



Ecosystem services of changing forests: Monitoring and insights from LabForest

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1 Project outline

- Climate Change with increasing extreme events threatens resilience and productivity of forests
- *LabForest* includes a living lab in a forest of the Ludwig-Maximilians-Universität near Landshut (Bavaria, Germany)
- *LabForest* investigates forest management and disturbance impacts on ecosystem services by integrating (1) large-scale experiment with high-resolution measurements and (2) comprehensive, multi-scale modeling framework
- Three-factorial experiment (with/without advanced regeneration (factor 1), cleared sites/gouged bark (factor 2), planting/natural regeneration (factor 3)) (Fig. 1)
- Spatio-temporal monitoring combines in situ measurements of hydrology, microclimate, forest characteristics, and biodiversity with advanced remote sensing techniques
- These data streams inform economic, life cycle, hydrometeorological, biotic risk, and forest growth models to project future ecosystem services and feed into an multidimensional assessment matrix (see Poster 32)

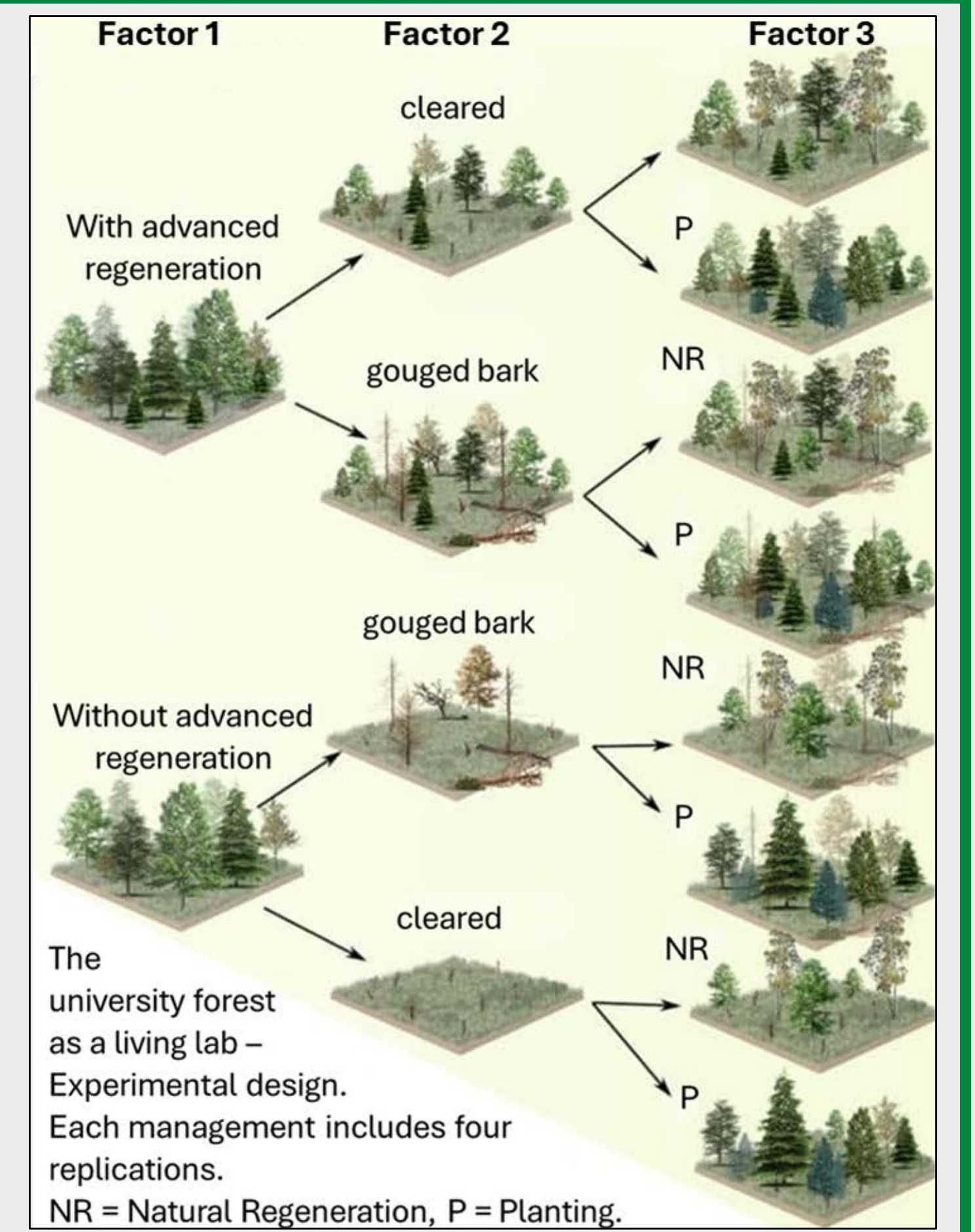


Fig. 1 Schematic representation of the three-factorial experimental design.

