

Viewshed and sense of place as conservation features: A case study and research agenda for South Africa's national parks



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Sense of place (SoP) refers to the meanings and values that people attach to places. The concept can be used to frame how people engage or form a connection with the natural environment. At a sensory level, SoP is influenced by people's visual experiences, which in turn can be linked to the concept of viewsheds. Viewsheds can be transformed, either abruptly (e.g. by infrastructure development such as wind turbines) or more gradually (e.g. by non-native trees invading a landscape). In this study, we focus on the Garden Route National Park to explore the potential importance of viewsheds as a conservation feature, specifically in the context of non-native (especially invasive) tree species. Using mixed information sources, we explore the potential role of invasive trees on experiences of visitors to this protected area and speculate on how viewsheds may shape SoP associations and how such associations may inform protected area management. Our investigation shows that people's experiences regarding natural and modified viewsheds are varied and intricate. Both SoP and viewsheds have the potential to inform conservation action, and these concepts should form an integral part of objective hierarchies and management plans for national parks. However, while legislation and park management plans make provision for the use of these concepts, associated research in South Africa is virtually non-existent. We conclude by proposing a conceptual model and research agenda to promote the use of viewsheds and SoP in the management of national parks in South Africa.

Conservation implications: Viewshed and sense of place can be used as boundary concepts to (1) facilitate interdisciplinary research between social and natural scientists, (2) help understand the connectedness and feedbacks between people and nature and (3) promote communication between science, management and stakeholders regarding desired conditions of landscapes in and around parks.

Introduction

A growing number of scientists believe that Earth has transitioned into a new geological epoch – the Anthropocene – characterised by a single, dominant species (*Homo sapiens*) that is affecting the planet's life support system at an unprecedented scale, including changes to landscapes and ecosystems, biological distributions, climate and atmospheric chemistry (Steffen, Crutzen & McNeill 2007; Zalasiewicz *et al.* 2010). The proclamation and effective management of representative networks of protected areas (PAs) is seen as critical to buffering society against adverse changes to the biosphere attributable to this human-dominated era (Watson *et al.* 2014). In this context, expected benefits from PAs include conserving biodiversity, safeguarding ecosystems and the services they provide, mitigating climate change and promoting social-ecological resilience, with associated economic and social benefits, at regional scales.

There is increasing recognition of the importance of less tangible or quantifiable benefits that people derive from nature and PAs. Such benefits are, for example, referred to as 'Nature's Gifts' in the Intergovernmental Platform on Biodiversity and Ecosystem Services Conceptual Framework (Díaz *et al.* 2015). These benefits are often grouped under the collective of 'cultural ecosystem services', including experiential, spiritual, educational and recreational interactions with nature that contribute to human well-being (Millennium Ecosystem Assessment 2005). Importantly, an appreciation of such benefits is often dependent on a pro-environmental identity or ability to engage or form a connection with the natural environment (Hinds & Sparks 2008), for example, through 'meaningful nature experiences' (Zylstra *et al.* 2014).

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How people connect with nature is invariably a function of their value systems (see Chan, Satterfield & Goldstein 2012; Raymond *et al.* 2009), which are context-specific and evolve dynamically over time. For example, while one group may value a particular landscape for its tangible materials (such as harvestable fruits and medicinal plants), another may value the same landscape for intangible benefits (such as relaxation and therapy) derived from its tranquil and scenic features. For the purpose of this study, we will focus on intangible benefits that people derive through experiential interactions with nature. In this context, connection between humans and nature relate strongly to aesthetics (Plieninger *et al.* 2015) and therefore link closely with concepts such as 'viewsheds' and 'landscapes'. Perceptions of 'beautiful scenery' may be a predictor for environmental connection. Likewise, the sensitivity of 'the public' to scenery or 'how the landscape looks' is an important driver of support for conservation actions. This is borne out by spatial metrics studies (Palmer 2004) and evidence that positive nature experiences (such as hikes) may predispose people to financially support conservation efforts (Zaradic, Pergams & Kareiva 2009).

Ironically, although the creation of PAs has often led to the separation of humans and nature (West, Igoe & Brockington 2006), these remnants of wilder, more natural or intact ecosystems and landscapes potentially offer greater opportunity to experience connection with nature and benefits such as psychological rejuvenation (see Ulrich *et al.* 1991). Higher ecological integrity should result in higher 'visual landscape quality', and together with the notion of 'sense of place' (SoP) and the related concept of 'place attachment' (the environmental psychologist's equivalent of the geographer's SoP) (Farnum, Hall & Kruger 2005) is subsumed in the landscape-quality construct (Daniel 2001).

Although sometimes regarded as vague (Shamai 1991) and elusive (Williams & Stewart 1998), the concept of SoP has been applied widely to describe the relationship between people and physical environment. It is generally used for framing the meanings and values that people attach to places (Larson, De Freitas & Hicks 2013; Williams & Stewart 1998) and may incorporate experiences of dependence, attachment, identity and satisfaction (Jorgensen & Stedman 2001; Stedman 2003). Such meanings and values are typically rich and varied (Williams & Stewart 1998), commonly based on a mix of cultural histories and natural features in a landscape (Larson *et al.* 2013), and develop as a result of biological, individual and sociocultural processes that take place while interacting with the physical environment (Hausmann *et al.* 2016). Many feel that SoP resides primarily in human experiences, interpretations and value endowment, rather than being intrinsic to the physical setting itself – 'space becomes place when we endow it with value' (Tuan 1977; but see Stedman 2003).

At a sensory level, what people do (e.g. fish from the bank of a river), feel (e.g. grass under their feet or warmth of the sun),

hear (e.g. the sound of birds or the wind in the trees) and see (e.g. a seascape or forest) will contribute to their experiences in relation to a place. Such experiences are likely to change over time (e.g. different seasons) and space (e.g. vantage points) and to be mediated by memory of previous such experiences. While the natural sciences have found ways to measure, for example, changes in soundscapes (Pijanowski *et al.* 2011) and viewsheds (Camp, Sinton & Knight 1997), neither of these concepts has been incorporated into the predominantly social construct of SoP. Apart from the social variable, there may be many different ways in which SoP can be altered or lost, through changes in physical appearance within a landscape, and thus its aesthetics. Let us consider viewsheds in 'natural' or 'wilderness' areas, defined in the *US Wilderness Act* (Public Law 88-577, 16 U.S.C. 1131–1136, 88th Congress, Second Session, September 3, 1964) as:

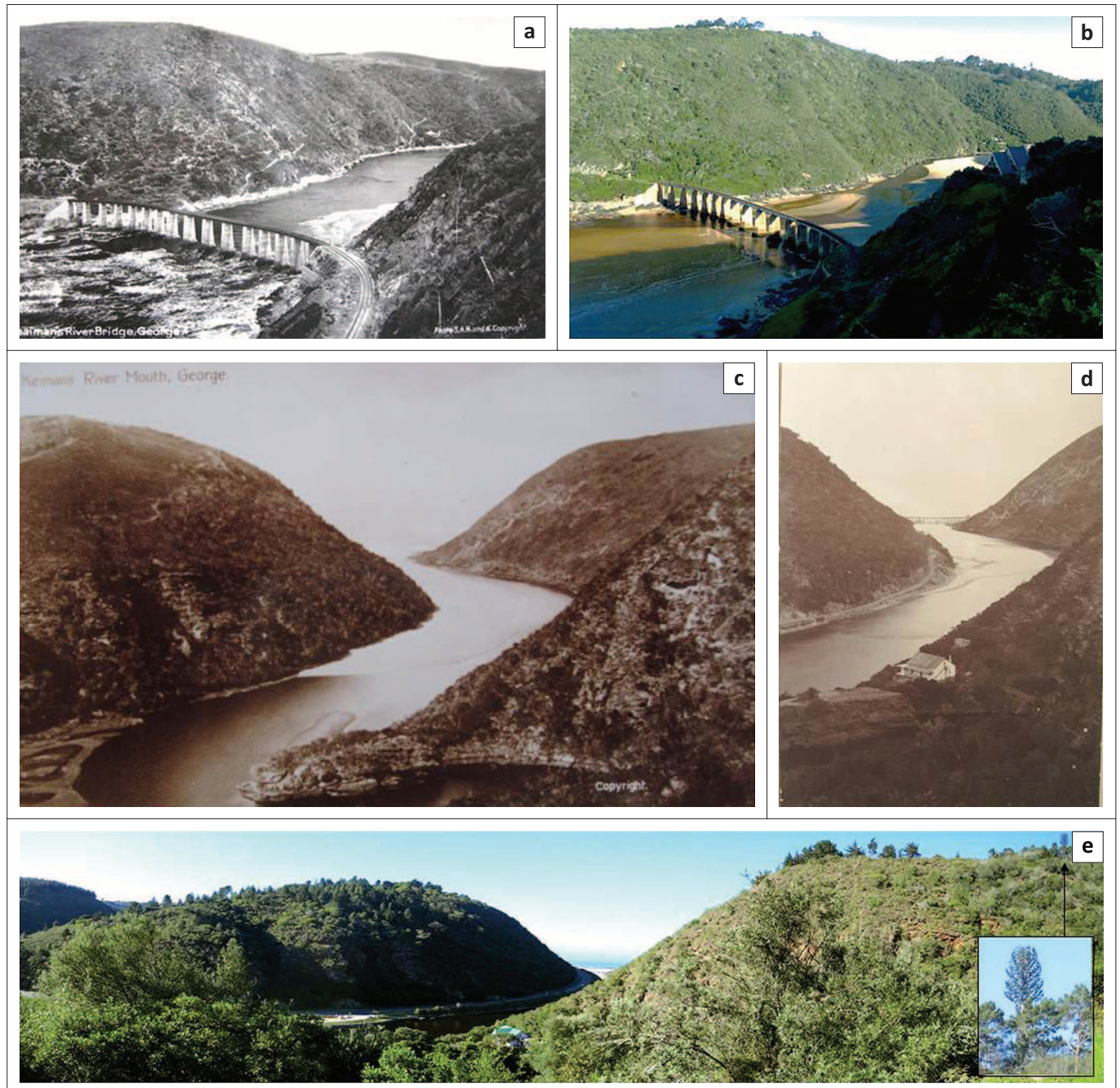
... undeveloped ... land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which ... generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; and ... has outstanding opportunities for solitude or a primitive and unconfined type of recreation. (n.p.)

