Strifes of the frontier: an assessment of *Acacia mearnsii* related park-community conflicts in the Golden Gate Highlands National Park, South Africa

Geoffrey Mukwada, Wisemen Chingombe and Philip Taru

Afromontane Research Unit and Department of Geography, University of the Free State, Phuthaditjhaba, South Africa

**ABSTRACT**

This study coins the “reality-worldview” framework to examine park-community conflicts arising from the expediency to protect the environmental integrity of a South African national park from bio-invasion. The study used remote sensing data to investigate the state of vegetation cover along the northern fringes of the park and an adjacent communal grazing area to determine differences in plant based resource endowments between the two areas. The study also involved the discriminant analysis of survey responses from park officials and local communities regarding perceptions about the environmental impacts of *Acacia mearnsii* invasion, as well as how the species spreads and how the species can be controlled. The objective of the study was to assess park-community conflicts arising from initiatives to limit community access to park resources on the justification of the need to prevent the invasion of the park by *A. mearnsii*. The study concludes that even though uncontrolled movement of people and livestock creates the obvious danger of invasion of the park by the species, the extent to which the species is viewed as an environmental threat depends on the “worldviews” of the stakeholders, the bridging of which can only be achieved through negotiation, environmental awareness and education campaigns and provision of training in conflict resolution to the belligerents.

**Introduction**

Conflict between parks and local communities are inevitable where local communities hold negative perceptions toward protected areas (Hulme & Murphree 2001). Conflict and uncertainty are detrimental to biodiversity and ecosystem services and are a threat to human well-being (Paloma et al. 2011). In some cases, the conflict takes the form of antagonism between people and wildlife, especially where the needs and behavior of wildlife impact negatively on goals of humans or vice versa (Barua et al. 2013). Redpath et al. (2013) note that conservation conflicts are increasing and need to be managed to minimise negative impacts on biodiversity, human livelihoods, and human well-being. Existing literature on...
parks-community conflicts in developing countries indicates that considerable attention has been given to the conflicts related to the impacts that wildlife protection areas have on human safety and health, as well as lifestyle and livelihoods (Anthony et al. 2010; Dickman 2010; Delibes-Mateos et al. 2013). Conflicts arising from the establishment and management of protected areas such as national parks often relate to issues of access rights (Dahlberg et al. 2010). Park-community conflicts are at the centre of the social challenges confronting wildlife management. This is due to the fact that such challenges define the context of wildlife management in and around protected areas and require a broad-based approach that can account for the numerous factors that underlie conservation effectiveness (Teel et al. 2010). One form of conflict that has not received similar attention relates to fears held by park authorities about the imminence of bio-invasion caused by uncontrolled movement of people and livestock across park boundaries. Fears of bio-invasion are usually justified on the impact that alien invasive species (IAS) have on natural habitats within parks as a result of dispersal. IAS alter natural habitats and disrupt ecosystems in protected areas (Moyo & Fatunbi 2010), thus undermining the value of these areas to biodiversity conservation, as well as tourism, a major source of revenue in some countries. However, some conflicts are not caused by differences in opinion as such but by differences in the interpretation of how issues are defined or interpreted (Webb & Raffaelli 2008; Liu et al. 2011).

Research conducted on non-native species in the Netherlands showed that though respondents were not particularly concerned about non-native species they recognized the need for invasive species management, especially when the species pose a threat to nature, the economy or human health (Verbrugge et al. 2013). IAS related conflicts are influenced by differences in stakeholder perceptions. While studying the attitudes of neighbours, visitors, volunteers, and staff in three urban natural areas in Michigan (USA), Ryan (2005) concluded that the expert’s vision of appropriate management of a natural area may differ from those of neighbours and users, which can readily lead to conflict, because each stakeholder has a distinct perspective. While the examples cited above show that IAS related conflicts are common amongst stakeholders, especially between park managers and the lay public or local communities in developed countries have been studied, attention to similar conflicts in developing countries have not received the same attention.

Even though the primary purpose of establishing national parks is to promote wildlife conservation, in many developing countries there is also an increasing awareness of the importance of wildlife protected areas like national parks as popular destinations for wildlife tourists (Teel et al. 2010), as well as their importance as a source of livelihood to local communities due to the products they supply to these communities (Vodouhê et al. 2010). Where communities depend on park based resources such as grazing land, phytomedicines and thatch grass, movement of people and livestock across park boundaries is inevitable. However, movement of this nature facilitates bio-invasion. Whereas invasion by *Acacia mearnsii* mainly encompasses the process of dispersal by natural forces such as wind and water, as well as by insects and other animals, particularly birds and rodents, (Rouget et al. 2002; Kull & Rangan 2008; Kull et al. 2011), the species is also potentially dispersed in mud on people and domestic animals (BioNET-EAFRINET 2011). It is also possible for seeds and pods from plant detritus or other seedbanks to collect on livestock hooves or fur and be transported across park boundaries by livestock, especially over short distances.

