Name of the case study	Húsavík in Skjálfandi Bay – Fishing to whale watching tourism – Iceland [Transformation]		
What about this case makes it interesting? How does this case contribute to understanding of resilience and/or regime shifts in the Arctic?	Fishing has been an important industry for Iceland since the beginning of the 20th century. It currently accounts for about 50 % of all exports (decreasing from 90 % in 1960s) (1). A number of changes in external (national and international) regulation during last decades (including whaling moratorium and the introduction of the individual transferable quota system) have negatively affected productivity of the fishing sector. These changes led to reorganization of local fishing communities to a more tourist orientated one, with new methods of approaching marine resources (1, 2:25). - The whaling moratorium in the 1980s has contributed to the increasing whale population and their huge consumption of fish has impacted the fishers and the fishing industry - Public perception of whales has been transformed in the past decades (1). Whales became symbols for environmental movements and no longer as a harvested object - The decreasing cod quotas in 2007-2008, due to stocks' poor conditions, had a negative impact on income and employment in fishing communities - New marine resource management (the Individual Transferable Quota system) allowed smaller fishing operators to sell their quotas to bigger ones and resulted in accumulation of quotas by a few companies These changes have resulted in the rise of whale watching industry (with the increasing numbers of tourists) in Icelandic fishing communities including the town of Húsavík (1).		
Template completed by: *Main contributors	Grete Hovelsrud*, Nordland Research Institute, University of Nordland Julia Olsen*, Nordland Research Institute, University of Nordland Níels Einarsson, Steffanson**, Arctic Institute (Iceland)	**Key references: Cite in the text using (1), (2), (3) etc. and provide a reference list at the bottom of the template.** (1) Einarsson, N. 2009. From good to eat, to good to watch: whale watching adaptation and change in Icelandic fishing communities. *Polar Research* 28:129-138. (2) Einarsson, N. 2011. *Culture, conflicts and crises in the Icelandic fisheries: An anthropological study of people, policy and marine resources in the North Atlantic Arctic.* PhD Thesis. Uppsala University, Uppsala, Sweden. (3) Visit Húsaík, 2015. *Visit Húsaík*. [online] URL: http://www.visithusavik.com/husavik/		
Reviewed by (name and affiliation)	**		
Category	**Resilience/ Adaptability**	**Loss of resilience**	**Transformation**

(mark with X)					X	
Case study details:	**Country**	**Place**	**Scale – space**	**Scale – time**	**Sector(s)**	**Other (e.g. disturbance)**
	Iceland	Húsavík on Skjálfandi Bay		1980-present	Fishing/ Tourism	

Drivers (mark with X in appropriate boxes)	**Climate**	**Geopolitical**	**Mineral/ oil extraction & infrastructure**	**Tourism**	**Shipping**	**Biological invasion**	**Rapid demographic change**	**Other:** ***state here***
		X (national + international)		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?** Location matters The area is known for its rich wildlife and variety of marine mammals (3). "*The reason for such a high percentage of whales in this area is the thriving ecosystem in the bay. Melting snow and rivers bring nutrients from mineral-rich locations which, when combined with the boundless summer sun, leads to teeming masses of plankton, the main source of food for baleen whales. Altogether, there are 23 species of whale which have been recorded in Icelandic waters. The most typical visitors to Skjálfandi Bay are humpbacks, minke and blue.*" (3). Whale-watching season is getting longer and the number of tourists is growing (1). **b) How are the case boundaries defined in terms of ecosystems or biophysical characteristics?** Case boundaries include the village of Húsavík and its coastal area, which are actively used by fishers and the whale watching industry.	**c) Who are the key groups of people in this case?** In this case we describe a sub-Arctic fishing community, the town of Húsavík, which is located in Skjálfandi Bay in northeastern Iceland. Húsavík has population of 2511 (based on 2006 statistics) and is one of the oldest known inhabited places in Iceland (1:131). - There are three whale-watching companies in Húsavík (Norðursigling, Hvalaferðir, and Salka, with more than 35-40 employees), which are family-owned and operated businesses. The owners of Hvalaferðir were active fishermen before. There are "*skilled individuals working in whale watching who have been engaged locally as culture brokers*" (1). In addition, about 15 people are working in the Húsavík Whale Museum. - Fishers - Tourists **d) What kinds of livelihoods are important in the system?** - Fishing. The main livelihood in the village has been fishing and fish processing, with recent development of demersal fishing and shrimps. Due to diminishing quotas, the shrimp fishing has declined in recent years. - Agriculture. The village has been connected to agriculture via a large slaughterhouse and meat-curing facilities. - Tourism. In the past decade the whale-watching industry has been growing in this area with three companies that offer tours to Skjálfandi Bay from April to October.

