

Conflicting human interests over the re-introduction of endangered wild dogs in South Africa

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Abstract In South Africa, a plan was launched to manage separate sub-populations of endangered African wild dogs (*Lycaon pictus*) in several small, geographically isolated, conservation areas as a single meta-population. This intensive management approach involves the re-introduction of wild dogs into suitable conservation areas and periodic translocations among them. To assess the attitudes towards re-introduced wild dogs, we conducted a questionnaire survey of multiple stakeholders—local community members, private landowners and tourists—in and around Hluhluwe-iMfolozi Park (HiP), one of the meta-population conservation areas. Here, we document conflicting human interests over

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the re-introduced wild dogs. Tourists in HiP, on the one hand, expressed overwhelmingly positive opinions about wild dogs across personal details of the respondents, but especially after having seen free-ranging wild dogs. On the other hand, we found misconceptions and perceptions that were more negative among the rural population around HiP, again largely independent of personal details of the participants, although educated respondents voiced more favourable views of wild dogs. These negative attitudes were in particular due to perceived and real threats of livestock losses. In a follow-up questionnaire survey, we also discovered apparent shortcomings of a previous short-lived conservation education programme among the local communities adjacent to HiP. Consequently, the mitigation of the conflict between wild dogs and rural people requires an understanding of the conditions under which livestock predation occurs, the encouragement of practices that prevent such predation, and increasing local tolerance of co-existence with wild dogs through both economic and non-monetary incentive schemes as well as continued conservation education.

Keywords African wild dog · Attitudes · Conservation education · Ecotourism · Human–wildlife conflict · Livestock predation · *Lycaon pictus* · Re-introduction

Introduction

The utilisation and management of natural resources in Africa is often associated with conflicts over the benefits provided by these resources (Du Toit 2002), an issue that depends largely on how various interest groups perceive, understand and value the environment (Bekoff 2001; Berg 2001). One natural resource category that evokes particularly strong controversies is carnivores. The relationship between humans and carnivores has been long and has always tended to be uneasy, alternating between extremes of fear and affection (Clutton-Brock 1996; Kruuk 2002). Many people feel a special attachment to the members of the order Carnivora, especially the urbanised majority of modern western societies that has adopted a more distant and romantic view of carnivores and nature in general (Kellert et al. 1996; Breitenmoser 1998). A large proportion of visitors to Africa's protected areas consists of this group of people. In contrast, rural people, particularly those living adjacent to protected areas containing large carnivores, have traditionally regarded predators as a threat to their livestock or ranched wildlife (Sillero-Zubiri and Laurenson 2001).

As a consequence of this historically negative attitude, most large carnivores have been persecuted for centuries and extirpated over large areas of their previous ranges on a global scale (Schaller 1996; Gittleman et al. 2001). One of the species brought to the brink of extinction is the African wild dog (*Lycaon pictus*), which has been killed, until recently, even by game rangers for their perceived cruel way of killing prey and for allegedly disrupting game populations (Fanshawe et al. 1991; Woodroffe and Ginsberg 1997a, 1999; Creel and Creel 1998, 2002; Woodroffe et al. 2004). Once widespread across sub-Saharan Africa, few potentially viable populations of this endangered species remain, with those remaining being patchily distributed predominantly in eastern and southern Africa and numbering fewer than 6,000 animals (Ginsberg 1993; Fanshawe et al. 1997; Woodroffe et al. 2004). In South Africa, in an effort to restore wild dog numbers in increasingly fragmented landscapes and to complement the single viable population occurring in Kruger National Park, a plan was launched to manage separate sub-populations of wild dogs in several small, geographically isolated, conservation areas as a single meta-population

(Mills et al. 1998). This intensive management approach involves the re-introduction of wild dogs into suitable conservation areas, and periodic translocations among them to mimic natural dispersal and maintain gene flow.

One of the conservation areas taking part in this meta-population management plan is the Hluhluwe-iMfolozi Park (HiP) in South Africa's KwaZulu-Natal Province, where wild dogs were re-introduced in 1980/1981 after an absence of half a century (Maddock 1995, 1999). To augment decreasing numbers and stimulate breeding activities, another translocation took place in 1997 (Somers and Maddock 1999). In the face of future translocations to the park (subsequently carried out in 2001 and 2003), a conservation education programme among the local communities around HiP was implemented from 1999 to 2000, and the attitudes of multiple stakeholders in and around HiP towards wild dogs were assessed through questionnaire surveys in 1999/2000 and then again in 2003. Here, we sought to integrate the perceptions of the different interest groups and to evaluate the impact of the conservation education programme, in order to develop measures that facilitate co-existence between humans and large carnivores.

Methods

Study area

The ca. 900 km² HiP is located in northern KwaZulu-Natal Province, eastern South Africa, and was proclaimed in 1895. HiP lies about 300 km south of Kruger National Park, which has the nearest viable population of wild dogs (Maddock and Mills 1994). The park, with its subtropical climate, has a diverse topography and the predominant vegetation is bushveld savannah. HiP supports a broad spectrum of large carnivores, including lion (*Panthera leo*), leopard (*Panthera pardus*), cheetah (*Acinonyx jubatus*), spotted hyaena (*Crocuta crocuta*), black-backed jackal (*Canis mesomelas*), and wild dog. HiP is enclosed by an electrified fence that separates the park from the densely human populated surroundings; however, wild dogs and other large carnivores are notoriously difficult to contain within the perimeter fence. The human population around HiP consists of Zulu villagers on communal land and farmers on private land whose livelihoods largely depend on livestock and ranched wildlife, including hunting and ecotourism. HiP receives a large number of both national and international visitors who engage in numerous ecotourism activities and make use of well-established tourist facilities in the park.

History of wild dogs in HiP

According to local verbal history, farmers and state-employed game rangers extirpated wild dogs in KwaZulu-Natal in the 1930s presumably for killing livestock. Twenty-two wild dogs were then re-introduced into HiP in four stages in 1980/1981. Wild dogs started leaving the park in 1984 and occasionally returned or were chased back, although the majority of emigrants left permanently and settled outside HiP or moved further away. Despite an addition of four animals in 1986, wild dog numbers in HiP fluctuated greatly over the years and dwindled to a mere five animals in 1996, without any signs of breeding

activities among the remaining individuals (Maddock 1995, 1999; also see Andreka et al. 1999; Krüger et al. 1999).

It was then decided to increase the number of wild dogs in an attempt to stimulate breeding through a translocation of four animals to the park in 1997 (Somers and Maddock 1999). This was the first implementation of the meta-population management plan for the conservation of wild dogs in South Africa (Mills et al. 1998; also see Moehrenschlager and Somers 2004), in which the previously largely isolated HiP became linked to other conservation areas through translocations. Another 10 animals were added to the park in 2001 and 2003 (Graf et al. 2006; Gusset et al. 2006a). At the end of 2004, there were 48 known wild dogs living in six packs (Gusset et al. 2006b), and future translocations of wild dogs to and from HiP are envisaged. In addition, an unknown number of wild dogs occur around HiP on private and communal land (also see Lindsey et al. 2004a).

Questionnaire survey and analysis

As continuous translocations are a vital part of the wild dog meta-population management plan (Mills et al. 1998), we decided in 1999 to launch a public relations campaign and as part of this to conduct a questionnaire survey to assess the attitudes towards wild dogs of multiple stakeholders—local community members, private landowners and tourists—in and around HiP, and to determine factors that influence those attitudes. The objectives of the campaign were to gain public acceptance of management practices relating to wild dogs and to evaluate whether re-introduced wild dogs can provide financial benefits to rural people through ecotourism.

As part of this campaign, we implemented a conservation education programme from 1999 to 2000, by visiting members of local communities adjacent to HiP in their villages for public meetings and workshops on wild dogs. In addition, we contacted livestock and game farmers from the Magudu area north of HiP during information meetings in 1999, and approached tourists randomly while staying in one of the rest camps in HiP in 2000. The participants were asked to fill in a structured, closed-format (dichotomous or multiple choice) questionnaire (assisted and translated into Zulu when necessary) regarding their perception of, knowledge about and potential problems with wild dogs. The questionnaire also included personal questions about the participants (gender, age, personal experience of wild dogs, engagement in hunting activity, residency, nationality, level of education and experienced livestock losses). Local community members completed the questionnaire after the conservation education programme was implemented. To assess the effects of the programme, the same villages were visited again in 2003 for public meetings and the participants were asked to complete another questionnaire (assisted and translated into Zulu when necessary).

