Human-animal conflicts and social dimension

Spatiotemporal patterns of wildlife-vehicle collisions on the Slovenian highways

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We studied species composition, monthly patterns and linear collision hotspots (using KDE+ methodology) of roadkill of large and medium sized mammal species (European roe deer (*Capreolus capreolus*), red deer (*Cervus elaphus*), wild boar (*Sus scrofa*), brown bear (*Ursus arctos*), golden jackal (*Canis aureus*), red fox (*Vulpes vulpes*), European badger (*Meles meles*), and brown hare (*Lepus europaeus*)) along 778 km of Slovenian fenced highways in the period 2018-2020. In the three-year period, we registered in total 2046 roadkill cases, with red fox (N=790; 39.6%), roe deer (N=592; 28.9%), and European badger (N=423; 20.7%) being the most exposed species. The finding that red fox was the most vulnerable mammal species considering highway roadkill strongly contradicts to registered wildlife roadkill on all Slovenian roads (including highways), where the number of road-killed roe deer in the same period (2018-2020) was fourfold higher in comparison with the roadkill of red fox. The high rate of red fox roadkill found in our study suggests their ability to access highways below or through damaged fences, which is consistent with findings from other Central European countries as well as with our own field inspection at Slovenian highways. On the other hand, fences were quite effective in keeping ungulates out of the highways.

We analysed the monthly distribution of roadkill for four species (roe deer, red fox, European badger, brown hare), which accounted for 97% of recorded vertebrate roadkill on highways. Temporal collision patterns with evident species-specific monthly peaks reflect the behaviour and activity of studied species, however with some exceptions (roe deer, badger) compared to previous studies. For example, we observed a significant variation in the monthly distribution of roe deer roadkill, with a pronounced peak in spring, but secondary peak in summer/autumn was not registered at Slovenian highways. Obviously, fences along highways effectively block roe deer wandering across highways in summer and autumn, while they are not so effective during much more intensive spring movements due to social restructuring, i.e. establishing territories, or dispersion of yearlings. Further, bimodal pattern of roadkill of badger at Slovenian highways was not detected, showing that either adults reproducing in summer/autumn or the later-born offspring have different movement behaviour, i.e. they have lower need to cross highways in comparison with the springtime. The yearly roadkill of red fox shows bimodal pattern: the two peaks occur in January and during late summer to autumn. Reported roadkill of brown hare was the least frequent and has almost uniform temporal distribution across months.

We identified 268 KDE+ hotspots, accounting for 48.5% of all roadkill and covering 9.3% (72.6 km) of the highway network. Recognising these hotspots is crucial for implementing the most effective mitigation measures to reduce wildlife vehicle collisions. Indeed, the identified hotspot locations may enable decision-makers to select and implement the most effective mitigation strategies.