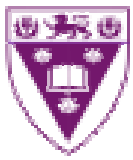
Makana Municipality
Local Environmental Action Plan
Comprehensive Audit Report: Urban Green Spaces, Recreational Facilities and Botanical Gardens
November 2004

Edited by J. Gambiza and T. Palmer



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1. URBAN GREEN SPACES AND RECREATIONAL FACILITIES IN MAKANA

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1.1. EXECUTIVE SUMMARY

Urban green spaces include buildings as well as hard-surfaced areas. However, the term is usually applied to areas that are permeable and green, and have soil, grass, trees and shrubs. Included within urban green spaces are parks, play areas and other green spaces intended for recreational use. Urban green spaces can thus be defined as those spaces associated with human settlement where wildlife can flourish. They are the collection of habitats that are found within urban areas. Urban green spaces include those that are privately owned and managed (private golf courses, business parks, company premises, and gardens), as well as those that are publicly owned and managed. Publicly managed green spaces are those owned by the municipality and include public parks, squares, parks in residential areas and school grounds. Public green spaces are primarily used by members of the public and are of considerable local importance for education and recreational purposes. These spaces and facilities are referred to as 'green infrastructure'.

Urban recreational planning is prompted by the need for energy conservation. Urban recreational planning can be defined as the structural and functional planning of the city, including provisions for sporting and recreational facilities and amenities, as well as green corridors that facilitate transportation and urban conservation.

Our study investigated the problems experienced by the communities, predominantly those of Grahamstown East, with regards to the provision, location and condition of green recreational facilities. In this context, research was undertaken to identify existing green recreational infrastructure, as well as the needs and requirements of the public. We used a questionnaire survey and key informant interviews to obtain data on people's views on urban green spaces and recreational facilities. Due to time constraints and guidance from Mr Kevin Bates of Makana's Department of Parks and Recreation, we focused on the Grahamstown area.

Our results showed big differences in the availability and condition of recreational facilities between the different socio-economic zones. High income zones had better facilities as well as better accessibility to a wider range of facilities than low income zones. Most people in higher income brackets viewed the existing facilities to be adequate and of sufficient quality. However, lower income zones felt that there was a greater need for recreational facilities in their communities. As green spaces and recreational facilities are viewed very highly amongst both socio-economic classes, there is a need for further developments in the future as well as the constant refurbishing of existing facilities. These facilities will not only improve the aesthetic quality of the communities but will also create the necessary spin off of job creation, and the provision of basic needs.

1.2 INTRODUCTION

Urban green spaces include buildings as well as hard-surfaced areas. The term is, however, usually applied to areas that are permeable and green, and have soil, grass, trees and shrubs. Included within urban green spaces parks, play areas and other green spaces intended for recreational use. Urban green spaces can thus be defined as those spaces associated with human settlement where wildlife can flourish. They are the collection of habitats that are

found within urban areas. Urban green spaces include those that are privately owned and managed (private golf courses; business parks, company premises; and gardens), as well as those that are publicly owned and managed. Publicly managed green spaces are owned by the municipality and include public parks, squares, parks in residential areas, and school grounds.

Public green spaces are primarily used for recreation by members of the public and are of considerable local importance for educational and recreational purposes. These spaces and facilities are referred to as 'green infrastructure'. According to Wolf (2003), green infrastructure delivers many social and environmental benefits which include the following:

- storm water management**;**
- air and water quality improvement;
- enrich habitat and biodiversity;
- improve health, and
- increase education, transportation and recreational opportunities.

Well planned green spaces may increase property values and decrease the costs of public infrastructure and public services. Furthermore, urban green infrastructure has both social and ecological benefits where the functioning of ecosystems is maintained and avenues for future economic development are provided. However, there are other motivations for urban conservation which include primarily urban planning for biodiversity conservation and recreational activities.

Essentially, in an urban planning context, land use types are determined by the expected benefits that will accrue to urban communities, and land and business owners. Key determinants of urban planning include economic growth as well as social well being and environmental sustainability. According to Gatrell and Jensen (2002), communities can capitalize on the benefits of urban greening which include economic development, aesthetic value and ecological benefits.

1.2.1 Urban recreational planning

Urban recreational planning is prompted by the need for energy (fuel) conservation (Gold, 1997). In this context, lack of local public parks and recreation facilities in most cities prompts people to travel long distances to non-urban recreational areas. In addition, Bach (1993) reaffirms the need for green recreational areas and facilities in urban areas. This need is said to be precipitated by people engaging in recreational activities such as skateboarding and cycling in inappropriate and dangerous areas such as parking lots and streets. Urban recreational planning can thus be defined as the structural and functional planning of the city, including provisions for sporting and recreational facilities and amenities, as well as green corridors that facilitate transportation and urban conservation.

1.2.2 Problems with urban recreational planning

There has been a general movement towards leading a health conscious lifestyle all over the world. This has proved to be a problem for people living in urban environments. According to Briffett (2001), the first obstacle when developing a green area is the location. The area for the green spacing has to be appropriate to achieve its function and this is often very hard in a built-up urban environment. Management and maintenance of green spaces is another problem. Different recreational needs of people such as jogging, walking and bird watching

may be incompatible. The objective of our study was to assess the maintenance and management of existing green recreational infrastructure in Makana.

