

Economic Development in the Canadian North:

Recent Advances and Remaining Knowledge Gaps and Research Opportunities

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Abstract and Methodology

This summary presents economic development-related research gains, gaps and opportunities gathered by the Canadian Polar Commission in fulfillment of its mandate to monitor and communicate polar knowledge in Canada and around the world. It is focused on the Canadian North, comprising the Yukon, Northwest Territories, Nunavut, Nunavik, and Nunatsiavut, during the seven-year period beginning with the International Polar Year (IPY) in 2007. The following observations are organized under recent advances and knowledge gaps and research opportunities. They are based on semi-structured interviews with northern housing research experts and practitioners, which have been supplemented and validated with both peer-reviewed and 'grey' literature. Recent advances and knowledge gaps pertaining to Arctic shipping, search and rescue, and oil spill management are covered in the summary on communications, infrastructure and transportation systems.

Overview

- The northern economy consists largely of government, mining, oil and gas, commercial fishing, seal hunting, tourism, trapping, arts and crafts (including film and sound), and the tertiary sector, as well as the more traditional subsistence economy, including hunting, fishing and gathering (Stapleton, 2008; Lutra Associates, 2011; Invest Yukon, 2013). Other sectors such as forestry and agriculture in the Yukon and NWT innovation and technology in the Yukon, including the development and testing of cold climate technologies and environmental research are also important (Invest Yukon, 2013). Mining and oil and gas resource development opportunities in the North have increased, and are expected to continue doing so as the warming climate facilitates access (Huntington, 2007; Fenge, 2009; Prowse & Furgal, 2009; Kativik Regional Government & Makivik Corporation, 2010). Also as a result of the warming climate, fish stocks in the Arctic Ocean are expected to be more accessible (Stapleton, 2008).
- In recognition of the dependence of the northern economy on resource development (Southcott & Irlbacher-Fox, 2009), and thus the vulnerability of the North to this boom-bust cycle, there have been efforts to enhance diversification by developing and/or strengthening other areas such as tourism and the knowledge sector (Fenge, 2009; Bolton et al., 2011; Pearce et al., 2011; Goldhar et al., 2012; Economic Development and Transportation – Government of Nunavut, 2013).
- Economic development-related strategies are in place or under development in many regions of the North. *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 Northwest Territories (NWT Chamber of Commerce et al., 2013). The GNWT also has a number of more sector-specific strategies, including *Tourism 2015* and *NWT Arts Strategy* (Government of the Northwest Territories, n.d.). 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 *Tunngasaiji: A Tourism Strategy for Nunavummiut* in 2013 (Economic Development & Transportation – Government of Nunavut, 2013). Makivik Corporation and the Kativik Regional Government released *Plan Nunavik: Past, Present and Future* in 2010 as a basis for development discussions regarding the region of Nunavik with the Government of Québec in terms of its development plans for northern Québec, *le Nord pour tous*. The Parnasimautik process is underway in the Nunavik region to develop a comprehensive vision for sustainable development that builds on the *Plan Nunavik* (Kativik Regional Government & Makivik Corporation, 2010; Makivik Corporation, 2013; Rodon & Schott, 2013; Gouvernement du Québec, 2013). The Government of Newfoundland and Labrador released its 5-year *Northern Strategic Plan for Labrador* in 2007 which details plans to enhance the health and wellbeing of people in Labrador through improved infrastructure, social programming, and the promotion of economic development (Government of Newfoundland and Labrador, 2007). The *SakKijânginnatuk Nunalik* initiative is currently underway in

Nunatsiavut to enhance community sustainability. Phase I of this initiative involved community workshops to understand community priorities, challenges and opportunities, which are documented in the report *SakKijânginnatuk Nunalik: Understanding opportunities and challenges for sustainable communities in Nunatsiavut, Learning from the coast*. Phase II will explore innovative and holistic approaches and solutions in response to Phase I findings (Goldhar et al., 2012).

- There is a lack of infrastructure in terms of transportation systems, telecommunications, and municipal infrastructure in many communities to enable and facilitate the growth of economic development (Northern Development Ministers Forum, 2010a). Financial services outside the larger communities are lacking and not always adequate to support business financing. Securing affordable and reliable energy that has limited environmental impact is also a challenge (A Northern Vision, 2011). This results in a high cost of living and doing business and can inhibit competitive pricing. While a number of operational development corporations and successful Aboriginal businesses have been established, economic development and employment opportunities are lacking in many areas of the North, especially in smaller, isolated communities that lack capacity, infrastructure and economies of scale to support business sectors (Walker, 2009; Goldhar et al., 2012).
- Climate change, including warming and/or thawing permafrost and more frequent and extreme weather events, has implications for all stages of resource development projects, including planning, operation and closure/reclamation (Huntington, 2007; Prowse et al, 2009; Pearce et al., 2011). The identification, assessment, management, and reduction of negative health, social, cultural and environmental impacts of resource development projects and related activities is also important with respect to sustainable development (Huntington 2007 & 2009; Voutier et al., 2008; Rodon & Schott, 2013), which can be challenging given the impacts of a rapidly changing climate and the dependence of Northerners on this environment for subsistence (Manley-Casimir, 2011).
- While economic development opportunities such as resource extraction are often highlighted as an opportunity to create employment for Northerners and improve socio-economic conditions (Huntington, 2007), this may not always be the case in practice if Northerners are not well-positioned to 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 and between people living in more isolated, remote communities and those in the larger hubs and in southern Canada. These challenges can impact educational outcomes and make it difficult to secure and maintain employment (National Collaborating Centre for Aboriginal Health, 2010; Inuit Tapiriit Kanatami, 2011; Sisco et al., 2012; Davison & Hawe, 2012b).
- There are low education attainment rates in many areas in the North as well as a skills shortage (Fenge, 2009; Howard et al., 2012). To obtain wage employment, Northerners are sometimes required to leave their family and communities (Stapleton, 2008). As well, Northerners may lack the education needed to move up positions within a company, and there is not always adequate and culturally appropriate support available (e.g. training programs in Inuktitut). Many workers are hired from southern Canada, who ‘fly in’ and ‘fly out’ (Fenge, 2009).

- 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 development while ensuring community wellbeing and involvement, cultural security, and environmental sustainability (Centre for the North, 2011b).

Recent Advances, Knowledge Gaps and Research Opportunities

State of the economy and economic development policies and initiatives

Recent Advances

- The *Economy of the North 2008* provides an overview of the economy of the circumpolar Arctic, including economic and social conditions, a comparative analysis of Arctic economies at a macro level, an overview of future production of petroleum, and of the interdependency of subsistence and market economies (Glomsrod & Aslaksen [Eds.], 2009).
- 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 *Northwest Territories 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 Northwest Territories, 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).
- In addition to outlining barriers and opportunities with respect to developing the economic potential of Canada's territories, a 2012 report by the Canadian Chamber of Commerce also provides a number of immediate, short-term and long-term recommendations for the federal government such as the establishment of incentives (e.g. tax credits) to encourage mentorship and collaboration between larger and smaller companies (The Canadian Chamber of Commerce, 2012).
- An empirical estimate was conducted of the economic impact (on local income, GDP and employment) of publically funded research expenditures in the Yukon, Northwest Territories and Nunavut from 2000 to 2009 from federally funded programs specifically mandated to support research. It was found that at its peak, territorial GDP was impacted by 0.04%, income by 0.09% and employment by 0.11%. Using Old Crow, YT as an example, it was also demonstrated that communities where field research is conducted may experience significant financial and intangible community-level benefits (Natcher, 2013).
- With a focus on Aboriginal communities in the Prairie Provinces, Olfert & Natcher discussed conditions under which place-specific (in addition to people-based)

economic development policy may be beneficial in order to help address local economic problems. While noting that place-specific policies should be used selectively, conditions under which these policies may be warranted include communities that are concentrated “in rural and remote areas of rapidly growing Aboriginal populations with below average educational attainment and high dependence on government transfers,” and those which are Aboriginal, noting that Aboriginal communities tend to have existing or potential social capital on which place-based policies might be based. A local network from the community of Postville in Nunatsiavut was examined to illustrate the extent of the kinds of relationships that underlie social capital. Given the complexity and differences in social capital among communities, the need to tailor place-based economic development policy to the community context through local participation in policy design was emphasized (Olfert & Natcher, 2013).

- Fugmann examined the regional and local impacts of bottom-up development in Nunavik and Nunatsiavut that have occurred in part through the settlement of regional agreements that have provided an economic base. While noting some of the challenges faced by these regions such as climate change and high costs of doing business, it was noted that bottom-up development including cooperatives; direct investments, subsidiaries and joint ventures of the ethnic corporations; and benefit agreements from resource development, has provided jobs and income for residents, and led to the establishment of small local businesses. The tourism industry in both Nunavik and Nunatsiavut was highlighted as a notable example of an industry which has benefited from bottom-up development (Fugmann, 2011).
- Research was undertaken to better understand the nature of poverty in Nunavut through an examination of socio-economic trends and current conditions and the dimensions of poverty including human capabilities, social exclusion, and economic wellbeing. This research found 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 economy. It was recommended that Nunavut use a more comprehensive measure of poverty to better understand its complexities (Impact Economics, 2012).
- Dowsley examined local hunting organizations and governance from an economic perspective in terms of the use of the polar bear in the Nunavut mixed economy for food, sport hunting, and the sale of hides and sport hunt outfitting. While it was found that for sport hunting (to which 20% of the polar bear quota is devoted) profit maximization is used, for subsistence there is a focus on longer-term goals to maintain social, human-environment and human-polar bear relations (Dowsley, 2010).
- An examination of community economic development with respect to Aboriginal communities noted that insufficient attention is given to human capital and that sustained investment is lacking. The need to address social issues within communities was emphasized, along with the need to use a long-term approach to develop a balanced plan that targets five, ten and fifteen year olds as well as the existing adult population (Impact Economics, 2005).

- The book *Migration in the Circumpolar North: Issues and Contexts* examines migration in the northern regions of the eight Arctic nations including factors that can influence migration such as employment, education, love, age and gender, as well as the associated consequences (Huskey & Southcott [Eds.], 2010), with one chapter focused on migration in Canada's North (Southcott, 2010).