		"*The town of Húsavík is globally recognised as <u>one of the best</u> locations in the world from which to watch whales. In fact, there is a higher chance of seeing whales in Húsavík than any other place in Iceland*" (3). **e) What institutions are key to this case? If possible, define what scale it addresses.** - The Icelandic Whale Watching Association. This organization criticised the government for resuming whaling for scientific purpose and protested against resumption of commercial whaling. - The parliament of Iceland. After introducing the contemporary Icelandic fisheries management system in 1984 the prices for fishing boats decreased. The individual transferable quota system (ITQ) that allowed smaller fishing operators to sell their quotas to bigger ones resulted in few companies accumulating quotas, which took them away from the villages. Thus, a large number of boats were available (1:132). Boat owners who sold their quotas could receive a grant if their boats were physically destroyed. Due to criticism, this clause was cancelled and cheap boats were available for use (mostly tourism). That supported the whale watching development. - International environmental organisations (boycotted Icelandic fish) - International Whaling Commission (whaling moratorium)

		f) How are the case's boundaries socially defined, and how do these social boundaries relate to biophysical boundaries? Social boundaries are defined within the village of Húsavík and a number of tourist-orientated sites around the place.

2. Timeline Draw a timeline of *key* events/ developments to the case. Points to include: Make clear the period of time over which the change is being considered. Provide a brief description of event/ actors, and ecological impacts. Mark particularly significant events with *. Consider both biophysical and social dimensions. Additional points that can be considered: Is it possible to identify periods of change from one type of system to another, transformations? Identify disturbances	1982: the International Whaling Commission (IWC) voted in favor of a moratorium on commercial whaling, starting from 1986 1986-89: Iceland continued whaling for research purposes 1989: Greenpeace organized boycotts of Icelandic fish 1989: Iceland stopped whaling 1990: Icelandic Fisheries Management Act, based on the Individual Transferable Quotas 1992: Iceland left International Whaling Commission, after IWC rejected a research proposal of taking 92 fin and 158 minke whales. 1990s: study by the International Fund for Animal Welfare on Icelandic whale watching concluded that this activity was a real and viable possibility. 1995: Starting of whale watching industry in Húsavík 2003-2007: Iceland's research whaling program took 200 minke whales 2006: in addition to research purposes the government started to issue licenses for a commercial whale hunt

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?** According to Icelandic authorities whales consume millions of tonnes of fish and krill, several times more than the total Icelandic fishery landings.	**b) Have there been major social disturbances that are relevant for the case?** External disturbances like whale moratorium in the 1980s and Icelandic Fisheries Management Act in 1990 (see 1e) were the triggers and the starting points for the whale watching industry's development. Owners of the whale watching companies having been active fishers.
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?**	**b) What are the key social drivers of change?** After implementing the individual transferable quota (ITQ) system (see 1e), lack of jobs forced people to find new occupations to sustain their livelihood. Thus, tourism orientated industries were a solution for the community.
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/	**a) Within the ecosystem?**	**b) Within society (e.g. people, social capital, management, institutions, infrastructure):** (-) Whale conservation was considered as a threat to livelihoods of local fishing communities and cultural viability (2:23). (+) Economic diversification and flexibility in the community increased the possibility for tourism development. (+) Whale watching is a form of adaptation to external drivers in the governance system (1) and was successful due