It stands to reason that such viewsheds (and associated place-value) may be transformed, or even destroyed, by evidence of human presence or activities. Viewshed transformation can intuitively be linked to structural developments, for example, housing on a lake shoreline (Stedman 2003), presence of roads (Selva *et al.* 2011) or power infrastructure such as overhead pylons and wind turbines (Gee 2010). However, there are other, less explicit, human-mediated changes. One such 'slow' transformer of viewsheds may be non-native plants that have become invasive, especially large, woody, tree species (Figure 1) – widely referred to as weeds, invaders or invasive alien plants (IAPs). While we acknowledge the variety of terms and connotations associated with describing IAPs (e.g. Richardson *et al.* 2000; Schlaepfer, Sax & Olden 2011), we choose to use the more neutral term 'non-native' except when explicitly referring to declared invasive alien species or 'weeds' as defined by the *Conservation of Agricultural Resources Act* (CARA, No. 43 of 1983, and amendments). The impacts of IAPs on biodiversity and ecosystems, and resultant ecosystem service loss, such as water quality (e.g. Chamier *et al.* 2012; Van Wilgen *et al.* 2008), are widely known and are often the primary determinants for allocation of funding and human resources to manage invasions (Marais, Van Wilgen & Stevens 2004). Less well understood is the impact of IAPs on cultural ecosystem services, such as mediated through SoP experiences (but see Le Maitre *et al.* 2011), and this aspect is generally not considered when prioritising areas for IAP clearing and restoration.

In this study, we use an interdisciplinary narrative approach, including the use of various pieces of 'evidence' and 'exhibits', to explore the potential importance of viewsheds

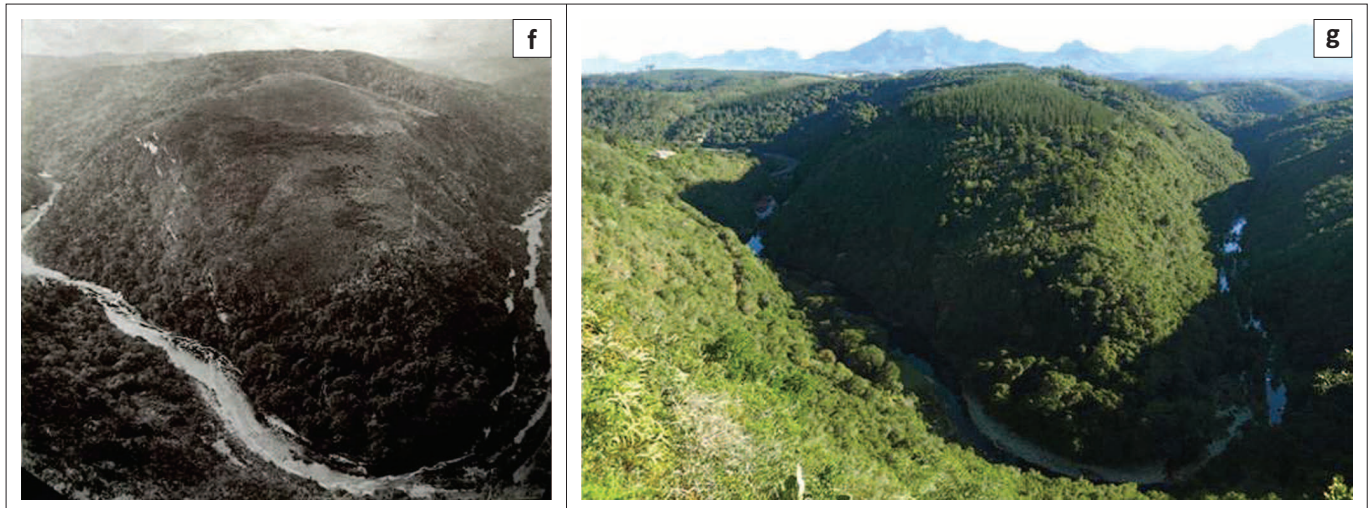
as conservation features, specifically in the context of non-native (especially invasive) tree species. We restrict our attention to the Western Cape, the province regarded as the epicentre for development of awareness about IAPs, mainly because of regional public reverence for the native vegetation of the globally recognised Cape Floristic Region (Bennett 2014). Furthermore, we focus on the Garden Route National Park (GRNP) along the southern Cape coast (Garden Route), a region widely known for its scenic beauty and an example of a PA embedded or integrated within a greater social-ecological landscape. Using mixed information sources,

including media, unpublished studies, scientific literature and management documents, we explore the potential role of invasive plants (especially trees) on experiences of visitors to this PA and speculate on how viewsheds may shape SoP associations and the interplay between such associations and PA management. To this end, we present a conceptual model relating the concepts of viewshed and SoP to the high-level objectives in a management plan for a national park in South Africa. Lastly, we propose a research agenda to inform the future incorporation of viewsheds and SoP in park management decisions.



Source: a, c, d and e were provided by Lynne Thompson, George Museum Research Library; b, e, and g were taken by Jaco Barendse

FIGURE 1: Non-native trees and invasive alien plants are examples of ‘slow transformers’ (compared to other human developments) of landscapes and viewsheds in and around the Garden Route National Park (also see Figure 3), as shown by photographs taken in different years near the iconic ‘Kaaimansgat’ – where the Kaaimans and Swart Rivers enter the Indian Ocean and located within the western Buffer/Viewshed Protection Zone of the GRNP. The view to the north from the Dolphin Point lookout in 1929 (a) and 2015 (b); the view to the south from next to the N2/Kaaimans Pass, pre-1910 (c), 1927 (d) and 2015 (e) – note cellular phone tower ‘disguised’ as pine tree shown by arrow and insert; and the ‘Map of Africa’ Viewpoint, pre-1910 (f) and in 2015 (g).



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The evolving association between people, non-native trees and sense of place

When considering terms such as ‘naturalness’, or whether non-native trees have a place in natural viewsheds, it is important to acknowledge that associated perceptions develop over time. Societal perceptions influence, and are influenced by, the reigning utilitarian values (e.g. forestry or dune stabilisation) and socio-economic circumstances of the period (Baard & Kraaij 2014). Therefore, sentiments about a specific ‘immigrant species’ may change as a society does, or according to whether it is associated with a negative impact or trait, such as being invasive or harmful (Coates 2007).

Perceptions may further depend on how informed individuals are, their level of knowledge of biodiversity, or on more personal values of aesthetics, or notions of scenic beauty (Dhami & Deng 2010; García-Llorente *et al.* 2008) (also see Box 1 and Figure 2). A case in point is the black wattle (*Acacia mearnsii*), arguably one of the most problematic IAP species in coastal areas of the Western Cape, originally introduced to support the tanning industry (Carruthers *et al.* 2011). Especially for a botanist or invasion biologist today, it may be unsettling to travel through the Garden Route where black wattle, together with other *Acacia* and *Pinus* species (see photographs in Cowling *et al.* 2009), dominate the viewsheds of coastal, riparian, mountain and production landscapes (Henderson 1998). That the wattle is now considered unwanted in this region was not always the case, as shown by a letter written to the *George and Knysna Herald* on 13 September 1893, titled ‘Wattle growing at Knysna’:

Last Sunday the writer took a stroll ‘over the hills’, but by no means so ‘far away’ to the Nursery at Concordia, and would recommend to those of his fellow townsmen who are blessed with the aptitude for enjoying natures beauties to lose no time in

BOX 1: Appreciating natural viewsheds and sense of place (see Figure 2).

