Totholz

kleine Hotspots der biologischen Vielfalt

Jörg Müller

Ökologische Station Fabrikschleichach

Totholz im Wald

1. Warum ist Totholz im Wald von Bedeutung
2. Welche Rolle spielt Totholz als Kohlenstoffspeicher
3. Wie viel Totholz (Quantität) braucht die Artenvielfalt
4. Welches Totholz ist besonders wichtig (Qualität)?
5. Wie sollte es räumlich angeordnet sein?
6. Die Chance in der Störung

1. Warum ist Totholz wichtig im Wald

Xylobionte Käfer & Pilze

1378 für Deutschland beschriebene Arten

27% auf RL, 6 FFH-Arten

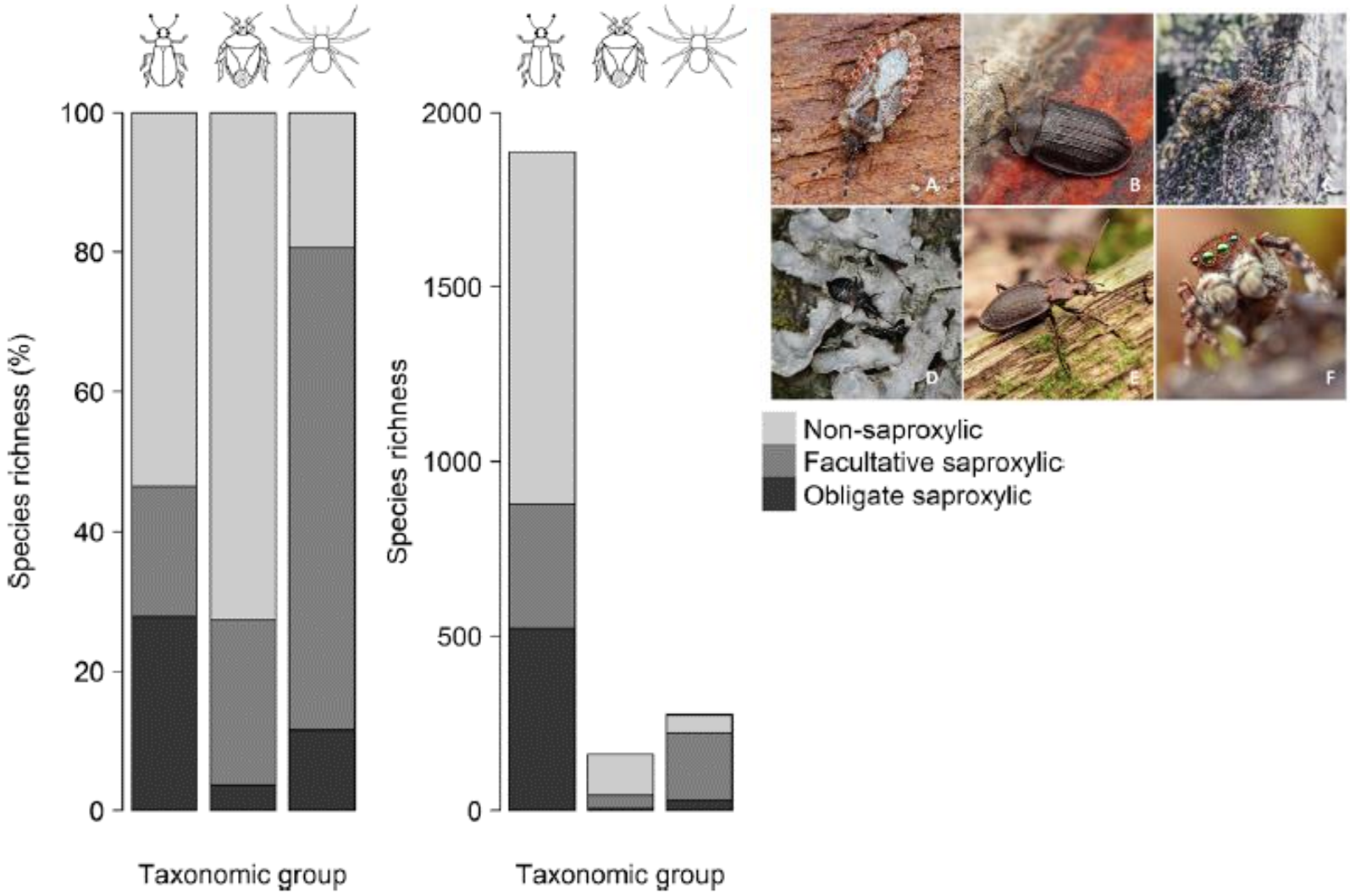
8989 für Deutschland beschriebene Arten

10% bestandsgefährdet

Die verborgene Vielfalt

Sequenzierung von Holzproben: 300 OTUs („Arten“)

Wen fördert Totholz

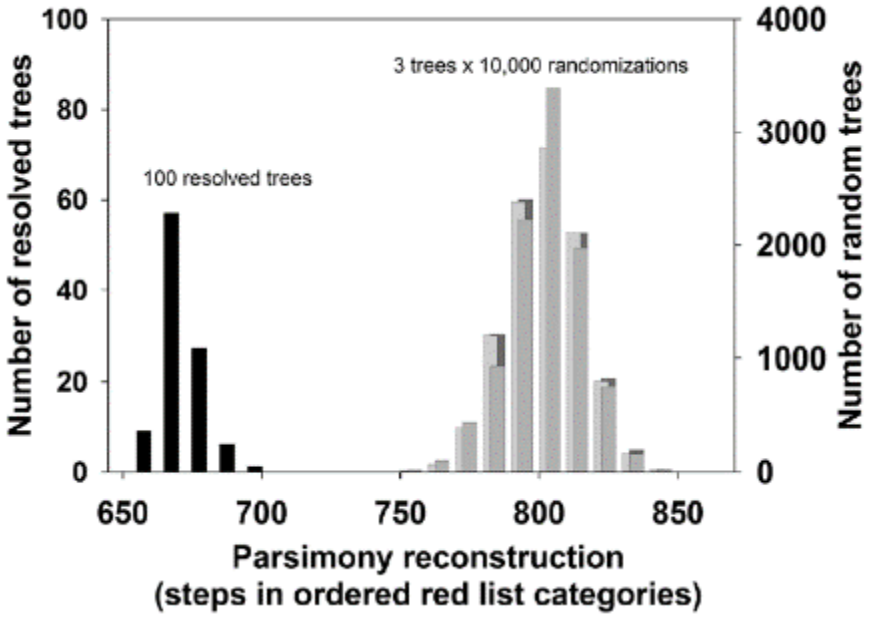


Graf et al 2022 Forest Ecology and Management

Aussterberisiko – Spiegelbild Moderner Forstwirtschaft

„Saproxylic Insects and the unsustainable Management of Forests: A 5000-Year European Experiment “

Grove 2002



Seibold et al 2015 Conservation Biology
Grove 2002 Annu Rev Ecol Syst

Megapenthes lugens

Arten des Flachlands sind stärker gefährdet

Ceruchus chrysomelinus

50cm

Große Arten und Arten an großem Totholz stärker gefährdet

Dicerca berolinensis

Arten an Laubholz stärker gefährdet

Eurythirea austriaca

Arten an besonntem Totholz stärker gefährdet

Aussterberisiko – Spiegelbild Moderner Forstwirtschaft

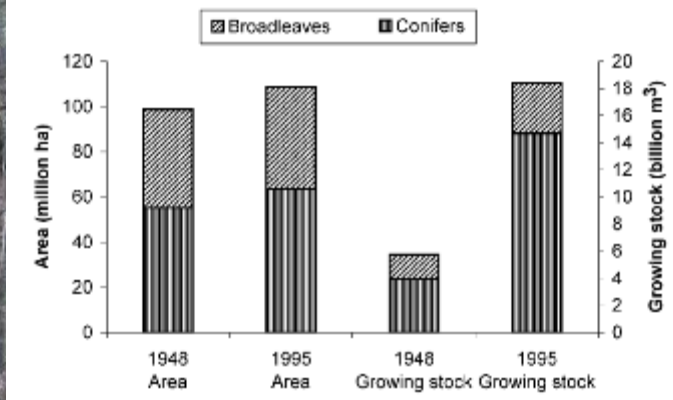
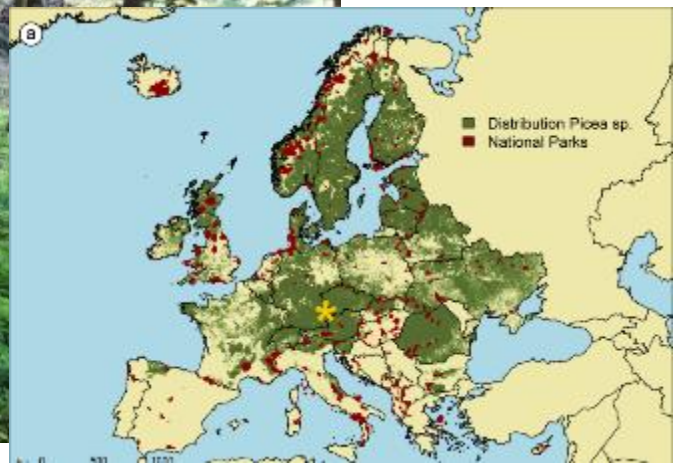


