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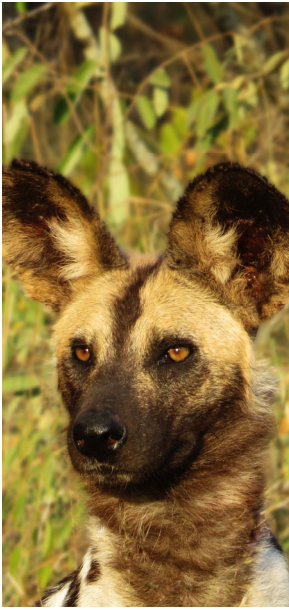
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# THE VULNERABILITY OF NEIGHBOURING COMMUNITIES AND THEIR INVESTMENT IN PROTECTED AREAS: A SPECULATIVE ANALYSIS

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## ABSTRACT

Climate change will increasingly impact species and habitat composition of protected areas, even if precise impacts are difficult to predict, especially in smaller areas. This raises questions for management authorities, not only regarding the ecological integrity of protected areas but also regarding wildlife that ‘escape’ and cause damage. The protected area is traditionally the primary responsibility of the management authority, but the introduction of charismatic and potentially damage-causing wildlife touches on the overlapping and shared commercial interests of the tourism industry and the neighbouring rural communities. As climate change manifests, the complex relationship between these three stakeholders is likely to become strained by the increased frequency of damage caused by wildlife as they attempt to move out of or expand their home ranges beyond the boundaries of the protected area. It is concluded that a laissez-faire approach to climate change by conservation authorities or protected area managers is likely to be problematic – particularly with respect to relationships with neighbouring rural communities. A greater awareness of climate change impacts among all stakeholders is required, including conservation agencies, the tourism industry and neighbouring rural communities and managing escaped wildlife should become a joint responsibility which is founded on a contractual agreement between these stakeholders.

**Key words:** Climate change, compensation, conservation, Covid-19, human–wildlife conflict, protected areas, rural communities, surrogate information, Wild Dog

## INTRODUCTION

Since the democratisation of South Africa in 1994 and the restitution of land to communities that were dispossessed of land during the apartheid era, there has been an increase in the number of community-owned protected areas as well as community-owned (in full or part) nature-based tourism or game lodge facilities within established protected areas (Koelble, 2011). This commercial interest of local communities has empowered them to have a substantial interest in the proper performance of tourism in the protected areas. Such shared commercial interests appear to be no different to those experienced elsewhere in Africa and beyond, where local communities have become owners of protected areas in addition to enjoying a direct commercial role in nature-based tourism (Shafer, 2020). This trend in biodiversity conservation brings additional economic vulnerability to these communities in the face of climate change, the significance of which is yet to be investigated.

At a protected area level, climate change research has mainly focused on the displacement of habitats and species and the increase in human–wildlife conflict that results from an increased migration of wildlife out of protected areas into neighbouring areas, due to reduction or loss of habitat or prey (Lamichhane et al., 2018). The scope of this research epitomises the challenges protected areas and protected area management face, as the consequences of climate change continue to manifest themselves. These challenges give rise to the primary concern that the ecological values and biodiversity within existing protected areas (and hence their management) are likely to deviate from the values for which the area was originally established (Goosen & Blackmore, 2019), and that new protected areas will be required to maintain the current protection of representative samples of a country’s biodiversity.

