Name of the case study	Upernavik- From hunters to fishers: Livelihood transformation challenged by socio political changes- Greenland (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 rctic?	Upernavik is in the North of Greenland. Inuit communities have lived from hunting seals, white whales, and narwhals. Social and environmental changes during the 20th century have forced the community to shift from a subsistence livelihood into a mixed economy combining their traditional hunting with Greenland halibut fishing. The fishing during the winter is in the sea ice and the summer in dinghies. Warmer temperatures are affecting their mixed economy. A shorter period of sea ice forces hunting and fishing to be in open dinghies in the dark winter period, which is dangerous and leads to reduced output. High temperature has increased the larger vessel's harvest, reducing the local population's participation in fishing. Fisheries policies allocate a greater portion of the halibut to larger ships that do not belong to the community. By this, the quota for dinghy and dog-sled fishing will be reduced, affecting local communities, and decreasing their flexibility and diversity to face climate change. With the new regulation of halibut fishing that undermines the mixed hunting-halibut fishing economy, local resilience will decline and lead to dependency on social benefits.	
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) Kåre Hendriksen & Ulrik Jørgensen (2015) Hunting and fishing settlements in Upernavik district of Northern Greenland – challenged by climate, centralization, and globalization, Polar Geography, 38:2, 123-145 (2) Delaney, A. 2016. The Neoliberal Reorganization of the Greenlandic Coastal Greenland Halibut Fishery in an Era of Climate and Governance Change. *Human Organization* 75:193–203. (3) Delaney, A., R. Jacobsen, and K. Hendriksen. 2012. *Greenland Halibut in Upernavik: a preliminary study of the importance of the stock for the fishing populace*. Aalborg University. 41. **(*) 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)**
	Greenland	Upernavick town		District-1990-2015	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	a) What types of ecosystem(s) and other major biophysical features are present? Sea-ice, inland ice cap. Seal, narwhale, white whale, walrus, polar bear, and birds b) How are the case boundaries defined in terms of ecosystems or biophysical characteristics? Boundaries are set according to livelihood areas. Fishers	c) Who are the key groups of people in this case? Inuit people from Upernavik town from Qaasquitsup Municipality (2) d) What kinds of livelihoods are important in the system? Mixed subsistence economy which includes traditional hunting of seal, beluga, narwhal, walrus, polar bear and numerous bird species and commercial fishing of halibut. (1,2) Fishing livelihoods is male dominated activity, woman

capture different periods in the case and the drivers/ actors/ events that characterize the period.	move around the basin and the hunter area covers most of the uninhabited Melville Bay.	works are related to school, groceries, and plant processing. Normally, the locals have been fishing for halibut in the winter by long line from the ice. (2) The coastal fisheries are conducted with small and large boats in open water, and sledges or snowmobiles during the iced-over period. Dinghy and sledge/snowmobile fishers use long lines. Large boats also fish with long lines (3) Hunts in the winter are through blowholes on the sea ice in Melville Bay. When the sun comes back, hunters travel by dogsled to open waters in sea ice and hunt narwhals and white whales from a kayak and from the ice edge. e) What institutions are key to this case? f) How are the case's boundaries socially defined, and how do these social boundaries relate to biophysical boundaries? The social boundaries are defined according to livelihood areas, which are beyond the physical area of the settlements. Fishers move around the basin and the hunter area covered most of the uninhabited Melville Bay.

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 *.	1940s: Until this period Danish policy in Greenland aimed to support the Inuit population to transit gradually to a “modern “society and minimize the cost of colonization. During the war there was no connection between Greenland and Denmark. The US maintained delivery to Greenland and built a military base. However, when the war finish Greenland was isolated, therefore Denmark changed their policies. New policies invest in modernizing Greenland building infrastructure and new housing in the main town and settlements. This increase the quality of living and health conditions to those area selected, however, Upernavik was not one of the “modern towns" 1979 “Home rule”: Greenland was under the new policy home rule. Upernavik was one of the poorest and least developed districts. This policy encourages the outmigration of small towns and settlements and promotes the urbanization of bigger towns. Home-rule government had large economic problems. Over-investments in other fish-processing plants, primarily for the cod fishery, combined with poor economic management and the dependence on subsidies from the Danish state (Danielsen 1998), which even today finances half of Greenland’s public administration. The result was massive unemployment in most cities, and public investments were once more concentrated in the larger cities, primarily in the capital, Nuuk. 1990s: Greenpeace campaigns against seal hunting, which hit all hunting activities in Greenland very hard and accelerated the shift from hunting to fishing. 1990s: Greenland’s cod fishing industry, which provided the country’s primary export income, collapsed as the cod disappeared from Greenland waters. 1990s: Potential for halibut fishing started developing in Upernavik district. Consequently, the district changed status from being on the periphery, referred to disparagingly and excluded from public development investments to being a place that made a positive contribution to national export incomes by changing its economic base. A network of processing and storage facilities was built in Upernavik and today there is a storage facility for halibut in the city and in seven of the district’s nine settlements. Storage facilities have given most hunters a supplementary source of income, while fewer have shifted from hunting to fishing. 2009: Self-government, composed of a parliamentary democracy within a constitutional monarchy. The country is called Kalaallit Nunaat (The country of the Greenlanders^) and home to approximately 56,000 people, about one third of whom live in the capital, Nuuk.

