (Figure 4), we see a more interesting and complex picture of knowledge production: many smaller areas emerge as visible hubs of innovation activity, although many of them are highly specialized.

Figure 4. Number of patents (left) and patents per 1 000 residents (right) in Alaska Boroughs



Source: USPTO; map prepared by Salma Zbeed, University of Northern Iowa.

The portfolio of inventions is quite diverse and assigned to multiple inventors. In contrast, in the non-metropolitan areas, patented inventions more frequently resulted from the work of a few individuals. Most were also confined to one or two main industries, for which technologies were produced. For example, in Sitka the majority of 15 patents were issued for inventions related to fisheries; in Kodiak the lion share of 38 patents dealt with fisheries, marine environment and skiing. Many Alaska inventors had patented technologies or products pertaining to freezing, snow removal, winter sports, oil spill, outdoor activities, etc.

Two clusters of patents outside larger cities, in Homer and Palmer, at least partially resulted from activities of single inventors: Alexander Hills in Palmer was responsible for multiple patents in wireless technology, and James Thacker in Homer patented dozens of inventions in electrical engineering. This example supports the thesis about the key role of individual inventors in smaller community's knowledge economy. At the same time, most patents registered to Alaska residents, especially in engineering and electronics, were prepared in cooperation with authors from other states. In other words, Alaska inventors were involved in the external innovation networks through what is known in the literature as knowledge 'pipelines'. In sum, Alaska's knowledge economy gravitates to urban centers, demonstrates clustering of inventions and human capital, limited variety of produced knowledge, and strong differences.

Cultural economy: geography of the Arctic 'bohemia'

Cultural economy is an important part of the 'other economy' in the Arctic. Elements of traditional knowledge, such as arts and crafts, are not only important components of Indigenous culture, but are also commodities that generate income. For example in Canada, the commercial production of arts and crafts from bone, ivory, soapstone, and hides was important since the 1950s. According to the Survey of Living Conditions in the Arctic (2001), 18 per cent of Aboriginal residents of the Canadian Arctic manufactured crafts for sale¹⁵. Almost one-third of all Aboriginal people reported receiving some income from selling pieces of traditional art. Involvement in commercial handcrafting and artisanship was the highest in Nunavut, especially in some communities, like Cape Dorset. In another survey, 30 per cent of Inuit living in Nunavut reported a part-time income from their sculpture, carving and print making. Interestingly, the region encompassing Baffin Island (including Iqaluit and Cape Dorset) has been one of the most creative rural areas in Canada measured by the proportion of labor force engaged in arts¹⁶.

Fragmentary evidence suggests, however, that cultural economic activities are highly complementary with traditional economy and provide part-time or full-time occupation of thousands of northerners and brings millions of dollars (in Nunavut alone it adds CAD 30 million to regional GDP¹⁷. Most of the purchases are made by tourists and collectors of northern art.

Summary

Modern Arctic economy is not exclusively dominated by resource extraction sectors. Other industries and services occupy strong, and, in some areas, leading positions in regional economic systems. Given continuing globalization, urbanization and growth of post-industrial sectors in the Arctic¹⁸, these 'other economies' will be playing even more substantial role in the future. 'Other economies' are predominantly urban. They emerge in cities (and towns) and constitute the integral part of local economic systems, resulting from the application of local human capital and other factors of production. They are endogenous, in contrast to public sector in urban locations, which is exogenous, i.e. is subject to extra-territorial control. Innovations, whether business, technological, civic or social, are often spurring new economic activities in northern communities. In effect, 'other economies' give rise to the "new frontier," a new Arctic economic development, where the importance of non-pillar sectors is poised to increase.

Notes

- ¹ This contribution is based on Petrov, A. 2016. Exploring Arctic's 'Other Economies: Knowledge, Creativity and the New Frontier. *Polar Journal* (in press)
- ² Huskey, L. 2010. Globalization and the economies of the North. In Heininen, L., & Southcott, C. (Eds.). *Globalization and the circumpolar north*. University of Alaska Press.
- ³ Glomsrød, S., & Aslaksen, I. 2008. *The economy of the north 2008*. Statistics Norway.
- ⁴ Glomsrød, S., & Aslaksen, I. 2008. *The economy of the north 2008*. Statistics Norway.
- ⁵ Megatrends, 2011. Rasmussen, R.O. (ed). Nordic Council of Ministers, Copenhagen.
- ⁶ Beyers, W. & Lindahl, D. 2001. Lone Eagles and High Flyers in Rural Producer Services. *Rural Development Perspectives*, 11 (3), 2-10. Boschma, R.A. 2005. Social Capital and Regional Development: An Empirical Analysis of the Third Italy. In R.A. Boschma, & R.C. Kloosterman (Eds.), *Learning from Clusters: A Critical Assessment from an Economic-Geographical Perspective*. (pp. 139-168). Netherlands: Springer. Gradus, Y. & Lithwick, H. 1996. *Frontiers in regional Development*. Lanham, MD: Rowman & Littlefield. Selada, C., Cunha, I., & Tomaz, E. 2011. Creative-based strategies in small cities: A case-study approach. *REDIGE*, 2(2): 79-111
- ⁷ Megatrends, 2011. Rasmussen, R.O. (ed). Nordic Council of Ministers, Copenhagen. Petrov, A. 2007. A look beyond metropolis: Exploring creative class in the Canadian periphery. *Canadian Journal of Regional Science* 30(3): 359-386. Petrov, A. 2014. Creative Arctic: Towards Measuring Arctic's Creative capital. In Heininen, L. (ed.) *Arctic Yearbook*. 2014 Northern Research Forum, Akureyri, Iceland. 2014. 149-166.
- ⁸ Hirshberg, D. & Petrov, A. 2014. Education and Human Development. In Larsen, J., & Fondahl, G. (eds). *Arctic Human Development Report II*. Stefansson Arctic Institute/Nordic Council of Ministers, Akureyri, Iceland. 2014, 349-399.
- ⁹ Florida, R. 2002. The economic geography of talent. *Annals of the Association of American Geographers* 94(2): 743-755.
- ⁹ Aarsæther, N. (editor). 2004. *Innovations in the Nordic Periphery*. Stockholm: Nordregio.
- ¹⁰ Pelyasov A.N. 2009. And the Last Become the First: Russian Periphery on the Way to Knowledge Economy. (И последние станут первыми: Северная периферия на пути к экономике знания.) URSS. [In Russian]
- ¹¹ Megatrends, 2011. Rasmussen, R.O. (ed). Nordic Council of Ministers, Copenhagen. Petrov, A. 2014. Creative Arctic: Towards Measuring Arctic's Creative capital. In Heininen, L. (ed.) *Arctic Yearbook*. 2014 Northern Research Forum, Akureyri, Iceland. 2014. 149-166
- ¹² Florida, R. 2002. The economic geography of talent. *Annals of the Association of American Geographers* 94(2): 743-755.
- ¹³ Acs, Z.J. & Audretsch, D.B. 1989. Patents as a measure of innovative activity *Kyklos*, 4 (1989), pp. 171-180. Feldman, M. P. 2000. Location and innovation: the new economic geography of innovation, spillovers, and agglomeration. *The Oxford handbook of economic geography*, 373-394.
- ¹⁴ Kogler, D. 2014. Intellectual Property and Patents: Knowledge Creation and Diffusion. In: Clark, Jennifer; Vanchan, Vida; Bryson, John B (eds). *The Handbook of Manufacturing Industries in the World Economy*. Cheltenham, UK: Edward Elgar, pp.1-25.
- ¹⁵ SLiCA. 2008. Survey of Living Conditions in the Arctic (Table 1, p. 48). www.arcticlivingconditions.org/
- ¹⁶ Hill Strategies Inc. 2010. Artists in Small and Rural Communities in Canada. Statistical Insights on the Arts, Vol. 8 No. 2 <http://www.arts.on.ca/AssetFactory.aspx?did=5773>
- ¹⁷ Nordicity Group, 2014. Needs Assessment: Arts Administration Skills and Resources in Nunavut's Arts and Culture Sector. Report for the Canadian center for the Arts. Nordicity Group. <http://canadacouncil.ca/council/research/find-research/2014/needs-assessment>
- ¹⁸ Megatrends, 2011. Rasmussen, R.O. (ed). Nordic Council of Ministers, Copenhagen.



Local marketplace, Nuuk, Greenland. Photo: Tom Nicolaysen

5. Arctic petroleum extraction under climate policies

Lars Lindholt and Solveig Glomsrød

Introduction

The IPCC 5th Assessment Report concluded that human influence on the climate system is clear and that recent climate change has had widespread impact on human and natural systems, also warning that climate change will amplify existing risks¹. Increasingly people around the world perceive that the climate is changing and the challenge of climate change has reached the minds of both investors and consumers.

At their meeting in Paris the Parties to the UN Framework Convention on Climate Change committed to limit the global temperature rise to 2°C above preindustrial level, aiming for 1.5°C. To keep temperatures below 2°C requires two-thirds of fossil fuels to remain in the ground², a message also communicated by the International Energy Agency (IEA) chief economist Fatih Birol³.

In 2015 fossil fuels accounted for 55 per cent of global energy investments, down from 61 per cent the year before, largely because of lower petroleum prices and subsequent cuts in upstream oil and gas activity. Investment in renewables remained stable through 2011–2015, but recent investments generated 40 per cent more capacity and a third more power per unit expenditure thanks to better and cheaper solar and wind technology⁴.

The Economy of the North 2008 included a chapter on the future perspectives of oil and gas production in the Arctic regions, in a business as usual setting, without taking into account climate policies that might come in the future. The perception of the climate change as a challenge was clearly present at that time, as also embedded in the Kyoto protocol. However, there was still a limited perception of what urgency might come among citizens and decision makers. A few years later we already see numerous and serious effects of climate

change in the arctic as well as in other regions of the world, having large impact on people's livelihood.

The Arctic contains huge resources of oil and natural gas which amounts to 11 and 26 per cent, respectively, of global undiscovered resources, i.e. expected to be worthwhile extraction from a business point of view.

Several of the arctic regions have their economic foundation built upon fossil fuel production. The resource income has been volatile, but generally seen as beneficial to the arctic communities and by many expected to deliver far into the future. This might change, considering the targets of several leading countries and coalitions pledging to move towards a low carbon society.

The contribution of petroleum to the gross regional product (GRP) in Arctic Russia, Alaska and Northern Canada is considerable, whereas Greenland and Faroe Island also have expectations of income from their potential resources that are huge, in particular for Greenland. Arctic regions with tiny population might turn wealthy per capita even if modest resources become profitable. Hence, the arctic economies sort of



Family Fishing in Tyonek – A father teaches his sons to pick fish nets outside Tyonek in West Cook Inlet. Although a sometimes tenuous relationship, the oil and gas industry has provided jobs and income to residents of Tyonek for over 50 years. Photo: Davin Holen

share the interest in continued oil and gas supply to a world that is increasingly worried about global warming.

Powerful climate policy has been or is now being implemented by EU, US and China and there is a surge in investments in renewable energy in terms of solar and wind energy.

Besides government policies there is a rapidly increasing movement within the business community, taking action on climate change by pledging to stay out of coal or fossil industries in general, or pledging to invest in renewables or other environmental friendly projects. What will these politics and trends on climate issues mean to the arctic regions in terms of petroleum activity level and income basis?

Combustion of fossil fuels is the main cause of increase in the concentration of CO₂ in the atmosphere. Hence, less fossil fuel combustion is necessary to reduce global warming. Since coal is more CO₂ intensive than oil, and oil is again more emission intensive than gas, targeting carbon emissions through regulations or taxes may cause shifts in demand, particularly encouraging a switch in the direction of gas consumption. The Paris agreement can therefore lead to increasing demand for gas, since gas is widely used in power generation where it can substitute for the more CO₂ intensive coal. However, natural gas and oil are also subject to climate policies, hence there are ambiguous trends influencing the future market for natural gas.

Lindholt and Glomsrød depict future arctic production of petroleum along a baseline to 2050 based on resource and cost data from the late 2000s.⁵ Since then the trend towards lower coal consumption and higher consumption of renewables, above all in the global power sector, has been striking. As part of the ECONOR III project we therefore carried out a new study of future potential for petroleum supply from the Arctic regions, based on the FRISBEE model of global petro-



Increasingly larger areas that formally were reindeer pastures become deteriorated by oil prospecting and production activities. Varandey area, Nenets Autonomous Okrug. Photo: Yasavey

leum extraction (See Box 5.1) We established a new baseline or reference scenario towards 2050 in line with the New Policy Scenario (NPS) of IEA⁶, assuming no new international climate agreement and with coal and renewable electricity trajectories following the NPS. We then asked if the petroleum supply from the Arctic will decline if the Paris agreement is implemented.

We introduce a scenario with a climate policy sufficient to reach the 2°C scenario, i.e. does not surpass the CO₂-concentration level of 450 parts per million (ppm) in the atmosphere. The climate policy is represented by a global carbon price leading to reduced demand for fossil fuels. This might affect the price and volumes of the Arctic's most important export products oil and gas. The CO₂-price will reach USD 100 per ton in 2030 and USD 140 in 2040 in most OECD-countries and somewhat lower in Non-OECD.

A price of CO₂ has far stronger effect on coal prices than oil prices, both because coal is more carbonaceous than oil, but also because oil basically represents significantly more expensive energy than coal. Thus, a price premium in proportion to the CO₂ content adds less, in relative term, to the retail price of oil than for coal.

Results

Figure 5.1 shows Arctic gas production in the two scenarios. The long lasting constant total Arctic supply of gas in the reference scenario until about 2035 has been replaced by an earlier increase from around 2025, reaching almost 850 Mtoe in 2050, more than 250 Mtoe above the level in the reference scenario. The relatively sharp increase in total Arctic gas production under climate policy is primarily due to higher Russian volumes, but also partly a result of increases in gas supply from the other arctic regions, although from generally low levels.

In spite of the significant increase in Russian gas production, Russian supply is still mainly based on already discovered reserves. The reference scenario is to a large extent based on production from already discovered reserves, both developed and undeveloped.

Arctic Russia is a giant petroleum producer in Arctic and global context, with 95 per cent of the total Arctic petroleum production today (and 90 per cent of total Russian petroleum production). Arctic Russia has as much as 70 per cent of total Arctic resources in terms of undiscovered gas reserves, of which almost 90 per cent are found offshore.

Table 5.2 shows that aggregated Russian petroleum production towards 2050 increases by 10 per cent over the period following the introduction of climate policies, and the lion's share of this increase has to come from offshore resources that is not yet been discovered. One can question if this is realistic as there

Table 5.1. Increase in accumulated gas production 2015-2050. Climate policies scenario. Deviation from reference scenario. Per cent

Total Arctic	Greenland	Russia	Canada	Alaska	Norway
12	98	10	28	51	11

Table 5.2. Arctic gas in relation to MENA and global production. Reference scenario and climate policies scenario. Per cent

	2015	Reference scenario 2050	Climate policies scenario 2050
Arctic share of total production outside Middle East/North-Africa	27	23	24
Arctic share of world gas production	17	11	13

is yet no gas production in Russian Arctic waters (the only offshore gas production takes place near the island of Sakhalin in more temperate regions). Russian engineers are world leaders in inland arctic pipeline technology as in the Yamal Peninsula⁷, where almost all Arctic Russian gas production takes place. Offshore extraction is more costly and demanding than on-shore production and is also dependent on different technological expertise and experience. The supergiant Bovanenkov onshore gas field, larger than the offshore Stockman gas field, currently put on hold, began production in 2012. Bovanenkov is planned to produce almost 20 per cent of total Russian gas as from 2020⁸.

It is difficult to predict how future European gas import will develop and affect future Russian gas export. Although there might be lower future demand for Russian gas in Europe, we can expect an increase in Asian demand. A new pipeline from Eastern Arctic Russia to Vladivostok and Asia linked to Yamal is being built and will transport gas soon after 2019⁹. There are plans for connecting this pipeline to the rest of the Russian pipeline network, so that in some years it might be possible to transport gas from Yamal in Western Siberia to the Asian markets. In addition, the Yamal LNG plant under construction will start production in 2017 for export to Asia along the Northern Sea Route and to Europe¹⁰. Hence, although there might be lower future demand for Russian gas in Europe, there will probably be an increase in Asian demand, leading to increased Russian output after 2025.

In this model based study we assume the gas companies have full access to the reserves, as there is no environmental or political barriers. At first petroleum investments target the most profitable areas, but are gradually directed to more remote and costly areas, leading to a geographically spread of the global gas production. It is also important to be aware of the simplification we make in assuming that national gas companies like the Russian apply the same investment rule of profit-maximization as private international petroleum companies. In general, social and political priorities are perceived to have a stronger hand on the national

Figure 5.1. Arctic gas production. Reference scenario and climate policy scenario. Mtoe

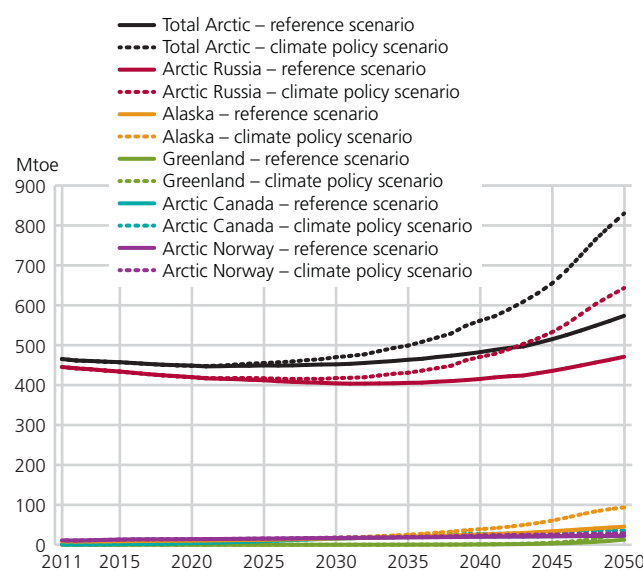
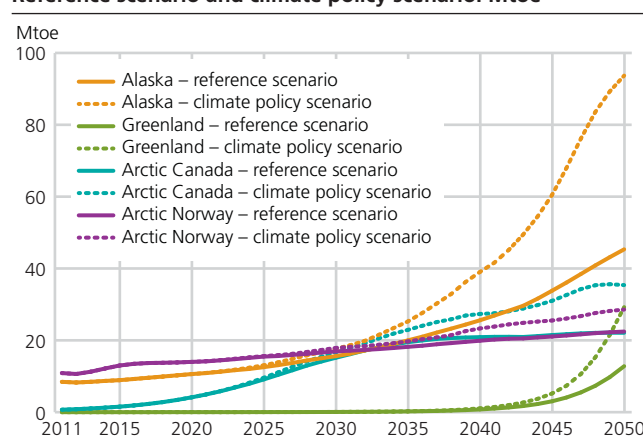
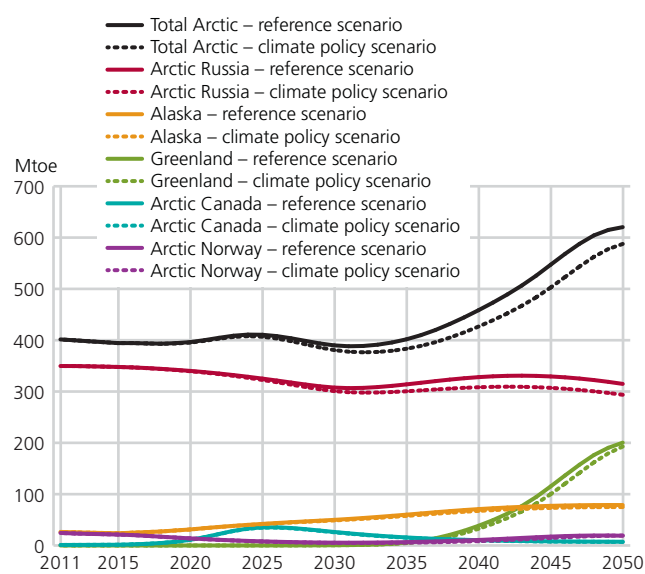


Figure 5.2. Regional distribution of West Arctic gas production. Reference scenario and climate policy scenario. Mtoe



gas companies, although national companies over time have approached commercial behaviour. Russia (and other circumpolar nations) might find it convenient to collaborate with international petroleum companies with the necessary technological expertise and experience regarding offshore extraction.

Figure 5.2 shows the projected future supply of gas from other arctic regions than Russia. The highest impact of climate policy is seen in Alaska, which early on enters a steeply rising production path reaching over 100 per cent above the old reference scenario by 2050. Although Alaska has 14 per cent of the undiscovered gas in the Arctic, including Alaskan shale gas, resources will only gradually be developed the first years and only start to really take off from around 2030. Such an increase is probably conditioned on a gas pipeline from Prudhoe Bay to e.g. the port city of Nikiski in southern Alaska similar to the existing North Slope oil pipeline. There are plans of other pipelines and LNG factories¹¹, above all a new LNG plant in Prudhoe Bay might come

Figure 5.3. **Arctic oil production. Reference scenario and climate policy scenario. Mtoe**

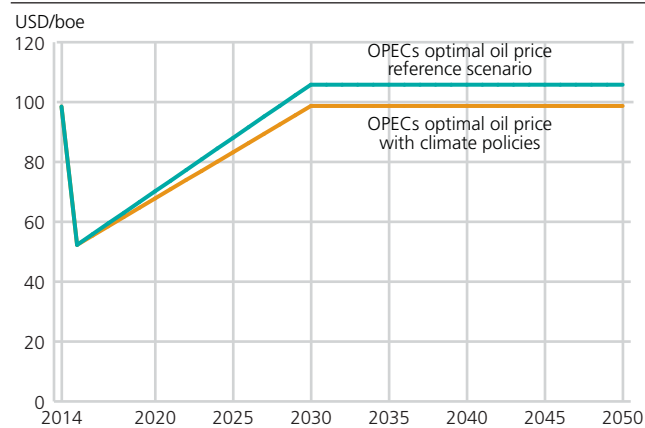
on stream. Shell and Statoil withdrew from exploratory drilling Chuchi Sea in 2015. However, over 90 per cent of the Alaskan undiscovered gas is found onshore on the North Slope as well as offshore in adjacent areas in the Arctic Ocean closer to land than the Chukchi Sea.

Canada starts out with a steady growth in gas supply from low levels, almost matching the production level of Alaska in the mid-2030s, before production flattens out after 2040. Such a rapid development of Canada's gas reserves probably depends on the development of the much debated (and delayed) Mackenzie pipeline that can transport gas from the North West Territories and south to Alberta oil sands areas and further. Lower gas prices and indigenous rights have postponed the project several times. Canada's indigenous peoples stopped for instance seismic surveys in Baffin Bay near Greenland due to the claim that they should be consulted first.

Today Norway has gas production in the Norwegian Sea and the Barents Sea (Snøhvit). A new pipeline was opened in 2015 – Polarled – which crosses the Arctic Circle and can transport gas from e.g. the Aasta Hansteen field to Nyhamna/Molde. The climate policy



Photo Mary Stapleton

Figure 5.4. **Oil price scenarios. USD (2014-prices)/boe**

scenario lifts the supply path of Arctic Norway marginally from the mid-2020s. Total accumulated supply is increased by 11 per cent.

In Greenland gas has been detected by seismic surveys, but no findings have proven viable. Various petroleum companies have stopped their exploration activities the last couple of years. In addition, even with relatively large undiscovered resources, relatively high costs and long lead time means that Greenland is unable to start production before 2040. In the climate policy scenario production is increased by the double in 2050.

As Table 5.2 shows, the arctic share of total gas production outside the Middle Eastern and North-African (MENA) region falls from 27 per cent in 2015 to 23 per cent in 2050 in the reference scenario. The reason is abundant and cheap gas supply from the MENA region, above all Iran and Qatar. With less demand for coal and more need for gas in the global power sector when introducing climate policy, we see that the Arctic increases somewhat its importance as a gas region, but not markedly. The Arctic is increasing its share in production outside MENA from 23 per cent to 24 per cent. Compared to world supply, the arctic share increases from 11 per cent to 13 per cent in the climate policy scenario. The need for gas to substitute for coal in the power sector gradually empties Iran's and Qatar's reserves and leads to even more thirst for arctic gas above all towards the end of the period.

In our study of the oil market, the oil price is exogenous (i.e. seen as given outside the model). A long term issue bringing price uncertainty into the petroleum market is the effect of rapidly growing supply of unconventional reserves like oil sands in Canada, light tight oil in the United States, and shale gas particularly in the United States. Our model approach addresses this issue by including both conventional and unconventional oil and gas reserves.

With regards to the reference oil price trajectory we started with the oil price in the 2°C scenario of IEA¹² (i.e. CO₂-concentration does not exceed 450 parts per million (ppm) in the atmosphere) and it is assumed

Table 5.3. **Increase in accumulated oil production 2015-2050. Climate policies scenario. Deviation from reference scenario. Per cent**

Total Arctic	Greenland	Russia	Canada	Alaska	Norway
-4	-10	-3	-3	-4	-8

Table 5.4. **Arctic oil in relation to Non-OPEC and global production. Reference scenario and climate policies scenario. Per cent**

	2015	Reference scenario 2050	Climate policies scenario 2050
Arctic share of total Non-OPEC oil	14	18	18
Arctic share of world oil production	10	7	7

that the oil price reaches a level somewhat below 100 USD per barrel in 2030 and is kept constant unto 2050. We moved the price path parallel up and down from this level and calculated OPEC's optimal oil price, i.e. the oil price that maximizes the present value of the cartel's future net stream of income over the period 2015-2050. This optimal price reached 106 USD per barrel in the reference scenario.

In the FRISBEE model, oil and gas investors respond with adaptive price expectations, assuming that the future petroleum price will settle at the average over the 6 previous years. When the price of oil is increasing, the adaptive expectations will lead investors onto a rising expected price path that is lagging somewhat behind the real price development. This will also be true for gas, if the endogenous gas price is increasing.

Starting with our reference scenarios, our model simulations show that the reference oil price trajectory will lead to a considerable rise in total arctic oil production beyond 2035. After a more or less constant supply period up to 2035 the arctic supply of oil will increase from around 400 Mtoe to almost 650 Mtoe towards the end of the time horizon. Behind this development, many fields are exhausted while new fields are being developed.

We see that accumulated Russian oil production declines marginally by 4 per cent over the period. For Russia almost all oil production prior to 2030 comes from already discovered reserves, onshore in Yamal-Nenets, Khanty-Mansi and Komi. Production offshore currently comes from only one field which is Prirazlomnoye at 20 m depth in Petchora Sea, which came into production in 2014. Towards 2050 a relatively large part of the oil production has to come from undiscovered fields.

Alaskan oil production today is mainly taking place on the North Slope, which covers the Central Arctic state lands and adjacent waters of the Beaufort Sea. Notice that as much as 28 per cent of the total arctic undiscovered oil resources are found in Alaska. Over time, investment in new discoveries contributes to a rapidly rising production. Alaskan future oil production in-

creases steadily and supply in 2050 is around 50 Mtoe above the present level. Substantial future increase in Alaskan oil production first of all requires that all onshore areas including the area of the Arctic National Wildlife Refuge (ANWR) and the National Petroleum Reserve Alaska are accessible. Over 90 per cent of the Alaskan undiscovered oil is found onshore on the North Slope as well as offshore in adjacent areas in the Arctic Ocean closer to land than the Chukchi Sea.

Canada produces lots of oil and gas, but little in the Arctic. There are some production in the Mackenzie Delta, Beaufort Sea and the Arctic Archipelago (Ben Horn). However, oil is expected to be found from the west close to Alaska to east towards Greenland. The relatively strong increase up to 2025, albeit from a low level, will require infrastructure and shorter lead time. The relatively small amount of undiscovered resources in Canada leads to falling production already from 2025 and provides more or less constant production as from 2040.

Arctic Norway includes the Norwegian Sea (where production started on the Draugen-field in 1993). There is only production from one oil field in the Barents Sea, as Goliat was developed in 2016. The areas of Lofoten, Vesterålen and Senja are put on hold, at least to 2017. Production in Arctic Norway declines up to 2030 and then increases somewhat as new yet undiscovered resources come into production. Production in 2050 is marginally lower than today.

Greenland has as much as 18 per cent of total Arctic undiscovered oil, but no reserves have been proven (profitable and recoverable). However, Greenland has the longest lead times and highest costs. Hence, production starts as late as from around 2035.

What will happen to arctic oil production under a climate treaty? We find that oil prices to producers do not fall as much as one could think. The long-term oil price declines from 106 USD to 99 USD per barrel. This



Prudhoe, Alaska Oil Deadhorse. A young grizzly bear ambles through the industrial trappings of Deadhorse, Alaska. Photo: Charles Mason/NTY/Scanpix

Box 5.1. The FRISBEE model of global petroleum markets

Method:

The FRISBEE-model is a recursive, dynamic partial equilibrium model for fossil fuels (oil, gas and coal), renewables and electricity in 15 regions worldwide. Demand is a function of end-user prices of energy, population, GDP per capita, and Autonomous Energy Efficiency Improvement (AEEI). Each region has three end-users: Industry, households (incl. services) and power producers.

The relevant consumer price of a fuel in a region is the sum of the producer price, delivery costs (due to transport, distribution and refining) and existing taxes and subsidies. The CO₂ tax comes in addition to delivery costs and existing taxes. They are imposed on the consumption of fossil fuels and vary with the carbon content of the fuel. Due to differing carbon content, a tax of USD 1 per barrel of oil corresponds to USD 0.71 per boe for gas and USD 1.24 per boe for coal.

A carbon tax will create a wedge between end user prices and producer prices (effect dependent on carbon content and the size of the end user price and substitution possibilities).

On the oil market OPEC is a dominant player and covers the residual demand (difference between global demand and Non-OPEC supply). We have perfect competition on the gas and coal markets (endogenous prices). Regarding oil and gas the model distinguishes between fields in production, field not developed and undiscovered fields. Both production and investment decision are modelled explicitly and are based on profitability. We model low flexibility in the short term and full flexibility in the long term, and differ between capital and production costs. We also implement bilateral gas trade between regions. Coal supply is based on more simple cost functions. Renewables are introduced in exogenous amounts.

The model covers five arctic regions; Alaska, Arctic Canada, Arctic Norway, Greenland and Arctic Russia.

We use the estimates of undiscovered resources from USGS (2008) and USGS (2012). However, with disappointing exploration activity in Greenland and the Chukchi Sea in Alaska supply we apply 50 per cent of the level in USGS (see critics towards to high USGS level). Production of oil and gas is based on profitability and detailed knowledge of access to the worldwide oil and gas fields. Investments first target the most profitable areas and gradually move to more costly and remote areas, and this leads to a geographical spread of petroleum production.

Resources consist of proven reserves defined as fully identified and economically viable resources, which may lead to production in the relative short-term, and undiscovered resources identified through geological surveys which only will lead to production in the long term. Around 80 per cent of the undiscovered resources were found offshore, but relatively shallow under less than 500 meters of water.

¹ USGS (2008): Fact sheet 2008-3049, Circum-Arctic resource appraisal estimates of undiscovered oil and gas north of the Arctic circle. USGS (2012): Fact sheet 2012-3042, An estimate of undiscovered oil and gas resources of the world.

² McGlade, C.E. (2012): A review of the uncertainties in estimates of global oil resources, *Energy* 47(1), 262–270.

is only marginally higher than the oil price in the 2°C scenario of IEA¹³ in 2040, the last year in their projections. The reason is that OPEC as a result of climate agreement finds it profitable to reduce its production to ensure roughly the same price of oil one would have even without a climate treaty.

Table 5.4 shows that in our reference scenario the Arctic clearly increases its importance as oil supplier outside OPEC, but in relation to world oil supply the Arctic slightly reduces its share from 10 per cent in 2010 to 7 per cent in 2050. The relative share of world and Non-OPEC production does not change when climate policies are introduced.

We emphasize that gas markets remain little affected by changes in oil prices. The model operates oil and gas companies as two distinct sectors. Therefore, more attractive prospects in the oil market do not affect investments in gas extraction. Since substitutability between oil and gas on the demand side is not particularly high a marginal decline in oil prices does not lead to some significant changes in gas production.

Notes

¹ IPCC (2014): *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Fifth Assessment Report of the Intergovernmental Panel on Climate Change.*

² Raupach, M.R. et al. (2014): Sharing a quota on cumulative carbon emissions, *Journal name: Nature Climate Change* Volume: 4, Pages: 873–879.

³ The Irish Times (2013): Two-thirds of energy sector will have to be left undeveloped. June 12, 2013.

⁴ IEA (2016): International Energy Agency, *World Energy Outlook 2016*, OECD/IEA, Paris.

⁵ Lindholt, L. and S. Glomsrød (2012): The Arctic: No big bonanza for the global petroleum industry, *Energy Economics* 34, 1465–1474.

⁶ IEA (2014a): International Energy Agency, *World Energy Outlook 2014*, OECD/IEA, Paris.

⁷ Stern, J.P. (2009): *Future Gas production in Russia: Is the Concern about Lack of Investment Justified?* Oxford: NG 35.

⁸ Gazprom (2016): Bovanenko, <http://www.gazprom.com/about/production/projects/deposits/bm/>

⁹ IEA (2014b): *Medium-Term Gas Market report*, IEA/OECD.

¹⁰ Total (2016): Yamal LNG: The gas that came in from the cold <http://www.total.com/en/energy-expertise/projects/oil-gas/lng/yamal-lng-cold-environment-gas>

¹¹ Alaska Public Media (2016): The Alaska LNG project explained, <http://www.alaskapublic.org/2015/10/27/the-alaska-lng-project-explained/>

¹² IEA (2015): *World Energy Outlook 2015*, OECD/IEA, Paris.

¹³ IEA (2015): *World Energy Outlook 2015*, OECD/IEA, Paris.



Svalbard. Photo: Colorbox

Box VI: Mineral extraction in the Arctic

In addition to oil and gas, the arctic region contains other abundant mineral resources. However, many known reserves are not exploited because of their inaccessibility. Arctic Russia clearly extracts the largest amount of minerals, but the other arctic nations also have certain important extractive industries, providing raw materials to the world's economy^{1,2}.

Below is a survey of important minerals that are found in the Arctic, including coal, iron and ferro-alloy minerals, several non-ferrous minerals, precious metal ores and industrial minerals. Due to the numerous sorts of minerals that exist, the list will obviously not be exhaustive. We also lack data for certain minerals. Some limited information on reserves will be included in the comments to production of the specific mineral. For information on the application of the different minerals, we have leaned heavily on Mbendi (2006) and Minerals Gallery (2005)³.

Mineral fuels

Coal is the world's most abundant and widely distributed fossil fuel. Coal is still the primary energy source for several countries worldwide, and is used primarily for electricity generation and steel production. Coal is a less abundant fossil fuel in the Arctic than oil and gas. We see from Table 1 that even if arctic coal production increased by 37 per cent from 2002 to 2011, the share of the world's coal extraction that takes place in the Arctic declined from 2.1 to 1.5 per cent (Figure 1). Coal production takes above all place in Arctic Russia, but there is also some minor production in Norway (Svalbard) and Alaska.

Iron and ferro-alloy minerals

Iron ore is the basic raw material used for the iron and steel making industry. Although iron has many specific uses as in pipes, fittings and engine blocks, its main use is in the production of steel. We see that the share of global iron ore extraction increases from 2.3 per cent to 3.1 per cent. The increase in production volume of 142 per cent over the period primarily takes place in Russia and to a minor extent in Kiruna in Sweden.

Chromite is used for a host of purposes. It is considered a strategic metal and is used in alloys for hardening and corrosion resistance. There are no economical substitutes for chromite ore in the production of ferrochromium. Northern Finland is the only arctic producer. Even if production is 26 per cent higher in 2011 than 2002, the share of global chromite production declines from 4.7 to 3 per cent of total global production.

Cobalt is mainly used as an alloy with iron, nickel and other metals to produce corrosion and wear resistant products used in high temperature applications such as jet engines and gas turbine engines. Cobalt based alloys are also used in highly durable steels. Cobalt oxide is an important additive in paint, glass and ceramics. The lion's share of production takes place in Arctic Russia. Production decreases by 30 per cent over the period leading to a steep decline in the share of global cobalt production from 11 to 1.6 per cent. In 2011 there is some minor production in Arctic Finland.

Nickel is used in the manufacture of stainless steel, steel alloys and super alloys, which have a major role in the chemical and aerospace industries. Nickel is also used in batteries and fuel cells, and as a catalyst in the production of fats and oils. We see from Figure 1 that extraction of nickel mainly takes place in Arctic Russia and total arctic extraction increases by 107 per cent from 2002 to 2011. Arctic production amounts to 10.6 per cent of the world's production in 2002 and 13.9 per cent in 2011. In 2011 there is also some extraction in Arctic Finland and a minor volume in Arctic Norway.

Titanium is light weight mineral, non-corrosive, able to withstand temperature extremes and has strength as steel. Titanium alloys have many applications in airplanes, missiles, space vehicles and even in surgical implants. Arctic Russia produces around 0.2-0.3 per

Figure 1. **Arctic share of global coal and iron and ferro-alloy mineral extraction. Percent. 2002 and 2011**

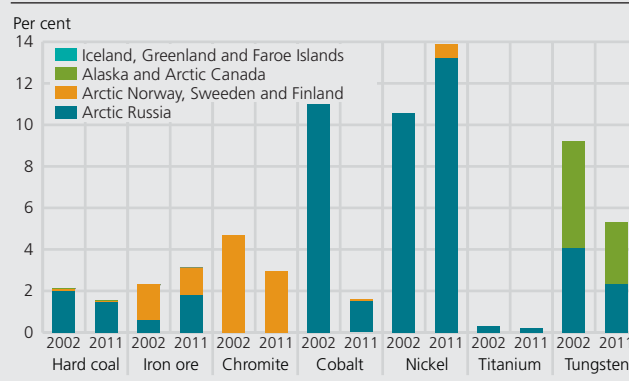


Table 1. **Change in the volume of coal and iron and ferro-alloy mineral extraction in the Arctic from 2002 to 2011. Per cent**

Coal	Iron ore	Chromite	Cobalt	Nickel	Titanium	Tungsten
37	142	26	-30	107	5	-32

cent of global titanium and production is relatively constant over the period.

Tungsten is produced both in Arctic Canada and Arctic Russia, and the share of worldwide production declines from around 9 to 5 per cent as extraction declines from 2002 to 2011 by 32 per cent. Tungsten is used for hardening steel and the manufacture of "hard metal", with hardness close to that of diamond. Tungsten metal products are extensively used in electric and electronic equipment. It is also used in the chemical industry as a catalyst.

Non-ferrous minerals

Bauxite is the main raw material for the production of alumina, and ultimately aluminum. The production of alumina consumes over 90 per cent of global bauxite output. Applications of aluminum include electrical equipment as well as car, ship and aircraft construction. It is also used in metallurgical processes, buildings and packaging materials. Figure 2 shows that extraction in the arctic area of Russia declines from 1.9 per cent of global production of bauxite to 1.6 per cent even if the production volume increases by 40 per cent (see Table 2). When it comes to production of aluminum, we find the Arctic's share to be around 3.6 per cent of world production in 2002. Russia's bauxite reserves was then less than 1 per cent of world's total (Leijonhielm and Larsson 2004) and therefore nepheline and apatite has been used as alternatives. These minerals have the disadvantage of needing more energy than bauxite in the production of aluminum. The Murmansk Oblast is the main region of nepheline and apatite production in Arctic Russia, and these reserves are considered to be sufficient for 60-100 years of production.

Copper has its end uses in construction and in the electrical and electronic sector. The Arctic produces around 3.7 per cent of total copper production in 2002, above all in Russia and to a minor extent in Northern Finland. A minor increase in arctic production of 4 per cent leads to a more or less constant share of global extraction over the period.

Lead has a variety of uses in manufacturing, construction and chemical industries. The manufacture of lead-acid storage car batteries, chemical products and cables dominate the end uses of lead. Lead is also used in X-Ray shielding equipment and at nuclear plants. Environmental regulations (particularly in the western world) are now controlling the use of lead in end products such as tetra ethyl, paint and as a petroleum additive. A large amount of lead is recycled (from old car batteries), resulting in a quite large "secondary" production amounting to about 50 per cent of current global lead production. Production in Northern Canada was around 1 per cent of world production during the period 2000-2002, but as was the case with zinc the mines were closed due to depleted resources. The Arctic produces around 5.6 per cent of the world total in 2002, above all in Alaska and to a minor degree in Russian arctic regions. The arctic volume of production is practically constant and the share of global extraction of lead declines by two percentage

¹ All figures for 2002 are taken from Glomsrød and Aslaksen (2006). For some of the surveyed minerals in Russia it was difficult to measure the arctic share. The most important source for separation between arctic and non-arctic extraction was the information in USGS (2013) and other annual volumes of this publication. They all describe specific mining areas and locations of mines, but sometimes the production figures are lacking. The arctic shares must therefore be regarded as approximate estimates. Consequently, the findings that follow must be treated with caution.

² Other sources: USGS (2016), Alaska Department of Natural Resources (2012), Statistics Canada (2013), Mining Journal (2016), CICERO (2014), AMAP (2014).

³ The most important source for world production decomposed on a country level is British Geological Survey (2014).

Figure 2. Arctic share of global non-ferrous mineral extraction. Percent. 2002 and 2011

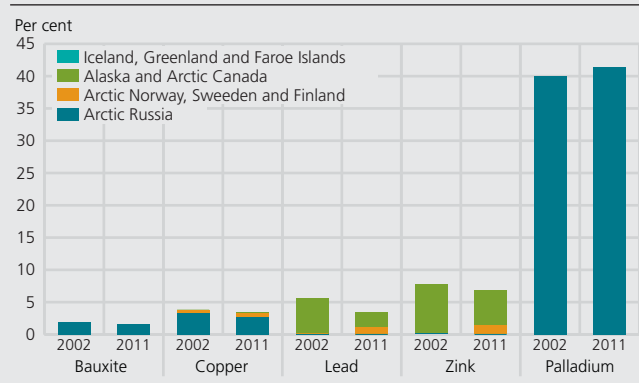


Table 2. Change in the volume of non-ferrous mineral extraction in the Arctic from 2002 to 2011. Per cent

Bauxite	Copper	Lead	Zink	Palladium
40	4	0	20	4

points from 2002 to 2011. While Russian production halts during the period some production starts in Arctic Sweden.

Zinc is used in special alloys for its unique industrial properties from great strength to unusual plasticity. Zinc coating of iron and steel products make them more corrosion resistant. Total extraction in the Arctic mainly takes place in Alaska and declines by 1 percentage point from 7.8 per cent of the world production over the period, even if the volume increases by 20 per cent.. Production in Northern Canada was around 2 per cent of world production during 2000-2002, but the mines were closed due to depleted resources. Production in Northern Finland and Sweden starts up during the period, while the activity in Arctic Russia comes to a halt.

Palladium is mainly used by the car industry for making catalytic converters. It is also used as a catalyst, in the production of nitric acids and in laboratory equipment. Palladium is also used in the electronics industry and as a dental material. Arctic Russia alone produces as much as 40 per cent of the world's palladium both in 2002 and 2011 as extraction increases by 4 per cent. Data suggests that Arctic Russia has around 10 per cent of global reserves in 2002 (Leijonhielm and Larsson 2004).

Precious metal ores

Gold has historically been used for jewelry and as a base for global monetary reserves. However, gold's role as a monetary reserve has been changing over the past decades, with several banks selling their reserves. This is seen as a move to disconnect gold from currencies. However, most countries hold gold as official reserves and large stocks of gold and jewelry are still held by banks and individual investors worldwide. Gold has a wide range of uses from catalyst in industrial processes to dental material and for decorative purposes. Of the world's gold production Figure 3 shows that the Arctic has a share of 3.2 per cent, primarily in Arctic Russia and to some extent in Alaska and Northern Canada. Some small production also takes place in Northern Finland and Sweden. As total Arctic extraction increases by 103 per cent (see Table 3), the share of worldwide extraction increases to around 6 per cent in 2011. In 2011 a tiny amount of gold production also takes place in Greenland.

Silver is often classified along with gold and platinum as a precious metal. Silver is primarily used in photographic paper and film, as well as for medical and dental purposes. It is also used as jewelry and in the electronic sector. The Arctic extracts 3.6 per cent of the global amount of silver in 2002 and following an increase in extraction of 168 per cent the share increases to almost 8 per cent in 2011. While production above all increases in Arctic Russia and to some extent in Northern Sweden, it declines in Alaska. In addition there is a minor increase in production in Arctic Canada.

Platinum is used in jewelry, laboratory equipment, cars, electrical contacts and dentistry. Around 15 per cent of the world's platinum extraction is found in Arctic Russia in 2002. Production declines by 15 per cent over the period leading to a share of 11 per cent of global extraction in 2011.

Figure 3. Arctic share of precious metal ores and industrial mineral extraction. Percent. 2002 and 2011

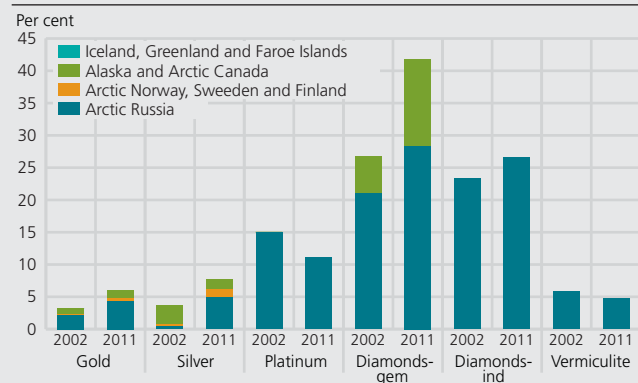


Table 3. Change in the volume of precious metal ores and industrial mineral extraction in the Arctic from 2002 to 2011. Per cent

Gold	Silver	Platinum	Diamonds-gem	Diamonds-ind	Vermiculite
103	168	-15	40	-13	13

Industrial minerals

Diamonds are famous for its use in jewelry. However, not all diamonds are of gem quality and in fact most diamond deposits contain a varying proportion of industrial and gem quality stones. Industrial diamonds in Arctic Russia make up around 23 per cent of global production by weight in 2002 and 26 per cent in 2011. Industrial diamonds main use is in lens manufacture and in wires in electrical circuits. Originally crushed diamonds were used for these purposes, however synthetic diamonds are now being produced in laboratories and pose a threat to the industrial diamond mine production globally. Synthetic diamonds have replaced natural diamonds in more than 90 per cent of industrial applications. Figure 3 also shows that production of gem quality diamonds in the arctic part of Russia and Canada combined increases by 40 per cent from 2002 to 2011. This leads to a large upturn in the share of global extraction from 26.8 per cent in 2002 to 41.7 per cent in 2011.

Vermiculite is a kind of clay, which is very useful for many industrial purposes. It is very light, chemically non-reactive and fire resistant. Vermiculite can be used to soak up toxic liquids like pesticides. This ability makes vermiculite serve well as bedding for pets and livestock. In addition, vermiculite can be used in concrete and ceramics as a heat resistant additive. Of total global production in 2002, Russian arctic regions constitute 5.8 per cent. Even if production increases by 13 per cent the share of worldwide extraction declines by one percentage point to 2011.

References

- Alaska Department of Natural Resources (2012): Alaska's mineral industry 2012, Special report 68.
- AMAP (2014): AMAP technical report no. 9.
- British Geological Survey (2014): World mineral production 2008-2012.
- CICERO (2014): Socio-economic drivers of change in the Arctic.
- Glomsød, S. and I. Aslaksen (2006): The economy of the north, Statistical Analyses 84, Statistics Norway.
- Leijonhielm, J. and R. Larsson (2004): "Russian strategic commodities: Energy and metals as security levers", FOI Report 1346, Swedish Defense Research Agency.
- Mbendi (2006): see www.mbendi.co.za/indy/ming/p0005.htm
- Mineral Gallery (2005): see www.galleries.com/minerals
- Mining Journal (2016): Various issues of supplements to Mining Journal.
- Statistics Canada (2013): Mining sector performance report 1998-2012, Energy and mines ministers' conference.
- USGS (2013): The mineral industry of Russia.
- USGS (2016): Various annual issues of the mineral industry in different countries, <https://minerals.usgs.gov/minerals/pubs/myb.html>



Raipon – The Russian Association of Indigenous People of the North Photo by Gérard Duhaime

6. Interdependency of subsistence and market economies in the Arctic

Davin Holen (lead author), Drew Gerkey, Even Høydahl, David Natcher, Martin Reinhardt Nielsen, Birger Poppel, Paul Inge Severeide, Hunter T. Snyder, Mary Stapleton, Ellen Inga Turi and Iulie Aslaksen
Contributing authors: Jesper Graubæk Andresen, Winfried Dallmann, Kåre Hendriksen, Ole Herz, Per Lyster Pedersen, Henrik Meilby and Carsten Smith

Introduction

Davin Holen and Iulie Aslaksen

In the mixed cash-subsistence economies of the Arctic, consumption possibilities are usually created by a combination of market participation and subsistence activities. The purpose of this chapter is to give a brief overview of the importance of subsistence activities in different Arctic regions. With some notable exceptions, as in Alaska, subsistence activities are mostly invisible in official statistics, due to lack of data and lack of recognition of how they contribute to livelihood. Hunting, herding, fishing and gathering continue to be of major significance to the indigenous peoples of the Arctic in providing food, social relationships and cultural identity.¹ The Arctic Human Development Report² stated that: "Customary harvesting practices are not only culturally but also economically important locally, although their role varies by region, ethnic group, urban or rural setting, and generation."

