Name of the case study	Dempster Highway – Highway development and Porcupine caribou herd (PCH) – Yukon and Northwest Territories, Canada [Resilience]	
What about this case makes it interesting? How does this case contribute to understanding of resilience and/or regime shifts in the Arctic?	With the construction of the Dempster Highway – *the road to resources*- in the 1960s, formerly remote communities in the Canadian Arctic became a lot more accessible. This case study focuses on how the introduction of this new infrastructure transformed local social systems and the way in which they deal with their primary resources; the Porcupine caribou herd (PCH). Historically, the indigenous population of this area applied a migratory lifestyle, following the migratory route of the herd as it provided them with food and clothing. However, as these communities became sedentary and new hunting strategies got introduced along with the Dempster highway, their hunting strategies changed. Out of fear that the migratory route and the population of the PCH would decrease, national and territorial government introduced many policy changes to steer their management. Of main interest in this case is the co-management efforts of the Canadian government together with indigenous leaders through the Porcupine Caribou Management Board. The Board usually uses modelling to replace lack of census data on the PCH. This case, however, focuses on an event when this board incorporated traditional ecological knowledge on the PCH when scientific information was lacking with the rule "let the leaders pass". While this rule was later rescinded, this case focuses on a process that resulted from a management board that focuses on consultation and consensus of parties and demonstrated the scope for integrating different interests, scales and knowledge types in management and governance.	
Template completed by:	Dries Stevens, Stockholm Resilience Centre Juan Carlos Rocha, Stockholm Resilience Centre	**Key references: Cite in the text using (1), (2), (3) etc. and provide a reference list at the bottom of the template.** (1) Padilla, E. and G. P. Kofinas. 2014. "Letting the leaders pass": barriers to using traditional ecological knowledge in comanagement as the basis of formal hunting regulations. *Ecology and Society* 19(2):7. http://dx.doi.org/10.5751/ES-05999-190207 (2) Nicolson, C., M. Berman, C. Thor West, G. P. Kofinas, B. Griffths, D. Russell, and D. Dugan. 2013. Seasonal climate variation and caribou availability: Modelling sequential movement using satellite-relocation data. *Ecology and Society* 18(2):1. http://dx.doi.org/10.5751/ES-05376-180201 (3) Bali, A. and G. P Kofinas. 2014. Voices of the caribou people: A participatory videography method to document and share local

