CLIMATE CHANGE ADAPTATION STRATEGIES FOR WILDLIFE:

INTERVIEW RESULTS – REPORT

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SUBMITTED TO:

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1. INTRODUCTION

The Government of Canada's Auditor General's 2017 report to the Northwest Territories (NWT) Legislative Assembly recommended the completion of an overall plan for wildlife management in response to climate change. In support of research to inform such a plan, interviews were carried out with key contacts to identify possible climate change adaptation actions and strategies for wildlife management. The interviews complemented a jurisdictional scan.

This report summarizes the findings from the interviews. The findings are organized as follows.

2. APPROACH

The following provides an overview of the interview approach. A total of 50 contacts from 24 organizations were invited to take part in an interview. The organizations included territorial, federal and provincial governments, Indigenous governments/organizations, renewable resources and co-management boards, and academia. Please see Appendix A for the full list of organizations invited to participate in an interview. Potential participants were contacted a minimum of three times by email / phone inviting them to take part in an interview.

The semi-structured interviews focused on the following lines of inquiry:

1. **Goals:** What should be the broad goal(s) of climate change wildlife adaptation actions / strategies in the NWT over the next 50 years?
2. **Key Challenges:** What are the key challenges related to climate change adaptation for wildlife?
3. **Key Opportunities:** What are the key opportunities related to climate change adaptation for wildlife?

4. **Current Actions:** What actions are being implemented or considered that will be key to successful climate change adaptation for wildlife?
5. **Potential Actions:** What other potential actions could be taken to achieve the broader goal(s) of climate change wildlife adaptation?[1]
6. **Other Contacts:** Who else should be interviewed on this topic?
7. **Communication & Engagement:** How would participants like ENR to communicate the results of this project to them, and to engage them on this topic in the future where in-person meetings are not possible due to COVID-19?

In alignment with the mandate of the Government of the Northwest Territories Department of Environment and Natural Resource (ENR), the interviews focused on terrestrial wildlife and wildlife habitat. Please see Appendix B for the full interview guide. The guide was shared with all participants in advance of the interviews, which were conducted by telephone.

3. RESULTS

3.1 Interview Participants

A total of 30 interviews were completed, with 36 participants. Responses for two of these participants were received in writing. The interviews were carried out between April 20 and May 20, 2020. Interviews ranged in length between 15 and 92 minutes, lasting 44 minutes on average.

The following organization types were represented among the completed interviews.

- co-management board (NWT)
- government (territorial, NWT overall), focus - environment, land use planning, community planning
- government (territorial, NWT regional), focus - environment
- government (territorial, Nunavut overall), focus - environment
- government (territorial, Nunavut regional), focus - environment
- government (federal)
- government (Indigenous)
- Indigenous organization
- university (academia)

Participants also occupied a range of roles:

- (assistant) professor
- co-management board member
- Indigenous Knowledge holder
- managerial role
- non-scientific government program staff (e.g. community planning, land use planning, climate change programming, research coordination, community conservation)
- scientist
- staff member representing youth

[1] This item encompasses perceived gaps in wildlife management with regards to climate change wildlife adaptation

3.2 Goals

The following section describes what participants identified should be the broad goal(s) of climate change wildlife adaptation actions / strategies in the NWT over the next 50 years. Interview participants identified a range of goals for climate change wildlife adaptation. Although the responses were diverse, themes emerged among the goals identified and are discussed below. The themes are discussed in order of the most to least frequently mentioned goals by number of interview participants[2].

3.2.1 Ensuring food security for people

This theme was identified by the largest number of interview participants (n=13). Goals under this theme included:

- Ensuring food security,
- supporting species and habitats related to culturally important species, species at risk and cultural practices, as well as
- protecting harvesting and harvesting rights.

There was a strong focus on ensuring food security for people, with 12 participants[3] identifying this as a goal. Maintaining ecosystem function and ecosystem services was the next most commonly identified goal with mention from 6 participants. Goals under this theme were identified by scientists from the Government of the Northwest Territories (GNWT), academia, Government of Nunavut (GN), co-management board, and federal government as well as a federal government program staff and GNWT manager. The article suggested by a participant (Salomon et al., 2019) similarly focuses on socially just and ecologically sustainable resources systems.

3.2.2 Healthy and functional ecosystems

This goals under this theme encompassed resilient, healthy, and intact ecosystems, maintaining ecosystem services and ecosystem function, as well as a variety of functional ecosystems. This theme was identified by 12 participants. Goals under this theme were identified by scientists from GNWT, academia, the federal government and co-management boards.

3.2.3 Change over time

This theme was identified by 10 participants. The goals under this theme related to accepting and allowing (slow, "natural") change over time among wildlife species and habitat, and interacting appropriately. Goals under this theme were identified by a GNWT manager, as well as scientists from co-management boards and the GNWT.

3.2.4 Survival of wildlife populations

The goals under this theme related to achieving healthy, sustainable populations of wildlife species and maintaining security for populations to the degree possible. Language around achieving a healthy wildlife population and the survival of wildlife for future generations was most common. One participant clarified that they viewed the goal as encompassing the maintenance of species even if populations of those species change. Goals under this theme were identified by nine participants comprised of a co-

[2] Throughout the report, where there is a reference to frequency, this focuses on the number of interview participants rather than the number of interviews. This acknowledges that some interviews included multiple participants that contributed to the interview responses.

[3] Participants could identify more than one goal within a theme. For example, one participant may have identified ecosystem services and food security for people as goals.

management board member, staff and Indigenous Knowledge holder, NU and NWT government and academic scientists, and a GNWT manager.

3.2.5 Habitats with various positive characteristics

This theme was identified by eight participants. The goals under this theme related to maintaining habitats that are:

- abundant,
- connected,
- representative, and
- intact.

Additional goals related to maintaining ecological niches and a landscape that supports "guilds" of animals (that interact and prefer a certain habitat). These goals were identified by managers, program staff and a scientist from GNWT as well as GNWT program staff, a university scientist, and federal government program staff.

3.2.6 Diversity

Goals under this theme related to maintaining biological diversity overall as well as diversity at the ecosystem, species, genetic, and habitat levels. Species and genetic diversity were identified most frequently. Goals under this theme were identified by six participants comprised of a scientist, managers, and program staff from the GNWT as well as an academic scientist and federal government program staff.

3.2.7 Other goals

For a GNWT program staff and manager, a goal was balancing resource development and conservation.

Three participants who were less directly involved in climate change wildlife adaptation (GNWT staff and a representative from an Indigenous organization) indicated that did not know what the goal of climate change wildlife adaptation should be.

3.3 Key Challenges

The following section describes the key challenges related to climate change adaptation for wildlife identified through the interviews. A large range of challenges were identified by interview participants. Overall, the challenges raised related to:

- circumstances or factors that could make climate change wildlife adaptation difficult,
- key impacts of climate change on wildlife, and
- knowledge and activity gaps.

The range of specific challenges identified by participants under these groupings is discussed below. Challenges that were raised repeatedly by participants are also flagged.

3.3.1 Circumstances or factors that could make climate change wildlife adaptation difficult

Challenges under this grouping are those that cannot be easily altered.

3.3.1.1 The challenge of climate change

There are challenges to climate change wildlife adaptation related to the nature of climate change itself – the speed and scale of climate change particularly as experienced in the NWT, the difficulty of communicating climate change because it is hard to see and understand, as well as the barriers to

climate change mitigation in NWT. It was mentioned that the NWT is one of the fastest warming places on the planet and the issue can be overwhelming; there is a lot of information to be brought together and understood. Five participants mentioned that the territory's limited ability to change the course of climate change was a challenge. Accepting that change will happen to some species and ecosystems was identified as both a goal and a challenge.

3.3.1.2 Non-climate change stressors

The impacts of non-climate change-stressors on wildlife (e.g. development) also presents a challenge to wildlife and their ability to cope with climate change.

3.3.1.3 NWT context

One of the most frequently mentioned challenges, identified by 11 participants, was related to the geography of the NWT. Participants noted that the geographic size, density and/or remoteness of the jurisdiction can make it more difficult and expensive to do research and monitoring. Other challenges related to the NWT context include the legacy of residential schools on the transmission of Indigenous Knowledge , and that land claim agreements in NWT were based on the assumption of persistence and do not take climate change into consideration.

Some species are already declining in NWT. At the same time, labelling a species "at risk" in the NWT can increase their desirability as "trophies" and increase hunting pressure in some cases.

3.3.1.4 Collaboration

Species are transboundary, which means that many levels of government with different jurisdictions and transboundary agreements, with the associated administrative burden of coordination, impact climate change wildlife adaptation in the NWT. Seven participants remarked that the complex governance in the NWT was a challenge. Collaboration is needed but there are a lot of stakeholders to consult with in different regions. Consultation and collaboration can be slow and expensive. In some communities, trust in the GNWT Department of Environment and Natural Resources may be lacking and there may still be barriers between government and Indigenous governments and people. Three participants also noted that government (GNWT, NU) is 'siloed' in their approaches to wildlife management.

3.3.1.5 Approach

Traditional wildlife management is too slow to identify changes and adaptation occurs too late. Wildlife management tools are also limited (e.g. limiting harvesting, regulating industry), which makes climate change wildlife adaptation challenging.

3.3.1.6 Resources

There are few / limited resources, particularly in relation to the geographic size of the NWT for climate change wildlife adaptation, including related activities such as data collection, monitoring, on the land programs, and assessment. This was flagged by eight participants. Broadly, there is also a lack of capacity that includes staff and expertise. There is a strong reliance on partnerships and knowledge that reside in the south. This has been highlighted by the pandemic, where field work has been cancelled due to travel restrictions for southern partners. In communities, there is a lack of capacity and funding at co-management boards, and local communities where adaptation actions will need to be implemented.

