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A leopard's favourite spots: Habitat preference and population density of leopards in a semi-arid biodiversity hotspot

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ABSTRACT

Leopards (Panthera pardus) are the only free-ranging large predators to still occur naturally throughout much of Africa, but are vulnerable to habitat loss, ecological degradation and persecution. We used a systematic camera trap survey covering an area of ~ 3100 km² in the Little Karoo, a semi-arid biodiversity hotspot in South Africa, to assess the impacts of land use and habitat type on leopard density. Camera data were supplemented by opportunistic scat collection to produce a habitat suitability model. We used a habitat suitability model to inform spatially explicit capture-recapture models used to estimate population density. We recorded 152 independent photographs of 27 individually recognisable leopards at 54 camera stations and collected scats from a further 76 locations. Our habitat suitability model showed that primary productivity and vegetation type were the best predictors of leopard habitat suitability. Our best performing population density model allowed for detection and movement of individuals to vary according to sex, and estimated population density at 1.26 (SE ± 0.26) leopards/100 km². Our results suggest that the Little Karoo contains large areas of leopard habitat, but that leopards only persist in low densities within this area. Our study serves as an important baseline estimate for leopard population density in farmed land-use, semi-arid areas.

1. Introduction

Large mammalian predators are vulnerable to habitat loss and degradation, which impact negatively on prey abundance and direct persecution by humans seeking to protect their livestock (Estes et al., 2011). Extirpation of large predators has been demonstrated to have broad ecosystem impacts through processes such as meso-predator release and changes in the behaviour of prey species which can alter plant communities (Ripple and Beschta, 2006). This combination of sensitivity to disturbance and apparently disproportionate impacts on ecosystems following their removal means that large predators are widely recognized as a conservation priority (Estes et al., 2011; Ripple et al., 2014). Effective conservation of large, wide ranging predators demands large protected areas which safeguard the preservation of other species as well (Di Minin et al., 2016). However, many large areas of suitable habitat may not support functional populations due to anthropogenic pressures, historical factors, or isolation from other suitable habitat patches (Phillips, 2012). Consequently, population level data are essential for implementing effective conservation and management plans.

Despite having the widest habitat tolerance of any African felids, leopards (*Panthera pardus*) have been extirpated from 36% of their historical range on the African continent (Jacobson et al., 2016). Extant populations are seldom assessed or monitored which makes it impossible to objectively evaluate population status and anthropogenic impacts or the efficacy of conservation interventions (Balme et al., 2013). In the Western Cape Province of South Africa, leopards have been largely restricted to the Cape Fold Mountains that extend in a broad belt across the province in a north-south and east-west axis (Swanepoel et al., 2013). Current threats to this population are largely unknown and population data from the region are sparse (but see Devens et al., 2016; Martins, 2010).

Species distribution models seek to quantify the presence or absence of a species from an area relative to biologically relevant environmental variables (Elith and Leathwick, 2009). Historically species distribution models had a similar mathematical basis to resource selection

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