Subsistence activities and the cash economy are mutually dependent on each other for providing consumption possibilities in the Arctic today, and are at the same time part of a lifestyle that represents continuity, sharing and connection to nature.³ A study by Rasmussen⁴ showed that for hunters in Greenland, the estimated value of their production for own consumption was almost as large as the sales value of their production, which is a considerable share of their income. Estimates of subsistence production for indigenous families in Northern Russia in 2008 indicate that the market value of consumed goods from own production can be as high as several times the annual monetary income.⁵

When hunting and fishing activities take place far away from modern infrastructure and market opportunities, high transportation costs can represent a barrier for broader participation in the market and thus limit the benefits, such as access to wage income, credit, subsidies and market-related transfer payments.⁶ Economic activities may have large impacts on the Arctic environment.⁷ Sustainable development requires that new economic activity provides additional benefits to indigenous and other local people.⁸

Understanding the dependence of indigenous peoples on combining subsistence activities and market participation is important for legal regulations like, for instance, compensation payments for lost lands. Documentation is needed on the hunting and harvesting and costs of these activities.

Circumpolar and reliable data on subsistence production and consumption are lacking and should be compiled in "satellite accounts", as the United Nations have recommended, i.e., supplementary accounts to the national accounts, to make the value of subsistence activities in the Arctic visible in the statistics.

Box 6.1. Traditional ecological knowledge

Traditional ecological knowledge is defined as the knowledge, practice, and beliefs about dynamic relationships of living beings and the environment, a knowledge based on experience, which has evolved in adaptive processes between humans and nature and has been handed down from generation to generation. In the Arctic, traditional ecological knowledge about animal migrations, ice patterns, vegetation and weather is used during hunting and harvesting, and may now supplement and enrich scientific data on climate change impacts. Combining traditional and scientific knowledge about nature is an important part of understanding the resilience capacity of ecological and social systems in the Arctic, enhancing the potential for sustainable development and self-sufficiency.

Reindeer herding provides examples of how traditional ecological knowledge is relevant for adaptation to climate change. The texture of snow and ice is an important determinant of the access of reindeer to food. "Reading" snow and ice is only one element of the ongoing process of observing and evaluating grazing pastures and weather conditions, wind directions, the sequence of changes in nature, all factors which determine access to pastures and the behaviour of the reindeer herd.¹

¹ Heikkilä, L. (2006): 'The Comparison of Indigenous and Scientific Perceptions of Reindeer Management', in Forbes, B.C. et al. (ed.) Reindeer Management in Northernmost Europe, Springer-Verlag, 73-93. Tyler, N.J.C. et al. (2007): Saami reindeer pastoralism under climate change: Applying a generalized framework for vulnerability studies to a sub-arctic social-ecological system, Global Environmental Change, 17, 191-206.

Subsistence in Alaska

Davin Holen, College of Fisheries and Ocean Sciences,
University of Alaska, Fairbanks

Subsistence in Alaska is a broad ranging category that refers to both a management regime and a way of life that is meaningful to residents of rural Alaskan communities. The Alaska Department of Fish and Game, Division of Subsistence defines subsistence as the customary and traditional uses of wild resource for food, clothing, fuel, transportation, construction, art, crafts, sharing, and customary trade. In sum any wild resource for human use is considered subsistence. Harvesting wild resources in Alaska occurs under several regulatory regimes. Most fish harvested by rod and reel are subject to sport fishing regulations, whereas the use of nets to harvest salmon for home use is considered subsistence. Game harvested under general hunts is considered sport hunting, and residents who are engaged in commercial fishing and often retain fish for home use, often have different seasons, gear allowances, and bag limits for harvest and often intersect, adding to the complexity of regulations for Alaskans that residents of Alaska must navigate in their efforts to harvest wild resources for home use and to share with their family and community. Sharing is an important and traditional component of the subsistence economy.

The subsistence way of life in Alaska involves harvesting wild resources to meet the needs for nutrition, personal, family, and community wellbeing, as well as spiritual and ritual ties to the land and animals, fish, and birds that are harvested. In Alaska and other areas of the North there continues to be strong cultural traditions governing human-environmental relations. Practices embedded in what we call Traditional Ecological Knowledge are largely dependent on social mechanisms with a cultural as well as pragmatic nature. Conservation practices of Traditional Ecological Knowledge systems require cultural internalization for knowledge to be shared by the social group¹. Federal and State resource management agencies recognize that indigenous peoples have extensive knowledge about the environment and there is a common perception that indigenous peoples have a conservation ethos that is integrated into their knowledge systems. In Alaska there are numerous thriving indigenous cultures and Federal and State agencies document their knowledge and customary and traditional practices. This gives indigenous peoples, who maintain a hunting and gathering lifestyle on northern lands, a voice in the management process.

Subsistence practices differ but are closely tied to other activities relating to wild resource harvests. Alaska has a robust commercial fishing economy for example. Commercial harvests of salmon, herring, pollack, and other fish are important for residents of rural communities. In Alaska the seafood industry directly employed 63 100 people in 2011, or 1 in 8 Alaska workers². Commercial and subsistence fisheries are often inter-re-



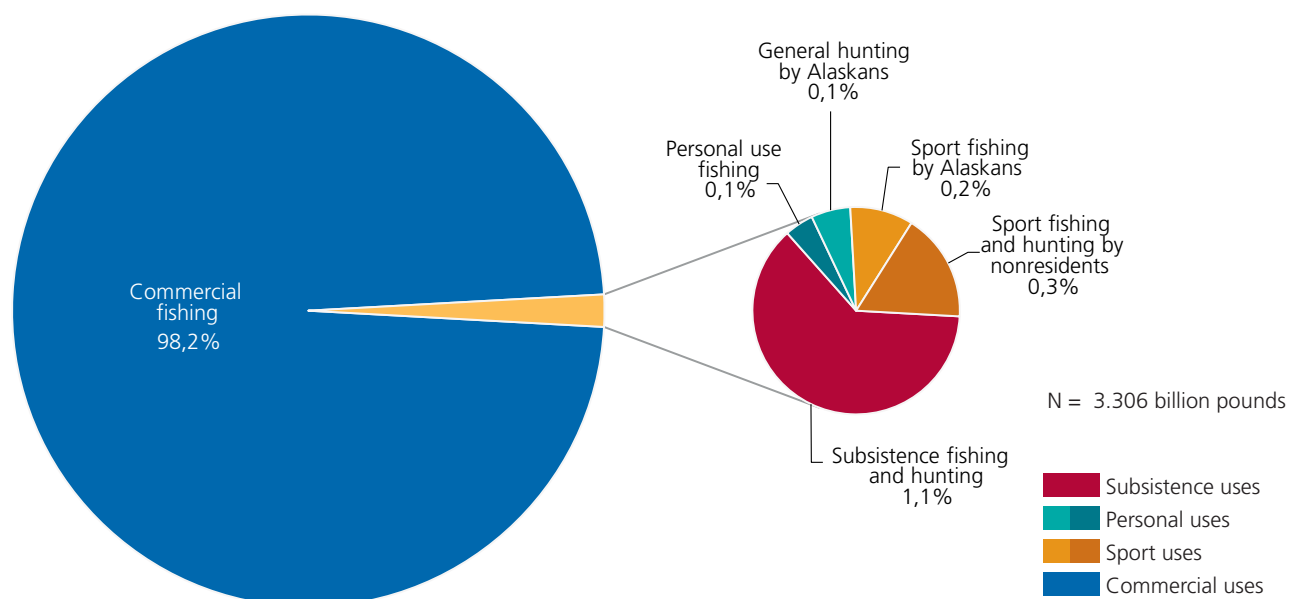
Sockeye salmon drying on the shores of Lake Clark, Bristol Bay, Alaska.
Photo: Michelle Ravenmoon, National Park Service.

lated as fishing equipment is often used for subsistence fishing outside commercial fishing periods³. In addition, households with commercial fishing permits are often also the households that have a high production of subsistence foods. A household's wild food harvest increases by 125.8 per cent if the household is also involved in commercial fishing⁴. In terms of subsistence, harvests in Alaska are still relatively high compared to other Arctic areas⁵. However, commercial fish harvests account for 98.2 per cent of the harvests of all wild resources in Alaska combined.⁶ In addition residents of both urban and rural communities in Alaska engage in sports hunting and fishing. Subsistence users harvest 1.1 per cent of wild resources while sport activities account for the other 0.7 per cent (see Figure 6.1).

Dual Management in Alaska

Subsistence regulations in Alaska are defined by both State and Federal Agencies, referred to as "dual management." The State of Alaska passed the subsistence law in 1978 providing a priority for subsistence over other consumptive uses of wild resources. Federal lands in Alaska comprise some 60 per cent of Alaska of which 80 per cent is set aside for public use⁷. Twenty-eight per cent of Alaska is designated State lands. In addition under the Alaska Native Claims Settlement Act (ANCSA) Alaskan Natives received 44 million acres which is considered private land and managed by Alaska Native corporations that were created as part of ANCSA. Other private lands make up less than 1 per cent of the total land area of Alaska. Federal and State regulations differ as to harvest limits and seasons.

Alaska seeks to manage wild resources for maximum opportunity for the residents of Alaska as well as visitors to the state. If there is a conservation concern, a fishery or hunt may be restricted to Alaska residents only, referred to as Tier I. If the harvestable surplus cannot sustain all Alaska residents, a Tier II restriction is established. The Alaska resident then must apply for the opportunity to participate by demonstrating through the application a long term and consistent

Figure 6.1. **Who harvests fish and game? Resource harvests by purpose in Alaska. 2012**

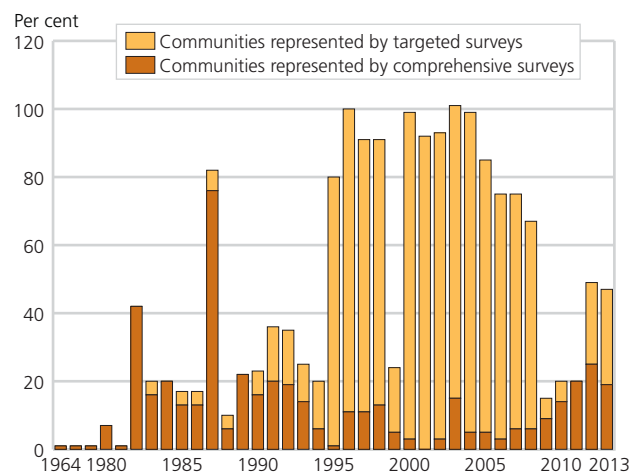
Source: Division of Subsistence, Alaska Department of Fish and Game, and Fall (2014), see note 6.

dependence on the resource. Since 1989 all residents of Alaska qualify to participate in subsistence.

Federal law provides for a rural preference to subsistence unlike the State of Alaska, which provides for subsistence for all Alaska residents. Two competing laws, the Alaska Subsistence Law of 1978 and the Alaska National Interest Lands Conservation Act (ANILCA) of 1980, are commonly referred to by Alaskans as the “subsistence dilemma.” Federal lands often have hunts that follow state seasons and harvest limits to make regulations less confusing for local users. There are cases where regulations are confusing, e.g. when crossing from federal land to state land could mean moving from an area where hunting is open to where it is closed. Varying court cases and efforts by the State of Alaska have tried to amend this impasse, however, in all likelihood it would require a change in the Alaska constitution to give a rural priority to come into compliance with Title VIII of ANILCA.

Variety of Subsistence Economies throughout Alaska

The Alaska Subsistence Law laid the groundwork for the Division of Subsistence within the Alaska Department of Fish and Game. One of the main tasks of the Division is to scientifically quantify harvests of wild resources by rural Alaska residents. The subsistence way of life is identified in regulation as a way of life that is based on consistent, long-term reliance upon fish and game resources for the basic necessities of life⁸. Since 1980 the Division has conducted comprehensive surveys documenting the harvest of all wild resources in 277 communities throughout Alaska (Figure 6.2). The map in Figure 6.3 shows the locations of communities that have been surveyed. Since 2009 the number of surveyed communities has increased to provide information for development projects. Most communi-

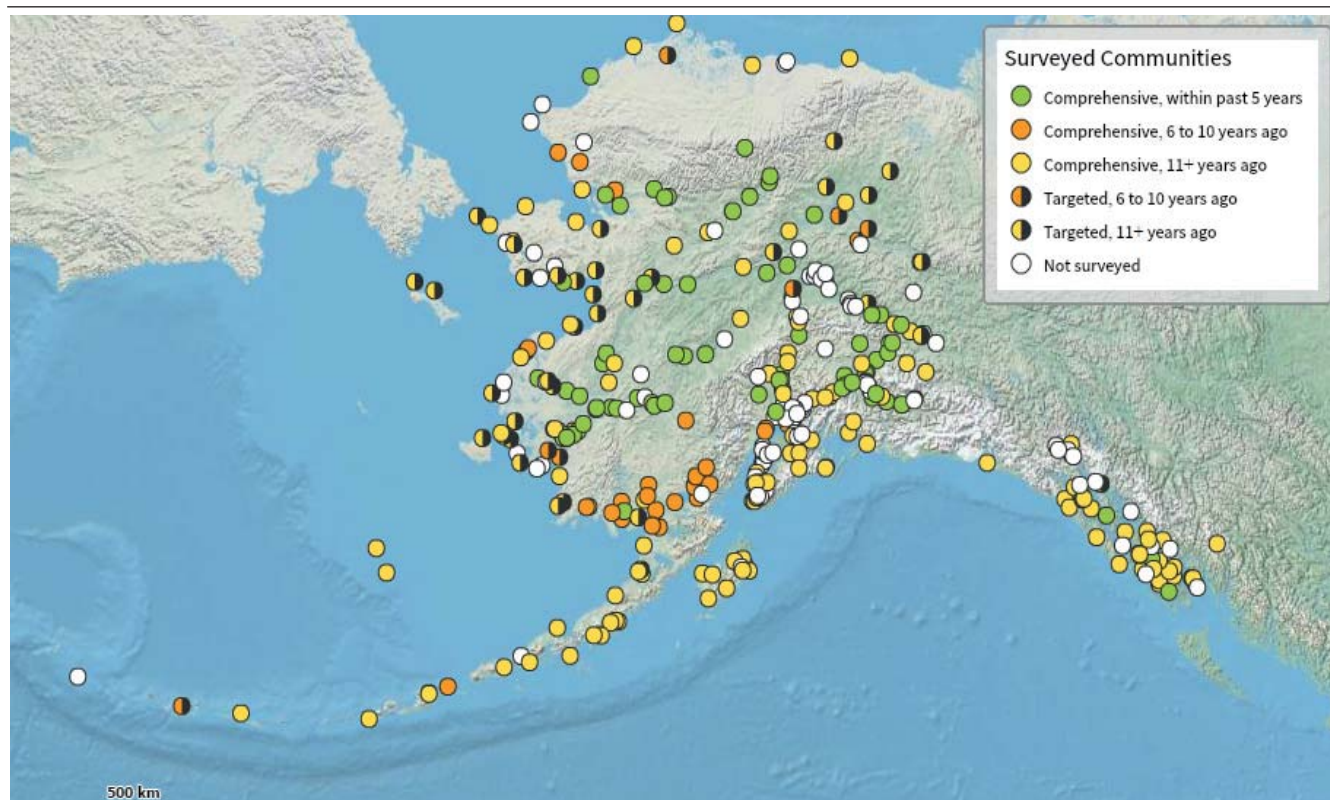
Figure 6.2. **Community harvest surveys to be included in the Community Subsistence Information System (CSIS) by year**

Source: Division of Subsistence, Alaska Department of Fish and Game, and CSIS.

ties that have not been surveyed are outside areas that the State of Alaska designated “non-subsistence areas”, i.e. areas near major urban centers such as Anchorage, Fairbanks, Juneau, Valdez and Ketchikan, where the only consumptive uses of fish and game are general hunts, personal use fisheries, and sport activities.

Harvest survey data (Figure 6.3) as well as permit data for fisheries or harvest ticket data for game are used to inform the Boards of Fisheries and Game. Household harvest surveys are carried out face-to-face in each household to record demographics, harvests, sharing and distribution of wild resources, and the cash economy including jobs and income. The surveys record use, attempt to harvest, harvest, and sharing for each possible wild resource that could be harvested in an area. Harvests are also mapped recording a variety of attributes such as month, access to resource, and gear type.

Figure 6.3. Map of communities in Alaska surveyed for harvest of wild resources. 2016



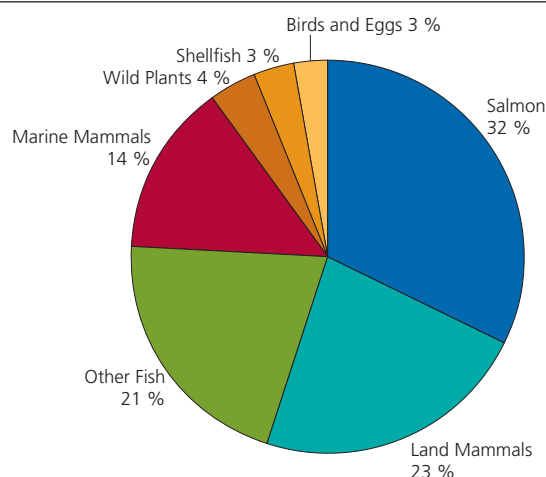
Source: Division of Subsistence, Alaska Department of Fish and Game.

In addition surveys are including food security questions and other questions to provide for Health Impact Assessments. The surveys are in English with Alaska Native translations such as Central Yup'ik and Inupiat in communities where Alaska Native languages are still spoken.

Surveys completed over the past 30 years have found that there is not one typical subsistence economy in Alaska; there are many, and they vary by region and even between neighboring communities. Alaska's ecosystems and natural resources are diverse, stretching from the high Arctic along Alaska's northern coastal

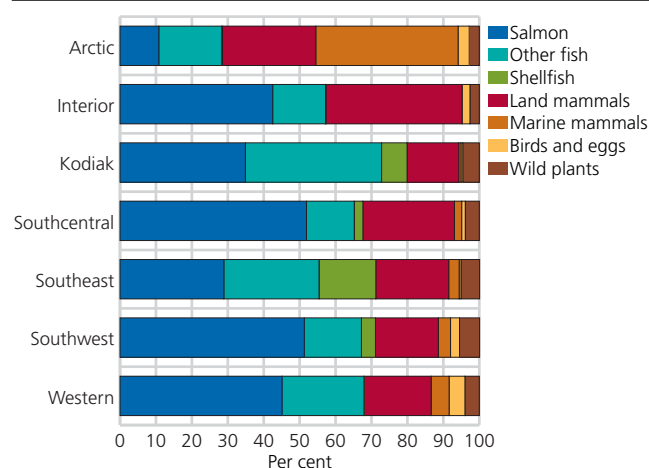
plane, interior Alaska with its boreal forest environment, southwest Alaska with its expansive tundra and multitude of river systems, the rainy windswept islands of the Aleutians, and the temperate rain forests of Southeast Alaska. Figure 6.4 shows the composition of wild food harvest in Alaska. Overall salmon (32 per cent) and large land mammals (23 per cent) such as moose, caribou, bears, and deer make up the highest percentage of harvest measured in terms of edible weight. Also important are other finfish (21 per cent), especially in coastal communities where halibut and cod are available and in communities in the interior of Alaska where whitefish, sheefish, and grayling are more abundant than salmon. Marine mammals (14 per cent)

Figure 6.4. Composition of wild food harvest by rural Alaska residents. 2012



Source: Fall (2014), see note 6.

Figure 6.5. Harvest composition by region. Alaska. 2012

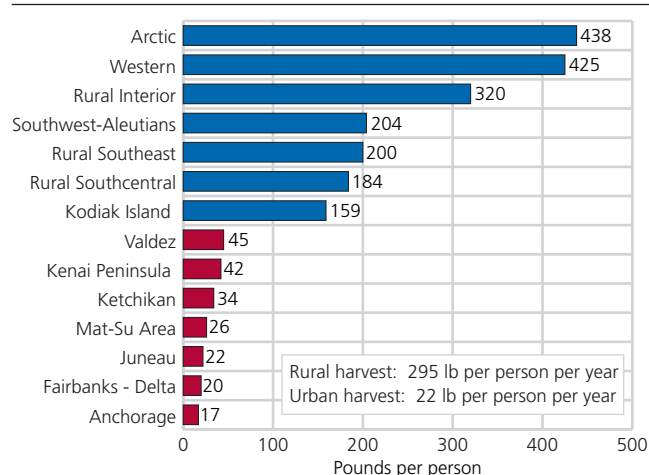


Source: Based on Fall (2014), see note 6.

such as harbor seals are harvested in many coastal communities and wales are harvested in the Arctic. Berries and other edible and medicinal wild plants make up 4 per cent of the harvest statewide, birds and eggs including migratory waterfowl and upland game birds make up 3 per cent, and shellfish such as clams, crab, and other marine invertebrates comprise 3 per cent⁹. Figure 6.5 shows the composition of harvests by region. Salmon are common in many areas, making up over 50 per cent of the harvest in Southcentral and Southwest Alaska, whereas in the Arctic households harvest more marine mammals¹⁰. In the interior, large land mammals such as moose and caribou comprise a larger percentage of the harvest than in other areas.

Harvests are typically higher in rural communities as compared to urban areas. Figure 6.6 shows urban areas in red and rural areas in blue. The harvest was lowest in Anchorage with an average of 17 pounds per person and highest in the Arctic at 438 pounds per person. Participation in harvesting wild resources is highest in Western Alaska with 70 per cent of households participating in harvesting game species and 98 per cent of households participating in fishing activities. In rural Alaska on average 60 per cent of households participate in harvesting game and 83 per cent participate in harvesting fish. In each case the number of households using wild resources is higher than those harvesting the wild resources. Over the decades of collecting harvest data the Division of Subsistence has found a general pattern emerge in that 30 per cent of households har-

Figure 6.6. **Wild food harvests in Alaska by area. 2012. Pounds usable weight per person per year**



Source: Fall (2014), see note 6.

vest 70 per cent of the resources as a community average¹¹. These households tend to have higher incomes and spend more money on subsistence related gear such as boats, snow machines, nets, rifles, and fuel. This high harvest is then shared with family and neighbors in these small rural communities.

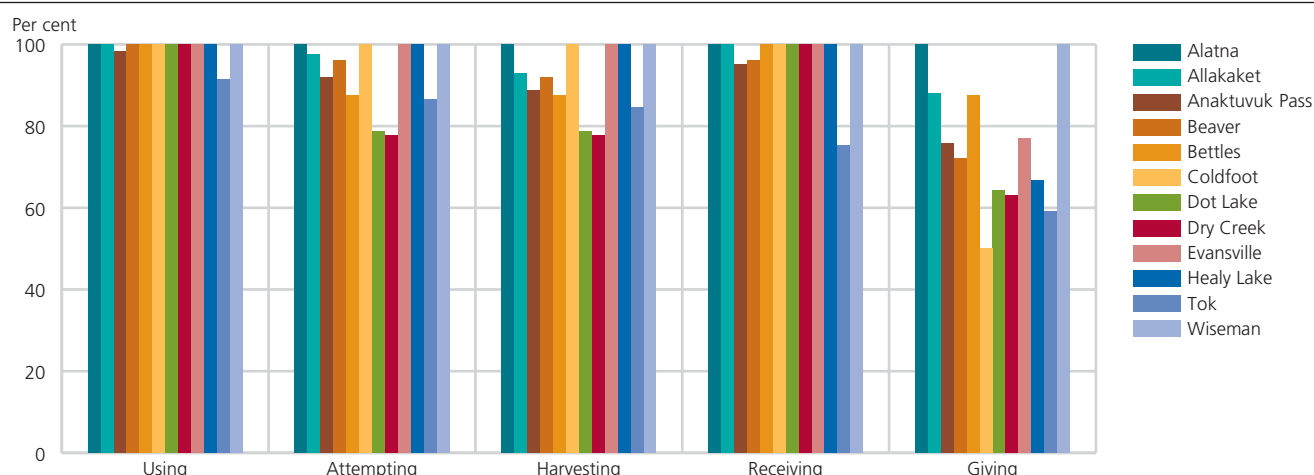
A recent study documented the harvest of wild resources in 12 communities spanning the eastern interior of Alaska, from the Arctic coastal plain to the upper Koyukuk, middle Yukon, and Tanana river watersheds. The study shows the diversity of harvest by communi-

Table 6.1. **Wild food harvests in Alaska: Nutritional and replacement values**

	Annual wild food harvest (pounds per person)	Annual wild food harvest (total pounds usable weight)	Percent of population's required:		Estimated wild food replacement value at \$4.00/pound	Estimated wild food replacement value at \$8.00/pound
			Protein (46 grams/day)	Calories (2,100 kcal/day)		
Rural areas						
Southcentral	184	1 368 571	117	16	5 474 284	10 948 568
Kodiak Island	159	2 229 342	101	14	8 917 367	17 834 734
Southeast	200	5 537 324	128	18	22 149 296	44 298 593
Southwest-Aleutian	204	3 416 176	130	18	13 664 705	27 329 409
Interior	320	3 211 194	205	29	12 844 777	25 689 554
Arctic	438	11 010 583	280	39	44 042 333	88 084 665
Western	425	10 099 562	271	38	40 398 250	80 796 500
Subtotal	295	36 872 753	189	26	147 491 012	294 982 023
Urban areas						
Ketchikan Area	34	473 626	22	3	1 894 506	3 789 011
Juneau Area	22	715 553	14	2	2 862 212	5 724 424
Mat-Su Area	26	2 448 794	17	2	9 795 176	19 590 352
Fairbanks-Delta	20	2 093 631	13	2	8 374 526	16 749 051
Kenai Peninsula	42	2 346 621	27	4	9 386 483	18 772 966
Anchorage Area	17	5 075 980	11	2	20 303 922	40 607 844
Valdez	45	185 026	29	4	740 103	1 480 206
Prudhoe Bay	22	47 761	14	2	191 044	382 089
Subtotal	22	13 386 993	14	2	53 547 972	107 095 943
Alaska Total						
Alaska Total	69	50 259 746	44	6	201 038 983	402 077 966

Source: Fall 2014.

Figure 6.7. **Per cent of households taking part in activities related to harvest of wild resources. Communities in the Eastern Interior of Alaska. 2011**



Source: Division of Subsistence, Alaska Department of Fish and Game, and Holen et al. (2012).

ties and the importance of wild foods in meeting the dietary requirements for rural residents. These communities exhibit a range of contemporary patterns of subsistence uses of wild resources. In the study year of 2011, residents of all the communities participated in subsistence hunting, fishing, and gathering. Virtually every household used wild resources: 100 per cent in 10 study communities and more than 90 per cent in the other 2. About 75 per cent or more of the households in the communities engaged in harvesting as well as in the sharing of wild foods (Figure 6.7).

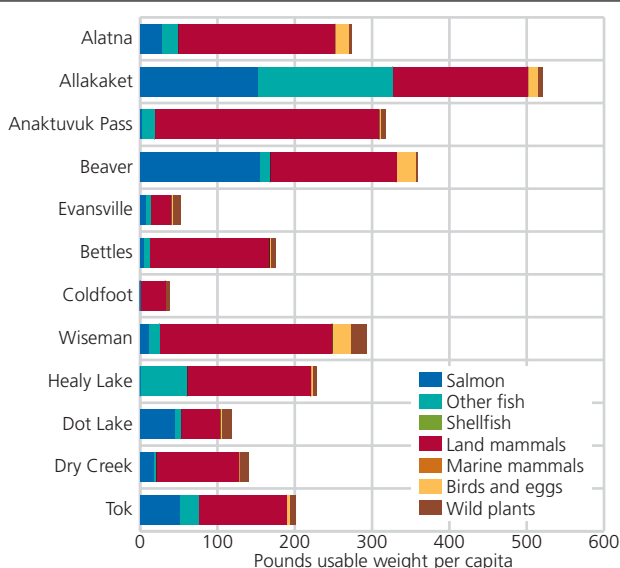
Harvests of wild foods, estimated in pounds usable weight per person, ranged from 520 lbs in Allakaket to 38 lbs in Coldfoot, and in all but 2 communities exceeding 100 lbs (Figure 6.8). These are substantial harvests: in 2008, the average American household purchased about 224 lbs of meat, fish, and poultry per person¹². In 9 of the 12 study communities, fish and

wildlife harvests contributed 50 per cent or more of this total (these comparisons exclude harvests of plants). Harvests in 10 of the 12 communities produced 50 per cent or more of the daily recommended protein requirements of 51 g/day (Figure 6.9). Four of the 5 communities with the highest per capita harvests are located off the road system (Wiseman is the exception), perhaps reflecting in part more abundant and accessible resources, more liberal regulations, and fewer alternatives for purchasing food¹³.

Cash and Subsistence Economy

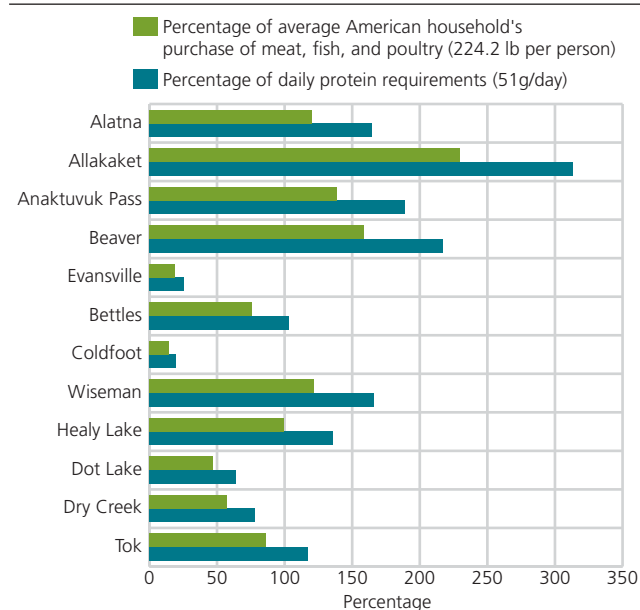
The cost of living in rural Alaska has risen significantly in recent years due to high gas prices for transportation. With few year-round ice free ports most goods must arrive in rural communities by air in winter. In the summer coastal communities receive barges loaded with fuel and supplied from ports on the West Coast of the United States. Smaller barges transport supplies up major rivers such as the Yukon and Kuskokwim as well cutting the cost of transportation. Residents must order a year's worth of groceries and other supplies to be brought in on the barge. In addition during trips to Anchorage or other urban centers rural residents stock up on supplies to be mailed back to their communities or pay freight fees on air transportation. Especially in winter, air transportation is the only reliable means to receive goods from urban centers. The cost of aviation fuel has significantly added to the cost increase for basic goods. When comparing costs in 2005, prior to the significant rise in gas prices seen in 2007 and 2008, the cost of groceries and basic necessities in the Subarctic in Alaska was 2.23 times higher than in urban Anchorage, and 2.47 times higher in Arctic communities¹⁴. To offset some of these costs Alaska Native residents receive dividends from shares held in both Alaska Native regional corporations and local village corporations. These arrangements are not universal across Alaska however. Each corporation is different in the resources it holds and payouts of dividends can reach USD 50 000 such as the one time payout by Cook Inlet Regional Corporation (CIRI) in 2000. These dividends

Figure 6.8. **Per capita harvest estimates and harvest composition of communities in the Eastern Interior of Alaska. 2011. Pounds**



Source: Division of Subsistence, Alaska Department of Fish and Game, and Holen et al. (2012).

Figure 6.9. **Comparison of share of harvest of wild foods in household consumption and protein requirements. Communities in the Eastern Interior of Alaska. Per cent. 2011**



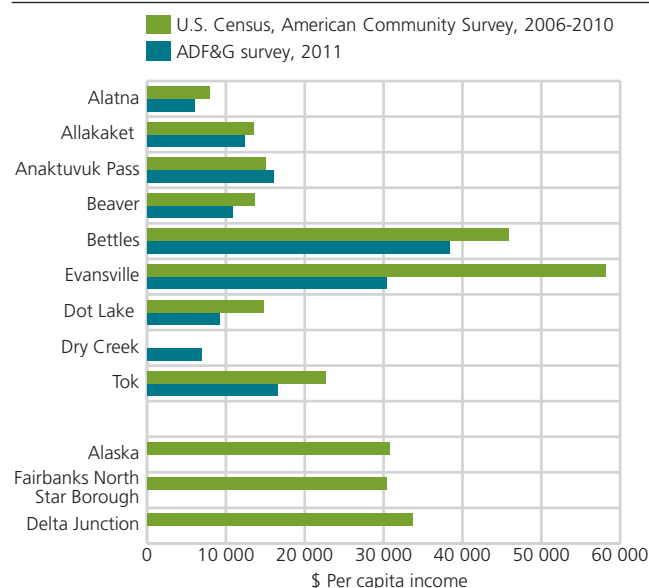
Source: Division of Subsistence, Alaska Department of Fish and Game, and Holen et al. (2012).

are not reliable income, and residents often put the money back into the subsistence economy. In Tyonek, one of the communities that received payments from CIRI in 2000 the payout led to new boats, motors, all-terrain vehicles, and investments in fish camps.

Energy costs are a main concern in rural Alaska. High prices for fuel for boats and all-terrain vehicles are limiting the ability of residents to get out on the land to engage in subsistence across rural Alaska. Heating oil in many communities replaced wood burning stoves. Today there is an effort to move towards using wood both in efficient home wood burning stoves as well as large scale biomass boilers being used in public buildings in rural Alaska. Typically during cold winters residents will use several barrels of heating oil throughout the winter. Many homes receive electricity from diesel powered generators. In the study mentioned above in the eastern interior of Alaska 7 out of 9 study communities had average incomes lower than the state-wide per capita average of USD 30 726 per year and lower than the larger interior Alaska communities of Fairbanks (USD 30 395) and Delta Junction (USD 33 716) in 2012 (Figure 6. 12)¹⁵. Many jobs are short term summer employment such as working on fire crews, commercial fishing, construction crews repairing roads or airports, and short term work through grant funded projects in communities. Local governments such as tribal and village organizations provide many of the short term jobs.

Subsistence is therefore a vital part of the economy in rural Alaska communities in maintaining the ability of residents to continue living in areas where jobs are harder to come by and costs of living are higher. Subsistence holds a special place in the maintenance of

Figure 6.10. **Average income per capita in studied rural communities in Alaska**



¹ Allakaket includes ² Census Designated Places (CDPs): Allakaket City and New Allakaket. American Community Survey (ACS) data are only available for Dot Lake Village CDP and not for Dot Lake CDP; ADF&G survey data include both CDPs. No ACS data are available for Dry Creek. Due to the small community size and related privacy concerns, no income data are presented for Coldfoot, Wiseman, and Healy Lake.

Source: Division of Subsistence, Alaska Department of Fish and Game.

cultural, as well as nutritional needs of rural Alaskan residents. A 2012 summary of wild food production in Alaska estimated the cost of replacing the wild food harvest of rural communities at USD 402 million at a replacement value of USD 8 per pound¹⁶. Residents in these communities are eating a higher percentage of protein in their diet than the national average due to their harvest of wild foods that averages from 159 lbs per capita edible weight found on Kodiak Island to a high of 438 lbs per capita in the Arctic.

But subsistence for rural Alaska residents is not just an issue of economics. Subsistence in Alaska today is an activity that enables residents to continue a practice that has a significant cultural meaning. It is an activity that ties one to the land, and is shared by the family and



Cleaning sockeye salmon on the shores of Sixmile Lake, Bristol Bay, Alaska. Photo: Davin Holen.



Alaska residents participate in the Kasilof River personal use dip net fishery, Cook Inlet, Alaska. Photo: Davin Holen.

community. Culture in Alaska is not static and residents have adapted in order to survive, and even thrive in a modern world. Many residents of rural communities respond that they live two lives, their traditional way of life and the western life. Subsistence is a large part of life, both offsetting the high cost of imported groceries and other goods, but more importantly continuing traditions that are culturally meaningful. Alaska is also undergoing a change which allows for residents to obtain jobs nearby their natal communities, while working in fields that have higher incomes. However, residents see this as a trade-off and long work weeks lead to less time for subsistence, although incomes provide the necessary means to pay for the equipment which today allows for the traditional subsistence economy to continue into the future¹⁷.

Living, working and harvesting in Northern Canada

Mary Stapleton, *Arctic Institute of North America*

The Arctic has experienced significant demographic, social, economic and political change in recent decades. These changes continue to influence the way the economy of northern Canada functions, with remote and diverse communities.

Arctic Canada is characterized by small populations, with a large proportion of indigenous residents (Table 6.2). This affects the overall economy and makes it different from the more urban and agricultural south. Nearly two-thirds of northern communities are located along coastlines. The majority of the communities have less than 500 residents. Only the three territorial capitals, Whitehorse, Yellowknife and Iqaluit, have populations exceeding 5 000. Just over half of northern residents are indigenous and represent diverse cultural and language groups. The majority of small communities are predominantly indigenous, and traditional ways of life remain important in daily life. The non-indigenous population grows because of resource development and increase in government and public administration.

In-migration has occurred predominately in the three main urban centres¹.

The Canada National Household Survey of 2011 shows that 1 400 685 people in Canada had an indigenous identity², including First Nations (North American Indians), Inuit, and Métis. The indigenous population is young and growing rapidly. The average age of northern residents is younger than for Canada as a whole, and more than 50 per cent of residents in Nunavut are less than 15 years old. For all of Canada, indigenous peoples accounted for 4.3 per cent of the population in the 2011 National Household Survey, up from 2.8 per cent in the 1996 Census. Population projections estimate that the indigenous population will continue this upward trend, though declines in fertility over time may occur³.

Indigenous and Northern Affairs

The Minister of Indigenous and Northern Affairs is responsible for overseeing and administering the Indian Act and other legislation dealing with “Indians and lands reserved for the Indians”. The Minister is also responsible for supervising federal involvement in the territorial governments of the Yukon, Northwest Territories (NWT) and Nunavut. An important issue has been charges of abuse and other ill effects for Aboriginal children from the Indian residential school legacy. The Commission on Truth and Reconciliation was part of a holistic and comprehensive response to the charges. The Ministry of Indigenous and Northern Affairs (now Indigenous Affairs) has indicated it will follow up the recommendations of the Commission. Actions based on their report will affect cooperation and co-management at all levels in the Canadian north⁴.

Labour market and social conditions

Between 1996 and 2006, the employment rate for indigenous individuals increased by 10.2 percentage points, from 52.8 per cent to 63 per cent. Unemployment rates were highest in the Yukon at 21.3 per cent and the NWT at 17.9 per cent. In 2005, median individual total income for the indigenous population was CAD 16 752, almost CAD 10 000 lower than for the non-indigenous (CAD 25 955). Across provinces and territories, median income for Indigenous people ranged from a high of CAD 20 690 in the Yukon to a low of CAD 13 843 in Saskatchewan. The income gap between the indigenous and non-indigenous populations remained fairly consistent over the past decade at about CAD 9 000. The gap in median income between genders is less in the indigenous population than in the non-indigenous population. The number of persons per room in private dwellings has decreased⁵.

Economic development opportunities such as resource extraction are often highlighted as an opportunity to create employment for Northerners and improve socioeconomic conditions. This may not always be the case in practice if Northerners are not well-positioned to

Table 6.2. Canadian indigenous identity population as percentage of population. 2011

Territory	Territorial Population	Indigenous Identity Population	Per cent
Yukon	35 400	7 705	23.1
Northwest Territories	43 500	21 160	51.9
Nunavut	34 200	27 360	86.3

Source: Statistics Canada, National Household Survey, 2011.
Publication 99-011x.

Table 6.3. Population characteristics of Arctic Canada. 2011

Indicator	Canada	Yukon	NWT	Nunavut
Population density (per km ²)	3.33	0.06	0.03	0.01
Percentage of population that is urban ¹	79.6	58.7	58.3	32.4
Percentage of population that is Aboriginal ²	3.4	22.9	50.5	85.2

Source: Statistics Canada, 2001.

take advantage of these opportunities. There are socio-economic issues (e.g. intergenerational trauma, mental health, addictions, etc.) and inequalities between Aboriginal peoples and other Northerners, between people living in more isolated, remote communities and those in the larger hubs of the North, and between people in northern and southern Canada. These challenges can impact educational outcomes and make it difficult to secure and maintain employment⁶, like in the minerals sector characterized by high wages⁷. Hence, the employment benefits of resource development in the North have been unevenly distributed in favor of those with the requisite skills. The education and skill levels of many Aboriginal Northerners can limit both their employment and advancement prospects in the industry⁸. Resource development companies continue to hire significant numbers of workers from southern Canada while many Aboriginal Northerners remain unemployed or under-employed.

Economic development-related strategies are in place or under development in many regions of the Canadian North⁹. Indigenous communities often lack access to human capital and sustained investment. Governance is a key aspect of economic development. Balancing the varying, and at times conflicting interests, needs and perspectives of multiple stakeholders can be challenging in terms of supporting and promoting economic development¹⁰.

Health and well-being

The health status of northern Canadians is lower than the national average, as measured by a number of health indicators. All three territories report lower life expectancy and higher infant mortality rates than national averages, and these disparities are particularly pronounced in Nunavut. The health status of Aboriginal northerners is, for many indicators, significantly below that of non-indigenous northern residents and national average. There are higher rates of mortality from suicide, lung cancer, drowning and motor vehicle acci-

Box 6.2. Indigenous (aboriginal) peoples in Canada

First Nations: Mainly Indian peoples, also called North American Indians

Inuit: Peoples who speak languages related to Inuktitut in Canada

Métis: Peoples of mixed ancestry

Native: An older term which covered all indigenous peoples in Canada

Indigenous: Current comprehensive term for all Canada's indigenous peoples

dents¹¹. Tuberculosis breaks out from time to time¹² and obesity, diabetes, and fetal alcohol syndrome are health issues to be addressed. Results from the 2007–2008 International Polar Year Inuit Health Survey indicate that Nunavut has the highest documented rate of food insecurity for any indigenous population living in a developed country.

Dimensions of poverty including human capabilities, social exclusion, and economic wellbeing in Nunavut were investigated in a study in 2012 finding that poverty was pervasive; that there was limited personal income in many homes, especially those with young children; that many communities and families were breaking down; and that many Nunavummiut lack the education and skills required to participate in the wage economy¹³.

Infrastructure

Shipping and land travel in Northern Canada are dependent on air and water shipping rather than roads and railways. There is no developed deep water port on the Arctic Coastline. A bridge across the Mackenzie River was completed in 2013. The one kilometre long Deh Cho Bridge replaces ferry service and a winter ice crossing. It is the first year-round road link between NWT's North Slave region communities, including the capital Yellowknife, and the rest of the country.

Land travel is commonly on ice roads and frozen rivers in winter. The technology of making ice roads for heavy truck traffic has improved access to mines and other developments. Warm winters and early break-up of ice present a problem to this form of transportation. Arctic cruises and limited shipping are growing, while search and rescue capabilities struggle to keep up¹⁴. The Arctic Council signed a groundbreaking search and rescue treaty to pool international resources in case of a maritime disaster. There is a general lack of infrastructure all over the north.

Securing affordable and reliable energy that has limited environmental impact is also a challenge. Outside the larger communities financial services are limited and not always adequate to support businesses. This results in a high cost of living and inhibits business and competition.

Table 6.4. **Selected social and economic indicators for Canada and its northern territories**

Indicator	Canada	Yukon	NWT	Nunavut
High social support	-	78.0	74.5	58.1
Sense of belonging to local community (very strong or somewhat strong)	62.3	69.3	72.3	80.9
Proportion of census families that are lone female parent families	15.7	19.8	21.0	25.7
Personal average income (in dollars), 2000	29 769	31 917	35 012	26 924
Government transfer income as proportion of total, 2000	11.6	8.6	7.3	12.9
Percentage of long-term unemployed (labour force aged 15 and over)	3.7	6.0	4.8	11.2
Percentage of population aged 25–29 that are high school graduates	85.3	85.4	77.5	64.7

Source: Statistics Canada, 2001, 2002.

Resource industries in Northern Canada

Many Northerners expect that resource development will provide economic benefits to their regions, that development will proceed in a sustainable manner, and that negative environmental and social consequences be minimized¹⁵. The dynamics of co-management and other resource governance regimes is decisive for the impacts. The strategies for adequately incorporating traditional knowledge and climate change considerations into assessment and regulation of large-scale resource development projects needs to be addressed¹⁶.

Climate change impacts, including warming, thawing permafrost and more frequent and extreme weather events, have implications for all stages of resource development projects, including planning, operation and closure/reclamation. The identification and reduction of negative health, social, cultural and environmental impacts of resource development is also important and can be challenging given the impacts of a rapidly changing climate and the dependence of northerners on this environment for subsistence development¹⁷.

The Canadian High Arctic Research Station Act, which came into force in 2015, established Polar Knowledge Canada, a new federal research organization that combines the mandate and functions of the Canadian Polar Commission and the Canadian High Arctic Research Station program at Indigenous and Northern Affairs Canada¹⁸.

Most people in the north have already been impacted by the mineral and petroleum industries. In 2009, the U.S. Geological Survey estimated that the Arctic could hold as much as 160 billion barrels of crude oil. In 2014, in accordance with the NWT Devolution Agreement and the NWT Devolution Act, the Government of Canada transferred administration and control of public lands, resources and rights to waters in the NWT to the Commissioner of the NWT. Administration of oil and gas rights in Nunavut and the Arctic Offshore remain under federal authority and the Minister of Indigenous and Northern Affairs. The National Energy Board regulates operational aspects of oil and gas activities in the NWT, Nunavut and offshore northern Canada.

There has been oil and gas activity in the NWT for decades, particularly in the Central Mackenzie Valley

around Norman Wells. The Department of Industry, Tourism and Investment is responsible for the administration of onshore oil and gas interests and its Petroleum Resources Division is primarily responsible for granting petroleum authorizations for this area¹⁹.

The federal government regulates and administers oil and gas development in Nunavut and the surrounding coastal waters. Nunavut Tunngavik Inc. (NTI) holds (on behalf of the Inuit) the title to 38 000 square kilometres of land with mineral rights in Nunavut, including rights to oil and gas. These rights guarantee that NTI will participate in the minerals, oil and gas industries when the right conditions exist²⁰.

Mining is the NWT's original industry. New mining regulations for Nunavut and specified areas of the NWT were introduced to coincide with the devolution of lands and resources management to the NWT in 2014. The NWT Mineral Development Strategy dated 2013 is in place²¹. The Gahcho Kué project at Kennady Lake in the NWT is the largest new diamond mine under development globally, producing high grade diamonds.

Nunavut has mining potential with significant resources of iron, gold, copper, uranium, and diamonds. There is wide interest in developing mining in Nunavut, and the regulatory framework is evolving. Baffinland Iron Mines Corporation project at Mary River extracts 18 million tonnes of iron ore per year; it is projected to be the fifth largest iron mine in the world. This and other mining projects are still under development. The Yukon Mineral Exploration Program is designed to promote and enhance mineral prospecting and exploration activities in Yukon.

Tourism

Tourism is important to all Canada's northern territories. The tourism sector is an important employer of both indigenous and non-indigenous northerners. Key tourist activities in the Arctic are heritage rivers, museums, arts and crafts, aurora viewing, hiking and canoeing. Tourism is the Yukon's second-largest industry. It contributes over CAD 100 million to Yukon's GDP and generates jobs for approximately 25 per cent of the territory's residents. The 2105 Tourism Plan, the 2013–2016 Tourism Marketing Strategy and the 2013–2016 Product Development Strategy, has as its goal to increase tourism.

Box 6.3. Social, Legislative and Land Use Developments

Participatory approaches to environmental management have become increasingly expressed in Canadian law. Policy change is related to land claims and general political movement towards greater self-government in the north. In a unanimous decision in 2014, *Tsilhqot'in Nation v. British Columbia*, 2014 SCC 44, the Supreme Court of Canada allowed the appeal by the Tsilhqot'in First Nation and held that it has Aboriginal title, meaning that this First Nation has exclusive control over decisions affecting the land. Aboriginal titled land by a First Nation must be used for collective benefit and for the enjoyment of future generations. This is a landmark decision which expands control of First Nations over titled land. Increasing political power of northern populations in general, and indigenous groups in particular, have led to modification of the environmental decision-making process. Local values, priorities, and traditional environmental knowledge have become more influential in environmental research, policy and management. Indigenous peoples have the right to be consulted and to be directly involved in decisions about their lands and activities. Industry is required to create new cooperative mechanisms to include all stakeholders. Traditional environmental knowledge has become important as a means of realizing these modified processes.

The Government of Canada has made the devolution of northern governance a pillar of Canada's Northern Strategy with the goal of providing northerners with more control over their own economic and political destiny. Yukon was the first territory to take over land and resource management responsibilities in 2003. In 2014, the NWT became the second territory to take over land and resources responsibilities, as the final major step in the territory's devolution process. A revenue sharing plan with the federal government is aimed at ensuring NWT residents and indigenous groups directly benefit from the development of the region's resource potential. NWT land use planning will continue to be controlled by regional planning boards. The large Mackenzie Valley Gas Pipeline project, which is on hold in 2015, will continue to go through review by the Mackenzie Valley Land and Water Board (MVLWB).

Total tourism revenue in the NWT for 2011 was CAD 98.2 million. NWT's strategic plan targets camping and touring, outdoor adventure, aurora viewing and business travel as key areas for growth. In Nunavut, real GDP calculated from the Nunavut Bureau of statistics sets the value of 2011 tourism related industries as CAD 41.6 million. Revenue has increased an average of 2.2 per cent per year.

Nunavut's strategic plan, *Tunngasajji: A Tourism Strategy for Nunavummiut*, calls for decentralization and development of tourist activities throughout the territory to make it more accessible. Hunting and fishing tourism activities have declined. Polar bear, muskox, caribou and sheep hunting and fishing have been replaced by lower-impact activities. This has meant a loss of employment to many indigenous guide outfitting companies. The tourism industry in both Nunavik and Nunatsiavut (Inuit areas in Newfoundland and

Labrador) was highlighted as a notable example of an industry which has benefited from bottom-up development²².

