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**The Effects of Invasive Alien Plants on Cultural
Ecosystem Services: *Tourism and Recreation***

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Submitted in partial fulfilment of the MPhil in Environmental Management from the
Department of Environmental and Geographical Sciences at the University of Cape Town

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Declaration

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Abstract

With the continued spread of invasive alien vegetation in South Africa, there is a growing need and recognition in protecting ecosystem service delivery. While most literature on ecosystem services has focussed on provisioning and supporting services, this study looks at the less addressed cultural ecosystem services, specifically focussing on tourism and recreation. This research explores the relationship between tourism and invasive alien vegetation. This was carried out at firstly a national level, utilising primarily quantitative methods to identify, and map alien vegetation overlaps with key tourist sites in South Africa. This was followed by a more in-depth qualitative analysis, at a case study level, focussed on the Stellenbosch municipality, to determine the understanding and perceptions, tourists, landowners, and tourism operators have regarding invasive alien plants. Moderate to high levels of infestation were found overlapping various key tourism destinations across the country. The most heavily impacted provinces include the Western Cape, Eastern Cape, and KwaZulu-Natal. In certain areas, invasion levels at key tourist destinations raise concerns regarding the management of these sites. The findings of this research signify a close link and definite relationship between tourism, and invasive alien vegetation. Looking specifically at tourism as a cultural ecosystem service, and the relationship this service has with invasive alien vegetation, future studies need to recognise the significance of this association, while the broader tourism industry needs to recognise the potential threats invasive alien vegetation poses to their operations. Furthermore, this research identifies the value in combining qualitative, human dimensions, with quantitative data and mapping approaches in ecosystem services research.

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1. INTRODUCTION

1.1 Background and rationale

The concept of ecosystem services dates back to the early 1970s but only started gaining prominence in scientific literature in the 1990s (de Groot et al., 1992; Costanza et al., 1997; Daily, 1997). Simply defined, the Millennium Ecosystem Assessment (MEA, 2003, 2005) identifies ecosystem services as the benefits people derive from ecosystems. More particularly, the MEA characterises and distinguishes between provisioning, regulating, cultural and supporting services. Since the publication of the MEA, the notion and concept of ecosystem services has gradually gained momentum and become a popular means of understanding the complex nature of society's engagement with, and dependence on, ecosystems (Tallis et al., 2008).

de Groot et al. (2010) explain that there is still a poor understanding of the quantitative relationship between biodiversity, ecosystem processes, and the services they offer that benefit humans. Most literature to date on ecosystem services, focuses on provisioning and supporting services, with little research concentrating sufficiently on cultural services (Pereira et al., 2005; Turpie et al., 2008; Vira and Adams, 2009; Reyers et al., 2009; O'Farrell et al., 2010). This is largely due to the difficulties in assessing and valuing cultural services which are primarily represented by aesthetics, values, intrinsic elements, spiritual enrichment, sense of place, tourism and recreational experiences (Martin-Lopez et al., 2009). Looking particularly at tourism and recreation, there are considerable challenges in attempting to quantify the capacity of ecosystems and landscapes to provide goods and services to human beings. According to the World Travel and Tourism Council (WTTC, 2007), travel and tourism account for 10% of world Gross Domestic Product (GDP), 8% of jobs and 12% of annual global investment. Furthermore the WTTC (2007) conclude that tourism, out of all other industries, has the highest potential for growth, with an annual growth rate of approximately 4%.

According to Garcia-Llorente et al. (2008), there is an enormous biotic homogenisation of the Earth's surface that is occurring. Mooney et al. (2005) explain this phenomenon as largely a result of a breaking down and fragmentation of the Earth's major biotic barriers that have sustained the distinct flora and fauna that characterise each continent. Globalisation has brought social and economic benefits to numerous people, but it has also presented new challenges of which invasive alien species are among one of the most significant (Reaser et al., 2007). At no time in history has the rate of biological invasion or the diversity and volume of these invaders been so high and the consequences so great (Mooney and Hobbs, 2000; McNeely et al., 2001; Reaser et al., 2007).

Invasive alien species by definition, are plants, animals and other organisms that are non-native (or alien) to “the ecosystem under consideration and whose introduction causes, or is likely to cause economic or environmental harm, or harm to human health” (Peter, 2009:1). More specifically to this study, invasive alien plants are plants that are able to survive, reproduce and spread, unaided (sometimes at alarming rates), often having severely negative impacts on ecosystems, and giving rise to particular management problems (van Wilgen and van Wyk, 1999). It is believed that one of the most important causes of biodiversity loss is due to the negative effects of invasive alien plants (Sala et al., 2000).

In recent decades, the spreading rate of invasive alien plants has increased significantly around the world presenting growing environmental and socio-economic concerns (Mwebaze et al., 2010). Invasive alien plants are now ranked as the second most serious threat to global biodiversity loss, directly after habitat destruction (Pimentel, 2000; Sala et al., 2000; MEA, 2005; van Wilgen and Richardson, 2010). South Africa’s biodiversity is no exception to the threat of invasive alien plants, and it is estimated that approximately 10 million hectares of land are invaded by invasive alien vegetation (Turpie et al., 2008). Furthermore, increased globalisation, and the effects of global climate change are expected to accelerate rates of invasion (Hellmann et al., 2008). Given the estimates obtained and threats posed by invasive alien plants on a variety of levels to South Africa, there is a growing need to promote practices based on ecological resilience, sustainability, healthy biodiversity retention, as well as growing recognition of the need to protect ecosystem service delivery (O’Farrell et al., 2010).

Once established, certain invasive alien plants have the ability to reduce biodiversity and cause significant changes in ecosystems (Lovell and Stone, 2005). This in turn will have a direct impact on the capability of these ecosystems to provide important services on which all life on Earth depends. There are also mounting concerns regarding the impacts that invasive alien plants could have on industries such as forestry, fisheries, agriculture, and international trade. This introduces the question of what are the effects invasive alien plants could have on industries rooted in cultural ecosystem services, such as tourism? By exploring the possible relationships, and the degree of association, between invasive alien plants and tourism in South Africa, there is an opportunity to contribute to the relatively limited understanding of cultural ecosystem services.

Furthermore, in contrasting this cultural service under conditions of natural versus invaded landscapes and riparian zones, there is the opportunity to better understand the biological underpinnings of these services. Thus a key challenge which this study tries to address is to determine the nature, characteristics, and key features that constitute these biological underpinnings, so as to gain a deeper understanding of the biological factors at play that influence and affect tourism and recreation.

Daniel and Muhar (2009) consider that for us to better understand the complex and dynamic relationship between cultural ecosystem services and ecosystems, it will require ecological and social science, (in many ways quantitative and qualitative science) to come together, benefit, and substantiate one another. As ecosystem services research advances, it becomes increasingly evident what role, or to what degree, cultural ecosystem services can communicate the need for sustainable ecosystem management.

1.2 Research focus

The broad research focus of this study is to determine the impacts and effects invasive alien plants have on cultural ecosystem services. The research specifically focuses on the cultural services of tourism and recreation. This investigation is carried out firstly at a national level, utilising primarily quantitative methods considering South Africa as a whole. This is followed by a more in-depth qualitative analysis, at a case study level, focussed specifically on the Stellenbosch municipality in the Western Cape. The methods adopted, incorporate both quantitative and qualitative means in an attempt to better understand the effects (negative or positive) of invasive alien plants on tourism in South Africa, as well as their degree of association.

1.3 Aim of research

According to the International Trade Centre (2010), the tourism sector in Africa is one of the continent's key economic drivers. Thus it goes without saying that it is important to understand if there is a relationship between invasive alien plant infestation, and the cultural services of tourism and recreation. Hence the central aim of this research is to establish the relationship between invasive alien plants and the tourism sector in South Africa. Furthermore, it is necessary to assess how this relationship is perceived, and manifests itself within the tourism sector.

1.4 Objectives of the research

To meet the aim of this research, two main objectives are addressed. The first is at the national scale, and sets out to develop an understanding of the degree of association and overlap between key tourism features (such as nature reserves, heritage sites, recreational venues, etc) and alien plant infestation. This part of the research sets out to develop an understanding of: the specific tourism sites chosen; what recreational activities they provide; assessing the popularity levels of the different activities each site offers to tourists; and to what degree invasive alien vegetation overlaps these tourism hotspots.

The second objective seeks to better understand the mechanistic relationship between invasive alien plant species and tourism. This will be established through a local case study, centred on the Stellenbosch municipality. Specifically this case study will look at selecting key tourism hotspots and appropriate activities to investigate in detail; the level of understanding and awareness tourists have concerning invasive alien vegetation; and finally to determine *tourist*, *landowner*, and *tourism operator* views, perceptions and recognitions of invasive alien plants and their association with tourism activities.

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2. LITERATURE REVIEW

2.1 *Ecosystem services and landscapes*

Over the last century there have been considerable alterations and transformations of the world's ecosystems (Millennium Ecosystem Assessment, MEA, 2005). Although the immediate benefits for humans seem clear, the changes often forced on our ecosystems could have far-reaching consequences (Reyers et al., 2009). Understanding these consequences requires an awareness and assessment of the links between ecosystems, biodiversity, and human well-being. By characterising and focusing on these links, the science of ecosystem services has emerged. Brauman et al. (2007) explains that the term *ecosystem services* describe a framework for structuring and synthesising a biophysical understanding of ecosystem processes in terms of human well-being. Daily (1997) defines ecosystem services as the conditions and processes, within the species composition of natural ecosystems, which sustain and fulfil human life. Costanza et al. (1997) define them as the benefits human populations obtain, directly or indirectly, from ecosystem functions. The MEA (2003; 2005) firmly established the concept of ecosystem services as an important model for linking the functioning of ecosystems to human welfare benefits. Essentially, the MEA was carried out to inventory the state of the planet's ecosystems and simultaneously served to demonstrate the importance of ecosystems. Up until now, it has been seen by many to be a successful precursor and introductory framework for explaining to people the importance of the services ecosystems provide us.

Changes in ecosystem services can be caused by multiple interacting drivers, for example climate change, soil erosion, land cover change, or concerning this particular study - invasive alien plants. When ecosystems are affected by these drivers, it is almost certain these changes will affect the functions and services these ecosystems provide (Reyers et al., 2009). Figure 1 highlights the various components of the four pillars of ecosystem services, namely: provisioning; regulating; cultural; and supporting ecosystem services. Most research of ecosystem services up until now has focussed largely on provisioning and regulating services (Pereira et al., 2005; Le Maitre et al., 2007; Turpie et al., 2008; Vira and Adams, 2009; Reyers et al., 2009; O'Farrell et al., 2010). If one examines figure 1 closely, it can be seen that within provisioning and regulating services, lie vital processes and natural capital such as fresh water, climate regulation, energy, food, air quality regulation and so on. Without these crucial services, humans would cease to exist and therefore it is justifiable that they have received the bulk of attention in recent decades.

However according to Daniel and Muhar (2009), cultural services play a central role in determining what ecosystems people are inclined to value and to protect. The authors conclude that when landscapes are appreciated for their cultural services, inevitably there will be more support for other environmental management goals, and gaining public support for the protection and/or intervention of these ecosystems is likely to occur more readily and successfully.

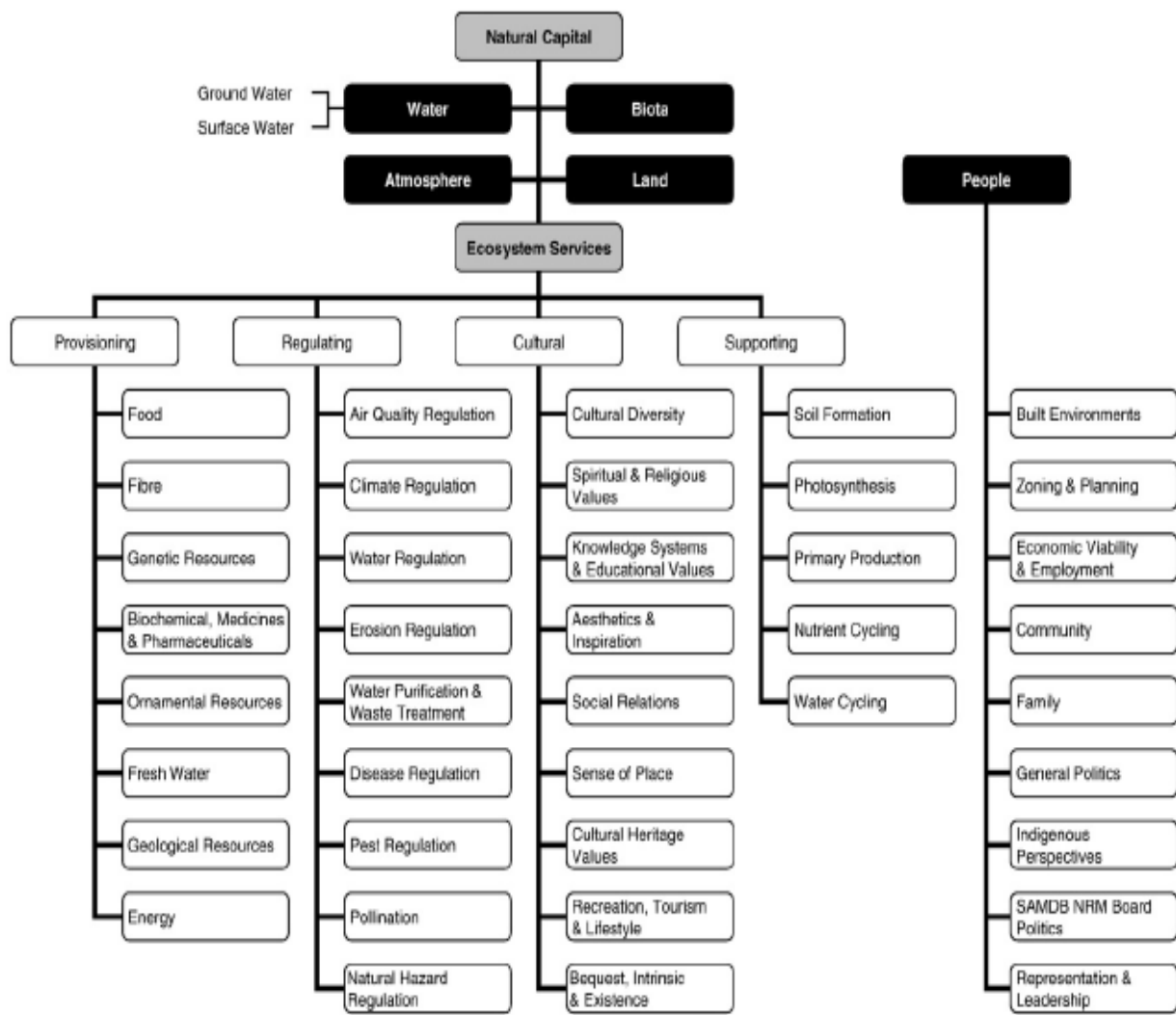


Figure 1- Ecosystem services typology (Raymond et al., 2009)

Figure 2 represents cultural services as occurring at the interface between ecological systems and human systems. The rationale behind the figure explains that ecosystems, along with other natural and human forces, shape the biophysical features and patterns of landscapes which in turn provides opportunities for human appreciation of cultural services. Even more significantly, it is evident that the appreciation of cultural services has direct and indirect impacts on landscapes and thus on ecosystems.

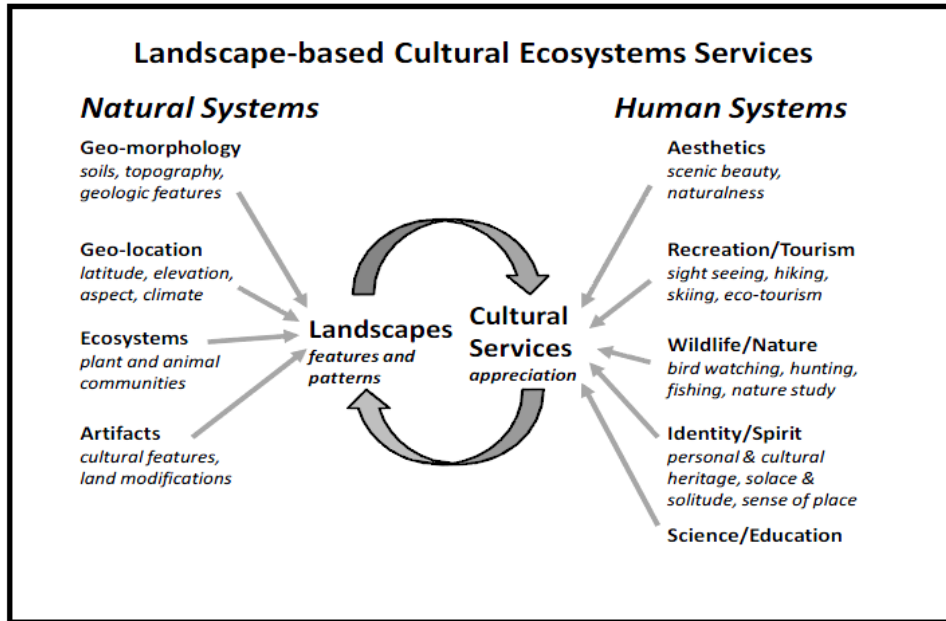


Figure 2 – Cultural services and landscape features(Daniel and Muhar, 2009)

Figure 3 represents a framework which gives a clear representation of the link between ecosystems and human wellbeing. The figure explains that “ecosystem services are generated by ecosystem functions which in turn are underpinned by biophysical structures and processes known as supporting services. Ecosystem functions are thus intermediate between ecosystem processes and services and can be defined as the capacity of ecosystems to provide goods and services that satisfy human needs, directly and indirectly” (de Groot et al., 2010:262).

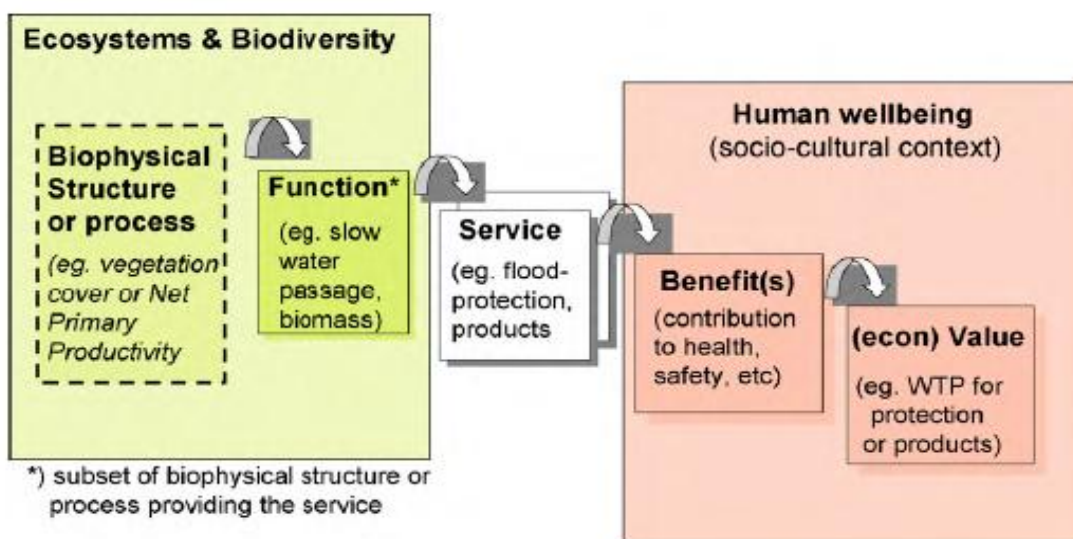


Figure 3 – Framework for linking ecosystems to human-wellbeing (De Groot et al., 2010; adapted from Haines-Young and Potschin, in press)

Where the general principle of ecosystem services is relatively clear, the connections between specific ecosystems and the products and services they provide, as well as which services are of more or less value to humans, can be complex (Daniel and Muhar, 2009). Therefore it is no surprise that the justification for particular management policies in this regard can be difficult to convey to the public. At the Interdisciplinary US-European Workshop on Landscape-based Cultural Ecosystem Services, Daniel and Muhar (2009) remark that in spite of considerable progress in their separate fields, ecologists, social scientists, and landscape planners have made little progress toward a generic understanding of the landscapes that mediate the relationships between ecosystems and their cultural services. In order to make adequate choices regarding land management, better information on spatial distribution of landscape functions and services is needed (de Groot et al., 2010).

Ecosystem service based approaches have grown in number and coverage in recent decades. The rationale behind these approaches inevitably means that by understanding and mitigating the threats posed to ecosystem services, one will also conserve the biodiversity that underpins these services, while at the same time increasing the relevance, incentives, and potential funding for conservation efforts (O'Farrell et al., 2010; Vira and Adams, 2009). O'Farrell et al. (2010) assessed, modelled, and mapped key ecosystem services (surface water, grazing, ground-water recharge, and tourism) and service hotspots in the Succulent Karoo biome of South Africa. A key objective in their research was to investigate the congruence between ecosystem services priorities and biodiversity priorities in relation to known threats.

O'Farrell et al. (2010:3) explain that "understanding tourism as an ecosystem service requires the identification of the biodiversity, ecosystem and landscape features or assets that drive tourism, as well as the socio-economic features that drive its promotion and development". However in previous studies it is recognised that this has been extremely difficult to achieve (European Communities, 2008; Shackleton et al., 2008). To determine the most prominent travel routes followed by tourists, the O'Farrell et al. (2010) study examined tourist brochures and travel guides, contacted tourism associations and examined the Automobile Association accommodation database to determine where accommodation was located, and identified the most important tourist features in the area. The study also incorporated assessing the viewsheds (areas visible ranging up to 10km) tourists experienced travelling along the most prominent tourist travel routes identified in the Succulent Karoo biome. The study found that in specific cases, particular ecosystem service levels (e.g. surface water, tourism, grazing levels) could be used to justify the management of a specific biodiversity priority area for conservation, on the basis of its contribution to the economic endeavour of tourism.

Ecosystem services can be assessed: from an ecological viewpoint when one is able to quantify their provisioning services in biophysical units; from a cultural or social perspective when one can explore the opinions of stakeholders as potential services beneficiaries; and from an economic stand point when one is able to estimate market and non-market values (Spash, 2000; Chan et al., 2006; Agbenyega et al., 2009; Castro et al., 2010). Chee (2004) specifies the importance of ecosystem service valuation, explaining it can elucidate trade-offs, inform decisions, illustrate the distribution of benefits and stimulate the creation of innovative instruments to be used towards sustainable ecosystem management.

2.2 Invasive alien plants and their effects on ecosystem services

Even though research and investigation into ecosystem services has gained considerable momentum in the last two decades, there are still noteworthy gaps and shortcomings in ecosystem service research (Larson et al., 2010). In South Africa, there is growing concern regarding the degradation of the natural environment, and ecosystems around the country (Department of Environmental Affairs: State of the Environment, 2007). Figure 4 depicts the current status of ecosystems in South Africa.

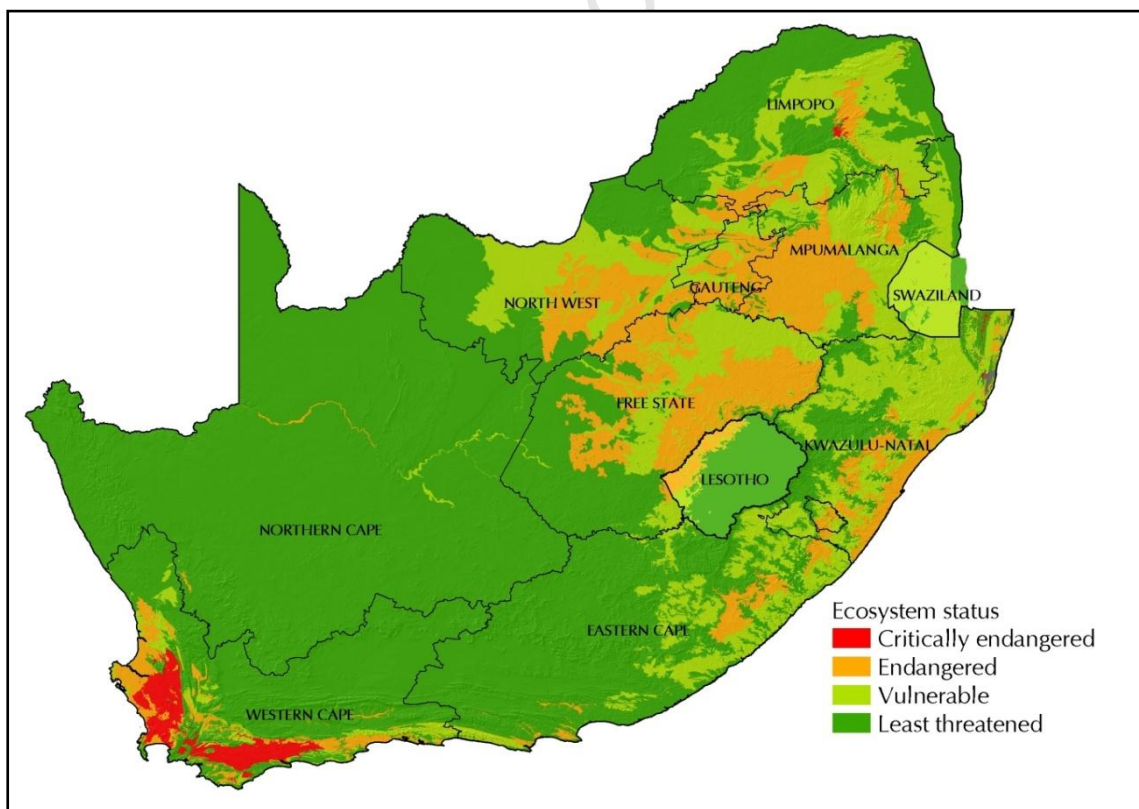


Figure 4 – Status of Terrestrial Ecosystems in South Africa
(Department of Environmental Affairs: State of the Environment, 2007)

With regards to invasive alien species, management plans should include objectives aimed at: increasing collaboration and building support with a broad range of stakeholders (e.g., individuals, agencies organisations, corporations); that influence invasive species introductions, spread, and control (Carlton, 2003; Moser et al., 2009); and have an interest in maintaining the value and quality of public and privately owned lands (Larson et al., 2010). In this regard, it is necessary to understand that perspectives on the environmental, social, and economic importance of invasive alien species and their management are likely to differ among stakeholders (Maguire, 2004; Stokes et al., 2006). In their research, Larson et al. (2010) aimed to make a case to policy makers for a new, sustainable approach to invasive species management. In doing so they sought to address the existing gaps in policy concerning invasive species.

There are inevitably conflicts of interest in cases where important commercial species become invasive and spread beyond the areas where they were originally intended to be cultivated (van Wilgen and Richardson, 2010). Examples of such instances include cases in plantation forestry (i.e. Pine species) documented by Richardson (1998); where alien plants provide firewood (various Acacia trees) documented by Higgins et al. (1997a); food crops (Opuntia species) documented by Brutsch and Zimmermann (1993); in the production of honey by bees (Eucalyptus species) documented by Johannesmeier (1985), and where invasive species have aesthetic or utilitarian value (ornamentals, shade trees, or windbreaks). One of the greatest threats in the Western Cape region, as well as other regions throughout South Africa is the negative impacts pine plantations have on ecosystem goods and services. Over the years there have been studies conducted in the Jonkershoek area in the Western Cape, that clearly demonstrate that pine plantations in mountain catchment areas can reduce stream flow by 130-300 mm per year compared to areas covered with indigenous fynbos vegetation (Department of Agriculture, Provincial Government of the Western Cape, 2007).

New species continue to arrive in South Africa, including many potential invasive species, some of which have already become established, but not yet invading (van Wilgen and Richardson, 2010). If one considers South Africa's history, many serious invasions have exhibited a "lag period" in which the introduced species may occur at relatively low population levels for several decades before becoming invasive. Notably, van Wilgen and Richardson (2010) denote that the ratio of cost of control compared to the potential damage avoided, will increase as invasions proceed to more advanced stages. As the stages of invasion progress, so too do the costs of control. A significant problem in this regard is that it is often very difficult to motivate for expenditure at early stages of invasion, when the future costs of these invasive alien plants have yet to become clearly apparent. There seems to be a general consensus that the initial stages of preventing the introduction of potentially invasive species into new areas would offer returns on investment (van Wilgen et al., 1996; Marais and Wannenburg, 2008; Currie et al., 2009), however this aspect of invasive species management has been neglected in the past (van Wilgen and Richardson, 2010).

Pejchar and Mooney (2009) compiled a study that assesses the costs and benefits of invasive alien species for provisioning, regulating, and cultural services, and illustrate the synergies and trade-offs associated with these impacts using case studies that include South Africa, the Great Lakes in the USA, and Hawaii. Impacts of invasive alien species on cultural services (defined here as those attributes of an ecosystem that are non-consumptive, i.e. hold value for recreation, tourism, history, education, science, heritage, inspiration, spirituality, and aesthetics) are difficult to assess because they are based on personal and local value systems. Pejchar and Mooney (2009) explain that invasive alien species usually alter cultural services, either negatively or positively, and sometimes in opposition to impacts on other ecosystem services. The authors estimate that of all cultural services, impacts of invasive alien species on recreation and tourism are most likely to be quantified.

Recent data depicts that both land and water based recreation is strongly affected by invasive alien plants (Pejchar and Mooney, 2009). For example, water-based recreation alone in Lake Tahoe is worth approximately US\$30-45 million per annum. Even if this region was to suffer a 1% loss in recreational revenue from the potential introduction of Eurasian water milfoil (*Myriophyllumspicatum*), potential costs of up to US\$500 000 a year could be experienced (Eiswerth et al., 2005). Invasive alien plants are just as costly in terrestrial ecosystems used for recreational purposes. Yellow star thistle has decreased the recreation value of large areas in western USA due to how they lacerate hikers (Dudley, 2000). Pejchar and Mooney (2009) conclude that of all ecosystem services, the interaction between invasive alien species and culture is perhaps the most complex and under addressed. Yet these types of services tend to resonate strongly with diverse stakeholders, such as private landowners, local communities and cultural practitioners (Hoagland and Jin, 2006). Table 1 depicts particular examples of invasive alien plants in South Africa, and the various ways they are able to influence the goods and services provided by the country's ecosystems.

Reaser et al. (2007) speculate that although most tourists probably neither know or are concerned with encountering invasive alien plants and the negative impacts they are associated with, their holiday may nevertheless be adversely affected. For example the Australian tree *Casuarinaequisetifolia* (beefwood) now dominates the shoreline on many islands in the Bahamas. Its coarse root masses provide no protection for the shoreline, hence many beaches are rapidly being eroded and thus their future as recreational sites is severely threatened (Sealey, 2006).Sagoff (2010) investigates a further three international examples: pollination services in the San Joaquin Valley; pest control services in the Netherlands; and sewage treatment services in Louisiana, USA, and demonstrates in each instance the significance, but unrealised, threat to tourism.

These international examples depict that in each case study, similar lessons can be learnt and that “market actors, interest groups, and property owners seem to have a good handle on the ecosystem services that affect them and they do fairly well in bargaining with each other to manage conflicts and scarcities” (Sagoff, 2010:3). While the number of studies are limited, the cases presented here show a growing recognition of the connection between invasive alien plant species and the potential economic impacts they pose on tourism.

Table 1 – Examples of goods and services provided by South African ecosystems and ways in which they are influenced by invasive alien plants (Richardson and van Wilgen, 2004)

Goods and services offered	Biomes or zones	Invasive alien species impacting on goods and services	Impact of invasive species
Water discharge	Fynbos, grassland	Wattles (<i>Acacia</i> species), pines (<i>Pinus</i> species) and gums (<i>Eucalyptus</i> species).	Reduced streamflow, and reduced yields from dams
Maintenance of soil stability in fire-prone catchments	Mountain catchments	Hakeas (<i>Hakea</i> species) and pines (<i>Pinus</i> species).	Increased fire intensity induces water repellency and increased erosion.
Replenishment of sand on beaches	Coastal zone	Rooikrans (<i>Acacia cyclops</i>)	Binding of sand, beach erosion
Timber	Indigenous forest and woodlands	Triffid weed (<i>Chromolaena odorata</i>) Cat's claw creeper (<i>Macfadyena unguis-cati</i>)	Provides 'ladder fuels' carrying fire to tree canopies Destruction of forest/woodland canopy
Grazing for livestock and wild-life	Grassland, savanna, karoo	Wattles (<i>Acacia</i> species), tussock grasses (<i>Nasella</i> species), cacti (<i>Opuntia</i> species), mesquite (<i>Prosopis</i> species)	Reduced grazing potential
Recreation	Aquatic, riparian	Aquatic weeds, mainly water hyacinth (<i>Eichhornia crassipes</i>)	Reduced capacity for boating, canoeing, water-skiing, fly fishing
Fishing	Estuaries	Wattles (<i>Acacia</i> species), pines (<i>Pinus</i> species) and gums (<i>Eucalyptus</i> species).	Reduced freshwater input to estuaries and altered frequency of mouth breaching

According to Garcia-Llorente et al. (2008), relatively little attention has been focused on public attitudes towards invasive alien species. This is primarily due to the difficulty in measuring social impacts, and the conflicts between different stakeholders. Fortunately in recent years increasing efforts to study public attitudes toward eradication and control management plans have been undertaken (Simberloff, 2005; Fraser, 2006; Hulme, 2006; Bremner and Park, 2007; Fischer and van der Wal, 2007). Other studies have assessed different ways to perform invasive alien species risk analysis (Simberloff, 2003, Keller and Lodge, 2007) and emphasised the necessity of involving different sectors in society in the management of invasive alien species (McNeely, 2001). Despite these efforts, there still seems to be many gaps in our knowledge of prevention, control, eradication, and management of invasive alien species (Garcia-Llorente et al., 2008). Due to the potential socio-economic importance and bearing invasive alien species pose, both ecological and social factors need to be considered (Zavaleta et al., 2001). Consequently a better understanding of invasive alien species and societal perceptions and attitudes toward invasive alien species remains a vital and urgent need to be addressed.

2.3 Valuing ecosystem services

The MEA (2003) refers to three broad value domains, namely, ecological, socio-cultural and economic, as a means of placing a degree of importance or value on ecosystems and their services. de Groot et al. (2010:262) explain that “the ecological value encompasses the health state of a system, measured with ecological indicators such as diversity and integrity, while socio-cultural values include the importance people give to, for example the cultural identity and the degree to which that is related to ecosystem services”. de Groot et al. (2010) goes on say that economic literature recognises two broad kinds of values, namely, *use value* and *non-use value*. Use values refer to the direct utilization and consumptive use values such as the direct value of resources such as water, or coal that are provided by ecosystems. Use values also include non-consumptive use values such as the value that can be placed on the recreational activities that are provided by ecosystems, for example hiking, or fishing. Other non-consumptive use values could include the aesthetic value, or the value one places on the sense of place, or heritage value. Indirect values can be associated with the services that ecosystems provide such as water purification, climate regulation, and pollination.

The notion of non-use value refers to the importance attributed to an aspect or aspects in the environment, regardless of its use values (Turner et al., 2003). Non-use values can thus also be referred to simply as the existence value of something, in this case referring to something in the environment. The National Oceanic and Atmospheric Administration (2011) in the U.S.A conclude that indirect-use values, non-use values and intrinsic value, are also associated with preserving environmental resources. Thus regarding the environment, ecosystem services, and its resources, the sum total of use value and non-use value is referred to as the Total Economic Value (TEV), or otherwise depicted as:

$$\text{Total economic value} = \text{direct-use value} + \text{indirect-use value} + \text{non-use value} + \text{intrinsic value}$$

Outdoor recreation is often attributed its own distinct categorisation (Balmford et al., 2008). There are a number of reasons why outdoor recreation warrants distinct attention. For example the time spent partaking in outdoor recreational activities is not only enjoyable, but also benefits one’s mental health, physical health and fosters a sense of fulfilment and well-being (Ulrich et al., 1991; Henwood, 2003; Bird, 2005; Brown and Grant, 2005). Many of the different types of recreational activities that people partake in, such as hiking, fishing, bird watching, game viewing or cycling, are directly associated and dependent on the natural environment “hosting” these activities. It is this relationship between the natural environment and tourism and recreational activities that this research aims to explore and contribute to our current level of understanding.

There are a wide range of factors that need to be taken into consideration, if one is to attempt to place a degree of value the environment has on recreational activities. However, often this is a relative phenomenon, as views and preferences will change from person to person. Outdoor recreationalists mostly rely on the provisions, services and aesthetics of landscapes as part of naturally functioning ecosystems, as the primary platform for their experiences (de Groot et al., 2005). A crucial question that needs to be asked is how the provision of the various benefits obtained from outdoor recreational activities is affected by changes in ecosystems and the environment? There is an extremely limited amount of reliable quantitative data on the extent to which changes in biodiversity affects and influences recreational benefits, and “the creation of the natural landscapes that make outdoor pursuits attractive is clearly a key benefit provided by biodiversity, yet there is currently insufficient knowledge to be able to define which attributes of the landscape are key to peoples experiences, let alone to quantify links between specific aspects of biodiversity and outdoor benefits” (Balmford et al., 2008:141). A fundamental aim in this study attempts to contribute to this deficit in data and understanding, and identify the possible relationship between invasive alien plants on the natural functioning of ecosystems, and the resultant impacts this has on tourism experiences.

As discussed due to the relative and preferential nature of one person’s experience to another, it becomes difficult to translate this information into biological terms or a reliable metric of biodiversity. However, according to Balmford et al. (2008), land use change for example, from natural to intensely cultivated or urbanised, will result in a clear reduction or total elimination of the recreational amenity value of an area. Therefore the obvious question this information poses is whether the same logic and argument can be made for the transformations generated by invasive alien vegetation on a specific landscape?

Certain tourism activities, as opposed to others, will essentially disclose the importance of the biodiversity, in terms of species presence (Balmford et al., 2008). For example wild-life based recreation, such as bird watching or game viewing, will generally be more sensitive to the availability of pristine environments, species richness and abundance, and diversity. Generally this is not the case for other types of outdoor recreational activities such as hiking, cycling and mountain biking, and horse riding, where the activities themselves do not directly rely on factors such as species richness and diversity. Balmford et al. (2008:142) concludes, “the relationship between changes in these elements of biodiversity and the provision (and value) of recreational benefits is complex, case specific, rarely linear and sometimes counter-intuitive”.

2.3.1 Quantifying people's values

Before one can truly assess the value people place on ecosystem services, it is necessary to firstly agree on the meaning/s of the term “value” in relation to a study of this nature. Whilst Verschuuren (2006) stipulates that there still does not seem to be a consensus on how to develop a single definition of *value*, three popular definitions of the term denote: (a) the general importance or desirability of something (Bingham et al., 1995); (b) value means that which has worth; something of merit, something estimable – whether or not such worth is assigned by people (Harmon, 2003); (c) the contribution of an action or object to user-specified goals, objectives or conditions (MEA, 2003).

A further important definition to consider is the *intrinsic value* people might relay onto a specific ecosystem service, like for example the beauty of a particular view. In their research Kumar and Kumar (2008) refer to the term *value*, as an entity which improves the wellbeing of the society, directly or indirectly. In their unique study, the authors attempt to address the missing links in literature between how people value ecosystem services by undertaking a psychological evaluation of the concept. The research attempts to explain how ecological identity of individuals is revealed at various levels of a decision-making hierarchy, ranging from a local, to a regional, to even a global level. The authors explain that “the interrelationship between man and nature has strong bearing on the psychological well-being of the individual which remains uncaptured by most of the conventional valuation methods” (Kumar and Kumar, 2007: 818).

