THE SIKUMIUT MODEL: A CROSS-CULTURAL DECOLONIZING RESEARCH APPROACH FOR SEA ICE TRAVEL SAFETY IN MITTIMATALIK, NUNAVUT

by © Katherine Jean Wilson,

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Abstract

Greater collaboration with Inuit in community-based sea ice research has led to changes in research approaches used by non-Indigenous researchers. However, there remains a gap in the collaborative sea ice literature describing how non-Indigenous researchers are decolonizing themselves and their research. This thesis explores a personal and collective research journey with Sikumiut (people of the sea ice), an Inuit research management committee from Mittimatalik (Pond Inlet), Nunavut, in order to fill this gap and to support the greater goal of Inuit self-determination in research It describes: 1) my decolonizing methodology; 2) the process of co-developing the Sikumiut model, a cross-cultural decolonizing research approach to advance Inuit self-determination in research; and 3) transitioning from theory into practice to meet Sikumiut's research needs.

Variable sea ice conditions, a reduced travel season, and pressure to expand shipping are climate change impacts compounding the dangers of sea ice travel in Mittimatalik. Sikumiut wanted to document their Inuit Qaujimajatuqangit (IQ, Inuit knowledge) to share critical sea ice travel knowledge and skills with youth, and to understand where and when the sea ice is changing. The Sikumiut model reconceptualized typical research approaches, with Sikumiut governing the research, and non-Indigenous research partners training and mentoring Inuit youth to conduct the research. The multiple benefits of Inuit leading and conducting this research, to capture and mobilize their own sea ice IQ are described through the co-production of: 1) Sikumiut's illustrated sea ice terminology book, three seasonal sea ice travel maps and two safety posters for community use; and 2) the Mittimatalik siku asijjipallianinga (sea ice change atlas), which involved the Inuit interpretation of satellite imagery and sea ice charts from 1997 to

2019 based on sea ice travel IQ. The Sikumiut products show the continued relevance of IQ as an adaptation tool for safe sea ice travel. The atlas also provides evidence that shipping during critical periods of sea ice formation and break-up would compromise the integrity and duration of the sea ice travel season for the community.

Covid Impact Statement

I had my fourteenth visit to the community of Mittimatalik, Nunavut in February 2020, just before the COVID-19 pandemic hit Canada. The pandemic then restricted research travel for research partners living outside of Nunavut. We had just finished reviewing the Inuktitut in the sea ice travel safety maps and posters with Sikumiut, the Inuit management committee in Mittimatalik that leads this research. In May 2020 the maps and posters were displayed at the Hamlet office, Hunters and Trappers Organization (HTO) office, SmartICE office, and the two grocery stores in town. However, due to the Covid-19 pandemic, maps and posters originally planned for the elementary and high schools, hotel, library/visitors centre, Parks Canada office, Environment and Climate Change Canada Research Station, and the Health Centre were postponed.

I had also been planning a field trip in April 2020 with students in Mittimatalik, enrolled in the Environmental Technology Program (ETP), run by Nunavut Arctic College (NAC). The ETP students were going to work with Sikumiut to plan their sea ice travel, and then travel with them on the sea ice to their field camp. We were planning to have Sikumiut members stop along the way and explain critical landmarks and sea ice observations on the trip. I was also going to travel with the group with some satellite imagery to teach some interpretation techniques and so students could compare what was in the imagery with where we were on the sea ice. However, the spring 2020 ETP field trip was cancelled due to the COVID-19 pandemic.

Despite some of the challenges of the pandemic, with our well-established research relationships, local research capacity and leadership, we were able to continue most of our work together.

Much of the co-development and training was done in person in Mittimatalik in 2018 and 2019. Andrea Arreak, the Inuit youth researcher on this project, and I continued our collaborative work by mailing data to each other on external drives and moving our training, discussions, and meetings on-line. Bandwidth limitations in the community reduced the use of videoconferencing as a collaboration platform, and many of our interactions were by text, telephone, and e-mail in 2020 and 2021. As well, I was able to continue to work with Jamesie Itulu, the Inuit youth artist for this research. Itulu and I were able to coordinate on his graphical illustrations through e-mail and by phone.

Arreak continued to independently organize and facilitate in-person Sikumiut meetings in Mittimatalik, while non-Inuit research partners participating by telephone in 2020. As the COVID-19 variants emerged and found their way to Iqaluit, Nunavut, in February 2021, research partners in Mittimatalik could no longer gather indoors. I was finally able to return to Mittimatalik in September 2021 to review the layout and text for the sea ice terminology booklet and atlas maps. The sea ice terminology booklet (Appendix A) is now complete with 500 copies printed and shipped to the community for distribution in late April 2022. The Mittimatalik sea ice atlas (Appendix B) is currently being translated into Inuktitut. The printing and distribution of the terminology booklet and atlas is expected in late spring 2022.

Co-Authorship Statement

The research has been a collaborative, co-produced process. Sikumiut, an Inuit Management Committee in Mittimatalik, Nunavut leads this research. Sikumiut retains the rights and ownership to their knowledge/data collected and documented during this research. However, Sikumiut has allowed Katherine Wilson to have access to this data/knowledge and publish the results to fulfill her studies at Memorial University (see Appendix C). Wilson was the sole author for Chapters 1 and 5 of this thesis. Chapters 2, 3 and 4 were co-authored and published in three separate journals.

Chapter 2 was published in the Journal of Arctic Science. For this paper, Wilson reviewed and summarized the materials for the background and literature review of the thesis. Arreak and Bell facilitated the community consultation and Sikumiut meetings. Wilson drafted the concept and the illustration of the Sikumiut Model. Koonoo and Angnatsiak (Sikumiut members), contributed to the Model conception and design, and the Sikumiut Management committee approved the Model. Wilson wrote all drafts of the manuscript. Bell, Ljubicic, Koonoo, Angnatsiak and Arreak contributed to manuscript revisions and approved the submitted version.

Chapter 3 was published in the Journal Arctic. For this paper, Arreak, Ljubicic and Wilson co-facilitated the sea ice terminology and mapping workshops. Arreak facilitated all the subsequent validation meetings to review the workshop materials and maintained revisions of the sea ice terminology list. Arreak digitized the Sikumiut maps and Wilson developed the design and layout of the maps. Itulu participated in all the workshop and validation meetings. Itulu designed the graphical illustrations for the posters and sea ice terminology booklet. Sikumiut reviewed and validated the posters, maps, and terminology booklet. Wilson wrote all drafts of the manuscript. Bell and Ljubicic contributed to manuscript revisions. Ljubicic, Bell, Arreak and Itulu read the manuscript and approved the submitted version.

Chapter 4 was published with the journal Frontiers in Climate. For this paper, Sikumiut contributed to conception and design of the study. Wilson archived and organized the data and trained Arreak in Geographic Information Systems (GIS) and satellite imagery interpretation. Arreak performed all the satellite interpretation and GIS digitizing. Wilson and Arreak performed the statistical data analysis. Sikumiut reviewed and validated the maps, suggesting other ways to analyze the data based on their climatological knowledge. Wilson led the development of the map legends, colours and layout with input from Ljubicic, Bell and Arreak. Wilson wrote all drafts of the manuscript. Ljubicic, Bell and Arreak read and contributed to manuscript revisions, and approved the submitted version.

Acknowledgements

I am truly blessed by the many new relationships I have developed through this research and by my deep-rooted friends and family that have sustained me.

First, I wish to thank my supervisors Drs. Trevor Bell (Memorial University of Newfoundland) and Gita Ljubicic (McMaster University) for guiding me through the most meaningful accomplishment of my career. They sought funding for my many trips, pushed the boundaries for me and this research. Their leadership was thoughtful, considerate, and consistent. Through multiple revisions of this thesis, they mentored me through the writing and revision process, pushing me to think deeply and beyond my own expectations. Thank you to Dr. Arn Keeling (Memorial University of Newfoundland), for being part of my PhD committee. His razor-sharp observations filled in the gaps and his humour always brought me back into focus.

Andrew Arreak's and Jamesie Itulu's contributions to this research were significant. We spent many hours working together and independently. I am truly grateful for their kindness and patience as we figured things out as we went along. Andrew, worked tirelessly in coordinating Sikumiut members, facilitating meeting and workshops, and in the interpretation and analysis of this satellite data. His dedication to this research was unyielding. Jamesie's artistic creativity is boundless and awe inspiring. In the end, I learned more from them then they did from me.

My enormous gratitude goes to all past and current members of the Sikumiut Management Committee for their leadership and generosity in sharing the time and wisdom: Brian Koonoo, Caleb Sangoya, Elijah Panipakoocho, David Angnatsiak, Gamalie Kilukishak, George Koonoo, Ivan Koonoo, Jaykolassie Killiktee, James Simonee, Jonathan Pitseolak, Moses Arnagoalik, Rachel Smale and Sheati Tagak. In 2019 Jaykolassie Killiktee, a founding member and Elder for Sikumiut passed away. Jaykolassie was part of the Committee from 2016 to 2018 and provided gracious and unwavering leadership in the design of the committee to ensure Mittimatalik's self-determination in research. In February 2022 we also lost a second Elder, Gamalie Kilukishak. Gamailie's dedication to documenting, sharing, and teaching his sea ice Inuit Qaujimajatuqangit with the next generation was evident in his attendance at every Sikumiut meeting held between 2016 and 2022. We are honoured to have known and worked with these Elders, and to have their contributions reflected in the products developed for the community.

Thank you, Shelly Elverum, and the Ikaarvik Inuit youth for all your advice and encouragement; you have been a constant source of inspiration for this research. The Elverum's invited me into their home for numerous meals, tea, and games. Their friendship snowballed many of my collaborations and partnerships in Mittimatalik. The workshop/meeting interpreters in this work play such a critical role in communicating and sharing knowledge and we are very thankful to Malachi Arreak, Morgan Arnakallak, and Abraham Kubulu (Mittimatalik and Arviat). Thank you to Mishak Allurut (Ikpiarjuk) for the timely translation of many Sikumiut documents. Thank you to: Lynn Moorman from Mount Royal University and Tom Zagon from the Canadian Ice Service for their dedication and efforts in helping train Inuit youth. I wish to thank Beverly Hancock for her professional assistance in the layout of the Sikumiut maps and posters, Carolann Harding with SmartICE for all her administrative support, and Becky Segal for her computer mapping advice.

I am indebted to the following from Environment and Climate Change Canada: Benoit Montpetit for programming scripts to convert hundreds of ice charts; Bhavana Chaudhar, Stephen Howell and Angela Cheng for their GIS, ice chart and remote sensing knowledge and advice; Evan Richardson for the accommodation at the Mittimatalik Research station; and John Parker for his steadfast support in me and of this research. Thank you to Geddie Pawlowski (nee Steltner), Sean Guistini (Nunavut Arctic College), Dr. Robert Frederking (emeritus scientists, National Research Council), and Mark Croke (SmartICE), for all their enthusiasm and assistance in getting the Arctic Research Establishment data back to Nunavut.

Chapter 2 of this dissertation was published in the Journal of Arctic Science, Chapter 3 was published in the Journal Arctic, and Chapter 4 was published in the Journal Frontiers in Climate. I would like to thank the anonymous journal reviewers for their time, comments, suggestions, and encouragement that helped to significantly improve the chapters of this thesis. This research was generously funded in part by the Public Safety Canada's Search and Rescue New Initiatives Fund, ArcticNet, and Polar Knowledge Canada. Scholarship support was gratefully received from the Social Sciences and Humanities Research Council of Canada, and the Northern Scientific Training Program. This research received the following approvals from: the Nunavut Research Institute #02 013 20R-M; and Memorial University of Newfoundland Interdisciplinary Committee on Ethics in Human Research, ethics approval #20190684-AR.

I have had been fortunate to have many strong, independent, and hardworking female role models in my life, namely my mother, my Aunt Mary, and my Nan. Always curious and always learning. Crystal O'Donnell and Tasha Yovetich are also in this league of exceptional

women, and their friendships are an essential part of my foundation. My father leads by example, with patience, kindness, and gratitude. My parents took my brothers and I on many adventures, camping across this country and spending time outdoors in all seasons. This fuelled my love for the environment and adventure. My neighbours and friends in Ottawa helped my family pack, watched our house, picked up the mail, feed us, and gave us a place to stay when visiting from St. John's and Waterdown. You are more than friends; you are my Ottawa family.

Most importantly, thank you to my husband and my daughter Rod and Mary Gillyatt. My family has been through many changes during that last six years. We moved from Ottawa, ON to St. John's, NL for the PhD, and back to Ottawa. Then to Waterdown, ON for extended family reasons and back to Ottawa again. We have had long periods of time apart, and together with just the three of us. Rod has been my constant and unwavering cheerleader throughout this PhD. Never questioning and immensely curious to share in this journey. Mary is my brave, resilient, creative, intelligent, and joyful girl. She is my only one and my number one.

Finally, as I have been learning the colonial history of Inuit, I am also becoming ever more aware and conscious of the First Nations lands that have benefited me and generations of my settler family. While the tradition of acknowledging lands does not exist among Inuit, I would like to conclude by gratefully acknowledging the following First Nations territories and ancestral homelands that I have lived and worked on during the past six years:

- the ancestral homelands of the Mi'kmaq and Beothuk people (St. John's, NL);
- the traditional unceded territory of the Algonquin Anishnaabeg people (Ottawa, ON); and

- the traditional territory of the Haudenosaunee and Anishnaabeg people (Waterdown, ON).

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Chapter 1

Climate change and change of heart

1.1 Introduction

The goal of this thesis was to co-develop, and apply, a cross-cultural decolonizing research approach to advance Inuit self-determination in research. This doctoral research reflects personal and collective experiences from working with Inuit in the community of Mittimatalik (Pond Inlet), Nunavut, to address their research priorities around sea ice safety. The dissertation also explores my ongoing decolonizing process to redefine my role as a non-Indigenous researcher, and to understand what was involved in working together with Inuit to co-develop and put into practice research that advances their self-determination.

Inuit Nunangat is the homeland of Inuit in the Canadian Arctic. It is “the distinct geographic, political, and cultural region that includes the Inuvialuit Settlement Region (Northwest Territories), Nunavut, Nunavik (Northern Québec), and Nunatsiavut (Northern Labrador)” (ITK, 2018a:18). The community of Mittimatalik is located at the northern tip of Baffin Island in Nunavut (Fig. 1.1). Inuit from the region are known as Tununirmiut, which is thought to mean “the people of a shaded or shadowy place” referring to the regions mountainous landscape (QIA, 2022). It has a population of approximately 1600 people, of whom 92% are Inuit and speak Inuktitut as their first language (Statistics Canada, 2017). The sea ice around the community begins to freeze in late October and is normally safe for travel by mid-November once the ice becomes landfast, or stable sea ice that is frozen to the land. Mittimatalingmiut (people of Mittimatalik) travel on the sea ice to hunt and fish for country food (caribou, narwhal, beluga, seal, and char) and to spend time away from town at family cabins. The Tursukattak floe edge is located approximately 65 km eastward from the community along the sea ice, and is one of the main hunting and fishing locations that Mittimatalingmiut use from December to early July (Fig. 1.1). The eight months or so of sea ice is extremely important to community members to maintain their nutritional and cultural needs.

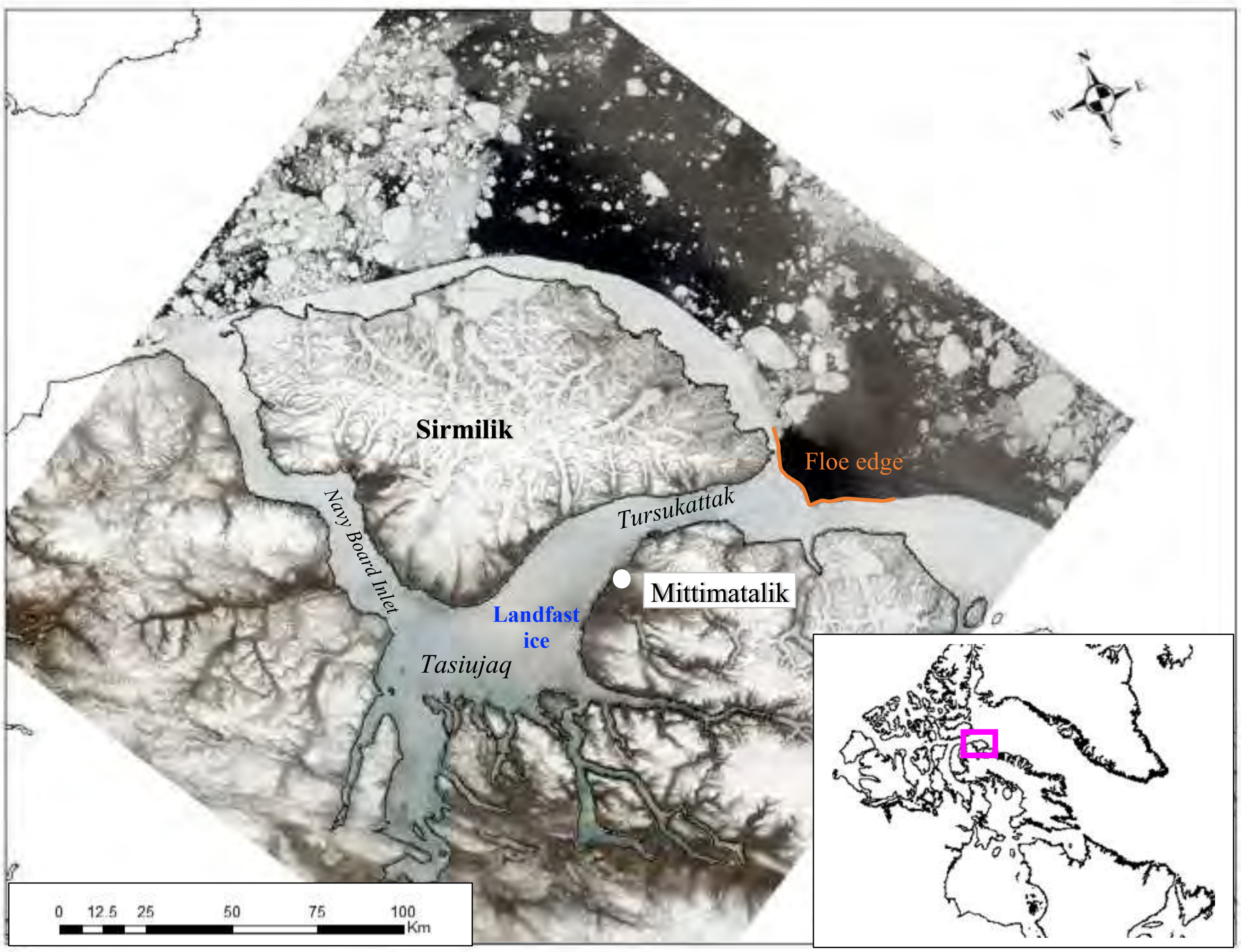

Figure 1.1 Location of the community of Mittimatalik, Nunavut, Canada. Background is a MODIS True Colour Composite from June 9, 2019 (NASA, 2019).

Climate change observations from Mittimatalik describe that the sea ice is freezing later in the fall and breaking up earlier in the summer, there are changes to the quality and strength of sea ice, and there are more areas of thin ice (Manseau, 2005; Knight Piésold Consulting, 2015; Carter et al., 2018). Changes to sea ice are resulting in dangerous sea ice travel conditions, limiting access to critical hunting locations and country food sources, and causing high rates of search and rescue, injury, trauma, and tragic deaths (Durkalec et al., 2014; Clark et al., 2016b, 2016a; Driscoll et al., 2016; Kenny et al., 2018a, 2018b; Ford et al., 2019). Mittimatalingmiut want to maintain their sea ice travel and in 2015 they began looking to additional information sources to augment their decision-making.

In November of 2015, a community-based organization called Ikaarvik invited Dr. Trevor Bell, founder of the northern social enterprise SmartICE, to Mittimatalik. Ikaarvik (which translates to "bridge" in Inuktitut) is a pan-territorial program based in Mittimatalik. The goal of Ikaarvik is to "give Northern Indigenous youth the opportunity, confidence and experience to help their communities work effectively with researchers and meet the communities' local needs" (Aaluk et al., 2018:15). Ikaarvik had heard about SmartICE, a sea ice monitoring and information program to support Inuit community sea ice travel needs, and they were interested in learning more about this program for Mittimatalik. As a new graduate student, I joined Bell on initial community visits not only to assist in the SmartICE consultations, but also to listen and learn. Early community consultations recommended the creation of a SmartICE community management committee to advise on operations and information needs. In Mittimatalik, this committee calls itself Sikumiut, meaning "people of the sea ice". During these first community visits Sikumiut shared their growing concerns about sea ice change and travel safety around

Mittimatalik, and at the same time I was being inspired and challenged to rethink my role in Arctic science. What followed over the next six years was an evolving research relationship, and a co-produced project that is explored throughout the chapters of this dissertation.

This thesis contributes to the growing decolonizing research literature by providing a practical example of how non-Indigenous researchers can transform themselves and their research to support Inuit self-determination in research.

1.2 Research goal and objectives

Normally, dissertations start by presenting the research goal, then breaking down that goal into a series of objectives to address that goal. Research can happen this way, but it does not always happen in such a linear fashion. Because of how I approached this research, and how it evolved through iterative discussions and Sikumiut guidance, I am unable to package the research goals and objectives in such a typical order. As a result, this introductory chapter to my doctoral dissertation is laid out a little differently, and here I explain my reasons for doing so and provide context to help guide the reader.

Decolonizing research critically assesses western scientific approaches that undermine Indigenous peoples and their knowledge (Smith, 2012), (discussed further in section 1.5.4). Western research is typically framed around individual goals and accomplishments, while Indigenous approaches to research are typically framed around the contributions of and benefits to the collective (discussed further in Section 1.5). Western based dissertations normally explain and explore what “I”, the individual, did in this research. However, this approach would exclude the community objectives of our co-produced research, a direct contradiction to the mutual goals of co-producing decolonizing research. It would also take away from the reality of how the objectives in this co-produced research emerged, intersect and overlap. Table 1.1 illustrates the evolution of the individual (my) research objectives, with those of Sikumiut, and those that are overlapping. I began to articulate the **1st objective** of my PhD in 2015, which was to understand and redefine my role as a non-Indigenous researcher towards decolonizing myself and my research (Table 1.1, in yellow). My first research objective was refined iteratively to become the statement it is now, influenced over time by reading the literature, learning to listen, and developing relationships with community partners.

Returning regularly to the community and earning the trust of Sikumiut members led to the evolution of Sikumiut's research objectives to support safe sea ice travel in the community (Table 1.1 in blue). **Objective 2** describes Sikumiut's priority of documenting their Inuit Qaujimajatuqangit (IQ) of sea ice travel knowledge and practices, and mobilizing this knowledge to educate young and inexperienced ice users. **Objective 3** summarizes Sikumiut's request to develop a baseline of local sea ice conditions to adapt, maintain, and assess impacts of change on Mittimatalingmiut sea ice travel. Objectives 2 and 3 are not specifically my research objectives, they reflect the relational accountability (see Section 1.5), essential in decolonizing research, to give back to the community and support Inuit self-determination in research.

Table 1.1 Evolution of research goals and objectives.
IQ stands for Inuit Qaujimajatuqangit. See text for discussion.

Individual - Katherine Wilson	
Community - Sikumiut	
Overlapping - Katherine Wilson and Sikumiut	

<table>
<tr><th rowspan="3">Research objectives</th><th colspan="9">Years</th></tr>
<tr><th>2008 to 2014</th><th>2015</th><th>2016</th><th>2017</th><th>2018</th><th>2019</th><th>2020</th><th>2021</th><th>2022</th></tr>
<tr><td>Working in Arctic science funding programs</td><td colspan="8">PhD Program</td></tr>
<tr><td>Individual</td><td>Research Gaps</td><td colspan="8">1. To understand and redefine my role as a non-Indigenous researcher towards decolonizing myself and my research.</td></tr>
<tr><td rowspan="2">Community</td><td rowspan="4"></td><td colspan="2"></td><td colspan="5">2. To document our sea ice travel knowledge and practises (sea ice IQ), and to mobilize this IQ to educate young and inexperienced ice users.</td><td></td></tr>
<tr><td colspan="2"></td><td colspan="5">3. To develop a baseline of our sea ice conditions to adapt, maintain, and assess impacts of change on Mittimatalingmiut sea ice travel.</td><td></td></tr>
<tr><td rowspan="2">Overlapping</td><td colspan="2"></td><td colspan="2">4. Co-develop a research approach to work together to address 2 and 3.</td><td colspan="4"></td></tr>
<tr><td colspan="3"></td><td colspan="4">5. Put this approach into practice to address Sikumiut research needs 2 & 3.</td><td></td></tr>
</table>

<table>
<tr><td>Research goal (shared)</td><td colspan="4"></td><td colspan="4">To co-develop and apply a cross-cultural decolonizing research approach to advance Inuit self-determination in research.</td><td></td></tr>
</table>

Objective 4 emerged through efforts to address Sikumiut's objectives, which involved co-developing a research approach for how to work together (Table 1.1 in green). This overlapping objective led to the co-development of the Sikumiut model, an approach that not only changed my role, but also the roles of Inuit partners in this research. We did this to begin decolonizing the research we were doing together. **Objective 5** was the next step in the research process, which was to put this approach into practice to address Sikumiut's research needs (Table 1.1 in green).

Through working together, the shared research goal emerged mid-way through the research journey (Table 1.1 in orange). Around 2018, we identified the **research goal** as being, to co-develop a cross-cultural decolonizing research approach to advance Inuit self-determination in research, and to put this approach into practice. This work was not just about sea ice research, it was about doing research in a way that empowered Inuit to lead the research based on their IQ and values; to do the research themselves. As this Section, and Table 1.1, illustrate, my doctoral research did not start with a defined goal and objectives. It developed through a highly iterative and cumulative process, bound up in my own personal learning journey, Mittimatalik's research needs, and Sikumiut's drive for self-determination in research.

1.3 My decolonizing Arctic research journey: Format and organization of thesis

This thesis is written in a manuscript style, a style approved by Memorial University of Newfoundland (MUN, 2021). Chapters 1 and 5 are reflexive chapters written in the first person based on my experiences as a non-Indigenous white settler researcher. Chapter 1 introduces and frames the subsequent chapters in relation to research objectives, while Chapter 5 reflects on the decolonizing lessons learned for non-Indigenous researchers and recommendations for future research. Chapters 2, 3 and 4 are peer-reviewed published journal articles co-authored with community partners and academic advisors. As a result of the manuscript style of this thesis, the introduction and background information for Chapters 2, 3 and 4 are somewhat repetitive to situate the different research audiences of each individual journal.

Chapters 1 and 5 are not intended to centre my own experience over that of Sikumiut's. They are meant to address **objective 1** - to understand and redefine my role as a non-Indigenous researcher towards decolonizing myself and my research. Objective 1 permeates all the research objectives (Table 1.1, in yellow), and the remainder of Chapter 1 is organized to share my decolonizing Arctic research journey and lessons learned. In **Section 1.4**, **making the decision to change (1995 to 2014),** I situate my experiences as a non-Indigenous researcher in Arctic science as part of my positionality and reflexive process. Based on my own experiences working in government agencies, I also describe my growing frustration as sea ice services and research for Inuit continued to be seen as a novelty instead of a necessity. Following this personal context is essential background on colonialism, knowledge production, and the state of decolonizing Arctic research as I began my PhD program. This was information necessary for me to begin **taking the responsibility to change (2015 to 2018, Section 1.5)**. By learning about Indigenous histories and methodologies, I began to re-educate myself to think differently about how I approach research. Gaining this context also provided valuable guidance to begin building research relationships in Mittimatalik.

Section 1.6, co-developing the research approach, describes my ongoing process of self-reflection and personal learning as I sat in many meetings, listening to Ikaarvik youth and Sikumiut members. Taking this time allowed me to hear first-hand about their negative experiences with "southern" researchers and their profound concerns about sea ice travel safety. Section 1.6 introduces Chapter 2, a co-authored journal article that explores my decolonizing methodology (Objective 1) and the co-development of the Sikumiut model (Objective 4) to ultimately meet Sikumiut's research needs (Objectives 2 and 3). **Section 1.7, putting this approach into practice,** introduces Chapter 3, a co-authored journal article that describes how the Sikumiut model guided the documentation and mobilization of Sikumiut's sea ice travel knowledge and practices to educate young and inexperienced ice users (Objective 2). Section 1.7 also introduces Chapter 4, the third co-authored journal article that illustrates how the Sikumiut model was also used to develop a baseline of local sea ice conditions to adapt, maintain, and assess impacts of change on Mittimatalingmiut sea ice travel (Objective 3). **Section 1.8,** titled **my ongoing commitment to change**, introduces Chapter 5, the concluding chapter to the thesis, which provides personal reflections and recommendations for other non-Indigenous researchers towards supporting Inuit self-determination in research.

1.4 Making the decision to change (1995 to 2014)

My interest in the Arctic began in 1995 with my first job after my undergraduate degree with the Canadian government. The Canadian Ice Service (CIS), part of Environment Canada, now Environment and Climate Change Canada (ECCC), provides operational sea ice charts for mariners navigating in Canadian waters using satellite and observational data. I started at the CIS during the transition from aerial reconnaissance to satellite observations to monitor sea ice. I had never seen or understood the expanse of sea ice covering the Canadian Arctic. Monitoring how it grew, broke up, melted and moved in satellite imagery was overwhelming and beautiful. I transitioned into a master's degree in Geography (Carleton University) a year later and began doing fieldwork in ice camps near Resolute Bay (Nunavut) and aboard Canadian Coast Guard (CGG) icebreakers, ground truthing sea ice information in satellite data for the CIS.

Around that time, we were beginning to hear initial reports of changing sea ice conditions due to climate change in the Arctic. In early June 1997, ten students and five teachers from the community of Mittimatalik became stranded on an ice floe (Bourgeois, 1997). The sea ice they were camping on broke off unusually early. It took four days to rescue the group because of poor weather and fortunately there were no injuries. I later learned that these break-offs at the floe edge are not unusual (Koonoo, 2022). However, this incident initiated the first research project between Inuit and the CIS to pilot the use of satellite imagery to predict the spring break-up of sea ice in Mittimatalik (McKibbon, 1999; Enfotec, 2001). I started following the PhD work of Fox (Fox, 2004) and Ljubicic (nee Laidler, (2007)), two women that were working closely and respectfully with Inuit to learn about the impacts of climate change on weather and sea ice. In 2004, I too began working with Inuit in Resolute Bay on a project to understand present and future sea ice travel impacts for Inuit (De Abreu et al., 2007). The extensive skills, knowledge, and experience in travelling on the sea ice, and the generosity and willingness of Inuit in Resolute Bay to share their knowledge of sea ice, affected me deeply.

Fast forward to 2015 and I had been working in Arctic research for 20 years. The most recent eight years (2008 to 2014) I was working at Arctic science funding programs such as the International Polar Year Program (IPY; the largest-ever international interdisciplinary polar science program), the Northern Contaminants Program (NCP), and a new Arctic research program called Polar Knowledge Canada (CIRNAC, 2012, 2021). Since my earlier time with the CIS, and subsequent employment experiences at various government funding programs, I observed that the gap in providing sea ice services for Inuit still existed, and little progress had been made in advancing Inuit knowledge and capacity in meaningful ways in research.

1.4.1 Lack of dedicated sea ice services for Inuit

Sea ice is an important global indicator of climate change, and substantial research funding and focus have been provided to monitor and model it to understand and predict the impacts of global climate change (Barber et al., 2008; Comiso et al., 2008; AMAP, 2017). As a result of these efforts, in 2014 the International Panel on Climate Change (IPCC) provided a sobering projection to the world that nearly ice-free summer conditions were likely for the Arctic Ocean by 2050 (IPCC, 2014). For Inuit, the sea ice is more than a global indicator of climate change. It is a critical platform for accessing country food, still a main source of the Inuit diet, and in maintaining their social cultural connections with the land (ICC-Canada, 2008). At a community scale, Inuit were already experiencing increased dangerous sea ice travel conditions, injuries and search and rescue (Fox, 2004; Tremblay et al., 2006; Laidler et al., 2010; Druckenmiller et al., 2013; Durkalec et al., 2015). Concerns were now growing about how the IPCC global model predictions would impact Inuit sea ice travel at the community scale.

There was a shift in Arctic monitoring approaches that occurred during IPY (2008-2012) towards Community Based Monitoring (CBM) efforts. Academics and Inuit began working together on CBM programs. In general, community members manage and maintain scientific instruments installed around the communities to monitor environmental conditions all year. This information is shared within the community and academics to better understand and monitor climate change from local to global scales (Eicken et al., 2009, 2014; Bell et al., 2014; Johnson et al., 2015).

Several excellent sea ice CBM pilot projects were started by academics, industry, and the federal government (Enfotec, 2001; Tremblay et al., 2008; Gearheard et al., 2011; Laidler et al., 2011). These projects developed new systems to monitor and provided additional sea ice information to support Inuit climate change adaptation needs for safe community travel. Unfortunately, all of these sea ice CBM pilot projects ended due to a lack of dedicated long-term funding. After 20 years working in Arctic research, I saw little progress in Canada to meet the needs of coastal Arctic communities and a continued gap in dedicated sea ice services for Inuit.

1.4.2 Lack of research benefiting Inuit

By 2014, Canadian Arctic research programs, such as ArcticNet, the Tri-Council, NCP and Polar Knowledge Canada, had all developed policies to increase Indigenous participation, capacity building and Indigenous knowledge consideration in Arctic environmental science. Arctic research funding proposals were now being ranked based in part on how many Inuit would be hired, and according to promises to incorporate Inuit traditional knowledge. Northern territorial and regional governments implemented research licensing processes to consult and seek approval for research in Indigenous communities (ARI, 2021; NRI, 2021; Yukon Government, 2021), and guidelines were developed for researchers working with Arctic Indigenous communities (ITK and NRI, 2006; Gearheard and Shirley, 2007). The Tri-Council developed a policy statement on the Ethical Conduct for Research Involving Humans in research with First Nations, Inuit, and Metis People (Tri-Council et al., 2010) which aims to minimize risk and identify areas of Western dominance and power in the research process (Castleden et al., 2012). Although these guidelines provide an institutionalized framework for consultation and ethical research with Indigenous peoples (Ninomiya and Pollock, 2017), others argue that these guidelines are simply another example of Western colonial values that are more concerned with university liability (Kovach, 2009; Castleden et al., 2012). Funding agencies, and I include my own involvement in this as a former member of funding agencies, developed and added these “Indigenous” requirements in an effort to have more Arctic research supporting the needs and priorities of Indigenous communities. A review of the Arctic research articles between 1965 and

2020 highlighted that Inuit participation in research had only slightly increased and varied by research discipline and region (Brunet et al., 2014).

I knew in 2014 that we needed to do research differently, but decolonizing or Indigenizing research was not yet part of my vocabulary, much less that of Arctic science. I also knew that before I could even contemplate navigating new ways of doing research with Inuit, I had to make a transformative change within myself. It was then that I made the decision to start a PhD.

1.5 Taking the responsibility to change (2015 to 2018)

Arctic research scientists in 2015 were not being taught the colonial history of Canada's North as part of the Arctic research curriculum. Journal articles discussed the settlement of Inuit into communities as a matter of fact, a single event. We did not utter the word colonization, or understand how colonialism underlies government and academic policies, or acknowledge that the research approaches we practiced continued to perpetuate colonialism. I did not pursue a PhD for career advancement, but to take the time and space to re-train myself and learn to do Arctic research differently. This learning came from reading work by Indigenous scholars, listening to Inuit community members, and through many discussions with my co-supervisors Drs. Gita Ljubicic and Trevor Bell.

Ljubicic and I met around 2002 as she began her PhD research with Inuit on understanding sea ice processes, use and change in three Nunavut communities (Laidler, 2007). We kept in touch, and I continued to follow her research and noted the respect she was earning from Inuit based on her unique approach. Another research project that caught my attention was SmartICE. Founded by Bell and the Nunatsiavut Government, it was originally run out of Memorial University of Newfoundland (Bell et al., 2014). I was interested in SmartICE because it was being developed and run by Inuit, for Inuit. In 2014 I began discussing with Ljubicic and Bell about doing my PhD with them.

I began my doctoral research at Memorial University in 2015. In my first year I attended a week-long workshop organized by the Carleton University Institute on the Ethics of Research with Indigenous Peoples (CUIERIP). I was extremely uncomfortable and anxious during this workshop. I felt like an imposter that had no right being in that room with these Indigenous leaders and students. The First Nations, Métis, and Inuit speakers shared their stories of colonization and resilience. Each day started with a smudging ceremony in which all were invited to participate. After each smudging I went straight to the bathroom to cry. I felt such shame and guilt for what my settler ancestors did, and for my ignorance in not knowing about the histories of Indigenous peoples in Canada. My red nose and puffy eyes heightened my anxiety further. As a white woman of privilege, what did I have to cry about? As the week went on, non-Indigenous research partners spoke about how they've changed their research and how they work with Indigenous partners. I began to see a role for myself as an ally in Indigenous research and realized it was my responsibility as a non-Indigenous researcher to educate myself and change how I do research.

1.5.1 Imperialism and colonialism of Canadian Inuit

As part of my PhD program, I started reviewing the literature to learn more about decolonizing and Indigenous research approaches. However, what the Indigenous scholars did first was to start in the 15th century to explain the origins, philosophies, and evolution of colonialism. This history helped me to understand and begin to recognize how I was raised and educated, and how colonialism still perpetuates our institutions.

While the terms colonialism and imperialism are both associated with oppression, colonialism is the actual process of taking control, conquering, and exploiting other nations peoples and resources (Singh, 2001). Imperialism refers to the philosophy, morals and ethics that put colonialism into place (Singh, 2001). Starting in the 15th century, the imperialist philosophy encouraged the beliefs that there were new worlds to discover, conquer and control to expand European empires and benefit from economically (Smith, 2012). This is when the colonization of Indigenous people around the globe began. The Europeans depleted their natural resources and brought with them disease, and new religious and imperialistic beliefs and values.

For the Inuit, it wasn't until the 17th century that explorers first began coming to the Canadian Arctic to "discover", claim, and rename "new" lands to expand the colonial Empires (Livingstone, 1992; ITK, 2006). Whalers and Hudson's Bay Company fur traders, exploited local resources, and missionaries came to "save" the Inuit with their "superior" religious beliefs (Livingstone, 1992; ITK, 2006). However, it was during the Cold War era of the 1950s that the large-scale colonialization of Inuit began. Inuit were forced to settle in communities as part of the Government of Canada's assimilation approach called the "in-gathering policy" (MacDonald 2018), and some communities were relocated into the High Arctic to further Canadian Arctic sovereignty (CBC 2010; Qikiqtani Inuit Association 2014). As part of the Canadian government settlement and assimilation process, Inuit children were required to attend school and sent away to residential schools. Children were taken without consent and sent to larger, northern hub communities to live in residential schools until the 1990s. Children were stripped of their connections with the land, language, education, and culture and were subjected to physical, sexual and mental abuses (ITK, 2014; TRC, 2015). The large distances and expense to travel to their home communities meant that children were disconnected from their families and "in some cases, children were separated from their families for years" (TRC, 2015:4).

1.5.2 Settler colonialism

Colonialism in the Canadian context is described as settler colonialism, in which people from other countries invaded, settled, and established sovereign power (Barker and Battell Lowman 2016). Settler colonialism is also the ongoing process that continues to structure and shape relations between Indigenous peoples and settlers (Wolfe 2006; Tuck and Yang 2012; Veracini 2013). Castleden (2012) and Simpson (2004) both argue that external colonial control and the "… geographies of power are still apparent in the contemporary Canadian context with Indigenous peoples deeply harmed by marginalization governmental policies and practices" (Castleden et al., 2012:161). Price (2007) and McGrath (2011), scholars from Nunavut, argue that colonialism continues to systematically and symbolically undermine and devalue Inuit cultural systems that once made them self-sufficient.

The impact of the residential school experience in the Canadian Arctic is significant because the history is so recent. There are many living survivors, and this trauma has had intergenerational impacts on their children (TRC, 2015). The effects of colonialism are no more apparent than in the significant physical and mental health disparities experienced between Inuit and other Canadians (ITK, 2014). Inuit in Canada have lower life expectancies, higher rates of infectious diseases, mental health issues, and significantly higher rates of suicide than most other Canadians. In Canada the direct link between "the stigmatization, marginalization and racism associated with colonialism have been known to cause detrimental and irreversible effects on health and longevity" (Council of Canadian Academies, 2014; ITK, 2014:15).

Another aspect of colonialism is the legacy of exploitive research being conducted "on" instead of "with" Indigenous peoples (Koster et al., 2012; Bell, 2016). In most cases, the research was not requested or relevant to Indigenous peoples. It treats Indigenous peoples as passive subjects and makes no attempt to include Indigenous communities in the research process (Wilson, 2008; Koster et al., 2012). Indigenous peoples currently lack the "ability and opportunity to participate as equal partners" (ITK, 2016:8), leaving them in vulnerable positions in the research relationship. Castleden calls attention to this fact that after decades of Indigenous health research it "has yet to address deep and persistent health disparities" (2015:1). As a result, "[Indigenous peoples] have become resentful of research in general" (Wilson, 2008:15). In the Canadian Arctic they have also become "research fatigued" (Castleden et al., 2008; Ford and Pearce, 2012; Bell, 2016) and may no longer consider the benefits of research (ITK, 2016).

1.5.3 A brief history of knowledge production

The study of knowledge, how it is produced, and the underlying beliefs, values, philosophies, and methodologies of knowledge systems is a vast and ever-evolving field. There are many research paradigms now that intersect and overlap. To briefly describe the evolution of decolonizing and Indigenous approaches to research, and how it differs from the more dominant research approaches, this Section intentionally focuses on a simplified review of three research paradigms: positivist, emancipatory and Indigenous.

Up until the 17th century, European's source of knowledge was dominated by religious beliefs and superstition (Shuttleworth, 2011). In the 17th century, researchers began conducting experiments and making discoveries about the world based on facts and evidence, shifting some of the power of knowledge from the church to science. This is called the Enlightenment, or Modern period, which resulted in Positivist approaches to research. Positivists believe that the truth exists independent of ourselves, and can be uncovered through quantitative measurements and experiments by collecting data that can be measured, for example Newton's law of gravity. Positivist approaches believe that there is only one answer, and that the truth is in the data. Positivists take what is known as an objective approach in gathering data. They attempt to remove themselves from social and cultural contexts of the data collection, so they do not influence or bias the data being gathered (Erlingsson and Brysiewicz, 2013).

The Positivist approach shaped the economic, political, and cultural life of imperialism. It "led to the development of science values and rules for how knowledge is produced, still in use today" (Kovach, 2005:22). This dominant approach for how knowledge production is often referred to in the literature as "Western" science, research and/or knowledge. While Western science made many significant scientific discoveries, its limitations started being questioned in the 1950s. Scholars began to ask how "objective" and "accurate" Western research really was, as a majority of this work was done by white men for white men. To truly produce science that represented humankind, academia began to include social, cultural, economic, political and gendered dimensions in their research (National Research Council, 1997; Brown and Strega, 2005).

By the late 1970s, several alternative research paradigms were emerging in which researchers were no longer separating themselves from the research, but subjecting themselves to it by embedding their experiences and perspectives in the research. Subjective research captures people's experiences and perspectives using qualitative, or non-numeric data gathering methods such as text, photography, film and audio. The goal of the new paradigm called Emancipatory research, is to produce knowledge that is inclusive and empowers marginalized people in the collection and analysis of the research, and that the results contribute towards social change (Noel, 2016). Within the Emancipatory research paradigm, feminist, disability, race, gender based, and decolonizing research was emerging (Kovach, 2005; Noel, 2016).

Decolonizing research questions why Western research is considered the only way to conduct scientific inquiry (Smith, 2012). It critically assesses Western science throughout the research process, from the beliefs and philosophies used to design and frame the questions and methods, to the conduct, analysis and communication of results that undermine Indigenous peoples (Smith, 2012). Kovach also discusses that the "purpose of decolonization is to create a space in everyday life, research, academia, and society for an Indigenous perspective without it being neglected, shunted aside, mocked, or dismissed" (Kovach, 2009:85). Indigenous research is inherently decolonizing research with multiple purposes (Castleden et al., 2012; Grimwood et al., 2012; Smith, 2012; Coombes et al., 2014). Indigenous research is political. It is about social justice, self-determination, reconciliation, and education "with a view to re-writing and rerighting our position in history" (Smith, 2012:29). Indigenous scholars all agree that there is a fundamental difference between Indigenous and Western knowledge (Price, 2007; Wilson, 2008; Kovach, 2009; Smith, 2012). Wilson describes Western science as being predominantly individual, whereas Indigenous science belongs to the community, the universe, all of which they are a part of (2008). Wilson goes on to quote Mayan scholar Carlos Cordero who describes that in Western science there is:

> "A separation of those areas called science from those called art and religion. The [Indigenous] knowledge base on the other hand, integrated those areas of knowledge so that science is both religious and aesthetic. We find then, an emphasis in the Western tradition of approaching knowledge through the use of intellect. For Indigenous people, knowledge is also approached through the senses and the intuition" (2008:55).

The perception that Western knowledge is more scientific degrades Indigenous knowledge rather than considering this "cultural knowledge being seen as extra intellectual" (Wilson, 2008:58). Indigenous peoples want to re-assert their knowledge and shift the unequal power dynamic by developing their own capacity, to do their own research, in their own way, in their own words, under their terms, and for their own purposes (Kovach, 2009; Smith, 2012; Dei, 2013). Reports by Inuit Tapiriit Kanatami (ITK, 2016, 2018a) outline that Inuit specific research is a fundamental need for Inuit self-determination, their quality of life, and as rights holders under their land claims. Indigenous scholars are creating a new research paradigm in the academy "that takes back, transforms and makes space for this type of knowledge" (Smith, 2012: ix). It is about acknowledging colonialism in Western research and challenging how these approaches view Indigenous people as objects, from which to collect data (Smith, 2012). It is also about changing the academy, so they recognize how Indigenous people "make and create knowledge" (Dei, 2013:30).

There is no one size fits all Indigenous research paradigm, as place-based knowledge systems are location specific (Louis, 2007; Wilson, 2008; Koster et al., 2012). However, several Indigenous scholars agree that Indigenous paradigms are based on the principles of relationality and relational accountability (Wilson, 2008; Kovach, 2009; McGrath, 2011; Stewart-Harawira, 2013; Healey and Tagak Sr., 2014). Knowledge for Indigenous peoples is generated through their interconnected relationships with the land, animals, people, and the cosmos (Wilson, 2008). Shawn Wilson explains that "relationships do not merely shape reality, they are reality" (2008:7). Indigenous research values these relationships and therefore relational accountability means that Indigenous research methodologies must maintain and be accountable for these relationships in the research (Wilson, 2008). Because Indigenous research is relational, it is "the process [that] is far more important than the outcomes" (Smith 2012a: xi). To demonstrate relational accountability throughout the research process, researchers must follow the principles originally described by Cora-Weber Pillwax and cited by Wilson (2008: 99) known as the 3 Rs of Respect, Reciprocity and Responsibility. Relationality is the major difference between Western and Indigenous research approaches (Wilson 2008).

Understanding the evolution of Western research and how I was trained based on a positivist paradigm was a major turning point in my decolonization process. I had never thought about or even questioned Western research approaches as a younger graduate student (i.e., when

I completed my undergraduate and master's degree). Learning about decolonizing and Indigenous research approaches opened a door to a whole new way of thinking. I realized that I now needed to be part of the research, to begin to understand my conscious and unconscious biases, to take the time to develop relationships, and begin to do research that shifts the power imbalance to work in partnership with Inuit. I was also beginning to understand why Arctic research was still not benefiting Indigenous peoples. Arctic research funding programs, and again I include myself in this, were simply shoehorning in requirements to build Indigenous research capacity and incorporate Inuit traditional knowledge. Margaret Kovach, a Canadian Indigenous scholar describes this approach as "add Indigenous knowledge and stir" (2009:156). We simply added in these requirements without reckoning with our own colonial/positivist approaches that dominate Arctic science or understanding and making space for the fundamental differences in worldviews and research approaches of Indigenous people.

1.5.4 Literature Review 2002 to 2017: The state of decolonizing sea ice research with Inuit and Iñupiat

As I became more familiar with the Indigenous research literature, I realized I needed to look more closely at Arctic sea ice literature to understand how/if decolonizing research practices were evolving. At the time in 2018, all collaborative sea ice research working with Inuit was being led by non-Indigenous researchers. I conducted a review of relevant literature to learn how these non-Indigenous researchers were decolonizing their roles and to understand the current state of decolonizing sea ice research with Inuit and Iñupiat (to cover work with Inuit across North America). This review was not intended to critique individuals, as many of these sea ice researchers are extremely committed to working with Inuit. However, it is because of this dedication that this research area could be assessed for its decolonizing role in Arctic science.

On-line scientific journal databases were queried using the search criteria of "sea-ice" or “sea ice” or “ice”, and "Inuit" or “Iñupiat". The initial search resulted in 69 published articles. Upon further reading, literature reviews, and articles/book chapters that synthesized already published journal articles were removed. Therefore, I reviewed and analyzed 50 published articles between the years of 2002 and 2017, covering a wide range of sea ice topics, including: i) Inuit sea ice IQ and use; ii) observations of climate change impacts on sea ice; iii) risk, vulnerability, and adaptive capacity; iv) impacts on health; v) risks and impacts related to shipping; and vi) adaptation tools. (Table 1.2). The focus of this review is not about what the research was about, but how they did the research. The results of this sea ice research are discussed in subsequent sections (see Introductions 1.1, 1.4, 3.4, 4.3; and Backgrounds 3.5, 4.4).

Table 1.2: Review of literature on sea ice research with Inuit and Iñupiat (2002 to 2017)
* Articles were often assigned to multiple categories.

<table>
<tr><th colspan="2">General Categories</th><th>References</th></tr>
<tr><td colspan="2">Inuit sea ice IQ and use</td><td>Aporta, 2002, 2010; Nichols et al., 2004; George et al., 2004; Gearheard et al., 2006; Henshaw, 2006; Laidler and Elee, 2008; Laidler and Ikummaq, 2008; Laidler et al., 2008; Krupnik et al., 2010; Druckenmiller et al., 2010, 2013; Eicken, 2010; Heyes, 2011; Tejsner, 2013; Eicken et al., 2014</td></tr>
<tr><td colspan="2">Observations of climate change impacts on sea ice</td><td>Nichols et al., 2004; Gearheard et al., 2011; Henshaw, 2006; Meier et al., 2006; Ford et al., 2006, 2008b, 2009, 2013; Gearheard et al., 2006, 2010; Laidler et al., 2009; Druckenmiller et al., 2010, 2013; Barber et al., 2012; Huntington et al., 2013, 2016; Baztan et al., 2017</td></tr>
<tr><td colspan="2">Risk, vulnerability and adaptive capacity from climate and socio-economic factors</td><td>Nichols et al., 2004; George et al., 2004; Meier et al., 2006; Ford et al., 2006, 2007, 2008a, 2009, 2013; Tremblay et al., 2008; Laidler et al., 2009; Huntington et al., 2013, 2016; Durkalec et al., 2014; Clark et al., 2016a; Archer et al., 2017; Baztan et al., 2017</td></tr>
<tr><td colspan="2">Impacts on physical, mental, emotional, spiritual, social, and cultural health</td><td>Ford et al., 2009; Cunsolo Willox et al., 2013; Statham et al., 2014; Durkalec et al., 2015; Driscoll et al., 2016; Baztan et al., 2017</td></tr>
<tr><td colspan="2">Risks and impacts with increased shipping</td><td>Stewart et al., 2015</td></tr>
<tr><td rowspan="5">Adaptation tools</td><td>GPS</td><td>Aporta and Higgs, 2005; Gearheard et al., 2011</td></tr>
<tr><td>Community Based Monitoring</td><td>Tremblay et al., 2008; Druckenmiller et al., 2010, 2013; Eicken, 2010; Gearheard et al., 2010, 2011; Wilkinson et al., 2011; Bell et al., 2014; Eicken et al., 2014</td></tr>
<tr><td>Satellite Imagery</td><td>Meier et al., 2006; Druckenmiller et al., 2009, 2010, 2013; Eicken, 2010; Laidler et al., 2011; Bell et al., 2014; Eicken et al., 2014</td></tr>
<tr><td>Forecasting</td><td>Eicken et al., 2014</td></tr>
<tr><td>IQ</td><td>Tejsner, 2013</td></tr>
</table>

To frame the review of the literature, decolonizing, Indigenous relational accountability principles, and cross-cultural aspects from: Fletcher (2003, 37-38) as outlined in (Koster et al., 2012:198), Healey (2014), Kovach (2009), Louis (2007:134–135), Smith (2012:175–176) and Wilson (2008) were summarized in Table 1.3. The literature was reviewed based on specific words and phrases in Table 1.3 to assess the roles of non-Indigenous researchers in decolonizing themselves and their research. Columns in Table 1.3 provide a count and a percentage for the articles which accounted for these particular decolonizing aspects.

Table 1.3: Assessing decolonization in the sea ice research literature (2002 to 2017)

	Decolonizing, Indigenous, and cross-cultural principles	**Key Words and/or Phrases**	**Count** out of 50 articles	**Percentage**
1	Were established protocols for working with the community identified?			
	• Community protocols or values?	ethics protocols values	10	20%
	• Research license?		15	30%
	• Ethics review?		10	20%
2	Did the articles discuss levels of community collaboration?			
	• Relevance of this research for community needs?	community needs relevance	40	80%
	• Original research question came from the community, not the researcher?		15	30%
	• The research was a partnership and/or was collaborative?	accountability co-authorship co-design collaborate consultation community-based data ownership giving back partners reciprocity relationships relationality	27	54%
	• Community input in the project design?		23	46%
	• Community involvement in the production and analysis of the research results?		23	46%
	• Community participation in reviewing/validating the research results?		26	52%
	• Community participation in writing up the research results?		16	32%

	• Community ownership and accessibility to the research data?	respect responsibility stakeholders trust	8	16%
	• How the research results were shared, understood, useful and accessible by the community?		18	36%
	• Community members employed in the research?	capacity co-production decision-making education employment leadership mentor opportunities training	27	54%
	• Training/educating community members an aspect of this research?		10	20%
	• Community members play a leadership role in the research?		6	12%
3	Which methodologies and methods were outlined in the articles?			
	• Western Methodologies	Ethnographic	5	10%
		Integrated	5	10%
		Place based	4	8%
		Vulnerability based	6	12%
	• Decolonizing, alternative methodologies	Community-based participatory research (CBPR)	13	26%
		Collaborative	9	18%
		Co-produced	1	2%
	• Indigenous methodologies	Indigenous	0	0%
	• Western Methods	Community based monitoring	11	22%
		Focus groups	2	4%
		Participatory mapping	7	14%
		Participant observation	12	24%
		Semi-directed interviews	30	60%
		Surveys	1	2%
		Workshops	3	6%
	• Indigenous methods	Experiential learning	10	20%
		Story telling	2	4%

	• Awareness that the purpose of the alternative methods is for decolonizing research?	Decolonizing	0	0%
4	How did the papers discuss and describe Inuit knowledge?			
	• Discuss multiple realities, worldviews, or holistic approaches?	experience holistic knowledge local knowledge multiple realities mythical observational ontology oral philosophy spiritual traditional knowledge, traditional ecological world views	26	52%
	• Accepting Inuit knowledge on its own merit		42	84%
5	Was there an acknowledgement or understanding of colonialism and decolonizing and/or Indigenous approaches in the articles?			
	• Describing early explorers, the settlement of Inuit and great socio-economic change	alternative epistemology empower cultural colonialism decolonizing imperialism leadership power privilege self-determination reflexive vulnerable bias position statement	21	42%
	• Awareness of the community's colonial past and current context (i.e., new mine, previous research history, and colonial history – residential schooling and relocations). • Acknowledging colonialism?		8	16%
	• Researcher reflexivity and decolonizing self in making transparent their intentions and motivations?		1	2%
	• Whether a power imbalance exists?		1	2%
	• Empowerment or self-determination for the community?		3	6%

Table derived from (Wilson, 2008; Kovach, 2009; Koster et al., 2012; Smith, 2012; Healey and Tagak Sr., 2014).

The first section in Table 1.3 aims to understand how and if the non-Indigenous researchers accounted for community protocols and values. Approximately 20% of the papers referred to following proper protocols in consulting with specific community organizations at the beginning of the research project. Some of the articles identified the project's research license (30%) and ethics approval (20%). Both these numbers were higher in Canadian papers due to mandatory ethics and research licensing requirements.

Section two looks at the level of collaboration discussed in the papers. A total of 80% of the papers indicated that the research was relevant for community needs. However, it was difficult to ascertain “who” said it was relevant for the communities, the researcher or the communities (Smith, 2012). Only 30% of the papers indicated that the research question came from the communities, not the researcher, which may provide a better indication of the relevance of the research to the community. Over half of the research projects (54%) reported that the research was a partnership and/or collaborative, and community members provided input into the project design (46%). Community members were reported to be involved in the analysis (46%) and validation (52%) of the research, with 32% of the papers co-authored with community members. Some of the research articles identified community ownership of the research (16%), and 36% of the papers described their efforts to share the research results and make them accessible through a variety of innovative ways such as books, movies, maps, posters, presentations, resources for community schools, websites, and interactive on-line databases. The articles were reviewed to identify if the research discussed capacity development and/or provided educational opportunities for community members during the research project. Of the projects identified, 54% reported hiring local research assistants, guides, and translators, but less than 20% identified training and mentoring of the local hires. Only 12% of the papers indicated that community members were involved in a leadership or decision-making role in the project.

Section three looks at the various methodologies and methods used in the research. To encourage the inclusion of Indigenous peoples and their knowledge, funding agencies were promoting multidisciplinary research in calls for proposals. Several funders even suggested Community-based participatory research (CBPR), a popular methodology in Emancipatory research approaches, that has been adopted for working with Indigenous communities (Kovach, 2009; Smith, 2012; Castleden et al., 2015). CBPR has been defined as "community-driven research that is rooted in the co-production of knowledge between academic and community partners for the purpose of societal and institutional change" (Castleden et al., 2015:4). This collaborative approach shares the "ownership and decision-making between the researcher and the community involved" (Castleden et al., 2012:162), to learn new knowledge from each other, build local research capacity, and to make a positive difference in the community (Castleden et al., 2012; Smith, 2012). While considered a decolonizing methodology, Castleden argues that CBPR can also support the "movement towards self-determination and re-assertion of Indigenous epistemologies and methodologies in research involving Indigenous peoples" (2015:5). However, not all Indigenous scholars agree. Several argue that Indigenous research needs to be conducted from a different worldview, and that even research strategies such as CBPR have evolved out of conventional Western research paradigms (Louis, 2007; Wilson, 2008; Kovach, 2009; Smith, 2012). However, the use of CBPR was on the rise and being used for work with Inuit communities, mostly around climate change research and monitoring, to incorporate Inuit knowledge and build capacity. A majority of papers discuss using more than one methodology, such as CBPR (25%) and place-based research (8%) approaches (Table 1.3). The articles reference the use of multiple and mixed methods, but none of them discuss using Indigenous research approaches. Many of the papers utilized western social science methods, such as semi-directed interviews (60%) and participant observations (24%), while 24% of the projects used alternative research methods such as storytelling (4%) and experiential learning (20%). None of the articles discuss how the approaches they were adapting, such as CBPR, were decolonizing approaches.

The fourth section in Table 1.3 assessed whether Inuit and Iñupiat knowledge was acknowledged for its own scientific merit and utilized in the research. More than half of the papers (52%) mention the philosophical and holistic approaches of Inuit and Iñupiat knowledge. However, 84% of the papers discussed a deep respect for Inuit and Iñupiat knowledge. Section five in Table 1.3 examines how the non-Indigenous authors discuss the history and ongoing colonization of Inuit and assess how alternative approaches were conceptualized in the research. Nearly half (42%) of the papers discuss accounts of early explorers, and the rapid socio-cultural change of Inuit since their settlement into communities. However, only 16% of the papers acknowledge colonialism, discuss Inuit relocation, residential schooling, and previous negative research relationships. Only 2% of the articles provide a sense of reflexivity or were transparent with their biases or positions of power in the research relationship. Very few articles (6%) discussed how the research would empower and support self-determination in research.

This literature review shows progress in how these non-Indigenous researchers were changing their research approaches to work collaboratively with Inuit and Iñupiat in community-based sea ice research. On average, half of these sea ice projects had community members employed and involved throughout the research process following community-based, and participatory research approaches and methods. The articles outline the importance of taking the time to build relationships and trust in communities. Additionally, the authors go into great detail to justify the inclusion of IQ and its value in Arctic science based on its own merit, years of experience and observational expertise on the land. Several authors discussed the benefits of joint, multiple, complementary, and parallel knowledge production to learn from each other and learn from their differences and similarities. This is a reflection on the state of collaborative sea ice research at this time, which was focused on ways to work with Inuit knowledge holders and their IQ in sea ice research

The results in Table 1.3, highlight that there is a gap in acknowledging colonialism and documenting how the researchers were decolonizing themselves and their research. The lack of recognition of the colonialism (or avoidance) may be for several reasons, including but not limited to: settler guilt; a post-colonial attitude; a lack of self-awareness; fear of being labelled an activist; and the resulting repercussions from the academy and traditional science journals. However, Kovach argues "that there can be no advance in Indigenous research approaches without acknowledging the historical influence of Indigenous-settler relations" (2009:157). Cameron, in her review of Arctic climate change adaptation literature, also noted that "Colonialism fails to appear as a word or concept in these studies, in spite of the fact that the projects are carried out in communities that are profoundly shaped by colonization...a substantive reckoning with colonial, postcolonial and decolonizing histories, practices, and ideas is necessary to move the field forward" (2012:104).

The purpose of decolonizing research is to empower communities and build self-determination through Indigenous decision-making and significant roles in the research. Only

2% of the articles discussed power imbalances in the research and 6 % articulated empowering the community. The research articles reported that only 30% of the research questions came from the community, 20% provided training and mentoring opportunities, and 12% of the research provided leadership and decision-making opportunities. These results show that in many of the articles, the decision-making in these collaborative projects remained with the non-Indigenous researcher. Although these decolonizing aspects were not discussed in the literature, it does not necessarily mean that they were not considered by all the non-Indigenous researchers. Some non-Indigenous sea ice researchers were gaining respect great respect from Inuit for their approaches; but they did not write about their decolonizing process in their publications at the time. However, the unknown nature of these decolonizing aspects provides an indication that either the non-Indigenous researchers:

- felt that the intended audience of the journal articles at the time would not have valued these aspects; and/or
- were using these alternative methodologies without understanding and fully conceptualizing the decolonizing aspects of these methodologies throughout the research practice; and/or
- that these decolonizing concepts were not considered.

Some may question the validity of posing such questions about decolonizing research approaches after the fact, when the non-Indigenous researchers may have been uninformed of these emerging principles, or that they would be compared against them. However, being unaware may provide the ideal conditions in which to assess the Arctic sea ice research being conducted with Inuit and Iñupiat. This review also highlighted a gap in collaborative sea ice literature. At the time there were no example of how non-Indigenous researchers could begin to decolonize themselves and their research. Therefore, I began to search for Inuit-specific research methodologies to learn from.

1.5.5 Literature Review 2002 to 2017: Inuit-specific research approaches

I then reviewed the literature to seek out Inuit-specific research methodologies to learn how they were similar and/or different in comparison with Indigenous research methodologies (Section 1.5.3). Although Indigenous research methodologies were evolving rapidly, there were few Inuit-specific research approaches published in the literature. In 2018, there were five Inuit-specific research methodologies to draw from across the Inuit Circumpolar regions, particularly in Canada and Alaska (Table 1.4). There were four areas of consensus in these Inuit research methodologies that paralleled the broader Indigenous research approaches.

1. As with many other Indigenous groups, Inuit knowledge is also based on a relational paradigm.
2. Relationality and relational accountability are part of Inuit values but need to be revitalized in a modern context due to the effects of colonialism.
3. Inuit research is a process towards decolonization and self-determination, and in reclaiming Inuit ways and decision-making power.
4. Inuit knowledge is a distinct system that must be recognized on its own merit. It is fundamentally and philosophically different than western knowledge.

I was looking for Inuit-specific models that provided examples of how relational accountability and Inuit methodologies were put into practice. The Piliriqatigiinniq model

(Healey and Tagak Sr., 2014) and the Alaskan Inuit food security conceptual framework (ICC-Alaska, 2015a) were the only two models that provided some of this practical guidance.

Table 1.4: Inuit-specific research methodologies as of 2018

#	Model name	Arctic Region	Description
1	The Kitchen Consultation Model (KCM) (Price, 2007)	Nunavut	• Many Nunavumiut do not feel that their voices are being heard through colonial consultation and decision-making process adopted by the Government of Nunavut (GN). • The GN solicits information from communities only through large public meetings. The GN directs and owns this information and determines and implements the solutions. • This process has resulted in political “inactivity and apathy” in communities (Price, 2007:68). • Historically, Inuit consulted one another and made decisions through an iterative process of group meetings and one-on-one discussions in people’s homes, around the kitchen table. • The KCM provides a framework for Inuit to re-gain ownership over the community consultation processes based on Inuit governance principals that successfully sustained them in the past.
2	The Qaggiq Model (McGrath, 2011)	Nunavut	• McGrath worked with Inuk Elder Mariano Aupilarjuk to develop an Inuk-centered process for Inuktitut knowledge renewal as a way to reclaim Inuit knowledge systems and self-determination. • The Qaggiq Model is based on four pillars: nuna (homeland), uqausiq (language), unipkaat (living histories), and iliqqusiq (culture). • The PhD dissertation, now book, (McGrath, 2018) describes and provides examples for how this model can be used as a conceptual tool to learn, support and understand barriers to Inuit relational knowledge systems in research, education and land claim agreements.
3	Indigenous frameworks for observing and responding to climate change in Alaska (Cochran et al., 2013).	Alaska	• Cochran shares examples of partnerships with Indigenous peoples from the Alaskan region working to achieve adaptation and climate solutions. • A multi-pronged approach outlines the benefits of early engagement in the design of the project, recognizing and respecting multiple ways of knowing throughout the project, and fostering regional and international networks so Inuit communities can learn from each other.
4	The Piliriqatigiinniq Partnership Model for Community Health Research (Healey and Tagak Sr., 2014).	Nunavut	• This model describes how Inuit concepts of inuuqatigiittiarniq (being respectful of all people), unikkaaqatigiinniq (storytelling), pittiarniq (being kind and good), and iqqaumaqatigiinniq (all things coming into one) provide the foundation for overarching goal of the model, piliriqatigiinniq (working together for the common good).

			• This model was developed to guide how research is conducted at the Qaujigiartiit Health Research Centre in Iqaluit, Nunavut and those partnering with them.
5	Alaskan Inuit Food Security Conceptual Framework (ICC-Alaska, 2015b).	Alaska	• Food security is often measured by the cost of food and its nutritional value. However, these measures do not capture what food security means for Inuit in the Alaskan region. • In this framework, "Inuit food security is characterized by environmental health and is made up of six interconnecting dimensions: 1) Availability, 2) Inuit Culture, 3) Decision-Making Power and Management, 4) Health and Wellness, 5) Stability and 6) Accessibility (ICC-Alaska, 2015b:31). • An important component of this framework is Inuit food sovereignty, without sovereignty, "food security will not exist" (ICC-Alaska, 2015b:31). • Using the examples of walrus health and sea ice thickness, we are also shown how the model can be used to guide the development of research projects and questions from an Inuit perspective to understand the connections and cumulative impacts.

The release of Inuit Tapiriit Kanatami's (ITK) National Inuit Strategy on Research (NISR) was a significant policy document that exposed the: historical and ongoing inequalities between Inuit Nunangat and the rest of Canada because of colonialism; the negative legacy of research on Inuit; and how past and current research policies fail to support Inuit self-reliance (ITK, 2018a). The NISR lays out the following five priority policy areas to assert and advance Inuit self-determination in research:

1. Advance Inuit governance in research
2. Enhance the ethical conduct of research
3. Align funding with Inuit research priorities
4. Ensure Inuit access, ownership, and control over data and information
5. Build capacity in Inuit Nunangat research (ITK, 2018a).

The publication of the NISR implementation plan later that year (ITK, 2018b) outlines ITK's approach to work with Government of Canada departments, funding agencies, and universities to achieve the priorities set out in the strategy (ITK, 2018a).

The NISR, the Inuit research methodologies, and the Arctic environmental literature provided little guidance for how individual non-Indigenous researchers, like me, could decolonize themselves and their research. To meet the 1st objective of my PhD, and to begin addressing this gap in decolonizing methodologies for non-Indigenous researchers, I began documenting my experiences.

1.5.6 A decolonizing methodology for the non-Indigenous researcher (Objective 1)

Few universities in Canada that focus on Arctic and northern studies, teach their undergraduate or graduate students about colonization, or decolonizing and Indigenous research approaches. Chapter 2 is entitled "Changing the role of non-Indigenous research partners in practice to support Inuit self-determination in research"(Wilson et al., 2020). The journal Arctic Science was doing a special issue on "Knowledge Mobilization on Co-Management, Co-Production of Knowledge, and Community-Based Monitoring to Support Effective Wildlife Resource Decision Making and Inuit Self-Determination". The target audience of this journal and the focus of the special issue presented an opportunity to share this methodology with other non-Indigenous Arctic researchers wanting to decolonize themselves and their research.

The initial Section of Chapter 2 is entitled "A decolonizing methodology for the non-Indigenous researcher". This piece is a summary of the literature review from Section 1.5.1 to

1.5.3 that examines the history and ongoing colonization of Inuit, colonial approaches to research, and the negative impacts of research on Indigenous peoples. A summary of the decolonizing, Indigenous and Inuit-specific research methodologies from Section 1.5.4 situates the decolonizing research gaps in Arctic science. In addition, I introduce the guidance from Indigenous scholars that helped me to recognize a path forward for my own decolonization journey, my role as a non-Indigenous researcher, towards addressing my **1st research objective** – to understand and redefine the role of the non-Indigenous researcher in supporting Inuit self-determination in research. As highlighted in Table 1.1, this individual objective continued and was iteratively informed and refined through Objectives 2 to 5.

1.6 Decolonizing my research approach (Objectives 2 to 4)

Beginning in November 2015, at the start of my PhD program I made my first of many visits to Mittimatalik. I was not sent to the community on my own; Bell and Ljubicic mentored me in the community during different trips. While Bell and Ljubicic were relatively new to Mittimatalik, with their experiences from other communities in Nunavut and Nunatsiavut, they knew what community organizations and leaders were important to meet with, how to adjust to the seasonal tempo of the community, and how to make themselves available if people wanted to discuss anything further. It was also an education in plain language communication. Learning not to interrupt, to slow down, to simplify my comments for simultaneous translation, and to be okay with uncomfortable pauses in the conversation that are part of cultural practices and allow people time to think.

Working with Ikaarvik provided a unique opportunity to work side-by-side and develop relationships with Inuit youth during the first two years in consulting and establishing SmartICE in the community (2015-2017). Ikaarvik youth were surprised that I was a researcher who had come to the community without a research plan and was there to listen and understand the community's research needs. I dedicated time to meet and learn from Ikaarvik youth about how Inuit would approach research, and about Inuit knowledge. Ikaarvik explained that Inuit Qaujimajatuqangit (IQ) was not just knowledge that Western researchers can collect as data. IQ translates to "what Inuit have known all along" and encompasses Inuit values and world views that have been passed down through generations and continues to be extensively practiced (Kalluak, 2017:41; Karetak and Tester, 2017). It was Ikaarvik youth that introduced me to the Inuit Societal Values (ISVs) listed below. IQ is based on Inuit cultural values, and the ISVs are the foundational values collectively agreed upon by Elders from the Kitikmeot (Western), Kivalliq (central) and Qikiqtaaluk (eastern) regions of Nunavut (Arnakak, 2002; McGrath, 2011, 2018; Karetak and Tester, 2017):

- **Pijitsirniq**: serving and providing for family or community, or both;
- **Piliriqatigiinniq** or **Ikajuqtigiinniq**: working together for a common cause;
- **Avatittinnik Kamatsiarniq**: respect and care for the land, animals and the environment.
- **Qanuqtuurniq**: being innovative and resourceful;
- **Pilimmaksarniq** or **Pijariuqsarniq**: development of skills through practice, effort and action;
- **Inuuqatigiitsiarniq**: respecting others, relationships and caring for people;
- **Tunnganarniq**: fostering good spirit by being open, welcoming, and inclusive; and
- **Aajiiqatigiinniq**: decision making through discussion and consensus.

Ikaarvik uses the ISVs to guide their work and recommends that non-Indigenous research partners learn to apply these principles when working with Inuit. The challenge for the non-Indigenous co-researcher such as myself and my supervisors, is how to understand these principles when you are not from the Inuit culture. In February of 2017, a small workshop was held with Ikaarvik youth to discuss what the ISVs mean to them, to help me understand, and for Ikaarvik to develop ways to explain and articulate these values to researchers coming from outside the community and the culture (Aaluk et al., 2018).

During the initial two years in the community, the Sikumiut committee was also being established to govern Mittimatalik's SmartICE operations. The ten-person committee includes Inuit men and women representing: Elders, Search and Rescue, Parks Canada, Canadian Rangers, Government of Nunavut Wildlife, Hunters and Trappers Association, young hunters and outfitters. Multiple visits to the community working with Ikaarvik and Sikumiut between 2015 and 2017, allowed time to build trust and learn about community priorities. As the research relationship developed with Sikumiut they began to share their worries about:

- Inuit youth lacking the IQ to travel safely on the sea ice;
- climate change making local sea ice travel unsafe; and
- increased shipping and possible icebreaking during the sea ice travel season.

We began discussing some research ideas and these conversations led to the evolution of Sikumiut's research **objectives 2 and 3** (Section 1.2, Table 1.1 in blue).

We also began discussing what values would underpin our research relationship and approaches. Discussing research values with Sikumiut was an awkward conversation. Perhaps they had never been asked, they didn't think I would understand, or it seemed ridiculous to discuss, as they have always lived their lives based on such values as the ISVs. The ISVs helped me to understand how Sikumiut would approach research from an Inuit perspective. This also led to the framing of **objective 4**, to co-develop a research approach to meet Sikumiut's objectives (Section 1.2, Table 1.1 in green).

In Chapter 2, Section 2.6 entitled*, "From guidance to practice: The Sikumiut model",* summarizes the decolonized research approach that emerged as we worked together and as I learned about the history of knowledge production, Inuit decolonizing approaches and Inuit Societal Values. The co-developed approach is called the Sikumiut model and Section 2.6 describes in detail the six goals of the Sikumiut model:

1. Support Inuit self-determination in research;
2. Embrace Inuit decision-making;
3. Prioritize community-based research needs;
4. Develop Inuit specific values for research;
5. Strengthen Inuit youth capacity; and
6. Change the role of non-Indigenous research partners.

This model reconceptualizes the typical research roles of Inuit from participants to decision-makers and researchers. Sikumiut governs the project and Inuit youth conduct the research. As a non-Indigenous research partner, my role in the research focused on training and mentoring the Inuit youth to be the researchers. We compare the Sikumiut model with the goals of the NISR (ITK, 2018a) to highlight how this co-developed approach supports Inuit self-determination in research. The benefits, challenges, and potential to build on the existing research capacity of Inuit youth are also discussed. Chapter 2 closes by sharing reflections and lessons learned from the perspective of the non-Indigenous research partners in practicing decolonizing research.

1.7 Decolonizing my research in practice (Objective 5)

All the discussions leading to the concerns shared by Sikumiut in the previous section also ensured the shared understanding and developing trust necessary to articulate Sikumiut's research objectives and to co-develop the Sikumiut model. However, the next step in our decolonizing research process was to put this approach into practice to address Sikumiut's research needs, in other words to address **objective 5** (Table 1.1 in green).

1.7.1 Documenting Sikumiut's sea ice travel knowledge and practices (Objective 2)

The ability to identify safe and dangerous sea ice while travelling is a critical lifesaving skill that Inuit have relied on for a millennium. Sea ice has always been dynamic and dangerous, but concerns have increased with new and more unpredictable conditions occurring as a result of climate change. Sikumiut are very concerned that Inuit youth lack the fundamental IQ to travel safely on the sea ice, and they wanted to document and mobilize their IQ in different ways to support safe community sea ice travel. A critical aspect of the Sikumiut model is reciprocity

(Wilson et al., 2020). This research was designed and implemented to focus on community research needs, and to support Inuit research capacity and leadership. To build local research capacity Andrew Arreak, the SmartICE Nunavut Operations Lead for the Qikiqtaaluk North region, became the lead youth researcher on this project. Mentoring and training Arreak to work on community research needs was a way I could give back.

Chapter 3 describes the co-produced steps to address **objective 2** (Table 1.1 in blue). Sikumiut were firm that this work needed to start with documenting Inuktitut sea ice terminology, as this was the foundation from which to build the next generations sea ice IQ. The methods used to train Arreak and co-facilitate the initial sea ice terminology workshops are outlined in Section 3.6.3, and the IQ that Sikumiut felt was most important to document and share are discussed. Participatory mapping workshops to capture Sikumiut's seasonal knowledge of safe and hazardous sea ice conditions, main trails and areas to seek shelter were also held. The workshop methods and the geographic information systems (GIS) training given to Arreak to create these seasonal maps are described in Section 3.6.4. Early on we realized that Sikumiut's knowledge could not always be captured in a term or on a map. During these workshops Sikumiut were teaching skills to youth in how to prepare and read the sea ice conditions as they travel. Jamesie Itulu, a local Inuit youth artist, then joined our research team to develop illustrations and posters to help mobilize Sikumiut's sea ice IQ in additional ways.

Section 3.7, the Results, reviews the application of these products throughout the various sea ice seasons and how sea ice IQ and experience is vital for decision-making out on the sea ice. Section 3.8, the Discussion section, also explores the unique ways and the time required to document, discuss, develop and validate a household sea ice terminology booklet, seasonal sea ice safety maps, and posters. These materials accommodate varying levels of Inuktitut proficiency and sea ice travel experience to be accessible to multiple generations of Mittimatalingmiut.

The journal article that comprises Chapter 3, is titled "`*When we're on the ice, all we have is our Inuit Qaujimajatuqangit'*: Mobilizing Inuit knowledge as a sea ice safety adaptation strategy in Mittimatalik, Nunavut" (Wilson et al., 2021b). This article was published in the journal Arctic, a highly referenced journal for physical and social science research scientists in the Canadian and circumpolar Arctic. This journal was selected to share an example of a decolonizing research approach in practice, with a broad cross-section of the Arctic research community. We wanted to demonstrate how sea ice IQ continues to be necessary and relevant for safe sea ice travel and decision-making out on the sea ice. We also wanted to explain how our research process was able to work with, honour and share Sikumiut's IQ to meet their community research needs.

1.7.2 Developing a baseline of Mittimatalik's sea ice conditions (Objective 3)

Inuit maintain the longest unrecorded climate history of sea ice in Canada. Sikumiut's sea ice climatology is preserved by orally passing down this IQ through generations and sharing their extensive and recent travel experiences on the sea ice. Sikumiut's sea ice climatology is therefore not in a database, but exits in the collective minds of these expert sea ice travellers. Also, their climatology is not focused on sea ice extents or volumes in a general scientific sense, but more specifically on ice conditions for safe travel. Sikumiut members have an intimate knowledge of the average seasonal evolution of sea ice for Mittimatalik. Knowledge of which sea ice areas are becoming more dangerous is critical information for adapting travel routes to avoid changing risks. Discussions across many Sikumiut meetings evolved around the need to develop a baseline of sea ice knowledge for Mittimatalingmiut to understand where and when the sea ice is changing most to adapt sea ice travel. Sikumiut were also interested in using this sea ice baseline to understand the cumulative impacts of shipping during sea ice formation and break-up.

To address the **3rd objective** of the PhD (Table 1.1 in blue), we again put the Sikumiut model into practice. To assist Sikumiut's climate change adaptation needs, a novel approach was co-developed to document their sea ice IQ with the aid of earth observations and CIS sea ice charts to create the Mittimatalik siku asijjipallianinga (sea ice change atlas). In Chapter 4 the process and methods to co-produce the IQ-based atlas are described. This atlas required an investment of four years during which Inuit were involved in the discussions from the very beginning, not just during a couple of workshops. These timelines are not significantly different from that required to coordinate scientific and environmental research and assessments. Mittimatalik's sea ice climate change trends (averages, variability, spatial changes) over the 23-year climatological period (1997-2019) demonstrate similarities and differences with circumpolar trends. Once illustrated, the value of such IQ-based, community-scale sea ice climatologies for local and regional scales are demonstrated. The atlas provides an adaptation tool that Mittimatalingmiut can use to share the weekly locations of known and changing sea ice conditions throughout the season to plan for safe sea ice travel. We also explore the value of this atlas as a case study in a current environmental assessment process. Sikumiut are very worried about the impacts of a proposal to extend the shipping season to the nearby Mary River Mine (MTHO, 2021; Sikumiut, 2021). Baffinland Iron Ore Mines wants to ship earlier during sea ice break-up and later as the sea ice is freezing (Bourbonnais et al., 2016). Avoiding disturbances to significant sea ice locations during freeze-up and break-up is critical for safe sea ice travel throughout the season, as well as for wildlife habitat and migration.

The published journal article for Chapter 4 is titled "The Mittimatalik siku asijjipallianinga (sea ice climate atlas): How Inuit knowledge, earth observations and sea ice charts can fill IPCC climate knowledge gaps" (Wilson et al., 2021a). The journal Frontiers in Climate was seeking input from researchers working in Arctic Indigenous communities for a special issue on *Knowledge Gaps from the International Panel on Climate Change (IPCC): Special Report on the Ocean and Cryosphere in a Changing Climate (SROCC) and Recent Advances*. Arctic assessments such as the SROCC are limited in addressing the specific climate change questions of Arctic Indigenous communities because of the global, top-down, model-focused approaches used (Ford et al., 2012). Perspectives from Arctic Indigenous peoples tend to be "fit in" as separate chapters in these assessments to provide a link between model output and community scales. The decision to submit this paper for the Frontiers in Climate special issue was to reach an international audience of climate scientists, particularly those involved in Arctic climate change and environmental assessments.

1.8 My ongoing commitment to change

Chapter 5 is the concluding chapter of the thesis, in which I summarize the research goal and objectives, the main research contributions, and what I learned during my doctoral research.

I also discuss the limitations to this research for other non-Indigenous researchers who want to learn from, apply and/or develop their own approaches to co-developing meaningful decolonizing research with Inuit. I explore how non-Indigenous researchers continue to remain in positions of power, and the challenge in building Inuit research capacity and providing accreditation for Inuit research leadership. I make recommendations to expand this type of IQ-based sea ice research to improve safe sea ice travel for other communities in Inuit Nunangat.

Although my PhD is complete, my commitment to engage in decolonizing Arctic science and to support Inuit self-determination in research is ongoing. The process of decolonizing institutions, and individuals, takes time, is iterative, and always evolving. The reflexive pieces in my thesis reflect my own journey, and what it meant to be decolonizing my role as a non-Indigenous researcher. In sharing about my learning journey, I hope that others may be encouraged to reflect on, and share their own experiences and lessons learned in a variety of contexts.

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Chapter 2

Changing the role of non-Indigenous research partners in practice to support Inuit self-determination in research

Wilson, K.J., Bell, T., Arreak, A., Koonoo, B., Angnatsiak, D., and Ljubicic, G.J. 2020. Changing the role of non-Indigenous research partners in practice to support Inuit self-determination in research. Arctic Science 6(3):127–153. https://cdnsciencepub.com/doi/pdf/10.1139/as-2019-0021

2.1 Abstract

Efforts to date have not advanced Indigenous participation, capacity building and knowledge in Arctic environmental science in Canada because Arctic environmental science has yet to acknowledge, or truly practice decolonizing research. The expanding literature on decolonizing and Indigenous research provides guidance towards these alternative research

approaches, but less has been written about how you do this in practice and the potential role for non-Indigenous research partners in supporting Inuit self-determination in research.

This paper describes the decolonizing methodology of a non-Indigenous researcher partner and presents a co-developed approach, called the Sikumiut model, for Inuit and non-Indigenous researchers interested in supporting Inuit self-determination. In this model the roles of Inuit and non-Indigenous research partners were redefined, with Inuit governing the research and non-Indigenous research partners training and mentoring Inuit youth to conduct the research themselves. The Sikumiut Model shows how having Inuit in decision-making positions ensured Inuit data ownership, accessibility, and control over how their Inuit Qaujimajatuqangit is documented, communicated and respected for its own scientific merit. It examines the benefits and potential to build on the existing research capacity of Inuit youth and describes the guidance and lessons learned from a non-Indigenous researcher in supporting Inuit self-determination in research.

2.2 Co-Authorship Statement

For this chapter, Wilson reviewed and summarized the materials for the background and literature review. Arreak and Bell facilitated the community consultation and Sikumiut meetings. Wilson developed the concept and design of the Sikumiut Model. Koonoo and Angnatsiak contributed to conception and design, and the Sikumiut Management committee approved the Model. Wilson wrote all drafts of the manuscript. Bell, Ljubicic, Koonoo, Angnatisiak and Arreak contributed to manuscript revisions and approved the submitted version.

2.3 Isumagillugu

Pinasuktaujut maannamut pivaallirtittisimangimmata nunaqarqaarsimajunik ilautitauninginnik, pijunnarsivallianirmik ammalu qaujimajaujunik ukiurtartumi avatilirinikkut kiklisiniarnikkut kanata pijjutigillugu ukiurtartumi avatilirinikkut kiklisiniarnikkut ilisarsisimangimmata, uvaluunniit piliringimmata issaktausimangittunik silataanit qaujisarnirmut. Uqalimaagait issaktausimangittunit silataanit ammalu nunaqarqaarsimajut qaujisarningit piviqartittikmata tukimuagutaujunnarlutik asiagut qaujisarnikkut, kisiani titirartauqattanginnirsaukmat qanuq pilirigajarmangaata ammalu ilautitauningit nunaqarqaarsimangittut qaujisarnirmut ikajurtuilutik Inuit nangminiq qaujisaqattarnirmut.

Taanna titirarsimajuq uqausiqartuq issaktausimangillutik iliqusiujumik nunaqarqaarsimangittut qaujisartiujut ammalu saqittillutik ikajurtigiiklutik pigiartittinirmik, taijaujuq sikumiut aturtanga, inungnut ammalu nunaqarqaarsimangittunut qaujisartinut pijumajunut ikajurtuilutik Inuit nangminiq qaujisarnirmut. Tavani aturtaujumi piliriaksangit Inuit ammalu nunaqarqaarsimangittut qaujisartiujut tukisinarsititaullutik, Inuit aulattillutik qaujisarnirmik ammalu nunaqarqaarsimangittut qausartit ilinniartittillutik ammalu pilimmaksaillutik makkuktunik inungnik nangminiq qaujisarunnarniarmata. Sikumiunut aturtaujuq takuksaujuq qanuq Inuit aaqiksuijiullutik Inuit pisimajiuniarlutik tinngirartaujunik, takujaujunnarningit ammalu aulatauningit qanuq Inuit qaujimajatuqangit titirartaukmangaata, tusaumajjutaukmangaata ammaluikpigijaulutik kiklisiniarnikkut atuutiqarninginnik. Takunangniujuq pivaalliutaujunnartunik ammalu pirurpalliagajartunik maanna qaujisarniujumik pijunnarsiqullugit makkuktut Inuit ammalu uqausiulluni tukimuagutaujunnartut ammalu ilitausimajut nunaqarqaarsimangittunit qausartinit ikajurtuilutik Inuit nangminiq qaujisarnirmut.

2.4 Introduction

Although Canadian Arctic research programs have developed policies to increase Indigenous participation, capacity building and Indigenous knowledge in Arctic science, Arctic research continues to mostly benefit non-Indigenous researchers, not Indigenous peoples and their communities (Kovach, 2009; Brunet et al., 2014, 2016; ITK, 2016a). Indigenous participation has not improved in Arctic environmental science because a majority of researchers and their organizations have yet to acknowledge how colonialism continues to impact Inuit and contemporary research approaches (Cameron, 2012), or truly practice decolonizing research. As a result, universities and research funding programs continue to conduct Arctic environmental research from conventional, western research perspectives (Wilson, 2008; Kovach, 2009; Smith, 2012a; McGrath, 2018). However, Inuit are making significant advancements to change the status quo, as demonstrated by the release of the National Inuit Strategy on Research (NISR) to advance Inuit self-determination in research (ITK, 2018).

The expanding literature on decolonizing and Indigenous research provides guidance and principles towards changing current research approaches with Indigenous peoples, but less has been written about how you do this in practice (Ninomiya and Pollock, 2017; Gerlach, 2018). There are also very few examples that illustrate the potential role for non-Indigenous research partners (Kovach, 2009; Gaudry, 2015). As the concept of decolonizing research is still in its infancy in Arctic environmental science, there is even less advice for Arctic research funders and non-Indigenous researchers in how to change their current approaches to support Inuit self-determination in research.

The purpose of this paper is to present a decolonizing research methodology for non-Indigenous researchers and a co-developed research model from the community of Mittimatalik (Pond Inlet), Nunavut to support Inuit self-determination in research. This research paper adds to the growing decolonizing research literature by providing Inuit and non-Indigenous researchers with a practical example in which the roles of Inuit and non-Indigenous research partners were redefined.

The first section *Positioning myself,* provides a personal introduction so readers can understand the positionality of the first author in the research and the authorship of this paper. The next section, *A decolonizing methodology for non-Indigenous researchers*, outlines the methodology used in efforts to decolonize oneself in preparation for - and throughout - the research process. *From guidance to practice: the Sikumiut Model* describes how the research relationship was co-developed. Sikumiut, which means "people of the sea ice" in Inuktitut, is the self-titled name of the 10-person committee that governs SmartICE, a community-based sea ice monitoring program (see www.SmartICE.org) in Mittimatalik. Through multiple visits to the community to build trust, establish SmartICE and practice decolonizing research approaches, a research relationship was developed. The Sikumiut Model describes how Inuit are governing this research, non-Indigenous research partners are training and mentoring Inuit youth, and Inuit youth are conducting the research to address the community's research needs. In the *Discussion* section the fundamental NISR priority of having Inuit in decision-making positions is emphasized as critical for achieving Inuit self-determination in research. Many learning experiences arose in developing the Sikumiut model and are related to securing data ownership, accessibility, and control over how Inuit Qaujimajatuqangit is documented, communicated and respected for its own scientific merit. The benefits, challenges, and potential to build on the existing research capacity of Inuit youth are also discussed. To close, reflections and lessons learned are provided from the perspective of a non-Indigenous researcher in decolonizing oneself, and in practicing decolonizing research to support the greater goal of Inuit self-determination in research.

2.5 Positioning Myself

I (Katherine Wilson) am a Federal Government employee that has been involved in Arctic science since 1995. I have been employed with the Canadian Ice Service (CIS), part of the Meteorological Service of Canada, Environment and Climate Change Canada (ECCC) for 15 years (1995 to 2008, and 2015 to present). During the first decade of my career, I was the typical researcher that flew into field camps and worked on and off ships without ever having a conversation with a member of the nearby Inuit community. It was in the early 2000s when my perspectives started to change based on PhD research from Fox (2004) and Laidler (2007). These women were working *with* Inuit to learn about the impacts of climate change on sea ice while deeply respecting Inuit and their knowledge. Between 2008 and 2015, I worked in the department formerly known as Indian and Northern Affairs (INAC) in coordinating calls for proposals for several Arctic research funding programs (International Polar Year, the Arctic Research Infrastructure Fund, the Northern Contaminants Program, and the Canadian High Arctic Research Station). During this time at INAC I was able to travel across the Canadian Arctic, work with Indigenous organizations, develop relationships, and begin to understand more about Inuit culture and worldviews. I also witnessed and contributed to many efforts to improve Inuit participation, capacity building and knowledge in Arctic science. During my time at INAC, one research project that caught my attention was SmartICE. Originally out of Memorial University, SmartICE was doing research differently and I was inspired by this Inuit-led community-based sea ice monitoring program (in 2017 SmartICE was incorporated as a not-for-profit, northern social enterprise). In 2015, I went back to school full-time to work on my PhD at Memorial University so I could become part of the SmartICE team and learn more about working with Inuit and their research needs. The 2018 release of ITK's National Inuit Strategy on Research (NISR) was a further motivation to explore how non-Indigenous researchers can contribute to the larger goals of social change (Wyborn et al., 2019) in supporting Inuit self-determination in research.

As first author, I have written this paper based on my personal experiences as a non-Indigenous person and as a result, a majority of this paper is written in the first person. Sikumiut members have endorsed the writing and publishing of this paper (Bell and Arreak, 2019). Andrew Arreak, Brian Koonoo and David Angnatsiak contributed to the manuscript through the review, editing and approval of the *Sikumiut Model* and *Discussion* sections. This paper has been intentionally written in a plain language format for accessibility and ease of translation. Trevor Bell and Gita Ljubicic my graduate supervisors and additional co-authors have been ever present on my research journey. Their roles in this paper were in editing, helping me to articulate and become mindful of the decolonization in the research and myself.

2.5.1 A decolonizing methodology for the non-Indigenous researcher

The review of the literature started with the goal of understanding if there was support and advice for non-Indigenous researchers as methodological guidance in advance of the research. Some Indigenous scholars recognize that particular non-Indigenous researchers have a "genuine desire to support the cause" (Smith, 2012a:186) and Kovach believes that there is a new generation "seeking ways to understand the world without harming it" (2009:11). Smith (2012a) and Louis (2007) discuss that excluding non-indigenous researchers would only perpetuate indigenous research as some sort of cultural privilege, when it's an opportunity for non-indigenous researchers to develop "the tools they need to ensure that their research agendas are 'sympathetic, respectful, and ethical from an indigenous perspective" (Louis, 2007:134).

To begin "decolonizing one's mind and heart" (Kovach, 2009:169), non-Indigenous researchers need to begin the "self-education process" well in advance of the research (Gaudry, 2015:259). The five sections that follow provide a summary from the literature that I utilized as initial guidance and advice to develop a process and a methodology in decolonizing myself. In this paper, the term *Indigenous* will refer to Indigenous research collectively. The term *Inuit* will be used when specifically discussing research in Inuit Nunangat, "the distinct geographic, political, and cultural region that includes the Inuvialuit Settlement Region (Northwest Territories), Nunavut, Nunavik (Northern Quebec), and Nunatsiavut (Northern Labrador)" (ITK, 2018). The term non-Indigenous will refer to research partners coming from outside of Indigenous cultures.

2.5.2 Learn more about the colonialism of Inuit in Canada

As a non-Indigenous researcher, I needed to educate myself further about the colonial history of Indigenous peoples and the resulting and continuing trauma. For the North American Inuit, the influence of colonialism started in the 17th century, when whalers, explorers, missionaries and Hudson's Bay Company fur traders first came to the Canadian Arctic (ITK, 2006). However, it was during the Cold War era of the 1950s when Inuit were forced to settle in communities as part of the Government of Canada's assimilation approach called the "in-gathering policy"(MacDonald, 2018), and some communities were relocated into the High Arctic to further Canadian Arctic sovereignty (CBC, 2010; QIA, 2014). As part of the Canadian government settlement and assimilation process, Inuit children were required to attend school and sent away to residential schools. For an Inuit-specific understanding on the impact of colonialism in Canada, the "Final Report of the Truth and Reconciliation Commission of Canada Commission report Volume 2: Canada's Residential Schools: The Inuit and Northern Experience"(TRC, 2015), and Chapter 4: Colonization as Gendered Oppression and specifically the sub-section entitled "Colonial Encounter: Distinctive Inuit Experiences" (MMIWG, 2019) are excellent resources.

The term post-colonial is often used to describe the current state of affairs, but many Indigenous scholars argue that this infers that "colonialism no longer exists" (Smith, 2012a:25). Colonialism in the Canadian context is described as settler colonialism*,* in which people from other countries invaded, settled and established sovereign power (Barker and Battell Lowman, 2016). Settler colonialism is an ongoing process that continues to structure and shape relations between Indigenous peoples and settlers (Wolfe, 2006; Tuck and Yang, 2012; Veracini, 2013).

Castleden (2012) and Simpson (2004) both argue that external colonial control through ongoing federal government policies and practices continues to marginalize Indigenous peoples in Canada. Price (2007) and McGrath (2018) argue that colonialism continues to systematically and symbolically undermine and devalue the Inuit cultural systems that once made them self-sufficient.

2.5.3 Learn about decolonizing and Indigenous research approaches

Self-education also requires learning the history and underlying colonial philosophies of western research. Smith (2012), Wilson (2008) and Kovach (2009) are outstanding resources to understand the foundations of western research beliefs and biases, and how these approaches continue to treat Indigenous peoples as passive subjects to study and collect data from (Smith, 2012a; Gaudry, 2015). Decolonizing research approaches critically assess and challenge western research production and power throughout the process, from the beliefs and philosophies used to design and frame the questions and methods, to the execution, analysis, and communication of results (Kovach, 2009; Smith, 2012a; Coombes et al., 2014). It questions why western research continues to dominate contemporary knowledge production and why it is considered the only way to conduct a scientific inquiry (Smith, 2012a; Tuck and Yang, 2012).

Indigenous research methodologies are inherently decolonizing methodologies that aim to serve multiple purposes (Castleden et al., 2012; Grimwood et al., 2012; Smith, 2012a; Coombes et al., 2014). Indigenous peoples want to conduct their own research, in their own way, in their own words, under their terms, and for their own purposes (Louis, 2007; Wilson, 2008; Kovach, 2009; Smith, 2012a; Dei, 2013; Gaudry, 2015). They want to re-assert their knowledge, worldviews and shift the unequal power dynamic by developing and revitalizing their own capacity (Kovach, 2009; Smith, 2012a; Dei, 2013). Indigenous research is political, it is about social justice, self-determination, reconciliation, education and sovereignty (Smith, 2012a; Tuck and Yang, 2012). It is also about changing the academy so it recognizes how Indigenous people "make and create knowledge" (Dei, 2013:30).

Wilson (2008) describes western research as being predominantly individual, whereas Indigenous research belongs to the community and the universe, in which they are a part. Indigenous scholars agree that Indigenous research methodologies are all based on the principle of relational accountability (Wilson, 2008; Kovach, 2009; Stewart-Harawira, 2013; Healey and Tagak Sr., 2014; McGrath, 2018). Relational accountability means that giving back to their community and being accountable to their relationships in the community are what guide their research. Because Indigenous research is relational, it is "the process [that] is far more important than the outcomes" (Smith, 2012a:xi). Relationality is the major difference between western and Indigenous research approaches (Wilson, 2008).

2.5.4 Understand why Indigenous knowledge is different

There is no one-size-fits-all Indigenous research approach because Indigenous knowledge systems are connected to the specific cultural values and practices that have evolved from particular environments and geographic contexts (Louis, 2007; Wilson, 2008; Koster et al., 2012). The term Indigenous knowledge is becoming more widely utilized due to concerns that the term "traditional knowledge" may give the impression that this knowledge is no longer relevant, when it is constantly evolving (ICC-Alaska, 2015). Inuit Qaujimajatuqangit (IQ) is commonly used to describe Inuit knowledge; however, IQ encompasses so much more than knowledge. IQ “embraces all aspects of traditional Inuit culture, including values, world-view, language, social organization, knowledge, life skills, perceptions and expectations” (Nunavut Department of Education, 2007:22). See also the interview with McGrath in (Canadian Polar Commission, 2003) and Tester and Irniq (2008) for a more in-depth description. Through the remainder of this paper, I will use Indigenous knowledge to refer to the collective Indigenous knowledge systems and IQ when referring specifically to Inuit knowledge.

Indigenous knowledge has not always been considered “scientific” enough by western research to stand on its own merit (Ellis, 2005; Bravo, 2009a; ITK, 2016a). There are also concerns about the integration of Indigenous knowledge “into” western science (Agrawal 1995; Nadasdy 1999; Ellis 2005; Bohensky and Maru 2011; McGrath 2018). It is ultimately the western researcher who decides what Indigenous knowledge is relevant, often stripping out the philosophical foundations and values (Simpson, 2004) for that which supports and validates western science (Nadasdy, 1999; Tester and Irniq, 2008; Bravo, 2009b; ITK, 2016a). Indigenous scholars agree there is a fundamental difference between Indigenous and western knowledge (Price, 2007; Wilson, 2008; Kovach, 2009; Smith, 2012a). Because Indigenous knowledge is so interconnected, highly contextual, and philosophically different than western knowledge, Indigenous knowledge cannot be extracted from its relational context as is done in western science (Wilson, 2008; Dei, 2013; Gaudry, 2015). As a result, Indigenous organizations are no longer advocating for “incorporating” or “integrating” Indigenous knowledge but for its recognition based on its own scientific merit (Price, 2007; Cochran et al., 2013; Healey and Tagak Sr., 2014; ICC-Alaska, 2015; McGrath, 2018) and its inclusion as a distinct knowledge system (ITK, 2016a; Yukon Government, 2016). Indigenous organizations and scholars continue to advocate for the inclusion of Indigenous knowledge as an important process to reclaim their sovereignty in research (Simpson, 2004; ITK, 2016a; Yukon Government, 2016).

2.5.5 Learn about decolonizing research in Inuit Nunangat

Programs that support Canadian Arctic research, such as ArcticNet, the Tri-Councils, the Northern Contaminants Program and Polar Knowledge Canada, have all developed policies over the years to increase Indigenous participation, capacity building and Indigenous knowledge consideration in Arctic environmental science. However, this continues to mostly benefit non-Indigenous researchers, not Indigenous peoples and their communities (Kovach, 2009; Brunet et al., 2014, 2016; ITK, 2016a). I conducted a more recent review of the Arctic environmental science literature between the years 2000 to 2018 to understand the level of decolonizing research now taking place in Inuit Nunangat. Using the Scopus journal database, articles were searched based on key words to:

- identify relevant Arctic environmental science research (“Arctic” AND "Inuit" OR "Inuvialuit" OR "Nunavut" OR "Nunavik" OR "Nunatsiavut” AND "community-based" OR "participatory" OR "participation" OR "action" OR "co-produced" OR "co-production" OR "collaborative" OR "collaboratively" OR "collaborated") and,
- in combination with indicators of alternative, decolonizing methodologies (“decoloni(s)zing” OR “decoloni(s)zation” OR “colonial” OR coloni(s)zation”).

From this search, 53 relevant Arctic environmental science articles were identified. Of these, 35 articles (66%) discussed the use of alternative research approaches; however, only 18 articles (34%) acknowledged colonialism or mentioned that these alternative approaches supported decolonizing research. Cameron, in her review of the Arctic climate change adaptation literature, also found that "Colonialism fails to appear as a word or concept in these studies, in spite of the fact that the projects are carried out in communities that are profoundly shaped by colonization" (2012:104). A majority of the articles that suggest they are working with Inuit tended to borrow from these alternative methodologies without appearing to understand, practice or discuss the decolonizing aspects of these methodologies.

The release of ITK's National Inuit Strategy on Research (NISR) highlights how past and current research policies continue to fail in supporting Inuit self-reliance (ITK, 2018). While ITK recognizes the needs for research, it questions its significance when Inuit are not involved, their research needs are not prioritized and the results are not relevant to their lives (ITK, 2016b, 2018). Inuit are now creating their own research spaces and initiatives such as the Kitikmeot Heritage Society (2019), Ittaq Heritage and Research Centre (2019), Qaujigiartiit Health Research Centre (2019), and Aqqiumavvik Society (2019). Inuit-specific research approaches, such as *Piliriqatigiinniq* (Healey and Tagak Sr., 2014), *Tukisivallialiqtakka* (Price, 2007), the *Qaggiq* Model (McGrath, 2018) and the Alaskan Inuit food security conceptual framework (ICC-Alaska, 2015), are all examples of emerging methodologies aimed to reclaim Inuit-specific research approaches. Compared to the broader Indigenous research approaches, these Inuit-specific approaches all share four important aspects:

- Inuit research is grounded in relational accountability according to Inuit cultural norms and values;

- Inuit research approaches need to be revitalized in a modern context due to the ongoing effects of colonialism;
- Inuit research is a process towards decolonization and self-determination, in reclaiming Inuit ways and decision-making power; and,
- IQ is a distinct system, it is fundamentally and philosophically unique, it cannot be integrated into western science, and must be recognized on its own merit.

ITK has advocated that Inuit-specific research is a fundamental need both for Inuit self-determination, their quality of life, and as rights-holders under Inuit land claims (2016a). The NISR discusses the following five priority policy areas to advance Inuit self-determination in research (ITK, 2018):

1. Advance Inuit governance in research;
2. Enhance the ethical conduct of research;
3. Align funding with Inuit research priorities;
4. Ensure Inuit access, ownership, and control over data and information; and
5. Build capacity in Inuit Nunangat research.

2.5.6 Re-examine and re-learn your approach to research

Through the process of decolonizing myself, I began to re-examine my own personal history, family, and how I was educated. This process is called reflexivity, a very personal process of critical reflection that is a necessary part of decolonizing oneself (Kovach, 2009). It is through the process of reflexivity that non-Indigenous researchers can begin to understand and acknowledge their biases throughout the research process in order to be transparent, continuously aware, and to re-examine how their biases affect their intentions, assumptions, decisions and reactions (Kovach, 2009; Grimwood et al., 2012; Sandoval et al., 2016).

In educating oneself about relational accountability, scholars have explored the questions of whether non-Indigenous researchers can learn how to be relational or support relational approaches (Kovach, 2009; Ninomiya and Pollock, 2017) to ensure authentic and ethical relationships with Indigenous people (Bull, 2010; Fletcher et al., 2016). There is an emerging group of non-Indigenous researchers aiming to further decolonize their approaches by grounding their research with Indigenous peoples in relational accountability (Oberndorfer, 2016; Gerlach, 2018). Gerlach (2018) and Oberndorfer (2016) outline how relationality influenced their motives, actions and reflexivity. Oberndorfer, in a community-based research project with Inuit in Makkovik, Nunatsiavut, discusses how relationality helped her to see "plants not as objects, but in the context of relationships: with people, with cultural practices, with animals, with weather, with soils, and with space and time" (2016:5). Gerlach reflexively discusses how relationality changed her approaches to create the necessary time needed to prioritize relationships, to learn from them rather than about them, about being humble and moving away from "researcher as expert knower" toward "researcher as learner" (2018:5).

The decolonizing journey is an essential and ongoing part of the research methodologies and methods for non-Indigenous researchers. Educating oneself about the colonialism of Indigenous peoples in Canada, the differences between western research, and decolonizing and Indigenous research approaches are necessary first steps in decolonizing oneself. Understanding that relational accountability is the foundation of Indigenous research can further situate and guide non-Indigenous researchers towards prioritizing relationships in their research. As Beeman-Cadwallader (2012:7) describes "it is the intent or mindfulness" that develops through educating yourself and your reflections that will make your research decolonizing.

2.6 From Guidance to Practice: The Sikumiut Model

My decolonizing process did not simply involve reading the decolonizing literature but included the invaluable experience of multiple trips to the community to practice decolonizing research. Mary Ellen Thomas, Senior Science Advisor for Nunavut, once told me "people don't really pay attention to you until at least the third visit" (M. Thomas, personal communication, November 20, 2015). Utilizing the decolonizing advice from the literature and from others such as Mary Ellen with long-term experience in northern research, my planned approach was to take the necessary time to develop relationships, build trust, understand the community-specific context, and assess the community need or desire to co-develop research. What has evolved from this co-development over many visits to Mittimatalik (Table 2.1) is *The Sikumiut Model*, which adopts the values and priorities of Sikumiut while respecting and enhancing Inuit self-determination in research.

Ikaarvik (which translates to "bridge" in Inuktitut) is a community-based group from Mittimatalik that believes research can be a tool for strengthening Northern communities, and a means for Inuit youth to become engaged and empowered to deal with environmental and social change in the Arctic (Elverum et al., 2017). Ikaarvik held workshops in Mittimatalik in 2013 with Inuit youth to discuss their community research priorities. These Inuit youth were then trained to hold workshops with the broader community to further develop and validate community-wide research priorities. Concerns around changing sea ice and safe travel on the ice were high on the list of the community's research priorities.

Ikaarvik then sought out meaningful partnerships with outside researchers to help address these community research priorities. In November of 2015 Ikaarvik invited one of my PhD research advisors and SmartICE principal investigator, Trevor Bell, to Mittimatalik (Table 2.1). Ikaarvik had heard about SmartICE, a community-driven local sea ice information service for Inuit. SmartICE uses a combination of stationary and mobile sensors to monitor ice thickness and temperature, and satellite images to support Inuit sea ice travel (Bell et al., 2014). Co-developed with the Nunatsiavut Government, SmartICE information supports local climate change adaptation decision-making so Inuit can continue to rely on sea ice transportation for hunting and fishing, and to maintain their nutritional and cultural wellness. Ikaarvik facilitated a wide range of community meetings with SmartICE to discuss if establishing this sea ice monitoring system in Mittimatalik would be useful in addressing some of the community's concerns about sea ice travel safety. The feedback from this initial visit was positive, and in May 2016, SmartICE hired Ikaarvik youth to help prepare for a larger community open house (Table 2.1). The youth helped SmartICE frame the discussion questions and provided feedback on the presentation to ensure it was communicated in accessible and culturally appropriate ways. Ikaarvik youth also facilitated break-out groups to gain feedback on how SmartICE should operate in Mittimatalik. Working with the Ikaarvik youth was my first step in developing relationships in the community. Ikaarvik provided a safe place for me to get feedback, ask questions and get honest answers about cultural protocols before engaging with the broader community.

It was during the May 2016 community open house that an Inuit sea ice expert committee was recommended in order to evaluate and communicate the SmartICE monitoring information to the community. In the following November 2016, SmartICE met individually with suggested Inuit sea ice experts and requested recommendations for additional members (Table 2.1). A meeting was held to introduce SmartICE and gauge interest in joining the Inuit sea ice expert committee. During this meeting the membership was discussed, and terms of reference were drafted to formalize their roles, responsibilities, and honoraria. It became clear during this initial meeting that the sea ice expert committee was not just about communications, it was about Inuit taking control to manage and be the decision-makers for SmartICE in Mittimatalik.

The Inuit management committee named themselves Sikumiut, which means “people of the ice” in Inuktitut. In February 2017, the Sikumiut management committee had their first formal meeting to review and approve their terms of reference and begin planning the SmartICE monitoring activities (Table 2.1). The Sikumiut ten-person committee includes Inuit men and women representing: Elders; Ikaarvik; Search and Rescue; Parks Canada, Canadian Rangers, Government of Nunavut Wildlife, Hunters and Trappers Association, young hunters and outfitters.

Table 2.1 Details of visits to Mittimatalik in co-developing research

#	Dates	Purpose/Activities	Research Team Members Involved	Outcomes
1	November 2015	• SmartICE invited to Mittimatalik by Ikaarvik to explore possible research relationship • Meetings with Hamlet Council, Hunters and Trappers Association, Parks Canada, Search and Rescue volunteers, GN Wildlife, Ikaarvik community researchers	• Trevor Bell, (Memorial University of Newfoundland (MUN)) • Katherine Wilson (MUN and Canadian Ice Service (CIS)) • Leah Braithwaite (CIS) • Andrew Arreak (SmartICE) • Shelly Elverum (Ikaarvik)	• General interest in SmartICE • Invited back to continue discussions on how SmartICE should operate in Mittimatalik • Hiring of SmartICE community coordinator in Mittimatalik
2	May 2016	• SmartICE community consultation with SmartICE partners from Nunatsiavut • Meetings with Hamlet Council, Hunters and Trappers Association, Parks Canada, Search and Rescue volunteers, GN Wildlife, Pond Inlet Archives, and Ikaarvik • Community open house	• Trevor Bell (MUN) • Katherine Wilson (MUN/CIS) • Rodd Laing (Nunatsiavut Government) • Joey Angnatok (Nunatsiavut Government) • Andrew Arreak (SmartICE) • Shelly Elverum (Ikaarvik)	• Approval by Hamlet Council for SmartICE to operate in the community of Mittimatalik • Feedback from Community Open House on how SmartICE should operate recommending an Inuit sea ice expert committee
3	November 2016	• Meetings with individuals recommended for the SmartICE Inuit Management Committee and recommendations for additional members • Update to Hamlet Council • Review historical sea ice research at the Pond Inlet Archives	• Trevor Bell (MUN) • Katherine Wilson (MUN/CIS) • Andrew Arreak (SmartICE) • Shelly Elverum (Ikaarvik)	• Initial Sikumiut meeting. • Draft terms of reference for committee
4	January 2017	• Meeting with Ikaarvik youth to ask questions about IQ and Inuit Societal Values • First Sikumiut meeting to formalize name and terms of reference	• Trevor Bell (MUN) • Katherine Wilson (MUN/CIS) • Andrew Arreak (SmartICE) • Shelly Elverum (Ikaarvik) • Tom Zagon (CIS) • Adrienne Tivy (CIS) • Rob Briggs (C-Core) • Steve Baillie (Nunavut Emergency Management) • Gita Ljubicic (Carleton University)	• Final Sikumiut terms of reference in Inuktitut and English • Sikumiut meeting minutes in English and Inuktitut

5	September 2017	• Sikumiut meeting: - Discussion about Sikumiut's research needs • Update to Hamlet Council	• Trevor Bell (MUN) • Katherine Wilson (MUN/CIS) • Andrew Arreak (SmartICE) • Shelly Elverum (Ikaarvik)	• Sikumiut meeting minutes in English and Inuktitut • Approval of Sikumiut research needs
6	March 2018	• Sikumiut meeting - Co-development of Sikumiut research project approach • Meet with potential youth researchers to discuss the project and gauge interest.	• Trevor Bell (MUN) • Katherine Wilson (MUN/CIS) • Andrew Arreak (SmartICE) • Shelly Elverum (Ikaarvik)	• Sikumiut meeting minutes in English and Inuktitut • Approval of initial research approaches in minutes • Contacts for Inuit youth that may be available in the fall of 2018 to work on the project.
7	October 2018	• Sikumiut meeting - Selection of most experienced sea ice users to contribute their IQ (Sikumiut sub-group) - Review of draft Sikumiut-Memorial research agreement • Sikumiut sub-group terminology workshops (3 half-days) • Meetings with Nunavut Arctic College ETP Program	• Trevor Bell (MUN) • Katherine Wilson (MUN/CIS) • Andrew Arreak (SmartICE) • Gita Ljubicic (Carleton)	• Sikumiut meeting minutes in English and Inuktitut • Draft list of Sikumiut sea ice terms • Approval of draft Sikumiut-Memorial research agreement
8	November 2018	• Sikumiut sub-group seasonal sea ice IQ mapping workshop • Meetings with Nunavut Arctic College ETP Program • Update to Hamlet Council	• Katherine Wilson (MUN/CIS) • Lynn Moorman (Mount Royal University (MRU)) • Andrew Arreak (SmartICE) • Jamesie Itulu (SmartICE) • Shelly Elverum (Ikaarvik)	o Paper maps with Sikumiut sea ice IQ • Training materials for Inuit youth to digitize Sikumiut maps • First drafts of digitized Sikumiut sea ice maps
9	January 2019	• Co-developing methods to create the 20-year history of sea ice for Mittimatalik	• Katherine Wilson (MUN/CIS) • Andrew Arreak (SmartICE)	o Draft methods on what sea ice IQ to be captured from the satellite imagery
10	February 2019	• Sikumiut sub-group - 1st review of draft IQ terminology lists, maps and graphical illustrations	• Andrew Arreak (SmartICE) • Jamesie Itulu (SmartICE) • Shelly Elverum (Ikaarvik)	• Sikumiut revisions to: • draft digitized Sikumiut maps • list of over 65 sea ice terms in draft • draft graphic illustrations of sea ice IQ to be used
11	March 2019	• Sikumiut sub-group - 2nd review of draft IQ terminology lists, maps and graphical illustrations	• Andrew Arreak (SmartICE) • Jamesie Itulu (SmartICE)	o Digitized Sikumiut maps in draft o list of over 65 sea ice terms in draft organized by season

		• Sikumiut members signatures on Sikumiut-Memorial research agreement		• Draft graphic illustrations of sea ice IQ in posters • Signed Sikumiut-Memorial research agreement
12	April 2019	• Satellite interpretation training for SmartICE Regional Operation Leads	• Trevor Bell (MUN) • Katherine Wilson (MUN/CIS) • Andrew Arreak (SmartICE) • Jamesie Itulu (SmartICE) • Shelly Elverum (Ikaarvik) • Lynn Moorman (MRU) • Tom Zagon (CIS) • Jenny Mosesie (SmartICE) • Robert Karetak (SmartICE)	• Training material for Inuit youth to interpret satellite imagery • Evaluations of the training by the trainers and SmartICE Operations Leads
13	June 2019	• Sikumiut meeting - 1st review and validation of IQ terminology, maps and illustrations with the larger Sikumiut membership - Discuss the publication of this research article	• Trevor Bell (MUN) • Andrew Arreak (SmartICE) • Jamesie Itulu (SmartICE)	• Sikumiut revisions to: - List of sea ice IQ terminology - Printed Sikumiut sea ice IQ Travel maps • Printed Sikumiut IQ posters
14	July 2019	• Training and co-developing methods to create the 20-year history of sea ice for Mittimatalik • Review of the Sikumiut model for publication with interested Sikumiut members	• Katherine Wilson (MUN/CIS) • Andrew Arreak (SmartICE) • Jamesie Itulu (SmartICE)	• Training materials to interpret, digitize and analyze community relevant sea ice conditions over 20-years • Edits to the Sikumiut Model description

Figure 2.1 The Sikumiut model. Centre photo used with permission from Lynn Moorman.

Being able to participate in the SmartICE consultation process in Mittimatalik and the establishment of the Sikumiut Management Committee over 2 years and 6 trips (Table 2.1), allowed me to develop relationships, listen, and learn about the research needs that emerged through these conversations. Although I intentionally did not go to the community with a specific research topic in mind, based on my experience I was interested in understanding more about their sea ice research needs. What I heard during the early Sikumiut meetings were their concerns about:

- The impacts of climate change making sea ice travel less predictable and unsafe;
- Challenges of sharing their local sea ice IQ with the next generation and wanting to improve the safe-sea ice travel knowledge of youth;
- The desire to repatriate and collate previous sea ice research data, which includes their sea ice knowledge, to support their own sea ice research priorities; and

- The impacts of proposed winter shipping with ice-breaking ships through the sea ice to the nearby Baffinland Mary River mine.

The process so far in co-developing the research is best explained graphically in what is being called *The Sikumiut Model* (Fig. 2.1 and Table 2.3). The set of nested rings is read from the outside in, reflecting a range of project goals from overarching to specific. The overlapping oval represents the broad influence of the non-Indigenous research partner role. Each of the model parts is explained in detail below.

2.6.1 Inuit self-determination in research

Motivated by ITK's NISR, the outside ring highlights the all-encompassing goal for this project to decolonize the research approach in practice and *Support Inuit Self-Determination in Research* (Fig. 2.1 and Table 2.3). Supporting Sikumiut's self-determination in research is addressed through Inuit governance and control of the research, which is focused on community-based research needs.

2.6.2 Embrace Inuit decision-making

The SmartICE Sikumiut management committee in Mittimatalik created a forum from the outset to *Embrace Inuit decision-making* (second ring, Fig. 2.1 and Table 2.3). We met with Sikumiut to discuss a Sikumiut-Memorial University research agreement to formally recognize their role in the governance of the project and as owner of the research data. As discussed later, this formal decision-making role was initially queried by Memorial University, but eventually approved.

In starting to plan our activities Sikumiut directed me to not start with mapping their IQ but to start with documenting their local sea ice terminology. Their sea ice terms do more than label different types of sea ice, they detail the formation, strength, decay, and safety of the sea ice. In an oral culture, having the next generation learn these specialized Inuktitut words is part of Sikumiut's relational accountability to the next generation. Also, helping Inuit youth to be able to communicate with experienced sea ice users in the community was a necessary first step in improving local sea ice safety that I hadn't considered.

Starting the workshops with a focus on sea ice terminology also changed the language of the workshops (October 2018 Table 2.1). Normally when western researchers are involved, workshops are run in English with simultaneous translation into Inuktitut. However, our sea ice terminology workshops were held in Inuktitut. This enabled the discussions and ideas to flow freely without interruption, so their IQ could be properly communicated, captured in their language and not lost in translation. Translators were involved, but used to translate discussions into English concurrently, mostly for the non-Indigenous research partners, but also to support the Inuit youth in expanding their Inuktitut language skills.

2.6.3 Prioritize community-based research needs

The third ring, *Prioritize Community-Based Research Needs*, shows how this research is focused on the research needs of the community (Fig. 2.1 and Table 2.3). While Sikumiut were pleased with the SmartICE sea ice monitoring in the community, they also emphasized that to travel safely you need to know so much more than the thickness of the sea ice. Sikumiut voiced the challenges in their ability to share their IQ with young people in their community. Due to the settlement of Inuit, youth are now at school, or work and unable to spend as much time on the sea ice and learning from experienced hunters. Many of the parents of these Inuit youth were also residential school survivors who were denied the experiences of extensive travel and learning sea ice IQ from their Elders to pass on to their children. Sikumiut were interested in new tools to document (e.g. mapping) and communicate (e.g. Web sites and mobile applications) their IQ to share with the community to improve sea ice safety (Wilson, 2017). While other western researchers have recorded and mapped Mittimatalik sea ice IQ, it was always done for external purposes such as the establishment of Sirmilik National Park (Manseau, 2006), Environmental Assessments for the Mary River Mine (Knight Piésold Consulting, 2015), and consultations for the Canadian Coast Guard's Arctic Shipping Corridors (Carter et al., 2018). In attempting to reclaim the previous sea ice IQ that was collected, it was realized that it did not capture the seasonal and regional sea ice IQ of freeze-up and break-up, and as a result it could not be re-purposed by Sikumiut. Therefore, the research idea that emerged was to have Inuit youth work with Sikumiut to map their IQ of safe and hazardous sea ice conditions throughout the seasons to share with the community.

I proposed the idea of training Inuit youth in the community to learn how to interpret satellite imagery. While the Canadian Ice Service (CIS) maintains the sea ice archive of maps for the main shipping channels in the Canadian Arctic back to 1968 ((ECCC, 2020), no sea ice archive exists at an Inuit community scale. However, the CIS satellite archive extends back to 1997. Training Inuit youth to interpret the archived satellite imagery would mean that this imagery could be utilized to map the changes in sea ice around Mittimatalik since 1997 using their IQ. These sea ice maps would be used by Mittimatalik to: 1) provide evidence of the impacts of climate change on sea ice around their community; 2) understand when and where the changes in sea ice are greatest to support their adaptation needs for safe sea ice travel; and 3) establish a baseline to monitor additional impacts on sea ice around the community in anticipation of winter shipping (i.e. ice-breaking) being proposed to the Baffinland Mary River Mine (Bell, 2019).

With Sikumiut's support and encouragement, the next step was to seek project funding. Trevor Bell and I wrote the funding proposal that was submitted in November 2017 to Public Safety Canada. The objective of the proposal was to develop Inuit-derived sea ice hazard maps that were community and culturally relevant to enhance safe sea ice travel. In April 2018 we were notified that the proposal was successful, and we began moving our discussions into practice.

2.6.4 Develop Inuit-specific values for research

Sikumiut's collective experience and IQ guide how this research has been and will be conducted. In discussing the model with Sikumiut members I originally labelled this goal, *Develop Inuit-Specific Methodologies*. However, the word methodologies didn't translate well or have meaning to the Sikumiut members, and so the label was changed to *Develop Inuit-Specific Values for Research* (Figs. 2.1 and 2.2, Table 2.3). We discussed early in the co-development of the research what IQ values would guide this research. The initial values that Sikumiut suggested were based on Nunavut's Inuit Societal Values (Government of Nunavut, 1999). The Inuit Qaujimajatuqangit Katimajiit (Council), comprising Elders from across Nunavut, collectively agreed upon these values as the IQ foundational principles for the territory of Nunavut (Table 2.2).

These values emphasize how Sikumiut wishes to govern the project and themselves and capture the intent of relational accountability in this research. These values also provided a context-specific framework for how I should conduct my research in Mittimatalik and are discussed further in the section, *Changing the non-Indigenous research partner role*.

2.6.5 Strengthening Inuit youth capacity

At the centre of the Sikumiut model is *Strengthening Inuit Youth Capacity* (centre circle in Fig. 2.1 and Table 2.3). Sikumiut wanted youth involved in the ice terminology and mapping workshops so they would be the recipients and beneficiaries of their IQ and to increase Inuit youth research capacity in the community. We discussed how Inuit youth would be trained by Sikumiut and the non-Indigenous research partners to complete the research. Andrew Arreak, the SmartICE Nunavut Operations Lead for Qikiqtaaluk North, now fills part of his time as the Inuit youth researcher for the Sikumiut project outside of the SmartICE monitoring season.

Starting in October of 2018 Sikumiut members and partners facilitated a series of workshops to begin documenting the Inuktitut sea ice terminology that is used in identifying safe and dangerous seasonal ice conditions (Table 2.1; Figs. 2.3 and 2.4). My co-supervisor, Gita Ljubicic (nee Laidler, then at Carleton University now at McMaster University), provided the training using methods that were co-developed with Inuit in the communities of Igloolik (Laidler and Ikummaq, 2008) Pangnirtung (Laidler et al., 2008) and Cape Dorset (Laidler and Elee, 2008).

Figure 2.2 Reviewing the Sikumiut model: Brian Koonoo and David Angnatsiak reviewing and editing the English and Inuktitut versions, 25 July 2019.

Table 2.2 Nunavut's Inuit Societal Values (Government of Nunavut 1999).

Inuit Societal Values	**Description**
Pijitsirniq	Serving and providing for family or community, or both
Piliriqatigiinniq or Ikajuqtigiinniq	Working together for a common cause
Avatittinnik Kamatsiarniq	Respect and care for the land, animals, and the environment
Qanuqtuurniq	Being innovative and resourceful
Pilimmaksarniq or Pijariuqsarniq	Development of skills through practice, effort, and action
Inuuqatigiitsiarniq	Respecting others, relationships and caring for people
Tunnganarniq	Fostering good spirit by being open, welcoming and inclusive
Aajiiqatigiinniq	Decision-making through discussion and consensus

In debriefing after the first workshops, we discussed how not all the IQ that was shared and discussed could be captured as individual terms and definitions, or as discrete map features. Some of this knowledge was about how to prepare before you travel on the ice, what to bring with you, how to test the ice for thickness, where to seek shelter, and warnings about how to travel safely under certain weather and ice conditions. It was then a local Inuit youth artist was proposed to Sikumiut to join the research team to specifically address the IQ that could not be communicated through words or map features. Jamesie Itulu now participates in all the meetings, workshops and training to develop illustrations as an additional method to communicate Sikumiut's IQ.

In November of 2018 the project facilitated another workshop to map Sikumiut's knowledge of seasonal areas of sea ice hazards and safety (Table 2.1). The participatory mapping methods used were based on a previous research partnership in the community between Ikaarvik and the University of Ottawa in which Ikaarvik youth received facilitation training (Carter et al., 2018). Following the mapping workshops, Arreak was provided with a laptop and trained by Lynn Moorman (Mount Royal University) and myself on Geographic Information Systems and software (ArcMap 10.5). This meant that Arreak could independently digitize the information captured during the workshop, develop the maps, and make corrections and additions as needed. A total of 8 workshops, meetings and training sessions took place between October 2018 and June of 2019 (see Table 2.1), in which Arreak facilitated all the validation meetings. These workshops have resulted in the documentation of at least 65 sea ice terms, as well as seasonal maps of sea ice IQ and illustrations/posters to help communicate Sikumiut's sea ice IQ further.

Table 2.3 The Sikumiut model summary description

The Sikumiut Model	Taijaujuq Sikumiut Aturtanga
Support Inuit Self-Determination in Research This model reconceptualizes a new role for non-Indigenous researchers and the approaches needed to truly support Inuit self-determination in research. The model outlines the goals for a community-based project to mobilize Inuit Qaujimajatuqangit (IQ) for sea ice safety in Mittimatalik (Pond Inlet), Nunavut**.**	**Ikajurturtauningit Inuit Nangminiq Piliriningit Qaujisarnikkut** Tanna piliriaksarijaujuq qaujisarutaujuq tukisiumajaunasuk&uni ilauqatauqattarningit Inuit qaujisarnikkut ammalu qanuq ikajurturtaujunnarmangaata nangminiq piliriaksaqarasuktillugit qaujisarnirmut. Ukua ataaniittut titirarsimajut saqippallianinganik uktuutaujunnartut aaqikpalliajuq nunalikni pigiartitausimalluni aulajjagiartitaujuq Inuit Qaujimajatuqangit sikulirinirmut attarnartailimanirmut Mittimatalingmi, Nunavut.
Embrace Inuit Decision-making The Inuit Management Committee for SmartICE in Mittimatalik, self-titled ***Sikumiut,*** governs this research. They decide what Inuit and scientific knowledge is needed and the roles of the partners. They also determine the methods used to communicate their sea ice IQ to their community.	**Atulirtitauninga Inuit Aaqiksiningit** Inuit aulattinirmut katimajingit sikulirijikkut mittimatalikmi, nangminiq taijaujumallutik sikumiut, aulajjutaujuq qaujisarnirmut. Aaqiksiqattartut qanuq Inuit kiklisiniartillu qaujimaningit aturtauniarmangaata qanuiliuqattarniarmangaatalu ilauqataujut. Aaqiksisimakmijut qanuiliurlutik tusaumatittiniarmangata sikulirinirmik Inuit qaujimajatuqangit nunalikni.
Prioritize Community-based Research Needs Sikumiut identified the need to document and share their IQ of sea ice to: 1) improve safe sea ice travel for the next generation; 2) document and understand the impacts of climate change on sea ice around Mittimatalik; and 3) develop a baseline of Mittimatalik sea ice conditions in anticipation of increased shipping during the fall and winter seasons to the Mary River mine.	**Sivulliujjauninga Nunalingni Pigiartitausimajuq Qaujisarnirmut** Sikumiut nalunairsilaurtut titirartauqattariaqarninginnik ammalu uqausiuqattarlutik Inuit qaujimajatuqangit sikulirinirmut ukununga: 1) attarnangittuk ingiraqattaqullugit kinguvaanguniartut; 2) titirartaulutik tukisijaujutiklu ikpiknautisimajut silaut asillirpallianinga sikumut qanigijangani Mittimataliup; ammalu 3) aaqiksilutik pigiarviuqattarunnartumik Mittimatalingmi sikungani qanuilinganinganik pijjutigillugu niriunarninga umiarjuaqarpallianiarninganut ukiaksaakkut ukiukkullu nuluujaani ujaraktartunut.
Develop Inuit Specific Values for Research Sikumiut's approach for this project is based on their IQ and the IQ principles outlined in Nunavut's Inuit Societal Values (Government of Nunavut, 1999). Sikumiut will evaluate this project from an Inuit perspective and based on their extensive sea ice experience	**Aaqqisiluti Inuit piqqusingitigut amma qaujisarnimut** Sikumiut qaujisarningit tungaviqartuq Inuit qaujimajatuqanginnik ammalu iliqusiunginnik Inuit titirarsimajut nunavuumi Inuit iliqusinginnik inusinginni (Gavamakkut Nunavut, 1999). Sikumiut qimiruqattarniartut piliriaksaujunik Inuit qaujimaningit maliklugit ammalu qaujimajaujut maliklugit sikulirinirmut.
Strengthen Inuit Youth Capacity Mittimatalik Inuit youth have been hired and trained to do this research. They are facilitating workshops with Sikumiut on sea ice terminology and mapping locations of safe and hazardous travel. Youth are being trained in computer mapping to interpret, detect and monitor sea ice trends in 20+ years of satellite imagery and to develop maps of local sea ice conditions. Inuit youth will also run the process to evaluate the project.	**Ajurunniirtitaunirsauqullugit Inuit Makkuktut Pijunnarnirsaulirlutik** Mittimatalikmi Inuit makkuktut iqanaijartitaujut pilimmaksartitaullutiklu qaujisarnikkut. Tukimuaktittiqattartut katimaniujunik sikumiut sikuliritillugit ammalu nunangualiritillugit attarnarningit nangiarnanginningillu titirartaulutik nunanguakkut. Makkuktut pilimmaksartitaujut qarasaujakkut nunangualirinirmik, takunasuqattar&utiklunu asillirpallianiujut nunanguakkut sikulirijjutinik aragu 20 iluani qangattartitausimajukkullu ajjinguanik nunangualiurpak&utiklu sikulirisimajunik. Inuit makkuktut aulattiniarmijut qimiruvaulirpatat piliriaksarijaujuq.
Changing the Role of Non-Indigenous Research Partners To be accountable and give back to the community, the role of non-Indigenous research partners is to mentor and strengthen Inuit youth capacity in community-based research. This role intersects all aspects of the research to support Inuit decision-making, IQ, methodologies and ultimately Inuit self-determination in research.	**Qallinaat Ikajuqattauninga Pilimmaksainimut Amma Ikajuqqattautigiinummut** Nunalikni pigiaviuluni nunaliknuarlunilu, ilaunirijangit qallunaat ikajurtuilutik piJnnarsitittivallialutiklu makkuktunik ajunginnirsauliqullugit nunalikni pigiartitaujumik qaujisarnikkut. Taakkua ilauqatauningit qaujisarnirmut ikajurtuijut Inuit aaqiktanginnik, Inuit qaujimajatuqanginnik, iliqusiujuniklu ammalu Inuit nangminiq pinasuktanginnik qaujisarnikkut

Figure 2.3 Andrew Arreak and Gita Ljubicic co-facilitating the sea ice terminology workshops with Sikumiut members Caleb Sangoya, David Angnatsiak and invited community sea ice expert Bethuel Ootoovak. Mittimatalik, Nunavut, 14–16 October 2018.

Figure 2.4 Sea ice terminology workshops, 14–16 October 2018, Andrew Arreak, Katherine Wilson, Gita Ljubicic and Trevor Bell in Mittimatalik, Nunavut.

The next phase of training for this project was in how to interpret optical and synthetic aperture radar satellite imagery. This training had dual purposes: i) to enable Arreak to review the archived satellite imagery (20+ years, 1997 to present); and ii) so Nunavut SmartICE Operation Leads, Arreak (Qikiqtaaluk North), Jenny Mosesie (Qikiqtaaluk South) and Robert Karetak (Kivalliq) could learn to interpret the satellite imagery to support local sea ice monitoring and travel decision-making in their home communities. In early April 2018 a four-day satellite interpretation training session was held in Mittimatalik to train Arreak, Mosesie and Karetak (Table 2.1; Fig. 2.5). The training focused on how to interpret sea ice in optical imagery, such as MODIS and Sentinel-2 (ESA, 2019; NASA, 2019) and in synthetic aperture radar imagery, such as Radarsat and Sentinel-1 (CSA, 2019; ESA, 2019).

Figure 2.5 Experiential satellite interpretation training on the sea ice near Mittimatalik, 11 April 2019. SmartICE Operations Leads Andrew Arreak (Mittimatalik), Jenny Mosesie (Qikiqtarjuaq), and Robert Karetak (Arviat) with Lynn Moorman (Mount Royal University), Trevor Bell (Memorial University). Photo used with permission from SmartICE Inc.

Trainers included Lynn Moorman (Mount Royal University), Tom Zagon (CIS), Trevor Bell (Memorial University), and myself. In training non-Indigenous students at universities and staff at the CIS, it would typically take several courses and semesters for students to learn all the basic concepts. However, we did not have to teach the SmartICE Operations Leads about the Arctic, weather or sea ice. Our training approach was not theoretical, but applied, experiential, focused only on what they really needed to know and done in an Inuit context, on the sea ice (Simpson, 2014). The capacity of these Inuit youth to learn how to interpret satellite imagery was nothing less than impressive.

Between January and July of 2019, Arreak and I worked together to develop the methods to review the satellite data over the past 20 years. Arreak put into practice his previous training on satellite interpretation (April 2019; Table 2.1) as we learned together what sea ice IQ could be interpreted and captured in the satellite imagery. Arreak also applied his training on Geographic Information Systems (November 2018; Table 2.1) as we worked together to determine how to map the sea ice conditions so we could compare and contrast over the past 20+ years.