1.3 METHODS

Although we initially intended to focus on the main urban areas in Makana namely Alicedale, Riebeeck East and Grahamstown, after consulting Mr Kevin Bates (Director of Parks and Recreation for Makana) we focused on Grahamstown. The reasons for this were that Riebeeck East is a very small community that is surrounded by adequate green spaces (Bates, 2004). This is supported by a statement on the Makana Municipality web page: "Riebeck East…offers many attractions and hiking trails through the surrounding diverse and beautiful hills" (Makana Municipality, 2002). Bates (2004) also indicated that Alicedale is currently surrounded by green spaces in the form of the private game reserve Shamwari.

A questionnaire survey was used to obtain data on the views of residents of Grahamstown. Residential areas in Grahamstown were stratified into high and low income zones. Seventy seven respondents were randomly selected in the high income zone and 82 in the low income zone. Questionnaires were both in Xhosa and English. We also interviewed key informants to obtain opinions about the availability and necessity of green spaces.

1.4 RESULTS AND DISCUSSION

The majority of people in Grahamstown chose sport recreational facilities as their most favourite. People from high income zones preferred water sports whereas those from low income zones preferred cultural activities. About 62% of the respondents from the high income zones felt that recreational facilities in their residential areas were adequate. In contrast, only 28% of the respondents from low income zones felt recreational facilities in their residential areas were inadequate. Furthermore, 80% of the respondents from the low income zones felt that there was a need for additional facilities. It is therefore clear that there is a need for the municipality to address this need.

About 61% of respondents from high income zones felt that recreational facilities were well maintained compared with only 24% of respondents from low income zones. This indicates that higher income areas of Grahamstown enjoy better maintenance of facilities than lower income areas. Efforts to improve the maintenance of facilities should be concentrated in lower income areas.

A surprisingly low number of people in Grahamstown were aware of projects such as the Cradock Heights Greenbelt or the Conservancy on the Southern Commonage. This indicates that people are not very interested in current green space projects that the Makana municipality is involved in. Perhaps Makana municipality should put more emphasis on public participation when planning recreational and green space infrastructure.

About 60% of interviewees indicated that would be willing to pay if there was a small fee for the use of recreational facilities. This indicates the potential for private firms and the Makana municipality to invest in financial initiatives to improve the quality of recreational facilities and green spaces in Grahamstown.

1.5 CONCLUSIONS AND RECOMMMENDATIONS

There is clearly a need for more recreational facilities in lower income zones. Along with the need for these new facilities, there is needed for better maintenance of existing facilities. In contrast, the majority of people in high income areas felt that the existing facilities were adequate. The majority of respondents independent of income zone, would be willing to pay a small fee for using these facilities.

Although a lot of emphasis with regard to green spaces in the Makana Municipal area is to a great extent on greenbelts and conservancies, 92% of the respondents had no idea as to what a greenbelt or conservancy was. There is a need for environmental awareness and education programmes as people are clearly unaware of what is happening around them. The Makana Municipality should promote public participation and community involvement when developing recreational facilities.

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2 THE IMPORTANCE OF MULTIPLE HABITATS TO OVERALL BIODIVERSITY IN THE GRAHAMSTOWN BOTANICAL GARDENS

By Tara Booth

2.1 EXECUTIVE SUMMARY

Concern over the loss of biodiversity has increased in recent years. The reasons for biodiversity loss are varied but most stem from increasing human populations and the expansion of urban centres. It has been recognised by the UN and other international bodies that a loss or reduction in biodiversity has consequences for mankind, many of which are not fully understood. In addition, to achieve sustainable development the ecosystems on which it is based must be fully functioning and thus their biodiversity must be intact. South Africa has committed itself to achieving sustainable development and has acknowledged the link between sustainability and biodiversity by subscribing to the principles enshrined in Agenda 21, the National Environmental Management Act (NEMA) of 1998 and the Local Environmental Action Plans (LEAPs).

As part of the Makana LEAP, this project assessed the insect biodiversity in the Grahamstown Botanical Gardens. This can be used as an indicator of the biodiversity of the Gardens although more work needs to be done to collect more comprehensive data. However, this study provides baseline data for work which is to be carried out on the development and rehabilitation of the Gardens. The development of the Gardens can be viewed as an improvement on the urban green spaces of the Municipality and possibly it could be seen as a model for the development of future green spaces in the Municipality as well as promoting the sustainable use of natural resources in line with the aims of LEAPs. In addition, the development of the Gardens and the conservation of the biodiversity within them will provide valuable hands-on experience in biodiversity conservation and infrastructure development. The Gardens can also be used for educational purpose. This study of insect diversity can also be used as a baseline study for looking at the effects that the developments in the Gardens may have.

This study looked at the collections of insects found in different types of habitats and tested the hypothesis that a large number of different habitats would result in a higher overall biodiversity, and thus would illustrate the need to conserve a number of different natural habitats to maintain a high level of biodiversity. Of the three sites studied, each had a different vegetation or habitat type. It was also found that each of the habitats studied contributed a different collection of Insect Families. This means that the overall biodiversity was greatest when there were more habitats and the biodiversity in each individual habitat only contributed a small amount to the total biodiversity. Without multiple habitats, the overall biodiversity would have been far lower than was found. Further studies should be carried out to test the hypothesis that this trend should hold true for other types of organisms including the vegetation and vertebrates.

