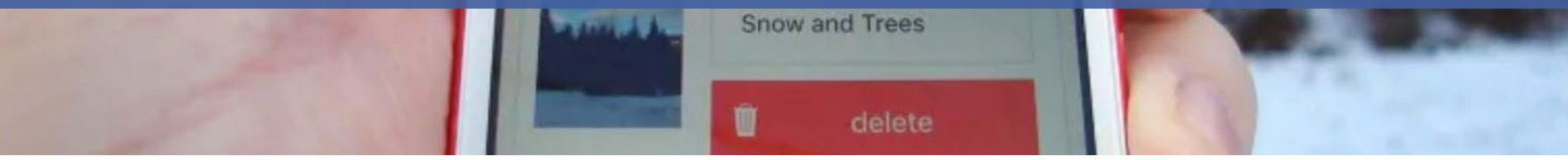
A PROFILE OF THE ENUK ENVIRONMENT AND HEALTH MONITORING PROGRAM



Amy Kipp[1 *], Ashlee Cunsolo[2], Daniel Gillis[3], Alexandra Sawatzky[1], Oliver Cook[3], Nic Durish[3], Inez Shiwak[4], Charlie Flowers[4], Rigolet Inuit Community Government[4], Marilynn Wood[5], and Sherilee L. Harper[1,6]

[1] *Department of Population Medicine, University of Guelph, Guelph, Ontario, Canada*

[2] *School of Computer Science, University of Guelph, Guelph, Ontario, Canada*

[3] *The Labrador Institute, Memorial University, Happy Valley - Goose Bay, Newfoundland and Labrador, Canada*

[4] *The Rigolet Inuit Community Government, Rigolet, Newfoundland and Labrador, Canada*

[5] *Department of Health and Social Development, Nunatsiavut Government, Happy Valley - Goose Bay, Newfoundland and Labrador, Canada*

[6] *School of Public Health, University of Alberta, Edmonton, Alberta, Canada*

* akipp@uoguelph.ca

The eNuk Environment and Health Monitoring Program (eNuk) is being led by Inuit researchers from Rigolet, Nunatsiavut, Labrador, in partnership with researchers at the University of Guelph, the Labrador Institute of Memorial University, the University of Alberta, and the Nunatsiavut Department of Health and Social Development. The study area consists of the area in and around the community of Rigolet, in the Labrador Inuit Settlement Area known as Nunatsiavut.

Abstract

Impacts of climate change in Northern Canada present major challenges for the health of humans and the environment, with many of the most acute impacts experienced among Indigenous peoples such as Inuit, throughout Inuit Nunangat. Although research has identified associations of climatic and environmental change with human health outcomes, detecting and responding to these outcomes is a significant challenge. Comprehensive, integrated, sustainable, and locally appropriate monitoring systems have been identified as one potential strategy to meet this complex challenge. In this article, we present an example of this type of monitoring, the eNuk program, which is a participatory, Inuit-led environment and health monitoring program in Rigolet, Nunatsiavut, Labrador. An integral part of the program is a mobile application (the eNuk app), which Inuit can use to track, analyze, and respond to environmental and health changes related to climate change. To conceptualize and develop the eNuk app, a variety of methods were used: focus group discussions and semi-structured interviews with community members and government representatives, two systematic literature reviews, an environmental scan of existing monitoring apps in the Circumpolar North, participatory development of the eNuk app through community open houses and consultations, and pilot testing of the eNuk app. Through these methods, the eNuk program has emerged as a comprehensive, Inuit-led monitoring system, which can be used to develop locally appropriate programming and policy in the region and provide management tools for decision makers and communities that are grounded in and guided by Inuit values, knowledge, and science.