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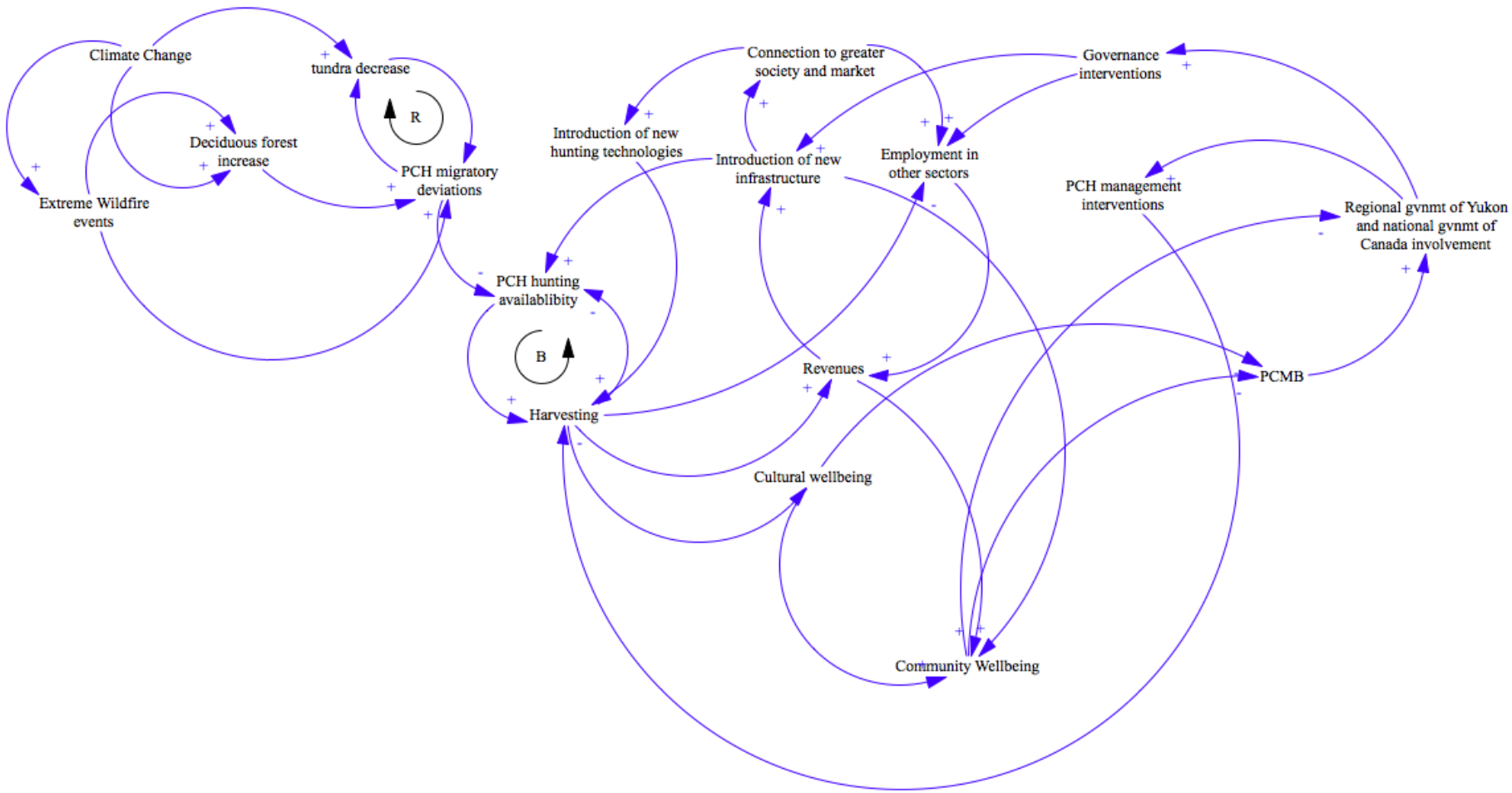
Reviewed by (name and affiliation)	Douglas Clark, University of Saskatchewan							
Category (mark with X)	**Resilience/ Adaptability**			**Loss of resilience**			**Transformation**	
	X							
Case study details:	**Country**	**Place**		**Scale – space**	**Scale – time**		**Sector(s)**	**Other (e.g. disturbance)**
	Canada	Yukon and NW territories – settlements along Dempster Highway		750 kilometres	1950s-present		Caribou management and road infrastructure	Top-down decisions regarding caribou migration and hunting and highway construction
Drivers (mark with X in appropriate boxes)	**Climate**	**Geopolitical**	**Mineral/ oil extraction & infrastructure**	**Tourism**	**Shipping**	**Biological invasion**	**Rapid demographic change**	**Other: *state here***
	x (unsure – may be affecting fire regimes and other components and processes)	X						X - highway planning and construction; hunting technologies

	Biophysical	**Social**
1. Basic description of coupled social-ecological system in focus (What are the key components and stake holders) If possible, draw a systems diagram or conceptual map of the case – this can be a series of diagrams to capture different periods in the case and the drivers/ actors/ events that characterize the period.	**a) What types of ecosystem(s) and other major biophysical features are present?** This case is delimited by the activity of hunting of Porcupine caribou along the Dempster Highway in the western Canadian Arctic. Arctic tundra and boreal forest biome. Key components include: - **Porcupine caribou** (*Rangifer tarandus*) **b) How are the case boundaries defined in terms of ecosystems or biophysical characteristics?** Even though the Porcupine caribou herd (PCH) follows a large migratory pattern (with annual migrations varying from 800 to 3000 km), the case is delimited to hunting practices along the Dempster Highway. The highway cuts right through the Arctic tundra and boreal forest. The Dempster Highway is a 736 kilometre gravel, two-lane road running from central Yukon Territory to Inuvik, Northwest Territories. For the settlements along the highway, it is the only year-round road connection.	**c) Who are the key groups of people in this case?** - Indigenous residents of Yukon and Northwest Territories. The main article which provided the basis for this case focused on three settlements along the Dempster Highway, i.e. Dawson City (population 1327), Fort McPherson (population 776), and Old Crow (population 253). The communities in question are not all entirely made up of indigenous people. Specifically, hunters are important in this case. Hunters from communities that are not along the highway also hunt the PCH. - Local political leadership in each First Nation is provided by an elected Chief and Council, with guidance by elders. Both Yukon and NWT First Nations people have an Aboriginal right to hunt Porcupine caribou, unless there is a conservation issue. - Porcupine Caribou Management Board: Advisory board through recommendations to the government. - Territorial Government of Yukon and National Government of Canada - Non-indigenous residents of Yukon and Northwest Territories **d) What kinds of livelihoods are important in the system?**