EXHIBIT 1: Appreciating natural viewsheds

The appreciation of natural viewsheds or ability to detect the presence of non-native trees (whether invasive or not) often requires in-depth biogeographical and botanical knowledge or experience in identifying and interpreting ecosystem patterns in a landscape. Sense of place not only depends on the physical locality but also the reference baseline or place attachment of the observer. Personal experiences can shape expectations, for example, European tourists may not experience pine trees as unusual or disturbing in the mountainous and forested landscape of the Garden Route, while Australian visitors may be reminded of places near ‘home’.

hieing tither ere [*hastening there before*] the many varieties of acacia lose their magnificent bloom. The wattles are just now simply one blaze of bright yellow, and are really a sight worth beholding. (n.p.)

The writer then goes on to suggest that establishing wattle plantations in the area would not only provide economic benefits on otherwise ‘idle ground’ or ‘sour waste lands’, but that anyone who has seen them in full bloom (as described) would be supportive of his suggestions, presumably on aesthetic grounds. Indeed, wattle growing did become an important economic mainstay in the region well into the 1960s and was strongly supported by the local authorities, as shown by a piece titled ‘The Municipal wattle plantations’ in 03 June 1914 edition of *The Herald*:

The public of George will learn with pleasure that at the last meeting of the Municipal Council it was unanimously resolved to prepare another 6 morgen of land for the planting of wattle. This is a move in the right direction and if steadily persevered in, this City will find itself within a few years the owner of a very valuable asset ... (n.p.)

The above example shows that the lower value attributed to local landscapes and vegetation and the higher value to the non-native species played an important role in promoting their deliberate spread. Contrast this with the present-day situation, where *A. mearnsii* is now one of the top invaders in the Garden Route (Baard & Kraaij 2014) of especially riparian

habitats (Holmes *et al.* 2005). Country-wide, it has cost an estimated R62 million from 1997 to 2006 to control invasions by *Acacia* spp. alone (Marais & Wannenburgh 2008) through national initiatives such as Working for Water.

The 'duality' in perspective on whether invasive species are 'good' or 'bad' has a strong cultural dimension (Tassin & Kull 2015) and ties closely to the leading discourse at any given time (Bennett 2014; Carruthers *et al.* 2011), but it can also vary between different industry sectors, for example, forestry and conservation. In King's 1951 paper 'Tree planting in South Africa', he stated:

There is a small section of the population who wage a wordy warfare against the planting of exotic trees. This element with fanatical zeal, presents only one side of the picture. Let us look at the other side. Criticism is often levelled against wattles on the Cape flats and pines on the mountains of the Cape peninsula. In order to put the matter in proper perspective we must go back to the time when much of the Cape flats was a

barren waste of drift sands and the only trees on the mountains were contained in small patches ... [on the Cape flats there are] ... Only shrubs called blombos (*Metalasia*) and waxberry (*Myrica*) both of which are much less valuable than the Australian wattles ... [that] yield excellent firewood. Can anyone be so foolish as to imagine that without wattles a population starved for firewood would not have stripped the mountains of woody vegetation? The claim can safely be made that indirectly the wattles have saved the mountain flora from extermination. (p. 13)

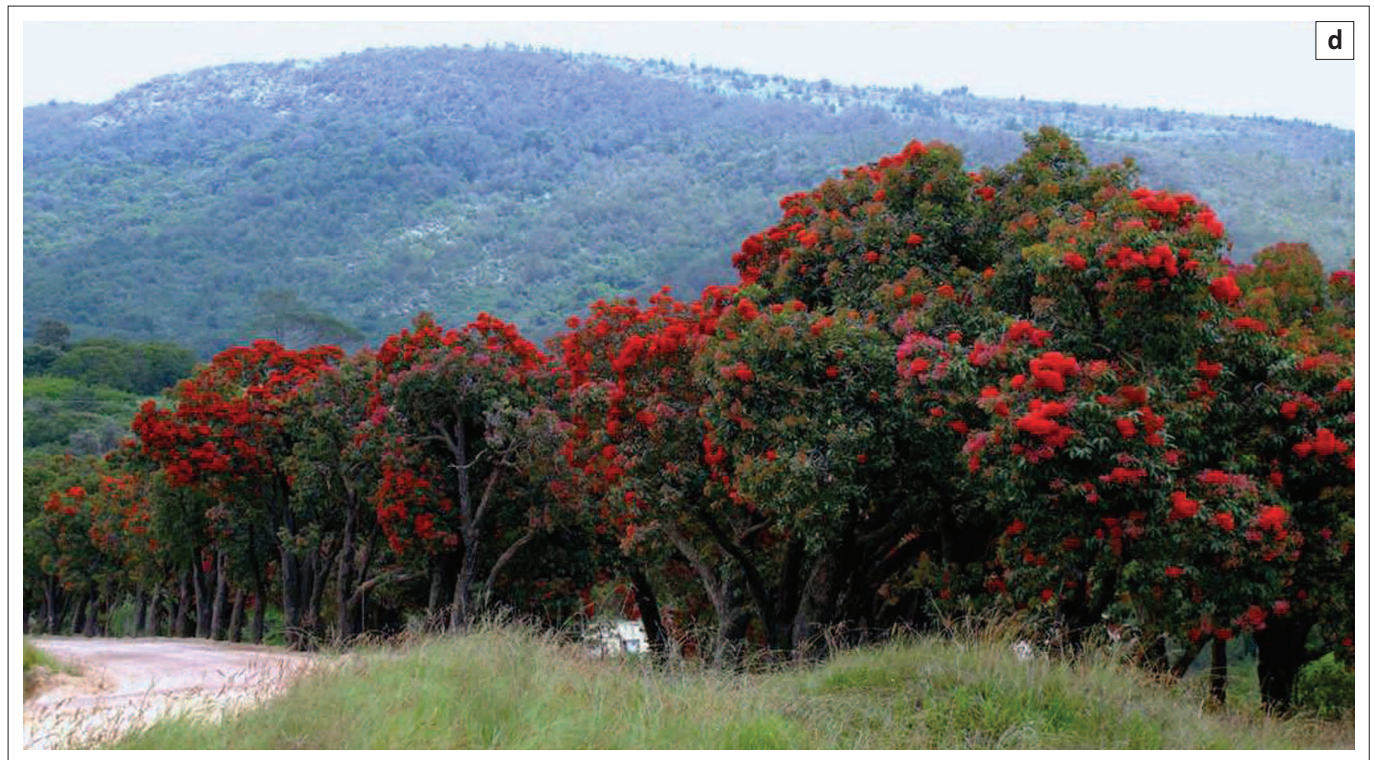
In a similar vein, King (1951) stated the following about pines:

Despite their high intrinsic value, pines have been described as weeds, mainly on the grounds that they tend to spread. This is only true of *Pinus pinaster*, which can readily be kept in check. The allegation that pine plantations are ousting indigenous vegetation is not entirely true, but, even if it were, it cannot be taken seriously, because the plantations occupy less than 3,000 of the 120,000 acres in the [Cape] peninsula. (p. 14)



Source: Photos by Jaco Barendse

FIGURE 2: Four scenes, three from around the Garden Route National Park: Views from (a) the 'Seven Passes Road' near the Woodville 'Big Tree' looking towards the Upper Touw River Catchment; and (b) Donaghy's Hill (42011°47.04"S, 145056°01.97"E) in the Franklin-Gordon Wild Rivers National Park, Tasmania; (c) The area north of Karatara in the Garden Route National Park, looking towards the mountains traversed by the Outeniqua Hiking Trail; (d) the non-invasive Australian red flowering 'gum' trees *Corymbia ficifolia* in full bloom at Bergplaas forestry station is a common and much-loved sight in the Garden Route; along with related alien Eucalypts (Rejmánek & Richardson 2011; Van Staden 2015) many consider these part of the region's natural-cultural heritage.



Source: Photos by Jaco Barendse

FIGURE 2 (Continues...): Four scenes, three from around the Garden Route National Park: Views from (a) the ‘Seven Passes Road’ near the Woodville ‘Big Tree’ looking towards the Upper Touw River Catchment; and (b) Donaghy’s Hill (42011°47.04’S, 145056°01.97’E) in the Franklin-Gordon Wild Rivers National Park, Tasmania; (c) The area north of Karatara in the Garden Route National Park, looking towards the mountains traversed by the Outeniqua Hiking Trail; (d) the non-invasive Australian red flowering ‘gum’ trees *Corymbia ficifolia* in full bloom at Bergplaas forestry station is a common and much-loved sight in the Garden Route; along with related alien Eucalypts (Rejmánek & Richardson 2011; Van Staden 2015) many consider these part of the region’s natural-cultural heritage.