3.3.1.7 Priorities

Four participants stated that there is a stronger focus on economy and industry than on wildlife and climate change in the NWT. The GNWT was thought to be reactive and politically motivated, while

climate change was not thought to be a priority. With limited funding and funding base, it is challenging to compete with priorities such as healthcare for resources.

3.3.2 Key impacts of climate change on wildlife

Climate change and the related impacts cannot be eliminated by action that is taken only in the NWT. Participants identified a number of key climate change-related impacts that pose challenges for climate change wildlife adaptation:

- changes to extreme weather events including wildfires
- permafrost degradation, which can impact species migration and habitat
- changing landscape and related shift in wildlife species and movements
- loss of sea ice
- southern species migrating north and invasive species
- predators increasing pressure on prey
- loss of glaciers/snow patches for caribou 'cooldown'
- insect harassment for wildlife (e.g. caribou)
- increase in vector-borne/ zoonotic diseases / parasites for wildlife
- risk of disease transmission / danger from feral animals due to increased agriculture
- habitat fragmentation from human adaptation to climate change (e.g. new all-season roads), and
- disturbance from increased travel (marine, road), shipping with warming.

With the linkage between people and wildlife, additional climate change-related impacts were identified with a stronger focus on people but with some link to wildlife:

- impact on human food security (e.g. reduction in some species such as caribou)
- increase in vector-borne/ zoonotic diseases for people
- weather is unpredictable and impacts travel and safety
- changes to drinking water for people

The climate change impacts that were most frequently raised were the changing landscape and related shifts in wildlife, southern species migrating north and invasive species, changes to extreme weather events including wildfires, and impact on human food security, with mentions by 11, 9, 7, and participants respectively.

3.3.3 Knowledge and activity gaps

Interview participants identified a number of knowledge and activity gaps that pose key challenges to climate change wildlife adaptation. The most commonly identified knowledge gaps were around the lack of understanding of climate change-related impacts, and lack of baseline information, mentioned by six and four participants, respectively.

Other knowledge gaps identified include the need for improved understanding of:

- concrete climate change adaptation actions, including actions that work at the scale that GNWT manages wildlife
- how to incorporate climate change into regional land use plans and processes
- species in general
- species vulnerability to climate change
- wildlife population drivers

- the multiple drivers of change (climate change is one of multiple drivers of change)
- addressing cumulative effects
- vegetation mapping
- landscape processes
- role of disease in wildlife
- pathogens

There is also a lack of long-term datasets.

Two key activity gaps were also identified by four participants each. These include the lack of monitoring and the lack of modeling. It was mentioned in particular that monitoring is key to inform adaptation.

3.4 Key Opportunities

The following section describes the large range of key opportunities related to climate change adaptation for wildlife identified through the interviews. With one exception, all participants identified key opportunities.

3.4.1 NWT context

Although the unique geography and context of the NWT was frequently flagged as a challenge, the most frequently identified key opportunities were also related to these aspects. Specifically, it was mentioned that the NWT has a (somewhat) pristine landscape, fewer non-climate stressors than in the south, a large geographic area, and (relatively) intact habitat / ecosystems, by eight, seven, six and five participants, respectively. These characteristics mean that the NWT does not face the same need for ecosystem restoration that exists in other areas, and the harsh, remote geography might slow or reduce impacts from invasive species and diseases. Although the rapid pace of climate change in NWT was identified above as a challenge, it was also flagged as an opportunity to see climate change impacts first and to learn for the rest of Canada. Given the context in the NWT and the relatively pristine landscape, NWT may have some advantage in terms of having some time to take action around climate change. The North is unique and there is an opportunity to make a "from scratch" climate change adaptation plan.

On the human side, the current slow-down in resource development in the NWT was identified as an opportunity to be cautious on activities that will change the environment. It was also seen as an opportunity that in some regions, there are settled land claims and well-established co-management processes; for example, the Tłı̨chǫ Government can implement its own laws. The NWT is also thought to be good at co-management and at collaboration. Collaboration is already underway and an opportunity to move away from a siloed approach. Eight participants identified close relationships, for example, between GNWT and co-management partners, and Indigenous peoples as an opportunity for adaptation. Partnership with Indigenous governments on conservation plans is valuable for climate change adaptation.

3.4.2 Resources

A lack of resources / few resources was repeatedly identified as a challenge. Although wildlife management is viewed as being typically under-funded / under-resourced, the North in particular is seen as the "poster child" for climate change and it was thought climate change might present an opportunity for additional funding (e.g. for wildlife monitoring, research or adaptation). The climate change adaptation plan specifically might lead to additional funding.

3.4.3 Awareness & support

The people of the NWT, and in particular Indigenous people, have a strong understanding of, and value the land, fish and wildlife; as a result, they generally support taking action on climate change.

3.4.4 Indigenous Knowledge

Indigenous Knowledge and science are both considered and valued in the NWT, and indigenous knowledge can help understand how species and habitat responded to changes in the past, are changing now, and possibly going forward under climate change. Archaeological/anthropological and wildlife research underway can help understand the distribution of species as well (e.g. caribou fences). These opportunities are consistent with the additional information received from participants that points to the importance of Indigenous Knowledge for detecting changes in wildlife (Kutz & Tomaselli, 2019; Tomaselli et al., 2018). This can be particularly important in the context where scientific knowledge can face challenges (e.g. field work is expensive, faces logistical challenges, and may only be possible during specific times) (Kutz & Tomaselli, 2019).

3.4.5 Analysis of existing data

A participant noted that in NU, there is additional research data that has been collected and is available for further analysis. The data have not been analyzed due to lack of capacity.

3.4.6 Positive aspects of climate change

Although a number of climate change-related impacts were identified as key challenges, eight participants identified positive climate change-related impacts for wildlife. Some habitats may be more productive, and some species will benefit from climate change (e.g. threatened species from Prairie or parkland habitat may benefit from habitat in the north). This could lead to increased food security through availability of different species and/or more wildlife that can be harvested, as well as increased agricultural activity. Some species also appear to be adapting to climate change (e.g. moose may be increasing in abundance), although there are differing perspectives on this).

3.4.7 Actions Underway

Finally, an identified opportunity is that some action on climate change is already being implemented. See the Current Actions (section 3.5 below) for additional details.

3.5 Current Actions

The following section describes actions that are currently being implemented or considered that participants identified as key to climate change adaptation for wildlife. Some participants took a broad view of actions that are key to climate change adaptation for wildlife. This section also includes key actions identified in additional information that was provided by the participants. The full list of actions is found in Appendix C; see Appendix E for the list of additional information sources provided by participants. Despite the challenges discussed above, a total of 125 actions currently being implemented or considered were identified through the interviews. Although the NWT faces challenges identified by participants such as resource limitations, it is possible that the visibility and pace of climate change in the territory, together with the strong understanding of and value placed by NWT residents on the land, fish, and wildlife, is allowing some climate change actions to move forward. Key themes that were mentioned repeatedly by participants or include multiple actions are discussed below. Although it was not possible to assess the extent of these actions, it has been assumed that number of actions may

reflect the level of activity related to a theme. The number of participants who identified a current action may reflect the level of awareness around a particular adaptation action.

3.5.1 Climate Change Plans (1 action)

Three participants identified the NWT's current 2020 Climate Change Strategic Framework and 2019-2023 Action Plan, which contains adaptation actions.

3.5.2 Climate Change Vulnerability Assessment (1 action)

Six participants mentioned that the NWT is in the process of conducting a climate change vulnerability assessment that includes wildlife.

3.5.3 Collaboration (21 actions)

Participants identified a number of actions being undertaken that involved multiple partners, which suggests that NWT is building on the opportunities identified around strong relationships among partners and the NWT's strengths around co-management and collaboration. These actions were related to education / communication, knowledge generation, monitoring, protected areas, to maximize resources, and targeted intervention. Actions involved collaboration within GNWT, as well as involving partners such as renewable resource boards, Aurora College, NWT communities and community members (e.g. Guardians programs), and Environment and Climate Change Canada (ECCC). The NWT 'Living on the Land Forum' was also identified as an example of a cross-regional forum with a climate change component.

3.5.4 Disturbance Regime (1 action)

More wildfires are anticipated under climate change and NWT is considering changing the approach to managing fires, shifting from letting wildfires burn to fighting fires to protect key caribou habitat. This was identified by four participants.

3.5.5 Invasive Species (6 actions)

A working group on the topic has been established, with an NWT Council being considered (NWT Pests, Pathogens and Invasive Species Council). An assessment of long-term impacts and the development of related surveillance systems is also under consideration for NWT. GNWT has hired an intern to focus on this issue (e.g. feral pigs) and vehicle washing stations are being considered and may have been piloted[4] at the NWT border. Invasive species also appear to be a key area of focus for monitoring efforts, with six related actions underway or under consideration.

3.5.6 Knowledge Generation (15 actions)

Actions under this theme relate to climate change impacts and mapping, as well as examining pests and pathogens at a landscape level and developing a portal to access data and research. Where the actions are targeted, the focus of the knowledge generation has a wide range. Topics include permafrost melt and slumping, wildfires, changes to marine traffic, erosion, shorelines and wetlands, caribou and moose, as well as pests and pathogens. It was also identified that Indigenous Knowledge and science are used together, and a key action under the GNWT Knowledge Agenda Action Plan 2019-2024 is related to GNWT improving its capacity to ensure that the use of Indigenous Knowledge into is part of research programs. This is consistent with the recognition among participants that Indigenous Knowledge can

[4] Following the interviews, it has been confirmed by GNWT ENR that vehicle washing stations are being pursued.

increase the understanding of how species respond to past and current changes, how they might respond in future, and for detecting changes in species and their habitat.