In the final funding year of the project (2019-2020) we will continue our work to analyse the satellite imagery and develop the output products from this research. A variety of formats are being considered to share and communicate Sikumiut's sea ice IQ such as digital and paper maps, graphic illustrations, posters, and a booklet of Sikumiut's sea ice terminology. This will be the first time that sea ice knowledge in the community of Mittimatalik has been documented and communicated with methods chosen by them, facilitated by Inuit youth from their own community, to meet their own research needs (Wilson, 2018a).

2.6.6 Changing the non-Indigenous research partner role

The embedded bottom oval in the Sikumiut model (Fig. 2.1 and Table 2.3) represents a re-defined role for non-Indigenous research partners when working with Inuit. The non-Indigenous role overlaps and intersects with all the goals (rings) of the Sikumiut Model to support and help facilitate the research. To ensure that this research was co-produced authentically in this context meant that I also had to follow the Inuit Societal Values (Table 2.2). I met with Ikaarvik youth early in the co-development process (January of 2017, see Table 2.1), to better understand the eight Inuit Societal Values, their meaning and how a non-Indigenous person could utilize these values in their research.

In reflecting on how to practice relational accountability in this context I looked to the Inuit Societal Values of: *Inuuqatigiitsiarniq*, respecting others, relationships and caring for people; *Piliriqatigiinniq* or *Ikajuqtigiinniq*, working together for a common cause; *Pijitsirniq*, serving and providing for family or community, or both; and *Avatittinnik Kamatsiarniq*, respect and care for the land, animals, and the environment. In respecting Sikumiut's leadership, the Inuit Societal Values of: *Aajiiqatigiinniq,* decision making through discussion and consensus; and *Tunnganarniq,* fostering good spirit by being open, welcoming, and inclusive were values that I practiced ensuring that all decisions about the project, how it is conducted, by whom and the resulting output products were made by Sikumiut.

In thinking relationally and being motivated by Sikumiut's desire to increase youth capacity, it became clear that it was no longer about *my* research. It was about practising relational accountability by using my experience to train local youth to do the research themselves. I take my role to mentor and train Inuit youth to Strengthen Inuit Youth Capacity very seriously. As such, the Inuit Societal Values of: *Pilimmaksarniq* or *Pijariuqsarniq*, development of skills through practice, effort, and action; and *Qanuqtuurniq*, being innovative and resourceful, are values that I adopted and continue to practice.

The combination of reading the literature and enacting relationality according to the community research needs and values allowed me to be open to *hear* their research requests as they emerged, to be *ready* to respond *differently*, and to be able to see my redefined role as a *mentor* in moving from decolonizing guidance to practice. The process of co-developing the Sikumiut Model has resulted in a model that respects Inuit decision-making, enhances Inuit self-determination in research, and redefines the role of non-Indigenous researchers. Each Inuit community and research project will have its own context; therefore, the Sikumiut model can only be considered as a potential guide, providing practical approaches and roles as ideas to build on and refine according to other community priorities. However, as Inuit self-determination advances, the ultimate goal would be that the current embedded non-Indigenous research partner role in the Sikumiut Model would become obsolete.

2.7 Discussion

The Sikumiut model provides examples of how non-Indigenous researchers, in engaging in decolonizing research, can contribute to the greater goal of Inuit self-determination in research. To frame this discussion, I come back to ITK's (2018) five NISR priorities to provide examples of some of the ways this research was able to support Inuit self-determination in practice, along with some personal reflections on my decolonizing journey.

2.7.1 Advance Inuit governance in research (NISR Priority #1)

The most important lesson that I have learned from decolonizing research in practice with Sikumiut is that Inuit need to be in decision-making positions to govern, design and co-produce as much of the research as possible. I now understand why advancing Inuit governance in research is NISR priority #1, because it influences and impacts the entire research process as will be discussed in the following sections.

2.7.2 Enhance the ethical conduct of research (NISR Priority #2)

Prior to starting to work directly with Sikumiut, I am required by the University to receive ethics approval for working with Indigenous peoples. Ethics approvals are based on the *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans* (Tri-Council et al., 2010), known as TCPS2. As part of the university's ethics procedures, participant consent forms are required to gain approval from Sikumiut members for this research. However, as Sikumiut are *governing* this co-developed research, they were more than participants, they were full-fledged research partners with the university. The Tri-Council Policy which directs the Memorial University ethics process did not include procedures for Inuit governing the research or for maintaining ownership and control over the data. As a result, a Sikumiut-Memorial University research agreement was developed to acknowledge Inuit governance and ownership of their IQ in this project (Appendix C). The University Research Ethics Board (REB) required a subsequent review of the agreement by Memorial University's contracting services as we had moved from requiring consent into a contractual agreement. After a few iterations to revise and reduce the technical language and ensure the ease of translation and accessibility in Inuktitut, the Sikumiut-Memorial University research agreement now states that:

> "Sikumiut retains the rights and ownership to their knowledge/data collected and documented during this project. Sikumiut will allow Katherine Wilson to have access to this data/knowledge to publish the results, thesis and/or report to fulfill her studies at Memorial University." (Wilson, 2018b; Appendix C).

Having Inuit in decision-making positions challenged the TCPS2, the University's REB and contracting services to reflect on their biases around Inuit capacity and their ability to govern and conduct their own research. It's a small example, but an example nonetheless, of how an individual researcher can make steps to enhance the ethical conduct of research (NISR Priority #2; (Stiegman and Castleden, 2015); and ensure Inuit access, ownership, and control over data and information (NISR Priority #4).

2.7.3 Align funding with Inuit Research Priorities (NISR Priority #3)

Inuit communities and organizations like Sikumiut are often ineligible to receive funding without western research accreditation in the form of a college or university degree, and the administrative infrastructure to report and account for funds used. As a result, the current barrier in the Sikumiut Model is the power imbalance when non-Indigenous researchers remain in control of the research funding. The funding proposal for this research was written prior to the release of the NISR and was therefore unable to benefit from its guidance and reference. However, the proposal was an opportunity to emphasize and communicate the intent to take a bottom-up rather than top-down approach to research, and to develop culturally appropriate emergency prevention information for the community. It also emphasized the value of Sikumiut's IQ in supporting community, territorial and federal Search and Rescue partners in their recovery efforts for the Mittimatalik region. Although this may not seem significant, our aim was to educate funders about the merits of Sikumiut's sea ice knowledge and the need to do this research differently.

2.7.4 Ensure Inuit access, ownership, and control over data (NISR Priority #4).

Having the research done by Inuit youth in Mittimatalik means that the data in this project never leaves the community. It eliminates the ongoing issue of Inuit communities not having access to their data. Sikumiut maps and sea ice terminology products were not digitized and produced by southern graduate students such as myself but produced and managed by Inuit youth in the community. Arreak and Itulu can share their work, get feedback, and make changes as needed, and as directed by Sikumiut. It shows that when Inuit have control and access to their own data, it provides an enormous amount of flexibility, time and cost savings compared to western researchers needing to return each time to the community to review and validate how they interpreted the research.

Another illustration of how this research supports the NISR Priority #4 is that with Sikumiut governing this research, they are able to control the language and the tools (western, Inuit, and artistic methods) used to best document and communicate their sea ice IQ. It also avoids the ongoing issue of communities receiving a final report that does not capture their IQ correctly or present it in a way that is unusable for the community. The Sikumiut Model eliminates the so-called challenges of how to "incorporate" or "integrate" IQ into western science and provides an example for how to respect Inuit decision-making and IQ for its own scientific merit.

2.7.5 Build capacity in Inuit Nunangat research (NISR Priority #5)

It didn't take long to discover the research capacity and interest in Mittimatalik. Arreak will be completing the equivalent of a master's research project by the time this work is done, without ever leaving his community. This is an example of how Inuit can do their own research. The training Arreak received from Sikumiut, and the non-Indigenous research partners are transferrable skills that can support more research independence in the community: either in the leading their own projects; or in choosing to work with non-Indigenous research partners that suit their priorities and approaches. It is also an example for how non-Indigenous researchers and their institutions can support and build capacity in Inuit Nunangat research. Unfortunately, Arreak's work will not be recognized through any formal qualifications or certification mechanisms. For Inuit to become employed in Arctic research at academic, territorial, or federal institutions, a university degree from a western research institution is typically required. There are currently no formal qualifications earned for the training and research conducted by Inuit in co-produced research. Arctic science institutions need to re-examine their hiring policies and job classifications to build in on-the-job training and equivalent work experience to support capacity building and employment in Inuit Nunangat research.

2.7.6 Reflections from a non-Indigenous researcher

My research relationships so far have developed over 11 community visits (Table 2.1) along with numerous phone calls, e-mails, texts, and time spent together in the south (i.e., southern Canada) at meetings and conferences. It has also taken time to learn how to be flexible and adaptable with the realities of life in Mittimatalik. The time required to develop relationships and co-develop research that is based on relational accountability means that it will take me 6 years to complete this research, longer than the typical 4-year funded PhD student program.

The institutional barriers of inadequate travel funding and time to develop authentic research relationships in communities have been raised in the literature (Castleden 2012; Bull 2010; Fletcher 2016). Understanding from the outset that I needed to prioritize time and relationships in Mittimatalik helped me and my graduate supervisors plan in advance and manage our expectations. It did require additional proposal writing to seek funding, but this research is an example that travel funding to co-produce research is becoming more available. Based on my experience in Arctic research and funding programs, overall community-based research costs are no more, and often less expensive than the logistical costs required for remote ship and land-based Arctic fieldwork. However, doing decolonizing research requires the unwavering support from your supervisors to advocate on your behalf about the merits and requirements for this type of research. If researchers and their mentors (Indigenous and non-Indigenous) don't advocate for the time and funding required to do decolonizing research, it will do little to decolonize the university.

Understanding the evolution of western research and how I was trained was a major turning point in my decolonization process. I had never thought about or even questioned western research approaches as a younger graduate student (i.e., when I completed my master's degree). When Inuit youth and Sikumiut members felt comfortable enough to share with me their negative experiences with western researchers, I was able to understand first-hand the colonial legacy of research. Learning about colonized, decolonizing and Indigenous research approaches opened a door to a whole new way of thinking and doing research differently. Being a mature student also meant that I brought experience that could be used in mentoring and training Inuit youth; however, the role of the non-Indigenous research partner may not always be as a mentor and trainer. With the proper support from their supervisors and the dedication to take the time to decolonize themselves and develop authentic relationships in the community, non-Indigenous researchers will find their own way to demonstrate relational accountability in their research.

Although I attempt to continuously challenge myself in my role as a mentor and be critically reflexive throughout this process, I know there is always room for improvement. Even as I write this article and re-read the literature I realize that more mentoring and training should be done in an Inuit context, on the sea ice with Sikumiut (Simpson, 2014). I cannot say that my motivations were completely without self-interest, or that in seeking funding and in writing this paper I didn't end up speaking for Inuit. Such questions are always on my mind, together with other ones such as:

- What am I suggesting? Is it based on a western or decolonizing research perspective?
- How can we do this research differently?
- How do I tap into and support Inuit youth capacity?
- What skills do I bring that can support community research needs so I can give back?
- How do we make sure this co-developed research is useful for the community?
- Am I prioritizing enough time to develop and maintain my relationships in the community?
- Am I getting caught up in southern timelines and deliverables and forgetting that it's not about the results, it's about the process?

Experiencing the highs and lows of life in Mittimatalik also changed me significantly. It allowed me to see the ongoing impacts of colonialism and understand why the trauma continues. It also allowed me to experience the incredible joy and strength of Inuit and reach a deeper sense of respect for the tenacity and resilience of Inuit in maintaining their culture and demanding their rights for sovereignty and Inuit self-determination in research. I have found that no matter what direction the research takes us, it always works out the way it's meant to. Learning to care for and deeply respect my friends and research partners in Mittimatalik goes beyond the conventional western research community partnership. It ensures my relational accountability to the community of Mittimatalik and gives this work greater meaning for me personally. Practicing relational accountability can transform non-Indigenous researchers from those that *say they do* to those that *do* decolonizing research.

2.8 Conclusion

Decolonizing research is a relatively undeveloped research approach in Arctic environmental science in Canada. While many attempts have been made to increase Indigenous participation, capacity building and knowledge, these efforts have not significantly advanced because Arctic environmental science has yet to acknowledge how western research continues to perpetuate colonialism (Cameron, 2012) or to sincerely practice decolonizing research.

The Sikumiut Model demonstrates that Inuit governance over their research was the single most influential NISR priority that contributed towards the overarching goal of Inuit self-determination in research. Greater support for Indigenous and decolonizing Arctic research is needed to demonstrate how universities, funders and government institutions can change their current approaches to support Inuit self-determination in research. This research also illustrates how non-Indigenous researchers can support Inuit self-determination in research by creating the space and time within their institutions and themselves to educate and decolonize their roles in the research.

2.9 Dedication and Acknowledgements

This paper is dedicated to the memory of Jaykolassie Killiktee, founding member and Elder for Sikumiut. From the beginning, Jaykolassie provided gracious and unwavering leadership in designing the research to share Inuit sea ice IQ with Inuit youth, build Inuit youth capacity and strengthen Mittimatalik's self-determination in research. My enormous gratitude goes to all members of the Sikumiut Management Committee for their leadership and generosity: Brian Koonoo; Caleb Sangoya; Elijah Panipakoocho; David Angnatsiak; Gamalie Kilukishak; George Koonoo; Rachel Smale; Sheati Tagak; Simon Merkosak and Moses Arnagoalik. Thank you to Ikaarvik, Shelly Elverum and the Inuit youth that invited SmartICE to Mittimatalik for your advice and encouragement; you have been a constant source of inspiration for this research. The workshop/meeting interpreters in this work play such a critical role in communicating and sharing knowledge and I am truly thankful to Malachi Arreak, Morgan Arnakallak, and Abraham Kubulu (Mittimatalik). Thank-you to Mishak Allurut (Ikpiarjuk) for the timely translation of many Sikumiut documents. Also thank you to Lynn Moorman from Mount Royal University and Tom Zagon from the Canadian Ice Service for their dedication and efforts in helping train Inuit youth. To Environment and Climate Change Canada's Canadian Ice Service, thank you for your ongoing encouragement and support for this research, and to the Canadian Wildlife Service, my multiple trips to the community would not have been possible without accommodation and meeting space at the Mittimatalik research station. Finally, thank you to the two anonymous journal reviewers for their comments, suggestions and encouragement that helped to significantly improve this paper.

2.10 Iqaumajjutaujuq Ammalu Qujagijaujut

Taanna titirarsimajuq iqaumajjutaulluni Jaykolassie Killiktee, pigiartittiqataulaurtuq ammalu Sikumiut insarijaulluni. Pigiarninganit, Jaykolassie kamattiar&uni ammalu surakpallianani sivulirtiulaurtuq aaqiksimaninganik qaujisarniup tusaumajjutauluni inungnut sikulirinirmut inuit qaujimajatuqangit makuktunut inuit, pijunnarsivalliaqullugit inuit makkuktut ammalu ajunginnirsaulirlutik Mittimatalik nangminiq pinasungningit qaujisarnirmut. Qujagillariktakka ilagijaujut sikumiut aulaninganut katimajit sivulirtiuninginnut ammalu ikajuttiarninginnut: Brian Koonoo; Caleb Sangoya; Elijah Panipakoocho; David Angnatsiak; Gamalie Kilukishak; George Koonoo; Rachel Smale; Sheati Tagak; Simon Merkosak; ammalu Moses Arnagoalik. Qujannamiik ikaarvik, Shelly Elverum ammalu inuit makkuktut tungasailaurmata SmartICE mittimatalikmut uqaujjigiarunsalaurmata ammalu kajungirsuillutik; pigiarutaujumavaallirsimagasi qaujisarnirmut. Katimanit/ilinniarniit tusaajiujut atuutiqanlaringmata tamatumunga piliriangujumut ammalu qaujimajarminik uqaqattarmata ammalu qujagillariktakka Malachi Arreak, Morgan Arnakallak, ammalu Abraham Kubulu (Mittimatalik). Qujannamiik Mishak Allurut (Ikpiarjuk) inuktituungalirtittiqattarmata titirarsimajunik unurtunik Sikumiut titiraqutinginnik. Ammalu qujannamiik Lynn Moorman tavangat ruiju ilinniarvikjuaq ammalu Tom Zagon kanatami sikulirinirmut pilisirtit aksuruutiqarninginnut ammalu pinasukninginnut ilinniartittillutik makkuktunik inuit. Avatilirinirmut silaullu asillirpallianinganut kanatami kanata sikulirinirmut pijisirtit, qujanamiik kajungirsuigassi ammalu ikajurtuigasi qaujisarnirmik, ammalu kanatami uumajulirinirmut

pijisirtit, atausiangiluar&ungalu niuruvigiqattartara nunalingnut ajurnarnirsaugajartillugu tujurmiviktaqangikkuni ammalu katimaviktaqangikkuni mittimatalikmi qaujisarvikmi. kingullirpaangani, qujannamiik maruuk qaujimanangittuuk kinauninginnik qimirulaurmatik uqausiksaqarlaurmatiklu, isumaksarsiurutiniklu ammalu kajungirsuilaurmatik ikajuutaulaurmata piusivaallirutaullunilu titirarsimajunut.

2.11 Other

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Chapter 3

"When we're on the ice, all we have is our Inuit Qaujimajatuqangit": Mobilizing Inuit knowledge as a sea ice safety adaptation strategy in Mittimatalik, Nunavut

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3.1 Abstract

Increased variability in weather and sea ice conditions due to climate change has led to high rates of injury, trauma and death for Inuit travelling on the sea ice. Contributing to these high rates are the ongoing effects of colonial policies that diminish and disrupt the intergenerational transfer of sea ice Inuit Qaujimajatuqangit (IQ). Despite these challenges,

place-based experiential IQ continues to be the most important information source for safe travel on the sea ice. This paper presents an Inuit-led, co-produced, cross-cultural, research project in which Inuit youth documented and mobilized sea ice IQ in Mittimatalik (Pond Inlet), Nunavut for safe community sea ice travel. We outline the Inuit youth training to facilitate the terminology and participatory mapping workshops and to document this IQ. We also discuss the IQ that was most important to share, and the mapping and artistic methods used to mobilize this IQ into a booklet, maps and posters.

Inuktitut sea ice terms are the foundation to enable youth with the skills to learn about sea ice IQ with experienced hunters. IQ enables Inuit to interpret and synthesize information from weather forecasts, earth observations, and community-based monitoring to apply to local conditions. Seasonal IQ maps of safe and hazardous sea ice conditions provides travel planning information at spatial and temporal scales that supplemental information sources cannot address. The IQ products mobilize preparedness, situational awareness, navigation and interpretation skills so Inuit youth can become more self-reliant, as access to technology is not always possible once out on the sea ice.

3.2 Co-Authorship Statement

The Sikumiut Management Committee governs this research. They have approved the publication of their IQ as outlined in the Sikumiut-Memorial research agreement (see Appendix C). For this chapter, Sikumiut contributed to conception and design of the study. Arreak, Ljubicic and Wilson co-facilitated the sea ice terminology and mapping workshops. Arreak facilitated all the subsequent validation meetings to review the workshop materials and maintained revisions of the sea ice terminology list. Arreak digitized the Sikumiut maps and

Wilson developed the design and layout of the maps. Itulu participated in all the workshop and validation meetings. Itulu designed the graphical illustrations for the posters and sea ice terminology booklet. Sikumiut reviewed and validated the posters, maps, and terminology booklet. Wilson wrote all drafts of the manuscript. Bell and Ljubicic contributed to manuscript revisions. Ljubicic, Bell, Arreak and Itulu read the manuscript and approved the submitted version.

3.3 ᐃᓱᒪᒋᓪᓗᒍ

ᐊᔾᔨᒌᖕᒋᓕᕐᐸᓪᓕᐊᓂᖕᒐᓄᑦ ᓯᓚ ᓯᑯᓗ ᓯᓚᐅᑦ ᐊᓯᓪᓕᕐᐸᓪᓕᐊᓂᖕᒐᓄᑦ ᐅᓄᕐᓯᕗᓪᓕᐊᖕᒪᑕ ᐱᕈᓗᖃᑦᑕᕐᑐᑦ, ᐊᒃᓱᕈᕐᓇᕐᑐᒦᑦᑐᑦ ᐊᒻᒪᓗ ᑐᕐᑯᔦᑦ ᐃᓄᐃᑦ ᓯᑯᒃᑯᒃ ᐃᖕᒋᕋᓪᓗᑎᒃ. ᐱᔾᔦᑕᐅᖕᒥᔦᖅ ᑕᒪᑐᒨᖕᒐ ᐃᓅᓯᖕᒋᑦ ᐊᓯᕈᕐᑕᐅᓇᓯᓚᐅᕐᓂᖕᒋᖖᓄᑦ ᒪᓕᒐᒃᑯᑦ ᐅᖃᐅᔾᔨᕆᐊᕈᑎᖕᒋᑦ ᐱᑕᖃᖕᒋᖖᓂᖅᐅᓕᕐᓘᑎᒃ ᐊᒻᒪᓗ ᑭᖕᒍᕚᕇᑦ ᖃᐅᔨᒪᓂᕆᒐᔭᓚᐅᕐᑕᖕᒐ ᐊᓯᐅᔨᔭᐅᓪᓗᓂ ᓯᑯᓕᕆᓂᕐᒧᑦ ᐃᓄᐃᑦ ᖃᐅᔨᒪᔭᑐᖃᖕᒋᑦ. ᑕᒪᒃᑯᐊᖕᒎᒐᓗᐊᕐᑎᓪᓗᒋᑦ ᐊᒃᓱᕈᕐᓇᐅᑕᐅᔦᑦ, ᓄᓇᓕᕆᓂᖅ ᓇᒦᓐᓂᖕᒋᓐᓂᒃᓗ ᐅᖃᐅᓯᐅᖃᑦᑕᕐᓂᖕᒋᑦ ᓱᓕ ᐱᓪᓚᕆᐅᕗᖅ ᑐᓴᒃᓴᐅᓪᓗᓂ ᐊᑦᑕᕐᓇᖕᒋᑦᑐᒃᑯᑦ ᐃᖕᒋᕋᖃᑦᑕᕐᓂᖅ ᓯᑯᒃᑯᑦ. ᑖᓐᓇ ᑎᑎᕋᕐᓯᒪᔦᖅ ᓴᕿᑎᑦᑎᕚᖅ ᐃᓄᖕᓂᒃ ᐱᒋᐊᕐᑎᑕᐅᔦᒥᒃ, ᓴᕿᑕᐅᓪᓗᓂ ᐃᑲᔪᕐᑎᖃᕐᓘᑎᒃ, ᐃᓕᕐᑯᓯᖃᑎᒌᖕᒋᑦᑐᑦ ᑲᑐᔾᔨᖃᑎᒋᒃᓘᑎᒃ, ᖃᐅᔨᓴᕐᑎᑦᑎᓪᓗᑎᒃ ᒪᒃᑐᑦ ᐃᓄᐃᑦ ᑎᑎᕋᕐᐸᓪᓕᐊᓪᓗᑎᒃ ᐊᒻᒪᓗ ᐊᑐᓕᕐᑎᑦᑎᕗᓪᓕᐊᓪᓗᑎᒃ ᓯᑯᒥ ᐃᓄᐃᑦ ᖃᐅᔨᒪᔭᑐᖃᖕᒋᑦ ᒥᑦᑎᒪᑕᓕᖕᒥ, ᓄᓇᕗᑦ ᐊᑦᑕᕐᓇᖕᒋᑦᑐᒃᑯᑦ ᓄᓇᓕᖕᒥᐅᑦ ᐃᖕᒋᕋᖃᑦᑕᕐᑯᓪᓗᒋᑦ ᓯᑯᒃᑯᑦ. ᐅᖃᐅᓯᕆᖕᒥᔭᕗᑦ ᒪᒃᑯᑦ ᐃᓕᓐᓂᐊᕐᑎᑕᐅᓂᖕᒋᑦ ᑕᐃᒍᓯᓂᒃ ᐊᒻᒪᓗ ᓄᓇᖑᐊᓕᕆᓂᕐᒥᒃ ᐃᓚᐅᖃᑦᑕᕐᓂᖕᒋᑎᒍᑦ ᐊᒻᒪᓗ ᑎᑎᕋᕐᐸᓪᓕᐊᓪᓗᑎᒃ ᐃᓄᐃᑦ ᖃᐅᔨᒪᔭᑐᖃᖕᒋᑦ. ᐅᖃᐅᓯᕆᖕᒥᔭᕗᑦ ᐃᓄᐃᑦ ᖃᐅᔨᒪᔭᑐᖃᖕᒋᑦ ᐱᓪᓚᕆᐅᓚᐅᕐᑐᑦ ᑐᓴᕐᑕᐅᔭᕆᐊᖁᑦ, ᐊᒻᒪᓗ ᓄᓇᖑᐊᓕᕆᓂᖅ ᐊᒻᒪᓗ ᑎᑎᕋᔭᕐᑕᐅᓂᒃᑯᑦ ᐊᑐᕐᑕᐅᔦᑦ ᐊᐅᓚᔾᔨᐊᕈᑕᐅᓪᓗᑎᒃ ᐃᓄᐃᑦ ᖃᐅᔨᒪᔭᑐᖃᖕᒋᑦ ᐅᖃᓕᒑᒐᖕᒍᕐᓘᑎᒃ, ᓄᓇᖑᐊᖕᒍᕐᓘᑎᒃ ᐊᒻᒪᓗ ᐊᑭᓐᓇᒦᑦᑐᒃᓴᐃᑦ.

ᐃᓄᒃᑎᑐᑦ ᑕᐃᒍᓯᑦ ᓯᑯᓕᕆᓂᕐᒥᒃ ᑐᙵᕕᐅᖕᒪᑕ ᐱᔪᓐᓇᕐᓯᔾᔪᑕᐅᓪᓗᑎᒃ ᒪᒃᑯᑐᓄᑦ ᐃᓕᓐᓂᐊᕐᑕᐅᓪᓗᑎᒃ ᓯᑯᓕᕆᓂᕐᒧᑦ ᐃᓄᐃᑦ ᖃᐅᔨᒪᔭᑐᖃᖕᒋᑎᒍᑦ ᐊᖑᓇᓱᒃᑎᐅᔪᓂᑦ. ᐃᓄᐃᑦ ᖃᐅᔨᒪᔭᑐᖃᖕᒋᑦ ᐱᔪᓐᓇᕐᑎᑦᑎᓯᒪᖕᒪᑕ ᐃᓄᖕᓂᒃ ᑐᑭᓯᔭᒃᓴᐅᕐᑯᓪᓗᒋᑦ

ᐊᒻᒪᓗ ᐊᑐᕐᑕᐅᔪᓐᓇᕐᑯᓪᓗᒋᑦ ᐅᖃᐅᓯᐅᔪᑦ ᓯᓚᓕᕆᓂᐅᔪᑦ ᖃᓄᐃᓕᖕᖓᓂᐊᕐᓂᕋᕐᑕᐅᓂᖕᖓ, ᓄᓇᕐᔪᐊᒥ ᐅᔾᔨᕆᔭᐅᔪᑦ, ᐊᒻᒪᓗ ᓄᓇᓕᖕᓂ ᐱᕆᐊᕐᑎᑕᐅᓯᒪᔪᑦ ᖃᐅᔨᓴᕐᓃᑦ ᐊᑐᕐᑕᐅᓪᓗᑎᒃ ᓄᓇᓖᑦ ᐊᕙᑎᖕᖓᓃᑦᑐᓄᑦ ᓯᓚᖕᖓᓄᑦ. ᐊᕋᒍ ᐃᓗᐊᓂ ᖃᖕᖓᐅᓕᕚᖕᖓᑦ ᐃᓄᐃᑦ ᖃᐅᔨᒪᔭᑐᖃᖏᑦ ᓄᓇᖑᐊᑦ ᐊᑦᑕᕐᓇᕐᑕᐃᓕᒪᓂᕐᒧᑦ ᐊᒻᒪᓗ ᓇᖏᐊᕐᓇᕐᑐᑦ ᓯᑯᑦ ᖃᓄᐃᓕᖕᖓᓂᖏᑦ, ᖃᐅᔨᒪᔾᔪᑕᐅᔪᓐᓇᕐᑐᑦ ᐃᖏᕋᓂᐊᕐᑐᓄᑦ ᐸᕐᓇᒃᑐᓄᑦ ᑐᓴᐅᒪᔭᐅᓂᐊᕐᓗᑎᒃ ᐊᓯᖏᓐᓂᑦ ᐱᑕᖃᖏᑦᑐᑦ. ᐃᓄᐃᑦ ᖃᐅᔨᒪᔭᑐᖃᖏᑦ ᓴᕿᑕᐅᔪᑦ ᐊᐅᓚᔾᔭᕆᐊᕈᑕᐅᕗᑦ ᐱᕙᓖᔭᕐᓯᒪᔭᓇᐊᖅᓂᕐᒥᒃ, ᖃᓄᐃᓕᖕᖓᓂᖕᖓ ᒪᓕᒃᓗᒍ ᐋᕿᑭᐊᕐᓯᓂᕐᒥᒃ, ᓇᐅᒃᑰᖕᖓᔭᓇᐊᖅᓂᕐᒥᒃ ᐊᒻᒪᓗ ᑐᑭᓯᑭᐊᕐᓂᕐᒥᒃ ᐊᔪᖕᒋᓐᓂᖅᓴᐅᓕᕐᓗᑎᒃ ᐃᓄᐃᑦ ᒪᒃᑯᒃᑐᑦ ᓇᖕᒥᓂᖅ ᐱᓇᓱᓕᕈᑎᒃ ᐊᔪᖕᒋᓐᓂᖅᓴᐅᓂᐊᕐᒪᑕ, ᖃᕋᓴᐅᔭᒃᑰᖕᖓᔪᑦ ᓄᓇᓖᑦ ᓯᓚᑖᓂᓕᕐᓗᓂ ᓯᑯᒦᓕᕐᓗᓂ ᐊᔪᓕᖅᑦᑕᕐᒪᑕ.

Inuktitut Abstract and Acknowledgement translations by Mishak Allurut, Ikpiarjuk, NU.

3.4 Introduction

Studies over the past 17 years have shown that climate change is resulting in increasingly dangerous sea ice travel conditions for Inuit (Fox, 2004; Tremblay et al., 2006; Laidler et al., 2010; Druckenmiller et al., 2013; Archer et al., 2017; Panikkar et al., 2018; Segal et al., 2020b). The reported high rates of sea ice travel-related injury, trauma, tragic deaths and search and rescue (SAR) requests of Inuit are further evidence of dangerous sea ice travel conditions as a result of climate change (Durkalec et al., 2014; Driscoll et al., 2016; Clark et al., 2016a). Territorial, federal, academic, industry and not-for-profit organizations have been developing climate change adaptation information to support safer sea ice travel for Inuit. Examples of additional information Inuit consult prior to travel include weather forecasts (ECCC, 2020a), satellite data (Polar View, 2019; Arctic Eider Society, 2020), and information from community-based weather and sea ice monitoring programs (SmartICE, 2020; Ittaq, 2021). When travelling on the sea ice, younger hunters are now relying more on Global Positioning Systems (GPS) devices, to navigate (Wenzel, 2004; Aporta and Higgs, 2005; Pearce et al., 2011; Christie et al., 2018).

What compounds the issue of safe sea ice travel for Inuit is the ongoing legacy of colonialism in the Canadian Arctic. Generations of Inuit were denied the experience of learning how to safely travel on the sea ice because as children they were sent (or taken) away from their communities to attend residential schools (QIA, 2014). More recently, the shift to wage employment has led to an erosion of the Inuit Qaujimajatuqangit (IQ) skills necessary for sea ice travel and survival (Aporta and Higgs, 2005; Gearheard et al., 2006; Ford et al., 2007; Pearce et al., 2010, 2011, 2015; Heyes, 2011; Laidler et al., 2011; Durkalec et al., 2015). IQ is commonly used to describe Inuit knowledge, but it encompasses so much more than knowledge. IQ "embraces all aspects of traditional Inuit culture, including values, world-view, language, social organization, knowledge, life skills, perceptions and expectations" (Nunavut Department of Education, 2007:22), for a more in-depth description see Kalluak (2017). In spite of these challenges, sea ice IQ endures and continues to be gained through experience and practice. Inuit who are out at their camps and cabins or who have recently returned to the community share their sea ice observations and knowledge, and these observations and experiences continue to be widely used by Inuit to make sea ice travel decisions (Ford et al., 2013a; ICC-Canada, 2014). Inuit have always experienced and adapted to variable sea ice and weather conditions from year to year; however, the nature and magnitude of recent changes are largely unprecedented in living memory (Pearce et al., 2010). Increased variability in weather and sea ice conditions due to climate change has left some experienced hunters doubting their weather and sea ice forecasting skills (Aporta, 2002; Gearheard et al., 2006, 2010; Ford et al., 2009; Laidler et al., 2011).

However, many hunters still have confidence in their IQ to navigate and make critical decisions on the sea ice, even under changing sea ice conditions (Gearheard et al., 2006; Pearce et al., 2010). At a recent meeting with Inuit in Mittimatalik (Pond Inlet), Nunavut, one experienced sea ice traveller said, “When we’re on the ice, all we have is our Inuit Qaujimajatuqangit” (Wilson, 2018a:4), as there is limited information to support Inuit once they leave their community and are on the sea ice. There have been some discussions about the need to improve the inter-generational transfer of sea ice IQ (Pulsifer et al., 2011; Pearce et al., 2015; Archer et al., 2017; Christie et al., 2018; Panikkar et al., 2018), but there are very few examples of mobilizing IQ as a sea ice safety adaptation strategy (Ford et al., 2007; Hackett et al., 2016; Aqqiumavik, 2020; Ilisaqsivik, 2020).

This research paper provides a practical example of mobilizing IQ for safe sea ice travel to address the adaption needs of Inuit youth in the community of Mittimatalik (Pond Inlet). The goals of this paper are two-fold. First, this paper outlines a co-produced, cross-cultural, Inuit-led research project that documented and mobilized sea ice IQ in Mittimatalik to support safe sea ice travel in the community. We present the methods used to train Inuit youth in facilitating the sea ice terminology and participatory mapping workshops to build capacity and to conduct this research themselves. We outline the geographic information systems (GIS) training and artistic methods utilized to mobilize the IQ that was most important to document and mobilize. We also describe the unique ways this sea ice IQ was mobilized into a booklet, maps and posters for different generations of Inuit with varying levels of Inuktitut proficiency and sea ice travel experience. Second, this paper demonstrates that sea ice IQ continues to be necessary and relevant for safe sea ice travel, even under changing sea ice conditions. The community-specific sea ice terminology in the booklet provides the foundation upon which Inuit youth can build their knowledge and experience. Mobilizing the Inuktitut sea ice terms equip youth with the ability to discuss and share sea ice conditions with more experienced Inuit hunters, which is especially critical during SAR events. While experienced hunters use novel information from weather forecasts, earth observations, and community-based monitoring sources to augment their knowledge, they are not reliant on them (Pulsifer et al., 2011; ICC-Canada, 2014; Pearce et al., 2015). IQ provides experienced Inuit sea ice users with the skills to interpret and synthesize these additional sources of information and apply them to their local conditions. The IQ maps provide Inuit youth with a baseline of seasonal knowledge for areas of safe and hazardous sea ice and areas for shelter. The sea ice terms and posters teach inexperienced hunters how to identify hazardous and safe sea ice conditions for safe navigation on the sea ice, filling spatial and temporal scales that additional information sources cannot address. The IQ products combined teach preparedness, situational awareness and navigational skills so Inuit youth can become more self-reliant as technology is not always accessible or reliable out on the sea ice.

3.5 Background

When Inuit refer to being out "on the land," it includes travel on land, water, and sea ice. In winter, the sea ice connects the land and provides greater access and mobility to areas that are separated by open water in the summer (ICC-Canada, 2008; Middleton et al., 2020). The sea ice becomes an extension of the land and so travelling "on the land" refers to travelling predominantly on the sea ice. Environmental changes to sea ice travel and travel on the land is having profound impacts on the physical, cultural and mental health of Inuit. These impacts intersect with and amplify the effects of colonialism, which continue to interrupt the transfer of sea ice IQ to younger generations of Inuit.

3.5.1 Climate change impacts on sea ice and Inuit

Records show that sea ice in the Canadian Arctic has been decreasing at a rate of 7% per decade and all regions in the Canadian Arctic have experienced a decreasing trend in sea ice between 1968 and 2018 (ECCC, 2021). Climate change observations from various Inuit Nunangat communities describe that the sea ice freezing later in the fall and breaking up earlier in the summer, and that there are changes to the quality and strength of sea ice, and more areas of thin ice (Laidler et al., 2009, 2010; Cunsolo Willox et al., 2013; Ford et al., 2013b; Gearheard et al., 2013; Archer et al., 2017; Panikkar et al., 2018; Segal et al., 2020b). Similar observations have been documented for Mittimatalik (Manseau, 2006; Knight Piésold Consulting, 2015; Carter et al., 2018).

The high cost of store-bought foods in Inuit Nunangat (Inuit homelands in the Canadian Arctic) means that Inuit spend over three times the amount of an average Canadian on basic supplies, and Inuit food insecurity rates are eight times higher than the rest of Canada (Kenny et al., 2018a). Climate change is challenging Inuit communities that are reliant on the sea ice to provide access to necessary country food, such as caribou, arctic char, seal, and narwhal (Laidler et al., 2009; Clark et al., 2016a; Kenny et al., 2018b). Research shows that even modest amounts of country foods contribute critical sources of nutrition that cannot be replaced by store-bought proteins such as canned tuna, chicken, and beef (Kenny et al., 2018a, 2018b; Anselmi, 2019). Country foods that comprise the traditional diet are significant aspects of Inuit cultural identity and taste preference. Although the amount of country food consumed by Inuit varies amongst communities, 80 percent of Inuit in communities in the Canadian western Arctic, would prefer to eat more country food (Kenny et al., 2018a).

Climate change is also affecting Inuit physical and mental well-being. For Inuit, being on the land provides a sense of peace, wholeness, calm, healing and enriches the soul (Cunsolo Willox et al., 2013; Middleton et al., 2020). Inuit have explained that travelling on the sea ice means freedom (Gearheard et al., 2013; Durkalec et al., 2015) and being unable to travel on the sea ice is directly connected to their mental and emotional health, and well-being (Cunsolo Willox et al., 2013; Ford et al., 2013b; Durkalec et al., 2015; Pearce et al., 2015; Middleton et al., 2020). Rates of unintentional injury and trauma are extremely high in Inuit Nunangat (Durkalec et al., 2014) and in Nunavut specifically, they "are more than twice the national average…and the leading cause of morbidity and mortality" (Clark et al., 2016a: 1). In Alaskan Inuit communities, unintentional injury such as frostbite, hypothermia or drowning from falling through the ice was "significantly more likely in months when respondents reported unseasonable environmental conditions, and particularly so when they changed travel plans as a consequence of those conditions" (Driscoll et al., 2016:455).

SAR requests in Nunavut doubled between 2006 and 2015 (Clark et al., 2016b) and of the approximate 300 SAR requests made each year, more than one-third occur in the transitional ice periods when the sea ice freezes-up in the fall or as it breaks-up in early summer (S. Baillie, pers. comm. 2017). The analysis of SAR records in Nunatsiavut and Nunavut found that requests have increased due to changing weather and sea ice conditions, but also due to mechanical breakdown and running out of gas (Clark et al., 2016a; Durkalec et al., 2014). Changing sea ice conditions means that Inuit are no longer able to access traditional hunting and fishing areas and are now having to navigate new, longer, and more dangerous routes. This increases the risk of becoming lost in unfamiliar areas, using more fuel, and running out of gas. Breaking through unexpected areas of thin ice and having to travel over rough ice and/or land is resulting in snowmobiles and other equipment being lost and damaged (Ford et al., 2007; Durkalec et al., 2015; Driscoll et al., 2016; Fawcett et al., 2018). Despite the risks of hunting and travelling on the sea ice due to climate change, Inuit have argued that the benefits of sea ice travel for their physical, nutritional, cultural, spiritual, and mental health still outweigh the risks (Clark et al., 2016b; Durkalec et al., 2015; Ford et al., 2013a; Gearheard et al., 2011; Kenny et al., 2018b).

3.5.2 Impacts of colonialism on Inuit sea ice travel safety

In the 1950s, Inuit were forced or induced to transition from land-based economies to settlement economies based on wage labour, as part of the Government of Canada's assimilation approach called the in-gathering policy (Tester and Kulchyski, 1994; Damas, 2002; Tester, 2017; MacDonald, 2018). Many Inuit children were sent (or taken) away to residential schools resulting in generations of Inuit being deprived of the ability to develop their sea ice IQ through observations and experiences with their parents and Elders (ICC-Canada, 2014; QIA, 2014; TRC, 2015). Colonialism has left many generations of Inuit unable to communicate in Inuktitut, which impacts their ability to learn, understand and share sea ice conditions and experiences with hunters and Elders (Ford et al., 2013a; Heyes, 2011; Pearce et al., 2011).

Settlement further contributed to the erosion of sea ice IQ with imposed work and school schedules that limit sea ice travel to weekends and holidays (Aporta and Higgs, 2005; Ford et al., 2007; Pearce et al., 2010, 2011, 2015; Heyes, 2011; Pulsifer et al., 2011; Durkalec et al., 2015; Panikkar et al., 2018). The introduction of the snowmobile in the 1960s allowed Inuit to travel greater distances in less time (Aporta, 2010; Ford et al., 2013b; Clark et al., 2016b; Panikkar et al., 2018). Weekend sea ice travel reduces the flexibility of Inuit to hunt when the environmental conditions are at their best. This can lead to increased risky behaviour as people may leave the community in less than ideal weather conditions in order to return for school or work commitments (Clark et al., 2016b; Ford et al., 2013a; Gearheard et al., 2006; Kenny et al., 2018a; Meier et al., 2006; Pearce et al., 2015a). The high rates of SAR are also related to wage employment. Inuit without a reasonable income cannot afford to purchase, fix, or replace the necessary equipment for safe travel on the sea ice (Clark et al., 2016b; Heyes, 2011). Snowmobiles are very expensive to purchase, fix and run. There are the costs of gas, extra gas, fuel for stoves, tents, clothing, food, VHF radios, GPS and SPOT devices, and satellite phones. Snowmobiles can break down due to make-shift repairs leaving Inuit stranded if they are unable to afford the necessary back-up supplies (Clark et al., 2016b).

In summary, the high rates of unintentional injury and SAR of Inuit on the sea ice are not simply due to climate change, but are intertwined with the ongoing effects of colonialism that have weakened the transmission of sea ice IQ through reduced language and practice (Tester and Kulchyski, 1994; Damas, 2002; MacDonald, 2018).

3.5.3 Sea ice travel adaptation tools

Better ice and weather information at community (local and regional) scales have been discussed to support Inuit climate change adaption needs for safer sea ice travel (Ford et al., 2007; Eicken et al., 2009; Eicken, 2013). Technological adaptation tools include access to weather, tide, and marine information, along with satellite imagery, GPS, and community-based sea ice monitoring (Table 3.1: columns 1 to 3). Community-based monitoring activities vary across the Arctic, but include the use of time lapse photography, webcams, and coastal radar systems to monitor sea ice break-up, and equipment to measure local weather, sea ice, snow and oceanographic conditions (Mahoney and Gearheard, 2008; Mahoney et al., 2009; Druckenmiller et al., 2010, 2013; Bell et al., 2014; Aqqiumavik, 2020; Arctic Eider Society, 2020; Segal et al., 2020a; Dufour-Beauséjour et al., 2020; Fox et al., 2020; Ittaq, 2021).

Satellite imagery and their derived products are another adaptation tool that Inuit are regularly consulting (Pearce et al., 2010, 2015; Laidler et al., 2011; Segal et al., 2020a) from websites such as SIKU (Arctic Eider Society, 2020), and Polar View (2019) (Table 3.1). Satellite imagery can benefit Inuit by providing an overhead view of the sea ice destinations further from the community to help identify routes for safe sea ice travel (Meier et al., 2006; Laidler et al., 2011). Sea ice charts produced for Arctic shipping at the Canadian Ice Service (CIS) have been tested as another adaptation tool for Inuit (Table 3.1) (ECCC, 2020b). The ice charts are a set of daily or weekly maps that synthesize observational, satellite and modelling data and describe the sea ice conditions using a numerical World Meteorological Organization (WMO) standard called "the egg code" (ECCC, 2016).

GPS devices are widely used by Inuit hunters to navigate while out on the sea ice (Table 3.1). The Igliniit project developed a mobile device for Inuit to monitor and track weather, wildlife and sea ice observations (Gearheard et al., 2010; 2011). Hunters can mark the geographic location of dangerous sea ice conditions to share with the community. As most mobile phones now have location tracking functionality, monitoring capabilities are now possible. The SIKU application, was designed specifically for Inuit to map hazardous ice conditions. It is currently the only publicly available app that can share hazardous ice conditions broadly to other mobile devices and on the SIKU on-line social media platform (Arctic Eider Society, 2020).

Inuit Elders and experienced hunters highlight that all these technological tools can only augment Inuit knowledge; they do not replace the decision-making skills needed when travelling on the sea ice (Gearheard et al., 2006). Community-specific sea ice IQ provides the foundation for Inuit to adapt to climate change (Krupnik and Jolly, 2002; George et al., 2004; Tremblay et al., 2006; Ford et al., 2007; Pearce et al., 2015). To improve sea ice IQ, Inuit have recommended and implemented community safety workshops, hunter meeting places, and young hunter training programs (Ford et al., 2007; Hackett et al., 2016; Aqqiumavik, 2020; Ilisaqsivik, 2020). The literature also has several examples of documenting and mapping Inuit sea ice IQ to: preserve IQ (Heyes, 2011; Krupnik, 2011; Weyapuk et al., 2012); understand local sea ice processes (Laidler and Elee, 2008; Laidler and Ikummaq, 2008; Laidler et al., 2008; Heyes, 2011; Krupnik, 2011); characterize conditions for wildlife migration (Ljubicic et al., 2018; Henri et al., 2020); undertake environmental assessments (Manseau, 2006; Knight Piésold Consulting, 2015); and develop Arctic shipping policy (Carter et al., 2018). However, there are only a few examples in which the documentation of sea ice IQ was done to improve safe sea ice travel (Tremblay et al., 2008; Arctic Eider Society, 2020; Fox et al., 2020; Nunavut Arctic College Media, 2020).

3.6 Methods

Katherine Wilson, the lead author of this paper, is a PhD candidate with Memorial University of Newfoundland, and an employee of the Government of Canada for over 25 years, with the CIS (17 years in total), Environment and Climate Change Canada (ECCC), and currently on interchange with SmartICE. As a settler scholar and government employee, the multiple roles of the lead author are both contradictory and complementary. The motivation for the lead author to return to school to retrain in decolonizing research approaches was to help create space in government and academia for reconceptualised approaches that better support Inuit self-determination in research (Wilson et al., 2020).

Trevor Bell, co-author, is the co-supervisor for Wilson and the founder of SmartICE. SmartICE (smartice.org), a work integration social enterprise, provides ice thickness measurements from: in-situ instruments (SmartBUOYs) located at strategic travel locations on the sea ice; and a mobile sensor (SmartQAMUTIK) towed behind a snowmobile throughout the season on the main sea ice trails (Bell et al., 2014). Bell and Wilson have been working in Mittimatalik since 2015.

Table 3.1 Sea ice safety information sources by season

1	2	3	4		5				
Sea ice travel tools	**Spatial resolution m²**	**Temporal Frequency**	**Use of information for: P = planning sea ice travel or D = during sea ice travel**		**Sea ice information used by Mittimatalik season**				
					Ukiaksaaq early fall	**Ukiaq** early winter	**Ukiuq** winter	**Upirngaaksa** early spring	**Upingaaq** spring
Public weather (ECCC, 2020a; Windyty, 2020)	Variable 1 -20,000	Hourly	**P**	Yes - to plan sea ice travel during good weather conditions	✓	✓	✓	✓	✓
			D	No - weather observations are from the airport, not out on the sea ice where the weather can be very different.					
Tide tables (DFO, 2020)	n/a	Hourly	**P**	Yes – knowledge of tide heights and timing needed to plan travel and avoid certain areas on the sea ice	✓	✓	✓	✓	✓
			D	No – cannot indicate which sea ice conditions are affected by tides and their locations.					
Public satellite imagery (ESA, 2019; NASA, 2019)	100-500	1-3 days	**P**	Yes – provides an aerial view to monitor sea ice conditions outside of town. Certain satellites can monitor during poor weather conditions.	✓	✓	✓	✓	✓
			D	No - difficult to interpret without training, cannot monitor ice thickness, spatial scales not detailed enough to capture local sea ice travel hazards.					
CIS charts (ECCC, 2020b)	500-1000	Daily Weekly	**P**	Yes - synthesis of weather and satellite information to monitor areas of open water during freeze-up and break-up.	✓				✓
			D	No – same drawbacks as satellite imagery. Difficult to interpret without training, cannot monitor ice thickness, spatial scales not detailed enough to capture local sea ice travel hazards.					
Community based sea ice monitoring (SmartICE, 2020)	3-10	Daily Weekly	**P**	Yes – at community scales, provides site specific monitoring of ice thickness and along community travel routes to plan travel. Cannot monitor during freeze-up and late break-up when the sea ice is not safe for travel.			✓	✓	✓
			D	Yes –recent measurements and observations are available on the SIKU app while travelling on the ice.			✓	✓	✓

GPS	3-10	Minute	**P**	Yes – to add locations of cabins and hazardous sea ice areas.	✓	✓	✓	✓	✓
			D	Yes – to help inexperienced travellers navigate, and all users navigate during poor visibility and in new travel routes.	✓	✓	✓	✓	✓
Sikumiut's sea ice IQ terminology, posters, travel maps (this study)	1-100	Minute	**P**	Yes – to synthesize all the available information to determine when and where it's safe to travel. Maps to be aware of known hazards and shelter. Posters to be prepared with extra supplies in case of an emergency.	✓	✓	✓	✓	✓
			D	Terminology and experience provide the knowledge to visually identify sea ice types, physically test the sea ice and make critical decision during travel on the sea ice.	✓	✓	✓	✓	✓

3.6.1 Community context

The population of Mittimatalik is approximately 1600, with 92% identifying as Inuit and with Inuktitut as their mother tongue (Statistics Canada, 2017). The community of Mittimatalik is located at the northern tip of Baffin Island in the Qikiqtaaluk region of Nunavut (Fig. 3.1). *Sirmilik* (Bylot Island), which means "place of glaciers", lies across *Tursukattak* (Pond Inlet) from the community (Fig. 3.1). The sea ice is the primary transportation platform for hunting, fishing and travel to family cabins, and the sea ice travel season for Mittimatalik is approximately eight months long (ICC-Canada, 2008, 2014). The ocean water around the community typically begins to freeze in late October and is safe enough for travel in late November once the ice becomes *tuvaq* (landfast ice or stable sea ice that is frozen to the land).

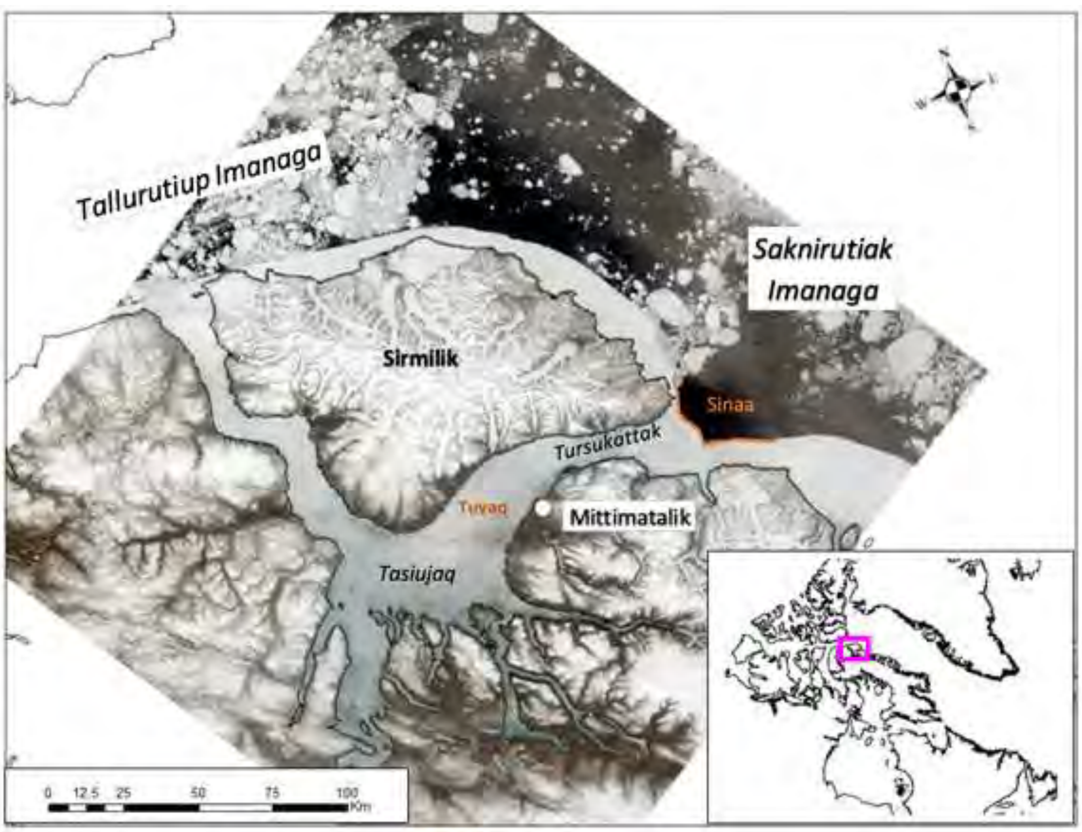


Figure 3.1 Location of the community of Mittimatalik, Nunavut, Canada. Background image MODIS True Colour Composite, June 9, 2019 (NASA, 2019).

A boundary sea ice feature called *sinaa* (floe edge) starts to establish in November between the stable *tuvaq* in *Tursukattak* and the southward moving mobile sea ice in *Saknirutiak Imanaga* (Baffin Bay) (Fig. 3.1). Dominant westerly weather patterns push the *Saknirutiak Imanaga* sea ice farther away from the *sinaa*, providing a naturally occurring area of open water. Located approximately 65 km from the community, the *Tursukattak sinaa* is one of the main hunting and fishing locations, as it provides a stable platform to access marine-based country food (narwhal, beluga, seal, and char) for Mittimatalingmiut (people of Mittimatalik). Mittimatalingmiut hunters will commonly tow small aluminum boats on a *qamutik* (Inuit sled) behind their snowmobiles to hunt and fish in the open water at the *sinaa*. Mittimatalingmiut will hunt and fish on the sea ice until late June or early July when the sea ice starts to break-up.

3.6.2 Co-developing the research approach

Bell and Wilson spent the first two years developing relationships and trust in order to set up the SmartICE community-based sea ice monitoring service. Andrew Arreak, co-author, was hired in 2015 and trained as the SmartICE Community Operator for Mittimatalik and the Nunavut Operations Lead for Qikiqtaaluk North.

In 2016, a 10-person committee of Elders, as well as experienced and emerging sea ice users, was established to govern SmartICE in Mittimatalik. Sikumiut, which means “people of the sea ice” in Inuktitut, is the self-titled name of the management committee (SmartICE, 2020). In September 2017, Sikumiut (also co-authors on this paper) were at a point they felt comfortable enough to discuss their research needs with Bell and Wilson. Sikumiut expressed that they were very pleased with initial SmartICE operations, but younger generations lacked the fundamental

IQ to keep them safe while they are traveling on the sea ice. Sikumiut identified the need to document and mobilize their IQ to support safe community sea ice travel. While southern researchers have recorded and mapped sea ice IQ in Mittimatalik, it was always done for external purposes such as the establishment of Sirmilik National Park (Manseau, 2006), Environmental Assessments for the Mary River Mine (Knight Piésold Consulting, 2015), and consultations for the Canadian Coast Guard's Arctic Shipping Corridors (Carter et al., 2018). Because previous sea ice IQ was not collected with the intent for use by Mittimatalingmiut, the result was a collection of IQ that could not be repurposed for Sikumiut needs.

During 2017, Bell and Wilson sought funding to address Sikumiut's research needs. It was also during the third year that time was spent co-developing the Sikumiut Model (Wilson et al., 2020), which is a cross-cultural research approach based on the following six goals, to:

1. Support Inuit self-determination in research;
2. Embrace Inuit decision-making;
3. Prioritize community-based research needs;
4. Develop Inuit specific values for research;
5. Strengthen Inuit youth capacity; and
6. Change the role of non-Indigenous research partners.

In the Sikumiut model, the research is focused on community-identified research needs. Sikumiut provided the direction on what sea ice IQ they felt was most important to document and how it would be most appropriate to share and mobilize their knowledge. Strong emphasis was placed on building Inuit youth capacity in research and on enhancing the intergenerational transfer of sea ice IQ. Therefore, the role of the non-Indigenous research partners was reconceptualised as facilitators and mentors for Inuit youth in Mittimatalik to do this research themselves. Arreak was the Inuit youth researcher for the Sikumiut project outside of the SmartICE monitoring season. Youth Sikumiut members were encouraged to participate fully in all the meetings and workshops to expand their sea ice IQ as emerging knowledge holders. A research agreement between Sikumiut and Memorial University was developed to outline the project plan, as well as roles and responsibilities of the Inuit and non-Indigenous project partners (Wilson, 2018b). The research agreement also outlined that the data from this project were owned by Sikumiut, and consent was given to Wilson to publish the results as part of her PhD requirements.

Sikumiut were interested in new ways to document and communicate their IQ to share with the community to improve safe sea ice travel. As one Elder Sikumiut member stated, "In the past we never had writing tools, so we did not record these things. This will be the first time we have documented our sea ice knowledge" (Wilson, 2018a:4). In reviewing possible methods to map their IQ, Sikumiut emphasized the importance of starting with documenting Inuktitut sea ice terminology. In an oral culture, the Inuktitut terms are key to identify and communicate sea ice conditions and hazards. Documenting and sharing Inuktitut sea ice terminology was considered the foundation upon which Sikumiut could build to more effectively mobilize their IQ. All of the workshops and validation meetings were held in Inuktitut to enable conversations and ideas to flow freely without interruption. Simultaneous translation into English was provided mostly for the non-Indigenous research partners and to assist youth members who are not fully bilingual.

3.6.3 Sea ice terminology workshops

The initial workshops to document local Inuktitut sea ice terminology occurred over three days in October 2018. Elder Sikumiut members requested the participation of two other community Elders with significant sea ice IQ. In total six Elders shared their IQ with three younger Sikumiut members listening. The terminology workshop used methods based on research in Kinngait, Igloolik, and Pangnirtung (Laidler and Elee, 2008; Laidler and Ikummaq, 2008; Laidler et al., 2008). Gita Ljubicic, co-author, is also a co-supervisor for Wilson. Ljubicic was present to help mentor and train Arreak and Wilson in the methods and co-facilitation of the workshops. The first day was a review of the Mittimatalik freeze-up and winter sea ice conditions, and the second day focused on sea ice break-up. The third day was used for initial validations and refinement of the terms and definitions, as well as to clarify any questions. As each Inuktitut sea ice term was discussed, the term was written in bold, large letters on a 4” by 6” index card, with the definition below it. The word and definition were discussed for translation into English and written on the other side of the card. For many of the sea ice terms, there were no equivalent English terms, so these terms were re-written in Inuktitut, with English definitions. This method of having the Inuktitut and English on one card ensured that the translations did not get mixed up. It also allowed for Sikumiut to collectively agree on the spelling and definitions of the terms. Arreak wrote the Inuktitut words and definitions on the card and Ljubicic wrote the English words and definitions. Wilson took notes of the overall discussion amongst the Sikumiut members, such as the questions and clarifications asked, and the associated examples/stories that Sikumiut members provided. The index cards enabled a hands-on experience during the workshop. The cards were placed on the table and Sikumiut members could point to the card, pick it up, edit it themselves and arrange the cards based on the discussion (e.g., to explain the various stages of sea ice freeze-up). The cards were also taped to the wall and arranged in a seasonal progression for review and adjustment (Fig. 3.2). Sikumiut then suggested the production of a small booklet of sea ice terminology, with accompanying photographs and illustrations of ice conditions, to be distributed to households as an important learning tool.

Figure 3.2 Arreak facilitating the sea ice terminology workshops with Sikumiut members. Mittimatalik, Nunavut October 14, 2018.

3.6.4 Sea ice mapping workshops

In November of 2018 a one-day workshop was held to map Sikumiut's seasonal sea ice knowledge of safe and hazardous areas. Four Elder and two youth Sikumiut members were present. The participatory mapping methods used were based on a previous research partnership in the community, in which Arreak had already received training (Carter et al., 2019; Dawson et al., 2020). We started by discussing the different sea ice seasons, and Sikumiut agreed on two distinct seasons that were most important to map: i) November to April, once the sea ice is frozen and stable; and ii) May to July, when the sea ice is breaking up. We used paper copies of the Canadian Hydrographic Service Nautical Chart #7212 for the Mittimatalik region as the base map, because it provided the greatest oceanographic and topographic details for the area. Sikumiut members were encouraged to draw features directly on the maps in pencil. Once consensus was reached on the feature, Arreak then used markers to trace and number the features on the map, as Wilson recorded the feature descriptions in detail. Following the mapping workshops, Lynn Moorman (Mount Royal University) and Wilson trained Arreak on the Geographic Information Systems software ArcMap (version 10.5). Digital pictures of the paper maps were imported into ArcMap and georeferenced. Arreak was then able to digitize the sea ice features drawn by Sikumiut by tracing the features on the georeferenced map photo to create the digital maps.

3.6.5 Sea ice IQ posters

In debriefing with Sikumiut after the terminology and mapping workshops it became apparent that not all the IQ shared could be defined as a term or captured on a map. This outstanding knowledge detailed such things as how to prepare for sea ice travel and how to identify and navigate hazardous sea ice conditions while on the sea ice. Jamesie Itulu, co-author, is a young Mittimatalik artist recommended by Sikumiut youth members to develop graphical illustrations for the posters. Itulu joined the research team in 2018 to specifically address and mobilize this IQ through art. Itulu continued with the research team to also developed graphical illustrations to support the sea ice terminology booklet.

3.6.6 Sea ice IQ validation meetings

Arreak facilitated a total of 14 validation meetings with Sikumiut between January 2019 and November 2020 to confirm and revise the documented sea ice IQ, and to discuss the methods to mobilize this knowledge through a booklet, maps, and posters. Meetings between October 2018 and February 2020 were scheduled when Wilson, Bell, Ljubicic, and Moorman came to the community. After March 2020, the COVID-19 pandemic restricted research travel for research partners living outside of Nunavut; however, the pandemic did not interrupt the project. Arreak continued to independently organize and facilitate in-person Sikumiut meetings in Mittimatalik, with the non-Indigenous partners participating by telephone. With well-established relationships, local research capacity and leadership, we were able to continue our work together despite the pandemic.

Over two years, the experienced Sikumiut hunters methodically reviewed the terms, illustrations, maps, and posters to confirm the accuracy of Inuktitut spellings, descriptions of ice conditions, mapping of important hazards and poster/booklet illustrations. Elder members requested different generations of Mittimatalingmiut on the Sikumiut committee so that this sea ice knowledge could be passed on. Being part of the process of documenting Sikumiut's IQ and creating the products was an important learning opportunity for youth members to expand their sea ice IQ and language skills. Sikumiut youth members reviewed the products to ensure that they were accessible to different generations of Inuit with varying levels of sea ice experience and language proficiency. For example, in Mittimatalik Inuktitut roman orthography is preferred by the younger generation, Inuktitut syllabics are preferred by the older generation, and having English was also considered important to reach a broader audience of youth that are not as comfortable in Inuktitut. As a result, all the products were designed to include two Inuktitut fonts and English. Having youth involved from the outset was an important aspect so they could learn through the process, but also provide guidance on how to best reach Inuit of their own generation.

Sikumiut members provided direction on the methods used to document and mobilize their IQ. What started off as a list of Inuktitut terms has now evolved into a booklet. While Sikumiut would like to see this information available on the SmartICE website it was also important to them that this information be made accessible to everyone. The decision was made to create a small paper booklet that could be duplicated in affordable ways so that every household in Mittimatalik could receive a copy. While mobilizing Sikumiut IQ through maps, posters, and a booklet utilizes more modern communications tools, what was unique about this approach was that Inuit adapted these tools, using Inuktitut language, knowledge, and artwork.

3.7 Results

The Sikumiut sea ice IQ products complement one another and provide an example of what IQ could be documented and what was important to document to improve sea ice travel safety from an Inuit perspective. The contents of the Sikumiut sea ice IQ products are best described by their application throughout the different seasons in Mittimatalik (Fig 3.3). Of the six typical seasons in Mittimatalik, sea ice is present in five: *ukiaksaaq* (early fall, late

September); *ukiaq* (late fall, October-November); *ukiuq* (winter, December-February; *upirngaaksa* (early spring, March-May); and *upingaaq* (spring, June-July). *Aujaq* (summer, August-early September), will not be discussed as sea ice is normally not present at this time of year.

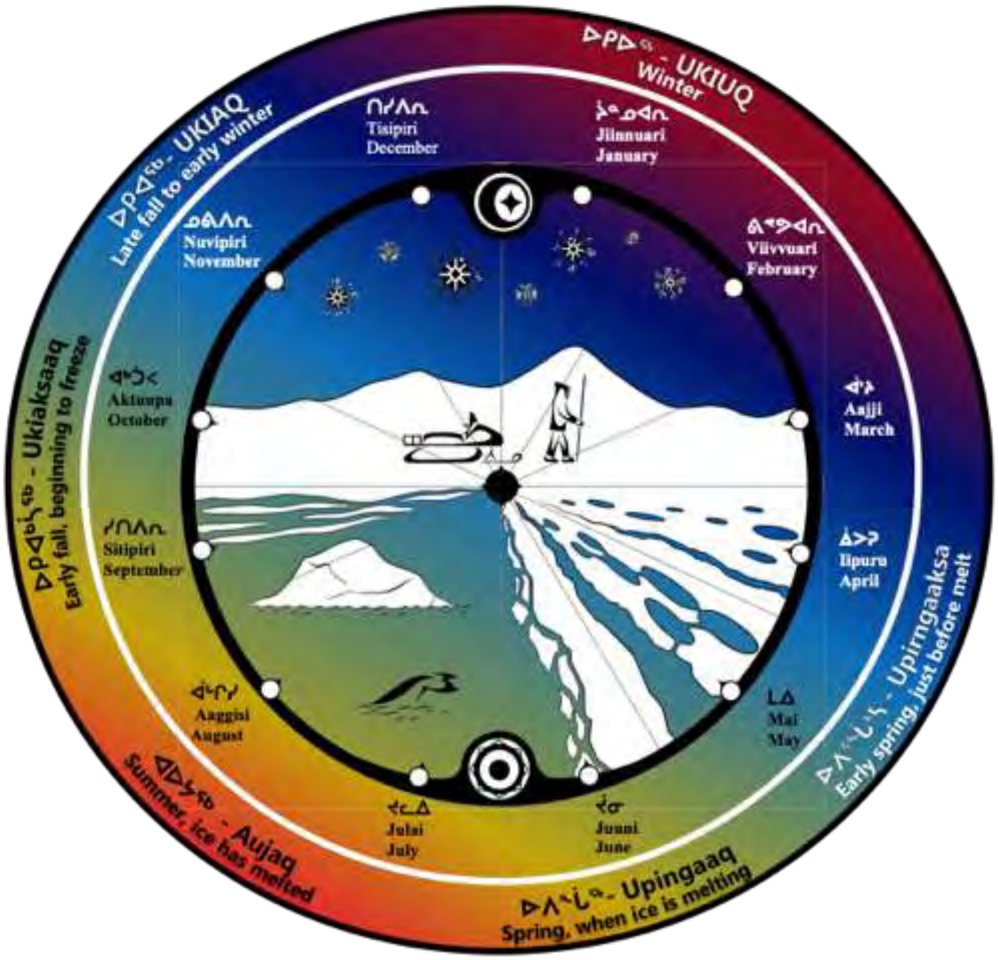


Figure 3.3 The Mittimatalik Seasonal Cycle Illustration: Jamesie Itulu, 2021

The workshops and meetings to document, validate and mobilize Sikumiut's sea ice IQ have resulted in:

1) a Mittimatalik sea ice IQ booklet containing 67 sea ice terms with accompanying photos or illustrations (see Table 3.2 – 3.6 for excerpts from the sea ice terminology booklet and Appendix A for the complete booklet);

2) three Sikumiut seasonal sea ice IQ travel maps (Figs. 3.4 – 3.6); and
3) two Sikumiut sea ice IQ travel safety posters (Figs. 3.7 – 3.8).

3.7.1 Ukiaksaaq (late summer/early fall)

Between late September and the end of October, the amount of daylight has reduced from approximately 12 to 5 hours (Timeanddate.com, 2020), the daily average October air temperature is - 9.7°C (ECCC, 2020c), and the initial signs of winter are starting in Mittimatalik. This season is known as *ukiaksaaq* (Fig. 3.3), when the sea ice is beginning to freeze-up and Mittimatalingmiut know that their ability to hunt and fish by motorboat is about to end. Travel on the sea ice is not yet possible and the sea ice terms, definitions and photographs/illustrations are intended to help Mittimatalingmiut to visually identify new ice types to safely navigate through with their motorboats and determine when navigation through the sea ice is no longer possible (Table 3.2). *Quvviquaq* is a very thin layer of sea ice that a motorboat can still navigate through. *Qinuaq* is a thicker layer of sea ice slush that you cannot drive through, or it will damage the boat motor. You can still break, paddle, and push your boat out of *qinuaq* along the shore to get out to the open water. *Ningutittuq* is the final, dense stage of slush. It is an indicator that the sea ice is about to become solid and community members need to pull their motorboats from the ocean before they get frozen in (Table 3.2). There were no maps or posters created for this season, as Mittimatalingmiut are not yet travelling on the sea ice. However, during a recent meeting in November 2020, Sikumiut suggested developing a poster to provide advice on safely navigating a motorboat during the early stages of sea ice freeze-up.

3.7.2 Ukiaq (late fall/early winter)

During *ukiaq*, from late October until the end of November (Fig. 3.3), the available daylight continues to decline. By mid-November there are zero hours of daylight (Timeanddate.com, 2020) with a daily average air temperature of - 21.7°C (ECCC, 2020c). Mittimatalingmiut can no longer hunt and fish by motorboat and are waiting for the sea ice to become thick enough to travel safely by snowmobile. This transition period can be a frustrating time as Mittimatalingmiut wait for the sea ice to freeze-up so they can get back out on the land. As the ice is freezing and thickening, it is a difficult and dangerous time to know when the sea ice is safe to travel on. The Sikumiut sea ice terminology describes the visual indicators and how to test the new sea ice types during *ukiaq* (Table 3.3). For example, *sikuaq* is the first thin solid layer of sea ice. You can see seals popping up in the *sikuaq*, but it is not yet strong enough for the seals to rest on the ice (Table 3.3). The terms describe how to test the sea ice for safety with a harpoon. If you strike the sea ice hard with your harpoon and it goes through with one strike, it is still *sikuaq* and is too thin and dangerous to walk on. If the sea ice holds after two harpoon strikes in the same spot, it is safe to walk on and this is called *sikuliaq* (Table 3.3). When the sea ice holds after three harpoon strikes in the same spot it is now possible to travel on; however, the sea ice is still flexible at this time of year. The terms also describe how to carefully and slowly drive your snowmobile on *ningijattuq*, so the sea ice does not break as you drive (Table 3.3).

The Sikumiut map for November to July (Fig. 3.4) shows the traditionally safe snowmobile routes in green, which are mainly established by experienced hunters at the beginning of *ukiaq*. These trails were mapped by Sikumiut so that Mittimatalingmiut with less sea ice experience could learn about them and follow these routes. Figure 3.4 also highlights the locations of cabins and places to take shelter from high winds or poor weather conditions, with supporting latitude and longitude coordinates for input into personal GPS devices. As most young hunters travel with GPS devices, having the coordinates on the maps was important to Sikumiut. Inuit cabins are typically left equipped with supplies to provide for emergency shelter and survival for any travellers who find themselves stuck in bad weather or with machinery failure. Figure 3.7, "*Are you prepared to travel on the ice?*", outlines the preparations and supplies needed in advance of travelling throughout all the sea ice seasons. The recommendation to never travel alone was not just because "two heads are better than one" but based on the understanding that not everyone can afford to purchase supplies. Therefore, travelling with more than one person also improves the chances that there will be an adequate combination of emergency supplies. Figure 3.8, "What to know as you travel on the sea ice" explains with illustrations how to test the sea ice with your harpoon and the number of strikes required to determine if it is safe to walk on or drive on with a snowmobile.

3.7.3 Ukiuq (winter)

The winter season in Mittimatalik covers the months of December, January, and February (Fig. 3.3). Temperatures reach their coldest in February, with daily averages of -33.8°C (ECCC, 2020c), and Inuit hunters have been travelling with zero sunlight for 3 months between mid-November and the end of January (Timeanddate.com, 2020). Sikumiut's sea ice terminology explains the process of *naggusittuq*, how the sea ice will crack (*nagguti*) due to high tides during a new or full moon, refreeze (*quglugniq*) and re-crack (Table 3.3). Once a crack in the sea ice occurs, it will freeze and re-crack in the same spot throughout the winter (Table 3.3).

In the extreme cold conditions of *ukiuq*, snowmobiles and equipment are more likely to break down. When travelling during the dark season there is a greater chance of getting lost, running out of gas or having an accident when you cannot see the surrounding landscape and sea ice. The Sikumiut seasonal sea ice map for November to April (Fig. 3.5) details the locations of known recurring *naggutiit* (cracks), *ivujuk* (ridges - rough ice that is difficult to travel over), and *siku saattuq aragulimaamik* (areas of thin ice all year due to strong ocean currents) with supporting latitude and longitude coordinates for input into personal GPS devices. Knowing where the locations of these hazardous ice conditions is of utmost importance when travelling in the dark of *ukiuq* and when there is poor visibility due to blowing snow. Safety and survival while travelling on the ice during the extreme cold of *ukiuq* is a matter of life and death, and knowing the closest areas of safe shelter identified by Sikumiut is essential (Fig. 3.4). The poster (Fig. 3.7) emphasizes the need for extra supplies for survival and to check *piturnirtillugu*, the phases of the moon prior to travel. For example, high tides during a new or full moon cause the expansion of cracks, thin ice areas, and the ridging of ice.

3.7.4 Upirngaaksa (early spring)

Early spring occurs between early March and late May and is the best season for sea ice travel around Mittimatalik (Fig. 3.3). Air temperatures are warming from daily averages of - 30.0°C in March to - 9.3°C in May (ECCC, 2020c). Visibility is also greatly improved with daylight averaging 9 hours in early March to 24 hours in early May (Timeanddate.com, 2020). After a cold and dark winter, a greater number of Mittimatalingmiut are now travelling on the sea ice to hunt, fish and spend time at family cabins. The Sikumiut sea ice terminology and accompanying photographs and illustrations detail the first signs of spring (Table 3.5). *Nagguti* will no longer refreeze in *upirngaaksa*, and will continue to expand, now called an *aajuraq* (Table 3.5). The term *pilagiarniq* (ice bridge) describes the areas of stable ice between *aajurait* that are safer for travel. The terminology also describes the stages of snowmelt on the sea ice starting with small puddles called *immattinniq* (Table 3.5).

The Sikumiut seasonal sea ice map for May to July (Fig. 3.6) details the locations of known *aajurait* and *siku saattuq upingaat pigiarningani* (more areas of thin ice starting in spring) with supporting latitude and longitude coordinates for input into personal GPS devices. The expanded thin ice areas now include locations of spring runoff from rivers and glaciers. Figure 3.7 emphasizes the need to wear *igaak* (sunglasses) to protect from snow blindness during this period of 24-hour sunlight. While the temperatures and daylight are ideal for sea ice travel, *aajurait* are getting wider and areas of *siku saattuq upingaat pigiarningani* are expanding, especially with the high tides during new and full moons (*piturnirtillugu*). Figure 3.8 provides guidance for how to travel and avoid accidents on the sea ice as the sea ice is melting. For example, *qaujigiarlugu ikaarianginnirni* explains that if you must cross an *aajuraq*, check before you cross. One side of the *aajuraq* may be higher than the other, and this can cause an accident if the skis on your snowmobile do not clear this ledge. *Qaujimallugut naukkut ikaarianginnirni* (know where to cross) explains to look for meltwater drainage on the other side of the *aajuraq* for areas that will be lower and safer to cross.

3.7.5 Upingaaq (spring)

The air temperatures during *upingaaq* (Fig. 3.3) are normally above zero with average daily temperatures of 2.4°C in June and 6.6 °C in July (ECCC, 2020c). The sea ice is now melting, and it is becoming difficult to travel due to the amount of water and slush on the sea ice.

The meltwater on the sea ice is absorbing more sunlight, further accelerating sea ice melt during this period of 24-hour daylight. By early July the sea ice is starting to break up and is no longer safe to travel on. The Sikumiut sea ice terms explain how to recognize *samunngaatuq,* a type of ice in which your snowmobile can get stuck (Table 3.6). The terms also detail the conditions that indicate the sea ice season is coming to an end such as: *kilaajuk* when the meltwater is draining through the sea ice, and *saluraq* when the meltwater has drained from the ice and the ice is no longer safe to travel on (Table 3.6).

The poster in Figure 3.8 provides important information for how to travel on the sea ice during the melt period. For example, *siqinirmut qillininga* (reflections) describe the importance of not driving into the sun when there are melt ponds. The reflections of the sky on the melt-ponds can be blinding and camouflage areas of thin ice or open water. The terminology and posters teach how to recognize melting sea ice conditions as it progresses from *puktaila* (snow melt ponds) through *kilaajuk* (the first drainage of meltwater), to *immattiliqiktuq* (ice flooded by sea water) to *saluraq* (the last drainage of meltwater), when the ice is now rotten and about to break-up (Table 3.2, Fig. 3.8).

Sikumiut compiled a list of locations to display the posters and maps in the community. In May 2020 maps and posters were displayed at the Hamlet office, Hunters and Trappers Organization (HTO) office, SmartICE office, and the two grocery stores in town. Due to the Covid-19 pandemic, maps and posters originally planned for the elementary and high schools, hotel, library/visitors centre, Parks Canada office, ECCC Research Station, and the Health Centre had to be postponed until spring 2021. The maps and posters are available on the SmartICE website in 2021. Additionally, 500 copies of the terminology booklet (approximately one for each household in Mittimatalik with extra copies in spare) have been printed and distributed in April 2022, along with updated Sikumiut maps and posters for display.

Table 3.2 Sikumiut terms for sea ice during late summer to early fall (September–October) excerpted from the Sikumiut sea ice IQ booklet
(see Appendix A for complete booklet)

#	Term	Definition	Photograph or Illustration
ᐅᑭᐊᒃᓵᖅ: ᓯᑎᐱᕆ - ᐊᒃᑑᐸ / Ukiaksaaq: Sitipiri – Aktuupa / Late summer to early fall: September – October			
1	**ᖁᕝᕕᖅᑯᐊᖅ**	ᓯᕗᓪᓕᖅᐹ ᖁᐊᑉᐸᓪᓕᐊᓂᖓ, ᖁᕝᕕᐅᑦᑐ ᖁᐊ ᐊᓄᕋᔮᑦᑎᓗᒍ. ᓂᓕᕝᕙᓕᐊᔪᖅ ᑕᕆᐅ, ᖁᐊᐸᓪᓕᐊᔪ ᑕᑭᔪᑯᑖᒃ.	
	Quvviqquaq	Sivulliqpaa quappallianninga, quvviuttu qua anurajaattilugu. Nilivvaliajuq tariu, quapalliaju takijukutaak.	
		First stage of freeze up. When ice is forming, and the wind is stretching out the ice and elongating it. It looks like frozen tears.	
2	**ᕿᓄᐊᖅ**	ᑭᓂᑦᑐᖁᔨᔪ ᐊᐳᑎᒻᒥ ᑕᕆᐅᒥᖢᓂ.	
	Qinuaq	Kinittuqujiju aputimmi tariumi&uni	
		Slushy ice, no strength to it (cannot hold a person's weight), but difficult to paddle through.	
3	**ᓂᖑᑎᑦᑐᖅ**	ᐱᔮᕐᓂᕈᓐᓃᑦᑐ ᓯᑯ. ᐊᐳᑎᕈᔪ ᐊᒻᒪ ᓂᓚᕈᔪ ᖁᐊᑉᐸᓕᐊᒐᒥ ᑭᓂᕐᑐᐊᓘᓕᕐᓗᓂ.	
	Ningutittuq	Pijarnirunniittu siku. Aputiruju amma nilaruju quappaliagami kinirtualuulirluni.	**Ningutittuq** (3). Photo credit Katherine Wilson. Quvviqquaq (1) and Qinuaq (2) not shown.
		Denser than qinuaq but still slush. Snow can accumulate on top, but it is not yet solid ice. You cannot use your paddle, starting to get hard to travel by boat. Used to predict when other areas will freeze.	

Table 3.3 Sikumiut terms for sea ice during late fall to early winter (October–November) excerpted from the Sikumiut sea ice IQ booklet
(see Appendix A for complete booklet)

#	Term	Definition	Photograph or Illustration
ᐅᑭᐊᖅ: ᐊᒃᑑᐸ - ᓄᕕᐱᕆ / Ukiaq: Aktuupa – Nuvipiri / Late fall/early winter October – November			
4	**ᓯᑯᐊᖅ**	ᓯᕗᓪᓕᑉᐹ ᓯᑯ, ᑲᑉᐱᐊᓇᖅᑐ ᐱᓱᕆᐊᕝᕕᒋᓪᓗᒍ	
	Sikuaq	Sivullippaa siku, kappianaqtu pisuriavvigillugu	
		First thin layer of ice, still very thin, can see seals popping up. Sea water rising.	
5	**ᓯᑯᓕᐊᖅ**	ᐱᓱᕝᕕᓴᐅᔪ ᓯᑯ ᓄᑖᖅ	
	Sikuliaq	Pisuvvisauju siku nutaaq	
		Thicker than Sikuaq. If the harpoon goes through the ice after one strike it is too thin and dangerous to walk on. If it holds two strikes in the same hole, it is safe to walk on.	
6	**ᓂᖏᔭᑦᑐᖅ**	ᓯᑯ ᐃᖏᐅᓕᔭᑦᑐᖅ, ᐃᖏᕐᕋᕕᒋᓗᒍ ᓱᒃᑲᐃᓵᕆᐊᓕ. ᓯᑯ ᓱᕋᑐᐃᓐᓇᓂᐊᓕᒃ ᖃᖓᓃᑦ ᐊᐅᓚᑎᑕᐅᔫᒃ ᐅᖁᒪᐃᑦᑐᒧᑦ.	**Ningijattuq** (6). Illustration: Itulu, 2020 Sikuaq (4) and Sikuliaq (5) not shown.
	Ningijattuq	Siku ingiulijattuq, ingirravigilugu sukkaisaariali uqumaittumut.	
		Flexible ice that moves as you travel on snowmobile. Need to check with harpoon. Slow travel only by snowmobile as the weight of the snowmobile can create waves underneath the ice and cause it to crack.	

Table 3.4 Sikumiut terms for sea ice during winter (December–February) excerpted from the Sikumiut sea ice IQ booklet (see Appendix A for complete booklet)

#	Term	Definition	Photograph or Illustration with Term #
ᐅᑭᐅᖅ: ᑎᓯᐱᕆ, ᔮᓐᓄᐊᕆ, ᕖᕝᕗᐊᕆ / Ukiuq: Tisipiri, Jaannuari, Viivvuari / Winter: December, January, February			
7	**ᓇᒡᒍᑎ**	ᓄᑕᐅᓯᖅᓯᒪᔪ.	 **Nagguti** (7). Source: Ljubicic, 2004 Naggusittuq (8) and Quglugniq (9) not shown.
	Nagguti (singular) **Naggutiit** (plural)	Nutausiqsimaju.	
		A crack in the sea ice. Once it cracks it reoccurs in the same spot or near the same spot throughout the whole winter	
8	**ᓇᒡᒍᓯᑦᑐᖅ**	ᓄᑖ ᓇᒡᒍᑎ ᓴᕿᑦᑐ ᑕᖅᑭᐅᑉ ᐱᔾᔪᑎᒋᓪᓗᒍ, ᐅᓕ ᐊᒻᒪ ᑎᓂ-ᐸᓪᓕᐊᓂᒡᓇᓄ, ᑕᒪᓂᑦᑕᐃᓐᓇᕈᔪ ᓴᕿᖃᑦᑕᕝᓗᑎᒃ ᐅᑭᐅᑯᑦ.ᐱᑐᓐᓂᑦᑎᑦᑐ (ᑕᖅᑭᒧᑦ ᐊᐅᓚᑕᐅᓗᓂ).	
	Naggusittuq	Nutaa nagguti saqittu taqqiup pijjutigillugu, uli amma tini-pallianignanu, tamanittainnaruju saqiqatta&utik ukiukut.pitunnittittu (taqqimut aulatauluni).	
		The cracking or re-cracking of the sea ice due to high tides during a new or full moon.	
9	**ᖁᒡᓗᒡᓂᖅ**	ᓇᒡᒍᑎ ᒪᑐᑉᐸᓕᐊᓂᖕᒐᓄᑦ ᓯᑯ ᐊᔭᖃᑦᑕᐅᑎᒌᓗᑎᒃ.	
	Quglugniq	Nagguti matuppalianinganut siku ajaqattautigiilutik.	
		The closing of nagguti. The sea ice pushes against each other and creates a pile or ridge along where the nagguti was.	

Table 3.5 Sikumiut terms for sea ice in early spring, just before melt (March–May) excerpted from the Sikumiut sea ice IQ booklet (see Appendix A for complete booklet)

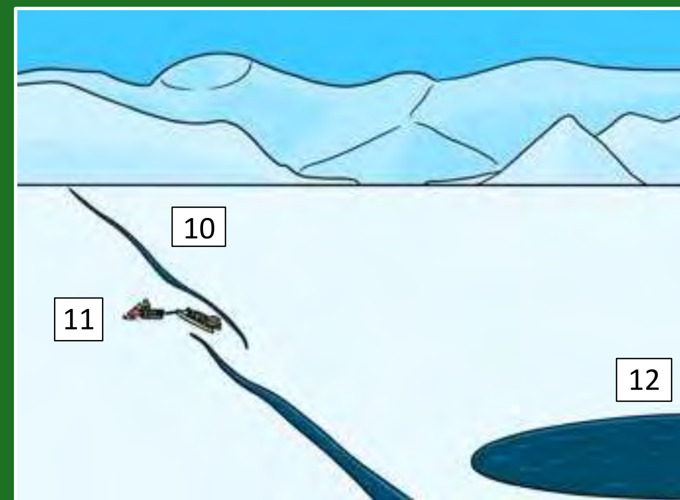
#	Term	Definition	Photograph or Illustration
ᐅᐱᕐᖓᒃᓵᖅ: ᐋᔾᔨ, ᐄᐳᕈ, ᒪᐃ / Upirngaaksa: Aajji, Iipuru, Mai / Early Spring, just before melt: March, April and May			
10	**ᐋᔪᕋᖅ**	ᐊᐅᔭᑯᑦ ᓇᒡᒍᑏ ᒪᑉᐱᖓᓕᖢᑎᒃ ᖁᐊᒃᑲᓐᓂᔾᔮᖏᓕᖢᓂ. ᓇᑦᑎᐊᖅᑲᓕᐅᑉ ᓄᖑᓕᖢᓂ, ᑐᐱᖅᑑᑦ ᐱᒋᐊᓕᖢᓂ.	
	Aajuraq (singular)	Aujakut naggutii mappingali&utik quakkannijjangi&uni. Nattiaqaliup nunguli&uni, tupiqtuut pigiali&uni.	
	Aajurait (plural)	An open nagguti or lead that doesn't refreeze in the spring. First sign of spring.	
11	**ᐱᓚᒋᐊᕐᓂᖅ**	ᐊᐅᔭᑯᑦ ᓇᒡᒍᑏ ᒪᑉᐱᖓᓕᖢᑎᒃ ᖁᐊᒃᑲᓐᓂᔾᔮᖏᓕᖢᓂ. ᓇᑦᑎᐊᖅᑲᓕᐅᑉ ᓄᖑᓕᖢᓂ, ᑐᐱᖅᑑᑦ ᐱᒋᐊᓕᖢᓂ.	
	Pilagiarniq	Aajurakkut ikaarvik siku. Aajuraup isua (sikumit).	
		Areas of stable ice between where leads begin and end. They are safe places to cross when leads get too wide but be cautious as these areas will eventually break off.	
12	**ᐃᒻᒪᑦᑎᓐᓂᖅ**	ᓯᑯ ᐃᒪᕈᔫᓗᓂ ᐊᐳᑎᐅ ᐊᐅᑉᐸᓪᓕᐊᓂᖓᓄ.	**Aajuraq** (10), **Pilagiarniq** (11) and **Immattinniq** (12). Illustration: Itulu, 2020
	Immattinniq	Siku imarujuuluni aputiu auppallianinganu.	
		First puddles on the ice from snow.	

Table 3.6 Sikumiut terms for sea ice during early summer (June–July) excerpted from the Sikumiut sea ice IQ booklet (see Appendix A for complete booklet)

#	Term	Definition	Photograph or Illustration
ᐅᐱᖕᒑᖅ: ᔫᓂ - ᔪᓚᐃ / Upingaaq: Juuni - Julai / Spring, when things are melting: June - July			
13	**ᓴᒧᖕᒑᑐᖅ:**	ᓯᑯ ᖄᖓᓂ ᐃᒪ, ᐃᒪᐅ ᖄᖓᓂ ᐊᐳᑎ. ᓇᖕᒋᓯᒪᓐᓂᕈᕕᑦ ᑲᑕᕋᔭᖢᑎ.	 **Kilaajuk** (14), Illustration: Itulu, 2020. Samunngaatuq (13) and Saluraq (15) not shown.
	Samunngaatuq	Siku qaangani ima, imau qaangani aputi. nangisimanniruvit kataraja&uti.	
		The surface has a little bit of snow/slush covering ice underneath. Difficult to travel and easy to get stuck. When standing your feet will go through to the ice, but you won't fall through to the open water.	
14	**ᑭᓛᔪᒃ**	ᓯᑯᒥ ᐃᒪ ᑰᓕᐅᓕᕋᖕᒐᒥᑦ.	
	Kilaajuk	Sikumi ima kuuliulirangamit	
		When the meltwater begins to drain through the ice making many drainage channels or holes. This signals that the sea ice travel season is ending soon.	
15	**ᓴᓗᕋᖅ**	ᐅᔾᔨᖅᓴᖅᓗᑎᑦ ᑭᓛᓂᕐᓂᒃ ᓯᑯᒥ ᐃᒪᒃᑎᓯᒪᔪᒥ; ᐃᒫᑐᐃᓐᓇᕆᐊᖃᕋᕕᑦ.	
	Saluraq	Ujjirsarlutit kilaanirnik sikumi imaktisimajumi; imaatuinnariaqaravit.	
		When the melting water on the sea ice surface has drained. The sea ice surface has dried up and the ice is full of drainage channels (Killak). The ice is rotten and getting thinner fast as it continues to melt rapidly.	

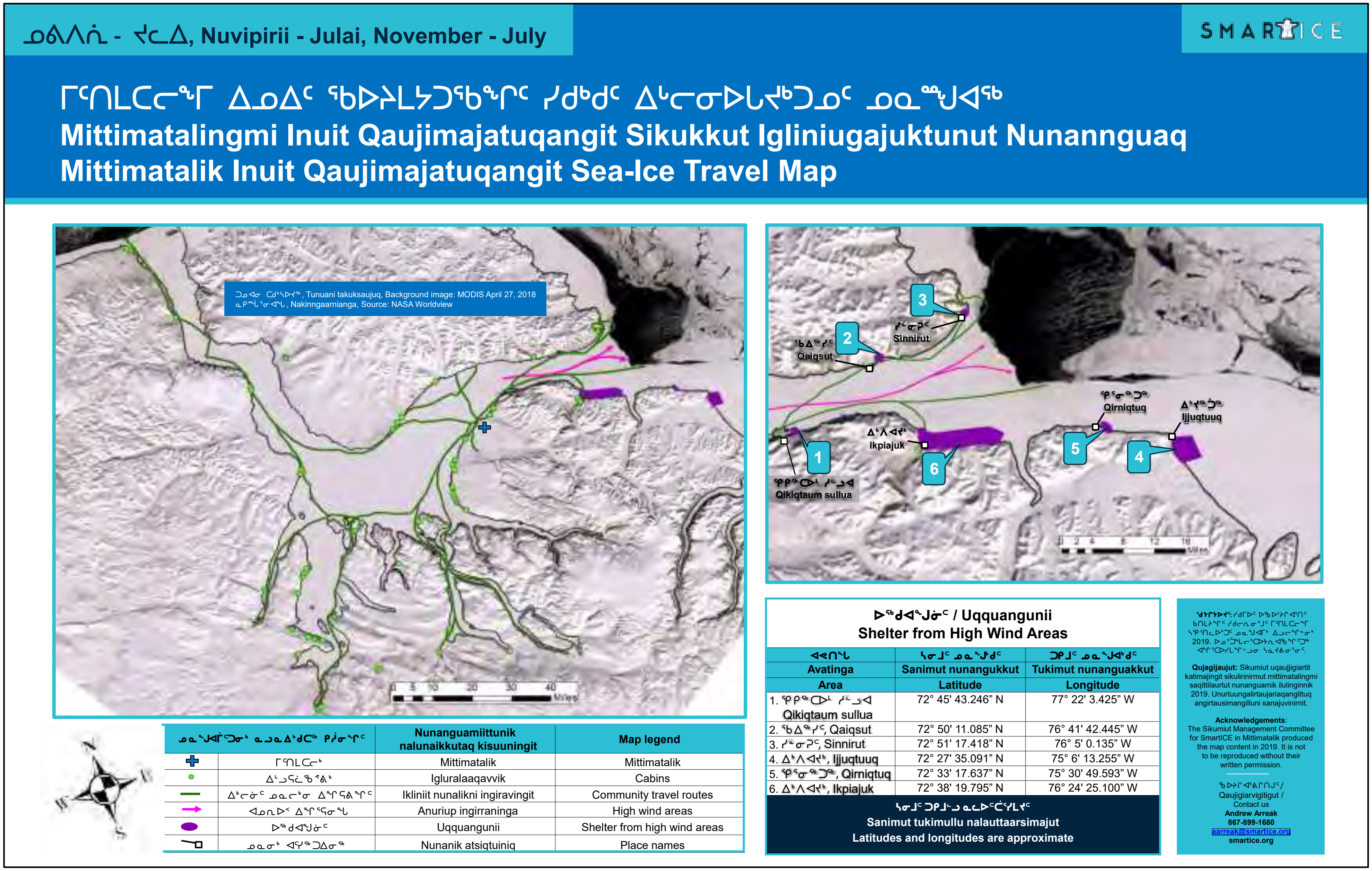


Figure 3.4 Safe travel routes and areas for shelter for the entire Mittimatalik travel season: November to July. To view in more detail please go to https://smartice.org/ice-safety/

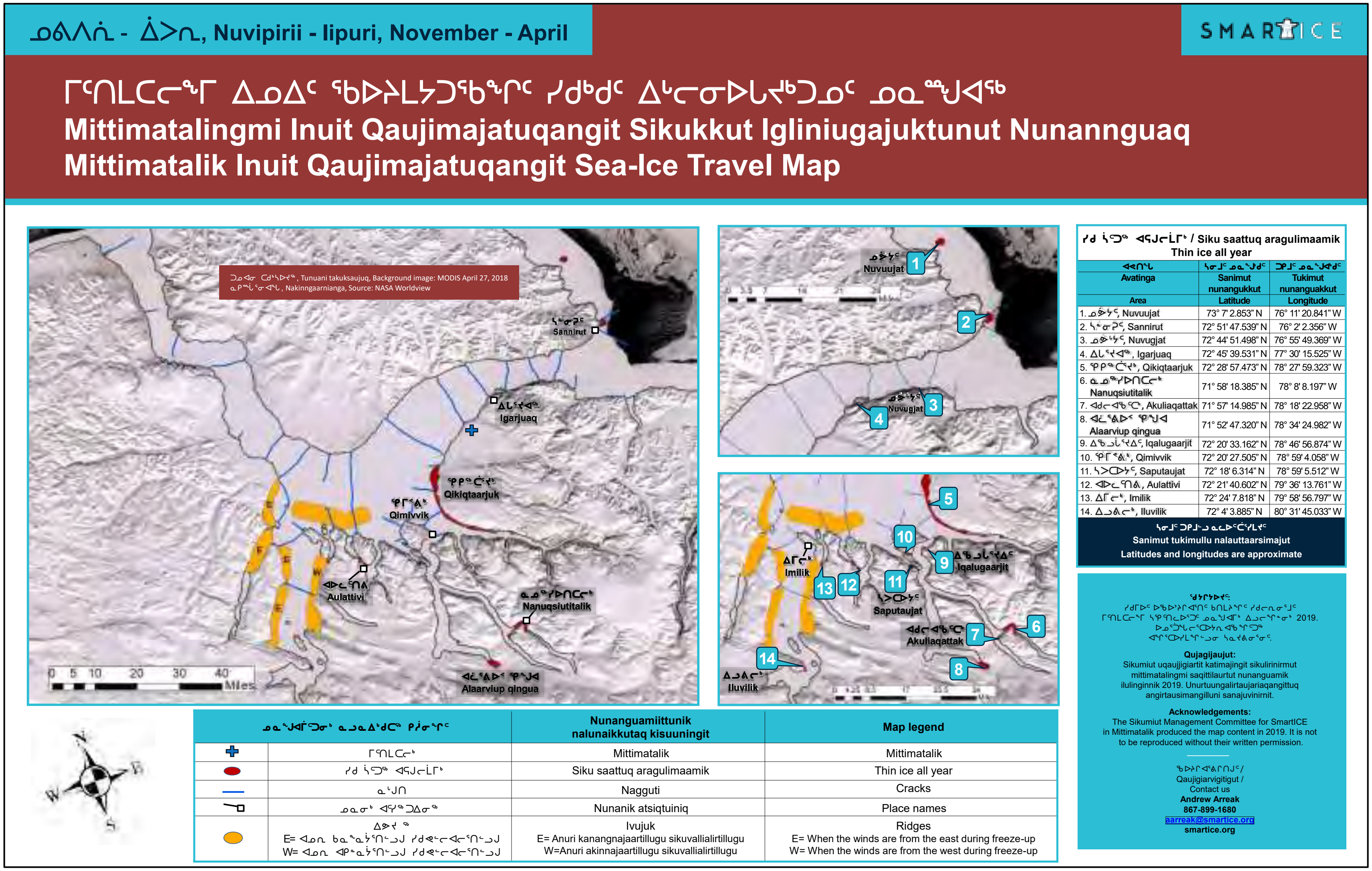


Figure 3.5 Areas of known sea ice travel hazards for late fall to early spring travel season
To view in more detail please go to https://smartice.org/ice-safety/

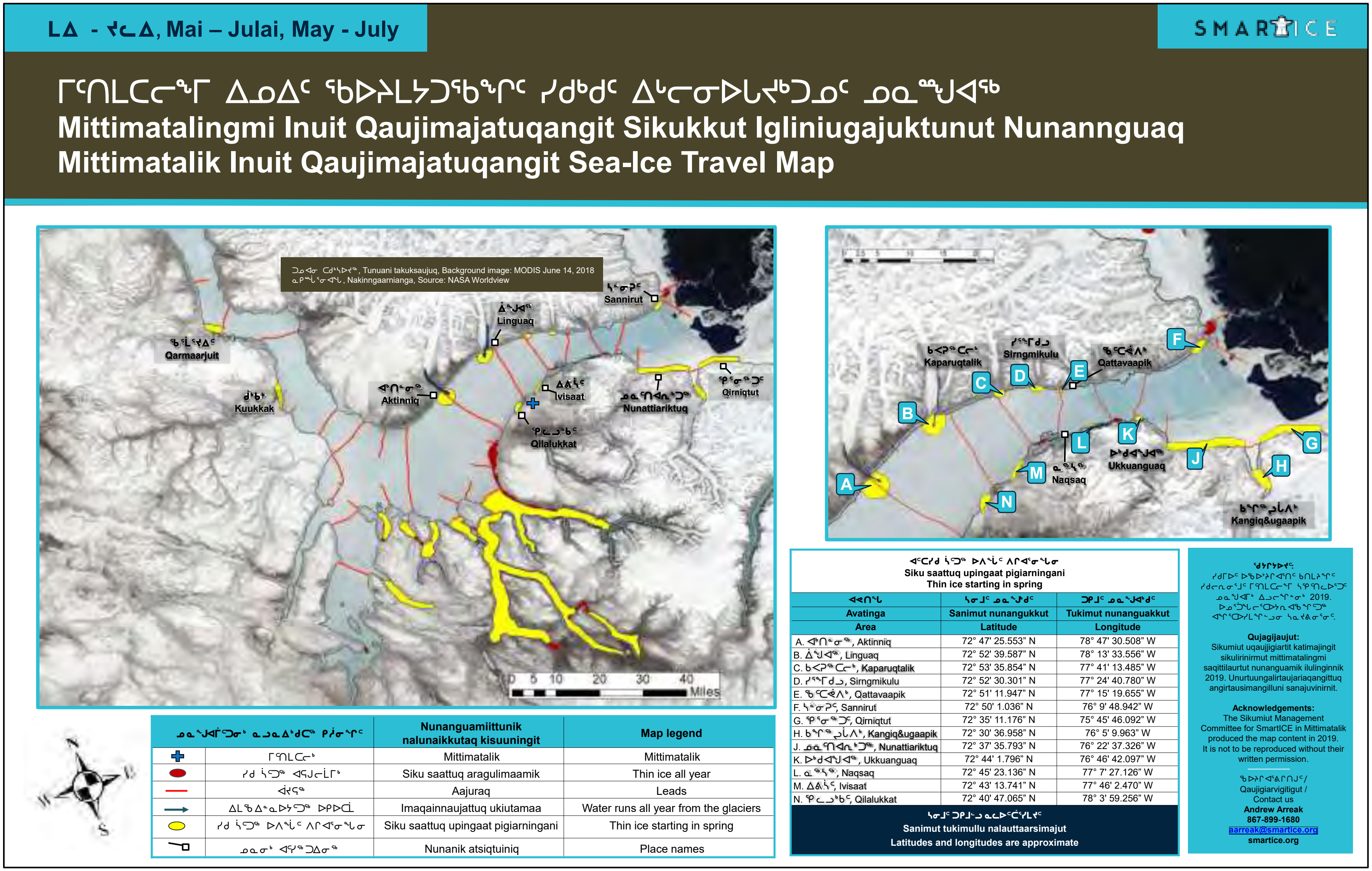


Figure 3.6 Areas of known sea ice travel hazards for spring break-up travel season
To view in more detail please go to https://smartice.org/ice-safety/

Figure 3.7 Sikumiut Poster – Are you prepared to travel on the sea ice?
To view in more detail please go to https://smartice.org/ice-safety/

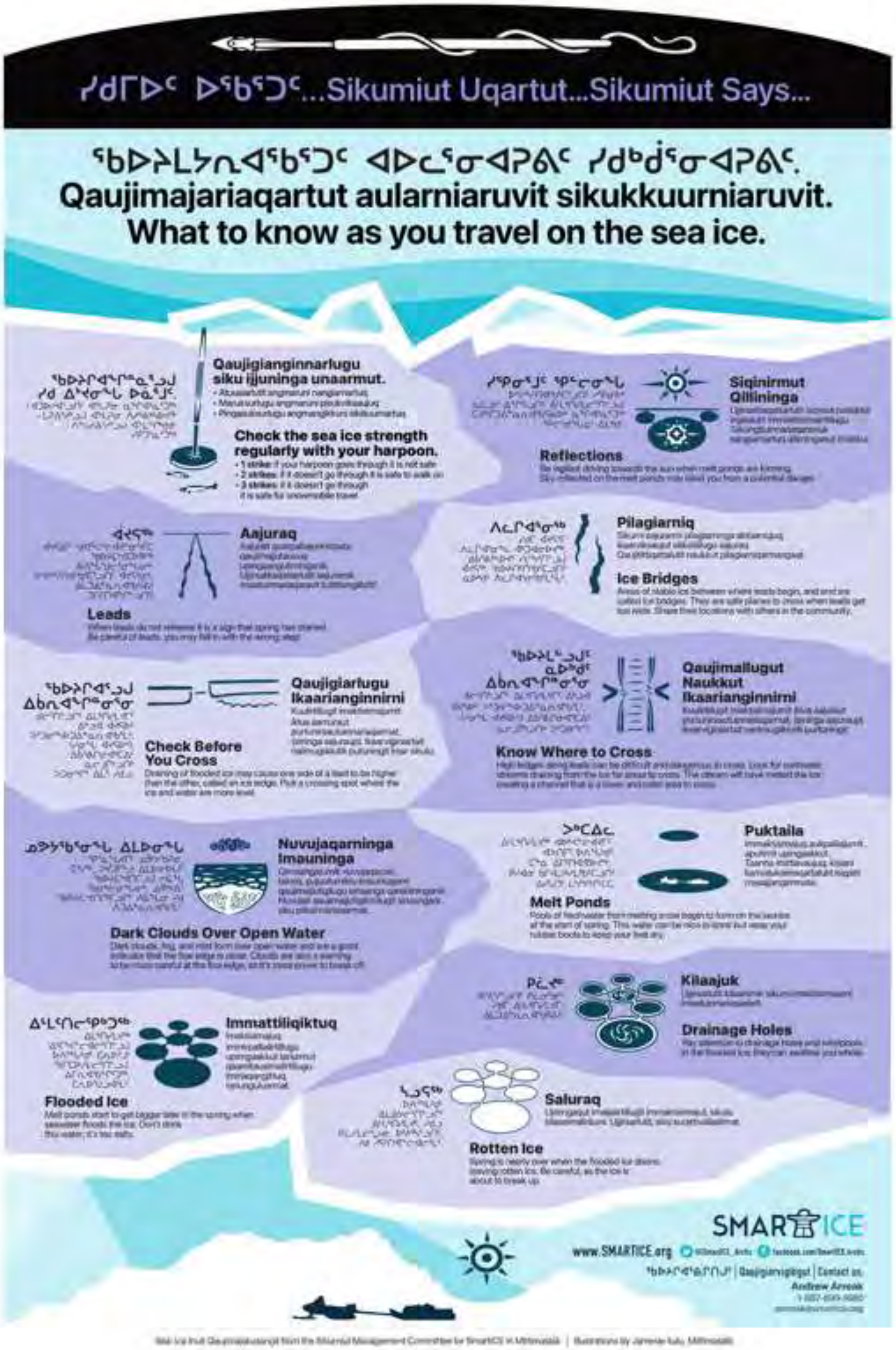


Figure 3.8 Sikumiut Poster – What to know as you travel on the sea ice
To view in more detail please go to https://smartice.org/ice-safety/

3.8 Discussion

Mobilizing IQ is essential for community-based adaptation for safe sea ice travel. This section discusses how sea ice IQ teaches Inuit youth the necessary communication skills to plan for sea ice travel and identify key geographic locations while traveling on the sea ice. We will also illustrate how sea ice IQ provides Mittimatalingmiut with the skills to interpret and apply supplemental information to local conditions for planning sea ice travel, and how sea ice IQ fills critical spatial and temporal gaps during sea ice travel.

3.8.1 Sea ice IQ communication skills

Early on in project planning workshops a Sikumiut member explained how their Inuktitut sea ice terminology is a critical communications tool for sharing information with each other. “We have a way of speaking to each other. We can say just one word and others will immediately understand the ice conditions we are talking about” (Wilson, 2017:4). The importance of learning the terminology in Inuktitut became obvious when cross-referencing terms with the English WMO standard for sea ice terminology (ECCC, 2005). Out of the 65 different Inuktitut terms recorded, there were very few equivalents in English. The English WMO terms evolved to describe sea ice areas for ships to avoid, such as thicker and higher concentrations of ice, and to target navigation through ice-free, thinner, or lower concentrations of ice. The Inuktitut terms in contrast evolved to support Inuit travel safety on the sea ice, to identify and avoid thinner areas of ice and open water, and to travel on the thicker, stable areas of ice. A few English terms are used in the Sikumiut sea ice terminology booklet only because Sikumiut members used them; these include leads, ridges, floe edge and melt ponds. The precision of the sea ice terms in Inuktitut is apparent in the booklet when comparing to the translated English definitions. The English definitions are much longer and require more text to explain because the English terminology did not evolve around travelling on the sea ice (Table 3.2).

Increasing the use of the Inuktitut sea ice terms is essential so different generations in the community can communicate with one another to make informed decisions around safe sea ice travel. Sea ice travel information is still primarily shared orally between experienced hunters over VHF radio, satellite or mobile phone, community radio, and during coffee breaks or gatherings at the HTO office. The Sikumiut seasonal maps share the locations of where ice hazards normally are, but these conditions can vary by year and season. Through this oral communication, Mittimatalingmiut can learn about current conditions from those who have recently returned from the sea ice, discuss travel plans, and the best routes to take. Learning the Inuktitut place names is also an integral part of sharing local sea ice information. Known sea ice hazards are often identified with local place names to provide a navigational reference. The first versions of the maps included GPS positions to provide geographical references for youth (Figs. 3.4-3.6); however, Sikumiut requested that the spring 2022 versions of the maps also include local place names. Understanding the local sea ice terminology and place names is especially necessary during SAR events to ensure clear communications amongst different generations of volunteers about sea ice conditions and search locations. Terminology and place names are also critical if Mittimatalingmiut need to be rescued while out on the sea ice. Communication tools such as VHF radio and satellite and mobile phone signals are not always clear and can degrade when outside of the community. Knowing and being specific in communicating your location, and the potential sea ice hazards around you is critical information to share to support your own rescue.

3.8.2 Sea ice IQ for planning and during travel

We return to the Table 3.1 (column 4) to discuss the currently available sources of information and their application for planning travel (white rows) and during travel (grey rows) on the sea ice. We compare and contrast this information across seasons to demonstrate how sea ice IQ is necessary to interpret this additional information for local conditions in planning travel and to fill critical spatial and temporal gaps for safety during sea ice travel (Table 3.1, column 5).

Sikumiut members recommend that Mittimatalingmiut check to ensure good weather conditions before they travel on the sea ice (Fig. 3.7). Available weather information is based on observations from the airport and two-to five-day forecasts from weather models (ECCC, 2020a). Weather information is important for planning travel, but these forecasts do not capture the scale of local weather conditions (Table 3.1). Once on the sea ice, the local weather can be very different and change unexpectedly. Being prepared with extra supplies and means for communication (Fig. 3.7), are a matter of survival on the ice when the weather suddenly changes. The maps (Figs. 3.4-3.6) are a consensus of Sikumiut's mental maps, which they use to visualize the sea ice conditions by season in order to integrate the weather information for planning travel. During travel, youth begin to develop their own mental maps to become aware of: their current location on the ice; where the hazardous sea ice is in relation to their location; and the nearest locations for shelter from changing weather conditions (Figs. 3.4-3.6). Preparedness and situational awareness instill a level of confidence and critical decision-making skills needed to identify and respond to changing conditions while out on the sea ice (Aporta & Higgs, 2005; Clark et al., 2016b; Ford et al., 2007; Pearce et al., 2010).

Checking the tide tables before travelling on the sea ice is also recommended by Sikumiut (Fig. 3.7). Sea ice IQ teaches Mittimatalingmiut how to interpret this tidal information for particular local sea ice features that become more hazardous during high tides when the ocean currents are stronger. For example, the terminology in Table 3.2 explains how during *ukiuq*, *naggutiit* will form during high tides, but are usually narrow, will refreeze, and are generally easy to cross by snowmobile. However, in *upirngaaksa*, the *naggutiit* will no longer re-freeze and are now called *aajurait*. These *aajurait* will expand during high tides and can become too wide and dangerous to cross. The Sikumiut maps provide a seasonal and spatial baseline of sea ice features that become more hazardous during a new and full moon (i.e. *siku saattuq aragulimaamik,* Fig. 3.5; and *siku saattuq upingaat pigiarningani*, Fig. 3.6) to integrate this tidal information for local conditions. Meteorological weather and ice offices around the world use "climate normals", observed conditions averaged over a 30-year period to provide a baseline of average or normal conditions (WMO, 2017). The Sikumiut IQ maps are Mittimatalik's sea ice climate normal maps, derived by consensus from a community perspective (Riedlinger and Berkes, 2001).

Publicly available optical true colour composite (MODIS and Sentinel-2) and synthetic aperture radar imagery (Sentinel-1) is another tool that some experienced Sikumiut members check to get an overview of sea ice conditions prior to travel (Table 3.1). For example, during *ukiaq* you can monitor the *sinaa* forming, which indicates that the sea ice is becoming *tuvaq*. In *upirngaaksa* and *upingaaq,* the satellite imagery can be used to monitor *siku saattuq upingaat pigiarningani* and any signs of break-up at the *sinaa* (Table 3.1). The current temporal coverage of publicly available satellite data for Mittimatalik is every 2-3 days, not frequent enough for the rapidly changing ice conditions during freeze-up and break-up. This suite of satellite imagery cannot tell you the thickness of the sea ice, and it can be difficult for untrained users to differentiate areas of smooth sea ice from open water in synthetic aperture radar imagery. Also, the resolution of publicly satellite imagery is not detailed enough to capture sea ice hazards dangerous for snowmobile travel (Table 3.1). For example, the average length of a snowmobile is approximately 3 m and *aajurait* greater than 2 m in width would be considered dangerous to cross. Sentinel-1 imagery available on public websites (Polar View, 2019; Arctic Eider Society, 2020) can detect features greater than 100 m, so only *aajurait* larger than this are visible in the imagery. The Sentinel-1 imagery can help to identify when these large *aajurait* open; however, Mittimatalingmiut need to know the locations of *aajurait* much smaller than100 m that are not visible in the satellite imagery. Sikumiut's sea ice IQ fills these temporal (2-3 days) and spatial (<100 m) gaps (Riedlinger and Berkes, 2001). The maps (Figs. 3.5, 3.6) provide the locations of the known sea ice hazards by season at spatial resolutions under 100 m, and the posters (Figs. 3.7, 3.8) teach Inuit how to visually identify hazardous sea ice features as they travel, how to test the sea ice, and how to navigate safely across *aajurait*. At community meeting places (i.e., the HTO), experienced Mittimatalingmiut will share the locations of new sea ice hazards as they emerge throughout *upingaksaak* and *upingaaq* using their sea ice IQ and communicate this IQ over local radio.

Sea ice charts available from the CIS are another potential sea ice travel adaptation tool because they provide a synthesis and interpretation of weather and satellite data. The ice charts are developed to support marine navigation and are produced using satellite data as their main source of information (Shokr and Sinha, 2015). Currently the CIS has access to more than twice daily satellite coverage of the Canadian Arctic compared to the 2–3-day coverage that is available publicly. The CIS charts are at spatial resolutions larger than the satellite data (> 500 m^2) and therefore do not capture the spatial scales needed for sea ice travel (Table 3.1). In reviewing the CIS charts with Sikumiut members, they found the WMO egg code difficult to understand, and the shipping sea ice terms were very different from theirs. However, there was interest in the locations of ice edges and areas of open water in the CIS charts. For the Mittimatalik region, the CIS daily ice charts are produced after sea ice break-up in mid-July when shipping to the Mary River mine starts, and continues until freeze-up in mid to late October when the shipping season ends. The production of the CIS charts shifts from daily to weekly for the Mittimatalik region between mid-October to mid-July when the sea ice is frozen, and shipping does not occur. However, there is a short period along the margins of the shipping seasons in which some Sikumiut members thought the daily ice charts could be useful. In July, during the late stages of break-up the daily ice charts could be used to locate areas of open water so Mittimatalingmiut could begin to hunt using their boats. Again in October as the shipping season is ending, the ice charts could be used to monitor areas of open water and new ice forming to continue to hunt by boat in the early stages of sea ice freeze-up. This short 2- to 3-week time period at the beginning and end of the sea ice season seems to be the only time of the year when Inuit and marine shipping ice information needs overlap (Table 3.1). Experienced hunters can use the CIS charts in planning their travel, but sea ice IQ is necessary to apply this information to local conditions. Sea ice conditions during freeze-up can change by the hour and knowledge of how wind directions and temperatures contribute to sea ice formation is essential. Sea ice IQ teaches Inuit to recognize and identify which thin ice types they can navigate their motorboats around/through (Table 3.2) and fills the necessary spatial and temporal scale information gaps as they travel during *ukiaksaaq*.

SmartICE provides community scale (3-10 m) daily sea ice thickness measurements from thermistor based stationary SmartBUOYs. Ice thickness maps are produced at weekly to daily scales (frequency often increases in *upingaaq*) along the main Mittimatalik travel routes using an electromagnetic induction sensor towed behind a snowmobile (SmartQAMUTIK). However, the ice thickness instruments cannot be deployed until *ukiuq,* once the sea ice is safe for travel (Table 3.4). The Sikumiut maps fill this seasonal (temporal) gap during *ukiaksaaq* and *ukiaq* by sharing the traditionally safe sea ice trails broken by experienced Mittimtatalingmiut once the sea ice is safe enough to travel on (Fig. 3.4). Between *ukiuq* and *upingaaq*, Mittimatalingmiut can consult the community SmartICE information posted on Facebook and the SIKU website (Arctic Eider Society, 2020) to plan their travel. Using the SIKU app on their mobile phones, Mittimtatalingmiut can track their GPS position in relation SmartQAMUTIK ice thickness maps. But it is the IQ reflected in the sea ice terminology (Table 3.2) and posters (Figs. 3.7, 3.8) that teach Inuit youth how to recognize hazards and test the sea ice thickness to fill the spatial and temporal scales needed during travel.

A tool that has been widely adapted by Inuit are GPS devices. GPS devices can provide a much-needed source of location information for orientation in low visibility (i.e., fog and darkness), when navigating new and alternative routes, and for marking the locations of hazardous sea ice conditions to share with others at community scales (3-10 m) (Aporta and Higgs, 2005; Gearheard et al., 2011; Christie et al., 2018; Arctic Eider Society, 2020). However, there are concerns that GPS devices give Inuit youth a false sense of security and increase risk-taking behaviour by navigating outside of established trails made by experienced hunters (Wenzel, 2004; Aporta and Higgs, 2005; Ford et al., 2008; Christie et al., 2018). Sea ice IQ teaches Inuit youth the skills to identify dangerous sea ice types as they travel (Table 3.2) and to understand where they are geographically on the ice (Figs. 3.5, 3.6), rather than simply travelling in the straight-line route provided by GPS devices (Aporta and Higgs, 2005; Christie et al., 2018). Sikumiut members understand that few youth have had the opportunity to learn the traditional ways of navigation. Sikumiut's decision to include GPS coordinates for areas of shelter and known hazardous ice conditions on the maps (Figs. 3.4-3.6) are to encourage youth to add these locations to their GPS devices in planning travel, so they can be more aware of these locations as they travel. Mobile and GPS devices can malfunction, especially in the extreme cold (batteries get cold and screens freeze) and readings misread (Aporta and Higgs, 2005; Pearce et al., 2011) (Table 3.1). Sikumiut's request to include important Inuktitut place names in the next version of the maps is intended to teach these important landmarks for navigation, so Mittimatalingmiut youth are not solely reliant on their GPS devices in case of a malfunction.

The "P = planning before travel", the white rows in Table 3.1 show that many of these information sources are useful in different ways, at different temporal and spatial scales for planning travel, but no one tool can provide all the information needed for planning travel across all seasons. IQ allows experienced Inuit sea ice travellers with the skills and knowledge to utilize and synthesize a variety of information to make decisions in preparation for local sea ice travel. The "D = during travel", the grey rows in Table 3.1 shows the usefulness of GPS and mobile devices, but IQ provides the skills to utilize these devices and make safe travel decisions when travelling on the sea ice.

3.9 Conclusion

This paper developed a novel, co-produced, cross-cultural, Inuit-led research approach to support safe sea ice travel for the community of Mittimatalik. The training of Inuit youth to document and learn sea ice IQ from Sikumiut members was critical to mobilize this knowledge across generations. Our research provides a practical example that emphasizes the continued relevance of sea ice IQ. New sources provide valuable information for planning sea ice travel; however, it is the community-specific IQ that help Inuit decipher and apply this information to their local sea ice conditions. IQ is reflected in the Inuktitut sea ice terms and provides a foundation for Inuit youth to expand their sea ice communication and navigation skills. Knowing and understanding the sea ice terms provides capacity for youth to participate in group discussions with experienced hunters to learn more about current sea ice conditions for planning travel. Sea ice IQ helps Inuit youth develop the decision-making skills to identify and test the safety of sea ice, and fill local spatial and temporal information gaps while travelling on the sea ice. IQ also teaches emergency preparedness skills in planning for travel, and situational awareness in learning your location to avoid dangerous sea ice areas, and in identifying the closest areas of shelter in case of unexpected weather, accidents or equipment failure. While these sea ice IQ products cannot replace going out with someone knowledgeable to learn and practise in context, Sikumiut's goals in producing the IQ products are to encourage and inspire more youth to start learning and practising their sea ice IQ.

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3.11 ᖁᔭᒋᔭᐅᔪᑦ

ᖁᔭᒋᓪᓚᕆᒃᑕᕗᑦ ᐊᒃᓱᐊᓗᒃ ᑲᑎᒪᔨᐅᔪᑦ ᓯᑯᒥᐅᑦ ᐊᐅᓚᑦᑎᓂᕐᒧᑦ ᑲᑎᒪᔩᑦ ᓯᕗᓕᕐᑎᐅᓂᖏᓐᓄᑦ ᐊᒻᒪᓗ ᐃᑲᔪᕈᒪᓯᒪᓂᖏᓐᓄᑦ: ᐳᓚᐃᐊᓐ ᑯᓄᒃ, ᑲᐃᓚᐱ ᓴᖑᔭ, ᐃᓚᐃᔭ ᐸᓂᒃᐸᑯᑦᑐᒃ, ᑕᐃᕕᑎ ᐊᕐᓇᑦᑎᐊᖅ, ᒐᒪᐃᓕ ᕿᓗᕿᓵᖅ, ᐊᐃᕗᓐ ᑯᓄᒃ, ᔮᓇᑕᓐ ᐱᑦᓯᐅᕋᖅ, ᒨᓯᓯ ᐊᕐᓇᒍᐊᓕᒃ ᐊᒻᒪᓗ ᓯᐊᑎ ᑕᓛᖅ. ᖁᔭᓐᓇᒦᒃ ᐃᑳᕐᕕᒃ, ᓯᓕ ᐃᐅᕗᓚᒻ ᐊᒻᒪᓗ ᐃᓄᐃᑦ ᒪᒃᑯᒃᑐᑦ ᑐᖓᓴᐃᓚᐅᕐᒪᑕ ᓯᑯᓕᕆᔾᑯᓐᓂᒃ ᒥᑦᑎᒪᑕᓕᖕᒧᑦ ᐊᒻᒪᓗ ᐅᖃᐅᔾᔨᕆᐊᖃᑦᑕᓚᐅᕐᓂᖏᓐᓄᑦ ᑲᔪᖏᕐᓴᐃᓚᐅᕐᓂᖏᓐᓄᓪᓗ; ᑕᑎᒋᔭᒃᓴᐅᖏᓐᓇᕐᐳᓯ ᐱᒋᐊᕐᓯᐃᓐᓇᕈᑕᐅᕙᓯᓗ ᖃᐅᔨᓴᕐᓂᕐᒧᑦ. ᑲᑎᒪᖃᑦᑕᕐᓂᖏᑦ/ᐃᓕᓐᓂᐊᕐᓂᖏᓐᓄᑦ ᑑᓵᔨᐅᔪᑦ ᐱᓪᓚᕆᐅᖃᑦᑕᓚᐅᕐᐳᑦ ᑐᓴᐅᒪᑎᑦᑎᓂᕐᒥᑦ ᐊᒻᒪᓗ ᖃᐅᔨᒪᔭᕐᒥᓂᒃ ᐅᖃᐅᓯᖃᕐᐸᒃᓱᑎᒃ ᖁᔭᒋᓪᓚᕆᒃᑕᕗᑦ ᐅᑯᐊ ᒪᓚᑲᐃ ᐋᓇᐊᖅ, ᒎᐊᓗᓐ ᐊᕐᓇᑲᓪᓚᒃ ᐊᒻᒪᓗ ᐊᐃᕙᓚᕼᐊ ᑯᑉᓗ (ᒥᑦᑎᒪᑕᓕᒃ). ᖁᔭᓐᓇᒦᕐᒥᔭᕗᑦ ᒥᓵᑭ ᐊᓗᕈᑦ (ᐃᒃᐱᐊᕐᔪᒃ) ᐃᓄᒃᑎᑑᖓᓕᓐᓇᖅᑕᓚᐅᕐᓯᑦ ᕿᓚᒻᒥᐅᔪᒃᑯᑦ ᐅᓄᕐᑐᓂᒃ ᑎᑎᕋᕐᓯᒪᔪᓂᒃ ᓯᑯᒥᐅ ᑎᑎᕋᕐᑯᑎᖏᓐᓂᒃ. ᖁᔭᓐᓇᒦᕐᑕᕗᑦᑕᐅᖅ ᐅᑯᐊ: ᓕᓐ ᒧᐊᕐᒪᓐ ᑕᕙᖓᑦ ᒪᐅᓐᑦ ᐅᒪᐃᔪ ᐃᓕᓐᓂᐊᕐᕕᒃᔪᐊᖅ ᐊᒻᒪᓗ ᐸᕙᓇ ᓵᑦᕼᐊᓕ ᐊᕙᑎᓕᕆᔩᒃᑯᑦ ᓯᓚᐅᓪᓗ ᐊᓯᓪᓕᕐᐸᓪᓕᐊᓂᖓᓄᑦ ᑲᓇᑕ ᓄᓇᓕᕆᓂᕐᒧᑦ ᑭᒃᓕᓯᓂᐊᕐᓂᕐᒧᑦ ᐃᑲᔪᓚᐅᕐᓂᖏᓐᓄᑦ ᓄᓇᖑᐊᓕᕆᓂᕐᒥᒃ ᐃᓄᐃᑦ ᒪᒃᑯᒃᑐᓂᒃ. ᖁᔭᓐᓇᒦᕐᒥᔭᕗᑦ ᐱᕗᓕ ᕼᐊᓐᑲᒃ ᐃᑲᔪᕐᑐᐃᓚᐅᕐᒪᑦ ᐋᕿᒃᓱᕐᓯᒪᓂᖓᓂᒃ ᓄᓇᖑᐊᖏᓐᓂᒃ ᐊᑭᓐᓇᒦᑦᑐᒃᓴᓂᒃᓗ ᐊᒻᒪᓗ ᑲᐃᓗᐊᓐ ᕼᐊᑎᖕ ᓯᑯᓕᕆᔾᑯᓐᓂᑦ ᑎᑎᕋᓕᕆᓃᑦ ᑲᒪᒋᓪᓗᓂᒋᑦ. ᖁᔭᒋᔭᕗᑦ ᐊᕙᑎᓕᕆᓂᖅ ᓯᒪᐅᓪᓗ ᐊᓯᓪᓕᓪᐸᓪᓕᐊᓂᖓᓄᑦ ᑲᓇᑕ ᐅᒪᔪᓕᕆᓂᕐᒧᑦ ᐱᔾᓯᕐᑎᑦ ᐊᑐᕐᑕᐅᓚᐅᕐᒪᑦ ᒥᑦᒪᑎᑕᓕᖕᒥ ᖃᐅᔨᓴᕐᕕᒃ ᑐᔪᕐᒥᕕᐅᓪᓗᓂ ᑲᑎᒪᕕᐅᖃᑦᑕᕐᓱᓂᓗ. ᐊᒻᒪᓗᑦᑕᐅᖅ ᖁᔭᓐᓇᒦᕐᑕᕗᑦ ᒪᐴᒃ ᐅᖃᐅᓯᐅᔪᒪᖏᑦᑑᒃ ᑭᓇᐅᓂᖏᓐᓂᒃ ᑎᑎᕋᕐᓯᒪᔪᓂ ᕿᒥᕈᐲᐅᓚᐅᕐᑐᒃ ᐅᖃᐅᔾᔨᕐᐊᖃᑦᑕᓚᐅᕐᒪᑎᒃ ᐋᕿᒋᐊᖃᒃᑲᓐᓂᕐᑐᓂᒃ ᑲᔪᖏᕐᓯᐃᓪᓗᑎᒃᓗ ᐃᑲᔫᑕᐅᓚᐅᕐᒪᑕ ᐱᐅᓯᒋᐊᕈᑕᐅᓪᓗᑎᒃ ᑐᑭᓯᓇᕐᓯᒋᐊᕈᑕᐅᓪᓗᑎᒃ ᑖᓯᒥᖓ ᑎᑎᕋᕐᓯᒪᔪᒥᒃ.

3.12 Other

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Chapter 4

The Mittimatalik siku asijjipallianinga (sea ice climate atlas): How Inuit knowledge, earth observations and sea ice charts can fill IPCC climate knowledge gaps

Wilson, K., Arreak, A., The Sikumiut Committee, Bell, T., and Ljubicic, G. 2021. The Mittimatalik Siku Asijjipallianinga (Sea Ice Climate Atlas): How Inuit Knowledge, Earth Observations, and Sea Ice Charts Can Fill IPCC Climate Knowledge Gaps. Frontiers in Climate 3(October). https://doi.org/10.3389/fclim.2021.715105

4.1 Abstract

The IPCC *special report on the ocean and cryosphere in a changing climate* (SROCC) highlights with high confidence that declining Arctic sea ice extents and increased ship-based transportation are impacting the livelihoods of Arctic Indigenous peoples. Current IPCC assessments cannot address the local scale impacts and adaptive needs of Arctic Indigenous

communities based on the global, top-down model approaches used. Inuit maintain the longest unrecorded climate history of sea ice in Canada, and to support Inuit community needs, a decolonized, Inuit knowledge-based research approach was co-developed in the community of Mittimatalik, Nunavut (Canada) to create the Mittimatalik siku asijjipallianinga (sea ice climate atlas) 1997-2019. This paper presents the novel approach used to develop the atlas based on Inuit knowledge, earth observations and Canadian Ice Service (CIS) sea ice charts and demonstrates its application.

The atlas provides an adaptation tool that Mittimatalik can use to share locations of known and changing sea ice conditions to plan for safe sea ice travel. These maps can also be used to support the safety and situational awareness of territorial and national search and rescue partners, often coming from outside the region and having limited knowledge of local sea ice conditions. The atlas demonstrates the scientific merit of Inuit knowledge in environmental assessments for negotiating a proposal to extend the shipping seasons for the nearby Mary River Mine.

The timing and rates of sea ice freeze-up (October-December) in Mittimatalik are highly variable. There were no significant trends to indicate that sea ice is freezing up later to support increased shipping opportunities into the fall. The atlas shows that the first two weeks of November are critical for landfast ice formation, and icebreaking at this time would compromise the integrity of the sea ice for safe travel, wildlife migration and reproduction into the winter months. There was evidence that sea ice break-up (May-July) and the fracturing of the nearby floe edge have been occurring earlier in the last 10 years (2010-2019). Shipping earlier into the break-up season could accelerate the break-up of an already declining sea ice travel season, which Inuit are struggling to maintain.

4.2 Co-Authorship Statement

The Sikumiut Management Committee governs this research. They have approved the publication of their IQ as outlined in the Sikumiut-Memorial research agreement (see Appendix C). For this chapter, Sikumiut contributed to conception and design of the study. Wilson archived and organized the data and trained Arreak in Geographic Information Systems (GIS) and satellite imagery interpretation. Arreak performed all the satellite interpretation and GIS digitizing. Wilson and Arreak performed the statistical data analysis. Sikumiut reviewed and validated the maps, suggesting other ways to analyze the data based on their climatological knowledge. Wilson led the development of the map legends, colours and layout with input from Ljubicic, Bell and Arreak. Wilson wrote all drafts of the manuscript. Ljubicic, Bell and Arreak read and contributed to manuscript revisions, and approved the submitted version.

4.3 Introduction

The International Panel on Climate Change (IPCC) Special Report on the Ocean and Cryosphere in a Changing Climate (SROCC) outlines that between 1979 and 2018, sea ice in the Arctic decreased by approximately 13% per decade (IPCC, 2019:6). This decline is expected to continue into the mid-century having significant impacts on Arctic Indigenous peoples nutritional, cultural, and overall health and wellness (IPCC, 2019:15). Inuit communities are already dealing with dangerous sea ice travel conditions, limiting access to critical hunting locations and country food sources, and causing high rates of search and rescue, injury, trauma, and tragic deaths (Durkalec et al., 2014; Clark et al., 2016a, 2016b; Driscoll et al., 2016; Kenny et al., 2018b; Ford et al., 2019). Additionally, the surge in shipping activity as a result of changing ice conditions is also impacting Arctic Indigenous peoples (IPCC, 2019). In the Canadian Arctic there has been a three-fold increase in the distance travelled by ships between 1990 and 2015 (Pizzolato et al., 2014, 2016; Dawson et al., 2018). This exposes Indigenous coastal communities to a higher risk of accidents, pollution, noise, invasive species, and disruptions to subsistence hunting areas, wildlife reproduction, populations and migration routes (Huntington et al., 2015; ICC-Alaska, 2015; Meredith et al., 2019).

IPCC assessments are limited in addressing the climate change questions of Arctic Indigenous communities because of the global scale used in predictive models. Also, the top-down, model-focused approaches used by a majority of assessments are a barrier to addressing the specific sea ice climate change adaptive needs of Arctic communities (Ford et al., 2012). Inadequate supports to engage meaningfully with Indigenous peoples limits an understanding of the cumulative impacts of colonialism and climate change on Arctic Indigenous communities (Ford et al., 2012; Cameron et al., 2015; IPCC, 2019:15). For example, increased shipping and changes to on-ice travel are not unrelated. In the Inuit community of Mittimatalik (Nunavut, Canada; Fig. 4.1), shipping and on-ice travel are in direct conflict with one another.

Sikumiut are a committee of Inuit sea ice users that govern the SmartICE community-based sea ice monitoring program (smartice.org) in Mittimatalik. Sikumiut members wanted to be able to share with younger generations where and when the sea ice is changing to support safer on-ice travel. Sikumiut also wanted to investigate the potential impacts of a proposed extension to the shipping season by Baffinland Iron Mines (BIM), the company that operates the Mary River iron ore mine and port near the community (Fig. 4.1). Sikumiut are concerned about BIMs proposal to ship earlier during sea ice break-up and later as the sea ice is freezing. The nearby sinaa (floe edge), a stable landfast sea ice edge critical for community hunting, is highly anticipated during the freeze-up season. Avoiding disturbances to the sinaa and tuvaq (landfast ice) as they form is critical to community members for safe sea ice travel throughout the season, as well as for wildlife habitat and migration.

This collaborative research project with Sikumiut began in 2017. In earlier phases of our work sea ice travel safety maps for the winter and spring travel seasons were developed based on Sikumiut's Inuit Qaujimajatuqangit (Wilson et al., 2021). Inuit Qaujimajatuqangit (IQ) is commonly used to describe Inuit knowledge, but it also encompasses all aspects of Inuit "values, world-view, language, social organization, knowledge, life skills, perceptions and expectations" (Government of Nunavut and Nunavut Department of Education, 2007). As a result, these IQ-based sea ice maps share more than locations of safe and hazardous ice conditions. Embedded in the Inuktitut place names and sea ice terms are important information for sea ice travel and survival (Wilson et al., 2021). These Sikumiut sea ice IQ travel safety maps also provide a time-integrated baseline of the winter and spring sea ice travel conditions for Mittimatalik. Typically, meteorologists call these baselines "climatologies," comprising databases of historical weather or sea ice observations (WMO, 2017). These climatologies are used to compare and track changes over time, and are used particularly to monitor climate change trends. Sikumiut's IQ-based sea ice climatology is maintained by passing down their IQ through generations, and orally sharing their extensive and recent travel experiences on the sea ice. Sikumiut's sea ice climatology is therefore not in a database but exits in the collective minds of these expert sea ice travellers. Also, their climatology is not focused on ice conditions in a general scientific sense, but more specifically on ice conditions supporting safe travel and spatio-temporal patterns of ice features that support hunting. To support Sikumiut's climate change adaptation needs, a novel approach was co-developed to document for the first time their sea ice IQ to create the Mittimatalik siku asijjipallianinga (sea ice climate atlas).

