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Arctic Economics Workshop

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Arctic Economics Workshop

Final Report

Arctic Economics Workshop Final Report

NSF Award Number #1745321

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BABSON
COLLEGE

Workshop Location:

Middlebury Institute of International Studies, Monterey, California

Workshop Dates:

November 6-8, 2017

About this Report

This report serves as the official Summary final report to participants and the public, from the Arctic Economics Workshop, sponsored by the National Science Foundation grant issued July 2017. It is a summary of participant remarks, ideas, and suggestions from the workshop. It will also be included as an addendum to our official reports to the National Science Foundation to be issued Spring, 2018. After the initial section on background and introduction, the remaining report highlights the three keynote presentations and the introductory presentation by the hosts who presented the research undertaken for the Workshop. The discussions for all of these presentations and the rest of the meeting are presented in the Summary section of this report and the section on Research Questions. The follow up recommendations appear in the final section.

Acknowledgments

We would like to thank the National Science Foundation Program Director for Arctic Social Sciences, Anna M. Kerttula de Echave for her encouragement and help toward our award of funds that allowed us to hold this workshop; to Meghan Rasmusson, Director of Foundation and Institutional Grants for The Middlebury Institute for her invaluable help with the NSF grant process; The Center for the Blue Economy at the Middlebury Institute of International Studies for hosting the meeting and funding the excellent dinners enjoyed by all; the extraordinary efforts of the Center for the Blue Economy Program Manager, Rachel Christopherson, who streamlined the travel and communications process and meeting logistics to ensure convenience for all; and many thanks go to both Ms. Christopherson and our Graduate Research Assistant, Karl Larsen for their detailed and summary notes from the workshop that made this report possible. Finally, thanks to Karl Larsen for his excellent research for the context paper presented by Kildow and Goldstein.

Judith Kildow and Michael Goldstein

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Background and Introduction

On November 6-8, 2018, an Arctic Economics workshop funded by the U.S. National Science Foundation¹ was held on the Monterey campus of The Middlebury Institute of International Studies (MIIS) in Monterey, California. The workshop was convened to better understand the state of economic research about the Arctic, search for possible reasons for the relatively few publications by economists, and, throughout this meeting to find ways to encourage more research by economists about the Arctic. The workshop was organized by Dr. Judith Kildow of the Center for the Blue Economy (CBE) at MIIS and Professor Michael Goldstein of Babson College, and attended by 16 academic and government participants.

The time was ripe for such a workshop. Over two years ago, researchers at The Center for the Blue Economy began to measure and describe the economy of the Arctic as part of its focus on “The Blue Economy”.² Unfortunately, despite notable searching by their team, there was a dearth of reliable, consistent data that could be used for time-series analysis or for serious economic study. However, in April 2017, the ECONOR III 2015 Update,³ produced with funds from the Norwegian government, and with the support of the Arctic Council, was released and provided a treasure trove of economic data. Perhaps due to the previous lack of data, a literature review showed academic economists were writing far fewer articles on the topic than non-economists such as anthropologists, lawyers, political scientists, and sociologists.

The workshop was thus convened to be an exploratory examination of the status of economic research about the Arctic, particularly research done by credentialed economists as either sole authors or among interdisciplinary teams. The workshop gathered a diverse team of experts, some were focused on the Arctic, some were not; some were economists, and some were in related fields; some were academics, some were practitioners, and some were government experts, to discuss why so few economists were publishing works about the Arctic and what might be done to encourage such work.

¹ The workshop was based on a grant awarded to Drs. Kildow and Goldstein from the Arctic Social Sciences Program of the U.S. National Science Foundation. We benefited greatly from the expertise of NSF Program Manager Dr. Anna Kerttula.

² The CBE considered The Arctic as ground zero for climate change impacts and included it as part of the CBE’s research effort to focus on key elements of climate change and oceans. This effort was started to add an important climate-related area to the National Ocean Economics Program (NOEP, www.oceaneconomics.org) datasets. In addition, the CBE hoped to counter the many published myths and guesstimates about economic trends in the Arctic region by focusing on reliable evidence.

³ The ECONOR III report: Glomsrød, S., G. Duhaime and I. Aslaksen (eds.), (2017): “The Economy of the North 2015”. Statistical Analyses 151, Statistics Norway, Oslo, Norway. Published 21 March 2017. <http://www.ssb.no/natur-og-miljo/artikler-og-publikasjoner/the-economy-of-the-north-2015>

Participants and Meeting Structure

The Program Agenda and annotated Participant List can be found in the Appendix.

I. Participants:

Experts from several disciplines were invited to the workshop, not only experts focusing on the Arctic but also mainstream economists, social and natural scientists, since it seemed likely that robust research would require interdisciplinary research including economists in many cases. The full participant list can be found in Appendix B.

The sixteen workshop participants included the following experts:

- 4 government agency experts:
 - 2 from the US – NOAA, NSF;
 - 1 Canadian from Department of Fisheries and Oceans, and
 - 1 from Norway, Statistics Bureau.

- 9 credentialed⁴ economists:
 - 5 focused on the Arctic,
 - 3 mainstream economists representing environmental/resource economics, regional economics;
 - 1 financial economist; and
 - 1 Arctic subsistence economist.

- 5 social scientists, representing political science/political economy, governance/policy and law, security, and socio-ecological coupling.

- 2 Polar natural scientists:
 - 1 NSF administer (Director of Arctic Programs)
 - 1 marine biologist/ecologist (Director of SEARCH).⁵

II. Overview of Meeting Structure:

The formal program commenced the morning of November 6 and continued until late afternoon on the 7th. The hosts for the meeting commissioned three keynote speakers, who had pre-meeting opportunities to coordinate their talks to provide continuity and avoid overlap. Each keynote had two designated discussants who responded to the talks, followed by a group discussion.

⁴ Credential economists means authors with graduate degrees in economics or business.

⁵ Study of Environmental Arctic Change, (SEARCH) is a collaborative program with an adaptive structure built to achieve SEARCH goals and engage the research community, government agencies and other Arctic stakeholders in the study of Arctic environmental change.

The keynote speakers were:

- **Julie Aslaksen**, Senior Researcher, Statistics Norway (Her ECONOR report was an impetus for the meeting)
- **Brendan Kelly**, Executive Director of SEARCH: Study of Environmental Arctic Change, and Professor, University of Alaska, Fairbanks and Senior Fellow, Center for the Blue Economy, Middlebury Institute of International. Studies
- **Oran Young**, Distinguished Professor Emeritus – Institutional and International Governance, Environmental Institutions, The Bren School, University of California at Santa Barbara

The program started Tuesday morning with introductions and welcomes from the meeting hosts, Dr. Jeff Dayton Johnson, the Senior VP and Dean of the Middlebury Institute, Professor Jason Scorse, Director of the Center for the Blue Economy, and the Co-Chairs of the Workshop, Judith Kildow and Michael Goldstein.

After these welcomes, the participants each introduced themselves and said a bit about themselves, their backgrounds, and their interests in the workshop.

After these introductions, to open the meeting, Dr. Judith Kildow and Dr. Michael Goldstein presented the meeting purpose. The workshop hosts instructed participants to use the workshop discussions to make recommendations during the final afternoon sessions regarding:

1. what if any next steps they felt would be appropriate following the meeting; and
2. research ideas that might inspire participation by economists, including interdisciplinary projects.

To help set the stage and provide background for the participants, Dr. Judith Kildow and Dr. Michael Goldstein started the workshop with a summary presentation of their preliminary literature review on the state of Arctic economic research, with a focus on academic work by economists and other academics.⁶

The conference then moved into more formal sessions. The first three sessions featured the keynote speakers who spoke on designated topics: Economics, Environmental Science, and Policy and Governance. Each speaker linked their topic to the other disciplines when appropriate to provide continuity to the flow of discussions and a clearer understanding of the big picture, so as to optimize each participant's contribution to the discussions and to ensure multiple ideas were considered.

The final afternoon session was dedicated to:

1. highlighting the key messages and summarizing the workshop to that point; and
2. soliciting participant recommendations for follow up.

A panel of the three keynote speakers began that discussion, with Simon Stephenson substituting for Brendan Kelly.

The final sessions were chaired by the co-chairs, with the meeting ending early evening Wednesday.

⁶ The presentation was a summary of a three-month literature search of articles in English, found via the Internet, on Arctic economics, separating those authored by economists from those published by authors from other disciplines.

