Enhancing Resilience Through Indigenous Traditional Knowledge in Ecological Restoration

Noor Jahan Punam*

Abstract

Although indigenous peoples – especially the Skolt Sami – are deemed to be inherently resilient, they are facing the limits of their resilience due to the unprecedented rate at which climate change is altering the ecosystems in the European High Arctic of which the Finnish Lapland is a part. Ecological restoration is often used as a tool to reverse this alteration and it has been recognised that ecological restoration should consider indigenous traditional knowledge beside ecological processes. A successful case which has attracted worldwide praise in this respect is the Näätämö River project where co-production of knowledge assisted in the restoration task. This case is used to highlight the conclusion that the resilience of the Skolt Sami can be enhanced by such collaboration of knowledge against climate change and changing ecological processes.

1. Introduction

Indigenous traditional knowledge (ITK) is derived from an array of sources and is inclusive of a vibrant collection of past tradition and present improvement gathered through trial and error over decades (Berkes 2008, 3-9). The knowledge is geographically specific and largely reliant on local and social mechanisms. Thus, it differs within and also between societies (See Berkes, et al. 2000). ITK has been increasingly respected as a significant source which can be utilised in favour of the growing interest in ecological restoration. It has been recognised that ecological restoration should consider cultural practices besides ecological processes. The use of ITK along with science in adaptation planning has been emphasised by the Paris Agreement. The importance of ecological restoration has been brought to the

* Researcher, University of Lapland.

forefront by the Aichi Targets under the Convention on Biological Diversity (CBD). In various parts of the Paris Agreement, emphasis has been put on ecosystem-based approaches and the importance of indigenous peoples' protection and value has been put on ITK. A recent international study conducted by Britta L. Timpane-Padgham (See Timpane-Padgham et al. 2017) and her team has given recognition to the crucial role of Arctic indigenous people in the efforts made towards ecological restoration. This contribution assists in building resilience to major climate change-driven changes in the distribution of land, marine and freshwater species. In this study, a case where ITK held by the Skolt Sami, who live in the Sevettijärvi area, has been used in the ecological restoration of the Näätämö watershed will be considered. Consideration will also be given to how accommodating ITK within ecological restoration plans can assist in upholding international obligations under the Convention on Biological Diversity and the Paris Agreement along with enhancing socio-ecological resilience.

In this article, I aim to look at whether using ITK in ecological restoration can enhance the resilience of indigenous people in Finnish Lapland against climate change. To attain this aim, it would be relevant to look at the key legislation in force tackling ecological restoration and resilience at international, supra-national and national levels. In this context, another sub-question becomes relevant, namely, do ecological restoration and resilience go hand in hand or do they contradict one another? Prima facie, it appears to be so in general, but in the context of this paper, it will be argued that in certain circumstances it might be possible to enhance the resilience of indigenous communities by using traditional knowledge in ecological restoration. I am aware of the alternative arguments with regard to use of the term 'resilience' in respect of indigenous communities but wish to argue that enhancing the resilience of indigenous communities is possible through collaboration between ITK and scientific knowledge.

Resilience, in the context of this paper, refers to the capacity of a system to self-organise following a disturbance and the degree to which the system can build the capacity to learn, adapt, share and make use of its knowledge of social and ecological interactions (Carpenter et al. 2000; Gunderson & Holling 2002; Arctic Resilience Report 2016). Gaps in previous literature remain as to promotion of resilience through appropriate use and implementation of ITK in regulatory and policy measures in terms of climate change. There has also been ignorance as to ITK collaborating with scientific knowledge. ITK has often been overlooked or 'disapproved' of by scientists and policy makers due to their disregard for non-Western knowledge systems (Whyte 2013, 2). In an era of climate change, when the resilience of indigenous communities such as the Skolt Sami is facing its limits, considering ITK in different restoration projects which are scientific in nature would enhance resilience at different levels. Using the example of the Skolt Sami in the Näätämö River area of Finnish Lapland, I intend to prove the argument that the resilience of indigenous people against climate change at psychological and community levels can be enhanced by collaboration between ITK and other ecologically-specific knowledge.

