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The truth about cats and dogs: Landscape composition and human occupation mediate the distribution and potential impact of non-native carnivores

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ABSTRACT

Humans alter landscapes and native species distributions in many ways, including alterations mediated via domestic pets. While the negative impacts of domestic cats are well documented worldwide, the ecological effects of domestic dogs have received less scientific attention, particularly in the United States. Prevalence of free-ranging dogs may be especially problematic in areas with low density, but relatively ubiquitous human populations. We used camera-trap data collected during a 2008–2010 landscape-scale study consisting of 1181 camera stations (357 camera clusters) stratified over 16 counties in southern Illinois, USA, to estimate occupancy for domestic cats and dogs. We compared models of occupancy for three land cover types (forest, grassland, and wetland) in relation to anthropogenic features and estimated and compared the proportion of the region occupied by each species. Cats occurred across a moderate proportion of the landscape ($\overline{\psi} = 0.44 \pm 0.13$ SE) and were associated with anthropogenic features. Moreover, we found domestic dog occupancy was greater across the landscape ($\overline{\psi} = 0.59 \pm 0.09$), influenced more generally by land cover type, and was highest on grasslands and privately owned land. Domestic cat occupancy was more localized than that of dogs and less influenced by land cover type compared to anthropogenic features. Model averaged probability of dog occupancy was >0.50 across 19,049.39 km^2 of the region (>99%), but only 2270.53 km^2 (11.8%) for cats. Thus, while domestic cats may pose a more intensive threat to wildlife within the area they occupy, the impact of domestic dogs is likely to be more geographically extensive. Predicting the potential effects of these non-native species is complicated by a nuanced interaction between landscape composition, human density, and human behavior, and upends simplistic perceptions of the relative threats posed by the two species.

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1. Introduction

The current Anthropocene epoch is characterized by profound human influences resulting in global environmental degradation, defaunation, and loss of biodiversity (Dirzo et al., 2014; Lewis and Maslin, 2015; Tucker et al., 2018). The worldwide introduction and support of free-ranging domestic pets are a primary mechanism of human disturbance to native animal populations (Bellard et al., 2016; Clavero and García-Berthou, 2005; Doherty et al., 2016). Domestic cats (*Felis catus*) and dogs (*Canis familiaris*) can cause devastating damage to native wildlife populations, directly through predation (Doherty et al., 2017; Loss et al., 2013), or indirectly through disease transmission (Brown et al., 2008; Furtado et al., 2016) and fear-mediated behavioral or demographic responses (Banks and Bryant, 2007; Bonnington et al., 2013; Farris et al., 2017; Zapata-Ríos and Branch, 2016). The threat is of increasing concern as domestic dog and cat populations are associated with almost all human populations, and as the human population has increased in density and expanded in range, so have the populations of domestic cats and dogs (Gompper, 2014a; Loss and Marra, 2017).

Variation in human attitudes towards domestic pets can modify the intensity and spatial scale of disturbance (Gompper, 2014a; Gramza et al., 2016; Parsons et al., 2016). Domestic pets are often entirely dependent on anthropogenic resources (Gompper and Vanak, 2008; Vanak and Gompper, 2009a, 2009b). As such, local distribution and demographics of human populations, commonly described along an urban-rural gradient, will determine where domestic pet-wildlife interactions are most likely to occur (Gompper, 2014a). Depending on local regulations and customs, domestic dogs and cats may be mostly constrained to human dwellings, or they may be free-ranging with varying degrees of dependence on humans. This dependence can range from owned companion or work animals to human-supplemented feral populations (Doherty et al., 2017; Loss and Marra, 2017). Thus, the extent of potential impacts to local environments can differ by region, human attitudes, and the distribution of human populations relative to wildlife habitat.

Numerous studies have attempted to quantify damage from domestic cats (Loss et al., 2013). However, impacts of domestic dogs have only recently received attention (Doherty et al., 2017; Gompper, 2014b; Hughes and Macdonald, 2013; Young et al., 2011). Domestic cats are intensive hunters presenting an immediate threat to native species (Dickman and Newsome, 2015) resulting in 7 times more local extirpations and extinctions compared to dogs (Doherty et al., 2016). Although they kill native wildlife more frequently, domestic cats are typically smaller than most domestic dogs, and thus can have smaller exploratory forays (Kays and DeWan, 2004) and be restricted in range by predation from larger native species (Crooks and Soule, 1999). In contrast, domestic dogs may range farther from human associated habitats (Young et al., 2011), are less susceptible to smaller-bodied predators (Ritchie et al., 2014), and commonly are brought by humans into remote areas for sport and other types of recreation (Wierzbowska et al., 2016). As a result, impacts from domestic cats may be intense but restricted to areas in close proximity to human dwellings, while impacts of dogs may be more pervasive across the landscape (Gompper, 2014a).

Studies in developing countries have found high rates of free-ranging dog occupancy and negative effects on native species (Farris et al., 2016; Silva-Rodríguez and Sieving, 2012; Zapata-Ríos and Branch, 2018). However, few studies within the contiguous United States have identified free-ranging dogs as a potential widespread conservation issue (Doherty et al., 2016; Young et al., 2011), but some do note high dog use congruent with human land use (Parsons et al., 2016). This may be because most studies in the US have occurred in centers of human density or protected areas with restrictions on dog activity where it is difficult to parse effects of dogs from general anthropogenic effects (Forrest and St. Clair, 2006; George and Crooks, 2006; Reed and Merenlender, 2011; Weston et al., 2014). In these areas, public perception and leash regulations can reduce the presence of free-ranging dogs as owners may restrain dogs (Parsons et al., 2016) and efforts to reduce the stray or feral population may receive greater attention and resources (Lord et al., 1998). However, there are many areas of the US where human density is lower and social norms concerning dog ownership are relaxed, including rural agricultural areas, areas with a tradition of hunting with dogs, and areas where dogs are used as guard animals for pastured livestock. As a result, domestic dogs may have considerable impacts on native wildlife populations (Home et al., 2017) including direct and non-consumptive effects on prey populations (Banks and Bryant, 2007; Lord et al., 2001; Silva-Rodríguez and Sieving, 2012), but also on mesopredator populations as a perceived or real predator (Gompper and Vanak, 2008; Vanak and Gompper, 2010, 2009a), and closely associate wild populations as disease reservoirs and vectors (Acosta-Jamett et al., 2011; Kat et al., 1995; Knobel et al., 2014).

We assessed domestic dog and cat occupancy in relation to anthropogenic features across three land cover types in the midwestern United States. We expected that occupancy of dogs and cats would decrease with distance from anthropogenic features, increase with density of human features, and be greater on privately owned parcels compared to publicly owned and managed lands. We predicted domestic dog occupancy would be higher compared to domestic cats and affect a larger proportion of the overall landscape. We also evaluated how the relationship between domestic pet occupancy to anthropogenic features changed by land cover type and used this information to assess potential impacts to native species and identified areas where conservation actions would be most effective to reduce potential impacts of domestic dogs and cats.