Marine Mammals

Arctic marine mammals are widely considered to be icons of climate change. In 2014, the "Arctic Biodiversity Assessment - Status and Trends" was launched by the Arctic Council Working Group on Conservation of Arctic Flora and Fauna (CAFF) to synthesize and assess the status and trends of biological diversity in the Arctic. The report updates the status and trends of all stocks of Arctic marine mammals. In total, 35 marine mammal species that inhabit or seasonally use Arctic waters were reviewed. The hooded seal, the polar bear, and the narwhal appear to be the three most sensitive Arctic marine mammal species, primarily due to reliance on sea ice and specialized feeding. The least sensitive species were the ringed seal and bearded seal, primarily due to large circumpolar distributions, large population sizes, and flexible habitat requirements²³.

Sealing in Canada takes place in Inuit regions (Nunangak). Sealing in Nunavut generates between CAD 4 million to CAD 6 million of food value each year. Before the European Union seal ban, incomes from seal pelts could reach up to CAD 1 million annually. Those incomes allowed Inuit to buy the equipment and gas necessary to continue to hunt, thus provide them with a crucial source of food. Sealing can represent from 25 to 35 per cent of sealers' total income; it is a very significant economic contributor to communities with limited economic opportunities. The sale of sealskins and other furs has the potential to be an important source of income for hunters and trappers, and helps to ensure continued access to a bountiful renewable resource as well as contributing to food security in the communities. Seal skins are processed as part of the complete use of the animal, which is often a source of daily food.

Seals are not just used for their fur. Seal oil is higher in omega-3 oils than fish oils and is sold in capsule form in Europe, Asia and Canada. The European Food Safety Authority, in a 2007 report, concluded that the approved methods used to harvest seals in Canada are humane. The Canadian seal harvest is sustainable. The Atlantic harp seal population is healthy and abundant; it is currently estimated at 6.9 million animals, and has more than tripled its size since the 1970s. The World Trade Organization ruled in 2013 that the European Union ban on seal product trade was valid. Canada continues to seek markets for seal products, which would result in economic benefits for northern coastal peoples.

Fishing

Fishing remains an important activity for northern people, both for subsistence and for recreation. Many species of fish are significant to both the diets and cultures of Canadian First Nations, including Lake Trout, Char, Inconnu (Conny), White Fish, Pike, Burbot, and

Table 6.5. **Fur harvest in Canada. Number and value of pelts produced. 2009**

Type of pelts	Yukon		Northwest Territories		Nunavut	
	Number of pelts	Value of pelts CAD	Number of pelts	Value of pelts CAD	Number of pelts	Value of pelts CAD
Black or brown bear	0	0	4	271	0	0
Grizzly bear	0	0	8	14 615	0	0
White (polar) bear	0	0	0	0	183	599 066
Beaver	125	2 375	1 037	14 978	0	0
Coyote or prairie wolf	22	792	3	52	0	0
Ermine	98	392	352	1 270	0	0
Fisher	1	49	18	905	0	0
Fox ¹	38	873	519	13 720	681	20 448
Lynx	450	50 850	862	100 355	0	0
Marten	993	68 517	8 740	556 808	0	0
Mink	15	210	455	5 653	0	0
Muskrat	70	630	15 006	83 375	0	0
Otter	4	180	17	576	0	0
Squirrel	150	210	151	1 952	3 352	169 271
Wolf	221	43 095	145	131	0	0
Wolverine	137	31 373	69	10 967	228	65 368
Other pelts	0	0	103	25 293	49	11 954
Total	2 324	199 546	27 489	830 921	4 493	866 107

¹ Fox comprises Blue Fox, Cross Fox, Red Fox, Silver and Black Fox and White (Arctic) Fox.

Source: Statistics Canada; Table 003-0013.

Salmon. The fisheries of Nunatsiavut, Nunavut, Yukon, and NWT are governed by their respective land claims. Community consultations are a tool to incorporate community and traditional knowledge, as well as the best available science. Land claims agreements protect indigenous fishing rights, giving special attention to food security and access to traditional foods.

In 1982, the salmon run in the Yukon River peaked at around 300 000 fish. By 2014, a run of 60 000 and 120 000 fish was predicted. The Yukon Salmon Subcommittee recommended in 2014 a total ban on fishing of the Chinook salmon in the Yukon River, including the Yukon First Nations' harvest. Some First Nations have set aside their aboriginal rights by voluntary compliance with the Department of Fisheries and Oceans' ban. Salmon fishing has been a way of life for many First Nations. Going to the fish camp, learning about fishing and cutting and drying the fish have always occupied a large part of every summer in the salmon communities. There are some signs that a recovery may be possible, which would restore an important subsistence activity to First Nations.

Hunting and Trapping

The NWT is one of the few remaining regions in the world with herds of wild migratory caribou, muskoxen, healthy populations of top predators, and rich northern biodiversity. Wildlife is one of the main links between people and the environment. Hunters and Trappers Organizations and Renewable Resource Councils have been the traditional associations which provide both supplies and information within northern communities.

According to NWT Labour Force Surveys, about 40 per cent of NWT people continue to fish and hunt (data from 1998, 2003, 2008, and 2013). This has changed little since the first survey in 1983. With the new Wildlife Act, indigenous hunters no longer need a license to exercise Aboriginal or treaty rights, and this indicator can no longer be tracked in statistical surveys. A recent (2009) hunter survey showed that residents of the NWT are hunting less caribou, while the harvested volume of other animals, e.g., grouse, ptarmigan, and hare, seems to be cyclical. The percentage of people in the territory who rely on country foods remained stable in small communities between 1999 and 2009, with approximately 50 per cent of families reliant on country foods for 75 per cent or more of their meat and fish. The rate of reliance decreased slightly in large (from approximately 10 per cent to 5 per cent) and medium (from approximately 25 per cent to 15 per cent) sized communities²⁴.

Resident and non-resident outfitted (professionally guided) hunting has decreased since the early 1990s, which is directly linked to the decline and management of caribou herds. Polar bears in Nunavut are hunted for food, income, and sport hunting. Twenty per cent of the polar bear quota is devoted to sports hunting, where maximizing profit is the goal. For subsistence hunting there is a focus on longer-term goals to maintain social, human-environment and human-polar bear relations²⁵. Commercial hunting requires a special Commercial Hunting License for sale of meat to markets in the NWT and elsewhere in Canada. This type of hunting occurs only on Banks Island for muskoxen, and has been permitted for other species only occasionally in the past.

Box 6.4. Caribou

Northern people and caribou (*Rangifer*) are so inter-related that, without caribou, the Arctic populations might not exist at all¹. Indigenous people recognize the central role of caribou in tundra and taiga ecology. The inter-connection of caribou with the cultures has parallels with the role of salmon on Canada's Pacific Coast. A measure of their importance is the annual harvest, which for example in Nunavut (1996 to 2001) averaged 24 522 caribou². In Nunangak, NWT, and Yukon, people from almost all communities hunt the migratory herds. A sharp decline among caribou herds implies difficult choices for First Nations and Inuit who rely on the animals for subsistence. Local and traditional knowledge has indicated that caribou go through periods of abundance and scarcity every 40-60 years. On average, northern caribou numbers reached lows around 1975 and a peak around 1995, when a decline began³.

Relatively objective population estimates have only been employed since the late 1960s and early 1970s. These estimates have shown one single "cycle" over the last 40 years. This cycle is somewhat synchronous around the Arctic, although there is a lot of individual herd variation. The precision and accuracy of measured trends are variable. Of 23 herds monitored by the CircumArctic Rangifer Monitoring and Assessment (CARMA), established in 2004, at least 19 remain at low numbers after severe declines of 70 per cent to 97 per cent, or have continued to decline, while only four herds are increasing or have remained stable at high numbers⁴.

Since 1970, for the 23 circum-Arctic herds whose size is tracked through aerial surveys, the numbers of caribou and wild reindeer have declined from a recorded peak of about 5.5 million to 2.7 million (CARMA, 2011). Population estimates indicate that the decline may be slowing, and that some herds, particularly in western Canada, may be recovering. These changes may be the result of co-management boards taking strong steps to reduce harvest levels. Increased development, more efficient harvesting methods and regional climate trends. At the same time, herds that have not declined since estimates began have started to decline.

Caribou adapt to environmental variability such as severe winters or increasing predation levels by changing their migration patterns. Caribou abundance is cyclic⁵. Overall, the cycles may be driven by climate interacting with predation, harvest, disease, parasite, development, pollution, forest fires and climate change. Winter conditions and forage availability influence caribou condition, which determines birth rates and calf survival. Climate warming and expansion of industrial developments affect vegetation. The increasing population, a shift to wage-earning, and changing technologies for hunting (snowmobiles, ATVs, aircraft, winter roads, and rapid communications) have likely altered hunting effort and made finding and harvesting caribou more efficient⁶. Under Canada's constitution and land claims settlement acts, indigenous hunting rights are protected except in cases of need for conservation. Previously indigenous hunters harvested unlimited numbers of caribou, but some are now choosing to adjust their hunting patterns to protect the herds.

The Nunavut government issued a harvesting ban in 2014 for all of Baffin Island but not in western regions. The chair of the Kugluktuk Hunters and Trappers Organization agreed in 2015 to a quota on hunting caribou in the region, and consultations with residents are ongoing. Surveys done in June and July 2015 show a decline from 32 000 caribou in 2012 to between 16 000 and 22 000 in 2015.

NWT biologist Jan Adamazewski (2014) has suggested that hunting, during which 60 per cent of the harvest consists of cows, is under-reported and may contribute to their plunging numbers. He has also correlated the numbers of wolf pups with the decline of Bathurst caribou.

In 2010, the Wek'èezhii Renewable Resources Board recommended sharply curtailing aboriginal harvesting and halting resident and commercial harvesting after extensive public hearings on a joint management proposal from the Tlicho Government and the Government of the NWT (WRRB, 2010). There was also oil and gas exploration on winter ranges of Bluenose East and Bluenose West herds.⁷ A controversy stems from fears that mineral exploration and development activity have trumped protecting caribou habitat. The co-management boards established in 2007 restrict aboriginal harvesting of the Bluenose-West. (Cape Bathurst Herd) The Wildlife Management Advisory Council (NWT) recommended an end to all harvesting, with non-aboriginal limitations implemented in 2006 and aboriginal limitations implemented in 2007. Preliminary estimates in 2009 indicate that the herd may have stabilized. Two herds that have recently shown improvement are the Porcupine Herd and the 40 Mile herd.

The Newfoundland and Labrador government announced a five-year ban on hunting caribou from the George River herd in Labrador in 2013. The ban applies to all hunters, including indigenous peoples. The Métis and the Inuit had agreed to stop hunting George River caribou for two years, but the Innu continue to maintain that their aboriginal rights outrank the province's hunting laws.

¹ (<http://www.registrelep-sararegistry.gc.ca/>), (Russell 2015).

² (Priest and Usher, 2004)

³ An interactive map of Rangifer herds is available at <http://carma.caff.is>.

⁴ (Russell and Gunn, 2013, unpubl. updates).

⁵ (Morneau and Payette, 2000; Gunn, 2003; Zalatan et al., 2006)

⁶ (Gunn, A., Russell, D. and Eamer, J., 2011. (Northern caribou population trends in Canada. Canadian Biodiversity: Ecosystem Status and Trends 2010, Technical Thematic Report No. 10. Canadian Councils of Resource Ministers. Ottawa) Some indigenous elders state that caribou have been displaced by such a human presence. Herd-specific assessments can be found at <http://www.biodivcanada.ca/default.asp?lang=En&n=137E1147-1>. (Gunn, A., Russell, D. and Eamer, J. 2011. (Northern caribou population trends in Canada. Canadian Biodiversity: Ecosystem Status and Trends 2010, Technical Thematic Report No. 10. Canadian Councils of Resource Ministers. Ottawa, ON. iv + 71 p.)

⁷ (<http://carma.caff.is/index.php/carma-interactive-map/status-and-trends>)



(<http://www.registrelep-sararegistry.gc.ca/>)

Box 6.5. Cultural Industry, media, art and crafts

Community radio and the Canadian Broadcasting Corporation's (CBC) Northern Service short-wave radio had been an integral part of northern life since the mid-1950s. Radio continues to be the most common source of community information all over the north. Personal communication through radio offers social connectivity. Isuma.tv, an international website intended to develop Inuit audiovisual production from all peoples of the world, has also experienced unprecedented growth.

Cultural industries generate employment and income and contribute to tourism. The NWT Arts Program promotes arts and fine crafts to local, national and international markets. Program registration is free to all NWT artists including those in traditional and contemporary visual arts and fine crafts, performing arts, literary arts and film/new media, see NWTArts.com. The government of the NWT also has a number of sector-specific strategies, including Tourism 2015 and NWT Arts Strategy.

Indigenous cultures have distinctive languages, traditions, beliefs, music, art, handicrafts, foods, clothing, implements, and stories. These ancient manifestations of culture are dynamic and reflect both the past and the present. The Government of Canada announced funding in 2015 to promote Inuit artists in national art galleries and museums, as well as in emerging international markets. The 2011 Yukon Visual Arts and Crafts Strategic Plan looks forward five years towards a vision where more wealth is being generated and Yukon's cultural landscape is further enriched by works produced by Yukon visual arts and craft creators.

Perhaps the most internationally recognized form of Inuit visual art is carving in stone, ivory, antler and bone. These carvings range in size from intricate, tiny works to sculptures, of mythical figures, marine mammals, arctic birds, hunters, mothers and children, and polar bears. Some of these highly stylistic masterworks are expensive to acquire. Inuit carving is an ancient art form that often achieves modern results of tremendous value. The Arctic Cooperative community stores and others try to ensure that artists receive financial reward for their efforts. In most areas there is excellent beadwork and bone, stone, talon, claw, ivory and metal jewellery, and distinctive Inuit prints are made in many parts of Nunavut.

Wildlife trapping is governed by provincial/territorial and municipal regulations which incorporate rules on legal requirements, permitted species and safe use of trapping devices. These regulations may vary by jurisdiction in recognition of regional differences but all designed to ensure the responsible trapping of wildlife. Trapping is a way of life with strong social and cultural traditions that pre-date European contact²⁶.

In the NWT, Local Wildlife Committees provide financial assistance to organizations recognized by the Minister of Environment and Natural Resources as representing the interests of hunters and trappers within communities. The Yukon Trappers Association has

been in operation since 1974. Article 5 of the Nunavut Land Claim Agreement identifies responsibilities and authority of designated wildlife organizations of which the Hunters and Trappers Organizations and Regional Wildlife Organizations are the main stakeholders²⁷.

NWT has introduced the Take a Kid Trapping program. It is designed to introduce youth to the traditional life-skills practices of hunting, trapping, fishing and outdoor survival. The Program was developed in 2002 out of concern that the average age of a trapper/harvester was 60; it was believed that the survival of traditional harvesting practices would be threatened if youth were not encouraged to participate²⁸.

The economic value of trapping in the Yukon is significant. It is an important winter revenue source in many smaller communities, providing income at a time of year when unemployment is high. Over the past two decades, the Yukon's fur harvest has fluctuated in value between CAD 250 000 to over CAD 1.5 million annually, with economic spin-offs worth two to three times that amount²⁹.

In Nunavut, trapping is part of the traditional way of life. The Government of Nunavut introduced revised wildlife regulations in 2015. It has also established a subsidy on pelts, in recognition of the importance of hunting and trapping to Inuit culture and to the health and socio-economic well-being of Nunavummiut. The price of hunting supplies such as gas, snowmobiles, traps, and rifles has increased while world markets are just recovering from a long decline.

The Minister of the Environment stated, "This decision clearly demonstrates the government of Nunavut's recognition of the importance of hunting and trapping to Inuit culture and to the health and socio-economic well-being of Nunavummiut. The sale of sealskins and other furs is an important source of income for our hunters and trappers, and helps to ensure continued access to a bountiful renewable resource as well as contributing to food security in our communities."³⁰

The Social Economy – Northern mixed economic activity

The social economy refers to the community voluntary or non-profit sector outside both the government (public) and private for-profit sectors. In addition, the social economy of the North also embraces many of the traditional economic activities of indigenous societies. Canada's northern economy continues to be characterized as having two economic sectors – subsistence, and the wage or cash economy. There are many cross-overs in which families and communities participate in both.

Government and industry supported programs form an interrelated relationship between the "formal" and the "informal" economies of indigenous communities³¹.



Despite the physical, economic and administrative challenges to health in the North, the deterioration of cultural ties to land-based and subsistence activities among indigenous people is the most serious cause of decline in well-being within circumpolar regions.

The loss of connection to the land through changes in ways of life, loss of language and dominance of non-indigenous education systems are impacting health and well-being in various and long-lasting ways. Hunting and fishing help connect people to the environment. These activities provide high quality food, which is linked to better human health in northern societies.

Subsistence living and country food

The most common country foods in the NWT are fresh-water fish, mammals including caribou and moose, hare, and birds, in particular duck, geese, grouse and ptarmigan. Inuit and Inuvialuit country foods include marine mammals such as seal, narwhal, walrus, whale, fish, and caribou. Berries are abundant and used in summer and to prepare meat for winter. Country foods are an essential part of the health of indigenous peoples³².

Dependence on game as food source leaves communities vulnerable to fluctuations in wildlife populations. The climate has unpredictable effects on the wilderness travel conditions faced by hunters and fishers, and calls upon the resilience of the peoples.

Subsistence and food security in the Canadian north

David Natcher, University of Saskatchewan

In northern Canada, a large body of research confirms that access to wildlife resources can reduce conditions of food insecurity and health related illness among Aboriginal peoples. Yet the procurement of wildfoods depends on the ability of Aboriginal households to overcome a range of obstacles that impede such access. Not all Aboriginal have access to wildfoods what in some cases has contributed to growing concerns about the declining health and social well-being of Aboriginal peoples in northern Canada. As noted by Olivier De Schutter, the United Nation's Special Rapporteur on the Right to Food: "Aboriginal peoples in Canada (who comprise over three percent of the population) are disproportionately vulnerable to food insecurity, diet-related illness, and lack of access to land and traditional foods"¹.

In this report, as well as in subsequent government sponsored research publications, the disproportionate rates of food insecurity among Canada's northern Aboriginal population are profound². Some of the more stark findings include: 54.2 per cent of Aboriginal households in Canada are considered food insecure³. The food insecurity rate in Nunavut is 45.2 per cent. As much as 90 per cent of Inuit children regularly experience conditions of hunger, 76 per cent missed meals, and 60 per cent often go an entire day without eating⁴.



Photo: Nenets family in a nomadic reindeer herders' camp, Cooperative 'Voskhod', village Oma, Nenets Autonomous Okrug. Photo: Yasavey

Households without an active hunter or a substantial income earner are particularly vulnerable to food insecurity⁵.

While the reasons for the high rates of food insecurity are complex, and defy simplistic causation, a number of contributing factors have been identified. For example, the cost of wildlife harvesting, including the purchase of small (guns, nets, ammunition) and large (boats, outboards, skidders) capital equipment, is for many Aboriginal households a formidable constraint⁶. The Nunavut Harvesters Support Program estimates that it takes on average CAD 200 to cover the costs of a weekend hunting trip; a cost that is prohibitive for low-income families who need to direct household incomes elsewhere, for instance to rent or household utilities⁷. Having the necessary time to hunt is also a barrier for some⁸.

Animals in the Arctic environments tend to be spatially and temporally dispersed. While some years or seasons may bring relative abundance, for instance caribou migrations relatively close to communities, more often than not harvesters must travel considerable distances to access game, and even then their efforts may prove unsuccessful. Regardless of success those harvesters who are employed in their communities must return home in time to meet employment commitments⁹. Having enough time to harvest is also influenced by factors including school attendance or childcare.

These scheduling demands often result in children and their parents spending less time on the land and consuming less wildfoods than the preceding generation¹⁰. In Nunavut the limited time spent harvesting has contributed to Inuit youth not learning the necessary land-based skills that will allow them to be providers of wildfoods for their own families¹¹. The effects of colonialism and residential schools are also widespread and traumatic in Aboriginal communities across northern Canada¹². During the first half of the 20th century, par-

ents and elders were unable to pass on their knowledge due to the forced removal of children from the home, with a generations of children losing the opportunity to acquire the land-based knowledge that would enable them to become proficient harvesters¹³. These spheres of influence serve today as formidable obstacles to Aboriginal peoples who hope to secure even a modest livelihood from the land.

Accompanying these socio-economic constraints are a number of bio-physical changes that are also limiting Aboriginal access to wildfoods. For instance, changing ice conditions in the Arctic have increased the time and cost of harvesting due to the need to develop new trails for safe transportation¹⁴. Similarly, the changing environmental conditions have made it more difficult for Inuit elders to share their predictive knowledge of the weather, which has contributed to growing uncertainty among younger harvesters to access the land, sea and ice¹⁵.

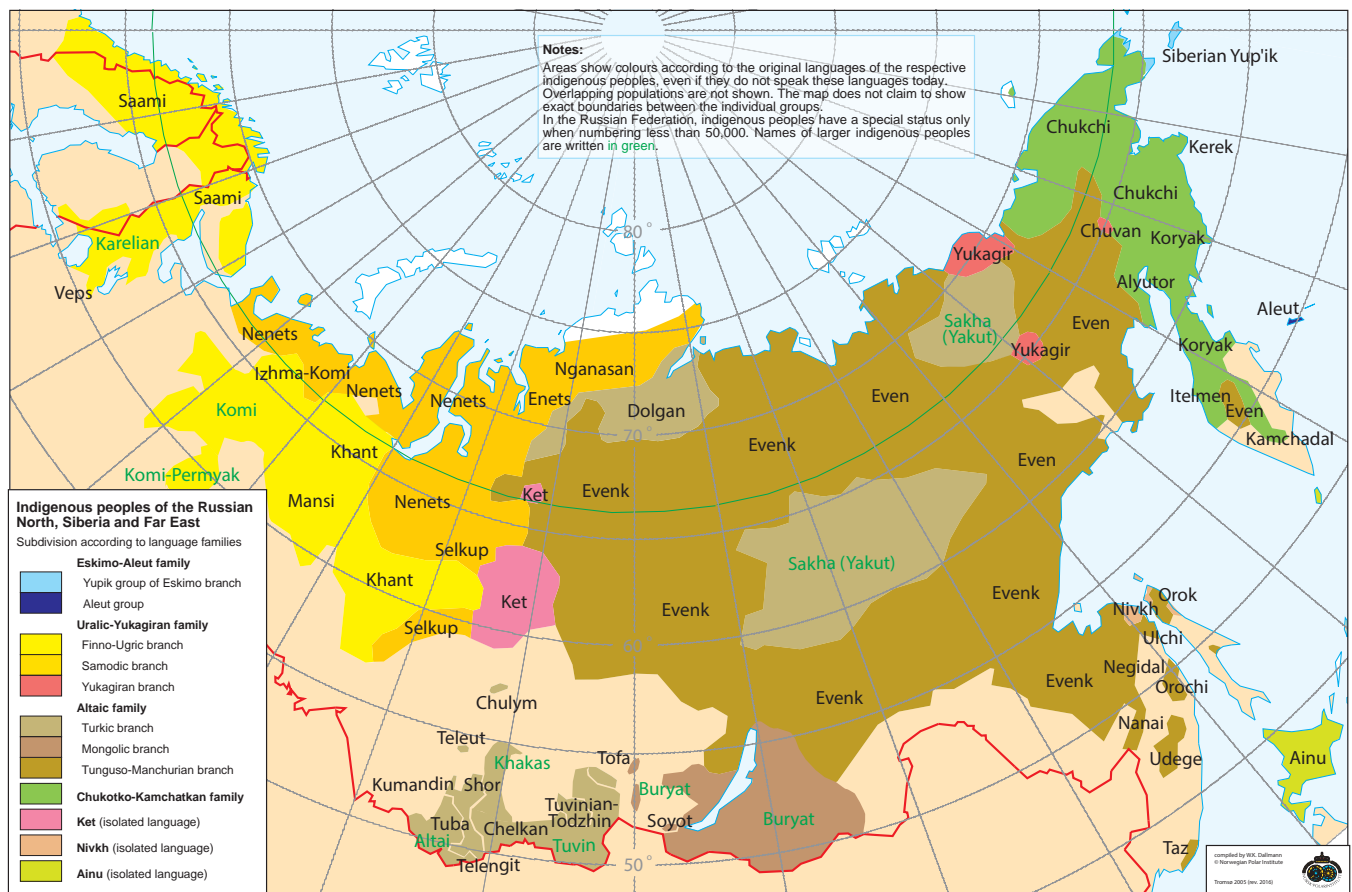
Unquestionably the factors that currently limit Aboriginal access to wildlife resources are complex, dynamic, and occur at multiple scales of experience. Because of this we should not expect a single strategy or policy response to reverse the trends that have long been in the making.

However, if wildfoods are going to making a meaningful contribution to alleviating food insecurity in the North, subsistence harvesting will need to be recognized as a vital and equally legitimate form of economic production in the eyes of the Canadian government. Canada's policies regarding Aboriginal food security have been premised on modernization schemes that fail to consider other viable and culturally relevant forms of economy that exist.

Lack of recognition of the importance of the subsistence economies may be followed by lack of public policy to provide economic support to supplement income from subsistence economies. On the other hand, a considerable amounts of economic support are directed to other economic activities, for instance the CAD 25 billion that the Canadian Government committed to extractive resource development in the North.¹⁶

If even a small proportion of this investment was directed to Aboriginal food security, a range of institutional support systems could be introduced in ways that could provide Aboriginal peoples with sustained opportunities to participate in the land-based economy. This will, however, require a committed effort on the part of government to allow for flexibility in policy design, and responsiveness to the plurality of constraints that challenge Aboriginal food systems. If this flexibility can be reflected in more informed public policy, wildlife harvesting might once again help support the culture, economies and food security needs of Aboriginal communities in Canada.

Figure 6.11. Indigenous peoples of the Russian North, Siberia and Far East. Compiled and drawn by W. Dallmann



Indigenous peoples and subsistence in the Russian Arctic

Drew Gerkey, Oregon State University

The indigenous peoples in the Russian Arctic are referred to as “Indigenous Numerically Small Peoples of the North, Siberia, and the Far East,” an official category that includes at least 40 ethnic groups with fewer than 50 000 members¹. Many rural communities in the Russian Arctic include substantial populations of non-indigenous settlers (*priehie*) whose ancestors migrated to the Arctic during the Pre-Soviet and Soviet eras. Many of these settlers rely on subsistence harvests in ways that are similar to local indigenous peoples.

With the collapse of the Soviet economy, privatization of Soviet state and collective farms, and difficulties of transitioning to new market economies, indigenous people throughout the Russian Arctic have been forced to expand their reliance on harvests of wild plants and animals. At the same time, policies and regulations governing subsistence harvests in Russia have undergone rapid transformations. The result is a complex and changing pattern of informal practices and formal rules that varies significantly between regions.

Contemporary Subsistence Activities

Indigenous peoples in the Russian Arctic practice a combination of subsistence activities, including hunting, trapping, fishing, and foraging. Subsistence activi-

ties are highly seasonal, timed in relation to changing environmental conditions and the movements of animals. In many regions people hunt migratory birds in the spring and fall, trap fur-bearing animals in the winter, forage for berries and mushrooms in the summer, catch fish during summer spawns or through the ice in winter. The combination of subsistence activities, the particular species targeted, and the seasonal timing of harvests varies on a broad level between regions and also within a region.

Perhaps the most widespread and iconic subsistence activity for indigenous peoples in Russia is reindeer herding. Domesticated reindeer are used as sources of meat, milk, clothing materials, crafts, tools, and transportation. Within a herd, some reindeer are trained to pull sleds or carry riders. Different regions and ethnic groups have developed distinct forms of reindeer herding. Some like the Saami allow their herds to migrate through summer pastures with limited influence exerted by herders. Others like the Nenets, Koryaks, and Chukchi actively restrict the herd's locations and movements, often in order to protect the herd from wolves, bears, and other predators. While Saami, Nenets, Koryak, and Chukchi herders rely heavily on their herds for subsistence and maintain large herds of 1 000 or more reindeer, others like the Evenki keep smaller herds of under 100 reindeer and utilize them primarily for milk and transportation while hunting wild reindeer and other species, rarely harvesting domestic reindeer



Magadan: Each person had permission to catch 50 kg of fish per year without a quota (2004), for their own consumption. This is not much fish to eat for people, whose traditional way of life is fishing for subsistence. Photo: M. Yashchenko (2004).

for food. Even when herders rely primarily on their herds for subsistence, other activities like hunting, fishing, and gathering remain important sources of food.

Although indigenous peoples in the Russian Arctic once relied almost entirely on subsistence activities to meet their needs, contemporary subsistence harvests are part of a mixed economy, where sources of monetary income are combined with harvests of wild plants and animals. Many communities today are struggling to integrate traditional subsistence activities with newly expanding market economies. During the Soviet era the majority of indigenous peoples were settled in villages and their traditional subsistence activities were integrated into the Soviet economy through state and collective farms. Now in the post-Soviet era, indigenous peoples are once again forced to adapt to a challenging and uncertain economic climate.

Reindeer herders who migrated semi-nomadically as extended family units during the pre-Soviet era were “professionalized” during the Soviet era, separating herders in the tundra from their families, who established households in remote villages. This system relied heavily on transportation equipment (helicopters, large all-terrain vehicles, snowmobiles) and fuel subsidies to maintain the flow of goods and people between tundra herding camps and villages. These subsidies diminished sharply during the post-Soviet era, forcing many herders to choose between spending many months in the tundra, separated from their families, or abandoning their herds for life in the village. The absence of these subsidies in the post-Soviet era is a central obstacle to sustaining subsistence as a viable way of life.

Russian federal laws that affect subsistence harvests

Following the collapse of the Soviet Union and the collective farm system, government officials and indigenous leaders sought to develop new institutions, laws, and management practices to facilitate the transition to new market economies. Three federal laws are central to subsistence in the post-Soviet era.

The first law, adopted in 1999, outlines the general rights of indigenous peoples in the Russian Arctic². It provides a legal framework for guaranteeing the “distinctive socio-economic and cultural development” of Russia’s indigenous peoples and protecting their “ancestral habitats, traditional ways of life, economic activities, and material culture.” This law focuses on the rights of indigenous peoples, living in ancestral territories (территория традиционного расселения) and practicing traditional ways of life, livelihoods, and material culture (традиционные образ жизни, хозяйствование и промыслы). The framework applies both to indigenous people who practice traditional economic activities full-time, as well as those who practice them part-time while engaging in other sectors of the economy. An amendment in 2009 also enabled the extension of the framework to non-indigenous peoples permanently residing in ancestral territories and practicing the traditional economic activities of indigenous peoples³.

The law provides the right to use lands and resources located in traditional territories to carry out traditional economic activities. Indigenous organizations also hold the right to participate in monitoring land use in relation to traditional economic activities, monitoring of environmental protection, natural resource use, and construction in traditional territories to ensure compliance with federal and provincial laws. In cases where traditional territories have been damaged, indigenous organizations have the right to receive compensation. This law provides indigenous organizations the right to receive material and financial resources necessary to pursue socio-economic development, protect traditional territories, and pursue traditional ways of life, from private companies, international organizations, non-government organizations, and individuals.

The second law focuses on traditional territories for natural resource use⁴. This law focuses on the formation, management, protection and use of traditional territories, defined as protected areas formed for the purpose of conducting traditional subsistence activities and ways of life, supporting the sustainable use of natural resources, and preserving and developing the customs and rules of conduct of indigenous peoples. Individuals and organizations have the right to use resources from traditional territories for entrepreneurial activities, as long as those activities do not violate the local rules of the traditional territory. The law provides for the establishment of easements on traditional territories for infrastructure (power lines, communications, pipelines), as long as these do not violate the local rules of the traditional territory. Provisions of the law can also be extended to non-indigenous individuals who permanently reside in traditional territories and practice traditional economic activities.

The size and dimensions of traditional territories are guided by the goals to ensure the sustainability of biological diversity, the ability of indigenous peoples to carry out traditional economic activities, and the integ-

Box 6.6. Indigenous peoples in the Russian Arctic: Some aspects of subsistence economy. A summary from "The Economy of the North 2008"

Winfried Dallmann, Arctic University of Norway, with updated data from Andrey Petrov

Survey in the Koryak Autonomous Okrug, Kamchatka

A survey on indigenous livelihoods in Kamchatka was carried out in 2002 by Olga Murashko, anthropologist, as part of a project with the Ethno-ecological Information Centre 'Lach'. The survey was conducted in coastal villages among the sedentary Koryak population (semi-nomadic Koryaks in the interior of Kamchatka pursuing reindeer-breeding). The survey had 350 respondents and is a reliable statistical basis. Without distinguishing between subsistence and trade economy, people answered in which traditional activities they were engaged.

The largest harvest and consumption of fish was noticed for members of fishing communities, and unemployed people. The smallest numbers of caught and consumed fish were noticed among civil servants and municipal workers. This group has the highest incomes within their settlements. Men hardly find time besides fishing to help the family to plant and harvest potatoes, and harvests are small. Women, old men and children are engaged in gathering of wild plants. Reindeer meat is exchanged from reindeer breeders for dried or salted fish, or for the money obtained from the sale of caviar. Licenses of winter hunting on some fur animals are restricted to professional hunters. The consumption pattern in Koryak is similar to that in the other coastal areas, where own consumption of hunting and reindeer herding is slightly lower, 10 per cent and 15 per cent respectively.

Survey in the Nenets Autonomous Okrug

A survey among Nenets reindeer herders in the Nenets Autonomous Okrug is mainly aimed at monitoring the influence of oil development on indigenous peoples' livelihoods¹. Preliminary results indicated a clear picture: The respondents are all fully engaged in traditional activities. Reindeer herding is pursued all-year-round, fishing over a 5-6 months period, and hunting 2-3 months a year.

Reindeer meat is consumed daily by more than half of the families, especially in winter, and 3-4 days a week by the others. Almost the same can be said about fish. Half of the families make their own traditional winter clothing themselves, others buy or barter with producers. Still, about 50 per cent of their income is used for food products and 20 per cent for clothes. Generally for Russia, the contribution of subsistence to the family budget is characteristically underestimated (Murashko). According to the respondents of the questionnaire campaign, production within traditional kinds of activity makes up half of the family income.

Since the Russian socio-economic crisis of the 1990s, reindeer herds have been rebuilt and stock numbers are now at a level around 160 000 reindeer. Although fluctuations

Figure 1. Number of reindeer and meat production in the Nenets Autonomous Okrug 2008-2013



Source: Prepared by W. Dallmann (IPY project MODIL-NAO) from data of the former Agricultural Department, Nenets AO. Updated data from Andrey Petrov.

Table 1. Participation in traditional activities and share of output for own consumption. Per cent. Koryak, Kamchatka. 2002

	Participation in activity	Share of output for own consumption
Fishing	91	100
Gathering	93	100
Hunting	11	20
Sea mammal hunting	9	25
Reindeer herding	1	20

Source: Olga Murashko and Ethno-ecological Information Centre 'Lach'.

occur, partly or mainly due to "bad winters" and problems in the management of collective farms, the overall productivity is still rising.

State subsidies and support programmes have certainly been a major reason for the overall restoration of the reindeer husbandry after 2000. Oil companies also pay compensation for ceded pasture lands. However, these are based on a variety of individual, often confidential agreements, and not captured by the statistics.

¹ The survey took place within the frame of a IPY-supported project conducted by Winfried Dallmann in cooperation with the Nenets People's Association 'Yasavey' and anthropologist Olga Murashko.

Table 2. Number of inhabitants and reindeer livestock size in Nenets Autonomous Okrug (NAO)

	Population total	Population urban (Naryan-Mar/Iskateley)	Per cent urban of total	Nenets population	Per cent Nenets of total	Komi population	Per cent Komi of total	Number of reindeer, total, per 1 January
1989	54 000	26 000	48	6 500	12	5 100	42 864	190 000
1996								180 000
2002	45 000	27 000	60	8 500	19	4 600	11	123 000
2008	41 500	26 600	64	7 200				157 000
2014	43 000	30 500	71	7 504 (in 2010)	17	3 623 (in 2010)	8	186 600

Source: Numbers are from various sources and may be based on different preconditions; thus they are not assumed to be statistically consistent, but they indicate trends. Updated data from Andrey Petrov.

rity of historical and cultural heritage. Traditional territories may include permanent and temporary settlements used to carry out traditional economic activities, lands and waters used for reindeer herding, hunting, fishing, and foraging, as well as places of cultural and spiritual value, including ancient settlements, burials, and places of worship. However, this legal framework for traditional territories remains primarily conceptual. No traditional territories have been established since the law's enactment in 2001, despite sustained efforts by native communities in multiple regions of the Russian Arctic.

The third law establishes a new formal institution for coordinating traditional subsistence activities and ways of life⁵. This law provides a framework for indigenous organizations called *obshchiny* (singular: *obshchina*). Although sometimes translated in English as “community” or “commune,” the Russian word is retained here to reflect the uniqueness of the *obshchina* as a form of self-government of indigenous peoples in the Russian Arctic. *Obshchiny* are defined as voluntary associations of indigenous people who share ties of kinship and territory, who inhabit traditional territories, and who pursue traditional economic activities and ways of life. Non-indigenous individuals are eligible for membership.

Earlier the term *obshchina* was used to refer to pre-Soviet socio-economic structures for managing property, coordinating subsistence activities, and maintaining other social relations among indigenous peoples. Today an *obshchina* is a formal institution intended to fill the vacuum created by the privatization of Soviet era collectives. Thus, *obshchiny* have begun to play a key role in subsistence activities, natural resource management, land claims, economic development, and indigenous governance and self-governance.

The *obshchina*'s charter may specify how its members will share access to and distribute natural resources and other common properties, proceeds from its economic activities, collective rights and responsibilities, and procedures for establishing and modifying rules. Although *obshchiny* are defined as “non-commercial” organizations, they have the right to generate revenue, and *obshchiny* may engage in educational activities that sustain indigenous cultures and practice religious traditions and customs. *Obshchiny* have the right to appeal actions by Russian federal, provincial, and local governments that infringe on their rights, as well as receive compensation for environmental damages that affect them.

Current Issues

Although the legal framework provides a range of support for Russia's indigenous peoples to sustain traditional subsistence activities and ways of life, efforts to mobilize this framework to establish traditional territories, maintain indigenous institutions, and secure access to land and natural resources have met with

Box 6.7. Convention on Biological Diversity (CBD) – Article 8 (j) on Traditional knowledge, Innovations and Practices

Article 8 (j): “Each contracting Party shall, as far as possible and as appropriate: Subject to national legislation, respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity and promote their wider application with the approval and involvement of the holders of such knowledge, innovations and practices and encourage the equitable sharing of the benefits arising from the utilization of such knowledge innovations and practices.”

mixed results. There is wide variation in the implementation of key principles across regions of the Russian Arctic, as well as within particular regions. Informal entitlements and patterns of resource use often predominate. Many indigenous communities throughout the Russian Arctic continue to practice subsistence in the same locations generation after generation. The lack of formal territories, however, means these subsistence activities and the people who rely upon them are increasingly vulnerable to the effects of industrial development and energy extraction. Indigenous peoples have been more successful in establishing formal institutions such as the *obshchina*. These institutions have facilitated greater access to natural resources – such as hunting territories, reindeer pastures, and fishing quotas – and have created new opportunities for indigenous self-governance and collective action. There are substantial regional variation in subsistence harvests and regulations, and focused case studies are essential for understanding the current status of subsistence in the Russian Arctic.

Sámi reindeer pastoralism in Norway – governance and economy

Ellen Inga Turi, University of the Arctic, Ealát Institute, International Centre for Reindeer Husbandry (ICR)

Reindeer pastoralism is an indigenous livelihood of key importance for more than 20 indigenous peoples in the Arctic and Sub-Arctic areas, in Sweden, Finland, Norway, Russia, Canada, Alaska, Greenland, Mongolia and China. In total the livelihood involves around 100 000 people and around 2.5 million reindeer (*Rangifer tarrandus*) grazing on natural pastures stretching from the North Sea to the Pacific Ocean, covering an area amounting to 10-15 per cent of the entire land area of the world.

Reindeer herding is a nomadic livelihood, a consequence of the strategy of securing forage for animals entirely through natural pastures and an adaptation to the natural migration patterns of reindeer, often from coastal grass areas in the summer to lichen covered inland areas during the winter. The nomadic life has enabled use of barren arctic mountain and tundra areas for food production since time immemorial. This

Figure 6.12. Circumpolar reindeer pastoralism



section provides a brief presentation of reindeer herding in Norway and aspects of governance important for the economy of reindeer pastoralism.

Reindeer pastoralism in Norway

Reindeer pastoralism in Norway is predominantly a Sámi livelihood practiced in the Sámi reindeer herding areas stretching from Hedmark in the south to Finnmark in the North. This area is 40 per cent of the total land area of mainland Norway and equals around 146 000 km². Within these areas around 3 100 people, including women, children and elders, are involved in the herding of around 250 000 reindeer. The traditional social organisation of reindeer pastoralism is based on herding partnerships or work communities. In Sámi reindeer pastoralism this unit is referred to as the *siida*, often defined as an organisation of households cooperating on herding and supervision of reindeer, where members work and migrate together, sharing the duties associated with nomadic reindeer herding. The households in a *siida* are usually made up of the core family and perhaps some hired help, but may also

include close relatives. The households are independent units responsible for their own economy. Members of households individually own reindeer and have private earmarks. The *siida* constellation is thus made up of individuals as owners of reindeer, and households as independent economic units. Although *siidas* are often made up of siblings or relatives, family ties are not necessarily prerequisites for *siida* constellations¹.

The traditional organisation of reindeer pastoralism show strong structural similarities across all reindeer herding regions. The organisation gives herders freedom to determine the structure and size of the herd according to available natural resources, and the best strategy for migration. The flexibility of this system is therefore an important factor in ensuring resilience for the livelihood. Activities related to herding, migrating across seasonal pastures, slaughtering, preparing meat and other products, contribute to sustain and transfer the traditional ecological knowledge the livelihood is based on.



Reindeer herding, Finnmark. Photo: Tom Nicolaysen.

One of the greatest challenges for reindeer husbandry in Norway is loss and fragmentation of pastures. Over the past decades reindeer pastures have been exposed to bit-by-bit encroachment following from, among other things, development of cabin resorts, infrastructure, hydropower, forestry and mineral exploration, causing increasing problems for reindeer husbandry depending on intact pasture resources². Fragmentation of pastures represents an economic cost to herders.

Governance of reindeer pastoralism

Reindeer pastoralism in Norway is governed by the Ministry of Agriculture. Each *siida* is composed of so-called 'siida shares' which consist of an individual reindeer owner or a family group. Subsidies are granted to *siida* shares, and it is the owners of *siida* shares that have the formal right to vote in *siida* issues. Pastures are often allocated through an informal traditional system.

The Reindeer Husbandry Act from 2007 regulates among other things, the formal administration of reindeer pastoralism, the rights to practice reindeer herding, property rights and other general rules. The Reindeer Husbandry Agreement is negotiated annually between the Association of Sami Reindeer Herders in Norway and the Ministry of Agriculture and Food. The majority of government transfers are allocated to development and investment, and as direct subsidies to reindeer herders. The subsidies granted through the reindeer husbandry agreement provide significant eco-

nomic incentives for regulating the size and structure of herds according to policy goals.

Governance processes for reindeer pastoralism and the use of traditional ecological knowledge

This section presents main results from the recent PhD thesis of Ellen Inga Turi on the role of traditional ecological knowledge in governance of reindeer herding. The governance of Sámi reindeer pastoralism in Norway can be described as a co-management system, with a range of governmental and non-governmental actors across different geographical and administrative scales, involving issues from the local to the transnational³. Although the co-management system is well-established, there is a lack of recognition in the governance processes of the traditional ecological knowledge and social organization in reindeer-herding. For example, while the *siida* organization is incorporated at various levels of governance, through participatory, representative and deliberative processes of decision-making, this has not facilitated further integration of the traditional knowledge and management principles inherent in the *siida*⁴.

Traditional ecological knowledge (TEK) can be seen as a holistic framework for understanding human-nature relations, encompassing the experience-based knowledge, practice and cosmology inherited through generations, as basis for local management systems⁵. While studies on environmental governance increas-

ingly highlight the benefits of incorporating traditional ecological knowledge into management, a central challenge remains to integrate this knowledge and to ensure interactions between different administrative levels. This challenge arises at different levels, in international processes for indigenous peoples' human rights, international processes for conservation of biological diversity, governance of sustainable reindeer herding, governance for land-use planning, and *siida* governance for building resilience to climatic uncertainty.

International law defines specific rights for reindeer herding as an indigenous livelihood, to be implemented to national frameworks⁶. The indigenous rights framework may be seen as overarching to national governance processes⁷. In Norway, reindeer herding is framed in sectorial policies as the economic activity carrying the Sámi culture. The articulation of indigenous rights at national and local levels is fragmented, however, and governance processes for indigenous rights are not constitutive for reindeer pastoralism, but interact through shaping reindeer-herding rights as an indigenous livelihood in certain policy areas.⁸

The Convention on Biological Diversity (CBD) is an international framework with relevance to reindeer pastoralism. Through the framework of the CBD, traditional knowledge of biological diversity and land use is awarded specific protection. However, as the CBD framework is shaped, translated and enacted upon at local and national levels, the connection between the biodiversity conservation and traditional knowledge is diluted. There is little explicit incorporation of CBD aims in arguments for protecting reindeer pastoralism at local or national levels in Norway. Similarly, the role of traditional knowledge and land use is not explicit in governance processes for CBD at national levels⁹. Moreover, reindeer-husbandry policy and legislation in Norway engage a framing of the biodiversity conservation issue, in which the focus is on reindeer herding as a threat to instead of a measure for conserving biodiversity.

The central aim of reindeer-husbandry management in Norway is to achieve an ecologically, economically and culturally sustainable reindeer herding. The sectorial administration of reindeer pastoralism in Norway has potentially competing objectives: controlling the size of reindeer populations while at the same time increasing economic profit in reindeer herding. In particular in western Finnmark the primary focus of policy implementation has been on reducing the number of reindeer to conform with calculations of the biological carrying capacity of pastures. The objectives of increasing profit and reducing reindeer numbers are linked through the use of economic policy instruments as incentives for reindeer herders to reduce herd sizes¹⁰. In this process, reindeer pastoralism is viewed as an agricultural production system, whereby issues of land use relate primarily to the process of harvesting resources, through grazing and meat production.

Reindeer-husbandry interests are represented in governance through participatory governance arrangements. However, this participatory process has not led to a closer merging of traditional knowledge-based instruments in formal governmental governance systems¹¹. Of particular importance for this governance process are instruments for monitoring and controlling pasture pressures. Examples include pasture-monitoring by use of scientific experts, biological calculations of carrying capacity maximum quotas of reindeer numbers for *siidas*, and production subsidies. In these issues quantitative criteria are prioritized as indicators of ecological sustainability. Qualitative traditional knowledge-based categories for assessing pasture quality, deciding herd composition, and evaluating animal welfare are not applied. Scientific knowledge is prioritized over reindeer herders' knowledge in shaping specific policy instruments of sectorial governance, despite the use of participatory approaches to designing instruments.

Defining boundaries between *siida* pastures is seen as a central policy instrument for achieving a reduction in reindeer numbers in western Finnmark, but how to ensure it is in line with traditional social organization or indigenous rights is not a salient part of this process. An inherent tension in these processes is seen, for instance, in defining land-use rights as a collective right (of the Sámi) or as specific to individual *siidas*. This is evident with regard to the internal division of winter pastures in western Finnmark, as a common reindeer-herding area, where the official setting of boundaries of pastures is in conflict with *siida*-level perceptions of customary land rights¹². The tension relates to how decision-making structures are defined in governing structures. This relates to Elinor Ostrom's arguments that local communities may organize themselves for the management of resources sustainably if authorities award at least a minimum formal recognition of such informal institutions.¹³

Central to the challenge of integrating reindeer-herding traditional knowledge in governance is a conflict of interests over the appropriate use of land and natural resources¹⁴. Increasing trends of infrastructure development and fragmentation of pastures have severe challenges for reindeer pastoralism. Reindeer herding as a livelihood is in competition and conflict with other land uses, such as mining, and represents an indigenous land use and is thus central to the contested and long-standing process of re-mapping and re-allocating Sámi land rights in Finnmark; but it is also a land use that operates in extensive undeveloped areas and is thus part of the issue of environmental conservation.

In Norway, land-use planning is regulated through the Planning and Building Act. Environmental and social impact assessments form a central foundation for decision-making. The land-use planning process incorporates a multi-level structure involving local municipal, regional and national planning authorities, while other actors or policy interests are incorporated through con-



Photo: Colorbox.

sultation processes. Other policy processes at national levels may be determinant for land-use planning. For example, the national mineral strategy is important for the context of land-use conflicts between reindeer-herding and mining interests. Within this structure, reindeer-herding siida is primarily involved as a voluntary partner in consultation processes or, as a source of knowledge in the impact assessment processes.

Reindeer pastoralism, due to its extensive nature and dependence on different types of pastures, constantly monitors and records any changes in land use. Failures to integrate such perspectives into governance systems above the local may thus be seen as a lost opportunity to account for cumulative long-term effects of land-use changes in decision-making.

The social organization in reindeer herding reflects a traditional knowledge-based steering process aimed at

Table 6.6. **Total account and composition of income and cost in reindeer pastoralism of Norway. 2014**

Type of income and cost	Value (1 000 NOK)	Per cent
Production based income	128 344	
Meat production total	122 767	44,3
Meat production slaughterhouse	98 214	35,4
Meat production private	24 553	8,9
Other production-based incomes	27 303	9,9
Changes in the value of the herd	-28 587	-10,3
Subsidary incomes	6 861	2,5
Subsidies	76 361	27,6
Compensation	72 419	26,1
Total incomes	277 124	100

Source: Norwegian Agriculture Agency (2016): Totalregnskap for reindriftnæringen (Total account for reindeer herding), Report 6/2016, Summary table 4.7.1, and Table 4.1.1. gives shares of market and private sale at about 80 and 20 per cent.

building livelihood resilience to climatic uncertainty and an inherently unpredictable nature. Resilience-building strategies are embedded in the social organization of reindeer pastoralism. The focus of the reindeer herding is not on controlling uncertainty but rather managing risk by fostering resilience¹⁵. Diversifying strategies as an approach to managing environmental uncertainty is highlighted in Sara's study of traditional knowledge in the siida in western Finnmark¹⁶. Strategies include the flexible use of seasonal pastures and diversity in herd structure¹⁷. Protecting the areas of pasture land may be seen as a crucial part of building resilience. Indigenous rights may be applied by local siidas to achieve goals of preserving pastoral flexibility.

