Name of the case study	Porsáŋgu and Várjat Vuota Varanger fjords – Social-ecological change of coastal communities - Norway [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 Porsáŋgu and Várjat Vuota fjords have experienced substantial social-ecological changes that may result in regime shifts. The communities living along the shorelines are heavily dependent on fishing; both from the revenues of the fishing industry for their economic wellbeing. Additionally, the *practice of being a fisher* is part of their cultural wellbeing. Fishing is an important characteristic of sea Sami culture. For this, the Sami Parliament has proven to be an important advocate. Nevertheless, different ecological processes have characterized this region in the last decades: disappearance of coastal cod from local spawning sites along with their overall depletion of stock-size; depletion of kelp forests due to an increase of sea urchins; migration of harp seals to these areas; and the introduction of the red king crab, an alien species without natural enemies in these waters. These changes triggered several social and governance responses in order to maintain revenues from the fishing industry. For example, the introduction of Individual Vessel Quotas (IVQs), the red king crab management regime, and opening local fishery landing sites. While time will tell in how the ecological system the fisheries continue to change, both due to climate change impacts on migration (cod and subsequently seal) and impacts of the invasive king red crab on the ecosystem and the fisheries industry, the responses have enabled these communities to adapt to change and maintain their livelihoods.	
Templated completed by:	Dries Stevens, 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) Broderstad, E. G., and E. Eythórsson. 2014. Resilient communities? Collapse and recovery of a social-ecological system in Arctic Norway. *Ecology and Society* 19(3):1. (2) Sundby, S., and O. Nakken. 2008. Spatial shifts in spawning habitats of Arcto-Norwegian cod related to multidecadal climate oscillations and climate change. *ICES Journal of Marine Science* 65: 953–962. (3) Arneberg, P., O. Korneev, O. Titov, and J. E. Stiansen, editors. 2009. *Joint Norwegian-Russian environmental status 2008 report on the Barents Sea Ecosystem: Part 1-Short version*. IMR/PINRO Joint Report Series, Norway and Russia. [online] URL: https://www.imr.no/filarkiv/2009/12/imr-pinro_2009-2_til_web.pdf/en

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)**
	Norway	Porsáŋgu and Unjárga municipalities' coastal communities and fjords				1970s-present	Fishing	Changes in cod stocks; invasive species
Drivers (mark with X in appropriate boxes)	**Climate**	**Geopolitical**	**Mineral/ oil extraction & infrastructure**	**Tourism**	**Shipping**	**Biological invasion**	**Rapid demograp hic change**	**Other: *state here***
	x	X (national)				x		Fisheries changes