Suggested citation:

Kipp, A., Cunsolo, A., Gillis, D., Sawatzky, A., Cook, O., Durish, N., Shiwak, I., Flowers, C., Rigolet Community Government, Wood, M., and Harper, S.L. 2018. A profile of the eNuk environment and health monitoring program. Polar Knowledge: Aqhaliat 2018, *Polar Knowledge Canada, p. 117–125. DOI: 10.35298/pkc.2018.14*

Résumé

Les répercussions des changements climatiques dans le Nord canadien présentent des défis importants pour la santé humaine et l'environnement, et bon nombre des répercussions les plus graves sont ressenties chez les peuples autochtones, comme les Inuits du Nord du Labrador. Bien que la recherche ait établi des liens entre les changements climatiques et environnementaux et les résultats pour la santé humaine, la détection de ces résultats et la réponse à ceux-ci constituent un défi important. Des systèmes de surveillance complets, intégrés, durables et appropriés à l'échelle locale ont été identifiés comme une stratégie possible pour relever ce défi complexe. Dans cet article, nous présentons un exemple de ce type de surveillance, le programme eNuk, qui est un programme participatif de surveillance de l'environnement et de la santé dirigé par les Inuits à Rigolet, au Nunatsiavut, au Labrador. Une partie intégrante du programme est une application mobile (l'application eNuk), que les Inuits peuvent utiliser pour suivre, analyser et réagir aux changements environnementaux et sanitaires liés aux changements climatiques. Pour conceptualiser et créer l'application eNuk, on a eu recours à diverses méthodes, notamment des discussions de groupe et des entrevues semi-structurées avec des membres de la collectivité et des représentants du gouvernement, deux examens systématiques de la documentation, une analyse contextuelle des applications de surveillance existantes dans le Nord circumpolaire, le développement participatif de l'application eNuk au moyen de journées portes ouvertes et de consultations communautaires, et la mise à l'essai pilote de l'application eNuk. Grâce à ces méthodes, le programme eNuk est devenu un système de surveillance complet dirigé par les Inuits, qui peut être utilisé pour élaborer des programmes et des politiques appropriés à l'échelle locale dans la région et fournir des outils de gestion aux décideurs et aux collectivités qui sont fondés sur les valeurs, les connaissances et la science inuites.

Introduction

Impacts of climate change in Northern Canada present major challenges for the health of humans and the environment, with the most acute impacts experienced among Indigenous peoples such as Inuit, throughout Inuit Nunangat (Cunsolo Willox et al. 2013; Furgal and Seguin 2006). Research has uncovered many negative associations of climatic and environmental change with human health outcomes, including morbidity and mortality due to rising temperatures and extreme weather events (Ford et al. 2006; Furgal and Seguin 2006; Pearce et al. 2010); diminished food and water security (Goldhar, Bell, and Wolf 2014; Harper et al. 2015a, 2015b; Organ et al. 2014); increased incidences of food-borne, water-borne, and vector-borne disease (Harper et al. 2011, 2015a, 2015b; Martin et al. 2007); and impacts on mental health and well-being due to displacement of people, loss of livelihoods and cultural identity, and changing relationships with the land and culturally significant natural places (Cunsolo Willox et al. 2012, 2013a, 2013b, 2015). Detecting and responding to these outcomes to support human health is a serious challenge.

To monitor and respond to these shifts in Inuit health and environment, government representatives, health practitioners, and academics are calling for comprehensive, integrated, sustainable, and locally appropriate monitoring programs (Jay and Marmot 2009; Haines et al. 2006; Ford 2012). To meet this call, a team of Inuit and non-Inuit researchers have been working with the Inuit community of Rigolet, Nunatsiavut (Fig. 1), to conceptualize, develop, and implement the eNuk program (Harper et al. 2016; Sawatzky et al. 2017a). The eNuk program is an Inuit-led participatory environment and health monitoring program intended to support Inuit efforts to track, analyze, and respond to the environmental and health impacts of climate change in Rigolet (Harper et al. 2016; Sawatzky et al. 2017a). The program involves supporting and extending existing research capacity in the community, as well as developing innovative monitoring tools. A foundational component of the eNuk program is the eNuk mobile application (eNuk app), a tool which will provide an opportunity for community members to record and share their observations of environmental and health indicators of climate change through a variety of multimedia while in the community and on the land (Harper et al. 2016; Sawatzky et al. 2017a, 2017b).