Vodouhê et al. (2010) noted that communities whose livelihoods chiefly involve direct exploitation of local natural resources often become embroiled in conflict with protected
areas, especially where the protected areas are primarily designated for natural resource conservation. Conflict assessment is an indispensable component in the protected area-community conflict resolution framework (Lewis 1996), yet only “a few studies have assessed the protected area-community conflicts … and described the relationship between social context and environmental attitudes of local people and the conflicts” (Liu 2010, p. 2255).

This study focusses on the Golden Gate Highlands National Park (GGHNP), a wildlife protection area in South Africa, where park-community conflicts have emerged due to perceived threats from *A. mearnsii* invasion. In the GGHNP, one of the factors assumed to be contributing to the spread of *A. mearnsii* is the uncontrolled movement of people and livestock across park boundaries. The eviction of some park residents during the second half of 2014 heightened the already deep-seated park-community conflicts. Park officials cited a number of reasons for the eviction. One of the reasons was that the grazing of livestock in the park by some residents spoiled opportunities for tourism. They noted that some wildlife tourists who visited the park were disappointed to see more livestock than wild animals. Another reason, and by far more controversial, is that the grazing of livestock in the park encouraged the spread of invasive species, especially *A. mearnsii*, which is the dominant invasive species in the park. Park officials noted that when communities from adjacent areas see livestock grazing in the park they are encouraged to bring their own herds into the park as well, and by so doing encourage the invasion of the park by alien species. However, while it has been noted that domestic animals such as cattle can play a direct role in the dispersion of *A. mearnsii* (Milton et al. 2003; BioNET-EAFRINET 2011), a more credible explanation is that the competition for pastures between domestic and herbivorous wild animals leads to overgrazing and the disturbance of the habitat, thus indirectly making the park more prone to bio-invasion (Moyo & Fatunbi 2010). It is therefore likely that park officials were using the control of *A. mearnsii* invasion as a reason to strengthen their case for park residents’ eviction.

Considerable research has already been done on park-community conflicts in the GGHNP (Slater 2002; Taru et al. 2014). These conflicts stem from competition on resource use, land use, land claims and economic benefits generated from the park (De Villiers 2009). Relating to recent attempts to relocate park inhabitants, for instance, Taru et al. (2014) observed massive resistance by park inhabitants who argued that they cannot leave the graveyards of their relatives and ancestors. The current GHHNP is an amalgamation of the former Golden Gate National Park and Qwaqwa National Park (QNP). Slater (2002) noted that the proclamation of the QNP is undoubtedly the source of the present conflict as no formal consideration was made to the inhabitants of these farms, who had been employed for decades as farm labourers by the farmers who were compensated, leaving behind their farm labourers. The park inhabitants, together with communities living within the vicinity of the park, are relatives of earlier generations that lived on the farms that were converted into the GGHNP. An important aspect of the current conflict is that government had guaranteed the park inhabitants (farm labourers) secure tenure and grazing rights when QNP was proclaimed in 1992. These rights have not been guaranteed since the incorporation of the QNP into the present day GGHNP. Unrestricted access to the park would endanger the plant diversity in the park from over-grazing by livestock. The resentment directed by the local community towards initiatives to limit access to the park has been expressed through the holes that have been cut in some sections of the perimeter fence, signifying the community’s agitation to gain access. However, while these long-standing conflicts have received considerable attention already conflicts arising from the barring of communities living adjacent to the
park from grazing their livestock in the park on the pretext that the practice would promote the invasion of the park by *A. mearnsii* have not yet been assessed. In line with its “high level objective…to ensure persistence of the ecological integrity” of the GGHNP SANParks has set up four programmes, including “alien and invasive species control, fire management, species of special concern and wildlife management” (SANParks 2012, p. 29). One of the objectives of the first programme is alien and invasive species control by developing a prevention and control strategy for alien plant control and for monitoring the effectiveness of this strategy. As noted by park officials during discussions that preceded this study, it is this strategy which constitutes the basis for the control of livestock movement across park boundaries.

The central objective of this paper is therefore to assess park-community conflicts arising from initiatives to limit community access to park resources on the justification of the need to prevent the invasion of the park by *A. mearnsii*, the invasive species that is most widespread in the area. In line with this objective, the paper aims to identify the environmental, social and economic factors that contribute to the conflict between the park authorities and the local community, including those that arise from differential resource endowment between the park and its surroundings. This focus is viewed as important because human behavior is influenced by how environmental, social and economic conditions are perceived rather than by reality alone. Dickman (2010, p. 462) argues, for instance, that in reality, people base their perceptions and attitudes not only upon facts and personal experiences, but also upon a myriad of factors such as wider societal experiences, cultural norms, expectations and beliefs … social factors that play an extremely important role in human–wildlife conflict, yet are relatively rarely considered.

After examining the theoretical framing of park-community conflicts, the paper presents the methodology of the study, the results and discussion of the key findings of the study, and finally draws up conclusions from those findings.

