Will woody plant encroachment impact the visitor experience and economy of conservation areas?

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Dates:
Received: 05 Aug. 2012
Accepted: 29 Apr. 2013
Published: 02 Aug. 2013

How to cite this article:
Gray, E.F. & Bond, W.J., 2013, 'Will woody plant encroachment impact the visitor experience and economy of conservation areas?', *Koedoe* 55(1), Art. #1106, 9 pages. http://dx.doi.org/10.4102/koedoe.v55i1.1106

Note:
Additional supporting information may be found in the online version of this article as an Online Appendix 1 http://dx.doi.org/10.4102/koedoe.v55i1.1106-1

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Woody plant encroachment into savannas is a globally prevalent phenomenon and impacts ecosystem goods and services such as biodiversity, carbon storage, nutrient cycling, grazing and hydrology. The direct ecological and economic consequences for rangelands have been fairly well studied, but, to our knowledge, the economic impact on conservation efforts has not been investigated. African savannas are important as conservation areas because they support large numbers of the world's remaining megafauna. This study used visitor surveys and long-term mammal distribution data to investigate how an increase in tree density might affect the visibility of animals in a conservation area, which could reduce the satisfaction of visitors to the area. We found that apparent herd sizes and density of animals were much reduced in woody areas, suggesting that visibility is negatively impacted. Visitor surveys determined that a large fraction (almost half) of potential future visitors to the park may be lost if animals became more difficult to see and that the majority of these would be the higher-spending visitors. Responses differed depending on the origin of visitors, with international visitors being more interested in seeing animals, whilst local visitors were more content with just being away from the city. The results suggest that woody plant encroachment may have significant impacts on visitor numbers to savanna conservation areas, whilst animal numbers and densities may also be significantly impacted.

Conservation implications: The results pointed to potentially significant economic consequences for conservation efforts as visitors become less satisfied with their experience. Perceptions of visitors are important for management decisions as park fees contribute significantly to conservation efforts. This could ultimately result in a reduced capacity for African conservation areas to conserve their biodiversity effectively. The results suggest that management may need to re-evaluate their approach to controlling woody plant encroachment.

Introduction

Savannas and grasslands are economically important as rangelands and agricultural lands (Costanza *et al.* 1997; Sankaran, Ratnam & Hanan 2004). In Africa in particular, savannas have an intrinsic sentimental value because they are home to most of the world's last remaining megaherbivores (animals > 1000 kg). This translates into an economic importance because they attract visitors from all over the world, which contributes significantly to the gross domestic product of many African countries (Akama & Kieti 2003; Akama, Maingi & Camargo 2011; Di Minin *et al*. 2012). The experiences of these visitors are an important source of information to guide park managers and planners in appropriate measures to achieve both visitor satisfaction and conservation goals (Boshoff *et al.* 2007; Obua & Harding 1996).

Woody plant encroachment has been extensive in both farmed and conserved savannas all over the world over the last century (Archer, Schimel & Holland 1995; Asner *et al.* 2003; Britz & Ward 2007; Fensham, Fairfax & Archer 2005; Skarpe 1990; Van Auken 2000; Wigley, Bond & Hoffman 2010). The drivers are strongly debated, but recent literature recognises the importance of both local drivers, such as changes in land use (fire and herbivore stocking rates), and global drivers, such as increases in atmospheric carbon dioxide concentrations (Bond 2008; Bond & Midgley 2012; Bowman, Murphy & Banfai 2011; Wigley *et al.* 2010). Besides environmental repercussions such as loss of biodiversity (Bond & Parr 2010; Parr, Gray & Bond 2012; Ratajczak, Nippert & Collins 2012) and altered ecosystem goods and services such as water supply and carbon sequestration (Coetsee *et al.* 2013), woody thickening also has economic consequences on commercial rangelands. Stocking rates are likely to drop as trees increasingly restrict animal access and forage is reduced as grass cover declines. The consequence is a reduction in the overall carrying capacity of the land (Moleele *et al.* 2002; Roques, O'connor & Watkinson 2001). In Namibia, cattle numbers have been reduced to 36% of what they were in 1959, and woody plant encroachment is estimated to cause a loss of more than N$700 million per annum (De Klerk 2004). What is often overlooked is that in savannas under conservation there are likely to be direct consequences for wild animals, which may translate into unforeseeable indirect economic consequences for conservation areas.