While the direct and indirect impacts of climate change are difficult to predict and monitor, let alone the

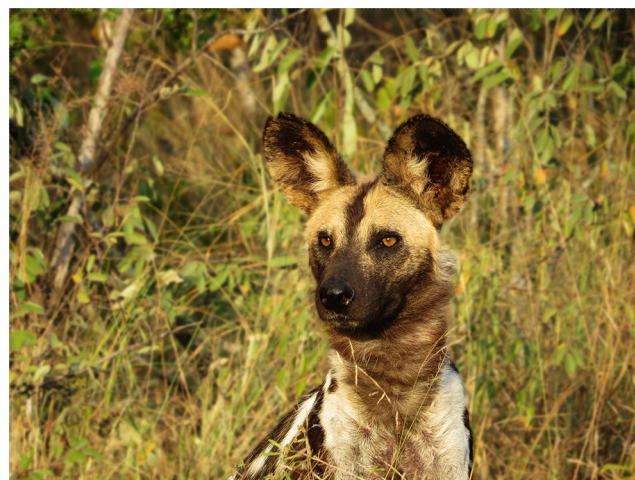
determination of causation at sub-landscape levels, the impacts of climate change on wildlife are likely to be more prevalent in smaller protected areas than larger ones (Carter et al., 2014). This assumption follows from the reasoning that the spatial extent of larger protected areas is likely to provide greater opportunities for stressed wildlife to relocate to more suitable habitat, without necessarily challenging retaining fences or moving across the boundary of the protected area (Di Minin et al., 2013). The smaller a protected area, the fewer the opportunities for wildlife to meet their needs within the area when conditions change.

Other than catastrophic events characteristically associated with climate change, the more subtle impacts of climate change on a protected area may not be easily discernible, in the short to medium term, from natural habitat dynamics caused by a combination of the general stochastic behaviour of wildlife and seasonal climate variation, protected area management, and human-induced disturbance (e.g. tourism, poaching). As a result, there is unlikely to be a discernible temporal threshold between incidental breakouts of wildlife from the protected area and that primarily caused by a changing climate. It is logical, in the absence of clear evidence and assuming that climate change may cause or intensify breakouts, for protected area management authorities to undertake a cautious and risk-averse approach to wildlife management and to build into their protected area management strategies mechanisms to ameliorate the growing impacts of climate change (Rannow et al., 2014). Such strategies may encompass, changes in vegetation management (i.e. altering burning regimes), and reducing the numbers of breakout-prone animals, or relocating (some of) them to other suitable existing or newly established protected areas (Wilke & Rannow, 2014).

Each of these management options in light of a changing or already altered climate have direct and indirect consequences for both the conservation of biodiversity as well as the socio-economic well-being of the protected area (Fisichelli et al., 2015). In the absence of sufficient government subsidies, the latter is predominantly dependent on the tourism appeal and concomitant revenue-generating potential of the protected area (Saayman & Saayman, 2017). From a wildlife perspective, the tourism appeal of an area is not limited solely to large charismatic species such as, or equivalent to, the 'African big five' – African Buffalo (*Syncerus caffer caffer*), African Elephant (*Loxodonta africana africana*), Leopard (*Panthera pardus*), Lion (*Panthera leo leo*) and White Rhinoceros (*Ceratotherium simum simum*) – but extends to other

iconic wildlife that may be cryptic, generally scarce, endangered or endemic to the protected area. Thus, the consequences of climate change for protected areas go beyond the strategic conservation of wildlife in that the economic viability of many protected areas tends to be dependent on its tourism appeal, which is in turn (in part) dependent on the persistence of iconic wildlife (Saayman & Saayman, 2017). Despite this nexus, the consequences of climate change for the potentially complex relationship that exists between the (i) protected area, (ii) the existence therein of iconic but potentially damage-causing wildlife that may be vulnerable to the impacts of climate change, (iii) the wildlife tourism industry, and (iv) neighbouring communities, remain, in many respects, under-researched if not uncharted and untested territory (Stone & Nyaupane, 2018).

Against this backdrop, this paper examines potential consequences of climate change at the interface between the protected area, its tourism appeal and neighbouring communities – with a view to gaining an increased understanding of the complexity of climate change-orientated decisions for conservation agencies and protected area managers. Although the effects of climate change on African Wild Dogs (*Lycan pictus*) are often difficult to determine and may vary (see Box 1), the introduction of a pack of 14 individuals into Tembe Elephant Park, KwaZulu-Natal, South Africa in 2010, provides an opportunity to explore decision-making at this interface. The traditional behaviour of African Wild Dogs is thus used as a proxy for potentially damage-causing species that may be displaced from, or break out of, small protected areas, such as TEP, as a consequence of the impacts of climate change.



