



# Habitat preferences determine species' response to forest management in boreal production forests of Fennoscandia and European Russia

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**Habitat preferences determine species' response to forest management in boreal production forests of Fennoscandia and European Russia. Uneven-aged forest management shows a strong positive effect on species richness of forest dependent species when compared to even-aged forests less than 80 years old. A similar effect is noticed when young even-aged forests are compared to mature (>80 years old) even-aged forests. In young even-aged forests and forests having undergone retention harvest, open habitat species and their individuals are more numerous. Natural forests have overall more species than even-aged forests, especially forest dependent species, but have a similar number of species than uneven-aged forests.**

## Why is this Evidence Synthesis Needed?

Timber and wood products are important for our everyday life. At the same time, we have an internationally recognised responsibility to protect and maintain biodiversity. Therefore, it is important to know how different forest management approaches affect forest biodiversity. In even-aged forest management all or most of the trees are removed during harvesting and a new tree generation is established afterward. This creates structurally uniform forests. In uneven-aged forest management only some trees or tree groups are removed in one harvest, which maintains heterogenous forest structure over time. This review examined the effectiveness of these management approaches to maintain species richness and abundance at stand-level. Overall impacts were examined as well as impacts on different types of species, e.g. forest dependent species and open habitat species, or different species groups, e.g. beetles. Also, the influence of time since harvesting and deadwood availability were assessed. In this review even-aged and uneven-aged forest management were compared directly to each other as well as to natural forests to provide a broad basis for public discussion on the advantages and disadvantages of different forest management approaches.

This Collaboration for Environmental Evidence systematic review examines impacts of different forest management approaches on species richness and abundance, and if the impacts are influenced by time since harvesting, deadwood availability or species type. The review summarises evidence from 251 studies on uneven-aged forest management and 603 studies on even-aged forest management.

## Main Findings

### *What studies are included?*

This review includes studies that evaluate the impact of forest management on species richness and abundance. Comparisons between uneven-aged and even-aged forest management and between managed and natural forests were included. A total of 854 studies from the period 1976 to 2019 were included in the final analysis. The majority of these studies were conducted in Finland and Sweden. The evidence base for uneven-aged forest management included 251 studies where forest had been harvested by selective felling or gap felling. Most of these studies examined impacts on arthropods, lichens, bryophytes and vascular plants. The evidence base for even-aged forest management included 603 studies and harvesting was either clear cut or clear cut with some trees retained in the harvested area. The most common species groups studied were arthropods, bryophytes and vascular plants.

### *What is the impact of uneven-aged forest management on species richness and abundance?*

Uneven-aged forest management has more forest dependent species and their individuals than even-aged forests under 80 years old. Over time, number of forest dependent species and their abundance becomes similar so that no differences are found between uneven-aged and mature even-aged forests over 80 years old. Compared to natural forests, uneven-aged forests have a similar number of species.

### *What is the impact of even-aged forest management on species richness and abundance?*

Even-aged forest management increases the number of open habitat species, especially in recently harvested forests. Despite the increase, even-aged forests have less species overall than natural forests, especially forest dependent species, but the number of individuals is similar between the forest types. Once even-aged forest matures, it harbours more forest dependent species.

### *What factors influence species richness and abundance?*

Habitat preference, i.e. forest or open habitat, is the most important factor when impact of forest management is assessed. It is difficult to assess whether certain species groups are more sensitive than others as species-specific responses are mixed with habitat preferences. Time since harvesting has two-fold impact: it increases the number of open habitat species after harvesting but later forest dependent species become more numerous. The amount of deadwood has a positive impact on some species but for most comparisons its influence could not be assessed due to lack of data.

## What are the Implications of the Review Findings?

Although the evidence-base is limited in terms of taxa and geographical scope, the results of this systematic review are rather uniform and in line with current understanding on the impact of disturbance from forest harvesting. Uneven-aged forest management is more favourable for forest dependent species than even-aged forest management (up to 80 years since harvesting) and the effect is strong (i.e. magnitude of effect size is large). However, there are factors whose influence could not be considered in this review. For example, type of harvesting in uneven-aged forests can influence environmental conditions and subsequently species' response. Similarly, environmental conditions of different sites can vary, for example regarding soil type. Therefore, an overarching conclusion on when and where uneven-aged forest management is beneficial cannot be drawn. Over time, the impact of harvesting seems to lessen but even older production forests (>80 years since harvest) have less forest dependent species than natural forests. This points to the importance of ensuring conservation of natural and near natural forests to safeguard forest dependent species in the future.



## Synthesis Time Frame

The review authors searched for studies published until end of September 2019. This CEE Systematic Review was published in January 2021.

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