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#4 New approaches to avoiding and mitigating the effects of streetlighting on bats

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Artificial light in the nighttime environment has increased massively over the last 50 years, with much of this increase being derived from road lighting. Many species of bats are highly light averse, but must travel large distances to reach foraging and roosting areas. Streetlights have been shown to adversely affect bat behaviour close to roosts, however the implications of lighting in the wider landscape are less clear.

Greater and lesser horseshoe bats are given strong protection under Annexe II of the habitats directive. This means that there is an obligation to ensure that new linear infrastructures, or changes to existing ones, do not impact on local bat populations. Using extensive acoustic surveys in paired lit and unlit locations in the UK, we have shown that bat activity is significantly depressed in lit locations across the landscape. Further, the effects of light interact with those of road type, with lights on minor roads have a greater impact than those on major roads. This suggests that the current focus of resource towards monitoring and mitigating for lighting on major roads may be misplaced.

To assist planners in understanding and avoiding these negative impacts of these road-related pollutants, we have developed a spatially explicit modelling system, based on Circuit-theory, which enable users to assess the impacts of roads of different types, and of potential mitigation measures, on the movements of bats. Finally, we have also formally assessed, through controlled experiments at 6 study sites in the UK, the potential value of red, rather than white, LED streetlights as a mitigation technique in situations where street lighting cannot be avoided entirely.

KEYWORDS: Lighting, Bats, Modelling, Spectral composition, Mitigation

#5 Effects of roads on European badger occurrence in intensively used Mediterranean farmland

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Understanding how transportation infrastructure affects wildlife is a key goal in conservation biology. This goal is particularly relevant in intensively used landscapes, where species are potentially impacted both by roads and the scarcity of suitable natural habitats. We investigated how road density and landscape composition and configuration affect the occurrence of the European badger (*Meles meles*) in intensively used Mediterranean farmland. Although most studies documenting road impacts on carnivores species in Mediterranean areas have been largely focused on the factors driving mortality at roads or habitat use near and far from roads, few have explicitly assessed how road density impacts species occurrence, particularly in intensively used farmland, where their preferred native woodland habitats are relatively scarce. Based on badgers' presence signs surveys conducted in three occasions (spring, summer and autumn) across 60 landscape units (3.14-km^2 circles) scattered through SW Portugal, we used occupancy-detection modelling to quantify the effect of paved road density on the occurrence of the species in intensively used Mediterranean farmland. In addition, we tested the prediction that forestry plantations and hedgerows embedded in the agricultural matrix should in turn result in increased probabilities of badger occupancy, as these habitats should provide substitute refuge areas for the species. According to our predictions, badger occupancy significantly decreased with increasing paved road density, and increased with increasing amount of forestry plantations and arboreal hedgerows. These results suggest that badger conservation in intensively used Mediterranean farmland requires the protection of areas with low road density, and the retention of wood cover, even where these are mostly forestry plantations and arboreal hedgerows.

KEYWORDS: Agricultural landscapes, Carnivores, Land use cover, Road effects, Tree plantations