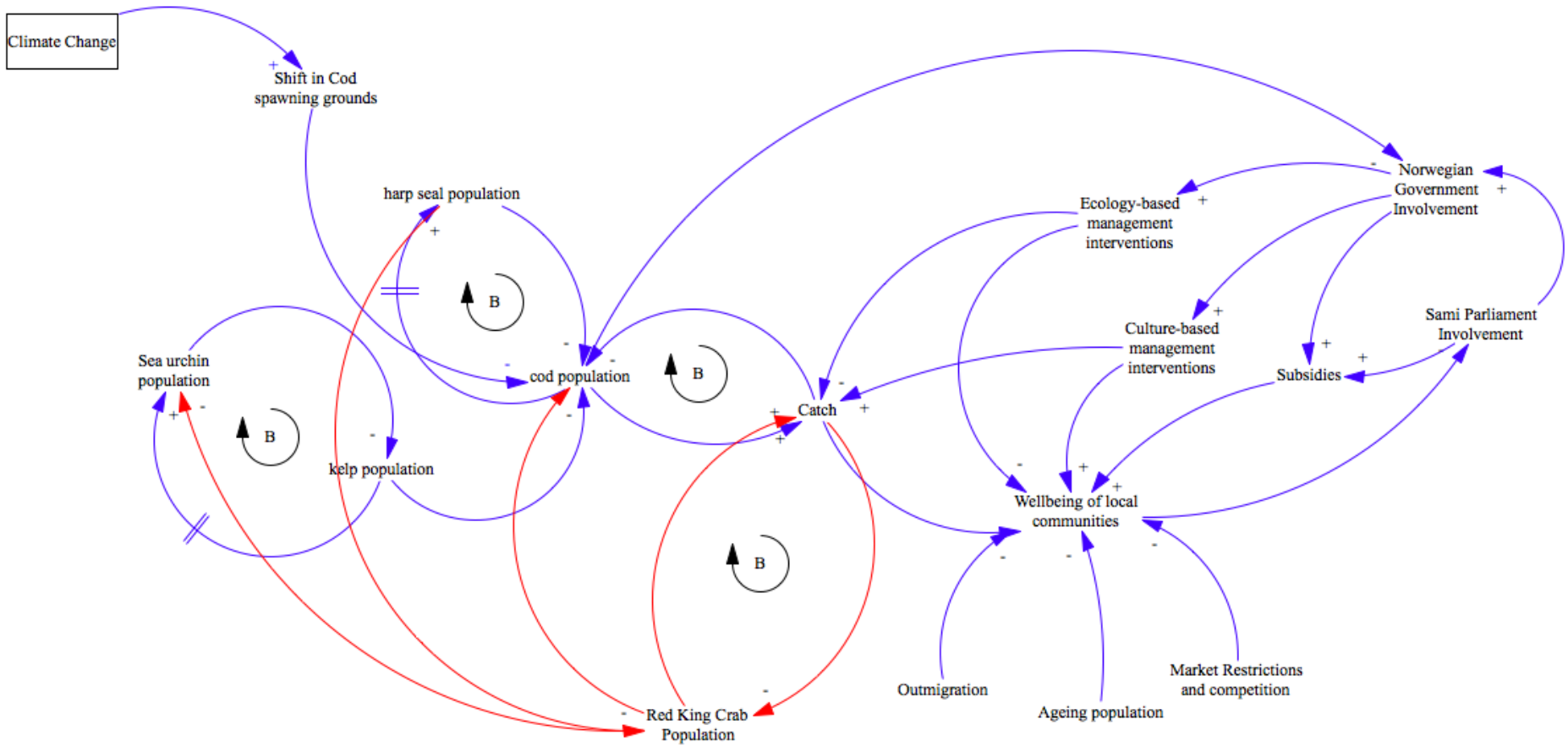
	Biophysical	**Social**
1. Basic description of coupled social-ecological system in focus (What are the key components and stakeholders) If possible, draw a systems diagram or conceptual map of the case – this can be a series of diagrams to capture different periods in the case and the drivers/actors/events that characterize the period.	**a) What types of ecosystem(s) and other major biophysical features are present?** The case is delimited by the coastal area along two fjords. The marine environment is very important for the livelihoods of local people. Key components include: - Coastal/fjord cod populations (*Gadus morhua*)	**c) Who are the key groups of people in this case?** - Population of Unjárga municipality: ~900 people, predominantly of Sami origin. (In 2009, 54% of the adult population was registered as voters for the Sami parliament). - Population of Porsáŋgu municipality: ~4500 people, of mixed ethnic origin (in 2009, 24% of the adult population was registered as voters

	- Harp seal populations (*Pagophilus groenlandicus*) - Red king crab populations (*Paralithodes camtschaticus*) - Sea urchin population (*Strongylocentrotus droebachiensis*) - Kelp forests **b) How are the case boundaries defined in terms of ecosystems or biophysical characteristics?** Two fjords in the Finnmark province of northern Norway; the Porsáŋgu fjord and the Várjat Vuota fjord; delimit the case boundaries. However, it has to be noted that ecological changes happening in these fjords do not happen in isolation, as they are incorporated in the larger marine ecosystem (1).	for the Sami parliament) - Sami Parliament: Representative body for the people of Sami heritage in Norway. Consists of 39 representatives elected by direct vote from 7 constituencies. Since 2010, the Norwegian government has to consult them on cases related to the Sami. Focuses on the rights of Sami as an indigenous group in Norway, strong advocacy for Sami fishermen rights (1) **d) What kinds of livelihoods are important in the system?** Historically, the coastal settlements in both fjords have been dependent on marine resources, in combination with animal husbandry, harvesting of terrestrial and freshwater resources, and seasonal wage labour. In this specific case we focus mainly on the fishing industry. It has become common for fishermen to also have part-time jobs within the cash economy (1). **e) What institutions are key to this case? If possible, define what scale it addresses.** • Norwegian Marine Resource Act 2009 [national]: Authorities are obliged to tailor management measures to 'secure the material basis for Sami culture' (2) • Individual Vessel Quotas [local]: As a response to a declining NEA-cod stock,