Fishing, reindeer herding, Arctic agriculture and other types of land uses have developed different bodies of knowledge, focusing on different aspects of the environment and climate. Yet, such diversity does not mean that experience-based and traditional knowledge is inapplicable to environmental governance any more than scientific disciplinary diversity is a barrier to the incorporation of scientific knowledge in governance. Rather, the knowledge diversity highlights the importance of directing specific attention to the knowledge generating processes in the design of governance processes.

The results may have particular relevance for understanding governance in Arctic resource peripheries, as it interacts with local livelihoods. Arctic areas are undergoing increasing changes, relating to climate and socio-economic development. While these changes represent opportunities for economic development, the results of this thesis highlight the challenges involved with incorporating local and traditional knowledge and social organization in the complex mix of governance processes.

Table 6.7. **Income from meat production in reindeer pastoralism in Norway 2014 (1 000 NOK)**

Reindeer herding area	Meat (tons)			Value per kg (NOK)	Value (1 000 NOK)
	Slaughterhouse	Private	Total		
Polmak/Varanger	137	27	164	74,57	12 240
Karasjok øst	47	31	79	72,56	5 708
Karasjok vest	139	40	178	67,60	12 062
Øst-Finnmark	323	98	421	69,12	30 011
Kautokeino øst	162	33	195	62,42	12 190
Kautokeino midt	210	50	260	67,06	17 433
Kautokeino vest	141	29	170	68,17	11 606
Vest-Finnmark	513	112	626	65,45	40 949
Troms	31	39	70	80,20	5 579
Nordland	59	35	94	75,53	7 134
Nord-Trøndelag	134	27	160	66,32	10 642
Sør-Tr./Hedmark	151	22	173	70,48	12 221
Other ¹	206	8	214	75,68	16 231
Total	1 418	342	1 759	69,78	122 767

¹ Reindeer cooperatives.

Source: Norwegian Agriculture Agency (2016): Totalregnskap for reindriftnæringen (Total account for reindeer herding), Report 6/2016, table 4.1.1. Note that some sums are rounded.

Table 6.8. **Siida share costs in reindeer pastoralism in Norway 2014 (1 000 NOK)**

Type of cost	Øst-Finnmark	Vest-Finnmark	Troms	Nordland	Nord-Trøndelag	Sør-Trøndelag	Total
Freight and transportation	979	573	136	87	13	44	1 832
Intermediate goods	10 599	3 259	873	4 579	1 041	1 772	22 123
Travels	1 051	390	311	342	288	213	2 594
Equipment	6 399	7 429	1 837	2 161	1 773	1 423	21 021
Vehicles and machinery	10 708	15 418	2 659	4 086	2 150	2 456	37 476
Buildings and infrastructure	1 641	1 321	194	487	220	223	4 085
Depreciation	11 213	12 280	2 799	3 190	2 040	2 170	33 692
Electricity, energy	2 574	3 885	546	688	423	489	8 605
Administration	1 400	1 751	432	571	549	312	5 015
Rent	1 008	474	532	1 007	715	201	3 937
Insurance	1 271	1 410	324	423	288	293	4 009
Sales and marketing	324	48	0	149	588	0	1 109
Aquisition of services	4 113	7 163	598	2 653	1 236	1 458	17 222
Provision costs	0	0	0	0	0	0	0
Miscellaneous	3 857	1 817	1 016	1 284	375	430	8 780
Total	57 136	57 220	12 256	21 706	11 698	11 483	171 500

Source: Norwegian Agriculture Agency (2016): Totalregnskap for reindriftsnæringen (Total account for reindeer herding), Report 6/2016, table 4.4.2. Note that some sums are rounded.

The economy of reindeer husbandry in Norway

Reindeer husbandry in Norway has a strong focus on meat production, and income from selling meat contributes to a considerable portion of the income of reindeer herding families. The Norwegian Agricultural Agency compiles annual reports of the economy in reindeer husbandry, where production based incomes, governmental subsidies, compensations and other aspects of reindeer herding economy are estimated. An overview over the composition of income in reindeer pastoralism in Norway in 2014 is presented in Table 6.6.

Table 6.6 shows that total value of meat makes up around 44 per cent of the total income of reindeer pastoralism¹⁸. Table 6.7 shows the income from meat production, in slaughter house and private, by reindeer herding areas. As reindeer herding is sensitive to climatic variations and weather patterns, the number of reindeer sold per year may fluctuate considerably. Government subsidies provide the second most significant contribution to the income of reindeer pastoralism, making up around 28 per cent of the total income.

Compensations represented about 26 per cent of total income of reindeer pastoralism in 2014, with compensation for loss of reindeer at 24 per cent of total income and compensation for loss of area at 2 per cent of total income. Of the compensation for loss of reindeer, 94 per cent is due to predators and 6 per cent is due to traffic accidents.

Income from subsidiary activities such as producing duodji (handicraft), making clothing, preparation of meat (e.g. drying, smoking), hunting, fishing, gathering firewood, picking berries, and even tourism are recognized as an integrated part of the Sámi reindeer herding economy. A common practice is for family members to make handicrafts of reindeer products such as antlers, bones and fur, and sell these to tourists during the summer season. Although these incomes are small in accounting terms, only 2.5 per cent of total incomes (Table 6.6), a complete picture of the reindeer herding economy calls for making these incomes visible in the accounting. The significance of subsidiary activities in reindeer herding goes beyond the economic realm.

Table 6.9. **Share of female and male siida share leaders with wage or self-employment income outside reindeer herding 2014 (per cent)**

Reindeer herding area	Women	Men	Income < 200.000		Income > 200.000	
			Women	Men	Women	Men
Polmak/Varanger	92	58	33	61	67	39
Karasjok	85	68	18	79	82	21
Øst-Finnmark	88	66	24	75	76	25
Vest-Finnmark	90	73	33	85	67	15
Troms	58	68	0	84	100	16
Nordland	67	64	25	78	75	22
Nord-Tr.lag	75	68	83	90	17	10
Sør-Tr./Hedmark	100	61	71	86	29	14
Total	83	69	34	82	66	18

Source: Norwegian Agriculture Agency (2016): Totalregnskap for reindriftsnæringen (Total account for reindeer herding), Report 6/2016, table 7.1.4. Note that some sums are rounded.

Table 6.10. **Share of female and male spouses with wage or self-employment income outside reindeer herding 2014 (per cent)**

Reindeer herding area	Women	Men	Income < 200.000		Income > 200.000	
			Women	Men	Women	Men
Polmak/Varanger	92	71	0	100	100	80
Karasjok	97	50	17	100	83	0
Øst-Finnmark	96	64	13	43	87	57
Vest-Finnmark	93	100	20	67	80	50
Troms	93	80	36	25	64	75
Nordland	82	50	21	0	79	100
Nord-Tr.lag	91	100	35	50	65	50
Sør-Tr./Hedmark	82	100	21	40	79	60
Total	92	79	21	41	79	59

Source: Norwegian Agriculture Agency (2016): Totalregnskap for reindriftsnæringen (Total account for reindeer herding), Report 6/2016, table 7.1.5. Note that some sums are rounded.

Table 6.11. Number of reindeer in reindeer pastoralism in Norway. 2010-2015

	2010	2011	2012	2013	2014	2015 (estimated)
East Finnmark	83 800	87 600	84 700	75 000	69 700	65 500
West Finnmark	98 200	96 000	106 500	106 100	95 900	80 400
Troms, Nordland, Trøndelag	54 500	53 500	55 200	54 700	54 500	53 200
Other (reindeer cooperatives)	12 100	12 300	12 100	12 400	12 900	12 600
Total	248 600	249 400	258 500	248 200	233 000	211 700

Source: Norwegian Agriculture Agency (2016): Totalregnskap for reindriftsnæringen (Total account for reindeer herding), Report 6/2016, from table 4.1.8.

The entire family engages in the activities, contributing to accumulation and inter-generational transfer of traditional knowledge. Data on Sámi reindeer herding in Norway are found in the economic accounts produced annually as basis for negotiation of the reindeer husbandry agreement. Table 6.8 shows cost in reindeer pastoralism. Vehicles, machinery and equipment are large items of the total cost. The data also illustrate the integration of reindeer herding in the cash economy (cost-production) and the significance of wage-income from outside reindeer herding.

Table 6.9 shows income from outside reindeer herding for female and male siida-share leaders. 83 per cent of female and 69 per cent of male siida share leaders have income outside reindeer herding. 34 per cent of female and 82 per cent of male siida share leaders with income outside reindeer herding have income below NOK 200 000. The gender pattern is opposite for higher incomes, 66 per cent of female and 18 per cent of male siida share leaders with income outside reindeer herding have income above NOK 200 000.

Table 6.10 shows income from outside reindeer herding for female and male spouses. 92 per cent of female spouses and 79 per cent male spouses have income outside reindeer herding. 21 per cent of female and 41 per cent of male spouses have income below NOK 200 000. 79 per cent of female and 59 per cent of male spouses have income above NOK 200 000. The income of the spouse outside reindeer herding is of great importance for the economy of the family, in particular the contribution from female spouses, as a relatively high share of them have rather high incomes¹⁹.

Table 6.11 shows that the total number of reindeer in Norway was estimated to 211 700 for 2015. This number is slightly higher than the allowed maximum number. For reindeer herding regions in Western Finnmark the number of reindeer is particularly higher than the allowed maximum number.

Norwegian reindeer pastoralism from an international perspective

Compared to other regions of reindeer husbandry, the Sámi reindeer husbandry in Norway, Sweden and Finland is characterised by high density of reindeer, strong focus on meat production, and being highly mechanised. In terms of number of reindeer, the Sámi reindeer husbandry in Norway is of the same magnitude as the Nenetsy reindeer husbandry in North West

Siberia (Box 6.6). Although reindeer pastoralism in Norway has a relatively high income, in comparison to other reindeer husbandries outside the Nordic countries, it is also characterised as perhaps the reindeer pastoralism with the highest level of costs, due to high degree of mechanical equipment.

Sámi statistics in Norway

Even Høydahl and Paul Inge Severeide, Statistics Norway

The Sámi traditional settlement area is in the North of Norway, Sweden and Finland, and at the Kola Peninsula in Russia. The national statistical offices of the Nordic countries publish population statistics based on census and population registers in each country. With regard to scope and accuracy, Nordic population statistics is considered among the best in the world. However, ethnicity is not included as a dimension in the census, neither for Sámi nor for any other ethnic groups. It is therefore not possible to produce population statistics for the Sámi population from the population registers.

From 1845 to 1930 the census in Norway included estimates of the number of Sámi and kvener (people of Finnish descent in Northern Norway). The 1950 census provided estimates of the use of Sámi and Kven language in some villages in the three northern counties in Norway. The 1970 census was the last time when questions about Sámi language and ethnical background were included, via a supplementary questionnaire distributed to selected municipalities and local communities in the three northern counties in Norway.

It is difficult to assess the number of Sámi in Norway based on previous census data. The reason is partly that the different censuses have used different basis for defining who is Sámi, according to ancestry, language or self-reporting, and partly that not all Sámi were reached by the census as the supplementary questionnaire about Sámi identity only was used in selected municipalities. The census had registered a Sámi population of about 15 000 from 1845 to 1875, and the number increased to about 20 000 from 1890 to 1930. In 1950 the number was 8 778, a number that was considered to be far too low. In 1970 the number was slightly below 10 000. The last decades have seen a distinct change in policies and attitudes towards the Sámi people in Norway. Assimilation into the Norwegian society was a clearly stated policy for a long period, lasting long into the post world war II period. Sámi

Box 6.8. Fisheries in coastal Sámi areas in Norway¹Carsten Smith²

A Government appointed Commission in Norway gave a Report of 2008 with a chapter on the international law basis for sea fishing rights for the Sea Sámi living on the coast of Norway, concluding that there is such an indigenous right³. The Commission proposed new legislation on the right to fish for those living along the coast of Finnmark county, Sámi as well as other local people.⁴ Fishing is the basis for Sea Sámi culture. The Sea Sámi were badly hurt by Norwegian assimilation policy. The legal situation has changed successively. In 1972 the UN Covenant on Civil and Political Rights was ratified by Norway. In the following period there has been a change in general Sámi policy and elements of cultural revitalization. Yet the Sea Sámi have experienced a continuous decline in population, fishing activities, and use of Sámi language. The local communities are crucial to give the Sea Sámi the opportunity to enjoy their culture, and if these communities should disappear, so would Sea Sámi culture. The Commission described the urgency of the situation as “five minutes before midnight” and recommended that the state must make strong interventions to secure the basis for Sea Sámi to preserve their cultural community identity.⁵ This implies that the right to fish must extend sufficiently to secure a realistic basis for future settlement in Sámi coastal communities. The Commission described it as “probably the last chance” for the state to redress effects of earlier discriminatory policy decisions and reach the goal of securing a future for Sea Sámi culture.⁶

However, the Government bill from the Ministry of Fishery for new legislation on fishing rights, enacted 2012, did *not* include such rights based in international law.⁷ The main point of international law discussed by the Commission is protection of culture laid down in article 27 of the UN Covenant on Civil and Political Rights. Concerning indigenous right to fish, there is no specific provision in the UN Declaration on the Rights of Indigenous Peoples of 2007 and the ILO Convention No. 169 of 1989, and one has to build on the more general Covenant article 27 which states that persons belonging to ethnic minorities “shall not be denied the right, in community with other members of the group, to enjoy their own culture”. The UN Human Rights Committee stated in 1994 that the right may consist of enjoying “a particular culture”, that this may be particularly true of “members of indigenous communities”, and that this right “may include such traditional activities as fishing or hunting”⁸.

How wide-ranging is this understanding of article 27? This can be seen as the most important legal question for Sámi fishing rights, with significance to other indigenous rights in the North. The core question is how far protection of a culture embraces the material basis of that culture, in this case sea fishing. The Ministry states “without any doubt” that the Sámi are a minority, and an indigenous people, and that article 27 in principle may embrace such livelihoods as sea fishing and coastal fisheries.⁹ A question is whether Sámi fisheries would be included when modern technology is used. The Ministry states that modern technology is not a hindrance, as long as it is a continuation of traditional forms of fisheries.

The Commission states that article 27 implies a duty for the state to take action to attain a result, to achieve the protection of Sea Sámi culture. The Ministry shares the view about the responsibility of the state (*resultatplikt*).¹⁰ According to

article 27, state responsibility is defined by the result for the culture: In order to judge whether present rules fulfill the requirements of international law, one must evaluate the development and present situation of Sea Sámi culture. The strength of the culture will signify the extent of fulfillment of legal requirements. One cannot say whether present regulations of fisheries are in conflict or in conformity with state responsibility solely by reading the regulations. The answer would depend on the government’s use of the regulations and the actual effect on Sea Sámi communities. The situation of continuous decline is the cultural ‘result’.

Despite a large extent of common understanding, the Ministry concludes it cannot adhere to the recommendations of the Commission.¹¹ The Ministry states that the Commission does not distinguish clearly between the state’s *international law responsibilities* and the state’s *policy goals* for coastal fishing in the north of Norway. The aim of the Commission was to infer the *international law* consequences of article 27. One would, however, tend to evaluate coherence between results aimed at in law and in national policy as a positive, rather than negative, outcome. The Ministry states that the future of settlements in these areas will depend on social factors other than fisheries. This is no doubt true, yet one can hardly see other trades than fishing-related activities, which may have an equal impact on Sea Sámi culture in these communities. Fishing rights will be a primary element in the state’s influence on Sea Sámi culture. The Ministry bill includes a statistical report on Norwegian fisheries which shows that fisheries in Sea Sámi areas have more negative development than other areas of north Norway.¹² One should expect this result to be a strong argument in favor of positive action. The Ministry points to the complexity of the causes of negative development, while article 27 is concerned primarily with the cultural result, the outcome of the predicament, rather than its cause. The Ministry concludes that the present rules on regulation of the fisheries were in conformity with the duty of the state in securing the basis of the Sea Sámi culture. How is the cultural “result” going to be achieved? One might ask what is the meaning of a “right” – Sea Sámi right “to enjoy their own culture” – if the trend is allowed to continue without legal intervention in negative direction towards a very uncertain future? This legal issue of indigenous rights, intertwined with policy trade-offs between small-scale coastal fisheries and large-scale marine fisheries, is of urgent concern for Sea Sámi culture and the livelihood of other local people on the coast of north Norway, and at the same time an issue with far-reaching consequences for the economy of the North.

¹ The text builds on the article: Carsten Smith: Fisheries in coastal Sami areas: Geopolitical concerns? Arctic Review on Law and Politics, vol. 5, 1/2014 pp. 4–10.

² Carsten Smith, Professor of Law, University of Oslo (em.), former president of the Supreme Court of Norway (1991–2002).

³ NOU 2008: 5 Retten til fiske i havet utenfor Finnmark, chapter 8, pp. 249–282. The author, leading the Commission, had main responsibility for this chapter of the report, however, the report was unanimous.

⁴ NOU 2008: 5, chapter 13, pp. 411–412.

⁵ NOU 2008: 5, chapter 6, pp. 161–208.

⁶ Ibid. p. 371, p. 408.

⁷ Prop. 70 L (2011–2012) Endringer i deltakerloven, havressurslova og finnmarsloven (kyst- fiskeutvalet).

⁸ General Comment No. 23 para 3.2 and para 7.

⁹ Prop. 70 L (2011–2012), p. 87–88.

¹⁰ Ibid. pp. 89 and 101.

¹¹ Ibid. p. 89.

¹² See vedlegg 2, pp. 146–170.

were expected to give up their language and adopt the way of life of the majority population. Starting around 1980, considerable efforts have been made to reverse the consequences of assimilation policies and to secure the rights of the Sámi people. A Sámi Parliament has been established, with its first election in 1989. The responsibility of the Sámi Parliament is to support the development and strengthening of Sámi identity and local communities.

While the Sámi Parliament has policy goals and means, there has however been a lack of statistical information basis to describe Sámi society and to evaluate to what extent the political objectives have been achieved. In 2003 the Sámi Parliament commissioned a project with cooperation between Statistics Norway and Sámi Instituhtta (Nordic Sámi Institute) to develop a permanent framework for development, production and dissemination of Sámi statistics in Norway.

Since the central population register does not include information on individual ethnicity, as explained, other approaches must be taken to produce Sámi statistics. The solution that has been chosen so far is to produce statistics for selected areas defined as Sámi settlement areas. In practice, this was operationalized by selecting those areas that qualify for financial support from the Sámi development fund (Samisk utviklingsfond SUF), called the SUF area. In 2009 the name was changed to Sametingets tilskuddsordninger for næringsutvikling (STN) (The Sámi Parliament support to Sámi business development). The fund is managed by the Sámi Parliament, and the Sámi Parliament decides which geographical areas that qualify for support from the fund. The geographical extent of the fund has been extended several times, most recently in 2012.

The main argument for choosing this geographical approach is that the selected area encompasses local communities whose viability is seen as crucial for sustaining and further developing Sámi culture and local businesses, at the same time as the Sámi Parliament has support schemes applicable to this area. In order to plan the use and evaluate the effect of these policy instruments, the Sámi Parliament needs data that can illustrate current status and development over time in this area.

This geographical approach to Sámi statistics, based on the STN area, has obvious shortcomings. First, many of the inhabitants in these areas are not Sámi. And equally important, many Sámi live outside these areas. Although old census data give reason to claim that Sámi people are strongly over-represented within the STN area and under-represented outside the STN area, the accuracy of the Sámi statistics is far from the level it should have, from the perspective of describing characteristics and development for the Sámi population.

The entire STN area lies north of the Arctic Circle, and none of the large towns and villages of Northern Norway are within the STN area. To a large extent, the

difference between Sámi and non-Sámi areas observed in the statistics therefore reflects the difference between urban and rural areas, and to some extent the difference between north and south. A statistical approach that would have allowed comparison of Sámi and non-Sámi, independently of place of residence, might have been better.

In 2008/2009 Statistics Norway explored the possibilities to produce Sámi statistics for individuals, based on combining existing registers where individuals directly or indirectly have declared themselves as Sámi, such as the 1970 census, the register owned by the Norwegian Agriculture Agency over persons affiliated with reindeer herding activities, and the electoral register of the Sámi Parliament. The results from this work was not followed up, partly due to difficulties to achieve permission to use and combine the registers, and uncertainty about the representativity of the resulting sample of the Sámi population.

Statistics Norway will nonetheless continue to produce geographically based Sámi statistics. As long as the Sámi Parliament continues to provide funds to particular geographical areas, regardless of whether the applicant is Sámi or not, it will be important to closely follow the development in these areas. The first of these publications *Samisk statistikk/Sámi statistihkka 2006* was launched in 2006 on the Day of the Sámi People on 6 February. Thereafter the publications have been issued on the same date every second year, with the most recent one published 6 February 2016. The topics of the statistical publications cover elections to the Sámi Parliament, population, education – included the use of Sámi language in schools and kindergartens - income and personal economy, labor market, reindeer herding and agriculture, and fishing and hunting. The publication is written in Norwegian and Northern Sámi (not in English).

A Government appointed expert group, where Statistics Norway is represented, has been appointed with the mandate of compiling an annual report on the situation and trends in the Sámi community in Norway. The report, with the name *Samiske tall forteller* (Sámi numbers tell), is used in annual budgeting and consultations between government authorities and the Sámi Parliament.

The reports contain articles that cover a broad range of topics of importance for Sámi communities. So far seven editions of the report have been published since the first edition in 2008. Population data for the current STN areas have been calculated back to 1990. The population in these areas has in recent years stabilized at about 55 000 persons, after a continuous decline since 1990, when population was 10 000 persons higher. Nonetheless, there is no population growth observed in the last four years, although population in Norway has increased with almost 190 000 persons, or 3.8 per cent, over the same period.

Income account for Sámi area

The areas in northern Norway defined as Sámi settlement areas are those areas that qualify for financial support from the Sámi Parliament support to Sámi business development (Sametingets tilskuddsordninger for næringsutvikling), in brief the STN area. The fund is managed by the Sámi Parliament, and the Sámi Parliament decides which geographical areas that qualify for support from the fund. The geographical extent of the fund has been extended several times, most recently in 2012.

Table 6.12 shows the income account for the STN area in 2013, compared to other areas of northern Norway (north of Saltfjellet) and average for Norway. Average total household income (before tax) for the STN area was NOK 626 900, considerably lower than average total household income for other northern areas with NOK 690 300 and the average for Norway with NOK 734 600. Note that table 6.12 shows average household income for households with income earners who have that particular income type: Income from work, property income, taxable transfers, and tax-free transfers. Hence, it does not show average across all households. Average total household income thus appears as a weighted average of the income types, weighted by the number of households receiving that income type.

Average income from work and property income was considerably lower in the STN area than the average for other northern areas and average for Norway. Taxable transfers were higher in the STN area. Average unemployment benefit in the STN area is slightly higher than in other northern areas and slightly lower than average for Norway. Child allowance and tax-free transfers in total are the only income type that is higher on average for recipients in the STN area, compared to other areas.

Table 6.12. **Income account for households. All of Norway and north of Saltfjellet. Average for households. 2013**

	All of Norway	STN-area ¹	Other areas in the north ²
Income from work	653 900	525 300	599 200
Employee income	631 200	504 500	580 000
Net income from self-employment	239 500	180 800	219 000
Property income	38 800	16 100	24 800
Taxable transfers	246 900	251 500	245 300
Social security benefits	255 200	251 500	253 600
Unemployment benefit	69 600	65 600	66 600
Compensation for illness leave	56 600	63 800	62 500
Tax-free transfers	36 400	42 300	37 700
Child allowances	21 800	26 800	22 700
Dwelling support	20 400	13 900	17 600
Social assistance	45 000	24 600	38 500
Total income	734 600	626 900	690 300
Total assessed taxes and negative transfers	197 100	137 800	171 600
After-tax income	545 900	499 500	526 000

¹ STN-area is defines as area that qualifies for support

² Those areas north of Saltfjellet not defined as STN-area

Source: Statistics Norway, Samisk statistikk 2016, Table 42.



The importance of hunting and small-scale fishing in Greenland

Martin Reinhardt Nielsen, Henrik Meilby, Birger Poppel, Per Lyster Pedersen, Jesper Graubæk Andresen, Kåre Hendriksen, Hunter T. Snyder, Ole Hertz

Dramatic changes in biodiversity and living conditions are expected in Arctic regions in the coming decades due to global climate change. Changes in thickness and cover of the sea ice, including later formation in the autumn/winter and earlier break-up in spring/summer have already been confirmed, both by research studies and through local observations. It is thus expected that the area covered by sea ice along Greenland's coasts will be reduced considerably already by the middle of the 21st century.

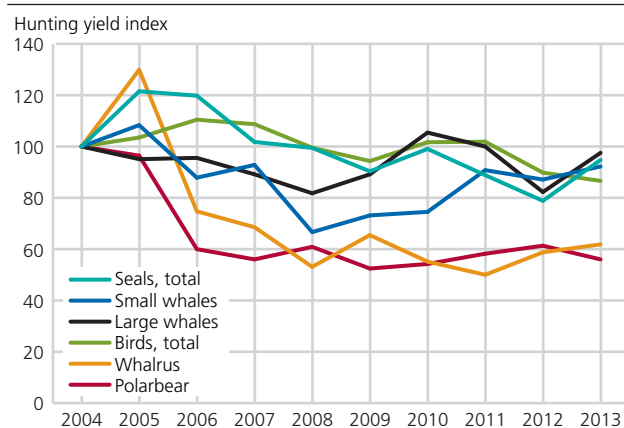
Changes in climate and ice cover are expected to affect populations of birds, mammals and fish and lead to changes in migration routes, distribution ranges, population sizes and possibly also extermination of particularly vulnerable species. To some extent, some of these effects can already be observed. Some species have furthermore historically been subjected to a hunting pressure that in certain cases and periods has contributed to decline of the hunted populations. These aspects, together with international agreements, have led to introduction of quotas on specific species and repeated tightening of hunting regulations.

Most people in smaller settlements along the coast of Greenland depend partly or entirely on hunting and small-scale fishing. The quotas for small-scale fishing have been reduced in favor of larger vessels. Only few studies have examined how climate change affects Arctic communities and evaluated their adaptation strategies, and the majority of the conducted studies are based on qualitative methods. Consequently, quantitative assessments of the importance of subsistence hunting and fishing as components in households' food supply and total income are scarce. Although it is well known that subsistence hunting and fishing is important to many households, this side of the economy is not visible in national income assessments. Furthermore, research indicates that a large proportion of Greenlandic hunting households can be considered poor, both in national and international contexts.

Reduced hunting and fishing yields, either as a consequence of climate change, regulation or both, may therefore severely affect the material wealth and general well-being of hunting households without being detected in national income statistics. Lack of documentation of such changes further implies that these aspects are often not included in political decision making.

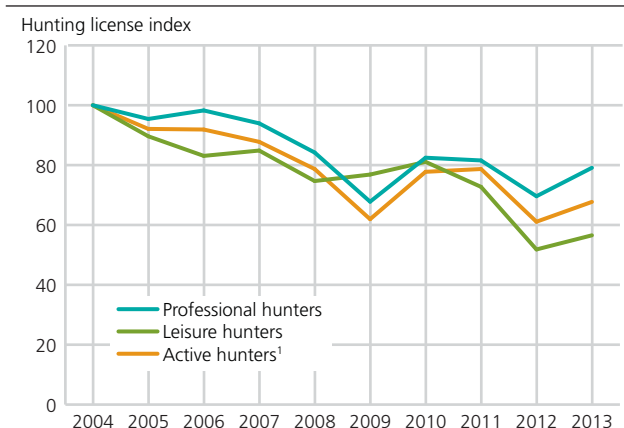
The role of hunting and small-scale fishing for livelihoods, living conditions and general well-being of hunters' and small-scale fishermen's households, as well as their contribution to the wider Greenlandic society and the national economy are examined in a research project anchored at the University of

Figure 6.13. Total yield of hunting in per cent of the yield in 2004 for categories of sea mammals and birds



Source: Ministry of Fisheries, Hunting and Agriculture (based on data in Statistics Greenland's Statistical Yearbook 2015, Table 11).

Figure 6.14. Hunting licenses in per cent of the licenses issued in 2004



¹ Active hunters are professional or leisure hunters who reported catch during the year.

Source: Ministry of Fisheries, Hunting and Agriculture (based on data in Statistics Greenland's Statistical Yearbook 2015, Table 10).

Greenland (Ilisimatusarfik) in Nuuk in partnership with the University of Copenhagen, University of Roskilde and Artek/Danish Technical University. The project involves a number of associated partners, such as the Ministry of Fisheries, Hunting and Agriculture, Ministry of Nature, Environment and Justice, Statistics Greenland, Greenland Institute of Natural Resources, the Association of Greenlandic Hunters' and Fishers' (KNAPK), and Royal Greenland A/S.

Figures 6.13 and 6.14 present some of the first results of the project, indicating the significance of hunting for hunters in Greenland. During the 10 year period from 2004, where quotas were introduced for some species, total annual yields of sea mammals and birds declined slightly for seals, birds and small whales and by as much as 40 per cent for walrus and polar bear (Figure 6.13). However, the number of active licensed hunters also declined from 2004 to 2013 (Figure 6.14), which resulted in an increased yield per hunter of important species such as seals, small whales and birds.



Photo: Greenland. Colorbox

Therefore, while the overall contribution of these species to the Greenland economy appears to have decreased, the contribution to the individual hunter's household does not appear to have decreased, at least not on average. However, individual households' reliance on hunting as a share of total household income (subsistence and cash) and the distribution of hunting incomes across households are not known and may change dramatically in the future as a result of predicted climate changes and further tightening of hunting regulations aiming to protect vulnerable species.

This project therefore aims to determine to what extent cash and subsistence income derived from individual species contribute to Greenlandic hunting households' total annual income. Reliance on hunting and hunting yield composition are compared over time and between locations to examine to what extent different species substitute each other and how this has been influenced by climatic factors, hunting regulations and trade prices. The project aims to help designing future hunting regulations in a way that might better serve the long-term interests of society as well as hunting households. This includes evaluating to what extent alternative income generating opportunities such as tourism may potentially fill household economic gaps resulting from tightened hunting regulations and climate change.

Initially, the project is based on analysis of existing, detailed register data including yields from hunting and small-scale fishing collected by the Ministry of Fisheries, Hunting and Agriculture and the Greenland Fisheries License Control Authority. These data will be combined with data on income, social benefits received, registered trade in skins, meat and commercial fishing products collected by Statistics Greenland. Subsequent stages of the project will collect primary empirical data through household surveys to examine hunters' preferences for income-generating activities and the validity of own reported catch and registered income as a basis for scenario and sensitivity analysis.

Subsistence in the Arctic – results from SLiCA 2015 in Qeqertarsuatsiaat, Greenland¹

Hunter T. Snyder, Dartmouth College, and Birger Poppel, Ilisimatusarfik, University of Greenland

The Survey of Living Conditions in the Arctic (SLiCA) is one of the most comprehensive comparative studies of the quality of Arctic life among Arctic indigenous peoples. As a circumpolar research project, it has taken place among Inuit, Saami and the indigenous peoples of Chukotka and the Kola Peninsula. More than 8 000 respondents in the northernmost parts of Russia,



Fishing in Qeqertarsuatsiaat, Greenland. Photo: Hunter T. Snyder

Alaska, Canada, Norway, Sweden and in Greenland have participated and contributed to the overall comprehensiveness of the SLiCA research program. This overview presents results from the most recent SLiCA study for the small-scale fisheries assessment in Qeqertarsuatsiaat, Greenland². Due to the comprehensiveness of SLiCA, we refer only to some of the most significant findings as basis for the study of the mixed cash and subsistence activities.

Case Study: Qeqertarsuatsiaat

Qeqertarsuatsiaat is a small settlement 170 km south of Nuuk. In 2005, a SLiCA research team conducted a survey there with satisfactory levels of participation among the community ($n=52$). The results bring to light the living conditions and quality of life experienced in the settlement³. The findings from 2005 serve as the baseline assessment for the 2015 revisit.

There are several reasons that the Greenland SLiCA team chose to return to Qeqertarsuatsiaat to reissue the Survey of Living Conditions in the Arctic. Studies over time of settlement living conditions in the Arctic are highly uncommon, even though some time series may be found from census-type questionnaires repeated over time. Because the SLiCA questionnaire is comprehensive and has been revised and improved, issuing SLiCA in 2005 has established a strong baseline for future study of change throughout Greenland and elsewhere in the circumpolar regions.

Moreover, industrial development near Qeqertarsuatsiaat has also staged opportunities, concerns and challenges for the private sector, policy-makers and importantly the individuals who call the settlements home. The questions posed by the SLiCA are critical because they highlight changes in quality of living, income, the socio-cultural significance of subsistence livelihoods as well as personal and collective orientations toward work/life balance. The extent to which Greenland sees change on all fronts in its settlements, including Qeqertarsuatsiaat, calls for studies over time that may help to predict future change and impacts of industrial development and other factors. Pinpointing change in Qeqertarsuatsiaat could illuminate not just how its residents may adapt into the immediate future, but more broadly indicate how other settlements would stand to reposition themselves in the face of development and industrialization.

Summary of the 2005 and 2015 Methods

Overall, more than a thousand respondents have participated in SLiCA in Greenland and over 8,000 Arcticwide⁴. The high participation in Greenland has resulted in a nationally representative study at the individual and household level. In 2005, the SLiCA team achieved a representative sample at the individual and household level in Qeqertarsuatsiaat. 53 households were interviewed over two trips with four Greenlandic interviewers. At the time of interviewing in 2005, the population of Qeqertarsuatsiaat was registered to be

195 persons who were 15 years or older. The respondents were randomly elected from the public personal register⁵.

The analytical approach we take is a comparison to the same questions asked in 2005, the changes of which are reported as descriptive statistics through frequencies. To support a comparison between the 2005 and a 2015 assessment, we employed random sampling. The 2015 study was carried out in August and November 2015 over the course of two visits. The final SLiCA interview was conducted on the 20th November 2015, just a few weeks before the nearby industrial project, the True North Gems ruby mine began mining for rubies. From February 2014, the mine was in the construction phase. An aim of the study was to assess living conditions in Qeqertarsuatsiaat before mining activity began and thus before settlement income fluctuated and employment diversified. We expect that the opening of Greenland's only mine would thereafter have direct effects on the local labor market, trade, access to goods and services and thus quality of life in the settlement.

When the SLiCA group arrived in August 2015, the caribou-hunting season had just begun. Interviewers found it difficult to meet people either spontaneously in their homes or to schedule interviews in advance. As the results show in both 2005 and 2015, gathering wild resources remains especially important and few residents prioritized their contributions to this questionnaire over the necessity to gather food for the coming winter. Residents also struggled to participate with the onset of the school year, which began only three days after arriving.

Adapting to these circumstances, the team collected as many interviews as possible during the August 2015 fieldwork period and returned in November 2015 when the caribou season had concluded for the year. Although summer foraging activities had ceased, the team also found that previously established rapport with community members promoted inclusivity and thus higher participation. Interviewers indicated increased ease with which they were able to schedule and complete interviews⁶. Interviewers indicated some challenges regarding the translation of the new section of the questionnaire on the ruby mine and the potential for respondents to interpret the questions differently.

Economic Aspects of Subsistence and Informal Economies

Since 2005, there has been an increase in the percentage of households that consume more than half of the fish and meats that were harvested by members of the household (44 per cent in 2005 and 53 per cent in 2015). However, more households in 2015 indicated that none of the meat and fish that they eat is harvested by members of the household (16 per cent in 2005 and 23 per cent in 2015). There are a number of factors that help promote the increase subsistence contributions, one of which is technology.

There has been an increase in the prevalence of both boats and outboard motors since 2005, up from 55 per cent and 49 per cent to 61 per cent and 65 per cent, respectively. Furthermore, in 2015, almost three quarters of all households owned fishing nets, whereas in 2005, the figure was less than half (up from 45 per cent in 2005 to 71 per cent in 2015). There has also been an increase in the ownership and use of rifles, generators, and freezers. More are also using equipment used to ensure their safety during subsistence activities, such as GPS, survival suits and VHF radios. More than half of Qeqertarsuatsiaat's residents own equipment used to support subsistence activities, which is more than those who have personal computers (41.7 per cent).

Food quality Aspects of Subsistence and Informal Economies

Despite meats and fish being caught in larger proportions in 2015, the distribution of harvested food consumed has changed significantly. All households still indicate that they have eaten harvested food in the last 12 months, although half have indicated that less than half of their meals are harvested (14 per cent in 2005 and 6 per cent in 2015). In 2015, more residents indicated that about half of their meals were harvested compared to 2005 (17 per cent to 35 per cent), whereas fewer indicated that more than half of their meals were harvested (down from 69 per cent in 2005 to 59 per cent in 2015).

Social Aspects of Subsistence and Informal Economies

Several social aspects continue to play a critical role in the evolution of subsistence livelihoods in Qeqertarsuatsiaat. Since 2005, there have been marginal increases in the types of activities that are performed or traditional skills learned as a child. Fishing, seal hunting, sleeping overnight in nature, preparing reindeer meats and pelts, predicting the weather, making Greenlandic handicraft and driving a snow machine were all skills learned and performed more frequently in 2015 than in 2005.

The conservation of meat and fish remained the same, whereas fewer learned and performed the making of harvested food, knowing the names of ancestors, treating skins, sewing Greenlandic clothes and hunting whale. While only 84 per cent of respondents in 2005 taught their children these skills, close to all of the households indicated that they shared or transferred their knowledge to the next generation (95.2 per cent) in 2015.

Where children are taught subsistence skills has largely remained the same. Marginally more children are taught in the home, within local society, at church events and youth camps. There were decreases in school-based teaching of subsistence skills. While 80 per cent of respondents in 2005 indicated that they still to this day use their traditional skills, more than 90 per cent use them in 2015.

Cultural Aspects of Subsistence and Informal Economies

Whereas in 2005, 72 per cent of households indicated that they received harvested food from others, only 67 per cent did in 2015. Fewer residents are also sharing harvested food, down from 85 per cent in 2005 to 67 per cent in 2015. One might assume that a reason for reduced sharing is because residents are selling harvested food instead of sharing it, but this is not necessarily the case. Fewer households indicate that they are purchasing harvested food in 2015 than they did in 2005 (down from 72 per cent to 66 per cent in 2015).

Identity Aspects from Subsistence and Informal Economies

Food continues to serve as an important indicator of changes to factors that influence cultural identity vis-à-vis subsistence and informal economies. There have been changes to how households describe the aspects that are important for upholding notions of cultural identity. Although a smaller percentage of Qeqertarsuatsiaat residents indicated that they were brought up with or trained with any traditional Greenlandic values (from 78 per cent down to 68 per cent), there is increased emphasis on some and less on others. Both in 2005 and a decade later, Greenlandic food remains important for almost all (98 per cent and 100 per cent, respectively). A majority of small-scale fishers share fish (57 per cent), although if given the ultimatum between sharing and selling, almost two thirds indicate that they would instead sell.

However, some aspects integral to cultural identity are less relevant, including the fish and meats that respondents hunt and catch (down from 94 per cent down to 88 per cent), knowing family history (from 96 per cent down to 92 per cent), preservation of Greenlandic foods (from 99 per cent down to 90 per cent), participation in traditional cultural events (from 82 per cent down to 71 per cent), and the way respondents see nature (from 100 per cent down to 98 per cent). The emphasis around the reading of Greenlandic poetry and literature is the only identified aspect that remained the same (92 per cent).

Regarding the weight that various socio-cultural aspects have on the quality of living, the use of the Greenlandic language, respect for elders, care for children, remained important for all (100 per cent), whereas other ideals hold less weight, including the way residents share things and help each other decreased from unanimity to 90 per cent, respect for others (down from 100 per cent to 92 per cent), respect for nature (down from 100 per cent to 92 per cent), spirituality (down from 43 per cent to 67 per cent), and local autonomy (down from 92 per cent to 88 per cent). Hard work (up from 60 per cent to 81 per cent), knowledge of family tree (up from 79 per cent to 92 per cent), the way residents avoid conflicts (up from 74 per cent to 77 per cent), humor (up from 88 per cent to 94 per cent), the roles in the family (up from 78 per cent to 94 per

cent), training of girls for traditional roles (up from 53 per cent to 75 per cent), training of boys for traditional roles (up from 60 per cent to 77 per cent), knowledge of hunting and fishing (up from 85 per cent to 92 per cent), house-making skills (up from 73 per cent to 94 per cent) and humility (up from 80 per cent to 85 per cent) all saw increased weight in relation to the quality of living.

Integration Aspects - the Integration of Market and Subsistence Economy

Education remains a concern in settlements and Qeqertarsuatsiaat is no exception. In 2005, 19 per cent held less than seven years of education in 'folkeskole', whereas only 11 per cent reported the same level of education in 2015. Fewer also reported the completion of general school in 2015, down from 47 per cent to 39 per cent. Lower secondary education remained low at 6 per cent in 2015, whereas 3 per cent reported this as their highest level of education in 2005. Where there is significant change in the distribution of the highest education attained is in the 'Other' category, which includes university education and other trade or technical education. There was a 20 per cent spike from 2005 in the percentage of respondents who indicated highest levels in the 'Other' category. Others were trained as a carpenter, mariner, captain, social worker, clerical worker, elementary level teacher, seminarian, miner or engineer, fish factory worker or social helper. Of the respondents who elected to answer questions about their work, 73 per cent indicated that they were salaried workers, which is the same percentage as in 2005. The percentage of independent contractors has risen significantly since 2005, up from 5 per cent to 22 per cent.

The pattern of when and for how long people work in Qeqertarsuatsiaat has changed. While fewer report working 40 hours a week (from 53 per cent in 2005 down to 41 per cent in 2015), more report working more than 40 hours (up to 23 per cent in 2015 from 8 per cent in 2005). The percentage of residents who work less than 40 hours a week has also dropped (down from 17 per cent in 2005 to 11 per cent in 2015).

Workplace satisfaction is up in 2015 from 2005. More of Qeqertarsuatsiaat residents are either very happy or happy with their workplace (up to 29 per cent and 55 per cent in 2015 from 20 per cent and 43 per cent in 2005, respectively). Fewer also indicated that they were neither satisfied nor dissatisfied (down to 13 per cent in 2015 from 15 per cent in 2005). More than 70 per cent of respondents in 2015 felt as if they were treated fairly in the workplace, which is up from 50 per cent in 2005. Of the respondents, 59 per cent were pensioners and 41 per cent were not. The percentage who were not working is up from 25 per cent in 2005, meaning that were more respondents who were not working in 2015.

The interplay between work and subsistence activities remains strong in Qeqertarsuatsiaat and the extent to

which residents are satisfied with the balance has increased since 2005. More are very satisfied or satisfied with the combination of work and subsistence activities in 2015 than they were in 2005 (up from 23 per cent and 49 per cent to 31 per cent and 57 per cent, respectively). Fewer are also dissatisfied with the combination of work and subsistence activities (down from 8 per cent to 3 per cent in 2015).

Since 2005, there has been an increase in the percentage of residents who would prefer salaried work over a subsistence lifestyle (up from 49 per cent to 57 per cent in 2015). Fewer indicated a subsistence lifestyle is their preference (down from 35 per cent to 23 per cent in 2015). Fewer also felt a combination of the two was their preference in 2015 (down from 16 per cent to 11 per cent in 2015).

Analysis and Conclusion

Despite entrenched beliefs in public discourse about the quality of life in settlements and the relationships between technology and the deterioration of socio-culturally significant activities, how living conditions of residents of Qeqertarsuatsiaat have changed over the last decade suggests a number of surprising counterpoints. Although the prevalence of various forms of technology for subsistence activities have increased since 2005, subsistence activity not only remains important but is considered more important and carried out more frequently than in 2005. When the use of technology for subsistence activities increases in Qeqertarsuatsiaat, the importance and frequency of subsistence activities increase too. It is important to also bear in mind that personal connections to other Greenlanders is less important in 2015 than it was in 2005, and that the use of the personal computer has also increased since 2005.

Because the proportion of total meat and fish that is consumed in the household has increased since 2005, we are not surprised to find that a larger percentage in 2015 indicated that about half of meals eaten in 2015 are described as Greenlandic. Where the Greenlandic food has come from is less important than it was in 2005. We also see shifts in what is perceived as Greenlandic food as a factor that affects the distribution of the consumption of Greenlandic food. Changing aspects of Greenlandic identity are also significant in the study of subsistence economies. Greenlandic food is more important than it was in 2005, even though a smaller percentage indicated that they were raised with Greenlandic values, cared about the preservation of Greenlandic foods and the fish and meats the respondents hunt and catch. Although some aspects that are less integral to cultural identity, their reduced significance is not drastic.

One may also assume that as Qeqertarsuatsiaat residents work longer hours, that (1) workplace conditions or satisfaction may decrease, that (2) subsistence activi-



Drying caribou meat and Atlantic cod in Qeqertarsuatsiaat, Greenland. Photo: Hunter T. Snyder

ties would become less important. Our results indicate the opposite. Among those who work, a larger percentage are working 40 hours or more than in 2005 and feel as if they are treated more fairly in 2015. Despite an increase in working hours more households are either satisfied or very satisfied with the combination of subsistence and work activities. There is underlining evidence that as respondents chose salaried work over a subsistence lifestyle, there is no reduction in the importance in the combination of subsistence and work activities. In fact, there is an increase, and furthermore, the frequency and significance of subsistence activities has increased as a higher percentage of people indicate their preference for salaried work. As other studies have shown, cash remains a driver of the continuation and even expansion of subsistence activities in the Arctic⁷.

Overall, our results indicate that several aspects of mixed cash-subsistence activities and living conditions in Qeqertarsuatsiaat have improved since 2005. Overall satisfaction with living conditions has remained the same since the last decade assessment. Of special significance is the sustained significance that subsistence hunting and fishing activities play in settlement life. There is promise and expectation among national policymakers and community members alike that development and nearby industrialization could further improve living conditions in Qeqertarsuatsiaat.

Although a follow-up study in 2025 would be among the longest and most comprehensive study over time of living conditions in an Arctic settlement⁸, our results show that the living conditions in one settlement have improved regardless of the presence of a fully-operational mine. The findings we present further explicate where subsistence economies are already becoming stronger without the presence of a new industrial player such as the True North Gems Ruby Mine. The people of Qeqertarsuatsiaat ask how much development industrial projects such as the True North Gems Ruby Mine will add to the growing significance of mixed cash and subsistence economies as well as the resilience of the communities in which they are practiced.

Notes

Notes for Introduction

- ¹ Poppel, B. (2006): Interdependency of subsistence and market economies in the Arctic. In S. Glomsrød and I. Aslaksen (eds.): *The Economy of the North*. Statistics Norway.
- ² AHDR (2004): Arctic Human Development Report. Akureyri, Stefansson Arctic Institute.
- Larsen, J.N. and G. Fondahl (eds.) 2014. Arctic human development report II. Regional processes and global linkages, Nordic Council of Ministers: Copenhagen.
- ³ Poppel, B. and J. Kruse (2008): 'The importance of a mixed cash- and harvest herding based economy to living in the Arctic – an analysis based on Survey of Living Conditions in the Arctic (SLiCA)'. In: V. Møller and D. Huschka (eds.): *Quality of Life and the Millennium Challenge: Advances in Quality-of-Life Studies, Theory and Research*. Social Indicators Research Series. © Springer Science+Business Media B.V.
- Poppel, B. (ed.) (2015): *SLiCA Arctic living conditions*. TemaNord 2015:501, Nordic Council of Ministers.
- ⁴ Rasmussen, R.O. (2005): *Socioøkonomisk analyse af fangererhvervet i Grønland [Socio-economic analysis of the Greenland hunters]*. Prepared under contract to the Greenland Home Rule Government, Department of Fisheries and Hunting.
- ⁵ Unpublished estimates by Olga Murashko.
- See Dallmann, W. (2009), in "The Economy of the North 2008", pp. 87-91.
- ⁶ Kleinfeld, J., J. Kruse, and R. Travis (1983): Inupiat Participation in the Wage Economy: Effects of Culturally Adapted Local Jobs. *Arctic Anthropology*. 20(1):1-21.
- Kruse, J. (1991): Alaska Inupiat Subsistence and Wage Employment Patterns: Understanding individual Choice. *Human Organization*, 50(4):317-326.
- Stabler, J.C., G. Tolley, and E.C. Howe (1990): Fur Trappers in the Northwest Territories: An Econometric Analysis of the Factors Influencing Participation. In: *Arctic* 43(1):1-8.
- Myers, H. and S. Forrest, (2000): Making Change: Economic Development In Pond Inlet, 1987 to 1997, *Arctic*, 53(2):134-145.
- Usher, J.P., G. Duhaime, and E. Searles (2003): The Household as an Economic Unit in Arctic Aboriginal Communities, and its Measurement by Means of a Comprehensive Survey, *Social Indicators Research*. 61: 175-203.
- ⁷ Ford, J.D., Smit, B. & Wandel, J. (2006): 'Vulnerability to climate change in the Arctic: A case study from Arctic Bay, Canada', *Global Environmental Change*, 145-160.
- ⁸ Duhaime, G., Rasmussen, R.O. & Comtois, R. (1998): *Sustainable Development in the North*. Québec, Gétic, Laval University.

