Name of the case study	Diet and lifestyle transformation affecting resilience on Siberian Arctic Indigenous People [Loss of Resilience]		
What about this case makes it interesting? How does this case contribute to understanding of resilience and/or regime shifts in the Arctic?	The traditional food of Indigenous Peoples of North-western Siberia provides a set of macro and microelements necessary for life in the Arctic challenging conditions. Currently, high consumption of local foods occurs typically during fishing or reindeer slaughter. For the rest of the season, indigenous communities have integrated imported food based on easily digestible carbohydrates. Climate change and regulations have constrained access to traditional food consumption and increased imported consumption, affecting well-being, decreasing communities' resilience. Climate change has impacted accessibility and, therefore, the consumption of traditional food. The hydrological regime of rivers has changed, and late freezing and early melting have disrupted the conventional herding routes, resulting in a shortening period for delivering meat to the villages. The seasons for certain fishing species of fish have also significantly changed. Periods without fishing have also started to appear, and food storage conditions based on cryo-resource have changed. On the other hand, regulations related to the slaughterhouse and meat trade, fish quotas, and commercial fisheries' introduction impact traditional food access.		
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) Andronov, S., A. Lobanov, A. Popov, Y. Luo, O. Shaduyko, A. Fesyun, L. Lobanova, E. Bogdanova, and I. Kobel'kova. 2020. Changing diets and traditional lifestyle of Siberian Arctic Indigenous Peoples and effects on health and well-being. Ambio.	
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)**
	Yamalo-Nenets Autonomous Okrug, Russia	Western Siberia		1877-2020	Food Security	

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

	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? Tundra Coast-line Rivers b) How are the case boundaries defined in terms of ecosystems or biophysical characteristics? The boundaries of the system are the coastline of the Kara Sea in the western part of Siberia.	c) Who are the key groups of people in this case? Nenets Indigenous communities from the Arctic zone of Western Siberia, specific from villages located on the coast of the Ob, Taz and Gydan bays of the Kara Sea, on Yamalo-Nenets Autonomous Okrug (YaNAO). d) What kinds of livelihoods are important in the system? Hunting and fishing are subsistence activities. Nomadic communities provide traditional food to the rest of the villages. Meat is present for only 5–6 months during spring, summer, and early autumn. Nenets slaughter a small number of animals to obtain skins suitable for sewing clothes. Meat is mostly sold to shift workers of the near-by oil and gas fields. e) What institutions are key to this case? Local authorities Indigenous communities from the three districts of Yamalo-

		Nenets Autonomous Okrug (YaNAO) f) How are the case's boundaries socially defined, and how do these social boundaries relate to biophysical boundaries? The social boundaries are the coastline of the Kara Sea in the western part of Siberia.

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 *.	1877: Yuraki essay providing the information of the traditional food system at that time. 2013-2014: Reclamation of the coastal area of Gulf of Ob resulted in the fishless period growing to 10 months.

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? Extreme precipitation events	b) Have there been major social disturbances that are relevant for the case? -Policies restrictions to prevent infections and regulate the trade have decreased the supply of reindeer meat and fish to villages. -Small farmers won't sell to indigenous communities unless they have their own slaughterhouses and refrigeration units for storing meat. -Large-scale building operations in 2013 and 2014 and reclamation of the coastal area of Gulf of Ob resulted in the fishless period growing to 10 months.
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? Land use change, development of mining industry	b) What are the key social drivers of change? Introduction of imported food rich on easily digestible carbohydrates (cereal, butter, white bread, sugar among other) Introduction of commercial fisheries exploiting the tundra lakes decreasing the fish stock.

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? (-) Decrease of the cryo-resource affecting the storage capacity (-) Migration routes are affected by climate change (-) Fishing season is shorter	b) Within society (e.g. people, social capital, management, institutions, infrastructure): (+) Traditional skills to store local food using natural cryo-resources has been one of the elements ensuring a stable food supply system all year round. (+) Sharing networks allows other indigenous people to have access to local food, and part of the meat is transported to relatives living in villages. (-) Decrease in traditional food consumption (-) Decrease in the access of traditional food. (+) Traditional nutrition is the main tool for preventing diseases of the cardiovascular and respiratory systems and metabolic disorders for the Indigenous Peoples.
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: Hydrological regime of rivers has changed, and late freezing and early melting have disrupted the traditional herding routes, resulting in a shortening of the period for delivering meat to the villages. The seasons for fishing certain species of fish have also significantly changed. Periods without fishing have also started to appear and conditions for food storage have changed.	b) Within society: Change: Traditionally Nenets food system is based on migrations and the season. Seasons provide different types of food (mainly different types of fish and reindeers meat). Since they have a nomadic lifestyle, they do not have food stock for more than 1-2 months. In the present there is a high consumption of fishing and reindeer only the slaughter season. The rest of the year they consume imported food rich in

