Name of the case study	Ulukhaktok - Evolution of traditional knowledge and social networks to support traditional livelihoods - 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?	Climate change and a shift in livelihoods have made harvesters in Ulukhaktok more vulnerable in the current warming state. The variability and unpredictability in climate conditions and the change in the ecosystems make the community more vulnerable, increasing travel risk, compromising travel routes to hunting areas, and affecting the health and availability of wildlife necessary for subsistence and cultural identity. The capacity of community members to deal with climate change is not uniform among community members. Societal factors, including the inability to access capital resources, time restrictions imposed by wage employment, changing levels of traditional knowledge and land skills among youth, and substance abuse, affect community members' capacity to deal with exposure sensitivities. Inuit in Ulukhaktok responses to the changes mixing subsistence activities with wage economies. For example, some families have directed financial resources to a full-time hunter, and some 30 country foods are being sold for cash income	
Templated completed by: *Main contributor	Carla Lanyon*, Stockholm Resilience Centre Juan 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) Fawcett, D., T. Pearce, R. Notaina, J. D. Ford, and P. Collings. 2018. Inuit adaptability to changing environmental conditions over an 11-year period in Ulukhaktok, Northwest Territories. *Polar Record* 54(2):119–132. (2)Pearce, T., Wright, H., Notaina, R., Kudlak, A., Smit, B., Ford, J. D., & Furgal, C. (2011b). Transmission of environmental knowledge and land skills among Inuit men in Ulukhaktok, Northwest Territories, Canada. Human Ecology, 39, 271– 288. doi: 10.1007/s10745-011-9403-1 **(*) Mainly all the information comes from (1). Otherwise, is explicit cited**

Reviewed by (name and affiliation)		

Category	**Resilience/ Adaptability**	**Loss of resilience**	**Transformation**
	X		

Case study details:	**Country**	**Place**	**Scale – space**	**Scale – time**	**Sector(s)**	**Other (e.g. disturbance)**
	Canada	Ulukhaktok		2005-2016	Fishing Hunting	Livelihood shift

Drivers (mark with X in appropriate boxes)	**Climate**	**Geopolitical**	**Mineral/ oil extraction & infrastructure**	**Tourism**	**Shipping**	**Biological invasion**	**Rapid demographic change**	**Other:**
	x							Social drivers

	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? Ulukhaktok is characterized by lowlands, hills and rugged, numerous ponds, rivers, drivers, and ecosystems. How are the case boundaries defined in terms of ecosystems or biophysical characteristics? This case is delimited by the harvesting activity, which takes place in Ulukhaktok and surrounding places in Victoria Island	b) Who are the key groups of people in this case? Ulukhaktok, a coastal Inuit community with 430 members. c) What kinds of livelihoods are important in the system? Wage labour and harvesting in land and sea. d) What institutions are key to this case? Ulukhaktok community Ulukhaktok Hunters and Trappers Committee (HTC): work with territorial and federal government agencies to develop recommendations for annual harvesting quotas.

		Inuit government Canada government e) How are the case's boundaries socially defined, and how do these social boundaries relate to biophysical boundaries? The social boundaries of the harvesting practice are defined by the biophysical limits of the harvesting activity. These boundaries are constantly expanding due to the decrease and migration of key species for the community.

2. Timeline Draw a timeline of *key* events/ developments to the case. Define the time period (decades – centuries) over which change is considered, Provide a brief description of event/ actors, and ecological impacts Is it possible to identify periods of change from one type of system to another, transformations? Identify disturbances or events that challenged, built, or reduced resilience or adaptive capacity in the system. Consider both biophysical and social dimensions. Mark particularly significant events with *.	1939: Ulukhaktok evolve to a permanent settlement with the establishment of Hudson's Bat company 1940s: Migration of western Inuit, now call Inuvialuit, moved into Ulukhaktok looking for employment 1960: Migration of Puvilingmiut family to the area 1984: Creation of Inuvialuit settlement region (ISR) by an agreement between six Inuit communities and the Canadian Government 1985s*: Social Change. The settlement has become a more important part of daily life than land. And there was a shift in the economy to wage income system. 1980-1993: Dramatic decrease in caribou population 1993-1998: Voluntary five-year moratorium on hunting Peary caribou 2005 (spring): Wind change event. The wind pushed broken ice into the community bay and prevented were unable to travel to hunt caribou. 2005 (winter): A significant decline in the quality of ringed seals and number of young individuals. 2008: U.s fish and Wildlife Service banned the importation of polar bear trophies under the endangered species. Muskox sport hunt increase