The answers extracted from the questionnaires were later grouped for comparison between stakeholder groups and for analysis according to personal details of the respondents (possible for the tourist and local community member 2003 surveys). For categorical data in the comparison between stakeholder groups, χ^2 tests for k ($k = 2, 3, 4$) independent samples for all contingency tables were used. Statistical associations between answers and personal details of the respondents in multiway contingency tables were assessed using log-linear models (Knokke and Burke 1980), a specialised case of generalised linear models that allows for testing conditional relationships between discrete, categorical variables. For

continuous data, Mann–Whitney U tests for two independent samples and Kruskal–Wallis one-way analysis of variance for three independent samples were used. All statistical tests were two-tailed, with the significance level set at $P = 0.05$, and were run on Statgraphics Plus 7.0 (1993).

Results

A total of 97 tourists and 165 Zulu villagers (94 in 1999/2000 and 71 in 2003, respectively) filled in the questionnaires. A low return rate was achieved in the questionnaires distributed to private landowners (35%, $n = 6$ respondents), therefore leaving a possible non-response bias in the farmer survey data and also largely reducing the expressiveness of the results. For this reason, the remainder of the article mainly focuses on tourists and local community members.

Stakeholder profiles

Tourists throughout had significantly more positive perceptions of wild dogs than did Zulu villagers in both surveys, with farmers having intermediate opinions (Table 1). Tourists were well aware of the endangered status of wild dogs (Fig. 1), with 95% of visitors ($n = 80$ respondents) reportedly having at least some knowledge about these animals, mainly acquired through the media (69% of information). This knowledge was fairly accurate and misconceptions among tourists were rare (Appendix 1). Otherwise, in general, neither gender, age, engagement in hunting activity, residency nor nationality significantly influenced a tourist's attitude (Appendix 1).

In contrast, a significant deterioration in views and increase in misconceptions among Zulu villagers from the first to the second survey became apparent (Table 1). The majority of participants in the 2003 survey had negative attitudes towards wild dogs, paired with fear of large carnivores and lacking knowledge about conservation issues (Appendix 2). Similar to the tourist survey, personal details of the respondents (gender, age and personal experience of wild dogs) generally did not significantly influence a local community member's perception, except for the respondents who experienced livestock losses and consequently had significantly less positive attitudes towards wild dogs (Appendix 2). The minority of educated participants constantly had more favourable opinions about wild dogs, but the statistical significance of this relationship was masked by small sample sizes of educated respondents (Appendix 2).

Value of wild dogs for ecotourism

Tourists ranked wild dogs as a top attraction in HiP (Fig. 1), with a high attractiveness of wild dogs and willingness to pay for seeing them (Table 1, Appendix 1). In addition, after having seen free-ranging wild dogs, tourists became significantly more favourable towards them (Appendix 1). In contrast, among Zulu villagers there was a significant decrease in the perceived value of re-introduced wild dogs for ecotourism from the first to the second survey (Table 1).

Table 1 Multiple stakeholders' attitudes towards re-introduced wild dogs in and around Hluhluwe-iMfolozi Park (percentages given in parentheses)

| | Stakeholders | | | |
|--|--------------|-----------|-----------------|-----------------|
| | Tourists | Farmers | LC members 2000 | LC members 2003 |
| Stakeholder profiles | | | | |
| What is your general attitude towards wild dogs? ($\chi^2 = 72.05$, $df = 6$, $P < 0.001$) | | | | |
| Positive | 78 (82.1) | 4 (66.6) | 37 (43.0) | 11 (16.7) |
| Neutral | 15 (15.8) | 1 (16.7) | 35 (40.7) | 40 (60.6) |
| Negative | 2 (2.1) | 1 (16.7) | 14 (16.3) | 15 (22.7) |
| Have you ever seen free-ranging wild dogs? ($\chi^2 = 22.39$, $df = 6$, $P < 0.01$) | | | | |
| Yes | 52 (65.0) | 3 (50.0) | 48 (53.3) | 35 (49.3) |
| No | 26 (32.5) | 3 (50.0) | 42 (46.7) | 26 (36.6) |
| Not sure | 2 (2.5) | 0 (0.0) | 0 (0.0) | 10 (14.1) |
| How many wild dogs do you think there are in Africa? ($H = 4.87$, $df = 2$, not significant) | | | | |
| Median | 2,500 | Not asked | 800 | 400 |
| How many wild dogs do you think there are in KwaZulu-Natal Province? ($H = 2.29$, $df = 2$, not significant) | | | | |
| Median | 50 | Not asked | 100 | 100 |
| Which predators do you think are the most dangerous to humans? ($\chi^2 = 5.18$, $df = 4$, not significant) | | | | |
| Wild dog | 0 (0.0) | Not asked | Not asked | 2 (2.9) |
| Lion | 36 (45.0) | | | 28 (41.8) |
| Spotted hyaena | 4 (5.0) | | | 1 (1.5) |
| Leopard | 11 (13.8) | | | 6 (9.0) |
| All equal | 29 (36.2) | | | 30 (44.8) |
| Value of wild dogs for ecotourism | | | | |
| As a tourist, would you be attracted to an area with free-ranging wild dogs? ($\chi^2 = 0.84$, $df = 1$, not significant) | | | | |
| Yes | 84 (88.4) | 4 (66.7) | Not asked | Not asked |
| No | 11 (11.6) | 2 (33.3) | | |
| As a hunter, would you prefer to hunt in an area with free-ranging wild dogs? ($\chi^2 = 1.43$, $df = 1$, not significant) | | | | |
| Yes | 17 (53.1) | 1 (16.7) | Not asked | Not asked |
| No | 15 (46.9) | 5 (83.3) | | |
| Stakeholder attitudes towards wild dog re-introductions | | | | |
| Are you in favour of re-introducing wild dogs into HiP? ($\chi^2 = 22.70$, $df = 6$, $P < 0.001$) | | | | |
| Yes | 16 (100.0) | 4 (66.6) | 54 (60.7) | 27 (38.6) |
| Neutral | 0 (0.0) | 1 (16.7) | 18 (20.2) | 19 (27.1) |
| No | 0 (0.0) | 1 (16.7) | 17 (19.1) | 24 (34.3) |
| If yes, what are your reasons for being in favour of re-introducing wild dogs into HiP? ($\chi^2 = 13.30$, $df = 4$, $P = 0.01$) | | | | |
| For biological reasons | 22 (78.6) | Not asked | 29 (42.0) | 18 (69.2) |
| For ecotourism | 3 (10.7) | | 23 (33.3) | 4 (15.4) |
| For other reasons | 3 (10.7) | | 17 (24.7) | 4 (15.4) |
| The costs of re-introducing wild dogs into HiP would exceed any future financial benefits. ($\chi^2 = 6.92$, $df = 2$, $P = 0.03$) | | | | |
| Agree | 8 (10.0) | 2 (33.3) | Not asked | Not asked |
| Neutral | 17 (21.3) | 3 (50.0) | | |

Table 1 continued

| | Stakeholders | | | |
|--|--------------|-----------|-----------------|-----------------|
| | Tourists | Farmers | LC members 2000 | LC members 2003 |
| Disagree | 55 (68.7) | 1 (16.7) | | |
| Re-introduced wild dogs would cause unacceptable levels of livestock losses outside HiP. ($\chi^2 = 1.41$, $df = 4$, not significant) | | | | |
| Agree | Not asked | 4 (66.7) | 45 (54.2) | 40 (59.7) |
| Neutral | | 0 (0.0) | 12 (14.5) | 8 (11.9) |
| Disagree | | 2 (33.3) | 26 (31.3) | 19 (28.4) |
| Re-introduced wild dogs would reduce game numbers to unacceptable levels in HiP. ($\chi^2 = 67.06$, $df = 6$, $P < 0.001$) | | | | |
| Agree | 2 (2.5) | 4 (66.7) | 39 (47.6) | 40 (60.6) |
| Neutral | 20 (25.0) | 0 (0.0) | 16 (19.5) | 11 (16.7) |
| Disagree | 58 (72.5) | 2 (33.3) | 27 (32.9) | 15 (22.7) |
| Do you have any additional comments on re-introducing wild dogs into HiP? ($\chi^2 = 4.59$, $df = 2$, not significant) | | | | |
| Positive | Not asked | 0 (0.0) | 27 (47.4) | 12 (29.3) |
| Negative | | 2 (100.0) | 30 (52.6) | 29 (70.7) |