Formal Presentation Highlights

I. Presentation: Context Paper of Literature Search Results

Judith T. Kildow and Michael Goldstein

Research Overview and Methodology:

Because of the narrow window of time available for this work, (Mid-August to mid-October) and the degree of detail we sought regarding each article, e.g. author's funding source, affiliation, paper topic, info on co-authors, date of publication, type of publication, etc. the literature search was carried out with the following limitations:

1. Only primary authors (not cited authors) were noted.
2. English only texts were considered which limited the findings especially for Norwegians and Russians, where we believe we could have found many others.
3. Internet was the primary source, using bibliographic search engines and keywords. Specific areas, such as natural resources were probably undercounted, because industry studies are often not publicly available, and grey literature reports not readily accessible.
4. In depth searches were done to verify authors' economic degree credentials.
5. Non-economist publications about Arctic Economics were placed in a separate list from those authored by economists.
6. Economists' publications were included with multidisciplinary ones, if at least one author was an economist.
7. The research covered only 20 years, beginning in 1998 and ending fall, 2017.
8. We specifically searched for articles with data because we felt that was a missing link as an inducement for economic research.
9. Because industry does much of its own research, we had limited access to this grey literature.

Hence the bibliography compiled by this research is a conservative estimate of what is available, particularly publications in other languages and during earlier years.

What follows is a brief summary of findings made by Kildow and Goldstein in their presentation of their research on the status of Arctic economic research based on their literature search before the workshop:⁷

1. Authorship:

a. Publications

- i. 51 publications by credentialed economists

⁷ A copy of the presentation is found on the Arctic Economics Workshop website.

<http://centerfortheblueeconomy.org/2017-arctic-economics-workshop>

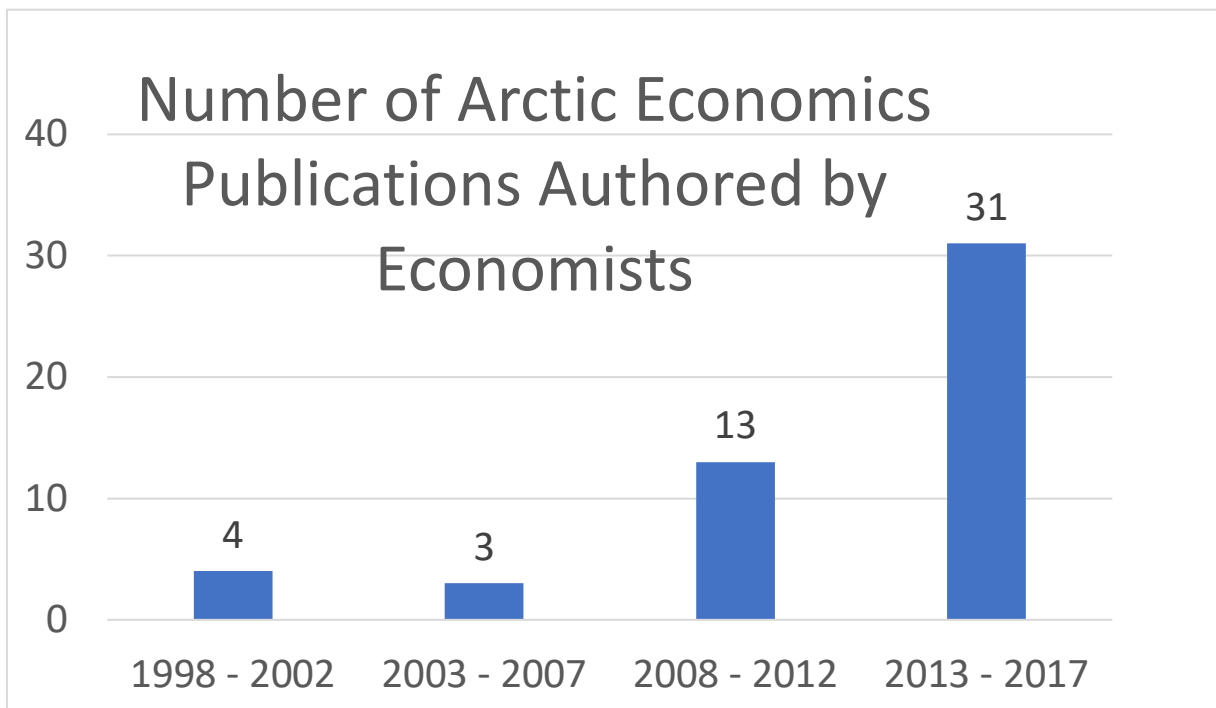
The actual paper will be published at a later date in the Journal of Ocean and Coastal Economy.

1. 24 of them in peer-reviewed journals.
2. 6 were government or other institutional reports.
3. 3 were the ECONOR reports issued over the past 15 years.
4. the others were editorials, research papers and reports, popular articles, research reviews, etc.

ii. 73 publications authored by those from other (non-economic) disciplines.

b. Conferences:

- i. There were fewer than a handful of conference presentations by economists, or even conference sessions that included economics as a topic.



2. Time:

Over the past 20 years investigated, the past five years showed an increased number of papers by economists, and 2017 to November had 7, the most in any year.

ii. It is possible that the search:

1. captured the beginning of an expanded research interest on the part of economists during the past year that may continue, or
2. The search method (using the internet) is biased in some way towards more recent work, for example:
 - a. The search algorithm is biased towards more recent work, or
 - b. Authors are more likely to post their work on the public internet in more recent years.

3. Funding Source

All economists' publications were government-funded; none received private funding. Unlike other fields of study, economics appears to have fewer non-governmental sources of funding, such as foundations and other private sources, which may inhibit research on this topic. Below is a list of primary funders for the research:⁸

a. Norwegian Government Institutions

- i. Norwegian Ministry of Foreign Affairs (MFA)
- ii. Nordic Council of Ministers (NCM)

b. U.S. Government Institutions

- i. National Science Foundation.
- ii. National Oceanic and Atmospheric Administration.
- iii. Alaska State Government
- iv. North Pacific Research Board (NPRB)

c. Canadian Government Institutions

4. Repeat Authors

- a. There were very few repeat authors, with the exception of fisheries research.
- b. Possible reasons may include:
 - i. Lack of timely, reliable, and accurate primary data sources available.
 - ii. Absence of a diverse stream of funding for Arctic economics research.
 - iii. Conducting research and data gathering in the Arctic is very expensive.
 - iv. Little coordination among research institutions to optimize funding sources and expertise.
 - v. Geopolitical tensions between NATO states and Russia, inhibiting potential areas of research.
 - vi. Too small an amount of economic activity to date to warrant broader interest.
 - vii. Scarcity of opportunities/venues to discuss/publish research.

⁸ This list is based on available information at the time and possibly incomplete.

5. Locations

The primary locations and institutions where the research was done:

i. Norway:

1. University of Tromsø (The Arctic University of Norway)
2. Statistics Norway
3. Center for International Climate and Environmental Research (CICERO)

ii. Canada

1. Université Laval

iii. United States

1. University of Alaska, Anchorage (Institute of Social and Economic Research)
2. University of Alaska, Fairbanks
3. National Marine Fisheries Service.
4. Alaska Fisheries Science Center, University of Washington

iv. Denmark

University of Southern Denmark

v. Netherlands

Erasmus University Rotterdam (Transportation & Shipping Economics)

vi. Iceland

Stefansson Arctic Institute

6. Topics/Areas Covered

The topics covered in these publications, ranked most to least included:

- i. Ecosystem Services Valuation (market and nonmarket)
- ii. Natural Resource Economics
- iii. Fisheries Management
- iv. Mining & Hydrocarbon (oil & gas)
- v. Climate Change Economics & Adaptation Economics
- vi. Energy & Electricity Development (Renewable)
- vii. Transportation Economics (Shipping and the Northern Sea Route)
- viii. Mixed Economies and Subsistence Activities
- ix. Opportunities for Sustainable Development in Arctic Communities

II. Keynote #1: Economics.

ECONOR III 2015 Update

The opening presentation that addressed the theme for the meeting was followed by the first keynote speaker, Dr. Iulie Aslaksen, an economist with Statistics Norway, who presented a summary and an overview of the ECONOR III 2015 Update study for which she was the project leader and co-editor.

Highlights of her talk include:

1. The ECONOR Report provides an overview of the economy of the Circumpolar Arctic and at the same time functions as a collaborative process among the Arctic Nations.
2. In any discussion of the Arctic, one must define it geographically, culturally, and understand the importance of the geopolitics that influences it.
3. While it is a collaboration among all of the Arctic countries, Norway, Iceland, Greenland, Sweden, Finland, Russia, Canada and the US, it is mostly funded by the Norwegian government and the Nordic Council of Ministers, and it has the official support of the Arctic Council which is a window into East-West cooperation.
4. The main issues addressed through data presentation and interpretation were
 - a) Natural resource extraction and income opportunities asking how much income stays local and how much leaves the region.
 - b) How nature-based traditional livelihoods are impacted by economic development and global economic activity.

