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Preface

Facing North: Investigating the Northern Dimension to Biodiversity

This special issue is based on papers presented at the symposium "Northern Dimension to Biodiversity: From Arctic to Boreal Environments" held 20–23 November 1999, in Saariselkä, Finnish Lapland. The symposium gathered researchers from various scientific fields and experts in biodiversity management. Science policy experts from the European Commission and national organisations also participated. In the symposium an international team of researchers presented their studies on northern biodiversity, its conservation and sustainable management. The topics ranged from the impacts of glacial history on species diversity to ecological effects of moose trampling in Swedish coniferous forests to today's forest management problems in Russia. In the discussions, management of biodiversity in the northern areas was a key component. Not surprisingly, several speakers were also concerned about the effects of climate change on northern ecosystems.

Is there something special about northern ecosystems, or biodiversity conservation and management at the high northern latitudes that would make these areas of specific concern? A wider interest to northern biodiversity can surely not be based on biodiversity hot spots in northern areas as there are none. On the contrary, northern areas have for long been used as textbook examples of areas characterised by low species diversity (Fischer 1961). There are, however, exceptions to this rule, namely lichens, marine benthic organisms, ichneumonid wasps, and soil nematodes (Huston 1994).

Northern continental areas experienced during the Pleistocene several glacial cycles, which make them very suitable areas for testing ideas on evolutionary divergence of both individual species and intraspecific lineages within geologically short time periods. Weider and Hobæk show, with support of abundant molecular data, that glaciations in some taxa clearly correlate with speciation events or subspecies divergence. The knowledge on the magnitude and ecological effects of these past climatic variations may help in predicting what will happen in the course of the on-going climate change. The data cited by Weider and Hobæk indicate that the period of mid- to late Pleistocene was indeed important for speciation and subspecies divergence for at least some Holarctic vertebrate taxa. Marusik and Koponen, who have studied spider diversity in the arctic and boreal areas, show that spiders exhibit the normal trend of decreasing species diversity toward the higher latitudes. Specifically, in this issue both Weider and Hobæk as well as Marusik and Koponen stress the need to invest more research on the Beringian area (especially eastern Siberia), where biodiversity is generally higher than in other northern areas. This is likely to be due to the periodic isolations between Siberia and Alaska caused by sea level rises in the Pleistocene, and the fact that Beringia (or parts of it) served as a refugium during the Ice Age.

The short time (approximately 10 000 years) that has elapsed since the last glaciation in the northern hemisphere has been used as a partial explanation for the low species diversity in northern areas. There are two opposing views on the effects of the glacial history and low diversity on the sensitivity of northern ecosystems to anthropogenic change. Some argue that since polar organisms were already subjected to dramatic environmental fluctuations during the Pleistocene and Holocene, they should be relatively resilient to current environmental changes (cf. Weider & Hobæk). The main counterargument against this optimistic view is the substantial difference in time-scales of glacial events and anthropogenic changes. Man-made changes occur much more rapidly, and therefore adaptations similar to those related to glacial cycles can hardly be expected.

The other view holds that northern areas, due to their low biodiversity and extremely harsh conditions, may be particularly vulnerable to even modest environmental change. This argument is supported by the fact that northern communities are 'simple' in the sense that their species diversity is usually low, and trophic interactions in these ecosystems are often reduced to a few dominant between-species interactions (Weider & Hobæk). This means that elimination of even one dominant species may sometimes change the community structure and dynamics. Further, due to slow decomposition rates and slow soil formation in the cold arctic climate, ecosystem recovery from local disturbances such as oil spills, or soil erosion caused by trampling may take several decades (Jackson & Jackson 1996: p. 343).

Anthropogenic effects are not solely responsible for changes in the ecological conditions for other species. In northern forest ecosystems both reindeer and moose have a considerable impact on the structure and functioning of these ecosystems. In this issue, the impact of reindeer on the structure of tundra and forest ecosystems is reviewed by Suominen and Olofsson, and the impact of moose in boreal forests by Persson *et al*. Reindeer grazing on *Cladina* lichens seems to increase the diversity of flora and invertebrates in most of the studied cases, excluding terrestrial gastropods. For plants the most obvious reason for the higher diversity in grazed areas is the release from competition with the successionally dominant *Cladina* lichens. Persson *et al*. analyse the ecological effects of food intake, trampling, defecation and urination by moose. One clear effect of moose browsing is a shift in the tree species composition towards increased dominance of non-preferred, unbrowsed species, which in turn influences the composition and quality of litterfall. The fact that the population densities of these two large ungulates are artificially high in northern Europe due to human influence, makes evolutionary considerations difficult. As the population densities have been at their current levels only for some decades, it may not be justified to speculate, for instance, on the coevolutionary relationships between these large herbivore species and their food plants.

High or low biodiversity are relative terms, and Hanski asks in his paper whether northern coniferous forests really are as species-poor as usually assumed. He shows that old-growth coniferous forests in fact host a high diversity of wood-decomposing fungi and beetles that depend on decaying wood. This diversity is now in Finland seriously threatened due to scarcity of protected old-growth forests (less than 1% protected in southern Finland), and forestry practices that have led to large and very homogeneous forest structures. Hanski presents a metapopulation model that examines the likely consequences of different scenarios of forest management and conservation for the survival of forest species. He predicts a bleak future for the biodiversity of Finnish forests, with an extinction debt of about 1000 species. To minimise species extinctions, Hanski recommends protecting such forest areas that are located close to the existing remnants of high-quality old-growth forests. This would facilitate migration of threatened target species to the restored forests.

Are there any conservation lessons to be learnt from the northern areas? Vuorisalo and Laihonen show that in the Scandinavian countries there is a long tradition of protecting forest resources and game animals, dating back to the Middle Ages. However, a real concern for habitat conservation did not arise until the late 19th century. Although the total protected area, as well as the number of protected species have greatly increased, they are still insufficient to meet the needs of, for instance, forest biodiversity conservation (cf. Hanski). The situation is even worse in Russia, where according to Selikhovkin the forest administration is facing real difficulties in handling the information flows on forest animal populations, and where even misdemeanours in forest use may occur. In the final paper of this issue, Niemelä discusses the theory and practice of biodiversity monitoring for decision-making. Niemelä brings up the importance and urgency of developing comparable methods for biodiversity monitoring as well as better and more efficient ways of communicating research results to decision-making processes. Niemelä provides an example currently tested in various parts of the world that may provide a model for the monitoring of biodiversity also in the northern areas around the globe.

Due to the small number of arctic countries (only eight) and the similarity of ecosystems and environmental threats (e.g. climate change and stratospheric ozone loss in the Arctic region) prospects for international collaboration are good. Collaboration in environmental issues such as biodiversity conservation and management are especially important due to the vast geographic area concerned, the sensitivity of the ecosystems, and the great potential of these areas for various natural resources and thus more intensive human impact in the future. A promising model for future circumpolar environmental collaboration is the Arctic Environmental Protection Strategy, adopted in 1991, which includes a specific programme on conservation of arctic fauna and flora. We hope that the contributions of the Saariselkä symposium will help towards this same goal, giving novel insights on the conservation and management of northern biodiversity.

The Saariselkä symposium on northern biodiversity also initiated a new series of symposia on biological diversity in Europe. This so called *biodiversity forum*, which is supported by the European Commission, will rotate in different Member States and will facilitate future discussions on key European biodiversity issues bringing together researchers, biodiversity managers and decision makers.

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