There are several issues, however, which need to be addressed for the Municipality to promote and conserve biodiversity within the Gardens and also within the greater Municipal area. The most pressing of these is the need to address the serious invasion of alien plant species into the Gardens. The Municipality also needs to consider development actions and programmes which will contribute to greater community participation and promote the

transfer of skills and aid in poverty alleviation. The proposed development of a restaurant, educational facility as well as a visitor's centre will all help meet these aspects of the LEAP.

2.2 INTRODUCTION

The loss of biodiversity has increased globally in recent years (International Union for the Conservation of Nature (IUCN), 2004). There is increased concern over what this loss in biodiversity may mean for the long-term future of the planet (IUCN, 2004). The loss of biodiversity around the globe has been well documented, and immediate causes such as deforestation are well understood (World Wide Fund for Nature (WWF), 2003). However, there has been little effort put towards understanding the forces that cause individuals and or nations to make choices that destroy the biodiversity present in the region (WWF, 2003). To address the global biodiversity loss, the United Nations (UN) developed Agenda 21 at the 1992 Earth Summit (also known as the United Nations Convention on Environment and Development [UNCED]) in Rio de Janeiro which addresses human impacts on the environment (UNCED, 1992). South Africa is a signatory and reaffirmed her commitment to the ideals in the Johannesburg Declaration on Sustainable Development (2002). The commitment to the principles of Agenda 21 is encapsulated in the National Environmental Management Act (NEMA) of 1998. Local level actions exist in the form of Local Environmental Action Plans (LEAPs). One aspect of the LEAPs is to address the loss of biodiversity (Makana Municipality, 2004). This study will investigate the importance of different habitats to the overall biodiversity of the Grahamstown Botanical Gardens with particular reference on insect diversity. In addition, the possible impacts of the development and rehabilitation of the Botanical Gardens proposed by Rhodes University's Grounds and Gardens division on biodiversity will be assessed.

The Grahamstown Botanical Gardens are the second oldest in the country after those in Cape Town (Anon., 2003). They were founded in 1853 by Deed of Grant of about 17 acres on the slopes of Gun Fire Hill. The original objectives for the establishment of the Gardens included procuring, from England and elsewhere, fruit trees, ornamental trees and shrubs, vegetable and flower seeds to improve and add to frontier stocks (Anon., 2003). These were all exotics. Some indigenous plants and shrubs were also grown, but this was not a priority. The curators also built up plants and exchanged seeds with botanic societies in places such as London, New Zealand, Melbourne and Brisbane (Anon., 2003). They also made timber a major concern and experimented with tree species to find those suitable for the terrain and climate. Due to these beginnings, there is a legacy of alien vegetation within the Gardens, with many of the tree species being very well established.

The Makana Municipality is growing in several areas including residential real estate, institutional development and tourism-related industries (Makana Municipality, 2004). To facilitate sustainable development in these areas, the Municipality has launched a Local Environmental Action Plan (LEAP) (Makana Municipality, 2004). This plan seeks to identify relevant sustainability goals and the specific actions needed to bring about a higher degree of environmental sustainability for future development projects (Makana Municipality, 2004).

2.2.1 Biodiversity

Biological diversity has no single standard definition. A simple but challenging definition is 'The totality of genes, species, and ecosystems of a region' (Noss, 1990). The advantage of this definition is that it describes the concept of biodiversity at the traditional three levels at which biodiversity has been identified. These are:

- Genetic diversity; the diversity of genes within a species. There is genetic variability among the populations and the individuals of the same species.
- Species diversity; this is the diversity among species or the variety of species (plant and animal) in a region. This is also sometimes known as species richness.
- Ecosystem diversity; this is diversity at a higher level of organization, namely the ecosystem and the richness of the different processes to which the genes ultimately contribute (Webster Dictionary Online, no date).

It is important to distinguish between species richness, which considers only the number of different species present in an area, and the evenness of abundance of each species, which is termed diversity (Begon *et al.*, 1996).

2.2.2 Multiple habitats and their importance.

A habitat can be defined as: “the natural abode, locality or region of an animal or plant" (Webster Dictionary Online, no date). A habitat can exist on a number of spatial and temporal scales and there can be microhabitats of a small spatial area within a larger habitat or area. Microhabitats are also sometimes referred to as 'patches' (Begon *et al*. 1996). Different plants and animals have diverse basic requirements for a successful existence. These include access to water, food, shelter and a safe area to breed. Patchiness or a high diversity of microhabitats in an environment is important because it provides a wide range of suitable living conditions for a diverse number of species. The greater the number of microhabitats within an area, the greater the range of organisms able to occupy that same spatial area (Begon *et al*. 1996).