Notes for Holen: Subsistence in Alaska

- ¹ Berkes, F., J. Colding, and C. Folke. 2000. Rediscovery of Traditional Ecological Knowledge as Adaptive Management. *Ecological Applications* 10(5):1251-1262. See p. 1256.
- ² McDowell Group (2013) Economic Value of Alaska Seafood Industry. Report to the Alaska Seafood Marketing Institute. <http://pressroom.alaskaseafood.org/wp-content/uploads/2013/08/AK-Seafood-Impact-Report.pdf>
- ³ Wolfe R.J., C.L. Scott, W.E. Simeone, C.J. Utermohle, and M.C. Pete. 2010. The "Super-Household" in Alaska Native subsistence economies. National Science Foundation, ARC 0352611. See p. 21.
- ⁴ Wolfe, et al. 2010: 23.
- ⁵ Poppel, B. 2006. Interdependency of subsistence and market economies in the Arctic. In: Glomsrød, S. (editor) 2006. *The Economy of the North*. Oslo: Statistics Norway: 65-80. See p. 68.
- ⁶ Fall, J.A. 2014. Subsistence in Alaska: A Year 2012 Update. Division of Subsistence, Alaska Department of Fish and Game. Special Publication.
- ⁷ Alaska Department of Natural Resources. (ADNR). 2000. Fact Sheet, Title: Land Ownership in Alaska. Juneau.
- ⁸ Alaska Administrative Code 99.005. Alaska Department of Community and Economic Development (2008) Community Database Online. www.commerce.state.ak.us/dca
- ⁹ Fall, J.A. 2014. Subsistence in Alaska: A Year 2012 Update. Division of Subsistence, Alaska Department of Fish and Game. Special Publication.
- ¹⁰ Figure derived from Fall (2014).
- ¹¹ Wolfe R.J., C.L. Scott, W.E. Simeone, C.J. Utermohle, and M.C. Pete. 2010. The "Super-Household" in Alaska Native subsistence economies. National Science Foundation, ARC 0352611. See p. 21.

¹² U. S. Census Bureau 2011.

¹³ Holen, D., S.M. Hazell, D.S. Koster. 2012. Subsistence harvests and uses of wild resources by communities in the eastern Interior of Alaska, 2011. ADF&G Division of Subsistence, Technical Paper No. 372.

¹⁴ USDA/UAF. 2007. Cost of Food Index. USDA/UAF Cooperative Extension Service. University of Alaska Fairbanks. Fairbanks.

¹⁵ Holen, D. 2009. The dynamic context of cultural and social sustainability of communities in Southwest Alaska. *Journal of Enterprising Communities*. (3): 306-316.

¹⁶ Fall, J.A. 2014. Subsistence in Alaska: A Year 2012 Update. Division of Subsistence, Alaska Department of Fish and Game. Special Publication.

¹⁷ Holen, D. 2009. The dynamic context of cultural and social sustainability of communities in Southwest Alaska. *Journal of Enterprising Communities*. (3): 306-316.

Notes for Stapleton: Northern Canada

- ¹ Einarsson et al., 2004. The book *Migration in the Circumpolar North: Issues and Contexts* (Huskey & Southcott [Eds.], 2010), discusses circumpolar and Canadian migration.
- ² Canada changed methods of conducting a regular national census in 2011. The last census was in 2006. A voluntary survey called the Canada National Household Survey (NHS) took its place. The format and reporting was modified. Wherever possible, data from the NHS has been used, as it is the most recent. Because of the changes, some social indicators in this report are dated earlier than 2011. The NHS gives Geography Series, (<http://www12.statcan.gc.ca/nhs-enm/2011/as-sa/fogs-spg/?Lang=E>), for different levels of geography. Topics include Aboriginal Peoples, Immigration and Ethnocultural Diversity, Education, Labour, Income and Housing. Data are presented for the population living in private households and/or for the number of occupied private dwellings.
- ³ INAC Aboriginal Population, Household and Family Projections, 2007 and Statistics Canada, Catalogue no. 91-520-SCB and 91-520-SCB
- ⁴ www.trc.ca/websites
- ⁵ A Demographic and Socio-economic Portrait of Canada, AANDC, published under the authority of the Minister of AANDC, 200.
- ⁶ National Collaborating Centre for Aboriginal Health, 2010; Inuit Tapiriit Kanatami, 2011; Sisco et al., 2012; Davison & Hawe, 2012b.
- ⁷ Sisco & Stonebridge, 2010
- ⁸ Fenge, 2009; Sisco & Stonebridge, 2010; Howard et al., 2012
- ⁹ Pathways to Prosperity: An Economic Growth Perspective 2005 to 2025 provides a long-term vision for Yukon's economy (Yukon Economic Development, 2006). The NWT Economic Opportunities Strategy was released in 2013 to support and promote diversification of the economy of the NWT (NWT Chamber of Commerce et al., 2013). Work is underway to review and renew the Nunavut Economic Development Strategy, which expired in 2013 (The Sivummut Economic Development Strategy Group, 2003; Nunavut Economic Forum, 2012). The Government of Nunavut released Tunngasajji: A Tourism Strategy for Nunavummiut in 2013 (Economic Development & Transportation – Government of Nunavut, 2013).
- ¹⁰ Centre for the North, 2011)
- ¹¹ Statistics Canada, 2001
- ¹² Inuit Tapiriit Kanatami is working towards the development of more culturally and contextually appropriate TB prevention, control and care programs (Inuit Tapiriit Kanatami, 2013), as there are personal, family and socio-economic barriers to TB treatment adherence (Volmink & Garner, 2007; Orr, 2010b; Kulmann & Richmond, 2011).
- ¹³ Impact Economics, 2012
- ¹⁴ Cryopolitics, an Arctic News and Analysis blog October 27, 2015-11-04
- ¹⁵ The Conference Board of Canada publishes an economic forecast report Territorial Outlook for the territories on a biannual basis, including an economic and fiscal outlook, output by industry, labour market conditions, and demographic information, which is available through the Conference Board of Canada's e-library website (Centre for the North, 2011a). Yukon Economic Outlook 2012, Yukon Economic Review 2012 and the NWT Economic Review and Outlook reports provide current and projected views of the Yukon and NWT economies by sector (Industry, Tourism and Investment – Government of the NWT, 2011; Yukon Economic Development, 2012a & b). The 2010 Nunavut Economic Outlook report, which was commissioned by the Nunavut Economic Forum, details the results of investments made in wealth-generating capital, and

- focuses on economic, social and environmental performance as indicators of progress (Nunavut Economic Forum, 2010).
- ¹⁶ Pearce et al., 2011 (<http://www.canada.ca/en/polar-knowledge/publications/stateofnorthernknowledge2014.html>) Research is needed to inform the evolving operations of these governance innovations to ensure the developments they regulate proceed with a sufficient degree of 'social license' (Prno & Slocombe, 2012)
- ¹⁷ Huntington 2007 & 2009; Voutier et al., 2008; Rodon & Schott, 2013. (Manley-Casimir, 2011)
- ¹⁸ Its goal is to advance knowledge of the Arctic and to strengthen Canadian leadership in polar science and technology. (<http://www.canada.ca/en/polar-knowledge/index.html>)
- ¹⁹ <http://www.iti.gov.nt.ca/sectors/oil-gas>
- ²⁰ <http://ntilands.tunnngavik.com>
- ²¹ nwt_mineral_development_strategy.pdf
- ²² Fugmann, 2011.
- ²³ Kristin L. Laidre, Ian Stirling, Lloyd F. Lowry, Øystein Wiig, Mads Peter Heide-Jørgensen, and Steven H. Ferguson 2008. QUANTIFYING THE SENSITIVITY OF ARCTIC MARINE MAMMALS TO CLIMATE-INDUCED HABITAT CHANGE. Ecological Applications 18:S97–S125. <http://dx.doi.org/10.1890/06-0546.1>
- ²⁴ Socio-Economic Baseline Report Jay Project Section 3, Baseline Setting September 2014. (GNWT-ENR 2013a)
- ²⁵ (Dowsley, 2010)
- ²⁶ (www.fur.ca). Genuine Mackenzie Valley Fur program guarantees that all wild furs in the GMVF Collection are harvested as part of an ongoing, centuries-old tradition using the most humane trapping techniques in the fur industry today, and comply with European market guidelines and standards set out in the Agreement on International Humane Trap Standards.
- ²⁷ <http://www.enr.gov.nt.ca>, <http://www.yukonfga.ca/support/yukon-trappers-association>, <http://www.niws.ca>
- ²⁸ <http://www.enr.gov.nt.ca/programs/trapping>
- ²⁹ <http://www.env.gov.yk.ca/hunting-fishing-trapping/abouttrapping.php>
- ³⁰ Nunatsiaq News, May 2015
- ³¹ Lutra Associates, 2011; Invest Yukon, 2013.
- ³² Kuhnlein et al., 2004; Egeland et al., 2011; Huet et al., 2012; Aboriginal Affairs and Northern Development Canada, 2012a.
- ### Notes for Natcher: Food security
- ¹ De Schutter, O. (2010). Food Commodities Speculation and Food Price Crises: Regulation to reduce the risks of price volatility. United Nations Special Rapporteur on the Right to Food Briefing Note, 2, 1–14.
- ² Council of Canadian Academies (CCA). (2014). Aboriginal Food Security in Northern Canada: An Assessment of the State of Knowledge. Edited by The Expert Panel on the State of Knowledge of Food Security in Northern Canada. Ottawa: Council of Canadian Academies.
- ³ First Nations Information Governance Centre (FNIGC). (2011). First Nations Regional Health Survey: RHS Phase 2. Ottawa, ON.
- ⁴ Egeland, G. (With Inuvialuit Settlement Region Steering Committee, CINE staff members, and graduate students for the International Polar Year Inuit Health Survey: Health in Transition and Resiliency). (2010). Inuit Health Survey 2007–2008: Inuvialuit Settlement Region. Montréal, (QC): Centre for Aboriginal Peoples' Nutrition and Environment (CINE).
- ⁵ Chan, L., Fediuk, C., Hamilton, S., Rostas, L., Caughey, A., Kuhnlein, H., & Loring, E. (2006). Food Security in Nunavut, Canada: Barriers and Recommendations. International Journal of Circumpolar Health, 65 (5), 416–31.
- ⁶ Lambden, J., Receveur O., Marshall, J., & Kuhnlein, H.V. (2006). Traditional and Market Food Access in Arctic Canada Is Affected by Economic Factors. International Journal of Circumpolar Health, 65 (4), 331–40. Chan et al. (2006) op.cit.
- ⁷ Boulton, D.A. 2004. Hunger in the Arctic: Food (in) Security in Inuit Communities. Ottawa, ON. http://www.naho.ca/documents/it/2004_Inuit_Food_Security.pdf. Accessed 6 January 2015. Collings, P. (2005). Housing Policy, Aging, and Life Course Construction in a Canadian Inuit Community. Arctic Anthropology, 42 (2), 50–65.
- ⁸ Natcher, D.C., Felt, L., & Procter, A. (2012). Settlement, Subsistence, and Change among the Labrador Inuit. Winnipeg, MB: University of Manitoba Press.
- ⁹ Gombay, Nicole. 2005. "The Commoditization of Country Foods in Nunavik : A Comparative Assessment of Its Development, Applications, and Significance." Arctic 58 (2): 115–28.
- ¹⁰ Kuhnlein, H., Receveur, O., Soueida, R., & Egeland, G. (2004). Arctic Aboriginal Peoples experience the nutrition transition with changing dietary patterns and obesity. Journal of Nutrition, 134(6), 1447–1453.
- ¹¹ Nickels, S., Furgal, C., Buell, M., & Moquin, H. (2005). Unikaaqatigitt: Putting the Human Face on Climate Change. Perspectives from Inuit in Canada. Ottawa, ON.
- ¹² Smith, D., Varcoe, C., and N. Edwards, N. (2005). Turning around the Intergenerational Impact of Residential Schools on Aboriginal People: Implications for Health Policy and Practice. Canadian Journal of Nursing Research, 37 (4), 38–60.
- ¹³ CCA (2014), op.cit.
- ¹⁴ Beaumier, M. & Ford, J. (2010). Food insecurity among Inuit women exacerbated by socio-economic stresses and climate change. Canadian Journal of Public Health, 101(3), 196–201.
- ¹⁵ Nickels et al. (2005), op.cit.
- ¹⁶ Canada's Northern Strategy. (2009). Canada's Northern Strategy: Our North, Our Heritage, Our Future. <http://www.northernstrategy.gc.ca/cns/cns-eng.asp>. Accessed 27 January 2016.
- ### Notes for Gerkey: Russian Arctic
- ¹ Excluded by this policy are several larger ethnic groups, including Sakha and Komi, who also inhabit the Russian Arctic, share cultural and linguistic ties with indigenous groups, and rely on subsistence harvests.
- ² On the Guaranteed Rights of the Indigenous Numerically Small Peoples of the North, Siberia, and Far East – 82-FZ, 30/04/1999. It has been amended multiple times (122-FZ, 22/08/2004; 118-FZ 26/06/2007; 66-FZ, 13/05/2008; 309-FZ, 30/12/2008; 40-FZ, 05/04/2009; 256-FZ, 07/13/2015). Indigenous peoples belong to one of the official "numerically small" ethnic groups (536-R, 17/04/2006), ancestral territories are located in an official list of regions/provinces of the Russian Federation (631-P, 08/05/2009), and traditional economic activities are defined by an official list (631-P, 08/05/2009).
- ³ (40-FZ, 05/04/2009).
- ⁴ On Territories of Traditional Natural Resource Use of the Indigenous Numerically Small Peoples of the North, Siberia, and Far East – 49-FZ, 04/04/2001. It has been amended multiple times since it was enacted in 2001 (118-FZ, 26/06/2007; 160-FZ, 23/07/2008; 250-FZ, 03/12/2008; 406-FZ, 12/28/2013; 171-FZ, 06/23/2014; 499-FZ, 31/12/2014).
- ⁵ On General Principles of the Organization of Obshchiny of the Indigenous Numerically Small Peoples of the North, Siberia, and Far East – 104-FZ, 20/07/2000. It has been amended several times since it was enacted in 2000, including: 31-FZ 21/03/2002; 122-FZ, 22/08/2004; 19-FZ 02/02/2006; and 396-FZ 28/12/2013.
- ### Notes for Turi: Sámi reindeer pastoralism
- ¹ Further, siida constellations are not necessarily stable or durable, meaning that siidas may break up to several units seasonally or change altogether in adaptation to local pasture circumstances or even social or economic conditions.
- ² The United Nations Environment Programme (UNEP) estimates that if the current rate of encroachment continues, there will be no room for traditional reindeer herding in Norway within less than 50 years as central pasture resources will be fragmented and incompatible with traditional reindeer herding. GLOBIO.
- ³ This section is based on the PhD thesis of Ellen Inga Turi: "State Steering and Traditional Ecological Knowledge in Reindeer Herding Governance: Cases from western Finnmark, Norway and Yamal, Russia". Umeå University 2016.
- ⁴ Until 2014 this governance structure included regional co-management boards. With recent changes in legislation, the regional-level co-management boards have been dissolved and their duties transferred to the respective county governors. A central argument for this restructuring was that participatory measures have not worked as intended, see Ulvevadet, B. 2008. Management of reindeer husbandry in Norway – power-sharing and participation reindeer husbandry in Norway. Rangifer 28(1):53–78.
- ⁵ TEK is a framework developed for Canadian indigenous contexts. Berkes, F. 2009. Evolution of co-management: Role of knowledge generation, bridging organizations and social learning. Journal of environmental management 90:1692–1702. Berkes, F. 2012. Sacred Ecology. 3rd ed.

- tion. Taylor & Francis, New York. Berkes, F., J. Colding, and C. Folke. 2000. Rediscovery of traditional ecological knowledge as adaptive management. *Ecological applications* 10(5):1251–1262. Berkes, F., and D. Jolly. 2001. Adapting to climate change: Social-ecological resilience in a Canadian western Arctic community. *Conservation Ecology* 5(2):18. Traditional empirical knowledge in reindeer herding (Eira 2012a) and traditional knowledge-based management (Sara 2011. Eira, I. M. G., C. Jaedicke, and O. Magga. 2013. Traditional Sámi snow terminology and physical snow classification—two ways of knowing. *Cold Regions Science and Technology* 85:117–130. Sara, M. N. 2011. Land usage and siida autonomy. *Arctic Review of Law and Politics* 3(2):138–158.
- ⁶ Åhrén, M. 2010. The Saami traditional dress & and beauty pageants: Indigenous peoples' rights of ownership and self-determination over their cultures. Dissertation (PhD), University of Tromsø, Tromsø. Castree, N. 2004. Differential geographies: place, indigenous rights and "local" resources. *Political Geography* 23(2):133–167.
- ⁷ Conversely, local processes may also be instrumental in shaping developments at international levels, as seen when the Fiettar district, together with a transnational non-governmental organization (NGO), the Sámi Council, appeals to UN bodies in cases of pasture encroachment associated with mining, thereby framing the land-use conflict within the framework of indigenous rights. Other studies have also noted this type of scalar interaction in land-use conflicts involving local and indigenous interests, e.g. Neumann, R. P. 2009. Political ecology: theorizing scale. *Progress in Human Geography* 33(3):398–406.
- ⁸ In cases of land-use conflicts, for example, indigenous rights have, an indirect influence. Indigenous-rights played a part in shaping the 2007 reindeer-husbandry policy reforms in Norway. The Finnmark Act of 2005 is often highlighted as the national-level implementation of ILO 169.
- ⁹ Another example is wildlife management, which has bearings on reindeer pastoralism though regulating predator numbers.
- ¹⁰ Ulvevadet, B., and V. H. Hausner. 2011. Incentives and regulations to reconcile conservation and development: thirty years of governance of the Sami pastoral ecosystem in Finnmark, Norway. *Journal of environmental management* 92(10):2794–802.
- ¹¹ Heikkilä, L. 2006b. Comparison of indigenous and scientific perceptions of reindeer management. Pages 47–71 in B. C. Forbes, M. Bølter, L. Müller-Wille, J. Hukkinen, F. Müller, and N. Gunsley, editors. *Reindeer Management in Northernmost Europe: Linking Practical and Scientific Knowledge in Social-Ecological Systems*. Springer, Berlin Heidelberg.
- ¹² Paine, R. 1994. *Herds of the tundra: a portrait of Saami reindeer pastoralism*. Smithsonian Institution Press, Washington, D.C.
- ¹³ Ostrom, E. 1990. *Governing the commons: An evolution of institutions for collective action*. Cambridge University Press, Cambridge.
- ¹⁴ Hayter, R., T. Barnes, and M. Bradshaw. 2003. Relocating resource peripheries to the core of economic geography's theorizing: rationale and agenda. *Area* 35(1):15–23.
- ¹⁵ Biggs, R., M. Schlüter, D. Biggs, E. L. Bohensky, S. BurnSilver, G. Cundill, V. Dakos, T. M. Daw, L. S. Evans, K. Kotschy, A. M. LeitC. Meek, A. Quinlan, C. Raudsepp-Hearne, M. D. Robards, M. L. Schoon, L. Schultz, P. C. West, and M. Schlüter. 2012. Toward principles for enhancing the resilience of ecosystem services. *Annual Review of Environment and Resources* 37:421–448. Chapin, F. S., G. Peterson, F. Berkes, T. V. Callaghan, P. Angelstam, M. Apps, C. Beier, Y. Bergeron, a-S. Crépin, K. Danell, T. Elmqvist, C. Folke, B. Forbes, N. Fresco, G. Juday, J. Niemelä, a Shvidenko, and G. Whiteman. 2004. Resilience and vulnerability of northern regions to social and environmental change. *Ambio* 33(6):344–349. Tyler, N. J. C., J. M. Turi, M. A. Sundset, K. Strøm Bull, M. N. Sara, E. Reinert, N. Os-kal, C. Nellemann, J. J. McCarthy, S. D. Mathiesen, M. L. Martello, O. H. Magga, G. K. Hovelsrud, I. Hanssen-Bauer, N. I. Eira, I. M. G. Eira, and R. W. Corell. 2007. Saami reindeer pastoralism under climate change: Applying a generalized framework for vulnerability studies to a sub-arctic social-ecological system. *Global Environmental Change* 17(2):191–206.
- ¹⁶ Sara, M. N. 2009. Siida and traditional Sámi reindeer herding knowledge. *The Northern Review* 30:153–178.
- ¹⁷ Paine, R. 1994. *Herds of the tundra: a portrait of Saami reindeer pastoralism*. Smithsonian Institution Press, Washington, D.C. Paine, R. 2009. *Camps of the tundra: Politics through reindeer among Saami pastoralists*. Instituttet for sammenlignende kulturforskning, Oslo.
- ¹⁸ In addition, there is own consumption and private sales. The distribution of total meat value between meat production for official sales and for own consumption and private sales is based on the percentage share of animals slaughtered for these purposes. The Norwegian reindeer husbandry administration estimates an average of 20 reindeer per year per siida share for own consumption and private sales.
- ¹⁹ These figures include income from doudji when income exceeds 50 000 NOK, as it is difficult to separate the different types of non-wage income, so they are classified as outside reindeer husbandry when they in fact are an integral part of reindeer husbandry.

Notes for Snyder and Poppel: SLiCA

- ¹ The authors are grateful to Jack Kruse for invaluable contributions to making the SLiCA databases comparable and to Tuperna Kristensen for constructing the 2015-database.
- ² SLiCA Team members who have participated in the completion of this most recent effort include Project Leader Hunter Snyder (Dartmouth College), Project Manager, emeritus Birger Poppel (Ilisimatusarfik, University of Greenland), Professor emeritus Jack Kruse (University of Alaska, Anchorage) and three dedicated Research Assistants, Tuperna Kristensen, Jakob Thorin and Svend-Åge Fleischer Johansen (Ilisimatusarfik, University of Greenland).
- ³ A report, published by the SLiCA team in 2011 for Grontmij Carl Bro A/S, describes the findings of the 2005 assessment of living conditions in Qeqertarsuaat.
- ⁴ Poppel (2015).
- ⁵ A random sample was achieved by asking the person in the household whose birthday was next to participate on behalf of the household. Respondents under the age of 18, but not younger than 15 participated with written parental/guardian approval. Part of the section on health issues (questionnaire section D) was issued to respondents in confidence, the self-administered responses were placed in a sealed envelope by the respondents to further ensure anonymity. All responses were recorded and anonymized. All interviewers signed a confidentiality agreement and presented this agreement to every participant before commencing the questionnaire.
- ⁶ On both occasions, the local municipality provided ample resources to the research team, including access to a service house, a public assembly hall as well as print services to help spread the word.
- ⁷ (Condon et al., 1995; Ford et al., 2006; Wenzel, 1995).
- ⁸ See Kruse (2010) on the study of living conditions in the North Slope Borough, Alaska since 1974.

The Barents region with its Arctic and Sub-Arctic regions is characterized by significant but vulnerable ecosystems. These ecosystems are home to a diverse flora and fauna and natural resources are abundant. One of these resource elements that is found on several locations in the Barents region deposited and continuously mined, is nickel. There are for example mining operations under way in the Murmansk region on the Kola Peninsula in Russia, the Kevitsa mine close to Sodankylä in Finnish Lapland and the Rönnskäcken Nickel Project in Västerbotten, Sweden.

From the perspective of Corporate Social Responsibility (CSR), the nickel mining industry in the European Arctic provides societal and economic services, but faces at the same time various social and environmental challenges. The regional economies are based on a limited amount of business sectors and resource extraction (e.g. wood, oil, gas, metals & minerals) stays on the forefront in this context. Further notable sectors comprise tourism, fishery and reindeer herding¹. In this framework nickel mining is an essential contribution to establish employment in the region and to the societal prosperity of the local communities. On the contrary, the mining industry is facing permanently strong criticism for polluting the natural environment and its responsibility for shortcomings in the field of health and safety among workers and citizens located nearby mining areas. The list of stakeholder groups that outline the threats, risks and damages that mining causes is long. This list can comprise representatives from local communities, indigenous peoples, NGO's, environmental activists, journalists, scientists and political actors. From a socioeconomic perspective the nickel mining organisations also find themselves often in conflicts with reindeer herders, fishermen and tourism organisations, as there is demand to internalise negative external effects such as land use conflicts with reindeer herders, pollution of lakes and rivers entailing consequences for fishery and obstacles to bring tourism and mining together in the same areas.

This brief portrayal of the economic, social and ecological relationships of nickel mining and their Barents region stakeholder groups already showcases a couple of reasons why it can be advantageous for nickel mining companies to implement a CSR strategy and possibly following specific CSR guidelines. Mining corporations could improve, with implementing organisational CSR, individual social and environmental performances and gain a "social licence to operate" to solve or lessen the conflicts with stakeholders and strengthen the image of being a proactive social responsible business actor². To enter the path of CSR, it is essential to provide gateways of communication between companies and stakeholders. The company websites have (due to its transparent character and rather easy accessibility) prevailed as platforms for mining companies to disclose non-financial CSR related information next to the "traditional" financial and operational web-content.

One of the most notable CSR standards throughout several business sectors (including metal mining) is the Global Reporting Initiative (GRI) standard. This framework provides economic, environmental and social performance indicators that allow mining organisations to depict clearly an overview about operational threats, performances and improvements, encompassing these three categories. Particularly, for the mining industry was a supplement established to allow

specific reporting and comparisons inside this sector. Further standards which find consideration inside the Barents region mining industry are amongst others the non-certifiable ISO 26000 CSR standard, OHSAS 18001 (Occupational Health and Safety Standard), ILO (International Labour Organization) standards and a few Environmental Management Systems (e.g. ISO 14001, EMAS - Eco-Management and Audit Scheme).

By looking at the annual non-financial reports of nickel-extracting enterprises in the European Arctic, there is an attitude to concede to some extent that mining is linked to irreversible impacts to the natural environment. By explaining the efforts to harm the nature as less as possible and highlighting that new technologies and other investments lead continuously to improvements, the willingness to concede impacts is normally limited. In this context, the Barents region mining organisations declare often the inevitable necessity to clear natural forest away to build up infrastructure to get access to the pit and also to be able to transport the extracted resources to the markets. Several forms of emissions play a superior role. The smelting of nickel for instance leads to sulphur dioxide emissions that have strong negative impacts to the surrounding natural areas and to the health conditions of local residents and workers. However, the mining organisations put more emphasis on depicting improvements for their environmental performance, instead of just outlining the negative effects. This is also valid by considering the social components of CSR reporting in the Barents region mining industry. The companies underpin often in CSR reports that social benefits of mining outweigh largely the shortcomings of mining. They highlight in this regard, that local communities in the Barents region counties are mostly located in remote areas and underline the dependence of the community towards a local economic power. Mining organisations operate often in so-called "mono-cities" (solely one company or one industry operating in the area) and the whole well-being of the communities is intertwined with the success of the mining organisation. The mining industry often provides health care, pension funds, leisure facilities and supports the local infrastructure in addition to the employment it could provide. Thus it follows, that many of the regional mining organisations claim they possess a "social license to operate" that goes along with a broad acceptance inside the communities. However, there is also potential for a number of conflicts that find less consideration in the CSR reports (e.g. land use conflicts, negative impacts for fishery sector).

In the upcoming years and decades, the global demand for metals will increase (e.g. rising demand in emerging markets) and consequently mining in the Barents region will certainly contribute to satisfy the global needs. In this light, it is crucial from the Barents region mining industry perspective to continue to focus on CSR strategies and practices to remain competitive, to have mutually beneficial relations with local communities and to improve corporate images to attract shareholders and investors.

¹ Kokko, K., Oksanen, A., Hast, S., Heikkinen, H. I., Hentilä, H., Jokinen, M., Komu, T., Kunnari, M., Lépy, É., Soudunsaari, L., Suikkanen, A. & Suopajarvi, L. (2014). Sound Mining in the North - A Guide to Environmental Regulation and Best Practices Supporting Social Sustainability. Different Land-Uses and Local Communities in Mining Projects (DILACOMI)

² Dashwood, H. S., (2014). Sustainable Development and Industry Self-Regulation: Developments in the Global Mining Sector. *Business & Society* Vol. 53 (4), 551-582



Reindeer herding, Finnmark.
Photo: Tom Nicolaysen

7. The Arctic as a “hotspot” for natural resource extraction and global warming

Birger Poppel (lead author), Mads Fægteborg, Mia Olsen Siegstad and Hunter T. Snyder

The Arctic as resource frontier and “hotspot”

Birger Poppel

The Arctic has increasingly been seen as a “hotspot” in terms of global demand for resources, with large impacts on the environment and local communities from the petroleum and mining activities. Resources create expectations of economic opportunities, yet the prospect of economic development creates concerns about short- and long-term environmental effects and potential consequences for the livelihoods of local communities. The potential for a sustainable and diversified economic development and resource use in the Arctic may be challenged by an increased global demand for minerals and petroleum.

At the same time, rapid climate change impacts take place in the Arctic. The combined effects of these trends have large impacts on the nature-based livelihoods and living conditions of indigenous peoples and other Arctic residents. The livelihoods of the indigenous peoples of the Arctic are traditionally based on renewable natural resource harvest, and subsistence hunting, fishing, reindeer herding, and gathering are prevalent lifestyles in many parts of the circumpolar Arctic. The Arctic regions have abundant mineral and hydrocarbon resources (see Box V). A picture has been emerging of the Arctic as the last “resource frontier”¹. The abundance of oil, gas and minerals creates high income potentials. Increased global demand for oil, gas and mineral resources has contributed to the notion of the Arctic as a hotspot, not least because increased resource extraction represents a potential risk to the natural environment.

Thus it is fair to see the Arctic as a hotspot: A dictionary definition states that ‘hotspot’ is ‘a small area with a relatively high temperature in comparison to its surroundings’, or ‘a place of significant activity, danger, or violence’². Both definitions relate to the Arctic, as impacts of climate change are most prominent in the circumpolar North³. The latest report from United Nations’ Intergovernmental Panel on Climate Change (IPCC) states that: “The Arctic has been warming since the 1980s at approximately twice the global rate”⁴. Further, it is well documented that global warming in the Arctic substantiates, literally, the notion of the Arctic as a ‘hotspot’, with the many impacts of climate change such as decreasing Arctic sea ice extent, retreat of glaciers, thawing of permafrost and cascading effects

of these changes on peoples’ living conditions⁵. In addition to rapid economic, social, and cultural changes, climate change implies increased risks for Arctic ecosystems and social systems, and the combined effect of these changes contributes to create what we understand as the hotspots of the Arctic.

In 2010 and 2015 the Gordon Foundation conducted two extensive Arctic Public Opinion Surveys in the Arctic States, focusing on Arctic security and a number of issues facing the Arctic, including climate change⁶. In these studies respondents were asked about what they perceived as ‘the greatest threat facing the Arctic today’. In all Arctic states ‘Global warming, climate change’ ranked highest. In the view of the North American respondents, the number two threat, was ‘Environmental damage/degradation’. ‘Ice caps melting, melting of sea ice/permafrost’ ranked second in the other Arctic states⁷. In the Survey of Living Conditions in the Arctic (SLiCA) conducted among Inuit, Sámi and the indigenous peoples of Chukotka and the Kola Peninsula between 2001 and 2008 three out of four indigenous residents perceived ‘climate change’ to be a problem in their community⁸.

A number of reports have aimed to document different aspects of the combined effects of economic drivers and climate change impacts for the socio-economic developments in the Arctic, including ACIA, AHDR, ASI, ECONOR, SLiCA, SWIPA, Megatrends, and the Arctic Resilience Assessment⁹. More knowledge is needed on the processes creating hotspots and their impacts, in processes that are interconnected and often with cascading effects¹⁰. As a first approach to the topic, this chapter presents case studies of hotspot areas of actual and proposed mining activities.

The ruby mine in Qeqertarsuaat, Greenland

Hunter T. Snyder and Birger Poppel

In conjunction with the reissue of the Survey of Living Conditions in the Arctic (SLiCA)¹¹ in Qeqertarsuaat in 2015, the research program included an additional section to the questionnaire that specifically focused on the largest nearby industrial project in Qeqertarsuaat’s history – the True North Gems Greenland Ruby Mine (TNGG), referred to interchangeably as Appalut-toq mine, or the True North Gems Mine¹². As the only mine ready to operate in Greenland and then the first

ruby mine in the history of the country, the project holds exceptional significance for planners and policy-makers alike as they attempt to assess the prospective impact of nearby industrial development on the living conditions of settlements throughout Greenland. The survey (a slightly revised version of the SLiCA questionnaire applied in the 2004- 2006 Greenland survey) was completed by all who participated in SLiCA, and thus attaining 80 per cent participation rate. The respondents are representative of the residents of Qeqertarsuatsiaat.

As seen in the SLiCA findings section in Chapter 6 of this report, perceptions of the quality of life and the importance of subsistence activities in Qeqertarsuatsiaat have remained the same since 2005. However, the extent to which the reported increase in quality of life is related to recent international interest in the area and/or increased revenue to Qeqertarsuatsiaat from TNGG activities has hitherto been unclear. 74 per cent of respondents indicated that they were not involved in activities related to the construction of the ruby mine, and a smaller proportion (14 per cent) indicated that they were involved as consultants. 10 per cent indicated that they worked for TNGG. Only one person reported to have supplied fish to the mine. The respondents who worked in TNGG's construction phase had work commitments ranging from one to eight weeks, with the most common periods of employment being one week or four-to-six weeks. Our results indicate that the residents of Qeqertarsuatsiaat had low participation in or limited temporal commitment to the construction phase of the TNGG ruby mine.

The mine was planned to begin operating only two weeks after the SLiCA survey was completed in Qeqertarsuatsiaat, but due to financial problems the operating has been postponed. Concerning the applications to take up employment in the mining phase, more than eight out of ten said that they did not apply to work in the mine. Of those who said that they did not apply, three out of four already had a job, were pensioners or no longer worked or had children. A smaller proportion indicated that they had forgotten to apply, did not have the qualifications or had poor health. According to respondents, nine out of ten said they were not offered work by TNGG. The largest proportion of those who said that they were not offered work (42 per cent) did not know why. A quarter of respondents felt it was because they were pensioners. Concerning whether respondents personally benefitted from the ruby mine, eight out of ten indicated that they did not.

Despite low workforce participation and low perceived personal benefits from the mine, a large majority perceived collective gains for the presence of the mine. More than eight out of ten indicated that Qeqertarsuatsiaat would benefit from the ruby mine. Half of the residents indicated that the most significant positive consequence for Qeqertarsuatsiaat would be in the employment sector, as well as a better economy,



Greenland Minerals and Energy's administration building in Narsaq.
Photo: Mads Fægteborg

settlement development and cheaper travel, among others. Just a small number of respondents indicated that the mine was not to the benefit of Qeqertarsuatsiaat and half of the adult population felt that the citizens should benefit from the project. Responding to municipal and national benefit, a majority of the residents also indicated that the mine would benefit higher tiers of society. The ruby mine was thought to benefit Greenland on the grounds of a better national economy (28 per cent) and employment (24 per cent) as well as to the benefit of the treasury (27 per cent)

Local involvement and consultation has been a controversial subject since the ruby mine project gained political traction in the late 2000s. Three out of four residents felt very satisfied or satisfied with the consultation process in the exploration stage, whereas 25 per cent were more or less satisfied or dissatisfied. We recorded similar findings regarding the exploitation stage, with 78 per cent very satisfied or satisfied and 22 per cent more or less satisfied or dissatisfied. A larger proportion (46 per cent) was more or less satisfied or dissatisfied with how conflicts surrounding the local collection of rubies were managed by the Government of Greenland. The majority, more than five out of ten were, however, very satisfied or satisfied with the handling of the case. Nearly two out of three indicated that they were very satisfied or satisfied with how they were informed of the benefits of the mine, whereas 35 per cent were more or less satisfied or dissatisfied.

The majority of respondents were also very satisfied or satisfied with how they were informed of the risks and the community's planning preparation or the upcoming mining activities. A large majority (roughly eight out of ten) also held confidence in the ability of the Government and the Bureau of Minerals and Petroleum to take into account the interests of the population of Qeqertarsuatsiaat. Respondents had high confidence in the ability of the governing institutions and the private company to take into account public concern, having considered the Ministry of Fishing, Hunting and Agriculture, the local municipality, the local village board and True North Gems Greenland (51 per cent, 65 per cent, 67 per cent, and 58 per cent respectively).



True North Gems Greenland Ruby Mine Site, Greenland. Photo: Hunter T. Snyder

Our findings indicate low levels of participation on the part of the local community in the construction phase of the mine and few offers of employment in the production phases. This finding clarifies the different perceptions between residents of Qeqertarsuaat and TNGG of how True North Gems Greenland and its partners are living up to its Impact Benefit Agreement of hiring a 75 per cent or greater Greenlandic workforce. When the SLiCA questionnaire was issued in 2015, the workforce was 100 per cent Greenlandic, but a large majority was not local. It is, however, important to bear in mind that a majority of those who did not take up employment in the mine was because they already had jobs or were retired and thus past the stage of seeking employment. Concerning the outcomes and benefit of the mine, it was generally supposed to be low benefits at the individual level, whereas community, municipal and national benefits were supposed to be high. Residents indicated very high levels of satisfaction with the communication of information about the project and its projected benefits and risks.

Uranium mining – Kiggavik in Nunavut

Plans to establish a uranium mine at the Kiggavik site in Nunavut faced energetic opposition from Inuit hunters near the community of Baker Lake, which had previously welcomed the development of a gold mine. A review panel ultimately rejected the Kiggavik proposal over the company's inability to commit to a start date (due to a fall in the world price for uranium after the review process had begun).

Kuannersuit – a uranium project in South Greenland

Mads Fægteborg and Mia Olsen Siegstad

Planned mining of rare earth minerals in Kuannersuit, near the town Narsaq, implies production of uranium as a by-product. Kuannersuit is a mountain eight kilometres northeast of Narsaq in South Greenland. Although the municipality is the smallest of the four Greenlandic municipalities, it is covering an area of approximately 32 000 km² with just 7 000 inhabitants, involved in sheep farming, reindeer breeding and animal husbandry. The average workforce in the municipality, men and women between 18 and 64 years, was 3 111 people in 2013 of which 2 693 were employed and 418 unemployed. To them should be added 1 349 persons who were outside the labour force. The municipality faces new priorities for business development. Fishing and hunting is expected to continue to be significant with a potential for development and growth through increased self-sufficiency and the processing and innovation. The mining industry is expected to become important in the future, and is considered to be of great importance for employment opportunities and secondary support jobs in e.g. crafts and services. Also, the tourism industry is expected to prosper in the coming years.

This mining project has also initiated huge political discussions and protests locally as well as nationally due to potential environmental and health risks. Further-



Kuannersuit mountain where the potential REE-mine will be situated. Photo: Mads Fægteborg

more, within the Danish Realm the Danish state still has the authority in foreign policy and security matters, including trade in uranium. There has for decades been a mutual understanding among a vast majority in the Greenland Parliament of a zero-tolerance policy regarding radioactive minerals, which according to the Arctic Strategy of the Danish Kingdom ‘means that it (the Greenland Government – ed. comm.) does not permit the exploration and exploitation of deposits that contain radioactive elements, either as a main product, by-product or residue’ (Kingdom of Denmark 2011:25)¹³. The zero-tolerance policy was lifted in 2013 by a majority of one vote in the Greenland Parliament.

At the end of January 2016 the Danish and Greenland governments issued agreements on how to handle security and other issues in relation to mining and export of uranium and other radioactive minerals. These agreements were confirmed by the parliaments in Greenland and Denmark in the 2016 spring sessions of the two parliaments.

Uranium in Kuannersuit

Uranium was found in the Kuannersuit Mountain in 1956 and has since been geologically mapped and measured. Over the period 1958-1981 the Danish state extracted uranium at Kuannersuit. In 1962, 180 tonnes of ore were taken, and in 1979-1981, 4 700 tonnes. In 1988 the so-called zero tolerance was introduced, which meant that no mineral extraction could take place, if the ore contained uranium¹⁴. The

idea of uranium mining has not previously divided the Greenlandic population, but this happened in recent years when proposals to extract rare earth elements (REE) were considered, in particular in Kuannersuit, where the rare earth elements are found in the same ore as the uranium. By mining the REE, uranium will be recovered as a by-product. In the election campaign to the Inatsisartut (parliament) in 2013, there were two opposing views, in favour of and against, the termination of the zero tolerance policy. Parties that wanted to abolish the zero tolerance won the election, and by a majority of one vote in the Inatsisartut the zero tolerance was lifted. The arguments for the abolition of the zero tolerance is clear and unambiguous, the creation of new jobs and increased export earnings. The argument against the repeal is likewise clear, the problem of waste, the use of foreign labour and social problems.

Inuit Circumpolar Council (ICC) Greenland found that many people feel they do not receive the information necessary to develop an informed opinion on the mining project on Kuannersuit¹⁵. A project ‘Better citizen involvement on Kuannersuit’ was established by ICC Greenland to identify, what needs there are for nuanced and qualified information of the public. In this context, ICC Greenland leaned on the ILO Convention no. 169¹⁵ which states indigenous peoples’ rights to consultation and benefit-sharing and further, the UN Declaration on the Rights of Indigenous Peoples (UNDRIP)¹⁶, which states that indigenous peoples are entitled to have an independent information in order

to give a free, prior and informed consent (FPIC) for projects of this nature and of this magnitude.

Greenland Minerals and Energy (GME) is an Australian owned company and has been operating in Greenland since 2007. GME's primary focus has been on advancing the Kuannersuit multi-element project (rare earth elements, uranium and zinc) through a feasibility period, which it hopes will result in development of the mine. By late 2007, it stood clear that Kuannersuit had the potential to become a resource of global significance with a poly-metallic deposit, strongly enriched by rare earth elements and uranium. On November 25, 2015 GME announced that the Greenland Self-Government had approved the public pre-hearing, the so-called 'White Paper' and the 'Terms of References', which will allow the company to go on with their application for exploitation.

Danish concerns

When the former Premier of the Greenland Government proclaimed that Greenland could become one of the biggest exporters of uranium¹⁷, she initiated a heated debate among the politicians in the Danish Parliament. Could Greenland do so on its own? Would it be legal? Extraction of rare earth elements could be a seminal factor for international markets and would be an introduction to a break of China's monopoly on these minerals. A recent report argues that a practice of zero tolerance existed, albeit on a case-by-case basis until the 'moratorium' was put to a vote in Inatsisartut in 2013¹⁸. Since no record of a decision on a zero tolerance policy has been located in the archives, it would seem that until 2013 no laws specific to uranium mining were in place in Greenland. Trade of uranium, however, requires a clear set of laws and regulations, such as an application of the Additional Protocol, which has applied to Denmark since 1998 but was not introduced to Greenland until 2013. In 2013, Greenland and Denmark established the Uranium Working Group (UWG) to look at all relevant issues related to mining and exporting radioactive minerals. "The work of the UWG demonstrates a joint approach to legalities and standards, which will define the Realm's pathway in the years to come. At this moment in history, the outlook is positive."¹⁹

Agreement between Denmark and Greenland

On January 19, 2016 Denmark and Greenland signed agreements on the rules for future commercial export of uranium. According to the Danish Minister of Foreign Affairs, the countries agreed after "prolonged discussions". "We had to agree on how we deal with the fact that Greenland has the right to extract uranium, while Denmark is responsible for what happens to it when it is ready to be exported." The biggest opposition party in the Inatsisartut, Inuit Ataqatigiit was not satisfied with how the agreements on uranium exports and control were handled by the Naalakkersuisut (Self-Government) and called for a new referendum.²⁰



Vegetables from the small farms around the village of Qassarsuk, South Greenland. Photo: Mads Fægteborg

In the spring of 2016, the Inatsisartut and the Danish Parliament dealt with a number of legislative proposals to set the framework for how uranium should be exported from Greenland – if and when a mine with uranium as a by-product opens. Under international law, the Danish Kingdom must uphold a number of obligations to prevent nuclear proliferation and most of those extend to Greenland: Export controls of dual-use goods and technologies are designed to ensure that sensitive goods and technology not are falling into the wrong hands and thus contribute to the development and spread of weapons of mass destruction, or being exported to countries that pose a risk to international security and stability."²¹

Local concerns

As part of the survey of the project 'Better citizen involvement on Kuannersuit', Mads Fægteborg and Mia Olsen Siegstad visited the Kujalleq municipality for 3 weeks in September and October 2015²². The first stop was at Qassarsuk, which is a sheep farming settlement with about 90 inhabitants, located on the opposite bank of the fjord where the Narsarsuaq airport is situated (about 40 kilometres from Narsaq). The settlement serves as a small community with shops, school, elders' home, church and post office. Sheep farming is the main occupation of the residents of Qassarsuk, as it is in the village's hinterland. There seems to be a large potential in developing the sheep farming and agriculture, and in refining of food products. Besides sheep farming there is also considerable potential in tourism.

The citizens were initially asked about the ways in which they had been informed about the plans for the extraction of rare earth elements with uranium as a by-product at Kuannersuit. At the same time, the citizens were asked if they were aware of their rights with respect to non-renewable resource development. The chairman of Sheep Farmers Association said that the association had discussed the three information meetings that had been held. On this basis, he indicated that a majority found the information fairly satisfactory and were not opposed to mining, or against uranium if it could be done in a responsible way. However, he added that the extraction should not be at the expense



Industrial waste at the dumping ground in Narsaq. Photo: Mads Fægteborg

of sheep farming. A majority of the association, however, was very negative towards the plans to deposit the residual material – known as tailings – in the Taseq Lake. A woman and her husband who run a sheep farm and have a guesthouse for tourists, believed that the statements that were made were of concern because they were incomplete. As an example she found that questions about the radioactive dust that can be carried by strong winds in the area could not be answered. Further she expressed that many are very concerned about the impacts that the prospected mine may inflict on the neighbourhood, especially the grazing areas, where sheep and lambs graze for several months a year. “It’s a bad idea to establish a mine that extracts minerals that is including radioactive materials, and close to the food producers who grow their products close the mine.”

The citizens wanted answers to a series of questions: “We are worried about environmental pollution. We want to know something about the dust and how it is going to be managed, because it is very windy in South Greenland. They claim that the dust does not blow away but will stay at the mine and the Taseq Lake where they will deposit the waste. How can we be assured that the lake does not pollute the nearby countryside – and how will they monitor it? And what happens when contamination happens? Do we get

any compensation? We have sent a letter to the Greenland Government and asked if there is going to be any compensation if there is pollution from the Taseq Lake. The answer was that it was not the Government’s responsibility, but the responsibility of GME (Greenland Minerals and Energy). GME claims the opposite. It is strange.” Another person said that there was no information about the cultural impacts on the small communities that might be expected: “The most important thing for us are the sheep and our profession. What will be the consequences for us when there will be many workers from outside?”²³

It was concluded from this meeting and the meetings held in Ipiutaq, Narsaq and Qaqortoq that groups both for and against mining at Kuannersuit, expressed that they needed more information on the project. The closer people live to the potential mine at Kuannersuit, the more worried people are, and this is especially the case for those who are dealing with sheep farming and food production. Since many of these people also earn part of their income from tourism, they are also worried, whether tourists will choose other destinations if there is a uranium mining near Narsaq. The whole question of uranium as a by-product of the mining of rare earth elements has divided the Greenlanders in two groups with roughly 50 per cent on each side. The situation

is the same in Narsaq, but with the side effect that families, neighbours and others no longer speak to each other. But the worst we experienced was that children were bullied. Shall Greenland join the club of uranium-producing countries? Will there be a referendum, as promised by the previous Greenland government? Opponent organizations are angry about the lack of a referendum, and this meets only political silence from the Naalakkersuisut. Meanwhile the mining company is working to prepare its final application for extraction²⁴.

Conclusion

It is challenging to interpret the results of the surveys in these case studies. There are clearly diverging opinions, ranging from acceptance of mining projects to divided local communities, regions and countries. The results indicate that emphasis needs to be on how to secure benefits to local communities, and how to secure involvement, capacity building and inclusion of traditional knowledge in regulatory frameworks. From a precautionary perspective, there is a need for diverse economic activities to avoid 'putting all one's egg in one basket', to support an economic development that is aligned with the well-being of indigenous peoples and other Arctic residents.