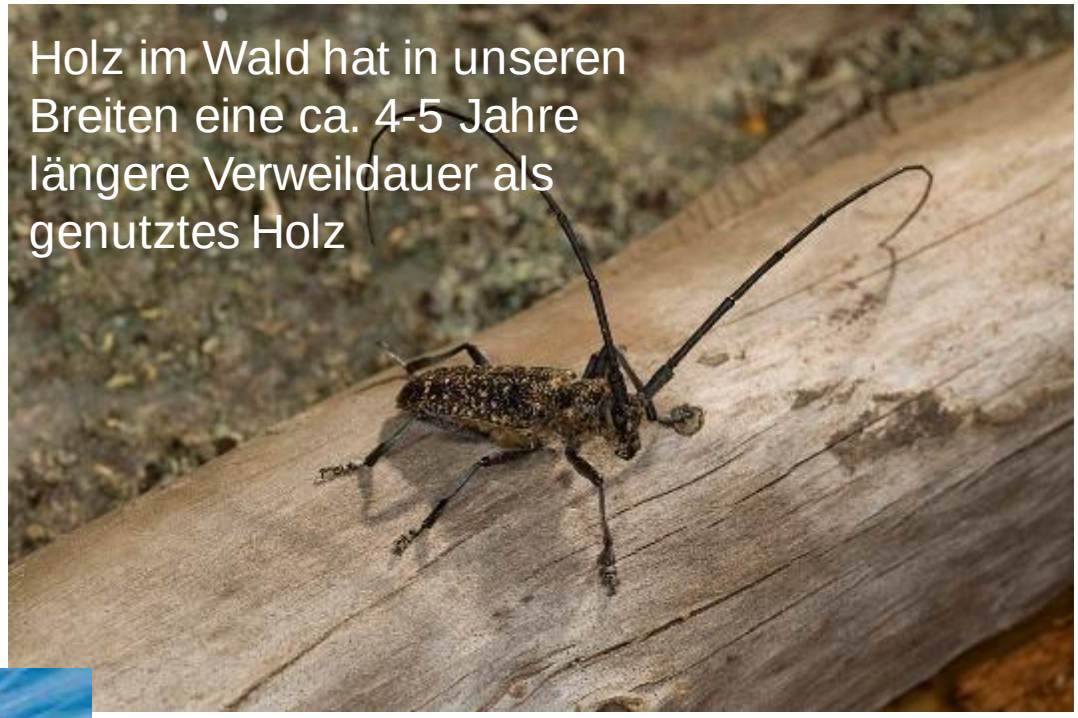
Fig. 12 Total forest area, area of conifers and total volume of growing stock in 19 European countries.



Schelhaas et al. 2003 Global Change Biology

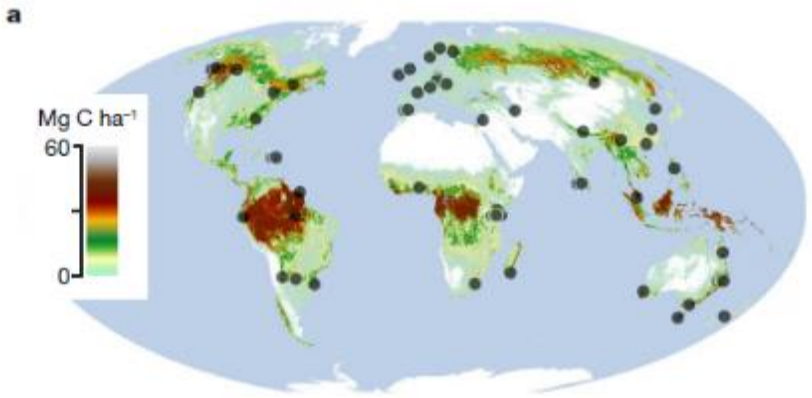
2. Die Rolle von Totholz als Kohlenstoffspeicher

- Verweildauer Nutzholz versus Totholz im Wald
- Der Substitutionseffekt
- Eine globale Perspektive



Calculation of substitution effects and recycling has also become more prominent. However, the lack of data is still an important constraint for a more realistic estimation of carbon stocks and fluxes. Therefore, if the sector wants to demonstrate the environmental quality of its products, it should make it a priority to provide reliable life cycle inventory data, particularly regarding aspects of time and location.
Brunet-Navarro et al 2016 Global Change Biology

Totholz global



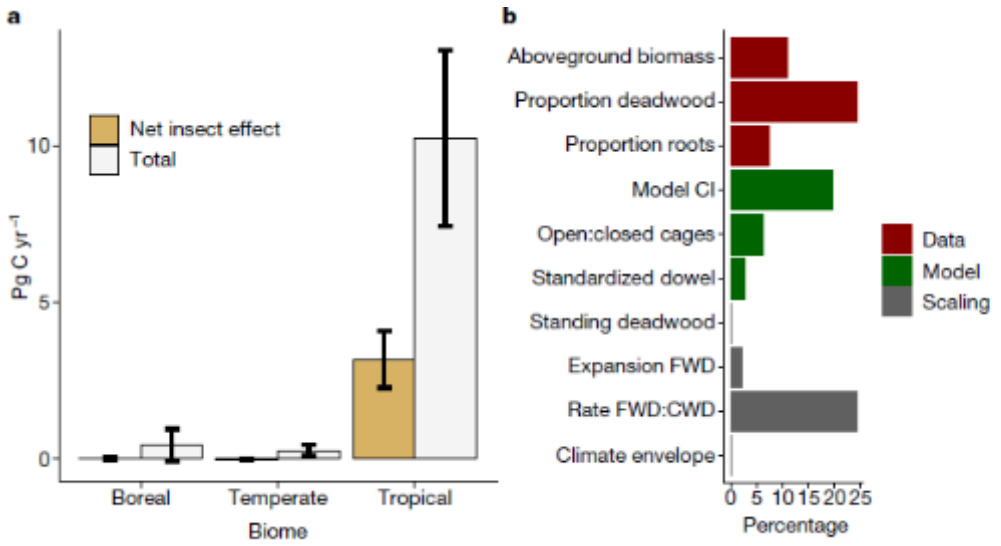
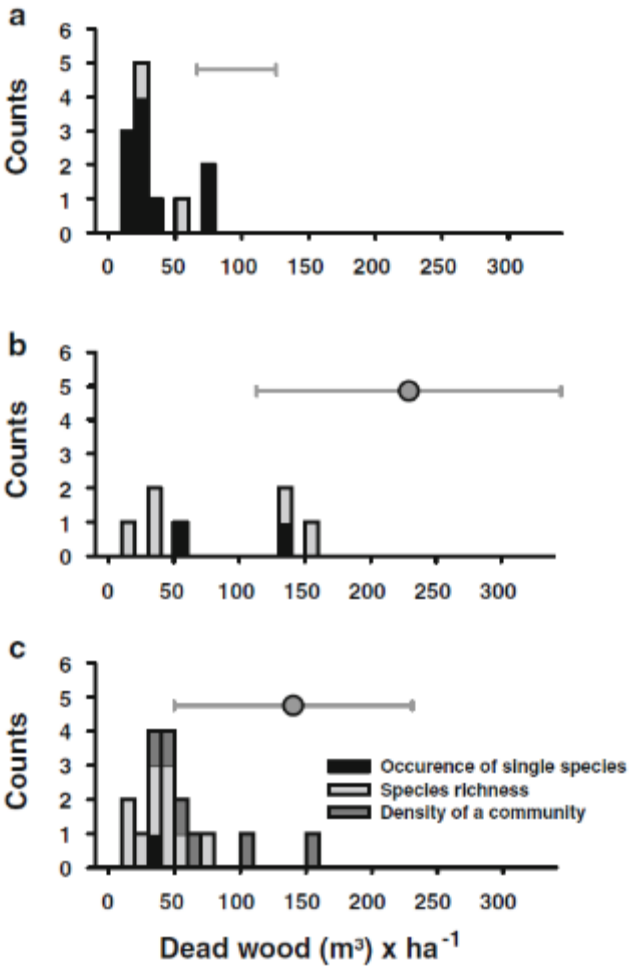


Fig. 3 | Global annual carbon release from deadwood and sensitivity analysis. a, Annual carbon released (Pg C yr^{-1}) from deadwood per biome. Error bars indicate the uncertainty of the biome-specific estimate as determined by the sensitivity analysis. **b**, Relative contributions to the overall uncertainty of the global estimate of total carbon release from the decomposition of deadwood. The colour of the bars indicates the uncertainty category. CI, confidence interval; CWD, coarse wood debris; FWD, fine woody debris. See Extended Data Table 2 for a detailed description of each factor and an uncertainty assessment of the net insect effect.

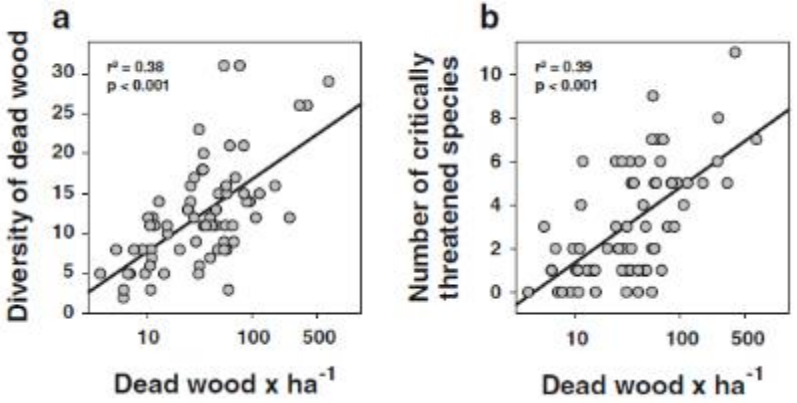
Seibold et al 2021 Nature

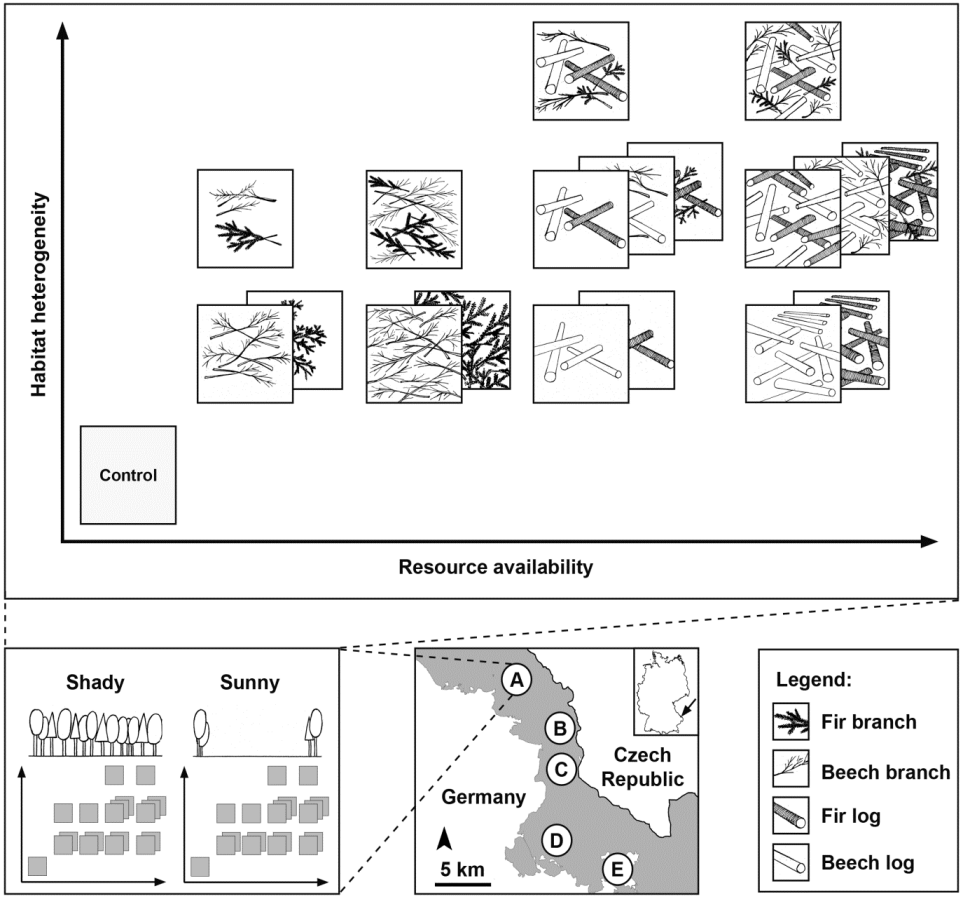
3. Wie viel Totholz (Quantität) braucht der Wald?