Knowledge Gaps and Research Opportunities

- There is an opportunity to examine the extent to which more southern-based rural economic development best practices can be applied in remote, northern communities (e.g. business promotion; leveraging of local markets, etc.).
- The higher cost of doing business in Nunavut in terms of human resources and operational expenses was examined in the context of informing national funding allocation formulas for economic development programs (Nunavut Community Economic Development Organization, 2007).
- There is a need to better understand mobility between northern communities and "brain drain" to better understand how the North is changing. This includes mobility and immobility associated with resource development activities (Resources and Sustainable Development in the Arctic, 2013b).
- Further research is needed to better understand "how and where wealth should be directed to have the greatest impact on Nunavut's overall prosperity," which could be informed by an examination of initiatives in other jurisdictions (Impact Economics, 2012).
- There is a need for further research to determine opportunities for public-private partnerships, including the associated costs and benefits.
- There is a need for further research to understand how to better transition from a mining boom to a post-boom economy.

Government

Recent Advances

- Timpson examined institutional, numerical, cultural, and linguistic initiatives that have been implemented since the establishment of the Government of Nunavut in an attempt to create an Inuit public service, in order to better understand the challenges associated with cultural integration in bureaucratic public government. The link between improving Inuit representation in public service employment and investment in Inuit education was highlighted, along with the importance of consultation between community elders and public servants to develop institutions that are reflective of Inuit values. Timpson asserts that the Government of Nunavut's emphasis on determining how key cultural values should inform government operations is innovative and that this approach might be beneficial in other jurisdictions (Timpson, 2008).
- White examined the governance regime in Nunavut against the objectives of having it controlled by Inuit, and aligned with Inuit culture and values. It was found that with high vacancy rates and turnover in key positions, capacity building remains a concern, and that this, along with financial constraints makes it difficult to provide

effective governance. It was also found that capacity building can sometimes conflict with efforts to incorporate Inuit culture and values if, for example, workers from the south are hired to fill key vacant positions. White does assert that in the longer term, capacity needs to include both bureaucratic effectiveness and the “ability to govern and administer via staff and processes steeped in Inuit culture and values” (White, 2009).

- With an examination of Inuit economic development corporations in the Inuvialuit Settlement Region in the NWT (Inuvialuit Regional Corporation and the Inuvialuit Game Council) and in Nunavik (Makivik Corporation), Wilson & Alcantara assert that they are an important and underappreciated de facto form of self-government, providing services, programs and economic opportunities and enabling the development of economic and political capacity (Wilson & Alcantara, 2010).

Social economy

Recent Advances

- The Social Economy Research Network of Northern Canada (SERNNNoCa) was comprised of the following four themes: 1) profile of the social economy in northern Canada; 2) resource regimes and the social economy in the North; 3) the state and the social economy in the North; and 4) Indigenous communities and the social economy (Social Economy Research Network of Northern Canada, n.d.). From the research undertaken under these themes, it was found that northern communities rely significantly on the social economy, the contemporary state of which emerged in response to unique conditions such as resource dependence, colonial state relations, and the significance of the mixed economy. While it was noted that there were two separate discourses on the social economy, one being social and cultural relations present in Indigenous subsistence economies and the other being the third sector comprised of organizations that are not profit-oriented or government-based, close linkages between these two types of social economy were found. For example, it was found that often the Indigenous social economy led to the development of third sector organizations which then served to mobilize resources to help communities cope with rapid social change. It was also found that some of the barriers to the further development of the northern social economy included difficulty finding funding and the associated resources to fulfill reporting requirements, obtaining training for staff and volunteers, finding people with the necessary job qualifications, and transience (Southcott, In press). Some of the research gains resulting from this initiative are discussed in further detail below.
- Southcott & Walker examined the profile of social economy organizations in the territorial North, as well as the potential of the social economy to support northern communities in terms of facilitating the development of social and human capital to address socio-economic challenges. Social economy organizations in the North were found to have greater economic significance than similar organizations in the rest of Canada. It was found that most organizations in the northern social economy are non-profits, with over half being voluntary organizations. The main activity of the organizations examined could be categorized under sports, recreation and

tourism; social services; arts and culture; or law, advocacy and politics. It was also found that most organizations are located in the territorial capitals and rely on funding from government sources, sales of goods and services, donations, and membership fees. Key challenges facing the socio-economic sector in the North were also identified, including lack of funding, difficulty finding volunteers, obtaining and retaining paid staff, and providing training (Southcott & Walker, 2009).

- While noting the existence of differing academic perspectives regarding the meaning and relevance of the social economy in Aboriginal communities, Natcher identified important social attributes of economic activities in Aboriginal communities such as the use of cash from wage employment to purchase equipment for wildlife harvesting. Natcher also examined the social, economic and political interconnectedness of the subsistence and wage economies, sharing and reciprocity, and regulatory regimes with respect to wildlife resources in Canada's Aboriginal North and suggests the need for policies that promote equitable linkages between the interdependent subsistence and wage economies in order to strengthen Aboriginal economies in Canada's North (Natcher, 2008 & 2009).
- MacPherson examined the extent and nature of cooperatives in the North, noting their evolution from partnerships between Northerners and Southerners to more current forms that vary within the North and that vary from southern-based cooperatives and serve as a significant employer in the North. Following an examination of some of the important economic, social, cultural and political contributions of cooperatives in the North, such as the provision of services and ability to foster community-based entrepreneurship, MacPherson argued that more attention should be given to cooperatives as a model for economic and social development (MacPherson, 2009).
- Delic examined the quality, including strengths and weaknesses, of major sources of statistical information regarding the socio-economic conditions of northern Aboriginal communities (primarily the Canadian censuses, and post-censal surveys including the Aboriginal Peoples Survey and the Survey of Living Conditions in the Arctic). While noting improvements over the years in terms of the scope, quality, and coverage of this statistical information, Delic notes that with the growing recognition of the ineffectiveness of more generic policies that aim to address socio-economic conditions, caution is needed when using this statistical information for research and analysis given that, for example, the data may not be representative of those who are living in small, remote Inuit communities that are widely dispersed (Delic, 2009).
- Research examining the reasons and motivations of women to work in the social economy in Whitehorse, YT found five contributing aspects including "sense of community; the need to create change; personal beliefs and goals; feelings of responsibility; and economic influence" (Hoshizaki, 2012).
- Research examined social networks of country food sharing in Ulukhaktok, NT as a way to better understand vulnerability to change. It was found that the sharing patterns of hunters tended to include distant and collateral kin, whereas the sharing patterns of wage workers tended to include parents and siblings. This research also indicated that the ability of wage workers to participate in the subsistence economy

is vulnerable to social and environmental change and that wage employment could lead to greater isolation of the wage worker, and that hunters may be vulnerable to economic and political change (Collings, 2011).

Knowledge Gaps and Research Opportunities

- Further research is needed to better understand how northern cooperatives have developed, and are developing to provide lessons learned that can inform current or future cooperatives (MacPherson, 2009).
- Work is needed to synthesize research to better understand the internal development of the regions of Canada's North and in turn the internal dynamics of their economies (Abele, 2009).
- Further work is needed to develop "more efficient and effective research tools for examining changes in the social economies of the various regions over time" (Southcott, In press).
- Further research is needed to better understand the impact of evolving relations between Aboriginal and other Northerners on the northern social economy (Southcott, In press).
- Further research is needed to "better understand the cultural preconditions for successful social economic development" (Southcott, In press).

Land use planning

Recent Advances

- Chaulk & Procter examined the historical and political context of land use planning in the Nunatsiavut region. Some of the challenges identified with respect to land use planning in this region included working with land and resources that have been divided into defined jurisdictions that do not necessarily reflect the relationships that Inuit have with the environment, working to incorporate other Inuit interests when the tendency is to use an economic perspective or interpretation of non-economic issues, balancing the need for certainty with the need for flexibility, and working within political and bureaucratic arrangements (Chaulk & Procter, 2012).
- The 2010 report *Canada's North: What's the Plan?* provides three different perspectives with respect to the extent to which land use planning is effective in the North. Thomas Berger asserts the importance of land use planning in terms of sustainable economic development and the self-determination of Aboriginal peoples. Steven A. Kennett argues that with changes to the process to address complex regulatory, institutional, and legal aspects, land use planning in the North can be beneficial. In contrast, Hayden King argues that land use planning does not appropriately reflect or incorporate Aboriginal ways of governance and relationships with the land, and in turn can disempower Aboriginal peoples (Berger et al., 2010).
- Francis & Hamm examined the use of scenario modeling with the ALCES landscape cumulative effects simulation model as a way to support decision-making regarding land use planning in the traditional territory of the Vuntut Gwitchin First Nation. The benefits of the modeling process were noted, including the requirement for

those involved in the planning process to identify key drivers of change and to better communicate and understand socioeconomic and ecological trade-offs. It also required domain experts, planners and decisions makers to work together to develop scenario parameters (Francis & Hamm, 2011).

- With the significance of sea ice to Inuit in terms of being a part of their homeland and facilitating access to resources, the Inuit Sea Ice Use and Occupancy Project (ISIUOP) undertaken during International Polar Year (IPY) was important in terms of documenting Inuit knowledge and use of sea ice. With sub-projects in Nunavut and Nunavik, this project involved the mapping of sea ice use, visual representations of sea ice activities, and documentation of community-specific Inuktitut sea ice terminology (Aporta, 2011). The Nunavik Marine Region Planning Commission (NMRPC) is undertaking a Use and Occupancy Mapping (UOM) study that aims to quantify current traditional ecological knowledge (TEK) data available in the region. Using a data collection methodology that has a scientific basis, this data will be used to demonstrate how communities use their land, and will provide a foundation for the Nunavik Marine Region land-use plan. With the growing interest in resource development, this quantifiable data on land-use can assist in identifying, understanding, and addressing potential impacts of development on the environment and on communities (Nunavik Marine Region Planning Commission, 2012).

Knowledge Gaps and Research Opportunities

- Land use planning among Aboriginal peoples is understudied (Booth & Muir, 2011). There is a need for further work to better understand planning processes used in the North, including what does and does not work.
- Cumulative effects assessment and management is highly important in informing land use planning (Francis & Hamm, 2011). Further research is needed to better understand cumulative effects and impacts of anthropogenic disturbance and climate change (Conservation of Arctic Flora and Fauna, 2010) as it relates to land-use planning. Further research is also needed to better understand climate-vegetation-hydrology-permafrost relationships and the broader implications of warming and/or thawing permafrost on resource development (Arctic Monitoring and Assessment Program, 2012).
- There is a need for better understanding of how to link land-use planning and environmental (and cumulative) effects assessment.