**Study framework**

How people comprehend conflicts varies according to worldviews regarding access to ecosystem services, property rights, and sovereign boundaries (Robards et al. 2011), as well as their framing of reality, referring to “a cognitive process whereby individuals and groups filter their perceptions, interpretations and understandings of complex situations in ways consistent with their own socio-political, economic and cultural world views and experiences” (Shmueli 2008, p. 2048). Framing provides an analytical approach in managing environmental disputes and provides a mechanism for clarifying, simplifying and communicating to the parties within the conflict the underlying roots of their respective positions and interests in order to further mutual understanding and facilitate compromise or resolution (Shmueli 2008). Frames can be “interpreted as ideas that shape people’s understanding of a situation, and that can be actively employed by actors such as organizations or the media to influence public views” (Fischer & Marshall 2010, p. 186). Frames are cognitive devices that are used as interpretive lens through which we see and make sense of complex situations in ways that are internally consistent with our worldviews (Shmueli 2008; Fischer & Marshall 2010). The notion of framing has gained recognition and is increasingly applicable when examining land management conflicts (Buijs 2009).
Shmueli (2008) notes two purposes of framing. First, frames give meaning to events in the context of life experience, understanding and roles. Second, they function as strategic communicative devices which help in rationalizing self-interest, or in persuading broader audiences in building coalitions or to promote preferred outcomes. As reported by Shmueli (2008), some frames relate to conflicts rooted in geographical stakes such as land, location and natural resources. Since people cannot be separated from nature, there is need to move away from the mentality of viewing conservation as detrimental to development to a view where conservation is seen as a tool for development (Folke 2006; Palomo et al. 2011). However, in practice this is rarely the case. The setting up of parks is usually considered a form of public goods provision to promote biodiversity protection while excluding livelihood activities in areas that have strictly defined borders (Coria & Sterner 2011). This is partly the reason why park-community conflicts arise.

In a study on discourse of woodland restoration and moorland management in Scotland, Fischer and Marshall (2010) observed that frames often reflected societal discourses, involving a variety of actors. Usually, these actors have different worldviews and different priorities, depending on the realities of their circumstances. In the case of the spread of IAS, there is bio-invasion involving public goods, the management of which requires multiple stakeholders, each with their own set of priorities, some of which are conflicting (Liu et al. 2010). Under these circumstances, adopting a common front for controlling bio-invasion becomes onerous while efforts to eliminate this problem remain daunting. In some instances these factors lead to resentment of wild animals and poaching, as well as violent conflicts between the affected communities and park authorities. There are cases when conflicts can be directed towards wildlife, leading to the decline of the targeted animals (Chen et al. 2013). Under such circumstances, designing a landscape where certain uses can coexist with biodiversity conservation and protected areas should be the first aim of landscape planning in a social-ecological system (Palomo et al. 2011). One way of doing so is to set up ecoagricultural landscapes around protected areas (Scherr & McNeely 2008). What remains unaddressed though is the question about the type of ecoagricultural landscape that would work for the GGHNP.

From the foregoing discussion, it is evident that there are two fundamental issues that regulate human behavior and foment conflict in wildlife areas. These are “reality”, denoting the state of social, economic and environmental circumstances under which communities find themselves, and “worldview”, depicting the perceptions of these communities about those circumstances. It is from this viewpoint that we propose to use our own framework, described here as the “reality-worldview” framework, which we consider to be indispensable to the protected area-community conflict resolution framework suggested by Lewis (1996). In the proposed framework, we investigate the congruence (or lack of it) between the coupled dimensions of “reality” as reflected by the state of the environment in the study area and the “worldviews” of the actors, as expressed in their perceptions of the reality prevailing in that area. In this framework “reality” denotes those positivist aspects that are stable, which can be tangibly observed and described from an objective point of view (Levin 1988). On the other hand the “worldview” comprises those aspects that are more transient and less tangible, including perceptions.
Methodology of the study

Description of the study area

This study was conducted in the GGHNP and the tribal area adjacent to it. The GGHNP is a montane national park located in the foothills of the Maluti-Drakensberg mountains, comprising the eastern part of the Free State province of South Africa (Figure 1). The park is about 32,690 ha and is characterized by beautiful scenery, and boasts of a variety of wildlife, the reasons why it has become an important tourist destination of international acclaim. According to SANParks (2012), the core of the GGHNP, approximately 1,792 ha in size was set up in 1962 when the provincial administration of the then Orange Free State purchased land around what was considered to be a popular picnic site at Golden Gate.

In 1963, the control of the park was handed over to the then National Parks Board. Since then the park has registered considerable growth in size as a result of subsequent incremental incorporation of surrounding farmland, reaching 6241 ha when the Noord Brabant farm was incorporated in 1981. The size of the park was further extended to 11, 630 ha, following the incorporation of another eight farms between 1988 and 1989. In 2008 the GGHNP was merged with the adjacent QNP, comprising a total of another 95 farms, under the provisions of Section 18 (1) of the Qwaqwa Nature Conservation Act (No. 5) of 1976, thus reaching its current size. Today the park is part of the Maloti Drakensberg Transfrontier Conservation Area, which was set up between South Africa and Lesotho, following the signing of a bilateral treaty between the two countries.