Savannas support a diversity of habitats for mammals and birds (Sirami *et al.* 2009). Different animals show diverse preferences for certain habitats owing to direct (Sinclair, Mduma & Brashares 2003) and indirect (Brown 1988, 1992, 1999; Brown, Laundré & Gurung 1999; Laundré, Hernández & Altendorf 2001; Ripple & Beschta 2004) effects of predation and the availability of grazing. This makes for a diversity of wildlife viewing experiences for visitors to conservation areas. This spatial heterogeneity is crucial for maintaining diverse species assemblages and may help to buffer against changes in resource availability due to a changing climate (Wang *et al.* 2006) by compensating for temporal variability in resource availability (Fryxell *et al.* 2005). Woody plant encroachment will reduce spatial heterogeneity in vegetation structure. This change in habitat structure is likely to affect animal distributions, herd sizes and densities, with the direction of change depending on the size and feeding habits of the species concerned (Du Toit & Owen-Smith 1989). However, whether actual animal numbers are reduced may be of little importance to visitors. An increase in tree cover will reduce visibility and, as more woody plants encroach, it is likely that animals will become more difficult to see (Marshall, Lovett & White 2008). An inability to see animals may lead to a reduced wildlife experience, which could lead to a decrease in visitor numbers in conservation areas. Regular visitors to a conservation area are likely to notice reduced animal visibility due to woody plant encroachment, which could translate to a reduction in their desire to return to the park.

Here we report how woody plant density affects wildlife viewing in a savanna park and how visitors are likely to respond to woody plant encroachment. Woody plant encroachment is widespread in African savannas and is well documented in our study area, which was far more open in the early and mid-20th century but has become heavily encroached in the last few decades (Watson & Macdonald 1983; Wigley *et al.* 2010). We addressed the following questions:

- Does denser vegetation result in fewer visible animals and therefore poorer game viewing opportunites?
- Do visitors go to parks primarily to see wildlife?
- If visitors' ability to view wildlife is reduced, will they be less likely to visit parks and, if so, could this lead to reduced visitor numbers in parks and subsequent loss of revenue?

Methods

Study area

This study was conducted in the Hluhluwe–iMfolozi Park (HiP) complex, South Africa (28°00'–28°26'S; 31°43'–32°09'E), which consists of the Hluhluwe Game Reserve (225 km²) in the north, the iMfolozi Game Reserve (447 km²) in the south and a corridor (227 km²) joining the two (Whateley & Porter 1983). HiP, which is managed by Ezemvelo KwaZulu-Natal (KZN) Wildlife, is a major contributor to the tourism industry of KZN (Aylward & Lutz 2003).

HiP contains the full complement of large mammal herbivores characteristic of the region (including black and white rhinoceros) and is the oldest conservation area in South Africa. The park is characterised by high habitat heterogeneity, with vegetation ranging from open grassland and savanna to closed woodland and forest (Whateley & Porter 1983). The vegetation in the park has thickened significantly over the last century (Watson 1995; Watson & Macdonald 1983) and a study by Wigley *et al.* (2010) found an increase in woody cover from 14% in 1937 to 58% in 2004 in a significant portion of the northern Hluhluwe section of the park. Visitors to HiP go there predominantly to see wildlife (Di Minin *et al.* 2012) and are an important source of income for the park, surrounding communities and smaller game reserves (Aylward & Lutz 2003).

The annual economic contribution of HiP to Ezemvelo KZN Wildlife is disproportionately large for its area and expenditures (Table 1) and therefore any loss in revenue that HiP suffers is likely to have repercussions for Ezemvelo KZN Wildlife parks in general. Reduced revenue generation from tourism may ultimately influence operational costs and conservation goals of the parks authority.

Visibility of animals in different habitats

To determine the impact of vegetation on animal visibility we used census data collected by the Earthwatch Institution in 2008, 2010 and 2012. During censuses, observation teams walked a total of 26 fixed-line transects of between 3.9 km and 10.4 km (Cromsigt *et al.* 2009). Teams of two observers walked transects just after sunrise over a three-month period in the dry season (from July to October). All sightings of herbivore species larger than a hare within 500 m of both sides of a transect were recorded. The species and abundance, the GPS coordinates of the observer and the distance and bearing of the animal(s) from the observer were recorded (Cromsigt *et al.* 2009). The vegetation in each transect was classified into

TABLE 1: The relative contribution of Hluhluwe–iMfolozi Park to annual income of Ezemvelo KwaZulu-Natal Wildlife.

Variable	Hluhluwe–iMfolozi Park		Other KZN wildlife reserves		Total for KZN wildlife reserves
	n	%	*n*	%	
Land area (ha)	96 000	14.2	579200	85.8	675 200
Revenue (millions of rand)	29.8	31.7	64.2	68.3	94
Expenditures (millions of rand)	16.8	23.5	54.7	76.5	71.5
Profit (millions of rand)	13.0	57.8	9.5	42.2	22.5

Source: Aylward, B.A. & Lutz, E. (eds.), 2003, *Nature tourism, conservation, and development in KwaZulu-Natal, South Africa*, World Bank Publications, Washington
n, number; KZN, KwaZulu-Natal.

five different categories according to increasing woodiness: grassland, open savanna, closed savanna, thicket (dense, impenetrable woody vegetation) and forest.

