

# Effects on biodiversity of forest fuel extraction, governed by processes working on a large scale

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## Abstract

The question whether forest fuel extraction will affect biodiversity is ultimately a question of whether there will be species extinctions due to this practice. Quantitative predictions, i.e. about how much habitat loss various species can tolerate, therefore require knowledge about processes that work over hundreds of square kilometres and over several years. Therefore, they are almost impossible to make. Instead, qualitative recommendations about which types of habitats or wood types that have the most threatened fauna and flora can be made based on information about landscape history and microhabitat associations of red-listed species. For Sweden a general conclusion for forest fuel extraction based mainly on saproxylic beetles is that coniferous wood can be harvested as forest fuel to a rather large extent, whereas deciduous tree species, and especially southern deciduous species and aspen, should be retained to a larger degree.

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## 1. Introduction

Biodiversity is a true buzzword of today, used for things that we should have a positive view of, and its meaning in common language is expanding. However, the word has a scientific meaning, although it is broadly defined [1]. Biodiversity encompasses the variety of life on all levels—from the genetic level to the level of ecosystems or biota. To measure biodiversity, one needs to define some level that is practically possible to use and relevant for the issue. The species level is therefore often used, because species are comparatively well-defined units that are rather easy to count. However, although easier than counting the number of ecosystems or genes, counting the number of species is not as easy as it may seem at first glance [2]. The number of species that occur in an area is moreover affected by processes working on large scales both in time and space.

Forest fuel in Sweden consists mainly of logging residues that were formerly left to decay on clear cuts. Removing this material may affect biodiversity because lower

amounts of wood in the forest imply fewer habitats for species using wood for breeding. Such species, which depend on wood for their survival, are termed saproxylic [3]. In Scandinavia several thousand species are saproxylic, most of which are fungi and insects [4,5]. They may also be threatened in two different ways. One is the loss of habitat, i.e. dead wood, in itself. Another is the risk that insects colonise wood bound for the heating plants, and thus are trapped in wood that is burned [6,7]. Other species could also be affected because removal of logging residues alters the structures on the ground and the amount of nutrients [8,9]. The removal of wood from managed forests has been identified as one of the main reasons for why many forest species in Scandinavia have declined and even gone regionally extinct [10,11]. Therefore, this paper focuses on saproxylic species, and these are in turn exemplified mainly by beetles. The aim is to describe how the diversity of these species is affected by logging residue extraction in the sense of habitat loss. This will largely be a description of the difficulties when assessing these effects because processes working on large scales are involved.

I describe three different approaches to study how biodiversity is affected by forest fuel extraction, and show

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which conclusions can be drawn from published sources. Firstly, I address the ultimate question: whether forest fuel extraction will lead to an increased risk that species will become regionally extinct. Preferably, one would like to have a quantitative prediction of how much forest fuel can be extracted without any species extinctions. This issue is determined by processes working on large scales both in time and space (Fig. 1a), and which are therefore costly to study, not least when compared with another issue related to the sustainable use of forest fuels, the nutrient status in the soil (Fig. 1a). That issue is anyway complex enough when it comes to making predictions [12]. However, studies relevant for making recommendations about forest fuel harvest in relation to biodiversity can be done with less cost (Fig. 1b). These can be assigned to two categories: studies of landscape history and studies of microhabitat associa-

tions, which in this case mean associations with different types of logging residues.

## 2. Risks for species extinctions

The final answer to the question of whether forest fuel harvest affects biodiversity is to know at what level of extraction species will become extinct in an area where forest fuel is harvested. This might be answered with some type of population viability analysis [13], which is mostly built more or less on the metapopulation concept [14]. This concept describes the habitat as an archipelago of patches, which the species may colonise or from which it may become extinct. If the rate of extinctions is larger than the rate of colonisations, the species will become extinct from the whole metapopulation. For making predictions based

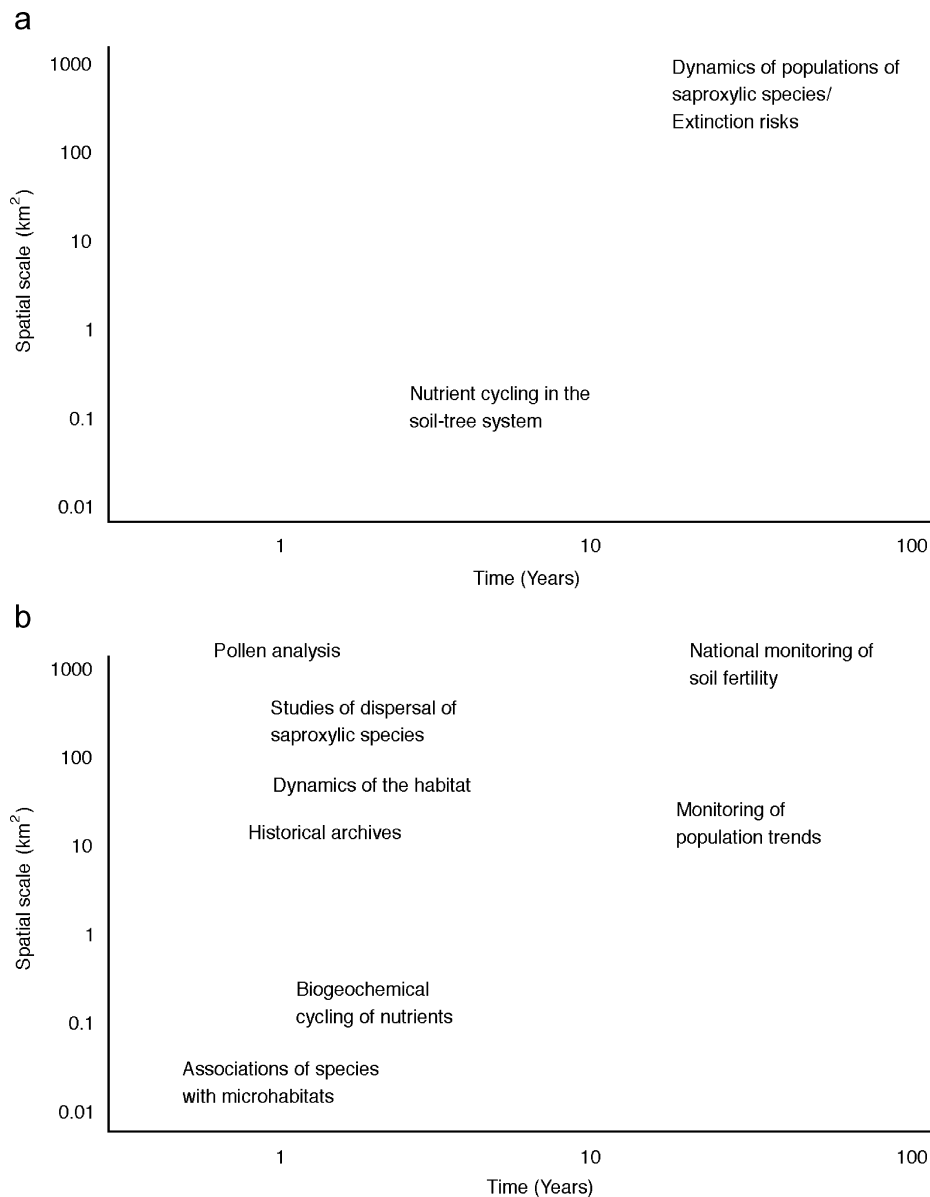


Fig. 1. The spatial and temporal scale for (a) processes associated with the sustainable use of forest fuels, and (b) studies relevant for studying these issues. Costs of studies increase when moving up and to the right.

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