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Assessing the Stone Marten’s Patch Occupancy in Fragmented Landscapes and its Relation to Road-Killing Occurrences

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Abstract

Habitat loss and fragmentation is generally considered to be the greatest threat worldwide to the survival of species. Habitat fragmentation is a process generally regarded as comprising three major components: reduction in total area, increase in isolation, and reduction in average size of patches of remnant natural vegetation. Today’s land use practices and road network’s expansion strongly promote habitat fragmentation reducing the habitat availability and its connectivity, which is assumed to strongly influence species occurrence and population survival in fragmented landscapes. Although several studies demonstrated the negative impact of habitat fragmentation, few focused in carnivore species, and particularly in Mediterranean environments. Carnivores’ position in the top of the food webs and their vulnerability to different human activities make this group especially significant in conservation and management actions. Our goal in this study was to assess the influence of human-related variables on the carnivore’s probability of occurrence, according to habitat patch size and isolation, and road network characteristics. Stone marten Martes foina was selected as the model species to investigate the response to cork oak woodland fragmentation, considering that forest dependent species would show a stronger response. Marten species are known to be sensitive to forest fragmentation, although there is some evidence that their response is mainly determined by the level of forest fragmentation and the matrix quality, due to their preference for structurally complex forests to avoid competition and increase den availability.

We compared the stone marten response to scent stations located in four large and continuous forest patches (mean 36000 ha, 19 sampling sites) and in 25 smaller and isolated forest patches (mean 2.67 ha, one sampling site). For each sampling site a variable number of scent stations was used (average=11, min=7, max=17) depending on the patch size. Using the software PRESENCE we developed models that best fit stone marten probability of presence. This method parallels a closed-population mark–recapture model with an additional parameter (Phi) that represents the probability of species presence. Also, it enables the introduction of covariate information using a logistic model for Phi. Nine human and road related variables were used to develop models that best fit stone marten probability of occurrence in the smaller and isolated patches. The best models were selected using the Akaike Information Criteria. Each variable importance was assessed by summing the AIC model weights (w) in which it was included. A data set of eighty stone marten road-kill locations and of eighty points randomly distributed along the sampled roads was used to evaluate if there were significant differences (one factor ANOVA), regarding the models’ most important variables on the road casualties locations.

Results suggest that the probability of presence of stone marten in larger and continuous patches was 90%, while for the smaller and isolated patches it decreases to 60%. Nine significant models were retained. Models evidenced that the probability of presence of stone marten in isolated patches is related to cork oak density (+) (w=0.73), distance to nearest patch (-) (w=0.67), distance to nearest large patch (-) (w=0.56), distance to roads with medium/higher traffic volume (+) (w=0.37), and distance to riparian galleries (-) (w=0.12). Moreover, we detected that road kills were also significantly related to higher forest area surrounding the road (F=7.37, d.f.=1, P<0.01) and also to the proximity of nearest forest patch (F=8.80, d.f.=1, P<0.01).

According to these findings, stone marten seems to be negatively affected by habitat fragmentation being essential to promote good land management practices to guarantee a minimum area availability and well connected habitat patches through the establishment of suitable corridors for species movements. Furthermore, in road stretches close to cork oak patches, mitigation measures as wildlife passages ought to be considered in order to diminish the mortality rates. One should be aware that other forest dependent carnivores as genets Genetta genetta and wild cats Felis silvestris, the later of higher conservation concern and with decreasing density in the Iberian Peninsula, may respond stronger to habitat fragmentation than stone marten. This means that smaller and isolated habitat patches may become unoccupied, leading to species disappearance, being therefore highlighted the need to incorporate these findings in conservation action plans.