		quotas for individual vessels were introduced in 1990. Quota allocation was based on vessel catches for the previous three years. IVQs involve a species-specific total allowable catch typically by weight and for a given time period (in this case, for the NEA-cod stock). This has influence on local fishermen. Those who did not qualify had an option to continue as part-time fishers in an "open group fishery." Fishers in the open group were allowed to catch a very limited amount of cod provided that they met certain requirements, such as an upper limit for income from other sources (1). • Buy-out program Norwegian government [local]: In order to reduce the size of the small-scale fleet, the government sponsored a buyout program (2002-2009). 95 vessels were removed. This influenced the number of fishermen (1). • Ministry of Fisheries and Coastal Affairs: National ministry responsible for governance and legislation of fisheries in the country. Need to consult the Sami parliament for fisheries in Sami settlement areas (1). • Management regime for the red king crab: Management regime favouring small-scale fishers living in certain 'economic zones'. Only these fishermen are allowed to fish red king crab. Introduced in 2002 (1).

		f) How are the case's boundaries socially defined, and how do these social boundaries relate to biophysical boundaries? Two municipalities situated in the Porsáŋgu and the Várjat Vuota fjord in central Finnmark, Norway, respectively the municipalities of Porsáŋgu and Unjárga, delimit the case boundaries. These municipalities consist of different settlements scattered along the area (mainly along the coastline). The municipality of Porsáŋgu includes the coastal settlements along the fjord as well as some inland settlements and the municipal center, Leavnja/Lakselv at the bottom of the fjord, where most inhabitants live. Unjárga is a municipality located in the inner part of Várjat Vuota in eastern Finnmark, close to the Russian border. Both municipalities are defined as a part of the Sami settlement area. Even though not all inhabitants belong to the Sami community, they all have equal opportunity to apply for financial support from the Sami Parliament. In addition, they can also benefit from policies targeted towards the Sami settlement areas (1). Some small-scale fishers are organized in so-called "open groups."

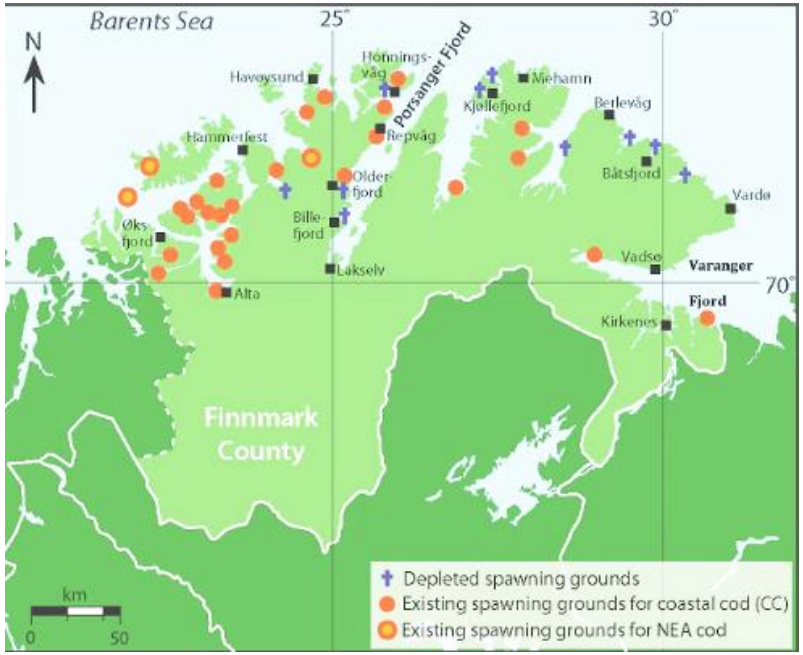
The coupled social-ecological system:



