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Guest Editorial, part of a Special Feature on Ecological Restoration in Northern Regions

Ecological and Social Aspects of Ecological Restoration: New Challenges and Opportunities for Northern Regions

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ABSTRACT. Interest in ecological restoration has recently intensified as scientists, policymakers, and stakeholders use restoration in management strategies to address and mitigate global climate change and biodiversity loss. Northern ecosystems offer special challenges to restoration managers because of their short growing seasons and long recovery periods. This special feature of Ecology and Society on ecological restoration in northern regions draws together 11 papers based on presentations from the conference "Restoring the North", convened in October 2011 in Selfoss, Iceland. We summarize two themes of this conference: (1) setting objectives and evaluating success in restoration, and (2) legislation, policy, and implementation of restoration. We conclude that northern countries altogether comprise a significant knowledge base and suggest five actions to enhance restoration practices within them: (1) improved documentation of restoration actions, including objectives, measures and results, (2) regular evaluation of restoration progress and outcome, (3) coordination of conservation actions among northern countries, including location of restoration actions to sites where they are most useful in a global context, (4) formation of a common platform to strengthen development of research about ecological, political, social, and technical aspects of ecological restoration, and (5) education of new generations of restoration actors who can work in diverse biogeographic settings and cultures.

Key Words: *ecological restoration; northern regions; policies; social-ecological systems; techniques*

INTRODUCTION

During the last few decades, the interest in ecological restoration has increased rapidly (Young et al. 2005, Aronson and Alexander 2013). Growing pressures on the world's ecosystems, increasing awareness of the value of ecosystem goods and services, biodiversity loss, and a need to adapt to changing climate are important reasons (MEA 2005, Harris et al. 2006, Hobbs et al. 2011, Zedler et al. 2012). Ecological restoration thus has a growing role in regional and national policies and strategies (Bullock et al. 2011, CBD 2011, EC 2013). Northern regions, which have experienced heavily intensified land use and extraction of natural resources during the last century, are no exception. Examples include oil extraction, energy and transport infrastructure, grazing, overharvest, tourism, and recreation (Forbes and McKendrick 2002, Halldórsson et al. 2012, CAFF 2013, Hagen et al. 2013).

Northern ecosystems offer special challenges for restoration managers. They are characterized by short growing seasons, constraints on plant colonization by physical disturbances on micro- and mesoscales, slow nutrient turnover that causes slow vegetation development (Forbes and Jefferies 1999), and long winters that may challenge biota with bottleneck situations (Bowman et al. 2005, Weber et al. 2013). Perturbations of northern ecosystems can therefore require long recovery periods, even after restoration has assisted recovery processes (Forbes and McKendrick 2002, Campbell and Bergeron 2012). These circumstances give more time for adjustments if systems develop in unwanted directions, but also mean that failures in restoration projects become more troublesome because of the time lost.

Climate change researchers predict that northern ecosystems belong among those that will encounter the largest changes in climate during this century (ACIA 2005, IPCC 2007, CAFF 2013). Therefore, restoration of northern ecosystems challenges restoration managers to assemble ecosystem components that will function under different climatic conditions. Furthermore, most restoration projects have a variety of stakeholders that represent a range of different expectations or even competing land uses, leading to compromises in project goals, objectives and implementation. Predicted changes in climate will increase exploitation and adaptation pressures on northern ecosystems (Nilsson et al. 2010), thus further complicating restoration opportunities.

In October 2011, in Selfoss in Iceland, the international conference "Restoring the North," with 80 participants from institutions responsible for ecosystem restoration and nature protection, drew specific attention to problems associated with ecological restoration in northern regions. There was a special focus on the Nordic countries, that is, Denmark, Finland, Iceland, Norway, and Sweden, and their associated territories, the Faroe Islands, Greenland, Svalbard and Åland. Although these countries have historically similar social and political structures, restoration efforts within them differ with respect to which ecosystems are put in focus and reflect diverse land-use pressures (Hagen et al. 2013). The conference showed that

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although much has been achieved in ecological restoration in the region, there are still many threats to its ecosystems. Furthermore, evaluation of restoration projects in the region was deemed to be incomplete. This was seen as a major obstacle to adaptive management and improvement of restoration methods in the north.