	2012: Implementation of Coastal Greenland Halibut Management Plan (GHMP) 2014: Modification to GHMP	
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? -Cod stock collapse	b) Have there been major social disturbances that are relevant for the case? - High cost of electricity in Upernavik affects the fishing plant and their capacity for storage. . - Lack of job opportunities for Women in the fisheries "industry". Due to market fluctuations and policies that promote the process plants in bigger cities there is a decrease of work in processing plants. The lack of employment of women results in a reduced money income for the families - New fishing regulation: Policy allocate a greater portion of the halibut quota to larger vessels outside the Upernavik district and simultaneously reduce the quota for dinghy and dog-sledge fishing. On the other hand, quotas can be sold to cutters or shipping companies -
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 are melting glaciers and permafrost, making unpredictable ice patterns (2). The change in ice patterns create new currents uncovered on the island, disrupting hunting activities	b) What are the key social drivers of change? - Livelihood transformation from hunter to fishing, becoming the primary means of livelihood. - No outmigration of the area as other settlements in Greenland to cities. Locals are attached to the place, and

	Inland ice cap has been reduced creating new open land and many new islands. The new islands create new water currents, which undermine the winter sea ice and make dog sledge and snow scooter transportation dangerous. The timing of solid ice´s formation has become unpredictable, comes late, and lasts for shorter period.	they do not consider themselves as poor, on the contrary. - Mismatch of world view between nations governance and local populations. The Ministry perceives that fishing is not productive enough to catch the halibut in the area, creating new policies for increasing the quota of fishing to large vessels. Hunting is a subsistence activity that is not promoted through policies since it does not contribute to taxes is perceived as unproductive activity. Community considers fishing as an extra income to survive and navigate climate change.
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 (+) Species move along the river looking for coldest water and more comfortable habitat. (+) Increase of new species in the area such as Siberia Salmon (+) Diversity of animals. There are seals, narwhale, white whale, walrus, and polar bear, and birds in large numbers in the summer.	b) Within society (e.g. people, social capital, management, institutions, infrastructure): (-) Halibut fish is considered an adaptive strategy. New fishing regulations (GHMP) undermines the mixed (hunting-halibut fishing) economy affecting halibut fishing, (-) Changes in sea-ice makes impacts for the fishing and hunting activities of the Inuit population, escalating to the knowledge related to those activities. (+) Diversification of livelihood through the integration of halibut fisheries at local scale supporting local economies. (+) Adaptation strategies related to seasonal and support networks. In the summer, they try to work together to keep the best fishing sites free of ice by regularly sailing around to break up the ice. In the winter, many of them continue dinghy fishing despite the dark and the ice until the sea ice freezes solid so they can fish from it near the settlement and

		in the smaller fjords. (+) Self-control of fish stock: Inuit only catch what they need to buy gasoline, ammunition, house rent, family clothing, dinghy engines, media technologies, among others to support their traditional livelihoods. The rest of the time, they provide for their families by hunting. (-) Lack of understanding for different perspectives: Greenland's officials wish to develop a modern independent state while the local Upernavik inhabitants wish to maintain the decentralized settlement pattern and the mixed economy that is the basis for their livelihood. (-) Lack of communication between the local population and central governance. During fieldwork done in 2010 people were not aware of the change of the fishing policies for halibut. (+) Kinship and social relations remain important for the communities. Individuals move to summer camps for hunting and gathering. They also keep sharing meat (kodgaver).
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: 1990s, most of Upernavik district was typically covered by sea ice from November to June, and the sea ice was a precondition for the people's hunting-based existence and livelihood. Warmer temperatures are melting glaciers and permafrost,	b) Within society: Change: Resource dependency gradually shifted from hunting to fishing, becoming the main livelihood. The integration of technology such as outboard motors and the development of storage facilities for halibut, facilitate the