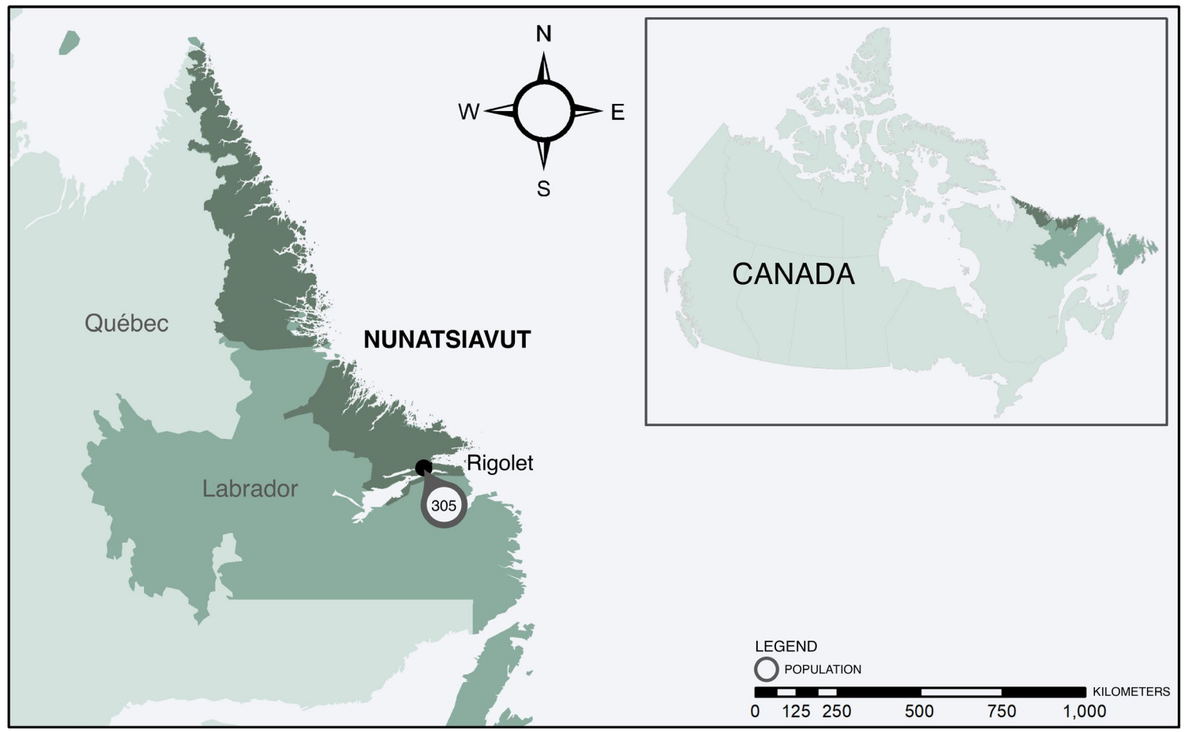


Figure 1: Map of Nunatsiavut, indicating location and population of Rigolet.

The eNuk program was developed using a community-led and participatory design research approach, involving collaboration with community research leads in Rigolet, the Rigolet Inuit Community Government, the Nunatsiavut Department of Health and Social Development, and academic researchers at the University of Guelph, the Labrador Institute of Memorial University,[1] and the University of Alberta (Harper et al. 2016; Sawatzky et al. 2017a, 2017b). This paper provides a summary of the eNuk program, detailing the methods used to co-create and develop the monitoring program and the eNuk app more specifically (Fig. 2), as well as identifying emergent themes. This research highlights the need for (1) integrated environmental and health monitoring and (2) community participation in all aspects of monitoring programs. Moreover, this profile paper emphasizes the potential benefits of such monitoring for community and regional adaptation strategies and policy decision-making in the face of rapidly changing climatic conditions in the North.

1 The Labrador Institute is a division of Memorial University.

Conceptualizing the eNuk program

For a decade, the community of Rigolet, Nunatsiavut (population 305; 95% identifying as Inuit), has been a leader in climate change and health research in the North. With research ranging from climate change impacts on food security (Harper et al. 2015c; Cunsolo Willox 2013b), the incidence of water-borne disease and acute gastrointestinal illness (Harper et al. 2011, 2015a, 2015b; Wright et al. 2017), mental health (Cunsolo Willox 2012, 2013a, 2013b), and cultural continuity (Cunsolo et al. 2017; Petrasek MacDonald et al. 2013a, 2013b). Rigolet has been actively leading and initiating research to understand the varying ways that warming temperatures, changing weather patterns, decreasing ice coverage and extent, and shifting plant and animal patterns are impacting Inuit health. Beyond the importance and usefulness of this research to supporting Inuit health, it was identified that in order to provide more timely and usable information, research on climate change and health in the community needed to move from climate-health documentation to response.

