Importance of habitat quality and surrounding landscape on biodiversity in Woodland Key Habitats

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Introduction

The forest of Sweden has, since the introduction of intensive forest management, experienced major changes which have led to fragmentation of natural forest. Additionally, intensive forest management was introduced earlier in southern Sweden compared to northwards.

There are several stand factors that enhance the species richness. One of them is occurrence of suitable substrate. Large old trees are shown to be important for the diversity of fungi, lichens, and bryophytes. Even if they are few, large old trees increase the diversity of a certain stand. Additionally, amount dead wood is important. For instance, the number of polypore species, red-listed and non-red-listed, increases with the volume of dead wood.

Connectivity between patches is important for the biodiversity. For instance, the number of red-listed species of fungi can be ten times higher in a well-connected landscape compared to a fragmented one, even if the amount of resources (dead trees) are the same. Furthermore, the amount of suitable habitat in the surrounding landscape is important for local species richness. One example is that the amount of mature forest (>120 years) in the surrounding landscape is a good predictor for local species richness.

Despite intensive research, the relative importance of stand and landscape factors, respectively, remains rather unclear. Maybe because it is a complex interplay between the two factors that determine local species diversity. Therefore, the present study aims to answer what, stand and/or landscape factors, determine species richness in Swedish key habitats. We will also investigate how the time since introduction of intensive forest management has affected species diversity.

Method

We used data from the biodiversity monitoring program where 615 key habitats have been surveyed by experts at the Swedish Forest Agency with regards to stand factors and species. Landscape data was downloaded form SLU, the Swedish forest Agency as well as the Swedish Environmental Protection Agency. To analyse what stand and landscape factors that determine the species richness, we used a Bayesian joint species distribution model.

Result & discussion

We show that key habitats in northern Sweden tend to have more species (mean = 28) compared to middle (mean = 17) and southern Sweden (mean = 14), contrary to what we expect given hat number of species often decrease towards the poles.

Key habitats in the north are larger and have the nearest neighbour closer than southwards (Fig. 1a-b), this might explain the higher species content. However, key habitats of a certain size in northern Sweden tend to harbour more species than key habitats of the same size in southern and middle Sweden (Fig. 1c). That key habitats in the north harbours more species might be due to later introduction of intensive forest management. A study from Finland found more polypore species in eastern, that have a shorter history of intensive forest management than the western part.
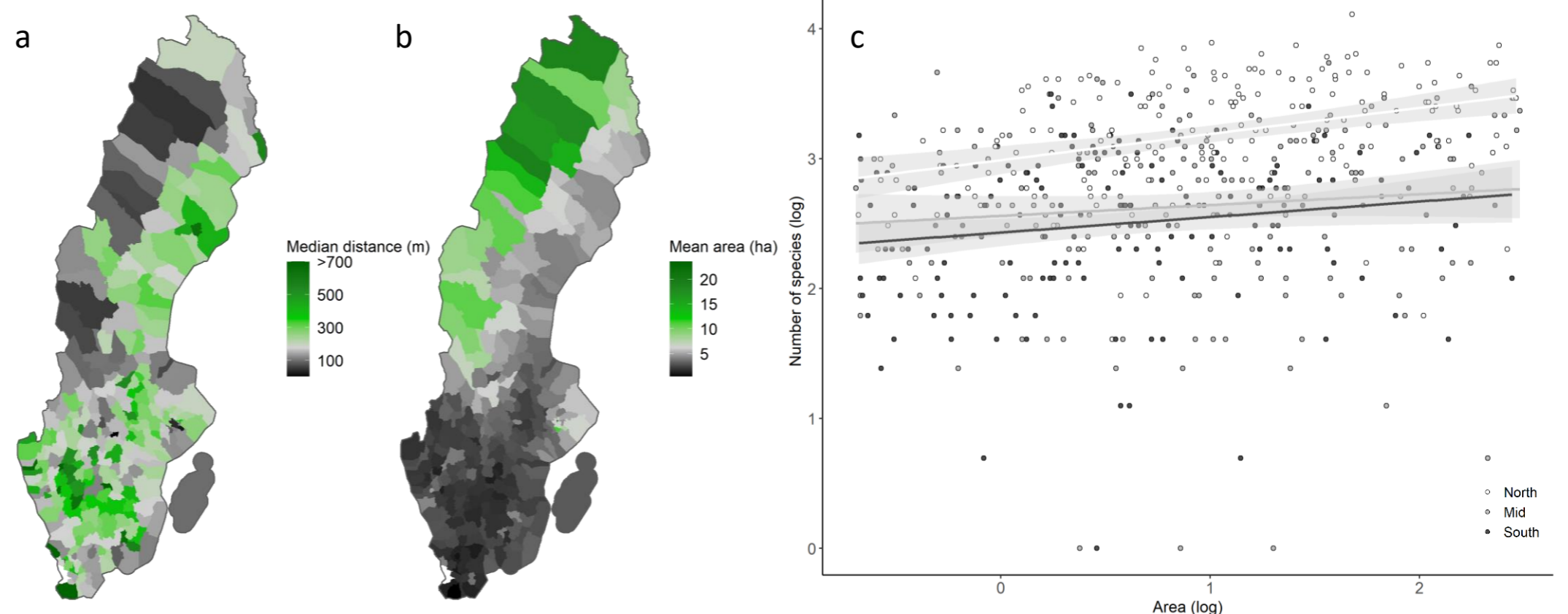

Figure 1. a) Median distance between a key habitat and its nearest neighbour per municipality. b) Mean area of key habitats per municipality. c) Species-area relationship of indicator species in key habitats in different parts of Sweden. Key habitats smaller than 0.5 ha and larger than 12 ha are removed since they were not present in all parts of the country.

We found that species respond very differently to stand and landscape factors. Number of large old trees was the stand variable that most species respond positively to, especially lichens and red-listed species. Additionally, a majority of the species that responded positively to number of large old trees also responded positively to a PCA-axis of landscape variables where most variation was explained by the amount of old forest within 5 km from the key habitat.

In conclusion, the earlier introduction of intensive forest management in the south has probably reduced the species numbers and increased the risk of extinction for forest dependent species due to fragmentation and change in forest structure. The differences between regions stress that different conservations strategies as well as forest management strategies might be needed to prevent loss of biodiversity, both nationally and locally. In addition, the relative importance of stand and landscape factors remains rather unclear. However, our result indicates an interplay between the two.