Eleven papers based on a subset of the contributions from the conference are presented in this special feature, with a focus on two main themes. One is setting objectives and evaluating restoration outcomes. Another is legislation, policy, and implementation of restoration. These contributions are briefly summarized in the two following sections.

SETTING OBJECTIVES AND EVALUATING RESTORATION OUTCOMES

Several authors have attempted to formalize the goals of restoration by setting up criteria that need to be fulfilled in order for a project to be considered successful (SER 2004, Ruiz-Jaen and Aide 2005). Morsing et al. (2013) analyzed 13 completed EU LIFE+ restoration projects in Denmark in relation to such criteria (SER 2004) and the 'five myths of restoration ecology' formulated by Hilderbrand et al. (2005). They found that individual projects only met a subset of the examined criteria, that Danish restoration policy was based on control paradigms assuming predictable endpoints (cf. Hilderbrand et al. 2005), and that it was oriented towards restoration of structures rather than processes.

Aradóttir et al. (2013) analyzed the drivers of ecological restoration in Iceland during the last century, based on 100 restoration projects. They identified a number of different drivers and showed that these have become more diverse in the last decades. However, the extensive land degradation is a strong motivator for ecological restoration in Iceland and its objectives often focus on functionality such as halting soil erosion or restoring soil fertility, rather than specific community types or historical fidelity (Aradóttir et al. 2013). This demonstrates that ecosystem restoration is not a luxury but can be a necessity to sustain the provision of basic ecosystem services (Dodds et al. 2008).

A policy focused on restoration of structures will not easily accommodate landscape alterations, such as those brought about by global climate change (Hobbs et al. 2011). Aware of such risks, Zedler et al. (2012) speak in favor of long-term restoration programs that will eliminate or minimize the causes of ecosystem degradation or allow ecosystems to adapt to various environmental constraints. Such a strategy will evoke new types of ecosystems with a better chance of, but no guarantee for, self-sustainability (cf. Hobbs et al. 2009).

The concept of open-ended ecosystems in adaptive restoration (Hughes et al. 2012, Zedler et al. 2012) requires a plethora of well-founded techniques and approaches to choose from. As an example of method development, Hagen and Evju (2013) present the results of a pilot project in the Norwegian mountains and its implications for larger-scale restoration. In their project, the revegetation of a former military area by three different techniques was evaluated, showing fairly convergent results with time. By assessing and discussing these differences with developers and contractors, acceptable best-practice solutions could be identified and agreed upon (Hagen and Evju 2013). Gardeström et al. (2013) provide a similar example from northern Swedish streams formerly used for timber-floating where two different methods, one being relatively simple and cheap and another more labor intensive and expensive, were compared. The latter method was more efficient in slowing down flows and creating heterogeneity. Its effects on biota remain to be evaluated but available data and experiences suggest that this type of restoration is an improvement over the current best practices in terms of methods, abiotic effects, as well as stakeholder support (Gardeström et al. 2013).

LEGISLATION, POLICY, AND IMPLEMENTATION OF RESTORATION

Although ecological restoration deals with practical alterations of ecosystems, it is not only a technical task. Instead, it has an important human element, with strong social and political connotations that are increasingly acknowledged in ecological restoration (Aronson et al. 2007, Shackelford et al. 2013). Baker and Eckerberg (2013) used a modeling exercise to uncover how politics is embedded in restoration and to provide a more thorough understanding of ecological restoration in a social and political perspective. They studied the various steps of restoration and concluded that restoration always includes negotiation, be it about the aims, the methods or the subsequent use of restored sites. This is the case even if there is apparent agreement about that restoration shall take place.

Tolvanen et al. (2012), using restoration of peatlands in Finland as an example, specifically analyzed conflicting interests that may require negotiations and that may even mean that restoration will never be completed. They concluded that, although different stakeholder groups had largely different views about peatland restoration, they also shared some views. For example, people were positive about restoration as long as it did not interfere with peat production, i.e., an analog to the NIMBY (Not In My BackYard) concept where people oppose developments when they disrupt their pre-existing affections (Devine-Wright 2005). Tolvanen et al. (2012) concluded that better understanding of various preferences and trade-offs can enhance planning of sustainable land use in peatlands. Jørgensen and Renöfält (2012) used a similar approach by analyzing the controversies related to dam removal in Sweden as expressed in the media. They also found opposing views among stakeholders that were rooted in different framing of the valuation of streams with and without dams. In contrast to the study of Tolvanen et al. (2012) they

found little common ground between the groups for and against dams, probably because a third alternative—building more or bigger dams—was not an option in their study.

