THE ABUNDANCE AND SPECIES RICHNESS OF THE SPIDERS (ARANEAE: ARACHNIDA) ASSOCIATED WITH A RIVERINE AND SWEET THORN THICKET, ROCKY OUTCROP AND *ALOE MARLOTHII* THICKET IN THE POLOKWANE NATURE RESERVE, LIMPOPO PROVINCE

by

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Declaration

I declare that the dissertation hereby submitted to the University of Limpopo for the degree of Master of Science in Zoology has not previously been submitted by me for a degree at this or any other university, that it is my own work in design and in execution, and that all material contained therein has been duly acknowledged.

T.T. Khoza

Abstract

Spiders are abundant and they play a major role in ecosystems. Few studies have been conducted throughout South Africa to determine the diversity and distribution of spiders. The current study was initiated to determine the species richness and diversity and to compile a checklist of spiders found at the Polokwane Nature Reserve. This survey was the first collection of spiders in the reserve and provides valuable data for the management of the reserve as well as to the limited existing information on the Savanna Biome. It will also improve our knowledge of spiders of the Limpopo Province and contribute to the South African National Survey of Arachnida database.

The study was conducted from the beginning of March 2005 to the end of February 2006. Three different vegetation types (riverine and sweet thorn thicket, rocky outcrop and *Aloe marlothii* thicket) were selected as sampling sites. Four collection methods (active searching, sweep netting, tree beating and pitfall trapping) were used to catch spiders. Sampling was done once a month, for three consecutive days per sampling site, using a different method every day but with the pitfall traps opened for five days of that week.

A total of 6045 specimens belonging to 33 families were caught, including 129 genera and 224 species. The most abundant family was the family Oxyopidae comprising 30% of all spiders collected, followed by Eresidae (16%), Thomisidae (13%), Salticidae (9%), Araneidae (6%) and Theridiidae (5%). The most species rich families were the families Araneidae with 35 species, followed by Thomisidae with 32 species, Salticidae with 27 species, Lycosidae with 19 species, Theridiidae with 18 species, Gnaphosidae with 17 species and Oxyopidae with 16 species. The most abundant species were *Stegodyphus dumicola* representing 16% of the total collected spiders, followed by *Oxyopes russoi* (11%), *O. pallidecoloratus* (9%),

Oxyopes sp. 3 (6%) and *Misumenops rubrodecoratus* (9%). Of these, 71% were wanderers and 29% web-dwellers. Of the wanderers 60% were plant-dwellers and 11% ground-dwellers with only 0.2% living in burrows.

Most specimens were obtained from the riverine and sweet thorn thicket site, followed by the rocky outcrop and *Aloe marlothii* thicket sites. The highest number of specimens caught from the riverine and sweet thorn thicket site corresponded with the highest species richness and the highest diversity of species from this site and was followed by those of the rocky outcrop and *Aloe marlothii* thicket sites.

Spiders were collected throughout the sampling period with the highest number of specimens collected in August, followed by April and February. The highest number of species was caught in February and July. Species diversity values were the highest during April and September, followed by July and February. The highest number of mature spiders was collected during June with 271 specimens, followed by March with 260 specimens and February with 256 specimens. Since a high number of mature spider species and a relatively high diversity of spiders were collected during February, it is suggested that February be included during sampling sessions in the Savanna Biome.

In conclusion, this study provided much needed information about the distribution and diversity of spiders in the Savanna Biome and the Limpopo Province with 8% of the currently known species of Southern Africa protected in these vegetation types in the Polokwane Nature Reserve.

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Chapter 1

Introduction

1.1 Convention on Biological Diversity

At the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro in 1992, the world community recognized the necessity of continued economic growth while at the same time maintaining the integrity of the biosphere. As a result, the Convention on Biological Diversity (CBD) was negotiated and opened for signature. The CBD has three goals (i) to promote the conservation of biodiversity, (ii) the sustainable use of its components, and (iii) the fair and equitable sharing of benefits arising out of the utilization of genetic resources (http://www.iisd.ca/biodiv/cbdintro.html, DOA 13/02/08). A decision was made that a comprehensive plan of action was to be taken globally, nationally and locally by organizations of the United Nations System, Governments and Major Groups in every area in which human impacts on the environment. This comprehensive plan is known as AGENDA 21 (http://www.un.org/esa/sustdev/documents/agenda21/index.htm, DOA 13/02/08) and its full implementation as well as the Programme for Further Implementation of Agenda 21 and the Commitments to the Rio principles, were strongly reaffirmed at the World Summit on Sustainable Development (WSSD) held in South Africa in 2002 (http://www.un.org/esa/sustdev/documents/agenda21/index.htm, DOA 13/02/08).

In November 1995, South Africa endorsed the CBD, forcing us to develop a strategic plan for the conservation and sustainable use of biodiversity. Achieving the goals of the CBD involves three scientific missions, namely (i) to discover, describe and to make an inventory of the species diversity of the world; (ii) to analyze and synthesize the information into predictive classification systems that reflect the history of life and (iii) to organize this information in an efficiently retrievable form that best meets the needs of science and the society (Dippenaar & Craemer 2000). To accomplish these goals will require an intensive national effort in South Africa.

In 1997 the "South African National Survey of Arachnida" (SANSA) was launched in accordance with the country's obligations to the CBD (Dippenaar-Schoeman & Craemer 2000). The main aim of SANSA is to make an inventory of the Arachnida of South Africa which will provide essential information needed to address issues concerning the conservation and sustainable use of our arachnid fauna. SANSA is an umbrella project conducted on a national basis in collaboration with other researchers and institutions countrywide and dedicated to the unification and enhancement of biosystematic research on Arachnology in South Africa. Trusts within SANSA focus on inventories of the different floral biomes, provinces, conserved areas and agro-ecosystems (Dippenaar-Schoeman & Wassenaar 2006).

1.1.1 Biodiversity of the Arachnida

The class Arachnida forms part of the phylum Arthropoda. This phylum of animals is responsible for the majority of biodiversity in any terrestrial ecosystem (Redak 2000; Harvey 2002). They inhabit a wide range of microhabitats ranging from the ground, through to the herb layer and the tree canopy. The Arachnida is a group of eight-legged animals and second only to insects in abundance and diversity among the terrestrial animals. They constitute 12 living and five extinct orders of which nine occur in South Africa namely Acari, Amblypygi, Araneae, Opiliones, Palpigradi, Pseudoscorpiones, Schizomida, Scorpiones and Solifugae (Dippenaar-Schoeman 2002a).

South Africa has a rich arachnid fauna with about 4 913 known species, which represents 6% of the global arachnid diversity. Currently 75% of the arachnids are endemic to South Africa (Dippenaar-Schoeman 2002a). However, our knowledge of the arachnids is still sketchy in terms of their taxonomy, ecology and distribution with large areas not being sampled. The taxonomy of the smaller orders (e.g. Amblypygi, Palpigradi and Schizomida) is better known, but groups within the larger orders e.g. spiders and mites have received less attention. One of the greatest threats posed to the conservation of the arachnids is the lack of baseline information and taxonomic support (Dippenaar-Schoeman 2002a).

1.1.2 Biodiversity of Araneae (spiders)

Spiders rank seventh in global diversity. Presently about 37 396 species have been described globally and this was estimated to increase to 170 000 (Adis & Harvey 2000). South Africa has a rich spider fauna with 67 families, 433 genera and about 2000 species known at present (Dippenaar-Schoeman 2002b), but only about 19% of the genera have been revised, while 2% of the genera are monotypic. These revisions indicate that on average between 20-25% of the species are new (Dippenaar-Schoeman 2002a). This lack of taxonomic research within certain of the spider families makes the identification of some specimens to genera and species level impossible (Dippenaar-Schoeman pers. comm.). Additionally, spiders in South Africa are still poorly sampled and little is known about their diversity within most ecosystems (Dippenaar-Schoeman & Wassenaar 2002).

1.1.3 The importance of spiders

Spiders are abundant and speciose, relatively easy to collect (Dippenaar-Schoeman 2002a) and frequently have a high bio-indicative value as they are usually more strongly associated with a biotope than flying insects. They can be used as bio-indicators since they are sensitive to pollution and habitat destruction (Balfour & Rypstra 1998; Dippenaar-Schoeman 2002a; Scharff *et al*. 2003) and have traits that make them good biodiversity indicators e.g. i) spiders are present at high densities from the ground to the top layer, ii) spiders exhibit specific ecological demands toward their natural habitat, iii) spider community variations can be detected even for a small area within a given biotope and iv) spiders hold a strategic level within the food chain as predators or prey (Marc *et al*. 1999). However, the main limitation in using spiders as bio-indicators is a lack of knowledge concerning their taxonomy, distribution and biology (Marc *et al.* 1999).

Additionally, spiders can be used in environmental monitoring while individual species can be used to assess grazing impact in the savanna (Warui *et al*. 2004). Spiders are therefore good representatives of ecological change (Work *et al*. 2002) because they interact with biotic and abiotic factors (Haddad 2005). Abiotic factors mostly influence the microhabitats and habitat structure occupied by spiders which in turn affect the diversity of species in an area (Warui *et al*. 2005), e.g. the presence of cattle and large herbivores will reduce the relative vegetation cover of an area (Warui *et al.* 2004, Saetnan & Skarpe 2006), while fire destroy the microhabitats of wingless invertebrates that live above the soil (Uys *et al*. 2006) and therefore is expected to affect spider distribution.

Spiders are also an important predatory group of terrestrial animals and therefore play a major role in the functioning of healthy ecosystems (Dippenaar-Schoeman & Wassenaar 2006) and in controlling pests in agricultural landscapes (Samu *et al*. 1999; Hawkeswood 2003). They are considered to be a potentially excellent group to limit pests since they are common predators in agro-ecosystems worldwide where they are known to play an important role in controlling pest species (Nyffeler & Benz 1987; Nyffeler *et al.* 1994). Some species may be used in integrated pest management (IPM) since they only take a narrow range of prey (Dippenaar-Schoeman *et al.* 1996). Thus, they contribute to ecological processes such as nutrient cycling as well as pollination (Redak 2000).

1.1.4 Studies of spiders in different floral biomes

Although spiders are found in all the ecoregions of South Africa, few of these regions have been thoroughly surveyed (Dippenaar-Schoeman 2002a). Different biomes consist of different vegetation types and it is therefore important to sample from different biomes in order to determine the occurrence and abundance of species in each biome since spider abundance and diversity are related to environmental diversity at different spatial scales (Samu *et al*. 1999). Compiling check lists for different areas is important because it provides valuable baseline information on species present and is the first step towards a better understanding of the fauna in an area (Dippenaar-Schoeman & Leroy 2003).

The following surveys have been completed in South Africa:

- *Forest Biome* (Van der Merwe *et al*. 1996; Dippenaar-Schoeman & Wassenaar 2002, 2006).
- *Fynbos Biome* (Coetzee *et al*. 1990; Visser *et al*. 1999).
- *Grassland Biome* (Lotz *et al*. 1991; Van den Berg & Dippenaar-Schoeman 1991a; Haddad & Dippenaar-Schoeman 2002; Haddad 2005).
- *Nama Karoo Biome* (Dippenaar- Schoeman 1988a, 2006; Haddad & Dippenaar-Schoeman 2005).
- *Savanna Biome* (Lawrence *et al*. 1980; Dippenaar-Schoeman *et al*. 1989; Whitmore *et al*. 2001, 2002; Foord *et al.* 2002; Dippenaar-Schoeman & Leroy 2003; Foord & Dippenaar-Schoeman 2003; Modiba *et al*. 2005; Haddad *et al*. 2006; Dippenaar-Schoeman *et al*. 2006; Dippenaar *et al*. 2008).
- *Succulent Karoo Biome* (Dippenaar-Schoeman 1988b, 2006; Dippenaar-Schoeman *et al*. 1999a, 2005).

1.1.5 Studies of spiders in different provinces

Most of the provinces in South Africa are working on developing a knowledge base, in which the value of the land in terms of its biodiversity is expressed. Different information tools are used and are aimed to support decisions regarding developments, which impact on the landscape. Baseline biodiversity information is needed in all groups to implement information tools. As part of SANSA, various projects are in progress to determine the arachnid species present in each province and a check list for each province is now available (Dippenaar-Schoeman & Craemer 2000; Dippenaar-Schoeman *et al.* 2005b).

Data from different projects were incorporated for example:

- *Eastern Cape* (Dippenaar-Schoeman 1988a, 2006).
- *Free State* (Lotz *et al*. 1991; Haddad & Dippenaar-Schoeman 2002; Haddad 2005).
- *Gauteng* (Van den Berg & Dippenaar-Schoeman 1991a; Dippenaar-Schoeman *et al*. 1989).
- *KwaZulu-Natal* (Lawrence *et al*. 1980; Van der Merwe *et al*.1996; Matthews *et al.* 2001; Dippenaar-Schoeman & Wassenaar 2002, 2006; Dippenaar-Schoeman *et al*. 2006, Haddad *et al.* 2006).
- *Limpopo* (Whitmore *et al*. 2001, 2002; Foord *et al.* 2002; Foord & Dippenaar-Schoeman 2003; Modiba *et al*. 2005, Dippenaar-Schoeman *et al*. 2006, Dippenaar *et al*. 2008).
- *Mpumalanga* (Van den Berg & Dippenaar-Schoeman1988b; Dippenaar-Schoeman *et al*. 2002a & b; Dippenaar-Schoeman & Leroy 2003; Dippenaar-Schoeman *et al*. 2005a).
- *Northern Cape* (Haddad & Dippenaar-Schoeman 2005, 2006; Haddad *et al*. 2004).

- *Western Cape* (Dippenaar-Schoeman *et al*. 1999a; Dippenaar-Schoeman *et al*. 2005b).

1.1.6 Studies of spiders in conserved areas

Conservation areas play a major role in conserving most of the habitat types and their accompanying fauna. Conservation of species requires a need of understanding the species distribution, composition and abundance (Ojeda *et al*. 2003). In conservation areas, surveys of invertebrate diversity are essential, because the resources are already in place for conserving potentially new, rare and endemic invertebrate species that could exist in these areas (Whitmore *et al*. 2002). However, conservation cannot take place if the species involved are not known (Whitmore *et al*. 2002).

Studies of spider diversity in conserved areas in South Africa include:

- *National Parks*: Mountain Zebra National Park (Dippenaar-Schoeman 1988a, 2006); Karoo National Park (Dippenaar-Schoeman *et al.*1999a); Kruger National Park (Dippenaar-Schoeman & Leroy 2003).
- *Reserves*: Roodeplaat Dam Nature Reserve (Dippenaar-Schoeman *et al*. 1989); Tembe Nature Reserve (Matthews *et al*. 2001); Makalali Nature Reserve (Whitmore *et al*. 2001, 2002); Swartberg Nature Reserve (Dippenaar-Schoeman *et al*. 2005b); Ndumo Nature Reserve (Haddad *et al.* 2006); Polokwane Nature Reserve (Dippenaar *et al*. 2008).
- *State Forests*: Bergvliet State Forest (Van den Berg & Dippenaar-Schoeman 1988b); Ngome State Forest (Van der Merwe *et al*. 1996; Dippenaar-Schoeman *et al*. 2006); Richards Bay coastal dune forest (Dippenaar-Schoeman & Wassenaar 2002, 2006).

- *Conservancy:* Western Soutpansberg Conservancy (Foord *et al*. 2002; Foord & Dippenaar-Schoeman 2003).

1.2 Sampling of spiders

Spiders are abundant and reasonably easy to sample. They are separated into two main guilds, the wandering spiders and the web-builders. Previous studies have shown that a good representation of members of the different guilds of the spider community can be collected when using various sampling methods (Bultman *et al*. 1982). Therefore, it is important to apply different methods in order to sample spiders from different vegetation levels (Scharff *et al*. 2003), since vegetation cover increases habitat complexity, which in turn increases the diversity of spiders (Ysnel & Canard 2000). Additionally it is important to collect during the day and during the night to ensure that both diurnal and nocturnal species are collected (Scharff *et al*. 2003).

In many of the surveys undertaken in South Africa only one or two methods have been used. However, some of the studies (Whitmore *et al*. 2001, 2002; Foord *et al.* 2002; Dippenaar-Schoeman & Leroy 2003; Foord & Dippenaar-Schoeman 2003; Modiba *et al.* 2005; Haddad *et al.* 2006) followed different sampling methods (tree beating, sweep netting, active searching and pitfall trapping). These methods are inexpensive and of simple design and are suitable for biodiversity surveys (Sørensen *et al*. 2002).

The most commonly method used to survey ground dwelling or surface active spiders is pitfall trapping (Uetz & Unzicker 1976). The efficiency of this method varies between habitat types (Curtis 1980). Pitfall trapping is mostly used to trap surface active invertebrates such as ants, beetles, scorpions and spiders (Gibb & Hochuli 2002). The advantages of this method include the catching of a large amount of spiders, continuous sampling and it is not labour-intensive (Gurdebeke & Maelfait 2002). The disadvantages of pitfall traps are that they mostly catch male spiders and furthermore they can be damaged by large herbivores such as kudu, rhino and zebra which will influence the trap's efficiency (Warui *et al*. 2004). Sweep netting is used to collect plant-dwellers. The advantage of this method is the catching of a large amount of spiders. Tree beating is also used to collect plant-dwellers. The advantage of this method is also catching a large amount of spiders while the disadvantage is that the efficiency of this method is hampered by windy conditions (Eardley & Dippenaar-Schoeman 1996). Active searching is used to collect specimens from all possible layers (Work *et al*. 2002) whereas leaf litter sifting is used to collect litter dwelling arthropods. The combination of these methods during a survey covers all vegetation levels except the canopy.

1.3 The aim of this study

The aim of this study is to survey the ground, plant and web-living spiders found in *Acacia karroo/Rhus pyroides* riverine thicket, a northern slope granite outcrop and an *Aloe marlothii* thicket on shale outcrop at the Polokwane Nature Reserve in the Savanna Biome, Limpopo Province.

The objectives of the study are:

- To provide an inventory of spiders for selected habitats in the Polokwane Nature Reserve for the SANSA project and to compare richness at different taxonomic levels with other areas,
- To compare differences between the spider communities of the vegetation types sampled,
- To compare spiders caught with different sampling methods,
- To compare spiders caught during different months and seasons of the year.

Importance of the study:

This study on the spider fauna of the Polokwane Nature Reserve has several benefits. Not only will it contribute valuable information towards SANSA in terms of the diversity of spiders in the Savanna biome, Limpopo Province and found in a conserved area but it will also provide valuable baseline information on species present, which is the first step towards a better understanding of the fauna of the Polokwane Nature Reserve.

1.4 Study area

The study area is situated in the Savanna Biome in the Central Bushveld Bioregion and the vegetation unit is the Polokwane Plateau Bushveld (Mucina & Rutherford 2006).

1.4.1 Savanna Biome

The Savanna Biome is the largest biome in southern Africa, occupying 46% of the total area. One-third of the total area of South Africa consists of savanna and is best known for its diversity and biomass of large mammals (Whitmore *et al*. 2002; Warui *et al*. 2004). It is well developed over the lowveld and Kalahari region of South Africa and Limpopo Province. This biome consists of a grassy ground layer and a distinct upper layer of woody plants. When the upper layer is near the ground it is referred to as a shrubveld, while a dense upper layer is known as a woodland, and the intermediate stages are generally known as bushveld. Therefore, the vegetation types of the Savanna Biome are shrubland, bushland and woodland (Low & Rebelo 1996). Savannas are characterized by a continuous cover of perennial grasses, often 0.9 to 1.8 m tall at maturity, with scattered shrubs and isolated trees. They are found in a wide band on either side of the equator on the edges of tropical rainforests. Savannas have a warm temperature year round with two very different seasons, a long dry season (winter), and a wet season (summer). The rainfall varies between

350 - 650 mm, occurring in summer while the temperature ranges from -8°C to 40°C, with an average of 21°C (Low & Rebelo 1996).

1.4.2 The Central Bushveld Bioregion

The Central Bushveld Bioregion includes Mopane savanna and is the Bioregion with the highest number of vegetation types. It covers most of the high-lying plateau, west of the main escarpment, from the Magaliesberg in the south to the Soutpansberg in the north. The soil variation is quite large. It is dominated by deep red weakly structured soils, with a loamy to clay texture in more level land, and the vegetation structure changes the rainfall that reaches the ground. The strong seasonal rainfall in the southern Africa savanna allows the plant material produced in the wet season to dry and be burned during the dry season (Mucina Rutherford 2006).

1.4.3 Polokwane Plateau Bushveld vegetation unit

Polokwane Plateau Bushveld is a very open savanna with low *Acacia tortilis* (Forsk.) Hayne trees, well developed grass layer to grass plains with occasional trees at higher altitudes. It is found at an altitude of 1100 m to 1500 m. It has a high summer rainfall with very dry winters, the maximum and minimum temperature for Polokwane is 33.2°C and 0.6°C for October and June respectively (Mucina & Rutherford 2006).