Müller & Bütler 2010 European Journal of Forest Research

Vielfalt oder Menge?





Seibold et al 2016 J Appl Ecology

Vielfalt ist wichtiger als Menge!



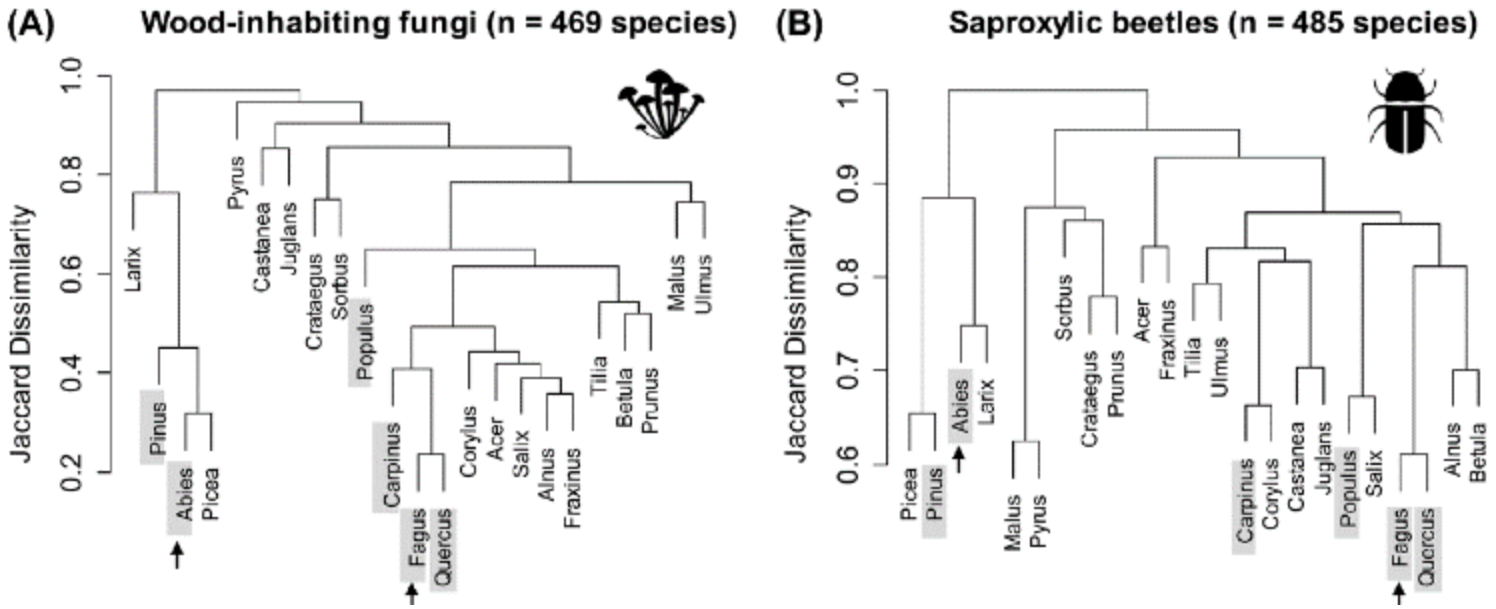



Durchmesser – Baumart – Totholztyp - Mikroklima

Seibold et al 2016 J Appl Ecology

4. Welches Totholz ist besonders wichtig? Baumarten

Literaturangaben



Müller et al 2020 Oikos

Was bestimmt die Artenzusammensetzung in einem Stamm?

2 Experimente

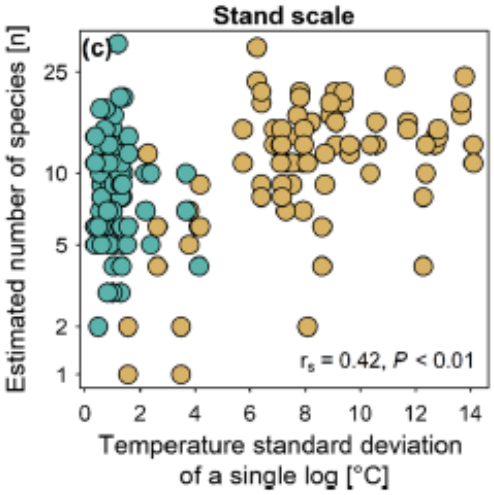
Baumart

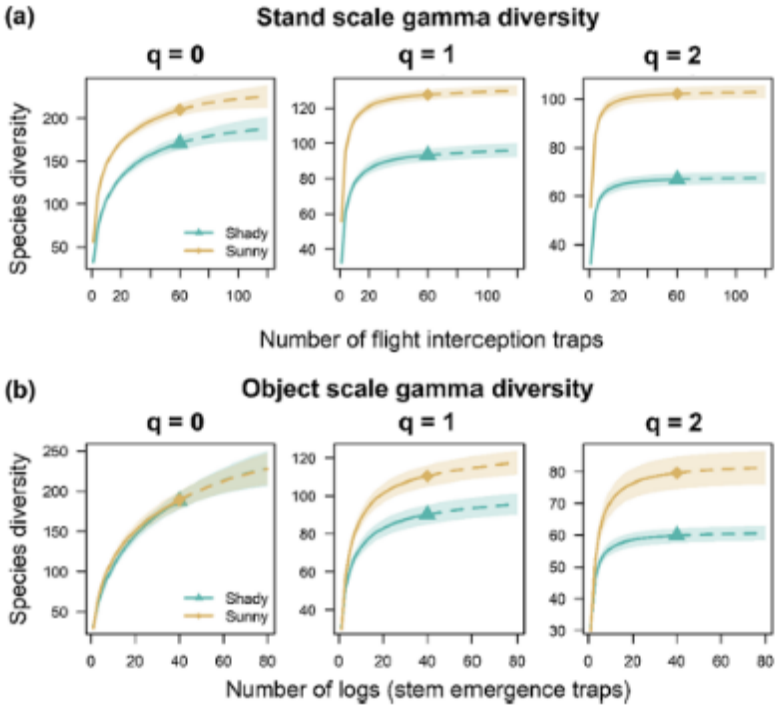
Zerfallsstadium

Mikroklima

Müller et al 2020 Oikos

Warum ist besonntes Totholz so wichtig?





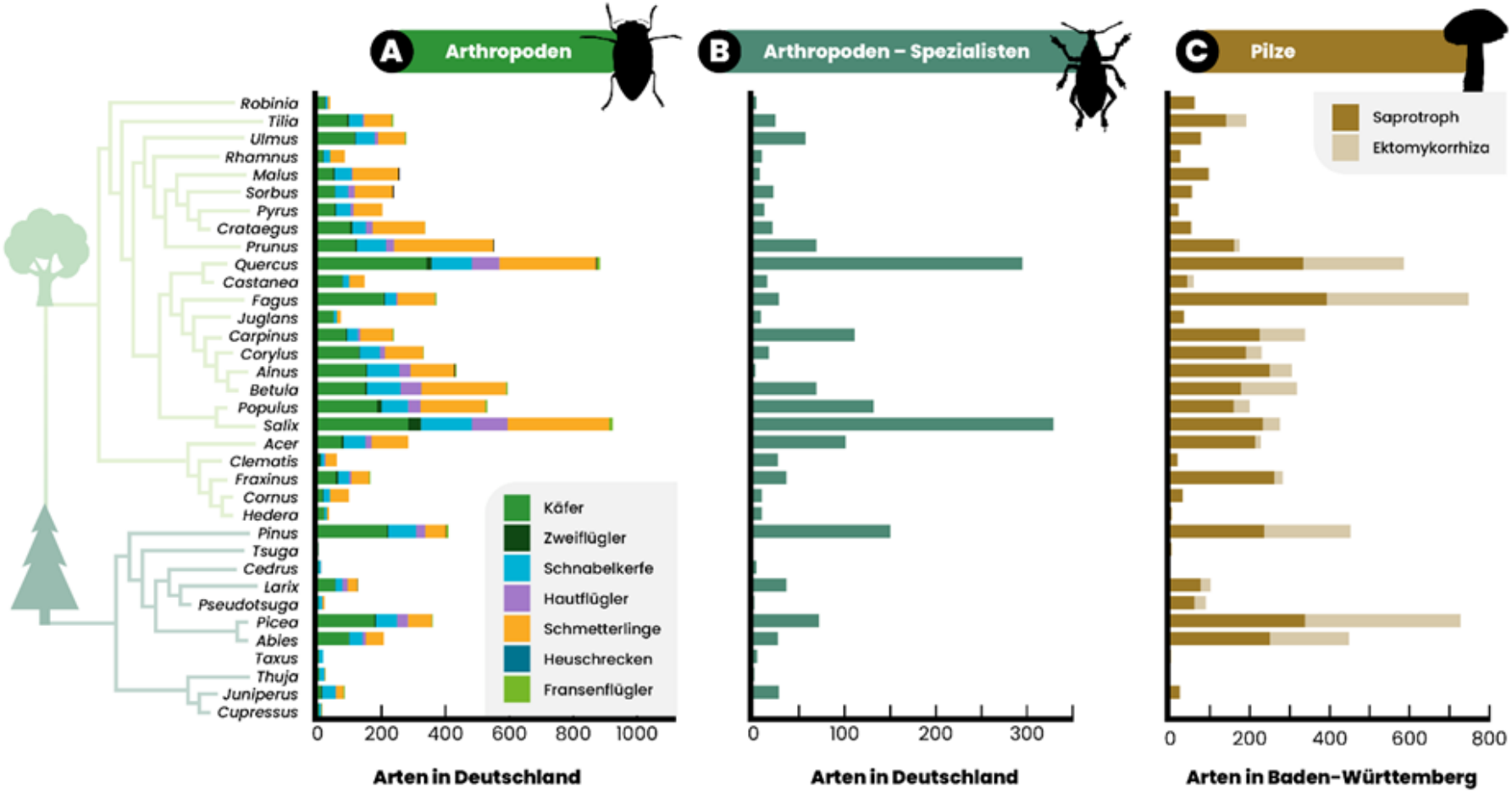
Diese Ergebnisse deuten darauf hin, dass die Sonneneinstrahlung die Totholzkäfer die Vielfalt der Totholzkäfer durch eine größere mikroklimatische Heterogenität innerhalb und zwischen Totholzstämmen