We used these data to make inferences about whether animal visibility is significantly reduced in habitats with dense tree cover. Besides analysing the visibility of all species in combination, we also looked at nyala (*Tragelaphus angasi*), kudu (*Tragelaphus strepsiceros*) and impala (*Aepyceros melampus*) in isolation. Nyala and kudu are predominantly browsers and so would be expected to be found in forested areas. Impala are predominantly grazers and so would be expected to be found mainly in savanna areas. We hypothesised that regardless of feeding preferences, larger herd sizes and higher animal densities would be recorded in open grassland and savanna areas because animals would more likely have been counted in these habitats, as visibility is not obstructed by trees (Marshall *et al.* 2008). We used the statistical software package R to build a generalised linear model to predict the response variable density of animals per area (km^2). We used habitat as an explanatory variable to determine if it explained a significant amount of deviance in the model. We included transect length as an offset to account for different sizes of each habitat. This produced a response variable of animal density. In this step, we were interested in the apparent rather than the actual density of animals in each habitat, so there was no need to standardise our estimates using correction factors.

Visitor surveys

We used structured questionnaires to survey 220 visitors to the park in July 2009 and May 2010. We approached visitors in accommodation camps, at the entrances to the park and in recreational areas throughout the park. The park has two main accommodation areas, with Hilltop being a luxury camp in the Hluhluwe section of the park and Mpila a budget camp in the iMfolozi section of the park. All visitor groups present were approached, with one representative per group completing the questionnaire. The questionnaire included both open-ended and multiple-choice questions (see Online Appendix 1).

Vegetation change and desirability

We asked repeat visitors to describe any change in vegetation they may have noticed since their first visit, without explaining the woody plant encroachment phenomenon to them. Visitors were also shown photographs depicting three different vegetation types (open savanna, heterogeneous landscapes with savanna and forest elements, and encroached thicket) and asked which vegetation they most enjoyed driving through. The responses to these questions were used to establish the main reasons for visiting the park and which aspects of the park and its wildlife visitors were most attracted to. Visitors were also asked to identify, from the same pictures, in which vegetation they had seen the most wildlife.

Visitor demography and reasons for visiting

At the onset of the survey we established where visitors were from, where they were staying, whether they had visited the park before and, if so, how often. Visitors were asked why they had chosen to visit HiP and to indicate which animals they most wanted to see in the park. This allowed us to determine whether responses differed depending on visitor origin and accommodation choice using contingency tables and chi-square tests.

Effect of encroachment on visitor satisfaction

We then explained the woody plant encroachment phenomenon. Visitors were asked to record, on a scale between 1 and 5, how strongly they agreed with a series of statements (5 = strongly agree; 1 = strongly disagree; also see Online Appendix 1) to establish whether they would return to visit the park despite a reduction in the visibility of wildlife. The results were subsequently related to the demographic profiles of visitors using contingency tables and chi-square tests.

Results

Visibility of animals in different habitats

Results from a generalised linear model of the form:

