

5.5 Elephants and fencing conflicts in the GLTFCA and KAZA TFCA

Ferguson, K.

Mammal Research Institute, University of Pretoria, Pretoria 0002, South Africa
selousgame@hotmail.com

Chase, M.

Elephants Without Borders and San Diego Zoo's Institute for Conservation Research, P.O. Box 682, Kasane, Botswana
er@info.bw

Introduction

African elephants (*Loxodonta africana*) are a 'keystone' fence species (Ferguson, et al., 2010). Their size and intelligence allows them to circumvent most types of fencing (Grant, et al., 2007), but it is also true to say that they have become a *de facto* flagship species when it comes to determining the potentially beneficial connectivity between various parts of a Transfrontier Conservation Area (TFCA). This section illustrates two very different problems with regards to elephant-fence interactions. The first case from the Kruger National Park's (KNP's) western boundary fence (Ferguson, et al., 2010) is based on the premise that elephants cannot be allowed to destroy this disease control fence that separates wildlife from the high human density settlements and their livestock that are found on the parks border. In the second case, in the Kavango-Zambezi (KAZA) TFCA, Chase and Griffin (2009) and Cushman, et al., (2010) have been determining how large elephant populations in northern Botswana can be allowed to disperse across large swathes of the newly proposed TFCA and how fences are obstructing this proposed meta-population redistribution.

Elephant movement rules

General rules governing the movement and landscape selection by African elephants are slowly being elucidated largely due to the development of more sophisticated telemetry devices. Chase & Griffin (2009), Loarie, et al., (2009), Thomas, et al., (2008) and Cushman, et al., (2010) have presented good evidence that park and veterinary fences in southern Africa (in addition to civil war and other human perturbations) have had a major impact on the traditional movement patterns of African elephant populations. Particular concern is given by these authors, to the excision of this species' wet season ranges as affected by the erection of fence barriers. In East Africa the use of fencing has aided the rapid privatisation of rangeland and has had a major impact on elephant and wildlife distribution (Okello & D'Amour, 2008). But fencing has also proved at this interface to be ineffective at controlling human-wildlife conflict and indeed in some cases even engendering human-human conflict (Okello & D'Amour, 2008).

The coarse scale spatial rules that define elephant movement across landscapes are likely to be primarily predicated on seasonal and rainfall parameters. Surface water availability often presents the best predictor of seasonal range use (Harris, et al., 2008; Smit, et al., 2007a; Cushman, et al., 2010). At a finer spatial scale movement may be linked to landscape

topography, such as avoidance of hills (Wall, et al., 2006 and corridor linkages (Douglas-Hamilton, et al., 2005), direct and indirect conflict with humans (Dublin & Hoare, 2004; Sitati, et al., 2003 Graham, et al., 2009; Knickerbocker & Waithaka, 2005), sexual dimorphism in feeding behaviour (Stokke & du Toit, 2002) and even the ecophysiology of temperature thermoregulation (Kinahan, et al., 2007). Bulls home ranges are larger and more overlapping than mixed herds and the movement rules for adult males may be dictated by water availability, male-male competition and searching for receptive females (Smit, et al., 2007b; Hoare, 1999).

Kruger National Park/ GLTFCA Case Study

Ferguson, et al., (2010) highlighted that elephants represent a unique 'threat' to sustainable fencing along KNP's western boundary fence. The degradation of game fences often is due not only to a consistent lack of maintenance and resources but also due to increasing pressure by elephants. Whilst, in the case of veterinary fences, the species that many of these fences are designed to exclude is primarily buffalo (*Syncerus caffer*) (due to their multiple role in disease transmission), buffalo are almost always of very little importance in terms of causing damage to the fence in comparison with elephants. In the last decade it has been suggested that at least four of KNP's six outbreaks of foot-and-mouth disease (FMD) along the western boundary may be attributed to buffalo crossing fences aided by elephant facilitation via fence breakages (R. Bengis, pers. comm., September 2008). However, another hypothesis is that buffalo are not managing to escape through the fence by using elephant fence breaks as such breaks may be mended too quickly for buffaloes to locate these breaks by chance (F. Jori, pers. comm., March 2010, and it is more likely that they primarily escape from the park by crossing the diffuse and structurally weak fencing that exist along the many watercourses that bisect the fence line.