3.5.7 Monitoring (30 actions)

Monitoring is being conducted by various parties, and community-based monitoring was frequently highlighted during the interviews. Along with actions identified through the Indigenous Knowledge theme below, this suggests that the NWT is building on the opportunity to advance understanding through Indigenous Knowledge and to address the challenges that face activities to gather scientific knowledge gathering (e.g. field work). Seven participants mentioned Guardians programs such as the Tłı̨chǫ 'Boots on the Ground', which monitors caribou migration, population, and herd health. Other actors included the Circum Arctic Ranger Monitoring and Assessment Network (CARMA), the Universities of Calgary and Alberta, GNWT, GN, as well as governments of British Columbia and the Yukon. In addition to general monitoring, a wide range of monitoring topics were mentioned. Examples include baseline monitoring, harvesting, chronic wasting disease, invasive and non-Indigenous species, zoonotic disease and disease vectors, migratory birds, and species movements.

3.5.8 Protected Areas and Range planning (20 actions)

A large number of protected area initiatives and actions were identified from across Canada. It was noted that there is a federal protected areas target of 25% of Canada's land by 2025 and 30% by 2030. In addition to large-scale, well-funded actions such as the North American Waterfowl Management Plan, associated with a $2.3 billion investment in wetland conservation in Canada and the $500 million Canada Nature Fund, a number of NWT-specific actions were also identified. For example, management plans are supporting the protection of boreal and barren ground caribou habitat (from human activity and development), Indigenous protected areas are underway in NWT, a new future protected area will be in the Wek'èezhìi Management Area on north shore of Great Slave Lake, and marine protected areas are being developed with the federal government. Closely related to protected areas is the range planning that is underway in NWT. Four participants identified that caribou range plans related to the Bathurst caribou herd and boreal caribou are under development, and at least one involves a climate change adaptation working group.

3.5.9 Indigenous Knowledge (5 actions)

Actions under this theme were largely related to knowledge generation. It was noted that Indigenous Knowledge and science are being considered together; specific actions included building knowledge with communities around alternative local food, a project related to cranberries, and mapping land cover with Elders to help understand and monitor shifts in habitat and wildlife ranges. The GNWT's 'Knowledge Agenda Action Plan' calls for improving capacity around Indigenous Knowledge informing research programs.

3.5.10 Other Actions

The following themes include four or fewer actions each and were mentioned infrequently. Please see Appendix C for the full list of actions within these themes.

- approach (to climate change adaptation for wildlife)
- capacity-building (related to knowledge, expertise)
- climate change mitigation
- education / communication
- harvesting
- land use planning

- leadership
- legislation
- non-climate stressors
- prediction (i.e., modeling)
- targeted intervention, and
- wildlife/human interaction.

3.6 Potential Actions

The following section describes potential actions that could be taken to achieve the broader goal(s) of climate change wildlife adaptation identified by the interview participants. This section also includes anything that participants identified as needed for climate change wildlife adaptation that is currently missing from wildlife management, as well as actions that were identified in additional information that was provided by the participants. The full list of actions is found in Appendix D. Please see Appendix E for the list of additional information sources provided by participants. Two participants indicated that they were not aware of anything missing from wildlife management (that was needed for climate change wildlife adaptation). A total of 162 actions and needs were identified through the interviews. Key themes that were mentioned repeatedly by participants or include multiple actions are discussed below. The number of participant mentions may reflect the level of perceived need for action under a theme, while the number of actions may reflect a greater range in the perceived actions needed or the degree to which a theme is understood and specific actions can be identified.

3.6.1 Approach

Actions / needs related to the approach taken to climate change adaptation for wildlife were mentioned by 20 participants and 19 actions were identified under this theme. The most frequently mentioned item (raised by nine participants) was the need to shift to a 'big picture' approach, to stop focusing on specific species and to move beyond just caribou. Four participants mentioned the need to shift away from a reactive approach. Other actions / needs under this theme were similarly strategic and ranged from:

- avoiding maladaptation (e.g. spraying insecticide to control mountain pine beetle and impacting species that eat the beetle)
- taking a diversity of management actions
- integrating climate change adaptation into other government plans and policies
- adaptation being long-term and planned
- adaptive management, and
- focusing limited resources on action that make the most difference, to
- developing management questions to guide research, monitoring and tool development.

3.6.2 Collaboration

Although collaboration was a key theme under current actions, actions /needs related to collaboration were mentioned by 19 participants / additional information sources. 22 actions were identified under this theme. The calls for collaboration spanned a wider range of partners including NWT communities, co-management boards and Indigenous governments, the need for coordination within the GNWT, as well as different levels of government, non-profit groups, industry, and academia. Collaboration was identified as part of achieving numerous objectives such as to share knowledge, maximize resources, coordinate research and action, support a particular species of interest, and ensure that communities are part of the conservation and management process.

3.6.3 Education / Communication

Participants identified little regarding education / communication under current actions, but potential actions / needs related to this theme were mentioned by nine participants and 16 actions were identified under this theme. The actions / needs identified focused largely on informing (the public) about climate change in order to support action on climate change and adaptation. Other actions/ needs related to providing education about climate change-related risks (e.g. zoonotic diseases) and communicating research needs (through the climate change wildlife adaptation plan).

3.6.4 Invasive Species

Actions / needs related to this theme were identified by 11 participants and six actions were identified. Participants suggested actions to manage / prevent / limit invasive species and diseases from the South. The need for related information was also identified.

3.6.5 Knowledge generation

Actions / needs related to this theme were identified by 14 participants and 24 actions were identified. Although a number of knowledge generation activities were identified under current actions, participants repeatedly identified this under potential actions, suggesting that participants perceived more effort is needed in this area. Topics for knowledge generation were varied, ranging from the need for a university in NWT to increase knowledge, to the need for community-based knowledge generation. Key topics with multiple mentions included understanding climate change impacts and understanding baseline conditions.

3.6.6 Monitoring

Actions / needs related to this theme were identified by 19 participants and 13 actions were identified. Although a number of monitoring activities were identified under current actions, participants repeatedly identified this under potential actions, suggesting that participants perceived more effort in this area is needed. In addition to specific monitoring topics (e.g. wildlife diseases, baseline and progressive monitoring, for invasive species), participants suggested community-based / community partnership around monitoring including a shift from aerial surveys to community-based monitoring that includes Indigenous Knowledge, and an ecological benchmark approach. The interview results showed a strong awareness of, activity around, and demand for monitoring. However, there was little focus on prediction (i.e., modeling, projections, scenario development). Five participants proposed climate change projections / modeling; there was a single action under the prediction theme.

3.6.7 Protected areas

Actions / needs related to this theme were identified by 14 participants and 13 actions were identified. In addition to suggesting protected areas themselves, participants mentioned Indigenous protected areas, protecting different types of areas (e.g. refugia, areas with permafrost) and protecting areas with specific focuses (e.g. protecting habitat from development activity, protecting habitats of species valuable to people). Suggestions from additional information provided by participants touched on expanding protected areas and Indigenous Protected and Conserved Areas as well as their supports (e.g. financing), ensuring Indigenous peoples are partners in wetland decision making and that Indigenous Knowledge is integrated in conservation. The additional information also suggested expanding protected areas related to carbon dense / high biodiversity ecosystems / forests.

3.6.8 Resources

Limited resources were identified as a key challenge and actions / needs related to this theme were also identified by 14 participants. A total of 12 actions were identified under this theme. Resources needed ranged from financial resources, time, and human resources. The need for dedicated, long-term resources to meet climate change goals was also flagged.

3.6.9 Indigenous Knowledge

Actions / needs related to this theme were identified by nine participants. The actions / needs related to recognizing the value of Indigenous Knowledge, and taking Indigenous knowledge into consideration around climate change adaptation and decision making.

3.6.10 Other Actions

The following themes include actions / needs that were identified by six or fewer participants, with individual actions / needs mentioned infrequently. Please see Appendix D for the full list of actions within these themes.

- capacity-building (related to knowledge, expertise)
- climate change mitigation
- climate change plans
- climate change vulnerability assessment
- connectivity
- disturbance regime
- harvesting
- land use planning
- leadership
- legislation
- management plans
- non-climate stressors, and
- targeted intervention.

3.7 Discussion of Current and Potential Actions

Figure 1 shows a comparison of key and other themes that were identified under the current actions, potential actions, or both sections. As mentioned above, themes were considered key when they were related to a large number of related actions being identified, a large number of participant mentions, or both.

Figure 1: Themes Identified Around Current and Potential Actions

3.7.1 Themes Being Addressed Through Current Actions

The participant responses show that there was strong awareness of current actions related to the key themes in part A of Figure 1above. These were later identified as other themes in section 3.6 (part F), which suggests that participants see these themes from part A of Figure 1 as less pressing areas for future action . Range planning and wildlife/human interaction were also identified as other themes under current actions (part B of Figure 1) but not under potential actions. This suggests that some action has taken place in these areas and further action in these areas is not thought to be key to climate change wildlife adaptation by interview participants.

3.7.2 Enduring High Priority Themes

Key themes shown in part C of Figure 1 were identified in both the current actions section as well as the potential actions section. This suggests that although action is being taken to address these themes, participants perceived that further action is needed.