Policy issues and questions the ECONOR data evoked included:

1. Crucial role of petroleum industry and other natural resource extraction as source of income.
2. Nature-based livelihoods: The importance of subsistence and local market economy.
3. What does it take to build a sustainable Arctic economy?
4. To explore conditions for sustainability: Need for systematic circumpolar statistical knowledge on the economy, socio-economic conditions and environmental impacts for Arctic region.
5. Large variations in livelihoods and living conditions between Arctic regions

Following her talk, Discussants, economist, Lance Howe from University of Alaska and Christine Irwin, economist from Fisheries and Oceans, Canada, provided feedback and comments, which are included in the workshop discussion Summary in this report.

III. Keynote #2: The Environment

Environmental Values and The Economy

Dr. Brendan Kelly, Marine Biologist specializing in Arctic marine mammals, opened the afternoon session of the first day with his keynote address about the unique period of environmental change underway in the Arctic. Dr. Kelly described where economic impacts are being felt and how economics could contribute to a greater understanding of these impacts. He provided the latest information about ice melt in the Arctic including both ocean and tundra, with estimates of their impacts on rising seas and climate changes there and elsewhere. Dr. Kelly discussed the implications that current trajectories and uncertainties hold for the various economic sectors, particularly maritime transportation, but also the enormous problems that melting tundra and increased rainfall will have on roads and buildings and suggested that the latter may be the costliest. To highlight this last point, he memorably ended his presentation with a photo of a dirigible which industry will be using to avoid the lack of roads.

The take-away message from Dr. Kelly's keynote address was the pace of massive environmental changes in the Arctic is unprecedented and the timeframes still uncertain, making it difficult if not impossible to predict what the Arctic will look like in the future. This uncertainty and massive change creates challenges for those anxious to develop the Arctic. Industry does not like uncertainty, the insurance industry likes it even less. Hence, the rate and types of development that can/will occur over time remain unknown to a large extent. Financing will also be problematic without greater certainty. Currently, nations such as Russia, Norway and Iceland appear to have the greatest economic stakes, while the US, Canada and the other Arctic and sub-Arctic nations are moving much more slowly. Of interest is the deep long-term interests of the Chinese and Japanese in maritime transit, and the Chinese in infrastructure and other investments over the next 20-50 years. Hence, it was clear from Dr. Kelly's talk that understanding the rate and types of environmental changes occurring are essential elements dictating the economy and geopolitics of this region.

Following this keynote, both Dr. Simon Stephenson, Section Head of the Office of Polar Programs at the National Science Foundation and Professor Steven Colt of Alaska Pacific University discussed issues raised in Dr. Kelly's address and provided further discussion of economic valuation challenges. In addition, Andreas Osthagen and Professor Sarah Trainor provided their insights on information needs for natural resources management and valuation.

IV. Keynote #3: Policy and Governance

Policy and Governance Issues and Economic Information

Dr. Oran Young gave the final keynote address in the morning of the second day of the workshop. Dr. Young's address described the dynamics and structure of the political economy of the Arctic, explaining the strong links between governance, institutions and geopolitical variables to economic decisions. He indicated that economics may be a driver for decisions, but regulations, laws and the institutions that create them have a strong influence on the outcomes. Dr. Young noted that carbon release from melting tundra and land under the sea could be considerable and cause even greater changes. He pointed out that governments own most of the land available for development in the Arctic region and thus will control much of what happens economically.

Dr. Young also noted ownership and governance, indicating that 60% of the land in Alaska is owned by the government, and more land is under government ownership in the other Arctic nations. He explained that governments own coastal lands both onshore, and offshore, sometimes up to 200 miles of offshore Exclusive Economic Zones, under the Law of the Sea Treaty, which is the operating mechanism determining jurisdiction over fisheries, offshore oil and gas developments, maritime transit, marine tourism, and marine protected areas, for example.⁹ He pointed out that most of the current economic enterprises there are either state-owned or partially state-owned and thus controlled through national regulations and laws, and thus, any analysis of Arctic economies must pay close attention to national policy processes and governance systems.

He went on to explain that the role of governments as owners, managers, operators, regulator/enforcers, builders/enablers and thus the controllers of the economy requires an understanding of the political processes within and among nations and institutions there. With eight Arctic and subarctic stakeholder nations, numerous indigenous tribes, regional corporations and international laws and regulations guiding activities, analyses of the political economy have to distinguish between policies and actual implementation; stakeholder positions and power balances; and, of course, national and multinational corporate positions.

Finally, Professor Young stressed the system complexity of the policy process amidst an array of institutions and laws, and used two case studies, to demonstrate his point: The Port of Sabetta, a domestic case that proceeded under well-defined rules and interest aggregation; and an international one based on “The Myth of the Unitary State in the International Arena.” He pointed out that depending on the nation, government policies changed with administrations, and the power of policy champions created a two-tiered system.

He closed with detailed lists of:

1. how economics could contribute to making informed choices in the Arctic; and
2. Arctic examples of important roles economists and economics could play in Arctic development, such as dealing with externalities and balancing market and non-market values in cost/benefit analyses.¹⁰

While national security was not a focus for this workshop, it was discussed explicitly and implicitly particularly during the final keynote discussions since tensions between Russia and Norway, Russia and the US, US and Canada, etc. over borders that are either fragile or still unresolved, are inhibitors of progress on other fronts.

Professor Amy Lovecraft, University of Alaska, Fairbanks, discussed Dr. Young’s keynote and provided good insights and context. Dr. Alan Haynie and Professor Phil King added comments on natural resource management information needs and how to use the tools we have to preserve the Arctic respectively.

⁹ While the US is the only nation not party to the Law of the Sea Treaty, it does abide the regulations to the word.

¹⁰ For all presentations and other pertinent workshop information not included in the appendices, please see <http://centerfortheblueeconomy.org/2017-arctic-economics-workshop>.

Workshop Discussion Summary

In addition to the keynote addresses, there were discussion sessions introduced by the above-mentioned designated participants to begin a larger roundtable discussion which ensued, with everyone contributing ideas.

Emerging Themes: From the presentations and discussions that followed, several important themes emerged that flowed throughout the discussion.

1. Arctic Economic Research and Economics:

The first theme reflected the age-old research community dichotomy between basic and applied research.

- i. to what extent should Arctic economic research move the field of economics forward with new methodologies, models, time series and possibly theories?
- ii. To what extent should Arctic economic research be practical, informing critical policy issues and indicating future trends?
- iii. To what extent does Arctic Economic Research lend itself to inter and trans-disciplinary research? Would such collaborations be an incentive or disincentive for economists to carry out Arctic Economics?
- iv. The consensus among our experts indicated both were essential and both needed each other.

2. Arctic Economic Research -- Why?

- a. The second important theme questioned the basic assumption for the meeting, suggesting that it might be better to shift to something more practical and helpful. Instead of focusing on whether the unique qualities of the Arctic merited a designation of the Arctic as a special field of research in economics, which opened up different perspectives that were difficult to resolve, one participant suggested an alternative approach for the discussions, asking:

1. Are there certain emerging questions that are developing in the Arctic that are important for society to think about which the Arctic is offering opportunities for scholars to study today focused on ideas such as adaptation, sustainability, risk, uncertainty, etc.?

2. Could the Arctic be a lab for advancing economics and also be a great place to be looking at some of the most interesting questions regarding climate change that affect society at large?

Everyone agreed this was a more productive way to approach our mission, which was to understand the state of Arctic economics, what important questions could inspire more economists and encourage more research, single disciplinary, multidisciplinary, and interdisciplinary. It was the wish of the group that economic studies be used to generate ideas and solutions that can apply globally.

After much debate, it was decided that although the Arctic is a special place, this group would shift focus from a new area for the discipline of economics, to practical ways to approach pressing problems.

This discussion made clear that the Arctic is on the leading edge of experiencing climate change impacts, sea-level rise, and social equity issues, which are all important issues being faced around the world.

3. Arctic Economic Data: Consistency, Availability, Reliability, and Accessibility

a. A third theme was Arctic economic data: consistency, availability, reliability, and accessibility to Arctic economic data.

- i. While the 3 ECONOR reports have provided a remarkable data set at national, regional and local levels, they are published in reports with content analyses and charts.
- ii. The ECONOR studies, without giving directions to the availability of the raw data underlying the published charts; without online data access to the broader research community or the public in an analytical format; and, without a predictable time schedule or content, has limited effectiveness. They could/should be part of a much broader community effort to optimize the use of this major effort and others already underway.
- iii. The additional economic data found on the website of the National Ocean Economics Program are more random, represent only data publicly available on the Internet and reflect both new datasets and overlaps with ECONOR.
 1. The NOEP data and others¹¹ should be integrated with the ECONOR data.
 2. It would be beneficial to pull together other data floating around without a coherent framework, host, or leadership, and put all data together into a single interactive website, accessible to an interested public, especially those who wish to carry out robust research or have a need for policy input.
- iv. Arctic and Sub-Arctic fisheries data are plentiful in some areas with large gaps in others. Fisheries agencies and organizations should compile and coordinate regional fisheries data to better monitor changes in species, habitat health and the other indicators that help fisheries management.
- v. Research and data collection of natural resource production data need to be centralized among Arctic nations and capabilities for spill and other pollution cleanup need to be addressed with more urgency.