It must be noted, however, that exceptionally fragmented habitats support a low biodiversity (Sole *et al*., 2004; Lienert, 2004; Opdam and Wascher, 2004; Anon. 2, no date). This is due to the fact that the individual patches in this scenario have a high 'edge to interior' ratio and some microhabitats are destroyed (Lienert, 2004; Anon. 2, no date). The balance between fragmentation and continuous habitat is a delicate one (Anon. 2, no date). The main objective of this study was to assess insect biodiversity in the Grahamstown Botanical Gardens.

2.3 METHODS

2.3.1 Habitat selection and vegetation analysis

Using aerial photographs of the Botanical Gardens, courtesy of the Rhodes University Grounds and Gardens Division and Conservation Support Services (CSS), the broad habitats were identified. This was done simply through delineating the different vegetation areas which appeared on the photograph. Ground-truthing was then carried out to determine what vegetation types were present in the delineated areas. Three sites were selected in areas which did not contain very dense alien plant infestations (< 30%) and each had different vegetation communities (Figs. 1 and 2). At each site a 10 m x 10 m quadrat was demarcated as the study area. In addition, previous work done by CSS and the Grounds and Gardens Division has resulted in a list of the alien species being compiled and the densities of alien vegetation infestation mapped (Fig. 2). Of these species, the Golden Wattle (*Acacia longifolia)*, the Black wattle (*Acacia mernsii)* are the most common (Hazell, pers. comm. 2004).

2.3.2 Insect collection

In each quadrat five small pitfall traps and two sticky traps for flying insects were erected (Figs. 3 and 4). These traps were set up randomly within the quadrat between 17:30 and 18:30

on Friday 10th September. The pitfall traps were dug into the ground so to be flush with the surface and were then half-filled with a mixture of Sunlight dishwashing liquid and water. This acted as a killing agent. The flying insect traps were coated with Fly-Tac which becomes sticky when dry. Twelve hours later, I collected any organisms that had fallen into the pit-fall traps and placed them into labelled plastic bags. In the case of the sticky traps, each pair in the quadrat was left for the duration of the experiment. I collected samples from the pitfall traps every 12 hours from 05:30 on Saturday 11th September till 17:30 on Monday 13th September. The insects were then identified in the laboratory, using a dissecting microscope and insect keys (Scholtz and Holms, 1985). I identified the specimens down to the family level. Further identification of the specimens is unfortunately too time-consuming.

In addition to the field work, I interviewed Mr. Mark Hazell, the manager of the Botanical Garden's rehabilitation project, on Tuesday 7th September. This interview posed questions relating to the project's background and the proposed rehabilitation of the Gardens. Questions pertaining to the Sustainable Development Framework (SDF) were also asked. These helped to determine whether or not the project manager had considered the sustainability of the project and some of the effects on the community, tourism and on the Gardens themselves.

2.4 RESULTS

2.4.1 Habitats and vegetation types

The major habitats in the gardens were planted lawns with scattered trees, *Portulacaria afra* woodland, xeric succulent thickets, wetlands and running and dry stream bed areas of *Eucalyptus* species, the Sydney Golden Wattle (*Acacia longifolia*), Black wattle (*Acacia mearnsii*) and *Jacaranda mimosifolia*. Other important vegetation in the Gardens includes several species of cycads of the *Encephalartos* genus and several medicinal plants including the African potato (*Hypoxis hemerocallidea*) and nasturtiums (*Tropaeolum majus*) (Hazell, pers. comm. 2004). At Site 1 there was little vegetative ground cover but a large amount of dead leaves, twigs and other detritus was present. The main species present were arum lilies (*Zantedeschia aethiopica)*, several small thorny succulents and a single willow tree. Site 2 was in a semi-dense xeric succulent thicket with plants typical of this vegetation type. These included spekboom (*Portulacaria afra),* Sweet Noorsdoring (*Euphorbia coerulescens*) and *Euphorbia bothae.* Couchgrass (*Cynodon dactylon)* and various *Aloe* species were present as well as several small specimens of Black wattle. Site 3 was an area of planted Kikuyu lawn (*Pennisetum clandestinum*). The Gardens had a high degree of infestation by alien species, up to 45% infestation in some areas (Fig. 2).

2.4.2 Insect collection

The relative abundance of species was different among all three sites. A total of 23 families of five orders were found, 11were from the order Coleoptera. At Site 1, there were eight families from five different orders (Fig. 3), of these the Scydmaenidae family of the Coleoptera order (the beetles) was the most abundant. This family made up 61% of all the specimens found and the Coleoptera order accounted for 73% of all specimens collected. The Shannon Weiner Index value was 0.255 and the Simpson's Index value was 2.653. At Site 2, there were eight families; the most abundant, Rhysodidae (18%) and Anobiidae (21%) were both from the order Coleoptera (Fig. 4). No specimens from the order Odonata (the dragonflies) were found. The Shannon-Weiner Index value was 0.256 and the Simpson's Index value was 9.692. At Site 3, 11 different families were found with the most abundant being the Chironomidae of the Diptera order (the flies). This family accounted for 58% of all specimens found (Fig. 5).

Again no specimens from the Odonata order were found. Table 1 shows the composition of all the specimens collected from all three sites at the order level.

Table 1. Composition of all insect specimens collected (by order).

