Name of the case study	Varnek – Shipping in the Barents Sea – Russia [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?	Climate change is transforming the Arctic Ocean into a seasonally navigable ocean (1, 4) and thereby increasing the potential for interaction with local communities (3). Increased shipping activities along the Northern Sea Route have already had direct and indirect impacts on the local environment and on socio-economic and cultural life of the local coastal Arctic communities (1, 3) that are heavily and directly dependent on land and marine resources and their environment. In the Russian Arctic the main challenge associated with increasing shipping traffic and the increasing number of island visitors is the transformation of local traditional economies. Residents of Vaygach Island exchange local traditional food (fish, berries, etc.) for goods (mostly alcohol) brought by visitors. The exchange has negative social consequences for traditional economic activities since natural resources are being collected not only for residents' consumption, but also for visitors. This exchange is also harmful for the local traditional economy. For example, in order to gather enough goods to exchange, the Nenets sometimes break hunting rules and poach (1). Coastal communities are also vulnerable to accidents associated with shipping traffic, such as oil spills and other types of pollution (2). The importance of identifying and protecting culturally important areas from increasing shipping activities was identified by PAME (4). Additionally, climate change has an impact on living standards and daily life. Changes in vegetation, dried lakes, the emergence of new species and disappearance of birds, changes in seasonality has affected the lives of the islanders. The local population has expressed concern with the changes as a result of shipping, however, residents are not considering moving from the island, but rather coping with change, since cultural identity is more important for their well-being. While the local population's activities show coping, with both climatic changes and increasing shipping in the Arctic, local communities have demonstrated their flexibility towards ongoing changes, the new activities could be affecting the resilience of their support system (overexploitation) and of their cultural and social spheres. This case highlights the rapid impacts of increased and unplanned connectivity with local communities, which is increasing throughout the Arctic. Both as a result of globalization in general but also as access to the Arctic increases for new actors.					
Template completed by:	Julia Olsen, Nordland Research Institute, University of Nordland Grete Hovelsrud, Nordland Research Institute, University of Nordland		**Key references: Cite in the text using (1), (2), (3) etc. and provide a reference list at the bottom of the template.** (1) Davydov, A. N., and G. V. Mikhailova. 2011. Climate change and consequences in the Arctic: perception of climate change by the Nenets people of Vaygach Island. *Global Health Action 2011* 4:8436.			
Reviewed by (name and affiliation)						
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)**

	Russia	Vaygach Island, Varnek settlement					Shipping	Impacts on local economy and culture
Drivers (mark with X in appropriate boxes)	**Climate**	**Geopolitical**	**Mineral/ oil extraction & infrastructure**	**Tourism**	**Shipping**	**Biological invasion**	**Rapid demographic change**	**Other:** ***state here***
	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?** The grass cover of the island is peculiar in northern Arctic tundra. There are many small lakes and rivers on the island. Nenets traditional economic system is dependent on presence of the tundra, marine mammals and seabirds (1, 2). **b) How are the case boundaries defined in terms of ecosystems or biophysical characteristics?** Vaygach Island, 3383 kilometres^2, is located between Novaya Zemlya and the mainland and surrounded by two straits: Karskiye Vorota (to the north of Vaygach) and Ugorsky Shar (to the south of Vaygach).	**c) Who are the key groups of people in this case?** Varnek is the only Nenets settlement on this island. Population 101 people in 2011. There are 24 families and 16 buildings in the village. Vaygach Island is one of the key points of the North Sea Route, which is located between Novaya Zemlya and mainland and between the Pechora Sea and the Kara Sea. Most ships operating the NSR going to Siberian seas from the west use 2 straits: Karskiye Vorota (to the north of Vaygach) and Ugorsky Shar (to the south of Vaygach) (1). **d) What kinds of livelihoods are important in the system?** Hunting, fishing, reindeer herding and gathering berries and mushrooms. Nenets traditional economic system is shaped by the presence of tundra, marine mammals and seabirds (1, 2). **e) What institutions are key to this case? If possible**

		define what scale it addresses. Each family is responsible for its goods' provision. All men are hunters (including all boys from the age of seven) and they follow local hunting rules. A family prepares about 100-120 cans of bird's meat for their own use, and collects about 100-120 eider eggs annually. During summer they collect Russian 'zolotoj koren', cloudberries up to 50 litres, and also mushrooms. **f) How are the case's boundaries socially defined, and how do these social boundaries relate to biophysical boundaries?** Varnek is the only settlement on the island with 101 residents. There is a shop, club, medical-station and a bakery, total 16 buildings with garages for winter motor sleds and dog huts. Electricity is generated from diesel motor from 07:00 to 14:00 (1).

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, built, or reduced resilience or adaptive capacity in the system.		
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?** - Changes in vegetation - Dried lakes - The emergence of new species and disappearance of birds	**b) Have there been major social disturbances that are relevant for the case?** Local traditional food (fish, berries, etc.) is being exchanged for goods (mostly alcohol) brought by visitors. The exchange has negative social consequences for traditional economic activities since natural resources are now not only exploited for residents' consumption, but also for visitors. Exchange is also harmful for the local traditional economy. In order to gather enough exchange goods, Nenets sometimes break the hunting rules and become poachers. (1)
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?** Warmer temperatures, changes in seasonality, sea ice decreasing.	**b) What are the key social drivers of change?** Increasing ship traffic in the Arctic.
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	**a) Within the ecosystem?** Migration patterns of birds and marine mammals are changing due to climatic changes.	**b) Within society (e.g. people, social capital, management, institutions, infrastructure):** Adapting to expanding shipping activities by developing goods exchange activities.