Petursdottir et al. (2013) took a holistic approach for analysis of the social-ecological system of rangeland restoration in Iceland. Their results indicate that social factors such as attitude towards restoration and land management practices can be used as indicators to evaluate the effectiveness of restoration policies. They also found that poor governance of social-ecological systems can reduce the efficiency of restoration programs. There are two very large restoration projects in Iceland, the "Farmers Heal the Land" which involves 600 farmers and aims at restoring degraded rangeland, and "Hekluskógar," a project aiming to restore native woodlands in the vicinity of Mt. Hekla to improve ecosystem resilience to impacts of volcanic ash (Aradóttir et al. 2013). Berglund et al. (2013) made an in-depth study of these two projects by analyzing the efficiency of the participatory processes in them, especially with regard to how the main authority—the Soil Conservation Service of Iceland—interacts with stakeholders. They found that interactions were generally satisfactory, but also that well-functioning interactions were necessary for positive results. Hagen and Evju (2013) also stressed the importance of good and continued interactions between different actors of ecological restoration, both to improve commitment and endurance of the actors and to accommodate potential future changes that might result from adaptive management.

CONCLUSIONS

Although the present special feature does not offer a comprehensive overview of ecological restoration in northern regions, it provides examples of various restoration approaches and how national policies and legislation and economic incentives vary among countries (e.g., Hagen et al. 2013). These facts offer new challenges and opportunities for northern regions. We present here five actions for improving restoration practices in these areas and hope that this special feature will contribute to these developments.

1. *Document projects.* Hallett et al. (2013) recently pointed out the importance of documenting the specifics of project objectives, measures and results as a way of linking theory and practice. A database of such information common to the northern regions would greatly enhance the common knowledge base; it would mean that mistakes can be avoided and that best-practice methods can be selected with greater accuracy. With time, such a database will also become an invaluable source of information for policy development and research undertakings in ecological restoration.
2. *Evaluate project progress and outcomes*. This special feature shows that evaluation of restoration projects in northern countries is inadequate. Regular quantitative assessment of projects should be a part of restoration policy, as advocated by Zedler et al. (2012). This forms the basis for adaptive management, is crucial to learning from successes and failures and hence promotes the progress both of restoration ecology as a science and the building of a restoration database (action 1.). The development of standardized and user-friendly evaluation frameworks will facilitate the incorporation of regular assessment into all restoration projects and enable meaningful comparisons among them.
3. *Coordinate restoration actions among countries.* Many northern species have circumpolar distribution, dispersal and migration patterns (Dalén 2005, Johnson et al. 2007, Taggart and Cross 2009). Therefore, it is important to coordinate conservation actions among northern regions so that restoration efforts can be directed to sites where they are most useful in a circumpolar context. Such a coordinated work should strive at applying the top practices and the best thought-out follow-up methodologies, thus accelerating the development of restoration know-how.
4. *Place research efforts on a common platform*. This special feature demonstrates research on ecological restoration in many northern countries. By forming a common platform for the research efforts from individual countries, their scientists will become a part of a vigorous research environment focusing on the ecological, political, social, and technical aspects of ecological restoration. This platform can strengthen already established research fields, but will also be able to identify and address gaps in knowledge. The former ReNo (Restoration of damaged ecosystems in the Nordic countries; http://www.reno.is/) project and the recently started EvRest (Evaluation of ecological restoration in the north; http://www.reno.is/evrest) project that focuses on improving the evaluation of restoration works are such examples.
5. *Educate new generations of restoration actors*. A common restoration database, project assessments, international coordination, and a common platform for research will provide a foundation for the education of new generations of restoration scientists, policymakers and practitioners. Equipped with a common knowledge base, these new generations should be able to work in diverse biogeographic settings and cultures across the northern regions and elsewhere.

Responses to this article can be read online at:
http://www.ecologyandsociety.org/issues/responses.php/6045

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