

The Importance of Including Plants in the Roads as Part of the Carnivore Conservation Strategy

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Opinion

Communication by scent marking is an integral part of the behavioral ecology of many carnivores [1,2]. Olfactory marking by urine, feces, secretions, scratching the ground, or rubbing is common in carnivorous species [3-5]. In this context, these scent marks have the advantage that they can be used where other signals may be difficult to detect, such as in dense vegetation, at night or underground [4]. In addition, such marks can remain active for a long time, so that other animals can smell individual signals even when the emitter is absent [6]. Due to the spatial dispersion of their populations, carnivores resort to scent making to deposit volatile chemical compounds as an indirect method of interspecific [2] and intraspecific [7,8] communication. Thus, one of the main functions includes informing about social status [1,2,9] announcing reproductive status [6,8,10] or determining the identity and kinship of individuals [1]. It is also used to defend a territory [7], as well as trophic resources [11,12]. In addition, these odorous cues can help individuals orient themselves within their own territories or feel safe in them [5,13]. Within odorous marks, feces are an important olfactory and visual cue for individuals [14], serving as a visual mark when it has stopped smelling. These feces are often deposited in latrines, which are strategic places that animals repeatedly use to defecate, urinate, and deposit various glandular secretions [13]. So repeated use over long periods of time by several individuals makes these marking sites important communication hubs. The use of latrines is crucial in carnivores due to their large distribution areas and low densities, where the possibilities of encounter with congeners are limited [13]. For this reason, latrines are usually located in visible places where the persistence of their smell is optimized by protecting the marks from the weather or from their disappearance by dwarfed beetles [13,15]. Therefore, regular marking and visitation by conspecifics means that these marked areas can be relevant in the activity of carnivores [3,4] and are therefore very important in the conservation of these species [5,16,17].

Associated with scent marks, carnivores produce secretions containing volatile and non-volatile compounds, essential vehicles for chemical communication [18]. In fact, some studies have shown that compounds present in feces were more abundant during the breeding season, when they could contribute to making the olfactory cue more conspicuous for potential mates [19]. On the other hand, during the months of reproduction, the concentrations of reproductive hormones within the fecal marks also vary [9,20], which may be related to the defense of their territory [9]. Finally, there is also a relationship between the presence of certain compounds and the signaling function of fecal marks [19], so that individuals seem to invest in those marks that interest them as an amplifier of the communicative signal to defend their resources. It should be borne in mind that carnivores occupy large distribution areas, so they cannot defend their territorial limits and resources constantly. Therefore, they should focus on depositing efficient and persistent scent marks, thus avoiding a considerable effort

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of constantly visiting their entire territory. Considering that scent marks are a relatively limited resource, these marks should not be deposited randomly. Therefore [21] in their economic approach to scent marking proposed that scent marks are placed where they maximise the chance of being detected by competitors or potential mates [6], e.g. in high and visible places, crossroads or in latrines [5,16,17].

The effectiveness of a scent mark is based on the degradation and oxidation of its chemical components. Depositing a mark on a visible substrate improves its visual effectiveness, as the message is more likely to be detected by intruders, but it can also improve its olfactory effectiveness through more extensive dissemination of the message by wind [2,17]. Carnivores use roads to move around and as limits of their distribution area [22], so they deposit their marks in strategic places on the roads such as at conspicuous places or on vegetation [5,11]. Carnivores may select some plants over other substrates because of their physical characteristics that support the mark more, slowing down its visual and olfactory degradation [2,16, 17] or because they slow down the release of volatile compounds, improving the olfactory efficacy of the mark [2]. In recent years, the boom in ecotourism and recreational activities has attracted thousands of people to natural areas [23], which implies the maintenance of roads for their safety and comfort. However, as has been shown, roads are important resources for carnivores to communicate, especially because of the plants located in them. Considering that carnivores are a key element in maintaining biodiversity [24] and based on the literature collected, it is necessary to include within the carnivore conservation plans the limitation of passage through these roads as well as the maintenance of the plants located on them during the breeding season, in order to maintain their populations in the area in good welfare conditions.

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