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?	- 1960s-1970s : Russian Scientists transported live red king crabs from the Pacific Ocean to the Barents Sea - 1979: Invasion of harp seals in the Várjat Vuota fjord - 1980s: Explosive increase in the population of sea urchins - 1987: Invasion of harp seals in the Porsáŋgu fjord - 1989: Disappearance of harp seals in both fjords - 1989: Return of coastal cod in the Várjat Vuota fjord after ten years of absence - 1990s: Unintentional introduction of red king crabs in the two fjords, as a result of the expansion of their territory from the Barents Sea. Invasive species. However, fishing of red king crab was banned in Norway due to Russia's ownership of the stock. Therefore, fishers were forced to throw over board the crabs caught as by-catch in other fisheries - 1990-2013: introduction of governance measures focusing on the Sami as an indigenous group - 1990: Introduction of Individual Vessel Quotas (IVQs) for the coastal fleet. With the introduction of IVQs the fishing commons closed. - 2002: Commercial red king crab fishing allowed. - 2004: Prohibition of Danish seine fishing in the fjord. - 2002-2008: Development of a new management regime for the red king crab. Russia's ownership of the stock was uplifted and Norwegian fishermen could harvest the red king crab. - 2002-2009: Buy-out program from the Norwegian government. - 2006: Coastal cod has been listed as severely threatened in the Porsáŋgu fjord. - 2006: Consultation agreement between the Sami Parliament and Norwegian government, grounded in International Labour Organization Convention 169 on Indigenous and Tribal Peoples in Independent Countries. - 2008-2012: Fishermen in Várjat Vuota fjord have observed the recovery of the kelp forests (in Porsáŋgu little recovery observed). - 2013: New government in Norway: the new minister of fisheries started to hollow out the arrangement for the fjord lines, which could be regarded as a response to larger vessels' interests and pressure from national fisheries organizations. (1)

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? - Depletion of capelin (*Mallotus villosus*) and cod in the Barents Sea caused a food shortage for the harp seals, triggering their mass migration to the Finnmark coast - Disappearance of coastal/fjord cod from its usual spawning sites. If their depletion is too big, the change might be irreversible. In 2006, the coastal cod complex was referred to as severely threatened - Depletion of kelp forests as a result of increased population of sea urchins - In-migration of the red king crab (alien marine species in this environment) from the Barents Sea. Red king crab was first perceived as a pest by local fishermen, as they got caught in their nets and damaged the harvest. Red king crab is a large mobile predator and polyphage eating sea herbivores such as sea urchins, in addition, it is a transmitter of a parasite for fish fry (1, 3) There is at the moment no scientific consensus on the causes that triggered the increase of sea urchins (1). NB. These four events are characteristic of both fjords. But they did not happen simultaneously!	b) Have there been major social disturbances that are relevant for the case? - One of the key social disturbances is the decrease in the number of fishermen in the region. There was a steep decline between 1995 and 2010. Small revival in the number of fishermen between 2010 and 2012 (but at the moment it is unsure if this trend will continue) (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? - **Climate Oscillations and Climate Change:** Research suggests that the spawning intensity and rate of reproduction of cod is strongly dependent on changes in climate. However, while the recruitment response to temperature is immediate and on an interannual time-scales, the response to changes in spawning sites is slower; on a multidecadal time-scale. When climate gets warmer, spawning grounds tend to move further north. From 2003, spawning has been observed along the coast of east	b) What are the key social drivers of change? - **Governance regimes - changes in fishery governance**: It is argued that the declining number of fishermen did not suffer as a result of governance measurements alone, but it did contribute to a certain extent. E.g. IVQs have made it more difficult for individual small-scale fishermen to make a living. – Direct effect - **General Demographic trends**: The decline in the number of fishermen can also be ascribed to general demographic trends that characterize the region. The

	Finnmark; where it did not occur during the previous 40 years. (2)	population is aging, there is an outmigration of the active population and the number of children and young adults is decreasing (which is being illustrated by the recent closing of several primary schools). Statistics Norway supports this claim. In 1990, Unjárga had 963 inhabitants, and Porsáŋgu had 4358. Early 2014, Unjárga had 919 inhabitants, and Porsáŋgu had 3963. – Direct effect - **Market restrictions and competition:** The global fish market also greatly affects the possibility for fishermen to make a livelihood, as fishing is not a sustenance practice anymore. The development of local fish delivery stations in the region made the industry much more easily connected to the (inter)national market. - Direct effect - **(Over)fishing:** Harvesting predatory species, such as king crab, limits their capacity to eat sea urchin and thus has a positive effect on urchin expansion and the concomitant destruction of kelp forests. Besides, even though the number of fishermen might be in decline, new fishing technologies might make fishing easier and thus limits the need for high number of fishermen – Direct effect (1)

