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Spatio-temporal relationship between free-roaming dogs and the critically endangered Chinese pangolin

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ABSTRACT

The rapid growth of human populations and urban expansion has led to habitat destruction, fragmentation, and heightened threats to biodiversity. Protected areas are essential for conservation, yet their effectiveness is increasingly challenged by invasive non-native carnivores, particularly domestic dogs (*Canis lupus familiaris*), which pose growing concerns for wildlife near urban settings. The critically endangered Chinese pangolin (*Manis pentadactyla*) faces significant threats, including habitat loss and injuries caused by dogs, but the specific impacts of dogs on their distribution and behavior remain poorly understood. Our study explored the spatial and temporal interactions between dogs and the Chinese pangolins in Yangmingshan National Park, situated within the Taipei-Keelung metropolis in northern Taiwan. From June 2018 to November 2019, we detected dogs at 50 camera sites whereas pangolins at 43 sites, and recorded 465 burrows. The habitat uses of dogs and pangolins showed partial overlap, with dogs present in more than one third of the areas where pangolins occurred. Presence of dogs declined with increasing distance from hot springs, areas tied to human activities and food subsidies, while pangolin site use was negatively linked to elevation and positively associated with distance from hot springs. The co-occurrence estimate between dogs and pangolins was −0.51, indicating a reduced likelihood of pangolin site use in areas with dogs. Low diel activity overlap (0.20) indicated limited temporal interaction. This study sheds light on the interactions between free-roaming dogs and the Chinese pangolins, illustrating how human-associated factors and invasive species affect wildlife in protected areas.

1. Introduction

The rise in human population and the rapid expansion of urban areas contribute to widespread habitat destruction and fragmentation, which are among the leading threats to global biodiversity (McDonald et al., 2008; Newbold et al., 2015). One of the primary strategies to mitigate these effects and conserve biodiversity is the establishment of protected areas (Gaston et al., 2008; Watson et al., 2014; Pacifici et al., 2020). Over the past few decades, the number and area of protected areas have increased substantially, from 1992 to 2020 (Dinerstein et al., 2019; Zero Draft of Post-2020 Global Biodiversity Framework, 2020). However, this progress is tempered by the rising human footprint within and around these protected areas. The development of infrastructure, including tourism and human settlements, often encroaches upon protected zones, undermining their ability to act as safe harbors for endangered species (Jones et al., 2018; Wittemyer et al., 2008).

One major consequence of human expansion is the proliferation of invasive, non-native carnivores, particularly domestic dogs (*Canis lupus familiaris*), which have emerged as a growing concern for conservation (Spear et al., 2013). With a global population exceeding 700 million, domestic dogs represent the most prevalent and abundant carnivores worldwide (Hughes and Macdonald, 2013). Approximately 75 % of these dogs are free-roaming, defined as either unowned or owned but not confined to a designated area (Vanak and Gompper, 2009). Free-roaming dogs pose extensive threats to wildlife through predation, disturbance, competition, hybridization with wild canids, and disease transmission (Belsare et al., 2014; Farris et al., 2017; Gompper, 2015; Hughes and Macdonald, 2013; Vanak and Gompper, 2009, 2010). Predation by free-roaming dogs threatens endangered species, contributing to the extinction of at least 11 vertebrate species (Doherty et al., 2017), while diseases like canine distemper and parvovirus severely impact small carnivores and ungulates (Belsare et al., 2014). Additionally, the presence of free-roaming dogs can decrease foraging time and increase vigilance (Parsons et al., 2016; Vanak and Gompper, 2009), alter site occupancies (Yen et al., 2019), activity patterns (Weng et al., 2022), and reduced reproductive success (Gingold et al., 2009). These changes in

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