2. Ecological restoration

Ecological restoration is an interdisciplinary process of undertaking restoration tasks, which must be inclusive of the experiences, political ideals and cultural practices held or pursued by people as well as their communities (Telesetsky et al. 2017, 24). In this part of the article, the definition of ecological restoration will be considered first and then consideration will be given to whether ecological restoration can be complemented by the use of ITK. In the later part of the section, I reflect upon the legal basis for ecological restoration using ITK followed by a discussion on what kind of resilience can be achieved through such collaboration of knowledge.

2.1 Relevance and definition

Activities by human beings are causing depletion to ecosystems at an unprecedented rate (Telesetsky et al. 2017, i). Despite efforts made globally in favour of nature conservation, many ecosystems involving those critical for human well-being have been either damaged or destroyed (Telesetsky et al. 2017, i). It has been realised that human beings are not capable of conserving the earth's biological diversity exclusively by protecting critical areas (IUCN, Ecosystem Restoration). It is understood that ecosystem restoration should be a significant element of conservation programmes so that the livelihoods of people relying on these degraded ecosystems can be sustained (IUCN, Ecosystem Restoration). Ecological restoration has been receiving an increased amount of attention from both scientists and policy-makers due to its focus on the 'long-term holistic recovery of ecosystems' (Telesetsky et al. 2017, i). Ecological restoration is commonly used as a tool of reversal against environmental degradation caused by human actions such as deforestation, pollution and land use practices which cause soil erosion, although variant ecosystems will recover at different rates (See ReyBenayas et al. 2009).

Ecological restoration as a concept was defined initially from the context of natural science. One of the early definitions was proposed by Bradshaw and Chadwick as a 'blanket term to describe all those activities which seek to upgrade damaged land or to re-create land that has been destroyed and to bring it back into beneficial use, in a form in which the biological potential is restored' (Bradshaw & Chadwick 1980, 2). A similar and related definition was offered by Berger, who defined it as a 'process in which a damaged resource or region is renewed' (Berger 1987). Diamond was the first academic to shed light on the social dimensions of restoration and he did so by posing a question: 'First, no community on Earth has escaped the direct or indirect effects of man, so which is the "natural community" that one would seek to restore?' (Diamond 1985, 629). This question led to a shift in looking at ecological restoration from a social perspective. In 1997, Higgs stated that, 'Ecological restoration is the total set of ideas and practices (social, scientific, economic, political) involved in the restoration of ecosystems' (Higgs 1997, 81). He laid emphasis on the fact that ecological restoration is a process in which the goals cannot be separated from the end results of the restored ecosystem. Furthermore, the

United Nations Convention on Biological Diversity defined ecological restoration in its publication of 2016 as 'the process of managing or assisting the recovery of an ecosystem that has been degraded, damaged or destroyed as a means of sustaining ecosystem resilience and conserving biodiversity' (CBD 2016, 4).

Several other definitions of ecological restoration exist but among these, the most widely used definition is provided by the Society for Ecological Restoration (SER) in its Primer as the 'process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed' (SER 2002, 3). For the purpose of this article, we will be using this definition.

Reference to the terms 'assist' and 'recovery' have importance and they were meant to be general enough to accommodate diverse activities designed to make ecosystems regain their health, integrity or other ecological functions (Allison 2012, 6). The SER Primer further elaborates that 'Ecological restoration is an intentional activity that initiates or accelerates the recovery of an ecosystem with respect to its health, integrity and sustainability […] Restoration attempts to return an ecosystem to its historic trajectory' (SER 2002, 1). What is termed as ecological restoration or ecosystem restoration is not to be confused with 'restoration ecology' as per the SER Primer (SER 2002, 11). The fact that ecological restoration is a combination of the restoration task alongside the experiences and cultural practices of communities is specifically inspiring. Thus, it is not astounding that interest in ecological restoration is growing at a fast pace all over the world and that, in most cases, cultural beliefs and practices are drawn upon to assist in determining and shaping what should be conducted under the umbrella of restoration (SER 2002, 2).