Figure 1. Location of the GGHNP and transects along which NDVI values were analyzed (T1 to P13, T2 to P14, T3 to P15 and T4 to P16). Areas infested with A. mearnsii are evident along the northern fringes of the park.
The area is characterized by montane grasslands and is home to many endemic and endangered plant and animal species, making it an important biodiversity hotspot in the country. An example of an endemic animal species that is found in the park is the sun gazer (*Cordylus giganteus*), while endangered species include the bearded vulture (*Gypaetus barbatus*), grass owl (*Tyto capensis*) and Bald Ibis (*Geronticus calvus*) (SANParks 2012). The park has a high wildlife species richness, comprising antelopes, carnivores, amphibians and birds. The park is also rich in plant diversity. Within the GGHNP is a range of vegetation types, comprising the Sandy Grassland; Basotho Montane Shrubland; Northern Drakensberg Highlands Grassland, Lesotho Highland Basalt Grasslands and Drakensberg-Amathole, as well as the Afromontane Fynbos (SANParks 2012). In general, the grasslands are dominated by species such as *Eragrostis species*, *Tristachya leucothrix* and *Themeda triandra* (SANParks 2012). This is one of the main reasons why park dwellers and communities from nearby tribal areas, depend on resources from the park, including pastures, herbal medicines and game. The park faces a number of threats, including potential habitat changes posed by invasive alien species (IAS) such as *Eucalypts* and *A. mearnsii*, veldt fires, poaching, overgrazing and overharvesting of resources, especially medicinal plants. Even though veldt fires are a natural phenomenon in the area, in the GGHNP fires are caused primarily by humans, either in a planned or unplanned manner, such as those originating from outside the park (SANParks 2012). Uncontrolled veldt fires and free ranging of livestock by communities who live within and around the park pose the major threat to the park’s potential as a wildlife based tourist attraction. Communal grazing is the main landuse practiced within these communities, where unemployment and poverty are worsening.

Slater (2002) notes that present park-community conflicts regarding the GGHNP partly resulted from the fact that no consideration was made to compensate the farm inhabitants, mostly farm labourers who had lived and worked on the incorporated farms for decades. Some of the labourers remained in the park. In terms of the South African constitution, these inhabitants or their offspring may not be evicted or relocated unless a more suitable home is found for them.

**Sources of data**

**Data reflecting “reality” and the state of the environment**

The first task was to establish why the communities from the tribal areas regard the GGHNP as an important source of pastures and products such as thatch grass, phytomedicines and other products, as well as why these ecosystem services are not obtainable from the surrounding tribal areas. In order to achieve this objective, it was necessary to establish whether there were any differences between the state of vegetation cover between the park and the surrounding tribal areas. This necessitated the determination of the state of the environment in these two areas, denoting part of the “reality” component of our analytical framework. Landsat images were used to achieve this objective. The use of satellite images served two purposes. The first was to determine the presence of IAS in the area, and the second was to determine the general state of health of the vegetation in both the park and the areas adjacent to it in an objective way. With regard to the first, our focus was on *A. mearnsii*, the most
widespread species that poses the greatest threat because of its ability to spread rapidly. Other IAS are no longer posing any serious threat following the park's earlier eradication efforts.

Normalized Digital Vegetation Index (NDVI) values were computed and used as a measure of the vegetation's state of health. NDVI values range between −1 and +1. Given the same type of vegetation, the assumption is that the higher the NDVI values, the healthier the state of the vegetation and therefore the higher the quality of the ecosystem services the vegetation is capable of providing. Landsat 8 images were used in the computation. The ArcGis 10.1 raster calculator was used to perform the calculations. In order to establish whether there were any differences between the state of vegetation health between the park and the surrounding tribal communal grazing areas, thirty-two evenly distributed sampling points were established in areas that occur on either side of the fence that separates the park from the tribal areas (Figure 1), and the NDVI values for those points were compared statistically, using SPSS. The Kruskall–Wallis Test was used in the comparison. Being non-parametric, the test was seen more appropriate for the small data-set that was analyzed, since the test does not assume normal distribution. The aim of the comparison was to determine if the state of health of the vegetation on either side of the fence was statistically different. This aspect of the assessment corresponds to the determination of the "reality" that drives people from the tribal areas to graze their livestock in the park. The comparison was done to ensure that local environmental conditions such as altitude and climatic variables such as temperature and rainfall were the same for the two areas. This was important because it was the only way to determine whether differences in landuse practices had an effect on state of vegetation health. Another reason for the comparison was to check if there was any objective scientifically justifiable reason for villagers from the tribal areas to graze their livestock in the park, one of the reasons why conflict often brews between them and park authorities. The villagers often graze their livestock herds in the park. To gain entry to the park, they either open the gates without permission from park officials or break the perimeter fence. However, there were other environmental conditions that influence NDVI values which make it difficult to determine how vegetation health varied at the local scale. These include atmospheric effects such as presence of water vapour and aerosols in the air, effects of cloud cover, soil moisture content and anisotropic conditions that generally influence the reflectance nature of any surface.