¹¹ An extensive list of data sources can be found at http://www.oceaneconomics.org/arctic/data_sources.aspx

Apart from the themes, important clarifications emerged, including a) the need to define the Arctic geographically and geopolitically; b) Indigenous and Arctic perspectives are essential for a) understanding the core issues in the Arctic and b) carrying out research to reach that understanding. Those who lived in the Arctic strongly stated that it was necessary to spend time in the Arctic to understand it. This reconfirmed the notion mentioned earlier that doing research in the Arctic required a deep commitment and could be very expensive and therefore an obstacle to getting sufficient funds for economists to carry out their work. Others suggested that those of us on the mainland do not and will not have the proper perspective until we go to the Arctic. Research must be conducted in situ. Simon Stephenson of the NSF encouraged the group to go for grants not in the 100Ks, but in the millions—the same that it would take for on the ground research in physical sciences to enable the proper scope and scale of research required.

Important Research Questions

All participants were then asked to think about what they thought should be the most important research questions that economists and collaborators should address. Everyone was asked to submit their questions at the end of the meeting, so that their input and perspectives on the discussions could be registered and organized as a way to summarize the important areas that had been covered in the discussions and those that the discussions had evoked. The following section reflects the categories that summarize those questions, laying out the key research areas the group believed needed attention and funding.

A. The Role of Economics in Arctic Research

1. In what ways can economists help meet the needs of indigenous peoples toward greater self-reliance by working with them to address issues such as behavioral health costs, costs and benefits of adaptation strategies including migration options?
2. How can economists partner with Indigenous peoples to meet their needs for climate adaptation, community self-reliance, and cultural integrity?
3. How can economists use their expertise on non-market and natural capital values to better balance development considerations in the Arctic, both as they affect local populations and the broader economy and society?
4. What economic methods and models can best be used to incorporate the large uncertainties regarding environmental changes in the Arctic as well as the unusually large number of variables that add to the complexity of any decisions? Or are new models and methods needed?
5. How can the institutions that influence policy in the Arctic incorporate economics more in their deliberations and policy outcomes? In what ways can economists contribute to the ongoing discussions of critical issues that need resolution over time?
6. How can economics contribute to inter and transdisciplinary research in the Arctic?

B. Data Needs and Metadata Studies: integrate current and past datasets and principles from multiple organizations for greater geographic comparability, better understanding and optimizing opportunities

1. Need for an **International Central Data Repository**. Currently there are numerous organizations compiling Arctic economic and other social science data, both on line and in research centers and their reports, but there are no metadata protocols for uniform definitions or indicators, no formats or frameworks, nor even an inventory of all the possible sources of data for such an effort. The National Science Foundation has funded this type of a website for Arctic natural science data from US sources at the University of California at Santa Barbara. While it contains limited social science data, it is not currently equipped through its format or software to include economic indicator data such as we are discussing.
2. There is **no obvious leader/funder** who can assure a central data registry will be created with regular, consistent and reliable economic and other socially relevant data collected in an organized and productive way and distributed to the public, policy makers and the research community. That leader needs to step forward soon.
3. With a variety of Arctic social science data collections, but no group to determine data gaps, data needs for timely policy decisions, this void needs to be filled soon. Each industry appears to collect its own information, The Arctic Council sometimes makes recommendations, and individual governments often allocate funds for data it needs. There is **no overarching group** to make recommendations to governments, foundations, or other institutions what data would be valuable. Research on this topic could be valuable.
4. Research on **integrating mainstream economic data with subsistence economy data** to move the field forward and get a fuller picture of the Arctic economy.
5. Explore how emerging issues of **socio-ecological risk and high-priority policy issues** can be integrated into UN SDG-Sustainable Development Goals, to present Arctic SDGs, as framework for economic decision support.
6. Linked to number 5 is the concept of creating a Sustainable Blue Economy plan for the Arctic Ocean and surrounding areas that could be a model or prototype for the rapidly evolving Blue Economy movement, helping to inform policy makers in other places.
7. Data collection on fisheries should be better coordinated among regions.
8. Data on natural resource production, particularly mining and oil and gas, are often closely held by industry, and should be made more publicly available for more effective economic research.

C. Arctic Investments: Needs, Vehicles, Incentives, benefits

1. Allow economists access to the Guggenheim Partners inventory of investment proposals for the Arctic as a research base for analyzing the following:
 - a. what are the macro-trends, micro needs, major challenges across the Arctic, nationally, regionally, and locally?

- b. how can local businesses and local communities be involved in and benefit from these investments through co-development, etc.?
 - c. which investments are most beneficial to local communities; which will affect local communities the most?
2. Which investments are likely to be most innovative and profitable and to whom, during what time frames?
3. Should Arctic investments be subjected to different rules and regulations from other places?
4. How can a significant amount of the profits and other economic benefits be kept in the Arctic instead of all benefits flowing out to other regions?

D. Impacts -- Economic, Environmental and Social: Capturing Externalities, Damage Costs, Restoration and Preservation Costs Values.

1. Which investments are likely to have the most burdensome/dangerous impacts on the local environment?
2. What mechanisms need to be in place to avoid hazardous situations and unintended disasters?
3. Since the environmental changes in the Arctic are largely due to carbon emissions, how can governance and other mechanisms curb these emissions for investments there in the most effective ways?
4. What will be the overall impact on the Arctic environment from current and projected economic trends, e.g. relocation of communities, replacement of native cultures with more mainstream ones, etc.?
5. What measures are in place, or missing for habitat destruction, hazard prevention such as accidents and spills, and other detrimental consequences of developments?
6. Who is responsible for ensuring the safety of Arctic life and environment from developers?
7. What governance institutions are most likely to be influential?

E. Non-market/Subsistence Valuation: Natural Capital, Ecosystem, Cultural, etc.

1. What is the **value of preserving local community values and cultures** to the broader **global** community?
2. What was (or has been) the **cost offset of the storage services** provided by the permafrost (substitute goods)?
3. Since **indigenous cultures** have been given special rights which are supposed to protect them, what is the value of those rights directly regarding **resource extraction allowances** and regarding political leverage over making their own choices, important to their communities? Is there a **trade-off between these rights and values**?

F. Climate Adaptation

1. What are the most effective strategies of adaptation derived and implemented among different governing structures and levels of government?
2. With the most rapid changes underway in the Arctic, what questions can researchers address now that could be most useful globally to adaptation?
3. What are the overall costs of climate change across the Arctic? How can these be estimated?
4. Which economic sectors are most likely to benefit from climate change? Which less likely?
5. What are the options for paying for impacts?
 - a. institutional or individual payments?
 - b. Large up-front investments or long-term ones?
 - c. Mitigation fees applied to resource extraction.
6. What are the options for sources of funds to pay for adapting? Governments, private sector, partnerships between public and private sector?
7. Since resource extraction will likely increase with the melting of arctic ice, how can resource extraction in the arctic be conducted to minimize negative spillovers? How does the almost inevitable expansion of arctic oil and gas extraction fit in with the Paris accords and other climate change agreements?

G. Political Economy: Implications of Institutional/Management Decisions on Economics; Influence of Economics on Institutions.

1. Can economists say something concrete about the effects of different institutions on outcomes for regions, for indigenous people, etc.?
2. Devise and implement a Pan-Arctic survey comparing government, both national and subnational subsidies for Arctic living and how these have changed over time. E.g. the political and economic development ways of paying to live in the North. Are the Arctic 8 similar or

different in their reasons for doing this?

3. What market value in revenue to rural communities has been forgone due to marine mammal restrictions?
4. How can we evaluate the performance of institutional/governance systems (e.g. ANCSA Corporations, CDQs, the Polar Code, etc.)?
5. Explore how indigenous and local traditional ecological knowledge can be integrated into economic decision support and governance at all levels for the Arctic, e.g. environmental impact assessments EIA.

Recommendations for Follow-up

All participants present for the last session agreed they wanted to continue the conversation and create a structure through which that could happen.