Bright eyed wild dog enjoying the early morning sun © Andy Blackmore

**Box 1**

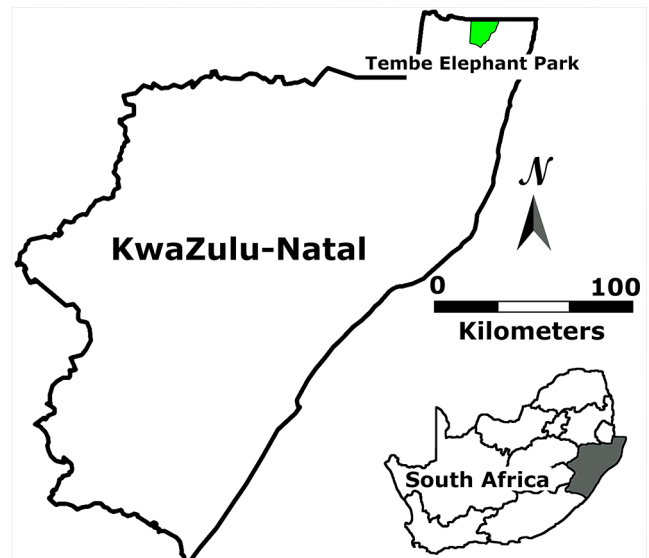
The ways in which, and degrees to which climate change influences Wild Dogs, and the anticipated net effect of climate change on the conservation prospects of the species, are gradually becoming clearer – but are still surrounded by uncertainty. As highly mobile animals, Wild Dogs appear to possess relatively few of the traits that typically make species vulnerable to climate change (Bellard et al., 2012; Pacifici et al., 2015; Woodroffe et al., 2017; Rabaiotti & Woodroffe, 2019).

Wild dogs have a habit of moving long distances and ranging widely, with such movements dictated by the availability of prey species and the presence of other large carnivores (Woodroffe, 2011; Darnell et al., 2014). In addition, fluctuations in movements and the population size of prey species and other predators exacerbated by the influence of climate change (e.g., through extreme weather events and disease) can be expected to correspond to increased mobility of Wild Dogs, including increased attempts to move beyond protected area boundaries. One of the key consequences of Wild Dogs escaping from a protected area is the predation of livestock by this species and the concomitant human–wildlife conflict this causes (Nyhus, 2016; Fraser-Celin et al., 2018; McNutt et al., 2018).

This study is grounded in challenges currently experienced by protected area managers and conservation agencies and uses these to extrapolate to future scenarios in which climate change manifests itself as described above, thus intensifying these challenges (van Kerkhoff et al., 2019).

**TEMBE ELEPHANT PARK**

The 30,000 ha Tembe Elephant Park (TEP) (Figure 1) is located on the undulating Maputaland Coastal Plain within South Africa on the southern Mozambican border and was established principally to conserve a representative example of the locally occurring population of African Elephants (Ferguson & Hanks, 2010; Blackmore, 2014). Subsequently, Lion and Black (*Diceros bicornis minor*) and White Rhinoceros have been introduced to transform TEP into a big five wildlife viewing destination. Floristically, the park comprises a mosaic of wooded hygrophilous grasslands, reeded wetlands, coastal forest and the endemic sand forest (Mucina & Rutherford, 2006). In addition to the species mentioned, TEP has an abundance of prominent wildlife such as the Greater Kudu (*Tragelaphus strepsiceros strepsiceros*), Nyala (*Tragelaphus angasii*)



**Figure 1. Location of Tembe Elephant Park within South Africa**

and Impala (*Aepyceros melampus melampus*), Common Warthog (*Phacochoerus africanus*), Cape Giraffe (*Giraffa camelopardalis*) and Hippopotamus (*Hippopotamus amphibius*) (EKZNW, 2018).