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? -More variables and less predictable weather -Increased storms and strong winds -Change in the sea ice dynamics -Rapid seasonal transitions: Earlier sea-ice break-up and later freeze-up -Flooding rivers in the spring - Incomplete freeze up and unstable ice -Changing wind ice regimes	b) Have there been major social disturbances that are relevant for the case? - Increase in travel risk on the land, water, and sea ice. - Decrease of local knowledge to harvesting - The rise of the muskox sport hunt - Commercialization of country foods
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? The increase of temperature and changes in seasonal patterns affect the sea ice, wind dynamics, and weather variability. This change in the environment had impacted the population of important species for subsistence and increased the risk associated with hunting and travel. (2).	b) What are the key social drivers of change? -Bear sport hunt prohibited -Relay on wage labour has affected traditional subsistence activities. Less time available to go hunting. - Limited access to financial resources to invest in technology, machinery, fuel, among others. -Lack of integration of local knowledge in the western educational system
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	a) Within the ecosystem? (-) Rapid periods of melting have also caused rivers to flood and lakes slushy affecting travel routes (-) Changes in the wind ice regimes and the freeze events decrease the population of key species such as ringed seals and caribou.	b) Within society (e.g. people, social capital, management, institutions, infrastructure): (-) In the past, people travelled by dog, and they could move in more challenging conditions with reduced visibility. People travel by snow machine, although it is faster, with the climate events and storms this type of traveling cannot adapt to rapid changes in the weather.

changes (+/-/0 = increasing/ reducing/ not affecting adaptive capacity)	(-) Occurrence of new species of wildlife specially predators such as grizzly, grolar bears and wolves. This arrival affects the availability of key sources that their population has been decreasing. (+) Occurrence of new species. In 2014 was an unprecedented hunt of 32 belugas whales. Community hope that this event can be something more regular. Other species migrating north are elk and moose. (+) During the 1990s muskox availability replaced caribou as primary source of meet.	(-) Decrease of local knowledge and land skills in youth (-) Inuit hunters have relied on knowledge of local environments to navigate weather events. Due to the constantly changing weather conditions, the knowledge cannot easily be applied to read the unpredictable situation. (-/+) Due to the ice conditions, hunters must investigate alternative routes to avoid the risk of accidents or lost equipment. Travel to other locations or use alternative routes are often longer, requiring more time and fuel. (+) The implementation of a voluntary five-year moratorium on hunting Pearcy Caribou from the Minto Inlet. From that agree Ulukhaktok harvests which have the resource (boat, fuel, and time) travel long distances to hunt caribou. (+) Depending on the migratory patterns and abundance of the species, hunters select the hunt´s time and location and the species harvested. (+) Hunters take extra precautions to travel. Read the environmental sign and weather forecasts. Travel with extra gas, fuel, food, and supplies. Travel close to the community and share information between them. (+) Share country food and financial resources at the family and community level. (-) Change in diet, supplement the diet with food from stores. This food is more expensive, less satisfying, and not connected with their cultural identity and livelihoods.
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 change and resilience in the face of change?	a) Within nature: Change in seasonality affects sea ice conditions. Later freeze-up and earlier break-up, and overall thinner sea ice. Thinner sea ice is also more susceptible to strong winds and ocean currents, which increase the risk of harvesting. Furthermore, changes in the sea ice dynamics also affect the quality and availability of relevant species. For instance, there has been a decrease in ringed seal, Peary, and a recent reduction in the muskox population. Resilience: The appearance of new species such as belugas, whales, and terrestrial species can be an opportunity for communities to diversify their portfolio. It is necessary to continue monitoring the change in the ecosystem.	b) Within society: Change: There have been several changes in the last century. Such as becoming a permanent community highly dependent on wage economy, compulsory schools, connected with external markets, growth of population land claim agreements, and imposition of wildlife management such as hunting quotas. These changes had affected livelihoods, their social networks, and cultural traditions. Leading to a change in traditional knowledge and land skill among youth (for instance, substance abuse). Resilience: New strategies to travel (extra precautions and new routes), to access food (buy in the grocery store, share food with family, change species harvested) where social networks is a key element.
II.2. What are the system's key components?	a) Key Ecological components (e.g. lakes, coastal zones, caribou) Sea ice, lowlands, hills and rugged plateaux, and numerous ponds, lakes and rivers. Most relevant species for the substance of community: Peary caribou, ringed seal, king eider ducks, muskox, artic char,	b) Actors in society (e.g. individuals, groups, public or private organizations)? How are people organised – by geography, livelihood, family, etc.? It is a coastal Inuit community with 430 inhabitants. 96% of them are Inuit. The community is described as a "Modern Inuit town". Wage labour is the main source of income. People from 18-64 have full time, part time or seasonal employment. However, hunting and fishing are still important activities to maintain identity and as the source of protein. 78% of the community members practice hunting and fishing. Some of them continuing hunting full time and others practice in their free time, balancing with the wage job.