Figure 2: Methods used to design the eNuk program and develop eNuk the app, 2014–2018.

In 2013, the initial concept of the eNuk program emerged from discussions with various members of the Rigolet Inuit Community Government, the Nunatsiavut Department of Health and Social Development, and researchers across different academic institutions about how to monitor and respond to the environmental and health impacts of climate change. From these initial discussions, the team wrote grant applications to fund the development of a community-based monitoring program, including an Inuit-specific app to enhance monitoring of changes in the land, waters, weather, plants, and animals (e.g., changes to ice thickness, warmer temperatures, increased prevalence of extreme weather events, changes to the presence and condition of flora and fauna), and associated impacts to physical, mental, emotional, and spiritual health and well-being (e.g., feelings of anxiety associated with unpredictable weather patterns, injury due to entrapment in unseasonably thin ice conditions).

To begin the design phase of the eNuk program, based on Inuit perspectives on environmental and health monitoring, and to situate this work within existing activities related to integrated and community-based monitoring in the North, several methods were used to engage people, seek input, understand needs and priorities, and support/enhance local capacity for research; herein, we outline examples of these activities.

Beginning in 2015, 31 interviews were conducted with individuals in and around Rigolet and Happy Valley - Goose Bay, Labrador, with community members (n=13), local and regional government representatives (n=14), and healthcare professionals (n=4), as well as several focus group discussions. Open-ended questions focused on what environmental and health conditions were important to monitor in Rigolet, why they were important to monitor, and how monitoring should be done, thereby supporting continued Inuit leadership and guidance.

To contextualize the eNuk program within the broader research literature on integrated environment-health monitoring in the Circumpolar North, a systematic realist review was conducted. MEDLINE® and Web of Science™ databases were systematically searched to identify relevant articles. Following a realist approach, questions were asked regarding how, why, and in what contexts integrated monitoring systems were discussed (Pawson et al. 2005; Braun and Clarke 2006). Key components of integrated environment and health monitoring systems were identified and characterized.

An environmental scan (Arksey et al. 2005; Mew et al. 2017; Pham et al. 2014) of community-based monitoring programs in the Circumpolar North was conducted to further contextualize and situate the eNuk program within already ongoing monitoring programs. Several methods, including academic consultation, participation in two workshops on community-based participatory monitoring in the North, searches of grey and peer-reviewed literature, and searches of an online database of monitoring programs,[2] were used to identify initiatives working with Indigenous communities and using web-based technology (e.g., smartphone apps or web-based databases). Information about these programs was organized based on characteristics of the program and indicators they monitored.

2 The Atlas of Community-Based Monitoring and Indigenous Knowledge in a Changing Arctic is an online atlas developed to highlight and compile community-based monitoring throughout the Circumpolar North.

