Challenges of ecological restoration: Lessons from forests

The ecology and biodiversity of boreal forests are relatively well understood making them a good model for restoration activities. Forest restoration is more than restoring tree cover. In order to achieve functioning forest ecosystems, including their essential structures, successful restoration of the natural dynamics and disturbance regime of those forests is required.

Photo: Restoration fire in northern Sweden/ Bengt Gunnar Jonsson

The North European forests

North European forests represent a relatively young biome that has developed since the last glaciation. Forest structure is affected by regional and local scale natural disturbances, such as fire, wind, snow, insects, fungi and ungulates. In the natural disturbance regime, partial and fine-scale disturbances dominate over stand-replacing ones, resulting in highly diverse and heterogeneous forest in terms of structure, tree species and age class distributions.

Human influence has been significant since the first establishment of agriculture 3000 – 5000 years ago. Land-use has had significant effects on the natural disturbance regimes during long periods of time. However, with the booming post-WWII economy, forestry soon became the backbone of national economies. The current forest management systems in North European forests, based on clear-cut harvesting, are probably an order of magnitude more intensive than the traditional ways of using forests during past centuries.

The human exploitation has led to substantial changes in forest dynamics, structure, age distribution and species composition. The disturbance regimes have markedly deviated from historical conditions. Old-growth forests and natural early-successional forests have virtually disappeared from the landscape, and forest structural complexity has dramatically declined resulting in habitat loss and degradation from the perspective of thousands of forest species. This calls for increased conservation and restoration of the North European forest ecosystems.

Restoration in north European forests

A multitude of restoration practices are currently being used in the North European forests. This includes restoring hydrology of altered habitats to facilitate natural processes such as peat and dead wood accumulation, modifying forest structure, e.g. by creating small gaps in conifer monocultures to enable regeneration of deciduous trees, or by adding dead wood. Most prominent though is the introduction of fire as a conservation tool. After 150 years of efficient fire suppression this is highly motivated. However, it is expensive and as a result, the burnt areas in current restoration practice are a tiny fraction of the annually burnt areas in the previous centuries.

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Lessons learned

Based on recent experiences in restoring forest biodiversity in northern Europe we identify a set of lessons learned

1. *Acquire better ecological knowledge of the target ecosystem*. Natural forest dynamics and disturbance regime can serve as guidelines for restoration actions. However, they are highly specific for each region or ecosystem and, therefore, the specific knowledge cannot usually be transferred to other regions or systems.
2. *Be aware of the problems in defining naturalness*. The aim of restoration is often to add components that are considered natural to the target ecosystem. However, the range of reference conditions used is usually derived from analyses of historical forests that may themselves have been altered by past human influence for thousands of years.
3. *Assess whether restoration is needed and can be successful with feasible resources*. It is important to consider the present state of the ecosystem, the quality of the surrounding landscape, and the potential of the ecosystem to recover without restoration.
4. *Set proper targets and monitor progress*. One should look for reference areas that are as natural as possible, and include these areas in the monitoring schemes. Monitoring reference sites is of particular importance because they are not static but subject to natural dynamics; restoration is likely to have a moving target.
5. *If you still have it – do not destroy it*. Conserving existing biodiversity is economically more viable than trying to restore them. Therefore, setting aside areas with high biodiversity values where we still have them, may in the long term turn out to be a better option.

Future challenges

A number of challenges for successful restoration need to be addressed.

1. *Coping with unpredictability*. Restoration is complicated due to system complexity and incomplete knowledge about causal relationships. Further the restored areas are usually relatively small, and thus vulnerable, to unpredictable catastrophic events and climate change.
2. *Maintaining connectivity in time and space*. To maintain viable habitat networks in a long-term, it is critical to consider the spatial and temporal aggregation of different restoration measures within the landscapes.
3. *Assessing functionality*. A main challenge is how to actually define a naturally functioning ecosystem and how to measure and monitor whether the function of the ecosystem is developing towards the desired state.
4. *Conflicting interests*. Climate change adaptation and mitigation may conflict with restoration. The use of fire will release CO_2 and other restoration measures may conflict with desires to extract bioenergy.
5. *Social restrictions*. High human population densities can cause potential social conflicts and discussions around some restoration techniques, but even in sparsely populated areas, conflicts over resources and land use may arise.
6. *Funding*. Long term funding is necessary to ensure the continuity of actions and monitoring of their effects. Without sufficient funding, the success of efforts will be difficult to assess.

This brief is based on
Halme, P. et al. 2013. Challenges of ecological restoration: Lessons from forests in northern Europe. Biological Conservation 167: 248-256

NB Forest Policy and Research Briefs
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Published March X, 2014

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