The goals of this paper are three-fold. First, we outline the unique IQ-based research co-production approach that utilized earth observations and Canadian Ice Service (CIS) sea ice charts to create a sea ice climatology for the community of Mittimatalik. We present how Sikumiut's IQ was the foundation for the development, analysis and production of the final maps in the siku asijjipallianinga. Second, we present the utility of the atlas in summarizing Mittimatalik's sea ice trends (averages, variability, spatial changes) over the 23-year climatological period (1997-2019). Third, we demonstrate the value of such IQ-based, community-scale sea ice climatologies for local and regional scales.

This paper does not include an analysis of the atmospheric drivers for local sea ice change in Mittimatalik. This would normally accompany the presentation of a regional sea ice climatology, but this was not requested by Sikumiut. Also, this paper is not an example of integrating or incorporating IQ into western science. Rather, in this sea ice climatology, IQ was the knowledge base to interpret, analyse and validate western data sources to address Inuit specific research questions. This paper provides an example of an IQ-based research co-production approach in practise, to fill the climate knowledge gaps and support adaptation needs for the community of Mittimatalik.

4.4 Background

In this background section we briefly review the impacts of climate change and colonialism on safe sea ice travel across Inuit Nunangat. Inuit Nunangat is the Inuit homeland in Canada that covers the four Inuit land claim settlement regions of: Inuvialuit Settlement Region (Northwest Territories), Nunavut, Nunavik (northern Québec), and Nunatsiavut (northern Labrador) (ITK, 2018). We also present the Inuit community of Mittimatalik, outline our six-year research co-production journey, introduce the research partners and co-authors, and how the need for a Mittimatalik sea ice climatology evolved. Finally, we review the current information sources available to build sea ice climatologies at community scales in the Canadian Arctic. In this paper we use the Mittimatalik Inuktitut sea ice and geographic terms, and Table 4.1 has been provided for reference to the equivalent English terms while reading.

4.4.1 Climate and colonial impacts for safe sea ice travel

The IPCC SROCC defines climate as the "average weather … over a period of time ranging from months to thousands or millions of years" (P rtner et al., 2019:680). In Inuktitut there is no word for climate or climate change. The closest word in Inuktitut is *sila,* which has been defined as weather and the spiritual power that controls weather (Fox, 2004; Leduc, 2007). In Inuktitut, the term *silaup qanuinnirigajuktanga* is now used for climate and the direct translation from Inuktitut is "[t]he usual temperature, rain or snow and wind conditions of an area over a very long number of seasons” (GN and NTI, 2005:39). Climate change is defined as “A change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer” (P rtner et al., 2019:680). The Inuktitut term *silaup asijjiqpallianinga* is the term used for climate change and has various definitions that include: “ A difference in the usual and extreme global temperatures that is not just a short cycle, but lasts for decades” (GN and NTI, 2005:35); and the “ongoing and continuous change in sila” (Cameron et al., 2015:278). For the context of this paper we are using the Government of Nunavut definitions (2005), but for a more in-depth discussion see {Formatting Citation}.

Environmental changes to sea ice travel is having profound impacts on the physical, cultural and mental health of Inuit (Cunsolo Willox et al., 2013; Ford et al., 2013b; Durkalec et al., 2015; Pearce et al., 2015). Sea ice provides a stable platform to access country food (wild food from plants and animals, which is gathered and caught from the land and ocean). Changing weather and sea ice conditions are limiting Inuit access to critical hunting locations and country food sources (Laidler et al., 2009; Clark et al., 2016a; Kenny et al., 2018b). The high cost of store-bought foods in Inuit Nunangat means Inuit food insecurity rates are eight times higher than the rest of Canada (Kenny et al., 2018a). Inuit are now having to navigate new, longer, and more dangerous routes on the sea ice to access country food, which increases the risk of becoming lost in unfamiliar areas. Changes to traditional sea ice routes have also led to the use of more fuel, running out of gas, breaking through unexpected areas of thin ice, having to travel over rough ice and/or land resulting in snowmobiles and other equipment being lost and damaged (Ford et al., 2007; Durkalec et al., 2015; Driscoll et al., 2016; Fawcett et al., 2018).

Search and rescue requests have not only increased due to changing weather and sea ice conditions, but also due to mechanical breakdown and running out of gas (Clark et al., 2016a; Durkalec et al., 2014). Rates of unintentional injury and trauma are extremely high in Inuit Nunangat, and in Nunavut specifically they "are more than twice the national average…and the leading cause of morbidity and mortality" (Durkalec et al., 2014; Clark et al., 2016a:44).

As identified in the IPCC SROCC, climate change has left some experienced hunters doubting their weather and sea ice forecasting skills (IPCC, 2019); however, many hunters still have confidence in their IQ to navigate and make critical decisions on the sea ice, even under changing sea ice conditions (Gearheard et al., 2006; Pearce et al., 2010; Wilson et al., 2021). The high rates of sea ice related injury and search and rescue experienced by Inuit are not simply due to climate change, but are intertwined with the ongoing effects of colonialism that have weakened the transmission of sea ice IQ through reduced language and practice (Tester and Kulchyski, 1994; Damas, 2002; MacDonald, 2018). The forced transition of Inuit into communities, wage labour, and residential schooling resulted in generations of Inuit deprived of the ability to develop this IQ through observations and experiences with parents and Elders (Tester and Kulchyski, 1994; Damas, 2002; QIA, 2014; TRC, 2015; MacDonald, 2018). Colonialism has left some Inuit unable to communicate in Inuktitut, impacting their ability to learn, understand and share sea ice conditions and experiences with hunters and Elders (Ford et al., 2013a; Heyes, 2011; Pearce et al., 2011). Despite these challenges, sea ice IQ has endured and continues to be gained through experience and practice. Inuit continue to share their sea ice observations and knowledge to make safe sea ice travel decisions (Pearce et al., 2010; Ford et al., 2013; Gearheard et al., 2013; ICC-Canada, 2014; Wilson et al., 2021).

Table 4.1 Mittimatalik Inuktitut sea ice terms and geographic place names with English equivalent terms and definitions

Inuktitut term	English equivalent
Aajuraq	Lead (singular). A crack in the sea ice that gets wider in the spring and is not always possible to cross
Aajurait	Leads (plural). Cracks in the sea ice that gets wider in the spring and are not always possible to cross
Imaqainnaujattuq ukiutamaa	Water that runs from glaciers onto the sea ice and melts it
Ivujuk	Ridges, high areas of rough ice you have to travel around
Mittimatalik	Pond Inlet
Mittimatalingmiut	People of Mittimatalik
Nagguti	A crack (singular) in the ice that refreezes in winter. Narrow enough to cross but can be dangerous
Naggutiit	Cracks (plural) in the ice that refreeze in winter. Narrow enough to cross but can be dangerous
Sila	Weather and climate
Silaup qanuinnirigajuktanga	Climate
Silaup asijjiqpallianinga	Climate change
Siku	Sea ice
Siku asijjipallianinga	Changes to the sea ice (sea ice atlas)
Sikumiut	People of the sea ice, self-titled name of the Inuit management committee that governs the SmartICE community-based sea ice monitoring program (smartice.org) in Mittimatalik
Siku saattuq aragulimaamik	Thin ice all year
Siku saattuq upingaat pigiarningani	Thin ice in spring
Sinaa	Floe edge (singular)
Sinaangit	Floe edges (plural)
Sirmilik	Bylot Island. The place of glaciers
Tasiujaq	Eclipse Sound marine region
Tursukattak	Pond Inlet marine region
Tuvaq	Landfast sea ice

4.4.2 Evolution of the research partnership and project

The community of *Mittimatalik* (Pond Inlet) is located at the northern tip of Baffin Island in Nunavut (Fig. 4.1). It has a population of approximately 1600 people, of which 92% are Inuit and speak Inuktitut as their first language (Statistics Canada, 2017). The sea ice around the community begins to freeze in late October, and is normally safe for travel by mid-November once the ice becomes tuvaq (landfast ice or stable sea ice that is frozen to the land) (Wilson et al., 2021). *Mittimatalingmiut* (people of Mittimatalik) travel on the sea ice to hunt and fish for country food (caribou, narwhal, beluga, seal, and char) and to spend time away from town at family cabins. Areas commonly travelled around Mittimatalik discussed in this paper include: Navy Board Inlet, *Tasiujaq* (Eclipse Sound), and *Tursukattak* (Pond Inlet; Fig. 4.1). There are two sinaangit (plural of sinaa = floe edges) in the region, one at the entrance to Navy Board Inlet and one at the entrance to Tursukattak (Fig. 4.1). Sinaangit are stable edges of tuvaq, located beside areas of open water that remain clear of ice throughout most of the sea ice season. The Tursukattak sinaa is located approximately 65 km from the community and is one of the main hunting and fishing locations that Mittimatalingmiut use from December to early July.

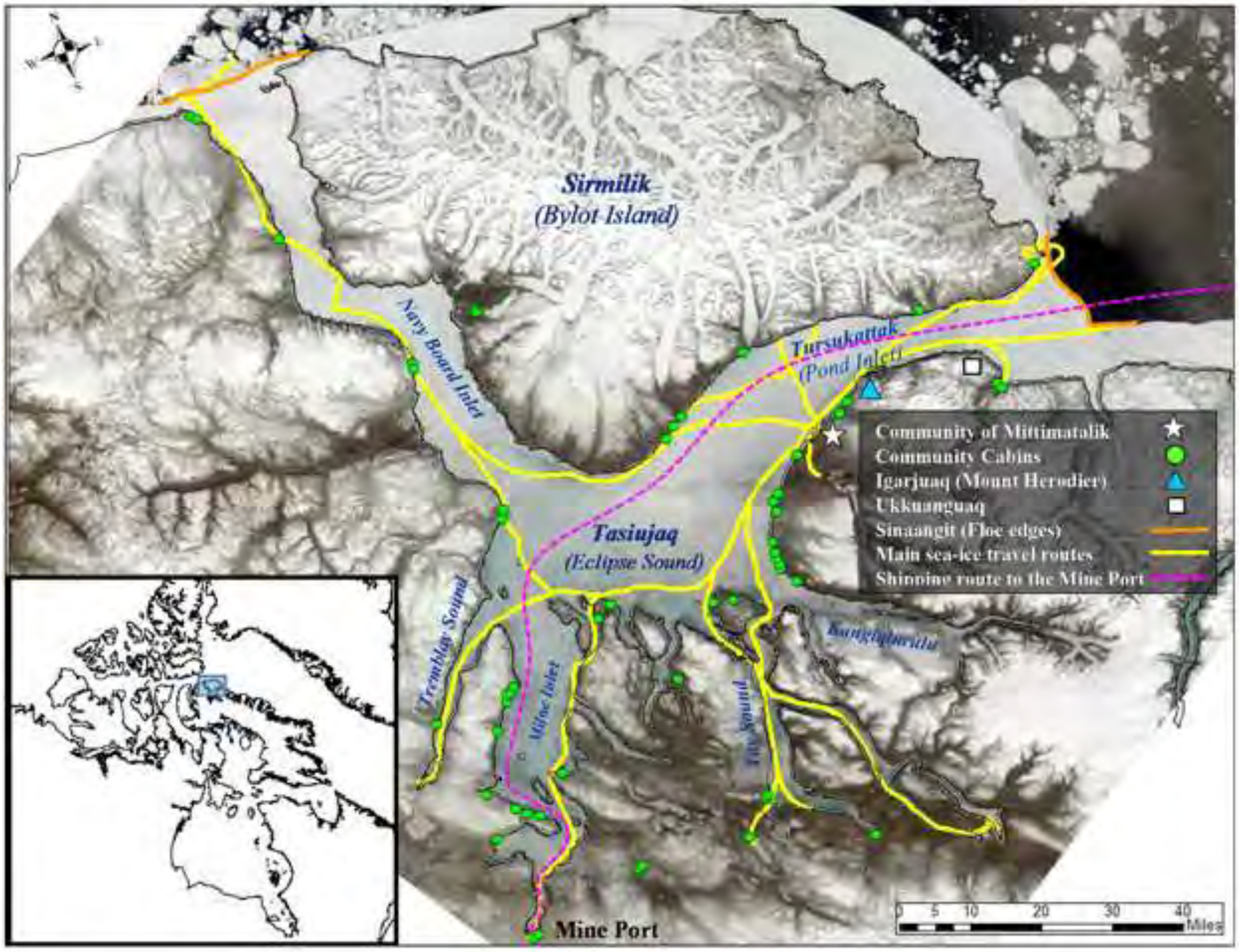


Figure 4.1 Geographical location of the community of Mittimatalik, Nunavut, Canada. Background image MODIS True Colour Composite, June 9, 2019 (NASA, 2019).

Mittimatalingmiut want to maintain their sea ice travel and are looking to additional information sources to augment their decision-making. Some members of the community heard about SmartICE and invited Trevor Bell to Mittimatalik in 2015 to discuss how SmartICE could support the community's sea ice travel safety concerns. SmartICE (smartice.org) is a work integration social enterprise that provides ice thickness measurements for Inuit communities using: in-situ instruments (SmartBUOYs) located at strategic travel locations on the sea ice; and a mobile sensor (SmartQAMUTIK) towed behind a snowmobile throughout the season on the main sea ice trails (Bell et al., 2014). Bell and Katherine Wilson spent two years developing relationships and trust to establish an Inuit-led SmartICE operations team in Mittimatalik. Bell is a co-author on this paper, a co-supervisor for Wilson, and the founder of SmartICE. Wilson, the lead author of this paper, is a PhD candidate with Memorial University of Newfoundland. She is also an employee of the Government of Canada for over 25 years, currently with the Canadian Ice Service (17 years in total), part of Environment and Climate Change Canada (ECCC). Wilson returned to school in 2015 under the co-supervision of Bell and Gita Ljubicic (McMaster University, also co-author), to retrain in decolonizing and Indigenous research approaches, and to put into practice a different way of doing research that empowers Inuit self-determination (Wilson et al., 2020).

Andrew Arreak, co-author, lives in Mittimatalik and was hired and trained in 2015 as the SmartICE community operator, now the Nunavut Operations Lead for the Qikiqtaaluk North (Baffin) region of Nunavut. In 2016, a 10-person management committee of Elders, experienced sea ice users and youth was established to govern SmartICE in Mittimatalik. Sikumiut, which means “people of the sea ice” in Inuktitut, is the self-titled name of the management committee (also co-authors on this paper, see Acknowledgements for list of members). Over these initial two years, Sikumiut began to share their concerns with Bell and Wilson about previous research relationships and younger Inuit lacking the necessary IQ needed to travel safely on the sea ice.

In 2017, our third year working together, we spent time planning the research focus and co-developing a cross-cultural research approach, called the Sikumiut Model (Wilson et al., 2020), with six goals:

1. Support Inuit self-determination in research;
2. Embrace Inuit decision-making;
3. Prioritize community-based research needs;
4. Develop Inuit specific values for research;
5. Strengthen Inuit youth capacity; and
6. Change the role of non-Indigenous research partners.

In the Sikumiut Model, the research is focused on community research needs and building Inuit youth capacity in research. As a result, we reconceptualised the role of the non-Indigenous research partners was as facilitators and mentors, to train Inuit youth in Mittimatalik to do this research themselves. Arreak was hired as the Inuit youth researcher to work on this project alongside his part-time SmartICE duties. To formalize the co-produced research approach, an agreement between Sikumiut and Memorial University was developed, which outlined the project goals, as well as roles and responsibilities of the Inuit and non-Indigenous project partners (Wilson, 2018). The research agreement also specified that the knowledge and data from this project are owned by Sikumiut, and they gave consent to Wilson to publish the results as part of her PhD requirements.

In 2018 we began the research phase of the project. Sikumiut wanted to first document and share their sea ice IQ with the next generation to improve safe sea ice travel in the community. During 2018, workshops were held to document Sikumiut's sea ice terminology and to map Sikumiut's knowledge of safe and dangerous sea ice travel areas from winter to early summer as the sea ice is breaking up (Figs. 4.2a, 4.3). Between 2019 and 2021 this sea ice IQ was made accessible to the community through the development of a sea ice terminology booklet, posters and seasonal maps of safe and dangerous areas to travel (Wilson et al., 2021).

Over several meetings Sikumiut members discussed that while the sea ice freezes and breaks up differently each year, changes in sea ice conditions are now beyond what they would consider normal. Sikumiut members were interested in understanding where the sea ice was becoming more dangerous, so they could adapt their travel routes to maintain their hunting and fishing activities. In addition, Sikumiut were also concerned about a request from BIM to extend the shipping to/from the mine into the sea ice season. Figure 4.1 shows the current shipping route from Baffin Bay, past the community, into Tasiujaq and down Milne Inlet currently used during the average open water season (August 5 – October 15). BIM wants to increase production at the mine, which would necessitate more shipping to export the ore. The company has proposed starting to ship 2-3 weeks sooner in the summer (as of July 15), and later into the fall (until November 15; Bourbonnais et al., 2016). These shipping dates were proposed based on the analysis of CIS charts and satellite imagery (1980-2016) to understand the historical sea ice conditions in the region, and determine the vessel class, safety and feasibility of shipping in the shoulder seasons (Bourbonnais et al., 2016). The assessment concluded that shipping into the shoulder seasons was possible based on the use of various ice-strengthened vessel classes (Bourbonnais et al., 2016). Sikumiut are concerned about the impacts of icebreaking in the fall as tuvaq, along with the Tursukattak sinaa, are forming at this time, and changes to fall sea ice could impact travel safety throughout the subsequent winter and spring ice seasons. For example, shipping in the fall will leave large tracks of deformed, rough ice, dangerous for navigation during the dark months and cutting off traditional travel routes (Fig. 4.1; Sikumiut, 2021).

Sikumiut are also concerned that icebreaking earlier in the summer could further accelerate sea ice break-up and black carbon emissions from ships could change the albedo of the sea ice (Sikumiut, 2021). Changes to the sinaa and tuvaq could have critical consequences for Mittimatalingmiut for sea ice travel safety, in accessing hunting areas, for spring seal reproduction on the ice, and for polar bear migration. Additional concerns are due to the noise from icebreaking and the effects on local seal and narwhal populations (Sikumiut, 2021).

Discussions across many Sikumiut meetings evolved around the need to document Mittimatalik's historical sea ice conditions and develop a baseline of sea ice knowledge for the region. This sea ice baseline would be analysed to understand:

- where and when the sea ice is changing to adapt sea ice travel; and
- how shipping later during sea ice freeze-up and earlier during sea ice break-up could compromise the safety of Mittimatalingmiut on-ice travel.

It was also important for Sikumiut to have this baseline to compare ongoing changes to sea ice, and the potential cumulative effects of shipping through the sea ice. To address Sikumiut's climate change adaptation and shipping impact questions, we needed to co-develop a novel way to create a Mittimatalik-specific sea ice climatology.

Figure 4.2 a) Sikumiut members mapping their sea ice IQ, November 2018. Photo credit Katherine Wilson. b) Sikumiut members reviewing the Mittimatalik siku asijjipallianinga maps, March 2021. Photo credit Shelly Elverum.

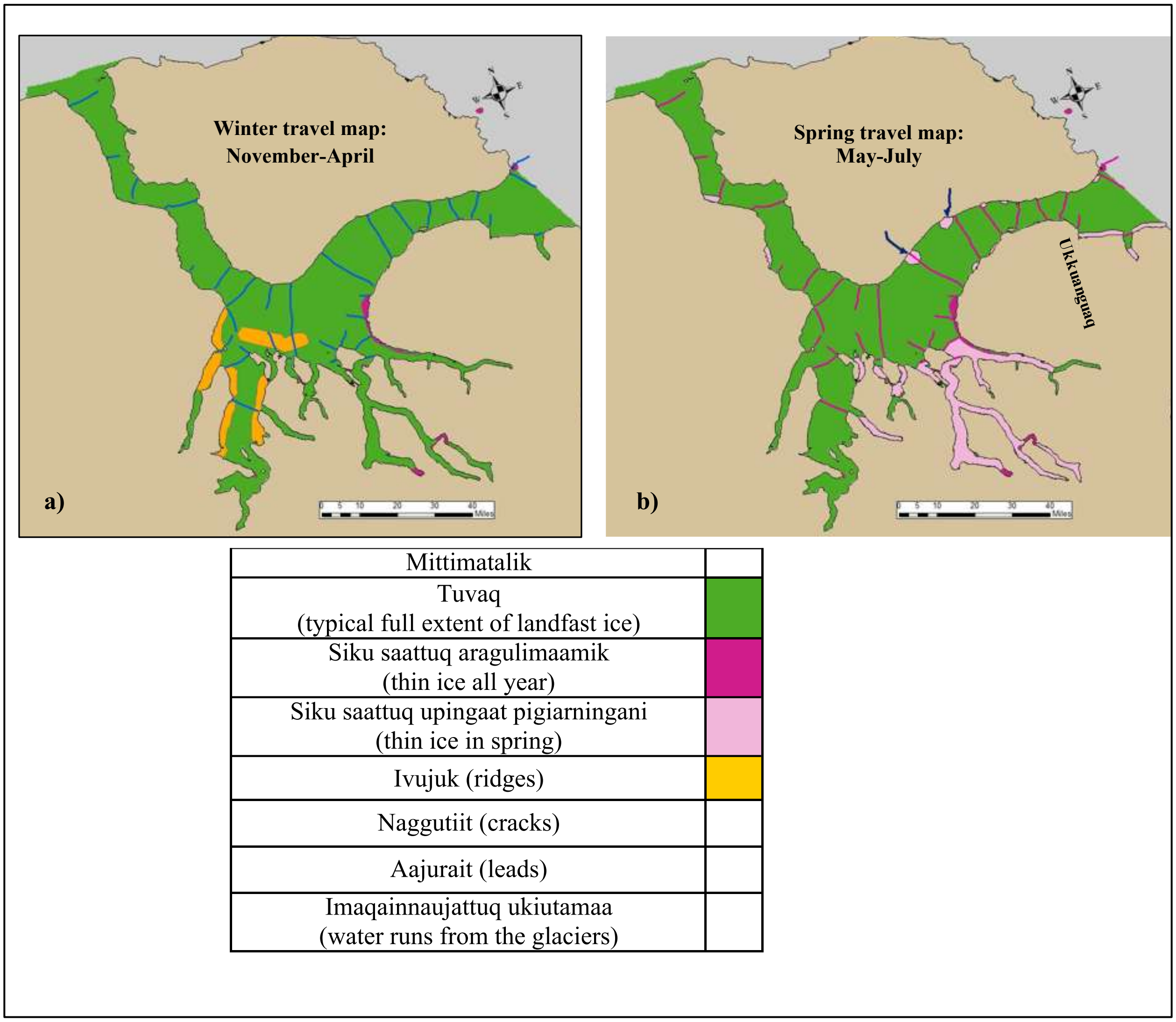


Figure 4.3 Sikumiut seasonal sea ice safety travel maps a) Winter sea ice IQ travel map, November to April; b) Spring sea ice IQ travel map, May to July.

4.4.3 Available data to support community-scale sea ice climatologies

Wilson started by reviewing the available satellite, CIS ice charts and in-situ datasets for the Mittimatalik region at a variety of scales to determine how additional data sources could supplement Sikumiut's IQ for a Mittimatalik specific sea ice climatology.

4.4.4 Satellite data

The most widely used sea ice climatology comes from the Special Sensor Microwave Imager (SSM/I) satellites (NSIDC, 2021). SSM/I satellites have been imaging the polar regions since 1978, providing a 44-year-long database to monitor changing sea ice conditions (Stroeve and Meier, 2018). However, the spatial resolution of SSM/I imagery is on the order of 25 km, and community sea ice conditions are indiscernible from the topography of the Canadian Arctic archipelago in this imagery (Cooley et al., 2020; NSIDC, 2021).

Two other types of satellite sensors are optimal for sea ice monitoring: optical; and synthetic aperture radar (SAR). Optical satellites, such as NASA's Moderate Resolution Imaging Spectroradiometer (MODIS) and the European Space Agency's Sentinel-2 (ESA, 2019; NASA, 2019), are dependent on sunlight and therefore cannot image the earth's surface when there are clouds or during winter polar darkness in northern latitudes. MODIS images the Mittimatalik region daily at a resolution of 250m and there is an archive of imagery dating back to the year 2000 (Fig. 4.1). MODIS has been used successfully to develop climatologies of landfast ice break-up for Inuit communities using cloud free imagery during the spring and summer seasons with long daylight hours (Cooley et al., 2020).

SARs, such as RADARSAT 1 and 2 (CSA, 2019) and Sentinel-1 (ESA, 2019), have their own energy source that send and receive microwave wavelengths to measure the roughness of the earth's surface. This built-in energy source allows for monitoring during the dark Arctic winters, approximately mid-November to mid-February (3 months). The microwave wavelengths of SARs can also penetrate most cloud cover, providing year-round imaging of the Arctic surface. The RADARSAT imagery archive dates back to 1997, with a majority of the imagery in a ScanSAR Wide beam mode with a 100m resolution (Fig. 4.4b).

4.4.5 Ice charts

The longest recorded sea ice archive for Canada is based at the CIS (ECCC, 2021). Since 1968 the CIS has been monitoring sea ice to support summertime marine navigation and Arctic community re-supply (Shokr and Sinha, 2015). Between 1968 and 1995, detailed daily ice charts were produced using a combination of visual and SAR aerial reconnaissance missions, low-resolution satellite data, and meteorological information. In 1996, the CIS transitioned to using RADARSAT as their primary data source to operationally monitor sea ice in the Canadian Arctic (Ramsay et al., 1996, 1998). The CIS produces detailed daily ice charts for the major shipping routes in the Arctic during the summer season. In the fall, as the sea ice starts to freeze-up, ships leave the Arctic and the CIS transitions to weekly, less detailed regional charts to monitor the sea ice conditions over the winter months until break-up the following summer. The CIS archive now captures three 30-year climatological periods: 1971-2000; 1981-2010; and 1991-2020. CIS climatological products have been developed to generate sea ice climate normal maps and graphs to review change and variability in sea ice conditions in Canada. The CIS climatology has been created at a regional scale for the Western Arctic, Eastern Arctic and Hudson Bay and are not at a scale to capture the ice conditions for the Mittimatalik region (ECCC, 2021). However, the weekly charts in the CIS archive do provide some details of Mittimatalik ice conditions and are an additional data source for the community climatology (Fig. 4.4a).

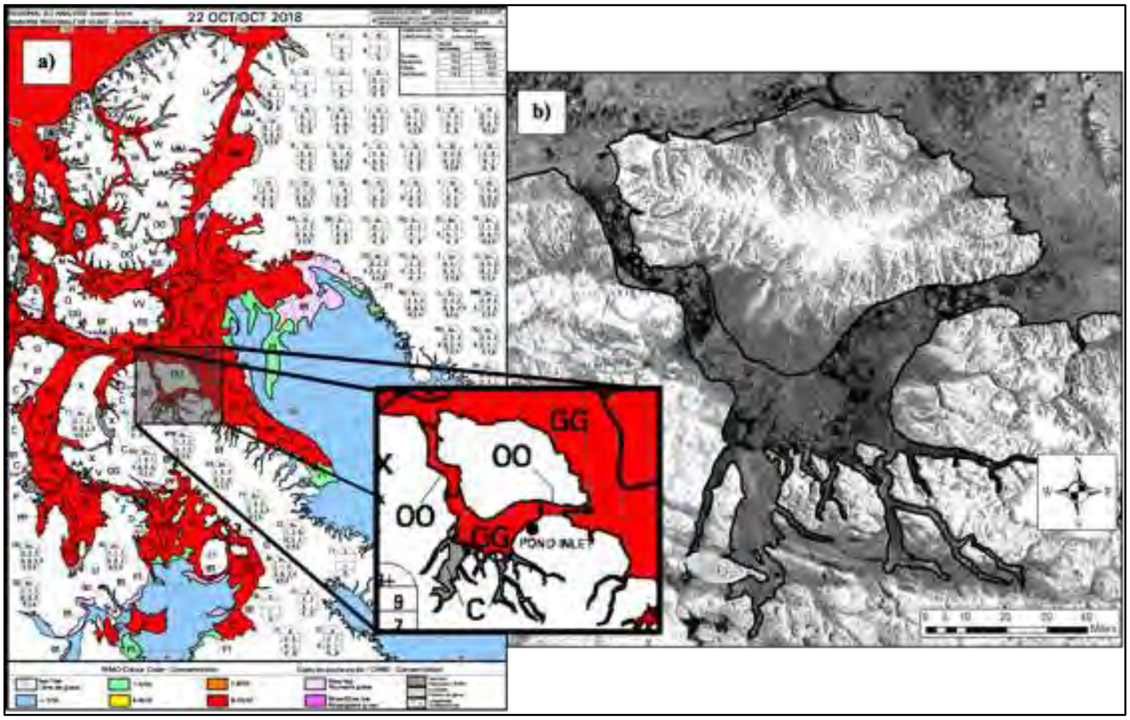


Figure 4.4 a) CIS eastern Arctic regional ice chart for October 22, 2018 (ECCC, 2020); b) Radarsat-2 ScanSAR Wide image of the Mittimatalik region, October 22, 2018 (CSA, 2019).)

4.4.6 In-situ observations

The Arctic Research Establishment (ARE) was a private research station run by the Steltner family based in Mittimatalik between 1975 and 1989. ARE collected oceanographic and sea ice data for ship engineering and ice-breaking research. Some Sikumiut members had worked for ARE taking measurements and requested that these data be relocated and returned to them. Between 2016 and 2018, Wilson searched Canadian archives, contacted retired scientists and eventually connected with members of the Steltner family. The data collection had been kept in the family home in southern Ontario and the data included environmental observations recorded in field books, reports, photographs and on film. Bell sought funding to archive this dataset, and between 2019 and 2020 the collection was scanned, sorted and boxed up. Digital copies of the collection are now in the community of Mittimatalik, but several years of work are still required to review and enter the observations into a database for research. The Steltner family donated the ARE collection to the Government of Nunavut and the physical records are now stored in their archives currently housed in Ottawa.

Community-based monitoring (CBM) has been gaining significant interest to fill gaps in sparse Arctic environmental information (Johnson et al., 2015). The benefits of CBM approaches include year round monitoring, conducted by the Indigenous peoples who live in the region, and in providing local scale information that Arctic communities can use to address their own research needs (Johnson et al., 2015). SmartICE is a CBM service that was established to monitor sea ice in the community of Mittimatalik in 2016. However, the current length of the SmartICE record (5 years) is not yet long enough for use in the Mittimatalik climatology.

4.4.7 Inuit Qaujimajatuqangit

Inuit hold the only long term and consistent record of sea ice in the Canadian Arctic. Riedlinger and Berkes (2001) discuss how IQ is a source of climate history and can provide a baseline to assess change and fill Arctic monitoring gaps. However, in reviewing the literature we found no practical examples where IQ was mobilized for its climate history.

The Sikumiut maps that were co-produced in 2018 share the IQ of known locations of safe and hazardous ice conditions by season (Figs. 4.2a; 4.3a, b). The winter travel map highlights dangerous areas such as reoccurring *naggutiit* (cracks in the ice that can be easily crossed), *ivujuk* (ridges, high areas of rough ice you have to travel around) and *siku saattuq aragulimaamik* (thin ice all year; Fig. 4.3a). The spring maps show new and expanding dangerous travel areas such as *aajurait* (leads, cracks in the sea ice that get wider in the spring that are not always possible to cross), *siku saattuq upingaat pigiarningani* (thin ice in spring), and *imaqainnaujattuq ukiutamaa* (water that runs from the glaciers; Fig. 4.3b). These maps provide an IQ-based climatology for the region of Mittimatalik; however, the information on which they are based is not in a database, they exist in the collective memory of Sikumiut members.

Based on the assessment of available sea ice information sources for Mittimatalik we had the following four: 1) Sikumiut's IQ; 2) the CIS charts (1968 to present); 3) RADARSAT 1 and 2 (1997 to present) imagery; and 4) MODIS imagery (2000 to present). The overlapping time period of the available information was from 1997 to 2019, a 23-year time period, slightly less than a standard 30-year climatology. We then began to explore how IQ could interpret and review the satellite and ice chart data to develop a Mittimatalik specific sea ice climatology based on IQ.

4.5 Methods

The co-production of the Mittimatalik sea ice atlas occurred over three years between 2019 and 2021, as outlined in Table 4.2. During 2019 a majority of the co-development and training was done in person in Mittimatalik. As the COVID-19 pandemic hit and travel restrictions were implemented, we continued our collaborative work by mailing data to each other on external drives and moving our training, discussions and meetings on-line (Table 4.2).

Table 4.2 Mittimatalik sea ice atlas co-production timelines and responsibilities

Year		Month	Arreak	Wilson
2018		June - December		Archiving satellite imagery and CIS charts
2019		February	In Mittimatalik: initial discussion on methods to interpret and map break-up.	
		March		Develop remote sensing training.
		April	In Mittimatalik: Remote sensing training.	
		May - July	Remote sensing interpretation practise: monitoring spring break-up conditions with satellite imagery on the SIKU website.	Develop training procedures for satellite imagery analysis and digitizing break-up.
		July	In Mittimatalik: external drive with archived satellite imagery provided to Arreak; training on interpretation and digitization of archived break-up imagery, and discussion on methods to interpret and map freeze-up. Start of satellite imagery analysis for break-up.	
		September	In Mittimatalik: reviewing work, sorting out issues	
		October	Satellite imagery analysis and digitization for break-up continued.	Freeze-up data pre-processing: converted CIS charts to raster, extracted ice type and fast ice parameters.
		December		Develop training procedures for freeze-up analysis: creating weekly average maps and yearly freeze-up maps in ArcMAP and graphing trends in Excel.
2020		February	In Mittimatalik: Training on freeze-up analysis of CIS charts External drive with freeze-up raster files provided to Arreak. Last trip before COVID.	
	COVID 19 Pandemic	March - May	Break-up GIS files copied to back-up external drive and mailed to Wilson.	Break-up data processing: Converting digitized weekly maps to raster for analysis.
		August	Freeze-up analysis: developing weekly average maps, yearly freeze-up maps and graphing trends.	Develop training procedures for break-up analysis: create weekly average maps, yearly freeze-up maps and graphing trends. Mailed copy of break-up raster files and analysis procedures on external drive to Arreak.
		September	E-mail freeze-up maps and graphs to Wilson Review freeze-up analysis and discuss results by phone.	
		October	Break-up analysis: Produce weekly average maps, yearly freeze-up maps and trend graphs.	Testing initial colour schemes and legends.
		November	E-mail maps and graphs to Wilson Review break-up analysis and discuss results by phone.	
		December	Sikumiut meeting: Initial results presented by Arreak (Wilson and Bell by phone).	
2021		January	Finalizing map colour schemes for visual accessibility and printing.	
		March	Draft #1 of freeze-up maps printed and mailed to Mittimatalik. Sikumiut meeting to review draft freeze-up maps (Wilson and Bell by phone).	
		May	Draft #1 break-up maps and draft #2 freeze-up maps and text printed and mailed to Mittimatalik. Sikumiut meeting: review of draft maps and translated text (Wilson and Bell by phone). Revisions to maps.	
		June - August	Layout, and drafting English text	
		September	In Mittimatalik, review of draft layout with text	
2022		January - February	Revising text	
		March - April	Translation of atlas into Inuktitut	
		May - June	Layout, printing of atlas and shipping to Mittimatalik for distribution	

Bandwidth limitations in the community reduced the use of videoconferencing as a collaboration platform, and a majority of our interactions were by text, telephone and e-mail in 2020 and 2021. This section illustrates our preliminary steps, the development and analysis of the break-up and freeze-up maps, and the process to create maps that were accessible and intuitive for Mittimatalingmiut.

4.5.1 Preliminary work

In 2018 Wilson began visually reviewing and archiving RADARSAT-1 (1997-2013) and RADARSAT-2 (2009-2019) imagery between October and July. Cloud free MODIS (2000-2019) imagery were visually reviewed between mid-February to the end of October when the region has adequate daylight hours for optical imagery (NASA, 2019). Weekly satellite coverage of the Mittimatalik area averaged 3 per week with RADARSAT data and an additional 2 per week with MODIS data during the freeze-up and break-up periods, totalling approximately 4000 images archived. Additionally 500 CIS weekly charts were also archived from the CIS (ECCC, 2021).

Once the data was archived, we began planning training for Arreak to learn how to interpret the satellite imagery. Optical imagery is fairly easy to interpret because it is very similar to a colour photograph. However, SAR imagery can be difficult to interpret for untrained users and requires a shift in thinking to understand that these images represent the surface roughness of the earth. For example, dark smooth areas in SAR imagery can commonly be areas of open water and/or smooth sea ice. The goals of this pilot satellite imagery training were two-fold: 1) so

Arreak could interpret the satellite imagery using his IQ to map the safe and unsafe sea ice travel conditions around Mittimatalik from 1997 to 2019; and 2) so SmartICE operators could start using publicly available satellite data from SIKU and Polar View on-line platforms in their day-to-day SmartICE operations (Polar View, 2019; Arctic Eider Society, 2020).

In April 2019, a four-day satellite interpretation training session was held in Mittimatalik to pilot this training with Arreak and two other Inuit SmartICE operators from Qikiqtarjuaq (Jenny Mosesie) and Arviat (Robert Karetak) (Wilson et al., 2020). This training was then put into practice between May and July with the three SmartICE operators monitoring their regions in near real-time during the 2019 sea ice break-up season by accessing the satellite imagery on the SIKU website (Table 4.2).

4.5.2 Break-up maps

Arreak and Wilson began co-developing the IQ-based sea ice climatology methods in February 2019 (Table 4.2). We began by looking at the spring and early summer satellite imagery together to understand what sea ice features could be identified in the imagery, and what was important from an Inuit perspective to capture in the imagery.

The interpretation of sea ice in satellite imagery for charting is based on an international standard established by the World Meteorological Organization (WMO). The Manual of Standard Procedures for Observing and Reporting Ice Conditions (MANICE) defines and describes the navigational terms for sea ice (ECCC, 2016). The MANICE terms evolved primarily by identifying sea ice from a bird's eye view using aircraft and helicopters from the

1960’s to 1990’s, and since the late 1990’s using predominantly satellites. We reviewed Sikumiut’s sea ice terms to determine if we could use Inuit specific ice types instead of the MANICE ice types to classify the satellite imagery. It was difficult to identify these specific ice types during break-up at the resolution of the MODIS (250 m) and RADARSAT ScanSAR Wide (100 m) imagery. While the MANICE terms evolved from above looking down at the sea ice surface, the Inuktitut sea ice terms evolved from travelling on the sea ice, at a scale of <1 m (Wilson et al., 2021). The spatial scales of the Sikumiut sea ice terms did not align with the scale of the available satellite imagery. We then discussed classifying the imagery using the MANICE sea ice types since they were at the scale of the satellite imagery, however for break-up the MANICE types do not indicate the stage of melt or break-up. For example, ice that is classified as thick first year ice in December, will remain this ice type until the area completely melts and becomes open water.

Ice charts describe sea ice conditions using a numeric code called “the egg code” (ECCC, 2016). Numbers are used in the egg code to eliminate language barriers in the polar navigational community. Polygons are drawn on the satellite imagery around homogenous areas of sea ice and the numeric egg code describes up to three sea ice types, their concentrations (expressed in tenths) and floe sizes within the polygon (Fig. 4.4a). Using these eggs codes, captains navigate through ice-free, or lower concentrations of ice, avoiding higher concentrations of moving ice dangerous for navigation. Estimating sea ice concentrations for the Mittimatalik climatology was also discussed. For example, break-up is often based on when ice concentrations, are less than 5/10ths (Archer et al., 2017; Segal et al., 2020b). Arreak did not feel that 5/10th concentration was a useful threshold to determine break-up in Mittimatalik. Break-up in the area does not occur all at once, it occurs in different areas and at different times, and is often linked to the stability of the sinaangit.

What Arreak felt was climatologically important to map were locations of rough sea ice, aajurait, sinaagnit and areas of sea ice breakup that were no longer safe for travel (open water and/or areas with numerous breaks in the ice). We first looked at roughness, as SAR imagery has been used to develop sea ice surface roughness maps for Inuit travel (Segal et al., 2020a). However, when travelling on the ice, areas in the SAR image that are rough can be smooth for sea ice travel with sufficient snow cover. In the spring, as puddles and melt ponds form on the sea ice, the presence of water dominates the SAR backscatter resulting in smooth areas on the SAR image, masking the ice surface underneath. For the purpose of this historical analysis, we were concerned that ice roughness would be overestimated in winter and underestimated during spring melt. Therefore, we removed sea ice roughness as a parameter and focused on mapping aajurait, sinaagnit and areas of break-up. The latter were defined as areas that were no longer safe for travel. The break-up areas could include open water, melting sea ice and/or areas with multiple aajurait, which would no longer be safe to travel on.

Wilson used the CIS climatology methods as initial inspiration for the Mittimatalik climatology. Using the same climatological weeks as the CIS, Arreak reviewed and interpreted the satellite data for each week. Arreak was trained using ArcMap 10.5 Geographic Information Systems (GIS) software to digitize the weekly locations of aajurait, sinaagnit and areas of break-up. Arreak spent half of his time over 6 months (Table 4.2) interpreting the imagery and digitizing maps. Arreak interpreted each week of the archived satellite data from late May until early August to create 10 weekly maps per year. This weekly analysis for break-up was repeated for each year from 1997 to 2019 (23 years), to create 230 weekly maps, analysing approximately 2000 satellite images in total.

As Arreak and Wilson reviewed the satellite data, they made notes detailing:

- the dates when the snow melted, and when the sea ice became visible in the MODIS imagery;
- when areas of open water on the sea ice first became visible in the MODIS and RADARSAT imagery; and
- the final break-up dates for the Tursukattak and Navy Board sinaangit as detected in the MODIS and/or RADARSAT imagery (± 2 days).

The RADARSAT SCW data was block averaged to reduce speckle for interpretation, reducing the resolution to 200m. The MODIS imagery was interpreted with a resolution of 250m. Wilson converted the weekly break-up polygons to raster in ArcMAP with a cell size of 500m^2. Each cell in the maps were assigned a value of 1 for break-up and 0 for tuvaq. Training focused on ArcMap spatial analysis tools to create weekly and yearly maps of average ice conditions, and to compare differences between years. Arreak developed weekly average break-up maps by adding together all the maps for the same climatological week over the 23-year record (1997-2019). The summed values provided an indication of how often break-up occurred in this cell over the 23-year record. For example, if the summed value was equal to 18, this meant that break-up occurred in this cell 18 times out of 23 years, or 78% of the time. The categories in the weekly maps were developed to indicate the following safe travel conditions: 1) dangerous; 2) frequently dangerous; 3) sometimes dangerous; and 4) generally safe (Table 4.3). The total area of break-up was calculated to determine and compare how much of the Mittimatalik region was breaking up each week. These percentages were exported to Microsoft Excel and Arreak generated graphs to analyse trends and variability in Mittimatalik's sea ice conditions over 23 years. Wilson performed linear regressions and tested the regressions for statistical significance.

Table 4.3 Weekly average break-up map categories

Weekly frequency of break-up 1997 – 2019 (23 years total)			**Average Travel Conditions**
# of years the area was breaking-up	**Percentage of time the area was breaking-up**	**Reclassified Value**	
1 – 5 years	0-25%	1	Generally safe
6 – 10 years	25-50%	2	Sometimes dangerous
11 – 16 years	50-75%	3	Frequently dangerous
17 – 23 years	75-100%	4	Dangerous

Sikumiut had mentioned on several occasions that the greatest change in sea ice has occurred in the last decade. While graphs can indicate trends and variability in break-up over the years, we wanted to develop maps to understand where break-up was occurring earlier. Using the same procedures for the weekly frequency of break-up maps, Wilson summed the maps for the same climatological weeks for the first 13 years (1997-2009) and the last 10 years (2010-2019). These maps were reclassified into four categories based on how often break-up was occurring in the area in the two separate time periods: 0-25% of the time; 25-50% of the time; 50-75% of the time; and 75-100% of the time (Table 4.4). The two reclassified time period maps were then added together to produce unique cell values that were grouped into 5 categories to indicate where break-up has changed the most during the last 10 years: earlier; sometimes earlier; no change; sometimes later; and later (Table 4.4).

Table 4.4 Classifications for the difference in the frequency of break-up maps for two time periods

1997-2009 First 13 years			2010-2019 Last 10 years			Difference Map First 13 + Last 10 Values			
# of years	% of time	Reclassified Value	# of years	% of time	Reclassified Value	New Value		Percent Change	Legend category
0 - 4	0 - 25%	0	0 - 2	0 - 50%	2	0 + 2 =	2	0	No change
0 - 4	0 - 25%	0	3 - 5	25 - 50%	20	0 + 20 =	20	+25%	Sometimes earlier
0 - 4	0 - 25%	0	6 - 7	50 - 75%	200	0 + 200 =	200	+50%	Earlier
0 - 4	0 - 25%	0	8 -10	75 - 100%	2000	0 + 2000 =	2000	+75%	Earlier
5 - 7	25 - 50%	-10	0 - 2	0 - 50%	2	(-10) + 2 =	(-8)	(-25%)	Sometimes later
5 - 7	25 - 50%	-10	3 - 5	25 - 50%	20	(-10) + 20 =	10	0	No change
5 - 7	25 - 50%	-10	6 - 7	50 - 75%	200	(-10) + 200 =	190	+25%	Sometimes earlier
5 - 7	25 - 50%	-10	8 -10	75 - 100%	2000	(-10) + 2000 =	1990	+50%	Earlier
7 - 9	50 – 75%	-100	0 - 2	0 - 50%	2	(-100) + 2 =	(-98)	(-50%)	Later
7 - 9	50 – 75%	-100	3 - 5	25 - 50%	20	(-100) + 20 =	(-80)	(-25%)	Sometimes later
7 - 9	50 – 75%	-100	6 - 7	50 - 75%	200	(-100) + 200 =	100	0	No change
7 - 9	50 – 75%	-100	8 -10	75 - 100%	2000	(-100) + 2000 =	1900	+25%	Sometimes earlier
10 - 13	75 – 100%	-1000	0 - 2	0 - 50%	2	(-1000) + 2 =	(-998)	(-75%)	Later
10 - 13	75 – 100%	-1000	3 - 5	25 - 50%	20	(-1000) + 20 =	(-980)	(-50%)	Later
10 - 13	75 – 100%	-1000	6 - 7	50 - 75%	200	(-1000) + 200 =	(-800)	(-25%)	Sometimes later
10 - 13	75 – 100%	-1000	8 -10	75 - 100%	2000	(-1000) + 2000 =	1000	0	No change

4.5.3 Freeze-up maps

Post analysis of sea ice freeze-up in the MODIS and RADARSAT satellite imagery proved challenging. It was difficult to historically map the fluid and dynamic sea ice conditions that moved with the winds and ocean currents until they consolidate in early winter (Fig. 4.4b). We again looked to the weekly CIS charts, as they were created using satellite data and meteorological observations in near-real time (Fig. 4.4a). We discussed using the ice charts concentrations as a way to classify freeze-up, based on a threshold of concentrations greater than 5/10ths (Archer et al., 2017; Segal et al., 2020b). Again, what Arreak felt was most important to know during freeze-up was when the sea ice was safe to travel on, and when the sinaagnit were forming, the 5/10ths threshold did not convey this information. We also looked at the MANICE ice types to infer the thickness of the sea ice. For example, estimating ice types greater than 1 foot (30 cm) as safe for travel. While some hunters are experienced and knowledgeable to travel on newer ice types, for most community members safe travel is considered possible once the ice becomes tuvaq (Wilson et al., 2021).

The CIS charts do code tuvaq (landfast ice) once first-year ice concentrations reach 9+ and 10/10ths (Fig. 4.4a). As a result, we used the CIS weekly ice charts over a 13-week period between October and December to capture Mittimatalik freeze-up. Historically, ice chart production ceased for the Mittimatalik region near the end of November as the sea ice froze and ships left the region, therefore there are no weekly ice charts available for the month of December between 1997 and 2005. With improved satellite coverage starting in 2006, the CIS began producing weekly charts into the winter months. Benoit Montpetit (ECCC Wildlife S&T Branch) developed scripts for us to extract the landfast ice polygons from the charts and convert to raster. Each cell in the maps were assigned a value of 1 for tuvaq and 0 if it wasn't tuvaq. The production of freeze-up average weekly maps, difference maps, yearly maps and trends and variability analysis followed the same steps as for break-up.

4.5.4 Accessible atlas colours and legends

As the siku asijjipallianinga was going to be something completely new for Mittimatalingmiut, it was important to develop maps that were intuitive, culturally accessible and distinct by season and map type. We spent several months testing different colour schemes for the maps in the atlas. Certain colours tend to be intuitive, for example green for safe, red for dangerous and blue for water. Red and green diverging colours were not used in the same map out of considerations for people with colour blindness. Red and blue, pink and green, and purple and orange are recommended contrasting colours for colour accessibility (Brewer et al., 2002). We tested using red for dangerous conditions and blue for safer conditions in the weekly average travel freeze-up maps. However, for Inuit, dangerous sea ice travel conditions are often because of open water, so using blue to indicate safer travel conditions was counter intuitive. We reached consensus on using the contrasting colours of green to indicate safer travel conditions and pink for more dangerous travel conditions for the weekly average travel maps.

With 6 different maps in the atlas, we were concerned that having 6 different legends would be confusing for users. For the weekly average travel maps, we tested and refined using green for safer travel conditions and pink for more dangerous travel conditions in order to have the same colour scheme for freeze-up and break-up (Table 4.5). The categories in the weekly maps were also developed so they could be used in both the freeze-up and break up maps (Tables

4.3, 4.5). For the difference maps, we also tested a colour scheme that could be used for both the freeze-up and break-up. Orange to indicate earlier freeze-up or break-up, and purple to indicate later freeze-up or break-up (Table 4.5). Once again, the categories in the difference maps could be used for both freeze-up and break-up: 1) earlier; 2) sometimes earlier; 3) no change; 4) sometimes later; and 5) later (Table 4.5).

For the yearly maps, a sequential colour scheme was more intuitive and preferred by all. For enough contrast in viewing and printing sequentially coloured maps, no more than 6 shades of the same colour are recommended (Brewer et al., 2002). We selected a red sequential colour scheme for break-up so red could indicate dangerous travel areas (Table 4.5). Arreak initially digitized 10 weeks for break-up, but in the end, we found that negligible break-up occurred in the first 3 weeks (May 28 – June 27) of the record, so these 3 weeks were removed. In the end, yearly break-up maps in the atlas represent seven weeks, between June 18 and August 5; from 1997 to 2019 (Table 4.5). We could not reduce the number of weeks to six to meet printing recommendations, but in reviewing the printed maps, we felt there was sufficient contrast for the seven weeks.

The yearly freeze-up maps initially showed freeze-up over 13 weeks, too many classes for a single colour scheme. Negligible freeze-up occurred between October 1 and 21 over the record, so these 3 weeks were removed. Very little change in freeze-up also occurred during the following two-week periods of 1) October 22 – November 4 when freeze-up is just starting; 2) December 4-16; and 3) December 17-20 when the sea ice growth slows as it consolidates. These three, two-week periods were merged reducing the number of classes for the yearly freeze-up maps to eight (Table 4.5). A sequential three-colour scheme used yellow for late October; green for November; blue for December; and dark blue for remaining areas of open water at the end of December (Table 4.5) (Brychtová et al., 2015). For the freeze-up and break-up yearly maps, the lightest colours indicate the areas in which sea ice is present for the longest period of time and the darkest colours where sea ice was present for the shortest amount of time.

Finally, we also wanted to ensure that each colour was used only once for consistency across all the maps, for example not using blue for ice in one map and blue for water in another map. Although not perfect, considerable effort was put into selecting the colours and developing the legends to reduce the number of legends from 6 to 4 and to ensure they were accessible and culturally intuitive for Mittimatalingmiut (Table 4.5). Sikumiut reviewed the maps and legends at meetings in December 2020, March, and May 2021 (Fig. 4.3b). During these meetings we also discussed what we would call this sea ice climatology in Inuktitut. Sikumiut decided on the "Mittimatalik siku asijjipallianinga" (changes of the sea ice).

Table 4.5 Mittimatalik siku asijipallianinga legend categories and colour schemes

Atlas maps	Legend colour/category							
1. Weekly average travel conditions for freeze-up and break-up	Dangerous							
	Frequently dangerous							
	Sometimes dangerous							
	Generally safe							
2. Weekly difference maps for freeze-up and break-up	Earlier							
	Sometimes earlier							
	No change							
	Sometimes later							
	Later							
3. Yearly freeze-up maps	Oct 22-Nov 4 2 weeks	Nov 5-11	Nov 12-18	Nov 19-25	Nov 26-Dec 2	Dec 3-16 2 weeks	Dec 17-30 2 weeks	Open Water
4. Yearly break-up maps	June 11-24	June 25-July 1	July 2-8	July 9-15	July 19-22	July 23-29	July 30-Aug 5	
Across all maps	Outside travel region							
	Land							

4.6 Results

The Mittimatalik siku asijjipallianinga project includes the following fourteen products to capture the sea ice climatology for the community between 1997 and 2019. Samples of these products are illustrated below (Figs. 4.5-4.15) as we review the averages, trends and variability in the sea ice freeze-up and break-up seasons over the 23-year climatology.

Freeze-up, October 22 – Dec 20, (1997-2019):

1) Ten weekly average tuvaq maps (e.g., Fig. 4.5)
2) Summary graph of average tuvaq formation by week (Fig. 4.6)
3) Summary graph showing the weekly variability in tuvaq formation (Fig. 4.7a)
4) Summary graph illustrating the weekly frequency of tuvaq formation (Fig. 4.7b)
5) Twenty-three maps showing the spatial formation of tuvaq for each year (e.g., Fig. 4.8)
6) Six weekly difference maps showing areas where tuvaq is forming earlier or later in the last 10 years (e.g., Fig. 4.9)

Break-up, June 18 – July 29, (1997-2019):

7) Frequency graph illustrating the key indicators for break-up (Fig. 4.10a)
8) Graphs of the Navy Board and Tursukattak sinaangit average break-up dates (Figs. 4.10b, c)
9) Six weekly average break-up maps (e.g., Fig. 4.11)
10) Summary graph of average break-up by week (Fig. 4.12)
11) Summary graph highlighting the weekly variability in break-up (Fig. 4.13a)
12) Summary graph illustrating the critical weeks for break-up (Fig. 4.13b)
13) Twenty-three maps showing spatial break-up of sea ice for each year (e.g., Fig. 4.14)
14) Six weekly difference maps showing areas where the sea ice is breaking up earlier or later in the last 10 years (e.g., Fig. 4.15)

The complete set of the Mittimatalik siku asijjipallianinga maps are available in Appendix B.

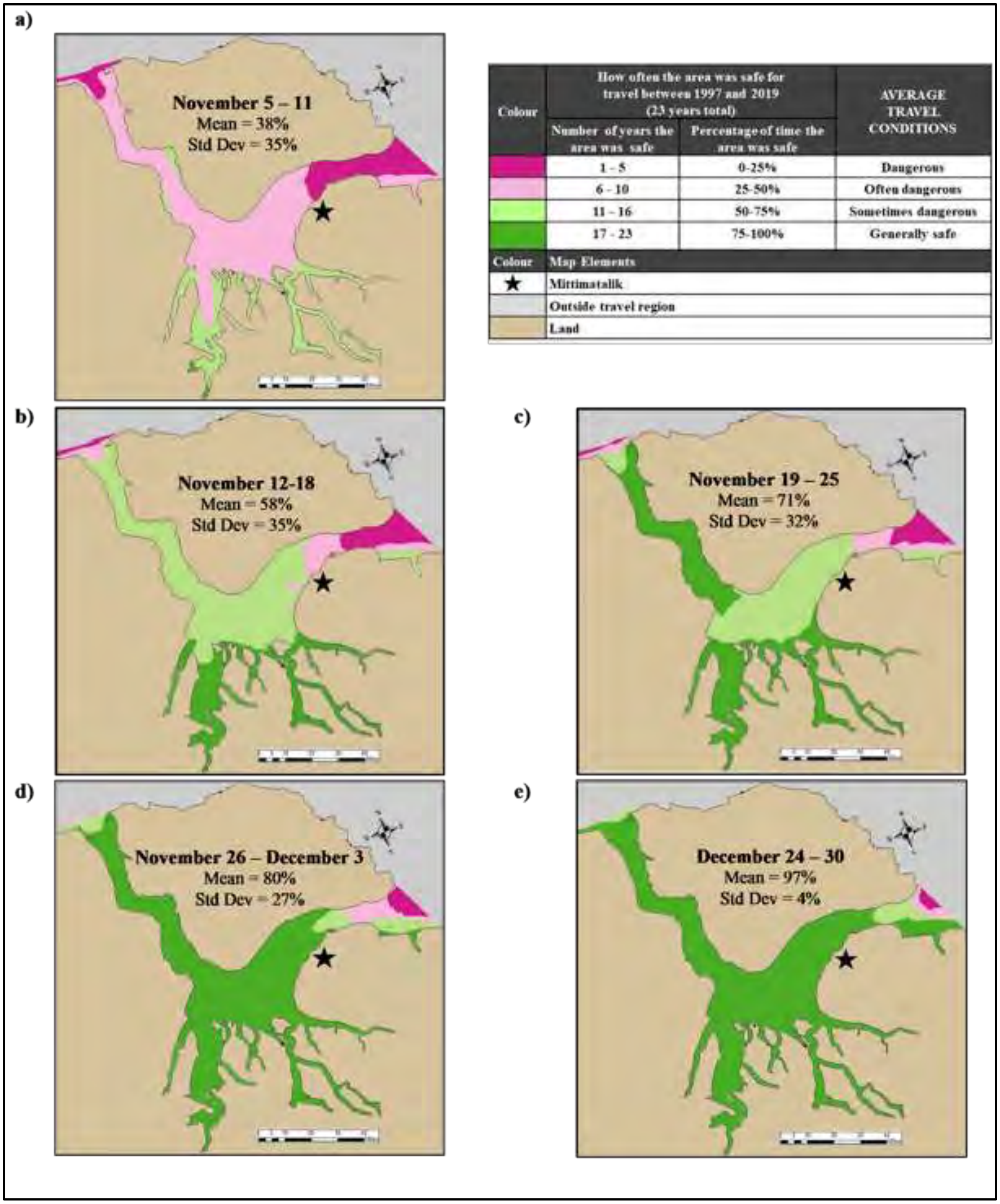


Figure 4.5 Weekly average tuvaq maps for showing freeze-up for the Mittimatalik region, 1997-2019. (a) Average tuvaq, November 5 – 11. (b) Average tuvaq, November 12 – 18. (c) Average tuvaq, November 19 – 25. (d) Average tuvaq, November 26 – December 3. (d) Average tuvaq, December 24 – 30.

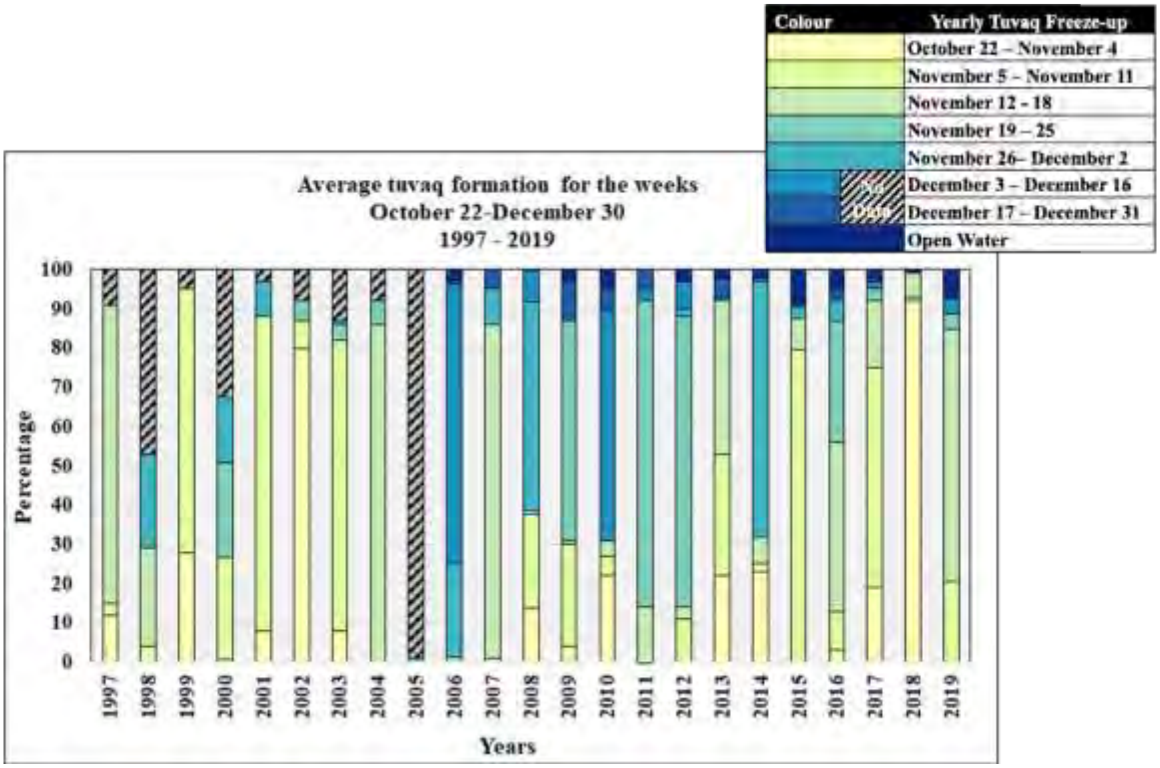
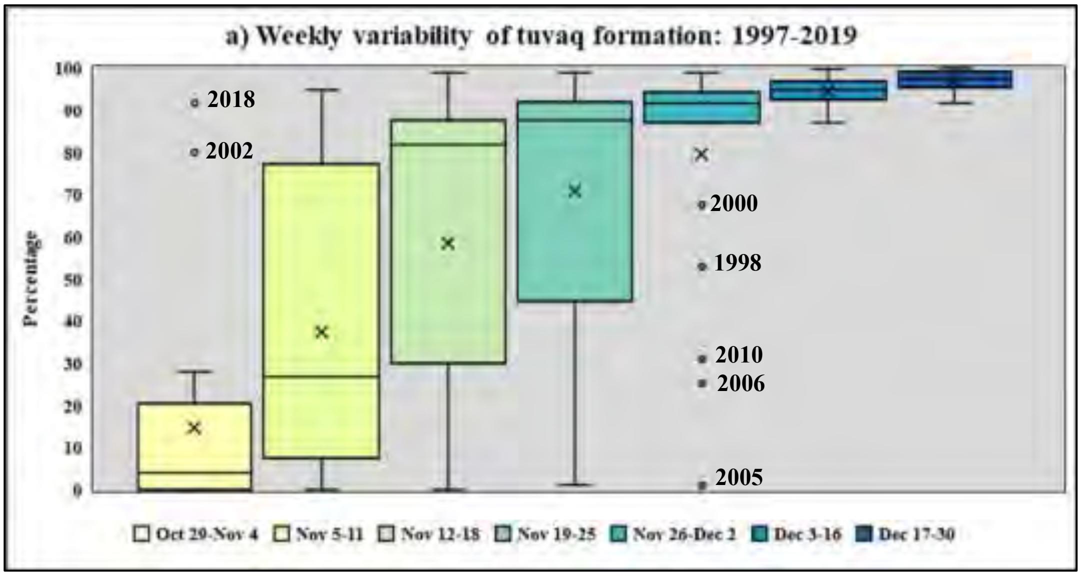


Figure 4.6 Summary graph of average tuvaq formation for freeze-up, 1997-2019. Each bar is a year showing the weekly percentage of tuvaq freeze-up by colour: yellow for late October; green for November; blue for December; and dark blue for remaining areas of open water at the end of December. Years with more blue represent the late formation of tuvaq. Years with more yellow represent the early formation of tuvaq.



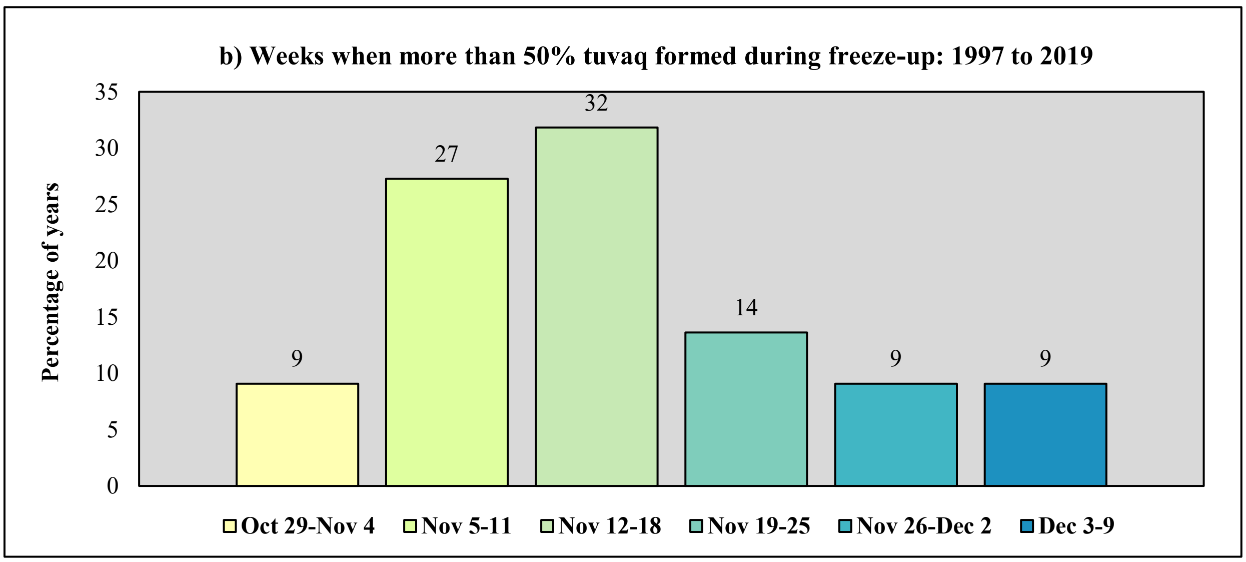


Figure 4.7 a) Summary graph of the weekly variability in tuvaq formation for freeze-up, 1997-2019. The box outlines the interquartile range, the average range in the variability of tuvaq formation for a particular week over the 23-year period (1997-2019). The line through the box is the median and the X denotes the mean. The vertical "whisker" lines show the minimum and maximum values. The dots correspond to outliers, or years with unusual tuvaq percentages. b) Weekly frequency of tuvaq formation, 1997-2019.

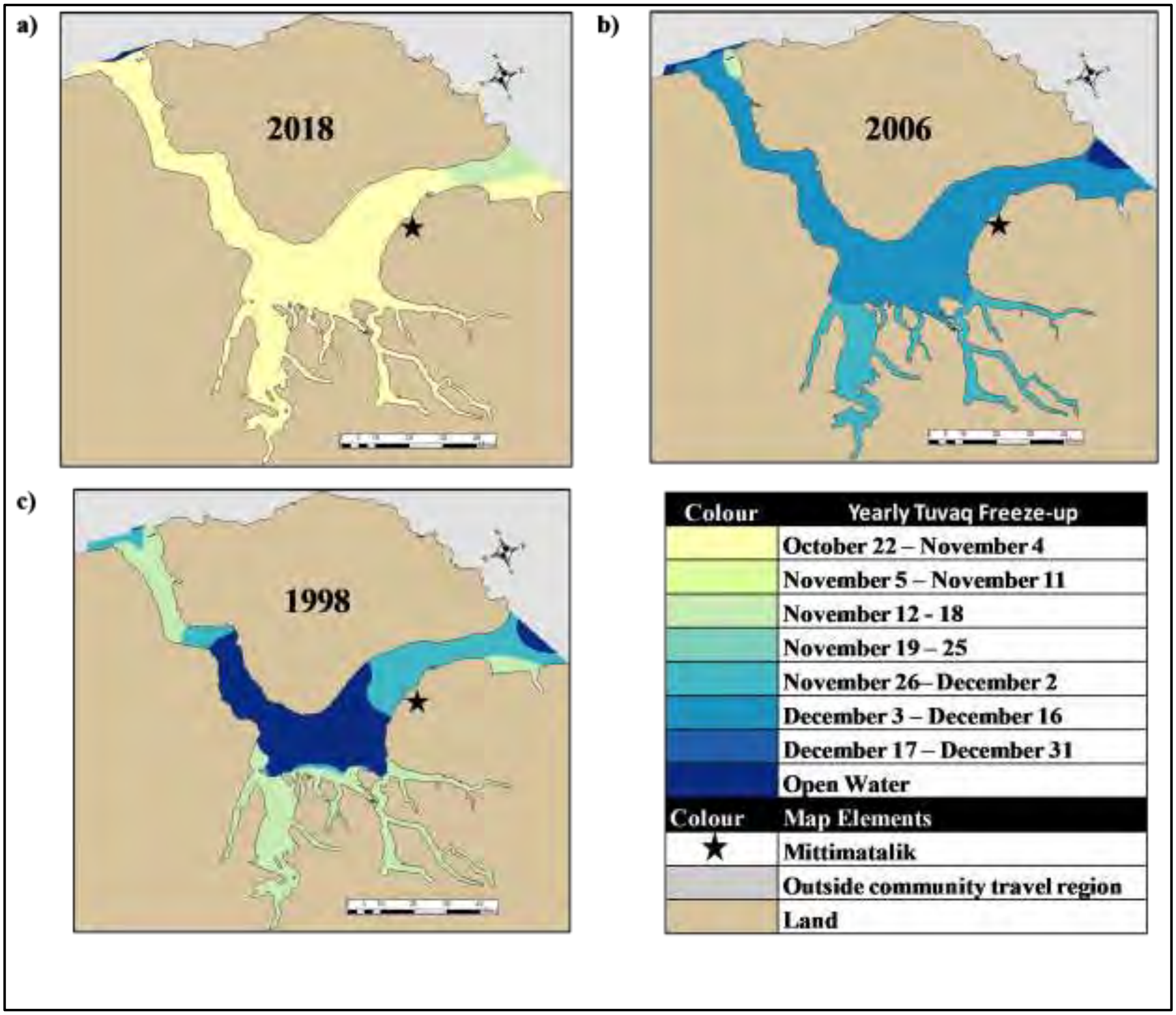


Figure 4.8 Yearly maps showing the spatial formation of tuvaq for the Mittimatalik region. a) example from 2018 showing the weekly freeze-up spatial pattern during years when the tuvaq formation was unusually early. b) An example from 2006 showing of the weekly freeze-up spatial pattern during years when the tuvaq formation was unusually late. c) The one exception to the normal freeze-up pattern in 1998 when tuvaq formed last in Eclipse Sound.

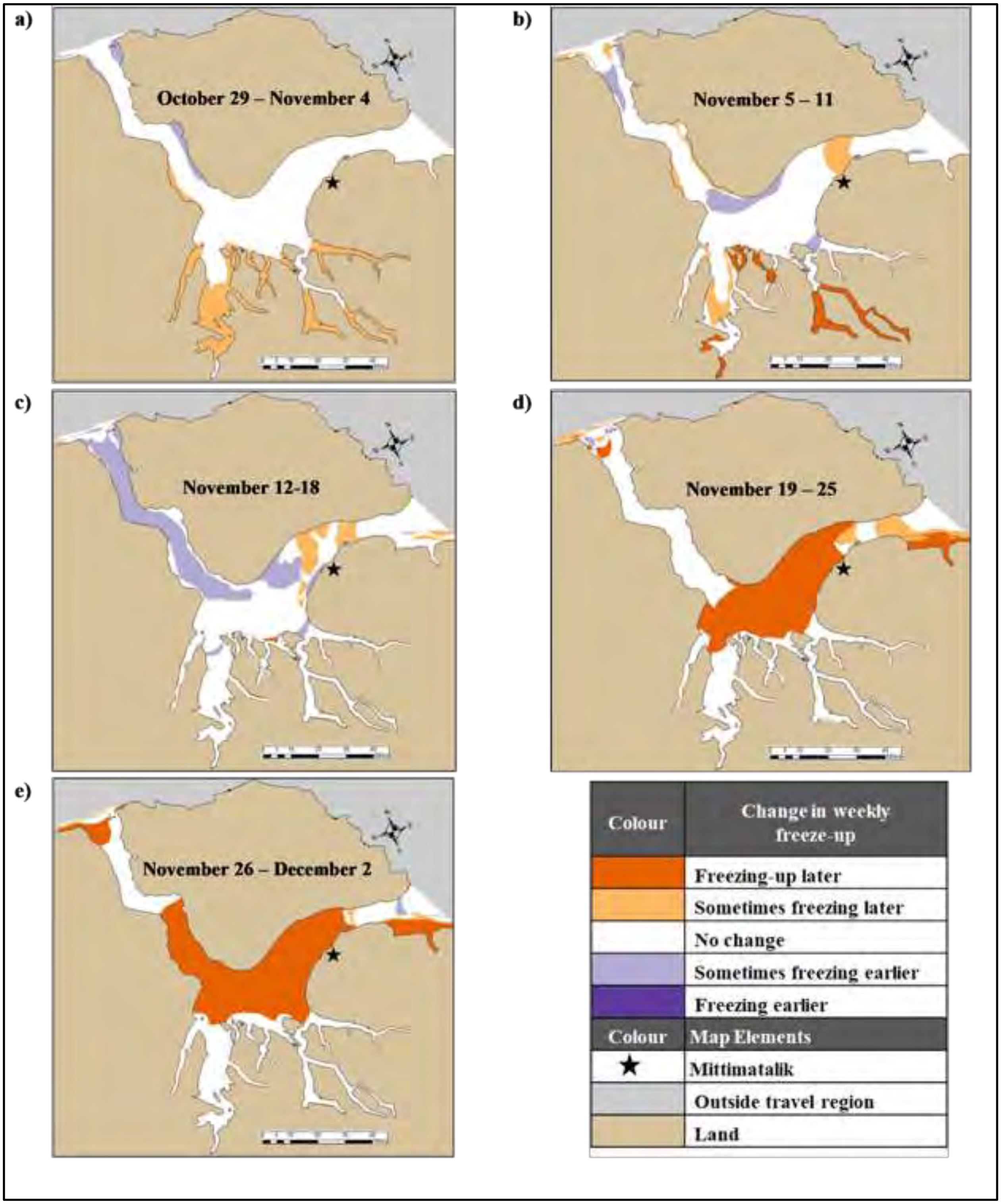


Figure 4.9 Weekly difference maps showing areas where tuvaq is forming earlier or later in the last 10 years (2010–2019). (a) Difference map, October 29 – November 4. (b) Difference map, November 5 – 11. (c) Difference map, November 12 – 18. (d) Difference map, November 19 – 25. (e) Difference map, November 26 – December 3.

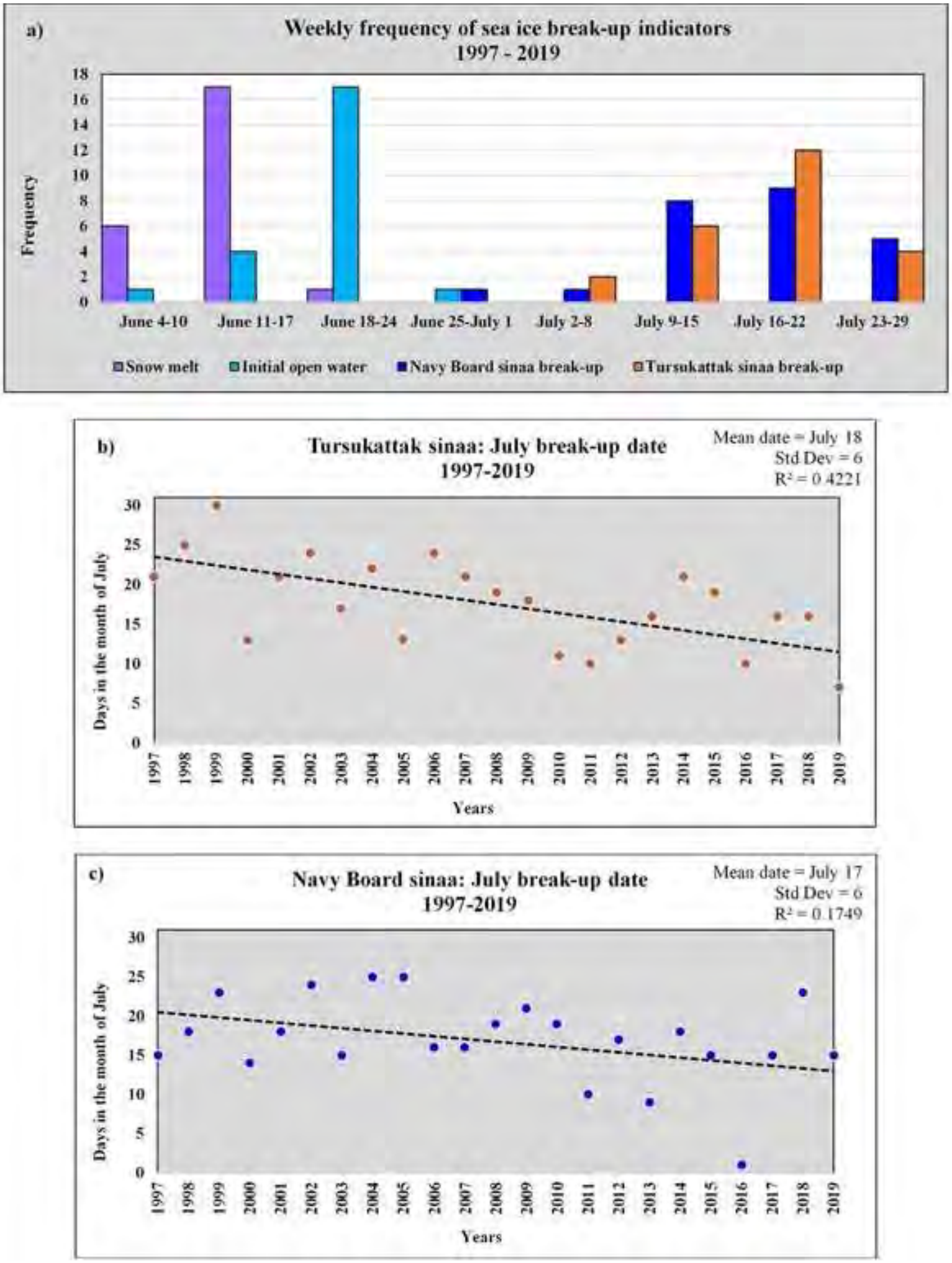


Figure 4.10 a) Frequency graph for indicators of break-up, 1997-2019. b) Graph showing the Tursukattak sinaa July break-up dates, 1997-2019. c) Graph showing the Navy Board sinaa July break-up dates, 1997-2019.

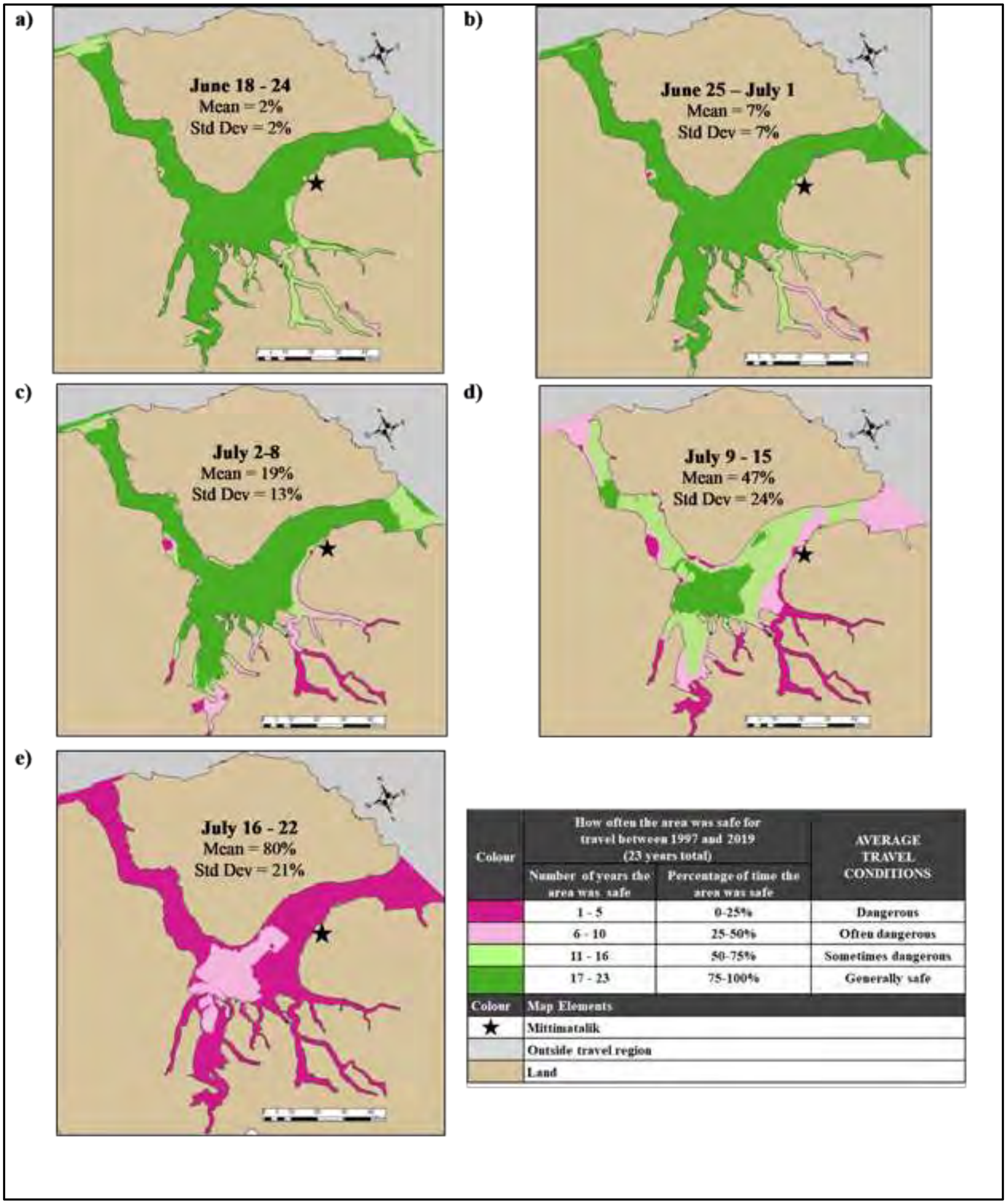


Figure 4.11 Maps showing weekly average break-up conditions June 18 to July 22, 1997–2019. (a) Average break-up, June 18–24. (b) Average break-up, June 25–July 1. (c) Average break-up, July 2–8. (d) Average break-up, July 9–15. (e) Average break-up, July 16–22.

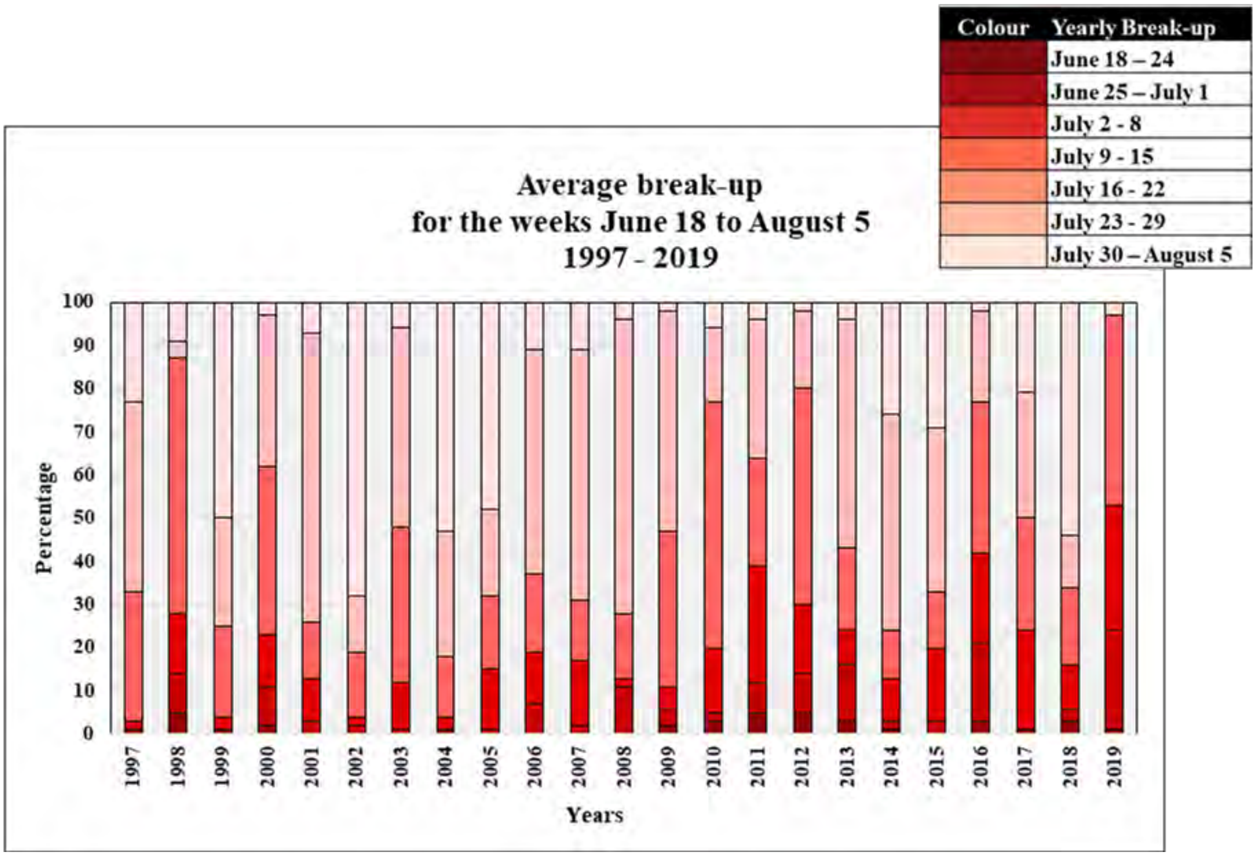


Figure 4.12 Summary of average break-up between June 18 to Aug 5, 1997-2019. Each bar is a year showing the weekly percentage of break-up by colour: dark red for late June; medium red for early July; and light red for the end of July. Years with darker red represent years that broke-up early. Years with more light red represent years that broke-up late.

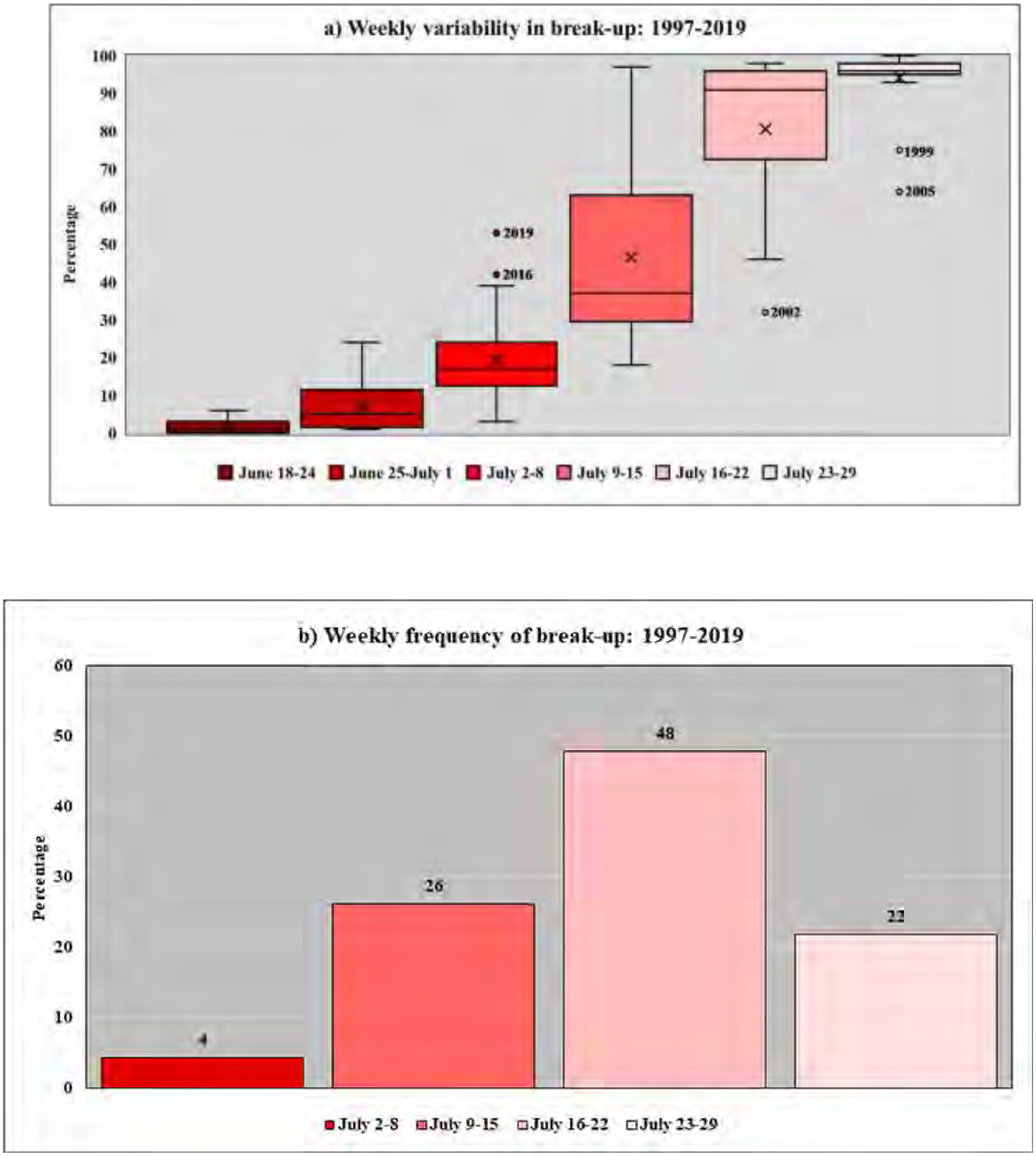


Figure 4.13 a) A summary of the weekly variability in break-up from 1997-2019. The box outlines the interquartile range, the average range in the variability of break-up for each week over the 23-year period (1997-2019). The line through the box is the median and the X denotes the mean. The vertical "whisker" lines show the minimum and maximum values. The dots correspond to outliers, or years with unusual break-up percentages. b) Weekly frequency of break-up, 1997-2019.

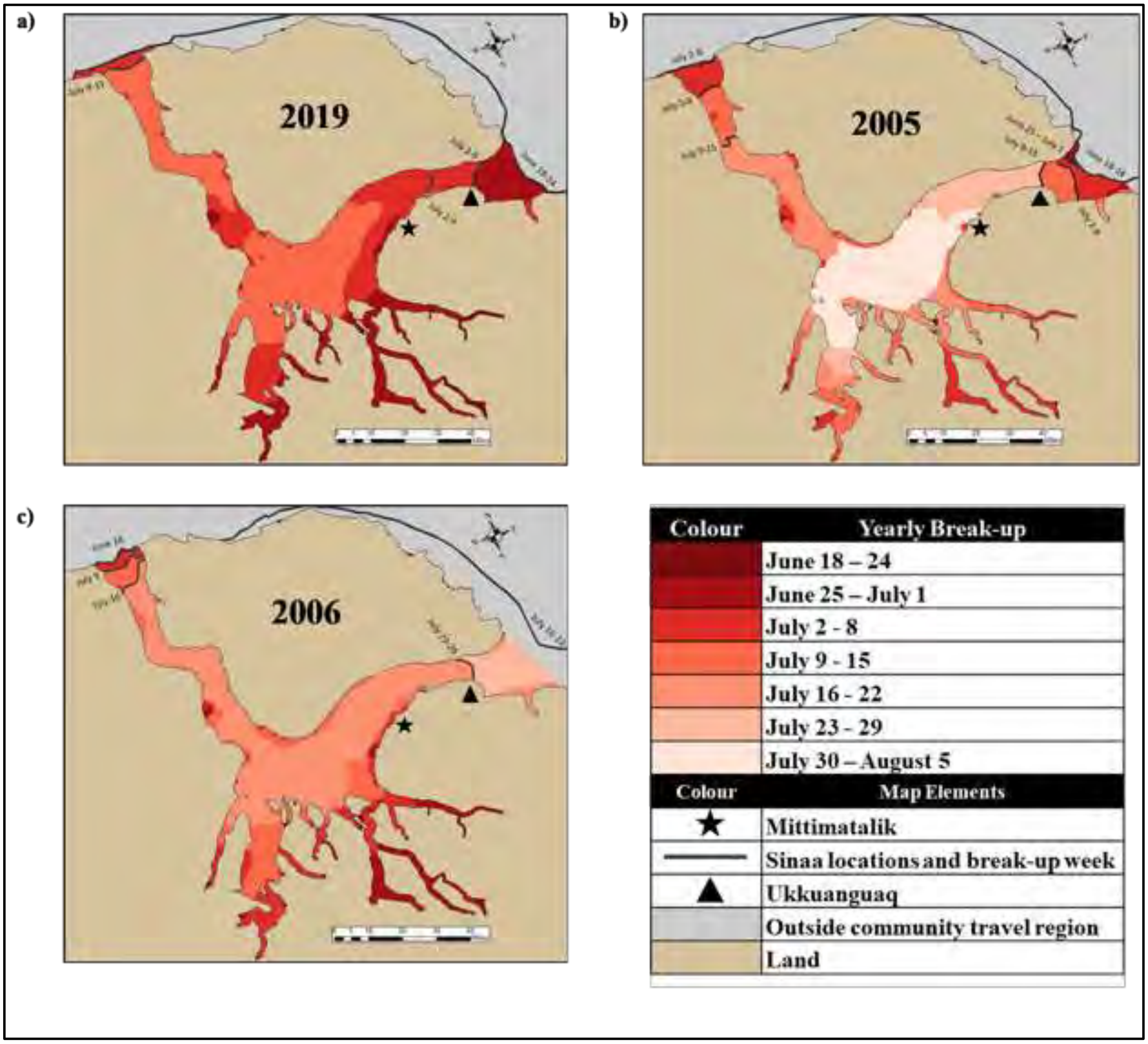


Figure 4.14 Yearly maps showing the spatial break-up of sea ice for the Mittimatalik region. a) Example from 2019 showing the weekly spatial pattern for an unusually early break-up. b) Example from 2005 showing the weekly spatial pattern for an unusually late break-up. c) Example from 2006 showing the weekly spatial pattern when the sea ice at the Tursukattak sinaa breaks last.

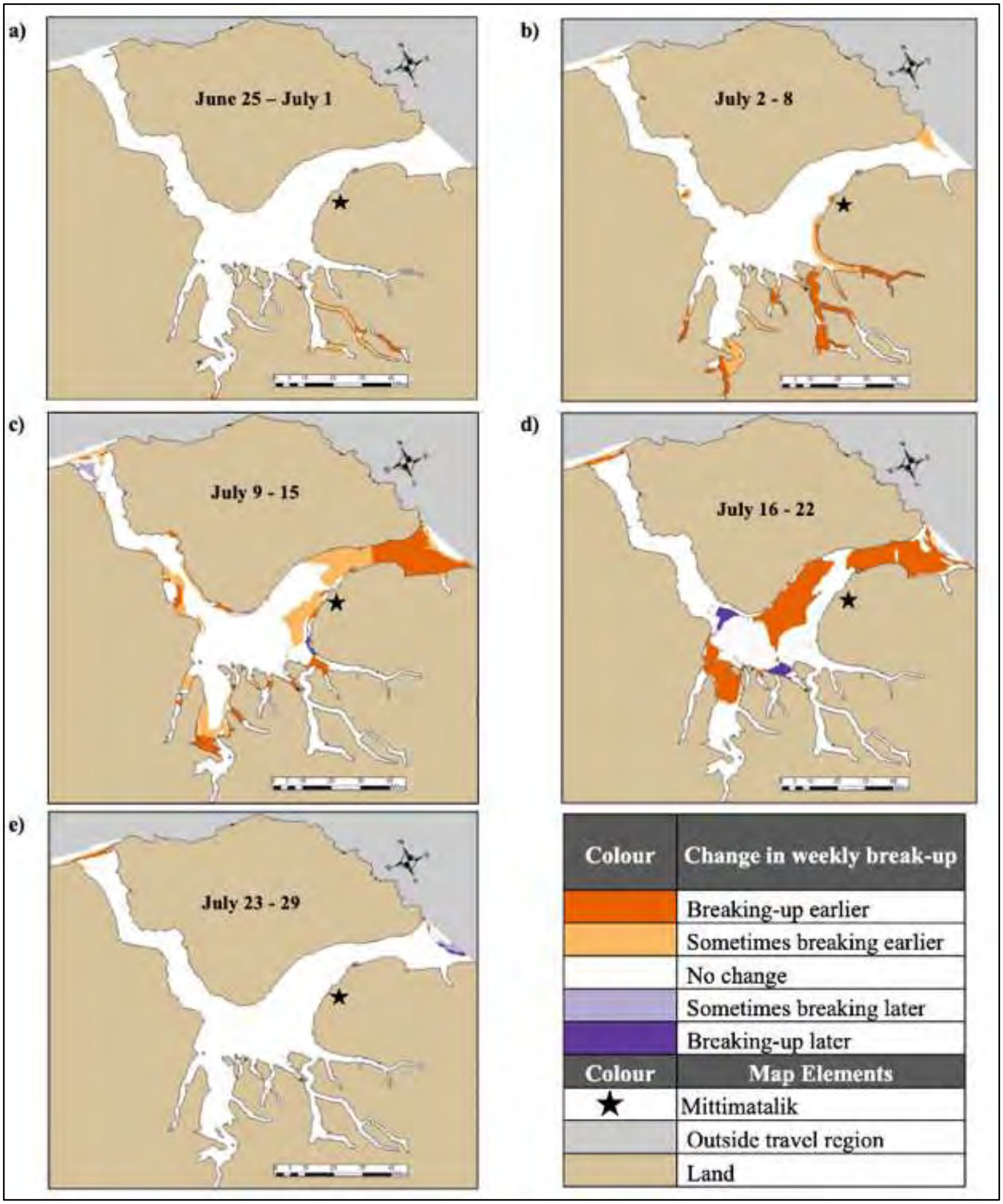


Figure 4.15 Weekly difference maps showing areas where break-up is occurring earlier or later in the last 10 years (2010–2019). (a) Difference map, June 25–July 1. (b) Difference map, July 2–8. (c) Difference map, July 9–15. (d) Difference map, July 16–22. (e) Difference map, July 23–29.

4.6.1 Freeze-up results

For the week of November 5-11, there is an average of 38% (std dev 35%) tuvaq in the region with initial areas of tuvaq forming in the southern inlets and sounds; however, the sea ice is not normally safe for community travel (Fig. 4.5a). By the weeks of November 12-18 and 19-25, tuvaq formation averages 58-71% (std dev 35-32%), both sinaangit are establishing in Navy Board and Tursukattak, and normally the sea ice is safe for Mittimatalingmiut to travel in the southern inlets and sounds (Fig. 4.5b, c). While the sea ice in Navy Board Inlet is generally safe for travel on by November 19-25, it is normally inaccessible until the formation of tuvaq in Tasiujaq. On average, tuvaq increases to 80% (std dev 27%) during the week of November 26-December 3 and Mittimatalingmiut are normally able to travel from the community west into Tasiujaq (Fig. 4.5d). By the week of December 24-30, the region averages 97% (std dev 4%) tuvaq and Mittimatalingmiut are normally travelling to the Tursukattak sinaa (Fig. 4.5e).

While freeze-up may be occurring later in other areas of the Arctic, we found no significant trends in the weekly formation of tuvaq between 1997 and 2019. These negligible trends are a result of the high variability in the formation of tuvaq during freeze-up between 1997 and 2019 (Fig. 4.6). However, this variability is high only for particular weeks during freeze-up. The initial freeze-up week of October 29 – November 4 shows moderate variability, with an inter-quartile range (IQR) of 21% (Fig. 4.7a). The outliers correspond to the years of 2002 and 2018 that had unusually high percentages of tuvaq early in the ice season (80 and 92% respectively; see Fig. 4.8a for the 2018 map). The subsequent three weeks show the largest variability in tuvaq formation: November 5-11 with an IQR of 70%; November 12-18 with an IQR of 58%; and November 19-25 with an IQR of 47%. Later into the freeze-up season, this variability decreases significantly with an IQR of 4-7% for the weeks of November 26 – December 2, December 3-16, and December 17-20. The week of November 26 – December 2 had five outlier years corresponding to 1998, 2000, 2005, 2006, and 2010, in which tuvaq formation was unusually late. The 2005 freeze-up season had only 1% tuvaq by this week and the 2006 season had the second lowest percentage of tuvaq at 25% (see Fig. 4.8b for the 2006 map).

A visual analysis of the yearly tuvaq freeze-up maps showed no spatial differences in where the tuvaq and sinaangit formed initially, or their subsequent expansion in early, average, or late freeze-up years. While there is large variability for when the sea ice freezes, the spatial patterns for progressive expansion of tuvaq and sinaangit were highly consistent throughout the climatology. The weekly average maps (Fig. 4.5) capture this consistent spatial pattern of freeze-up for all years except 1998 when tuvaq formed last in Tasiujaq (Fig 4.8c for 1998 map).

To understand which weeks were critical for tuvaq formation during freeze-up, those with the highest percentages of tuvaq formation were tabulated for each year from 1997 to 2019 (Fig. 4.7b). The weeks with the highest frequency of tuvaq formation were November 5-11 (27%) and November 12-18 (32%). Together, these two weeks comprise on average 59% of the annual formation of tuvaq and highlight the importance of this freeze-up period in early November.

The weekly difference maps show the spatial change in tuvaq within the last 10 years (Fig. 4.9). The week of November 5-11 shows that tuvaq is forming earlier in some of the southern inlets and sounds (Fig. 4.9a). The weeks of November 19 – December 2 show that tuvaq has been freezing up earlier in Tasiujaq and into Navy Board Inlet (Figs. 4.9d, e). These results are counter intuitive to our expectations. Because we are mapping immobile tuvaq, this earlier freeze-up cannot be due to an increase of imported ice. Sikumiut were also perplexed to see freeze-up happening earlier in certain areas and during certain weeks, as this does not align with their IQ. It would be interesting to have Inuit map the freeze-up of sea ice in real-time to compare with the CIS charts to understand if there are differences in how Inuit and the CIS would interpret tuvaq freeze-up.

4.6.2 Break-up results

The start of the break-up season begins with snowmelt on land. Snowmelt increases local river runoff, flooding and melting the sea ice at the mouths of rivers. The onset of snowmelt was detectable in the MODIS imagery in 17 of 23 years (74%) for the week of June 11-17 (Fig. 4.10a). By the following week of June 18-24, areas of open water became visible in the satellite imagery in the southeast inlets and mouths of local rivers, as was captured in the average break-up maps (Fig. 4.11a). Typically, the sea ice is still safe for travel during the week of June 25 – July 1 with an average of only 7% (std dev 7%) of the area breaking-up (Fig. 4.11b). By July 2-8, the area is averaging 19% (std dev 13%) break-up. Areas that are no longer safe for sea ice travel are expanding in the south and southeast sounds and inlets, and along the coastlines. Travel to both sinaangit are less safe (Fig. 4.11c). The week of July 9-15 shows how quickly the break-up season advances (Fig. 4.11d). While the region on average is 47% (std dev 24%) broken-up, break-up around the community is advanced, and Mittimatalingmiut are no longer able to access safe areas for sea ice travel from the community. By July 16-22 the area averages

80% (std dev 21%) break-up (Fig. 4.11e) and the Tursukattak and Navy Board sinaangit normally break-up this week (Fig. 4.10b, c). On average, by the week of July 23-29 the area is 94% (std dev 8%) broken-up (not shown), and Mittimatalingmiut are waiting for the remaining ice to melt, or be exported by winds and ocean currents, to begin hunting and fishing by boat.

Only the week of July 2-8 showed a trend towards earlier break-up in Mittimatalik region with an R^2=0.34 (p value <0.5). There is also a high amount of variability in sea ice break-up, and earlier break-up has become more frequent in the last 10 years (Fig. 4.12). The variability in weekly break-up was not as large compared to freeze-up (Fig. 4.13a). For the first three weeks of break-up, variability is minimal: June 18-24 has an IQR of 3%; June 25-July 2 an IQR of 10%; and July 2-8 an IQR of 12%. The outliers for the week of July 2-8 correspond to the 2016 and 2019 seasons that broke up unusually early. The 2019 season had the earliest break-up on record with 97% of the region broken-up by July 9-15 (see Fig. 4.14a for 2019 map). At the mid-point of break-up, variability increases with the weeks of July 9-15 and July 16-22 having IQRs of 34% and 24%, respectively (Fig. 4.13a). The outlier for the week of July 16-22 corresponds to the 2002 season, with only 32% of the sea ice broken-up this week. The final week of break-up, July 23-29, had minimal variability with an IQR of 3%. The outliers for the week of July 23-29 correspond to the years of 1999 and 2005. The year of 2005 had the latest break-up in our record with only 64% of the sea ice broken-up this week (see Fig. 4.14b for 2005 map).

The Navy Board sinaa has been breaking up earlier in the last 10 years. For example, 2011, 2013 and 2016 represent the earliest break up years in our 23-year record (Fig. 4.10c). The trend for the Navy Board sinaa had an R^2 = 0.18 (p value <0.05) (Fig. 4.10c). When compared to the two earliest tuvaq break-up years of 2016 and 2019, the Navy Board sinaa responded in 2016 with the earliest break-up date in our record (July 01). However, for 2019, the Navy Board sinaa break-up date was near normal around July 15th. Sikumiut have also discussed that the Tursukattak sinaa is not as stable as it has been in the past. The Tursukattak sinaa shows a moderate trend for earlier break-up in July with an $R^2 = 0.42$ (p value <0.05) (Fig. 4.10b). The Tursukattak sinaa broke-up early in the anomalous years of 2016 and 2019. In 2016, it broke around July 10 and in 2019 around July 7, the earliest break-up date for this sinaa in the record.

The sinaangit can fracture and sections of tuvaq can break off to form a new sinaa during the break-up season (Fig. 4.14). The yearly maps were analysed to understand if the Tursukattak sinaa fractures and retreats to any consistent locations during break-up. The Tursukattak sinaa fractured to a variety of locations; however, in 17 out of 23 years (74% of the time), it did fracture to a location called Ukkuanguaq (Fig. 4.14). Additionally, in 16 out of these 17 years, Ukkuanguaq is the last location of the Tursukattak sinaa before the tuvaq completely breaks-up.

The outlier break-up years from Figure 4.13a were visually analysed for any differences in spatial patterns for where and when the sea ice broke-up. The patterns were consistent with the seasonal spatial evolution of the average break-up maps in Figure 4.11. However, Arreak explained that in some years, the sea ice in front of the community can break-up earlier than at the Tursukattak sinaa. To continue to hunt and fish as long as possible, Mittimatalingmiut will travel overland to access the sea ice just past Igarjuaq (Mount Herodier; Fig. 4.1). The average break-up maps did not capture this pattern, so we again visually reviewed the individual yearly maps. This type of break-up pattern occurred 11 out of 23 years, just less than half of the time

(48%) in the years of 1998, 1999, 2000, 2003, 2006, 2007, 2009, 2011, 2015, 2018, and 2019 (see Fig. 4.14c for 2006 map). This pattern of break-up was random and there was no increase in the frequency of this pattern of break-up in the last 10 years. Finally, we examined whether the spatial and temporal patterns of sea ice freeze-up in the fall influences sea ice break-up patterns in late spring, but no obvious patterns were detected.

To understand the critical periods for sea ice break-up, the weeks with the highest percentages of break-up were extracted for each year from 1997 to 2019. Figure 4.13b shows that a majority of break-up is distributed over a three-week period from July 9 to 29. The week with the highest average percentages of break-up was July 16-22, in which almost half of the annual break-up occurs (48%).

The weekly difference maps show spatially where sea ice break-up is changing the most in the last 10 years of the climatology (2010-2019; Fig. 4.15). The June 25-July 1 and July 2-8 difference maps show that the sea ice is breaking up earlier in: the sounds and inlets; at river mouths; in front of Mittimatalik; and at the northern tip of the Tursukattak sinaa (Figs. 4.15a, b). The July 9-15 and July 16-22 difference maps show greater break-up in Milne Inlet and Tursukattak (Figs. 4.15c, d). The July 16-22 difference map also shows a greater amount of break-up occurring this week in Milne Inlet and Tasiujaq. The July 23-29 difference map shows no spatial changes in sea ice break-up during the last 10 years (Fig. 4.15 e).

4.7 Discussion

The Mittimatalik siku asijjipallianinga not only documents trends, spatial patterns, and locations of sea ice change in the Mittimatalik region, but it also addresses community-identified questions from an Inuit point of view, and at spatial and temporal scales that assessments such as the IPCC SROCC currently cannot address. Our discussion first looks at the benefits of this IQ-based based climatology and its application for community and regional sea ice travel safety. We then discuss the value of this IQ-based sea ice climatologies to meet their Mittimatalingmiut environmental assessment needs.

4.7.1 IQ-based research for community adaptation needs

It is important to note that this research is not an example of integrating or incorporating IQ into western science. These approaches tend to select IQ that fits or validates western research questions (Bravo, 2009; Bohensky and Maru, 2011; ITK, 2016; McGrath, 2018). In this IQ-based sea ice climatology, we turned typical research approaches inside out by utilizing western science data sources to apply IQ to Inuit research questions (Bell, 2016). In this project, the satellite imagery and CIS charts were used to apply Sikumiut's IQ to the reconstruction of a 23-year ice climatology at seasonal to weekly scales. Additionally, IQ determined the approach to the analysis, filled gaps in the analysis and in the interpretation of the results to answer Mittimatalingmiut sea ice adaptation needs.

Arreak's teachings and travel experience allowed him to interpret the sea ice break-up in the satellite imagery based on his IQ and from an Inuit travel safety perspective. He was able to identify in the satellite imagery early signs of melt and aajurait in the satellite imagery that would have remained undetected without this context specific IQ and on-ice experience. Arreak digitized the locations of hundreds of aajurait over the 23 break-up seasons. In our GIS analysis, we were unable to find any spatial or temporal patterns for where and when, or if specific aajurait were key locations for break-up. However, in the IQ workshops Sikumiut mapped the main locations of the re-occurring aajurait without hesitation (Figs. 4.2a; 4.3a, b). Additionally, Sikumiut already knew of the significance of the Ukkuanguaq aajuraq, but being able to quantify that the Tursukattak sinaa fractures and retreats to this location 74% of the time supports community sea ice adaptation needs. For example, talks are already underway to position time-lapse cameras and other monitoring equipment at this location to provide Mittimatalingmiut advance notice of break-up (Bell et al., 2020).

Arreak also pointed out that the average and difference break-up maps did not capture the years when the sea ice in front of the community breaks-up earlier than at the Tursukattak sinaa. This is an important break-up pattern that occurred 11 out of 23 years, 48% of the time (Fig. 4.14c). Without Arreak's IQ, this break-up pattern would have been missed if we relied solely on statistical and GIS analyses. When you factor in that the sea ice is breaking up earlier (Fig. 4.15) with the fact the sea ice in front of the community breaks-up first 48% of the time, access to the Tursukattak sinaa is becoming extremely difficult in late June and early July. Within the community, there have been suggestions to build a road to Igarjuaq as an adaptation strategy to maintain consistent access to the Tursukattak sinaa (Fig. 4.1).

Sikumiut validated the average weekly break-up maps to ensure that the maps aligned with their IQ (Figure 4.2b). The benefit of the weekly average and difference maps are that they document and mobilize Sikumiut's knowledge from a seasonal to a weekly scale and highlight areas that have become more dangerous for sea ice travel. During break-up, these weekly maps can support travel planning. For example, by the week of June 25 – July 1, Mittimatalingmiut need to be cautious when travelling in Tay Sound because on average, the sea ice is sometimes dangerous (Fig. 4.11b). By the week of July 2-8 travel in Tay Sound is frequently dangerous (Fig. 4.11c) but based on the increase in break-up in the last 10 years, this area sometimes breaks-up early and should be avoided (Fig. 4.15b).

When you view the Sikumiut seasonal sea ice IQ spring travel map (Fig. 4.3b) compared with the weekly average break-up maps (Fig. 4.11), you will notice striking similarities in the dangerous travel areas. However, the Sikumiut map shows additional hazardous sea ice areas along the southeast shore of *Sirmilik* (Bylot Island; Fig. 4.1), around the Tursukattak sinaa, and the main aajurait locations not captured in the weekly average maps. To fill these gaps, the final version of the weekly average maps will overlay Sikumiut's additional IQ of aajurait and hazardous travel area locations.

The Sikumiut seasonal sea ice IQ winter travel map shows travel conditions once the sea ice has become tuvaq, in other words when it is generally safe for travel (Fig. 4.3a). Early winter sea ice travel requires extreme caution and Sikumiut recommends that only the most knowledgeable and experienced hunters break initial snowmobile trails. Sikumiut would not historically have the bird's eye perspective of the region provided by the satellite data to monitor tuvaq formation. Sikumiut's freeze-up IQ is based on experiences passed down through generations on where it is normally safe to access the sea ice from the land in early winter. For example, Sikumiut members know that on average the first areas of tuvaq formation are in the southern inlets and sounds (Fig. 4.5b). However, the weekly average tuvaq maps for freeze-up, based on the CIS ice charts, show the formation of tuvaq in Navy Board inlet, normally inaccessible for Mittimatalingmiut until the ice is safe for travel in Tasiujaq. Sikumiut reviewed and validated these maps to support travel planning in late freeze-up. For example, the November 12-18 map shows that the sea ice is normally not safe for travel anywhere near the community this week (Fig. 4.5c). By the week of November 26-December 2 it is normally safe to travel on the sea ice from the community into Tasiujaq, but it is normally still not safe for sea ice travel in Tursukattak until the end of December (Fig. 4.5e). Once more the Sikumiut winter seasonal map provides additional detail, such as naggutiit, ivujuk, and siku saattuq aragulimaamik not in the weekly freeze-up maps. To fill these gaps, the final versions of the weekly maps will overlay the locations of these Sikumiut features to enhance the sea ice travel safety information for freeze-up.

In Canada's north, search and rescue operations are a complement of multi-jurisdictional partners. In Nunavut communities, local volunteers in Mittimatalik are often the first responders. Nunavut Emergency Management (NEM) coordinates at the Territorial scale. Based on the severity and type of the incident, NEM can request support from the following Federal agencies: Department of National Defense (air); Royal Canadian Mounted Police (land); and Canadian Coast Guard (sea). The Mittimatalik siku asijjipallianinga can also support the safety and situational awareness of regional and national search and rescue partners that would have a limited knowledge of the area and local sea ice conditions. For example, hazardous sea ice areas and areas of shelter to focus search and rescue efforts. The weekly average maps would support the effective, efficient, and proactive deployment of resources and assets (human or infrastructure based) based on known areas of high risk at a weekly scale. Additionally, community scale IQ-based sea ice climate maps would be beneficial for national ice services. The presence of melt ponds in the spring saturates the SAR imagery making it impossible to identify sea ice features. As well, spring storms with significant cloud cover can result in weeks without optical imagery. Ice services would benefit from such community scale climate atlases to help fill in satellite imagery gaps during the sea ice break-up season.

4.7.2 IQ-based research for environmental assessments

The normal open water season for shipping to the Mary River mine is from August 5 to October 15 (Bourbonnais et al., 2016). In 2020, BIM requested an extension to the shipping season from approximately July 15 to November 15, based on declining sea ice extent in the Arctic. An ice conditions shipping assessment report was submitted to the Nunavut Impact Review Board (NIRB) describing current shipping conditions to and from the mine (Bourbonnais et al., 2016). The ice conditions report highlights that climate change is resulting in sea ice freezing up later and breaking up earlier in the Canadian Arctic (Bourbonnais et al., 2016). The ice conditions report also outlined that the sea ice conditions in the region are highly variable, that climate change increases the risk of dangerous mobile old ice floes, and that ice-breaking support would be needed to ship during these shoulder seasons (Bourbonnais et al., 2016).

Responses to the proposed BIM lengthening of the shipping season have been sent from Sikumiut, the Mittimatalik Hunters and Trappers Organization (MTHO) and the Canadian Department of Fisheries and Oceans (DFO) to NIRB. All outline the importance of sea ice in the fall and late spring for wildlife reproduction and migration, and concerns regarding the impacts of noise from icebreaking on marine mammals (DFO, 2019; MTHO, 2021; Sikumiut, 2021). Sikumiut and the MTHO both outline the importance of sea ice for their culture and food security. They also emphasize that their concerns are based on IQ and that the environmental assessment process has not given IQ an equivalent voice when understanding the impacts of an extended shipping season on Mittimatalingmiut (MTHO, 2021; Sikumiut, 2021). Although NIRB outlines that their process is guided by IQ principles and that IQ has an important contribution to make to the review process (NIRB, 2021), it has been very difficult for oral knowledge to compete with technical reports and in evidence based decision-making processes (White, 2006; Healey and Tagak Sr., 2014; McGrath, 2018).

The Mittimatalik siku asijjipallianinga provides IQ-based evidence concerning the proposed extended shipping seasons and raises some interesting questions. For example, by the week of November 12-18, Milne inlet averages 75-100% tuvaq and by November 19-25, there is 50-75% tuvaq in northern Tasiujaq, which would require a considerable amount of icebreaking to ship through (Figs. 4.5b, c). Figure 4.7a also shows that a majority of tuvaq formation (56%) occurs in the first two weeks of November. Shipping during this critical period could compromise the formation of tuvaq and the Tursukattak sinaa, consequently affecting winter sea ice travel and wildlife. It is interesting to note that both the ice conditions report (Bourbonnais et al., 2016) and the siku asijjipallianinga used the CIS charts to review freeze-up conditions. However, the shipping report interpreted the data from a safe shipping perspective and the siku asijjipallianinga from a safe sea ice travel and wildlife perspective. While the shipping report notes that there is an expectation that the sea ice extent in Mittimatalik is declining due to climate change, we found no trend towards later freeze-up, and that in the last 10 years tuvaq freeze-up could be occurring earlier in some areas. The Milne Inlet port shows signs of earlier tuvaq freeze-up during the week of November 5-11 (Fig. 4.5b), which could have implications for the feasibility of extended shipping at the port. Due to the high variability of freeze-up conditions (Fig. 4.7a), it is impossible to pre-determine a specific week to cease shipping for the season. Sikumiut have recommended that the end of the shipping season be assessed on a year-by-year basis, according to the sea ice conditions at the time (Sikumiut, 2021).

The Mittimatalik siku asijjipallianinga also evaluated the potential impacts to sea ice travel based on the proposal to start shipping earlier around July 15. On average, by the week of July 16-22, the Mittimatalik region is 80% broken up (Fig. 4.11e) and normally the Navy Board and Tursukattak sinaangit break-up this week (Figs. 4.10b, c). Also, for this week there is a trend towards an earlier break-up of the Tursukattak sinaa (R^2=0.42), and along the shipping route to Milne Inlet in the last 10 years (Fig. 4.15d). However, the break-up conditions are variable (Fig. 4.13a). For example, even in the two most recent years in the record, Mittimatalingmiut experienced both an early (2019, 97% break-up by July 9-15) and late (2018, 95% break-up by July 23-29) break-up (Fig. 4.11). Shipping earlier into the first two weeks of July would compromise community sea ice access to the Tursukattak sinaa in years when they are experiencing a late break-up. A follow-up letter from Sikumiut to NIRB is being sent to highlight this IQ-based evidence from the Mittimatalik siku asijjipallianinga in preparation for the next round of hearings.

4.8 Conclusion

Mittimatalik is just one out of 48 coastal communities in Inuit Nunangat that need answers to their climate change questions. International assessments such as the IPCC SROCC cannot address community-scale issues based on the current global scale of the models and methodologies used. The community of Mittimatalik is already dealing with the impacts of climate change influencing sea ice conditions, compounded by the pressure to increase shipping into the margins of the sea ice travel season. A deep climatological history of sea ice continues to thrive in IQ, but for many Inuit communities, it has yet to be documented. In the Mittimatalik siku asijjipallianinga, IQ was the foundation upon which their sea ice climatology was built. While satellite imagery, CIS ice charts and other western methods were used to document and mobilize this knowledge from a seasonal to weekly time scale, IQ was the ultimate scientific authority in this project. This ensured that the data were analysed from an Inuit travel safety perspective, and according to an intimate knowledge of the local environmental conditions. As a result, this IQ-based research was able identify greater detail in the supporting data, fill gaps in the data, and provide direction on how interpret the data to reveal patterns that western-based research methods could not capture.

This atlas provides an adaptation tool that Mittimatalingmiut can use for safe sea ice travel planning, for monitoring specific sea ice indicators during break-up, and in planning alternative land routes in late spring to maintain access to the Tursukattak sinaa. These maps can also support the safety and situational awareness at regional scales for search and rescue partners that would have limited knowledge of local sea ice conditions. This project provides a practical example for how to develop an IQ-based sea ice climatology, and how this research approach can serve local Inuit community needs and beyond at regional scales. There would be a great benefit in expanding this work to other Inuit communities to support local safe sea ice travel and emergency management programs and practices across the Canada North. This atlas also has great value to the larger scientific community as climate change does not affect all areas of the Arctic equally.

The Mittimatalik siku asijjipallianinga demonstrates the scientific merit of IQ and its value in environmental assessments. The IQ-based evidence from the atlas shows that extending the shipping season into the first two weeks of November and the first two weeks of July will compromise the integrity of the sea ice for safe travel, and wildlife migration and reproduction. If shipping is extended into the freeze-up and break-up seasons to support mining activities, Mittimatalingmiut now have a baseline of their local sea ice conditions with which to compare and provide evidence for any future cumulative effects.

This co-produced research is also an example of the time required to meaningfully engage and work with Indigenous knowledge holders, whether its for environmental or scientific assessments like the IPCC SROCC. It required an investment of over four years in which Inuit were involved in the discussions from the very beginning and throughout the research, not just during a couple of workshops. By co-producing the research together and agreeing from the beginning on how to collect, analyse and interpret the information, different knowledge systems can work together to address community-scale issues missing in IPCC SROCC reports.

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Chapter 5

Review, reflections, and recommendations

The goal of this PhD research was to co-develop a cross-cultural decolonizing research approach to advance Inuit self-determination in research, and to put this approach into practice to meet Sikumiut's research needs. To achieve this goal, the following five individual, Sikumiut and overlapping research objectives were addressed and described in the chapters of this thesis:

1. My overarching and individual objective was to understand and redefine my role as a non-Indigenous researcher towards decolonizing myself and my research (all chapters).
2. Sikumiut wanted to document their sea ice travel knowledge and practices (sea ice IQ), and to mobilize this IQ to educate young and inexperienced ice users (Chapter 3).
3. Sikumiut also wanted to develop a baseline of the Mittimatalik sea ice conditions to adapt, maintain, and assess the impacts of change on local sea ice travel (Chapter 4).
4. Together, we co-developed a research approach called the Sikumiut model to address Sikumiut research needs (Chapter 2).
5. We then put this approach into practice to address Sikumiut's research (Chapters 3 and 4).

This research has resulted in the co-development of the Sikumiut model. In this model, we reconceptualized typical research roles with Sikumiut governing the research, non-Indigenous research partners training and mentoring Inuit youth to conduct the research, and Inuit youth learning valuable skills from all partners.

This thesis explored the benefits of Inuit leading and conducting research, and describes the methods used to document and mobilize sea ice IQ into a terminology booklet, three sea ice travel maps and two safety posters. The continued relevance of Inuktitut and IQ to communicate, plan and interpret sea ice conditions were also discussed. The creation of the Mittimatalik siku asijjipallianinga (sea ice change atlas) involved the interpretation of satellite imagery and sea ice charts using Sikumiut's IQ to produce 68 maps and 22 graphs to review changes in safe sea ice travel between 1997 and 2019. The atlas provides a critical travel adaptation tool and also demonstrates that shipping during critical periods of sea ice formation and break-up would compromise the integrity and duration of the sea ice travel season for Mittimatalingmiut.

Putting this model into practice not only involved documenting and mobilizing Sikumiut's sea ice IQ, it also built Inuit capacity in research and greater self-determination in community-driven research. While the research outcomes were successful in delivering products that benefit the community, there are many lessons learned in decolonizing research that I reflect on as I consider this six-year journey working with Sikumiut.

5.1 Reflections

Through my own experiences, and those that others share with me, I am continuously learning about the colonial experience of Inuit. In taking the responsibility to change, understanding the evolution of Western research – and how I was trained in it – was a major turning point in decolonizing myself (Chapter 1). Reading the literature and learning about the differences between Western and Indigenous research approaches allowed me to start the process of decolonizing my own research, to be conscious and reflexive about why I think the way I do, and why I make certain choices. Taking this reflexivity into the work with Sikumiut, and taking the time to build research relationships was, and continues to be, a conscious effort to decolonize myself and my role in research. As I reflect on the accomplishments of this research, there are six important insights that stand out from the experiences of working with Sikumiut:

1. You need to begin decolonizing the individual before you can start decolonizing your research
2. IQ is a climate change adaptation tool
3. Inuit knowledge in research requires Inuit governance of their knowledge
4. Co-production of research needs co-evaluation of research
5. Control over research comes with control of research funding
6. Inuit research capacity building needs accreditation

5.1.1 Decolonizing the individual before decolonizing the research

Since 2018, new Inuit and Iñupiat research methodologies have been emerging. The Aajiqatigiingniq Research Methodology, developed by the Aqqiumavvik Society (2020a) in Arviat, Nunavut, requires building meaningful community relations, developing shared understandings of contexts, applying lived experiences, and validating emerging ideas to achieve a consensus. As well, the ScIQ concept was developed by Ikaarvik Inuit youth from four different communities in Nunavut (Pedersen et al., 2020). ScIQ outlines 45 specific recommendations for researchers throughout the research process to ensure meaningful engagement with Inuit and Inuit knowledge holders. An Iñupiaq specific methodology based on the Iñupiat Ilitqusiat (Iñupiaq values) and Katimarugut (We Are Meeting) documents the ways that Iñupiat have gathered, conducted, and presented research in a holistic way (Topkok, 2015). In addition, more of these Inuit-specific models are now being put into practice, for example:

- the Aajiqatigiingniq Research Methodology (Aqqiumavvik, 2020a) has been used in community-based health research (Ferrazzi et al., 2019);
- Uvvatuq Naluallangniaqtugut (I Humbly Hope We Run Into Game), utilizes the Iñupiat Ilitqusiat towards developing and an Iñupiaq research process (Topkok, 2021);
- the Qaggiq model (McGrath, 2018) has been used for community-based caribou research (Ljubicic et al., 2021); and,
- the Kitchen Consultation Model (Price, 2007) was used to gather community perspectives on the roles and contributions of Inuit youth in environmental research in Nunavut (Sadowsky et al., 2022).

I went back to the literature to review how decolonizing sea ice research in the Arctic with Inuit and Iñupiat had been evolving since 2018 (see section 1.5.4). On-line scientific journal databases were again queried using the same search criteria of "sea-ice" or “sea ice” or “ice”, and "Inuit" or “Iñupiat" between the years of 2018 and 2022. The initial search resulted in 22 published articles. Upon further reading, articles that were not community-based or about sea ice were removed, as well as literature reviews and book chapters that were not open access. I reviewed and analyzed 16 published articles between the years 2018 and 2022, covering a similar range of sea ice topics as in section 1.5.4, including: i) Inuit sea ice IQ and use; ii) observations of climate change impacts on sea ice; iii) risk, vulnerability, and adaptive capacity; iv) impacts on health; v) risks and impacts related to shipping; and vi) adaptation tools.

Table 5.1: Review of literature on sea ice research with Inuit and Iñupiat (2018 to 2022)
* Articles were often assigned to multiple categories.

<table>
<tr><th colspan="2">General Categories</th><th>References</th></tr>
<tr><td colspan="2">Inuit sea ice IQ and use</td><td>Panikkar et al., 2018; Carter et al., 2019; Simonee et al., 2021; Wilson et al., 2021b; Bishop et al., 2022</td></tr>
<tr><td colspan="2">Climate change sea ice observations</td><td>Ford et al., 2019; Fox et al., 2020; Sansoulet et al., 2020; Bishop et al., 2022</td></tr>
<tr><td colspan="2">Risk, vulnerability and adaptive capacity from climate and socio-economic factors</td><td>Christie et al., 2018; Fawcett et al., 2018; Panikkar et al., 2018; Sansoulet et al., 2020</td></tr>
<tr><td colspan="2">Impacts on physical, mental, emotional, spiritual, social, and cultural health</td><td>Christie et al., 2018; Panikkar et al., 2018; Ford et al., 2019; Segal et al., 2020; Simonee et al., 2021; Bishop et al., 2022</td></tr>
<tr><td colspan="2">Risks and impacts with increased shipping</td><td>Panikkar et al., 2018; Carter et al., 2019; van Luijk et al., 2022</td></tr>
<tr><td rowspan="4">Adaptation tools</td><td>Community Based Monitoring</td><td>Dufour-Beauséjour et al., 2020; Fox et al., 2020</td></tr>
<tr><td>Satellite Imagery</td><td>Dufour-Beauséjour et al., 2020; Segal et al., 2020; Simonee et al., 2021</td></tr>
<tr><td>Weather products, forecasting</td><td>Panikkar et al., 2018; Fox et al., 2020; Simonee et al., 2021</td></tr>
<tr><td>IQ</td><td>Wilson et al., 2020, 2021a, 2021b; Simonee et al., 2021</td></tr>
</table>

To frame the review of the literature, I used the same decolonizing, Indigenous relational accountability principles, and cross-cultural aspects from Table 1.3. The literature was reviewed based on the same specific words and phrases from Table 1.3 to assess the roles of non-Indigenous researchers in decolonizing themselves and their research. I removed my 3 published papers (Wilson et al., 2020, 2021a, 2021b), and the Simonee et al., (2021) article, as this project was Inuit-led, for a total of 13 articles reviewed. The results in Table 5.2 provide counts and percentages of reviewed papers that discussed the topics listed for the periods 2018 to 2022 and 2002 to 2017 (in grey) for comparison.

Table 5.2: Assessing decolonization in the sea ice research literature (2018 to 2022)

	Decolonizing, Indigenous, and cross-cultural principles	**Key Words and/or Phrases**	**Percentage** 2002-2017 50 articles	**Count** out of 13 articles	**Percentage** 2018 – 2022 13 articles
1	Were established protocols for working with the community identified?				
	• Community protocols or values?	ethics protocols values	20%	7	58%
	• Research license?		30%	7	58%
	• Ethics review?		20%	7	58%
2	Did the articles discuss levels of community collaboration?				
	• Relevance of this research for community needs?	community needs relevance	80%	6	50%
	• Original research question came from the community, not the researcher?		26%	4	33%
	• The research was a partnership and/or was collaborative?	accountability co-authorship co-design collaborate consultation community-based data ownership giving back partners reciprocity relationships relationality respect responsibility stakeholders trust	54%	6	50%
	• Community input in the project design?		46%	4	33%
	• Community involvement in the analysis of the research results?		36%	0	0%
	• Community participation in reviewing/validating the research results?		52%	5	42%
	• Community participation in writing up the research results?		32%	4	33%
	• Community ownership and accessibility to the research data?		16%	3	25%
	• How the research results were shared, understood, useful and accessible by the community?		36%	5	42%
	• Community members employed in the research?	capacity co-production	54%	8	67%

	• Training/educating community members an aspect of this research?	decision-making education employment leadership mentor opportunities training	20%	1	8%
	• Community members play a leadership role in the research?		12%	2	17%
3	Which methodologies and methods were outlined in the articles?				
	• Western Methodologies	Ethnographic	10%	1	8%
		Integrated	10%	1	8%
		Reductionist		1	8%
		Structured decision analysis		1	8%
		Place based	8%	1	8%
		Vulnerability based	12%	2	17%
	• Decolonizing, alternative methodologies	Community-based participatory research (CBPR)	26%	3	25%
		Collaborative	18%	2	17%
		Co-produced	2%	2	17%
	• Acknowledge that these alternative methodologies are decolonizing	Decolonizing	0%	0	0%
	• Indigenous methodologies	Indigenous	0%	0	0%
	• Western Methods	Community based monitoring	22%	4	31%
		Focus groups	4%	2	17%
		Modelling		2	17%
		Participant observation	24%	1	8%
		Participatory mapping	14%	5	42%
		Semi-directed interviews	60%	10	83%
		Surveys	2%	1	8%
		Workshops, Public meetings	6%	6	50%

	• Indigenous methods	Experiential learning	20%	5	42%
		Story telling	4%	0	0%
	• Awareness that the purpose of the alternative methods is for decolonizing research?	Decolonizing	0%	0	0%
4	How did the papers discuss and describe Inuit knowledge?				
	• Discuss multiple realities, worldviews, or holistic approaches?	experience holistic knowledge local knowledge multiple realities mythical observational ontology oral philosophy spiritual traditional knowledge, traditional ecological world views	52%	4	33%
	• Accepting Inuit knowledge on its own merit		84%	9	75%
5	Was there an acknowledgement or understanding of colonialism and decolonizing and/or Indigenous approaches in the articles?				
	• Describing early explorers, the settlement of Inuit and great socio-economic change	alternative epistemology empower cultural colonialism decolonizing imperialism leadership power privilege self-determination reflexive vulnerable bias position statement	42%	4	33%
	• Awareness of the community's colonial past and current context (i.e., new mine, previous research history, and colonial history – residential schooling and relocations). • Acknowledging colonialism?		16%	5	42%
	• Researcher reflexivity and decolonizing self in making transparent their intentions and motivations?		2%	1	8%
	• Whether a power imbalance exists?		2%	0	0%
	• Empowerment or self-determination for the community?		6%	3	25%

Table derived from (Wilson, 2008; Kovach, 2009; Koster et al., 2012; Smith, 2012; Healey and Tagak Sr., 2014).

The sample size (13 articles) is relatively small and may not be considered large enough to extrapolate any significant trends. However, as this work is coming to an end, it was important to compare current collaborative sea ice research with that from the 2002-2017 literature review (section 1.5.4). The first section in Table 5.2 aims to understand how and if the non-Indigenous researchers were accounting for community protocols and values. We see an increase from 20% to 58% referencing consultation with specific community organizations and following protocols at the beginning and during the research project. We also see an increase from 30% to 58% and 20% to 58% in articles identifying the project's research license and ethics approval, respectively. The actual numbers for research licensing and ethics is expected to be much higher, as these are now fundamental requirements for working with Inuit in Canada, but not required to report in journal articles.

Section two looks at the level of community collaboration discussed in the papers. We see a reduction from 80% to 50% in the number of papers indicating that the research was relevant for community needs. The percentage of papers reporting that the research questions came from the communities, not the researcher, remained around the same at 23-33%. The percentage of articles discussing the research as a partnership and/or collaboration remained at 54-50%, while there was a slight decrease in those that provided details about community input in the project design (from 46% to 33%). There was a large decrease in the reporting of community involvement in the analysis of the results, from 36% to 0%. Community participation in the review and validation of results (52% and 42%) and in co-authorships of the articles (32% and 33%) were similar. There is an increase in research articles identifying community ownership of the research from 16% to 25%, and an increase from 36% to 42% in papers describing their efforts to share the research results and make them accessible to the community. The hiring of local research assistants, guides and translators increased from 54% to 67%, while the description of training and mentoring of local hires decreased from 20% to 8%. The level of community members involved in leadership or decision-making roles in the documented research increased from 12 to 17%, but overall remained relatively low. We can see that the papers in this generation of collaborative sea ice research did focus more on having Inuit in leadership and decision-making roles, in employing community members and ensuring the research results and data were accessible. However, it appears that a majority of the research questions still did not originate with the community, and few Inuit were provided training opportunities to be involved in the actual production of the research. Most of the research was conducted by non-Indigenous researchers with Inuit reviewing and validating the results.