TEP currently has two community/private co-owned luxury safari lodges, and there is a prospect of a third being built in 2021/2. Given that tourist occupancy of the lodges appears to be directly related to the scenic and wildlife attractiveness of the protected area, it is natural for the community to appreciate that the profits derived from the lodges (the primary source of the financial benefit flowing to them) depend on the continued existence of wildlife, and, in particular, charismatic animals such as the big five – as well as Wild Dogs (Di Minin et al., 2013). Needless to say, the COVID-19 pandemic has interrupted the revenue from the lodges.

Human occupation of this surrounding landscape generally consists of sparsely distributed single households or small clusters. Three relatively densely populated areas occur near the southern boundary of the park along or in close proximity to the national road. The primary activity undertaken by these communities is livestock husbandry and subsistence agriculture.

**THE MOTIVATION FOR THE INTRODUCTION OF AFRICAN WILD DOG**

Notwithstanding the introduction of Lion and the existence of Hyena (*Crocuta crocuta*) and Leopard, the Nyala and to a lesser extent other antelope, have increased in numbers to a point where sensitive vegetation types (e.g. endangered sand-forest) are being



negatively impacted by browsing pressure from these species (Ferguson & Hanks, 2010). Based on this situation and despite the presence of other large predators, the conservation management authority determined that sufficient prey was available for the protected area to sustain at least nine Wild Dogs (Unpublished internal memorandum, 2010). The primary motivation for the introduction of this species to TEP concerned the conservation status of Wild Dogs in South and Southern Africa and the boosting of the attractiveness of the protected area for tourism.

### DAMAGE-CAUSING WILDLIFE

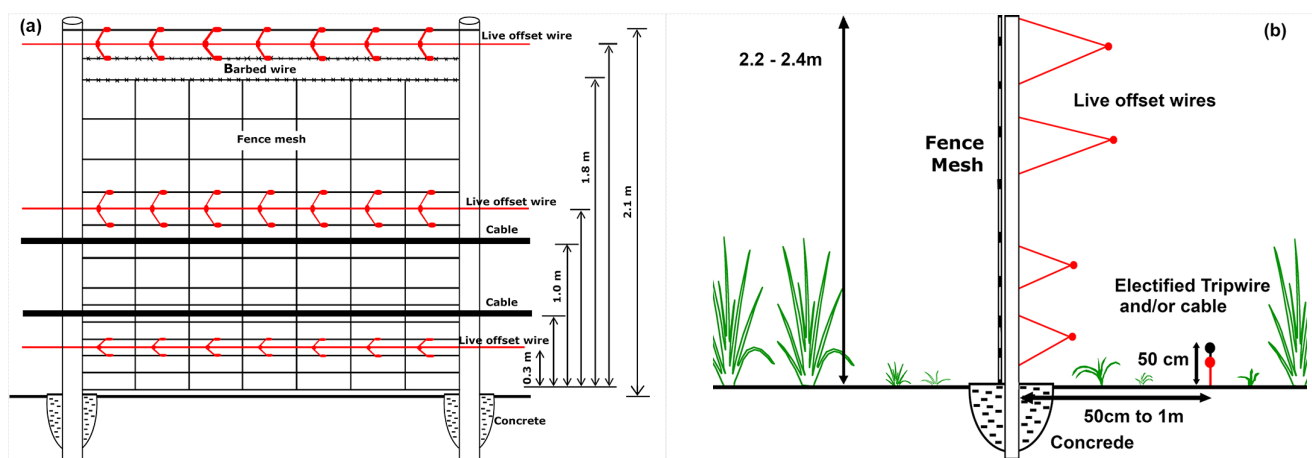
In the context of this paper, wildlife that leave the protected area and thereafter damage people's physical property, predate on livestock, cause or increase the probability of disease transfer to domestic livestock, or are a nuisance or pose a direct threat to human life are considered to be damage-causing animals (DCA) (VerCauteren et al., 2018). This can result in what is commonly referred to as 'human-wildlife conflict', when the two (damage-causing wildlife and humans) fail to co-exist harmoniously, and the damage caused undermines the livelihoods and well-being of the people affected. The outcome of such circumstances can be twofold. The first is a call for the removal or extermination of the DCA (Treves, 2009) and the second is to seek reasonable compensation from the conservation management authority for the damage caused (Nyhus, 2016).