In order to address this challenge, it was necessary to check if abrupt changes in NDVI values occurred across the perimeter fence, since such changes would depict the effect of landuse and land management practices on vegetation health on either side of the fence rather than the effects of environmental conditions. Due to this abruptness of change, it can be argued that conditions such as presence of water vapour and aerosols in the air, effects of cloud cover, soil moisture content and anisotropic conditions mentioned above were not responsible for differences in NDVI values. An assessment of the variations of NDVI values between the park and the communal grazing area in the adjacent tribal area was necessary to establish the state of the environment without relying on the biased perceptions of the contending stakeholders, that is the communities that graze their livestock in the park and the park authorities. The best way of achieving this goal was to determine if the differences between NDVI values in the park and the communal grazing area were statistically different. In order to determine the appropriate type of significant test the NDVI data was checked for normality, using the Shapiro Test. The Shapiro Test revealed that whereas the NDVI values for
the park were normally distributed those for the communal grazing area were not. It was on the basis of this lack of normality that the Kruskal-Wallis Test was chosen to perform the significance testing. The test was performed at 95% confidence level, using SPSS. The assumption was that if the NDVI values within the park and those within the adjacent communal grazing area were significantly different then the two areas were differentially endowed regarding availability of plant resources, which consequently leads to the breaching of the frontiers of the park by people from the surrounding communities, and hence causing conflict.

### Data reflecting worldviews and the perceptions about the environment

The worldviews of the belligerent stakeholders were explored by analyzing stakeholder perceptions about the impact of *A. mearnsii* on the livelihoods of local communities and the impact that the species has on the environment, as well as how the environment would be affected through its eradication. These perceptions were considered to be an expression of the knowledge and attitudes that the stakeholders had and were the basis for certain forms of practices or behaviour related to the matters that were investigated in this study. Data on perceptions were collected through a structured questionnaire which was distributed to both randomly sampled park officials and villagers from the abutting tribal area. The main

| Table 1. Categories of questions and statements that were employed in DA. |
|---|
| **Category 1:** |
| Is the black wattle a source of problems to the GGHNP? (Yes/No) |
| Is the black wattle a resource to people living in this area? (Yes/No) |
| Should the black wattle be conserved or not? (Conserve/Not to be conserved) |
| Is it necessary to completely eradicate the black wattle? (Yes/No) |
| **Category 2:** |
| Which of the following environmental changes can arise from the prevalence of the black wattle: |
| Soil erosion (Yes/No) |
| Drying of streams (Yes/No) |
| Silting of streams (Yes/No) |
| Suppression of growing of grass (Yes/No) |
| Displacement of native trees species (Yes/No) |
| Fire damage within the habitat (Yes/No) |
| Other environmental changes (Yes/No) |
| No change in the environment (Yes/No) |
| **Category 3:** |
| Which of the following environmental changes can arise from the eradication of the black wattle: |
| Soil erosion (Yes/No) |
| Drying of streams (Yes/No) |
| Silting of streams (Yes/No) |
| Suppression of growing of grass (Yes/No) |
| Displacement of native trees species (Yes/No) |
| Fire damage within the habitat (Yes/No) |
| Other environmental changes (Yes/No) |
| No change in the environment (Yes/No) |
| **Category 4:** |
| How does the black wattle spread? |
| Seeds are dispersed by wind (Yes/No) |
| Seeds are dispersed by livestock through ingestion (Yes/No) |
| Seeds are dispersed by people (Yes/No) |
| Seeds are scattered when the fruit splits (Yes/No) |
| Seeds are dispersed by running water (Yes/No) |
| Roots extend underground (Yes/No) |
The purpose of the questionnaire survey was to establish the critical areas that lead to conflict between the two groups so that these areas could be targeted for conflict resolution and management. The data were used to perform Discriminant Analysis (DA), using SPSS. Afifi et al. (2004) defined DA as a technique which allows the classification of an individual into one of two or more distinctive populations, on the basis of a set of measurements. In this study the primary purpose of DA was to select the variables that best differentiated between two feuding groups, namely park authorities and communities that live around the park and depend on the park for pastures and other plant products. It was for this reason that the stepwise method of DA was adopted. Under these circumstances, the DA provided the most parsimonious way of distinguishing the disagreements between the belligerent stakeholders.

The measurements that were employed in the study belonged to four categories of questions or statements that both park officials and local communities were asked to respond to. These questions are presented in Table 1.