The impacts of FMD outbreaks are serious in terms of cost and the potential banning of exports. Egypt has only recently lifted its beef import ban on South Africa which dates back to 2000 due to an FMD outbreak in that year (Ghoneim, et al., 2010; SABC3 News, March 2010). The salient fact is often forgotten that it is a relatively simple behaviour, such as elephants physically pushing over fences to reach some resource that triggers off a series of economic and political events. Therefore, elephants can be determined to be a 'keystone' fence breaker. The KNP western boundary fence largely adjoins 'bull enclave' areas (Ferguson, et al., 2010; Smit, et al., 2007a). Habitual fence challengers in this setting are therefore likely to be almost always bull elephants. The 'sub-population' of elephants whose home ranges adjoin the fence is relatively small (data from ear-notch identification files), but this 'cohort' is also likely to be continually replaced after lethal incidents (approximately 10 bull elephant deaths reported during the study period) caused by humans.

The reasons for this study area being a predominantly 'bull area' are not clear. It may be in part due to a sexual dimorphism in elephant physiology, with cow/calf groups being limited by such factors as water or forage or because the area represents an anthropogenic danger to elephants due to lethal control measures. It is also possible that bull home ranges, and movements vary widely due to social pressures induced by hierarchy and musth (Wittmeyer, et al., 2008). The processes which drive elephants to cross the fence (it is debatable that the short-time they seem to spend outside, should be termed part of their 'home range') are therefore multi-factorial and seasonal. Osborn & Parker (2003) contend that in the case of crop raiding, elephant bulls exit

protected areas when the quality of the available forage declines below the level of the quality of the crop species grown outside of the area.

In the case of KNP, it has been long suggested that a seasonal peak in elephant 'excursions' (defined as a repeated series of short-term movements out of the park) is caused by the marula (*Sclerocarya birrea*) fruiting season and this implies that the number of mature female trees that fruit was higher in density outside of the park (R. Bengis, pers. comm., August 2008). This differential may be mainly due to elephant damage of the tree population within the park and perhaps also to differential fire regimes across the boundary preventing seedling recruitment (see Gadd (2002) for more information on tree damage estimates).

Our research has shown, from line transect data inside and outside of the KNP boundary (Fig. 5.5.1), that a tree density differential does exist on either side of the fence and that the February-March peak of elephant movements out of the park is likely to be driven by the availability of this seasonal resource. This result suggests that elephant-induced mortality of marula trees inside the park act as a driver of short-term elephant excursions. Presumably, as the park's elephant population has increased so has the mortality of marula trees within the park.

Ferguson, et al. (2010) found that the ratio of marula trees (of all age classes surveyed) found in compared with directly outside of the fence was approximately 1:4 and that twice the numbers of trees outside of the park fence showed no signs of presumed elephant damage compared with those inside the park (Fig. 5.5.1). The high incidence of fence permeability due to elephant breaks and the evidence from our marula transects accords well with the marula fruiting season. This is further evidence to add to that of Helm, et al. (2009) who state that marula could face local extinction within KNP and its environs. Local extinction is likely to be related to the actions of elephant and fire, but, we suggest a population 'nursery' may exist directly outside of the park boundary. The higher number of marula trees outside relative to inside the park suggests either that fences in the past have worked and they have only recently become highly permeable (due to the park wide floods of the year 2000) or that an increase in elephant numbers has led to a segment of the 'risk-prone' population seeking out the last of these resources on the other side of the fence.

This observation could lead to an interesting management scenario. The rate of elephant induced fence breakages during the peak of the marula season could be reduced by encouraging local people to pre-harvest the fruit and to store and ripen it for later use (F.V. Osborn, pers. comm., December 2009). Another alternative is to deter fence breakages by the selective culling of identifiable 'habitual' elephant fence breakers or to deploy non-lethal mitigation methods, such as direct protection of the fence by chilli pepper or indirect protection by aversion therapy by 'shooting' elephants with 'pepper balls' (Lamarque, et al., 2008).

