



Bad moon rising? The influence of the lunar cycle on amphibian roadkills

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Abstract

Annually, roads, and their associated users, are responsible for millions of roadkills worldwide. Mortality affects multiple taxonomic groups, but amphibians are particularly vulnerable, due to their size and underreporting. In fact, very high mortality frequencies can occur, mostly during short periods of time, when individuals migrate to and from reproduction areas (e.g., ponds). In this study, we assess the influence of the lunar cycle on amphibian roadkills, while accounting for weather conditions. As expected, the main environmental effects explaining roadkill numbers were weather related, with increases in minimum air temperature, average relative air humidity, and cumulative rainfall during the previous 24 h having a positive effect on roadkill numbers for all studied species. However, the lunar cycle also affected roadkills for two of the studied species. Darker nights had higher numbers of roadkills of *Pleurodeles waltl*, while moonlit nights had higher numbers of *Salamandra salamandra*. As such, these moon effects are species specific. Animals that are more active in moonlight may be at an advantage if their visual acuity is better than that of their predators. We hypothesize that differences between species in the response to moonlight may be due to differences perceived in predation risk. This information should be considered when designing mitigation measures. Volunteer actions, for instance, can be planned and coordinated keeping in mind the most appropriate weather conditions for the general amphibian community and specific phases of the lunar cycle for particular species.

Keywords Lunar effects · Migration · Moonlight · Roads · Weather conditions

Introduction

The threat posed to biodiversity by linear infrastructures, including roads and railways, is widely acknowledged in the scientific literature (Seiler and Helldin 2006; Coffin 2007;

Benítez-López et al. 2010; van der Ree et al. 2015; Richardson et al. 2017; Santos et al. 2017). In particular, road networks have three mainly reported negative impacts (van der Ree et al. 2015): (i) indirect landscape effects (habitat degradation or loss and barrier effect); (ii) direct mortality (e.g., roadkill); and (iii) avoidance behavior, due to the high disturbance caused by the road traffic to its surroundings. By comparison, some positive effects have been reported. In fact, some species find the road margins an attractive and suitable habitat as in the case of several birds (reviewed in Morelli et al. 2014) and small mammals, like the Cabrera's vole (*Microtus cabreræ*) in studies conducted in Portugal (Santos et al. 2007a) and the common vole (*Microtus arvalis*) and crowned shrew (*Sorex coronatus*) in studies in France (Redon et al. 2015). Moreover, some studies have documented the use of road verges as preferential movement corridors such as for the hazel dormouse (*Muscardinus avellanarius*) in Germany (Encarnação and Becker 2015). However, this attraction to road surroundings may also transform the road into an ecological trap, leading animals to suffer increased mortality (Morelli et al. 2014), with the positive effects of roads resulting in negative consequences.

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