The first category comprised questions and statements about the role of *A. mearnsii* in livelihood construction, as well as whether the species should be eradicated or not. *A. mearnsii* was singled out because park officials regarded it as a serious environmental threat arising from uncontrolled movement of people and livestock between the park and the abutting tribal areas where the species was already prevalent. The second category consisted of questions and statements about perceptions regarding the environmental damage caused by *A. mearnsii*, while the third category comprised questions and statements about the kind of environmental effects that would result from the eradication of the species. The last category included questions and statements about how the spreading of *A. mearnsii* was understood by the stakeholders. Whereas DA was ideally designed to analyze ratio/scale data, it can also be applied for categorical data whose responses are dichotomous in nature, especially where variables require the selection of a particular response or its lack of selection. For each variable, the code “1” was given where a particular response was selected and the code “2” where the response was not selected. Similarly, where dichotomous questions that required responses such as “yes” and “no”, “yes” was coded “1”, while “no” was coded “2”. DA enabled us to determine if a belligerent group tended to give specific types of responses which the contending stakeholder group was unlikely to give.

The assumption behind the selection of this approach was that if the conditions that distinguish the two groups (and the similarities between them as well) are carefully analyzed and understood, then the differences between the groups could possibly be resolved by reconciling the differences while using the similarities as tools for negotiation. This aspect of our research constitutes the “worldview” dimension of the framework that was applied in this research, denoting the way the two groups relate to the world in which they live and function. DA was employed because the data was categorical, since multiple regression analysis could not be used under these circumstances. As noted in the Equation below, a simple linear discriminant function transforms an original set of measurements on a sample into a single discriminant score (Mahmood and Naeem 2011, p. 14).

The general formula used in DA is as follows:

\[ D = v_1 X_1 + v_2 X_2 + v_3 X_3 + \ldots \ldots + v_i X_i + a \]

where \( D \) = discriminate function, \( v \) = the discriminant coefficient or weight for that variable, \( X \) = respondent’s score for that variable, \( a \) = a constant, \( i \) = the number of predictor variables.
Results

State of the environment along the frontiers of the GGHNP

Figure 1 shows how NDVI values vary across the fence that separates the communal grazing area from the park. As illustrated in Figure 1, NDVI values are conspicuously higher in the park compared to the communal grazing area, showing that vegetation cover is more abundant in the park than in the communal grazing area. There is an abrupt change in NDVI values along the fence (Figure 1), suggesting that the variation of NDVI values is a reflection of the presence of the human barrier and differences in landuse and land management practices on the opposite sides of the fence. The same patterns of NDVI variability are shown in Figure 2(a–d), which presents a graphic analysis of the variability of NDVI values along the four transects indicated in Figure 1. Along all transects, except T3 to P15, as shown in Figure 2(c), NDVI values are higher in the park than in the communal grazing area. In Figure 2(c), the high NDVI value which occurs 1 kilometre from the northern end of the sampled area is the result of the prevalence of *A. mearnsii* which invaded the site. There is proliferation of this species in the communal grazing area, posing a threat of imminent invasion of the park by the species, especially along some sections of the fence where dense stands of the species already exist (Figure 1).

1. Variability of NDVI values along transect T1 to P13.
2. Variability of NDVI values along transect T2 to P14.
(3) Variability of NDVI values along transect T3 to P15
(4) Variability of NDVI values along transect T4 to P16

A further analysis of the NDVI values showed that there was a statistically significant difference ($\Pi^2 = 17.82$, $p = 0.05$, Kruskal-Wallis test) between NDVI values in the park and those in the communal grazing area, indicating that the two areas have different quality of plant cover. With mean NDVI values of 0.03 and 0.13 for the communal grazing area and the park respectively, the average of NDVI values for the latter is five times higher than that for the former. Signs of overgrazing are more evident in the communal grazing area than in the park. However, in both the park and the communal grazing area, NDVI values are far too low compared to what is expected for a typical grassland, depicting a relatively high scarcity of plant life in the area as a whole. NDVI values for a typical grassland range between 0.20 and 0.30 (ESRI 2010).

**Contrasting worldviews and conflicting opinions regarding access to the GGHNP and invasion by A. mearnsii**

This section highlights the differences between the views of park officials and the views of the members of the communities from the adjacent tribal areas regarding threats of invasion by *A. mearnsii*, the role that it plays in rural livelihoods, its environmental effects and the environmental effects arising from the eradication of the species. DA was conducted to determine the main factors that polarize the worldviews of park authorities from those of abutting communities, using four categories of variables noted noted above. For category 1 variables, the overall Chi-squared test was not significant (Wilks $\lambda = 0.830$, $\chi^2 = 3.066$, $df = 4$, Canonical correlation = 0.412, $p < .001$). None of the variables can be used to differentiate the views of stakeholders since the model explains only 16.97% of the variation in the grouping variable, indicating that park officials and local community members hold similar views about the benefits derived from the species, the environmental effects of the species and the control of the species. Some park officials and local community members use or have in the past used the species for firewood. Also, some members of the local community have previously been hired as labourers in the Working for Water wattle eradication projects.