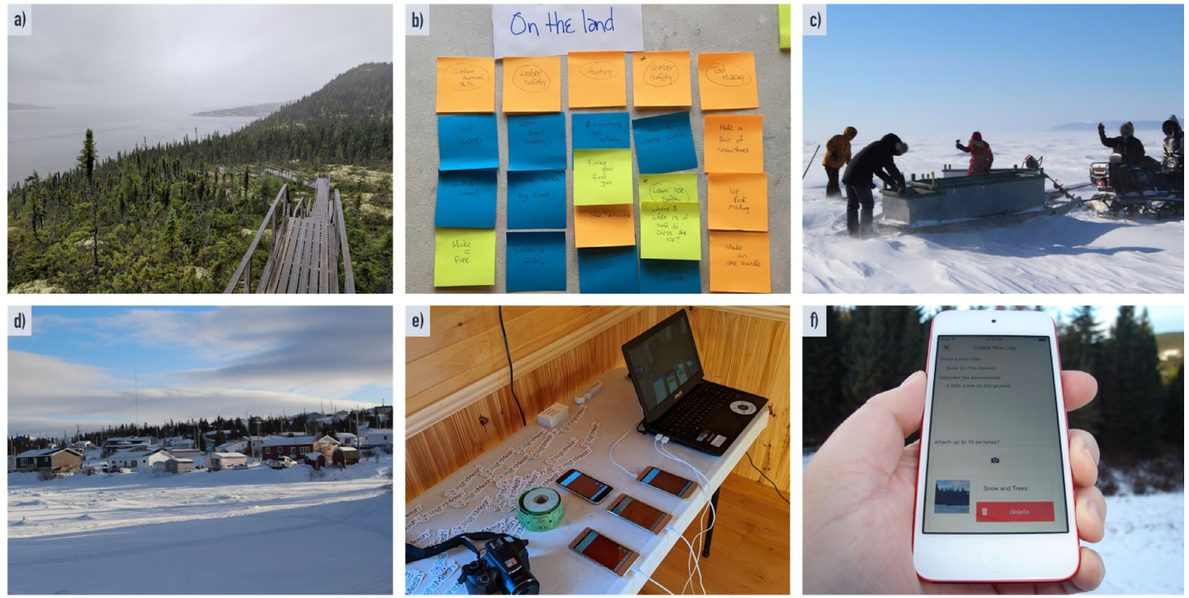


Figure 3: Images of Rigolet and the different stages of the eNuk program: (a) view from the boardwalk stretching from Rigolet to key historic and archaeological sites in the region, (b) participatory post-it-note method used when consulting community members about app design, (c) the eNuk research team testing out technical equipment with community partners on English River in –40°C conditions, (d) view of houses in the community of Rigolet during wintertime, (e) booth for the eNuk app at a community open house, and (f) the pilot version of the eNuk app.

Developing the eNuk app

To ensure the eNuk app was developed to meet community needs, and was both useful and timely, a participatory design approach was central to its development.[3] This approach, which used a variety of methods, allowed for community members and the research team to co-develop and co-design app features and functionality (Sanoff 2008; Simonsen et al. 2012; Racadio et al. 2014).

In October 2015 and February 2016, a series of in-depth, semi-structured, conversational interviews were conducted with community members to assess the technological resources available in Rigolet, identify what technical components community members wished to see incorporated into the app, and determine who was interested in having an active role in app design and evaluation. Additionally, throughout the app design process, a series of eight well-attended open houses were held between 2015 and 2017 to encourage community input, participation, and engagement. For example, several interactive activities at each open house allowed community members to contribute to the co-design of the eNuk app through such activities as participatory mapping, paper prototyping of the app interface, and ranking priorities. Several classroom workshops were hosted at the Northern Lights Academy to further engage youth in co-development of the app (Robertson and Simosen 2018).

In 2016, a prototype of the eNuk app was complete, and it was piloted in five Rigolet households. The pilot households had been identified by the community research leads and reflected a diversity in gender, age, livelihood, and land experience. Through the technology and community leads, evaluation of the prototype was ongoing, and the experiences of these pilot-users contributed to an updated version of the eNuk app, to be released in the summer of 2018.

At the time this paper was written (March 2018), another series of semi-structured interviews were being led by community research leads (n=8). These interviews were designed to provide Rigolet Inuit with the opportunity to identify and characterize specific environment and

3 For more information on participatory design, see Sanoff 2008; Simonsen et al. 2012; and Racadio et al. 2014.

health indicators that should be monitored by the eNuk app (e.g., indicators related to ice, snow, rain, wind, tide, temperature, wildlife, vegetation, drinking water, and mental wellness) and to describe how the app could best capture data related to these indicators. Initial analysis of the interviews found that Inuit described environmental information that is used for decision-making on the land and in the community, the sources and the sharing of this environmental information, and connections between changes in certain environmental conditions and community health. Inuit insights from these interviews will contribute to the development of updates for the app.