Section three looks at the various methodologies and methods used in the research. Most papers in Table 5.2 discuss using more than one methodology. CBPR (25%) and collaborative (17%) approach percentages remained consistent. Co-produced approaches increased from 2% to 17% and the use of Indigenous research approaches remained at 0%. The use of multiple and mixed methods such as semi-directed interviews (83%), workshops (50%), participatory mapping (42%), and community-based monitoring (31%) to capture community input all increased. There was also an increase in the use of experiential learning from 20% to 42%. Again, the percentage of articles that discussed how the authors are decolonizing their research, or that the intent of these collaborative approaches are for decolonizing research remained unchanged at 0%.

The fourth section in Table 5.2 assessed whether there was an understanding of Inuit knowledge and if it was acknowledged for its own scientific merit and utilized in the research. There was a general decrease in papers describing the philosophical and holistic approaches of IQ (52% to 33%) and in accepting IQ (84% to 75%). Based on the high percentages from the 2002 to 2017 literature review, my interpretation is that many of these sea ice researchers have moved beyond the need to explain or justify the inclusion of IQ, and acknowledge and accept IQ for its own scientific merit

Section five in Table 5.2 examines how the non-Indigenous authors discuss the history and ongoing colonization of Inuit and Iñupiat, and alternative (decolonizing and Indigenous) approaches to research. It was encouraging to see that the percentage of the papers avoiding the topic of colonialization when describing the history of communities decreased from 42% to 33%. This is substantiated with an increase from 16% to 42% of papers acknowledging the colonialism of Inuit and the history of residential schools and relocations. As well, discussions of empowerment and self-determination also increased from 6% to 31%. However, the percentage of articles that shared a sense of reflexivity or were transparent with their biases or positions of power in the research relationship remained low at 8% and 0%, respectively.

Overall, the 2018 to 2022 literature review shows some progress in the expansion of collaborative methodologies and methods with Inuit, and a greater acknowledgement of the historical and ongoing policies that continue to perpetuate colonialism. The literature shares more examples of the importance of taking time to build trust and relationships in Inuit communities for collaborative research approaches. However, because the decolonizing process is not being described in any of these publications, it again suggests that some non-Indigenous sea ice researchers are not making the connection; that the decolonizing aspects of these methodologies are to decolonize their roles to empower Inuit for greater self-determination in research. This is evident in the fact that a majority of the research questions still do not come from the community, and the low percentage of Inuit involved in conducting the research, and in leadership and decision-making positions of power in the research. The results from Table 5.2 show a continued gap in the literature describing how non-Indigenous sea ice researchers are being reflexive in decolonizing themselves and their research. As a result, this dissertation contributes to the non-Indigenous decolonizing literature by providing as example to begin filling this gap.

It a challenge to compare this work with that of the 2018 to 2022 literature review, as collaborative work with Inuit requires a co-evaluation approach (see section 1.5.4). However, the Sikumiut model was co-developed to decolonize the typical research relationships for any research discipline to address the overarching goals of the National Inuit Strategy on Research (NISR; ITK, 2018; see Section 2.7). While this model was developed within the Mittimatalik SmartICE context, is may be applicable in other Inuit communities for Inuit and non-Indigenous partners to use as a tool to start initial research discussions, to help outline co-development and community leadership goals. For example, it could be used to consider how you plan to work together, and the values, roles and responsibilities of the Inuit and non-Indigenous partners in the research relationship. I have been using the Sikumiut model as a tool to teach and reconfigure the typical colonial approaches to working with Inuit. For example, within ECCC I share the Sikumiut model as a way to explain the goals laid out in the NISR and how to support Inuit self-determination in research. The Sikumiut model can also be used as a tool to discuss who will do the research, how decisions are made, data ownership, and control over how IQ is documented, communicated, and respected. Every community and research project will be different, and so the research process between Inuit and non-Indigenous partners will need to be adapted in each community to reflect that context.

However, I must caution government and academic organizations that the Sikumiut model, CBPR, or other collaborative, co-produced, and cross-cultural approaches are not a quick fix. Through the 2018 to 2022 literature review, discussions with other Arctic researchers, and my own experience in this research, has led me to realize that it’s not just the methods and methodologies that non-Indigenous researchers need to change, but most importantly it’s ourselves. We cannot simply apply decolonizing approaches without learning about the colonial history of knowledge production, reflecting on how we were trained to conduct research, and learning about why these decolonizing and Indigenous research approaches are emerging to change the status quo. Without making the change within ourselves, utilizing any decolonizing model is just another ‘add and stir’ approach to decolonizing research (Kovach, 2009), and we will simply continue to perpetuate colonialism in research.

This dissertation fills a critical gap in the current collaborative Arctic sea ice literature that is increasingly conducted through community partnerships, but is still primarily led by non-Indigenous researchers. By describing the work I did to begin decolonizing myself, and sharing the process of co-developing the Sikumiut model, my intent was to rethink and contribute to decolonizing typical research roles. I also fill a fundamental gap in describing how we transitioned from theory into practice to support the greater goal of Inuit self-determination in research.

5.1.2 IQ is a climate change adaptation tool

To truly document Mittimatalingmiut sea ice IQ we had to adapt our workshops and meetings to be conducted entirely in Inuktitut. The discussions and conversations to document Sikumiut's IQ needed to flow in Inuktitut, and interpreters were brought in to assist the non-Inuktitut speaking partners as well as to support youth Sikumiut members in strengthening their language skills. The review of the sea ice terms took three times as long as it did to originally document them. But it is important to recognize that these words had never been written down. Time and extensive discussion were needed to enable different generations of Sikumiut members to reach consensus on the spelling of the words and nuanced descriptions to truly reflect their meaning. Bringing in photographs and illustrations to accompany the terms sparked new discussions around each term, along with opportunities to refine descriptions as well as opportunities to transfer this knowledge to train the youth Sikumiut members—and Arreak and Itulu—who were present at these meetings and keen to listen and learn.

The changing climate, causing unprecedented variability in sea ice conditions, is often the sole reason given for the increase in accidents, trauma and deaths experienced by Inuit travelling on the sea ice. However, the settlement of Inuit and residential schooling also contributed to the erosion of the knowledge of sea ice conditions and travel safety through the loss of language and travel experience. Colonialism continues to disrupt the transfer of IQ with imposed work and school schedules that limit sea ice travel to weekends and holidays (Aporta and Higgs, 2005; Ford et al., 2007; Pearce et al., 2010, 2011, 2015; Heyes, 2011; Pulsifer et al., 2011; Durkalec et al., 2015; Panikkar et al., 2018). The second insight that emerged while working with Sikumiut was that sea ice IQ continues to be relevant, and is a climate change adaptation tool to teach the next generation of Inuit how to identify and avoid dangerous ice conditions while they are travelling on the sea ice. Rooted in each geographical placename and in each Inuktitut sea ice term is situational awareness and knowledge of travel safety that has evolved over a millennium of land use and occupancy. As Inuit youth develop navigational skills and sea ice knowledge through intergenerational IQ and first-hand experience, they develop the ability to understand the greater context and application of the geographical placenames and sea ice terms for safe sea ice travel.

IQ that is shared and passed down through generations maintains the sea ice climate record from a community perspective in Mittimatalik. Without Sikumiut's and Arreak's IQ and direction, we would never have been able to create the Mittimatalik siku asijjipallianinga or analyze its results. The atlas provides an adaptation tool that Mittimatalik can use to share locations of known and changing sea ice conditions to plan for safe sea ice travel. The atlas also clearly demonstrates the scientific merit of Inuit knowledge in environmental assessments for negotiating the proposed extension to the shipping seasons for the nearby Mary River Mine.

5.1.3 Inuit knowledge in research requires Inuit governance of their knowledge

In the many presentations given during my PhD program I am often asked, "but how do you incorporate traditional knowledge into research?" While calls for integrating Indigenous knowledge and western science are on the rise, there have also been many concerns because it is ultimately the non-Indigenous researcher who decides what Indigenous knowledge is relevant to support and validate Western science (Agrawal, 1995; Nadasdy, 1999; Simpson, 2004; Ellis, 2005; Tester and Irniq, 2008; Bohensky and Maru, 2011; ITK, 2016; McGrath, 2018). In this project we never stumbled over the “integration” challenge because when research is Inuit-led and being used for their own purposes and in their own language, Inuit have control over the most appropriate ways to record and share their knowledge. It was through many meetings with my headset on and the translator whispering in my ear that the third insight of my PhD was revealed. It’s not about “how” you integrate Inuit knowledge, it’s about “who” has control of the integration. For example, when Arreak interpreted the satellite data and analysed the results for the Mittimatalik siku asijjipallianinga atlas, he was using his IQ to focus on sea ice travel safety for his community. A western researcher would have interpreted the satellite data and analysed the results very differently based on their research interests. In this research, Inuit were in charge of the data collection, interpretation and analysis of the results and drew on Western science methods as needed.

To encourage more Inuit knowledge in Arctic research requires Inuit governance of their knowledge, throughout the entire research process. Inuit governance has to start from the beginning and involve iterative and ongoing discussions about the research approach (values), objectives, and how to collect, analyse and interpret the information of interest. This requires an investment of time; it cannot be a workshop added on to a project at the end.

5.1.4 Co-production of research needs co-evaluation of research

As this research with Sikumiut draws to a close, my role in the research relationship will be formally critiqued by the academy. But I ask how can the academy really know if Sikumiut were satisfied with our co-produced research approach and outcomes? Is it enough for me to write that we did great work? Shouldn't we be asking Sikumiut? While the plan is to have a Sikumiut representative as a non-voting member present at my PhD defense, there is currently no formal process for Inuit to provide feedback to universities through the research ethics or thesis defense process. Arctic funders rely on final reports submitted by predominantly non-Indigenous principal investigators. The Nunavut Research Institute (NRI) research licensing process provides feedback opportunities at the beginning of the research process, but there is no follow-up mechanism unless a complaint is received from a community. The fourth insight is that the co-production of research also requires the co-evaluation of the process and outcomes. I have approached Ikaarvik to help facilitate workshops with Sikumiut so we can take the opportunity to reflect on our research, what we learned about working together, what we did well, and what we should do differently next time. During the initial conversations between Ikaarvik and Sikumiut in November 2020, the following three key points emerged:

1. To foster co-creation in Arctic research, we need a process to allow Inuit feedback throughout the research process: at the beginning, middle and end of the research.
2. Feedback on the engagement, effectiveness, relevance and benefits of co-produced research with Inuit needs to be done by Inuit and from an Inuit perspective, not by academic researchers or funding agencies.
3. Such feedback will benefit everyone. For Inuit this means empowerment. For southern-based scientists this means better and more relevant research. For funders

> this means an improved understanding of what is involved in co-created research and the impacts of funding provided. For policy makers this leads to better information for policy development, co-management, and decision-making.

Organizations like Ikaarvik can create a safe space, a middle ground between community members, researchers, and the academic/government funding agencies. Ikaarvik is in the early stages of developing an Inuit-specific feedback process, based on research values that are important to Inuit. Ikaarvik will be piloting this Inuit research feedback process with Sikumiut to discuss our research together. The workshops Ikaarvik planned to facilitate with Sikumiut were initially delayed until the fall of 2021 and again in winter 2022 due to community restrictions on indoor gatherings resulting from the COVID-19 pandemic. We are hopeful that, in the future, such a feedback process can create a leadership role for Inuit youth, increased opportunities for Inuit training and employment, and enhanced Inuit self-determination in research.

5.1.5 Control over research comes with control of research funding

Although Arreak, Itulu, and other members of Sikumiut read drafts of the journal articles, the fifth insight is that I remain in a position of power as the lead author on the written materials resulting from this research. Additionally, Inuit are often ineligible to receive funding without a college or university degree. Communities and organizations like Sikumiut are ineligible to receive funding without institutional research accreditation and the administrative infrastructure to account for and report on funds used. As a result, non-Indigenous government, and academic researchers (like myself) and their institutions, remain in positions of power because they control the research funds. Until Inuit community organizations have control over funding, the decolonizing process is incomplete. Innovations in funding programs are needed, such as Inuit Qaujisarnirmut Pilirijjutit – the pan-Inuit Nunangat program supported by ArcticNet – is a bold new step towards changing this paradigm.

5.1.6 Inuit research capacity building needs accreditation and space

Finding Inuit youth to work on this research project was a challenge. Many of the Ikaarvik youth I met who were interested in research had enrolled in the Environmental Technology Program (ETP), run by Nunavut Arctic College (NAC) in Mittimatalik (2018/19-2019/20). Presentations, multiple meetings, and lesson plans were shared with NAC administrators and instructors in Mittimatalik and Iqaluit to discuss adapting the ETP curriculum for Mittimatalik. Instructors were excited that the Mittimatalik ETP students would be working on real research to benefit their own community. However, institutional hierarchies and staff turnover was a constant barrier to recruitment and participation. I also tried to collaborate on the end-of-year field trips, where ETP students could travel with and learn sea ice IQ directly from Sikumiut members, along with experiential learning and ground truthing of satellite images. However, this did not work out because the first field trip in 2019 was moved to Clyde River when a Mittimatalik-based field trip coordinator could not be organized. Then the second field trip planned for spring 2020 was cancelled due to the COVID-19 pandemic.

The training Arreak received from Sikumiut and the non-Indigenous research partners in this project are transferrable skills that can support more research independence in the community. Arreak can support other community-led research or in co-developing research with non-Indigenous research partners that suit Mittimatalik priorities and approaches. It is also an example for how non-Indigenous researchers and their institutions can support and build capacity in Inuit Nunangat research. My sixth insight is that although Inuit contribute significantly to Arctic research and develop tremendous capacity in co-developed projects, they do not receive any accreditation for their work while I get a PhD. The amount of work Arreak has done to organize and facilitate workshops, interpret, analyse, and validate results exceeds these aspects in an average master's research project. However, none of Arreak's work will be recognized through any formal qualifications or certification mechanisms. For Inuit to become employed in Arctic research at academic, territorial, or federal organizations, a university degree from a western research institution is typically required. There is an assumption that if we just get Inuit interested in research, they will leave their communities, come south, and go to university. Inuit youth are commonly parents with family responsibilities and cannot (or do not want to) leave the community. The length of time away from the community, and the culture of southern universities, are some of the many reasons this colonial approach to educating Inuit "like us", continues to fail.

Governments and academia need to re-examine their hiring policies and job classifications to remove university educational requirements to value the diverse knowledge, and relevant and specialized skills of Inuit (e.g., language specialists, artists, and cultural knowledge holders). A lifetime of living on the land with an intimate knowledge of the environmental history and current conditions are esteemed science skills that most undergraduate and graduate students will never achieve. Hiring based on relevant skills and on-the-job training in community research would significantly support capacity building and employment in Inuit

Nunangat. Funding agencies also need to work with colleges and universities to develop formal qualifications earned for the training and research conducted by Inuit in co-produced research.

As an ECCC employee, I was able to stay at the ECCC research centre in Mittimatalik and hold meetings and workshops there. Arreak had office space in the community as part of his SmartICE position and Itulu was also able to work there. However, this is not the norm. Capacity building and community-driven research are difficult when community partners have to work off their kitchen tables and in crowded housing conditions. Dedicated community research space and full-time research (or research coordinator) positions are essential to support community-led research, along with the capacity to secure and manage research funding. Examples from other Inuit communities show that community-led work can thrive where there is dedicated research space (e.g., Clyde River (Ittaq, 2019), Arviat (Aqqiumavvik, 2019), Cambridge Bay (Kitikmeot Heritage Society, 2019), and Iqaluit (Qaujigiartiit Health Research Centre, 2019).

5.2 Recommendations for future research

5.2.1 The Arctic Research Establishment climate data

The Arctic Research Establishment (ARE), mentioned briefly in Chapter 4 (Section 4.2.3.3) was a private research station run by the Steltner family based in Mittimatalik between 1975 and 1989. Some Sikumiut members had worked for ARE taking weather, sea ice and oceanographic measurements, and they had requested that these data be located and returned to them. I spent a considerable amount of time looking for these data. It was understood that the data were archived at the Arctic Institute of North America (AINA), the National Research Council (NRC), the CIS, and the Polar Continental Shelf Project (PCSP). Between 2016 and

2018, I searched these archives and contacted retired scientists. What had been archived were the publications and reports summarizing the research, but not the data.

I eventually connected with the daughters of the Steltner family. One was living in the family home, and her parents "southern office" remained in the basement of the home. I spent a year getting to know this daughter, explaining that the community would like the data back, and discussing donation options and locations for the physical archive with the Mittimatalik and Government of Nunavut archivists. Sean Guistini, with NAC, and I did an initial review of the ARE collection over two trips to understand what and how much was there. The data included environmental observations recorded in field books (in English and Inuktitut), reports, photographs, and films.

Bell sought and received funding in 2020 to archive the dataset. Wilson, Bell, Mark Croke (SmartICE) and Dr. Robert Frederking (retired NRC scientist that worked with the Steltners) spent a week sorting, scanning the environmental data, and boxing up the collection. Although the goal was to ship the ARE collection to Mittimatalik, the Mittimatalik archivist is now retired. There are currently no plans in place to fill this position, so the future of the community archive is unknown. The Steltner family donated the ARE collection to the Government of Nunavut and the physical records are now stored safely in the territorial archives (currently housed in Ottawa). A digital copy of the environmental data was also transferred to the Mittimatalik archive, although it remains closed.

Several years of work are still required to review and enter the ARE observations from reports and field notes into a database for research use. There is a wealth of climate data in this collection to add to Mittimatalik's sea ice climatology and this is future research that I hope myself or others can work on with Mittimatalingmiut. It would be interesting to compare the ARE record (1975-1989) with the Mittimatalik siku asijjipallianinga (1997-2019) to expand our understanding of how much the sea ice conditions have changed. Additionally, the media (photography, slides, and films) have not been digitized and contain a historical and cultural treasure of family and environmental footage for the community. This kind of archival work is another example of decolonizing research. By returning the data – their knowledge and culture – and making it accessible, will preserve and share the history of the community of Mittimatalik for future generations.

5.2.2 Develop climate atlases for other Inuit communities

Mittimatalik is just one out of 48 coastal communities in Inuit Nunangat interested in understanding where and when the sea ice is changing around their community, and how to adapt their sea ice travel to maintain hunting activities and cultural practices on the sea ice. There would be a great benefit in expanding the siku asijjipallianinga work in other Inuit communities and making these maps available on the SIKU website to support safe local sea ice travel and emergency prevention programs across the Inuit Nunangat. It would also benefit future circumpolar assessments by providing a greater inclusion of Indigenous knowledge and perspectives on climate change and impacts.

Future work could include comparing sea ice change at Arctic community scales with regional and global climate model outputs to better understand the effects of global and synoptic scale weather patterns on local sea ice. Furthermore, community scale sea ice climatologies could also be used in the development of new community scale sea ice forecast models. Initial runs of new models are always done using historical climate data to assess how well the models match the historical conditions. The results of the initial runs are critical to improve and understand the limitations of new models prior to providing forecasts.

5.3 Concluding statement

I cannot say that my motivations were completely without self-interest and that I am free of colonial biases. The capacity building that I learned through this decolonizing research benefits me personally in the sense of earning a doctoral degree and publishing journal articles. I also cannot say that in seeking funding, making presentations, writing journal articles, reports to funding agencies, and in this dissertation, that I didn't end up speaking for Inuit. However, this work has changed how I view the world, how I think and the importance of relationships. Through this PhD I have shared both personal and practical experiences in hopes that other non-Indigenous researchers can also learn to transform themselves and their research.

Government and academia in Canada are based on colonial systems. It will take considerable time for individuals within, and for these organization as a whole, to understand the unconscious biases they continue to perpetuate, creating barriers to providing sea ice services for Inuit Nunangat. With climate change affecting daily life across Inuit Nunangat, Inuit do not have the luxury of time. Sustained funding is needed now for coordinated sea ice services supporting communities across Inuit homelands.

As of 2022, long-term funding for dedicated sea ice monitoring services for Inuit Nunangat still does not exist. A new mixture of academic (Dufour-Beauséjour et al., 2020), industry (Polar View, 2019), and not-for-profit (Aqqiumavvik, 2020b; Arctic Eider Society, 2020; Ittaq, 2020; SmartICE, 2020) sea ice monitoring services and platforms support Inuit coastal communities through a patchwork of funding opportunities. However, what has changed, is that some of these more recent community-based sea ice monitoring services are now being co-produced through a decolonizing lens (Aqqiumavvik, 2020b; Arctic Eider Society, 2020; Ittaq, 2020; SmartICE, 2020). There is a greater degree of self-determination in these community-driven monitoring services with Inuit now managing and conducting their own sea ice monitoring.

I have changed in many ways over these past six years, but there is more work to do, and my decolonizing research journey is far from over. In whatever roles I have in research going forward, I will continue to check-in and be reflexive, share my decolonizing journey, challenge the status quo, and advocate for sustained sea ice services for Inuit in Canada.

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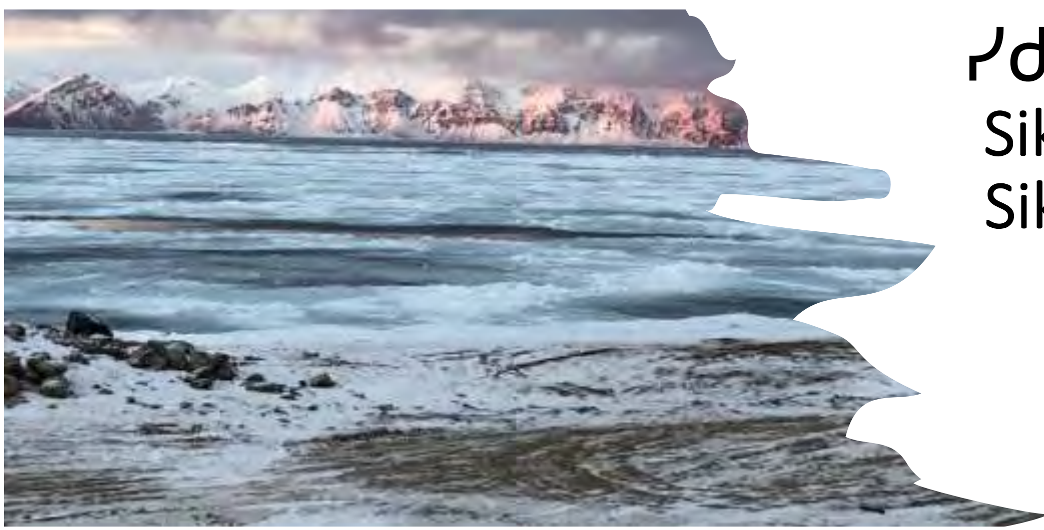
Appendix A

Sikumiut sea ice terminology booklet

This booklet is currently undergoing further layout and design prior to printing.

The booklet is expected to be printed and shipped to Mittimatalik in spring 2022

The final booklet will be available at https://smartice.org/ice-safety/



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Sikumiut sea ice terminology

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Mittimatalik, Nunavut

Dedication

"Whenever an elder dies, a library burns down"

Amadou Hampâté Bâ

This atlas is dedicated to the memory of Jaykolassie Killiktee and Gamailie Kilukishak, founding members and Elders for the Sikumiut Management Committee. Jaykolassie was part of the Committee from 2016 to 2018 and provided gracious and unwavering leadership in the design of the committee to ensure Mittimatalik's self-determination in research. Gamailie's dedication to documenting, sharing, and teaching his sea ice Inuit Qaujimajatuqangit with the next generation was evident in his attendance at every Sikumiut meeting held between 2016 and 2022. We are honoured to have known and worked with these Elders, and to have their contributions reflected in this atlas.

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Sikumiut aulattijiit katimajingit sikulirijikkunnut mittimatalingmi saqittilaurtut tavani takuksaujunik.
Unurtuungalirtaujariaqangittuq angirtausimangilluni titirarsimajukkut.

The Sikumiut Management Committee for SmartICE in Mittimatalik produced this content. The information in this atlas is based on Inuit knowledge and cannot be modified or altered without Sikumiut's written permission. Access to this data requires permission from the Sikumiut Committee.

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https://smartice.org/ice-safety/

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ᓇᓗᓇᐃᓯᐅᑎᑦ

ᓄᓇᓕᐅᔪᖅ ᒥᑦᑎᒪᑕᓕᒃ, ᓄᓇᕗᑦ

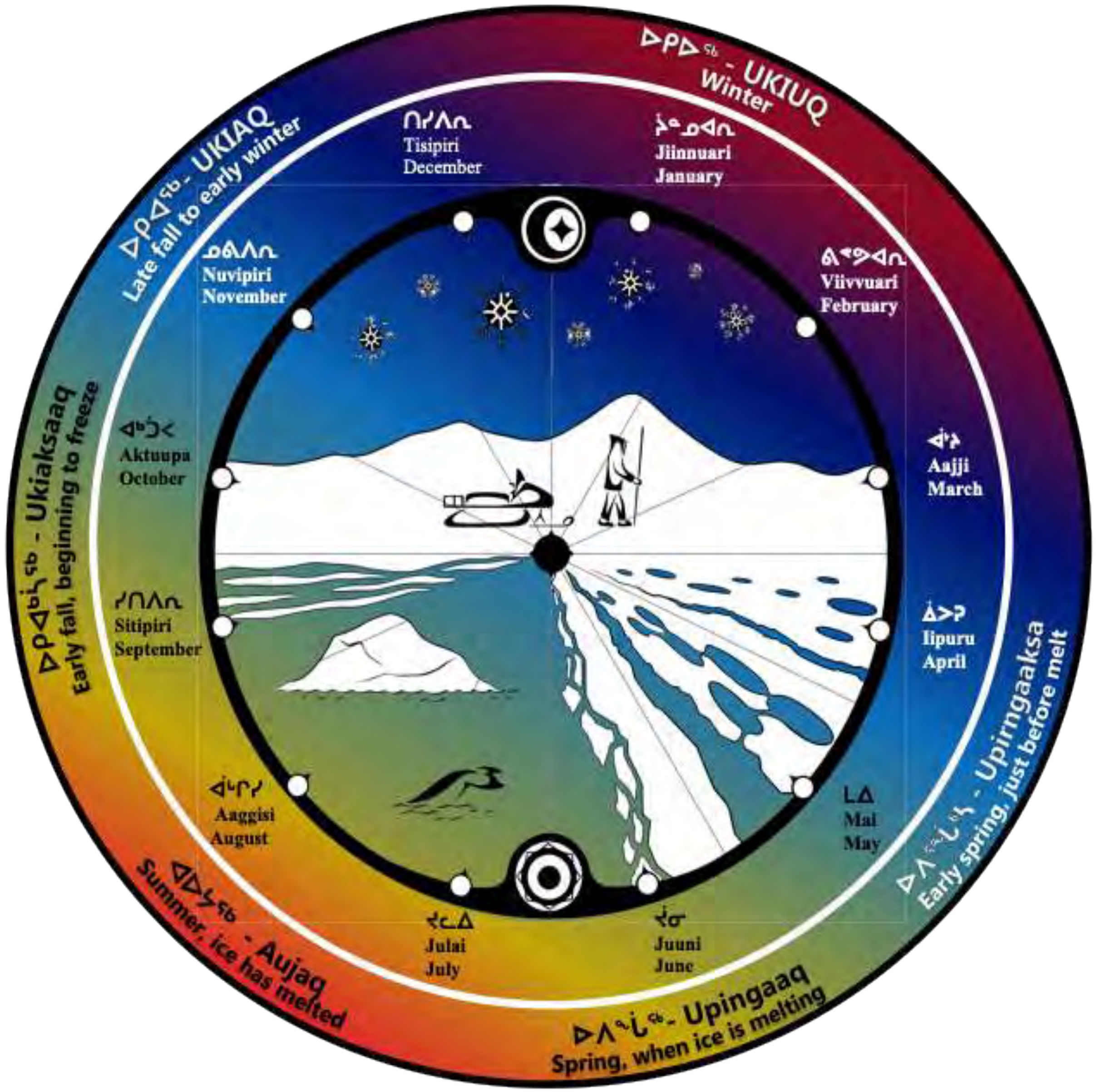
ᓄᓇᓕᐅᔪᖅ ᒥᑦᑎᒪᑕᓕᒃ ᐅᐊᖕᓇᖕᒐᓂᑦᑐᖅ ᖁᑭᖁᑖᓗᖕᒥ ᓄᓇᕗᑦ (ᑎᑎᕋᖁᓯᒪᔪᑦ ᑕᑯᓗᒍ 1).

ᒥᑦᑎᒪᑕᓕᖕᒥᐅᑦ ᐃᖕᒋᕋᖃᑦᑕᖅᒪᑕ ᓯᑯᒃᑯᑦ ᑕᕿᓂᒃ 7 ᐊᕋᒍ ᐃᓗᐊᓂ ᐊᖑᓇᓱᒃᑯᑎᒃ ᐃᖃᓪᓕᐊᖁᑎᒃᑐ ᓂᖀᒃᓴᖅᓯᐅᖁᑎᒃᑐ (ᑑᒃᑐ,ᖀᓚᓗᒐᖅ,ᓇᑦᑎᖅ ᐊᒻᒪᓗ ᐃᖃᓗᒃ) ᐊᒻᒪᓗ ᐃᓚᒌᑦ ᐃᒃᑐᕋᓚᖏᒋᐊᖁᑐᑦ (ᑎᑎᕋᖁᓯᒪᔪᑦ ᑕᑯᓗᒍ 1). ᐃᖕᒋᕋᕕᐅᒐᔫᒃᑐᖅ ᖃᓂᒋᔭᖕᒐᓂ ᒥᑦᑎᒪᑕᓕᐅᑉ Navy Board Inlet , ᑕᓯᐅᔭᖅ, ᐊᒻᒪᓗ ᑐᖁᓱᑲᑦᑕᒃ (ᑎᑎᕋᖁᓯᒪᔪᑦ ᑕᑯᓗᒍ 2).

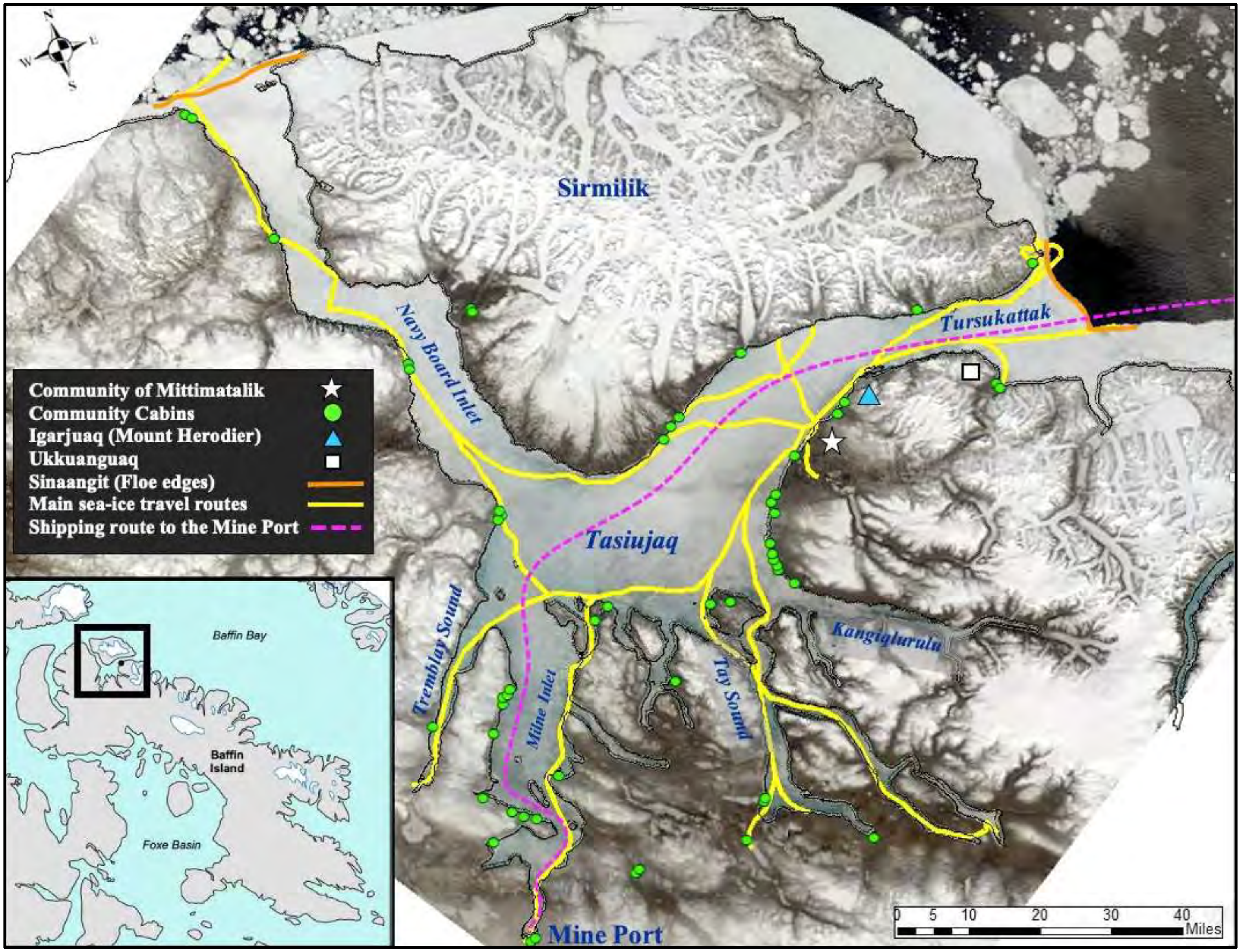
ᒪᕈᖕᒪᑎᒃ ᓯᓈᖕᒋᒃ ᑖᒪᓂ, ᐹᖕᒐᓂ ᓱᓪᓗᖕᒐᑕ Navy Board Inlet ᐊᒻᒪᓗ ᐹᖕᒐᓂ ᑐᖁᓱᑲᑦᑕᒃ (ᑎᑎᕋᖁᓯᒪᔪᑦ ᑕᑯᓗᒍ 2). ᓯᓈᖕᒋᒃ ᑐᕓᐅᑉ ᑭᒃᑲᖕᒐᓂ ᑐᕓᖅ (ᓯᑯᓚᕆᐅᔪᖅ ᑭᒃᑲᖕᒐ ᐃᒪᐅᓂᖕᒐᑕ ᓄᓇᒧᑦ ᓯᑯᓯᒪᔪᖅ), ᐊᒃᑐᐊᔪᖅ ᐃᒪᐃᓂᖕᒐᓄᑦ ᓯᑯᔪᓐᓇᖕᒋᑦᑐᖅ ᐊᖕᒋᓂᖅᓴᐅᓪᓗᓂ. ᑐᖁᓱᑲᑦᑕᒃ ᓯᓈ ᐅᖕᒐᓯᖕᓂᖃᖅᑐᖅ 65 ᑭᓛᒥᑕ ᓄᓇᓕᖕᓂᑦ ᐊᒻᒪᓗ ᐊᖑᓇᓱᒋᐊᖅᕕᐅᒐᔫᒃᑐᖅ ᐊᒻᒪᓗ ᐃᖃᓪᓕᐊᖅᑐᓄᑦ ᐊᖅᑯᑕᐅᓪᓗᓂ ᒥᑦᑎᒪᑕᓕᖕᒥᐅᓄᑦ.

ᒥᕐᑎᒪᑕᓕᖕᒥ ᓯᑯᖓ ᐊᐅᓚᓂᖓ

ᑕᖅᐅᑦ ᓯᑯᖓ ᓄᓇᓖᑦ ᐊᕙᑖᓂ
ᖁᐊᕐᐸᓪᓕᐊᓕᖅᑕᕐᑐᖅ
ᓄᖑᕐᐸᓯᐊᓂ ᐅᑐᐱᕆ ᐊᒻᒪᓗ
ᓯᑯᒃᑰᕐᓇᕐᓯᖅᑕᕐᑑᓂ
ᕿᑎᐸᓗᐊᓂ ᓄᕕᐱᕆ ᓯᑯ
ᑐᕚᓕᕇᖕᖏᑦ. ᒥᕐᑎᒪᑕᓕᖕᒥᐅᑦ
ᓯᑯᒃᑰᖅᑕᕐᑐᑦ ᑕᕿᓄᑦ 7-ᓄᑦ
ᐊᕋᒍ ᐃᓗᐊᓂ ᔪᓚᐃᒧᑦ ᑎᑭᓪᓗᒍ
ᑕᑯᓗᒍ ᑎᑎᕋᕐᓯᒪᔪᖅ 1,
ᒥᕐᑎᒪᑕᓕᖕᒥ ᑕᖅᐅᑦ ᓯᑯᖓᑕ
ᐊᐅᓚᓂᖓ.



ᑎᑎᕋᕐᓯᒪᔪᖅ 1: ᒥᕐᑎᒪᑕᓕᒃ ᑕᖅᐅᖓᑕ ᓯᑯᖓ ᐊᐅᓚᓂᖓ. ᑎᑎᕋᐅᔭᖅᑐᖅ ᔭᐃᒥᓯ ᐃᑦᑐᓗᒃ



ᑎᑎᕋᕐᓯᒪᔪᖅ 2: ᓄᓇᖑᐊᖅ ᒥᑦᑎᒪᑕᓕᒃ ᑕᕆᐅᖓᑕ ᓯᑯᖓ ᐃᒃᓕᓂᐅᖅᑲᑦᑕᕐᑐᖅ, ᓄᓇᕗᑦ, ᑲᓇᑕ. ᖃᖓᑦᑕᕐᑎᑕᐅᓯᒪᔪᒃᑯᑦ ᐊᔾᔨᖑᐊᖅ: MODIS ᑲᓚᖅᑲᕐᑐᖅ ᐊᔾᔨᓕᐅᕐᓯᒪᔪᖅ, ᔪᓂ 9, 2019 (NASA, 2019).

ᓯᑯᒥᐅᖅ ᐊᐅᓚᑦᑎᔩᑦ ᑲᑎᒪᔨᙳᑦ

ᓯᑯᒥᐅᑦ ᑐᑭᖃᖅᑐᖅ “ᐃᓄᐃᑦ ᓯᑯᒥᐅᑕᐅᔪᑦ”. ᑲᑎᒪᔨᐅᔪᑦ ᐃᓄᐃᑦ ᑕᓇᐅᑉ ᓯᑯᖓᓂᒃ ᐃᖏᕋᔨᐅᔪᑦ ᐊᐅᓚᑦᑎᓯᒪᔪᑦ ᓯᑯᓕᕆᔨᒃᑯᓐᓂᒃ SmartICE ᓄᓇᓕᖕᓂ ᐱᒋᐊᖅᑎᑕᐅᓯᒪᓪᓗᓂ ᑕᓇᐅᑉ ᓯᑯᖓᓂᒃ ᖃᐅᔨᓴᖃᑦᑕᖅᑐᑦ ᐊᐅᓚᑦᑎᔪᑦ (smartice.org) ᒥᑦᑎᒪᑕᓕᖕᒥ ᑕᐃᒪᙵᑦ 2016. ᐅᑯᐊ ᑲᑎᒪᔨᐅᔪᑦ ᐃᓚᐅᖃᑦᑕᖅᓯᒪᔪᑦ ᐅᖃᓕᒫᒐᓕᐅᖅᑐᓄᑦ.


ᐳᓚᐃᐊᓐ ᑯᓄᒃ,
ᒥᖕᒎᐃᓯᖅᕕᓕᕆᔨᒃᑯᑦ ᑲᓇᑕ


ᑲᐃᓚᐱ ᓴᖑᓭ,
ᓇᕈᑎᑦ ᐅᓇᑕᖅᑐᒃᓴᐃᑦ


ᑕᐃᕕᑎ ᐊᖅᓇᑦᓯᐊᖅ,
ᕿᓂᖅᑎᑦ ᐸᖅᓴᐄᑦ


ᐃᓚᐃᕓ ᐸᓂᒃᐸᑯᑦᑐᒃ,
ᐃᓐᓇᓪᒪᓇᒃ, ᐅᒪᔪᖅᓂᐊᖅᑎᒃᑯᑦ ᑲᑎᒪᔨᙳᑦ


ᒐᒪᐃᓕ ᖃᓗᖅᑮᖅ,
ᐃᓐᓇᓪᒪᓇᒃ


ᐊᐃᕙᓐ ᑯᓄᒃ
ᐃᑳᖅᕕᒃ


ᔭᓇᑖᓐ ᑎᑦᓯᐅᓛᖅ
ᒪᑯᒃᑐᖅ ᐊᖑᓇᓯᒃᑎ


ᒨᓯᓯ ᐊᒪᕈᐊᓕᒃ
ᒪᑯᒃᑐᖅ ᐊᖑᓇᓯᒃᑎ


ᐸᐃᓯ ᓯᒪᐃᓕ
ᐃᑳᖅᕕᒃ


ᓯᐊᑎ ᑕᓘᖅ,
ᐊᐅᓪᓚᐅᔾᔨᔨ

ᖃᓄᐃᒻᒪᑦ ᑕᓇᐅᒥ ᓱᑯᒥ ᑕᐃᒨᓰᑦ ᐅᖃᓕᒫᒐᙳᖅᑎᑕᐅᓚᐅᖅᐸ

ᐊᕋᒍᖓᓂ 2017, ᓱᑯᒥᐅᑦ ᑲᑎᒪᔨᖏᑦ ᐃᓱᒫᓗᑎᖃᓚᐅᖅᒪᑕ ᒪᒃᑯᒃᑐᑦ ᖃᐅᔨᒪᙱᓗᐊᖅᓂᖏᓐᓂᒃ ᐃᓄᐃᑦ ᖃᐅᔨᒪᔪᑦᑐᖃᖏᓐᓂᒃ ᐊᑦᑕᖅᓇᖅᑕᐃᓕᒪᓂᖅᒥᒃ ᑕᓇᐅᖅ ᓱᒃᑯᑦ ᐃᖏᕋᓗᑎᒃ. ᐃᓚᖓ ᓱᑯᒥᐅᑦ ᑲᑎᒪᔨᐅᖃᑕᐅᕙᖅ ᐅᖃᓚᐅᖅᑐᖅ ᖃᓄᑎᒋᑦ ᐋᑐᑎᖃᖅᑎᒋᓂᖓᓂᒃ ᑕᐃᒍᓯᑦ ᓱᑯᒧᑦ ᐱᓪᓚᕆᐅᓂᖓᓂᒃ ᑐᓴᐅᒪᖃᑦᑕᐅᑎᓂᖏᓐᓄᑦ.

“ᐅᖃᓪᓚᖃᑎᕆᒍᓐᓇᖅᑕ. ᐅᖃᐅᓯᕐᒥᒃ ᐅᖃᑐᐃᓐᓇᕐᓗᑕ ᑐᑭᓯᔭᐅᑲᐅᑎᒋᒐᔭᕐᑐᖅ ᓱᑯ ᖃᓄᐃᓕᖓᓂᖓᓂᒃ ᐅᖃᐅᓯᕆᔭᕐᑎᓐᓂᒃ”.

ᐳᓚᐃᐊᓐ ᑯᓄᒃ, ᒥᕐᖑᐃᓯᕐᕕᓕᓇᔨᒃᑯᑦ ᑲᓇᑕ

ᐃᓄᒃᑎᑐᑦ ᑕᐃᒨᓰᑦ ᑕᓇᐅᕐᒥ ᓱᑯᐃᑦ ᐱᓪᓚᓇᐅᕙᖕ ᐃᓕᓐᐊᖅᑕᐅᓗᑎᒃ ᐃᓕᑕᐅᕙᓐᓇᖅᒪᑕ ᒪᒃᑯᒃᑐᓄᑦ ᓇᖏᐊᖅᓇᖅᑐᑦ ᐊᑦᑕᖅᓇᖅᑐᓪᓗ ᖃᓄᐃᓕᖓᖕᒪᖔᑕ ᐃᖏᕋᕕᒋᓗᒋᑦ. ᓱᑯᒥᐅᑦ ᑎᑎᕋᖅᑯᔨᓚᐅᖅᒪᑕ ᐊᒻᒪᓗ ᖃᐅᔨᒪᔪᐅᓗᑎᒃ ᐃᓄᐃᑦ ᖃᐅᔨᒪᔪᑦᑐᖃᖏᑦ ᓄᓇᓕᖕᓂ ᐃᓄᖏᑦ ᓇᖏᐊᖅᓇᖏᑦᑐᒃᑯᖅᓗᑎᒃ ᐃᖏᕋᖅᑲᑦᑕᖅᓂᐊᕐᒪᑕ ᓱᒃᑯᑦ.

“ᓱᑯᓃᑦᓗᑕ, ᐱᓯᒪᔪᑐᐊᓇᒐᖅᑎᒍ ᐃᓄᐃᑦ ᖃᐅᔨᒪᔪᑦᑐᖃᖏᑦ”

ᑲᐃᓚᐱ ᓴᖑᔭ, ᓇᐳᑎᑦ ᐅᓇᑕᖅᑐᒃᓴᐃᑦ

ᐃᑲᔪᖅᓯᒪᔪᑦ ᑕᓇᐅᕐᒥ ᓯᑯᐃᑦ ᑕᐃᒨᓯᕐᑎᓐᓂᒃ

ᓯᑯᒥᐅᑦ ᑲᑎᒪᔩᕐᑎᑦ ᐃᓚᐅᖅᑯᔨᓚᐅᖅᒪᑕ ᒪᑭᒃᑲᓐᓃᕐᓂᒃ ᐃᓐᓈᕐᓂᒃ ᓯᑯᓕᕆᓂᖅᒥᒃ ᐃᓄᐃᑦ ᖃᐅᔨᒪᔾᔪᑎᖃᕐᑎᑎᒍᑦ, ᓵᓕ ᐃᓄᐊᕋᖅ ᐊᒻᒪᓗ ᐱᑐᐃᓕ ᐆᑦᑐᕙᒃ. ᐃᓐᓇᐃᑦ ᓯᑯᒥᐅᑦ ᑲᑎᒪᔩᐅᖃᑕᐅᔪᑦ ᐱᔪᒪᓚᐅᖅᒥᔪᑦ ᒪᒃᑯᒃᑐᓂᒃ ᐃᓚᐅᖅᑯᔨᓪᓗᑎᒃ ᑲᑎᒪᖃᑕᐅᖃᑦᑕᖅᓗᑎᒃ ᖃᐅᔨᒪᓕᖅᓂᖅᓴᐅᖅᑯᓪᓗᑎᑦ ᐃᓄᐃᑦ ᖃᐅᔨᒪᔾᔪᑎᖃᕐᑎᓐᓂᒃ ᖃᐅᔨᒪᔩᐅᔪᓂᑦ ᓯᑯᓕᕆᓂᖅᒥᒃ.

ᑕᒪᖅᒥᒃ ᑲᑎᒪᔩᐅᔪᑦ ᐃᓄᒃᑎᑐᑦ ᐅᖃᓪᓚᖃᑦᑕᓚᐅᖅᑐᑦ ᐅᖃᓪᓚᖃᑎᒌᖅᑯᓪᓗᑎᑦ ᐊᒻᒪᓗ ᐃᓱᒪᒃᓴᖅᓯᐅᖅᓗᑎᒃ ᐅᓚᕕᓴᖅᑕᐅᖅᒥᓪᓗᑎᒃ. ᐊᑕᐅᑎᒃᑯᑦ ᐅᖃᓪᓚᒃᑎᓪᓗᑎᑦ ᑐᓵᖅᑲᖅᑲᑦᑕᖅᓗᑎᒃ ᐃᓄᒃᑎᑐᑦ ᐅᖃᓪᓚᒍᓐᓇᖅᒥᑐᓄᑦ ᐊᒻᒪᓗ ᐃᑲᔪᖅᑕᐅᓪᓗᑎᒃ ᒪᒃᑯᑦ ᐃᓄᒃᑎᑑᓗᐊᖅᓇᖅᒥᑐᑦ.

ᐱᑎᐅᓪ ᐅᑐᕙᒃ, ᖃᐃᖁᔭᐅᓯᒪᔪᖅ

ᓵᓕ ᐃᓄᐊᕋᖅ , ᖃᐃᖁᔭᐅᓯᒪᔪᖅ

ᓯᑯᒥᐅᑦ ᖃᐅᔨᓴᕐᓂᕐᒧᑦ ᐃᓚᒌᑦ

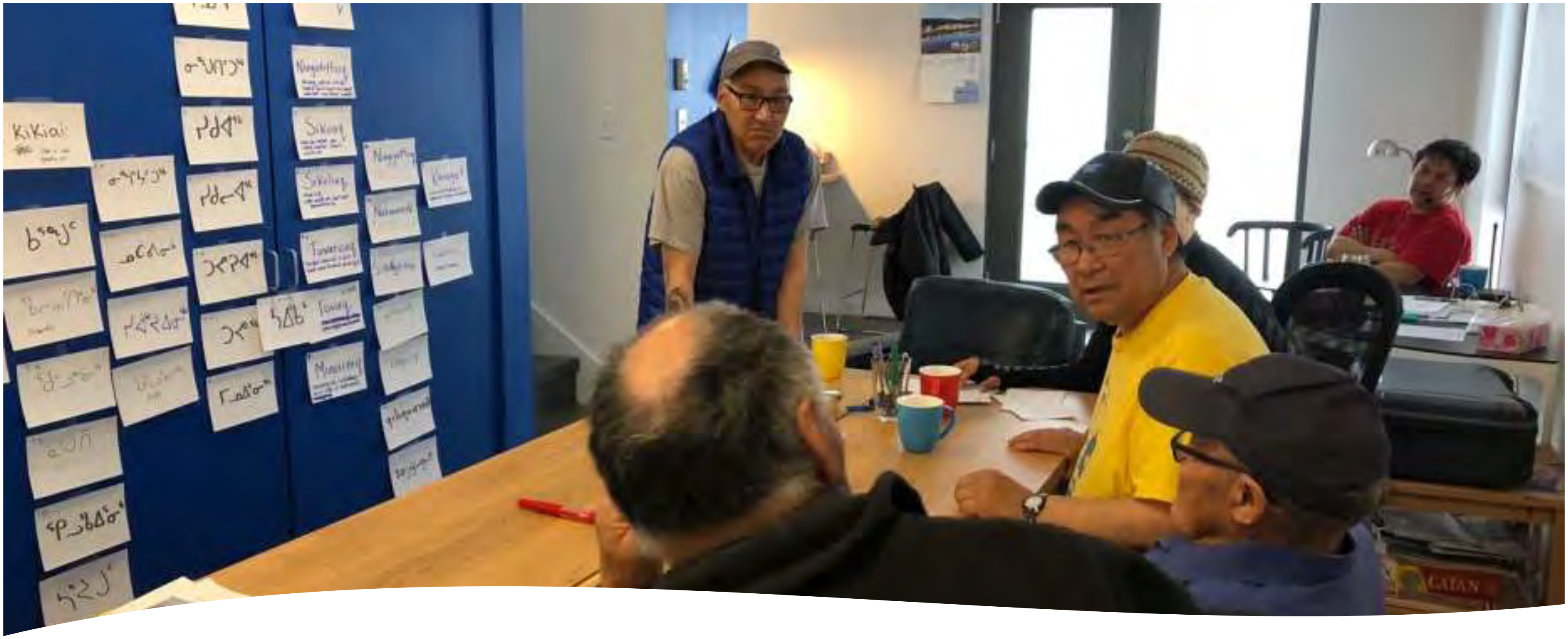
ᐋᓐᑐᓗ ᐋᓇᐊᖅ ᓯᑯᓕᕆᔩᒃᑯᓐᓄᑦ SmartICE ᓄᓇᓕᖕᓂ ᐊᐅᓚᕐᑎᔨᐅᔪᖅ ᒥᕐᑎᒪᑕᓕᖕᒥ ᐊᒻᒪᓗ ᓄᓇᕗᑦ ᐊᐅᓚᓂᖓᓄᑦ ᓯᕗᓕᕐᑎᐅᔪᖅ ᕿᑭᕐᑖᓗᖕᒥ ᐅᐊᖕᓇᖓᓂ. ᐋᓇᐊᖅ ᒪᒃᑯᒃᑑᓪᓗᓂ ᖃᐅᔨᓴᕐᑎᐅᓚᐅᕐᑐᖅ ᓯᑯᒥᐅᑦ ᑕᐃᒎᓯᓕᐅᕐᑎᓪᓗᒋᑦ ᓯᓚᑖᒍᑦ ᓯᑯᓕᕆᔩᒃᑯᑦ ᖃᐅᔨᓴᕐᓇᐅᔪᓐᓃᖀᖓᑦ.

ᑲᑐᓇᓐ ᕗᐃᓪᓴᓐ ᖁᕐᑎᓛᒥ ᐃᓕᓐᓂᐊᕐᑎᐅᔪᖅ ᐃᓕᓐᓂᐊᕐᕕᒃᔪᐊᕐᒥ ᒥᒧᐊᓇᐅ ᓂᐅᕘᓐᓛᓐᒥ. ᑲᑐᓇᓐ ᐃᓕᒋᔭᐅᔪᖅ ᐊᓐᑐᓘᒃᑯᑦ ᑐᑭᒧᐊᒃᑎᕐᑎᓐᓗᑎᒃ ᑲᑎᒪᓂᕐᓂᒃ ᐊᒻᒪᓗ ᑕᐃᒎᓰᑦ ᐅᖃᓕᒫᒐᕐᒥᒃ.

ᔩᑕ ᔪᐱᒃ ᐃᓕᓴᐃᔨᒻᒪᑎ ᐃᓕᓐᓂᐊᕐᕕᒃᔪᐊᕐᒥ ᒫᒃᓛᓯᑐ ᐊᒻᒪᓗ ᑲᑐᓇᓐ ᐅᖓᔪᖅᑳᖓᑕ ᐱᖃᑖ. ᔩᑕ ᐃᖃᓇᐃᔭᖅᑕᖅᓯᒪᔪᖅ ᓄᓇᕘᒥ ᑕᐃᒪᖓᑦ 2001. ᔩᑕ ᐃᓕᓐᓂᐊᕐᑎᑎᓚᐳᕐᑐᖅ ᐊᓐᑐᓗ ᐊᒻᒪᓗ ᑲᑐᓇᓐ ᑐᑭᒧᐊᒃᑎᕐᑎᓂᕐᒥᒃ ᑕᐃᒎᓯᓕᕆᓂᕐᒥᒃ ᑲᑎᒪᓂᖏᓐᓂ.

ᑐᓇᕗ ᐱᐅᓪ ᐱᒋᐊᕐᑎᕐᑎᓯᒪᔪᖅ ᓯᑯᓕᕆᔩᒃᑯᓂᒃ SmartICE ᑕᓇᐅᑦ ᓯᑯᖓᓂ ᖃᐅᔨᓴᕐᓂᕐᒥᒃ ᐊᒻᒪᓗ ᑐᓴᐅᒪᔭᐅᔪᒃᓴᓂᒃ Sea Ice Monitoring & Information Inc. ᐃᓕᓴᐃᔨᒻᒪᑎᐅᓪᓗᓂᓗ ᒥᒧᐊᓇᐅᓪ ᐃᓕᓐᓂᐊᕐᕕᒃᔪᐊᖓᓂ ᓂᐅᕘᐅᓐᓛᓐᒥ ᐊᒻᒪᓗ ᑲᑐᓇᓐ ᐊᖓᔪᖅᑳᖓᑕ ᐱᖃᑖ.

ᐊᔾᔨᖑᐊᖅ ᓴᐅᒥᖕᒥᑦ ᑕᓕᕐᐱᖕᒧᑦ: ᐋᓐᑐᓗ ᐋᓇᐊᖅ, ᑲᑐᓇᓐ ᕗᐃᓪᓴᓐ, ᔩᑕ ᔪᐱᒃ ᐊᒻᒪᓗ ᑐᓇᕗ ᐱᐅᓪ



ᑎᑎᕋᕐᑕᐅᓂᖏᑦ ᓯᑯᒥᐅᑦ ᑕᓇᐅᕐᒥ ᓯᑯᖓᓂᒃ ᑕᐃᒎᓯᓕᓇᓂᖏᑦ

ᐱᕆᐊᕐᓂᖓᓂ ᑲᑎᒪᓂᖏᑦ ᐅᓪᓗᓄᑦ ᐱᖓᓱᓄᑦ ᐅᑐᐱᕆ 2018. ᐊᑐᓂ ᐃᓄᒃᑎᑐᑦ ᑕᐃᒍᓯᑦ ᐅᖃᐅᓯᐅᓪᓗᑎᒃ, ᑎᑎᕋᕐᑕᐅᔪᓪᓗ, ᐊᖏᔮᑕᐅᓪᓗᑎᒃ ᑎᑎᕋᕐᕕᒃᓴᕋᓛᒧᑦ ᑐᑭᖏᓪᓗ ᐊᑖᓃᓪᓗᑎᒃ. ᑎᑎᕋᕐᕕᒃᓴᕋᓛᑦ ᖃᐅᔨᔅᔭᕐᑕᐅᔪᓐᓇᓚᐅᕐᑐᑦ. ᑎᑎᕋᕐᕕᒃᓴᕋᓛᑦ ᑭᐳᒧᐊᕐᑕᐅᒐᒥᒃ ᐊᒻᒪᓗ ᓯᑯᒥᐅᑦ ᑲᑎᒪᔩᖏᑦ ᑎᒃᑯᐊᕐᓯᖃᑦᑕᕐᓗᑎᒃ, ᑎᒍᓗᓂᐅᒃᓗ, ᐋᕐᑭᐊᕐᑕᐅᓪᓗᑎᒃ, ᐊᒻᒪᓗ ᐅᖃᐅᓯᐅᓂᖏᑦ ᒪᓕᒃᓗᒋᑦ ᑐᖏᓕᓇᒃᑐᒥᒃ ᐋᕐᑭᒃᓱᕐᑕᐅᓪᓗᑎᒃ. ᑎᑎᕋᕐᕕᒃᓴᕋᓛᑦ ᓂᐱᑎᕐᑕᐅᓪᓗᑎᒃ ᐊᑭᓐᓇᒧᑦ ᐊᒻᒪᓗ ᐋᕐᑭᒃᓱᕐᑕᐅᓪᓗᑎᒃ ᐊᕋᒍ ᐃᓗᐊᓂ ᑐᖏᓕᓈᖑᓪᓗᑎᒃ ᕿᒥᕈᔭᐅᔪᓐᓇᕐᓗᑎᒃ ᐋᕐᑭᐊᕐᑕᐅᔪᓐᓇᕐᓗᑎᒃᓗ.

ᑐᑭᓯᐊᒃᑲᓂᕈᒪᒍᕕᑦ ᑎᑎᕋᕐᓯᒪᔪᓂᒃ ᑕᐃᒍᓯᖏᓐᓂᒃ ᑲᑎᒪᑎᓪᓗᒋᑦ, ᑕᑯᒋᐊᕐᓗᒍ ᐅᕗᖓ:

Wilson, K.J., Arreak, A., Itulu, J., Sikumiut Community Management Committee, Ljubicic, G.J., and Bell, T. 2021. “When we’re on the ice, all we have is our Inuit Qaujimajatuqangit”: Mobilizing Inuit knowledge as a sea ice safety adaptation strategy in Mittimatalik, Nunavut. Arctic 74: 525–549.

https://doi.org/10.14430/arctic74212

Jonathan Pitseolak, young hunter

Jamesie Itulu, Mittimatalik artist

ᐋᕿᒃᓱᕐᓯᒪᓂᖓ ᐅᖃᓕᒫᒐᖅ

ᓯᑯᒥᐅᑦ ᒪᒃᑯᒃᑐᑦ ᑲᑎᒪᔩᐅᖃᑕᐅᔪᑦ ᐊᔪᓇᕐᓱᕐᑕᐅᕙᓪᓕᐊᓪᓗᑎᒃ ᖃᓄᖅ ᐱᐅᓛᖑᒪᖕᓛᑦ ᑕᐃᒨᓯᖏᑦ ᑐᑭᓪᓗ ᐃᓄᖕᓄᑦ ᓇᓕᒧᖏᓐᓄᑦ ᖃᐅᔨᒪᔭᖃᐅᕐᒪᑕ ᐊᔾᔨᒌᖏᑦᑐᓂᒃ ᐅᖃᐅᓯᖃᕐᑐᓂᒃᓗ. ᐆᒃᑐᑎᒋᓪᓗᒍ, ᒪᑯᒃᑐᑦ ᐃᓄᒃᑎᑐᑦ ᐃᓅᓯᖓᔪᓂᒃ ᐅᖃᓕᒪᕈᒪᓂᕐᓴᐅᖕᒪᑕ, ᐃᓄᒃᑎᑐᑦ ᑎᑎᕋᐅᓯᖓ ᐅᖃᓖᕐᑕᐅᔪᒪᓂᕐᓴᐅᓪᓗᓂ ᐃᓐᓇᐅᓂᕐᓴᐅᔪᓄᑦ. ᑐᑭᖏᑦ ᖃᓪᓗᓈᑎᑐᖓᑎᓪᓗᒋᑦ ᐱᓪᓚᕆᐅᕆᔭᐅᓚᐅᕐᒥᔪᖅ ᐅᓄᕐᓂᕐᓴᐃᑦ ᒪᒃᑯᒃᑐᑦ ᐃᓚᐅᑎᑕᐅᓂᐊᕐᒪᑕ ᐃᓄᒃᑎᑑᕈᓐᓇᑦᑎᐊᖏᓐᓂᕐᓴᐃᑦ. ᑕᐃᒪᐃᑎᓪᓗᒍ, ᐅᖃᓕᒫᒐᖅ ᒪᕉᓕᖓᔪᓂᒃ ᐃᓄᒃᑎᑐᑦ ᐊᒻᒪᓗ ᖃᓪᓗᓈᑎᑐᑦ.

ᐋᕿᒃᓯᓚᐅᕐᑐᑦ ᓴᕿᑦᑎᔪᒪᓪᓗᑎᒃ ᐅᖃᓛᒐᕐᒥᒃ ᑐᓂᐅᖃᕐᑕᐅᓂᐊᕐᑐᒥᒃ ᐃᒃᓗᓕᒫᓄᑦ ᒥᑦᑎᒪᑕᓕᖕᒥ. ᑕᐃᒨᓯᑦ ᐊᑐᓂ ᐊᔾᔨᖑᐊᓂᒃ ᐃᓚᖏᓐᓂᒃ ᐱᔪᓐᓇᓚᐅᖏᑦᑐᒍᑦ ᓇᖏᐊᕐᓇᕐᑐᒦᑦᑐᓂᒃ ᐅᕙᓅᓐᓃᑦ ᑐᑭᖓ ᐊᐅᓚᓂᐅᑎᓪᓗᒍ. ᔭᐃᒥᓯ ᐃᑐᓗᒃ, ᒥᑦᑎᒪᑕᓕᖕᒥᐅᑕᖅ ᒪᒃᑯᒃᑐᖅ ᑎᑎᕋᐅᔭᕐᑎ ᐊᑭᓕᕐᓱᕐᑕᐅᓚᐅᕐᑐᖅ ᑎᑎᕋᐅᔭᕐᑯᔭᐅᓪᓗᓂ ᑕᐃᒨᓯᑦ ᐅᖃᓕᒫᒐᕐᓂᒃ.

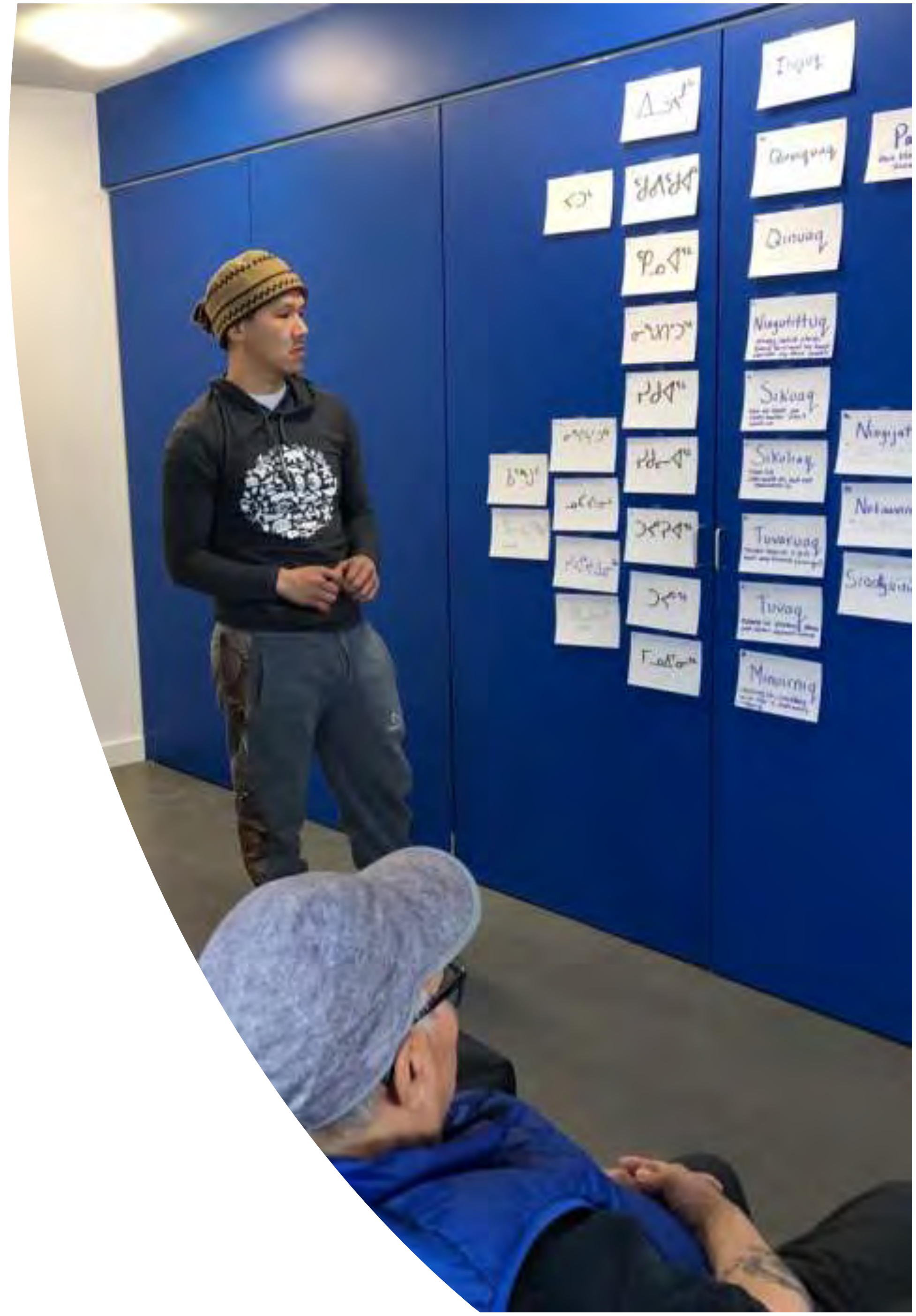
ᕿᒥᕈᓯᐅᓂᖏᑦ ᑕᕆᐅᕐᒥ ᓱᑯ ᑕᐃᒍᓱᖏᑦ ᑐᑭᖏᓪᓗ

ᐋᓐᑐᓗ ᐋᕆᐊᖅ ᑐᑭᒧᐊᒃᑎᑦᑎᓚᐅᕐᑐᖅ ᑲᑎᓪᓗᒋᑦ 16 ᑲᑎᒪᓂᐅᔪᑦ ᓇᓗᓇᐃᕐᓯᒋᐊᕐᓂᖏᑦ ᓱᑯᒥᐅᑦ ᐊᑯᓐᓂᖓᓂ ᔭᓄᐊᕆ 2019 ᐊᒻᒪᓗ ᓯᑎᐱᕆ 2021. ᐊᑯᓂᐅᔾᔪᑎᒋᓚᐅᕐᑕᖓ ᐊᖏᖃᑎᒌᖓᔪᒃᓗᑎᒃ ᐱᔾᔪᑎᒋᓪᓗᒍ ᑎᑎᕋᕐᑕᐅᓚᐅᕐᓯᒪᖏᒻᒪᑕ. ᐃᓚᖓᑦ ᐃᓐᓇᐅᔪᖅ ᐅᖃᓚᐅᕐᑐᖅ,

“ᑭᖑᓂᑦᑎᓐᓂ ᑎᑎᕋᐅᑎᖃᓚᐅᖏᓐᓇᑦᑕ, ᑎᑎᕋᓚᐅᖏᓐᓇᑎᒍ. ᓯᕗᓪᓕᕐᐸᕆᓚᐅᕋᑎᒍ ᑎᑎᕋᕐᑕᐅᓪᓗᑎᒃ ᑕᕆᐅᕐᓱᑯᐃᑦ ᑕᐃᒍᓱᖏᑦ ᖃᐅᔨᒪᔭᐅᔪᓐ”

ᒐᒪᐃᓕ ᕿᓗᕿᒄ, ᐃᓐᓇᒻᒪᕆᒃ

ᐊᓂᒍᕐᑎᓪᓗᒍ ᒪᔨ 2020, ᓄᓇᕗᑦ ᓄᓇᕐᔪᐊᕐ ᐱᔾᔪᑕᐅᓪᓗᓂ ᓂᐅᕈᓂᖅ ᐱᑐᐃᓐᓇᐅᔪᓐᓃᓚᐅᕐᒪᑦ ᓯᓚᑖᓂ ᓄᓇᖃᕐᑐᓄᑦ ᖃᐅᔨᓴᕐᑎᐅᔪᓄᑦ; ᑭᓯᐊᓂ, ᓄᓇᕗᑦ ᓄᓇᕐᔪᐊᖅ ᑲᑦᑐᕈᑕᐅᓚᐅᖏᑦᑐᖅ ᑲᔪᓯᓂᖓᓄᑦ. ᐊᓐᑐᓗ ᐋᕆᐊᖅ ᓇᖕᒥᓂᖅ ᐊᐅᓚᑦᑎᓪᓗᓂ ᐊᕿᒃᓱᐃᓪᓗᓂ ᐊᒻᒪᓗ ᑐᑭᒧᐊᒃᑎᑦᑎᓪᓗᓂ ᑕᐅᑐᖃᑎᒌᒃᓗᑎᒃ ᓱᑯᒥᐅᑦ ᑲᑎᒪᔨᖏᑕ ᑲᑎᒪᓂᖏᑦ ᒥᑦᑎᒪᑕᓕᖕᒥ, ᖃᓪᓗᓈᑦ ᐃᖃᓇᐃᔭᖃᑎᖏᑦ ᐃᓚᐅᑲᑕᒃᓗᑎᒃ ᐅᖄᓚᐅᑎᒃᑯᑦ. ᐋᕿᑦᑎᐊᕐᓯᒪᓂᖓᓄᑦ ᐃᖃᓇᐃᔭᖃᑎᒌᒍᓇᕐᓂᕗᓪᓗ, ᓄᓇᓕᖕᓂ ᖃᐅᔨᓴᕐᑎᐅᔪᑦ, ᐊᒻᒪᓗ ᓯᕗᓕᕐᑎᖃᑦᑎᐊᕐᓂᕐᒧᑦ, ᐱᔮᕈᓐᓇᓚᐅᕐᑕᕗᑦ ᐱᔭᒃᓴᕆᔭᕗᑦ ᓄᓇᕗᑦ ᓄᓇᕐᔪᐊᕐᑕᖃᕐᓗᐊᕐᑎᓪᓗᒍ.



Nalunaijautit

Nunaliujuq mittimatalik, nunavut

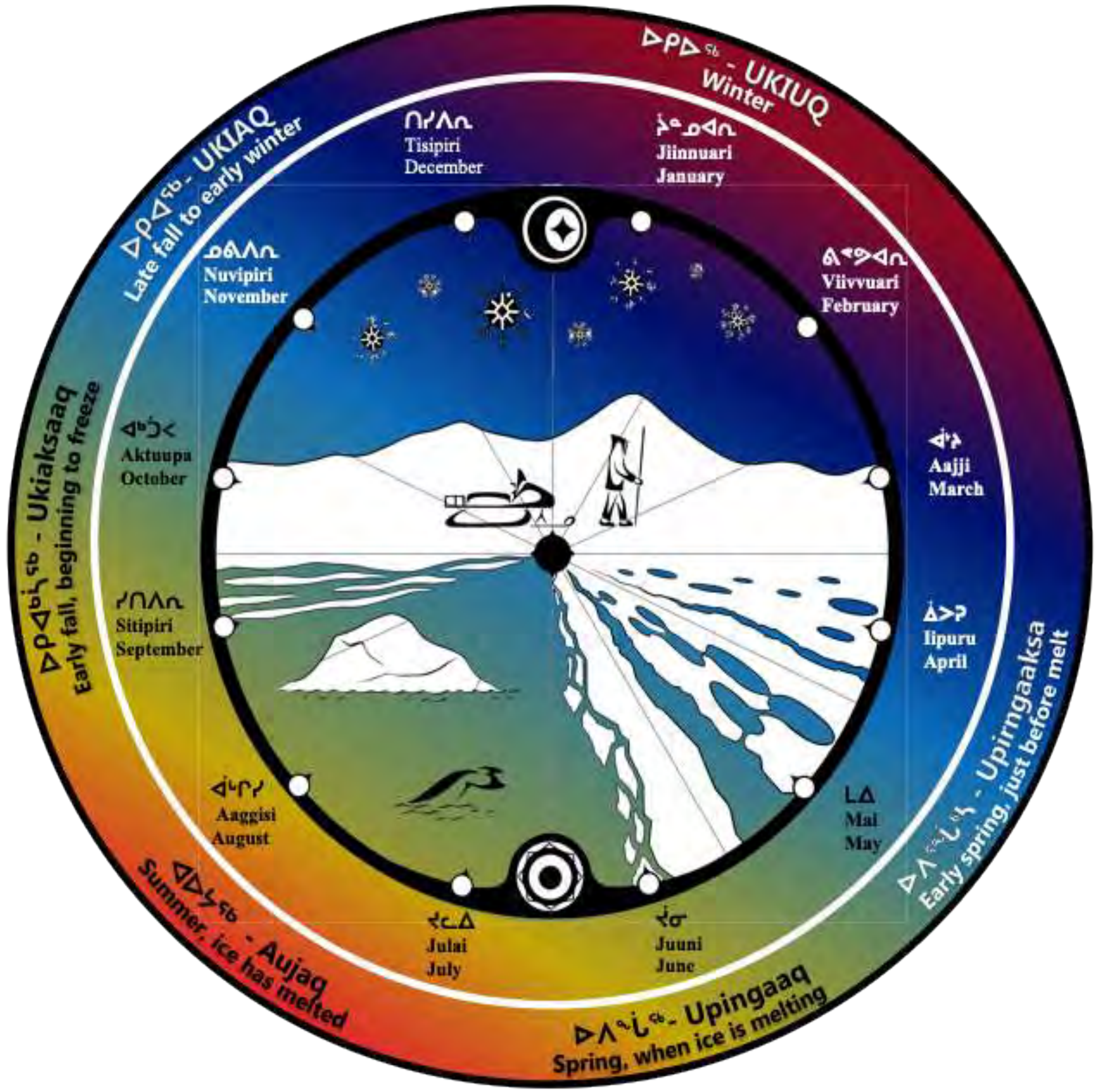
Nunaliujuq mittimatalik uangnanganittuq qikirtaalungmi nunavut (titirarsimajut takulugu 1).

Mittimatalingmiut ingiraqattarmata sikukkut taqinik 7 aragu iluani angunasuk&utik iqalliar&utiklu niqiksarsiur&utiklu (tuktu,qilalugaq,nattiq ammalu iqaluk) ammalu ilagiit ikluralamiigiarturtut (titirarsimajut takulugu 1). Ingiraviugajuktuq qanigijangani mittimataliup Navy Board Inlet , tasiujaq, ammalu tursukattak (titirarsimajut takulugu 2).

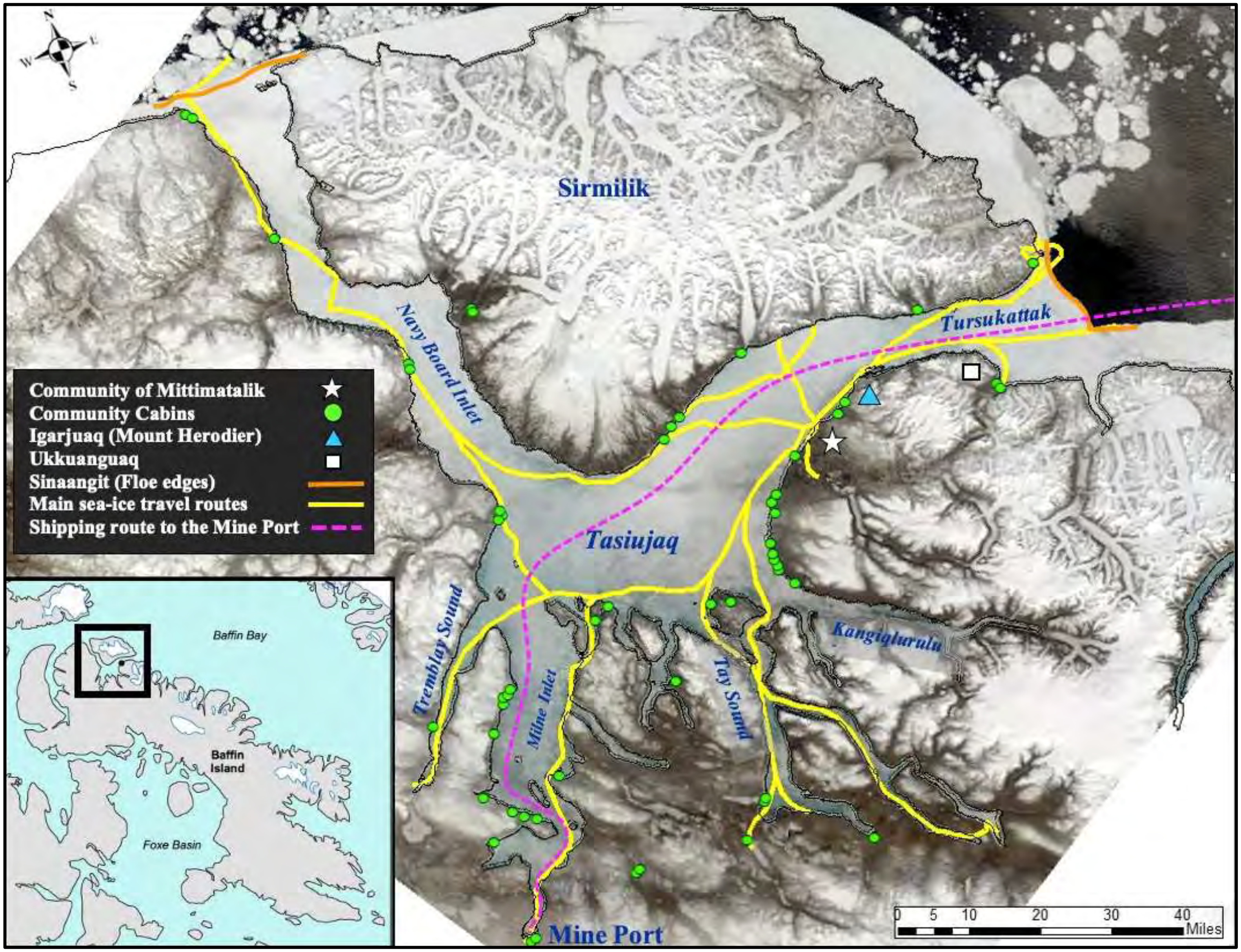
Marungmatik sinaangik tamaani, paangani sullungata Navy Board Inlet ammalu paangani tursukattak (titirarsimajut takulugu 2). Sinaangik tuvaup kiklingani tuvaq (sikulariujuq kiklinga imauningata nunamut sikusimajuq), aktuajuq imaininganut sikujunnangittuq anginirsaulluni. Tursukattak sinaa ungasingniqartuq 65 kilaamita nunalingnit ammalu angunasugiarviugajuktuq ammalu iqalliartunut aqutaulluni mittimatalingmiunut.

Mittimatalingmi sikunga aulaninga

Tariut sikunga nunaliit avataani quarpallialiqattartuq nungurpasiani utupiri ammalu sikukkuurnarsiqattar&uni qitipaluani nuvipiri siku tuvauliraangat. Mittimatalingmiut sikukkuuqattartut taqinut 7-nut aragu iluani julaimut tikil&ugu takulugu titirarsimajuq 1, Mittimatalingmi tariut sikungata aulaninga.



Titirarsimajuq 1: Mittimatalik tariungata sikunga aulaninga. Titiraujaqtuq Jamesie Itulu



Titirarsimajuq 2: Nunanguaq mittimatalik tariungata sikunga ikliniuqattartuq, Nunavut, Kanata. Qangattartitausimajukkut ajjinguaq: MODIS kalaqartuq ajjiliursimajuq, juni 9, 2019 (NASA, 2019).

Sikumiuq aulattijiit katimajingit

Sikumiut tukiqartuq “Inuit sikumiutaujut”. Katimajiujut inuit tariup sikunganik ingirajiujut aulattisimajut sikulirijikkunnik SmartICE nunalingni pigiartitausimalluni tariup sikunganik qaujisaqattartut aulattijut (smartice.org) mittimatalingmi taimangat 2016. Ukua katimajiujut ilauqattarsimajut uqalimaagaliurtunut.

Brian Koonoo,
Mirnguisirvilirijikkut Kanata

Caleb Sangoya,
Narutit Unatartuksait

David Angnatsiak ,
Qinirtit Parsaijiit

Elijah Panipakoocho,
Innammarik, Umajurniartikkut Katimajingit

Gamalie Kilukishak,
Innammarik

Ivan Koonoo
Ikaarvik

Jonathan Pitseolak
Makuktuq Angunasukti

Moses Amagoalik
Makuktuq Angunasukti

Rachel Smale
Ikaarvik

Sheati Tagak,
Aullaujjiji

Qanuimmat tariumi sikumi taiguusiit uqalimaaganngurtitaulaurpa

Aragungani 2017, Sikumiut katimajingit isumaalutiqalaurmata makkuktut qaujimangiluarninginnik Inuit qaujimajatuqanginnik attarnartailimanirmik tariur sikukkut ingiralutik. ilanga Sikumiut katimajiuqataujuq uqalaurtuq qanutigit atuutiqartigininganik taigusit Sikumut pillariuninganik tusaumaqattautininginnut.

"Uqallaqatigiigunnaratta. Uqausirmik uqatuinnarluta tukisijaukautigigajartuq siku qanuilinganinganik uqausirijattinnik"

Brian Koonoo, Mirnguisirvilirijikkut Kanata

Inuktitut taiguusit tariurmi sikuit pillariujuq ilinartaulutik ilitaujunnarmata makkuktunut nangiarnartut attarnartullu qanuilingangmangaata ingiravigilugit. Sikumiut titiraqujilaurmata ammalu qaujimajaulutik Inuit qaujimajatuqangit nunalingni inungit nangiarnangittukkuurlutik ingiraqattarniarmata sikukkut.

"Sikuniil&uta, pisimajatuarigattigu Inuit qaujimajatuqangit"

Caleb Sangoya, Narutit Unatartuksait

Ikajursimajut tariurmi sikuit taiguusinginnik

Sikumiut katimajingit ilauqujilaurmata marukkanniingnik innaangnik sikulirinirmik Inuit qaujimajatuqangitigut, saali inuaraq ammalu pituili uuttuvak. Innait sikumiut katimajiuqataujut pijumalaurmijut makkuktunik ilauqujillutik katimaqatauqattarlutik qaujimalirnirsauqullugit Inuit qaujimajatuqanginnik qaujimajiujunit sikulirinirmik.

Tamarmik katimajiujut inuktitut uqallaqattalaurtut uqallaqatigiiqullugit ammalu isumaksarsiurlutik ulavisartaungillutik. Atautikkut uqallaktillugit tusaajiqaqattar&utik inuktitut uqallagunnangittunut ammalu ikajurtaullutik makkuktut inuktituuluarunnangittut.

Bethuel Ootoovak, qaiqujausimajuq

Charlie Inuarak, qaiqujausimajuq

Sikumiut qaujisarnirmut ilagiit

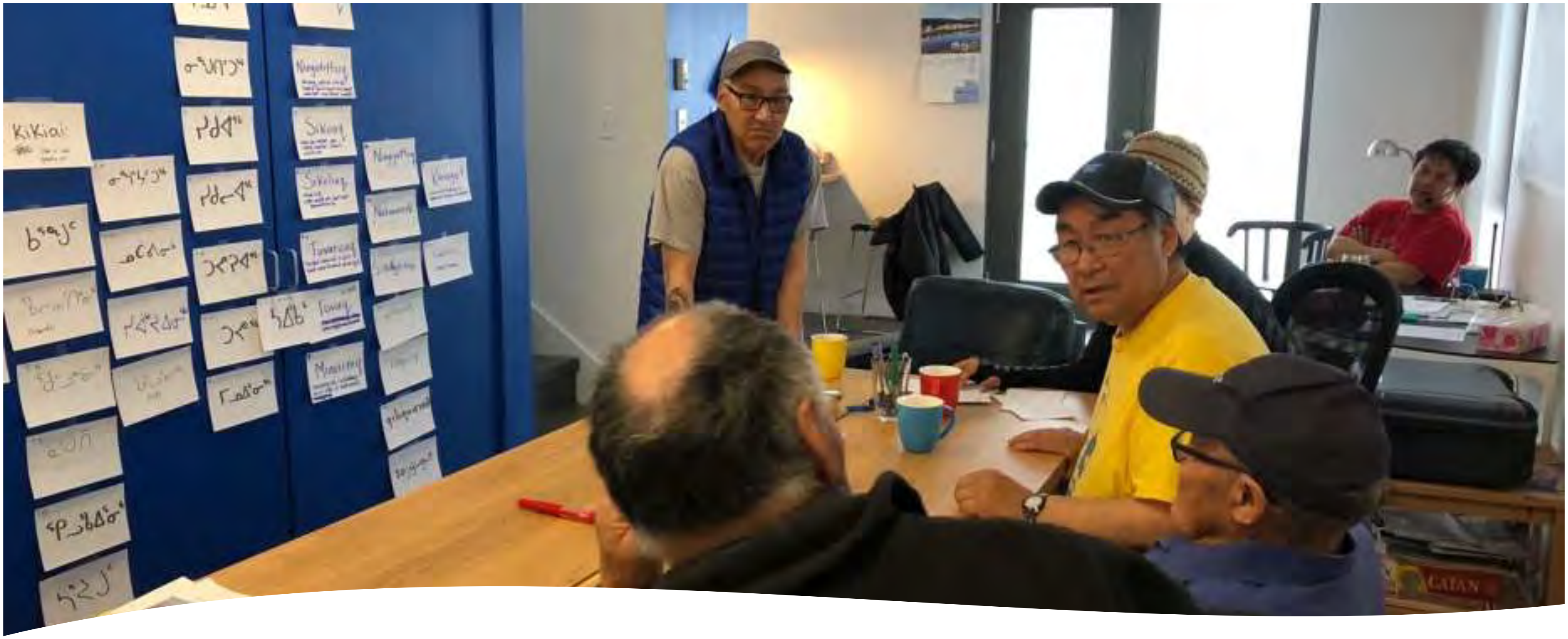
Andrew Arreak sikulirijikkunnut SmartICE nunalingni aulattijiiujuq mittimatalingmi ammalu nunavut aulaninganut sivulirtiujuq qikirtaalungmi uangnangani. Andrew makkuktuulluni qaujisartiulaurtuq sikumiut taiguusiliurtillugit silataagut sikulirijikkut qaujisarnaujunniiraangat.

Katherine Wilson quttilaami ilinniartiujuq ilinniarvikjuarmi mimuariu niuvanlaanmi. Katherine ilagijaujuq Andrew tukimuaktittillutik katimanirnik ammalu taiguusiit uqalimaagarmik.

Gita Ljubicic ilisaijimmari ilinniarvikjuarmi maklaasitu ammalu Katherine’s ungajuqaangata piqataa. Gita iqanaijaqattarsimajuq nunavuumi taimangat 2001. Gita ilinniartitilapurtuq Andrew ammalu Katherine tukimuaktittinirmik taiguusilirinirmik katimaninginni.

Trevor Bell pigiartittisimajuq sikulirijikkunnik SmartICE tariut sikungani qaujisarnirmik ammalu tusaumajaujuksanik Sea Ice Monitoring & Information Inc. Ilisaijimmariullunilu mimuariul ilinniarvikjuangani niuvaunlaanmi ammalu Katherine’s angajuqaangata piqataa.

Ajjinguaq saumingmit talirpingmut: Andrew Arreak, Katherine Wilson, Gita Ljubicic ammalu Trevor Bell



Titirartauningit Sikumiut tariurmi sikunganik taiguusiliriningit

Pigiarningani katimaningit ullunut pingasunut utupiri 2018. Atuni inuktitut taigusit uqausiullutik, titirartaujullu, angijuutaullutik titirarviksaralaamut tukingillu ataaniil&utik. Titirarviksaralaat qaujijjutaujunnalaurtut. Titirarviksaralaat kipumuartaugamik ammalu sikumiut katimajingit tikkuarsiqattar&utik, tiguluniuklu, aaqigiartaullutik, ammalu uqausiuningit malik&ugit tungiliriktumik aaqiksurtaullutik. Titirarviksaralaat nipitirtaullutik akinnamut ammalu aaqiksurtaullutik aragu iluani tungiliriingullutik qimirujaujunnarlutik aaqigiartaujunnar&utiklu.

Tukisigiakkannirumaguvit titirarsimajunik taigusinginnik katimatillugit, takugiarlugu uvunga:

Wilson, K.J., Arreak, A., Itulu, J., Sikumiut Community Management Committee, Ljubicic, G.J., and Bell, T. 2021. “When we’re on the ice, all we have is our Inuit Qaujimajatuqangit”: Mobilizing Inuit knowledge as a sea ice safety adaptation strategy in Mittimatalik, Nunavut. Arctic 74: 525–549.

https://doi.org/10.14430/arctic74212

Jonathan Pitseolak, young hunter

Jamesie Itulu, Mittimatalik artist

Aaqiksursimaninga uqalimaagaq

Sikumiut makkuktut katimajiuqataujut ajurirsurtauvalliallutik qanuq piulaangungmangaat taiguusingit tukillu inungnut nalimunginnut qaujimajaqaurmata ajjigiingittunik uqausiqartuniklu. Uuktutigillugu, makuktut inuktitut inuujingajunik uqalimarumanirsaungmata, inuktitut titirausinga uqalimaartaujumanirsaulluni innaunirsaujunut. Tukingit qallunaatitungatillugit pillariugijaulaurmijuq unurnirsait makkuktut ilautitauniarmata inuktituurunnattianginnirsait. Taimaitillugu, uqalimaagaq maruulingajunik inuktitut ammalu qallunaatitut.

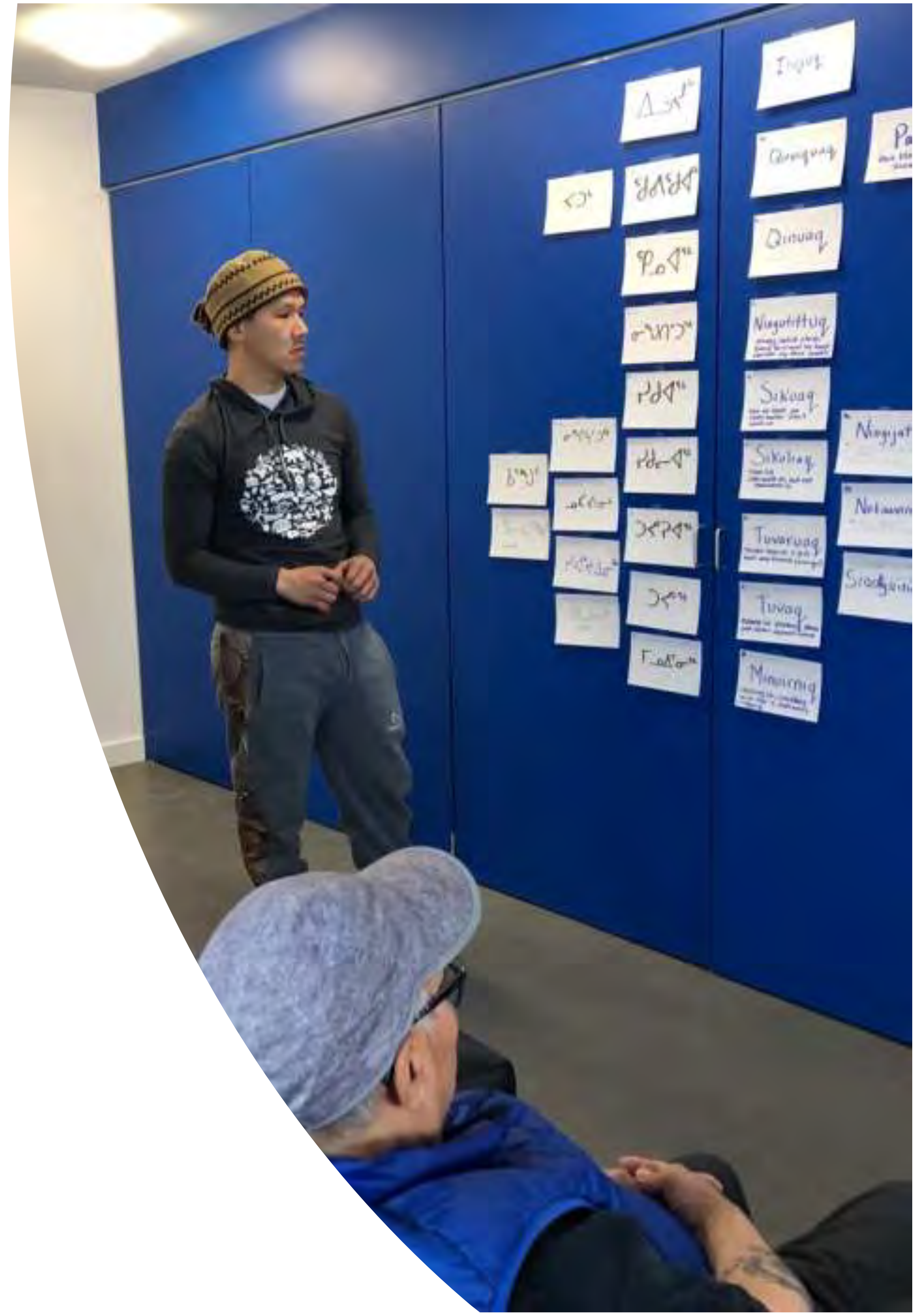
Aaqiksilaurtut saqittijumallutik uqalilaagarmik tuniuqartauniartumik iklulimaanut mittimatalingmi. Taiguusit atuni ajjinguanik ilanginnik pijunnalaungittugut nangiarnartumiittunik uvaluunniit tukinga aulaniutillugu. **Jamesie Itulu**, mittimatalingmiutaq makkuktuq titiraujarti akilirsurtaulaurtuq titiraujaqujaulluni taiguusit uqalimaagarnik.

Qimirujauningit tariurmi siku taigusingit tukingillu

Andrew Arreak tukimuaktittilaurtuq katil&ugit 16 katimaniujut nalunairsigiarningit sikumiut akunningani januari 2019 ammalu sitipiri 2021. Akuniujjutigilaurtanga angiqatigiigasuk&utik pijjutigillugu titirartaulaursimangimmata. ilangat innaujuq uqalaurtuq,

> *"Kingunittinni titirautiqalaunginnatta, titiralaunginnattigu. Sivullirparilaurattigu titirartaullutik tariur sikuit taigusingit qaujimajaujut"*
>
> ***Gamalie Kilukishak, Innammarik***

Anigurtillugu maji 2020, nuvangnarjuar pijjutaulluni niuruniq pituinnaujunniilaurmat silataani nunaqartunut qaujisartiujunut; kisiani, nuvangnarjuaq katturutaulaungittuq kajusininganut. Andrew Arreak nangminiq aulattilluni aqiksuilluni ammalu tukimuaktittilluni tautuqatigiik&utik sikumiut katimajingita katimaningit mittimatalingmi, qallunaat iqanaijaqatingit ilaukatak&utik uqaalautikkut. aaqittiarsimaninganut iqanaijaqatigiigunarnivullu, nunalingni qaujisartiujut, ammalu sivulirtiqattiarnirmut, pijariirunnalaurtavut pijaksarijavut nuvangnarjuartaqaraluartillugu.



Introduction

The Community of Mittimatalik, Nunavut

The community of Mittimatalik (Pond Inlet) is located at the northern tip of Baffin Island in Nunavut (Figure 1).

Mittimatalingmiut (people of Mittimatalik) travel on the sea ice for about 7 months of the year to hunt and fish for country food (caribou, narwhal, beluga, seal, and char) and to spend time away from town at family cabins (Figure 1). Areas commonly travelled around Mittimatalik include Navy Board Inlet, *Tasiujaq* (Eclipse Sound), and *Tursukattak* (Figure 2).

There are two *sinaangit* (plural of sinaa = floe edges) in the region, one at the entrance to Navy Board Inlet and one at the entrance to Tursukattak (Figure 2). Sinaangit are stable edges of *tuvaq* (landfast or stable ice that is frozen to the land), located beside areas of open water that remain clear of ice throughout most of the sea ice season. The Tursukattak sinaa is located 65 km from the community and is one of the main hunting and fishing locations that Mittimatalingmiut use.

Mittimatalik sea ice seasonal cycle

The sea ice around the community begins to freeze in late October and is normally safe for travel by mid-November once the ice becomes tuvaq. Mittimatalingmiut travel on the sea ice for 7 months of the year until early July and shown in figure 1, the Mittimatalik sea ice seasonal cycle.

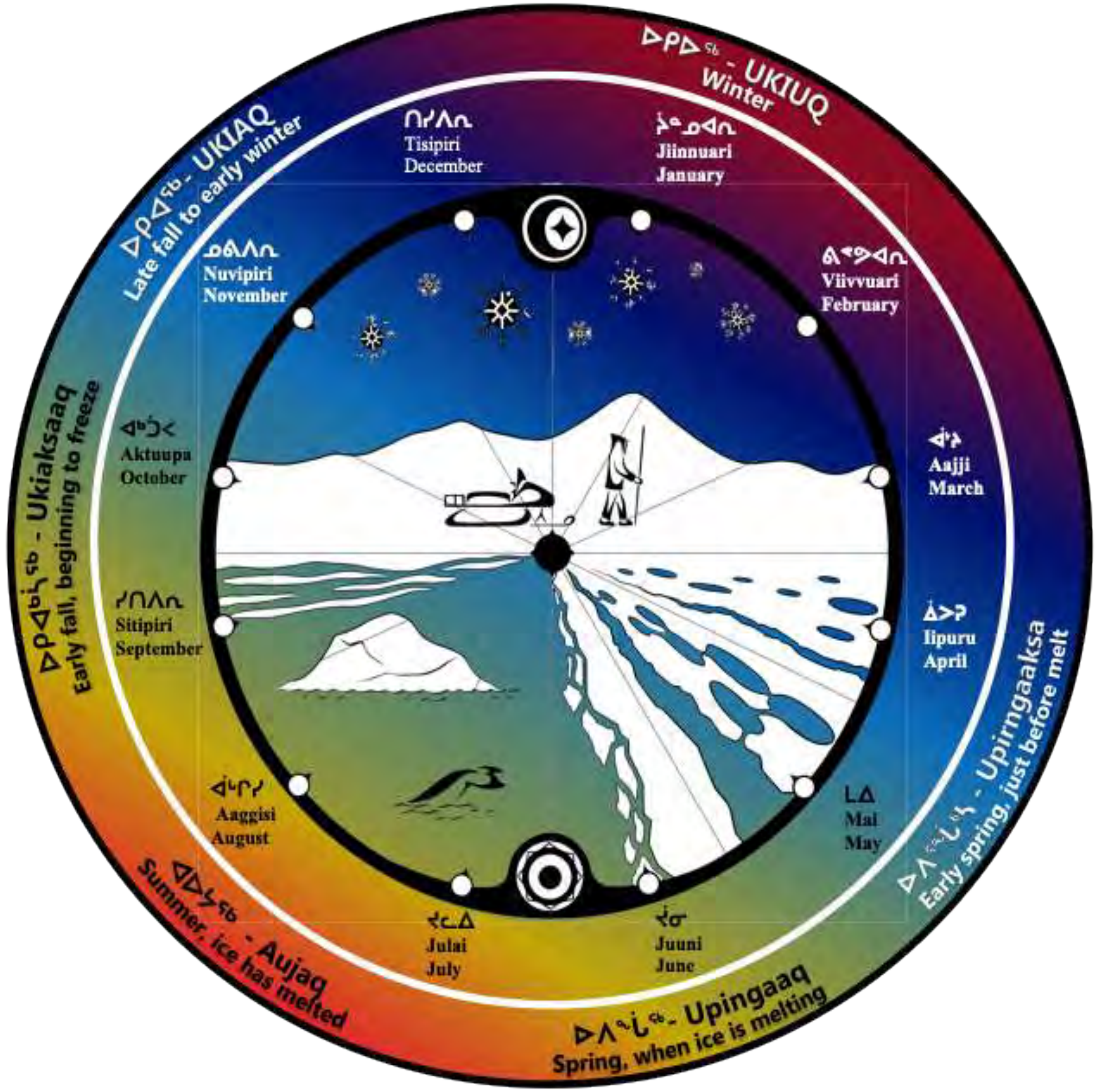


Figure 1: The Mittimatalik sea ice seasonal cycle. Illustration by Jamesie Itulu

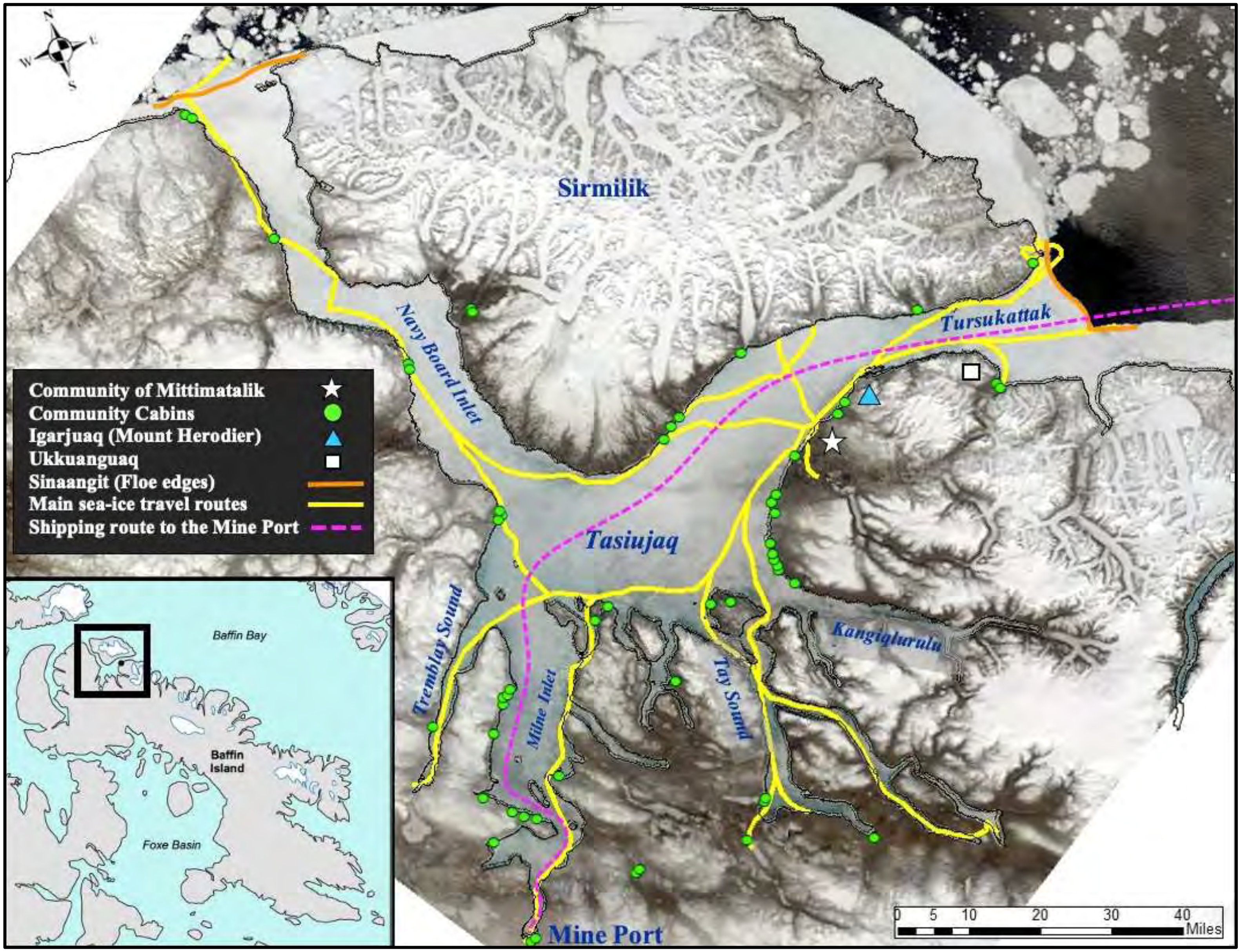


Figure 2: Map of the Mittimatalik sea ice travel region, Nunavut, Canada.
Background satellite image: MODIS True Colour Composite, June 9, 2019 (NASA, 2019).

The Sikumiut management committee

Sikumiut means “people of the sea ice”. It is a committee of Inuit sea ice users that has been managing the SmartICE community-based sea ice monitoring program (smartice.org) in Mittimatalik since 2016. The following members were involved in the making of this booklet.

Brian Koonoo,
Parks Canada

Caleb Sangoya,
Canadian Rangers

David Angnatsiak ,
Search and Rescue

Elijah Panipakoocho,
Elder, Hunters and Trappers Organization

Gamalie Kilukishak,
Elder

Ivan Koonoo
Ikaarvik youth

Jonathan Pitseolak
Young hunter

Moses Amagoalik
Young hunter

Rachel Smale
Ikaarvik youth

Sheati Tagak,
Local Outfitter

Why the sea ice terminology book was made

In 2017, Sikumiut members expressed concern about younger generations lacking the fundamental Inuit Qaujimajatuqangit (IQ) to keep them safe while they are traveling on the sea ice. One Sikumiut member explained how their Inuktitut sea ice terminology is a critical communication tool for sharing information with each other.

"We have a way of speaking to each other. We can say just one word and others will immediately understand the ice conditions we are talking about".

Brian Koonoo, Parks Canada

The Inuktitut sea ice terms are important to learn as they teach youth how to identify safe and dangerous ice conditions while they are travelling. Sikumiut wanted to document and share their IQ with the community to improve safe sea ice travel.

"When we're on the ice, all we have is our Inuit Qaujimajatuqangit"

Caleb Sangoya, Canadian Rangers

Contributors to the sea ice terminology

Sikumiut members requested the participation of two additional Elders with significant sea-ice IQ, Charlie Inuarak and Bethuel Ootoovak. Elder Sikumiut members also requested youth Sikumiut members to attend the workshops to expand their sea ice IQ as emerging knowledge holders.

All the project meetings were held in Inuktitut to enable conversations and ideas to flow freely without interruption. Simultaneous translation into English was provided mostly for the non-Inuit research partners and to assist youth members who are not fully bilingual.

Bethuel Ootoovak, invited sea ice expert

Charlie Inuarak, invited sea ice expert

Sikumiut research partners

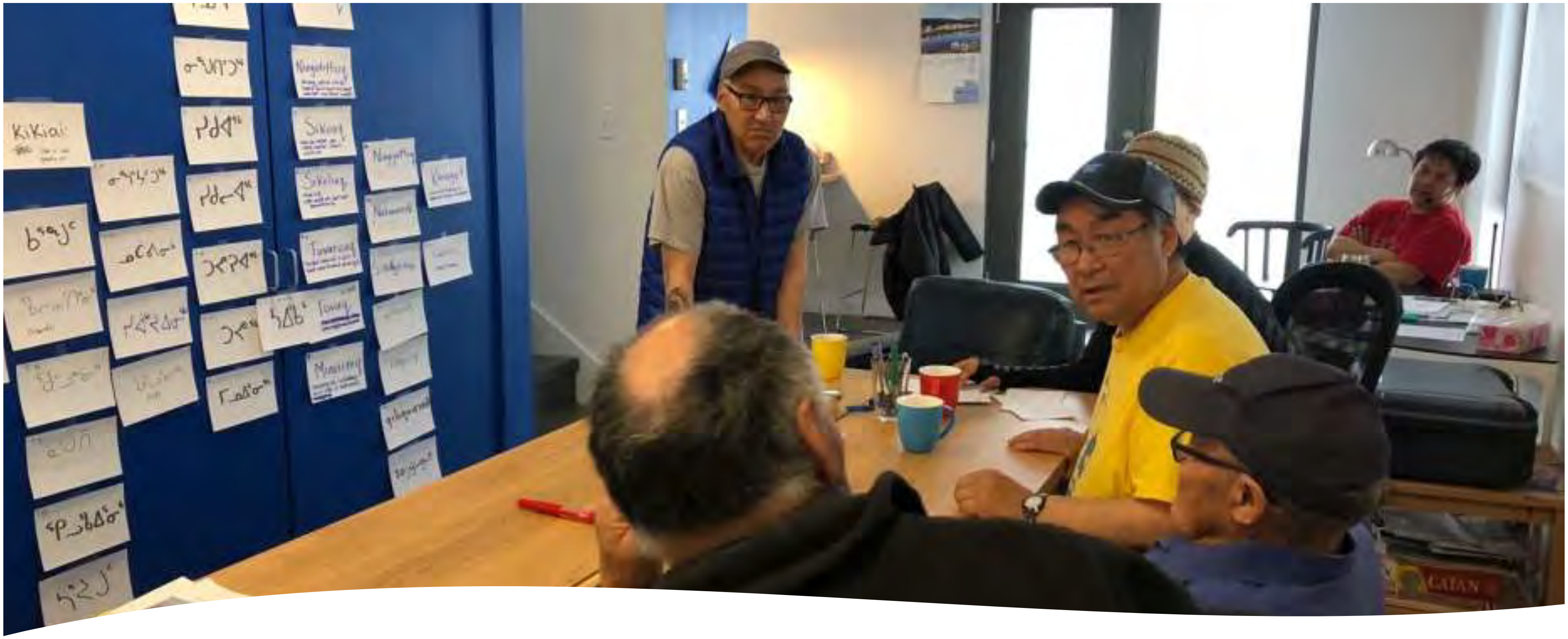
Andrew Arreak is the SmartICE Community Operator for Mittimatalik and the Nunavut Operations Lead for Qikiqtaaluk North. Andrew was the Inuit youth researcher for the Sikumiut terminology project outside of the SmartICE monitoring season.

Katherine Wilson is a PhD student with Memorial University of Newfoundland. Katherine partnered with Andrew to coordinate the workshops, meetings and the terminology booklet.

Gita Ljubicic is a professor at McMaster University and Katherine's co-supervisor. Gita has been working with Nunavummiut since 2001. Gita trained Andrew and Katherine in facilitating the terminology workshops.

Trevor Bell is the founder of SmartICE Sea Ice Monitoring & Information Inc. He is also a professor at Memorial University of Newfoundland and Katherine's co-supervisor.

Pictured from left to right: Andrew Arreak, Katherine Wilson, Gita Ljubicic and Trevor Bell



Documenting Sikumiut’s sea ice terminology

The initial workshops occurred over three days in October 2018. As each Inuktitut sea ice term was discussed, the term was written in bold, large letters on an index card, with the definition below it. The index cards allowed for a hands-on experience. The cards were placed on the table and Sikumiut members could point to a card, pick it up, edit it themselves, and arrange the cards based on the discussion. The cards were also taped to the wall and arranged in a seasonal cycle for review and adjustment.

For more detailed information on the terminology workshop methods, please see:

Wilson, K.J., Arreak, A., Itulu, J., Sikumiut Community Management Committee, Ljubicic, G.J., and Bell, T. 2021. “When we’re on the ice, all we have is our Inuit Qaujimajatuqangit”: Mobilizing Inuit knowledge as a sea ice safety adaptation strategy in Mittimatalik, Nunavut. Arctic 74: 525–549.

https://doi.org/10.14430/arctic74212

Jonathan Pitseolak, young hunter

Jamesie Itulu, Mittimatalik artist

Designing the booklet

Sikumiut youth members provided guidance on how best to describe the terms for Inuit of their own generation with varying levels of sea ice experience and language. For example, younger generations prefer Inuktitut roman orthography, while Inuktitut syllabics are preferred by older generations. Having definitions in English was also considered important to reach a broader audience of youth that are not as comfortable in Inuktitut. As a result, the booklet is produced with two Inuktitut fonts and English.

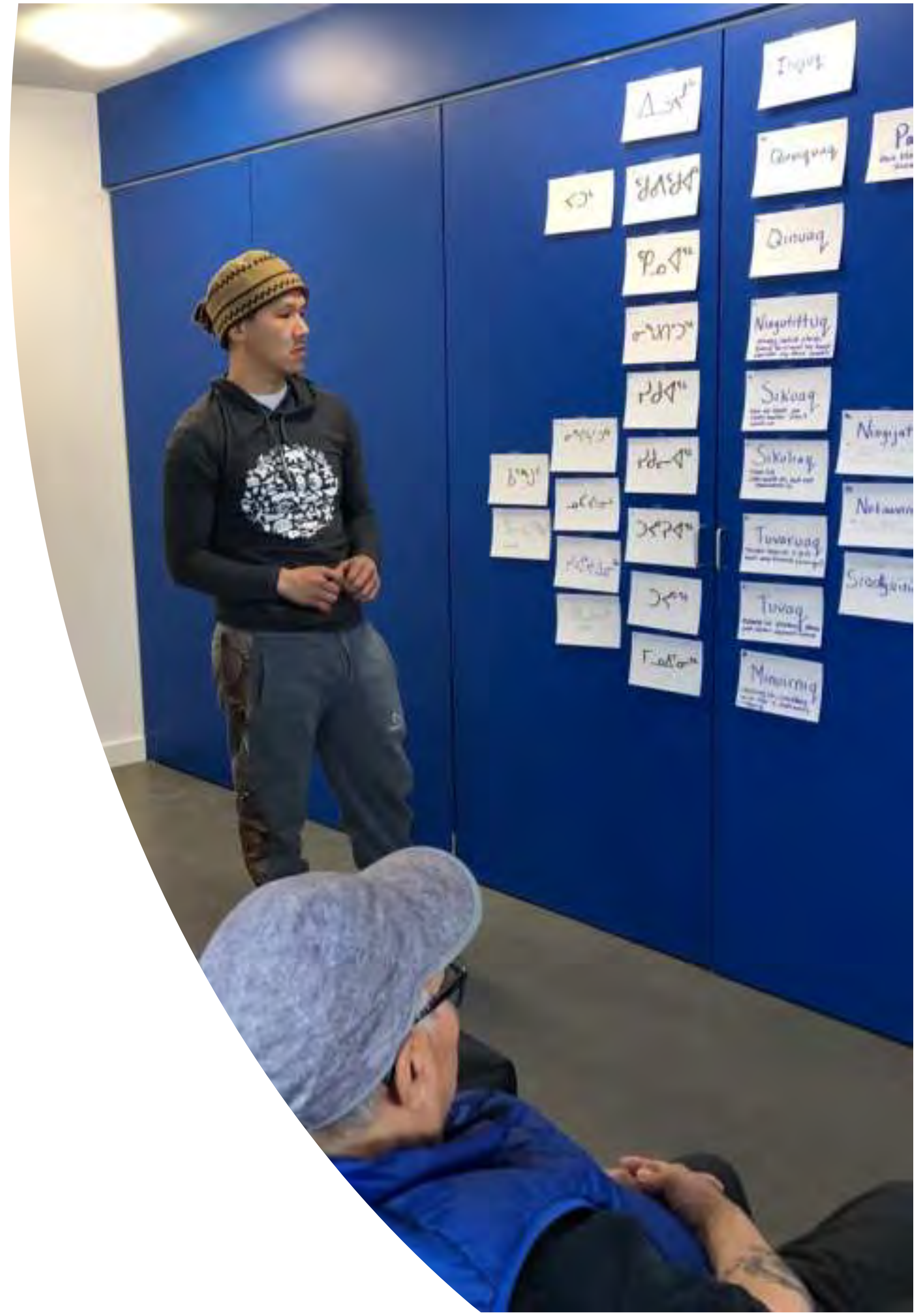
The decision was made to create an illustrated paper booklet to distribute to every household in Mittimatalik. We were not able to get pictures for all the terms because it was either too dangerous, or because the term described an action. **Jamesie Itulu**, a Mittimatalingmiut youth artist was hired to make illustrations for the terminology booklet.

Reviewing the sea ice terminology descriptions

Andrew Arreak facilitated a total of 16 validation meetings with Sikumiut between January 2019 and September 2021. It took time for Sikumiut to collectively agree and review the spelling and definitions of the terms since they had never been written down before. As one Elder Sikumiut member stated,

> *"In the past we never had writing tools, so we did not record these things. This will be the first time we have documented our sea ice knowledge"*
>
> ***Gamalie Kilukishak, Elder***

After March 2020, the COVID-19 pandemic restricted travel for the non-Inuit research partners living outside of Nunavut; however, the pandemic did not interrupt the project. Andrew Arreak continued to independently organize and facilitate in-person Sikumiut meetings in Mittimatalik, with the non-Inuit partners participating by telephone. With well-established relationships, local research capacity, and leadership, we were able to complete our work together despite the pandemic.



Mittimatalik sea ice terminology by season

ᐅᑭᐊᒃᓵᖅ: ᓯᑎᐱᕆ - ᐊᒃᑑᐸ
UKIAKSAAQ: SITIPIRI – AKTUUPA
LATE SUMMER TO EARLY FALL: SEPTEMBER – OCTOBER

Source: Jamesie Itulu

ᐃᓗᔪᖅ - **Ilujuq**

Source: Jamesie Itulu

1. ᐃᓗᔪᖅ (ᐃᓗᕙᓪᓕᐊᔪᒡ)
   Ilujuq (Iluvalliajug)

   ᐅᑭᐅ ᐱᒋᐊᓕᓐᓂᖓ (ᐳᑦᑎ).

   Ukiu pigialinninga (putti).

   First signs of winter. When ice starts to form on the inside edge of windows. Condensation, when glass and your binoculars start to fog up. Freezing ice crystals in the air (pieces of Ilujug). Freezing starts along the beach and with fresh water.

ᕿᕝᕕᖅᑯᐊᖅ - Quvviqquaq

Source: Jonathan Delisle

2. ᕿᕝᕕᖅᑯᐊᖅ - Quvviqquaq

ᓯᕗᓪᓕᖅᐹ ᖁᐊᑉᐸᓪᓕᐊᓂᖓ, ᖁᕝᕕᐅᑦᑐ ᖁᐊ ᐊᓄᕋᔮᑦᑎᓗᒍ. ᓂᓕᕝᕙᓕᐊᔪᖅ ᑕᕆᐅ, ᖁᐊᐸᓪᓕᐊᔪ ᑕᑭᔪᑯᑖᒃ.

Sivulliqpaa quappallianninga, quvviuttu qua anurajaattilugu. nilivvaliajuq tariu, quapalliaju takijukutaak.

First stage of freeze up. When ice is forming and the wind is stretching out the ice and elongating it. It looks like frozen tears. When the ice is slush it can create light and glow, but only during this slushy phase.

ᐸᑐᒃ - **Patuk**

Source: Jamesie Itulu

Source: Katherine Wilson

3. ᐸᑐᒃ - Patuk

ᐊᐱᖏᑦᑐᖅ ᑭᓯᐊᓂ ᖁᐊᑉᐸᓪᓕᐊᓕᖅᑦᑐ, ᐃᒪ ᓴᕿᔮᕈᓐᓂᖅᖢᓂ. (ᑲᓂᖅ)

Apingittuq kisiani quappallialiqttu, ima saqijaarunniq&uni. (kaniq)

Thin blanket of frost that covers the ice (not snow). Happens when it begins to get cold at the end of summer. You wake up in the morning and the frost looks like the snow and the sun will melt it. This word can be used throughout the season as well. If you are near a seal hole and there is a thin layer of frost on the water it means the hole hasn't been used.

4.ᐸᑑᑎ - Pattuuti (no picture)

ᓯᑯᒐᓛᒃ ᐊᐳᑎᐅᑉ ᖀᖓᓂᓲᑦ ᐃᒃᑮᖑᓂᖓᓄᑦ, ᐊᐱᓚᐅᖏᖢᓂ. ᐅᓪᓗᒃᑯᑦ ᐊᓯᖃᑦᑕᖢᑎᓗ.

Sikugalaak aputiup qaanganisuut ikkiinguninganut, apilaungi&uni. ullukkut asiqatta&utilu.

Frost that forms when its foggy and near open water. You go to bed and there is nothing, when you wake up and its all over everything, but melts as the sun comes up. Can scrape off and drink.

ᖃᐃᖑ - **Qaingu**

Source: Katherine Wilson

5. ᖃᐃᖑ - Qaingu

ᓯᔾᔭᑯᑦ ᓯᑰᓕᖅᑐ. (ᓂᐱᖓᔪᑦ ᓄᓇᒧᑦ) ᑎᓂᓐᓂᓪ ᖁᐊᖑᓕᑦᑐᖅ. ᐅᓕᕐᖓᓂ ᓯᑯᔭ

Sijjakut sikuuliqtu. (nipingajut nunamut) tininnil quangulittuq. Ulirngni sikuja

When ice is forming on the high tide line.

ᕿᓄᐊᖅ - Qinuaq

Source: Brian Koonoo

Source: Gita Ljubicic

6. ᕿᓄᐊᖅ - Qinuaq

ᑭᓂᑦᑐᖁᔨᔪ ᐊᐳᑎᒻᒥ ᑕᕆᐅᒥᖢᓂ.

Kinittuqujiju aputimmi tariumi&uni.

Slushy ice, grease ice, no strength to it (cannot hold weight) but difficult to paddle through.

ᓂᖑᑎᖅᑐᖅ - Ningutiqtuq

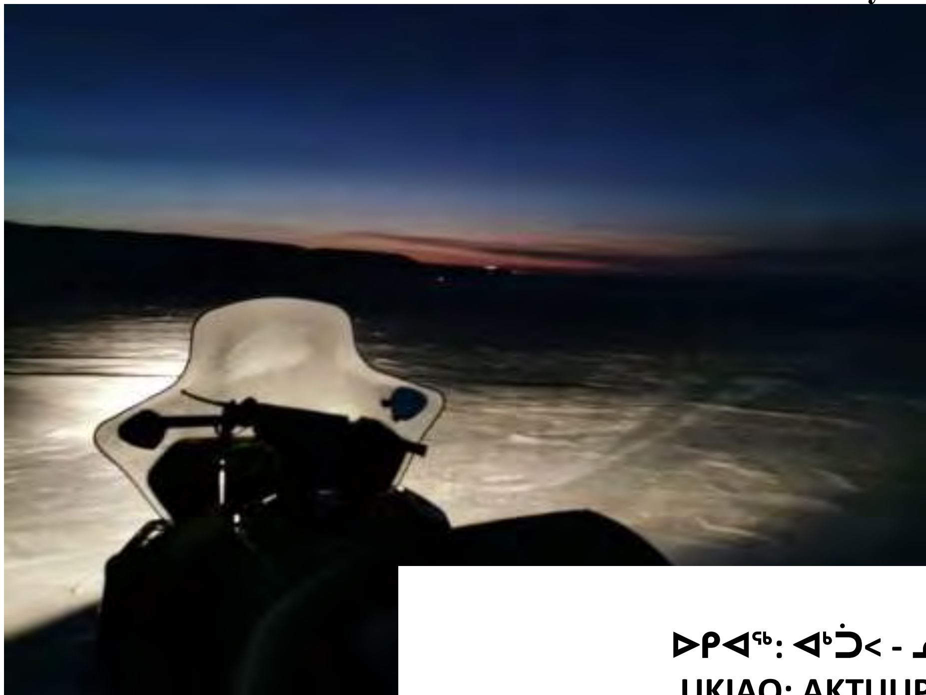
Source: Katherine Wilson

7. ᓂᖑᖅᑎᑦᑐᖅ - Ninguqtittuq

ᐱᔾᓂᕈᓐᓃᑦᑐ ᓯᑯ. ᐊᐳᑎᕈᔪ ᐊᒻᒪ ᓂᓚᕈᔪ ᖁᐊᑉᐸᓕᐊᒐᒥ ᑭᓂᕐᑐᐊᓘᓕᕐᓗᓂ.

Pijarnirunniittu siku. Aputiruju amma nilaruju quappaliagami kinirtualuulirluni.

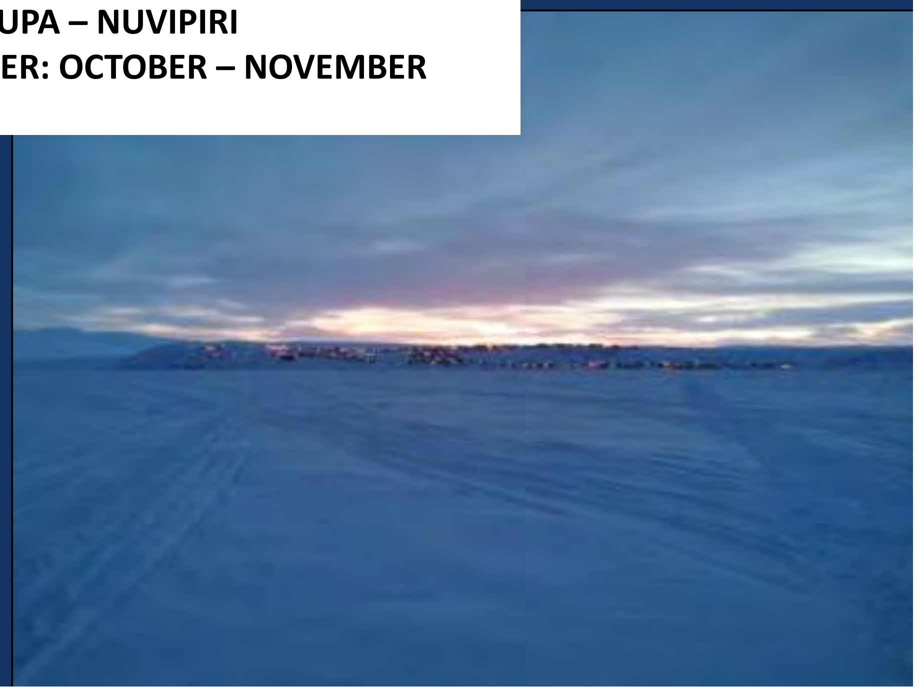
Denser than qinuaq but still slush. Snow can accumulate on top but it is not yet solid ice. You cannot use your paddle; starting to get hard to travel by boat. Used to predict when other areas will freeze.



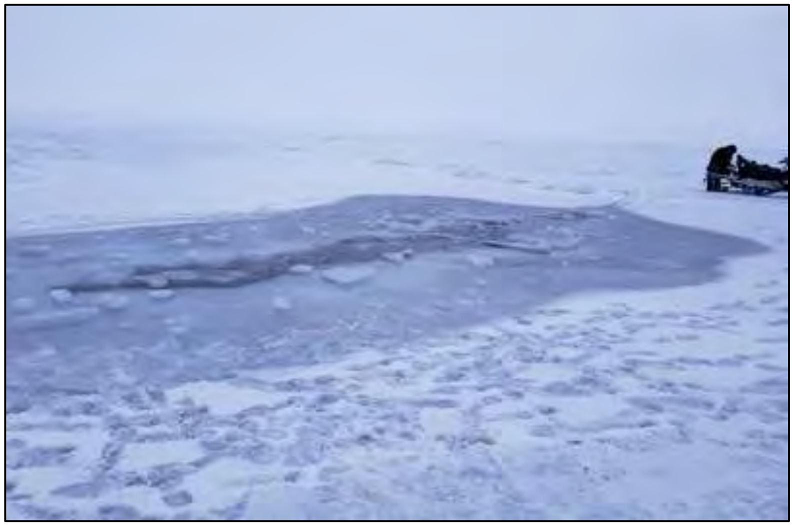
ᐅᑭᐊᖅ: ᐊᒃᑑᐸ - ᓄᕕᐱᕆ ᐋᓪᒋᓯ

UKIAQ: AKTUUPA – NUVIPIRI

LATE FALL TO EARLY WINTER: OCTOBER – NOVEMBER



ᐳᐃᒪᔪᖅ - **Puimajuq**



Source: Brian Koonoo

ᓂᒐᔪᑕᖅ - **Nigajutaq**

Source: Gita Ljubicic

8. ᐳᐃᒪᔪᖅ - Puimajuq

ᓯᑰ ᖃᖓ ᒪᓴᐅᓪᓗᓂ. ᒪᓴᓐᓇᕐᔫᓂ.

Sikuu qanga masaulluni. Masannar&uni.

Salt water rising up through the ice making the surface wet. The rising salt water also melts the surface ice. Similar to when they put salt on the road and it melts the ice. Very hard to travel on, slow going with a dog team or snowmobile.

9. ᓂᒐᔪᑕᖅ - Nigajutaq (qatturaarunni) (ᖃᑦᑐᕋᐂᕈᓐᓂ)

ᓯᑯᒥᒃ ᓇᒥᑐᐃᓐᓇ, ᖁᐊᑉᐸᓕᐊᑎᓪᓗᒍᑦ.ᓇᑦᑎᕐᓂᑦ, ᐅᒪᔪᓂ ᐃᒪᐅᑎᑕᐅᔪ ᐅᑭᐅᒃᑯᑦ. ᓇᑕᐃᑦᑐ

Immattinni sikumik namituinna, quappaliatillugut. Nattirnit, iqalunniluuniit umajuni imautitauju ukiukkut. Nataittu

Puddles of water on the ice during freeze-up, caused by seal movement not allowing the ice to freeze. Too many seals making the ice not freeze (snow covered water).

ᓯᑯᐊᖅ - Sikuaq

Source: Gita Ljubicic

Source: Gita Ljubicic

10. ᓯᑯᐊᖅ - Sikuaq

ᓯᕗᓪᓕᑉᐹ ᓯᑯ, ᑲᑉᐱᐊᓇᖅᑐ ᐱᓱᕆᐊᕝᕕᒋᓪᓗᒍ .
Sivullippaa siku, kappianaqtu pisuriavvigillugu
First thin layer of ice, still very thin, can see seals popping up and sea water rising.

ᑲᕐᖑᓯᕐᓯᒪᔪᖅ - Karngusirsimajuq

Source: Arctic Eider Society

11. ᑲᕐᖑᓯᕐᓯᒪᔪᖅ - Karngusirsimajuq
ᑲᕐᖑᖅ - Karnguq

ᓯᑯ ᓄᑖ ᑕᕆᐅ ᖃᖓᓅᐸᓕᐊᓗᓂ, ᐱᕈᖅᓯᐊᑎᑐ ᐱᕈᕐᑰᔨᓪᓗᓂ.ᓯᑯᕋᑖᑐᒥᒃ ᐊᐳᑎᖃᖏᑐᒥᒃ ᑕᕆᐅᕈᔪᙱᒃ ᐱᕈᖅᓯᐊᖑᕐᑰᔩᔪᑦ ᓴᕿᓕᖢᑎᒃ. ᓯᑯᕙᓕᐊᔫᑉ ᖃᖓ ᐊᐱᕙᓕᐊᔪᒃ ᐃᒻᒥᓂᒃ.

Siku nutaa tariu qaanganuupalia&uni, piruqsiatitu piruquujilluni. Sikurataatumik aputiqangitumik tariurujunnik piruqsianguquujijut saqili&utik. Sikuvaliajuup qaanga apivaliajuk imminik.

When the sea ice is forming it makes crystals, about 2 cm high on the top of the ice that looks like flowers. About the size of a twoonie. You never find just one, there is always a colony, they can cover the whole surface, and are very salty. The cold weather and the warmth of the ocean cause these to condense and form on the sea ice.

ᓯᑯᓕᐊᖅ - **Sikuliaq**

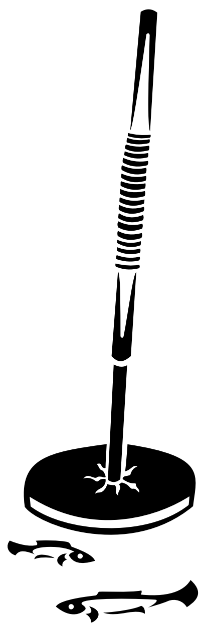
Source: Gita Ljubicic

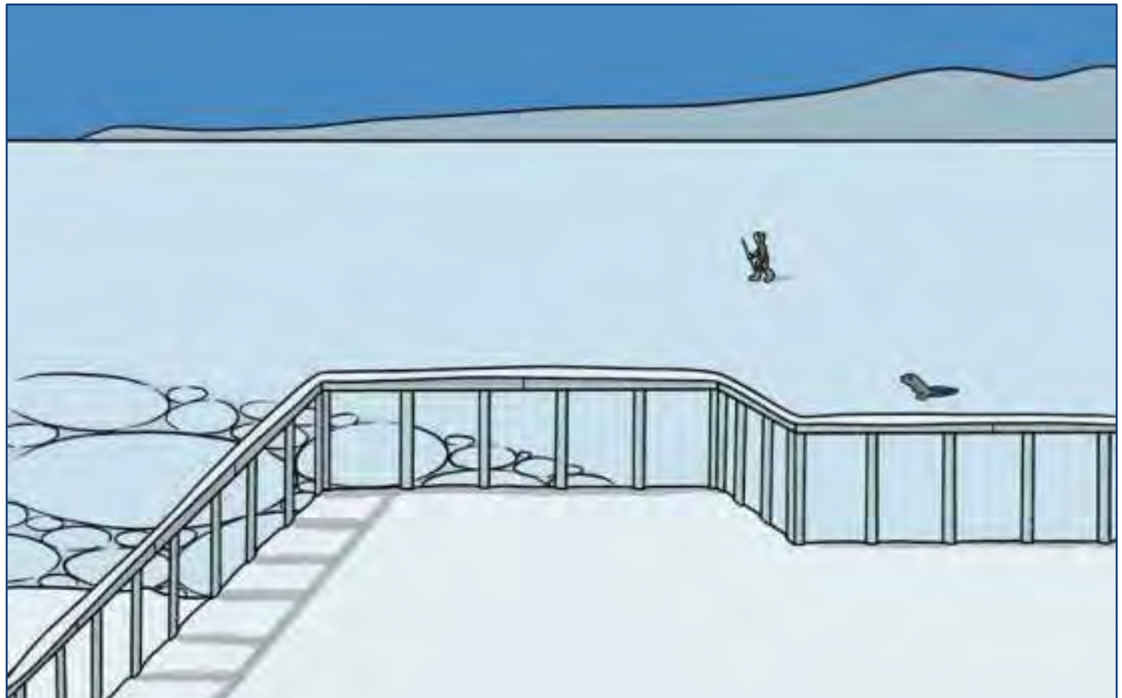
12. ᓯᑯᓕᐊᖅ - Sikuliaq

ᐱᓱᖅᕕᓴᐅᔪ ᓯᑯ ᓄᑖᖅ.

Pisuvvisauju siku nutaaq.

Thicker then Sikuaq. People can walk on the ice.





Source: Jamesie Itulu

ᖃᐅᔾᔨᒋᐊᖕᒋᓐᓇᕐᓗᒍ ᓯᑯ ᐃᔾᔪᓂᖓ ᐅᓈᕐᒧᑦ

- ᐊᑐᐅᓯᐊᕐᓗᑎᑦ ᐊᖕᒪᕈᓂ ᓇᖏᐊᕐᓇᕐᑐᖅ
- ᒪᕈᐃᕐᓱᕐᓗᒍ ᐊᖕᒪᖕᒋᒃᑯᓂ ᐱᓱᒃᕕᒃᓴᐅᔪᖅ
- ᐱᖓᓱᐃᕐᓱᕐᓗᒍ ᐊᖕᒪᖕᒋᒃᑯᓂ ᓯᑮᑑᕐᓇᕐᑐᖅ

Qaujigianginnarlugu siku ijjuninga unaarmut

- Atuusiarlutit angmaruni nangiarnartuq
- Maruirsurlugu angmangikkuni pisukviksaujuq
- Pingasuirsurlugu angmangikkuni sikiituurnartuq

Check the sea-ice strength regularly with your harpoon

- 1 strike: if your harpoon goes through it is not safe
- 2 strikes: if it doesn’t go through it is safe to walk on
- 3 strikes: if it doesn’t go through it is safe for snowmobile travel

ᓂᖏᔭᑦᑐᖅ - **Ningijattuq**

Source: Gita Ljubicic

Source: Jamesie Itulu

13. ᓂᖏᔭᑦᑐᖅ - Ningijattuq

ᓯᑯ ᐃᖏᐅᓕᔭᑦᑐᖅ, ᐃᖏᕐᕋᕕᒋᓗᒍ ᓱᒃᑲᐃᓵᕆᐊᓕ. ᓯᑯ ᓱᕋᑐᐃᓐᓇᓂᐊᓕᒃ ᖃᖓᓃᑦ ᐊᐅᓚᑎᑕᐅᔪᒃ ᐅᖁᒪᐃᑦᑐᒧᑦ.

