Assessing Forest Age Dynamics with Ecological Function in Urban and Peri-Urban Landscapes: A Case Study of Nagoya City

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Introduction

Urban and peri-urban forests provide critical ecological functions, including carbon sequestration, biodiversity support, and microclimate regulation, yet these services vary depending on forest age and landscape context. In fragmented, human-modified environments, younger forests often emerge in disturbed areas, while older forests contribute to ecological stability and resilience. Recent studies highlight the need for age-sensitive approaches to urban forest management that account for anthropogenic pressures such as roads and infrastructure development (Slagter et al., 2023; Bogachev et al., 2023). This part of study assesses the relationship between forest regeneration age, spatial fragmentation, and proximity to anthropogenic features in Nagoya City, Japan, to better understand how age dynamics shape ecological patterns in an urban landscape.

Experimental Procedures

Forest age groups were delineated through time-series analysis integrating Landsat imagery, high-resolution land use/land cover (HRLULC) data, and historical landcover maps. The groups were processed into vectorized regeneration polygons, from which centroids were extracted for spatial analysis. Proximity to roads was evaluated through multiple buffer zones, reflecting different levels of landscape accessibility and potential anthropogenic influence. Complementary ecological assessment was conducted using seasonal vegetation indicators to capture functional differences across forest age groups.

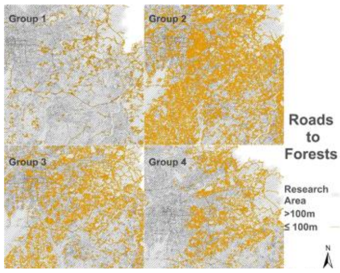

Figure 1 Roads within 100m to different age groups

Results and Discussion

This section presents the anthropogenic results, focusing on the proximity of forest age groups to roads, buildings, and traffic features (Figures 1–3). Roads showed the strongest influence across all buffers, while buildings followed similar patterns, and traffic-related features had the lowest overall adjacency. In every case, Group 2 forests were most exposed to infrastructure, reflecting regeneration on fragmented and disturbed parcels near developed areas. Conversely, Group 4 forests, although dominant in area, remained least exposed, consistent with their historical continuity. These spatial patterns suggest that younger, infrastructure-adjacent forests provide limited ecological stability, whereas older, less disturbed stands contribute more strongly to long-term ecological functions.

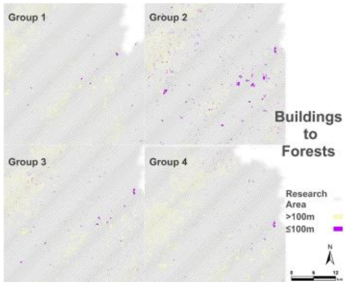

Figure 2 Buildings within 100m to different age groups

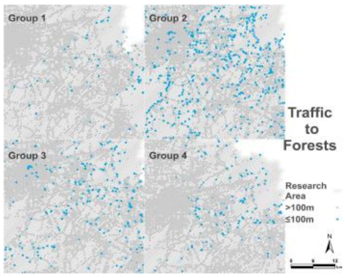

Figure 3 Traffics within 100m to different age groups

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References

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