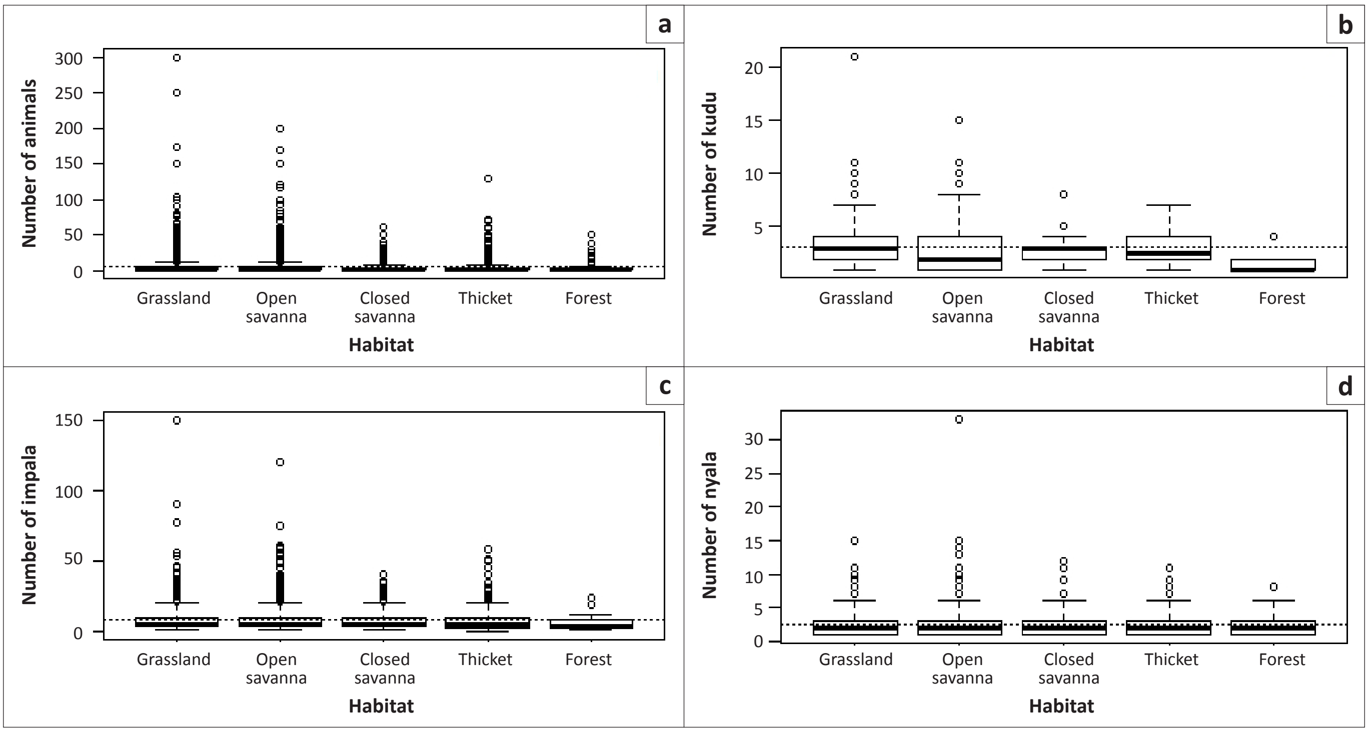
$$density = \beta_0 + \beta_1 \times habitat + \varepsilon \qquad \text{[Eqn 1]}$$

suggested that mean density was significantly higher in grasslands and open habitats than in closed habitats (see results of model summarised in Table 2). Forests had the lowest observed animal densities (0.38 animals/km^2). Some 30% of the deviance in the model was explained by habitat. The open habitats had much larger animal groups, with a maximum of 300 individuals in one group in grassland, and a maximum of just 50 in forest (Figure 1a). This pattern was repeated regardless of feeding ecology when animals were grouped according to species (Figure 1b–d). These results suggest that an increase in woody plants would likely cause a reduction in the apparent density of animals.

TABLE 2: Results from a generalised linear model investigating how much of the variation in the density of animals is explained by differences in habitat.

Habitat	Density (animals/km²)	SE	*z* value	*p*-value
Grassland	0.648069	1.006613	−65.8054	< 0.0001
Open woodland	0.554642	1.008421	−18.5647	< 0.0001
Closed woodland	0.46389	1.017664	−19.0947	< 0.0001
Thicket	0.484873	1.013238	−22.059	< 0.0001
Forest	0.38877	1.044456	−11.7485	< 0.0001

SE, standard error.



Dotted horizontal lines indicate mean number of animals per group for all habitats. Of interest are the tails of the distribution.

FIGURE 1: Boxplots showing medians and quartiles of the number of animals recorded at each sighting in each habitat type: (a) all species, (b) kudu, (c) impala and (d) nyala.

Visitor perceptions

Before woody plant encroachment was explained to visitors, they were asked how long they had been visiting the park and whether they had noticed a change in vegetation since they had first visited. Of the 64.7% of returning visitors (n = 66) who answered that they had noticed a change, 80% (n = 53) described a vegetation change that could be identified as woody plant encroachment. Figure 2 shows the percentage of visitors who had observed vegetation change as a function of how long ago their first visit was. Time since first visit increased the likelihood of having noticed vegetation change (χ^2 = 22.30, df = 6, p = 0.001). Of the 20 visitors who had been visiting the park for more than 30 years, 80% (n = 16) had noticed woody encroachment. A further 10% had noticed some change in the vegetation but did not describe it. This was in contrast to responses from visitors who had been visiting for less than 10 years (n = 48), with only 31.2% having noticed woody plant encroachment and 12.5% having noticed some change in vegetation.

When visitors were asked to identify, using photographs, the habitat they thought they had seen most animals in, 63% chose photographs showing open savannas or landscapes with both forest and savanna elements. Only 37% of visitors indicated that they had seen more animals in closed thicket and forest landscapes. We used the same photographs to ask visitors which scenery they enjoyed most when driving through the park. According to the responses, 48% of visitors preferred driving through landscapes with forest and savanna elements (i.e. heterogeneous landscapes), 27% preferred open savanna landscapes and 25% preferred closed habitats.

