



# Attitudes and tolerance of private landowners shape the African wild dog conservation landscape in the greater Kruger National Park

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**ABSTRACT:** The survival of wildlife ultimately relies on its acceptability to humans. The African wild dog *Lycaon pictus* is an endangered species that often comes into conflict with humans. Currently, the only viable population in South Africa resides in the Kruger National Park (KNP). To begin to understand the acceptability of wild dogs outside this important wild dog stronghold, we interviewed private landowners (n = 186) along the KNP western and southern boundaries. Respondents generally held positive attitudes towards wild dogs and had a good knowledge of them. Attitudes were also more positive when the property was part of a conservancy, indicating that the conservation landscape for wild dogs on private land outside the KNP is promising. However, the impact of edge effects such as disease transmission should not be ignored in future research, and creative solutions for mitigating these effects must be sought to ensure the future conservation of wild dogs.

**KEY WORDS:** *Lycaon pictus* · Questionnaire · South Africa · Carnivore · Human–wildlife conflict

## INTRODUCTION

Attitude is a psychosocial concept that is affected by knowledge and beliefs, emotions and behavior (Eagly & Chaiken 1998). However, human attitudes towards wildlife are more than simply a collection of beliefs, emotions and behaviors. It is the interrelationships among values, value orientations and societal norms which are key drivers of attitudes and which dictate human behavior towards wildlife; this is known as a cognitive hierarchy (Homer & Kahle 1988, Fulton et al. 1996, Vaske & Manfredi 2012). Attitudes can directly influence intentions and behavior; so, to help predict behavior, a sound understanding of underlying attitudes is required (Vaske &

Needham 2007). Equally, to promote long-term changes in behavior, changes in attitudes underpinning such behaviors are needed (Manfredo et al. 2004, Vaske & Manfredi 2012). Thus, to mitigate against conflict between people and wildlife, especially along the borders of protected areas, it is important to understand the attitudes of landowners and what drives these attitudes (Oli et al. 1994). For example, if attitudes are deemed negative or result in undesirable behavior (e.g. killing of carnivores), then efforts to change attitudes and subsequent behaviors would be required.

Human attitudes towards carnivores can be correlated with factors such as wealth, self-assessed and factual knowledge, cultural perspectives, income,

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and personal values and experiences (Vaske et al. 2001, Zimmermann et al. 2005). For example, more knowledgeable individuals generally have more positive attitudes towards carnivores (Bruskotter et al. 2007). Yet, in some instances, greater knowledge may not change attitudes but rather may provide the basis for rationalizing existing negative attitudes (Kaczensky et al. 2004). First-hand knowledge or experience with carnivores is also known to result in the manifestation of negative attitudes (Houston 2009).

In Africa, African wild dogs *Lycaon pictus*, like many other predators, are contentious, especially for landowners whose land borders protected areas (Holmern et al. 2007, Lagendijk & Gusset 2008). Once distributed across most of sub-Saharan Africa (Woodroffe et al. 1997, Creel & Creel 2002), wild dogs have disappeared from the greater part of their historical range, mainly due to habitat fragmentation, direct persecution for livestock depredation and prey depletion (Woodroffe et al. 1997). Many landowners maintain negative perceptions of wild dogs and a low tolerance for the species on their properties (Davies & du Toit 2004). Wild dogs kill their prey by disembowelment or dismemberment and are consequently perceived as destructive, cruel and high-impact predators that kill more than necessary (Woodroffe & Ginsberg 1999). Further, wild dogs have shown the ability to adapt and utilize surrounding fence lines, or the contours created by fences, to trap and capture larger prey (Davies-Mostert et al. 2013). Thus, wild dogs can have negative effects on prey numbers and target non-typical prey species, which further exacerbates conflict with landowners (Davies-Mostert et al. 2013).

To date, human-wildlife conflict research in the areas bordering the Kruger National Park (KNP) in South Africa has focused on the context of rural pastoralists (Pollard et al. 2003, Jori et al. 2011), crop growers (Anthony 2007, Anthony et al. 2010) and commercial wildlife ranchers (Lindsey et al. 2005), assessing their attitudes towards, and tolerance of, problem animals generally (Lagendijk & Gusset 2008). No research has collectively considered the matrix of land use types bordering the KNP, where conflict with wild dogs is expected to be highest (Jori et al. 2011). Our study, by means of questionnaire interviews, engaged with wildlife ranchers, crop farmers and the managers and/or owners of private reserves, lodges and wildlife estates and sought to assess their attitudes towards wild dogs and the drivers behind these attitudes. We hypothesized that landowners who received no benefit (either real or

perceived, financial or otherwise) from having wild dogs on their properties, or moving through their properties, would maintain negative attitudes towards wild dogs (sensu Davies & du Toit 2004). We further hypothesized that economic potential (e.g. increased income) would likely be the most important driver of attitude.