Mining, oil and gas

Recent Advances

- In addition to the ongoing geological surveys being carried out in the North by each of the territories and the provinces of Québec and Newfoundland and Labrador to provide information regarding the geology and resource potential of their respective jurisdictions, research gains have also been made through the Geo-mapping for Energy and Minerals (GEM) program and the Strategic Investments in Northern Economic Development (SINED) program. From the GEM program, which

began in 2008 to provide geosciences knowledge needed by the private sector to support investment decisions, and the SINED program, which was designed to strengthen the economies of the territories, new geoscientific information is available for some remote parts of Nunavut, the NWT and Yukon as well as some northern areas of six provinces (Natural Resources Canada, 2012a; Canadian Northern Economic Development Agency, 2012). Results have encouraged industry investment in some of these regions (Natural Resources Canada, 2012b; Benoit, 2012). A 2012 evaluation report of the GEM program provides an assessment of its performance in terms of meeting its objectives (Natural Resources Canada, 2012b).

Knowledge Gaps and Research Opportunities

- Approximately 60% of territorial land is not mapped at a resolution required by clients such as the resources industry or northern communities, and is not geologically mapped to modern international exploration standards (Benoit, 2012). In particular, sedimentary basins of the eastern and western Arctic and the Canadian shield of the central Arctic lack sufficient geosciences information to support effective decision making. These areas have significant potential to attract investment in mineral and petroleum exploration. To support land use planning and foster resource development investment, further geological mapping and basic field work is needed (Benoit, 2012). The second phase of the GEM program, which aims to provide geological maps and data sets to cover the rest of Canada's North, will run from 2013 to 2020 (Natural Resources Canada, 2013).

Oil and gas industry

Recent Advances

- There is a better understanding of the undiscovered oil and gas resource potential in the Arctic, as well as factors that can impact the extent to which both known and undiscovered resources are developed (Gautier et al., 2011; Harsem et al., 2011). In addition to providing an overview of the Yukon's oil and gas regime, the *Yukon Oil and Gas: A Northern Investment Opportunity 2011* report includes information regarding oil and gas resource potential along with summaries of resource assessments that have been undertaken in the Yukon (Energy, Mines and Resources – Yukon Government, 2013b).
- Research has examined potential impacts of Arctic offshore oil and gas development on indigenous communities in Canada's North, as well as the Mackenzie Gas Pipeline development including how potential shorter and longer term impacts, such as direct and indirect financial benefits and environmental impacts on country food sources, are perceived by First Nations and Inuit (Dana et al., 2008; Manley-Casimir, 2011; Mason et al., 2012).
- The Arctic Monitoring and Assessment Program (AMAP) overview report *Arctic Oil and Gas 2007* and the related publication *Assessment 2007: Oil and Gas Activities in the Arctic* provide an assessment of the environmental, social, economic, and human health impacts of current and future Arctic oil and gas activities (Huntington, 2007; Arctic Monitoring and Assessment Program, 2007). Some of the potential

environmental impacts identified in recent research include altered marine habitats and disruption of marine mammal behaviour; increased chronic pollution; increased risk of an oil spill; and cumulative impacts (Huntington 2007 & 2009).

- Dell & Pasteris developed an adaptation assessment methodology with an Alaskan Arctic case example to assist oil and gas companies to develop adaptation plans in response to projected impacts of climate change (Dell & Pasteris, 2010).
- Research has contributed to baseline information for several biophysical components of terrestrial and aquatic ecosystems of the Mackenzie Valley and Delta and Beaufort Sea regions to assist in anticipating, preventing and mitigating potential environmental impacts of energy development activities (Indian and Northern Affairs Canada, 2011).
- The multi-stakeholder Beaufort Regional Environmental Assessment (BREA) initiative, which began in 2011, is currently underway until 2015 to develop a knowledge base to strengthen understanding of scientific and socio-economic impacts of offshore oil and gas exploration and development to support future regulatory decisions. Research is also underway under this initiative to develop tools to assess the risks associated with oil spills in the Beaufort Sea and the risks and benefits of countermeasures to clean up spills. The *BREA Results Forum 2013 Report* highlights progress and results achieved during the first two years of the initiative (Beaufort Regional Environmental Assessment, 2013).
- Environmental and social studies continue to be undertaken under the Environmental Studies Research Funds (ESRF) research program with publications available to inform oil and gas exploration and development taking place on frontier lands (Environmental Studies and Research Funds, 2014).
- Technical papers presented at the annual Offshore Technology Conference and the associated Arctic Technology Conference in Houston, Texas detail current scientific and technical knowledge regarding drilling, exploration, production, and environmental protection, as well as emergency escape and recovery operations (Offshore Technology Conference, 2013).
- *SS: Canadian: Atlantic Development; Technological Advances to Assess, Manage and Reduce Ice Risk in Northern Developments*, a 2009 Offshore Technology Conference paper, highlights some recent technological advances with respect to remote sensing, ice management, and ice engineering that can help improve the economics of oil and gas production in cold regions (Randell et al., 2009).
- A framework was developed to assist in identifying safety-related implications of icing on offshore platforms and an assessment of the extent to which ice protection technologies developed for use in areas such as aviation can be applied in an offshore context on platforms and supply boats (Ryerson, 2008, 2009 & 2011).
- A methodology was developed to estimate the probability of success of escape, evacuation and rescue strategies for Arctic offshore facilities (Yun & Marsden, 2010).
- The Centre for Arctic Resource Development (CARD), within the Centre for Cold Ocean Resources Engineering (C-CORE), has been established to plan, coordinate, and conduct research to enhance knowledge, technologies, methodologies, and training in support hydrocarbon development in the Arctic and sub-Arctic. The

Centre's R&D needs are prioritized in its Arctic Development Roadmap (Murrin et al., 2012; Taylor et al., 2012).

- An examination of strategic environmental assessment (SEA) was conducted as a potential solution in response to shortcomings of project-based environmental assessment used in Arctic offshore energy planning, exploration and development instead of current project-based assessment. This provided increased understanding of: 1) the perceived benefits (including managing cumulative effects and more certainty for industry stakeholders) and risks (including loss of flexibility in decision making and added layer of bureaucracy) of SEA; 2) some of the associated opportunities and challenges that might be faced in terms of implementation; and, 3) understandings and expectations of stakeholders regarding SEA (Ketilson, 2011; Fidler & Noble, 2012 & 2013; Noble et al., 2013).
- Dagg et al. compared Canada's Arctic offshore drilling regulatory regime with those in the US, UK, Greenland and Norway including management systems requirements, drilling and well activities, facility and drilling system requirements, requirements for well control, independent verification of safety, and oil spill preparedness requirements. This study did not, however, provide recommendations for Canada's regulatory regime, and did not indicate which regimes were better (Dagg et al., 2011). A paper which examined offshore oil and gas regulation in the Arctic among Arctic Ocean coastal states with a focus on Canada and the US proposed environmental monitoring, decommissioning and training as three areas for possible harmonization (Baker, 2012).
- In terms of oil and gas development in the NWT, a discussion paper by Taylor et al. provides an evaluation of the Frontier Lands Petroleum Royalty Regime and the system used to award oil and gas lease rights and examines opportunities for the NWT in terms of capturing revenue from oil and gas development (Taylor et al., 2010).
- Grant et al. examined the risks to the Mackenzie River Basin from oil sands development in Alberta including tailings dam failures and impacts on water quantity and quality and identifies ways in which the Basin can be better protected, including through further monitoring and the establishment of a transboundary community network to raise awareness of the risks and explore solutions (Grant et al., 2010).

Knowledge Gaps and Research Opportunities

- Continued and ongoing research is needed to better understand the impacts of the changing climate on oil and gas exploration, production and delivery and inform adaptive measures and technologies (Prowse & Furgal, 2009).
- Further research is needed to inform improved escape, evacuation and rescue plans for fires or other crises related to offshore petroleum drilling platforms that are appropriate for extreme Arctic conditions.
- Further research is needed to better understand the environmental impacts of unconventional oil and gas production (e.g. fracking and other high-pressure underground retrieval systems), including studies of surface and sub-surface water and mapping of deep aquifers.

- There is a need for more continuous and holistic water monitoring to identify environmental changes and trends in the Mackenzie River Basin that are occurring from downstream oil sands development in Alberta (Grant et al., 2010).

Mining industry

Recent Advances

- There is understanding that climate change, including warming and/or thawing permafrost and more frequent and extreme weather events, can have significant impacts on mining infrastructure (e.g. buildings, containment facilities, transportation routes, etc.), with implications for the environment such as release of contaminants (Pearce et al., 2011). Climate change can impact industrial development infrastructure in the areas of initial engineering design, operation, and closure/reclamation (Prowse et al., 2009). A 2009 literature review-based report prepared by Stratos for the Centre for Excellence in Mining Innovation provides more information regarding climate change impacts on mining operations and infrastructure, especially impacts applicable to the North (Stratos, 2009). A report prepared by Journeaux Associates for the Government of Nunavut, details climate change-related engineering challenges for tailings management facilities and related infrastructure in Nunavut (Journeaux Associates, 2012).
- An examination by Pearce et al. (2011) of the climate change implications for mining in Canada highlighted that mining infrastructure has typically not been designed to cope with climate change impacts and limited adaptation planning is underway, and that there is the presence of significant vulnerabilities in the post-operational phase of a mine. It also outlined a number of factors that affect future adaptive capacity including access to engineering solutions; knowledge of how the climate is expected to change in the future; access to expert resources; and incentives to address long-term hazards (such as legal obligations to do so) (Pearce et al., 2011).
- The multi-stakeholder Green Mining Initiative which began in 2009 is underway to support the development of technologies and practices for more sustainable mining in Canada. Research is focused on assessing and developing improved: 1) mining and processing methods to reduce waste; 2) sound waste management that is more cost-effective and environmentally sound; 3) tools to assess and mitigate environmental risks and impacts; and, 4) options for site reclamation, mine closure and long-term monitoring (Canada Mining Innovation Council, 2011).
- Yukon College is working to develop soil amendments and native species seed mixes for tailings and soil covers to facilitate long-term re-vegetation with respect to mine site restoration (Yukon College, 2012b). Yukon College is also working with private industry to advance research regarding cold climate environmental remediation technologies, with a focus on water treatment and management (Yukon College, 2012d).
- The Centre for the North's 2013 report *The Future of Mining in Canada's North* provides an examination of Canada's northern mining potential, business factors associated with mining development, impacts and benefits for northern communities, environmental stewardship and other sustainability considerations.