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) - Primary production - knowledge and educational values - traditional livelihoods.	b) From society to nature – modifying nature, extracting resources (e.g. hunting, mining, water pollution) - Hunting/harvesting
II.4. What are key interactions?	a) What are the key ecological interactions within the case? Sea ice changes affect the presence of seal population in the area. When the ice breaks early, it is blown out into the ocean and young seal and adult animals are removed from the area. The increase of temperature had led to extremes weather increasing the day with sub-zero temperature during the migration of caribou. The formation of ice layers does not allow caribou to move and look for food. b) What are the most important biophysical tele-connections to distant systems? The increase in temperature due to the rise in greenhouse gasses. Change in the migration route of species.	c) What collaborations, conflicts, or other key linkages exist between actors? Community-sponsored hunts have been organised recently to help provide country foods for community members who may not otherwise have access to them. These hunts have involved the local HTC and Community Corporation hiring local hunters to harvest wildlife (mainly muskox), which is then shared with elders, single mothers, and other marginalised groups in the community Since the polar bear ban, the muskox sport hunt had increased, becoming an important source of income. There could be a conflict within the community between the guide and helpers for muskox sport and the hunters. The HTC is the organization in charge of selecting guides and helpers, which can also become a potential conflict between HTC and community hunters.

		There is an increase in country food commercialization by stores and hunters on social media. This has implications for local sharing networks, which play a key role in food security. Some community members do not agree with this new practice and can potentially create a conflict among community members. d) Between local actors and distant actors? Potential conflict between tourists who pay to hunt, mostly coming from the U.S.A and local community. Potential conflict between Canada government and community if there are further regulations in important species for the community. The rise of gas prices and the increase of investment that hunters must consider adapting requires financial support. The lack of support from local and national institutions could transform into a potential conflict with local hunters.
II.5. Culture	a) How is the relationship between society and nature viewed? There is an interdependence between the availability of species and livelihood. What meanings are attributed to nature and to interactions with nature? Nature provide food to the community and cultural identity. (2)	b) What are key cultural features of relevance for the case? Family is the centre of the culture and a key element to build social networks. Family gives financial support to the hunters of the family since they share the food. Their traditional knowledge, practices, and collective memory are essential components of their adaptive capacity. c) What are key cultural practices and beliefs related to nature?