A second hypothesised 'excursion peak' in winter has yet to be detected by our data but it has been suggested that the primary resource 'capture' in this case seems to be water (R. Bengis, pers. comm., August 2008.). Grant, et al. (2007) showed that in the winter of 2005 up to 35 elephant fence breaks per day occurred along a 12km stretch of the western fence where presumably the elephants were breaking out to drink in one of the few remaining pools in the Klein Letaba River.

The closure of boreholes within the park over the last several decades may have led to recent increases of fence challenges by elephants (and possibly lions) in order to access water sources outside of the KNP (D. Keet, pers. comm., November 2009.). It has also been suggested that a density-dependent effect occurs in terms of increasing annual rates of fence damage and excursions (Grant, et al., 2007). This hypothesis will remain untested until such time that the Kruger fence monitoring system (Ferguson & Jori: 6.1) has accumulated substantial data and that this can be directly related to the results of elephant censuses. However, our marula density results suggest indirect evidence of a density-dependent effect.

Grant, et al., (2007) make the assumption that the marked increase in elephant numbers in KNP since the end of the elephant cull (1995) has led to an increase in the levels of fence damage by this species. How likely is this hypothesised density-dependent causation? Certainly an increase in the number of elephants sighted per kilometre of fence should be a cause for concern, but the available data are inadequate to determine the reasons underlying the increased incidence of fence breaks, especially since 2000. Density independent factors such as the floods of 2000 were largely claimed to be responsible for the disabling of the recently up-graded electric fence and thereafter fence maintenance could not keep pace with the high levels of elephant fence destruction. In addition, theft of fence components was also a factor in the long-term degradation of the fenceline.

We caution, as does Hoare (1999), of suggesting that a greater density of elephants necessarily translates to a higher number of fences breaks. An indirect density dependent effect may be operating however, in that if problem bull fence breakers are responsible for the majority of breaks then a larger population size will contain a greater number of the habit-forming cohort and recruitment into the latter will be greater. Therefore an increase in habitual fence breakage (mainly by bull elephants) could be an indirect result of one or a combination of other factors including (i) more bulls being available and younger being 'taught' to break by older bulls, (ii) younger bulls avoiding an increased number of musth males and/or an increased number of musth males searching more widely, (iii) bulls seeking other essential resources e.g. forage and water, and (iv) dominant herds forcing sub-dominant herds to the periphery of the protected areas boundary (Wittmeyer, et al., 2008).

Increases in elephant density, climatic changes (Ogutu & Owen-Smith, 2003) and floods (D. Keet, pers. comm.) can have impacts on both species movement and fence damage. Further, elephant management control options (lethal and non-lethal) may also alter excursion patterns that could be detected by the monitoring system proposed by Ferguson, et al. (2010). These data, when analysed over-extended periods of time, could be used to adaptively manage fences damage and its causes with optimal effect.

The management of KNP must determine how they wish to try and control their fence breaking elephants. Options are wide and could include the culling of known habitual individual offenders, the targeted culling of the habitual 'cohort' or adopting trial non-lethal measures as part of the overall elephant reduction impact plan or even more desirably a 'boundary management plan' that takes into account the desires of all bordering stakeholders.

Fencing and the redistribution of elephants in the KAZA TFCA

In conservation terms the main aim of the removal of fences in the GLTFCA and KAZA TFCA centres around allowing the previous high build up of elephant

numbers to spread out (facilitated dispersal) to other countries, and thus it is hoped, to avoid the culling due to overabundance impacts (Cushman, et al., 2010; but see Skarpe, et al., 2004). The elephant corridors that have been identified in the Kruger study area may mark the 'gateways' through fences and the interconnectedness between the nation states that form the TFCA. It should be noted that an 'elephant corridor' need not be synonymous with a 'wildebeest corridor' (or any other migratory species), though some species overlap will occur and that gauging the extent and placement of major corridors, through the maze of fences, based on the largest and most mobile species is probably the most parsimonious way forward. Indeed Cushman, et al., (2010) have attempted to create a species-specific landscape resistance model for elephants within key parts of the KAZA TFCA. These authors point out that precise spatial records of elephant movement pathways 'allows direct assessment of the influences of landscape features' on such movement, and therefore on the optimal placing of these corridors. The removal of a 30km section of the Caprivi-Botswana border fence has allowed some elephants to move through this gap from northern Botswana and re-distribute themselves over a wider area including Angola that has fewer elephants than Botswana (Fig. 5.5.2). The large range sizes of these elephants (and the straight line distance that they can cover) mean that key fences do indeed restrict movement and block recolonisation from the source population. The partial or full removal of fences therefore becomes a key strategy in the facilitated dispersal of the northern Botswana elephant population.