		This case mainly focuses on hunting of the Porcupine caribou herd (PCH) along the Dempster highway - Hunting the PCH for food and clothing, as well as for their cultural heritage, is important for the local communities. However, the extent to which they depend on hunting varies between the different communities. Old Crow is almost entirely dependent on the PCH, whereas Dawson City also dependent on the PCH for its economy, there are also revenues from gold mining and tourism. And even though Dawson harvests caribou, the community is much more dependent on moose. **e) What institutions are key to this case? If possible, define what scale it addresses.** - Porcupine Caribou Management Agreement (PCMA): Agreement between the Government of Canada, Yukon Government, Northwest Territories Government, the council for Yukon First Nations, the Inuvialuit Game Council, The Dene Nation and the Métis Association of the Northwest Territories. Legislative framework for caribou hunting done by indigenous people. As a part of the agreement, the Porcupine Caribou Management Board (PCMB) was created. - Canadian Aboriginal Law: The body of law which is concerned with the rights of indigenous people in Canada. **f) How are the case's boundaries socially defined, and how do these social boundaries relate to biophysical boundaries?**

		The Dempster Highway is a 736 km gravel, two-lane road running from central Yukon Territory to Inuvik, Northwest Territories. For the settlements along the highway, it is the only year-round road connection. The PCH migrate over areas beyond the highway and hunters hunt the caribou in these areas as well as come to the highway to hunt. The highway is important as it bisects a wide range of the Porcupine caribou migration and wintering range.


Climate Change
tundra decrease
R
Deciduous forest increase
PCH migratory deviations
Extreme Wildfire events
Connection to greater society and market
Governance interventions
Introduction of new hunting technologies
Introduction of new infrastructure
Employment in other sectors
PCH management interventions
Regional gvnmt of Yukon and national gvnmt of Canada involvement
PCH hunting availablibity
B
Revenues
PCMB
Harvesting
Cultural wellbeing
Community Wellbeing

2. Timeline Draw a timeline of *key* events/ developments to the case. Points to include: Make clear the period of time over which the change is being considered. Provide a brief description of event/ actors, and ecological impacts. Mark particularly significant events with *. Consider both biophysical and social dimensions. Additional points that can be considered: Is it possible to identify periods of change from one type of system to another, transformations?	The article (1) which constituted the basis of this case already applied a historical analysis: **Phase one: traditional hunting (pre-contact to 1950s)** In this time, hunting was sustenance-based and necessary for survival. - 1950s to 1970s: Introduction of new harvesting technologies such as snowmobiles and automobiles, changed the traditional ways of hunting by foot and dog sled. **Phase two: pre-comanagement: Dempster Highway construction to completion and signing of the Canadian PCMA (1960s-1985)** - 1959: Canada's Prime Minister John Diefenbakker announced the construction of the Dempster Highway. - 1977: top Yukon government officials: "Hunting caribou is not necessary in contemporary society". - 1977: abnormal calving year - 1978: The Yukon Government Department of Renewable Resources formed a Dempster Highway committee to assist in coordination of the PCH management - 1978: Establishment of a 16 kilometre no-hunting corridor along the highway. - 1981: General perception changed, hunting restrictions legally not applicable to indigenous people. (Hunting increased again around the Fort McPherson area. No- hunting corridor decreased to two kilometres. - 1983: a wildlife advisory committee meeting proposed a range-wide management plan to increase cooperation with indigenous hunters and establish harvest quotas. - 1985: Formal approval of the *Porcupine Caribou Management Agreement*, as a part of the agreement, the Porcupine Caribou Management Board was created. **Phase three: Caribou Management through the PCMB (1985-1995)** - 1989: Population peak of PCH with 178 000 caribous. Contrary to popular belief, hunting practices didn't reduce size of the PCH. - 1990: Snow machine was permitted for indigenous hunters and a 2 km no-hunting corridor was implemented