## METHODS

### Study area

The KNP forms part of the northeastern South African lowveld and stretches approximately 20 000 km<sup>2</sup>, roughly 350 km from north to south, with an average width of 60 km (Mabunda et al. 2003). The KNP is bordered by Mozambique in the east and Zimbabwe in the north, with 2 South African provinces, Mpumalanga and Limpopo, on the west and south (Ferreira & Funston 2010, Jori et al. 2011; Fig. 1). The Crocodile River delineates the southern boundary of the KNP (Ferreira & Funston 2010).

The western and southern boundaries of the KNP are bordered by a matrix of land use types including private and commercial farms, communal land and rural settlements (Pollard et al. 2003) and span a total of 750 km (Jori et al. 2011). Communal pastoral lands and agricultural farms (managed by the Department of Agriculture, Forestry and Fisheries of the South African government) border 66.0% of the total boundary (Jori et al. 2011). The southern boundary fence (122 km) is dominated by private commercial sugar cane *Saccharum* spp. and fruit (citrus species and bananas *Musa* spp.) farmers (Jori et al. 2011). The western boundary of the KNP, between the Phalaborwa and Paul Kruger gates, is dominated by private nature reserves and wildlife ranches, estates and lodges which cover 34.0% of the total boundary (Pollard et al. 2003, Jori et al. 2011).

For the purposes of our study, a buffer of 35 km was chosen to encompass the maximum home range size for a wild dog pack in the KNP system (930 km<sup>2</sup>, Mills & Gorman 1997). Although the shape of home ranges may vary according to a number of environmental, ecological and social factors (Pole 1999, Creel & Creel 2002), a standard circular home range was used to determine the extent of the study area beyond the western and southern boundaries of the KNP (Lindsey et al. 2004). Our study covered an area of 6132 km<sup>2</sup> (excluding the KNP). Only private properties within the 35 km buffer zone along the south and southwestern boundaries of the KNP, reaching

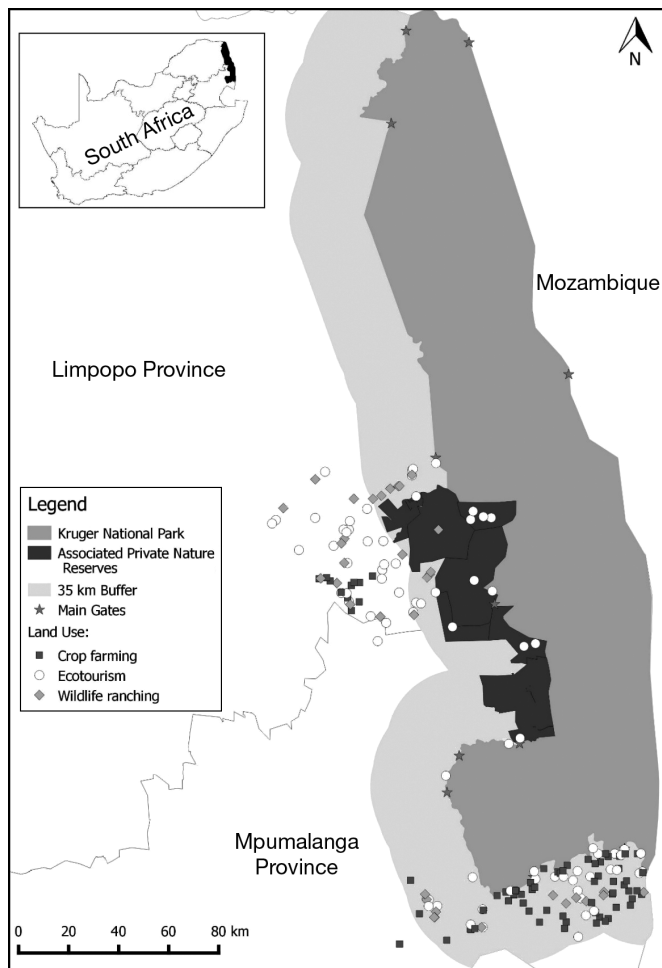


Fig. 1. Study area within South Africa and the positions and land uses of the respondent properties

as far north as Phalaborwa, were included. Previous research has focused on the role of local communities (Pollard et al. 2003, Jori et al. 2011) in human-wildlife conflict outside of the KNP. As such, our study attempted to gather more comprehensive data on the socio-economic environment of a hitherto undersampled sector of the greater KNP. Moreover, time and resources precluded complete sampling of the area.