However, the idea asserted in the SER Primer that ecological restoration should 'return an ecosystem to its historic trajectory' is not free from controversy. Ecologists have commonly noted that returning to past ecosystems is generally not possible per se, in the sense that history cannot be repeated (Andel & Aronson 2012, 7). What is meant by ecological trajectory has been described by SER as the 'developmental pathway of an ecosystem through time […] The trajectory embraces all ecological parameters. Any given trajectory is not narrow and specific. Instead, a trajectory embraces a broad yet confined range of potential ecological expressions through time' (SER 2002, 6). Trajectory refers to an all-inclusive approach to the task that has to be undertaken in ecological restoration. It is the notion that the reference point used for restoration needs to consider a variety of factors and affects the restoration of the habitat (Telesetsky 2017, 26). Therefore, the requirement to restore an ecological trajectory is integral to the SER definition. When restoration practitioners are given the task of deciding on a historical point of reference to use for the purposes of restarting an ecosystem based on its historical trajectory – that is when the challenges arise. A reference site for an ecosystem is particularly distinctive from the current state that an ecosystem is in (Telesetsky 2017, 26). This is so because the logic behind restoration is generally that an ecosystem will be taken past its degraded state, which is presumed to be the current state it is in. According to Newbold, a reference system would not inevitably be the natural state of the ecosystem, as the natural state of an ecosystem might be different from what the ecosystem was like prior to its degradation in some way by anthropogenic influences (Newbold 2015, 45-50).

It is not an easy task to point out the historical trajectory of an ecosystem because one needs to ask which indigenous form of the ecosystem they are interested in and what are the possible features of that system which would allow it to be self-perpetuating. It has been argued by Rackham that the best approach for considering the historical trajectory of an ecosystem is to identify the losses which complement degradation (Rackham 1986). Significant losses involve the loss of historical vegetation and wildlife (Rackham 1986). The problem with this perspective is that restoration needs to be about ecological recovery by concentrating on loss. In doing so, we tend to make the decision-making process more complex. This is because emphasis is put on what humans value in the ecosystem (Telesetsky 2017, 27). A significant problem with reinstating an ecosystem to its historical trajectory lies with the fact that ecosystems are dynamic in the sense that they react to both internal and external influences (Telesetsky 2017, 27). It needs to be agreed that it is impossible to return nature to a state where it was untouched by the influence of human beings. For example, present temperatures, levels of pollution, and soil conditions might prevent the achievement of a natural state or a pre-degradation state. Due to the huge amount of uncertainty with regard to ecological histories, identifying a reference point or natural baseline might be too complex and impractical to be included in projects (Normander 2008, 25).

Nevertheless, a number of arguments can be made for the return of an ecosystem to its historical trajectory as contrasted to forming a new trajectory. First, restoration managers are not required to select from alternatives as to what to leave in and out of the management of the restoration process (Telesetsky 2017, 28). No space is left for creatively interpreting the potential or capacity of an ecosystem to endure, so long as the aim of the project is to return an ecosystem to a certain natural state baseline (Jordan 2003, 23-24). One of the problems with picking what to restore in an ecosystem is the chance of overlooking the effects that minor species or inconspicuous processes exert (Jordan 2003, 23). It has been argued by Gross on these lines that restoration has to assist with the recovery of the ecosystem in ways which are not under the control of human beings (Gross 2006, 172-179). Another point is that returning to a historical trajectory might overlook the homogenisation of landscapes presently triggered by increasing climate change besides invasive species (Kareiva 2007, 1866-1869). Use of historical trajectories might promote recovery efforts which are not always influenced by what is immediately beneficial for human beings. And, finally, historical authenticity is implied in the idea of historical trajectories and it assists restorationists to avoid any criticism that they are substituting natural value with technologically and economically influenced priorities and possibilities.

