Comparative analysis of Camera Trap data to assess Red Deer and Wild Boar movement parameters in Gemenc area of Hungary

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Red deer (*Cervus elaphus*) and wild boar (*Sus scrofa*) are sympatric ungulate species in Central European forests, where understanding their temporal niche dynamics is important for both ecological research and wildlife management. While their general diel patterns are known, fine-scale behavioural plasticity, particularly in response to seasonal and annual environmental changes within the dynamic floodplain ecosystems, remains poorly documented. This study aimed to quantify and compare the diel activity patterns of red deer and wild boar in Hungary's Gemenc floodplain forest, with a specific focus on evaluating their seasonal, interannual, and photoperiod-driven behavioural plasticity.

Data were collected over three autumn-winter seasons (2022-2024) using a systematic grid of motion-activated camera traps, following the standardised ENETWILD protocol. A post-hoc 30-minute independence filter was applied to the raw sequence data in R to generate an appropriate dataset for temporal analysis. Activity patterns were analysed using kernel density estimation, overlap coefficients (Δ_4), circular statistics and linear regression to address the study's four main objectives.

The results revealed a highly significant difference in the diel activity patterns between the two species ($p < 0.001$). Red deer exhibited a predominantly crepuscular pattern, while wild boar were strongly nocturnal. Despite these distinct peak activity times, the overall temporal overlap was high ($\Delta_4 = 0.82$, 95% CI: 0.79-0.86), indicating co-occurrence during transitional crepuscular hours. Both species demonstrated significant behavioural plasticity. Seasonally, the activity patterns of both species changed significantly from October to December ($p < 0.01$). This was seen by a broadening of the activity window into diurnal hours for red deer, while wild boar showed a trend towards more consolidated nocturnal activity. Contrary to

expectations of reduced winter movement, overall trap rates for both species increased significantly in December. Furthermore, activity patterns for both red deer and wild boar differed significantly between 2022 and 2023 ($p < 0.001$), highlighting their capacity to respond to annual variations in environmental conditions. Finally, activity was strongly coupled with photoperiod; evening activity for both species was significantly correlated with sunset times ($p < 0.001$), whereas the relationship with sunrise was more varied.

In conclusion, this study reveals that red deer and wild boar in the Gemenc floodplain coexist through a combination of temporal niche partitioning and discernible behavioural plasticity. This flexibility in response to seasonal, annual, and photoperiodic cues suggests that their temporal behaviour is not fixed but is continuously shaped by energetic needs, reproductive strategies, and (likely) avoidance of human disturbance. These findings have direct implications for evidence-based wildlife management, particularly for scheduling hunting activities and developing strategies to mitigate human-wildlife conflict.