The original response to both DCA and the general loss of wildlife from protected areas in South Africa was to erect fences to limit the movement of animals and people across the boundaries of the protect areas. The design of the fences, over time, has been improved to

become more effective at retaining DCA and other wildlife (see Figure 2). These improvements have included the addition of a trip-cable, particularly for the retention of Rhinoceros and Hippopotamus, and for other DCA (e.g. Elephant, Lion, Hyena), an electrified fence with various electrified offset wires perpendicular to the fence. Furthermore, for those DCA that traditionally burrow under fences (including Wild Dogs), an electrified offset tripwire at the base of the fence, or a limited distance away from the fence, is often used to deter these animals from this habit (Figure 2b).

Despite the establishment of such electrified boundary fences, DCA and other wildlife continue to breakout (Prager et al., 2012). Such breakouts may occur when fences are rendered ineffective through natural processes (e.g. flood events, treefalls, Elephant damage, and collision damage by large animals), human-induced damage (e.g. theft, cutting of fences by poachers, vandalism), lack of maintenance, or mechanical or electrical failure or inconsistent electricity supply (Ferguson & Hanks, 2010; Davies-Mostert et al., 2013). These breakouts may significantly impact households in neighbouring communities.

The net result of these predators (Wild Dogs) and other potential DCA, and the damage caused in the absence of adequate and timely compensation, is (even for a single breakout) potentially catastrophic for the individual households affected and also tends to affect the rural community as a whole (Khumalo & Yung, 2015; Bond & Mktu, 2018). Withholding or delaying the payment of compensation not only impoverishes those affected, but increases the persecution of DCA by affected people and creates or aggravates a negative attitude of rural communities towards the protected area (Rakshya,



**Figure 2.** Two examples of a protected area fence configuration used in South Africa to retain dangerous wildlife. Both examples employ energised (live) offset wires and steel cables and fencing mesh (diagrams adapted from (a) Ezemvelo KZN Wildlife, Undated; and (b) Potgieter et al., 2012).



The reception to the community-owned lodge. The lodge goes beyond mere employment of members from the neighbouring community but creates careers for those who have an interest in tourism hospitality. © Henri Frenken

2016). This, in turn, risks precipitating a loss in political support for protected areas and biodiversity conservation as a whole (Treves, 2009). From a Wild Dog conservation perspective, reintroductions of the species make sense mainly for areas that are securely fenced, and if breakouts can be foreseen, where a proactive strategy is in place to avoid preventive or retaliatory killing of this species by affected or potentially affected people outside the protected area (Gusset et al., 2008).

The potential consequences for neighbouring communities that arise from the introduction and conservation of DCA in protected areas are, therefore, a particularly relevant consideration for conservation authorities and protected area managers. It is sensible not to take decisions to either introduce or maintain DCA in a protected area without considering the interests and well-being of people that may be affected (Barrow & Fabricius, 2002). This is particularly relevant in view of the anticipated consequences of climate change highlighted above.