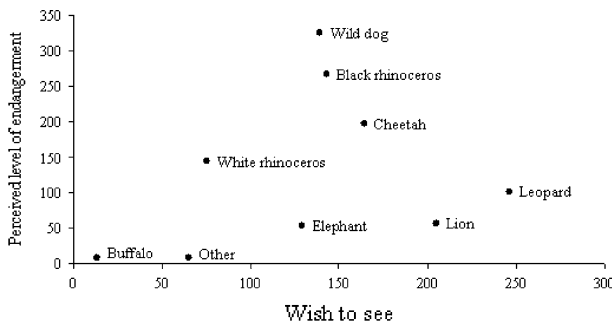
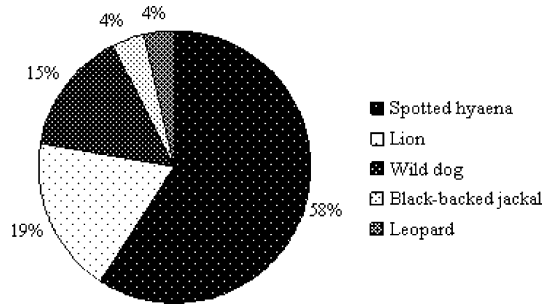


Fig. 1 Animal species that tourists wanted to see most in Hluhluwe-iMfolozi Park and the perceived level of endangerment of those species ($n = 79$ respondents)

Stakeholder attitudes towards wild dog re-introductions

Tourists answered all questions in favour of wild dog re-introductions and most respondents weighed the biological value of re-introductions higher than potential economic and non-monetary costs (Table 1, Appendix 1). In contrast, the attitudes of Zulu villagers towards wild dog re-introductions significantly deteriorated from the first to the second survey (Table 1). In the 2003 survey, the majority of participants had negative opinions about the employed management practices (Appendix 2). Wild dogs and other predators apparently are continuously persecuted outside HiP by a number of respondents, mainly for perceived and real threats of livestock losses (Appendix 2). Half of the participants who

Fig. 2 Predators held responsible by local community members for killing livestock around Hluhluwe-iMfolozi Park ($n = 27$ respondents)



own livestock claimed losses due to large carnivore predation, mainly blamed on spotted hyaenas but occasionally also on wild dogs (Fig. 2).

Discussion

Our study has demonstrated the continued conflict of interests among different stakeholder groups over the conservation of large carnivores, despite their value for ecotourism. This corroborates previous findings that the outcome of large carnivore re-introductions can be influenced by valuational aspects and socio-political considerations (Reading and Clark 1996; Breitenmoser et al. 2001). Therefore, what seems to matter for the restoration and recovery of large carnivore populations is the attitude people have towards these animals.

Breitenmoser (1998) argued that representatives of modern western societies, with a basic lifestyle secured, regard the traditional aversion to predators as a symbol of human intolerance against nature, and to let large carnivores return is therefore no more than compensation for the persecution they have suffered. Our study has shown that the vast majority of tourists, who mostly live in areas where large carnivores do not occur, have indeed overwhelmingly positive attitudes towards wild dogs and the employed management practices. Misconceptions were rare and almost all respondents were aware of the endangered status of wild dogs, which emphasises the importance of positive media coverage for wildlife conservation. Personal details of the respondents in general appeared to play a minor role; however, seeing wild dogs in their natural habitat was a major factor in promoting the conservation of this species among tourists. Visitors to HiP ranked wild dogs as a top attraction and were prepared to pay extra money to see free-ranging wild dogs (up to US\$150), which has been confirmed by Lindsey et al. (2005b) for other protected areas in South Africa. Wild dogs, therefore, seem to be a natural resource that can be used sustainably and profitably for ecotourism. Money generated through wild dog-based ecotourism could potentially also be used for subsidising future planned, but costly, wild dog re-introductions and translocations (Lindsey et al. 2005b), which are desired from both a conservationist and tourist perspective.

Conflicting with those interests, however, we found that most members of local communities were generally much more sceptical of wild dogs, and many apparently continue to persecute them outside HiP, despite formal legal protection. Similar results have been obtained in recent comparable studies on wild dogs in many parts of Africa (Kock et al. 1999; Breuer 2003; Davies and Du Toit 2004; McCreery and Robbins 2004; Dutson and Sillero-Zubiri 2005; Lindsey et al. 2005a). Our results suggest that the acceptance of large

carnivores by people around HiP will depend on the degree of predation on their livestock, a worldwide problem in large carnivore management (Treves and Karanth 2003; Graham et al. 2005). Wild dogs leaving HiP may on rare occasions be a threat to the poorly attended livestock that is kept in large numbers around HiP (see Childes 1988; Hines 1990; Kock et al. 1999; Rasmussen 1999; Davies and Du Toit 2004; Dutson and Sillero-Zubiri 2005; Woodroffe et al. 2005), despite people neighbouring the park being informed about such emigration events. Furthermore, whether wild dogs have actually been responsible for claimed livestock losses remains questionable. More research is needed to assess true economic losses and the precise circumstances under which wild dogs take livestock. Problems might be more perceived than real when considering other sources of livestock loss (e.g. theft or road kills), with predation on livestock often being manageable through improved livestock husbandry practices and predator deterrents (Ogada et al. 2003; Shivik et al. 2003). Nevertheless, most rural people around HiP do not see any ecological, aesthetic or ethical value in large carnivores, so how can we motivate them to care about these animals and increase the threshold of what they are prepared to tolerate?

As efforts to force rural people into protecting large carnivores often lead to poaching and poor relations with conservation authorities (see Infield 1988 for experiences around HiP), the emerging consensus among conservationists is to provide people with an incentive to willingly tolerate predators on their land (Mishra et al. 2003; Naughton-Treves et al. 2003). This is particularly important around the borders of protected areas that generally cannot contain large carnivores within their boundaries (Marker et al. 2003; Patterson et al. 2004; Kolowski and Holekamp 2006). Thus, if the conflict is solely centred around economic interests, its intensity should be reduced if acceptable and adequate financial incentive schemes are instituted, for example through elaborated compensation measures (Montag 2003; Nyhus et al. 2003). In spite of such economic incentives being in place in HiP, with its commitment to investing park revenues generated through ecotourism in community development and compensating for livestock losses, conflicts continue to exist. Consequently, the conflict may reflect more than diverging economic interests, and it appears that various stakeholders involved also differ in more fundamental beliefs regarding the relationship between humans and the rest of nature.

In addition to important but potentially short-lived financial incentive programmes that are largely dependent on the prevailing economic and political situation, one key to long-term conservation success seems to be continued education (Taylor 2004). Our results show that the view of wild dogs by rural people is undermined by misconceptions and fear, and that after the conservation education programme ended in 2000, the opinions about wild dogs worsened from the first to the second questionnaire survey in 2003. With no obvious change in the relationship between park management and local communities or in financial benefits received from the park in the time between the two surveys, this suggests that the conservation education programme was actually successful in creating more favourable perceptions of wild dogs, but without lasting impact probably due to its short-lived nature. Many respondents, however, were undecided in their attitude towards wild dogs and thus potentially still susceptible to a change in perception. These and other of our findings were corroborated by the study of Infield (1988) on the same local communities.

Although we found an encouraging number of private landowners who have positive attitudes towards wild dogs, raising the awareness among livestock and game farmers should also be an integral part of any public relations campaign in order to dispel chronic antagonism and deep-rooted prejudices (Lindsey et al. 2005a). Farmers could be encouraged to manage their land for the benefit of wild dogs, as Lindsey et al. (2005b, c) found wild dog conservation on private land to be cost efficient and predicted revenue from wild

dog-based ecotourism to exceed costs under most game ranching conditions. Incorporating game ranches around protected areas into wild dog conservation efforts would be a major step forward (Woodroffe and Ginsberg 1997b, 1999; Lindsey et al. 2004b), as these properties still contain wild prey and are often free of other large carnivores, with lion and spotted hyaena competition being a potentially important factor in keeping wild dog densities low (Creel and Creel 1996, 2002; Mills and Gorman 1997; Van Dyk and Slotow 2003). Tourist revenues, particularly extra money generated through wild dog-based ecotourism, could potentially fund such awareness campaigns.