It is generally agreed that cultural and spiritual values are essential driving forces in nature conservation and ecosystem management, but often can be difficult to portray in decision-making processes (Verschuuren, 2006). The author further explains that “the way people perceive nature depends on culturally defined value and belief systems that form an important, often intergenerational source of information. Accounting for the various worldviews, and their corresponding cultural and spiritual values in the practice of ecosystem management forms a challenge for managers, policy-makers and local people alike” (Verschuuren, 2006: 299). Approaches that inform decision-making and management processes have a better chance of succeeding, as Verschuuren (2006) denotes, when they are based on local cultural values and responses that are derived from the needs of the local people.

Balmford et al. (2008) comments that specific valuation studies examining the importance of aspects of biodiversity and ecosystems on recreation, are too context specific for generalisation. Further up-scaling to national or international preferences concerning nature-based recreational users, is also problematic as often the results will depict a trend dependent on the physical and cultural environment from which the people derive.

Based on their research, Petrosillo et al. (2007) explain that tourists' perceptions of environmental quality and intrinsic value is influenced by their past experiences, socio-economic background and their inherent culture. Therefore when formulating management objectives based on cultural and spiritual values, it is of critical importance to understand these values in their socio-cultural context. Thus it can be understood that when managing culturally significant ecosystems, it is extremely important to recognise these values and include them in assessment and monitoring processes.

The problem with valuation techniques reside not only in intrinsic concerns, but also in the greater complexity of social-ecological systems, in which ecosystem services are enjoyed or used by humans (Martin-Lopez et al., 2009). As part of a participatory mapping study carried out by Raymond et al. (2009), applicants were asked to assign the highest natural capital asset value for the production of cultural, regulating, supporting, and provisioning services. Their results depicted that the highest values were placed on cultural services, and more particularly the highest quantities of value were placed on tourism and recreation.

Examining people's values and perceptions, and investigating methods utilised by authors such as; Verschuuren (2006); Kumar and Kumar (2008); Balmford et al. (2008), and Raymond et al. (2009) respectively, one begins to grasp the importance of considering human actions, as well as including their impacts upon ecosystem services as part of the social-ecological system. In doing so it should also be noted that there are several types of stakeholders who can have different perceptions about the importance of various cultural services. Therefore it is necessary to consider the relationship between a specific cultural service and its users before informed decision making proceeds (Martin-Lopez et al., 2009). Doing so however, as discussed, is challenging, with distinct limitations and complexities to consider.

2.3.2 Methods pertaining to the analysis of peoples values and experiences, and ecosystem services

Land-cover change has been identified as one of the most, if not the most important drivers of change in ecosystems and their services (Vitousek et al., 1997; MEA, 2005). According to Reyers et al. (2009), information on the consequences of land-cover change for ecosystem services and human well-being is largely absent, especially at a local level. In their investigation of land-cover change and ecosystem services, Reyers et al. (2009) sought to address this gap in research by attempting to quantify the consequences of land-cover change for ecosystem services in the Little Karoo region in South Africa. The authors proposed to firstly quantify and map ecosystem services; secondly, assess the distribution of ecosystem services, areas of importance to service delivery, and areas of overlap between services; and thirdly assess changes in ecosystem service delivery as a result of past land-cover change.

Reyers et al. (2009) adopt methods that analyse ecosystem service assessment in both a qualitative and quantitative manner, aimed at identifying and implementing strategies for enhancing and safeguarding ecosystem service delivery. More specifically, the authors assess the value of tourism to the region, and mapped this cultural service in relation to the most attractive and most popular tourist routes in the area. Also interesting was how the study incorporated and analysed tourists viewsheds. These viewsheds were determined to ascertain the effectiveness of the tourists views throughout their travels in the Little Karoo region. This inevitably contributed towards understanding changes in ecosystem service supply. The results showed that the tourism hotspots showed the highest congruence with other ecosystem service hotspots (e.g. water supply). Areas of importance to tourism and recreation were seen to be determined by a combination of topography and road networks, and influenced significantly by the level of land-cover change characterising a given area i.e. pristine, or degraded, or transformed.

In recent years numerous valuation methods have been developed to identify, map and measure landscape values such as aesthetics, biodiversity, cultural, economic, historic, recreation and wilderness values (Brown and Reed, 2000; Brown et al., 2004; Brown, 2005; Alessa et al., 2008). In these methodologies, negative values are often associated with degrading processes or threats (for example invasive alien plants) operating within specific ecosystem services. From a cultural perspective, ecosystems provide critical, often intangible information (de Groot et al., 2002; MEA, 2005). However, the number of cultural valuation studies is notably low (Clark, 2006). This may be due to the various socio-cultural complexities involved with valuation techniques such as scale, boundaries, units, indicators and verifiers. As discussed previously, more notable are the complexities and complications that can arise when dealing with people's perceptions and preferences.

There currently exists no standard approach or methodology to assess and value the cultural importance of natural ecosystems (Verschuuren, 2006). The MEA has developed a framework for assessing ecosystem services but this framework is not specifically tailored to provide guidance and directions for assessing cultural services. Therefore the development of methodologies for the assessment and analysis of the cultural benefits provided by natural ecosystems is considered to be of primary importance to nature conservation at scientific, management and policy levels (Ghosh et al., 2005; Secaria and Molina, 2005). Chee (2004) explains that due to the complexities, uncertainties and the multi-faceted nature of ecosystems, techniques used for their valuation suffer from serious limitations and many ecosystem services are simply not amenable to valuation by the techniques available. Conversely, examples of studies compiled by authors such as Brown et al. (2004), Brown (2005), Martin-Lopez et al. (2007; 2009), Garcia-Llorente et al. (2008), Raymond et al. (2009), Castro et al. (2010), O'Farrell et al. (2010), and de Groot et al. (2010) have adopted various techniques and methods that attempt to quantify peoples values, preferences and perceptions of specified ecosystem services.

Methods based on social preferences have been proposed as a useful tool to support environmental policy decision-making (Czech et al., 1998; Martin-Lopez et al., 2007, 2009). According to Bateman and Turner (1993), social preferences towards ecosystem services delivery can be explored by utilising ranking techniques, which is a useful tool for understanding which ecosystem services are considered more, or less important (Agbenyega et al., 2009). Castro et al. (2010) undertook a study that looks to the contingent valuation method (CVM) to capture specific socioeconomic information relevant to ecosystem services. Their aim was to establish to what extent or degree, people are willing to accept as compensation for the loss of ecosystem services, or their willingness to pay (WtP) for ecosystem services preservation (Edwards-Jones et al., 1995; Venkatachalam, 2004).

The authors chose to target a population sample that included both local residents and tourists, utilising questionnaires in a face-to-face survey approach. After determining the various ecosystem services to be included (most notably recreation), respondents were asked to indicate the relative importance of each service respectively. From this information they created an ordinal numerical measure of the importance that individuals placed on each service (Winkler, 2006). Their resultant cluster analysis depicted five classes, namely: active, environmentally aware tourists; passive tourists; local residents with some level of environmental awareness; local residents who were not environmentally aware; and workers whose work depended directly on ecosystem services generated by the study area.

In contrast to Martin-Lopez et al. (2007), where local respondents showed a strong preference towards cultural services, Castro et al. (2010) found that preferences of local respondents could be differentiated by their level of environmental awareness. The methods and techniques incorporated in this particular study were successful in exploring the depth of ecosystem knowledge of locals and tourists, as well as the social perceptions related to conservation practices. Castro et al. (2010) support the widely accepted view that the knowledge of locals and tourists must be considered for successful ecosystem service management, and stress the importance of including the social dimension in decision making processes.

Garcia-Llorente et al. (2008) compiled a study that aimed to assess the perception of different stakeholders affected by invasive alien species and to evaluate the implications for public support of management practices. More specifically they sought to identify the key trade-offs between stakeholders and invasive alien species management by:

1. Identifying and characterising the different stakeholders who are positively or negatively affected by invasive alien species.
2. Evaluating stakeholder knowledge and perceptions of the problems associated with invasive alien species.

3. Analysing stakeholder attitudes toward invasive alien species introduction and management, including their willingness to pay for invasive alien species eradication.

The authors attempted to represent the heterogeneity of users who may be either positively or negatively affected by the introduction of invasive alien species in the Donana region in Spain. Through the use of questionnaires, the target group the authors decided to focus on were local residents, tourists, managers, researchers and members in positions of authority. As well as incorporating the use of pictures to provide a more accurate means of portraying the effects of invasive alien species, questionnaires covered topics such as user activities in the region, knowledge and perception of invasive alien species, general environmental behaviour, socio-demographic information, as well as questions on willingness to pay for the eradication of alien plant species. The results depicted that different stakeholder groups have remarkably different perceptions about the impacts and benefits generated by invasive alien species, and different attitudes toward their introduction and eradication. It was also seen that most stakeholders and decision makers have a limited perception of the problems invasive alien species pose. Furthermore, Garcia-Llorente et al. (2008) conclude that their research represents a common view in ecosystem service research, pointing out that the human dimension is imperative for successful invasive alien species management. Such notions and findings should be taken seriously by all managers and members in positions of authority throughout the world, including South Africa, if we are to make headway in understanding and maintaining healthy ecosystems, and continue receiving the vital services they provide.

Garcia-Llorente et al. (2008) state that humans act as vectors in the introduction of invasive alien species, whether it be accidental or intentional. Thus it can be said that so too, do humans suffer the negative impacts and consequences of invasive alien species. Essentially, this also means that humans have the capacity to act and make informed decisions, concerning effectively managing and mitigating the negative impacts caused by invasive alien species. Taking these factors into consideration, Garcia-Llorente et al. (2008), conclude that invasive alien species can be seen to be considerably influenced and affected by societal dimensions. For example in recent years, the concerns raised in the media by citizens living in the Western Cape, and their views (positive or negative) on invasive alien plants has grown in number (van Wilgen, submitted). Newspapers such as the Cape Times have reported on both the people who are in favour of alien vegetation being removed for certain areas/landscapes, as well as reporting on cases where residents are in favour the presence of alien invasive trees and/or plants. Here, it is important to recognise that sustainable policy and management are also based on cultural perceptions, as they are constituents of social choice (Garcia-Llorente et al., 2008). Therefore if social dimensions play such a significant role in cultural services, qualitative methods should be viewed as an invaluable source of attaining information, and inform decision making.

Raymond et al. (2009) describe that while important, few studies have attempted to understand how the physical and sociological dynamics of *place* influence the spatial distribution and intensity of threat perception. In their study, participatory mapping was undertaken where participants interviewed were asked to locate and describe places of value and threat by arranging plastic dots on a topographical map. The participants were then asked the following questions to extract more detailed information about each place of specific value:

- What natural asset do you value there?
- What ecosystem service does that asset provide that you value?
- Is there anything that could happen to impact what you value?
- Is there anything that could be done to protect what you value?

This strategic natural capital and ecosystem service approach permitted a clearer understanding of the links between natural value and human interactions with natural systems. This specific type of mapping method provides an informative step in the systematic identification and measurement of values based on local ecological knowledge. It also addresses some of the concerns relating to the limited representation in community values in both ecosystem service valuation and in relation to general environmental management priorities (Raymond et al., 2009). Crossman and Bryan (2009) believe that community values and threats can be integrated with natural science and economics (for example cost, biodiversity value, recreation benefits and landscape benefits) to strengthen and advance regional planning. As an holistic outline, table 2 depicts an overview of the various analytical and participatory methods available in an attempt to place a value on ecosystem services (Christie et al., 2008).

Table 2 – Economic and non-economic methods available to value biodiversity (Christie et al., 2008)

Economic Techniques	Non-economic Techniques
Market price approaches	Consultative methods
Market cost approaches	- Questionnaires
- Replacement cost approaches	- In-depth interviews
- Damage cost avoided approaches	Deliberative and participatory approaches
- Production function approaches	- Focus groups, in-depth groups
Revealed preference methods	- Citizen juries
- Travel cost method	- Health-based valuation approaches
- Hedonic pricing method	- Q-methodology
Stated preference methods	- Delphi surveys
- Choice modelling	- Rapid rural appraisal
- Contingent valuation	- Participatory rural appraisal
Participatory approaches to valuation	- Participatory rural appraisal
- Deliberative valuation	- Participatory action research
- Mediated modelling	Methods for reviewing information
Benefit transfer	- Systematic reviews

A growing amount of literature recognises the essential role of cultural ecosystem services in promoting nature conservation (Eagles, 2004). However, Reyers et al. (2009) believes that it becomes essential that efforts extend beyond just the conservation sector, but also to other sectors such as landowners. Further studies highlight the potential that privately owned areas can play in safeguarding ecosystems and their services, especially if partnered with useful information, incentives, and management guidelines (Fitzsimons and Westcott, 2008; Gallo et al. 2009). Pursuing the avenue of private land ownership, and evaluating if there is any association to be made between invasive alien plants and recreational activities, is likely to be a valuable method to explore concerning a study of this nature.

Challenges of integrating the concept of ecosystem services, as well as the notion of values, in landscape planning, management and decision making, remain (de Groot et al., 2010). According to the International Council for Science (ICSU, 2008), coherent and integrated approaches to advance practical applications of the concept of ecosystem and landscape functions in planning, management and decision-making is still lacking.

2.4 Economic costs and incentives related to invasive alien vegetation clearing

The conceptual distance between market-based and science-based methods of gathering information and applying knowledge, poses a difficult challenge in the realm of ecosystem services (Sagoff, 2010). Ecologically-minded economists call for “standardised units of account to measure the value of ecosystem services to society” (Boyd and Banzhaf, 2007:617). Sagoff (2010) remarks that without the benefit of a general ecological theory about the structure and function of ecosystems, market players may have gone a long way to: (1) identify ecosystem services and service-providing units that concern them; (2) establish prices that signal the scarcity of these services relative to demand. With regards the economic uncertainties that invasive alien species pose, most research to date has focussed on quantifying the direct economic costs of invasive alien species, yet often are accompanied by methodological shortcomings compared with their theoretical foundations (Born et al., 2005).

Even though cultural ecosystem services such as tourism and recreation can play a crucial role in economic development, these services often fall outside the sphere of markets, and usually tend to be invisible in traditional economic analysis (Martin-Lopez et al., 2009). In sourcing relevant literature on the economic costs of invasive alien plants and possible incentives relating to alien vegetation clearing, several studies of interest emerged as possible points of entry. One of the studies, carried out by Mwebaze et al. (2010), assessed the value of impacts of invasive alien plants on biodiversity, natural resources, and the national economy of the Seychelles islands.

Biodiversity underpins most economic activities in the Seychelles, and thus a loss of biodiversity as a result of invasive alien plants could result in major negative economic impacts to the country. A major constraint facing local authorities is the lack of economic valuation of the impacts of invasive alien plants, mainly because the biodiversity impacted by invasive alien vegetation are often not valued. Given the very high financial costs of control and eradication measures associated with invasive alien plants, often with negative impacts only emerging in the long-term, policy makers often do not see the need to manage them (Mwebaze et al., 2010). Another major constraint is the lack of economic data on the costs and benefits of alien vegetation control. Both these factors act as major constraints for the effective mainstreaming of prevention and control efforts (Ilkin and Dogley, 2005).

Currie et al. (2009) compile a study centred around assessing the benefits derived from water and tourism in efforts to restore alien invaded parcels of land in the Western Cape to their original fynbos state. The study argues that the opportunity to view endemic animal and plant species attract many tourists to the fynbos areas of the Western Cape each year. Thus a primary aim for the authors was to determine, as well as justify, the costs of clearing alien vegetation. A cost-benefit analysis was carried out to determine if tourism and water benefits outweigh the costs of the alien clearing programmes headed by Working for Water. The estimated tourism value was derived purely from the direct profits obtained from permit sales granting access to potential visitors. Day and annual permits (sold for activities such as cycling, hiking, and horse-riding) were correlated to the income (benefit) these tourists bring into the region (MTO Forestry, 2005; Franschhoek Wine Valley and Tourism Association, 2005; cited in Currie et al., 2009). This study, in a monetary framework, successfully links the negative impacts associated with invasive alien plants and the recreational activities identified, and thus proves as a valuable source of literature pertaining to this particular study.

Similarly van Wilgen et al. (1996) compares the cost of alien plant management in South African fynbos ecosystems, with that of developing additional water supply facilities (dam construction, desalination plants). The authors demonstrated that alien plant clearing and management was more cost effective to ensuring water production and supply than alternative supply options. Valuation of additional fynbos ecosystem services such as wildflower harvest, and tourism opportunities further strengthened the argument for continued investment in invasive alien plants clearing programs (Higgins et al., 1997).

Comparable research by Marais and Wannenburg (2008) delves into the domain of investigating the costs incurred by Working for Water Programmes concerned with alien vegetation clearing. By analysing the data extracted from the Working for Water Information Management System (WIMS) the study aimed to evaluate clearing costs and the estimated impacts of clearance on water resources. Again, a cost-benefit analysis approach depicted that the money spent thus far on alien clearing projects can be considered a good investment.

These studies show how a legitimate case can be built for how income and benefits from tourism and recreational activities could outweigh the costs of clearing alien vegetation, as well as providing valuable insight as to how to practically go about quantifying the value of tourism activities in a fiscal composition. Furthermore, alternative funding mechanisms, such as Payment for Ecosystem Services (PES) and willingness to pay, could also prove a valuable path to pursue pertaining to quantifying the value of tourism and recreational activities in South Africa (Reyers et al., 2009; Mwebaze et al., 2010).

Key to this literature study was to better understand and explore various notions and perceptions regarding ecosystem services, and invasive alien vegetation, and the possible associations that can be made between them. Considering this pool of information, as well as examining the various methodologies utilised, the overall methodological strategy for this study is further informed and strengthened, to help achieve the goals set out in this dissertation.

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3. Methods

The methods outlined and utilised in this study, aim to establish and ascertain the degree of association, and the nature of this association, between invasive alien plants, and tourism and recreational activities in South Africa. The research undertaken seeks to meet this objective in a two pronged approach. Firstly at a national scale, looking at all nine provinces in South Africa, followed by a more localised, case study analysis of the Stellenbosch municipality in the Western Cape.

3.1 National analysis

3.1.1 Study area

Covering an area of approximately 1.2 million km², South Africa can be classified as a climatically varied country, with a wide range of ecosystems (van Wilgen and Richardson, 2010). As figure 5 depicts, these varied ecosystems, recognised as biomes, range from savannas to grasslands to shrublands, deserts, forests, as well as ecosystems exposed to typically Mediterranean climatic conditions (Mucina and Rutherford, 2006). South Africa is richly endowed with biodiversity, notably in both flora and fauna (Cowling et al., 1997). However as population numbers and poverty increase, the demand for land for urban and agricultural use also increases. Coupled with natural factors that also adversely affect ecosystems such as climate change and the spreading of invasive alien vegetation, South Africa's biodiversity is increasingly under threat (Turpie et al., 2008). Furthermore, South Africa is also a chronically water stressed country, as the availability of fresh water remains one of the country's most urgent problems to be addressed (Le Maitre et al., 2002; Turpie et al., 2008).

According to the 2010 Annual Tourism Report, South Africa is currently the 34th most popular tourist destination in the world. The diversity and resource base in South Africa makes the country's tourism potential exceedingly high (South African Government Information, 2008). Some of the features that make South Africa such a popular tourist destination include: accessible wildlife; diverse landscapes and scenic beauty; diverse cultures; a warm and favourable climate; historical and heritage sites; as well as unlimited opportunities for special interest activities such as whale-watching, hiking, game viewing, fishing, hunting, and diving, to name only a few. In 2010, there were 8,073,552 tourist arrivals to South Africa, which represented a 15.1% increase compared to 2009, but is likely to also be higher due to the Fifa Soccer World Cup tournament held in the country. Nevertheless, this is well above the global average growth rate which was estimated at 6.7% (South African Tourism, 2011).

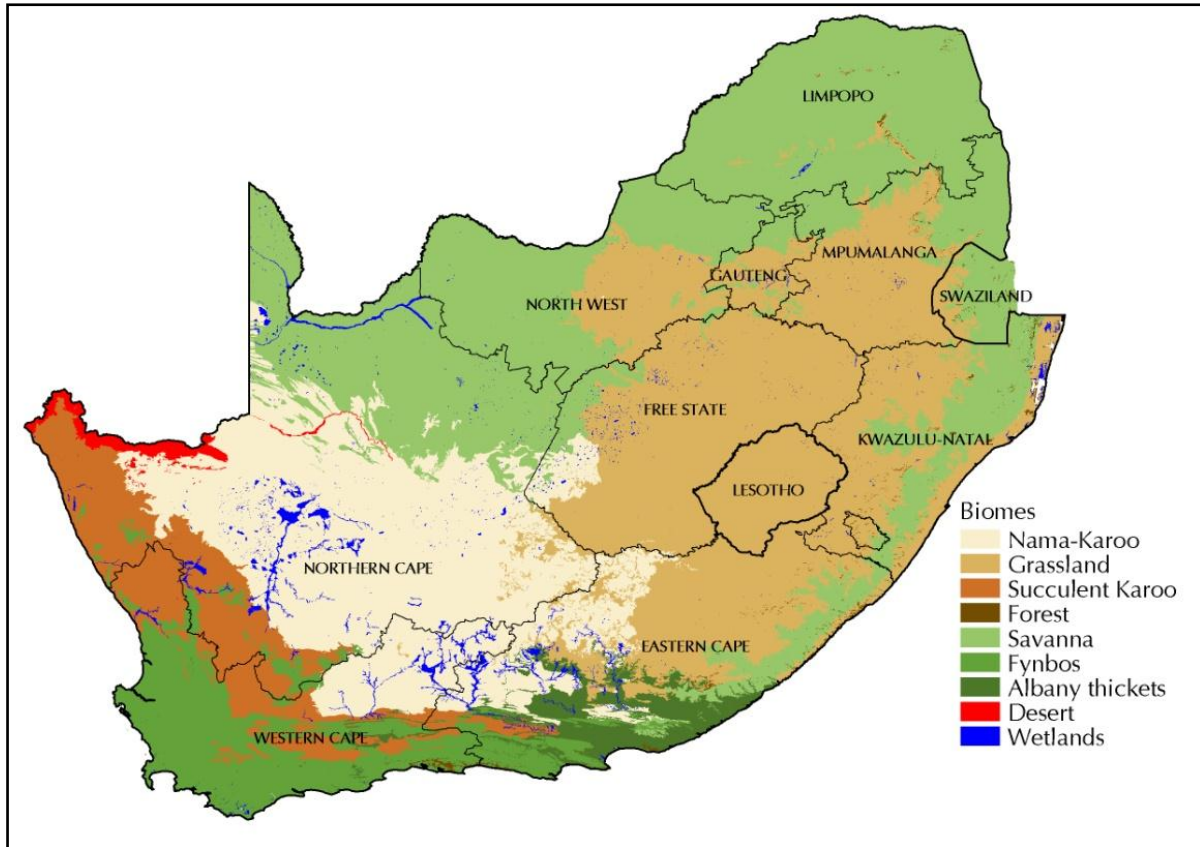


Figure 5 – Biomes of South Africa (Department of Environmental Affairs: State of the Environment, 2007)

3.1.2 Materials and techniques

In an initiative to objectively determine the spatial distribution data of invasive alien plants, the National Invasive Alien Plant Survey project was initiated by the Working for Water Programme and implemented by the Agricultural Research Council. The primary objective of the project was to develop and apply a cost effective, objective and statistically valid invasive alien plant monitoring system for South Africa, Lesotho and Swaziland at a quaternary catchment level. Approximately 74 000 sample points were allocated to the study area, assessing variables such as rainfall, soil depth, clay content in the B-horizon, and terrain. Differing and extensive field surveys were then conducted of the sample points. Once the field data was analysed and verified, the relevant invasive alien plant maps were produced. Figure 6 depicts a visual representation of the current level of invasive alien plant coverage in South Africa (Kotze et al., 2010). It is this research by Kotze et al. (2010) that provides the data and spatial framework necessary to carry out the methods proposed in this study, namely to map and overlay invasive alien vegetation and tourism and recreational sites for each of the nine provinces in South Africa.

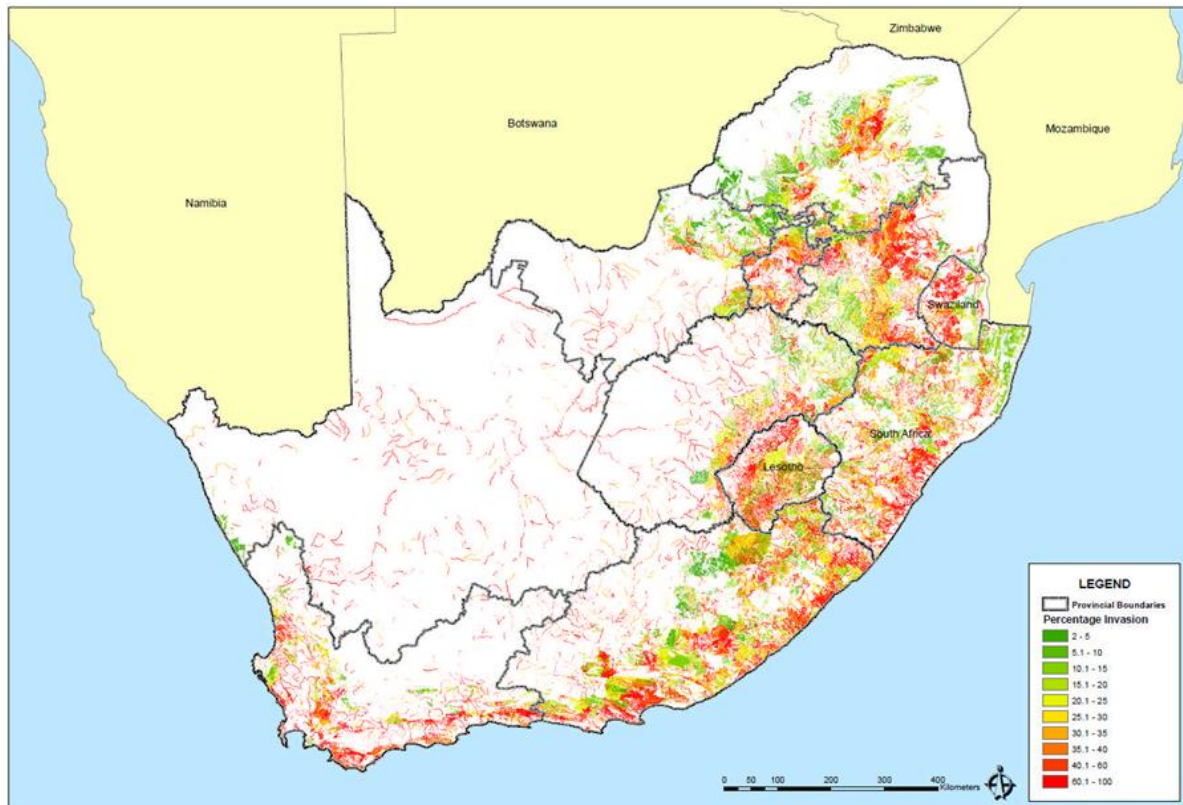


Figure 6 – Invasive alien plant infestation in South Africa (National Invasive Alien Plant Survey, Kotze et al., 2010)

The first step in the national analysis was to identify the top/most popular tourist destinations in each of the nine provinces in South Africa, respectively. This was achieved by contacting the relevant tourism offices and authorities in each province. In each province the tourism potential and sites available to tourists vary notably. Furthermore in certain cases the data concerning the statistics (e.g. tourist numbers) for specific tourist locations were unknown. Therefore it was decided to choose each provinces' top tourist destinations based on popularity. This information was primarily based on the feedback of the tourism offices and authorities contacted, but also verified by researching and contacting private tourism organisations that market and promote popular tourist locations throughout South Africa. Included in identifying each provinces top tourist sites, was to investigate the various activities offered to tourists at each of these sites. Once identified, and in conjunction with the information obtained from the various stakeholders, these activities were then graded on how popular they are to each particular tourist site.

Utilising Arc Map 9.2 GIS software, each of the popular tourist sites and hotspots were mapped accordingly. Once completed the created polygons, lines and points of interest were overlaid with the invasive alien plant coverage data for South Africa (Kotze et al., 2010). For each line created, a 500 m buffer, and for each point, a 200 m buffer was utilised to compensate for the presence of alien plant coverage. This was performed to identify overlaps and determine physical levels of association between tourism hotspots and alien plant coverage throughout the country.

Once each map was completed, each tourist site identified was categorised based on mean levels of alien plant coverage. Each site was classified as either *low coverage* (0 – 33.33%), *moderate coverage* (33.4 – 66.66%), or *high coverage* (66.7 – 100%). In cases where the tourist sites were situated on transformed land such as urban or agricultural areas, the sites were classified as *transformed land/no data*. Due to the scope of this research, alien plant coverage of individual activities for each tourist site was not determined, but rather the average coverage for each tourist site as a whole. Based on these coverage values, the average infestation values of each of the eight tourist activities identified across South Africa were also determined.

3.1.3 Limitations

Within the national analysis research lie certain limitations. Firstly the data presented by Kotze et al. (2010) is itself an extrapolation and does not offer alien plant coverage for certain areas across South Africa. This is most notably in urban areas, or areas characterised by intense agricultural activity. As previously mentioned, in such cases where identified tourist sites were within these areas, they were classified as *transformed land/no data*. In the national research component of this study, where large expanses of land were characterised by transformed land or no data, it proved to hinder the analysis process, and thus can be specified as a data limitation.

Another limitation in the national analysis stems from the mapping of the tourist sites themselves. Each site was mapped either as a polygon (e.g. national park) or a line (e.g. important river) or as a point (e.g. historical monument). Where polygons are easier to discern the level of alien plant coverage for a given area, this becomes notably more difficult for points and lines. When looking at a river, there might be stretches of little alien plant coverage, while other stretches of higher coverage. Certain sites might be too small and not support a reliable scale to discern alien plant coverage. Thus the use of buffers was utilised, and a mean classification incorporated, in an attempt to compensate for this limitation. Added to this limitation is the difficulty in determining the boundaries for specific sites, where a clear boundary is not quantified. Where most tourist sites identified were demarcated by a definitive boundary, certain sites were not, such as whale watching sites for example.

3.2 Case study analysis: Stellenbosch municipality

Following on from the national analysis, a more localised study of the Stellenbosch municipality was carried out. This particular area was chosen due to the high tourism potential, and multiple recreational activities in the region, as well as the varying levels of alien plant coverage, ranging from low, to moderate, to high densities of invasive vegetation. With these particular coverage levels, it also suggests

the people living in, and visiting Stellenbosch would have seen and encountered invasive alien plants to some degree.

These factors were also highlighted by the national assessment, which pointed to the Stellenbosch municipality as an ideal region to investigate in detail, to get a better handle on people's perceptions concerning invasive vegetation. Essentially, this case study research aimed to bridge the national analysis with a more localised context, and human perspective.

3.2.1 Study area

Stellenbosch lies east of Cape Town (figure 7), and is considered one of the most popular tourist destinations in South Africa (Western Cape Tourism, 2007). The most prominent and well-known tourism attraction in Stellenbosch is the numerous array of wine farms in the area. Stellenbosch forms part of the heart of the Cape Winelands region, an industry that is considered to be the second largest contributor to the Western Cape's economy (Cape Winelands Biosphere Reserve, 2008). The area is characterized by a Mediterranean climate with dry sunny summers and interspersed winter rainfall, and over the centuries has gained a prestigious reputation as being one of the finest wine producing regions in the world (Stellenbosch Tourism, 2009). Furthermore with various other tourist attractions such as hiking, museums, nature reserves, horse riding, fishing, mountain biking, and others, this area is visited by thousands of tourists each year (Cape Town and Western Cape Information Centre, 2011).

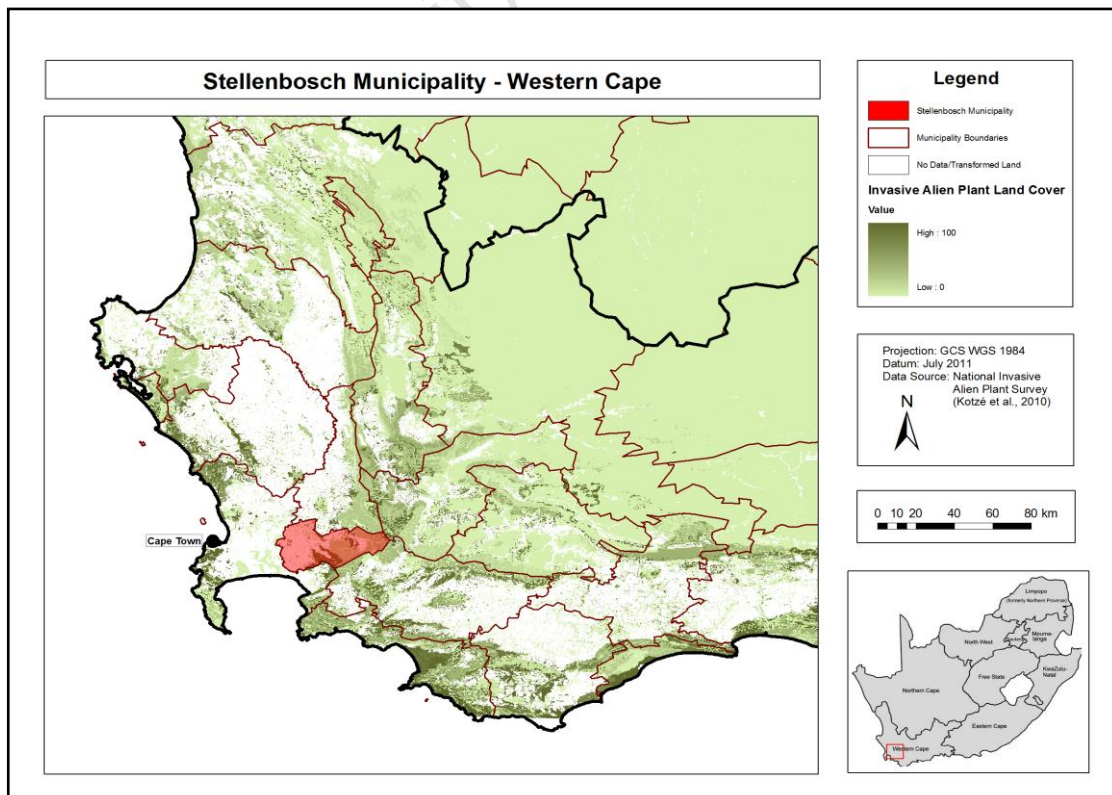


Figure 7 – Location of Stellenbosch municipality in the Western Cape, South Africa

3.2.2 *Materials and techniques*

The primary goal of this particular phase of the study was to gain a deeper understanding, and assess the relationship between tourism activities and invasive alien vegetation within the Stellenbosch municipality. To accomplish this, a qualitative assessment was utilised in an effort to determine if in fact invasive alien plants play a negative (or positive) role in the experiences a tourist encounters in whatever recreational activity he or she participates in. Firstly popular tourist and recreational activities were identified in the area. This was achieved by: examining tourist brochures and travel guides concerning Stellenbosch; visiting the Stellenbosch Tourism offices directly; as well as investigating online resources. Secondly, and more importantly, relevant stakeholders were identified as key sources to attain the necessary information required. They included:

- Tourists (local, national, and international)
- Private landowners
- Tourism operators

Three types of questionnaires were formulated (see Appendix), for each of the three types of stakeholders identified. Once identified, each respective stakeholder was asked to fill out the relevant questionnaire. This was carried out either via face-to-face interviews, or through telephonic means, or via electronic mail. Certain interviews with land owners and tourism operators were recorded with their consent, and transcribed. In total, questionnaires were completed by 54 tourists, 11 landowners and 4 tourism operators.

According to Stellenbosch Tourism (2011), the most popular tourist activity is visiting the number of different wine farms the region has to offer. Also highlighted as a popular recreational destination was Jonkershoek Nature Reserve. Therefore the two locations chosen to complete the tourist questionnaires was a popular wine farm in Stellenbosch and within Jonkershoek Nature Reserve itself. Semi-structured interviews based on the questionnaire, were carried out at the designated locations. The tourist questionnaire aimed to identify standard information such as age, gender, origin, as well as purpose and frequency of visit. However more specifically they were designed to investigate the tourists' knowledge of invasive alien plants and/or the effects these alien plants have (positive or negative) on their tourism experience. Open ended questions were also incorporated to seek more personal responses.

Furthermore this method aimed to determine what degree of value the tourists place on the recreational activity itself, but also on the flora and fauna in the area, the landscape, and the aesthetic views experienced. Pictures of alien invaded landscapes and riparian zones versus pristine, alien free areas, were also shown to each tourist interviewed (see Appendix) to aid this process. The aim here was to establish tourists perceptions of invasive alien plants and understand how they feel about alien vegetation in the area, or the possibility of future invasion occurring. Questions were also asked concerning their willingness to pay an extra fee, over and above the normal fee for the activity or permit, to aid the removal of alien vegetation, or for the prevention of alien plants invading. Essentially, what would their willingness be to pay to keep the area un-infested, or cleared of alien vegetation. This information could then be expanded further to highlight schemes previously discussed such as willingness to pay or payment for ecosystem services, described in Reyers et al. (2009) and Mwebaze et al. (2010), respectively.

The landowners who were interviewed were predominantly farmers. Through semi-structured interviews, either face-to-face on the respondent's property, or telephonically, landowners were asked questions centred on gaining more insight into the effects invasive alien plants have on the overall running and operations of their farms. If invasive alien plants were identified as a problem, respondents were asked to elaborate on exactly what negative effects are occurring, as well as the severity of these impacts. Seeking subjective responses, particular open-ended questions gave the respondents the opportunity to voice their personal feelings on the matter. Additionally if landowners were willing to respond, they were also asked questions related to the costs accrued each month as a result of the presence of alien vegetation. More specifically, the goal was to obtain a better idea of the costs experienced by these farmers in combating the negative effects of the invasive alien vegetation.

Tourism operators were asked similar questions, in a very similar format. Again interviews were either carried out face-to-face, or via telephonic means. Firstly it was necessary to ascertain if respondents knew what invasive alien plants are, and if they are aware of the potential negative effects they pose. Questions were then asked on the possible role invasive alien vegetation plays in the tourists recreational experience. This led to determining if at all, a tourists' recreational experience and the overall recreational value of their experience is lessened, or negatively affected by the presence of invasive alien plants. Questions were then asked on the knowledge tourists have regarding alien plants, and if they ever raise questions concerning the presence of the invasive vegetation whilst partaking in the recreational activity. If yes, the operator was then asked whether it was local, national or international tourists, who were more knowledgeable on the matter. Finally the respondent was asked if they are aware of any additional costs incurred on the activity, due to any issues or effects related to the presence of invasive alien plants, such as clearing costs for example. Again the questions and interview process was designed in a manner that aimed to draw subjective responses of the respondents personal feelings on the matter.

3.2.3 Limitations

An area of contention that needs to be noted, is that where certain links between recreation and biodiversity have been identified, it still remains unclear to what extent we can generalise such a relationship, especially if taken from specific and localised case studies (Balmford et al., 2008). With regards to this study, it is recognised that the research undertaken at the case study level, might not necessarily speak for South Africa at a national scale, due to the case specific characteristics of the area. However it should also be noted that there will be elements and results found in the case study that can be scaled up and applied on a more national scale, with the primary aim of increasing our understanding of the relationship between invasive alien vegetation and tourism.