### **BENEFITS AND NEIGHBOURING COMMUNITY ACCEPTANCE**

While the flow of benefits arising out of protected areas may temper or offset the residual resentment arising

out of the impacts of DCA on rural communities (Snyman, 2012), these benefits together with the compensation may not be sufficient to maintain meaningful tolerance of DCA, let alone a peaceful co-existence. This understandable outcome would primarily appear to result from community members enduring direct personal risks which are disproportionate to the benefits they derive from the protected area, and those risks taken by the conservation agency or the management authority for keeping DCAs the protected area. This is particularly relevant for community members deriving no tangible benefits from the existence of the DCA. It is, therefore, important for the community (including those members that have suffered or risk DCA-related losses) to gain tangible benefits and an interest in the existence and conservation of the DCA. This is primarily achieved when (1) the protected area provides meaningful employment to community members to manage the protected area and particularly its DCA, and (2) the community develops or is a primary shareholder in nature-based tourism enterprises such as the establishment and management of lodges and guided expeditions for visitors to experience the DCA and other wildlife. In these circumstances, the removal of a population of DCA would produce a reduction in tourism attractiveness, which would in turn lead to a



reduction in income and employment generated for the community by the protected area (Lapeyre, 2011).

### A BRIEF SUMMARY OF THE WILD DOGS CONUNDRUM

The introduction of Wild Dogs, on both conservation and ecological grounds, is best not undertaken without comprehensive consultation with neighbouring communities, given the risk to livestock should they escape (Whittington-Jones, 2015). In the case of TEP, this consultation and provision of information on the importance of Wild Dogs was originally undertaken by the NGO Endangered Wildlife Trust, on behalf of the conservation management authority, and gained the community's support for the introduction (Whittington-Jones, 2015). The 14 Wild Dogs were subsequently released into the park (Whittington-Jones, 2015) and were recorded to have produced one litter of pups shortly after release.

Some five years following their introduction in 2010, the management authority received complaints of livestock loss apparently caused by Wild Dogs that had escaped (Hanekom, pers. com., 26 June 2020). The opposition of the neighbouring community to the Wild Dogs resulted in the conservation management authority revising its position on Wild Dogs in TEP, which culminated in the Wild Dogs being recaptured and relocated to another protected area. This decision was further underpinned by a continual reduction in the authority's conservation budgets (see, for example, Cundill et al., 2013) and the concomitant reduction in the availability of DCA compensation funds.

The first author was witness to this decision being challenged by the management of one of the lodges in TEP, who argued that the presence of Wild Dogs was paramount for tourism attractiveness and the growth of this industry within TEP. The lodge manager argued that the financial benefits, which were to a certain extent linked to the presence of Wild Dogs in the park, accrued to the neighbouring community as the main economic partner in the lodges, but had not been given sufficient weight in the decision taken by the conservation management authority to remove the animals from TEP. When these arguments were presented at a Tribal Authority Meeting (18 September 2018, Tembe Tribal Court, Nkwangase, KwaZulu-Natal, South Africa), describing the various financial benefits to the community from gate entrance fees, lodge occupancies, employment and career development, the community requested the management authority to secure additional Wild Dogs and release these into TEP. This decision by the community was taken on condition that community members impacted by any escaped

Wild Dogs would be adequately compensated for stock losses incurred.

Given the financial constraints of the conservation management authority and the reduction in its ability to pay compensation, the lodge manager gave his assurance that he would provide (independent of the community's financial interests) the necessary compensation in those instances where the conservation management authority determined the loss of livestock was caused by Wild Dogs that had escaped TEP. Such assurance was offered on the assumption that the overall financial benefits generated by the presence of Wild Dogs in TEP far outweighed the post compensation residual costs incurred by community members as a result of stock loss.

Four Wild Dogs were subsequently re-released into TEP as a result of the multilateral partnership that was forged between the neighbouring community (through their traditional council), the tourism industry in TEP, and the conservation management authority.

### CLIMATE CHANGE AND CONSERVATION DECISIONS WITHIN PROTECTED AREAS

There is little argument against the notion that climate change is going to have a lasting impact on protected areas and that this impact will occur at a rate not readily detectable at the scale at which management of these areas tends to occur, extreme weather events aside. The response of wildlife, and in particular DCA, to such climate change effects is likely to be subtle and not easily differentiated from the stochastic responses of these species to perturbations associated with protected area



Collared adult wild dog so that the movements of individuals and the pack can be monitored and alerts Park Management of a possible break out if the wild dogs dwell along the fence line and enables to wild dogs to be located should they escape. © Cathariné Hanekom

management, climatic events or tourism (Bennett et al., 2011). Despite this uncertainty, conservation management decisions will still need to be taken (Carvalho et al., 2011).