These apparent issues raised as to the definition of ecological restoration under the SER Primer and the wide-ranging definitions available for the process led to a proposition by Martin to amend the definition provided by the SER Primer (Martin 2017, 668-673). According to Martin, 'Ecological restoration is the process of assisting the recovery of a degraded, damaged or destroyed ecosystem to reflect values regarded as inherent in the ecosystem and to provide goods and services that people value' (Martin 2017, 670).

In summation, for the purpose of this article and the example case to be considered and in light of the challenges faced by ecological restoration process, the most appropriate definition appears to be the one proposed by Martin as it does not separate people from the ecological restoration process whilst staying focused on the ecosystem itself.

2.2 ITK for ecological restoration

Extensive knowledge is held by the traditional people of the world regarding the natural resources they use (Gadgil et al. 1993, 151). The Convention on Biological Diversity asserts that it can be used as a source of information for conservation, management and sustainable use of natural resources. Traditional knowledge has also been regarded as significant in informing scientific approaches to the management of natural resources (Gadgil et al. 1993, 155-156). Collaboration between ITK and science can contribute to adaptive management (Berkes et al 2000, 1260). There are various similarities between adaptive management and many traditional knowledge systems as it is an 'integrated method for resource and ecosystem management' (Berkes et al 2000, 1260). Besides this, such collaboration contributes to self-determination of indigenous communities. Science, at present, with limited effectiveness with respect to environmental issues of increasing magnitude and complexity, has also made room for the acknowledgement of substitute sources of knowledge (Stevenson 2005, 4). There are many examples showing where ITK has complemented ecological data collected previously by contributing concordant and additional information on a more specific geographic scale compared to scientific data (see, Moller et al. 2004). The current interest in ecological restoration is on an upward trend and it is increasingly recognised that ecological restoration must consider cultural practices in the same way as ecological processes (Higgs 2003, 163). It has also been suggested that traditional knowledge has co-evolved with ecosystems and thus provides a solid base for ecological restoration (see, Long et al. 2003).

Nevertheless a number of scholars have been sceptical about the scientific legitimacy of traditional knowledge and its effectiveness beyond the local level, whereas others are concerned about the ethical issues of exploiting traditional knowledge for the purpose of academic or policy matters (see, Chalmers & Fabricius 2007). As such, integrating traditional knowledge within top-down approaches to ecological restoration still appears to be a great challenge (Zhou et al. 2009, 2010). However, community participation is very important throughout the restoration process, specifically when it concerns societies with important traditional knowledge that is inherently connected to biodiversity and natural resources management (Ramakrishnan 2007, 138). In those landscapes where the influence of traditional people has been given recognition, the cultural and social features of ecological restoration become particularly significant (see, Garibaldi & Turner 2004). The role of ITK for the purpose of ecological restoration has been acknowledged in recent years (See Anderson 2001) but its probable contribution has not been studied properly (Perrow & Davy 2002, xiv). Moreover, some authors working with ITK and restoration have indicated that ITK has been disregarded in ecological restoration programmes due to what is referred to as the 'epistemological authority' of the Western, objectivist thought process amongst restoration and conservation ecologists (Reyes-Garcia, et al. 2019, 4). An example illustrating where ITK has complemented the restoration process can be found in the biocultural landscape restoration in northern Veracruz, Mexico (see, Velazques-Rosas et al. 2018).