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4. RESULTS

4.1 National analysis results

For each of the nine provinces in South Africa, maps were created in exploring the overlap between popular tourist destinations and invasive alien vegetation. The results varied for each province. Certain provinces displayed a considerable overlap between tourist and recreational sites, and the invasive alien data, whilst other maps depict a lesser degree of association and overlap.

4.1.1 Limpopo Province

According to Limpopo Tourism and Parks Board (2011), Limpopo Province has contrasting landscapes, and over the decades has become a highly popular destination for tourists not only in South Africa, but also from around the world. With a population of approximately 5.4 million people and an area of 125 755 square kilometres, Limpopo Province offers a variety of tourist sites and recreational activities, but most prevalent in the region are the numerous nature reserves and parks (Statistics South Africa, 2006).

Table 3 depicts the most popular tourist sites identified in Limpopo, the level of alien plant coverage for each site, as well as the relative popularity of each tourist activity within each site. In a province characterised predominantly by national parks and game reserves, it is no surprise that of the most popular activities identified, viewing (primarily game, birds and landscape viewing) is the most popular activity. Other activities that are identified as moderately important include hiking, fishing and off-road driving for specific tourist sites, as well as site specific activities such as horse riding for example. Within Bela-Bela the most popular activities identified include the specific water activities in the area such as the warm springs, as well as site specific activities. In Magoebaskloof the most popular activities identified include that of hiking, viewing and fishing.

Figure 8 highlights the region's most established and popular game reserves and national parks. If one analyses the image, it can be seen that most of these game reserves and national parks are predominantly clear of invasive alien plants, apart from specific patches, particularly in the western area of the Kruger National Park. Furthermore the rivers located within the reserves and parks, are portrayed in the figure as being minimally affected by invasive alien vegetation.

Table 3 – Alien plant coverage and activity popularity for major tourist sites in the Limpopo Province (less popular - √; moderately popular - √√; most popular - √√√)

Tourist Sites	Activities								Alien Cover Description
	Hiking and/or Walks	Viewing (game, landscapes whales, birds, etc)	Off-Road Driving	Cycling and/or Mountain Biking	Fishing	Heritage/Cultural	Water Activities (beaches, swimming, water sports, etc)	Site Specific and/or Other	
<u>Valley of the Olifants</u>									
Blyde River Nature Reserve	√√	√√√		√√	√√		√	√√	Low Coverage
Selati Game Reserve		√√√							Low Coverage
Klaserie Private Nature Reserve		√√√	√√						Low Coverage
Umbabat Nature Reserve		√√√							Low Coverage
Timbavati Game Reserve		√√√							Low Coverage
Manyeleti Game Reserve	√	√√√						√√	Low Coverage
Kruger National Park	√	√√√	√√	√		√	√	√√√	Low Coverage
<u>Southern Limpopo</u>									
Marakele National Park	√√	√√√	√√					√√	Low Coverage
Bela-Bela	√	√√	√	√√	√√	√	√√√	√√√	No Data/Transformed Land
- Bela-Bela Waterfront								√√	No Data/Transformed Land
- Hot Springs							√√√	√√√	No Data/Transformed Land
Mabula Game Reserve	√√	√√√						√√√	High Coverage
Mabalingwe Game Reserve		√√√	√√					√√√	High Coverage
<u>Magoebaskloof</u>									
Magoebaskloof	√√√	√√√	√√	√	√√√	√	√	√√√	No Data/Transformed Land
- Magoebaskloof Fishing Sites					√√√		√		Low Coverage
- Magoebaskloof Birding Sites	√√√	√√√							Moderate Coverage
- Magoebaskloof Hiking Trails	√√√	√√√							Moderate Coverage

Figure 9 represents the alien plant infestation for Magoebaskloof in the Limpopo province. The resultant image depicts dispersed alien vegetation for the region, with overlaps occurring in certain fishing sites, hiking trails and birding sites in the area. While most rivers in the vicinity depict low levels of invasive alien plant coverage, there are several that do demonstrate a higher degree of alien plant presence.

Located in the southern region of the Limpopo Province, lie several key tourist destinations (figure 10). Among these lie the town of Bela-Bela, a popular destination among recreationalists, known particularly for the hot springs in the area, as well as highly regarded game reserves and parks (Limpopo Tourism and Parks Board, 2011). Whilst Marakele Park in the north-west of the image displays little alien plant coverage, Mabalingwe and Mabula Game Reserves, as well as Bela-Bela itself, exhibit high invasive alien plant infestation either within these sites or in close proximity. The rivers and riparian zones in the region are depicted in the image as being affected very little by alien plant presence.

Valley of the Olifants Popular Game Reserves - Limpopo Province

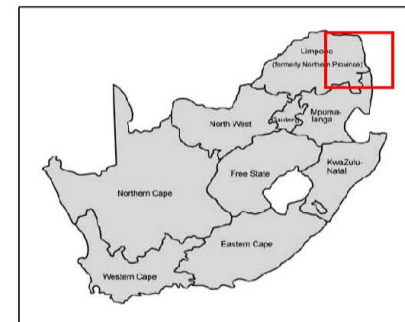
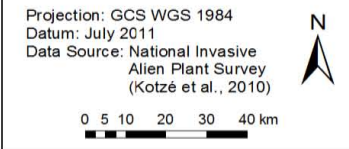
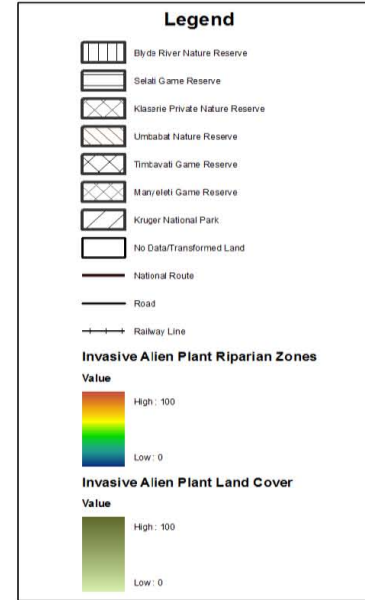
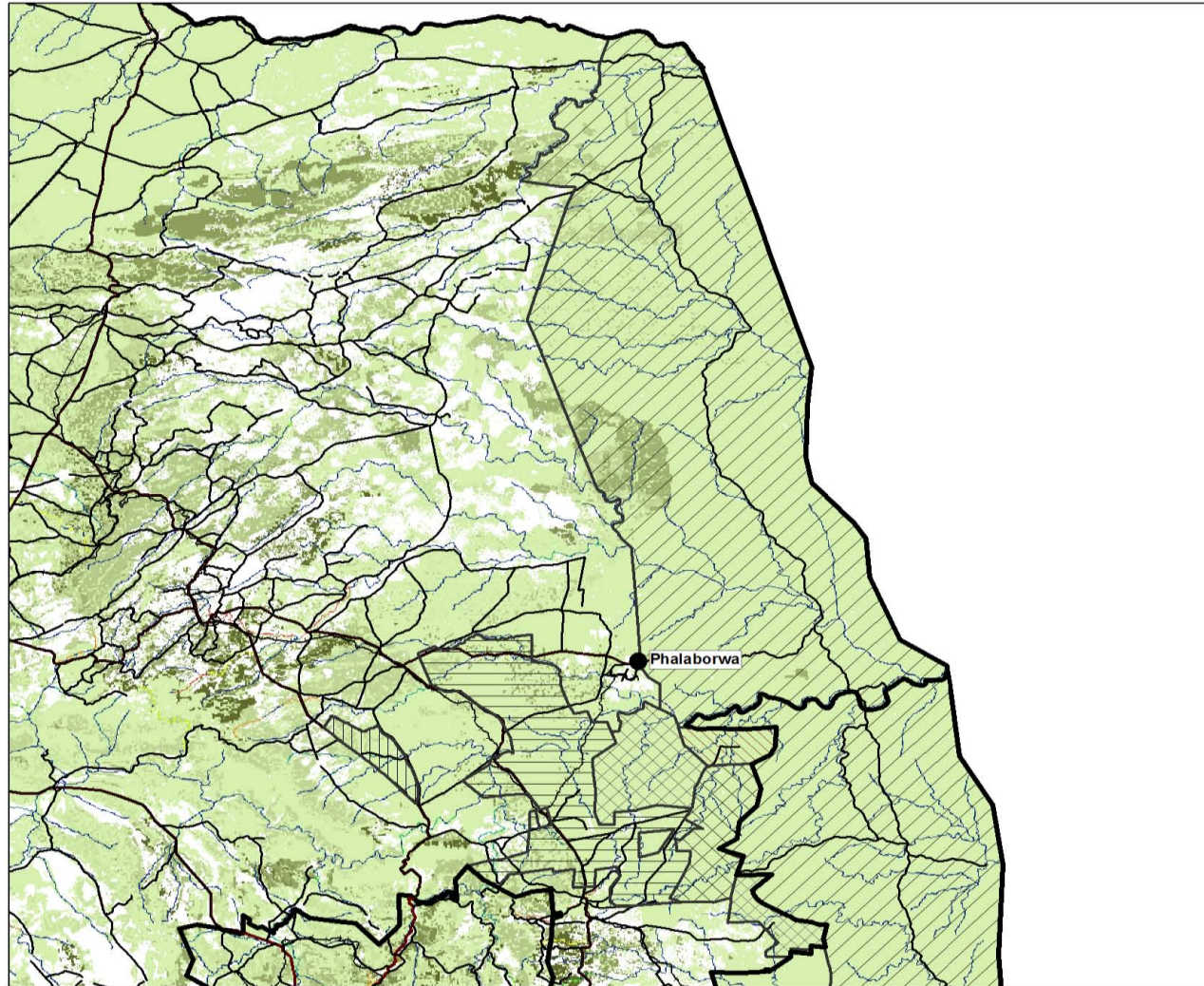


Figure 8 – Valley of the Olifants popular Game Reserves and National Parks, Limpopo Province

Popular Tourist Sites - Limpopo Province

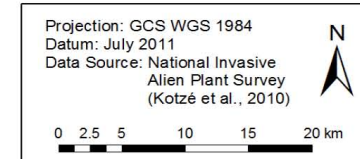
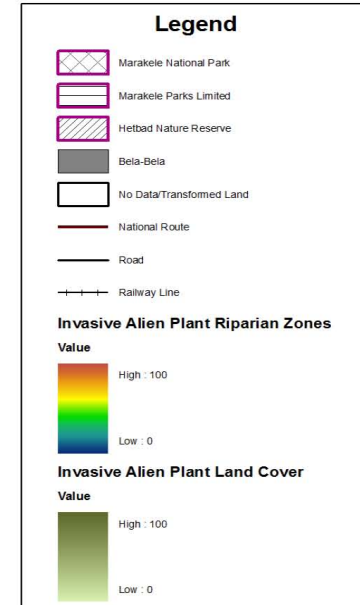
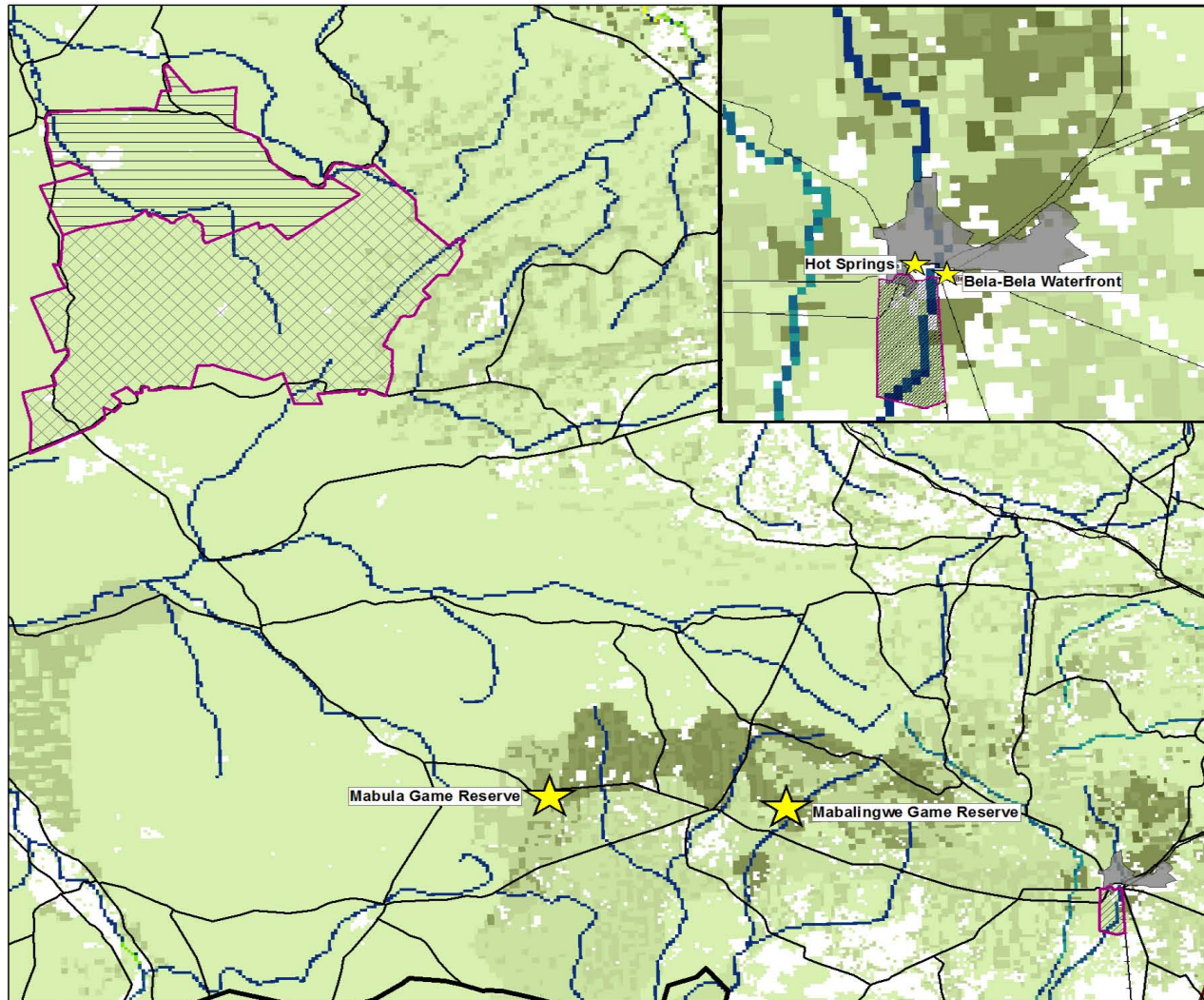


Figure 9 – Popular tourist sites in southern Limpopo Province

Popular Tourist Sites in Magoebaskloof - Limpopo Province

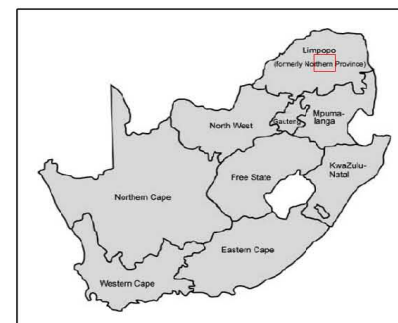
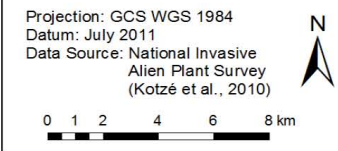
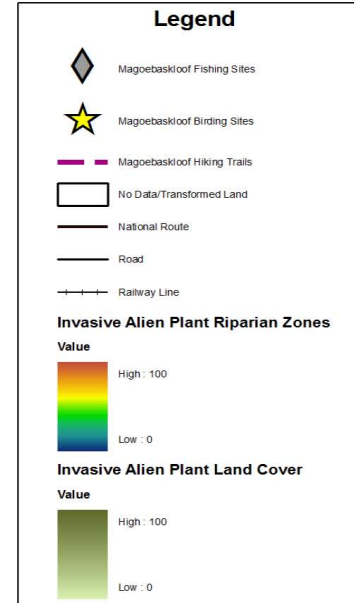
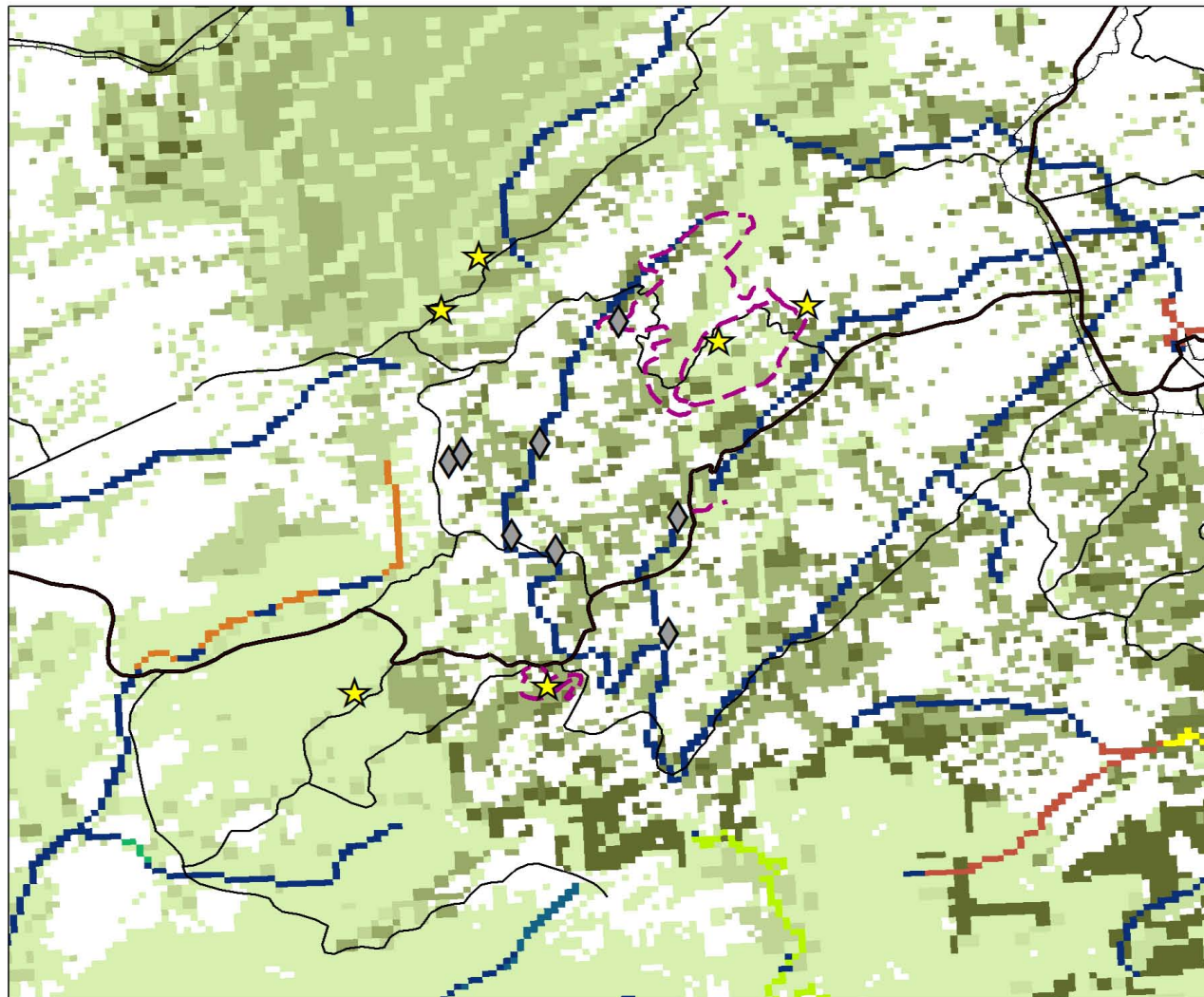


Figure 10 - Magoebaskloof tourist sites, Limpopo Province

4.1.2 Mpumalanga

Mpumalanga Tourism and Parks Agency (2011) states that Mpumalanga's history, culture and terrain are among the richest in South Africa. It is estimated that the province is home to approximately 3.6 million people, and covers an area of 76 495 square kilometres (Statistics South Africa, 2006). With popular game reserves and parks such as the world renowned Kruger National Park, as well as a vast array of tourist activities, the province is among one of the most popular tourist destinations in South Africa (South African Tourism, 2011).

In table 4 it can be seen that within the areas in Mpumalanga characterised predominantly by game reserves and national parks, the most popular tourist activity is that of game, bird and landscape viewing. A high degree of popularity is also placed on the site specific activities offered at these destinations such as a spa or popular restaurants, for example. Moving onto the Panorama region table 4 depicts again a strong prevalence placed on viewing, but just as important in this area are other activities such as hiking, off-road driving, fishing, water activities, mountain biking, site specific activities, as well as certain sites with a high heritage and cultural value. In the Dullstroom area, the most popular activity identified is that of fishing, while other activities such as hiking, viewing and biking, are either moderately or less popular in nature.

Figure 11 depicts the most popular tourist destinations within the Panorama region, situated in the northern reaches of the province, and east of the Kruger National Park. Among these sites include renowned destinations such as God's Window and the Blyde River Canyon. Analysing the image, it can be seen that throughout the region, there are scattered pockets of invasive alien vegetation, with certain patches reaching high levels of infestation. This is particularly evident in the eastern areas of Motlatse Canyon National Park. Certain rivers in this area also indicate an extremely high presence of invasive alien vegetation.

Figure 12 represents the level of invasive alien vegetation in the eastern region of Mpumalanga, known particularly for its game reserves and national parks. The figure depicts a fairly low level of invasive alien vegetation presence within the game reserves and national parks themselves. The riparian zones in the vicinity tell much of the same story. However the same observation cannot be made for certain landscapes and rivers nearby to these parks and recreational sites.

Table 4 – Alien plant coverage and activity popularity for major tourist sites in Mpumalanga (less popular - v; moderately popular - vv; most popular -vvv)

Tourist Sites	Activities								Alien Cover Description
	Hiking and/or Walks	Viewing (game, landscapes whales, birds, etc)	Off-Road Driving	Cycling and/or Mountain Biking	Fishing	Heritage/Cultural	Water Activities (beaches, swimming, water sports, etc)	Site Specific and/or Other	
<u>Eastern Mpumalanga</u>									
Sabi Sands Game Reserve	v	vvv						vvv	Low Coverage
Songimvelo Game Reserve	v	vvv							Low Coverage
Krugar National Park	v	vvv	vv	v		v	v	vvv	Low Coverage
SabiSabi Game Reserve	v	vvv						vvv	Low Coverage
Nelspruit	v	vv	v	vv	v	vvv	vv	vvv	Moderate Coverage
<u>Panorama Region</u>									
Motlatse Canyon National Park	vvv	vvv	vvv	vvv	vvv		vvv	vvv	Moderate Coverage
Echo Caves	vv	vvv				vvv		vvv	Low Coverage
Blyde River Canyon	vvv	vvv	vvv	vvv	vvv		vvv	vvv	Low Coverage
Bourkes Luck Potholes	vv	vvv				vvv			Low Coverage
God's Window	vv	vvv						vv	Low Coverage
<u>Dullstroom</u>									
Dullstroom Town	vv	vv	v	vv	vvv	v		vvv	High Coverage
- Dullstroom Fishing Ponds					vvv				High Coverage

Another important tourist destination in Mpumalanga is the town of Dullstroom, an area well known for its highly regarded fly fishing locations (Mpumalanga Tourism and Parks Agency, 2011). Figure 13 displays the extent and severity of invasive alien plant coverage across the landscape, as well as the riparian zones. The image depicts a patchy spread of alien vegetation, namely a mix of low, medium, and high levels of infestation. Most notable is the severe presence of invasive alien plants west of Dullstroom. The two main rivers flowing in and near the town, portray a moderate level of infestation.

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Popular Panorama Tourist Sites - Mpumalanga

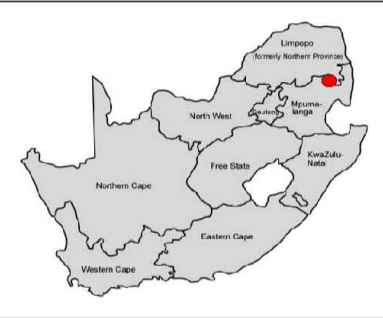
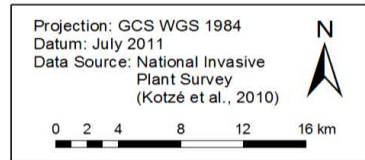
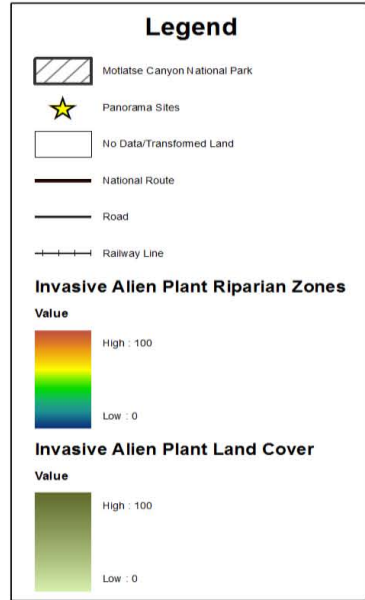
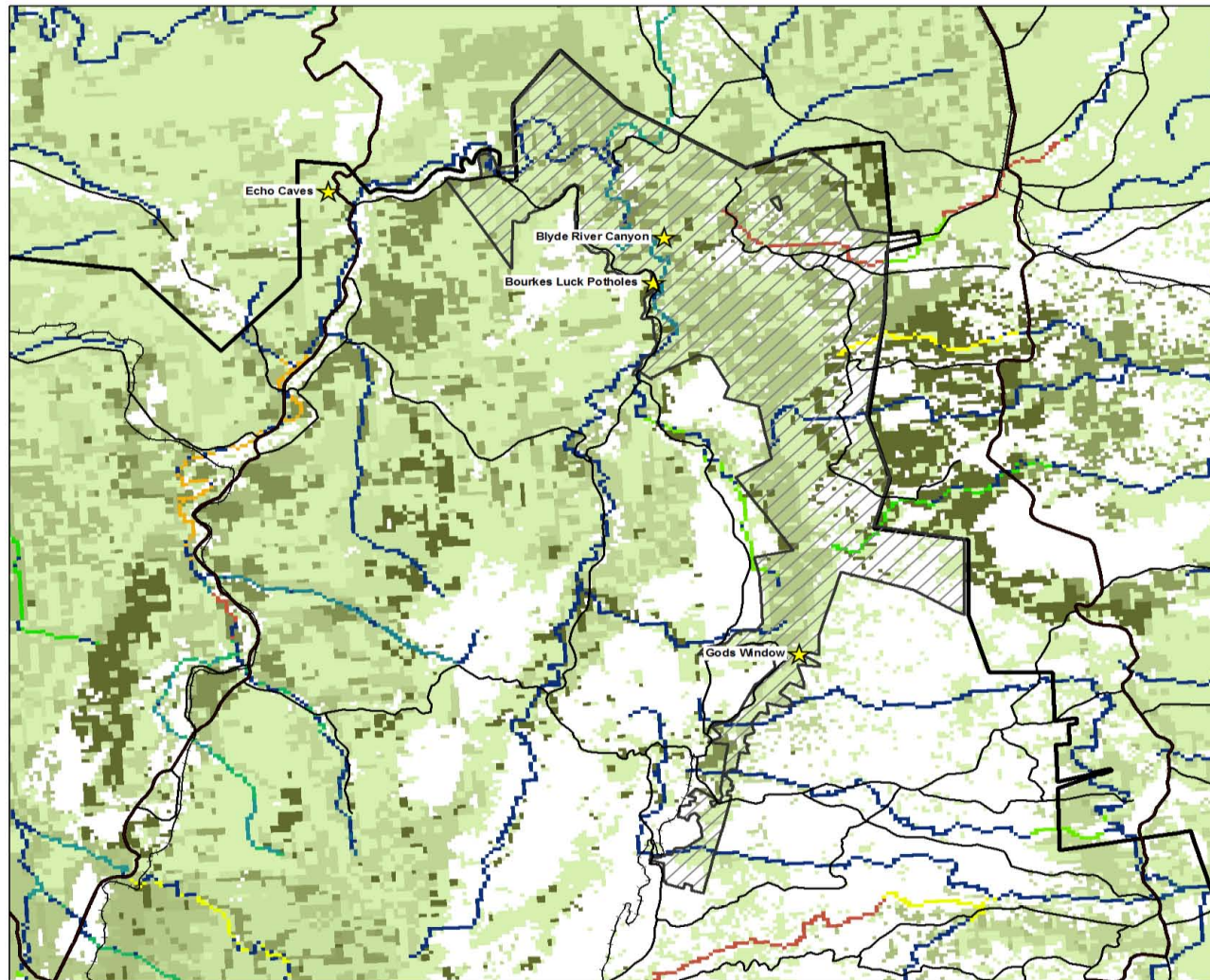


Figure 11 – Popular tourist site in the Panorama region of Mpumalanga

Popular Game Reserves and National Parks - Mpumalanga

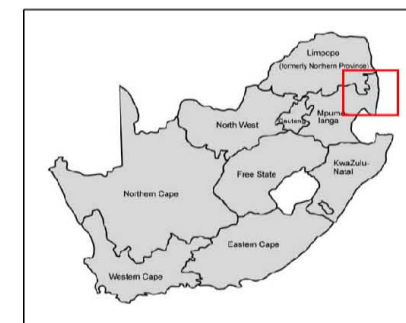
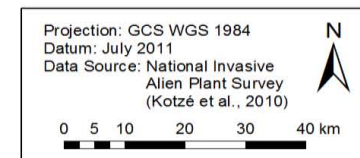
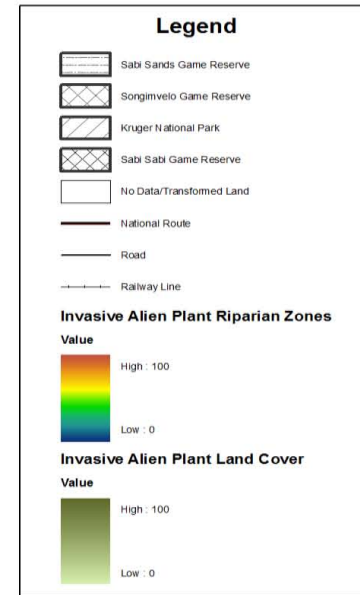
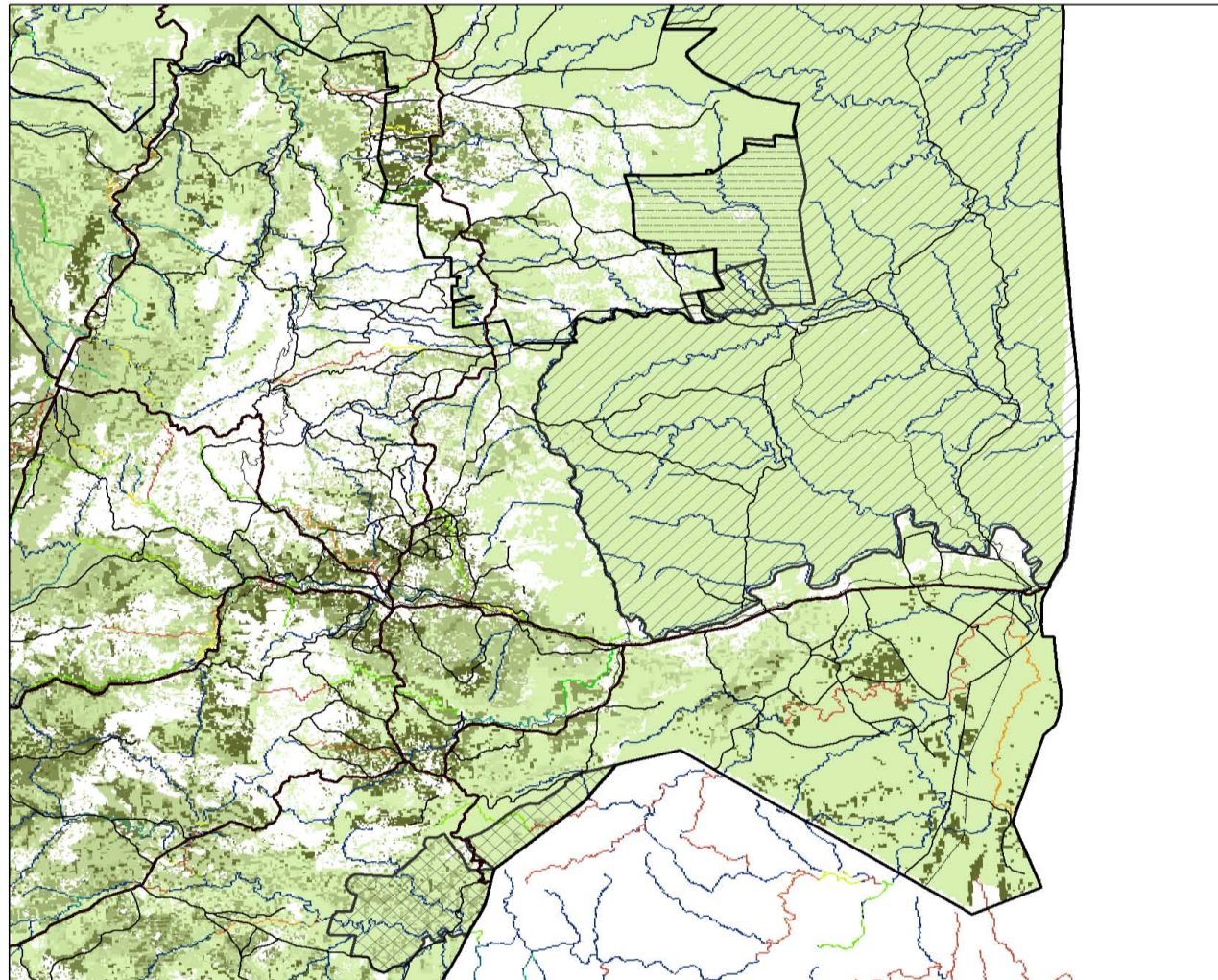


Figure 12 – Popular Game Reserves and National Parks in Mpumalanga

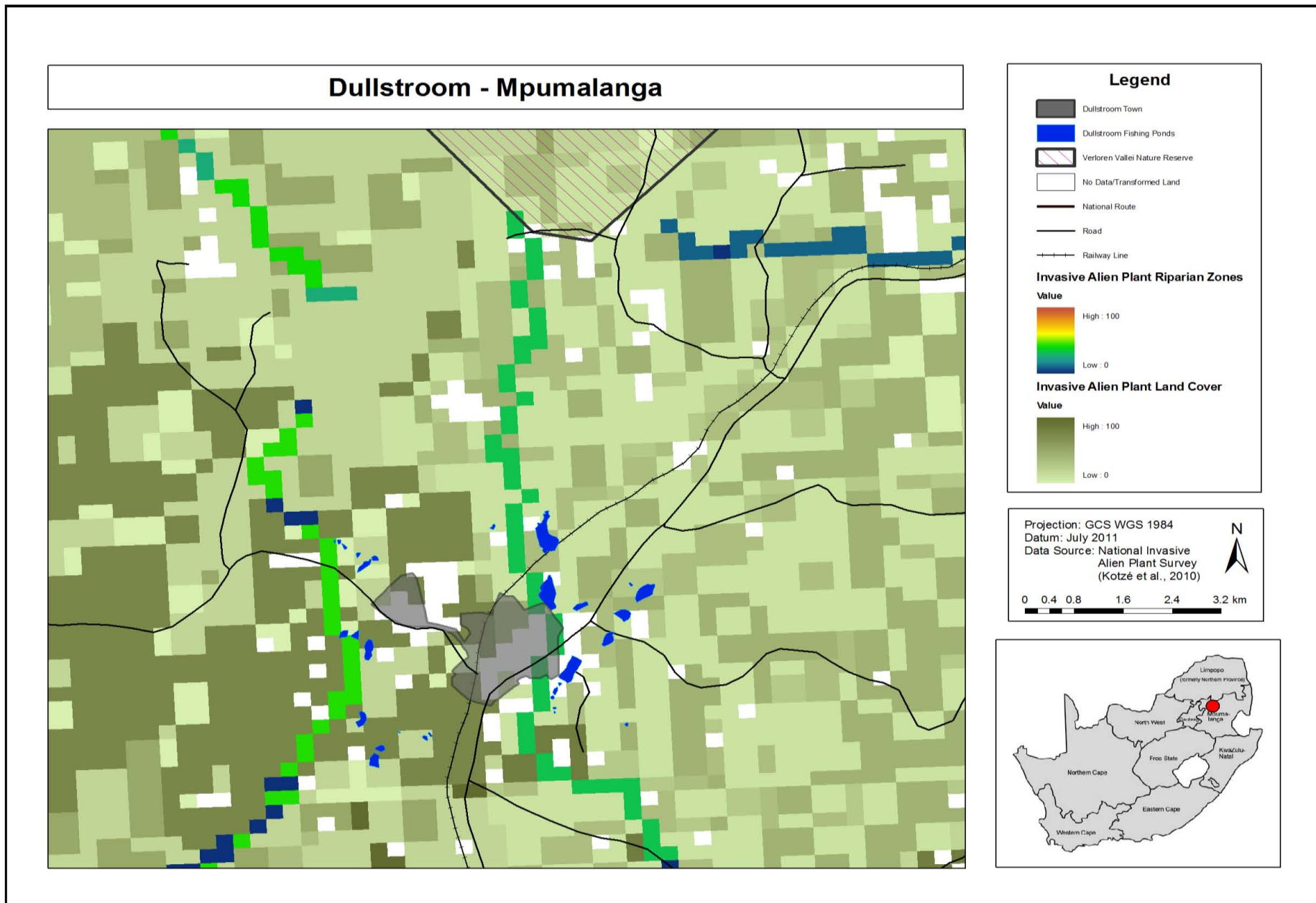


Figure 13 – Tourist sites in Dullstroom, Mpumalanga

4.1.3 Gauteng

According to South African Tourism (2011), the Gauteng province boasts a population of over 11 million people, covers an area of 16 548 square kilometres, and is considered to be the economic capital of South Africa. Due to the considerable rate of development and high population numbers, much of the natural landscape in the Gauteng province has been transformed. However, there are a number of tourist sites throughout the province.

Where much of the landscape in Gauteng is characterised by urban and residential settlements, and thus transformed land, most of the activities identified in the province depict a varying degree of popularity (table 5). Within the largely urban and residential areas of Pretoria, Johannesburg and Soweto, the most popular activities identified include sites with heritage or cultural value. Also highly popular are destinations with site-specific value such as Gold Reef City theme park for example, or the Pretoria zoo. The few nature reserves and protected areas identified depict a high popularity for viewing, hiking and mountain biking, with activities such as fishing, off-road driving and water related recreation showing less prominence. Conversely, in the southern most region of Gauteng, the results suggest a strong prevalence for water-related activities, including that of recreational fishing. Within these water based tourist sites, it appears less value is placed on activities such as viewing, hiking and off-road driving.