Notes

- ¹ Nuttall analyses and discusses 'frontier' as an image and a concept – especially in relation to the Canadian Arctic – in *Pipeline Dreams, People, Environment, and the Arctic Energy Frontier* (Nuttall 2010). See also Wood Mackenzie (2006) and Guggenheim Partners January 21, 2016: <https://www.guggenheimpartners.com/firm/news/guggenheim-partners-endorses-world-economic-forums>
- ² The Oxford electronic dictionary.
- ³ United Nations Intergovernmental Panel on Climate Change (IPCC), Working Group II. WGII. (2013) Fifth Assessment Report, AR5. <https://www.ipcc.ch/report/ar5/>. Chapter 28:3.
- ⁴ The faster rising average temperature in the Arctic has led to the notion of the Arctic as 'the canary in the mine' indicating 'an early warning'.
- ⁵ Arctic Council (2013). Arctic resilience interim report 2013. Stockholm: Environment Institut and Stockholm Resilience Centre, Stockholm; Hovelsrud, G. K., Poppel, B., van Oort, B., & Reist, J. D. (2011a). Arctic societies, cultures, and peoples in a changing cryosphere. *Ambio*, 40, 100-110; Hovelsrud, G.K., Poppel, B., van Oort, B., & Reist, J. (2011b). Arctic societies, cultures and peoples in a changing cryosphere. In: *Snow, Water, Ice and Permafrost in the Arctic (SWIPA)*. Arctic Monitoring and Assessment Programme (AMAP). Norway; Nuttall, M., Burkes, F., Forbes, B. C., Kofinas, G., Vlasova, T., & Wenzel, G. (2005). Hunting, herding, fishing and gathering. In: *Arctic Climate Impact Assessment*. New York: Cambridge University Press; Rasmussen, R. O. (Ed.) (2011). *Analyzing megatrends*. [TemaNord 2011:527]. Copenhagen: Nordic Council of Ministers. http://library.arcticportal.org/1526/1/TemaNord2011-527_Megatrends.pdf.
- ⁶ The report from the Gordon Foundation, *Rethinking the Top of the World: Arctic Public Opinion Survey*, Vol. 2 (Gordon Foundation 2015) was based on interviews conducted in 2015 with representative samples in the eight Arctic states (in Canada and the United States including residents both in and outside the Arctic).
- ⁷ Gordon Foundation 2015:27-28, see note 12.
- ⁸ Poppel, Birger, Jack Kruse, Gérard Duhaime, Larissa Abryutina. 2007. SLiCA Results. Anchorage: Institute of Social and Economic Research, University of Alaska Anchorage (www.arcticlivingconditions.org); Poppel, B. (ed.) 2011. Arctic living conditions. Survey of Living Conditions in the Arctic. Major SLiCA findings presented to the Arctic Council Ministerial meeting. 6 pages. Nuuk.
- ⁹ Arctic Climate Impact Assessment. (2005). Cambridge, UK: Cambridge University Press and Arctic Monitoring and Assessment Programme (AMAP) (2011). *Snow, water, ice and permafrost in the Arctic (SWIPA): Climate change and the cryosphere*. Oslo, Norway: Arctic Monitoring and Assessment Programme.
- ¹⁰ Due to obvious limitations because of the length of the chapter the focus has been on topics at an aggregate level and several aspects (including actual and potential geopolitical tensions as well as the discourse whether a new arms race in the Arctic has started) that might have been included are left out. As an example, the definition of 'hot spot' includes 'violence'. Domestic violence at the family and household level is a huge and well-documented social problem in many Arctic communities but for the reasons afore-mentioned not dealt with in this chapter. Arctic Governance Project 2010. <http://arcticgovernance.custom-publish.com/home.132703.en.html> Arctic Council (2013). Arctic resilience interim report 2013. Stockholm: Environment Institute and Stockholm Resilience Centre, Stockholm.
- ¹¹ See www.arcticlivingconditions.org and Poppel, B. (Ed.) (2015). SLiCA: Arctic living conditions. Living conditions and quality of life among Inuit, Sami and indigenous peoples of Chukotka and the Kola Peninsula. *TemaNord* 2015:501. Copenhagen: Nordic Council of Ministers. (426 pages). DOI:10.6027/TN2015-501.
- ¹² In September 2016 True North Gems Greenland went bankrupt and the Norwegian owned company LNS Greenland took over the Appaluttoq mine and the licenses necessary to operate the mine. (<http://knr.gl/da/nyheder/lns-greenland-overtager-rubinminen-ved-qeqertarsuaat>)
- ¹³ Ministry of Foreign Affairs, Denmark; Department of Foreign Affairs, Greenland; Ministry of Foreign Affairs, Faroe Islands (2011). *Denmark, Greenland, Faroe Islands : Kingdom of Denmark Strategy for the Arctic 201-2020*. Copenhagen.
- ¹⁴ The zero tolerance was decided by the Joint Council for Mineral Resources in Greenland and has, although it was never formally decided in the Greenlandic nor the Danish parliament, been generally accepted as normative for handling uranium mining in Greenland. The general acceptance is illustrated for example in the Arctic strategy of the Danish Kingdom stating that 'Regarding radioactive minerals, the Self Government follows a zero-tolerance, which means that it does not permit the exploration and exploitation of deposits that contain radioactive elements, either as a main product, by-product or residue (page 25 – see note 11).
- ¹⁵ The project 'Better citizen involvement on Kuannersuit' was funded by the Premier's Office, and to undertake the investigation project, ICC Greenland hired Mads Fægteborg and Mia Olsen Siegstad.
- ¹⁶ International labour Organization (ILO). *Indigenous and Tribal Peoples Convention*, 1989 (No. 169) .
- ¹⁷ http://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:0::NO:12100:P12100_INSTRUMENT_ID:312314:NO United Nations Declaration on the Rights of Indigenous Peoples (2007). http://www.un.org/esa/socdev/unpfii/documents/DRIPS_en.pdf
- ¹⁸ (DIIS Report 2015)
- ¹⁹ In an address to the Arctic Circle Assembly in Reykjavik, Iceland on October 12 2013, former Greenlandic Premier Aleqa Hammond (from the social democratic Siumut party) claimed that the abandonment of the zero-tolerance policy towards mining uranium might lead to Greenland ranking among the ten – maybe even five – leading exporters of uranium. <http://knr.gl/en/node/92964>
- ²⁰ Despite the lack of a parliamentary decision on the zero tolerance policy there seems to be a joint understanding at different levels of society. The Arctic strategy of the Danish Kingdom from 2011 is one example (Danish Kingdom 2011).
- ²¹ Vestergaard, C. and Thomasen, G. 2015. *Governing Uranium in the Danish Realm*. Copenhagen: Danish Institute for International Studies. DIIS Report 2015:17, page 29. Press Release from Inuit Ataqatigiit January 21, 2016. Signed by Sara Olsvig, Chairman. Fælleserklæring mellem Erhvervs- og Vækstministeriet og Departementet for Erhverv, Arbejdsmarked og Handel om eksportkontrol af dual-use produkter og teknologi. page 1.
- ²² The project 'Better citizen involvement on Kuannersuit', was conducted during the period 1 August to 30 November 2015. The final editing was carried out in December-February.
- ²³ Siegstad, M.O. & Fægteborg, M. 2016. *Ajorpoq – vi får ingen svar!* page 33.
- ²⁴ Tavshed om uranafstemning. *Sermitsiaq*, February 4, 2016.



Tunulliarfik Fjord in South Greenland. Photo: Mads Fægteborg

8. Tourism in the Arctic: economic impacts

Kristine Grimsrud¹

Introduction

The Arctic is for many an exotic destination that offers aurora borealis, ice and snow, big landscapes, dog sledding, skiing, reindeer, wildlife habitats, hunting and fishing, and cultural heritage sites². Arctic tourism has grown rapidly over the last couple of decades as a result of increased demand for “last-chance” tourism experiences as warming of the Arctic melts glaciers and ice-caps. A large number of retired people with strong purchasing power increasingly seek tourism destinations in the Arctic.³ The improved physical accessibility caused by a reduced amount, extent and duration of Arctic sea ice⁴ also drives demand for Arctic tourist destinations. Over the years, ice-strengthened vessels used in cruise tourism have become more available, and Arctic tourist destinations have new and expanded infrastructure⁵.

On the one hand, it is often hoped that tourism can be a significant source of revenue, jobs, personal income, and public finance in the Arctic, and that tourism can revitalize and stop outmigration from communities that formerly had resource dependent economies.⁶ And it is often hoped that tourism can contribute to boost the preservation and transmission of cultural and historical traditions⁷. In general, benefits from tourism to communities tend to increase if the tourism industry employs staff locally, buy locally produced goods and services and contribute through taxes. While, the potential for small scale tourism is present in some Arctic regions, related to e.g. hunting and fishing, this potential may be smaller for other Arctic regions if the desired tourism development of e.g. cruise ports requires relatively large infrastructure investments. Synergy effects between large and small scale tourism may exist⁸.

On the other hand, communities may experience several negative socio-cultural impacts from tourism. Sparsely populated Arctic communities may be overwhelmed

when the number of tourists by far exceeds the populations and infrastructure capacities of their host communities. The ecosystems in the Arctic are fragile and susceptible to change when impacted by pollution, waste and rapid development of tourism-related infrastructure⁹. Traditional cultures may also change as a result of tourism; there may be increasing commodification of traditional religious rituals and rites and a changed perception toward sacredness of sites and objects. Local communities may engage in so called “staged authenticity” to adapt to tourists’ demands. Fast food and hotel chains enter into local communities as tourists often demand standardized services for accommodation, food, and beverage. Economic inequality between locals and

Box 8.1. Arctic marine tourism

Cruise tourism has increased in several Arctic regions, including Svalbard, Alaska, and the Canadian Arctic regions. Arctic cruise tourism can only take place in spring, summer and fall, with the vast majority of tourists visiting in the summer and fall months. The summer and fall seasons are preferred because of improved accessibility when the extent of Arctic sea ice dips to the lowest levels during the months of August and September.¹ Arctic cruise tourism is now possible for longer periods of the years since much sea ice has melted. Further loss of summer sea ice will result in an increasingly navigable Northern Sea Route with new opportunities for cruise shipping. Projections suggest that by 2050, the Northern Sea Route will have 125 days/year with less than 75 per cent sea-ice cover, which will improve conditions for cruise-tourism.²

Increasing cruise-tourism may appear promising for the economy of Arctic communities, but the total benefit of this tourism is questioned in a number of studies³. There are several reasons for this. Cruise ships are self-contained to the degree that cruise tourism offer little economic benefit to local communities. Arctic cruise ships face considerable hazards, such as challenging weather conditions and drifting sea ice and icebergs. Cruise traffic increases local air emissions and increases the risk of oil spills and other environmental damage in sensitive Arctic regions. Arctic marine tourism can lead to transmission of marine invasive species through the ballast water. International cooperation and a common set of regulations for Arctic cruise-ships may alleviate some of these negative effects.

¹ NSIDC, 2015. National Snow and Ice Data Center “Quick facts on Arctic Sea Ice”. <http://nsidc.org/cryosphere/quickfacts/seaice.html> Last accessed 4. July, 2015.

² Instanes A, Anisimov O, Brigham L, et al, eds. (2005) Infrastructure: Buildings, support systems, and industrial facilities. In Arctic Climate Impact Assessment: Scientific Report. Cambridge: Cambridge University Press, 2005. Pp. 907-944

³ Lück, M., Maher, P. T., & Stewart, E. J. (Eds.). (2010). Cruise Tourism in Polar Regions. Promoting Environmental and Social Sustainability? London and Washington DC: Earthscan. Le Miére, Christian and Jeffrey Mazo. 2013. “Arctic Opening: Insecurity and Opportunity”. Adelphi Series 440. The International Institute for Strategic Studies.



Greenland. Photo: Colorbox

Table 8.1. **Tourism characteristic industries**

1. Accommodation for visitors
1.a. Accommodation for visitors other than 1.b
1.b. Accommodation associated with vacation home ownership
2. Food and beverage-serving industry
3. Railway passenger transport
4. Road passenger transport
5. Water passenger transport
6. Air passenger transport
7. Transport equipment rental
8. Travel agencies and other reservation services industry
9. Cultural industry
10. Sports and recreational industry
11. Retail trade of country-specific tourism characteristic products
12. Other country-specific tourism characteristic industries

tourists becomes more apparent and may also increase within the local community¹⁰. A large influx of tourists in small communities may also increase problems with crime. Thus, while Arctic tourism has the potential to bring economic growth to local communities, it will likely also bring cultural change to Arctic communities.

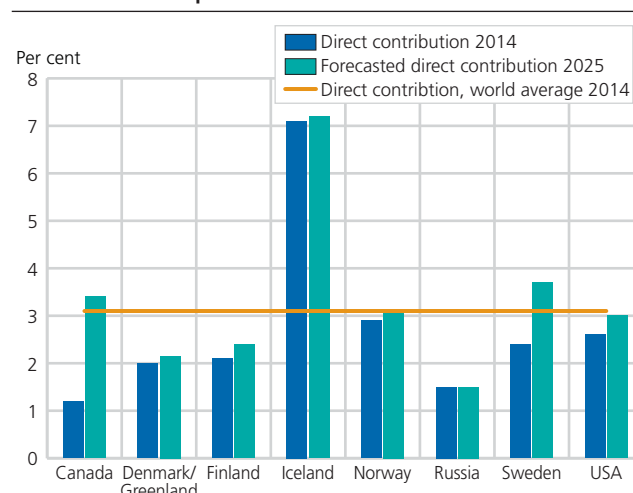
This chapter focuses mainly on the economic impacts of Arctic tourism in the ECONOR-regions. In general, the economic impact of tourism may be measured using both *monetary* indicators such as the value added to the regional economy from tourism-related economic activity (Gross Regional Product (GRP)) and *non-monetary* indicators such as nights spent at a tourist accommodation establishment or the number of employees in tourism-related jobs. A particular challenge for comparison of economic impacts of tourism among regions is that no consistent economic indicator exists for all ECONOR-regions¹¹. These regions also vary in their data-richness. While cost is one reason for lack of data, another reason is confidentiality concerns in sparsely populated regions. Further, there are language barriers. This chapter seeks to provide an overview of the regional economic impacts of Arctic tourism using the best available indicators. This chapter first discusses how to measure the regional economic impact of tourism, and then presents data on economic impact and trends for several Arctic regions. The chapter finishes by discussing some potential future trends in Arctic tourism as well as suggests some directions for future work.

Measuring the economic impact of tourism

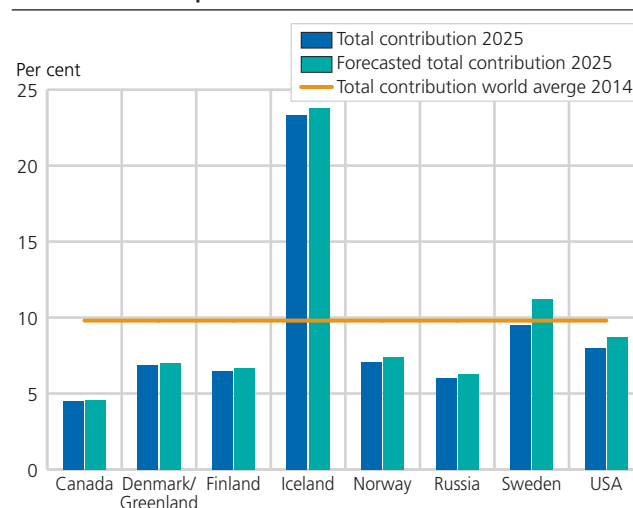
The United Nations System of National Accounts (SNA) defines tourism as the activities of persons traveling to and staying (less than a year) in a location outside their usual environment where the purpose of the trip is leisure, business and other purposes.¹² Further, if a visitor to a location stays overnight at that location, the visitor is called a tourist. Inbound tourism is the activities of non-resident visitors to the country/region of reference, while internal tourism comprises both domestic tourism and inbound tourism, that is to say, the activities of resident and non-resident visitors within the country/region of reference as part of domestic or

international tourism trips. We will focus on measures of inbound tourism, internal tourism, and visitors. Activities due to visitors not staying overnight are mainly induced by cruise-ships, which increasingly are visiting Arctic destinations.

Ideally, this chapter would compare estimates of the gross regional product (GRP) from tourism-related activity for ECONOR-regions. Tourism contributes to the local economy through visitors' demand for and consumption of a number of goods and services from a range of industries, many of which serve both tourists and the local community. But isolating the part of the total consumption in a community that is due to tourism can be challenging. Looking at tourism-related production may be easier since some industries are considered tourism characteristic in the System of National Accounts (see Table 8.1). The 'accommodation for visitors'-sector serves almost entirely tourists¹³, and the economic activity in this sector is an important indicator of the economic impact of tourism. Note that

Figure 8.1. **Direct contribution to GDP in percent from travel and tourism for circumpolar nations**


Source: WTTC 2015a-2015g, see note 16.

Figure 8.2. **Total contribution to GDP in percent from travel and tourism for circumpolar nations**


Source: WTTC 2015a-2015g, see note 16.

activity in this sector excludes the economic impact of day-visitors, e.g. cruise passengers. Other sectors such as food and beverage-serving industries and transportation sectors serve both visitors and the local community. The value added from tourism can be estimated if one knows the portion of the production in these tourism characteristic industries that is consumed by tourists and visitors as opposed to the local community.

Comparing the direct contribution to GRP from tourism to the direct contribution of for example resource extracting industries is challenging because of the risk of double counting of effects: some tourism consumption can be incurred as part of the normal operation of industry. For non-tourism industries where much travel is necessary, double counting effects could be large. Developing satellite accounts for tourism has therefore been deemed necessary.

Tourism Satellite Accounts¹⁴ (TSA) is an accounting framework constructed to highlight the amount of economic activity in a country that is a result of tourism. Tourism induces economic activity related to demand, and TSA reconcile tourism driven consumption with production in the tourism characteristics sectors. The goal is to determine the contribution of tourism to gross domestic product (GDP). The TSA are compiled every year for a large number of countries and can be accessed at UN World Tourism Organization. Unfortunately, these TSA rarely present numbers for the economic impact of tourism on subnational regions.

As a first indicator of the economic impact of tourism in circumpolar nations we use the readily available numbers from the World Travel and Tourism Council (WTTC), which provides annual estimates of the contribution to GDP of tourism for a large number of nations. The numbers from WTTC are similar to, but may be higher for some countries than, those reported from national statistical bureaus.¹⁵ The WTTC estimates for the circumpolar nations are displayed in Figure 8.1 and 8.2.¹⁶ Figure 8.1 displays the *direct* economic contribution of tourism in 2014 as well as the forecasted number for 2025. Figure 8.2 shows the *total* contribution of tourism in 2014 and the forecasted number for 2025. The total contribution includes the direct contribution plus the indirect and induced impacts on the economy. The induced impacts are the GDP and jobs resulting from travel and tourism investment spending, Government 'collective' spending, and domestic purchases of goods and services by the sectors dealing directly with tourists.¹⁷ Among the circumpolar nations, Iceland stands out in that tourism contributes more than twice as much to GDP as for the other nations.

A framework for regional TSA (R-TSA) numbers has been developed.¹⁸ R-TSA numbers would have been quite informative for circumpolar comparisons of economic impact of tourism in Arctic regions. Complete R-TSA would contain estimates of the production and



Northern lights. Photo: Colorbox

gross fixed capital formation, employment in tourism industries, number of overnight stays, and number of arrivals of inbound visitors by means of transportation. Unfortunately, few, if any, countries compile complete R-TSAs regularly. Reasons are that R-TSA are costly, there may be limited statistical capacity at the regional level, the quality of the regional data may not be good enough, and confidentiality issues may arise in sparsely populated regions. Thus, even if R-TSA existed for all the circumpolar nations, it would be unlikely that all numbers would be available for all Arctic regions.

For measuring the economic impact of tourism in ECONOR-regions we have relied on data from a number of different sources. Unfortunately, time constraints and language barriers prevented us from including as much numerical material about Russian Arctic regions as we would have preferred. Iceland is the ECONOR-region where one most easily can measure the economic impacts of tourism since a range of national accounts numbers related to tourism are available and since the ECONOR-region coincides with the country itself. Fairly complete R-TSA exist to our knowledge only for Norway for two separate years, 1997 and 2007¹⁹. Gross Regional Product of tourism in Norway was also estimated for 2011. Several of the required tables in the R-TSA framework were completed for Finland for the year 2002²⁰. In Sweden, The Swedish Agency for Economic and Regional Growth (Tillväxtverket) produces statistics on regional earnings from the hotel accommodation industry only and these numbers could be used to impute the GRP of tourism if excluding day visitors. Statistics Greenland produces a number of mostly non-monetary indicators of tourism such as number of arrivals and number of nights in hotel accommodations. The Alaska Department of Commerce, Community and Economic Development produces annual reports on the Economic Impact of Alaska's visitor industry. Canada produces a Provincial-Territorial Human Resource Module (PTHRM) of the Canadian Tourism Satellite Account that includes a range of numbers related to employment in the tourism industry. Canadian territorial level statistical offices also collect some additional tourism statistics. In the following, sections we will discuss the numbers from each of these regions and provide a limited regional comparison of economic impact from tourism in the ECONOR-regions.

Russia: Russian Arctic National Park

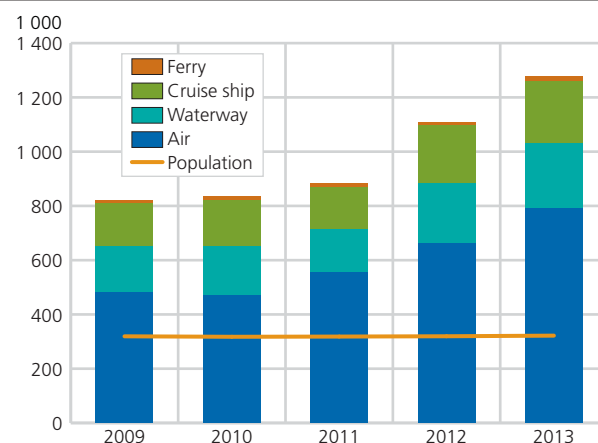
Reflecting the growing interest in preserving Arctic landscapes, nature and history, the national park “Arctic Russia” was established in 2009 and is the third largest national park in Russia. The park includes the northern half of the Novaya Zemlya Island. It includes 632 thousand hectares of land and 794 thousand hectares of marine areas. The national park also manages the state wildlife sanctuary on 191 islands of Franz Josef Land with a total area of 4.2 million hectares of lands²¹. The park was established to preserve and protect of unique nature and wildlife as well as to protect objects of cultural and historical value such as traces of early expeditions. Parts of the national park had to be cleaned up from former uses. In 2012 a Governmental funded clean-up of Franz Joseph Land was initiated, and the same year, about 8 000 tons of waste was removed, mostly old military and household waste.²² Visitors to the park may view pristine landscapes and wildlife such as view gray whales and bowhead whales, which have reappeared only here after almost being extinct. Arctic Russia is also used in environmental education and research and scientific work.²³

The visiting season for Arctic Russia is from July to September. About 90 per cent of visitors are foreigners with the biggest group arriving from China and the second biggest group from USA. In 2011 there were 11 tours to Arctic Russia with altogether 800 visitors.²⁴ In 2012 the number of visitors increased to 1040. The high cost of cruises to Arctic Russia contributes to limit the number of visitors. Just in 2013, the cheapest cruise to Arctic Russia cost USD 10 000. The natural environment in Arctic Russia is vulnerable to environmental impact of tourism and Arctic Russia will draw on experiences for managing tourism in other Arctic regions such as Svalbard.²⁵

Iceland: Recovery from the financial crisis through tourism

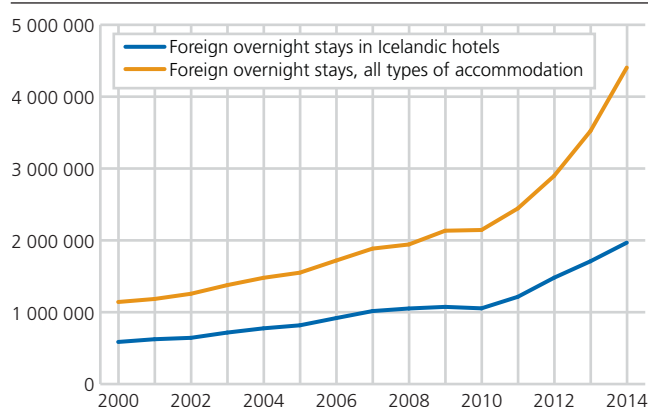
Iceland has experienced a rapid growth in the tourism industry. Statistics show that from 2009 to 2013 there was a 50 per cent increase in the number of international travelers to Iceland from 800 000 to 1.2 million (Figure 8.3). Figure 8.4 shows the increase in the number of overnight stays in hotel accommodations on Iceland as well as in other accommodations. Tourists increasingly find accommodation in private homes by connecting with home owners using for example “Airbnb.” This recent change in the market for overnight accommodation is reflected in Figure 8.4 because Statistics Iceland collects data on the number of overnight stays by tourists in “hotel accommodation” and “other accommodation” including private homes. Along with the rising number of tourists, the number of employees in this industry has grown substantially (Figure 8.5). From 2000 to 2014, the number of employees in the Icelandic tourism industry more than doubled from 8 000 to 16 800.

Figure 8.3. International arrivals to Iceland by mode of transport



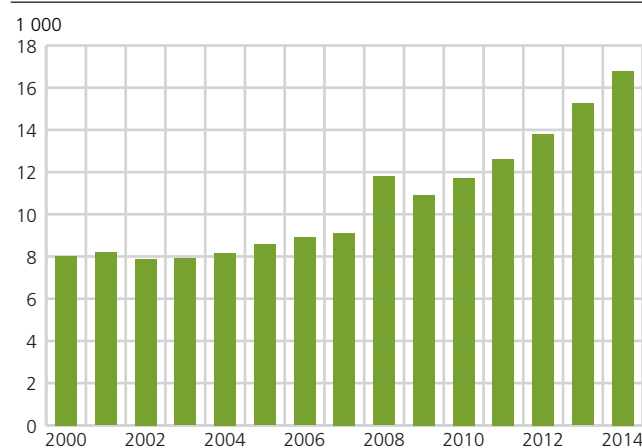
Source: Statistics Iceland, 2015.

Figure 8.4. Number of overnight stays in hotel and other accommodations in Iceland



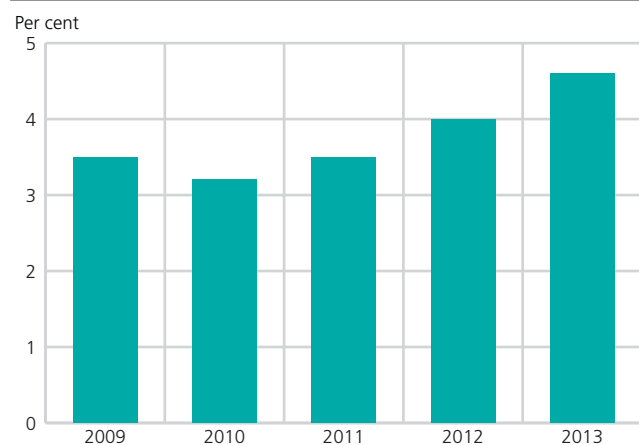
Source: Statistics Iceland (2015)

Figure 8.5. Number of employees in tourism in Iceland



Source: Statistics Iceland (2015)

The expansion of the Icelandic tourism industry significantly contributed to the recovery of the country's economy after the financial crisis in 2008. Tourism is now the second most important source of export revenues, and is now one of the fastest growing sectors of the Icelandic economy.

Figure 8.6. **Gross value added of tourism for Iceland.**

Source: Statistics Iceland (2015)

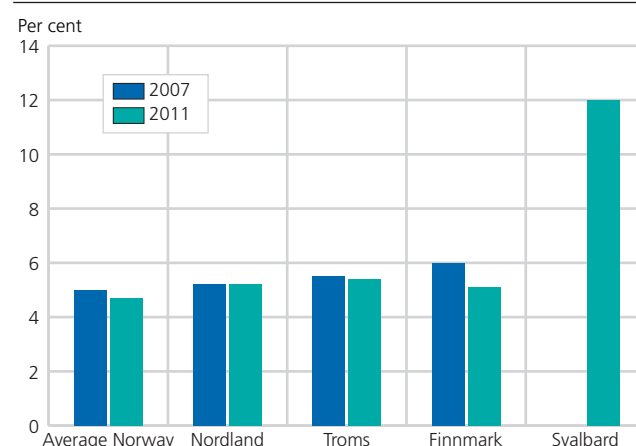
Figure 8.6 presents estimates of the direct contribution to GDP from tourism based on number from Statistics Iceland. GDP share from tourism rose every year from 2010 when it was 3.2 per cent to 4.6 per cent in 2013. In comparison, the WTTC estimates the same number for 2014 to 7.1 per cent²⁶. The big difference between these two estimates likely reflects that the two agencies (WTTC and Statistics Iceland) use somewhat different estimation methods and not only that the estimates are for two different years.

Cruise-visitors contribute little to Iceland's economy relative to their numbers. As day-visitors, cruise-visitors spend much less money in general than overnight visitors. In 2013, cruise-visitors represented 22 per cent of all inbound tourism, but only 1.2 percent of all inbound tourist expenditures, and less than 0.8 percent of the inbound tourism expenditures on products that are defined as tourism characteristic in SNA²⁷.

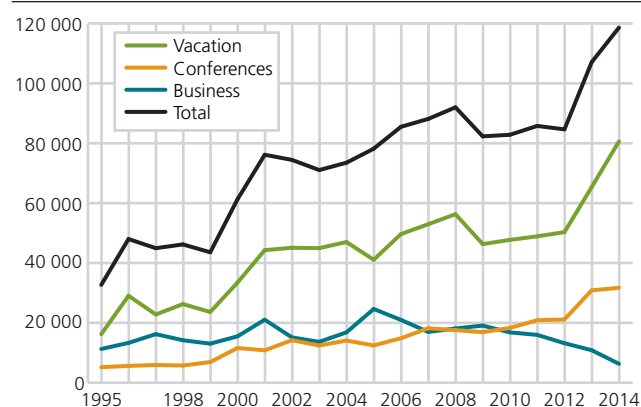
Arctic Norway: Svalbard as tourist attraction

Arctic Norway includes the counties of Finnmark, Troms, Nordland as well as the region Svalbard (not formally a county). Norwegian R-TSA were completed for two years, 1997 and 2007²⁸, and Gross Regional Product (GRP) in the tourism industry was estimated for 2011. The 2011-numbers also included Svalbard County. The GRP of the tourism industry for Svalbard and 2011 are presented in Figure 8.7, which indicates that the GRP from the tourism industry may be slightly higher in Norway's Arctic regions than in Norway on average. In 2011, the direct contribution to GRP of tourism in percent of the regional economy was higher in Svalbard than in any other Norwegian region.

There are many reasons why Svalbard, which only has a population of 2700, is a visitor attraction. Svalbard has the largest continuous untouched wilderness area in Norway; about 98 per cent of its 61 022 km² is wilderness and 67 per cent of the area is protected.²⁹ Since 1990 it has been a goal for the Norwegian Government

Figure 8.7. **The direct contribution to gross regional product from tourism for Arctic Norway**

Source: Auno, Anne Mari. 2011. "Fylkesfordelt satellittregnskap for turisme 2007 TOURIMPACT rapport nr 3" Statistics Norway Reports no. 27/2011 and Statistics Norway tourism satellite accounts, ssb.no.

Figure 8.8. **Overnight stays in hotel accommodation on Svalbard**

Source: MOSJ 2015. Miljøovervåkning på Svalbard og Jan Mayen. www.mosj.no

to develop the tourism industry on Svalbard.³⁰ The accessibility has increased with direct flights from Oslo to Longyearbyen and the tourism industry has expanded along with the growing number of tourists.

While coal mining has traditionally been the most important industry on Svalbard, revenues here been falling every year since 2008 (except for in 2013). At the same time the hotel and accommodation sector have



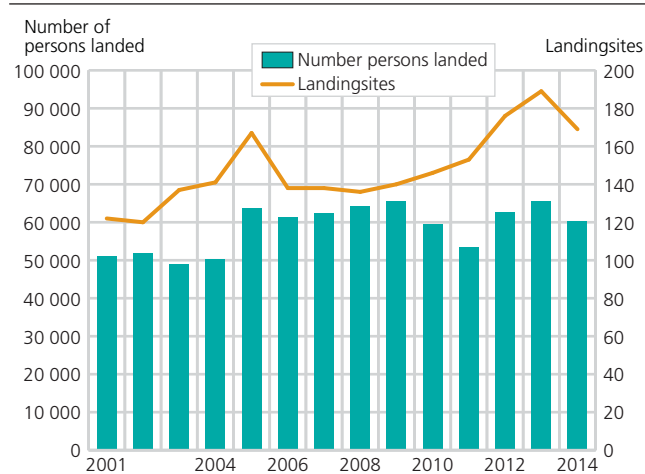
Svalbard. Photo: Colorbox



increased the number of overnight stays (see Fig 8.8) and thus their revenues. If the current trends continue, the hotel and accommodation sector will within few years have higher revenues than the mining industry³¹.

Cruise-tourism on Svalbard has also increased in the recent years. One reason is that Svalbard has become more accessible for cruise-ships as a result of higher average annual temperatures and less sea ice³². An indicator of the number of cruise-visitors is the number of persons landed. Note that the same person visiting Svalbard could be recorded multiple times on different landing sites. The first year with complete reporting of the number of persons landed is 2001. Figure 8.9 shows the development in number of persons landed and number of landing sites on Svalbard. There are statistics for two types of cruise-tourism to Svalbard; overseas cruise tourism and expeditions. After the financial crisis in 2008 there was a significant drop in overseas cruise tourism to Svalbard, but the expedition tourism was not as affected by this global economic downturn. Since 2011 overseas cruise tourism has gradually recovered. In the recent years there has been a testing out of potential landing sites since tourists demand new

Figure 8.9. Cruise tourism to Svalbard. Number of persons landed and landing sites



Source: MOSJ.no and Statistics Norway

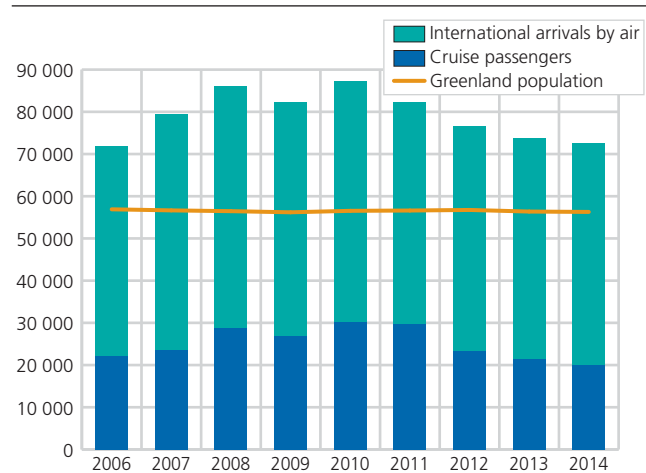
types of activities at the landing sites such as skiing to mountain peaks.³³

Greenland: Impact of financial crisis on tourism

Tourism indicators for Greenland are largely non-monetary, e.g. number of visitors. Figure 8.10 shows the number of foreign visitors to Greenland for the years 2006-2014 along with the national population. Foreign visitors to Greenland must arrive either by air or by water with the majority arriving by air. The main entryway for international arrivals is the Kangerlussuaq international airport. The number of international tourists has exceeded the national population every year since 2004. Whether visitors arrive by air or water, the majority of visitors arrive in the summer and fall months and there is no cruise tourism during the winter months (see Figure 8.11 and 8.12).

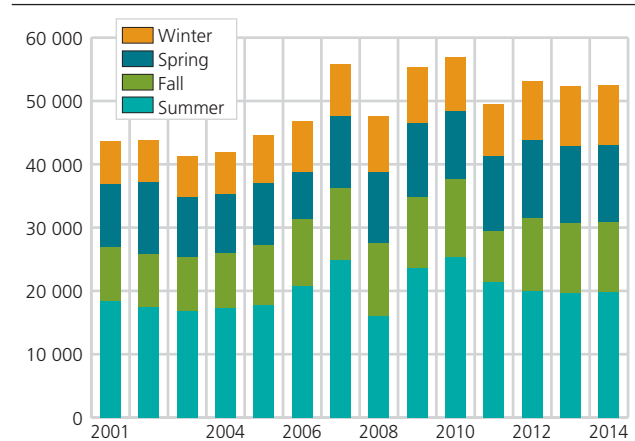
Another non-monetary measure of the impact of tourism on Greenland is the number of foreign overnight stays in hotel accommodations, Figure 8.13. The strong historical and political ties between Denmark and

Figure 8.10. Number of international visitors to Greenland



Source: Statistics Greenland (2015).

Figure 8.11. Number of international arrivals by air to Greenland, year and season



Source: Statistics Greenland (2015).

Box 8.2. Market segments in the Greenland tourism market

VisitGreenland.com is responsible for visitor surveys inquiring about what tourists to Greenland wish to see and do. They find that the tourism market may be divided into five categories: mass tourism, sport fishing and hunting, nature tourism, adventure tourism, and cultural and heritage tourism. Nature based activities are by far the most popular among international tourists, but many tourists also seek to interact with local cultures. Tourism occurs both in the summer and the winter season with the summers, the season of the midnight sun, having the greatest number of tourists. Winters draw a large number of tourists because of the aurora borealis and the opportunity for snow-related sports such as dog-sledding and skiing.

VisitGreenland.com has further performed a mapping of tourism market segments.¹ They identify 11 market segments that combine four focuses of interest (culture, culture & nature, nature, personal challenge) with three levels of engagement (observation, interaction, total immersion). VisitGreenland.com finds that the majority of tourists wish to experience both culture and nature in their visit (42 per cent) while not immersing themselves completely, the next most important focus of interest is nature (35 per cent) where there is a full spectrum of engagement levels. Finally about 16 per cent travel mainly to experience the culture and about 7 per cent of tourists are adventure seekers.

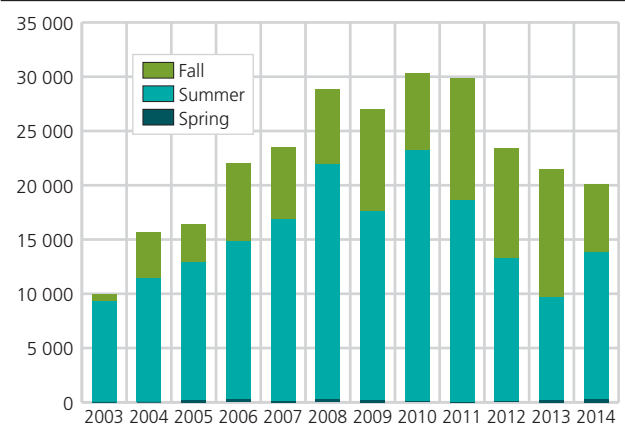
¹ Visit Greenland, 2012. "Tourists in Greenland" Greenland.com. Retrieved from the world wide web: <http://corporate.greenland.com/en/tools/tourism-statistics/>. Last accessed 9. Jul. 2015.

Greenland are reflected in that about 60-70 percent of tourists to Greenland each year were Danish until 2008, the beginning of the financial crisis, coinciding with the year Greenland was granted home rule. In the period 2008 to 2014 the share of Danish tourists fell by 11 per cent. The financial crisis in 2008 likely also impacted tourism to Greenland, since it appears that travelers from other countries and regions also fell in 2008. In 2010, the number of visitors was approximately the same as in 2006.

Arctic Finland: Tourism is of growing importance

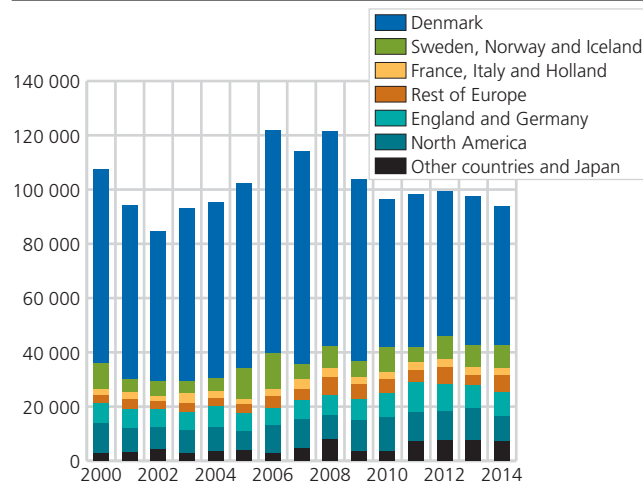
Arctic Finland includes Lapland, Kainuu and North Ostrobothnia. Of these regions, Lapland has the highest Value Added from tourism. Lapland's and Uusimaa's (capital region) gross value added from tourism is comparable in size. While Åland (group of islands southwest of Finland's main land) by far is the most important tourism region in Finland, Lapland, Uusimaa and Kainuu are the next most important tourism regions in Finland.³⁴ Thus, Arctic Finland is relatively important for the country's tourism industry. What is more, the value added of tourism in Arctic regions increased from 2002 to 2006 while the Finnish average fell in the same period.

Figure 8.12. Number of cruise visitors to Greenland, year and season



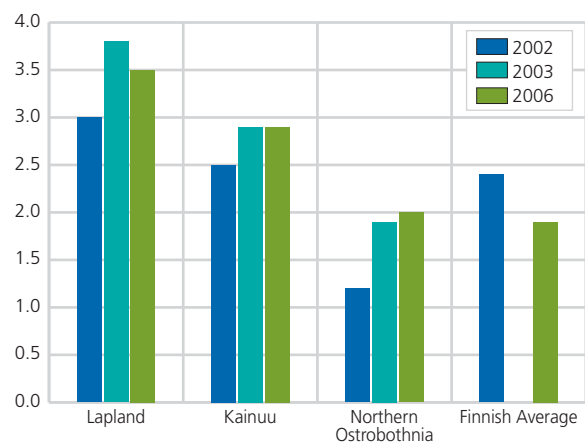
Source: Statistics Greenland (2015).

Figure 8.13. Foreign overnight stays in hotel accommodations on Greenland by year and group



Source: Statistics Greenland (2015).

Figure 8.14. Tourism value added as share of gross value added in Finnish regions, percent



Source: Konttinen (2006, 2008), see note 34.

Arctic Sweden: Tourism is of average importance

Arctic Sweden, comprises the two counties Norrbotten og Västerbotten. Statistics Sweden keeps regional data on the number of overnight stays in hotels and other rented accommodation. To our knowledge, very little data exist on the regional economic effects of tourism in Sweden. The Swedish Agency for Economic and Regional Growth (Tillväxtverket) uses income per capita from overnight accommodation as a measure of the regional importance of tourism. Using this measure and numbers for 2014, tourism was of average importance in Västerbotten with income per capita from overnight accommodation of SEK 1 918 and the corresponding number for Norrbotten was SEK 2 980³⁵. Total income from all commercial overnight accommodation has increased in all Swedish regions from 2008 to 2014.

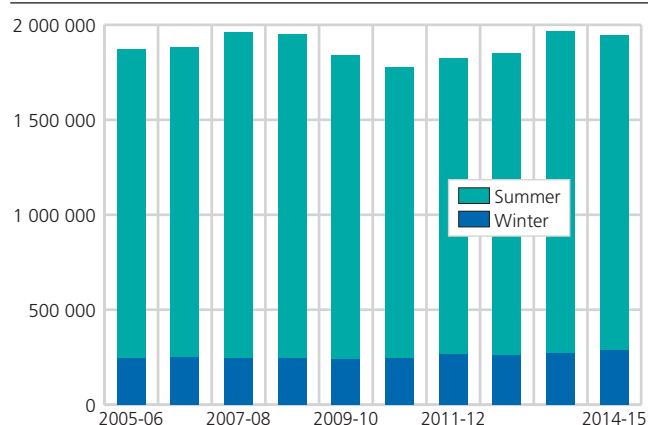
Arctic US: Alaska a popular destination for cruise-tourists

The state of Alaska is the only Arctic US region. Tourism and travel currently have become Alaska's most important driver of economic growth. Nearly two

million people visit Alaska annually. There was a slight drop in visitors for a couple of years following the financial crisis (Figure 8.15). Tourism Satellite accounts for Alaska were completed in 2004, and it was estimated that travel and tourism contributed USD 1.6 billion or 5.6 per cent of Alaska Gross State Product.³⁶ In recent years, annual reports on the economic impact of Alaska's visitor industry have been completed. These reports follow the US fiscal year, and there is one report for winter and one report for summer. The most recent report, published in 2014 covers the period of October 2012 through September 2013. This report estimates the economic impact of visitor industry to be USD 3.93 billion in 2012-13. This represents 6.9 per cent of Gross State Product of Alaska for 2013. (The total economic activity for 2013 is used as reference in calculating this percentage).³⁷

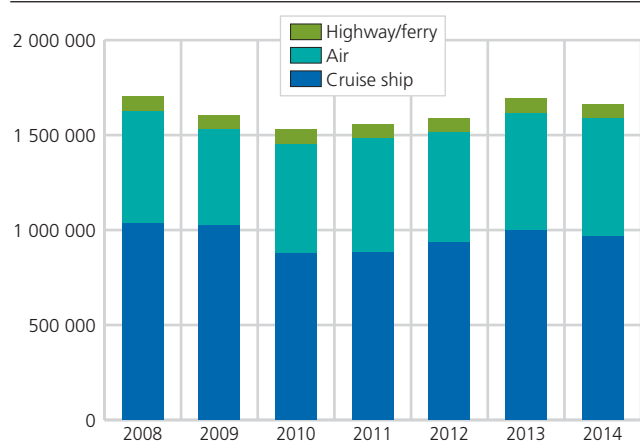
The 2014 report estimates the total employment related to the visitor industry to 39 000 jobs. This number includes part-time and full-time, direct, indirect and induced impacts. At the peak of the season, the report estimates that this number may rise to 46 500. The biggest share of the visitor industry is located in Southcentral Alaska. As in all Arctic regions most of the visitors (nearly 90 per cent for Alaska) arrive in the summer months, and approximately 50 per cent of visitors (1 million) arrive by cruise ships (see Figure 8.16). Alaska has likely the greatest number of cruise-tourists per year of any Arctic-region.

Figure 8.15. Visitors to Alaska in the years from 2005-06 to 2014-15



Source: McDowell Group, 2014. "The Economic Impact of Alaska's Visitor Industry. 2012-13 update. Prepared for State of Alaska, Alaska Department of Commerce, Community, and Economic Development. January 2014.

Figure 8.16. Summer visitors to Alaska by means of travel



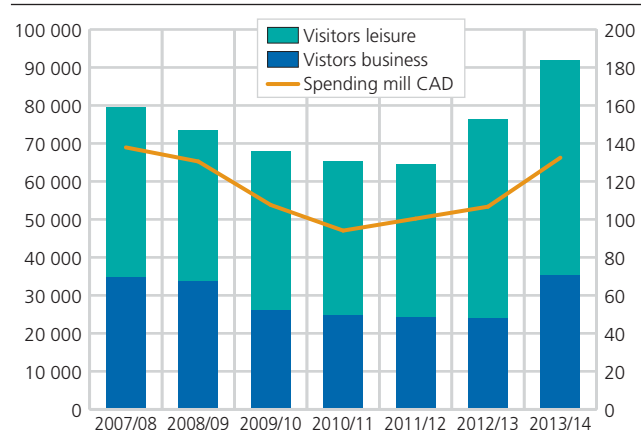
Source: McDowell Group, 2014. "The Economic Impact of Alaska's Visitor Industry. 2012-13 update. Prepared for State of Alaska, Alaska Department of Commerce, Community, and Economic Development. January 2014.

Arctic Canada: Tourism is relatively important to Arctic economies

Arctic Canada includes The Northwest Territories, Yukon and Nunavut. In 2014, Statistics Canada published a Provincial-Territorial Human Resource Module (PTHRM) of the Tourism Satellite Account 2012³⁸. This module presents statistics on employment in the tourism industry the regional level. The following key statistics are available: jobs, hours worked and employment earnings. In addition, one may calculate the number of full-time equivalents, average hourly earnings and average annual hours worked per job. The Arctic territories have only a minor importance for tourism in Canada as a whole. However, the tourism sector is relatively more important to the local economies in the Arctic than in other regions of Canada. It is a stated goal for all three territories to further develop their tourism industry.

Of all provinces and territories, with the exception of British Columbia where 12.2 per cent of jobs are in the tourism sector, the Arctic territories have the largest share of jobs in the tourism industry. The share of jobs in the tourism industry in The Northwest Territories was 12.1 per cent, in Yukon the share was 11.3 per cent, and in Nunavut the share was 7.1 per cent. If measured in terms of number of jobs, Yukon and Northwest territories have tourism sectors that are twice as big as the tourism sector in Nunavut. In 2012, the growth in tourism jobs was largest in Yukon at 27.4 per cent compared to 1.5 per cent for tourism industries in

Figure 8.17. Number of visitors and spending in million Canadian Dollars in the Northwest Territories



Source: Northwest Territories Industry, Tourism and Investment (NWITI) 2015. "Visitor Spending and Numbers". <http://www.iti.gov.nt.ca/infopage/visitor-spending-and-numbers> Last Accessed Jan. 15, 2016.

Canada.³⁹ Each of the Arctic territories collects tourism fees providing additional income.

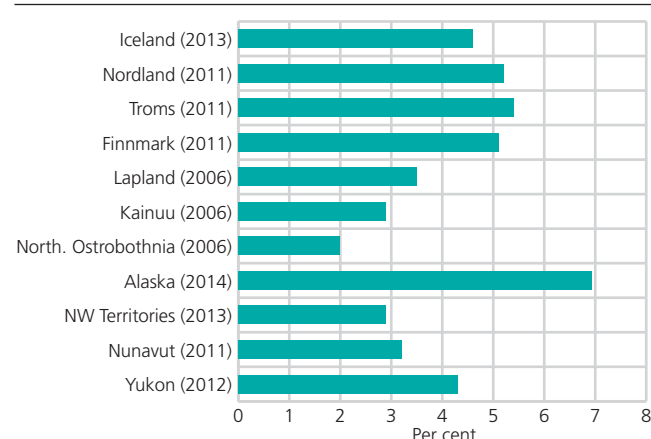
Figure 8.17 shows the number of visitors, the main purpose of the trip (business or leisure) and the amount of tourism spending annually in the Northwest Territories.⁴⁰ Tourism fell after the financial crisis in 2008 but has since recovered. The amount of tourism spending is annually about twice the amount of the GRP of hotel accommodation and food service in the Northwest Territories. Tourism spending was 2.9 per cent of GRP of the average GRP between 2008 and 2009. In Nunavut, tourism's contribution to GRP was estimated to 3.2 per cent in 2011.⁴¹ In Yukon, the number was high as 7.2 per cent before the financial crisis in 2008 but fell to 4.3 percent in 2012.⁴²

Final remarks

UN World Tourism Organization estimates that the global, relative growth in tourism in the period 2010-2030 will be on average 3.3 per cent per year. Arctic tourism will likely also continue to increase in the years to come. Climate change will also contribute to increase tourism to Arctic regions. Arctic regions, which are relatively more affected by climate change because of the high latitude, may increasingly become the destination of 'last chance' tourism. Also, as a result of climate change, tourism is expected to move northward since many regions that currently are attractive tourist destinations will on average become hotter and drier and thus less attractive for tourists. It is important that this tourism develops in such a way that the benefits to the host communities are greater than the costs.