5. Sources of adaptive capacity: What factors allow(ed) the system to adapt to disturbances in the past and present? Give a brief assessment of recent or on-going changes (+/-/0 = increasing/ reducing/ not affecting adaptive capacity)	a) Within the ecosystem? (+/-) **Harp seal migratory pattern**: Harp seals follow a migratory pattern. When fish stocks decline, they move to other waters. After, fish stocks can restore again (+) **Red king Crab eat sea urchins:** Adult red king crabs eat sea urchins and thus limit their effects on kelp forests, making the system more resilient (1, 2, 3)	b) Within society (e.g. people, social capital, management, institutions, infrastructure): (+) **Individual strategies**: In coastal communities, **the traditional way** of coping with poor fishing seasons is through diversification, reliance on subsistence self-employment, and seeking employment in other sectors. Flexible adaptations are a long-standing cultural adaptation of coastal Sami communities, based on their extensive experience with fluctuating fjord environments. It is common that people combine fishing with other part-time jobs within the cash economy in order to cope with difficult fishing seasons. (+) **Community responses**: The municipality of Unjárga followed an active strategy for rebuilding the local fishery by offering grants and inexpensive credit for investment in vessels and quota, in combination with SP funds, and by funding the development of fisheries infrastructure. During the 1990s, the red king crab gradually became a source of income for Unjárga fishers, and, because the cod had returned, the traditional cod fishery could now be combined with the new crab fishery. In Porsáŋgu, the options in the 1990s were different.

		(+) **National governance responses**: The Norwegian government offered some fast responses to local social-ecological disturbances. The IVQ system underwent some changes in the late 1990s in order to ease the livelihoods of coastal fishers in the concerned regions. After 2000, alarming assessments of the situation of the coastal cod stock complex led to new protective measures; namely, fjord lines were introduced in 2004, prohibiting Danish seine fishing in the fjords. The cooperation between the Sami Parliament and the Norwegian government has also increased active community participation. (1, 2, 3)
The next two sections break down the information in Section I. While it is not necessary to fill these sections, if you have additional information pertinent to specific rows below feel free to enter the material.		
II.1-8 SES, resilience and adaptive capacity		
	Biophysical	**Social**

II.1. Where do we find changes and resilience in the face of change?	a) Within nature: **Change** is found in the species composition of the region; there is an increase in the number of sea urchins and harp seals, and the red king crab, an alien species is introduced in the region. **Resilience** can be found in the migratory patterns of harp seals and coastal cod. The red king crab, even though considered an invasive species, also contributes to the system's resilience by feeding on sea urchins and thus limiting kelp forests.	b) Within society: **Change** can be found in: • Demographics: Population is changing, ageing, outmigration of younger people. • Legislative framework: Top-down governance of fisheries • Fishing has become an export-oriented activity rather than a self-sustaining one. These fisheries have now become dependent on the external market. Besides, it has become more and more common to combine fishing with other part-time jobs within the cash economy. **Resilience** can be found in traditional coping strategies of the Sami communities, as well as through active involvement of the Sami Parliament in the advocacy for the people's right, as well as through the national government's legislative framework to protect the fishing stocks and their financial support.

II.2. What are the system's key components?	a) Key Ecological components (e.g. lakes, coastal zones, caribou) The case is delimited by the **coastal area** along two **fjords**. **The marine environment** is very important for the livelihoods of local people. Key components include: - Coastal/fjord cod populations (*Gadus morhua*) - Harp seal populations (*Pagophilus groenlandicus*) - Red king crab populations (*Paralithodes camtschaticus*) - Sea urchin population (*Strongylocentrotus droebachiensis*) - Kelp forests (1, 3)	b) Actors in society (e.g. individuals, groups, public or private organizations)? How are people organised – by geography, livelihood, family, etc.? - Even though the population in the settlements are not 100% homogenous, the Sami identity is a very important factor in organizing and advocating community rights. The communities are in the Sami settlement areas and the Sami parliament is an important advocate. - Local and national government, ministry of fisheries (1)
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) - As the communities in question are heavily dependent on revenues from their fisheries, cod is a very important resource. Red king crab is now also used as a commercial resource. - Cultural service: Fishing is an important factor for reconfirming Sami identity. (1)	b) From society to nature – modifying nature, extracting resources (e.g. hunting, mining, water pollution) - Fishing has an influence on the cod population and on the red king crab population. (1, 3)