Habitat[1]	Total	Coleoptera	Diptera	Hymenoptera	Orthoptera	Odonata
Site 1	112	25	80	3	4	0
Site 2	33	24	3	3	2	1
Site 3	28	20	4	2	2	0
Total	173	69	87	8	8	1

[1]Site 1 = lawn; site 2 = wetland, and site 3 = woodland.

2.5 DISCUSSION

2.5.1 Habitat and vegetation types

Due to the way in which the Gardens were founded, as discussed in the introduction, a large proportion of the Gardens contains some degree of infestation by alien vegetation. In addition where natural vegetation exists, it has been invaded by a number of different exotic species. However, there must be a balance between the aesthetics of the Garden and the desire to replace exotic vegetation with indigenous flora, a policy in line with most Botanical Gardens in South Africa (Anon., 2003). There are a number of old and well established exotic trees in the Gardens. It would not be beneficial to remove these trees and replace them with mere saplings (Hazell, pers. comm., 2004). However, the removal of alien species which are invading areas of natural vegetation could prove to be highly effective. The removal of the *Acacia* species in the Gardens has a number of advantages including an increase in the level of the water table thereby increasing the amount of water available to natural vegetation (Working for Water (WfW), no date).

The vegetation is typical of the Eastern Cape though the Gardens as a whole show evidence of deliberate alterations. This is expected as the purpose of the Gardens is to provide a sample of a range of habitats found in the Eastern Cape and Albany regions. A more exhaustive study of the vegetation in the Gardens needs to be carried out. Unfortunately, time constraints did not permit this to be done in this study.

2.5.2 Insect collection

This study was carried out over a very short period of time and thus certain biases are inherent. Insects which may be summer migrants would not have been sampled. The short-term nature of the collection phase may also produce a small bias and for this to be resolved a longer term, more exhaustive study would need to be carried out. In addition, there are several limitations with the indices used. However, despite these limitations, the insects found are typical of the habitats sampled (Scholtz and Holm, 1985).

The different habitats had different assemblages of families; this is to be expected as each of the habitats will provide different niches for different insects. As each of the sample sites was equal in area, I did not see the need to calculate family-area curves. Both Site 1 and Site 3 were dominated by a single family and although the abundance was high, these two sites were not considered to be diverse. This is reflected in the low values of the Simpson and Shanon-

Weiner indices. This may be due to the relatively homogenous nature of the sites. Site 2 is far more diverse because the relative abundance of the families in the site is more or less equal. This may be due to the fact that Site 2 is composed of more natural vegetation which contains more niches than the other two sites. In addition, the natural vegetation which has evolved to be suited to the region may contain specialist endemic species. However, it must be noted that an area of exceptional infestation by alien plants was not sampled and therefore I am unable to conclude whether the insect biodiversity in such an area would have made a significant contribution to the overall diversity of the Gardens.

2.6 RECOMMENDATIONS

To ensure and promote the conservation of biodiversity within the Gardens and within the greater Makana Municipal area, the following actions need to be carried out. First the development of the Gardens should be earmarked as a model which future green space developments can follow. The success of the Gardens may lead to the development of other recreational parks and the rehabilitation of existing ones throughout the region. Second, there is an urgent need to remove the alien invasive species, especially Black and Golden Wattle. The Working for Water programme has already shown the effectiveness of this step and can be consulted on the best methods.

Finally, the Municipality should also embark on a general programme of community education and awareness on the importance of biodiversity. This should include support for educators and the provision of centres for the transfer of skills. For example, the proposed restaurant could be used as a training centre for previously disadvantaged people. This support can also extend to the local entrepreneurs and craftspeople by providing a safe and well advertised market for their products. In addition, revenues can be generated for the greater Makana Municipal area through the promotion of the Gardens as an example of the unique flora and fauna which can be found in the Eastern Cape.