Lettenmeier et al 2022 Oecologia

Höhere Heterogenität in besonntem Totholz – Chancen in der Störung

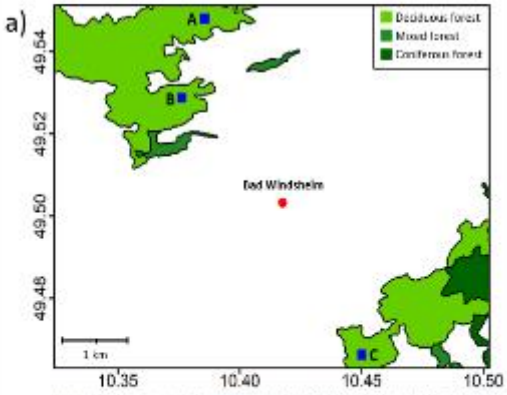
Lettenmeier et al 2022 Oecologia

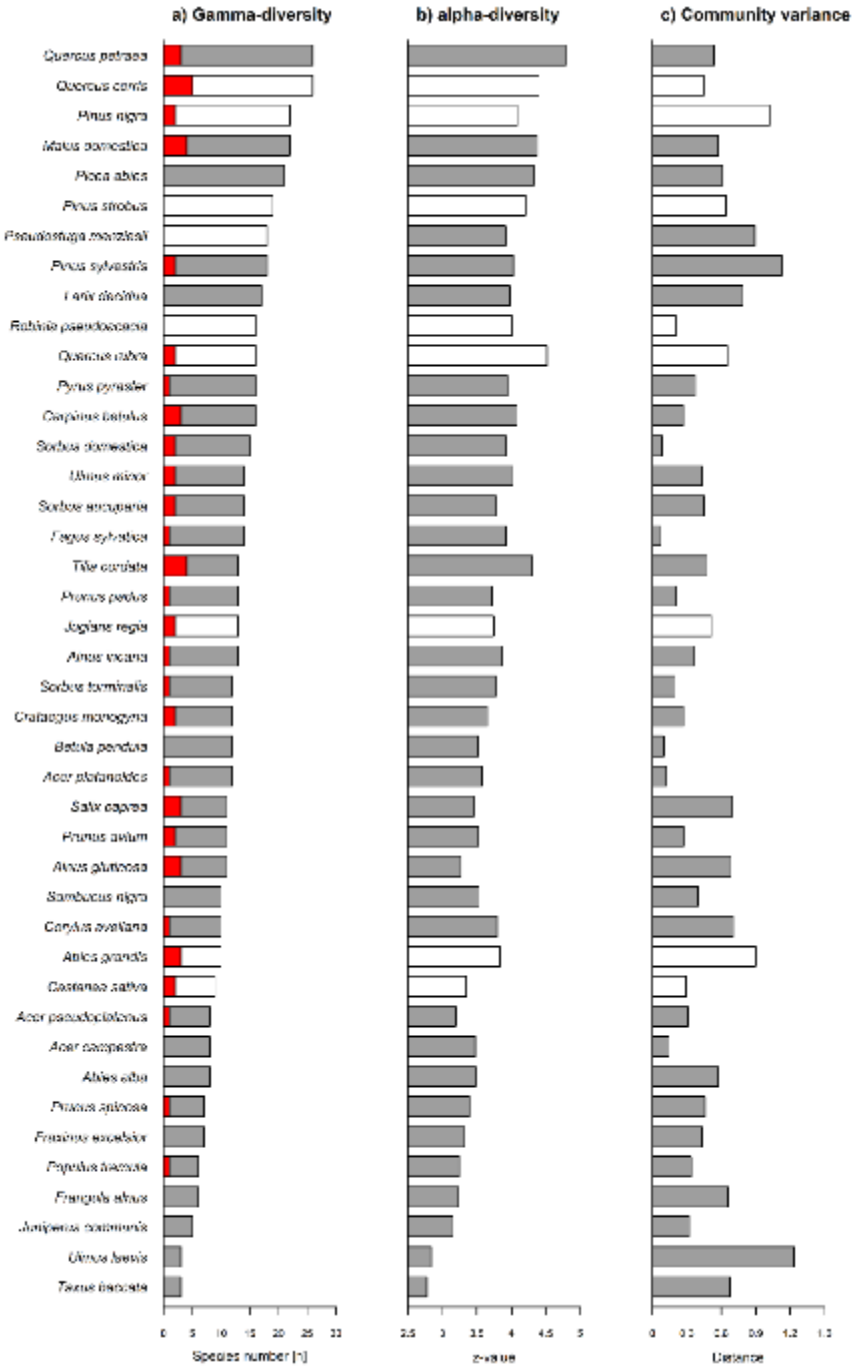
Baumartenvielfalt



Nach Brändle & Brandl 2001 J Animal Ecology

Baumartenvielfalt





Vogel et al. 2020 Insect Conservation & Diver

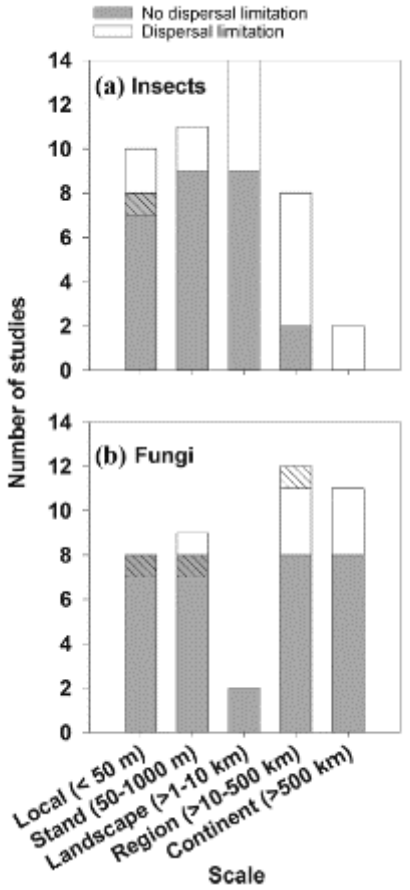
5. Wie sollte Totholz verteilt sein?

Conservation Biology

Review

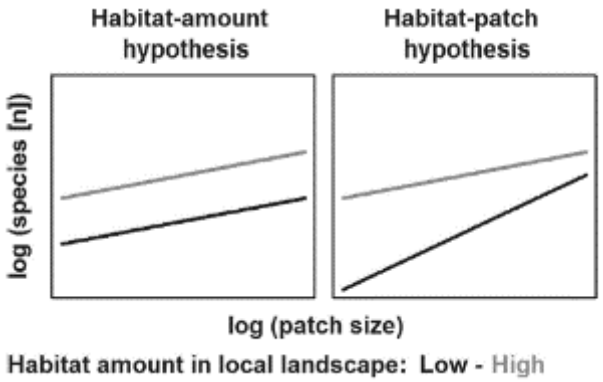
Dispersal ecology of deadwood organisms and connectivity conservation