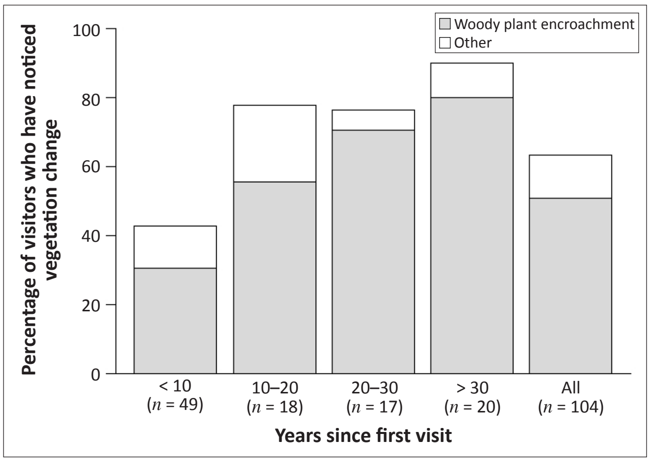


FIGURE 2: Percentage of return visitors who noticed vegetation change over time.

Demographic profiles of visitors

The demographic profiles of visitors are shown in Table 3 and Table 4. Although the majority of visitors to the park were local travellers (i.e. from KZN or elsewhere in or close to South Africa[1]) a large proportion (45.5%) of visitors were international guests. Most guests were day visitors (58.1%). Of the overnight visitors (n = 92), 65.2% stayed at the Hilltop camp and the majority of these (60%) were international visitors. A chi-square test confirmed that local overnight visitors were less likely to stay at Hilltop, whilst international visitors were more likely to stay there than would be expected by chance (χ^2 = 13.04, df = 4, p = 0.011).

1.Very few African visitors were from outside South Africa and therefore all African and South African visitors were grouped together.

Of the surveyed visitors, 47.3% had been to the park before. More than half of the overnight visitors (n = 48) were return visitors. Most of the day visitors (56.1%, n = 72) had not visited the park before. Likelihood of staying in park accommodation was not different for first-time or regular visitors ($\chi^2 = 3.62$, $df = 2$, $p = 0.16$) (Table 4).

Reasons for visiting Hluhluwe–iMfolozi Park

This was an open-ended question, so answers were combined into categories. The most commonly cited reason for choosing to visit HiP was that it was close or convenient (Figure 3). For international visitors, the most commonly cited reason for visiting was that it was recommended by someone or because it formed part of a tour. Tranquillity or being in nature was most commonly cited by local visitors as a reason for choosing the park. The park's heritage and its well-known rhino conservation efforts appeared to be more important to international than local visitors. A chi-square test confirmed that the origin of visitors (i.e. local vs international) influenced their reasons for choosing to visit HiP ($\chi^2 = 26.8$, $df = 10$, $p = 0.003$). Surprisingly, only 17.7% of visitors cited seeing animals in general, and the 'big five' (lion, leopard, elephant, white rhino and buffalo) in particular, as the most important reason for visiting the park. However, in response to the statement: 'The main reason I am visiting this park is to see animals,' 58.6% strongly agreed, whilst only 5.58% strongly disagreed. Visitor demography strongly influenced how they answered this question ($\chi^2 = 38.9$, $df = 8$, $p < 0.0001$): 46.0% of visitors who strongly agreed with the statement were international guests, whilst 83.3% of respondents who strongly disagreed with the statement were local visitors, specifically from KZN. Visitors from elsewhere in Africa were more likely to have a neutral view, although the majority of them still strongly agreed with the statement.

The 'big five' tended to be the most desirable animals (Figure 4) for visitors to see whilst in the park, although giraffe were more popular than buffalo. Animal preferences were affected by visitor origin ($\chi^2 = 51.90$, $df = 26$, $p = 0.002$), with giraffe and zebra being more popular sightings amongst international visitors, and buffalo and birds being more popular sightings amongst local visitors. Whether visitors had been to the park before or not also affected their desire to see certain animals ($\chi^2 = 78.7$, $df = 52$, $p = 0.0098$): the desire to see leopard, impala, nyala and cheetah increased if people had been to the park before, but the desire to see zebra decreased.

TABLE 3: Demographic profile and accommodation choice of visitors.

Origin of visitors	Day visitors	Hilltop	Mpila
Africa (excluding KZN)	24	12	8
International	54	36	8
Local (KZN)	50	12	16

KZN, KwaZulu-Natal.

Visitor response to changing vegetation

Although the vast majority of visitors (87.4%) indicated that they would like to return to the park given the opportunity, 42.4% of visitors agreed or strongly agreed with the statement that they would not return to the park if it became more difficult to see animals (Table 5). Accommodation choice and whether they had been to the park before affected their response to this statement ($\chi^2 = 36.86$, $df = 22$, $p = 0.025$). Day visitors or visitors staying at Hilltop were less likely to return if game became more difficult to spot than those staying at Mpila. First-time visitors were also less likely to return than regular visitors if animals became more difficult to see.