They recommended that we create a new academic society: that there be a small fee to join. In return, the society would

1. support members in furthering economic studies of the Arctic (i.e., when a member applies to present on the topic, having this affiliation may be a boost to their credentials;
2. Conduct periodic meetings
3. Be a vehicle for facilitating research collaboration and be proactive in recruiting new members to strengthen the network and interests in Arctic economic research.

a. Michael Goldstein offered to take the lead on that.¹²

Other follow up suggestions and offers included:

1. Andreas Oesthagen offered to host a second meeting in Norway at the Business School that he is affiliated with in Bodo;¹³
2. Iulie Aslaksen suggested to strengthen cooperation with the CBE in the next ECONOR report;

¹² While the first suggestion for the name of the society was “The Society for the Study of the Economies of the Arctic and Subarctic (SEAS)”, the websites www.seas.org or other versions were already taken. Hence the name of the society is the Arctic and Sub-Arctic Economics Association (ASAEA) and can be found at www.asaea.org. Further work on this effort will continue during spring 2018 to create protocols, mission, etc.

¹³ Andreas, soon after the meeting ended, notified CBE folks for project collaboration with Norwegian colleagues, invitation to speak at an Arctic conference in April, etc.

3. Judith Kildow offered to chair a subcommittee to create new research proposals for economic studies and NSF grant applications;
4. Judith Kildow enlisted all participants to give input on the summary final report from this meeting, which will be distributed not only to the participants and NSF but more broadly to those that have indicated an interest in receiving it and any others suggested by the aforementioned. It will also be published on the CBE website for public access.
5. The literature review/context paper written by Drs. Kildow and Goldstein will be revised and submitted for publication.
6. All keynote speakers were encouraged to turn presentations into formal papers that can be published on JOCE for special edition on Arctic Economy.¹⁴

¹⁴ The CBE sponsored Journal of Ocean and Coastal Economics distributed this spring a Call for Papers on this topic for a special edition of the journal.

APPENDIX A—Workshop Schedule

ARCTIC ECONOMICS WORKSHOP NOVEMBER 6-8, 2017 MIDDLEBURY INSTITUTE OF INTERNATIONAL STUDIES

Monday, November 6	
<p>18:00 Dinner with all participants, Ambrosia Indian Bistro, 565 Abrego St., Monterey, CA (introductions)</p>	
Tuesday, November 7	
Morning	Afternoon
<p>07:30-08:30: Breakfast at Hotel Pacific Meeting Room McCone Bldg. Board Room, MIIS</p> <p>08:30-9:00: Welcome-Moderator: Dr. Judy Kildow, National Ocean Economics Program, Middlebury Institute of International Studies</p> <p>Welcome and Introductions: Professor Jason Scorse, Center for the Blue Economy, Middlebury Institute of International Studies and Dr. Jeff Dayton-Johnson, Vice President for Academic Affairs and Dean of the Middlebury Institute of International Studies</p> <p>9:00 – 9:15: Introduction of participants</p> <p>Setting the Stage</p> <p>09:15-9:45: Co-Moderators: Dr. Judy Kildow and Professor Michael Goldstein, Babson College</p> <p>Meeting purpose and context: Summary of research and draft paper reflecting the State of Arctic Economic Research.</p> <p>Instructions for participants</p> <p>9:45 – 10:30: Session 1: The Economy of the Arctic: Definition, Status of Research, Issues, and Needs (ECONOR Update 2015) Keynote: Dr. Iulie Aslaksen, Statistics Norway</p> <p>10:30-10:45: Break</p> <p>10:45-12:00: Session 1 Discussion</p> <p>Discussant: Dr. Lance Howe, University of Alaska, Anchorage</p> <p>Canadian perspectives: Purpose and Value, Christine Irwin, Dept. Fisheries and Oceans, Canada</p> <p>12:00-13:30: Lunch with MIIS Students –Workshop Objectives, Discussion and Q and A with students.</p>	<p>13:30-15:00: Session 2: Bridging the Gap between Environmental Values and the Economy</p> <p>Keynote: Dr. Brendan Kelly, University of Alaska, Fairbanks and Center for the Blue Economy, Middlebury Inst. Of Intl. Studies</p> <p>Discussant: Simon Stephenson, National Science Foundation</p> <p>Professor Steve Colt, Alaska Pacific University – valuation challenges</p> <p>15:00-15:15: Break</p> <p>15:15-16:45: Session 2 Discussion</p> <p>Information needs for natural resource management and valuation</p> <p>Andreas Østhagen, University of British Columbia, Fridtjof Nansen Institute, Arctic Institute, Norway</p> <p>Sarah Trainor, University of Alaska, Fairbanks</p> <p>18:30-20:30 Dinner, Scales on the Wharf</p> <p>End of Day 1</p>

Wednesday, November 8

Morning	Afternoon
<p>07:30-08:30: Breakfast at Hotel Pacific</p> <p>08:30-10:00: Session 3: Linking Economic Information to Policy and Governance Issues</p> <p>Keynote: Dr. Oran Young, University of California at Santa Barbara</p> <p>Discussant: Dr. Amy Lovecraft, University of Alaska, Fairbanks</p> <p>10:00-10:15: Break</p> <p>10:15-12:00: Session 3 Discussion Management of Natural Resources: Alan Haynie, NOAA Alaska Fisheries Dr. Phil King, San Francisco State University How to use the tools we have to preserve the Arctic</p> <p>12:00-13:30: Lunch</p>	<p>13:30-15:00: Session 4: Meeting Highlights and Insights Panel: Moderator, Michael Goldstein, Panelists: Aslaksen, Young and Stephenson</p> <p>15:00-15:15 Break</p> <p>15:15-17:00: Session 4: Meeting wrap up: Next Steps – Participants’ discussion regarding possible group formations, a model research project, etc. Judith Kildow, Moderator</p> <p>17:00: End of Program</p> <p>Thank you and departing remarks: Judith Kildow and Michael Goldstein</p> <p>Dinner on your own, or informally arranged with other participants</p>

APPENDIX B--List of Participants

Dr. Iulie Aslaksen
Senior Researcher, Statistics Norway
Citizen of: Norway

Iulie Aslaksen is senior researcher in the Research Department of Statistics Norway. She has a PhD in economics from University of Oslo and has been a visiting scholar at Harvard and UC Berkeley. During the last 10 years her work has focused on the ECONOR projects, where she is project leader and co-editor of the ECONOR reports, “The Economy of the North”. The purpose of the ECONOR reports is to give a comprehensive picture of the Arctic economies, combining knowledge on the economy, natural resources, socio-economic conditions, subsistence activities of the indigenous peoples, and environmental impacts. She has a strong interest in ecological economics and works with indicators for sustainable development, biodiversity indicators such as the Nature Index for Norway, and the UN proposed system of Experimental Ecosystem Accounting. Her professional journey is intertwined with personal interests. Iulie spends much time in nature during all seasons, hiking in the mountains, taking part in fieldwork for nature mapping, and visiting and learning from Sámi reindeer herders on the tundra in Northern Norway.

Dr. Charles Colgan
Director of Research, Center for the Blue Economy, Middlebury Inst. of Intl. Studies
Editor-in-Chief, Journal of Ocean and Coastal Economics, Center for the Blue Economy,
Middlebury Institute of International Studies
Citizen of: USA

Charles S. Colgan is Director of Research at the Center for the Blue Economy at the Middlebury Institute of International Studies at Monterey in Monterey, CA., where he is also Editor-in-Chief of the *Journal of Ocean and Coastal Economics* and an adjunct professor of International Environmental Policy. He is Professor Emeritus of Public Policy & Planning in the Muskie School of Public Service at the University of Southern Maine, where he chaired the Graduate Program in Community Planning & Development. He is also Director Emeritus of the Maine Center for Business & Economic Research at USM. He served 12 years in the Maine State Planning Office including positions as Maine State Economist and director of the Maine Coastal Program. He received his BA from Colby College and his PhD in Economic History from the University of Maine.

Dr. Stephen Colt
Professor of Economics, Alaska Pacific University
Citizen of: USA

Steve Colt is a professor of economics at Alaska Pacific University. He recently retired from 32 years at the Institute of Social and Economic Research at the University of Alaska, where he served as research associate, professor, and director. Steve’s research has focused on Alaska Native corporations, rural energy and sanitation challenges, and the economic benefits of healthy ecosystems. He enjoys participating in multidisciplinary working groups such as the Federal Field Work Group on Alaska Rural Sanitation, the Aspen Institute Commission and Dialogue on Arctic Climate Change, and the National Center for Ecological Analysis and Synthesis (NCEAS) Marine Valuation Working group.