3.7.3 Enduring Low Priority Themes

Items in part D were identified as other themes within both the current actions section and the potential actions section. This suggests that while there is some action occurring under these themes and some interest in additonal effort, these areas are of lesser interest to the participants than the themes in part C of Figure 1.

3.7.4 Potential Gaps

The key themes identified under potential actions shown in part E of Figure 1 were not as strongly represented under current actions (part B of Figure 1). This suggests that participants think greater effort should be considered against these areas going forward, and that additional resourcing is required. In addition to these key themes, 'connectivity' and 'management plans' are missing from current actions and first identified under potential actions (in part F of Figure 1). This suggests that although they are a lower priority than the themes in part E of Figure 1, 'connectivity' and 'management plans' are gaps where there is low awareness of related current actions and interview participants believe some future effort is needed.

4. OTHER CONTACTS

Participants were invited to identify additional individuals that GNWT may wish to engage on the topic of climate change wildlife adaptation. A total of 56 additional contacts were identified.

5. COMMUNICATION & ENGAGEMENT

The following section describes interview participant preferences around ongoing engagement and communication from GNWT regarding climate change wildlife adaptation, including the results of the interviews. Interview participants were asked about these preferences in the context of the ongoing COVID-19 pandemic, where in-person workshops to meet and discuss the findings of this project would not be possible for the foreseeable future.

Of those interviewed, 27 indicated a preference regarding engagement[5]. Participants indicated interest in seeing the summary report and among respondents, the most popular method of engagement was video conference / webinar, with 17 (63%) of respondents in favour of this option. Some participants indicated that they preferred small group discussions and short virtual sessions (rather than a day-long virtual meeting). A virtual workshop could also be held in conjunction with the Living on the Land Forum.

Next in popularity was email correspondence (n=11, 41% of respondents), and teleconference / phone call (n=9, 33% of respondents). Other participants suggested postponing the workshop and conducting it in person as originally planned. A few internal GNWT staff suggested communication through internal channels such as the Interdepartmental Species at Risk Committee (InterSARC) or through ADM-level communications. For outward-facing communication, doing so through the Association of Communities

[5] Respondents were able to identify more than one mode of communication / engagement.

was also raised. Three individuals (11% of respondents) indicated that they would like the information to be posted on a website. One respondent noted the importance of engaging with youth. Others offered to be more involved e.g. offering to join an advisory group.

6. SUMMARY

This summary of results from the interviews with a range of stakeholders has shown that common climate change wildlife adaptation goals among these respondents include:

- Ensuring food security for people
- Healthy and functional ecosystems
- Accepting and allowing (slow, "natural") change over time among wildlife species and habitats
- Survival of wildlife populations
- Maintaining habitats with various positive characteristics (abundant, connected, representative, intact habitats)
- Maintaining diversity (biological, ecosystem, species, genetic, habitat)

At the same time, participants indicated that despite a number of activities already underway, further action is needed in the following priority areas to achieve climate change wildlife adaptation goals:

- Collaboration
- Invasive Species (prevention and management)
- Knowledge Generation
- Indigenous Knowledge
- Monitoring
- Protected Areas

Further, participants proposed actions and identified gaps around the following additional priority themes.

- Approach (to climate change adaptation for wildlife)
- Education / Communication
- Resources

These themes were not strongly identified in the description of current actions, which suggests that these may be gaps.

Participants identified additional contacts that GNWT may wish to approach for additional input on this topic. The additional contacts included a large number of scientists, a group who were well-represented within the current group of interview participants. However, the additional contacts identified also include hunters and trappers' groups/members, Indigenous group representatives, and government contacts with different areas of expertise (e.g. hydrology, fire), who may have different perspectives on these topics from current interview participants.

Finally, interview participants provided input on their preferences around continued engagement on this topic. Participants would like to see the report shared and although an in-person workshop would be best, many also supported remote engagement (e.g. via webinar). GNWT could also share the results of the project through internal channels such as the Interdepartmental Species at Risk Committee (InterSARC) and externally through the website and groups such as the Association of Communities where appropriate. Email and teleconferences are also supported by participants.

7. NEXT STEPS

The GNWT Department of Environment and Natural Resources (ENR) is developing an overall climate change adaptation plan for wildlife in the NWT. The interview results described in this report were one activity to identify possible climate change adaptation actions and strategies for wildlife management to support the development of this plan. A jurisdictional scan was also conducted previously to identify climate change adaptation actions and strategies being considered in other northern jurisdictions with relevance to NWT. The results of both of these activities will be reviewed to identify actions that were mentioned by interview participants as well as identified in the jurisdictional scan and which may be of interest to ENR given the goals, challenges, and opportunities identified through the interviews.

APPENDICES

APPENDIX A: FULL LIST OF ORGANIZATIONS INVITED TO PARTICIPATE IN AN INTERVIEW

Contacts from the following organizations were invited to take part in an interview.

Table 1: Invited Organizations

#	Organization
1	Beverly and Qamanirjuaq Caribou Management Board
2	Canadian Wildlife Service, Environment and Climate Change Canada
3	Climate Services, Pan-Canadian Framework Implementation Office, Environment and Climate Change Canada
4	Dehcho First Nations
5	Department of Environment and Natural Resources, Government of the Northwest Territories
6	Department of Environment, Government of Nunavut
7	Department of Environment, Government of Yukon
8	Department of Infrastructure, Government of the Northwest Territories
9	Department of Lands, Government of the Northwest Territories
10	Fish and Wildlife Division, Government of Alberta
11	Government of British Columbia[6]
12	Gwich'in Renewable Resources Board
13	Inuvialuit Game Council, Joint Secretariat Inuvialuit Settlement Region
14	Lands, Resources and Negotiations, Kátł'odeeche First Nation
15	Mackenzie River Basin Board
16	Municipal and Community Affairs, Government of the Northwest Territories
17	North Slave Métis Alliance
18	Northern Environmental Consulting & Analysis (NECA)
19	Sahtú Renewable Resources Board
20	University of Calgary, Faculty of Veterinary Medicine
21	Wek'èezhìı Renewable Resources Board
22	Wildlife Branch of Manitoba Conservation and Water Stewardship, Government of Manitoba
23	Wildlife Management Advisory Council, Joint Secretariat Inuvialuit Settlement Region

[6] The contact identified appears to no longer be employed with this organization

APPENDIX B: INTERVIEW GUIDE: CLIMATE CHANGE ADAPTATION ACTIONS AND STRATEGIES FOR WILDLIFE

Background

The Government of the Northwest Territories, Department of Environment and Natural Resources (ENR) is currently identifying possible climate change adaptation actions and strategies for wildlife management. ENR is looking mostly at terrestrial wildlife and wildlife habitat. The independent firm DPRA Canada has been contracted to support this project.

Your experience and expertise have been identified as critical to inform a strategy using both western science and Indigenous Knowledge.

An initial jurisdictional scan on the topic suggests that key adaptation actions / strategies include those related to:

1. Protection of intact ecosystems and the diversity of species and processes that are part of them
2. Connecting protected areas through sustainably managed landscapes and waterscapes
3. Restoration of degraded ecosystems, and support of species recovery
4. Maintaining or restoring natural disturbance regimes to reflect the natural range of variability characteristic for the ecosystem of interest
5. Consideration of active management approaches, such as assisted migration, where appropriate
6. Governance, management approaches and regulatory actions (e.g. to further the other actions / strategies identified above)

Strategies to protect areas with high carbon storage potential as part of climate change mitigation, and as a last resort, accepting loss have also been identified. Some of the strategies you are aware of may also relate to these action areas.

If you are able to provide reports or other materials that you think would assist ENR with their work on possible climate change adaptation actions and strategies for wildlife management, that would be greatly appreciated.

Questions

8. Please describe **your role** related to wildlife management. This can be generally or related to climate change adaptation.

   [*This will allow the interviewer to better tailor the interview to your role*]

9. What should be the broad **goal(s)** of climate change wildlife adaptation actions / strategies in the NWT over the next 50 years?

   [The goals relate to the vision, the broader objectives for the medium or long term…For example, keeping wildlife and wildlife habitats the same as they are today. This might include keeping out invasive species, or ecosystems that are functional and also provide food security for people but may look different than they do today.]

10. What are the key **challenges** in your region / jurisdiction related to climate change adaptation for wildlife?

[Why are they challenges?]

11. What are the key **opportunities** in your region / jurisdiction related to climate change adaptation for wildlife?

    [If yes, what are they? Why are they opportunities?]

12. Thinking about your responses to the earlier questions (Q. 2 – 4 above):

    a. Do you know of specific **actions that *are being implemented or considered*** that will be **key to successful climate change adaptation** for wildlife? These can be outside your region / jurisdiction.

    b. Can you identify any ***other potential actions that could be taken*** to achieve the broader goal(s) you mentioned?

    [The actions are specific ways to achieve the broad goals identified in Q. 2….If yes, what will be the key to their success? Would they benefit wildlife in the Northwest Territories? Would it be possible to implement this in the Northwest Territories?]

13. Please think about your region / jurisdiction. What is needed for climate change wildlife adaptation that is currently **missing** from wildlife management?

14. We may not be able to involve everyone, but is there anyone else that you suggest we should interview on this topic?

    [If yes, please let us know how we can reach them.]

15. The Department of Environment and Natural Resources was planning to hold in-person workshops later in this project, but due to COVID-19, this may not be possible. How would you like ENR to communicate the results of this project, and to engage with you / others on this topic in the future?