1.4.4 Polokwane Nature Reserve

The Polokwane Nature Reserve (23º58'S 29º28'E) is situated 3 km south of Polokwane in the Limpopo Province. It was established in 1962 as a recreation facility for the residents of Polokwane. The reserve covers approximately 3500 ha and constitutes an area of mostly open savanna plains with low *Acacia tortilis* trees. Today the reserve conserves one of the largest pristine examples of the Pietersburg Plateau False Grassveld (Acocks 1975) along with its associated plant and animal species (Grosel pers. comm.). This vegetation type is characterized by open

Themeda sp. grassland with scattered *Acacia* spp. trees and bush clumps. The dominant trees are *Acacia tortilis* and *A. rehmanniana* Schinz. Other interesting plant communities in the reserve include riverine and sweet thorn thickets, granite outcrops, quartzite pebble slopes, saline patches and an *Aloe marlothii* A. Berger thicket.

Chapter 2

Material and methods

2.1 Collecting methods

Spiders were collected at the Polokwane Nature Reserve (23º58'S 29º28'E) for a period of 12 months (March 2005 to February 2006). Three sampling sites were selected (Fig. 1) in three different vegetation types namely in *Acacia karroo*/*Rhus pyroides* riverine thicket (riverine and sweet thorn thicket, RST) (Fig. 2a), a northern slope granite outcrop (rocky outcrop, RO) (Fig. 2b) and *Aloe marlothii* thicket on shale outcrop (*Aloe marlothii* thicket, AM) (Fig. 2c). Each of the three study sites was sampled once a month, for three consecutive days, using a different collecting method every day but with the pitfall traps opened on that site for five days. This results in 12 samples (one per month for each of the four sampling methods) for every sampling site. All collected specimens were preserved in 70% EtOH, studied (using a stereo microscope) and identified (up to family level) using the African Spider family keys (Dippenaar-Schoeman & Jocqué 1997). Thereafter the specimens were identified to genus and species level, as far as possible, by Prof AS Dippenaar-Schoeman (ARC-PPRI).

Four collection methods (pitfall trapping, active searching, sweep netting and tree beating) (Eardley & Dippenaar-Schoeman 1996) were used to catch spiders from the three different sampling sites to cover all vegetation levels excluding the canopy.

- Pitfall trapping

Pitfall traps were used in all sampling sites. Plastic containers (10 cm diameter, 20 cm depth) were buried in such a way that the upper rim was level with the ground surface and the vegetation around the trap was undisturbed. A smaller container (6 cm diameter), containing 70% EtOH to immobilize and preserve caught specimens, was placed inside the larger one covered with a funnel on top. Ten pitfall traps were set in each sampling site and remained at the same place during the entire sampling period. The traps were placed in a star shape format (with three legs from a central trap), with each trap 10 m from the previous one (Fig. 3). They were kept open for 5 days during the week of sampling on the specific site. The traps were checked every day and caught specimens were removed and the evaporated ethanol replaced. Specimens collected from all 10 traps during the five days of sampling on a site were regarded as one sample. The traps were used for 60 days per sampling site during the study period.

- Active searching

Active searching was conducted in all three sampling sites. Spiders were collected by hand from different vegetation levels. Ground, plant and web-dwellers were captured by actively searching and lifting of stones. It was done for two hours, once during the sampling week in each studied site. All collected specimens were regarded as one sample. The area covered extended beyond the last of the pit traps in all three directions. In total, 24 hours was spent per site searching for spiders during the sampling period.

- Sweep netting

A sweeping net (diameter 31 cm) was swung through the grass layer to dislodge specimens, which are then knocked off the plants into the net. The contents from the net were placed into plastic bags. Sweep netting was conducted for two hours per site during the sampling week in each of the three sites. Twenty sweeps were taken every 20 m and all collected specimens were regarded as one sample. The area covered extended beyond the last of the pit traps in all three directions. In total, 24 hours was spent per site sweeping the vegetation during the sampling period. A variety of organisms were collected by this method and they were separated from the vegetation in the laboratory by hand.

- Tree beating

Tree beating was done to knock spiders down from mainly the lower branches of a tree and caught them into a tray. Tree beating was conducted in all sampling sites using a tray (60 x 30 cm length, 7 cm depth) and a stick (1.4 m length). It was done once during the sampling week in each studied site for two hours. Trees less than 2 m tall were beaten 10 times, whereas trees taller than 2 m were beaten 20 times. All collected specimens were regarded as one sample. The area covered extended beyond the last of the pit traps in all three directions. Spiders were separated from other organisms by hand. In total, 24 hours was spent per site beating the trees during the sampling period.

2.2 Determination of vegetation types of the sampling sites

The species composition of each site was determined by doing a transect of 200 m in a straight line through every site. Every 2 m along the transect the grass species at that point was identified. This information was used to calculate the percentage of occurrence for each species in order to determine dominance of grass species per site. Additionally, a 10 x 10 m plot was selected in each site in which tree cover, grass cover and grass height were determined. Since the savanna has a continuous grass layer with only scattered shrubs and isolated trees (Low & Rebelo 1996), the emphasis in the determination of vegetation types was placed on grass species.

- Grass height was determined according to the following four classes:
    - Very short grass (0-50 mm)
    - Short grass (50-250 mm)
    - Medium grass (250-500 mm)
    - Tall grass (500 mm and upwards)

- Grass cover was determined according to the following five classes of grass cover:
    - Bare ground (no grass)
    - Low grass cover (0-25%)
    - Average grass cover (25-50%)
    - High grass cover (50-75%)
    - Full grass cover (75-100%)

- Tree cover was determined according to the broad scale structure classification of vegetation, similar to that used by Edwards (1983):
    - Sparse woodland (0-25%)
    - Open woodland (25-50%)
    - Closed woodland (50-75%)
    - Forest (75-100%)

2.2.1 Site descriptions

- *Riverine and sweet thorn thicket* (Fig. 2a)

This site is located in a closed woodland (75-100% tree cover) situated along a water stream characterized by clay soil with full grass cover (75-100%) consisting of tall grass (500 mm and upwards). The dominant tree is *Acacia karroo* Hayne. Nine different species of grass occurred along the 200 m transect (Table 1). The dominant grass species are *Setaria sphacelata* (Schum.) Moss with 49% occurrence followed by *Chloris gayana* (Kunth) and *Themeda triandra* (Forssk.) both with 12% occurrence, while *Melinis nerviglumis* (Franch.) Zizka is represented by 1% occurrence. Shrub species that generally occur on the site are: *Asparagus* sp., *Lippia rehmannii* H. Pearson, *Lycium* sp. and a *Solanum* sp.

- *Rocky outcrop* (Fig. 2b)

This sampling site is located in an open woodland (0-25% tree cover) on rocky soil with low grass cover (0-50 mm) of low (0-25%) height. The tree community is dominated by *Combretum molle* G. Don. and *Gymnosporr*a sp. A high number of grasses (14 spp.) occurred along the transect (Table 1). The dominant grass species are *Heteropogon contortus* (L.) Roemer & Schultes with 20% occurrence, followed by *Urochloa mosambicensis* (Hack.) Dany with 16% occurrence and *Melinis repens* (Willd.) Zizka had 10%, while a *Brachiaria* sp. with 1% occurrence is the least encountered. Shrub and herb species that generally occur on the site are: *Clerodendrum glabrum* E. Mey., *Commelina africana* L., *Gymnosporia senegalensis* (Lam.) Loes., *Lippia javanica* (Burrm. F.) Spreng., *Lippia rehmannii*, *Lycium* sp. and a *Solanum* sp.

- *Aloe marlothii thicket* (Fig. 2c)

This site occurs in a sparse woodland (25-50% tree cover) on sandy soil with average grass cover (25-50%) consisting of short grass (50-250 mm). The dominant tree species are *Acacia karroo* and *Aloe marlothii* Berger. Nine grass species were encountered along the transect (Table 1). The dominant grass species are *Urochloa mosambicensis* (Hack.) Dandy with 33% occurrence, followed by *Tragus berteronianus* Schult with 20% occurence and *Setaria verticillata* (L.) P. Beauv. with 1% occurrence. Tree, shrub and herb species that generally occur on the site are: *Cleome* sp., *Lycium* sp., *Eulophia* sp., *Pearsonia aristata* (Schinz) Dummer, *Portulacaria afra* Jacq., *Zinnia peruviana* (L.) L., *Ziziphus mucronata* Willd.

2.2.2 Comparison of vegetation types

Bray-Curtis similarities of the percentage dominance values of the grass species occurring in each of the three sampling sites were used to compile a dendrogram (Fig. 4). The dominance of grass species occurring in the *Aloe marlothii* thicket and rocky outcrop were 45% similar, while that of the riverine and sweet thorn thicket was 15% similar to the previous two. Only three grass species occurred in both the *Aloe marlothii* thicket and the northern slope granite outcrop while only two grass species occurred in both the riverine and sweet thorn thicket and in *Aloe marlothii* thicket (Table 1). *Panicum maximum* Jacq. is the only species that occurred in all three sampling sites.

In terms of tree cover and grass cover a gradual increase was observed from the rocky outcrop (0-25%) to the *Aloe marlothii* thicket (25-50%) with the riverine and sweet thorn thicket exhibiting the most dense tree and grass cover (75-100%). The same pattern was observed in the grass height of the three sites with the rocky outcrop with very short grass (0-50 mm), the *Aloe marlothii* thicket with longer grass (50-250 mm) while the riverine and sweet thorn thicket was covered with tall grass (500-upwards). Even though only percentages occurrence of grass values were used to construct the dendrogram (Fig. 4) it may be a true reflection of the similarity of the different sites, with the *Aloe marlothii* thicket and rocky outcrop more similar to each other than to the riverine and sweet thorn thicket. Since the diversity and number of spider species increase with an increase in vegetation layers and habitat diversity (Ysnel & Canard 2000), more spiders and a higher diversity of spiders is expected from the riverine and sweet thorn thicket site compared to the other two sites.

2.3 Precipitation

The rainfall was measured with three rain gauges at different locations throughout the reserve. Measurements were taken after every incidence of rainfall. The annual rainfall for Polokwane Nature Reserve is normally 478 mm. During the study period rain fell during six of the 12 months namely: March 2005 (15 mm), April 2005 (41 mm), November 2005 (130 mm), December 2005 (138 mm), January 2006 (51 mm) and February 2006 (112 mm). The annual rainfall for the year starting March 2005 until February 2006 was 487 mm.

2.4 Data analyses

Analyses including Shannon-Wiener diversity indices, accumulation curves, cluster analyses and multidimensional scaling were done using Primer v5 (Clarke & Warwick 2001). These analyses were performed to estimate the degree of association or similarity among spiders caught in the three different sampling sites, using different sampling methods and during different months and seasons.

- Diversity indices can be used to compare two different habitats, when species are common in the two communities. A larger number of species increases species diversity, and a more even or equitable distribution among species will also increase species diversity (Krebs 1985; Begon *et al*. 1996). Shannon-Wiener's diversity index is define as $-p_i$ log (pi), where pi is the observed relative abundance of a particular species (Green 1999). It is sensitive to changes in the abundance of rare species in a community. Shannon-Wiener's diversity index was used to compare species diversity of spiders caught from the three different sampling sites and during the different months since the sampling effort on all sites and during the entire sampling period was the same. The species evenness diversity index is a measure of the distribution of species in a community which quantifies how equal the communities are numerically (Begon *et al.* 1996). The evenness of species caught from the three different sampling sites was determined using the species evenness diversity index (E_H = H / ln(S)).

- Accumulation curves are used to record the total number of sample units (species or families) revealed during the sampling process since additional sample units (species or families) are added to the pool of previously collected samples (species or families) (Gotelli & Colwell 2001). The cumulative numbers of actual species and families caught respectively, per month, were used to plot graphs. These graphs are used to indicate the possible numbers of species and families present in an area, since the graph will reach a plateau when most or all of the species and families in the area are caught. Raw species richness or higher taxon counts can only be validly compared once the accumulation curves have reached a clear asymptote (Gotelli & Colwell 2001).

- Cluster analyses are used to determine similarities or dissimilarities among samples. Similarity is defined as the quality of being similar (e.g. when two species have significant representation at the same set of sites) between every pair of samples while dissimilarity is defined as the quality of being dissimilar (if they never co-occur in the same set of sites) between every pair of samples (Clarke & Warwick 2001). The data is standardized to give a total of 100%. A similarity matrix is constructed which is used to construct a cluster diagram using group average linking (Clarke & Warwick 2001). Bray-Curtis similarity groups similar species from different samples to their lower levels of similarity (Clarke & Warwick 2001). Bray-Curtis similarity measures were used to compare the percentage dominance of grasses in different sampling sites as well as to determine the similarities between samples caught, using different methods. The values of the similarity matrices were used to construct dendrograms.

- Multidimensional scaling (MDS) analyses are used to determine similarities or dissimilarities among samples (Clarke & Warwick 2001). A similarity matrix is used to construct a map of the samples in a specified number of dimensions.

Multidimensional scaling places similar species from different samples close to each other (Clarke & Warwick 2001). Multidimensional scaling was used to compare the species caught in different sampling sites as well as to determine the similarities between species caught, using different sampling methods.

Beta-diversity is a measure of biodiversity that compares species diversity between ecosystems and involves comparing the number of taxa that are unique to each of the ecosystems (http://en.wikipedia.org/wiki/Beta_diversity, DOA 19/02/08). Sørensen's similarity indices ($\beta = 2c/S_1 + S_2$) were calculated in order to compare the species diversity among the three different sampling sites, as well as between this study and other studies done in the Savanna Biome.

Table 1. Vegetation structure of the sampling sites (riverine and sweet thorn thicket, rocky outcrop and *Aloe marlothii* thicket) indicating the percentage value of dominant grass species during the sampling period (March 2005-February 2006) at the Polokwane Nature Reserve.

Sites	Riverine and sweet thorn thicket	Rocky outcrop	*Aloe marlothii* thicket
Tree cover	75-100%	0-25%	25-50%
Grass cover	75-100%	0-25%	25-50%
Grass height	500 mm-upwards	0-50 mm	50-250 mm
Bothriochloa sp.	8%	-	-
Brachiaria sp.	-	1%	-
Cenchrus ciliaris L.	-	-	14%
Chloris gayana Kunth	12%	-	-
Chloris pycnothrix Trin.	-	-	8%
Chloris Virgata Swart	-	9%	-
Cynodon dactylon (L.) Pers.	4%	-	5%
Digitaria eriantha Steud	-	3%	-
Digitaria sp.	-	2%	-
Eragrotis sp.	2%	5%	-
Eragrostis aethiopica Chiov	-	13%	-
Eragrostis racemosa (Thunb.) steud	-	-	3%
Eriochloa sp.	-	3%	-
Heteropogon contortus (L.) Roem & Schult	-	20%	13%
Melinis nerviglumis (Franch.) Zizka	1%	2%	-
Melinis repens (Willd.) Zizka	-	10%	-
Panicum maximum Jacq.	4%	3%	3%
Setaria sphacelata (Schumach.) Moss	49%	-	-
Setaria verticillata (L.) P. Beauv.	-	-	1%

Table 1 continued.

Sorghum sp.	8%	-	-
Themeda triandra Forssk	12%	-	-
Trachypogon sp.	-	2%	-
Tragus berteronianus Schult	-	11%	20%
Urochloa mosambicensis (Hack.) Dany	-	16%	33%

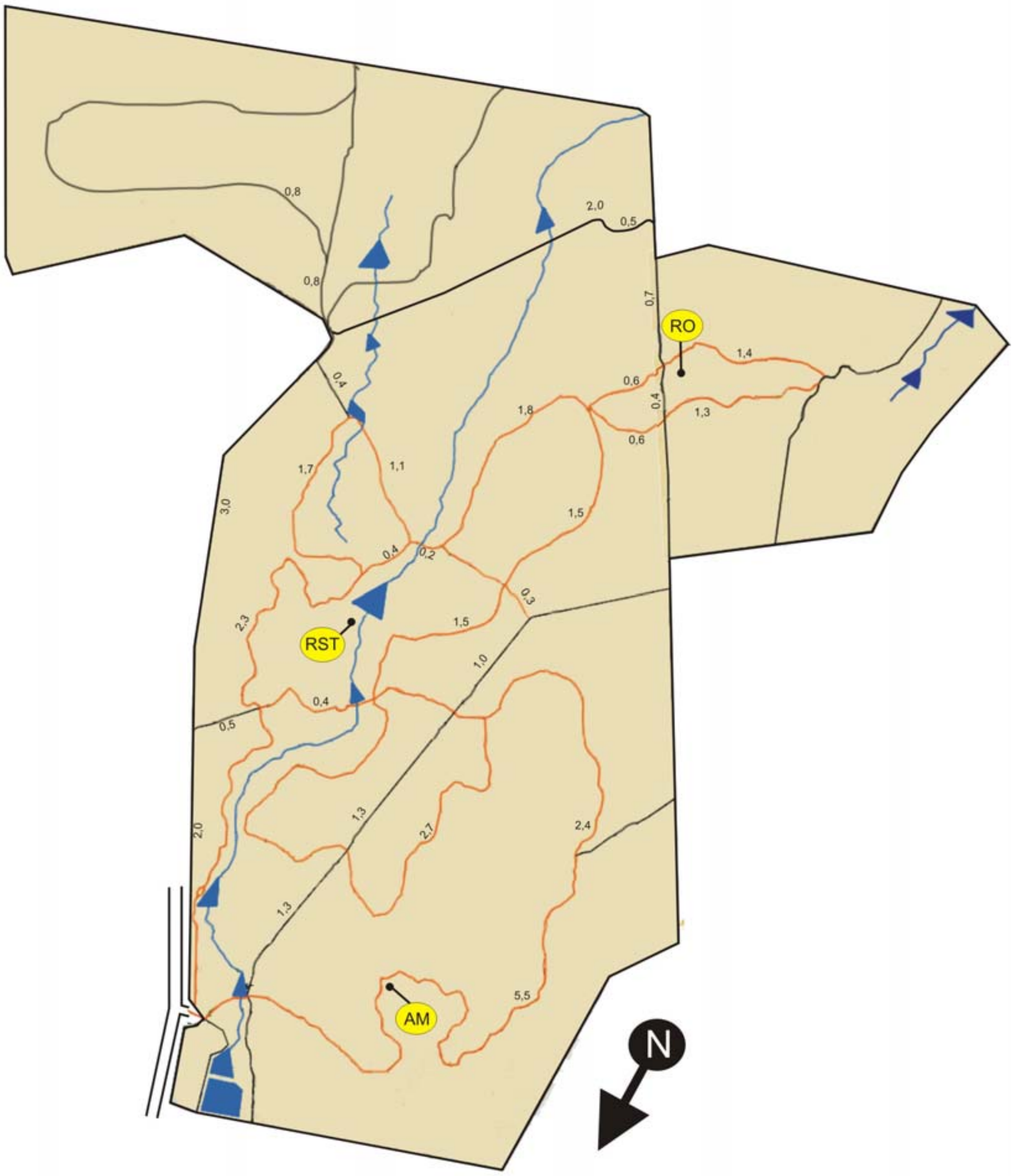

Fig. 1. A map of the Polokwane Nature Reserve, Limpopo Province indicating the distances in km of the roads as well as the location of the three sampling sites (RST = *Acacia karroo*/*Rhus pyroides* riverine thicket, RO = a northern slope granite outcrop, AM = *Aloe marlothii* thicket on shale outcrop).

a

b

c

Fig. 2. Photographs of the different sampling sites in the Polokwane Nature Reserve, Limpopo Province: **(a)** Riverine and sweet thorn thicket (RST), **(b)** Northern slope granite outcrop (RO) and **(c)** *Aloe marlothii* thicket on shale outcrop (AM).

