ForestPaths
Co-designing holistic forest-based policy pathways for climate change mitigation

ForestPaths Features #4:
a series showcasing ForestPaths' insights and results.

Effects of forest management on animal biodiversity in Europe and beyond

Transitions to more biodiversity-smart forest management are needed to avoid forestry-related biodiversity loss, which requires the identification of such management. Statistical analyses of species-level abundance data reveal significant reductions of 56–63% in animal biodiversity in response to forest management in Europe in comparison to natural, unmanaged systems, but with little differences between types of management (van 't Veen et al. 2025). On the global scale, biodiversity is reduced by 23–47% in response to selective cutting followed by natural regrowth, while it is reduced by 56–80% under forest plantations. While intactness, estimated as mean species abundance (MSA) (see Box 1) increases with ±70% in forest plantations globally over a period of 80 years, it rises with ±25% in European plantations over that period. The results highlight an opportunity to adopt more biodiversity-smart forest management in Europe. Inspiration may be found in European management systems that mimic natural disturbances, such as shelterwood cutting, as well as close-to-nature forestry. Inspiration could also be drawn from selective cutting followed by natural regrowth, as well as reduced-impact logging observed in other parts of the world.

Box 1: Mean species abundance (MSA): MSA is a measure of biodiversity intactness. It is calculated by dividing the abundances of species in managed forest sites by the abundances of the same species in undisturbed forest sites. If the abundance response ratio is higher than 1, the value is set at 1 (maximum biodiversity intactness). If a species does not occur in the undisturbed forest sites, it is removed from the calculation.

Table 1. Types and definitions of common forest management systems and restoration types in Europe and globally.

European forest management systems		Global forest management systems	
Clear cutting and natural regrowth	• Removal of all trees in a forest area • Natural regeneration of the forest	Clear cutting and natural regrowth	• Removal of all trees in a forest area • Natural regeneration of the forest
Forest plantations	• Trees are planted • Replanting occurs after harvesting • Shorter rotations than clear cutting and natural regeneration	Forest plantations	• Trees are planted • Replanting occurs after harvesting
Selection cutting and natural regrowth or planting	• Selective harvesting of trees • Planting and natural regeneration	Selective cutting and natural regrowth	• Selective harvesting of trees • Forest regenerates naturally
		Reduced-impact logging and natural regrowth	• Selective harvesting of very few trees • Forest regenerates naturally
		Agroforests	• Crops growing underneath tree canopy
		Perennial tree crops	• Planted trees that produce crops for food production
		Silvopasture	• Livestock grazing under the canopy

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Analysis of international and EU policies

We combined and expanded three global biodiversity databases with animal species-level abundance data (i.e., vertebrates and insects) gathered in studies that compared the biodiversity of undisturbed forests to that of managed forests. To overcome bias towards tropical biomes, we conducted meta-analyses on forest management in Europe. We identified common forest management systems (Table 1), conducted mixed modelling to derive biodiversity estimates and temporal dynamics. We quantified biodiversity as mean species abundance (MSA), which is a biodiversity intactness indicator (Box 1). See van 't Veen et al. (2025) for more information.

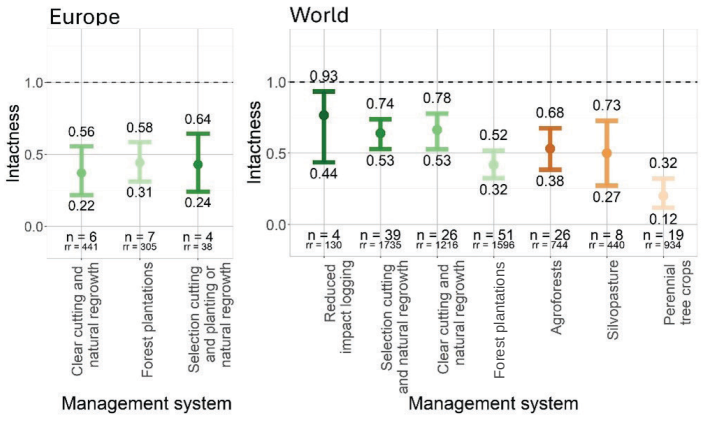

Figure 1. Effects of forest management on intactness in Europe and globally. n = number of studies. rr = number of response ratios.

European outcomes

- Similar biodiversity implications for various management systems (Fig. 1). MSA of managed forests lies between 0.37 and 0.43.
- Biodiversity increases with ±25% over 80 years in multipurpose plantations (Fig. 2) but remains stable during the first 16 years of natural regrowth following clear cutting.
- *Alternative systems:* Biodiversity-smart forestry may exist in Europe; we may not have captured their biodiversity impact. Future studies could focus on alternative management systems, such as shelterwood forestry systems and close-to-nature management.

Global outcomes

- Lower impacts of selective cutting followed by natural regrowth and reduced-impact logging on biodiversity than of forest plantations (Fig. 1). MSA ranges between 0.2 and 0.77.
- Biodiversity increases ±70% in forest plantations over 80 years (Fig. 2), ±30% in agroforests over 40 years, and slightly under selective cutting followed by natural regrowth over 50 years. An MSA loss over time is observed following natural regeneration after clear cutting over 70 years.

Research avenues

The following research avenues could be explored to unravel why we found limited distinction between forest management systems in Europe.

- *Planting*: To test a common hypothesis that tree planting inhibits biodiversity recovery, biodiversity under selective cutting and natural regrowth could be compared with biodiversity under selective cutting followed by planting.
- *Seed sources*: The predominance of relatively few tree species could prevent forest regeneration to natural reference levels. To test this, biodiversity in sites where cutting is followed by natural regrowth surrounded by native undisturbed forests could be compared to those surrounded by forest plantations.

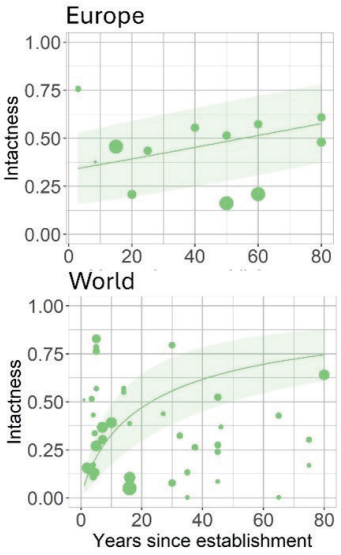

Figure 2. Changes in animal biodiversity intactness over time since the establishment of forest plantations. Sizes of dots indicate the number of species.

References

[1] van't Veen, H., Kuipers, K., Schipper, A., Marques, A., Schelhaas, M. J., & Alkemade, R. (2025). A Global Assessment of Plant and Animal Community Responses to Forest Management Over Time. ***Global Change Biology***, 31(6), e70279. https://doi.org/10.1111/gcb.70279

This ForestPaths Features #3 is based on:

- van 't Veen, H., Raymond, J., Brown, C., Rounsevell, M., Zeng, Y., Byari, M., Arneth, A., Alkemade, R. (2024). D3.3 *Biodiversity and ecosystem services modelling*. ForestPaths project deliverable D3.3.

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