Furthermore, monetary benefits are not the only possible incentives (Hackel 1999; Berkes 2004); a participatory approach by allowing local community members and farmers to take on shared responsibility in management practices relating to large carnivores (e.g. in selective problem animal control) might represent a feasible option. Neither local community members nor private landowners were consulted on the original wild dog re-introduction and subsequent translocations to HiP, and this marginalisation and lack of control over their traditional environment might have contributed to their currently negative perceptions of management practices.

In conclusion, our results suggest that conservation of large carnivores can be viable if financial incentive schemes are modified, elaborated and continued education is provided, livestock management techniques are improved, and other forms of incentives such as the already implemented co-management become more effective and are further promoted (also see Sillero-Zubiri and Switzer 2004; Sillero-Zubiri et al. 2004). For that purpose, it might be necessary to appoint local full-time carnivore community conservation and education officers to implement education and incentive programmes, including verifying livestock losses due to predators, as well as to encourage and supervise improvements in livestock husbandry practices.

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Appendix 1 Tourists' attitudes towards re-introduced wild dogs in Hluhluwe-iMfolozi Park (HiP) across personal details of the respondents (percentages given in parentheses)

| Tourists | | | | | | | | | | | | | |
|---|-----------|-----------|----------------|-----------|-----------|----------------------------------|-----------|---------------------|-----------|------------------------|-----------|--------------------------|-----------|
| | Gender | | Age (in years) | | | Personal experience ¹ | | Hunter ² | | Residency ³ | | Nationality ⁴ | |
| | Male | Female | 11–30 | 31–50 | 51–70 | Yes | No | Yes | No | Urban | Rural | SA | Non-SA |
| Stakeholder profiles | | | | | | | | | | | | | |
| What is your general attitude towards wild dogs? | | | | | | | | | | | | | |
| Positive | 64 (81.0) | 38 (79.2) | 26 (83.9) | 24 (82.8) | 45 (88.2) | 17 (65.4) | a | 24 (75.0) | 40 (85.1) | 47 (78.3) | 17 (89.5) | 27 (87.1) | 36 (76.6) |
| Neutral | 14 (17.7) | 9 (18.7) | 5 (16.1) | 2 (13.3) | 7 (21.2) | 5 (9.8) | | 8 (25.0) | 6 (12.8) | 12 (20.0) | 2 (10.5) | 4 (12.9) | 10 (21.3) |
| Negative | 1 (1.3) | 1 (2.1) | 0 (0.0) | 0 (0.0) | 1 (2.0) | 0 (0.0) | | 0 (0.0) | 1 (2.1) | 1 (1.7) | 0 (0.0) | 0 (0.0) | 1 (2.1) |
| Have you ever seen free-ranging wild dogs? | | | | | | | | | | | | | |
| Yes | 52 (65.0) | 32 (66.7) | 20 (62.5) | 9 (60.0) | 21 (61.8) | 21 (72.4) | N/A | 20 (62.5) | 32 (66.7) | 37 (61.7) | 15 (75.0) | 25 (80.6) | 27 (56.3) |
| No | 26 (32.5) | 16 (33.3) | 10 (31.3) | 5 (33.3) | 13 (38.2) | 8 (27.6) | | 12 (37.5) | 14 (29.2) | 22 (36.7) | 4 (20.0) | 6 (19.4) | 19 (39.6) |
| Not sure | 2 (2.5) | 0 (0.0) | 2 (6.2) | 1 (6.7) | 0 (0.0) | 0 (0.0) | | 0 (0.0) | 2 (4.1) | 1 (1.6) | 1 (5.0) | 0 (0.0) | 2 (4.1) |
| Would you be afraid of hiking in an area with free-ranging wild dogs? | | | | | | | | | | | | | |
| Yes | 13 (16.5) | 4 (8.3) | 9 (29.0) | 3 (20.0) | 7 (20.6) | 3 (10.7) | 7 (13.7) | 6 (23.1) | c | 5 (15.6) | 8 (17.0) | 4 (13.3) | 9 (18.8) |
| Neutral | 6 (7.6) | 5 (10.4) | 1 (3.2) | 2 (13.3) | 2 (5.9) | 2 (7.1) | 1 (2.0) | 5 (19.2) | | 0 (0.0) | 6 (12.8) | 1 (3.3) | 5 (10.4) |
| No | 60 (75.9) | 39 (81.3) | 21 (67.8) | 10 (66.7) | 25 (73.5) | 23 (82.2) | 43 (84.3) | 15 (57.7) | | 27 (84.4) | 33 (70.2) | 25 (83.4) | 34 (70.8) |
| Which predators do you think are the most dangerous to humans? | | | | | | | | | | | | | |
| Wild dog | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | f | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| Lion | 36 (45.0) | 27 (56.3) | 9 (28.1) | 7 (46.7) | 14 (41.2) | 15 (51.8) | 28 (53.9) | 7 (26.9) | | 17 (53.2) | 19 (39.5) | 16 (51.6) | 19 (39.6) |
| Hyaena | 4 (5.0) | 1 (2.1) | 3 (9.4) | 1 (6.6) | 1 (2.9) | 2 (6.9) | 4 (7.7) | 0 (0.0) | | 1 (3.1) | 3 (6.3) | 3 (9.7) | 1 (2.1) |
| Leopard | 11 (13.8) | 8 (16.6) | 3 (9.4) | 3 (20.0) | 4 (11.8) | 3 (10.3) | 6 (11.5) | 5 (19.2) | | 5 (15.6) | 6 (12.5) | 5 (16.1) | 6 (12.5) |
| All equal | 29 (36.2) | 12 (25.0) | 17 (53.1) | 4 (26.7) | 15 (44.1) | 9 (31.0) | 14 (26.9) | 14 (53.9) | | 9 (28.1) | 20 (41.7) | 7 (22.6) | 22 (45.8) |
| Value of wild dogs for ecotourism | | | | | | | | | | | | | |
| As a tourist, would you be attracted to an area with free-ranging wild dogs? | | | | | | | | | | | | | |
| Yes | 69 (87.3) | 41 (87.2) | 28 (87.5) | 11 (78.6) | 30 (88.2) | 26 (89.7) | 49 (94.2) | 18 (72.0) | g | 27 (84.4) | 42 (89.4) | h | 29 (96.7) |
| No | 10 (12.7) | 6 (12.8) | 4 (12.5) | 3 (21.4) | 4 (11.8) | 3 (10.3) | 3 (5.8) | 7 (28.0) | | 5 (15.6) | 5 (10.6) | 10 (16.7) | 9 (18.7) |