II.4. What are key interactions?	a) What are the key ecological interactions within the case? - **Kelp forests** are an important habitat for juvenile cod and other fish - **Sea urchins** feed on kelp - **Harp seals** feed on cod. Harp seals have a migratory pattern and move to other places when the amount of fish availability is low - **Red king crab** is a generalist predator that feeds on the most available benthic prey. In addition, it collects and filters out small invertebrates from the substratum. Even though the red king crab is an invasive species that is altering the ecosystem, it is unclear what the effect on local fish stocks is. Red king crab feeds on sea urchins, limiting their population and therewith influencing the spawning grounds of sea cod. However, red king crab is also known to carry a parasite that is lethal to cod fry. Although locals report that the fish is almost gone from some fjords, fishery statistics for eastern Finnmark do not suggest that traditional fisheries have declined as a result of king crab invasion (1, 3) b) What are the most important biophysical tele-connections to distant systems? - Climate change: is affecting migratory patterns of the different species in question. Spawning grounds of cod populations are moving further north. - Migration from red king crab: from the Pacific to the Barents Sea by Russia, then moved further to Finnmark (1, 2, 3)	c) What collaborations, conflicts, or other key linkages exist between actors? - Sami parliament as a representative body for Sami interests. Collaborates with the Norwegian government and advocates for the Sami's indigenous rights. - Open group fisheries: cooperation between local fishermen d) Between local actors and distant actors? - Revenues from the fishing industry are heavily dependent on the external market. Transportation centers have made the fishing in these communities more easily connected with the market (1) - Russia originally claimed ownership of the red king crab stock, which denied the Norwegian fishermen the right to fish them. Conflict between Russia and Norway. In 2002, this became upheaved with the establishment of the management regime (cf. supra) (1)

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? Fishing is an inherent part of the Sami identity and culture. 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). - New species: Introduction of red king crab - Sudden increase in the number of sea urchins. However, the reason for this sudden increase remains contested, as there is no scientific consensus. - Harp seals immigration - Depletion of cod (1)	b) Describe important social shock and stresses (e.g. austerity policies, changes in government policy, introduction of new technologies, etc) - Individual Vessel Quotas (IVQ) - Red king crab management regime - Prohibition of Danish seal line fishing
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? - **Shift in species composition**: With the increase in the number of sea urchins and the introduction of the red king crab, the species composition of changing in the region. At the moment it is unsure how these interactions will alter the ecosystem's make-up - **Climate Oscillations and concomitant cod spawning shifts** (1, 2)	b) What types of slow social processes (e.g. aging, population growth, loss of language) are driving important changes in social institutions and behaviors? - **General Demographic trends**: The decline in the number of fishermen can also be ascribed to general demographic trends, which characterize the region. The population is aging, there is an outmigration of the active population, and the number of children and young adults is declining. (No numbers in the literature reviewed – Indirect) - **Erosion of ecological memory**: this is related to the previous argument. When there are less young people

		becoming fishermen, the knowledge is not passed on anymore. (1)
II.8. Relationships with ecological regime shifts	a) Are ecological regime shifts driving further ecological change or pressure? **Climate change** is warming the seawaters in the Finnmark region. It is suggested that this will move the spawning grounds of cod further northwards. Climate change also influences the benthic production (1, 2). b) Are external or internal ecological dynamics potentially or actually producing ecological regime shift(s)? It is credible that with the introduction of red king crab in the region, the shift in species composition will eventually result in an ecological regime shift. As cod and red king crab compete over the same food source and red king crab transmits a virus to cod. However, at the moment it is rather unclear how it will play out in the future and further research is necessary (1, 2, 3).	c) Can social stresses or major changes be attributed to ecological regime shifts? The introduction of red king crab from the Pacific into the Barents Sea by Russian scientists in the seventies, followed by a harvesting prohibition of king crab for the Norwegians by the Russians, as they claimed ownership of the stock. This provided the king crab with the opportunity for to roam freely in Norwegian waters without disturbance (1). d) Are there specific social practices that might be contributing to ecological regime shifts - Subsidies are a social practice that disconnect fishermen from the feedback of scarcity (1)
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)? How do the properties and behaviors 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 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 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)	Broderstad, E. G., and E. Eythórsson. 2014. Resilient communities? Collapse and recovery of a social-ecological system in Arctic Norway. *Ecology and Society* 19(3):1.
(2)	Sundby, S., and O. Nakken. 2008. Spatial shifts in spawning habitats of Arcto-Norwegian cod related to multidecadal climate oscillations and climate change. *ICES Journal of Marine Science* 65: 953–962.
(3)	Arneberg, P., O. Korneev, O. Titov, and J. E. Stiansen, editors. 2009. *Joint Norwegian-Russian environmental status 2008 report on the Barents Sea Ecosystem: Part 1-Short version*. IMR/PINRO Joint Report Series, Norway and Russia. [online] URL: https://www.imr.no/filarkiv/2009/12/imr-pinro_2009-2_til_web.pdf/en

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.