While there are many proponents of adaptive management and decision-making as a means for dealing with climate change uncertainty (Williams & Brown, 2016), such a strategy may not be appropriate in all circumstances. The same applies to decision-making that arises from rigorous hypothesis testing. For instance, where a wildlife population faces extinction or where there is a high risk to human health and well-being as a result of DCA moving out of protected areas, an immediate decision that may have a long-term consequence is advocated. In such situations, the management authority or conservation agency must have sufficient policy flexibility to avert imminent problems from arising, preferably based on a proactive, anticipatory, risk-averse planning and evidence-based decision-making strategy (Blackmore, 2014; van Kerkhoff et al., 2019). Although a pragmatic or command-and-control approach to conservation decisions may be suitable for certain aspects of protected area management (e.g. maintenance of the genetic integrity of wildlife, destruction of a DCA), this approach is becoming increasingly less desirable, if not inappropriate, for decisions that have consequence for the benefits or risks arising out of protected areas for neighbouring communities. This is particularly relevant when communities and the tourism industry have an economic stake in the protected area and the presence of certain species. Decision-making by protected area management authorities in response to the unfolding impacts of climate change is, therefore, becoming significantly more complex as communities become owners and economic partners in protected areas and the conservation of wildlife. The COVID-19 pandemic and the associated cessation in domestic and global tourism markets as a result of travel bans has brought into play an additional dimension of complexity and vulnerability regarding this economic relationship between the community and the protected area (Newsome, 2020).

## CONCLUSION

Within small fenced protected areas, the impacts of climate change are difficult to discern, let alone predict with any degree of certainty, which complicates anticipatory and adaptive management to mitigate such impacts. By drawing solely on the behaviour of African Wild Dogs as an indicative surrogate for carnivores and other potentially damage-causing wildlife that are likely to be displaced by climate change, speculative insights

are gained into the potential consequences of climate change at protected area boundaries. Given the attractiveness of Wild Dogs, this focus enables further insights regarding the importance of iconic wildlife to nature-based tourism and the financial benefits they bring to the protected area and neighbouring rural communities.

If climate change exacerbates the prevalence of damage-causing wildlife escaping protected areas into neighbouring communities, then an increase in persecution of these species can be expected alongside a reluctance by the communities concerned to support introductions of such species from elsewhere. The persistence of resentment even after damage caused by escaped wildlife has been compensated may be prevented or overcome when neighbouring communities have a substantial and meaningful beneficial interest in the introduction and conservation within the protected area of damage-causing and/or iconic wildlife (which may include species that are cryptic, generally scarce, endangered or endemic). The growing trend of rural communities playing a proactive role in and becoming economically dependent on protected areas, results in complex and intertwined relationships between the stakeholder community, wildlife tourism industry and the conservation agency involved. The conservation management of wildlife in a changing climate, especially with regard to small fenced protected areas, therefore requires more than a simple decision by conservation agencies to relocate species to more suitable habitats. Rather, protected area management authorities should take into consideration the relationship between the parties involved before decisions are taken in response to climate change or in response to any other conservation imperative. A degree of flexible governance is required to do justice to the specific nuances where there are overlapping and interdependent benefits and commercial interests arising out of the protected area for neighbouring communities and the wildlife tourism industry.

