Name of the case study	Yakutia- Political transformation versus climate adaptation in Bulunsky ulus fishing communities-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?	Arctic Yakutia fishing communities are facing environmental changes among socio-economic transformations that are affecting their resilience. Fish is an important activity providing traditional food, subsistence economy, and allow the social-culture reproduction. Environmental changes related to warmer temperatures, changes in the river, change in fish migration patterns, and decreased fish stock are constraining traditional fisheries. Local communities have been able to cope with climate challenges as part of their history by traditional adaptation of fishing seasonality. However, fisheries regulations, introduced after the collapse of the Soviet Union, established quotas and temporary limitations that have restricted their fishing activities and limiting their adaptive capacity.		
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) Ksenofontov, S., Backhaus, N., and Schaepman-Strub, G. (2017). 'To fish or not to fish?': Fishing communities of Arctic Yakutia in the face of environmental change and political transformations. Polar Record, 53(3), 289-303. (2) Ksenofontov, S., N. Backhaus, and G. Schaepman-Strub. 2019. 'There are new species': indigenous knowledge of biodiversity change in Arctic Yakutia. Polar Geography 42(1):34–57. **(*) Mainly all the information comes from (1). Otherwise, is explicit cited**	
Reviewed by (name and affiliation)			
Category	**Resilience/ Adaptability**	**Loss of resilience**	**Transformation**

			X			
Case study details:	**Country**	**Place**	**Scale – space**	**Scale – time**	**Sector(s)**	**Other (e.g. disturbance)**
	Russia	Allaukhovsky ulus-Bulunsky ulus-Yakutia		1997-2017	Fishing	Political and economic

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? Lena river at the Laptev Sea Arctic tundra Estuaries Marine and freshwater ecosystem. b) How are the case boundaries defined in terms of ecosystems or biophysical characteristics? The boundaries of the system are defined by the rivers and the migration paths of the species.	c) Who are the key groups of people in this case? Tiksi and Kyusyur are two settlements in the Bulunsky ulus of the Republic of Sakha (Yakutia), northeaster Siberia, Russia. These settlements are in the deltas of Lena River at the Laptev Sea. Northern Skaha Indigenous communities inhabited this area. Tiksi is the capital of the Bulunsky district and is the northernmost town of Yakutia. The area has 4,556 inhabitants both indigenous and non-indigenous. Kyusyur is an ethnic village on the right bank of the Lena River, 120 km from with a population of 1,272, inhabitants mainly indigenous people. d) What kinds of livelihoods are important in the system? In general, both practice fishing, hunting, and reindeer

		herding. Fishing has is the source of employment, income, food, and cultural identity. Fishers use different techniques depending on the seasons. For instance, in October, after the ice freeze, they ice fishing using nets. In winter, the fish under the ice with a short rod in the ice, and in spring, they ice fishing with small cells. Tiksi population is also employed by the seaport, airport, meteorological station, among others. Kyusyur communities rely on agriculture, but the locals are also involved in fishing, hunting, and reindeer herding. e) What institutions are key to this case? Obshchina is the organization that represents small-scale fisheries in the areas. Federal government which created fishing regulation Regional authorities from the Siberian fishery basin adapt the fishing regulation according to local reality. f) How are the case's boundaries socially defined, and how do these social boundaries relate to biophysical boundaries? The social boundaries of fishing extend beyond the physical area of the settlements. Fishers move around the basin of Lena´s rivers.

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 *.	1930's: Policy of collectivization 1950's: Policy of "forced sedentariness of nomadic families 1950's: Russification of the education system 1950's-1960s: The campaign against so-called "unpromising villages." 1991: The collapse of the Soviet regime generated economic changes local people had to adapt to the new market economy. No more subsidy from the state to the Statal fishing and hunting companies. Local communities had to deal with it on their own. 2004: Implementation of fishing quotas and closed seasons.