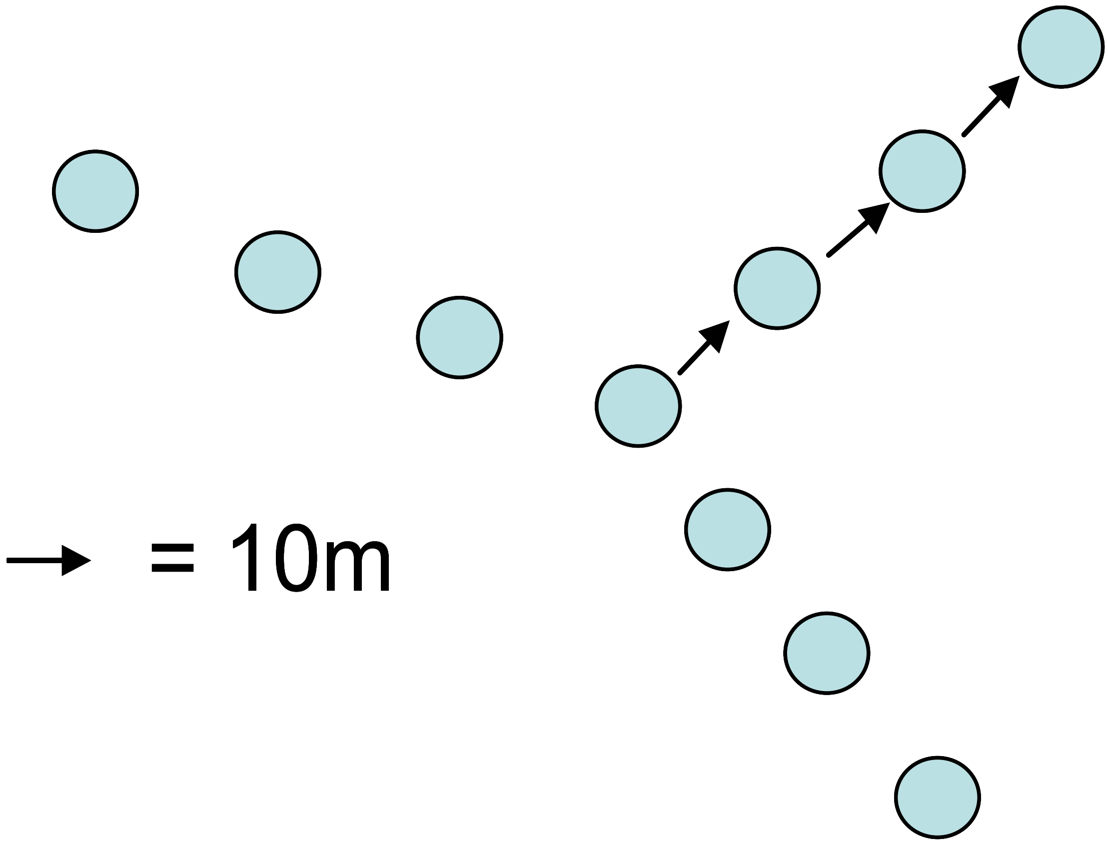

Fig. 3. A diagrammatic representation of the arrangement of pitfall traps on the three sampling sites (riverine and sweet thorn thicket, rocky outcrop and *Aloe marlothii* thicket) during the sampling period (March 2005-February 2006) at the Polokwane Nature Reserve, Limpopo Province.

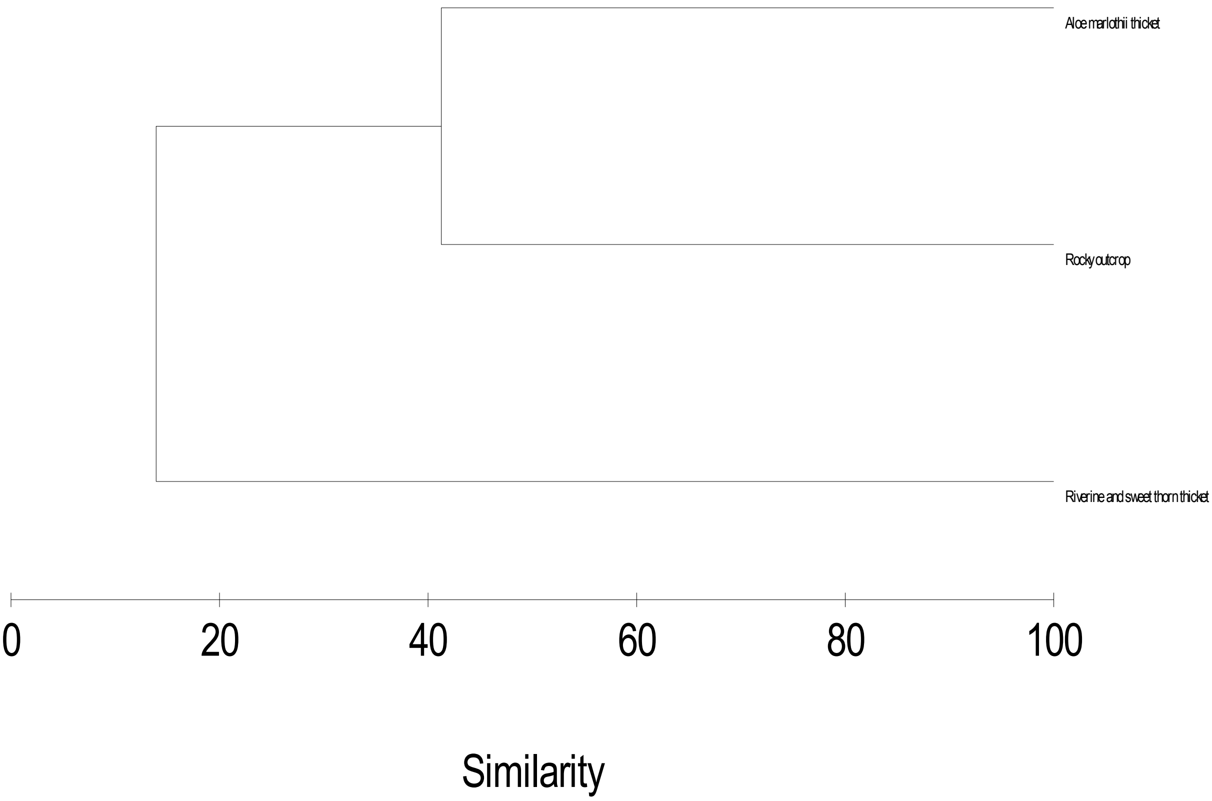

Fig. 4. Bray-Curtis similarities of the dominant percentage values of the grass species occurring on the three sampling sites (riverine and sweet thorn thicket, rocky outcrop and *Aloe marlothii* thicket) during the sampling period (March 2005-February 2006) at the Polokwane Nature Reserve.

Chapter 3

Results and Discussion

3.1 Inventory of spiders from three sampling sites studied and comparison with other studied areas in the Savanna Biome

3.1.1 Spider composition

A total of 6045 specimens were collected during the study period. These specimens belong to 33 families, which include 129 genera and 224 species (Appendix 1), representing 49% of the currently known families in southern Africa. Of these, 71% were wanderers and 29% web-dwellers. Of the wanderers 60% were plant-dwellers and 11% ground-dwellers with only 0.2% living in burrows. These results compare well with other surveys from the Savanna Biome:

- A study done at Makalali Private Game Reserve was conducted during four summer periods (preliminary survey (February), late summer (March), early summer (October) and mid-summer (December)) using the same collecting methods. During this study five different vegetation types were sampled. A total of 4832 specimens were collected which included 38 families, 268 species and 147 genera (Whitmore *et al*. 2002), representing 57% of the currently known families of southern Africa. Of these 41% represented web-builders and 59% wanderers. Of the wanderers 11% were ground-dwellers and 48% plant-dwellers.

- During an *ad hoc* survey in the Kruger National Park that ran over a period of 16 years using three collecting methods, a total of 40 families including 152 species and 116 genera were collected (Dippenaar-Schoeman & Leroy 2003). These represent 60% of the currently known families of southern

Africa of which 21% were web-dwellers and 79% wanderers. Of the collected wanderers, 62% was plant-dwellers and 17% ground-dwellers.

- During a survey at Sovenga Hill, five collecting methods were used and the study was conducted for a period of two months. A total of 29 families including 62 genera and 76 species were collected (Modiba *et al.* 2005), representing 43% of the currently known families of southern Africa. Of these, 84% represented wandering spiders and 16% represented web-builders.

- A survey at Lajuma on the Western Soutpansberg used five years of sporadic *ad hoc* sampling. A total of 46 families including 109 genera and 127 species were collected (Foord *et al.* 2002), representing 69% of the currently known families of southern Africa. Of these, 64% were wandering spiders and 36% build webs.

- During a survey done at Ndumo Game Reserve that extended over a period of six years of *ad hoc* sampling during 11 trips using five collecting methods, a total of 46 families including 222 genera and 431 species were collected (Haddad *et al*. 2006). These represent 69% of the currently known families of southern Africa and comprised of 24.1% web-builders and 79.5% wanderers.

- At the Springbok Flats, three collection methods were used over a period of two years resulting in a total of 3139 spiders collected from 35 families (Van den Berg *et al.* 2003), representing 52% of the currently known families of southern Africa.

From these results it is clear that the spider community in the Savanna Biome is dominated by wanderers. This is to be expected when considering the brief description of the vegetation of the Savanna Biome, i.e. a continuous layer of grass with scattered shrubs and isolated trees (Low & Rebelo 1996). Thus, the guild of the spiders collected can give an indication of the vegetation with wanderers mostly collected from areas with few or an absence of trees and shrubs. Additionally, it is important to consider the representation of spiders in the Afrotropical Region since the currently known spiders consist of 1428 genera representing wanderers (66%) and 669 genera (34%) representing web-builders (Dippenaar-Schoeman & Jocqué 1997). It is therefore expected that wanderers should dominate captures.

The collected number of species (224) compares well with other studies done in the Savanna Biome with more species collected only from the Makalali Private Game Reserve (268) (Whitmore *et al*. 2002) and Ndumo Game Reserve (431) (Haddad *et al*. 2006). Sampling at the Makalali Private Game Reserve was done during only four months (summer periods) using the same methods (Whitmore *et al*. 2002) as the current study, but from five different vegetation types. Since sampling was only done from three different vegetation types during the current study it may explain the lower number of species collected. Sampling in Ndumo Game Reserve was conducted in eight broad habitat types using five different sampling methods (Haddad *et al*. 2006). The use of a variety of collecting methods in many different habitat types explain the high number of species collected during the survey in Ndumo Game Reserve. Therefore, the results confirm previous statements that the spider diversity increases with increasing habitat complexity (Ysnel & Canard 2000), where habitat complexity refers to vegetation architecture or cover rather than diversity (Marc *et al*. 1999).

The highest number of families collected during a study in the Savanna Biome was caught at Lajuma on the Western Soutpansberg (46 families) (Foord *et al.* 2002) and on Ndumo Game Reserve (46 families) (Haddad *et al*. 2006), followed by the 40 families caught in the Kruger National Park (Dippenaar-Schoeman & Leroy 2003).

During the current study only 33 families were caught. The high number of families caught during all of the above mentioned studies may be attributed to the long period of *ad hoc* sampling conducted in both (five, six and 16 years respectively).

3.1.2 Family composition

Of the collected specimens 79% belong to only six families. These families include:

- *Oxyopidae:* The most abundant family was Oxyopidae with 1840 specimens representing 30% of the total number of spiders collected (Table 2). This family comprises nine genera and four are recorded from the Afrotropical Region (Dippenaar-Schoeman & Jocqué 1997). Collected oxyopids comprised of three genera and 16 species. The most abundant genus was *Oxyopes* with 1818 specimens representing 12 species (Appendix 1). The oxyopids are free living wandering spiders very commonly found on vegetation in the Savanna Biome. They are diurnal or nocturnal hunters with good vision and they leap from leaf to leaf in search of prey (Dippenaar-Schoeman & Jocqué 1997).

- *Eresidae*: During the study period, the second most abundant family collected was the Eresidae with 993 specimens, representing 16% of the total captures (Table 2). This family consists of 10 genera and about 110 species in two subfamilies (Dippenaar-Schoeman & Jocqué 1997). Caught eresids were represented by two genera and two species. The most abundant genus was *Stegodyphus* with 990 individuals belonging to one species (Appendix 1). *Stegodyphus* species live socially in community nests and they occur in a variety of habitats.

- *Thomisidae*: The third most abundant family was Thomisidae with 801 specimens representing 13% of the total collected spiders (Table 2). This family comprises of 160 genera and about 2000 species in seven subfamilies (Dippenaar-Schoeman & Jocqué 1997). In the current study captured thomisids comprised 15 genera and 33 species. The most abundant genus was *Misumenops* with 202 specimens belonging to a single species (Appendix 1). Members of the Thomisidae are known as crab spiders and are free living wandering spiders (De Souza & Módena 2004), commonly found on grass, herbs and trees with only a few species living on soil (Dippenaar-Schoeman & Jocqué 1997). They are commonly found in the Savanna Biome.

- *Salticidae*: The fourth most abundant family collected was Salticidae with 529 specimens representing 9% of the total number of spiders collected (Table 2). This family comprises of more than 5000 species worldwide with 111 genera recorded from the Afrotropical Region (Dippenaar-Schoeman & Jocqué 1997). During this survey 18 genera and 27 species were sampled. The most abundant genus was *Euophrys* with 140 individuals representing a single species (Appendix 1). Representatives of Salticidae are free-living ground and plant dwelling spiders. They occupy a wide range of habitat types and are active during the day (Dippenaar-Schoeman & Jocqué 1997).

- *Araneidae*: 334 specimens of araneids representing 6% of the total collected spiders were caught (Table 2). This family comprises of more than 4000 species in 156 genera (Dippenaar-Schoeman & Jocqué 1997). In the current study captured araneids were represented by 22 genera and 35 species (Appendix 1). The most abundant genus was *Neoscona* with 138 individuals representing five species. Members of this family construct orb-webs and occupy a wide range of habitat types (Dippenaar-Schoeman & Jocqué 1997).

- *Theridiidae*: A total of 307 theridiids representing 5% of the total number of spiders collected were caught (Table 2). This family comprises of 60 genera of which 27 have been recorded from the Afrotropical Region (Dippenaar-Schoeman & Jocqué 1997). In the current study captured theridiids were represented by 6 genera and 18 species (Appendix 1). The most abundant genus was *Theridion* with 170 specimens representing 8 species. However, some of the theridiids could not be identified to genus or species level due to a lack of taxonomic knowledge. Theridiids constitute a diverse group of web building spiders occurring in a variety of habitats (Dippenaar-Schoeman & Jocqué 1997).

The most dominant families of the current study (Oxyopidae and Eresidae) differ from those found in other surveys in the Savanna Biome. In the Makalali Private Game Reserve the dominant family was Araneidae (32% of the total), followed by the Salticidae (18%) and the Thomisidae (10%) (Whitmore *et al.* 2002). Most of the members of these families are plant-dwelling (Dippenaar-Schoeman & Jocqué 1997) and are therefore expected from areas with a complex vegetation structure such as Makalali Private Game Reserve that consists of a broad-leafed savanna ecosystem (Whitmore *et al.* 2001). At Sovenga Hill the dominant family was Thomisidae (21.1%) followed by the Gnaphosidae (12.7%) and Lycosidae (9.7%) (Modiba *et al*. 2005). Members of Thomisidae are mostly plant-dwelling while Gnaphosids and Lycosids are wanderers running around on the soil surface (Dippenaar-Schoeman & Jocqué 1997). Since Sovenga Hill is a closed woodland (Modiba *et al*. 2005), domination by plant dwellers is to be expected. This confirms again that there is a correspondence between the vegetation and the composition of the associated spider community (Marc *et al*. 1999).

3.1.3 Species composition

During the study period the most abundant species caught were:

- *Stegodyphus dumicola* Pocock, 1898 of the family Eresidae with 990 specimens representing 16% of the total number of spiders collected (Appendix 1). It is one of the community nest species and they build their nests with extended webs mostly on *Acacia* trees. In the current study their nests were patchily distributed. Each nest contained generally more than 100 individuals, including males, females and juveniles.

- *Oxyopes russoi* Caporiacco, 1940 of the family Oxyopidae was the second most abundant species with 687 specimens representing 11% of the total number collected (Appendix 1). This species is a very common grass-living species.

- *Oxyopes pallidecoloratus* Strand, 1906, the third most abundant oxyopid species with 567 specimens represented 9% of the total number collected (Appendix 1).

- The fourth most numerous species was an undescribed oxyopid species (*Oxyopes* sp. 3) with 340 specimens representing 6% of the total number collected (Appendix 1).

- The fifth species, *Misumenops rubrodecoratus* Millot, 1942 of the Thomisidae with 202 specimens representing 3% of the total number collected (Appendix 1). *M. rubrodecoratus* inhabits grass, shrubs, flowers and trees and they capture their prey by leaping forward grabbing the prey (Dippenaar-Schoeman 1983).

The number of species collected per family differs among surveyed regions. In the current study the family Araneidae contributed the highest number of species (35 spp.), 16% of the total number of species caught, followed by Thomisidae (32 spp.) with 14%, Salticidae (27 spp.) with 12%, Lycosidae (19 spp.) with 8%, Theridiidae (18 spp.) with 8%, Gnaphosidae (17 spp.) with 8% and Oxyopidae (16 spp.) with 7% of the total (Tables 2 & 3).

Representative species caught from the above mentioned families were:

- *Araneidae:* The most numerous member of this family of orb-web builders was *Hypsosinga lithyphantoides* Caporiacco, 1947 with 60 specimens representing 1% of all specimens caught. The second most abundant species was *Neoscona subfusca* (C.L. Koch, 1837) with 48 specimens, followed by *N. blondeli* (Simon, 1885) with 41 specimens and *N. quincasea* Roberts, 1983 with 40 specimens (Appendix 1).

- *Thomisidae:* These free-living wanderers were represented by *Misumenops rubrodecoratus* with 202 specimens accounting for 3% of all specimens caught, followed by *Runcinia flavida* (Simon, 1881) with 190 specimens and *Tmarus cameliformis* Millot, 1942 with 60 specimens each accounted for 1% of all caught spiders (Appendix 1). *Runcinia flavida* with their elongated bodies are typical grass dwellers while the greyish brown *T. cameliformis* live on trees.

- *Salticidae:* This free-living wandering family was represented by *Euophrys* sp. 1 with 140 specimens, followed by *Heliophanus debilis* Simon, 1901 with 92 specimens each made up about 2% of the caught specimens, followed by *Thyene burnea* (Gerstäcker, 1873) with 52 specimens and *Brancus bevisi* Lessert, 1925 with 34 specimens with each representing 1% of all specimens collected (Appendix 1).

- *Lycosidae:* This free living ground dwelling family was represented by *Proevippa* sp. 1 with 41 specimens, followed by *Proevippa wanlessi* (Russel-Smith, 1981) with 40 specimens with each representing 1% of all specimens caught, followed by *Pardosa* sp. 10 with 26 specimens representing 0.4% of all caught specimens and *Lycosa* sp. 1 with 15 specimens representing 0.2% of all specimens collected (Appendix 1).

- *Theridiidae:* The theridiids construct gum-foot webs and the most abundant species caught were *Theridion* sp. 13 with 130 representing 2% of all specimens caught, followed by *Enoplognatha molesta* O.P.-Cambridge, 1904 with 66 specimens representing 1% of all specimens collected, *Argyrodes convivans* Lawrence, 1937 with 24 specimens representing 0.4% of all collected specimens and *Latrodectus geometricus* C.L.Koch, 1841 with 18 specimens representing 0.3% of all specimens collected (Appendix 1).

- *Gnaphosidae:* The gnaphosids are free living ground dwellers and the most abundant species caught were *Camillina aestus* Tucker, 1923 with 89 specimens, followed by *Asemesthes ceresicola* Tucker, 1923 with 46 specimens each representing 1% of all collected spiders, *Xerophaeus appendiculatus* Purcell, 1907 with 23 specimens and *Xerophaeus bicavus* Tucker, 1923 with 17 specimens each accounting for 0.3% of all specimens caught (Appendix 1).

- *Oxyopidae:* The free living plant dwellers of the family Oxyopidae were represented by *Oxyopes russoi* with 687specimens that accounted for 11% of all specimens caught, followed by *O. pallidecoloratus* with 567 specimens representing 9%, *Oxyopes* sp. 3 with 340 specimens representing 6% and *O. hoggi* Lessert, 1915 with 95 specimens representing 2% of all caught specimens (Appendix 1).

The species dominance in the current study compares reasonably well with other surveys from the Savanna Biome. Araneidae was also the dominant family in terms of species richness in the Kruger National Park with 23 species (Dippenaar-Schoeman & Leroy 2003), while it was the second most dominant family in both the Makalali Private Game Reserve with 31 species (Whitmore *et al.* 2002) and in the Western Soutpansberg with 10 species (Foord *et al.* 2002). Thomisidae was represented by the highest number of species both at Sovenga Hill with 12 species (Modiba *et al.* 2005) and at the Western Soutpansberg with 15 species (Foord *et al.* 2002), while it had the second highest number of species in Ndumo Game Reserve with 51 species (Haddad *et al*. 2006) and in the Kruger National Park with 15 species (Dippenaar-Schoeman & Leroy 2003).

There is very little species overlap (β=0.1) between the current study and other studies done in the Savanna Biome (Kruger National Park, Sovenga Hill, Western Soutpansberg, Makalali Private Game Reserve and Ndumo Game Reserve). This is probably due to the differences in vegetation types among these areas that provide habitat to different spider species.

During the current study 14 species collected are new species while three represent new records for Africa (Appendix 1).

3.2 Comparison of the differences among the spider communities of the vegetation types sampled

3.2.1 Spider composition and abundance

- *Riverine and sweet thorn thicket*

During the study period a total of 2604 specimens were collected from this site (Appendix 1). Of these collected specimens, 69.7% represented wanderers with 1802 specimens and 30.7% web-dwellers with 802 specimens. The wanderers were dominated by plant-dwellers with 1732 specimens representing 66.5%, followed by ground-dwellers with 65 specimens and borrow-dwellers with five specimens.