Identify disturbances or events that challenged, built, or reduced resilience or adaptive capacity in the system.	**Phase four: co-managing caribou hunting with traditional hunting in a new political context (1995-2009)** - 1995: "Let the leaders pass"- proposal. This proposal, based on traditional knowledge of herd leaders and their importance for the wellbeing of the herd, forbids hunting 'herd leaders' in order to safeguard the migratory route of the rest of the herd. - 1995: "Dempster Highway Workshop" organized by the PCMB between Fort McPherson hunters and government employed resource managers. Conclusion: As science-based knowledge on caribou leaders and the impacts of the PCH were both unavailable and costly, TEK should constitute the basis of knowledge. - 2007: PCMB meeting: "protecting caribou leaders is a top priority" - In September 2007, a "stay of proceedings" against a Tr'ondëk Hwëch'in (Dawson) First Nation's member ended enforcement of the one-week closure to let the leaders pass. This younger hunter who violated the hunting closure was charged by wildlife officers and announced his intent to contest his case in court. In September 2007 the Yukon Territory Minister of Environment announced that it would not enforce the one-week closure and the no-hunting corridor until consultation and consensus was reached among all affected parties. Source (1)	
3. Disturbances What are the key disturbances in the system (present and past)	a) Have there been major biophysical disturbances that are relevant for the case? - **Increase in wildfires**: The frequency of wildfires has increased over the last decades, and possibly their intensity. This has an influence on food sources for the PCH and could cause migration deviations (4, 8, 9, 10, 11)	b) Have there been major social disturbances that are relevant for the case? - **Abrupt policy changes:** There have been a series of policy changes such as no-hunting corridor zones and harvest quotes of the PCH (2)

4. Drivers of change Clarify what impacts these drivers have on the SES and if these are direct or indirect	a) What are the key biophysical drivers of change? - **Construction of the Dempster Highway**: The construction of the Dempster Highway connected some far-off settlements. However, some have argued that the expanding human infrastructure has and/or will potentially have a negative impact on caribou; this is however contested. Nevertheless, the Dempster Highway has increased accessibility of humans to the PCH and it creates an opportunity to hunt in automobiles (1) - **Climate Change:** Research (4) suggests that climate change *may* have an effect on the migratory pattern of the PCH. Climate change may also affect wildfire regimes, plant abundance, composition and successional patterns. It may also reduce the availability of lichen, a primary food source for the porcupine caribou, during wintertime, which might force the caribou to change their winter habitat and thus affect their availability for neighbouring communities.	b) What are the key social drivers of change? - **Changes in traditional authority systems and the social organization of harvesting caribou:** Hunting has become an individual task instead of a group effort. *We had one boss that we go out hunting, we all gather together and the oldest guys told us what to do, you go there, you go there, you go there so everybody knows who's here who's there. That's the way we used to do it. ... We used to have, circle around the caribou. Now you just go up and help yourself, and don't have to wait for nobody*. (Old Crow respondent) (1) - **New hunting technology:** New technologies such as guns and snow scooters are replacing traditional ways of - **Indigenous efforts towards self-government and political autonomy** (1)

5. Sources of adaptive capacity: What factors allow(ed) the system to adapt to disturbances in the past and present? Give a brief assessment of recent or on-going changes (+/-/0 = increasing/ reducing/ not affecting adaptive capacity)	a) Within the ecosystem? - (+) **PCH migratory pattern:** The PCH has a migratory pattern. In springtime, they reside in coastal areas for calving. From August onwards, they migrate to the boreal forest in the south. Their migratory pattern is based on the availability of food sources. Protein-rich vascular tundra plants prove to be critical for calving and lactating whereas energy-rich lichen in taiga zones (which the caribou can access with their uniquely shaped hooves), provide with the necessary energy for surviving the winter times. (4)	b) Within society (e.g. people, social capital, management, institutions, infrastructure): - **Changes in traditional authority systems and the social organization of harvesting caribou:** Hunting has become an individual task instead of a group effort. No longer shared game or social support. "*We had one boss that we go out hunting, we all gather together and the oldest guys told us what to do, you go there, you go there, you go there so everybody knows who's here who's there. That's the way we used to do it. ... We used to have, circle around the caribou. Now you just go up and help yourself, and don't have to wait for nobody*." (Old Crow respondent) (1) - (+) **Traditional Ecological Knowledge (TEK) of the PCH:** Traditional hunting strategies of Inuit in the Northwest Territories show concern for deviating caribou movement from common migration routes. Even though science-based knowledge on caribou leaders is quite limited, there exists a great deal of traditional knowledge on the importance of caribou leaders for the animals' migratory pattern. However, the knowledge and strategies vary by locality and between generations. The "let the leaders pass" regulation brought these differences to the surface – as well as conflict with regulations protecting indigenous rights to hunt caribou. (1) - (+) **Representation of indigenous people through the PCMB**: Provides a forum to share knowledge between indigenous people, researchers and policy makers (1) - (-) **Permanent Settlements**: Livelihood systems that