Integrated environment and health monitoring

During the eNuk program and app co-development, several themes emerged. Through the semi-structured interviews, a variety of specific environment and health indicators were categorized by Inuit, including freshwater conditions; sea ice and trail conditions; trends in plants, animals, and wildlife; changing weather, temperature, and climate patterns; and increased anxiety and depression among community members (Sawatzky et al. 2017a). Beyond these indicators, Inuit discussed community priorities for the eNuk program, including the promotion of environmental stewardship, cultural knowledge, and evidence-based decision-making (Sawatzky et al. 2017a). These priorities highlight the importance of land for Inuit conceptualizations of well-being, and the need to develop the eNuk program in a holistic way, led by Inuit ways of knowing (Harper et al. 2016; Sawatzky et al. 2017a). An integrated approach to an environment-health monitoring program is therefore in line with Inuit understandings of the health impacts of climate change in Rigolet (Sawatzky, et al. 2017b).

Furthermore, we found that to respond to environmental change, programs need to consider numerous sources of information, multiple stressors, wide geographic coverage, and different knowledge systems (Sawatzky et al. 2017c). The importance of community co-designed and co-developed technology has also become increasingly clear. Community-led and community-designed monitoring ensures community needs are met, and enables robust and authentic environmental and health data collection that can inform research, policy, programming, and decision-making (Sawatzky et al. 2017c).

The importance of participatory and community-led research and design

A community-led approach used throughout the eNuk program, including the co-development of the app, has ensured Inuit knowledge, values, and expertise are reflected in the monitoring program. Indeed, through the participatory methods highlighted herein, the eNuk program has been and continues to be developed as culturally relevant and useful for community members (Sawatzky et al. 2017a, 2017b).

Conclusion

Through community-led research and participatory co-design, the eNuk program is facilitating locally appropriate, integrated environment-health monitoring. The process of conceptualizing and co-developing the eNuk program has highlighted several potential lessons for researchers as well as policy and decision makers in Northern Canada, including

- the importance of Inuit-led and co-designed programs;
- the power of using Inuit-identified indicators and incorporating Indigenous understandings of wellness in monitoring programs;
- the need for integrated monitoring programs that are context-specific and culturally relevant; and
- the usefulness of innovative technology (e.g., apps) that is designed by and for Inuit as a tool for monitoring programs.

The eNuk program is an example of an Inuit-led monitoring system that could inform locally appropriate programming in Rigolet, as well as the region, providing management tools for decision makers and communities that are grounded in and guided by Inuit values, knowledge, and science. This type of monitoring program has the potential to strengthen resilience to environmental change while directing future adaptation responses in the region and across the North.

Community considerations

The eNuk program is premised on community participation and leadership. Through the eNuk app, community members in Rigolet, Nunatsiavut, will be able to monitor the health and environmental impacts of climate change in and around their communities, promoting the collecting and sharing of important community information. In this way, the eNuk program supports community-level adaptation to environmental change.

Acknowledgements

This research takes place in the ancestral and continued homelands of Inuit in the Labrador Inuit Settlement Area known as Nunatsiavut. The eNuk research team would like to thank the community of Rigolet for its invaluable leadership and insight on the project, as well as Polar Knowledge Canada, the Canadian Internet Registration Authority, the Canadian Institutes for Health Research, and the Natural Sciences and Engineering Research Council of Canada for their funding support. The team would like to give special thanks to Charlotte Wolfrey of Rigolet for her early visions of the eNuk program and for her continued guidance, wisdom, and support.

References

Arksey, H. and O'Malley, L. 2005. Scoping studies: Towards a methodological framework. International *Journal of Social Research Methodology* 8:19–32.

Bano, M. and Zowghi, D. 2013. User involvement in software development and system success: A systematic literature review. *In* Proceedings of the 17th International Conference on Evaluation Assessment in Software Engineering (EASE 2013). pp. 125–130.

Björgvinsson, E., Ehn, P., and Hillgren, P. 2012. Design things and design thinking: Contemporary participatory design challenges. *Design Issues* 28:101–116.

Braun, V. and Clarke, V. 2006. Using thematic analysis in psychology. *Qualitative Research in Psychology* 3:77–101.

Cunsolo Willox, A., Harper, S.L., Edge, V.L., Landman, K., Houle, K., Ford, J.D., and Rigolet Inuit Community Government. 2013a. The land enriches the soul: On climatic and environmental change, affect, and emotional health and well-being in Rigolet, Nunatsiavut, Canada. *Emotion, Space, and Society* 6:14–24.