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 the riverbed and sandbanks had affected the fish stock. Fishes tend to swim down to the river. According to the actors, fish tend to hide in the river's lower reaches where it is colder, and the sand is blocking the migration routes. Weather patterns have changed, winters are warmer, and summers are colder, and the weather is unpredictable. Yakutian fish species are shifting towards the north. Several species move to Lena River to the estuary, which is the habitat of white fish and char having more competition. Consequently, native species are more vulnerable to external predators. Increase in the bacterial diseases in the aquatic ecosystem due to warmer temperature of the river. The community had caught white fish with more than 12 parasites.	b) Have there been major social disturbances that are relevant for the case? - Out Migration of young people to other cities - Increase the dependence on natural resources, especially fish, as a source of food and income. - They used larger nets despite being prohibited by fishing regulations that stipulate the use of only certain types of nets.
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? Warming water has increased the rates of bacterial diseases in aquatic ecosystems and changed the movement patterns of the species. Arctic fishes rather cold water migrating to northern areas. Warmer weather has accelerated the river ice break and the permafrost melting, increasing the water levels. These changes have changed the riverbed affecting also the movement patterns of the fishes.	b) What are the key social drivers of change? The collapse of Soviet Union, impact on local economies. Communities rely on the subsidy and employment from the governments. The end of the Soviet regime was the end of statal support, without this support, communities started to rely more on natural resources. Fisheries policies have set quotas and closed seasons restricting the type, quantity, and size of fishing gear without considering local contexts. This legislation affected fishers'

		adaptive capacity. Westernization of society. Sedentariness, western education, and money-oriented society influenced young people's interests and values affecting traditional livelihoods.
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? (-) Native species are more vulnerable to external predators (-) Increase in bacterial diseases (+) Species move along the river, looking for colder water and a more comfortable habitat. (+) Increase of new species in the area such as Siberia Salmon	b) Within society (e.g. people, social capital, management, institutions, infrastructure): (-) The fishing quota allocated per person or obshchina is by weight. According to the community, these quotas are not enough. (-) Fishing restriction related to the size and type of the gear does not match with the arctic conditions. (+) Mobilization capacity along the river to catch. However, this strategy is expensive. (+) Diversity of fishing strategies and catch according to seasonality. (+) Include new species in their diet. They had learned how to cook pike or burbot, species with less nutritional value according to the community. This strategy had been learning from immigrants. (-) The decline of traditional knowledge and practices due to the shift of interest from the younger generation. (-) Food security: the unpredictable weather makes access to food more difficult, affecting the quality of nutrients of the population.

		(+) Traditional practices as nimat (sharing food) enable the social and cultural reproduction
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: Weather has become more unpredictable, with changing freezing and thawing patterns of the ice negatively impacting fishing. Members of all communities stated that river levels have essentially increased, changing the river's bed. Warmer waters changed the fish migration patterns and brought new species to the area. Resilience is found in: Capacity of fish to move along the river looking for better conditions. Arrive of new species in the area.	b) Within society: Change: The livelihoods of the communities have been altered by political and economic drivers. The collapse of the Soviet Union caused a shift in livelihoods. Communities started to rely more on fishing and secondly on hunting and reindeer herding. New regulation in fisheries had increased the difficulties of fishing regulations. Among the colonization process, the area is suffering depopulation and aging. The transition to a market-oriented society, and the shift in youth interest, has led to outmigration and a decrease in fishing, and a loss of traditional knowledge and practices that sustain indigenous communities. Resilience: Communities follow their rules based on the traditional knowledge systems. They keep practicing collaborative strategies to cope with disturbance in the system, such as nimat (sharing food). On the other hand, there are national programs currently in the area that look to improve the quality of life and decrease the vulnerability regarding their livelihoods and traditional knowledge. However, there is still an ongoing process.

II.2. What are the system's key components?	a) Key Ecological components (e.g. lakes, coastal zones, caribou) Whitefish, White Salmon, Siberian Cisco, Muskun, among others that move from marine to freshwater depending on the seasonality. Pike is also another essential species for the case. Rivers, estuary, marine ecosystem.	b) Actors in society (e.g. individuals, groups, public or private organizations)? How are people organised – by geography, livelihood, family, etc.? Obshchina: This is a self-organized indigenous community and recognized under the Russian Federal Law as small-scale fisheries. They sell their catch to the bigger city Yakuskt and for subsistence. This figure provides 73% of the whole catch and is the primary source of subsistence and employment. The indigenous community that practices traditional fishing for subsistence purposes. Elders are the one who keeps using traditional knowledge and transmits across generations.
II.3. What are the key linkages? E.g. ecosystem services, resource extraction. These linkages should exist. If there are not mutual links between social and ecological components the case is not a social-ecological system.	a) From nature to society (e.g. ecosystem services) - Primary production - climate regulation - knowledge and educational values - traditional livelihoods.	b) From society to nature – modifying nature, extracting resources (e.g. hunting, mining, water pollution) - Fishing - Hunting
II.4. What are key interactions?	a) What are the key ecological interactions within the case? Warmer waters affect fish abundance and distribution. Fish behaviour (e.g. growth, reproduction) depends on temperature variations. Water fluctuations due to the melt of ice and permafrost, also affected fish populations, especially white fish.	c) What collaborations, conflicts, or other key linkages exist between actors? Local communities perceive that fishing regulations aren't appropriate for their reality, generating a constant conflict with the regional authorities. For instance, the spawning season of fish does not match with the fishing ban during