Atte Komonen and Jörg Müller

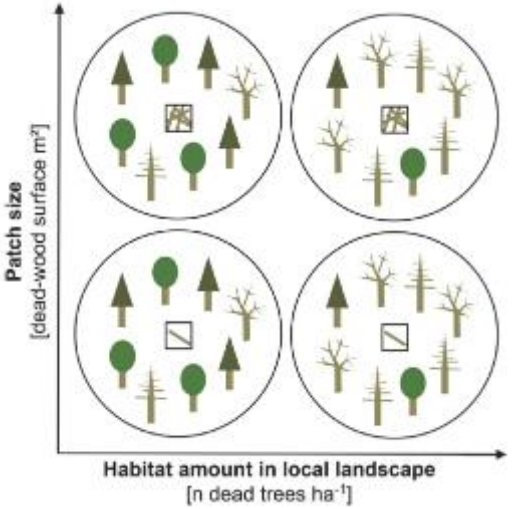


Ein Experiment mit Totholzkäfern

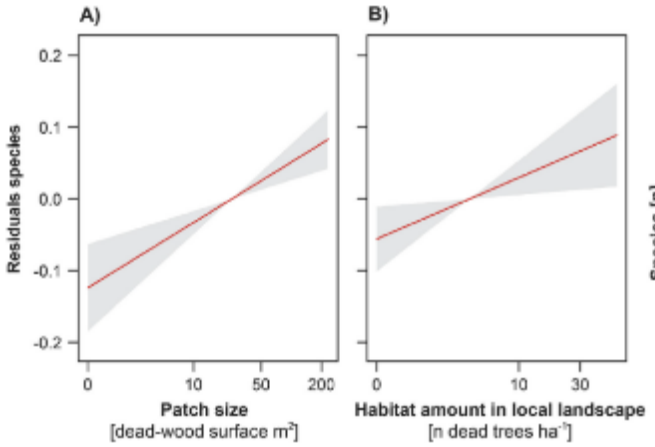
Theorie

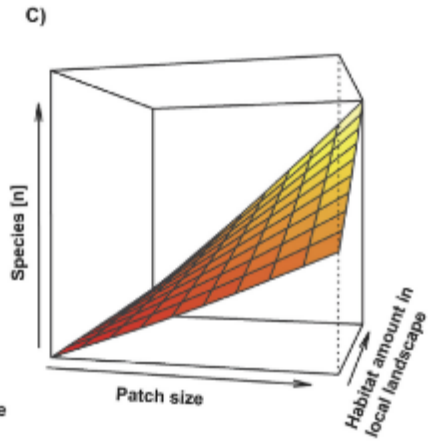


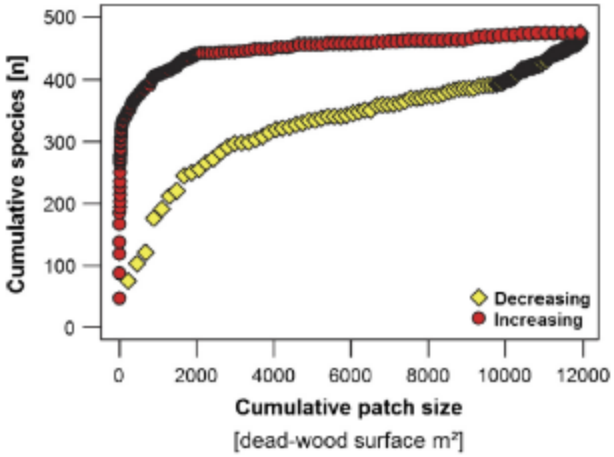
Design



Ergebnis

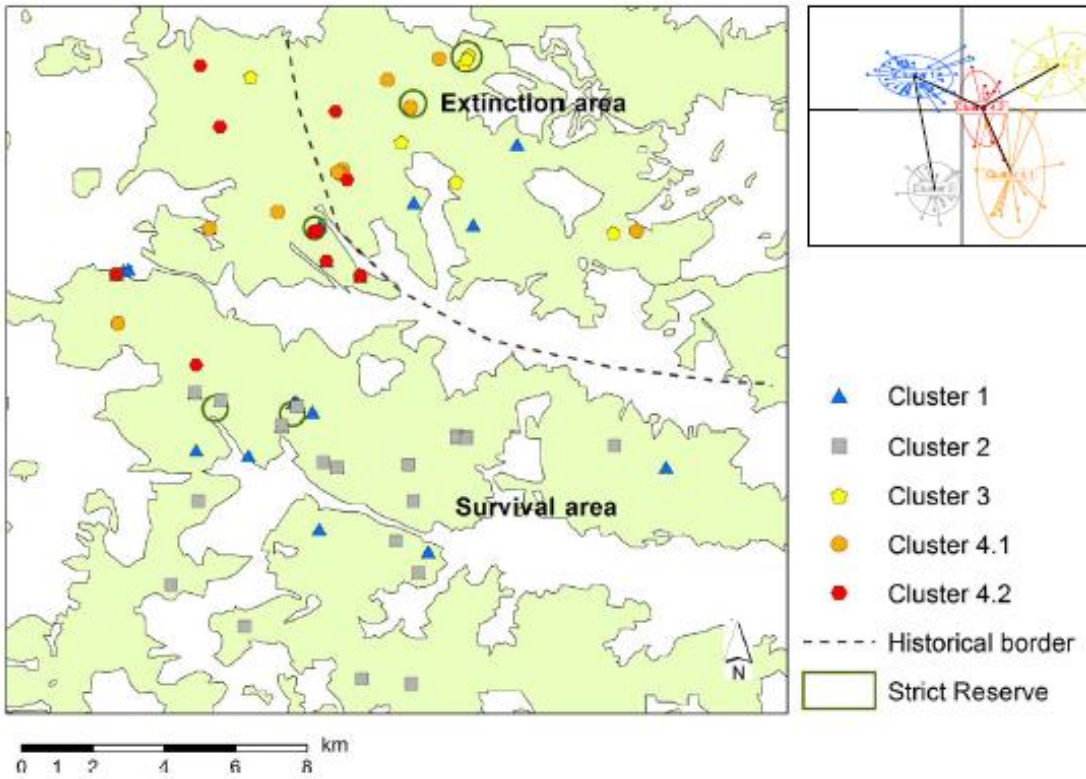


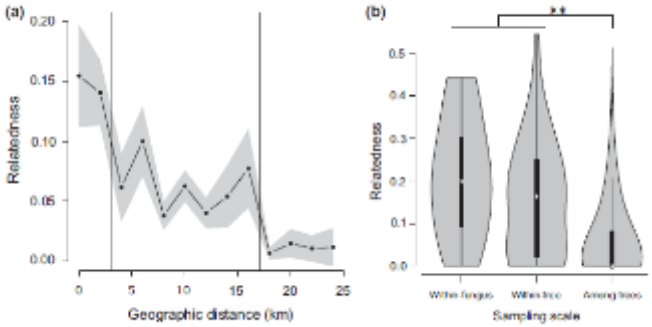




Seibold et al 2018 Ecology

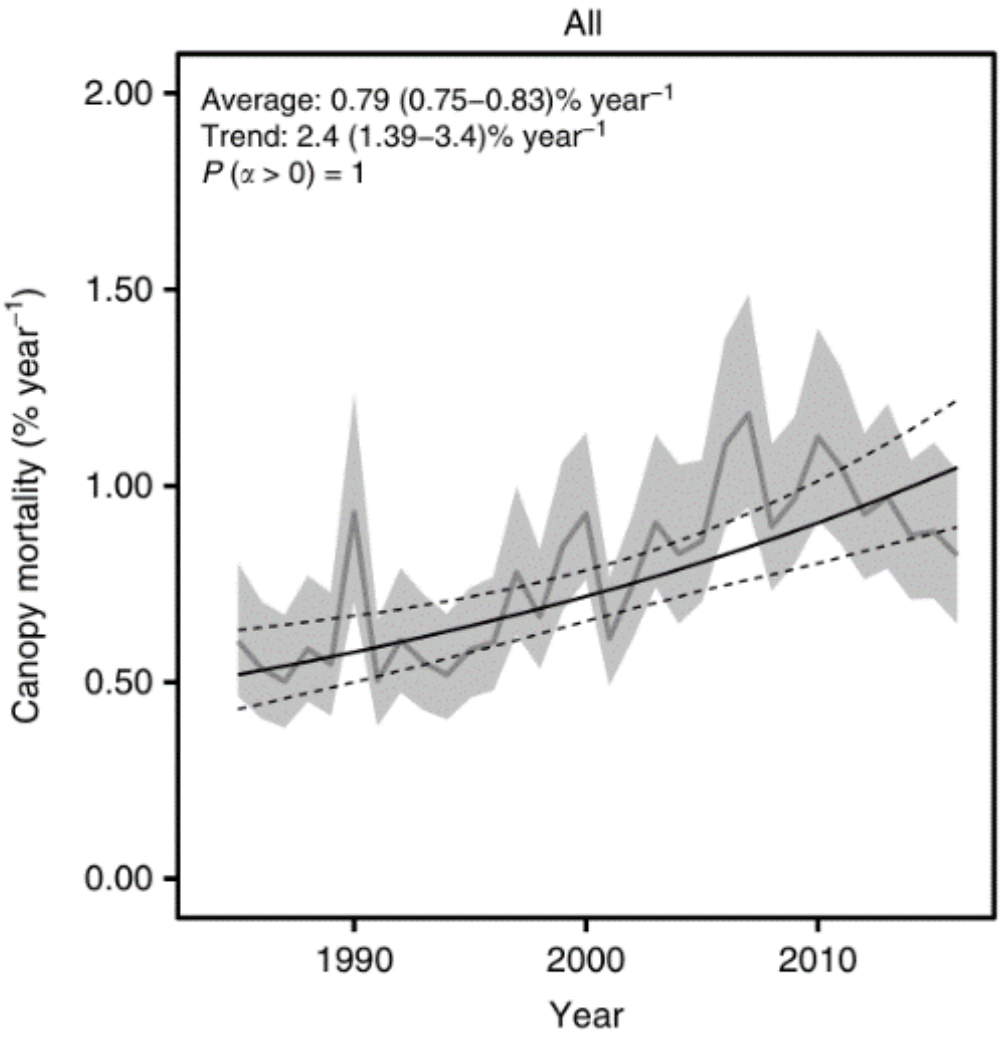
Die Rückkehr von *Bolitophagus reticulatus*





Zytynska et al 2018 J Appl Ecol

6. Die Chance in der Störung



Baummortalität steigt in Europa

Senf et al 2018 Nat Comm

6. Die Chance in der Störung

Preventing European forest diebacks

For centuries, forest management has tried to minimize the impact of natural disturbances in Central European forests by removing dead trees and by promoting continuous tree cover (*1*). The consecutive loss of forest gaps and deadwood structures has contributed to a decline in light-demanding tree species and a depletion of forest biodiversity, including the extinction of many specialized fungi and insects (*1*). Many of these forests have faced unprecedented diebacks due to drought, insect outbreaks, and wildfire triggered by extreme climatic events (*2*). In July, the German minister of agriculture called for a "clear-up followed by reforestation strategy" to address the troubled forests, supported by public subsidies on the order of hundreds of millions of euros (*3*). However, this policy increasing forest resilience to extreme weather events (*6*). By contrast, rapid reforestation creates dense, even-aged tree cohorts at high risk (*7*). Subsidies should promote diversity in tree species and age structure, as well as temporary forest gaps, while contemplating species' resistance to projected future climatic and disturbance conditions. This strategy would benefit economically important, light-demanding tree species and highly threatened insects simultaneously.

Past reforestation after natural disturbances was largely motivated by the need for future economic returns from timber, but it has contributed to forest diebacks (*8*). A radical shift is needed in the way disturbed forests are treated to adapt Central European forests to current and future conditions.

The rare longhorned beetle (shown here) thrives in deadwood, a result of bark beetle outbreaks.