16. Do you have any other comments? Is there anything else you would like us to know, or documents that you would be able to share?

Thank you so much for your time and input today. If you happen to think of additional information you would like to provide following the interview, please feel free to contact us at [EMAIL / PHONE].

APPENDIX C: ACTIONS KEY TO SUCCESSFUL CLIMATE CHANGE ADAPTATION FOR WILDLIFE BEING IMPLEMENTED /CONSIDERED

The following table shows the specific actions identified by interview participants that are being implemented or considered that will be key to successful climate change adaptation for wildlife. Participants may have broad perspectives on actions that are key to successful climate change adaptation for wildlife. The list also includes key actions that were identified in additional information that was provided by participants. A total of 125 actions were identified. Actions are grouped under the following themes:

- Approach (to climate change adaptation for wildlife)
- Capacity-building (related to knowledge, expertise)
- Climate Change Mitigation
- Climate Change Plans
- Climate Change Vulnerability Assessment
- Collaboration
- Disturbance Regime
- Education / Communication
- Harvesting
- Invasive Species
- Knowledge Generation
- Land Use Planning
- Leadership
- Legislation
- Monitoring
- Non-climate stressors
- Prediction
- Protected Areas
- Range Planning
- Targeted intervention
- Indigenous Knowledge
- Wildlife/Human interaction

Table 2: Actions Being Implemented / Considered

#	Theme	Actions Being Implemented / Considered
1	Approach	Ecosystem -based management concepts are being used by GNWT ENR Forest Division
2	Capacity-building	Find creative solutions to recruit, train and retain research expertise in the NWT
3	Capacity-building	Strengthen internal research expertise required to advance Knowledge Agenda research priorities
4	Capacity-building	Sustain and enhance world class regional research facilities and programs
5	Climate Change Mitigation	(outside NWT) Price on carbon emissions (via climate offsets) and energy source shift; (Note: The NWT does also broadly have a price on carbon)
6	Climate Change Mitigation	Gwich'in leading installation of solar panels in Inuvik (30 residences, subsidized, Northern Store)
7	Climate Change Mitigation	Reducing fossil fuel use
8	Climate Change Plans	Climate change plan - 2020 NWT climate change strategic framework and 2019-2023 action plan contains adaptation actions, actions underway

#	Theme	Actions Being Implemented / Considered
9	Climate change vulnerability assessment	NWT (climate change wildlife) vulnerability assessment in progress
10	Collaboration	Indigenous Guardians program to ensure people travelling and fishing along the Inuvik / Tuktoyaktuk Highway are aware of the community hunters and trappers' fishery plan
11	Collaboration	Annual information sharing with harvester groups (changes being observed, their recommendations re: harvesting)
12	Collaboration	Coordinate existing and future research efforts, and bring multiple partners together to advance northern research and innovation
13	Collaboration	Create and maintain mechanisms for the GNWT research community to share information and identify opportunities to collaborate
14	Collaboration	ENR Forest Division is sharing vegetation maps with Wildlife Division in ENR; can help understand how habitat is changing and how climate change will impact wildlife
15	Collaboration	GNWT with Environment and Climate Change Canada (ECCC) is measuring understanding of climate change impacts; addressing need for local weather data
16	Collaboration	Support best practices for working with communities on research
17	Collaboration	Support community research capacity development
18	Collaboration	Wildlife Management Advisory Council (WMAC), Sahtú Renewable Resources Board (SRRB), Gwich'in Renewable Resources Board (GRRB) are looking at caribou habitat / landscape change, scenario modelling; leveraging partnership to manage and adapt in context of current and future change
19	Collaboration	Holistic approach - national discussions around relationship between species at risk and the forest industry
20	Collaboration	Aurora College meeting with GNWT in April / May 2020 to discuss how Environment and Natural Resources Technology could support climate change, e.g. monitoring
21	Collaboration	Guardians program (opportunity for monitoring, getting people on the land)
22	Collaboration	GNWT is working with partners on protected areas and land use planning
23	Collaboration	GNWT scoping how it can support communities with concerns about increasing beaver numbers in the Beaufort Delta (invasive species)
24	Collaboration	Encourage departments' business units to pool resources to solve common research related issues and/or maximize the value of research dollars
25	Collaboration	Reducing disturbance – co-management board working with Transport Canada, Canadian Coast Guard on restrictions related to shipping / cruise ships / pleasure craft traveling the Northwest Passage under the longer ice-free season, to protect caribou
26	Collaboration	GNWT (ENR) climate change gathering in February 2020 was good for networking, informing organizations
27	Collaboration	Multispecies project on climate change with partners including ENR, Indigenous partners, and Environment and Climate Change Canada. Could be a good example for the north

#	Theme	Actions Being Implemented / Considered
28	Collaboration	NWT Living on the Land Forum (and other cross-regional forums, most work has climate change component)
29	Collaboration	Wildlife and fire folks working more together, will likely increase in future
30	Collaboration	Working across jurisdictions for caribou
31	Disturbance Regime	Approach to forest fires in the NWT - under climate change more forest fires, considering changing wildfire control to protect woodland caribou habitat (considering shift from letting wildfires burn to fighting fires); winter caribou habitat is key consideration (priority) for wildlife management in the NWT fire protection framework e.g. GNWT including woodland and boreal caribou habitat in Wek'èezhìi fire management
32	Education / Communication	Possibly new climate change display at the museum (NWT)
33	Harvesting	Harvesting quotas – Hunters and Trappers Committees in the communities have their own quotas
34	Harvesting	Harvesting quotas - NU being considered in context of climate change, being influenced by climate change
35	Indigenous Knowledge	GNWT 'On the Land Unit', Déljnę and Sahtú communities working to build knowledge in alternative local food- Muskox
36	Indigenous Knowledge	Improve GNWT's capacity to include Indigenous Knowledge into research programs
37	Indigenous Knowledge	NWT 'On the Land Unit' and ENR Wildlife Division pursuing a project related to cranberries using Indigenous and community knowledge, may be linkages with wildlife and species at risk
38	Indigenous Knowledge	South Slave Region NWT communities creating maps of land cover with Elders including what types of changes may be good for which species; putting it online and into GIS (help understand baseline and monitor shifts, habitat and wildlife ranges, including Indigenous Knowledge); satellite imagery not as precise
39	Indigenous Knowledge	Indigenous Knowledge and science together is happening
40	Invasive Species	GNWT hired intern to look at invasive species (e.g. feral pigs)
41	Invasive Species	Establish NWT Pests, Pathogens and Invasive Species Council, Action 2.9C funded under the NWT 2019-2023 climate change Action Plan
42	Invasive Species	Wek'èezhìı Renewable Resources Board working with GNWT working group on invasive species
43	Invasive Species	Assess long term impacts of new species, action 7.6 under the NWT climate change action plan 2019-2023 (not funded at this time)
44	Invasive Species	Develop surveillance systems to support predictions of species distribution changes, action 7.6 under the NWT climate change action plan 2019-2023 (not funded at this time)
45	Invasive Species	Vehicle washing stations are being pursued at the NWT border
46	Knowledge Generation	Assess indirect effects of climate change on species at risk, action 7.6 under the NWT climate change Action Plan 2019-2023 (not funded at this time)
47	Knowledge Generation	Research by GNWT and academia into how permafrost melt will affect habitat

#	Theme	Actions Being Implemented / Considered
48	Knowledge Generation	Research carried out by GN with University of Alberta and University of Ottawa examined ability of caribou to adapt to changing timing of spring; the study found the earlier spring green-up on the calving area for coincided with an earlier migration and calving by caribou.
49	Knowledge Generation	Research on permafrost and slumping - can help understand climate change impacts on wildlife and how to manage harvest
50	Knowledge Generation	Understand climate change impacts and stressors on mitigation measures to plan for enhanced resiliency of wildlife, action 8.5 under the NWT climate change action plan 2019-2023 (not funded at this time)
51	Knowledge Generation	Work with wildlife co management partners to consider and assess climate change impacts on habitat for all barren ground caribou herds in the NWT, action 8.5 under the NWT climate change action plan 2019-2023 (not funded at this time)
52	Knowledge Generation	Mapping and logging fires are becoming more precise
53	Knowledge Generation	Efforts underway to understand how to prevent interference from increased sea traffic under climate change, with animal migration
54	Knowledge Generation	Arctic Research Foundation developing plan for research in/ around Great Slave Lake, Mackenzie River, Beaufort Delta and up some tributaries and on the land
55	Knowledge Generation	GNWT is developing an online portal to access climate change data and research
56	Knowledge Generation	Permafrost studies on changes to shorelines and wetlands
57	Knowledge Generation	Research on climate change and boreal caribou / moose decline to inform adaptation
58	Knowledge Generation	Research on erosion to inform adaptation
59	Knowledge Generation	Studies of landscape level pests and pathogens
60	Knowledge generation	GN considering doing climate change risk assessments for sectors, regions, possibly territorial level to identify priorities; looking at best practices across Canada, north, circumpolar north. Risk assessment could inform harvesting recommendations and wildlife management.
61	Land Use Planning	Community-based conservation planning underway in the NWT
62	Land Use Planning	Wek'èezhìı Management Area (WMA) Land Use Plan; GNWT is doing land use planning
63	Land Use Planning	Regional land use plans have been established or are being developed in the NWT to manage land / resource uses and development activity. They consider wildlife in their objectives and have or will have references to climate change.
64	Leadership	GNWT has a Land Use Sustainability Framework to guide decisions around the use of land and land management