	The arrival of new species in the area competes with native species and increases their vulnerability. Higher water levels cause floods that result in sediment input smothering macroinvertebrates and incubating fish eggs. Higher water levels make fish go deeper in the river, challenging the catch (2). b) What are the most important biophysical tele-connections to distant systems? The connection with the coastal line and the possible arrival of non-native species to the river basin. (2) Climate change has triggered the main drivers of the case, such as ice and permafrost melting. (2)	spring or autumn in the research areas; or the size of gear restriction does not correspond with the size of species available. The lack of reality in the fishing policies had led to the self-organization of local fishers. They follow their own rule to manage resources based on their traditional beliefs. d) Between local actors and distant actors? The local company for traditional fishing and reindeer herding in Kyusyur is currently operated by external management from Yakutsk. The main plan is to separate into two industries, which may lead to a conflict with the external management of the company and the community. (2) People are concerned because fishing profits help to invest in reindeer herding practices. Indigenous community and governance. The introduction of western perspective creates a clash of different worldviews creating conflicts between the actors.
II.5. Culture	a) How is the relationship between society and nature viewed? Fishing is crucial for the subsistence and the construction of local societies. Social practices around fishing such as Nimat (sharing food) and sharing knowledge create networks and bonds. b) What meanings are attributed to nature and to interactions with nature?	c) What are key cultural features of relevance for the case? Indigenous communities have their norms constructed by their beliefs and traditional knowledge shaping their relationship with nature. d) What are key cultural practices and beliefs related to nature? Nimat is a traditional practice, where the spoils of hunt and

	From nature, communities create their own rules to manage the system, for instance, self-enforced norms that establish the quota catch (2).	fish are shared with the community, especially with the poorest families. These traditions allow the community to create relations within the community and with nature. Any offense to these practices can release Buga´s punishments. Currently, this practice is becoming more market-oriented, Fishers and hunters commonly sold the whole catch to have more income. Overharvesting is an act of disrespect. Buga (nature) will punish and deprive fishermen of luck, "is fundamental to feed the land or river spirit before fishing." This norm enforced the sustainable use of the resources.
II.6. Disturbance What are important types of stress & shock	a) Describe important biophysical or ecological shocks and stresses (e.g. floods, storms, etc). The increase in water levels is changing the riverbed. Communities are facing floods in the area.	b) Describe important social shock and stresses (e.g. austerity policies, changes in government policy, introduction of new technologies, etc) Fishing policies limit traditional activities The introduction of new technologies has influenced the change of harvesting habitats, leading to overexploitation (2)
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? The loss of permafrost affects the water level creating slow changes in the riverbed. The increase in temperature affects the behaviour of the fish species. This process could lead to a shift in species	b) What types of slow social processes (e.g. aging, population growth, loss of language) are driving important changes in social institutions and behaviours? The shift of the nomadic society to a sedentary society forced by the government. They separate the children from their parents and put them in traditional schools introducing them to western perspectives. The shift of the interest and values of young people, affecting

	distribution along the rivers.	the transfer process of traditional knowledge and loss of native language. Loss of traditional practices and languages
II.8. Relationships with ecological regime shifts	a) Are ecological regime shifts driving further ecological change or pressure? Not present in the case b) Are external or internal ecological dynamics potentially or actually producing ecological regime shift(s)? Yes, the shift of species in the rivers.	c) Can social stresses or major changes be attributed to ecological regime shifts? The river levels and the temperature of the water have affected the fishing in the area. This increases the vulnerability of the communities that rely on fishing and source of food and income
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)? Potential regime shifts in the area include a change in the species composition due to the melting of permafrost and the water fluctuation. The is arctic tundra ecosystems with arctic species. 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) The livelihoods of the communities have been altered by political and economic drivers. The collapse of the Soviet Union caused a shift in livelihoods. Communities started to rely more on fishing and secondly on hunting and reindeer herding. New regulation in fisheries had increased the difficulties of fishing regulations. Among the colonization process, the area is suffering depopulation and aging. The transition to a market-oriented society, and the shift in youth interest, has led to outmigration and a decrease in fishing, and a loss of traditional knowledge and practices that sustain indigenous communities.	
II.8.b. Feedback	Ecological feedback mechanisms	Social feedback mechanisms