The popular city of Pretoria (figure 14) is located in the northern region of the province. Although most of the area is predominantly urban and residential, the figure depicts a significant array of alien vegetation in and around the region. In addition, the rivers in the vicinity indicate a high presence of invasive alien vegetation. In the vicinity of Johannesburg, one can distinguish the spread of alien vegetation, more specifically in the northern and western districts (figure 14). The image suggests that popular tourist attractions such as Newtown and the Apartheid Museum, being in a primarily urban environment, are affected relatively little by the presence of alien vegetation. However the Cradle of Humankind, a World Heritage site, depicts dispersed pockets of infestation. The overall severity levels of alien plant invasion is limited to scattered pockets distributed sporadically throughout the area. The riparian zones in central, northern, and western Johannesburg are depicted in the image as highly impacted by alien plant infestation. Once again this level of infestation extends into and across the Cradle of Humankind, a historical and cultural gem, both to South Africans, and the rest of the world (Gauteng Tourism Authority, 2011). South west of Johannesburg, Soweto depicts little alien vegetation coverage, apart from diminutive pockets of exposure.

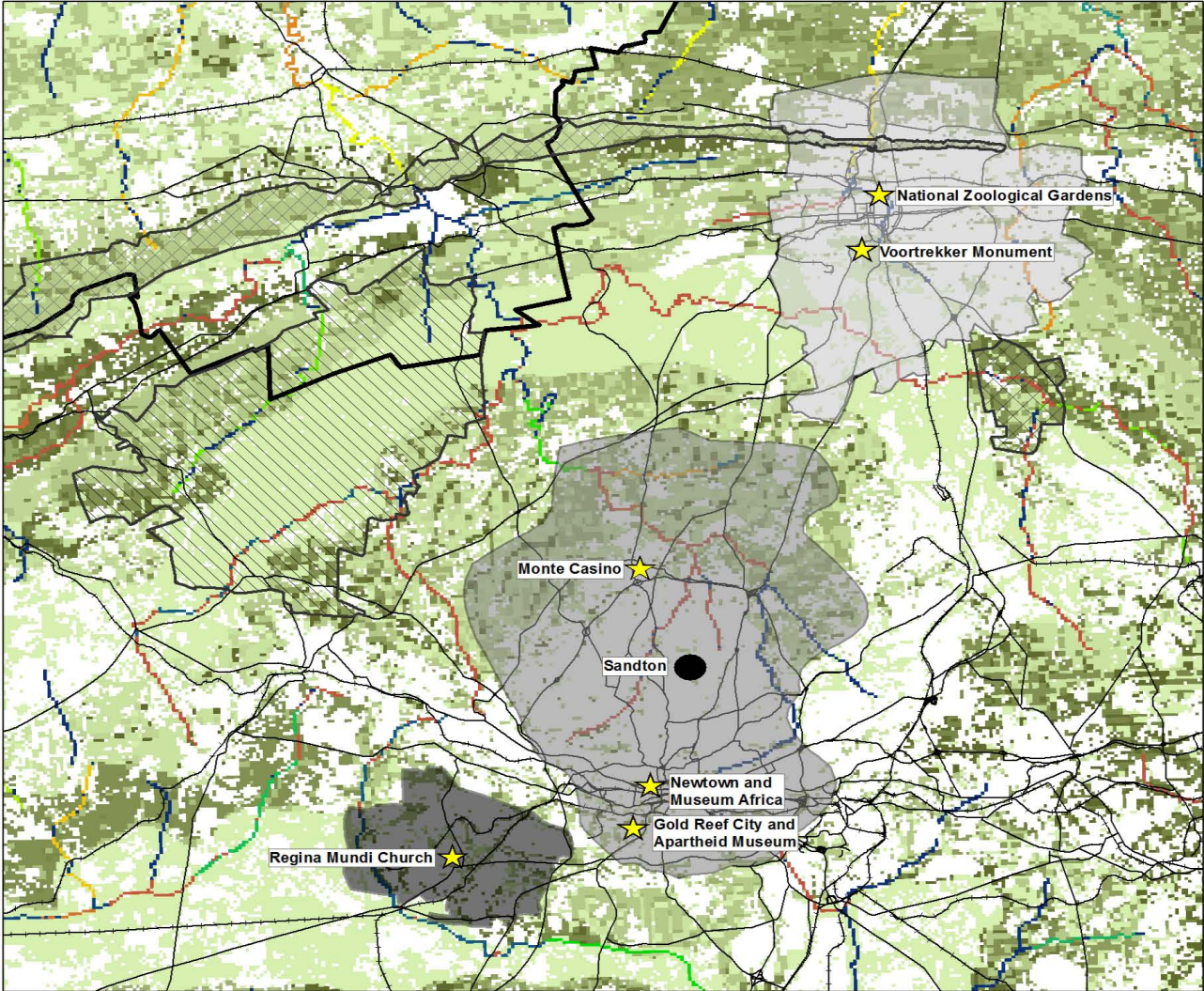
Table 5 –Alien plant coverage and activity popularity for major tourist sites in Gauteng (less popular - v; moderately popular - vv; most popular -vvv)

Tourist Sites	Activities								Alien Cover Description
	Hiking and/or Walks	Viewing (game, landscapes, whales, birds, etc)	Off-Road Driving	Cycling and/or Mountain Biking	Fishing	Heritage/Cultural	Water Activities (beaches, swimming, water sports, etc)	Site Specific and/or Other	
<u>Northern/Central Gauteng</u>									
Magaliesberg	vvv	vvv		vv	v	vv	v	vv	Moderate Coverage
Rietvlei Dam Munic. Nature Res.	vv	vvv			vv				High Coverage
Crade of Humankind WHS		vvv				vvv		v	Moderate Coverage
Pretoria	v	vv	v	vv	v	vvv	vv	vvv	No Data/Transformed Land
- National Zoological Gardens		vvv						vv	No Data/Transformed Land
- Voortrekker Monument						vvv		vv	Low Coverage
Central/Northern Johannesburg	v	vv	v	vv	v	vvv	vv	vvv	No Data/Transformed Land
- Newtown						vv		vvv	No Data/Transformed Land
- Museum Africa						vvv		vv	No Data/Transformed Land
- Monte Casino		v						vvv	No Data/Transformed Land
- Gold Reef City						vv		vvv	No Data/Transformed Land
- Apartheid Museum						vvv		vv	No Data/Transformed Land
Soweto		vv		v		vvv	v	vvv	No Data/Transformed Land
- Regina Mundi Church						vvv		vvv	No Data/Transformed Land
<u>Southern Gauteng</u>									
Suikerbosrand Prov. Nature Res.	vvv	vvv	vv	vv				vv	High Coverage
Vaal Dam		v			vvv		vvv	vvv	Low Coverage
Vaal River		v			vvv		vvv	vvv	Moderate Coverage
Emerald-Casino Resort							vv	vvv	No Data/Transformed Land

Figure 15 depicts the southern region of Gauteng, and several popular tourist locations that are visited by many tourists each year (Gauteng Tourism Authority, 2011). The most prevalent of these locations is the Vaal dam and Vaal river. Figure 15 suggests that certain areas are highly infested with invasive alien vegetation, particularly in western areas of the Vaal dam, as well as both sides of the Vaal river. Also most notable is the heavily invaded vistas within Suikerbosrand Provincial Nature Reserve. Various rivers in the area, most particularly the Vaal river, are characterised by high levels of alien plant infestation.

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Popular Tourist Sites - Gauteng Province



Legend

- Magaliesberg
- Rietveld Dam Municipal Nature Reserve
- Cradle of Humankind World Heritage Site
- Pretoria
- Central and Northern Johannesburg
- Soweto
- No Data/Transformed Land
- Main Roads
- Railway Line

Invasive Alien Plant Riparian Zones

Value

High : 100
Low : 0

Invasive Alien Plant Land Cover

Value

High : 100
Low : 0

Projection: GCS WGS 1984
 Datum: July 2011
 Data Source: National Invasive Alien Plant Survey (Kotzé et al., 2010)

0 2.5 5 10 15 20 km

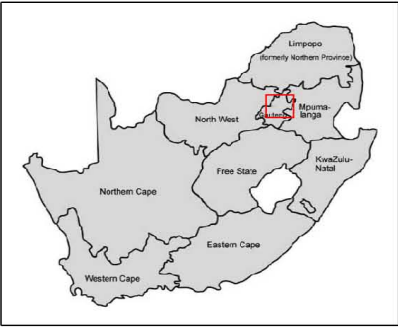
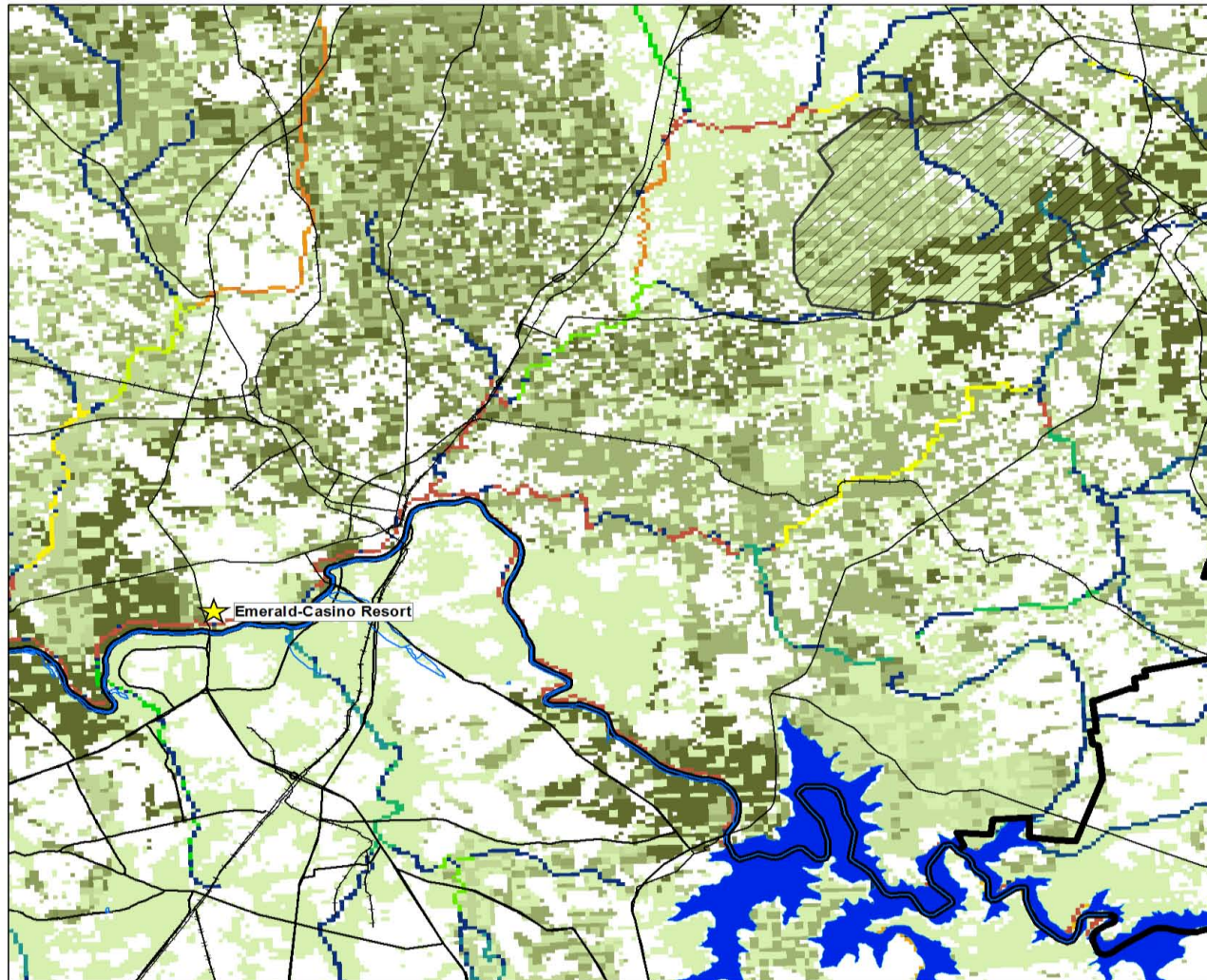








Figure 14 – Popular tourist sites in central and northern Gauteng

Popular Tourist Sites - Gauteng Province

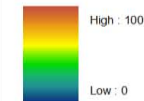


Legend

-  Suikerbosrand Provincial Nature Reserve
-  Vaal River
-  Vaal Dam
-  No Data/Transformed Land
-  Main Roads
-  Railway Line

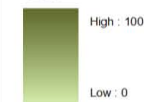
Invasive Alien Plant Riparian Zones

Value



Invasive Alien Plant Land Cover

Value



Projection: GCS WGS 1984
 Datum: July 2011
 Data Source: National Invasive
 Alien Plant Survey
 (Kotzé et al., 2010)

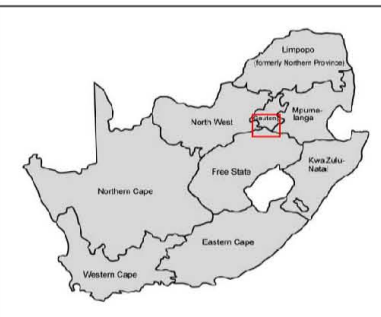


Figure 15 - Popular tourist sites in southern Gauteng

4.1.4 North-West Province

The North West Parks and Tourism Board (2011) states that the North West Province has a wide array of species, ecosystems and habitats. They explain that most of the province (approximately 71%) falls within the Savannah Biome, associated with most Bushveld vegetation. The remainder is characterised by a wide variety of grasses, thus falling within the Grassland Biome. The region is home to a population of approximately 3.3 million people, and covers an area of 106 512 square kilometres (South African Tourism, 2011).

Table 6 depicts the degree of popularity for the various recreational and tourism activities for each site in the North-West province. Sites such as the Vredefort Dome, Hartbeespoort dam, Mafikeng, and Magaliesburg portray many activities available to tourists, however levels of popularity differ significantly from site to site. Other sites such as Lesedi Cultural Village and Sun City display particularly high levels of popularity for specific activities within each site. Viewing again is classified as one of the most important activities concerning the game reserves and national parks in the province.

In figure 16, it can be seen that there is a variable spread of invasive alien vegetation, and while most of the landscape coverage appears relatively low, there are pockets of high infestation. This is especially prominent near the Hartbeespoort dam and Magaliesberg, two of the most popular tourist destinations in the entire province (The North West Parks and Tourism Board, 2011). There is a similar situation as far as the rivers and riparian zones, with certain rivers flowing through or near these recreational sites, either moderately or highly infested with alien vegetation.

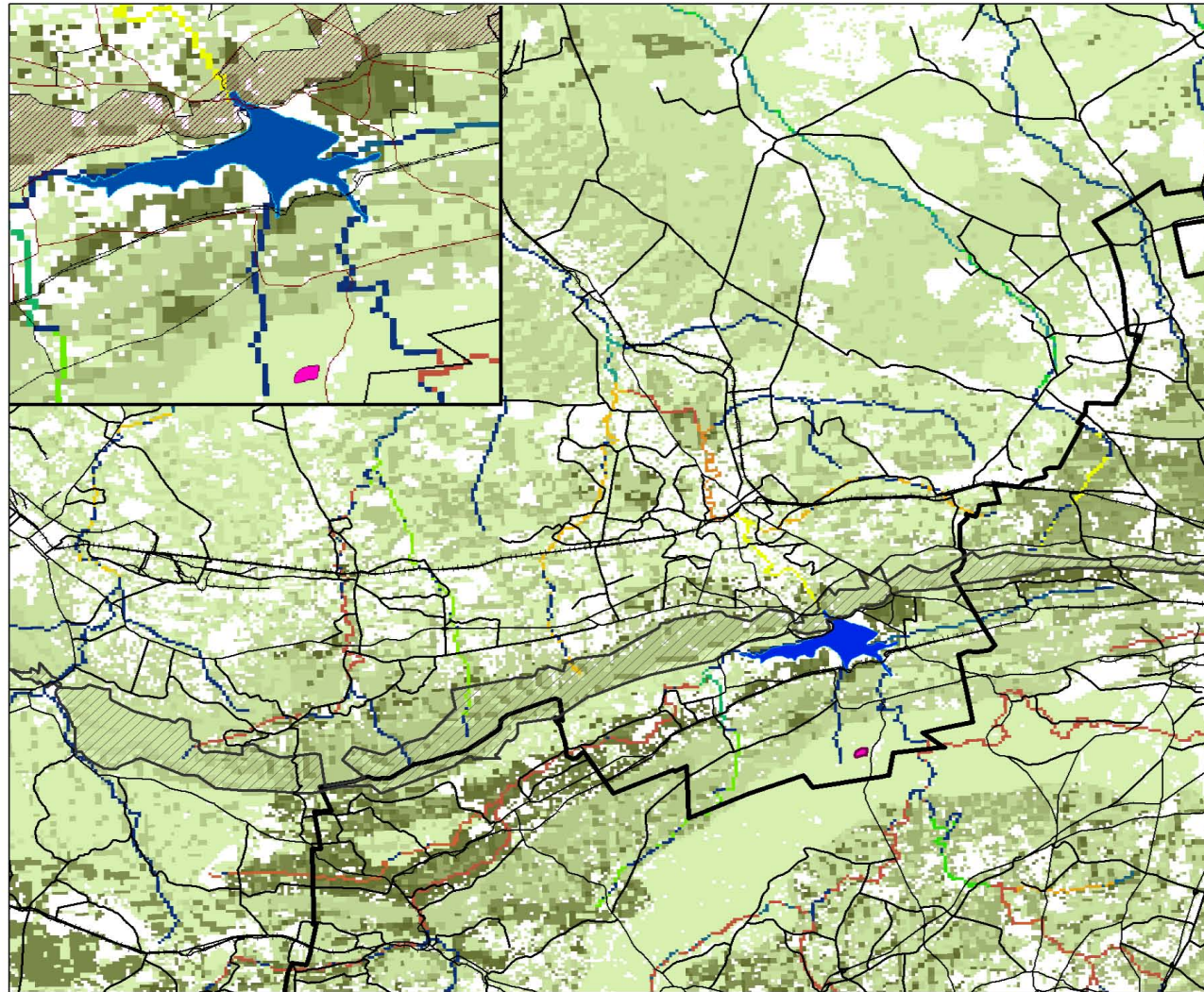
Figure 17 represents three popular tourist sites in the North-West Province, namely Sun City, Madikwe Game Reserve and Pilansberg National Park. Little alien plant coverage is evident, both across the landscape, as well as the riparian zones, with the exception of small pockets of invasive alien vegetation to the west of Sun City and Pilansberg National Park.

Another well-known and highly regarded tourist destination in the North-West Province is the Vredefort Dome (The North West Parks and Tourism Board, 2011). According to IUCN World Heritage Evaluation Report (2005), the Vredefort Dome is the oldest and one of the largest meteorite impact sites in the world. Figure 18 portrays a variable range of alien plant infestation occurring in the area. Within the Vredefort Dome itself there appears to be a similar case, with certain areas depicting low levels of invasion, whilst the central to western areas range from moderate to high landscape coverage. Even though most of the town of Potchefstroom is characterised by transformed land, large areas of low alien plant coverage can be seen. Certain riparian zones in the image also appear highly invaded, but most notable is the Vaal river.







Table 6 – Alien plant coverage and activity popularity for major tourist sites in the North-West Province (less popular - v; moderately popular - vv; most popular -vvv)

Tourist Sites	Activities								Alien Cover Description
	Hiking and/or Walks	Viewing (game, landscapes whales, birds, etc)	Off-Road Driving	Cycling and/or Mountain Biking	Fishing	Heritage/Cultural	Water Activities (beaches, swimming, water sports, etc)	Site Specific and/or Other	
<u>North-Eastern Region</u>									
Hartbeespoort Dam	v	vv		v	vvv		vvv	vvv	Moderate Coverage
Magaliesberg	vvv	vvv		vv	v	vv	v	vv	Moderate Coverage
Lesedi Cultural Village						vvv		vvv	Low Coverage
<u>Northern Region</u>									
Madikwe Game Reserve	vv	vvv							Low Coverage
Pilansberg National Park	vv	vvv						vv	Low Coverage
Sun City	v	vv					vvv	vvv	Low Coverage
<u>Eastern Region</u>									
Potchefstroom	v	vv	v	vv	v	vv	v	vvv	Low Coverage
Boskop Dam Nature Res.		vvv			vvv		vv		Low Coverage
Vredefort Dome	vv	vvv	vv	vv		vvv	vv	v	High Coverage
Vaal River		vv			vvv		vvv	vvv	High Coverage

Popular Tourist Sites - North-West Province

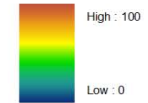


Legend

-  Magaliesberg
-  Lesedi Cultural Village
-  Hartbeespoort Dam
-  No Data/Transformed Land
-  Road
-  Railway Line

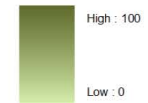
Invasive Alien Plant Riparian Zones

Value



Invasive Alien Plant Land Cover

Value



Projection: GCS WGS 1984
 Datum: July 2011
 Data Source: National Invasive
 Alien Plant Survey
 (Kotzé et al., 2010)



0 2.5 5 10 15 20 km

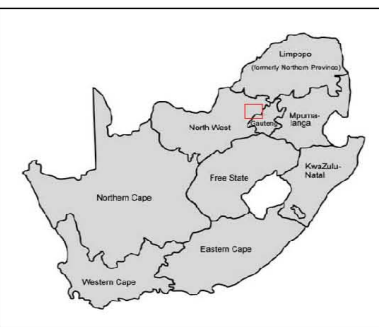
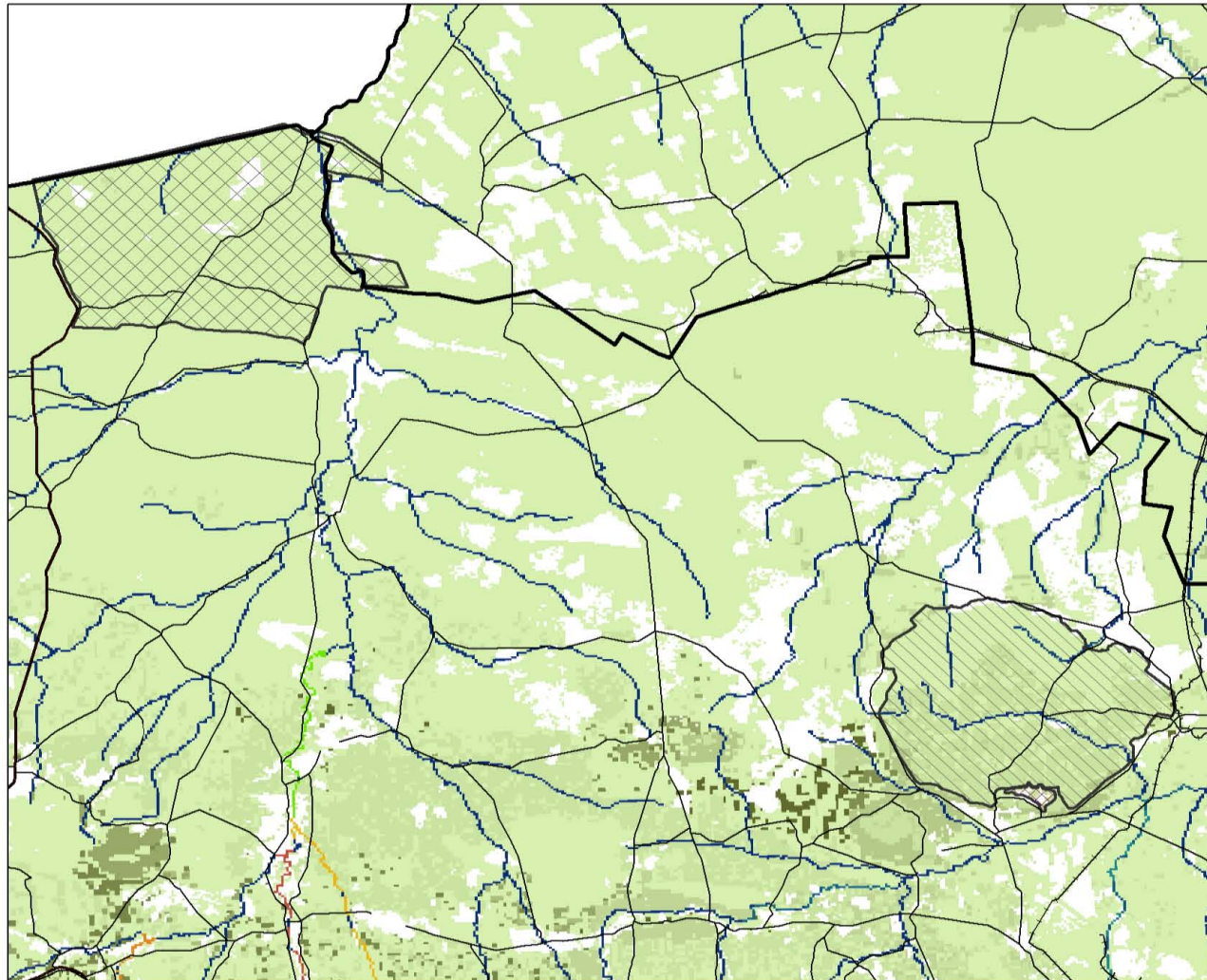









Figure 16 – Popular tourist sites in the eastern region of the North-West Province

Popular Tourist Sites - North-West Province

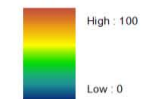


Legend

-  Madikwe Game Reserve
-  Pilansberg National Park
-  Sun City
-  No Data/Transformed Land
-  National Route
-  Road
-  Railway Line

Invasive Alien Plant Riparian Zones

Value



Invasive Alien Plant Land Cover

Value



Projection: GCS WGS 1984
 Datum: July 2011
 Data Source: National Invasive
 Alien Plant Survey
 (Kotzé et al., 2010)

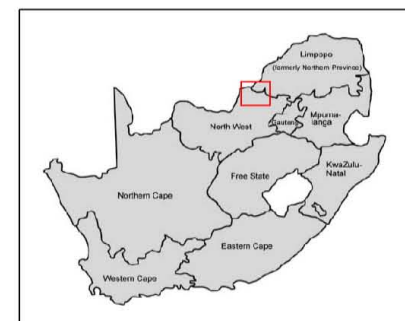
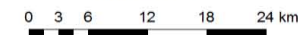


Figure 17 – Popular tourist sites in the northern region of the North-West Province

Popular Tourist Sites - North-West Province

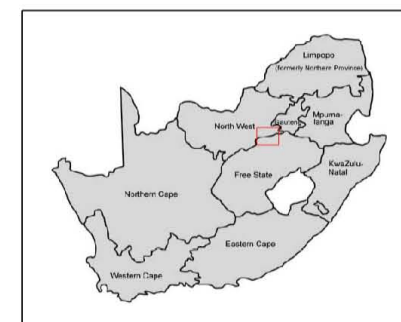
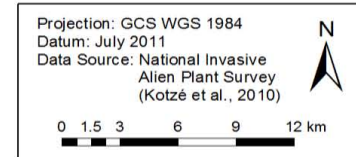
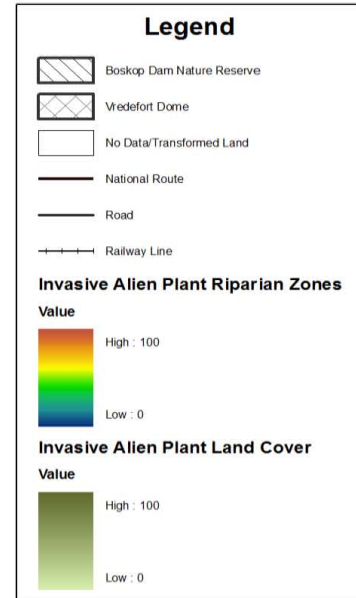
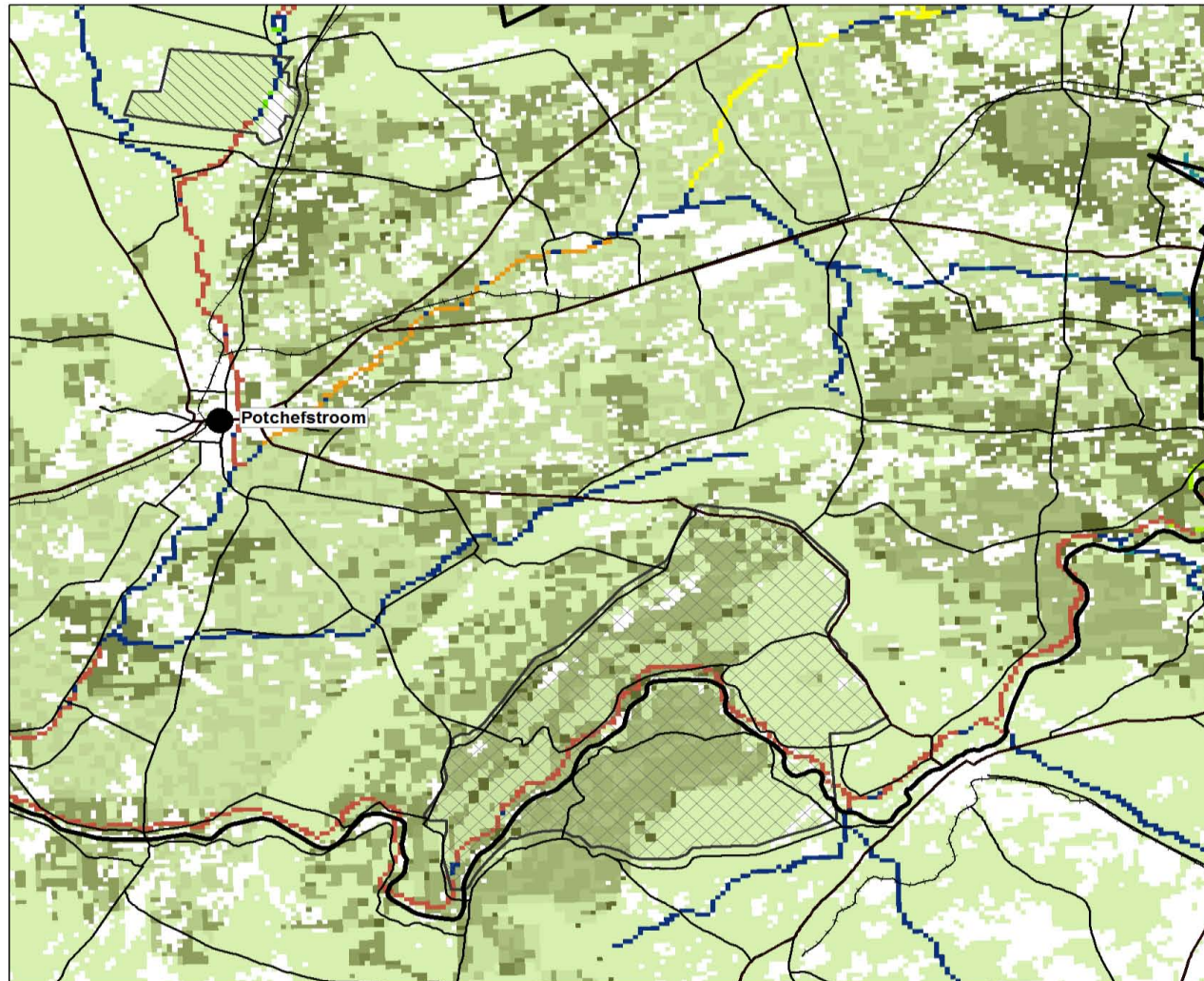


Figure 18 – Popular tourist sites in the North-West Province

4.1.5 Free State Province

According to the Free State Tourism Authority (2011), the Free State province covers an area of 129 464 km and is inhabited by a population of approximately 2.8 million people. Roughly 71% of the provinces total population lives in urban areas, however most of the region is still considered primarily rural in nature, characterised by vast expanses of farmlands.

Table 7 displays the identified key tourist destinations and their associated activities in the Free State province. The popularity of differing recreational activities within each site only varies vaguely. The results suggest that the most popular activities throughout the province include fishing, other water related activities, viewing and hiking. Only two of the most popular tourist sites identified represented a high value for heritage or cultural activities, namely the Vredefort Dome and the Golden Gate Highlands National Park. It was also seen that activities such as cycling and off-road driving, were far less popular, compared to other provinces in the country.

Figure 19 depicts two of the most popular tourists destinations in the Free State (Free State Tourism Authority, 2011), namely the Golden Gate Highlands National Park, and the Sterkfontein Dam. The figure reveals sporadic levels of alien vegetation occurs in this area. For the most part it appears that the spread of alien vegetation seems mostly low, apart from small pockets appearing within the Golden Gate Highlands National Park. The riparian zones in the area are minimally affected by invasive alien vegetation.

In figure 20 similar results can be concluded, with much of the landscape being characterised by predominantly uniformly flat topography. The most popular tourist destination in this central region of the province, is Bloemfontein itself (Free State Tourism Authority, 2011). Being primarily an urban environment, the presence of extensive alien vegetation appears limited. However if one analyses the riparian zones, particularly in the eastern areas of the image, various rivers appear to be heavily affected by alien plant infestation.

Other important tourist destinations in the Free State are the Vredefort Dome, the Vaal dam, and the Vaal river (Free State Tourism Authority, 2011). In figure 21 it can be seen that all three sites are either directly infested by alien vegetation, or in close proximity to landscapes and riparian zones highly infested. The western areas of the Vaal dam are highly inundated with alien vegetation, whilst along the Vaal river, pockets of moderate to high infestation exists. Out of all the rivers in this region, it appears the Vaal river is the most heavily affected by the presence of invasive alien plants.

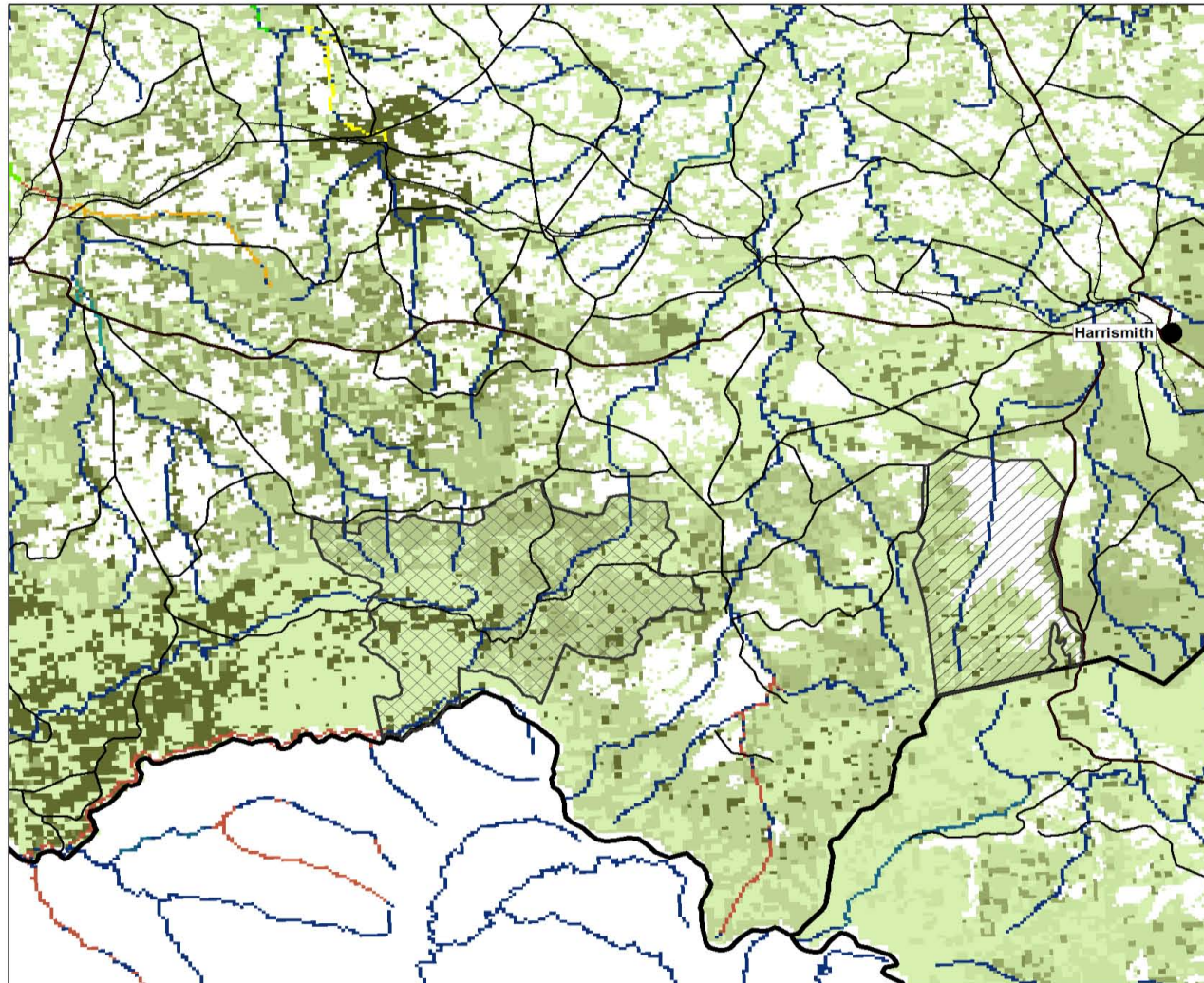
Table 7 – Alien plant coverage and activity popularity for major tourist sites in the Free State (less popular - √; moderately popular - √√; most popular - √√√)

Tourist Sites	Activities								Alien Cover Description
	Hiking and/or Walks	Viewing (game, landscapes, whales, birds, etc)	Off-Road Driving	Cycling and/or Mountain Biking	Fishing	Heritage/Cultural	Water Activities (beaches, swimming, water sports, etc)	Site Specific and/or Other	
<u>Central Free State</u>									
Rustfontein Nature Reserve		√√			√√√		√√√	√√√	Low Coverage
Soetdoring Nature Reserve	√√	√√√			√√			√√	Low Coverage
Bloemfontein	√	√√	√	√√	√	√√√	√	√√√	No Data/Transformed Land
- Kings Park								√√√	No Data/Transformed Land
<u>Eastern Free State</u>									
Sterkfontein Dam Nature Reserve	√√	√√√			√√		√√√	√√√	Low Coverage
Golden Gate Highlands Nat. Park	√√	√√√				√√√	√	√√	Moderate Coverage
<u>Northern Free State</u>									
Vredefort Dome	√√	√√√	√√	√√		√√√	√√	√	High Coverage
Vaal Dam		√			√√√		√√√	√√√	Low Coverage
Vaal River		√			√√√		√√√	√√√	Moderate Coverage
<u>Southern Free State</u>									
Caledon Nature Reserve	√√	√√√	√√		√√√			√	No Data/Trans. Lan.
Tussen Die Riviere Nat. Res.	√√√	√√√						√√	Low Coverage
Hendrik Verwoerd Dam Nat. Res.	√√	√√√			√√		√√√	√√	Low Coverage
- Gariiep Dam		√√√			√√		√√√	√√	Low Coverage







In the southern region of the Free State lies Gariep dam, a popular tourist destination, as well as several nature reserves in the vicinity. Figure 22 reveals a relatively low presence of alien vegetation in the area. However moving north east in the image there appears to be a large, and moderate to high presence of alien plant infestation. Caledon Nature Reserve finds itself within this infestation. From a riparian perspective, the results suggest that several rivers, both near Gariep Dam and Caledon Nature Reserve, appear either moderately or highly impacted by invasive alien vegetation.