#	Theme	Actions Being Implemented / Considered
65	Leadership	(NWT, Sahtú Region) Sahtú Youth Network to engage youth in leadership and governance; all activities try to include knowledge transfer from Elders to Youth
66	Leadership	NWT climate change council being developed
67	Legislation	New regulations in the NWT on importing southern products e.g. deer meat for wildlife disease prevention; no harvest restrictions on deer to limit spread
68	Legislation	Yukon has animal health legislation that supports response to animal disease and invasive species; allows for maintenance and infrastructure, staff; lacking in the NWT and may become bigger issue with push for agricultural strategy in the NWT
69	Legislation	Consider regulatory amendments to Wildlife Act depending on changes in species distribution, action 8.5 under the NWT climate change action plan 2019-2023 (not funded at this time)
70	Legislation	NWT Species at Risk legislation incorporates Indigenous Knowledge in recovery / management plans looking at climate change and habitat; some species listed in the NWT but not federally
71	Monitoring	Apps to record harvester observations e.g. community-based monitoring via Inuvialuit Joint Secretariat, Indigenous Knowledge social network – Arctic Elder Society
72	Monitoring	Baseline monitoring of species (with partners); have good information base (plants, animals, insects, etc.)
73	Monitoring	CircumArctic Rangifer Monitoring and Assessment Network (CARMA) for caribou monitoring; CARMA supports collaboration among scientists, managers and communities in different jurisdictions and countries to support monitoring and knowledge generation to support caribou; previously federally funded; some piecemeal monitoring continues but problems - lack of freezer space, staff time, archival space, lack of academic support to analyze samples
74	Monitoring	Chronic wasting disease (may spread north into NWT due to climate change) from hunter moose heads
75	Monitoring	Continue monitoring invasive and non-indigenous species and assess impacts from range shifts on wildlife, Action 2.9B Funded under the NWT climate change 2019-2023 Action Plan
76	Monitoring	Enhance monitoring of invasive and non-indigenous species for ongoing assessment of impacts on wildlife, action 7.6 under the NWT climate change action plan 2019-2023 (not funded at this time)
77	Monitoring	Monitoring currently for feral pigs - concerned they will enter NWT; need regulation changes to eradicate this invasive, highly disruptive species
78	Monitoring	Harvest reporting program to ENR (almost 100% participation rate for large game, even small game, First Nation in South Slave Region); community-based programs may not be sustainable, dependent on federal funding and academic interests and priorities of universities
79	Monitoring	More monitoring of disease and disease vectors in South Slave and other NWT regions (e.g. harvested heads for chronic wasting disease, for small

#	Theme	Actions Being Implemented / Considered
		mammals to identify other new disease vectors (e.g. ticks), insect monitoring)
80	Monitoring	U of Calgary project community-led (NWT, NU) wildlife population health monitoring - ongoing data collection from harvested animals (tracking animal conditions, infectious diseases (including those that impact people), early detection of population changes), interviews to establish baseline knowledge and track changes annually; collaboration among communities, government, academia; transferrable to any species
81	Monitoring	Cumulative Impact Monitoring Program (CIMP), Indigenous Knowledge program on traditional harvest techniques
82	Monitoring	Federal climate change monitoring program uses both Indigenous Knowledge and science, looks at multiple indicators
83	Monitoring	Guardians program e.g. Tłı̨chǫ Boots on the Ground (monitors caribou migration, population surveys, monitor herd health); Guardians fund for land monitoring program
84	Monitoring	(In Nunavut) May not be adequate but need to keep monitoring programs that already exist
85	Monitoring	(in Yukon) U of AB developed ecological benchmarks in Yukon and looking to implement in Alaska (identified reference sites, identify response to human disturbance within the reference sites)
86	Monitoring	Alberta Biodiversity Monitoring Initiative dropped a grid over the province, regularly sample the ecological conditions and species on the grid square to understand changes over time
87	Monitoring	Canadian Wildlife Service monitoring migratory birds
88	Monitoring	Community-based monitoring and management plans are being increasingly rolled out in Nunavut; more holistic than harvest restrictions (appropriate for climate change a holistic problem)
89	Monitoring	Community-based monitoring with the Joint Secretariat
90	Monitoring	Monitoring including community-based monitoring to track species as they extend ranges and become established in the NWT, action 7.6 under NWT climate change action Plan 2019-2023 (not funded at this time)
91	Monitoring	Intestinal parasites (life cycle may speed up under climate change) (NWT)
92	Monitoring	Monitoring in the NWT, including in collaboration with communities in some areas
93	Monitoring	Moose health; important food sources (NWT)
94	Monitoring	More water, soil monitoring is occurring
95	Monitoring	NWT including ecosystem monitoring, state of the ecosystem reports - provide baseline to see and measure changes, help NWT interact appropriately with changed landscape
96	Monitoring	Some climate monitoring
97	Monitoring	Trapping mosquitoes and moose ticks (NWT)
98	Monitoring	Tuberculosis in bison (NWT)
99	Monitoring	Wolf and caribou movement in Wood Buffalo National Park
100	Monitoring	YK and BC have structured monitoring; not in the NWT

#	Theme	Actions Being Implemented / Considered
101	Non-climate stressors	Minimizing non-climate change stressors – e.g. minimizing impact of new development, through habitat restoration outside of NWT; less relevant to NWT where there is a lot of intact habitat
102	Prediction	The CircumArctic Rangifer Monitoring and Assessment Network (CARMA) has a modeling tool and indices of changes to climate indicators and how caribou experience the landscape
103	Protected Areas	The North American Waterfowl Management Plan (since 1986), which has seen $2.3 billion invested in wetland conservation in Canada.
104	Protected Areas	Finding and protecting key habitat for caribou from development, in most caribou management plans
105	Protected Areas	$500 million Canada Nature Fund....had three goals: Indigenous reconciliation through conservation, transforming the federal government's approach to protecting species at risk, and meeting Target 1 (17% of Canada's land and freshwater protected by 2020). 39M hectares have or will be protected or conserved because of this fund.
106	Protected Areas	Community-based protected areas, but not recognized by GNWT
107	Protected Areas	Conservation network being established
108	Protected Areas	Conservation zone development, creation of climate refugia in the NWT
109	Protected Areas	(Nationally) The Cree Nation Government's (CNG) protected area strategy is based on the Cree Regional Conservation Strategy, which aims to: promote and sustain the interconnectedness of the community; protect wildlife, which is also a cultural food source; ensure full Cree participation in conservation management and planning; ensure Cree knowledge plays a central role in conservation; build Cree capacity; and they are starting to seriously take action climate change, among other goals. Currently 15% of the territory is fully protected and they are looking to protect 20%, and an additional 30% to non-industrial development....There is now a strategic approach to protecting areas, using both science and Indigenous Knowledge.
110	Protected Areas	Dark Woods Conservation and Forest Carbon Project is led by the Nature Conservancy of Canada. In SE British Columbia, it is one of North America's largest carbon sequestration areas...The forest is divided into zones, and certain zones are focused on biodiversity targets. There are many co-benefits of the project, which include: connecting corridors, water protection, protection of old growth forest, research, recreation, species and breeding habitat protection, and experimental forestry harvest.
111	Protected Areas	Federal target of 25% of Canada's land by 2025 and 30% by 2030
112	Protected Areas	GNWT is establishing protected areas (thinking of protecting representative ecosystems and habitats, habitats resilient to climate change)
113	Protected Areas	Indigenous Guardians Pilot Program supported 30 Indigenous-led proposals protecting over 300,000 km2 of land (in Canada)
114	Protected Areas	Indigenous protected areas underway in the NWT
115	Protected Areas	Made-in-Manitoba Climate and Green Plan was created in 2017, and had money specifically set aside for conservation (to the Winnipeg Foundation in a trust so that future governments couldn't go back on the funding). The

#	Theme	Actions Being Implemented / Considered
		purpose of the fund was specifically around natural infrastructure and landscape-based approaches that would have the following co-benefits: improving biodiversity, soil health, protecting priority wildlife, sequestering carbon, and improving water quality
116	Protected Areas	Marine protected area with federal government in the NWT
117	Protected Areas	New future protected area in the Wek'èezhìı Management Area on north shore of Great Slave Lake (of cultural significance to Indigenous groups, to be designed federally as important migratory bird habitat)
118	Protected Areas	Planning for protected areas
119	Protected Areas	Protected areas in Nunavut
120	Protected Areas	Tłı̨chǫ Government looking at establishing Protected Area for barren ground caribou habitat
121	Range Planning	Caribou range plans - e.g. Bathurst caribou range plan (different from Bathurst caribou management plan), boreal caribou range plan being developed in WMA and other regions, includes a climate change adaptation working group
122	Range Planning	Habitat planning – with co-management system
123	Targeted intervention	(outside NWT) Building shade habitat (where the impact is clearly understood; lack of understanding makes this challenging for NWT)
124	Targeted intervention	(outside NWT) Considering how much to facilitate / resist shifts through facilitated or assisted adaptation movement; in the NWT nowhere for species to go
125	Wildlife/Human interaction	(NWT, Sahtú Renewable Resources Board): has supported climate change health adaptation activities (federally funded)

APPENDIX D: POTENTIAL ACTIONS THAT COULD BE TAKEN TO ACHIEVE CLIMATE CHANGE WILDLIFE ADAPTATION GOALS / WHAT IS NEEDED FOR CLIMATE CHANGE WILDLIFE ADAPTATION THAT IS MISSING FROM WILDLIFE MANAGEMENT

