Optimizing post-bark beetle disturbance management in mountain forests to promote biodiversity and natural tree regeneration under climate change

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BACKGROUND

The **European spruce bark beetle** (*Ips typographus*) is causing increasing damage in **Norway spruce** (*Picea abies*) forests, driven by warm and dry conditions, with outbreaks now reaching higher elevations. As climate change makes timely interventions more challenging, **post-disturbance management** is becoming essential. Yet little is known about the ecological outcomes of leaving beetle-killed trees in place versus salvage logging.

Our research in spruce-dominated mountain forests in the Swiss and Italian Alps examines the **short- to medium-term impacts** of post-bark beetle interventions on **biodiversity potential** and **natural tree regeneration**, by analysing site, forest, and tree characteristics.

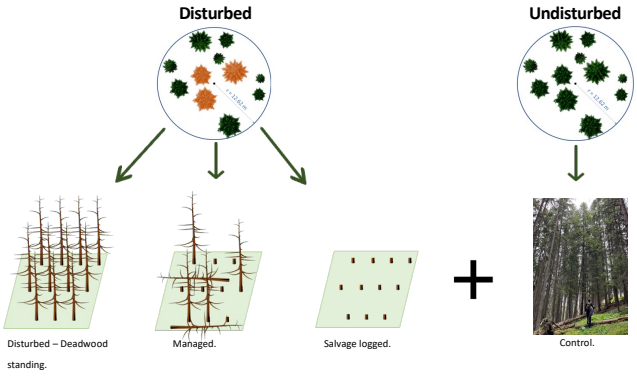
RESEARCH QUESTION

What are the **effects** of common **post-bark beetle management** interventions on **biodiversity potential** in spruce-dominated mountain forests across Europe?

What are the **effects** of common **post-bark beetle management** interventions on **natural tree regeneration** in spruce-dominated mountain forests in Europe?

METHODS

- **Spruce-dominated mountain forests**
- Study sites in **CH** and **IT** (see Fig. 1A)
- Temporal focus: **short to medium-term dynamics**, recent disturbance 1 – 15 years
- **Management interventions**: + control



Fieldwork

- Circular plots r = 12.62m
- Assessment of site factors (exposure, slope, etc.) and various forest characteristics (e.g. tree species, DBH, crown length, tree health, amount of deadwood, natural tree regeneration, Index of Biodiversity Potential, etc.)

Natural tree regeneration:
- Seedlings (height < 10 cm) (Fig. 1B)
- Regeneration on nurse logs (Fig. 1C)
- Regeneration around the plot centre (height > 10 cm and DBH < 12 cm) (Fig. 1D)

Index of Biodiversity Potential: Proxies to simplify assessment using structural indicators (Larrieu et al. 2008)

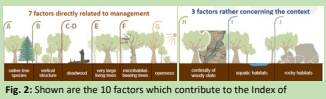


Fig. 2: Shown are the 10 factors which contribute to the Index of Biodiversity Potential (IBP).

CONCLUSION

Given the **increasing frequency** and **severity** of **bark beetle disturbances** in mountain forests, it is crucial to **understand** their impacts to **conserve forest biodiversity**, enhance ecosystem resilience, and **promote sustainable forest management** under a changing climate.

REFERENCES

Larrieu, L., & Gonin, P. (2008). L'indice de biodiversité potentielle (IBP) : une méthode simple et rapide pour évaluer la biodiversité potentielle des peuplements forestiers. 60(6), 727–748. https://doi.org/10.4267/2042/28373

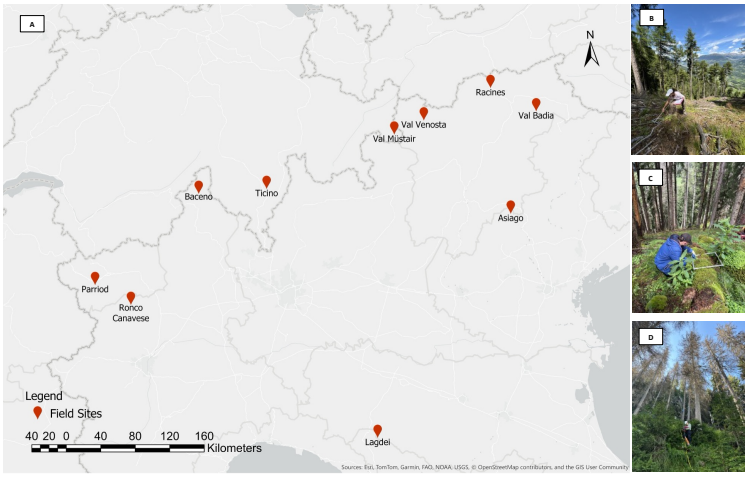


Fig. 1. A: Shown are the 10 study sites in Switzerland (Val Müstair, Ticino) and in Italy (Val Venosta, Val Badia, Racines, Asiago, Parriod, Lagdei, Baceno and Ronco Canavese). B: Using the matched case-control method in the field on a salvage logged area. C: Looking for nurse logs within a plot. D: Assessment of the regeneration around the plot centre in a bark beetle-disturbed forest.

PRELIMINARY RESULTS

Tab. 1. Overview of the surveyed plots in the project.

Region	Nr. Plots	Treatments			
		Disturbed – DW standing	Managed	Salvage logged	Control
Val Müstair	11	3	4	1	3
Ticino	21	6	6	4	5
Val Badia	17	5	2	5	4
Val Venosta	19	5	4	5	6
Racines	17	5	2	5	5
Asiago	14	5	1	3	5
Parriod	10	5	0	0	5
Lagdei	14	5	1	3	5
Baceno	10	5	0	0	5
Ronco Canavese	11	5	0	1	5
Total	**144**	**49**	**20**	**27**	**48**

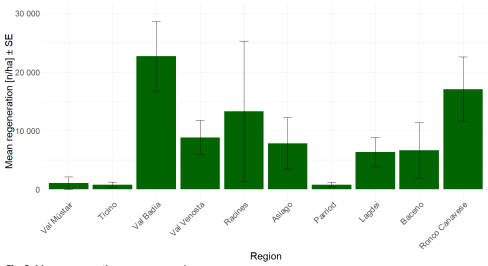


Fig. 3. Mean regeneration per survey region.

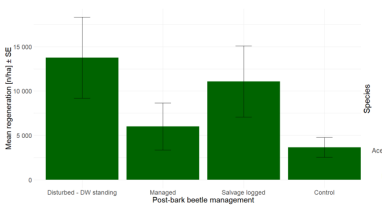


Fig. 4. Mean regeneration per management class.

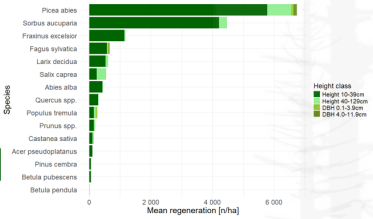


Fig. 5. Mean regeneration per species and height class.

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BARKSHIELD

VELUX STIFTUNG