Appendix 1 continued

| | | Age (in years) | | | | Personal experience ¹ | | Hunter ² | | Residency ³ | | Nationality ⁴ | | | |
|--|-----------|----------------|-----------|-----------|-----------|----------------------------------|-----------|---------------------|-----------|------------------------|-----------|--------------------------|----|-----------|-----------|
| Total | | Male | Female | 11–30 | 31–50 | 51–70 | Yes | No | Yes | No | Urban | Rural | SA | Non-SA | |
| Tourists | | | | | | | | | | | | | | | |
| As a hunter, would you prefer to hunt in an area with free-ranging wild dogs? | | | | | | | | | | | | | | | |
| Yes | 17 (53.1) | 16 (59.3) | 1 (20.0) | 2 (33.3) | 7 (50.0) | 8 (66.7) | 12 (60.0) | 5 (41.7) | N/A | N/A | 10 (40.0) | 7 (100) | j | 10 (71.4) | 7 (38.9) |
| No | 15 (46.9) | 11 (40.7) | 4 (80.0) | 4 (66.7) | 7 (50.0) | 4 (33.3) | 8 (40.0) | 7 (58.3) | | | 15 (60.0) | 0 (0.0) | 4 | 4 (28.6) | 11 (61.1) |
| What would be the most you are prepared to pay for visiting an occupied wild dog den? | | | | | | | | | | | | | | | |
| US\$0 | 23 (30.3) | 13 (27.6) | 10 (34.5) | 6 (40.0) | 7 (20.6) | 10 (37.0) | 14 (28.6) | 8 (30.8) | 10 (31.2) | 13 (29.5) | 17 (28.8) | 6 (35.3) | | 10 (35.7) | 13 (27.7) |
| US\$10–20 | 38 (50.0) | 24 (51.1) | 14 (48.3) | 5 (33.3) | 21 (61.8) | 12 (44.5) | 25 (51.0) | 13 (50.0) | 14 (43.8) | 24 (54.6) | 30 (50.9) | 8 (47.1) | | 13 (46.4) | 24 (51.1) |
| US\$50–150 | 15 (19.7) | 10 (21.3) | 5 (17.2) | 4 (26.7) | 6 (17.6) | 5 (18.5) | 10 (20.4) | 5 (19.2) | 8 (25.0) | 7 (15.9) | 12 (20.3) | 3 (17.6) | | 5 (17.9) | 10 (21.2) |
| Stakeholder attitudes towards wild dog re-introductions | | | | | | | | | | | | | | | |
| Because of the existing wild dog population in Kruger National Park, there is no need for re-introducing wild dogs into HIP. | | | | | | | | | | | | | | | |
| Agree | 3 (3.8) | 2 (4.2) | 1 (3.1) | 1 (6.7) | 0 (0.0) | 2 (6.9) | 1 (1.9) | 2 (7.7) | 2 (6.3) | 1 (2.1) | 3 (5.0) | 0 (0.0) | 1 | 2 (6.5) | 1 (2.1) |
| Neutral | 9 (11.2) | 6 (12.5) | 3 (9.4) | 1 (6.7) | 6 (17.6) | 2 (6.9) | 3 (5.8) | 6 (23.1) | 5 (15.6) | 4 (8.3) | 9 (15.0) | 0 (0.0) | | 1 (3.2) | 8 (16.7) |
| Disagree | 68 (85.0) | 40 (83.3) | 28 (87.5) | 13 (86.6) | 28 (82.4) | 25 (86.2) | 48 (92.3) | 18 (69.2) | 25 (78.1) | 43 (89.6) | 48 (80.0) | 20 (100) | | 28 (90.3) | 39 (81.2) |
| The costs of re-introducing wild dogs into HiP would exceed any future financial benefits. | | | | | | | | | | | | | | | |
| Agree | 8 (10.0) | 5 (10.4) | 3 (9.4) | 2 (13.3) | 3 (8.8) | 2 (6.9) | 6 (11.5) | 1 (3.8) | 3 (9.3) | 5 (10.4) | 7 (11.7) | 1 (5.0) | | 5 (16.1) | 3 (6.3) |
| Neutral | 17 (21.3) | 11 (22.9) | 6 (18.8) | 3 (20.0) | 9 (26.5) | 5 (17.2) | 8 (15.4) | 9 (34.6) | 10 (31.3) | 7 (14.6) | 14 (23.3) | 3 (15.0) | | 1 (3.2) | 16 (33.3) |
| Disagree | 55 (68.7) | 32 (66.7) | 23 (71.8) | 10 (66.7) | 22 (64.7) | 22 (75.9) | 38 (73.1) | 16 (61.6) | 19 (59.4) | 36 (75.0) | 39 (65.0) | 16 (80.0) | | 25 (80.7) | 29 (60.4) |
| Re-introduced wild dogs would reduce game numbers to unacceptable levels in HIP. | | | | | | | | | | | | | | | |
| Agree | 2 (2.5) | 1 (2.1) | 1 (3.1) | 1 (6.7) | 0 (0.0) | 1 (3.4) | 0 (0.0) | 2 (7.7) | 1 (3.1) | 1 (2.1) | 2 (3.3) | 0 (0.0) | | 1 (3.2) | 1 (2.1) |
| Neutral | 20 (25.0) | 12 (25.0) | 8 (25.0) | 3 (20.0) | 10 (29.4) | 6 (20.7) | 10 (19.2) | 9 (34.6) | 9 (28.1) | 11 (22.9) | 16 (26.7) | 4 (20.0) | | 4 (12.9) | 16 (33.3) |
| Disagree | 58 (72.5) | 35 (72.9) | 23 (71.9) | 11 (73.3) | 24 (70.6) | 22 (75.9) | 42 (80.8) | 15 (57.7) | 22 (68.8) | 36 (75.0) | 42 (70.0) | 16 (80.0) | | 26 (83.9) | 31 (64.6) |

Appendix 1 continued

| Tourists | | Age (in years) | | | Personal experience ¹ | | Hunter ² | | Residency ³ | | Nationality ⁴ | |
|---|-----------|----------------|-----------|-----------|----------------------------------|-----------|---------------------|-----------|------------------------|-----------|--------------------------|-----------|
| Total | Gender | 11–30 | 31–50 | 51–70 | Yes | No | Yes | No | Urban | Rural | SA | Non-SA |
| | Male | | | | | | | | | | | |
| | Female | | | | | | | | | | | |
| Re-introduced wild dogs would have a negative impact on big game hunting opportunities outside HHP. | | | | | | | | | | | | |
| Agree | 1 (1.3) | 0 (0.0) | 0 (0.0) | 1 (3.8) | 1 (2.0) | 0 (0.0) | 1 (3.1) | 0 (0.0) | 1 (1.7) | 0 (0.0) | 1 (3.4) | 0 (0.0) |
| Neutral | 24 (31.6) | 11 (23.9) | 13 (43.3) | 3 (20.0) | 13 (39.4) | 7 (26.9) | 12 (24.5) | 11 (44.0) | 8 (25.0) | 16 (36.4) | 5 (17.2) | 19 (41.3) |
| Disagree | 51 (67.1) | 34 (73.9) | 17 (56.7) | 12 (80.0) | 20 (60.6) | 18 (69.3) | 36 (73.5) | 14 (56.0) | 23 (71.9) | 28 (63.6) | 23 (79.4) | 27 (58.7) |

¹ Refers to the question whether a respondent has ever seen free-ranging wild dogs (Yes) or not (No)

² Refers to the question whether a respondent hunts (Yes) or not (No)

³ Refers to the question whether a respondent lives in an area with more (Urban) or less (Rural) than 10,000 people

⁴ Refers to the question whether a respondent is South African (SA) or not (Non-SA)

a: $\Delta L^2 = 7.64$, $df = 2$, $P = 0.02$, $R^2 = 0.14$; b: $\Delta L^2 = 7.32$, $df = 2$, $P = 0.03$, $R^2 = 0.10$; c: $\Delta L^2 = 9.14$, $df = 2$, $P = 0.01$, $R^2 = 0.13$; d: $\Delta L^2 = 7.47$, $df = 2$, $P = 0.02$, $R^2 = 0.11$; e: $\Delta L^2 = 11.20$, $df = 3$, $P = 0.01$, $R^2 = 0.09$; f: $\Delta L^2 = 11.91$, $df = 3$, $P < 0.01$, $R^2 = 0.02$; g: $\Delta L^2 = 7.11$, $df = 1$, $P < 0.01$, $R^2 = 0.19$; h: $\Delta L^2 = 5.96$, $df = 1$, $P = 0.02$, $R^2 = 0.16$; i: $\Delta L^2 = 4.72$, $df = 1$, $P = 0.03$, $R^2 = 0.13$; j: $\Delta L^2 = 10.59$, $df = 1$, $P < 0.01$, $R^2 = 0.42$; k: $\Delta L^2 = 6.91$, $df = 2$, $P = 0.03$, $R^2 = 0.14$; l: $\Delta L^2 = 7.63$, $df = 2$, $P = 0.02$, $R^2 = 0.15$; m: $\Delta L^2 = 13.42$, $df = 2$, $P < 0.01$, $R^2 = 0.17$; n: $\Delta L^2 = 7.59$, $df = 2$, $P = 0.02$, $R^2 = 0.11$; all other associations are not significant

Significant associations are indicated by letters (a to n) at the right side of the respective columns and the corresponding statistical parameters of the log-linear model are reported