- *Rocky outcrop*

On this site a total of 2297 specimens were collected during the study period (Appendix 1). Plant-dwellers again dominated the caught specimens with 1402 specimens, followed by web-dwellers with 657 specimens, ground-dwellers with 230 specimens and borrow-dwellers with 8 specimens.

- *Aloe marlothii thicket*

A total of 1144 specimens were collected from this site during the study period (Appendix 1). As on the previous two sites, numbers of caught spiders were dominated by plant-dwellers with 478 specimens, followed by web-dwellers with 382 specimens, ground-dwellers with 283 specimens and borrow-dwellers with one specimen.

From the above it is clear that most specimens were collected from the riverine and sweet thorn thicket, followed by the rocky outcrop and the least specimens were caught on the *Aloe marlothii* thicket site. Since the riverine and sweet thorn thicket site had a high percentage of tree and grass cover (75-100%, Table 1) more habitats are available for plant and web-builders. The *Aloe marlothii* thicket site apparently has a higher percentage of grass and tree cover (25-50%, Table 1) than the rocky outcrop site, but most of the trees are *A. marlothii* trees which do not provide a multitude of habitats because of the plant structure. Additionally these trees could not be beaten in search of spiders but were actively searched instead. However, this could only be done up to eye level. Therefore, even though the rocky outcrop was covered by a smaller percentage of grass and trees (0-25%, Table 1) many plant-dwellers and web-builders were collected.

3.2.2 Family composition and abundance

- *Riverine and sweet thorn thicket*

The specimens caught on the riverine and sweet thorn thicket represented 26 families (Appendix 1). The highest number of specimens caught on this site belonged to the family Oxyopidae with 897 specimens, followed by the Eresidae with 324 specimens and the Salticidae with 314 specimens. Two members of the families Nemesiidae and 14 specimens from the family Nephilidae were caught only on this site. Only a single specimen was encountered from each of the families Agelenidae and Hersiliidae during the study period.

- *Rocky outcrop*

The specimens caught on the rocky outcrop also represented 26 families (Appendix 1). The highest number of specimens caught on this site belonged to the family Oxyopidae with 676 specimens, followed by Thomisidae with 387 specimens and Eresidae with 371 specimens. Three members of the families Barychelidae, a single specimen of the family Oonopidae, two members of the family Prodidomidae and six members of the family Selenopidae were only caught on this site. Only a single specimen was encountered from the families Hersiliidae, Oonopidae and Sparassidae during the study period.

- *Aloe marlothii thicket*

The specimens caught on the *A. marlothii* thicket represented 21 families (Appendix 1). The highest number of specimens caught on this site belonged to the family Eresidae with 298 specimens, followed by Oxyopidae with 267 specimens and Thomisidae with 128 specimens. A total of 58 specimens from the family Ammoxenidae were only caught on this site. Only a single specimen of both the families Theraphosidae and Uloboridae was caught during the study period.

On the rocky outcrop and on the riverine and sweet thorn thicket 26 different families were respectively collected. The highest number of caught specimens on both these sites belonged to the family Oxyopidae. This may be due to the fact that members of this family occupy a wide range of vegetation types that was available on both these sites. The highest number of specimens caught on the *Aloe marlothii* thicket belonged to the family Eresidae. Fewer specimens of Oxyopidae were caught compared to the riverine and sweet thorn thicket and rocky outcrop sites probably because of the general absence of trees (apart from *Aloe marlothii*) from this site.

Members of the family Nemesiidae are active at night and they live in burrows (Dippenaar-Schoeman 2002). They may have been caught on the riverine and sweet thorn thicket site because this site has a high percentage of grass cover (75-100%) which may have provided protection against high temperatures. Additionally, members of the family Nephilidae spin large golden orb-webs between trees (Leroy & Leroy 2003) and the high percentage of tree cover (75-100%) as well as the occurrence of a lot of shrubs on this site provided sufficient habitat for them to support their webs. Furthermore insects e.g. locusts that occurred on this site provide them with the necessary prey. Only a single specimen of Agelenidae was caught on this site, probably due to the grass height (500 mm and upwards) since these spiders build funnel-shaped webs on short grass and low vegetation (Dippenaar-Schoeman

& Jocqué 1997). Members of the family Hersiliidae have diverse life-styles ranging from wandering tree-dwellers to ground-dwelling web-builders and since this site has a high tree cover (75-100%), more members of this family are probably present. However tree living hersiliids are very cryptic and not so easily seen and they can only be sampled by hand.

Members of the families Barychelidae, Oonopidae and Selenopidae were only caught on the rocky outcrop. Representatives of the family Barychelidae are active at night and they build silk-lined burrows or retreats under rocks, sometimes closed with a trap door (Dippenaar-Schoeman 2002). Their presence on this site is probably due to the large amount of rocks found on the site which provided suitable habitat. The site also provided suitable habitat for members of the families Oonopidae and Prodidomidae that are also active at night and hiding under rocks during the day (Dippenaar-Schoeman & Jocqué 1997) as well as for members of the family Selenopidae that are normally found on large, flat rocks and tree trunks. Only one hersiliid *Tyrotama soutpansbergensis* Foord & Dippenaar-Schoeman 2005 have been collected during the study from this site. They are ground-dwellers that make retreats under rocks (Foord & Dippenaar-Schoeman 2005).

The *Aloe marlothii* thicket was the only site from which specimens of the family Ammoxenidae were caught. Ammoxenids are known as sand divers (Dippenaar-Schoeman *et al.* 1996). They are specialist termite feeders and most likely occurred on this site because of the presence of termites. Only a single specimen of both the families Theraphosidae and Uloboridae was caught on this site. Members of the family Theraphosidae are active at night and they inhabit silk-lined burrows and retreats made in open field or under rocks (Dippenaar-Schoeman & Jocqué 1997).

3.2.3 Species composition, abundance and diversity

- *Riverine and sweet thorn thicket*

During the study period a total of 167 species were caught on the riverine and sweet thorn thicket (Table 3). *Stegodyphus dumicola* was the most abundant with 324 specimens, followed by *Oxyopes russoi* with 286 specimens, *O. pallidecoloratus* with 224 specimens and *Oxyopes* sp. 3 with 220 specimens (Appendix 1). A total of 55 species were caught only on this site, while only a single specimen from 30 species was encountered.

- *Rocky outcrop*

A total of 147 species were caught on this site during the study period (Table 3). *Stegodyphus dumicola* had the highest number with 368 specimens of individuals, followed by *Oxyopes russoi* with 292 specimens, *O. pallidecoloratus* with 232 specimens, *Misumenops rubrodecoratus* with 112 specimens and *Runcinia flavida* with 105 specimens (Appendix 1). A total of 24 species were caught only on this site, while only a single specimen of eight species was encountered.

- *Aloe marlothii thicket*

During the study period a total of 95 species were caught on the *Aloe marlothii* thicket (Table 3). Similar to the previous two sites, *Stegodyphus dumicola* was the most numerous with 298 specimens, but was followed by *Oxyopes pallidecoloratus* with 111 specimens, *O. russoi* with 109 specimens and *Ammoxenus amphalodes* Dippenaar & Meyer, 1980 with 98 specimens (Appendix 1). A total of 14 species were caught only on this site, while a single specimen of eight species was encountered.

The highest number of species was collected from the riverine and sweet thorn thicket site with 167 species, followed by the rocky outcrop site with 147 species and the *Aloe marlothii* thicket site with 95 species. This is probably due to the fact that the riverine and sweet thorn thicket has more structured vegetation (Table 1) that provides habitat to a wider variety of species and a high amount of moisture on the ground surface, while on the rocky outcrop and *A. marlothii* thicket the vegetation is less structured and therefore provides less habitat and any moisture evaporated quickly.

The Shannon-Wiener's diversity index (H´) value (Table 3) was the highest for the riverine and sweet thorn thicket (H´=3.7), followed by the rocky outcrop (H´=3.6) and the *A. marlothii* thicket (H´=3.2). From these values it is apparent that a higher diversity of species was captured on the riverine and sweet thorn ticket site than on the rocky outcrop and *Aloe marlothii* thicket sites. The overall Shannon-Wiener's diversity index (H´) for the three sampling sites is 3.5. The evenness values (E_H=0.7) show that most species are relatively uniformly distributed over the three sampling sites (Table 3). In comparing the species diversity between the riverine and sweet thorn thicket and the rocky outcrop sites (β=0.3) little species overlap was found with even less overlap between riverine and sweet thorn thicket and the *Aloe marlothii* sites (β=0.2). The same amount of species overlap (β=0.3) was found between the rocky outcrop and *Aloe marlothii* sites as between the riverine and sweet thorn thicket and rocky outcrop sites. This emphasizes that even though a relative uniform distribution of species occurred on all the sampling sites there was little overlap of species.

Combining the data from the three sites, *Stegodyphus dumicola* had the highest number with 990 specimens, followed by *Oxyopes russoi* with 687 specimens and *O. pallidecoloratus* with 567 specimens. As previously mentioned the specimens of Eresidae (e.g *Stegodyphus dumicola*) are social members occurring in nests with a large number of spiders while those of Oxyopidae (e.g *Oxyopes russoi* and *O.*

pallidecoloratus) are occupying a diversity of vegetation types but mainly grass. Therefore, *Stegodyphus dumicola*, *Oxyopes russoi* and *O. pallidecoloratus* were collected in abundance because all the sampling sites had suitable habitats for them to occupy.

During the study period the highest number of specimens was collected from the riverine and sweet thorn thicket representing 43% of all caught specimens, 79% of all caught families and 75% of all caught species. Spiders caught from the rocky outcrop represented 38% of all caught specimens, 79% of all caught families and 66% of all caught species. Collected specimens from the *Aloe marlothii* thicket represented 19% of all caught specimens, 64% of all caught families and 42% of all caught species (Fig. 5). Therefore, most of the collected spiders (81%) were caught from the riverine and sweet thorn thicket and rocky outcrop sites (43% and 38% respectively). These figures seem to relate to the percentage of species collected from those sites with 75% of the total number of species caught on the riverine and sweet thorn thicket site and 66% of the total number of species collected on the rocky outcrop site. However, a high number of collected specimens does not necessary imply a high number of families. The 43% of the total number of spiders, collected from the riverine and sweet thorn thicket site represented 79% of the total number of families collected, while 38% of the total number of spiders, collected from rocky outcrop, also represented 79% of the total number of collected families.

The general lower number of specimens, families and species collected from the *Aloe marlothii* thicket site is probably due to the fact that the site had a lower tree and grass cover (25-50%) (Table 1). Additionally, the *A. marlothii* trees could not be beaten in search of spiders. Therefore, it seems that a higher number of spiders and higher number of species are associated with an increase in plant cover and plant diversity and thus confirms that the diversity of vegetation structure influences spider diversity (Marc *et al*. 1999; Whitmore *et al*. 2002).

3.3 Comparison of spiders caught with different sampling methods

3.3.1 Sweep netting

3.3.1.1 Number of spiders caught

During the study period a total of 2060 specimens were collected by sweep netting (Table 4) representing 34% of the total number of spiders caught. Most of these spiders were caught on the riverine and sweet thorn thicket with 850 specimens (n=12; $\bar{x}$ =70.8;s=42.6), followed by the rocky outcrop with 778 specimens (n=12; $\bar{x}$ =64.8;s=39) and the *Aloe marlothii* thicket with 432 specimens (n=12; $\bar{x}$ =36;s=39) (Fig. 5). The high number of specimens caught on the riverine and sweet thorn thicket site using sweep netting may be a result of the high percentage of grass cover (75-100%, Table 1) on this site.

3.3.1.2 Families collected and abundance

The specimens caught by sweep netting represented 13 families (Table 4). The family Oxyopidae had the highest number of individuals with 753 specimens, followed by Thomisidae with 530 specimens, Salticidae with 227 specimens and Araneidae with 208 specimens. Four members of the family Tetragnathidae with were only caught by this method. This result was expected because the families Oxyopidae, Thomisidae and Salticidae are strongly represented on the grass-layer. Additionally, members of the families Araneidae and Tetragnathidae, with their webs, are mainly sampled by sweep netting.

3.3.1.3 Species collected and abundance

The specimens caught by sweep netting represented 118 species (Table 4). *Oxyopes pallidecoloratus* had the highest number of individuals with 410 specimens, followed by *Runcinia flavida* with 186 specimens, *Misumenops rubrodecoratus* with 143 specimens and *Oxyopes russoi* with 134 specimens. A total of 42 species were only caught using this method. All four of the most abundant species, have cream coloured bodies and they blend in well with grass. *Runcinia flavida*, with its elongated abdomen, is a typical grass dweller (Dippenaar-Schoeman 1983) while *Misumenops rubrodecoratus* is commonly found on plants.

3.3.2 Tree beating

3.3.2.1 Number of spiders caught

Of the 6045 spiders collected during the study period, a total of 1996 spiders were collected by tree beating (Table 4) representing 33% of the total number of spiders caught. The highest number of spiders was caught in the riverine and sweet thorn thicket with 1122 specimens (n=12; $\bar{x}$ =93.5;s=35.4), followed by the rocky outcrop with 777 specimens (n=12; $\bar{x}$ =64.8;s=48.2) and the *Aloe marlothii* thicket with 97 specimens (n=12; $\bar{x}$ =8.1;s=22.0) (Fig. 6). The high number of specimens caught in the riverine and sweet thorn thicket using tree beating, may be due to the high percentage (75-100%, Table 1) of tree cover and the diversity of trees found on this site.

3.3.2.2 Families collected and abundance

The specimens caught by tree beating represented 15 families (Table 4). The family Oxyopidae had the highest number of individuals with 1010 specimens, followed by Salticidae with 224 specimens and Thomisidae with 223 specimens. Three members of the family Mimetidae were only caught by this method. This result was expected because representatives of the family Oxyopidae occupy a wide range of vegetation types, while members of both Salticidae and Thomisidae are plant-dwellers.

3.3.2.3 Species collected and abundance

The specimens caught by tree beating represented 89 species (Table 4). *Oxyopes russoi* had the highest number of individuals with 552 specimens, followed by *Oxyopes* sp. 3 with 268 specimens and *O. pallidecoloratus* with 122 specimens. A total of 18 species were only caught using tree beating. Oxyopids are very abundant on vegetation with both *O. russoi* and *O. pallidecoloratus* being abundant on both grass and trees.

3.3.3 Active searching

3.3.3.1 Number of spiders caught

Of the 6045 spiders collected during the study period, a total of 1749 were collected by active searching (Table 4) representing 29% of the total number of spiders caught. The highest number of specimens collected during active searching was on the rocky outcrop site with 707 specimens (n=12; $\bar{x}$ =58.9;s=41.1), followed by the riverine and sweet thorn thicket with 572 specimens (n=12; $\bar{x}$ =47.7;s=47.6), and *Aloe marlothii* thicket sites with 470 specimens (n=12; $\bar{x}$ =39.;s=45.9) (Fig. 6). The high number of specimens caught on the rocky outcrop site using active searching, was due to the presence of a large amount of rocks which could not be searched for spiders using any of the other methods.

3.3.3.2 Families collected and abundance

The specimens caught by active searching represented 28 families (Table 4). The highest number of specimens caught by active searching belonged to the family Eresidae with 993 specimens, followed by Gnaphosidae with 1990 specimens and Lycosidae with 129 specimens. Three members of the families Agelenidae and Barychelidae, four member of the family Segestriidae and eight members of the family Selenopidae were only caught by active searching. Since the members of Eresidae (*Stegodyphus dumicola*) occur in community nests, the best way to catch them is by cutting the nest and actively removing all the inhabitants. Therefore, Eresidae represented the most abundant family caught by active searching.

3.3.3.3 Species collected and abundance

Of the 224 species collected during the study period, a total of 118 species were collected by active searching (Table 4). *Stegodyphus dumicola* had the highest number of individuals with 990 specimens, followed by a gnaphosid *Camillina aestus* with 83 specimens and pisaurid *Euprosthenopsis vuattouxi* Blandin, 1977 with 71 specimens. A total of 35 species were only caught by active searching. *Stegodyphus dumicola* is a social species with more than 100 specimens found in a nest and thus represented the most abundant species.

3.3.4 Pitfall trapping

3.3.4.1 Number of spiders caught

Of the 6045 spiders collected during the study period, a total of 240 were collected by pitfall trapping (Table 4) representing 4% of the total number of spiders caught. The highest number of spiders collected by pitfall trapping was in the *Aloe marlothii* thicket with 145 specimens (n=12; $\bar{x}$ =12.1;s=14.0), followed by the riverine and sweet thorn thicket with 60 specimens (n=12; $\bar{x}$ =5.0;s=2.9) and rocky outcrop with 35 specimens (n=12; $\bar{x}$ =2.9;s=3.5) (Fig. 6). A considerable part of the specimens collected in the *Aloe marlothii* thicket using pitfall trapping was made up by members of the family Ammoxenidae which only occurred on this site.

3.3.4.2 Families collected and abundance

The specimens caught by pitfall trapping represented 18 families (Table 4). The highest number of specimens caught in pitfall traps belonged to the family Lycosidae with 87 specimens, followed by Ammoxenidae with 58 specimens and Gnaphosidae with 42 specimens. Members of the families Ammoxenidae with 58 specimens, Oonopidae with one specimen and Scytodidae with two specimens were only caught using this method. The high numbers of Lycosidae, Ammoxenidae and Gnaphosidae caught using pitfall traps were expected because representatives of these families are mostly ground-dwellers.

3.3.4.3 Species collected and abundance

Of the 224 species collected during the study period, a total of 53 species were collected by pitfall trapping (Table 4). The ammoxenid *Ammoxenus amphalodes* had the highest number with 58 specimens of individuals, followed by two lycosids *Proevippa* sp. 1 with 32 specimens and *Proevippa wanlessi* with 22 specimens. A total of 18 species were only caught by pitfall traps. *Ammoxenus amphalodes* is a ground-dweller and is active on the soil surface only during periods when harvester termites are foraging (Dippenaar-Schoeman *et al.* 1996).

During the study period the highest number of individuals was caught using sweep netting with 2060 specimens, followed by tree beating with 1996 specimens, active searching with 1749 specimens and pitfall trapping with 240 specimens (Table 4, Fig. 6). In terms of the number of families, the highest number was caught using active searching with 28 families, followed by pitfall trapping with 18 families, tree beating with 15 families and sweep netting with 13 families. The highest number of species was obtained using both sweep netting and active searching (both resulted in 118 species), followed by tree beating with 89 species and pitfall trapping with 53 species. Therefore, the most effective method in terms of number of spiders caught was sweep netting with both sweep netting and tree beating most successful in terms of number of species caught.

The dendrogram constructed from the Bray-Curtis similarities of species caught using different collecting methods (Fig. 7) indicates that species collected by tree beating and sweep netting were the most similar (50%). The 50% similarity is due to 60 similar species that were caught by both methods (Table 4). Most of the species are plant-dwellers and web-builders. Species caught by active searching were plant-dwellers, web-builders and ground-dwellers and were 35% similar to those caught by sweep netting and tree beating due to 38 species caught by all three methods (Table 4). Species caught by pitfall trapping were least similar (30%) and consisted mostly of ground-dwellers. Eighteen species caught by pitfall trapping were not encountered using either sweep netting, tree beating or active searching.

From these results it is clear that different species are caught by different collecting methods and therefore it is essential to use a variety of sampling methods to determine the species diversity of an area.

3.4 Spiders collected during the study period

3.4.1 Specimens caught per month

During the study period specimens were collected throughout the year (Fig. 8). Of the 6045 caught spiders, the highest number of specimens was collected in August with 632 specimens (n=3; $\bar{x}$ =210.7;s=53.3), followed by April with 600 specimens (n=3; $\bar{x}$ =200;s=123.5) and February with 582 specimens (n=3; $\bar{x}$ =194;s=109.7) (Table 6). The lowest number of specimens was collected in January with 383 specimens (n=3; $\bar{x}$ =127.7;s=98.9) and March with 404 specimens (n=3; $\bar{x}$ =134.7;s=80.0). During August the highest number of specimens was collected on the rocky outcrop with 270 specimens, followed by the riverine and sweet thorn thicket with 195 specimens and the *Aloe marlothii* thicket with 167 specimens (Fig. 8). The high number of specimens caught on the rocky outcrop in August may be due to the normal pattern of the life cycle of species and more spiders were exposed and easier to catch because of less grass cover due to the drought. This was evident in the increase in the numbers of web-dwellers, ground-dwellers and borrow-dwellers caught on this site during August compared to the other months.

3.4.2 Families caught per month

The highest number of families was collected in July and November with 21 families respectively, followed by September with 20 families and August with 19 families. The lowest number of families was collected in March with 14 families. During July and November the highest number of families was collected on the rocky outcrop. On the *Aloe marlothii* thicket site the number of families caught in March, April, December, January and February was stable. Two members of the family Scytodidae were only caught in June. A single specimen of the family Oonopidae was caught in July probably because members of this family are mostly active during winter (Lotz *et al*. 1991). Some of the families, such as Araneidae, Eresidae, Gnaphosidae, Lycosidae, Miturgidae, Oxyopidae, Salticidae, Theridiidae and Thomisidae were caught during all months and seem to be active throughout the year.