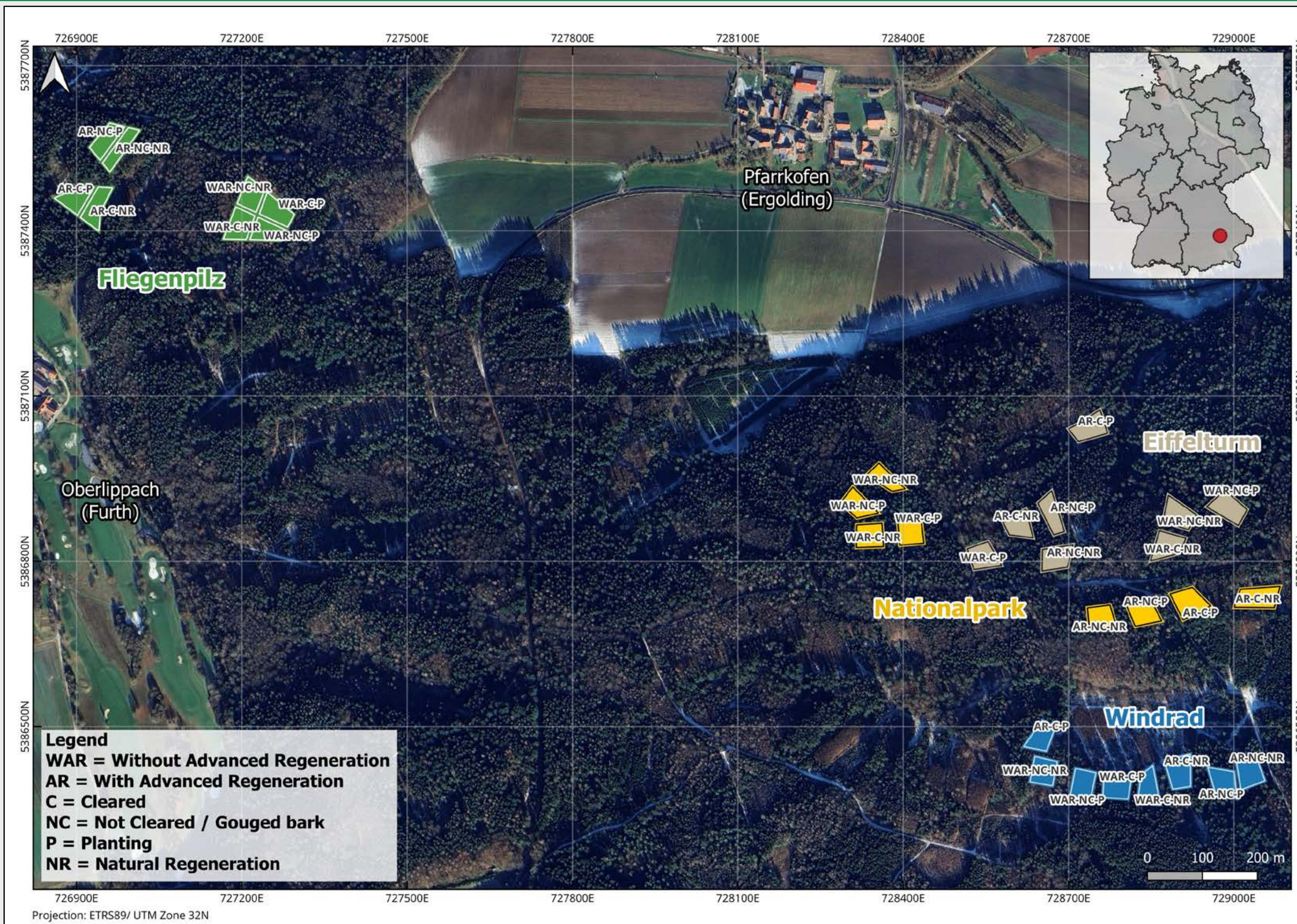


Fig. 2 Overview map of living lab in university forest. Spatial distribution of experimental plots (4 replications, each with 8 plots).

2 Monitoring

- Measurement network at all four test sites (four replications of eight experimental plots with ~0.25 ha) (Fig. 2)
- **Biodiversity:** Pitfall traps, flight-interception traps, Audio bird call recorders, camera traps, Vegetation survey, Fungi monitoring, solar insolation with hemispheric pictures
- In micro-catchment of *Eiffelturm* site more extensive hydrometeorological measurements & capturing of biogeochemical fluxes
- **Hydrometeorology:** Meteorological Station, Temperature & Relative Humidity at different heights, Soil Temperature & Moisture at different depths, PAR (\uparrow & \downarrow), Nitrate Soil Leaching, Gas Chamber Measurement of soil CO_2 & N_2O fluxes, Groundwaterlevel & Groundwaterquality at microcatchment outlet
- Additionally barkbeetle monitoring & remote sensing (see Poster 1 & 20)

3 Preliminary Results Biodiversity

- Beetles & bees higher species numbers without advanced regeneration
- Plants in herbaceous layer benefited from cleared sites
- Most fungi species on cleared sites with advanced regeneration
- Species numbers of spiders and birds constant among treatments (Fig. 3)
- Mean forest affinity of beetles FT & PT, & spider communities decreased with higher solar insolation (TSF), while forest affinity diversity increased
- Open-habitat species increase with higher TSF \rightarrow forest species remain present rather than being completely replaced
- Retention of deadwood has no effect on forest affinity (Fig. 4)