While these remarks may appear naïve given (expert) knowledge about the current causes, extent and impacts of pine tree invasions (McConnachie *et al.* 2015), they do represent views that persist to the present, even in scientific circles. For example, a recent ‘Pine plantation vs. Fynbos’ debate (De Ronde 2012) publicly pitched ecologists (Stellenbosch University 2012) against forestry scientists (Du Toit 2012), showing that some perceptions remain entrenched (De Wit, Crookes & Van Wilgen 2001). The article that sparked much of the discussion (Van Wilgen & Richardson 2012) did recognise that exotic conifers may offer aesthetical and recreational benefits to people, especially in peri-urban areas. Such opposing perceptions about non-native species are also pervasive among members of the public, often reflecting incomplete understanding about ecological processes or biodiversity conservation, as shown by 62% of park visitors to the Addo Elephant National Park who did not consider the potential presence of introduced fauna to be in conflict with conservation objectives (Boshoff *et al.* 2008). Being uninformed can lead to the confusion of unrelated issues, for example, the felling of plantations perceived as synonymous with deforestation of natural forests, or where ‘saving’ a tree – any tree – is seen as positive (Van Wilgen 2012). Perceptions are highly context-specific, for example, species that have been naturalised for a long time are not necessarily perceived as ‘alien’ even by traditional communities (Shackleton *et al.* 2007); or, despite knowing a species’ alien status, a high utility value may reduce the support for its outright eradication (De Neergaard *et al.* 2005). This may further vary according to

socio-economic variables, where people of higher economic status or better education may rate non-consumptive values of indigenous plants (e.g. aesthetics) higher than poorer or less educated people (Le Maitre *et al.* 1997). The resultant conflict (between informed and uninformed parties) over non-native species (Dickie *et al.* 2014) may reduce the potential support for clearing IAPs in PAs, in particular those located close to urban areas, or ‘embedded’ in cities (Van Wilgen 2012).

This does not mean that the potential contribution of PAs in preserving natural viewsheds or landscapes on the basis of aesthetics has escaped recognition. Possibly the earliest local proponent of this cause was Wicht (1943) who – using the cluster pine *Pinus pinaster* (= *maritima*) as an example – suggested (almost prophetically, see Cowling *et al.* 2009; Kraaij, Cowling & Van Wilgen 2011) that exotic plants would, over time, dominate everywhere except in nature reserves and that ‘To botanists and all other lovers of nature the thought that such a change is likely to come is very distressing’ (p. 34). He further suggested that ‘species that are spreading into natural vegetation ... [are] undesirable from an aesthetic or scientific view’ (p. 43) and (quoting the *Forest and Veld Conservation Act* of 1941) that nature reserves should be set aside for the ‘preservation of natural scenery, forests, flora or fauna thereon’ (p. 45) (Wicht 1943).

The above raises three important questions, which we discuss in the ensuing sections, using the GRNP and surrounds as example:

- Is the preservation of natural viewsheds and associated SoP included or provided for in current national legislation relating to PAs?
- Do park management plans recognise the potential impact of IAPs on viewshed and SoP as conservation features?
- Do visitors to PAs value 'natural' viewsheds and perceive the presence of IAPs as a threat to SoP in such areas?

Viewshed and sense of place in a protected area context

National legislation

The *National Environmental Management: Protected Areas Act* (57/2003) (NEM:PA – Norms and standards for the management of PAs in South Africa) stipulates (Chapter 1, p. 3) under guiding principle (a) that PAs should 'protect ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes'; and under (k) 'contribute to human, social, cultural, spiritual ... development'. In Chapter 2 (p. 4), one of the indicators of relative importance is that an area 'protects a representative sample or iconic feature of South Africa's land/seascapes'. While provision is made for a zoning plan that determines different activities and conservation objectives within a PA (p. 15), there is no mention of SoP or viewsheds, and the section referring to visitor's experiences mainly considers visitor facilities (p. 24). In an amendment to NEM:PA (Strategy on Buffer Zones for National Parks Notice 106 in Government Gazette No. 35020, 08 February 2012) in the context of managing activities in buffer zones surrounding national parks, a viewshed is defined as 'an area of land, or other environmental element that is visible to the human eye from a fixed vantage point'. In Chapter 3 (p. 12), two of the stated objectives of the policy are to (1) 'Protect, enhance and restore the unique and memorable character – the SoP – that underpins the image of the national parks and their approaches'; and (2) 'Protect and enhance the wilderness experience of park users'. To this end, the policy calls for 'Viewshed protection' in buffer zone areas that are visible from the park, especially 'from wilderness areas, or ... night lights which negatively effect [sic] the ambience of the park' (p. 13). Forestry is specifically listed as a development that 'may have a negative impact or effect on a national park' (p. 13) and the control of IAPs in buffer zones (p. 19) is mentioned in the context of local community involvement and ecosystem rehabilitation; however, the policy falls short of making the link between the potential impact of IAPs or non-native trees (other than in plantations) on viewsheds, or SoP.

Another area of governance that holds implications for activities in park buffer zones and takes into consideration viewshed and SoP is land-use planning and environmental management. At a national level, the *National Environmental Management Act* and the *Environmental Conservation Act*,

which guide Environmental Impact Assessments, include visual impact considerations as a component. Further, the *National Heritage Resources Act* (Act No. 25 of 1999) provides protection for listed or proclaimed heritage resources and sites, such as urban conservation areas, nature reserves, and recognised scenic routes. Western Cape provincial legislation requires the preparation of a Spatial Development Framework (SDF) and an Integrated Development Plan for each sub-region or municipality. These documents aim to guide land-use to be compatible with cultural and scenic landscapes and could include reference to open-space and scenic resources, together with management guidelines for the area covered by these plans, for example, the Knysna SDF (<http://www.knysna.gov.za/wp-content/uploads/2012/12/Knysna-SDF-Nov-2008-Core.pdf>).

Under these management guidelines, protection is provided not only to existing natural assets such as existing and proposed PAs but also to transformed, so-called 'Productive Green Areas', that include existing agricultural and commercial forestry areas, which:

have historically been, and should remain important sources of productive economic activity in the municipal area, as well as being contributors to the sense of place. (n.p.)

This role of SoP and visual amenity of non-native vegetation thus finds legal application (which may be in conflict with the application of NEM:PA) in urban expansion developments. In a recent case at the coastal town of Plettenberg Bay on the Garden Route, a part of a residential development was not granted environmental authorisation in order to retain a stand of mature, non-native *Eucalyptus* trees alongside an indigenous forest on the same property.

Park management plans

A somewhat more detailed consideration of viewshed is found at the park management plan level. For example, the Garden Route National Park Management Plan (GRNPMP; SANParks 2012) – and in fact all other park management plans – make generic provision for viewshed protection areas and defines a Viewshed Protection Zone as 'an area where any developments should be screened to prevent excessive impact on the aesthetic appeal of the park'. The GRNPMP recognises five different zones (Table 1, Figure 2) that stipulate limits of acceptable change in terms of aesthetics and recreational activities, including consideration of facilities and infrastructure development and visitor numbers. Although terms such as 'wild appearance and character', 'natural appearance' and 'wilderness characteristic' are used to distinguish between the different types of zones, there is no specific mention of IAPs and their potential influence on the aesthetic appeal in these zones, or visitor's experiences. We are unaware of any initiatives in the national parks through which viewsheds or the SoP experiences of visitors in relation to viewsheds are being monitored. This might be a function of NEM:PA providing only limited support for monitoring and reporting against progress in implementing

plans, with legal obligations to monitor largely confined to the impact of revenue-generating activities.

Public perceptions towards invasive alien plants in protected areas

Information on the perception of park visitors regarding the presence of IAPs in viewsheds, or more generally on SoP in South African PAs, appears to be non-existent. Here, we present results from an exploratory and an opportunistic survey. The first was conducted during 2013 in the Knysna Section of the GRNP at three sites: Spitskop Viewpoint and the Fisantehoek and Sinclair Huts on the Outeniqua Hiking Trail (Figure 3). The second opportunistic survey was conducted along the course of the 5-day Tsitsikamma Hiking Trail (in January 2014), which crosses mountain fynbos and

indigenous forest areas managed by South African National Parks (Tsitsikamma section of the GRNP) and pine plantations (Cape Pine).