2.3 Legal basis for ecological restoration: International, supranational and national

Article 8(f) of the Convention on Biological Diversity provides that: 'Each Contracting Party shall, as far as possible and as appropriate…rehabilitate and restore degraded ecosystems and promote the recovery of threatened species, inter alia, through the development and implementation of plans or other management strategies'. In addition, Article 10(d) of the Convention provides that each contracting party should so far as possible 'support local populations to develop and implement remedial action in degraded areas where biological diversity has been reduced'. Gardner has explained that, when speaking of remedial action to degraded wetlands, this should be inclusive of restoring the site to its previous condition (Gardner 2003, 582). The same would clearly apply to other kinds of ecosystem.

A specifically significant development with regard to restoration has been noticed in the Conference of the Parties (COP) to the CBD[1] where it has been recognised as a crucial component. The vision of the plan is a world of living in coherence with nature where biodiversity will be valued, conserved, restored and used whilst ecosystem services are maintained, by 2050. This in turn is deemed to sustain a healthy planet whilst providing benefits important for all human beings.[2] As can be seen, restoration is a part of this mission and the central topic of two separate targets within the Aichi Biodiversity Targets. Under these targets it is expected that, by 2020, 'ecosystem resilience and the contribution of biodiversity to carbon stocks' will be enhanced by way of conservation and restoration along with restoring at least 15% of degraded ecosystems. This is estimated to contribute to mitigation and adaptation of climate change and to fighting desertification (Target 15, Aichi Targets). Along these lines, the Aichi targets also lay out that by 2020 ecosystems providing essential services, such as those relating to water, are restored and protected, accounting for the needs of women, indigenous and local communities and the poor and vulnerable.

1 CBD Decision X/2.

2 *Ibid*.

The COP decision very clearly highlights the significance of restoration in terms of equivalence to the prevention approach and states that, 'while longer-term actions to reduce the underlying causes of biodiversity are taking effect, immediate action can help conserve biodiversity, including critical ecosystems, by means of protected areas, habitat restoration, species recovery programmes and other targeted conservation interventions'.[3] The significant role that restoration can play was even more expressly emphasised at the COP in 2012, where contracting parties adopted Decision XI/16 and noted that, 'ecosystem restoration will play a critical role in achieving the Strategies Plan for Biodiversity 2011-2020, including conservation of habitats and species' (CBD 2016, 1).

Apart from this, the Paris Agreement has focused on including perspectives according to ecosystems when adaptation actions are considered. These actions are to be guided by best available science and, where appropriate, knowledge of indigenous people and traditional knowledge. This is contained in Article 7(5) as:

> […] parties acknowledge that adaptation action should follow a country-driven, gender-responsive, participatory and fully transparent approach, taking into consideration vulnerable groups, communities and ecosystems, and should be based on and guided by the best available science and, as appropriate, traditional knowledge, knowledge of indigenous peoples and local knowledge systems, with a view to integrating adaptation into relevant socioeconomic and environmental policies and actions, where appropriate.

It needs to be pointed out that the European Commission has expressly adopted ecological restoration in their policy targets which are set out in the Biodiversity Strategy to 2020 (EU Biodiversity Strategy 2020). Legal obligations towards ecological restoration in the EU are a matter of consideration under biodiversity protection directives, where conservation is defined as 'maintain or *restore* the natural habitats and the populations of species of wild fauna and flora at a favourable status' under the 1992 Habitat Directive (Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora). Express reference to restoration is also made for the mentioned purpose under several substantive obligations of the Directive.

As this article takes into consideration a case example from Finnish Lapland, it is important to consider the national legal measures in place as to ecological restoration. It should be acknowledged that Finland has been a party to the CBD since 1994 and the country is also committed to the Aichi Targets. In its 'Related Aichi Targets', targets 14, 15 and 18 focus on ecological restoration committing to restoring and safeguarding ecosystems providing services related to water, health, livelihoods and well-being of the indigenous Sami Community (Finland, Related Aichi Targets). Moreover, Finland is a party to the Paris Agreement, and as such the obligations under the Paris Agreement can be deemed to be binding on Finland.

3 *Ibid*.

Besides these, Finland became a member of the European Union in 1995 pursuant to which EU policy measures relating to ecological restoration along with all legal measures are applicable to Finnish national policy and legal measures as to any efforts relating to ecological restoration.

