EGU25-8555, updated on 22 Apr 2026
https://doi.org/10.5194/egusphere-egu25-8555
EGU General Assembly 2025

Coexistence Dynamics and Behavioral Analysis of Brown Bears (*Ursus arctos*) in Peri-Urban Forest Ecosystems

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Advancements in GPS radiotelemetry have facilitated the collection of extensive data on elusive wildlife species, including brown bears (Ursus arctos), for which direct observations are frequently impractical. Grounded in the premise that individual animals often exhibit temporally consistent behavioral traits, this study investigates habitat use, movement patterns, and resting behaviors of 50 brown bears inhabiting peri-urban forest ecosystems. In total, 61,562 GPS locations were recorded and linked to ecological covariates such as forest type, elevation, slope, land cover, forest biomass, deadwood availability, forest disturbance, and proximity to roads, water, impervious surfaces, and forest edges. The dataset underwent thorough cleaning to remove incomplete and erroneous points, followed by chronological ordering to capture diurnal and seasonal variability. Each location was classified into one of four seasons (winter, spring, summer, autumn) and further categorized into diel periods (dawn, day, dusk, night), adjusted according to season.

Movement analyses incorporated diel cycles, seasonal variation, sex, age, and the presence of cubs. Using clustering algorithms, we identified resting clusters and active movement segments at various spatial scales, subsequently quantifying home ranges across demographic groups and time frames. To ensure robust insights, large temporal and spatial gaps were omitted, and continuous trajectories were used to calculate key metrics, including travel time, distance, elevation change, and slope.

Mixed-effects models indicated significant seasonal and diel effects on bear velocity, with faster travel observed in summer and at dusk, and slower movement in winter and during daytime—particularly in higher-elevation and more rugged terrain. Although demographic factors (sex, age, presence of cubs) exerted limited influence on velocity itself, they were associated with variation in home range sizes and resting cluster distribution. By spatially linking GPS data and movement segments to ecological parameters, this investigation provides a comprehensive perspective on the interplay between landscape structure and bear behavior.

Through this integrative approach, our findings show both active and stationary bear behaviors in human-influenced habitats. By identifying critical periods and key habitats for resource acquisition and rest, these results may offer practical insights for conservation efforts and promote coexistence in peri-urban landscapes.