Dr. Michael Goldstein
Donald P. Babson Chair in Applied Investments
Faculty Director, Master of Science in Finance (MSF) Program
Babson College
Citizen of: USA

Michael A. Goldstein is the Donald P. Babson Chair in Applied Investments and a Professor of Finance at Babson College, where he serves as Faculty Director of the Master of Science in Finance program. He is also currently a Visiting Professorship Fellow with the Climate Change Research Center at the University of New South Wales (Sydney, Australia). Dr. Goldstein's research specialty is examining the structure of equity and bond markets, as well as dividend policy, asset pricing, real estate, privatization, and climate change. He has presented his work at numerous conferences worldwide, has thrice won the "Best Paper in Market Microstructure" at major national conferences, and is an Associate Editor at two finance journals. His papers have been published in major finance academic journals, including *The Journal of Finance*, *The Journal of Financial Economics*, *The Review of Financial Studies*, as well as *Climatic Change*, *Scientific Reports*, and *Water Resources Research*. He was a Principal Investigator on a \$400,000 National Science Foundation (NSF) grant studying the arctic economy and is a Principal Investigator on an NSF grant for an Arctic Economy workshop. Dr. Goldstein currently serves as Chair of the Financial Regulatory Authority (FINRA) Economic Advisory Committee and has served on three U.S. Securities and Exchange Commission roundtables. He also consults to a variety of large financial services and trading firms and indigenous peoples and has been interviewed extensively by national and international television, radio, and print media. Dr. Goldstein received a B.S., an M.B.A., an M.A., and a Ph.D. in Finance from the Wharton School at the University of Pennsylvania.

Dr. Alan Haynie
Economist, National Marine Fisheries Service, Alaska Fisheries Science Center
Citizen of: USA

Alan Haynie has been an economist at NOAA Fisheries' Alaska Fisheries Science Center in Seattle since 2004 after attending graduate school in economics at the University of Washington. Alan's research includes the spatial analysis of fisheries under changing climate, biological, market, and management conditions. Since 2008, Alan has been a member of the North Pacific Fishery Management Council's Bering Sea and Aleutian Islands Groundfish Plan Team and oversees the spatial economics toolbox for fisheries (FishSET), a NOAA Fisheries initiative to improve the spatial modeling and management of fisheries. Alan's climate-related work has included being a PI in the Bering Sea Integrated Ecosystem Research Program and the Alaska Climate Integrated Modeling (ACLIM) Project, co-authoring the National Climate Assessment Oceans Chapter and the Alaska Regional Action Plan (RAP), and co-organizing workshops at numerous marine science meetings. Alan's work also explores the design and implementation of bycatch reduction incentives, the evaluation of spatial bycatch closures, and the identification of unintended consequences of marine reserves. Alan is the co-chair of the ICES Strategic Initiative on Human Dimensions (SI-HD), a board member of the North American Association of Fisheries Economics (NAAFE), and is part of the NOAA Integrated Ecosystem Assessment (IEA) team. Alan received the Presidential Early Career Award for Scientists and Engineers (PECASE) and is currently an affiliate faculty member at the University of Washington and the University of Alaska Fairbanks. Alan teaches cross-country skiing to kids and enjoys all forms of being outdoors. He also recently survived teaching his 15-year-old son to drive.

Dr. Lance Howe
Professor of Economics, University of Alaska Anchorage
Citizen of: USA

Lance Howe is an Associate Professor of Economics at the University of Alaska Anchorage. For the last two years, he has served as Chair of the Department of Economics and Public Policy, prior to that he served as the founding Director of the UAA Experimental Economics Lab. He regularly teaches Economic Development, Econometrics, and a Research Seminar for Economics majors. He has served on the University IRB committee for several years. Current research can be summarized in three areas. First, his research explores the effects of risk and uncertainty on cooperation using laboratory and field experiments. In related NSF funded fieldwork, he has collaborated with economists and anthropologists to conduct experiments in Western Alaska and Kamchatka Russia; some of this work is published and they are in the process of analyzing and publishing the remaining data. Second, Lance is working with Dr. Matthew Berman to analyze American Community Survey Microdata for Alaska at a Census Research Data Center. The project involves identifying migration patterns using the 1 year migration question and exploring changes in welfare using revised income estimates. Third, Lance is working with other economists to explore the effects of risk on harvest decisions in a fishery using experimental methods. Experiments are designed in light of unique features of the Kenai River watershed and the economic contest literature.

Ms. Christine Irwin
Economist, Department of Fisheries and Oceans, Canada
Citizen of: Canada

Christine Irwin is currently an economist in the Economic Analysis group at Fisheries and Oceans Canada. She is the co-author of the paper "From the Orderly World of Frameworks to the Messy World of Data: Canada's Experience Measuring the Economic Contribution of Maritime Industries". In addition to working on the marine economy and Arctic marine economy files, she also works on other files related to fisheries economics, including landed price modelling, license fee analysis, and Aboriginal fisheries. She has a bachelor's degree in Statistics from the University of Waterloo.

Dr. Brendan Kelly

Executive Director of SEARCH: Study of Environmental Arctic Change, University of Alaska, Fairbanks

Senior Fellow, Center for the Blue Economy, Middlebury Institute of International Studies

Citizen of: USA

Dr. Brendan P. Kelly is a Senior Fellow at the Center for the Blue Economy (CBE), Middlebury Institute of International Studies (MIIS), and Executive Director of the Study of Environmental Arctic Change (SEARCH). SEARCH is a U.S. program with a mission to provide a foundation of Arctic change science through collaboration with the research community, funding agencies, and other stakeholders. SEARCH activities are supported by a collaborative grant from the National Science Foundation Division of Polar Programs, the International Arctic Research Center, and the Arctic Research Consortium of the US. As SEARCH Executive Director, Dr. Kelly will work with the SEARCH Science Steering Committee, part of the collaborative structure of the SEARCH program, to provide leadership and strategic direction and to forge strong cooperative relationships between academia, agencies, and stakeholders. Dr. Kelly is a marine ecologist with a focus on sea ice environments. He has participated in and led collaborative research in the North Pacific Ocean, the Arctic Ocean, the Sea of Okhotsk, the Baltic Sea, and Antarctica. He has served on numerous national and international science panels and as a science adviser to indigenous organizations in Alaska. Dr. Kelly received degrees in Biology from the University of California Santa Cruz (B.A.), the University of Alaska Fairbanks (M.S.), and Purdue University (Ph.D.). Dr. Kelly is employed by the International Arctic Research Center, University of Alaska Fairbanks, as the Executive Director of the Study of Environmental Arctic Change and adviser to the Center for Arctic Policy Studies. His career in Arctic research and policy includes serving on the faculty and administration of the University of Alaska, as a research scientist with NOAA's National Marine Mammal Laboratory, Deputy Director of Arctic Sciences at the National Science Foundation, Chief Scientist of the Monterey Bay Aquarium, and Assistant Director for Polar Science in the White House Office of Science and Technology Policy. Currently, he serves on the National Academy of Sciences' Polar Research Board and as a Senior Fellow at the Center for the Blue Economy, Middlebury Institute of International Studies at Monterey.

Dr. Judith Kildow

Director, National Ocean Economics Program

Educator, Lecturer, Researcher

Center for the Blue Economy, Middlebury Institute of International Studies

Citizen of: USA

Dr. Judith Kildow is founder and Director of the National Ocean Economics Program (NOEP) (www.OceanEconomics.org), at the Center for the Blue Economy at the Middlebury Institute of International Studies at Monterey, California. Her research bridges science, economics and policy, identifying how economic activities and ocean changes affect each other and influence policies. She spent 25+ years on the faculty at MIT, in the Department of Ocean Engineering, was Senior Social Scientist at the Monterey Bay Aquarium Research Institute, James W. Rote Distinguished Professor, California State University Monterey Bay, Research Faculty/Senior Fellow at Harvard University, University of Southern California and University of Vermont. Dr. Kildow has an AB in Political Science from Grinnell College and a PhD. in International Relations and Science Policy from The Fletcher School of Law and Diplomacy, Tufts University. She was a member of The Presidential Commission, NACOA, has served on National Academy of Sciences boards and committees, on federal and state government, corporate and editorial boards, and has published and lectured widely in the fields of coastal and ocean policy and economics. More recently, she has given talks in China, Korea, Italy, Ireland, France and England, and throughout the

US, about the value of oceans and coasts and the high risks from climate change impacts to our shores. Her current focus is the importance of the Arctic to understanding the economics of climate change. Publications, lectures and awards can be found on her longer CV at www.oceaneconomics.org.

Dr. Philip G. King

Professor of Economics, Department Chair, San Francisco State University

Senior Fellow, Center for the Blue Economy, Middlebury Institute of International Studies

Citizen of: USA

Dr. Philip King has worked on the economics of coastal resources in California for over 20 years. He has published numerous papers on the economics of coastal resources, mostly in California. He participated in numerous studies on the economics of sea level rise for California's coastal communities and is currently working on several local coastal programs. Dr. King just retired after thirty years as Professor of Economics at San Francisco State University. He was chair from 2002-2005. He received his PhD in Economics from Cornell a long time ago.