Whilst there is no direct reference to ecological restoration in the Finnish Constitution, inferences can be drawn from Section 20, which stipulates 'responsibility for the environment'. Further, it states that, 'the public authorities shall endeavour to guarantee for everyone the right to a healthy environment and for everyone the possibility to influence the decisions that concern their own living environment'. Besides this, the Water Act (587/2011) contains a provision which is specifically relevant for the case study in this article. Section 14(3) of the Act states that the party responsible for a water resources management project has a fisheries obligation. This is the case if such a project has a detrimental impact on waterways comprising a fish passage. The provision imposes an obligation on the responsible party to undertake a 'restoration' measure relating to fisheries. The problem with this obligation is that it is obligatory only for the party responsible for a water resources management project.

Since this paper argues for the use of ITK in restorative measures, it is worth noting Section 51a of the Constitution of Finland, which guarantees the cultural autonomy of the Sami people concerning their language and culture within the Sami homelands. Besides this, Finnish policy measures show a commitment towards restoration of forests and waterways amongst other natural ecosystem services. For example, the Forest Biodiversity Programme METSO has elaborate conservation and restoration plans for Southern Finland's forest ecosystems (See Ministry of Environment, 2015). The only missing link in the policy measures as well as legal provisions appears to be ignorance towards including traditional knowledge in ecological restoration processes.

Nevertheless, it should be noted that Finland has adopted the Akwé : Kon Voluntary Guidelines (adopted at the seventh meeting of the Conference of the Parties in 2004) under the CBD (See Juntunen and Stolt 2013). Essentially, the Akwé : Kon Guidelines should be applied to any evaluation of cultural, environmental and social impact of projects and plans concerning the Sami (Sami Homeland) which might have any impact on Sami culture, their livelihood and cultural heritage (Juntunen and Stolt 2013, 21). The Ministry of Environment in Finland appointed a national group of experts on Article 8(j) of the CBD (See Markkula et al. 2019). Article 8(j) sets out a requirement for respecting, preserving and maintaining knowledge of indigenous and local communities, comprising traditional lifestyles relevant for conservation and sustainable use of biological diversity and promotion of their 'wider application with the approval and involvement of the holders of such knowledge'. In summary, it requires participation by indigenous people throughout any conservation plans which will have an impact on indigenous peoples' traditional lifestyle. The Akwé : Kon Guidelines have been adopted for management and land use planning and also adopted as the permanent protocol of Metsähallitus[4] for wilderness and conservation area planning (See Markkula et al. 2019). This kind of effort as to use of the Akwé : Kon Guidelines is yet to be established for waterways restoration or management plans.

2.4 Relevance of ecological restoration in enhancing resilience

Resilience has been defined abundant times from different dimensions and perspectives. It is thus important to specify a standard definition which can be appropriately used for this article. The most widely used definition of resilience is provided by Gunderson and Holling. They define resilience as 'the capacity of a system to undergo disturbance and maintain its functions and controls' (Gunderson & Holling 2002, 51). In line with this definition, a broader perspective is favoured by Carpenter et al whereby they state that resilience should have three properties: i) the amount of transformation the system can undergo and still have similar controls on the function and structure; ii) the extent to which the system can self-organise; and iii) the extent to which it can build its capacity to learn and adapt (Carpenter et al. 2001, 766). Adaptive capacity is said to be a feature of resilience which suggests the learning aspect of system behaviour in responding to disturbance (Gunderson 2000, 428). Adaptation to climate change emerges from the reduction of vulnerability to climate change (Schmidt-Thome 2017, 55).