Since the Associated Private Nature Reserves (APNR) adjacent to the KNP (Fig. 1) are effectively an extension of the park, we extended the 35 km buffer in this part of the study area.

### Data collection

Information on the socio-economic environment of the private properties within the greater KNP was

collected using semi-structured questionnaire interviews. All interviews were conducted in English and by the same 2 researchers (G.B. and J.P.W.). The questionnaire consisted of 4 pages was designed to take an average of 10 to 15 min to complete (Watermeyer 2012). Data were collected between March 2010 and April 2011, and respondents were surveyed opportunistically. A snow-balling approach was adopted for the questionnaire sampling wherein all APNR properties were surveyed first (all had known and current contact details) and each one was then asked if they could provide contact details for any non-APNR properties. G.B. was also resident in the area and had built up a small database of contacts that were interviewed. Before answering any questions, respondents were given a full description of the research and gave their informed consent to be interviewed. Respondents were also informed that their answers would be confidential. We received ethical clearance for the study from the Rhodes University Ethical Standards Committee (clearance number: ZOOL-06-10).

We asked respondents to comment on the physical elements of their land/property (e.g. size of the property) and to provide information on their game and whether the property was part of a conservancy or not. Respondents were also asked to stipulate their land use type (e.g. crop farming, wildlife ranching or ecotourism). In situations where more than 1 land use type was applicable, the respondent's most important economic activity defined the land use type. Game numbers were totaled separately for each property, and fencing was defined as predator proof (e.g. standard electric game fence with either a trip wire/Bonnox/buried mesh) or not (e.g. cattle fencing/security fencing/barbed fencing).

Respondents were asked to identify a wild dog from a series of photographs, and their attitudes towards wild dogs were explored using a series of suggested statements about wild dogs (Watermeyer 2012). Thereafter, a broad index of attitude was generated. The attitude indices (hereafter AI) were established from 6 statements (see Table 2). Index scores were calculated by allocating values of between  $-1$  and  $1$  to the series of suggested statements depending on the positive, don't know/neutral or negative responses of respondents. Responses for the indices were limited to 3 categories (i.e. yes, no, unsure). For example, if a respondent answered 'yes' to 'You are more tolerant of wild dogs than your neighbors', she/he received a score of  $1$  for that statement. By contrast, if a respondent answered 'no' to the same statement, she/he received a score of  $-1$ . If

a respondent stated that she/he was unsure of their tolerance levels compared to their neighbors, she/he received a score of 0 (see Table 2). The AI values were determined for each respondent as the sum of the scores of the relevant questions (Zimmermann et al. 2005, Anthony 2007). We recognize that this approach has an element of subjectivity associated with it, but it is based on published work used for quantifying respondent attitudes towards carnivores (Parker et al. 2014, Page et al. 2015, Page-Nicholson et al. 2017). Higher AI scores indicated a more positive overall attitude towards wild dogs (Zimmermann et al. 2005). The AI (composite reliability = 0.62) had a potential maximum of 6 points and a potential minimum of -6 points.

The remainder of the questionnaire included open-ended questions, which allowed respondents to expand on their responses (Anthony 2007), and questions with a 3-point, as opposed to a 5-point, Likert scale were used to simplify the questionnaire and reduce miscommunication (Anthony 2007, Lagendijk & Gusset 2008). Finally, we collected 4 socio-demographic variables for each respondent: age, gender, education level and first language (see Watermeyer 2012 for full details).

