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Wood-living beetle diversity and Swedish forest management

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Abstract

Humans have impacted Fennoscandian forests for thousands of years, through grazing, burning, and since the industrial revolution increasingly through efficient industrial forestry. These impacts have changed the composition and structure of these forests, by reducing forest age, simplifying forest structure, and reducing the amount of broadleaved trees, among other things. To achieve a forestry model that is sustainable, the consequences of these changes on forest biodiversity need to be evaluated.

In this thesis, I focus on saproxylic (wood-living) beetles, within south-central Swedish forestry and forest conservation. This ecological group utilizes dead wood in various forms and is species-rich (1,200 Swedish species), threatened (400 red-listed Swedish species), ecologically diverse, and of high conservation and management relevance.

In **Paper I**, I test the 10-year effect of conservation-oriented thinning on oak-associated saproxylic beetles in 8 pairs of 1-hectare oak-dominated forest plots spread across southern Sweden. For each pair, one plot was treated with thinning in 2002/2003, and one was left as a minimal intervention reference plot. Beetles were sampled shortly before, shortly after, and in my study, 10 years after thinning. The number of beetle species in the thinning plots relative to the reference plots increased slightly and non-significantly shortly after thinning, but significantly 10 years later, equaling around a 33% increase.

In **Paper II**, I compare the diversity of saproxylic beetles and several ecological subgroups between a common spruce forestry stage (young pre-commercially thinned stands), and small broadleaf-dominated unmanaged semi-natural stands (Woodland Key Habitats). Ten pairs of stands of the two forest types were used, spread across Jönköping county in southern Sweden. While the local (alpha) diversity of beetles was similar between the forest types, the total (gamma) diversity was higher for red-listed and broadleaf-associated species in the Woodland Key Habitats. Further, the species composition differed between the forest types, and Woodland Key Habitats had higher compositional (beta) diversity.

Paper III uses related but broader comparisons, between middle-aged commercially thinned spruce stands, middle-aged not recently thinned spruce stands, spruce-dominated Woodland Key Habitats and spruce-dominated nature reserves. Here, sampling was spread over two regions, one with higher occurrence of Woodland Key Habitats (Örebro county) and one with lower (Jönköping county). A total of 10 pairs, 10 triplets, and 3 single stands were used. Local diversity was higher in the thinned stands than in Woodland Key Habitats, but did not differ for the other forest types. Total diversity of most ecological groups did not differ between forest types, but red-listed species were more diverse in Woodland Key Habitats than in thinned stands in the region with more Woodland Key Habitats, but not in the region with less. The species composition did not differ between the forest types, but Woodland Key Habitats had higher compositional diversity.

Paper IV combines data from the two previous papers, this time looking at the influence of characteristics of the surrounding landscape on local diversity of saproxylic beetles. Four landscape variables (volume of broadleaf forest, amount of old forest, amount of conservation forest, amount of clear-cut) were examined, at three scales (within 250 m, 1,250 m, and 2,500 m from stands). At the scale of 2,500 m, the volume of broadleaf forest influenced saproxylic beetle diversity positively, while the amount of old forest surprisingly influenced red-listed species negatively.

Overall, the studies show the varied and complex ways management can affect beetle diversity and communities. Beetle diversity patterns are clearly scale-dependent, and aspects of the surrounding landscape are important for local diversity. Thinning seems to have a positive influence on the local number of saproxylic beetle species, in oak and to a certain extent spruce forests, and for the former at least for 10 years. Several common spruce forestry stages have as many or more saproxylic beetle species per stand as nearby conservation stands. However, the managed stages are more homogenous, lowering their contribution to overall saproxylic diversity. Conservation stands, including Woodland Key Habitats, strengthen conservation of Swedish saproxylic beetles. A crucial aspect seems to be the amount and diversity of broadleaved trees, an increase of which both within forestry and conservation should benefit saproxylic beetles.