Cushman, et al. (2010) analysing the satellite telemetry data gathered by *Elephants Without Borders* found that the autocorrelation of elephant movements is long-term, complex and seasonally related. Movement resistance models (based on elephant movement pathways) can be used to allow the direct assessment of landscape selection of this species and illustrate the impediments (e.g. variables such as roads, rivers fences, towns, villages and subsistence huts) to such movement across the landscape surface (Figs. 5.5.3 & 5.5.4). However, the relationship between elephant movements and these hypothesised impediments may vary with the spatial scale that is considered. The spatial co-variation of the variables (for example the locations of human settlements and water are linked) further, each factorial variable needs to be statistically 'weighted' against the others (and combinations of variables). The conclusion of this work was that the maximum landscape resistance due to settlements was equal to that of fences (examples of a 'virtual' and a physical barrier respectively). Water effects seem to dominate landscape selection at the broadest spatial scales but are 'highly subordinate to settlement and fence effects at fine spatial scales' (Cushman, et al., 2010). In the case of northern Botswana the inter-relationship between defined borders, rivers and veterinary fences protecting the country from transboundary animal diseases are likely to be highly correlated, and that this leads to veterinary fences having a dominant impact on landscape connectivity for elephants in this area.

Acknowledgements

The KAZA TFCA elephant telemetry study was made possible with funding from the Zoological Society of San Diego, the Rockefeller Family Foundation, Mr. and Mrs. Brett Warren, the Malashock Family Foundation, Mutual & Federal Insurance Company Botswana, the Seattle Foundation, Linda & Bob Bradley, the Bester Family and Conservation International. The Governments of Angola, Botswana, Namibia and Zambia are thanked for allowing us permission to

conduct this study. We are grateful for the support and encouragement of J. Hanks, L. Braack, H. Kolberg, B. Beytell, T. Uahengo, C. Taolo, and Kelly Landen. Ken Ferguson's research in the Kruger National Park was supported by generous grants from WWF-SA (Project ZA-1490) and the USFWS (Project Afe-0401). He thanks all those who assisted with his work in the park and especially Drs. Dewald Keet and Roy Bengis and Messrs. Louis Olivier and Albert Machaba.

Figure 5.5.1. Fence incident distribution for elephant in relation to marula tree distribution and density within 24x1km transects in the Kruger NP study area (October 2008– July 2009).