Siku ingiulijattuq, ingirravigilugu sukkaisaariali uqumaittumut.

Flexible ice that moves as you travel on snowmobile. Need to check with harpoon. Slow travel only as the weight of the snowmobile can create waves underneath the ice and cause it to crack.

14. ᓄᑖᕕᓂᖅ - Nutaaviniq

ᓯᑯ ᓄᑖᖅ ᐊᐳᑎᖃᖏᓪᓗᓂ, ᐃᔾᔪᓂᖓ ᖃᓄᑐᐃᓐᓈᕈᓇᓪᓗᓂ. ᐃᒪᕕᓂ ᓯᑰᓕᖅᑐᖅ.

Siku nutaaq aputiqangi&uni, ijjuninga qanutuinnaaruna&uni. Imavini sikuuliqtuq

New ice just formed. Can be thin or thick with no snow cover. You often see nutaavinik forming at the floe edge.

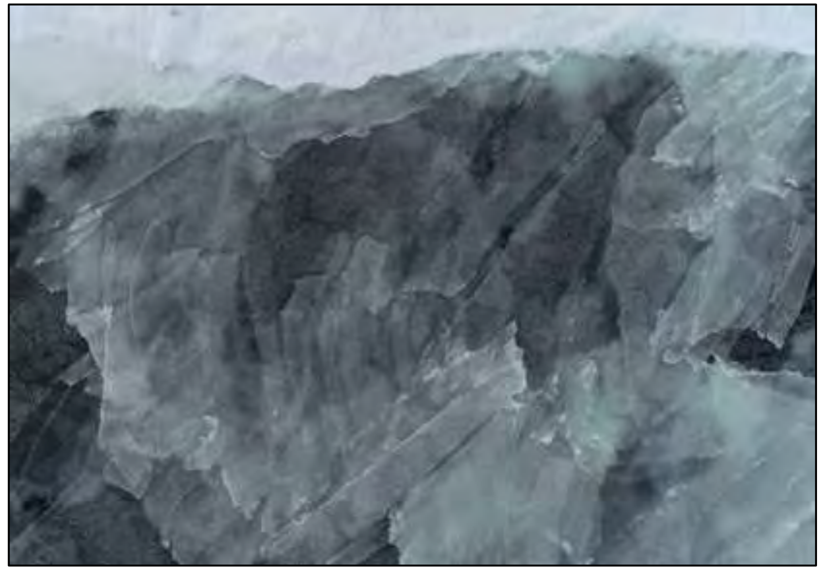
ᓄᑖᕕᓂᖅ - Nutaaviniq

Source: Gita Ljubicic


ᓯᐋᒃᔪᐃᓂᖅ - Siaakjuiniq

Source: Hajo Eicken

ᖃᓕᕇᒃᑎᓐᓂᖅ - Qaliriiktinniq


Source: Arctic Eider Society

15. ᓯᐋᒃᔪᐃᓂᖅ - Siaakjuiniq

ᑕᑯᓗᒍ ᓴᔾᔪᒎᑦ ᒪᓂᓚᑯᑕ ᐊᐅᓚᔪᕕᓂ ᐋᒪ ᐊᐅᓚᖏᑐᓪᓗ ᐊᒃᑐᐊᓂᕕᓂᖓ ᓇᓗᓇᖏᑉᐸ ᒪᓂᓚᒐᓚᖑᑕᖑᓗᓂ.
Takulugu sajjugut manilakuta aulajuvini aama aulangitullu aktuanivininga nalunangippa manilagalangutanguluni.
Ice is driven against another ice, pushing up and freezes.

16. ᖃᓕᕇᒃᑎᓐᓂᖅ - Qaliriiktinniq

ᓯᑯ ᖃᖓᓄᐴᐸᓪᓕᐊᓘᑎ ᐃᔾᔪᓂᖅᓴᐅᓪᓗᓂ ᓯᑯᓄᑖᒥᑦ, ᐊᑦᑕᓐᓇᖏᓐᓂᖅᓴᐅᓪᓘᓂ.
Siku qaanganuupallia&uti ijjuniqsaulluni sikunutaammit, attannanginniqsauli&uni.
When ice overlaps on top of each other in layers. Can be safter to travel as the layers make it thicker

ᐋᓕᑯᓛᖅ - **Iilikulaaq**

Source: Gita Ljubicic

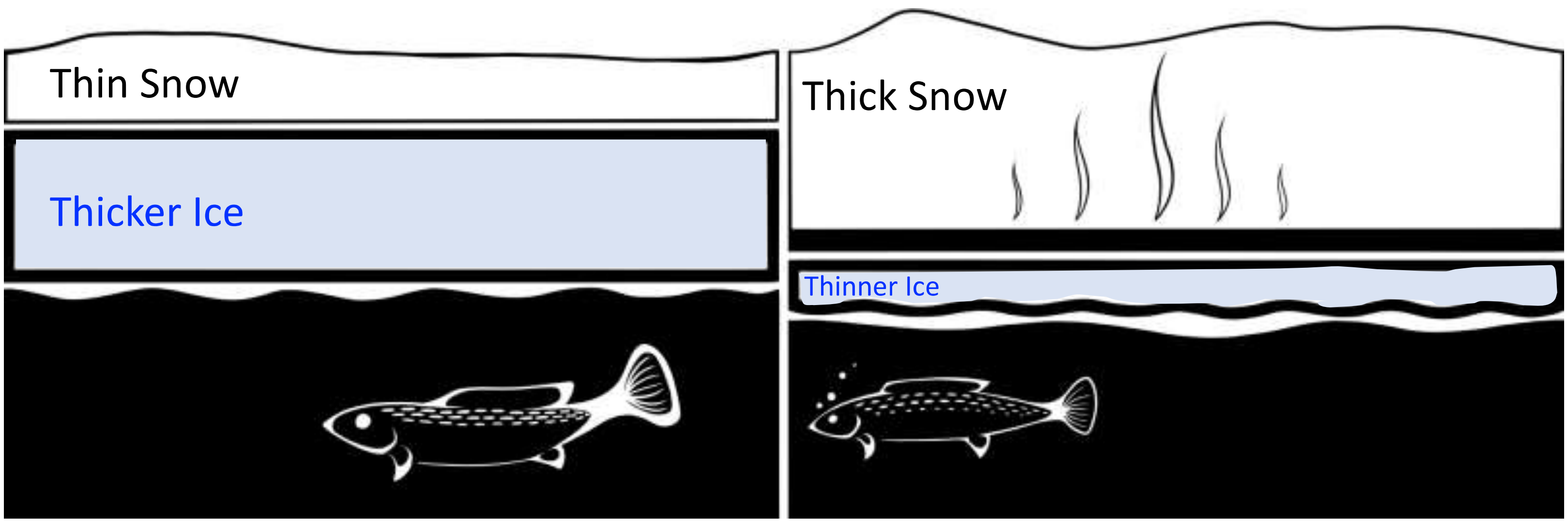
17. ᐋᓕᑯᓛᖅ - Iilikulaaq

ᓯᑯ ᑐᐊᑦᑐᑯᓘᓗᓂ ᑲᑎᓯᒪᓪᓗᑎᓘᓃᒃ ᐊᓄᕆᒧᑦ ᑕᐃᒪᑎᑕᐅᓪᓗᓂ, ᐊᐱᓯᒪᖏᑦᑐ.

Siku tuattukuluuluni katisimallutiluuniik anurimut taimatitaulluni, apisimangittu.

Bumpy ice caused during freeze-up. When new ice breaks up from wind to create small plate sized/circular flows. These small ice floes pile up and get frozen on top. Very bad for travel, until a wind event blows in and levels the surface with snow.

ᐅᖁᕈᓯᖅᑐᖅ - **Uqurusirtuq**



Source: Jamesie Itulu

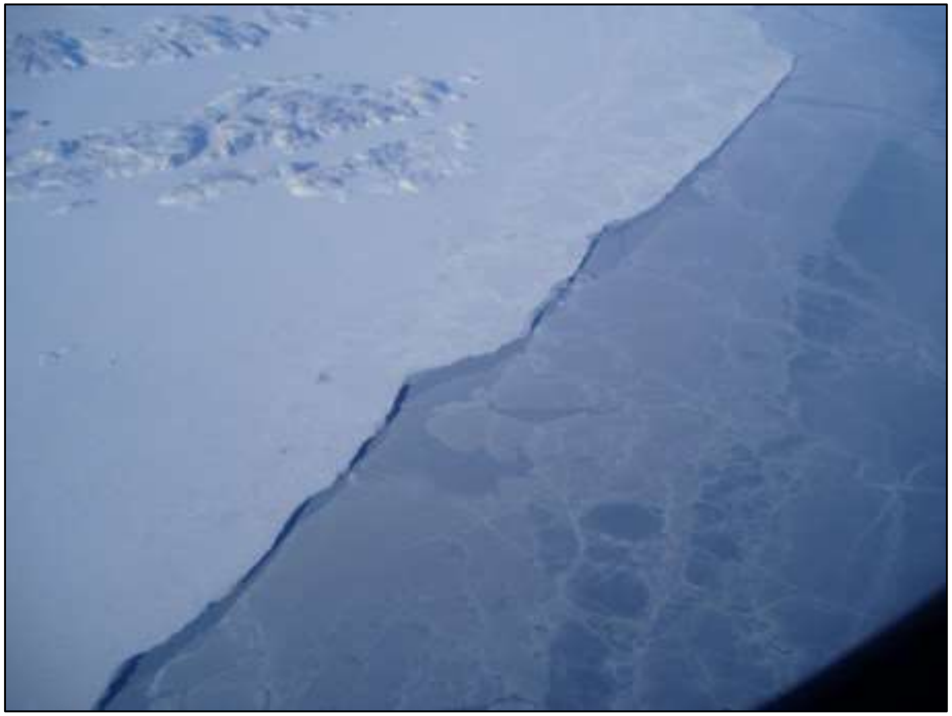
18. ᐅᖁᕈᓯᖅᑐᖅ - Uqurusirtuq

ᐊᐳᑎᒧᑦ ᖁᐊᑉᐸᓪᓕᐊᑦᑎᑎᕈᓐᓂᓗᓕ ᓯᑯ ᐃᔾᔪᐸᓪᓕᐊᕈᓃᓗᓂᓗ, ᑭᓯᐊᓂ ᓯᑰᑉ ᐊᑦᑕᓂ ᓄᒍᑉᐸᓕᐊᕈᓇᕆᓗᓂ ᑕᕆᐅᑉ ᐊᐅᓚᓂᖓᓄᑦ. ᓯᑯ ᐊᐳᑎᖃᓕᕋᒥᒃ ᐃᔪᑦᑎᑉᐸᓕᐊᖏᑐ, ᓯᑯ ᐊᐳᑎᒧᑦ ᓵᒡᓕᕙᓕᐊᔪᒃ.

Aputimut quappalliattitirunni&uli siku ijjupalliarunii&unilu, kisiani sikuup attani nuguppaliarunariluni tariup aulaninganut. Siku aputiqaliramik ijuttippaliangitu, siku aputimut saaglivaliajuk.

Insulation from snow stopping the ice from getting thicker, but melting could occur at the bottom.

ᓴᐃᒃᑲ - **Saikkak**



Source: Gita Ljubicic

19. ᓴᐃᒃᑲ - Saikkak

ᒪᓂᕋᑐᐃᓐᓇ ᓇᒍᑎᑕᖃᖏᑦᑐ ᒪᓂᓚᖃᖏᑦᑐ ᓄᑕᖑᑉᐸ-ᓄᑕᖑᖏᑉᐸᓪᓗᓂ.

Maniratuinna nagutitaqangittu manilaqangittu nutanguppa-nutangungippalluni.

Water that starts to freeze alongside a stable ice form. Not just bay or inlet – can happen at the floe edge or or anywhere there is landfast ice.

20. ᖁᓪᓗᓂᖅ - Qulluniq (no photo)

ᓇᒡᒍᑎ ᐃᕗᔪᖅ ᐅᑭᐅᒃᑯᑦ. ᐊᖏᔫᑎᑦ ᓯᑯᑦ ᐊᐅᓚᔪᑦ ᑕᕆᐅᑉ ᐃᖏᕋᓂᖕᒐᓄᑦ ᖁᐊᕐᐸᓪᓕᐊᓪᓗᑎᒃ ᓯᕋᑦᑎᓴᕋᐃᓪᓘᑎᒃᓗ.
Nagguti ivujuq ukiukkut. Angijuutit sikut aulajut tariup ingiraninganut quarpalliallutik sirattisarail&utiklu.
Large pieces of ice moving around with the ocean currents during freeze up that can easily break-up.

21. ᑐᕙᑭᑦᑐᖅ - Tuvakittuq

ᓵᑐ ᓯᑯ. ᓇᖏᐊᓐᓇᑦᑐᖅ.

Saatu siku. Nangiannattuq.

Thin tuvaq. "Thin" meaning one or two strikes with the harpoon. If it goes through once, it is too thin and dangerous to walk on. If it holds two strikes in the same hole, it is safe to walk on.

22. ᑐᕙᕈᐊᖅ - Tuvaruaq

(No photo)

ᓯᑯ ᓄᑖ ᒪᒃᑯᖕᓂ, ᐱᕈᑉᐸᓕᐊᓪᓗᓂᓗ. ᐊᖏᒻᒥᐊᓕᑦᑐᖅ.

Siku nutaa makku&uni, piruppaliallunilu. Angimmialittuq.

Teenage ice, getting thicker.

ᑐᕙᕈᐊᖅ - Tuvaruaq

Source: Gita Ljubicic

Winter: December, January, February

Source: Oceans North

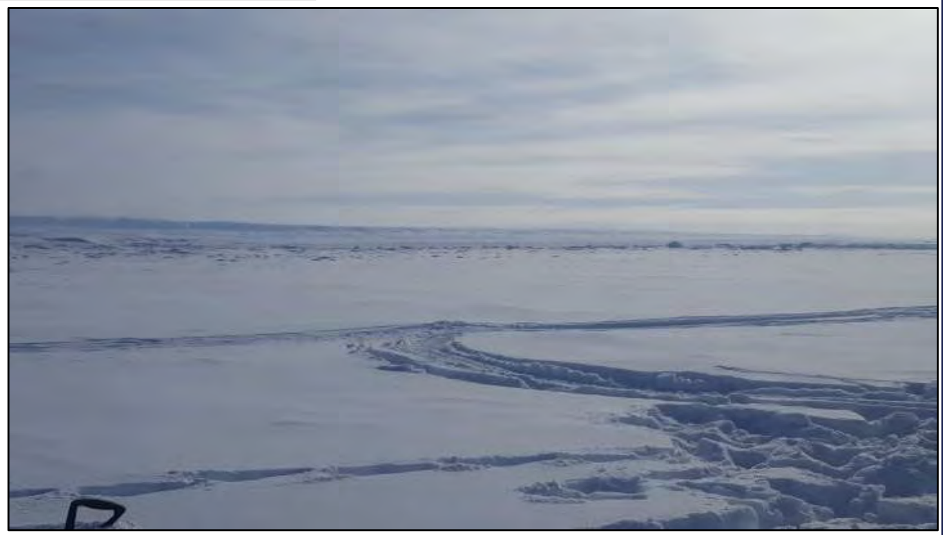
ᑐᕙᖅ - Tuvaq

23. ᑐᕙᖅ - Tuvaq

ᐊᐅᓚᖏᑦᑐᖅ ᓯᑯ ᐃᔾᔪᓂᖅᓴ.

Aulangittuq siku ijjuniqsa

Solid land fast ice (it doesn't move). Thickness may vary, but it is safe because it doesn't move.



Source: Andrew Arreak

Source: Andrew Arreak

ᓯᓈ - **Sinaa**

24. ᓯᓈ - Sinaa

ᑕᓯᐅᑉ ᑭᒡᓕᖓ ᓯᓈᖑᕗ, ᓯᔾᔭᐅ ᑭᓪᓕᖓ ᓯᓈ, ᓯᑯ ᑭᓪᓕᖓ ᐃᒪᐅᓪᓗᓂ ᓯᓈ.

Tasiup kiglinga sinaanguvu, sijjau killinga sinaa, siku killinga imaulluni sinaa.

Floe edge. The edge of the sea ice, always moving.

Source: Andrew Arreak

ᐳᔫᓚᖅ- Pujuulaq

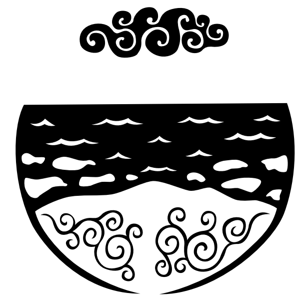
Source: Gita Ljubicic

25. ᐳᔫᓚᖅ- Pujuulaq

ᑕᒃᑐᑦ, ᐊᒻᒪᓗ ᐳᔪᖅ ᒪᓴᒃ ᐱᙴᕐᓯᒪᔪᖅ ᖁᓛᓂ ᐃᒪᐅᓂᖓᑕ ᐊᒻᒪᓗ ᖃᐅᔨᒪᔾᔪᑕᐅᔪᓐᓇᕐᓱᖅ ᐃᒪᕐᑕᖃᕐᓂᖓᓂᒃ ᐊᒻᒪᓗ ᓯᓇᖓ ᖃᓂᓐᓂᖓᓂᒃ.
Taktut, ammalu pujuq masak pinngursimajuq qulaani imauningata ammalu qaujimajjutaujunnarsuq imartaqarninganik ammalu sinanga qaninninganik.
Fog, and mist form over open water and are a good indicator of open water and that the floe edge is close.

ᓄᕗᔭᖃᕐᓂᖓ ᐃᒪᐅᓂᖓ - Nuvujaqarninga Imauninga

Source: Gita Ljubicic



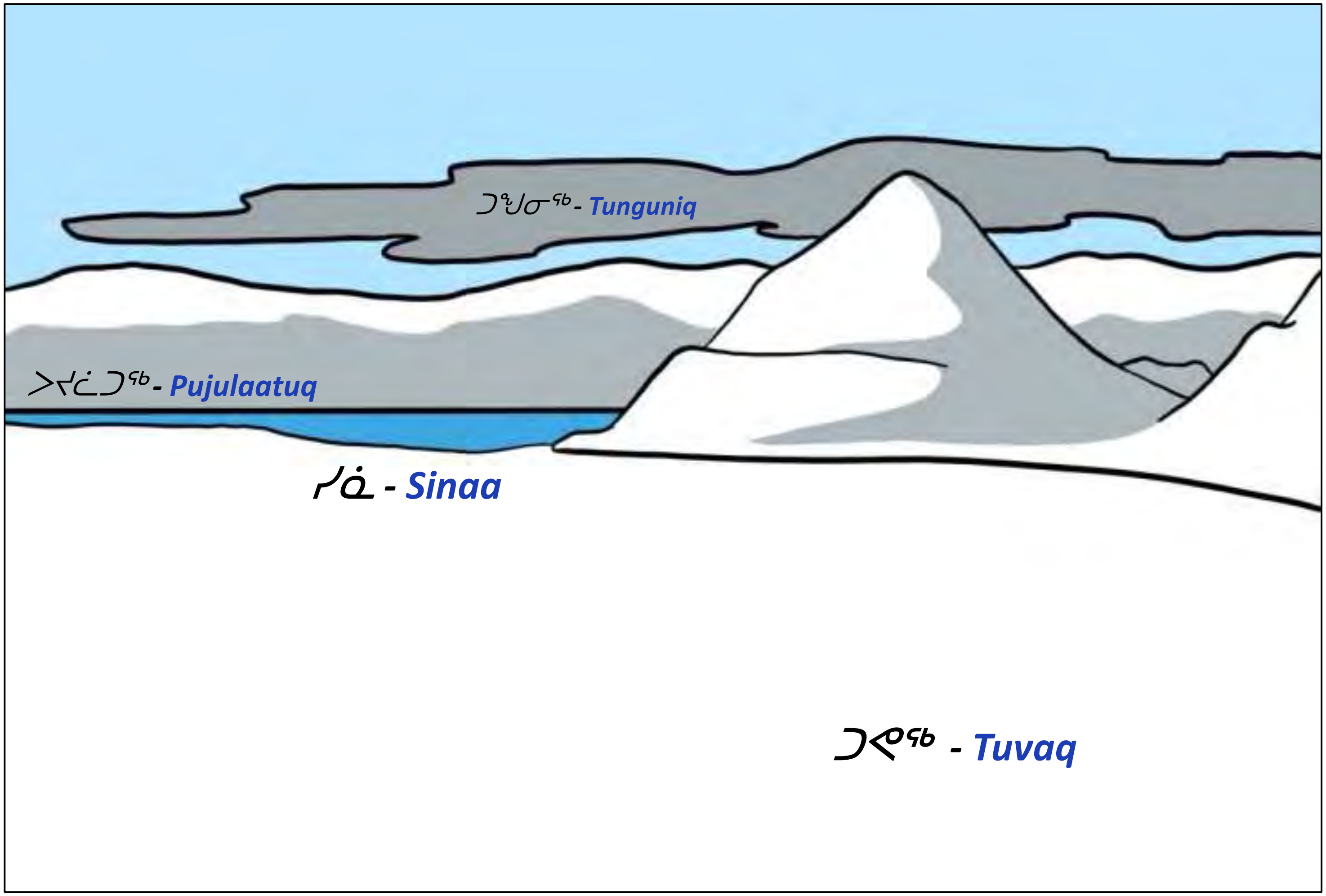
Source: Jamesie Itulu

26. ᓄᕗᔭᖃᕐᓂᖓ ᐃᒪᐅᓂᖓ - Nuvujaqarninga Imauninga

ᕿᕐᓈᖓᔪᒥᒃ ᓄᕗᔭᖃᕈᓂ, ᑕᒃᓯᖅ, ᐳᔫᑐᒥᒃᓗ ᐃᒪᐅᓂᐅᒐᒥ ᖃᐅᔨᒪᔾᔪᑎᒋᓗᒍ ᓯᓈᖓ ᖃᓂᒃᓚᓂᖓᓂᒃ.
ᓄᕗᔭᐃᑦ ᖃᐅᔨᒪᔾᔪᑎᒋᒃᒥᓗᒋᑦ ᓯᓈᖓᓂ ᓯᑯ ᐲᑐᐃᓐᓇᕆᐊᖃᕐᒪᑦ.

Qirnaangajumik nuvujaqaruni, taksiq, pujuutumiklu imauniugami qaujimajjutigilugu sinaanga qanikliningánik.
Nuvujait qaujimajjutigikmilugit sinaangani siku piituinnariaqarmat.

Dark clouds form over open water and are a good indicator that the floe edge is close. Clouds are also a warning to be more careful at the floe edge, as it’s more prone to break off.



Source: Jamesie Itulu

ᓴᔾᔪᒍᑦ - Sajjugut

Source: Gita Ljubicic

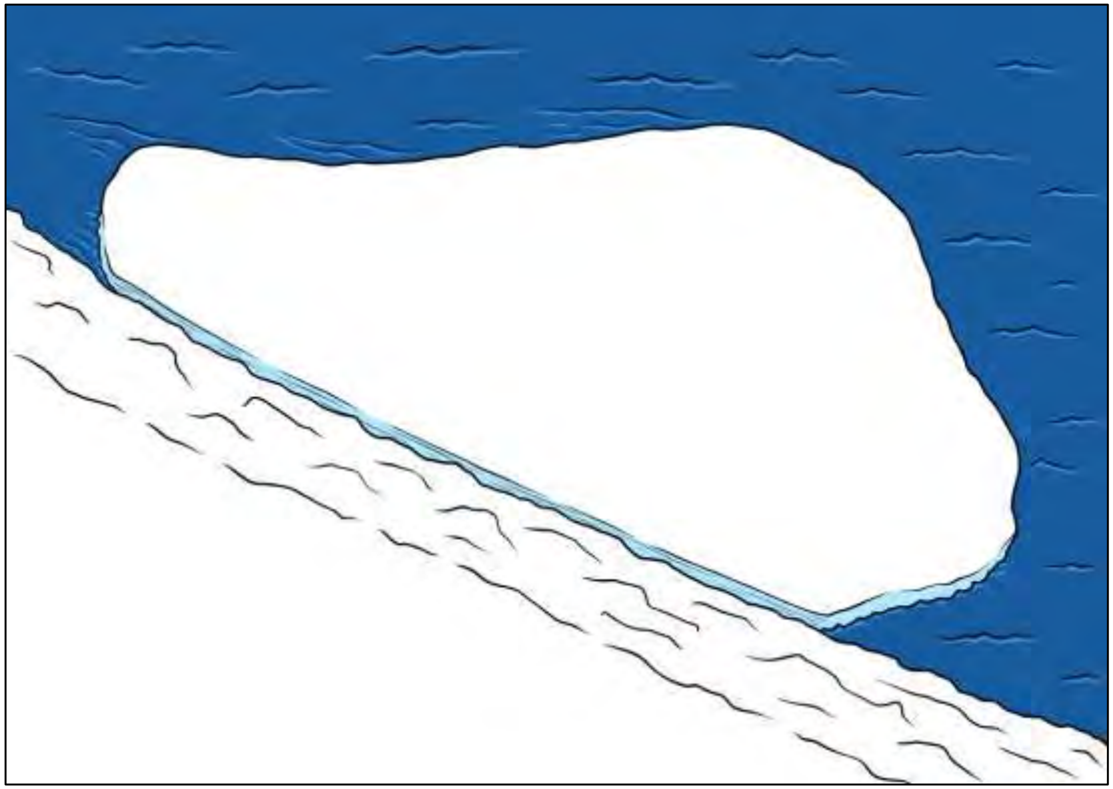
27. ᓴᔾᔪᒍᑦ - Sajjugut

ᓯᓈ ᑎᒥᖓᓂ ᓯᑯ ᓵᕐᓂᒃᓴᖅ ᓄᑖᖑᓪᓗᓂ. ᓯᑯᕙᓪᓕᐊᔪᒃ ᐲᒃᐸᒡᓗᓂ ᖃᓕᕆᕐᑎᓂ ᑕᑭᔪᒃ.

Sinaa timingani siku saarniksaq nutaangulluni. sikuvalliajuk piikpagluni qalirirtini takijuk.

New thin ice that forms in the open water at the floe edge and moves away with the ocean currents.

ᓴᓂᒧᐊᓕᓂᖅ - Sanimualiniq



Source: Jamesie Itulu

28. ᓴᓂᒧᐊᓕᓂᖅ - Sanimualiniq

ᓯᓈᕐᒥᑦ ᑭᓪᓕᙵᑕ ᐃᕐᕿᕋᓐᓂᙵᓄᑦ ᐊᑦᑐᐊᓂᕕᓂᙵ.

Sinaarmit killingata ingiranninganut attuanivininga.

Between the tuvaq and pack ice in Baffin Bay. When a big piece of ice shears off moving against the solid tuvaq at the floe edge.

ᐊᐅᒃᑲᓐᓂᖅ - Aukkanniq

Source: Arctic Eider Society

29. ᐊᐅᒃᑲᓐᓂᖅ - Aukkanniq

ᐃᒪᐅᓂᖅ ᓯᑯᑉ ᐊᑯᓐᓂᖓᓂ. (ᓯᑯᓱᐃᑦᑐᖅ) ᖃᖓᑐᐃᓐᓇᖅ ᓯᑯᖃᕐᑎᓪᓗᒍ ᓴᕿᓯᒪᔪᖅ. ᑕᕆᐅᑉ ᐃᖏᕐᕋᓂᖓᓄᑦ ᐊᒻᒪᓗ ᐃᒪᖅ ᐳᐃᕐᐸᓪᓚᖃᑦᑕᕐᓂᖓᓄᑦ ᓯᑯᔪᓐᓇᖏᑦᑐᖅ. ᐊᖑᓯᒃᕕᑦᑎᐊᕙᐅᔪᖅ. ᑭᒃᓕᖓ ᓯᓂᖓ ᐃᔾᔪᓪᓗᓂ ᓯᑯᖓ ᖃᓕᕇᒃᑎᓐᓂᕐᒧᑦ ᓯᑯᓄᑦ, ᑭᓯᐊᓂ ᑐᑎᕝᕕᒃᓴᐅᖏᑦᑐᖅ ᐊᒧᓯᓇᓱᒃᓗᓂ ᓇᑦᑎᕐᒥᒃ, ᑭᒃᓕᖓ ᓇᖏᐊᓇᕐᑐᖅ ᐊᑦᑕᕐᓇᕐᑐᖅ.

Imauniq sikup akunningani. (Sikusuittuq) qangatuinnaq sikuqartillugu saqisimajuq. Tariup ingirraninganut ammalu imaq puirpallaqattarninganut sikujunnangittuq. Angusukvittiavaujuq. Kiklinga sininga ijjulluni sikunga qaliriiktinnirmut sikunut, kisiani tutivviksaungittuq amusinasukluni nattirmik, kiklinga nangianartuq attarnartuq.

Open water with ice all around (polynya). They can occur all ice season. Ocean currents and upwelling keeps these areas ice free. Good for hunting. They can have thick white edges from ice build up, but don't step on it when pulling in a seal, this edge is not safe.

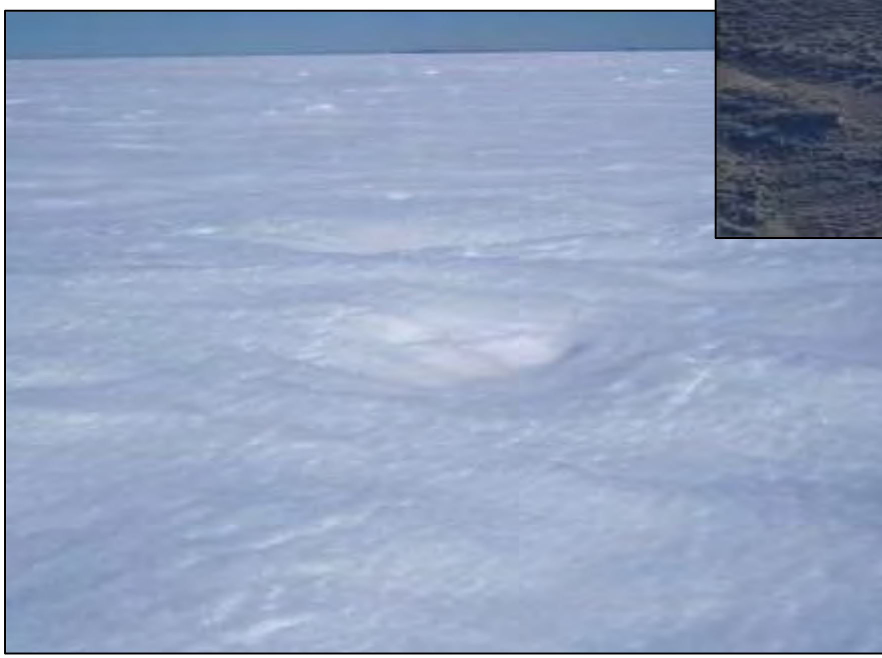
30. ᓂᒐᔪᑕᒃ - **Nigajutak** (no photo)

ᐊᐅᒃᑲᕐᓂᐅᔭᖅ ᑭᓯᐊᓂ ᐊᓄᕆᒧᑦ ᓯᑯᔪᓐᓇᖕᒋᑦᑐᖅ.
Aukkarniujaq kisiani anurimut sikujunnangittuq.
Winds keeps these areas ice free

31. ᖃᖅᑐᕌᕈᓐᓂᖅ - **Qaqturaarunniq** (no photo)

ᐊᐅᒃᑲᕐᓂᐅᔭᖅ ᑭᓯᐊᓂ ᓇᑦᑎᕐᓄᑦ ᐳᐃᕝᕕᐅᕙᒃᖢᓂ ᓯᑯᑎᑕᐅᓯᒪᖕᒋᑦᑐᖅ.
Aukkarniujaq kisiani nattirnut puivviuvak&uni sikutitausimangittuq.
Seals keep these areas open.

32. ᐊᐳᑕᐃᓐᓇᕐ - Aputainnar



ᐃᒪᐅᑉ ᐃᖏᕐᕋᓂᖓᓄᑦ ᐊᑖᒍ ᓯᑯ ᐊᐅᑉᐸᓪᓕᐊᓕᕈᓂ.
Imaup ingirraninganut ataagu siku auppalliali&uni.
A thin layer of slush on the water with snow on top. Can be seen as a slight depression, but very hard to tell the difference, dangerous. Occurs when the ice is breaking up due to the ocean currents. The slush keeps the snow from melting.

Sources: Gita Ljubicic

ᐱᖅᑲᓗᔭᒃ - **Piqalujak**

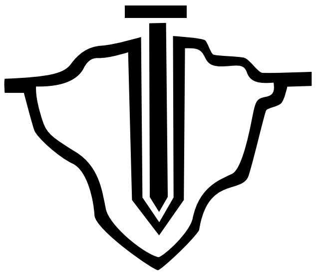
Source: Andrew Arreak

33. ᐱᖅᑲᓗᔭᒃ - Piqalujak

ᓯᒻᒥᒦᖓᑦᑐ ᓯᑯ ᑕᕆᐅᒦᓕᕐᓂ.

Simmimiingattu siku tariumiili&uni.

Chunk(s) of ice that came from a glacier, an iceberg now floating in the ocean or frozen into the Tuvaq.



Source: Jamesie Itulu

Source: Gita Ljubicic

34. ᑭᑭᐊᒃ - Kikiak

ᑭᑭᒃᑎᑐᑦ ᓯᑰᑉ ᓄᖅᑲᖕᒐᔾᔪᑎᖕᒐ ᐅᑭᐅᒃᑯᑦ.

Kikiktitut sikuup nuqangajjutinga ukiukkut.

Grounded Iceberg near the sinaa, even the moving pack ice won't move it. Common near Button Point. Acts like a nail to hold the surrounding sea ice stable during the winter months. You will see shearing and cracks around the iceberg.8

35. ᓄᕗᒃᓯᕐᖅ - Nuvuk&iq

ᓴᕐᓕᖅᐹ ᐱᖃᓗᔭ.

Sarliqpaa piqaluja.

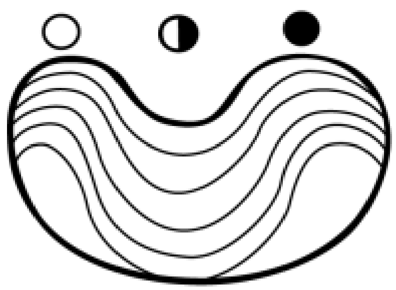
Furthest iceberg closest to the sinaa. There are no icebergs past this point

36. ᓇᒡᒍᓯᑦᑐᖅ - Naggusittuq

ᓯᑯ ᖁᐊᖑᓕᕋᖓᒥ ᓄᑎᖃᒥ ᐅᕋᐸᖓᓕᕈᓂ.

Siku quangulirangami nutiqami urapangali&uni.

The cracking of the sea-ice controlled by the moon. Happens at the new moon or full moon time due to high tides. Creates nagguti as well as the reopening of the nagguti (#36).



Source: Jamesie Itulu

ᓇᒡᒍᑎ, ᓇᒡᒍᑏᑦ - Nagguti, Naggutiit

Source: Gita Ljubicic

37. ᓇᒡᒍᑎ, ᓇᒡᒍᑏᑦ - Nagguti, Naggutiit

ᓄᑕᐅᓯᖅᓯᒪᔪ

Nutausiqsimaju

A crack(s) in the ice. Once the sea ice is thick enough, it cracks, usually in November. Once it cracks it re-occurs in the same spot or near the same spot throughout the whole winter. Can open depending on moon phases, or create quglugniq (see #37) when it closes.

ᖁᒡᓗᒡᓂᖅ- **Quglugniq**

Source: Gita Ljubicic

38. ᖁᒡᓗᒡᓂᖅ- Quglugniq

ᓇᒡᒍᑎ ᒪᑐᑉᐸᓕᐊᓂᖓᓄᑦ ᓯᑯ ᐊᔭᖅᑲᑦᑕᐅᑎᒌᓗᑎᒃ.

Nagguti matuppalianinganut siku ajaqattautigiilutik.

Nagguti closing and ice pushes up and creates a ridge (like an A-frame) along where the nagguti was. You see this near Amherst Island. No snow on the sea ice.

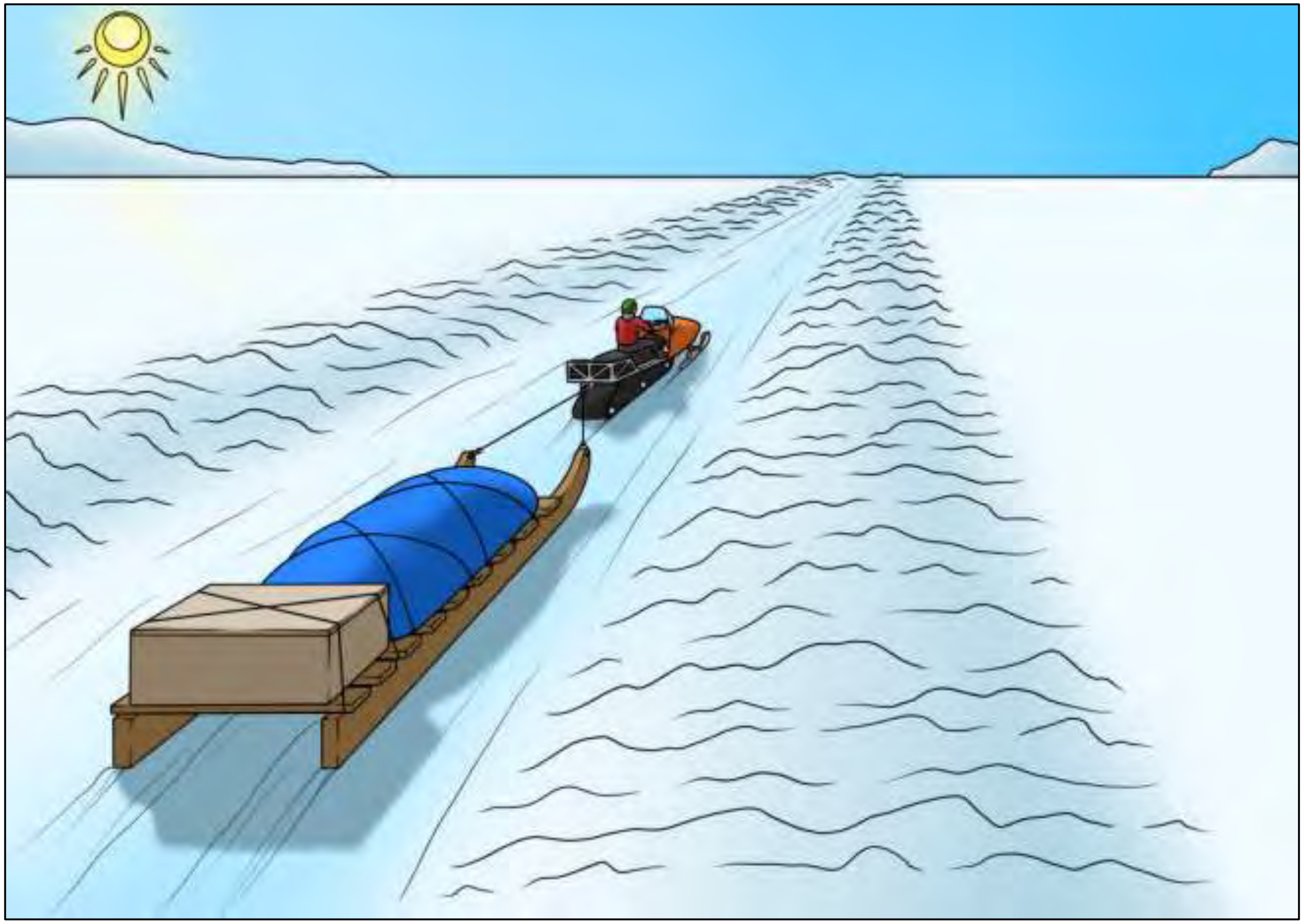
39. ᕿᓗᖃᐃᓂᖅ - Qiluqainiq

ᓯᑯ ᓄᓇᒧᑦ ᖁᐊᕈᑎᒐᒥ ᓂᐱᓪᓗᓂ ᐃᑲᕈᓪᓗᓪᓗ.

Siku nunamut quarutigami nipilluni ikarullullu.

Pressure within the ice causing a crack (pressure release) that can go in any direction. This word is also used for rapids.

Sources: Gita Ljubicic



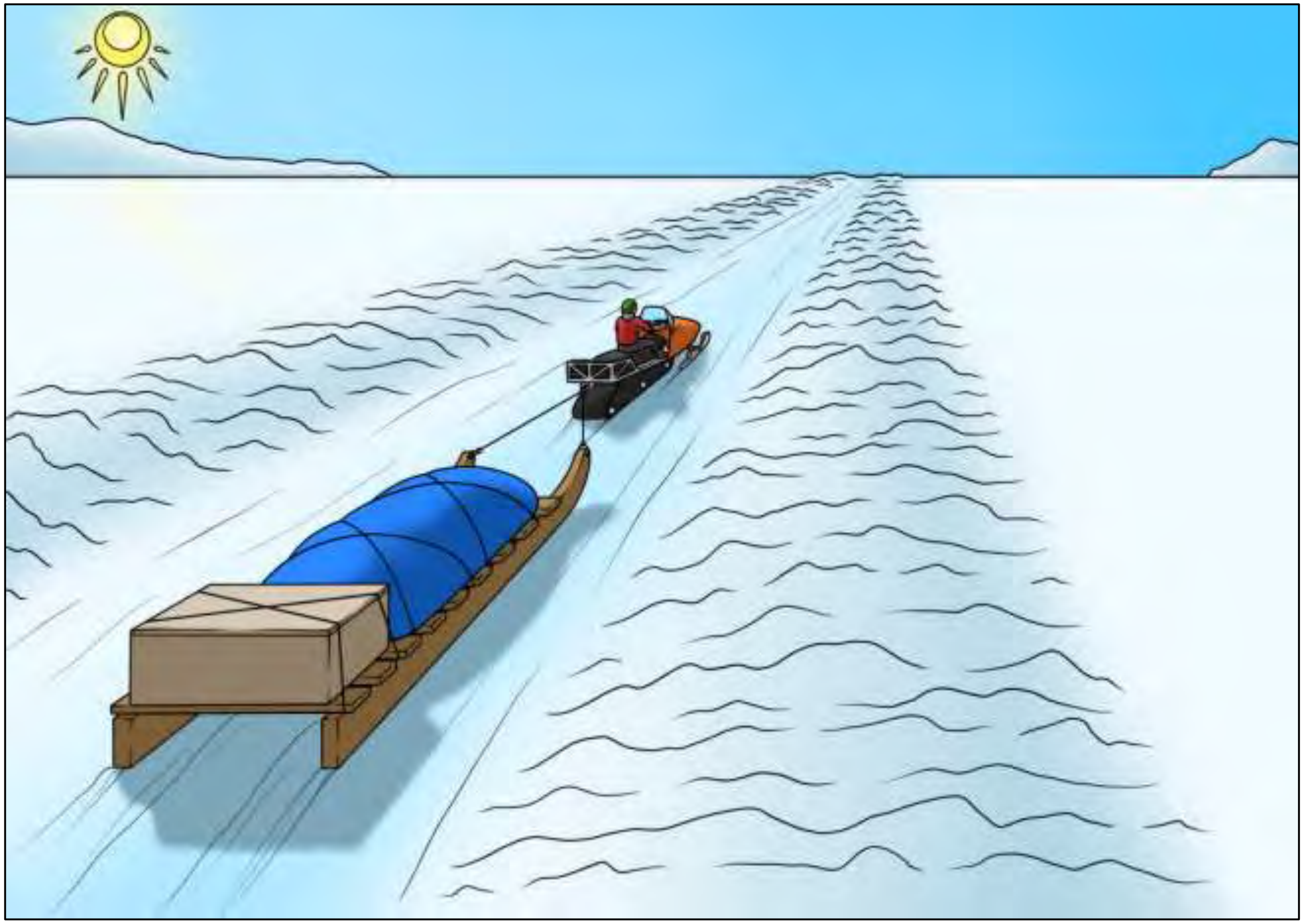
Source: Jamesie Itulu

40. ᓴᔾᔪᒎᑦ - Sajjugut

ᓯᑯ ᒪᓂᕋᐅᓂᐅᓪᓗᓂ, ᐱᓱᒃᕕᒃᑎᑐᑦ ᒪᓕᒐᒃᓴᐅᓪᓗᓂ ᐊᒻᒪᓗ ᓱᒃᑲᓴᕐᓗᓂ ᐃᖏᕋᕕᒋᓗᒍ.

Siku manirauniulluni, pisukviktitut maligaksaulluni ammalu sukkasarluni ingiravigilugu.

A band of smooth ice, like a sidewalk that you can follow and go full speed.



Source: Jamesie Itulu

40. ᓴᔾᔪᒍᑦ - Sajjugut

ᓯᑯ ᒪᓂᕋᐅᓂᐅᓪᓗᓂ, ᐱᓱᒃᕕᒃᑎᑐᑦ ᒪᓕᒐᒃᓴᐅᓪᓗᓂ ᐊᒻᒪᓗ ᓱᒃᑲᓴᕐᓗᓂ ᐃᖏᕋᕕᒋᓗᒍ.

Siku manirauniulluni, pisukviktitut maligaksaulluni ammalu sukkasarluni ingiravigilugu.

A band of smooth ice, like a sidewalk that you can follow and go full speed.

ᐃᕗᔪᒃ - Ivujuk

Source: Jamesie Itulu

Source: Gita Ljubicic

42. ᐃᕗᔪᖅ - Ivujuq

ᓯᑯ ᓄᓇᒨᖃᐸᓪᓕᐊᖢᑎᒃ ᐅᓄᑉᐸᓕᐊᖠᓗᓂᓘᓃᒃ, ᓯᓈᓂᕈᓐᓇᕆᓪᓗᓂ.

Siku nunamuuqapallia&utik unuppalia&iluniluuniik, sinaanirunnarilluni.

Pilling up of ice due to ocean currents. Can happen against the land or Tuvaq. Can happen in all types of ice, anytime, and anywhere moving ice meets a solid form. In Navy Board Inlet the ridging can get as high as a building.

ᓯᑯᑐᖃᖅ- Sikutuqaq

ᐊᓇᖅᓗᒃ - Anaqluk

Sources: Gita Ljubicic

43. ᓯᑯᑐᖃᖅ- Sikutuqaq

ᑕᕆᐅ ᓯᑯ ᐱᑐᖃᐅᓪᓗᓂ.

Tariu siku pituqaulluni.

Ice that formed the previous year that did not melt. Multi-year ice, old ice.

44. ᐊᓇᕐᓗᒃ - Anarluk

ᓯᑯᑐᖃ ᐃᑉᐸᖅ.

Sikutuqa ippaq.

Dirty multi-year ice. Hunters often mistake this for an animal

ᒪᓃᑦᑐᐊᓗ - **Maniittualuq**

Source: Adrienne Tivy

45. ᒪᓃᑦᑐᐊᓗ - Maniittualuq

ᓯᑯ ᖃᓕᕇᒃᓯᓯᒪᔪᖅ, ᐃᖏᕋᕕᒃᓴᐅᖏᑦᑐᖅ. ᓱᓪᓗᖕᒐᓂ Navy Board Inlet ᑕᐃᒪᐃᒐᔪᒃᑐᖅ, ᓯᓈᖕᒐᑕ ᖃᓂᒋᔮᓂ ᐊᒻᒪᓗ ᐅᐊᖕᓇᖕᒐᓂ ᐊᑭᐊᓗᐊᑕ ᕿᑭᕐᑕᐅᑉ ᐱᔾᔪᑎᒋᓪᓗᒍ ᑕᓪᓗᕈᑎᐅᑉ ᐃᒪᖕᒐᓂ ᐃᖏᕋᓂᕐᒧᑦ. ᐳᕐᑐᓂᖅᑲᕈᓐᓇᕐᑐᖅ 10 ᐃᓯᒐᐃᑦ.

Siku qaliriiksisimajuq, ingiraviksaungittuq. Sullungani Navy Board Inlet taimaigajuktuq, sinaangata qanigijaani ammalu uangnangani akialuata qikirtaup pijjutigillugu tallurutiup imangani ingiranirmut. purtuniqarunnartuq 10 isigait.

Rough ice, impossible to travel on. Common in Navy Board Inlet, near the floe edge and along the north side of Bylot Island due to the Lancaster Sound current. Can be 10 feet high.

ᑲᒡᕙᖅ - Kagvaq

Sources: Gita Ljubicic

46. ᑲᒡᕙᖅ - Kagvaq

ᓯᑯᑐᖃᐃ ᑲᑎᒑᖓᑎ, ᓯᔾᔾᒥ ᐅᕝᕙᓗᓐᓂ ᓯᓈᓂᒍᓐᓇᖅᑐ ᓯᔾᔭᐸᓯᒻᒥᒃ.

Sikutuqai katigaangati, sijjammi uvvalunni sinaanigunnaqtu sijjapasimmik.

When old ice (sikutuqaq) piles up and becomes stuck together along shore (can be kikiak).

ᖃᖓᖑᖅᑐᖅ - Qanguqtuq

Source: Gita Ljubicic

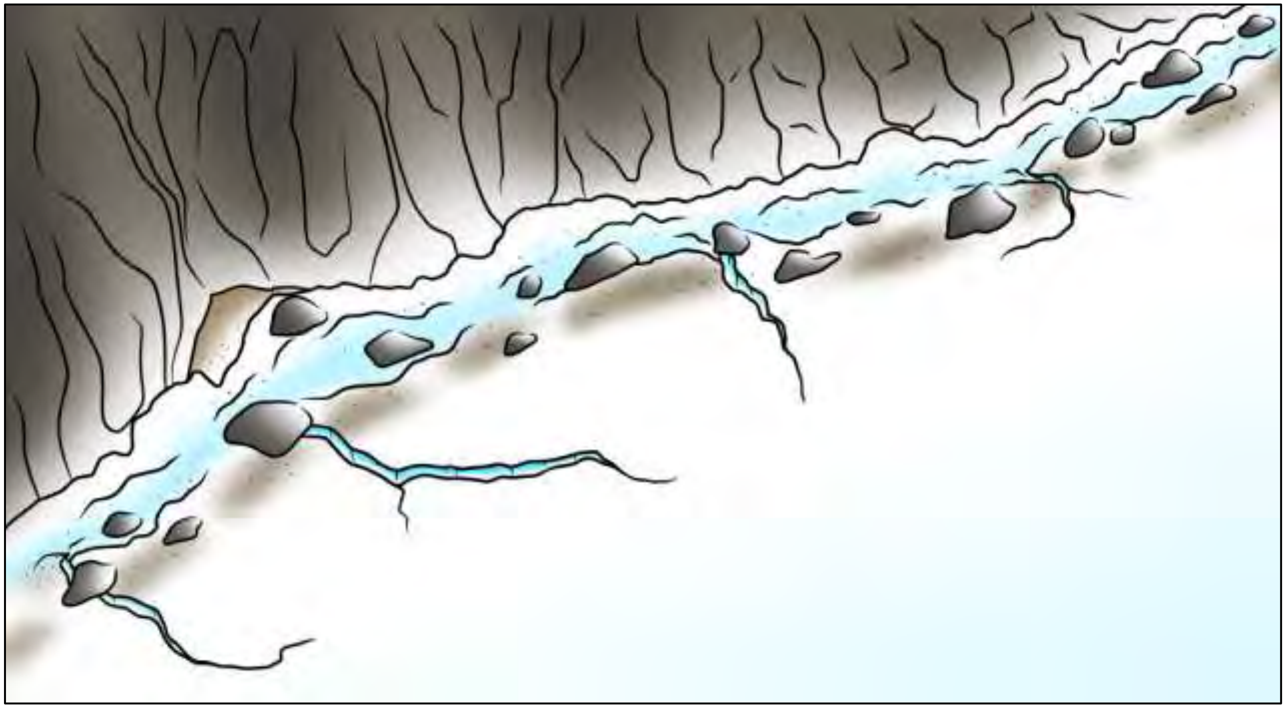
47. ᖃᖓᖑᖅᑐᖅ - Qanguqtuq

ᓯᑯ ᓯᕗᓪᓕᐅᔪᖅ ᓄᓇᒧᑦ ᐊᒃᑐᐊᔪᖅ ᐃᖃᖓᓇᓗᓐᓗ ᑐᙵᓪᓗᓂ. ᐃᓛᓐᓂᒃᑯᑦ ᓯᑯᐃᓚᐅᖃᑦᑕᖅᑐᖅ ᓄᓇᒥᑦ ᐊᒻᒪᓗ ᑕᕆᐅᕐᒥᑦ ᐊᑯᓐᓂᖓᓂ ᐊᒻᒪᓗ ᑖᓐᓇ ᓯᑯᐃᕐᓂᖓ ᑕᐃᔭᐅᓪᓗᓂ ᖃᖓᖑᖅᑐᖅ. ᑐᓴᕐᓴᐅᔪᓐᓇᖅᑐᖅ ᓄᑎᖕᓂᖓ ᓲᕐᓗ ᓄᔪᒃᓴᓪᓚᒃᑐᑐᑦ ᓄᓇᕐᔪᐊᕐ.

Siku sivulliujuq nunamut aktuajuq iqanganullu tunngalluni. Ilaannikkut sikuilauqattartuq nunamit ammalu tariurmit akunningani ammalu taanna sikuirninga taijaulluni qanguqtuq. Tusarsaujunnartuq nutingninga suurlu nujuksallaktutut nunarjuar.

The ice that forms first is closest to the land and connected to the bottom of the sea. Occasionally this ice breaks between the land and the ocean and this break-up is called Qangugtuq. You can hear this cracking like an earthquake.

ᐊᒋᐅᐱᓂᖅ - Aggiupiniq



Source: Jamesie Itulu

48. ᐊᒋᐅᐱᓂᖅ - Aggiupiniq

ᑭᓕᐅᕐᑐᕐᑐᖅ, ᓄᓱᒃᑕᕐᑐᖅ, ᓴᓕᒍᕐᑐᖅ ᓯᑯ ᓯᒃᔮᒃᑯᑦ. “ᐊᒋᐊᕐᑕᐅᔪᖅ ᓄᓇ” ᓯᑯ ᑭᓕᐅᕐᑎᓪᓗᒍ ᓴᓂᒧᑦ ᓄᓇᒥᒃ. ᓱᕋᑦᑎᕙᓪᓕᐊᔪᖅ ᐃᑦᑕᕐᓂᓴᖃᕐᕖᑦ ᓯᒃᔭᒥ ᓯᑯ ᖃᓖᕆᒃᓯᕙᓪᓕᐊᓪᓗᓂ. ᑕᑯᒃᓴᐅᓪᓗᓂ ᓄᓇᒥ ᓴᓕᒍᕐᑕᐅᔪᕕᓂᖅ ᓯᑯᒧᑦ.

Kiliurturtuq, nusuktartuq, saligurtuq siku sikjakkut. “Agiartaujuq nuna” siku kiliurtillugu sanimut nunamik. Surattivalliajuq ittarnisaqarviit sikjami siku qaliriiksivallialluni. Takuksaulluni nunami saligurtaujuviniq sikumut.

Grinding, pulling, scraping of ice along the coast. "Filing the land" as the ice scrapes sideways along the land. A destructive process for archeological sites along the shore where the ice is piling up. You can see where the land has been gouged by the pack ice.

ᐅᐱᕐᖔᒃᓴ: ᐋᔾᔨ, ᐄᐳᕈ, ᒪᐃ

UPIRNGAAKSA AAJJI, IIPURU, MAI

EARLY SPRING (JUST BEFORE MELT): MARCH, APRIL, MAY

Source: Jamesie Itulu

Source: Andrew Arreak

49. ᐋᔪᕋᖅ (ᐋᔪᕋᐃᑦ) - Aajuraq (Aajurait)

ᓇᒡᒍᑏ ᒪᑉᐱᖓᓕᓗᑎᒃ ᖁᐊᒃᑲᓐᓂᔾᔭᖏᓗᓂ. ᓇᑦᑎᐊᖃᓕᐅᑉ ᓄᖑᓕᓗᓂ, ᑐᐱᖅᑑᑦ ᐱᒋᐊᓕᓗᓂ.

Naggutii mappingali&utik quakkannijjangi&uni. Nattiaqaliup nunguli&uni, tupiqtuut pigiali&uni.

A crack in spring that doesn't refreeze (lead). First sign of spring, end of April and early May (singular)

ᐋᔪᕿᕐᓱᕐᓂᖅ - **Aajuqirsurniq**

Source: Gita Ljubicic

50. ᐋᔪᕿᕐᓱᕐᓂᖅ - Aajuqirsurniq

ᓄᑦᑕᕙᓪᓕᐊᖏᓐᓇᕐᑐᖅ ᓄᓇᒥᑦ ᐱᒋᐊᕐᓘᓂ, ᑕᕿᖓᓂ ᒪᐃ. ᑐᑭᖅᑲᕆᓪᓗᓂ ᓄᑦᑕᕕᓂᑐᖅᑲᖅ, ᐊᑦᑐᐃᒃᓴᕐᓯᒪᔪᖅ ᓯᑯ.

Nuttavallianginnartuq nunamit pigiar&uni, taqingani mai. Tukiqarilluni nuttavinituqaq, attuiksarsimajuq siku.

Reoccurring cracks the start at specific points of land, usually happens in May. Can also mean old cracks, caused by pressure.

ᐋᔪᕋᖅ (ᐋᔪᕋᐃᑦ) - Aajuraq (Aajurait)

ᖃᐅᔨᒋᐊᕐᓗᒍ ᐃᑳᕆᐊᖕᒋᓐᓂᕐᓂ

Qaujigiarlugu Ikaarianginnirni

Check before you cross

ᑰᓕᕐᑎᓪᓗᒋᑦ ᐃᒪᒃᑎᓯᒪᔪᒥᑦ ᐃᒃᓗᐊ ᐋᒧᕋᐅᑦ ᐳᕐᑐᓂᕐᓴᐅᑐᐃᓐᓇᕆᐊᖃᕐᒪᑦ (ᓯᓂᖓ ᐋᔪᕋᐅᑉ). ᐃᑳᕐᕕᒋᓂᐊᕐᑕᐃᑦ ᓇᓕᒧᒌᒃᓗᑎᒃ ᐳᑐᓂᖏᑦ.

Kuulirtillugit imaktisimajumit iklua aamuraut purtunirsautuinnariaqarmat (sininga aajuraup). Ikaarviginiartait nalimugiiklutik putuningit.

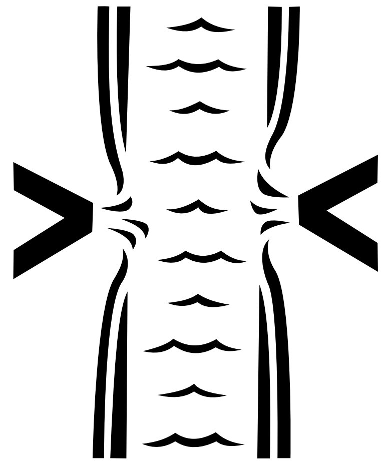
Draining of flooded ice may cause one side of a lead to be higher than the other, called an ice ledge. Pick a crossing spot where the ice and water are more level.

Source: Jamesie Itulu

Source: Andrew Arreak

ᐋᔪᕋᖅ (ᐋᔪᕋᐃᑦ) - Aajuraq (Aajurait)

Source: Andrew Arreak



Source: Jamesie Itulu

ᖃᐅᔨᒪᓪᓗᒍᑦ ᓇᐅᒃᑯᑦ ᐃᑳᕆᐊᖕᒋᓐᓂᕐᓂ

Qaujimallugut Naukkut Ikaarianginnirni

Know Where to Cross

ᑰᓕᕐᑎᓪᓗᒋᑦ ᐃᒪᒃᑎᓯᒪᔪᒥᑦ ᐃᒃᓗᐊ ᐋᔪᕋᐅᑦ ᐳᕐᑐᓂᕐᓴᐅᑐᐃᓐᓇᕆᐊᖃᕐᒪᑦ, (ᓯᓂᖓ ᐋᔪᕋᐅᑉ) ᐃᑳᕐᕕᒋᓂᐊᕐᑕᐃᑦ ᓇᓕᒧᒌᒃᓗᑎᒃ ᐳᕐᑐᓂᖏᑦ.

Kuulirtillugit imaktisimajumit iklua aajurait purtunirsautuinnariaqarmat, (sininga aajuraup) ikaarviginiartait nanimugiiklutik purtuningit.

High ledges along leads can be difficult and dangerous to cross. Look for meltwater streams draining from the ice for areas to cross. The stream will have melted the ice creating a channel that is a lower and safer area to cross.

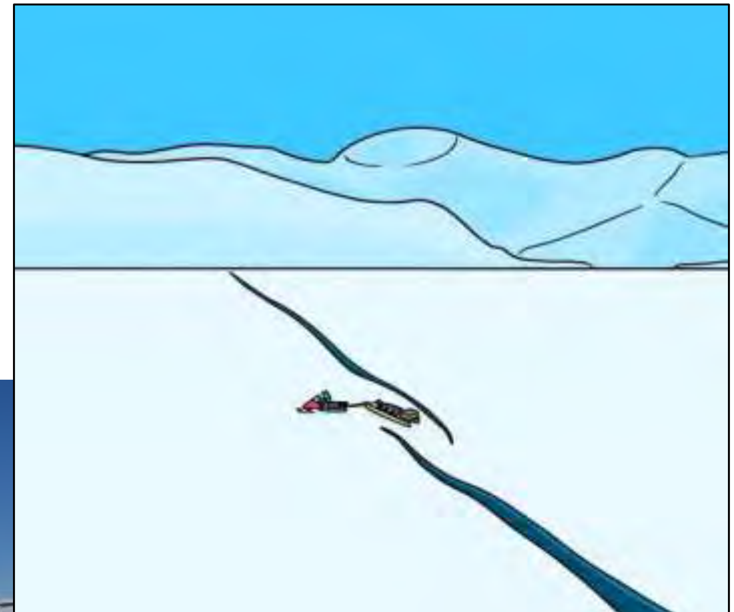
51. ᐱᓚᒋᐊᕐᓂᖅ - Pilagiarniq

ᐋᔪᕋᒃᑯᑦ ᐃᑳᕐᕕᒃ ᓯᑯ. ᐋᔪᕋᐅᑉ ᐃᓱᐊ (ᓯᑯᒥᑦ).

Aajurakkut ikaarvik siku. Aajuraup isua (sikumit).

Areas of stable ice between where leads begin and end. Also called ice bridges. They are safe places to cross when leads get too wide. Share their locations with others in the community, but be cautious as this will eventually break off.

ᐱᓚᒋᐊᕐᓂᖅ - **Pilagiarniq**



Source: Jamesie Itulu

Source: Andrew Arreak

52. ᕿᖅᓱᖅᑳᖅᑑᑦ - Qiqsuqqaqtuut (no photo)

ᐃᒻᒪᒃᑎᓐᓂᐊᓕᕐᑎᓪᓗᒍ ᓯᑯᒥ. ᖄᖓ ᓯᑰᑉ ᖁᐊᖅᑲᑦᑕᕐᖢᓂ ᐅᓐᓄᒃᑯᑦ ᐊᐅᒃᐸᒃᖢᓂ ᐅᓪᓗᒃᑯᑦ. ᐊᔾᔨᖓ ᐊᖁᑎᒥ ᕿᕐᓂᕐᑕᖅ ᓯᑯ. ᑐᑎᓪᓗᒍ ᐊᐳᑎ ᒪᐅᓐᓇᕐᖢᓂ. ᑕᐃᒪᐃᑎᓪᓗᒍ ᐃᖏᕋᕝᕕᑦᑎᐊᕙᐅᓂᕐᓴᐅᓪᓗᓂ ᐅᓐᓄᐊᒃᑯᑦ, ᐊᕿᓗᐊᕐᓂᖓᓄᑦ ᐅᓪᓗᒃᑯᑦ. ᕿᒧᒃᓯᒥ ᐊᑐᕐᑕᐅᕙᓚᐅᕐᑐᖅ ᐅᓐᓄᒃᑯᑦ.

Immaktinnialirtillugu sikumi. Qaanga sikuup quaqattar&uni unnukkut aukpak&uni ullukkut. Ajjinga aqutimi qirnirtaq siku. Tutillugu aputi maunnar&uni. Taimaitillugu ingiravittiavaunirsaulluni unnuakkut, aqiluarninganut ullukkut. Qimuksimi aturtauvalaurtuq unnukkut.

Just prior to water puddles forming. The top surface of the ice freezes at night and melts during the day. Similar to black ice on roads. When you step on the snow your boot goes through. At this time of year it becomes better to travel at night, too soft during the day. Good for dog team travel in the evening.

Sources: Gita Ljubicic

53. ᐃᒻᒪᑦᑎᓐᓂᖅ - Immattinniq

ᓯᑯ ᐃᒪᕈᔫᓗᓂ ᐊᐳᑎᐅ ᐊᐅᑉᐸᓪᓕᐊᓂᖕᒐᓄ.

Siku imarujuuluni aputiu auppallianinganu.

First puddles on the ice from snow.

ᐃᒪᖅᑯᖅ - Imaqquq

ᐃᒪᖅᑯᖅ - Imaqquq

Sources: Gita Ljubicic

54. ᐃᒪᖅᑯᖅ - Imaqquq

ᐃᒪ ᐃᒃᑲᖃᑦᑐ ᓯᔾᔭᒥᒃ.

Ima ikkaqattu sijjamik

Means water around the edge of a feature. These puddles form because the water is coming up/down with tides near the coast.

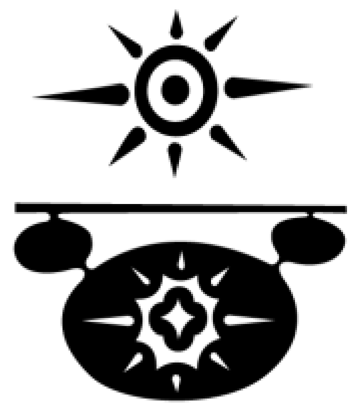
ᐅᐱᖕᒑᖅ: ᔫᓂ, ᔪᓚᐃ
UPINGAAQ: JUUNI, JULAI
EARLY SUMMER (WHEN THINGS ARE MELTING) : JUNE, JULY

Source: Jamesie Itulu

ᓯᕿᓂᕐᒧᑦ ᕿᓪᓕᓂᖓ - Siqinirmut qillininga

Sources: Gita Ljubicic

55. ᓯᕿᓂᕐᒧᑦ ᕿᓪᓕᓂᖓ - Siqinirmut qillininga



ᐅᔾᔨᕐᓴᑦᑎᐊᖃᑦᑕᕐᓗᑎᑦ ᓯᕿᓂᐅᑦ ᓇᓛᓄᑦ ᐃᖏᕋᓗᑎᑦ ᐃᒻᒪᒃᑎᓯᒪᓕᕐᑎᓪᓗᒍ.
ᑕᑯᖏᑐᐃᓐᓇᕆᐊᖃᕋᕕᐅᒃ ᓇᖏᐊᕐᓇᕐᑐᖅ ᕿᓕᕐᓂᖓᓄᑦ ᐃᒪᒃᑯᑦ
Ujjirsattiaqattarlutit siqiniut nalaanut ingiralutit immaktisimalirtillugu.
takungituinnariaqaraviuk nangiarnartuq qilirninganut imakkut.
Be vigilant driving towards the sun when melt ponds are forming. Sky reflected on the melt ponds may blind you from seeing big seal holes or open water.

Source: Jamesie Itulu

Source: Flicker/Constantine

56. ᐅᔪᒥᕆᐊᖅᑐᖅ - Ujumiriaktuq

ᐊᓄᕆᒧᑦ ᑭᓱᑐᐃᓐᓇ ᑕᓯᖅᑯᔨᓪᓗᑎ.

Anurimut kisutuinna tasiqqujilluti.

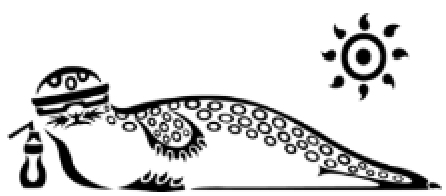
A mirage caused by temperature variations and wind. It seems like the land or ice has risen.

57. ᐳᐃᒃᑲᖅᑐᖅ - Puikkaqtuq

ᓂᓪᓚᓱᖅᑐᖅ ᐊᒻᒪ ᐅᖅᑰᔪᒃ ᑲᑎᑎᓪᓕᒋᑦ ᑭᓱᑐᐃᓐᓇ ᑕᓯᖅᑰᔨᓪᓗᑎᒃ.

Nillasuqtuq amma uqquujuk katitilligit kisutuinna tasiqquujillutik.

A "mirage" that stretches objects that are far away, making them seem closer and bigger (flexing) like they are floating above the ice.



Source: Jamesie Itulu

ᐃᒑᒃ - Igaak

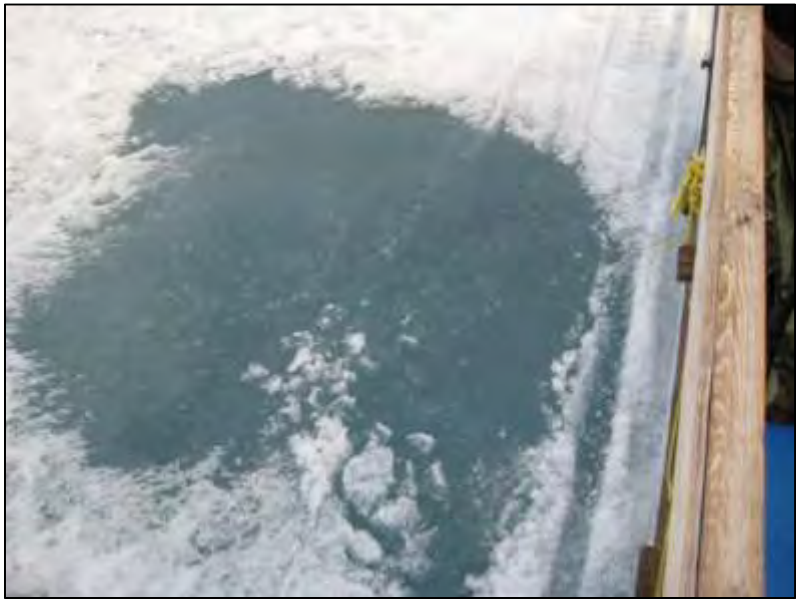
ᓯᕿᓐᓂᕐᑎᓪᓗᒍ ᐊᑐᖅᑕᕐᓗᒋᑦ ᐃᒑᒃ ᓯᑯᒦᓪᓗᑎᑦ ᐃᓪᓗᓕᔾᔨᐊᖏᓐᓇᕕᑦ.

Siqinnirtillugu atuqattarlugit igaak sikumiillutit illulijjianginnavit.

On a sunny day always wear sunglasses out on the ice so you don’t become snow blind.

Source: www.atoptics.co.uk

ᑭᑦᑎᓯᒪᔪᖅ - **Kittisimajuq**



58. ᑭᑦᑎᓯᒪᔪᖅ - Kittisimajuq

ᐊᐳᑎᐅ ᐊᑖᓂ ᐊᒻᒪ ᓯᑰ ᖃᖓᓂ ᐃᒪᐅᓪᓗᓂ.

Aputiu ataani amma sikuu qangani imaulluni.

Slushy water on top of the ice, slow travel.

59. ᑯᔾᔨᓂᖅ - Kujjiniq

ᐊᒡᓗᒧᑦ ᑰᑉᐸᓕᐊᔪ, ᐊᒡᓗ ᐊᖏᓪᓕᑉᐸᓕᐊᓕᕆᓂ ᑰᑕᖓᑕ ᐅᐃᔮᑉᐸᓪᓕᐊᓂᖓᓄᑦ.

Aglumut kuuppaliaju, aglu angillippaliali&uni kuutangata uijaappallianinganut.

Seal hole that is expanding and acting like a whirlpool

ᑯᔾᔨᓂᖅ - **Kujjiniq**

Sources: Gita Ljubicic

ᓴᒧᖕᒑᑐᖅ - **Samunngaatuq**

Sources: Gita Ljubicic

60. ᓴᒧᖕᒑᑐᖅ - Samunngaatuq

ᓯᑯ ᖄᖕᒐᓂ ᐃᒪ, ᐃᒪᐅ ᖄᖕᒐᓂ ᐊᐳᑎ. ᓇᖏᓯᒪᓐᓂᕈᕕᑦ ᑲᑕᕋᔾᔪᑎ.

Siku qaangani ima, imau qaangani aputi. Nangisimanniruvit kataraja&uti.

The surface has a little bit of snow/slush covering ice underneath. Difficult to travel and easy to get stuck. When standing your feet will go through to the ice, but you won't fall through to the open water.

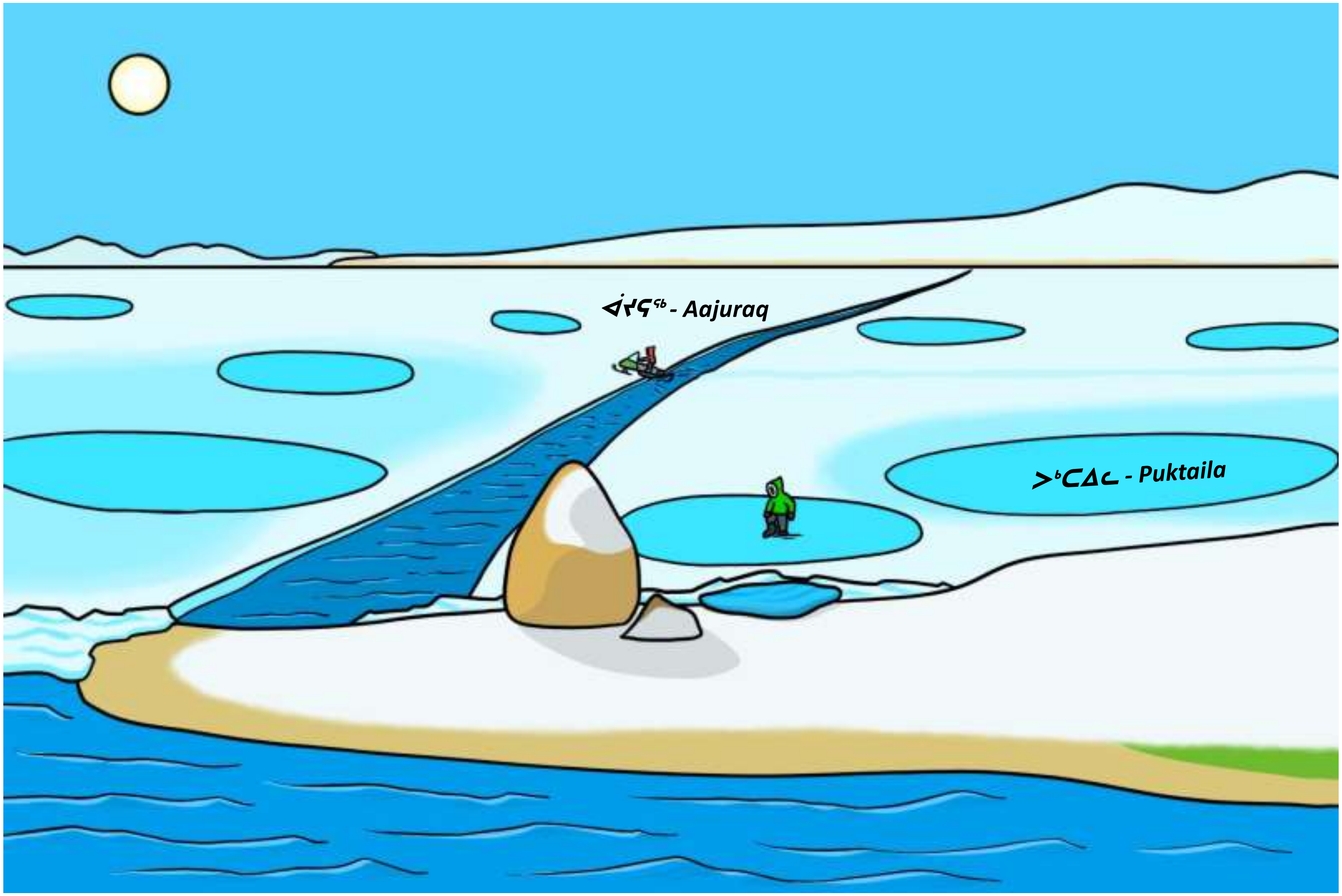
Sources: Gita Ljubicic

61. ᐳᒃᑕᐃᓚ - **Puktaila**

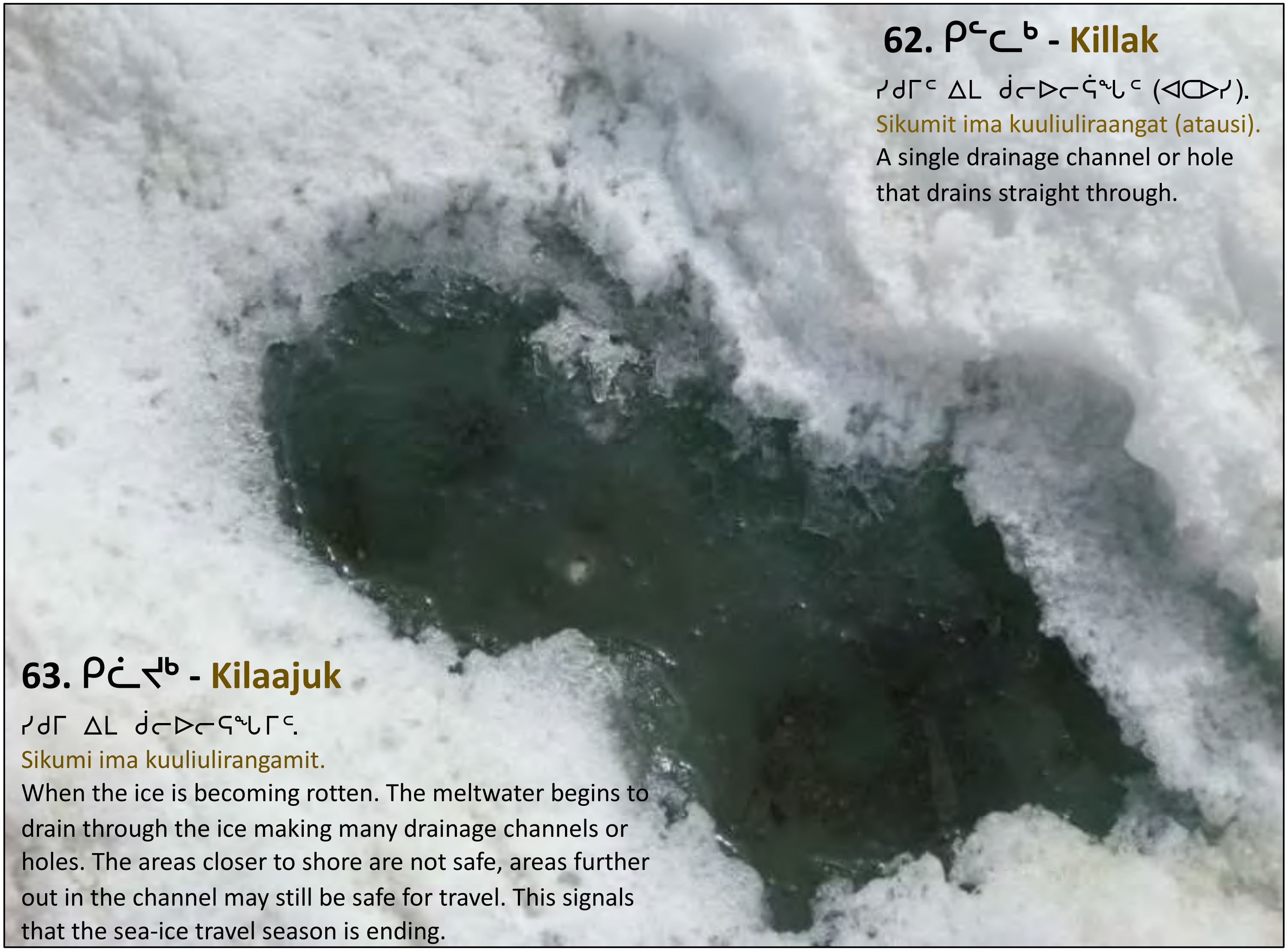
ᓯᑯᒥ ᐃᒪᑯᔅᓱ ᐃᑎᔪᓪᓗᓂ.

Sikumi imakussu itijulluni.

Pools of freshwater from melting snow begin to form on the sea ice (melt ponds). Large amount of water on the ice, around 1 foot deep, like large lakes before it drains. The ice bends from the weight of the water. This water can be nice to drink but wear your rubber boots to keep your feet dry.



Source: Jamesie Itulu



62. ᑭᓪᓚᒃ - Killak

ᓯᑯᒥᑦ ᐃᒪ ᑰᓕᐅᓕᕌᖓᑦ (ᐊᑕᐅᓯ).
Sikumit ima kuuliuliraangat (atausi).
A single drainage channel or hole that drains straight through.

63. ᑭᓛᔪᒃ - Kilaajuk

ᓯᑯᒥ ᐃᒪ ᑰᓕᐅᓕᕋᖓᒥᑦ.
Sikumi ima kuuliulirangamit.
When the ice is becoming rotten. The meltwater begins to drain through the ice making many drainage channels or holes. The areas closer to shore are not safe, areas further out in the channel may still be safe for travel. This signals that the sea-ice travel season is ending.

Source: Gita Ljubicic

ᐃᒻᒪᑦᑎᓕᕿᒃᑐᖅ - **Immattiliqiktuq**

Source: Gita Ljubicic

64. ᐃᒻᒪᑦᑎᓕᕿᒃᑐᖅ - Immattiliqiktuq

ᐱᖃᑖᓂ ᐃᒻᒪᒃᑎᑎᓪᓗᒍ ᓯᑯᒥ. ᒪᕉᐃᕐᓱᒐᔪᓚᐅᕈᓗᐊᕐᒪᑦ ᑭᓛᑎᓪᓗᒍ, ᑭᓯᐊᓂ ᓯᓚ ᐅᖁᓂᕐᓴᐅᓕᕐᓂᖓᓄᑦ ᐊᑕᐅᓯᐊᑐᐃᓐᓇᖃᑦᑕᓕᕐᒪᑦ ᐊᒻᒪᓗ ᓱᑯᔪᒥᒃ. ᒫᓐᓇ ᔪᓚᐃ ᐱᒋᐊᕐᓂᖓᓂ, ᐃᖏᕋᓐᓇᕐᑑᒐᓗᐊᖅ ᑭᓯᐊᓂ ᓇᖏᐊᕐᓇᕐᑐᖅ ᐅᔾᔑᓴᕆᐊᓕᒃ. ᐃᒻᒪᒃᑎᓐᓃᑦ ᐊᖏᓂᕐᓴᐅᖃᑦᑕᓕᕐᒪᑕ ᖄᒥᒃᑲᖓ ᓯᑯ ᑕᕆᐅᕐᒥᑦ. ᐃᒥᒐᒃᓴᐅᖏᑦᑐᖅ;ᑕᕆᐅᖑᓗᐊᕐᑐᖅ. ᑕᕆᐅᕐ ᓰᓯᑑᓕᕐᕈᓂ ᐳᑐᒐᓛᒃᕈᓂ. ᖃᐅᔨᒪᔾᔪᑕᐅᔪᖅ ᓯᑯᒃᑯᑦ ᐃᖏᕋᓐᓇᕈᓐᓃᕐᓂᐊᓕᕐᑐᖅ.

Piqataani immaktitillugu sikumi. Maruirsugajulauruluarmat kilaatillugu, kisiani sila uqunirsaulirninganut atausiatuinnaqattalirmat ammalu sukujumik. Maanna julai pigiarningani, ingirannartuugaluaq kisiani nangiarnartuq ujjisarialik. Immaktinniit anginirsauqattalirmata qaamikkanga siku tariurmit. Imigaksaungittuq; tariunguluartuq. Tariur siisituulir&uni putugalaak&uni. Qaujimajjutaujuq sikukkut ingirannarunniirnialirtuq.

The second time melt ponds are forming from ice melting. Normally happened twice after Kilaajuk, but with climate change it happens only once and it happens fast. Now in early July, you can still travel on it if you are very careful. Melt ponds start to get bigger when seawater floods the ice. Don’t drink this water; it’s too salty. The sea ice is like Swiss cheese. This signals that the sea-ice travel season is almost over.

ᓴᓗᕋᖅ - **Saluraq**

Source: Gita Ljubicic

65. ᓴᓗᕋᖅ - Saluraq

ᓯᑯᒥ ᐃᒪᖃᓚᐅᖤᓂ ᐃᒪᑕᖃᕈᓐᓂ, ᓵᓐᓂᖅᓴᐅᓗᓂᓗ ᐊᒻᒪ ᐴᑕᖓᖤᓂ. ᐅᐱᕐᖓᖁᑦ ᐃᒪᐃᔭᓕᕐᑎᓪᓗᒋᑦ ᐃᒻᒪᒃᑎᓯᒪᔪᑦ, ᓯᑯᓗ ᑭᓛᓯᒪᓕᖤᓂ. ᐅᔾᔨᕐᓱᕐᓗᑎᑦ, ᓯᑯ ᓱᕋᑦᑎᕙᓪᓕᐊᓕᕐᒪᑦ.

Sikumi imaqalau&uni imataqarunni, saanniqsaulunilu amma puutanga&uni. Upirngaqut imaijalirtillugit immaktisimajut, sikulu kilaasimalir&uni. Ujjirsurlutit, siku surattivallialirmat.

When the melting water on the sea ice surface has drained. The surface has dried up and the ice is full of drainage channels (Killak). The ice is rotten and floating on the ocean. Its getting thinner fast as it continues to melt rapidly. Spring is nearly over when the flooded ice drains, leaving rotten ice. Be careful, as the ice is about to break up.

ᒫᐅᔭᖅ - **Maujaraq**

Source: Katherine Wilson

66. ᒫᐅᔭᖅ - Maujaraq

ᓯᑯᒐᓛᖑᓪᓗᑎ ᓯᔾᔭᒥ ᐊᒻᒪ ᓇᒥᑐᐃᓐᓇ.

Sikugalaangulluti sijjami amma namituinna.

Floating ice along the beach in the summer.

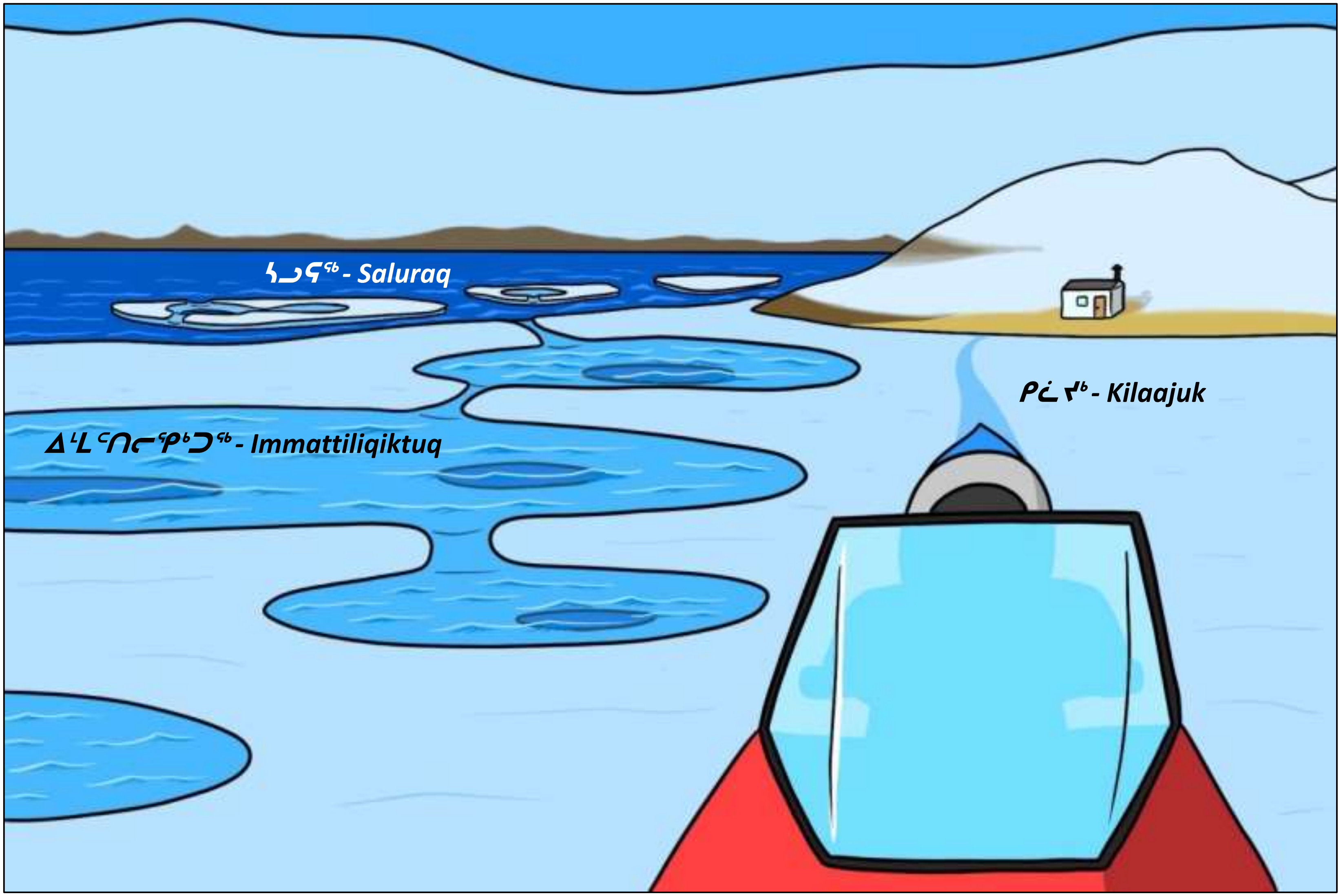
Source: Gita Ljubicic

67. ᐳᒃᑖᖅ - Puktaaq

ᓯᑯᑐᖅᑲ ᐃᒫᓂᑦᑐ. ᐃᔾᔪᔪᖅ.

Sikutuqa imaanittu. Ijjujuq.

Thick pieces of multi-year ice that are either floating or stranded on the beach. Can be 8-15 feet thick. Aged ice (good for tea).



Source: Jamesie Itulu

Appendix B

The Mittimatalik siku asijjipallianinga (sea ice climate atlas), 1997-2019

The atlas is currently being translated into Inuiktitut. The final atlas will be formated and printed for 11 x 17 paper. The atlas will be printed and shipped to Mittimatalik spring 2022.

The final booklet will be available at www.smartice.org

ᒥᑦᑎᒪᑕᓕᖕᒥ ᓯᑰᑉ ᒥᒃᓵᓄᑦ ᓄᓇᙳᐊᒃᑯᕕᒃ
Mittimatalik siku asijjipallianinga
Mittimatalik sea ice change atlas
1997-2019

Dedication

"Whenever an elder dies, a library burns down"

Amadou Hampâté Bâ

This atlas is dedicated to the memory of Jaykolassie Killiktee and Gamailie Kilukishak, founding members and Elders for the Sikumiut Management Committee. Jaykolassie was part of the Committee from 2016 to 2018 and provided gracious and unwavering leadership in the design of the committee to ensure Mittimatalik's self-determination in research. Gamailie's dedication to documenting, sharing, and teaching his sea ice Inuit Qaujimajatuqangit for the next generation was evident in his attendance at every Sikumiut meeting held between 2016 and 2022. We are honoured to have known and worked with these Elders, and to have their contributions reflected in this atlas.

Publishing information

Publication date: February 2022

The information in this atlas can be shared and referenced as:

Sikumiut Committee, Wilson, K., and Arreak, A. (2022). **Mittimatalik siku asijjipallianinga (sea ice change atlas), 1997 to 2019**. SmartICE Inc., Mittimatalik, Canada, 111 p.

ᑕᑯᔭᒃᓴᐅᔪᑦ ᓂᐅᕋᕐᓗᒋᑦ ᖃᕋᓴᐅᔭᕐᒥᑦ ᐅᕙᙵᑦ:
Takujaksaujut niurarlugit qarasaujarmit uvanngat:
Available for download at:
h1ttps://smartice.org/ice-safety/

- Andrew Arreak, SmartICE Regional Operations Lead, Qikiqtaaluk Region, aarreak@smartice.org, or
- Katherine Wilson, SmartICE Director of Knowledge Co-Production, katherine@smartice.org

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Thank you to Shelly Elverum and the Ikaarvik youth in Mittimatalik for your advice and encouragement—you have been a constant source of inspiration for this work. The workshop/meeting interpreters in this work play such a critical role in communicating and sharing knowledge, and we are truly thankful to Malachi Arreak (Mittimatalik), Morgan Arnakallak (Mittimatalik), and Abraham Kubulu (Mittimatalik and Arviat). Thank you to Mishak Allurut (Ikpiarjuk) for the timely translation of many Sikumiut documents.

Thank you to Lynn Moorman from Mount Royal University and Bhavana Chaudhary, Benoit Montpetit, Stephen Howell, Angela Cheng, and Tom Zagon with Environment and Climate Change Canada for sharing their programming, GIS, ice chart and remote sensing knowledge to support and develop the training for this research. We are also grateful to management at ECCC for their ongoing encouragement and support for this research, and Evan Richardson with ECCC's Mittimatalik Research Station for accommodation and meeting space. Thank you to Carolann Harding at SmartICE for all the administrative support.

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This Research has received the following approvals: Nunavut Research License #02 013 20R-M; and Memorial University of Newfoundland Interdisciplinary Committee on Ethics in Human Research, ethics approval #20190684-AR.

The community of Mittimatalik, Nunavut

The community of Mittimatalik (Pond Inlet) is located at the northern tip of Baffin Island in Nunavut (Figure 1). Areas commonly travelled around Mittimatalik include Navy Board Inlet, Tasiujaq (Eclipse Sound), and Tursukattak.

There are two sinaangit (plural of sinaa = floe edges) in the region, one at the entrance to Navy Board Inlet and one at the entrance to Tursukattak. Sinaangit are stable edges of tuvaq (landfast or stable ice that is frozen to the land), located beside areas of open water that remain clear of ice throughout most of the sea ice season. The Tursukattak sinaa is located approximately 65 km east of the community and is one of the main hunting and fishing locations that Mittimatalingmiut use.

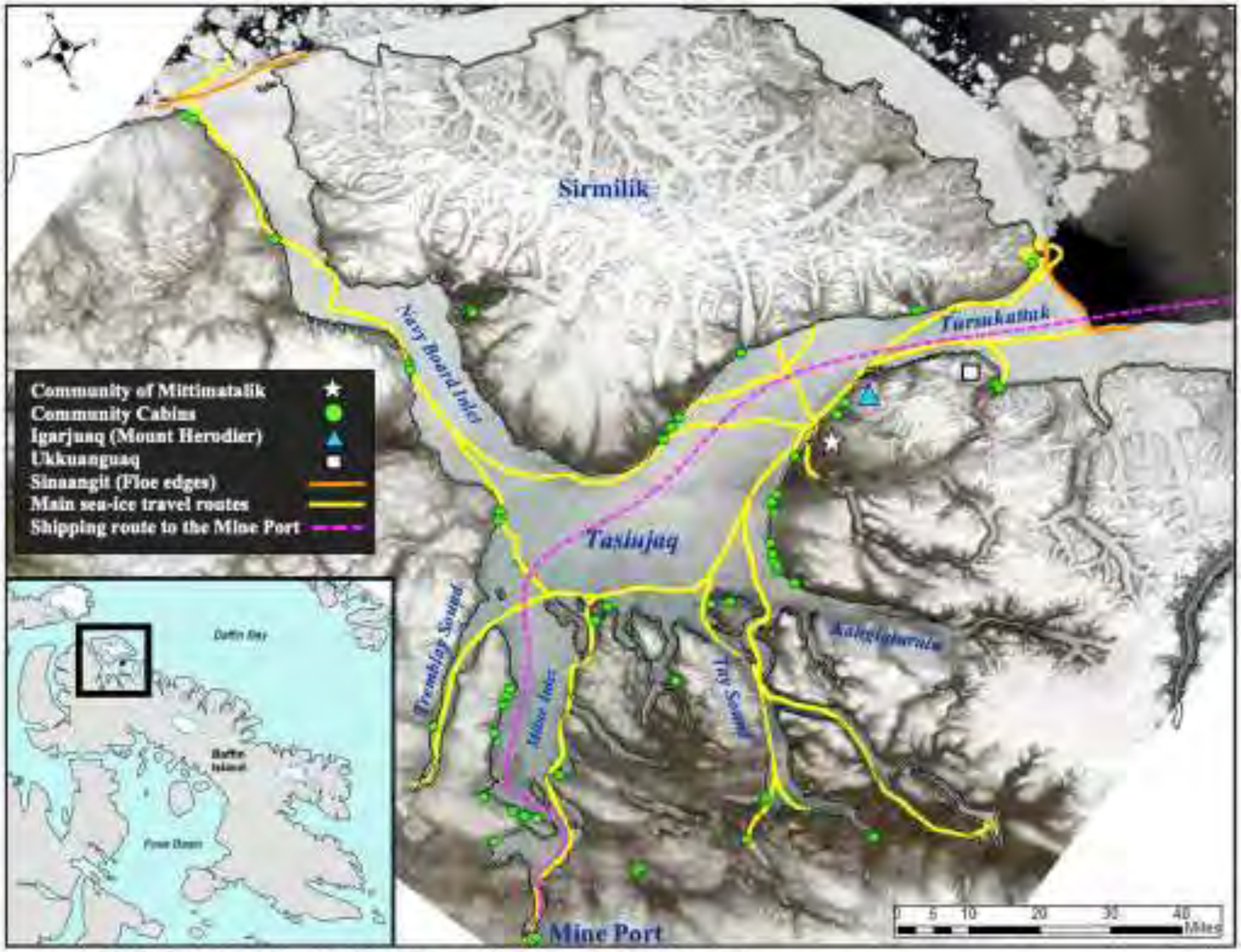


Figure 2: Map of the Mittimatalik sea ice travel region, Nunavut, Canada.
Background satellite image: MODIS True Colour Composite, June 9, 2019 (NASA, 2019)

Mittimatalik sea ice seasonal cycle

The ice begins to freeze in late October and is normally safe for travel by mid-November. Mittimatalingmiut (people of Mittimatalik) travel on the sea ice until early July, as shown in figure 2.

Mittimatalingmiut travel on the ice for 7 months to hunt and fish for country food (caribou, narwhal, beluga, seal, and char), and to spend time away from town at family cabins.

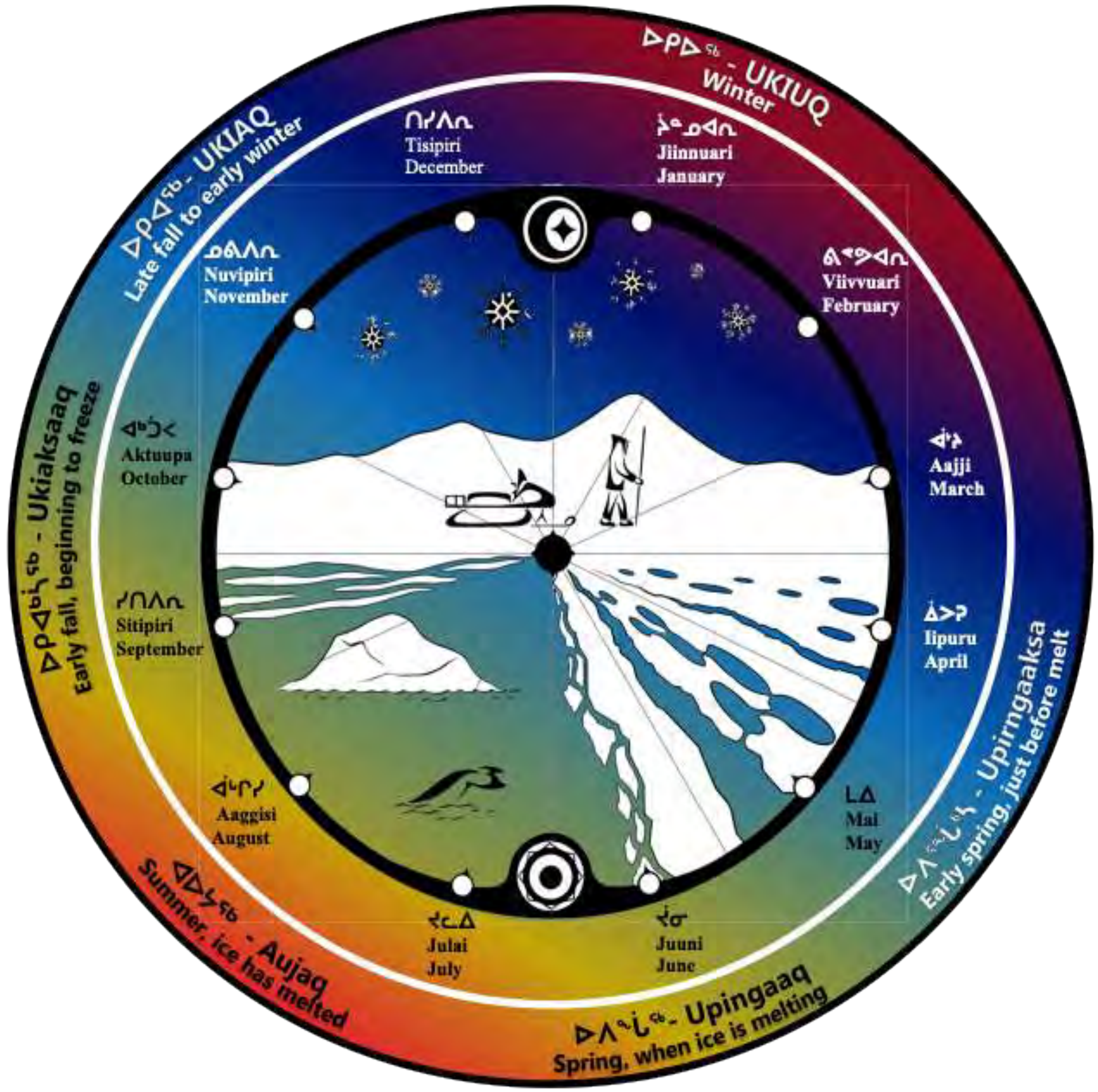


Figure 2: The Mittimatalik sea ice seasonal cycle. Illustration by Jamesie Itulu

The Sikumiut management committee

Sikumiut means "people of the sea ice". It is a committee of Inuit sea ice users that have been managing the SmartICE community-based sea ice monitoring program (www.smartice.org) in Mittimatalik since 2016. The following members were involved in the making of this atlas.

Brian Koonoo,
Parks Canada

Caleb Sangoya,
Canadian Rangers

David Angnatsiak ,
Search and Rescue

Elijah Panipakoocho,
Hunters and Trappers Organization

Gamalie Kilukishak,
Elder

Sheati Tagak,
Local Outfitter

Moses Amagoalik
Young hunter

Ivan Koonoo
Ikaarvik youth

Andrew Arreak,
Sikumiut researcher

Katherine Wilson,
Sikumiut research trainer / mentor

Why the Mittimatalik siku asijjipallianinga was made

In 2017, Sikumiut members discussed that while the sea ice freezes and breaks up differently each year, changes in ice conditions are now beyond what they would consider normal. They were interested in understanding where the sea ice was becoming more dangerous, so they could adapt their travel routes and practices to maintain safe hunting and fishing activities.

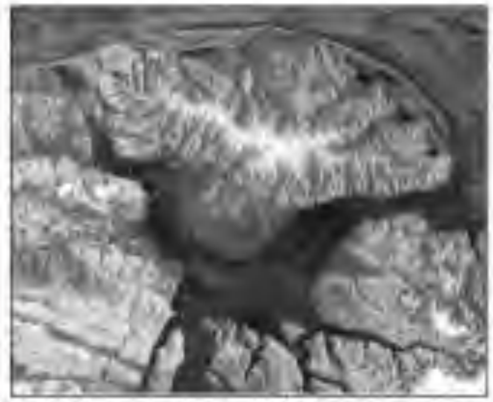
Sikumiut also wanted to understand the potential impacts of a proposed extension to the shipping season by Baffinland Iron Mines (BIM), the company that operates the Mary River iron ore mine and port near the community. The shipping route to the mine port in Milne Inlet passes through Tursukattak and Tasiujaq (Figure 1). BIM wanted to ship earlier during sea ice break-up and later as the sea ice is freezing. Avoiding disturbances to the Tursukattak sinaa and tuvaq as they form and late in the seasons is critical for safe sea ice travel, as well as for wildlife habitat and migration.

Sikumiut identified the need to document Mittimatalik's historical sea ice conditions and develop a baseline of sea ice knowledge for the region. To address this knowledge gap, Andrew Arreak and Katherine Wilson worked with Sikumiut to co-develop the Mittimatalik siku asijjipallianinga (sea ice change atlas).

Information sources used

The following four sea ice information sources used to make the Mittimatalik siku asijjipallianinga. The overlapping time period for all these information sources was 1997 to 2019, or 23 years.

1) Sikumiut's Inuit Qaujimajatuqangit (IQ), the only long-term and consistent record of sea ice for the area



3) Radars satellite data, RADARSAT 1 and 2 (1997 to present) imagery to review break-up

2) Canadian Ice Service sea ice shipping charts (1968 to present) to review freeze-up

4) Optical satellite data, MODIS imagery (2000 to present) to review break-up

Making the maps

The co-production of the Mittimatalik siku asijjipallianinga occurred over three years between 2019 and 2021. Andrew Arreak was trained to interpret satellite imagery and Canadian Ice Service charts using his and Sikumiut's Inuit Qaujimajatuqangit.

Satellite interpretation training on the sea ice near Mittimatalik, 11 April 2019. Andrew Arreak (Mittimatalik), Jenny Mosesie (Qikiqtarjuaq), and Robert Karetak (Arviat) with Lynn Moorman (Mount Royal University). Source: SmartICE Inc.

Interpretting the maps

In this project, science data and tools were adapted to map Sikumiut's Inuit Qaujimajatuqangit of safe and dangerous sea ice travel conditions using computer software. Maps were created to show ice conditions over the 23-year study period, and the results were reviewed and analysed based on Sikumiut's Inuit Qaujimajatuqangit.

Andrew Arreak presenting results to Sikumiut. Source: Shelly Elverum

For more detailed information on the methods used, please see:

Wilson, K.J., Arreak, A., The Sikumiut Committee, Bell, T., and Ljubicic, G.J. 2021. **The Mittimatalik Siku Asijjipallianinga (Sea Ice Climate Atlas): How Inuit Knowledge, Earth Observations, and Sea Ice Charts Can Fill IPCC Climate Knowledge Gaps**. Frontiers in Climate. https://doi.org/10.3389/fclim.2021.715105.

Weekly summary freeze-up maps

Source: Katherine Wilson

10-weeks of freeze-up

To see patterns in safe ice travel during freeze-up across the 23 years, the information was summarized into one map for each of the following ten weeks.

- October 22 to 28
- October 29 to November 4
- November 5 to 11
- November 12 to 18
- November 19 to 25
- November 26 to December 2
- December 3 to 9*
- December 10 to 16*
- December 17 to 23*
- December 24 to 30*

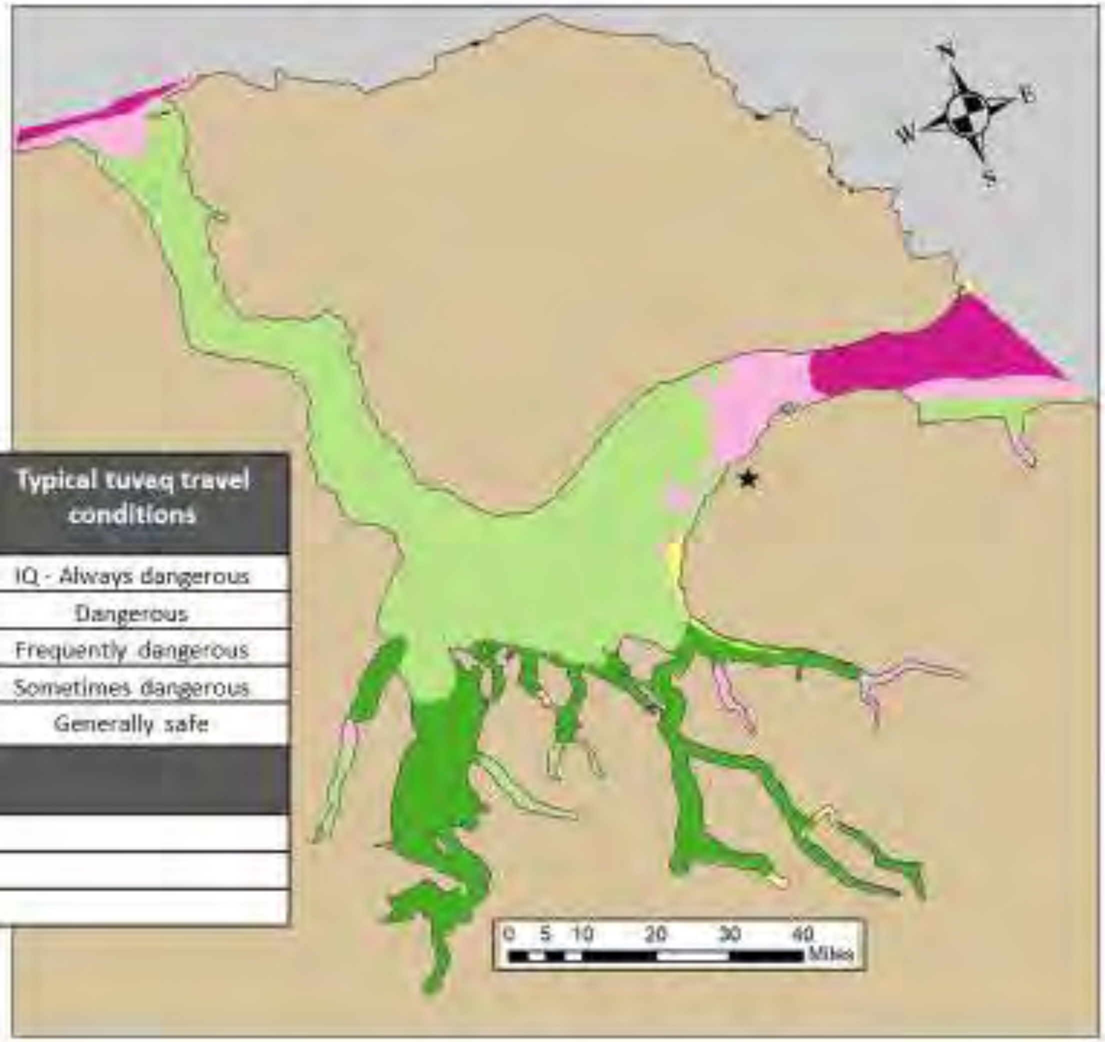
*Weeks with 13 to 14 years of data as Canadian Ice Service charts were not produced into December until 2006.

Reading the weekly summary freeze-up maps

We coloured areas of the summary map depending on how often the ice was tuvaq (when it was safe to travel on). The sample map on the right shows how often tuvaq conditions occurred for the week of November 12 to 18, over the 23-year study period.

(yellow)	Yellow areas are always dangerous based on Sikumiut's Inuit Qaujimajatuqangit (IQ). These areas were not captured at the resolution of the Canadian Ice Service charts.
(dark pink)	Dark pink areas rarely had tuvaq developed by the week of November 12 to 18. Out of the 23 years mapped, these area were tuvaq less than 25% of the time and are still dangerous for ice travel.
(light pink)	Light pink areas had tuvaq only 25 to 50% of the time during the week of November 12 to 18. These areas would be normally considered dangerous for travel during this week of freeze-up.
(light green)	Light green areas had tuvaq 50 to 75% of the time during the week of November 12 to 18. Typically, these areas would be considered sometimes dangerous for travel during this week in November.
(dark green)	Dark green areas had tuvaq 75 to 100% of the time during the week of November 12 to 18. These areas are generally safe for ice travel during this week of freeze-up. **You should always consult experienced hunters in the community and the most recent weather and ice information before you travel.**

November 12 to 18 tuvaq summary map: 1997 to 2019



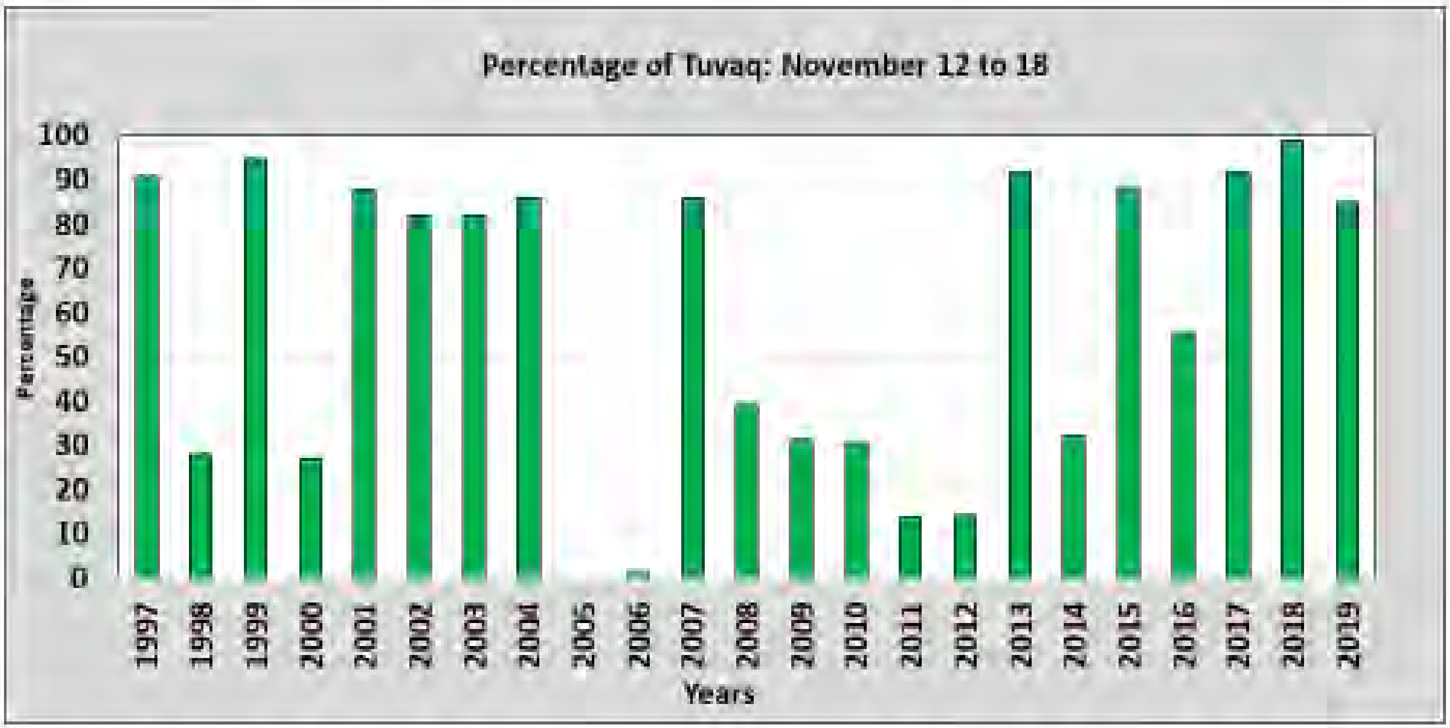
Map colour	Number of years the area was Tuvaq	Percentage of years the area was tuvaq	Typical tuvaq travel conditions
	—	—	IQ - Always dangerous
	1 - 5	0-25%	Dangerous
	6 - 10	25-50%	Frequently dangerous
	11 - 16	50-75%	Sometimes dangerous
	17 - 23	75-100%	Generally safe

Map Colour	Map Elements
★	Mittimatalik
	Outside travel region
	Land

Reading the freeze-up graphs

The graphs show how much tuvaq there was for the week of November 12 to 18 over the 23-year study. Each green bar represents a year from 1997 to 2019 listed on the bottom of the graph. The length of each bar shows the percentage of tuvaq that was present. For example:

- In 1997 the amount of tuvaq around Mittimatalik for the week of November 12 to 18 was around 90%
- In 2005 tuvaq had not formed anywhere around Mittimatalik by this week in November
- In 2019 there was around 85% tuvaq this week



Using the weekly summary freeze-up maps and graphs

1. Safe sea ice travel information

For people with less travel experience, these weekly maps can help those understand areas that are normally safe or dangerous for travel during each week of freeze-up.

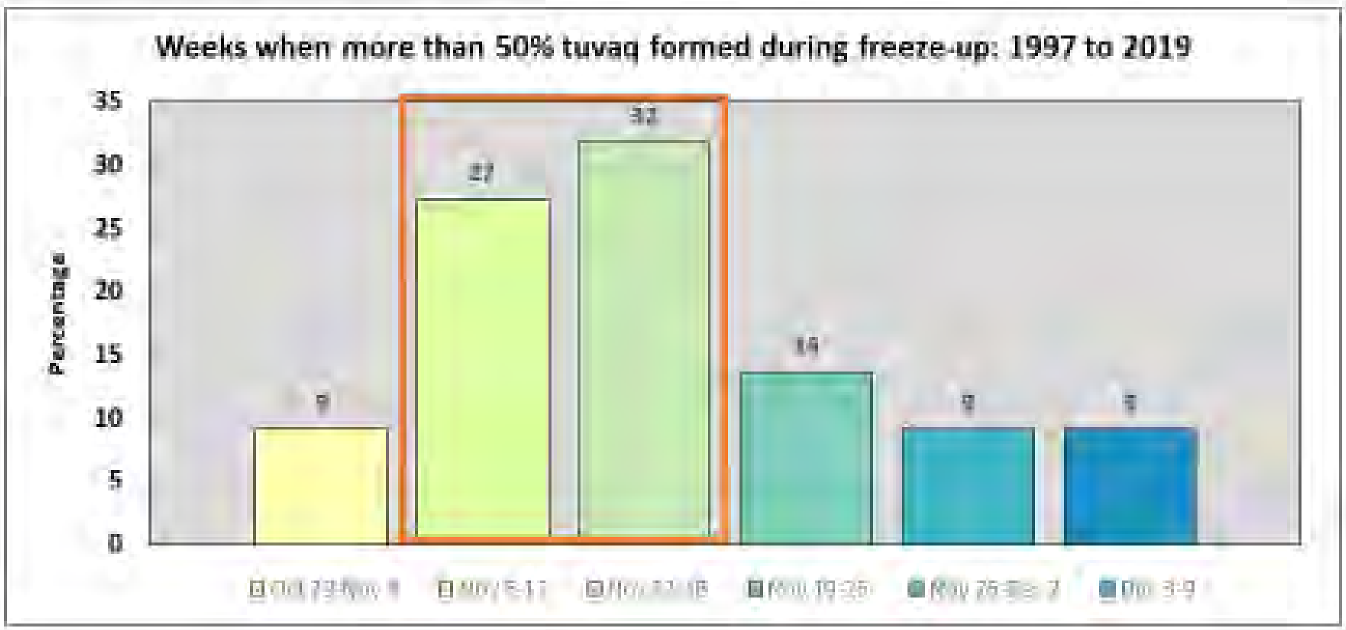
2. Change in sea ice due to climate change

The graphs can be used to see if the amount of tuvaq forming each week has changed over the 1997-2019 period. We don't see a trend showing that the sea ice is freezing up later. However, the analysis shows that freeze-up is becoming more inconsistent from year to year and is not as predictable.

Continued.....

3. Impacts from shipping later into the winter

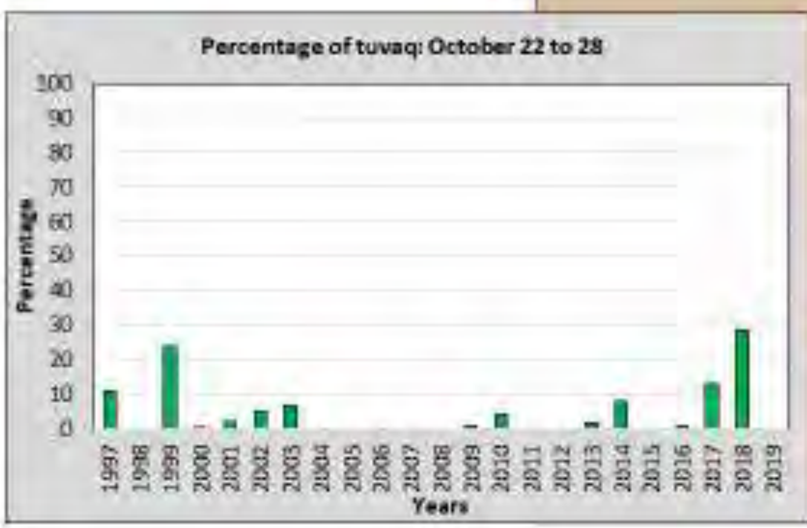
- Freeze-up can happen quickly and Sikumiut wanted to understand which weeks were critical for tuvaq formation if shipping to Mary River is extended from mid-October to mid-November. We reviewed our 23-year record to identify the weeks when more than 50% of the tuvaq formed.
- In the graph below, each bar represents a week, and the length of each bar shows how often more than 50% of the tuvaq formed this week.
- In the two weeks between November 5 and 18 (identified by the orange box), critical tuvaq formation occurred 59% of the time.
- BIM shipping later into freeze-up could compromise the formation of tuvaq and the Tursukattak sinaa, affecting winter sea ice travel and wildlife.