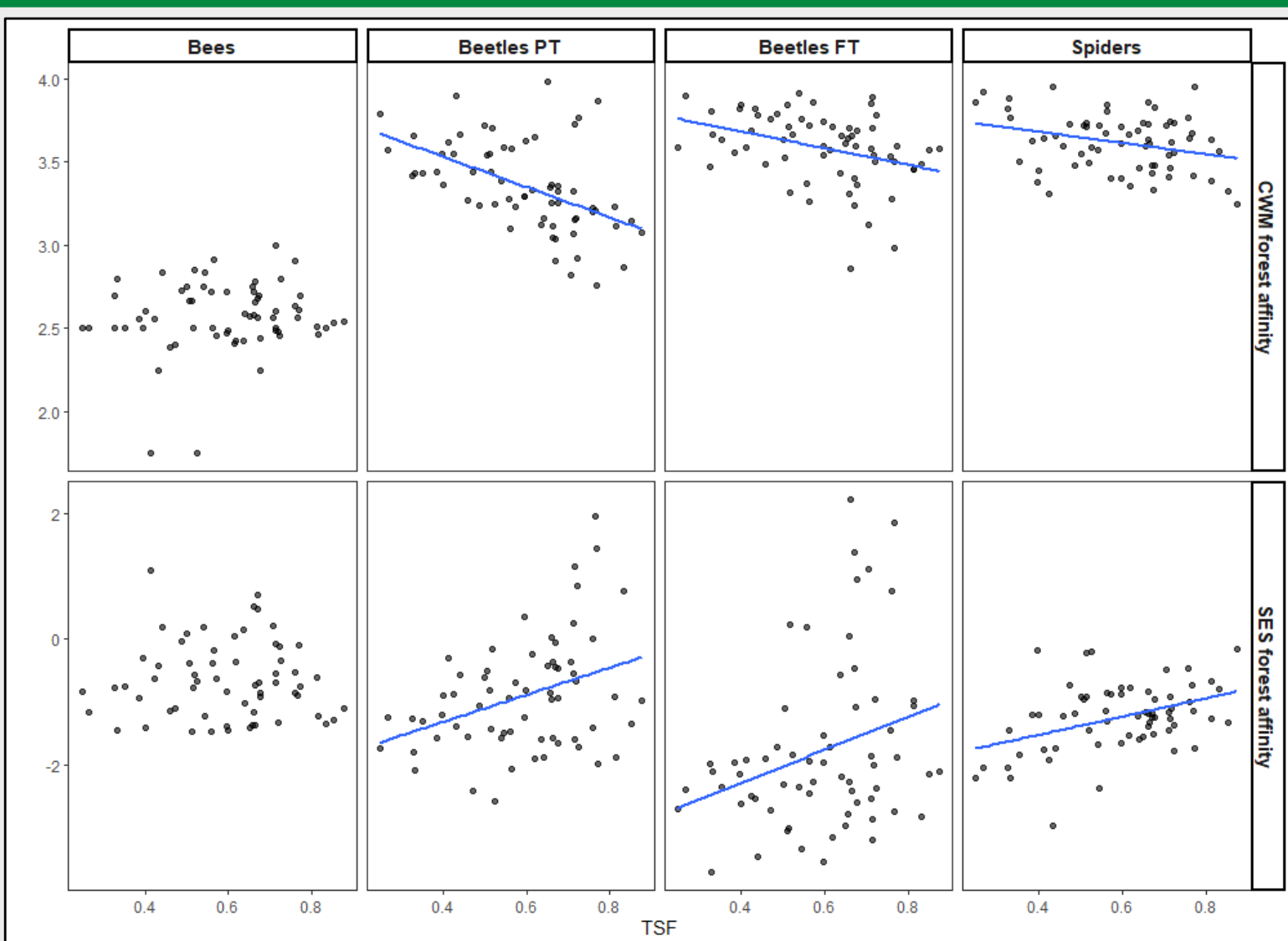


Fig. 3 Species numbers of beetles, bees, spiders, breeding birds, & fungi on different managed sites. Different letters indicate significant differences in species numbers between treatments based on pairwise comparisons of estimated marginal means.