The following table shows potential actions that could be taken to achieve the broader goal(s) of climate change wildlife adaptation identified by the interview participants. This section also includes actions that participants identified as needed for climate change wildlife adaptation that are currently missing from wildlife management, as well as actions that were identified in additional information that was provided by the participants. A total of 162 actions and needs were identified through the interviews. The actions and needs are grouped under the following themes:

- Approach (to climate change adaptation for wildlife)
- Capacity-building (related to knowledge, expertise)
- Climate Change Mitigation
- Climate Change Plans
- Climate Change Vulnerability Assessment
- Collaboration
- Connectivity
- Disturbance Regime
- Education / Communication
- Harvesting
- Invasive Species
- Knowledge Generation
- Land Use Planning
- Leadership
- Legislation
- Management Plans
- Monitoring
- Non-climate stressors
- Prediction
- Protected areas
- Resources
- Targeted intervention
- Indigenous knowledge

Table 3: Potential Actions / Needs

#	Theme	Potential Actions / Needs
1	Approach	Need to think about how people will interact with changed ecosystems e.g. caribou hunting may have to change
2	Approach	Anticipate and prepare for change, some effort but don't focus on conserving specific species, ecosystems
3	Approach	Ecosystem landscape analysis through ecosystem-based management (look at what makes the landscape strong under climate change, look at groups of species not a single species to inform adaptation for a group of species)
4	Approach	Avoid maladaptation (e.g. spraying insecticide to control mountain pine beetle and impacting species that eat the beetle)
5	Approach	Collective management strategy to protect wildlife
6	Approach	Consider practical and theoretical management approaches at different levels -species, ecosystem
7	Approach	Diversity of management actions "climate smart conservation" measures (US) e.g. manage for change not persistence

#	Theme	Potential Actions / Needs
8	Approach	Monitoring / management of/on species beyond the key ones of interest to people (other ones may be of high ecosystem value)
9	Approach	Need to shift to big picture - stop looking at single species and large mega fauna only; go beyond caribou
10	Approach	Holistic approach – need integrated approach including community planning, transportation, forests, fire, health, economy in the adaptation plan
11	Approach	Integrate wildlife climate change adaptation into other government plans and policies
12	Approach	Management approaches need to consider climate change but also other drivers of change, cumulative effects
13	Approach	Need to identify novel and bold measures for conservation (traditional methods are not working)
14	Approach	Adaptation needs to be long term and planned
15	Approach	Need to shift from reactive mode to proactive approach
16	Approach	Shift from mitigation to adaptation - need to think about adaptation not only mitigation
17	Approach	Develop management questions to guide research, monitoring and tool development
18	Approach	Adaptive management
19	Approach	Response is a weak point (in wildlife management for climate change adaptation); need to not only detect and predict changes but to respond to changes
20	Approach	Focus limited resources on actions that make the most difference
21	Approach	Need to think strategically for evidence-informed adaptation (need to identify why species are doing poorly, knowledge gaps to understand, what is needed and how long it will take to gather the knowledge)
22	Capacity-building	Build capacity and interest among youth
23	Capacity-building	Need a broader knowledge base in staff e.g. entomologists, biologists, veterinarians, individuals with knowledge of human behaviour and behaviour change
24	Capacity-building	Need to make a plan to increase knowledge base
25	Climate Change Mitigation	Increase incentives for local residents for alternative energy use
26	Climate Change Mitigation	Consider mitigation not only adaptation for industry (e.g. renewable energy, truck load efficiency reduces greenhouse gases and disturbance to caribou habitat)
27	Climate Change Plans	Climate change wildlife adaptation plan is key
28	Climate Change Vulnerability Assessment	Understand species vulnerability to climate change
29	Climate Change Vulnerability Assessment	Climate change vulnerability assessment

#	Theme	Potential Actions / Needs
30	Climate Change Vulnerability Assessment	Results of vulnerability assessment to identify missing pieces
31	Collaboration	Communities share knowledge; GIS specialists to move into mapping
32	Collaboration	GNWT Forest Manager ENR open to working with Wildlife Division to collect additional information together (e.g. how vegetation is impacted by permafrost melt under climate change, changes to forest landscape); Forest Manager has tools to provide spatial understanding of wildlife habitat
33	Collaboration	GNWT ENR Wildlife and Forest Divisions should work together
34	Collaboration	Better collaboration
35	Collaboration	Need to collaborate among different levels of governments, non-profit groups, industry, academia to share expertise, info and aligning interests for making climate change adaptation decisions; discuss options
36	Collaboration	Work across jurisdictions for species other than caribou
37	Collaboration	(In NU) GN climate change secretariat, bring together community climate change needs, researchers, funding opportunities
38	Collaboration	(in NU) Annual research meeting in NU could help with coordination, to take climate change priorities and help develop research programs around them
39	Collaboration	Ensure that the GNWT vulnerability assessment and the climate change adaptation plan are linked between GNWT Wildlife Division and Forestry Division including around timelines
40	Collaboration	Community conservation - developing plans for community to decide how they want to protect and have relationship with the land
41	Collaboration	Community planning approaches
42	Collaboration	People have different knowledge and observations, talking to more people provides a better understanding of what is happening to the landscape and wildlife
43	Collaboration	Need to increase diversity in participants (Sahtú RRB actively working to address age, gender bias e.g. cranberry knowledge project)
44	Collaboration	Community consultation key to success of management plans
45	Collaboration	Community leadership (Sahtú communities want to be cogoverning / leading monitoring and research with universities e.g. Northern Water Futures Program, Tracking Change, Community Winter Track project with ENR)
46	Collaboration	Coordination (other jurisdictions) especially re: chronic wasting disease
47	Collaboration	Integrate local knowledge into wildlife monitoring and surveillance; feeds into collaboration around development of management plans and support for related wildlife management actions
48	Collaboration	Equitable sharing of power and authority between federal and Indigenous resource managers; the importance of engaging diverse user groups and Indigenous Knowledge as well as scientific knowledge to understand key features of target species

#	Theme	Potential Actions / Needs
49	Collaboration	Need Federal /territorial harvest guidelines in a rights and status agreement with Indigenous peoples to provide certainty
50	Collaboration	Need Indigenous governments to control harvesting to make sure harvesting supports adaptation
51	Collaboration	Species are transboundary - can work with people with different knowledge, perspectives
52	Collaboration	Need expanded coordinated data collection, research, monitoring
53	Connectivity	Connecting conservation areas (give species space to shift range/ migrate/ etc.); reasonably feasible in the NWT
54	Connectivity	Network of protected areas all landscape types, corridors
55	Connectivity	Ensure enough habitat for species to be able to move to new areas
56	Disturbance Regime	Restoring disturbance regime in the NWT; may need controlled fires in future (e.g. re: pine bark beetles)
57	Disturbance Regime	Prepare for different fire and moisture regime under climate change but unsure of exact concrete actions
58	Education / Communication	Increased tourism under climate change is an opportunity to educate on climate change
59	Education / Communication	Learn from other jurisdictions' mistakes
60	Education / Communication	Need public health messaging if zoonotic disease anticipated with climate change
61	Education / Communication	Public education about zoonotic diseases
62	Education / Communication	Use the climate change wildlife adaptation plan to help identify research needs to academia
63	Education / Communication	Climate change education for public for buy-In to do adaptation, behaviour change, Indigenous Knowledge has a role
64	Education / Communication	Change viewpoint of wetland's value to general public; need to include Indigenous perspectives and science perspectives in education
65	Education / Communication	GNWT provide more communication about climate change projects so that organizations can prioritize
66	Education / Communication	Education for public about impact of climate change on wildlife, habitat, and possible action (e.g. connectivity, monitoring, personal climate change mitigation), changing expectations - public education very feasible
67	Education / Communication	Proactive government climate change education - if people were more conscious of the damage to wildlife, could help; small climate change mitigation actions can make a difference; lack of public awareness makes it hard to support adaptation
68	Education / Communication	Actions could be identified in the Outreach and Communications Plan for the NWT Climate Change Strategic Framework to support the climate change wildlife adaptation plan
69	Education / Communication	Need to be motivated to take action on climate change
70	Education / Communication	Education for public to reduce invasive species coming into NWT

#	Theme	Potential Actions / Needs
71	Education / Communication	Increase knowledge of wildlife adaptation issues, actions, progress
72	Education / Communication	Structural support / incentives for behaviour change
73	Education / Communication	Need for awareness of link between climate change and work / activities e.g. forestry
74	Harvesting	Help people adapt to climate change impact on harvesting, change harvesting or harvesting expectations, need communication and buy-in; GNWT (ENR) with Inuvialuit co-management bodies should update harvesting / management posters
75	Harvesting	Restrict fall/ spring caribou hunting and avoid calving areas; avoid polar bear denning areas; harvest fewer females and more males both caribou and polar bear
76	Harvesting	Limit / change harvesting to reduce non-climate stressors, to control invasive species
77	Harvesting	Support alternative harvesting to support country food
78	Indigenous Knowledge	Dene identities and ways of life are core to the practices of conservation and knowledge
79	Indigenous Knowledge	Recognize value of Indigenous Knowledge; include it in climate change adaptation - people can detect changes over time; Indigenous peoples are there for longer than southern researchers (dissatisfied with ArcticNet program and Australian, Greenland researchers are not supporting Indigenous Knowledge; sometimes biologists identify 'new species' that Indigenous Knowledge holders say have been there forever)
80	Indigenous Knowledge	Indigenous Knowledge in decision making; utilization of Indigenous Knowledge as a way to move forward with self government and reconciliation
81	Invasive Species	Manage invasive species
82	Invasive species	Prevent / limit invasive species and diseases from south (e.g. with a policy)
83	Invasive species	Prevent parasites
84	Invasive species	Prevent wildlife diseases (incl from domestic species)
85	Invasive Species	Need invasive species and disease, predator information
86	Invasive Species	Understand species migration from south
87	Knowledge generation	Research / GNWT to collect information required to understand climate change impacts on wildlife including status of species in the NWT - as per 2017 OAG Report to NWT Legislative Assembly; research missing because of lack of resources
88	Knowledge generation	Need to know the impact of disease; don't currently understand it and don't currently put resources into this; not accounted for in current models (critical because zoonotic diseases are important for people, food safety, trapper health, for wildlife sustainability)
89	Knowledge generation	Need to better understand forest and landscape dynamics in the NWT; forest and landscape changes after a fire; where caribou, moose and bison are migrating to