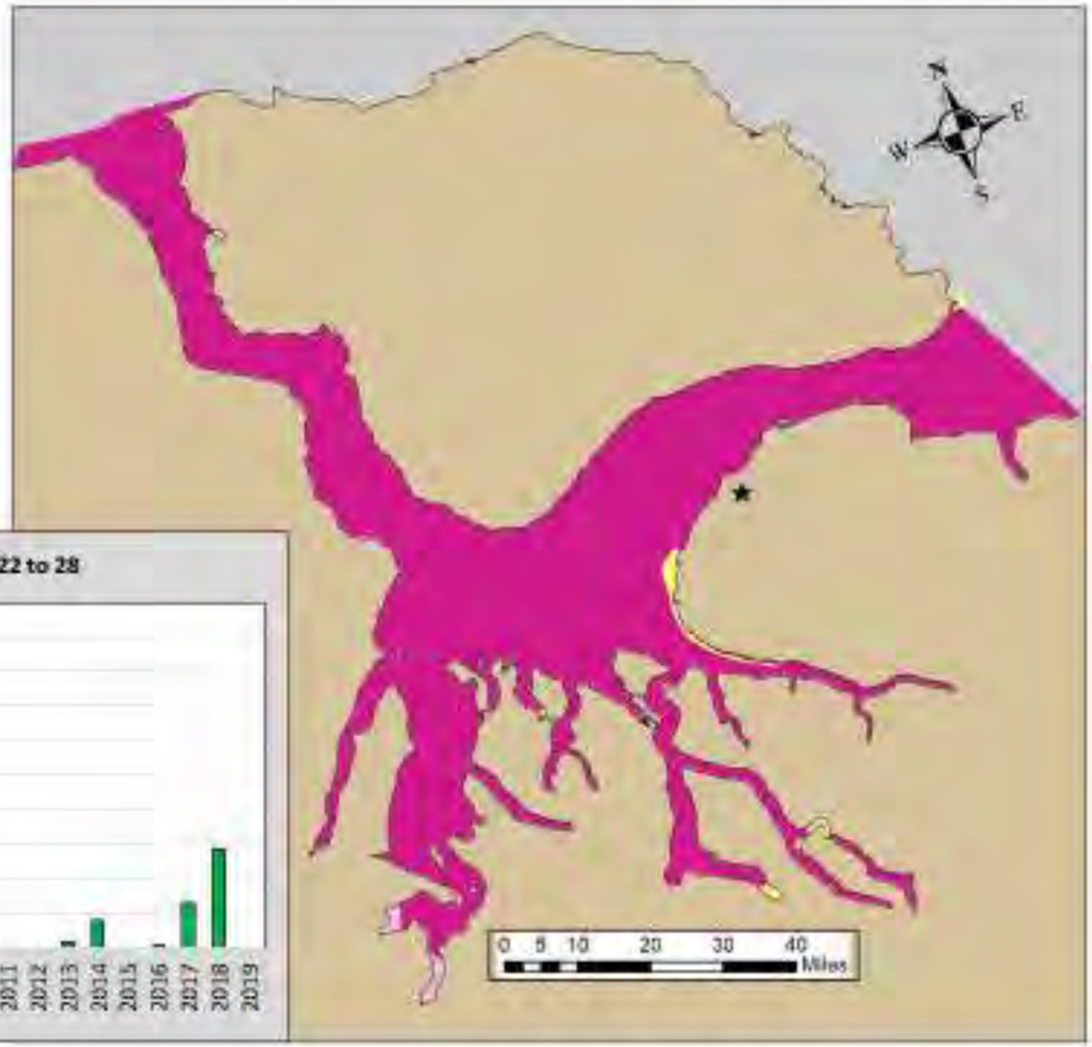


Weekly summary freeze-up maps:
October 22 to December 30

October 22 to 28 summary freeze-up map: 1997 to 2019

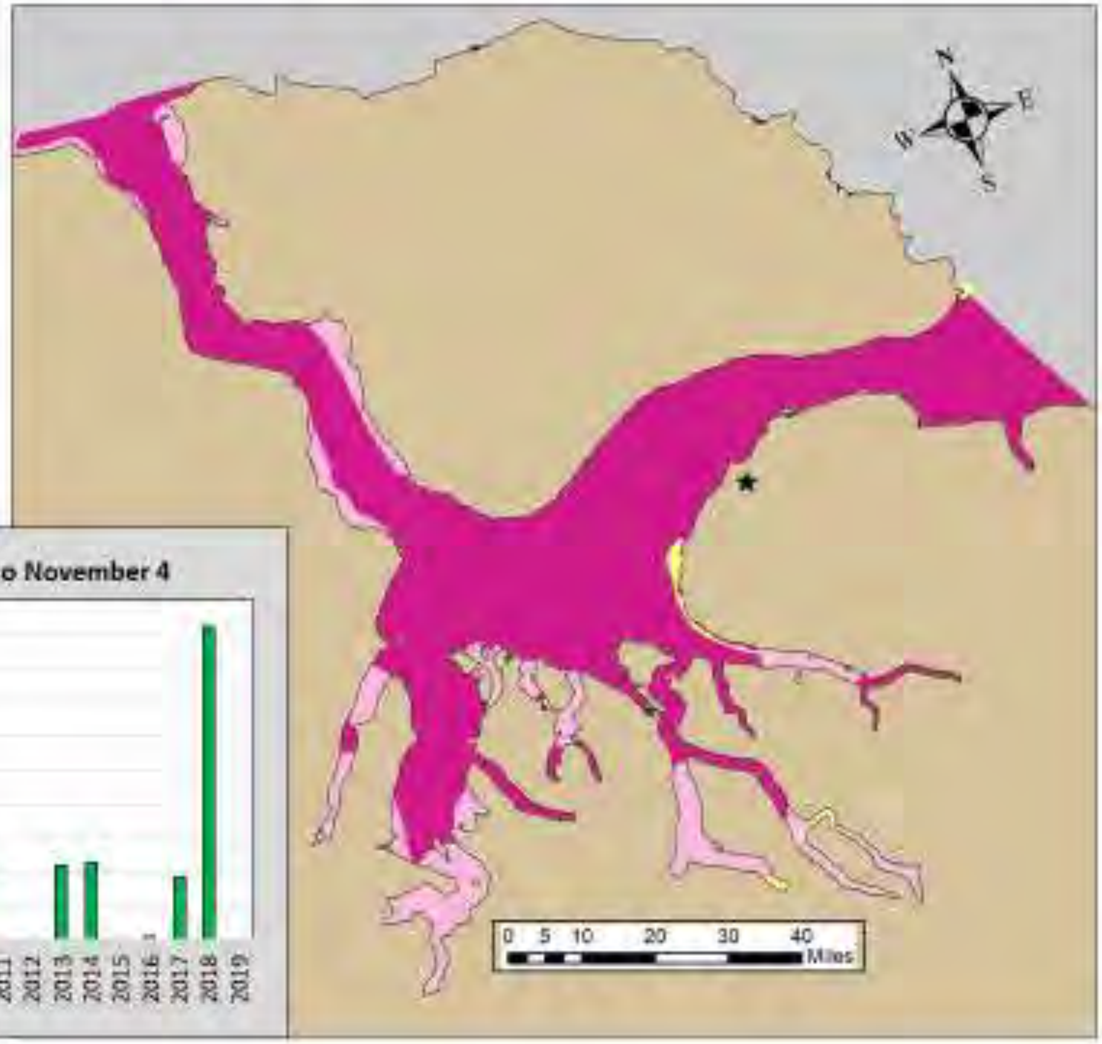
Map colour	Percentage of years the area was tuvaq	Typical tuvaq travel conditions
	–	IQ - Always dangerous
	0-25%	Dangerous
	25-50%	Frequently dangerous
	50-75%	Sometimes dangerous
	75-100%	Generally safe
Map Colour	**Map Elements**	
★	Mittimatalik	
	Outside travel region	
	Land	

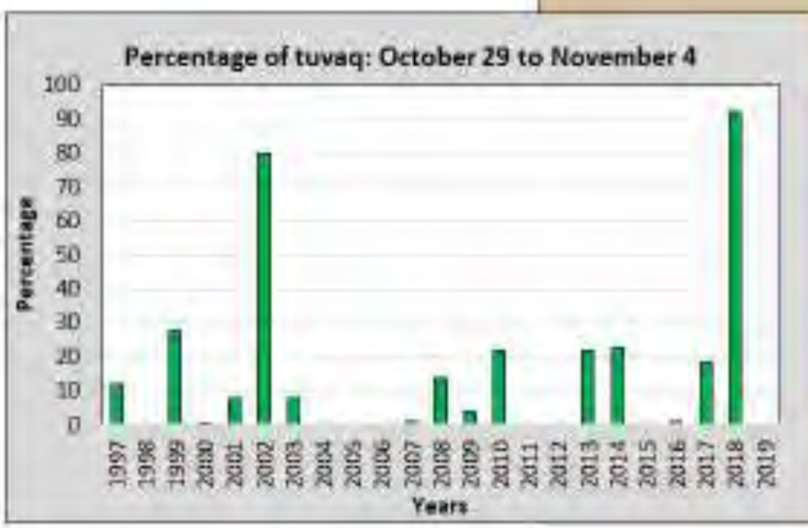




October 29 to November 4 summary freeze-up map: 1997 to 2019

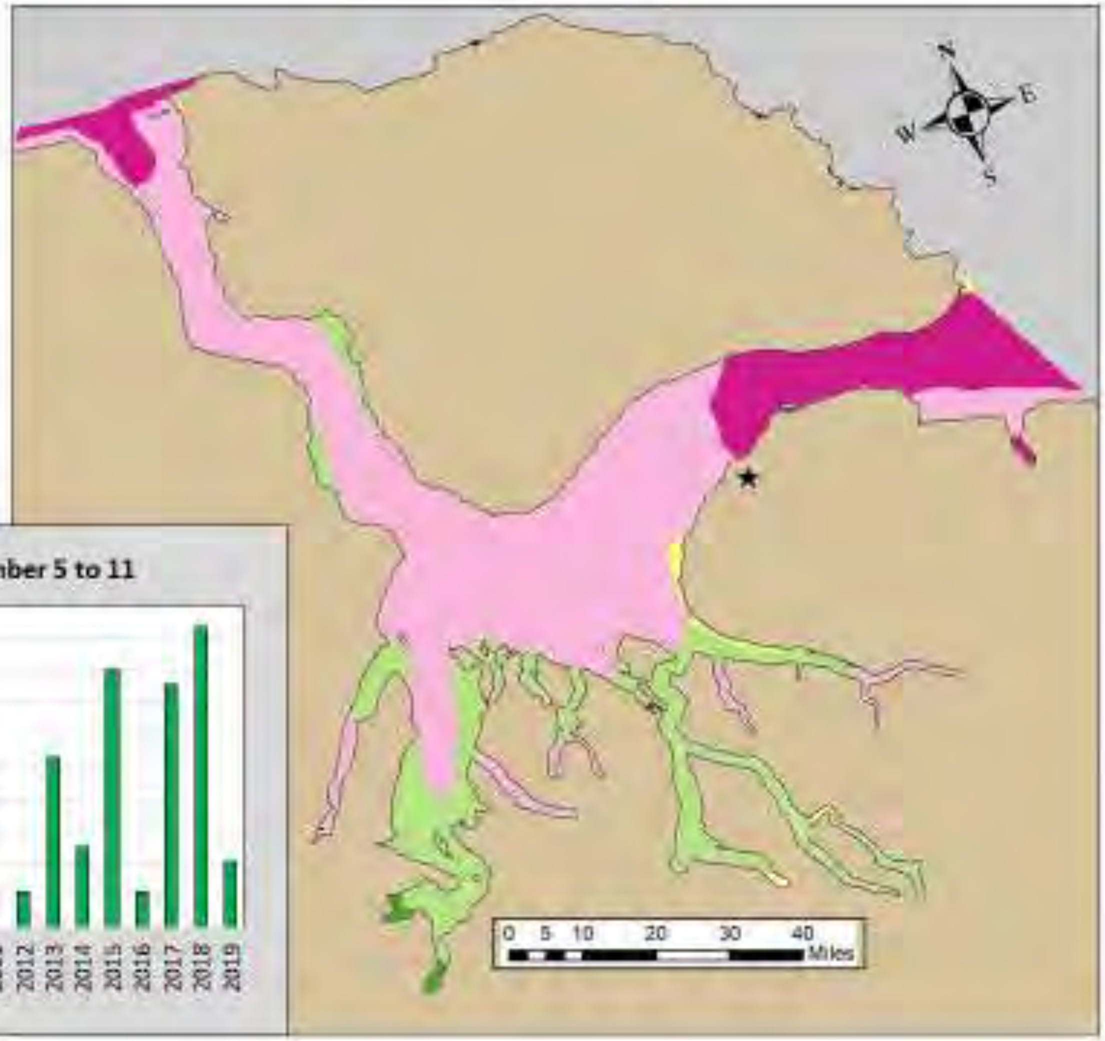
Map colour	Percentage of years the area was tuvaq	Typical tuvaq travel conditions
	–	IQ - Always dangerous
	0-25%	Dangerous
	25-50%	Frequently dangerous
	50-75%	Sometimes dangerous
	75-100%	Generally safe
Map Colour	**Map Elements**	
★	Mittimatalik	
	Outside travel region	
	Land	

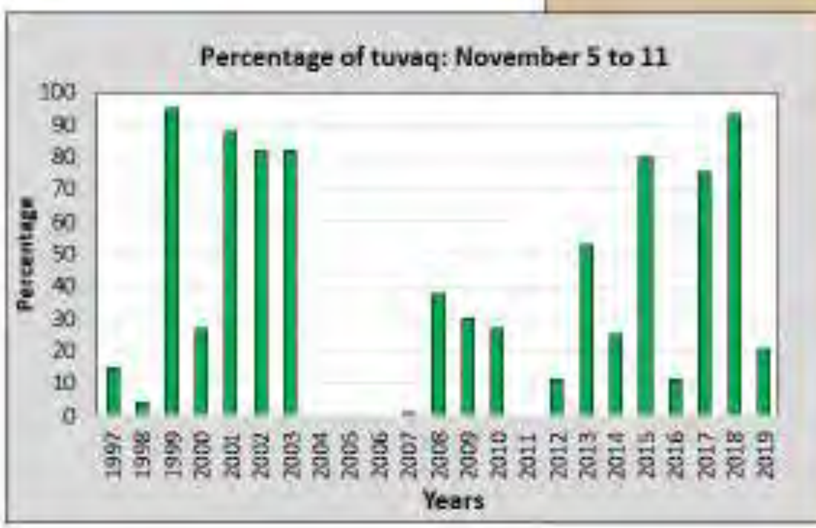




November 5 to 11 summary freeze-up map: 1997 to 2019

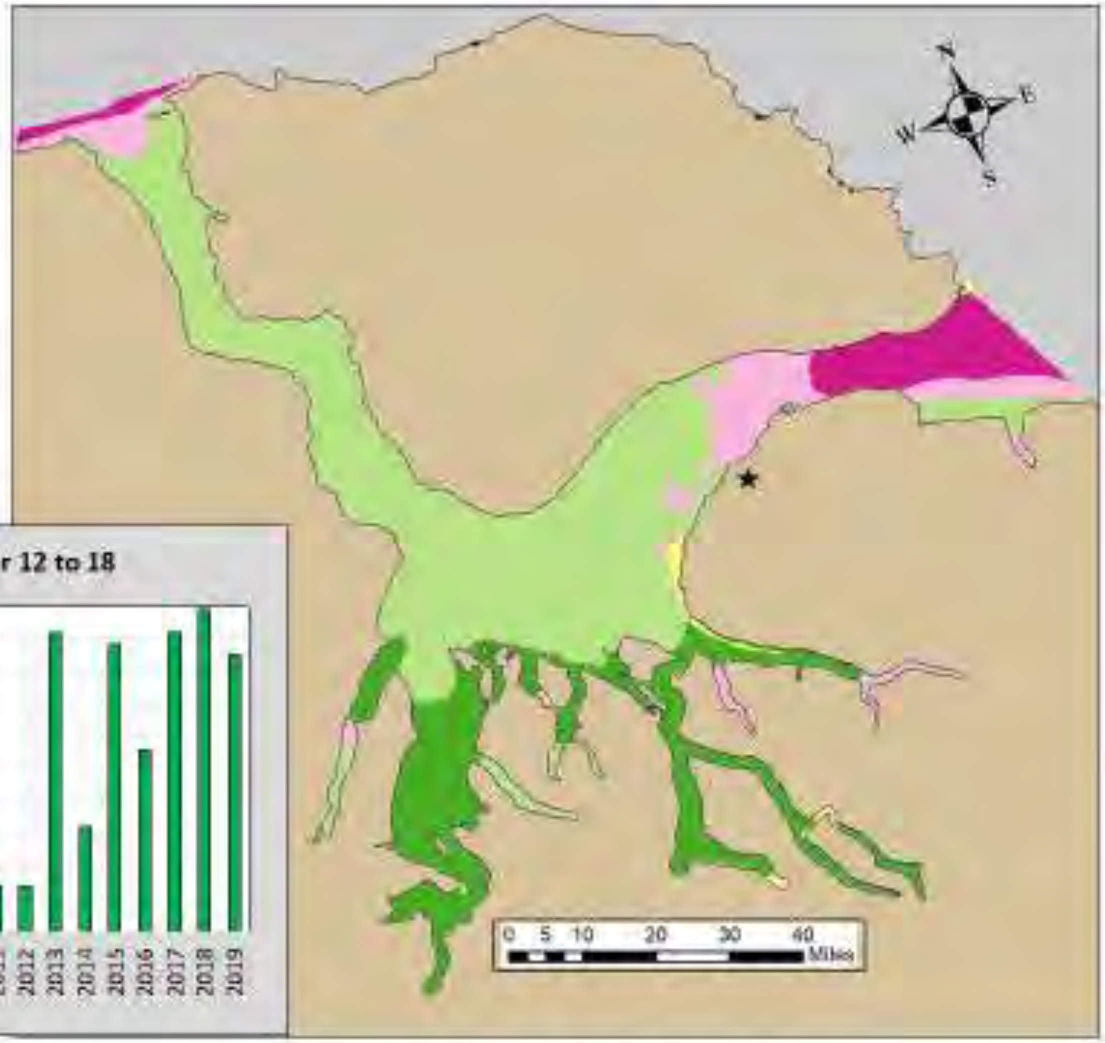
Map colour	Percentage of years the area was tuvaq	Typical tuvaq travel conditions
	–	IQ - Always dangerous
	0-25%	Dangerous
	25-50%	Frequently dangerous
	50-75%	Sometimes dangerous
	75-100%	Generally safe
Map Colour	**Map Elements**	
★	Mittimatalik	
	Outside travel region	
	Land	

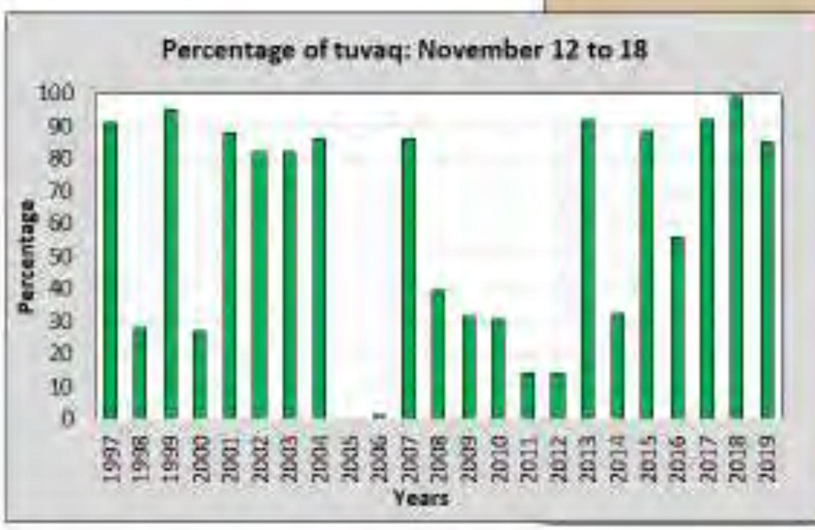




November 12 to 18 summary freeze-up map: 1997 to 2019

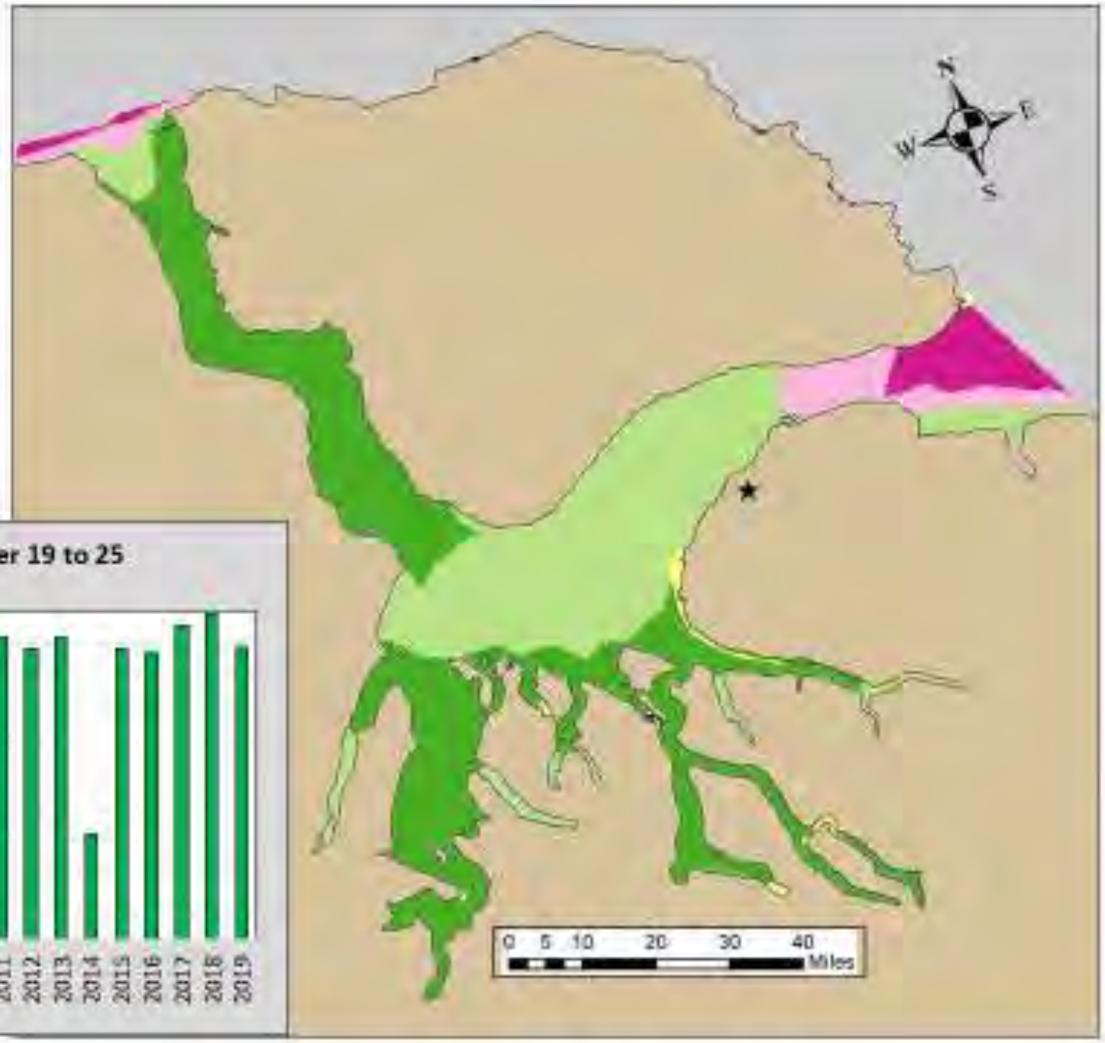
Map colour	Percentage of years the area was tuvaq	Typical tuvaq travel conditions
	–	IQ - Always dangerous
	0-25%	Dangerous
	25-50%	Frequently dangerous
	50-75%	Sometimes dangerous
	75-100%	Generally safe
Map Colour	**Map Elements**	
★	Mittimatalik	
	Outside travel region	
	Land	

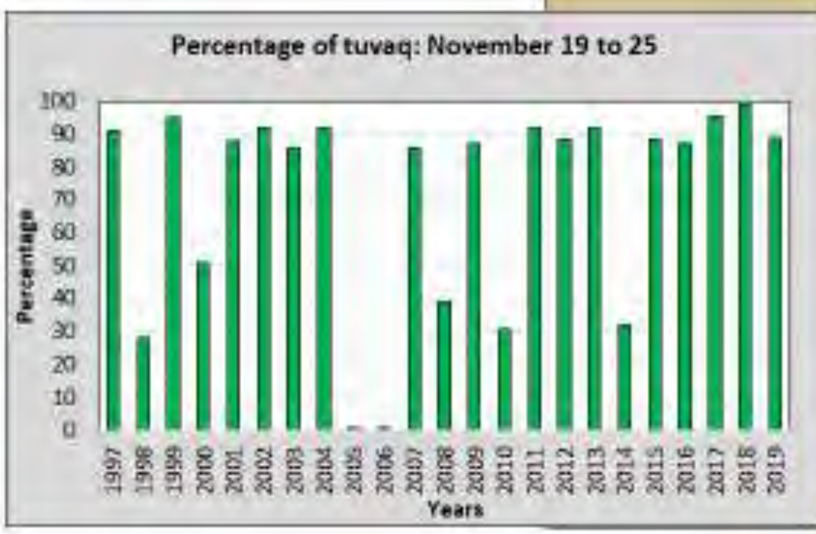




November 19 to 25 summary freeze-up map: 1997 to 2019

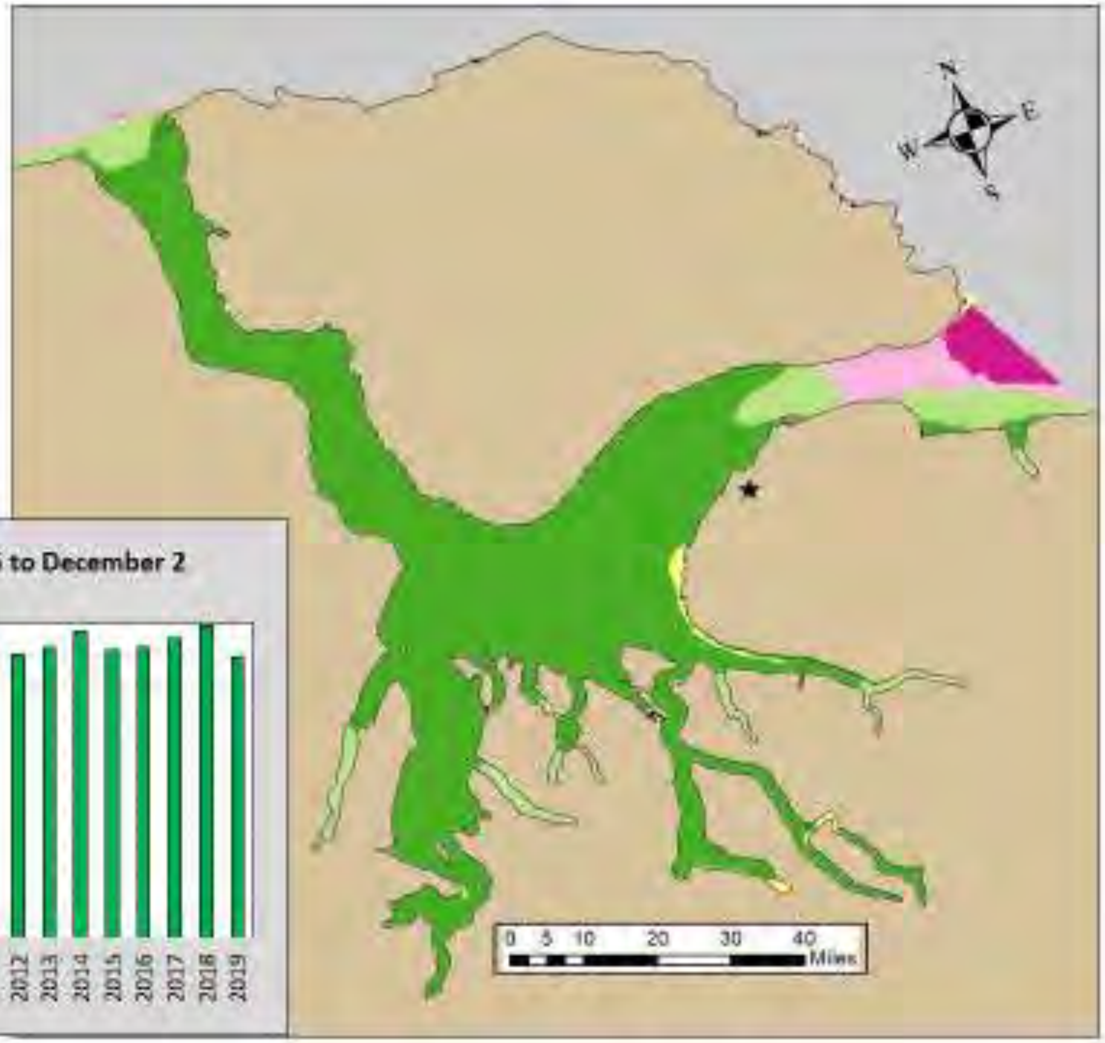
Map colour	Percentage of years the area was tuvaq	Typical tuvaq travel conditions
	–	IQ - Always dangerous
	0-25%	Dangerous
	25-50%	Frequently dangerous
	50-75%	Sometimes dangerous
	75-100%	Generally safe
Map Colour	**Map Elements**	
★	Mittimatalik	
	Outside travel region	
	Land	

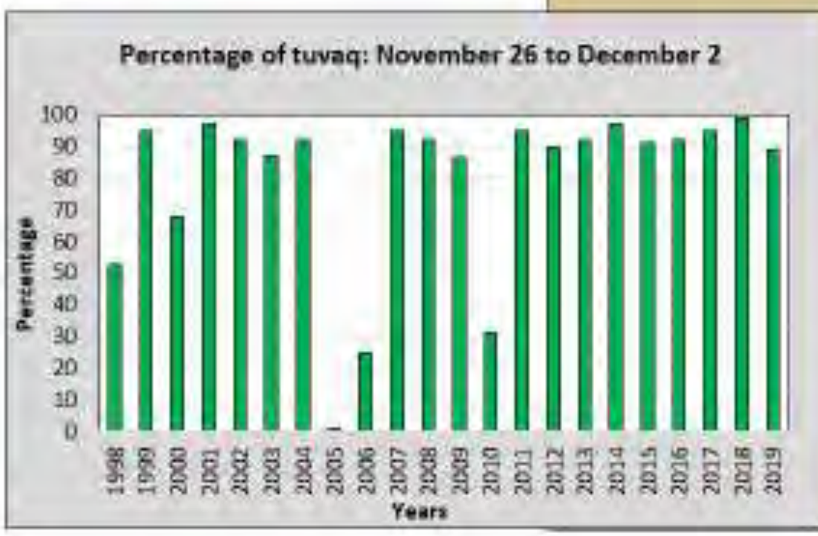




November 26 to December 2 summary freeze-up map: 1998 to 2019

Map colour	Percentage of years the area was tuvaq	Typical tuvaq travel conditions
	–	IQ - Always dangerous
	0-25%	Dangerous
	25-50%	Frequently dangerous
	50-75%	Sometimes dangerous
	75-100%	Generally safe
Map Colour	**Map Elements**	
★	Mittimatalik	
	Outside travel region	
	Land	

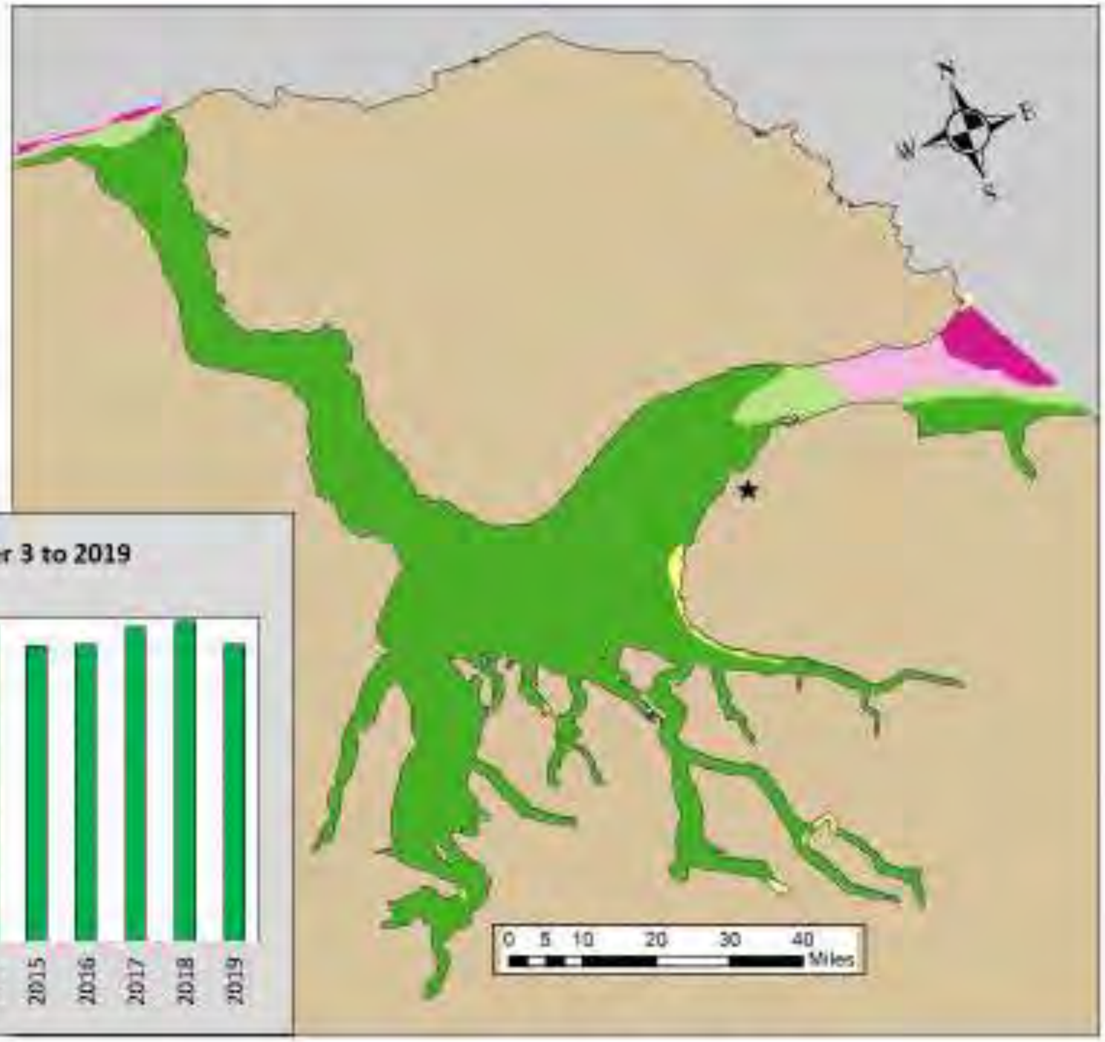


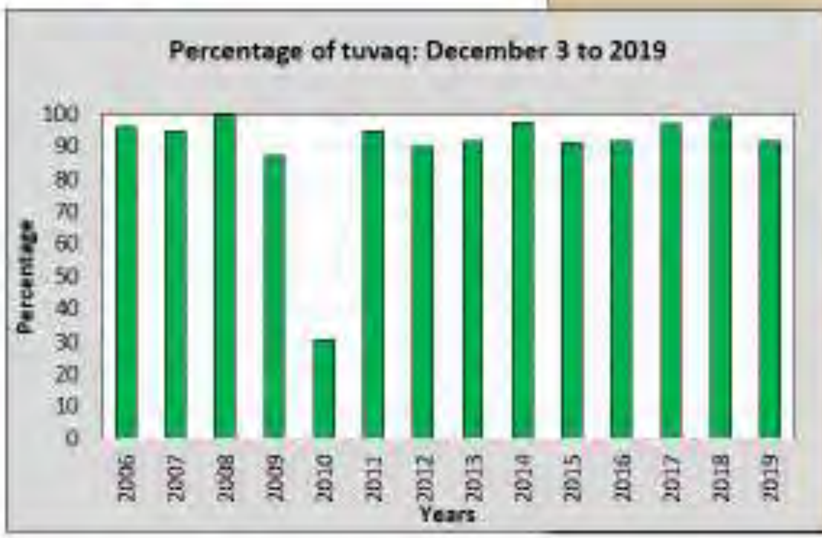


December 3 to 9 summary freeze-up map: 2006 to 2019

Map colour	Percentage of years the area was tuvaq	Typical tuvaq travel conditions
(yellow)	–	IQ - Always dangerous
(magenta)	0-25%	Dangerous
(pink)	25-50%	Frequently dangerous
(light green)	50-75%	Sometimes dangerous
(green)	75-100%	Generally safe

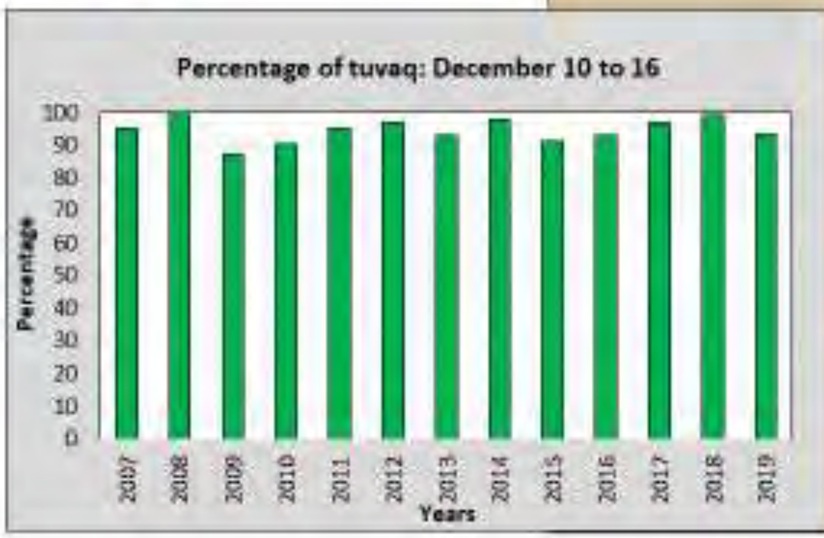
Map Colour	Map Elements
★	Mittimatalik
(grey)	Outside travel region
(tan)	Land

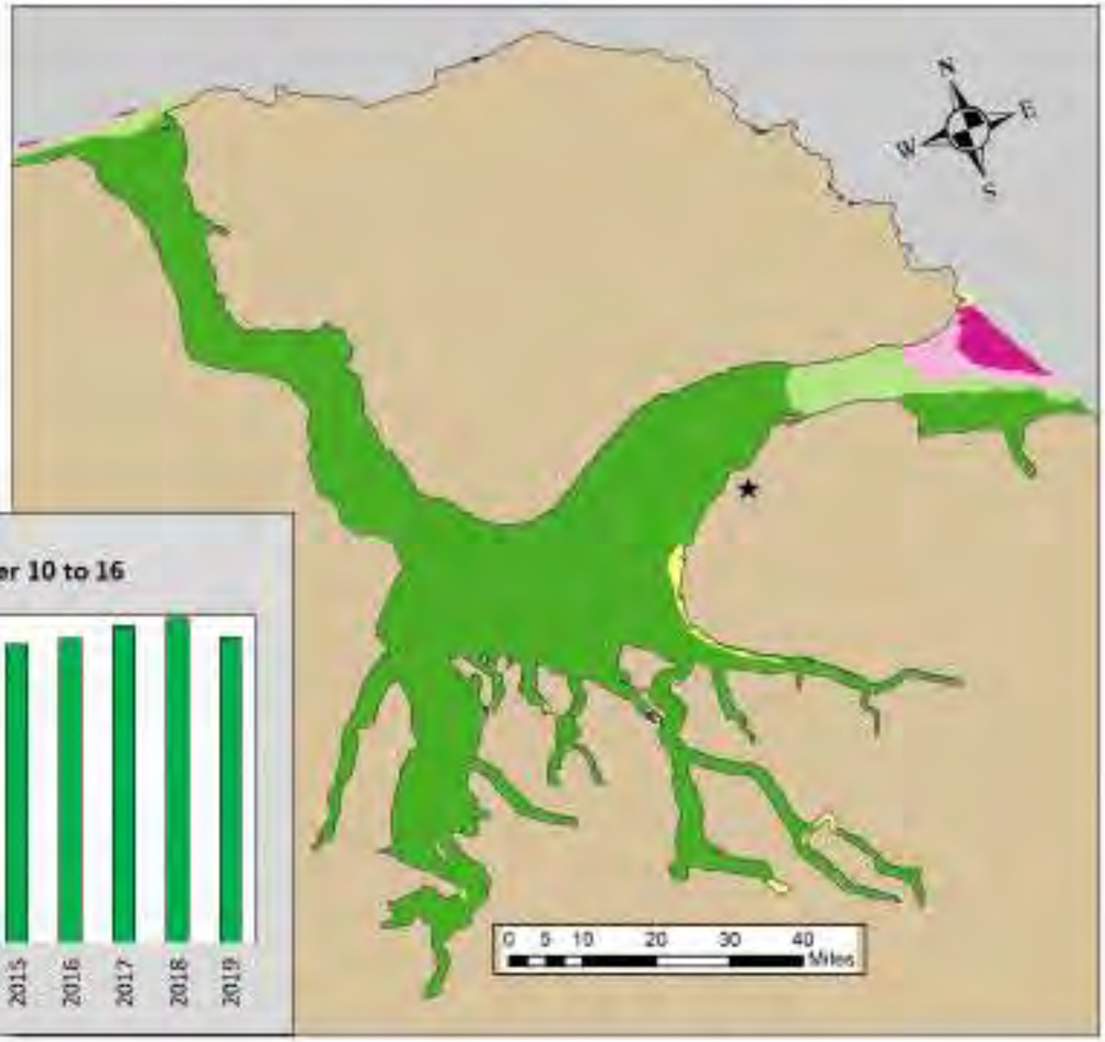




December 10 to 16 summary freeze-up map: 2007 to 2019

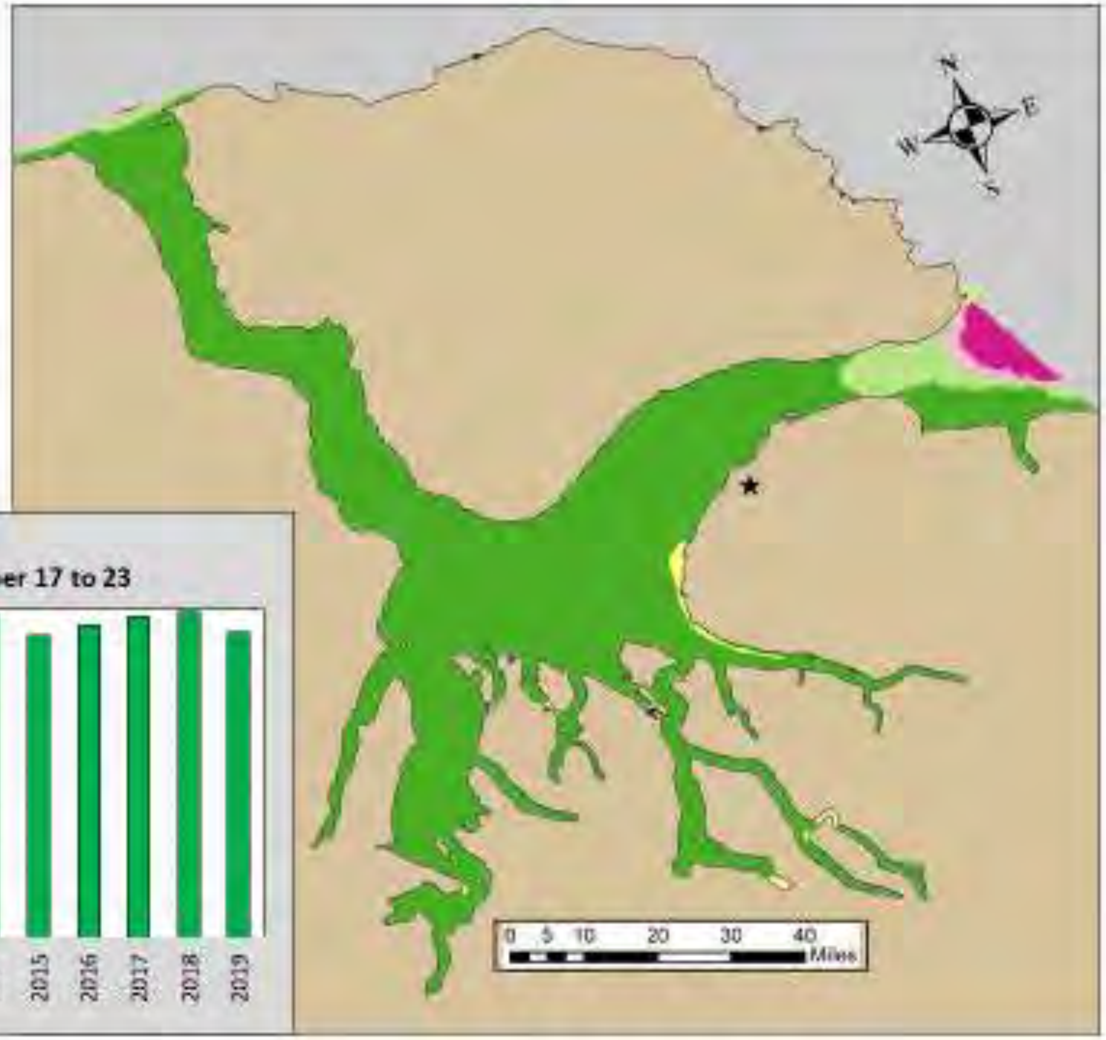
Map colour	Percentage of years the area was tuvaq	Typical tuvaq travel conditions
	–	IQ - Always dangerous
	0-25%	Dangerous
	25-50%	Frequently dangerous
	50-75%	Sometimes dangerous
	75-100%	Generally safe
Map Colour	**Map Elements**	
★	Mittimatalik	
	Outside travel region	
	Land	





December 17 to 23 summary freeze-up map: 2006 to 2019

Map colour	Percentage of years the area was tuvaq	Typical tuvaq travel conditions
	–	IQ - Always dangerous
	0-25%	Dangerous
	25-50%	Frequently dangerous
	50-75%	Sometimes dangerous
	75-100%	Generally safe
Map Colour	**Map Elements**	
★	Mittimatalik	
	Outside travel region	
	Land	

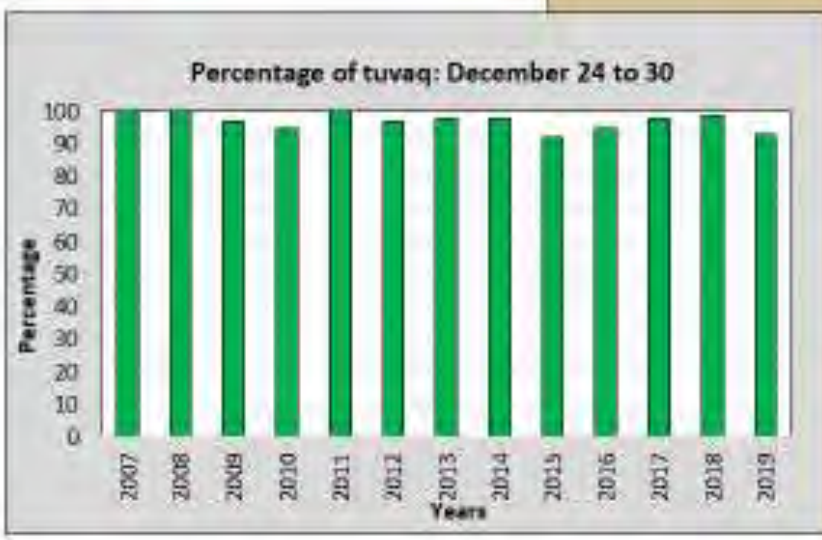


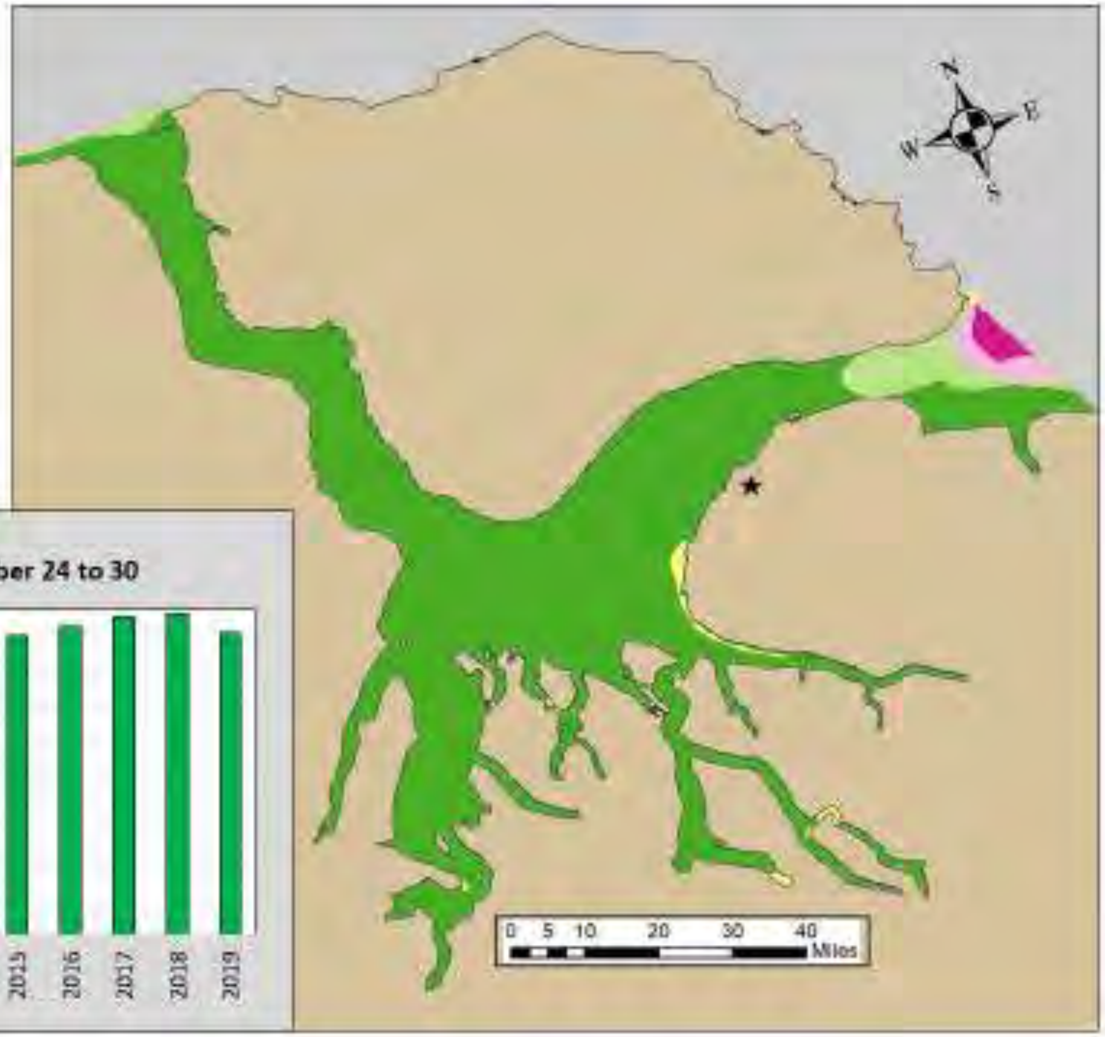
December 24 to 30 summary freeze-up map:

2007 to 2019

Map colour	Percentage of years the area was tuvaq	Typical tuvaq travel conditions
	–	IQ - Always dangerous
	0-25%	Dangerous
	25-50%	Frequently dangerous
	50-75%	Sometimes dangerous
	75-100%	Generally safe

Map Colour	Map Elements
★	Mittimatalik
	Outside travel region
	Land



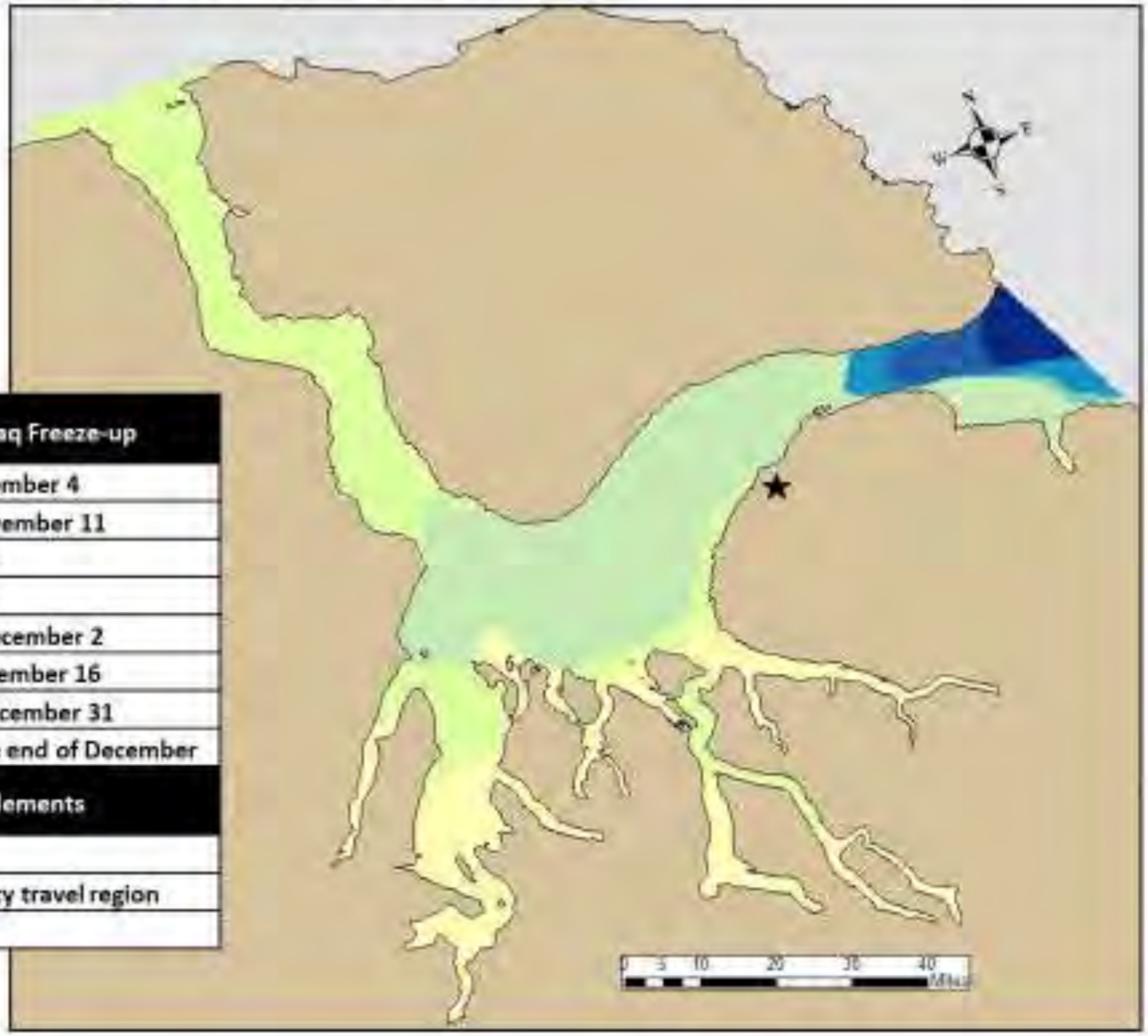


Annual freeze-up maps

Reading the annual freeze-up maps

- The annual freeze-up map shows when and where the tuvaq formed over time for each year of our 23-year record
- The map on the right shows how the tuvaq froze-up for the year 2013
- Each week in the annual freeze-up map is shown as a separate colour
  - The yellow shows where tuvaq formed in late October
  - The greens show where it became tuvaq in November
  - The blues show the areas of tuvaq formation in December
  - The darkest blue shows where there is still open water at the end of December
- The 2013 map shows a typical freeze-up season with sea ice becoming tuvaq in the southern inlets first (late October) and then expanding through Navy Board Inlet (early November), Tasiujaq (mid-November) and Tursukattak (from mid-November to late December).
- We have annual maps like this one for 1997 to 2019.

Tuvaq freeze-up map: 2013



Map colour	Annual tuvaq Freeze-up
	October 22 – November 4
	November 5 – November 11
	November 12 – 18
	November 19 – 25
	November 26 – December 2
	December 3 – December 16
	December 17 – December 31
	Open Water at the end of December
Map colour	**Map elements**
★	Mittimatalik
	Outside community travel region
	Land

Using the annual freeze-up maps

1. Looking at freeze-up patterns

It may be helpful to compare current conditions with previous years to understand where and when the tuvaq may form this year.

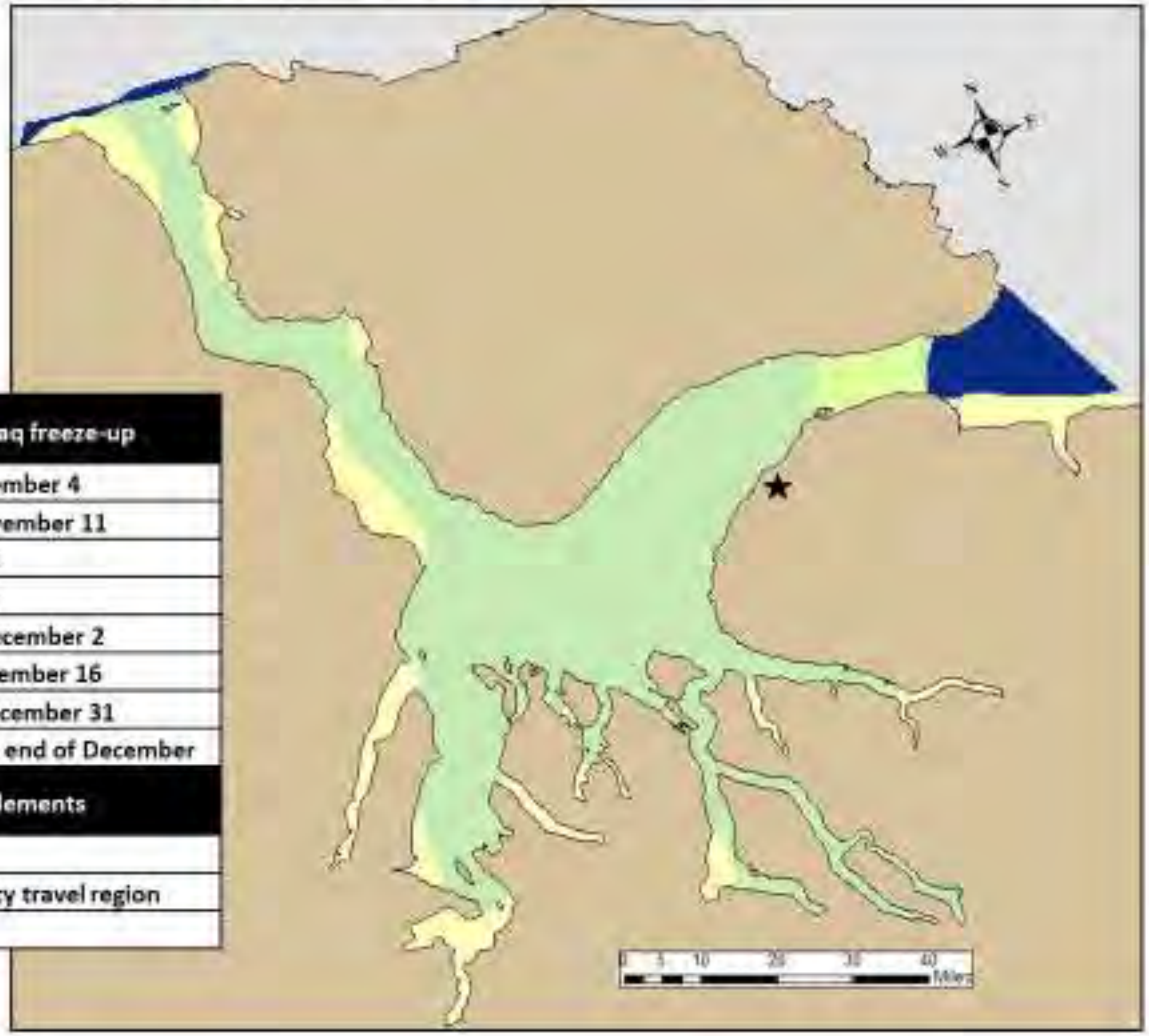
- Look at where and when the tuvaq formed each year between 1997 and 2019.
- In 2006 the tuvaq formed very late, and in 2018 it formed very early.
- Is the freeze-up of tuvaq this year similar to any other years in the record?

2. Change in sea ice due to climate change

The annual freeze-up maps can also be used to track if tuvaq formation is becoming less predictable, or if a new pattern of freeze-up is starting to emerge.

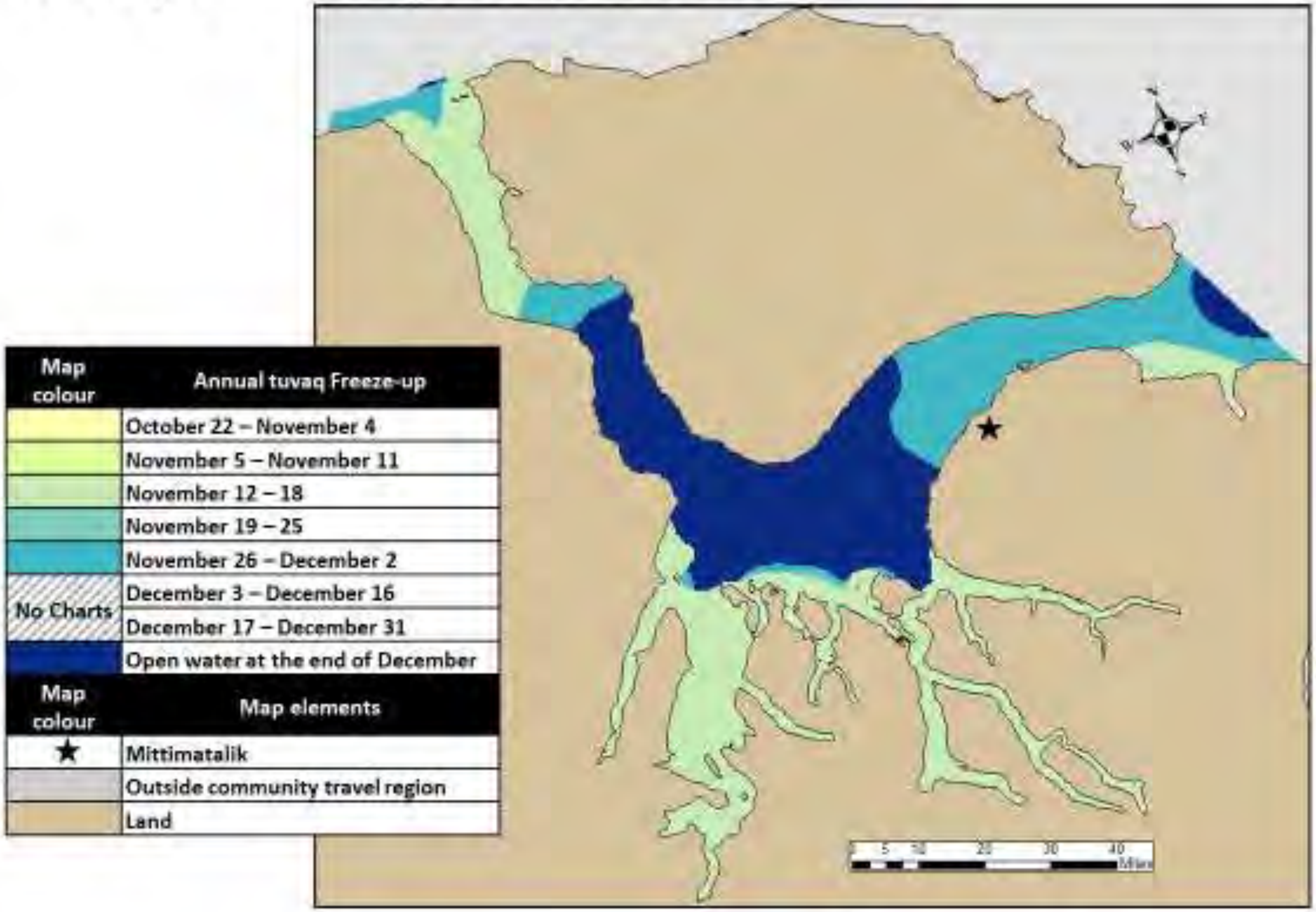
Annual freeze-up maps:
1997 to 2019

Tuvaq freeze-up map: 1997

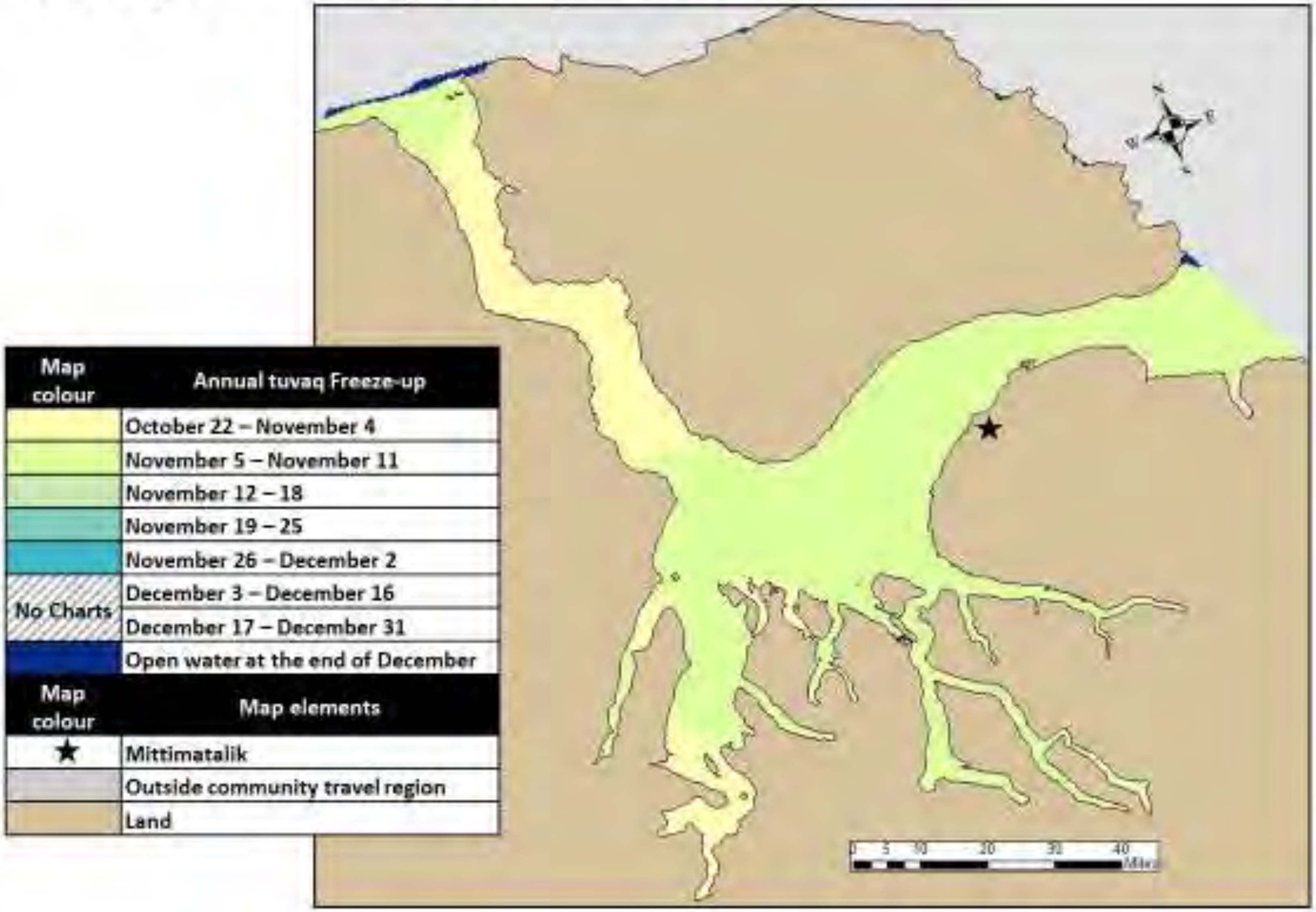


Map colour	Annual tuvaq freeze-up
	October 22 – November 4
	November 5 – November 11
	November 12 – 18
	November 19 – 25
	November 26 – December 2
No Charts	December 3 – December 16
	December 17 – December 31
	Open water at the end of December
Map colour	**Map elements**
★	Mittimatalik
	Outside community travel region
	Land

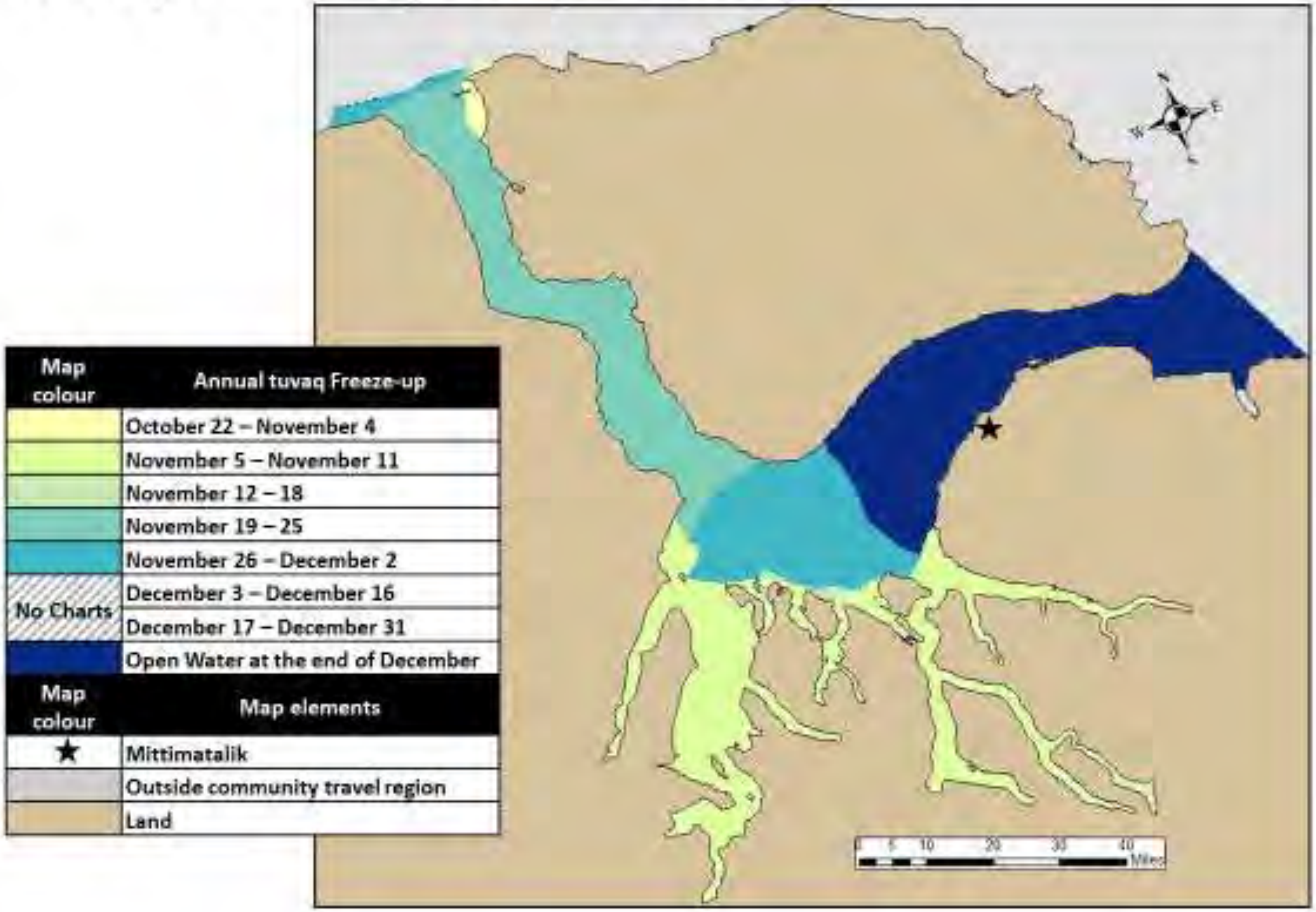
Tuvaq freeze-up map: 1998



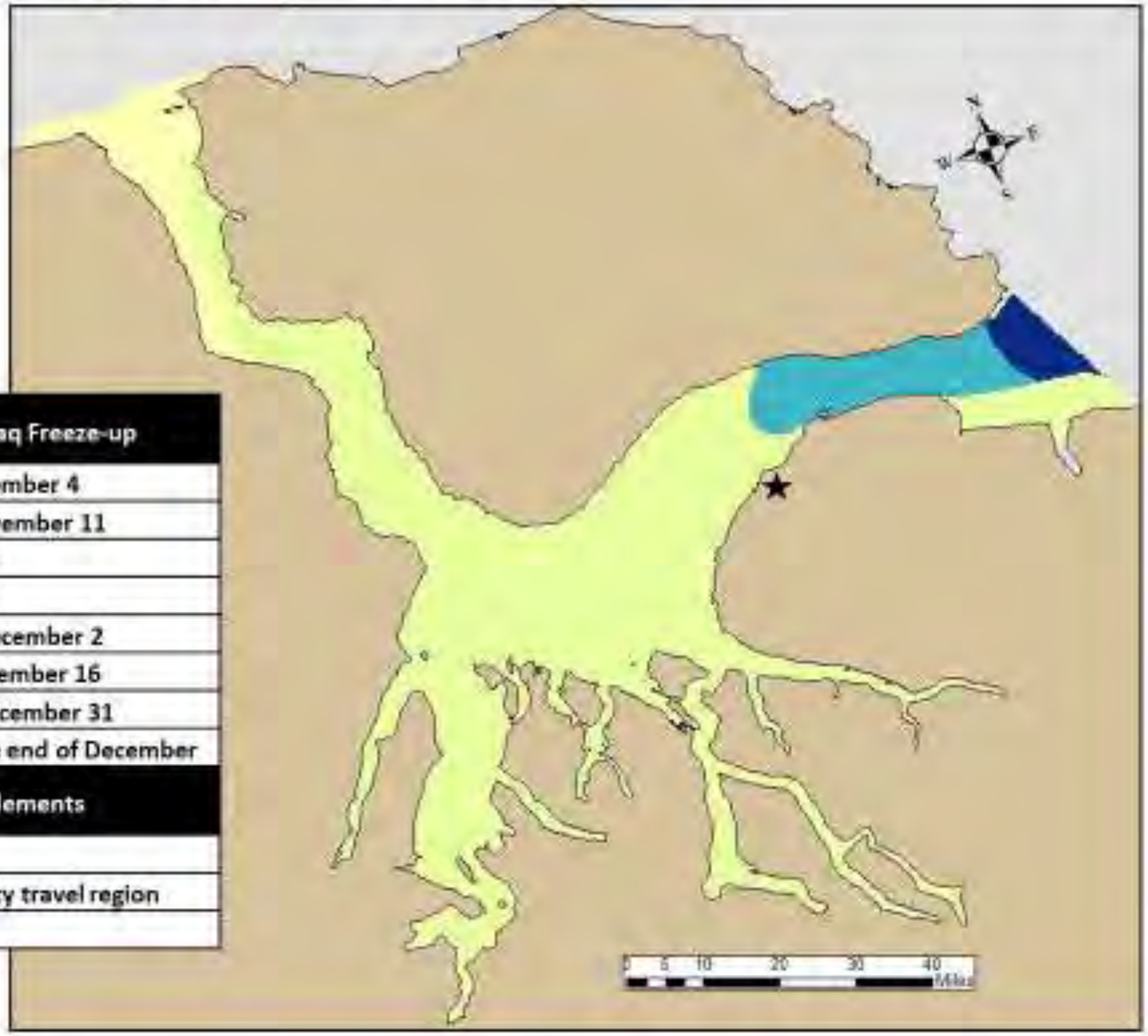
Tuvaq freeze-up map: 1999



Tuvaq freeze-up map: 2000

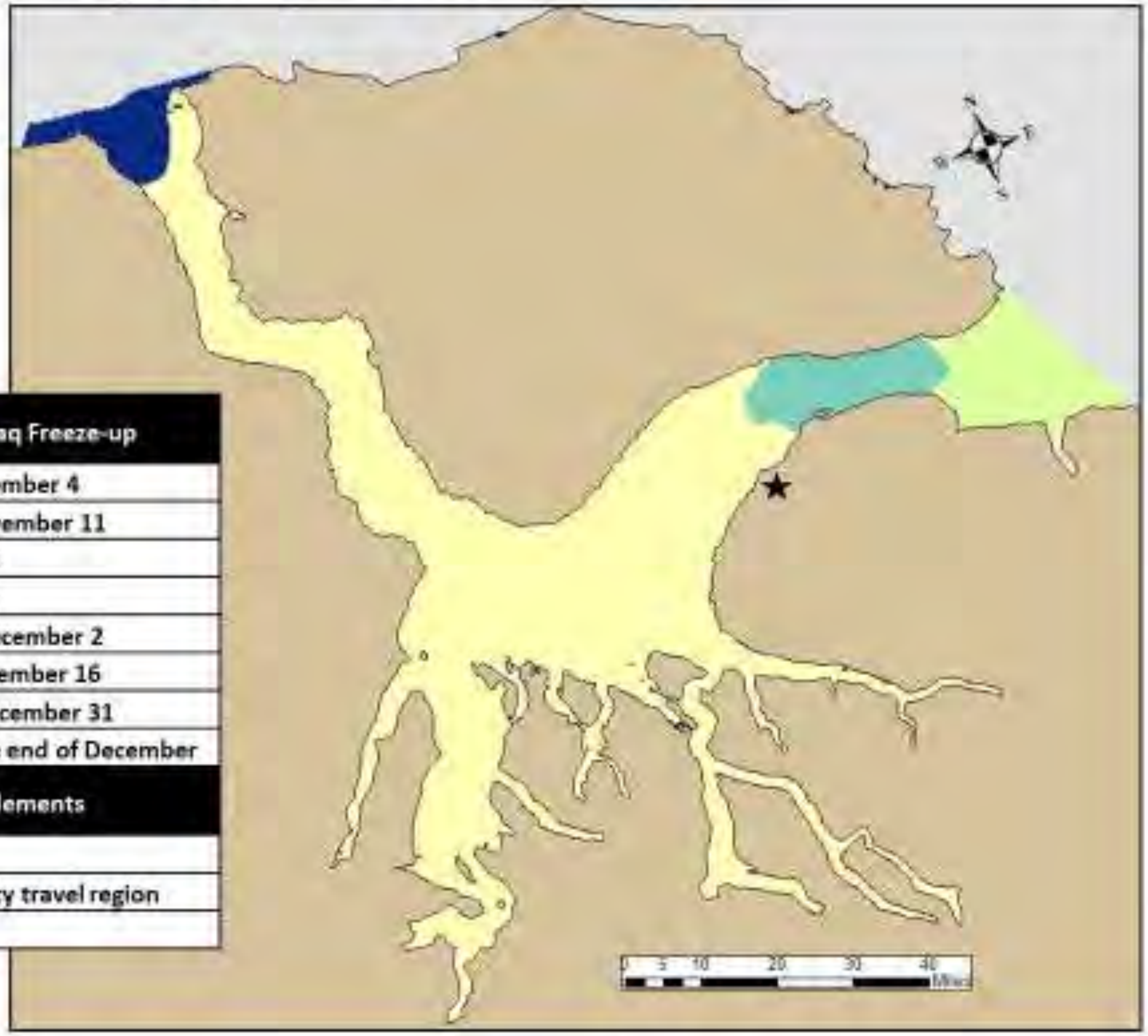


Tuvaq freeze-up map: 2001



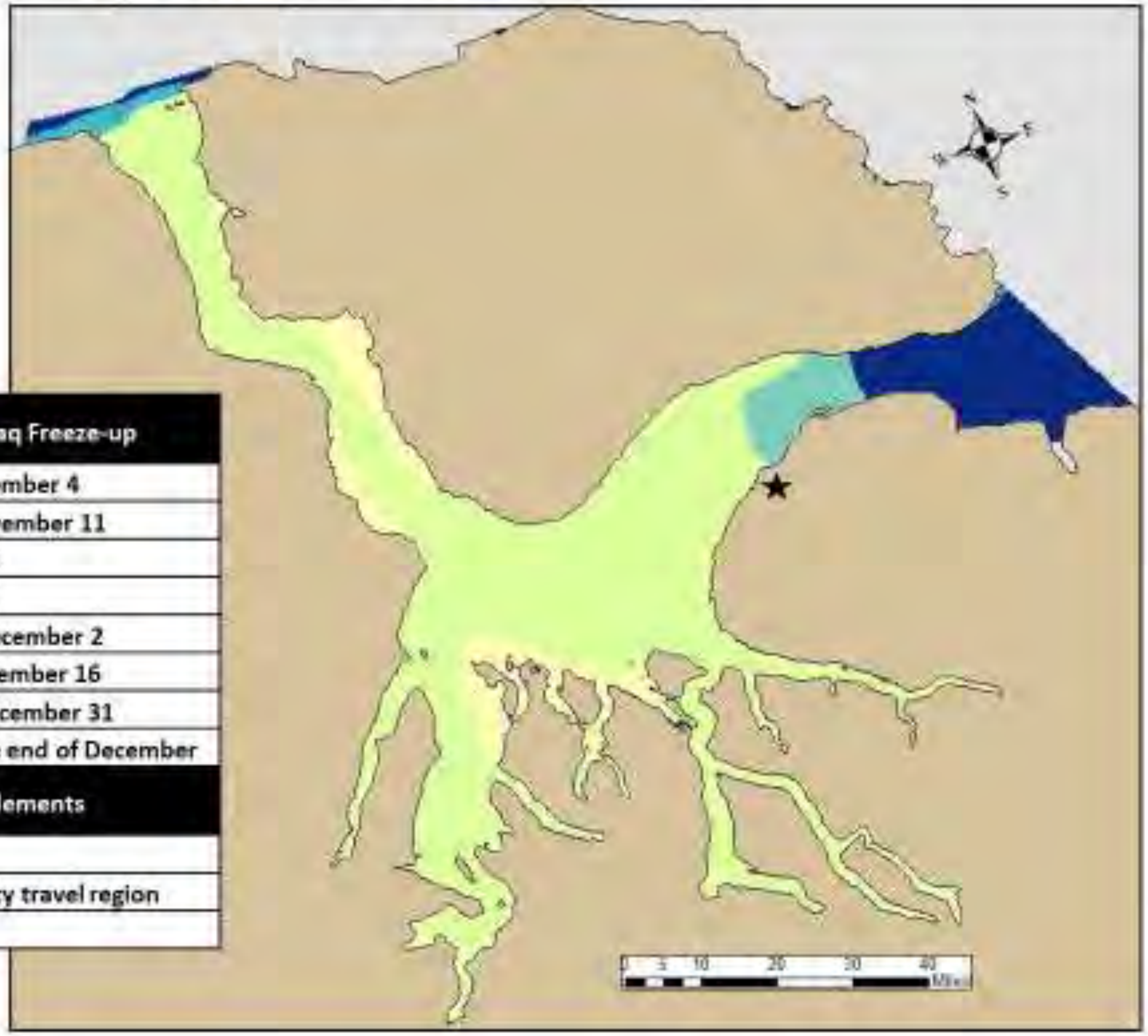
Map colour	Annual tuvaq Freeze-up
	October 22 – November 4
	November 5 – November 11
	November 12 – 18
	November 19 – 25
	November 26 – December 2
No Charts	December 3 – December 16
	December 17 – December 31
	Open Water at the end of December
Map colour	**Map elements**
★	Mittimatalik
	Outside community travel region
	Land

Tuvaq freeze-up map: 2002



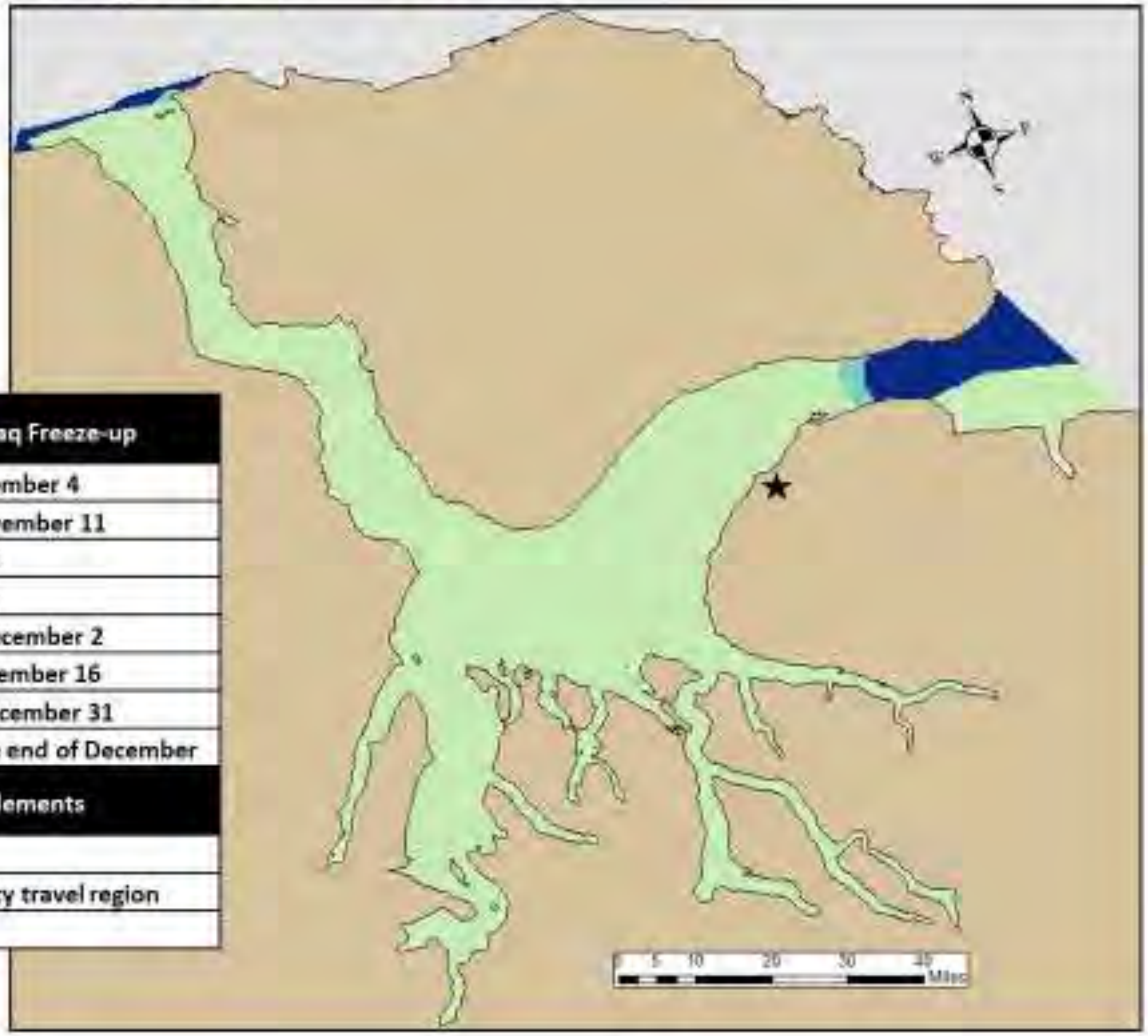
Map colour	Annual tuvaq Freeze-up
	October 22 – November 4
	November 5 – November 11
	November 12 – 18
	November 19 – 25
	November 26 – December 2
No Charts	December 3 – December 16
	December 17 – December 31
	Open Water at the end of December
Map colour	**Map elements**
★	Mittimatalik
	Outside community travel region
	Land

Tuvaq freeze-up map: 2003



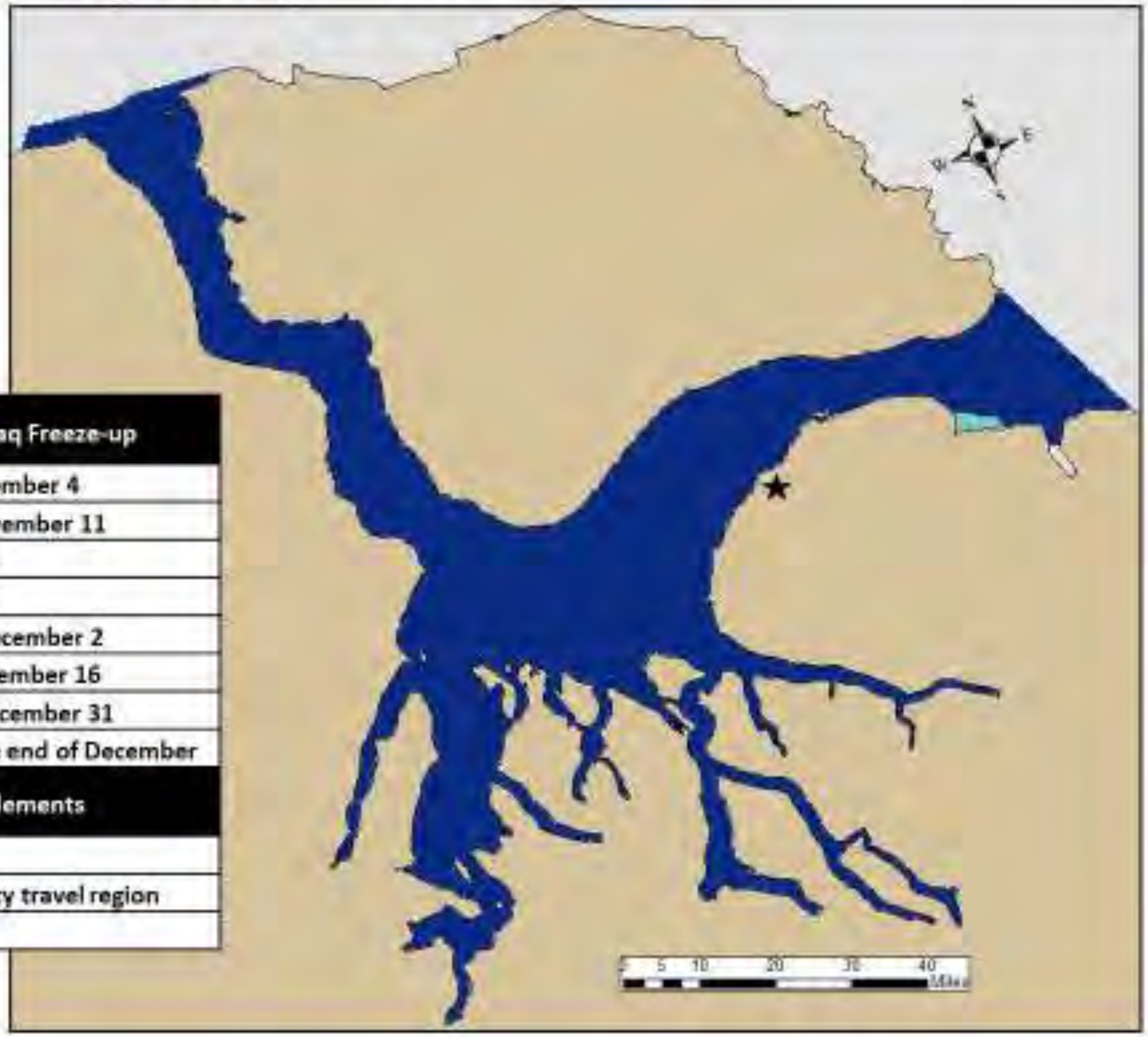
Map colour	Annual tuvaq Freeze-up
	October 22 – November 4
	November 5 – November 11
	November 12 – 18
	November 19 – 25
	November 26 – December 2
No Charts	December 3 – December 16
	December 17 – December 31
	Open Water at the end of December
Map colour	**Map elements**
★	Mittimatalik
	Outside community travel region
	Land

Tuvaq freeze-up map: 2004



Map colour	Annual tuvaq Freeze-up
	October 22 – November 4
	November 5 – November 11
	November 12 – 18
	November 19 – 25
	November 26 – December 2
No Charts	December 3 – December 16
	December 17 – December 31
	Open Water at the end of December
Map colour	**Map elements**
★	Mittimatalik
	Outside community travel region
	Land

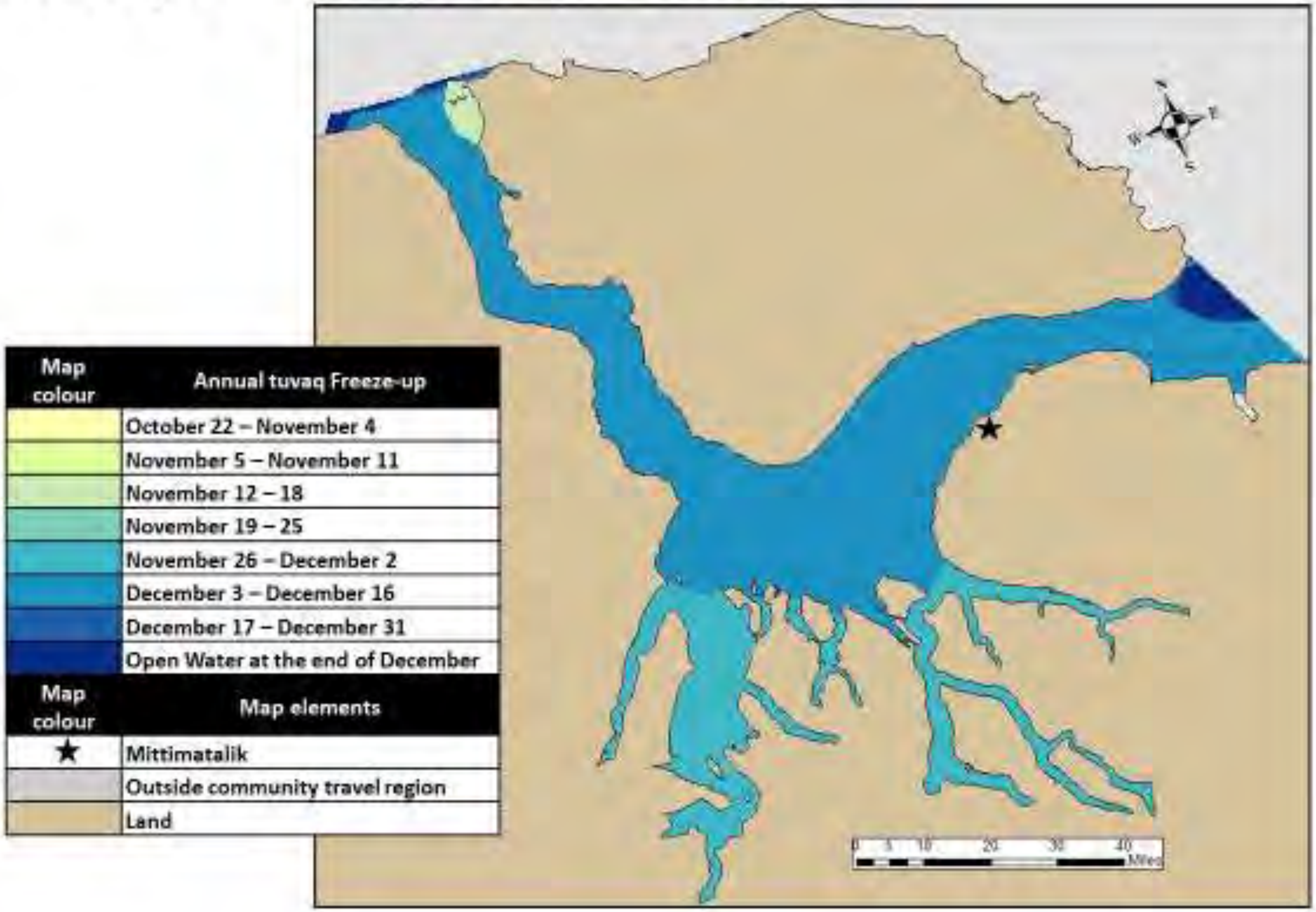
Tuvaq freeze-up map: 2005



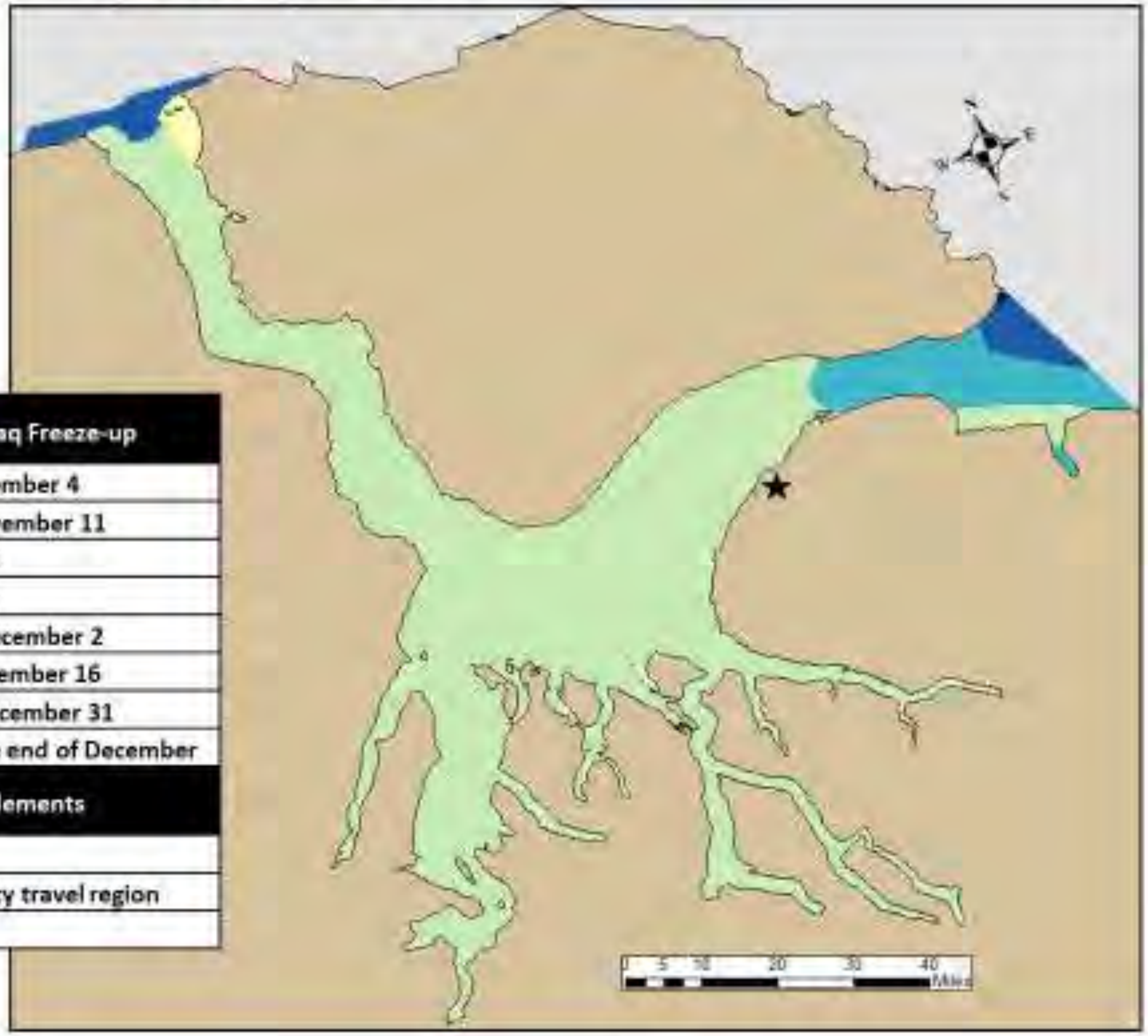
Map colour	Annual tuvaq Freeze-up
	October 22 – November 4
	November 5 – November 11
	November 12 – 18
	November 19 – 25
	November 26 – December 2
No Charts	December 3 – December 16
	December 17 – December 31
	Open Water at the end of December

Map colour	Map elements
★	Mittimatalik
	Outside community travel region
	Land

Tuvaq freeze-up map: 2006

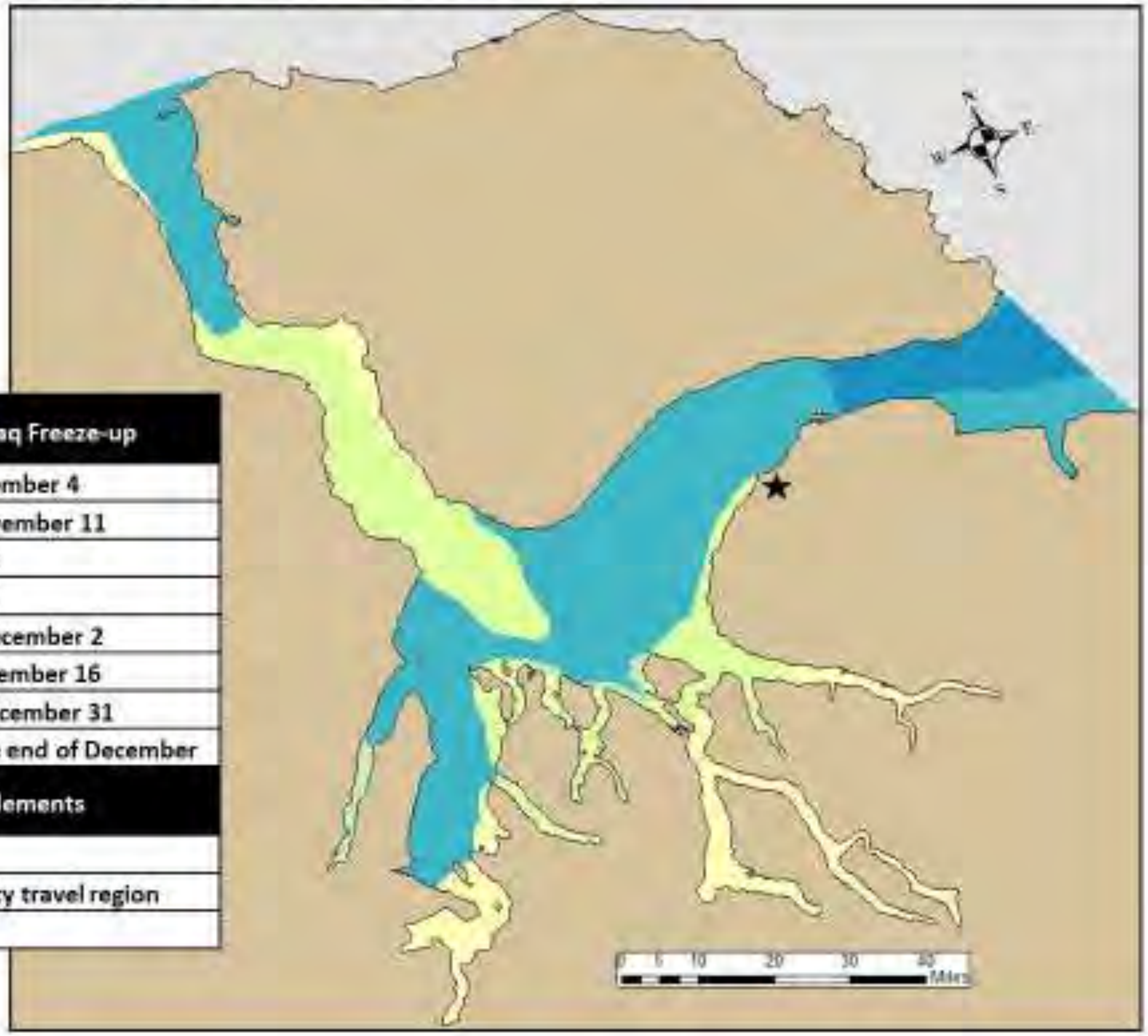


Tuvaq freeze-up map: 2007



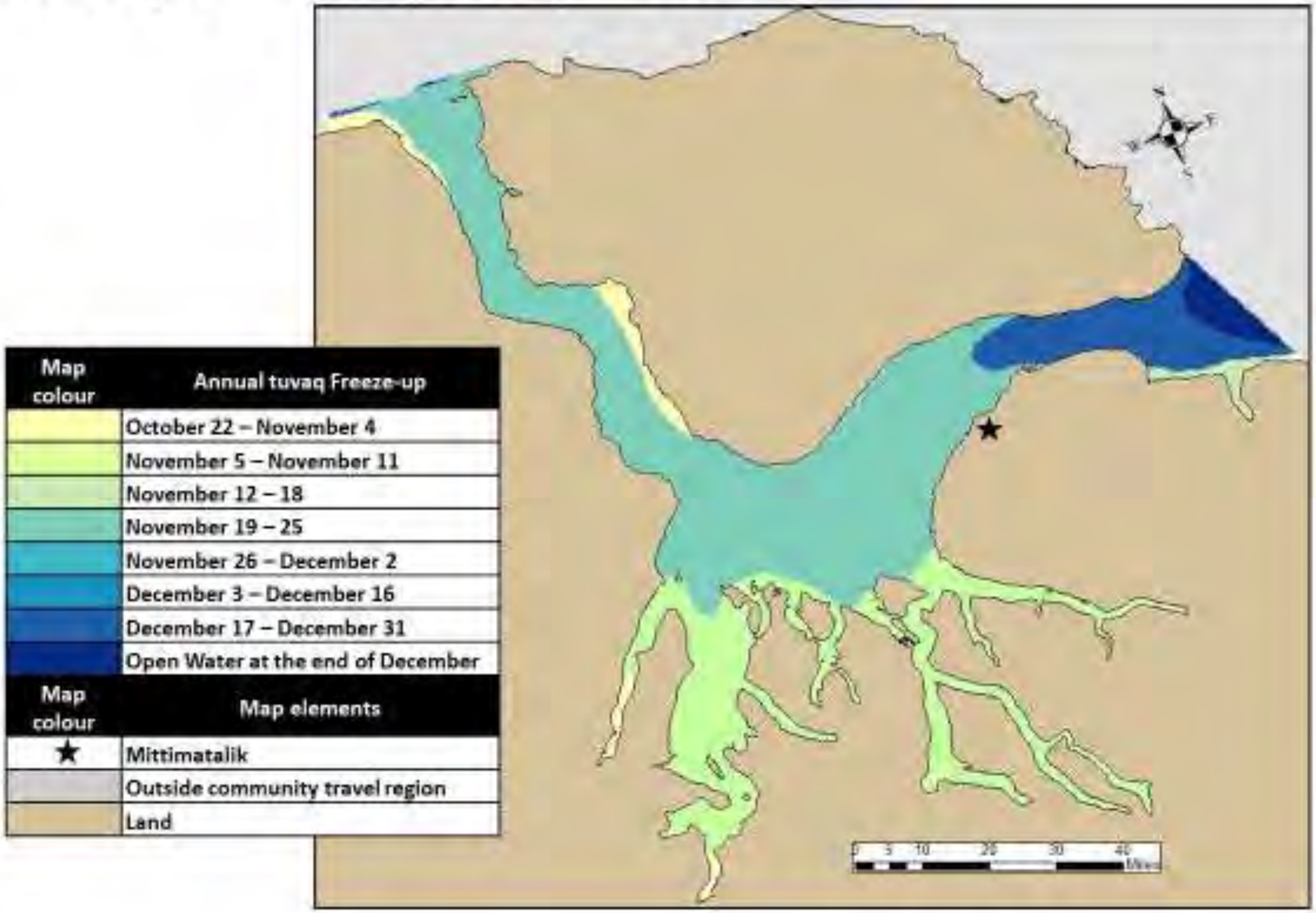
Map colour	Annual tuvaq Freeze-up
	October 22 – November 4
	November 5 – November 11
	November 12 – 18
	November 19 – 25
	November 26 – December 2
	December 3 – December 16
	December 17 – December 31
	Open Water at the end of December
Map colour	**Map elements**
★	Mittimatalik
	Outside community travel region
	Land

Tuvaq freeze-up map: 2008

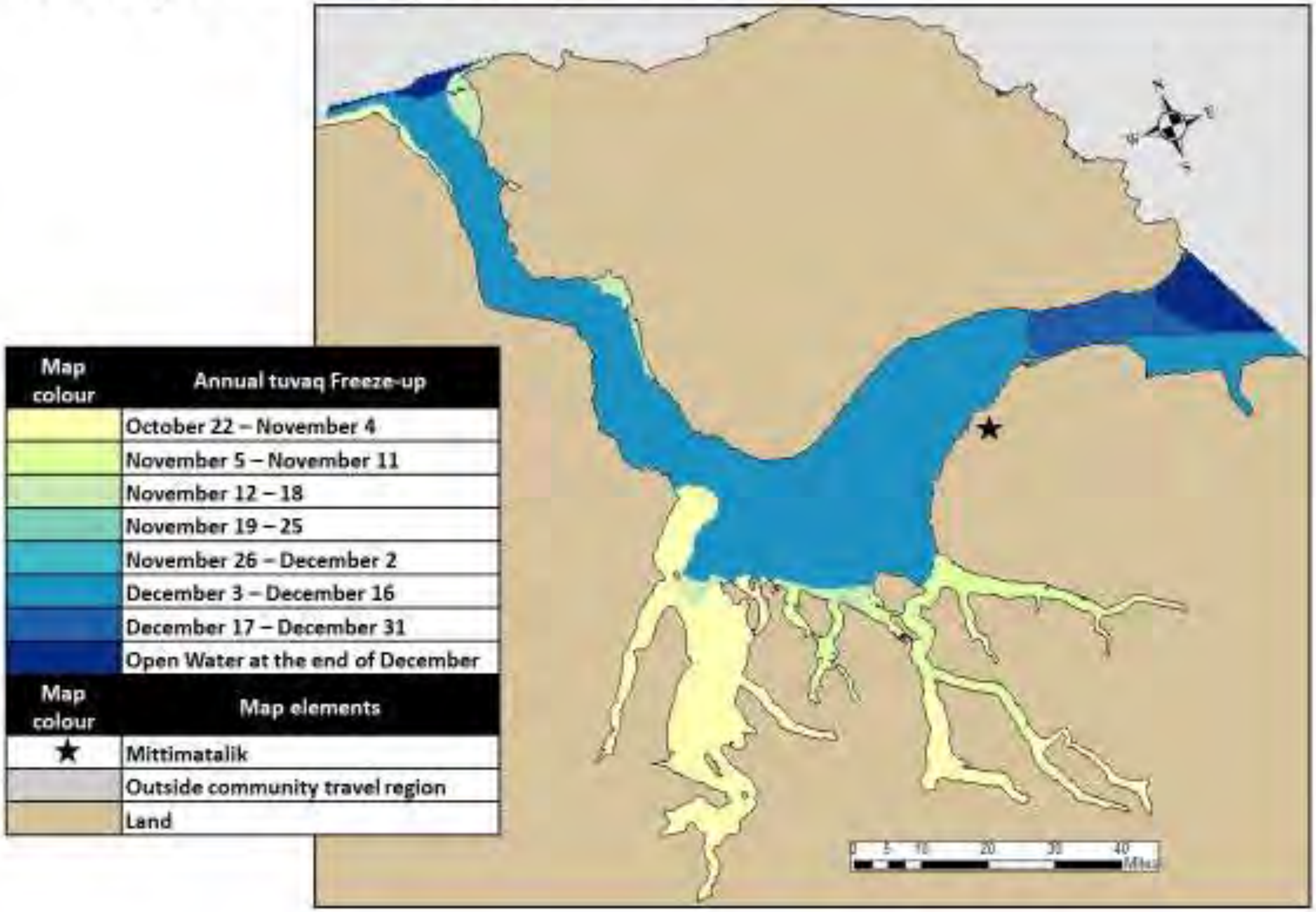


Map colour	Annual tuvaq Freeze-up
	October 22 – November 4
	November 5 – November 11
	November 12 – 18
	November 19 – 25
	November 26 – December 2
	December 3 – December 16
	December 17 – December 31
	Open Water at the end of December
Map colour	**Map elements**
★	Mittimatalik
	Outside community travel region
	Land

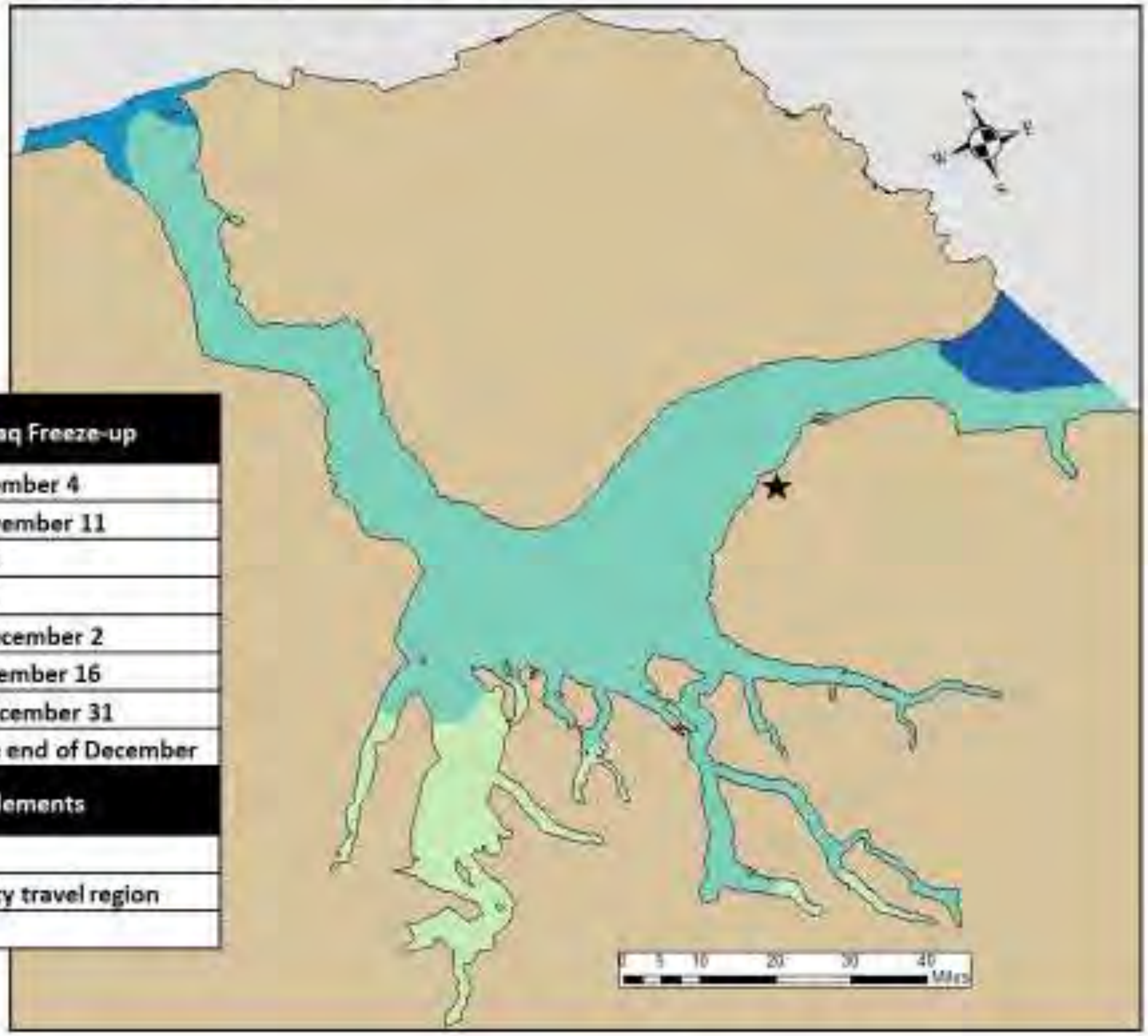
Tuvaq freeze-up map: 2009



Tuvaq freeze-up map: 2010

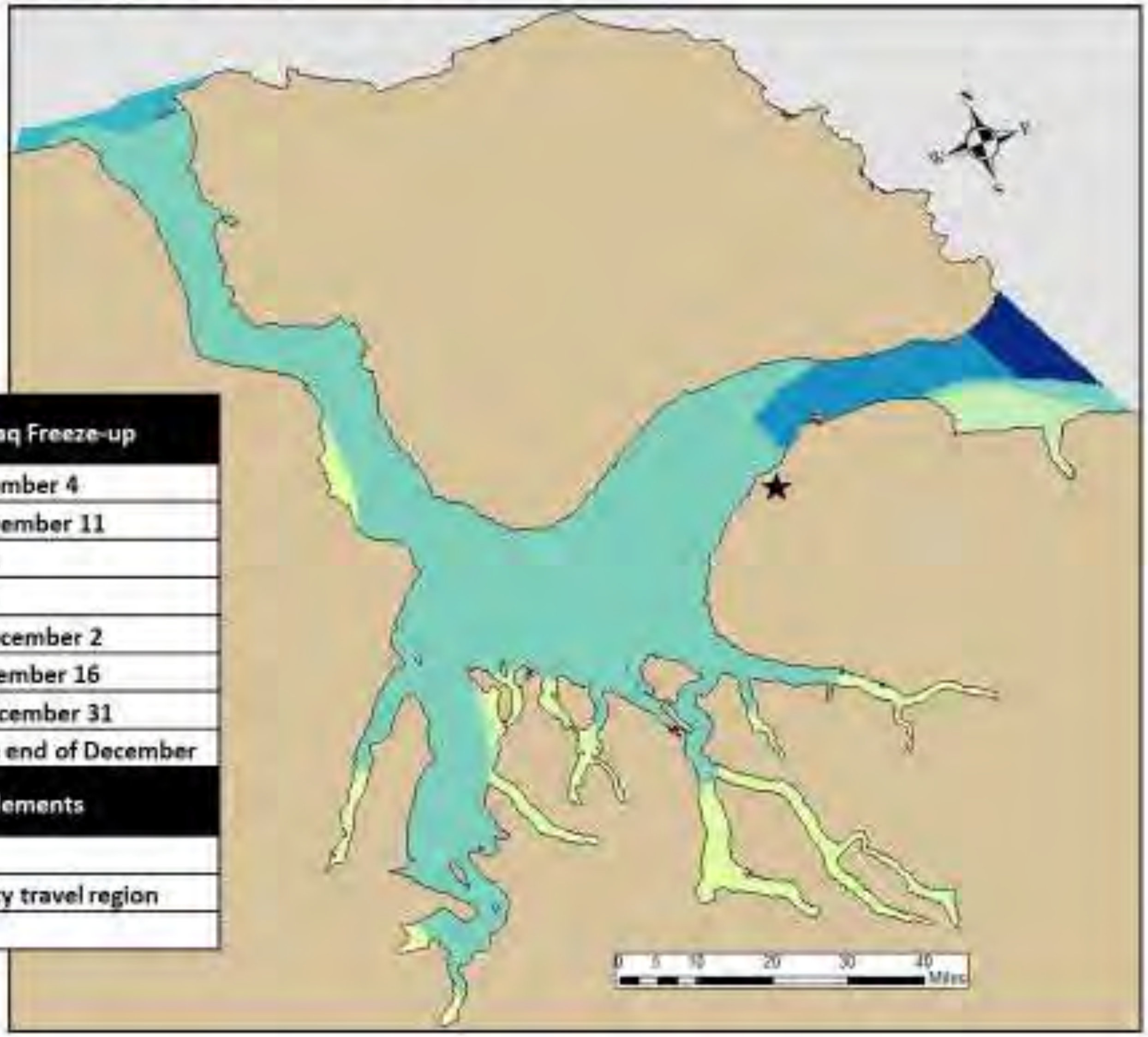


Tuvaq freeze-up map: 2011



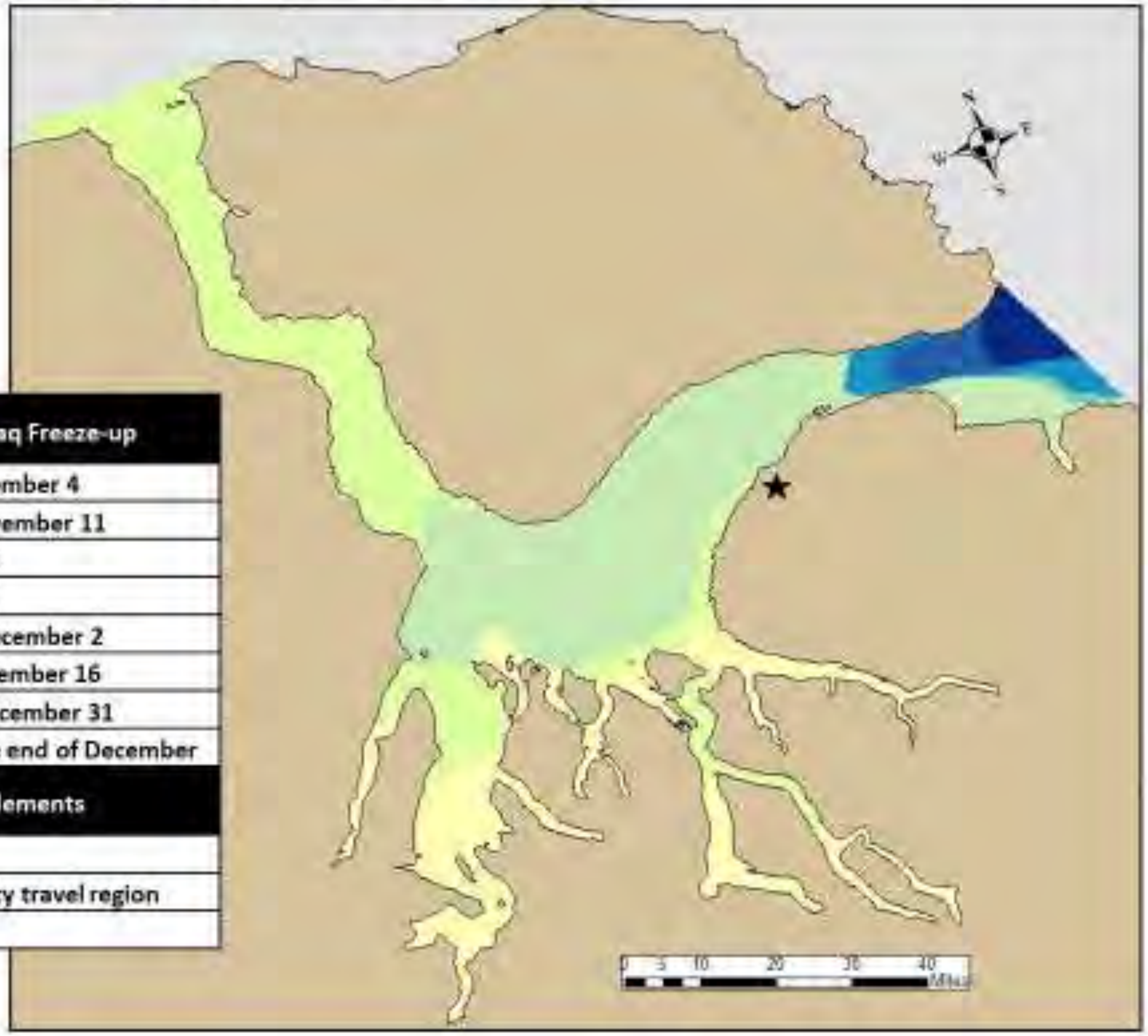
Map colour	Annual tuvaq Freeze-up
	October 22 – November 4
	November 5 – November 11
	November 12 – 18
	November 19 – 25
	November 26 – December 2
	December 3 – December 16
	December 17 – December 31
	Open Water at the end of December
Map colour	**Map elements**
★	Mittimatalik
	Outside community travel region
	Land

Tuvaq freeze-up map: 2012



Map colour	Annual tuvaq Freeze-up
	October 22 – November 4
	November 5 – November 11
	November 12 – 18
	November 19 – 25
	November 26 – December 2
	December 3 – December 16
	December 17 – December 31
	Open Water at the end of December
Map colour	**Map elements**
★	Mittimatalik
	Outside community travel region
	Land

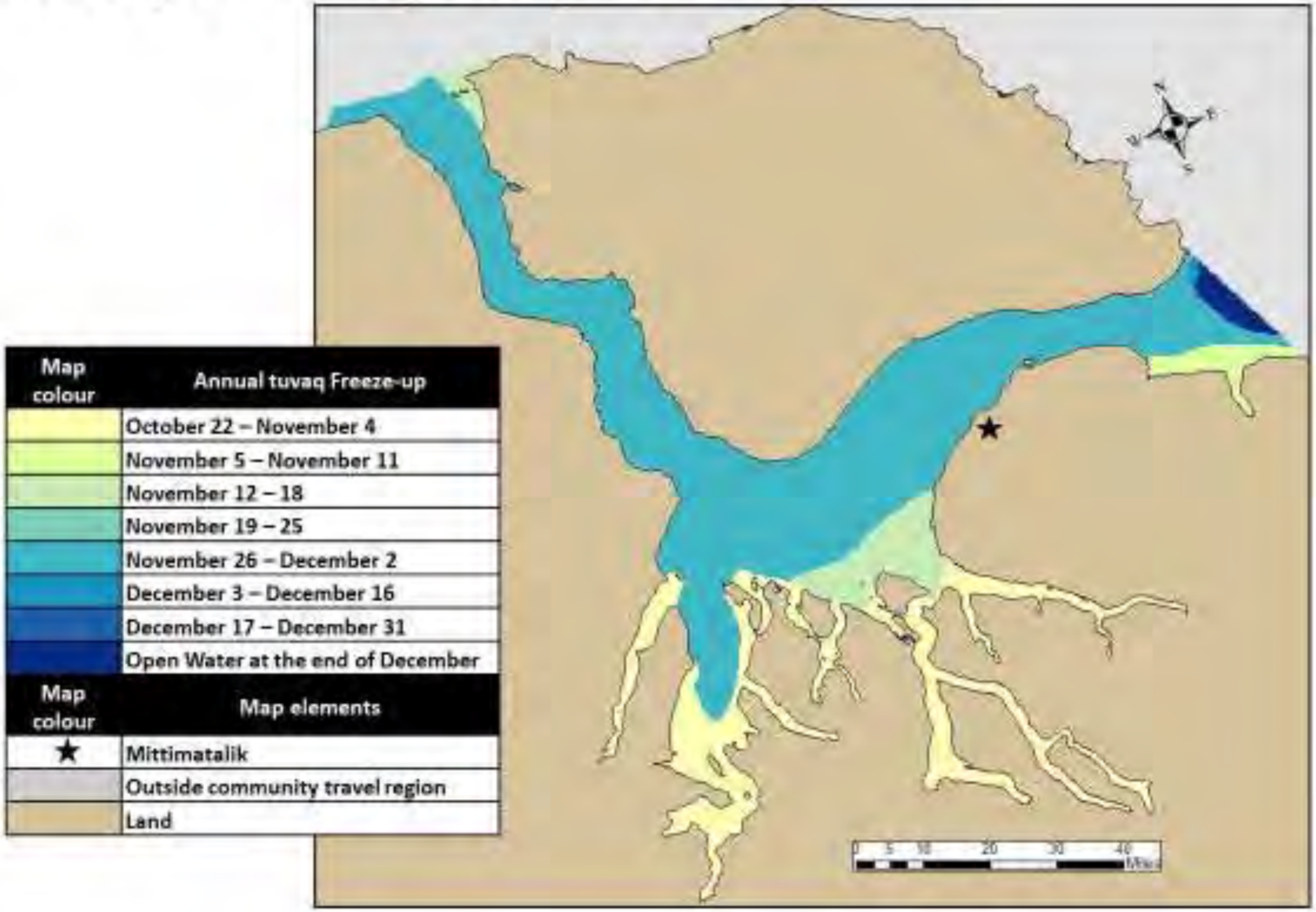
Tuvaq freeze-up map: 2013



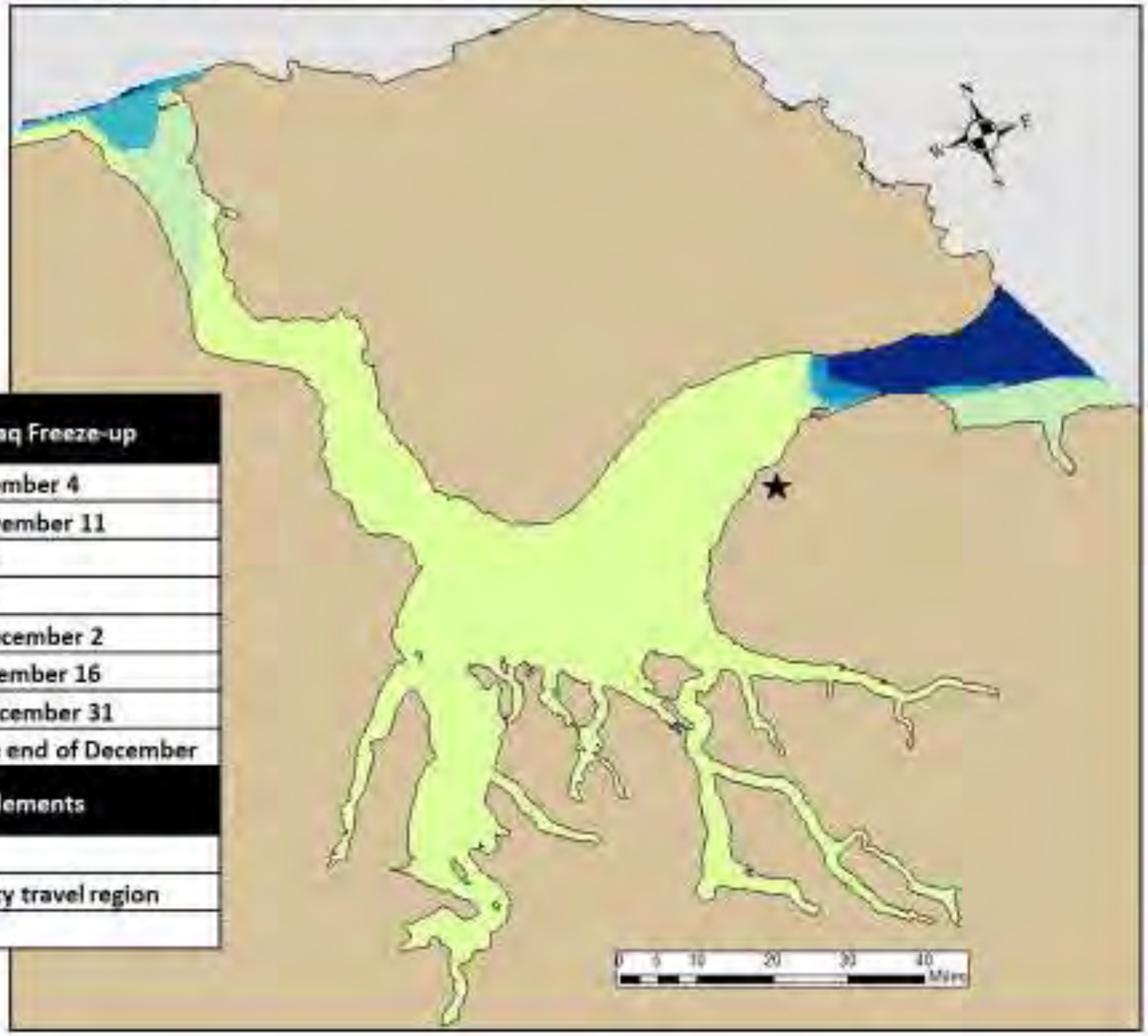
Map colour	Annual tuvaq Freeze-up
	October 22 – November 4
	November 5 – November 11
	November 12 – 18
	November 19 – 25
	November 26 – December 2
	December 3 – December 16
	December 17 – December 31
	Open Water at the end of December

Map colour	Map elements
★	Mittimatalik
	Outside community travel region
	Land

Tuvaq freeze-up map: 2014

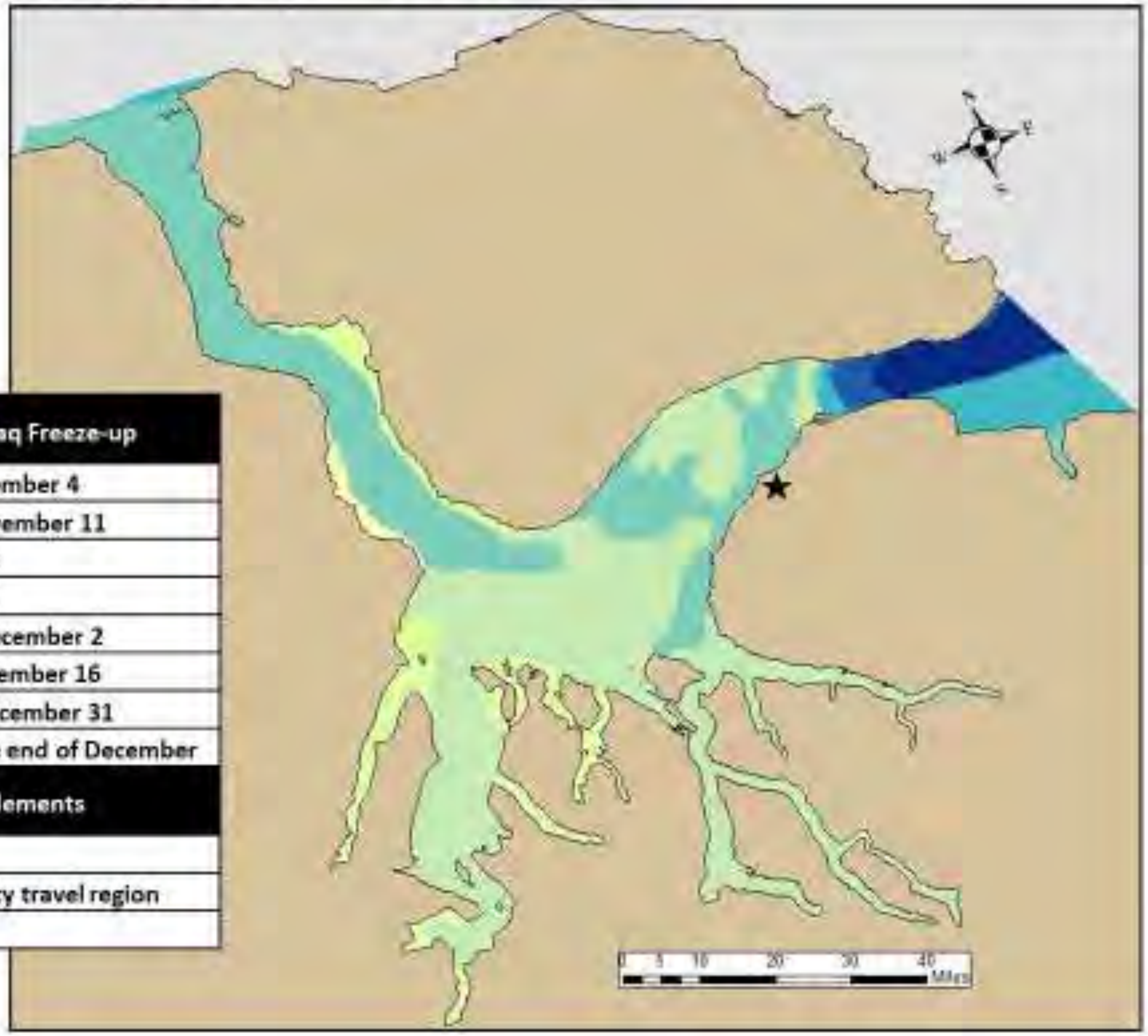


Tuvaq freeze-up map: 2015



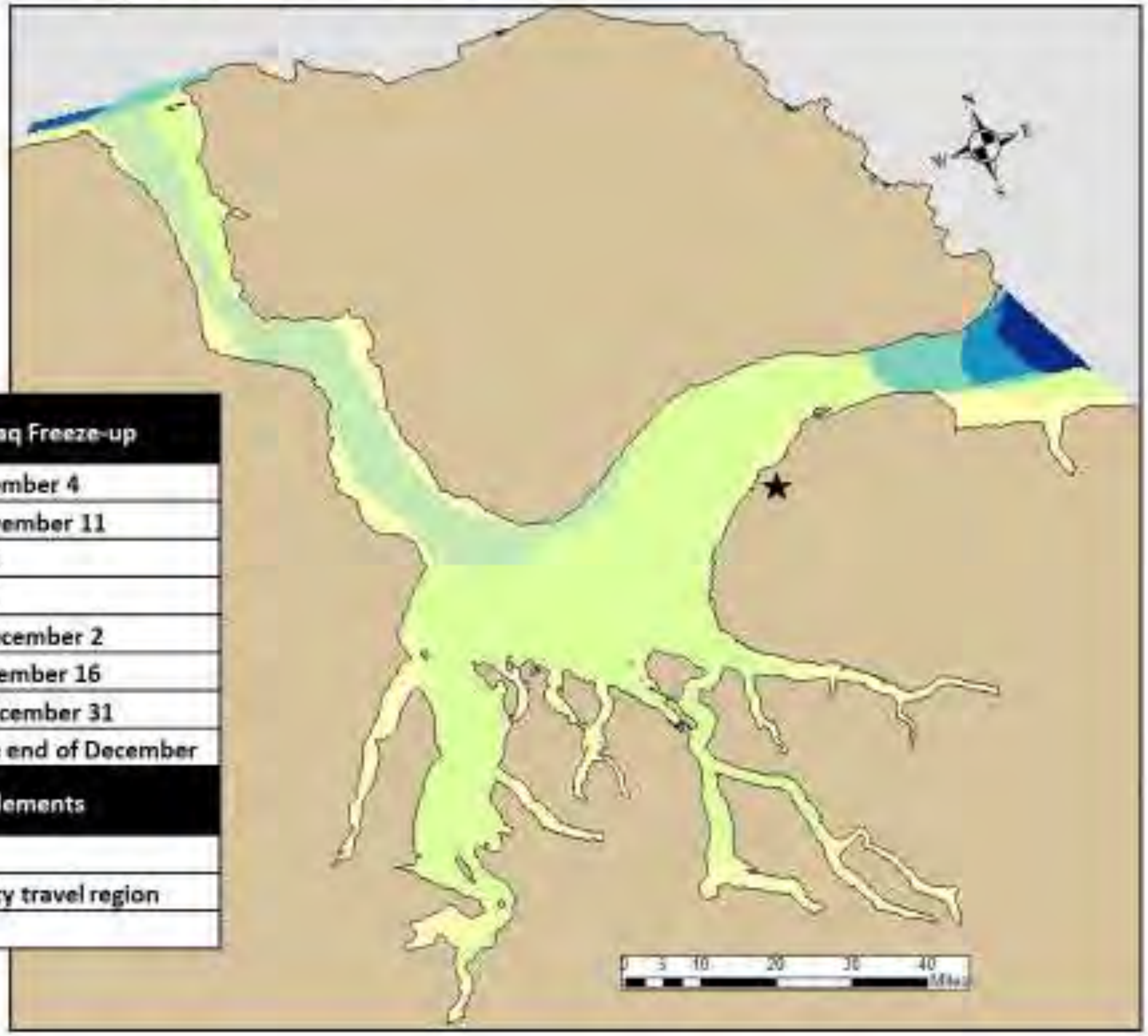
Map colour	Annual tuvaq Freeze-up
	October 22 – November 4
	November 5 – November 11
	November 12 – 18
	November 19 – 25
	November 26 – December 2
	December 3 – December 16
	December 17 – December 31
	Open Water at the end of December
Map colour	**Map elements**
★	Mittimatalik
	Outside community travel region
	Land

Tuvaq freeze-up map: 2016



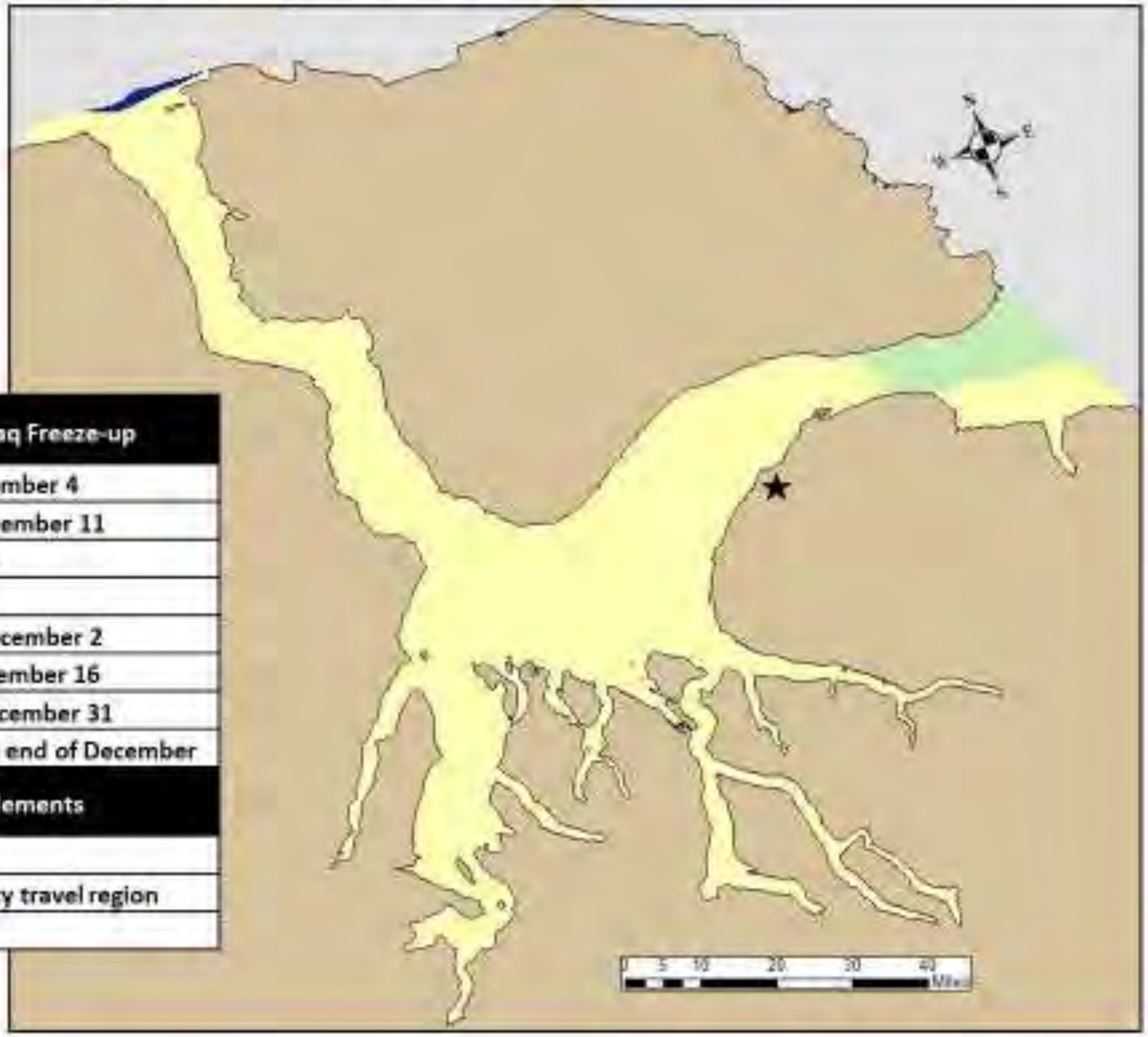
Map colour	Annual tuvaq Freeze-up
	October 22 – November 4
	November 5 – November 11
	November 12 – 18
	November 19 – 25
	November 26 – December 2
	December 3 – December 16
	December 17 – December 31
	Open Water at the end of December
Map colour	**Map elements**
★	Mittimatalik
	Outside community travel region
	Land

Tuvaq freeze-up map: 2017



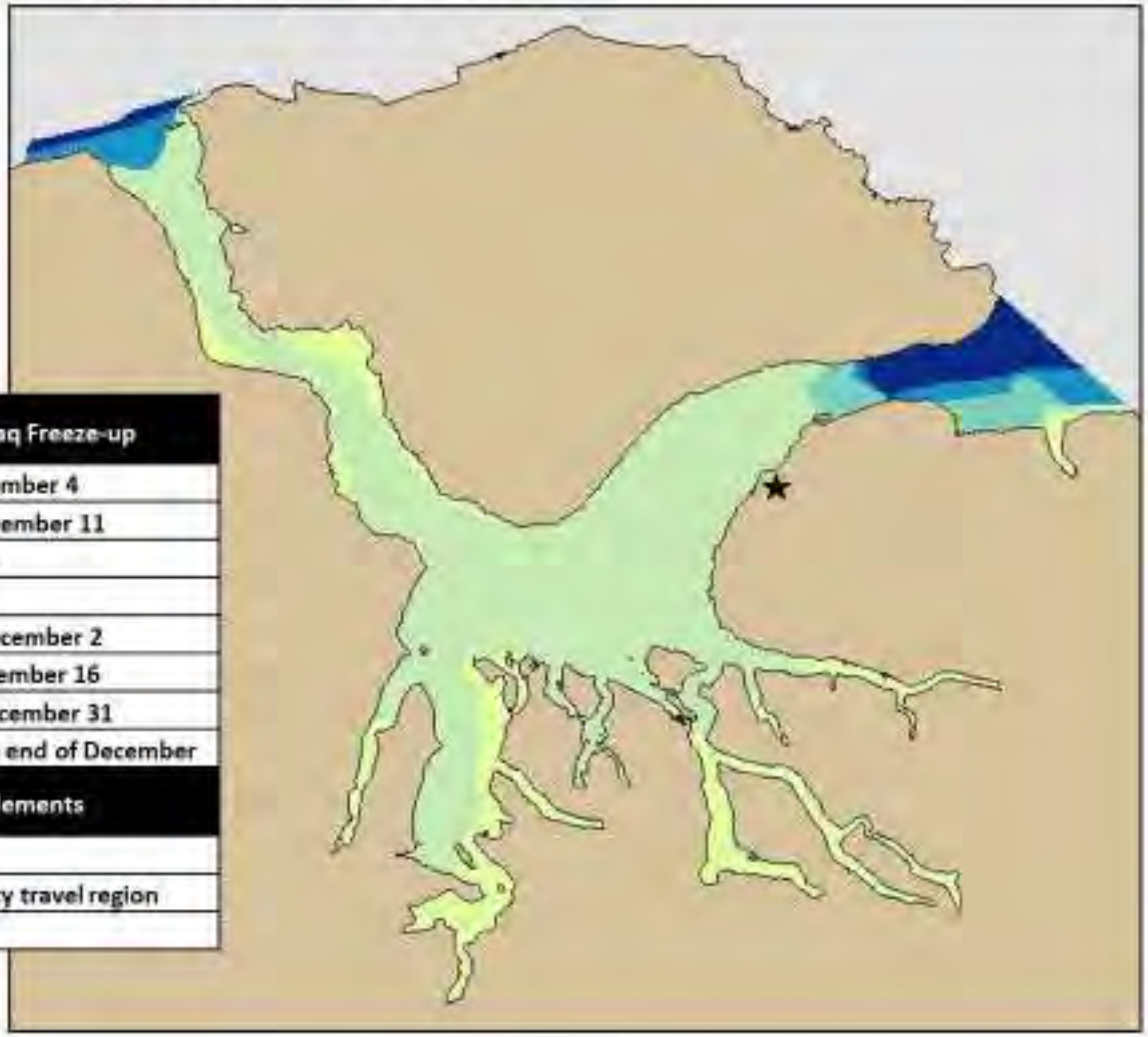
Map colour	Annual tuvaq Freeze-up
	October 22 – November 4
	November 5 – November 11
	November 12 – 18
	November 19 – 25
	November 26 – December 2
	December 3 – December 16
	December 17 – December 31
	Open Water at the end of December
Map colour	**Map elements**
★	Mittimatalik
	Outside community travel region
	Land

Tuvaq freeze-up map: 2018



Map colour	Annual tuvaq Freeze-up
	October 22 – November 4
	November 5 – November 11
	November 12 – 18
	November 19 – 25
	November 26 – December 2
	December 3 – December 16
	December 17 – December 31
	Open Water at the end of December
Map colour	**Map elements**
★	Mittimatalik
	Outside community travel region
	Land

Tuvaq freeze-up map: 2019



Map colour	Annual tuvaq Freeze-up
	October 22 – November 4
	November 5 – November 11
	November 12 – 18
	November 19 – 25
	November 26 – December 2
	December 3 – December 16
	December 17 – December 31
	Open Water at the end of December

Map colour	Map elements
★	Mittimatalik
	Outside community travel region
	Land

Weekly summary break-up maps

6-weeks of break-up

To see patterns in safe ice travel during break-up across the 23 years, the information was summarized into one map for each of the following six weeks.

