Name of the case study	Vilhelmina North reindeer herding community (VNRHC) – Reindeer husbandry – Sweden [LoR]					
What about this case makes it interesting? How does this case contribute to understanding of resilience and/or regime shifts in the Arctic?	Traditional Sami reindeer herding practices have faced challenges and have had to adapt to a number of changes over the past decades. While changes have been widespread across the Sámpi region, this case focuses on Sami reindeer herding in Sweden, specifically the Vilhelmina North reindeer herding community (VNRHC). Climate change, technology, increased motorization, and changes in standard of living have all influenced Sami reindeer herding in the VNHRC. Institutional inconsistencies across governance levels have also had impacts on reindeer herding practices, and have provided little protection for Sami reindeer herders in Sweden. Despite functional changes and institutional challenges, Sami reindeer herders in Sweden adapted to challenges, though this has influenced some aspects of traditional reindeer herding practices.					
Template completed by: *Main contributor	Ashley Perl*, Stockholm Resilience Centre Daniele Crimella, 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) Löf, A. 2014. *Challenging adaptability: Analysing the governance of reindeer husbandry in Sweden*. Ph.D Thesis. Department of Political Science, Umeå Univerity, Umeå, Sweden. (2) Löf, A. 2015. Locking in and locking out: a critical analysis of the governance of reindeer husbandry in Sweden. *Critical Policy Studies*:1-22. (4) Löf, A. 2013. Examining limits and barriers to climate change adaptation in an Indigenous reindeer herding community. *Climate and Development* 5(4):328-339.			
Reviewed by (name and affiliation)						
Category (mark with X)	**Resilience/ Adaptability**		**Loss of resilience/ Collapse**		**Transformation**	
			X			
Case study details:	**Country**	**Place**	**Scale – space**	**Scale – time**	**Sector(s)**	**Other (e.g. disturbance)**
	Sweden	Northern Sweden – case work	Approximately 150km^2	Late 19th century to present day	Sami reindeer herding/husbandry	

		comes from Vilhelmina North reindeer herding community (VNRHC), primarily located within Västerbotten county		(2014)			
Drivers (mark with X in appropriate boxes)	**Climate**	**Geopolitical**	**Mineral/ oil extraction & infrastructure**	**Tourism**	**Shipping**	**Biological invasion**	**Rapid demographic change**	**Other:** ***Increased standard of living, price of reindeer meat (1-p.45)***
	X		X		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	a) What types of ecosystem(s) and other major biophysical features are present? Tundra Mountains b) How are the case boundaries defined in terms of ecosystems or biophysical characteristics?	c) Who are the key groups of people in this case? Sami reindeer herders – individuals indigenous to Northern Sweden/Scandinavia. In this specific case, reindeer herders belonging to VNRHC. Swedish government (political): • Department of Rural Affairs – decides on reindeer husbandry policies and financial allocation • County Administrative Boards - responsible for setting maximum reindeer quotas and mediating land conflicts Reindeer Herding Communities (operational) – administrative

periods in the case and the drivers/ actors/ events that characterize the period.		duties for defined geographic and social area (aka Reindeer Herding District (4)) • VNRHC is considered a pioneer in land use planning, and even created the first reindeer management plan (RBP) created in collaboration with the Swedish Forest Agency in 2000, and is used as a communication tool (particularly with the forestry industry) (4). 8400 reindeer are permitted in VNRHC (1-p.47, 4, 9) Swedish Sami Council (administrative) – administrative control over reindeer husbandry Swedish Sami Association (SSR) - d) What kinds of livelihoods are important in the system? Sami reindeer husbandry – economically (and culturally) important for Sami, but nationally only contributes a very small amount economically (1-p.45). • Largely focused on meat production • In Västerbotten there are more reindeer/herder, less in Jämtland, and considerably less in Norbotten Forestry – the regions that reindeer herding occurs in (three regions Västerbotten, Norbotten, Jämtland) overlaps with 40% of the productive forestry area in Sweden (1-p.47; 3) e) What institutions are key to this case? If possible, define what scale it addresses. Formal Sami reindeer herding institutions (regional): • Membership to a Reindeer Herding Community (RHC,

		sameby) is required to be able to practice reindeer husbandry (1-p.45) • Each RCH has a maximum number of reindeer permitted, and thus number of reindeer herders (1-p.45). The county administrative boards limit the number of herders (4). Swedish formal institutions (national): • Reindeer Management Rights (RMR) – exclusive to Indigenous Sami, but to exercise this right, individuals must belong to a RHC, which has defined "herding" and non-herding Sami, and has created a source of conflict. Protected in the Swedish constitution (1-p.45). Applies to state and private land (1-p.47, 4) • After the Reindeer Husbandry Act (1971) came into place, "husbandry" was defined legislatively as a *privileged* industry, meaning that land cannot be used by RHCs for alternative uses that might be more profitable. This is possibly linked to the decline in herding activities (2) • The Climate Bill from the Swedish Climate and Vulnerability Commission – identifies reindeer herding as an extremely vulnerable to climate change. However, it offers very few concrete instruments or direction for climate adaptation (4) f) How are the case's boundaries socially defined, and how do these social boundaries relate to biophysical boundaries? As reindeer herding often transcends county and national boarders, Sami institutions are often poorly fitted with administrative institutions (1-p.44).