A chi-square test found that visitors whose responses indicated that they were unlikely to return if encroachment made wildlife more difficult to see were likely to agree with the statement that encroachment should be controlled ($\chi^2 = 50.18$, $df = 16$, $p < 0.0001$). Day visitors were also more likely to agree with controlling encroachment than overnight guests staying in park accommodation ($\chi^2 = 19.46$, $df = 8$, $p = 0.01$).

Discussion

Woody plant encroachment will impact on many savanna ecosystem goods and services such as fodder availability in rangelands (De Klerk 2004), biodiversity (Parr *et al.* 2012), hydrology and nutrient cycling (Archer, Boutton & McMurtry 2004). It is also likely to have regional-scale feedbacks to the earth–atmosphere system because of changes in albedo and gas exchange (Asner *et al.* 2004; Beerling & Osborne 2006).

This study set out to determine whether woody plant encroachment would have additional economic impacts due to a reduction in game viewing capacity in HiP, where evidence of extensive woody plant encroachment has been seen over the last century (Wigley *et al.* 2010). Specifically, we set out to investigate (1) whether woody encroachment would reduce visibility of animals, (2) whether guests visited the park predominantly to see animals and (3) whether reduced visibility of animals could therefore result in reduced visitor numbers and, consequently, reduced park revenue.

TABLE 4: Contingency table showing the number of return and first-time visitors to the park and their respective accommodation choices.

Visitor category	First-time visitors		Return visitors		Total	
	n	%	n	%	n	%
Day visitors	72	32.7	56	25.5	128	58.2
Overnight visitors: Hilltop	32	14.5	28	12.7	60	27.3
Overnight visitors: Mpila	12	5.5	20	9.1	32	14.5
Total	**116**	**52.7**	**94**	**47.3**	-	-

n, number.

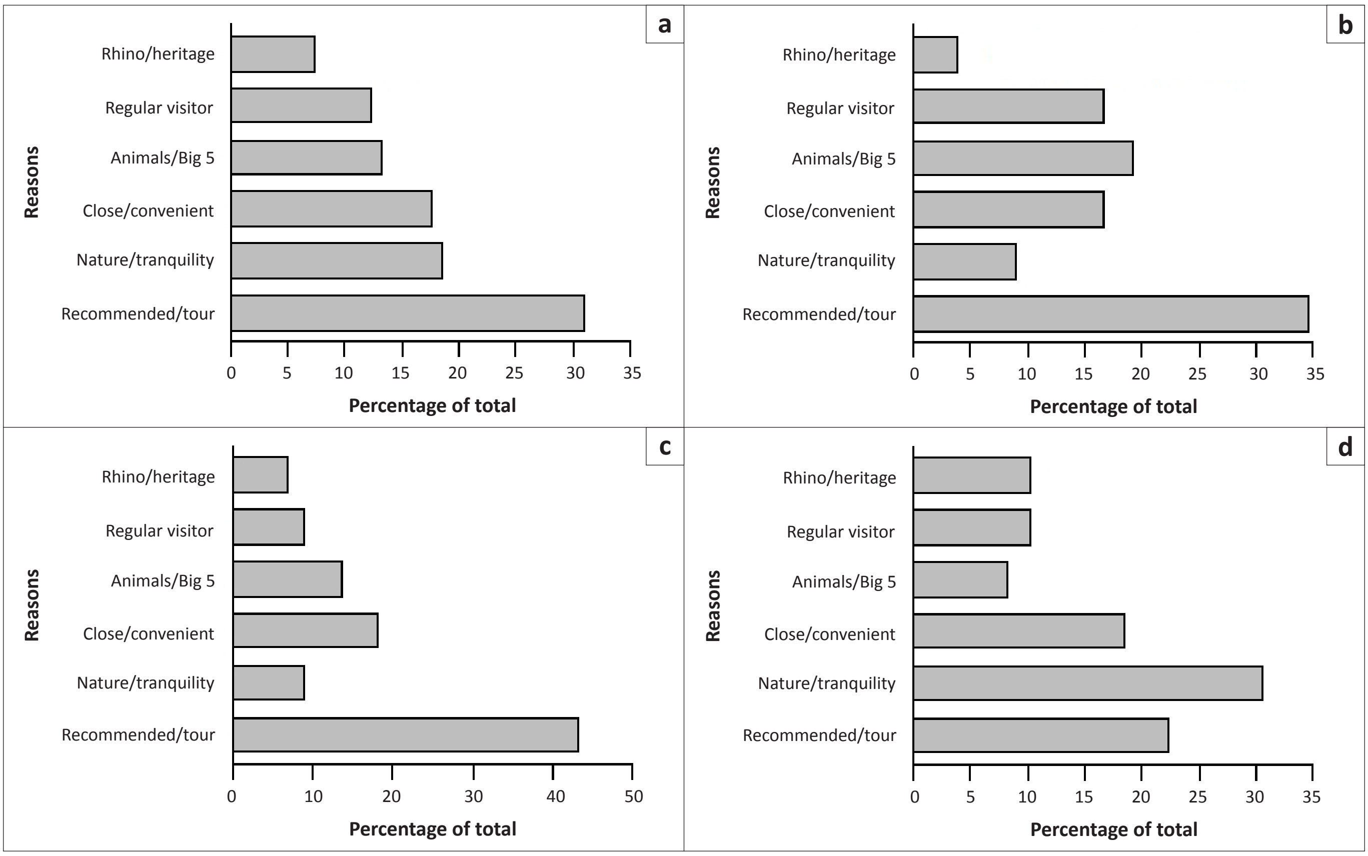
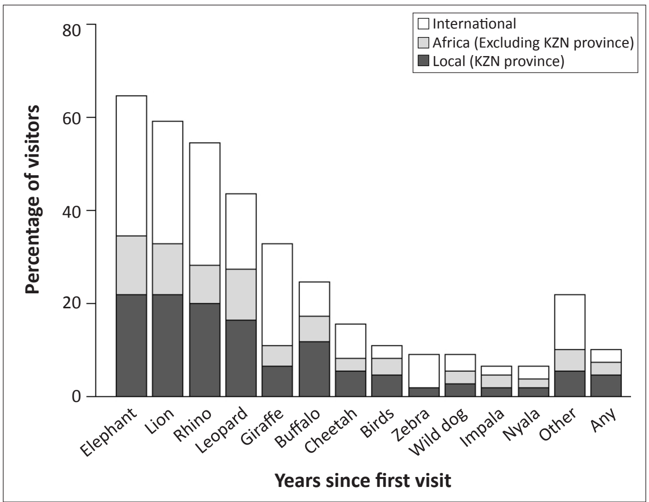