Dr. Amy Lovecraft

Professor of Political Science, Department Chair, University of Alaska Fairbanks

Faculty of Arctic and Northern Studies (ACNS)

Affiliate, International Arctic Research Center (IARC)

Steering Committee Member, Study of Scientific Arctic Change (SEARCH)

Citizen of: USA

In her research, Dr. Lovecraft explores power dynamics in social-ecological systems. In particular how problems are defined, and policies designed in light of climate change, development, identity, and economic uncertainties. Her scholarship has been published as book chapters and in journals such as Arctic, Marine Policy, The American Review of Canadian Studies, Polar Geography, Policy Studies Journal, and the Proceedings of the National Academy of Sciences. Most recently she published on the human geography of sea ice and a book chapter is forthcoming in 2018 on the chronotypical features of natural disasters. She has been a Dickey Fellow in Arctic Studies at Dartmouth College and a Fulbright Research Scholar in Norway at the Center for International Climate and Environmental Research (CICERO). She has served two terms as a member of the U.S. National Academies Polar Research Board and is currently a Nordforsk Science Advisory Board member for the Joint Nordic Initiative on Arctic Research. She was the Principle Investigator (2013-2017) for a National Science Foundation grant – Northern Alaska Scenarios Project (NASP). This was interdisciplinary team of faculty and students working with resident experts in the Northwest Arctic and North Slope Boroughs on participatory scenarios focused on the question "what is required for healthy sustainable communities in Arctic Alaska by 2040?" She received her B.A. in 1994 from Trinity University and began graduate studies in Vienna, Austria focusing on international economics and European integration. Unable to resist North America for long she returned to earn her Ph.D. from the University of Texas at Austin concentrating on American political development, public policy, and political theory. She has been faculty at UAF since 2001.

Mr. Andreas Østhagen
PhD Candidate, University of British Columbia
Research Fellow, Fridtjof Nansen Institute
Senior Fellow, Leadership Group, Arctic Institute
Affiliated Fellow, High North Center, Nord University Business School
Citizen of: Norway

Andreas Østhagen is a Research Fellow at the Fridtjof Nansen Institute in Oslo, Norway (2015-). He is additionally a PhD-candidate at the University of British Columbia (UBC) in Vancouver (2015-), and a Senior Fellow and Leadership Group member at The Arctic Institute (2011-). He is also an affiliated fellow at the High North Center at Nord University Business School (2014-). Previously, Andreas worked for the Norwegian Institute for Defence Studies (IFS) in Oslo (2014-2017), and at the North Norway European Office in Brussels (2010-2014). He has also had shorter work-stints at the Centre for Strategic and International Studies (CSIS) in Washington D.C. (2011), and the Walter & Duncan Gordon Foundation in Toronto, Canada (2013). From Bodø, North Norway, Andreas has been concerned with Arctic-related issues for a decade. Currently, his work focuses on maritime boundaries and resource management, under the larger framework of international relations. In addition, he has worked on questions concerning security, legal frameworks, and natural resource development across the Arctic states and regions. He has published a number of articles, reports and op-eds, including in Defense Studies, Journal of Military and Strategic Studies, and Arctic Review on Law and Politics. Andreas holds a Master of Science (MSc) from the London School of Economics (LSE) in European and international affairs, and a Bachelor's degree in political economy from the University of Bergen (UiB) and the Norwegian University of Science and Technology (NTNU).

Dr. Jason Scorse
Director, Center for the Blue Economy
Associate Professor and Chair, International Environmental Policy Program
Middlebury Institute of International Studies
Citizen of: USA

Jason Scorse is the Director of the Center for the Blue Economy (CBE) and Chair of the International Environmental Policy (IEP) program at the Middlebury Institute of International Studies at Monterey. He completed his Ph.D. in Agricultural and Natural Resource Economics at UC-Berkeley in 2005 with a focus on environmental economics and policy, international development, and behavioral economics. Upon graduation, he joined the faculty of the Middlebury Institute of International Studies, was promoted to Chair in 2009, and launched the CBE in 2011. He teaches courses in environmental and natural resource economics, ocean and coastal economics, and sustainable development. Professor Scorse consults for major environmental organizations, including the Natural Resources Defense Council (NRDC) and the Sierra Club. In addition to his roles as Director of the Center for the Blue Economy, and Chair of the International Environmental Policy program, he also serves as a member of the Editorial Board for the Journal of Ocean and Coastal Economics, the online scholarly journal of the Center for the Blue Economy. Dr. Scorse has published articles in American Economic Review, California Management Review, The Solutions Journal, and for books published by the Brookings Institution and Routledge Press. In 2010 his book, What Environmentalists Need to Know About Economics, was published by Palgrave Macmillan. His work has also been featured in The New York Times, Fortune, and The Washington Post. Dr. Scorse sits on the Monterey Bay National Marine Sanctuary Research Activities Panel and on the board of Save Our Shores. In his spare time he surfs, cooks gourmet vegan food, and writes fiction for when he starts his new career after we've solved all of the world's great environmental challenges.

Mr. Simon Stephenson
Section Head, Arctic Sciences, National Science Foundation
Citizen of: USA

Dr. Sarah Trainor
Associate Professor of Social-Ecological Systems Sustainability, School of Natural Resources and Extension, University of Alaska, Fairbanks
Director, Alaska Center for Climate Assessment and Policy
Citizen of: USA

Sarah Fleisher Trainor is Associate Professor of Sustainability of Social-Ecological Systems in the School of Natural Resources and Extension and Associate Research Professor in the International Arctic Research Center, both at the University of Alaska, Fairbanks. She is Principle Investigator and Director of the Alaska Center for Climate Assessment and Policy, funded through the National Oceanic and Atmospheric Administration’s Regional Integrated Science Assessment (RISA) program and the Alaska Fire Science Consortium, one of the Joint Fire Science Programs’ Knowledge Exchange Network. She specializes in engaging in knowledge co-production, conducting use-inspired science, and serving Alaskan stakeholders in multiple sectors. She holds a Ph.D. and M.S. from the Energy and Resources Group at the University of California, Berkeley and a B.A. from Mount Holyoke College, in South Hadley, MA.

Dr. Trainor was lead contributing author for the Alaska Chapter of the U.S. Global Change Research Program’s 3rd National Climate Assessment (2014) and is contributing author for the Alaska Chapter of the 4th National Climate Assessment (expected 2018). She is lead author on the Adaptation Chapter and contributing author on the Synthesis of the Arctic Council Report, “Adaptation Actions for a Changing Arctic – Bering/Chukchi/Beaufort Region” expected soon from the Arctic Monitoring and Assessment Programme. Her research centers around climate change adaptation, bridging science and decision-making, and sustainability of social-ecological systems in Alaska and the Arctic.

Dr. Oran R. Young

**Distinguished Professor Emeritus, Institutional and International Governance, Environmental Institutions, The Bren School, University of California at Santa Barbara
Citizen of: USA**

Oran Young is professor emeritus and co-director of the Program on Governance for Sustainable Development at the Bren School of Environmental Science & Management at the University of California (Santa Barbara). His research focuses on theoretical issues relating to the roles of social institutions as governance mechanisms with applications to matters of governance relating to climate change, marine systems, and the polar regions. He also does comparative research on environmental governance in China and the United States. Dr. Young served for six years as founding chair of the Committee on the Human Dimensions of Global Change of the US National Academy of Sciences. He chaired the Scientific Steering Committee of the international project on the Institutional Dimensions of Global Environmental Change (IDGEC). He was a founding co-chair of the Global Carbon Project and from 2005 to 2010 chaired the Scientific Committee of the International Human Dimensions Programme on Global Environmental Change. An expert on Arctic issues, Dr. Young chaired the Steering Committee of the Arctic Governance Project and is the science advisor to the North Pacific Arctic Conferences. Past service in this realm includes co-chair of the Working Group on Arctic International Relations, member of the US Polar Research Board, founding board member of the Arctic Research Consortium of the United States, vice-president of the International Arctic Science Committee, chair of the Board of Governors of the University of the Arctic, consultant to the Standing Committee of Parliamentarians of the Arctic Region, and co-chair of the 2004 Arctic Human Development Report. He is the author of more than 20 books. His recent books include *On Environmental Governance: Sustainability, Efficiency, and Equity* (2013) and *Governing Complex Systems: Social Capital for the Anthropocene* (2017).

APPENDIX C—Research Question Summary

The following categories were created to include all of the research questions and agenda that were submitted by participants at the end of the Arctic Economics Workshop in Monterey. The list does not include contributions from the following people, who did not submit anything.

Brendan Kelly, Charles Colgan, Jason Scorse, Judy Kildow, and Michael Goldstein.

