



The impact of partial overstorey removal on insect and arachnid diversity in temperate and boreal forests: **A systematic review and meta-analysis**



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*The leaves were long, the grass was green,
 The hemlock-umbels tall and fair,
 And in the glade a light was seen
 Of stars in shadow shimmering.*
 From Strider's tale of Tinúviel in *The Fellowship of the Ring*

Background

- Early-seral habitats are a key area of concern in the conservation of temperate and boreal forest insects
- Forest management practices vary in their potential to offer high-quality early-seral habitats (as part of a mosaic of successional stages)

Methods

- A systematic literature search of Web of Science, ScienceDirect and other databases was conducted up to March 2017
- Studies were included that looked at partial harvesting, gap creation, or thinning
- Random-effects meta-analysis of log response ratios from included studies was performed using the metafor package in RStudio 1.1.383 (RStudio, Inc)

Results

- Sixty-four comparisons of species richness were extracted from 53 included studies in the systematic review (Fig. 1)
- An overall increase in richness was found of 22% (95% CI, 11–34%) with canopy opening
- Subgroup analysis (Table 1) revealed that partial overstorey removal had a particularly marked effect in understorey and herb-layer arthropods compared with ground-level and soil arthropods

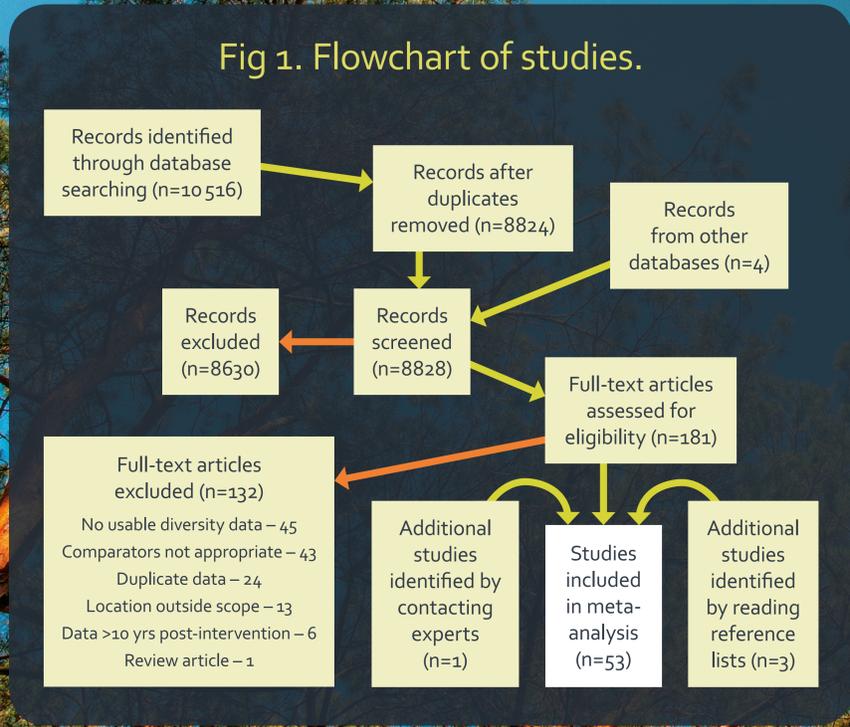


Table 1. Subgroup analyses.

	Subgroup	Mean change in richness	95% CI
Forest layer	Understorey and herb layer	+50%	+25% to +78%
	Ground level (including leaf litter)	+13%	+1 to +27%
	Soil	+11%	-7% to +34%
Taxonomic group	Coleopterans	+29%	+15% to +44%
	Non-Coleopteran insects (chiefly Diptera, Lepidoptera and Hymenoptera)	+37%	+7% to +77%
	Arachnids	+7%	-12% to +29%

Discussion

- The increased arthropod diversity found with partial overstorey removal is likely to relate to the increased diversity of available ecological niches, including food-plants, with particular benefits for thermophilic species
- This is supported by the benefit being particularly marked in the understorey, which receives more direct light and has highest plant diversity
- The especially large effect noted in non-beetle insects may in part relate to the tendency of these organisms to use the understorey layer

Conclusion

- Across studies, partial overstorey removal was linked to a statistically and biologically significant increase in arthropod species richness