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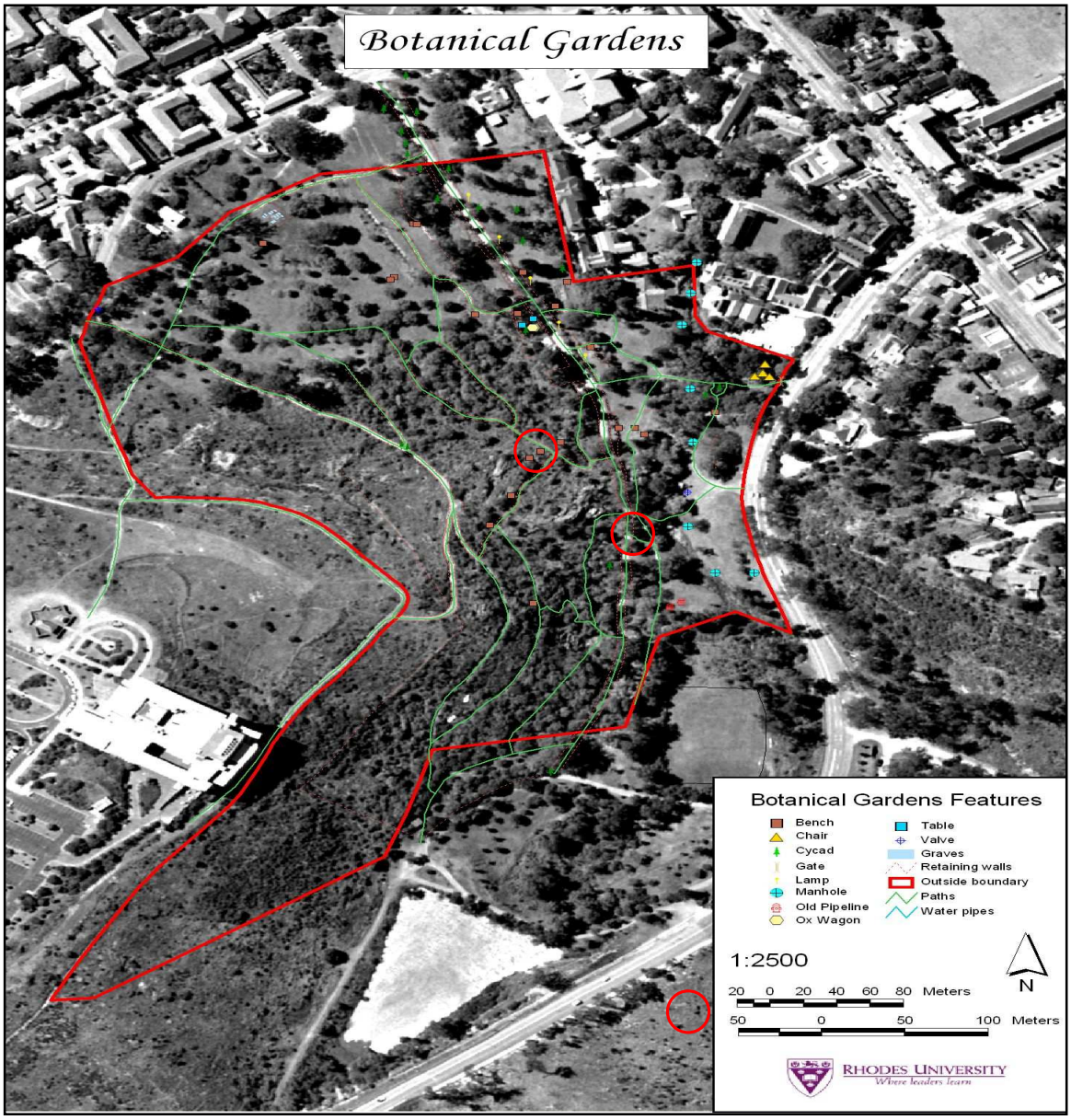

Fig. 1. Location of the three study sites (red circles) within the Botanical Gardens. Image courtesy of CSS and Rhodes University Grounds and Gardens Division.