All of the following were made following this statement made early in the meeting by Oran Young: “Don’t ask whether the Arctic is different in some general sense. Rather, ask whether there are emerging issues in the Arctic that provide attractive opportunities for economic research.”

A. The Role of Economics in Arctic Research

1. How do participants in the primary polar / Arctic meetings (e.g. Arctic Circle) think about the role of economics in their problems? Similarly, what will the role of economics be following the Arctic Science Agreement? We should engage in this context and better understand their interests and priorities and how they fit with the interests and tools of economics.
2. How should we best include economists in national marine resource agencies across countries to develop fisheries management institutions in a manner that maximizes net benefits of marine resources? The US is a leader in this area and improved data collection and analyses across countries is very likely to increase benefits to all countries.
3. There are a variety of pressing behavioral health questions in the arctic to which economists can contribute.
4. There are several migration related questions that can be addressed given available data
5. Given that indigenous peoples have vested rights, how can social scientists, particularly economists, maximize benefits and minimize costs of various adaptation strategies?
6. Consider ways to represent nonmarket values and to deal with high levels of uncertainty
7. Recognize the implications of living in a world of increasingly complex systems.
8. What factors determine indigenous peoples’ preferences for various economic development strategies (e.g., supporting oil/gas exploration)?
9. What are the risk preferences of various communities?

B. Data needs and Meta Data Studies: integrate current and past datasets and principles from multiple organizations for greater geographic comparability, better understanding and optimizing opportunities

1. Apply the Alaska Dept. of Fish and Game Survey on community harvest of wild food circumpolar-wide to all Arctic regions, to demonstrate cultural values and achieve a better basis for economic studies of total consumption.
2. Explore how emerging issues of socio-ecological risk and high-priority policy issues can be integrated into UN SDG-Sustainable Development Goals, to present Arctic SDGs, as framework for economic decision support.
3. Suggest to national statistical offices to regionalize data on consumption of public goods to consumers (health, education, etc.), to achieve better measures of total (extended) consumption possibilities in Arctic regions.
4. What primary Arctic social science data sets would be most valuable to obtain on an ongoing basis and what might be the value of having them? (examples: ongoing panel of Arctic residents, consumer expenditure survey, energy use)
5. Data: A low cost /high return option is to encourage all Nordic countries to contribute Census data to a repository. I have two specific suggestions:
 - a. Microdata should be contributed to the IPUMS (University of Minnesota) International Database
 - b. Community level data to a central data repository. This resource should be easily accessible to researchers in any country.
6. Data: new survey efforts are needed BUT there should be a concerted effort to insure full disclosure of the data to all researchers.
 - a. Encourage social scientists to submit survey data to a central data repository like Harvard Dataverse.
7. *How can we value the contribution of the subsistence economy to the North, and incorporate this value along with other sectors?
8. How can we compare data, data management plans, etc., across the Arctic in order to identify areas where we might be able to improve?
9. What are the better ways of obtaining or estimating data in the Arctic and how can we ensure that we can continue to obtain or estimate this data in the future?

C. Arctic Investments: Needs, Vehicles, Incentives, benefits

1. Macro-trends:
 - a. What are the macro-trends of Arctic investments? (I.e. who is investing, what, where, how?)
2. Micro-challenges:

- a. What are the perceived future economic challenges amongst Arctic communities, across Arctic countries? (identify challenges)
 - b. How can the infrastructure from oil and other natural resource extraction benefit indigenous and other communities? Understanding the benefits to communities of different types of infrastructure can lead to improved co- development of resources
3. Factors influencing profitability:
 - a. What factors contribute to the varying degrees of profitability in Arctic business projects (by sector)?
 - b. Will economies like Alaska shrink with declining oil rents in the same way they grew during previous oil booms? (Hysteresis/ Path dependency)
 - c. What are the areas with the greatest potential for innovation and investment in the Arctic (for example: port infrastructure, navigation aids, safety/emergency preparedness) and how could they impact the Arctic economy?
 4. Local involvement
 - a. How do you involve and include local companies and competencies in larger business projects in Arctic communities?
 5. Rules of the game:
 - a. Are Arctic investments and/or projects subject to different rules in terms of profitability/local impact/climate output?
 6. Work with national statistical offices to regionalize investment data in Arctic regions and present by investing country, to explore international investment activity in the Arctic.

D. Impacts -- Economic, environmental and social: capturing externalities, damage costs, restoration and preservation costs and values.

1. Suggest to environmental agencies, in context of Arctic Council, to give more comprehensive overview of environmental costs of Arctic mining projects and clean-up costs and responsibilities.
2. What kinds of benefit-sharing mechanisms would Arctic residents choose if they could (Willingness to Accept concept) to mitigate the negative externalities/consequences of Arctic climate change and rapid resource development?
3. What are the main threats from extractive activities and transportation and what are the costs of different mitigation method? For example, marine invasives will be a major impact – what steps can be taken to reduce impacts?
4. What will be the impact on the Arctic economy of emerging trends (i.e. natural resource development, marine transportation corridors, commercial fisheries and tourism)
5. How can we limit carbon and other GHG emission from Arctic drilling and permafrost melting?
6. Explore the possibility, in context of Arctic Council, to introduce fee on Arctic cruise ship passengers as measure to ensure pay-back to affected Arctic communities.

E. Non-market/Subsistence Valuation: natural capital, ecosystem, cultural, etc.

1. How much and in what ways does the rest of the world value Arctic ecosystems and ecosystem services?
2. What's the value for preserving Arctic communities and the Arctic environment to US households? This is not a simple question because preferences will change over time as more is known or appreciated about the Arctic.
3. What was (or has been) the cost offset of the storage services provided by the permafrost (substitute goods)?
4. What is the market value of the total whale (seal, fish) caught legally as food? (willingness to pay), i.e. difference between whales' value and value of marketplace for whale meat...
5. How can we value the contribution of the subsistence economy to the North, and incorporate this value along with other sectors?
6. What is the value of Indigenous Rights as leverage over decisions and choice?
7. How can we address tradeoffs between rights and values?

F. Climate Adaptation

1. Assistance to Arctic residents has historically been place-based (e.g. build infrastructure in community x). What role, if any, could assistance to individuals play in helping people adapt to change? (Choice experiments, randomized controlled trials, could be used to elicit answers from Arctic people.)
2. How can communities adapt to rapid social, environmental, and economic change? Climate change is leading to coastal erosion, changing sea ice, and increase variability in fisheries. Technological change is contributing to rapid social and cultural change. Revenues from oil and gas will continue to decline; how will communities adapt in light of declining state and ANSCA transfers?
3. If we "cap" GHG in the Arctic, how do we allocate various activities to achieve this goal?
4. What are the sector specific impacts and opportunities of climate change (e.g. commercial fisheries (such as Alan's work), shipping, tourism, agriculture, aquaculture, rural freshwater source/ waste water systems).
5. What is the potential for increased development [e.g. mining, oil & gas, population expansion (migration from lower latitudes)].
6. How will climate change impact economic growth (on local, borough and state-wide scales)?
7. What are the costs of climate change? And by extension, costs and trade-offs of adapting vs not adapting. There has been work on this in infrastructure and wildfire (Melvin et al papers and Larsen et al 2013). There are multiple other avenues to take this in other sectors and more work

could be done in these sectors as well.

8. What are the options for adaptation to the impacts of climate change, especially at the community level?
9. How can we avoid institutional lock in/maximize agility in responding to nonlinear and surprising changes?
10. Are there opportunities to engage in advanced thinking about opportunities for changes in policies/governance systems that may arise during period of crisis?

G. Political Economy: Implications of Institutional/Management decisions on economics; Influence of Economics on Institutions.

1. Can economists say something concrete about the effects of different institutions on outcomes for regions, for indigenous people, etc.? For instance,
 - a. Have Alaska Native Corporations improved outcomes for Alaska Native people?
 - b. Has the Community Development Quota program increased education, employment and other measures of well-being for communities?
 - c. Have differences in fisheries management decisions in Russia and Alaska led to differences in abundance or variability in abundance (e.g. salmon abundance in Kamchatka Russia vis a vis the Yukon or Kuskokwim region)?
 - d. What is the effect of the Permanent Fund Dividend on poverty and income inequality? This ties in with questions related to universal basic income.
2. A pan-Arctic survey comparing government (national and subnational) subsidies for Arctic living and how these have changed over time. (political economic development of paying to live in the North...are the Arctic 8 similar or different in their reasons for doing this?)
3. What market value in revenue to rural communities has been forgone due to Marine mammal restriction?
4. How can we evaluate the performance of institutional/governance systems (e.g. ANCSA Corporations, CDQs, the Polar Code, etc.)?
5. Explore how indigenous and local traditional ecological knowledge can be integrated into economic decision support and governance at all levels for the Arctic, e.g. environmental impact assessments EIA.