Appendix 2 Local community members' attitudes towards re-introduced wild dogs around Hluhluwe-iMfolozi Park (HiP) across personal details of the respondents in 2003 (percentages given in parentheses)

| Local community members 2003 | | | | | | | | | | | |
|--|-----------|-----------|-----------|-----------|----------------------------------|-----------|---------------------------------|-----------|-------------------------------|-----------|---|
| | Gender | | Age | | Personal experience ¹ | | Level of education ² | | Livestock losses ³ | | |
| | Male | Female | Adult | Minor | Yes | No | High | Low | Yes | No | |
| Stakeholder profiles | | | | | | | | | | | |
| What is your general attitude towards wild dogs? | | | | | | | | | | | |
| Positive | 11 (16.7) | 2 (20.0) | 2 (15.4) | 5 (15.2) | 7 (21.2) | 4 (16.7) | 3 (27.3) | 3 (13.6) | 3 (11.5) | 6 (25.0) | a |
| Neutral | 40 (60.6) | 2 (20.0) | 7 (53.8) | 24 (72.7) | 17 (51.5) | 17 (70.8) | 7 (63.6) | 9 (40.9) | 14 (53.9) | 16 (66.7) | |
| Negative | 15 (22.7) | 6 (60.0) | 4 (30.8) | 11 (33.3) | 4 (12.1) | 9 (27.3) | 1 (9.1) | 10 (45.5) | 9 (34.6) | 2 (8.3) | |
| Have you ever seen free-ranging wild dogs? | | | | | | | | | | | |
| Yes | 35 (49.3) | 9 (69.2) | 5 (35.7) | 16 (47.1) | N/A | N/A | 6 (54.5) | 13 (50.0) | 17 (63.0) | 7 (26.9) | b |
| No | 26 (36.6) | 4 (30.8) | 8 (57.2) | 16 (43.2) | 10 (29.4) | | 4 (36.4) | 12 (46.2) | 7 (25.9) | 14 (53.9) | |
| Not sure | 10 (14.1) | 0 (0.0) | 1 (7.1) | 2 (5.4) | 8 (23.5) | | 1 (9.1) | 1 (3.8) | 3 (11.1) | 5 (19.2) | |
| How many wild dogs do you think there are in Africa? | | | | | | | | | | | |
| Median | 400 | 1,000 | 74 | 400 | 261 | 319 | 300 | 253 | 237 | 750 | |
| How many wild dogs do you think there are in KwaZulu-Natal Province? | | | | | | | | | | | |
| Median | 100 | 150 | 78 | 100 | 100 | 100 | 100 | 105 | 109 | 100 | |
| How many wild dogs do you think there are in HiP? | | | | | | | | | | | |
| Under estimate | 13 (18.8) | 0 (0.0) | 3 (21.4) | 9 (25.7) | 4 (11.8) | 6 (17.6) | 7 (28.0) | 6 (54.5) | 3 (12.5) | 4 (14.8) | c |
| Correct number (ca. 44) | 18 (26.1) | 1 (9.1) | 4 (28.6) | 8 (22.9) | 10 (29.4) | 8 (23.5) | 6 (24.0) | 3 (27.3) | 5 (20.8) | 8 (29.6) | |
| Over estimate | 38 (55.1) | 10 (90.9) | 7 (50.0) | 18 (51.4) | 20 (58.8) | 20 (58.9) | 12 (48.0) | 2 (18.2) | 16 (66.7) | 15 (55.6) | |
| Did you know that wild dogs are in danger of becoming extinct because of human activities? | | | | | | | | | | | |
| Yes | 8 (11.3) | 1 (7.7) | 2 (14.3) | 5 (13.5) | 3 (8.8) | 6 (17.1) | 2 (7.7) | 2 (18.2) | 3 (11.5) | 5 (18.5) | |
| No | 63 (88.7) | 12 (92.3) | 12 (85.7) | 32 (86.5) | 31 (91.2) | 29 (82.9) | 24 (92.3) | 9 (81.8) | 23 (88.5) | 22 (81.5) | |

Appendix 2 continued

| Local community members 2003 | | | | | | | | | | | | |
|---|-----------|-----------|------------|-----------|----------------------------------|-----------|---------------------------------|-----|-------------------------------|-----------|-----------|-----------|
| Total | Gender | | Age | | Personal experience ¹ | | Level of education ² | | Livestock losses ³ | | | |
| | Male | Female | Adult | Minor | Yes | No | High | Low | Yes | No | | |
| Do you think it is important to protect animal species from becoming extinct? | | | | | | | | | | | | |
| Yes | 54 (80.6) | 8 (72.7) | 11 (84.6) | 28 (82.4) | 26 (78.8) | 28 (84.8) | 19 (79.2) | D | 10 (90.9) | 18 (78.3) | 21 (77.8) | 22 (88.0) |
| No | 13 (19.4) | 3 (27.3) | 2 (15.4) | 6 (17.6) | 7 (21.2) | 5 (15.2) | 5 (20.8) | | 1 (9.1) | 5 (21.7) | 6 (22.2) | 3 (12.0) |
| Would you be able to distinguish between different predators? | | | | | | | | | | | | |
| Yes | 45 (67.2) | 10 (90.9) | 8 (61.5) | 24 (70.6) | 21 (63.6) | 25 (78.1) | 14 (56.0) | | 7 (63.6) | 17 (73.9) | 17 (65.4) | 21 (80.8) |
| No | 22 (32.8) | 1 (9.1) | 5 (38.5) | 10 (29.4) | 12 (36.4) | 7 (21.9) | 11 (44.0) | | 4 (36.4) | 6 (26.1) | 9 (34.6) | 5 (19.2) |
| Are you scared of wild dogs? | | | | | | | | | | | | |
| Yes | 55 (79.7) | 9 (69.2) | 13 (100.0) | 30 (83.3) | 25 (75.8) | 26 (76.5) | 20 (76.9) | | 8 (72.7) | 22 (88.0) | 22 (88.0) | 21 (80.8) |
| No | 14 (20.3) | 4 (30.8) | 0 (0.0) | 6 (16.7) | 8 (24.2) | 8 (23.5) | 6 (23.1) | | 3 (27.3) | 3 (12.0) | 3 (12.0) | 5 (19.2) |
| Which predators do you think are the most dangerous to humans? | | | | | | | | | | | | |
| Wild dog | 2 (3.0) | 0 (0.0) | 0 (0.0) | 1 (2.9) | 1 (3.0) | 2 (6.3) | 0 (0.0) | | 1 (9.1) | 0 (0.0) | 1 (3.7) | 1 (3.8) |
| Lion | 28 (41.7) | 8 (80.0) | 5 (35.7) | 15 (44.2) | 13 (39.4) | 16 (50.0) | 9 (36.0) | | 3 (27.3) | 12 (52.2) | 13 (48.2) | 12 (46.2) |
| Spotted hyaena | 1 (1.5) | 0 (0.0) | 0 (0.0) | 1 (2.9) | 0 (0.0) | 0 (0.0) | 1 (4.0) | | 1 (9.1) | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| Leopard | 6 (9.0) | 1 (10.0) | 1 (7.1) | 4 (11.8) | 2 (6.1) | 3 (9.4) | 2 (8.0) | | 2 (18.2) | 2 (8.7) | 2 (7.4) | 0 (0.0) |
| All equal | 30 (44.8) | 1 (10.0) | 8 (57.2) | 13 (38.2) | 17 (51.5) | 11 (34.3) | 13 (52.0) | | 4 (36.3) | 9 (39.1) | 11 (40.7) | 13 (50.0) |
| Stakeholder attitudes towards wild dog re-introductions | | | | | | | | | | | | |
| Are you in favour of re-introducing wild dogs into HiP? | | | | | | | | | | | | |
| Yes | 27 (38.6) | 7 (58.8) | 2 (15.4) | 15 (41.7) | 12 (35.3) | 14 (40.0) | 11 (44.0) | | 7 (63.6) | 8 (32.0) | 8 (30.7) | 11 (42.3) |
| Neutral | 19 (27.1) | 1 (7.7) | 7 (53.8) | 9 (25.0) | 10 (29.4) | 9 (25.7) | 8 (32.0) | | 1 (9.1) | 8 (32.0) | 6 (23.1) | 8 (30.8) |
| No | 24 (34.3) | 5 (38.5) | 4 (30.8) | 12 (33.3) | 12 (35.3) | 12 (34.3) | 6 (24.0) | | 3 (27.3) | 9 (36.0) | 12 (46.2) | 7 (26.9) |