		depend on mobile resources, should be constantly adapting. When environmental changes change migratory routes of herds, communities are in danger to lose their primary resources. Traditionally, indigenous people had migratory settlements in order to play into the herds' route. However, with the introduction of permanent settlements and infrastructure this flexibility became a lot more limited (1)

The next two sections break down the information in Section I. While it is not necessary to fill these sections, if you have additional information pertinent to specific rows below feel free to enter the material.		
II.1-8 SES, resilience and adaptive capacity		
	Biophysical	**Social**
II.1. Where do we find changes and resilience in the face of change?	a) Within nature **Change** *might* be found in the way in which climate change and the Dempster Highway are affecting herd sizes and migratory routes (however, this is highly contested). **Resilience** can be found in the PCH migratory system, moving to other places based on climatic conditions and food availability (1, 3, 4).	b) Within society **Change** in harvesting the PCH can be found in many aspects of these traditional communities; people have started living in permanent settlements, have started using new technologies and methods for hunting (e.g. rifles and automobiles), have decreased their dependency on the PCH as a primary source of sustenance, and the policy landscape targeted towards the PCH herd has changed. **Resilience** can be found in the traditional ecological knowledge of migratory patterns and herd leaders, which is now being incorporated in the policy framework (1).

II.2. What are the system's key components?	a) Key Ecological components (e.g. lakes, coastal zones, caribou) This case is delimited by the activity of hunting of Porcupine caribou along the Dempster Highway in the western Canadian Arctic. **Arctic tundra** biome. Key components include: - **Porcupine caribou** (*Rangifer tarandus*)	b) Actors in society (e.g. individuals, groups, public or private organizations)? How are people organised – by geography, livelihood, family, etc.? **Key groups of people in this case:** - Indigenous residents of Yukon and Northwest Territories. Specifically, this case focuses on three settlements along the Dempster Highway, i.e. Dawson City (population 1327), Fort McPherson (population 776), and Old Crow (population 253). **Hunters** are important in this case. - Porcupine Caribou Management Board: Advisory board through recommendations to the governments represented on it. - Territorial Government of Yukon and National Government of Canada - Non-indigenous residents of Yukon and Northwest Territories First Nation governments and elders provide indigenous leadership. First Nation citizens have an Aboriginal right to hunt Porcupine caribou, unless there is a conservation issue (1, 2).

II.3. What are the key linkages? E.g. ecosystem services, resource extraction. These linkages should exist. If there are not mutual links between social and ecological components the case is not a social-ecological system.	a) From nature to society (e.g. ecosystem services) - The PCH is important, both as a source of food and clothing, but also for cultural purposes.	b) From society to nature – modifying nature, extracting resources (e.g. hunting, mining, water pollution) - It is estimated that hunting takes away 3-4% of the PCH annually - Introduction of new infrastructure is changing the landscape as well as providing the availability to reach further-away and more remote places for hunting - The PCH also provides cultural services (see section II.5) (2)

II.4. What are key interactions?	a) What are the key ecological interactions within the case? In general, the herd moves from northern coastal calving areas in the spring to southern taiga areas in the winter. This migratory movement happens because: • Protein-rich vascular tundra plants provide with the necessary nutrients for lactating cows • Coastal zones in the north are windy, which prevents them from insect harassment. • Lichen in the boreal forest provide nutrients caribou need during the winter months (4) b) What are the most important biophysical tele-connections to distant systems? - The PCH migrates over state borders to Alaska, USA - The Dempster Highway itself is an infrastructure that physically connects these former remote communities with greater society (1, 2)	c) What collaborations, conflicts, or other key linkages exist between actors? - Conflict between Yukon communities and Northwest communities. Each of these groups has demonized the other over hunting practices, and lack of consensus persists. - Intergenerational conflicts due to shifts of perspectives on ethical hunting (1) d) Between local actors and distant actors? - Incorporation of society and market