3.4.3 Species caught per month

The highest number of species was caught in February with 82 species (n=3; $\bar{x}$ =40.8;s=19.3), followed by July with 76 species (n=3; $\bar{x}$ =46.5;s=21.3), while the lowest number of species was collected in December with 58 species (n=3; $\bar{x}$ =16.4;s=35.25) (Table 6). During February the highest number of species was caught on the riverine and sweet thorn thicket with 59 species, followed by rocky outcrop with 43 species and the *Aloe marlothii* thicket sites with 14 species (Fig. 9). Of the 224 caught species, only the species *Euophrys* sp. 1, *Runcinia flavida*, *Stegodyphus dumicola* and *Theridion* sp. 13 were collected throughout the year. The Multidimensional scaling plot of species caught during the different months (Fig. 10) indicates that species caught during November, December and January were more similar than those caught during the rest of the sampling period.

3.4.4 Phenology of dominant species

- *Stegodyphus dumicola:* The most abundant species is *S. dumicola* and their population peaked in November with 184 specimens, where after it declined slightly to 179 individuals during December and 147 individuals during March. The lowest number of individuals was collected during June with 5 specimens and October with 4 specimens (Fig. 11).

  During November the highest number of *S. dumicola* specimens was collected on the rocky outcrop with 67 specimens, followed by the *Aloe marlothii* thicket with 117 specimens while no specimen of *S. dumicola* was collected in November on the riverine and sweet thorn thicket site.

- *Oxyopes russoi:* The second most abundant species *O. russoi* peaked in August with 129 specimens followed by February with 101 specimens while the lowest numbers occurred in April with eight specimens and four specimens in May (Fig. 11).

  During August the highest number of *O. russoi* specimens was collected on the rocky outcrop site with 99 specimens, followed by the riverine and sweet thorn thicket site with 30 specimens while no specimen of *Oxyopes russoi* was collected on the *Aloe marlothii* thicket site during August.

- *Oxyopes pallidecoloratus:* The third most abundant species was *O. pallidecoloratus* and it peaked in July with 149 specimens, declined in June with 108 specimens to a low of no individuals during November and January (Fig. 11).

During July the highest number of *O. pallidecoloratus* specimens was collected on the rocky outcrop with 71 specimens, followed by the *Aloe marlothii* thicket with 61 specimens and the riverine and sweet thorn thicket sites with 17 specimens.

- *Oxyopes* sp. 3: The fourth most abundant species is *Oxyopes* sp. 3 that peaked in October with 81 specimens and declined to a second high in November with 54 specimens and no specimens were caught in March and May (Fig. 11).

  During October the highest number of *Oxyopes* sp. 3 specimens was collected on the *Aloe marlothii* thicket site with 74 specimens, followed by the rocky outcrop site with seven specimens while no specimen of *Oxyopes* sp. 3 was collected on the riverine and sweet thorn thicket site.

- *Misumenops rubrodecoratus:* The fifth most abundant species *M. rubrodecoratus* peaked in May with 88 specimens, and were present in very low number from August to December (Fig. 11).

  During May the highest number of *M. rubrodecoratus* specimens was collected on the rocky outcrop site with 88 specimens, followed by the *Aloe marlothii* thicket site with seven specimens while no specimen of *Misumenops rubrodecoratus* was collected on the riverine and sweet thorn thicket site.

Shannon-Wiener’s diversity indices (H´) were calculated for the sampling months (Table 6). The Shannon-Wiener’s diversity index (H´) value was the highest during April and September (H´=3.4), followed by July and February (H´=3.3) and June, August and October (H´=3.2). The overall Shannon-Wiener’s diversity index (H´) for the sampling months is 3.1. Species caught during the different months were fairly uniform in their distribution as indicated by relatively high evenness values (E_H = 0.6 – 0.8) (Table 6). Therefore, these results indicate that the highest diversity of spiders was caught during April and September, followed by February and July. However, diversity values did not differ vastly and ranged from 2.6 – 3.4 while the evenness values ranged from 0.6 – 0.8 indicating that species exhibited a fairly even distribution across months.

3.4.5 Seasonal activity

The highest number of specimens collected during the sampling period was caught in winter (June, July, August) with 1612 specimens (n=3; $\bar{x}$ =806;s=10.5), followed by autumn (March, April, May) with 1563 specimens (n=3; $\bar{x}$ =782;s=65.5), summer (December, January, February) with 1464 specimens (n=3; $\bar{x}$ =732;s=66.6) and spring (September, October, November) with 1406 specimens (n=3; $\bar{x}$ =703;s=45.2) (Fig. 12). During winter the highest number of specimens was caught on the rocky outcrop site with 695 specimens, followed by the riverine and sweet thorn thicket site with 576 specimens and the *Aloe marlothii* thicket site with 341 specimens.

In terms of families, the highest number of families was collected in winter with 27 families, followed by spring with 26 families, summer with 24 families and autumn with 20 families. During winter the highest number of families was collected from the rocky outcrop site with 19 families followed by the *A. marlothii* thicket with 18 families and the riverine and sweet thorn thicket site with 16 families.

In terms of species, the highest number of species was collected in autumn with 134 species (n=3; $\bar{x}$ =43.7;s=8.1), followed by winter (n=3; $\bar{x}$ =43.1;s=5.6) and summer (n=3; $\bar{x}$ =42;s=9.2) with 119 species respectively and spring with 114 species (n=3; $\bar{x}$ =39;s=3.3) (Fig. 13). During autumn the highest number of species was collected on the rocky outcrop site with 94 species, followed by the riverine and sweet thorn thicket site with 91 species and the *A. marlothii* thicket with 41 species.

According to Warui *et al*. (2005) spiders are known to increase their activity and reproduction after the onset of rainfall and this may result in an increase in the population size. During this study the highest number of specimens were collected during winter (1612 specimens, n=3; $\bar{x}$ =806;s=10.5) and the number of specimens caught decreased with 206 specimens from winter to spring (1406 specimens, (n=3; $\bar{x}$ =703;s=45.2) and increased with 58 specimens from spring to summer (1464 specimens, (n=3; $\bar{x}$ =732;s=66.6). This could be the effect of sampling or the higher numbers recorded of some of the more abundant species (*Oxyopes russoi* and *O. pallidecoloratus*) during winter. Since the amount of precipitation was high in summer (especially during November and December), it additionally increased the quality of vegetation and microhabitats available for arthropods and this may also have lead to the higher number of species caught during autumn (134 specimens, (n=3; $\bar{x}$ =43.7;s=8.1). The slightly lower number of specimens caught during spring compared to the other seasons, may be due to the effect of collecting methods or limited resources available during winter which resulted in competition for food and high rates of predation.

From the results of the current study it is evident that a high number of species (82) was collected and a relatively high diversity of spiders (H'=3.3) were obtained during

February. Based on the above, it is suggested that February be included during sampling sessions in the Savanna Biome.

3.4.6 Age of spiders

Of the 6045 caught specimens only 38% were adults (34% females and 4% males) while 62% were juveniles. The highest number of juveniles was caught in December with 422 specimens, followed by January with 399 specimens and November with 377 specimens. The highest number of adults was caught in June with 271 specimens, followed by March with 260 specimens and February with 256 specimens. The high number of juveniles caught during December is probably due to the normal life cycle of most species that mate and reproduce during November and December. The high number of adults caught during June may be a result of the high number of juveniles produced during November to January.

Reasonably high numbers of adults were collected during February compared to the other months. Therefore, during February a high number and diversity of mature identifiably species were captured. When comparing the results of the current study with those of previous studies (Foord *et al.* 2002; Whitmore *et al*. 2002 & Dippenaar-Schoeman & Leroy 2003) it seems like sporadic sampling during selected periods in a variety of vegetation types using as many sampling methods as possible, results in the capture of more representative species of the sampled area.

3.4.7 Accumulation curves for the number of families and species caught during the sampling period

The cumulative number of families caught per month on all three studied sites during the study period increased from 14 in March to a maximum of 33 in November (Fig. 14). No new families were added from November to February. The cumulative number of families increased with 15% from March to April, 15% from May to June, 0% from September to October and again with 6% from October to November while there was no increase from November to February. The slope of the graph reached an asymptote which indicates that most of the families present in the studied sites were collected. Since a clear asymptote was reached this value for the number of families can validly be compared with other studies where a clear asymptote was also reached (Gotelli & Colwell 2001).

The cumulative number of species caught per month on all three studied sites during the study period increased from 64 in March to a maximum of 224 in February (Fig. 15). The cumulative number of species increased with 15% from March to April, 16% from April to May again with 1% from December to January and 3% from January to February. A clear asymptote was not reached which indicates that more species will be added as sampling continues and an estimate about the total number of species occurring in the three sampling sites cannot be made.

Table 2. Dominant spider families caught during the sampling period (March 2005-Feb 2006) at the Polokwane Nature Reserve on the riverine and sweet thorn thicket, rocky outcrop and *Aloe marlothii* thicket sites indicating the percentage specimens of the total number of caught specimens and the percentage of species of the total number of collected species of each of the dominant families.

Family	Total no of spiders	% of total	Total no of species	% of total
Araneidae	334	6	35	16
Eresidae	993	16	2	1
Gnaphosidae	232	3	17	8
Lycosidae	216	3	19	8
Oxyopidae	1840	30	16	7
Salticidae	529	9	27	12
Theridiidae	307	5	18	8
Thomisidae	801	13	32	14

Table 3. Shannon-Wiener's diversity index values (H´) and evenness values of species caught during the sampling period (March 2005-February 2006) at the Polokwane Nature Reserve on the riverine and sweet thorn thicket, rocky outcrop and *Aloe marlothii* thicket sites.

Sites	Individuals	Species caught	Diversity index	Evenness
Riverine and sweet thorn thicket	2604	167	3.7	0.72
Rocky outcrop	2297	147	3.6	0.72
Aloe marlothii thicket	1144	95	3.2	0.70

Table 4. Spider families caught during the sampling period (March 2005-February 2006) at the Polokwane Nature Reserve on the riverine and sweet thorn thicket, rocky outcrop and *Aloe marlothii* thicket indicating the number of specimens caught using active searching, sweep netting, tree beating and pitfall trapping.

		Sampling methods				
Family	*Species*	Active searching	Sweep netting	Tree beating	Pitfall trapping	Totals
Agelenidae	*Agelena* sp. 1	3	-	-	-	3
Ammoxenidae	*Ammoxenus amphalodes*	-	-	-	58	58
Araneidae	*Acanthepeira* sp. 1	-	2	-	-	2
	Araneidae sp. 1	-	2	-	-	2
	Araneilla sp. 1	-	11	-	-	11
	Araneilla sp. 2	-	1	1	-	2
	Araneilla sp. 3	2	3	-	-	5
	Araneus nigroquadratus	-	2	-	-	2
	Argiope aurocincta	-	3	-	-	3
	Argiope australis	-	1	-	-	1
	Argiope lobata	-	4	-	-	4
	Argiope trifasciata	-	18	5	-	23
	Caerostris sexcuspidata	1	3	3	-	7
	Chorizopes sp. 1	-	1	3	-	4
	Cyclosa insulana	-	6	1	-	7
	Cyphalanothus larvatus	-	-	1	-	1
	Cyrtophora citricola	2	1	3	-	6
	Gasteracantha sanguinolenta	1	-	-	-	1
	Gea infuscata	-	1	-	-	1
	Hypsosinga lithyphantoides	3	54	3	-	60
	Hypsosinga sp. 2	-	12	-	-	12
	Larinia natalensis	-	1	-	-	1
	Lipocrea longissima	-	2	-	-	2
	Mahembea hewitti	-	1	-	-	1
	Nemoscolus elongatus	-	1	-	-	1
	Nemoscolus sp. 2	-	4	-	-	4
	Neoscona blondeli	1	27	13	-	41
	Neoscona moreli		8	-	-	8
	Neoscona penicillipes	-	-	1	-	1
	Neoscona quincasea	1	5	34	-	40
	Neoscona subfusca	3	10	35	-	48
	Paraplectana sp. 1	-	6	-	-	6
	Pararaneus cyrtoscapus	6	11	2	-	19
	Prasonica sp. 1	-	1	-	-	1
	Pycnacantha tribulus	-	1	-	-	1
	Singa lawrencei	-	5	-	-	5
	Singa sp. 2	-	-	1	-	1
Barychelidae	*Brachionopus pretoriae*	3	-	-	-	3
Caponiidae	*Caponia chelifera*	7	-	-	4	11
Clubionidae	*Clubiona abbajensis*	1	-	2	-	3
	Clubiona sp. 1	1	-	-	-	1
Corinnidae	*Casteineira* sp. 2	2	-	-	-	2

Family	Species	Sampling methods Active searching	Sweep netting	Tree beating	Pitfall trapping	Totals
	Cetonana simoni	-	-	-	2	2
	Copa flavoplumosa	-	-	-	1	1
Eresidae	*Dresserus colsoni*	3	-	-	-	3
	Stegodyphus dumicola	990	-	-	-	990
Gnaphosidae	*Asemesthes ceresicola*	33	-	-	13	46
	Asemesthes decoratus	1	-	-	1	2
	Camillina aestus	83	-	-	6	89
	Camillina maun	2	-	-	-	2
	Camillina procurva	4	-	-	-	4
	Drassodes bechuanicus	2	-	-	-	2
	Drassodes solitarius	-	-	-	1	1
	Drassodes splendens	12	-	-	4	16
	Poecilochroa sp. 1	-	-	-	1	1
	Scotophaeus marleyi	2	-	-	-	2
	Trephopoda hanoveria	-	-	-	3	3
	Upognampa parvipalpa	-	-	-	2	2
	Xerophaeus appendiculatus	21	-	-	2	23
	Xerophaeus bicavus	17	-	-	-	17
	Zelotes reduncus	12	-	-	4	16
	Zelotes sp. 1	1	-	-	1	2
	Zelotes tuckeri	-	-	-	4	4
Hersiliidae	*Tyrotama soutpansbergensis*	1	-	1	-	2
Linyphiidae	*Mecynidis* sp. 1	1	-	-	-	1
	Meioneta sp. 1	-	2	-	-	2
	Pelecopsis sp. 1	-	-	1	-	1
Lycosidae	*Evippomma squamulatum*	35	-	-	1	36
	Geolycosa sp.	-	-	-	1	1
	Lycosa sp. 1	12	-	-	3	15
	Lycosa sp. 2	6	-	-	1	7
	Lycosidae sp. 1	-	-	-	6	6
	Lycosidae sp. 10	1	-	-	-	1
	Lycosidae sp. 2	5	-	-	5	10
	Lycosidae sp. 4	2	-	-	-	2
	Lycosidae sp. 5	2	-	-	1	3
	Lycosidae sp. 6	-	-	-	5	5
	Lycosidae sp. 7	-	-	-	1	1
	Lycosidae sp. 8	13	-	-	-	13
	Pardosa leipoldti	4	-	-	-	4
	Pardosa sp. 10	19	-	-	7	26
	Pardosa sp. 11	1	-	-	1	2
	Proevippa sp. 1	9	-	-	32	41
	Proevippa wanlessi	18	-	-	22	40
	Trabea purcelli	-	-	-	1	1
	Zenonina albocaudata	2	-	-	-	2
Mimetidae	*Ero sp.*	-	-	3	-	3
Miturgidae	*Cheiracanthium furculatum*	5	28	68	3	104
	Cheiracanthium inclusum	8	10	-	-	18
	Cheiracanthium vansoni	-	4	41	1	46

		Sampling methods				
Family	*Species*	Active searching	Sweep netting	Tree beating	Pitfall trapping	Totals
Nemesiidae	*Hermacha mazoena*	1	-	-	1	2
Nephilidae	*Nephila senegalensis*	3	7	4	-	14
Oonopidae	*Gamasomorpha humicola*	-	-	-	1	1
Oxyopidae	*Hamataliwa fronticornis*	-	1	7	-	8
	Hamataliwa kulczynski	1	-	8	-	9
	Hamataliwa strandi	-	1	4	-	5
	Oxyopes affinis	1	-	-	-	1
	Oxyopes bedoti	-	9	3	-	12
	Oxyopes bothai	4	31	-	-	35
	Oxyopes hoggi	10	46	37	2	95
	Oxyopes jacksoni	20	43	3	-	66
	Oxyopes pallidecoloratus	35	410	122	-	567
	Oxyopes russoi	1	134	552	-	687
	Oxyopes schenkeli	-	8	2	-	10
	Oxyopes sp. 10	-	-	1	-	1
	Oxyopes sp. 3	3	69	268	-	340
	Oxyopes sp. 5	-	-	1	-	1
	Oxyopes turberculatus	-	-	2	-	2
	Peucetia viridis	-	1	-	-	1
Palpimanidae	*Palpimanus armatus*	3	-	-	-	3
	Palpimanus transvaalicus	17	-	-	2	19
Philodromidae	*Ebo* sp. 1	-	-	4	-	4
	Philodromus browningi	-	4	41	-	45
	Philodromus grosi	-		42	-	42
	Philodromus guineensis	1	13	62	2	78
	Suemus punctatus	5	9	2	-	16
	Thanatus dorsilineatus	4	2	-	-	6
	Thanatus sp. 1	2	2	-	-	4
	Tibellus gerhardi	-	2	-	-	2
	Tibellus hollidayi	-	20	-	-	20
	Tibellus minor	1	29	-	-	30
Pisauridae	*Afropisaura* sp.	5	50	4	1	60
	Euprosthenops australis	1	-	-	-	1
	Euprosthenopsis vuattouxi	71	11	1	1	84
	Rothus purpurissatus	1	1	-		2
Prodidomidae	*Theuma parva*	1	-	-	1	2
Salticidae	*Aelurillus* sp. 1	-	3	3	1	7
	Baryphas ahenus	-	-	1	-	1
	Brancus bevisi	6	23	5	-	34
	Cosmophasis sp. 2	5		-	-	5
	Dendryphantes sp. 1	4	4	13	-	21
	Dendryphantes sp. 2	2	-	-	-	2
	Euophrys sp. 1	5	35	99	1	140
	Heliophanus debilis	4	61	27	-	92
	Heliophanus demonstrativus	1	-	-	-	1
	Heliophanus insperatus	1	16	13	1	31
	Heliophanus transvaalicus	-	-	4	-	4
	Hyllus sp. 2	1	-	-	-	1
	Hyllus sp. 3	2	-	-	-	2

Family	Species	Sampling methods Active searching	Sweep netting	Tree beating	Pitfall trapping	Totals
	Hyllus sp. 4	-	-	1	-	1
	Hyllus treleaveni	2	7	16	-	25
	Langelurillus sp. 1	6	-	4	4	14
	Mogrus sp. 1	1	-	2	-	3
	Natta horizontalis	3	-	-	-	3
	Pellenes sp. 1	4	12	11	2	29
	Phlegra sp. 1	-	-	1	-	1
	Pseudicius sp. 1	6	4	6	-	16
	Rhene machadoi	1	9	16	-	26
	Stenaelurillus nigricaudus	1		-	-	1
	Stenaelurillus sp. 1	3	2	-	-	5
	Stenaelurillus sp. 2	7	1		-	8
	Thyene inflata	4	46	2	-	52
	Thyenula aurantiaca	-	4	-	-	4
Scytodidae	*Scytodes* sp.	-	-	-	2	2
Segestriidae	*Ariadna* sp.	4	-	-	-	4
Selenopidae	*Anyphops* sp.	6	-	-	-	6
	Selenops sp.	2	-	-	-	2
Sparassidae	*Olios* sp. 1	1	6	-	-	7
	Olios sp. 2	1	2	-	-	3
	Palystes superciliosus	-		1	-	1
	Pseudomicrommata longipes	-	1	-	-	1
Tetragnathidae	*Leucauge decorata*	-	3	-	-	3
	Leucauge festiva	-	1	-	-	1
Theraphosidae	*Harpactira* sp. 1	4	-	-	2	6
	Harpactirella sp. 2	2	-	-		2
	Hermacha mazoena	-	-		1	1
Theridiidae	*Argyrodes convivans*	-	-	24	-	24
	Argyrodes zonatus	-	6		-	6
	Dipoena sp. 4	-	2	1	-	3
	Enoplognatha molesta	17	45	4	-	66
	Latrodectus geometricus	5	12	1	-	18
	Latrodectus renivulvatus	10	2	-	-	12
	Phoroncidia eburnea		3	-	-	3
	Theridiidae sp. 21	1	1	-	-	2
	Theridiidae sp. 24	1		-	-	1
	Theridiidae sp. 33		2	-	-	2
	Theridion purcelli	3	-	-	-	3
	Theridion sp. 1	-	-	1	-	1
	Theridion sp. 11	-	1	9	-	10
	Theridion sp. 13	2	43	85	-	130
	Theridion sp. 19	1			-	1
	Theridion sp. 23	1	1	9	-	11
	Theridion sp. 3	3	1	9	-	13
	Theridion sp. 4	-	1		-	1
Thomisidae	*Avelis hystriculus*	-		6	-	6
	Camaricus nigrotesselatus	-	2	-	-	2
	Heriaeus crassispinus	1	3	-	-	4
	Misumenops rubrodecoratus	2	143	57	-	202

Family	Species	Sampling methods Active searching	Sweep netting	Tree beating	Pitfall trapping	Totals
	Monaeses austrinus	-	34		-	34
	Monaeses gibbus	-	12	1	-	13
	Monaeses paradoxus	-	3	-	-	3
	Monaeses pustulosus	-	2	-	-	2
	Monaeses quadrituberculatus	-	15	-	-	15
	Oxytate argenteooculata	-	1	-	-	1
	Ozyptila sp. 1	-	1	-	-	1
	Pactactes trimaculatus	12		-	-	12
	Pherecydes sp.		1		-	1
	Runcinia aethiops	7	28	3	-	38
	Runcinia affinis		5	-	-	5
	Runcinia erythrina	5	17	-	-	22
	Runcinia flavida		186	4	-	190
	Stiphropus affinis	1	5	2	-	8
	Synema decens	-		3	-	3
	Synema diana	-	6		-	6
	Synema imitator	-	9	41	-	50
	Synema nigrotibiale	1	15	2	-	18
	Thomisus blandus	-	1		-	1
	Thomisus citrinellus	-	5	1	-	6
	Thomisus congoensis	-	2		-	2
	Thomisus scrupeus	-		9	-	9
	Thomisus stenningi	-	16	3	-	19
	Tmarus cameliformis	-	14	45	1	60
	Tmarus cancellatus	-		2	-	2
	Tmarus comellini	-		38	-	38
	Tmarus foliatus	-	1		-	1
	Tmarus sp. 1	-	3	3	-	6
	Xysticus fagei	13		3	5	21
Uloboridae	*Miagrammopes longicaudus*	-	14	10	-	24
	Uloborus plumipes	-		1	-	1
	Uloborus sp. 1	1	1	1	-	3
	Uloborus sp. 2		-	1	-	1
Zodariidae	*Capheris decorata*	14	-	-	8	22
	Cydrela sp.	4	-	-	1	5
	Diores auricula		-	-	1	1
	Ranops sp. 1		-	-	1	1
Total		1749	2060	1996	240	6045

Table 5. Shannon-Wiener's diversity index (H´) values, mean values, standard deviation values and evenness values of species caught per month during the sampling period (March 2005-February 2006) at the Polokwane Nature Reserve on the riverine and sweet thorn thicket, rocky outcrop and *Aloe marlothii* thicket sites.