The report also puts forth a number of recommendations to ensure more sustainable mining, including more transparent and open communication and information sharing between stakeholders, addressing infrastructure gaps in terms of transportation and power generation, and focusing more effort on building meaningful community engagement and implementing agreements (Rhéaume & Caron-Vuotari, 2013).

- A Feasibility Study was undertaken for a Centre for Northern Innovation in Mining, which is an initiative of Yukon College to establish a centre for mine training, education and research. The study examined education, training and research development models in the mining sector, governance models, funding options, program delivery and research opportunities (Yukon College, 2012a; Derome & Associates, 2012). With at least \$17 million secured in capital funding and funding to support the delivery of trades training, the target operational date for the Centre is 2017 (Yukon College, 2012c; Yukon Government, 2013).
- An analysis of various scenarios using input-output and demoeconomic modeling to better understand the short and long-term economic consequences (including direct, indirect and induced effects) of mass mine closures in the Yukon during the late 1990s found that extended consequences, not just direct impacts, were significant. Induced effects pertaining to demographic shifts in the household sector, including aging and depopulation, and changes in consumption were found to have the most impact, weakening diversified and knowledge-based industries and services (Petrov, 2010).
- The book *Pouvoir et régulation dans le secteur minier: leçons à partir de l'expérience canadienne* (translation: *Governance and Regulation in the Mining Sector: Lessons Learned from the Canadian Experience*) includes case studies from Canada's North including the Ekati mine in the NWT, Raglan nickel mine in northern Quebec, and the Voisey's Bay mine in northern Labrador (Campbell et al., 2012).
- The report *Pathways to Mineral Development* identifies some of the major deterrents to mineral investment based on the opinions of stakeholders including uncertainty regarding the regulatory regime, the need for improved infrastructure, restricted access to land, and unsettled land claims. Associated recommendations are also provided including that the GNWT identify current and future mineral workforce needs and the availability of workers in all NWT communities, establish a Mining Incentive Program, and work with other stakeholders to develop a marketing and investment promotion plan (Stakeholders Engagement Panel, 2013). This report was used to inform the *Northwest Territories Mineral Development Strategy* which was developed to attract investment for the resource-based economy by creating a competitive edge, improving the regulatory environment, enhancing Aboriginal and community engagement, promoting sustainability, and enhancing workforce development (NWT and Nunavut Chamber of Mines & Industry, Tourism and Investment – Government of the Northwest Territories, 2011).

Knowledge Gaps and Research Opportunities

- Increased adaptation planning is needed to prepare for future climate change impacts (Pearce et al., 2011). There is a need for enhanced regional climate

forecasting to inform more site-specific adaptation and engineering strategies with respect to design, construction and maintenance of mine related infrastructure (Pearce et al., 2011).

- Further research is needed to inform the adaptation of mining infrastructure, including tailings retention structures and storage sites, to withstand the impacts of climate change, during operations and in the longer term post-operational phase (Prowse & Furgal, 2009; Pearce et al., 2011).
- Further research is needed to inform and adapt environmental reclamation and remediation practices to future climate change impacts (Pearce et al., 2011). There is a need for further research to adapt remediation technologies used in milder climates for use in the northern environment.
- Continued development, adaptation, testing, and demonstration of alternative fuels for the mining sector are needed to reduce operational costs and improve environmental sustainability.
- Further research is needed to better understand the cultural, social, and community impacts of mining projects.

Fisheries industry

Recent Advances

- Research has highlighted some of the current and anticipated impacts of climate change on fish species, including northward migration and invasive species, and changes in range, distribution, survival and recruitment (e.g. Reist et al., 2006; Barber et al., 2008; Prowse et al., 2009; Michaud et al., 2010; Chavarie et al., 2010; Fisheries and Oceans Canada, 2010; Power et al., 2012; Sinnatamby et al., 2013). Research has also provided knowledge gains regarding anthropogenic activities (e.g. van der Velden et al., 2013a & b), commercial fisheries (e.g. Dempson et al., 2008; Zeller et al., 2011), subsistence fisheries (Roux et al., 2011; Felt et al., 2012), and ecology and life-history traits (e.g. Michaud et al., 2013), which are important in informing fisheries management.
- The Government of Nunavut and Nunavut Tunngavik Incorporated released the *Nunavut Fisheries Strategy* in 2005 to strengthen the Nunavut fisheries industry in the areas of science and conservation; organizational capacity and governance; access and allocation; the labour market; infrastructure; funding and revenue generation; and capacity building through partnerships (Government of Nunavut & Nunavut Tunngavik Incorporated, 2005). The Nunavut Fisheries Science and Research Agenda, as an objective of this strategy, identifies priorities for fisheries research from 2011-2014 (Government of Nunavut, 2010; Lynch, 2010). The 2010 Nunavut Fisheries Symposium in Iqaluit, NU included discussions regarding the science research priorities for the Nunavut Fisheries Science and Research Agenda, as well as fisheries policies, branding and marketing, and human resources development. Symposium presentations are available on the Nunavut Fisheries Training Consortium (NFTC) website (Nunavut Fisheries Training Consortium, 2010).

- The Torngat Joint Fisheries Board (TJFB)'s Research Program focused on commercial fisheries within and adjacent to the Labrador Inuit Settlement Area. Exploratory surveys were conducted for snow crab (Brothers & Whalen, 2013) and Greenland halibut (Whalen & Brothers, 2012) in non-traditionally fished areas. The annual snow crab survey (Whalen & Boudreau, 2012; Whalen & Boudreau, In preparation) provides data for stock assessment, including habitat and recruitment prospects.

Knowledge Gaps and Research Opportunities

- Increased baseline data, including scientific and traditional/local knowledge (e.g. fish stock abundance, distributions, reproduction, ecology, health), is needed to better understand climate change impacts at species-specific levels, including future range and population, as well as subsistence harvesting impacts (Felt & Natcher, 2011) and impacts of other anthropogenic activities. More detailed harvesting data is also needed (Conservation of Arctic Flora and Fauna, 2013b).
- Further research is also needed to better understand and predict future direct and indirect impacts of climate change on fish species and their habitat to inform management strategies (Prowse & Furgal, 2009; Prowse et al., 2009; Conservation of Arctic Flora and Fauna, 2013b). As well, further research is needed to better understand cumulative effects on fisheries from climate change and anthropogenic activities (Conservation of Arctic Flora and Fauna, 2013b).
- With respect to fisheries in the Arctic, there is a need to address information gaps in the areas of "fish life history, such as spawning, migration, maturity, and growth; stock structure; trophic (predator-prey) relationships; and taxonomy" (Five Arctic Coastal States, 2013).
- Ongoing research is needed to identify and sustainably develop commercial fisheries opportunities (Rompkey & Patterson, 2010).

Tourism industry

Recent Advances

- Conference proceedings from the 2008 International Polar Tourism Research Network meeting that was held in Kangiqsujuaq, Nunavik covering some of the issues and challenges related to polar tourism are included in *Polar Tourism: A Tool for Regional Development* (Grenier & Müller, 2011). Proceedings from the 2010 conference held in Abisko, Sweden are included in *New Issues in Polar Tourism: Communities, environment, politics* (Müller et al., 2012). Proceedings from the 2012 conference held in Nain, Nunatsiavut are included in *From Talk to Action: How tourism is changing the Polar Regions* (Lemelin et al., 2013).
- In addition to identifying a number of research gaps, research by Stewart et al. provides a review of tourism research regarding the Polar Regions under four research clusters: 1) tourism patterns; 2) tourism impacts; 3) tourism policy and management; and, 4) tourism development (Stewart et al., 2005). Research by Maher examined polar tourism research from the perspective of academia, industry, and community (Maher, 2013).

- A survey completed by member jurisdictions of the Northern Development Ministers Forum (NDMF) revealed a number of perceived challenges with respect to tourism development, including increasing national and global competition, lack of 'market-ready' local products, and insufficient and uncoordinated marketing resources; as well as a number of perceived opportunities, including increased global awareness of the North, and web-based access to potential tourists. Survey participants also identified perceived best practices including the 'Look Up North' marketing campaign for the three territories, Cruise North Expeditions in Nunavut and Nunavik, and Aurora tourism in the NWT, which could provide insight in terms of overcoming tourism development challenges (Northern Development Ministers Forum, 2008).
- Approaches to tourism development have been examined through a social economy lens by Bennett et al. (2010), who investigated the ways in which social economy concepts helped to explain ideas about involvement in tourism in a proposed national park in the NWT. Noakes and Johnston (2008) also discussed the social economy in their examination of the constraints and opportunities associated with the development of diamond related tourism in the NWT.
- Research has examined the development of cruise tourism in light of climate change and sea ice conditions (Stewart et al., 2007; Stewart et al., 2010), as well as elements needed to enhance the sustainability of cruise tourism in terms of affected communities, the environment (including protected areas), and cruise operators and clients (Stewart & Draper, 2009; Maher, 2012). Stewart et al. (2011) examined the perspectives of residents on changes in the industry, and Stewart & Dawson (2011) explored the management implications of a ship grounding in the Canadian Arctic.
- Research has looked more generally at the potential outcomes of climate change for tourism, and in particular, observed and predicted changes with a view to understanding the depth and breadth of climate change implications in terms of risks and opportunities (Johnston, 2006; Dawson et al., 2007; Lamers & Amelung, 2010). One opportunity in particular that was examined was that of 'last chance tourism' including the ways in which the changing environment in the Arctic has become a draw for tourism (Johnston, M.E. et al., 2012).
- The Cruise Tourism in Arctic Canada (C-TAC) project was undertaken from 2008 to 2012 to examine changes in the expedition cruise tourism industry in Arctic Canada within the context of climate change, increasing concerns about security and sovereignty, and continuing global awareness of the Arctic. The research explored stakeholder views on change and adaptation and included a policy Delphi aimed at prioritizing strategies for managing risks and taking advantage of opportunities. Results from the research program are described in several publications (Johnston, A. et al., 2012a & b; Lemelin et al., 2012a & b; Stewart et al., 2012), and further details regarding research findings including community reports in English and Inuktitut are available (Environment, Society and Policy Research Group, n.d.; Tourism Change and Adaptation in Northern Communities, 2013).
- A scoping study was undertaken by Johnston et al. (2013) to provide information about the state of pleasure craft tourism in the Canadian Arctic, to describe knowledge gaps and to identify possible management approaches. Some of the

knowledge gaps identified included the need to better understand vessel numbers, growth potential and projected future activity; visitor behaviour; the numbers and demographics of passengers and crew; “safety, preparedness, self-rescue capacity, and perceptions/knowledge of risk among passengers and crew;” and management approaches used in other polar regions (Johnston et al., 2013).