reducing/ not affecting adaptive capacity)		to its contribution to the local economy and community well-being (1:135) and its integration to the community's maritime culture. That led to: (+) Increasing number of tourists (40 000), use local services, and strengthened the village's economy and its viability (1). (+/-) Development of harbour facilities directed at tourists cause a lot of disturbance for the fishers. (+) Possibility to use old fishing boats (1). (+) Younger people get a good education and are able to learn other languages in order to work in an internationally orientated industry (1). (+) "*Marine wildlife tourism has adapted to the local culture and economy"* (1:136) (-) There were a number of conflicts between the fishers and whale watching industries since they operate in the same water. (see also II.4. c- for more details) (1)" (-) Fishers complain that the harbour has become overcrowded.
The next two sections break down the information in Section I. While it is not necessary to fill these sections, if you have additional information pertinent to specific rows below feel free to enter the material.		
II.1-8 SES, resilience and adaptive capacity		
	Biophysical	**Social**
II.1. Where do we find changes and resilience in the face of change?	**a) Within nature**	**b) Within society** In this case, the community showed resilience to external changes by reorganizing their livelihood activities.
II.2. What are the	**a) Key Ecological components (e.g. lakes, coastal zones,**	**b) Actors in society (e.g. individuals, groups, public or**

system's key components?	**caribou)** Coastal zones, marine mammals, fish stock	**private organizations)? How are people organised – by geography, livelihood, family, etc.?** - The owners of whale watching companies were active fishermen before. There are "*skilled individuals working in whale watching who have been engaged locally as culture brokers*" (1). - Fishers - Local and national government - The Icelandic Whale Watching Association
II.3. What are the key linkages? E.g. ecosystem services, resource extraction. These linkages should exist. If there are not mutual links between social and ecological components the case is not a social-ecological system.	**a) From nature to society (e.g. ecosystem services)**	**b) From society to nature – modifying nature, extracting resources (e.g. hunting, mining, water pollution)** Tourism, including marine wildlife tourism, fishing and whaling.
II.4. What are key interactions?	**a) What are the key ecological interactions within the case?** According to Icelandic authorities, whales consume millions of tonnes of fish and krill; several times more than total Icelandic fishery landings (1). **b) What are the most important biophysical tele-**	**c) What collaborations, conflicts, or other key linkages exist between actors?** There were a number of conflicts between the fishers and whale watching industries since they operate in the same water. "*During the first years of whale watching several incidents occurred in which fishermen had been disturbed during hunting, and tourists had been upset when seals*

	connections to distant systems?	*were hunted close to their boat. Instead of leading to increased confrontations and controversies, involving territorial conflict regarding the now joint hunting and whale-watching grounds, such episodes were addressed through dialogue on land, between spokespersons for the whale-watching operations and individual hunters or fishermen. Fishermen decided to take their hunting further away from the village, and some seem even have stopped hunting entirely,*" (1). **d) Between local actors and distant actors?** There is an increasing number of whale watching tourists. Local fishers complain that the harbour has become overcrowded (1).
II.5. Culture	**a) How is the relationship between society and nature viewed?** *"Northern fishing communities are characterized by a very close relationship with the environment on which they base their livelihood*. (1)" **b) What meanings are attributed to nature and to interactions with nature?**	**c) What are key cultural features of relevance for the case?** Culture, in this case, is presented as flexible. The success of integration of: "*whale watching to the community's maritime culture includes the use of salvaged old fishing boats and the creation of a scene that includes other elements of authenticity and local identity,*" (1). **d) What are key cultural practices and beliefs related to nature?** - There was a cultural transformation in the community's perception of marine mammals from whale harvesting to whale watching (1:135) - Fishers see mammals as competitors for fish resources (1, 2:90)

II.6. Disturbance What are important types of stress & shock	**a) Describe important biophysical or ecological shocks and stresses (e.g. floods, storms, etc).** Fishers share the same marine ecosystem with the sea mammals and thus perceive them as competitors (1).	**b) Describe important social shock and stresses (e.g. austerity policies, changes in government policy, introduction of new technologies, etc)** Same as 1.e: The parliament of Iceland. After introducing the contemporary Icelandic fisheries management system in 1984, the prices for fishing boats decreased. The individual transferable quota system (ITQ) that allowed smaller fishing operators to sell their quotas to bigger ones resulted in a few companies acquiring the quotas, taking them away from the villages. Thus, a large number of boats were available (1:132). Boat owners who sold the quotas could receive a grant if their boats were physically destroyed. After that notion received criticism this clause was cancelled and cheap boats were available for use (mostly tourism). That supported the whale watching development. In addition, the whaling moratorium in the 1980s raised the opposition of Icelandic population. "*According to Icelandic authorities, whales consume about millions of tonnes of fish and krill that is several times more than total Icelandic fishery landings*" (1).
II.7. What are key slow variables Changes that occur over decadal or longer time scales	**a) What types of ecological processes (e.g. loss of permafrost, shifts in species composition) are driving important long-term changes in ecological structures and processes?**	**b) What types of slow social processes (e.g. aging, population growth, loss of language) are driving important changes in social institutions and behaviours?** Loss of jobs and employment opportunities