Months	Individuals	Mean	Standard deviation	Species caught	Mean	Standard deviation	Diversity index	Evenness
March	404	134.7	80.0	64	40.8	19.0	2.9	0.7
April	600	200	123.5	73	47.3	20.4	3.4	0.8
May	559	186.3	74.0	74	43	24.7	3.1	0.7
June	466	155.3	63.3	64	38.0	21.7	3.2	0.8
July	513	171.3	75.0	75	47.0	21.3	3.3	0.8
August	632	210.7	53.3	74	45.3	19.6	3.2	0.7
September	481	160.7	87.0	65	39	22.2	3.4	0.8
October	446	148.7	68.0	66	39.3	19.1	3.2	0.8
November	478	159.3	55.0	65	39.0	22.0	2.6	0.6
December	499	166.3	102.2	58	35.3	17.0	2.7	0.7
January	383	127.7	99.0	61	35.8	21.0	3.1	0.8
February	582	194	109.7	82	50.0	28.7	3.3	0.7

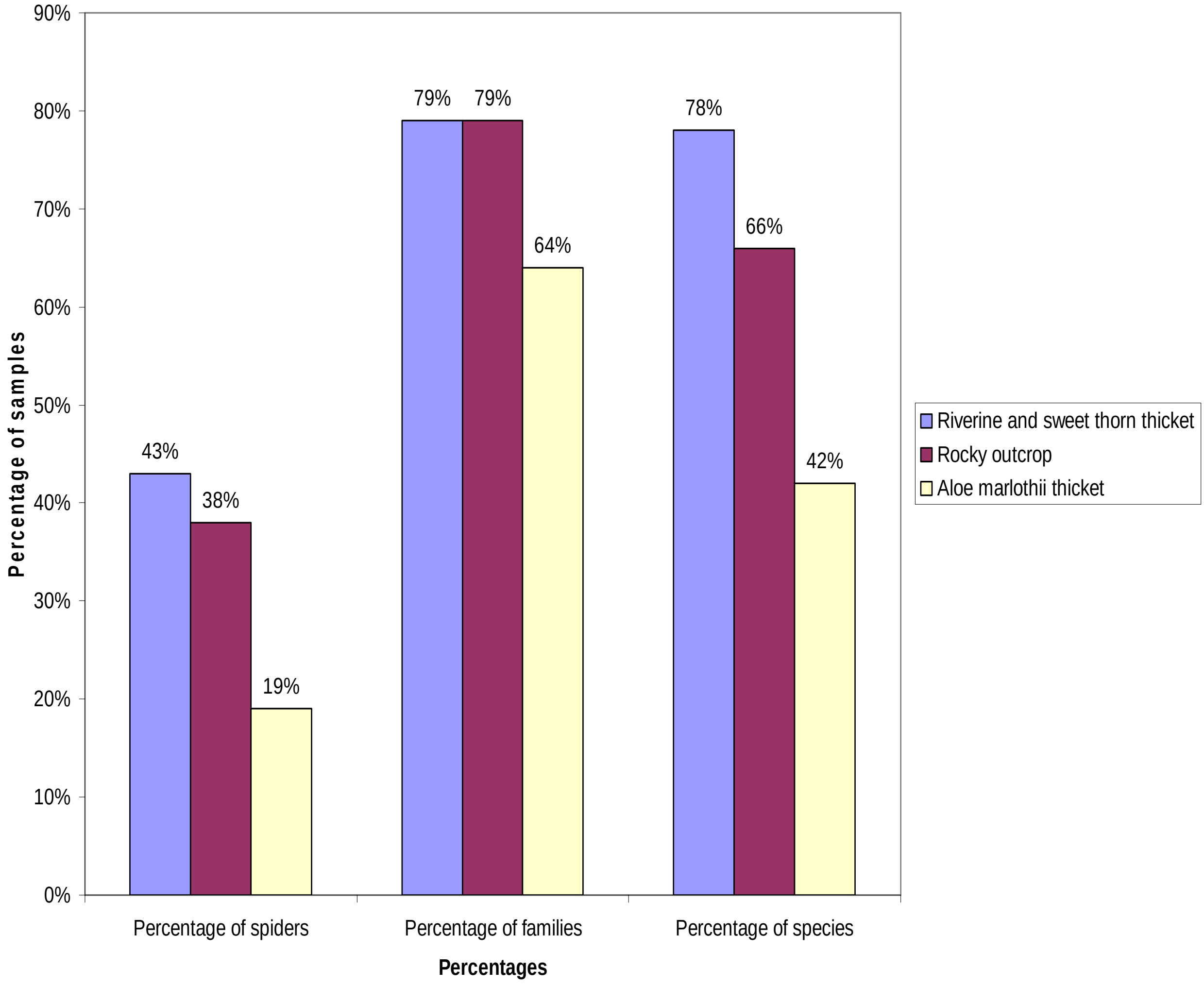

Fig. 5. Percentages of the total number of spiders, families and species caught on the three sampling sites (riverine and sweet thorn thicket, rocky outcrop and *Aloe marlothii* thicket) during the sampling period (March 2005-February 2006) at the Polokwane Nature Reserve.

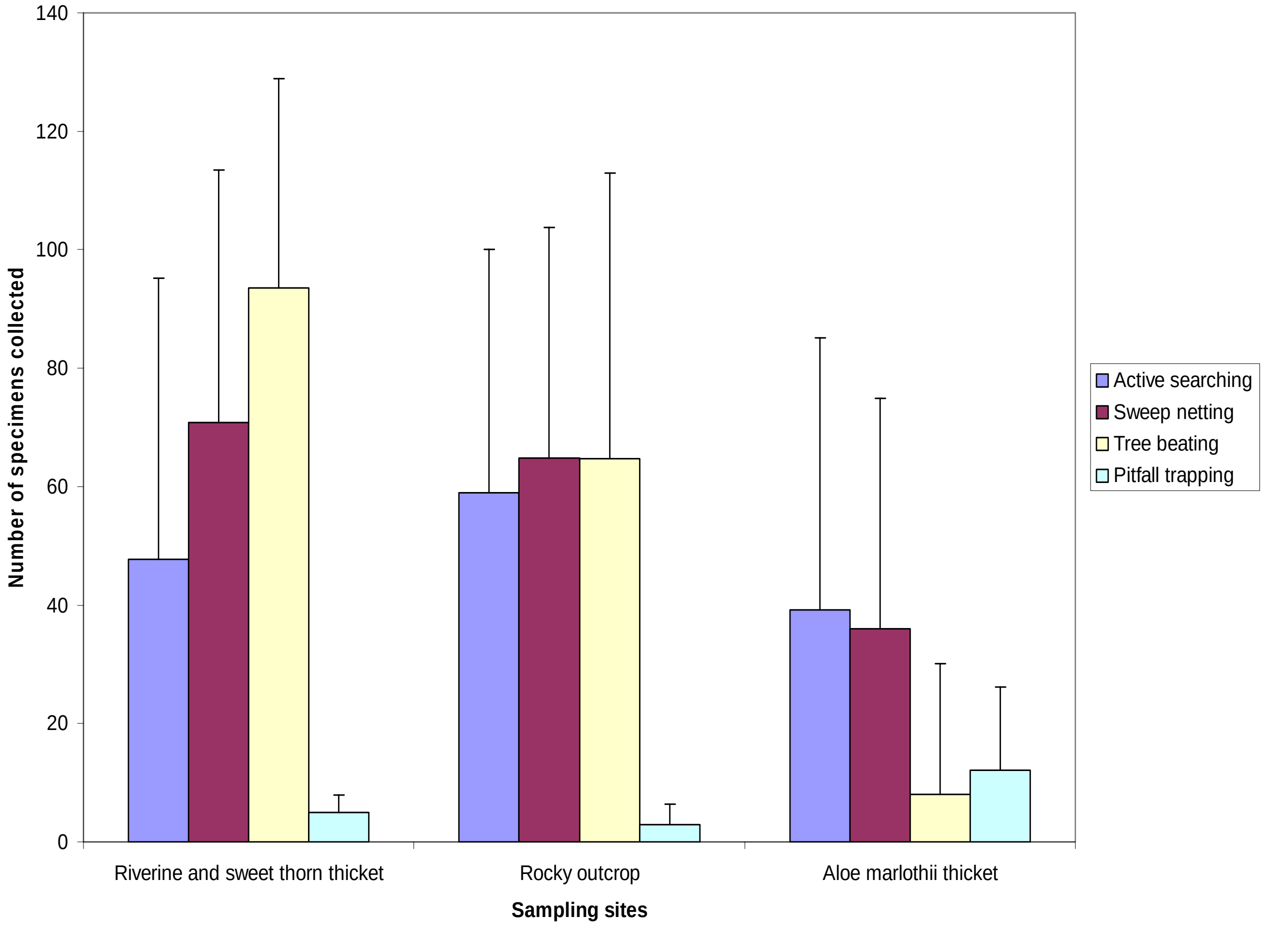

Fig. 6. The mean number of spiders caught on the three sampling sites (riverine and sweet thorn thicket, rocky outcrop and *Aloe marlothii* thicket) during the sampling period (March 2005-February 2006) at the Polokwane Nature Reserve using active searching, sweep netting, tree beating and pitfall trapping (bars indicate standard deviation).

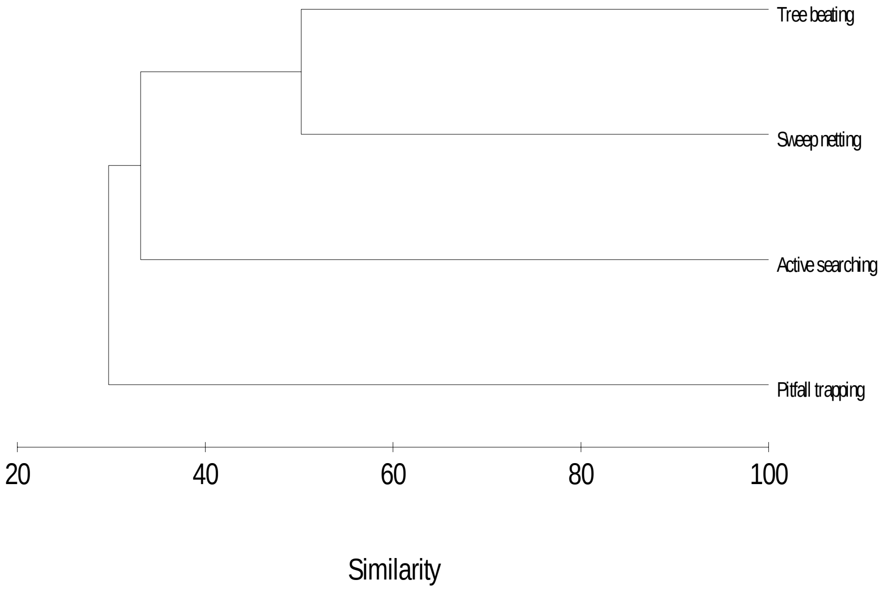

Fig. 7. A dendrogram of Bray-Curtis similarities of the species caught on the three sampling sites (riverine and sweet thorn thicket, rocky outcrop and *Aloe marlothii* thicket) during the sampling period (March 2005-February 2006) at the Polokwane Nature Reserve using tree beating, sweep netting, active searching and pitfall trapping.

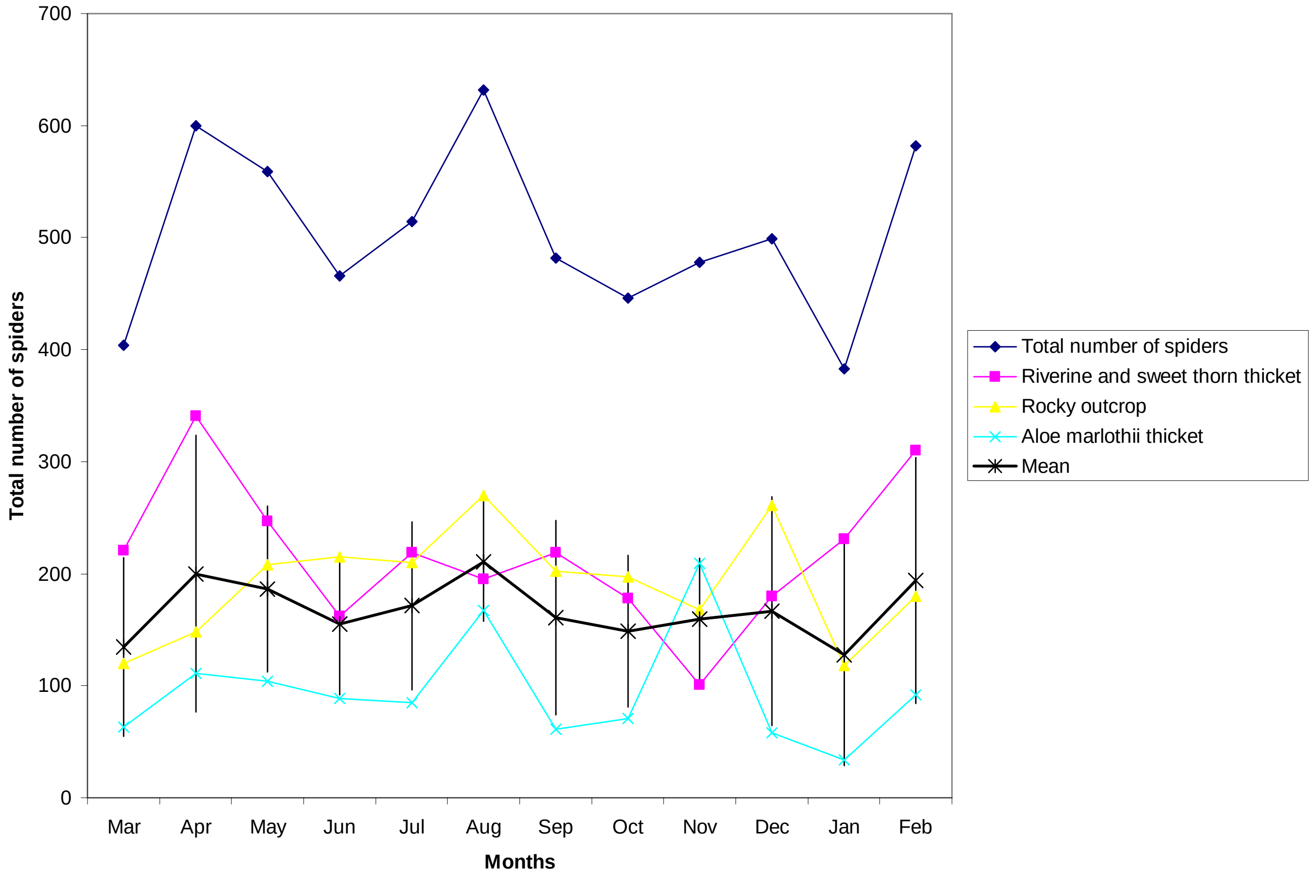

Fig. 8. The monthly fluctuations of the number of spiders caught on the three sampling sites (riverine and sweet thorn thicket, rocky outcrop and *Aloe marlothii* thicket) during the sampling period (March 2005- February 2006) at the Polokwane Nature Reserve (bars indicate standard deviation).

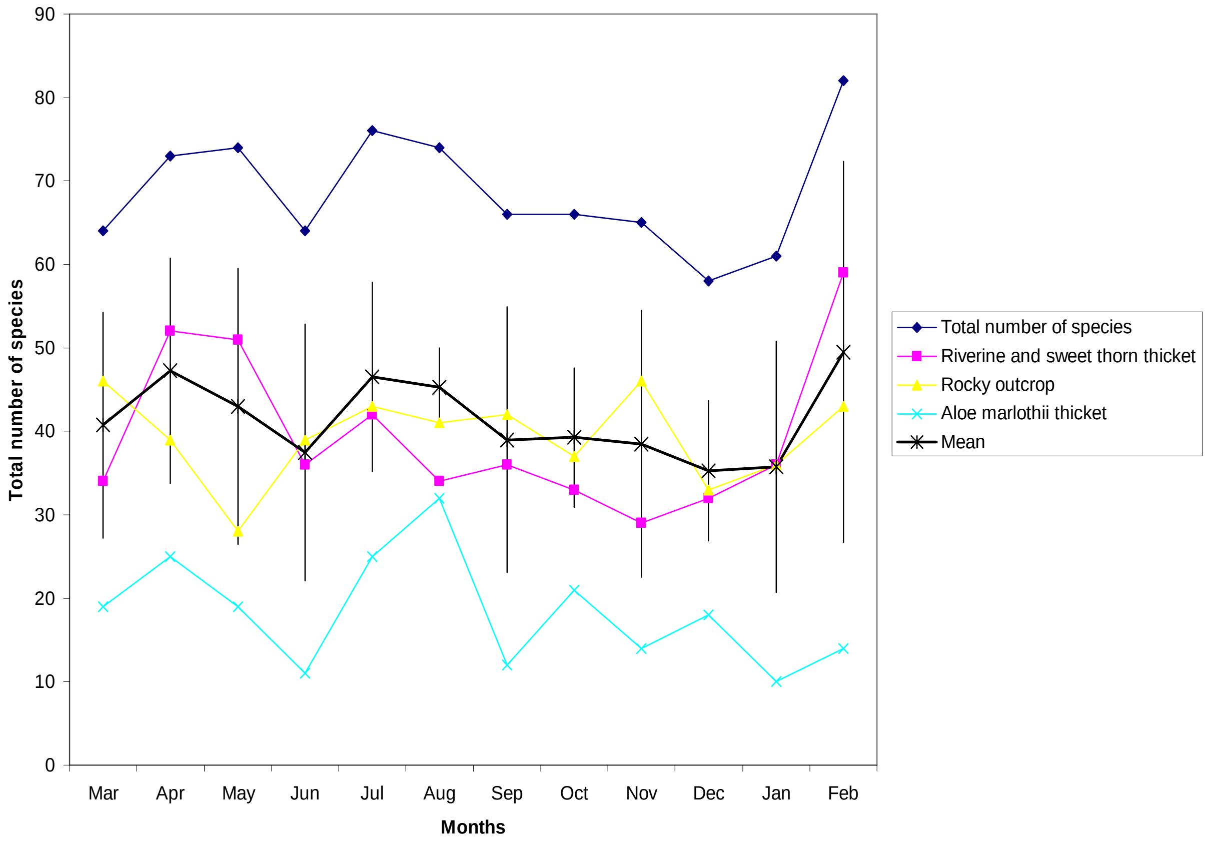

Fig. 9. The monthly fluctuations of the number of spider species caught on the three sampling sites (riverine and sweet thorn thicket, rocky outcrop and *Aloe marlothii* thicket) during the sampling period (March 2005-February 2006) at the Polokwane Nature Reserve (bars indicate standard deviation).