It would seem advisable for protected area managers and conservation agencies to incorporate into the management of protected areas a proactive strategy to mitigate and adapt to the impacts of climate change. To increase the chances of success, such a strategy should, as a minimum, encompass: (1) increasing the awareness and understanding of both neighbouring rural communities and the associated tourism industry of the latent consequences of climate change for the protected area concerned and its wildlife; (2) empowering both these stakeholders to adapt their expectations and business plans to take into consideration the impacts of



climate change on both the protected area and its tourism attractiveness; (3) mechanisms to enhance the effectiveness of boundary fences to retain wildlife, in particular potentially damage-causing animals, should they become increasingly prone to escape under the influence of climate change; and (4) jointly determining with the community and resident tourism industry the, yet to be researched, indicators or thresholds (not limited only to escape frequency) to determine when a species would need to be removed from the protected area and relocated to more suitable habitat, whether as a result of climate change or otherwise.

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## AUTHOR STATEMENT

AB conceptualised the study, performed the principal analysis, and drafted most of the manuscript. AT contributed research and drafted parts of the manuscript. The ideas, arguments and opinions expressed in this article are the authors' own and do not necessarily represent those of Ezemvelo KZN Wildlife.

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## RESUMEN

El cambio climático tendrá impactos crecientes en las especies y en la composición del hábitat de las áreas protegidas, aunque es difícil predecir con exactitud las repercusiones, especialmente en las áreas más pequeñas. Esto plantea interrogantes a las autoridades de gestión, no solo con respecto a la integridad ecológica de las áreas protegidas, sino también con respecto a la fauna silvestre que "escapa" y ocasiona daños.

Tradicionalmente, las áreas protegidas son responsabilidad primordial de las autoridades de gestión, pero la introducción de fauna y flora carismática y potencialmente dañina afecta los intereses comerciales superpuestos y compartidos de la industria turística y las comunidades rurales vecinas. Conforme se manifiesta el cambio climático, es probable que la compleja relación entre estas tres partes interesadas se vea afectada por la mayor frecuencia de los daños ocasionados por la fauna silvestre cuando intenta salir o expandir sus áreas de distribución más allá de los límites del área protegida. Se concluye que es probable que un planteamiento laissez-faire por parte de las autoridades de conservación o los administradores de las áreas protegidas con respecto al cambio climático plantee problemas, especialmente en lo tocante a las relaciones con las comunidades rurales vecinas. Se requiere una mayor conciencia de los efectos del cambio climático entre todos los interesados directos, incluidos los organismos de conservación, la industria del turismo y las comunidades rurales vecinas, y la gestión de la fauna silvestre que se escapa debería ser una responsabilidad conjunta basada en un acuerdo contractual entre dichos interesados.

## RÉSUMÉ

Le changement climatique aura un impact progressivement croissant sur les espèces et la composition de l'habitat des aires protégées, même si cet impact précis est difficile à prévoir, en particulier dans les petites zones. Cela soulève des questions pour les autorités de gestion, non seulement en ce qui concerne l'intégrité écologique des aires protégées, mais aussi en ce qui concerne la faune qui « s'échappe » et cause des dommages. Les aires protégées sont traditionnellement sous la responsabilité première de leur autorité de gestion, mais l'introduction d'une faune charismatique qui puisse potentiellement causer des dommages impacte également des intérêts commerciaux de l'industrie du tourisme et des communautés rurales voisines. A mesure que le changement climatique se manifeste, la relation complexe entre ces trois parties prenantes est susceptible de devenir tendue en raison de la fréquence accrue des dommages causés par les espèces sauvages lorsqu'elles tentent de quitter ou d'étendre leur territoire au-delà des limites de l'aire protégée. Nous concluons qu'une approche laxiste face au changement climatique par les autorités de conservation ou les gestionnaires d'aires protégées est susceptible de poser problème - en particulier en ce qui concerne les relations avec les communautés rurales voisines. Une plus grande sensibilisation aux impacts du changement climatique parmi toutes les parties concernées est nécessaire, y compris les agences de conservation, l'industrie du tourisme et les communautés rurales voisines, et la gestion de la faune échappée devrait devenir une responsabilité conjointe fondée sur un accord contractuel entre ces parties prenantes.