	making unpredictable ice patterns (2). The change in ice patterns create new currents uncovered on the island, disrupting hunting activities. Resilience: Halibut stock enables the local fisheries	commercial fisheries. Resilience: Community still identify as hunter this have allowed to keep the social networks and sharing food systems among the community. Halibut fisheries have been used as an adaptive strategy to cope with change.
II.2. What are the system's key components?	a) Key Ecological components (e.g. lakes, coastal zones, caribou) -Greenlandic Halibut, - Seal, narwhale, white whale, walrus, and polar bear, and birds in large numbers in the summer. -Coastal zones - Sea ice -Open waters	b) Actors in society (e.g. individuals, groups, public or private organizations)? How are people organised – by geography, livelihood, family, etc.? Upernavik Seafood: Owned 50% by Polar Seafood and 50% by Royal Greenland. They have almost 200 employees in the peak season. Seven work full-time in the office. They have eight Greenland halibut factories in the district. They had administrative and social responsibilities with the fishers (3). Inuit hunters that also fish. Fish is male dominated activity where women work in process plants, schools, grocery or at municipalities (3).
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	a) From nature to society (e.g. ecosystem services) ● Primary production ● knowledge and educational values ● traditional livelihoods.	b) From society to nature – modifying nature, extracting resources (e.g. hunting, mining, water pollution) ● Fishing ● Hunting

components the case is not a social-ecological system.		
II.4. What are key interactions?	a) What are the key ecological interactions within the case? Due to the increase of temperature the inland ice cap has been reduced creating new open land and many new islands. The new islands create new water currents, which undermine the winter sea ice and make dog sledge and snow scooter transportation along known pathways dangerous in many places, even in periods when the ice is most solid. The sea ice freezes much later than previously. The ice cap melts very quickly and forms a layer of fresh surface water that freezes to ice. Freshwater ice is hard and sharp, so that even a thin layer makes sailing a dinghy impossible. b) What are the most important biophysical tele-connections to distant systems? Increase of temperature due to climate change	c) What collaborations, conflicts, or other key linkages exist between actors? Local communities have strong social relations, supporting each other and keeping traditional practices such as sharing networks (1) (3) Upernavik Seafood is a key actor supporting the local community. Upernavik Seafood helps the hunters finance new dinghies, motors, snow scooters, and other fishing equipment, according to need and not according to how much fish they deliver. Then, the following year, they pay off the debt by the number of fish they deliver. Furthermore, Upernavik Seafood takes on administrative and social responsibilities. If a hunter becomes dependent on social benefits for a period, due to illness, poor hunting, weather, ice conditions, etc., the municipality sends a message to Upernavik Seafood, that in the following time deducts the social benefits from the payments fish and returns it to the municipality. The municipality functions less as a social office and more as a loan bank (2). d) Between local actors and distant actors? Conflict between central administration and local communities, clashing local subsistence practices and knowledge with the economic rationales and expert knowledge included in fishery regulations and commercial

		strategies (1). Local populations see halibut fishing as a supplement to the traditional hunting way of life. At national level, the subsistence livelihoods are considered inefficient and finds that it does not ensure a proper way of living providing a minimum level of money-based wages comparable with the income for unskilled labour. In this context the government has implemented different policies to promote the migration to urban areas, for instance, closing stores in little settlements, investing in infrastructure in urban areas (2). .
II.5. Culture	a) How is the relationship between society and nature viewed? Hunting is the main livelihood and element of their culture that allows them to reproduce their social networks. This livelihood can only be developed if the landscapes provide sea ice as a platform. b) What meanings are attributed to nature and to interactions with nature? For Inuit their culture, economy and identity rely on ice and snow. A disappearance of the sea ice could lead to an end of traditional Inuit hunting lifestyles (2).	c) What are key cultural features of relevance for the case? Hunting Identity: hunter is related to the role of subsistence and self-supply, implying that there is a survival limit to the engagement in the trade including that part of the fishing that can provide money needed for goods supplies. d) What are key cultural practices and beliefs related to nature? Hunting is the primary basis for the food supply, and the old tradition of ‘meat gifts’ remains. If someone catches a whale, walrus, or polar bear, it is shared in the smaller settlement according to traditional rules for distribution, and if someone cannot hunt due to illness, age or mental state, the rest of the settlement makes sure that the family has fresh seal or other meat