- Research examined tourism development in the Torngat Mountains National Park in Labrador, identifying future opportunities, such as ‘learning vacations’ in which participants engage in research projects with scientists, and challenges, including transportation and access issues, lack of human and infrastructure capacity, difficulties managing risk, and ensuring safety (Maher & Lemelin, 2012). Research has also examined the tourism industry in Nunavik, focusing on changes and emerging issues affecting the industry and tourism diversification strategies that have been developed in response, providing a historical, current, and future look at the industry (Lemelin et al., 2012a).
- Research regarding the tourism experience has included work by de la Barre & Brouder (2013) which explored food related cultural dimensions in the consumption of Arctic places through tourism (de la Barre & Brouder, 2013). Grimwood and Doubleday (2013) examined questions of responsibility, ethics and cultural sensitivity in the tourism experience through research on travel on the Thelon River (Grimwood & Doubleday, 2013).
- Research by Fay and Karlsdóttir involved the assessment of data available to monitor tourism trends and social impacts in the Arctic, and the collection of data available from 1980 to 2008 for Canada, Alaska, Norway, Greenland, Lapland, and Iceland for 12 select indicators that are useful in assessing and monitoring long-term changes (Fay & Karlsdóttir, 2011).
- With a focus on polar bears in Nunavut, Chanteloup examined wildlife as a tourism resource for Inuit communities in terms of viewing and sport hunting. Some issues such as consumptive and non-consumptive tourism were discussed within this context, both in terms of perceptions (such as that by viewing wildlife there is little to no harm to nature) and findings of research studies including that greenhouse gas generating transportation is needed to get to the northern sites for wildlife viewing and that participation in sport hunting can provide communities with more income than wildlife viewing with fewer tourists. While questioning whether wildlife viewing is more environmentally friendly than sport hunting, Chanteloup asserts that investments to support wildlife viewing could be beneficial in terms of tourism development given that this type of tourism is more in line with the expectations of Westerners (Chanteloup, 2013). Dowsley (2008) examined polar bear hunting as ecotourism and its important contribution to Nunavut’s mixed economy and describes the challenges for Inuit in terms of developing a culturally appropriate polar bear hunting industry (Dowsley, 2008).

Knowledge Gaps and Research Opportunities

- Further research, including baseline data is needed to better understand the impacts of the environment and climate change and anthropogenic activities on

northern tourism and to inform appropriate adaptive responses (Hall & Saarinen, 2010; Bolton et al., 2011; Chanteloup, 2013).

- The development of an Arctic tourism observation system is needed with standardized/ comparable time series data to support monitoring and modeling of environmental changes and associated impacts on tourism (Fay & Karlsdóttir, 2011).
- A 2005 review by Stewart et al. of tourism research regarding the polar regions identified a number of research gaps pertaining to the Arctic including the need to: 1) have local communities to be involved in developing research priorities; 2) understand the motivations, attitudes and on-site behaviour of tourists; 3) develop and compile comprehensive circumpolar tourist statistics; 4) undertake longitudinal study of the cultural, economic, social, and environmental impacts on communities; 5) determine the effectiveness of tourism governance and regulation; and, 6) understand endogenous and exogenous influences on tourism development (Stewart et al., 2005).
- There is a need to understand more about tourism experiences in the Arctic, especially in relation to understanding of community economic development processes, the production and consumption tourism, and the roles of local and regional stakeholders in addressing tourism development. A focus is needed on industry and government stakeholders, alongside community residents, to understand the processes of tourism development and management in relation to other goals such as environmental protection and cultural development.
- There is a need for further tourism research to support management responses to developments in regards to tourism that are occurring as a result of rapid environmental change (Economic Development & Transportation – Government of Nunavut, 2013; Johnston et al., 2013).
- There is a need for better understanding of the way tourism intersects with other sectors of the economy as well as community benefits that may result from activities that are resident-oriented, yet developed or used for tourism purposes.
- There is a need for more comparative case study tourism research to examine critical similarities and differences in Arctic tourism development issues and opportunities across regions. This includes an examination of the tourism ‘product,’ the mode of delivery, key markets, and emerging products and markets, as well as degrees of ‘remoteness’ including factors such as transportation access and how these aspects intersect and/or shape challenges and opportunities.

Forestry industry

Forests cover about 28.1 million hectares in the Yukon (Invest Yukon, 2014) and 70 million hectares in the NWT (Environment and Natural Resources – Government of the Northwest Territories, 2012) and are important to the economies of these territories.

Recent Advances

- The Yukon Government publishes regular reports on forest health initiatives that have been undertaken, such as monitoring of the spruce bark beetle infestation and

the northward incursion of the mountain pine beetle (Energy, Mines and Resources – Yukon Government, 2013a).

- An examination of the economics of community sawmill operations was undertaken in the NWT to identify conditions needed to ensure profitability. From a sustainability perspective, the study results emphasized the need for mills to cater more towards the product needs of the housing and industrial markets in the NWT in order to better secure their business and reduce the reliance on imports. The need for support measures from the territorial and federal government was also identified, including increasing the timber resource allocation for communities and providing tax relief (Forintek Canada Corp., 2007).
- A mountain pine beetle pest risk analysis for Yukon Lodgepole Pine Forests was conducted, which identified the overall risk as low in the short term (i.e., before 2020) and moderate to high in the longer term (i.e., in 2070) (Energy, Mines and Resources – Yukon Government, 2013b).
- Research examined the perspectives of forest practitioners in the Yukon and NWT regarding likely climate change impacts and adaptation options. Some of the impacts identified included changes in extreme weather events, and in the intensity, severity or magnitude of forest insect outbreaks and forest fires. Some of the areas identified by practitioners as requiring further information to support decision making included forest growth and productivity, precipitation, climate variability, and changes in forest fires and forest insect outbreaks (Ogden & Innes, 2007).
- Available information regarding climate change in the southwest Yukon was synthesized to provide a baseline to facilitate the evaluation of climate impacts, assessment of risks, and development of adaptation options for forest management in the Champagne-Aishihik Traditional Territory (Ogden, 2007).
- An examination of the Strategic Forest Management Plans for the Champagne and Aishihik First Nations Traditional Territory and the Teslin Tlingit Traditional Territory in the Yukon was undertaken to assess the extent to which they addressed climate change adaptation. It was found that more attention needed to be given to identify climate change vulnerabilities and associated actions to be undertaken to reduce these vulnerabilities and manage risk (Ogden & Innes, 2008).
- Forest practitioners in the Yukon have been involved in identifying and evaluating options for adaptation that aim to achieve sustainable forestry management in the context of climate change (Ogden & Innes, 2009).
- To better understand the connections between community members, forestry, and resource development, informant interviews and a community workshop involving people from the Champagne Aishihik First Nation Traditional Territory in the Yukon were used to link resource development related cumulative effects that had been observed by the community with indicators for sustainable forest and land management (Christensen et al., 2010).

Knowledge Gaps and Research Opportunities

- Continued work is needed to build local forest management capacity through participation in research and monitoring (Ogden & Innes, 2009; Energy, Mines and Resources - Yukon Government, 2011a).

- There is a need for further research to better understand, reduce and manage vulnerabilities to forests such as drought stress and to communities such as forest fires and impacts on hunting areas.
- Continued research is needed to inform forestry related legislation and policy and to identify best practices in forestry management (Energy, Mines and Resources - Yukon Government, 2011a).
- Further research is needed to better understand the impacts of climate change on forests and support the adaptation of forestry resources and management (Ogden & Innes, 2009; Energy, Mines and Resources - Yukon Government, 2011a).
- Further research is needed to better understand forest carbon dynamics and the contribution of forests to the global carbon cycle (Kurz et al., 2008a & b; Ogden & Innes, 2009).
- With the northward incursion of the mountain pine beetle, a long-term prevention and suppression strategy is needed for the Yukon to reduce the associated risks and consequences. Further research is also needed to better understand the biology, causes, distribution, and control measures for the mountain pine beetle in new habitats (Energy, Mines and Resources - Yukon Government, 2013b).
- There is a need to incorporate more socio-economic research in forest management planning such as quality-of-life measures, as well as the needs of communities (Ogden & Innes, 2009). There is also a need for further research to better understand economic benefits associated with the forestry sector.
- There is a need to identify best practices with respect to timber harvesting in caribou habitats.

Small business and entrepreneurship

Recent Advances

- The 2009 *Northern Entrepreneurship* paper published by the International Institute for Sustainable Development synthesizes some key research findings pertaining to indigenous and northern entrepreneurship to provide an overview of: 1) the importance of small to medium-sized businesses in Canada's North in terms of their contribution to GDP and employment; 2) differences between indigenous and non-indigenous entrepreneurs, with the former being more connected to traditional lands and their community with a desire to improve socio-economic conditions; 3) obstacles faced by northern entrepreneurs including small markets spread across a vast region, inadequate infrastructure, lack of management skills, and difficulty accessing risk capital; and, 4) ways in which entrepreneurship can be encouraged, including capacity building, infrastructure investment, and promotion of the 'creative class' consisting of scientists, entrepreneurs, leaders and artists. Findings included the need for community involvement in order to successfully promote entrepreneurship (Walker, 2009).
- Research by Dana, Mason, and Anderson has added to understanding of entrepreneurship and small businesses in the North. For example, studies focused on Rankin Inlet and Coral Harbour, NU provided insight into enterprise and entrepreneurship in small, isolated northern communities, including the resulting

challenges with respect to entrepreneurship and the reliance on self-employment through subsistence harvesting and related activities (Mason et al., 2008 & 2009). The use of cooperatives in Nunavik was explored as a way in which the traditional value of collectivity/community is maintained in entrepreneurship (Dana, 2010). A study of Aboriginal and other self-employed individuals in Churchill, MB found that self-employment among Aboriginal peoples was usually more informal and culturally influenced, while self-employment among non-indigenous peoples was more full-time and formally structured, often in pursuit of an identified opportunity, which highlighted the importance of culture on enterprise (Dana, 2007).