Appendix 2 continued

| Local community members 2003 | | | | | | | | | | |
|--|-----------|-----------|-----------|-------------|----------------------------------|-----------|---------------------------------|-----------|-------------------------------|-----------|
| Total | Gender | | Age | | Personal experience ¹ | | Level of education ² | | Livestock losses ³ | |
| | Male | Female | Adult | Minor | Yes | No | High | Low | Yes | No |
| If yes, what are your reasons for being in favour of re-introducing wild dogs into HIP? | | | | | | | | | | |
| For biological reasons | 18 (69.2) | 3 (100.0) | 1 (100.0) | 8 (72.7) | 10 (66.7) | 6 (54.5) | 5 (62.5) | 3 (100.0) | 5 (55.6) | 8 (66.6) |
| For ecotourism | 4 (15.4) | 0 (0.0) | 0 (0.0) | 2 (18.2) | 2 (13.3) | 3 (27.3) | 2 (25.0) | 0 (0.0) | 2 (22.2) | 2 (16.7) |
| For other reasons | 4 (15.4) | 0 (0.0) | 0 (0.0) | 1 (9.1) | 3 (20.0) | 1 (8.3) | 1 (12.5) | 0 (0.0) | 2 (22.2) | 2 (16.7) |
| Re-introduced wild dogs would cause unacceptable levels of livestock losses outside HIP. | | | | | | | | | | |
| Agree | 40 (59.7) | 9 (75.0) | 8 (57.1) | 21 (58.3) | 19 (61.3) | 17 (51.5) | 4 (36.4) | 17 (68.0) | 15 (57.7) | 13 (54.1) |
| Neutral | 8 (11.9) | 0 (0.0) | 4 (28.6) | 4 (11.1) | 4 (12.9) | 4 (12.1) | 0 (0.0) | 4 (16.0) | 2 (7.7) | 4 (16.7) |
| Disagree | 19 (28.4) | 3 (25.0) | 2 (14.3) | 11 (30.6) | 8 (25.8) | 12 (36.4) | 7 (63.6) | 4 (16.0) | 9 (34.6) | 7 (29.2) |
| Do you perceive wild dogs inside HIP as a threat to your livestock? | | | | | | | | | | |
| Yes | 31 (46.3) | 6 (54.5) | 6 (42.9) | 15 (42.9) | 16 (50.0) | 15 (45.5) | 3 (27.3) | 12 (50.0) | 13 (48.1) | 10 (38.5) |
| No | 36 (53.7) | 5 (45.5) | 8 (57.1) | 20 (57.1) | 16 (50.0) | 18 (54.5) | 8 (72.7) | 12 (50.0) | 14 (51.9) | 16 (61.5) |
| Have you ever lost livestock to any predators? | | | | | | | | | | |
| Yes | 27 (45.7) | 7 (77.8) | 5 (35.7) | f 16 (51.6) | 11 (39.3) | 17 (63.0) | G 4 (44.4) | 12 (54.6) | N/A | N/A |
| No | 26 (44.1) | 2 (22.2) | 8 (57.2) | 13 (41.9) | 13 (46.4) | 7 (25.9) | 4 (44.4) | 9 (40.9) | | |
| No livestock | 6 (10.2) | 0 (0.0) | 1 (7.1) | 2 (6.5) | 4 (14.3) | 3 (11.1) | 1 (11.2) | 1 (4.5) | | |

¹ Refers to the question whether a respondent has ever seen free-ranging wild dogs (Yes) or not (No)

² Refers to the question whether a respondent comes from an educationally advanced (High, i.e. tertiary education) or disadvantaged (Low, i.e. basic or no formal education) background

³ Refers to the question whether a respondent has ever lost livestock to any predators (Yes) or not (No)

a: $\Delta L^2 = 6.17$, $df = 2$, $P = 0.05$, $R^2 = 0.57$; b: $\Delta L^2 = 8.36$, $df = 2$, $P = 0.02$, $R^2 = 0.30$; c: $\Delta L^2 = 6.44$, $df = 2$, $P = 0.04$, $R^2 = 0.48$; d: $\Delta L^2 = 4.36$, $df = 1$, $P = 0.04$, $R^2 = 0.52$; e: $\Delta L^2 = 8.07$, $df = 2$, $P = 0.02$, $R^2 = 0.51$; f: $\Delta L^2 = 6.22$, $df = 2$, $P = 0.05$, $R^2 = 0.23$; g: $\Delta L^2 = 8.36$, $df = 2$, $P = 0.02$, $R^2 = 0.30$; h: $\Delta L^2 = 6.87$, $df = 2$, $P = 0.03$, $R^2 = 0.81$; all other associations are not significant

Significant associations are indicated by letters (a to h) at the right side of the respective columns and the corresponding statistical parameters of the log-linear model are reported

References

- Andreka G, Linn IJ, Perrin MR, Maddock AH (1999) Range use by the wild dog in the Hluhluwe-Umfolozi Park, South Africa. *S Afr J Wildl Res* 21:1–9
- Bekoff M (2001) Human–carnivore interactions: adopting proactive strategies for complex problems. In: Gittleman JL, Funk SM, Macdonald D, Wayne RK (eds) *Carnivore conservation*. Cambridge University Press, Cambridge, pp 179–195
- Berg KA (2001) Historical attitudes and images and the implications on carnivore survival. *Endang Species Update* 18:186–189
- Berkes F (2004) Rethinking community-based conservation. *Conserv Biol* 18:621–630
- Breitenmoser U (1998) Large predators in the Alps: the fall and raise of man’s competitors. *Biol Conserv* 83:279–289
- Breitenmoser U, Breitenmoser-Würsten C, Carbyn LN, Funk SM (2001) Assessment of carnivore reintroductions. In: Gittleman JL, Funk SM, Macdonald D, Wayne RK (eds) *Carnivore conservation*. Cambridge University Press, Cambridge, pp 241–281
- Breuer T (2003) Distribution and conservation of African wild dogs in Cameroon. *Canid News* 6.1 [online]
- Childes SL (1988) The past history, present status and distribution of the hunting dog *Lycodon pictus* in Zimbabwe. *Biol Conserv* 44:301–316
- Clutton-Brock J (1996) Competitors, companions, status symbols, or pests: a review of human associations with other carnivores. In: Gittleman JL (ed) *Carnivore behavior, ecology, and evolution*. Cornell University Press, Ithaca, pp 375–392
- Creel S, Creel NM (1996) Limitation of African wild dogs by competition with larger carnivores. *Conserv Biol* 10:526–538
- Creel S, Creel NM (1998) Six ecological factors that may limit African wild dogs, *Lycodon pictus*. *Anim Conserv* 1:1–9
- Creel S, Creel NM (2002) *The African wild dog: behavior, ecology, and conservation*. Princeton University Press, Princeton
- Davies HT, Du Toit JT (2004) Anthropogenic factors affecting wild dog *Lycodon pictus* reintroductions: a case study in Zimbabwe. *Oryx* 38:32–39
- Du Toit JT (2002) Wildlife harvesting guidelines for community-based wildlife management: a southern African perspective. *Biodivers Conserv* 11:1403–1416
- Dutson G, Sillero-Zubiri C (2005) Forest-dwelling African wild dogs in the Bale Mountains, Ethiopia. *Canid News* 8.3 [online]
- Fanshawe JH, Frame LH, Ginsberg JR (1991) The wild dog—Africa’s vanishing carnivore. *Oryx* 25:137–146
- Fanshawe JH, Ginsberg JR, Sillero-Zubiri C, Woodroffe R (1997) The status & distribution of remaining wild dog populations. In: Woodroffe R, Ginsberg J, Macdonald D (eds) *The African wild dog: status survey and conservation action plan*. IUCN, Gland, pp 11–57
- Ginsberg J (1993) Mapping wild dogs. *Canid News* 1:2–6
- Gittleman JL, Funk SM, Macdonald DW, Wayne RK (2001) Why ‘carnivore conservation’? In: Gittleman JL, Funk SM, Macdonald D, Wayne RK (eds) *Carnivore conservation*. Cambridge University Press, Cambridge, pp 1–7
- Graf JA, Gusset M, Reid C, Janse van Rensburg S, Slotow R, Somers MJ (2006) Evolutionary ecology meets wildlife management: artificial group augmentation in the re-introduction of endangered African wild dogs (*Lycodon pictus*). *Anim Conserv* 9:398–403
- Graham K, Beckerman AP, Thirgood S (2005) Human–predator–prey conflicts: ecological correlates, prey losses and patterns of management. *Biol Conserv* 122:159–171
- Gusset M, Slotow R, Somers MJ (2006a) Divided we fail: the importance of social integration for the re-introduction of endangered African wild dogs (*Lycodon pictus*). *J Zool* 270:502–511
- Gusset M, Graf JA, Somers MJ (2006b) The re-introduction of endangered wild dogs into Hluhluwe–iMfolozi Park, South Africa: an update on the first 25 years. *Re-introd News* 25:31–33
- Hackel JD (1999) Community conservation and the future of Africa’s wildlife. *Conserv Biol* 13:726–734
- Hines CJH (1990) Past and present distribution and status of the wild dog *Lycodon pictus* in Namibia. *Madoqua* 17:31–36
- Infield M (1988) Attitudes of a rural community towards conservation and a local conservation area in Natal, South Africa. *Biol Conserv* 45:21–46
- Kellert SR, Black M, Reid Rush C, Bath AJ (1996) Human culture and large carnivore conservation in North America. *Conserv Biol* 10:977–990
- Knoke D, Burke PJ (1980) *Log-linear models*. Sage Publications, Newbury Park