II.5. Culture	a) How is the relationship between society and nature viewed? b) What meanings are attributed to nature and to interactions with nature?	c) What are key cultural features of relevance for the case? Indigenous communities do not live in isolation from one another or the global society. With the introduction of the highway, the dependency on the PCH as their primary source of sustenance decreased marginally as other sources of income became available (e.g. tourism, services) and they became connected to other food markets. Nevertheless, hunting caribou is still very important for both the confirmation of indigenous identity and sustenance (1, 2). d) What are key cultural practices and beliefs related to nature People and caribou are intertwined, in a deep belief system whose full meaning must be experienced in order to be understood (7). *"In the time before there was time people and caribou were the same." After their separation, caribou gave themselves to people as gifts, with each partner fulfilling a set of obligations to care for each other. This constituted the basis for rules and norms of hunting"* (1). - The indigenous population has a deep understanding of the importance of herd leaders for the well-being and migration of the PCH which is absent in more "conventional" science; *My mama always tell us don't bother 'em. Let them go through first, there be more caribou coming. And if they*

		have a trail, caribou follow. She said don't bother 'em. So we always respected, we never bother the front caribou. (1)
II.6. Disturbance What are important types of stress & shock	a) Describe important biophysical or ecological shocks and stresses (e.g. floods, storms, etc). - **Wildfires:** Wildfires destroy lichen (among other things) and thus the primary food source of the PCH during its winter migration. Caribou tend to refrain from burnt areas. (4)	b) Describe important social shock and stresses (e.g. austerity policies, changes in government policy, introduction of new technologies, etc.) - Introduction of new policies; e.g. establishments of no-hunting corridors - Introduction of new hunting technologies: snowmobiles, automobiles

II.7. What are key slow variables Changes that occur over decadal or longer time scales	a) What types of ecological processes (e.g. loss of permafrost, shifts in species composition) are driving important long-term changes in ecological structures and processes? - **Climate changes:** Evidence (4, 8, 9, 10, 11) suggests that an increase in temperatures and an increase in the frequency (and possibly intensity) of wildfires are related. A transformation of the wildfire regime might alter plant composition and successional patterns and thus the ecosystem. The alteration of the ecosystem might have a consequence on the PCH's migratory pattern.	b) What types of slow social processes (e.g. aging, population growth, loss of language) are driving important changes in social institutions and behaviours? - Increased attention towards indigenous knowledge and rights
II.8. Relationships with ecological regime shifts	a) Are ecological regime shifts driving further ecological change or pressure? Climate change appears to be increasing the frequency of wildfires, which in turn *might* result into a shift in the migratory route of the PCH as food (lichen) becomes less available (4, 8, 9, 10). Increased temperatures and fire frequency could disrupt lichen reproduction. - A regime shift, caused by climate change and the concomitant changing wildfire regime, in areas of the PCH migration route is the shift from conifer to deciduous forest (see below). This might also affect food availability and the PCH's migratory route. - A second regime shift is from conifer forest cover (lichen-rich) to non-forested shrublands (lichen-poor) (12,13). Increased fire activity, leads to overlapping burn scars, which can lead to a shift from conifer forest cover to non-	c) Can social stresses or major changes be attributed to ecological regime shifts? - **Shift in migratory patterns** of the PCH might lead to social stresses if the caribou refrain from the areas of the communities in question. d) Are there specific social practices that might be contributing to ecological regime shifts - New hunting strategies such as e.g. hunting caribou from automobiles or killing group leaders *might* alter their migratory route.

	forested shrublands because a lack of seed availability prevents forest regeneration (and there is no available seed source for other tree species to establish). This shift would also reduce food availability (lichen) to the PCH. b) Are external or internal ecological dynamics potentially or actually producing ecological regime shift(s)? One regime shift currently influencing the region is the **shift from coniferous to deciduous forest in the boreal forest**. This regime shift is being caused by changes in climate and the effect it has on the wildfire regime. As temperatures increase, the relative humidity of the boreal forest decreases, which makes wildfires more common. This has an effect on soil conditions, making them more favourable for deciduous trees. This shift has an influence on food provision for large herbivores such as the Porcupine caribou and thus, *might* change their migratory pattern. While the extent of this regime shift could be minor along the Dempster Highway, itself, it could nevertheless directly affect the PCH and therefore its presence near the highway. **Reference:** The shift from coniferous to deciduous forest is described in more detail in the RSDB (5).	
II.8 Regime shifts	**If a regime shift exists and is important to this case describe it below.** Please indicate whether the regime dynamics are well established, contested, or speculative.	