affecting adaptive capacity)		
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** - Shift in species composition - Drying lakes - Changes in seasonality - Sea ice decreasing.	**b) Within society** Climate change has an impact on living standards and daily life. However, they are not considering moving from the island, but rather are coping with change, since cultural identity is more important for their well-being. Decreasing sea ice has increased shipping activities and is bringing more visitors to the island. Local traditional food (fish, berries, etc.) is being exchanged for goods (mostly alcohol) brought by visitors. The exchange has negative social consequences for traditional economic activities since natural resources are exploited not only for resident's consumption, but also for visitors. Exchange is also harmful for the local traditional economy. In order to gather enough exchange goods, Nenets sometimes break the hunting rules and become poachers (1).
II.2. What are the system's key components?	**a) Key Ecological components (e.g. lakes, coastal zones, caribou)** Tundra, lakes, rivers, swamps, coastal zone, reindeer, marine	**b) Actors in society (e.g. individuals, groups, public or private organizations)? How are people organised – by geography, livelihood, family, etc.?**

	mammals (seal, walrus, beluga), birds, polar bears (1,2)	Village residents and visitors
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)** Ecosystem services	**b) From society to nature – modifying nature, extracting resources (e.g. hunting, mining, water pollution)** Hunting, fishing, reindeer herding, gathering berries and mushrooms (1). One family can pick up to 50 litres of cloudberries.
II.4. What are key interactions?	**a) What are the key ecological interactions within the case?** Changes in climate has a great impact on the local ecosystem, including changes in vegetation and species (new unknown for local residents are arriving while some bird species are disappearing) **b) What are the most important biophysical tele-connections to distant systems?**	**c) What collaborations, conflicts, or other key linkages exist between actors?** Exchange of local food for imported goods (including alcohol) is harmful for local traditional economy. In order to gather enough exchange goods, Nenets sometimes break the hunting rules and become poachers (1). **d) Between local actors and distant actors?**
II.5. Culture	**a) How is the relationship between society and nature viewed?** *Weather events are managed by the spirit (1):* *Fog, wind, rainfall is a form of manifestation of the spirits' relationship to actions: people's behavior.*	**c) What are key cultural features of relevance for the case?** Cultural identity is important for Nenets well-being. Nenets village, Varnek, is characterized as a special kind of Nenets Port economy and is influenced by the culture of the Russian Pomors

	Below is a fragment of one of the legends of Vaygach, as submitted by residents of the island: *I learned that there is an inscription on the Semiliky Idol (Spirit with Seven Faces) translated into Russian: 'In 1988, six grandchildren will be born of Vesako Idol.' There should be six boys in one family line... According to the belief of the villagers of Varnek and my own observations, one of those six grandchildren controls the weather. (. . .). . . Archaeologists took the idol to one of the museums in Moscow... During this time, while Vesako was absent, on Vaygach there were strong blizzards, hurricanes, sweeping everything in their path, but when he was brought back, the weather calmed down,' (1).* **b) What meanings are attributed to nature and to interactions with nature?** Vaygach Island is a holy land for the Nenets (1).	(1). **d) What are key cultural practices and beliefs related to nature?** Residents follow hunting rules (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).**	**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?** Changes in vegetation (more southern species are able to survive), the emergence of new species and disappearance of birds affect the traditional way of life with possible impact on hunting activities. - Drying lakes - Changes in seasonality - Sea ice decreasing	**b) What types of slow social processes (e.g. aging, population growth, loss of language) are driving important changes in social institutions and behaviours?** Exchange activities have an impacted resident's traditional economic activities and household life. Traditional nature management is transformed according to visitor's demand (1). Some hunter's rules are broken, and Nenets of Varnek become poachers (1).
II.8. Relationships	**a) Are ecological regime shifts driving further**	**c) Can social stresses or major changes be attributed to**

with ecological regime shifts	**ecological change or pressure?** **b) Are external or internal ecological dynamics potentially or actually producing ecological regime shift(s)?**	**ecological regime shifts?** Changes in climate have affected the traditional life of residents, including a decreased standard of living. However, few residents were considering moving from the island. **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)?** Vegetation and species shift Drying lakes Sea ice decreasing **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)** Decreasing sea ice increases shipping activities and brings more visitors to the island. Local traditional food (fish, berries, etc.) is being exchanged for goods (mostly alcohol) brought by visitors. The exchange has negative social consequences for traditional economic activities since natural resources are exploited, not only for resident's consumption but also for visitors. Exchange is also harmful for local traditional economy. In order to gather enough exchange goods, Nenets sometimes break the hunting rules and become poachers (1).	
II.8.b. Feedback mechanisms within the system that maintain each regime	**Ecological feedback mechanisms**	**Social feedback mechanisms** Cultural identity is important component for overall well-being

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).** Climatic changes **b) How do these changes alter biophysical feedback processes?**	**c) Drivers of social regime shifts (either social or ecological).** Increasing shipping in the Arctic and increasing amount of visitors on the island. **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**

REFERENCES/ SOURCES CITED:

(1) Davydov, A. N., and G. V. Mikhailova. 2011. Climate change and consequences in the Arctic: perception of climate change by the Nenets people of Vaygach Island. *Global Health Action 2011* 4:8436.

(2)	AMAP/CAFF/SDWG. 2013. *Identification of Arctic Marine areas of heightened ecological and cultural significance: Arctic Marine Shipping assessment (AMSA) IIc*. Arctic Monitoring and Assessment Programme (AMAP), Oslo, Norway.
(3)	Arctic Council. 2009. *Arctic Marine Shipping Assessment 2009 Report*. Arctic Council: Protection of the Arctic Marine Environment (PAME).
(4)	Humpert, M. 2014. *The Future of Arctic Shipping: A New Silk Road for China?* The Arctic Institute and Center for Circumpolar Security Studies, Washington, DC, USA.

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.