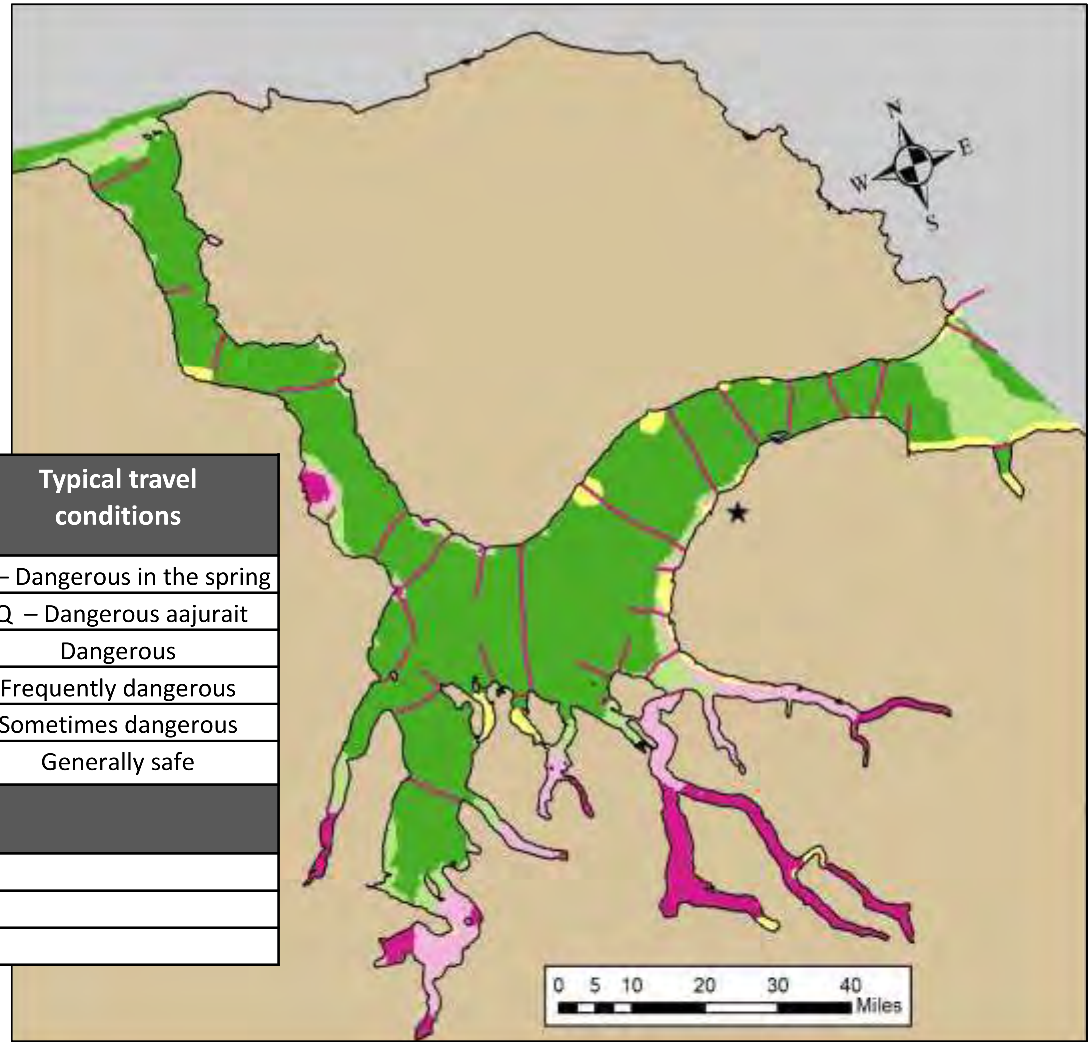
- June 18 - 24
- June 25 – July 1
- July 2 – 8
- July 9 – 15
- July 16 – 22
- July 23 – 29

Reading the weekly summary break-up maps

We coloured areas of the summary map depending on how often in the 23-year period the ice was safe to travel on. The sample map on the right shows how often tuvaq conditions occurred for the week of November 12 to 18 over the 23-year study period.

Yellow	Yellow areas are always dangerous and dangerous in the spring based on Sikumiut's Inuit Qaujimajatuqangit (IQ). These areas were not always visible in the satellite imagery.
Dark pink line	Dark pink lines show where reoccurring aajurait (leads) form each year based on Sikumiut's Inuit Qaujimajatuqangit (IQ). These areas are dangerous for travel and were not visible in the satellite imagery until late in the season.
Dark pink	Dark pink areas are rarely safe for travel by the week of July 2 to 8. Out of the 23 years mapped, these areas were broken-up 75 to 100% of the time and are normally dangerous for ice travel.
Light pink	Light pink areas were broken-up 50 to 70% of the time during the week of July 2 to 8. These areas would be normally considered dangerous for travel during this week of break-up.
Light green	Light green areas were broken-up 25 to 50% of the time. Typically, these areas would be considered sometimes dangerous for travel during this week of July 2 to 8.
Dark green	Dark green areas were broken-up 0 to 25% of the time during the week of Jul 2 to 8. These areas are generally safe for ice travel during this week of break-up. **You should always consult experienced hunters in the community and the most recent weather and ice information before you travel.**

July 2 to 8 summary break-up map: 1997 to 2019



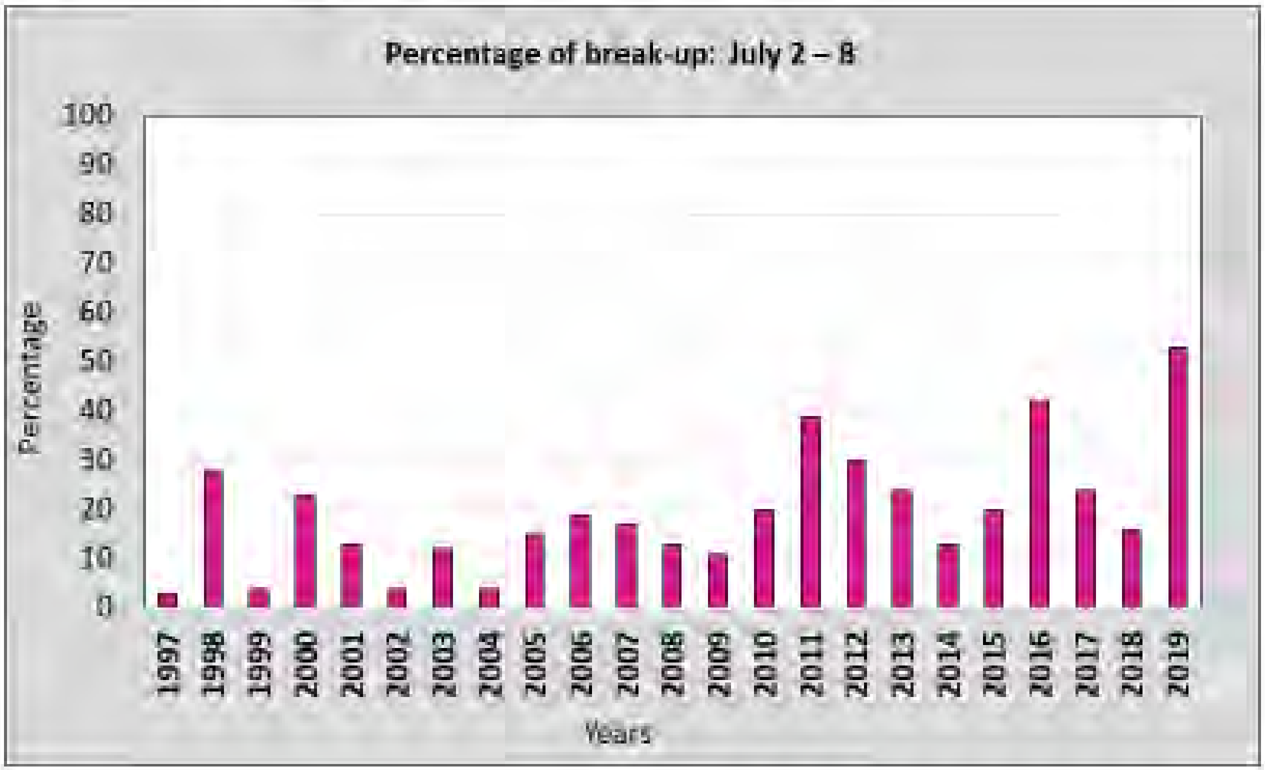
Map colour	Number of years the ice was broken-up	Percentage of years the ice was broken-up	Typical travel conditions
	--	--	IQ – Dangerous in the spring
	--	--	IQ – Dangerous aajurait
	17 - 23	75-100%	Dangerous
	11 - 16	50-75%	Frequently dangerous
	6 - 10	25-50%	Sometimes dangerous
	1 - 5	0-25%	Generally safe

Map Colour	Map Elements
★	Mittimatalik
	Outside travel region
	Land

Reading the average weekly break-up graphs

The graphs show how much of the ice was breaking-up for the week of July 2 to 18 over the 23-year study. Each pink bar represents a year from 1997 to 2019 listed on the bottom of the graph. The length of each bar shows the percentage breakup, For example:

- In 1997 the amount of tuvaq that had broken-up around Mittimatalik for the week of July 2 to 8 was around 5%
- In 2011 the amount of break-up this week was around 40%
- In 2019 the amount of break-up was over 50% for this week



Reading the weekly change in break-up maps

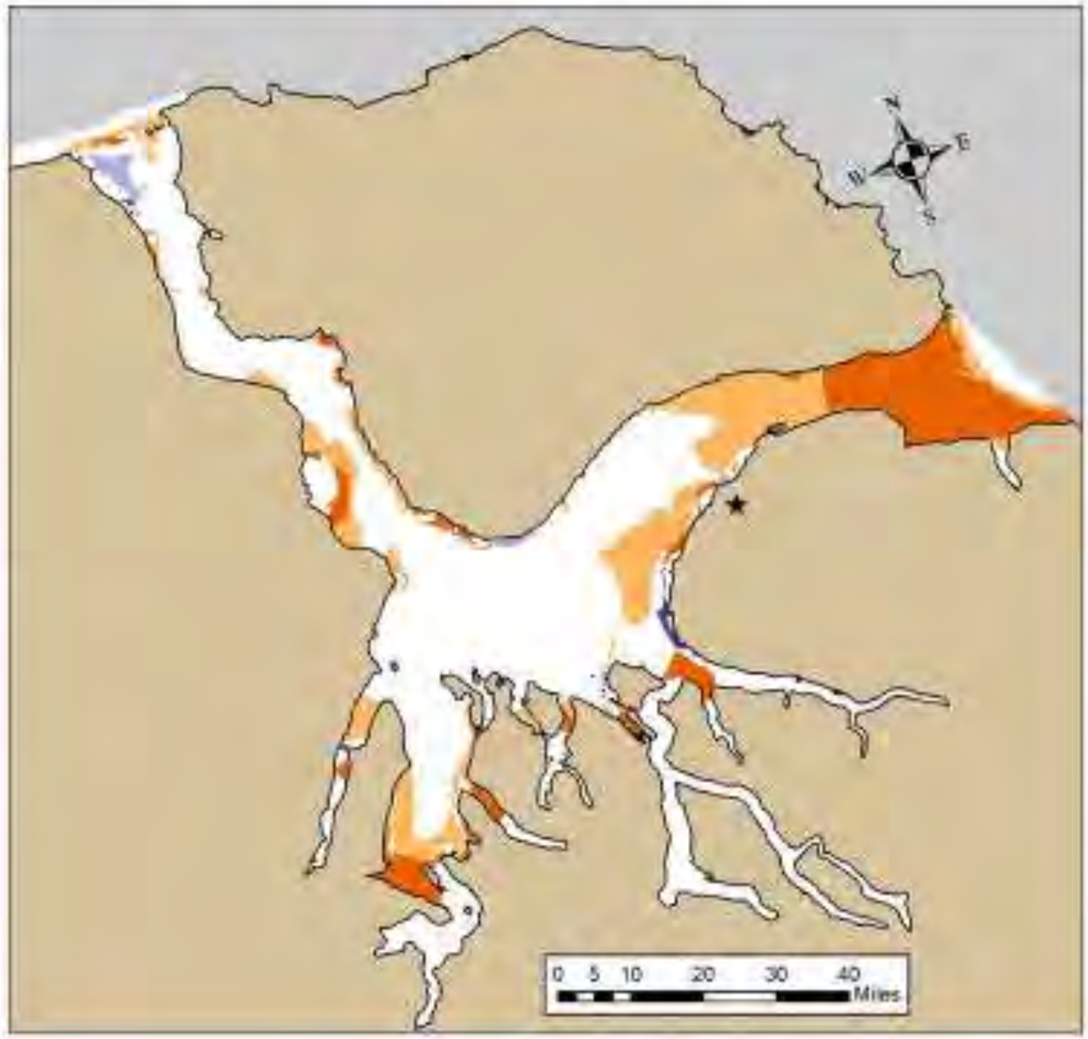
Sikumiut said that the greatest changes in the sea ice break-up have occurred over the last 10 years. We compared the first 13 years (1997-2009) to the last 10 years (2010-2019) in our 23-year record to map what areas were breaking-up earlier.

We coloured areas on the map depending if the ice was break-up earlier or later. The sample map on the right shows the weekly change in break-up map for the week of July 9 to 15.

	Dark orange areas are breaking up earlier in the last 10 years. Break-up is occurring earlier the week of July 9 to 15 at the Tursukattak sinaa, in Milne Inlet and at the entrance to Kangiqluruluk.
	Light orange areas are sometimes breaking earlier. We see more light orange areas around the community the week of July 9 to 15.
	White areas have no change in break-up in the last 10 years
	Light purple areas are sometimes breaking up later in the last 10 years. For the week of July 9 to 15 we see a light purple area near the Navy Board sinaa.
	Dark purple areas show where the ice is freezing-up later in the last 10 years. We do not see any dark purple areas in our change map for the week of July 9 to 15.

July 9 to 15 change in break-up map:

Map colour	Change in weekly break-up
	Breaking-up earlier
	Sometimes breaking earlier
	No change
	Sometimes breaking later
	Breaking-up later
Map colour	**Map elements**
★	Mittimatalik
	Outside travel region
	Land



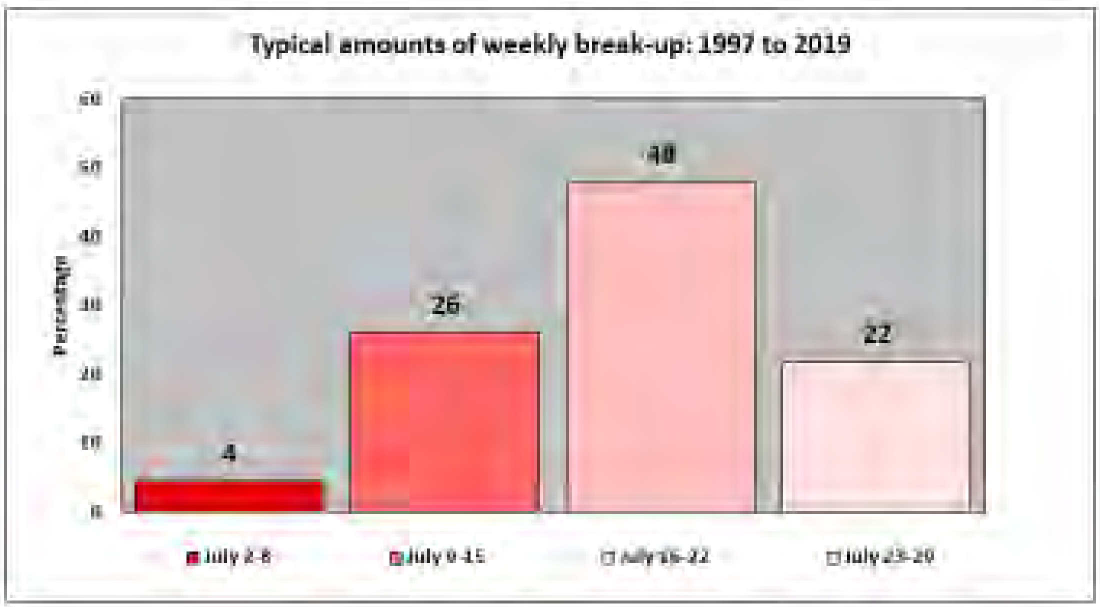
Using the weekly break-up maps and graphs

1. **Safe sea ice travel information**
   For people with less travel experience, these weekly maps can help those understand areas that are normally safe or dangerous for travel during break-up.
2. **Change in sea ice due to climate change**
   The graphs can be used to see if the break-up of occurring earlier for a particular week. We do see that there is more break-up is occurring earlier in the Mittimatalik region.

Continued…

3. Impacts of shipping earlier in the summer

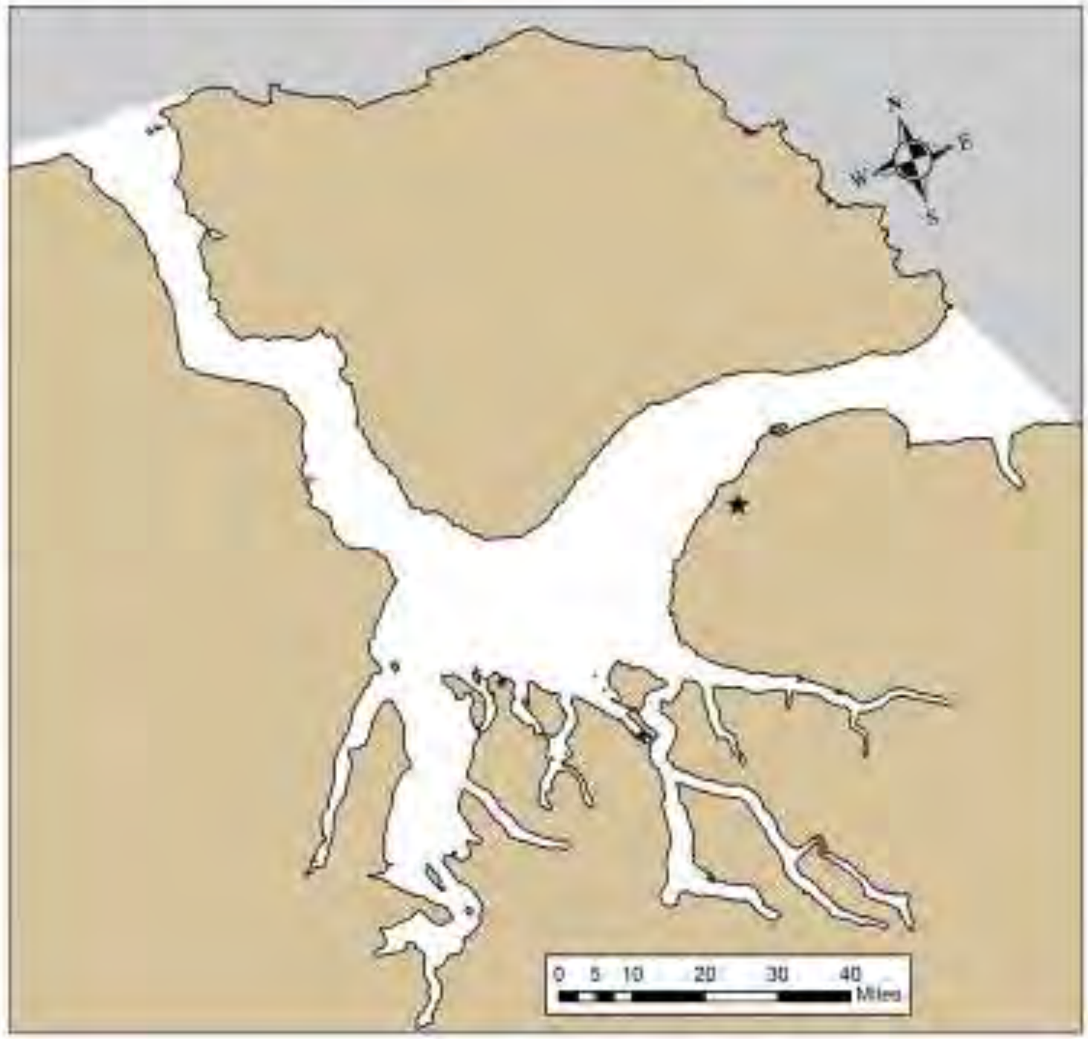
- Sikumiut wanted to understand the potential impacts if Baffinland moved the start of shipping from early August to mid-July. We reviewed our 23-year record to identify the weeks when break-up normally occurs.
- In the graph below, each bar represents a break-up week, and the length of each bar shows how much break-up normally occurs in the Mittimatalik region that week.
- Normally for the week of July 2 to 8, 4% of the sea ice has broken-up. By July 9 to 15, another 26% of the areas has broken-up.
- Starting to ship in mid-July could accelerate break-up and compromise community access to the sea ice and the Tursukattak Sinaa.



Weekly summary break-up maps:
June 18 to July 29

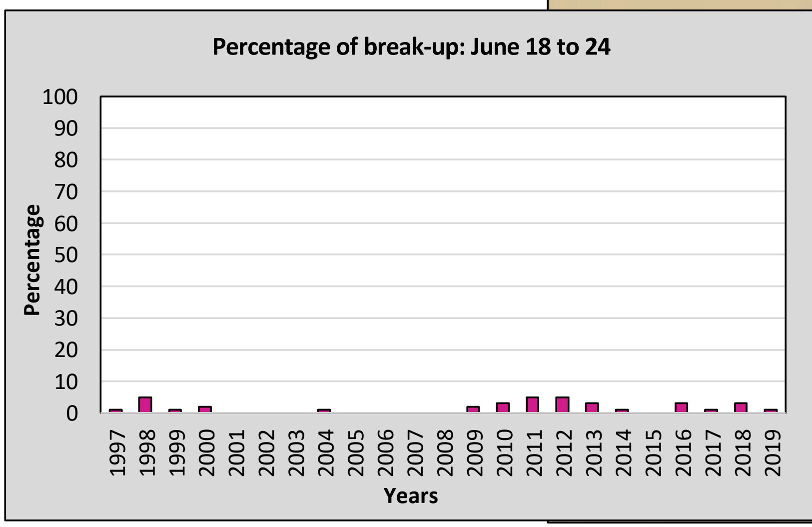
June 18 to 24 change in break-up map:

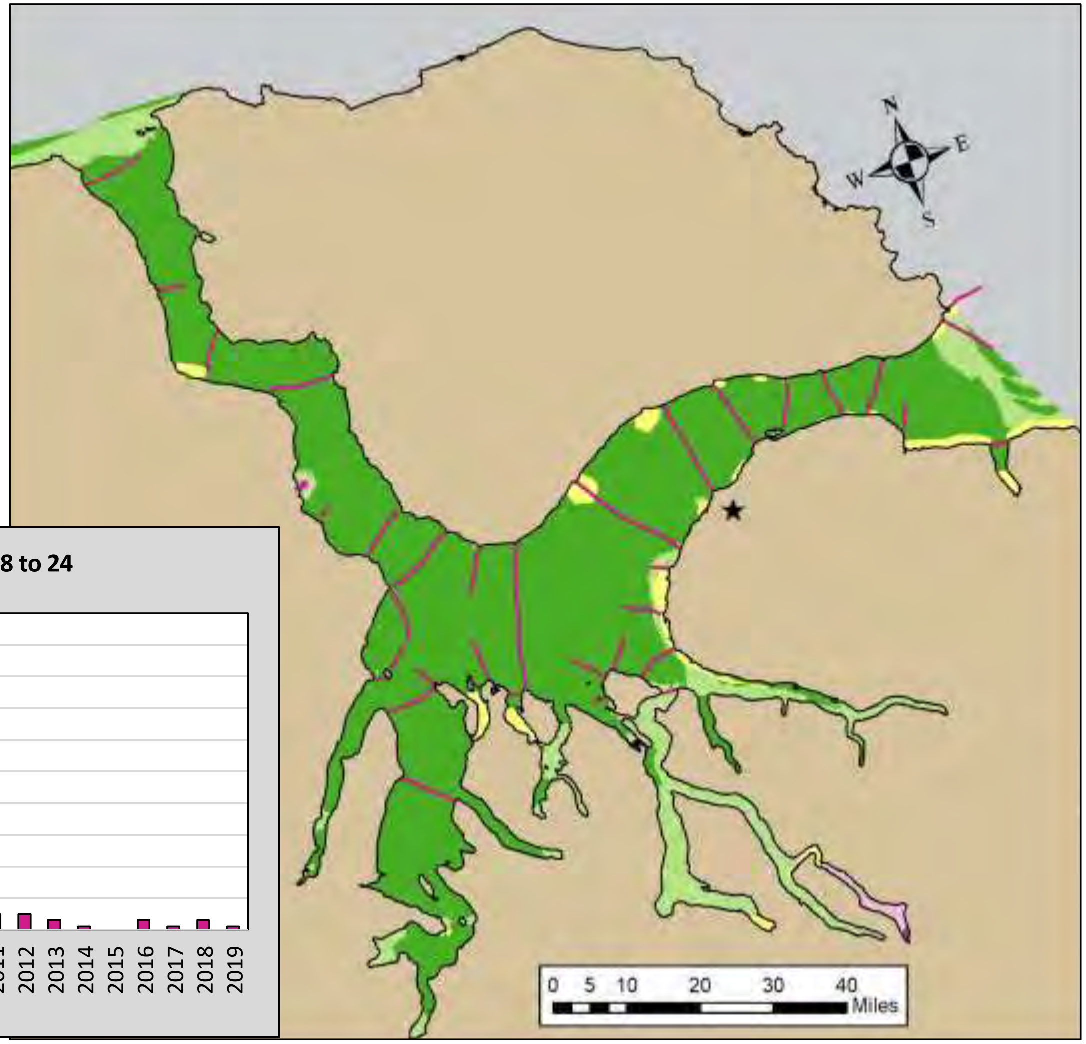
Map colour	Change in weekly break-up
	Breaking-up earlier
	Sometimes breaking earlier
	No change
	Sometimes breaking later
	Breaking-up later
Map colour	**Map elements**
★	Mittimatalik
	Outside travel region
	Land



June 18 to 24 summary break-up map: 1997 to 2019

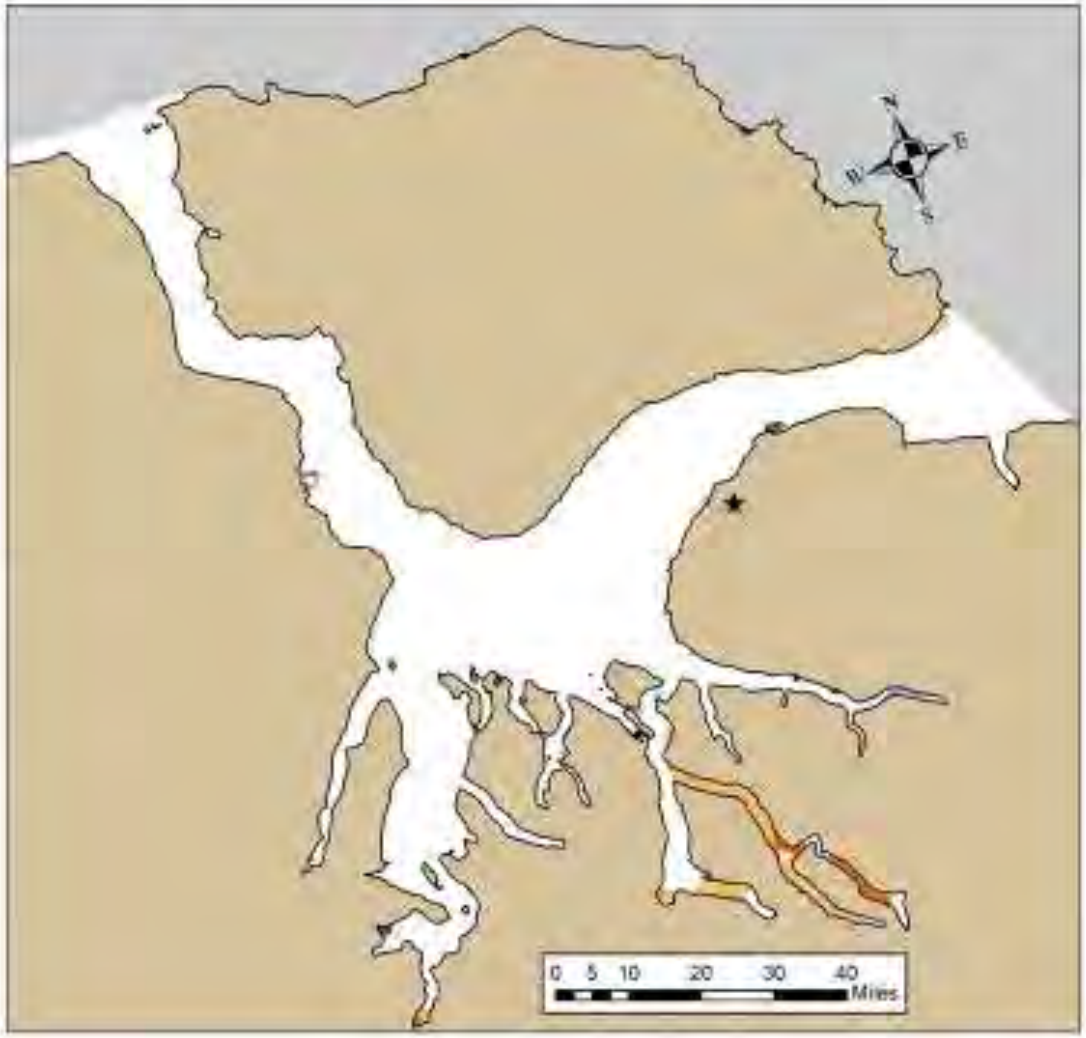
Map colour	Percentage of years the ice was broken-up	Typical travel conditions
	--	IQ – Dangerous in the spring
	--	IQ – Dangerous aajurait
	75 - 100%	Dangerous
	50 - 75%	Frequently dangerous
	25 - 50%	Sometimes dangerous
	0 - 25%	Generally safe
Map Colour	**Map Elements**	
★	Mittimatalik	
	Outside travel region	
	Land	





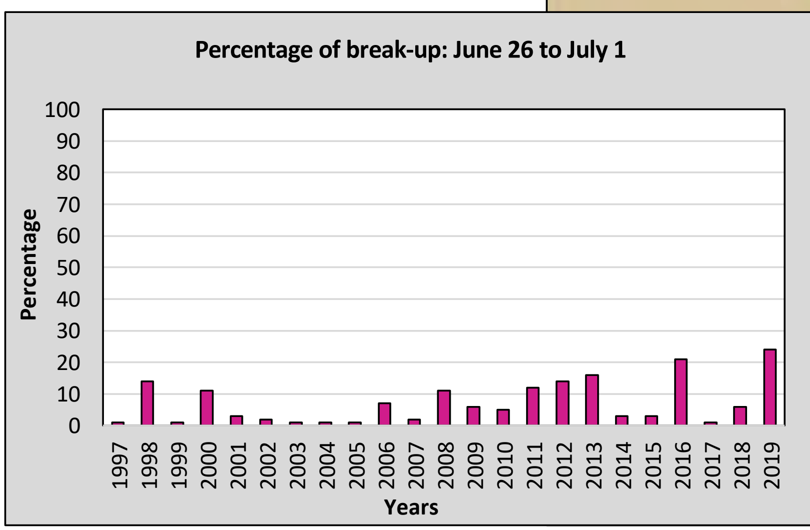
June 25 to July 1 change in break-up map:

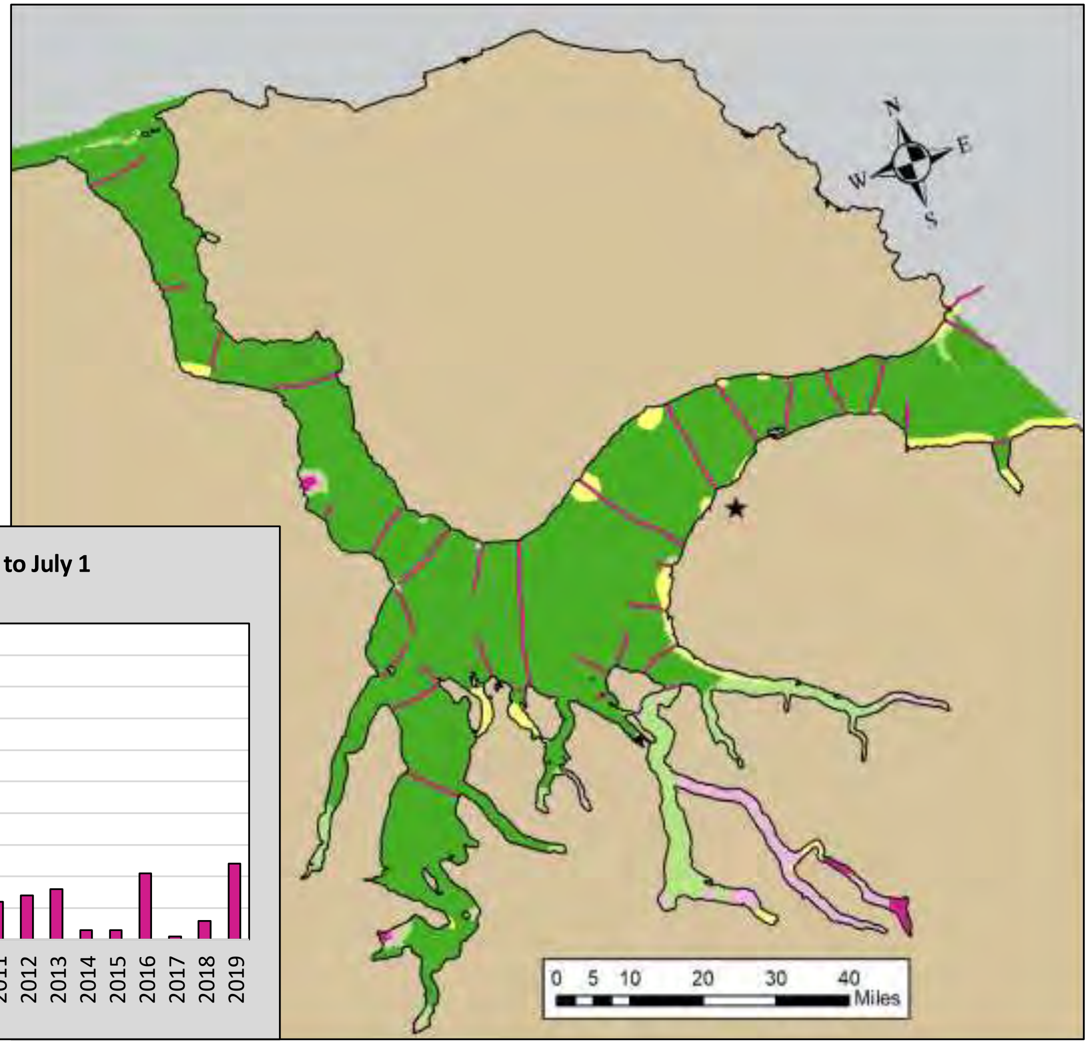
Map colour	Change in weekly break-up
	Breaking-up earlier
	Sometimes breaking earlier
	No change
	Sometimes breaking later
	Breaking-up later
Map colour	**Map elements**
★	Mittimatalik
	Outside travel region
	Land



June 25 to July 1 summary break-up map: 1997 to 2019

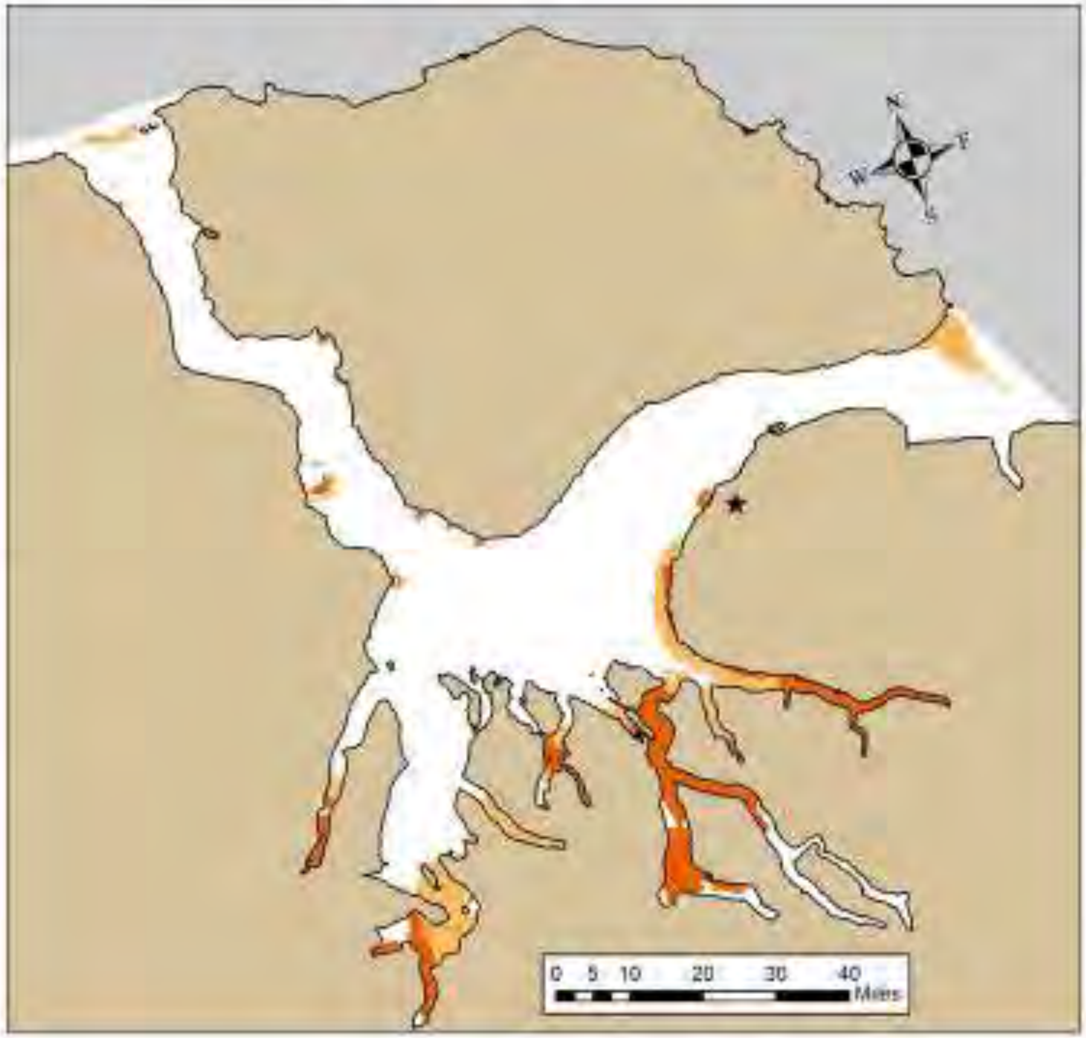
Map colour	Percentage of years the ice was broken-up	Typical travel conditions
	--	IQ – Dangerous in the spring
	--	IQ – Dangerous aajurait
	75 - 100%	Dangerous
	50 - 75%	Frequently dangerous
	25 - 50%	Sometimes dangerous
	0 - 25%	Generally safe
Map Colour	**Map Elements**	
★	Mittimatalik	
	Outside travel region	
	Land	





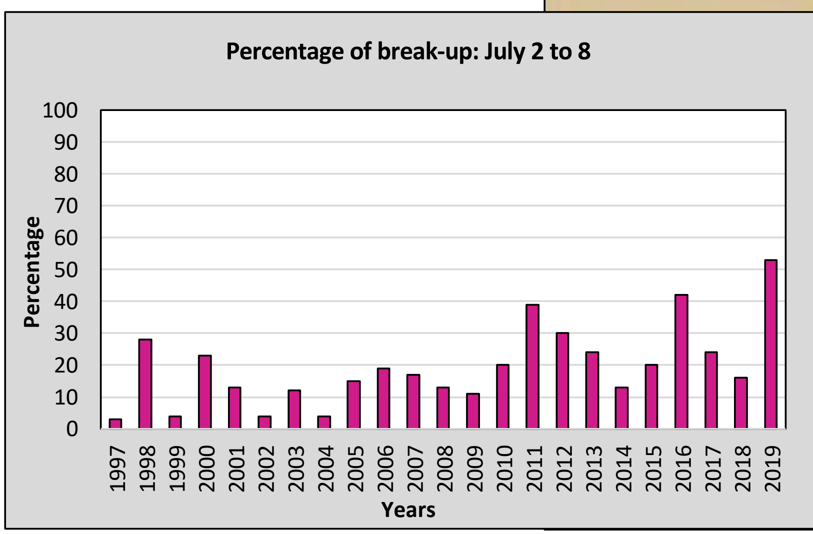
July 2 to 8 change in break-up map:

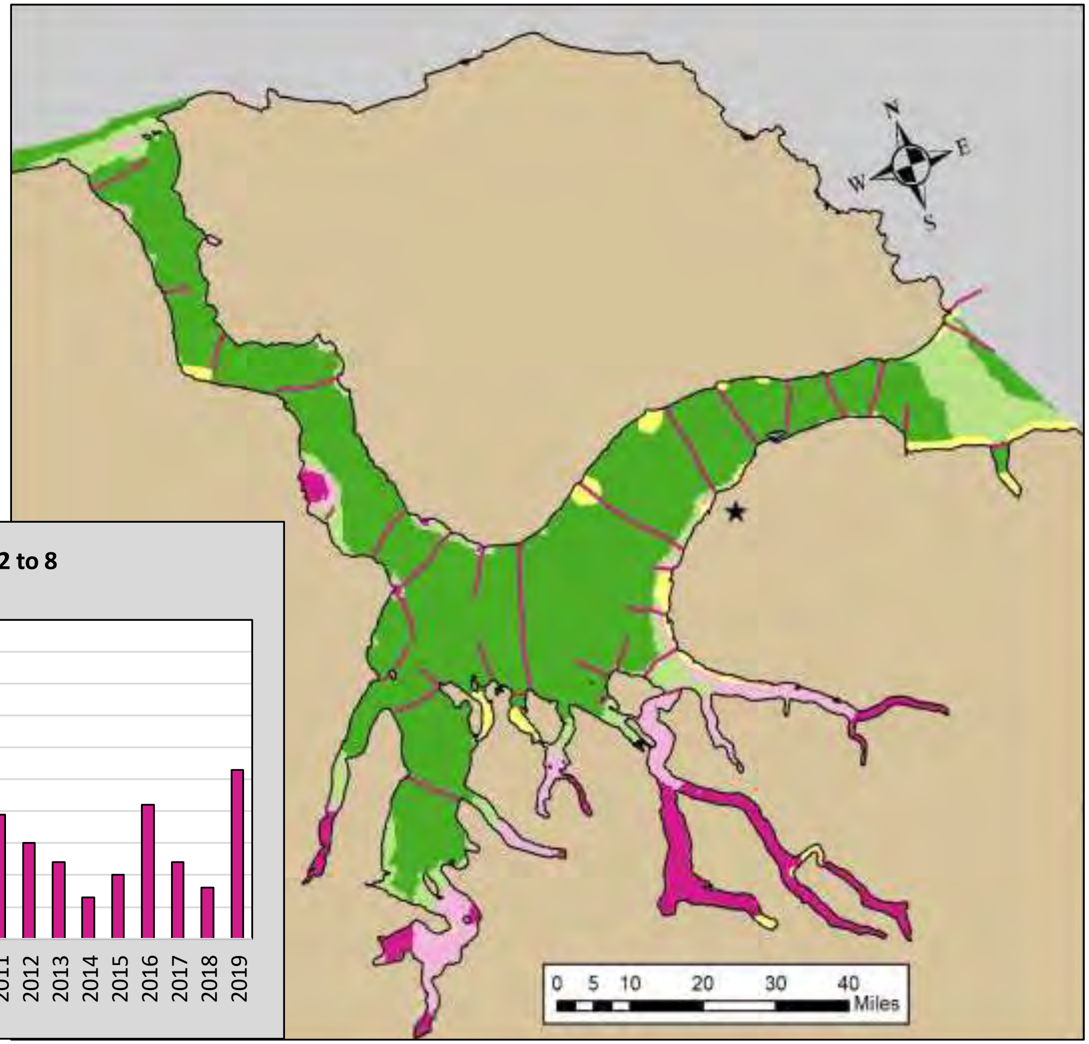
Map colour	Change in weekly break-up
	Breaking-up earlier
	Sometimes breaking earlier
	No change
	Sometimes breaking later
	Breaking-up later
Map colour	**Map elements**
★	Mittimatalik
	Outside travel region
	Land



July 2 to 8 summary break-up map: 1997 to 2019

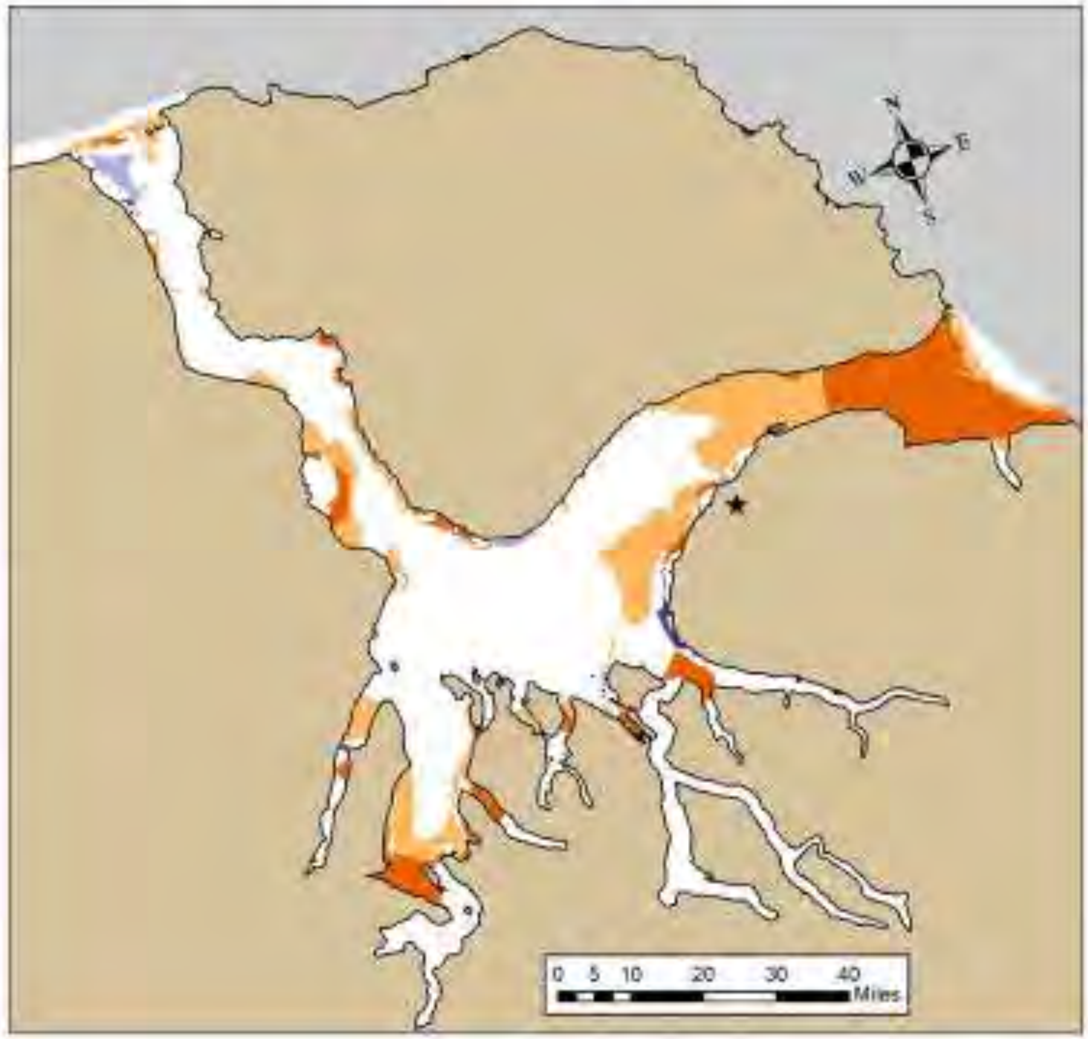
Map colour	Percentage of years the ice was broken-up	Typical travel conditions
	--	IQ – Dangerous in the spring
	--	IQ – Dangerous aajurait
	75 - 100%	Dangerous
	50 - 75%	Frequently dangerous
	25 - 50%	Sometimes dangerous
	0 - 25%	Generally safe
Map Colour	**Map Elements**	
	Mittimatalik	
	Outside travel region	
	Land	





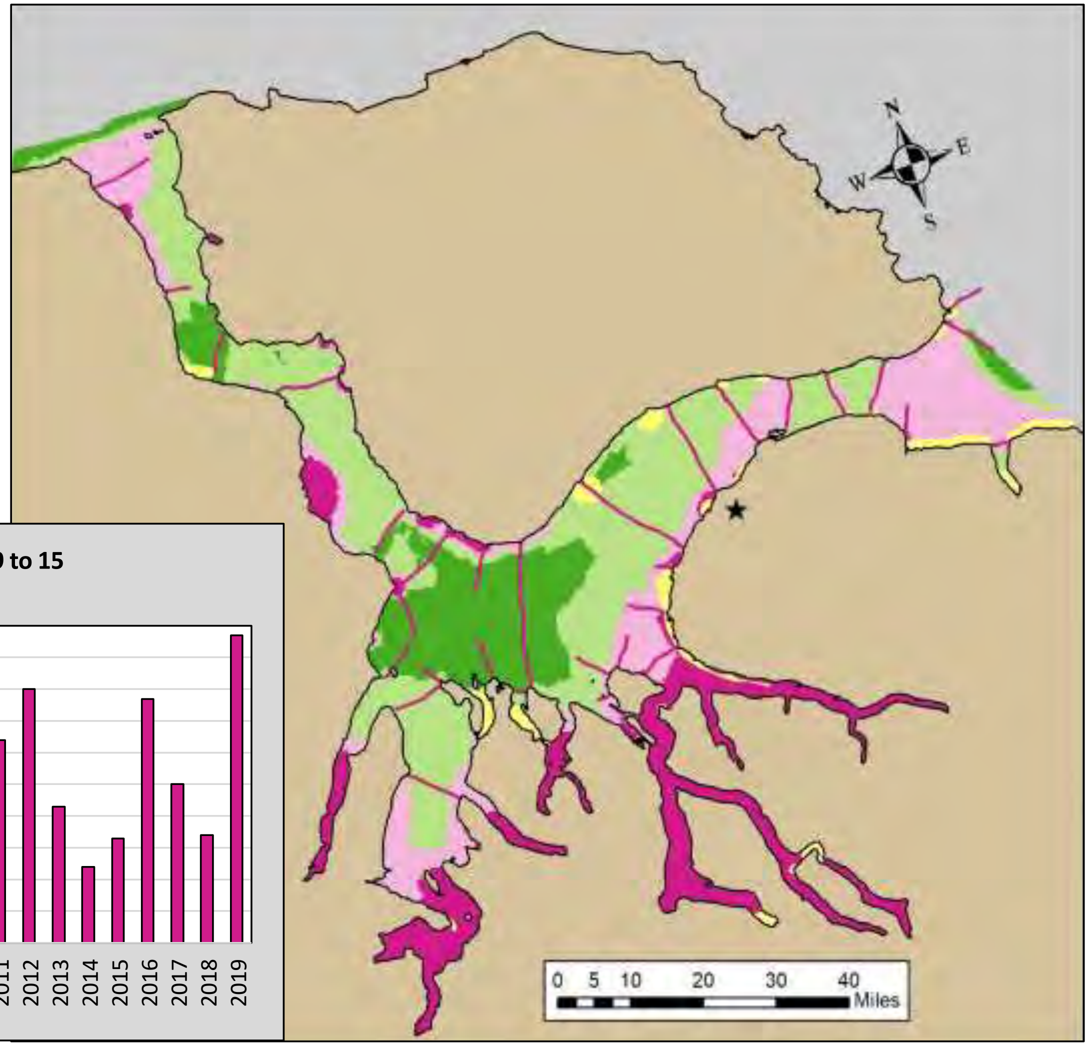
July 9 to 15 change in break-up map:

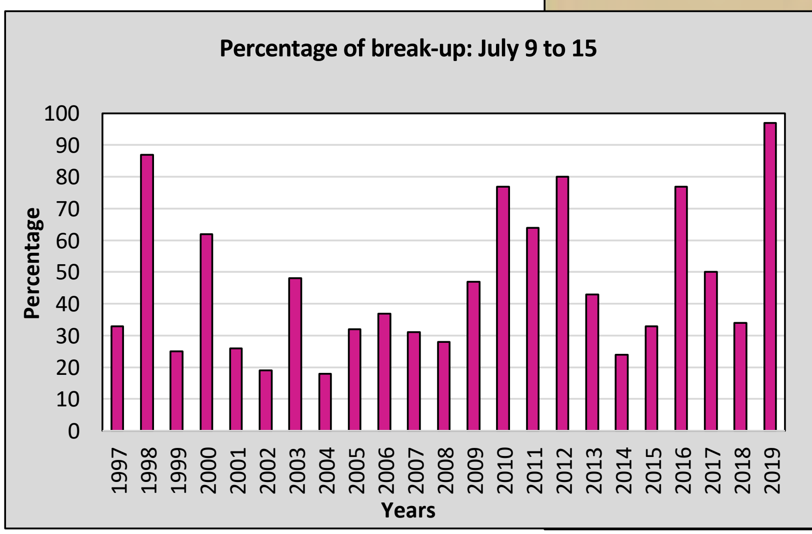
Map colour	Change in weekly break-up
	Breaking-up earlier
	Sometimes breaking earlier
	No change
	Sometimes breaking later
	Breaking-up later
Map colour	**Map elements**
★	Mittimatalik
	Outside travel region
	Land



July 9 to 15 summary break-up map: 1997 to 2019

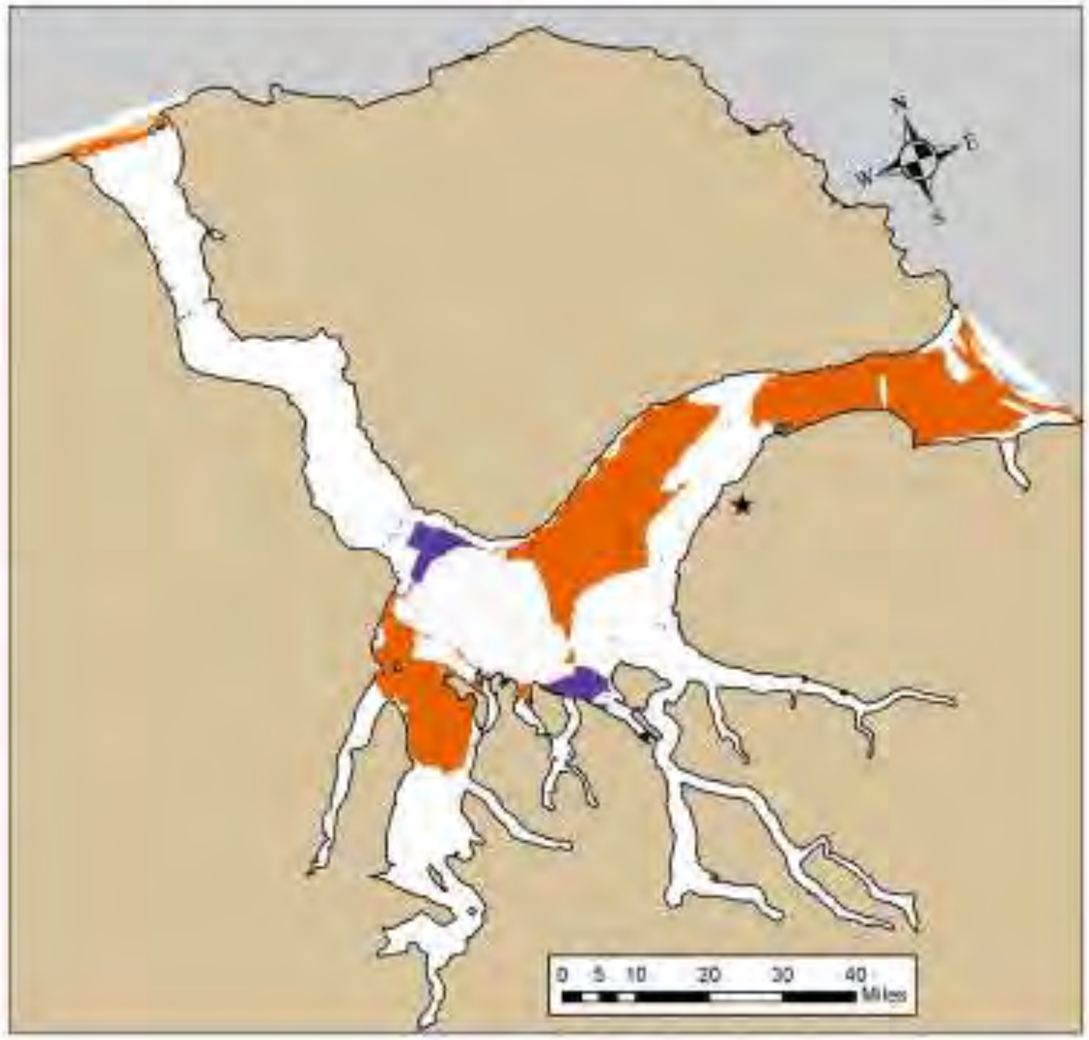
Map colour	Percentage of years the ice was broken-up	Typical travel conditions
Yellow	--	IQ – Dangerous in the spring
Magenta line	--	IQ – Dangerous aajurait
Dark magenta	75 - 100%	Dangerous
Light pink	50 - 75%	Frequently dangerous
Light green	25 - 50%	Sometimes dangerous
Dark green	0 - 25%	Generally safe
Map Colour	**Map Elements**	
★	Mittimatalik	
Grey	Outside travel region	
Tan	Land	





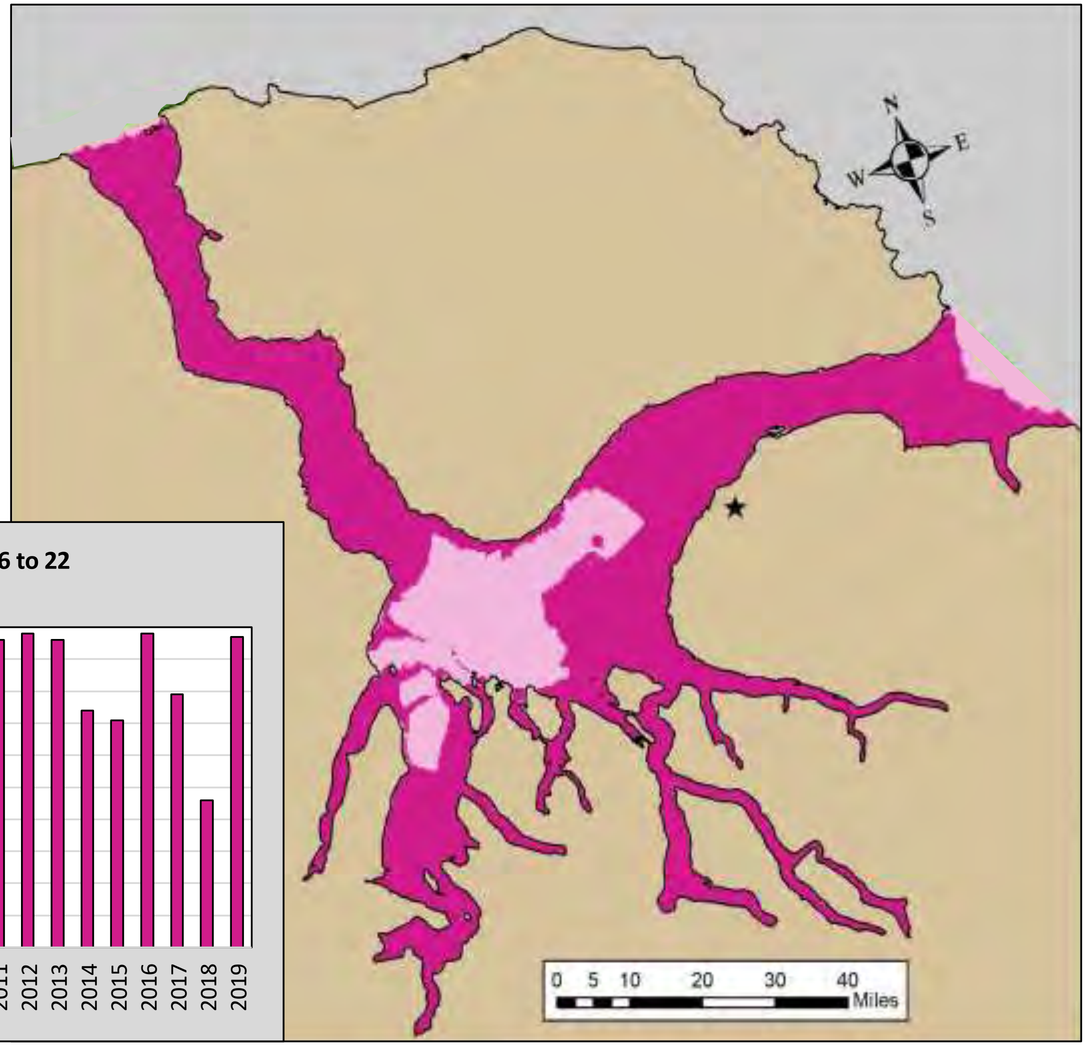
July 16 to 22 change in break-up map:

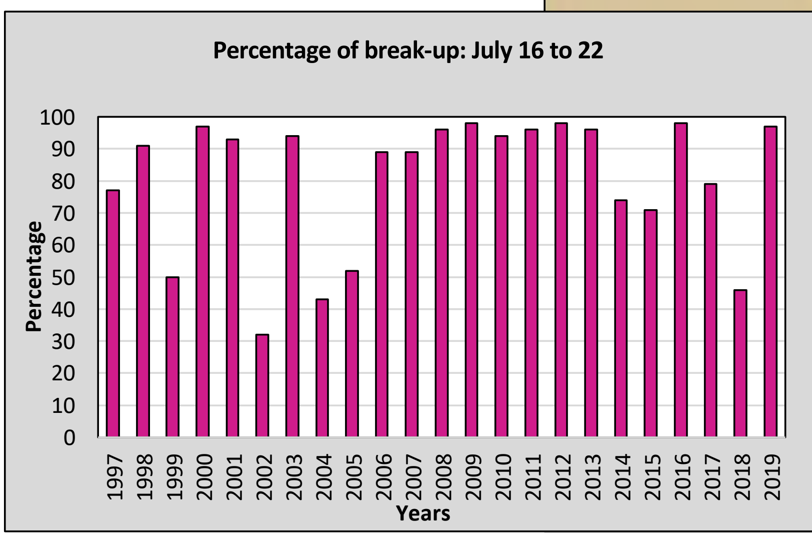
Map colour	Change in weekly break-up
	Breaking-up earlier
	Sometimes breaking earlier
	No change
	Sometimes breaking later
	Breaking-up later
Map colour	**Map elements**
★	Mittimatalik
	Outside travel region
	Land



July 16 to 22 summary break-up map: 1997 to 2019

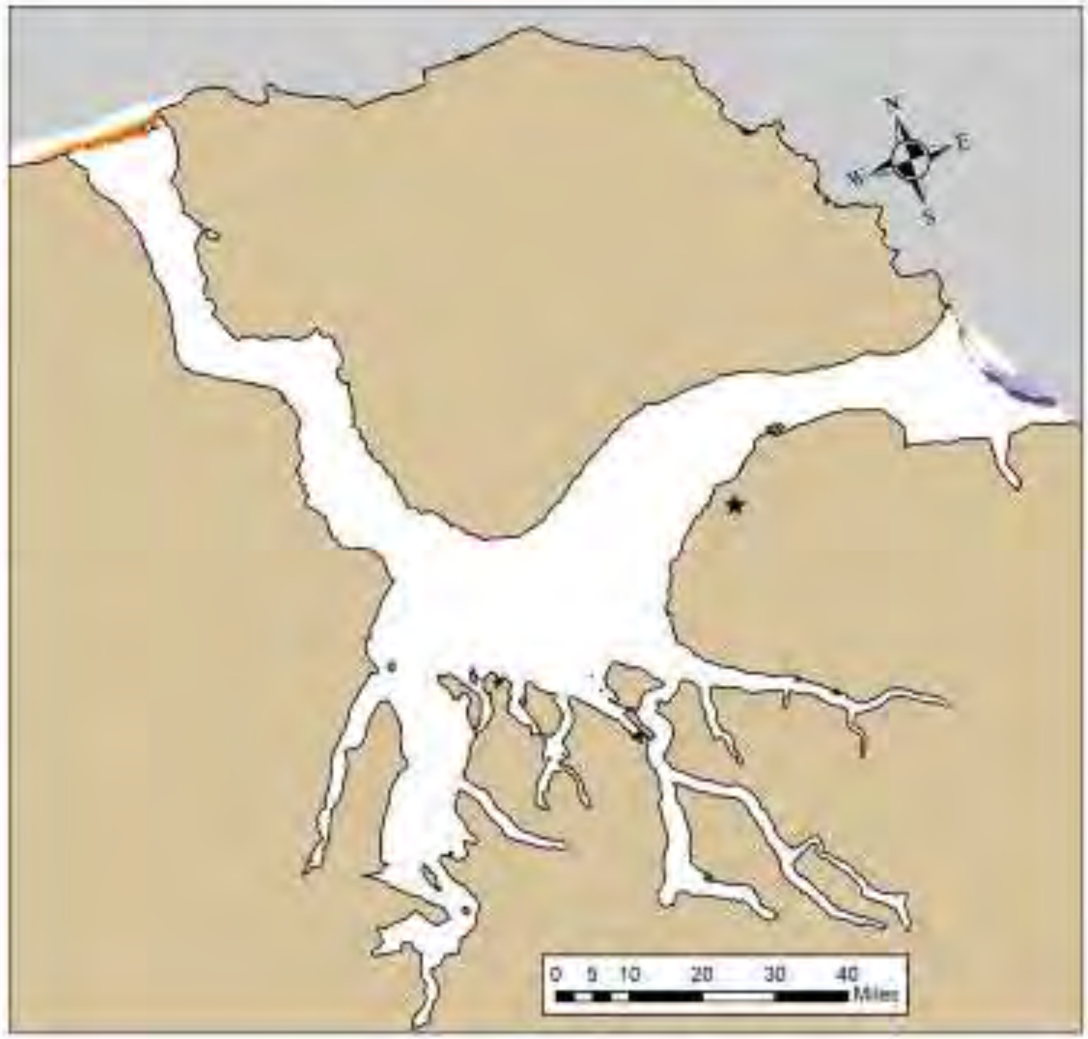
Map colour	Percentage of years the ice was broken-up	Typical travel conditions
	--	IQ – Dangerous in the spring
	--	IQ – Dangerous aajurait
	75 - 100%	Dangerous
	50 - 75%	Frequently dangerous
	25 - 50%	Sometimes dangerous
	0 - 25%	Generally safe
Map Colour	**Map Elements**	
★	Mittimatalik	
	Outside travel region	
	Land	





July 23 to 29 change in break-up map:

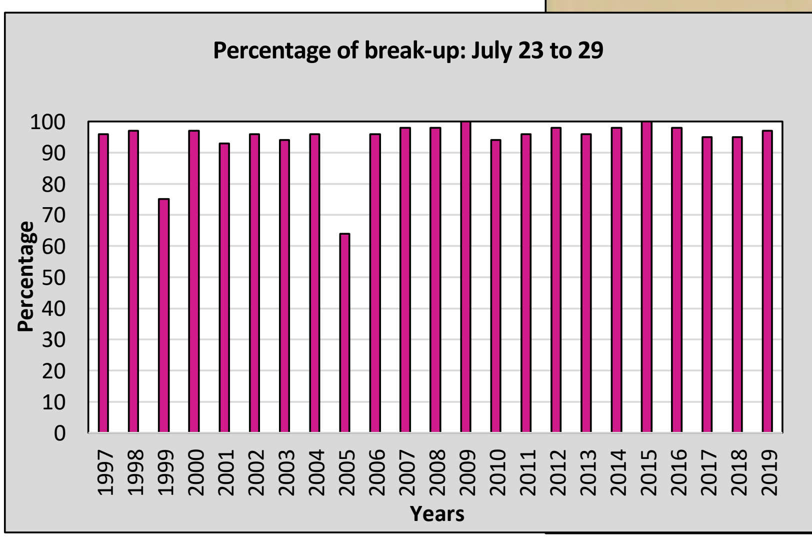
Map colour	Change in weekly break-up
	Breaking-up earlier
	Sometimes breaking earlier
	No change
	Sometimes breaking later
	Breaking-up later
Map colour	**Map elements**
★	Mittimatalik
	Outside travel region
	Land

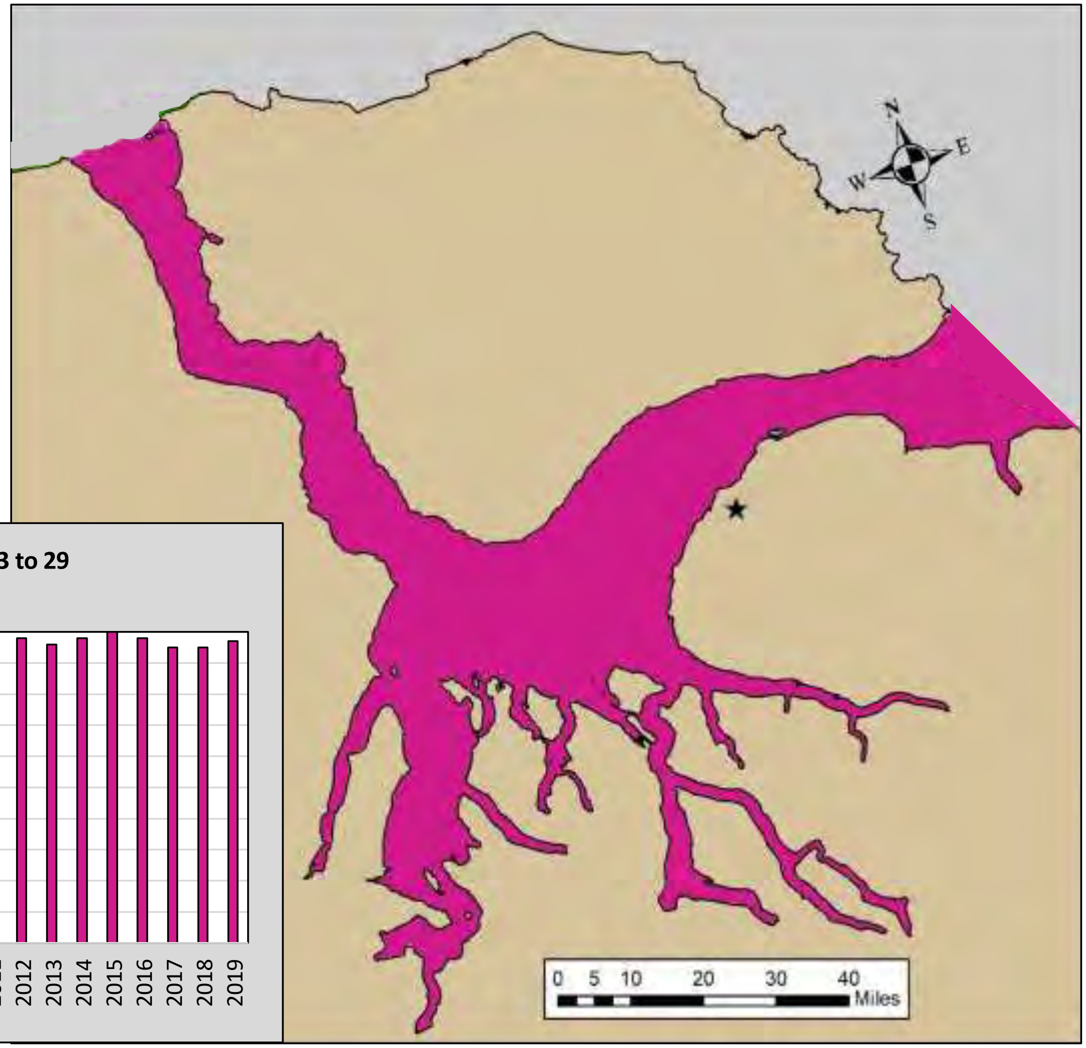


July 23 to 29 summary break-up map: 1997 to 2019

Map colour	Percentage of years the ice was broken-up	Typical travel conditions
	--	IQ – Dangerous in the spring
	--	IQ – Dangerous aajurait
	75 - 100%	Dangerous
	50 - 75%	Frequently dangerous
	25 - 50%	Sometimes dangerous
	0 - 25%	Generally safe

Map Colour	Map Elements
★	Mittimatalik
	Outside travel region
	Land



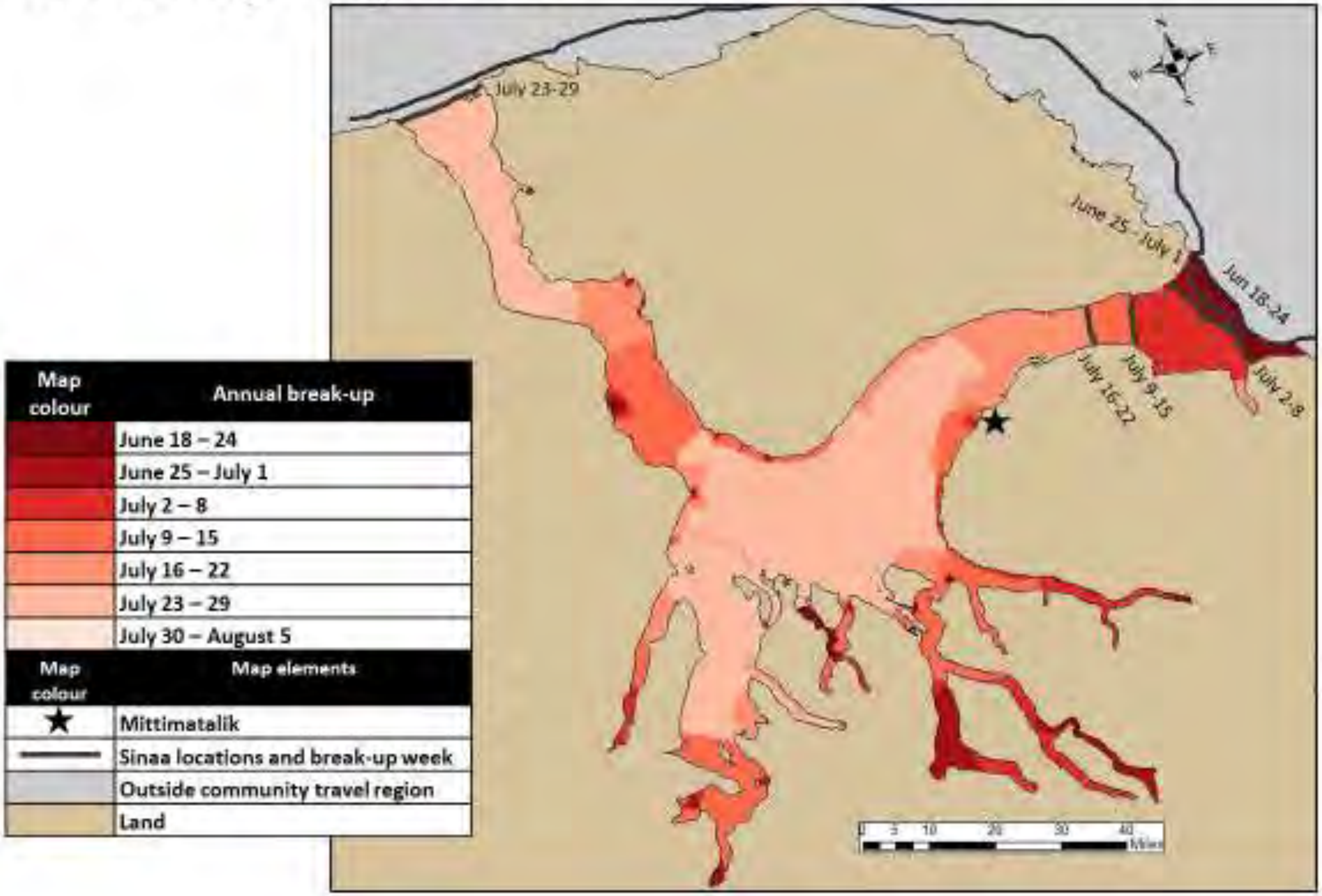


Annual break-up maps: 1997 to 2019

Reading the annual break-up maps

- The annual break-up map shows when and where the tuvaq broke-up over time for each year of our 23-year record
- The map on the right shows how the tuvaq broke-up for the year 2018
- Each week in the annual break-up map is shown in a different shade of red
  - The dark red colours are for late June, and you can see them in the inlets, mouths of rivers and sometimes at the sinaangit
  - The lighter red colours show where it breaks up later into July, for 2018 it broke up last in Tasiujaq
- We have annual maps like this one for 1997 to 2019.

Break-up map: 2018



Using the annual break-up maps

1. Looking at break-up patterns

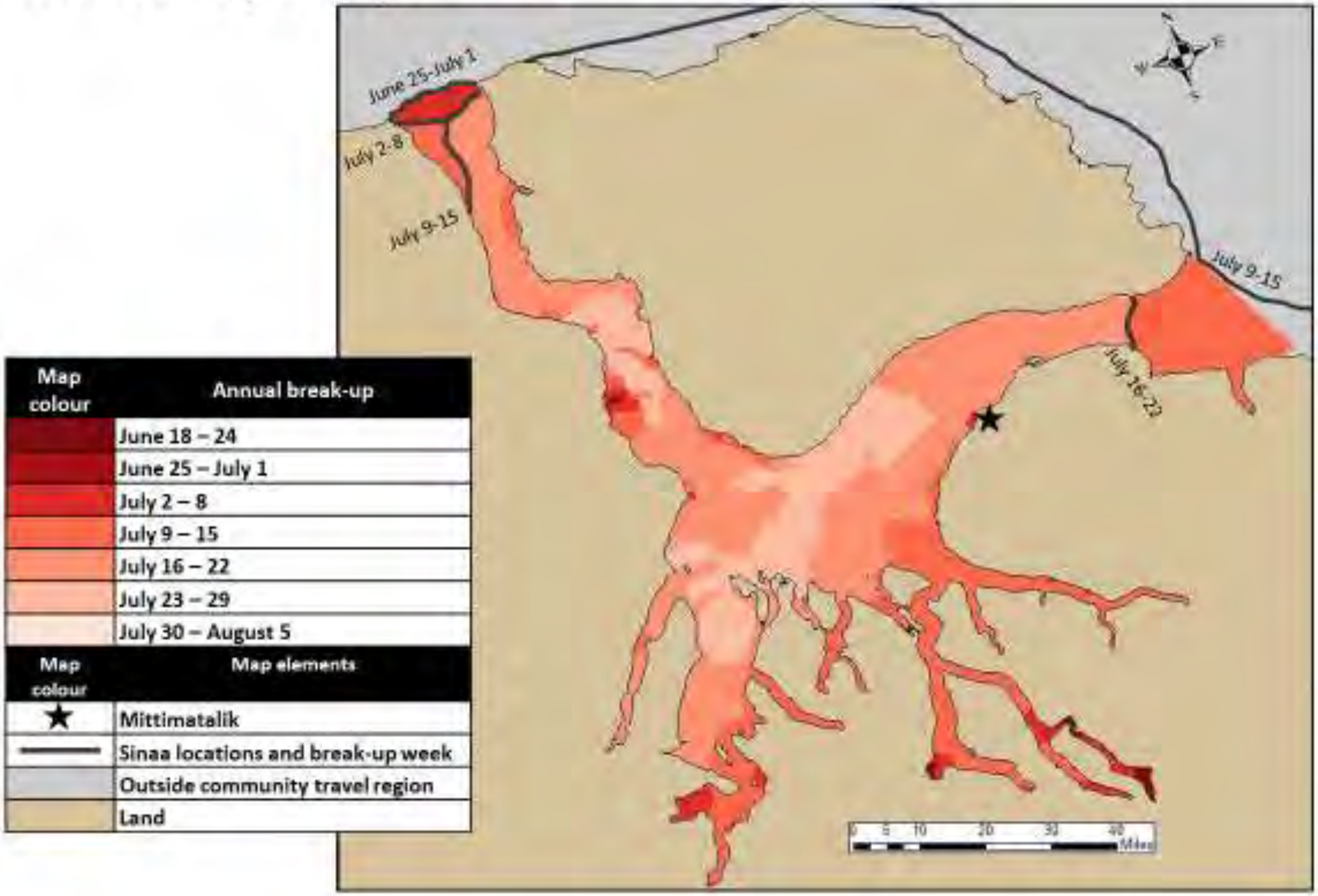
- It may be helpful to compare current conditions with previous years to understand where and when the tuvaq may break-up this year.
- Look at where and when the tuvaq formed each year between 1997 and 2019.
- For example, in 2005 the tuvaq broke up very late, and in 2019 it broke-up very early.
- Was the break-up of tuvaq this year similar to any other years?
- In 11 out of the 26 years, the sea ice in front of the community broke up before the Tursukattak sinaa.
- In these year Mittimatalingmiut had to travel over the land to continue to access the Tursukattak sinaa.
- We also noticed the 75% of the time the Tursukattak sinaa fractures to the area called Ukkuanguaq (Figure 1)

2. Change in break-up due to climate change

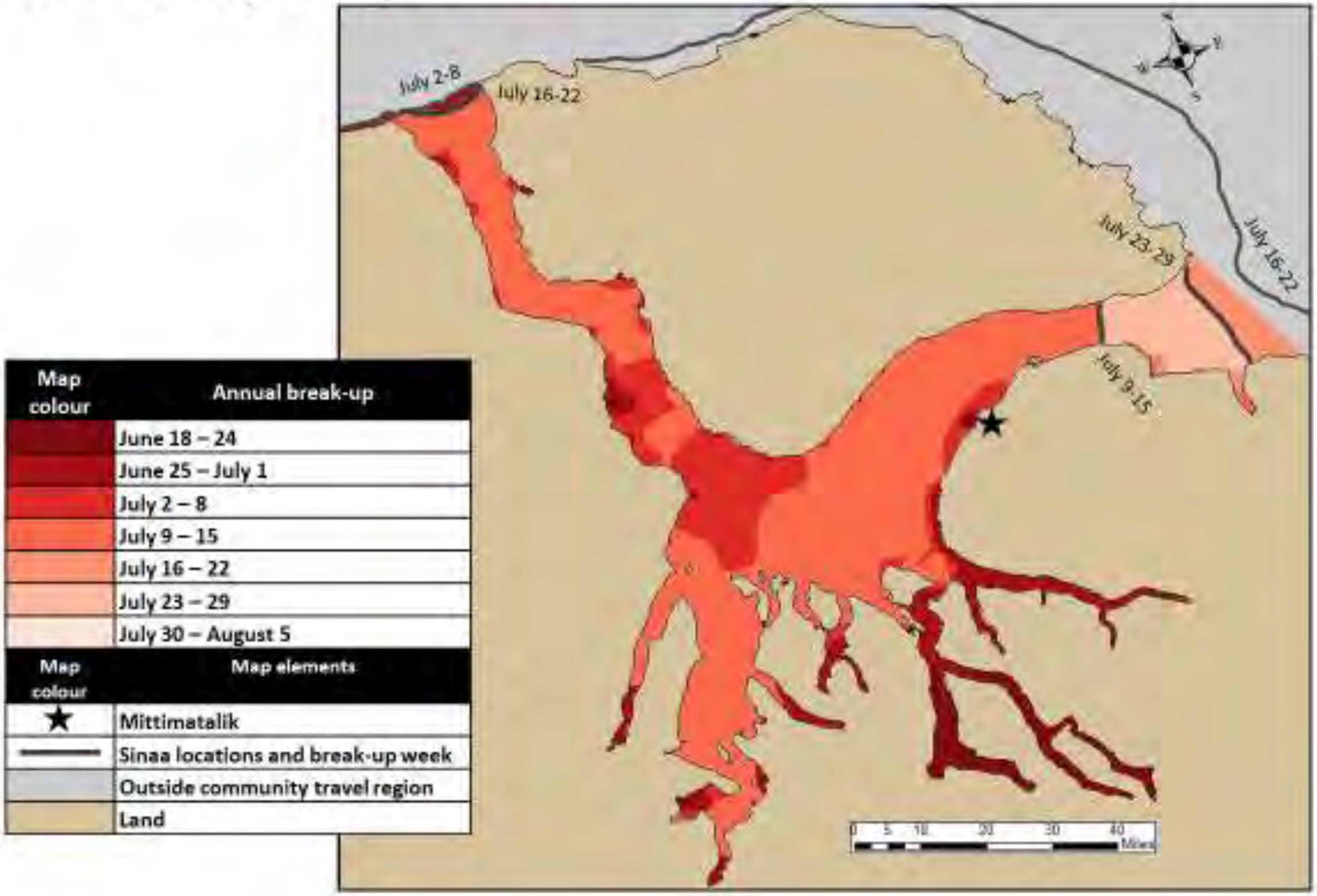
The annual maps can also be used to track if tuvaq break-up is becoming less predictable, or if a new pattern of freeze-up is starting to emerge.

Annual break-up maps:
1997 to 2019

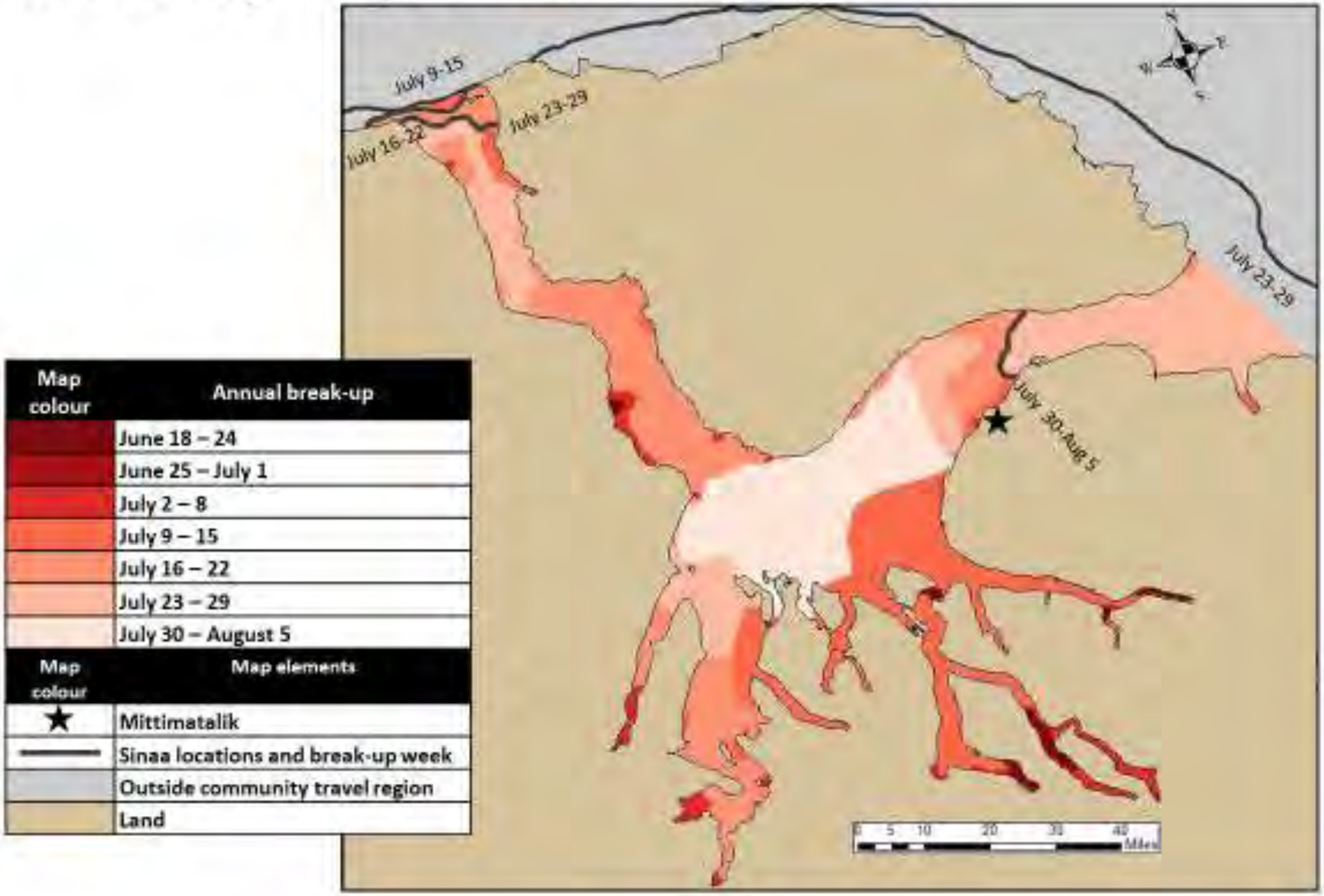
Break-up map: 1997



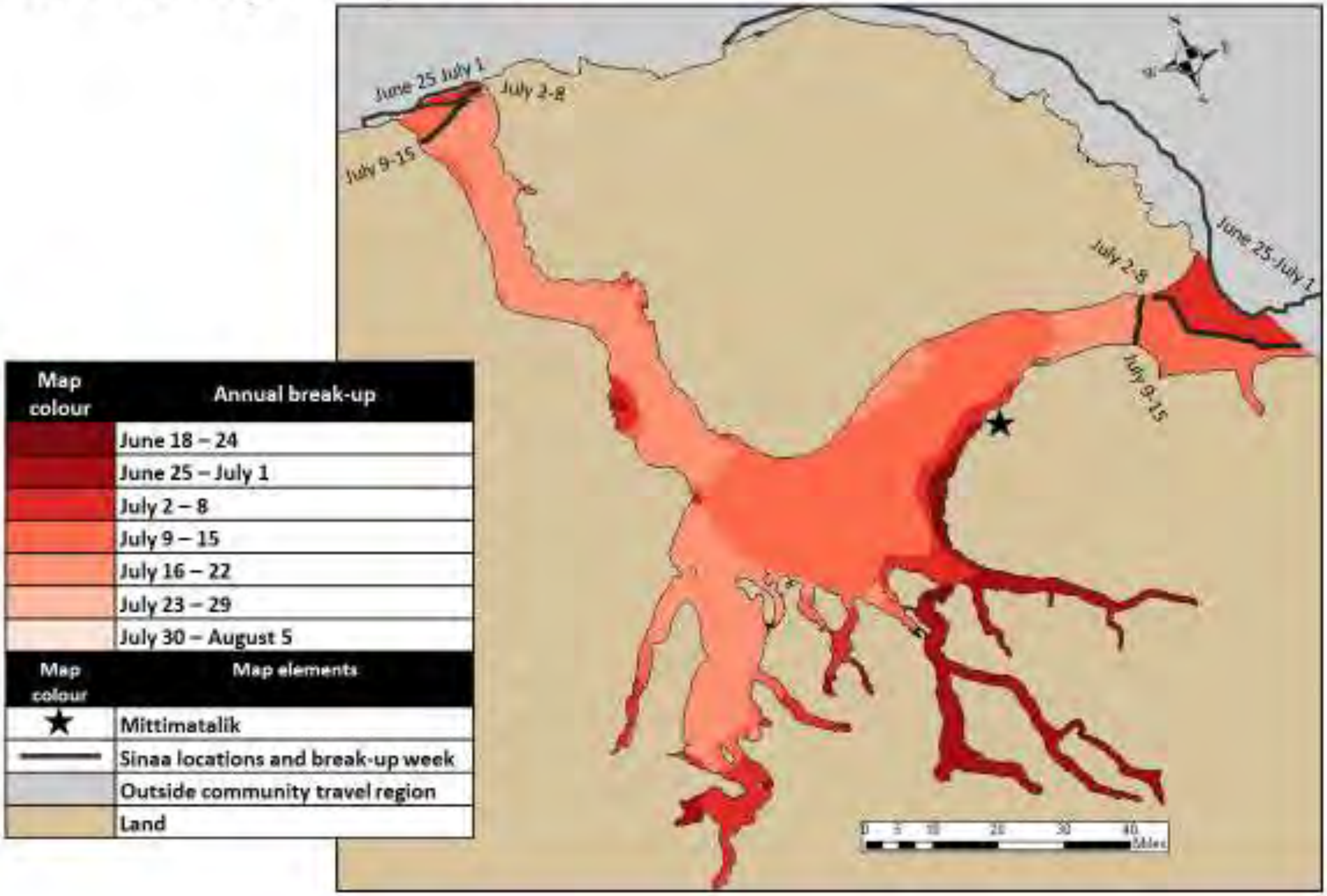
Break-up map: 1998



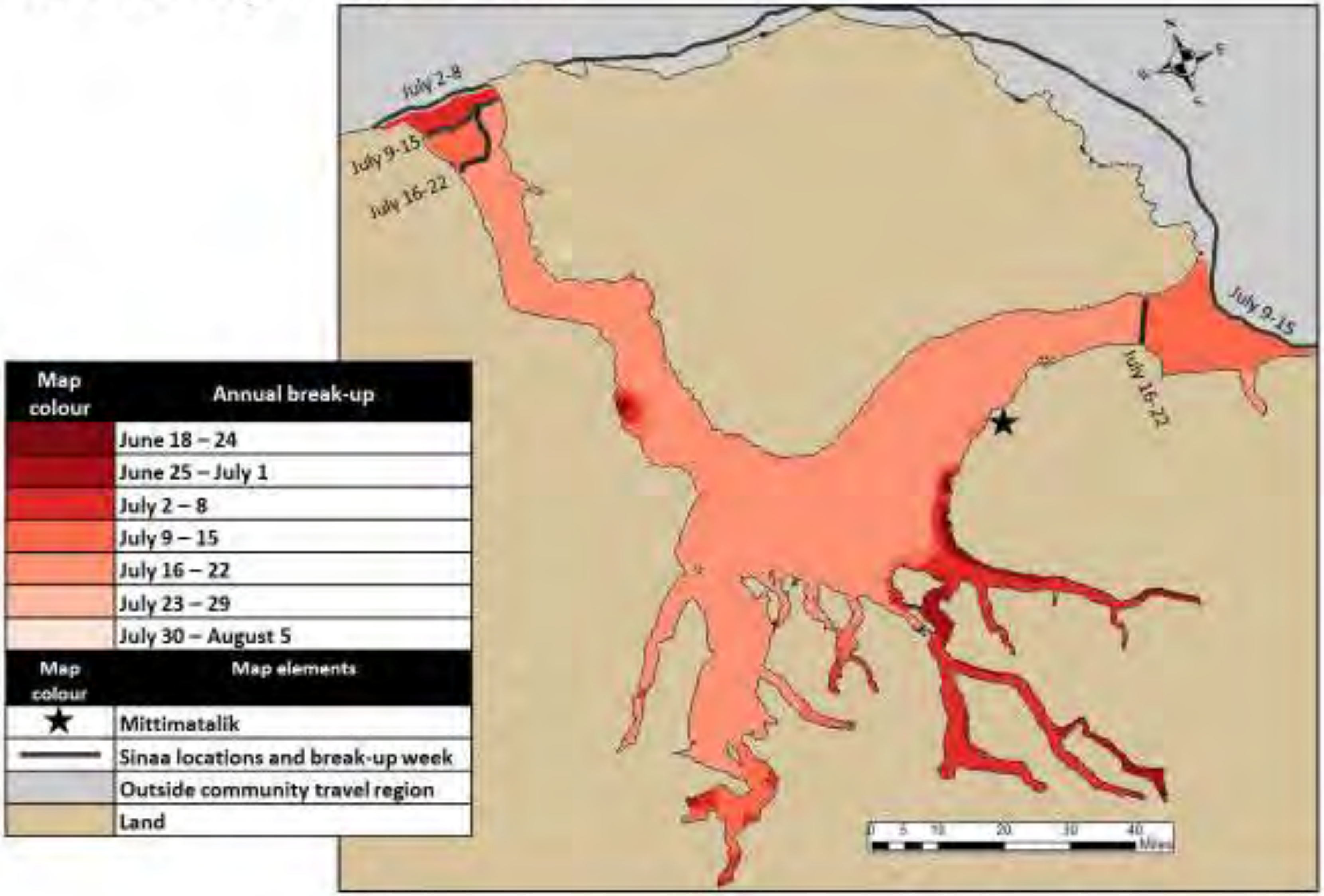
Break-up map: 1999



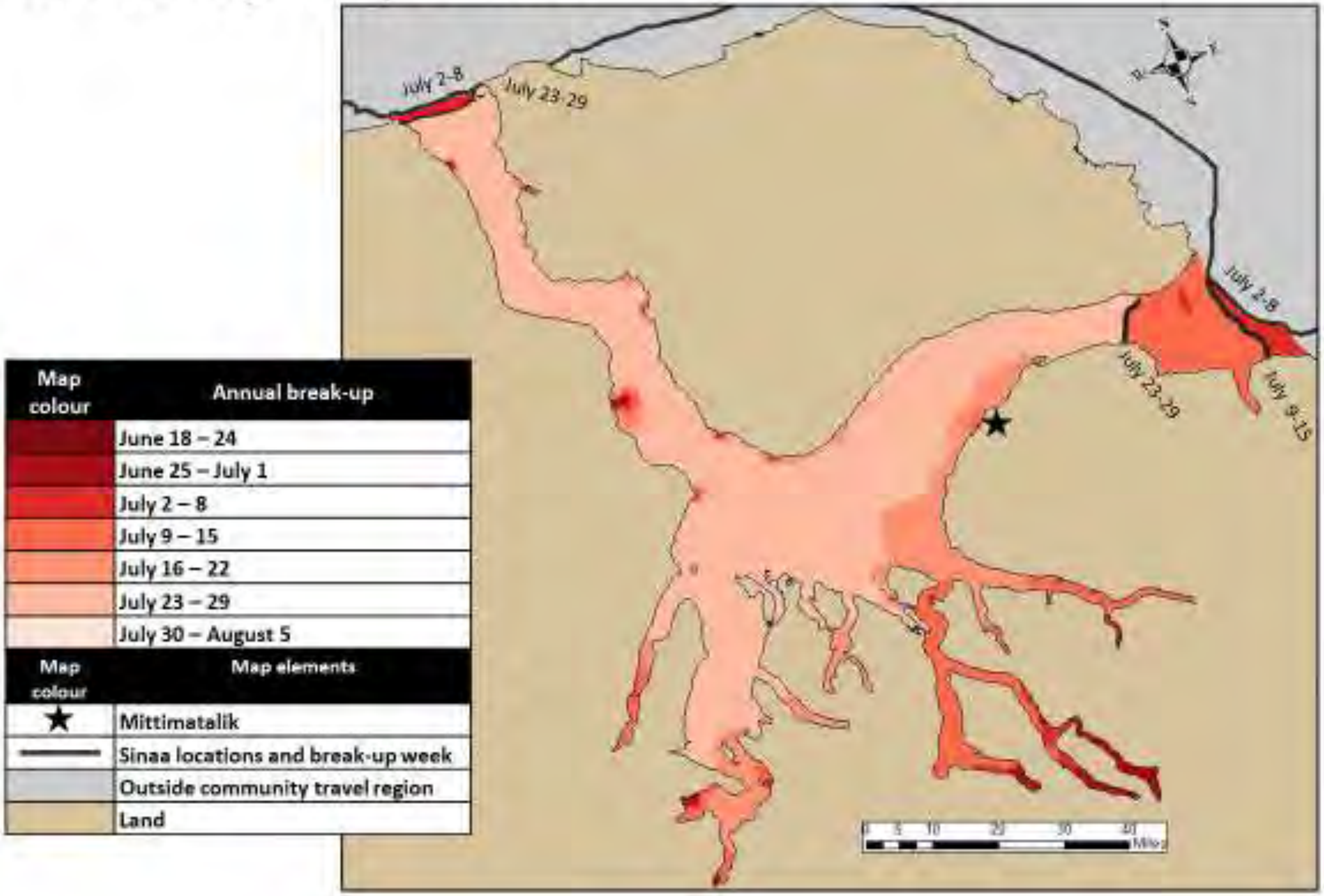
Break-up map: 2000



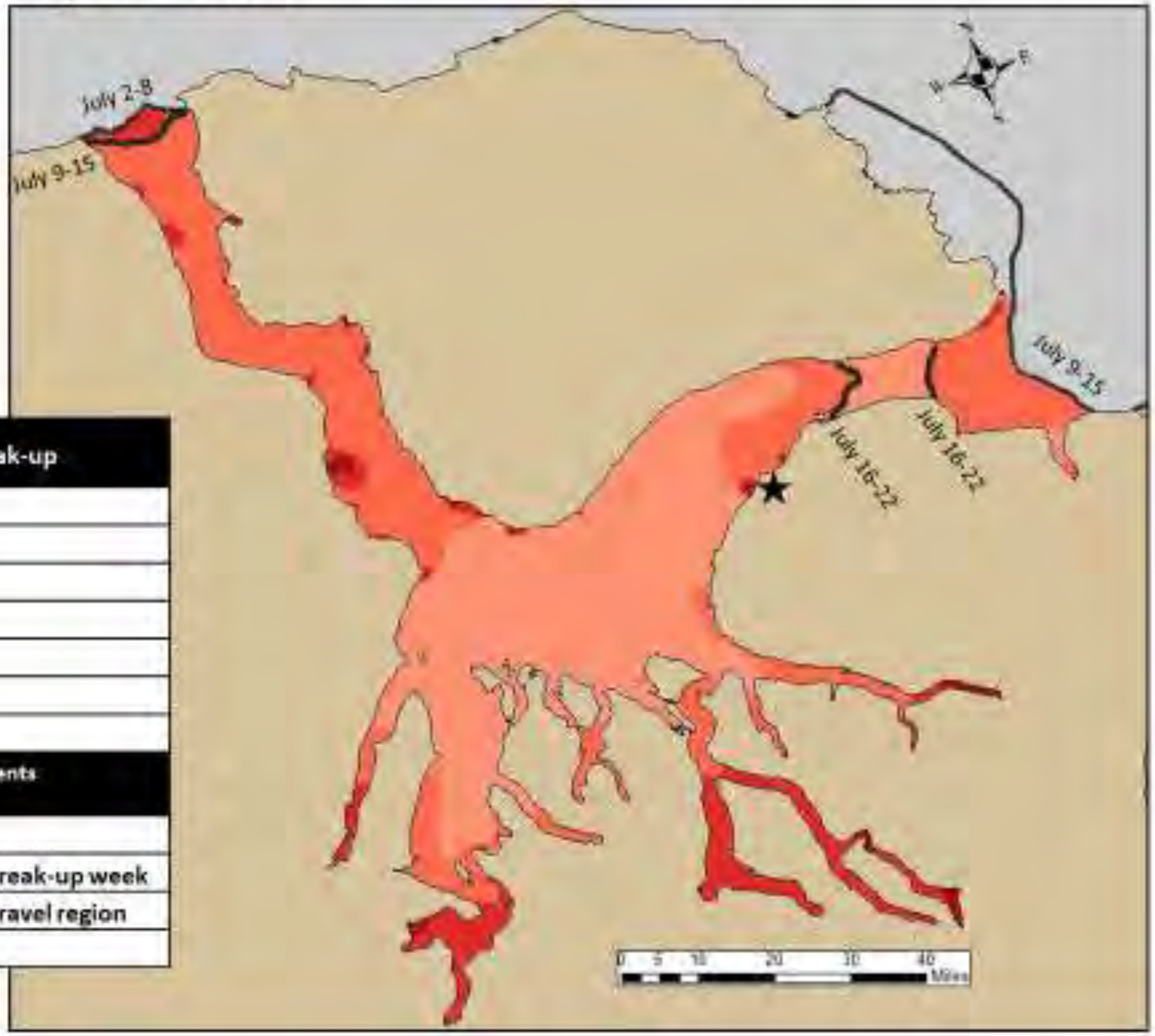
Break-up map: 2001



Break-up map: 2002

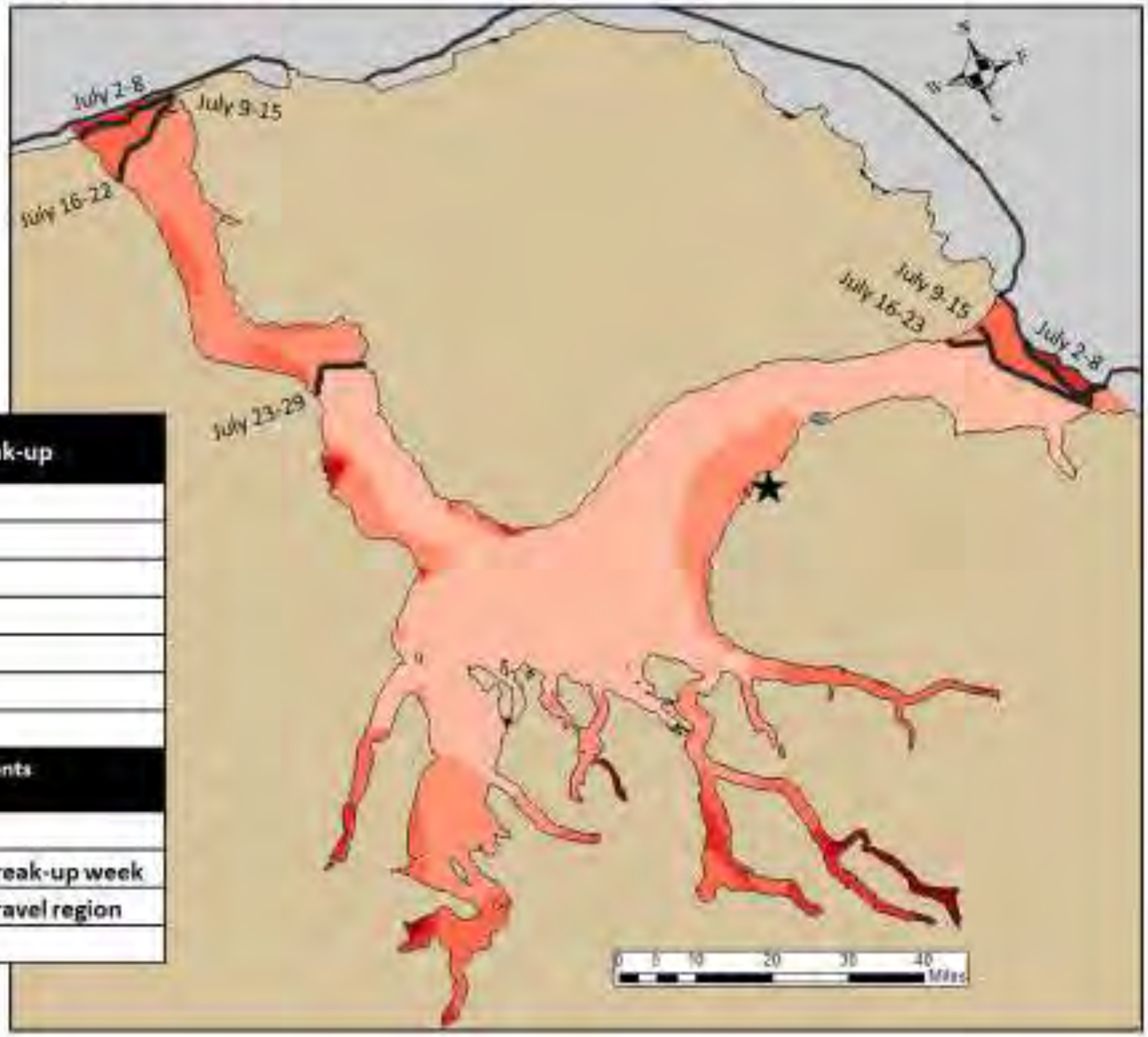


Break-up map: 2003



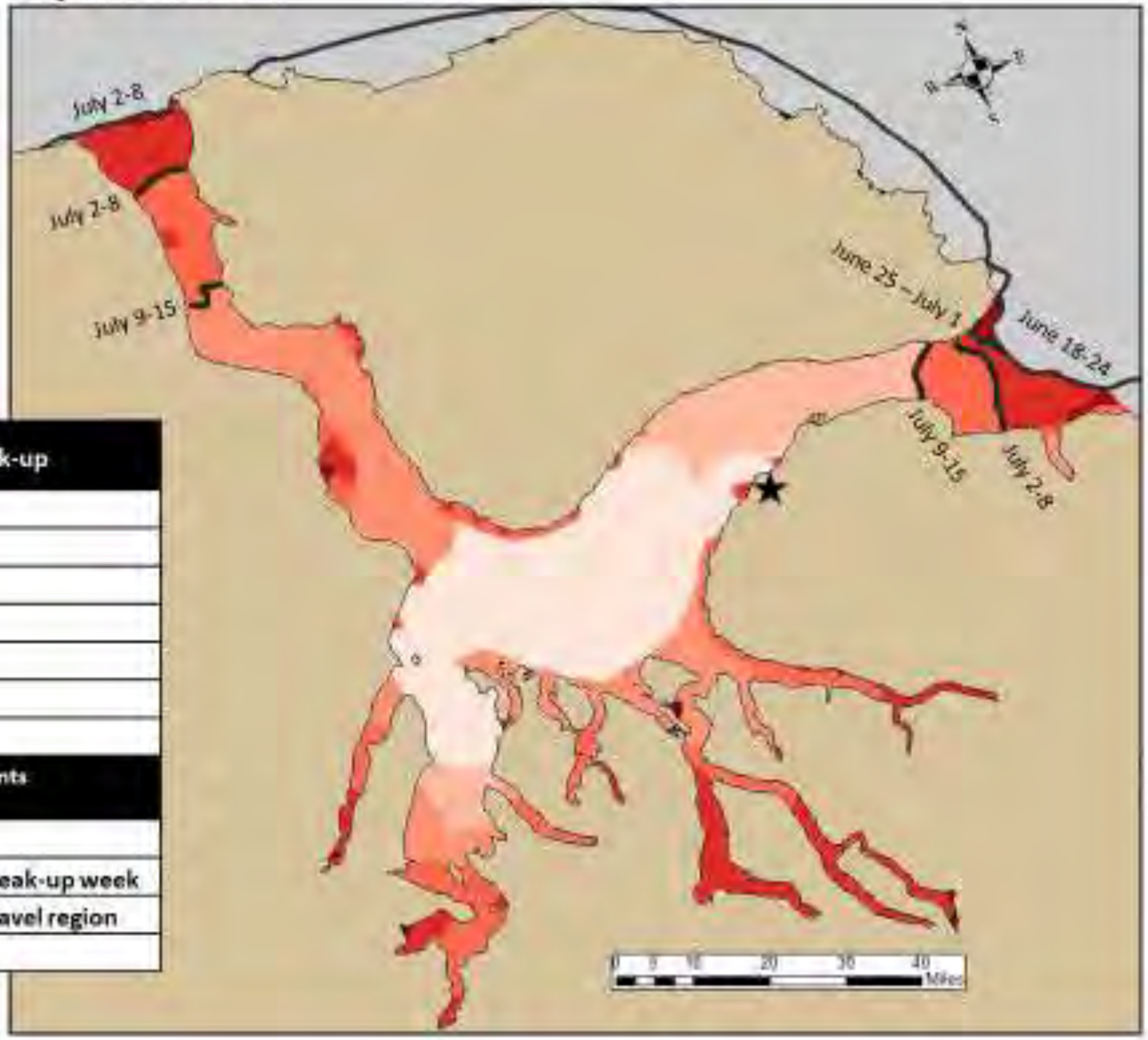
Map colour	Annual break-up
	June 18 – 24
	June 25 – July 1
	July 2 – 8
	July 9 – 15
	July 16 – 22
	July 23 – 29
	July 30 – August 5
Map colour	**Map elements**
★	Mittimatalik
——	Sinaa locations and break-up week
	Outside community travel region
	Land

Break-up map: 2004



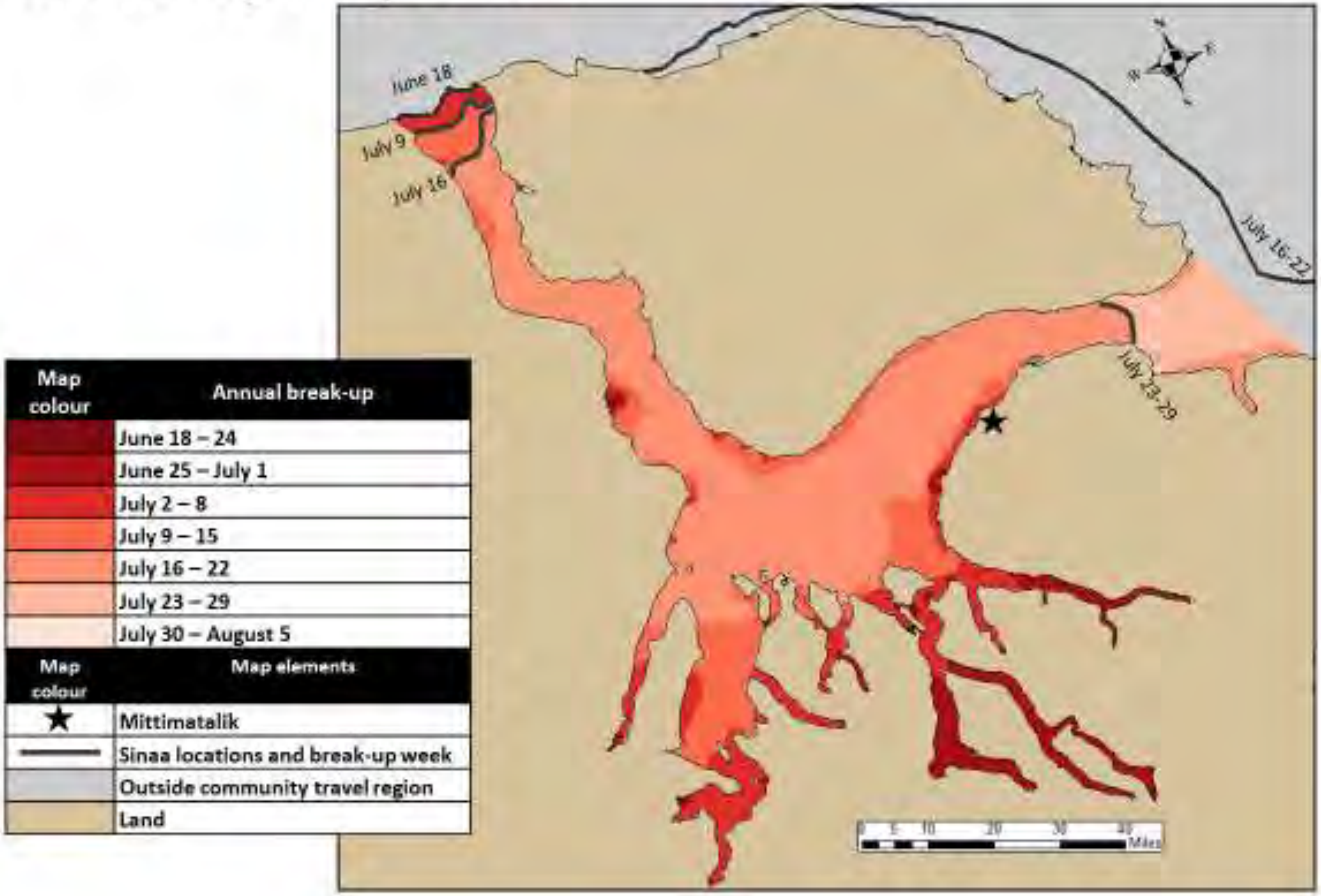
Map colour	Annual break-up
	June 18 – 24
	June 25 – July 1
	July 2 – 8
	July 9 – 15
	July 16 – 22
	July 23 – 29
	July 30 – August 5
Map colour	**Map elements**
★	Mittimatalik
———	Sinaa locations and break-up week
	Outside community travel region
	Land

Break-up map: 2005

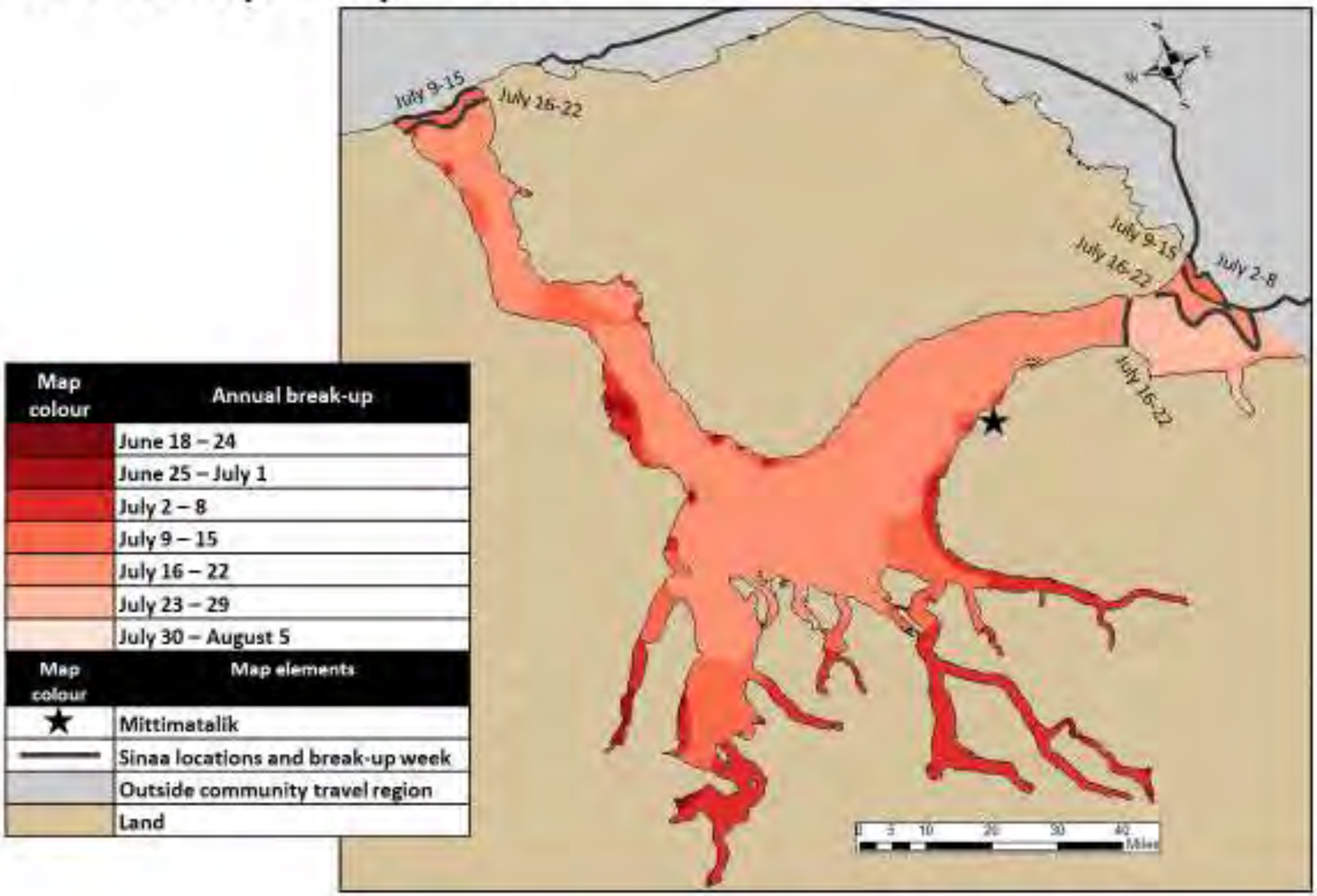


Map colour	Annual break-up
	June 18 – 24
	June 25 – July 1
	July 2 – 8
	July 9 – 15
	July 16 – 22
	July 23 – 29
	July 30 – August 5
Map colour	**Map elements**
★	Mittimatalik
	Sinaa locations and break-up week
	Outside community travel region
	Land

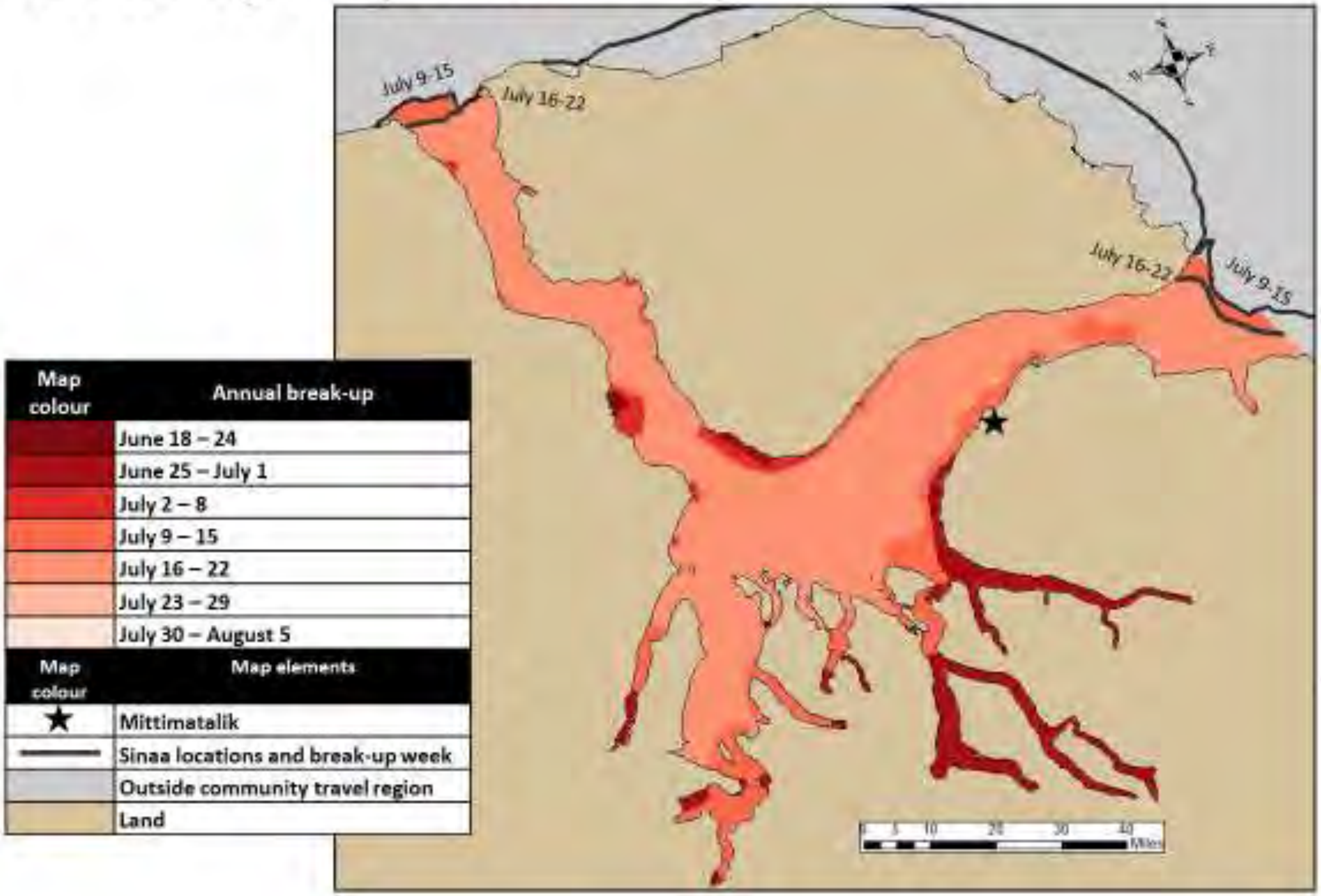
Break-up map: 2006



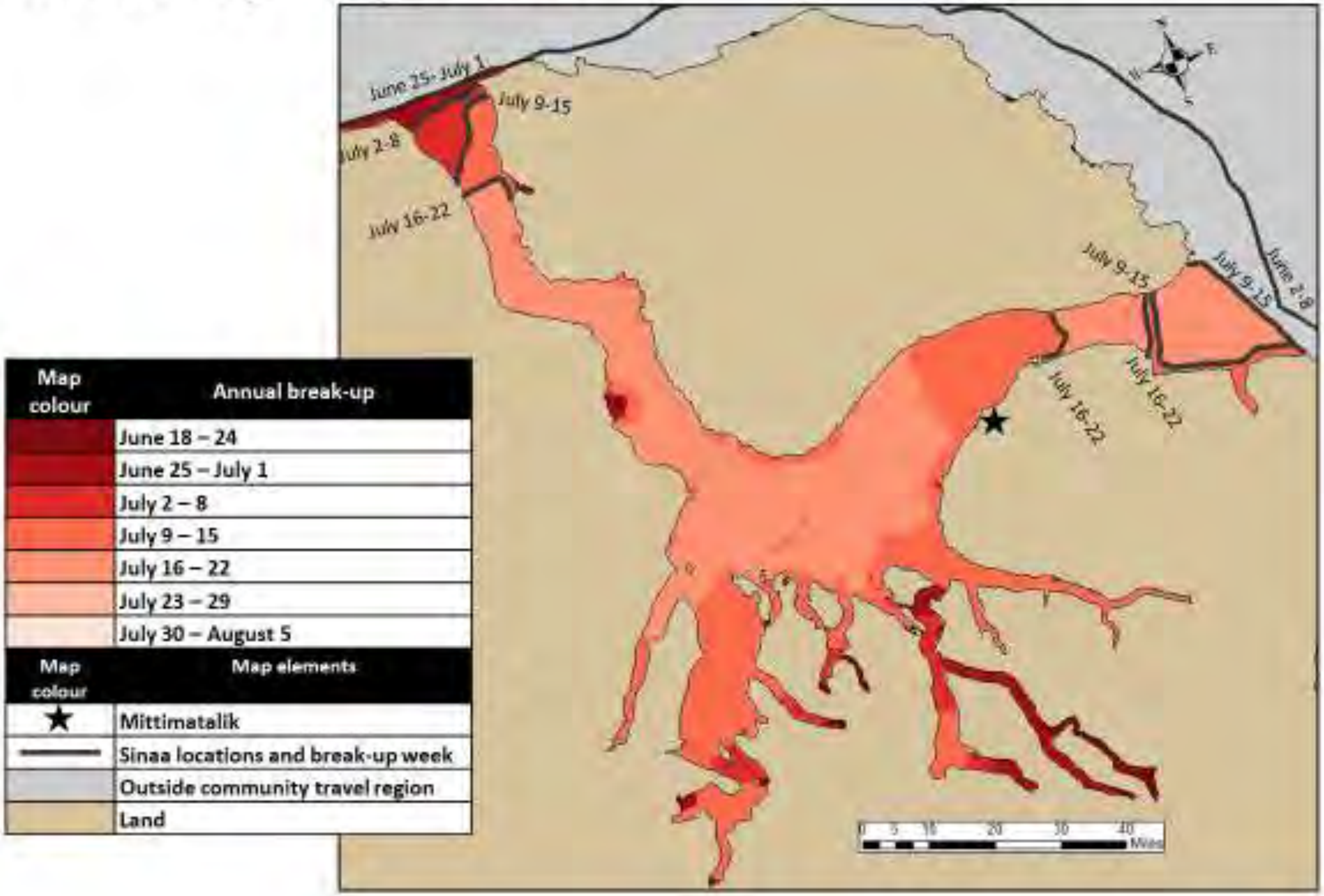
Break-up map: 2007



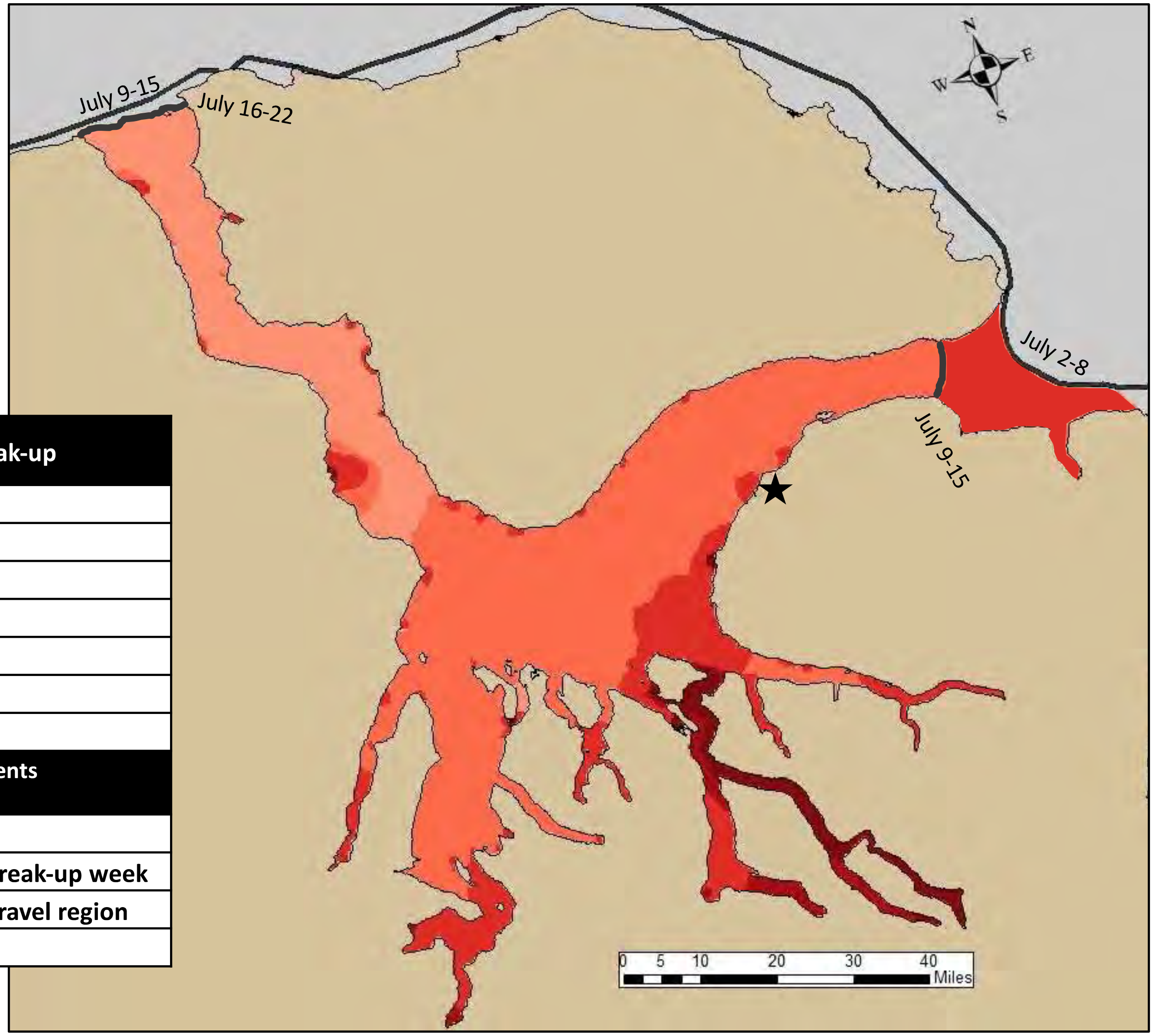
Break-up map: 2008



Break-up map: 2009

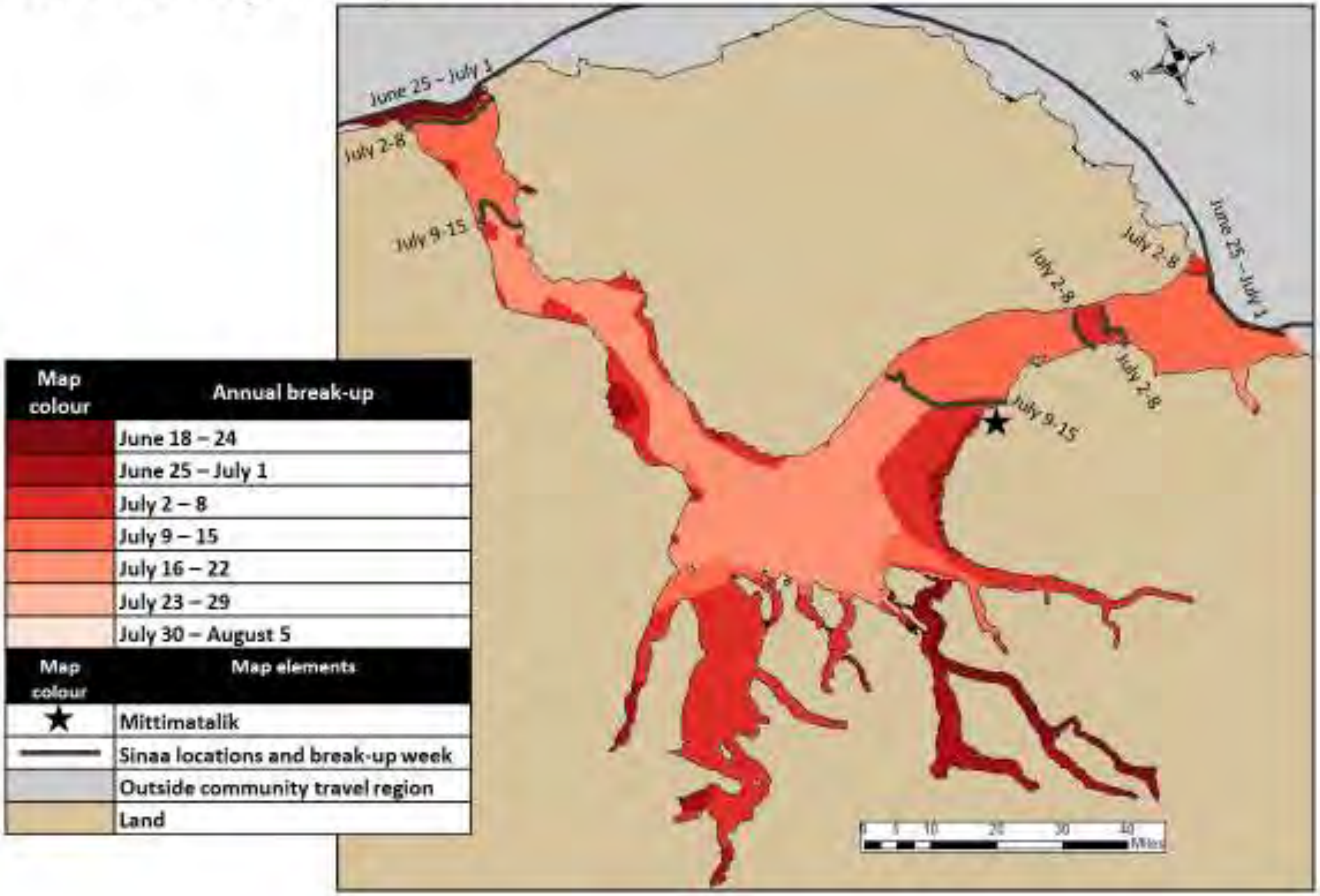


Break-up map: 2010

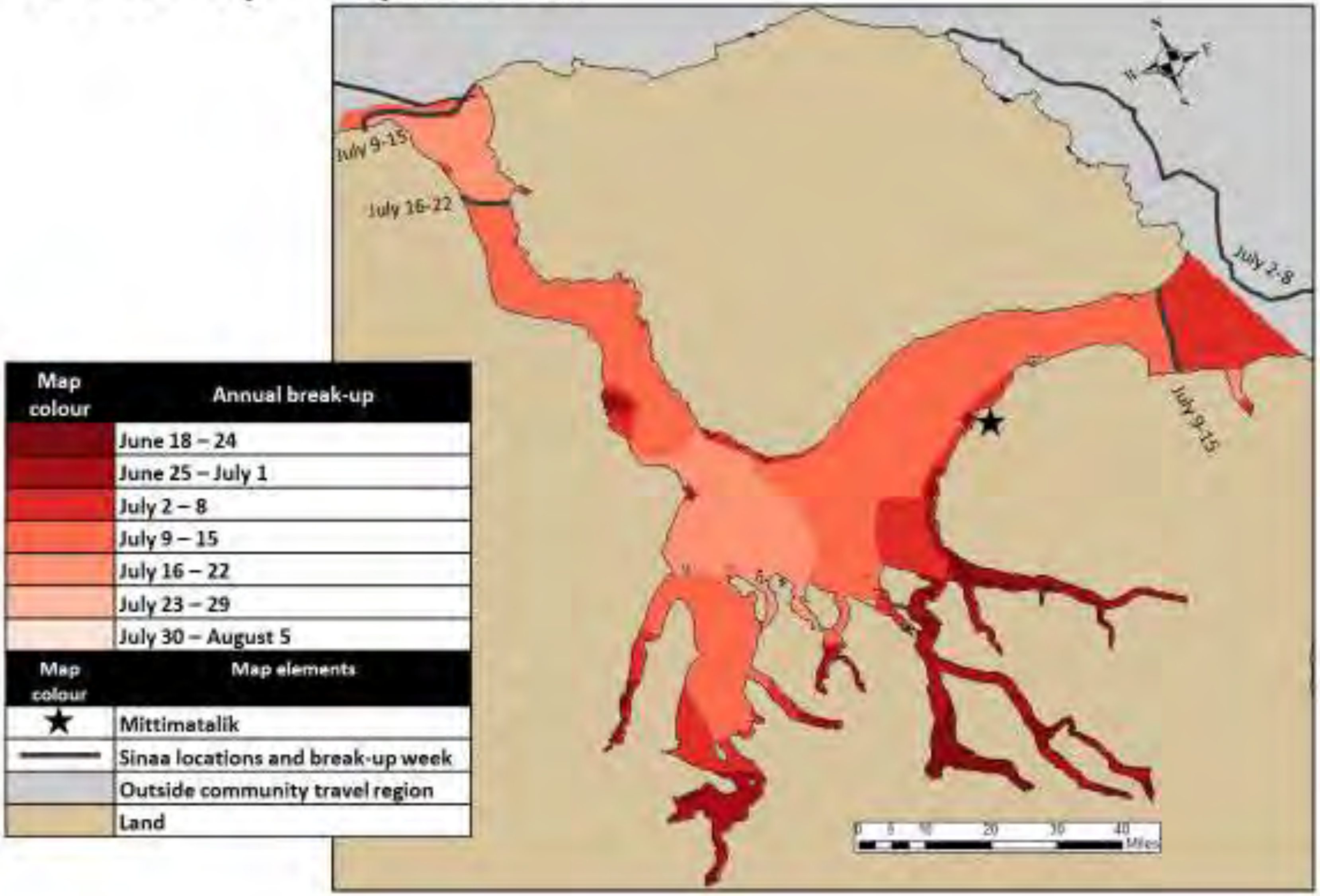


Map colour	Annual break-up
	June 18 – 24
	June 25 – July 1
	July 2 – 8
	July 9 – 15
	July 16 – 22
	July 23 – 29
	July 30 – August 5
Map colour	**Map elements**
★	Mittimatalik
▬	Sinaa locations and break-up week
	Outside community travel region
	Land