### Statistical analysis

We conducted a multi-model analysis using Akaike's information criterion adjusted for small sample sizes (Burnham & Anderson 2002). Socio-demographic variables (age, education level [secondary, tertiary or no response] and first language [English, Afrikaans or other] of respondents; land use type [wildlife ranching, crop farming or ecotourism]; location [west or south of the KNP] and size [in ha] of the property; whether the property was fenced or not; and whether the property was part of a conservancy or not) were all included as potential predictors of the AI. The gender of respondents was not included in the analysis since there were only 12 female respondents (out of a total of 186). We used a generalized linear model (GLM, Gaussian family with an identity link; Codron et al. 2007, Rowe 2009, Motulsky 2010, Symonds & Moussalli 2011) to assess the effect of the individual and all possible combinations of the predictor variables on the AI. We identified candidate models by using the dredge function in the MUMiN package of R (Barto 2009). We re-ran the GLM on the highest-ranking model (Schoepf & Schradin 2012) and tested for significant differences in the likelihood of respondent attitudes based on the tested variables (Schoepf

& Schradin 2012). We set statistical significance at 0.05 and analyzed all data using R 3.0.2 software (R Core Team 2013).

## RESULTS

Between March 2010 and April 2011, 186 questionnaire interviews were completed. The number of respondents represented approximately 10% of all identifiable landowners in the study area. Seventy-two crop farmers, 35 wildlife ranchers and 79 respondents involved in ecotourism ventures agreed to participate in the research. Ninety-seven percent of the questionnaires were completed by face-to-face interviews, with the remainder being completed via email ( $n = 5$ ) and over the phone ( $n = 1$ ). The respondent who was interviewed over the phone was not able to visually identify a wild dog, but it was clear from the answers given that the respondent was familiar with all large predators, including wild dogs. The majority of respondents surveyed were male (93.6%). A large proportion of respondents (61.3%) had tertiary education, and 79.6% were between the ages of 31 and 50 yr. Just over half of the respondents were first-language Afrikaans speakers (51.1%). The remainder of the respondents were English (45.2%) or communicated in another language as their mother tongue (e.g. German, Portuguese, Shangaan, Vhavhenda and Tsonga).

Ecotourism ventures constituted the largest proportion (65.5%) of the total area surveyed (6132 km<sup>2</sup>), while wildlife ranchers (24.7%) and crop farmers (9.9%) occupied substantially less of the total surveyed area. Almost 60.0 and 26.8% of respondents surveyed along the western boundary of KNP were involved in ecotourism and wildlife ranching incentives, respectively. By contrast, more than half (58.7%) of the respondents along the southern boundary were crop farmers.

### Knowledge of African wild dogs

Almost all respondents correctly identified a wild dog (99.0%) and generally showed a sound understanding of wild dog behavior, biology and conservation (Table 1). Ninety-six percent of respondents knew that wild dogs were social carnivores that existed in packs, and 85.0% agreed that fewer wild dogs occurred in the area compared to lions *Panthera leo*. Twenty-one percent believed that wild dogs were dangerous to humans.

Table 1. Statements illustrating respondents' knowledge of wild dog behavior, biology and conservation status. Values are percentages of 186 respondents

Knowledge statement	Yes	No	Unsure
Respondent could identify a wild dog	99	1	0
Wild dogs are dangerous to humans	21	76	3
Wild dogs are more common than lions in the lowveld	11	85	4
Wild dogs are pack animals	96	2	2

### Attitudes towards African wild dogs

The mean  $\pm$  SD attitude score for all respondents was  $3.0 \pm 2.3$ , while the maximum achieved was 6 and the minimum  $-4$ . All of the respondents stated that they enjoyed seeing wild dogs in the bush (Table 2). Almost all respondents wanted to learn more about wild dogs (99.0%), and most believed that wild dogs held cultural value for them (93.0%). Moreover, 99.0% of the respondents believed the species formed an important part of the natural environment and should be protected. Even though more than half of the respondents were happy to have wild dogs move through their properties (63.0%), there was a substantial decrease in the percentage of positive responses when respondents were asked to comment on statements pertaining to wild dogs either temporarily or permanently residing on their proper-

ties. Interestingly, this negative sentiment was similar across the 3 major land use types (ecotourism = 21 respondents; wildlife ranching = 17 respondents; crop farming = 25 respondents). Just under half of the respondents believed that they were more tolerant of wild dogs than their neighbors (48.0%) or stated that they would tolerate wild dogs denning on their properties (47.0%). The spread of intolerant (i.e. negative AI scores) landowners was also similar across the 3 land use types (ecotourism = 5 respondents; wildlife ranching = 3 respondents; crop farming = 4 respondents). Twelve percent of respondents stated that they would be happy if wild dogs were completely absent from their properties (ecotourism = 6 respondents; wildlife ranching = 10 respondents; crop farming = 7 respondents), and negative comments were associated with fear of livestock and/or game losses (5.3% of respondents) and human safety (4.8%). Just under half (47%) of respondents agreed with the statement that wild dogs could generate economic benefits for them (Table 2).