#	Theme	Potential Actions / Needs
90	Knowledge generation	Need to better understand interactions of climate on forests (e.g. fire, natural disturbances) for better management decisions)
91	Knowledge generation	Need more information to support decision making
92	Knowledge generation	Need to strengthen research presence in the NWT; more collaboration and work with academia
93	Knowledge generation	GNWT to conduct risk assessment for overall wildlife management strategy to ensure climate change risks to wildlife have been identified - as per 2017 OAG Report to NWT Legislative Assembly
94	Knowledge generation	Should understand small not just large species
95	Knowledge generation	Need a university in the NWT to increase knowledge
96	Knowledge generation	Turnover in government staff is an issue; need to send senior not junior people to communities; researchers need to plan longer trips because the north is very weather dependent and need to anticipate potential delays rather than cancellation
97	Knowledge generation	Community-based knowledge generation
98	Knowledge generation	Need research, (communities, government) to work better with researchers
99	Knowledge generation	Understand baseline
100	Knowledge generation	Identify (existing) climate change impacts (as quickly as possible)
101	Knowledge generation	Understand climate change impacts
102	Knowledge generation	Identify likely climate change impacts
103	Knowledge generation	Access to data, research
104	Knowledge generation	Identify climate change adaptation methods
105	Knowledge generation	Understand ecosystem function
106	Knowledge generation	Understand functioning ecosystems
107	Knowledge generation	Understand interaction of climate change and other drivers of change
108	Knowledge generation	Understand interactions wildlife, health, changing landscapes and diseases
109	Knowledge generation	Understand pathogens
110	Knowledge generation	Understand wildlife genetics

#	Theme	Potential Actions / Needs
111	Land Use Planning	Consider GNWT Land Use and Sustainability Framework principles: balanced and sustainable, responsible and responsive, respectful, relevant and informed, coordinated and collaborative, fair and equitable, and transparent and accountable
112	Land Use Planning	Improve regional land use plans to be more responsive to changing interests, info
113	Leadership	Leadership
114	Legislation	Change in legislation to address climate change
115	Legislation	Strong policy to protect species at risk can have a positive long-term impact on forested areas
116	Management Plans	Ecosystem-based management plans, not species-specific
117	Management Plans	Management plans to protect habitat from development and slowly change under climate change
118	Management Plans	Need to make wildlife management plans easy, simple, can be used by government, communities, and co-management boards
119	Management Plans	Faster response - management plans and recovery plans need to move more quickly, streamline agreements, collaboration, avoid politics
120	Monitoring	Monitoring
121	Monitoring	Community partnership/ community-based monitoring
122	Monitoring	Monitoring - (In Nunavut) baseline and targeted monitoring for effects of climate change on species of interest (caribou, polar bears); needed to take the right action to address the issue or if your actions are working.
123	Monitoring	Monitoring of wildlife diseases, agricultural diseases, diseases that impact humans; currently no monitoring, mandate or legislation for domestic animal health in the NWT; need monitoring and monitoring infrastructure)
124	Monitoring	Need baseline and progressive habitat monitoring
125	Monitoring	NWT should do something similar to the ecological benchmarks developed in YK, could be job creation program with Indigenous partners and build community capacity
126	Monitoring	Communities need to design, implement and adhere to/enforce own monitoring and harvesting guidelines
127	Monitoring	Broaden monitoring actions to more species where information is lacking
128	Monitoring	For diseases and invasive species; needed and definitely feasible in the NWT
129	Monitoring	Monitoring (in NU) needs to shift from wildlife aerial surveys to community-based monitoring and including Indigenous Knowledge
130	Monitoring	Need earlier detection of changes
131	Non-climate stressors	Make sure human activities don't exacerbate current / future change; Manage people, not wildlife; adjust unsustainable human activities
132	Non-climate stressors	Limit non-climate change disturbance to habitat

#	Theme	Potential Actions / Needs
133	Non-climate stressors	Non- climate change stressors: NWT needs to reduce (e.g. new development, increase climate change resilience with minimal non climate change stressors)
134	Prediction	Climate change projections / modeling (i.e., prediction)
135	Protected areas	Protected areas
136	Protected Areas	Expanding planned protected areas to consider climate change needs of species and people emphasizing corridors and connectivity;
137	Protected Areas	Expansion of protected areas related to, and protected forests to include- carbon-dense /high biodiversity ecosystems / forests
138	Protected areas	Creating Indigenous protected areas (IPAs)
139	Protected Areas	Expanding Indigenous Protected and Conserved Areas (IPCA) and recognizing Indigenous rights and governance
140	Protected Areas	Scaling up financing for protected areas and Indigenous-led management
141	Protected Areas	Wetlands - ensuring Indigenous peoples are core to decision-making, and Indigenous Knowledge is included in conservation and education
142	Protected areas	Need sufficient intact habitat and connectivity between habitats for wildlife survival
143	Protected areas	Protect habitat from industry
144	Protected areas	Protect refugia and adapt when they eventually change
145	Protected Areas	Accept that species will change and prioritize protecting the stage (habitat) except unless a species is culturally valuable or threatened
146	Protected areas	Protect/maintain habitat of species valuable to people, across their range
147	Protected Areas	Limiting development and wildfires on areas with permafrost; may be linked to better wildlife habitat
148	Resources	Limited resources (see also challenges)
149	Resources	Need resources - money, time, specialist staff- to make wildlife management plans and consult with communities
150	Resources	Resources - dedicated resources: needed with buy-in from governments (all levels), community leaders
151	Resources	Resources - Dedicated resources: All climate change adaptation goals require prioritization and long-term commitment to achieve; all funding is short-term; academics rarely have long-term funding as they are not hired to monitor (they are hired to generate new research)
152	Resources	Need independent monitoring to ensure funding and resources continue separate from political priorities (e.g. like Canadian Wildlife Health Cooperative, which has no node in the north). The NWT lacks labs, facilities to handle animals Currently sending animals south from the NWT to process and not prepared to dispose of diseased tissue if there is outbreak.
153	Resources	Resources - high cost for community monitoring projects in NU
154	Resources	Resources- need proper funding and programming for community-based approach to community conservation and Guardian program
155	Resources	Resources: lack of staff to analyze the data

#	Theme	Potential Actions / Needs
156	Resources	Resources: need funding and resources for wildlife management in the NWT; lots of funding spent on consultation but needs to be used wisely (travel eats so much of the budget)
157	Resources	Resources: need resources to ensure sufficient monitoring of species and the NWT (some species and some parts of the NWT are not being monitored adequately)
158	Resources	Staffing - make invasive species intern position permanent
159	Targeted intervention	Address climate change risks identified (through efforts to collect information to understand climate change impacts on wildlife) fulfilling commitments previously identified as important to addressing climate change impacts on wildlife - as per 2017 OAG Report to NWT Legislative Assembly
160	Targeted intervention	Active intervention to support ecosystems (e.g. prescribed burns, releasing water from the dam)
161	Targeted intervention	Assisted migration - might help in some circumstances as a shorter-term strategy to conserve some ecosystems
162	Targeted intervention	Effective rehabilitation programs for Species at risk - SAR, threatened, endangered

APPENDIX E: ADDITIONAL INFORMATION SOURCES PROVIDED BY INTERVIEW PARTICIPANTS

In a number of cases, participants provided additional information to supplement the information they provided through the interviews. The following is a list of the additional information sources received. These sources have been integrated into the interview results summary above.

CARMA - About. (n.d.). Retrieved May 26, 2020, from https://carma.caff.is/index.php/about-carma

Government of the Northwest Territories. (n.d.). *Government of the Northwest Territories Knowledge Agenda: Action Plan 2019-2024*.

Kutz, S., & Tomaselli, M. (2019). "Two-eyed seeing" supports wildlife health. *Science*, *364*(6446), 1135–1137. https://doi.org/10.1126/science.aau6170

Mallory, C. D., Williamson, S. N., Campbell, M. W., & Boyce, M. S. (2020). Response of barren-ground caribou to advancing spring phenology. *Oecologia*, *192*(3), 837–852. https://doi.org/10.1007/s00442-020-04604-0

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Tomaselli, M., Kutz, S., Gerlach, C., & Checkley, S. (2018). Local knowledge to enhance wildlife population health surveillance: Conserving muskoxen and caribou in the Canadian Arctic. *Biological Conservation*, *217*, 337–348. https://doi.org/10.1016/j.biocon.2017.11.010

Zingel, A. (2020, May 5). Qamanirjuaq caribou adapt to early spring: University of Alberta study. *CBC News*. https://www.cbc.ca/news/canada/north/qamanirjuaq-caribou-migration-1.5555378[7]

[7] Note: In the analysis, the source Zingel (2020) has been grouped together with the source Mallory et al. (2020) as the article is a description of the source Mallory et al. (2020)