- Kock R, Wambua J, Mwanzia J, Fitzjohn T, Manyibe T, Kambe S, Lergoi D (1999) African hunting dog translocation from Mount Kenya (Timau) to Tsavo West National Park Kenya 1996–1998. Unpublished report. WWF, Nairobi
- Kolowski JM, Holekamp KE (2006) Spatial, temporal, and physical characteristics of livestock depredations by large carnivores along a Kenyan reserve border. *Biol Conserv* 128:529–541
- Krüger SC, Lawes MJ, Maddock AH (1999) Diet choice and capture success of wild dog (*Lycaon pictus*) in Hluhluwe-Umfolozi Park, South Africa. *J Zool* 248:543–551
- Kruuk H (2002) Hunter and hunted: relationships between carnivores and people. Cambridge University Press, Cambridge
- Lindsey P, Du Toit JT, Mills MGL (2004a) The distribution and population status of African wild dogs (*Lycaon pictus*) outside protected areas in South Africa. *S Afr J Wildl Res* 34:143–151
- Lindsey PA, Du Toit JT, Mills MGL (2004b) Area and prey requirements of African wild dogs under varying habitat conditions: implications for reintroductions. *S Afr J Wildl Res* 34:77–86
- Lindsey PA, Du Toit JT, Mills MGL (2005a) Attitudes of ranchers towards African wild dogs *Lycaon pictus*: conservation implications on private land. *Biol Conserv* 125:113–121
- Lindsey PA, Alexander RR, Du Toit JT, Mills MGL (2005b) The potential contribution of ecotourism to African wild dog *Lycaon pictus* conservation in South Africa. *Biol Conserv* 123:339–348
- Lindsey PA, Alexander R, Du Toit JT, Mills MGL (2005c) The cost efficiency of wild dog conservation in South Africa. *Conserv Biol* 19:1205–1214
- Maddock A (1995) Wild dogs in Hluhluwe-Umfolozi Park. *Re-introd News* 11:16–17
- Maddock AH (1999) Wild dog demography in Hluhluwe-Umfolozi Park, South Africa. *Conserv Biol* 13:412–417
- Maddock AH, Mills MGL (1994) Population characteristics of African wild dogs *Lycaon pictus* in the eastern Transvaal lowveld, South Africa, as revealed through photographic records. *Biol Conserv* 67:57–62
- Marker LL, Mills MGL, Macdonald DW (2003) Factors influencing perceptions of conflict and tolerance toward cheetahs on Namibian farmlands. *Conserv Biol* 17:1290–1298
- McCreery EK, Robbins RL (2004) Sightings of African wild dogs *Lycaon pictus* in southeastern Kenya. *Canid News* 7.4 [online]
- Mills MGL, Gorman ML (1997) Factors affecting the density and distribution of wild dogs in the Kruger National Park. *Conserv Biol* 11:1397–1406
- Mills MGL, Ellis S, Woodroffe R, Maddock A, Stander P, Rasmussen G, Pole A, Fletcher P, Bruford M, Wildt D, Macdonald D, Seal U (eds) (1998) Population and Habitat Viability Assessment for the African wild dog (*Lycaon pictus*) in southern Africa. Final workshop report. IUCN/SSC Conservation Breeding Specialist Group, Apple Valley
- Mishra C, Allen P, McCarthy T, Madhusudan MD, Bayarjargal A, Prins HHT (2003) The role of incentive programs in conserving the snow leopard. *Conserv Biol* 17:1512–1520
- Moehrenschräger A, Somers MJ (2004) Canid reintroductions and metapopulation management. In: Sillero-Zubiri C, Hoffmann M, Macdonald DW (eds) *Canids: foxes, wolves, jackals and dogs: status survey and conservation action plan*. IUCN, Gland, pp 289–297
- Montag J (2003) Compensation and predator conservation: limitations of compensation. *Carnivore Damage Prev News* 6:2–6
- Naughton-Treves L, Grossberg R, Treves A (2003) Paying for tolerance: rural citizens' attitudes toward wolf depredation and compensation. *Conserv Biol* 17:1500–1511
- Nyhus P, Fischer H, Madden F, Osofsky S (2003) Taking the bite out of wildlife damage: the challenges of wildlife compensation schemes. *Conserv Pract* 4:37–40
- Ogada MO, Woodroffe R, Oguge NO, Frank LG (2003) Limiting depredation by African carnivores: the role of livestock husbandry. *Conserv Biol* 17:1521–1530
- Patterson BD, Kasiki SM, Selempo E, Kays RW (2004) Livestock predation by lions (*Panthera leo*) and other carnivores on ranches neighboring Tsavo National Parks, Kenya. *Biol Conserv* 119:507–516
- Rasmussen GSA (1999) Livestock predation by the painted hunting dog *Lycaon pictus* in a cattle ranching region of Zimbabwe: a case study. *Biol Conserv* 88:133–139
- Reading RP, Clark TW (1996) Carnivore reintroductions: an interdisciplinary examination. In: Gittleman JL (ed) *Carnivore behavior, ecology, and evolution*. Cornell University Press, Ithaca, pp 296–336
- Schaller GB (1996) Introduction: carnivores and conservation biology. In: Gittleman JL (ed) *Carnivore behavior, ecology, and evolution*. Cornell University Press, Ithaca, pp 1–10
- Shivik JA, Treves A, Callahan P (2003) Nonlethal techniques for managing predation: primary and secondary repellents. *Conserv Biol* 17:1531–1537

- Sillero-Zubiri C, Laurenson MK (2001) Interactions between carnivores and local communities: conflict or co-existence? In: Gittleman JL, Funk SM, Macdonald D, Wayne RK (eds) Carnivore conservation. Cambridge University Press, Cambridge, pp 282–312
- Sillero-Zubiri C, Switzer D (2004) Management of wild canids in human-dominated landscapes. In: Sillero-Zubiri C, Hoffmann M, Macdonald DW (eds) Canids: foxes, wolves, jackals and dogs: status survey and conservation action plan. IUCN, Gland, pp 257–266
- Sillero-Zubiri C, Reynolds J, Novaro AJ (2004) Management and control of wild canids alongside people. In: Macdonald DW, Sillero-Zubiri C (eds) Biology and conservation of wild canids. Oxford University Press, Oxford, pp 107–122
- Somers MJ, Maddock AH (1999) Painted dogs of Zululand. *Afr Wildl* 53:24–26
- Taylor D (2004) Conservation education and its relevance to wild canids. In: Sillero-Zubiri C, Hoffmann M, Macdonald DW (eds) Canids: foxes, wolves, jackals and dogs: status survey and conservation action plan. IUCN, Gland, pp 298–305
- Treves A, Karanth KU (2003) Human-carnivore conflict and perspectives on carnivore management worldwide. *Conserv Biol* 17:1491–1499
- Van Dyk G, Slotow R (2003) The effects of fences and lions on the ecology of African wild dogs reintroduced to Pilanesberg National Park, South Africa. *Afr Zool* 38:79–94
- Woodroffe R, Ginsberg JR (1997a) Past and future causes of wild dogs' population decline. In: Woodroffe R, Ginsberg J, Macdonald D (eds) The African wild dog: status survey and conservation action plan. IUCN, Gland, pp 58–74
- Woodroffe R, Ginsberg JR (1997b) Measures for the conservation and management of free-ranging wild dog populations. In: Woodroffe R, Ginsberg J, Macdonald D (eds) The African wild dog: status survey and conservation action plan. IUCN, Gland, pp 88–99
- Woodroffe R, Ginsberg JR (1999) Conserving the African wild dog *Lycaon pictus*. I. Diagnosing and treating causes of decline. *Oryx* 33:132–142
- Woodroffe R, McNutt JW, Mills MGL (2004) African wild dog (*Lycaon pictus*). In: Sillero-Zubiri C, Hoffmann M, Macdonald DW (eds) Canids: foxes, wolves, jackals and dogs: status survey and conservation action plan. IUCN, Gland, pp 174–183
- Woodroffe R, Lindsey P, Romañach S, Stein A, Ole Ranah SMK (2005) Livestock predation by endangered African wild dogs (*Lycaon pictus*) in northern Kenya. *Biol Conserv* 124:225–234