Simon Thorn[1]*, Jörg Müller[2,3], Alexandro B. Leverkus[1,3]

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4. S. Thorn *et al.*, *J. Appl. Ecol.* **55**, 279 (2018).
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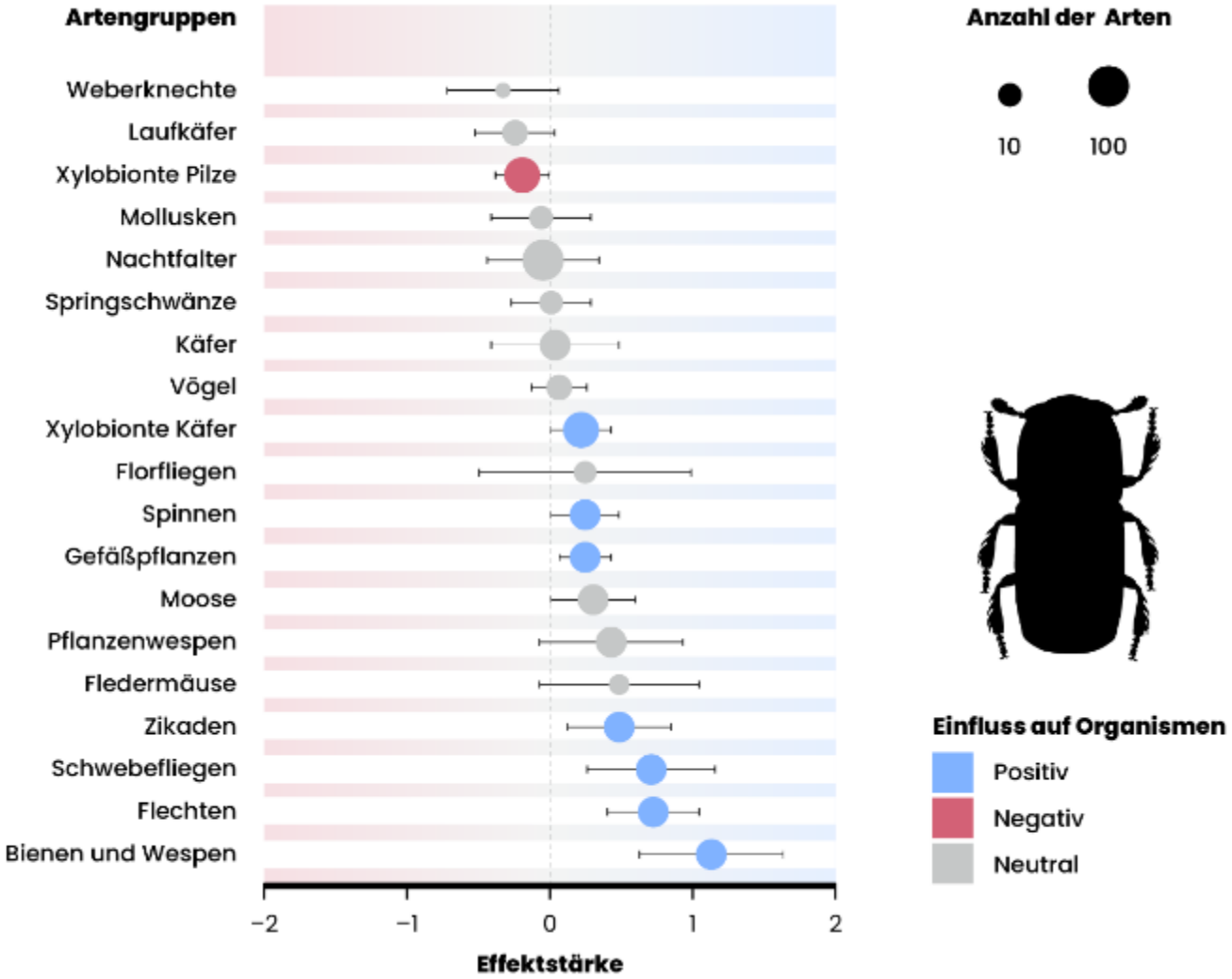
6. R. Seidl, D. C. Donato, K. F. Raffa, M. G. Turner, *Proc. Natl. Acad. Sci. U.S.A.* **113**, 13075 (2016).
7. K. L. O'Hara, B. S. Ramage, *Forestry* **86**, 401 (2013).
8. R. Seidl *et al.*, *Nat. Clim. Chang.* **7**, 395 (2016).

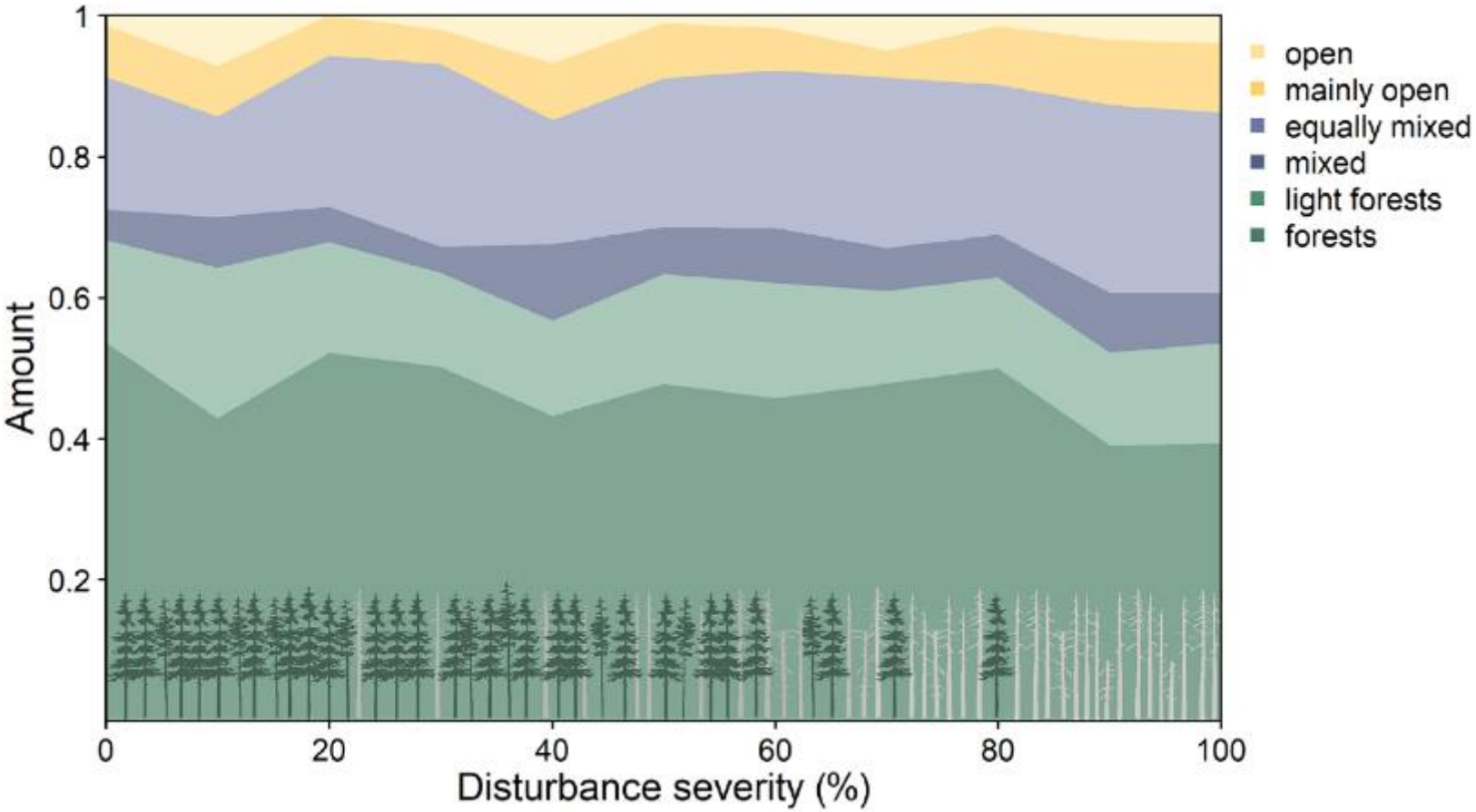
10.1126/science.aaz3476

Fichtenborkenkäfer: Das Ende der Artenvielfalt?



Beudert et al 2015 Conservation Letters

Fichtenborkenkäfer: Das Ende der Waldarten?