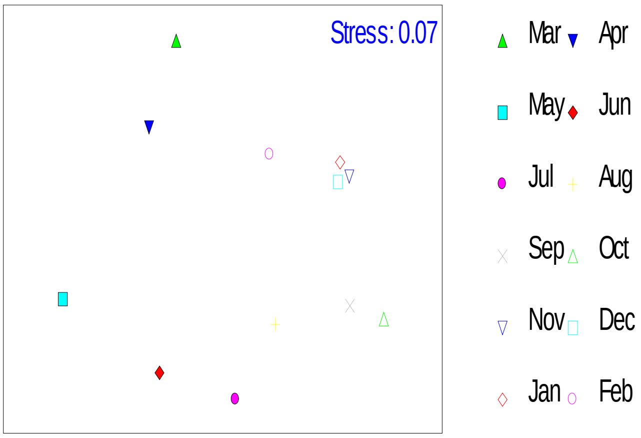

Fig. 10. The multidimensional scaling plot of the number of spiders caught on the three sampling sites (riverine and sweet thorn thicket, rocky outcrop and *Aloe marlothii* thicket) in different months during sampling period (March 2005-February 2006) at the Polokwane Nature Reserve.

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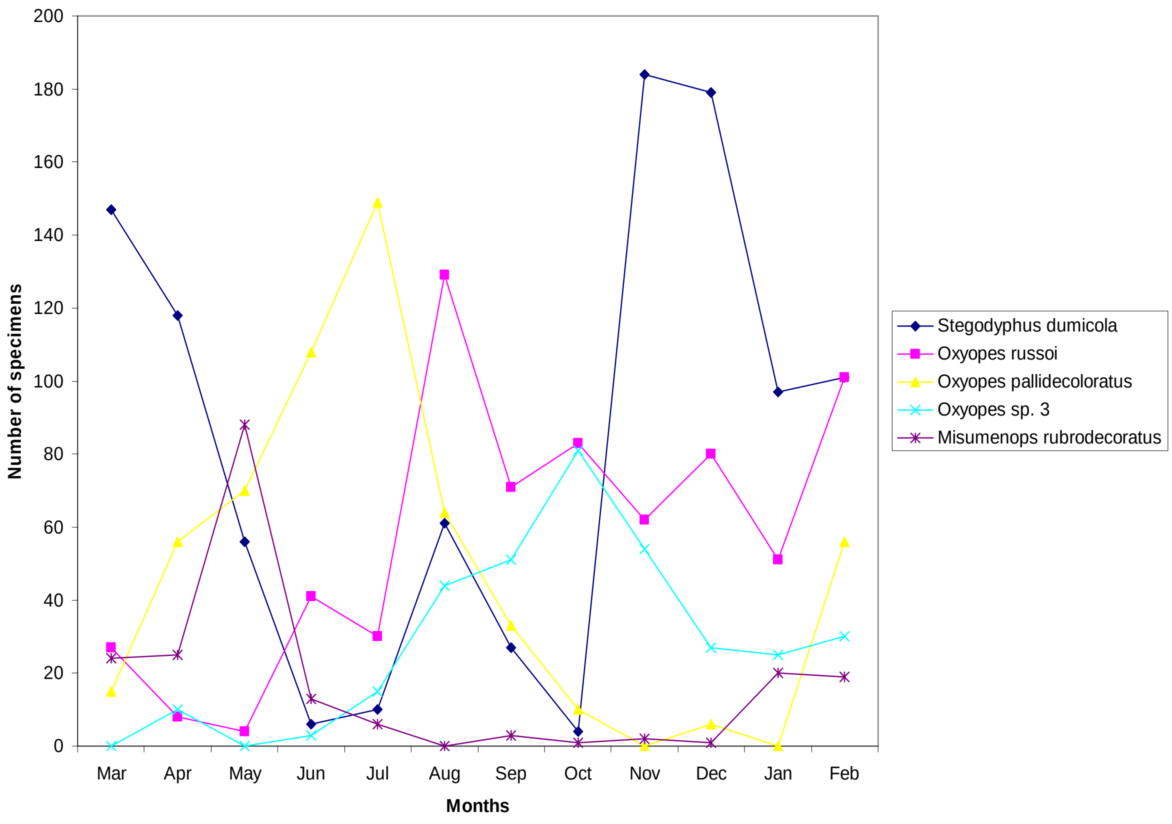

Fig. 11. Dominant species caught during the sampling period (March 2005-February 2006) at the Polokwane Nature Reserve on the riverine and sweet thorn thicket, rocky outcrop and *Aloe marlothii* thicket sites indicating the total number of collected species per month.

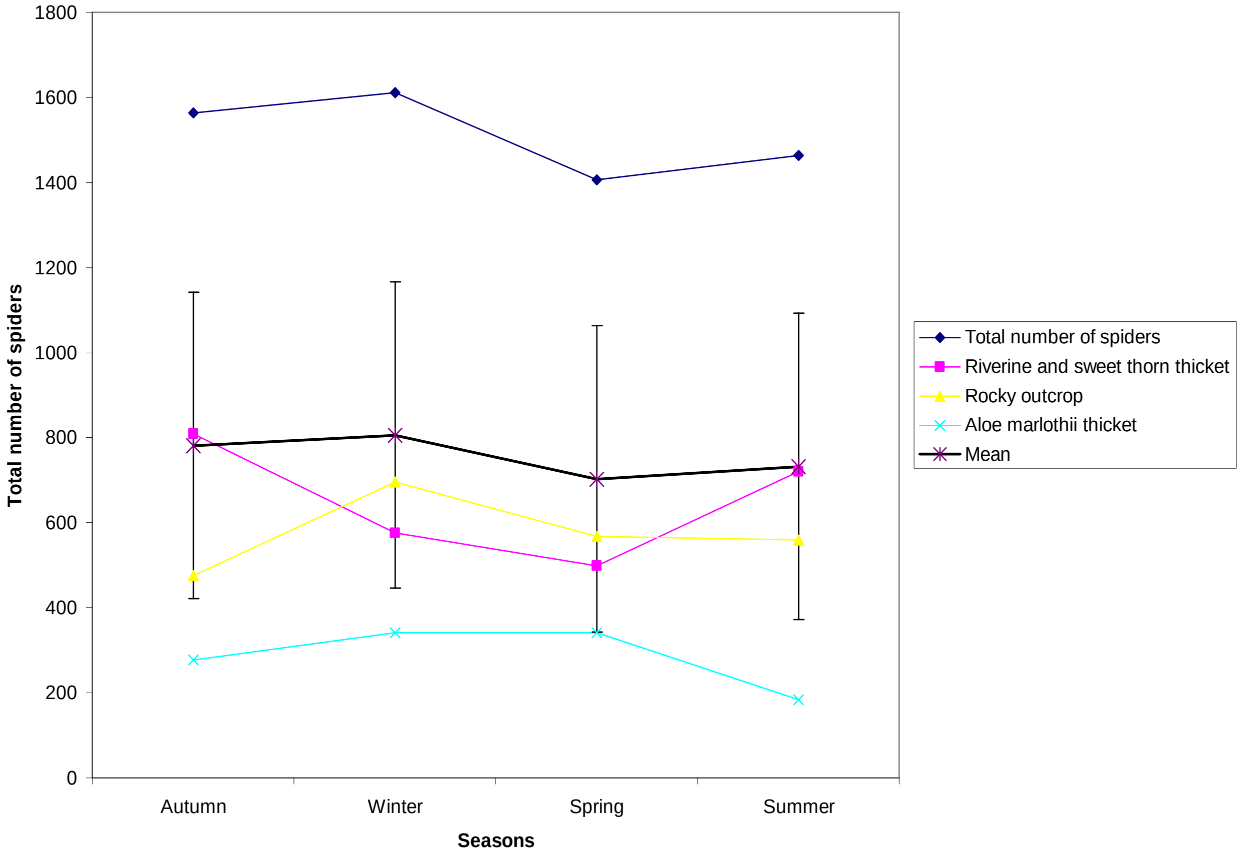

Fig. 12. Seasonal fluctuations of the number of spiders caught on the three sampling sites (riverine and sweet thorn thicket, rocky outcrop and *Aloe marlothii* thicket) during the sampling period (March 2005-February 2006) at the Polokwane Nature Reserve.

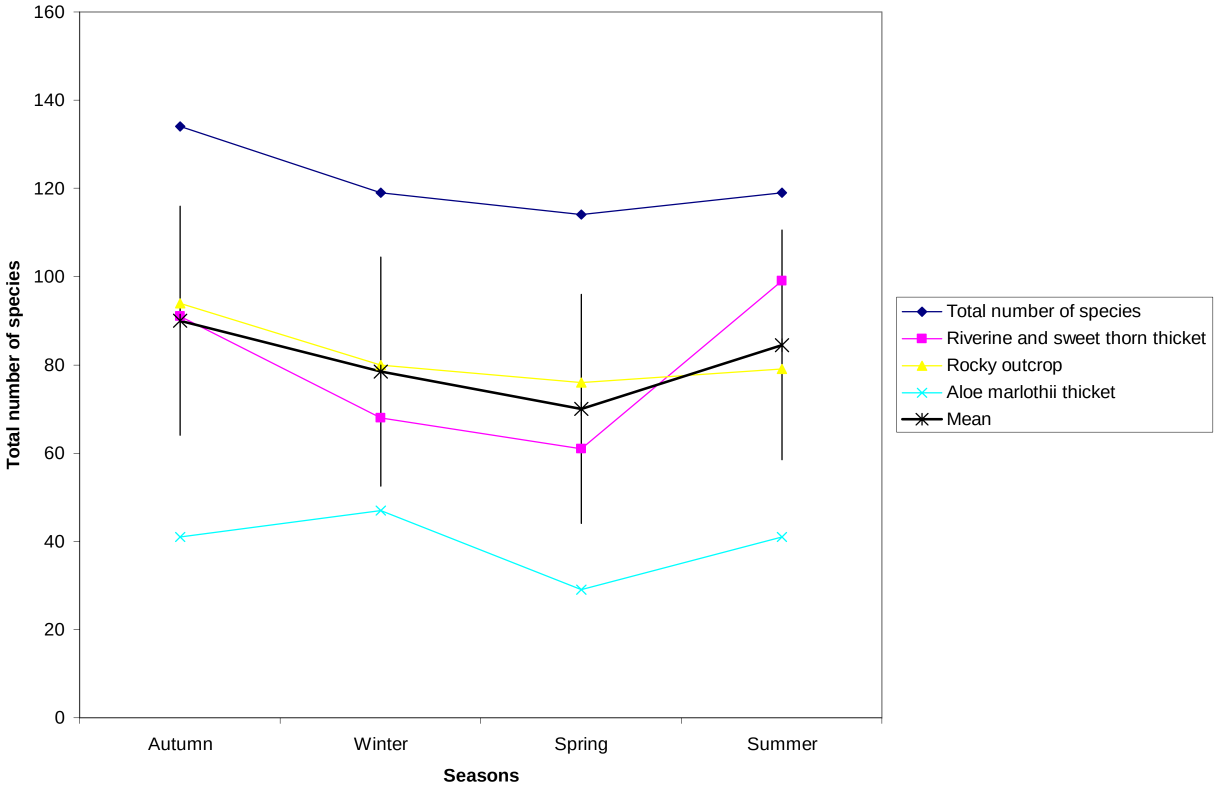

Fig. 13. Seasonal fluctuations of the number of spider species caught on the three sampling sites (riverine and sweet thorn thicket, rocky outcrop and *Aloe marlothii* thicket) during the sampling period (March 2005-February 2006) at the Polokwane Nature Reserve.

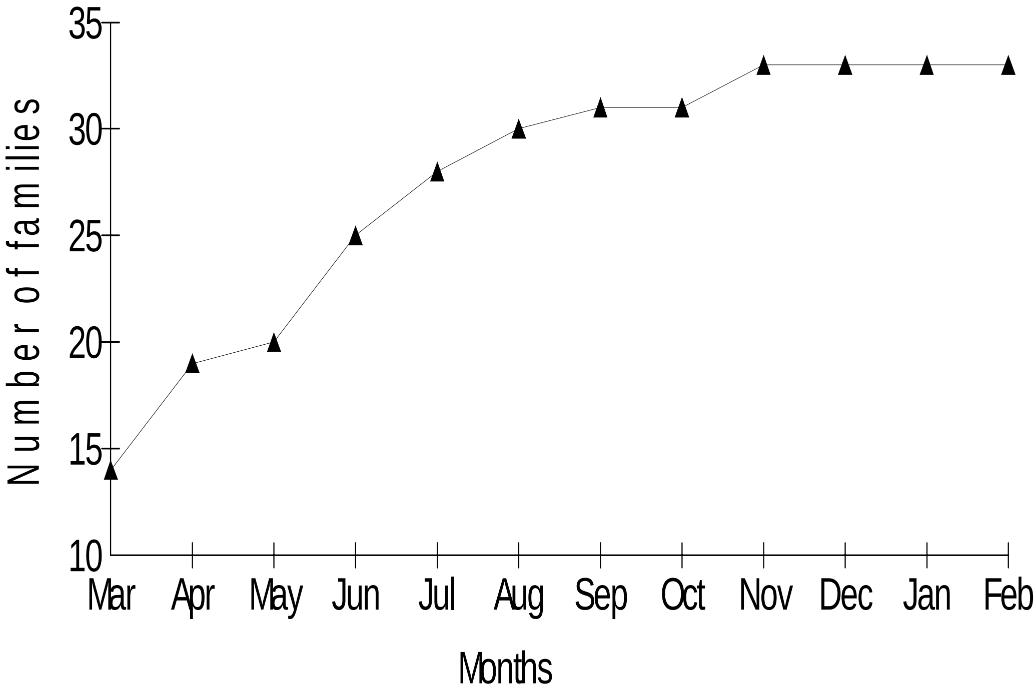

Fig. 14. Accumulation curve of spider families caught per month starting from March 2005 to February 2007 on the three sampling sites (riverine and sweet thorn thicket, rocky outcrop and *Aloe marlothii* thicket) during the sampling period (March 2005-February 2006) at the Polokwane Nature Reserve.

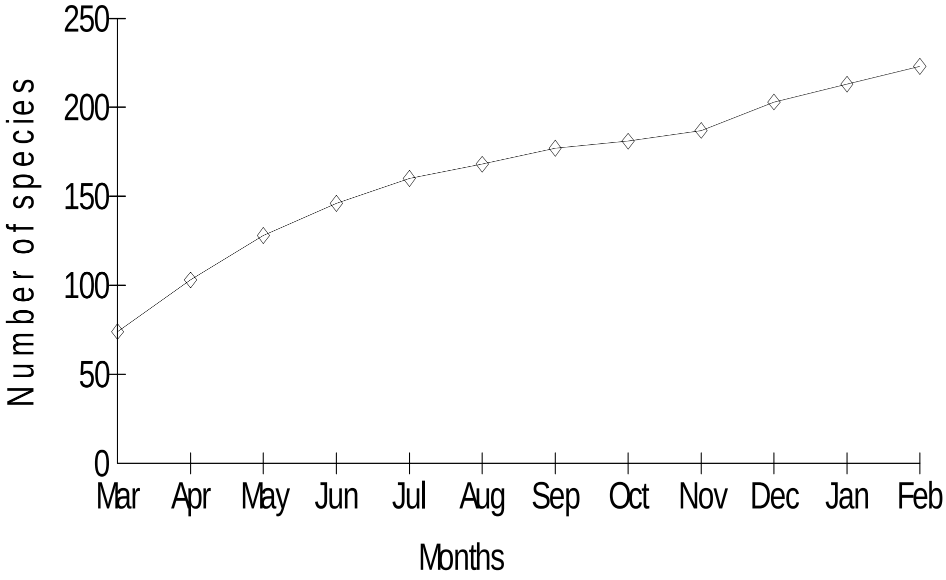

Fig. 15. Accumulation curve of spider species caught per month starting from March 2005 to February 2007 on the three sampling sites (riverine and sweet thorn thicket, rocky outcrop and *Aloe marlothii* thicket) during the sampling period (March 2005-February 2006) at the Polokwane Nature Reserve.

Chapter 4

Conclusions

4.1 An inventory of spiders for selected habitats in the Polokwane Nature Reserve

This was the first survey of spiders at the Polokwane Nature Reserve and provides valuable information on the diversity of the spiders in the Savanna Biome and therefore makes an important contribution to the South African National Survey of Arachnida.

During the study period spiders were collected from three different vegetation types using four different collection methods. A total of 6045 specimens were collected. These specimens belong to 33 families, which include 129 genera and 224 species. Of these, 71% were wanderers and 29% web-dwellers. Of the wanderers collected during the current study 60% were plant-dwellers and 11% ground-dwellers with only 0.2% living in burrows.

All the species sampled are new records for the area and 8% of the currently known species of Southern Africa is conserved in these three habitat types of the reserve. Additionally, 80 species could not be identified to species level with the possibility of at least 14 new species that may be described. *Ozyptila* sp. 1 represents a new record for South Africa with an addition of three new records for Africa (Appendix 1).

The family Oxyopidae was the numerically dominant family with a total of 1840 spiders collected representing 30% of the whole sample. The second most abundant family was Eresidae with 993 specimens, followed by the families Thomisidae with 801 specimens, Salticidae with 529 specimens, Araneidae with 334 specimens and Theridiidae with 307 specimens. In terms of the number of species caught, the family

Araneidae was the numerically dominant family with a total of 35 species representing 16% of the whole sample. The second most species rich family caught was the family Thomisidae with 32 species, followed by Salticidae with 27 species, Lycosidae with 19 species, Theridiidae with 18 species, Gnaphosidae with 17 species and Oxyopidae with 16 species.

The most abundant species caught were *Stegodyphus dumicola* (Eresidae) with 990 specimens, followed by *Oxyopes russoi* (Oxyopidae) with 687 specimens, *O. pallidecoloratus* (Oxyopidae) with 567 specimens, *Oxyopes* sp. 3 (Oxyopidae) with 340 specimens and *Misumenops rubrodecoratus* (Thomisidae) with 202 specimens. These species were collected from all three sampling sites. Other species like *Ammoxenus amphalodes*, *Aelurillus* sp. 1 and *Olios* sp. 2 were only collected from one of the three sampling sites (Appendix 1).

4.2 Comparison of differences between the spider communities of the vegetation types sampled

In terms of sampling sites, the riverine and sweet thorn thicket site had the highest number of specimens with 2604 specimens, followed by the rocky outcrop with 2297 specimens and *Aloe marlothii* thicket sites with 1144 specimens. The riverine and sweet thorn thicket site also had the highest number of species caught with 167 species, followed by the rocky outcrop with 147 species and *A. marlothii* thicket sites with 95 species. Some species e.g. *Ammoxenus amphalodes* was only caught at the *A. marlothii* thicket site. Therefore it is important to sample different vegetation types in order to catch species that are specific in terms of their required habitat.

4.3 Comparison of spiders caught with different sampling methods

Most specimens were collected using sweep netting with 2060 specimens, followed by tree beating with 1996 specimens, active searching with 1749 specimens and pitfall trapping with 240 specimens. The highest species richness was obtained using both sweep netting and active searching, followed by tree beating and pitfall trapping. Therefore, the most effective method in terms of number of spiders caught was sweep netting while both sweep netting and tree beating were the most successful methods in terms of the number of species caught.

4.4 Comparison of spiders caught during different months and seasons of the year

During the current study spiders were collected throughout the sampling period. The highest number of specimens was collected in August with 632 specimens with a second peak in April with 600 specimens and a third peak in February with 582 specimens. In terms of species caught, the highest number of species was caught in February with 82 species, followed by July with 76 species. Species diversity values were the highest during April and September (H´=3.4), followed by July and February (H´=3.3) and June, August and October (H´=3.2). However, evenness values varied from 0.6 to 0.8 for all months sampled indicating that there was a relatively even distribution of species throughout the sampling period. During February a high number of species (82) and a relatively higher diversity of spiders (H'=3.3), compared to the other months, were obtained. Additionally, a high number of mature specimens (256) were collected even though the highest number of adults was captured during June (271). Therefore, it is suggested that February be included during sampling sessions in the Savanna Biome.

4.5 Limitations of the study and suggestions for future studies

Unfortunately, no replication of sampling using each method in each vegetation type was performed on a monthly basis. Hence, the data could not be tested for statistical significance among sites or using different sampling methods. Another shortcoming was the amalgamation of specimens sampled on a sampling site using a specific sampling method rather them keeping e.g. each sweep netting or tree beating sample separate which would have resulted in several samples per method per site per month and would have allowed statistical analyses and comparisons. Furthermore it is suggested that each sampling site should be quantified in terms of size and that sampling should be conducted in the same sized area during every sampling event. Since sampling was done in a nature reserve during the current study, sampling sites could not be marked or surrounded by rope or tape. In an attempt to sample the same sized area during each sampling event, the time of sampling events remained constant. However, as one becomes more familiarized with the sampling site and methods, it is possible to sample quicker and therefore covers a larger area.