		As reindeer herding has withstood many socio-political, economic, and ecological changes, it is thought to be a highly adaptable and resilient practice that is well fitted to its ecological conditions (1-p.44). Herding vs. non-herding Sami creates a social boundary within the Sami population; those who are able to participate in reindeer husbandry, and those who are not. This separates those who can participate in reindeer husbandry, and those who may be willing to but unable as a result of the formal institutions aforementioned (1-p.45). Physical boarders and boundaries are disputed between (1-p.47): • Different RHCs • RHC and state actors

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? Identify disturbances or events that challenged,	Pre-1800s – reindeer husbandry was self-governed and not of national interest, though the state had some indirect influence (ex. taxation, school, boarder jurisdictions, etc.). However, the Sami had the rights to the land, and in 1602 that was formally institutionalized, and there was an individual rights-based land tax (2). 1885 – Lapp Administration was established by the County Administration Board (CAB). It was a major actor and institution in forming and implementing Sami and reindeer-herding policy, though did not involve Sami actors (2). 1886-1950 – reindeer husbandry formally institutionalized, and ended with Sami political mobilization reaching a tipping point. Sami political organization and participation was attempted, but was discouraged and halted by the state administration. Reindeer Grazing Act (RGA) was formed, which redefined geographical and social boundaries. Sami were not actors with decision making power in the governance system; in theory they could provide input, but ultimately the county administration board had final decision making powers. Maximum quotas on how many reindeer could be present was established, which in turn limited the number of reindeer herders (2). 1950 & 1956 – Sami Parliament and Nordic Sami Council were formed, respectively. This provided a formal institutionalized entrance for the Sami into reindeer husbandry governance (2). 1960-1970's – The "snowmobile revolution" fundamentally altered Sami reindeer herding practices (8). 1971 – Reindeer Husbandry Act (RHA) replaced the RGA, which prompted a number of structural changes. Reindeer Herding Communities (RHC) took over organization of reindeer husbandry activities as well as gained legal status and influence over decision making. RHCs re-established herding as a collective right, but created a herder/non-herder dichotomy within the Sami population. Lapp Administration was abolished and responsibilities were given to the central and regional Agricultural Boards. Herding representatives were introduced into government advisory boards (2). 1977 – Sweden recognized the Sami as indigenous people in their own territory, Sámpi (2). 1993 – Swedish Sami Parliament (SP) was established, but was not as a self-governing authority. Powers were limited to culture and language (2).

built, or reduced resilience or adaptive capacity in the system.	1996 – The Nordic Sami Council, now Sami Council, joined the Arctic Council, promoting Sami rights (2). 2002 – Swedish Sami Parliament (SP) have also become a member of the Sami Parliamentary Council, which advocates for Sami rights at the EU level (2). 2007 – Sweden adopted the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP), "international principle of all peoples' rights to self determination, especially in relation to control over traditional lands and natural resources." (1-p.47) *however, formal institutions eliminate self-determination (p. 56).* 2007 – SP was appointed administrative agency over reindeer husbandry, with tasks including provisioning which concerned reindeer counts, reindeer mark registry, consultative body for government matters, etc. However, the Department of Rural Affairs formally decides on reindeer husbandry policies, and CABs are still responsible for setting maximum quotas and mediating land conflicts (2).	
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?	b) Have there been major social disturbances that are relevant for the case?
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? Encroachment: compromising grazing areas (1-p.57). Forestry has compromised grazing areas reducing the availability and quality of lichen available (10). Climate change: extreme variability in weather patterns has made migration and access to grazing areas difficult (4). Predators account for 40 000-45 000 reindeer deaths a year, which is approximately 55 million SEK/year lost (1).	b) What are the key social drivers of change? Poorly fitted institutional framework (1-p.57): • State/market actors do not view traditional knowledge of reindeer herding as legitimate on its own (1-p.57) Lack of collaboration between actors dampens action across levels with respect to climate change (1-p.57). Changing standards of living, motorization (i.e. use of snowmobiles, which reduces the number of required personnel), and decrease in market price of reindeer meat (5, 6) have made herding a practice that not everyone is able to participate in, even if an individual is willing (4).