II.8.a. Detailed description of alternate regime shifts A case study can contain more than one type of regime shift	Briefly describe the structure of each regime. What does each regime look like? What are differences in ecosystem structure and function? (e.g. permafrost loss, vegetation change)? In this case study, the harvesting of caribou by indigenous population constitutes the prime focus. For this activity, the migratory route of the PCH plays an important part, deviations to this migratory route can put heavy stress on indigenous communities. There are **two well-established regime shifts** identified which potentially (but likely) will influence the migratory route of the PCH, i.e. the shift from tundra to forest and the shift from coniferous to deciduous forest. **Tundra:** Low temperatures and short growing seasons. Subsoil is permafrost. Low vegetation (dwarf shrubs, lichen, etc.). **Coniferous forest:** Evergreen. Spruce and pine as dominant species. No longer permafrost subsoil. Cold moist soil conditions. **Deciduous forest:** Deciduous trees. Nutrient rich dry soil. These regime shifts are well-established. However, it has to be noted that these regime shifts are happening gradually. A more detailed description can be found in the RSDB (5, 6). Besides, there is also a past shift in livelihood systems which can be characterized as a regime shift. This is the shift from migratory to sedentary livelihoods. **Regime 1: Traditional indigenous hunting systems** - Communities were migratory and almost totally dependent on the PCH for survival. Trusted their knowledge on the ecosystem for their livelihoods. Hunting was a group activity, leadership was based on the legitimacy of village elders. **Regime 2: "modern" hunting systems** - Communities are sedentary and are connected through newly established infrastructure. Hunting strategies have changed due to new hunting technologies (rifles, automobiles, snowmobiles). Management of hunting is done by government policies, influenced by traditional communities through the PCMB (1). How do the properties and behaviours of regimes differ?

	e.g. collapse of subsistence food sources, fundamental change in types of livelihoods, change in governance institutions, new actors with significant political power who transform decision making) **Deviations to the PCH migration route:** In their seasonal migration, the PCH migrates on basis of the availability of food sources; i.e. tundra plants in summer and lichen in winter. However, if the vegetation of the region changes, it is highly possible that the migratory route of the PCH will change accordingly. With tundra declining, summer grazing area is declining; with coniferous forest declining, there is less lichen in winter available. **Livelihood change:** The extent to which communities are dependent on the PCH as a prime food source is decreasing, as a result of the incorporation of these (formerly) remote communities in greater society through the establishment of the Dempster Highway. Ethnicities as well as livelihoods start to diversify, with new incomes generated through, for example tourism (the degree differs from community to community). Caribou is now also exported. **Change in hunting management:** Hunting management is now governed under a complex, multi-level co-management regime, operationalized through territorial government regulations, instead of by traditional local management. However, as scientific knowledge about the caribou and their migratory pattern is often lacking, the importance of TEK in managing this resource is being acknowledged. The PCMB advises in the decision-making on PCH management. (1, 2, 3, 4)	
II.8.b. Feedback mechanisms within the system that maintain each regime	Ecological feedback mechanisms - Grazing - Nutrient cycling feedback - Competition between vegetation types - Soil moisture - Shrub microbial activity - Albedo - Soil drainage - Shrub permafrost mechanism	Social feedback mechanisms - Management of hunting practices (regional and local) - Alternative livelihoods such as tourism. Decreases the need for hunting caribou. But these remain marginal alternatives. - Market feedback: price of caribou meat and skin