FIGURE 3: Reasons cited for visiting the park for (a) all visitors combined, (b) visitors from KwaZulu-Natal (local), (c) visitors from the rest of South Africa and Africa (excluding KwaZulu-Natal province) and (d) international visitors.



KZN, KwaZulu-Natal.

FIGURE 4: Animals that visitors most wanted to see, as a percentage of all visitors.

Our study showed clear evidence that wildlife visibility is compromised by woody plant encroachment (Figure 1), regardless of the species of animal. In addition, most visitors indicated that they had seen more animals in open and heterogeneous habitats. Visitors also found heterogeneous landscapes with typical savanna characteristics, such as open plains and single large trees, more aesthetically pleasing than encroached areas. Besides the aesthetics, heterogeneous vegetation is ecologically important in increasing the carrying capacity of populations, because it provides a diversity of resources (Fryxell *et al.* 2005; Wang *et al.* 2006). In a previous study undertaken in HiP, Cromsigt, Prins and Olff (2009) suggested that habitat heterogeneity might facilitate herbivore diversity in savanna ecosystems.

Whilst the conclusion that denser vegetation will result in reduced visibility of animals may seem an obvious one, it is likely to have numerous less obvious knock-on effects, one of which is the potential reduction in visitor numbers to game reserves. Our results established that whilst wildlife viewing may not be the main reason for visitors choosing HiP (Figure 3), the majority of visitors were indeed intent on seeing wildlife. This was, however, affected by visitor origin, with international visitors being more interested in seeing animals than local visitors. Di Minin *et al.* (2012) found a similar trend when investigating the relative importance of the 'big five' in HiP, with more wealthy and less experienced international visitors most interested in seeing these animals.

Whether visitors will stop visiting the park because of encroachment was not clear from our results, but the responses to our questions have led us to make certain inferences. People who visit the park because it is close or convenient (Figure 3) are unlikely to be much affected by a change in woody vegetation as the location of the park and its proximity to other areas will not change. Those who visit the park because of its heritage and rhino conservation efforts, as well as those who have come to escape city life and experience the tranquillity of nature, are also unlikely to stop visiting the park as a results of encroachment. For international visitors,

TABLE 5: Contingency table showing the proportion of return visitors, their accommodation choice, and response to the statement 'I would not visit the park again if game became more difficult to spot'.