		Competing land uses: Mining, forestry, wind power, hydro-power, and tourism (4) have fragmented the land, has decreased herder's mobility and flexibility (1-p.62, 2). • Forestry has reduced the quality and availability of lichen in the winter time – the main food source (7) Technology: snowmobiles, helicopters, GPS collars for reindeers. All have transformed how reindeer herding is conducted, but all comes at a cost of traditional reindeer herding practices themselves. For example, reindeer herding used to only be done on skies, whereas now it is done completely reliant on snowmobiles. Additionally, GPS has changed the way herding practices are conducted (9).
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? (-) Fragmented landscape, as a result of competing land uses, reduces the flexibility and mobility of reindeer herding practices (4).	b) Within society (e.g. people, social capital, management, institutions, infrastructure): (-) State governance inconsistencies: despite having adopted the UNDRIP, the Swedish state demonstrates a number of inconsistencies with respect to reindeer husbandry. Sami perceive rights from Swedish state as insufficiently supported, and RHCs dialogue-based instruments lack capacity when it comes to exercising rights. Taken altogether, the state appears to view the reindeer husbandry as one of many industries in the area (1-p.57), and instead of considering their rights, deliberate them with respect to shared land use (4). (+) Sami perspective on reindeer herding: a lifestyle with fundamental rights (1). Sami also see themselves as having had to adapt in the past and always will adapt to new challenges (with respect to climate change). Perseverance attitude and view of reindeer herding as a way of life in this

		case acts as a source of adaptive capacity (4). (-) Lack of goals and collaboration between actors (1-p.57). Power of reindeer herders is limited, regulations are strict, and influence is limited. (-) Limitations of the formal definition of reindeer husbandry as an industry, whose land use must adapt to others (2) (+/-) Paradox regarding use of reindeer herding knowledge: emphasized or criticized depending on the situation (2). Traditional knowledge is now challenged by technology. For instance, grazing activities information from herders is now challenged by GPS information (4). (-) Sweden's failure to ratify the ILO's Indigenous and Tribal Peoples Convention (2). (-) Institutional diversity in the case of Swedish reindeer husbandry governance has created a weak, poorly functioning governance system full of inconsistencies. This is particularly true when comparing higher order governance levels (state control) compared to operational, problem-solving based issues (RHCs) lack the institutional infrastructure they need to deal with the issues they actually face (2). (-) Lack of adaptation action: at the Swedish state level (ex. the Climate Bill) and at the Sami Parliament level (ex. emergency funds for winter food, but no long term plans in place) (4). (-) Economic constraints – there are many strategies for dealing with climate issues (supplementary feeding, move

		via helicopters or trucks). However, costs make them unsustainable solutions (4). (-) Inability to diversify livelihoods (i.e. Reindeer Husbandry Act), makes adapting to changing conditions difficult (4) (-) Decreasing abilities for adaptation has eroded flexibility, traditional responses, and thereby resilience (4) (+/-) The use of snowmobiles and helicopters have allowed for reindeer herding to continue in the new conditions. However, new generations of herders now find it unfathomable that herding could be done without the use of technology (9). (+/0/-) GPS collars allow for additional information about herds to be gathered and used for herding practices (ex. good grazing grounds if a reindeer is staying put) or for RBPs. However, information is not substitutable for herder's practical knowledge, and should always be explained in context. If information is used out of context, it could act as a double-edged sword and in some cases is ignored (ex. GPS generated RBP was ignored in court against a wind farm) (9)

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	b) Within society
II.2. What are the system's key components?	a) Key Ecological components (e.g. lakes, coastal zones, caribou)	b) Actors in society (e.g. individuals, groups, public or private organizations)? How are people organised – by geography, livelihood, family, etc.? Swedish government (national) RHC (sub-regional) Sami reindeer herders – organized into different RHCs
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)	b) From society to nature – modifying nature, extracting resources (e.g. hunting, mining, water pollution)

II.4. What are key interactions?	a) What are the key ecological interactions within the case? b) What are the most important biophysical tele-connections to distant systems?	c) What collaborations, conflicts, or other key linkages exist between actors? Swedish government (national) – RHC (sub-regional) – the government interpretation of Sami self-determination rights views the them as a privilege and condition, and not absolute. The state determines the interpretation of Sami self-determination, which includes reindeer husbandry, but then the operational institutions are left to the RHC (1-p.56) d) Between local actors and distant actors?
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? d) What are key cultural practices and beliefs related to nature?
II.6. Disturbance What are important types of stress & shock	a) Describe important biophysical or ecological shocks and stresses (e.g. floods, storms, etc).	b) Describe important social shock and stresses (e.g. austerity policies, changes in government policy, introduction of new technologies, etc)
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?
II.8. Relationships with ecological regime shifts	a) Are ecological regime shifts driving further ecological change or pressure? 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? d) Are there specific social practices that might be contributing to ecological regime shifts

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)? 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 system that maintain each regime	Ecological feedback mechanisms	Social feedback mechanisms
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
II.8.e. What is (+/-) impacted by changes in ecosystem services	a) Impacts from regime shift on ecological components	b) Impacts from regime shift on social actors

directly or indirectly		
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

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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.