University of Cape Town

Popular Tourist Sites - Free State Province

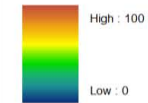


Legend

-  Sterkfontein Dam Nature Reserve
-  Golden Gate Highlands National Park
-  No Data/Transformed Land
-  National Route
-  Road
-  Railway Line

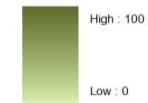
Invasive Alien Plant Riparian Zones

Value



Invasive Alien Plant Land Cover

Value



Projection: GCS WGS 1984
Datum: July 2011
Data Source: National Invasive
Alien Plant Survey
(Kotzé et al., 2010)



0 2 4 8 12 16 km

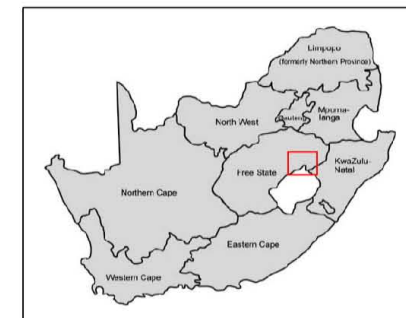


Figure 19 – Popular tourist destinations in eastern Free State

Popular Tourist Sites - Free State Province

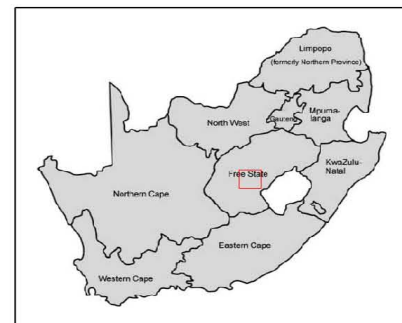
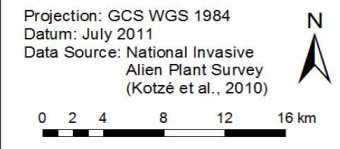
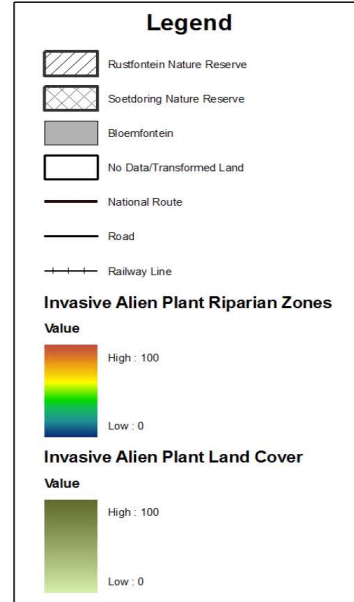
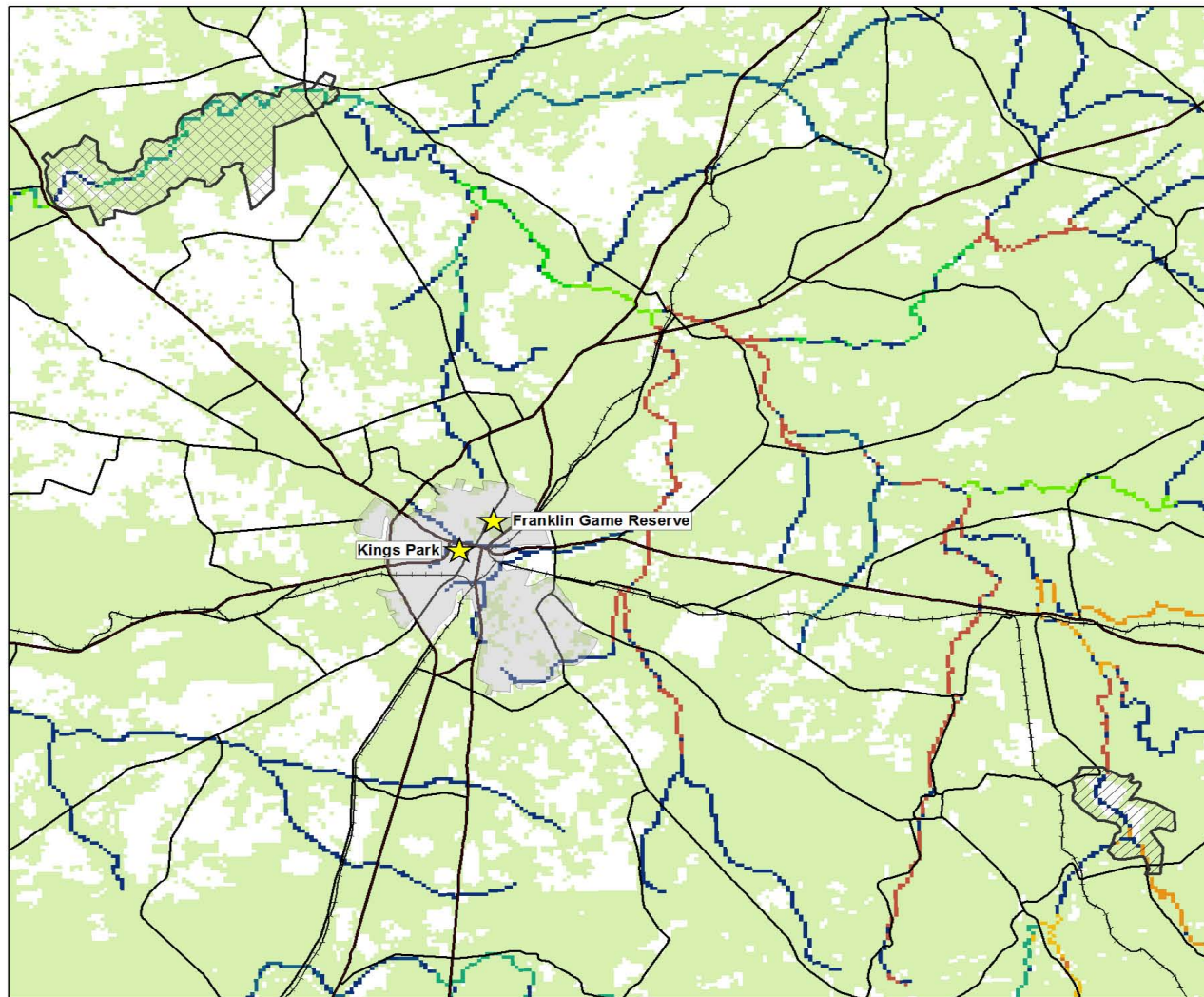


Figure 20 – Popular tourist sites in central Free State

Popular Tourist Sites - Free State Province

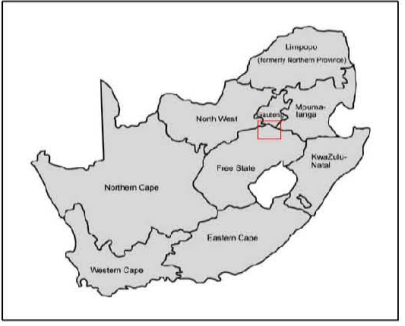
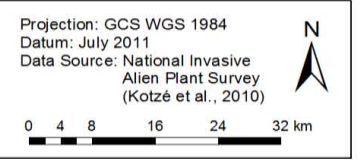
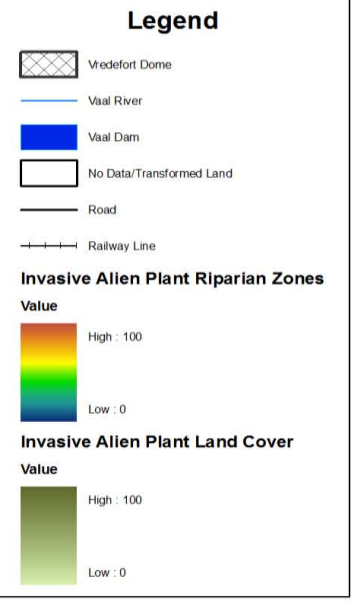
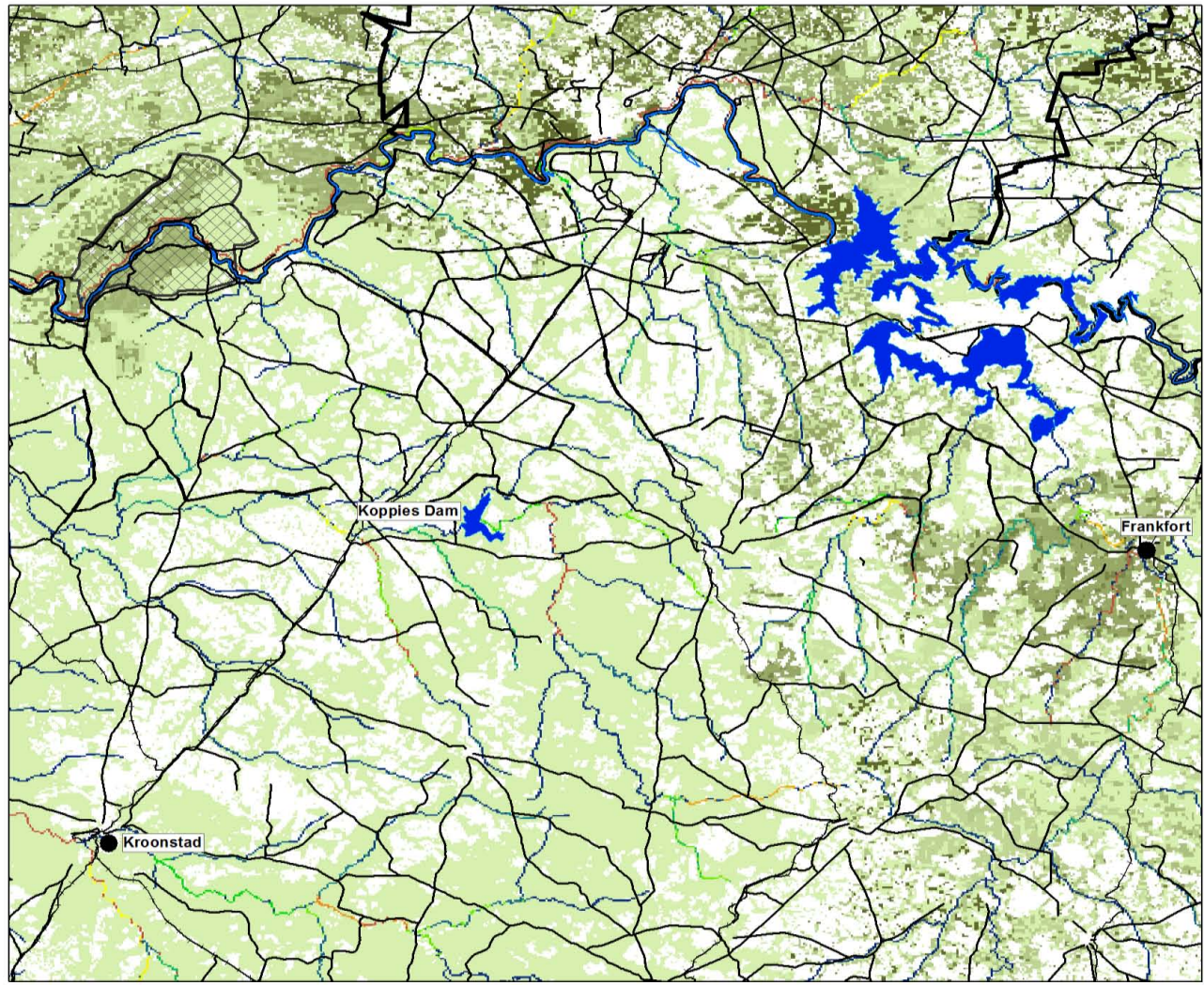


Figure 21 – Popular tourist sites in northern Free State

Popular Tourist Sites - Free State Province

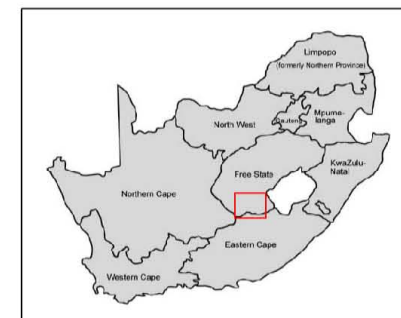
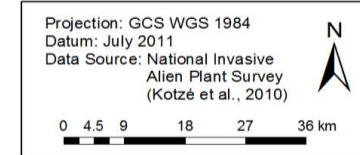
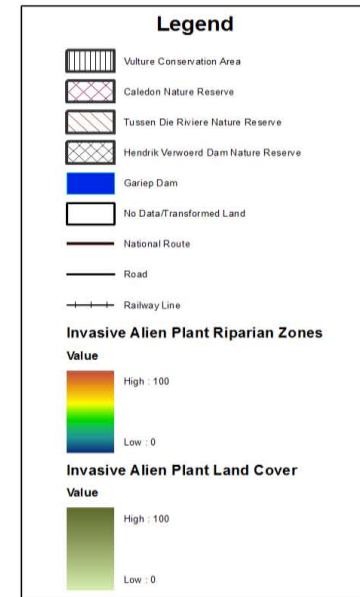
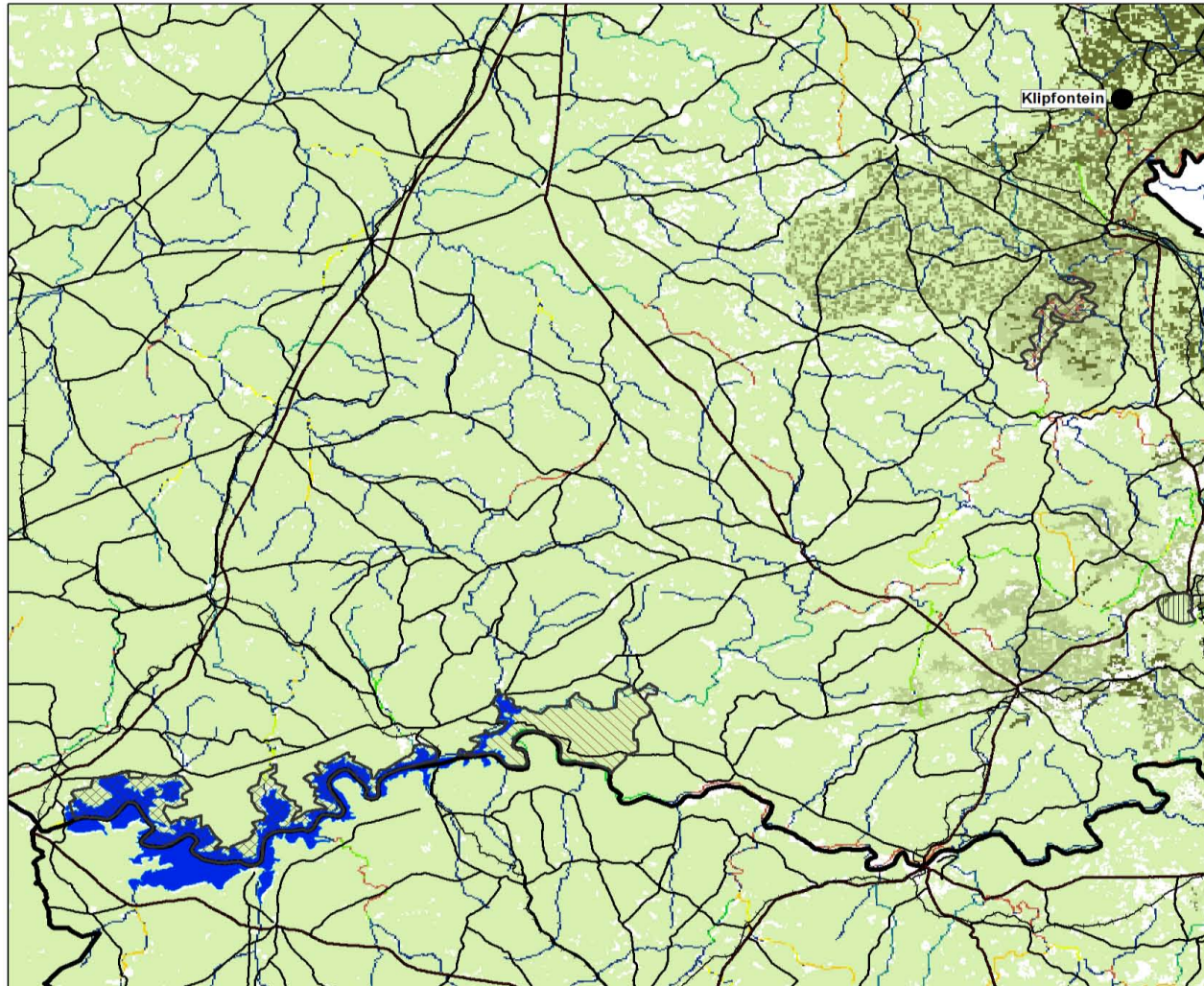


Figure 22 – Popular tourist sites in southern Free State

4.1.6 KwaZulu-Natal

KwaZulu-Natal, also known as the Zulu Kingdom, is home to approximately 10.2 million people, who occupy one of the most popular provinces in South Africa from a tourism and recreational perspective (South African Tourism, 2011). Part of this popularity is due to various landscapes and natural sites in the province covering an area of 94 361 square kilometres. In a province rich in culture and biodiversity, cultural ecosystem services such as tourism and recreation forms an integral part of the local inhabitants, as well as visitor experiences (KwaZulu-Natal Tourism Authority, 2011).

One of the most prominent factors that characterise tourism in KwaZulu-Natal is that it is situated along a coastline. Not only that, but the coastline is characterised by warm waters, typified by sub-tropical climates. Table 8 suggests that these warm waters and favourable climatic temperatures have a significant bearing on tourism in this province. Certain sites such as Durban Beachfront, Ballito and Umhlanga Rocks offer popular activities such as fishing, swimming and water sports - which all stem from the coastline itself. Similar to other provinces, the inland landscapes, particularly parks and reserves are also subject to highly popular activities such as hiking, and viewing. Durban city itself hosts an array of tourist activities, and even though primarily characterised by transformed land, there are various patches of moderate to high pockets of alien vegetation in close proximity. However as mentioned, it is activities that are predominantly affiliated with water based recreation, that appear to be the most popular activities enjoyed by tourists (table 8).

One of the most important regions in the province from a tourism perspective, is known as the Elephant Coast, the northern most region in the province. Home to the Greater St. Lucia World Heritage Site (iSimangaliso Wetland Park), figure 23 portrays that this tourist site is inundated with a moderate degree of alien plant cover, with patches of high infestation occurring along or near the coastline. Mkuze Game Reserve shows large patches of high alien plant cover, while other areas throughout the Elephant Coast are infested with sporadic patches of mostly moderate pockets of infestation, with high patches only occurring in a few instances. Most rivers in the area appear less affected, bar a minority of riparian zones that illustrate moderate to high levels of invasion.

Table 8 – Alien plant coverage and activity popularity for major tourist sites in KwaZulu-Natal (less popular - v; moderately popular - vv; most popular -vvv)

Tourist Sites	Activities								Alien Cover Description
	Hiking and/or Walks	Viewing (game, landscapes whales, birds, etc)	Off-Road Driving	Cycling and/or Mountain Biking	Fishing	Heritage/Cultural	Water Activities (beaches, swimming, water sports, etc)	Site Specific and/or Other	
<u>Elephant Coast</u>									
St. Lucia World Heritage Site	vv	vvv	vv	vv	vvv	vv	vvv	vvv	Moderate Coverage
Ndumo Game Reserve	vv	vvv	vv				v		No Data/Transformed Land
Kosi Bay		vvv			vvv		vvv		No Data/Transformed Land
Temba Elephant Park		vvv						vv	Low Coverage
Hluhluwe-Imfolozi Game Res.	v	vvv	vv				vv		Moderate Coverage
Mkuze Game Reserve	vv	vvv					v		High Coverage
<u>eThekweni-Durban Region</u>									
Ballito		vv	v		vv		vvv	vvv	Low Coverage
Umhlanga Rocks					vv		vvv	vvv	No Data/Transformed Land
Durban Beachfront	vv			vv	vvv		vvv	vvv	No Data/Transformed Land
Valley of a Thousand Hills	vvv	vvv						vv	High Coverage
Midmar	vv	vv			vv		vvv	vv	Moderate Coverage
Albert Falls	vv	vvv			vvv		vv	v	High Coverage
Durban	vv	vv	v	vv	vvv	vvv	vvv	vvv	No Data/Transformed Land
<u>uKhahlamba-Drakensburg</u>									
Spioenkop Nature Reserve	vv	vvv				v	v	vvv	Low Coverage
Royal Natal National Park	vvv	vvv	v		vv		vv	vv	Low Coverage
Natal Drakensburg Park	vvv	vvv		v	vv	vv	vv	vv	Moderate Coverage

More central to the coastline of KwaZulu-Natal lies the tourism hotspot of eThekweni-Durban (KwaZulu-Natal Tourism Authority, 2011). Figure 24 depicts a visual representation of the level of alien plant infestation for the area. The most predominant cover of alien vegetation occurs more inland, while the severity and extent of the alien plant cover is seen as covering a considerable percentage of the landscape. The popular beach areas in eThekweni-Durban such as Ballito, Durban Beachfront, and Umhlanga Rocks fall under transformed land/data classification, as well as their surrounding areas of close proximity. The image depicts an overlap between the invasive alien vegetation and the Valley of a Thousand Hills, highly popular amongst off-road driver and bike recreationalists. Moreover, the riparian zones in the entire region, appear to substantiate the excessive presence of infestation.

Another extremely important tourist region in KwaZulu-Natal is the Drakensburg mountains, spanning a distance of 200 kilometres across a landscape rich in biodiversity (KwaZulu-Natal Tourism Authority, 2011). Of the most prominent tourist sites in the area (figure 25), the Natal Drakensburg Park portrays mixed levels of invasion within its borders. Highly sporadic, certain parts of the landscape depict low levels of alien plant invasion, whilst others a moderate to high percentages of infestation. Nonetheless a significant overlap can be seen between the alien vegetation and the mapped tourist locations. Most riparian zones in the area appear less infested by invasion, apart from certain rivers which are depicted as being moderately or highly invaded.

Elephant Coast Tourist Sites - KwaZulu-Natal

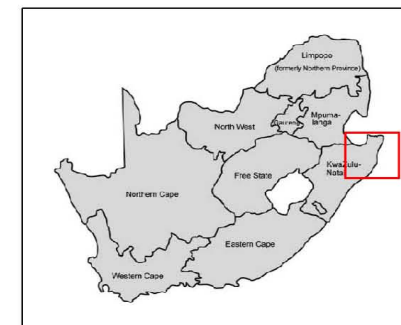
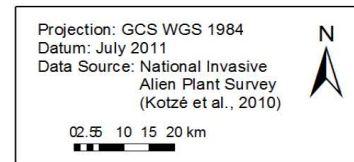
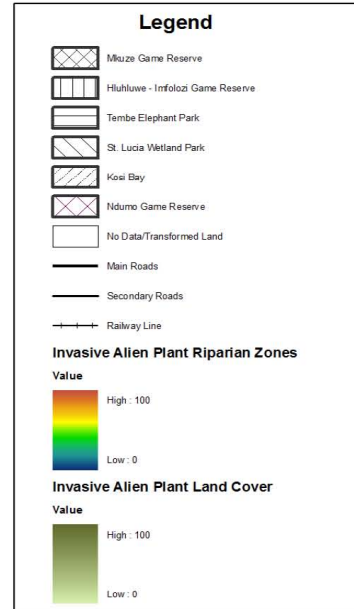
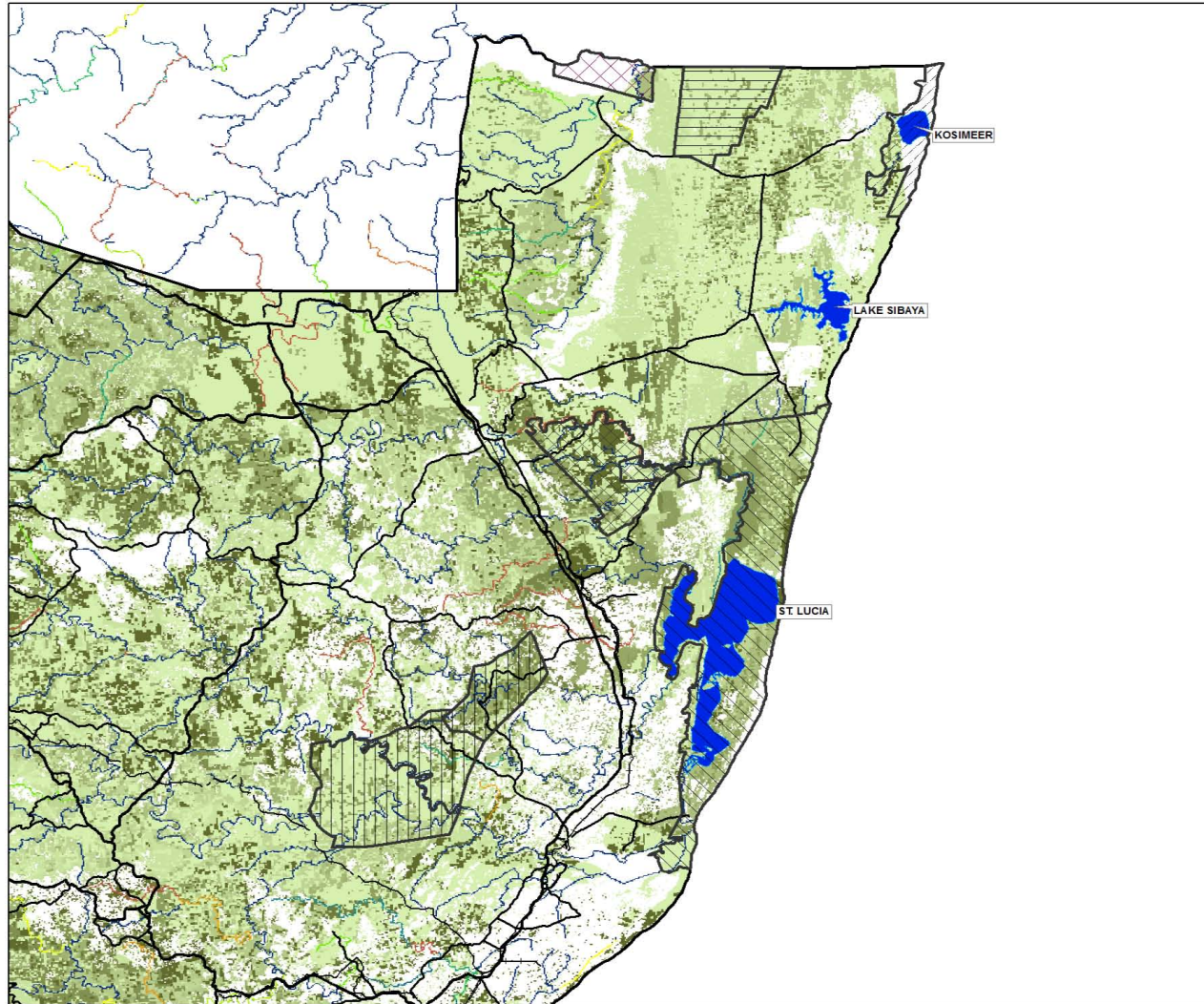
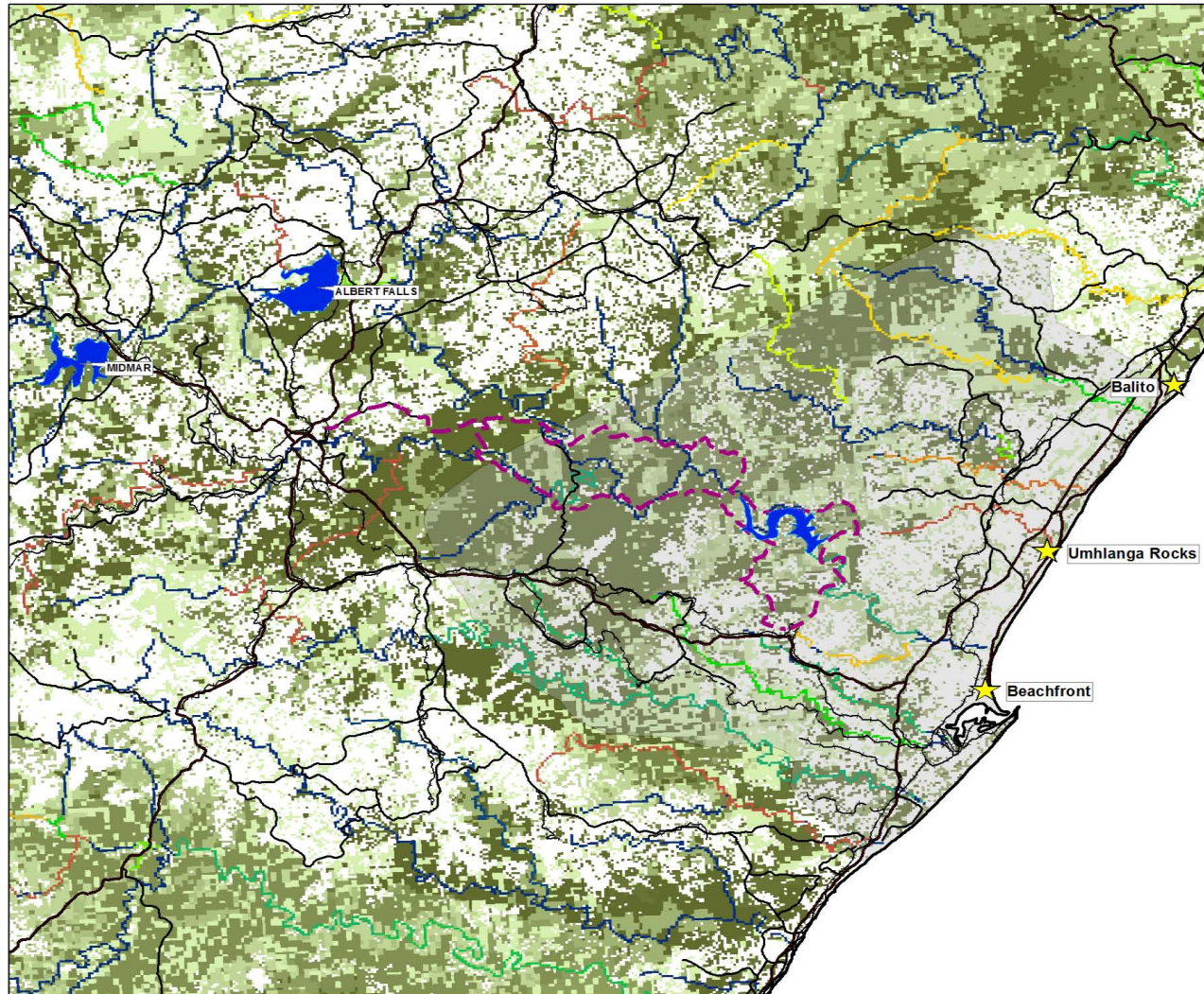


Figure 23 – Popular tourist sites in the Elephant Coast, KwaZulu-Natal

eThekwini-Durban Region - KwaZulu-Natal

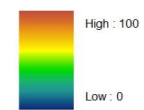


Legend

- eThekwini-Durban Region
- Valley of a Thousand Hills 4x4/Bike Route
- No Data/Transformed Land
- National Route
- Road
- Railway Line

Invasive Alien Plant Riparian Zones

Value



Invasive Alien Plant Land Cover

Value



Projection: GCS WGS 1984
Datum: July 2011
Data Source: National Invasive Alien Plant Survey (Kotzé et al., 2010)



0 3 6 12 18 24 km

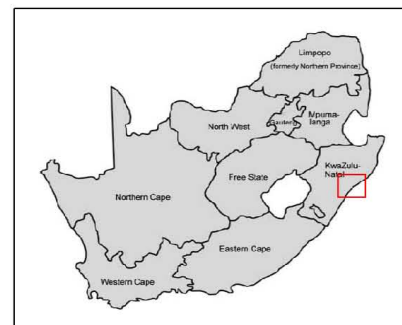


Figure 24 – Popular tourist sites in the eThekwini-Durban Region, KwaZulu-Natal

uKhahlamba-Drakensberg - KwaZulu-Natal

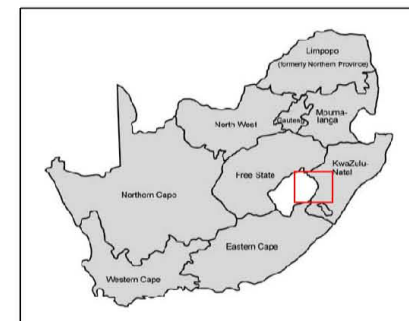
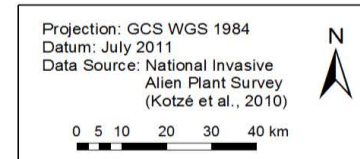
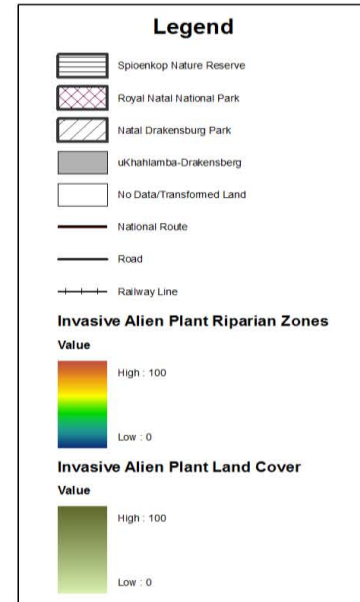
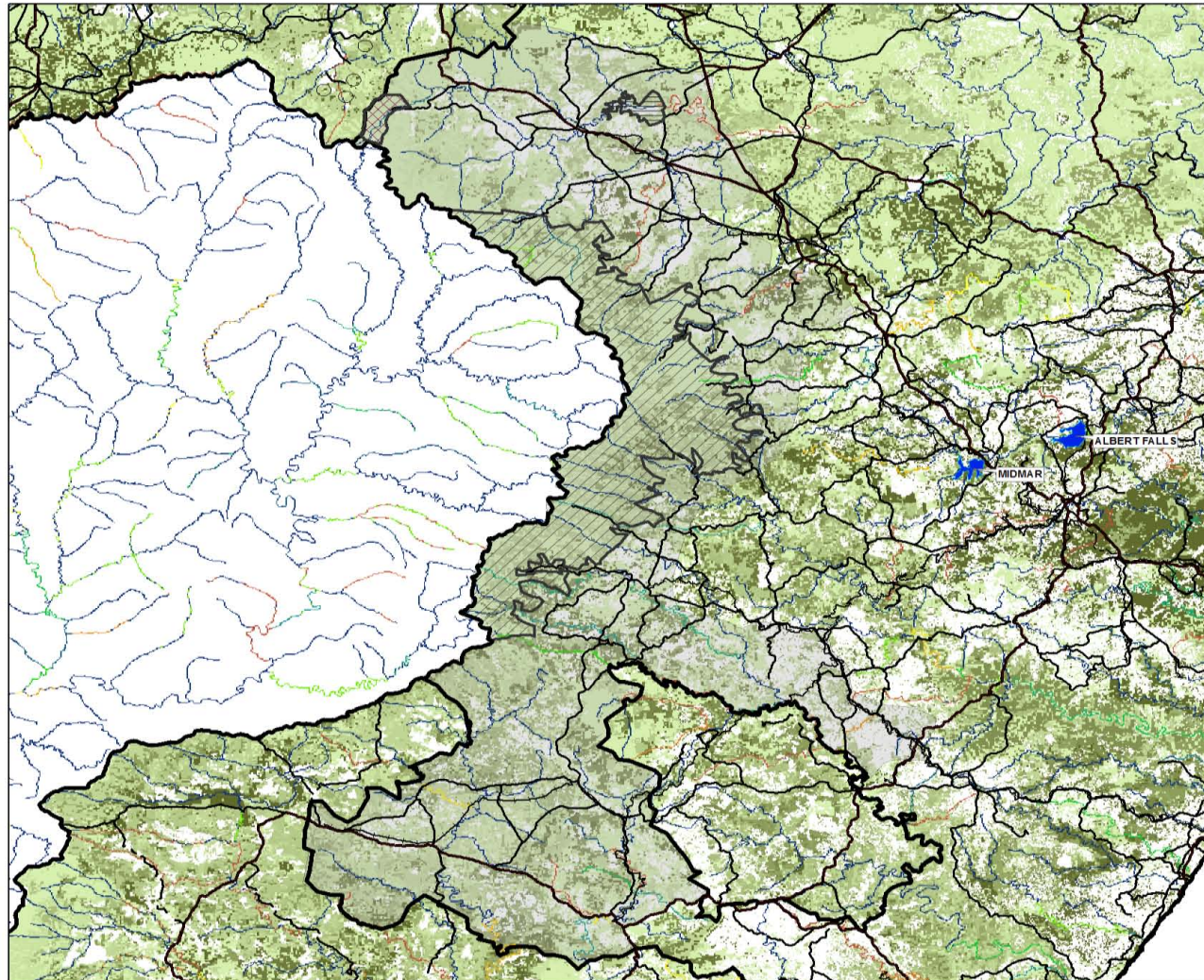


Figure 25 – Popular tourist sites in uKhahlamba-Drakensberg region, KwaZulu-Natal

4.1.7 Eastern Cape

Known for some of the most pristine environments in South Africa, and a world renowned coastline approximately 800 km long, the Eastern Cape is a highly regarded tourist destination (Eastern Cape Tourism Board, 2011). With an area covering 168 966 square kilometres, the region is home to a population estimated at 6.9 million people (Statistics South Africa, 2006). One of the poorer provinces in South Africa, the Eastern Cape has great potential for the future development of the tourism sector (Eastern Cape Parks, 2011; Eastern Cape Tourism Board, 2011).

The results suggest that the Eastern Cape varies considerably concerning the popularity of activities within each tourism site identified (table 9). In a province with such highly regarded natural beauty, it is no surprise viewing and hiking are highly popular activities. Also popular is site specific activities such as horse riding along various beaches, the well-known Wild Coast Sun casino, or the Port Elizabeth Apple Express train journey. Less popular activities amongst these specific sites include that of cycling, off-road driving, as well as surprisingly, certain water based recreational activities.

East London, host to range of tourist activities (as depicted in table 9), is characterised by scattered pockets of low, medium and high alien plant infestation (figure 26). If one examines figure 27, a large amount of invasive alien vegetation is seen in the region known as the Sunshine Coast. In the popular Addo Elephant National Park and Shamwari Game Reserve, certain patches of landscape appear to be moderately or highly infested with invasive alien plant infestation. Along the coastline itself, near Port Elizabeth, and particularly near the Port Elizabeth Apple Express railway line, high levels of alien plant infestation exist. Certain riparian zones in the region appear moderately to highly affected, whilst the remaining rivers seem less affected by the presence of invasive flora.

Similar observations can be made by analysing the lower regions of the Eastern Cape (figure 28). The northern areas of the image depict a low level of alien plant invasion, however moving closer to the coastline there appears to be significant pockets of coverage. Looking particularly at the popular Tsitsikamma hiking trail (Eastern Cape Tourism Board, 2011), a noteworthy presence and overlap of alien vegetation exists. A further observation that can be made concerns the riparian zones in the region. Numerous rivers are displayed in yellow, orange and red, signifying high levels of invasion.