A significant share of visitors to Arctic regions is international. Visiting Arctic regions is relatively expensive compared to other destinations. At the same time, tourism is often relatively more important to Arctic economies than to non-Arctic economies. As a result, Arctic economies may be quite vulnerable to fluctuations in the global economy. Immediately after the 2008 financial crisis, tourism fell in several Arctic

Figure 8.18. Per cent share of tourism in gross regional product for Arctic regions



Source: Regional accounts (see previous figures).

regions including Alaska, Canada and to some extent Greenland. Iceland, on the other hand, took advantage of the financial crisis to diversify their economy to become more tourism based.

Considering the lack of consistent economic data across regions, a complete circumpolar comparison the economic impact from tourism using the same measure for the same year was impossible. There are likely possible workarounds to estimate better numbers for each region in a future version.

Figure 8.18 summarizes numbers for the per cent gross regional product (GRP) from tourism for 11 of the ECONOR-regions for the latest year a GRP number is available. While the first-best indicator of the economic impact of tourism is the GRP from tourism-related activity, a second best measure of the economic impact of tourism is the regional *production* in tourism characteristic industries that almost exclusively serve tourists, such as the accommodation industry. The number of overnight stays in hotels and other accommodation industry is an important indicator of the production in the tourism industry. These numbers may be used as a basis for estimating total tourism related consumption. Tourism related production may be a more accurate measure than tourism related consumption. The production measure may also be preferred because many tourism goods and services are actually consumed at the location where they are produced.⁴³ This means that it is easier to place geographically the tourism related economic activity. Thus, given resources and time, one might estimate value added from tourism based on production in the most central tourism-related industries such as the accommodation industry and a certain percentage economic activity in the food and beverage industries and scale up⁴⁴. In addition, one would need to account for tourism related consumption by day-visitors (cruise-tourists).

Tourism related employment is another indicator that may also be used to make inferences about the econom-

ic activity induced by tourism. This number is challenging to use because much of the employment is part-time and/or seasonal. The number of visitors is the measure that exists most consistently in one form or another across regions⁴⁵ and does serve as a non-monetary indicator of economic activity related to tourism. It also may give an indication of the impact the tourism may have on sparsely populated communities and vulnerable Arctic ecosystems.

Notes

- ¹ The author thanks Helene Amundsen, CICERO, for valuable comments to an earlier version.
- ² Stewart, E.J., D. Draper and M.E. Johnston. 2005. "A review of Tourism Research in the Polar Regions" *Arctic*, 58(4):383-394.
- ³ Dawson, J., M.E. Johnston, E.J. Stewart, C.J. Lemieux, R.H. Lemeelin, P.T. Maher, B. Grimwood. 2011. "Ethical dimensions of last chance tourism." *Journal of Ecotourism* 10(3): 250-262.
- ⁴ C. M. Hall & J. Saarinen (Eds.) (2010) *Tourism and Change in Polar Regions: Climate, Environments and Experiences*. Oxon, UK: Routledge.
- ⁵ Grenier, A. A., & Müller, D. K. (Eds.). (2011). *Polar Tourism. A Tool for Regional Development*: Presses de l'université du Québec. Hall, C. M., & Saarinen, J. (2010). *Polar Tourism: Definitions and Dimensions*. *Scandinavian Journal of Hospitality and Tourism*, 10(4), 448-467.
- ⁶ Müller & Jansson, 2007, *The Difficult Business of Making Pleasure Peripheries Prosperous: Perspectives on Space, Place and Environment*. In D. K. Müller & B. Jansson (Eds.), *Tourism in Peripheries: Perspectives from the far North and South* (pp. 3-18). Oxfordshire, UK and Cambridge, MA: CAB International
- ⁷ UNEP 2015. "Tourism and Socio-Cultural Conservation". United Nations Environmental Programme. Retrieved from the world wide web: <http://www.unep.org/resourceefficiency/Business/SectoralActivities/Tourism/FactsandFiguresaboutTourism/ImpactsofTourism/Socio-CulturalImpacts/TourismandSocio-CulturalConservation/tabid/78782/Default.aspx>. Last accessed 4. July, 2015.
- ⁸ AHDR-II. Arctic Human Development Report: J. N. Larsen & G. Fondahl (Eds.), Arctic human development report. Regional processes and global linkages. TemaNord 2014:567. Copenhagen: Nordic Council of Ministers: (p. 405-406).
- ⁹ The Guardian "Inuit fear they will be overwhelmed as 'extinction tourism' descends on Arctic" Sunday August 21, 2016.
- ¹⁰ Muller and Jansson (2007)
- ¹¹ Fay, Ginny and Anna Karlsdóttir. 2010. "Developing an Arctic Tourism Observation System" (retrieved from the www.iser.uaa.alaska.edu/projecs/search-hd/index.htm) Last accessed Aug. 19, 2015.
- ¹² Frechtling, Douglas. 2013. "The economic impact of tourism: overview and examples of macroeconomic analysis". UNWTO Statistics and TSA Issue paper series. STSA/IP/2013/03, (Online), available: <http://statistics.unwto.org/content/papers>.
- ¹³ A night spent is each night a guest/tourist (resident or non-resident) actually spends (sleeps or stays) or is registered (his/her physical presence there being unnecessary) in a tourist accommodation establishment.
- ¹⁴ UNWTO, 2010. United Nations World Tourism Organization. "Tourism Satellite Account: Recommended Methodological Framework (TSA:RMF 2008)" available: <http://unstats.un.org/unsd/tradeserv/tourism/manual.html>
- ¹⁵ Auno, Anne Mari. 2015. Statistics Norway. Personal communication.
- ¹⁶ WTTC 2015a. World Travel & Tourism Council. Travel & tourism: Economic impact 2015 Canada. Retrieved from the world wide web: <http://www.wttc.org/research/economic-research/economic-impact-analysis/country-reports/>. Last accessed 16. Nov. 2015; WTTC 2015b. World Travel & Tourism Council. Travel & tourism: Economic impact 2015 Finland. Retrieved from the world wide web: <http://www.wttc.org/research/economic-research/economic-impact-analysis/country-reports/>. Last accessed 16. Nov. 2015; WTTC 2015c. World Travel & Tourism Council. Travel & tourism: Economic impact 2015 Iceland. Retrieved from the world wide web: <http://www.wttc.org/research/economic-research/economic-impact-analysis/country-reports/>. Last accessed 16. Nov. 2015; WTTC 2015d. World Travel & Tourism Council. Travel & tourism: Economic impact 2015 Norway. Retrieved from the world wide web: <http://www.wttc.org/research/economic-research/economic-impact-analysis/country-reports/>. Last accessed 16. Nov. 2015; WTTC 2015e. World Travel & Tourism Council. Travel & tourism: Economic impact 2015 Russian Federation. Retrieved from the world wide web: <http://www.wttc.org/research/economic-research/economic-impact-analysis/country-reports/>. Last accessed 16. Nov. 2015; WTTC 2015f. World Travel & Tourism Council. Travel & tourism: Economic impact 2015 Sweden. <http://www.wttc.org/research/economic-research/economic-impact-analysis/country-reports/>. Last accessed 16. Nov. 2015; WTTC 2015g. World Travel & Tourism Council. Travel & tourism: Economic impact 2015 United States of America. <http://www.wttc.org/research/economic-research/economic-impact-analysis/country-reports/>. Last accessed Nov. 16 2015
- ¹⁷ WTTC 2015a. World Travel & Tourism Council. Travel & tourism: Economic impact 2015 Canada. Retrieved from the world wide web: <http://www.wttc.org/research/economic-research/economic-impact-analysis/country-reports/>. Last accessed 16. Nov. 2015
- ¹⁸ Cañada, Augustín. 2013. "Regional Tourism Satellite Account" UNWTO Statistics and TSA Issues Paper Series STSA/IP/2013/02 (Online), available: <http://statistics.unwto.org/en/content/papers>.
- ¹⁹ Auno, Anne Mari and Knut Ø. Sørensen. 2009. «Norsk reiselivs økonomiske rolle: En analyse basert på satellittregnskapet for turisme». Statistics Norway Reports 32/2009.
- ²⁰ Konttinen, Juha-Pekka. 2015. Personal communication. Konttinen, Juha-Pekka. 2006. «Regional Tourism Satellite Accounts (RTSA) in Finland – Data, Concepts, Methods and Key Results». Paper at the 46th Congress of European Regional Science Association. August 30th - September 3rd, 2006, Volos, Greece. <http://www.sre.wu-wien.ac.at/ersa/ersaconfs/ersa06/papers/107.pdf>. Konttinen, Juha-Pekka. 2008. «The Economic Effects and Development of Tourism in Finnish Regions 2000-2006». Paper at the 48th Congress of European Regional Science Association. August 27th - 31, 2008, Liverpool, UK. http://www.ekf.vsb.cz/export/sites/ekf/projekty/cs/webby/esf-0116/database-prispevky/clanky_ERSA_2008/214.pdf
- ²¹ Barents Observer (2013b). "Svalbard's experience - for Russian Arctic?". April 23.
- ²² Barents Observer (2013a). "Cleans up Franz Josefs Land". April 15.
- ²³ Barents Observer (2011). "Russia ready to boost Arctic tourism". August 29.
- ²⁴ Barents Observer (2011). "Russia ready to boost Arctic tourism". August 29
- ²⁵ Barents Observer (2013b). "Svalbard's experience - for Russian Arctic?". April 23.
- ²⁶ WTTC (2015c)
- ²⁷ Based on numbers from Statistics Iceland, 2015.
- ²⁸ Auno, Anne Mari. 2011. "Fylkesfordelt satellittregnskap for turisme 2007 TOURIMPACT rapport nr 3" Statistics Norway Reports no. 27/2011.
- ²⁹ Undelstvedt, J.K. 2014. «Miljøstatistikk for Svalbard: Mildere på Svalbard» world wide web, <http://www.ssb.no/natur-og-miljo/artikler-og-publikasjoner/mildere-paa-svalbard>, retrieved 19. november, 2015
- ³⁰ St. Meld. nr. 50 (1990–91): Næringsstiltak for Svalbard
- ³¹ Statistics Norway
- ³² MOSJ 2015. Miljøovervåkning på Svalbard og Jan Mayen. www.mosj.no
- ³³ MOSJ 2015. Miljøovervåkning på Svalbard og Jan Mayen. www.mosj.no
- ³⁴ Konttinen, Juha-Pekka. 2006. «Regional Tourism Satellite Accounts (RTSA) in Finland – Data, Concepts, Methods and Key Results». Paper at the 46th Congress of European Regional Science Association. August 30th - September 3rd, 2006, Volos, Greece. <http://www.sre.wu-wien.ac.at/ersa/ersaconfs/ersa06/papers/107.pdf>. Konttinen,

Juha-Pekka. 2008. «The Economic Effects and Development of Tourism in Finnish Regions 2000-2006». Paper at the 48th Congress of European Regional Science Association. August 27th - 31, 2008, Liverpool, UK. http://www.ekf.vsb.cz/export/sites/ekf/projekty/cs/webby/esf-0116/databaze-prispevku/clanky_ERSA_2008/214.pdf

³⁵ Tillväxtverket. 2014. «Fakta om svensk turism» (Facts about Swedish tourism) available at: <http://www.tillvaxtverket.se>. Retrieved 20. nov. 2015

³⁶ Sacks, Adam. 2004. The Alaska Tourism Satellite Account: A Comprehensive Analysis of the Economic contribution of Travel and Tourism. Prepared for Alaska Department of Commerce, Community and Economic Development by Global Insight, October 25, 2004.

³⁷ McDowell Group, 2014. "The Economic Impact of Alaska's Visitor Industry. 2012-13 update. Prepared for State of Alaska, Alaska Department of Commerce, Community, and Economic Development. January 2014.

³⁸ Martin, Terrence. 2014. Provincial-Territorial Human Resource Module (PTHRM) of the Tourism Satellite Account 2012. Statistics Canada.

³⁹ Martin, Terrence. 2014. Provincial-Territorial Human Resource Module (PTHRM) of the Tourism Satellite Account 2012. Statistics Canada.

⁴⁰ Northwest Territories Industry, Tourism and Investment (NWITI) 2015. "Visitor Spending and Numbers". <http://www.iti.gov.nt.ca/infopage/visitor-spending-and-numbers> Last Accessed Jan. 15, 2016.

⁴¹ Government of Nunavut, 2013. "Tunngasaiji: A Tourism Strategy for Nunavummiut". <http://www.nunavut.ca/files/07%20GN%20Tourism%20Strategy.pdf>. Last accessed 15. January, 2016.

⁴² YBS, Yukon Bureau of Statistics. 2013. "Yukon Business Survey 2013". http://www.eco.gov.yk.ca/stats/pdf/2013_Business_Survey_Report_RR.pdf Last accessed Jan. 15, 2015. (YBS, 2013). YBS, Yukon Bureau of Statistics. 2009. "Yukon Business Survey 2009". http://www.eco.gov.yk.ca/stats/pdf/2009_Business_Survey_Report.pdf Last accessed Jan. 15, 2015.

⁴³ Auno, Anne Mari and Knut Ø. Sørensen. 2009. «Norsk reiselivs økonomiske rolle: En analyse basert på satellittregnskapet for turisme». Statistics Norway Reports 32/2009.

⁴⁴ For example if hotel accommodation on average is 25 percent of the tourism expenditure on a trip, then the total expenditure could be found by scaling up the accommodation industry production numbers.

⁴⁵ Fay, Ginny and Anna Karlsdóttir. 2010. "Developing an Arctic Tourism Observation System" (retrieved from the www <http://www.iser.uaa.alaska.edu/projects/search-hd/index.htm>) Last accessed Aug. 19, 2015.



Polar fox. Photo: Colorbox.

9. Ecological change in Arctic regions – a GLOBIO3 pilot study of impacts on biodiversity¹

Wilbert van Rooij (lead author), Iulie Aslaksen, Philip Burgess, Per Arild Garnåsjordet and Svein D. Mathiesen

Introduction

Biodiversity is a precondition for human life, and in the Arctic biodiversity is generous but vulnerable. The aim of the pilot study described in this chapter is to relate ecological change more directly to human impacts, in order to enhance the knowledge basis for policies. One way to link ecological change and human activities is to use models of individual and integrated effects on biodiversity. This chapter presents results from a pilot study on assessment of anthropogenic influence on Arctic biodiversity with the GLOBIO3 model.

GLOBIO3² is a pressure based model developed by PBL-Netherlands Environmental Assessment Agency to assess human-induced changes in terrestrial biodiversity at global and regional scale. It is well known for applications in global biodiversity assessments such as for the Global Biodiversity Outlooks of the Convention for Biological Diversity (CBD), UNEP's Global Environment Outlooks and OECD's Environmental Outlooks, but has also been implemented for sub-national assessments in several temperate and tropical countries. In this pilot study, it is for the first time investigated whether the GLOBIO3 model can also contribute to the assessment of impacts on Arctic biodiversity on a regional and local scale.

This chapter presents results for Finnmark county in Norway. The study illustrates the considerable extent of data and model adaptation needed in order to down-scale assessment from global to regional scale. The research for this chapter has benefitted from close cooperation with a project for comparing the use of GLOBIO3 and the Nature Index for Norway³, in order to test out the adjustment of global average assumptions to regional level. Collaboration was also made with the project Nomadic Herders Sápmi by the International Centre for Reindeer Husbandry and the project Adaptation Actions for a Changing Arctic (AACA) for the Barents region, for the Arctic Council.

The quality of the assessment for the Arctic regions depends highly on the quality of available data. Therefore an overview is provided of the methodology, the datasets and the important assumptions made to adjust the global average assumptions of the model to typical Arctic conditions to create regional and national datasets. The approach of the pilot assessment can later be extended to studies of impacts on biodiversity in other regions of the circumpolar Arctic. Down-scaling the

model to local conditions gives possibilities for its use in local decision support and co-management. In addition to an assessment of current biodiversity, the GLOBIO3 model can be used for assessing future biodiversity for selected scenarios. This is beyond the scope of the present ECONOR project, however, in the cooperating project Nomadic Herders Sápmi the analysis of selected future scenarios has been implemented for pilot areas within the Barents region.

The GLOBIO3 model

The GLOBIO3 model can indirectly assess current state and projected changes of biodiversity measured by the Mean Species Abundance indicator (MSA). The model does not measure biodiversity directly, but estimates biodiversity loss by measuring the impact of different pressures based on cause–effect relationships derived from research literature⁴. The Mean Species Abundance indicator is analogue to a natural intactness indicator where the current state of an ecosystem (species number and abundance) is compared to the state of a baseline situation. For natural ecosystems this baseline situation refers to an 'untouched' or primary ecosystem with intact species composition. For semi-natural cultural landscapes the baseline situation refers to an ecosystem maintained by grazing or other traditional land use management that has contributed to retain the species composition for many centuries. The extensively used grazing systems of semi-natural lands in northern and arctic regions, for reindeer herding and agricultural practices of ruminant grazing, are



Photo: Colorbox



Photo: Colorbox

examples of traditional land use where the baseline situation is conditioned by human use.

The GLOBIO3 model determines the combined effect of five different pressures: land-use change, infrastructure development, land fragmentation, climate change and atmospheric nitrogen deposition. However, nitrogen deposition is not included in this pilot study as the impact is virtually absent in the Arctic regions. Land use change impacts biodiversity negatively through loss of natural area, by conversion of land into a different land use type with a lower intactness, e.g. caused by urban and agricultural development, forestry, mining, urbanization, and other developments.

Infrastructure development impacts biodiversity negatively by disturbances that can be linked to the physical presence and use of the infrastructure, e.g. by noise from roads. This pressure also includes impact of disturbance, hunting, gathering, and urban encroachment. Land fragmentation implies a loss of connected nature areas, e.g. representing a barrier to migration of species. Climate change impacts are represented by migration or disappearance of characteristic species from their original natural habitat areas due to changing temperatures.

The GLOBIO3 model is designed so that the effects of each pressure factor are independent of the other pressure factors, in order to avoid double counting. This structure of the model allows for the pressures factors to be multiplied and combined into a total index of biodiversity measured by MSA⁵. The quality of the model

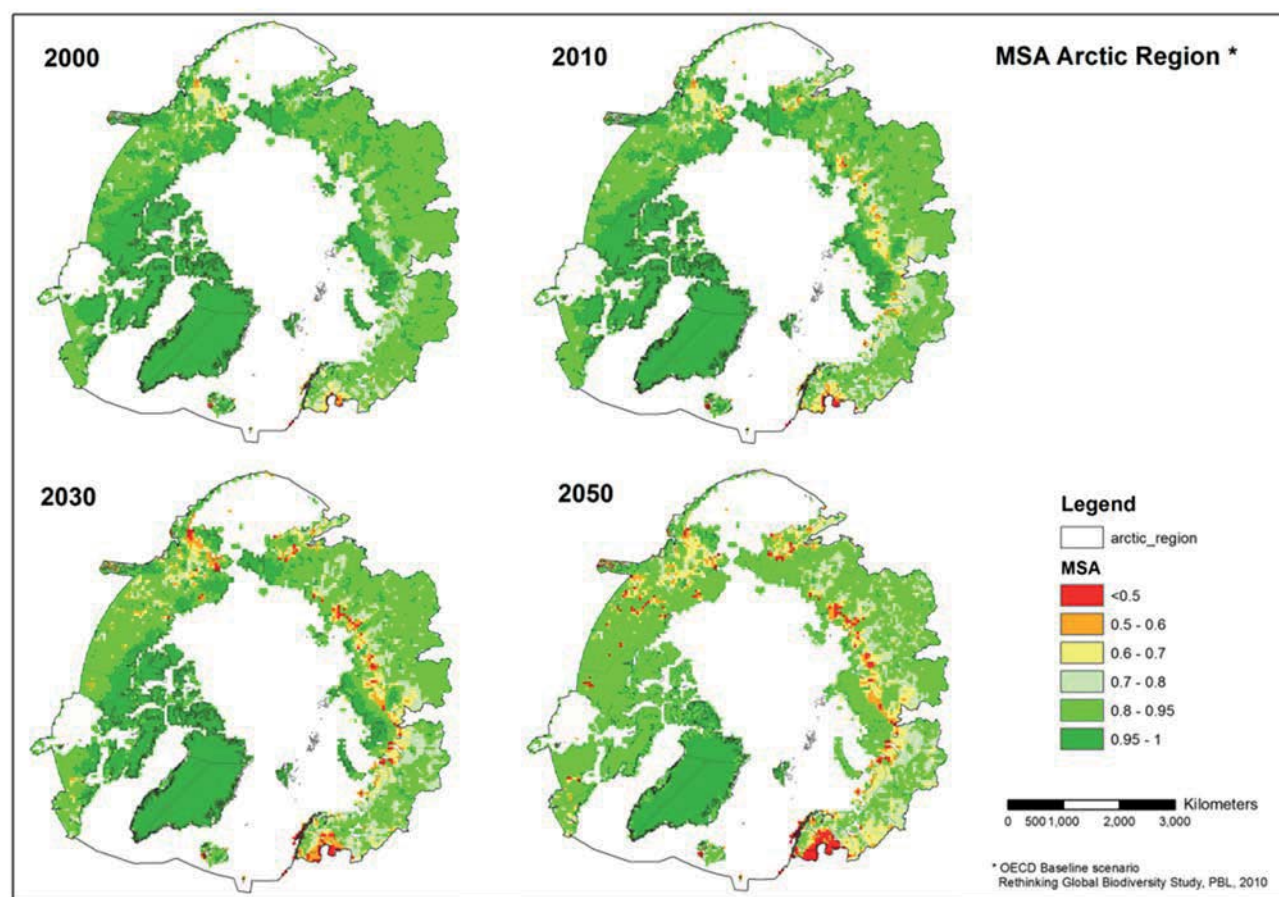
output can be improved by including more detailed local data sets, expert knowledge, and local and traditional knowledge.

Global biodiversity trends and the Arctic

Scenarios of future trends for global biodiversity have been made for the Rethinking Global Biodiversity Strategies⁶ study carried out by Netherlands Environmental Assessment Agency (PBL). Different scenarios were developed to assess potential impacts of sets of policy measures aiming at changes in production and consumption patterns which result in minimal biodiversity loss. The scenarios in the Rethinking study were based on global macroeconomic assumptions developed for the IMAGE model (Integrated Model to Assess the Global Environment)⁷. For the Rethinking study, the global datasets and general cause–effect relationships were not adjusted to Arctic conditions, so the circumpolar overview in Figure 9.1 is less representative for the Arctic regional level and should be interpreted only as a general trend at the global scale, illustrating the principles of a GLOBIO3 analysis⁸.

Given the global assumptions, Figure 9.1 zooms in at the Arctic region. The dark green colour refers to intact ecosystems (MSA close to 100 per cent). In the red areas the MSA is lower than 50 per cent of the natural baseline. The colour scheme changing from green to light green, yellow, orange and finally red, indicates a scale of increasing human induced biodiversity loss.

The largest losses in biodiversity are expected in the northern parts of Scandinavia, Russia, Alaska and

Figure 9.1. MSA trend in the Arctic region for the global baseline scenario of the *Rethinking Global Biodiversity Study*¹

¹ Figures constructed based on data from the Rethinking Global Biodiversity study by PBL, 2010: Rethinking Global Biodiversity Strategies: Exploring structural changes in production and consumption to reduce biodiversity loss. © Netherlands Environmental Assessment Agency (PBL), The Hague/Bilthoven, 2010.

Source: Global Rethinking Study by PBL, 2010, see note 6.

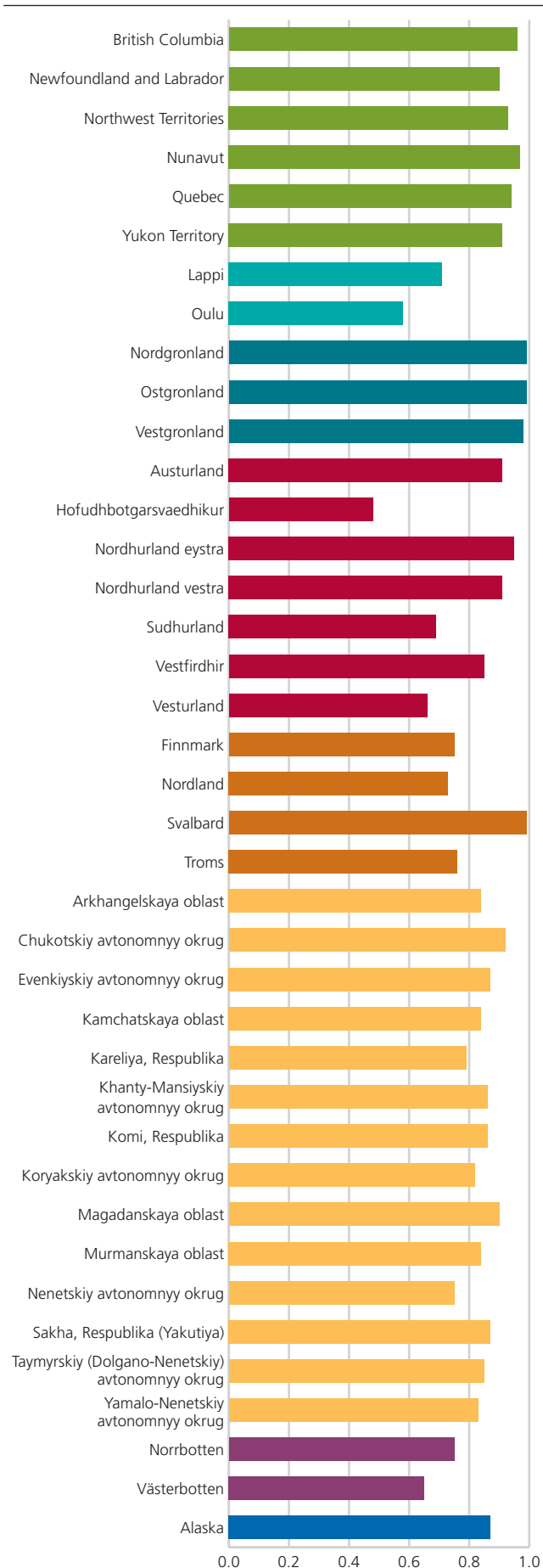
Canada. These areas are mainly situated in the Wooded Tundra biome and to a lesser extent in the Tundra biomes. The explanation based on global datasets is that these areas may become more suitable for agriculture and grazing and for increased forestry due to an expected increase in woody biofuels from 2050 onwards. These developments are expected to result in a large conversion of natural and semi-natural lands.⁹

Figure 9.2 illustrates how biodiversity measured by MSA varies between the Arctic regions, based on global datasets and a global scenario, as in Figure 9.1. There is a large uncertainty of the assessments for the Arctic regions as knowledge is limited on the differentiation of land use and the dose-response relations in GLOBIO3 for Arctic species. As land use intensity is one of the important determinants for the intactness of ecosystems measured by MSA, the quality of the land use map is important. The spatial land use data used for the Rethinking Global Biodiversity Study is based on the Global Land Cover (GLC) map for 2000 that has been constructed from satellite image interpretation and auxiliary data. For global assessments such data are very useful for their consistency, but for assessments on a national or sub-national scale, more detailed information is desirable.

A limitation of the use of global assessment results is that studies of local infrastructural development, including the development of mines, hydropower and wind turbines, requires regionalized data. Another restriction of the use of the global assessment results for the Arctic is that recent IPCC results¹⁰ show that climate change in the Arctic is far more extreme (both temperature and precipitation) than in the rest of the world, while the climate impact calculation in the Rethinking Global Biodiversity Study uses older global projections that underestimate the climate change impact in the Arctic. For a more accurate analysis on regional level, detailed spatial data must be used and assumptions adjusted to Arctic conditions, as carried out for the regional pilot studies presented here.

Regional and national datasets for the Arctic

The circumpolar arctic area comprises of the Arctic parts of Russia, Finland, Sweden, Norway, Canada, Iceland, Faroe Islands, Greenland and Alaska. The first step of the assessment is the collection of spatial and non-spatial data for all of these 8 Arctic regions. The most important spatial data that need to be collected are recent land use maps of each region, preferably with land use classes that indicate land use intensities. In addition, national or local maps are needed with

Figure 9.2. **Average MSA per Arctic region in 2010 calculated with GLOBIO3 based on global datasets**

Source: Own calculation, assumptions in OECD Environmental Outlook.

Table 9.1. **GLOBIO3 global MSA values for land use categories**

Biodiversity class name	MSA value
Primary forests	1
Forest plantations	0.2-0.3
Secondary forests	0.5
Light used primary forests	0.7
Agro forestry	0.5
Extensive agriculture	0.3
Irrigated intensive agriculture	0.05
Intensive agriculture	0.1
Perennials & woody bio fuels	0.2
Natural grass & shrub lands	1
Man-made pastures (intensive management)	0.1
Extensive livestock grazing	0.3-0.7
Natural Bare, rock & snow	1.0
Natural inland water	.
Artificial water	.
River/stream	.
Wetlands (natural)	1
Built up areas	0.05
Mining (surface land area)	0.05

Source: Alkemade et al. (2009), see note 2.

respect to infrastructure (roads, railways, power lines etc.), population intensity, protected areas and administrative zones. For the collection of these data and other related information on biodiversity, collaboration has been set up with several research institutions and organizations¹¹.

Spatially related information on climate change has been derived from the Integrated Model to Assess the Global Environment (IMAGE) developed by PBL¹². Due to the limited scope of the pilot study only a few local and national datasets could be assembled, based on literature search and through the existing contacts of the ECONOR team. For some of the regions no local dataset could be found at all. In Annex 9.1 an overview is given of collected spatial data for land cover and land use per country.

Model adjustments: differences between arctic and non-arctic regions

In terms of pressures on the environment, the Arctic is quite different from the rest of the world. While population pressure is by far the largest driver of global biodiversity loss, this driver is much less significant in the Arctic with its sparsely populated regions. Land use has the largest impact, also in the Arctic, relative to the other pressures (Figure 9.12) where the contribution of land use to the total MSA loss is 38 per cent while that of infrastructure is only 9 per cent. However, as land use is not projected to change much between the current and future situation, it does not add significantly to the expected pressure in a future situation. As such it is less relevant for the policy makers, as they will be more interested in how to put a halt to the additional biodiversity loss from planned human developments that are expected to increase in scale, like infrastructure development and land fragmentation.

Table 9.2. **Global MSA values for different grazing categories**

Type of rangeland	Short description	MSA Global
Natural rangelands	Rangeland ecosystems determined by climatic and geographical circumstances and grazed by wildlife or domestic animals at rates similar to those of free-roaming wildlife	1
Very extensively used or recent abandoned rangelands	Rangelands with low stocking rates or original grasslands no longer in use, lacking wildlife grazing and no forests developed	0.7
Moderately used rangelands	Rangelands with higher stocking rates: grazing has different seasonal patterns or vegetation structure is different compared with natural rangelands	0.6
Intensively used rangelands	Rangelands with very high stocking rates: grazing has different seasonal patterns and vegetation structure is different compared with natural rangelands	0.5
Man-made grasslands: Extensive managed	Man-made rangeland with extensive/organic management, including converted forests	0.3
Man-made grasslands: Intensive managed	Man-made rangeland with intensive management, including converted forests	0.1

Source: R. Alkemade, R. Reid, M. van den Berg, J. de Leeuw and M. Jeuken 2013. Assessing the impacts of livestock production on biodiversity in rangeland ecosystems. PNAS 20900-20905, dec 24 2013 Vol. 110, No 52.

Currently, land use change is a minor pressure factor in the Arctic compared to the rest of the world, however, climate change might imply larger land use changes in the future. Climate conditions are less favourable for agriculture, and forestry is less intensive in the Northern regions as trees grow slower and large scale forestry becomes commercially less attractive. Whereas winter and snow limit grazing for cows and sheep, semi-domesticated reindeer graze all year round. Climate change is expected to be the dominant pressure on Arctic biodiversity in the future.

Globally, land use change is an important pressure on biodiversity. For GLOBIO3 the land use impact on MSA for the Arctic has been determined of various land use categories based on literature research. See Table 9.1. for an overview of land use categories with corresponding MSA values for land use.

The grazing categories have been subdivided allowing a higher differentiation of grazing intensity (Table 9.2). As land use conditions differ per country, local adjustments can be made based on detailed spatial data and the knowledge of local land use and biodiversity specialists. Information on land use in the Arctic is derived from many sources, from available spatial data, review of research articles, the ECONOR project, assessments by the Conservation of Arctic Flora and Fauna (CAFF), international conferences, and expert advice.¹³

The land use classes of available maps are being aggregated into land use classes based on similarities in land use intensity and biodiversity intactness. Aggregation of these classes makes a comparison possible between countries and regions. For the assessment of the entire Arctic region based on global data sets, use is made of the GLC2000 map which includes the following classes within the Arctic region: 2: Closed broad-leaved deciduous forest; 3: Open broad-leaved deciduous forest; 4: Evergreen needle-leaved forest; 5: Deciduous needle-leaved forest; 6: Mixed leaf forest; 9: Mosaic: forest/other natural vegetation; 10: Tree cover, burnt;

11: Evergreen closed-open scrubland; 12: Deciduous closed-open scrubland; 13: Herbaceous closed-open cover; 14: Sparse herbaceous or shrub cover; 15: Regularly flooded herbaceous or shrub cover; 16: Cultivated and managed areas; 17: Mosaic: cropland/forest/other natural vegetation; 18: Mosaic: cropland/shrub or grass cover; 19: Bare areas; 20: Water bodies; 21: Snow and ice; 22: Artificial surfaces and associated areas.

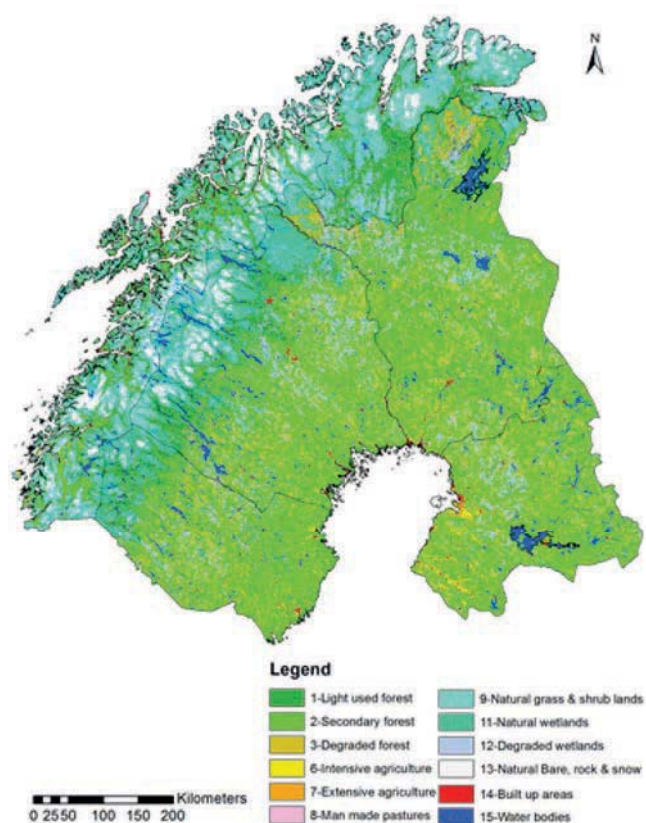
These GLC land cover /land use classes are aggregated into GLOBIO3 land use classes according to the classification scheme in Table 9.3. GLOBIO3 land use classes are subdivided according to land use intensities from the IMAGE model¹⁴. The GLC land use classes are broad and in reality there will be quite some variation in use intensity within each class.

Table 9.3. **GLC2000 land cover categories and corresponding GLOBIO land use categories**

Land cover (GLC2000 class)	GLOBIO Land Use class
Forest (1-9)	Natural forest
	Forestry – Plantation
	Forestry – Clear-cut harvesting
	Forest – Selective logging
	Forest – Reduced impact logging
Burnt forest (10)	Burnt forest
Grassland (11,15)	Natural grassland
Grassland (12-14)	Pasture (30) - moderately to intensively used
	Pasture (30) - Man-made
	Ungrazed abandoned grasslands
Cropland (16)	Extensive cropland
	Intensive cropland
	Irrigated cropland
	Woody biofuels
Cropland/forest (17) e	-
Cropland/natural vegetation (18) e	-
Bare areas (19)	Bare area
Water bodies (20)	-
Snow and ice (21)	Snow and ice
Urban area (22)	Urban area

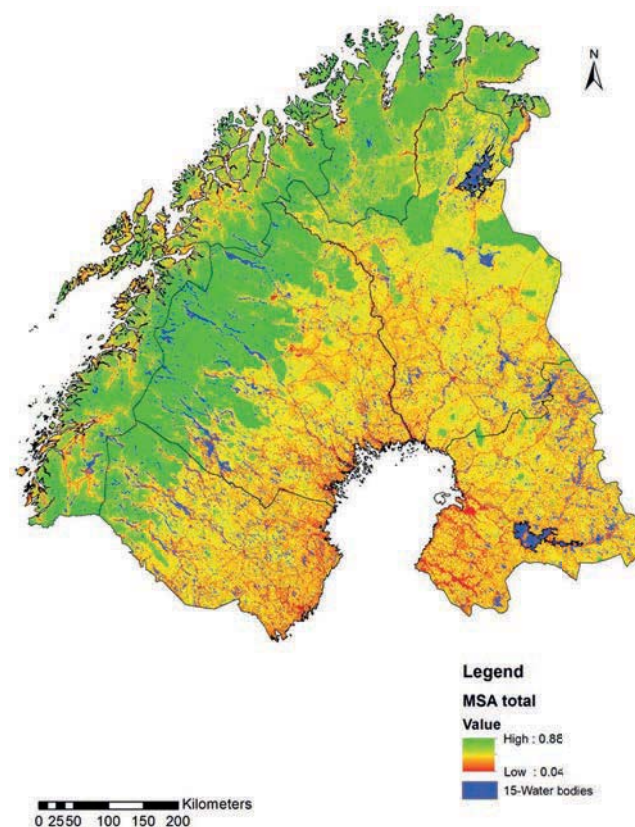
Source: Alkemade et al. (2009), see note 2.

Figure 9.3. Aggregated land use map Sápmi region based on CORINE 2006



Source: Own calculation, CORINE Land cover maps, eea.europa.eu

Figure 9.4. MSA total map Sápmi region based on CORINE 2006



Source: Own calculation, CORINE Land cover maps, eea.europa.eu

Assessment of Arctic biodiversity on regional scale

In order to compare the results of the global assessment with the Arctic pilot study another assessment has been carried out based on a combination of both global and regional datasets. For this regional assessment the CORINE land use map has been used, a map established by the European Community as a means of compiling geo-spatial environmental information in a standardized and comparable manner across the European continent. It only covers Europe and has been made for 2000, 2006 and the 2012 map is under development.

A clip of the CORINE map has been made for a part of the Sápmi region, the homeland of the reindeer herd-

ing Sámi people (Figure 9.3). The CORINE land use map is available for northern areas of Norway, Sweden and Finland. Due to a lack of comparable data, it was not possible to include the Russian part of Sápmi in this first pilot study. The results of the assessment of the Sápmi region have a resolution of 1*1 km.

The CORINE land use classes have been aggregated into the GLOBIO3 classes (Annex 9.2) and provided with the corresponding MSA values for land use that are shown in tables 9.2 and 9.3. The coniferous forests in the Northern Scandinavian region are assumed to be exploited regularly, while the broad-leaved forests (mainly birch forests) are considered to be light used. The other forest types are considered as secondary forests. Forests within the strictly protected parks¹⁵ are expected to be almost intact and get therefore an MSA value for land use at 0.9. The 'Transitional woodland' class is considered as secondary forest and as lightly used forest within the parks.

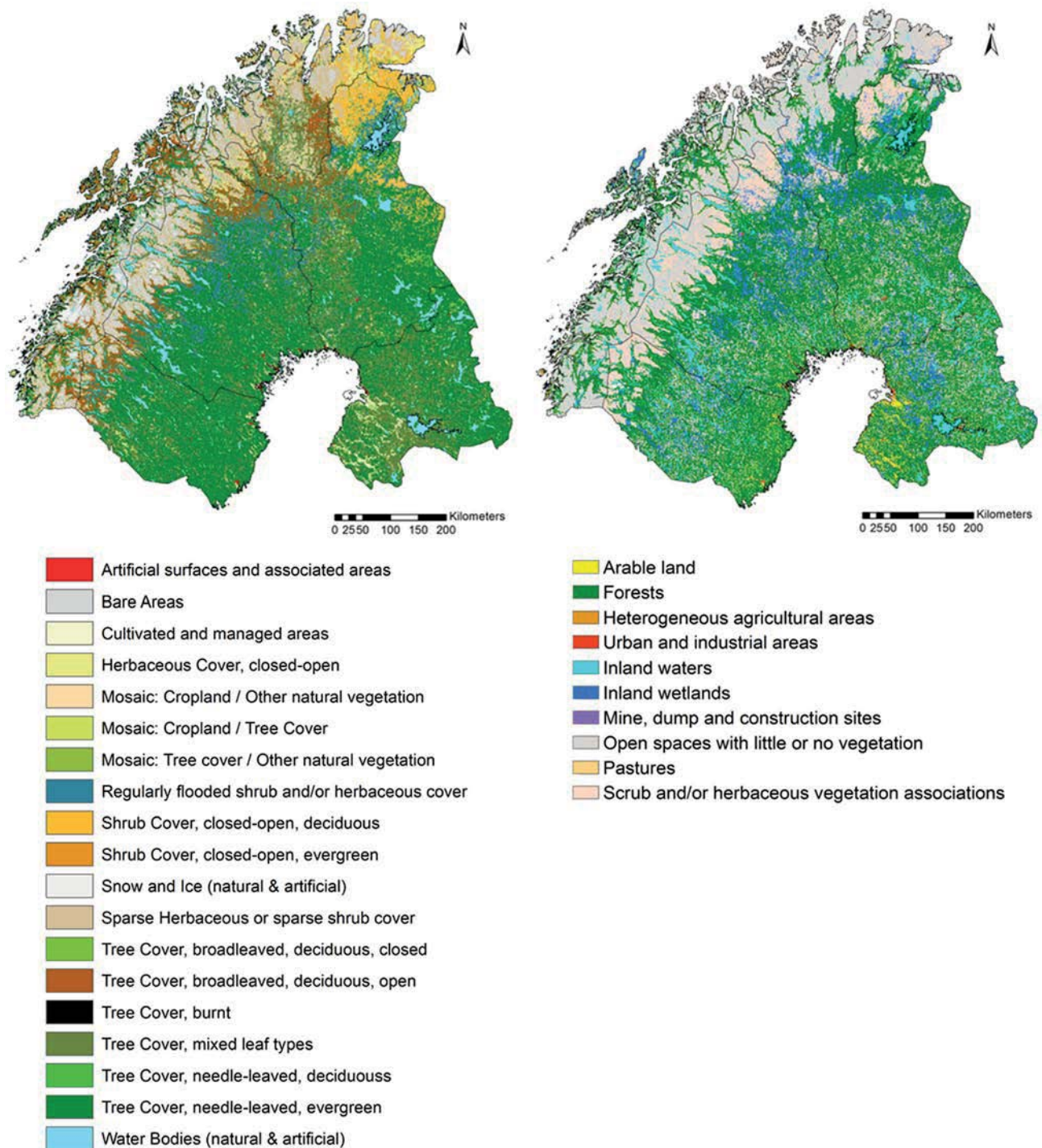
Figure 9.4 shows the overall MSA map, which is the result of multiplying the MSA pressure indices with each other¹⁶. From Figure 9.4 it can be seen that the most intact region are the Nordland, Troms and Finnmark regions of Norway and the north-western part of the Västerbotten and Norrbotten regions of Sweden. Land use change is the dominant pressure type in these

Table 9.4. Average overall MSA value per province for CORINE 2006 and GLC 2000 dataset

Province	Country	Area (km ²)	Msa_total CORINE 2006	Msa_total GLC 2000
Nordland	Norway	34677	0.64	0.70
Troms	Norway	24660	0.65	0.72
Finnmark	Norway	46372	0.72	0.74
Västerbotten	Sweden	55095	0.47	0.65
Norrbotten	Sweden	98246	0.60	0.76
Lappi	Finland	93811	0.50	0.73
Oulu	Finland	57128	0.38	0.60

Source: Own calculation, CORINE Land cover maps, eea.europa.eu, Global Land Cover (GLC) maps.

Figure 9.5. Overview of the GLC 2000 and CORINE 2006 land cover maps of the Sápmi region



Source: Own calculation, CORINE Land cover maps, eea.europa.eu, Global Land Cover (GLC) maps.

regions and the main explanation for the higher intactness can be seen on the land use map of Figure 9.5. According to the CORINE land use map these intact regions consist of large areas of semi-natural grazing land and natural bare land, rock and snow, which have a MSA value for land use value of 0.9. In the other part of the Sápmi region the intactness of the nature is much lower. These areas consist of more forest areas which are commercially exploited and also contain according to the CORINE land use map of a relatively large area of degraded forest and wetlands. An overview of mean MSA values per province is provided in Table 9.4.

The result of the regional assessment for the Fenno-Scandinavian Sápmi region can be compared with the result of the global assessment based on global data-sets. The global assessment has been carried out on a $0.5^{\circ} \times 0.5^{\circ}$ degrees resolution (approx. $50^{\circ} \times 50^{\circ}$ km) with the GLC2000 as land cover map (resolution approx. $1^{\circ} \times 1^{\circ}$ km) while for the regional assessment a resolution of $1^{\circ} \times 1^{\circ}$ km is used with the CORINE2006 (resolution $250^{\circ} \times 250^{\circ}$ m) as land cover map (Figure 9.5).

The calculations of impacts of climate change, land fragmentation and infrastructure were the same, based

Table 9.5. **The relationship between semi-natural area size in km² and MSA value of fragmentation**

Cluster size	MSA
0-1	0.35
1-10	0.45
10-100	0.65
100-1000	0.9
1000-10000	0.98
>=10000	1

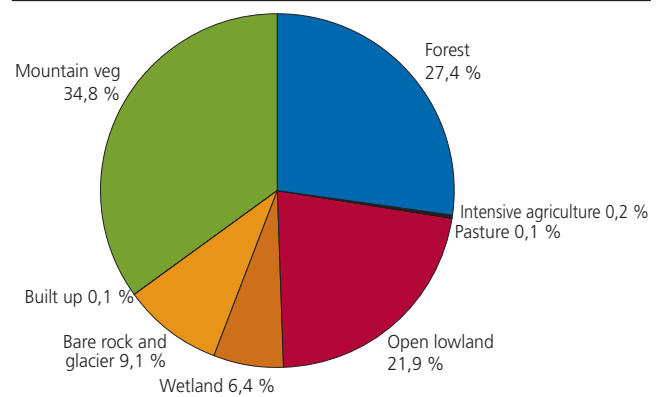
Source: Alkemade et al. (2009), see note 2.

on the same input except for the resolution and land use map. Table 9.5 shows an overview of the MSA total results per province for both assessments. Although the differences are small for the Norwegian regions, they are significant for the Swedish and Finnish regions. The main reason for the differences is caused by the level of detail of the land use maps. The CORINE map has a higher differentiation in land use intensities which results in a different value for MSA of land use.

For the global assessment the global average MSA land use values were used without adjustment for local conditions. Most forests are considered as natural land with an MSA land use value of 1. For the regional assessment some adjustment to local conditions has been applied for the MSA valuation of regional land cover classes in Norway.¹⁷ In Sweden and Finland the evergreen and mixed forests can be considered as secondary forests that are logged on a frequent basis.

The map resolution also influences the outcome. For the global analysis the GLC2000 land cover map is aggregated to 50*50 km grid cells. Due to this process smaller sized land use patterns disappear, as only the land use type with the largest area within each grid cell

Figure 9.6. **Land cover / land use distribution in Finnmark; Norway 2011**



Source: Data from Statistics Norway and Norwegian Institute for Nature Research (NINA).

remains, although the real land use can be mixed and thus quite different. These effects are less in Northern Norway, as a large part of the land is covered by semi-natural landscapes. But the fragmented land use patterns in the south of the Swedish Västerbotten and Norbotten regions and in the Finnish regions cause a difference in the generalization level.