Cunsolo Willox, A., Harper, S.L., Ford, J.D., Edge, V.L., Landman, K., Houle, K., Blake, S., and Wolfrey, C. 2013b. Climate change and mental health: An exploratory case study from Rigolet, Nunatsiavut, Canada. *Climatic Change* 121:255–270.

Cunsolo Willox, A., Harper, S.L., Ford, J.D., Landman, K., Houle, K., Edge, V.L., and Rigolet Inuit Community Government. 2012. "From this place and of this place": Climate change, sense of place, and health in Nunatsiavut, Canada. *Social Science & Medicine* 75:538–547.

Cunsolo, A., Shiwak, I., Wood, M., and IlikKuset-Ilingannet team. 2017. "You need to be a well-rounded cultural person": Youth mentorship programs for cultural preservation, promotion, and sustainability in the Nunatsiavut region of Labrador. *In* Northern sustainabilities: Understanding and addressing change in the circumpolar world. Springer, Cham. pp. 285–303.

Cunsolo Willox, A., Stephenson, E., Allen, J., Bourque, F., Drossos, A., Elgaroy, S., Kral, M., Mauro, I., Moses, J., Pearce, T., Petrasek MacDonald, J., and Wexler, L. 2015. Examining relationships between climate change and mental health in the Circumpolar North. *Regional Environmental Change* 15:169–182.

Ford, J.D., Smith, B., and Wandel, J. 2006. Vulnerability to climate change in the Arctic: A case study from Arctic Bay, Canada. *Global Environmental Change* 16:145-160.

Ford, J.D. 2012. Indigenous health and climate change. *American Journal of Public Health* 102:1260–1266.

Furgal, C. and Seguin, J. 2006. Climate change, health, and vulnerability in Canadian northern Aboriginal communities. *Environmental Health Perspectives* 114:1964–1970.

Gearheard, S., Aporta, C., Aipellee, G., and O'Keefe, K. 2011. The Igliniit project: Inuit hunters document life on the trail to map and monitor Arctic change. *The Canadian Geographer / Le Géographe canadien* 55:42–55.

Goldhar, C., Bell, T., and Wolf, J. 2014. Vulnerability to freshwater changes in the Inuit Settlement Region of Nunatsiavut, Labrador: A case study from Rigolet. *Arctic* 67:71–83.

Haines, A., Kovats, R.S., Campbell-Lendrum, D., and Corvalan, C. 2006. Climate change and human health: Impacts, vulnerability, and public health. *Public Health* 120:585–596.

Harper, S.L., Cunsolo, A., Shiwak, J., Shiwak, I., Flowers, C., Wood, M., Gillis, D., Ford, J., Furgal, S., Sawatzky, A., and Cook, O. 2016. Implementing a community-driven environment and health surveillance program with Inuit in Rigolet, Nunatsiavut. Open Access Government.

Harper, S.L., Edge, V.L., Ford, J., Thomas, M.K., IHACC Research Group, Rigolet Inuit Community Government, and McEwen, S.A. 2015a. Lived experience of acute gastrointestinal illness in Rigolet, Nunatsiavut: "Just suffer through it." *Social Science & Medicine* 126:86–98.

Harper, S.L., Edge, V.L., Ford, J., Thomas, M.K., Pearl, D.L., Shirley, J., IHACC Research Group, Rigolet Inuit Community Government, and McEwen, S.A. 2015b. Acute gastrointestinal illness in two Inuit communities: Burden of illness in Rigolet and Iqaluit, Canada. *Epidemiology & Infection* 143:3048–3063.

Harper, S.L., Edge, V.L., Ford, J., Willox, A.C., Wood, M., IHACC Research Group, Rigolet Inuit Community Government, and McEwen, S.A. 2015c. Climate-sensitive health priorities in Nunatsiavut, Canada. *BMC Public Health* 15:605.

Harper, S.L., Edge, V.L., Schuster-Wallace, C.J., Berke, O., and McEwen, S.A. 2011. Weather, water quality, and infectious gastrointestinal illness in two Inuit communities in Nunatsiavut, Canada: Potential implications for climate change. *EcoHealth* 8:93–108.