- Case studies have increased understanding of how northern businesses can overcome challenges faced in the northern operating context. For example, a case study of Kivalliq Arctic Foods and Coral Harbour Development Corporation in Nunavut highlights the success of these companies through the use of quality assurance, Aboriginal branding, e-commerce, and international trade shows (Mason et al., 2007). The 2009 Centre for the North report *True to Their Visions: An Account of 10 Successful Aboriginal Businesses* includes case studies of two northern businesses: Arctic Adventures in Nunavik, QC and Kavik-Axys Inc. in Inuvik, NT, which highlight the importance of having an evolving business model in response to changing markets, building relationships, and building community capacity through partnerships (Sisco & Stewart, 2009).
- Research has also examined the establishment of regional and development corporations and the varying contexts under which they were established and continue to operate, with a view towards trying to understand the extent to which they are effective in terms of advancing economic development (Saku, 2008; Fugmann, 2009).
- A 2010 Northern Development Ministers Forum Briefing Paper highlights some of the success factors and challenges that exist with respect to Aboriginal youth entrepreneurship, and noted the lack of availability of programs regarding mentoring and business information (such as business plan development, how to obtain funding for a business idea, etc.). It also provided recommendations, including the development of targeted educational curriculum regarding Aboriginal youth entrepreneurship (Northern Development Ministers Forum, 2010b).

Knowledge Gaps and Research Opportunities

- Northern entrepreneurship is 'understudied.' As well, further research regarding indigenous entrepreneurship is needed (Walker, 2009). Research by Peredo et al. provides a series of questions that cover a number of issues regarding indigenous entrepreneurship requiring future research (Peredo et al., 2004).
- There is a need for more indigenous entrepreneurship research that is generated and directed by Aboriginal communities in order to inform appropriate policies and best practices that can more effectively address aspects that hinder entrepreneurship (Hindle & Moroz, 2009).

Economic diversification and sustainable economic development

Recent Advances

- Research is assisting in the identification of ways in which economic diversification can be strengthened. In addition to providing insight on Yukon's knowledge sector, for example, the 2012 report *Survey of Yukon's Knowledge Sector: Results and Recommendations* provides recommendations to provide support and encourage its growth, including offering training and professional development at the Yukon College, and developing a marketing strategy and action plan to increase exports of the Yukon knowledge sector (Voswinkel, 2012). The current state of business and industry in the NWT, and regional and community-level opportunities and challenges were examined to inform the development of the *NWT Economic Opportunities Strategy* which was released in 2013 (NWT Chamber of Commerce et al., 2013). At the workshops held in Nunatsiavut as part of the *SakKijânginnatuk Nunalik* initiative to enhance community sustainability, community members identified tourism, including cruise tourism, whale watching, and outfitting and guiding, as areas for potential economic growth (Goldhar et al., 2012).
- A 2011 study by Outcrop Communications examined film commission structures, reporting authority, budgets and level of activity; types and costs of support programs and other incentives; and the size and economic impacts of the film industry in jurisdictions with smaller populations including the NWT, Nunavut, Yukon, and Newfoundland and Labrador. This study, which was commissioned by the GNWT, also outlined a number of initiatives that could be implemented to support this industry in the NWT, including the development of an interactive and informative website, and support for the development of an industry association (Outcrop Communications, 2011; Lutra Associates, 2011).
- An analysis of creative capital in northern Canada identified Whitehorse, YT, Yellowknife, NT, Inuvik, NT, Fort Smith, NT, and Iqaluit, NU as being the "creative core of the North," in terms of having the highest levels of creative capital and the ability to compete nationally to attract a creative labour force. Although this analysis found that the potential and degree of development of the creative class is low in northern Canada, the implementation of policies to support the growth of creative capital in the areas of education and business skills, leadership, entrepreneurship, and artistic talent was recommended as a way to support regional development (Petrov, 2008).
- Southcott & Irlbacher-Fox (2009) examined opportunities and challenges associated with changing northern economies, noting the continued reliance on resource-based mega-projects. Some of the main drivers for economic diversification that were identified included new transportation initiatives, tourism and knowledge-based activities. Findings included the importance of partnerships with regional populations and Aboriginal communities and the need to further examine the role of educational institutions in terms of economic development (Southcott & Irlbacher-Fox, 2009).

Knowledge Gaps and Research Opportunities

- There is a need for further research to better understand the economic linkages between large-scale development and local business development and economic diversification in the North.

- Collaborative research among governments, Aboriginal groups and organizations, academia, and the private sector is needed to develop and promote a knowledge economy in the Yukon, informed by the findings and recommendations contained in the 2012 report *Survey of Yukon's Knowledge Sector: Results and Recommendations* (Voswinkel, 2012).
- Further research is needed to better understand creative capital in Canada's North, including the impact of proximity to more southern creative centres and of pull-factors and push-factors such as housing issues and isolation, and potential unintended impacts of creative economies such as an increased housing shortage (Petrov, 2008).
- Further research is needed to better understand community-level social capital, networks and conditions which can inform more long-term sustainable economic development policies (Olfert & Natcher, 2013).

Labour market and workforce participation

Recent Advances

- There are more labour market forecasting information and tools available in the Yukon. For example, stemming from its 10-year Labour Market Framework, the *Yukon Business Survey 2010* provides an overview of labour supply and labour demand needs and the Yukon Occupational Modelling System (YOMS) assists in projecting labour market changes (Yukon Government, 2010; Yukon Bureau of Statistics, 2011; Blais, 2013).
- The Centre for the North's 2012 report *Understanding the Value, Challenges, and Opportunities of Engaging Métis, Inuit, and First Nations Workers* provides an overview of challenges and opportunities encountered by employers with respect to the engaging, attracting, hiring, and retaining Aboriginal workers based on a survey and interviews with businesses, industry associations, and Aboriginal employment organizations, and provides a number of recommendations for employers, policy makers and Aboriginal organizations (Howard et al., 2012).
- Centre for the North's 2011 report *Building Labour Force Capacity in Canada's North* identifies some potential ways in which northern communities and employers can build labour force capacity and provides recommendations for future research (Martin, 2011).
- A forecast and gap analysis was released in 2012 of the hiring needs and available talent for the Yukon's mining industry (including the exploration, service and placer mining sectors) over the next two, five, and ten years for 42 key occupations. The largest gaps were found to be in the technologist and technician occupations. While gaps were identified for all occupations, for some gaps it was determined that a sufficient number of workers would be available elsewhere in the mining industry (e.g. cooks) and as such, strengthened recruitment strategies may be an appropriate response. For other occupational gaps it was determined that there would in fact be a shortage throughout the mining industry (e.g. underground mine support workers), and as such, more would need to be done to increase the talent pool (Derome and Associates Development + Management Inc., 2012).

- The Nunavut Mine Training Initiative and an associated Roundtable were established in 2008 to bring together stakeholders including the Government of Nunavut, Inuit organizations, Nunavut Arctic College, the federal government, and industry in order to coordinate training related to mining, help ensure that the training provided meets the needs of many projects and is widely available across regions (Aboriginal Affairs Working Group, 2011).
- With the Voisey's Bay nickel mine in Labrador as a case study, Mills examined the implications of corporate-Aboriginal alliances (which can be in the form of an Impact and Benefit Agreement) for union engagement. With the dissatisfaction of some Aboriginal communities with the outcomes of IBAs in terms of protecting the interests of workers and beneficiaries, Mills argues that unions can play an important role such as replicating IBA provisions in collective agreements to help ensure that they are enforced (Mills, 2011).

Knowledge Gaps and Research Opportunities

- Further research is needed to better understand factors affecting the attraction, recruitment, and retention of the workforce in the northern environment (Université Laval, 2012; Howard et al., 2012).
- Further research is needed to inform strategies to assist in attracting and retaining skilled workers from southern Canada to assist in providing training and expertise (Martin, 2011).
- Further research is needed to better understand which industries are facing the biggest challenges with respect to the recruitment of Aboriginal workers, and identify ways in which these challenges can be overcome (Howard et al., 2012).
- An evaluation of recruitment and retention strategies is needed to better understand their impact (Howard et al., 2012).
- Further research is needed to inform strategies that can be developed to respond to mobility related challenges that can limit training and employment opportunities for Aboriginal Northerners (Martin, 2011).
- Further research is needed to examine the effectiveness of agreements to train and hire local Northerners (Hodgkins, 2013).
- Collaboration is needed to develop tools to enable learning between Aboriginal and other communities and businesses of both business and cultural norms in order to facilitate adaptation (The Canadian Chamber of Commerce, 2012).
- There is a need for further research to identify ways in which the advancement of Northerners to positions of higher authority and decision-making responsibility can be increased (e.g. through human resources practices, skills acquisition, social supports, etc.).
- Further research is needed to measure the return on investment of labour force capacity building (Martin, 2011).
- Following a forecast and gap analysis of the hiring needs and available talent for the Yukon's mining industry a number of research gaps were identified. Gaps included the need for further research regarding: the "social and economic impacts of a large commuter workforce"; the "social and economic impacts of rapid industry growth and development on infrastructure, education and training, and communities";

special populations of labour supply (e.g. women) including barriers to inclusion; the “glass ceiling” with respect to career progression, education, and skills development for Aboriginal peoples to inform effective strategies; effective ways to attract youth and engage new workers from other areas of Canada or internationally; effective ways to integrate immigrants into the industry; and available supports and services for small and medium sized enterprises that support the industry (Derome and Associates Development + Management Inc., 2012).