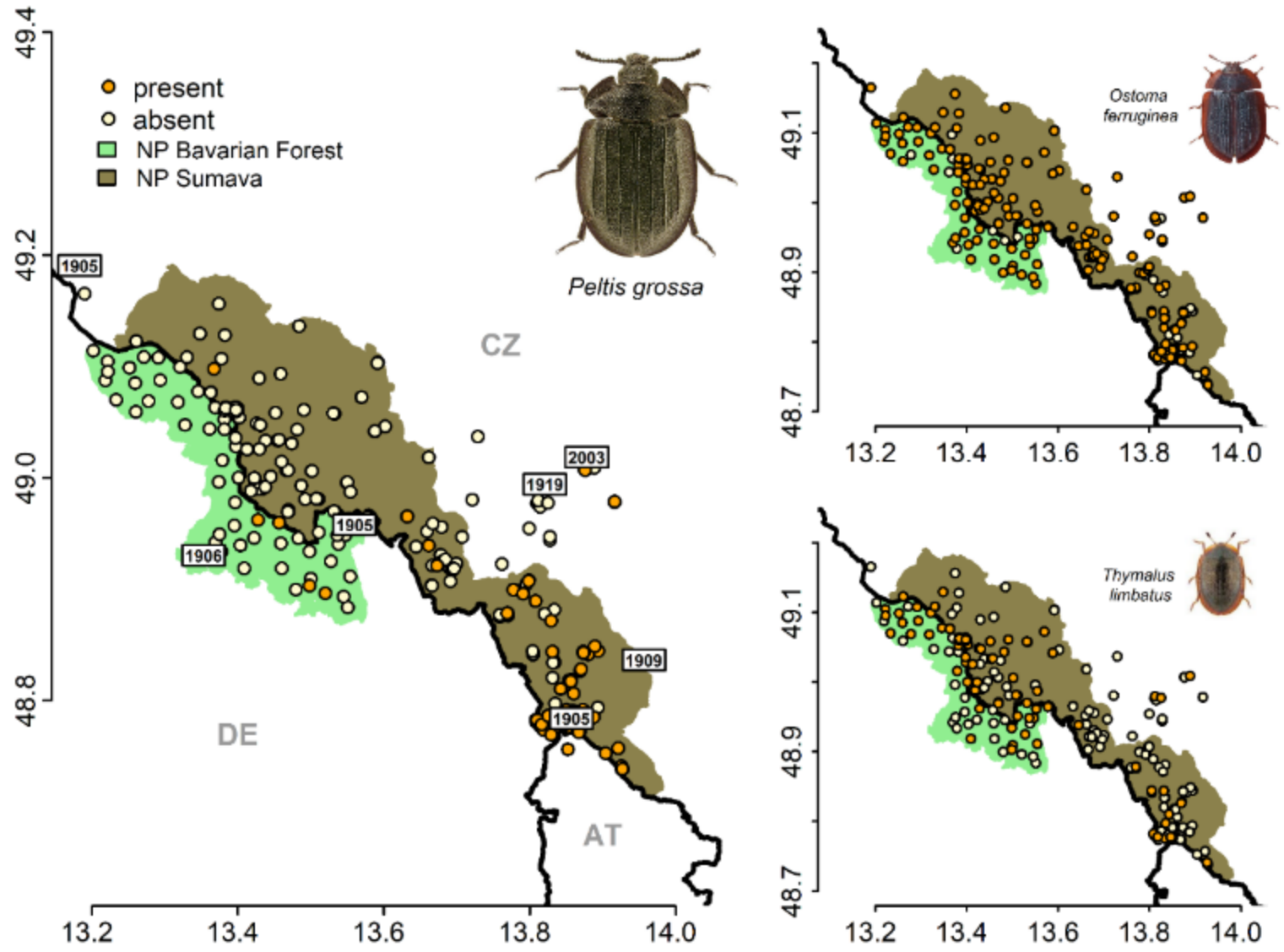


Kortmann et al 2024 Insect Conservation & Diversity

Die Rückkehr von *Peltis grossa* in den NP Bayerischer Wald

Busse et al 2022 Conservation Science and Practice

Die Rückkehr von *Peltis grossa* in den NP Bayerischer Wald



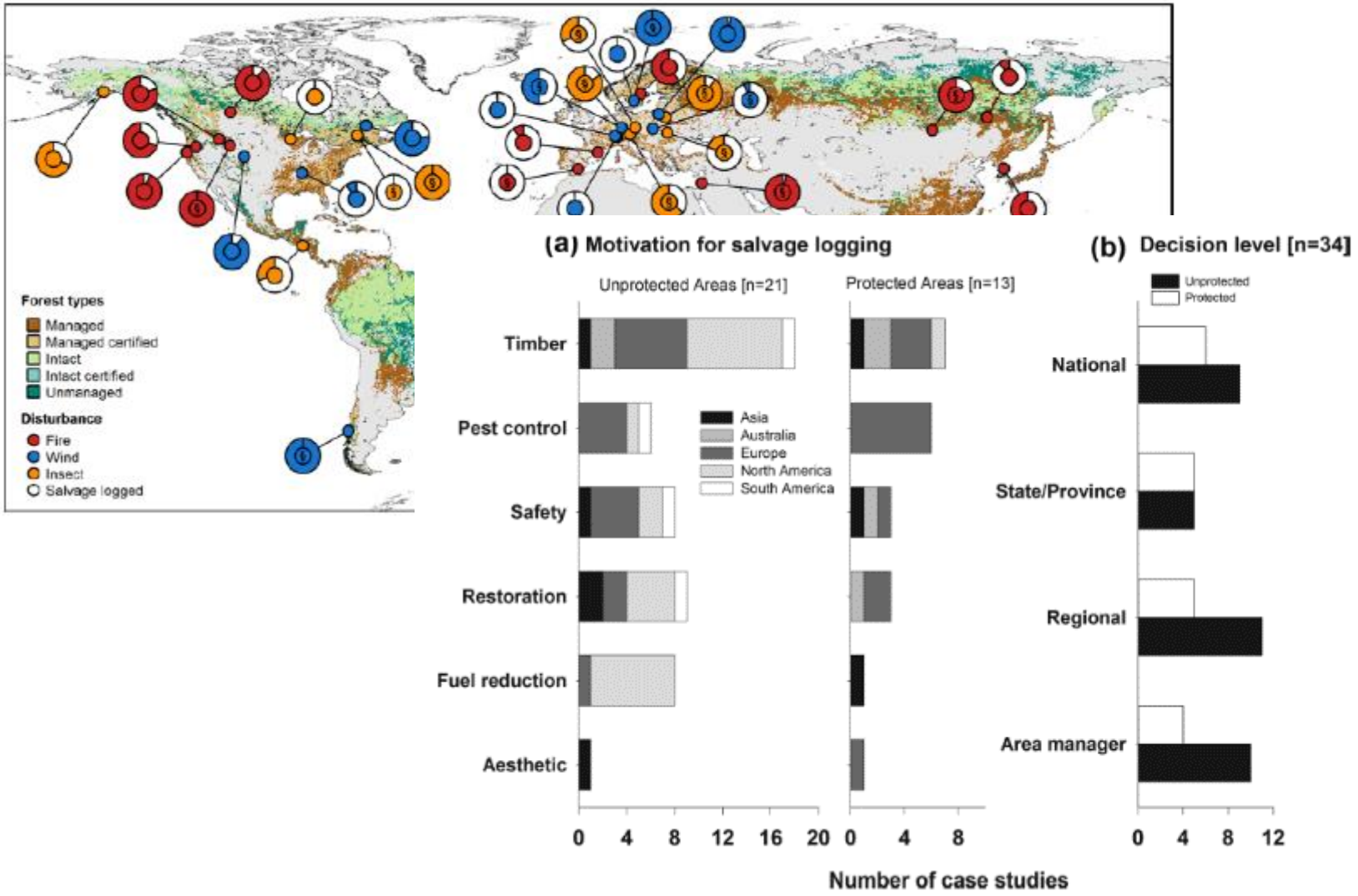
Busse et al 2022 Conservation Science and Practice

Mortalität in Eichenmischwäldern - Trendwende bei hochbedrohten Arten

Scharlachkäfer
Cucujus cinnabarinus

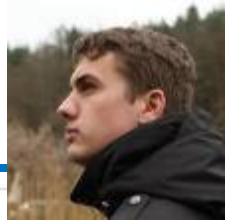
Bussler et al 2023 Nachrichtenblatt Bayerischer Entomologen

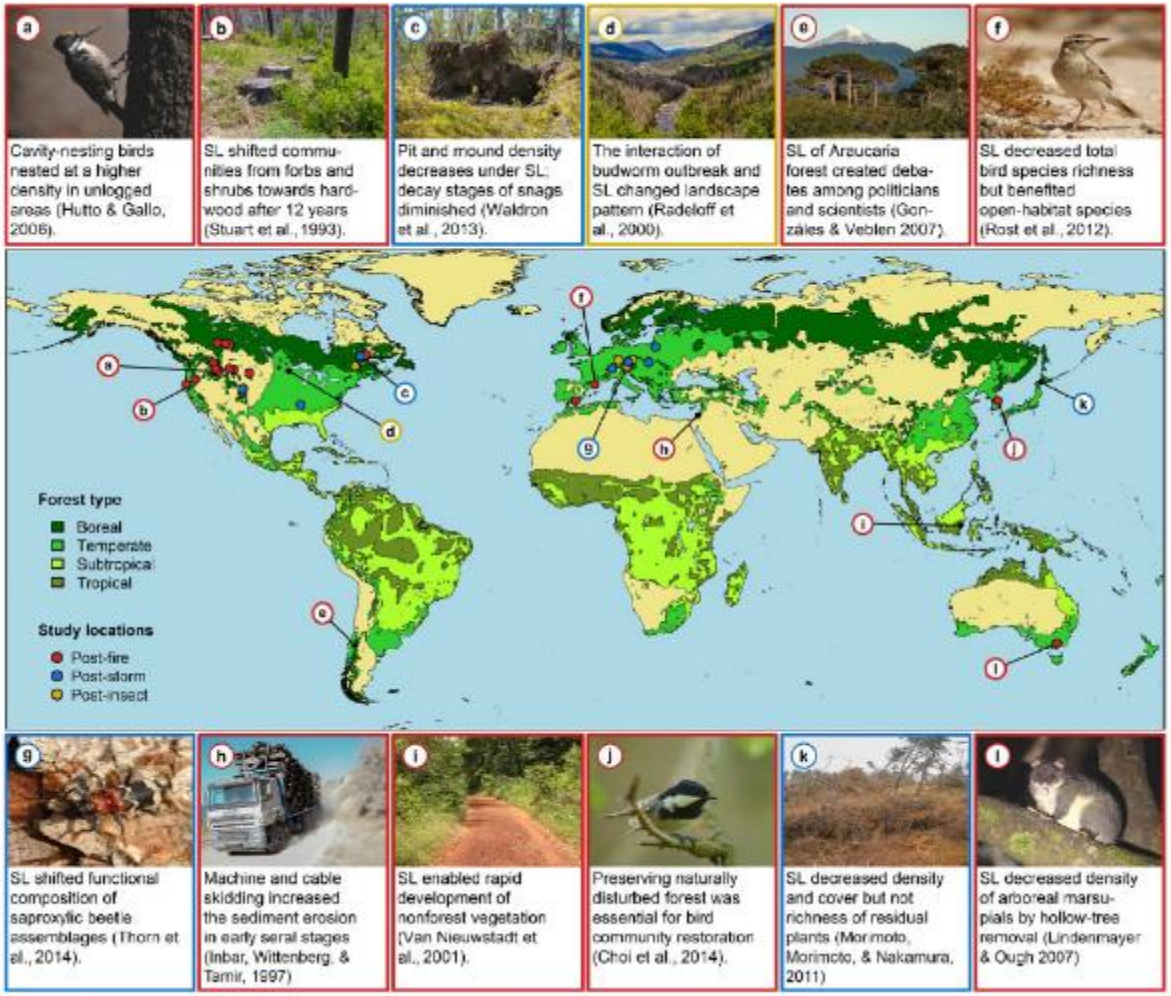
Salvage logging in Schutzgebieten weit verbreitet