II.8.c. What key changes drive regime shifts? Describe how these changes alter the state of the system or feedback processes.	a) Drivers of ecological regime shifts (either social or ecological). Temperature increase, climate change, greenhouse gas emissions. Herbivory. b) How do these changes alter biophysical feedback processes? Climate change: Temperature increase, melting of the permafrost, increase of extreme event such as wildfires and winter icing events. Caribou eat tundra plants.	c) Drivers of social regime shifts (either social or ecological). - New hunting technologies - New infrastructure - Policies from the national and regional government: e.g. educational policies, forcing the indigenous communities to adapt sedentary lifestyles so that their children could enjoy formalized education. - New sources of income; e.g. tourism d) How do these changes alter the social feedback processes?
II.8.d. Ecosystem services substantially impacted by regime shift	a) Changes in ecological processes that produce ecosystem services Primary production is changing. Biomass available is decreasing.	b) Changes in demand for ecosystem services (market and non-market) Market: with the incorporation of these communities in the greater market they are dependent on it for export and import of their goods and services. Recreational value of the region is increasing, for example the highway led to the creation of Tombstone Territorial Park, a popular destination. But tourism remains of marginal importance to livelihoods. c) Changes in the institutional context of ecosystem services e.g. changes in access and changes in how ecosystem services are valued as expressed by rules and regulations. From traditional local government to regional/national to an incorporation of TEK via the PCMB

II.8.e. What is (+/-) impacted by changes in ecosystem services directly or indirectly	a) Impacts from regime shift on ecological components	b) Impacts from regime shift on social actors - Lifestyles and livelihoods of the traditional communities changed
II.8.f. Potential cascading effects	Describe, if any, the likelihood of potential ecological cascading effects to other SES	Describe, if any, the likelihood of potential social cascading effects to other SES
II.8.g. Where do actors intervene to alter regime shift dynamics and who can do the intervening?	Ecological oriented interventions	Socially oriented interventions Hunting regulations, such as the establishment of a no-hunting corridor.

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GLOSSARY OF TERMS IN THE TEMPLATE

	We use this term generally to look for individuals, groups, organisations, and so on that structure actions and/ or are stakeholders.
Adaptive capacity	Is the capacity of actors in the system to manage resilience in order to stay within a desired state during periods of change. This is related to the diversity in the system behind the provision of a function.
Disturbance	This refers to any disturbance to the system, regardless of scale, duration, intensity and frequency. See shock and stress.
Driver	Actor or process that directly or indirectly affects change in a social-ecological system. External means that the system in question (the scale being looked at) is unable to affect the driver in question – there is no feedback from the system to the driver.
Ecosystem services	The goods and services humans derive from ecosystems. These include: provisioning, regulating, cultural ecosystem services respectively.
Feedbacks	A change within a system that occurs in response to a driver, and that loops back to control the system. A feedback can help to maintain stability in a system (negative or balancing feedback), or it can speed up processes and change within the system (positive or enhancing feedback). Feedback processes play a very important role in determining system thresholds and in maintaining system resilience.
Institution	Here we refer to the humanly devised constraints that shape human interactions, such as rules, norms and laws. These can be formal or informal. Note that we are not referring here to institutions as organisations.
Regime shift	For complex systems, a substantial and enduring reorganization of the system, where the internal dynamics and the extent of feedbacks undergo change.
Resilience	This is a property, in this context of social-ecological systems. It relates to the capacity of a system to cope with disturbances and recover in such a way that they maintain their core function and identity. It also relates to the capacity to learn from and adapt to changing conditions, and when necessary, transform.
Shock	A sudden, unexpected disturbance. This kind of disturbance is often punctual, and has important impacts on large parts of the system.
Slow variable	When analysing complex system is often useful separating “fast” and “slow” variables. Fast variables often represent the primary concern of ecosystem users, for instance game or crop production. Slow variables shape the behaviour of fast ones but change slowly with respect to the overall dynamics of the system. Examples of slow variables might include permafrost thawing for a social-ecological system of Arctic hunters where the fast variable is game, or soil organic matter for an agricultural system where the fast variable is crop production.
Stress	This is a disturbance that has long persistence and often low intensity in impact.

Social-ecological system	This is an interwoven system of human societies and ecosystems. This concept emphasises that humans are part of nature and that these components function in interdependent ways. In the template identifying these interactions between the components aims to identify the processes and actors/ components that interact and particularly the feedbacks between the human-related components and the ecosystems/ biophysical components.
Stakeholder	See “actor”
Systems Diagram	This is using a diagram to illustrate the configuration of a system. This is done by defining its structure, function, and feedbacks. For a case there may be more than one diagram if the system changes in character (actors, processes, drivers, disturbances, feedbacks etc.) over time.
Timeline	The goal with the timeline is to capture important events – both punctual and over longer periods of time, identifying the causes of these events and the actors/ processes involved. This should be done chronologically and distinguishing events.