- There is a need for further research to better understand labour force characteristics at the industry and the community level.
- There is a need for further research to provide a more clear understanding of the number of workers being flown in for major resource development projects, and their conditions of employment. Arrangements offered to workers who are flown in should also be compared to those afforded to northern Aboriginal peoples who are also in search of work.
- Further research is needed to examine workforce trends to determine whether there has been an increase or decrease over time in the workforce that is flown in. In addition to statistical analysis, interviews could provide better understanding of the perspectives of Northerners who are transitioning from training to employment and the barriers they face.
- More qualitative, longitudinal learning-to-work transition studies are needed, including those which examine mobility, to monitor and better understand pathways of different population groups of the labour force including Aboriginal peoples, temporary workers and women, and inform appropriate policies to support these transitions (Hodgkins, 2013).
- There is a need for transition studies that link Grades K to 12 learning to post-secondary education to better understand gaps in the education system and ways in which participation in wage labour can be increased.

Impacts of mining, oil and gas projects

Recent Advances

- The multi-stakeholder Resources and Sustainable Development in the Arctic (ReSDA) research network, a 7-year major collaborative initiative that began in 2011, is examining how to minimize negative impacts from resource development and enhance benefits to northern communities. Gap analyses were conducted to identify research priorities with respect to resource development in the following 13 areas: 1) history; 2) impacts; 3) measurement of impacts; 4) revenue regimes; 5) social, economic and environmental impact assessment; 6) regional economic development approaches and analyses; 7) social dimensions of economic development including what is needed for community wellbeing; 8) community-industrial relations; 9) community-industrial relations with respect to IBAs; 10) comprehensive land claims and protection of environmental livelihoods; 11) traditional knowledge; 12) environmental issues; and, 13) cross-cutting themes (Resources and Sustainable Development in the Arctic, 2013a).

- With the marketing of diamonds from Canada as more ethical alternatives to diamonds from African countries, Schlosser critiqued the idea of ‘ethical consumption’ using focus groups conducted in Kugluktuk, NU and archival and interview research from Yellowknife, NT. Schlosser asserts the need to consider risks and benefits that extend beyond just the point of production and consider the geographic and longer term historical context and suggests examining power throughout commodity networks rather than arbitrary criteria to better understand the extent to which diamonds should be considered ethical consumption (Schlosser, 2013).

Knowledge Gaps and Research Opportunities

- A comparative and systematic analysis of the benefits of resource development and how they differ by project is needed (Resources and Sustainable Development in the Arctic, 2013c). As well, further research is needed to identify ways in which positive impacts of mining can be maximized (Davison & Hawe, 2012a).
- There is a need for further research to determine how best to ensure that a larger portion of the benefits from resource development remains in the local communities and region.

Cultural impacts

Recent Advances

- Research by Angell & Parkins explored the relationship between resource development and Aboriginal culture in Canada’s North since the 1970s, noting that relevant research from the 1970s to the mid-1990s focused on documenting cultural impacts on Aboriginal peoples, whereas research from the mid-1990s to the present has moved towards understanding the functional role of Aboriginal culture, with a focus on community needs, concerns, and interests. Cultural impacts were found to depend on the scale and spatial disturbance of development. Although the authors synthesize what is currently known about the relationship between resource development and Aboriginal culture in Canada’s North based on past research, they do note the difficulties in tracking this relationship given the lack of data and systematic attention devoted to it, as well as changing research questions and various interpretations (Angell & Parkins, 2011).

Knowledge Gaps and Research Opportunities

- There is a need for governments and research institutions to devote more attention to understanding and mitigating the cultural impacts of resource development activities (Angell & Parkins, 2011). The collection of baseline data regarding culture (e.g. data regarding cultural practices, etc.) and monitoring is needed, as well as the development of markers for cultural continuity to facilitate research and understanding of the relationship between cultural continuity and social problems (Hallett, 2005; Angell & Parkins, 2011).
- There is the potential for further research regarding resilience indicators and models to enhance understanding of the ways in which impacts are distributed,

experienced, and mediated by Aboriginal peoples (Gibson & Klinck, 2005; Angell & Parkins, 2011).

- There is a need for longitudinal research with respect to resource development and Aboriginal culture in Canada's North to better understand causal relationships between the economy, society, and culture, and how Aboriginal communities are changing, and the associated cultural and community impacts (Angell & Parkins, 2011).

Socio-economic and community impacts

Recent Advances

- Increased quantitative and qualitative socio-economic data has been gathered in response to economic pressures, which has been triggered by environmental assessment requirements, which is helping to establish a baseline against which change can be weighed and upon which programs and policies can be established and strengthened.
- The 2004 *Arctic Human Development Report* and *Economy of the North 2008* provide an overview of socio-economic conditions from a circumpolar perspective (Arctic Human Development Report, 2004; Glomsrod & Aslaksen [Eds.], 2009). More socio-economic indicators are available to assist in providing greater understanding of socio-economic conditions (Duhaime & Caron, 2009).
- The ArcticStat Socioeconomic Circumpolar Database facilitates access to socioeconomic research (ArcticStat, 2013).
- A 2006 report *Resource Extraction Development and Well-Being in the North* published by the Ajunnginiq Centre (National Aboriginal Health Organization) provides an overview of impacts of resource extraction on Inuit communities with respect to boom and bust economies, culture and nutrition, mental health, community dynamics, income inequality, substance abuse, crime, housing, and women (Buell, 2006).
- Research by Gibson & Klinck explored the impacts of mining in Canada's North on individual, family, and community wellbeing to inform a model of resilience to better understand the ways in which impacts are distributed, experienced, and mediated (Gibson & Klinck, 2005). Research conducted by Keith Storey, which referenced mines across Canada and in Alaska and Australia, highlighted some of the implications of fly-in/fly-out wage employment on community sustainability (Storey, 2010). Research by Bowes-Lyon et al. of the Nanisivik and Polaris mines in Nunavut has provided some insight regarding socio-economic impacts of these mines, both positive (including creation of new businesses and jobs) and negative (including increased alcohol consumption, and the inability to transfer certification to obtain another job following mine closure), and concluded that the mines did not contribute to long-term sustainable development in the region because the benefits were short-lived (Bowes-Lyon et al., 2009). Research has also examined the diverse community experiences with respect to mining in Baker Lake, NU in the areas of employment, education, contracts for local businesses, and the social determinants of health (Peterson, 2012).

- Research by Rodon & Schott provides an overview and assessment of socio-economic and living conditions and economic opportunities that have been identified for the Nunavik region to offer sustainable development directions, including a recommendation to establish a sustainable development advisory board consisting of elders, youth and community and institutional representatives to provide guidance, and to enhance engagement of community members in the collection and interpretation of data and in decision making (Rodon & Schott, 2013).
- Research by Haley et al. provides a review and assessment of data regarding Arctic mining to identify mining trends, associated social effects, and drivers of change from a circumpolar perspective (Haley et al., 2011).
- Research by Pearce et al. was undertaken to develop a methodology to facilitate climate change adaptation planning in remote, resource-dependent communities, with the community of Paulatuk, NT as a case study example. This research also identifies key exposure sensitivities of communities in the business and economy, culture and learning, health and wellbeing, subsistence harvesting, and transportation and infrastructure sectors (Pearce et al., 2012).
- The Nunatsiavut Government is currently undertaking the Voisey's Bay 10 Year Review in partnership with Vale Newfoundland and Labrador (Vale NL), Memorial University, and Trent University. This review of the Voisey's Bay nickel mine near Nain, Nunatsiavut which is owned by Vale NL will include the development and refinement of indicators to monitor and better understand present and future social, economic, cultural, health, and biophysical impacts. The findings of this review will be beneficial in informing future large-scale industrial mining projects in terms of environmental management planning and the negotiation of Impact and Benefit Agreements (IBAs) (Nain Research Centre, 2013).
- Gibson researched Dene engagement with the diamond mining industry in the NWT, arguing that experiences are derived from relationships of reciprocity and the rules, practices and values that have arisen from relationships in the past and present. This research also highlights the various layers of a relationship including social, cultural, spiritual, and economic to which attention must be given in terms of the recruiting, retaining and supporting the advancement of Aboriginal peoples in mining companies (Gibson, 2008).
- Research examined the impact of diamond mining on youth in Behchoko, NT. Some of the benefits noted included that they can serve as resources for communities, support educational and cultural activities, and provide employment. It was also noted, however, that the level and type of supervision provided for young people and the identity and role of family caregivers can be negatively impacted. An increase in gambling was found, and substance abuse remained a concern. As well, some young people chose to work in the mine without finishing high school while the availability of jobs in the mining sector encouraged others to finish high school (Davison & Hawe, 2012a).
- An examination by Noble & Bronson of the state of health integration in environmental assessment found that health was mostly addressed during the pre-decision stages and less during post-decision follow-up and monitoring. It was also found that the integration of health tended to focus more on the physical

components of health arising from physical environmental change, and less on the social or cultural aspects of health (Noble & Bronson, 2006).

Knowledge Gaps and Research Opportunities

- Further research is needed to better understand the needs of communities in order to facilitate the collection of community- and culturally-appropriate baseline data that can be used to help set environmental and socio-economic standards, predict and measure impacts, and inform legislation, policies, and programs (Hallett, 2005; Angell & Parkins, 2011).
- There is a need for further research to inform the development of innovative programming to prepare communities for the opportunities and impacts of economic development activities so that they are able to benefit (e.g. life skills training, financial management, family wellness, addictions treatment, education/training and career development opportunities).
- There is a need for further research regarding socio-economic and health impacts of the fly-in/fly-out wage economy and influx of industrial-level wages on northern communities and social relationships (e.g. addictions, money management, family break up, spousal assault, and effect on the more traditional sharing economy).
- Rodon & Schott's research focusing on the Nunavik region identified the need for more varied, detailed and consistent data collection to support the evaluation of progress against the region's vision for sustainable development, as well as the need to verify the relevance of the type of data being collected to ensure that it is reflective of individual and community wellbeing and that it will adequately inform progress from a community perspective (Rodon & Schott, 2013).
- Further research is needed regarding community-based models of sustainable development (Gibson, 2008). Further research is needed to better understand "how land claims policy and implementation approaches and mineral policy mutually influence the resilience of communities" (Gibson, 2008).
- Based on research regarding Dene engagement with the diamond mining industry in the NWT, Gibson noted the need for further research in terms of gender roles and household management, including how funds are shared in households and families and the impact of mining on gender relations (Gibson, 2008).
- Further research is needed to better understand resource development from a gender perspective, including participation in, and impacts of, resource development. Research taking place as part of the Resources and Sustainable Development in the Arctic initiative will attempt to address a number of associated gaps such as the influence of mineral development on gender roles within communities and in the governance of resources (Resources and Sustainable Development in the Arctic, n.d.[a]).
- Further research is needed to better understand the impacts of mining on young people (Davison & Hawe, 2012a).