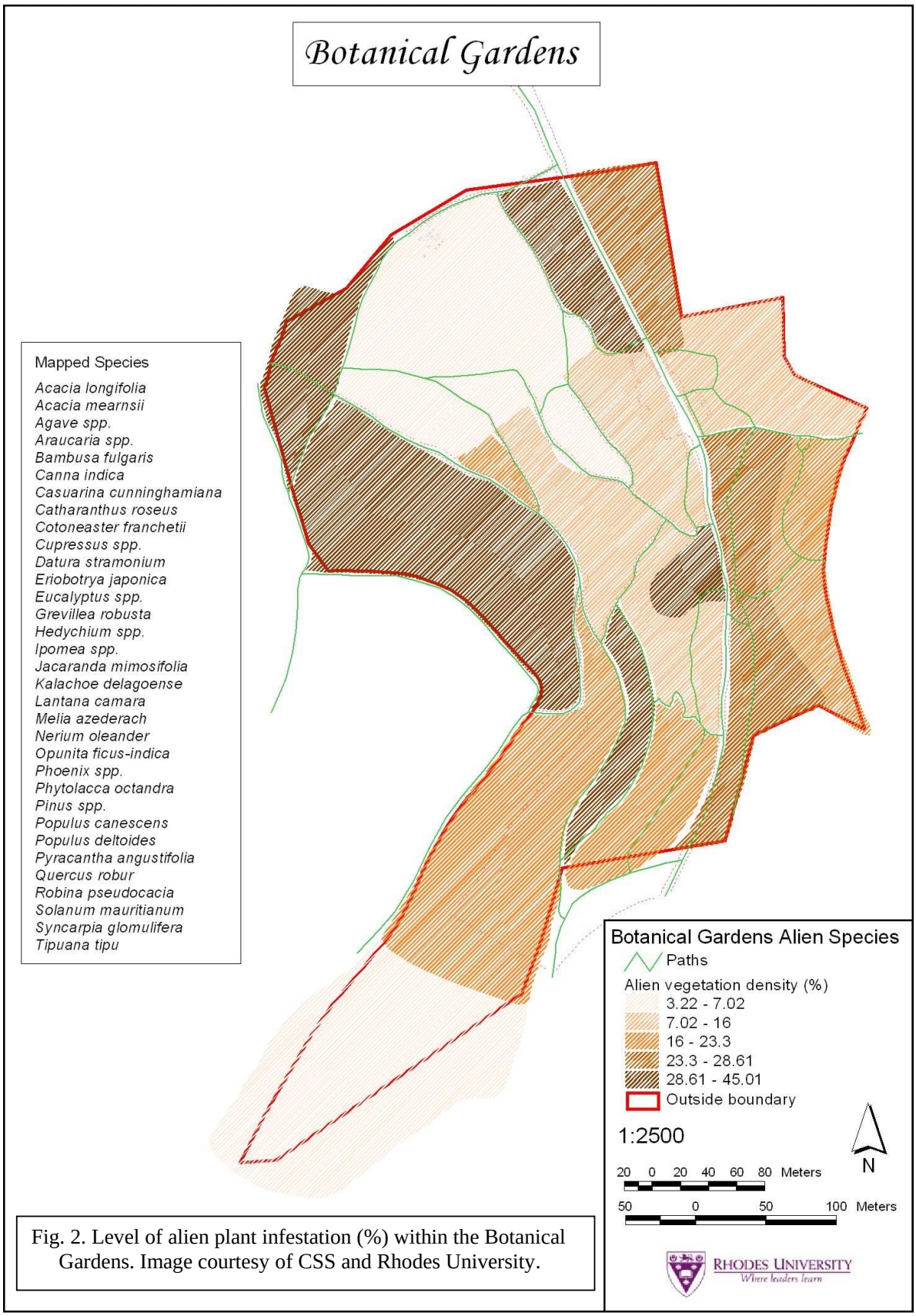

Fig. 2. Level of alien plant infestation (%) within the Botanical Gardens. Image courtesy of CSS and Rhodes University.

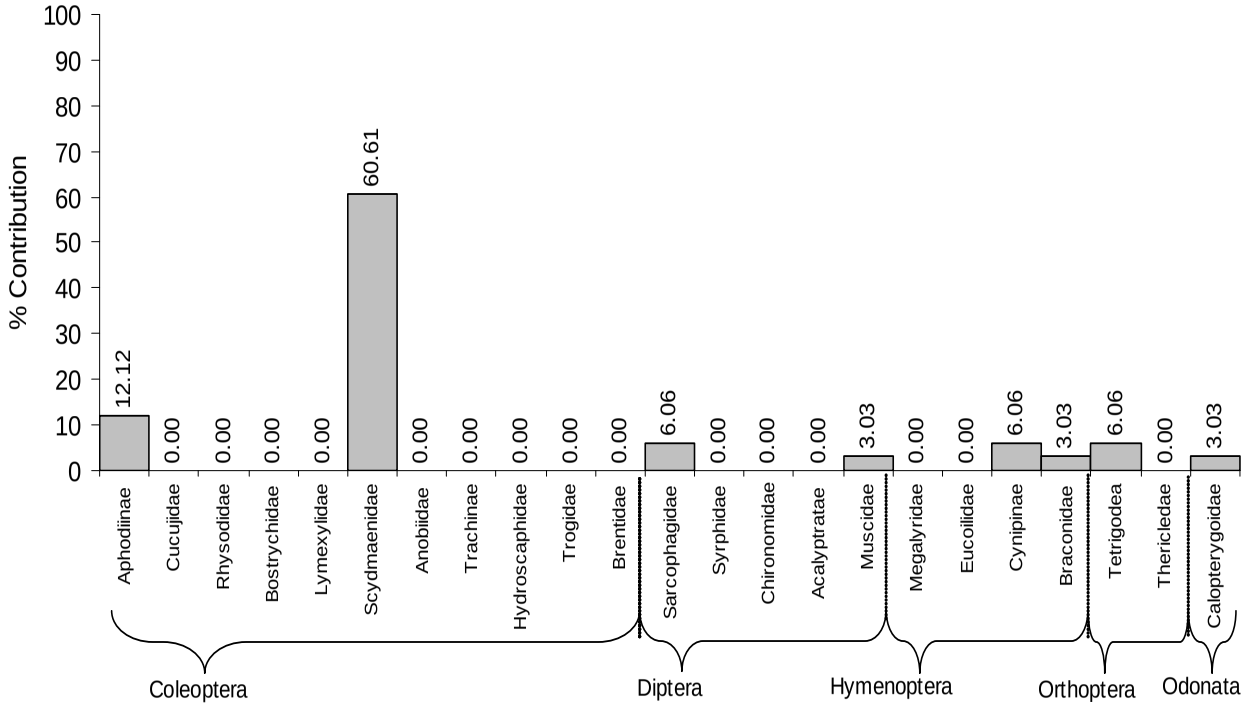

Fig. 3: Composition at the family level of insect specimens from Site 1.

