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Effects of roads on small-mammal movements: Opportunities and risks of vegetation management on roadsides

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ABSTRACT

Roads can block animal movement and reduce persistence of species living in road surroundings. Movement restrictions on local populations may even increase extinction risk of abundant small mammals. However, road verges (road managed area between the edge of the road and the beginning of private land) may provide refuge and corridors for small mammals when properly managed. Information on the effects of roads and roadside management on small-mammal movement is still scarce for low traffic roads (<20,000 vehicles per day) crossing well-preserved habitats. We aimed to fill this gap by comparing fine-scale movement patterns of wood mice (*Apodemus sylvaticus*) in a road and in a similar roadless area without management. Both areas consisted of a well-preserved Mediterranean agro-silvo pastoral system. We studied several movement patterns: road crossings, verge use, length, and direction of movement. Additionally, we assessed how roadside management, animals' sex and residency status, season and microhabitat affect movement at the road area. At the roadless area, we defined a virtual road and verges at equivalent locations to the road area for comparison purposes. We gathered capture-mark-recapture data for two years to characterize movement patterns. Wood mice tended to avoid the road by crossing it less often and moving away from it more frequently than from equivalent locations in the roadless area. Wood mice used road verges more frequently than virtual verges and moved more often parallel to the road than to the virtual road. Road crossings were more frequent after firebreak openings (strips of mowed land) in surrounding areas and near taller shrubs. Also, males used road verges more often than females. Differences on several movement patterns between areas and their trends within the road area can be explained mainly by the presence of the road and roadside vegetation management (e.g., firebreaks openings). We suggest roadside vegetation management practices (e.g., avoid land mowing; maintain vegetation strips) to promote the role of verges as refuges and/or corridors for small mammals.

1. Introduction

Roads are among the ten major threats to biodiversity worldwide (Maxwell et al., 2016) and road networks are expanding rapidly (Laurance et al., 2014). The road network in Europe is already substantial with half of its area being less than 1.5 km away from a transportation

infrastructure (Torres et al., 2016). Therefore, mitigation of road effects on biodiversity will become essential tools to fulfil United Nations' Sustainable Development Goals (Ibisch et al., 2016).

Among many harmful effects, roads contribute to habitat loss and fragmentation, which are main causes for species decline and extinction (Forman et al., 2003; Fahrig and Rytwinski, 2009; Benítez-López et al.,

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