Environmental impacts

Recent Advances

- There is more data regarding the northern environment, which has been driven in part by development proposals and the associated monitoring requirements stemming from federal, regional, and local regulations as well as IBAs (Centre for the North, 2011b).
- LOOKNorth, which is a Canadian Centre for Excellence for Commercialization and Research that is hosted by the Centre for Cold Ocean Resources Engineering (C-CORE), has an R&D program which is working to advance the development and integration of monitoring technologies (including those which are space, terrestrial and subsea-based) to meet the needs of the resource sector. Its *Mining Sector Assessment* highlights opportunities in which remote sensing technologies can add value (LOOKNorth, n.d. & 2011).

Knowledge Gaps and Research Opportunities

- There is a need for further work to establish baseline conditions to better understand and respond to the impacts of resource development projects, including those with are cumulative on the environment, work to minimize these impacts, and develop best practices. While the establishment of the Nunavut General Monitoring Program (NGMP), the Cumulative Impact Monitoring Program in the NWT and other local monitoring projects has been useful, further implementation of on-going monitoring programs is also needed. Potential challenges or barriers may include difficulty in coordinating effort among organizations that have diverse mandates, obtaining funding, and accessing data.
- There is a need for more remote sensing to support decision-making. While resources are required to implement remote sensing, there is also a need to identify key research questions that remote sensing can help to address.
- There is a need for further research and monitoring to better understand air quality trends in the context of resource development and the associated impacts for human health.
- Further cumulative impact monitoring and assessment is needed to understand the effects of human and natural disturbance (Conservation of Arctic Flora and Fauna, 2010).
- Further research is needed to understand the impacts of an oil spill on marine mammals (Huntington, 2009).
- More research is needed to better understand downstream impacts from industrial development in Alberta (Office of the Auditor General, 2011).
- There is a lack of peer-reviewed literature on the potential impacts of climate change on the business and economic sectors in Nunavut, Nunavik, Nunatsiavut, and the western Arctic (Ford & Pearce, 2010; Ford et al., 2012).

Governance and flow of benefits

Recent Advances

- Research by White regarding northern regulatory and co-management land-claim boards, including the number, influence, extent of powers of Aboriginal board members, independence of the board, and willingness and capacity to incorporate

traditional knowledge, concluded that they have increased the participation and influence of Aboriginal peoples in terms of decision-making (White, 2008). Research by White that focused on the Nunavut Wildlife Management Board and the Mackenzie Valley Environmental Impact Review Board found that the capacity of these boards to fully incorporate traditional knowledge into their practices is limited because of the more westernized, bureaucratic governance processes within which the boards are operating (White, 2005 & 2006). Research has also examined ways in which co-management structures can be improved. For example, a case study of polar bear management in Nunavut demonstrated how the establishment of community clusters can build the capacity of harvesters with a greater decision-making role and enhance the extent to which management corresponds to local objectives and conditions (Dowsley, 2009). Research has also increased understanding of learning and adaptation through co-management in order to respond to environmental change. For example, Berkes examined the evolution of co-management, including the emergence of adaptive co-management through successive rounds of learning and problem solving, and various aspects associated with co-management including knowledge generation and social learning (Berkes, 2009). Research by Armitage et al. examined how knowledge co-production in co-management can enable learning and adaptation (Armitage et al., 2011).

- Research by Natcher & Davis found that some of the institutional and ideological factors that are inconsistent with Aboriginal forms of management continue to influence First Nations land and resource management in the Yukon post devolution, which in turn can limit the empowerment and authority of First Nations (Natcher & Davis, 2007).
- Focusing on three Aboriginal communities in the Sahtu Region of the NWT, Dokis examined their involvement in the assessment and regulation of the Mackenzie Gas Project. Several barriers to their participation in decisions regarding resource development were identified including the presence of techno-rational worldviews and legal discourse; the way in which environmental impacts are assessed and determined to be important; differing communication and relationship norms; and changing governance structures as a result of the comprehensive land claim (Dokis, 2010).
- The Impact and Benefit Agreement (IBA) Research Network website provides a list of existing research regarding IBAs, a list of known IBAs in Canada, as well as a list of knowledge gaps that has been compiled since 2006 (Impact and Benefit Agreement Research Network, n.d.).
- The 2009 Report *Impact Benefit Agreements: A Tool for Healthy Inuit Communities?* published by the National Aboriginal Health Organization examines the role of Impact and Benefit Agreements (IBAs) with respect to community wellbeing and highlights aspects which could be addressed to improve the effectiveness, enforceability and legality of IBAs, including increasing the transparency in terms of processes and content; utilizing penalty clauses for non-performance; and holding open consultations for active and direct community participation (Knotsch & Warda, 2009). Research by Caine & Krogman has also examined the power aspect of IBAs (Caine & Krogman, 2010).

- The *IBA Community Toolkit: Negotiation and Implementation of Impact and Benefit Agreements* was published in 2010 to serve as a practical guide to assist communities in negotiating agreements. It was developed based on a review of all publicly available literature regarding agreements in Canada and Australia, and on the experience of the authors (Gibson & O’Faircheallaigh, 2010).
- An examination by Hitch of IBAs in Nunavut using a political ecology approach found that decision-making power was unequal, resting largely with industrial and regional Inuit associations. It was also found that with its current structure, IBAs are limited in their utility in terms of a tool of sustainability, but that they may be more useful in this regard if used in conjunction with other agreements and processes (Hitch, 2006).
- A 2007 discussion paper commissioned by the Walter and Duncan Gordon Foundation provides an overview of some lessons learned from devolution and resource revenue sharing negotiations as well as some policy options to promote intergenerational equity (Irlbacher-Fox & Mills, 2007).
- In the context of the release of the GNWT’s four-year non-renewable resource development strategy from 2000 and the desire to reduce dependence on federal transfer payments, a 2006 policy brief examined policy tools and funds (including permanent funds) used by various governments for non-renewable resources revenue collection. The establishment of a non-renewable permanent fund was recommended for the NWT as a way to provide social and economic benefits to current and future generations in response to the boom and bust cycles of resource development and the need to support economic diversification (Taylor et al., 2006).
- Research by Speca examined current resource sharing systems in the NWT, Yukon and Greenland to identify potential resource sharing options for Nunavut in a devolution negotiation context (Speca, 2012).
- Research examined indigenous participation in multipartite dialogue processes pertaining to resource extraction including the Whitehorse Mining Initiative (WMI) and other dialogues in Canada and abroad. Enabling conditions for indigenous-led tripartite, national dialogue were identified including government/industry buy in; narrow focus of the dialogue; negotiation of a legally binding outcome; sufficient resources for an in-depth process; appropriate Aboriginal representation; use of an independent facilitator; sufficient capacity of all parties in areas such as conflict resolution and indigenous rights; willingness to compromise; and establishment of an implementation and monitoring mechanism (Weitzner, 2010).

Knowledge Gaps and Research Opportunities

- There is a need for continued research to identify and document the economic, cultural, and social impacts stemming from the implementation of land claims, impact and benefit agreements and governance structures.
- There is a need for further research to examine the overall interaction of land claims settlements, co-management boards and devolution and the combined effect on environmental and socio-economic planning and assessment for development.
- There is a need for further research to examine the interaction and effects of IBAs and efforts to attain a social license to operate on development opportunities and

their impacts in turn on environmental and socio-economic conditions in project and broader regions.

- Further examination of the dynamics of effective regimes for resource governance is needed, including the factors that can strengthen or undermine their effectiveness (Caulfield, 2004).
- Further research is needed to inform regulations, enhance their efficacy, and ensure that they require the consideration of climate change impacts, especially with respect to the planning, infrastructure, and operations of large resource development projects (Pearce et al., 2011).
- There is a need for further examination of decision-making (e.g. incorporation and balance of values, consideration of risk, etc.) in a co-management context where there are competing values, interests, and needs to better understand the extent to which decisions effectively respond to and address complex socio-economic and environmental assessments and to identify potential improvements.
- In examining the origins of the ‘social license to operate’ that mining companies need from communities to minimize conflict, Prno & Slocombe note the need for further research to identify governance arrangements that can facilitate and maintain the establishment of this social license (Prno & Slocombe, 2012).
- There is a need for the development of best practices and templates for negotiating and advocating for appropriate process and content in IBAs (Knotsch & Warda, 2009; Southcott & Irlbacher-Fox, 2009).
- There is a need for further research regarding the ways in which community well-being can be improved through IBAs, and the extent to which the resource extraction industry can or should be involved in ensuring health care services (Knotsch & Warda, 2009).
- There is a need to further assess and document the effectiveness of IBAs with respect to implementation to support the attainment of positive benefits for communities (Impact and Benefit Agreement Research Network, n.d.; Knotsch & Warda, 2009).
- Further work is needed to identify “alternatives to IBAs that might create greater opportunities for communities in terms of both economic development and social justice” (Bradshaw, n.d.).
- Further research to inform and strengthen resilience and wellbeing indicators is needed to track the ways in which benefits and impacts of resource development projects are distributed, and to inform how these projects should be managed in the future to ensure that sufficient benefits flow to communities (Gibson & Klinck, 2005). There is a need for statistical analysis and modeling of the benefits and costs of resource development, including what real revenues (e.g. royalties, taxes, fees) are paid and how these compare to the costs associated with programs and services for workers and their families, how community wellbeing is affected, and what lasting benefits or legacy is really left behind. An examination of the outcomes of different scenarios (e.g. the impact of an increase in taxation rate, etc.) was also suggested.
- There is a need for further research to identify ways in which intergenerational equity and sustainability from the development of non-renewable resources can be improved.

- Further research is needed to assess the extent to which multipartite dialogue pertaining to resource extraction can lead to social and transformative learning regarding how to strengthen the participation of Aboriginal peoples in subsequent processes (Weitzner, 2010).

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