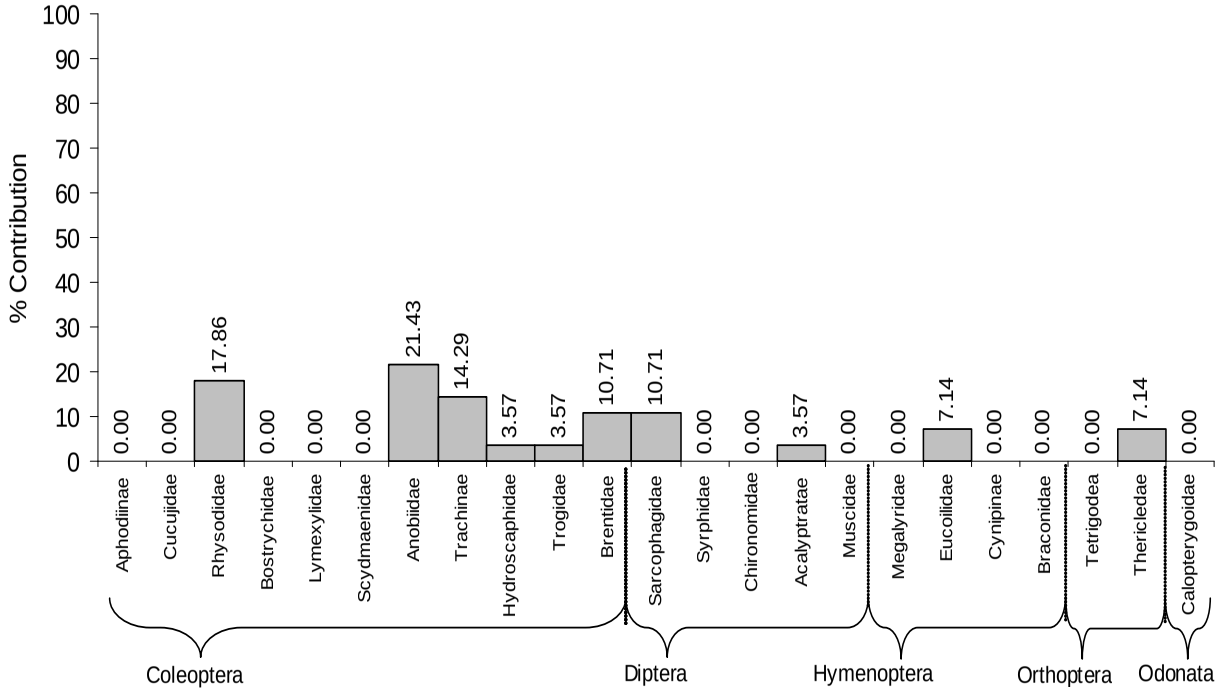

Fig. 4: Composition at the family level of insect specimens from Site 2.

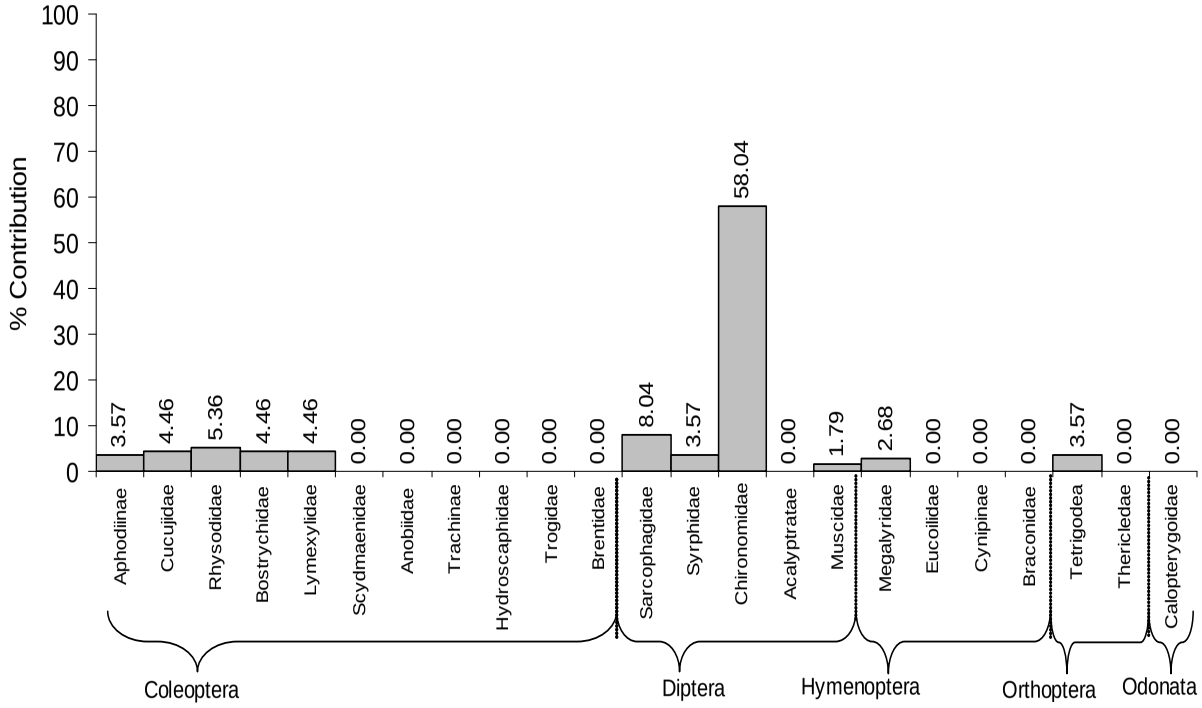

Fig. 5: Composition at the family level of insect specimens from Site 3.

Fig. 6: Flying insect trap coated with Fly-Tac.

Fig. 7: Pitfall trap with Sunlight and water. Diameter approximately 10 cm.