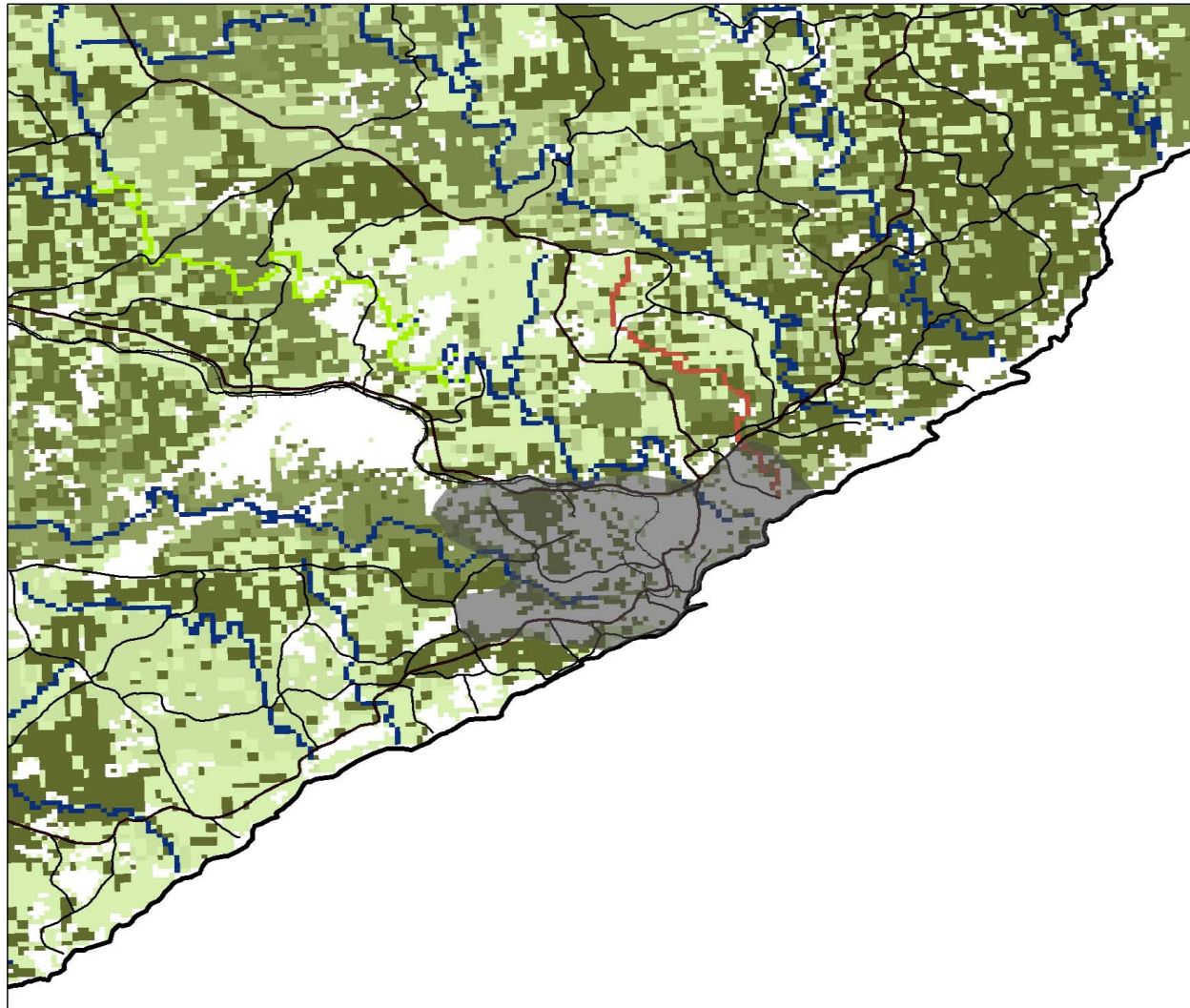
Table 9 – Alien plant coverage and activity popularity for major tourist sites in the Eastern Cape (less popular - √; moderately popular - √√; most popular - √√√)

Tourist Sites	Activities								Alien Cover Description
	Hiking and/or Walks	Viewing (game, landscapes whales, birds, etc)	Off-Road Driving	Cycling and/or Mountain Biking	Fishing	Heritage/Cultural	Water Activities (beaches, swimming, water sports, etc)	Site Specific and/or Other	
<u>Wild Coast</u>									
Wild Coast Sun							√	√√√	High Coverage
Mkambati Nature Reserve	√√√	√√√					√		High Coverage
NduliLuchaba Nature Reserve		√√√						√√	Low Coverage
Coffee Bay	√√	√√√					√√	√√√	Moderate Coverage
<u>Eastern Region</u>									
East London	√√	√√√	√	√√	√√√	√√	√√√	√√√	No Data/Transformed Land
<u>Sunshine Coast</u>									
Shamwari Game Reserve		√√√				√	√√	√√√	Moderate Coverage
Amakhala Game Reserve	√√√	√√√					√√		High Coverage
Addo Elephant National Park	√√√	√√√	√√					√√√	High Coverage
Port Elizabeth Apple Express						√√√		√√	High Coverage
Port Elizabeth	√√	√√√	√	√√	√√√	√√√	√√√	√√√	No Data/Transformed Land
<u>Southern Region</u>									
Baviaanskloof Nature Reserve		√√√	√√	√			√		Moderate Coverage
Tsitsikamma Hiking Trail	√√√	√√√		√√			√		High Coverage
Cape St. Francis Bay	√√	√√√	√		√√		√√√	√√√	Low Coverage

Some of the most pristine and untransformed environments the Eastern Cape boasts, can be found in the Wild Coast (South African Tourism, 2011). Unlike most popular tourist regions in South Africa, this particular region contains fairly limited information on recreational hotspots. As mentioned, the Eastern Cape possesses great potential for tourism development, and the Wild Coast stands out as one of the areas with the highest potential. Figure 29 depicts a varied level of alien plant cover for the region. Much like the landscape, the riparian zones are variable in alien plant coverage, ranging from low levels of impact, to moderate, to high levels of invasion.

University of Cape Town

East London - Eastern Cape Province

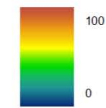


Legend

- East London
- No Data/Transformed Land
- National Route
- Road
- Railway Line

Invasive Alien Plant Riparian Zones

Value



Invasive Alien Plant Land Cover

Value



Projection: GCS WGS 1984
 Datum: July 2011
 Data Source: National Invasive
 Alien Plant Survey
 (Kotzé et al., 2010)



0 1.5 3 6 9 12 km



Figure 26 – East London, Eastern Cape

Sunshine Coast Popular Tourist Sites - Eastern Cape Province

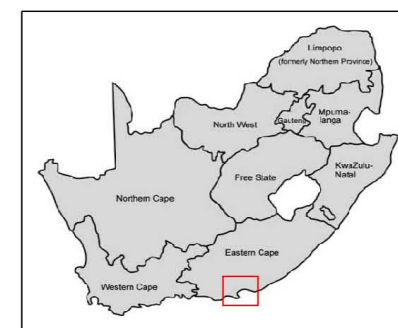
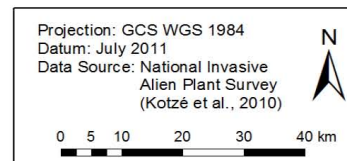
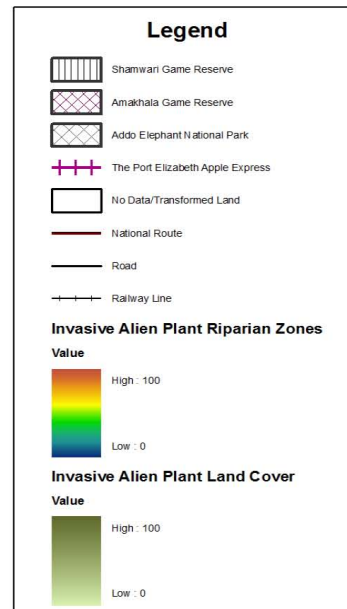
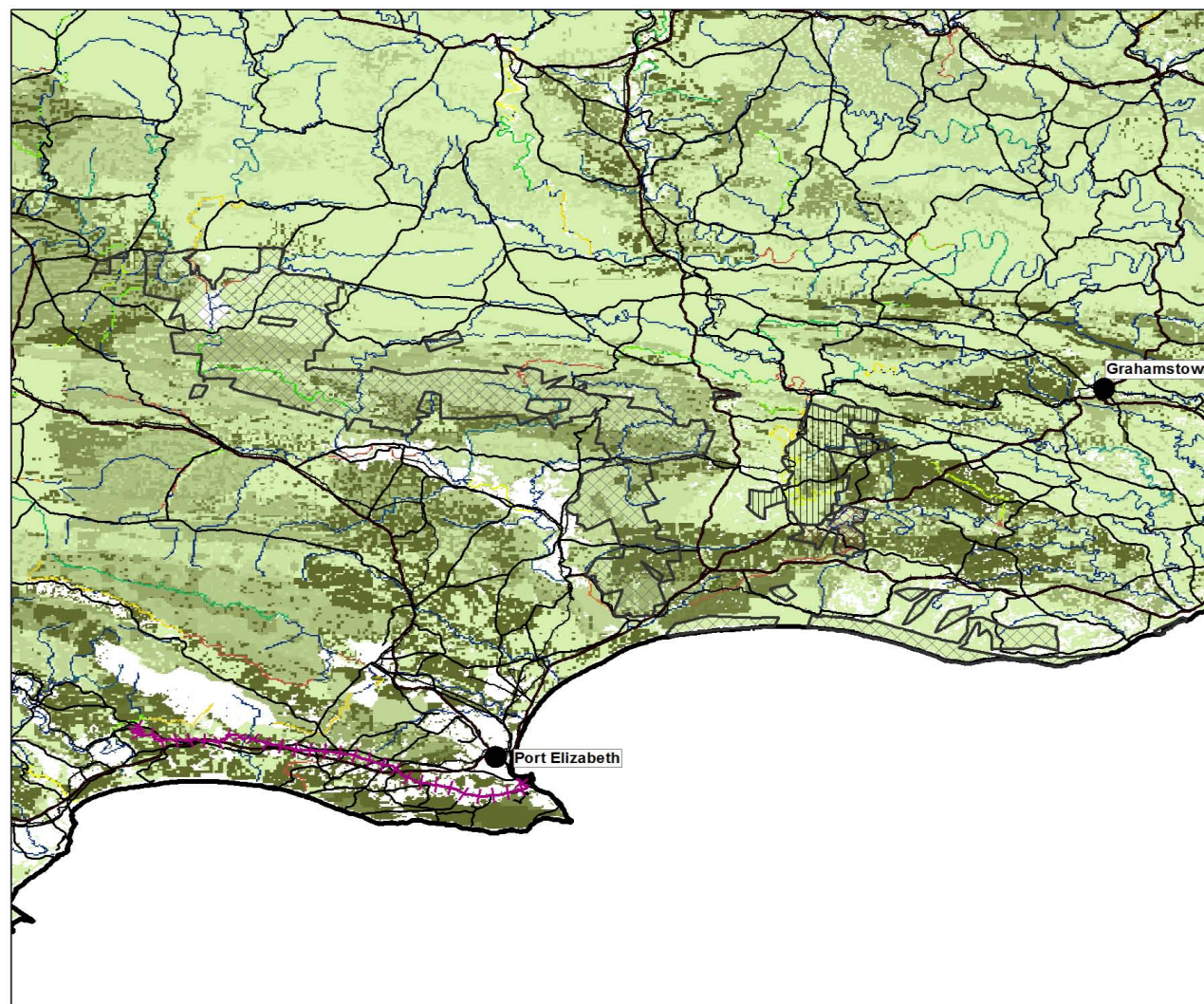
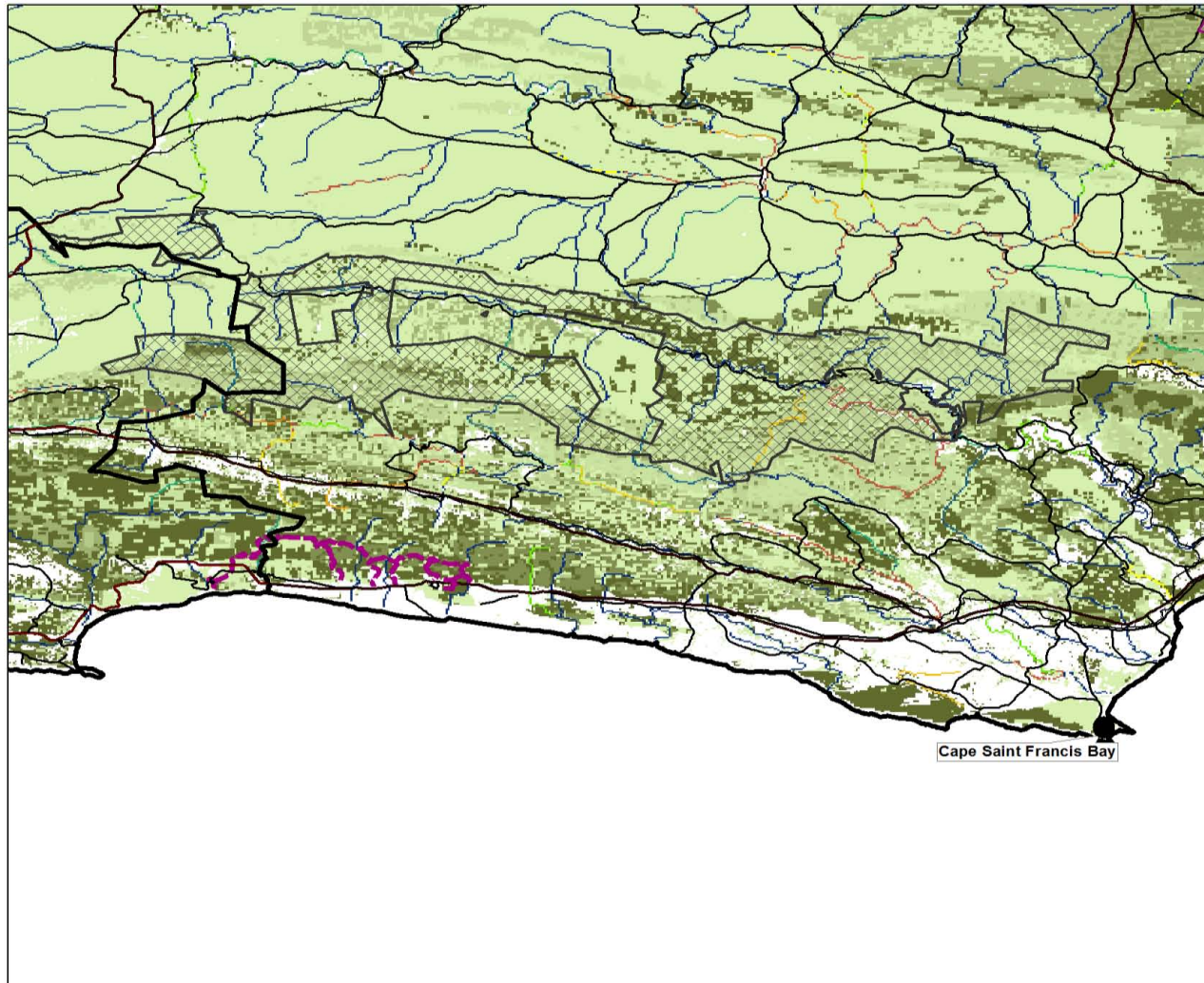


Figure 27 – Popular tourist destinations in the Sunshine Coast, Eastern Cape

Popular Tourist Sites - Eastern Cape Province

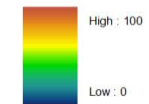


Legend

- Baviaanskloof Nature Reserve
- Tsitsikamma Hiking Trail
- No Data/Transformed Land
- National Route
- Road
- Railway Line

Invasive Alien Plant Riparian Zones

Value



Invasive Alien Plant Land Cover

Value



Projection: GCS WGS 1984
 Datum: July 2011
 Data Source: National Invasive
 Alien Plant Survey
 (Kotzé et al., 2010)



0 4.5 9 18 27 36 km

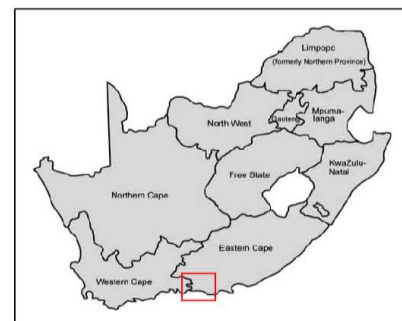


Figure 28 - Popular tourist sites in southern Eastern Cape

Wild Coast Popular Tourist Sites - Eastern Cape Province

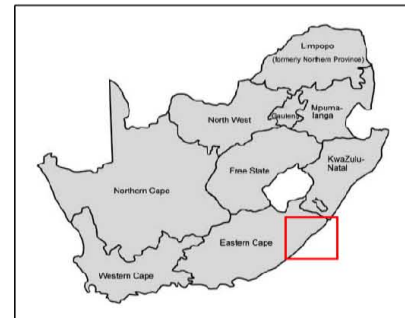
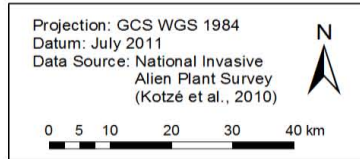
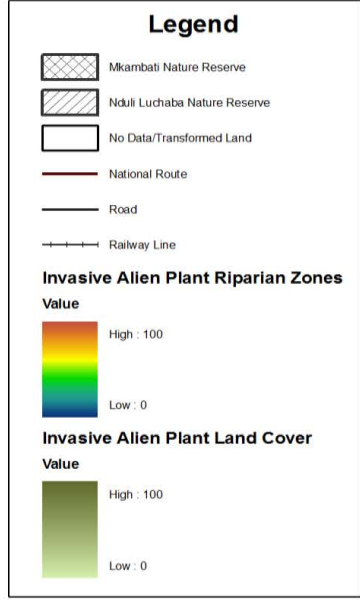
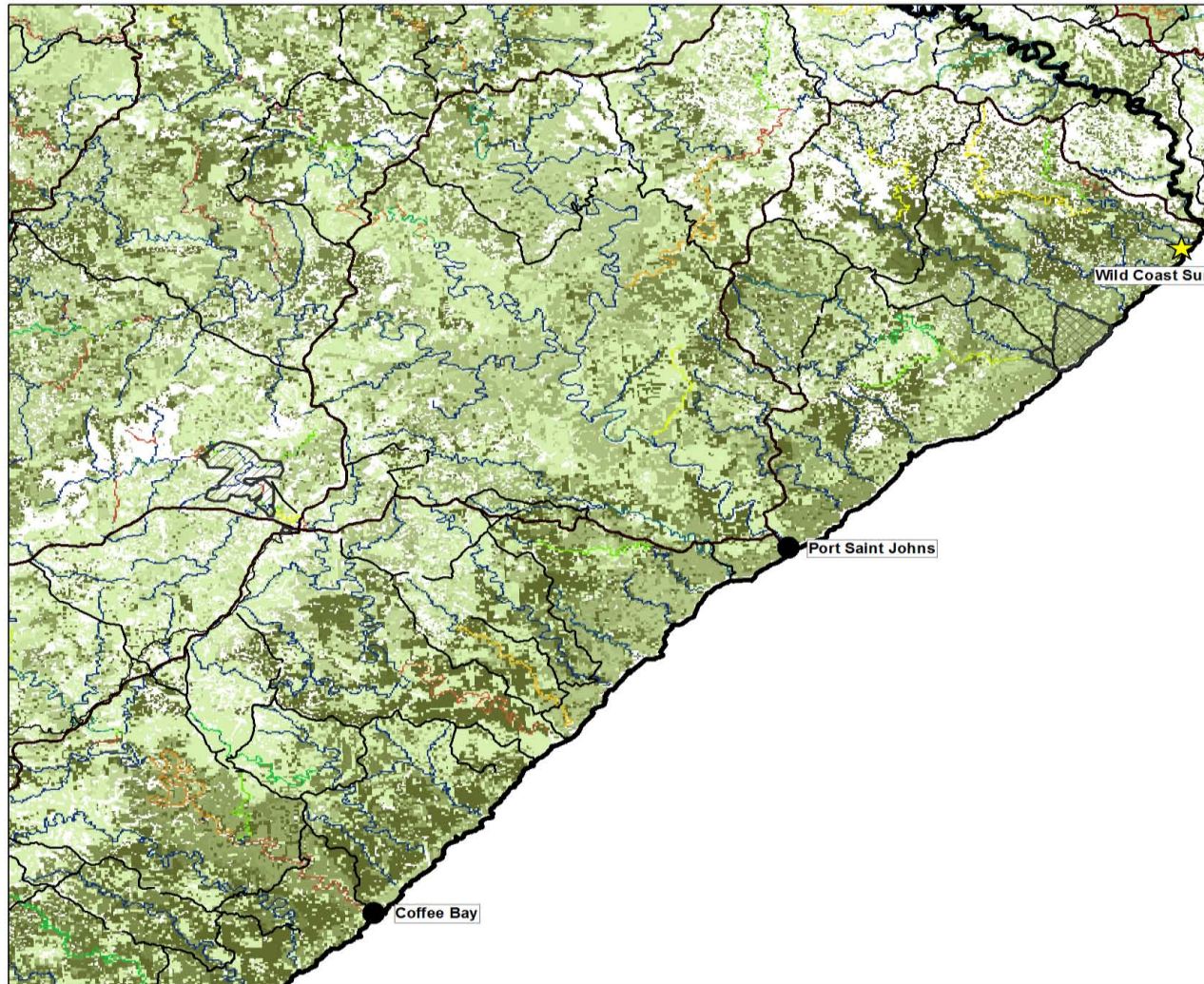


Figure 29 – Popular tourist sites in the Wild Coast, Eastern Cape

4.1.8 Western Cape

The Western Cape covers an area of 129 462 square kilometres, and contains a population of approximately 5.2 million people (Statistics South Africa, 2006). South African Tourism (2011), stipulates that of South Africa's top ten tourist destinations, four of them are found in the Western Cape. Of these top ten attractions, Cape Town and the Cape Peninsula takes first position as being the most popular tourist destination in South Africa, followed by the Cape Winelands in second, and the Garden Route in third.

Taking into account annual tourism statistics, the Western Cape Province can be considered the most popular tourist destinations in South Africa (South African Tourism, 2011). Numerous tourism sites, as well as recreational activities can be seen in table 10. Protected areas such as Table Mountain National Park and Jonkershoek Nature Reserve, are seen to be the most popular for hiking and viewing purposes. Activities such as fishing and mountain biking fluctuate between moderately popular to less popular. Much like KwaZulu-Natal, water based recreational activities are highly popular along coastal areas in the Western Cape. Other tourism sites such as Kirstenbosch Botanical Gardens, or the V&A Waterfront are predominantly popular for site specific purposes and activities. Sites such as Cape Point and the West Coast National Park are seen has hosting highly to moderately popular activities that cover various interests. Whale watching is another extremely popular tourist activity within the Western Cape, particularly in areas such as Hermanus, Arniston, and along the West Coast.

Assessing figure 30, it is clear that the Cape Town region is home to a variety of the provinces top tourist destinations (Cape Town and Western Cape Information Centre, 2011). If one travels north of Cape Town up the West Coast, a highly popular tourist destination particularly in the wildflower season, high levels of invasive alien plants can be observed along the coastline. Where much of the landscape in and around Cape Town and Stellenbosch is transformed due to urban development or farming occurring in the area, specific areas are protected under the Protected Areas Act 57 of 2003. These protected areas include Table Mountain National Park, as well as parks and reserves in and around Stellenbosch, Franschoek and Gordons Bay. However even though protected, figure 30 depicts a moderate to high level of alien plant infestation within certain areas of these sites. Most notable, include Jonkershoek Nature Reserve and Table Mountain National Park. In identifying such a significant overlap, it is also necessary to mention that in certain cases such as in the Table Mountain National Park, various other key tourist sites could be affected by the presence of alien vegetation. This could include highly popular tourist destinations such as Kirstenbosch Botanical Gardens and Chapmans Peak Drive for example. Whilst figure 30 depicts many riparian zones minimally affected by alien plant coverage, certain rivers throughout the region appear highly affected by alien plant infestation.

Table 10 – Alien plant coverage and activity popularity for major tourist sites in the Western Cape (less popular - v; moderately popular - √v; most popular - √√v)

Tourist Sites	Activities								Alien Cover Description
	Hiking and/or Walks	Viewing (game, landscapes whales, birds, etc)	Off-road driving	Cycling and/or Mountain Biking	Fishing	Heritage/Cultural	Water Activities (beaches, swimming, water sports, etc)	Site Specific and/or Other	
<u>Cape Town Region</u>									
Chapmans Peak Drive	√v	√√v		√v					Low Coverage
V & A Waterfront								√√v	No Data/Transformed Land
Boulders Beach		√v					√√v		Low Coverage
Camps Bay Beach							√√v		No Data/Transformed Land
Cape Point	√√v	√√v		√√v	√√v	√v	√√v	√√v	Low Coverage
Kirstenbosch Botanical Gardens	√v	√√v				v		√√v	No Data/Transformed Land
Table Mountain National Park	√√v	√√v		√v					High Coverage
Jonkershoek Nature Reserve	√√v	√√v		v	v			v	High Coverage
Cape Town	√√v	√√v		√v	√v	√√v	√√v	√√v	No Data/Transformed Land
Stellenbosch	√v	√v	v	√v	v	√v	v	√√v	No Data/Transformed Land
<u>Garden Route</u>									
Cango Caves		√√v				√√v		√√v	Low Coverage
Outeniqua Pass		√√v							Moderate Coverage
Knysna	√v	√√v	√v	√v	√√v	√v	√√v	√√v	No Data/Transformed Land
<u>Overberg</u>									
Hermanus		√√v			√v		√√v	√v	Moderate Coverage
Arniston		√√v			√v		√√v	√v	High Coverage
<u>West Coast</u>									
West Coast National Park	√√v	√√v		√v			√v	√v	Moderate Coverage
Groot Winterhoek Wilder. Area	√√v	√√v				v		√v	Moderate Coverage
Cederberg Wilderness Area	√√v	√√v				√v		v	Low Coverage
Lambert's Bay		√√v			√v		v		Moderate Coverage
Elandsbaai		√√v			√v		v		No Data/Transformed Land

Figure 31 reveals the alien plant coverage within the Garden Route, which hosts popular tourist destinations such as Knysna and Plettenberg Bay (South African Tourism, 2011). The figure portrays moderate to high levels of invasive alien vegetation occurring from George moving eastwards, right through to the Eastern Cape border. Conversely most of the rivers in this particular area appear less affected by alien plant infestation. Apart from scattered pockets of alien coverage in the northern parts of the image near the Cango Caves, most of the vegetation appears relatively low in alien plant cover.

Another highly popular tourist destination is the Overberg region, situated west of the Garden Route, and known especially for the world renowned whale watching sites in the area (Cape Town and Western Cape Information Centre, 2011). Figure 32 shows moderate to high infested pockets of invasive alien plants occurring in the region. More importantly concerning the whale watching sites, significant coverage appears to be in close proximity to the coast, as well as along the routes travelled by tourists to reach these sites. Particularly high coverage exists near Hermanus and Arniston, moving right into De Hoop Nature Reserve. Many riparian zones within these areas substantiate these results, appearing moderately to highly impacted by invasive alien vegetation.

Most of the upper regions of the West Coast appears relatively low in invasive alien plant infestation, apart from several pockets depicting moderate levels of invasion (figure 33). However in the southern region, including within the West Coast National Park, moderate to high levels of invasion can be deduced from the figure. Certain riparian zones in these southern areas verify the presence of alien infestation, being characterised by moderate to high levels of invasion, while further up the coast, riparian zones appear less affected.

Popular Tourist Sites in the Cape Town Region - Western Cape

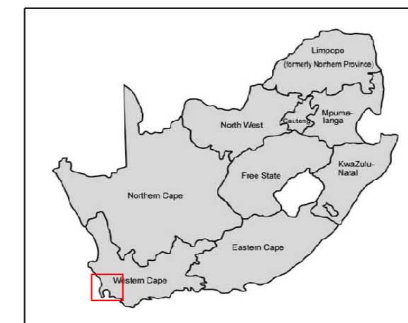
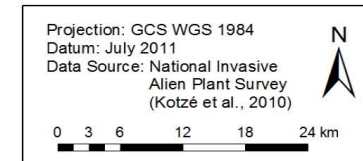
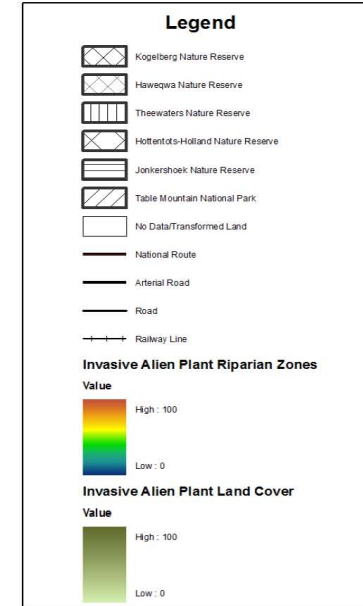
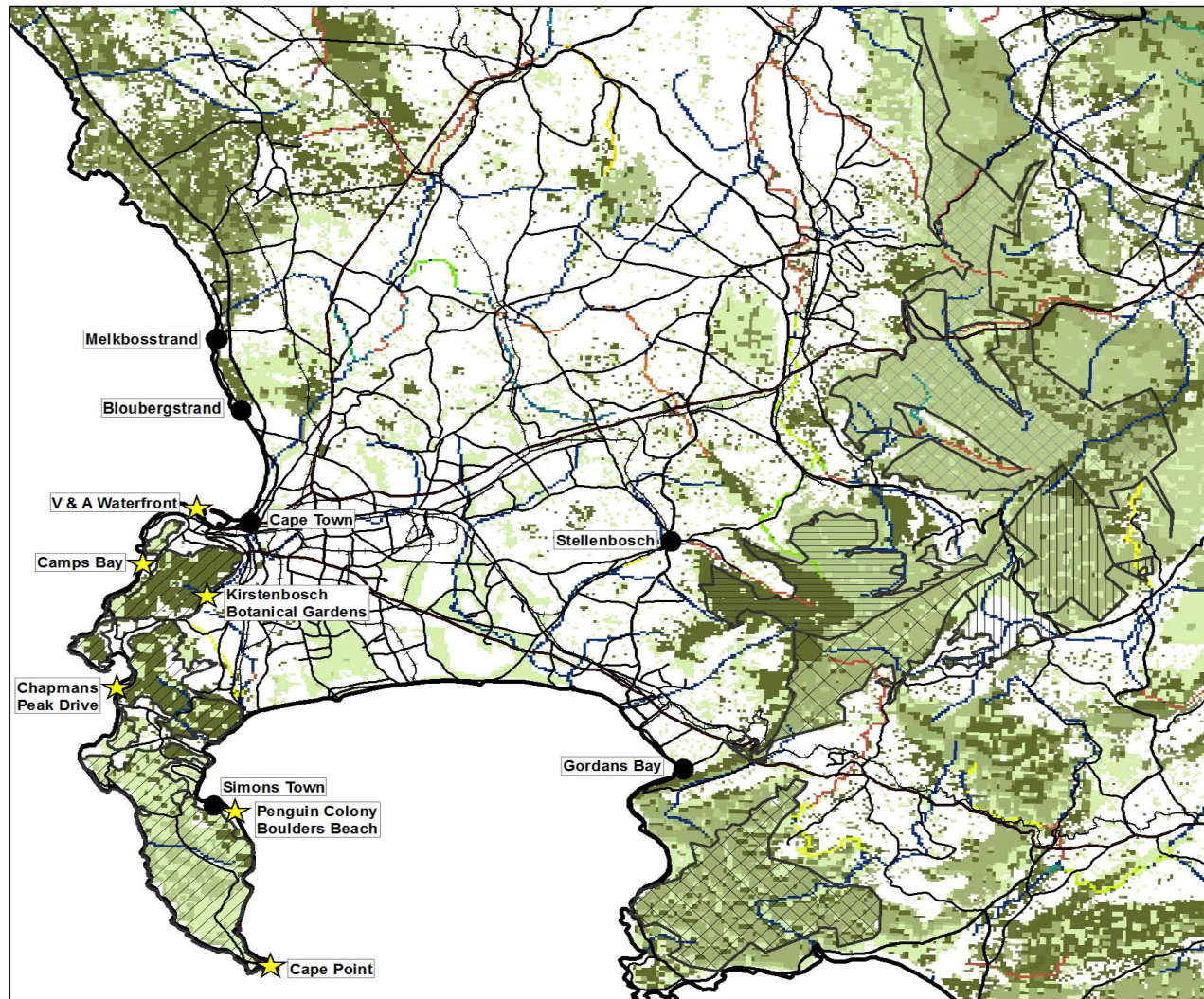


Figure 30 – Popular tourist sites in the Cape Town region, Western Cape

Popular Tourist Sites in the Garden Route - Western Cape

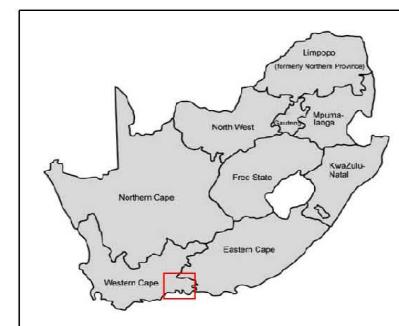
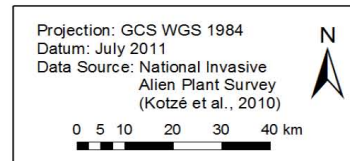
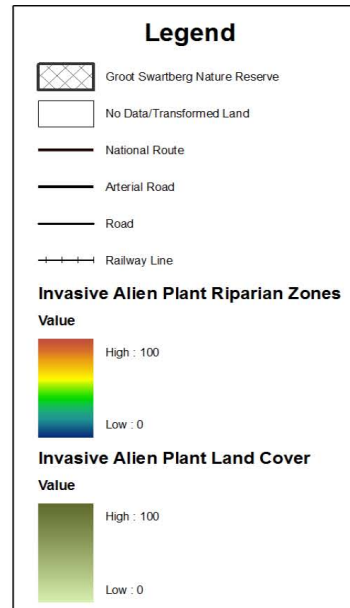
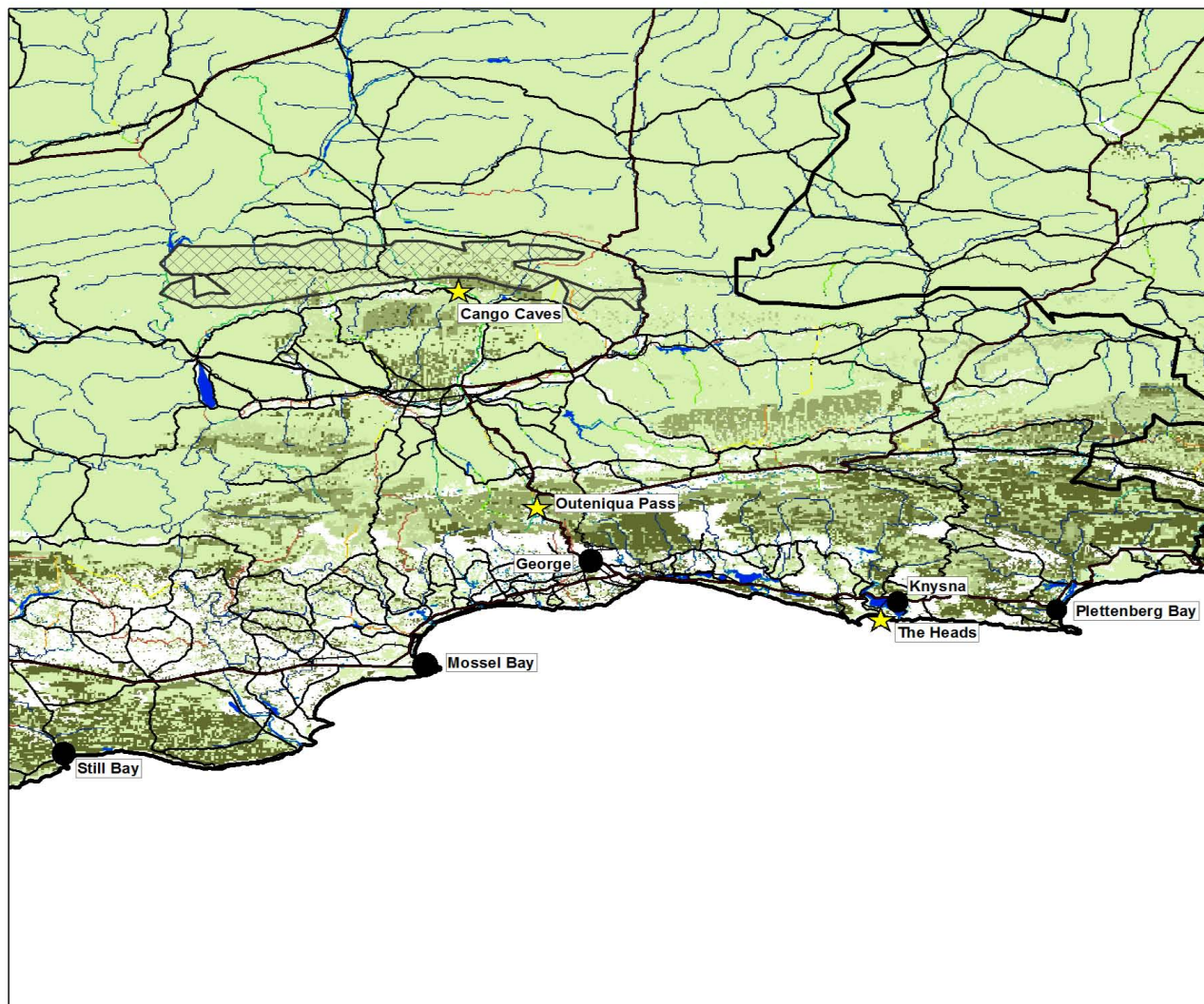