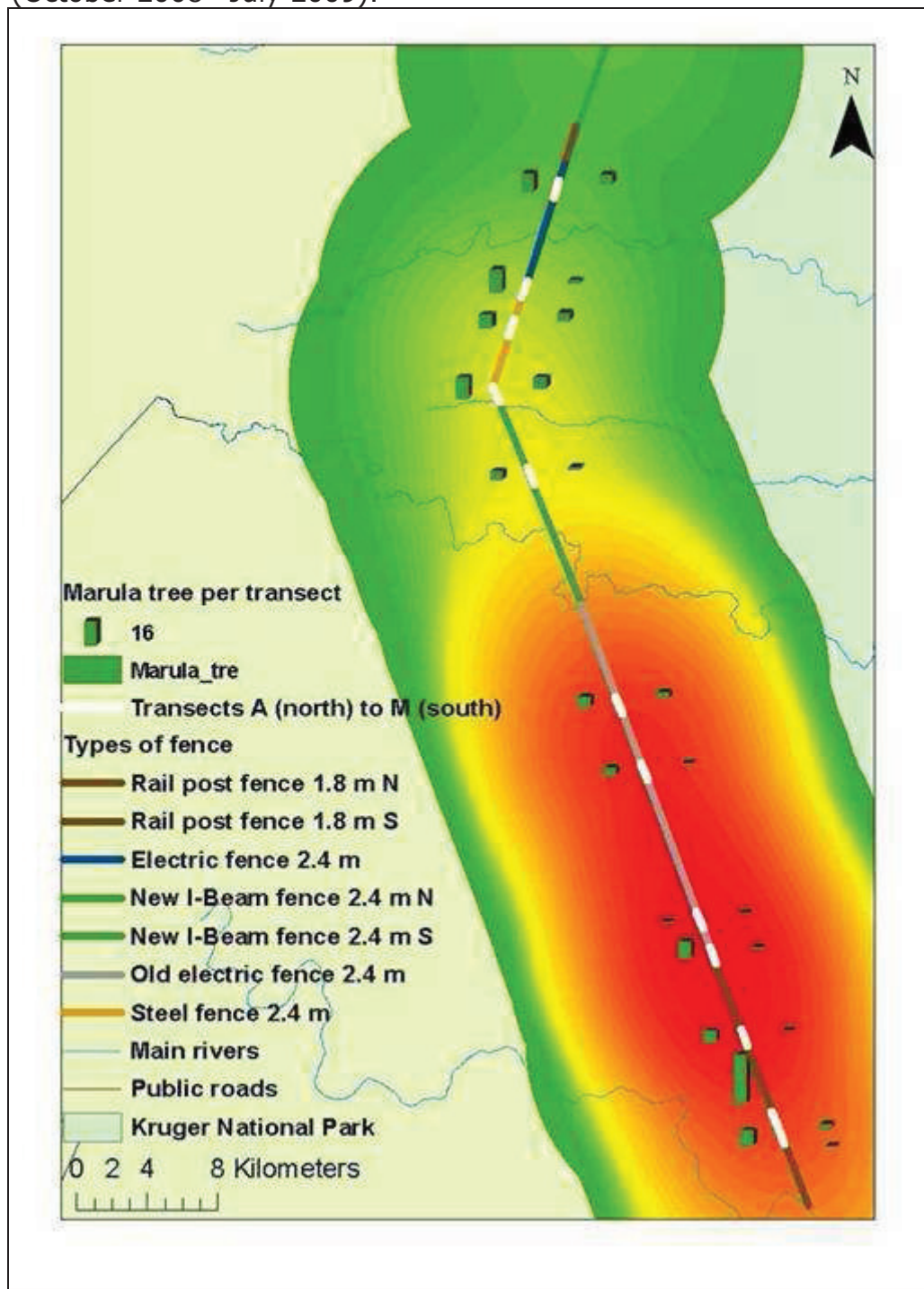


Figure 5.5.2. Human settlements in relation to fencing in part of the KAZA TFCA.