The Arctic Resilience Report (Arctic Resilience Report 2016, 8) defines socio-ecological resilience as 'the capacity of people to learn, share and make use of their knowledge of social and ecological interactions and feedbacks, to deliberately and effectively engage in shaping adaptive or transformative social-ecological change'. For the purpose of this article, resilience refers to the capacity of a system to self-organise following a disturbance and the degree to which the system can build the capacity to learn and adapt and share and make use of indigenous peoples' knowledge of social and ecological interactions. This might appear to contradict the idea of ecological restoration as resilience favours the idea of a system or people to self-organise. I argue that along with the unprecedented rate at which climate change is altering the ecosystem, it is becoming more difficult for a system and the people within the system to self-organise and as such the process of becoming resilient requires external inputs. Ecological restoration in this context can thus be considered as a tool to enhance resilience. Ecological restoration of ecosystems or the natural environment reduces the vulnerability of the ecosystem. As a result, restoration is arguably an adaptation measure triggering enhanced resilience at a socio-ecological level. As discussed elsewhere in the article, traditional knowledge has often been disregarded by Western scientists in the context of restoration. It is argued that collaboration of traditional knowledge with scientific knowledge, whilst contributing to self-determination, also promotes community resilience. It

4 Metsähallitus is a Finnish state-owned enterprise, responsible for the management of one third of Finland's surface area (editors' note).

has been argued that community resilience can ensue from socio-ecological and psychological resilience. From the perspective of psychology, the general definition of resilience lays emphasis on the capability of individuals to recover from adversity (Buikstra et al. 2010, 982). The resilience of a community is commonly deemed to be the capacity of its social system to work together to achieve a communal objective, which often includes intentional actions to bring about objectives (Berkes & Ross 2013, 6).

3. Case study: Knowledge co-production and the ecological restoration of Näätämö river, Finland

In a broader sense, co-production of knowledge is a collaboration of knowledge production instituting numerous research disciplines and stakeholders who belong to other sectors of society (Harvey 2019, 1). In the context of climate change, co-production of knowledge is deemed to be inherently crucial as it is deemed to have the ability to draw in knowledge from different disciplines and promotes shared learning on the basis of combined experience. In particular, it increases the apparent legitimacy and relevance as well as use of the knowledge held by non-academic stakeholders (Harvey 2019, 2). In the case study, I consider such a collaboration of knowledges in practice.

The Näätämö watershed is located in the Finnish-Norwegian borderlands and is a major Atlantic salmon stream (Mustonen & Feodoroff 2013, 84). It has a wide diversity of fish species (Apgar et al. 2016, 59). It is the home of the Skolt Sami people who live in the Sevettijärvi area of Finland. Currently, the management of the Näätämö salmon fishery is governed by the Atlantic Salmon Management Bilateral Agreement between Norway and Finland. The Skolt Act of Finland (253/1995) implies responsibilities on the state towards recognition of Sami rights. The Act provides for user rights as to the traditional lifeway of hunting, herding and fisheries but it has been poorly executed (Apgar et al. 2016, 60). The Eastern Sami people have expressed that their cyclical and non-linear view of the world has not been sufficiently accounted for in the management of natural resources by the state.[5] They claim that, partly for this reason, the ecosystems have faced their demise and this in turn is threatening their way of life.[6] As a response, the Skolt Sami got involved in a community-based initiative supported by the Snowchange Cooperative to comprehend the status – and to undertake ecological restoration – of the damaged parts of the Näätämö basin.

The process began in 2011 and was the first attempt at a formal process of co-management by combining ITK and science in Finland. It focused on responding to negative impacts of climate change and the need to tackle previous ecological damage (See Mustonen & Mustonen 2015). Co-construction of the process was expedited by combining ITK and science in a joint process of comprehending the changes in

5 Skolt Sámi Nation and Snowchange Cooperative (2011) Sevettijärvi Declaration.
6 *Ibid.*

the ecosystem and by relating them to livelihood strategies. It began with thorough baseline work, which involved preparation of the Eastern Sami Atlas (See Mustonen & Mustonen 2015). The Atlas included information on indigenous governance of water bodies, which was in practice before a large-scale colonial presence (Mustonen & Mustonen 2011, 211). Interviews conducted by the Snowchange Co-operative with local fisherfolk in the Skolt language contributed to the process by providing information about salmon, names of places and past environmental change, which assisted in documentation of traditional knowledge (See Mustonen & Feodoroff 2013). Based on the historical baseline, local fisherfolk from the area were leading the environmental monitoring of the watershed between 2013 and 2014.