Jay, M. and Marmot, M. 2009. Health and climate change. *British Medical Journal* 339:645–646.

Martin, D., Bélanger, D., Gosselin, P., Brazeau, J., Furgal, C., and Déry, S. 2007. Drinking water and potential threats to human health in Nunavik: Adaptation strategies under climate change conditions. *Arctic* 60:195–202.

Mew, E.J., Ritchie, S.D., VanderBurgh, D., Beardy, J.L., Gordon, J., Fortune, M., Mamakwa, S., and Orkin A.M. 2017. An environmental scan of emergency response systems and services in remote First Nations communities in Northern Ontario. *International Journal of Circumpolar Health* 76:132–208.

Organ, J., Castleden, H., Furgal, C., Sheldon, T., and Hart, C. 2014. Contemporary programs in support of traditional ways: Inuit perspectives on community freezers as a mechanism to alleviate pressures of wild food access in Nain, Nunatsiavut. *Health and Place* 30:251–259.

Pals, N., Steen, M., Langley, D., and Kort, J. 2008. Three approaches to take the user perspective into account during new product design. *International Journal of Innovation Management* 12:275–294.

Pawson, R., Greenhalgh, T., Harvey, G., and Walshe, K. 2005. Realist review: A new method of systematic review designed for complex policy interventions. *Journal of Health Services Research & Policy* 10:21–34.

Pearce, T., Smit, B., Dierden, F., Ford, J., Goose, A., and Kataoyak, F. 2010. Inuit vulnerability and adaptive capacity to climate change in Ulukhaktik, Northwest Territories, Canada. *Polar Record* 46:157–177.

Petrasek MacDonald, J., Harper, S.L., Willox, A.C., Edge, V.L., and Rigolet Inuit Community Government. 2013a. A necessary voice: Climate change and lived experiences of youth in Rigolet, Nunatsiavut, Canada. *Global Environmental Change* 23:360–371.

Petrasek MacDonald, J., Ford, J.D., Willox, A.C., and Ross, N.A. 2013b. A review of protective factors and causal mechanisms that enhance the mental health of Indigenous circumpolar youth. *International Journal of Circumpolar Health* 72:21775.

Pham, M.T., Rajić, A., Grieg, J.D., Sargeant, J.M., Papadopoulos, A., and McEwen, S.A. 2014. A scoping review of scoping reviews: Advancing the approach and enhancing the consistency. *Research Synthesis Methods* 5:371–385.

Racadio, R., Rose, E., and Kolko, B. 2014. Research at the margin: Participatory design and community-based participatory research. *In* Proceedings of the 13th participatory design conference: Short papers, industry cases, workshop descriptions, doctoral consortium papers, and keynote abstracts. ACM, New York. pp. 49–52.

Robertson, T. and Simonsen, J. 2018. Challenges and opportunities in contemporary participatory design. *Design Issues* 28:3–9.

Sanoff, H. 2008. Multiple views of participatory design. *International Journal of Architectural Research* 2:131–143.Sawatzky, A., Cunsolo, A., Gillis, D., Shiwak, I., Flowers, C., Cook, O., Wood, M., Rigolet Inuit Community Government, and Harper, S.L. 2017a. Profiling the eNuk program. *Northern Public Affairs*.

Sawatzky, A., Cunsolo, A., and Harper, S.L. 2017b. The eNuk program: Developing a community-based, participatory health and environment surveillance strategy. Open Access Government.

Sawatzky, A., Cunsolo, A., Jones-Bitton, A., Middleton, J., and Harper, S.L. 2017c. Integrated environment and health surveillance: A systematic realist review. *In* Proceedings of the 2017 International Arctic Change Conference (ArcticNet 2017). p. 129.

Simonsen, J. and Robertson, T. 2012. Routledge international handbook of participatory design.

Wright, C.J., Sargeant, J.M., Edge, V.L., Ford, J.D., Farahbakhsh, K., Rigolet Inuit Community Government, Shiwak, I., Flowers, C., Harper, S.L., and IHACC research team. 2017. Water quality and health in northern Canada: Stored drinking water and acute gastrointestinal illness in Labrador Inuit. *Environmental Science and Pollution Research* pp. 1–13. doi:10.1007/s11356-017-9695-9.