	Resilience:	carbohydrates. Storage conditions have also been affected by climate change. Nenets used natural cryogenic resources (snow, ice and underground permafrost) to store fish and reindeer. Due to the warmer temperature this resource is becoming less available, affecting the storage capacity. Resilience: Traditional food provides them with a set of proteins, fats, vitamins among other elements necessary to adapt to the cold and other Arctic conditions. Sharing networks allows other indigenous people to have access to local food, part of the meat is transported to relatives living in villages. Traditional skills to store local food using natural cryo-resources has been one of the elements ensuring a stable food supply system all year round.
II.2. What are the system's key components?	a) Key Ecological components (e.g. lakes, coastal zones, caribou) Coastline, rivers, lakes white fish, reindeer,	b) Actors in society (e.g. individuals, groups, public or private organizations)? How are people organised – by geography, livelihood, family, etc.? Indigenous Nomadic communities: a family of nomadic Nenets reindeer herders, consisting of 2–4 adults and 3–7 children. Indigenous people settle in villages Nomadic fishers and hunters. who provide traditional food to their community and relatives settle in villages.
II.3. What are the key linkages? E.g. ecosystem services, resource	a) From nature to society (e.g. ecosystem services) - Supporting services - Primary production	b) From society to nature – modifying nature, extracting resources (e.g. hunting, mining, water pollution) - Fishing

extraction. These linkages should exist. If there are not mutual links between social and ecological components the case is not a social-ecological system.	- Knowledge and educational values - Traditional livelihoods.	- Hunting - Collecting
II.4. What are key interactions?	a) What are the key ecological interactions within the case? Warming temperatures affect the ice snow and the seasonality. Ice must be thick enough to be able to support people but not too thick to make cutting holes too difficult. Due to a significant decrease of winter snowfall, the snow period is also getting shorter and rain-on-snow events cause ice layers to form on the surface. These events cause starvation of reindeer and even death. Starvation causes a reduction in the reindeer meat's nutritional value to local people Molluscs have a key role in the system. As the main source of food for freshwater fish living in the estuaries and rivers, Molluscs concentrate zinc and copper and, consequently, the meat of fish that eat molluscs and the meat of predatory fishes are rich in these microelements. b) What are the most important biophysical tele-connections to distant systems? Climate change is affecting the temperature of the area. The period with temperature below 0 C has shortened by 15 days between 2010 and 2015 in the territory of Western Siberia.	c) What collaborations, conflicts, or other key linkages exist between actors? Sharing networks d) Between local actors and distant actors? The commercial exploitation of tundra lakes by village fishermen, lead to overexploitation of the area, leaving with no fish to indigenous communities. Active campaigns against poaching fish and strict fishing quotas for whitefish have been introduced.
II.5. Culture	a) How is the relationship between society and nature	c) What are key cultural features of relevance for the case?

	viewed? The cryostorage ventilation system allowed the tunnel walls to freeze to - 20 C during the winter, which made it possible to maintain the temperature in the range of - 9 to - 12 C in summer (Fig. 4b). This temperature allows not only the cooling, but also the freezing of intact fish b) What meanings are attributed to nature and to interactions with nature?	Food systems are a key cultural feature. Food systems allow the reproduction of traditional livelihoods The season of traditional food consumption is short, using traditional skills to store local food using natural cryo-resources has been one of the elements ensuring a stable food supply system all year round. d) What are key cultural practices and beliefs related to nature? Sharing networks allow communities to have access to traditional food. 20% of the total volume of reindeer meat is consumed by the herders themselves, 18% is sold in Indigenous villages or transferred to relatives and 62% is exported outside the Yamalo-Nenets Autonomous Region.
II.6. Disturbance What are important types of stress & shock	a) Describe important biophysical or ecological shocks and stresses (e.g. floods, storms, etc). Overfishing of whitefish in tundra lakes in the Yamal Peninsula in the period of 2013–2016 led to a significant depletion of fish stocks	b) Describe important social shock and stresses (e.g. austerity policies, changes in government policy, introduction of new technologies, etc) Policy restriction: The trade from sledges in the villages and cities of the Yamalo-Nenets Autonomous Region is Fishing quotas in poaching fish and white fish
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? Change in diet

	-Loss of permafrost (2)	
II.8. Relationships with ecological regime shifts	a) Are ecological regime shifts driving further ecological change or pressure? Land-use change is affecting the biodiversity of the area Climate change, increasing temperature are transforming the Arctic in warmer environment change the system b) Are external or internal ecological dynamics potentially or actually producing ecological regime shift(s)?	c) Can social stresses or major changes be attributed to ecological regime shifts? Food security has been contrains by change in the climate, decreasing the availability, distribution of key species fo Inuit diet. d) Are there specific social practices that might be contributing to ecological regime shifts The increase of industries in the area is changing the landscape.
II.8 Regime shifts	**If a regime shift exists and is important to this case describe it below.** **No regime shift exist** 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)? 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)	
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?	Ecological oriented interventions .	Socially oriented interventions

This can be listed here or marked with (*) in the table above		

REFERENCES/ SOURCES CITED:	
(1)	Andronov, S., A. Lobanov, A. Popov, Y. Luo, O. Shaduyko, A. Fesyun, L. Lobanova, E. Bogdanova, and I. Kobel'kova. 2020. Changing diets and traditional lifestyle of Siberian Arctic Indigenous Peoples and effects on health and well-being. Ambio.
(2)	
(3)	

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.