Throughout the summer field season, local fisherfolk were recording what they observed with digital cameras and continuously shared the results with the science team. This developed a new field method, which was termed visual-optic histories (Mustonen 2015, 776), which usually refers to histories which are recorded, painted, and documented, and includes expressions ranging from recorded oral histories and rock art to digital photography. This approach gives way to a new approach of monitoring and documenting changes an ecosystem is undergoing and it can inform as to species distribution enabling decision-makers of Arctic change to take into account significant details which might not be found by use of Western science alone (Mustonen 2015, 766). The approach amounted to detection of new species entering the ecosystem. For instance, they documented for the first time the presence of the southern *Potosiacuprascarabaeid* beetle, which was recorded through oral communication. Observations and photographs from the field by Skolts were put together with species identification by a specialist on insects, which confirmed the new geographical discovery. Furthermore, observations of water level and temperature fluctuations which are connected to salmon movement patterns and changes in the quality of water-like algae blooms and foam were co-constructed by sharing the monitoring data with limnological data available publicly for the basin (Apgar et al. 2016, 61).

Throughout the Atlantic salmon fishing season, records were kept of catches by the Skolts. These statistics were compared with scientific surveys of the quantities and qualities of salmon coming upriver (See Mustonen & Mustonen 2015). For instance, the Skolt records noticed an increase in the number of northern pike to stream sections of the river proximate to Opukasjärvi. No observation science records have yet been detected but it could assist in understanding the warming of waters. The Skolts also recorded on maps what were thought to be lost salmon spawning areas (See Mustonen & Mustonen 2015). These sites were lost because of state-sponsored management actions, in particular forestry experiments which were conducted in the 1960s and 1970s, as well as the development of new boating routes. The recording of sites of erosion on lake and river banks, which are signs of possible climate change impact, were vital for facilitating ecological restoration activities (Apgar et al. 2016, 61).

This process amounted to revitalisation of Sami knowledge by creating a community-based traditional knowledge archive to assist the community and research work in future. Moreover, using ITK in monitoring has resulted in new management options and actions for the watershed. Although co-management is yet to be made formal, national institutes such as Metsähallitus and the local Centre for Economic Development, Transport and the Environment – have shown an interest in learning about novel management alternatives through a Skolt research agreement (Apgar et al. 2016, 61).

4. Conclusion

Based on the discussion above, it appears to be the case that combining ecological restoration and ITK can assist in reversing a number of ecosystem degradations caused by human activities. This is indeed a recommended way of using ITK with science to overcome damage to ecosystems. Nevertheless, in order to achieve results which are effective, it is worth observing ITK in combination with science at a local level. Besides giving recognition to ITK of the Skolt Sami and forming a participatory and inclusive environment, this practice can also enable Finland to uphold its obligation under the Aichi targets and to a certain extent the obligations under the Paris Agreement. This further leads to building trust between indigenous communities and projects taking place in their locality.

Whilst agreeing that resilience is a self-organising process, it is concluded that at the current rate at which ecosystems are being altered, resilience cannot be achieved by self-organisation. It rather requires external factors or inputs like 'ecological restoration' to activate a self-organised process of resilience. Ecological restoration projects such as the Näätämö River example can be the external factor to enhance resilience of ecosystems, psychological resilience of indigenous people and resilience of the community when indigenous people participate by their input of traditional knowledge. Besides increasing the resilience of the Skolt Sami, the Näätämö River project also brought results to benefit the Skolt Sami by restoring the salmon spawning area.

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