Figure 31 – Popular tourist sites in the Garden Route, Western Cape

Popular Tourist Sites in the Overberg - Western Cape

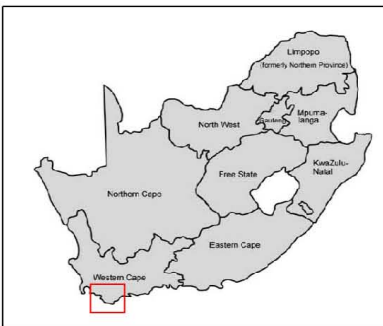
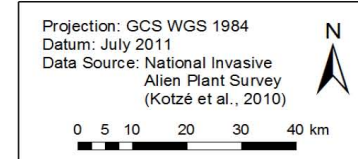
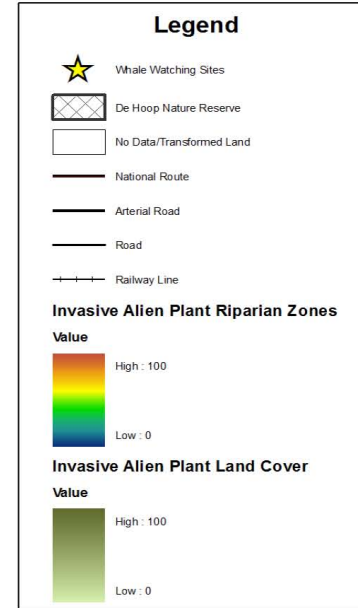
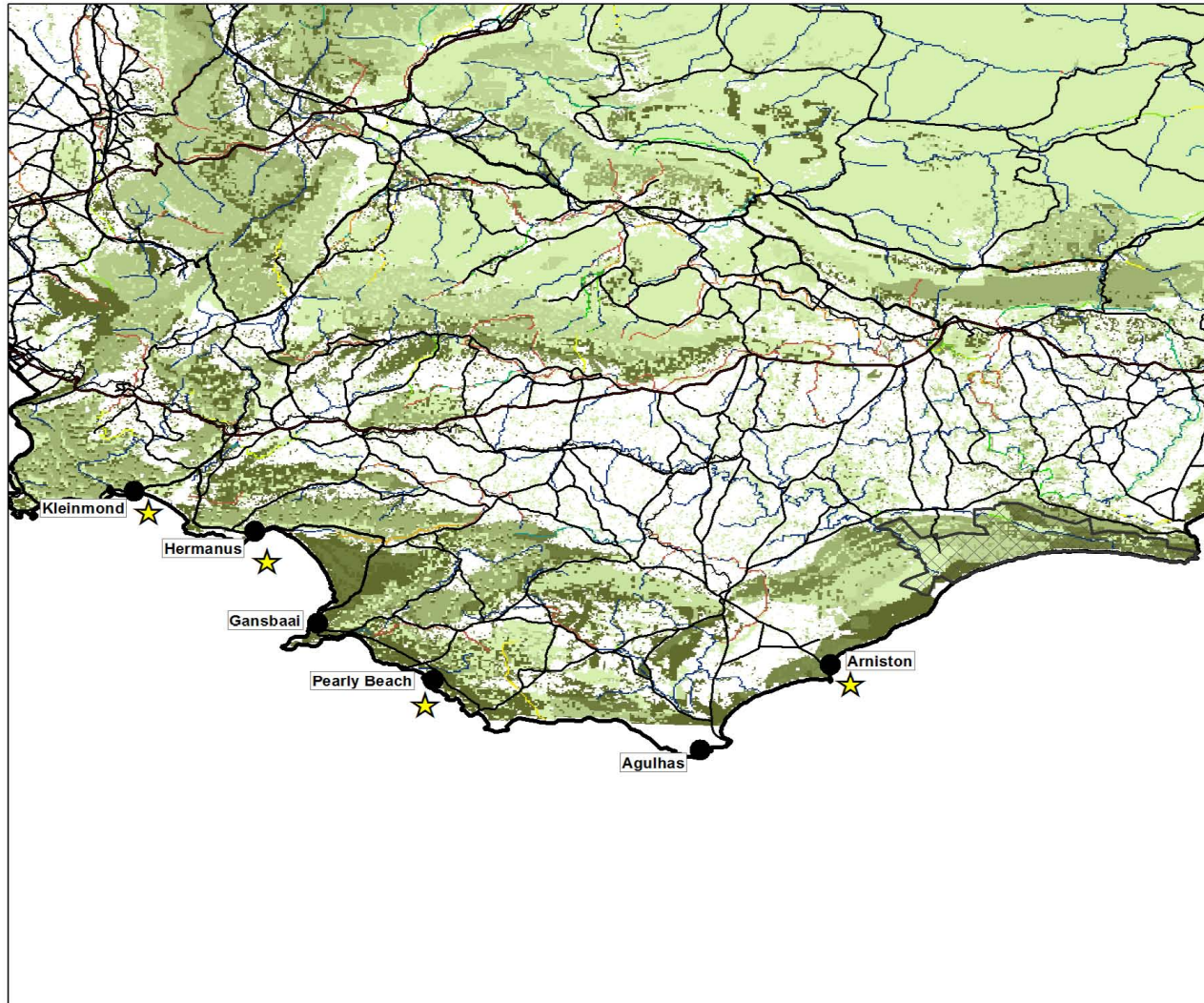


Figure 32 – Popular tourist sites in the Overberg, Western Cape

West Coast Popular Tourist Sites - Western Cape

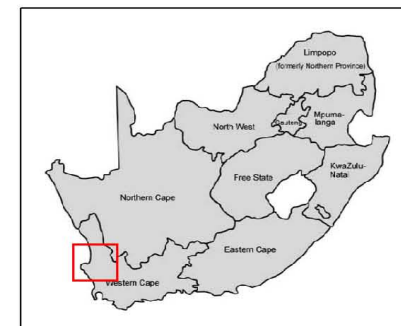
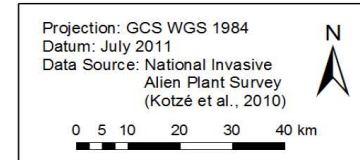
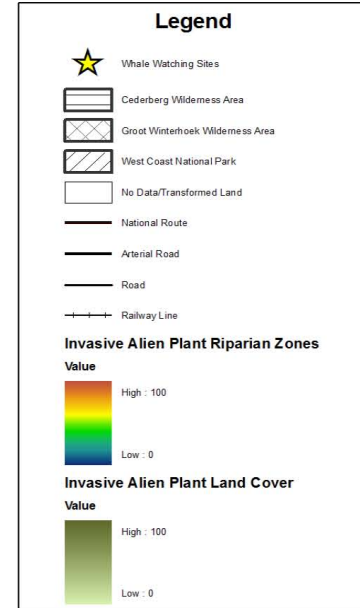
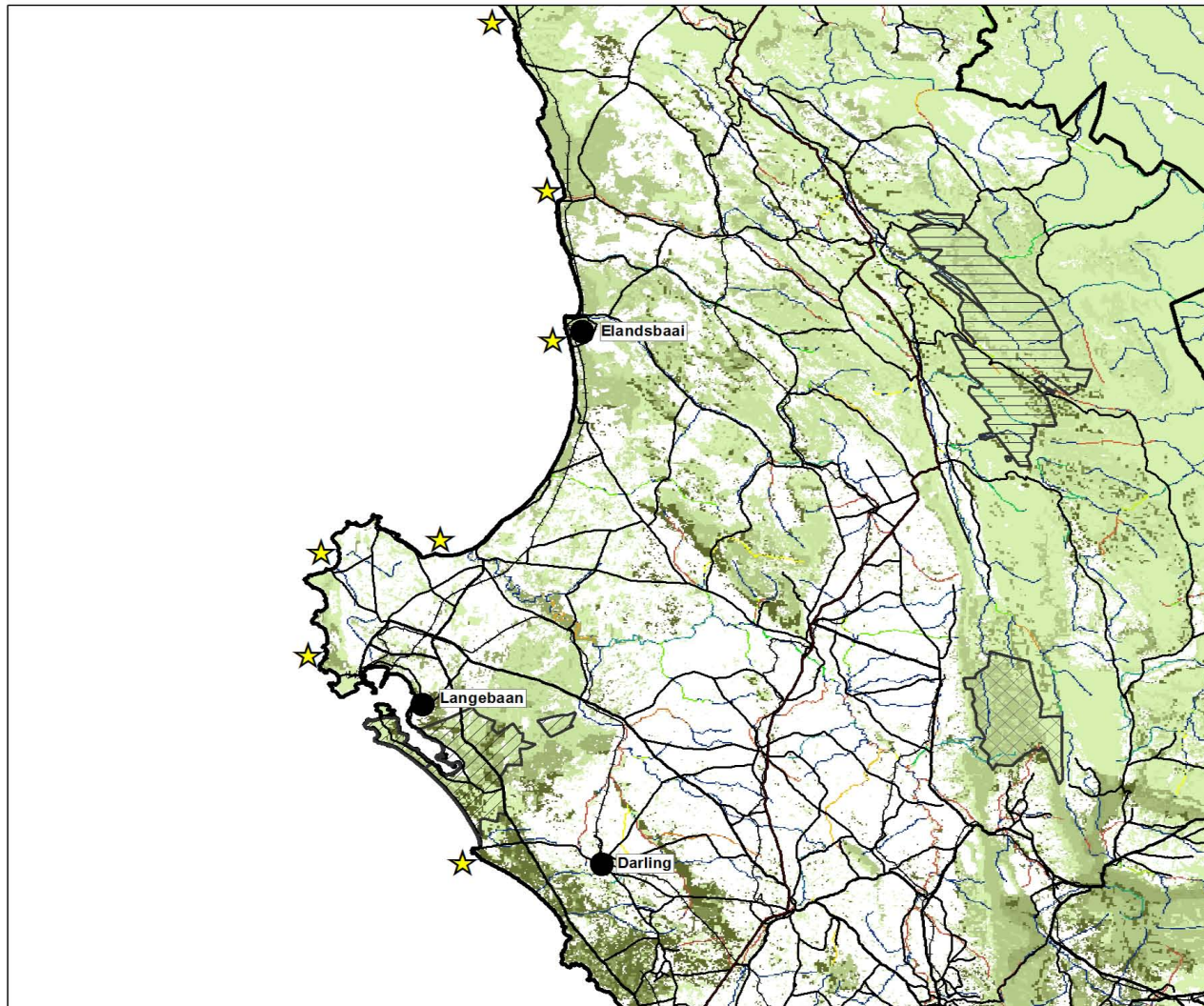


Figure 33 – Popular tourist sites in the West Coast, Western Cape

4.1.9 Northern Cape

With a population of approximately 850 000 people and covering an area of over 350 000 square kilometres, the Northern Cape is the largest province in South Africa, but also the driest (Northern Cape Tourism Authority, 2011). The province is predominantly characterised by large expanses of dry landscapes, part of the Succulent Karoo and Nama-Karoo biomes.

Table 11 depicts the various tourist sites within the Northern Cape, and the level of popularity of the activities within these sites. Overall it appears there is varying range of activities within the different sites, each depicting differing levels of popularity. More consistently, viewing is portrayed as being one of the most popular recreational activities within numerous tourist sites, such as the Richtersveld World Heritage Site and the Augrabies Falls National Park. Less popular activities include off-road driving and mountain biking in particular sites.

In the Namaqualand region, the most popular tourism capital is the wildflower season which brings in many tourists into the area annually (South African Tourism, 2011). Almost the entire region is free of invasive alien plant infestation (figure 34). The riparian zones demonstrate identical traits, with only a minority of rivers appearing moderately or highly impacted by alien vegetation.

In the northern region of the Northern Cape, lie popular tourist destinations such as Kgalagadi National Park and Augrabies Falls National Park, as well as the popular Orange river utilised by many recreationalists (Northern Cape Tourism Authority, 2011). Once again by examining figure 35 it can be seen that the majority of the landscape contains very little alien plant coverage. So too do the riparian zones which depict a lesser extent of alien plant infestation.

Also well known among tourists who visit the province is the town of Kimberly, famous for the mining in and around the area, and home to the Big Hole (South African Tourism, 2011). Much the same as Namaqualand, figure 36 portrays a landscape that is affected very little by the presence of invasive alien vegetation, and thus no significant overlap can be identified. Other popular towns in the Northern Cape (Northern Cape Tourism Authority, 2011) such as Colesberg and Calvinia depict similar results, where landscape coverage of invasive alien plants appears low. Where most rivers verify this low infestation, certain cases such as the Rietriver flowing through the area just north of Mokala National Park, is highly affected by invasive alien vegetation.

Table 11 – Alien plant coverage and activity popularity for major tourist sites in the Northern Cape (less popular - v; moderately popular - vv; most popular -vvv)

Tourist Sites	Activities								Alien Cover Description
	Hiking and/or Walks	Viewing (game, landscapes whales, birds, etc)	4x4ing	Cycling and/or Mountain Biking	Fishing	Heritage/Cultural	Water Activities (beaches, swimming, water sports, etc)	Site Specific and/or Other	
<u>Kimberley Region</u>									
Kimberley	v	vv		v		vvv		vvv	No Data/Transformed Land
- Kimberley Mine (The Big Hole)		vvv				vvv		vv	No Data/Transformed Land
Mokala National Park	vv	vvv		vv	vv		v	vv	Low Coverage
Vaalbos National Park		vvv						vv	Low Coverage
<u>Namaqualand Region</u>									
Namaqua National Park	v	vvv	v						Low Coverage
Orange River					vvv		vvv	vv	Low Coverage
Richtersveld National Park	vv	vvv	vv				v		Low Coverage
Richtersveld World Heritage Site	vv	vvv	vv			vvv			Low Coverage
Steinkopf	vv	vv	vv			vv		vv	Low Coverage
<u>Northern Region</u>									
Kgalagadi National Park	vv	vv	v						Low Coverage
Augrabies Falls National Park	vv	vvv	vv	v			vv	vv	Low Coverage
Belgravia	vv					vvv		vv	Low Coverage
Orange River					vvv		vvv	vv	Low Coverage

Tourist Sites in the Namaqualand Region - Northern Cape

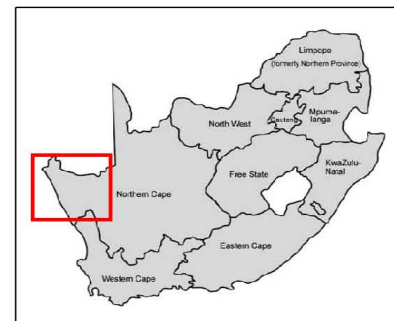
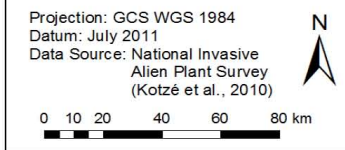
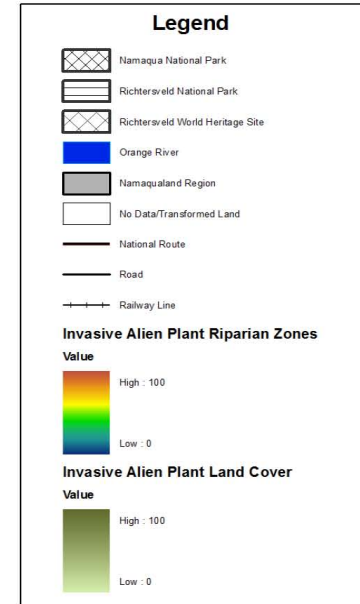
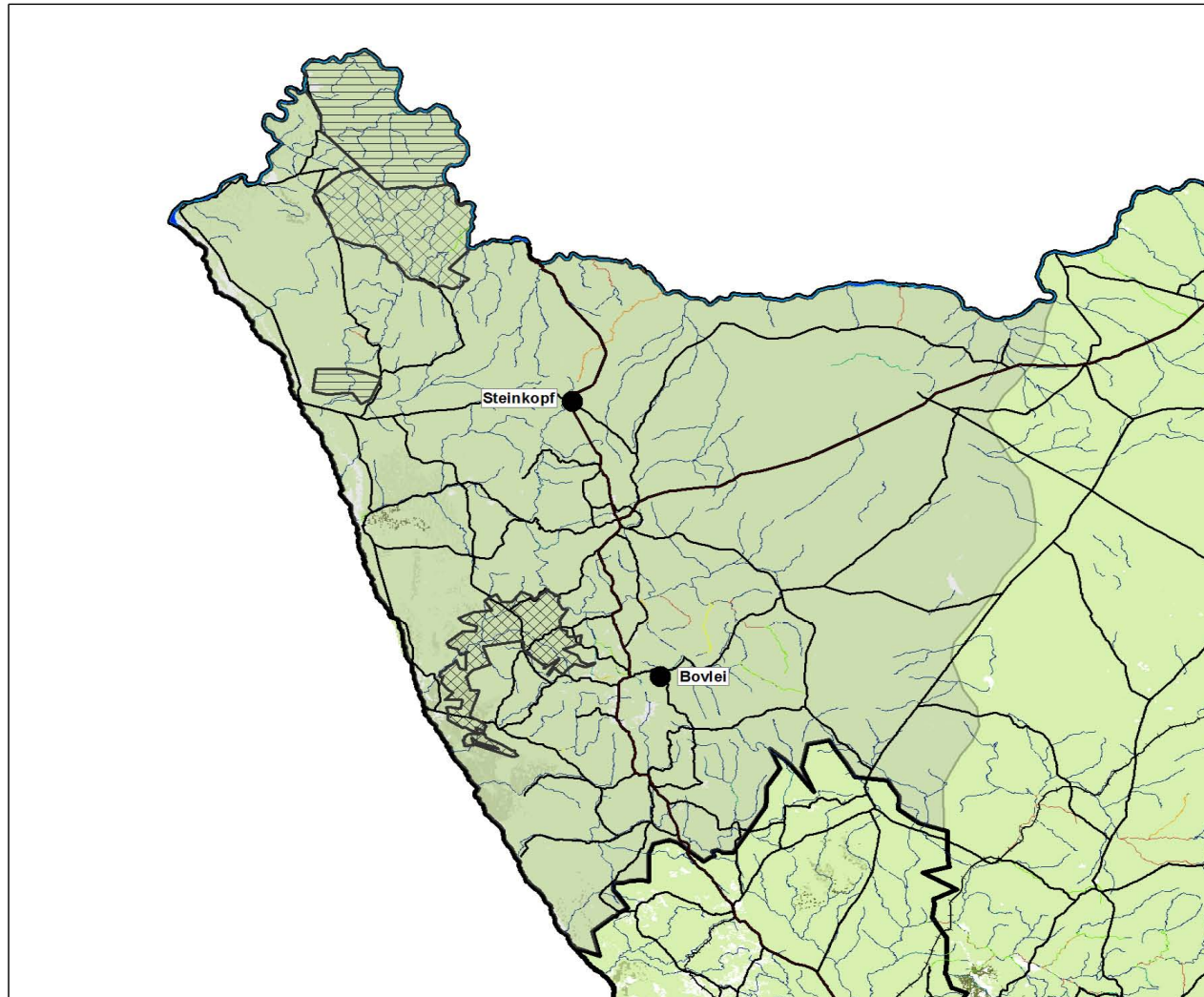


Figure 34 – Popular tourist sites in the Namaqualand region of the Northern Cape

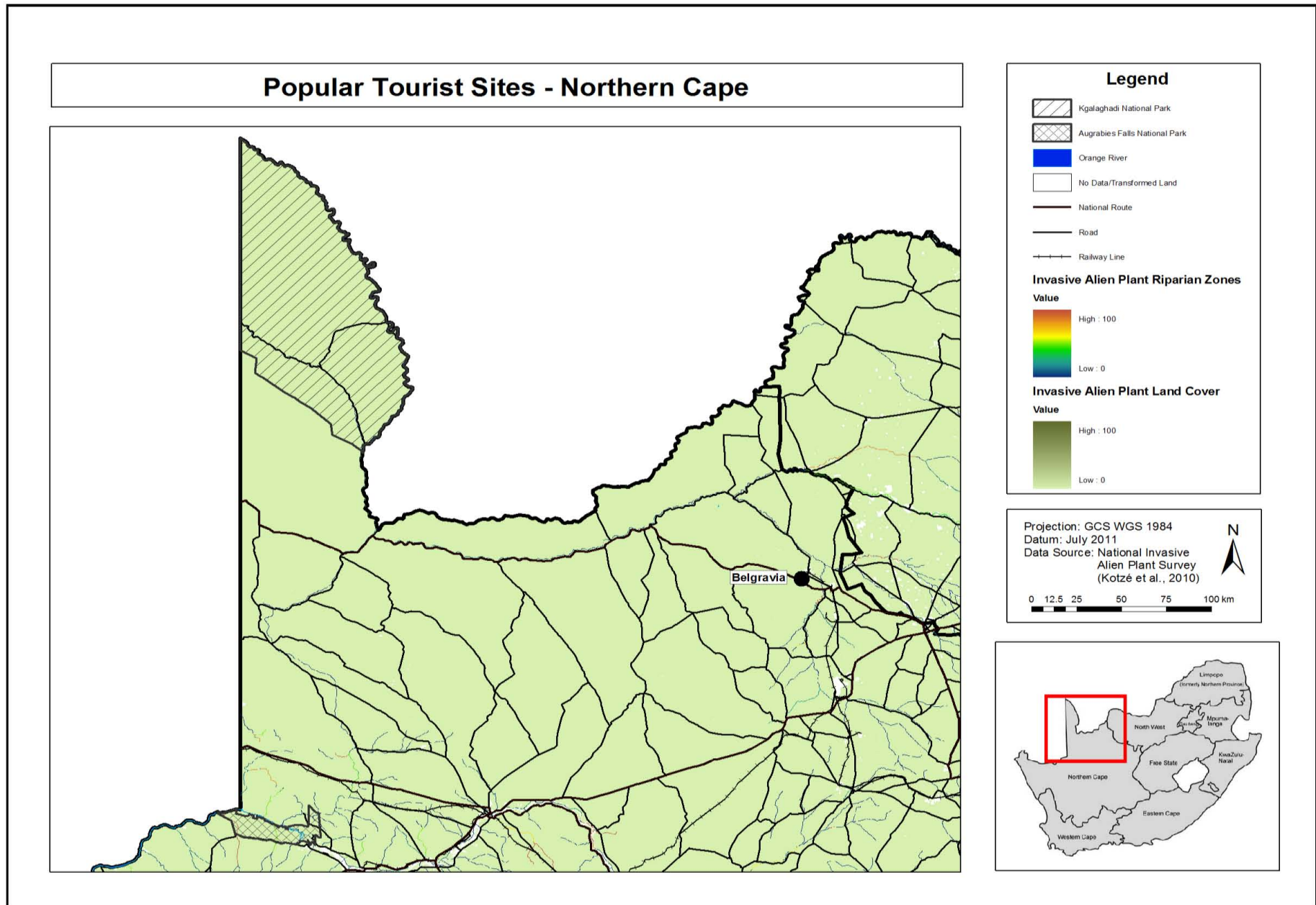
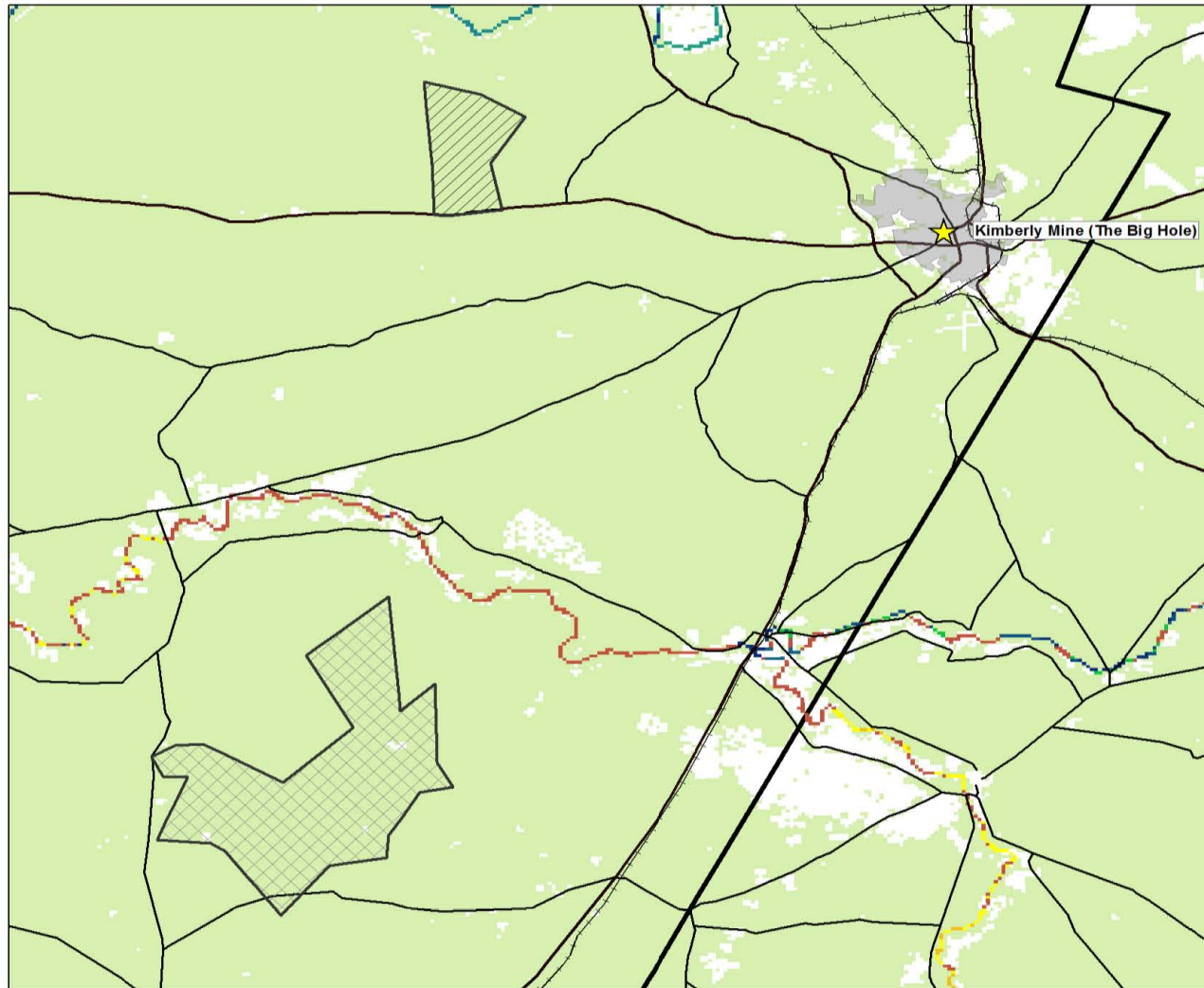
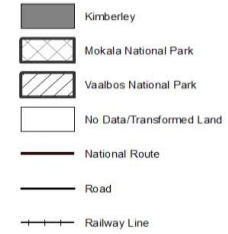


Figure 35 – Popular tourist sites in the northern region of the Northern Cape

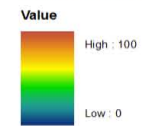
Popular Tourist Sites - Northern Cape



Legend



Invasive Alien Plant Riparian Zones



Invasive Alien Plant Land Cover



Projection: GCS WGS 1984
Datum: July 2011
Data Source: National Invasive
Alien Plant Survey
(Kotzé et al., 2010)

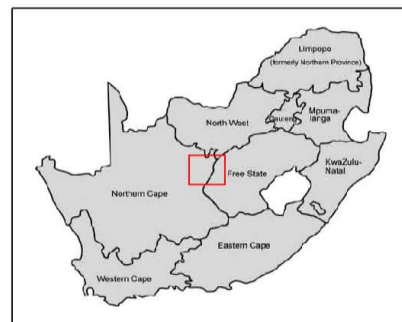


Figure 36 – Popular tourist sites in the eastern region of the Northern Cape

4.1.10 National scale alien plant infestation per activity

Based on the average alien plant cover for each of the eight tourist activities in each of the tourist sites identified across South Africa, the average coverage levels were determined at a national scale (figure 37). This was achieved by assessing each of the summary tables (table 3 through to table 11) regarding the alien vegetation cover for the tourist activities identified for each province. Each tourist activity identified bearing its specific coverage level, was then added up, and averaged out, to determine an average national depiction of the infestation levels concerning each identified activity.

Large portions of the areas these activities are situated in, display predominantly low infestation cover, with moderate coverage characterising slightly lower values. However all tourist activities identified, do constitute a percentage of highly infested alien plant cover, the highest activity being that of hiking and walking, followed by cycling and mountain biking, off-road driving, and viewing, respectively. The tourist activities with a noteworthy portion of their area characterised by no data or transformed land include: cultural and heritage based activities; off-road driving; and cycling and mountain biking, respectively.

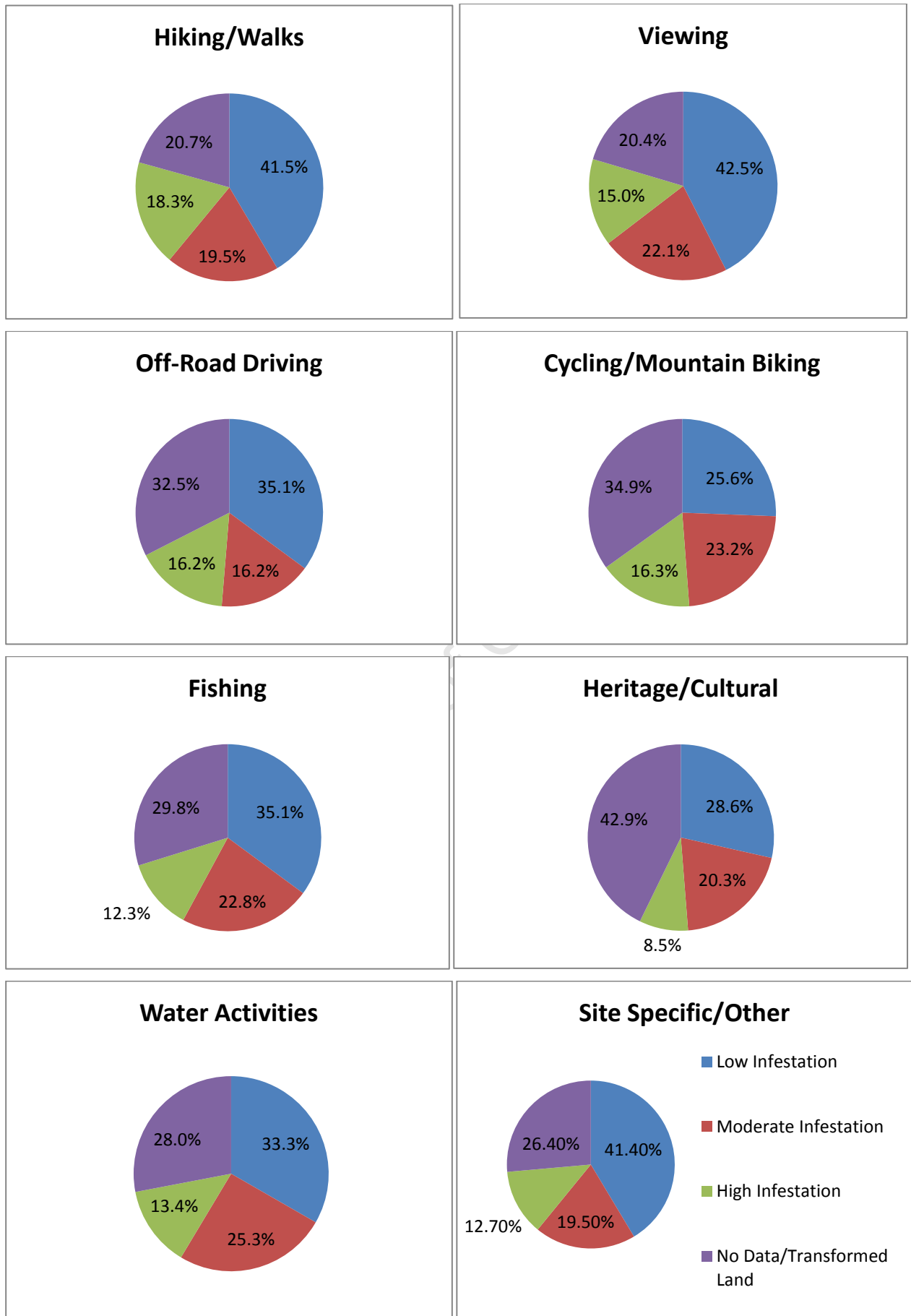


Figure 37 – Average levels of alien plant infestation per activity at a national scale

4.2 Case study analysis results: Stellenbosch municipality

The feedback and responses collected in the case study varied. Interviews ranged from approximately eight to thirty minutes depending on stakeholder responses, particularly concerning the open ended questions where responses varied in length due to their subjective nature.

4.2.1 Tourist questionnaire results

With regards the tourists interviewed, the results depict a range of responses. This includes factors such as: the average tourists knowledge of invasive alien plants; the potential effects these invasive alien plants have on their recreational activity; how they feel about alien plants being present in their recreational activity; their preferences towards invaded versus non-invaded vistas; as well as their willingness to pay extra fees for the removal or prevention of invasive alien flora. The sample included tourists from the Western Cape, tourists from the rest of South Africa, as well as tourists from around the world (figure 38).

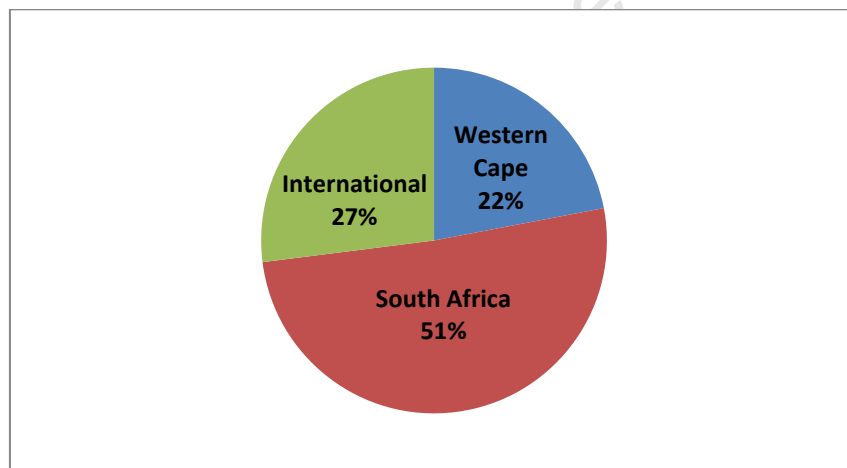


Figure 38 – Origin of tourists interviewed

The results show a variable account of age and gender statistics for the sample group (figure 39). Of the total number of tourists interviewed, 67% of the questionnaires completed were carried out in Jonkershoek Nature Reserve, whilst 33% were completed on a private wine farm. Looking specifically at the tourists interviewed at Jonkershoek Nature Reserve, the results depicted that 66% of the tourists were interested in hiking or walking, 25% in viewing (landscape and/or fauna and flora), 6% in recreational fishing interests, and 3% in mountain biking. Looking at the tourists interviewed on the wine estate, the results depicted that 77% of the tourists stated the reason for their visit, was for the wine farm itself, and the wine tasting activity. Of the remaining tourists, 17% stated their reason for visiting was for site specific reasons, such as the spa or restaurant on the premises, while 6% explained they were holiday makers.

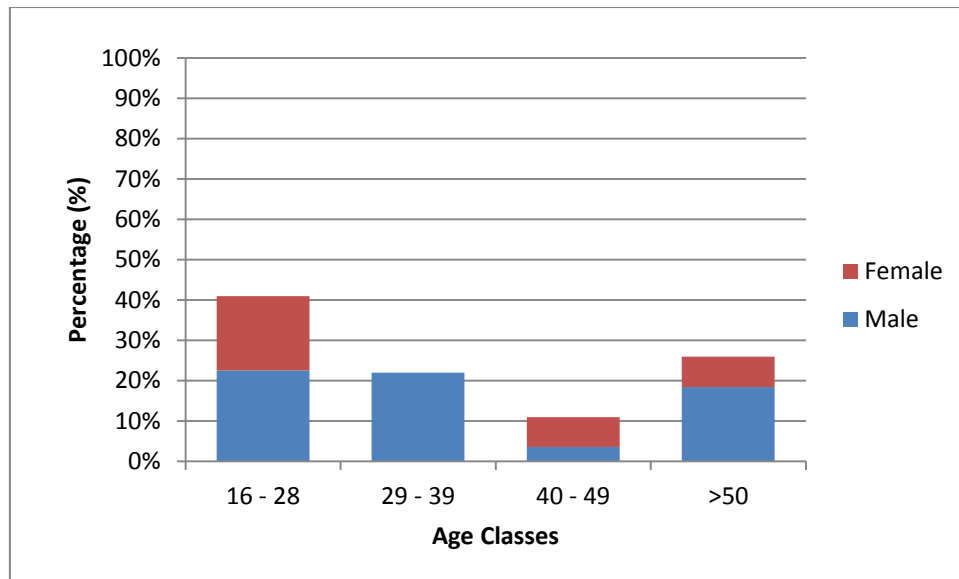


Figure 39 – Gender and age characteristics of tourists interviewed

Combining both locations and reviewing the total number of tourists interviewed, the primary reason stated by the respondents for partaking in the tourism activity was identified. The results show that 41% of tourists explained they do so for entertainment reasons, 43% for relaxation, and 16% for exercise or health reasons. As far as transport is concerned, 91% of the respondents used cars to reach the tourist sites, while 6% walked, and 3% used bicycles. Table 12 represents the responses of tourists regarding the natural assets they most value in the recreational activities they partake in. The results illustrate that most tourists place a moderate, to high value on natural assets such as flora and fauna, while even higher value is placed on views and landscapes. When asked how important the recreational activity or the area and proximity of the recreational activity is to the tourist, 0% of the respondents replied no value or slight value, while 63% found it to be moderately important, 30% highly important and 7% most important.

Table 12 – Natural assets most valued by tourists

Natural Feature	No Value	Slight Value	Moderate Value	High Value	Most Value
Flora	0%	19%	33%	37%	11%
Fauna	0%	11%	41%	41%	7%
Landscape	0%	0%	15%	63%	22%
Views	0%	0%	15%	52%	33%

With regards the questions that sought to identify the tourists general knowledge of invasive alien vegetation, the results depict that 26% of the respondents did not know what invasive alien plants were, while 74% did. Figure 40 depicts these statistics on environmental knowledge regarding invasive alien plants, plotted with the relevant age distribution. For each age group category, the red bar represents the percentage of respondents that did know what invasive alien plants are.

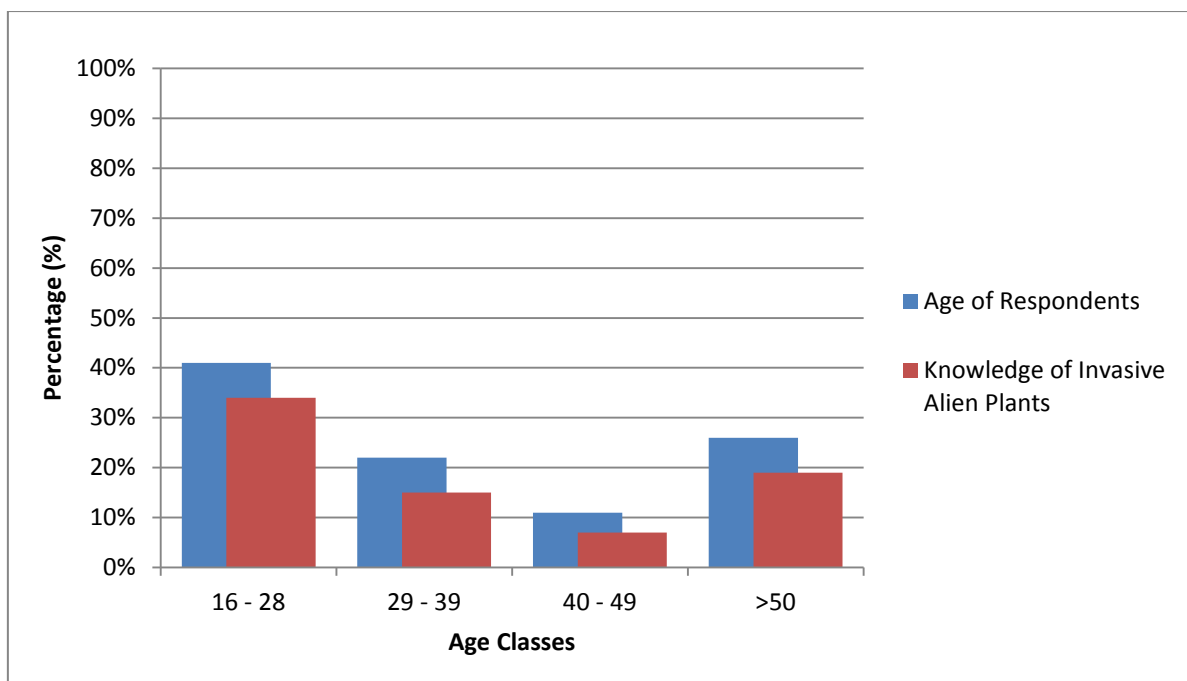


Figure 40 – Environmental knowledge of tourists per age group

Of the tourists that frequently visit the recreational site, 63% of them did not notice a change in alien plant coverage (growth or decline), while 37% did. One tourist commented that he has noticed a decrease in water levels and a decline in species biodiversity. In total, 59% of tourists explained that they are in fact aware of the negative impacts and consequences associated with invasive alien vegetation. When asked if the presence of this invasive alien vegetation affects their recreational experience negatively in any way, 44% responded yes, while 56% said no (figure 41). One particular tourist commented that in the past they have experienced problems concerning access to particular routes due to presence of alien vegetation in the area.