		Harvester used their local knowledge to face sudden storms. They draw the local geography and local to a suitable place to find refugee and set up camp (3).
II.6. Disturbance What are important types of stress & shock	a) Describe important biophysical or ecological shocks and stresses (e.g. floods, storms, etc). A decrease of Peary caribou population in the arctic during the 70s. A study found that caribou population declined from 4500 in 1980 to about 100 in 1993. Currently caribou is an endangered species in Canada. (2) Spring 2005, the change in the wind pushed broken ice into the community bay and prevented us from being unable to travel to hunt caribou. Winter 2005 significant decline in the quality of ringed seals and in number of young individuals. Although the community doesn't depend on seals, the health of the seal population was recognized as an indicator that the health of the ecosystem is under threat. (2)	b) Describe important social shock and stresses (e.g. austerity policies, changes in government policy, introduction of new technologies, etc) The 'end' of the polar bear sport hunt. Wage income economy: Relays on wage labour have affected traditional subsistence activities. Some community members balance harvesting with the wage employment necessary for generating income to purchase harvesting equipment, supplies, and fuel. Employment, however, also constrains the timing and duration of harvesting activities. Employment acts as an aid to adaptation by providing access to a needed source of income. Still, it can also constrain adaptation by limiting the timing and duration of harvesting activities (2). Abuse substance. Addictions and lack of support services have left some community members more susceptible to stresses associated with from climate change, (2). Technology as Global positioning system (GPS, satellite phones, very high frequency (VHF) radios are used to analyses the weather and decrease the time needed for hunt. However, this has brought issues with the loss of local knowledge and overconfidence (3).
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?	b) What types of slow social processes (e.g. aging, population growth, loss of language) are driving important changes in social institutions and behaviours?

	Mean annual temperature is a slow variable that affects different biophysical elements having cascade effects in the ecosystem. For instance, the migration of critical species to the north or decreasing the wildlife's health.	Traditionally, knowledge and skills were developed and transmitted through practice in the land and from listening to and learning from elders and other experienced individuals. Currently, elder see the risk of loss of knowledge that allows Inuit to manage the change in climate conditions. Young Inuit do not spend too much time in traditional subsistence activities, (under 25) haven't developed the skills to have successful and safe harvesting (2).
II.8. Relationships with ecological regime shifts	a) Are ecological regime shifts driving further ecological change or pressure? There is no regime shift recognized in the case study b) Are external or internal ecological dynamics potentially or actually producing ecological regime shift(s)? Yes, climate change is promoting a possible socio-cultural shift.	c) Can social stresses or major changes be attributed to ecological regime shifts? Not now. Most social stresses have been a product of the change in livelihood from hunters to wage labour communities. d) Are there specific social practices that might be contributing to ecological regime shifts Not now
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)?	
II.8.b. Feedback mechanisms within the	Ecological feedback mechanisms	Social feedback mechanisms

system that maintain each regime		
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). b) How do these changes alter biophysical feedback processes?	c) Drivers of social regime shifts (either social or ecological). 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	b) Changes in demand for ecosystem services (market and non-market) . 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.
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 .
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? This can be listed here or marked with (*) in the	Ecological oriented interventions	Socially oriented interventions

table above		

REFERENCES/ SOURCES CITED:

(1)	Fawcett, D., T. Pearce, R. Notaina, J. D. Ford, and P. Collings. 2018. Inuit adaptability to changing environmental conditions over an 11-year period in Ulukhaktok, Northwest Territories. *Polar Record* 54(2):119–132.
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(3)	Pearce, T., Wright, H., Notaina, R., Kudlak, A., Smit, B., Ford, J. D., & Furgal, C. (2011b). Transmission of environmental knowledge and land skills among Inuit men in Ulukhaktok, Northwest Territories, Canada. Human Ecology, 39, 271– 288. doi: 10.1007/s10745-011-9403-1

GLOSSARY OF TERMS IN THE TEMPLATE

Actor	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.