Future studies focusing on obtaining the spider composition of an area in the Savanna Biome can use results from this and previous studies (e.g. Foord *et al.* 2002; Whitmore *et al.* 2002; Modiba *et al.* 2005; Haddad *et al*. 2006) to determine the best period of sampling during which high numbers of mature species (necessary for positive identification) may be collected. These results can also be used to determine the approach to the survey with prolonged periods of sporadic *ad hoc* sampling resulting in higher family and species representation than a long continuous period of sampling. Additionally the results can also be used to determine the most effective collecting methods to use with e.g. leaf litter sifting being ineffective in an area dominated by *Acacia* trees.

Since information is now available concerning which species are currently present in the Polokwane Nature Reserve and the abundance of each, future studies can focus on aspects of their endemicity, distribution and biology and make recommendations concerning their conservation status or possible use as bio-indicators.

4.6 Summary

From these results and those of previous studies (e.g. Foord *et al.* 2002; Whitmore *et al.* 2002; Modiba *et al.* 2005; Haddad *et al*. 2006) it is clear that the Savanna Biome is dominated by free-living wandering spiders. However, very little overlap of species occurs between different vegetation types which confirm the association between the composition of the spider community and the vegetation cover or vegetation architecture of the area where they occur. The guilds of a spider community can thus be used to predict the vegetation cover of the area from which they were sampled or the vegetation cover can be used to predict the guilds of the spiders expected from the area. It is therefore important that collection is done from a large number of different vegetation types, using many different collecting methods in order to obtain a true reflection of the species diversity of the Savanna Biome.

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Appendix 1. Spider families and species collected from the riverine and sweet thorn thicket (RST), rocky outcrop (RO) and *Aloe marlothii* thicket (AM) sites at the Polokwane Nature Reserve during the sampling period (March 2005-February 2006), indicating the number of species and genera caught in each family and their functional guild (Guilds: WD = web dweller; GD = ground dweller; PD = plant dweller; Status: NA = not applicable, NS = new species, NR = new record, 1 = only in PNR, 2 = only Limpopo province, 3 = Limpopo & one other province, 4 = South Africa, 5 = Southern Africa, 6 = Africa, 7 = cosmopolitan).

Family	Guild	Species	Status	RST	RO	AM	Total
Agelenidae	WD	*Agelena* sp. 1	NA	1	2	-	3
Ammoxenidae	GD	*Ammoxenus amphalodes* Dippenaar & Meyer, 1980	NA	-	-	58	58
Araneidae	WD	*Acanthepeira* sp. 1	NS	-	2	-	2
	WD	Araneidae sp.1 (genus undetermined)	NS	1	1	-	2
	WD	*Araneilla* sp. 1	NS	-	10	1	11
	WD	*Araneilla* sp. 2	NS	-	2	1	2
	WD	*Araneilla* sp. 3	NS	-	4	1	5
	WD	*Araneus nigroquadratus* Lawrence, 1937	4	1	1	-	2
	WD	*Argiope aurocincta* Pocock, 1898	6	3	-	-	3
	WD	*Argiope australis* (Walckenaer, 1805)	6	1	-	-	1
	WD	*Argiope lobata* (Pallas, 1772)	6	3	1	-	4
	WD	*Argiope trifasciata* (Forskål, 1775)	7	18	5	-	23
	WD	*Caerostris sexcuspidata* (Fabricius, 1793)	6	5	2	-	7
	WD	*Chorizopes* sp. 1	NS	3	1	-	4

WD	*Cyclosa insulana* (Costa, 1834)	7	2	4	1	7
WD	*Cyphalanothus larvatus* (Simon, 1881)	6	1	-	-	1
WD	*Cyrtophora citricola* (Forskål, 1775)	7	3	3	-	6
WD	*Gasteracantha sanguinolenta* C.L. Koch, 1884	6	1	-	-	1
WD	*Gea infuscata* Tuulgren, 1910	6	1	-	-	1
WD	*Hypsosinga lithyphantoides* Caporiacco, 1947	6	31	18	11	60
WD	*Hypsosinga* sp. 2	NS	5	6	1	12
WD	*Larinia natalensis* (Grasshoff, 1971)	4	1	-	-	1
WD	*Lipocrea longissima* (Simon, 1881)	6	-	2	-	2
WD	*Mahembea hewitti* (Lessert, 1930)	6	1	-	-	1
WD	*Nemoscolus elongatus* Lawrence, 1947	4	1	-	-	1
WD	*Nemoscolus* sp. 2	NA	1	3	-	4
WD	*Neoscona blondeli* (Simon, 1885)	6	28	10	3	41
WD	*Neoscona moreli* (Vinson, 1863)	6	2	4	2	8
WD	*Neoscona penicillipes* (Karsch, 1879)	6	-	1	-	1
WD	*Neoscona quincasea* Roberts, 1983	6	5	35	-	40
WD	*Neoscona subfusca* (C.L. Koch, 1837)	6	30	15	3	48
WD	*Pararaneus cyrtoscapus* (Pocock, 1898)	6	8	6	5	19

	WD	*Paraplectana* sp. 1	NA	4	2	-	6
	WD	*Prasonica* sp. 1	NS	-	1	-	1
	WD	*Pycnacantha tribulus* (Fabricius, 1781)	6	-	1	-	1
	WD	*Singa lawrencei* (Lessert, 1930)	6	-	4	1	5
	WD	*Singa* sp. 2	NA	1	-	-	1
Barychelidae	BD	*Brachionopus pretoriae* Purcell, 1904	3	-	3	-	3
Caponiidae	GD	*Caponia chelifera* Lessert, 1936	6	3	5	3	11
Clubionidae	PD	*Clubiona abbajensis* Strand, 1906	6	2	-	1	3
	PD	*Clubiona* sp. 1	NA	-	-	1	1
Corinnidae	GD	*Casteineira* sp. 2	NA	-	-	2	2
	GD	*Cetonana simoni* (Lawrence, 1942)	4	2	-	-	2
	GD	*Copa flavoplumosa* Simon, 1885	6	1	-	-	1
Eresidae	WD	*Dresserus colsoni* Tucker, 1920	4	-	3	-	3
	WD	*Stegodyphus dumicola* Pocock, 1898	6	324	368	298	990
Gnaphosidae	GD	*Asemesthes ceresicola* Tucker, 1923	4	1	33	12	46
	GD	*Asemesthes decoratus* Purcell, 1908	4	-	1	1	2
	GD	*Camillina aestus* Tucker, 1923	4	2	46	41	89
	GD	*Camillina maun* Platnick & Murphy, 1987	5	-	2	-	2
	GD	*Camillina procurva* (Purcell, 1908)	4	-	-	4	4

	GD	*Drassodes bechuanicus* Tucker, 1923	4	-	-	2	2
	GD	*Drassodes solitarius* Purcell, 1907	4	-	-	1	1
	GD	*Drassodes splendens* Tucker, 1923	4	2	11	3	16
	GD	*Poecilochroa* sp. 1	NA	-	1	-	1
	GD	*Scotophaeus marleyi* Tucker, 1923	4	-	2	-	2
	GD	*Trephopoda hanoveria* Tucker, 1923	4	2	1	-	3
	GD	*Upognampa parvipalpa* Tucker, 1923	4	-	-	2	2
	GD	*Xerophaeus appendiculatus* Purcell, 1907	4	-	11	12	23
	GD	*Xerophaeus bicavus* Tucker, 1923	4	-	6	11	17
	GD	*Zelotes reduncus* (Purcell, 1907)	4	4	12	-	16
	GD	*Zelotes tuckeri* Roewer, 1951	4	1	1	-	4
	GD	*Zelotes* sp. 1	NA	1	-	-	2
Hersiliidae	WD	*Tyrotama soutpansbergensis* Foord & Dippenaar-Schoeman, 2005	CHECK	1	1	-	2
Linyphiidae	WD	*Pelecopsis* sp. 1	NA	1	-	-	1
	WD	*Meioneta* sp. 1	NA	2	-	-	2
	WD	*Mecynidis* sp. 1	NA	1	-	-	1
Lycosidae	GD	*Evippomma squamulatum* (Simon, 1898)	5	1	10	25	36
	GD	*Geolycosa* sp. 1	NA	1	-	-	1

	GD	*Lycosa* sp. 1	NA	1	9	5	15
	GD	*Lycosa* sp. 2	NA	-	5	2	7
	GD	Lycosidae sp. 1	NA	5	1	-	6
	GD	Lycosidae sp. 2	NA	-	6	4	10
	GD	Lycosidae sp. 4	NA	-	-	2	2
	GD	Lycosidae sp. 5	NA	-	3	-	3
	GD	Lycosidae sp. 6	NA	5	-	-	5
	GD	Lycosidae sp. 7	NA	-	-	1	1
	GD	Lycosidae sp. 8	NA	-	1	12	13
	GD	Lycosidae sp. 10	NA	1	-	-	1
	GD	*Pardosa* sp. 10	NA	5	20	1	26
	GD	*Pardosa leipoldti* Purcell, 1903	4	4	-	-	4
	GD	*Pardosa* sp. 11	NA	1	1	-	2
	GD	*Proevippa* sp. 1	NA	-	7	34	41
	GD	*Proevippa wanlessi* (Russel-Smith, 1981)	4	14	1	25	40
	GD	*Trabea purcelli* Roewer, 1951	4	1	-	-	1
	GD	*Zenonina albocaudata* Lawrence, 1952	4	1	-	1	2
Mimetidae	PD	*Ero* sp.	NS	3	-	-	3
Miturgidae	PD	*Cheiracanthium furculatum* Karsch, 1879	6	80	15	9	104
	PD	*Cheiracanthium inclusum* (Hentz, 1847)	7	6	4	8	18
	PD	*Cheiracanthium vansoni*	5	22	24	-	46

		Lawrence, 1936					
Nemesiidae	BD	*Hermacha mazoena* Hewitt, 1915	5	2	-	-	2
Nephilidae	WD	*Nephila senegalensis* (Walckenaer, 1842)	6	14	-	-	14
Oonopidae	GD	*Gamasomorpha humicola* Lawrence, 1947	4	-	1	-	1
Oxyopidae	PD	*Hamataliwa fronticornis* (Lessert, 1927)	6 NR	7	1	-	8
	PD	*Hamataliwa kulczynskii* (Lessert, 1915)	6	5	3	1	9
	PD	*Hamataliwa strandi* Caporriacco, 1939	4	3	1	1	5
	PD	*Oxyopes affinis* Lessert, 1915	6	-	1	-	1
	PD	*Oxyopes bedoti* Lessert, 1915	6	3	9	-	12
	PD	*Oxyopes bothai* Lessert, 1915	6	29	6	-	35
	PD	*Oxyopes hoggi* Lessert, 1915	6	78	9	8	95
	PD	*Oxyopes jacksoni* Lessert, 1915	6	38	26	2	66
	PD	*Oxyopes pallidecoloratus* Strand, 1906	6	224	232	111	567
	PD	*Oxyopes russoi* Caporiacco, 1940	6 NR	286	292	109	687
	PD	*Oxyopes schenkeli* Lessert, 1927	6	-	9	1	10
	PD	*Oxyopes* sp. 10	NA	1	-	-	1
	PD	*Oxyopes* sp. 3	NA	220	86	34	340
	PD	*Oxyopes* sp. 5	NA	1	-	-	1
	PD	*Oxyopes tuberculatus* Lessert, 1915	6	2	-	-	2
	PD	*Peucetia viridis* (Blackwall, 1858)	7	-	1	-	1

Palpimanidae	GD	*Palpimanus armatus* Pocock, 1898	4	-	-	3	3
	GD	*Palpimanus transvaalicus* Simon, 1893	4	3	13	3	19
Philodromidae	PD	*Ebo* sp. 1	NS	-	4	-	4
	PD	*Philodromus browningi* Lawrence, 1952	4	23	21	1	45
	PD	*Philodromus grosi* Lessert, 1943	6	11	31	-	42
	PD	*Philodromus guineensis* Millot, 1942	6	38	32	8	78
	PD	*Suemus punctatus* Lawrence, 1938	4	10	2	4	16
	PD	*Thanatus dorsilineatus* Jézéquel, 1964	6 NR	3	3	-	6
	PD	*Thanatus* sp. 1	NA	1	3	-	4
	PD	*Tibellus gerhardi* Van den Berg & Dippenaar-Schoeman, 1994	6	-	2	-	2
	PD	*Tibellus hollidayi* Lawrence, 1952	6	20	-	-	20
	PD	*Tibellus minor* Lessert, 1919	6	10	12	8	30
Pisauridae	PD	*Afropisaura* sp. 1	NA	51	4	1	60
	WD	*Euprosthenops australis* Simon, 1898	6	1	-	-	1
	WD	*Euprosthenopsis vuattouxi* Blandin, 1977	6	81	2	1	84
	PD	*Rothus purpurissatus* Simon, 1898	6	2	-	-	2
Prodidomidae	GD	*Theuma parva* Purcell, 1907	4	-	2	-	2
Salticidae	GD	*Aelurillus* sp. 1	NA	5	2	-	7

PD	*Baryphas ahenus* Simon, 1902	5	1	-	-	1
PD	*Brancus bevisi* Lessert, 1925	6	24	9	1	34
GD	*Cosmophasis* sp. 2	NA	5	-	-	5
PD	*Dendryphantes* sp. 1	NA	14	7	-	21
PD	*Dendryphantes* sp. 2	NA	1	1	-	2
PD	*Euophrys* sp. 1	NA	85	48	7	140
PD	*Heliophanus debilis* Simon, 1901	6	46	32	14	92
PD	*Heliophanus demonstrativus* Wesolowska, 1986	6	-	1	-	1
PD	*Heliophanus insperatus* Wesolowska, 1986	5	17	9	5	31
PD	*Heliophanus transvaalicus* Simon, 1901	4	4	-	-	4
PD	*Hyllus treleaveni* Peckham & Peckham, 1902	5	18	6	1	25
PD	*Hyllus* sp. 2	NA	1	-	-	1
PD	*Hyllus* sp. 3	NA	1	1	-	2
PD	*Hyllus* sp. 4	NA	1	-	-	1
PD	*Langelurillus* sp. 1	NA	12	2	-	14
PD	*Mogrus* sp. 1	NA	2	1	-	3
PD	*Natta horizontalis* Karsch, 1879	6	3	-	-	3
PD	*Pellenes* sp. 1	NA	16	10	3	29
GD	*Phlegra* sp. 1	NA	1	-	-	1

	PD	*Pseudicius* sp. 1	NA	5	10	1	16
	PD	*Rhene machadoi* Berland & Millot, 1941	6	10	16	-	26
	GD	*Stenaelurillus* sp. 1	NA	2	3	-	5
	GD	*Stenaelurillus* sp. 2	NA	-	8	-	8
	GD	*Stenaelurillus nigricaudus* Simon, 1885	6	-	-	1	1
	PD	*Thyene inflata* (Gerstäcker, 1873)	6	37	12	3	52
	PD	*Thyenula aurantiaca* (Simon, 1902)	4	3	1	-	4
Scytodidae	GD	*Scytodes* sp. 1	NA	-	2	-	2
Segestriidae	WD	*Ariadna* sp. 1	NA	2	2	-	4
Selenopidae	PD	*Anyphops* sp. 1	NA	-	4	2	6
	PD	*Selenops* sp. 1	NA	-	2	-	2
Sparassidae	PD	*Olios* sp. 1	NA	2	-	5	7
	PD	*Olios* sp. 2	NA	2	1	-	3
	PD	*Palystes superciliosus* L. Koch, 1875	5	1	-	-	1
	PD	*Pseudomicrommata longipes* (Bösenberg & Lenz, 1895)	6	1	-	-	1
Tetragnathidae	WD	*Leucauge decorata* (Blackwall, 1864)	7	1	2	-	3
	WD	*Leucauge festiva* (Blackwall, 1866)	6	1	-	-	1
Theraphosidae	BD	*Harpactira* sp. 1	NS	2	3	1	6
	BD	*Harpactirella* sp. 2	NA	-	2	-	2

Theridiidae	WD	*Argyrodes convivans* Lawrence, 1937	4	24	-	-	24
	WD	*Argyrodes zonatus* (Walckenaer, 1842)	6	2	4	-	6
	WD	*Dipoena* sp. 4	NA	1	1	1	3
	WD	*Enoplognatha molesta* O.P.-Cambridge, 1904	4	14	23	29	66
	WD	*Latrodectus geometricus* C.L.Koch, 1841	7	3	6	9	18
	WD	*Latrodectus renivulvatus* Dahl, 1902	6	2	7	3	12
	WD	*Phoroncidia eburnea* (Simon, 1895)	4	1	2	-	3
	WD	Theridiidae sp. 21	NA	2	-	-	2
	WD	Theridiidae sp. 24	NA	-	1	-	1
	WD	Theridiidae sp. 33	NA	2	-	-	2
	WD	*Theridion purcelli* O.P.-Cambridge, 1904	6	1	2	-	3
	WD	*Theridion* sp. 1	NA	1	-	-	1
	WD	*Theridion* sp. 3	NA	10	3	-	13
	WD	*Theridion* sp. 4	NA	1	-	-	1
	WD	*Theridion* sp. 11	NA	2	8	-	10
	WD	*Theridion* sp. 13	NA	63	63	4	130
	WD	*Theridion* sp. 19	NA	1	-	-	1
	WD	*Theridion* sp. 23	NA	6	3	2	11
Thomisidae	PD	*Avelis hystriculus* Simon, 1895	4	6	-	-	6

PD	*Camaricus nigrotesselatus* Simon, 1895	6	2	-	-	2
PD	*Heriaeus crassispinus* Lawrence, 1942	4	1	3	-	4
PD	*Misumenops rubrodecoratus* Millot, 1942	6	59	112	31	202
PD	*Monaeses austrinus* Simon, 1910	6	9	19	6	34
PD	*Monaeses gibbus* Dippenaar-Schoeman 1984	4	4	7	2	13
PD	*Monaeses paradoxus* (Lucas, 1846)	7	-	2	1	3
PD	*Monaeses pustulosus* Pavesi, 1895	6	1	-	1	2
PD	*Monaeses quadrituberculatus* Lawrence, 1927	5	3	9	3	15
PD	*Oxytate argenteooculata* (Simon, 1886)	6	1	-	-	1
PD	*Ozyptila* sp. 1	NS	-	-	1	1
PD	*Pactactes trimaculatus* Simon, 1895	6	12	-	-	12
PD	*Pherecydes* sp. 1	NS	1	-	-	1
PD	*Runcinia aethiops* (Simon, 1901)	6	36	-	2	38
PD	*Runcinia affinis* Simon, 1897	6	1	4	-	5
PD	*Runcinia erythrina* Jézéquel, 1964	6	5	14	3	22
PD	*Runcinia flavida* (Simon, 1881)	6	33	105	52	190
GD	*Stiphropus affinis* Lessert, 1923	4	3	4	1	8
PD	*Synema decens* (Karsch, 1878)	4	3	-	-	3

	PD	*Synema diana* (Audouin, 1826)	6	6	-	-	6
	PD	*Synema imitator* (Pavesi, 1883)	6	28	19	3	50
	PD	*Synema nigrotibiale* Lessert, 1919	6	5	7	6	18
	PD	*Thomisus blandus* Karsch, 1880	6	-	-	1	1
	PD	*Thomisus citrinellus* Simon, 1875	6	2	4	-	6
	PD	*Thomisus congoensis* Comellini, 1957	6	-	2	-	2
	PD	*Thomisus scrupeus* (Simon, 1886)	6	9	-	-	9
	PD	*Thomisus stenningi* Pocock, 1900	6	7	9	3	19
	PD	*Tmarus cameliformis* Millot, 1942	6	24	30	6	60
	PD	*Tmarus cancellatus* Thorell, 1899	6	-	2	-	2
	PD	*Tmarus comellini* Garcia-Neto, 1989	6	13	25	0	38
	PD	*Tmarus foliatus* Lessert, 1928	6	1	-	-	1
	PD	*Tmarus* sp. 1	NA	-	3	3	6
	GD	*Xysticus fagei* Lessert, 1919	6	11	7	3	21
Uloboridae	WD	*Miagrammopes longicaudus* O.P.-Cambridge, 1882	4	18	5	1	24
	WD	*Uloborus plumipes* Lucas, 1846	7	1	-	-	1
	WD	*Uloborus* sp. 1	NA	2	1	-	3
	WD	*Uloborus* sp. 2	NA	1	-	-	1
Zodariidae	GD	*Capheris decorata* Simon, 1904	4	-	11	11	22
	GD	*Cydrela* sp. 1	NA	-	5	-	5

	GD	*Diores auricula* Tucker, 1920	5	-	-	1	1
	GD	*Ranops* sp. 1	NS	-	-	1	1
Total				2604	2297	1144	6045