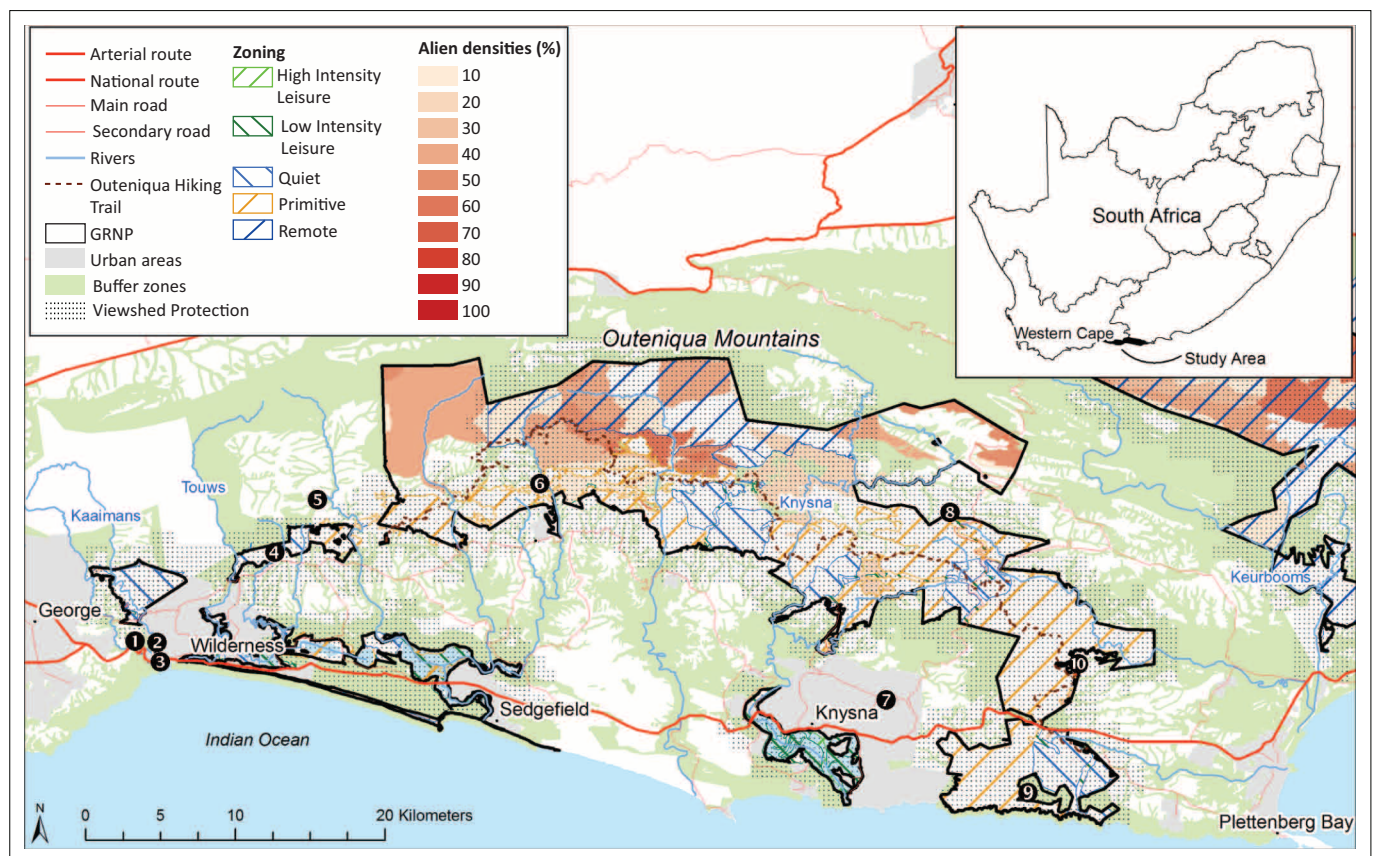
In the first survey, a composite panoramic photograph was taken of the available viewshed at each of the three sites, and each photo was delineated into numbered sections based on the visible extent of IAP coverage (see examples in Figure 4a), but excluding barren areas such as roads. For each of the identified numbered sections, this was equated to actual IAP densities (see Table 1-A1) derived from aerial vegetation cover and transformation surveys (Vlok, Euston-Brown & Wolf 2008) and further classified according to the height class of the predominant vegetation (≤ 2 m or > 2 m) and state of transformation by IAPs, relative to the desired natural state (on a five-point scale, from fully transformed to completely

TABLE 1: Zonation and limitations of acceptable change to aesthetics and recreational activities.

Zone	Limits of acceptable change
Remote	Activities that impact on the intrinsically wild appearance and character of the area will not be tolerated
Primitive	Activities that impact on the intrinsically wild appearance and character of the area should be restricted, and impacts limited to the site of the facility
Quiet	Activities that impact on the relatively natural appearance and character of the area should be restricted, though the presence of larger numbers of visitors and the facilities they require, may impact on the feeling of wildness found in this zone
Low-intensity leisure	Although it is inevitable that activities and facilities will impact on the wild appearance and reduce the wilderness characteristics of the area, these should be managed and limited to ensure that the area still provides a relatively natural outdoor experience
High-intensity leisure	Although it is inevitable that the high visitor numbers, activities and facilities will impact on the wild appearance and reduce the wilderness characteristics of the area, these should be managed and limited to ensure that the area generally still provides a relatively natural outdoor experience appropriate for a national park

Source: Adapted from SANParks 2012

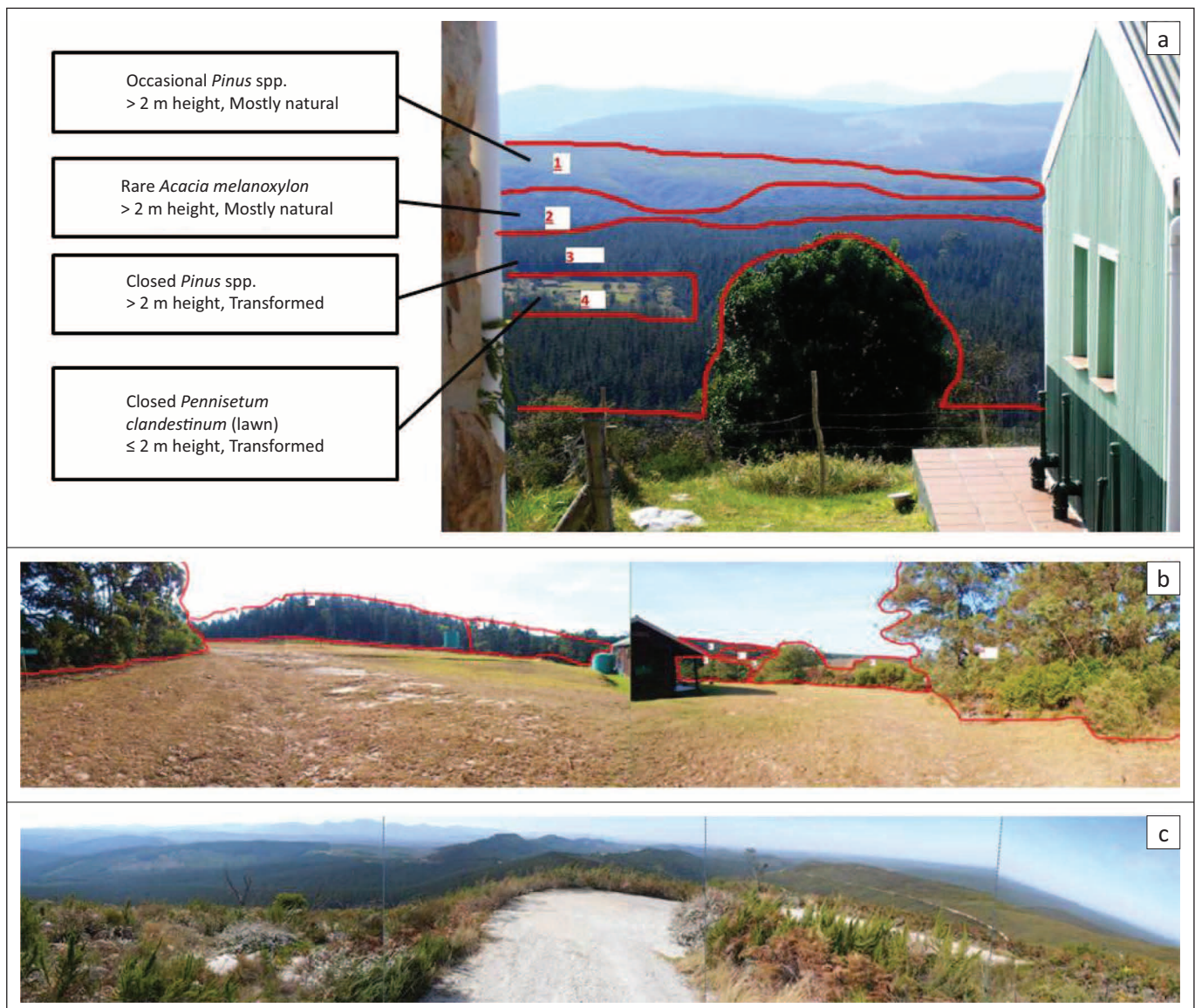
Also see Figure 3.



Source: Map developed by authors as part of this research drawn by Johan Baard

1, Kaaimansgat; 2, Map of Africa; 3, Dolphin Point; 4, Woodville Big Tree; 5, Bergplaas; 6, Karatara; 7, Concordia; 8, Spitskop; 9, Sinclair Hut; 10, Fisantehoek Hut.