### Factors influencing attitude

In the global model, the highest-ranked model included the position of the property relative to the KNP, whether the property was part of a conservancy or not and the land use of the property. Respondents whose land formed part of a conservancy were sig-

Table 2. Statements illustrating the attitudes of respondents towards African wild dogs. Values are percentages of the answers (yes/no/unsure) of 186 respondents to each statement. The average attitude index (AI) for each statement is also shown (see 'Methods: Data collection' for details). Only the first 6 statements were included in the calculation of the AI. The remaining 7 statements were not included in the calculation of the AI either because they were factual/normative statements that had little bearing on actual attitudes towards wild dogs or because their removal improved the composite reliability of the index. na: not applicable

Attitude statement	Yes	No	Unsure	Average AI
<b>Included in AI calculation</b>				
You would be happier if wild dogs were completely absent from your property	12	71	17	1
You are happy to have wild dogs on your property	63	7	30	1
You or your neighbors have successfully removed wild dogs	6	77	17	1
You are more tolerant of wild dogs than your neighbors	48	7	45	0
You would tolerate a pack of wild dogs denning on your property	47	33	20	0
You or your neighbors are tolerant of wild dogs in the area	56	11	33	0
<b>Not included in AI calculation</b>				
Wild dogs negatively impact your business	10	84	6	na
Wild dogs form an important part of the environment	99	1	0	na
Wild dogs should be protected	99	0	1	na
Wild dogs could produce tourism benefits for your business	47	44	9	na
You enjoy seeing wild dogs in the bush	100	0	0	na
Wild dogs are culturally important to you	93	3	4	na
You would like to learn more about wild dogs	99	0	1	na

nificantly more likely to have positive attitudes towards wild dogs (Table 3).

## DISCUSSION

The attitudes of landowners within the greater KNP towards wild dogs were mostly positive (average index of 3.0). In addition, all respondents answered positively about the enjoyment they gained from viewing wild dogs. Similarly, almost all respondents indicated that they wanted to learn more about wild dogs, said that wild dogs are important to them culturally and wanted to see wild dogs protected. However, more than half of the respondents would not tolerate wild dogs denning on their properties, and a small proportion stated that they did not ever want wild dogs on their properties.

Previous work in Africa has demonstrated that negative attitudes and perceptions towards carnivores are associated with the fear that carnivores are a threat to livestock/game and human life (Parker et al. 2014, Mkonyi et al. 2017). In fact, in the rural pastoralist areas outside the Tarangire National Park, Tanzania, the majority of respondents disliked carnivores for this very reason (Mkonyi et al. 2017). Although negative sentiment towards wild dogs in our study area was generally low, 9.1% of respondents, mostly wildlife ranchers, indicated that they would prefer to see wild dogs completely removed from the landscape. These attitudes could be driven by wildlife ranchers believing that they have the most to lose from a financial perspective when wild dogs are present, and this would support our first hypothesis (Lindsey et al. 2005).

However, negative perceptions of wild dogs in our study area were not widespread and were generally independent of land use type. For example, although about half of the 23 respondents who wished to see wild dogs completely removed from the landscape were wildlife ranchers, owners of ecotourism proper-

ties (6 respondents) and crop farms (7 respondents) also shared this view. Such results support the notion that relationships between demographic variables and levels of human–predator conflict are not always linear or necessarily simplistic (Lagendijk & Gusset 2008, Mkonyi et al. 2017). However, for some of our attitude statements, we asked respondents to comment on either their own or their neighbor’s feelings towards wild dogs in an attempt to capture the broader sentiment towards wild dogs outside of the KNP. We recognize that such an approach may influence the interpretation of landowner attitudes, especially wildlife ranchers, who were a relatively under-sampled group. Nevertheless, we still contend that the drivers of attitudes towards carnivores are either significantly affected by the local conditions (e.g. the dominant human demographic of the area) and predators (e.g. how visible they are to the landowners) or the opportunistic sampling approaches adopted in many attitude studies (including ours) have resulted in biased results.