II.8. Relationships with ecological regime shifts	**a) Are ecological regime shifts driving further ecological change or pressure?** **b) Are external or internal ecological dynamics potentially or actually producing ecological regime shift(s)?**	**c) Can social stresses or major changes be attributed to ecological regime shifts?** External political regulations change the perception of the local population on whales. Public perception of whales has been transformed in the past decades (1). Whales became symbols for environmental movements and are no longer viewed as a harvested object. **d) Are there specific social practices that might be contributing to ecological regime shifts** Local fishers have knowledge and resources (boats, harbour) to reorganize their marine activity.
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 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)** Moratorium on whaling and changes in quota system resulted in: - Changes of subsistence food sources - Fundamental change in types of livelihoods and its reorganization - Change in governance institutions	
II.8.b. Feedback mechanisms within the system that	**Ecological feedback mechanisms** Whaling moratorium has contributed to the increasing	**Social feedback mechanisms** Mainly reorganization of activities.

maintain each regime	whale population. Their huge consumption of fish has impacted fishers and the fishing industry.	
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).** External changes in regulations **b) How do these changes alter biophysical feedback processes?** "*Minke whales have become used to being watched but not harpooned. In areas like Skjálfandi Bay the relatively few animals who stay during the whale-watching season have become tame and easy to get close to, which is of great value for tourists and their experience with the animals. The docile animals, which show interest in boats, accost them and, it appears, view the tourists themselves during an egomorphic encounter (Milton 2005), are called in Icelandic skoðarar, spectators*," (1:136).	**c) Drivers of social regime shifts (either social or ecological).** Moratorium on whaling resulted in the social regime shift of Icelandic fishing. Some fishers used available knowledge and resources to start a tourist-oriented industry, namely whale watching. **d) How do these changes alter the social feedback processes?** See 5b
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)** There is an increasing number of whale watchers. **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** Mostly positive impacts on local community: + Increasing number of tourists (40 000) use local services, which strengthens the village economy and its viability (1). + Development of harbour facilities directed at tourist use cause a lot of disturbance for the fishers. + Opportunity to use old fishing boats (1). + Younger people gain a better education and are able to learn other languages while working in an internationally orientated industry (1). + "*Marine wildlife tourism has adapted to the local culture and economy"* (1:136) "*However, the success of whale watching in Icelandic communities, such as Húsavík, has also had the effect of changing the perception of whales as almost vermin to a much more positive one, as whales have now proven their value and therefore right to exist* (1:134)".
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** Another use of marine mammals contributed to the local economic viability and individual's benefits. Changes in perception on whales.
II.8.g. Where do actors intervene to alter regime shift dynamics and who can do the intervening?	**Ecological oriented interventions**	**Socially oriented interventions** The actors reorganised their activities when the consequences of external changes became a real threat for their livelihoods; decreased the flexibility of a daily life; and made them more vulnerable.

REFERENCES/ SOURCES CITED:	
(1)	Einarsson, N. 2009. From good to eat to good to watch: whale watching adaptation and change in Icelandic fishing communities. *Polar Research* 28:129-138.
(2)	Einarsson, N. 2011. *Culture, conflicts and crises in the Icelandic fisheries: An anthropological study of people, policy and marine resources in the North Atlantic Arctic.* PhD Thesis. Uppsala University, Uppsala, Sweden.
(3)	Visit Húsavík, 2015. *Visit Húsavík*. [online] URL: http://www.visithusavik.com/husavik/

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.