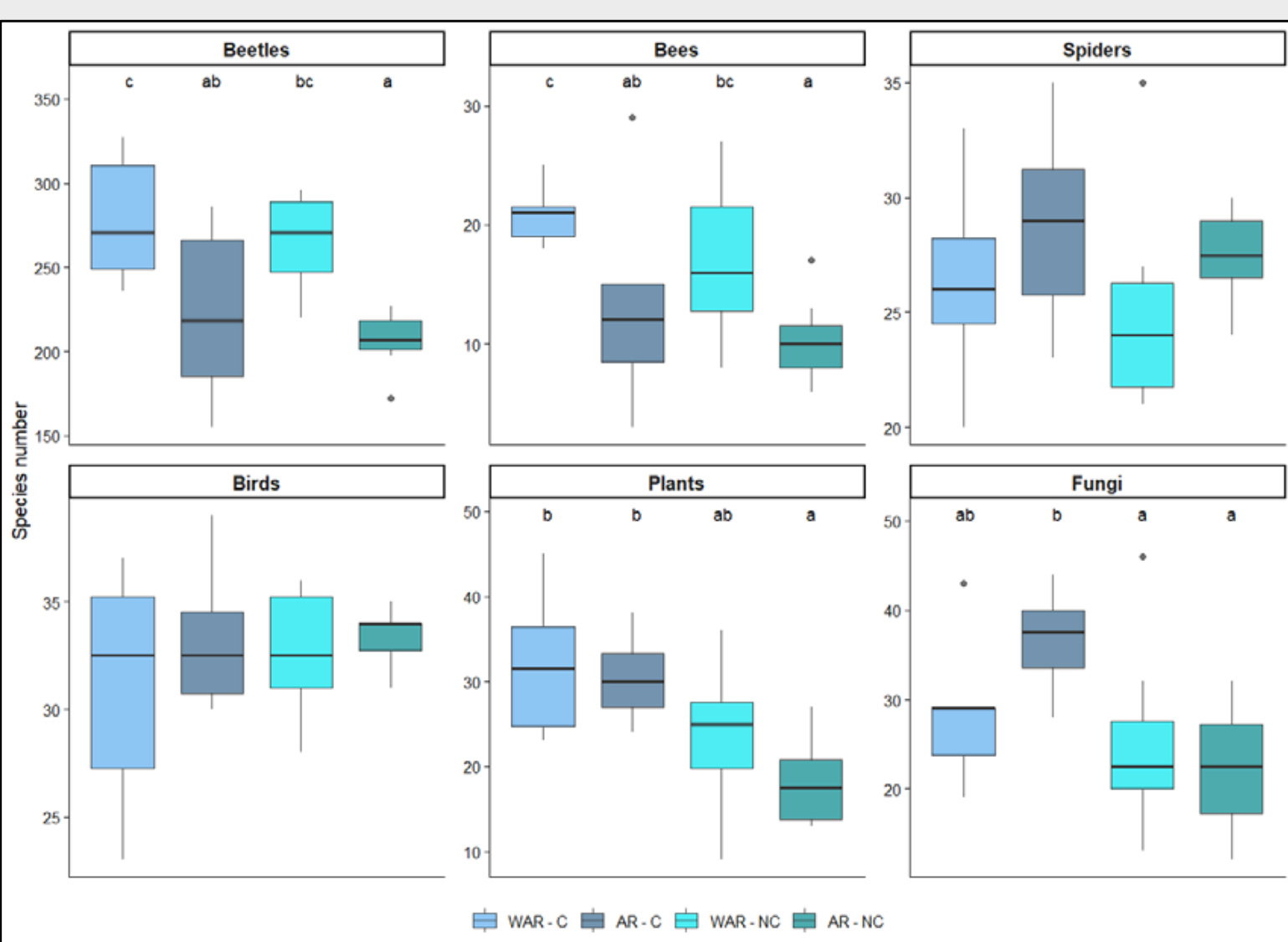


Fig. 4 Mean forest affinity (top) and forest affinity diversity (bottom) of bee & beetle communities from flight interception traps (FT), beetle communities from pitfall traps (PT), & spider communities depending on solar insolation (TSF) in percent.

4 Preliminary Results Hydrometeorology

- Mean & Maximum soil temperatures (-6 cm) are lower with reduced diurnal amplitude at uncleared compared to cleared sites
- These differences diminish above ground (+2 cm) & are negligible at +15 cm height
- Advance regeneration have weaker influence on soil & near-ground temperatures than complete clearing (Fig. 5)