We believe it is likely to be the latter, and this limitation is seldom acknowledged in the published literature. In our study, our interviews accounted for approximately 10% of all identifiable private landowners within our study area, and this is clearly a limitation of our opportunistic sampling approach. As such, and despite adopting a conservative approach, the results of our modeling exercise must be interpreted with caution. However, our study was concerned with attitudes towards a highly endangered carnivore adjacent to the KNP which supports the only viable population of the species in South Africa. Thus, we believe that our findings are still valuable and should be viewed as the first step towards unpacking the human dimensions of wild dog conservation along the boundaries of the KNP. Future work should endeavor to adopt more systematic methodologies to achieve complete coverage and improve our understanding of this important issue, especially since we had to exclude several groups (i.e. females and rural pastoralists) from our analysis.

The mismatch between respondent answers to attitude-related questions (i.e. all respondents stated that they enjoyed viewing wild dogs, but just over half would not tolerate them denning on their properties) highlights the NIMBY (not in my backyard) effect (Zimmermann et al. 2005). While the respondents in our study may be comfortable with the overall notion that wild dogs should be conserved, their attitudes likely change to be more negative if their own livelihoods become affected (Zimmermann et al. 2005).

Table 3. Results from the generalized linear model using 3 key variables to determine their effect on the attitude index.

**Bold:** significant results ( $p < 0.05$ )

Variable	Estimate	SE	t-value	p-value
(Intercept)	<b>5.30</b>	<b>0.60</b>	<b>8.78</b>	<b>&lt;0.0001</b>
Position (west)	-1.04	0.83	-1.25	0.21
Land use (ecotourism)	1.14	0.94	1.21	0.23
Land use (wildlife ranching)	-0.79	1.13	-0.78	0.48
Conservancy (yes)	<b>1.93</b>	<b>0.95</b>	<b>2.03</b>	<b>0.04</b>

A key driver of respondent attitude in our study was whether the respondent's property was part of a conservancy or not. The extent to which predators impose costs on landowners is affected by land use (Lindsey et al. 2005), and this directly affects attitudes towards predators, as some land uses can gain financially (e.g. conservancy properties) while others suffer financial costs from predators (e.g. wildlife ranching). Our study revealed that respondents who owned properties that were part of a conservancy tended to have more positive attitudes towards wild dogs. Properties that form part of conservancies clearly promote conservation, and these types of properties can benefit financially from having charismatic species such as wild dogs on their land (Di Minin et al. 2013, Thorn et al. 2013). Importantly, most of the landowners in our study area included ecotourism in one form or another (many as their primary income stream), supporting our second hypothesis that being part of a broader conservation consortium like a conservancy is likely one of the most important drivers of positive attitudes towards wild dogs. A cost-benefit assessment of wild dog presence for promoting economic gain may therefore be an effective approach for changing attitudes given the demographics of the respondents (Lindsey et al. 2005).

The long-term survival of wild dogs in South Africa relies heavily on the positive attitudes and behavior of landowners adjacent to protected areas (Parker et al. 2014), especially the KNP. Negative attitudes towards predators can limit the survival of carnivores on private land, while positive attitudes promote carnivore conservation (Lindsey et al. 2005). Our work demonstrates that the private landowners whom we interviewed adjacent to the KNP generally hold positive attitudes towards wild dogs. Thus, the development of wildlife corridors and the potential for range expansion of wild dogs outside of the KNP may be possible. However, for such an approach to be successful and since fences are not known to limit wild dog dispersal (Parker et al. 2014), the impacts of significant edge effects such as disease transmission from domestic dogs *Canis familiaris* (Butler et al. 2004), road traffic accidents and direct persecution for stock losses would need to be adequately addressed. Significantly, despite intensive national monitoring, we are only aware of 1 case where dispersing wild dogs from the KNP have successfully colonized other protected areas (Davies-Mostert et al. 2012, G. Beverley pers. obs.), bringing the need to assess the extent to which wild dogs are constrained by the human population on the western boundary of

the KNP into sharp focus. Nevertheless, we advocate the continued vaccination of domestic dogs against canine distemper, rabies and parvovirus in the areas immediately adjoining the KNP and the APNR (Butler et al. 2004) and perhaps even the vaccination of the wild dogs themselves (Woodroffe et al. 2007). Mitigating against road traffic accidents and direct persecution is more challenging, but the provision of tangible benefits (e.g. income generated from ecotourism cooperatives) for community members must be prioritized to curb persecution.

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