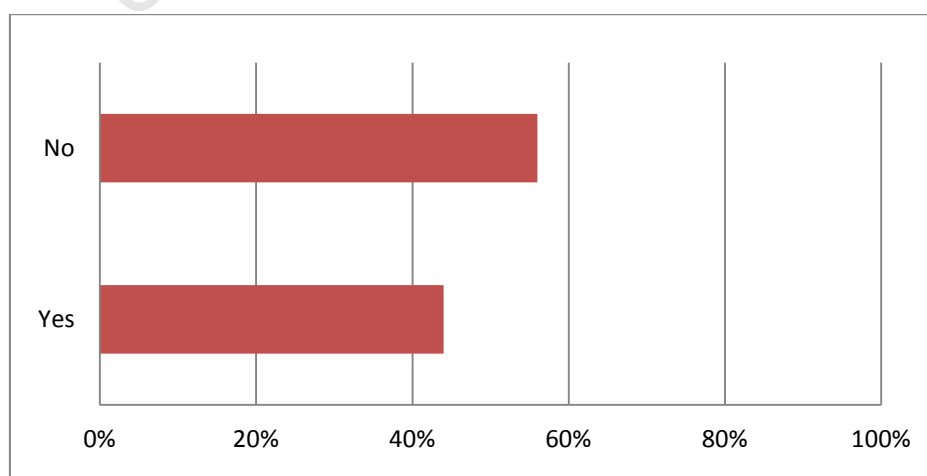


Figure 41 – Respondents views on whether invasive alien vegetation impact their tourism experience

When respondents were asked if they would be willing to pay more for the recreational experience to clear the alien vegetation, or prevent future invasion occurring, 63% agreed yes, while 37% said no. Figure 42 depicts the ratio of the respondents who were willing to pay more (red bar), categorised into their respective age grouping. The figure reveals that all of the respondents in the fifty and up age category were willing to pay extra, while in youngest age grouping, a far lower percentage of respondents were willing to pay more. Combining all the respondents who stipulated their willingness to pay more, they were then asked how much more would they willing to pay. The results suggest 47% of tourists agreed they would pay one and a half times the original amount to partake in the activity, while 53% were willing to pay twice the original amount. None of the tourists questioned were prepared to pay amounts higher than twice the original amount to partake in the activity. One tourist commented he would only be willing to pay as much as twice the monetary amount, as long as he knew exactly the benefits he would be receiving, like experiencing better views for example.

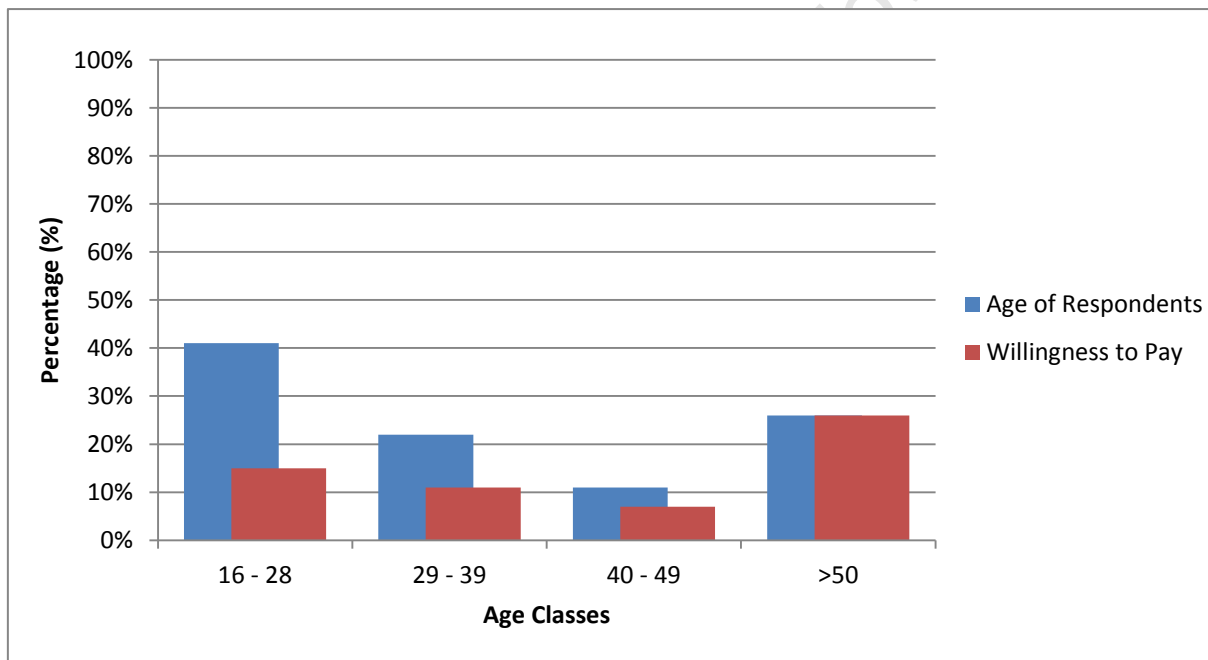


Figure 42 – Tourists willingness to pay per each respective age grouping

Each tourist was then asked how much they value the views and line of sight the recreational experience provides. In total, 26% of the respondents felt it had moderate value, 59% felt it had a high value, and 15% felt it had the most value. None of the respondents felt the recreational activity’s views and their line of sight had no value or slight value. When asked if the invasive alien plants hinder their line of sight at all, 56% responded yes, while 46% said they had no effect. Lastly, pictures were shown to respondent of invaded landscapes and riparian zones, versus pictures of pristine landscapes and riparian zones. In total, 89% of the respondents said they preferred non-invaded landscapes and riparian zones, while 11% of the tourists questioned preferred the pictures of invaded vistas (figure 43).

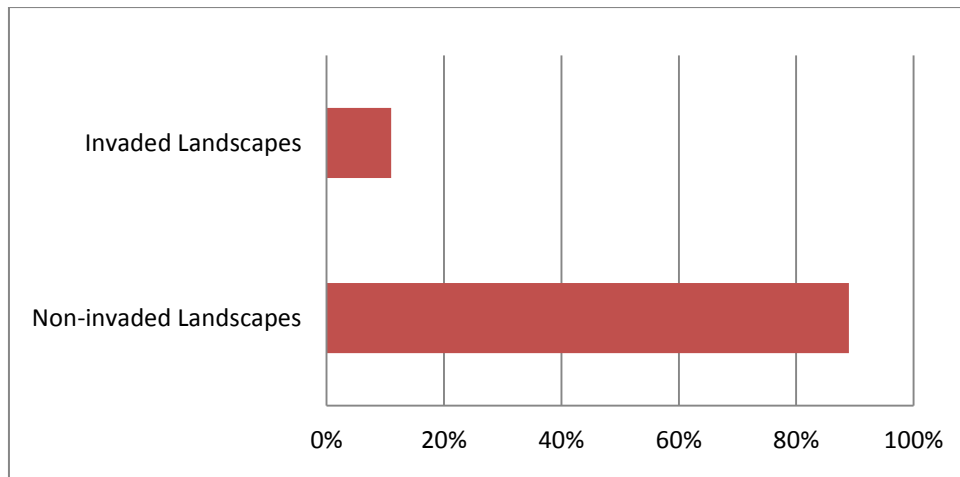


Figure 43 – Tourists preferences concerning invaded versus non-invaded landscape

4.2.2 Tourism operator questionnaire results

Of the four tourism operators interviewed, all claimed to know what invasive alien plants are, as well as the negative impacts associated with them. When asked if these negative impacts, and which ones in particular, affect their tourism operation, the responses varied. Two of the respondents commented that if left unattended, the alien vegetation would grow out of control, which in turn would cause access issues to certain routes and paths within the operation itself. One respondent explained that the main issue they were experiencing due to alien vegetation was the large amounts of water they consume on their establishment. Another tourism operator commented that when hosting certain corporate and social events, such as an expo or the launch of a new product or a project that involves the community, certain clients will seek to host such events in pristine environments. In such cases the excessive presence of alien vegetation could affect the pristine and intrinsic value their establishment would be able to offer. The example the tourism operator gave was if their client wants to show off the renosterveld as part of the event, the presence of alien vegetation could become a problem and measures would need to be taken to mitigate the alien plant coverage.

When asked if these negative impacts caused by the invasive alien plants affect the tourists experience negatively in any way, the results again varied. Two of the tourism operators replied yes, one said no, while the other was unsure, but commented possibly. When asked if the tourists themselves ever ask any questions regarding alien plants, all the respondents replied no. However one tourism operator explained that occasionally if they see plants and trees cut down, or in the process of getting cut down, this can prompt them to ask why the vegetation is being cut down. They stipulated that this has sometimes been difficult to explain, as the tourists might not understand the reasons behind it, and it could leave a negative impression.

As far as additional costs incurred on the tourism operation due to the presence of invasive alien vegetation, all the respondents had similar views. All four tourism operators explained that trying to prevent or remove invasive alien vegetation incurs variable costs, depending on the location and severity of the alien plant coverage. Actual amounts could not be verified, but between the tourism operators, the extent and severity of alien plant coverage varied, and therefore so did their costs.

4.2.3 Land owner questionnaire results

All the landowners interviewed knew what invasive alien plants are, and the negative impacts associated with them. Conversely when asked if they could give examples of the negative consequences experienced, the nature of the answers varied. One landowner commented that one of the biggest negative impacts they experience on their farm is the visuals and aesthetics that are impaired due to the spreading and growth of invasive alien plants. They explained that if they do not attempt to keep the growth of alien vegetation under control, the natural fynbos would be overgrown. They also commented that these prevention measures also help sustain the natural heritage of the farm.

The negative effects of water consumption and being potential fire hazards, were also mentioned as reasons why these landowners continually undergo alien vegetation clearing and prevention measures. Certain respondents explained that currently the level of invasion on their farms is low and they are happy with the results of their efforts over the years. When asked on the costs involved, one respondent expressed that it is very difficult to give an accurate answer as costs incurred fluctuate from season to season. Another landowner commented that the biggest problem he experiences due to invasive alien plants on his property is the high levels of water consumption they impose. Due to the high costs involved with clearing this invasive vegetation, the landowner stated that only areas of high importance are kept alien plant free, whilst areas of less importance on the farm are left unattended. Due to the excessive costs, a certain degree of prioritisation is deemed necessary by the landowner.

When asked on the consequences of alien vegetation, an owner of a wine farm expressed his feelings that a major drawback to alien plant presence is that visitors want to see natural biodiversity, “as rich a biodiversity as possible”. This particular landowner also indicated a monthly budget for clearing alien vegetation, but again stipulated that costs fluctuate. However the most notable comment made by the landowner was that if the spreading of invasive alien plants on their property was left unattended and unmanaged, they would not be able to advertise and market their establishment as being pristine, and promote the natural flora on their farm.

Another one of the landowners commented that as far as the negative effects of invasive alien plants on their property, they experience a combination of problems concerning issues with access, views, and water consumption. Furthermore the landowner interviewed explained that there was a large fire that occurred in 2008, and the presence of alien vegetation was partly to blame. The estimated costs to the farm due to the fire was approximately R200 000. Additional costs to the landowner due to alien plant invasion incur continual clearing costs. This particular landowner estimated that on average, he spends approximately R10 000 each month on costs related to the clearing and/or prevention of invasive vegetation.

Tying together both the national analysis results, as well as the case study results, a platform is set to discuss key findings in more detail. Important findings regarding overlaps with tourist sites and invasive alien vegetation, methodological considerations, as well as concerns around the possible negative effects and resultant consequences of alien plant invasion, will be the areas of discussion targeted in the section to follow.

5. DISCUSSION

Where the central aim of this research is to establish the relationship between invasive alien plants and the tourism sector in South Africa, the results obtained shed light, and expand our knowledge on this relationship. Consideration is given to the degree of overlap between tourism sites and invasive alien plants, the significance of this overlap, how it is perceived, and how this relationship manifests itself within the tourism sector. Also looking at: the specific tourism sites chosen; the popularity levels of the different activities each site offers; what recreational activities they provide; and to what degree the tourists who participate in these activities are affected by invasive alien vegetation, noteworthy findings are discovered.

5.1 Tourism features and invasive alien plants: Geographic overlaps identified

The quantitative results indicate that each province in South Africa has variable levels of alien plant infestation, as well as variable levels of tourism and recreational value. The most heavily invaded provinces in South Africa include the Western Cape, the Eastern Cape, and KwaZulu-Natal. As noted in figure 4, certain areas, primarily in the Western Cape, are currently classified as critically endangered ecosystems (Department of Environmental Affairs: State of the Environment, 2007). The results portray these three provinces as the regions in South Africa that raise the most concern, when considering the negative effects associated with invasive alien vegetation. These findings demonstrate that the highest infestation, naturally leads to the greatest overlap. Within all of these three provinces, key protected areas such as national parks and reserves, as well as various other tourist sites and activities, display moderate to high levels of alien invasion. These three provinces also contain some of the most popular tourist destinations in South Africa, particularly along or near coastlines (South African Tourism, 2011). These include popular tourist destinations in regions such the Garden Route, the Overberg, the West Coast, Cape Town, eThekweni-Durban, the Sunshine Coast, uKhahlamba-Drakensburg, and the Elephant Coast.

Limpopo, Mpumalanga, and the Free State show predominantly lower levels of alien plant invasion. However the maps generated do highlight scattered pockets of moderate to high alien plant infestation in certain areas, and therefore site specific cases, where alien infestation overlaps with popular tourist sites. Among these, were popular tourist destinations, particularly specific national parks and game reserves. In light of the fact that the biggest tourism draw cards in provinces such as Limpopo and Mpumalanga are the national parks and game reserves (South African Tourism, 2011), these findings are important and highlight overlaps between key tourism sites and invasive alien vegetation. These findings point towards managerial and administrative issues that need to be addressed within certain national parks and game reserves, especially if one considers the principles and legislative parameters expressed in the Protected Areas Act 57 of 2003.

Apart from protecting and enhancing the natural biodiversity in a specific area, two of the key principles set out in the Protected Areas Act 57 of 2003 are to: ensure the provision of environmental goods and services; and, to provide for nature-based recreation and tourism opportunities. If a moderate to high presence of alien vegetation exists within specific protected areas in South Africa, these highlighted principles are compromised. This further highlights the constant challenge alien plants pose, and the need for strategic prioritisation in managing them effectively.

In provinces such as the Northern Cape and North-West Province, invasive alien plant infestation was seen to be relatively low. In these regions, there is little overlap between alien vegetation and key tourist sites. The results show nearly all popular tourist sites as minimally affected by the presence of alien vegetation, and therefore these regions represent areas of least concern.

The analysis of overlap between key tourism features and invasive alien plants shows tourism sites to have a notable relationship and link with invasive alien plant species. In this regard, the rationale for this study is validated where this cultural ecosystem service has a significant interface with invasive alien vegetation, and is an important relationship to take into account, especially considering tourism accounts for 10% of the world GDP, 8% of jobs and 12% of annual global investment (WTTC, 2007). Certain provinces in South Africa are severely more affected by invasive alien vegetation, and management and educational efforts should be a focus in these regions.

5.2 Tourist activities affected by invasive alien vegetation

At a national level, each of the key activities identified in this study, portray variable results for their overlap with mean coverage of alien plant infestation. Bearing in mind the quantitative foundation behind the national analysis results, the three activities that showed to be the most heavily impacted by alien invasion include hiking and walking, cycling and mountain biking, and water based activities such as swimming, canoeing, and boating, to name a few. These findings compare with those of Pejchar and Mooney (2009), Eiswerth et al. (2005), and Dudley (2000), where their research depicts both land and water-based recreation as being strongly affected by invasive alien plants. Also discussed in their research is the potential loss of revenue to these tourists sites, invasive alien vegetation poses. Similar research should continue in the future, particularly in efforts to target management efforts. In this study, the activities identified as having the greatest overlap, together with that of “viewing”, were also found to be the most popular tourist activities in South Africa. These results therefore show a close relationship between key tourist and recreational activities and invasive alien plant cover, and understanding the nature of this relationship is evidently important.

Also to be noted, is that most activities identified in this research are seen to be consistently characterised by a significant percentage of moderate alien plant infestation. Again, concerns can be raised as to the level of alien plant coverage in these regions, looking at possible future scenarios where invasion levels may continue to increase (Moody and Mack, 1988; van Wilgen and Richardson, 2010). This should again raise the attention of various stakeholders, as numerous regions across the country may experience increasingly high levels of alien plant infestation, and thus the associated impacts they pose.

5.3 Concerns around biodiversity

Noteworthy detrimental impacts concerning the effects of invasive alien vegetation on tourism that needs to be mentioned, is the changes within biodiversity, that results in changes in biotic or abiotic species composition (Pimentel et al., 2000). If certain plant, animal or microbial species begin to die off or leave an area because of the presence of alien vegetation, the changes that result in an ecosystem could have disadvantageous effects on tourism. For a recreational bird viewer for example, this could mean the absence of bird species that makes the recreational activity appealing to begin with. As the number of species in a community begins to decrease, so does the functioning of the ecosystem (Naeem et al., 1999). Furthermore, biodiversity and species redundancy act as a buffer, protecting ecosystems from loss of functionally important components (Currie et al., 2009). These functionally important components are typically lost as an ecosystem becomes invaded and plant compositions and structures change (Le Maitre et al., 2011). The results in this case study show that landowners are aware of the value of biodiversity to their establishments. One respondent commented that if invasive alien vegetation was left to grow out of control on their farm, the biodiversity value and richness would decrease. This in turn would have a negative effect on the ecosystems resilience, and ability to cope with phenomena such as fires (Brooks et al., 2004; Keeley, 2006).

An added function of retaining biodiversity is the marketing value biodiversity offers to private landowners and tourism operators. As stated by a private landowner, if natural flora and fauna were to decrease, and alien vegetation were to increase, they would struggle to market and advertise their establishments as containing natural species, with pristine value (Mwebaze et al., 2010). Similarly a tourism operator explained that in certain cases where clients want to hold an event or corporate function, the biodiversity richness and diversity of the establishment is an important and appealing factor they might take into account. These concerns are further strengthened by the high value most tourists interviewed in this study placed on biodiversity elements such as flora and fauna, views, and landscapes. For both private landowners and tourism operators, the negative impacts around the biodiversity value of their establishments being compromised, should prompt legitimate concerns.

5.4 Accessibility issues

One of the negative impacts of invasive alien plants highlighted in this research concerns that of access. Access is noted as a vital aspect in the valuation of recreation and tourism as a cultural ecosystem service (de Groot et al., 2010). It is seen that “the recreational function of a landscape or ecosystem is not only defined by the land cover of a specific location (e.g. natural area) but depends also on accessibility properties (e.g. distance to roads) and characteristics of the surrounding landscape” (de Groot et al., 2010:266). Where the quantitative analysis can point towards the notion that moderate to high levels of invasion could cause access issues for tourists, the case study results give more conclusive insight on the matter, where for each of the three stakeholder groups identified, the issue of accessibility was brought up by certain respondents. Examples of activities that could be prone to accessibility problems due to the presence of alien vegetation include that of fishing or hiking. A recreational fisher could find it difficult to access a favourable fishing site, or the water itself could be inundated with invasive alien plants (e.g. hyacinth species), making fishing more difficult (de Groot et al., 2010). Such concerns around accessibility could play a significant role in the enjoyment and overall recreational experiences.

Certain landowners and tourism operators also experienced access problems due to the presence of alien vegetation. The results offered insight on the severity of problems concerning access. Inevitably, the issues with access often results in increased costs for these stakeholders. If important access routes have alien vegetation encroaching, these stakeholders often have no choice but to take the necessary measures to ensure their access routes are clear and well maintained. The estimated figures suggested by respondents, amount to significant sums of money. Where the tourism operators interviewed could not comment on the financial particulars concerning the clearing of alien plants, they still commented that costs are involved in the clearing and maintenance processes. Not only that, but the tourists themselves, paying customers, could feel aggrieved if their recreational experience is compromised due to alien vegetation blocking access to certain locations. This would inevitably cause problems for tourism operators, as tourists could choose to go elsewhere, to more pristine and alien free locations, for the same experience. As de Groot et al. (2010) points out, an essential aspect in the valuation of tourism and recreation as a cultural service of ecosystems is accessibility, and more research is needed in future studies. Where international literature is notably limited, the results of this study contributes to this under explored area, with clear views expressed in relation to the problems invasive alien vegetation poses to accessibility issues.

5.5 Travel routes affected

The findings of the qualitative survey suggest that views and landscape scenery are critical components of the tourism experience, negatively impacted by invasive alien plants. This highlights the spatial overlap in cover seen in the national analysis between tourism routes and invasive alien vegetation. Prime examples that can be extracted from the national analysis, are evident in the Western Cape, KwaZulu-Natal, and the Eastern Cape. In the Western Cape certain travel routes are characterised by moderate, to high alien plant infestation. This is most notable in regions along the West Coast, travelling north of Cape Town, towards popular tourist destinations such as Melkbos and Laangebaan, as well as further north. Similar conclusions can be made as one assesses the major travel routes travelling eastwards, through the Overberg, the Garden Route, and well up into the Eastern Cape, where again moderate to high alien plant infestation is evident.

Outdoor tourism and recreation differ to other ecosystem services, in that tourism benefits do not proceed to the beneficiary but rather the reverse, meaning for beneficiaries to enjoy and partake in the benefits of the tourism activities, they have to travel to the point where the services are available (Balmford et al., 2008). As tourists travel up along the West Coast for example, to reach certain destinations, their travel experience could be negatively affected. If one considers the exceedingly high homogenisation of the Earth's surface (Garcia-Llorente et al., 2008), and the possible alterations and transformations in an ecosystems biodiversity due to alien vegetation, questions can be raised on the impacts these changes could have on views and a tourists line of sight (Reyers et al., 2009; O'Farrell et al., 2010). Certain alien plants and trees have the potential to grow rapidly and densely, which in turn could affect the viewing potential specific tourist sites have to offer. If for example the tourists travel experience is hindered by views of alien invasive plants, as opposed to natural floral landscapes, or the ocean horizon itself, it could be evident that these travel routes are in fact being impacted negatively by alien plant presence.

To continue with the example of the West Coast, this area has many tourists visiting each year to witness the wildflowers blooming. Alien infestation could make the tourist activity less appealing for visitors to partake in, and affect tourism negatively. Another notable example includes the travel routes up the north coast of KwaZulu-Natal, within the Elephant Coast. The results found in this research, elude to the fact that it is not only the tourist destinations themselves that raise concern regarding their alien plant coverage, but possibly too the popular travel routes taken by tourists to reach their desired locations. This national coverage combined with how tourists feel about views, makes travel routes an important aspect to consider in cultural services research. Again, where international literature is limited regarding this particular subject, this study puts forward the rationale and highlights why such considerations should be made in future ecosystem services research.

5.6 Issues and difficulties in measuring peoples values

It is important to keep in mind the difficulties and issues in attempting to measure peoples values and preferences, as this is subjective and will vary from person to person. Furthermore, valuation studies examining the importance of certain aspects such as views and landscapes for example, are context specific, and it therefore becomes difficult for generalisations to be made (Balmford et al., 2008). Results are likely to be dependent on the physical and cultural environment from which people derive (Petrosillo et al., 2007). For example a person exposed primarily to one type of environment, such as an urban environment, or rural environment, may hold a higher (or lesser) regard for another type of environment. However, concerning this particular research, the results suggest that most of the tourists interviewed expressed their preference for non-invaded landscapes and riparian zones, over invaded vistas. Keeping in mind the tourists interviewed were from different parts of South Africa, as well as other countries, these results point towards a clear preference toward pristine areas versus alien invaded areas. Also to be noted is that land use change, from natural, to intensely cultivated or urbanised, will result in a clear reduction or total elimination of the outdoor recreational amenity value of an area (Balmford et al., 2008). Many different types of recreational activities such as hiking, fishing, and bird watching, to name a few, are directly linked and dependent on the natural environment that host these activities (de Groot et al., 2005). Taking these factors into consideration, and focussing on the tourism sector in particular, it is essential for stakeholders to realise the importance in recognising the potentially negative impacts invasive alien vegetation poses to tourism experiences.

Balmford et al. (2008) also addresses the limited amount of available data concerning which changes in biodiversity affects and influences tourism benefits, and which attributes of the landscapes are key to peoples recreational experiences. The research undertaken, and the results of this particular study, speaks to this deficient knowledge base, and highlights the link between invasive alien vegetation and tourism experiences. However, looking at this relationship into the future, it will be important to take into consideration the confounding issues around values, and how people ultimately perceive the environments in which they are exposed to, and how in fact people perceive and understand invasive alien vegetation.

5.7 Target groups identified

Looking specifically at the profile characteristics of the tourists interviewed, the results point towards particular target groups that can be identified in future initiatives and strategies aimed at managing alien vegetation effectively. Concerning the environmental knowledge tourists have of alien vegetation, the results show a fairly close relationship between environmental knowledge of alien vegetation within each specific age category. The young adults age class of 16-28 did however show to be the most knowledgeable on the matter. Conversely, while more knowledgeable, younger people were less likely to pay extra for their tourist experience for combating alien vegetation.

The fact that willingness to pay increased with age, is likely to be a function of economic status. Similar results were found in Garcia-Llorente et al. (2008), where different perceptions and attitudes were found amongst stakeholders, concerning willingness to pay, and general alien vegetation knowledge. Their research points out that understanding people's perceptions and attitudes, and including the human dimension is imperative for successful invasive alien species management. Similarly, the information obtained in this research concerning environmental knowledge and willingness to pay, substantiates this notion, and points towards particular target groups that can be highlighted and pursued further, for example in future management strategies and conservation efforts regarding alien plant infestation (Castro et al., 2010). A viable option to consider is the use of separate strategies for separate target groups. For example, as seen in this research, the older age groups could be targeted in educational efforts to increase their environmental knowledge.

The results also show that tourists consider landscapes and the views offered at tourism sites, as the most important factors regarding their recreational experience. This information proves important in understanding the value tourists place on their tourism experience. This links to parallel studies (Crossman and Bryan, 2009; Raymond et al., 2009), where societal values and perceptions can be integrated with natural science and economics (for example cost, biodiversity value, recreation benefits and landscape benefits) to strengthen and advance regional planning. Also noted by Daniel and Muhar (2009), they suggest when landscapes are appreciated for their cultural services, inevitably there will be more support for other environmental management goals, and gaining public support for the protection and/or intervention of these ecosystems is likely to occur more readily, and successfully. Knowing the value respondents placed in this study on landscapes and views, this research builds on the findings of previous studies, and offers insight as to what constituents of tourism is key to highlight, and target in future research and respective studies. More particularly, future management plans and educational strategies should take these views into consideration, to improve, and aid effective management of invasive alien vegetation.

5.8 Methodological considerations: Points, lines, and polygons

As part of the quantitative analysis, in mapping the overlap between key tourism hotspots and alien plant coverage in South Africa, numerous points, lines and polygons needed to be created. We know from the literature particular aspects of these methods pose challenges (Clark, 2006). For example, creating the *polygons* themselves, overlaying them with the alien plant data, and drawing conclusions concerning the severity of alien plant infestation proved a straight forward process. However, certain limitations arose with regards creating the tourist sites represented by *points* and *lines*.

Looking at the line shapefiles that needed to be created, it became apparent that assessing the alien plant coverage for certain tourist destinations would be challenging. The primary reason for this is that alien plant cover often varied considerably along the designated line, making analysis difficult to execute. The lines themselves were also not easy to visually assess, due to their narrow nature. Therefore specified buffers were created to compensate for this inconsistency and aid the mean coverage assessment value of the alien plant data. Similar methods were employed concerning the point shapefiles created. The most challenging issue in creating points as representatives of tourist sites was that of scale. Certain points such as monuments or museums varied in size and were therefore allocated standard reference points. However, it was again necessary to allocate a buffer value for each respective site. Due to the small nature of these points, the buffer value sought to compensate for this, as well as include the possible effects of alien vegetation, not only found right on top of the site, but also within close proximity. Similarly, certain activities such as whale watching sites could not be allocated specific boundaries due to their varying sizes and scales, thus standard reference points were used. Consequently, the scale of particular tourist sites played a large role in the national analysis.

O'Neill and King (1998) describe scale as the physical dimension, in space or time, of phenomena or observations. There is increasing awareness of the importance of spatial and temporal scales for the analysis and valuation of ecosystem services (de Groot et al., 2002; MEA, 2003). The importance of scales has been widely recognised in both economics and ecology (Berkes and Folke, 1998; Peterson, 2000). Few ecosystem valuation studies have explicitly considered the implications of scales in the analysis and valuation of ecosystem services (de Groot et al., 2010). With regards this research, it was seen that scales did in fact play a part in the evaluation and assessment of ecosystem services. Within the quantitative analysis, the scale at which certain activities were mapped, affected the evaluation process of distinguishing any overlaps between tourist sites and invasive alien vegetation. Where most of the maps created were characterised with scales that made assessment viable, certain tourist sites and destinations needed to be mapped at higher resolutions. This meant that the area of analysis was limited, and that certain resultant images appeared pixelated.

If one applies a similar rationale and criteria towards cultural ecosystem services, the question can be raised, at what scales could one assess cultural ecosystem services? It could be argued that invasive alien vegetation could have impacts on cultural ecosystem services at varying scales. Recreation and tourism, more specifically, could be prone to these impacts, especially as the scale in ecosystem services is considered crucial to environmental management (Balmford et al., 2002; Hein et al., 2006, de Groot et al., 2010). Moving forward in ecosystem services research, it is important to remember “that the analyses of the dynamics of ecosystem services supply requires consideration of drivers and processes at scales relevant for the ecosystem services at stake” (de Groot et al., 2010:269). This study was successful in integrating different methods and scales to determine key overlaps, but also recognises the importance of future methodological and scale issues to be addressed, and further refined, as research into ecosystem services progresses in the future.

5. 9 Cultural ecosystem services research: The way forward

Based on the findings of this research, recommendations can be made regarding future ecosystem services research. Looking specifically at the national alien plant surveys carried out in the past (Versfeld et al., 1998; Henderson, 2007) as well as the current survey utilised in this research (Kotze et al., 2010), a broader approach needs to be utilised in future analysis. Where national alien plant surveys in the past have been very specific, looking at alien vegetation in an isolated context, this research recognises that considerations need to be given to include other important factors in the analysis, such as tourism for example. Prior to this study, tourism data was poorly linked to alien vegetation data. This study highlights the relationship between invasive alien vegetation and the tourism sector. So for one, this relationship must be acknowledged in future surveys and research of a comparable nature. Similarly, the data itself needs to be broadened to include other spatial contexts such as agricultural or urban environments. Future surveys can build on the findings compiled in this study, where the relationship between invasive alien vegetation, and tourism is clearly linked.

Also important in future cultural ecosystem services research, is for the tourism industry to recognise the relationship between tourism and invasive alien vegetation. Where biodiversity as a whole, is likely to be recognised by tourism operators as fundamental to their enterprises, this notion should be taken one step further to incorporate invasive alien vegetation. Essentially this would mean the tourism industry needs to acknowledge the threats invasive alien vegetation pose, and the negative effects alien spread could have on their establishments and economic viability.

Looking at future scenarios where various initiatives, partnerships, and possible funding mechanisms could be employed, it will be imperative that tourism operators, and the broader tourism industry, acknowledges the threats and potential impacts invasive alien plant infestation pose. This work highlights clear and identified entry points for this, for example focussing on the financial implications for those tourist activities identified in this research as being most affected.

6. CONCLUSION

Building on the research undertaken by Kotze et al. (2010), this study aimed to map the overlap between tourism hot spots, and alien plant infestation in South Africa. Examination of the spatial relationships between popular tourist locations and invasive alien vegetation can identify hotspots of value, as well as potential conflicts. The national overlay showed various tourism activities across South Africa to be inundated with moderate or high levels of alien plant cover. The most heavily impacted provinces, as well as the most popular tourist destinations (South African Tourism, 2011), were found in the Western Cape, Eastern Cape and KwaZulu-Natal. Other provinces depicted low infestation levels, but moderate to high patches of overlap occurring over key tourist hotspots. The least affected provinces, with the lowest overlap include the Northern Cape and the North-West Province. These results highlight where national efforts need to focus accordingly. Furthermore, certain tourist activities are also identified with higher levels of alien plant infestation, which highlights a “second layer” of analysis that further strengthens which areas need to be targeted and incorporated into management efforts.

The methods carried out in this research posed certain challenges, and distinct limitations were identified. With regards cultural ecosystems services in general, the lack of available and adequate data is a major hindrance in ecosystem service research (Balmford et al., 2008). As noted, the link between tourism and invasive alien vegetation is poorly understood. However, this study contributes to this information deficiency, and even with methodological limitations, highlights useful techniques to be employed in ecosystem services research. This study further suggests that stakeholders’ perceptions and values can be integrated with spatial quantitative data to expand our knowledge of cultural ecosystem services. The qualitative research carried out in this study illustrates a consistency in ecosystem services research - that understanding and incorporating the human dimension (Garcia-Llorente et al., 2008) is critically important to inform the successful management of invasive alien vegetation. Hence this research considered the importance of social perceptions and stakeholder attitudes in relation to invasive alien vegetation. It is essential to continue to develop methods of ecosystem services measurement, valuation and reporting practices regarding ecological, socio-cultural and economic frameworks (de Groot et al., 2010), however this has proven in the past to be no easy task, and challenges still remain.

Also noted in this research, is aspects such as access issues and travel routes affected by alien plant infestation, that both the quantitative and qualitative findings point towards. This clearly demonstrates the value in utilising the two sets of methodological approaches. For us to better understand the complex and dynamic relationship between cultural services and ecosystems, it will require ecological and social science, (in many ways quantitative and qualitative science) to come together, assist, and substantiate one another (Daniel and Muhar, 2009).

Effective management of invasive alien vegetation is a costly and labour-intensive endeavour, however the costs and implications of not managing invasive species will have far greater repercussions and resultant costs (Larson et al., 2010). As the various negative impacts associated with invasive alien plants continue to culminate across South Africa, and across the globe, there is a growing need for greater investments in prevention, control and post-invasion restoration. Mapping the cultural ecosystem services of tourism and recreation in relation to the spread and severity of invasive alien vegetation, enables the targeting of management actions, particularly areas of greater concern, thus prioritising clearing efforts. Such targeting has the potential to empower local interest groups, and initiatives focussed on effective environmental management (Raymond et al., 2009).

Looking forward, it is important for research to continue, and methods to develop, in cultural ecosystem services research (de Groot et al., 2010). Looking specifically at tourism as a cultural ecosystem service, and the relationship this service has with invasive alien vegetation, future studies need to recognise the significance of this association, as demonstrated in this research. Furthermore, tourism operators, and the broader tourism industry, need to recognise the potential threats invasive alien vegetation poses to their establishments and operations. Where current and future initiatives, partnerships and programmes are to be strengthened, and employed to manage the spread of alien plant infestation, this research shows that the tourism industry needs to recognise their role and the importance in understanding and effectively managing the threats posed by invasive alien vegetation. As ecosystem services research advances, it becomes increasingly evident the role cultural ecosystem services communicate the need for sustainable ecosystem management.

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APPENDIX

Tourist Questionnaire – Impacts of Invasive Alien Plants on Tourism and Recreation

Origin	Western Cape	National	International			
Age	16 - 28	29 - 39	40 - 49	>50		
Gender	Male	Female				
Method of transportation to the site	Bus	Car	Motorbike/Scooter	Bicycle	Walk	
Purpose of visit	Hiking/walks	Viewing (e.g. birds)	Fishing	Mountain Biking	Horse Riding	Off-road driving
	Other					
Reason for visit	Relaxation	Exercise/health	Cultural/Spiritual	Aesthetics	Entertainment	
	Other					
What natural assets do you value?						
Flora	No value	Slight value	Moderate value	High value	Most value	
Fauna	No value	Slight value	Moderate value	High value	Most value	
Landscape	No value	Slight value	Moderate value	High value	Most value	
Views	No value	Slight value	Moderate value	High value	Most value	
How important is this recreational area/activity to you?		Not important	Slightly important	Moderately important	Highly important	Most important
Do you know what alien plants are?	Yes	No				
Frequency of visit	1st	2 ~ 5	>5			

If frequently visited, have you seen a change (growth or decline) in alien plant coverage? Yes No

Comment

Are you aware of the negative impacts associated with alien plants? Yes No

Do they affect your recreational experience negatively in any way? Yes No
(i.e. blocking access points/routes; blocking/hindering of views; depleting water levels; fire hazards; aesthetics; etc)
If so, how?

If yes, would you be willing to pay more for the recreational experience to prevent alien plant infestation? Yes No

If so, to what extent of the entrance fee/admin/membership price? x1.5 x2 x4

What is the highest amount you would be willing to pay to prevent alien plant infestation?

*To what degree do you value the views (line of sight) in your recreational activity?
No value Slight value Moderate value High value Most value

*Do alien plants hinder your line of sight or play a negative role in this regard? Yes No

Comments

*Which landscape do you prefer? Invaded Non-invaded

**Make use of the pictures to aid the question --> alien invaded vistas vs. non-invaded*

THANK YOU FOR YOUR TIME!

Alien Invaded Vistas



Alien Invaded Vistas



Non-Invaded Vistas



Non-Invaded Vistas



Landowner Questionnaire

Do you know what alien plants are? Yes No

Are you aware of negative impacts associated with alien plants? Yes No

If yes, what negative impacts do you experience as a land owner?
e.g. blocking access points/routes; blocking/hindering of views; depleting water levels; fire hazards; aesthetics; etc

.....
.....
.....

Are there any additional costs that are incurred to you as a land owner due to alien plant invasion?
i.e. Clearing alien vegetation for fire breaks, access issues, blocking of views, etc

.....

If so, how much more of your monthly upkeep/operational costs (on average) as a land owner is spent on mitigating the negative impacts caused by alien invasive plants?

.....

THANK YOU FOR YOUR TIME!

Tourism Operator Questionnaire

Do you know what alien plants are? Yes No

Are you aware of the negative impacts associated with alien plants? Yes No

If yes, what negative impacts does your tourism/recreational operation experience?
(i.e. blocking access points/routes; blocking/hindering of views; depleting water levels; fire hazards; aesthetics; etc)

.....

.....

Do these impacts have a negative effect on the tourists enjoyment and recreational experience? Yes No

What tourism activities in particular are being most affected by alien plant invasion?
(i.e. Hiking, fishing, bird watching, mountain biking, off-road driving, etc)

.....

Do certain tourists ask questions about alien plants? Yes No

Are you aware of any additional costs that are incurred to the tourism operation due to alien plant invasion?
(i.e. Clearing alien vegetation for fire breaks, access issues, blocking of views, etc)

.....

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THANK YOU FOR YOUR TIME!