For category 2 variables, the overall Chi-squared test was highly significant (Wilks $\lambda = 0.071$, $\chi^2 = 44.889$, $df = 3$, Canonical correlation = 0.964, $p < .001$). This indicates that responses on perceptions about the relationship between *A. mearnsii* and soil erosion, silting of streams and other environmental changes differed remarkably between the two groups. With a Canonical correlation coefficient of 0.964 the model shows that the two variables explain 92.93% of the variation in the grouping variable. Thus the two groups of stakeholders hold conflicting views about the effect of *A. mearnsii* on the prevalence of soil erosion, silting and other environmental changes. Park officials noted that due to limited undergrowth in areas that have been invaded by the species erosion is inevitable. This also explains why siltation becomes prevalent along streams of infested areas. This knowledge was not evident among local community members. There was a greater awareness of the environmental impacts of *A. mearnsii* among park officials than among members of the local community. However, both park officials and members of the local community held similar views regarding the impacts of *A. mearnsii* on drying of streams, proneness of an area to fire and displacement of native tree species.
Also, highly significant was the Chisquared test for category 3 variables (Wilks $\lambda = 0.105$, $\chi^2 = 38.248$, $df = 4$, Canonical correlation = 0.946, $p < .001$), indicating the highly differentiating power of the variables. The variables that caused the biggest differences between park officials and members of the local community are proneness of streams to siltation and proneness to fire damage as a result of eradication of $A. mearnsii$. The two variables explain 89.49% of the variation in the grouping variable, signifying their importance as grouping variables. Whereas park officials assumed that the eradication of $A. mearnsii$ would generally reverse the environmental impacts associated with it members of the local community held an opposite view. Regarding category 4 variables, the overall Chi-squared test was not significant (Wilks $\lambda = 0.786$, $\chi^2 = 4.453$, $df = 1$, Canonical correlation = 0.462, $p < .001$). None of the variables can be used to differentiate the stakeholders, suggesting convergence of worldviews among them. The similarities between responses from park officials and local community members resulted from the fact that both groups were generally not aware of the ways through which the species spreads.

Overall, the results from DA indicate that the biggest differences arising from the worldviews of the stakeholders concern their perceptions about the impact of $A. mearnsii$ on the environment, as well as those about its eradication from the environment. These differences relate to category 2 and category 3 variables noted earlier. On the other hand there are no major disagreements between the two groups of stakeholders regarding their perceptions about whether $A. mearnsii$ should be considered as a resource or a problem, or whether it should be conserved or eradicated.

**Discussion**

Whereas there are numerous causes of conflicts between park officials and communities abutting the GGHNP (Slater 2002; De Villiers 2009; Taru et al. 2014), as noted earlier, the focus of this paper is the conflicts revolving around the curtailment of rights of access to the pastures in the park on the pretext of the need to prevent bio-invasion. Conflicts that arise when neighbouring communities enter the park illegally for purposes of grazing their livestock may also result from the need by park officials to prevent overgrazing in the park and ensure that the ecosystem disturbances that have occurred in the communal grazing areas are not extended into the park. Besides, livestock grazing is generally considered as incompatible with the purpose for which national parks are founded. Similarly, it would certainly be the priority of park officials to prevent the ecosystem degradation arising from bio-invasion in the communal grazing lands being extended into the park in line with the park’s management plan (SANParks 2012). However, while there are many sources of park-community conflicts we confine our discussion to the implications of the findings of this research as they relate to the disagreements and compromises associated with fears of invasion of the GGHNP by $A. mearnsii$. As shown by the results of this study, $A. mearnsii$ is prevalent in the communal grazing area from which it can easily spread into the park. Invasion by this species will impact negatively on ecosystem health and biodiversity in the park, as well as undermine conservation efforts and ecosystem services, which in turn will reduce the value of the park as a tourist destination. This constitutes the “reality” part of the framework that we employed in this study.

However, park-community conflicts involving poor and marginalised rural populations should be expected, where access rights to land, natural resources and forums for
management decisions are restricted or curtailed (Dahlberg 2010). A similar argument has been presented by Martin et al. (2014), who stated that the fact that humans hold equity so dear may help to explain why environmental conflicts often arise from competing visions of fairness, while in the long run inequity can undermine efficiency in conservation due to conflict. While they may be effective and efficient in promoting conservation and maintaining ecological integrity, restrictions that limit the access of conservation areas by local communities may be viewed as unfair by these communities. Arguing from an empirical justice perspective, Sikor et al. (2014) maintain that there is need for conservation scientists and managers to analyze the justice of ecosystem governance in addition to their effectiveness and efficiency. Perceptions about fairness vary according to stakeholders. Recent studies in China indicated that villagers’ notions of justice emerge within particular political economic conditions characterizing rural environmental management and, more broadly, rural governance (He and Sikor 2015).

In the case of the GGHNP, the restrictions which may actually be arising from genuine fears of imminent invasion by *A. mearnsii* or from lack of information about how the species spreads are one source of these conflicts. In the GGHNP restrictions imposed by controlled movement of people and livestock across park frontiers have been justified on the need to maintain ecological integrity, even though this might be a proximate concern. As already noted, *A. mearnsii* spreads through many other ways (Rouget et al. 2002; Kull and Rangan 2008; Kull et al. 2011) other than the movement of people and livestock across park boundaries. Thus, though DA shows divergent worldviews based on the impact that *A. mearnsii* and its eradication have on the environment conflict arising from this phenomenon is only accentuating already existing underlying long-standing disputes.