mechanisms within the system that maintain each regime	- Competition between species - Permafrost - Fish behaviour according to habitat conditions	- Values shift: Change in education, the sedentary life has shifted the value of young people. They rather migrate to other areas than continue practicing traditional livelihood - Loss of traditional knowledge: younger generations are not interested in reproducing traditional livelihoods, losing the knowledge within.
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). Increase in water temperature and permafrost melting b) How do these changes alter biophysical feedback processes? The melt of permafrost has increased the level of water in the river, modifying the riverbed. The change has affected fish distribution among the river, making it harder to catch. Furthermore, the sediment of the river blocks the migration patterns of native species. The increase in water temperature has changed fish behaviour moving forward to colder water. The warmer water has increased the bacterial disease in fishes and has brought new species to the area.	c) Drivers of social regime shifts (either social or ecological). Fishing policies The collapse of the Soviet Union Westernization of culture Introduction of new technologies d) How do these changes alter the social feedback processes? The introduction of western culture among young people has shifted their value and interest in practicing traditional fishing and hunting. Society is more money-oriented, changing the objective of traditional practices such as nimat and fishing. Fishing policies have restricted the catch by season, gear, and amount without considering the traditional knowledge. Constrains the adaptive capacity of fishers. For instance, due to changes in seasonality, fishers must change the gear that is not allowed for that season according to the policies (2). Collapse of Soviet Union, impact on local economies. Communities rely on the subsidy and employment that the governments give to them. The end of the Soviet regime was the end of state support.

		With the lack of jobs and subsidies, communities started to rely more on natural resources. Climate drivers and policies have made more difficult and less productive the fishing activity. The shift in values in the younger population due to the introduction of western culture is risking the reproduction of traditional livelihoods, which are a key element of communities' resilience.
II.8.d. Ecosystem services substantially impacted by regime shift	a) Changes in ecological processes that produce ecosystem services Species availability and quality of fish. Loss in species leads to a loss of traditional knowledge related to that ecological component.	b) Changes in demand for ecosystem services (market and non-market) Market-oriented society, change the fishing practices. Technology allows fishers to be more efficient and increase their catch. Efficiency could lead to overharvesting. 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. Communities have their own rules to manage their natural resources created from their traditional knowledge. The shift in traditional practices and the lack of employment in the area have changed how fishers related to the ecosystems.
II.8.e. What is (+/-) impacted by changes in ecosystem services directly or indirectly	a) Impacts from regime shift on ecological components (-) Change in the river can lead to a complete shift in native species.	b) Impacts from regime shift on social actors (-) Change in fishing practices could lead to an ecological collapse (-) The shift will decrease traditional livelihoods in the community, meaning their adaptive capacity.
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

	If the river's dynamics continue changing, freshwater runoff to the sea will increase, affecting the coastline area and all the basins.	The loss of traditional fishing can lead to an over-exploitation of the aquatic and terrestrial systems. Communities may need to rely more on terrestrial fauna.
II.8.g. Where do actors intervene to alter regime shift dynamics and who can do the intervening? This can be listed here or marked with (*) in the table above	Ecologically oriented interventions At the local to regional scale, actors can intervene by changing policies and make bottom-up strategies. Local governments are creating programs to support communities to maintain their livelihoods.	Socially oriented interventions Government intervention makes the community dependent on subsidies. Later the ongoing colonization and westernization shifted the value of the young population risking the loss of traditional practices. Top-down policies have constrained the adaptive capacity of the community to deal with climate change and social processes.

REFERENCES/ SOURCES CITED:

(1)	Ksenofontov, S., Backhaus, N., and Schaepman-Strub, G. (2017). 'To fish or not to fish?': Fishing communities of Arctic Yakutia in the face of environmental change and political transformations. Polar Record, 53(3), 289-303.
(2)	Ksenofontov, S., N. Backhaus, and G. Schaepman-Strub. 2019. 'There are new species': indigenous knowledge of biodiversity change in Arctic Yakutia. Polar Geography 42(1):34–57.

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.