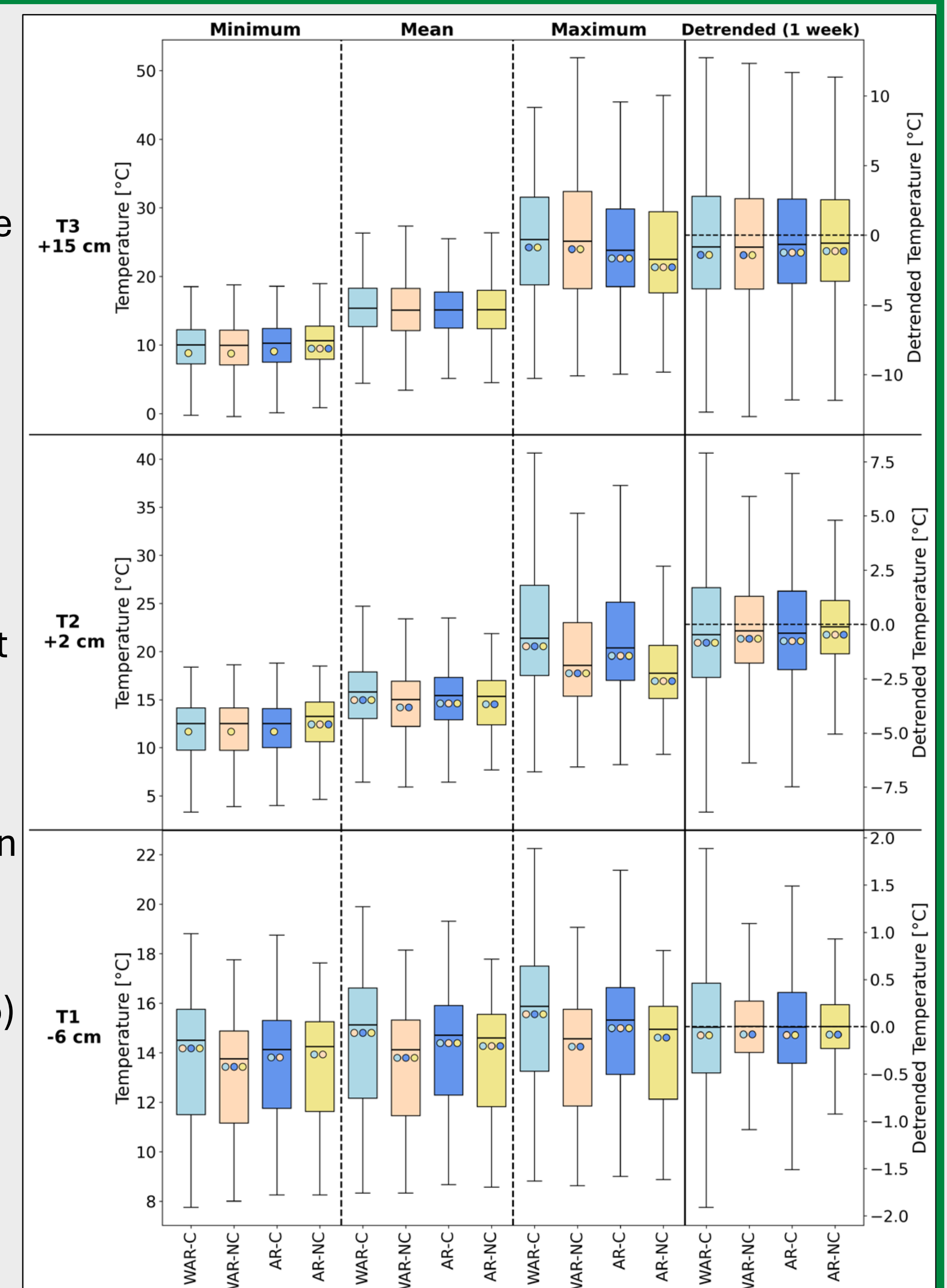


Fig. 5 Daily Minimum, Mean, Maximum and weekly detrended temperatures at (-6 cm, +2 cm & +15 cm) at Eiffelturm site (27.04. - 16.10.25). Colored dots in boxplots represent if significant different to other treatment.