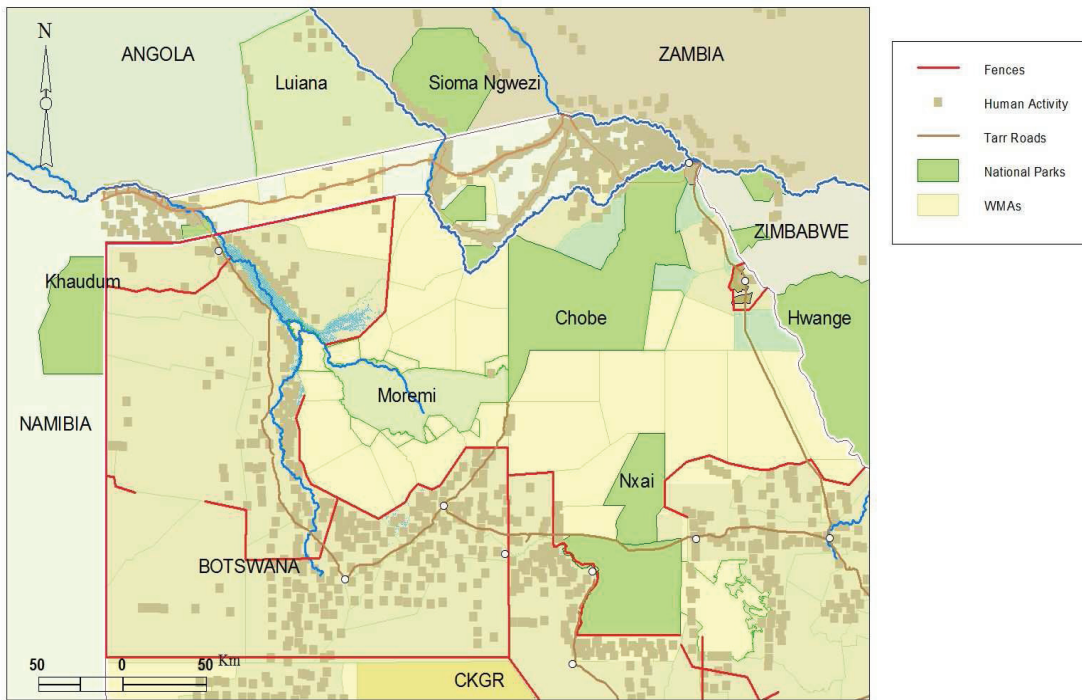


Figure 5.5.3. The movements of nine elephants in relation to fences in part of the KAZA TFCA.

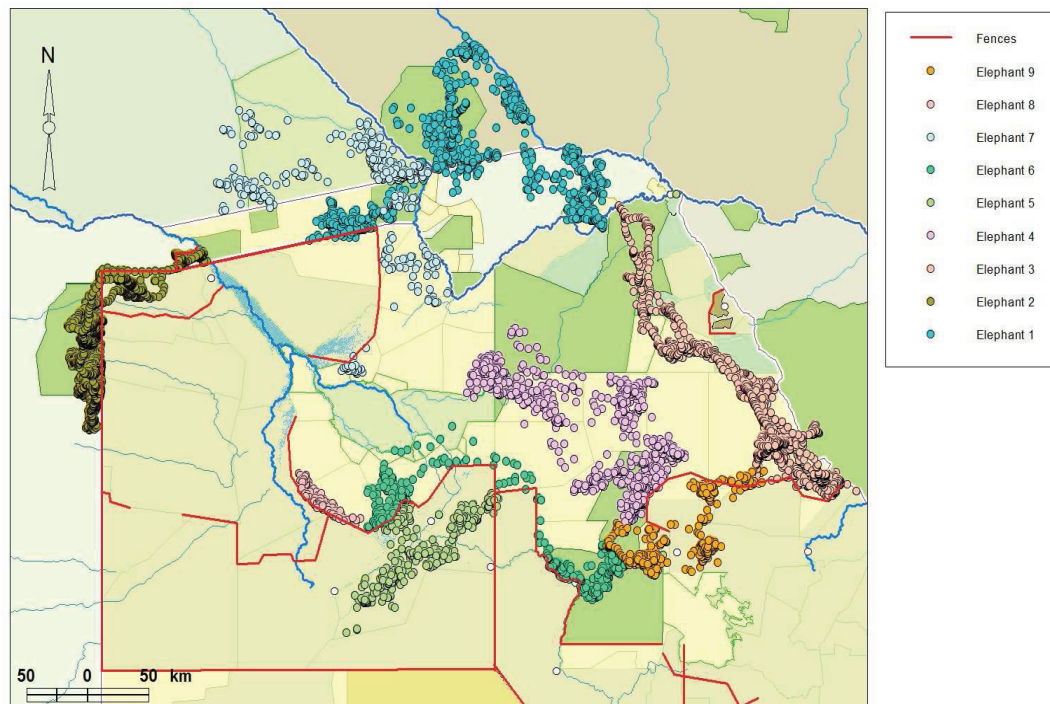


Figure 5.5.4. Map showing the KAZA study area and landscape features used in the resistance hypotheses (fences, roads, rivers and settlements) and the locational data for each of the four elephants included in the analyses of Cushman, et al., (2010; reproduced with permission from page 352, Cushman, et al., 2010)

