

Spatial organization and population dynamics of a recolonizing wolf population are affected by the presence of an introduced ungulate species, the fallow deer *Dama dama*

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The gray wolf *Canis lupus* was extirpated from western Poland, but since enforcement of strict protection in 1998 recolonized most of the suitable habitats. One of such recently recolonized areas is Tuchola Forest, a large forest complex in north-western Poland, where an alien medium-sized ungulate species, fallow deer *Dama dama*, was introduced for hunting purposes. Highest fallow deer density (on average 30-40% of the ungulate community, locally up to 60%) occurs in the south-eastern part of the study area (where cumulative ungulate biomass is also the highest) and it gradually decreases towards the north-west. Using a combined approach involving (i) non-invasive genetics, (ii) identification of wolf core areas and reproduction sites by camera trap surveys and tracking, and (iii) camera trap-based occupancy analyses, we studied demographic dynamics and spatial organization of the local wolf population and investigated if they are shaped by the fallow deer density. The wolf population in the study area increased from one family group in 2011/12 to 14-15 groups in 2022. Interestingly, the breeding pair from the pioneer pack (that settled in the high fallow deer abundance zone) survived until 2021, producing at least ten litters of pups and in consequence contributing to a local founder effect revealed by genetic analyses. The nearest neighbor distance between core areas of wolf territories was the lowest (10.1 km) in the south eastern part of the study area. Moreover, we found a positive correlation between the fallow deer abundance and the rate of the predicted territory overlap between adjacent packs. Importantly, the high density of wolf family groups in the south-eastern region could not be explained by other factors such as lower anthropopressure, as road density and share of urbanized areas are in this area higher, while forest cover percentage is lower, than in the north-western part. On the other hand, we found no significant relationship between fallow deer abundance and wolf family group size in winter or number of pups per pack in summer. Thus, we suggest that the main effect of high abundance of the introduced fallow deer is the increase of the number of family groups.



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