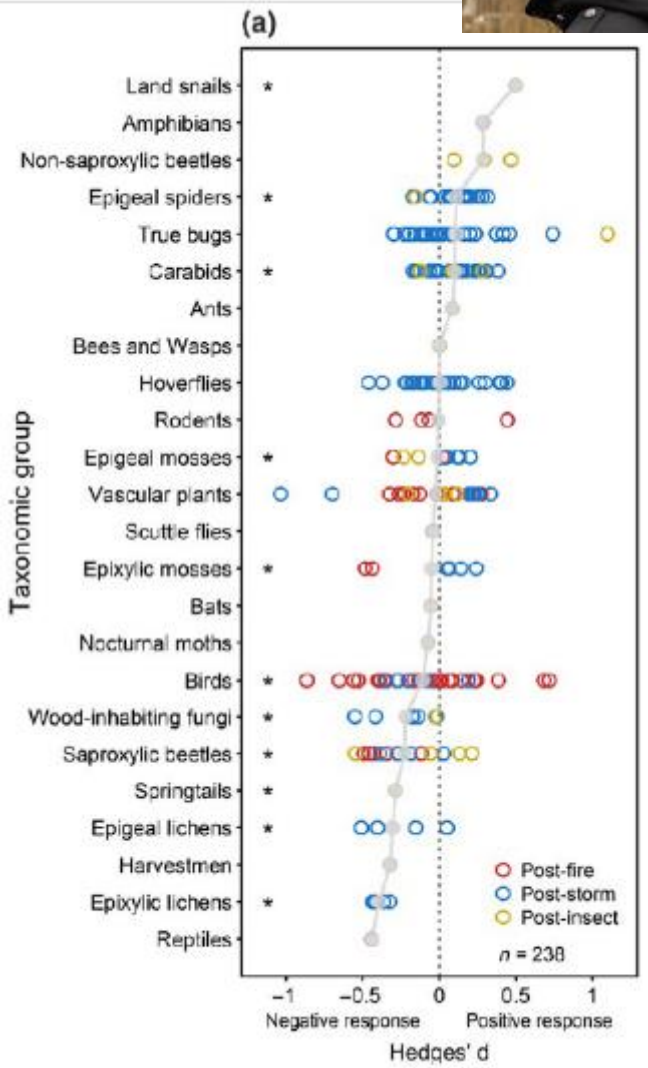


Müller et al 2020 Conservation Letters

Aufräumen schadet vielen Artengruppen

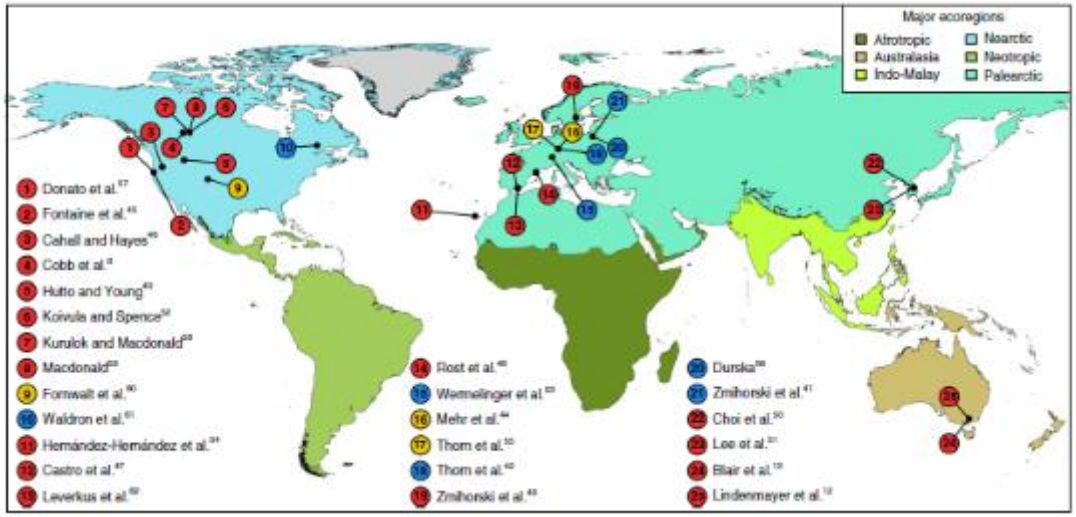


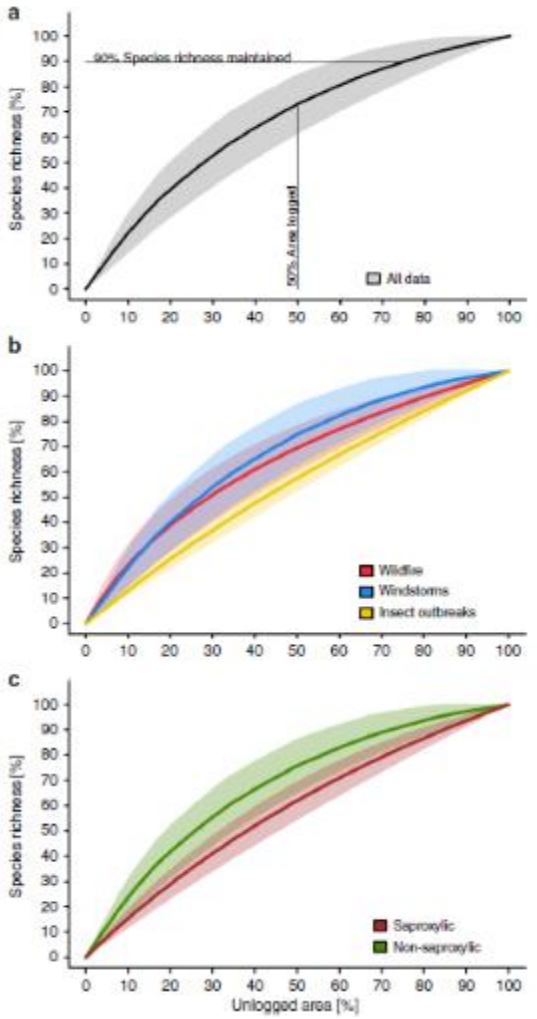




Thorn et al 2018 J Appl Ecology

Wie viel sollte liegen bleiben?

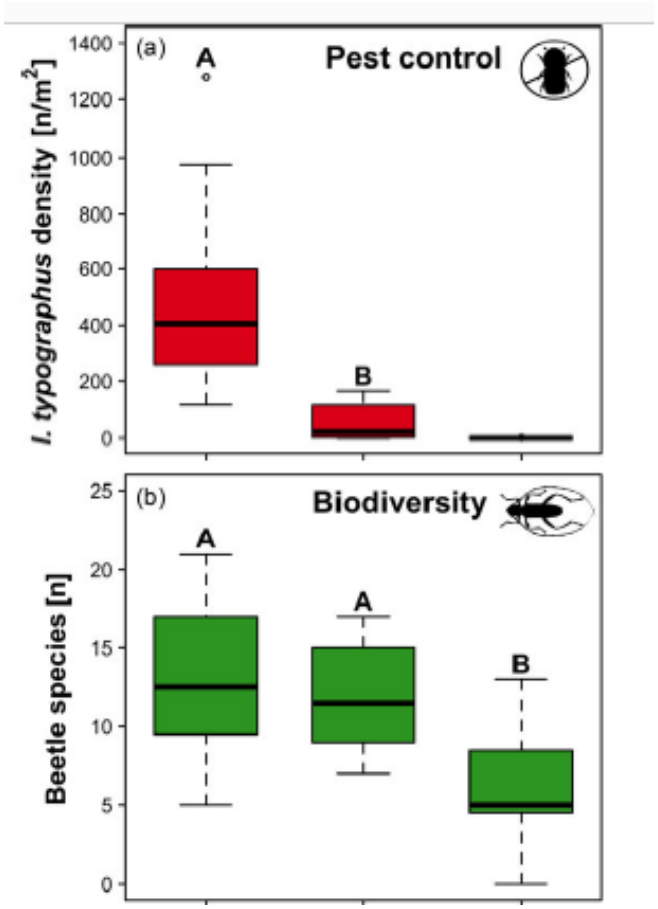




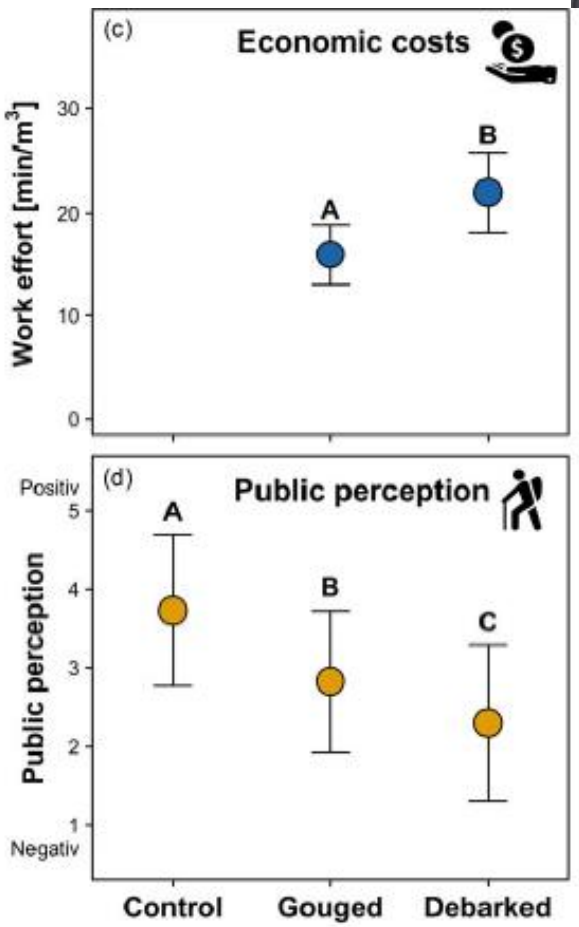
Thorn et al 2020 Nature Communications

Totholzanreicherung versus Forstschutz: Kompromisslösung Schlitzen statt Räumen oder Entrinden

Buchdrucker wird kontrolliert, Biodiversität bleibt hoch, Kosten sind geringer, Besucherwahrnehmung ist besser!



Kontrolle Gestreift Entrindet



Kontrolle Gestreift Entrindet

Hagge et al 2020 Conservation Letters

Totholzignoranz gefährdete Integrität der Wälder weltweit

Thorn et al 2020 Frontiers in Ecology and Environment

Öffentlichkeitsarbeit + Differenzierte Strategien