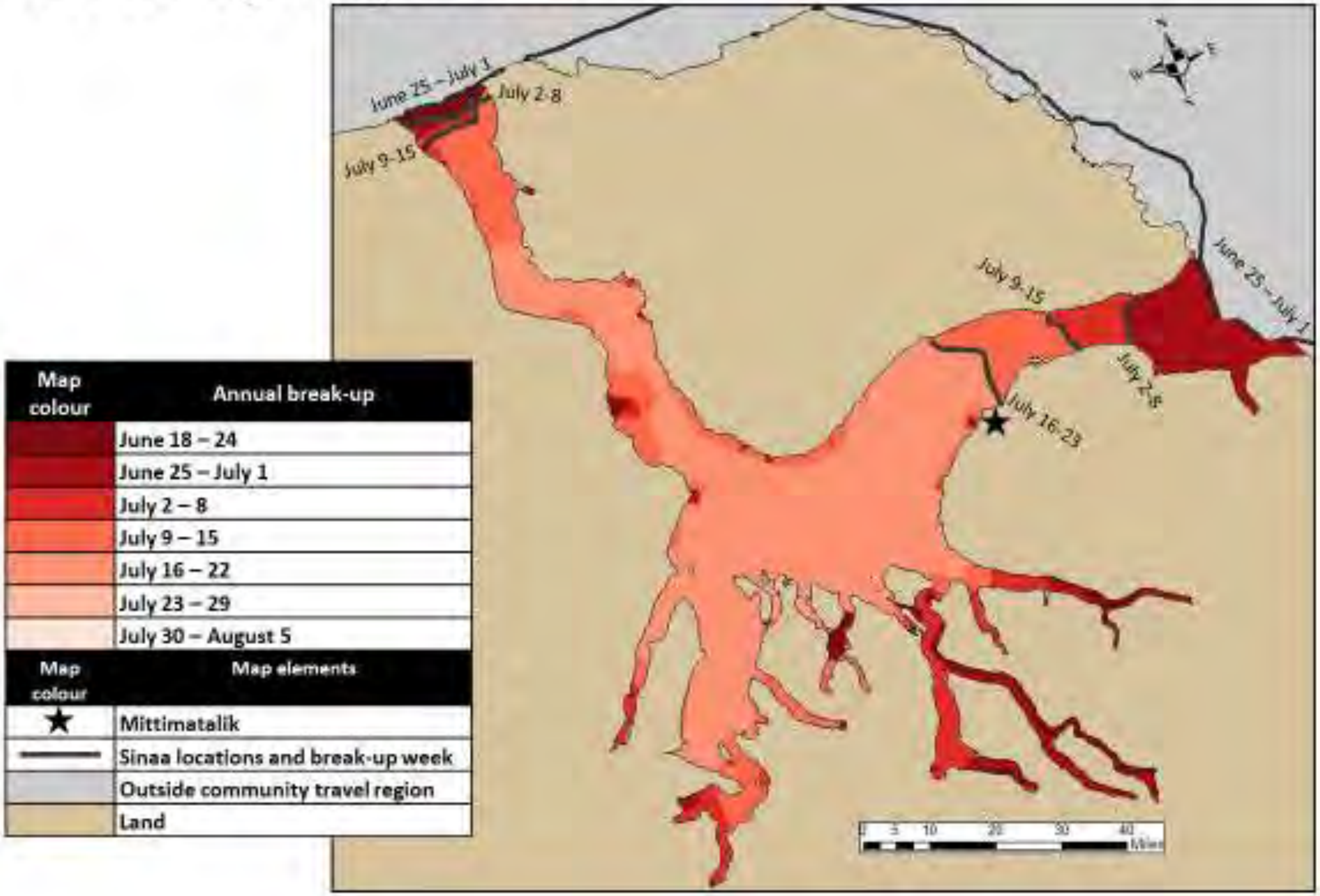
Break-up map: 2011



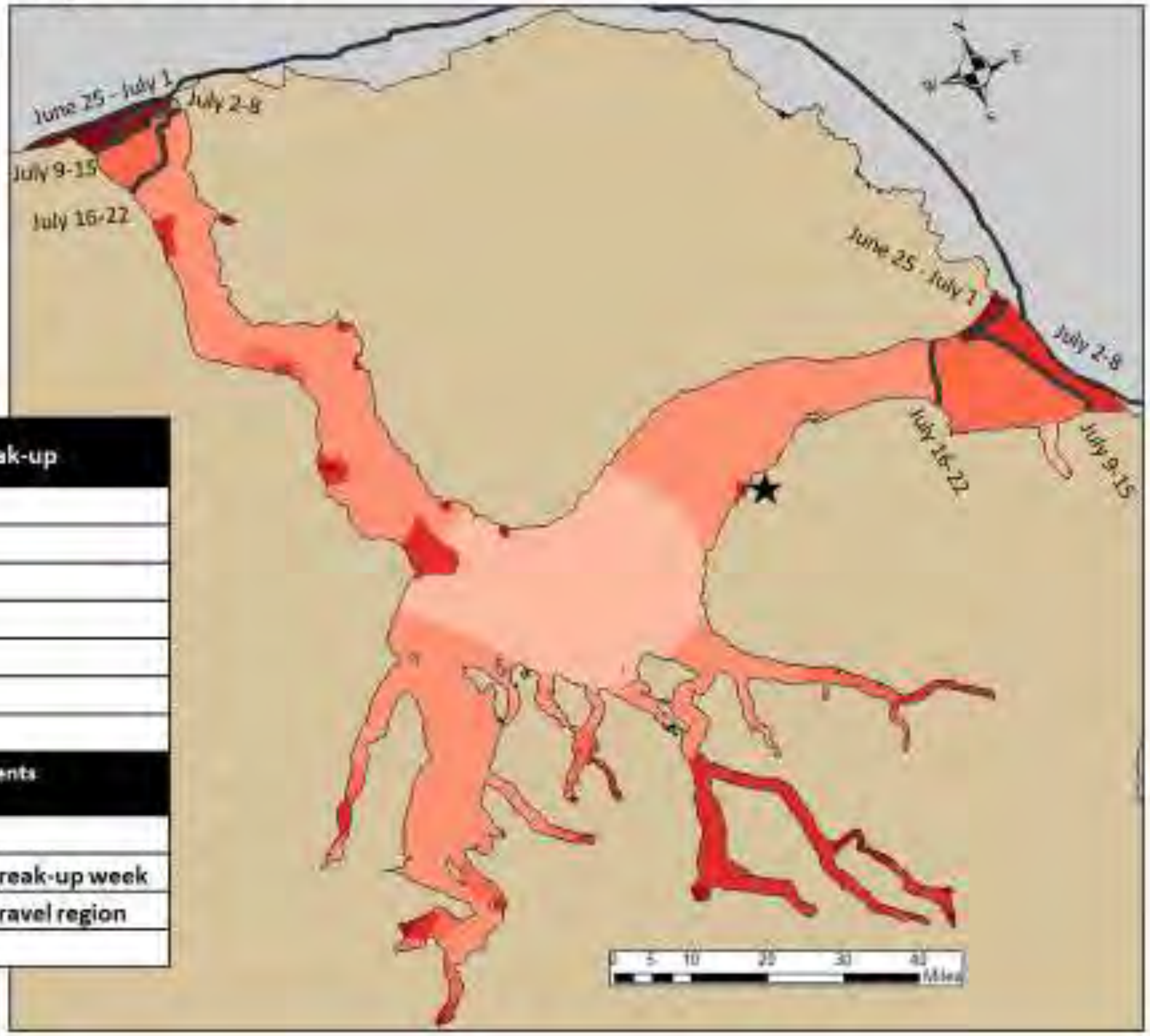
Break-up map: 2012



Break-up map: 2013

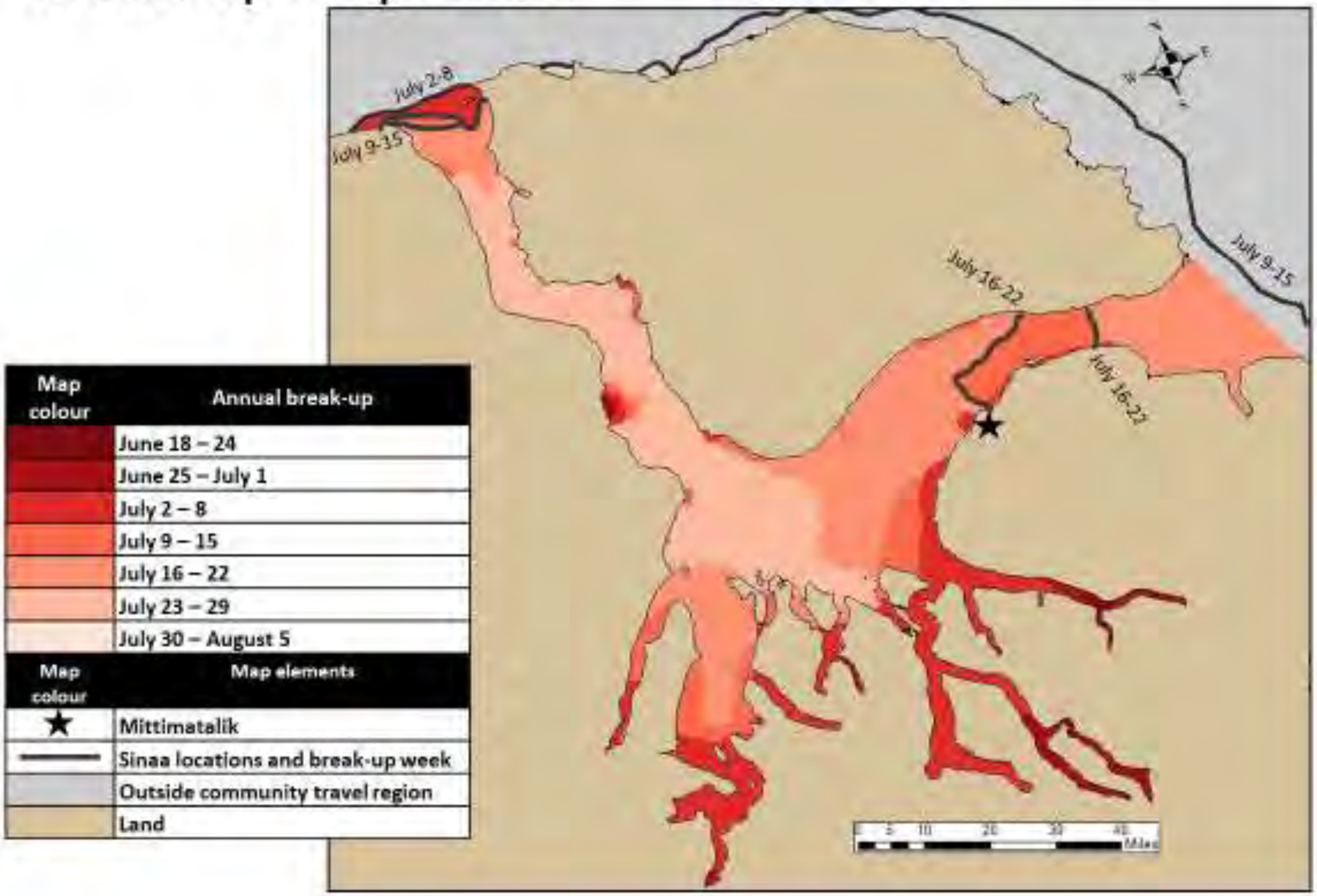


Break-up map: 2014

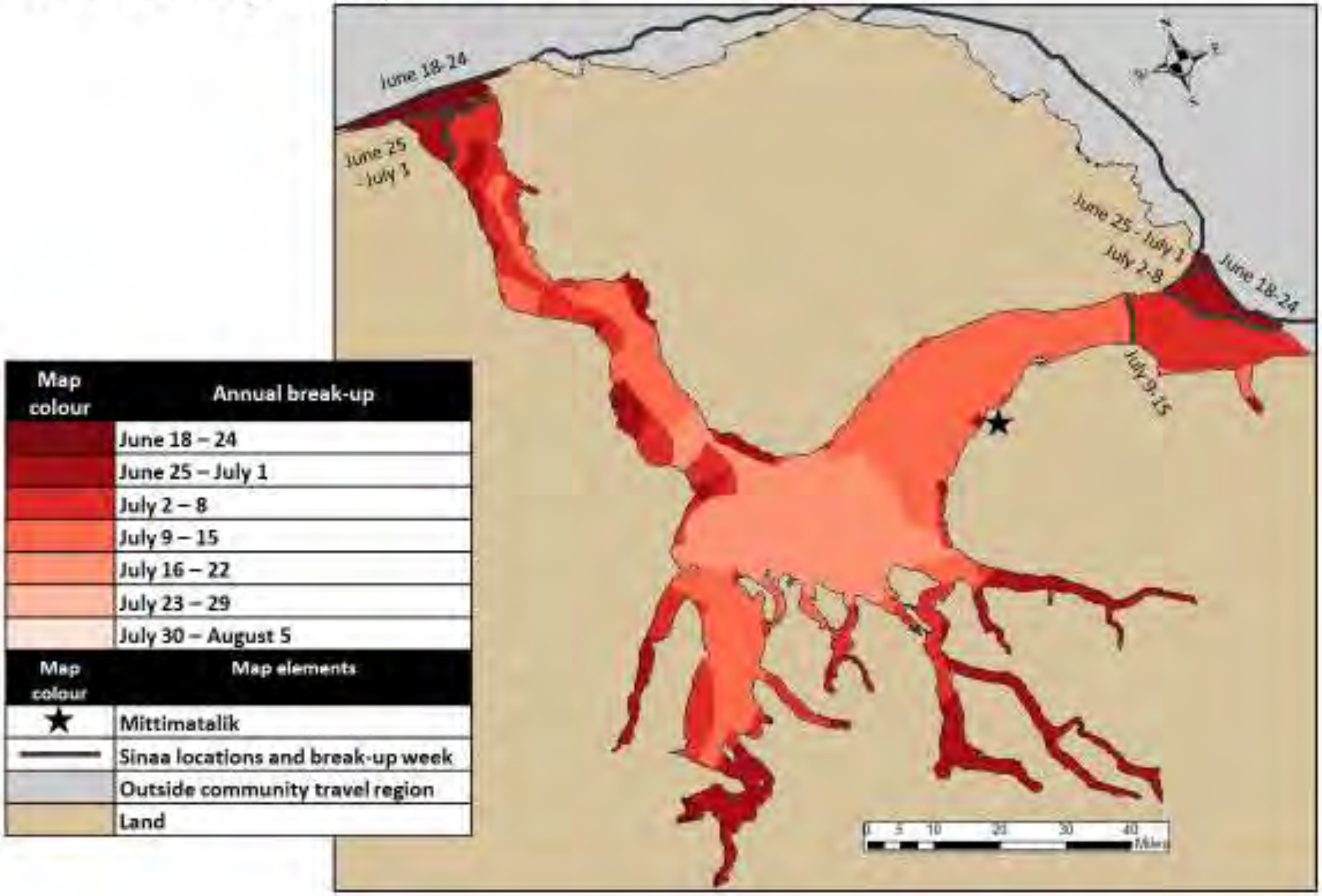


Map colour	Annual break-up
	June 18 – 24
	June 25 – July 1
	July 2 – 8
	July 9 – 15
	July 16 – 22
	July 23 – 29
	July 30 – August 5
Map colour	**Map elements**
★	Mittimatalik
——	Sinaa locations and break-up week
	Outside community travel region
	Land

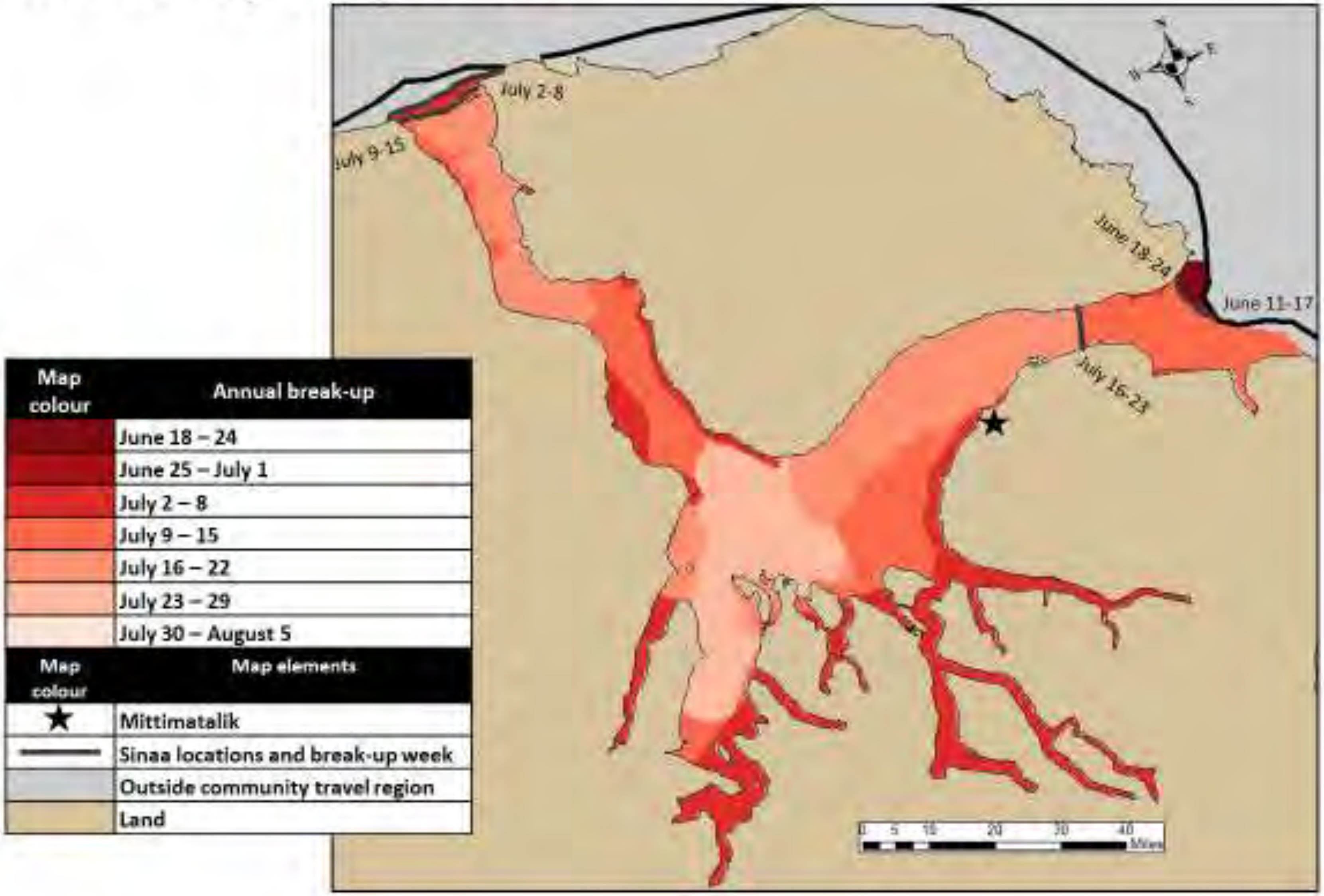
Break-up map: 2015



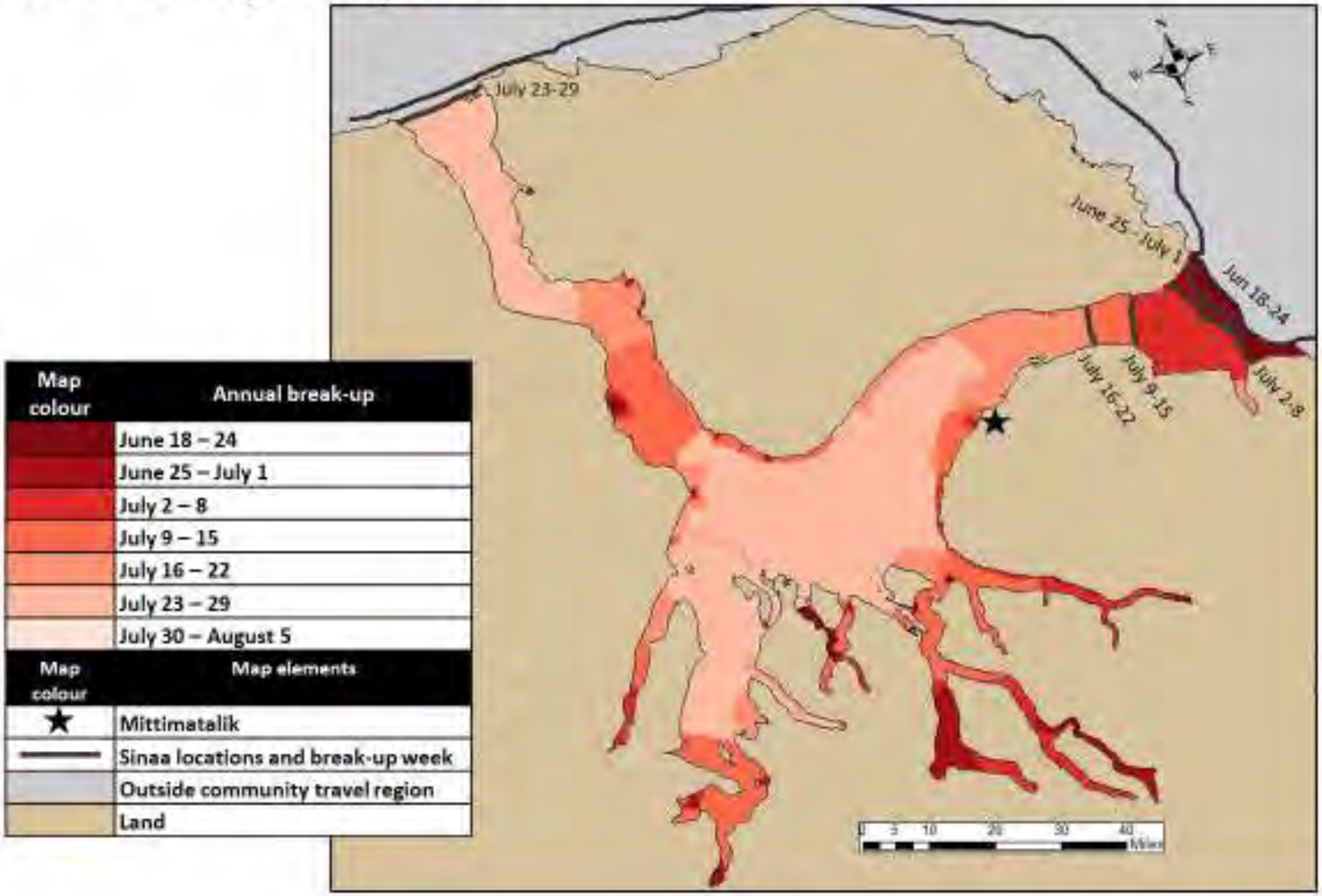
Break-up map: 2016



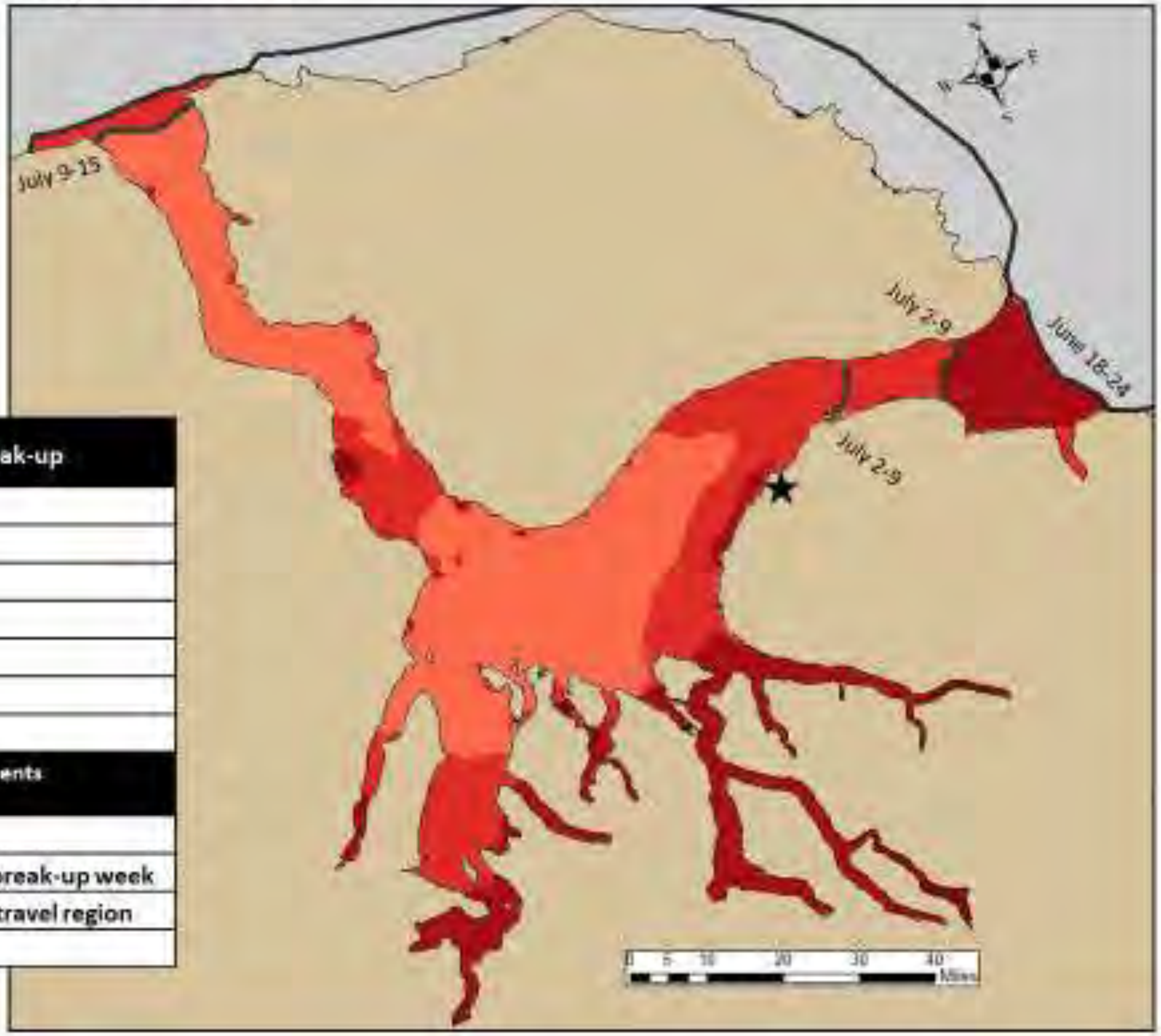
Break-up map: 2017



Break-up map: 2018



Break-up map: 2019



Map colour	Annual break-up
	June 18 – 24
	June 25 – July 1
	July 2 – 8
	July 9 – 15
	July 16 – 22
	July 23 – 29
	July 30 – August 5
Map colour	**Map elements**
	Mittimatalik
	Sinaa locations and break-up week
	Outside community travel region
	Land

Appendix C

Sikumiut-Memorial Research Agreement

ᐊᐅᓚᔾᔨᐊᕐᓂᖅ ᐃᓄᐃᑦ ᖃᐅᔨᒪᔪᖃᖕᒋᑦ ᓯᑯᒥ ᐊᑦᑕᕐᓇᕐᑕᐃᓕᒪᓂᕐᒧᑦ: ᓯᑯᒥᐅᑦ ᖃᐅᔨᓴᕐᓂᖕᒋᑦ ᐃᑲᔪᕐᑐᐃᓐᓗᑎᒃ ᓇᖏᓂᖅ ᐱᓕᕆᓂᕐᒧᑦ ᖃᐅᔨᓴᕐᓂᒃᑯᑦ

(ᐅᑐᐱᕆ2018)

ᖃᐅᔨᓴᕐᑎᓖᑦ:

<u>ᓯᑯᒥᐅᑦ ᐊᐅᓚᑦᑎᓂᕐᒧᑦ ᑲᑎᒪᔩᖏᑦ:</u>

ᓯᑯᒥᐅᑦ (*ᐃᓄᐃᑦᓯᑐᒦᑦᑐᖅ*) ᑲᑎᒪᔩᐅᔪᑦ 12−ᖑᓪᓗᑎᒃ ᐊᐅᓚᑦᑎᓂᕐᒧᑦ ᑲᑎᒪᔩᐅᔪᑦ ᒥᑦᑎᒪᑕᓕᒃᒥ ᐊᐅᓚᑕᐅᓪᓗᓂ ᓯᑐᒥ ᖃᐅᔨᓴᕈᑎ SmartICE ᓄᓇᓕᒃᓂ ᐱᒋᐊᕐᑎᑕᐅᓯᒪᔪᖅ ᓯᑯᒃ ᖃᐅᔨᓴᕈᑕᐅᖃᑦᑕᕐᑐᖅ ᐊᐅᓚᓂᖓ (smartice.org). ᑲᑎᒪᔩᐅᔪᑦ ᐅᑯᐊ:

ᐳᕋᐃᐊᓐ ᑯᓄᒃ	ᒥᕐᖑᐃᓯᕐᕕᓕᕆᔩᒃᑯᑦ ᑲᓇᑕ
ᑲᐃᓚᐱ ᓴᖑᔭ	ᐅᓇᑖᒃᑐᖅᓴᒃᑯᑦ ᓇᕈᑎᑦ
ᑕᐃᓯ ᑯᓄᒃ	ᐆᒪᔪᕐᓂᐊᕐᑎᒃᑯᑦ ᐊᖑᓇᓱᒃᑐᓕᕆᔩᒃᑯᑦ ᑲᑎᒪᔩᖏᑦ
ᑕᐃᕙᑦ ᐊᕐᓇᑦᓯᐊᖅ	ᕿᓂᕐᑎᑦ ᐱᖏᖕᓇᕐᑐᓕᕆᔩᒃᑯᑦ/ᑐᓴᐅᒪᑎᑦᑎᔩᑦ
ᒐᒪᐃᓕ ᕿᓗᕿᓵᖅ	ᐃᓐᓇᕐᑕᕆᔭᐅᔪᖅ
ᔪᐊᔩ ᑯᓄᒃ	ᒐᕙᒪᒃᑯᑦ ᓄᓇᕗᑦ ᐆᒪᔪᓕᕆᓂᕐᒧᑦ
ᔭᐃᑯᓛᓯ ᕿᓕᕐᑎ	ᐃᓐᓇᕐᑕᕆᔭᐅᔪᖅ
ᒥᐊᓕ ᔪᕗᕆᓐᑯ	ᕿᓂᕐᑎᑦ ᐱᖏᖕᓇᕐᑐᓕᕆᔩᒃᑯᑦ/ᑐᑭᒧᐊᒃᑎᑦᑎᔩ
ᒨᓯᓯ ᐊᕐᓇᒍᓕᖅ	ᒪᑯᒃᑐᖅ ᐊᖑᓇᓱᒃᑎ
ᕋᐃᓯ ᓯᒪᐃᓕ	ᐃᑳᕐᕕᒃ
ᓯᐊᑎ ᑕᖖᖅ	ᐊᐅᓪᓚᐅᔾᔩᔩ
ᓴᐃᒪᓐ ᒥᕐᑰᓴᖅ	ᕿᓂᕐᑎᑦ ᐱᖏᖕᓇᕐᑐᓕᕆᔩᒃᑯᑦ/ᓯᕗᓕᕐᑎ

<u>ᐃᑲᔪᕐᑐᐃᔪᑦ ᑕᓯᐅᕐᑎᑦ</u>

ᐋᓐᑐᕈ ᐋᕆᐊᖅ
SmartICE
ᐊᐅᓚᓂᖓᓄᑦ ᓯᕗᓕᕐᑎ ᓄᓇᕗᑦ
ᒥᑦᑎᒪᑕᓕᒃ, ᓄᓇᕗᑦ
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ᓯᓕ ᐃᐅᕗᕋᒻ
ᐃᑳᕐᕕᒃ− ᐊᔪᕈᑎᓂᑦ ᐃᑲᕈᑎᓄᑦ
ᐅᑭᐅᕐᑕᕐᑐᒥ ᒪᑯᒃᑐᓂᒃ ᑐᑭᒧᐊᒃᑎᑦᑎᔩ
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ᐃᓕᓐᓂᐊᕐᓂᕐᒧᑦ
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<u>ᒥᒧᐊᕆᐊᓪ ᐃᓕᓂᐊᕐᕕᒃᔪᐊᖅ ᖃᐅᔨᓴᕐᓂᕐᒧ ᐃᑲᔪᕐᑐᐃᔩᑦ</u>

ᓘᒃᑖᖅ ᑐᕆᕗ ᐱᐅᓪ
ᓄᓇᒥᖕᒑᕐᑐᓕᕆᓂᖅ,
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ᓄᓇᒥᑳᕐᑐᓕᕆᔩᒃᑯᑦ,
ᐃᓕᓐᓂᐊᕐᕕᒃᔪᐊᖅ ᓂᐅᕙᐅᓐᓛᓐᑦ
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ᑕᐃᕙᑦ ᒥᓪᓗᕐ
ᐊᐅᓚᑦᑎᔩᒻᒪᑎᒃ, ᖃᐅᔨᓴᕐᓂᕐᒧᑦ ᑐᓂᔭᐅᖃᑦᑕᕐᑐᓄᑦ ᐊᕈᑕᐅᔪᓄᓪᓗ ᐱᔩᓯᕐᓂᕐᒧᑦ

ᒥᒧᐊᕆᐊᓪ ᐃᓕᓂᐊᕐᕕᒃᔪᐊᖅ ᓂᕙᐅᓐᓛᒥ
ᐳᕈᓄ ᑐᖓᕕᒃ ᖃᐅᔨᓴᕐᓂᕐᒧᑦ ᐊᒻᒪ ᐱᐊᕐᑕᐅᔪᓄᑦ
230 ᐃᓕᓴᐱ ᐊᕐᑯᑎ, ᓴᐃᓐᑦ ᔫᓐᔅ ᓂᐅᕙᐅᓐᓛᑦ
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ᑖᓐᓇ ᐊᖏᖃᑎᒋᒍᑎ ᖃᐅᔨᓴᕐᓂᕐᒧᑦ ᐃᑲᔪᕐᑎᒌᒃᑐᓄᑦ ᖃᐅᔨᓴᕐᑕᐅᔪᒧᑦ ᐅᖃᕐᓯᒪᔼᖅ ᐅᑯᓂᖓ: ᑭᓯᓕᕆᒃᒪᖖᑕ; ᖃᓄᕐ ᐊᐅᓚᑕᐅᓂᐊᕐᒪᖗᑦ, ᑮᓇᐅᔭᖃᕐᑎᑕᐅᓂᖓ, ᖃᐅᔨᓴᕐᑕᐅᔪᑦ ᐊᒻᒪᓗ ᑐᓴᐅᒪᑎᑦᑎᓂᖅ; ᐱᒋᐊᕐᕕᒃᓴᖓ ᐃᓱᓕᕕᒃᓴᖓᓗ ᐅᓪᓗᖏᑦ; ᐱᕐᑯᑎᖃᕐᑎᐅᓂᐊᕐᑐᑦ ᑎᖦᖏᕋᕐᓯᒪᔪᓂᒃ. ᑐᓯᖃᑎᒌᒃᓂᒃᑯᑦ ᖃᐅᔨᓴᕈᑕᐅᔪᒥᒃ ᐊᒻᒪᓗ ᐊᑐᓂ ᐱᓕᕆᐊᒃᓴᖏᓐᓂᒃ. ᐊᖏᕐᑕᐅᓚᐅᕐᑐᖅ ᖃᐅᔨᓴᕐᓂᖅ ᐱᔭᐅᓚᐅᕐᑐᖅ ᐊᒻᒪᓗ ᐅᖃᐅᓯᐅᑲᑖᒃᓯᒪᓪᓗᓂ ᓯᑎᐱᕆ 2017 ᐊᒻᒪᓗ ᒫᔾ 2018 ᓯᑯᒥᐅᑦ ᑲᑎᒪᓂᖏᓐᓂ, ᑎᑎᕋᕐᑕᐅᓪᓗᓂ ᑲᑎᒪᔾᔪᑎᕕᓂᕐᓂ. ᑖᓐᓇ ᐊᖏᖃᑎᒋᒍᑎ ᐅᖃᕐᓯᒪᒋᓪᓗᓂ ᒫᓐᓇ ᐊᒻᒪᓗ ᓯᕗᓂᒃᓴᒥ ᖃᐅᔨᓴᕐᓂᕐᒧᑦ ᐃᑲᔪᕐᑎᕆᑦᑐᑦ ᐱᔪᓐᓇᐅᑎᖏᑦ ᐃᓚᐅᔪᒪᔪᓐᓃᕈᑎᒃ ᖃᐅᔨᓴᕐᓂᕐᒧᑦ ᖃᖓᑐᐃᓐᓇᒃᑯᑦ. ᖃᐅᔨᓴᕐᓂᕐᒧᑦ ᐃᑲᔪᕐᖃᑎᒋᑦ ᐃᓚᐅᔪᒪᔪᓐᓃᕈᑎᒃ ᖃᐅᔨᓴᕐᓂᕐᒧᑦ ᐅᕙᓘᓐᓂᑦ ᓄᖃᕈᒪᓕᕈᑎᒃ ᖃᐅᔨᓴᕐᓂᕐᒧᑦ ᐱᒋᐊᕐᓯᒪᓕᕐᑎᓪᓗᒍ, ᐊᑭᕋᕐᑐᕐᓂᕐᑕᖃᒃᐲᐊᖏᑦᑐᖅ, ᒫᓐᓇ ᓯᕗᓂᒃᓴᒥᓗ.

ᖃᐅᔨᒋᐊᕐᕕᒋᓗᒍ **ᑳᑐᓇᓐ ᕗᐃᓪᓭᓐ** ᐊᐱᕐᑯᑎᒃᓴᖃᕈᕕᑦ ᖃᐅᔨᓴᕐᓂᐅᔪᒧᑦ ᐅᕙᓘᓐᓃᑦ ᑐᑭᓯᒋᐊᒃᑲᓐᓂᕈᒪᒍᕕᑦ ᐊᖏᕈᑎᐅᑦ ᒥᒃᓵᓄᑦ.

ᐱᔾᔪᑎᖓ ᖃᐅᔨᓴᕐᓂᐅᑦ:
ᐱᔾᔪᑎᖃᕐᑐᖅ ᖃᐅᔨᓴᕐᓂᖅ ᐃᑲᔪᕐᑐᐃᓇᓱᒃᓗᑎᒃ ᐃᓄᐃᑦ ᓇᖏᓂᖅ ᐱᔪᓐᓇᕐᓯᕐᑯᓪᓗᕆᑦ ᖃᐅᔨᓴᕐᓂᒃᑯᑦ ᐱᓇᓱᒃᑕᐅᓗᓂ ᒥᑦᑎᒪᑕᓕᒃᒥ (ᒥᑦᑎᒪᑕᓕᒃ), ᓄᓇᕗᑦ. ᑐᕋᖓᐅᔪᑦ ᖃᐅᔨᓴᕐᓂᕐᒧᑦ ᐃᓄᐃᑦ ᖃᐅᔨᓴᕐᓂᒃᑯᑦ ᓯᕗᑲᕐᑕᕐᑯᓪᓗᕆᑦ, ᐋᕿᒃᓯᐃᔪᓐᓇᕐᓗᑎᒃ, ᖃᐅᔨᒪᔭᖏᑦ, ᐱᒋᐊᕐᑕᖏᑦ ᐊᒻᒪᓗ ᐊᔪᕈᓐᓂᕐᐸᓪᓕᐊᓂᖏᑦ. ᓯᑯᒥᐅᑦ ᓇᓗᓇᐃᕐᓯᓯᒪᔪᑦ ᖃᐅᔨᓴᕐᑕᐅᔪᓄᑦ ᓯᑯᒧᑦ ᖃᐅᔨᓴᕈᑎᒧᑦ ᐊᑐᕐᑕᐅᓪᓚᕆᒃᓂᖓᓂᒃ, ᐃᓄᐃᑦ ᖃᐅᔨᒪᔭᑐᖃᖏᑦ ᑎᑎᕋᕐᑕᐅᔭᕆᐊᖃᕐᒥᒃᒪᑕ ᓯᑯ ᑕᕆᐅᕐᒥ ᐊᑦᑕᕐᓇᖏᑦᑐᒃᑯᑦ ᐃᖏᕋᕙᐅᔪᓐᓇᕐᓗᓂ, ᖃᐅᔨᓴᕐᑕᐅᓯᒪᓗᓂᓗ ᓯᓚᐅᑦ ᐊᓯᓪᓕᕐᐸᓪᓕᐊᓂᖓ ᐊᒻᒪᓗ ᐱᔪᓐᓇᕐᕙᓪᓕᐊᓂᕐᒧᑦ, ᖃᐅᔨᒪᔭᐅᔪᓪᓗ ᑐᓴᐅᒪᑎᑕᐅᓗᑎᒃ ᓄᓇᓕᒃᓂ ᓯᕗᓂᒃᓴᒥᓗ ᐃᓅᓂᐊᕐᑐᓄᑦ.

ᓯᑯᒥᐅᑦ ᐃᒪᐃᑦᑐᒪᔪᑦ :

- ᑲᑎᑕᐅᓗᑎᒃ ᐊᑐᕐᑕᐅᓗᑎᒃᓗ ᒥᑦᑎᒪᑕᓕᒃᒥ ᓯᑯᓕᕆᓂᕐᒧᑦ ᐃᓄᐃᑦ ᖃᐅᔨᒪᔭᑐᖃᖏᑦ ᖃᐅᔨᓴᕐᑕᐅᓚᐅᕐᓯᒪᔪᓄᑦ ᑭᖑᓂᑦᑎᓐᓂ. ᓱᕐᓗ, ᑎᑎᕋᕐᑕᐅᓯᒪᔪᑦ ᖃᐅᔨᓴᕐᑕᐅᓯᒪᔪᑦ ᑕᕙᖓᑦ ᐅᑭᐅᒃᑕᕐᑐᒥ ᖃᐅᔨᓴᕐᕕᒃ ᐊᐅᓚᑕᐅᓚᐅᕐᓯᒪᔪᖅ (1973-1989), ᒥᕐᖑᐃᓯᕐᕕᓕᕆᔨᒃᑯᑦ ᑲᓇᑕᒥ ᐃᓄᐃᑦ ᖃᐅᔨᒪᔭᑐᖃᖏᑦ ᖃᐅᔨᓴᕐᑕᐅᓂᖓᓂᑦ (2005), ᓄᓘᔾᔨ ᐅᔭᕋᒃᓯᐅᕐᓂᕐᒧᑦ ᐃᓄᐃᑦ ᖃᐅᔨᔭᑐᖃᖏᑦ ᖃᐅᔨᓴᕐᑕᐅᓂᖏᑦ (2015), ᐊᒻᒪᓗ ᐃᓄᐃᑦ ᓂᐱᖏᑦ ᐅᑭᐅᕐᑕᕐᑐᒥ ᑕᕆᐅᖓᓂ ᐃᖏᕋᔪᓕᕆᓂᕐᒧᑦ ᐊᕐᑯᑕᐅᔪᑦ (2017).
- ᐊᑐᕐᓗᒋᑦ ᑕᒪᕐᒥᒃ ᐱᔭᐅᒃᑲᓐᓂᕐᑐᑦ ᐊᒻᒪᓗ ᓄᑖᖑᔪᑦ ᑎᑎᕋᕐᑕᐅᔪᑦ ᓯᑯᒥ ᐃᓄᐃᑦ ᖃᐅᔨᒪᔭᑐᖃᖏᑦ, ᐱᖃᓯᐅᑎᓗᒋᑦ ᖃᖓᑦᑕᕐᑎᑕᐅᓯᒪᔪᒃᑯᑦ ᐊᔾᔨᓕᐅᕐᑕᐅᓯᒪᔪᑦ, ᐋᕿᒃᓯᓗᑎᒃ ᑎᑎᕋᕐᑕᐅᓗᓂ ᐃᓕᕐᑯᓯᕆᓚᐅᕐᑕᖏᑦ ᐊᓯᑉᐸᓕᕐᐸᓪᓕᐊᔪᓪᓗ ᓯᑯ ᒦᒃᓴᓄᑦ ᒥᑦᑎᒪᑕᓕᑦ ᖃᓂᒌᔭᓂ.

ᐃᑲᔪᕐᑎᒌᒃᓂᒃᑯᑦ ᖃᐅᔨᓴᕐᓂᖅ ᒪᓕᒃᓯᒪᔼᖅ ᓯᑯᒥᐅᑦ ᐱᔪᒪᔭᖏᓐᓂᒃ ᖃᐅᔨᓴᕐᓂᒃᑯᑦ ᐊᑐᓕᕐᑎᑕᐅᓗᑎᒃ ᐃᓄᐃᑦ ᓯᕗᒃᑲᕐᑕᕐᓗᑎᒃ, ᐃᓄᐃᓪᓗ ᒪᒃᑯᒃᑐᑦ ᐱᔪᓐᓇᕐᓯᕙᓪᓕᐊᓗᑎᒃ ᖃᐅᔨᓴᕐᓂᒃᑯᑦ, ᐊᒻᒪᓗ ᕿᒥᕈᔭᐅᓗᑎᒃ ᖃᐅᔨᓴᕐᓂᕐᒥᒃ ᒪᓕᒃᓗᒋᑦ ᐃᓄᐃᑦ ᐃᓕᕐᑯᓯᖏᑎᒎᑦ.

ᖃᐅᔨᓴᕐᓂᕐᒧᑦ ᐸᕐᓇᐅᑎ:
ᓯᑯᒥᐅᑦ ᐊᐅᓚᑦᑎᓂᐊᕐᑐᑦ ᐊᒻᒪᓗ ᕿᒥᕈᕙᒃᓗᑎᒃ ᖃᐅᔨᓴᕐᓂᕐᒥᒃ ᒪᓕᒃᓗᒋᑦ ᐃᓄᐃᑦ ᖃᐅᔨᒪᔭᑐᖃᖏᑦ ᐊᒻᒪᓗ ᖃᐅᔨᒪᔭᖏᓪᓗ ᓯᑰᑦ ᒥᒃᓴᓄᑦ. ᐊᔪᕈᓐᓃᕐᐸᓪᓕᐊᓂᕐᒧᑦ ᖃᐅᔨᓴᕐᓂᒃᑯᑦ ᐱᔪᓐᓇᕐᓯᕙᓪᓕᐊᓗᑎᒃ. ᐊᕋᒍ 3 ᐊᕆᕐᑐᓂ ᐃᓄᐃᑦ ᒪᒃᑯᒃᑐᑦ ᐃᓕᓐᓂᐊᕐᑎᑕᐅᓗᑎᒃ ᐋᕿᒃᓯᐃᓂᕐᒥᒃ ᑲᑎᒪᑎᑦᑎᓂᕐᒥᒃ ᐃᓕᓐᓂᐊᕐᑎᑦᑎᓂᕐᒥᒃᑯ ᓯᑯᒥᐅᓂᒃ ᐃᒪᐃᓕᐅᕐᓗᑎᒃ:

- ᐃᓕᓐᓂᐊᕐᑕᐅᔪᓂ ᓯᑯ ᐃᓄᐃᑦ ᖃᐅᔨᒪᔭᑐᖃᖏᑎᒍᑦ ᑐᑭᓯᐅᒪᔭᐅᓂᐊᕐᒪᑦ ᓯᑯᒥᐅᑦ ᖃᐅᔨᒪᔭᖏᑦ
- ᕿᒥᕗᔪᑎᒃ ᐊᒻᒪᓗ ᑕᑯᓇᒃᔪᑎᒃ ᖃᐅᔮᓵᕈᑕᐅᖃᑦᑕᕐᓯᒪᔪᕚᓃᑦ ᒥᑦᑎᒪᑕᓕᒃᒥ ᓯᑯᓕᕆᓂᕐᒧᑦ ᐃᓄᐃᑦ ᖃᐅᔨᒪᔭᑐᖃᖏᑎᒍᑦ ᖃᓪᓗᓈᓂᖑᕐᑐᓄᑦ ᖃᐅᔮᓴᕐᑎᓄᑦ
- ᑐᑭᓯᓇᕐᓯᑎᑕᐅᔪᑎᒃ ᐊᒻᒪᓗ ᕿᒥᕗᔭᐅᔪᑎᒃ ᖃᖓᑦᑕᕐᑎᑕᐅᓯᒪᔪᒃᑯᑦ ᑎᑎᕋᕐᓯᒪᔪᑦ
- ᐅᖃᐅᓯᕆᔭᐅᔪᑎᒃ ᐃᓄᐃᑦ ᐃᓕᕐᑯᓯᖏᑦ ᖃᐅᔮᓴᕐᓂᕐᒧᑦ ᐊᒻᒪᓗ ᐃᓄᐃᑦ ᐱᕐᑯᓯᖏᑦ ᐃᓄᖃᑎᒌᒃᓂᕐᒧᑦ ᐊᑐᕐᑕᐅᓯᒪᔪᑦ ᖃᐅᔮᓴᕐᓂᕐᒧᑦ ᐊᒃᑐᐊᓂᖃᓕᕐᔪᑎᒃ
- ᐅᖃᐅᓯᕆᔭᐅᔪᑎᒃ ᐊᒻᒪᓗ ᐋᕿᒃᓯᔪᑎᒃ ᐱᐅᓛᖑᔪᒃᑯᑦ ᑐᓴᐅᒪᑎᑦᑎᓂᕐᒥᒃ ᐊᒻᒪᓗ ᐅᖃᐅᓯᐅᖃᑦᑕᕐᔪᑎᒃ ᓯᑯᒥᐅᑦ ᓯᑯᓕᕆᓂᕐᒧᑦ ᐃᓄᐃᑦ ᖃᐅᔨᒪᔭᑐᖃᖏᑦ ᓄᓇᓕᒃᓄᑦ.
- ᕿᒥᕗᔭᐅᔪᑎᒃ ᖃᐅᔮᓵᕈᑕᐅᔪᑦ ᐃᓄᐃᑦ ᐃᓕᕐᑯᓯᖓᒍᑦ

ᐱᔭᒃᓴᓇᔭᖏᑦ ᖃᐅᔮᓴᕐᓂᕐᒧᑦ ᐃᑲᔪᕐᑐᐃᔪᑦ ᖃᐅᔮᓴᕐᑎᓪᓗᒋᑦ:

<u>ᓯᑯᒥᐅᑦ</u>

- ᐊᐅᓚᑦᑎᓵᐅᔪᑎᒃ ᖃᐅᔮᓴᕐᓂᕐᒥᑦ ᖃᐅᔨᒪᔭᕐᒥᓂᒃ ᐊᑐᕐᔪᑎᒃ ᐊᑐᐊᕈᐅᔪᓂᒃᑐ
- ᐋᕿᒃᓯᓂᐊᕐᔪᑎᒃ ᖃᓄᐃᑦᑐᑦ ᖃᐅᔮᓴᕐᑕᐅᔪᕚᓂᑦ ᖃᖓᑦᑕᕐᑎᑕᐅᓯᒪᔪᒃᑯᓪᓗ ᐊᔾᔨᓕᐅᕐᓯᒪᔪᑦ ᐊᑐᕐᑕᐅᓂᐊᕐᒪᖓᑕ.
- ᐃᓄᐃᑦ ᖃᐅᔨᒪᔭᑐᖃᖕᓂᒃ ᑐᓴᐅᒪᑎᑦᑎᔪᑎᒃ ᓯᑯᓕᕆᓂᕐᒧᑦ ᐊᒻᒪᓗ ᐊᕿᒃᓯᔪᑎᒃ ᖃᓄᖅ ᑐᓴᐅᒪᔭᐅᑎᑕᐅᓂᐊᕐᒪᖓᑕ
- ᐅᖃᐅᔾᔭᐅᕆᐊᖃᑦᑕᕐᔪᑎᒃ ᐃᓕᓐᓂᐊᕐᑎᑕᐅᔪᑎᒃ ᒪᒃᑯᒃᑐᑦ ᐃᓄᐃᑦ ᓯᑯᓕᕆᓂᕐᒥᒃ ᐃᓄᐃᑦ ᖃᐅᔨᒪᔭᑐᖃᖏᑎᒍᑦ ᐊᒻᒪᓗ ᐃᓄᐃᑦ ᐃᓕᕐᑯᓯᖓᒍᑦ ᖃᐅᔮᓴᕐᓂᖅ
- ᕿᒥᕗᔭᐅᔪᑎᒃ ᐊᒻᒪᓗ ᐊᖏᕐᑕᐅᔪᑎᒃ ᑐᓴᒃᓴᐅᔪᑦ ᓴᕿᑕᐅᔪᓪᓗ ᐃᓄᒃᓄᑦ
- ᐋᕿᒃᓯᔪᑎᒃ ᓇᒧᖓᖃᑦᑕᕐᓂᐊᕐᒪᖔᑕ ᑐᓴᒃᓴᐅᔪᑦ ᑲᑎᑕᐅᓂᐊᕐᒪᖔᑕ ᑭᓇᓗ ᑕᑯᖃᑦᑕᕗᓐᓇᕐᒪᖕᖏᑦ
- ᐋᕿᒃᓯᔪᑎᒃ ᖃᓄᑎᒋ ᐃᓚᐅᖃᑕᐅᓂᐊᕐᓂᕐᒥᓂᒃ ᕿᒥᕗᔭᐅᑎᓪᓗᒋᑦ ᐊᒻᒪᓗ ᐊᖏᕐᓯᔪᑎᒃ ᐅᓂᒃᑲᓕᐊᓂᒃ ᐊᒻᒪᓗ ᓴᕿᑕᐅᔪᓂᒃ ᑐᓴᒃᓴᓂᒃ, ᐊᒻᒪᓗ ᖃᓄᖅ ᐃᓕᓴᕆᔭᐅᓯᒪᖃᑕᐅᓂᐊᕐᒪᖓᑕ ᑎᑎᕋᖃᑕᐅᓯᒪᓂᖏᓐᓂᒃ ᖃᐅᔮᓴᕐᑎᓪᓗᒋᑦ.

<u>ᖃᐅᔮᓴᕐᓂᕐᒧᑦ ᐅᖃᐅᔾᔮᕆᐊᕐᑎᑦ ᐃᓕᓴᐃᔩᑦ:</u>

ᓯᓕ ᐃᐅᓪᓗᕚᓪ

- ᐊᐅᓚᑦᑎᔪᓂ ᐊᒻᒪᓗ ᐊᖓᔪᖃᕐᖑᕐᖃᑕᐅᔪᓂ ᐃᓄᐃᑦ ᒪᒃᑯᒃᑐᑦ ᒥᑦᑎᒪᑕᓕᒃᒥ ᑕᒪᑐᒥᖓ ᖃᐅᔮᓴᕐᓂᕐᒧᑦ
- ᐅᖃᐅᔾᔪᕐᑐᐃᔪᑎᒃ ᐃᓕᓐᓂᐊᕐᑎᑦᑎᔪᑎᒃ ᐃᓄᖕᓂᒃ ᒪᒃᑯᒃᑐᓂᒃ ᐱᕚᕆᔭᐃᓂᕐᒥᒃ ᐊᒻᒪᓗ ᐃᓚᐅᖃᑕᐅᓂᕐᒥᓂᒃ ᑲᑎᒪᓂᕐᒥ, ᐊᒻᒪᓗ ᐊᑐᓂ ᖃᐅᔮᓴᕐᑕᐅᕙᓪᓕᐊᔪᑦ ᐱᓕᕆᐊᒃᓴᓂᒃ
- ᐃᓚᐅᖃᑦᑕᕐᔪᓂ ᐋᕿᒃᓯᐃᖃᑕᐅᖃᑦᑕᕐᔪᓂ ᑎᑎᕋᖃᑕᐅᔪᓂᓗ ᑭᖑᓪᓕᕐᐸᖓᓂ ᑎᑎᕋᕐᑕᐅᔪᓂ ᐅᓂᒃᑳᓕᐊᓂᒃ ᖃᐅᔮᓴᕐᓂᕐᒧᑦ ᖃᓄᐃᓕᖓᓂᖓᓂᒃ ᐊᒻᒪᓗ ᓴᕿᑕᐅᔪᓂᒃ
- ᐃᑲᔪᕐᔪᓂ ᑐᓴᐅᒪᑎᑦᑎᓂᒃᑯᑦ ᐊᒻᒪᓗ ᓴᕿᑎᑦᑎᔪᓂ ᑭᖑᓪᓕᕐᐸᖓᓂ ᐅᓂᒃᑲᓕᐊᖑᔪᓂᒃ ᓴᕿᑕᐅᔪᓂᒃᑐ ᓯᑯᒥᐅᓄᑦ ᓄᓇᓕᒃᓄᓪᓗ

ᐋᓄᓗ ᐋᓇᐊᖅ

- ᑐᑭᒧᐊᒃᑎᑦᑎᔪᓂ ᐊᒻᒪᓗ ᐃᑲᔪᖃᑕᐅᔪᓂ ᓯᑯᒥᐅᑦ ᑲᑎᒪᓂᖏᓐᓂ ᒪᑯᒃᑐᑦ ᐃᓚᐅᔪᑎᒃ
- ᐊᖓᔪᖄᖑᖃᑕᐅᔪᓂ ᐊᒻᒪᓗ ᐅᖃᐅᔾᔨᕆᐊᕐᑎᐅᔪᓂ ᐃᓕᓐᓂᐊᕐᑎᑦᑎᔪᓂ ᐃᓄᐃᑦ ᒪᑯᒃᑐᓂᒃ ᒥᑦᑎᒪᑕᓕᒃᒥ ᖃᐅᔮᓴᕐᓂᕐᒧᑦ
- ᐃᓚᐅᖃᑕᐅᔪᓂ ᓴᕿᑎᑦᑎᖃᑕᐅᔪᓂ ᐊᒻᒪᓗ ᑎᑎᕋᖃᑕᐅᔪᓂ ᑭᖑᓪᓕᕐᐸᖓᓂ ᐅᓂᒃᑲᓕᐊᖑᔪᓂᒃ ᓴᕿᑕᐅᔪᓂᒃᑐ
- ᐃᑲᔪᕐᔪᓂ ᑐᓴᐅᒪᑎᑦᑎᓂᒃᑯᑦ ᓴᕿᑎᑦᑎᔪᓂ ᑭᖑᓪᓕᕐᐸᖓᓂ ᐅᓂᒃᑲᓕᐊᖑᔪᓂᒃ ᓴᕿᑕᐅᔪᓂᒃᑐ ᓯᑯᒥᐅᓄᑦ ᓄᓇᓕᒃᓄᓪᓗ

ᑳᑐᓇᓐ ᕗᐃᓪᓴᓐ

- ᑮᓇᐅᔭᓂᒃ ᐱᓂᐊᕐᓗᑎᒃ ᐃᑲᔪᕐᑎᖃᕐᓗᓂ ᑐᕋᕗ ᐱᐅᓪᒥᑦ ᒪᒃᑯᒃᑐᑦ ᖃᐅᔨᓴᕐᓂᖏᓐᓄᑦ ᐊᒻᒪᓗ ᒥᑦᑎᒪᑕᓕᒃᒥ ᐅᖃᐅᕝᔨᒋᐊᕐᑎᐅᔪᑦ ᐊᒻᒪᓗ ᑲᑎᒪᓂᕐᒧᑦ, ᐃᓕᓐᓂᐊᕐᓂᕐᒧᑦ ᓂᐅᕈᕝᔪᑎᓄᓪᓗ ᐊᑭᖏᓐᓄᑦ
- ᑲᑎᑕᐅᓗᑎᒃ ᖃᐅᔨᒪᔭᐅᓂᖏᑦ ᓯᑯᓕᕆᓂᕐᒧᑦ ᖃᐅᔨᓴᕐᑕᐅᖃᑦᑕᕐᓯᒪᔪᑦ ᖃᓪᓗᓈᓂᑦ.
- ᐃᓕᓐᓂᐊᕐᑎᑕᐅᓗᑎᒃ ᑐᑭᓯᐅᒪᓂᕐᒥᒃ ᖃᖓᑦᑕᕐᑎᑕᐅᓯᒪᔫᒃᑯᑦ ᐊᕝᔨᖑᐊᑦ, ᓄᓇᖑᐊᓕᕆᓂᓪᓗ ᐊᒻᒪᓗ ᑎᑎᕋᕐᓯᒪᔪᓕᕆᓂᕐᒥᒃ
- ᐋᕿᒃᓱᐃᖃᑎᒌᒃᓂᕐᒥᒃ ᐊᑐᓂ ᖃᐅᔨᓴᕐᑕᐅᓂᐊᕐᑐᓂᒃ ᒪᑯᒃᑐᓄᑦ
- ᐃᖃᓇᐃᔭᖃᑎᒌᓗᒋᑦ ᑎᒥᐅᔪᑦ ᐃᓄᒃᓄᑦ ᓇᓗᓇᐃᕐᓇᓱᒃᓗᑎᒃ ᐊᑯᓂᐅᔪᒧᑦ ᐃᓂᖃᕐᑎᑦᑎᓂᕐᒥᒃ ᑎᑎᕋᕐᓯᒪᔪᓂᒃ ᐊᓯᐅᔭᖏᓪᓗᑎᒃ ᖃᐅᔨᒋᐊᒐᒃᓴᐅᓗᑎᒃᓗ
- ᑐᑭᒧᐊᒃᑎᑦᑎᖃᑕᐅᓗᑎᒃ ᑎᑎᕋᕐᑕᐅᓂᖏᓐᓂᒃ ᖃᐅᔨᒪᖃᑦᑕᐅᑎᓂᕐᒥᒃᓗ ᑭᖑᓪᓕᕐᐸᕐᒥᒃ ᑎᑎᕋᕐᑕᐅᓯᒪᔪᓂᒃ ᐅᓂᒃᑳᓕᐊᓂᒃ ᓴᕿᑕᐅᔪᓂᒃᓗ
- ᑎᑎᕋᕐᑕᐅᓗᑎᒃ ᖃᐅᔨᓴᕐᑕᐅᕙᓪᓕᐊᔪᑦ ᐆᒃᑐᑕᐅᔪᓐᓇᕐᓗᑎᒃ ᐃᓄᐃᑦ ᓇᖕᒥᓂᖅ ᖃᐅᔨᓵᕈᓐᓇᕐᓂᖏᓐᓂᒃ ᐃᓕᓐᓂᐊᕐᕕᒃᔪᐊᒧᑦ ᕐᑯᕙᕆᐊᕈᑎᒋᓇᓱᒃᓗᓂᐅᒃ ᐊᖓᔪᖄᕐᖃᕐᓗᓂ ᔫᒃᑕᖅ ᑐᕋᕗ ᐱᐅᓪ ᐃᓕᓐᓂᐊᕐᕕᒃᔪᐊᒥ ᒥᒧᐊᕆᐅ ᓴᐃᓐᑦᔮᓐᓯᒥ ᐊᒻᒪᓗ ᔫᒃᑕᖅ ᔩᑕ ᔪᐱᓯᒃ ᐃᓕᓐᓂᐊᕐᕕᒃᔪᐊᒥᑦ ᑲᕈᑕᓐ ᐋᑐᕙᒥ.

ᔩᑕ ᔪᐱᓯᒃ

- ᐃᑲᔪᕐᓗᓂ ᖃᐅᔨᓴᕐᓂᕐᒧᑦ ᐅᖃᐅᓯᕐᒋᐊᕐᑎᐅᔪᓂᒃ ᐊᒻᒪᓗ ᒪᑯᒃᑐᓂᒃ ᐋᕿᒃᓱᐃᓗᓂ ᓯᑯᓕᕆᓂᕐᒥᒃ ᐅᖃᐅᓯᕐᑕᖏᓐᓂᒃ ᑲᑎᒪᓂᒃᑯᑦ ᓯᑯᒥᐅᑦ
- ᐊᖓᔪᖄᖑᖃᑕᐅᓗᓂ ᐊᒻᒪᓗ ᐅᖃᐅᔾᔨᒋᐊᕐᑎᐅᖃᑕᐅᓗᓂ ᑳᑐᕆᓐ ᕗᐃᓴᓐᒧᑦ ᐃᓚᒋᓗᓂᐅᒃ ᐃᓕᓐᓂᐊᕐᕕᒃᔪᐊᕐᒥ ᕐᑯᕙᕆᐊᕋᓱᒃᓂᖓᓄᑦ ᖃᐅᔨᓴᕐᑎᓪᓗᒋᑦ
- ᐃᑲᔪᕐᓗᓂ ᖃᐅᔨᒪᑎᑦᑎᓂᕐᒥᒃ ᐊᒻᒪᓗ ᑎᑎᕋᕐᑕᐅᓂᖓᓂᒃ ᐅᓂᒃᑳᓕᐊᓂᒃ ᓴᕿᑕᐅᔪᓂᒃᓗ

ᑐᕋᕗ ᐱᐅᓪ

- ᑮᓇᐅᔭᕐᑖᕐᓗᓂ ᐃᑲᔪᕐᑎᒋᓗᒍ ᑲᑐᕆᓐ ᕗᐃᓪᓴᓐ ᐊᒻᒪᓗ ᐊᐅᓚᑦᑎᓗᓂ ᑮᓇᐅᔭᓂᒃ ᐊᑭᓕᐅᑎᒃᓴᓂᒃ ᒪᒃᑯᒃᑐᓄᑦ ᖃᐅᔨᓴᕐᑎᐅᔪᓄᑦ, ᐅᖃᐅᔾᔨᒋᐊᕐᑎᐅᔪᓄᑦ, ᑲᑎᒪᓂᕐᒧᑦ, ᐃᓕᓐᓂᐊᕐᑎᑦᑎᓂᕐᒧᑦ ᐊᒻᒪᓗ ᓂᐅᕈᓂᕐᒧᑦ
- ᐃᑲᔪᕐᓗᓂ ᐅᖃᐅᔾᔨᒋᐊᕐᓂᕐᒥᒃ ᒪᒃᑯᒃᑐᓂᒃ ᐊᒻᒪᓗ ᐋᕿᒃᓱᐃᓗᓂ ᑲᑎᒪᓂᕐᓂᒃ ᓯᑯᒥᐅᑦ
- ᐊᖓᔪᖄᖑᖃᑕᐅᓗᓂ ᐊᒻᒪᓗ ᐅᖃᐅᔾᔨᒋᐊᕐᑎᐅᓗᓂ ᑲᑐᕆᓐ ᕗᐃᓴᓐᒧᑦ ᐃᓚᒋᓗᓂᐅᒃ ᐃᓕᓐᓂᐊᕐᕕᒃᔪᐊᕐᒥ ᕐᑯᕙᕆᐊᕋᓱᒃᓂᖓᓄᑦ ᖃᐅᔨᓴᕐᑎᓪᓗᒋᑦ
- ᑐᑭᒧᐊᒃᑎᑦᑎᖃᑕᐅᓗᓂ ᖃᐅᔨᒪᑎᑦᑎᓂᕐᒥᒃ ᐊᒻᒪᓗ ᑎᑎᕋᕐᑕᐅᓂᖓᓂᒃ ᐅᓂᒃᑳᓕᐊᓂᒃ ᓴᕿᑕᐅᔪᓂᒃᓗ

ᑮᓇᐅᔭᓕᕆᓂᖅ

ᑮᓇᐅᔭᖃᕐᑎᑕᐅᓂᖓ ᖃᐅᔨᓴᕐᓂᖅ ᓚᕙᒪᑐᖃᒃᑯᓐᓂᖔᕐᓂᐊᕐᑐᖅ ᐊᑦᑕᕐᓇᕐᑕᐃᓕᒪᓂᕐᒧᑦ ᐃᓄᑐᐃᓐᓇᐃᑦ, ᐊᐅᓚᑕᐅᔪᒥ ᕿᓂᕐᓂᖅ ᐱᖕᒋᖕᓇᕐᑐᓕᕆᓂᕐᓗ ᓄᑖᖑᔪᖅ ᐱᒋᐊᕐᑎᑕᐅᓯᒪᔪᖅ ᑮᓇᐅᔭᕐᑖᕐᕕᒃ. ᑖᓐᓇ ᕿᓄᕐᖓᓯᑎ ᐱᒋᐊᕐᑎᑕᐅᓪᓗᓂ ᓚᕙᒪᒃᑯᑦ ᓄᓇᕗᑦ ᑐᐊᕕᕐᓇᕐᑐᕆᓇᓂᕐᒧᑦ ᐊᐅᓚᑦᑎᓂᕐᒧᑦ (ᔨᒥ ᓄᐳ ᓄᑲᕐᖠᖅ ᐊᐅᓚᑦᑎᔨᐅᓪᓗᓂ) ᐊᒻᒪᓗ ᑐᑭᒧᐊᒃᑎᑕᐅᓪᓗᓂ ᓯᑯᓂᒃ ᖃᐅᔨᓴᕈᑎᒧᑦ SmartICE (ᑐᐱᕗ ᐱᐅᓪ) ᐊᒻᒪᓗ ᑲᓇᑕᒥ ᓯᑯᓕᕆᓂᕐᒧᑦ ᐱᔨᓯᕚᐅᔪᒥᑦ (ᑲᑐᕆᓐ ᕗᐃᓪᓴᓐ). ᑮᓇᐅᔭᐃᑦ ᐊᑐᕐᑕᐅᓂᐊᕐᑐᑦ ᐊᕋᒍᓄᑦ ᐱᖓᓱᓄᑦ, ᐱᒋᐊᕐᓗᓂ ᐊᐃᕆᓛᑦ 1 2018 ᑎᑭᓪᓗᒍ ᒫᔨ 31, 2021.

ᐊᑯᓂᐅᑎᒋᓂᖓ: ᐅᑐᐱᕆ 1st, 2018 ᑎᑭᓪᓗᒍ ᒫᔨ 31st, 2021

ᐊᑭᓕᕐᓱᕐᑕᐅᓂᖏᑦ:

- ᓯᑯᒥᐅᑦ ᑲᑎᒪᔨᖏᑦ ᐊᑭᓕᕐᓱᕐᑕᐅᖏᑦᑐᑦ ᑲᑎᒪᐅᓯᐊᖃᑦᑕᕐᓗᑎᒃ $200 ᐅᓪᓗᕐᒧᑦ, ᐅᕙᓘᓐᓃᑦ $100 ᐅᓪᓘᑦ ᐃᓚᖓᓂ ᐅᖃᕐᓯᒪᓂᖓ ᑎᑎᕋᕐᓯᒪᔪᒥ ᒪᓕᒃᑐᒍ ᓯᑯᒥᐅᑦ ᒪᓕᒃᑕᖏᑦ ᐊᑐᐊᕆᐃᓪᓗ.
- ᑮᓇᐅᔭᖃᕐᑎᑕᐅᔪᓐᓇᕐᑐᑦ ᐅᓪᓗᓕᒫᕐᓗᑎᒃ ᐃᖃᓇᐃᔭᕐᑑᒃ ᒪᕚᒃ ᒪᑯᒃᑑᒃ ᖃᐅᔨᓴᕐᑏᒃ ᑕᕿᓄᑦ 6-ᓄᑦ ᐊᕋᒍᑕᒫᑦ (ᐅᑐᐱᕆᒥᑦ ᒫᔾᒧᑦ). ᒪᒃᑯᒃᑐᑦ ᐃᓄᐃᑦ ᖃᐅᔨᓴᕐᑎᐅᔪᑦ ᐊᑭᓕᕐᑕᐅᖃᑦᑕᕐᓗᑎᒃ ᐊᔾᔨᖓᑎᑐᑦ ᐃᓕᓐᓂᐊᕐᕕᒃᔪᐊᕐᒥ ᖃᐅᔨᓴᕐᑎᑦ ᐃᑲᔪᕐᑎᖓᑕ ᐱᖃᑖ ᐊᑭᖓᓂᒃ ᐃᒪᓐᓇᑎᒋ $24.94 ᐃᑲᕋᒧᑦ, ᐃᓚᓗᒍ $13.30 ᐃᑲᕋᒧᑦ ᐅᑭᐅᕐᑕᕐᑐᒦᔾᔪᑎᖓ, ᑲᑎᓪᓗᒋᑦ $38.24 ᐃᑲᕋᒧᑦ.
- ᓯᓕ ᐅᐃᕗᕋᒻ ᐊᑭᓕᕐᑕᐅᖃᑦᑕᕐᓗᓂ ᐅᓪᓗᕐᒧᑦ ᒪᓕᒃᑐᒍ ᐊᑭᓕᕐᑕᐅᖃᑦᑕᕐᓂᖓ ᑐᑭᒧᐊᒃᑎᑦᑎᔨᐅᓂᖓᓄᑦ ᐃᑳᕐᕚᒃ ᐅᑭᐅᕐᑕᕐᑐᒥ.

ᐃᓚᐅᔪᒪᔪᓐᓃᕐᓂᖅ ᖃᐅᔨᓴᕐᓂᕐᒧᑦ:

ᖃᖓᑐᐃᓐᓇᖅ ᐃᓚᐅᔪᒪᔪᓐᓂᕈᓐᓇᕐᑐᑎᑦ ᖃᐅᔨᓴᕐᓂᕐᒧᑦ. ᑎᑎᕋᕐᑕᐅᔪᑦ ᓯᑯᒥᐅᑦ ᑲᑎᒪᑎᓪᓗᒋᑦ ᐊᒻᒪᓗ ᐃᓕᓐᓂᐊᖃᑎᒌᒃᑎᓪᓗᒋᑦ ᑲᑎᑕᐅᓯᒪᓗᑎᒃ ᐊᖏᕈᑕᐅᔫᑯᓪᓗ ᓯᑯᓕᕆᓂᕐᒧᑦ ᖃᐅᔨᒪᔭᐅᔪᓂᒃ ᑲᑎᒪᔨᐅᔪᓂᑦ. ᑕᐃᒪᐃᓐᓂᖓᓄᑦ, ᖃᖓᑐᐃᓐᓇᖅ ᐃᓚᐅᔪᒪᔪᓐᓂᕈᓐᓇᕐᑐᑎᑦ, ᑭᓯᐊᓂ ᐅᖃᐅᓯᕆᓚᐅᕐᑕᑎᑦ ᐲᕐᑕᐅᔾᔨᐊᖏᑦᑐᑦ ᐃᓚᔭᐅᓯᒪᓕᕐᑎᓪᓗᒋᑦ ᐅᖃᐅᓯᐅᔪᓄᑦ ᑲᑎᒪᑎᓪᓗᒋᑦ ᐃᓕᓐᓂᐊᖃᑎᒋᒃᑎᓪᓗᒋᓪᓗ.

ᐃᑲᔫᑕᐅᔪᓐᓇᕐᑐᑦ ᐱᕓᓪᓕᐅᑕᐅᔪᓐᓇᕐᑐᑦ:

ᑕᓐᓇ ᖃᐅᔨᓴᕐᓂᖅ ᑐᕋᖓᖃᕋᓗᐊᕐᑎᓪᓗᒍ ᐊᑦᑕᕐᓇᖏᓐᓂᕐᓴᒃᑯ ᓯᑯᒃᑯᑦ ᐃᖏᕋᖃᑦᑕᕐᓂᕐᒥᒃ ᓄᓇᓕᒃᒥᐅᓄᑦ, ᐃᑲᔫᑕᐅᔪᓇᕐᒥᔪᖅ ᐅᑯᓄᖓ:

<u>ᓄᓇᓕᖓ ᒥᑦᑎᒪᑕᓕᒃ</u>

- ᓯᕗᓂᑦᑎᓐᓂ ᐱᑕᖃᕐᑐᓂᒃ ᐱᕙᓪᓕᐊᑎᑦᑎᓂᖅ: ᐱᕆᐊᕈᑕᐅᔪᓐᓇᕐᓗᓂ ᒥᑦᑎᒪᑕᓕᒃᒥ ᓯᑯ ᖃᓄᐃᓕᖓᖃᑦᑕᕐᓯᒪᓂᖓᓂᒃ ᐊᒻᒪᓗ ᐃᓄᐃᑦ ᓯᑯᖓᓂ ᐃᖏᕋᖃᑦᑕᕐᓯᒪᓂᖏᓐᓂᒃ ᖃᐅᔨᒪᔾᔪᑕᐅᓗᓂ ᐊᕙᑎᖓᓂᒃ ᖃᐅᔨᓴᕐᑐᓄᑦ ᐊᒻᒪᓗ ᑐᑭᓯᓇᓲᒃᑐᓄᑦ ᐃᒃᐱᒃᓇᐅᑎᐅᓚᔭᕐᑐᓂᒃ ᐱᑕᖃᕐᑐᓂᒃ ᐱᕙᓪᓕᐊᑎᑦᑎᓇᓲᒃᑐᓄᑦ ᓯᑯᒥ: ᓲᕐᓗ, ᐃᓱᒫᓗᑕᐅᓂᖓ ᐅᒥᐊᕐᔪᐊᖃᓕᕐᐸᓪᓕᐊᓂᖓ ᓯᑯᖃᖏᓐᓂᕐᓴᐅᕙᓪᓕᐊᑎᓪᓗᒍ ᐅᕙᓘᓐᓂᑦ ᐅᓯᑲᕐᑕᕐᑎᐅᔪᑦ ᓯᑯᓯᐅᖃᑦᑕᕋᔭᕐᓂᖏᑦ ᓯᑯᖃᕐᑎᓪᓗᒍ);
- ᓯᓚᐅᖅ ᐊᓯᓪᓕᕐᐸᓪᓕᐊᓂᖓ: ᑎᑎᕋᕐᑕᐅᓗᑎᒃ ᐊᒻᒪᓗ ᖃᐅᔨᒪᔾᔪᑕᐅᓗᑎᒃ, ᓇᒥ, ᖃᖓ ᐊᒻᒪᓗ ᖃᓄᖅ ᕿᓚᒻᒥᐅᑎᒋᔪᒥᒃ ᓯᑯ ᐊᓯᓪᓕᕐᐸᓪᓕᐊᑎᕆᓂᖓᓂᒃ, ᐊᒻᒪᓗ ᐃᒃᐱᒃᓇᐅᑎᐅᓂᖓᓂᒃ ᓄᓇᓕᒃᒥᐅᓄᑦ. ᐅᓗᕆᐊᓇᕋᔭᕐᑐᓄᓪᓗ ᐋᕿᕆᐊᕈᑕᐅᔪᓐᓇᕐᓗᓂ ᐃᖏᕋᖃᑦᑕᕐᓂᖏᑦ ᓯᑯᒃᑯᑦ.
- ᑭᖑᕚᕆᓄᑦ ᖃᐅᔨᒪᔭᐅᓕᕋᔭᕐᓂᖓ: ᑕᐃᒪᖓᑦ ᐃᓄᐃᑦ ᓄᓇᓕᖃᕐᑎᑕᐅᓚᐅᕐᒪᑕ ᐊᕋᒍᑦ 6ᔾ ᐱᕆᐊᕐᓘᑎᒃ, ᑭᖑᕝᕖᖑᔪᑦ ᐊᐅᓚᖃᑦᑕᖏᓐᓂᖅᐅᓕᕐᒪᑕ ᖃᐅᔨᒪᖏᓐᓂᖅᐅᓕᕐᒪᑕ ᓯᑯᒥᒃ ᐱᔾᔪᑎᒋᓪᓗᒍ ᐃᓕᓐᓂᐊᕝᒧᐊᖃᑦᑕᕐᓂᖅᐅᒃᒪᑕ ᐃᖃᓇᐃᔮᓄᓪᓗ. ᓯᑯᒥᐅᑦ ᐱᑕᖃᐃᓐᓇᕐᑎᑦᑎᓂᖅᐅᕙᔭᕐᒪᑕ ᐃᓄᐃᑦ ᖃᐅᔨᒪᔭᑐᖃᖏᓐᓂᒃ ᒫᓐᓇ ᑭᖑᕙᖑᔪᓄᑦ ᑭᖑᕝᕖᖑᓂᐊᕐᑐᓄᓪᓗ ᓯᕗᓂᑦᑎᓐᓂ, ᐊᑐᕐᑕᐅᔪᓐᓇᕐᓗᑎᒃ, ᑕᑯᔭᐅᕆᐊᕈᓐᓇᕐᓗᑎᒃ ᐃᓕᑦᑯᓯᖏᓐᓄᓪᓗ ᒪᓕᒃᓯᒪᓗᑎᒃ.

<u>ᓄᓇᕗᑦ ᑐᐊᕕᕐᓇᕐᑐᓕᕆᓂᕐᒧᑦ ᐊᐅᓚᑦᑎᓂᕐᒧᑦ ᓄᓇᓕᒃᓂ</u>

- ᐊᕿᒃᓱᐃᓗᑎᒃ ᑐᐊᕕᕐᓇᕐᑐᓕᕆᓂᕐᒥᒃ ᐊᐅᓚᑦᑎᓂᕐᒥᒃ ᑐᓴᐅᒪᔭᐅᔭᕆᐊᓕᒃᓂᒃ (ᓄᓇᓕᓐᓂᙳᕐᑐᓂᒃ) ᑐᓂᔭᐅᑐᐃᓐᓇᕆᓚᐅᕐᓗᑎᒃ ᒐᕙᒪᒃᑯᓐᓂᑦ ᐃᓕᖁᓯᖏᓐᓄᓪᓗ ᐊᒃᑐᐊᓂᖅᐅᓗᑎᒃ ᐊᑐᑎᖃᕐᓂᖅᐅᓗᓂ ᐃᓄᒃᓄᑦ ᓄᓇᓕᖕᒥᐅᑕᓄᑦ.
- ᖃᐅᔨᒪᔭᐅᓂᖅᐅᓕᕐᓗᑎᒃ ᓄᓇᓕᒃᓂ ᓯᑯᖓᓂᒃ ᑐᐊᕕᕐᓇᕐᑐᓕᕆᓂᕐᒧᑦ ᐊᐅᓚᑦᑎᔪᑦ (ᓲᕐᓗ ᓄᓇᕗᑦ ᑐᐊᕕᕐᓇᕐᑐᑎᓕᕆᓂᕐᒧᑦ ᐊᐅᓚᑦᑎᔪᑦ, ᓯᑯᓯᐅᑎᓕᕆᔫᒃᑯᑦ ᐊᒻᒪᓗ ᕿᓂᕐᑎᑦ ᐱᖁᙳᕐᑐᓕᕆᔫᒃᑯᑦ ᑐᖓᕕᖏᑦ (JRCCs).

- ᐱᐅᓯᕆᐊᕐᔪᕆᑦ ᓄᓇᓕᒃᓂ ᐃᑲᔪᕐᑐᐃᖃᑦᑕᕐᑐᑦ ᑐᐊᕕᕐᓇᕐᑐᓕᕆᓂᒃᑯᑦ ᐱᑕᐃᓕᒪᑎᑦᑎᓂᕐᒥᒃᓱ ᐊᒻᒪᓗ ᐅᐸᒍᑎᓂᕐᒥᒃ ᐃᑲᔪᕐᔪᑎᒃ ᓇᙵᓂᖅ ᐱᔾᔭᓇᕐᓯᕙᓪᓕᐊᔪᑎᒃ ᐊᒻᒪᓗ ᐅᔾᔾᕈᓱᓕᕐᓂᖕᓴᐅᔪᑎᒃ ᐱᐅᓯᕆᐊᕆᐊᖅᑲᕐᓂᕐᒥᒃ ᓇᙵᓂᖅ ᕿᒥᕈᔪᑎᒃ ᐊᐅᓚᓂᕐᒥᓂᒃ ᐊᒻᒪᓗ ᐋᕿᒃᓯᔾᔭᓇᕐᔪᑎᒃ.

ᐅᔪᕆᐊᓇᕐᑐᐃᓐᓇᕆᐊᖅᑲᕐᓂᖏᑦ:
ᐅᖅᑲᐅᓯᐅᑎᓪᓗᒍ ᓯᑯᒥ ᓇᖏᐊᕐᓇᕐᑐᑦ, ᐃᖃᐃᔾᔭᑕᐅᑐᐃᓐᓇᕆᐊᖅᑲᕐᑐᑦ ᐊᒃᓱᕈᕐᓇᓚᐅᕐᑐᓂᒃ, ᓄᓘᓇᕐᑐᓂᒃ, ᐱᕕᒃᓇᕐᓂᐅᓚᐅᕐᑐᓂᒃᓱ ᓇᙵᓂᖅ ᐊᑐᓚᐅᕐᑕᒥᓂᒃ, ᐃᓚᒋᔭᖏᑕᓗ ᖃᑕᙳᑎᙱᑕᓗ ᐊᑐᓚᐅᕐᑕᖏᓐᓂᒃ ᓯᑯᒥ. ᐃᓱᒪᒃᑯᑦ ᐃᒃᐱᒍᓱᓗᐊᓕᕈᕕᑦ ᐅᖅᑲᐅᓯᐅᔭᒥᒃ, ᓄᖃᙱᓚᐅᑲᒍᓐᓇᕐᑐᑎᑦ ᖄᙵᑐᐃᓐᓇᖅ, ᐃᑲᔪᕐᑕᐅᔭᒪᔪᑎᓪᓗ ᐅᕙᓘᓐᓃᑦ ᐃᓚᐅᔭᒪᔪᓐᓂᕐᔪᑎᑦ (ᖃᐅᔨᓴᕐᓂᐅᔭᒍᑦ). ᐅᑯᐊ ᐃᑲᔪᕐᑐᐃᔪᓐᓇᕐᑐᑦ ᓄᓇᓕᒃᓂ ᐅᖃᓚᐅᑎᒃᑯᓪᓗ, ᖃᐅᔨᕆᐊᕐᕕᕆᔪᓐᓇᕐᑕᑎᑦ ᐃᑲᔪᕐᑕᐅᔭᒪᒍᕕᑦ.

<u>ᒥᑦᑎᒪᑕᓕᒃᒥ ᐋᓐᓂᐊᕕᒃ</u>
ᒪᑐᐃᙵᐃᓐᓇᕐᑐᖅ ᐃᑲᕋᓄᑦ 24
1-867-899-7500

<u>ᓄᓇᕗᑦ ᑲᒪᑦᑎᐊᕐᑐᑦ ᐃᑲᔪᕐᑕᐅᕕᒃ ᐅᖄᓚᐅᑎᒃᑯᑦ (7ᐅᓐᓄᒃᑯᑦ– 54112–ᒧᑦ ᐅᓐᓄᐊᒃᑯᑦ– ᐅᓪᓗᓄᑦ 7 ᐱᓇᓱᐊᕈᓯᐅᑦ ᐃᓗᐊᓂ)</u>
1-867-979-3333, ᐊᑭᖃᙱᑦᑐᖅ ᐅᖄᓚᐅᑖ 1-800-265-3333
www.nunavuthelpline.ca

ᑲᙶᓇᕐᑎᑕᐅᓂᖓ ᐊᒻᒪᓗ ᖃᐅᔨᒪᔭᐅᙱᓐᓂᖓ:
ᑭᓇᐅᓂᙱᓐᓂᒃ ᑎᑎᕋᕐᑕᐅᖃᑦᑕᔾᔮᐊᙱᑦᑐᑦ ᖃᐅᔨᓴᕐᑎᓪᓗᕆᑦ. ᖃᐅᔨᒪᓂᑎᑦ ᑲᑎᑕᐅᓂᐊᕐᑐᑦ ᐅᖃᐅᓯᐅᔪᓄᑦ ᑲᑎᒪᔾᔮᐅᓪᓗᑎᒃ ᓯᑯᒥᐅᓄᑦ ᑲᑎᒪᑎᓪᓗᕆᑦ ᐃᓕᓐᓂᐊᖃᑎᒃᑎᓪᓗᕆᓪᓗ ᐊᒻᒪᓗ ᓯᑯᓕᕆᓂᕐᒧᑦ ᐃᓄᐃᑦ ᖃᐅᔨᒪᔭᑐᖃᙱᑦ ᐊᑐᕐᑕᐅᓂᐊᕐᑐᑦ ᐱᓕᕆᐊᙳᔪᒧᑦ ᐊᙱᕐᓯᒪᓂᙱᑦ ᑲᑎᒪᔾᔮᐅᔪᑦ ᒪᓕᒃᓗᕆᑦ. ᐃᓚᐅᖃᑕᐅᓃᑦ ᖃᐅᔨᒪᔭᐅᔾᔪᑕᐅᓂᐊᕐᑐᖅ ᐅᕙᓘᓐᓃᑦ ᑲᙶᓇᕐᑎᑕᐅᔾᔮᐊᙱᑦᑐᖅ ᐱᔾᔪᑎᖃᕐᒪᑦ ᐱᓕᕆᐊᙳᔪᖅ ᓯᑯᓕᕆᓂᕐᒥᒃ ᖃᐅᔨᒪᑎᑦᑎᓇᓱᒃᔪᑎᒃ ᒥᑦᑎᒪᑕᓕᒃᒥ, ᐱᓪᒪᕆᐅᒃᒪᓪᓗ ᐃᓕᓴᕆᔭᐅᓯᒪᔪᓂ ᓯᑯᓕᕆᓂᖅ ᐃᓄᐃᑦ ᖃᐅᔨᒪᔭᑐᖃᙱᑦ ᐃᑲᔪᓚᐅᕐᑐᓪᓗ.

ᓂᐱᓕᐅᕐᑕᐅᓂᖅ ᐊᔾᔨᓕᐅᕐᑕᐅᓂᕐᓗ ᐅᖅᑲᐅᓯᐅᔭᓂᒃ:
ᐃᓄᐃᑦ ᒪᒃᑯᒃᑐᑦ ᖃᐅᔨᓴᕐᑎᐅᔪᑦ ᐃᓕᓐᓂᐊᕐᓂᐊᕐᑐᑦ ᑎᑎᕋᕐᓂᕐᒥᒃ ᓯᑯᓕᕆᓂᕐᒥᒃ ᐃᓄᐃᑦ ᖃᐅᔨᒪᔭᑐᖃᙱᓐᓂᒃ ᑲᑎᒪᓂᒃᑯᑦ ᐊᒻᒪᓗ ᐃᓕᓐᓂᐊᕐᑎᑕᐅᓂᒃᑯᑦ. ᐃᓚᖏᑦ ᑲᑎᒪᓂᐅᔪᑦ ᐃᓕᓐᓂᐊᕐᓂᐅᔪᓪᓗ ᓂᐱᓕᐅᕐᑕᐅᖃᑦᑕᕐᓂᐊᕐᑐᑦ ᐃᑲᔫᑕᐅᓂᐊᕐᒪᑦ ᒪᒃᑯᑐᓄᑦ ᖃᐅᔨᓴᕐᑎᓄᑦ ᐅᖅᑲᐅᓯᐅᔭᓂᒃ ᐱᓇᓱᒃᔪᑎᒃ.

ᐊᔾᔨᓕᐅᕐᑕᐅᖃᑦᑕᕐᓂᐊᕐᑐᑦ ᐃᓕᓐᓂᐊᕐᑎᑕᐅᑎᓪᓗᕆᑦ ᑐᓴᐅᒪᔭᐅᔭᑎᒃᓴᓂᒃ ᐊᒻᒪᓗ ᐅᓂᒃᑲᐅᓯᐅᕈᑎᒃᓴᓂᒃ ᐱᔭᑎᖅᑲᕐᔪᑎᒃ. ᓄᓇᙶᐊᒃᑯᑦ ᓇᔪᓇᐃᕐᑕᐅᔪᑦ ᖃᐅᔨᒪᔭᐅᔭᓇᐊᓖᓪ ᓯᑯ ᒥᒃᓴᓄᑦ ᑎᑎᕋᕐᓯᒪᔪᒃᑰᓚᐅᕐᔪᑎᒃ ᖃᕋᓴᐅᔭᒨᐊᕐᑕᐅᕙᓪᓕᐊᔪᑎᒃ. ᑭᙶᓪᓕᕐᐸᙵᓂ ᑎᑎᕋᕐᕖᔅᓴᙵᓂ ᐊᖏᕐᓯᒪᓂᕐᒧᑦ ᐃᓱᒪᕐᓱᕐᑐᑎᑦ ᓂᐱᓕᐅᕐᑕᐅᔪᒪᖏᒃᑯᕕᑦ ᐅᕙᔫᓐᓂᑦ ᐊᔾᔨᓕᐅᕐᑕᐅᔪᒪᖏᒃᑯᕕᑦ.

ᐊᑐᕐᑕᐅᓂᖓ, ᑕᑯᔭᐅᔫᓇᕐᓂᖓ, ᐱᕐᑯᑎᖅᑎᐅᓂᖓ ᐊᒻᒪᓗ ᑐᖅᑯᕐᑐᕐᑕᐅᓯᒪᓂᖏᑦ ᑎᑎᕋᕐᑕᐅᓯᒪᔪᑦ:
ᓯᑯᒥᐅᑦ ᐱᕐᑯᑎᖅᑎᐅᓂᐊᕐᐳᑦ ᑎᑎᕋᕐᑕᐅᔪᓕᒫᓂᒃ ᑐᑭᓯᐅᒪᔾᔪᑎᒃᓴᐃᓪᓗ ᓴᕿᑕᐅᔪᓂᒃ.

ᖃᕋᓴᐅᔭᒃᑰᕐᑐᑦ ᑐᑭᓯᐅᒪᔾᔪᑎᒃᓴᑦ (ᓵᕐᓗ ᓄᓇᙵᐊᑦ, ᐅᓂᒃᑳᓕᐊᙳᔪᑦ, ᑕᑯᒃᓴᐅᑎᑕᐅᔪᓪᓗ) ᐱᔭᐅᔫᓇᕐᓂᐊᕐᑐᑦ ᓯᑯᒥᐅᑦ ᐊᑐᕐᔪᑎᒃ ᓯᑯᓕᕆᓂᕐᒧᑦ ᐊᐅᓚᑕᐅᔪᖅ SmartICE ᑎᑎᕋᕐᓯᒪᔪᒃᑯᕕᐊᓂᑦ ᖃᕋᓴᐅᔭᒃᑯᑦ ᐅᕗᖓ (smartice.looknorthservices.com). ᓯᑯᓕᕆᓂᕐᒧᑦ ᐊᐅᓚᑕᐅᔪᖅ SmartICE ᑎᑎᕋᕐᓯᒪᔪᒃᑯᕕᐊᓂ ᐊᐅᓚᑕᐅᔪᖅ ᐅᑯᓄᖓ LOOKNorth Data Services Coresight ᐋᕿᒃᑕᐅᓯᒪᓪᓗᓂ, ᖃᕋᓴᐅᔭᓕᕆᔾᔪᑎᒃᑯᑦ ᐊᑐᕐᓗᑎᒃ HTTPS ᑐᓴᐅᒪᖃᑦᑕᐅᑎᓂᒃᑯᑦ. ᓯᑯᓕᕆᓂᕐᒧᑦ ᐊᐅᓚᑕᐅᔪᖅ SmartICE ᑎᑎᕋᕐᑕᐅᓯᒪᔪᑦ ᐃᓂᖃᕐᑎᑕᐅᔪᑦ ᑐᖅᑯᕐᑕᐅᓯᒪᔪᑦ ᑕᐃᒪᙵᓕᒫᙶᓂᐊᕐᑐᖅ ᑕᑯᔭᐅᑐᐃᓐᓴᕈᓇᙱᑦᑐᒥ. ᖃᕋᓴᐅᔭᒦᑦᑐᑦ ᑎᑎᕋᕐᓯᒪᔪᑦ ᐊᑎᓕᐅᕐᓯᒪᔪᓂᒃ ᖃᐅᔨᓴᕐᓂᕐᒧᑦ ᐊᙱᕈᑎᑦ

ᓯᑯᒥᐅᑦ, ᐊᖏᕐᓯᒪᓂᕐᒧᑦ ᑎᑎᕋᕐᓯᒪᔪᑦ ᐊᓯᖏᓐᓄᑦ ᓄᓇᓕᒃᓄᑦ ᐃᓚᐅᖃᑕᐅᔪᓄᑦ, ᓂᐱᓕᐅᕐᓯᒪᔪᑦ ᐊᒻᒪᓗ ᐅᕙᓘᓐᓂᑦ ᑕᕆᔭᐅᓯᐊᖑᔪᑦ, ᐊᔾᔨᓕᐅᒐᐃᓪᓗ, ᑎᑎᕋᕝᕕᐅᔪᓪᓗ ᓄᓇᖑᐊᑦ ᐊᒻᒪᓗ ᖃᕋᓴᐅᔭᒃᑯᑦ ᓄᓇᖑᐊᑦ ᐃᓂᖃᕐᑎᑕᐅᓂᐊᕐᑐᑦ ᑐᖅᑯᕐᓯᒪᓗᑎᒃ ᐃᓯᕈᓐᓇᐅᑎᖃᕐᓗᓂ, ᓯᑯᓕᕆᓂᕐᒧᑦ ᐊᐅᓚᑕᐅᔪᖅ SmartICE ᒥᑦᑎᒪᑕᓕᒃᒥ ᖃᕋᓴᐅᔭᒃᑯᑦ, ᑕᑯᐊᕐᑕᐅᔪᓐᓇᕐᓗᓂ ᓯᑯᒥᐅᑦ ᐱᓕᕆᔪᑐᐊᓄᑦ ᐊᒻᒪᓗ ᒍᒥᐅᕆᐅ ᐃᓕᓐᓂᐊᕐᕕᒃᔪᐊᕐᒥ ᖃᐅᔨᓴᕐᑎᐅᔪᓄᑦ. ᑖᒃᑯᐊ ᖃᐅᔨᓴᕐᓂᕐᒧᑦ ᑎᑎᕋᕝᕕᒃᓴᐅᔪᑦ, ᐊᖏᕈᑎᓪᓗ ᑎᑎᕋᕐᓯᒪᔪᓪᓗ ᐱᓯᒪᔭᐅᓂᐊᕐᑐᑦ ᐊᖃᒍᓄᑦ ᑕᓪᓕᒪᓄᑦ, ᐱᔭᕆᐊᖃᕐᑎᑕᐅᓂᖓ ᒪᓕᒃᓗᒍ ᒥᒧᐊᕆᐅ ᐃᓕᓐᓂᐊᕐᕕᒃᔪᐊᕐᒥ ᐊᑐᐊᒐᖏᓐᓂ ᐅᒃᐱᕐᓇᑦᑎᐊᕆᐊᖃᕐᓂᕐᒧᑦ ᐃᓕᓐᓂᐊᕈᑎᓕᕆᓂᒃᑯᑦ ᖃᐅᔨᓴᕐᓂᕐᒧᑦ.

ᐸᐃᕚᓂᒃ ᑎᑎᕋᕐᓯᒪᔪᓂᒃ ᐊᒻᒪᓗ ᖃᕋᓴᐅᔭᒃᑰᕐᑐᓂᒃ ᓂᐱᓕᐅᕐᓯᒪᔪᑦ, ᐊᔾᔨᓕᐅᒐᐃᓪᓗ ᐊᒻᒪᓗ ᑎᑎᕋᕝᕕᐅᓯᒪᔪᑦ ᓄᓇᖑᐊᑦ ᐱᔭᐅᔪᓐᓇᕐᓂᐊᕐᒥᔪᑦ ᒥᑦᑎᒪᑕᓕᒃᒥ ᐅᖃᓕᒪᒐᖃᕐᕕᒃᒥ. ᐊᔾᔨᖏᓐᓂᒃ ᑎᑎᕋᕐᓯᒪᔪᑦ ᓇᒃᓯᐅᔭᐅᓂᐊᕐᒥᔪᑦ ᐃᓄᐃᑦ ᑲᑐᔾᔨᖃᑎᒋᓄᑦ ᓯᑯᒥᐅᑦ ᓂᕈᐊᕐᑕᖏᓐᓄᑦ (ᓖᕐᓗ ᓄᓇᕗᑦ ᖃᐅᔨᓴᕝᕕᒃ, ᕿᑭᕐᑕᓂ ᐃᓄᐃᑦ ᑲᑐᔾᔨᖃᑎᒌᖏᑦ, ᓄᓇᕗᑦ ᑐᙵᕕᒃᑯᑦ, ᐃᓄᐃᑦ ᑕᐱᕇᑦ ᑲᓇᑕᒥ). ᑲᑐᓇ ᕗᐃᓭ ᑲᑎᒪᖃᑎᖃᕐᓂᐊᕐᑐᖅ ᐃᓄᐃᑦ ᑲᑐᔾᔨᖃᑎᒋᖏᓐᓂᒃ ᐅᖃᐅᓯᕆᓗᓂᐅᒃ ᐊᑯᓂᐅᔪᑦ ᐃᓂᖃᕐᑎᑕᐅᓂᖏᓐᓂᒃ ᐊᒻᒪᓗ ᑕᑯᔭᐅᔪᓐᓇᕐᓂᖏᓐᓂᒃ ᐊᒻᒪᓗ ᖃᓄᕐᑑᕋᕈᑎᒃᓴᓂᒃ ᐊᖏᕐᑕᐅᓇᓱᒃᓂᐊᕐᓗᑎᒃ ᓯᑯᒥᐅᑦ ᑲᑎᒪᔨᖏᓐᓄᑦ. ᐋᕿᒃᑕᐅᒍᓂ, ᑖᒪᓂᕐᓇᔫᒃᑯᑦ ᑲᒪᔨᐅᔪᓄᑦ ᑎᑎᕋᕐᓯᒪᔫᒃᑯᕕᓕᕆᔨᓄᑦ ᐃᓚᔭᐅᓂᐊᕐᑐᖅ ᐊᖏᕈᑎᒧᑦ.

ᓯᑯᒥᐅᑦ ᐱᔪᓇᐅᑎᒥ ᐱᓯᒪᓂᐊᕐᑐ ᐊᒪᓗ ᐱᕐᑯᑎᖃᕐᑎᐅᓗᑎ ᖃᐅᔨᒪᔭᐅᔪᓂᒃ/ᑎᑎᕋᕐᑕᐅᔪᓂᒃ ᑲᑎᑕᐅᔪᓂᒃ ᒪᓗ ᑎᑎᕋᐅᔪᓂᒃ ᐱᓕᕆᐊᖑᑎᓪᓗᒍ. ᓯᑯᒥᐅᑦ ᐱᕕᖃᕐᑎᑦᑎᓂᐊᕐᐳ ᑕᑐᓇ ᕗᐃᓭᒥᒃ ᖃᐅᔨᐊᕈᓇᕐᓗᓂ ᒪᑐᐃᕈᓇᕐᓗᓂᐅ ᑎᑎᕋᕐᓯᒪᔪ/ᖃᐅᔨᒪᔭᐅᔪ ᓴᕿᑕᐅᔪᓇᕐᓗᑎᒃ ᖃᐅᔨᔭᐅᔪᑦ, ᐅᓂᒃᑳᓕᐊᖑᓗᑎᒃ ᐊᒻᒪᓗ ᐅᕙᓘᓃᑦ ᐅᖃᐅᓯᓴᓕᐊᖑᓗᑎᒃ ᐃᓕᓐᓂᐊᕐᓂᖓᓄᑦ ᒥᒧᐊᕆᐊᓪ ᐃᓕᓂᐊᕐᖁᔪᐊᕐᒥ.

ᑭᖑᓕᕐᐸᖓᓂ ᓴᕿᑕᐅᔪᑦ ᐱᔭᕇᕐᑕᐅᔪᑦ ᑕᑯᑎᑕᐅᓂᐊᕐᑐᑦ ᐃᑲᔪᕐᑐᐃᔪᓄᑦ ᖄᓇᐅᔭᖃᕐᑎᑦᑎᔪᓄᑦ ᖃᐅᔨᓴᕐᓂᕐᒧᑦ (ᐃᓄᑐᐃᓐᓇᐃᑦ ᐊᑦᑕᕐᓇᕐᑕᐃᓕᒪᓂᕐᒧᑦ ᑲᓇᑕᒥ, ᒐᕙᒪᒃᑯᑦ ᓄᓇᕗᑦ ᑐᐊᕝᕙᕐᑐᓕᕆᓂᑦᒧᑦ ᐊᐅᓚᑦᑎᓂᕐᒧᑦ ᐊᒻᒪᓗ ᓯᑯᓯᐅᑎᓕᕆᔨᒃᑯᑦ, ᕿᓂᕐᑎᑦ ᐱᖏᖓᕐᑐᓕᕆᔨᒃᑯᑦ ᑲᑐᔾᔨᖃᑎᒌᖏᑦ ᐊᒻᒪᓗ ᑲᓇᑕᒥ ᓯᑯᓕᕆᓂᕐᒧᑦ ᐱᔨᓯᕐᑎᑦ).

ᐅᓂᒃᑲᐅᓯᐅᓂᖏᑦ ᐱᔭᕇᕐᑕᐅᔪᑦ ᐅᓂᒃᑳᖏᑦ ᖃᐅᔨᓴᕐᓂᒃᑯᑦ:

ᓯᑯᒥᐅᑦ ᕿᒥᕈᓂᐊᕐᑐᑦ ᐊᒻᒪᓗ ᐊᖏᕐᓯᓗᑎᒃ ᖃᐅᔨᓴᕈᑎᓂᒫᓂᒃ ᓴᕿᑕᐅᓂᐊᕐᑐᓂᒃ ᐃᓄᒃᓄᑦ ᑕᑯᔭᐅᓚᐅᖏᓐᓂᖏᓐᓂ.

ᐱᔭᕇᕐᑕᐅᔪᑦ ᐅᓂᒃᑳᖏᑦ ᑕᑯᑎᑦᑎᓂᐊᕐᑐᑦ ᐃᑲᔪᕐᑎᒋᔭᖏᓐᓄᑦ ᑕᕗᖓ ᓄᓇᕗᑦ ᑐᐊᕝᕙᕐᑐᓕᕆᓂᕐᒧᑦ ᐊᐅᓚᑦᑎᓂᕐᒧᑦ ᐊᒻᒪᓗ ᑲᓇᑕᒥ ᓯᑯᓕᕆᓂᕐᒧᑦ ᐱᓕᓯᕐᑎᑦ ᐃᑲᔪᕈᑕᐅᓂᐊᕐᒪᑕ ᕿᓂᕐᑎᓄᑦ ᐱᖏᖓᕐᑐᓕᕆᔨᓄᑦ ᓄᑕᓄᑦ ᐱᕆᐊᕐᑕᐅᕙᓪᓕᐊᔪᓄᑦ ᖄᓇᐅᔭᖃᕐᑎᑦᑎᔪᓄᑦ ᖃᐅᔨᓴᕐᓂᕐᒥᒃ ᐊᒻᒪᓗ ᐊᕋᒍᑕᒦᑦ ᐅᓂᒃᑲᓕᐊᑦ ᓴᕿᑕᐅᕙᔭᕐᒥᔪᑦ ᐱᔭᕆᐊᖃᕐᓂᖓ ᒪᓕᒃᓗᒍ.

ᐱᔾᔪᑎᖃᕐᑐ ᖃᐅᔨᓴᕐᓂ ᖃᐅᔨᔭᐅᔪᑦ ᓴᕿᑕᓂᐊᕐᓗᑎ ᐅᖃᓖᒪᒐᑦ ᖁᕙᕆᐊᕋᓯᓂᖓᓄ ᐃᓕᓂᐊᕈᑎᖓᓂᒃ ᐅᓂᑳᓂ ᑲᑐᓇ ᕗᐃᓭ. ᐊᔪᕐᓇᖏᒃᑯᓂ, ᓯᑯᒥᐅᑦ ᑲᑎᒪᔨᐅᔪᖅ ᐅᐸᒃᓯᒪᕙᔭᕐᑐᖅ ᓴᕿᑎᕆᐊᓕᕈᓂ ᐅᓂᒃᑳᓕᐊᒥᓂᒃ ᐃᓄᐃᑦ ᐊᒻᒪᓗ ᓯᑯᓕᕆᓂᖅ ᐱᔾᔪᑕᐅᓂᖓ ᖃᐅᔨᒪᔨᐅᓂᖏᓐᓂᒃᓗ ᐃᓚᒋᓗᓂᐅᒃ ᐃᓕᓐᓂᐊᕝᕕᒃᔪᐊᒥ ᐃᓕᓐᓂᐊᕐᑐᓄᑦ ᕿᒥᕈᔨᐅᔪᑦ ᑲᑎᒪᔨᖏᓐᓄᑦ. ᐅᓂᒃᑲᓕᐊᖓ ᑕᑯᔭᐅᔪᓐᓇᕐᓯᓂᐊᕐᑐᖅ ᒥᒧᐊᕆᐅ ᐃᓕᓐᓂᐊᕐᕕᒃᔪᐊᖓᓂ ᑯᐃᓐ ᐃᓕᓴᐱ II ᐅᖃᓕᒫᒐᕐᕕᐊᓂ, ᐊᒻᒪᓗ ᖃᕋᓴᐅᔭᒃᑯᑦ ᑕᑯᔭᐅᔪᓐᓇᕐᓗᓂ ᐅᕙᓂ: http://collections.mun.ca/cdm/search/collection/theses.

ᓴᕿᑦᑎᖃᑕᐅᔪᔪᑦ ᑎᑎᕋᖃᑕᐅᔪᓪᓗ ᑭᒃᓕᓯᓂᐊᕐᓂᒃᑯᑦ ᑲᑎᒪᑎᓪᓗᒋᑦ ᐊᒻᒪᓗ ᐅᖃᓕᒪᒐᓕᐅᕐᑎᐅᔪᑦ ᐅᖃᐅᓯᐅᓂᐊᕐᒥᔪᑦ ᓯᑯᒥᐅᑦ ᐊᒻᒪᓗ ᒪᒃᑯᒃᑐᑦ ᐃᓄᐃᑦ ᐃᓚᐅᓂᖏᓐᓂᒃ ᖃᓄᑎᒋ ᐃᓚᐅᑎᒋᓂᕐᒥᒃ ᐊᒻᒪᓗ ᖃᓄᖅ ᐱᐅᓛᖑᖕᒪᖕᒫᑦ ᑎᑎᕋᖃᑕᐅᓗᓂ ᐊᒻᒪᓗ ᐃᓕᓴᕆᔭᐅᓂᒃᑯᑦ ᖃᐅᔨᓴᕐᓂᕐᒧᑦ.

ᑕᒃᓴᐅᑎᑕᐅᓂᖏᑦ ᐱᔭᕆᕐᑕᐅᔪᑦ ᐅᓂᒃᑳᖏᑦ ᓄᓇᓕᒃᓂ ᒥᑦᑎᒪᑕᓕᒃᒥ:

ᓯᑯᒥᐅᑦ ᕿᒥᕈᓂᐊᕐᑐᑦ ᐊᒻᒪᓗ ᐊᖏᕐᓯᓗᑎᒃ ᐱᔾᔪᕐᑕᐅᔪᓕᒫᓂᒃ ᐃᓄᒃᓄᑦ ᓴᕿᑕᐅᓚᐅᖏᓐᓂᖏᓐᓂ ᐃᓕᖅᑯᓯᖏᓐᓄᓪᓗ ᐊᑐᑎᖃᕐᓂᖏᑦ ᐱᔭᕆᐊᖃᕐᓂᖏᓪᓗ ᑐᓴᐅᒪᑎᑦᑎᓇᓱᒃᓗᓂ ᖃᐅᔨᑎᑦᑎᓇᓱᒃᓗᓂᓗ ᐃᓄᖏᓐᓂᒃ ᐊᑐᕐᑎᐅᐃᔪᓂᒃ ᓄᓇᓕᒃᓂ. ᐃᓱᒪᒋᔭᐅᔪᑦ ᑐᓴᐅᒪᑎᑦᑎᓂᕐᒧᑦ ᐅᑯᐊᖑᔪᑦ: ᓄᓇᖑᐊᖃᕐᑐᓂᒃ ᐅᖃᓕᒫᒐᓕᐅᕐᓗᑎᒃ ᐊᒻᒪᓗ ᐅᕙᓘᓐᓃᑦ ᓴᕿᔮᕐᓂᐊᕐᑐᓂᒃ ᐊᑭᓇᒥ ᓯᑯᓕᕆᓂᐅᑦ ᐅᖃᐅᓯᖏᓐᓂᒃ ᑐᑭᖏᓐᓂᒃ ᐊᒻᒪ ᓗᓄᓇᖑᐊᑦ ᐱᔭᐅᔪᓐᓴᕐᓗᑎᒃ ᐱᖑᐊᕐᕕᒃᒥ, ᐃᓕᓐᓂᐊᕐᕕᒃᒥ, ᐳᓚᕋᑦᑐᓕᕆᕕᒃᒥ ᐊᒻᒪᓗ ᐊᖓᓇᓱᒃᑐᓕᕆᔨᒃᑯᓐᓂ ᑎᑎᕋᕐᕕᖓᓂ; ᐊᒻᒪᓗ ᖃᕋᓴᐅᔭᒃᑯᑦ ᓴᕿᑎᑕᐅᓯᒪᔪᑦ ᓴᕿᔮᕐᓗᑎᒃ ᓂᐅᕕᕐᕕᒃᒥ ᐊᒻᒪᓗ ᓯᑯᓕᕆᓂᕐᒧᑦ ᐊᐅᓚᑕᐅᔪᖅ ᑎᑎᕋᕐᓯᒪᔪᒃᑯᕕᐊᓂ ᐊᒻᒪᓗ ᑎᒍᒥᐊᒐᒃᑯᑦ ᑐᓴᐅᒪᖃᑦᑕᐅᑎ'ᔪᑎᓂ.

ᐃᓕᓐᓂᐊᕐᕕᒃᔪᐊᒥ ᐃᓕᕐᑯᓯᐅᔪᓂᒃ ᕿᒥᕈᓂᖅ

ᑕᓐᓇ ᖃᐅᔮᓴᕐᓂᕐᒧᑦ ᐊᖏᕈᑎ ᕿᒥᕈᔭᐅᓯᒪᔪᖅ ᐃᓄᖃᑎᒋᓕᕆᓂᕐᒧᑦ ᑲᑎᒪᔨᖏᓐᓂᑦ ᐃᓕᕐᑯᓯᐅᔪᓂᒃ ᐃᓄᑐᐃᓐᓇᐃᑦ ᖃᐅᔮᓴᕐᑕᐅᑎᓪᓗᒋᑦ ᐊᒻᒪᓗ ᒪᓕᒃᓯᒪᓂᕋᕐᑕᐅᔪᖅ ᒥᒍᐊᕆᐅ ᐃᓕᓐᓂᐊᕐᕕᒃᔪᐊᒥ ᐃᓕᕐᑯᓯᐅᔪᑦ ᐊᑐᐊᒐᖏᓐᓂᒃ. ᐃᓕᕐᑯᓯᐅᔪᑦ ᒥᒃᓵᓄᑦ ᐃᓱᒫᓗᑎᖃᕈᕕᑦ ᖃᐅᔮᓴᕐᓂᕐᒧᑦ, ᓲᕐᓗ ᖃᓄᐃᑕᐅᓐᓂᕈᕕᓪᓘᓐᓃᑦ ᐱᔪᓇᐅᑎᒋᔭᑎᑦ ᐃᓚᐅᖃᑕᐅᑎᓪᓗᑎᑦ, ᖃᐅᔨᒋᐊᕐᕕᒋᔪᓇᕐᑕᐃᑦ ᐃᒃᓯᕙᐅᑕᖓᑦ ᐅᕗᖓ icehr@mun.ca ᐅᖄᓚᐅᑎᒃᑯᓪᓗᓐᓃᑦ ᐅᕗᖓ 709-864-2861.

ᐊᐅᓚᔾᔨᐊᕐᓂᖅ ᐃᓄᐃᑦ ᖃᐅᔨᒪᔪᑦᖃᕐᒋᑦ ᓯᑯᒥ ᐊᑦᑕᕐᓇᕐᑕᐃᓕᒪᓂᕐᒧᑦ: ᓯᑯᒥᐅᑦ ᖃᐅᔨᓴᕐᓂᖏᑦ ᐊᑐᕐᑕᐅᔪᓐᓴᕐᑐᓂᒃ ᐃᑲᔪᕐᑐᐃᓪᓗᑎᒃ ᐃᓄᐃᑦ ᓇᖏᓂᖅ ᖃᐅᔨᓴᕐᓗᑎᒃ

ᐊᑎᓕᐅᕈᕕᑦ ᑎᑎᕋᕐᕕᒃᓴᒃᑯᑦ ᑕᕝᕙ, ᐱᔪᓐᓇᐅᑎᒋᔭᑎᑦ ᐊᓯᐅᔨᔾᔨᐊᖏᑕᑎᑦ ᐱᕐᑯᔭᑎᒍ ᐊᒻᒪᓗ ᐱᔪᓐᓇᐃᓕᑎᔾᔨᐊᖏᑕᑎ ᖃᐅᔨᓴᕐᑎᐅᔪᑦ ᐱᓕᕆᐊᒃᓯᒥᒃᓂᒃ.

ᐊᑎᓕᐅᕐᑕᐃᑦ ᐊᑖᓂ ᓇᓗᓇᐃᕐᓯᕗᖅ ᐃᒪᓐᓇ:

- ᐅᖃᓕᒫᕐᓯᒪᓂᕐᓂᒃ ᑎᑎᕋᕐᑕᐅᓯᒪᔪᓂᒃ, ᐱᕕᖃᕐᓭᑎᓪᓗ ᐃᓱᒪᒃᓴᕐᓯᐅᕈᑎᒋᓪᓗᒍ, ᐅᖃᐅᓯᕆᓗᒍᒪ ᐊᐱᕐᑯᑎᒋᓗᒍᓗ ᐊᒻᒪᓗ ᐊᐱᕐᑯᑎᑎᑦ ᑭᐅᔾᔭᐅᓪᓗᑎᒃ.
- ᑐᑭᓯᔪᑎᑦ ᖃᐅᔨᓴᕐᓂᖅ ᐱᔾᔪᑎᖓᓂᒃ ᐱᓕᕆᐊᒃᓴᕆᔭᕐᓂᒃᓗ ᐃᑲᔪᕐᑎᐅᓪᓗᑎᒃ ᖃᐅᔨᓴᕐᓂᕐᒧᑦ.
- ᑐᑭᓯᔪᑎᑦ ᐅᓗᕆᐊᓇᕐᑐᔪᓂᒃ ᐊᒻᒪᓗ ᐱᕚᓪᓕᐅᑕᐅᔪᓂᒃ ᐊᒻᒪᓗ ᐃᓚᐅᓂᕆᔭᐃᑦ ᐃᓱᒪᕐᓱᕐᓘᑎᑦ ᐱᔪᒪᓂᕐᓄᑦ. ᐃᓚᐅᔪᓐᓃᕈᓐᓇᕐᑐᑎᑦ ᖃᖓᑐᐃᓐᓇᒃᑯᑦ ᐱᔾᔪᑎᒋᔭᐃᑦ ᐅᖃᐅᓯᕆᖏᒃᑲᓗᐊᕐᓗᒍ, ᐃᓚᐅᔪᓐᓃᕈᕕᓪᓗ ᓱᕋᑐᑕᐅᔾᔨᐊᖏᓚᖅ ᐃᓕᒃᓄᑦ ᒫᓐᓇ ᓯᕗᓂᒃᓴᒥᓗ.
- ᑐᑭᓯᕗᑎᑦ ᑎᑎᕋᕐᑕᐅᔪᑦ ᑲᑎᑕᐅᔪᑦ ᓯᑯᒥᐅᑦ ᑲᑎᒪᑎᓪᓗᒋᑦ ᐃᓕᓐᓂᐊᖃᑎᒋᒃᑎᓪᓗᒋᓪᓗ ᐂᔭᕐᑕᐅᔪᓐᓇᖏᑦᑐᑦ ᐅᖃᐅᓯᐅᓯᒪᓕᕐᑎᓪᓗᒋᑦ, ᐊᖏᕐᑕᐅᓂᖏᑦ ᒪᓕᒃᓗᒋᑦ, ᑲᑎᑕᐅᓯᒪᒃᒪᑕ ᐃᓄᐃᑦ ᖃᐅᔨᒪᔪᑦᖃᕐᒋᑦ ᐱᓯᒪᔭᐅᓂᐊᕐᓗᑎᒃᓗ ᓯᑯᒥᐅᓄᑦ.
- ᐱᔾᔪᑎᒋᓗᒍ ᖃᐅᔨᓴᕐᓂᖅ ᐊᖏᕐᑐᑎᑦ ᓂᐱᓕᐅᕐᑕᐅᔭᒪᓪᓗᑎᑦ, ᐊᔾᔨᓕᐅᕐᑕᐅᓗᑎᑦ ᐊᒻᒪᓗ ᐊᑎᕋ ᓴᕿᔮᖃᑦᑕᕐᑯᔭᕋ ᑎᑎᕋᕐᑕᐅᔪᓂ ᓴᕿᑕᐅᔪᓂ ᖃᐅᔨᓴᕐᓂᕐᒧᑦ.

ᑐᙵᓱᒃᑐᑎᑦ ᐊᐱᕆᔪᒧᑦ ᓯᕗᓂᐊᓂ, ᐱᓕᕐᑎᓪᓗᒍ ᐊᓂᒍᕐᑎᓪᓗᒍ ᖃᐅᔨᓴᕐᓂᐅᔪᖅ. ᑐᑭᓯᒃᑲᓂᕈᒪᒍᕕᑦ, ᖃᐅᔨᒋᐊᕐᕕᒋᓗᒍ ᑲᑐᕆᓐ ᕗᐅᐃᓪᓴᓐ ᐊᖏᔪᖃᖓᓘᓐᓂᑦ ᑎᑎᕋᕐᓯᒪᔪᒥ ᒪᒃᐱᒐᖓᓂ 1.

ᐊᔾᔨᖓᓂᒃ ᐊᖏᕈᑎᒥᒃ ᐱᑎᑕᐅᓂᐊᕐᑐᑎᑦ ᐊᑎᓕᐅᕐᓯᒪᔪᐃᓐᓇᐅᓕᕐᐸᑕ.

Mobilizing Inuit Qaujimajatuqangit for Sea Ice Safety: A Sikumiut case study to support Inuit Self-Determination in Research

(October 2018)

Research Partners:

Sikumiut Management Committee:

Sikumiut (*people of the sea ice*) is the 12-person management committee in Mittimatalik that governs the SmartICE community-based sea ice monitoring program (smartice.org).

Members are:

Brian Koonoo	Parks Canada
Caleb Sangoya	Rangers
Daisy Koonoo	Hunters and Trappers Organization
David Angnatsiak	Search and Rescue/Communications
Gamalie Kilukishak	Elder
George Koonoo	Government of Nunavut Wildlife
Jaykolassie Killiktee	Elder
Mary Jeworenko	Search and Rescue/Coordinator
Moses Arnagolik	Young hunter
Rachel Smale	Ikaarvik
Sheati Tagak	Outfitter
Simon Merkosak	Search and Rescue/Captain

Research Mentors

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Memorial University Contract Administration
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Bruneau Centre for Research and Innovation
230 Elizabeth Ave., St. John's, NL A1C 3S7
Phone: (709) 864-2409
E-mail: RGCS@mun.ca

This agreement between the research partners for this project describes: what the project is about; how it will be managed, funded, researched, and communicated; expected start and end dates; and ownership of the data. It ensures we all understand the project and each other's roles. Consent for this research project was received and discussed at the September 2017 and March 2018 Sikumiut meetings, as recorded in the meeting minutes. This agreement also describes the current and future research partners' rights to withdraw from the study at any time. If research partners decide to not take part in this research or withdraw from the research once it has started, there will be no negative consequences for them, now or in the future.

Please contact **Katherine Wilson** if you have any questions about the project or would like more information about this agreement.

Purpose of the Project:
The purpose of this project is to support Inuit self-determination in research through a case study in Mittimatalik (Pond Inlet), Nunavut. The goals of the project are to advance Inuit research leadership, decision-making, knowledge, approaches and capacity building. Sikumiut has identified that while the information produced from SmartICE is of great use, they also felt the need to document their Inuit Qaujimajatuqangit (IQ) of sea ice to support safe sea ice travel, assess the impacts of climate change and resource development, and to share this knowledge with the community and future generations.

Sikumiut would like to:
- Gather and utilize Mittimatalik sea ice IQ that has been collected in previous projects by southern researchers. For example, data from the Arctic Research Establishment (1973-1989), Parks Canada Inuit Knowledge Project (2005), Mary River Project Inuit Knowledge Study (2015), and Inuit Voices for the Northern Marine Transportation Corridors (2017).
- Use both reclaimed and newly documented sea ice IQ, along with interpreted satellite imagery, to develop products that document the history and changes to sea ice conditions around Mittimatalik.

This collaborative case study responds directly to Sikumiut's request while operationalizing a research approach that reclaims Inuit leadership, builds Inuit youth capacity to conduct the research, and evaluates the project according to Inuit perspectives.

The Research Plan:
Sikumiut will govern and evaluate this project according to their IQ principles and extensive experience with sea ice. To build research capacity, local Inuit youth will be hired and trained to conduct the research. Over the next 3 years Inuit youth will be trained to organize meetings and workshops with Sikumiut to:

- learn sea ice IQ so they can better understand Sikumiut's sea ice knowledge
- review and evaluate reclaimed Mittimatalik sea ice IQ collected by southern researchers
- interpret and review satellite data
- discuss Inuit ways of doing research and Inuit societal principles to guide the research
- discuss and develop the best methods to communicate and share Sikumiut's sea ice IQ with the community
- evaluate the research project from an Inuit perspective

Roles of the Research Partners in this Study:

<u>Sikumiut</u>

- Will govern the research using their knowledge and principles
- Will decide what information from previous research and satellite imagery is useful
- Will share their IQ of sea ice and determine how best to communicate it
- Will mentor Inuit youth on sea ice IQ and Inuit ways of doing research
- Will review and approve all information and products to be shared publicly
- Will determine where to archive the information and who can have access to it
- Will determine their level of involvement in reviewing and approving reports and publications, and how best to co-author and credit their roles in the research

<u>Research Mentors:</u>

Shelly Elverum

- Will manage and co-supervise the Inuit youth in Mittimatalik during the project
- Will mentor Inuit youth in preparation for and during workshops, and during individual research project work
- Will participate in the co-production and co-writing of the final project results and products
- Will assist in the communications and sharing of final project results and products with Sikumiut and the community

Andrew Arreak

- Will coordinate and co-facilitate the Sikumiut meetings with the Inuit youth
- Will co-supervise and mentor the Inuit youth in Mittimatalik during the project
- Will participate in the co-production and co-writing of the final project results and products
- Will assist in the communications and sharing of final project results and products with Sikumiut and the community

Katherine Wilson

- Will secure funding with Trevor Bell to fund Inuit youth researchers and Mittimatalik mentors and workshop, training and travel costs
- Will gather available Mittimatalik sea ice IQ from southern archives
- Will provide training in satellite interpretation, digital map production and database management
- Will co-develop individual research projects with the youth
- Will work with Inuit organizations to identify long-term data storage that is secure and accessible
- Will co-coordinate the sharing and writing up of the final project results and products
- Will document the project as an example of Inuit self-determination in research for her PhD thesis under the supervision of Dr. Trevor Bell at Memorial University in St. John's and Dr. Gita Ljubicic at Carleton University in Ottawa.

Gita Ljubicic

- Will assist research mentors and youth in organizing sea ice terminology workshops with Sikumiut
- Will co-supervise and mentor Katherine Wilson as part of her PhD throughout the project
- Will assist in the sharing and writing up of the final project results and products

Trevor Bell

- Will secure funding with Katherine Wilson and will manage the funding to pay for the Inuit youth researchers, mentors, workshops, training and travel costs
- Will assist in mentoring the Inuit youth and organizing workshops with Sikumiut
- Will co-supervise and mentor Katherine Wilson as part of her PhD throughout the project
- Will co-coordinate the sharing and writing up of the final project results and products

Funding

Funding for the project comes from the Federal Department of Public Safety, through a program called the Search and Rescue New Initiatives Fund. This proposal was led by the Government of Nunavut's Emergency Management (Jimmy Noble Jr., Director) and coordinated by SmartICE (Trevor Bell) and the Canadian Ice Service (Katherine Wilson). Funds for the project are for 3 years, from April 1st, 2018 until March 31st, 2021.

Length of Time: October 1st, 2018 to March 31st, 2021

Compensation:

- Sikumiut members not receiving a salary during the meeting will receive an honorarium of $200 per day, or $100 per half day as stated in the Sikumiut terms and conditions.
- Funding is available to pay for the equivalent of 2 fulltime Inuit youth researchers for 6 months each year (October to March). Inuit youth researchers will be paid the equivalent of a Memorial University Research Assistant II at the rate of $24.94 per hour, plus $13.30 per hour in Northern Allowance; for a total of $38.24 per hour.
- Shelly Elverum will be compensated equivalent to her current daily rate as Ikaarvik northern coordinator.

Withdrawal from the Study:

You may withdraw from this study at any time. Information collected during Sikumiut meetings and/or workshops will be based on the collective and agreed upon sea ice knowledge of the group. As a result, you can withdraw at any time, but your specific input cannot be removed after it has been contributed during group meetings and workshops.

Possible Benefits:

While the purpose for developing these IQ maps are to improve safe sea ice travel in the community, this research will also benefit:

<u>The community of Mittimatalik</u>

- Future resource development: A baseline of Mittimatalik's historical sea ice conditions and Inuit sea ice use can be used in environmental assessments and in understanding the impacts from resource development on the sea ice (for example, concerns around extending shipping seasons or shipping/ice breaking during the ice season);
- Climate change: To document and provide evidence for where, when and how quickly the sea ice is changing, and the effect this has on the community. To also mitigate the risks and develop adaptation tools to improve community sea ice travel.
- Intergenerational Knowledge Transfer: Since Inuit were forced to settle in communities over 60 years ago, subsequent generations have less on-the-land experience due to school and wage employment. Sikumiut would like to preserve and share their IQ with current and future generations, in a format that is useful, accessible and culturally relevant.

<u>The Nunavut Emergency Management Community</u>

- Development of emergency management information from the bottom-up (community/hamlet) instead of top-down (Federally/Territorially) that is culturally relevant and more useful for Inuit communities
- Increased local scale sea ice information for use by Emergency Management partners (i.e., Nunavut Emergency Management, Canadian Coast Guard, and Joint Rescue Co-ordination Centres (JRCCs).
- Enhanced community volunteer emergency prevention and response capabilities and capacity by facilitating self-reliance and awareness for improved risk assessment and decision-making

Possible Risks:
Discussions of ice hazards could raise difficult, sad, or traumatic memories for participants about their own, and their friends and family's experiences on the sea ice. If you become emotionally distressed by any topics of discussion, you can take a break from the discussion at any time, request support or withdraw from that session (or the project). The following is a list of support services in town or by phone, that you can access if needed.

Pond Inlet Health Care Centre
Open 24 hours
1-867-899-7500

Nunavut Kamatsiaktut Help Line (7PM-Midnight - 7 days a week)
1-867-979-3333, Toll-free at 1-800-265-3333
www.nunavuthelpline.ca

Confidentiality and Anonymity:
No personal individual information will be collected during this project. Your knowledge will be collected in a group setting at Sikumiut meetings or workshops and the sea ice IQ utilized in this project will be based on the consensus of the group. Your participation will not be anonymous or confidential, as the intent of this project is to share this sea ice IQ with the community of Pond Inlet, and it will be important to acknowledge your sea ice IQ and contributions.

Recording of Data:
Inuit youth researchers will learn to collect and document sea ice IQ during meetings and/or workshops. Portions of the meetings and workshops may be audio recorded to assist the Inuit youth researchers in capturing these conversations.

Photographs of people working together during the workshops will be taken for communications and reporting purposes. The locations of important sea ice features will be collected on paper maps and transferred to digital maps. On the last page of this form you can decide if you do or do not wish to be audio recorded, or have your photograph taken.

Use, Access, Ownership, and Storage of Data:
Sikumiut will own all the information generated.

Digital information (e.g. maps, reports, posters) will be accessible to Sikumiut through the SmartICE data portal (smartice.looknorthservices.com). The SmartICE data portal is hosted by the LOOKNorth Data Services Coresight platform, which is encrypted using HTTPS communication protocols. The SmartICE data are stored indefinitely on this secure system. Digital copies of the signed research agreements with Sikumiut, consent forms for other community participants, audio and/or video recordings, photographs, hand-drawn and digital maps will be stored in the password-protected, SmartICE Pond Inlet computer system, accessible only to the Sikumiut and Memorial University project researchers. These project forms, agreements and data will be kept for a minimum of five years, as required by Memorial University's policy on Integrity in Scholarly Research.

A hard-copy and soft-copy back of up the audio recordings, photographs and hand-drawn and digital maps will be provided to the Pond Inlet Archive at the local library. An additional copy of this information will be sent to an Inuit organization of Sikumiut's choice (e.g., Nunavut Research Institute, Qikiqtani Inuit Association, Nunavut Tungavik Incorporated, Inuit Tapiriat Kanatami). Katherine Wilson will be meeting with Inuit organizations to discuss their long-term data storage and accessibility capabilities and the options will be presented to Sikumiut for their final approval. Upon this decision, a Third-Party Data Storage section will be added to this agreement.

Sikumiut retains the rights and ownership to their knowledge/data collectedand documented during this project. Sikumiut will allow Katherine Wilson to have access to this data/knowledge to publish the results, thesis and/or report to fulfill her studies at Memorial University.

The final products will be shared with research funders and partners (Public Safety Canada, the Government of Nunavut's Emergency Management and their partners Canadian Coast Guard, Joint Rescue Co-ordination Centres (JRCCs) and the Canadian Ice Service).

Reporting of Results:
Sikumiut will review and approve all research outputs before they are shared publicly.

Results will be shared with partners from Nunavut Emergency Management and the Canadian Ice Service to better support Nunavut Search and Rescue efforts. Public Safety Canada's Search and Rescue New Initiatives program funds this research and annual reports will be generated as required.

It is intended that this research will result in the publication of a PhD thesis by Katherine Wilson. If possible, a Sikumiut member will be present during her PhD defense to provide the Inuit and sea ice subject matter expertise as part of her PhD review committee. Her thesis will be available at Memorial University's Queen Elizabeth II library, and can be accessed online at: http://collections.mun.ca/cdm/search/collection/theses.

Co-presented and co-authored papers for scientific conferences and journals will also be discussed with Sikumiut and Inuit youth to determine their level of involvement and how-to best co-author and credit their roles in the research

Sharing of Results with the Community of Mittimatalik:
Sikumiut will review and approve all products before they are shared publicly and determine the variety of culturally relevant formats needed to communicate and share this information to the different generations of users in the community. Suggestions for communicating this information include: the production of a paper atlas and/or posters with sea ice terminology and maps available at the community centre, school, visitor centre and Hunters and Trappers Organization office; and digital information for display on screens at the grocery store and the SmartICE data portal and mobile app.

University Ethics Review
This research agreement has been reviewed by the Interdisciplinary Committee on Ethics in Human Research and found to be in compliance with Memorial University's ethics policy. If you have ethical concerns about the research, such as the way you have been treated or your rights as a participant, you may contact the Chairperson of the ICEHR at icehr@mun.ca or by telephone at 709-864-2861.

Mobilizing Inuit Qaujimajatuqangit for Sea Ice Safety: A Sikumiut case study to support Inuit Self-Determination in Research

By signing this form, you do not give up your legal rights and do not release the co-researchers from their professional responsibilities.

Your Signature Below Confirms:

- You have read the information, had adequate time to think about it, discuss, ask questions and have your questions answered.
- You understand what the project is about and your role as a research partner.
- You understand the risks and benefits and that your participation is voluntary. You may end your participation without having to give a reason, and that doing so will not affect you now or in the future.
- You understand that data collected during Sikumiut meetings and/or workshops cannot be removed after it is contributed, as it is agreed-upon, collective Inuit sea ice knowledge and will be retained by Sikumiut.
- For the purpose of this research you agree to be audio-recorded, photographed and allow your name to be identified in any co-publications resulting from this study.

You are welcome to ask questions before, during, or after this project. If you would like more information, please contact Katherine Wilson or her supervisors listed on page 1.

A copy of this Agreement will be provided for your records once all signatures have been received.