Assessment of Arctic biodiversity on provincial scale

The timeframe of this GLOBIO pilot study allowed only the assessment of one region based on detailed data. As the data availability for Norway appeared very high, the county of Finnmark was selected for the most detailed GLOBIO3 analysis of an Arctic region with data of a 100*100 m resolution. The study for Finnmark has been made in collaboration with the Nomadic Herders Sápmi (NHS) project, using most of the same data

Figure 9.7. **Land use and MSA land use map of Finnmark, Norway 2011**

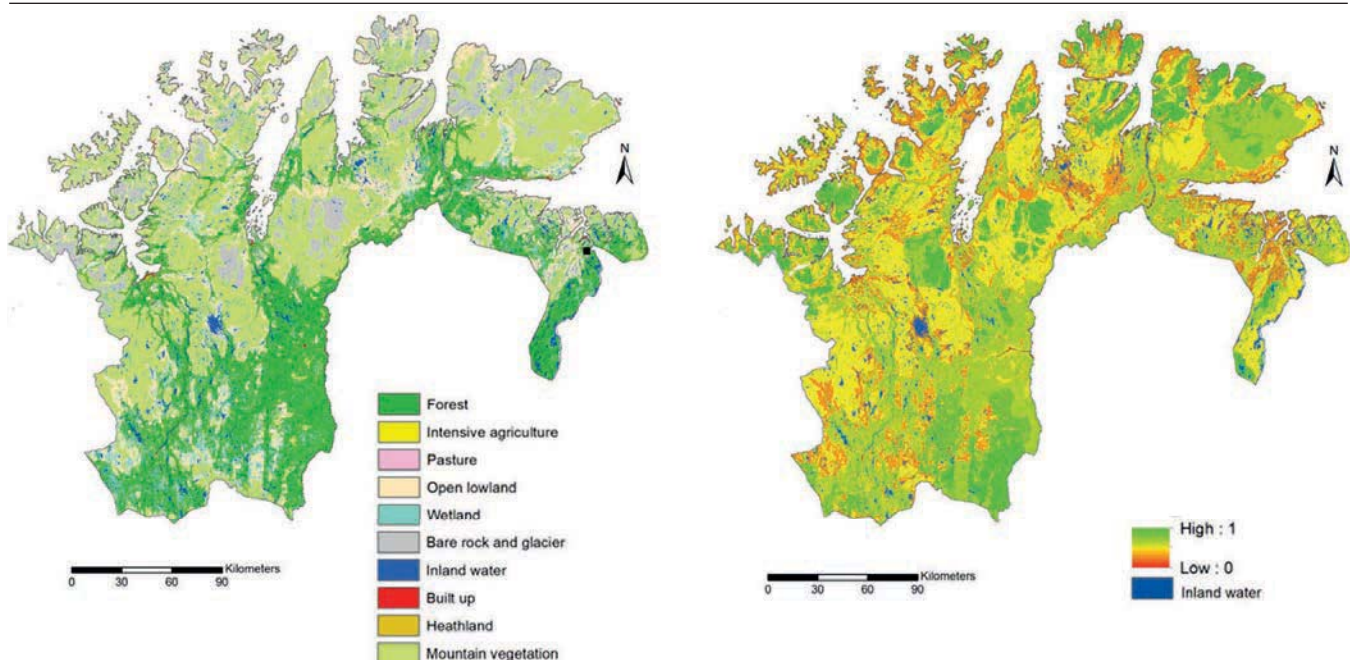
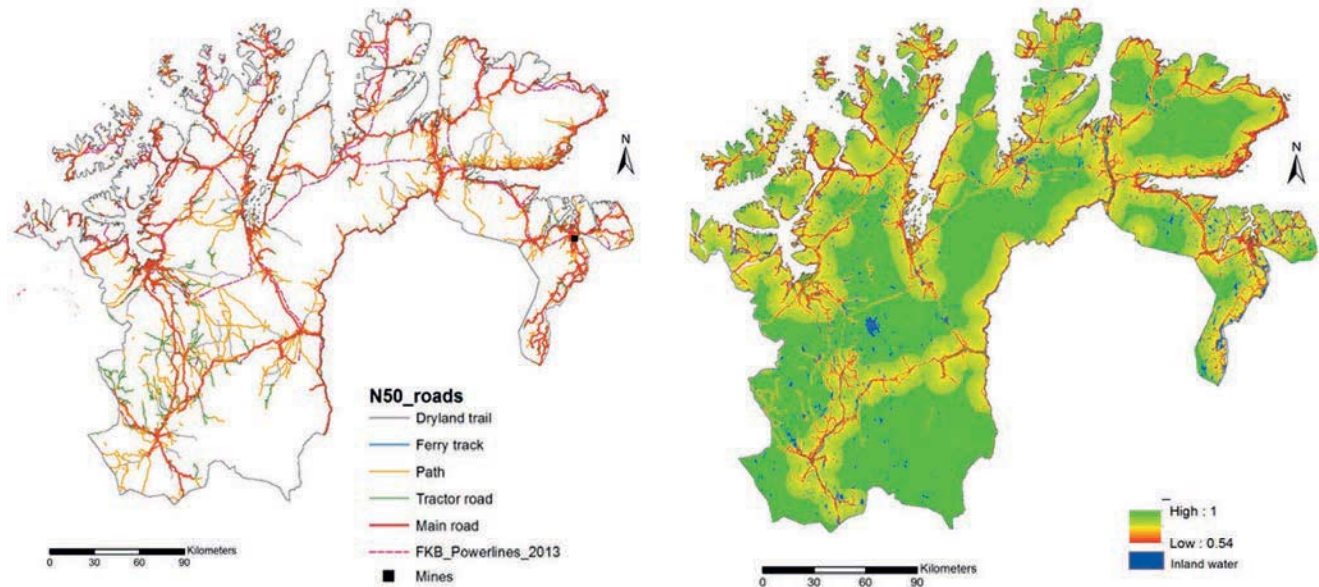


Figure 9.8. Infrastructure and MSA infrastructure map of Finnmark, Norway 2011



base (GIS layers for the maps). However, the results differ slightly, as the NHS project incorporated more local information, both local spatial data, local expert knowledge and reindeer owners' traditional knowledge on use of pastures.

Impact of land use

In order to test the quality of regional assessments, by comparison with assessment at national level, an assessment of impacts on biodiversity for all of Norway was first carried out. This gave the opportunity to discuss with specialists from Norwegian environmental

research institutes¹⁸ what the impacts of the different types of land use were on the intactness of the nature.

In Finnmark forests cover 27 per cent of the landcover, while open lowland and mountain vegetation cover respectively 22 per cent and 35 per cent of the land area. These open areas are located in Tundra and Taiga biomes. In Finnmark extensive grazing by reindeer is the most dominant land use of these open lands.

Compared to other regions of Norway, forestry in Finnmark is of much less scale, as spruce and pine trees are less dominant than deciduous trees (mainly birch) and forest growth is much slower due to colder conditions in the north. Intensive agriculture is relatively small in Norway and covers only 3 per cent of the land area and even much less in Finnmark also due to the colder conditions. Fenced pastures near farms cover only a small area in Finnmark (0.1 per cent).

Wetlands consist of marshlands including bogs and mires and cover approximately 5 per cent of the land area and more than 6 per cent in Finnmark. Built up area is concentrated mostly in urban areas and cover only 0.1 per cent of the land area in the sparsely populated Finnmark (0.1 per cent). Among the most intact ecosystems is the bare rock and glacier land use class which covers 9 per cent of the land area in Finnmark and in average for Norway. Figure 9.6 shows an overview of the distribution of land use in Finnmark for 2011.

MSA land use values for each of the land use types were determined based on similarity with the GLOBIO3 land use types (Figure 9.7) and adjusted according to land use intensity descriptions provided by specialists for each nature type.¹⁹

Figure 9.9. MSA land fragmentation map for Finnmark, Norway 2011

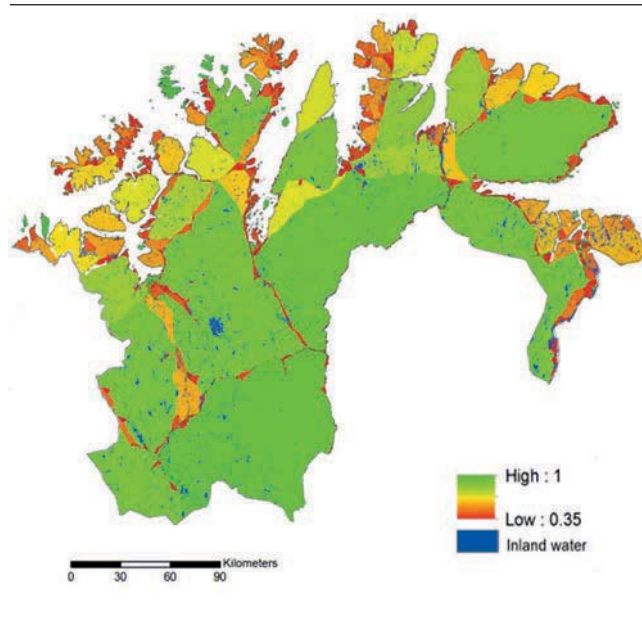


Figure 9.10. MSA climate map for Finnmark, Norway 2011

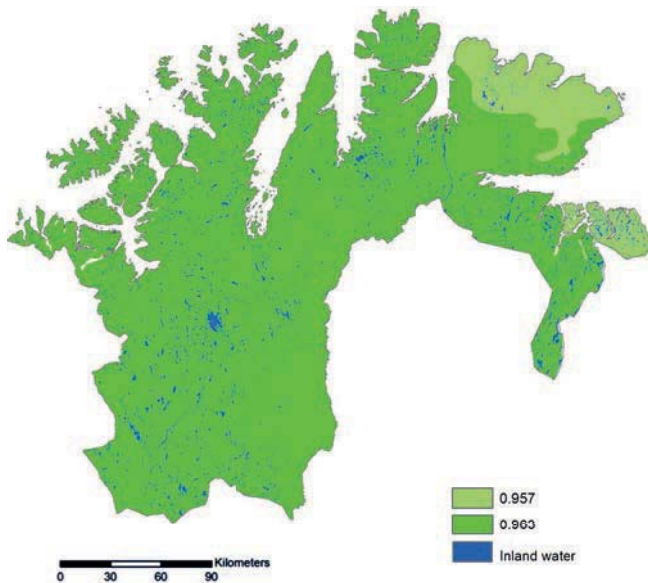
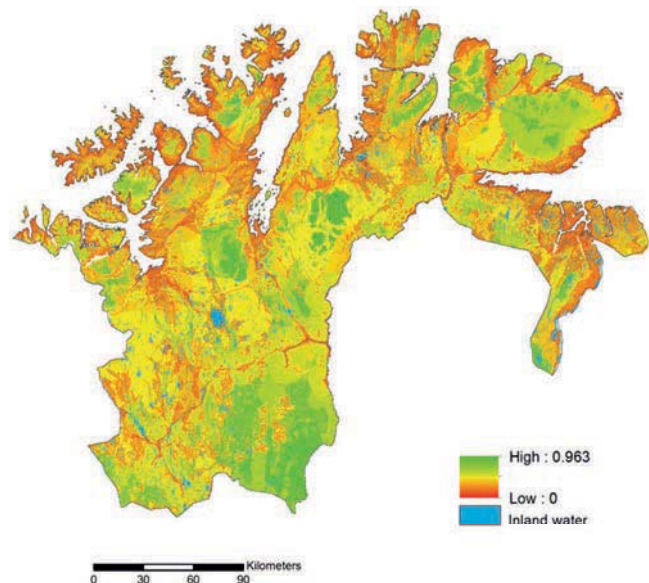


Figure 9.11. MSA total map for Finnmark, Norway 2011



Impact by infrastructure

The impact of infrastructure on biodiversity in GLOBIO3 is calculated based on known cause-effect relations for a zone of 5 km distance around linear infrastructure such as roads and railways, and for an impact zone of 10 km from urban areas, mines and agricultural areas. To avoid double counting of other pressures (e.g. land use) this impact is only calculated for natural and semi-natural areas. In urban and agricultural areas the impact of land use already includes the presence of roads and other existing pressures. Figure 9.8 shows an overview of existing infrastructure and the corresponding MSA map for impact of infrastructure in Finnmark.

Impact by fragmentation

In GLOBIO3 the impact by fragmentation is limited to the cause-effect relations between intact (semi-) natural area size and biodiversity intactness in terms of MSA value for fragmentation. The larger an intact area is, the lower the impact. Intact areas of more

than 10 000 km² are considered to have no fragmentation impact²⁰. Table 9.5 shows the GLOBIO3 relationship between patch size and MSA. Figure 9.9 shows the MSA map for land fragmentation for Finnmark for 2011.

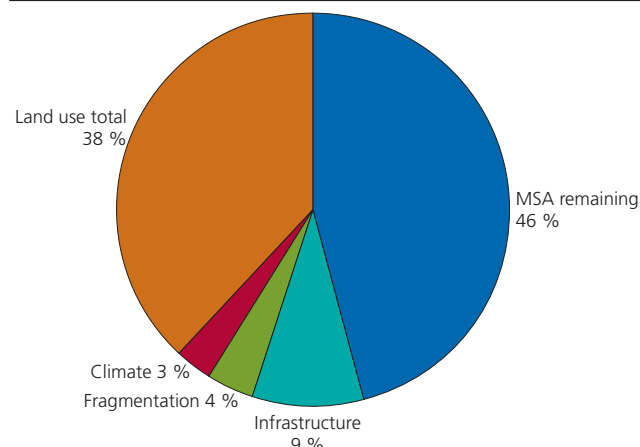
Impact by climate change

In GLOBIO3 climate impact is based on a combination of the integrated environmental model (IMAGE) and climate envelope models for plant and vertebrate systems²¹. The share of remaining species at a locality is used as an indicator for biodiversity impact. Regression is used to calculate the climate impact on the biodiversity for different biomes. Tundra, boreal forest and cool conifer forest are the predominant biomes in Finnmark. Figure 9.10 shows the MSA map for climate for Finnmark in 2011. As climate change in 2011 is still relatively small the MSA impact is also small for the current situation, but expected to increase considerably in the future.

Overall impact

The overall MSA impact map is calculated by multiplying the different MSA indices with each other in a raster GIS system. Figure 9.11 shows this map for total effect on MSA for Finnmark for 2011. Next to land use, both infrastructure development and land fragmentation have a strong local impact on biodiversity. The most intact biodiversity (green colour) can be observed in the national parks and reserves. The highest impact can be seen in the open lowland and around the main urban areas and near the major roads. Figure 9.12 provides an overview of the MSA loss distribution per type of pressure in Finnmark. According to this analysis the remaining biodiversity in Finnmark is 46 per cent of the intact situation. The largest biodiversity loss is caused by land use (38 per cent), followed by infrastructural developments (9 per cent), fragmentation (4 per cent) and climate change (3 per cent).

Figure 9.12. Distribution of biodiversity loss per pressure in Finnmark, Norway 2011





Reindeer grazing land, Rávdoaiivi, Finnmark. Photo: Tom Nicolaysen.

Conclusions

Based on the GLOBIO3 model the impact of different human related pressure types on biodiversity has been calculated. As biodiversity is costly to measure in the field, and biodiversity data often are sparse in many areas, an estimation of biodiversity loss by assessing the pressure intensities seems an appropriate approach. The current impact of socio-economic developments in terms of changes in land use, infrastructural developments and land fragmentation can be assessed based on existing data.

An advantage of the model, not yet tested in this pilot study, is that it can also be used to assess implications of socio-economic development in the future, based on selected scenarios. Scenarios for trends of past, present and future biodiversity can be generated, and these results can be used by local decision makers and stakeholders to assess the potential implications of existing or future policies on biodiversity.

The quality of the output is critically dependent on the availability of national or provincial land use maps and expertise from local specialists for the adjustment of land use impact for local conditions. The impact of pressures on the extensive grazing systems in the Arctic, such as grazing by reindeer herds, need more

attention in order to combine assessment of impacts in terms of MSA loss and local knowledge on biodiversity.

The land use map is one of most important input data for the model. However, as land use change is rather limited in the Arctic, the other pressure types will contribute more to the loss of biodiversity in the future. Another limitation for implementation of the model in Arctic regions is that in some of these regions land use maps are poor and hardly differentiate between different levels of land use intensity.

Climate calculations are so far based on average global data with limited information on Arctic species and should be refined with species information and down-scaled climate scenarios in order to get more accurate climate impact results for Arctic conditions.

Although the current pilot assessment of Arctic biodiversity is restricted to an assessment of the current biodiversity status only, it provides valuable insight how human related pressures interact with the current biodiversity and gives an overview how the impact is distributed over the geographical pilot areas and to what extent each pressure contributes to the overall loss of biodiversity in the Arctic pilot areas.

Notes

¹ This research builds on previous cooperation with Ben ten Brink and Michel Bakkenes of PBL - Netherlands Environmental Assessment Agency, and their contribution is gratefully acknowledged. The authors also thank the experts involved in the Nature Index for Norway for data and discussions of approaches for adapting GLOBIO3 to applications in Norway and in Arctic regions.

² Alkemade, R. et al., 2009, GLOBIO3: A Framework to Investigate Options for Reducing Global Terrestrial Biodiversity Loss. In *Ecosystems* DOI: 10.1007/s10021-009-9229-5. Authors: Rob Alkemade, Mark van Oorschot, Lera Miles, Christian Nellemann, Michel Bakkenes, and Ben ten Brink. See also the www.globio.info website.

³ van Rooij, W., P. A. Garnåsjordet and I. Aslaksen (2016): Impacts on Arctic biodiversity: Comparing GLOBIO3 and the Nature Index for Norway in dialogue with experts for national and regional scenario building. Report under publication.

⁴ Alkemade et al 2009

⁵ $MSA_{total} = MSA_{landuse} * MSA_{infrastructure} * MSA_{fragmentation} * MSA_{climate}$.

⁶ Figures constructed based on data from the Rethinking Global Biodiversity study by PBL, 2010: Rethinking Global Biodiversity Strategies: Exploring structural changes in production and consumption to reduce biodiversity loss. © Netherlands Environmental Assessment Agency (PBL), The Hague/Bilthoven, 2010

⁷ van Vuuren et al. 2015.

⁸ The global assessment results including all Arctic regions have a resolution of approximately 50*50 km.

⁹ Alkemade et al 2009, see note 2.

¹⁰ 2013, AR5 report

¹¹ Cooperation has been carried out between the project team of Statistics Norway (SSB), the ECONOR III project members of the Arctic Regions, the Norwegian Institute for Nature Research (NINA), the Norwegian Environment Agency, and the Arctic Council i.e the biodiversity working group of the Arctic Council, Conservation of Arctic Flora and Fauna (CAFF). In addition a scan on national spatial data has been carried out on the internet.

¹² Nitrogen deposition in the Arctic region is in general lower than the threshold levels and is expected to cause therefore no additional impact on the biodiversity. Data on national level: Only for Norway a national map of Nitrogen deposition was available. (Not used in Arctic pilot study.)

¹³ Arctic Biodiversity Congress in Trondheim (2-4 December 2014) and at International Society for Ecological Economics in Reykjavik (13-15 August 2014).

¹⁴ Stehfest, E., van Vuuren, D., Kram, T., Bouwman, L., Alkemade, R., Bakkenes, M., Biemans, H., Bouwman, A., den Elzen, M., Janse, J., Lucas, P., van Minnen, J., Müller, M., Prins, A. (2014), Integrated Assessment of Global Environmental Change with IMAGE 3.0. Model description and policy applications, The Hague: PBL Netherlands Environmental Assessment Agency

¹⁵ IUCN categories Ia, Ib, II

¹⁶ From the MSA map (Figure 9.4) it can be observed that the main impacts in these regions are situated along linear features. These linear zones are the impact areas along roads. For the impact calculation of infrastructure and land fragmentation, primary and secondary roads are used in combination with the aggregated land use map.

¹⁷ According to forest specialist from Norway (a.o. Erik Framstad).

¹⁸ NINA, NIBIO, MET.

¹⁹ Ann Norderhaug and Sølvi Wehn, grassland and semi-natural landscape specialists of Bioforsk, agriculture economist specialist Ivar Gaasland of SNF, Jarle Werner Bjerke, Senior Researcher and Reindeer Grazing Specialist at NINA, GIS and Ecology specialist Stefan Blumenrath of the Landscape and Ecology Department of NINA, and Forestry specialist Stein Tomter of Skog og Landskap/NIBIO.

²⁰ The impact of fragmentation is not measured for islands smaller than 100 km². Additional cause-effect relations are needed for these smaller islands which can be found quite numerous in the Arctic region.

²¹ Alkemade R., M. Bakkenes and B. Eickhout 2011. Towards a general relationship between climate change and biodiversity: an example for plant species in Europe. *Regional Environmental Change* 2011 Suppl 1: S143-S150.

Annex 9.1. Overview of selected land cover maps for Arctic countries with highest detail

	Russia	Finland	Sweden	Norway	Iceland	Greenland	Faroe Islands	Canada	Alaska
Land cover									
Global: Globcover2009 (G)	x	x	x	x	X	x	x	X	x
Regional: CORINE 2006 (C)		x	x	x	X		x		
National (N)	x		x	x	X				x
Forest general	G	C	N	N	N	G	G	G	N
Forest closed /dense	N	G	G	G	G	G	G	G	G
Forest moderate dense	N	G	G	G	G	G	G	G	G
Forest open	N	G	G	G	G	G	G	G	G
Scrubland	N	G	G	G	G	G	G	G	G
Grassland	N	G	G	G	G	G	G	G	G
Open land	G	C	C	N	C	G	G	G	G
Natural lands		C	C	C	C				
Natural vegetation general									
Wetlands	N	C	N	N	C	G	G	G	G
Heather and Moor lands		C	C	C	C				
Glaciers / Snow /Bare rock									
Dunes, Sands, etc	N	C	N	N	C				
Water bodies / rivers	N	C/G	C/G	N	C/G	G	G	G	N
Land use									
Agriculture general	G	C	N	N	C	G	G	G	G
Irrigated intensive agriculture	G	C							
Intensive agriculture		C		N					
Extensive agriculture	G	C	C	C	C	G	G	G	G
Recent abandoned arable land		C	C	C	C				
Perennial		C	C	C	C				
Biofuel crops		C	C	C	C				
Forestry general			N	N					
Forestry natural		C	C	C	C				
Forestry light used									
Forestry secondary		C	C	C	C				
Forestry degraded									
Forest plantations		C	C	C	C				
Grazing /Pasture general		C	N	N	C				
Natural grazing		C	C	C	C				
Light grazing				N					
Moderate grazing		C	C	N					
Heavy grazing		C	C	N					
Reindeer grazing general				N					
Reindeer density									
Livestock density general	FAO	FAO	FAO	N	FAO	FAO	FAO	FAO	FAO
Urban areas	N	C	N	N	C	G	G	G	G
Mining areas								N	

x: available, G: Globcover2009, C: CORINE 2006, N: National data

Source: CORINE Land cover maps, eea.europa.eu, Global Land Cover (GLC) maps, national data sources.

Annex 9.2. **Reclassification of CORINE level 3 classes to GLOBIO3 land use classes**

CLC Level 3	GLOBIO3 class
1.1.1. Continuous urban fabric	Built up areas
1.1.2. Discontinuous urban fabric	Built up areas
1.2.1. Industrial and commercial units	Built up areas
1.2.2. Road and rail networks and associated land	Built up areas
1.2.3. Port areas	Built up areas
1.2.4. Airports	Built up areas
1.3.1. Mineral extraction sites	Built up areas
1.3.2. Dump sites	Built up areas
1.3.3. Construction sites	Built up areas
1.4.1. Green urban areas	Built up areas
1.4.2. Sport and leisure facilities	Built up areas
2.1.1. Non-irrigated arable land	Intensive agriculture
2.1.2. Permanently irrigated land	Irrigated intensive agriculture
2.1.3. Rice fields	Irrigated intensive agriculture
2.2.1. Vineyards	Perennials & woody bio fuels
2.2.2. Fruit trees and berry plantations	Perennials & woody bio fuels
2.2.3. Olive groves	Perennials & woody bio fuels
2.3.1. Pastures	Man made pastures
2.4.1. Annual crops associated with permanent crops	Intensive agriculture
2.4.2. Complex cultivation patterns	Intensive agriculture
2.4.3. Land principally occupied by agriculture, with significant areas of natural vegetation	Extensive agriculture
2.4.4. Agro-forestry areas	Agro forestry
3.1.1. Broad-leaved forest	Light used forest
3.1.2. Coniferous forest	Secondary forest
3.1.3. Mixed forest	Secondary forest
3.2.1. Natural grassland Low productivity grassland. Often situated in areas of rough uneven ground. Frequently includes rocky areas, briers, and heathland	Natural grass & shrub lands
3.2.2. Moors and heathland Vegetation with low and closed cover, dominated by bushes, shrubs and herbaceous plants (heath, briers, broom, gorse, laburnum, etc.).	Natural wetlands
3.2.3. Sclerophyllous vegetation Bushy sclerophyllous vegetation, includes maquis and garrigue	Natural grass & shrub lands
3.2.4. Transitional woodland shrub Bushy or herbaceous vegetation with scattered trees. Can represent either woodland degradation or forest regeneration / colonisation	Degraded forests
3.3.1. Beaches, dunes, and sand plains	Natural Bare, rock & snow
3.3.2. Bare rock	Natural Bare, rock & snow
3.3.3. Sparsely vegetated areas Includes steppes, tundra and badlands Scattered high-altitude vegetation	Natural grass & shrub lands
3.3.4. Burnt areas Areas affected by recent fires, still mainly black	Intensive agriculture
3.3.5. Glaciers and perpetual snow	Natural Bare, rock & snow
4.1.1. Inland marshes Low-lying land usually flooded in winter, and more or less saturated by water all year round	Natural wetlands
4.1.2. Peatbogs Peatland consisting mainly of decomposed moss and vegetable matter. May be exploited	Degraded wetlands
4.2.1. Salt marshes Vegetated low-lying areas, above the high-tide line, susceptible to flooding by sea water. Often in the process of filling in, gradually being colonised by halophilic plants	Natural wetlands
4.2.2. Salines Sections of salt marsh exploited for the production of salt by evaporation.	Degraded wetlands
4.2.3. Intertidal flats Generally unvegetated expanses of mud, sand or rock lying between high and low water-marks. On contour on maps	Natural Bare, rock & snow
5.1.1. Water courses	Natural inland water
5.1.2. Water bodies	Natural inland water
5.2.1. Coastal lagoons	Sea related water bodies
5.2.2. Estuaries	Sea related water bodies
5.2.3. Sea and ocean	Sea related water bodies

Source: Alkemade et al. (2009), see note 2.

10. Concluding remarks

Solveig Glomsrød, Gérard Duhaime and Iulie Aslaksen

The purpose of the ECONOR project has been to give a comprehensive overview of the economy in the Arctic, including the subsistence economy of the indigenous peoples and other local people of the region. To achieve this goal we have utilized data from the statistical agencies of the Arctic nations and from other sources when relevant. The overview of the Arctic economy provided by this report in terms of scale, composition and structure may help policy makers and communities to better see the position of various stakeholders, the large scale commercial interests, the local and central governments, the indigenous peoples, and the citizens of the Arctic as a whole.

There are large differences in the GDP per capita levels among the Arctic regions and nations. However, in natural resource based economies, using GDP figures to evaluate the wealth or well-being of the population can be especially misleading. Since a large part of GDP in such economies comprises return to fixed capital and resource rents that can be taken out of the region as income, it is difficult to assess what share of GDP is actually available in the region for consumption and investments. Hence, data for household disposable income are included, to give a better picture of consumption possibilities. The change in income during 2008-2012 is discussed, and a broad set of socio-economic indicators contributes to a better picture of well-being, livelihood, and public services from regional and national government.

In the Arctic, with its population of indigenous peoples, subsistence activities are very important for providing local food, as well as maintaining social relationships and cultural values. Subsistence activities contribute to consumption possibilities over and above what is recorded as consumption in the national accounts. As more attention is brought to the intertwined nature of the market economy and subsistence economy and its importance for the well-being of the Arctic indigenous peoples, an important challenge for analysts and policy-makers is the lack of systematic monitoring of the subsistence activities. Knowledge on the subsistence activities could be established, for example in sets of sustainable development indicators, or as supplementary accounts, so-called "satellite accounts" to the national accounts.

A crucial question that we have not been able to answer in this report is to what extent climate change impacts and other environmental impacts, such as long range transported pollution, will limit the possibilities for traditional subsistence activities in the Arctic. Since environmental impacts of economic activity are not explicitly included in GDP, it is a challenge to develop environmental statistics and environmental indicators that can be applied complementarily with economic indicators.

Many tasks are remaining for Arctic statistical agencies and researchers in order to compile economic, environmental and social statistics for the Arctic regions. There is a clear potential for establishing a wider set of data and economic, social and environmental indicators for the circumpolar Arctic. Based on the experiences from the ECONOR projects, we see a need to follow up by studies with a more direct focus on sustainable development. In particular, one can:

- Continue dialogue with statistical agencies of Arctic nations in order to enhance statistical cooperation, in order to establish an institutional basis for providing statistical information on the economy, livelihood and environmental impacts in the circumpolar Arctic.
- Improve statistical indicators to give a better indication of social conditions, well-being, and inequalities in Arctic regions. Continue to link the national account based industry data with environmental and climate data to facilitate a consistent analysis of sustainability.
- Establish statistical indicators relevant for Sustainable Development Goals that set out a wide range of economic, social and environmental objectives. To support the High-level political forum on sustainable development to maintain the strategy of sustainable consumption and production, sustainably managing the natural resources and taking urgent action on climate change, so that it can support the needs of the present and future generations.
- Facilitate research on how climate change will affect the Arctic economy by formatting the statistics, such as providing gridded data on population, capital assets and nature based activities to make knowledge compatible with output from regionally downscaled climate models.
- Establish statistical indicators for the subsistence economy of indigenous and other local people of the Arctic. These indicators could be compatible with national account concepts in the format of satellite accounts (supplementary accounts). Indicators for subsistence production could provide assessment of welfare implications of climate change impacts and trans-boundary pollution.

The list above does not aim to be complete, and there are certainly more areas that need further study. Taking into account the lack of economic statistics and economic analysis of the circumpolar Arctic before the ECONOR projects, there are many tasks that deserve further efforts. The Economy of the North 2015 has updated the earlier version and demonstrated that there is potential for both regularly update and expanded coverage. However, a stronger focus on the income and welfare issues, resource dependence and sustainable development can be regarded as a synthesis of the main findings from the ECONOR project.

List of authors and other contributors

Chapter	Author	Institution	Country
List of authors:			
1, 6, 9, 10	Iulie Aslaksen	Statistics Norway	Norway
1, 3, 4, 5, 10	Solveig Glomsrød	CICERO	Norway
1, 2, 10	Gérard Duhaime	Université Laval	Canada
2	Andrée Caron	Université Laval	Canada
2	Sébastien Lévesque	Université Laval	Canada
2	André Lemelin	Université INRS Institut national de la recherche scientifique	Canada
2, 3, 4	Ilmo Mäenpää	University of Oulu	Finland
2	Olga Nigai	Université Laval	Canada
2	Véronique Robichaud	Université INRS Institut national de la recherche scientifique	Canada
Box I	Bjart Holtsmark	Statistics Norway	Norway
3, 4, Box I	Taoyuan Wei	CICERO	Norway
4, 5, Box III, Box VI	Lars Lindholt	Statistics Norway	Norway
4	Helen Mc Donald	Statistics Canada	Canada
4, Box II	Scott Goldsmith	University of Alaska	USA
Box III	Mads Greaker	Statistics Norway	Norway
Box IV	Jan Henrik Wang	Statistics Norway	Norway
Box IV	Jan Erik Kristiansen	Statistics Norway	Norway
Box V	Andrey N. Petrov	University of Northern Iowa	USA
6	Davin Holen	University of Alaska	USA
6	Drew Gerkey	Oregon State University	USA
6	Even Høydahl	Statistics Norway	Norway
6	Paul Inge Severeide	Statistics Norway	Norway
6	David Natcher	University of Saskatchewan	Canada
6	Martin Reinhardt Nielsen	University of Copenhagen	Denmark
6, 7	Birger Poppel	Ilisimatusarfik, University of Greenland	Greenland
6, 7	Hunter T. Snyder	Dartmouth College	USA
6	Mary Stapleton	Arctic Institute of North America	Canada
6	Ellen Inga Turi	Univ. of the Arctic, Ealát Institute, International Centre for Reindeer Husbandry	Norway
6	Jesper Graubæk Andresen	University of Aarhus	Denmark
6	Winfried Dallmann	Arctic University of Norway	Norway
6	Kåre Hendriksen	Arctic Technology Centre, Technical University of Denmark	Denmark
6	Ole Hertz	Nordic Seaweed Project/Nordic Bee Consult	Denmark
6	Per Lyster Pedersen	Mizar Consult	Greenland
6	Henrik Meilby	University of Copenhagen	Greenland
6	Carsten Smith	University of Oslo (emeritus), Supreme Court of Norway (emeritus)	Norway
Box VII	Adrian Braun	University of Eastern Finland, Arctic Centre/University of Lapland	Finland
7	Mads Fægteborg	Inuit Circumpolar Council, ICC	Greenland
7	Mia Olsen Siegstad	Inuit Circumpolar Council, ICC	Greenland
8	Kristine Grimsrud	Statistics Norway	Norway
9	Wilbert van Rooij	Plansup	Netherlands
9	Philip Burgess	Univ. of the Arctic, Ealát Institute, International Centre for Reindeer Husbandry	Norway
9	Per Arild Garnåsjordet	Statistics Norway	Norway
9	Svein D. Mathiesen	Univ. of the Arctic, Ealát Institute, International Centre for Reindeer Husbandry	Norway
List of other contributors providing data and statistical and scientific advice:			
1, 4	Alexander Goncharov	Federal State Statistical Service	Russia
8	Helene Amundsen	CICERO	Norway
8	Anne Mari Auno	Statistics Norway	Norway
4	Magnus Helliesen	Statistics Norway	Norway
2	Yannick Marchand	McGill University	Canada
3,4	Anton Orlov	CICERO	Norway
4	Cara Williams	Statistics Canada	Canada
4, 8	Edita Zahirovic	Statistics Norway	Norway

List of figures

Chapter 2

2.1. North America model, main pattern, 2012	14
2.2. Nordic Countries model, main pattern, 2012	14
2.3. Nordic Countries model, main pattern, 2012 (cont.)	14
2.4. Russian Federation model, main pattern, 2012	14
2.5. Russian Federation model, main pattern, 2012 (cont.)	14
2.6. North America model, variation, 2012	14
2.7. Nordic Countries model, variation, 2012	15
2.8. Russian Federation model, variation, 2012	15
2.9. Gini coefficient by Arctic regions 2012	16
2.10. Map of circumpolar Arctic income inequality measured by the Gini coefficient. 2012	17
2.11. Population by Arctic regions, changes between 2006-2012	18
2.12. Female rate by Arctic regions, changes between 2006-2012	18
2.13. Youth rate by Arctic regions, changes between 2006-2012	18
2.14. Demographic dependancy ratio by Arctic regions, changes between 2006-2012	18
2.15. Life expectancy by Arctic regions, changes between 2006-2012	19
2.16. Tertiary education by Arctic regions, changes between 2006-2012	19
2.17. Disposable income per capita by Arctic regions, changes between 2006-2012	19
2.18. Gross domestic product per capita by Arctic regions, changes between 2006-2012	19

Box 2.2

1. Selected social and economic indicators, Nunavik, changes between 2001-2011	21
--	----

Box I

1. GDP per capita by Arctic Region 2012. 1 000 USD at 2010 prices	25
2. Arctic Region share of total circumpolar GDP. 2012. Per cent	25

Chapter 3

3.1. The circumpolar Arctic	28
3.2. Arctic surface area, population and GRP of Arctic states as share of the Arctic total. 2012. Per cent	29
3.3. Arctic region share of surface area, population and GRP of corresponding country. 2012. Per cent	29
3.4. Population growth. Arctic and non-Arctic regions by country. 2000-2012. Per cent	29
3.5. Population growth by Arctic region. 2000-2012. Per cent	30
3.6. Dependency ratio in Arctic and non-Arctic regions, by country. 2012. Per cent	30
3.7. Dependency ratio, by Arctic sub-region. 2012. Per cent	30
3.8. Gross regional product (GRP) per capita. 2012. 1 000 USD-PPP	31
3.9. Disposable income of households per capita. 2012. 1 000 USD-PPP	31
3.10. Gross regional product (GRP) per capita and disposable income of households (DIH) per capita, by Arctic regions. 2012. 1 000 USD-PPP	32
3.11. Average annual economic growth of Arctic and non-Arctic regions, by country. 2000-2012. Per cent	32
3.12. Average annual economic growth, by Arctic region. 2000-2012. Per cent	33

Chapter 4

4.1. Price indices of food, metals and energy. 2002-2016	37
4.2. Price indices for fish. 2002-2016	37
4.3. GRP volume index and growth rate. Alaska. 2000-2012	38
4.4. Value added by main industry. Alaska. Per cent of GRP. 2008 and 2012	39
4.5. Gross regional product (GRP) per capita and Disposable Income for Households (DIH) per capita. United States. 2012. 1 000 USD-PPP	39
4.6. Alaska permanent fund dividend	39
4.7. Mineral production of Alaska. 2005-2007	41
4.8. GRP volume index and growth rate. Arctic Canada. 2000-2012	45
4.9 Value added by main industry. Arctic Canada. Per cent of GRP. 2008 and 2012	45
4.10. Gross regional product (GRP) per capita and Disposable Income for Households (DIH) per capita. Arctic Canada. 2012. 1 000 USD-PPP	45
4.11. Diamond production. Arctic Canada. 2002-2014	46
4.12. Oil production. Arctic Canada. 2002-2014	46
4.13. Natural gas production. Arctic Canada. 2002-2014	46
4.14. Value added in selected industries. Arctic Canada. 2007-2015. Mill. CAD	47
4.15. GRP volume index and growth rate. Faroe Islands. 2000-2012	49
4.16. Value added by main industry. Faroe Islands. Per cent of GRP. 2008 and 2012	49
4.17. Gross regional product (GRP) per capita and Disposable Income for Households (DIH) per capita. Faroe Islands. 2012. 1 000 USD-PPP	49
4.18. Fish harvest by main species. 2008-2015	50
4.19. Export of fish products by species. 1 000 DKK	50
4.20. GRP volume index and growth rate. Arctic Finland. 2000-2012	51
4.21. Value added by main industry. Arctic Finland. Per cent of GRP. 2008 and 2012	52

4.22. Gross regional product (GRP) per capita and Disposable Income of Households (DIH) per capita. Arctic Finland. 2012. 1 000 USD-PPP	52
4.23. GRP volume index and growth rate. Greenland. 2000-2012	53
4.24. Value added by main industry. Greenland. Per cent of GRP. 2008 and 2012	54
4.25. Gross regional product (GRP) per capita and Disposable Income for Households (DIH) per capita. Greenland. 2012. 1 000 USD-PPP	54
4.26. Catch of fish and shellfish. Ton	55
4.27. Exports of fish and shellfish. Greenland	55
4.28. GRP volume index and growth rate. Iceland. 2000-2012	57
4.29. Value added by main industry. Iceland. Per cent of GRP. 2008 and 2012	58
4.30. Gross regional product (GRP) per capita and Disposable Income for Households (DIH) per capita. Iceland. 2012. 1 000 USD-PPP	58
4.31. Catch by species. Tonnes	59
4.32. Export of marine products by species. 1 000 ISK	59
4.33. GRP volume index and growth rate. Arctic Norway. 2000-2012	60
4.34. Value added by main industry. Arctic Norway. Per cent of GRP. 2008 and 2012	61
4.35. Gross regional product (GRP) per capita and Disposable Income for Households (DIH) per capita. Arctic Norway. 2012. 1 000 USD-PPP	61
4.36. GRP index and growth rate. Arctic Russia. 2000-2012	62
4.37. Value added by main industry. Arctic Russia. 2008 and 2012. Per cent of GDP	63
4.38. Gross regional product (GRP) per capita and Disposable Income of Households (DIH) per capita. Arctic Russia. 2012. 1 000 USD-PPP	63
4.39. Russian oil production. 1990-2013	63
4.40. Russian gas production. 2000-2013	63
4.41. Value added in petroleum and other mining in current Rubles. Annual growth rates 2008-2012. Per cent	64
4.42. GRP volume index and growth rate. Arctic Sweden. 2000-2012	66
4.43. Value added by main industry. Arctic Sweden. Per cent of GRP. 2008 and 2012	66
4.44. Gross regional product (GRP) per capita and Disposable Income for Households (DIH) per capita. Arctic Sweden. 2012. 1 000 USD-PPP	66
4.45. Gross regional product (GRP) per capita and Disposable Income for Households (DIH) per capita. Total. 2012. 1 000 USD-PPP	67

Box III

1. Average decomposition of gross production in the Norwegian oil and gas sector. Million NOK	69
2. Five-year average resource rents from the renew-able natural resources in Norway. NOK (2015-prices)/capita	69

Box IV

1. Svalbard. Protected areas. 2016	70
2. Persons in settlements on Svalbard. 1 January	71
3. Age distribution in the Norwegian settlement on Svalbard and on the mainland. 1 January 2015. Per cent	71
4. Shipped coal from Svalbard. Tonnes	72
5. Number of guest nights in accommodation establishments on Svalbard, by nationality	73
6. Research man-days in Ny-Ålesund, including field days, support and logistics activity	73
7. Students at the University Centre in Svalbard (UNIS)	73

Box V

1. Talent Index in Arctic regions	74
2. Applied Science Index in Arctic regions	75
3. Tech Pole Index in Arctic regions	75
4. Number of patents (left) and patents per 1 000 residents (right) in Alaska Boroughs	76

Chapter 5

5.1. Arctic gas production. Reference scenario and climate policy scenario. Mtoe	81
5.2. Regional distribution of West Arctic gas production. Reference scenario and climate policy scenario. Mtoe	81
5.3. Arctic oil production. Reference scenario and climate policy scenario. Mtoe	82
5.4. Oil price scenarios. USD (2014-prices)/boe	82

Box VI

1. Arctic share of global coal and iron and ferro-alloy mineral extraction. Percent. 2002 and 2011	86
2. Arctic share of global non-ferrous mineral extraction. Percent. 2002 and 2011	87
3. Arctic share of precious metal ores and industrial mineral extraction. Percent. 2002 and 2011	87

Chapter 6

6.1. Who harvests fish and game? Resource harvests by purpose in Alaska. 2012	91
6.2. Community harvest surveys to be included in the Community Subsistence Information System (CSIS) by year	91
6.3. Map of communities in Alaska surveyed for harvest of wild resources. 2016	92
6.4. Composition of wild food harvest by rural Alaska residents. 2012	92
6.5. Harvest composition by region. Alaska. 2012	92
6.6. Wild food harvests in Alaska by area. 2012. Pounds usable weight per person per year	93
6.7. Per cent of households taking part in activities related to harvest of wild resources. Communities in the Eastern Interior of Alaska. 2011	94
6.8. Per capita harvest estimates and harvest composition of communities in the Eastern Interior of Alaska. 2011. Pounds	94
6.9. Comparison of share of harvest of wild foods in household consumption and protein requirements. Communities in the Eastern Interior of Alaska. Per cent. 2011	95
6.10. Average income per capita in studied rural communities in Alaska	95
6.11. Indigenous peoples of the Russian North, Siberia and Far East. Compiled and drawn by W. Dallmann	105

Box 6.6

1. Number of reindeer and meat production in the Nenets Autonomous Okrug 2008-2013	107
6.12. Circumpolar reindeer pastoralism	109
6.13. Total yield of hunting in per cent of the yield in 2004 for categories of sea mammals and birds	118
6.14. Hunting licenses in per cent of the licenses issued in 2004	118

Chapter 8

8.1. Direct contribution to GDP in percent from travel and tourism for circumpolar nations	138
8.2. Total contribution to GDP in percent from travel and tourism for circumpolar nations	138
8.3. International arrivals to Iceland by mode of transport	140
8.4. Number of overnight stays in hotel and other accommodations in Iceland	140
8.5. Number of employees in tourism in Iceland	140
8.6. Gross value added of tourism for Iceland	141
8.7. The direct contribution to gross regional product from tourism for Arctic Norway	141
8.8. Overnight stays in hotel accommodation on Svalbard	141
8.9. Cruise tourism to Svalbard. Number of persons landed and landing sites	142
8.10. Number of international visitors to Greenland	142
8.11. Number of international arrivals by air to Greenland, year and season	142
8.12. Number of cruise visitors to Greenland, year and season	143
8.13. Foreign overnight stays in hotel accommodations on Greenland by year and group	143
8.14. Tourism value added as share of gross value added in Finnish regions, percent	143
8.15. Visitors to Alaska in the years from 2005-06 to 2014-15	144
8.16. Summer visitors to Alaska by means of travel	144
8.17. Number of visitors and spending in million Canadian Dollars in the Northwest Territories	145
8.18. Per cent share of tourism in gross regional product for Arctic regions	145

Chapter 9

9.1. MSA trend in the Arctic region for the global baseline scenario of the Rethinking Global Biodiversity Study	151
9.2. Average MSA per Arctic region in 2010 calculated with GLOBIO3 based on global datasets	152
9.3. Aggregated land use map Sápmi region based on CORINE 2006	154
9.4. MSA total map Sápmi region based on CORINE 2006	154
9.5. Overview of the GLC 2000 and CORINE 2006 land cover maps of the Sápmi region	155
9.6. Land cover / land use distribution in Finnmark; Norway 2011	156
9.7. Land use and MSA land use map of Finnmark, Norway 2011	156
9.8. Infrastructure and MSA infrastructure map of Finnmark, Norway 2011	157
9.9. MSA land fragmentation map for Finnmark, Norway 2011	157
9.10. MSA climate map for Finnmark, Norway 2011	158
9.12. Distribution of biodiversity loss per pressure in Finnmark, Norway 2011	158
9.11. MSA total map for Finnmark, Norway 2011	158

List of tables

Chapter 2

2.1. Selected social and economic indicators ¹ and composite index ² . Arctic regions. 2012 ³	12
2.2. Arctic regions distribution by socio-economic model, 2012	15

Box 2.2

1. Selected social and economic indicators. Nunavik, changes between 2001-2011.....	21
---	----

Chapter 4

4.1. Value added ¹ by industry. Alaska. 2008 and 2012	38
4.2. Value added ¹ by industry. Arctic Canada. 2008 and 2012.....	44
4.3. Basic indicators. Arctic Canada. 2014.....	45
4.4. Value added ¹ by industry. Faroe Islands. 2008 and 2012.....	48
4.5. Value added ¹ by industry. Arctic Finland. 2008 and 2012	51
4.6. Value added ¹ by industry. Greenland. 2008 and 2012	53
4.7. Fisheries in Greenland. Value added ¹ 2008 and 2012. Mill DKK.....	53
4.8. Value added ¹ by industry. Iceland. 2008 and 2012	57
4.9. Value added ¹ by industry. Arctic Norway. 2008 and 2012	60
4.10. Value added ¹ by industry. Arctic Russia. 2008 and 2012	62
4.11. GRP by sub-regions of Arctic Russia. 2008, 2012 and 2014.....	64
4.12. Value added ¹ by industry. Arctic Sweden. 2008 and 2012	65

Box IV

1. Main economic figures for the Norwegian settlements on Svalbard in 2014 (SIC2007).....	72
---	----

Box V

1. Talent Index (TI) in selected Arctic cities (Ranking).....	74
---	----

Chapter 5

5.1. Increase in accumulated gas production 2015-2050. Climate policies scenario. Deviation from reference scenario. Per cent	81
5.2. Arctic gas in relation to MENA and global production. Reference scenario and climate policies scenario. Per cent.....	81
5.3. Increase in accumulated oil production 2015-2050. Climate policies scenario. Deviation from reference scenario. Per cent.....	83
5.4. Arctic oil in relation to Non-OPEC and global production. Reference scenario and climate policies scenario. Per cent.....	83

Box VI

1. Change in the volume of coal and iron and ferro-alloy mineral extraction in the Arctic from 2002 to 2011. Per cent	86
2. Change in the volume of non-ferrous mineral extraction in the Arctic from 2002 to 2011. Per cent	87
3. Change in the volume of precious metal ores and industrial mineral extraction in the Arctic from 2002 to 2011. Per cent.....	87

Chapter 6

6.1. Wild food harvests in Alaska: Nutritional and replacement values.....	93
6.2. Canadian indigenous identity population as percentage of population. 2011	97
6.3. Population characteristics of Arctic Canada. 2011	97
6.4. Selected social and economic indicators for Canada and its northern territories.....	98
6.5. Fur harvest in Canada. Number and value of pelts produced. 2009	100

Box 6.6

1. Participation in traditional activities and share of output for own consumption. Per cent. Koryak, Kamchatka. 2002	107
2. Number of inhabitants and reindeer livestock size in Nenets Autonomous Okrug (NAO)	107
6.6. Total account and composition of income and cost in reindeer pastoralism of Norway. 2014.....	112
6.7. Income from meat production in reindeer pastoralism in Norway 2014 (1 000 NOK).....	112
6.8. Siida share costs in reindeer pastoralism in Norway 2014 (1 000 NOK)	113
6.9. Share of female and male <i>siida share leaders</i> with wage or self-employment income outside reindeer herding 2014 (per cent).....	113
6.10. Share of female and male spouses with wage or self-employment income outside reindeer herding 2014 (per cent).....	113
6.11. Number of reindeer in reindeer pastoralism in Norway. 2010-2015	114
6.12. Income account for households. All of Norway and north of Saltpjellet. Average for households. 2013.....	117

Chapter 8

8.1. Tourism characteristic industries	138
--	-----

Chapter 9

9.1. GLOBIO3 global MSA values for land use categories	152
9.2. Global MSA values for different grazing categories	153
9.3. GLC2000 land cover categories and corresponding GLOBIO land use categories	153
9.4. Average overall MSA value per province for CORINE 2006 and GLC 2000 dataset.....	154
9.5. The relationship between semi-natural area size in km ² and MSA value of fragmentation.....	156
Annex 9.1. Overview of selected land cover maps for Arctic countries with highest detail.....	161
Annex 9.2. Reclassification of CORINE level 3 classes to GLOBIO3 land use classes	162

The Economy of the North 2015

The Arctic regions belong to different national regimes and a consequence of this is that information on social and economic issues has been dispersed and not easily available at the circumpolar level.

This clearly applies to the information on the economy. Among several good reasons for compiling an overview of the circumpolar Arctic economy is a need for an information platform from where to assess the sustainability of the Arctic communities in terms of natural wealth management and vulnerability towards global policies and trends and climate change. A central task of *The Economy of the North 2015* is to contribute to filling this gap by presenting a comprehensive overview of the scale and structure of the circumpolar Arctic economy.

Statistics Norway

Postal adresse:

Postboks 8131 Dep
NO-0033 Oslo

Visit address:

Akersveien 26, Oslo
Oterveien 23, Kongsvinger

E-mail: ssb@ssb.no

Internet: www.ssb.no

Telephone: +47 62 88 50 00

ISBN 978-82-537-9508-9 (print)

ISBN 978-82-537-9509-6 (electronic)

ISSN 0804-3221



Statistisk sentralbyrå
Statistics Norway