FIGURE 3: The location of the Garden Route National Park Wilderness and Knysna Sections, main geographical features and places, and the Viewshed Protection Zones defined in Table 1, relative density of Alien Invasive Plants within the GRNP and selected points of interest mentioned in the text or illustrated in other figures.



Source: Photos by Waldo Erfmann

FIGURE 4: Examples of photographs shown to park visitors to determine viewshed preferences and assess awareness about invasive alien plants: Views at (a) Fisantehoek Hut and (b) Sinclair Hut showing 4 and 10 delineated sections, respectively, to illustrate the methodology used; and composite panoramic photo of the view at (c) Spitskop Viewpoint (11 sections, not shown).

natural). Overnight hikers and day visitors were approached between 08 May and 07 July 2013 and shown a photo of the viewshed (with numbered sections) at the given site. They were then asked to score each section on how it influenced their viewshed experience, where 1 = a reduced experience, 2 = no effect and 3 = an enhanced experience. They were asked to motivate each score: every time IAPs were mentioned, it was recorded against the specific section. The survey was concluded with the question, 'Why did you specifically choose to visit this site'? If the answer included words or phrases alluding to the aesthetic appeal of the site (e.g. 'naturalness', 'wildness', 'prettiness'), it was recorded (see Box 2 and Figure 5).

During the second opportunistic survey, hikers encountered were asked three questions. This was after hiking for at least 2 days through a landscape with a high prevalence of non-native trees, including dense stands of pines (see Figure 6) and wattles in the fynbos sections (see Box 3).

BOX 2: Results from visitor surveys in the Knysna Section of the Garden Route National Park.

EXHIBIT 2: Results from visitor surveys

In total 73 visitors were interviewed: 38 at Fisantehoek Hut, 29 at Sinclair Hut, and 6 at Spitskop Viewsite. This yielded a total of 508 experience scores for all 25 numbered sections (38 respondents × 4 sections for Fisantehoek Hut; 29 respondents × four sections for Sinclair Hut; six respondents × 11 sections for Spitskop Viewpoint; see Figure 4). Overall, 57 respondents mentioned invasive alien plants (IAPs) at least once, bearing in mind that they had the opportunity to do so for every numbered section. This suggests that there is a relatively high awareness about IAPs in the surroundings, but this does not necessarily translate into negative viewshed experiences, especially when it comes to mature trees of any type (Figure 5).

Synthesis of insights

Our varied assemblage of evidence suggests that SoP, although provided for in legislative spheres and by national park and environmental management, remains a poorly developed concept in South Africa. Where and when considered, it rarely relates to a holistic appreciation of viewsheds, landscapes or biodiversity, including non-native trees. Specifically for the GRNP, the extant zonation

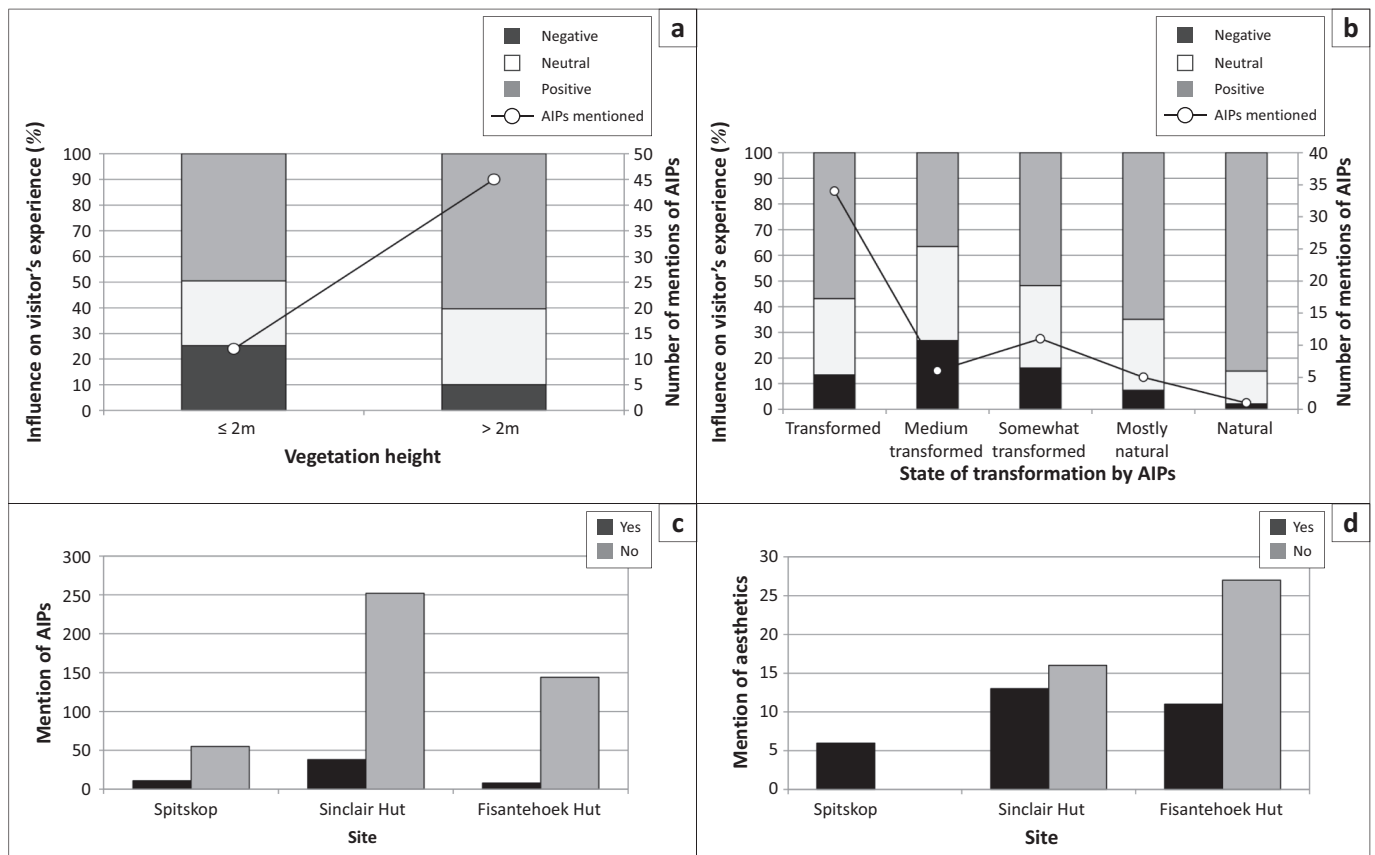


FIGURE 5: Influence on visitor's experience attributable to (a) vegetation height and (b) state of transformation of the vegetation in perceivable viewshed sections on photographs, combined for three sites. Also indicated is the number of times invasive alien plants were mentioned per vegetation height class or transformation state. The number of respondents who specifically mentioned (c) invasive alien plants per viewshed section or (d) aesthetics per survey site.



Source: Photo by Dirk Roux

FIGURE 6: Invasive pine trees growing along the Tsitsikamma Hiking Trail may, or may not, impact on the viewshed and sense of place experiences of hikers (Box 3).

scheme (Table 1) recognises changes to aesthetics due to human activities, albeit at a very coarse scale, but it does not consider non-native trees or IAPs. The same applies to the demarcated Viewshed Protection Zone (Figure 3) where, ironically, high AIP densities may occur in areas zoned as 'Remote' or along the Outeniqua Hiking Trail (Figure 2c), particularly in fynbos vegetation. In buffer zones, our examples show that over the past century, non-native trees have become established features of iconic

view sites (Figure 1) and main tourist routes (Figure 2b). This is indicative that wattles and pines continue to form part of a publicly acceptable viewshed, firstly, due to the historic role of these non-native trees in the development of the region, and secondly, due to a lack of a collective mental model of what a representative Garden Route viewshed should look like. Thus, while Le Maitre *et al.* (2011) argue that invasive Australian acacias can negatively affect both tourist experience and SoP by reducing 'landscape diversity' and degrading recreational areas, our exploratory surveys suggest that this relationship is not so straightforward. Even where park visitors were aware of non-natives, such knowledge did not necessarily translate into negative experiences (as suggested by results from our survey – Figure 5a), and it seems that mature (> 2 m) non-native trees may even contribute to positive scenic or aesthetic experiences. Likewise, while some hikers displayed fairly good understanding of invasive pines and alluded to negative experiences, others were apparently oblivious or tended towards absolute biocentricity – simply enjoying any trees (Box 3). Therefore, while scientists may be able to distinguish between ecosystem service benefits offered by initial introductions of non-natives, and ecosystem service losses due to subsequent invasions, this may not be intuitive for non-scientists, especially when such species also provide tangible benefits (e.g. De Neergaard *et al.* 2005). This may hinder public support or understanding of clearing and restoration efforts.