Respondent demography	Strongly disagree		Disagree		Neutral		Agree		Strongly agree		Total	
	Proportion	Number of responses	Proportion	Number of responses	Proportion	Number of responses	Proportion	Number of responses	Proportion	Number of responses	Proportion	Number of responses
First-time visitors												
Day visitors	0.074	16	0.065	14	0.046	10	0.101	22	0.037	8	0.323	70
Overnight visitors: Hilltop	0.018	4	0.009	2	0.037	8	0.055	12	0.028	6	0.147	32
Overnight visitors: Mpila	0.000	0	0.028	6	0.009	2	0.009	2	0.009	2	0.055	12
Return visitors												
Day visitors	0.037	8	0.065	14	0.051	11	0.092	20	0.009	2	0.253	55
Overnight visitors: Hilltop	0.018	4	0.037	8	0.018	4	0.046	10	0.009	2	0.129	28
Overnight visitors: Mpila	0.018	4	0.037	8	0.009	2	0.009	2	0.018	4	0.092	20
Total	**0.166**	**36**	**0.240**	**52**	**0.171**	**37**	**0.313**	**68**	**0.111**	**24**	-	-

however, recommendations and choice of tour operator were important reasons for visiting HiP. Mmopelwa, Kgathi and Molefhe (2007) found that in Botswana international visitors were more willing to pay higher rates for wildlife tourism, a finding mirrored by our observations that international tourists often stayed in the more expensive accommodation. Tour operators are unlikely to take tourists to a game reserve where wildlife viewing success is poor, and the same may be expected from guide book recommendations. This suggests that the park could lose a significant fraction of their international visitors (and therefore highest spenders) because of woody plant encroachment.

Although the majority of visitors indicated they had enjoyed their experience and would like to return to the park, a large portion of visitors confirmed that reduced visibility of animals would impact their decision to the return to the park (with nuances depending on whether they were regular visitors and choice of accommodation). Based on visitor responses we estimated that Hilltop could lose at least half of its potential future visitors and about 40% of its regular visitors if animals became more difficult to see. If we consider return visitors as definite future visitors, the park would lose about 40% of its definite future visitors and about one third of these would be visitors to Hilltop (i.e. the visitors who are likely to spend the most money whilst in the park). In addition, with an estimated return rate of 47% for first-time visitors, Hilltop could lose nearly half of potential future visitors. This combines to a possible total loss of about 40% of potential future visitors to the park if animals became more difficult to see. These results suggest that park managers should consider suitable encroachment control measures if they are to ensure return visits. On the whole, visitors did not object to the suggestion of controlling encroachment, so park managers are not likely to face public outcry if such measures were put in place.

Conclusion

Our study has shown strong evidence that woody plant encroachment influences visitor experience in HiP and suggests that visitor numbers might diminish in heavily encroached areas. Woody plant encroachment is not merely a debate on conservation objectives for park management, but could negatively influence the economy of the park. Our results suggest that the park may lose a significant portion of visitors if woody encroachment continues unchecked.

However, studies have shown that visitor demand for large wildlife viewing is unlikely to disappear and the overall number of wildlife tourists in Africa is unlikely to drop (Boshoff *et al.* 2007; Goodwin & Leader-Williams 2000; Lindsey *et al.* 2007; Mmopelwa *et al.* 2007; Obua & Harding 1996). Rather, we may see a shift in visitor numbers to different parks as visitors choose parks where they are more likely to have their desired experience. To ensure success of their parks in the future, managers need to make decisions based on conservation principles, but with an understanding that conservation will be facilitated by the revenue generated by visitors (Boshoff *et al.* 2007; Kiss 2004; Lindsey *et al.* 2007; Mmopelwa *et al.* 2007). As HiP contributes significantly to the revenue of Ezemvelo KZN Wildlife as a whole (Aylward & Lutz 2003), a decrease in revenue may affect the organisation significantly. In addition, Ezemvelo KZN Wildlife employs many members of the local community (Aylward & Lutz 2003) and many livelihoods could therefore be affected by a drop in visitor numbers, as well as the many smaller businesses and private game reserves and local ecotourism ventures that benefit from being in close proximity to such a large tourist attraction (Bookbinder *et al.* 1998; Kiss 2004). Our conclusions on the impact of habitat change on park visitors are not restricted to HiP, as woody encroachment is a widespread phenomenon in many savannas in Africa. It will be prudent for managers to consider strategic management of the phenomenon using fire and other management tools.

Acknowledgements

This study was made possible through funding from the University of Cape Town Woolworths Fellowship and the German Academic Exchange Programme (DAAD). Thanks to the Earthwatch Institute for mammal census data, Geoffrey Clinning for providing data, and Amy Rose Wilkinson for assistance in the field. Thanks also to field and administrative staff at Hluhluwe–iMfolozi Park for allowing us to undertake the study and providing us with assistance at every stage.

Competing interests

The authors declare that they have no financial or personal relationship(s) that may have inappropriately influenced them in writing this article.

Authors' contributions

W.J.B. (University of Cape Town) was the project leader. E.F.G. (University of Cape Town) and W.J.B. were both responsible for project design. E.F.G. undertook all fieldwork and analyses and wrote the manuscript. W.J.B. made conceptual contributions to the manuscript.

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