While this may be the case, it is important to note that access to the resources in the park or related benefits do not always translate to better conservation practices or minimization of conflict. For example, research on community-based conservation interventions by Waylen et al. (2010) did not provide strong support for the hypothesis that benefit provision is an important determinant of intervention success. Diagonally opposed to this view is the observation by Brooks et al. (2006) showing that conservation projects that register greater attitudinal success are those providing better opportunities for local communities. They also noted that greater behavioural success among projects increased with more community involvement in the establishment (implementation) and day-to-day running (decision) of a project, while greater ecological success occurred among those projects in which the community was actively involved in day-to-day activities.

In short, Brooks et al. (2006) argue that the participation of communities provides better opportunities for the successful implementation of conservation practices. Even though this may be the case, results from DA indicate that the local community and the park authorities are in different camps and bridges need to be built to make it possible for the two groups of actors to work towards the same goal, which is minimization of the spread of IAS while promoting the sustainable flow of ecosystem benefits that support both conservation needs and the needs of the local community. Invasive species are not directly viewed as a threat by the local community. This confirms results from earlier research which revealed that when threats from invasive species are less apparent to the lay public, support for invasive species management may be reduced (Verbrugge et al. 2013). This suggests that reconciling the worldviews of the two categories of actors is problematic due to the conflicting values they hold.
As noted by Warren (2007, p. 441) “discussions of alien species are fraught precisely because they involve multiple, competing values, with one person’s Eden conflicting with another’s”. Previous studies on competing values have shown that expert views of appropriate management of a natural area may deviate from those of other stakeholders (such as volunteers or frequent users), which may result in conflicts (Ryan 2005; Buijs 2009). For instance, while studying the attitudes neighbours, visitors, volunteers, and staff in three urban natural areas in Michigan (USA), Ryan (2005) concluded that the expert’s vision of appropriate management of a natural area may differ from those of neighbours and users, which can readily lead to conflict, because each stakeholder has a distinct perspective. This conclusion confirms the view that no conservation conflict has ever been fully resolved, even though there have been varying degrees of success at managing them (Redpath et al. 2013).

However, the major points of difference between park authorities and local communities are likely to be the main “flash points” around which conflict can flare and escalate, since they constitute the core of the major conflicting worldviews, arising from attitudinal differences. Dickman (2010) notes that differences in attitudinal factors have critical implications for the success or failure of conflict mitigation. Nevertheless, environmental awareness campaigns, educational projects and other forms of community engagement, for example participation in the activities of the GGHNP forum, could target areas of major disagreements so that the conflicts around them are resolved to provide room for negotiations that can bridge the “worldviews” of the belligerent stakeholders. Diametrically opposed worldviews can be transformed through better environmental education and training, as well as deliberations that are aimed to clarify the worldviews of different stakeholders. Lessons learnt in Vanuatu demonstrate that communities that live in wildlife areas can be trained in peace-building and conflict resolution (Westoby 2010).

Conflict resolution and management can also buttress community support towards better management of bio-invasion. Environmental awareness campaigns and community engagement can reshape community worldviews by adjusting the knowledge and attitudes that communities have in a way that influences their environmental behaviour. However, provision of alternative grazing areas and the relocation of the park dwellers and adjacent communities are also possible options if considered as part of a well planned ecoagricultural landscape (Scherr & McNeely 2008). Considering high levels of unemployment and poverty in areas around the GGHNP, the total exclusion of the communities from these areas from the park would undermine the efficiency and effectiveness of conservation in these areas as a result of perpetual conflict (Martin et al. 2014). However, even though total exclusion of these communities may not be acceptable on ethical grounds, it may be vouched for where options for alternative grazing and relocation are available, since it provides better opportunities for biodiversity conservation and sustained flow of ecosystem benefits in the park.

**Conclusion**

This study used the “reality-worldview” framework to examine the park-community conflicts that arise from the expediency to prevent bio-invasion for purposes of protecting environmental integrity. Two main interrelated conclusions can be drawn regarding these conflicts. First, the differences in access to vegetation resources between the park and the surrounding areas constitute the “reality” that drives the conflicts. Communities living in the resource impoverished overgrazed tribal areas near the GGHNP get locked up in conflicts
with park authorities because of the basic livelihood necessities they derive from the park. Second, whereas uncontrolled movement of people and livestock between the park and the abutting areas creates the danger of invasion of the park by *A. mearnsii*, the perception about whether this is a problem really depends on the “worldview” of the stakeholders, the bridging of which can only be done through negotiation, environmental awareness and provision of training in conflict resolution to the stakeholders. This depends on which side of the fence one lives. However, were unrestricted access to the park to be granted to livestock the park too would soon reach the same level of degradation as the communal grazing areas, the same reason why communities in the tribal areas find pastures in these areas insufficient.

**Disclosure statement**

No potential conflict of interest was reported by the authors.

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