BOX 3: Responses of nine hikers on the Tsitsikamma Hiking Trail.

EXHIBIT 3: Responses of nine hikers on the Tsitsikamma Hiking Trail to an informal survey about their experience of viewsheds, sense of place and invasive alien plants along the trail. The results suggest varying levels of awareness about invasive alien plants and different appreciation of the natural surroundings. It appears that more obvious signs of human impacts were found more disturbing than pine trees.

Question 1: Have you seen a particularly pleasing view on the trail?

1. 'Looking down at Nature's Valley was a pristine scene; waterfall at Bloukrans [overnight hut]; stream at picnic site'
2. 'View from Bloukrans of mountains; forests, large pool, fynbos flowers'
3. 'View of mountains – sense of space; some evidence of human activity but no noticeable human presence; pools and waterfalls; deep forest and rays of sunlight through trees'
4. 'Pools of water; brown coloured water'
5. 'Mountain ranges'
6. 'Looking down on rainforest; being in forest; clean water; green moss-grown stones'
7. 'Looking down into valleys from top of mountains; fynbos; clouds; looking over gorge from Bloukrans; forest ferns; opportunity to see bigger picture "big-sky country"'

Question 2: Have you seen anything disturbing on the trail?

1. 'Jeep-track (as opposed to hiking trail) and signs of human activity distracted from pristine forest; crowded overnight facilities'
2. 'Burned patch; 4 x 4 trails'
3. 'Burned area – something beautiful has been destroyed; roads stood out like a scar'
4. 'Cigarette butt; bare burnt section; roads'
5. 'Small piece of litter'
6. 'Human misuse of land (litter, toilet next to river, cut down trees)'
7. 'Car driving on a road; tower; expected isolation and don't want to see sign of human activity; small piece of litter'

Question 3: Have you noticed alien (that do not naturally belong) plants along the trail? If so, which ones and how did you feel about them?

1. 'Yes: eucalypts and pines – disgrace'
2. 'Yes: pines – not a problem as long as they do not replace fynbos; would not enjoy walking through just pines'
3. 'Yes: pines – ambivalent about them'
4. 'Yes: pines – troubled to see pines in natural section'
5. 'Don't know plants well enough'
6. 'Yes: wattle and pine – disappointing, could have just climbed a mountain at Simon's Town, this is supposed to be pristine; would be nice to have more information about alien vegetation'
7. 'Yes: Tomato plant at overnight facility'
8. 'Yes: pine trees – I like trees so the more trees the merrier'

The same applies at park management level, where managers may be aware of the negative impact of IAPs on biodiversity and provision of ecosystem services, but may not value the preservation of aesthetics (e.g. in California – Funk *et al.* 2013) or consider the potential impact on tourism (Forsyth *et al.* 2012) as a reason to combat IAPs. This is similar for attitudes towards non-native ornamental species that are found in rest camps in Kruger National Park (Foxcroft, Richardson & Wilson 2008), where it required education and increased awareness of staff to gain support for the removal of such plants. Similarly, tourists in Pilanesberg who were aware of the invasive prickly pear (*Opuntia stricta*) indicated a willingness to contribute financially to its control (Nikodinoska *et al.* 2014). In an 'open-access' scenario such as the GRNP where visitors do not necessarily have to pass through a gate to experience the park, the demarcation between PAs, surrounding buffer zones and the rest of the landscape is less easily observable. Given that non-native trees are entrenched as part of the Garden Route's cultural heritage, it will require a particularly pragmatic (and creative) approach to use feedbacks from visitor SoP experiences to inform park management.

The role of shifting baselines in sense of place

Given how attachment to place and SoP develop over time and is closely related to individual baselines, it is worth considering how the concepts of naturalness or reference states are formed. Retaining historical character of a region may serve as motivation for AIP eradication but over time people become accustomed to non-natives (Schlaepfer *et al.* 2011). There may be differences between experiences of local and foreign visitors, making 'novel' ecosystems more acceptable to some due to a lack of historic perspective, or personal familiarity with similar viewsheds elsewhere.

Internationally, there is some indication that the way in which people appreciate natural areas is evolving. A recent

case study in the River Piedra floodplain (Spain), has shown that over the past 50 years, there has been a positive shift towards appreciation of social and cultural ecosystem services, including aesthetics, inspiration and SoP (see Figure 5 in Felipe-Lucia, Comín & Escalera-Reyes 2015). Similarly, land managers of The Nature Conservancy in the USA consider impacts of non-natives on aesthetics at least equally important to degradation of other (provision) ecosystem services (Kuebbing & Simberloff 2015). While restoration and AIP clearing can have positive effects on ecosystem service provision and tourism in certain biomes or vegetation types (e.g. fynbos – Currie, Milton & Steenkamp 2009), the 'human element' also needs due consideration. An example from Finnish national parks showed that the natural characteristics such as scenery and biotype diversity are significant determinants of park visitation, along with factors such as recreational opportunities, for example, availability of trails (Neuvonen *et al.* 2010).

While it is easy to understand the danger of an 'absolute ecocentric' attitude (Sharp *et al.* 2011), which would oppose the clearing of any tree at all costs, a single-minded, negative focus on non-native species without considering other factors may be counter-productive. In the case of the Garden Route, the contribution of non-native trees and plantation forestry to the historic heritage (e.g. 'flower gums', Figure 2d) deserves consideration. There are legal mechanisms to guide some of these trade-off situations, such as the 'Champion Tree' project by the Department of Agriculture, Forestry and Fisheries (in terms of Section 12 of the *National Forests Act* of 1998) which recognises individual specimens or clumps of non-native trees of historic value or exceptional size. Also, the *South African National Heritage Resources Act* (Act No. 25 of 1999) mandates protection of 'heritage objects' including natural landscapes of cultural significance; even non-native trees associated with such landscapes, for example, historic arboretums. This emphasises the need for a deliberate process of consultation informed by history, public participation and

science to agree on acceptable viewsheds, both native and non-native, that contribute to SoP.

Conceptual framework for incorporating viewsheds and sense of place in the management plans of national parks

In South Africa, the NEM:PA makes it obligatory for authorities responsible for PAs to develop a management plan for each such area, to submit this plan for the approval of the Minister responsible for the environment and to manage the PA in accordance with the approved plan. In the case of SANParks, an adaptive planning approach is followed to formulate a hierarchy of objectives that serve as a basis for developing management plans for the various national parks (see Biggs & Rogers 2003; Foxcroft & McGeoch 2011). Adaptive planning takes place in consultation with relevant organs of state, local communities and other affected parties.

In Figure 7 we propose a conceptual framework for linking the concepts of viewshed and SoP to the typical high-level management objectives of a national park. According to our framework, viewsheds (and other sensory features such as soundscapes) can be described in both biophysical and social or cultural terms. SoP experiences can be viewed as an

emergent property of the interaction between people and the environment. Such experiences are mediated by factors such as community history, identity and value systems and can be facilitated or hindered by park management actions. Regarding the latter, there is an obvious interplay between management action and visitor experiences: while conservation initiatives have the potential to build on existing, or to create new, SoP associations (Larson *et al.* 2013), being aware of SoP experiences can be an effective driver of conservation actions (Ardoin 2014).

Several arrows in Figure 7 indicate bi-directional influence. Such two-way feedbacks should be important considerations in designing monitoring and management interventions for incorporating viewsheds and SoP into park management plans.

Concluding thoughts and proposing a research agenda

In this article, we have explored the potential impact of IAPs on viewsheds, within a broader context of SoP as experienced by visitors to GRNP. The novelty of our study also results in limitations, in that insights derived from focussing on IAPs, the GRNP and park visitors are not necessarily applicable to other landscape transformers, PAs or sectors of society.