II.6. Disturbance What are important types of stress & shock	a) Describe important biophysical or ecological shocks and stresses (e.g. floods, storms, etc). Cod collapse	b) Describe important social shock and stresses (e.g. austerity policies, changes in government policy, introduction of new technologies, etc) -Changes in GHMP includes the privatization of fishing rights and limited participation through the introduction of ITOs. This modification affects indigenous fishers. (2) -Decreasing demands for and prices of blubber, oil, furs, and animal teeth on the European markets contribute to livelihoods transformation during the 20th century. - Local fisheries are being challenged by international market demands. The EU has introduced the demand that halibut may only be exported to the EU if it has been caught from boats over 30 feet long. The argument is fear of bacteria because there is a slightly larger potential danger of transferring bacteria in connection with dinghy fishing. Therefore, Upernavik Seafood systematically carries out bacterial control of all the fish purchased and sorts out any infected catch when they are delivered, regardless of whether it comes
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, for instance the collapse of cod and decrease of seal population.	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? No further information in the case	c) Can social stresses or major changes be attributed to ecological regime shifts?

	b) Are external or internal ecological dynamics potentially or producing ecological regime shift(s)? No further information in the case	Yes, the abundance of halibut and the sea ice conditions and open sea, lead to better conditions for larger vassals to catch fish in the area. This is reinforced by the halibut fishing policies. d) Are there specific social practices that might be contributing to ecological regime shifts Yes, the harvesting of species in a climate change context.
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 northern Norway include the shift from steppe to tundra and tundra to forest (2,3). Both regime shifts are fairly well-established. Steppes are grass-dominated systems usually in drier environments, which have higher primary production and nutrient cycling. Tundra is dominated by moss and has lower primary production and nutrient cycling. Forests, on the other hand, are dominated by tree and shrub species such as spruce, pine, larch and tamarack. 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) From the ecological perspective, a shift towards bushy vegetation and early succession of forest will further reduce the grazing area for reindeers. Warmer climates could also promote permafrost thawing with implications for global carbon storage. From the social perspective that could represent a major impact on Sámi traditional livelihoods and therefore their culture.	
II.8.b. Feedback	Ecological feedback mechanisms	Social feedback mechanisms

mechanisms within the system that maintain each regime	-	-
II.8.c. What key changes drive regime shifts? Describe how these changes alter the state of the system or feedback processes.	a) Drivers of ecological regime shifts (either social or ecological). b) How do these changes alter biophysical feedback processes?	c) Drivers of social regime shifts (either social or ecological). d) How do these changes alter the social feedback processes?
II.8.d. Ecosystem services substantially impacted by regime shift	a) Changes in ecological processes that produce ecosystem services	b) Changes in demand for ecosystem services (market and non-market) c) Changes in the institutional context of ecosystem services e.g. changes in access and changes in how ecosystem services are valued as expressed by rules and regulations.
II.8.e. What is (+/-) impacted by changes in ecosystem services directly or indirectly	a) Impacts from regime shift on ecological components	b) Impacts from regime shift on social actors
II.8.f. Potential cascading effects	Describe, if any, the likelihood of potential ecological cascading effects to other SES	Describe, if any, the likelihood of potential social cascading effects to other SES
II.8.g. Where do actors intervene to alter	Ecological oriented interventions	Socially oriented interventions

regime shift dynamics and who can do the intervening? This can be listed here or marked with (*) in the table above		

REFERENCES/ SOURCES CITED:

(1)	Kåre Hendriksen & Ulrik Jørgensen (2015) Hunting and fishing settlements in Upernavik district of Northern Greenland – challenged by climate, centralization, and globalization, Polar Geography, 38:2, 123-145
(2)	Delaney, A. 2016. The Neoliberal Reorganization of the Greenlandic Coastal Greenland Halibut Fishery in an Era of Climate and Governance Change. *Human Organization* 75:193–203.
(3)	Delaney, A., R. Jacobsen, and K. Hendriksen. 2012. *Greenland Halibut in Upernavik: a preliminary study of the importance of the stock for the fishing populace*. Aalborg University. 41.

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.