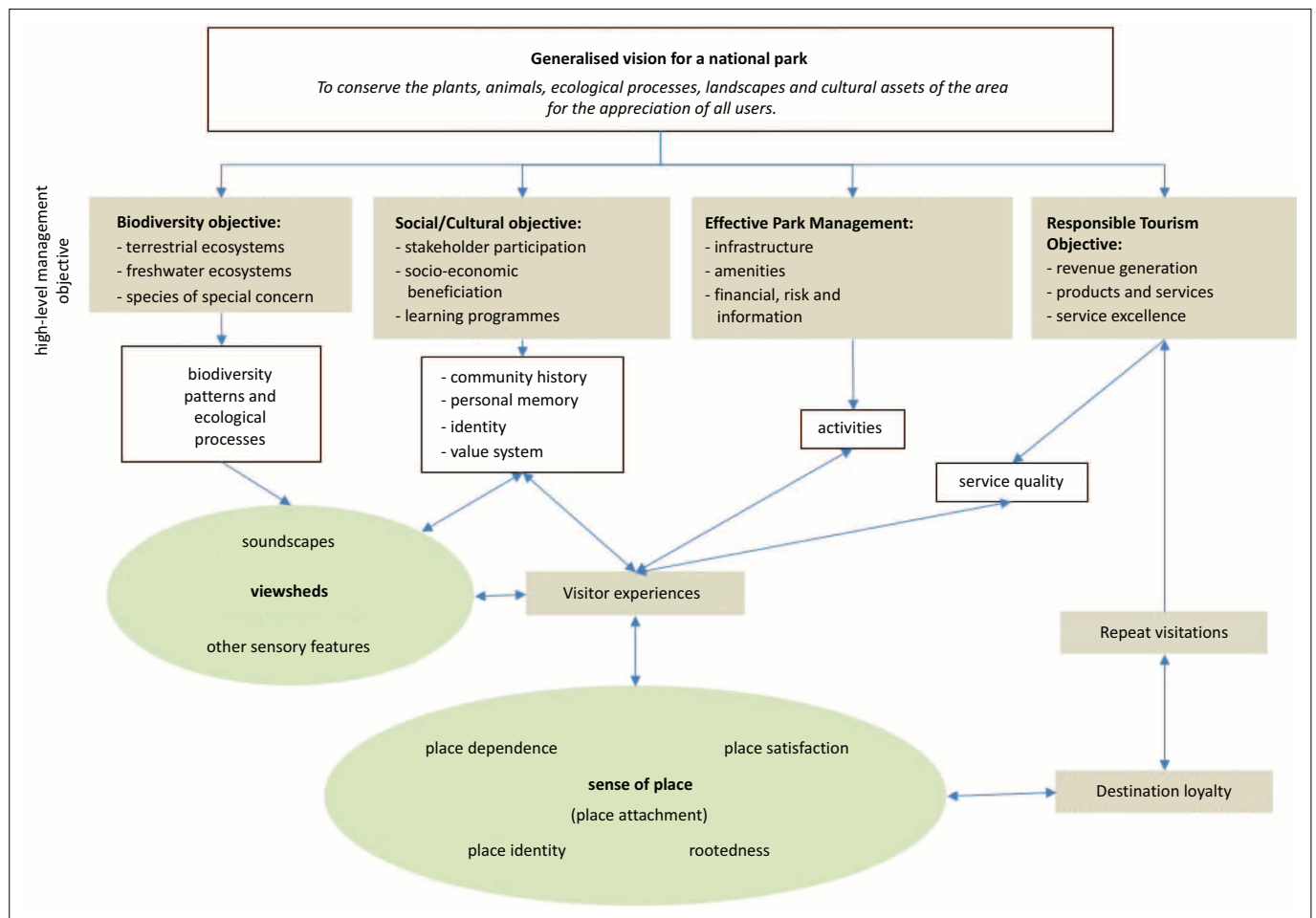


FIGURE 7: Schematic showing how viewshed and sense of place relate to a typical set of high-level objectives that serve as a basis for developing park management plans in South African National Parks. Viewshed and sense of place are cross-cutting concepts likely to be influenced via multiple objectives and in turn impact on the Responsible Tourism Objective.

However, our study also highlights some pertinent points with generic relevance to PAs in South Africa.

Firstly, the mixed information sources considered in this study suggest that viewshed and SoP are important conservation features from both conceptual and legal perspectives. As such, these concepts need to inform conservation action and therefore should be incorporated into park management plans.

Secondly, viewshed and SoP should be considered through both natural and social lenses to facilitate discussions of the 'desired future conditions' of landscapes under conservation from both ecological and social perspectives (Williams & Stewart 1998). To this end, viewshed and SoP can potentially serve as 'boundary concepts' to promote interdisciplinary learning between social and natural scientists as well as communication between science, management and stakeholders (Chapin III & Knapp 2015).

Thirdly, the links and feedbacks between conservation features such as viewshed and SoP, disturbances such as non-native and invasive plants and various park management objectives are multiple and intricate. These relationships may straddle human history (shifting baselines) and thus environmental and social contexts. Place-specific monitoring will be required to meaningfully incorporate these concepts into park management practice.

Fourthly, the current lack of formal research in South Africa on viewsheds and SoP, especially relating to national parks and their buffer areas, represents a considerable void in our understanding of the relationship between park management and visitor experiences. Some studies on visitors' motivations to visit South African PAs have identified activities such as photography (e.g. Saayman, Saayman & Ferreira 2009), implying recognition of scenic values. However, there is a need to explicitly evaluate the role and value of SoP and natural viewsheds in PAs as well as the potential implications that may result from various threats. Threats are likely to be region- and context-specific (e.g. IAPs in GRNP, hydraulic fracturing activities and infrastructure in the Karoo parks and wind farms in coastal areas), further emphasising the breadth of research opportunities.

How do the relationships depicted in Figure 7 play out in the real-world setting of a specific park? We conclude by proposing research questions that could serve as a basis from which to develop a more comprehensive research programme for improved appreciation of viewsheds and SoP as conservation constructs. Firstly, we consider questions related to viewsheds:

- Considering a broad definition of biodiversity, encompassing genetic, species and ecosystem (including habitat) diversity, could viewshed serve as a surrogate feature (similar to an umbrella species) for conservation?
- Should South Africa be concerned with conserving a representative sample of natural viewsheds (e.g. per

bioregion or biome) and to what degree can or should national parks contribute to such a purpose?

- What are 'representative' or 'iconic' viewsheds for specific PAs in terms of historic naturalness and biogeography?
- How should specific sites for representative and iconic viewsheds be identified? Should such viewsheds be restored where they no longer exist, and which methods should be used to reconstruct acceptable baselines (e.g. soliciting park visitors to submit historic photographs from chosen sites)?
- What are the main threats to, and modifiers of, natural or cultural viewsheds and how do these affect SoP experiences of visitors?
- What is the role of buffer zones in viewshed conservation?
- Should thresholds of potential concern (TPCs – Biggs *et al.* 2011) be developed for viewsheds and how could such TPCs inform monitoring (e.g. through fixed-point photography) for compliance with set objectives?

Questions related to SoP are:

- How should SoP experiences (based on feedback from stakeholders and visitors) be considered in the design, establishment and management of PAs?
- Can we characterise SoP experiences for each national park and surrounding areas?
- How do activities, such as guided hikes, animal tracking (e.g. cheetah tracking in Mountain Zebra National Park), trail running and mountain biking (in the GRNP) influence SoP experiences of participating and other visitors to these PAs?
- How do SoP experiences differ across age groups, cultures and nationalities of visitors, as well as local versus non-local residents, or day versus overnight visitors?
- Are the dynamics of SoP experiences different in open-access PAs to those in fenced-off PAs with distinct boundaries?
- What is the relationship between individual and collective experiences in developing attachment to place?

Implementing a research agenda as suggested here could significantly contribute to people-centred conservation while at the same time promoting South African National Parks' vision of 'connecting to society' (http://www.sanparks.co.za/about/connecting_to_society/).

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Competing interests

The authors declare that they have no financial or personal relationships which may have inappropriately influenced them in writing this article.

Authors' contributions

J.B. (South African National Parks and Nelson Mandela Metropolitan University) and D.R. developed the project concept, J.B. (South African National Parks and Nelson Mandela Metropolitan University), D.R. and W.E. were responsible for experimental design, data collection and analyses. T.K. and C.N. made conceptual contributions and literature suggestions. J.B. (South African National Parks) drew the map in Figure 3. J.B. (South African National Parks and Nelson Mandela Metropolitan University) and D.R. wrote the manuscript with contributions by W.E., T.K., J.B. (South African National Parks) and C.N.

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Appendix 1

TABLE 1-A1: The density classes (percentage ground cover) and description used in the analysis of results of viewshed zone preference by visitors as surveyed at Spitskop Viewpoint, Sinclair and Fisantehoek Huts.

Class	Description
Rare	The species is present in the area but at very low densities with individuals being seen here and there; density = 0.01% (average 0.005%)
Occasional	Plants are widely spaced, occurring here and there – on average more than 10 canopy covers apart; density = 0.02% – 1% (average 0.15%)
Very scattered	The plants average 3–10 canopy diameters apart; density = 1.1% – 5% (averaged 0.51%)
Scattered	The plants average 1–3 canopy diameters apart; density = 5.1% – 25% (average 15.05%)
Medium	There are clear and plentiful gaps between the canopies of the plants and other vegetation is still present and vigorous; plants average 0.3–1 canopy diameters apart; density = 25.1% – 50% (average 37.55%)
Dense	There are small gaps between canopies and no canopy overlap and the other vegetation is still present; plants average 0.1–0.3 canopy diameters apart; density = 50.1% – 75% (average 62.55%)
Closed	Plant canopies are closed, touching or overlapping and other vegetation is generally suppressed, sparse or lacking; the plants average less than 0.1 canopy diameters apart; density > 75% (average 87.55%)